37107F

# MFR 3
# Multi Function Relay


## Manual
**Software Version 3.4xxx**

**Manual 37107F**

## 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 | 04-05-05 | Tr | Release |
| A | 05-02-02 | TP | Minor corrections |
| B | 05-07-12 | TP | Minor corrections, parameter numbers added, language revision |
| C | 05-10-11 | TP | Minor corrections, changes of mains monitoring, relay and analog output manager, rotation field monitoring |
| D | 08-08-20 | TP | Pulse outputs updated; power factor definition added; inverse time-overcurrent monitoring updated; receive telegram added; analog output manager corrected |
| E | 08-10-30 | TE | Minor corrections |
| F | 08-12-02 | TE | Minor corrections, power display format |

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## Illustrations

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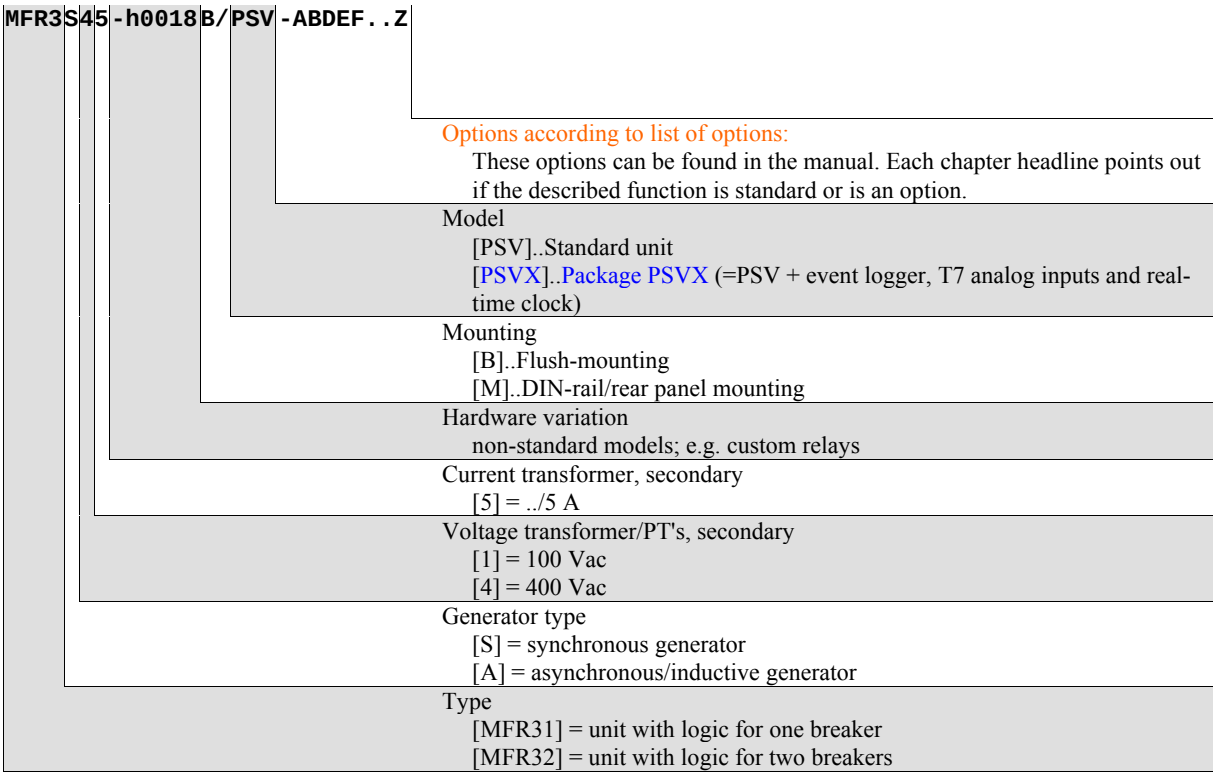
# Chapter 1.
# General Information

## Introduction

The MFR 3 has been designed to provide circuit breaker and load control and protection. It is possible to monitor both the generator and mains simultaneously. The MFR 3 permits two circuit breakers to be synchronized and control of the mains power.

The MFR 3 starts as a standard unit that may have additional functions added with each model. The model of the MFR 3 is designated as follows:




**Examples:**

- MFR 31S45B/PSVX+Q (standard unit with one breaker logic for synchronous generators and is flush-mounting, 400 Vac PT inputs as well as ../5 A CT measuring inputs; Option Q: analog or three-position controller functionality selectable, and an event logger, T7 analog inputs, and real-time clock
- MFR 32S15B/PSVX+Q (standard unit with two breaker logic for synchronous generators and is flush-mounting, 100 Vac PT inputs as well as ../5 A CT measuring inputs; Option Q: analog or three-position controller functionality selectable, and an event logger, T7 analog inputs, and real-time clock

**Intended Use:** The control unit must only be operated as described in this manual. The prerequisite for a proper and safe operation of the product is correct transportation, storage, and installation as well as careful operation and maintenance.

## NOTE

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

**The present manual has been prepared to enable the installation and commissioning of the unit. Because of 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 can be taken from the enclosed list of parameters at the rear of this manual.**

# Measuring

## Voltage

The control unit performs three-phase true RMS measurement of two star or delta voltage systems (generator and mains). This unit can be delivered with the following measuring voltage ranges (rated values). The voltage measuring is specific to the part number ordered (please note chapter "Technical Data", page 138):
- [1] 66/115 Vac
- [4] 230/400 Vac

## Frequency

The measured voltages are digitally filtered for frequency measurement. The control unit performs three-phase true RMS measurement of the frequency if the measured voltages exceed the rated value (100/400 Vac) by 15 %. This ensures rapid and precise measurement of the frequency. Frequency is still measured correctly if voltage is only measured in one phase.

## Current

The control unit performs three-phase true RMS current measurement.

## Real power

The control unit performs three-phase true RMS power measurement. This is accomplished by real-time multiplication of the wye voltage and instantaneous conductor current values (three-phase measurement) or the phase voltage $V_{L12}$ and the current $I_{L1}$ (single-phase measurement).

## Re-active power

The control unit performs single-phase true RMS re-active power measurement, which is calculated from apparent power and active power.

## Power factor

Power factor is determined as a time measurement between the filtered measured values of the voltage $V_{L12}$ and the conductor current $I_{L1}$.

## Real energy

The positive real energy is integrated with a time measurement. The counter is controlled in the non-volatile memory and has reverse counting protection. The data is saved in three-minute time frames with a resolution of 1 Watt-hour. The display automatically updates the measured units when required to go to a larger reference. This permits the control unit to count up to 4,290 GWh. The counter is not PTB-calibrated.

# Functional Range

The unit contains of the following features dependent upon the model:

| Function | Option | Package PSVX+Q |
|---|---|---|
| **Common features** | | |
| 1× ready for operation relay | Standard | ✓ |
| 4(2) *× control relays (N.O. contact) | Standard | ✓ |
| 7× freely configurable relay outputs (N.O. contact) | Standard | ✓ |
| 2× three-position controller for n/f/V/P, power factor | Standard | ✓ |
| 2× three-position controller for n/f/V/P, power factor and 2 analog controller for n/f/V/P/Q and PWM outp. | Q | ✓ |
| 10(8) *× discrete control inputs * | Standard | ✓ |
| 12× discrete alarm inputs | Standard | ✓ |
| 7× analog inputs | | ✓ |
| 1× analog input for mains real power (instead of current transducer) | | ✓ |
| 2× analog outputs | Standard | ✓ |
| 1× kWh pulse output | Standard | ✓ |
| 1× kvarh pulse output | Standard | ✓ |
| Password system | Standard | ✓ |
| Configuration via PC and DPC cable possible (direct configuration) | Standard | ✓ |
| CAN bus interface | Standard | ✓ |
| Event recorder with real-time clock | | ✓ |
| Language manager for message texts | Standard | ✓ |
| Ignition speed relay function | Standard | ✓ |
| Running hours counter | Standard | ✓ |
| Maintenance call counter | Standard | ✓ |
| Start counter | Standard | ✓ |
| kWh- and kvarh counter | Standard | ✓ |
| **Protection functions** | | |
| Over-/undervoltage protection (2step), generator | $V_{gen}$>/< | Standard | ✓ |
| Over-/undervoltage protection (1step), mains | $V_{mains}$>/< | Standard | ✓ |
| Over-/underfrequency protection | f>/< | Standard | ✓ |
| Voltage asymmetry protection | $V_{as}$> | Standard | ✓ |
| dφ/dt phase/vector jump protection | dφ/dt | Standard | ✓ |
| df/dt protection | df/dt | Standard | ✓ |
| Reverse/reduced power protection | +/-$P_{Gen}$< | Standard | ✓ |
| Overload protection | $P_{Gen}$> | Standard | ✓ |
| Unbalanced load protection | ΔP> | Standard | ✓ |
| Reactive power protection (loss of excitation) | Q< | Standard | ✓ |
| Time-overcurrent protection | $I_{time}$>/>> | Standard | ✓ |
| Inverse time-overcurrent protection, IEC 255 | $I_{inv\text{-}time}$> | Standard | ✓ |
| Voltage restraint time-overcurrent protection | $I_{Vtime}$> | Standard | ✓ |
| Ground fault protection | $I_{earth}$> | Standard | ✓ |
| Battery monitoring | $V_{Bat}$< | Standard | ✓ |

* the lower number of control relays or inputs applies for units with one circuit breaker

| Function | Option | Package PSVX+Q |
|---|---|---|
| **Control/synchronization** | | |
| Synchronization of 2 circuit breakers with V and f control | Standard | ✓ |
| Closing to a dead busbar (dead bus start) | Standard | ✓ |
| Voltage control | Standard | ✓ |
| Power factor control | Standard | ✓ |
| Speed/frequency control | Standard | ✓ |
| Real power control | Standard | ✓ |
| Mains interchange power control | Standard | ✓ |
| Load sharing | Standard | ✓ |
| var sharing | Standard | ✓ |
| Analog set point value for real power | Standard | ✓ |
| Analog set point value for power factor | | ✓ |
| Breaker logic "open transition" | Standard | ✓ |
| Breaker logic "closed transition" | Standard | ✓ |
| Breaker logic "soft loading" | Standard | ✓ |
| Breaker logic "parallel operation" | Standard | ✓ |
| Breaker logic "external" | Standard | ✓ |
| Remote control via interface | Standard | ✓ |
| **Control inputs (DIs)** | | |
| Switch set point value 1 ↔ 2 | Standard | ✓ |
| Enable monitoring | Standard | ✓ |
| Configuration blocked | Standard | ✓ |
| Block mains protection | Standard | ✓ |
| Mains decoupling via MCB | Standard | ✓ |
| Operation mode selector blocked | Standard | ✓ |
| Switch breaker logic | Standard | ✓ |
| Release GCB/MCB | Standard | ✓ |
| Isolated controller ON | Standard | ✓ |
| External acknowledgement | Standard | ✓ |
| **Packages** | | |
| MFR 3/PSVX+Q (7 analog inputs, event logger with real-time clock, setpoint value for cosφ) | | ✓ |

# 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 performing 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 much as synthetics.

3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cup holders, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, and plastic ash trays) away from the control, the modules, and the 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 de-energized (all connectors must 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 with your hands.
   - When replacing a PCB, keep the new PCB in the protective antistatic 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 protective antistatic bag.

**CAUTION**

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

# Chapter 3.
# Installation

## CAUTION

**A circuit breaker must be provided near to the device 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

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

# Wiring Diagram

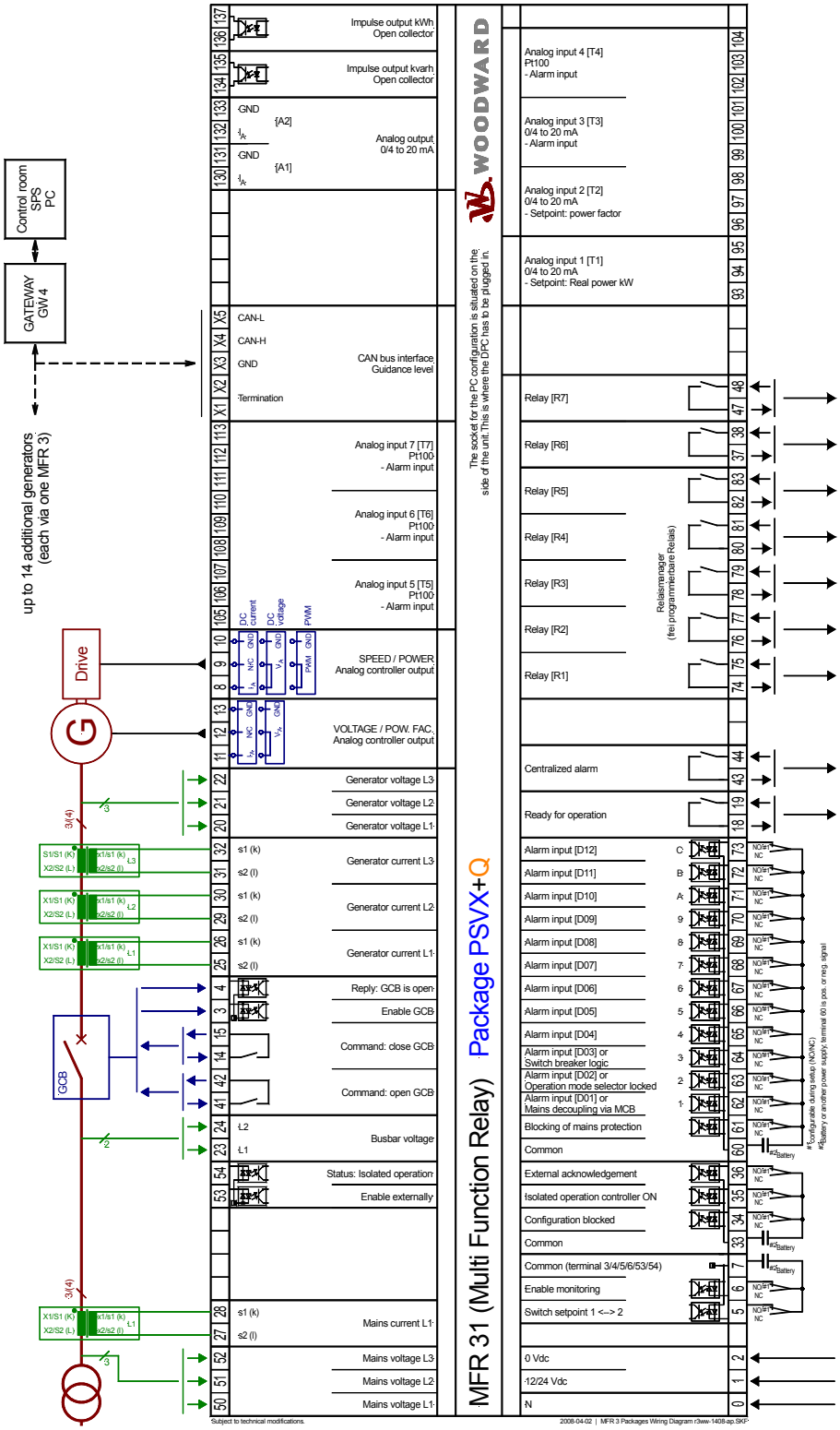



Figure 3-1: Wiring diagram MFR 31

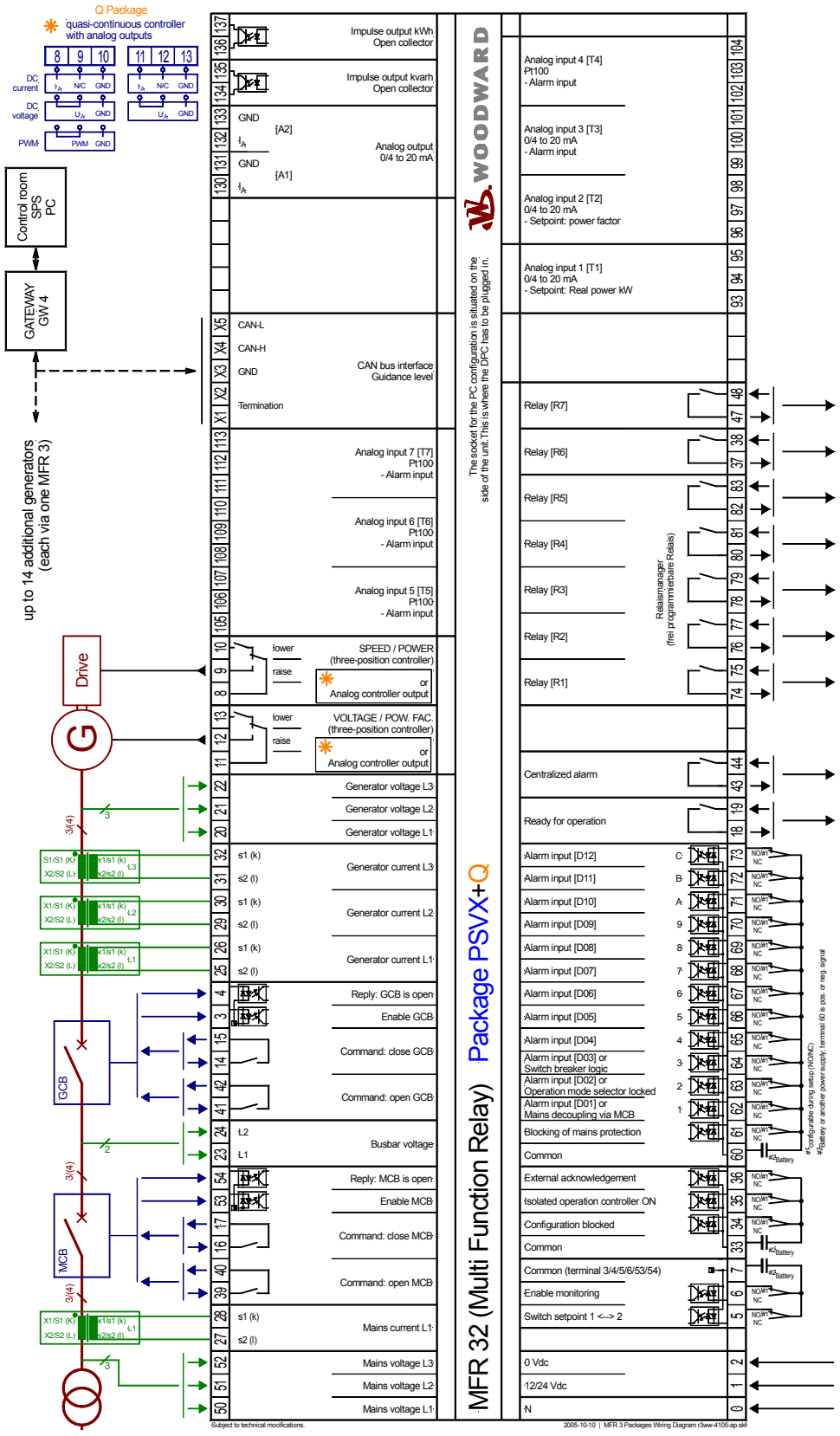



Figure 3-2: Wiring diagram MFR 32

# Power Supply

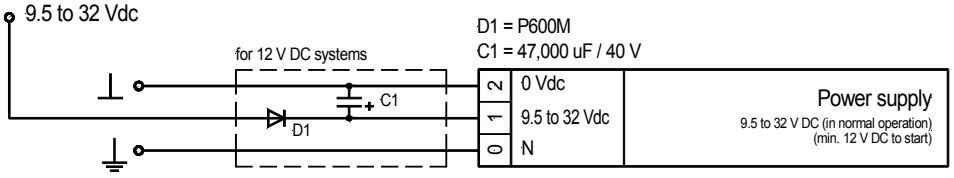



Figure 3-3: Power supply

| Terminal | Description | $A_{max}$ |
|---|---|---|
| 0 | N terminal of the low voltage system or neutral terminal of the voltage transformer/PT's (measuring reference point) | 2.5 mm² |
| 1 | 9.5 to 32 Vdc, 15 W | 2.5 mm² |
| 2 | 0 Vdc reference point | 2.5 mm² |

**Note:** When used in a 12 Vdc system, please wire the power supply as described above.

# Measuring Inputs

**NOTE**

**The three-phase system must have a dextrorotatory field (right-handed rotary field). If the unit is used with a laevorotatory field (left-handed rotary field), the power factor measurement will not be correct.**

## Voltage

### Generator

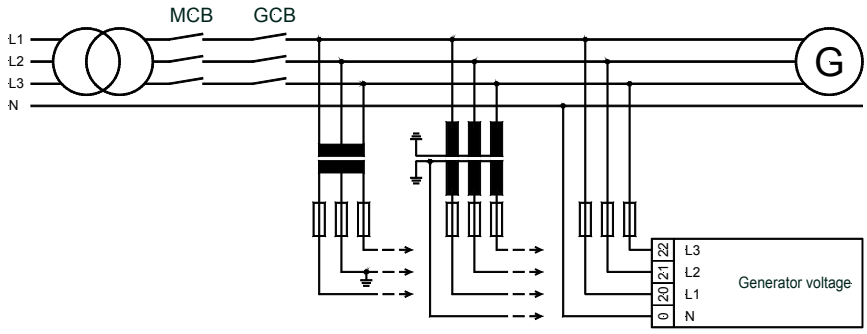



Figure 3-4: Measuring inputs - voltage - generator

| Terminal | Measuring | Description | $A_{max}$ |
|---|---|---|---|
| 20 | 400 Vac direct or via measuring transducer ../100 Vac | Generator voltage L1 | 2.5 mm² |
| 21 | | Generator voltage L2 | 2.5 mm² |
| 22 | | Generator voltage L3 | 2.5 mm² |
| 0 | | Neutral point of the 3-phase system/transformer/PT's | 2.5 mm² |

## Busbar

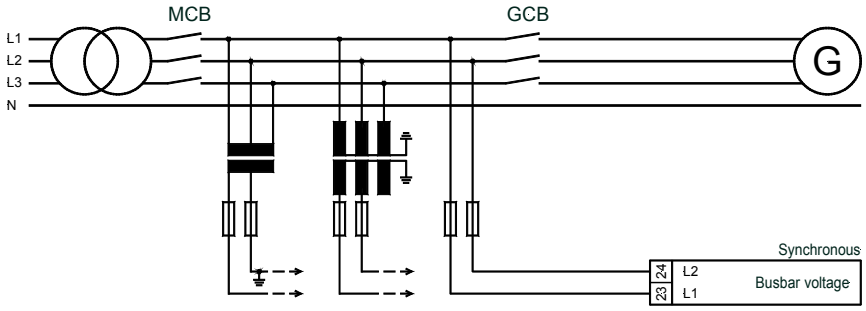



Figure 3-5: Measuring inputs - voltage - busbar

| Terminal | Measuring | Description | $A_{max}$ |
|---|---|---|---|
| 23 | 400 Vac | Busbar voltage L1 | 2.5 mm² |
| 24 | 100 Vac | Busbar voltage L2 | 2.5 mm² |

## Mains

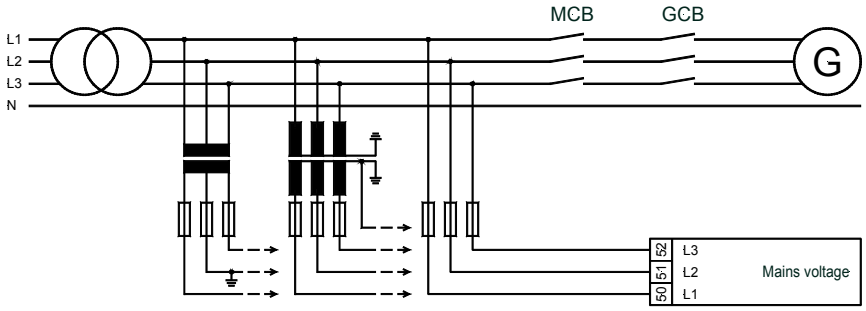



Figure 3-6: Measuring inputs - voltage - mains

| Terminal | Measuring | Description | $A_{max}$ |
|---|---|---|---|
| 50 | 400 Vac direct | Mains voltage L1 | 2.5 mm² |
| 51 | or via measu- | Mains voltage L2 | 2.5 mm² |
| 52 | ring transducer | Mains voltage L3 | 2.5 mm² |
| 0 | ../100 Vac | Neutral point of the 3-phase system/transformer/PT's | 2.5 mm² |

**NOTE**

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

## Current

### CAUTION

**Before disconnecting the secondary current transformer (CT) connections or the connections of the CT at the device, make sure that the CT is short-circuited.**

### NOTE

**Generally current transformers should be grounded on one side.**

### Generator

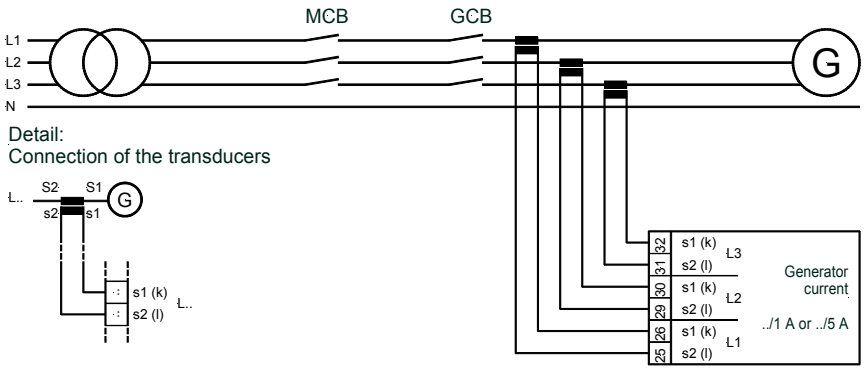



Figure 3-7: Measuring inputs - current - generator

| Terminal | Measuring | Description | $A_{max}$ |
|---|---|---|---|
| 25 | Transformer ../5 A | Generator current L1, transformer term. s2 (l) | 2.5 mm² |
| 26 | | Generator current L1, transformer term. s1 (k) | 2.5 mm² |
| 29 | | Generator current L2, transformer term. s2 (l) | 2.5 mm² |
| 30 | | Generator current L2, transformer term. s1 (k) | 2.5 mm² |
| 31 | | Generator current L3, transformer term. s2 (l) | 2.5 mm² |
| 32 | | Generator current L3, transformer term. s1 (k) | 2.5 mm² |

### Mains

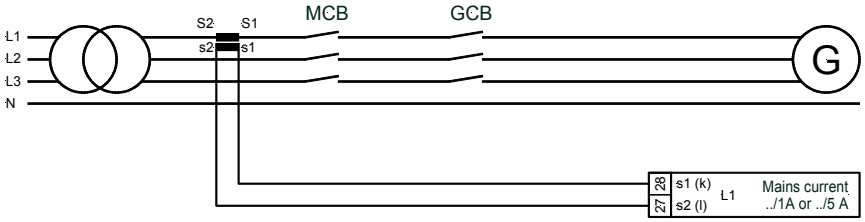



Figure 3-8: Mains current transformer measuring inputs

| Terminal | Measuring | Description | $A_{max}$ |
|---|---|---|---|
| 27 | Transformer ../5 A | Mains current L1, transformer term. s2 (l) | 2.5 mm² |
| 28 | | Mains current L1, transformer term. s1 (k) | 2.5 mm² |

# Discrete Inputs

**CAUTION**

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

**Maximum input range: +/-18 to 250 Vac.**

## Control Inputs

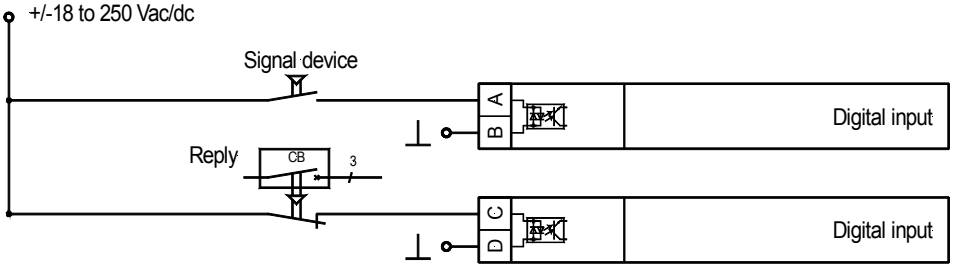



Figure 3-9: Discrete inputs - control inputs

| Terminal | Associated common | Description (according to DIN 40 719, part 3, 5.8.3) | $A_{max}$ |
|---|---|---|---|
| ***A*** | ***B*** | **Make contact (NO)** | |
| 3 | 7 | Enable GCB | 2.5 mm² |
| 5 | | Switch set point value 1 ↔ 2 | 2.5 mm² |
| 6 | | Enable monitoring | 2.5 mm² |
| 53 | | MFR 31: Enable externally<br>MFR 32: Enable MCB | 2.5 mm² |
| 34 | 33 | Configuration blocked | 2.5 mm² |
| 35 | | Isolated controller ON | 2.5 mm² |
| 36 | | External acknowledgment | 2.5 mm² |
| 61 | 60 | Block mains protection | 2.5 mm² |
| ***C*** | ***D*** | **Break contact (NC)** | |
| 4 | 7 | Reply: GCB is open | 2.5 mm² |
| 54 | | MFR 31: Status: Isolated operation<br>MFR 32: Reply: MCB is open | 2.5 mm² |

## Alarm / Control Inputs

The discrete inputs may be either connected in a positive or a negative polarity:
positive polarity The discrete input is connected with +/-18 to 250 Vac/dc.
negative polarity The discrete input is connected with GND.

### Positive Logic

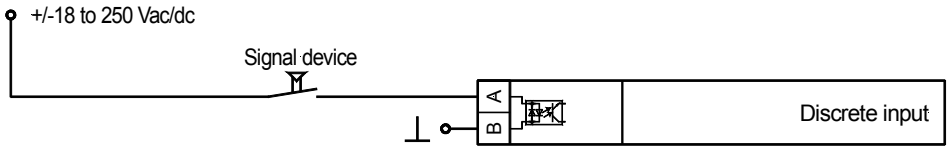



Figure 3-10: Discrete inputs - alarm inputs - positive polarity

| Terminal<br>***A*** | Associated common<br>***B*** | Description<br>(according to DIN 40 719, part 3, 5.8.3) | $A_{max}$ |
|---|---|---|---|
| 62 | 60 | Discrete input [D01]<br>- alarm input or<br>- mains decoupling via MCB | 2.5 mm² |
| 63 | | Discrete input [D02]<br>- alarm input or<br>- operation mode selector blocked | 2.5 mm² |
| 64 | | Discrete input [D03]<br>- alarm input or<br>- switch breaker logic | 2.5 mm² |
| 65 | | Discrete input [D04] - alarm input | 2.5 mm² |
| 66 | | Discrete input [D05] - alarm input | 2.5 mm² |
| 67 | | Discrete input [D06] - alarm input | 2.5 mm² |
| 68 | | Discrete input [D07] - alarm input | 2.5 mm² |
| 69 | | Discrete input [D08] - alarm input | 2.5 mm² |
| 70 | | Discrete input [D09] - alarm input | 2.5 mm² |
| 71 | | Discrete input [D10] - alarm input | 2.5 mm² |
| 72 | | Discrete input [D11] - alarm input | 2.5 mm² |
| 73 | | Discrete input [D12] - alarm input | 2.5 mm² |

### Negative Logic

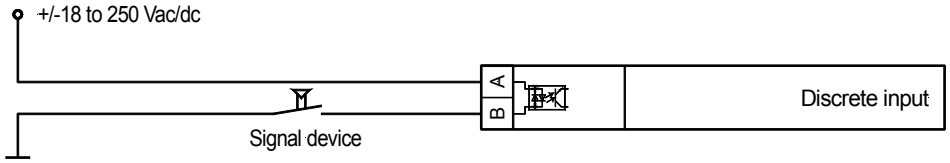



Figure 3-11: Discrete inputs - alarm inputs - negative polarity (examples)

| Associated common<br>***A*** | Terminal<br>***B*** | Description<br>(according to DIN 40 719, part 3, 5.8.3) | $A_{max}$ |
|---|---|---|---|
| 60 | 62 | Discrete input [D01]<br>- alarm input or<br>- mains decoupling via MCB | 2.5 mm² |
| | 63 | Discrete input [D02]<br>- alarm input or<br>- operation mode selector blocked | 2.5 mm² |
| | 64 | Discrete input [D03]<br>- alarm input or<br>- switch breaker logic | 2.5 mm² |

# Analog Inputs

**WARNING**

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

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

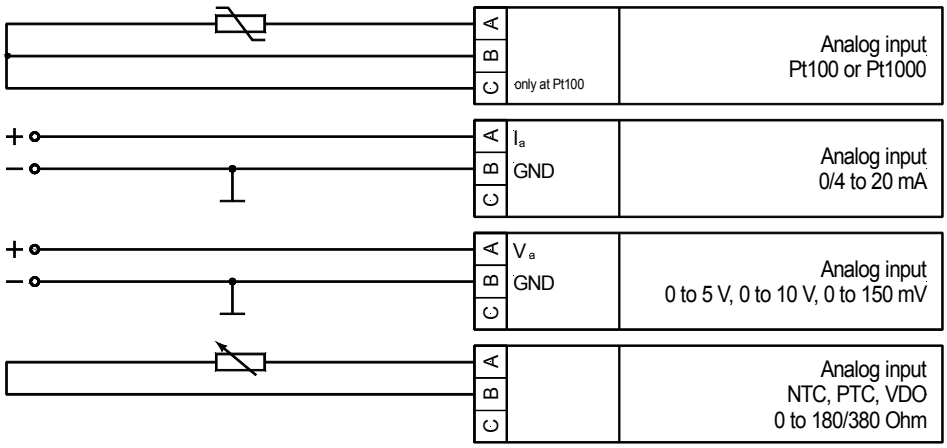



Figure 3-12: Analog inputs

| Terminal *A* | Terminal *B* | Terminal *C* | Description (according to DIN 40 719, part 3, 5.8.3) | $A_{max}$ |
|---|---|---|---|---|
| 93 | 94 | 95 | Analog input 1 [T1]<br>• PSVX 0/4 to 20 mA, set point value P (kW) | 1.5 mm² |
| 96 | 97 | 98 | Analog input 2 [T2]<br>• PSVX 0/4 to 20 mA, set point power factor | 1.5 mm² |
| 99 | 100 | 101 | Analog input 3 [T3]<br>• PSVX 0/4 to 20 mA | 1.5 mm² |
| 102 | 103 | 104 | Analog input 4 [T4]<br>• PSVX Pt100 | 1.5 mm² |
| 105 | 106 | 107 | Analog input 5 [T5]<br>• PSVX Pt100 | 1.5 mm² |
| 108 | 109 | 110 | Analog input 6 [T6]<br>• PSVX Pt100 | 1.5 mm² |
| 111 | 112 | 113 | Analog input 7 [T7]<br>• PSVX Pt100 | 1.5 mm² |

# Relay Outputs

## Control Outputs

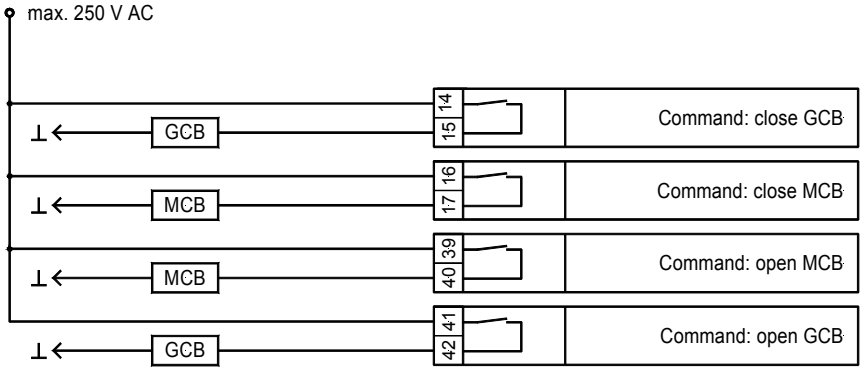



Figure 3-13: Relay outputs - control outputs - CB control

| ***Make contact*** | | Description | $A_{max}$ |
|---|---|---|---|
| Root ***A*** | Make contact ***B [NO]*** | | |
| 14 | 15 | Command: close GCB | 2.5 mm² |
| 16 | 17 | Command: close MCB | 2.5 mm² |
| 39 | 40 | Command: open MCB | 2.5 mm² |
| 41 | 42 | Command: open GCB | 2.5 mm² |

## Relay Manager

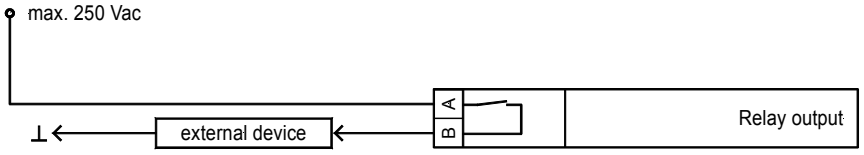



Figure 3-14: Relay outputs - relay manager

| ***Make contact*** | | Description | $A_{max}$ |
|---|---|---|---|
| Root ***A*** | Make contact ***B [NO]*** | | |
| 18 | 19 | Readiness for operation | 2.5 mm² |
| 74 | 75 | Relay [R1] (relay manager) | 2.5 mm² |
| 76 | 77 | Relay [R2] (relay manager) | 2.5 mm² |
| 78 | 79 | Relay [R3] (relay manager) | 2.5 mm² |
| 80 | 81 | Relay [R4] (relay manager) | 2.5 mm² |
| 82 | 83 | Relay [R5] (relay manager) | 2.5 mm² |
| 37 | 38 | Relay [R6] (relay manager) | 2.5 mm² |
| 47 | 48 | Relay [R7] (relay manager) | 2.5 mm² |

# Analog Outputs

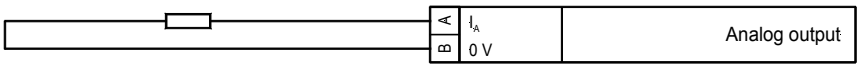



Figure 3-15: Analog outputs

| Ia<br>***A*** | GND<br>***B*** | Description | $A_{max}$ |
|---|---|---|---|
| 130 | 131 | Analog output [A1] - 0/4 to 20 mA | 1.5 mm² |
| 132 | 133 | Analog output [A2] - 0/4 to 20 mA | 1.5 mm² |

# Pulse Outputs

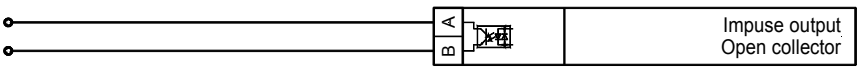



Figure 3-16: Pulse outputs

| Terminal | | Description | $A_{max}$ |
|---|---|---|---|
| Real energy kWh | | | |
| A | 137 | Pulse output (kWh pulse) | 1.5 mm² |
| B | 136 | Emitter (Open Collector) | 1.5 mm² |
| Re-active energy kvarh | | | |
| A | 135 | Pulse output (kvarh pulse) | 1.5 mm² |
| B | 134 | Emitter (Open Collector) | 1.5 mm² |

Example

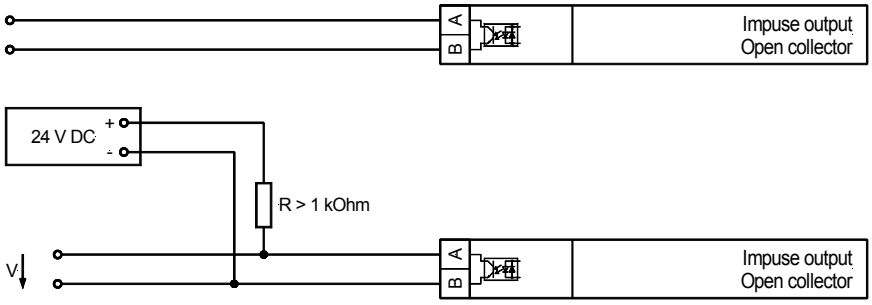



Figure 3-17: Pulse output - wiring example

# Controller Outputs

The controllers are configured in the standard version as three-position controllers (made up of a change-over contact and a normally open contact]. With option Q these contacts can be used as different types of outputs depending on the use of jumpers and the parameters selected.

## Three-Position Controllers (Standard)

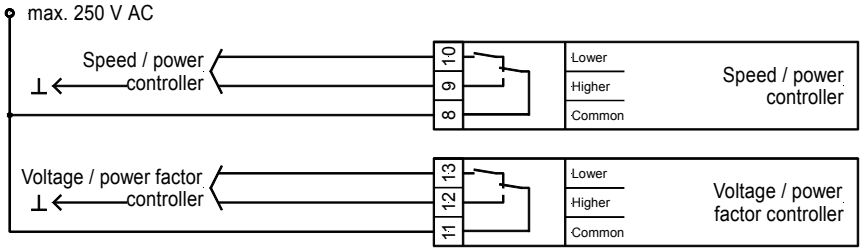



Figure 3-18: Controller - three-position controller

| Terminal | | Description | $A_{max}$ |
|---|---|---|---|
| 8 | common | Speed governor (n/f) / real power controller (P) | 2.5 mm² |
| 9 | raise | | 2.5 mm² |
| 10 | lower | | 2.5 mm² |
| 11 | common | Voltage regulator (V) / power factor controller | 2.5 mm² |
| 12 | raise | | 2.5 mm² |
| 13 | lower | | 2.5 mm² |

## Multi Functional Controller Outputs

The Option Q is a controller output for the following signals which can be selected in the configuration menu and by installing an external jumper.

### Versions

- **Three-position controller** via relay manager
  - Control of n/f/P: Parameter "**F/P contr.type**" = THREESTEP
    n+/f+/P+ = relay manger parameter 99
    n-/f-/P- = relay manager parameter 100
  - Control of V/Q: Parameter "**V/Q contr.output**" = THREESTEP
    V+/Q+ = relay manager parameter 101
    V-/Q- = relay manager parameter 102

- **Analog controller** output
  - Control of n/f/P: Parameter "**F/P contr.type**" = ANALOG
    Current output (mA) = no jumpers necessary
    Voltage output (V) = jumpers between 8/9
    Connect governor to terminals 9/10
  - Control of V/Q: Parameter "**V/Q contr.output**" = ANALOG
    Current output (mA) = no jumpers necessary
    Voltage output (V) = jumpers between 11/12
    Connect governor to terminals 12/13

- **PWM controller** output
  - Control of n/f/P: Parameter "**F/P contr.type**" = PWM
    PWM output = jumpers between 8/9
    Connect governor to terminals 9/10

## Wiring of Controller

### *Option Q - setting: THREESTEP (three-position controller)*

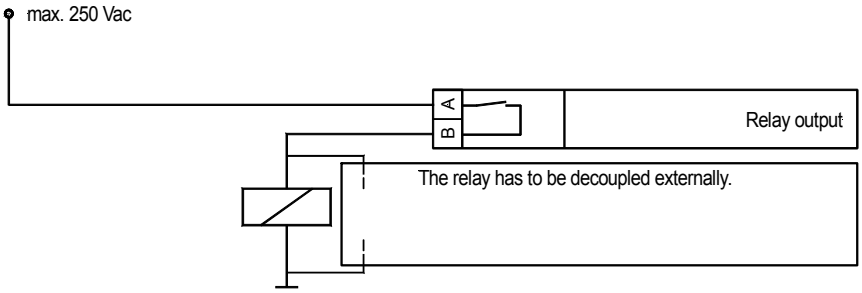



Figure 3-19: Three-position controller - external RC wiring for relay manager

### *Option Q - setting: ANALOG or PWM (analog controller) - frequency/real power controller*

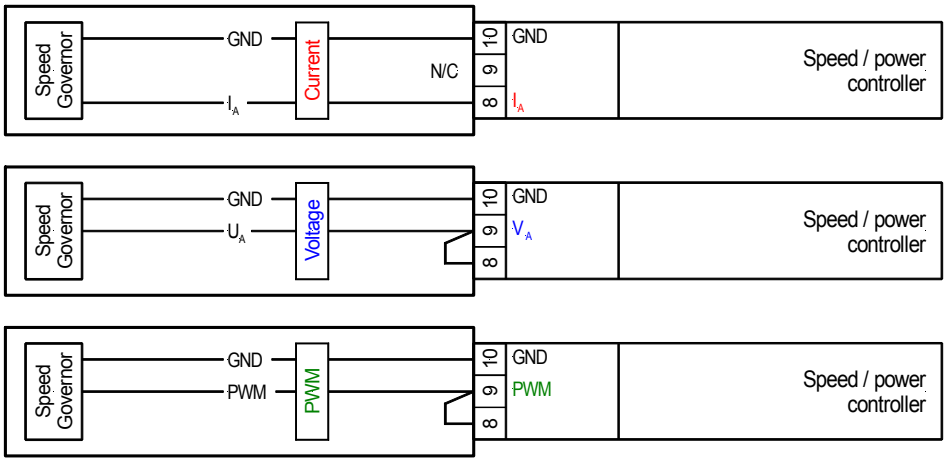



Figure 3-20: Analog controller n/f/P - wiring and jumper setting

### *Option Q - setting: ANALOG (analog controller) - voltage/reactive power controller*

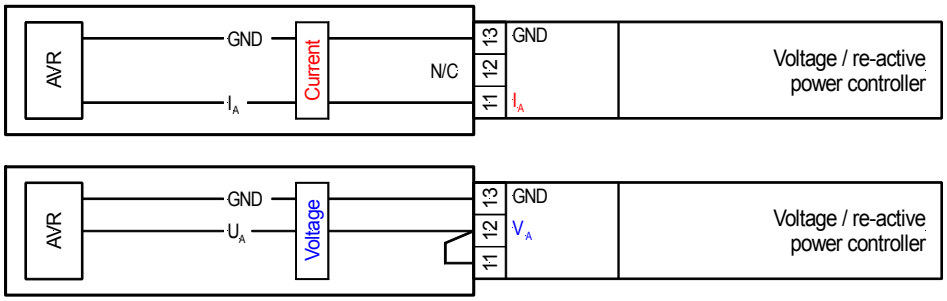



Figure 3-21: Analog controller V/Q - wiring and jumper setting

# Interface

## Interface Wiring

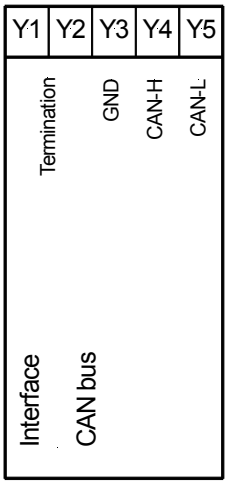



Figure 3-22: Interface - terminals

| Wiring | | | | | Description |
|---|---|---|---|---|---|
| Whether the terminals are designated X or Y depends on the configuration of the system. Please refer to the wiring diagram (A = X/Y, B = X/Y, etc.) | | | | | |
| **all** | | | | | |
| A (X1) | B (X2) | C (X3) | D (X4) | E (X5) | |
| [1] | [1] | GND | CAN-H | CAN-L | CAN bus |

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

## CAN Bus Shielding

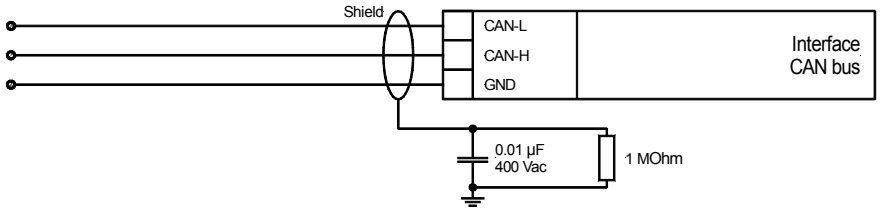



Figure 3-23: Interface - CAN bus shielding

## CAN Bus Loop

### NOTE

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

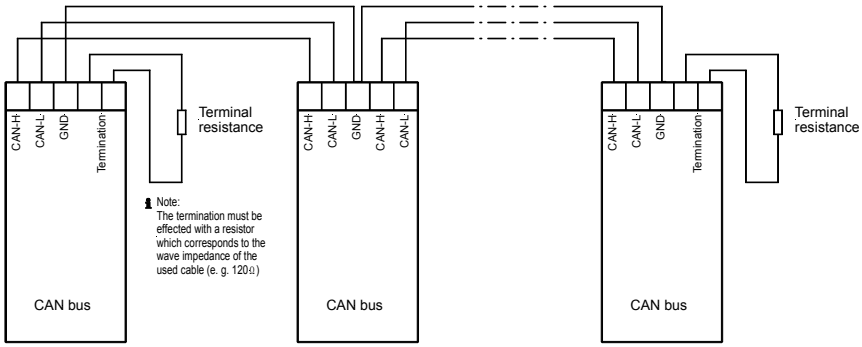



Figure 3-24: Interface - loop the CAN bus

### Possible CAN Bus Problems

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

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

### Maximum CAN Bus Length

The maximum length of the communication bus wiring is dependent on the configured Baud rate. Refer to Table 3-1 for the maximum bus length (Source: CANopen; Holger Zeltwanger (Hrsg.); 2001 VDE VERLAG GMBH, Berlin und Offenbach; ISBN 3-8007-2448-0).

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

Table 3-1: Maximum CAN bus length

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

## DPC - Direct Configuration Interface

**NOTE**

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

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

# Chapter 4.
# Functional Description

## Function

## Operating Conditions

### Idle Control and Synchronization

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

| Input signals [terminal] | | | | Function | Conditions |
|---|---|---|---|---|---|
| Reply: GCB is open [4] | Enable GCB [3] | Reply : MCB is open [54] | Enable MCB [53] | | |
| 1 | 0 | x | x | Idle control | A |
| 1 | 0 | x | x | N/A | B |
| 1 | 1 | x | x | Synchronization of the GCB | C |
| 0 | x | 1 | 1 | Synchronization of the MCB | D |

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

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

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

| Conditions | Function |
|---|---|
| A | Parameter "automatic idle control" is ON. |
| B | Parameter "automatic idle control" is OFF. |
| C | For the generator and for the busbar variables, the following must apply:<br>- 50 % $V_{set}$ < voltage < 125 % $V_{set}$<br>- 80 % $f_{rated}$ < frequency < 110 % $f_{rated}$ |
| D | For the busbar and for the mains variables, the following must apply:<br>- 50 % $V_{set}$ < voltage < 125 % $V_{set}$<br>- 80 % $f_{rated}$ < frequency < 110 % $f_{rated}$<br>- The "Command: GCB open" may not be apply. |

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

## Dead Bus Start

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

| Input signals [terminal] | | | | Function | Conditions |
|---|---|---|---|---|---|
| Reply: GCB is open [4] | Enable GCB [3] | Reply : MCB is open [54] | Enable MCB [53] | | |
| 1 | 1 | 1 | 0 | Dead bus start GCB | E |
| 1 | x | 1 | 1 | Dead bus start MCB | F |

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

Table 4-3: Operating conditions - dead bus start

The busbar must be de-energized.

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

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

## Isolated Operation

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

| Input signals [terminal] | | | | | Function | Conditions |
|---|---|---|---|---|---|---|
| Isolated operation controller ON [35] | Reply: GCB is open [4] | Enable GCB [3] | Reply : MCB is open [54] | Enable MCB [53] | | |
| 0 | 0 | x | 1 | 0 | no control of f/V | --- |
| 1 | 0 | x | 1 | 0 | Isolated operation | --- |

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

Table 4-5: Operating conditions - isolated operation

An isolated operation only takes place if the generator frequency is greater than 42 Hz. Voltage control only takes place if the generator voltage is at least 80 % of the secondary transformer rated voltage and the parameter "Voltage controller isolated operation" is enabled. Voltage, frequency, and synchronization control may be enabled or disable in the configuration menu.

**NOTE**

**When using three-position controllers, these must be configured using the relay manager (see appendix "Relay Manager").**

## Mains Parallel Operation

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

| Input signals [terminal] | | | | | Function | Conditions |
|---|---|---|---|---|---|---|
| Isolated operation controller ON [35] | Reply: GCB is open [4] | Enable GCB [3] | Reply : MCB is open [54] | Enable MCB [53] | | |
| x | 0 | x | 0 | x | Mains parallel operation | |

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

Table 4-6: Operating conditions - mains parallel operation

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

# Direction of Power

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

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

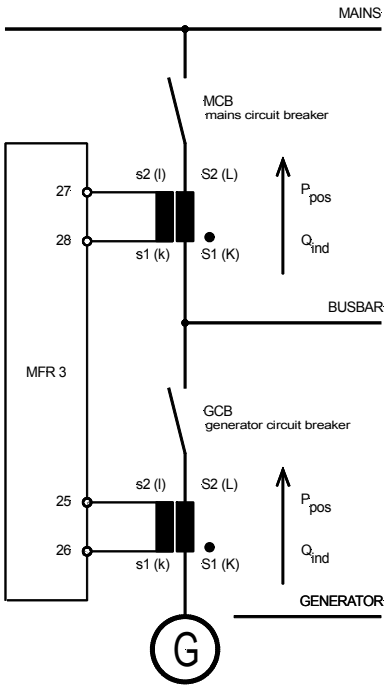



Figure 4-1: Direction of power

# 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)<br>lg.91 (lagging) | c0.93 (capacitive)<br>ld.93 (leading) |

Reactive power display at the unit:

| | |
|---|---|
| 70 kvar (positive) | -60 kvar (negative) |

Output at the interface:

| | |
|---|---|
| + (positive) | - (negative) |

Compared with the voltage, the current is …

| | |
|---|---|
| lagging | leading |

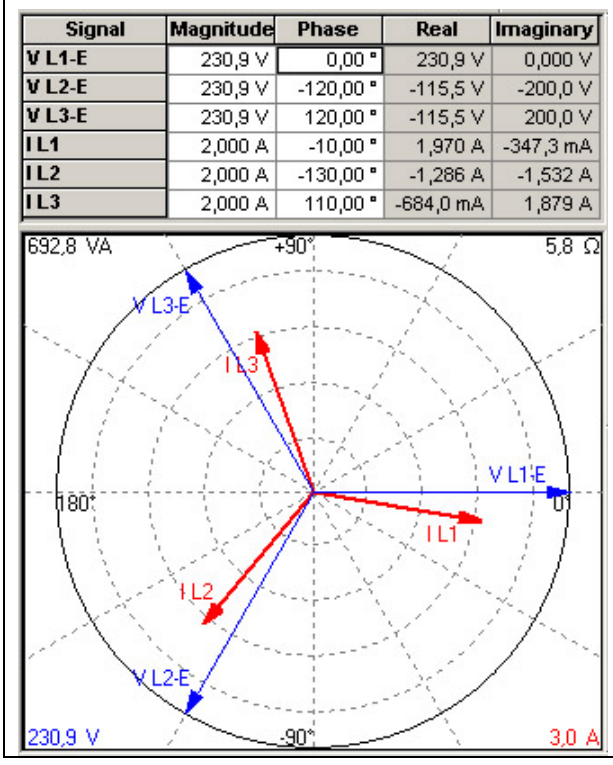
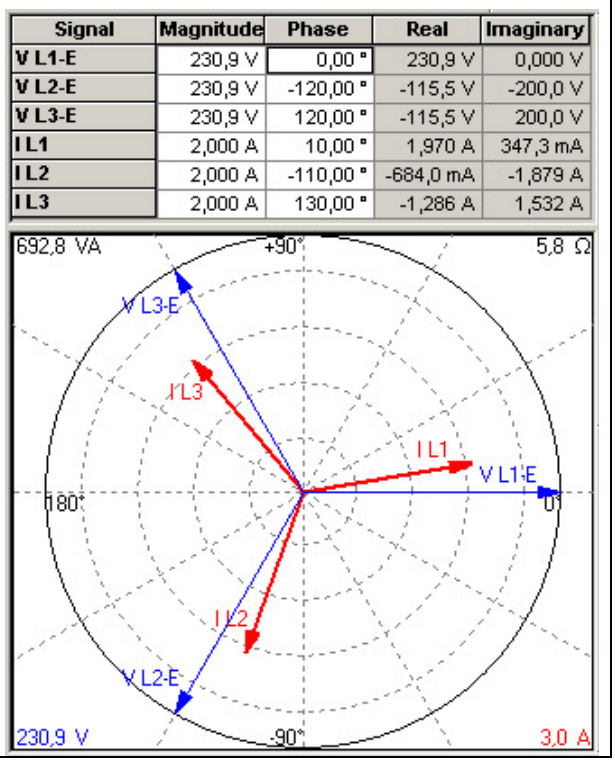
The generator is …

| | |
|---|---|
| over excited | under excited |

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

| | |
|---|---|
| a voltage lower "-" signal is output as long as the measured value is "more inductive" than the reference set point<br>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<br>Example: measured = c0.91; set point = c0.95 |

Phasor diagram:

| inductive | capacitive |
|---|---|
|  |  |

# Activation of the Circuit Breakers

## Operating Sequence for the MCB

Figure 4-2 represents the switch behavior for the following settings:

MCB open via "Enable MCB": ON

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

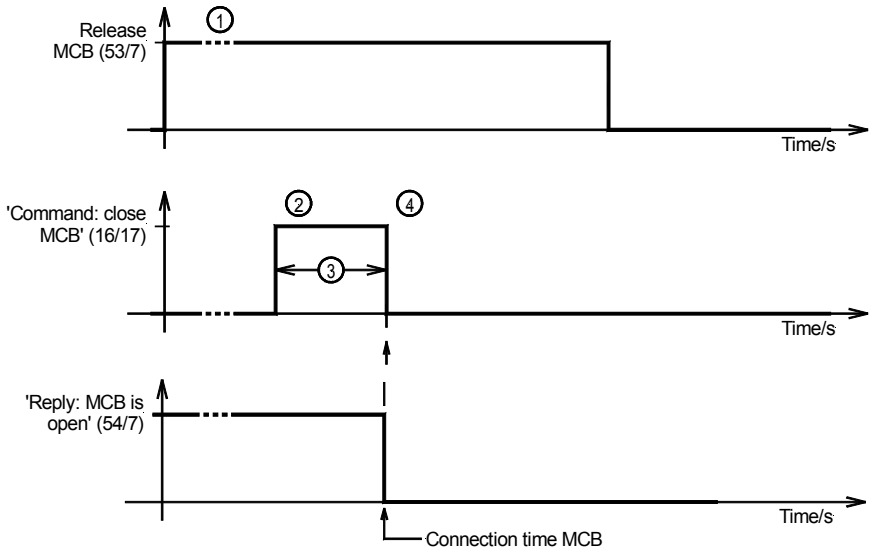



Figure 4-2: Activation of the circuit breakers - MCB

**ON/OFF switching pulse:**

***1*** Synchronization

→ ***2 close MCB:***

***2*** closing pulse for the MCB energized

***3*** breaker inherent delay

***4*** closing pulse de-energized

## Operating Sequence for the GCB

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

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

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

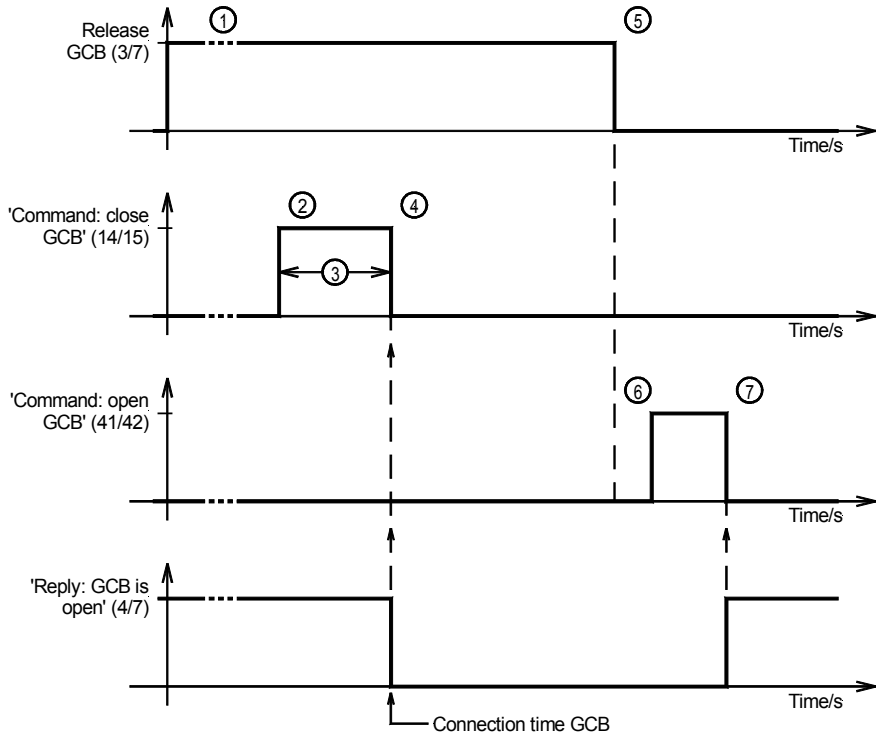



Figure 4-3: Activation of the circuit breakers - GCB

**ON/OFF switching pulse:**

***1*** Synchronization

→ ***2 close GCB:***

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

→ ***6 open GCB:***

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

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

# Analog Controller Outputs

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

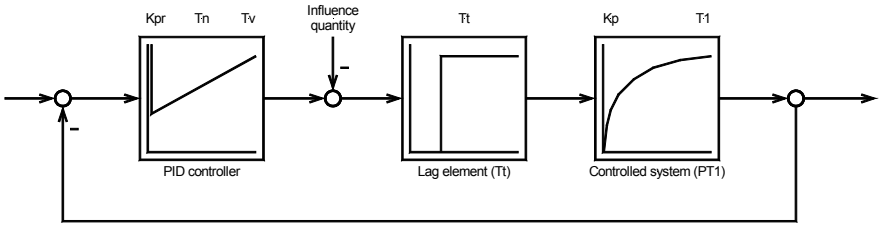



Figure 4-4: Closed loop

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

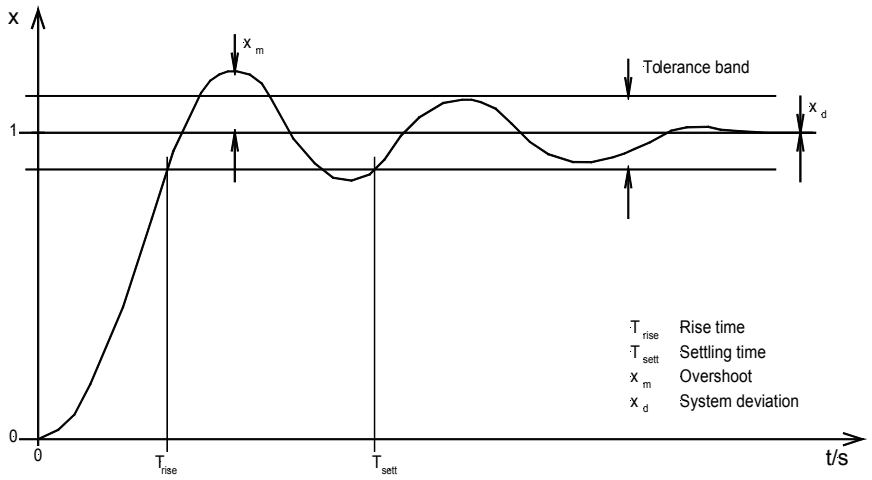



Figure 4-5: Step response (example)

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

**Rise time $T_{rise}$:** The period of time starting when a control variable leaves its steady-state condition following a disturbance variable being applied to it and ending the first time the value re-enters the new steady-state condition.

**Transient time $T_{sett}$:** The period of time starting when a control variable leaves its steady-state condition following a disturbance variable being applied to it and ending when the value permanently re-enters the new steady-state condition.

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

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

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

## Controller Setting

### CAUTION

**The following must be observed regarding setting up the controller:**

- **Ensure that the emergency shutdown system is functional.**
- **While determining the critical frequency, monitor the amplitude and frequency.**
- **If either of the two values change uncontrollably:**

**➔ EMERGENCY SHUTDOWN ←**

**Initial state:** The start position of the controller is determined using the initial state of the controller. If the controller is switched off, the basic setting can be used to output a fixed controller position. If the genset is not running, the controller automatically resets to the initial state.

```
Initial state
frequency = 000%
```

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

Analog controller output setting with controller switched off. This value is also used as the control start point when the generator is initially started.

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

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

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

## CAUTION

**If the engine starts to oscillate uncontrollably, perform an emergency shutdown and alter the screen setting accordingly.**

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

**PID controller**

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

**PI controller**

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

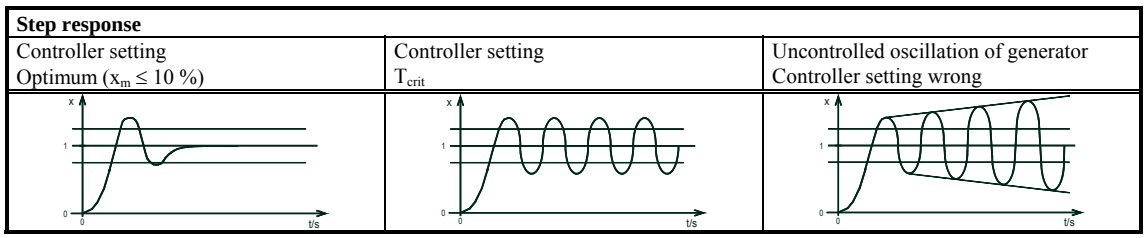



Figure 4-6: Step response - controller setting

```
P-gain
      Kpr = 000
```

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

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

```
Reset time
     Tn = 00,0s
```

**Reset time** ($T_n$) **0.2 to 60.0 s**

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

```
Rate time
      Tv=0,00s
```

**Rate time** ($T_V$) **0.00 to 6.00 s**

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

# Load and/or Var Sharing

The control ensures load and/or var sharing proportional to the rated power of the generators under every operating condition (mains parallel operation, isolated operation in parallel with other gensets, or reverse synchronization of the busbar to the mains).
The controller can communicate with up to 14 generators with a maximum power rating of 16MW each. Any controller not in constant power/base load mode and that has the GCB closed will load and/or var share.

**Operating in mains parallel with mains interchange (import/export) real power control:** Each controller participating in load/var sharing controls the generator set that it is assigned so the real power set point at the mains interchange remains constant. The real power set point for the mains interchange must be configured identically in each controller.
All controllers communicate via a CAN bus. This enables the controllers to adjust the real power generated by the generator while remaining within the rated power of the generator. A smaller generator will contribute less real power as compared to a large generator, but they will both be utilized to the same capacity factor. An example of this would be a 100KW generator and a 1000KW generator and a mains interchange of 825KW. The 100KW generator would contribute 75KW and the 1000KW generator would contribute 750 KW or both generators would be at 75% of their rated capacity.
No reactive power sharing is performed when operating in parallel with the mains. The reactive power will be defined by the configured power factor set point of the individual controllers.

The parameter "kW/kvar sharing: reference variable kW" can be used now to define the priority of the reference variable (real power at interchange) for real power sharing. A higher percentage influences the control more towards the real power set point for the interchange. A lower percentage influences the control more towards real power sharing.
The parameter "kW/kvar sharing: reference variable kvar" has no influence here.

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

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

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

**Pre-requisites:** It is imperative that the rated system frequencies (page 64) and the circuit breaker logic (page 88) are set identically for all units participating in load/var sharing.

**Description of the interface for load/var sharing:** Load/var sharing is based on a multi-master-capable bus between the controls. This structure enables the parallel operation of up to 14 generators.

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

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

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

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

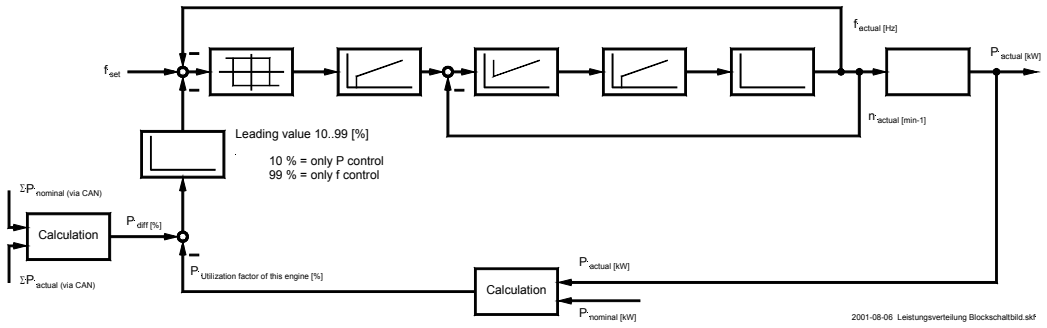



Figure 4-7: Load/var sharing - schematic

# Language Manager

**NOTE**

**Please also note the parameters to this option in chapter Language Manager at page 56.**

In order to load a different language into the unit, please proceed as follows:

1. Establish a connection between your PC and the unit via the direct configuration cable (DPC) or via a Gateway GW 4. To do this, connect the serial cable end to the COM port of your PC and insert the RJ45 plug in the socket on the side of the unit.

2. Enter the password for code level 2 into the unit. Also read chapter Password Protection at page 59.

3. Scroll down through the display to the configuration screen "load language".

4. Enter "YES" to load the language.

5. Scroll down only until you reach the configuration screen "language number" and select the base language in which you enter "0".

6. Enter in the "number of tool" screen the numbers (1 to 8) with which you operate the MFR via LeoPC1. These numbers are identical to the unit numbers.

7. Now start the LeoPC1 and load the corresponding configuration file. Ensure, that direct configuration is selected in the device settings in LeoPC1 and the connection between device and LeoPC1 has been started.

8. Open the "Load Language" window and load the desired language file.

9. Go to the "Which texts have to be transferred?" area and select "All texts". Next click on the "Transfer language" button to start loading the file into the control unit.

10. If, after transmission of the first language an additional language is to be loaded, the SECOND language must be selected in the configuration screen "Sprache/language" of the unit or enter a "one" in the "Language number" screen. Next repeat steps 6 through 9.

11. It is also possible to load a language via the CAN interface. If this method is utilized, the direct configuration port is disabled in the device and the data communication settings in LeoPC1 must be changed to CAN.

# Alarms

## Alarm Class

The monitoring functions are divided into four alarm classes:

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

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

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

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

## Internally Detected Alarms

List of alarms determined internally depending on the monitored variables:

| Type of alarm | see page | Alarm class | Alarm text | Relay output (terminal) |
|---|---|---|---|---|
| Generator overfrequency, level 1 | 107 | F3 | **Gen.overfreq. 1** | |
| Generator overfrequency, level 2 | 107 | F3 | **Gen.overfreq. 2** | |
| Generator underfrequency, level 1 | 108 | F3 | **Gen.underfreq. 1** | |
| Generator underfrequency, level 2 | 108 | F3 | **Gen.underfreq. 2** | |
| Generator overvoltage, level 1 | 109 | F3 | **Gen.overvolt. 1** | |
| Generator overvoltage, level 2 | 109 | F3 | **Gen.overvolt. 2** | |
| Generator undervoltage, level 1 | 110 | F3 | **Gen.undervolt. 1** | |
| Generator undervoltage, level 2 | 110 | F3 | **Gen.undervolt. 2** | |
| Generator time-overcurrent, level 1 | 99 | F3 | **Gen.overcurr. 1** | |
| Generator time-overcurrent, level 2 | 99 | F3 | **Gen.overcurr. 2** | |
| Reverse/reduced load | 96 | F3 | **Revers/min.power** | |
| Overload | 97 | F2 | **Gen.overload** | |
| Unbalanced load | 105 | F3 | **Load unbalance** | |
| Mains overvoltage | 112 | F0 | **Mains-overvolt.** | |
| Mains undervoltage | 112 | F0 | **Mains-undervolt.** | |
| Main overfrequency | 111 | F0 | **Mains-underfreq.** | |
| Mains underfrequency | 111 | F0 | **Mains-overfreq.** | |
| Mains phase/vector jump | 114 | F0 | **Phase shift** | |
| Mains df/dt | 116 | F0 | **df/dt error** | |
| Battery undervoltage | 117 | F1 | **Batt.undervolt.** | |
| GCB synchronization time monitoring | 92 | F1 | **GCB syn.failure** | |
| MCB synchronization time monitoring | 92 | F1 | **MCB syn.failure** | |
| Switching to dead busbar time monitoring | 93 | F1 | **Failure df/dVmax** | |
| Mechanical GCB malfunction on closing | 94 | F1 | **GCBclose failure** | |
| Mechanical MCB malfunction on closing | 94 | F1 | **MCBclose failure** | |
| Mechanical GCB malfunction on opening | 94 | F1 | **GCB open failure** | |
| Mechanical MCB malfunction on opening | 94 | F1 | **MCB open failure** | |
| Faulty ref.power zero contr.with interch.syn. GCB | 88 | F1 | **Power not zero** | |
| Maintenance call | 131 | F1 | **Service** | |
| Interface error X1 to X5 | 87 | F1 | **Interf.err. X1X5** | |
| Interface error Y1 to Y5 | 87 | F1 | **Interf.err. Y1Y5** | |
| Rotation field mismatch | 91 | -* | **Phase sequence!** | |
| Generator reactive power, capacitive | 98 | | **Gen.reac.pow.cap** | |
| Generator reactive power, inducitive | 98 | | **Gen.reac.pow.ind** | |

**Note:** In the event of mains faults, the GCB or the MCB is opened according to the configuration, and is closed again following the mains settling time.

* This message is no alarm message in the actual sense, but an informative message, which does not have to be acknowledged and causes no shutdown of the engine. The display disappears automatically after correcting the rotating field.

Table 4-7: Alarms - text messages

## Alarm Acknowledgement

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

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

**NOTE**

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

### Short acknowledgment (< 2.5 s)

**Action**

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

**Result**

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

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

Table 4-8: Alarms - short acknowledgment

### Long acknowledgment (>2.5 s)

**Action**

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

**Result**

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

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

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

Table 4-9: Alarms - long acknowledgment

# Chapter 5.
# Display and Push-Buttons

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, comprised of 2 lines with 16 characters each, which are indirectly illuminated in red. The contrast of the display can be infinitely adjusted via a rotary potentiometer positioned on the left side. The configuration plug is located on the left side of the unit. The direct configuration cable (DPC) connects there.

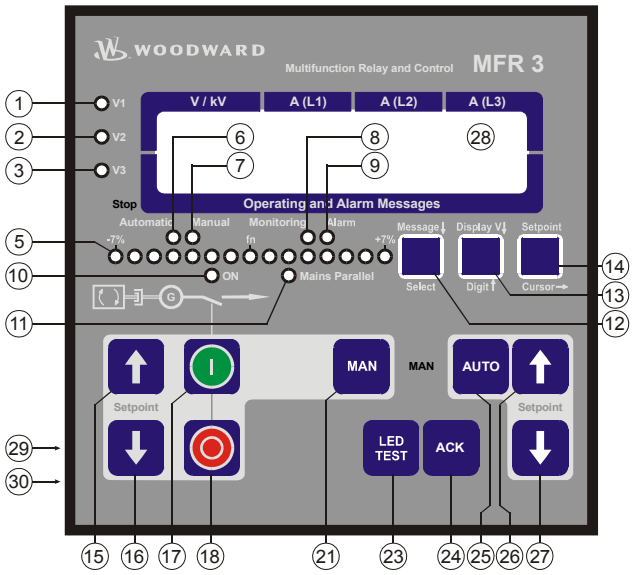



Figure 5-1: Front panel MFR 31

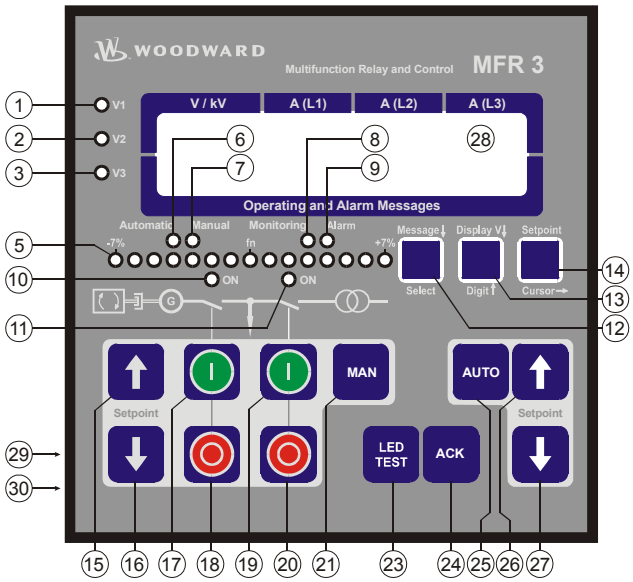



Figure 5-2: Front panel MFR 32

# Brief Description of LED and Push-Buttons

## LEDs

| No. | Description | Function |
|---|---|---|
| **1** | V1 | Voltage L1 |
| **2** | V2 | Voltage L2 |
| **3** | V3 | Voltage L3 |
| **5** | -7%..fn..+7% | Synchroscope |
| **6** | Automatic | Operating mode AUTOMATIC selected |
| **7** | Manual | Operating mode MANUAL selected |
| **8** | Monitoring | Monitoring is activated |
| **9** | Alarm | Alarm is active |
| **10** | GCB is closed | Reply: GCB is closed |
| **11** | MCB is closed | Reply: MCB is closed |

## Push-Buttons

| No. | Description | Function |
|---|---|---|
| **12** | Message↓ | Route messages |
| **12** | Select | Confirm selection |
| **13** | Display V↓ | Route voltage display |
| **13** | Digit↑ | Increase digit |
| **14** | Set point | Activate set point value |
| **14** | Cursor→ | Move cursor one position right |
| **15** | Set point↑ | Increase MANUAL set point value |
| **16** | Set point↓ | Decrease MANUAL set point value |
| **17** | GCB ON | Close GCB manually |
| **18** | GCB OFF | Open GCB manually |
| **19** | MCB ON | Close MCB manually |
| **20** | MCB OFF | Open MCB manually |
| **21** | MAN | Select operating mode MAN |
| **23** | LED TEST | Execute LED test |
| **24** | ACK | Acknowledge alarm messages |
| **25** | AUTO | Select operating mode AUTOMATIC |
| **26** | Set point↑ | Increase AUTO setpoint value |
| **27** | Set point↓ | Decrease AUTO setpoint value |

## Miscellaneous

| No. | Description | Function |
|---|---|---|
| **28** | LC display | LC display |
| **29** | DPC plug | Configuration plug |
| **30** | Potentiometer | Adjust LCD contrast |

# LEDs

**1 V1 - V2 - V3** **Voltage control**
**2** Color: Green
**3**

The LED's "V1", "V2" and "V3" show which voltage ($V_{L1N}$, $V_{L2N}$, $V_{L3N}$, $V_{L12}$, $V_{L23}$ or $V_{L31}$) is currently being displayed. This applies both to the generator and the mains voltage display.

**5 -7%..$f_N$..+7%** **Phase position / synchroscope**
Color: Red/Yellow/Green

The LED's between -7 % and +7 % serve to visualize the generator frequency. The rated frequency ($f_N$) is entered in the "generator rated frequency" screen. If the frequency is greater than +7 % or less than -7 %, the corresponding outer LED flashes.
As soon as the synchronization is started, the double voltage/double frequency display appears and the synchroscope becomes active. The LEDs show the current phase angle between the two displayed voltages. The green LED in the center of the 15 LED's indicates that the measured phase angle between the voltage systems displayed is less than 12 ° electrical. The phase angle is only displayed if the frequencies of the two voltages are within the following permissible ranges:

| | |
|---|---|
| Generator | 88 to 112 % $f_N$ |
| Mains | 96 to 104 % $f_N$ |

A distinction is made between two directions of rotation:
**-7 % → +7 %** = The LEDs illuminate from left to right, the generator frequency is higher than the mains.
**+7 % → -7 %** = The LEDs illuminate from right to left, the generator frequency is lower than the mains.

**6 Automatic** **Operating mode AUTOMATIC**
Color: Green

When the AUTOMATIC operation mode has been selected, the "Automatic" LED is illuminated. The "Setpoint↑", "Setpoint↓", "GCB ON", "GCB OFF", "MCB ON", and "MCB OFF" push buttons (for the operating mode MANUAL) are disabled.

**7 Manual** **Operating mode MANUAL**
Color: Green

When the MANUAL operation mode has been selected, the "Manual" LED is illuminated. The push buttons "Setpoint↑" and "Setpoint↓" (for the operating mode AUTOMATIC) are disabled.

**8** **Monitoring**
Color: Green

**Monitoring**

If the "Monitoring" LED is illuminated, monitoring is enabled. The delayed programmed alarm inputs are monitored in addition to the permanently monitored alarm inputs. Generator underspeed, underfrequency, undervoltage and reverse power are also monitored.

**9** **Alarm**
Color: Red

**Alarm**

The unit has detected an alarm condition when the "Alarm" LED is illuminated. The control unit reacts according to the alarm class. The alarm message is shown in the LC display. If the alarm LED is flashing, a new alarm condition has occurred within the last two minutes. By performing a short acknowledgment, the alarm LED changes to continuous illumination and the centralized alarm (horn) is terminated.

**10** **GCB on**
Color: Green

**Reply: GCB is closed**

The "GCB ON" LED indicates that the GCB is closed when illuminated.

**11** **MCB on**
Color: Green

**Reply: MCB is closed**

The "MCB ON" LED indicates that the MCB is closed when illuminated.

# Push-Buttons

In order to facilitate configuring the parameters, the push buttons have an AUTOROLL function. It permits the user to advance to the next setting, configuration screen, the digit, and/or cursor position by pressing and holding the corresponding push button.

## General / Configuration

**12** **Message↓ / Select**
Color: Blue

**Message↓ / Select**

**Normal operation:** Message↓ - By pressing this push button, the user my advance through the operating and alarm messages.

**Configuration:** Select - The user advancesto the next configuration screen by pressing this button. If the original displayed value has been changed by pressing either the "Digit↑" or "Cursor→" push buttons, the new value is saved by pressing the "Select" push button once. By pressing this push-button again, the user causes the system to display the next configuration screen.

**13** **Display V↓ / Digit↑**
Color: Blue

**Display V↓ / Digit↑**

**Normal operation:** Display V↓ - By pressing this push-button, the generator and mains voltage display is moved forwards. **Note:** If this push-button is pressed for at least 5 seconds, the counter that is currently been displayed is (re)set.

**Configuration:** Digit↑ - With this push-button, the number at which the cursor is currently located is increased by one digit. The increase is restricted by the admissible limits (see list of parameters included in the appendix). In case the maximum number is reached which can be set, the number automatically returns to the lowest admissible number.

**14** **Setpoint / Cursor→**
Color: Blue

**Setpoint / Cursor→**

**Normal operation** Setpoint - By pressing this push-button, the individual setpoint values are displayed. The displayed setpoint values can be adjusted with the "Setpoint↑" or "Setpoint↓" push-buttons (depending on the selected operating mode alternatively the setpoint values for the operating modes AUTOMATIC or MANUAL can be changed). Certain setpoint values, which are entered into the unit from external sources, can only be displayed.

**Configuration** Cursor→ - This push-button is used to move the cursor one position to the right. When the last right-hand position is reached, the cursor automatically moves to the first position left-hand of the value to be entered.

**15** **Setpoint↑ / Setpoint↓**
**16** Color: Blue

**Setpoint↑ / Setpoint↓ - operating mode AUTOMATIC**

By pressing the "Setpoint↑" or "Setpoint↓" push-buttons, the setpoint selected via the "Setpoint" push-button for the operating mode AUTOMATIC is changed accordingly. Only those values which are available in the relevant operating mode and which were switched on during configuration can be changed.

**26** **Setpoint↑ / Setpoint↓**
**27** Color: Blue

**Setpoint↑ / Setpoint↓ - operating mode MANUAL**

By pressing the "Setpoint↑" or "Setpoint↓" push-buttons, the setpoint selected via the "Setpoint" push-button for the operating mode MANUAL is changed accordingly. Only those values which are available in the relevant operating mode and which were switched on during configuration can be changed.

## Control of the Power Circuit Breakers

**17** **GCB ON / GCB OFF** **Close GCB / open GCB**
**18** Color: Green/Red

Note: This function is only enabled if the MANUAL operation mode has been enabled.

**GCB ON.....** Depending on which power circuit breaker logic has been selected, the GCB can be closed by pressing the "GCB ON" push button. This process can be aborted if either the "GCB OFF" or "MCB ON" push buttons are pressed or the operating mode is changed.

**GCB OFF....** Depending on which power circuit breaker logic has been selected, the GCB can be opened or synchronization of the GCB can be aborted by pressing the "GCB OFF" push-button.

**19** **MCB ON / MCB OFF** **Close MCB / open MCB**
**20** Color: Green/Red

Note: This function is only enabled if the MANUAL operation mode has been enabled.

**MCB ON.....** Depending on which power circuit breaker logic has been selected, the MCB can be closed by pressing the "MCB ON" push button. This process can be aborted if either the "MCB OFF" or "GCB ON" push buttons are pressed or the operating mode is changed.

**MCB OFF ...** Depending on which power circuit breaker logic has been selected, the MCB can be opened or synchronization of the MCB can be aborted by pressing the "MCB OFF" push button.

## Operating Mode Selector

### NOTE

**It is possible to block the MANUAL and AUTOMATIC operation mode push buttons by enabling the discrete input [D02] (terminal 63), preventing the operating mode from being changed.**

**21** **MAN** **Select operating mode MAN**
Color: Blue

If the MANUAL operation mode is selected, automatic control of the power circuit breaker control is disabled. The push buttons are used to control the equipment manually. Critical automatic processes continue to remain in operation (e.g. mains watchdog function for mains parallel operation).

**23** **LED Test** Color: Blue **Check LED's**

All control unit LED's are illuminated by pressing this button to check for proper operation.

**24** **ACK** Color: Blue **Acknowledgment**

Alarm messages are acknowledged pressing the "ACK" push button. The alarm messages on the LC display are cleared and the "Alarm" LED will darken. The display is reset to the basic screen. Class F2 and F3 alarms can only be acknowledged in the MANUAL operation mode. Refer to Alarm Acknowledgement on page 45.

**25** **AUTO** Color: Blue **Select operating mode AUTOMATIC**

If the AUTOMATIC operation mode is selected, automatic control of the power circuit breaker control is enabled. By energizing or de-energizing "Set point 1↔2" (terminal 5), the power set point can be changed.

- Terminal 5 "Setpoint 1↔2" de-energized:
  Real power set point 1 is active.
- Terminal 5 "Setpoint 1↔2" energized:
  Real power set point 2 or an external setpoint value is active. The user may configure if set point 2, a 0/4-20 mA input, or an interface is to be utilized.

## LC Display

**28** **LC display** **LC display**

The LC display shows messages and values, depending on the respective mode applied. In configuration mode, the individual parameters are displayed and changed. In automatic mode the operating variables (e. g. voltages and currents) can be called up.

**NOTE**

**Using push-button "Display V↓" the voltages can be displayed.**

### Automatic Mode (First Display Line: Measuring Values)

```
xxxx yyy yyy yyy
----------------
```

**Display in automatic mode, first line: measuring value**

The following measuring values are displayed (depending on the LEDs V1/V2/V3) on the top line of the display:

- "xxxx" - generator voltage relating to which LEDs V1/V2/V3 are illuminated:

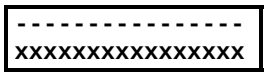
| | | |
|---|---|---|
| V1 illuminates | line-to-neutral voltage | $V_{L1-N}$; |
| V2 illuminates | line-to-neutral voltage | $V_{L2-N}$; |
| V3 illuminates | line-to-neutral voltage | $V_{L3-N}$; |
| V1&V2 illum. | line-to-line voltage | $V_{L1-L2}$; |
| V2&V3 illum. | line-to-line voltage | $V_{L2-L3}$; |
| V3&V1 illum. | line-to-line voltage | $V_{L3-L1}$. |

- "yyy" - generator currents (line currents $I_{L1}$, $I_{L2}$ and $I_{L3}$).

## Automatic Mode (Second Display Line: Measuring Values)

### NOTE

**The bottom line can be scrolled using the "Message↓" push button. It is also possible, to scroll through any alarms that may be present using the "Message↓" push button.**




**Display in automatic mode, second line: measuring values**

The following measured values are displayed in the "**xxxxxxxxxx**" area shown to the left:

**Basic screen:**

- generator cosphi/power factor
- actual generator real power
- the unit operation currently being carried out (synchronization, etc.)

**Subordinate screen:** Depending on the unit's equipment

- mains voltage
- mains current/power
- mains cosphi/power factor
- analog inputs
- generator real power
- generator re-active power (determined using phase L1 current; also if "three-phase" power measurement was selected)
- operating hours
- time remaining to the next maintenance call
- start counter
- battery voltage (power supply)
- number of subscribers participating in load sharing
- maximum generator current (slave pointer)
- the four alarm messages which occurred first
- time/date
- energy counter kWh and kvarh

These screens are displayed in succession by pressing the "Message↓" push button. When the last screen has been reached, the basic screen is displayed. If alarms have occurred, the related message texts are displayed in the sequence of their occurrence prior to the basic screen. If unit functions are active (e.g. synchronization of the GCB), the basic screen is superimposed with the corresponding message (e.g. " synchronization"). Following the termination of the unit function, the basic screen is displayed again.

## Automatic Mode (Second Display Line: Alarm Display)

**NOTE**

**It is possible to scroll through any alarms that may be present using the "Message↓" push-button.**

```
----------------
yyyyyyyyyyyyyyyy
```

**Display in automatic mode, second line: alarms**

If an alarm occurs the message is displayed in the second line of the LC display according to the following list.

| Type of alarm | see page | Alarm class | Alarm text | Relay output (terminal) |
|---|---|---|---|---|
| Generator overfrequency, level 1 | 107 | F3 | Gen.overfreq. 1 | |
| Generator overfrequency, level 2 | 107 | F3 | Gen.overfreq. 2 | |
| Generator underfrequency, level 1 | 108 | F3 | Gen.underfreq. 1 | |
| Generator underfrequency, level 2 | 108 | F3 | Gen.underfreq. 2 | |
| Generator overvoltage, level 1 | 109 | F3 | Gen.overvolt. 1 | |
| Generator overvoltage, level 2 | 109 | F3 | Gen.overvolt. 2 | |
| Generator undervoltage, level 1 | 110 | F3 | Gen.undervolt. 1 | |
| Generator undervoltage, level 2 | 110 | F3 | Gen.undervolt. 2 | |
| Generator time-overcurrent, level 1 | 99 | F3 | Gen.overcurr. 1 | |
| Generator time-overcurrent, level 2 | 99 | F3 | Gen.overcurr. 2 | |
| Reverse/reduced load | 96 | F3 | Revers/min.power | |
| Overload | 97 | F2 | Gen.overload | |
| Unbalanced load | 105 | F3 | Load unbalance | |
| Mains overvoltage | 112 | F0 | Mains-overvolt. | |
| Mains undervoltage | 112 | F0 | Mains-undervolt. | |
| Main overfrequency | 111 | F0 | Mains-underfreq. | |
| Mains underfrequency | 111 | F0 | Mains-overfreq. | |
| Mains phase/vector jump | 114 | F0 | Phase shift | |
| Mains df/dt | 116 | F0 | df/dt error | |
| Battery undervoltage | 117 | F1 | Batt.undervolt. | |
| GCB synchronization time monitoring | 92 | F1 | GCB syn.failure | |
| MCB synchronization time monitoring | 92 | F1 | MCB syn.failure | |
| Switching to dead busbar time monitoring | 93 | F1 | Failure df/dVmax | |
| Mechanical GCB malfunction on closing | 94 | F1 | GCBclose failure | |
| Mechanical MCB malfunction on closing | 94 | F1 | MCBclose failure | |
| Mechanical GCB malfunction on opening | 94 | F1 | GCB open failure | |
| Mechanical MCB malfunction on opening | 94 | F1 | MCB open failure | |
| Faulty ref.power zero contr.with interch.syn. GCB | 88 | F1 | Power not zero | |
| Maintenance call | 131 | F1 | Service | |
| Interface error X1 to X5 | 87 | F1 | Interf.err. X1X5 | |
| Interface error Y1 to Y5 | 87 | F1 | Interf.err. Y1Y5 | |
| Rotation field mismatch | 91 | -* | Phase sequence! | |
| Generator reactive power, capacitive | 98 | | Gen.reac.pow.cap | |
| Generator reactive power, inducitive | 98 | | Gen.reac.pow.ind | |

**Note:** In the event of mains faults, the GCB or the MCB is opened according to the configuration, and is closed again following the mains settling time.

* This message is no alarm message in the actual sense, but an informative message, which does not have to be acknowledged and causes no shutdown of the engine. The display disappears automatically after correcting the rotating field.

Table 5-1: Alarms - text messages

# Chapter 6.
# Configuration

Configuration can be performed via the front panel push buttons and LC display or using a PC and the LeoPC1 program with the serial interface. Additionally it is possible to configure the unit via CAN bus. The following baud rates apply to each method:

- Direct configuration 9,600 Baud (8 bit, no parity, 1 stop bit)
- CAN bus configuration 125 kBaud

## CAUTION

**Please note that configuration only should be performed when system is not operating.**

**Generator voltage must not be connected during configuration and the DI "Configuration blocked" (terminal 34) must be de-energized.**

**Code level 2 access is required to select between direct configuration or configuration via CAN.**

## NOTE

**Refer to Appendix B for a complete list of parameters at the end of this manual.**

# Introduction

The configuration screens have an AUTOROLL function when you are in configuration mode (simultaneously pressing "Digit↑" and "Cursor→"). If the "Select" button is pressed and held, the scroll function will be activated and the user will be able to rapidly advance through the parameter screens. It is possible to back-up four configuration screens (exception: the break from the first to the last screen is not possible). To do this, simultaneously press and release the "Select" and "Cursor→" buttons. If an action, entry, or modification, is not performed within 60 seconds, the unit reverts to the automatic mode.

**NOTE**

**There are two different hardware versions described in this manual: A 100 Vac version [1] and a 400 Vac version [4]. The two versions vary as far as the configuration screens, the input of the parameters and the setting limits are concerned. The respective voltage values ([1]... or [4]...) are placed first to differentiate the two types.**

# Basic Data

## Language Manager

Parameter 1

```
Sprache/language
----------------
```

**Language** **first/second**

**first**.....All texts are displayed in the base/first language.
**second**.....All texts are displayed in the second language.

Parameter 2

```
Load language
         YES
```

**Load language** **YES/NO**

**YES** .....A language file may be loaded if code level 2 has been activated.
**NO** .....Language loading capabilities are disabled. The following related configuration screens are not displayed.

Parameter 3

```
Language number
              0
```

**Language selection** **0/1**

The number entered here determines if the first or second language is to be loaded.
**0** .....The base/first language is to be loaded.
**1** .....The second language is to be loaded.

Parameter 4

```
Number of tool
             00
```

**Unit number on the CAN bus** **1 to 14**

If the control unit language is being modified over the CAN bus, the assigned unit number must be entered here. If the control unit language is being modified via the DPC, it is not necessary to enter a value in this screen (refer to next parameter).

**NOTE**

**Please also note chapter "Direct Configuration" on page 63.**

Parameter **5**

```
Direct para.
             YES
```

**Direct configuration** **YES/NO**

**YES**..... The language will be uploaded via the DPC and the DPC connection is disabled.

**NO**..... The language will be uploaded via the CAN bus and the DPC connection is disabled.

## Version Number

Parameter **6**

```
Software version
     Vx.xxxx
```

**Software version**

Display of the current software version.

## Service Display

Parameter **7**

```
Service display
            ON
```

**Service display** **ON/OFF**

**ON**..... The following three screens are displayed:

- the generator and busbar voltages and frequencies
- the mains and busbar voltage and frequencies
- the controller breaker and relay statuses during synchronization

The specific displayed values are dependent upon the control unit hardware.

**OFF**..... The service display is disabled.

### Service Display for Versions without Potential Transformers (400 V)

```
B:  000V 00,00Hz
G:  000V 00,00Hz
```

**Double voltage/frequency display**

The generator and busbar voltage and frequency are displayed. The phase angle between the generator and busbar is displayed by the synchroscope (LED strip):

**B**..... Busbar voltage and frequency

**G** ..... Generator voltage and frequency

```
M:  000V 00,00Hz
B:  000V 00,00Hz
```

**Double voltage/frequency display**

The busbar and mains voltage and frequency are displayed. The phase angle between the busbar and mains is displayed by the synchroscope (LED strip):

**M**..... Mains voltage and frequency

**B**..... Busbar voltage and frequency

## Service Display for Versions with Voltage Transformers (100 V)

```
B 00,0kV 00,00Hz
G 00,0kV 00,00Hz
```

**Double voltage/frequency display**

The generator and busbar voltage and frequency are displayed. The phase angle between the generator and busbar is displayed by the synchroscope (LED strip):
**B** .....Busbar voltage and frequency
**G**.....Generator voltage and frequency

```
M 00,0kV 00,00Hz
B 00,0kV 00,00Hz
```

**Double voltage/frequency display**

The busbar and mains voltage and frequency are displayed. The phase angle between the busbar and mains is displayed by the synchroscope (LED strip):
**M** .....Mains voltage and frequency
**B** .....Busbar voltage and frequency

## Status of Relays During Synchronization

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

**Status of breakers and relays of the controller**

This screen displays the real-time statuses for the three-position controller outputs with respect to the analog controller and the signals issued to the power circuit breaker during synchronization:

| | | | |
|---|---|---|---|
| **f**.....+ | | Frequency controller raise | terminal 8/9 |
| | - | Frequency controller lower | terminal 8/10 |
| **V** .....+ | | Voltage controller raise | terminal 11/12 |
| | - | Voltage controller lower | terminal 11/13 |
| **MCB**.....on | | Close pulse of the MCB | terminal 16/17 |
| | off | Open pulse of the MCB | terminal 39/40 |
| **GCB** .....on | | Close pulse of the GCB | terminal 14/15 |
| | off | Open pulse of the GCB | terminal 41/42 |

# Password Protection

The unit is equipped with a three-level code and configuration hierarchy. This permits multiple levels of access to configuration screens for different users. A distinction is made between:

**Code level 0 (CS0) -** User: Third Party
Only monitoring of measured values is permitted. The configuration of parameters is blocked.

**Code level 1 (CS1) -** User: Customer
Monitoring of measured values and select parameters may be changed (e.g. rated power, etc.). Changing a password is not possible in this level.

**Code level 2 (CS2) -** User: Commissioner
The user has complete access to display and change all parameters. The user may also set and change passwords for code levels 1 and 2 (see below).

## NOTE

**Access codes remain active for two hours after the last action is performed, even if the configuration mode is accessed repeatedly. If an incorrect password is entered, the control unit reverts to code level CS0 and external users are blocked from accessing the unit (setting of password on page 72). The desired code level may be accessed again by entering the correct password for that code level.**

Parameter **8**

```
Enter code
          0000
```

**Enter code number** **0000 to 9999**

To access the configuration mode, the control unit requests the code number that is specific to a code level. The number in the LC display is a randomly generated number (RN) and may be confirmed by pressing the "Select" push button. If the random number is confirmed the code level remains at its current level. Two four-digit code numbers (0000 to 9999) exist for accessing the code levels or setting up new pass codes for the users. A pass code is not required for "third party" code level CS0, as the user does not require access to configuring parameters (protected via the code).

# Event Recorder

**NOTE**

**The viewing and acknowledgment of alarms depends on access authorization:**

| | |
|---|---|
| **Viewing of alarms** | **Access authorization CS# 0, CS# 1 and CS# 2** |
| **Acknowledgment of alarms** | **Access authorization CS# 2** |

**# CS = code level (see chapter "Alarm Class" on page 44.**

If an alarm occurs in the unit, an entry into the event log is made. The following information is supported/stored:

Event
Date of occurrence
Time of occurrence

The event recorder stores the last 50 alarms in a FIFO (First In First Out) format, beginning with the most recent event. By pressing the "ACK" push button, the displayed alarm condition is deleted from the event recorder. The alarms are displayed on two lines. The top line indicates the date and time of the alarm occurred; the lower line shows the type of alarm.

Parameter **9**

```
Check event list
                YES
```

**Event recorder** **YES/NO**

**YES** .....The events can be viewed and acknowledged.
**NO** .....The events cannot be viewed or acknowledged.

## Internal Events and Discrete Inputs

```
 YY-MM-DD hh:mm
xxxxxxxxxxxxxxxx
```

**50 × alarm log**

| | |
|---|---|
| **YY-MM-DD hh:mm** | Display of day and time of the event. |
| **xxxxxxxxxxxxxxxx** | See table below. |

| Type of alarm | xxxxxxxxxxxxxxxx | |
|---|---|---|
| | German | English |
| **Internal alarm** | | |
| Generator overfrequency, level 1 | Gen.Überfreq. 1 | Gen.overfreq. 1 |
| Generator overfrequency, level 2 | Gen.Überfreq. 2 | Gen.overfreq. 2 |
| Generator underfrequency, level 1 | Gen.Unterfreq. 1 | Gen.underfreq. 1 |
| Generator underfrequency, level 2 | Gen.Unterfreq. 2 | Gen.underfreq. 2 |
| Generator overvoltage, level 1 | Gen.-Überspg. 1 | Gen.overvolt. 1 |
| Generator overvoltage, level 2 | Gen.-Überspg. 2 | Gen.overvolt. 2 |
| Generator undervoltage, level 1 | Gen.-Unterspg. 1 | Gen.undervolt. 1 |
| Generator undervoltage, level 2 | Gen.-Unterspg. 2 | Gen.undervolt. 2 |
| Generator time-overcurrent, level 1 | Gen.-Überstrom 1 | Gen.overcurr. 1 |
| Generator time-overcurrent, level 2 | Gen.-Überstrom 2 | Gen.overcurr. 2 |
| Reverse/reduced load | Rück/Minderleist | Revers/min.power |
| Overload | Gen.-Überlast | Gen.overload |
| Unbalanced load | Schieflast | Load unbalance |
| Mains overvoltage | Netz-Überspg. | Mains-overvolt. |
| Mains undervoltage | Netz-Unterspg. | Mains-undervolt. |
| Mains overfrequency | Netz-Überfreq. | Mains-underfreq. |
| Mains underfrequency | Netz-Unterfreq. | Mains-overfreq. |
| Mains vector/phase jump | Phasensprung | Phase shift |
| Mains df/dt | df/dt-Fehler | df/dt error |
| Battery undervoltage | Batt.-Unterspg. | Batt.undervolt. |
| GCB synchronization time monitoring | Synch.Zeit GLS | GCB syn.failure |
| MCB synchronization time monitoring | Synch.Zeit NLS | MCB syn.failure |
| Switching to dead busbar time monitoring | Stör. df/dU-max. | Failure df/dVmax |
| Mechanical GCB malfunction on closing | Störung GLS ZU | GCBclose failure |
| Mechanical MCB malfunction on closing | Störung NLS ZU | MCBclose failure |
| Mechanical GCB malfunction on opening | Störung GLS AUF | GCB open failure |
| Mechanical MCB malfunction on opening | Störung NLS AUF | MCB open failure |
| Faulty zero power ref. control at interch. synchronization on GCB | Bezugsleist. <>0 | Power not zero |
| Maintenance call | Wartung | Service |
| Interface error X1-X5 | Fehl.Schnit.X1X5 | Interf.err. X1X5 |
| Interface error Y1-Y5 | Fehl.Schnit.Y1Y5 | Interf.err. Y1Y5 |
| **Discrete inputs** | | |
| Discrete input [D01] | freely configurable | freely configurable |
| Discrete input [D02] | | |
| Discrete input [D03] | | |
| Discrete input [D04] | | |
| Discrete input [D05] | | |
| Discrete input [D06] | | |
| Discrete input [D07] | | |
| Discrete input [D08] | | |
| Discrete input [D09] | | |
| Discrete input [D10] | | |
| Discrete input [D11] | | |
| Discrete input [D12] | | |
| Internal | | |
| Internal | | |
| Internal | | |
| Internal | | |

Table 6-1: Event recorder - messages - Part 1

| Type of alarm | xxxxxxxxxxxxxxxx | |
|---|---|---|
| | German | English |
| **Others** | | |
| Change into operating mode MANUAL | BAW Hand | Manual mode |
| Change into operating mode AUTOMATIC | BAW Automatik | Automatic mode |
| Push-button "MCB OFF" depressed (in operating mode MANUAL) | Taste NLS AUS | Button MCB OFF |
| Push-button "GCB OFF" depressed (in operating mode MANUAL) | Taste GLS AUS | Button GCB OFF |
| Push-button "GCB ON" depressed (in operating mode MANUAL) | Taste GLS EIN | Button GCB ON |
| Push-button "MCB ON" depressed (in operating mode MANUAL) | Taste NLS EIN | Button MCB ON |
| Remote start | Fernstart | Remote start |
| Remote stop | Fernstop | Remote stop |
| Remote acknowledgment via interface | Fernquittierung | Remote acknowl. |
| Remote acknowledgment via terminal 36 | Quittierung Kl.36 | Acknowledg-ter 36 |
| Acknowledgment via push-button "ACK" | Quittierg. Taste | Ackn.button QUIT |
| Mains failure | Netzausfall | Mains failure |
| Mains return | Netzwiederkehr | Mains o.k. |

Table 6-2: Event recorder - messages - Part 2

## Analog Inputs

The name of the analog input is moved to the right according to the number of letters of the operating mode type. The alarm type is written in the space that has become open.

WR Wire break
AL Limit 1
STOP Limit 2

```
Analog inp.1 000
STOP Analog inp.
```

**Example**

Limit value 2 (STOP) for analog input 1 has been exceeded. The text of the analog alarm input will be moved to the right either two or four spaces depending on the alarm class (here alarm class "STOP"). In this case the measured value is not displayed due to the length of the text. The length of the analog input text must be taken into consideration when configuring the analog input!

# Direct Configuration

## NOTE

**To carry out direct configuration, you require a direct configuration cable (order code "DPC"), the LeoPC1 program (supplied with the cable) and the corresponding configuration files. After the program has been installed, consult the online help utility for a description of the PC program and its setup.**

**Remote configuration**: For remote configuration, the CS2 password must be entered via the parameter "password DPC", otherwise the values can only be read and not written. If the unit is at the CS0 pass code level it will only permit the user to read the parameters. The control unit will not permit the user to modify any of the parameters. When the CS2 pass code is entered via LeoPC1 through the CAN bus, configuration of the unit will only be able to be performed through the CAN bus. The pass code level will change back to CS0 after 2 hours of inactivity, at which point the pass code will have to be entered again to modify any parameters. The password must be input prior to loading a language file. If the CS2 password is entered directly into the control unit, configuration via the CAN bus is automatically enabled.

## NOTE

**The direct configuration via LeoPC1 and the configuration using the control panel are independent of each other and must be unlocked independent of each other. Unlocking the access via the control panel does not permit a configuration via LeoPC1 and the other way round.**

## CAUTION

**If the following parameter "direct para." is configured to "YES", communication via the CAN bus (terminals X1 to X5) is disabled. If communication is to be re-established via the CAN bus after the unit is configured (e.g. CAN bus connection to a Gateway GW 4), "Direct para." must be set to "NO"!**

**Direct configuration is disabled once the firing speed has been reached. This means that if further mofifications to the control unit's parameters is desired, the only possible methods to do this is using the display and push buttons manually or via the CAN bus interface. The parameter "Direct para." is automatically changed from YES to NO (this is a function of the control unit software). The direct configuration function is de-activated for safety reasons. This is to prevent the possibility of a simultaneous generator start up and closing of circuit breakers to a dead bus in a multiple generator system (e.g. emergency power situation).**

Parameter **10**

```
Direct para.
                YES
```

**Direct configuration** **YES/NO**

**YES**..... The direct configuration plug is enabled and direct configuration of the control is possible. The CAN bus terminals X1-X5 are disabled, terminating any communication for the unit on the CAN bus. 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**..... The configuration port is disabled and direct configuration cannot be performed. The CAN bus connection via the terminals X1 to X5 is enabled.

# Basic Settings

## CAUTION

**Failure to ensure correct configuration of parameters may lead to incorrect measurements and the control failing to respond properly!**

Parameter **11**

```
Configure
Measuring     YES
```

**Configure base settings** **YES/NO**

Various groups of parameters are grouped together in blocks to aid in the rapid navigation through the large number of configuration screens. Selecting "YES" or "NO" does not determine if control or monitoring is performed. The user's selection has the following effect:

**YES** .....The configuration screens in this block are displayed and can either be viewed ("Select" push button) or modifications can be made to the parameters ("Cursor→", "Digit↑" or "Select" push buttons). This does not disable or enable individual parameters, only if the individual parameters in this parameter block may be accessed for modifications.

**NO** .....The parameters in this block are not displayed, cannot be modified and are therefore skipped.

Parameter **12**

```
Generator number
              00
```

**Generator number** **1 to 4**

For multiple generator applications that are coupled via a CAN bus, a unique number must be assigned to each generator for differentiation purposes. The generator number 1 should be assigned if the control is used in a single unit application. The generator number entered here corresponds to the generator number in the program LeoPC (in files for multiple generators).

## Generator and Mains Environmental

### Rated Values of the Frequency

Parameter **13**

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

**Generator set point frequency** **40.0 to 70.0 Hz**

The generator frequency set point is entered in this screen. This is required for the frequency controller in isolated and no-load operation. In most cases, the values entered into this screen will be 50 Hz or 60 Hz. It is possible to enterdifferent values.

Parameter **14**

```
Rated system
frequency 00.0Hz
```

**System rated frequency** **50/60 Hz**

The rated frequency of the system is entered in this screen. This parameter depends on the three-phase system in the relevant country.

## Voltage Transformer, PTs

### CAUTION

**If the following parameter values are modified, the values of the following parameters must be verified:**

- **generator voltage set point (at page 66)**
- **voltage controller dead band (at page 77)**
- **synchronization dVmax (at page 91)**
- **dead bus start GCB dVmax (at page 93)**
- **generator overvoltage tripping value (at page 109)**
- **generator undervoltage tripping value (at page 110)**

Parameter **15**

```
Gen.volt.transf.
secondary   000V
```

**PTs, secondary, generator** **[1] 50 to 125 V; [4] 50 to 480 V**

The secondary voltage is set here in V. This is the voltage level that will be measured at the control unit input terminals.

Parameter **16**

```
Gen.volt.transf.
primary 00.000kV
```

**PTs. primary, generator** **[1] 0.005 to 65,000 kV; [4] 0.020 to 65,000 kV**

The primary voltage is set here in kV. This entry serves to indicate the primary voltages in the display. If a potential transformer is not used, the measured voltage of 120V would be configured as "**00.120kV**" and 480V would be configured as "**00.480kV**".

Parameter **17**

```
Bus.volt.transf.
secondary   000V
```

**PTs, secondary, busbar** **[1] 50 to 125 V; [4] 50 to 480 V**

The secondary voltage is set here in V. This is the voltage level that will be measured at the control unit input terminals.

Parameter **18**

```
Bus.volt.transf.
primary 00.000kV
```

**PTs, primary, busbar** **[1] 0.005 to 65,000 kV; [4] 0.020 to 65,000 kV**

The primary voltage is set here in kV. This entry serves to indicate the primary voltages in the display. If a potential transformer is not used, the measured voltage of 120V would be configured as "**00.120kV**" and 480V would be configured as "**00.480kV**".

## CAUTION

**If the following parameter values are modified, the values of the following parameters must be verified:**

- **mains overvoltage tripping value (at page 112)**
- **mains undervoltage tripping value (at page 112)**

Parameter **19**

```
Mains volt.trans
secondary   000V
```

**PTs, secondary, mains** **[1] 50 to 125 V; [4] 50 to 480 V**

The secondary voltage is set here in V. This is the voltage level that will be measured at the control unit input terminals.

Parameter **20**

```
Mains volt.trans
primary 00.000kV
```

**PTs, primary, mains** **[1] 0.005 to 65,000 kV; [4] 0.020 to 65,000 kV**

The primary voltage is set here in kV. This entry serves to indicate the primary voltages in the display. If a potential transformer is not used, the measured voltage of 120V would be configured as "**00.120kV**" and 480V would be configured as "**00.480kV**".

### Rated Values of the Voltage

Parameter **21**

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

**Generator setpoint voltage** **[1] 25 to 125 V; [4] 50 to 480 V**

This value of the voltage specifies the generator voltage set point for no-load and isolated operation. This value corresponds with the secondary voltage of the PTs.

Parameter **22**

```
Rated voltage
System      000V
```

**System rated voltage** **[1] 25 to 125 V; [4] 50 to 480 V**

The rated voltage of the system is entered in this screen. This parameter depends on the three-phase system in the relevant country. This value corresponds with the secondary voltage of the PT'.

Parameter **23**

```
Voltage system
---------------
```

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

**Voltage measuring system** **threephase/singlephase**

**Three-phase network** The electrical system (generator, busbar, and mains) is a delta system consisting of only the three external conductors (without a neutral conductor). The N-lug (terminal 0) is not connected. Only the phase-to-phase voltages are indicated in the display.

**Single-phase network** The electrical system (generator, busbar, and mains) is a wye system consisting of the three external conductors and a neutral conductor. As a result, the N-lug (terminal 0) must be connected. The phase-to-phase voltages and the phase-to-neutral voltages are indicated in the display.

## CAUTION

**If the following parameter is configured to "singlephase" a phase/vector jump monitoring is not possible.**

Parameter **24**

```
Voltage meas.
Mains ----------
```

This screen affects the protective functions.

**Voltage measurement system protection** **threephase / singlephase**

The device can either monitor the phase-to-neutral voltages (four-wire system) or the phase-to-phase voltages (three-wire system). Generally the phase-to-neutral voltages are monitored when using the 400V model on low-voltage systems, and the phase-to-phase voltages are monitored when using the 100V model for the medium-high-voltage systems. Monitoring the phase-to-phase voltage is vital to prevent detection of line-to-earth-faults in compensated or isolated mains applications, which result in a voltage monitoring system fault.

**singlephase** .. The voltage at the terminals 1 through 4 are measured as a four-wire installation. All subsequent screens concerning protective functions refer to the phase-to-neutral voltage ($V_{L-N}$).

**threephase** ... The voltages at the terminals 1 through 4 are measured as a three-wire system. All subsequent screens concerning protective functions refer to the phase-to-phase voltage ($V_{L-L}$).

## Generator Current, CT

Parameter 25

```
Current transf.
generator 0000/x
```

**CT ratio, generator** **[5] 10 to 7,000/5**

The current transformer ratio is necessary in order to display the actual values and control the power. When sizing a CT for the system, the minimum current flow for the CT should not be lower than 60% of the transformer's rated current at rated current. A lower percentage may lead to malfunctions and additional inaccuracies in the control and monitoring functions also occur.
The primary rated current of the CT must be entered here. It is indicated on the data plate of the CT. The secondary rated current cannot be configured and is 5 A.
If the current in the primary winding of the CT reaches the primary rated current, the secondary rated current flows in the secondary winding of the CT.

Example for current transformer ratio 300/5:
Current in the primary winding = 300 A -> current in the secondary winding = 5 A
Current in the primary winding = 150 A -> current in the second. winding = 2,5 A

## NOTE

**The following parameter is only available for units with a software version of 3.4006 or higher. Units with a lower software version use the internal value "3".**

Parameter **26**

`Format Power`

**Power display format** **1 / 2 / 3 / 4 / 5 / 6 / 7 / 8**

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

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

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

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

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

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

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

**7**.....00.0k [W/VA/var] (S up to 70 kVA)
0000k [W/VA/var] (S from 70 kVA up to 7000 kVA)
00.0M [W/VA/var] (S from 7000 kVA up to 60 MVA)
000M [W/VA/var] (S from 60 MVA)

**8**.....00.0k [W/VA/var] (S up to 80 kVA)
0000k [W/VA/var] (S from 80 kVA up to 8000 kVA)
00.0M [W/VA/var] (S from 8000 kVA up to 60 MVA)
000M [W/VA/var] (S from 60 MVA)

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

## NOTE

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

Parameter **27**

```
Power measuring
Gen. ----------
```

**Generator power measuring** **singlephase/threephase**

When selecting generator power measurement, single-phase or three-phase measurement may be selected. If "single-phase power measurement" is configured, the voltage in phase $L_{12}$ and the current in phase $L_1$ are used for power measurement. If "three-phase power measurement" is configured, the currents from all three phases and the relevant voltages are used for power measurement.

## NOTE

**When producing positive real power, a positive real current flows in the "k to l" direction in the current transformer. Positive re-active power means that with a positive effective direction, inductive re-active (lagging) current flows in the effective direction. If the unit is connected to the terminals of a generator and the outgoing circuits of the current transformer facing the generator are connected to "k", the unit shows a positive real power when the generator supplies real power. Refer to the "Direction of Power" section on page 34.**

Parameter **28**

```
Rated power
gen.      0000kW
```

**Generator rated power** **5 to 16,000 kW**

The generator rated power is entered into this screen. It is critical to enter the correct value in this parameter as numerous measurement, control, and monitoring functions refer to this value (e.g. generator overload monitoring).

Parameter **29**

```
Rated current
generator  0000A
```

**Generator rated current** **10 to 7,000 A**

The generator rated current is entered into this screen. It is critical to enter the correct value in this parameter as numerous measurement, control, and monitoring functions refer to this value (e.g. generator overcurrent monitoring).

## Mains Current, CT / Mains Power

### *Mains current measuring via mains current transformer/CT*

Parameter **30**

```
Current transf.
mains     0000/x
```

**CT ratio, mains** **5 to 7,000/x A**

The current transformer ratio is necessary in order to display the actual values and control the power. When sizing a CT for the system, the minimum current flow for the CT should not be lower than 60% of the transformer's rated current at rated current. A lower percentage may lead to malfunctions and additional inaccuracies in the control and monitoring functions also occur.
The primary rated current of the CT must be entered here. It is indicated on the data plate of the CT. The secondary rated current cannot be configured and is 5 A
If the current in the primary winding of the CT reaches the primary rated current, the secondary rated current flows in the secondary winding of the CT.

Example for current transformer ratio 300/5:
Current in the primary winding = 300 A -> current in the secondary winding = 5 A
Current in the primary winding = 150 A -> current in the second. winding = 2,5 A

Parameter **31**

```
Angle adjustment
Mainscurr.  000°
```

**Angle adjustment for measuring of mains current** **-180 to 180 °**

If a transformer is located between the measuring point for the voltage of the mains and the generator, it is possible that there is a phase shift between these two measuring points. If so, special voltage transducers must be used to adjust the phase angle of the voltages. The synchronization is at the right phase angle with these transducers, but measurement of the mains power is wrong because mains current is still measured without phase angle correction. This configuration screen allows the user to adjust the phase angle measurement of the mains current, so that the measurement of the mains power is correct.

## Change Passwords

### NOTE

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

Parameter **32**

```
Define level 1
code          0000
```

**Assign code level 1 (customer)** **0000 to 9999**

This screen is only displayed in code level 2. The user may change the password for this code level in this screen. After entering this code, the user has access rights to only a select few parameters.
The default password for this code level (CS) is **CS1 = 0 0 0 1**

Parameter **33**

```
Define level 2
code          0000
```

**Assign code level 2 (commissioner)** **0000 to 9999**

This screen is only displayed in code level 2. The user may change the password for this code level in this screen. After entering this code, the user has full access rights to all parameters.
The default password for this code level (CS) is **CS2 = 0 0 0 2**

# Controller

## CAUTION

**Entering incorrect values can lead to the control unit failing to function properly and destroy the generator!**

Parameter 34

```
Configure
Controller   YES
```

**Configure controllers** **YES/NO**

Various groups of parameters are grouped together in blocks to aid in the rapid navigation through the large number of configuration screens. Selecting "YES" or "NO" does not determine if control or monitoring is performed. The user's selection has the following effect:

**YES**..... The configuration screens in this block are displayed and can either be viewed ("Select" push-button) or modifications can be made to the parameters ("Cursor→", "Digit↑" or "Select" push buttons). This does not disable or enable individual parameters, only if the individual parameters in this parameter block may be accessed for modifications.

**NO**..... The parameters in this block are not displayed, cannot be modified and are therefore skipped.

## Constant and Interchange Real Power Controller

These screens appear only if the real power controller (see chapter "Real Power Controller" on page 82) is configured to "ON".

## NOTE

**The fixed-value power controller does not monitor the mains interchange point. If excess power for the load requirements is generated, the excess power is exported to the mains. If insufficient power for the load requirements is generated, remaining power required is imported from the mains.**

Parameter 35

```
Power controller
Pset1    I0000kW
```

**P controller: setpoint value 1** **C/I/E 0 to 16,000 kW**

Setpoint 1 is enabled when the discrete input "Setpoint 1↔2" is de-energized (no voltage applied to terminal 5). The mains interchange (import/export) real power is then controlled to the set point 1 value.

Generator real power control

**C**..... The letter C stands for constant power set point (= base load). The generator shall always supply the value entered for the constant power level. All load swings are absorbed by the utility. The generator will always start when a constant power (base load) operation is enabled.

Mains interchange (import/export) real power control

**I**..... The letter I stands for import power (power supplied by the mains). The value entered for the import level shall always be supplied by the utility. All load swings are absorbed by the generator(s) provided the load rating for the generator(s) is not exceeded. The generator will start when the power imported from the utility exceeds the level configured in this parameter.

**E**..... The letter E stands for export power (power supplied to the mains). The value entered for the export level shall always be supplied to the utility. All load swings are absorbed by the generator(s) provided the load rating for the generator(s) is not exceeded. The generator will always start when an export power operation is enabled.

Parameter **36**

```
Power controller
Pset2    I0000kW
```

**P controller: setpoint value 2** **C/I/E 0 to 16,000 kW**

Setpoint 2 is enabled when the discrete input "Setpoint 1↔2" is energized (voltage applied to terminal 5) and the external setpoint value (via 0/4 to 20 mA analog input or interface) has not been selected. The mains interchange (import/export) real power is then controlled to the set point 2 value.

Generator real power control

**C** .....The letter C stands for constant power set point (= base load). The generator shall always supply the value entered for the constant power level. All load swings are absorbed by the utility. The generator will always start when a constant power (base load) operation is enabled.

Mains interchange (import/export) real power control

**I** .....The letter I stands for import power (power supplied by the mains). The value entered for the import level shall always be supplied by the utility. All load swings are absorbed by the generator(s) provided the load rating for the generator(s) is not exceeded. The generator will start when the power imported from the utility exceeds the level configured in this parameter.

**E** .....The letter E stands for export power (power supplied to the mains). The value entered for the export level shall always be supplied to the utility. All load swings are absorbed by the generator(s) provided the load rating for the generator(s) is not exceeded. The generator will always start when an export power operation is enabled.

## Frequency Controller

Parameter **37**

```
Initial state
Frequency   000%
```

**f controller: initial state** **0 to 100 %**

This value is the initial state or start value for the frequency controller when the control unit is not operating or changing from a real power controller to a frequency controller. This value relates to Parameter 46 "F/P contr. output".

Parameter **38**

```
Freq.controller
             ON
```

**f controller** **ON/OFF**

**ON**.....The generator frequency control is enabled. The generator frequency is controlled is controlled according to the operation function being performed (isolated operation / synchronization). The subsequent screens of this function are displayed.

OFF.....Generator frequency control is disabled, and the subsequent screens of this function are not displayed.

Parameter **39**

```
f-contr. active
at:       00.0Hz
```

**f controller: start frequency** **0.0 to 70.0 Hz**

The frequency controller is activated when the generator frequency exceeds this configured value. This parameter prevents the control unit from affecting other control units in parallel with it while going through the start up cycle.

Parameter **40**

```
Delay time for
f-contr.    000s
```

**f controller: delayed start** **0 to 999 s**

The frequency must exceed the value configured in the previous screen uninterrupted for the time configured here to enable the frequency controller.

Parameter **41**

```
Freq.controller
Ramp      00Hz/s
```

**f controller: setpoint value ramp** **1 to 50 Hz/s**

The set point value is transmitted to the speed governor via a ramp. The slope of the ramp is used to alter the rate at which the governor modifies the setpoint value. The more rapidly the desired change of the setpoint value is to be carried out, the greater the value entered here must be.

## NOTE

**The following settings in the n/f controller area affect the P controller.**

Parameter **42**

```
F/P contr.type
---------------
```

**f controller: type** **THREESTEP / ANALOG / PWM**

**THREESTEP** The signal to control the speed/frequency/real power is output via the relay manager to any configured relay. You can use the following parameters of the relay manager:
parameter 99 = n+/f+/P+
parameter 100 = n-/f-/P-

**ANALOG** .... Control is performed via the analog controller outputs to terminals 8/9/10. The signal selection is made in Parameter 46 "F/P contr. output" and though the use of an external jumper depending on the configured signal.

**PWM** ..... The control of speed/frequency/real power is performed via a PWM signal. The signal amplitude is set in Parameter 47 "Level PWM". An additional jumper must be added.

### Three-Position Controller (Setting THREESTEP)

Parameter **43**

```
Freq.controller
dead band 0.00Hz
```

**f controller: dead band** **0.02 to 1.00 Hz**

**Isolated operation** The generator frequency is controlled in such a manner, that in a steady state, the actual value does not deviate from the generator frequency set point by more than the configured dead band value.

**Synchronization** The generator frequency is controlled in such a manner, that in its steady state, the differential frequency does not exceed the configured dead band value. The mains or busbar frequency is used as the set point value.

Parameter **44**

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

**f controller: minimum ON period** **10 to 250 ms**

The minimum ON period of the relay should be selected in such a manner that the speed governor responds reliably to the control pulse. The time configured here determines the length of the control pulse. The smallest possible time must be configured in order to ensure optimum control behavior.

Parameter **45**

```
Freq.controller
gains.Kp    00.0
```

**f controller: gain** **0.1 to 99.9**

The gain factor $K_P$ indicates the frequency controller gain. By increasing the gain factor, the response is increased to permit larger corrections to the variable to be controlled. The farther out of tolerance the process is the larger the response action is to return the process to the tolerance band. If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value.

## Analog Controller Output (Setting ANALOG/PWM)

Parameter **46**

```
F/P contr.output
----------------
```

**f controller: output range** **see below**

If Parameter 42 "F/P contr. type" has been configured as "ANALOG", the type of analog output must be selected in this screen. The use of a jumper between terminals 8/9 determines if the output is a voltage or current output. The PWM signal can be inverted in this screen (refer to the note below the table). All available ranges are listed in the table below.

| Type | Setting in above configuration screen | Jumper between term. 8/9 | Range | Lower level | Upper level |
|---|---|---|---|---|---|
| Current | +/-20mA (+/-10V) | no | +/-20mA | -20 mA | +20 mA |
| | +/-10mA (+/-5V) | | +/-10mA | -10 mA | +20 mA |
| | 0 to 10mA (0 to 5V) | | 0 to 10mA | 0 mA | 10 mA |
| | 0 to 20mA (0 to 10V) | | 0 to 20mA | 0 mA | 20 mA |
| | 4 to 20mA | | 4 to 20mA | 4 mA | 20 mA |
| | 10 to 0mA (5 to 0V) | | 10 to 0mA | 10 mA | 0 mA |
| | 20 to 0mA (10 to 0V) | | 20 to 0mA | 20 mA | 0 mA |
| | 20 to 4mA | | 20 to 4mA | 20 mA | 4 mA |
| Voltage | +/-20mA (+/-10V) | yes | +/-10V | -10 Vdc | +10 Vdc |
| | +/-10mA (+/-5V) | | +/-5V | -5 Vdc | +5 Vdc |
| | +/-3V | | +/-3V | -3 Vdc | +3 Vdc |
| | +/-2.5V | | +/-2,5V | -2.5Vdc | +2.5 Vdc |
| | +/-1V | | +/-1V | -1 Vdc | +1 Vdc |
| | 0 to 10mA (0 to 5V) | | 0 to 5V | 0 Vdc | 5 Vdc |
| | 0.5V to 4.5V | | 0.5 to 4.5V | 0.5 Vdc | 4.5 Vdc |
| | 0 to 20mA (0 to 10V) | | 0 to 10V | 0 Vdc | 10 Vdc |
| | 10 to 0mA (5 to 0V) | | 5 to 0V | 5 Vdc | 0 Vdc |
| | 4.5V to 0.5V | | 4.5 to 0.5V | 4.5 Vdc | 0.5 Vdc |
| | 20 to 0mA (10 to 0V) | | 10 to 0V | 10 Vdc | 0 Vdc |

### NOTE

**The control logic of the PWM signal can be inverted by the following steps:**

- **Select "F/P contr.type" = ANALOG**
- **Select with parameter "F/P contr.output" any of the listed inverted control outputs (10 to 0mA, 20 to 0mA, 20 to 4mA, 5 to 0V, 4.5V to 0.5V, or 10 to 0V outputs)**
- **Back-up one screen to "F/P contr.type" (by pressing "Select" and "Cursor→" simultaneously)**
- **Select "F/P contr.type" = PWM**

**Now the PWM signal is inverted.**

Parameter **47**

```
Level PWM
----------------
```

**f control: PWM level** **3.0 to 10.0 V**

If PWM has been selected in the previous screen the amplitude of the PWM signal can be adjusted here.

Parameter **48**

```
Freq.controller
gain.Kpr     000
```

**f controller: P gain** **1 to 240**

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

Parameter **49**

```
Freq.controller
reset Tn   00.0s
```

**f controller: reset time** **0.0 to 60.0 s**

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

Parameter **50**

```
Freq.controller
derivat.Tv 0.00s
```

**f controller: derivative-action time** **0.00 to 6.00 s**

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

## Voltage Controller

Parameter **51**

```
Starting point
voltage     000%
```

**V controller: initial state** **0 to 100 %**

This value is the intial state or start value for the frequency controller when the control unit is not operating or changing from a power factor controller to a voltage controller. This value relates to Parameter 57 "V/Q contr. output".

Parameter **52**

```
Volt.controller
              ON
```

**V controller** **ON/OFF**

**ON**..... Generator voltage control is enabled. The subsequent screens of this function are displayed.
**OFF**..... Control is disabled, and the subsequent screens of this function are not displayed.

### NOTE

**The following settings in the V controller area affect the power factor (cosphi) controller.**

Parameter **53**

```
V/Q contr.type
---------------
```

**V controller: Type** **THREESTEP / ANALOG**

**THREESTEP** The signal to control the voltage/cosphi (power factor) is output via the relay manager to any configured relay. You can use the following parameters of the relay manager:
parameter 101 = U+/cosphi+
parameter 102 = U-/cosphi-
**ANALOG** .... A control is done via the analog controller outputs to terminals 11/12/13. The signal selection is made in Parameter 57 "V/Q contr. output" and though the use of an external jumper depending on the configured signal.

## Three-Position Controller (Setting THREESTEP)

Parameter **54**

```
Volt.controller
dead band  00.0V
```

**V controller: dead band** **[1] 0.1 to 15.0 V; [4] 0.5 to 60.0 V**

**Isolated operation** The generator voltage set point is controlled in such a manner, that in a steady state, the actual value does not deviate from the generator voltage set point by more than the configured dead band value.

**Synchronization** The generator voltage is controlled in such a manner , that in its steady state, the differential voltage does not exceed the configured dead band value. The mains or busbar frequency is used as the set point value.

Parameter **55**

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

**V controller: minimum ON period** **20 to 250 ms**

The minimum ON period of the relay should be selected in such a manner that the voltage regulator responds reliably to the control pulse. The time configured here determines the length of the control pulse. The smallest possible time must be configured in order to ensure optimum control behavior.

Parameter **56**

```
Volt.controller
gain.Kp     00.0
```

**V controller: gain** **0.1 to 99.9**

The gain factor $K_P$ indicates the voltage controller gain. By increasing the gain factor, the response is increased to permit larger corrections to the variable to be controlled. The farther out of tolerance the process is the larger the response action is to return the process to the tolerance band. If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value.

## Analog Controller (Setting ANALOG)

Parameter **57**

```
V/Q contr.output
----------------
```

**V controller: range** **see below**

If Parameter 53 "V/Q contr. type" has been configured as "ANALOG", the type of analog output must be selected in this screen. The use of a jumper between terminals 11/12 determines if the output is a voltage or current output. All available ranges are listed in the table below.

| Type | Setting in above configuration screen | Jumper between term. 11/12 | Range | Lower level | Upper level |
|---|---|---|---|---|---|
| Current | +/-20mA (+/-10V) | no | +/-20mA | -20 mA | +20 mA |
| | +/-10mA (+/-5V) | | +/-10mA | -10 mA | +20 mA |
| | 0 to 10mA (0 to 5V) | | 0 to 10mA | 0 mA | 10 mA |
| | 0 to 20mA (0 to 10V) | | 0 to 20mA | 0 mA | 20 mA |
| | 4 to 20mA | | 4 to 20mA | 4 mA | 20 mA |
| | 10 to 0mA (5 to 0V) | | 10 to 0mA | 10 mA | 0 mA |
| | 20 to 0mA (10 to 0V) | | 20 to 0mA | 20 mA | 0 mA |
| | 20 to 4mA | | 20 to 4mA | 20 mA | 4 mA |
| Voltage | +/-20mA (+/-10V) | yes | +/-10V | -10 Vdc | +10 Vdc |
| | +/-10mA (+/-5V) | | +/-5V | -5 Vdc | +5 Vdc |
| | +/-3V | | +/-3V | -3 Vdc | +3 Vdc |
| | +/-2.5V | | +/-2.5V | -2.5Vdc | +2.5 Vdc |
| | +/-1V | | +/-1V | -1 Vdc | +1 Vdc |
| | 0 to 10mA (0 to 5V) | | 0 to 5V | 0 Vdc | 5 Vdc |
| | 0.5V to 4.5V | | 0.5 to 4.5V | 0.5 Vdc | 4.5 Vdc |
| | 0 to 20mA (0 to 10V) | | 0 to 10V | 0 Vdc | 10 Vdc |
| | 10 to 0mA (5 to 0V) | | 5 to 0V | 5 Vdc | 0 Vdc |
| | 4.5V to 0.5V | | 4.5 to 0.5V | 4.5 Vdc | 0.5 Vdc |
| | 20 to 0mA (10 to 0V) | | 10-0V | 10 Vdc | 0 Vdc |

Parameter **58**

```
Volt.controller
gain.Kpr     000
```

**V controller: P-gain** **1 to 240**

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

Parameter **59**

```
Volt.controller
reset Tn   00.0s
```

**V controller: reset time** **0.0 to 60.0 s**

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

Parameter **60**

```
Volt.controller
derivat.Tv 0.00s
```

**V controller: derivative-action time** **0.00 to 6.00 s**

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

## Power Factor Controller

Parameter **61**

```
Pow.fact.contr.
             ON
```

**Power factor controller** **ON/OFF**

**ON** .....The power factor is controlled independent of the load in mains parallel operations. If the measured secondary currents are lower than 5% of the rated current, the power factor cannot be accurately measured. In order to prevent power factor 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, and the subsequent screens of this function are not displayed.

Parameter **62**

```
Pow.fact.contr.
setpoint    0.00
```

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

When operating in mains parallel, the control regulates the re-active power in a manner that results in the generator producing power at the power factor configured here. The designation "i" equals inductive (generator overexcited/leading) and "c" capacitive (generator underexcited/lagging) re-active power. This set point is enabled only in mains parallel operation.

### NOTE

**Please note the configured settings for the voltage controller (refer to Voltage Controller on page 77). The settings for the voltage controller also affect the power factor controller.**

### External Power Factor Set Point Value

Parameter **63**

```
Power factor
external     ON
```

**Power factor set point: external set point value** **ON/OFF**

**ON** .....The power factor set point 2 value may be enabled via an external signal. The subsequent screens of this function are displayed. This set point 2 is enabled when terminal 5" ("Setpoint 1↔2) is energized.

**OFF** .....If this function is configured as "OFF", the control unit utilizes set point 1 only. The external set point value specification cannot be carried out via the 0 to 20 mA input. The subsequent screens of this function are not displayed.

Parameter **64**

```
Analog input
          0-00mA
```

**Power factor set point: range** **0 to 20 / 4 to 20 mA**

A 0 to 20 mA or 4 to 20 mA analog input for the power factor controller is selected here, depending on the type of input used.

**0 to 20 mA** ...Minimum value of the setpoint is 0 mA; maximum value is 20 mA.

**4 to 20 mA** ...Minimum value of the setpoint is 4 mA; maximum value is 20 mA.

Parameter **65**

```
Ext. Pow.Factor
 0mA         0.00
```

**Power factor set point: minimum value** **i0.70 to 1.00 to c0.70**

The minimum value of the power factor is defined here (e.g. i0.95).

Parameter **66**

```
Ext. Pow.Factor
20mA         0.00
```

**Power factor set point: maximum value** **i0.70 to 1.00 to c0.70**

The maximum value of the power factor is defined here (e.g. c0.95).

## Three-Position Controller (Setting THREESTEP)

Parameter **67**

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

**Power factor controller: dead band** **0.5 to 25.0 %**

The unit automatically calculates the amount of re-active power, which is required to maintain the configured power factor. In mains parallel operation, the re-active power is controlled in such a manner, that in its steady state, the actual value does not deviate from the internally calculated percentage set point (set point 1) value by more than the configured dead band. In this case, the percentage value refers to the generator rated power.

Parameter **68**

```
Pow.fact.contr.
gain Kp    00.0
```

**Power factor controller: gain** **0.1 to 99.9**

The gain factor $K_P$ indicates the power factor controller gain. By increasing the gain factor, the response is increased to permit larger corrections to the variable to be controlled. The farther out of tolerance the process is the larger the response action is to return the process to the tolerance band. If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value.

## Analog Controller (Setting ANALOG)

Parameter **69**

```
Pow.fact.contr.
gains Kpr   000
```

**Power factor controller: P gain** **1 to 240**

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

Parameter **70**

```
Pow.fact.contr.
reset Tn   00.0s
```

**Power factor controller: reset time** **0.0 to 60.0 s**

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

Parameter **71**

```
Pow.fact.contr.
derivat.Tv 0.00s
```

**Power factor controller: derivative-action time** **0.00 to 6.00 s**

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

## Real Power Controller

Parameter 72

```
Power controller
             ON
```

**P controller** **ON/OFF**

**ON** .....In a mains parallel operation, the real power is automatically controlled at the configured set point (see page 73) when the real power controller is enabled. The subsequent screens of this function are displayed.

**OFF** .....Control is disabled, and the subsequent screens of this function are not displayed.

### Set Point Ramp %/s

Parameter 73

```
Power controller
ramp     000 %/s
```

**P controller: set point ramp %/s** **0 to 100 %/s**

The setpoint change is supplied to the controller via a percent per second ramp in reference to the generator rated power (Parameter 28). The slope of the ramp is used to alter the rate at which the controller modifies the set point value. The more rapidly the change in the set point is to be carried out, the greater this value must be.

### Power Limitation

Parameter 74

```
Power limit
P max.       000%
```

**P controller: real power limitation - maximum** **10 to 120 %**

If the maximum generator real power is to be limited, the desired limit of the generator rated power (Parameter 28) must be entered into this screen as a percentage. The generator is controlled in such a manner that this value is not exceeded. The value "$P_{max}$" only limits the real power controller set point and has no effect in isolated operation.

Parameter 75

```
Power limit
P min.       00%
```

**P controller: real power limitation - minimum** **0 to 50 %**

If the minimum generator real power is to be limited, the desired limit of the generator rated power (Parameter 28) must be entered into this screen as a percentage. The generator is controlled in such a manner that the generator real power does not fall below this value. This parameter is not enabled during constant power control.

## External Set Point Value

Parameter 76

```
Power setpoint
external     ON
```

**P set point: external set point value** **ON/OFF**

**ON**..... The real power set point 2 value may be specified via an external signal. The subsequent screens of this function are displayed. This setpoint is enabled when terminal 5 ("Setpoint 1↔2") is energized.

**OFF**..... If this function is configured to "OFF", the control unit utilizes set point 1 only. The external set point value specification cannot be carried out via the 0-20 mA input. The subsequent screens of this function are not displayed.

Parameter 77

```
Analog input
          0-00mA
```

**P set point: range** **0 to 20 / 4 to 20 mA**

A 0 to 20 mA or 4 to 20 mA analog input of the power factor controller is selected here depending on the type of input used.

**0 to 20 mA** ... Minimum value of the setpoint is 0 mA; maximum value is 20 mA.

**4 to 20 mA** ... Minimum value of the setpoint is 4 mA; maximum value is 20 mA.

### CAUTION

**The interchange power set point (import/export power) can be scaled. When controlling interchange power, it is vital to ensure that a constant power setting is not configured simultaneously with an Import or Export power setting when scaling the external analog input.**

| | | | | | | |
|---|---|---|---|---|---|---|
| External setpoint | 0/4 mA | C | I | E | I | E |
| External setpoint | 20 mA | C | I | E | E | I |

Parameter 78

```
Ext.setpoint
 0mA       0000kW
```

**P set point: minimum value** **C/E/I 0 to 16,000 kW**

The minimum real power value is defined here (e.g. 0 kW).

Parameter 79

```
Ext.setpoint
20mA       0000kW
```

**P set point: maximum value** **C/E/I 0 to 16,000 kW**

The maximum real power value is defined here (e.g. 100 kW).

## Three-Position Controller (Setting THREESTEP)

Parameter **80**

```
Power controller
dead band  00.0%
```

**P controller: dead band** **0.1 to 25.0 %**

In mains parallel operation, the real power is controlled in such a manner, that in its steady state, the current value does not deviate from the real power set point by more than the configured percentage value. In this case, the percentage value refers to the generator rated power (Parameter 28).

Parameter **81**

```
Power controller
gain Kp     00.0
```

**P controller: gain factor** **0.1 to 99.9**

The gain factor $K_P$ indicates the power controller gain. By increasing the gain factor, the response is increased to permit larger corrections to the variable to be controlled. The farther out of tolerance the process is the larger the response action is to return the process to the tolerance band. If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value.

Parameter **82**

```
Power controller
band ratio  *0.0
```

**P controller: dead band factor** **1.0 to 9.9**

Once the controller has reached a steady state condition and has not output a raise/lower pulse for more than 5 seconds, the dead band is increased by the configured dead band ratio factor.

Example: In the case of an dead band of 2.5 % and a factor of 2.0 the dead band is in-creased after 5 s to 5.0 %. If the control deviation subsequently exceeds 5.0 %, again, the controller's original sensitivity is automatically reset (2.5 %). This input can be used, in the event of small control deviations, to avoid unnecessarily frequent actuation processes, thereby protecting the adjustment facility.

## Analog Ccontroller (Setting ANALOG)

Parameter **83**

```
Power controller
gain Kpr     000
```

**P controller: P gain** **1 to 240**

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

Parameter **84**

```
Power controller
reset Tn   00.0s
```

**P controller: reset time** **0.0 to 60.0 s**

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

Parameter **85**

```
Power controller
derivat.Tv 0.00s
```

**P controller: derivative-action time** **0.00 to 6.00 s**

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

## Partial Load Limit

Parameter **86**

```
Warm up load
limit value 000%
```

**P controller: partial load limit** **5 to 110 %**

If the engine requires warming up, the control may be configured to run with a partial load. The partial load value is configured as a percentage of the generator load rating. Refer to generator rated power (Parameter 28).

Parameter **87**

```
Warm up load
time        000s
```

**P controller: partial load limit time** **0 to 600 s**

The time period for the partial load warm up is configured in this screen. The time period is started with the initial closing of the GCB. If a partial load warm up period is not desired, this parameter must be configured as zero.

## Load/var Sharing

Parameter **88**

```
Active power
load share   ON
```

**Load sharing** **ON/OFF**

**ON** .....Real power is shared between all generators operating in parallel. The power output by each generator is dependent upon the individually configured values. The subsequent screens of this function are displayed.

**OFF** .....Load sharing is not carried out, and the subsequent screens of this function are not displayed.

Parameter **89**

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

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

The load sharing reference variable is a weighing factor. By increasing the configured value, the greater priority the primary control variable becomes. By lowering the configured value, the greater priority the secondary control variable becomes.

Definition "primary control variable"

- Isolated operation = frequency control
- Mains parallel operation = real power control at the mains interchange (import/export)

Definition "secondary control variable"

- Isolated operation = real power load sharing in reference to the other generators
- Mains parallel operation = real power load sharing in reference to the other generators

Parameter **90**

```
Reactive power
load share   ON
```

**var sharing** **ON/OFF**

**ON** .....Re-active power is shared between all generators operating in parallel. The power output by each generator is dependent upon the individually configured values. The subsequent screens of this function are displayed.

**OFF** .....Re-active load sharing is not carried out, and the subsequent screens of this function are not displayed.

Parameter **91**

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

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

The load sharing reference variable is a weighing factor. By increasing the configured value, the greater priority the primary control variable becomes. By lowering the configured value, the greater priority the secondary control variable becomes.

Definition "primary control variable"

- Isolated operation = voltage control
- Mains parallel operation = re-active power control at the mains interchange (import/export)

Definition "secondary control variable"

- Isolated operation = re-active load sharing in reference to the other generators
- Mains parallel operation = re-active load sharing in reference to the other generators
-

Var sharing is only performed during parallel isolated operations.

# Interface

## CAN Bus (Terminal X1 to X5)

Parameter **92**

```
Control via
COM X1X5     ON
```

**CAN bus: control via interface COM X1-X5** **ON/OFF**

**ON**..... Control via the serial interface is enabled if the direct configuration parameter is configured to "OFF" (Parameter 5), "Control via COM X1X5" configured to "ON", the AUTOMATIC operating mode is enabled, and the discrete input "Setpoint 1↔2" (terminal 5) has been energized. The generator can be given a remote start, synchronized, and the GCB can be opened via the CAN bus (refer to Appendix F, page 146, for a description of the interface telegram). The generator real power setpoint and the generator power factor set point may also be transmitted. If an unsuccessful data exchange is determined, a class F1 alarm is initiated.

**OFF**..... Interface monitoring is disabled. The control unit does not receive control data via the CAN bus. The internally power setpoint "$P_{Set-point2}$" is enabled with the discrete input "Setpoint 1↔2" (terminal 5). At the same time, the internal power factor set point is enabled.

# Breaker

Parameter **93**

```
Configure
Breaker       YES
```

**Configure breakers** **YES/NO**

Various groups of parameters are grouped together in blocks to aid in the rapid navigation through the large number of configuration screens. Selecting "YES" or "NO" does not determine if control or monitoring is performed. The user's selection has the following effect:

**YES** .....The configuration screens in this block are displayed and can either be viewed ("Select" push button) or modifications can be made to the parameters ("Cursor→", "Digit↑" or "Select" push buttons). This does not disable or enable individual parameters, only if the individual parameters in this parameter block may be accessed for modifications.

**NO** .....The parameters in this block are not displayed, cannot be modified and are therefore skipped.

## Breaker Logic

Parameter **94**

```
Breaker logic:
---------------
```

**Breaker logic** **see below**

The unit automatically controls the two breakers (MCB and GCB). Up to five (5) breaker logic modes may be selected from. These are: EXTERNAL and PARALLEL for MFR-31 & MFR-32, and OPEN TRANSIT, CLOSED TRANSIT, and INTERCHANGE for MFR-32.

### NOTE

**For a dead bus start it is necessary to enable the dead bus start function. To trigger the watchdogs "generator underfrequency" as well as "generator undervoltage", terminal 6 (enable monitoring) must be energized. It is possible to switch the breaker logic by energizing and de-energizing discrete input [D03] (terminal 64). The second breaker logic may be configured during the configuration of the discrete inputs. When discrete input [D03] is energized, the second breaker logic is enabled.**

## Logics

### CAUTION

**Following table is valid only if Parameter 241 "Download and open GCB" is configured "ON".**

| Operation mode MANUAL | Operation mode AUTOMATIC |
|---|---|
| Breaker logic **EXTERNAL**<br>In this operating mode, the MCB and the GCB are operated in "MANUAL" mode only. | |
| The MCB and the GCB can be manually opened and closed without synchronization. The circuit breakers are opened for decoupling from the mains. | All breaker control must be carried out via a master controller (e.g. a PLC). The MFR 3 issues the breaker open commands under fault conditions. |
| Breaker logic **PARALLEL** - Mains parallel operation<br>This breaker logic represents continuous mains parallel operation. | |
| Mains parallel operation can be initiated by pressing the "GCB ON" or "MCB ON" push-button. | By energizing terminal 3 "Enable GCB", the GCB is synchronized or closed to the dead busbar without synchronization and the generator initiates a mains parallel operation. When terminal 3 is de-energized, the generator performs a power reduction and opens the GCB. |
| Breaker logic **OPEN TRANSITION** - break-before-make<br>With this breaker logic, the MCB and GCB are never synchronized. | |
| The source of power can be changed from either the mains or generator without synchronization by pressing the "GCB ON" or "MCB ON" push-button. | When terminal 3 "Enable GCB" is energized, the system changes to generator operation. When terminal 3 "Enable GCB" is de-energized, the system changes back to mains operation. If terminal 53 is not energized, the MCB remains closed even if the busbar is voltage-free - terminal 53 "Enable MCB" must be energized. |
| Breaker logic **CLOSED TRANSITION** - make-before-break<br>In this breaker logic, the MCB and the GCB are synchronized, in order to avoid a voltage-free busbar. Immediately after the synchronization of one breaker, the other is opened. Continuous mains parallel operation is not possible. | |
| Via the "GCB ON" and "MCB ON" push-button, synchronization to either generator or the mains operation is performed. | The GCB is synchronized and closed via a signal "Enable GCB" (terminal 3 energized). The MCB is then opened. Following disabling the "Enable GCB" signal, the MCB is reverse synchronized and closed. The GCB is then opened. |
| Breaker logic **INTERCHANGE** - soft loading<br>In this breaker logic, the MCB and the GCB are synchronized, in order to avoid a voltage-free busbar. The generator assumes load at the configured rate, avoiding block loading or unloading. Continuous mains parallel operation is not possible. When terminal 3 "Enable GCB" is de-energized, the MCB is synchronized. The set point of the mains import power must be set to "I0000kW", the mains current transducer or the analog input for the mains power measuring (option IN20) must be connected to the control. | |
| By pressing either the "GCB ON" or "MCB ON" push button, synchronization to either generator or mains operation can be carried out. The power controller must be enabled. If during an interchange synchronization "zero" import power is not achieved within the configured time, a message and a class 1 alarm are issued. | When terminal 3 "Enable GCB" is energized, the GCB is synchronized and the generator assumes load until a mains interchange power = 0 kW is reached. The MCB is then opened. When terminal 3 "Enable GCB" is de-energized, the MCB is reverse synchronized, the generator performs a power reduction, and the GCB is then opened. |

## Parameter

Parameter **95**

```
Add-off ramp
max.time    000s
```

**Add-on/add-off ramp** **0 to 999 s**

This time can be used to influence two functions:

**Add-off:** The maximum amount of time the generator has to shed load below 3% of the generator load rating (Parameter 28) is configured here. If the generator has not dropped below 3% of the generator load rating within this time period, the GCB is opened.

**Add-on with soft loading:** If the mains interchange (import/export) real power value does not reach 0kW in breaker logic "INTERCHANGE" within the time configured here, a class F1 alarm and an alarm message are issued. In addition, the relay manager relay programmed with relay manager function 93 (Appendix E) is enabled and the MCB is prevented from opening.

Parameter **96**

```
GCB open at F2
max.time    000s
```

**Max. permissible time with F2 prior to open the GCB** **0 to 999 s**

Prerequisite: Load sharing and automatic start/stop are configured "ON". The generator is in isolated operation and at least one additional generator is connected to the busbar.

If a class F2 alarm occurs, shutting the generator down is delayed by the time configured here. This gives another generator the opportunity to start and assume the load. The generator is shut down when this time expires.

Parameter **97**

```
Signal logic GCB
----------------
```

**GCB: signal logic** **Continuous/Impulse**

**Continuous** ..The "Command: close GCB" relay can be looped directly into the self-holding circuit of the power circuit breaker. After the connect pulse has been issued and the reply from the GCB has been received, the "Command: close GCB" relay remains energized. If the power circuit breaker has to be opened, the relay de-energizes.

**Impulse** .....The "Command: close GCB" relay issues a connect pulse. An external holding circuit must performs the GCB self-holding functions of the GCB. The reply of the GCB is used to detect the closed contacts.

In both cases, the "Command: open GCB" relay energizes to open the breaker.

Parameter **98**

```
Opening GCB
----------------
```

**GCB: open (terminal 41/42)** **NO-cont./NC-cont.**

**NO-cont.** .....If the GCB is to be opened, the "Command: open GCB" relay (terminal 41/42) is energized. Following "Reply: GCB is open" the relay is de-energized again.

**NC-cont.**.....If the GCB is to be opened, the "Command: open GCB" relay (terminal 41/42) is de-energized. Following "Reply: GCB is open" the relay is energized again.

## Synchronization

Parameter **99**

```
Synchronize
df max    0.00Hz
```

**Synch.: max. permissible differential frequency (pos. slip)** **0.02 to 0.49 Hz**

This is the upper frequency differential limit for synchronization. The prerequisite for a breaker closure command is that the positive frequency differential be lower than the configured value. A positive value corresponds to positive slip. This means that the generator frequency is higher than the busbar frequency for synchronizing the GCB or the bus bar frequency is higher than the mains frequency for synchronizing the MCB.

Parameter **100**

```
Synchronize
df min   -0.00Hz
```

**Synch.: max. permissible differential frequency (neg. slip)** **0.00 to -0.49 Hz**

This is the lower frequency differential limit for synchronization. The prerequisite for a breaker closure command is that the negative frequency differential be lower than the configured value. A negative value corresponds to negative slip. This means that the generator frequency is lower than the busbar frequency for synchronizing the GCB or the bus bar frequency is lower than the mains frequency for synchronizing the MCB.

Parameter **101**

```
Synchronize
dV max     00.0%
```

**Synch.: max. permissible differential voltage** **00.1 to 15.0 %**

The measured voltage differential between the two systems to be connected cannot exceed the percentage value configured here for a connect command to be issued.

Parameter **102**

```
Synchronize
time pulse>0.00s
```

**Synch.: pulse time** **0.02 to 0.26 s**

The duration of the connect pulse can be adjusted for the switching element. This applies to synchronization and dead bus start closure.

Parameter **103**

```
Closing time
GCB        000ms
```

**Synch.: inherent breaker time GCB** **40 to 300 ms**

The time configured here permits the control to compensate for the inherent delay in the GCB from the time it receives the command to close and the contacts are closed. This permits the controller to issue the closure command independent of the differential frequency so that the GCB contacts close at the synchronous point.

Parameter **104**

```
closing time
MCB        000ms
```

**Synch.: inherent breaker time CB** **40 to 300 ms**

The time configured here permits the control to compensate for the inherent delay in the MCB from the time it receives the command to close and the contacts are closed. This permits the controller to issue the closure command independent of the differential frequency so that the MCB contacts close at the synchronous point.

Parameter **105**

```
Autom.breaker
deblocking   ON
```

**Synch.: breaker de-blocking** **ON/OFF**

**ON**..... Prior to each connect pulse, a "Command: open GCB" or "Command: open MCB" is issued for 1 second. A connect signal is then issued until the circuit breaker is closed.

**OFF**..... Circuit breaker initialization on closing is carried out only via the connect pulse. No open pulse is issued prior to the close pulse.

## Synchronization Time Monitoring

Parameter **106**

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

**Synchronization time monitoring** **ON/OFF**

**ON** .....Synchronization time monitoring is performed. The subsequent screens of this function are displayed.

**OFF** .....Synchronization time monitoring is not performed. Synchronization is attempted until it is accomplished. The subsequent screens of this function are not displayed.

Parameter **107**

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

**Synchronization time monitoring: final value** **10 to 999 s**

When the synchronization of the GCB or MCB is initiated, this timer is started after the delayed monitoring functions have expired. If the circuit breaker to be synchronized has not closed prior to this timer expiring, a message and a class F1 alarm are issued. The control continues to attempt to synchronize the breaker.

**Tripping of class F1 alarm**

## Dead Bus Start

If the busbar is in a voltage-free state, the direct connection (dead bus start) of the GCB or MCB may be carried out. If both connect commands are issued simultaneously, priority is given to the MCB if the input "Enable MCB" (terminal 53) is energized.

### NOTE

**The MCB is never opened except in a mains failure function.**

Parameter **108**

```
GCB dead bus op.
            ON
```

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

**ON**..... A dead bus start is performed in the event of a de-energized busbar and an open MCB. The prerequisite for the dead bus operation to initiate is the detection of operating conditions, which correspond to the configured specifications below. The subsequent screens of this function are displayed.

**OFF**..... A dead bus start is not performed, and the subsequent screens of this function are not displayed.

Parameter **109**

```
GCB dead bus op.
df max    0.00Hz
```

**Dead bus start: max. permissible differential frequency GCB** **0.05 to 5.00 Hz**

The prerequisite to issuing a close command is that the monitored generator frequency does not deviate from the generator rated frequency by more than the value configure here.

Parameter **110**

```
GCB dead bus op.
dV max     00.0%
```

**Dead bus start: max. perm. differential voltage GCB** **00.1 to 20.0 %**

The prerequisite to issuing a close command is that the monitored generator voltage does not deviate from the generator rated voltage by more than the percentage configure here.

Parameter **111**

```
GCB dead bus op.
max.time    000s
```

**Dead bus start: max. time to close the GCB** **0 to 999 s**

If the GCB is to be closed onto a dead busbar, this timer is initiated at the start of the breaker closing sequence. If the breaker fails to close before the configured time expires, a class F1 alarm is issued.

**Tripping of class F1 alarm**

Parameter **112**

```
MCB dead bus op.
            ON
```

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

**ON**..... A dead bus start is performed in the event of a de-energized busbar and an open GCB. The subsequent screens of this function are displayed.

**OFF**..... A dead bus start is not performed.

## Breaker Monitoring

Parameter **113**

```
Supervision GCB
            ON
```

**Breaker monitoring GCB** **ON/OFF**

**ON** .....Monitoring of the GCB is performed (except in the "EXTERNAL" CB logic). If the circuit breaker cannot be closed by the fifth attempt, the relay manager function 89 relay is energized and a class F1 alarm and message are issued. The control unit continues to attempt to close the GCB. If, 2 seconds following a "Command: open GCB" pulse, the "Reply: GCB is open" is detected, the relay manager function 91 relay is energized and an alarm message is displayed. If the generator is load sharing, the add-on command is deleted so that another control can close the breaker.

**Tripping of class F1 alarm**

**OFF** .....Monitoring is not performed.

Parameter **114**

```
Supervision MCB
            ON
```

**Breaker monitoring MCB** **ON/OFF**

**ON** .....Monitoring of the MCB is performed (except in the "EXTERNAL" CB logic). If the circuit breaker cannot be closed by the fifth attempt, the relay manager function 90 relay is energized and a class F1 alarm and message are issued. The control unit continues to attempt to close the MCB. If, 2 seconds following a "Command: open MCB" pulse, the "Reply: MCB is open" is detected, the relay manager function 92 relay is energized and an alarm message is displayed. If the generator is load sharing, the add-on command is deleted so that another control can close the breaker.

**Tripping of class F1 alarm**

**OFF** .....Monitoring is not performed.

## Mains Decoupling

If the application the control unit is being configured for is an isolated system, this configuration screen and its settings do not apply. If the application is a single-breaker unit in a mains parallel operation, the GCB is configured as always open.

### NOTE

**The "Blocking of mains protection" input (terminal 61) disables mains monitoring and decoupling.**

Parameter **115**

```
Mains decoupling
via          ---
```

**Mains decoupling through ...** **MCB/GCB**

The fault condition decoupling logic for the control unit is configured here. If the generator is used in a parallel isolated application, the MCB must be configured here. If the generator is to be used in a mains parallel application, the GCB must be configured to decouple.

## Mains Settling Time

Parameter **116**

```
Mains settling
time        000s
```

**Mains settling time** **0 to 999 s**

It is possible for to delay the synchronization of the generator to the mains for the period of time configured here. This will permit the user to ensure that the mains voltage is stable while the generator continues to operate in an isolated (parallel) mode or idle offline.

# Protection

Parameter 117

```
Configure
Monitoring   YES
```

**Configure monitoring** **YES/NO**

Various groups of parameters are grouped together in blocks to aid in the rapid navigation through the large number of configuration screens. Selecting "YES" or "NO" does not determine if control or monitoring is performed. The user's selection has the following effect:

**YES**..... The configuration screens in this block are displayed and can either be viewed ("Select" push button) or modifications can be made to the parameters ("Cursor→", "Digit↑" or "Select" push buttons). This does not disable or enable individual parameters, only if the individual parameters in this parameter block may be accessed for modifications.

**NO**..... The parameters in this block are not displayed, cannot be modified and are therefore skipped.

## Mains Power Monitoring

A main power limit may be configured and monitored. One of the freely configurable relays may also be assigned relay manager function 84 so that the system may disconnect from the load via an external circuit.

### NOTE

**This function does not issue a centralized alarm or output a message. Only a relay output is enabled, which must be monitored externally.**

### CAUTION

**Mains power monitoring is not designed as a generator protective function. If this function is to be used for generator protection, it must be utilized in conjunction with an external circuit.**

Parameter 118

```
Mains power mon.
             ON
```

**Mains power monitoring** **ON/OFF**

**ON**..... Mains power monitoring is enabled. One relay must be configured with relay manager function 84. The subsequent screens of this function are displayed.

**OFF**..... Mains power monitoring is not enabled. The subsequent screens of this function are not displayed.

Parameter 119

```
Mains power mon.
res.val.B00000kW
```

**Mains power monitoring: limit** **E/I 0 to 16,000 kW**

The monitored limit value is configured here. If the value is exceeded, the configured relay is energized. Incoming/import power is entered with a "-", before the value. Outgoing/export power is entered with a "+" before the value. When the value is saved the "-" becomes "I" and the "+" becomes "E".

Parameter 120

```
Mains power mon.
hysteresis 000kW
```

**Mains power monitoring: hysteresis** **0 to 999 kW**

If the monitored limit has been exceeded, the power must drop below the mains power monitoring limit value by the value configured here before the relay will de-energize.

Parameter 121

```
Mains power mon.
Dealy       000s
```

**Mains power monitoring: delay** **0 to 600 s**

The mains power monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Reverse/Reduced Power Monitoring

**NOTE**

**All percentage indications of the power are in relation to the generator rated power (Parameter 28).**

**Function:** "Real power not within the permissible range"
The real power measured in a single phase or in three phases is below the configured limit value for the minimum load or below the configured value for reverse power. By configuring positive threshold values (minimum load monitoring), a shutdown can be performed before the generator goes into reverse power.

Parameter 122

```
Rev./red.power
monitoring   ON
```

**Generator reverse/reduced power** **ON/OFF**

**ON** .....Generator real power monitoring is enabled. The subsequent screens of this function are displayed.
**OFF** .....Generator power monitoring is not enabled. The subsequent screens of this function are not displayed.

Parameter 123

```
Rev./red.power
resp.value  -00%
```

**Generator reverse/reduced power: limit** **-99 to 99 %**

**Reverse power monitoring:** When the real power falls below the negative percentage limit value, the unit recognizes a reverse power condition. The unit issues a class F3 a alarm.
**Reduced power monitoring:** When the real power falls below the positive percentage limit value, the unit recognizes a reduced power condition. The unit issues a class F3 a alarm.

**Tripping of class F3 alarm**

Parameter 124

```
Rev./red.power
Delay      00.0s
```

**Generator reverse/reduced power: delay** **00.1 to 99.9 s**

The reverse/reduced power monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Generator Overload Monitoring

**NOTE**

**All percentage indications of the power are in relation to the generator rated power (Parameter 28).**

**Function:** "Positive real power not within the permissible range"
The real power of the generator is outside the configured overload limit values, and an alarm is issued.

Parameter **125**

```
Gen.overload
monitoring   ON
```

**Generator overload** **ON/OFF**

**ON**..... Generator overload monitoring is enabled. The subsequent screens of this function are displayed.
**OFF**..... Generator overload monitoring is not performed. The subsequent screens of this function are not displayed.

Parameter **126**

```
Gen.overload MOP
resp.value  000%
```

**Generator overload: limit MOP (Mains Operating in Parallel)** **80 to 150 %**

The value configured in this screen is a percentage of the configured generator rated power. If this level is reached or exceeded for the configured delay time, the unit issues an alarm and opens the GCB.

**Tripping of class F2 alarm**
without load shedding

Parameter **127**

```
Gen.overload MOP
Delay        00s
```

**Generator overload: delay MOP (Mains Operating in Parallel)** **0 to 99 s**

The generator overload MOP monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

Parameter **128**

```
Gen.overload IOP
resp.value  000%
```

**Generator overload: limit IOP (Isolated Operating in Parallel)** **80 to 150 %**

The value configured in this screen is a percentage of the configured generator rated power. If this level is reached or exceeded for the configured delay time, the unit issues an alarm and opens the GCB.

**Tripping of class F2 alarm**
without load shedding

Parameter **129**

```
Gen.overload IOP
Delay        00s
```

**Generator overload: delay IOP (Isolated Operating in Parallel)** **0 to 99 s**

The generator overload IOP monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Generator Re-active Power Monitoring

**NOTE**

**All percentage indications of the power are in relation to the generator rated power (Parameter 28).**

**Function:** "Re-active power not within the permissible range"
The re-active power of the generator is outside the configured re-active power limits, and an alarm is issued.

Parameter **130**

```
Reactive power
Monitoring   ON
```

**Re-active power monitoring** **ON/OFF**

**ON** .....Generator inductive re-active power monitoring is enabled. The subsequent screens of this function are displayed.
**OFF** .....Generator inductive re-active power monitoring is not performed. The subsequent screens of this function are not displayed.

### Inductive Re-active Power Monitoring

Parameter **131**

```
Reactive pow.ind
Limit       000%
```

**Re-active (inductive) power: limit** **5 to 100 %**

The value configured in this screen is a percentage of the configured generator rated power. If this level is reached or exceeded for the configured delay time, the unit issues an alarm and opens the GCB.

**Tripping of class F3 alarm**

Parameter **132**

```
Reactive pow.ind
Delay       000s
```

**Re-active (inductive) power: delay** **0 to 600 s**

The generator inductive re-active power monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

### Capacitive Re-active Power Monitoring (Loss of Excitation)

Parameter **133**

```
Reactive pow.cap
Limit       000%
```

**Re-active (capacitive) power: limit** **5 to 100 %**

The value configured in this screen is a percentage of the configured generator rated power. If this level is reached or exceeded for the configured delay time, the unit issues an alarm and opens the GCB.

**Tripping of class F3 alarm**

Parameter **134**

```
Reactive pow.cap
Delay       000s
```

**Re-active (capacitive) power: delay** **0 to 600 s**

The generator capacitive re-active power monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Time-Overcurrent Monitoring (TOC)

**NOTE**

**All percentage indications of the current are in relation to the generator rated current (Parameter 29).**

**Function:** The user may configure two steps for time-overcurrent monitoring. The threshold values and delays can be configured so that the individual set points are independent of each other. Overcurrent level 1 disconnects lower overcurrent levels that are present over longer periods of time. Overcurrent level 2 disconnects the more destructive higher currents quickly to protect against short circuit conditions.

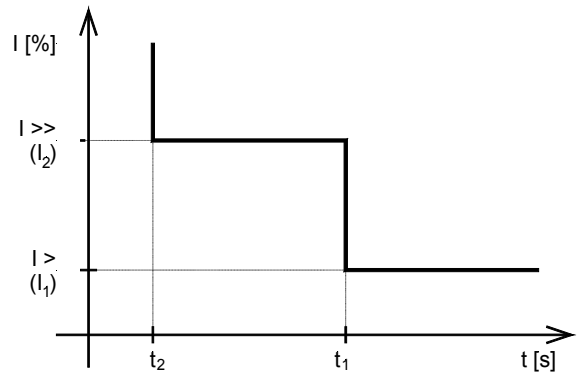



Figure 6-1: Characteristic of the time-overcurrent monitoring

Parameter **135**

```
Gen.overcurrent
monitoring   ON
```

**Time-overcurrent monitoring** **ON/OFF**

**ON**..... Generator overcurrent monitoring is enabled. The subsequent screens of this function are displayed.

**OFF**..... Generator overcurrent monitoring is not performed. The subsequent screens of this function are not displayed.

Parameter **136**

```
Gen.overcurr. 1
resp.value  000%
```

**Time-overcurrent: limit 1** **0 to 300 %**

The value configured in this screen is a percentage of the configured generator rated current. If this level is reached or exceeded for the configured delay time, the unit issues an alarm and opens the GCB.

**Tripping of class F3 alarm**

Parameter **137**

```
Gen.overcurr. 1
Delay     00.00s
```

**Time-overcurrent: delay 1** **0.02 to 99.98 s**

The generator time-overcurrent monitoring threshold limit 1 must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

Parameter **138**

```
Gen.overcurr. 2
resp.value  000%
```

**Time-overcurrent: limit 2** **0 to 300 %**

The value configured in this screen is a percentage of the configured generator rated current. If this level is reached or exceeded for the configured delay time, the unit issues an alarm and opens the GCB.

**Tripping of class F3 alarm**

Parameter **139**

```
Gen.overcurr. 2
Delay     00.00s
```

**Time-overcurrent: delay 2** **0.02 to 99.98 s**

The generator time-overcurrent monitoring threshold limit 2 must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Inverse Time-Overcurrent Monitoring

**NOTE**

**All percentage indications of the current are in relation to the generator rated current (Parameter 29).**

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

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

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

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

Variables:

| | |
|---|---|
| $t$ | tripping time |
| $t_p$ | time set point value |
| $I$ | fault current / monitored current |
| $I_n$ | rated (nominal) current (Parameter 29) |
| $I_p$ | current set point value |

If t is greater than 650 s the system trips at 650 s. If t is lower than $t_{min}$ the tripping time is $t_{min}$. The reaction time for $t_{min}$ depends on the time it takes to monitor the fault and the operating time of the relays. $t_{min}$ is at least 20 ms.

Please consider during configuration:

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

## Configuration Screens

Parameter **140**

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

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

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

Parameter **141**

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

**Inverse time-overcur.: characteristic** **normal inv./high inv./extremely inv.**

**normal inv.**....."normal inv." tripping characteristic is used.
**high inv.**....."high inv." tripping characteristic is used.
**extremely inv.** ..."extremely inv." tripping characteristic is used.

**Tripping of class F3 alarm**

Parameter **142**

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

**Inverse time-overcurrent: time constant Tp** **0.00 to 1.98s**

The time constant for $t_p$ is defined by this parameter.

Parameter **143**

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

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

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

Parameter **144**

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

**Inverse time-overcurrent: I start** **1.00 to 3.00*In**

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

## Characteristics

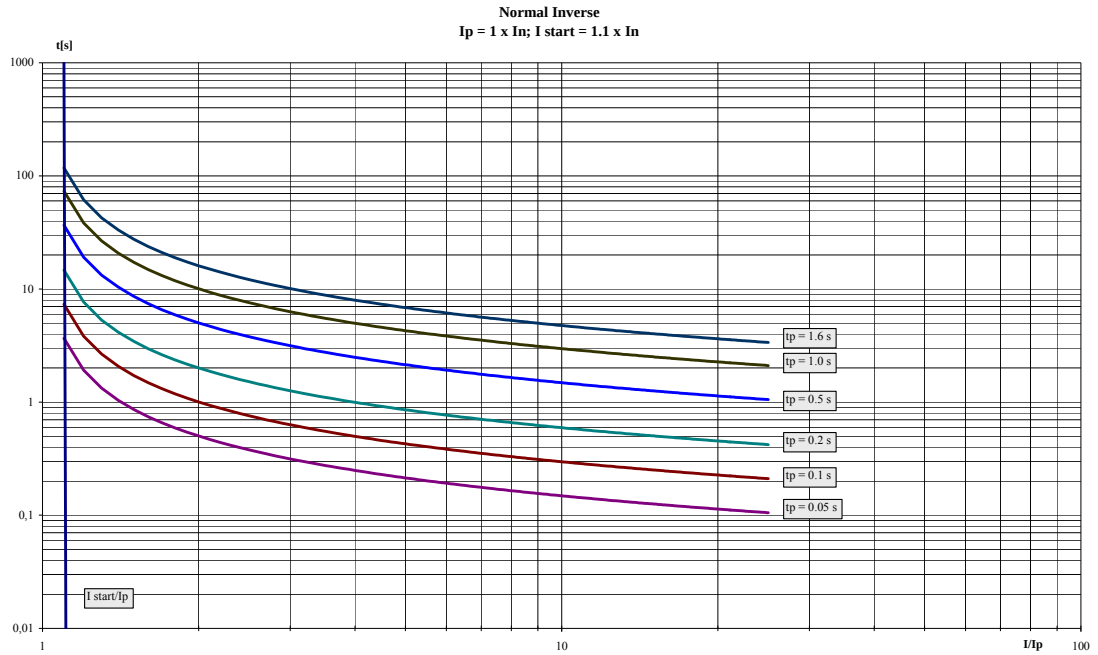



Figure 6-2: Inverse time-overcurrent - characteristic "normal inverse"

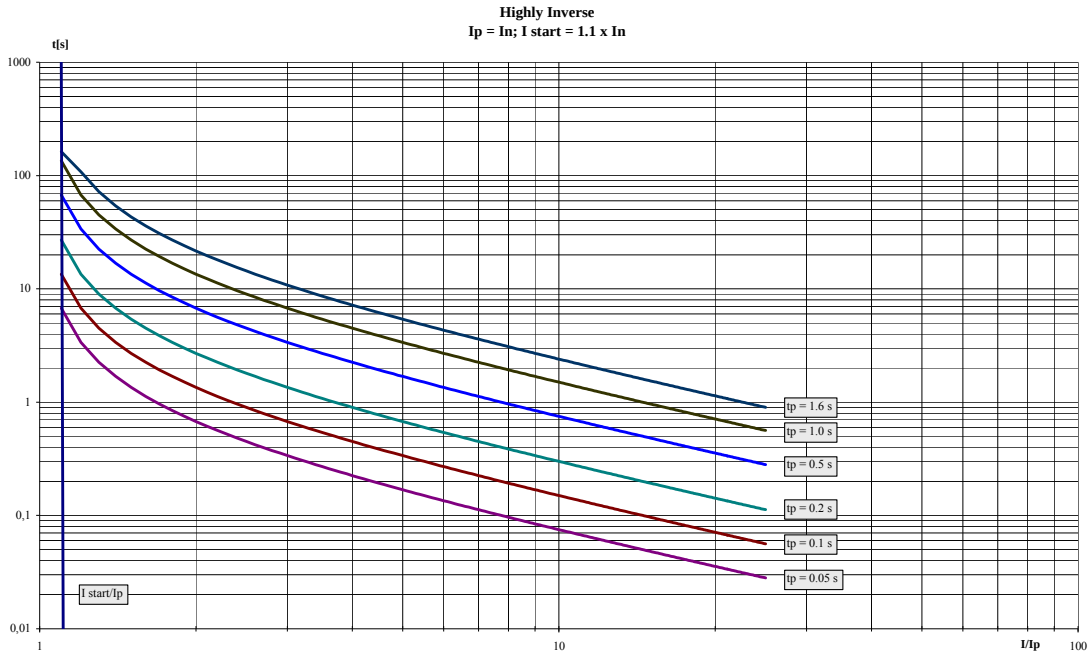



Figure 6-3: Inverse time-overcurrent - characteristic "high inverse"

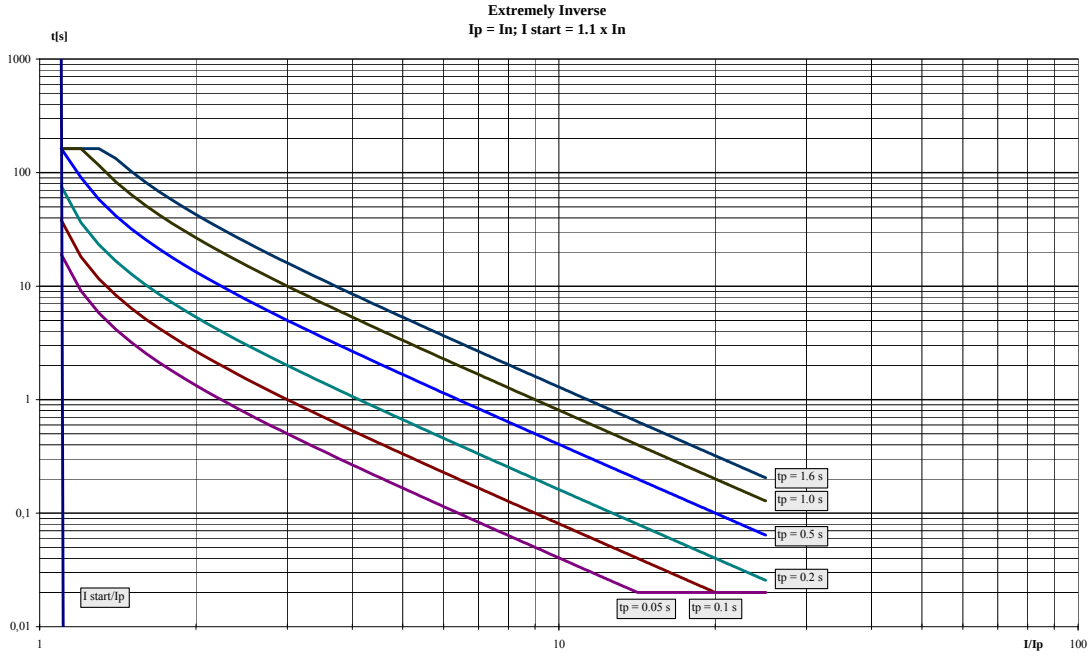



Figure 6-4: Inverse time-overcurrent - characteristic "extremely inverse"

## Inverse Time-Overcurrent Monitoring with Voltage Restraint

### NOTE

**This monitoring function is an additional functionality for the inverse time overcurrent monitoring function. If the inverse time overcurrent monitoring is disabled (Parameter 140), time-overcurrent monitoring with voltage restraint is disabled too.**

**All percentage indications of the current are in relation to the generator rated current (Parameter 29).**

**Function:** This function is recommended for a generator that must be monitored with droop excitation and precautions for short-circuit excitation (e.g. supplementary components) are not available. A short-circuit close to the terminal may be caused due to the low voltage excitation cannot be maintained. As a result, the unit cannot maintain power in order to initiate a voltage independent overcurrent delay. The voltage restraint functionality reduces the overcurrent threshold of the inverse time overcurrent monitoring function proportionally with the monitored voltage if this function is enabled. If the monitored voltage falls below the threshold defined by the knee curve setting (Parameter 146), the overcurrent threshold remains at the value of the knee curve setting. The reduction of the inverse time threshold occurs according to Figure 6-5.

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

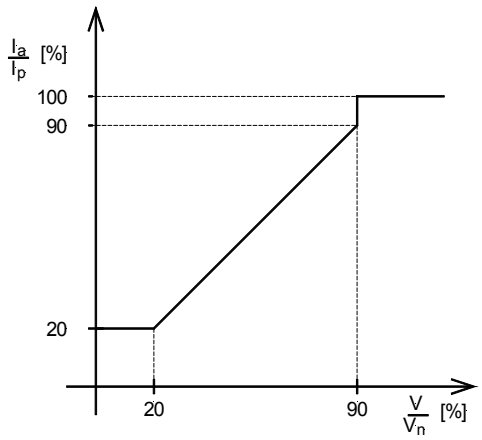



Figure 6-5: Characteristic of the inverse time-overcurrent monitoring with voltage restraint (knee curve setting 20 %)

Legend:
- $I_a$ Adjusted current threshold value
- $I_p$ Configured value (Parameter 143)
- $V_n$ Rated voltage
- V Monitored voltage

Example:

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

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

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

Case 3 (monitored voltage V < knee curve setting):
If the monitored voltage falls below the percentage value of the rated voltage configured by the knee curve setting (Parameter 146), the configured value is adjusted to the proportional value at the knee curve setting.
-> $I_a$ = {(knee point setting in [%])/100} * $I_p$
If the knee curve setting is configured to 20% for example and the monitored voltage is lower than 20% of the rated voltage, the adjusted value $I_a$ falls not below 20% of the configured value $I_p$.

Parameter **145**

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

**Voltage restraint time-overcurrent** **ON/OFF**

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

Parameter **146**

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

**Voltage restraint time-overcurrent** **10 to 90 %**

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

**Tripping of alarm class 3**

## Earth Fault Monitoring

**Calculation of the ground current:**
The measuring of the ground current is based on the calculation of the vectoral sum of the three phase currents. To ensure that the ground fault protection operates properly, the configured ground currents should be a minimum of 10% of the current transformer's rating.

Parameter **147**

```
Earth fault
monitoring   ON
```

**Ground fault monitoring** **ON/OFF**

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

Parameter **148**

```
Earth fault
response v. 000%
```

**Threshold ground current limit** **5 to 100 %**

If the value of the ground current exceeds the entered percentage, the unit issues an alarm. In an additional relay is configured in the relay manager the alarm is also transmitted to this relay.

Parameter **149**

```
Earth fault
delay    00,00s
```

**Earth fault delay** **0.02 to 99.98 s**

The ground fault monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Generator Load Imbalance Monitoring

### NOTE

**All percentage indications of the current are in relation to the generator rated current (Parameter 29).**

**Function:** "Generator load imbalance not within the permissible range"
The threshold value, expressed as a percentage,specifies the permissible deviation of the current in a conductor from the calculated mean value of all three-conductor currents. If the measured value is greater than the threshold value, an alarm is issued.

Parameter **150**

```
Load unbalance
Monitoring   ON
```

**Unbalanced load** **ON/OFF**

**ON** .....Generator load imbalance monitoring is enabled. The subsequent screens of this function are displayed.
**OFF** .....Generator load imbalance monitoring is not performed. The subsequent screens of this function are not displayed.

Parameter **151**

```
Load unbalance
max.        000%
```

**Unbalanced load: limit** **0 to 100 %**

The value configured in this screen is a percentage of the configured generator rated current. If this level is reached or exceeded, the unit issues an alarm and opens the GCB.

**Tripping of class F3 alarm**

Parameter **152**

```
Load unbalance
Delay     00.00s
```

**Unbalanced load: delay** **0.02 to 99.98 s**

The load imbalance monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Generator Overfrequency Monitoring

The monitoring of the frequency is carried out at two levels. The measurement of the frequency encompasses all three phases if all voltages are greater than 15 % of the rated value (100 Vac or 400 Vac). This enables a very rapid and precise frequency measurement. The frequency, however, is also correctly detected if voltage in only one phase is present.

**Function:** "Generator frequency not within the permissible range"
A fault condition is recognized if the frequency of the generator is outside of the limit values configured for overfrequency. The enabling of generator overfrequency monitoring is delayed via "Delayed monitoring" in order to enable correct generator start-up. An alarm is issued if a fault condition is detected.

Parameter **153**

```
Gen.overfreq.
monitoring   ON
```

**Generator overfrequency** **ON/OFF**

**ON**..... Generator overfrequency monitoring is enabled. The subsequent screens of this function are displayed.
**OFF**..... Generator overfrequency monitoring is not performed. The subsequent screens of this function are not displayed.

Parameter **154**

```
Gen.overfreq. 1
f >      00.00Hz
```

**Generator overfrequency: limit 1** **40.00 to 85.00 Hz**

The value for overfrequency limit 1 is configured in this screen. If the monitored frequency reaches or exceeds this level for the configured delay time, the unit issues an alarm and opens the GCB.

**Tripping of class F3 alarm**

Parameter **155**

```
Gen.overfreq. 1
Delay     00.00s
```

**Generator overfrequency: delay 1** **0.02 to 99.98 s**

The generator overfrequency monitoring threshold limit 1 must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

Parameter **156**

```
Gen.overfreq. 2
f >      00.00Hz
```

**Generator overfrequency: limit 2** **40.00 to 85.00 Hz**

The value for overfrequency limit 2 is configured in this screen. If the monitored frequency reaches or exceeds this level for the configured delay time, the unit issues an alarm and opens the GCB.

**Tripping of class F3 alarm**

Parameter **157**

```
Gen.overfreq. 2
Delay     00.00s
```

**Generator overfrequency: delay 2** **0.02 to 99.98 s**

The generator overfrequency monitoring threshold limit 1 must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Generator Underfrequency Monitoring

The monitoring of the frequency is carried out at two levels. The measurement of the frequency encompasses all three phases if all voltages are greater than 15 % of the rated value (100 Vac or 400 Vac). This enables a very rapid and precise frequency measurement. The frequency, however, is also correctly detected if voltage in only one phase is present.

**Function:** "Generator frequency not within the permissible range"
A fault condition is recognized if the frequency of the generator is outside of the limit values configured for underfrequency. The enabling of generator underfrequency monitoring is delayed via "Delayed monitoring" in order to enable correct generator start-up. An alarm is issued if a fault condition is detected.

**NOTE**

**Energizing terminal 6 ("monitoring") enables this monitoring.**

Parameter **158**

```
Gen.underfreq.
monitoring   ON
```

**Generator underfrequency** **ON/OFF**

**ON** .....Generator underfrequency monitoring is enabled. The subsequent screens of this function are displayed.
**OFF** .....Generator underfrequency monitoring is not performed. The subsequent screens of this function are not displayed.

Parameter **159**

```
Gen.underfreq. 1
f <      00.00Hz
```

**Generator underfrequency: limit 1** **40.00 to 85.00 Hz**

The value for underfrequency limit 1 is configured in this screen. If the monitored frequency reaches or falls below this level for the configured delay time, the unit issues an alarm and opens the GCB.

**Tripping of class F3 alarm**

Parameter **160**

```
Gen.underfreq. 1
Delay     00.00s
```

**Generator underfrequency: delay 1** **0.02 to 99.98 s**

The generator underfrequency monitoring threshold limit 1 must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

Parameter **161**

```
Gen.underfreq. 2
f <      00.00Hz
```

**Generator underfrequency: limit 2** **40.00 to 85.00 Hz**

The value for underfrequency limit 2 is configured in this screen. If the monitored frequency reaches or falls below this level for the configured delay time, the unit issues an alarm and opens the GCB.

**Tripping of class F3 alarm**

Parameter **162**

```
Gen.underfreq. 2
Delay     00.00s
```

**Generator underfrequency: delay 2** **0.02 to 99.98 s**

The generator underfrequency monitoring threshold limit 1 must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Generator Overvoltage Monitoring

The line-to-line voltage is monitored to detect overvoltage conditions.

**Function:** "Generator voltage not within the permissible range"
At least one phase of the generator voltage is outside of the limit values configured for overvoltage. The enabling of generator overvoltage monitoring is delayed via "Delayed monitoring" in order to enable correct generator start-up. An alarm is issued if a fault condition is detected.

Parameter **163**

```
Gen.overvoltage
monitoring   ON
```

**Generator overvoltage** **ON/OFF**

**ON**..... Generator overvoltage monitoring is enabled. The subsequent screens of this function are displayed.
**OFF**..... Generator overvoltage monitoring is not performed. The subsequent screens of this function are not displayed.

Parameter **164**

```
Gen.overvolt. 1
U >          000V
```

**Generator overvoltage: limit 1** **[1] 20 to 150 V; [4] 20 to 520 V**

The value for overvoltage limit 1 is configured in this screen. If the monitored voltage reaches or exceeds this level for the configured delay time, the unit issues an alarm and opens the GCB. This value refers to the secondary voltage of the generator PT inputs (Parameter 15).

**Tripping of class F3 alarm**

Parameter **165**

```
Gen.overvolt. 1
Delay     00.00s
```

**Generator overvoltage: delay 1** **0.02 to 99.98 s**

The generator overvoltage monitoring threshold limit 1 must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

Parameter **166**

```
Gen.overvolt. 2
U >          000V
```

**Generator overvoltage: limit 2** **[1] 20 to 150 V; [4] 20 to 520 V**

The value for overvoltage limit 2 is configured in this screen. If the monitored voltage reaches or exceeds this level for the configured delay time, the unit issues an alarm and opens the GCB. This value refers to the secondary voltage of the generator PT inputs (Parameter 15).

**Tripping of class F3 alarm**

Parameter **167**

```
Gen.overvolt. 2
Delay     00.00s
```

**Generator overvoltage: delay 2** **0.02 to 99.98 s**

The generator overvoltage monitoring threshold limit 1 must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Generator Undervoltage Monitoring

The line-to-line voltage is monitored to detect undervoltage conditions.

**Function:** "Generator voltage not within the permissible range"
At least one phase of the generator voltage is outside of the limit values configured for undervoltage. The enabling of generator undervoltage monitoring is delayed via "Delayed monitoring" in order to enable correct generator start-up. An alarm is issued if a fault condition is detected.

### NOTE

**Energizing terminal 6 ("monitoring") enables this monitoring.**

Parameter **168**

```
Gen.undervolt.
monitoring   ON
```

**Generator undervoltage** **ON/OFF**

**ON** .....Generator undervoltage monitoring is enabled. The subsequent screens of this function are displayed.
**OFF** .....Generator undervoltage monitoring is not performed. The subsequent screens of this function are not displayed.

Parameter **169**

```
Gen.undervolt. 1
U >          000V
```

**Generator undervoltage: limit 1** **[1] 20 to 150 V; [4] 20 to 520 V**

The value for undervoltage limit 1 is configured in this screen. If the monitored voltage reaches or falls below this level for the configured delay time, the unit issues an alarm and opens the GCB. This value refers to the secondary voltage of the generator PT inputs (Parameter 15).

**Tripping of class F3 alarm**

Parameter **170**

```
Gen.undervolt. 1
Delay      00.00s
```

**Generator undervoltage: delay 1** **0.02 to 99.98 s**

The generator undervoltage monitoring threshold limit 1 must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

Parameter **171**

```
Gen.undervolt. 2
U >          000V
```

**Generator undervoltage: limit 2** **[1] 20 to 150 V; [4] 20 to 520 V**

The value for undervoltage limit 2 is configured in this screen. If the monitored voltage reaches or falls below this level for the configured delay time, the unit issues an alarm and opens the GCB. This value refers to the secondary voltage of the generator PT inputs (Parameter 15).

**Tripping of class F3 alarm**

Parameter **172**

```
Gen.undervolt. 2
Delay      00.00s
```

**Generator undervoltage: delay 2** **0.02 to 99.98 s**

The generator undervoltage monitoring threshold limit 1 must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Mains Frequency Monitoring

**NOTE**

**The "Blocking of mains protection" input (terminal 61) disables mains monitoring and decoupling.**

Monitoring of the mains frequency is absolutely vital if a generator is to be operated in parallel with a public utility. In the event of a mains failure (e. g. short interruption) the generator which is in mains parallel operation, must be automatically disconnected from the mains.

**Function:** "Mains frequency not within the permissible range"
The mains frequency is outside of the limit values configured for overfrequency or underfrequency. The power circuit breaker, which is configured to carry out decoupling from the mains, is immediately opened. The prerequisite of mains frequency monitoring is a mains parallel operation (both GCB and MCB are closed). An alarm is issued if a fault condition is detected.

Parameter **173**

```
Mains frequency
monitoring   ON
```

**Mains frequency** **ON/OFF**

**ON**..... Mains frequency monitoring is enabled. The subsequent screens of this function are displayed.
**OFF**..... Mains frequency monitoring is not performed. The subsequent screens of this function are not displayed.

Parameter **174**

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

**Mains overfrequency: limit** **40.00 to 70.00 Hz**

The value for the mains overfrequency limit is configured in this screen. If the monitored frequency reaches or exceeds this level for the configured delay time, the unit issues an alarm and opens either the GCB or the MCB depending on which is configured for decoupling from the mains.

**Tripping of class F0 alarm**

Parameter **175**

```
ains overfreq.
Delay    00.00s
```

**Mains overfrequency: delay** **0.02 to 99.98 s**

The mains overfrequency monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

Parameter **176**

```
ains underfreq.
f <      00.00Hz
```

**Mains underfrequency: limit** **40.00 to 70.00 Hz**

The value for the mains underfrequency limit is configured in this screen. If the monitored frequency reaches or falls below this level for the configured delay time, the unit issues an alarm and opens either the GCB or the MCB depending on which is configured for decoupling from the mains.

**Tripping of class F0 alarm**

Parameter **177**

```
Mains underfreq.
Delay    00.00s
```

**Mains underfrequency: delay** **0.02 to 99.98 s**

The mains underfrequency monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Mains Voltage Monitoring

**NOTE**

**The "Blocking of mains protection" input (terminal 61) disables mains monitoring and decoupling.**

Monitoring the mains voltage is absolutely vital if a generator is to be operated in parallel with a public utility. In the event of mains failure (e. g. short interruption) the generator which is in mains parallel operation must be automatically disconnected from the mains.

**Function:** "Mains voltage not within the permissible range"
At least one phase of the mains voltage is outside of the limit values configured for overvoltage or undervoltage. The power circuit breaker configured for mains decoupling is immediately opened. The prerequisite of mains voltage monitoring is a mains parallel operation (both GCB and MCB are closed). An alarm message is issued if a fault condition is detected.

Parameter **178**

```
Mains voltage
monitoring   ON
```

**Mains voltage** **ON/OFF**

**ON** .....Mains voltage monitoring is enabled. The subsequent screens of this function are displayed.
**OFF** .....Mains voltage monitoring is not performed. The subsequent screens of this function are not displayed.

Parameter **179**

```
Mains volt.monit
       U Ph.-N.
```

**Mains voltage monitoring** **U Ph.-Ph. / U Ph.-N.**

**U Ph.-Ph.**.....Mains voltage monitoring refers to the phase-phase voltages $V_{Ph-Ph}$.
**U Ph.-N.** .....Mains voltage monitoring refers to the phase-neutral voltages $V_{Ph-N}$.

Parameter **180**

```
Mains overvolt.
U Ph.-Ph.>  000V
```

**Mains overvoltage: limit** **[1] 20 to 150 V; [4] 20 to 520 V**

The phase-phase voltage value for mains overvoltage limit is configured in this screen. If the monitored voltage reaches or exceeds this level for the configured delay time, the unit issues an alarm and opens the GCB. This value refers to the secondary voltage of the mains PT inputs (Parameter 19).
This setting is only valid if the mains voltage monitoring (Parameter 179) is configured to U Ph.-Ph.

**Tripping of class F0 alarm**

Parameter **181**

```
Mains overvolt.
U Ph.-N.>  000V
```

**Mains overvoltage: limit** **[1] 20 to 87 V; [4] 20 to 300 V**

The phase-neutral voltage value for mains overvoltage limit is configured in this screen. If the monitored voltage reaches or exceeds this level for the configured delay time, the unit issues an alarm and opens the GCB. This value refers to the secondary voltage of the mains PT inputs (Parameter 19).
This setting is only valid if the mains voltage monitoring (Parameter 179) is configured to U Ph.-N.

**Tripping of class F0 alarm**

Parameter **182**

```
Mains overvolt.
Delay     00,00s
```

**Mains overvoltage: delay** **0.02 to 99.98 s**

The mains overvoltage monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

Parameter **183**

```
Mains undervolt.
U Ph.-Ph.<  000V
```

**Mains undervoltage: limit** **[1] 20 to 150 V; [4] 20 to 520 V**

The phase-phase voltage value for mains undervoltage limit is configured in this screen. If the monitored voltage reaches or falls below this level for the configured delay time, the unit issues an alarm and opens the GCB. This value refers to the secondary voltage of the mains PT inputs (Parameter 19).
This setting is only valid if the mains voltage monitoring (Parameter 179) is configured to U Ph.-Ph.

**Tripping of class F0 alarm**

Parameter **184**

```
Mains undervolt.
U Ph.-N.<  000V
```

**Mains undervoltage: limit** **[1] 20 to 87 V; [4] 20 to 300 V**

The phase-neutral voltage value for mains undervoltage limit is configured in this screen. If the monitored voltage reaches or falls below this level for the configured delay time, the unit issues an alarm and opens the GCB. This value refers to the secondary voltage of the mains PT inputs (Parameter 19).
This setting is only valid if the mains voltage monitoring (Parameter 179) is configured to U Ph.-N.

**Tripping of class F0 alarm**

Parameter **185**

```
Mains undervolt.
Delay     00.00s
```

**Mains undervoltage: delay** **0.02 to 99.98 s**

The mains undervoltage monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Mains dφ/dt Phase/Vector Shift Monitoring

**NOTE**

**The "Blocking of mains protection" input (terminal 61) disables mains monitoring and decoupling.**

A dφ/dt phase/vector jump is a sudden change in the voltage vector angle, and may be caused by a major generator load change. In this case, the measuring circuit detects a change in the cycle duration once. This change in the vector angle is compared with a calculated mean value from previous measurements. Monitoring encompasses all three phases. The threshold value in degrees specifies the difference in time between the mean and the current value in reference to a full cycle. Monitoring can be set in various manners. The dφ/dt phase/vector shift monitoring may be used as an additional method for decoupling from the mains. The minimum voltage at which the phase shift monitoring is enabled is 70 % of the rated PT secondary voltage input.

**Function:** "Voltage cycle duration not within the permissible range"
The voltage vector exceeds the configured limit value for the phase/vector shift. The breaker configured for mains decoupling is opened. The requirement therefore is a mains parallel operation (both GCB and MCB are closed). An alarm is issued if a fault condition is detected.

Parameter **186**

```
Phase shift
monitoring   ON
```

**dφ/dt phase/vector shift** **ON/OFF**

**ON** .....Mains voltage phase shift monitoring is enabled. The subsequent screens of this function are displayed.

**OFF** .....Mains voltage phase shift monitoring is not performed. The subsequent screens of this function are not displayed.

Parameter **187**

```
Monitoring
----------------
```

**dφ/dt phase/vector shift: type** **one/three-phase / three phase only**

**one/three-phase:** During single-phase voltage phase shift monitoring, tripping occurs if the phase shift exceeds the configured threshold value in any one of the three phases. This type of monitoring is very sensitive, and may lead to nuisance tripping if the configured phase angle settings are too small.

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

**Tripping of class F0 alarm**

## NOTE

**If monitoring is configured to "three phase only", only the second screen will be displayed; if monitoring is configured to "one/three-phase", both screens are displayed.**

Parameter **188**

```
Phase shift
one-phase    00°
```

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

**dφ/dt phase/vector shift: limit single-phase** **3 to 30 °**

Tripping occurs if the electrical angle of the voltage curve shifts in any one phase by more than this configured angle. If the value is reached or exceeded, the unit issues an alarm message.

Parameter **189**

```
Phase shift
three-phase  00°
```

**dφ/dt phase/vector shift: limit three-phase** **3 to 30 °**

Tripping occurs if the electrical angle of the voltage curve shifts simultaneously in all three phases by more than this configured angle. If the value is reached or exceeded, the unit issues an alarm message.

## Mains df/dt Rate Of Change Of Frequency Monitoring (ROCOF)

**NOTE**

**The "Blocking of mains protection" input (terminal 61) disables mains monitoring and decoupling.**

**Function:** "Frequency change per time unit not within the permissible range"
The control unit determines a measuring value for the change in frequency per unit of time (Hz/s). In order to enable reliable differentiation between dφ/dt phase/vector shift and df/dt, measurement is carried out over 4 cycles. This results in a minimum tripping time of approx. 100 ms (at 50 Hz). The breaker configured as the mains decoupling breaker is opened. The requirement therefore is a mains parallel operation (both GCB and MCB are closed). An alarm is issued if a fault condition is detected.

Parameter **190**

```
df/dt-monitoring
             ON
```

**df/dt (ROCOF)** **ON/OFF**

**ON** .....Mains frequency monitoring is enabled, and any change in frequency per unit of time (Hz/s) within the defined range is registered. The subsequent screens of this function are displayed.
**OFF** .....Mains frequency monitoring is not performed. The subsequent screens of this function are not displayed.

Parameter **191**

```
df/dt-monitoring
release> 0.0Hz/s
```

**df/dt (ROCOF): limit** **1.0 to 9.9 Hz/s**

The value to be monitored for the ROCOF is configured in this screen. If the monitored frequency reaches or exceeds this level for the configured delay time, the unit issues an alarm and opens in dependence of the setting the GCB or the MCB depending on which is configured for decoupling from the mains.

**Tripping of class F0 alarm**

Parameter **192**

```
df/dt-monitoring
Delay time  0.0s
```

**df/dt (ROCOF): delay** **0.1 to 9.9 s**

The ROCOF monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

## Mains Decoupling (Selection Between dφ/dt and df/dt)

Parameter **193**

```
Mainstrip via
---------------
```

**Mains decoupling via** **Phase shift / df/dt**

The opening of the GCB/MCB (refer to Parameter 115"Mains decoupling via...") may be performed if either df/dt or phase/vector shift monitoring fault condition is detected.
**df/dt**.....Decoupling from the mains is performed if a df/dt fault condition is detected.
**Phase shift**....Decoupling from the mains is performed if a dφ/dt phase/vector shift fault condition is detected.

## Battery Voltage Monitoring

Parameter **194**

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

**Battery voltage: limit** **9.5 to 30.0 V**

The battery undervoltage threshold value is configured in this screen. If the monitored voltage reaches or is falls below this level for the configured delay time, the unit issues an alarm.

**Tripping of class F1 alarm**

Parameter **195**

```
Batt.undervolt.
Delay        00s
```

**Battery voltage: delay** **0 to 99 s**

The battery undervoltage monitoring threshold limit must be exceeded, without interruption, for the time period configured here before the configured relay will be energized.

**Note:** Regardless of the configured battery voltage watchdog, readiness for operation is withdrawn and a message is displayed if the power supply falls below 9 Vdc.

# Discrete Inputs

Parameter **196**

```
Configure
Dig.input   YES
```

**Configure discrete inputs** **YES/NO**

Various groups of parameters are grouped together in blocks to aid in the rapid navigation through the large number of configuration screens. Selecting "YES" or "NO" does not determine if control or monitoring is performed. The user's selection has the following effect:

**YES** .....The configuration screens in this block are displayed and can either be viewed ("Select" push button) or modifications can be made to the parameters ("Cursor→", "Digit↑" or "Select" push buttons). This does not disable or enable individual parameters, only if the individual parameters in this parameter block may be accessed for modifications.

**NO** .....The parameters in this block are not displayed, cannot be modified and are therefore skipped.

## Blocking of Operation Mode Selector [D02]

Parameter **197**

```
opMode blocking
via term.63  ON
```

**Blocking of the operating mode selector** **ON/OFF**

**ON** .....By enabling this discrete input [D02] (terminal 63), the operating mode cannot be changed between MANUAL and AUTOMATIC by pressing the push buttons.

**OFF** .....The discrete input is used as an alarm input.

## Selection of the Mains Decoupling via Discrete Input [D01]

Parameter **198**

```
Mains decoupling
via term.62  OFF
```

**Mains decoupling via terminal 62** **ON/OFF**

**ON** .....The designated mains decoupling breaker may be changed according to the state of discrete input [D01]:

- Discrete input [D01] (term. 62) not energized: decoupling via GCB
- Discrete input [D01] (term. 62) energized: decouplingvia MCB

**OFF** .....The discrete input is used as an alarm input.

## Breaker Logic via Discrete Input [D03]

Parameter **199**

```
Breaker logic
via term.64  ON
```

**Breaker logic via discrete input [D03]** **ON/OFF**

**ON**..... This discrete input is used as a control input:
- Discrete input [D03] (terminal 64) is not energized:
  The breaker logic configured in Parameter 94 is used
- Discrete input [D03] (terminal 64) is energized:
  The breaker logic configured in Parameter 200 is used

**OFF**..... The discrete input is used as an alarm input.

Parameter **200**

```
Breaker logic:
---------------
```

**Breaker logic** **see below**

The unit automatically controls the two breakers (MCB and GCB). In this case, up to five control functions (modes) may be selected. These are: EXTERNAL, PARALLEL, OPEN TRANSIT, CLOSED TRANSIT and INTERCHANGE.

### NOTE

**For a dead bus start it is necessary to enable the dead bus start function. To trigger the watchdogs "generator underfrequency" as well as "generator undervoltage", terminal 6 (enable monitoring) must be energized. It is possible to switch the breaker logic by energizing and de-energizing discrete input [D03] (terminal 64). The second breaker logic may be configured during the configuration of the discrete inputs. When discrete input [D03] is energized, the second breaker logic is enabled.**

## Discrete inputs: Setting

| Discrete input | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |
| Terminal | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 |
| Function | A/C | A/C | A/C | Alarm input | | | | | | | | |

A/C..Alarm or control input (dependent on configuration)

### NOTE

**Operating current (NO, make contact): The discrete input is enabled by energizing it.**
**This does not provide wire break monitoring!**

**Closed circuit current (NC, break contact): The discrete input is enabled by de-energizing it.**
**This may provide wire break monitoring.**

**Example:** Discrete inputs 1 through 4 (same procedure for inputs 5 to 12)

Parameter **201**

```
Dig.input   1234
function    EEEE
```

**Discrete input: function** **E/D**

The alarm inputs can be enabled regardless if the contact is configured as an operating current (NO) or an idle current (NC) contact. The idle current input enables monitoring for an opening in the circuit. Either a positive or a negative polarity voltage may be applied.

**E** Enable to operate as an operating current (NO) contact. Energizing the discrete input enables the alarm.

**D** Disable to operate as a closed circuit current (NC) contact. De-energizing the discrete input enables the alarm.

Parameter **202**

```
Dig.input   1234
delay       0000
```

**Discrete input: delay** **0 to 9**

A delay can be assigned to each alarm input. The delay is entered in the form of delay stages. The individual stages are listed below. The input must be present, without interruption, before the configured time period before the alarm is issued.

| Delay [stage] | Delay [time] |
|---|---|
| 0 | 100 ms |
| 1 | 200 ms |
| 2 | 500 ms |
| 3 | 1 s |
| 4 | 2 s |
| 5 | 5 s |
| 6 | 10 s |
| 7 | 20 s |
| 8 | 50 s |
| 9 | 100 s |

Parameter **203**

```
Delayed     1234
monitoring  YYYY
```

**Alarm input: delayed monitoring** **Y/N**

This screen defines the discrete alarm inputs that are to have the monitoring delayed until engine-firing speed has been achieved.
**Y** .....The discrete input is only monitored after engine-firing speed has been achieved (the green "Monitoring" LED is illuminated).
**N** .....The discrete input is constantly monitored.

Parameter **204**

```
Dig.input   1234
Alarm class 0000
```

**Discrete input: alarm class** **0 to 3**

The user may assign the desired alarm class to each discrete alarm input.

The monitoring functions are divided into four alarm classes:
**F0 - Warning alarm -** This alarm does not lead to an interruption of the operation. An alarm message is displayed without a centralized alarm.
→ Alarm text.
**F1 - Warning alarm -** This alarm does not lead to an interruption of the operation. An alarm message is displayed and a centralized alarm will be output.
→ Alarm text + flashing LED "Alarm" + Relay "Centralized alarm" (horn).
**F2 - Triggering alarm -** This alarm leads to a soft shutdown. A power reduction is performed prior to the GCB being opened. A cool down period is also carried out.
→ Alarm text + flashing LED "Alarm" + Relay "Centralized alarm" (horn) + cool down.
**F3 - Triggering alarm -** This alarm leads to the immediate opening of the GCB and a hard shutdown.
→ Alarm text + flashing LED "Alarm" + Relay "Centralized alarm" (horn) + immediate shutdown.

## Discrete Inputs: Text

**Example:** Alarm text terminal 62

**NOTE**

**It is possible to configure upper and lower case letters, numbers, and characters.**

Parameter **205**

```
Errortxt.term.62
Terminal 62
```

**Discrete input: name** **user defined**

The user may define the text to be displayed when the corresponding discrete input alarm is enabled.

# Analog Inputs

Parameter **206**

| Configure Analg.inp. YES |
|---|

**Configure analog inputs** **YES/NO**

Various groups of parameters are grouped together in blocks to aid in the rapid navigation through the large number of configuration screens. Selecting "YES" or "NO" does not determine if control or monitoring is performed. The user's selection has the following effect:

**YES**..... The configuration screens in this block are displayed and can either be viewed ("Select" push button) or modifications can be made to the parameters ("Cursor→", "Digit↑" or "Select" push buttons). This does not disable or enable individual parameters, only if the individual parameters in this parameter block may be accessed for modifications.

**NO**..... The parameters in this block are not displayed, cannot be modified and are therefore skipped.

## Analog Inputs: Setting

- Analog input 1 real power set point
- Analog input 2 power factor set point
- Analog input 3 0/4 to 20 mA
- Analog inputs 4/5/6/7 Pt100

Fixed assignment of the inputs:

| Analog input | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Type | | | 0/4 to 20 mA | Pt100 | | | |
| Terminals | 93/94/95 | 96/97/98 | 99/100/101 | 102/103/104 | 105/106/107 | 108/109/110 | 111/112/113 |
| Function | Real power set point | Power factor set point | Alarm input | | | | |

## Pt100 Input ([T4] to [T7])

The Pt100 temperature input is designed for temperatures up to 240 °C. A name may be assigned to each Pt100 input. Each input is displayed with its name, and can be monitored in two stages. The first stage initiates a class 1 alarm, and the second stage initiates a class 3 alarm.

Parameter **207**

```
Temperature x
Pt100        ON
```

[x = 4 to 7]

**Analog input, Pt100** **ON/OFF**

**ON** .....The value of this analog input is displayed and monitoring is enabled. The subsequent screens of this function are displayed.
**OFF** .....Monitoring is not performed. The analog input value and the subsequent screens of this function are not displayed.

Parameter **208**

```
***Name****
----------000°C
```

**Analog input, Pt100: name** **user defined**

A user-defined name up to 11 characters may be assigned to the analog input. If an alarm condition is detected, the name and temperature threshold value are displayed with an exclamation mark.

Parameter **209**

```
Limit
warning    000°C
```

**Analog input, Pt100: warning (limit 1)** **0 to 255 °C**

The limit value at which a warning occurs is configured here.

**Tripping of class F1 alarm**

Parameter **210**

```
Limit
shutdown   000°C
```

**Analog input, Pt100: shutdown (limit 2)** **0 to 255 °C**

The limit value at which a shutdown occurs is configured here.

**Tripping of class F3 alarm**

Parameter **211**

```
Delay
limit 1/2   000s
```

**Analog input, Pt100: delay (limit 1 + 2)** **0 to 600 s**

The analog input monitoring threshold limit must be exceeded, without interruption, for the time period configured here before an alarm is issued (this delay time applies to both limit values).

Parameter **212**

```
Monitoring for
---------------
```

**Analog input, Pt100: monitoring for** **high limit mon./low limit mon.**

The analog input is monitored in different manners:
**high limit mon.** .... The value must exceed the configured limit.
**low limit mon.**..... The value must fall below the configured limit.

### NOTE

**If limit value monitoring is not required, a limit value which is higher than the expected level must be configured in the corresponding screen (e. g. for the ambient temperature: 100 °C).**

## Analog Input 0/4 to 20 mA ([T2]-[T3])

0/4 to 20 mA values can be read here. A name and a unit of measurement may be assigned to the input. The analog input is displayed with its name, and can be monitored in two stages. The first stage initiates a class 1 alarm, and the second stage initiates a class 3 alarm.

Parameter **213**

```
Analog input 3
scaleable    ON
```

**Analog input, 0/4 to 20 mA** **ON/OFF**

**ON**..... The value of this analog input is displayed and monitoring is enabled. The subsequent screens of this function are displayed.
**OFF**..... Monitoring is not performed. The analog input value and the subsequent screens of this function are not displayed.

Parameter **214**

```
Name and unit
---------------
```

**Analog input, 0/4 to 20 mA: name** **user defined**

A user-defined name may be assigned to the analog input. A maximum of four zeros may be used to reserve places for the numerical measuring values. The placeholders may be divided by characters (e. g. comma). The measured values subsequently appear wherever the zeros are placed.

Parameter **215**

```
Analog input x
          0-00mA
```

[x = 1-7]

**Analog input, 0/4 to 20 mA: measuring range** **0 to 20 mA / 4 to 20mA**

The input range 0 to 20 mA or 4 to 20 mA is selected in this screen. If 4 to 20 mA is selected here and a current of less than 2 mA is measured, this is assessed as a broken wire (Parameter 222).

Parameter **216**

```
Value at
  0%         0000
```

**Analog input, 0/4 to 20 mA: lower level value** **-9,999 to 9,999**

The scaleable analog input must be assigned a numerical value which corresponds to the lowest input value → Definition of the lower value (0 % equals 0 kW, 0 V etc.) with minimum analog input value (0 mA or 4 mA).

Parameter **217**

```
Value at
100%       0000
```

**Analog input, 0/4 to 20 mA: upper level value** **-9,999 to 9,999**

The scaleable analog input must be assigned a numerical value which corresponds to the highest input value → Definition of the upper value (100 % equals 500 kW, 400 V etc.) with maximum analog input value (20 mA).

Parameter **218**

```
Limit warning
value      0000
```

**Analog input, 0/4 to 20 mA: warning (limit 1)** **-9,999 to 9,999**

Threshold limit value at which a warning occurs is configured here.

**Tripping of class F1 alarm**

Parameter **219**

```
Limit shutdown
value      0000
```

**Analog input, 0/4 to 20 mA: shutdown (limit 2)** **-9,999 to 9,999**

The limit value that a shutdown occurs is configured here.

**Tripping of class F3 alarm**

Parameter 220

```
Delay
Limit 1/2   000s
```

**Analog input, 0/4 to 20 mA: delay (limit 1 + 2)** **0 to 600 s**

The analog input monitoring threshold limit must be exceeded, without interruption, for the time period configured here before an alarm is issued (this delay time applies to both limit values).

Parameter 221

```
Monitoring for
---------------
```

**Analog input, 0/4 to 20 mA: monitoring for** **high limit mon./low limit mon.**

The analog input is monitored in different manners:
**high limit mon.** .... The value must exceed the configured limit.
**low limit mon.** The value must fall below the configured limit.

## Measuring Range Monitoring

Parameter 222

```
Analog in.  --.-
```

**Analog input: measuring range monitoring**

This message appears when positive or negative deviation from the measuring range occurs. The control assesses a fault condition depending on the values specified below.

### NOTE

**The control assesses that a wire break has occurred when the following values are measured for the listed analog input types. When a wire break has been assessed by the control, the threshold limit monitoring for the analog input is deactivated.**

**Measuring range monitoring, tripping at**

| | | |
|---|---|---|
| **4 to 20 mA** | **2 mA** | **(negative deviation)** |
| **Pt100** | **240 °C** | **(positive deviation)** |
| **Pt1000** | **150 °C** | **(positive deviation)** |
| **PTC** | **16 kΩ** | **(positive deviation)** |
| **180 Ω VDO, 0 to 5 bar** | **193 Ω** | **(positive deviation)** |
| **180 Ω VDO, 0 to 10 bar** | **193 Ω** | **(positive deviation)** |
| **180 Ω VDO temperature** | **400 Ω** | **(positive deviation)** |

## Delayed Monitoring of the Analog Inputs

Parameter 223

```
An.input    1234
Superv.del. YYYY
```

**Analog input: delayed monitoring 1 through 4** **Y/N**

The user may enable analog inputs 1 through 4 to be constantly monitored or only monitored when the engine is running ("firing speed reached").
**Y** .....Monitoring of the analog input is delayed by the time configured in Parameter 239 (green "Monitoring" LED is illuminated).
**N** .....The analog input is always monitored.

Parameter 224

```
An.input    5678
Superv.del. NNNN
```

**Analog input: delayed monitoring 5 to 8** **Y/N**

The user may enable analog inputs 5 through 8 to be constantly monitored or only monitored when the engine is running ("firing speed reached").
**Y** .....Monitoring of the analog input is delayed by the time configured in Parameter 239 (green "Monitoring" LED is illuminated).
**N** .....The analog input is always monitored.

# Outputs

Parameter 225

```
Configure
Outputs      YES
```

**Configure outputs** **YES/NO**

Various groups of parameters are grouped together in blocks to aid in the rapid navigation through the large number of configuration screens. Selecting "YES" or "NO" does not determine if control or monitoring is performed. The user's selection has the following effect:

**YES**..... The configuration screens in this block are displayed and can either be viewed ("Select" push button) or modifications can be made to the parameters ("Cursor→", "Digit↑" or "Select" push buttons). This does not disable or enable individual parameters, only if the individual parameters in this parameter block may be accessed for modifications.

**NO**..... The parameters in this block are not displayed, cannot be modified and are therefore skipped.

## Analog Outputs

The analog output manager can be used to apply specific measurement variables to the available analog outputs. The outputs may be configured as 0 to 20 mA or as 4 to 20 mA. A list of the parameters, which may be configured, is located in Appendix D. Each parameter is assigned a unique number. The parameter may be scaled via an upper and a lower input value. The analog outputs may also be assigned an engineering unit of measure (refer to "Analog output manager" in Appendix D).

**NOTE**

**The list of values and setting limits for the analog output manager is contained in chapter "Analog Output Manager" starting on page 141.**

**Possible outputs:** 130/131 and 132/133
**Example:** Analog output 130/131

Parameter 226

```
Analg.out.130131
parameter    00
```

**Analog outputs: parameter** **0 to 23**

The number of the desired measurement variable output is entered here. A list of all parameters available for configuration, along with the output and limit value ranges, is located in Appendix D.

Parameter 227

```
Analg.out.130131
          0-00mA
```

**Analog outputs: range** **OFF / 0 to 20 / 4 to 20 mA**

The output is enabled or disabled and the type of output (0 to 20 mA or 4 to 20 mA) may be selected.

Parameter 228

```
Analg.out.130131
  0%         0000
```

**Analog output: scaling of the lower level** **0 to 9,990**

The 0 % value for the monitored range is set here: refer to Appendix D.

Parameter 229

```
Analg.out.130131
100%         0000
```

**Analog output: scaling of the upper level** **0 to 9,990**

The 100 % value for the monitored range is set here: refer to Appendix D.

## Relay Manager

The relay manager enables the user to assign combinations of functions to each relay of terminals 37/38, 47/48. and 74-83. In order to achieve this, each possible function has its own number. A text, which describes a logical condition for this relay's picking up, must now be entered in the configuration menu for each relay. Up to three numbers may be involved in this link. The length of the text must not exceed 16 characters. The unit detects incorrect function numbers or incorrect formula constructions, and does not accept these. The user must enter the logical combination to be performed.

**NOTE**

**The list of function numbers for the relay manager is located in Appendix E"Relay Manager" starting on page 126.**

### Description of the programming

Permissible text and their meaning include:

| | | |
|---|---|---|
| + | OR operator | (logical function) |
| ★ | AND operator | (logical function) |
| - | NOT operator | (logical function) |
| **1, 2, 3, ...** | Function numbers | |
| +/★ | the following applies: "★" before "+" | |

**Example** of logical conditions and relevant texts

| **Requested function**<br>Relay energizes if ... | **Programming** |
|---|---|
| ... function 22 is enabled. | 22 |
| ... function 22 is not enabled. | - 22 |
| ... function 2 and function 27 are enabled. | 2 ★ 27 |
| ... function 2 or function 27 is enabled. | 2 + 27 |
| ... function 5 is not or function 3 or function 13 are enabled. | 3 + -5 + 13 |
| ... functions 4 or 7 or 11 are enabled. | 4 + 7 + 11 |
| ... function 4 is not and function 7 is not and function 11 is not enabled. | - 4 ★ -7 ★ -11 |
| ... functions 4 and 7 and 11 are enabled. | 4 ★ 7 ★ 11 |
| ... functions 7 and 11 are enabled simultaneously or function 4 is enabled. | 4 + 7 ★ 11 |
| ... function 4 is not or function 7 is not or function 11 is not enabled. | -4 + -7 + -11 |

**NOTE**

**If the user programs an illogical function, the entered line is deleted.**

### Programming of Relay Outputs

Parameter **230**

```
Assignm.relay x
3+-8+13
```

[x = 1 to 7]

**Relay manager: programming** **user defined**

Relay x [x = 1 through 7] is enabled if the logical condition in the second line is met.

Example: **3 + -8 + 13** (OR link)

| | |
|---|---|
| **3** | Alarm class 3 is enabled |
| **-8** | Operating mode MANUAL is not enabled |
| **13** | Alarm "Generator underspeed" is enabled |

## Pulse Outputs

**NOTE**

**The pulse outputs of the energy counter are not calibrated!**

**These outputs issue pulses whose frequency is proportional to the measured real power or re-active power. The frequency of the pulses can be adjusted. The length of a pulse is 50 ms to 100 ms. The pulse frequency is adjustable so that the time between pulses does not fall under 100 ms at maximum power.**

### Pulse Counter for Real Power

Parameter **231**

```
Pulse output 1
---------------
```

**Output of kWh pulses** **+kWh / -kWh**

**+kWh** ..... The output of pulses occurs for positive real power.
**-kWh** ..... The output of pulses occurs for negative real power.

Parameter **232**

```
Pulse output 1
logic   --------
```

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

**positive** ..... The output of the kWh pulses (both positive/negative) occur with positive logic (per kWh pulse the Open Collector output will be opened).
**negative** ..... The output of the kWh pulses (both positive/negative) occur with negative logic (per kWh pulse the Open Collector output will be closed).

Parameter **233**

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

**Pulse per positive kWh** **0.1 to 150.0**

The number of pulses per measured unit to be output is configured here. (Ex.: If 20 kWh have been measured and "Pulse/kWh 020.00" has been configured, a total of 20 kWh × 20 pulses/kWh = 400 pulses have been output. The evaluation of the pulses must be performed externally.)

### Pulse Counter Re-active Power

Parameter **234**

```
Pulse output 2
---------------
```

**Output of kvarh pulses** **+kvarh / -kvarh**

**+kvarh** ..... The output of pulses occurs for inductive re-active power.
**-kvarh** ..... The output of pulses occurs for capacitive re-active power.

Parameter **235**

```
Pulse output 2
logic   --------
```

**Output of the kvarh pulse** **positive/negative**

**positive** ..... The output of the kvarh pulses (both positive/negative) occur with positive logic (per kvarh pulse the Open Collector output will be opened).
**negative** ..... The output of the kvarh pulses (both positive/negative) occur with negative logic (per kvarh pulse the Open Collector output will be closed).

Parameter **236**

```
Reactive energy
Pulse/kvah 000.0
```

**Pulse per kvarh** **0.1-150.0**

The number of pulses per measured unit to be output is configured here. (Ex.: If 20 kvarh, inductive have been measured and "Pulse/kvah 020.00" has been configured, a total of 20 kvarh inductive × 20 pulses/kvarh = 400 pulses have been output. The evaluation of the pulses must be performed externally.)

# Drive

Parameter 237

```
Configure
Drive          YES
```

**Configure drive** **YES/NO**

Various groups of parameters are grouped together in blocks to aid in the rapid navigation through the large number of configuration screens. Selecting "YES" or "NO" does not determine if control or monitoring is performed. The user's selection has the following effect:

**YES** .....The configuration screens in this block are displayed and can either be viewed ("Select" push button) or modifications can be made to the parameters ("Cursor→", "Digit↑" or "Select" push buttons). This does not disable or enable individual parameters, only if the individual parameters in this parameter block may be accessed for modifications.

**NO** .....The parameters in this block are not displayed, cannot be modified and are therefore skipped.

Parameter 238

```
Automatic idle
running        ON
```

**Automatic idle control** **ON/OFF**

The automatic idle control may be enabled in this screen.

**ON** .....The automatic idle control is enabled. The controller adjust the machine to the configured voltage and frequency.

**OFF** .....The automatic idle control is disabled.

## Delayed Monitoring and Ignition Speed

Parameter **239**

```
Monitoring on
after        00s
```

**Delayed monitoring** **0 to 99 s**

Any parameters configured for delayed monitoring (e.g. oil pressure, generator underfrequency, etc.) will not be assessed until the expiration of the time configured here. This timer starts when the control unit detects that the engine has reached firing speed.

Parameter **240**

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

**Ignition speed** **15 to 70 Hz**

The user configures the point that the engine firing speed has been reached. Once the controller detects this, the frequency controller assumes speed control.

**Note**: Measurement is only possible above 15 Hz, even if 5 Hz are displayed.

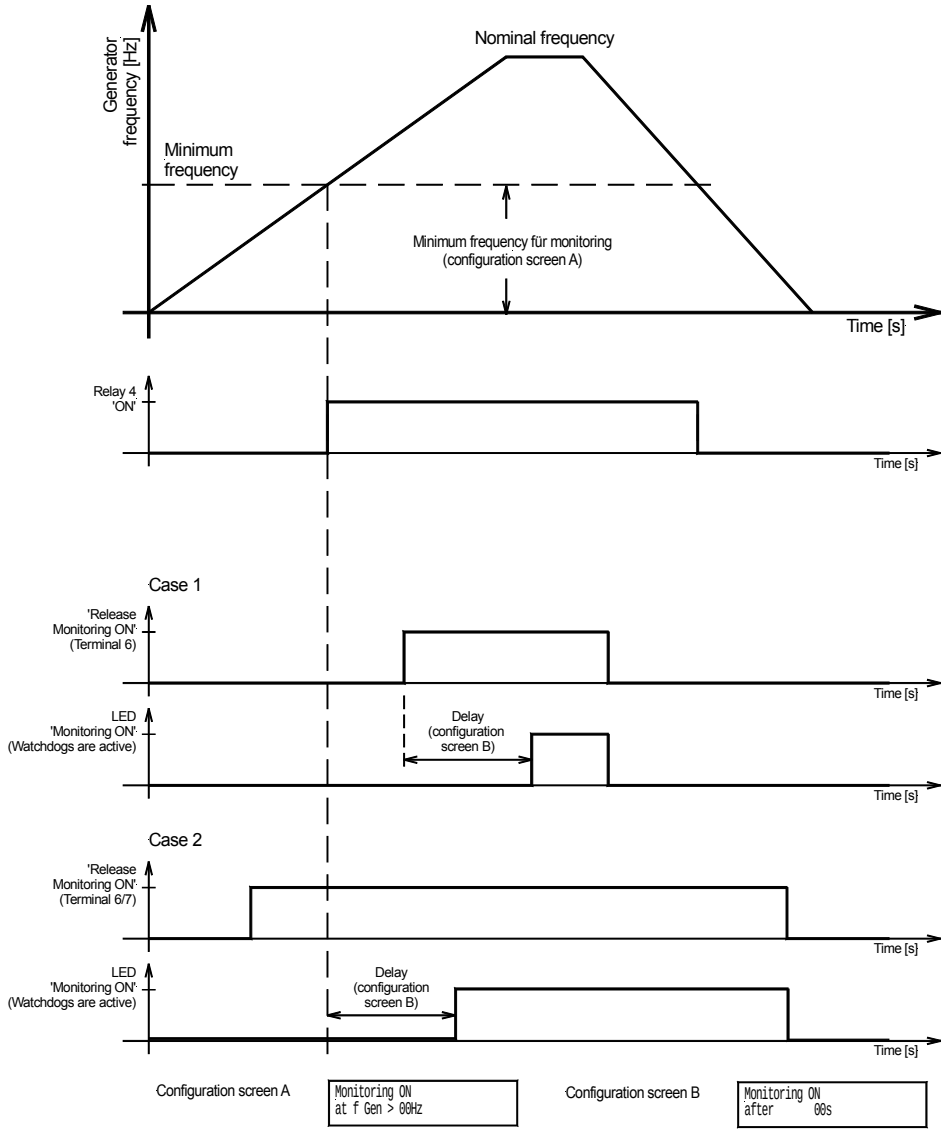



Figure 6-6: Ignition speed - delayed monitoring

## Shutdown (Unload and Open GCB)

### NOTE

**Please note chapter "Breaker Logic" (starting page 88) for description of the breaker logics.**

Parameter **241**

```
Download and
open GCB      ON
```

**Shutdown** **ON/OFF**

**ON** .....The GCB is opened (following power reduction), if terminal 3 is de-energized.

**OFF** .....The GCB remains closed, and the controller set points are maintained.

# Counter

Parameter **242**

```
Configure
Counters      YES
```

**Configure counters** **YES/NO**

Various groups of parameters are grouped together in blocks to aid in the rapid navigation through the large number of configuration screens. Selecting "YES" or "NO" does not determine if control or monitoring is performed. The user's selection has the following effect:

**YES**..... The configuration screens in this block are displayed and can either be viewed ("Select" push button) or modifications can be made to the parameters ("Cursor→", "Digit↑" or "Select" push buttons). This does not disable or enable individual parameters, only if the individual parameters in this parameter block may be accessed for modifications.

**NO**..... The parameters in this block are not displayed, cannot be modified and are therefore skipped.

## Maintenance Call

Parameter **243**

```
Service interval
             ON
```

**Maintenance call** **ON/OFF**

**ON**..... Maintenance call counter is enabled and an alarm message will be displayed when the counter expires. Refer to Parameter 244 for a description of the maintenance call function.

**OFF**..... The maintenance call counter is disabled.

Parameter **244**

```
Service interval
in          0000h
```

**Maintenance call: sequence** **0 to 9.999 h**

A maintenance interval can be specified in this screen. After the engine has been in operation for the number of hours configured here, a maintenance call message (class F1 alarm) is displayed. Following the acknowledgement of the message, the counter is reset to this value.

### NOTE

**If maintenance has been performed prior to the counter expiring, it is possible to reset the maintenance counter to the configured value. The unit must be in code level 1 or 2 in order to achieve this. The counter is reset in a 2-step procedure for safety reasons. The following procedure applies:**

**1. Step: Configure the desired number of hours for the maintenance call.**

**2. Step: Integration of the value which has been saved:**

1. **Exit the configuration mode and switch the controller into AUTOMATIC mode**
2. **Navigate to the display screen "`Service interval in 000h`" using the "Select" button**
3. **Press and hold the "Digit" push button for 7 seconds**

## Operating Hours Counter

Parameter 245

```
Op.hours counter
              ON
```

**Operating hours counter** **ON/OFF**

**ON** .....Operating hours counter is enabled. Refer to Parameter 246 for a description.
**OFF** .....The counter is not enabled.

### NOTE

**The operating hours counter can be set to a maximum value of 65,000 hours.**

Parameter 246

```
Op.hours counter
set       00000h
```

**Operating hours counter: value** **0 to 65,000 h**

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

### NOTE

**If the control unit operating hours must be configured to a specific value, the unit must be in code level 2 in order to achieve this. The counter is reset in a 2-step procedure for safety reasons. The following procedure applies:**

**1. Step: Configure and store the desired operating hours.**

**2. Step: Integration of the value which has been saved:**

1. **Exit the configuration mode and switch the controller into AUTOMATIC mode**
2. **Navigate to the display screen "Op.hours 000h" using the "Select" button**
3. **Press and hold the "Digit" push button for 7 seconds**

## Start Counter

Parameter 247

```
Start counter
             ON
```

**Start counter** **ON/OFF**

**ON**..... Start counter is enabled. Refer to Parameter 248 for a description.
**OFF**..... The counter is not enabled.

### NOTE

**After 32,000 starts, the counter is automatically reset.**

Parameter 248

```
Start counter
set        00000
```

**Start counter: value** **0 to 32,000**

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

Only maintenance personnel should configure the start counter!

### NOTE

**If the control unit number of starts must be configured to a specific value, the unit must be in code level 2 in order to achieve this. The counter is reset in a 2-step procedure for safety reasons. The following procedure applies:**

**1. Step: Configure and store the desired number of starts.**

**2. Step: Integration of the value which has been saved:**

1. **Exit the configuration mode and switch the controller into AUTOMATIC mode**
2. **Navigate to the display screen "`Start counter 00000`" using the "Select" button**
3. **Press and hold the "Digit" push button for 7 seconds**

## kWh/kvarh Counter

Parameter 249

```
Display kWh   +-
on?           YY
```

**Display kWh counter** **Y/N**

It is possible to display the positive kWh counter (+) and/or the negative kWh counter (-) by selecting "Y" or "N". It is possible to display no counters, one counter or both counters by making the appropriate entry
**Y**..... The selected kWh counter is visible.
**N**..... The selected kWh counter is not visible.

Parameter 250

```
Display kvarh +-
on?           YY
```

**Display kvarh counter** **Y/N**

It is possible to display the inductive kvarh counter (+) and/or the capacitive kvarh counter (-) by selecting "Y" or "N". It is possible to display no counters, one counter or both counters by making the appropriate entry.
**Y**..... The selected kvarh counter is visible.
**N**..... The selected kvarh counter is not visible.

## Resetting the Counters

Resetting the counters (start counter, operating hours counter, kWh counter, kvarh counter) must be performed in code level 2.

To reset the individual counters, the control unit must be in the AUTOMATIC mode. Navigate to the display screen that is to be reset or changed. Press and hold the "Digit" button for at least 7 seconds.
For the start counter and the operating hours counter, the values that have been configured in the parameters "Start counter set" or "Op.hours counter set" will be integrated into the display.

## Real Time Clock

Parameter 251

```
Time
          00:00
```

**Time** **user defined**

The hours and minutes of the internal clock are configured.

| **Hour** | |
|---|---|
| **00** | Beginning hour of the day |
| **01** | 1st hour of the day |
| **...** | ... |
| **23** | 23rd hour of the day |
| **Minute** | |
| **00** | Beginning minute of the hour |
| **01** | 1st minute of the hour |
| **...** | ... |
| **59** | 59th minute of the hour |

Parameter 252

```
Year,month
          00,00
```

**Date** **user defined**

The year and date of the internal clock are configured.

| **Year** | |
|---|---|
| **99** | Year 1999 |
| **00** | Year 2000 |
| **01** | Year 2001 |
| **...** | ... |
| **Month** | |
| **01** | Month January |
| **02** | Month February |
| **...** | ... |
| **12** | Month December |

Parameter 253

```
Day,weekday
          00/0
```

**Day and weekday** **user defined**

The day and weekday of the internal clock are configured.

| **Day** | |
|---|---|
| **01** | 1st day of the month |
| **02** | 2nd day of the month |
| **...** | ... |
| **31** | 31st day of the month, if available |
| **Weekday** | |
| **1** | Monday |
| **2** | Tuesday |
| **...** | ... |
| **7** | Sunday |

## Current Slave Pointer

A current slave pointer, which records and stores the maximum generator current, is implemented in the unit. The display of the maximum generator current can be selected in **Automatic** mode via the "Message" push button. The following screen appears in the display:

```
000 000 000 000
max. Gen.current
```

**Current slave pointer**

The maximum generator current in the three phases is displayed and stored in this screen.
**Resetting:** Pressing and holding the "ACK" pushbutton for 3 seconds while the current slave pointer screen is displayed, will reset the display screen.

# 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 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 rotating field 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!**

## CAUTION

**Please consider that the unit does not have an internal rotating field monitoring.**

**The unit assumes always a clockwise phase rotation direction of all three voltage systems, which are measured.**

**A rotating field monitoring must be provided by the customer in order to avoid a CB closure with a counter-clockwise rotating field.**

**Procedure**

1. After checking to ensure that all measuring voltages have been connected to the correct phases, the power supply (12/24 Vdc) may be connected.

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 (refer to the Configuration section).

3. After the control unit has been configured, the unit will display the measured system values. These values should be confirmed with a calibrated measuring instrument.

4. The initial operation should be performed in the **MANUAL operation mode** (press the "MANUAL" push button). All measured generator values must be verified. Any alarm messages should be investigated to determine the cause.

5. Operating mode **AUTOMATIC** (press the push button "AUTO"): A synchronization can now be carried out for the GCB by energizing the "Enable GCB" discrete input.

   **Check-out of the synchronization**: Disconnect the connect pulse "Command: close GCB".Check the generator and the generator busbar phase rotation. Check the connect command with a zero voltmeter (determination of the phase angle) at the GCB. If several pulses have been output at the correct synchronous point, switch the operating mode to MANUAL and reconnect the connect pulse "Command: close GCB".

6. If steps 1 through 5 have been carried out successfully, mains parallel operations may commence. It is recommended to start with a constant power/base load operation (approx. 25 % of the generator rated power). While this operation is being performed, the displayed measuring values must be verified. Test the GCB shutdown for proper operation. Check the real power controller and, if necessary, the power factor controller. Enter various set point values and verify proper operation.

7. If mains parallel operation performs in a satisfactory manner, the synchronization of the MCB must be checked:

   A power failure in the system must be simulated or monitored by the control Unit.. During mains parallel operation, change the operating mode from AUTOMATIC to MANUAL. Open the MCB ("MCB ON" LED will turn off). Press the AUTOMATIC pushbutton to return the control unit back to the AUTOMATIC operating mode.

   Check the generator busbar and the mains field rotation. Check the connect command with a zero voltmeter (determination of the phase angle) at the MCB. If several pulses have been output at the correct synchronous point, switch the operating mode to MANUAL and reconnect the connect pulse "Command: close MCB".

## NOTE

**The automatic operation mode is influenced by the input signals “Automatic 1” and “Automatic 2”. Ensure that the power circuit breaker reply messages are processed as the opposite of the condition (i.e. when the power circuit breaker is closed the reply message for the inputs: CB is open (terminal 54) is 0 volts. The CB auxiliary contact should be configured as normally closed contacts (NC)! Refer to the description of the alarm and control inputs starting on page 22 of this manual). It is vital that these replies be connected!**

**Electrical isolation** between voltage supply and discrete control and feedback inputs: By the use of corresponding external wiring, the common reference point of the discrete inputs can be electrically isolated from the power supply voltage (0 V, terminal 2). This is necessary if the discrete inputs are not to be enabled with 24 Vdc and an electrically isolation of the control voltage (e. g. 220 Vdc, 220 Vac) from the supply voltage must be ensured.

# Appendix A.
# Dimensions

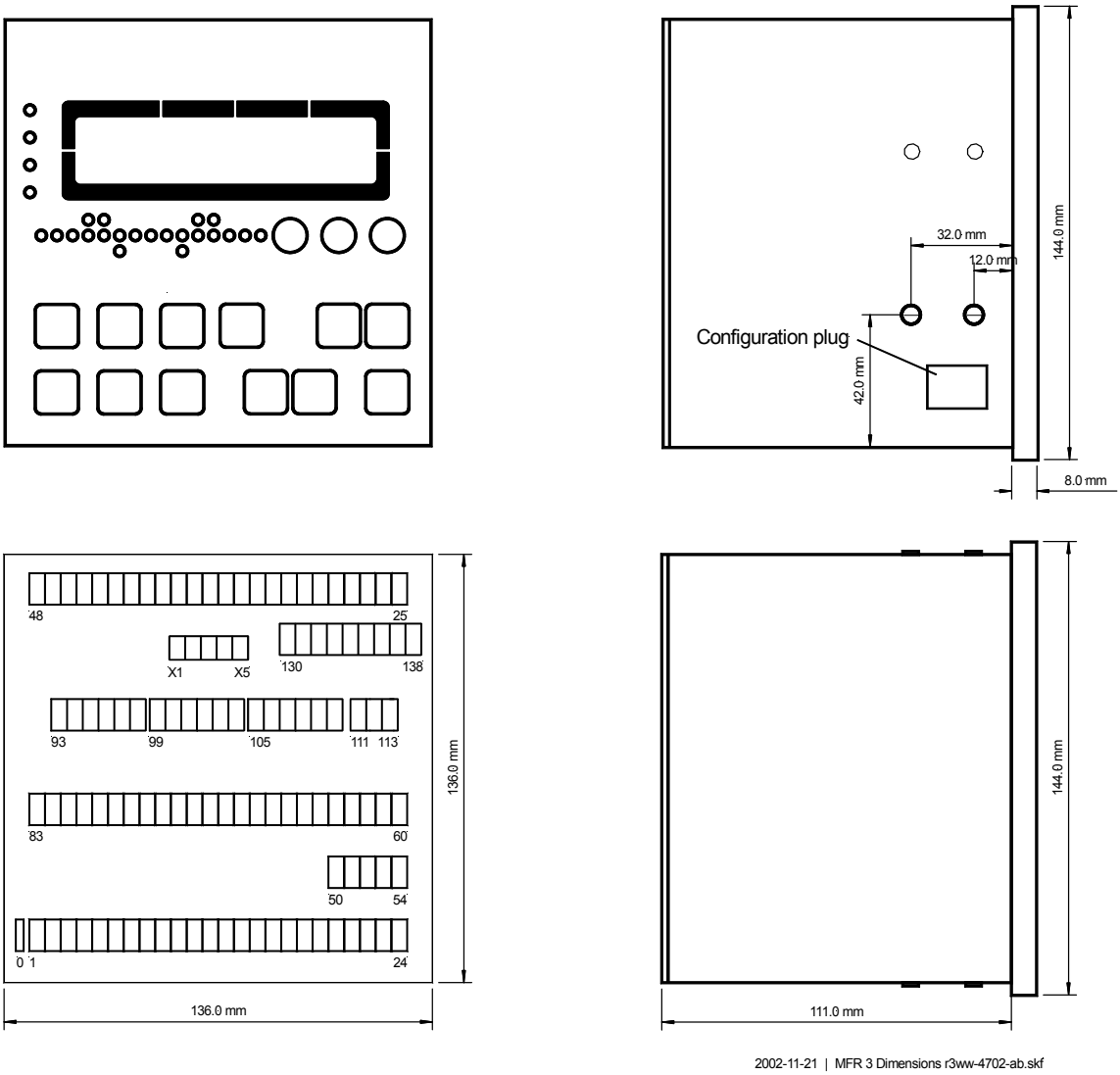



Figure 7-1: Dimensions

# Appendix B.
# Technical Data

**Measuring voltage** ----------

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

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

- Measuring current ..... [5]../5 A
- Accuracy ..... Class 1
- Maximum continuous current ..... $I_{Gen} = 3.0 \times I_{rated}$, $I_{Mains} = 1.5 \times I_{rated}$
- Power consumption ..... < 0.15 W
- Rated short to time current (1 s) ..... [5] $10.0 \times I_{rated}$

**Ambient variables** ----------

- Power supply ..... 12/24 Vdc (9.5 to 32 Vdc)
- Intrinsic consumption ..... max. 15W
- Ambient temperature ..... -20 to 70 °C
- Ambient humidity ..... 95 %, not condensing

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

- Input range ($V_{Cont, digital input}$) ..... 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 ..... B300
  - DC ..... 1.00 Adc@24 Vdc
    0.22 Adc@125 Vdc
    0.10 Adc@250 Vdc

**Pulse outputs**----------

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

**Analog inputs ---------- freely scaleable**

- Resolution.....10 Bit
- Pt100/Pt1000 input..... for measuring resistance according to IEC 751
  [Pt100] 2/3 wire measuring, 0 to 200 °C
  [Pt1000] 2 wire measuring, -30 to 200 °C
- 0/4 to 20 mA input.....Differential measuring, load 150 Ω
- 0 to 5/10 V input..... Differential measuring, input resistance approx. 16.5 kΩ
- 0 to 180/380 Ω input.....Differential measuring, sensor current ≤1.9 mA

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

- At rated value .....freely scaleable
- Insulation voltage .....3,000 Vdc
- Versions..... 0 to 5 Vdc, ±5 Vdc, 0 to 10 Vdc, 0 to 20 mA
- Resolution PWM ..... 8/12 Bit (depending on model)
- 0/4 to 20 mA output..... Maximum load 500 Ω
- 0 to 10 V/±5 V output..... Internal resistance ≤ 1 kΩ

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

- Insulation voltage .....3,000 Vdc
- Version .....variable

**Housing ----------**

- Type.....APRANORM DIN 43 700
- Dimensions (W× H × D) .....144 × 144 × 118 mm
- Front cutout (W×H)..... 138 [+1.0] × 136 [+1.0] mm

- Wiring.....Screw to type terminals
  1.5 mm² or 2.5 mm² (depending on plug connector)
  use 60/75 °C copper wire only
  use class 1 wire only or equivalent
- Weight ..... approx. 1,000 g

**Protection----------**

- Protection system..... IP 42 from front with proper installation
  IP54 from front with gasket (gasket: P/N 8923-1039)
  IP21 from back
- Front foil..... insulating surface
- EMC test (CE) ..... tested according to applicable EN guidelines
- Listings ..... CE marking; UL listing for ordinary locations
  UL/cUL listed, Ordinary Locations, File No.: E231544

# Appendix C.
# Measured Quantities and Accuracy

| Measuring value | Display/range | Accuracy | Note |
|---|---|---|---|
| **Frequency** | | | |
| Generator, busbar $f_{L1gen/bus}$, $f_{L2gen/bus}$, $f_{L3gen}$ | 15.0 to 85.0 Hz | | |
| Mains $f_{L1mains}$, $f_{L2mains}$, $f_{L3mains}$ | 40.0 to 85.0 Hz | | |
| **Voltage** | | | |
| $V_{L1}$, $V_{L2}$, $V_{L3}$, $V_{L12}$, $V_{L23}$, $V_{L31}$ | 0 to 520 V | 1 % | Transformer ratio adjustable |
| **Current** | | | |
| Generator, mains $I_{L1gen/mains}$, $I_{L2gen}$, $I_{L3gen}$ | 0 to 9,999 A | 1 % | - |
| Maximum value $I_{L1gen}$, $I_{L2gen}$, $I_{L3gen}$ | 0 to 9,999 A | 1 % | Current slave pointer |
| **Real power** | | | |
| Total real actual power | -32.0 to 32.0 MW | 2 % | - |
| **Re to active power** | | | |
| Actual value in L1, L2, L3 | -32.0 to 32.0 Mvar | 2 % | - |
| **Power factor cos φ** | | | |
| Actual power $factor_{L1gen/mains}$ value | i0.00 to 1.00 to c0.00 | | - |
| **Miscellaneous** | | | |
| Real energy | 0 to 4,200 GWh | | not calibrated by PTB |
| Running hours | 0 to 65,000 h | | - |
| Maintenance call | 0 to 9,999 h | | - |
| Start counter | 0 to 32,750 → 1 | | - |
| Battery voltage | 10 to 30 V | | - |
| **Analog inputs** | | | |
| Pt100 | 0 to 250 °C | | not calibrated by PTB |
| 0/4 to 20 mA | freely scaleable | | - |
| 0 to 10 V | freely scaleable | | - |
| 0 to 150 mV | freely scaleable | | - |

**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 = 1
Ambient temperature 23 °C ± 2 K
Warm to up period = 20 minutes.

# Appendix D.
# Analog Output Manager

**NOTE**

**The parameters listed below can only be output correctly if the existing version of the unit permits this.**

| Para-meter | Output | Value | Range of the two limit values |
|---|---|---|---|
| 0 | The analog output is inactive. | --- | --- |
| 1 | Generator real power [1)] | [dimensionless] | 0% lower power value (can also be negative) e. g. -0050 kW<br>100% upper power value (can also be negative) e. g. 0200 kW |
| 2 | Generator power factor [e. g. (-070 to +080) /100] (find definition at the end of this table) | [dimensionless] | 0% lower difference to power factor = 1 e. g. -0030 corresponds to c0.70<br>100% upper difference to power factor = 1 e. g. 0030 corresponds to i0.70 |
| 3 | Generator frequency | [Hz*100] | 0% lower frequency e. g. 0000 corresponds to 00.00 Hz.<br>100% upper frequency e. g. 7000 corresponds to 70.00 Hz. |
| 4 | Generator re-active power | [kvar] | 0% capacitive re-active power (negative) e. g. -0100 kvar<br>100% inductive re-active power (positive) e. g. +0100 kvar |
| 5 | Rated power of all generators connected to generator busbar minus nominal actual power | [kW] | 0% lower power value (can also be negative) e. g. -0050 kW<br>100% upper power value (can also be negative) e. g. 0200 kW |
| 6 | Total actual power of all generators connected to generator busbar | [kW] | |
| 7 | Generator apparent power in L1 | [A] | 0% lower current output e. g. 0000 A<br>100% upper current output e. g. 500 A |
| 8 | Generator apparent power in L2 | [A] | |
| 9 | Generator apparent power in L3 | [A] | |
| 10 | Speed via Pickup (terminal 91, 92, 93) | [rpm] | 0% lower speed e. g. 0000 rpm<br>100% upper speed e. g. 3000 rpm |

| Para-meter | Output | Value | Range of the two limit values |
|---|---|---|---|
| 11 | Analog input [T1] | [°C] or [°F] or freely scaleable | 0% lower value<br>e. g. 0000 corresponds to 000 °C at temperature input<br>100% upper value<br>e. g. 0255 corresponds to 255 °C at temperature input<br><br>0% lower value e. g. 0000 corresponds to 00.0 bar oil pressure<br>100% upper value e. g. 0100 corresponds to 10.0 bar oil pressure |
| 12 | Analog input [T2] | [°C] or [°F] or freely scaleable | |
| 13 | Analog input [T3] | [°C] or [°F] or freely scaleable | |
| 14 | Analog input [T4] | [°C] or [°F] or freely scaleable | |
| 15 | Analog input [T5] | [°C] or [°F] or freely scaleable | |
| 16 | Analog input [T6] | [°C] or [°F] or freely scaleable | |
| 17 | Analog input [T7] | [°C] or [°F] or freely scaleable | |
| 18 | additional freely scaleable analog input (terminal 91, 92) | | |
| 19 | Mains real power | [kW] | 0% lower value<br>e. g. -0800 kW<br>100% upper value<br>e. g. 0800 kW |
| 20 | Mains apparent power in L1 | [A] | 0% lower current value<br>e. g. 0000 A<br>100% upper current value<br>e. g. 500 A |
| 21 | Mains power factor<br>[e. g. (-070 to +080) /100]<br>(find definition at the end of this table) | [dimensionless] | 0% lower difference to power factor = 1<br>e. g. -0030 corresponds to c0.70<br>100% upper difference to power factor = 1<br>e. g. 0030 corresponds to i0.70 |
| 22 | Mains re-active power | [kvar] | 0% capacitive re-active power (negative)<br>e. g. -0100 kvar<br>100% inductive re-active power (positive)<br>e. g. +0100 kvar |

[1]**Note to parameter 1 and 2:** The analog output is calculated according to the displayed real power without the engineering unit of measure "kW" or "MW". The number of displayed digits is valid. Example: 20 mA corresponds to "200".

20 mA will be output at the following display: 200 kW or 20.0 MW
10 mA will be output at the following display: 100 kW or 10.0 MW

The control unit automatically switches from "kW" to "MW" when the primary transformer real power of 3,000 kW is exceeded: $I_{gen\ prim} \times V_{gen\ prim} \times \sqrt{3} \geq 3{,}000$ kW.

The description 0 % corresponds to the minimum input of 4 mA or 0 mA; the description 100 % corresponds to the maximum input of 20 mA. The values can be entered with or without a leading sign (see parameter 1).

**Definition of power factor scaling:** According to the scaling of the analog output, the power factor can be output within the range from capacitive values ranging from c0.00 to unity power factor = 1 to inductive values up to i0.00.

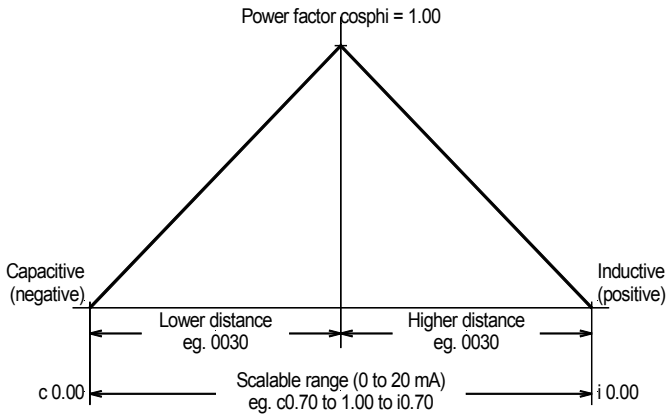



Figure 7–2: analog outputs – power factor scaling

# Appendix E.
# Relay Manager

| No. | Output |
|---|---|
| 1 | Class F1 alarm |
| 2 | Class F2 alarm |
| 3 | Class F3 alarm |
| 4 | Class F1, F2 or F3 centralized alarm |
| 5 | Class F2 or F3 centralized alarm |
| 6 | Ignition speed reached |
| 7 | Generator voltage within 88 to 112 % of the rated voltage |
| 8 | Busbar voltage within 88 to 112 % of the rated voltage |
| 9 | Mains voltage within 88 to 112 % of the rated voltage |
| 10 | AUTOMATIC operating mode |
| 11 | MANUAL operating mode |
| 12 | Mains overfrequency |
| 13 | Mains underfrequency |
| 14 | Mains overvoltage |
| 15 | Mains undervoltage |
| 16 | Mains phase/vector jump |
| 17 | Mains df/dt failure |
| 18 | Generator underfrequency 1 |
| 19 | Generator overfrequency 1 |
| 20 | Generator overspeed |
| 21 | Plausibility check: Generator frequency |
| 22 | Generator undervoltage 1 |
| 23 | Generator overvoltage 1 |
| 24 | Generator time-overcurrent 1 |
| 25 | Generator time-overcurrent 2 |
| 26 | Generator load imbalance |
| 27 | Generator overload 1 |
| 28 | Generator reverse/reduced power |
| 29 | Time limit exceeded: Synchronization GCB |
| 30 | Generator re-active power, capacitive |
| 33 | Generator re-active power, inductive |
| 32 | Ground failure |
| 33 | Battery undervoltage |
| 34 | Interface failure terminals X1 to X5 |
| 35 | Analog input [T1], terminals 93 - 95, level 1 |
| 36 | Analog input [T1], terminals 93 - 95, level 2 |
| 37 | Analog input [T2], terminals 96 - 98, level 1 |
| 38 | Analog input [T2], terminals 96 - 98, level 2 |
| 39 | Analog input [T3], terminals 99 - 101, level 1 |
| 40 | Analog input [T3], terminals 99 - 101, level 2 |
| 41 | Analog input [T4], terminals 102 - 104, level 1 |
| 42 | Analog input [T4], terminals 102 - 104, level 2 |
| 43 | Analog input [T5], terminals 105 - 107, level 1 |
| 44 | Analog input [T5], terminals 105 - 107, level 2 |
| 45 | Analog input [T6], terminals 108 - 110, level 1 |
| 46 | Analog input [T6], terminals 108 - 110, level 2 |
| 47 | Analog input [T7], terminals 111 - 113, level 1 |
| 48 | Analog input [T7], terminals 111 - 113, level 2 |
| 49 | Analog input, terminals 91 - 92, level 1 |
| 50 | Analog input, terminals 91 - 92, level 2 |
| 51 | Discrete input, terminal 34 |
| 52 | Discrete input, terminal 35 |
| 53 | Discrete input, terminal 36 |
| 54 | Discrete input, terminal 37 |
| 55 | Discrete input [D01], terminal 62 |
| 56 | Discrete input [D02], terminal 63 |
| 57 | Discrete input [D03], terminal 64 |
| 58 | Discrete input [D04], terminal 65 |

| No. | Output |
|---|---|
| 59 | Discrete input [D05], terminal 66 |
| 60 | Discrete input [D06], terminal 67 |
| 61 | Discrete input [D07], terminal 68 |
| 62 | Discrete input [D08], terminal 69 |
| 63 | Discrete input [D09], terminal 70 |
| 64 | Discrete input [D10], terminal 71 |
| 65 | Discrete input [D11], terminal 72 |
| 66 | Discrete input [D12], terminal 73 |
| 67 | Reply: MCB is closed |
| 68 | Reply: GCB is closed |
| 69 | Mains parallel operation is desired |
| 70 | Power monitoring |
| 71 | Mains failure: mains voltage, mains frequency or mains phase/vector shift have been tripped |
| 72 | Dependent time-overcurrent |
| 73 | Class F1 alarm acknowledged |
| 74 | Class F2 or F3 alarm acknowledged |
| 75 | Generator undervoltage 2 |
| 76 | Generator overvoltage 2 |
| 77 | Generator underfrequency 2 |
| 78 | Generator overfrequency 2 |
| 79 | Internal |
| 80 | Generator overload 2 |
| 81 | Interface failure terminals Y1 to Y5 |
| 82 | Load shedding introduced: closing/synchronization GCB has happen or breaker is closed |
| 83 | Closing/synchronization MCB has happen or breaker is closed |
| 84 | Power monitoring mains incoming |
| 85 | Maintenance call |
| 86 | Time limit exceeded: Synchronization MCB |
| 87 | Synchronization MCB is happening |
| 88 | Lamp test activated |
| 89 | Malfunction "Reply: GCB is open" - failure during closing |
| 90 | Malfunction "Reply: MCB is open" - failure during closing |
| 91 | Malfunction "Reply: GCB is open" - failure during opening |
| 92 | Malfunction "Reply: MCB is open" - failure during opening |
| 93 | Mains interchange power <> 0 |
| 94 | Closing time at dead bus start exceeded |
| 95 | Internal |
| 96 | Engine release |
| 97 | Push button "ACK" pressed |
| 98 | Class F1, F2 or F3 centralized alarm (pre-assigned to relay [8]) |
| 99 | Three-position controller: raise n/f/P (external RC wiring required !!!) |
| 100 | Three-position controller: lower n/f/P (external RC wiring required !!!) |
| 101 | Three-position controller: raise V/Q (external RC wiring required !!!) |
| 102 | Three-position controller: lower V/Q (external RC wiring required !!!) |
| 103 | Engine running (f > 15Hz) |
| 104 | Internal |
| 105 | Rotation field generator/mains mismatch |
| 106 | Left rotation field mains |
| 107 | Right rotation field mains |
| 108 | Left rotation field generator |
| 109 | Right rotation field generator |
| 110 | Open GCB |
| 111 | Wire break analog input 1 |
| 112 | Wire break analog input 2 |
| 113 | Wire break analog input 3 |
| 114 | Wire break analog input 4 |
| 115 | Wire break analog input 5 |
| 116 | Wire break analog input 6 |
| 117 | Wire break analog input 7 |

## NOTE

**Rotation field monitoring (relay manager no. 105 through 109) is only active within the synchronization limits (refer to Synchronization on page 91).**

# Appendix F.
# Interface Telegram

## Transmission Telegram

| MUX | No. | Content (words) | Unit | Comment |
|---|---|---|---|---|
| 0/1 | 1 | Protocol number | | "1300" |
| 0/2 | 2 | Generator frequency f | Hz / 100 | |
| 0/3 | 3 | Actual generator real power P | $W \times 10^{PgenEXPO}$ | |
| 1/1 | 4 | Exponents | | High Byte: PgenEXPO Generator power<br>Low Byte: VgenEXPO Generator voltage |
| 1/2 | 5 | Generator real power setpoint value | see on the right | $W \times \frac{PGNWD}{2.800} \times 10^{PGNEXPO}$ |
| 1/3 | 6 | Conversion factor steps → kW | | PgenWD (intern) |
| 2/1 | 7 | Busbar voltage delta $V_{12}$ | $V \times 10^{VbusEXPO}$ | |
| 2/2 | 8 | Mains voltage delta $V_{12}$ | $V \times 10^{VmainsEXPO}$ | |
| 2/3 | 9 | Active alarm class | | Bit 15 = 1 --Internal-- |
| | | | | Bit 14 = 1 --Internal-- |
| | | | | Bit 13 = 1 --Internal-- |
| | | | | Bit 12 = 1 --Internal-- |
| | | | | Bit 11 = 1 --Internal-- |
| | | | | Bit 10 = 1 --Internal-- |
| | | | | Bit 9 = 1 --Internal-- |
| | | | | Bit 8 = 1 --Internal-- |
| | | | | Bit 7 = 1 \ Bit 6 = 1 / Class F3 alarm |
| | | | | Bit 5 = 1 \ Bit 4 = 1 / Class F2 alarm |
| | | | | Bit 3 = 1 \ Bit 2 = 1 / Class F1 alarm |
| | | If both bits are set for double bits, the input is activated. | | Bit 1 = 1 \ Bit 0 = 1 / Class F0 alarm |
| 3/1 | 10 | Control register 2 | | Bit 15 = 1 \ Bit 14 = 1 / Terminal 4, reply: GCB is closed |
| | | | | Bit 13 = 1 \ Bit 12 = 1 / Terminal 54, reply: MCB is closed |
| | | | | Bit 11 = 1 \ Bit 10 = 1 / Terminal 3 DI "Release GCB" |
| | | | | Bit 9 = 1 \ Bit 8 = 1 / Terminal 53 DI "Release MCB" |
| | | | | Bit 7 = 1 \ Bit 6 = 1 / Terminal 5 DI "Set point value 1↔2" |
| | | | | Bit 5 = 1 \ Bit 4 = 1 / --Internal-- |
| | | | | Bit 3 = 1 \ Bit 2 = 1 / Terminal 6 DI "Release monitoring" |
| | | If both bits are set for double bits, the input is activated. | | Bit 1 = 1 \ Bit 0 = 1 / --Internal-- |
| 3/2 | 11 | Actual mains interchange (import/export) real power | $W \times 10^{PmainsEXPO}$ | |
| 3/3 | 12 | Internal | | |

| MUX | No. | Content (words) | Unit | Comment | |
|---|---|---|---|---|---|
| 4/1 | 13 | Alarms 8 | | Bit 15 = 1 | F3: Generator overfrequency, level 2 |
| | | | | Bit 14 = 1 | F3: Generator underfrequency, level 2 |
| | | | | Bit 13 = 1 | F3: Generator overvoltage, level 2 |
| | | | | Bit 12 = 1 | F3: Generator undervoltage, level 2 |
| | | | | Bit 11 = 1 | F3: Reactive power, inductive |
| | | | | Bit 10 = 1 | F3: Reactive power, capacitive |
| | | | | Bit 9 = 1 | --Internal-- |
| | | | | Bit 8 = 1 | --Internal-- |
| | | FS: Control input, not active | | Bit 7 = 1 | --Internal-- |
| | | F0: Class F0 alarm, not active | | Bit 6 = 1 | --Internal-- |
| | | F1: Class F1 alarm, active until acknowledged | | Bit 5 = 1 | --Internal-- |
| | | | | Bit 4 = 1 | --Internal-- |
| | | F2: Class F2 alarm, active until acknowledged | | Bit 3 = 1 | --Internal-- |
| | | | | Bit 2 = 1 | --Internal-- |
| | | F3: Class F3 alarm, active until acknowledged | | Bit 1 = 1 | --Internal-- |
| | | | | Bit 0 = 1 | --Internal-- |
| 4/2 | 14 | Internal alarms 6 | | Bit 15 = 1 | --Internal-- |
| | | | | Bit 14 = 1 | --Internal-- |
| | | | | Bit 13 = 1 | Dead bus start error, time overrun |
| | | | | Bit 12 = 1 | --Internal-- |
| | | | | Bit 11 = 1 | Switch fault "MCB open" |
| | | | | Bit 10 = 1 | Switch fault "GCB open" |
| | | | | Bit 9 = 1 | Synchronization time monitoring MCB |
| | | | | Bit 8 = 1 | Synchronization time monitoring GCB |
| | | FS: Control input, not active | | Bit 7 = 1 | --Internal-- |
| | | F0: Class F0 alarm, not active | | Bit 6 = 1 | --Internal-- |
| | | F1: Class F1 alarm, active until acknowledged | | Bit 5 = 1 | --Internal-- |
| | | | | Bit 4 = 1 | --Internal-- |
| | | F2: Class F2 alarm, active until acknowledged | | Bit 3 = 1 | --Internal-- |
| | | | | Bit 2 = 1 | --Internal-- |
| | | F3: Class F3 alarm, active until acknowledged | | Bit 1 = 1 | --Internal-- |
| | | | | Bit 0 = 1 | Range alarm analog input [T1] |
| 4/3 | 15 | Generator voltage delta $V_{23}$ | $V \times 10^{VgenEXPO}$ | | |
| 5/1 | 16 | Generator voltage delta $V_{31}$ | $V \times 10^{VgenEXPO}$ | | |
| 5/2 | 17 | Generator voltage wye $V_{1N}$ | $V \times 10^{VgenEXPO}$ | | |
| 5/3 | 18 | Generator voltage wye $V_{2N}$ | $V \times 10^{VgenEXPO}$ | | |
| 6/1 | 19 | Generator voltage wye $V_{3N}$ | $V \times 10^{VgenEXPO}$ | | |
| 6/2 | 20 | Generator voltage delta $V_{12}$ | $V \times 10^{VgenEXPO}$ | | |

| MUX | No. | Content (words) | Unit | Comment |
|---|---|---|---|---|
| 6/3 | 21 | Internal | | |
| 7/1 | 22 | Generator current in L1 | $A \times 10^{IgenEXPO}$ | |
| 7/2 | 23 | Generator current in L2 | $A \times 10^{IgenEXPO}$ | |
| 7/3 | 24 | Generator current in L3 | $A \times 10^{IgenEXPO}$ | |
| 8/1 | 25 | Actual generator reactive power | $var \times 10^{PgenEXPO}$ | positive = inductive |
| 8/2 | 26 | Generator power factor | | Example: FF9EH PF = c 0.98 (capacitive)<br>FF9DH PF = c 0.99 (capacitive)<br>0064H PF = 1.00<br>0063H PF = i 0.99 (inductive)<br>0062H PF = i 0.98 (inductive) |
| 8/3 | 27 | Internal | | |
| 9/1 | 28 | Internal | | |
| 9/2 | 29 | Number of participants on CAN bus | | |
| 9/3 | 30 | H.B. mains status<br>L.B. generator status | | FFH Voltage and frequency present<br>00H Voltage and frequency not present |
| 10/1 | 31 | Exponents | | High Byte: IgenEXPO generator current<br>Low Byte: --- free |
| 10/2 | 32 | Busbar frequency | Hz / 100 | |
| 10/3 | 33 | H.B. busbar status<br>L.B. internal | | FFH Voltage and frequency present<br>00H Voltage and frequency not present |
| 11/1 | 34 | Mains voltage delta $V_{23}$ | $V \times 10^{VmainsEXPO}$ | |
| 11/2 | 35 | Mains voltage delta $V_{31}$ | $V \times 10^{VmainsEXPO}$ | |
| 11/3 | 36 | Mains voltage wye $V_{1N}$ | $V \times 10^{VmainsEXPO}$ | |
| 12/1 | 37 | Mains voltage wye $V_{2N}$ | $V \times 10^{VmainsEXPO}$ | |
| 12/2 | 38 | Mains voltage wye $V_{3N}$ | $V \times 10^{VmainsEXPO}$ | |
| 12/3 | 39 | Mains frequency off $V_{N12}/V_{N23}/V_{N31}$ | Hz / 100 | |
| 13/1 | 40 | Mains current in L1 | $A \times 10^{ImainsEXPO}$ | |
| 13/2 | 41 | Mains reactive power | $var \times 10^{QmainsEXPO}$ | |
| 13/3 | 42 | Mains power factor | | Example: FF9EH PF = c 0.98 (capacitive)<br>FF9DH PF = c 0.99 (capacitive)<br>0064H PF = 1.00<br>0063H PF = i 0.99 (inductive)<br>0062H PF = i 0.98 (inductive) |
| 14/1 | 43 | Exponents | | High Byte: PmainsEXPO mains power<br>Low Byte: VmainsEXPO mains voltage |
| 14/2 | 44 | Exponents | | High Byte: ImainsEXPO mains current<br>Low Byte: VbusEXPO busbar voltage |
| 14/3 | 45 | Engine operating hours ( H.W. ) | $h \times 2^{16}$ | Double word |
| 15/1 | 46 | Engine operating hours ( L.W. ) | h | |
| 15/3 | 47 | Hours until next maintenance | h | |
| 15/3 | 48 | Generator start number | | |
| 16/1 | 49 | Internal | | |

| MUX | No. | Content (words) | Unit | Comment | |
|---|---|---|---|---|---|
| 16/2 | 50 | Generator active energy ( H.W.) | kWh × $2^{16}$ | Double word | |
| 16/3 | 51 | Generator active energy (L.W.) | kWh | | |
| 17/1 | 52 | Battery voltage | V / 10 | | |
| 17/2 | 53 | Internal alarms 1<br><br>If both bits are set for double bits, the input is activated.<br><br>FS: Control input, not active<br>F0: Class F0 alarm, not active<br>F1: Class F1 alarm, active until acknowledged<br>F2: Class F2 alarm, active until acknowledged<br>F3: Class F3 alarm, active until acknowledged | | Bit 15 = 1 \<br>Bit 14 = 1 / | F3: Generator overfrequency 1 |
| | | | | Bit 13 = 1 \<br>Bit 12 = 1 / | F3: Generator underfrequency 1 |
| | | | | Bit 11 = 1 \<br>Bit 10 = 1 / | F3: Generator overvoltage 1 |
| | | | | Bit 9 = 1 \<br>Bit 8 = 1 / | F3: Generator undervoltage 1 |
| | | | | Bit 7 = 1 \<br>Bit 6 = 1 / | --Internal-- |
| | | | | Bit 5 = 1 \<br>Bit 4 = 1 / | F1: Battery undervoltage |
| | | | | Bit 3 = 1 \<br>Bit 2 = 1 / | F3: Generator overload |
| | | | | Bit 1 = 1 \<br>Bit 0 = 1 / | F3: Generator reverse power |
| 17/3 | 54 | Internal alarms 2<br><br>If both bits are set for double bits, the input is activated.<br><br>FS: Control input, not active<br>F0: Class F0 alarm, not active<br>F1: Class F1 alarm, active until acknowledged<br>F2: Class F2 alarm, active until acknowledged<br>F3: Class F3 alarm, active until acknowledged t | | Bit 15 = 1 \<br>Bit 14 = 1 / | F0: Mains overfrequency |
| | | | | Bit 13 = 1 \<br>Bit 12 = 1 / | F0: Mains underfrequency |
| | | | | Bit 11 = 1 \<br>Bit 10 = 1 / | F0: Mains overvoltage |
| | | | | Bit 9 = 1 \<br>Bit 8 = 1 / | F0: Mains undervoltage |
| | | | | Bit 7 = 1 \<br>Bit 6 = 1 / | Interface fault X1 to X5 |
| | | | | Bit 5 = 1 \<br>Bit 4 = 1 / | --Internal-- |
| | | | | Bit 3 = 1 \<br>Bit 2 = 1 / | F0: df/dt fault |
| | | | | Bit 1 = 1 \<br>Bit 0 = 1 / | F0: Mains phase/vector jump |
| 18/1 | 55 | Internal alarms 3<br><br>If both bits are set for double bits, the input is activated.<br><br>FS: Control input, not active<br>F0: Alarm class 0, not active<br>F1: Alarm class 1, active until quit<br>F2: Alarm class 2, active until quit<br>F3: Alarm class 3, active until quit | | Bit 15 = 1 \<br>Bit 14 = 1 / | F3: Independent time-overcurrent protection, level 2 |
| | | | | Bit 13 = 1 \<br>Bit 12 = 1 / | --Internal-- |
| | | | | Bit 11 = 1 \<br>Bit 10 = 1 / | --Internal-- |
| | | | | Bit 9 = 1 \<br>Bit 8 = 1 / | F3: Generator load imbalance |
| | | | | Bit 7 = 1 \<br>Bit 6 = 1 / | F3: Independent time-overcurrent protection, level 1 |
| | | | | Bit 5 = 1 \<br>Bit 4 = 1 / | --Internal-- |
| | | | | Bit 3 = 1 \<br>Bit 2 = 1 / | F1: Maintenance call |
| | | | | Bit 1 = 1 \<br>Bit 0 = 1 / | --Internal-- |

| MUX | No. | Content (words) | Unit | Content | |
|---|---|---|---|---|---|
| 18/2 | 56 | Internal | | | |
| 18/3 | 57 | Internal | | | |
| 19/1 | 58 | External alarms 1 | | Bit 15 = 1 \ | Terminal 34 |
| | | | | Bit 14 = 1 / | DI "Configuration blocked" |
| | | | | Bit 13 = 1 \ | Terminal 35 |
| | | | | Bit 12 = 1 / | DI "Isolated controller ON" |
| | | | | Bit 11 = 1 \ | Terminal 36 |
| | | | | Bit 10 = 1 / | DI "External acknowledgement" |
| | | | | Bit 9 = 1 \ | Terminal 61 |
| | | | | Bit 8 = 1 / | DI "Block mains protection" |
| | | | | Bit 7 = 1 \ | Terminal 62 |
| | | | | Bit 6 = 1 / | Discrete input [D01] |
| | | | | Bit 5 = 1 \ | Terminal 63 |
| | | | | Bit 4 = 1 / | Discrete input [D02] |
| | | | | Bit 3 = 1 \ | Terminal 64 |
| | | | | Bit 2 = 1 / | Discrete input [D03] |
| | | If both bits are set for double bits, the input is activated. | | Bit 1 = 1 \ | Terminal 65 |
| | | | | Bit 0 = 1 / | Discrete input [D04] |
| 19/2 | 59 | External alarms 2 | | Bit 15 = 1 \ | Terminal 66 |
| | | | | Bit 14 = 1 / | Discrete input [D05] |
| | | | | Bit 13 = 1 \ | Terminal 67 |
| | | | | Bit 12 = 1 / | Discrete input [D06] |
| | | | | Bit 11 = 1 \ | Terminal 68 |
| | | | | Bit 10 = 1 / | Discrete input [D07] |
| | | | | Bit 9 = 1 \ | Terminal 69 |
| | | | | Bit 8 = 1 / | Discrete input [D08] |
| | | | | Bit 7 = 1 \ | Terminal 70 |
| | | | | Bit 6 = 1 / | Discrete input [D09] |
| | | | | Bit 5 = 1 \ | Terminal 71 |
| | | | | Bit 4 = 1 / | Discrete input [D10] |
| | | | | Bit 3 = 1 \ | Terminal 72 |
| | | | | Bit 2 = 1 / | Discrete input [D11] |
| | | If both bits are set for double bits, the input is activated. | | Bit 1 = 1 \ | Terminal 73 |
| | | | | Bit 0 = 1 / | Discrete input [D12] |
| 19/3 | 60 | Internal alarms 7 | | Bit 15 = 1 | --Internal-- |
| | | | | Bit 14 = 1 | --Internal-- |
| | | | | Bit 13 = 1 | Ground current failure |
| | | | | Bit 12 = 1 | F3: ground current failure |
| | | | | Bit 11 = 1 | --Internal-- |
| | | | | Bit 10 = 1 | --Internal-- |
| | | | | Bit 9 = 1 | --Internal-- |
| | | | | Bit 8 = 1 | --Internal-- |
| | | | | Bit 7 = 1 | MCB close malfunction |
| | | | | Bit 6 = 1 | GCB close malfunction |
| | | | | Bit 5 = 1 | --Internal-- |
| | | | | Bit 4 = 1 | --Internal-- |
| | | | | Bit 3 = 1 | --Internal-- |
| | | | | Bit 2 = 1 | --Internal-- |
| | | | | Bit 1 = 1 | --Internal-- |
| | | | | Bit 0 = 1 | --Internal-- |
| 20/1 | 61 | Analog input 1 (terminals 93-95) | | | |
| 20/2 | 62 | Analog input 2 (terminals 96-98) | | | |
| 20/3 | 63 | Analog input 3 (terminals 99-101) | | | |
| 21/1 | 64 | Analog input 4 (terminals 102-104) | | | |
| 21/2 | 65 | Analog input 5 (terminals 105-107) | | | |
| 21/3 | 66 | Analog input 6 (terminals 108-110) | | | |
| 22/1 | 67 | Analog input 7 (terminals 111-113) | | | |
| 22/2 | 68 | Internal | | | |

| MUX | No. | Content (words) | Unit | Comment | |
|---|---|---|---|---|---|
| 23/3 | 69 | Speed detection | | Bit 15 = 1 | --Internal-- |
| | | | | Bit 14 = 1 | --Internal-- |
| | | | | Bit 13 = 1 | --Internal-- |
| | | | | Bit 12 = 1 | --Internal-- |
| | | | | Bit 11 = 1 | --Internal-- |
| | | | | Bit 10 = 1 | --Internal-- |
| | | | | Bit 9 = 1 | --Internal-- |
| | | | | Bit 8 = 1 | --Internal-- |
| | | | | Bit 7 = 1 \<br>Bit 6 = 1<br>Bit 5 = 1<br>Bit 4 = 1 / | Firing speed exceeded |
| | | | | Bit 3 = 1 \<br>Bit 2 = 1<br>Bit 1 = 1<br>Bit 0 = 1 / | Machine is running |

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

## Receiving Telegram

A Gateway GW 4 may be used for start/stop synchronizing the MFR. The following three data words can be received by the MFR. Refer to the GW 4 manual on how to control several MFR units.

| MUX | No. | Contents (words) | Unit | Note | |
|---|---|---|---|---|---|
| **1/1** | **1** | Set point value for the generator real power | kW | with control argument; see below | |
| **1/2** | **2** | Set point value for the generator power factor cos φ | | Example: FF9EH cos φ = c 0.98 (capacitive/lagging)<br>FF9DH cos φ = c 0.99 (capacitive/lagging)<br>0064H cos φ = 1.00<br>0063H cos φ = i 0.99 (inductive/leading)<br>0062H cos φ = i 0.98 (inductive/leading) | |
| **1/3** | **3** | Control word | | Bit 15 = 1 | --Internal-- |
| | | | | Bit 14 = 1 | --Internal-- |
| | | | | Bit 13 = 1 | --Internal-- |
| | | | | Bit 12 = 1 | --Internal-- |
| | | | | Bit 11 = 1 | --Internal-- |
| | | | | Bit 10 = 1 | --Internal-- |
| | | | | Bit 9 = 1 | --Internal-- |
| | | | | Bit 8 = 1 | --Internal-- |
| | | | | Bit 7 = 1 | --Internal-- |
| | | | | Bit 6 = 1 | --Internal-- |
| | | | | Bit 5 = 1 | --Internal-- |
| | | | | Bit 4 = 1 | Remote acknowledgement |
| | | | | Bit 3 = 1 | Always "0" |
| | | | | Bit 2 = 1 | Always "0" |
| | | | | Bit 1 = 1 | Remote stop synchronization (high priority) |
| | | | | Bit 0 = 1 | Remote start synchronization |

# CAN Bus Structure

## CAN Bus

### Transmission Telegram

The data in the following table can be processed using a Gateway GW 4 or a PLC and transmitted to other communication busses. The MFR 3 sends its data via cyclic CAN messages with this.

The transfer rate of this communication is 125 kBaud.

The CAN ID, on which the MFR 3 is sending, is calculated as follows:

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

(The ID number is a parameter, which can be set at the MFR 3, which influences the CAN ID directly on which the item sends its visualization messages.)

A visualization message, which is sent by an MFR 3, consists of 8 bytes and is assembled as follows:

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

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

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

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

## Current Direction Message

The current direction can be recognized via the prefix of the power. A positive transmitted value indicates exported power (power supplied to the mains, supply) and a negative transmitted value indicates imported power (power supplied by the mains, consumption).

## Power Set Point Value Message

The following power values may be pre-specified: constant/baseload power (C power), outgoing/export power (E power) and incoming/import power (I power). The real power set point value is transmitted in binary form using bits 0-13. The control argument must be transmitted in the basis of bits 14 and 15. In this case, the following coding applies:

| Control argument | Bit 15 | Bit 14 |
|---|---|---|
| C power | 0 | 1 |
| E power | 0 | 0 |
| I power | 1 | 1 |

**Example:**
C power of 150 kW is to be compensated. The value transmitted is then:

**01/00 0000 1001 0110 B ⇨ 4096 H**

E power of 300 kW is to be compensated. The value transmitted is then:

**00/00 0001 0010 1100 B ⇨ 012C H**

I power of 600 kW is to be compensated. Negative power is transmitted. The value transmitted is then:

**11/11 1101 1010 1000 B ⇨ FDA8 H**

## CAN Bus Address Requirements

The IDs given in the following are reserved for the data exchange between MFRs. If third-party devices are connected to the bus, third-party device addresses must not conflicts with these addresses.

| | CAN-ID in [hex] | [decimal] |
|---|---|---|
| **MFR sends** | | |
| Distribution message to other MFRs | 180 + GENNO | 384 + GENNO |
| Visualization | 320 + GENNO | 800 + GENNO |
| **MFR receives** | | |
| Distribution message from other MFR | 180 + GENNO | 384 + GENNO |
| Configuration messages from a higher control | 33F | 831 |

# Appendix G.
# List of Parameters

Product number P/N _____ Rev _____

Version MFR3 _____

Project _____

Serial number S/N _____ Date _____

| Option | Parameter 100/400V; 5 A | Setting range | Standard setting | Customer settings | | Level |
|---|---|---|---|---|---|---|
| **CONFIGURE GENERAL** | | | | | | |
| | Sprache/language | first /second | first | | | |
| | Software version | V 3.3xxx | | | | |
| | Enter code | 0 to 9999 | | | | |
| | Load language | YES/NO | NO | ☐ Y ☐ N | ☐ Y ☐ N | |
| | Language number | 0/1 | | | | |
| | Number of tool | 1 to 14 | | | | |
| | Direct para. | YES/NO | NO | ☐ Y ☐ N | ☐ Y ☐ N | |
| | Service display | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Check event list | YES/NO | NO | ☐ Y ☐ N | ☐ Y ☐ N | |
| **CONFIGURE BASIC SETTINGS** | | | | | | |
| | Configure Measuring | YES/NO | NO | ☐ Y ☐ N | ☐ Y ☐ N | |
| | Generator number | 1 to 14 | 01 | | | |
| | Generator freq. f set | 40.0 to 70.0 Hz | 50.0 Hz | | | |
| | Rated system frequency | 50/60 Hz | 50.0 Hz | | | |
| | Gen.volt.transf. secondary | 50 to 125 V; 50 to 480 V | 100 V | | | |
| | Gen.volt.transf. primary | 0.005 to 65.000 / 0.020 to 65.000kV | 10.000 kV | | | |
| | Bus.volt.transf. secondary | 50 to 125 V; 50 to 480 V | 100 V | | | |
| | Bus.volt.transf. primary | 0.005 to 65.000 / 0.020 to 65.000kV | 10.000 kV | | | |
| | Mains volt.trans secondary | 50 to 125 V; 50 to 480 V | 100 V | | | |
| | Mains volt.trans primary | 0.005 to 65.000 / 0.020 to 65.000kV | 10.000 kV | | | |
| | Gen.voltage U set | 25 to 125 V; 50 to 480 V | 100 V | | | |
| | Rated voltage System | 25 to 125 V; 50 to 480 V | 100 V | | | |
| | Voltage systems | phase to phase/Phase to neutral | phase to phase | | | |
| | Voltage measuring Main | threephase / singlephase | threephase | | | |
| | Current transf. generator | 10 to 7,000/5 A | 0100/5 | | | |
| | Power measuring Gen. | singlephase/threephase | threephase | | | |
| | Rated power gen. | 5 to 16,000 kW | 02000 kW | | | |
| | Rated current generator | 10 to 7,000 A | 0100 A | | | |
| | Current transf. mains | 5 to 7,000/5 A | 0200/5 | | | |
| | Angle adjustment Mainscurr. | -180 to 0 to 180 ° | 000 ° | | | |
| | Define level 1 code | 0 to 9999 | 0001 | | | |
| | Define level 2 code | 0 to 9999 | 0002 | | | |

| Option | Parameter 100/400V; 5 A | Setting range | Standard setting | Customer settings | | Level |
|---|---|---|---|---|---|---|
| **CONFIGURE CONTROLLER** | | | | | | |
| | Configure Controller | YES/NO | NO | ☐ Y ☐ N | ☐ Y ☐ N | |
| | Power controller Pset1 | C/E/I 0 to 16,000 kW | C000200kW | | | |
| | Power controller Pset2 | C/E/I 0 to 16,000 kW | C000100kW | | | |
| | Initial state Frequency | 0 to 100 % | 50 % | | | |
| | Freq.controller | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | f-contr. active at: | 0.0 to 70.0 Hz | 30,0 Hz | | | |
| | Delay time for f to contr. | 0 to 999 s | 005 s | | | |
| | Freq.controller ramp | 1 to 50 Hz/s | 05 Hz/s | | | |
| | F/P contr.type | THREEST. / ANALOG / PWM | ANALOG | | | |
| | Freq.controller dead band | 0.02 to 1.00 Hz | 0.10 Hz | | | |
| | Freq.controller time pulse> | 10 to 250 ms | 080 ms | | | |
| | Freq.controller gains.Kp | 0.1 to 99.9 | 10.0 | | | |
| | F/P contr.output | see table | +/-10V | | | |
| | Level PWM | 3.0 to 10.0 V | 3.0V | | | |
| | Freq.controller gain.Kpr | 1 to 240 | 20 | | | |
| | Freq.controller reset Tn | 0.0 to 60.0 s | 1.00 s | | | |
| | Freq.controller derivat.Tv | 0.00 to 6.00 s | 0.00 s | | | |
| | Starting point voltage | 0 to 100 % | 50% | | | |
| | Volt.controller | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | V/Q contr.type | THREESTEP / ANALOG | ANALOG | | | |
| | Volt.controller dead band | 0.1 to 15.0 V / 0.5 to 60.0 V | 00.5% | | | |
| | Volt.controller time pulse> | 20 to 250 ms | 080 ms | | | |
| | Volt.controller gain.Kp | 0.1 to 99.9 | 10.0 | | | |
| | V/Q contr.output | see table | +/-10V | | | |
| | Volt.controller gain.Kpr | 1 to 240 | 20 | | | |
| | Volt.controller reset Tn | 0.0 to 60.0 s | 1.00 s | | | |
| | Volt.controller derivat.Tv | 0.00 to 6.00 s | 0.00 s | | | |
| | Pow.fact.contr. | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Pow.fact.contr. setpoint | i0.70 to 1.00 to c0.70 | 1.00 | | | |
| | Power factor external | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Analog input | 0 to 20 / 4 to 20 mA | 4 to 20 mA | | | |
| | Ext. Pow.Factor 0mA | i0.70 to 1.00 to c0.70 | | | | |
| | Ext. Pow.Factor 20mA | i0.70 to 1.00 to c0.70 | | | | |
| | Pow.fact.contr. dead band | 0.5 to 25.0 % | 01.0 % | | | |
| | Pow.fact.contr. gain Kp | 0.1 to 99.9 | 10.0 | | | |
| | Pow.fact.contr. gains Kpr | 1 to 240 | 20 | | | |
| | Pow.fact.contr. reset Tn | 0.0 to 60.0 s | 1.00 s | | | |
| | Pow.fact.contr. derivat.Tv | 0.00 to 6.00 s | 0.00 | | | |
| | Power controller | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Power controller ramp | 0 to 100 %/s | 005 %/s | | | |
| | Power controller ramp | 1 to 100 kW/s | 20 %/s | | | |
| | Power limit P max. | 10 to 120 % | 100 % | | | |
| | Power limit P min. | 0 to 50 % | 00 % | | | |
| | Power setpoint external | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Analog input | 0 to 20 / 4 to 20 mA | 4 to 20 mA | | | |
| | Ext.setpoint 0mA | C/E/I 0 to 16,000 kW | C00000kW | | | |
| | Ext.setpoint 20mA | C/E/I 0 to 16,000 kW | C00200kW | | | |
| | Power controller dead band | 0.1 to 25.0 % | 01.0 % | | | |
| | Power controller gain Kp | 0.1 to 99.9 | 20.0 | | | |
| | Powercontr. dead band ratio | 1.0 to 9.9 | *2.0 | | | |
| | Power controller gain Kpr | 1 to 240 | 20 | | | |
| | Power controller reset Tn | 0.0 to 60.0 s | 1.00 s | | | |
| | Power controller derivat.Tv | 0.00 to 6.00 s | 0.00 | | | |
| | Warm up load limit value | 5 to 110 % | 015 % | | | |
| | Warm up load time | 0 to 600 s | 000 s | | | |
| | Active power load share | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Act.load share factor | 10 to 99 % | 50 % | | | |
| | Reactive power load share | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | React.load share factor | 10 to 99 % | 50 % | | | |

| Option | Parameter 100/400V; 5 A | Setting range | Standard setting | Customer settings | | Level |
|---|---|---|---|---|---|---|
| | Configure Automatic | NO/YES | NO | | | |
| | Control via COM X1X5 | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Control via COM Y1Y5 | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Delay to send MOD to Bus | 0.2 to 50.0 ms | | | | |
| **CONFIGURE BREAKER** | | | | | | |
| | Configure Breaker | YES/NO | NO | ☐ Y ☐ N | ☐ Y ☐ N | |
| | Breaker logic: | see table | PARALLEL | | | |
| | Add-on/off ramp max.time | 0 to 999 s | 020 s | | | |
| | Open GCB with F2 max.time | 0 to 999 s | 010 s | | | |
| | Signal logic GCB | Continuous/Impulse | Cont | | | |
| | Opening GCB | NO to cont./NC to cont. | N.O. to contact | | | |
| **CONFIGURE SYNCHRONIZATION** | | | | | | |
| | Synchronize df max | 0.02 to 0.49 Hz | 0.20 Hz | | | |
| | Synchronize df min | 0.00 to -0.49 Hz | -0.10 Hz | | | |
| | Synchronize dV max | 0.1 to 15 % | 01.0 % | | | |
| | Synchronize time pulse> | 0.02 to 0.26 s | 0.24 s | | | |
| | Closing time GCB | 40 to 300 ms | 080ms | | | |
| | Closing time MCB | 40 to 300 ms | 080 ms | | | |
| | Autom.breaker deblocking | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Sync.time contr. | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Sync.time contr. Delay | 10 to 999 s | 180 s | | | |
| **CONFIGURE DEAD BUSSTART** | | | | | | |
| | GCB dead bus op. | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | GCB dead bus op. df max | 0.05 to 5.00 Hz | 0.45 Hz | | | |
| | GCB dead bus op. dV max | 0.1 to 20 % | 10,0 % | | | |
| | GCB dead bus op. max.time | 0 to 999 s | 030 s | | | |
| | MCB dead bus op. | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| **CONFIGURE BREAKER MONITORING** | | | | | | |
| | Supervision GCB | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Supervision MCB | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Mains decoupling via | MCB/GCB | GCB | | | |
| | Mains settling time | 0 to 999 s | 010 s | | | |
| | Mains decouplingvia term.62 | ON/OFF | OFF | | | |
| **CONFIGURE MONITORING** | | | | | | |
| | Configure Monitoring | YES/NO | NO | ☐ Y ☐ N | ☐ Y ☐ N | |
| | Mains power mon. | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Mains power mon. res.val. | E/I 0 to 16,000 kW | E100 kW | | | |
| | Mains power mon. hysteresis | 0 to 999 kW | 10 kW | | | |
| | Mains power mon. Delay | 0 to 600 s | 1 s | | | |
| | Rev./red.power monitoring | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Rev./red.power resp.value | -99 to 0 to 99 % | -10 % | | | |
| | Rev./red.power Delay | 00.1 to 99.9 s | 03.0 s | | | |
| | Gen.overload monitoring | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Gen.overload MOP resp.value | 80 to 150 % | 120 % | | | |
| | Gen.overload MOP Delay | 0 to 99 s | 20 s | | | |
| | Gen.overload IOP resp.value | 80 to 150 % | 105 % | | | |
| | Gen.overload IOP Delay | 0 to 99 s | 03 s | | | |
| | Reactive power Monitoring | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Reactive pow.ind Limit | 5 to 100 % | 010 % | | | |
| | Reactive pow.ind Delay | 0 to 600 s | 010 s | | | |
| | Reactive pow.cap Limit | 5 to 100 % | 010 % | | | |
| | Reactive pow.cap Delay | 0 to 600 s | 010 s | | | |

| Option | Parameter 100/400V; 5 A | Setting range | Standard setting | Customer settings | | Level |
|---|---|---|---|---|---|---|
| | Gen.overcurrent monitoring | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Gen.overcurr. 1 resp.value | 0 to 300 % | 110 % | | | |
| | Gen.overcurr. 1 Delay | 0.02 to 99.98 s | 01.00 s | | | |
| | Gen.overcurr. 2 resp.value | 0 to 300 % | 300 % | | | |
| | Gen.overcurr. 2 Delay | 0.02 to 99.98 s | 00.04 s | | | |
| | Inv.time ov.cur. Monitor | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Inv.time char. | normal inv/ high inv /extremely inv. | normal inv | | | |
| | Inv.time ov.cur. Tp | 0.00 to 1.98s | 0,10 s | | | |
| | Inv.time ov.cur. Ip | 0.1 to 3.0*In | 1.0*In | | | |
| | Inv.time ov.cur. I start | 1.00 to 3.00*In | 1.00*In | | | |
| | Inv.time ov.cur. V-restr | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Inv.time ov.cur knee crv.U> | 10 to 90 % | 20 % | | | |
| | Inv.time ov.cur1 Delay | 0.02 to 99.98 s | 1.00 s | | | |
| | Inv.time ov.cur2 knee crv | 0 to 300 % | | | | |
| | Inv.time ov.cur2 Delay | 0.02 to 99.98 s | 1.00 s | | | |
| | Load unbalance Monitoring | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Load unbalance max. | 0 to 100 % | 030 % | | | |
| | Load unbalance Delay | 0.02 to 99.98 s | 01.00 s | | | |
| | Earth fault Monitoring | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Earth fault Response v. | 5 to 100 % | 015 % | | | |
| | Earth fault Delay | 0.02 to 99.98 s | 1.00 s | | | |
| | Gen.overfreq. monitoring | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Gen.overfreq. 1 f > | 40.00 to 85.00 Hz | 55.00 Hz | | | |
| | Gen.overfreq. 1 Delay | 0.02 to 99.98 s | 01.00 s | | | |
| | Gen.overfreq. 2 f > | 40.00 to 85.00 Hz | 58.00 Hz | | | |
| | Gen.overfreq. 2 Delay | 0.02 to 99.98 s | 00.10 s | | | |
| | Gen.underfreq. monitoring | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Gen.underfreq. 1 f < | 40.00 to 85.00 Hz | 45.00 Hz | | | |
| | Gen.underfreq. 1 Delay | 0.02 to 99.98 s | 01.00 s | | | |
| | Gen.underfreq. 2 f < | 40.00 to 85.00 Hz | 42.00 Hz | | | |
| | Gen.underfreq. 2 Delay | 0.02 to 99.98 s | 00.10 s | | | |
| | Gen.overvoltage monitoring | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Gen.overvolt. 1 U > | [1] 20 to 150 V; [4] 20 to 520 V | 110 V | | | |
| | Gen.overvolt. 1 Delay | 0.02 to 99.98 s | 01.00 s | | | |
| | Gen.overvolt. 2 U > | [1] 20 to 150 V; [4] 20 to 520 V | 125 V | | | |
| | Gen.overvolt. 2 Delay | 0.02 to 99.98 s | 00.10 s | | | |
| | Gen.undervolt. monitoring | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Gen.undervolt. 1 U < | [1] 20 to 150 V; [4] 20 to 520 V | 090 V | | | |
| | Gen.undervolt. 1 Delay | 0.02 to 99.98 s | 01.00 s | | | |
| | Gen.undervolt. 2 U < | [1] 20 to 150 V; [4] 20 to 520 V | 075 V | | | |
| | Gen.undervolt. 2 Delay | 0.02 to 99.98 s | 00.10 s | | | |
| | Mains frequency monitoring | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Mains overfreq. f > | 40.00 to 70.00 Hz | 50.20 Hz | | | |
| | Mains overfreq. Delay | 0.02 to 99.98 s | 00.06 s | | | |
| | Mains underfreq. f < | 40.00 to 70.00 Hz | 49.80 Hz | | | |
| | Mains underfreq. Delay | 0.02 to 99.98 s | 00.06 s | | | |
| | Mains voltage monitoring | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Mains volt.monit U Ph.-N. | U Ph.-Ph. / U Ph.-N. | U Ph.-Ph. | ☐ pp ☐ pn | ☐ pp ☐ pn | |
| | Mains overvolt. U Ph.-N. > | [1] 20 to 150 V; [4] 20 to 520 V | 110/440 V | | | |
| | Mains overvolt. U Ph.-Ph. > | [1] 20 to 87 V; [4] 20 to 300 V | 64/254 V | | | |
| | Mains overvolt. Delay | 0.02 to 99.98 s | 00.06 s | | | |
| | Mains undervolt. U Ph.-N. < | [1] 20 to 150 V; [4] 20 to 520 V | 90/360 V | | | |
| | Mains undervolt.U Ph.-Ph. < | [1] 20 to 87 V; [4] 20 to 300 V | 52/208 V | | | |
| | Mains undervolt. Delay | 0.02 to 99.98 s | 00.06 s | | | |

| Option | Parameter 100/400V; 5 A | Setting range | Standard setting | Customer settings | | Level |
|---|---|---|---|---|---|---|
| | Phase shift monitoring | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Monitoring | one/three-phase three phase only | threephase | | | |
| | Phase shift one to phase | 3 to 30 ° | 12 ° | | | |
| | Phase shift three to phase | 3 to 30 ° | 08 ° | | | |
| | df/dt to monitoring | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | df/dt to monitoringrelease> | 1.0 to 9.9 Hz/s | 2.6 Hz/s | | | |
| | df/dt to monitoringDelay ti | 0.1 to 9.9 s | 0.1 s | | | |
| | Mainstrip via | Phase shift / df/dt | df/dt | | | |
| | Batt.undervolt. U < | 9.5 to 30.0 V | 10.0 V | | | |
| | Batt.undervolt. Delay | 0 to 99 s | 10 s | | | |
| | Mains power mon. | ON/OFF | ON | | | |
| | Mains power mon. res.val. | E/I 0 to 16,000 kW | E00100kW | | | |
| | Mains power mon. hysteresis | | 010 kW | | | |
| | Mains power mon. Delay | 0.02 to 99.98 s | 001 s | | | |
| **CONFIGURE DISCRETE INPUTS** | | | | | | |
| | Configure Dig.input | YES/NO | NO | ☐ Y ☐ N | ☐ Y ☐ N | |
| | Dig.input 1234 function | E/D | DDDD | | | |
| | Dig.input 1234 delay | 0 to 9 | 0000 | | | |
| | Delayed by 1234 eng.speed | Y/N | NNNN | | | |
| | Dig.input 1234error class | 0 to 3 | 3210 | | | |
| | Dig.input 5678 function | E/D | DDDD | | | |
| | Dig.input 5678 delay | 0 to 9 | 0000 | | | |
| | Delayed by 5678 eng.speed | Y/N | NNNN | | | |
| | Dig.input 5678 error class | 0 to 3 | 1111 | | | |
| | Dig.input 9ABC function | E/D | DDDD | | | |
| | Dig.input 9ABC delay | 0 to 9 | 0000 | | | |
| | Delayed by 9ABC eng.speed | Y/N | NNNN | | | |
| | Dig.input 9ABC error class | 0 to 3 | 1111 | | | |
| | Errortxt.term.62Terminal 62 | any | Terminal 62 | | | |
| | Errortxt.term.63Terminal 63 | any | Terminal 63 | | | |
| | Op.mod blocked by Ter.63 | ON/OFF | OFF | | | |
| | Errortxt.term.64Terminal 64 | any | Terminal 64 | | | |
| | Breaker logic by Ter.64 | ON/OFF | OFF | | | |
| | Errortxt.term.65Terminal 65 | any | Terminal 65 | | | |
| | Errortxt.term.66Terminal 66 | any | Terminal 66 | | | |
| | Errortxt.term.67Terminal 67 | any | Terminal 67 | | | |
| | Errortxt.term.68Terminal 68 | any | Terminal 68 | | | |
| | Errortxt.term.69Terminal 69 | any | Terminal 69 | | | |
| | Errortxt.term.70Terminal 70 | any | Terminal 70 | | | |
| | Errortxt.term.71Terminal 71 | any | Terminal 71 | | | |
| | Errortxt.term.72Terminal 72 | any | Terminal 72 | | | |
| | Errortxt.term.71Terminal 73 | any | Terminal 73 | | | |
| **CONFIGURE ANALOG INPUTS** | | | | | | |
| | Configure Analg.inp. | YES/NO | NO | ☐ Y ☐ N | ☐ Y ☐ N | |
| | Temperature x Pt100 | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | ***Name**** | any | Analog 1 | | | |
| | Limit warning | 0 to 255 °C | | | | |
| | Limit shutdown | 0 to 255 °C | | | | |
| | Delay limit 1/2 | 0 to 600 s | 1 s | | | |
| | Monitoring for | high limit mon./low limit mon. | high limit mon. | | | |
| | Analog input x scaleable | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Name and unit | any | Analog X | | | |
| | Analog input x | 0 to 20 mA / 4 to 20mA | 4 to 20mA | | | |
| | Value at 0% | -9,999 to 0 to 9,999 | | | | |
| | Value at 100% | -9,999 to 0 to 9,999 | | | | |
| | Limit warning value | -9,999 to 0 to 9,999 | | | | |
| | Limit shutdown value | -9,999 to 0 to 9,999 | | | | |
| | Delay Limit 1/2 | 0 to 600 s | 1.0 s | | | |
| | Monitoring for | high limit mon./low limit mon. | high limit | | | |
| | An.input 1234 Superv.del | Y/N | NNNN | | | |
| | An.input 5678 Superv.del | Y/N | NNNN | | | |

| Option | Parameter 100/400V; 5 A | Setting range | Standard setting | Customer settings | | Level |
|---|---|---|---|---|---|---|
| **CONFIGURE OUTPUTS** | | | | | | |
| | Configure Outputs | YES/NO | NO | ☐ Y ☐ N | ☐ Y ☐ N | |
| | Analg.out.130131 | OFF / 0 to 20 / 4 to 20 mA | OFF | | | |
| | Analg.out.130131 parameter | 0 to 23 | 01 | | | |
| | Analg.out.130131 0% | 0 to 9,990 | 0000 | | | |
| | Analg.out.130131 100% | 0 to 9,990 | 0200 | | | |
| | Analg.out.132133 | OFF / 0 to 20 / 4 to 20 mA | OFF | | | |
| | Analg.out.132133 parameter | 0 to 23 | 01 | | | |
| | Analg.out.132133 0% | 0 to 9,990 | 0000 | | | |
| | Analg.out.132133 100% | 0 to 9,990 | 0200 | | | |
| | Pulse output 1 | +kWh / -kWh | | | | |
| | Pulse output 1 logic | positive/negative | negative | | | |
| | Active energy Pulse/kWh | 0.1 to 150.0 | 001.0 | | | |
| | Pulse output 2 | +kvarh / -kvarh | | | | |
| | Pulse output 2 logic | positive/negative | negative | | | |
| | Reactive energy Pulse/kvah | 0.1 to 150.0 | 001.0 | | | |
| **CONFIGURE DRIVE** | | | | | | |
| | Configure Drive | YES/NO | YES | ☐ Y ☐ N | ☐ Y ☐ N | |
| | Automatic idle Running | ON/OFF | OFF | ☐ on ☐ off | ☐ on ☐ off | |
| | Download and open GCB | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Monitoring on at f gen > | 15 to 70 Hz | 15 Hz | | | |
| | Monitoring on after | 0 to 99 s | 08 s | | | |
| **CONFIGURE COUNTER** | | | | | | |
| | Configure Counters | YES/NO | NO | ☐ Y ☐ N | ☐ Y ☐ N | |
| | Service interval | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Service interval in | 0 to 9.999 h | 0300 h | | | |
| | Op.hours counter | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Op.hours counter set | 0 to 65,000 h | 00000 h | | | |
| | Start counter | ON/OFF | ON | ☐ on ☐ off | ☐ on ☐ off | |
| | Start counter set | 0 to 32,000 | 00000 | | | |
| | Display kWh +- on? | Y/N | YY | | | |
| | Display kvarh +- on? | Y/N | YY | | | |
| | Time | 00:00 to 23:59 | 00:00 | | | |
| | Year,month | 00 to 99, 1 to 12 | 00,00 | | | |
| | Day,weekday | 01 to 31, 1 to 7 | 00,0 | | | |

# Appendix H.
# Service Options

## Product Service Options

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

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

## Returning Equipment For Repair

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

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

**CAUTION**

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

## Packing a Control

Use the following materials when returning a complete control:

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

## Return Authorization Number RAN

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

**NOTE**

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

# Replacement Parts

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

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

# How To Contact Woodward

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

Woodward GmbH
Handwerkstrasse 29
70565 Stuttgart - Germany

Phone: +49 (0) 711 789 54-0 (8:00 - 16:30 German time)
Fax: +49 (0) 711 789 54-100
eMail: 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 5811 |
| 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 3 _____

Serial number S/N _____

## Description of your problem

_____

_____

_____

_____

_____

_____

Please be sure you have a list of all parameters available. You can print this using LeoPC1. Additionally you can save the complete set of parameters (standard values) and send them to our Service department via e-mail.

**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 (0) 711 789 54-0 • Fax +49 (0) 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).**

2008/12/Stuttgart