37396A

MFR 300
Measuring Transducer

Manual
Software Version 1.xxxx

Manual 37396A

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	07-10-31	TP	Release
A	08-05-07	TP	Minor corrections; 100 V PT inputs added

Content

Figures and Tables

Figures

Tables

Chapter 1.
General Information

Type		English	German
MFR 300			
MFR 300 - Manual	this manual ⇨	37396	-

Table 1-1: Manuals - overview

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

NOTE

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

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

Chapter 2.
Electrostatic Discharge Awareness

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

Follow these precautions when working with or near the control.

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

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

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

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

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

CAUTION

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

Chapter 3.
Installation

Introduction

WARNING

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

NOTE

Connected inductances (e.g. operating current coils, undervoltage tripping devices, auxiliary contactors, and/or power contactors) must be wired with an appropriate interference protection.

WARNING

The unit described here is available in several versions with different PT/CT combinations (100 Vac or 690 Vac PTs and 1 A or 5 A CTs).

Refer to the data plate on the unit and Table 3-1 to determine, how your two unit is configured. Mistaking the unit may cause personal injury and/or damage to the product.

The detailed model description for the MFR 300 reads as follows:

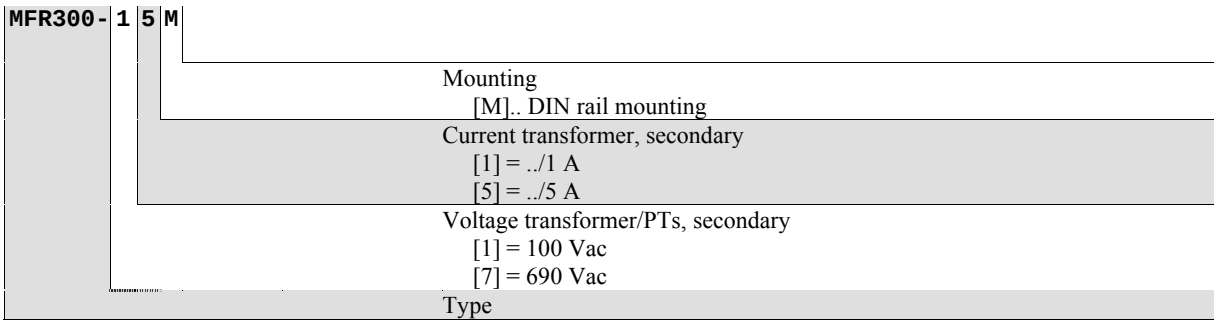


Table 3-1: MFR 300 - model description

Examples:

- MFR300-11M (DIN rail mounted, standard unit with 100 Vac PT and ../1 A CT inputs)
- MFR300-75M (DIN rail mounted, standard unit with 690 Vac PT and ../5 A CT inputs)

The following table may be used to convert the wire size from mm² to AWG and vice-versa:

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

Table 3-2: Conversion table - wire size

Wiring Diagram

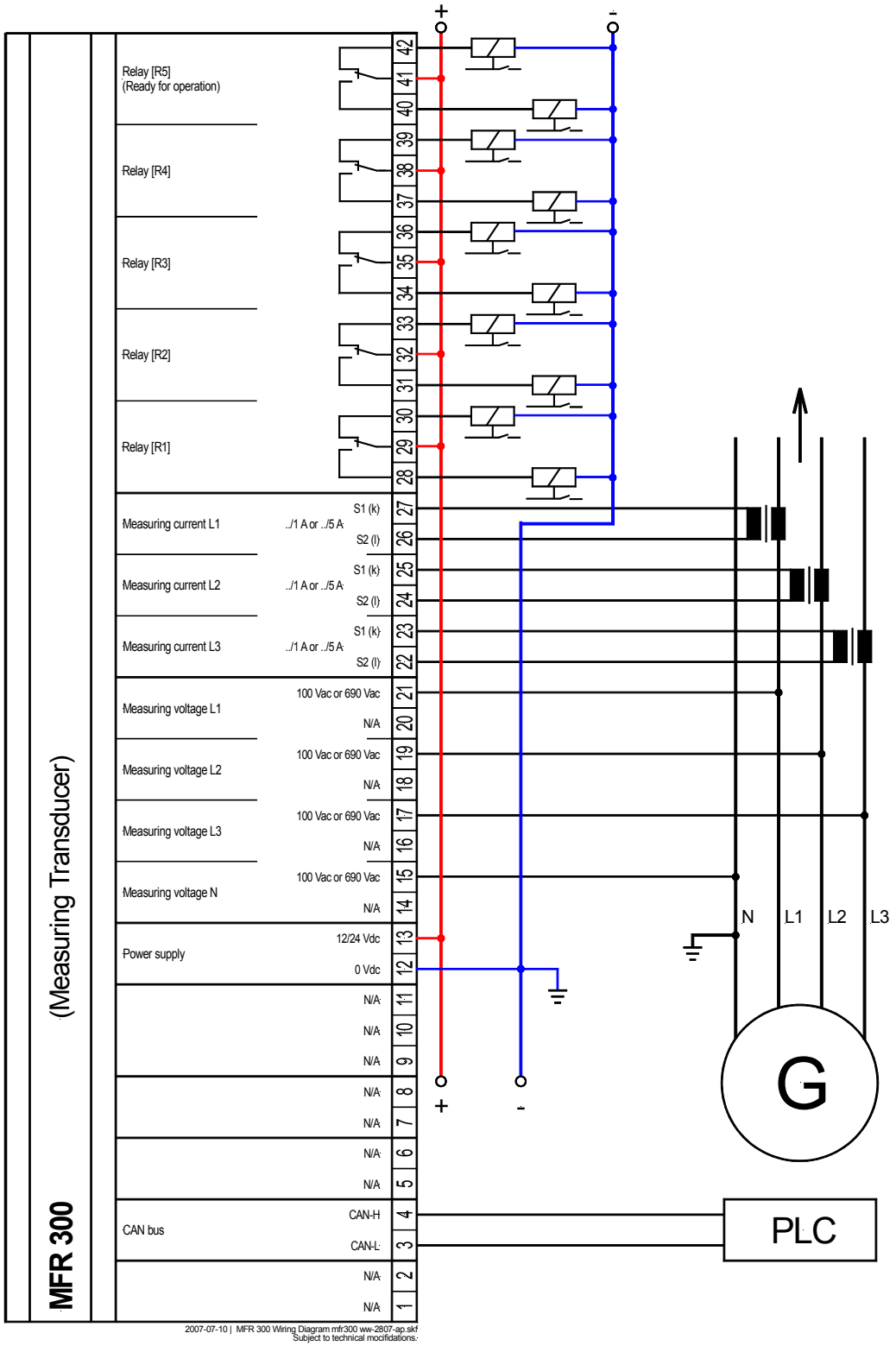


Figure 3-1: Wiring diagram MFR 300

Dimensions

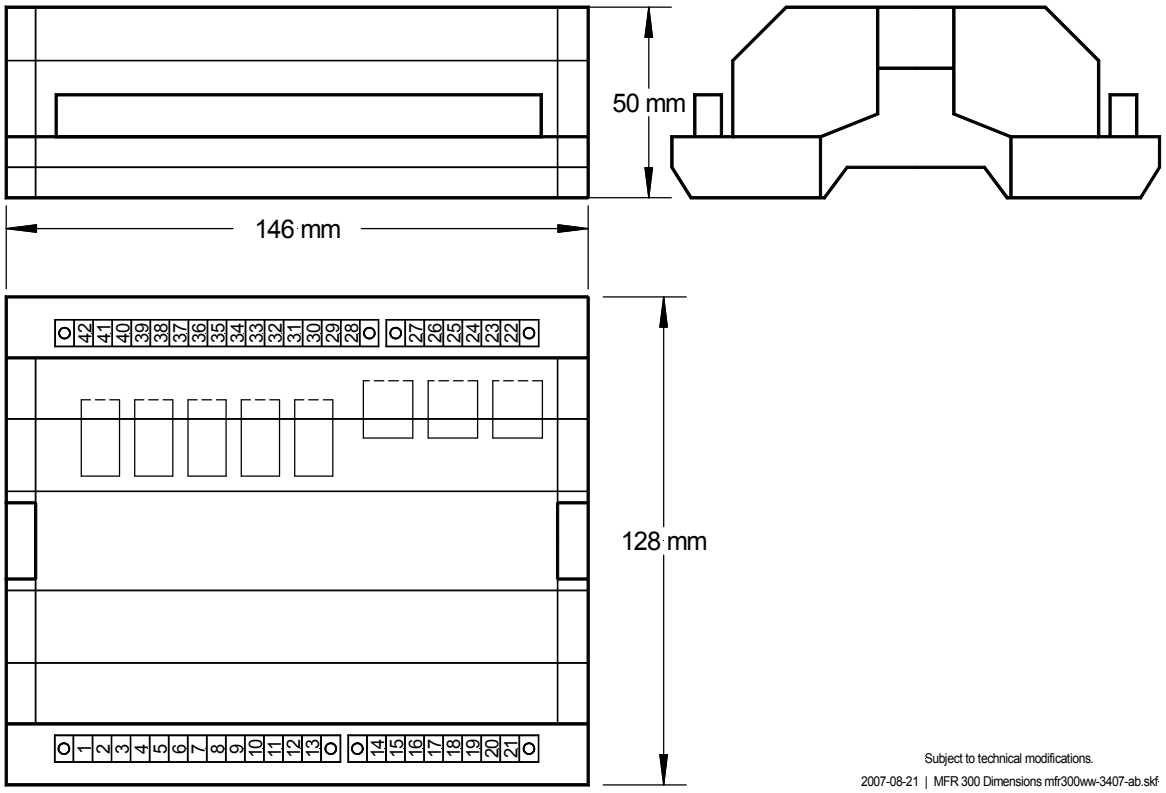


Figure 3-2: Dimensions MFR 300

Chapter 4.
Connectors - Details

Terminal Arrangement

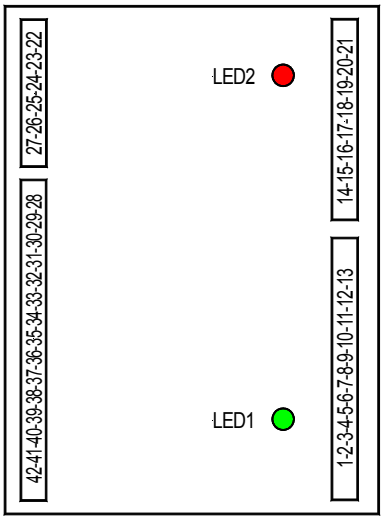


Figure 4-1: MFR 300 top view - terminal arrangement

WARNING

All technical data and ratings indicated in this chapter are not definite! Only the values indicated in Technical Data on page 56 are valid!

Power Supply

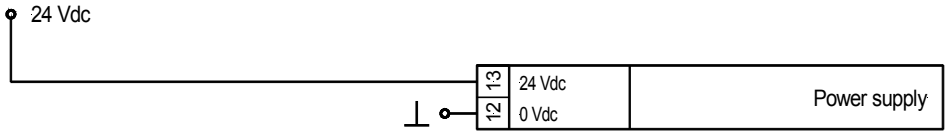


Figure 4-2: Power supply

Terminal	Description	A_{max}
13	24 Vdc	2.5 mm²
12	0 Vdc reference potential (grounded)	2.5 mm²

Table 4-1: Terminal layout - power supply

Measuring Inputs

WARNING

The unit described here is available in several versions with different PT/CT combinations (100 Vac or 690 Vac PTs and 1 A or 5 A CTs).

Refer to the data plate on the unit and Table 3-1 to determine, how your two unit is configured. Mistaking the unit may cause personal injury and/or damage to the product.

Voltage Measuring 690 V

NOTE

This description is only valid for units with 690 V voltage measuring inputs.

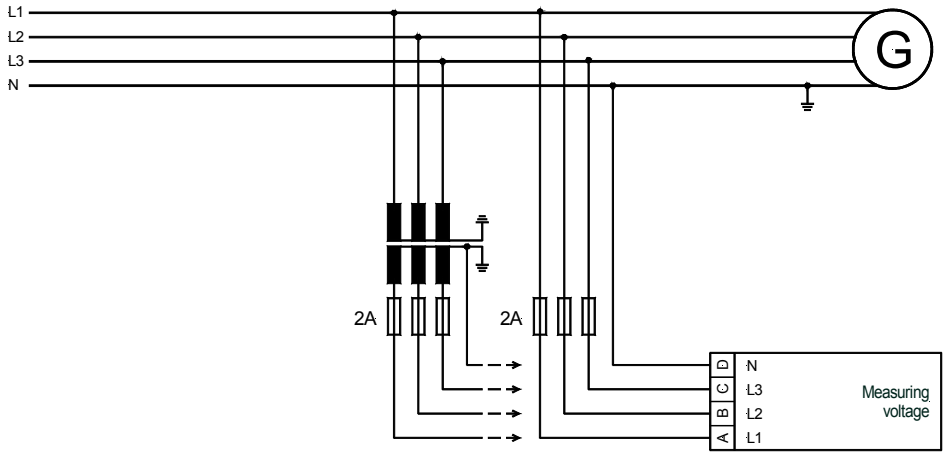


Figure 4-3: Measuring inputs - voltage 690 V

NOTE

Refer to Technical Data on page 56 for detailed information.

Terminal		Measuring	Description	A_{max}
A	21	690 V directly	Measuring voltage L1	2.5 mm²
B	19		Measuring voltage L2	2.5 mm²
C	17		Measuring voltage L3	2.5 mm²
D	15		Neutral point of the 3-phase wye system/transformer	2.5 mm²

Table 4-2: Terminal assignment - voltage measuring 690 V

Voltage Measuring 100 V

NOTE

This description is only valid for units with 100 V voltage measuring inputs.

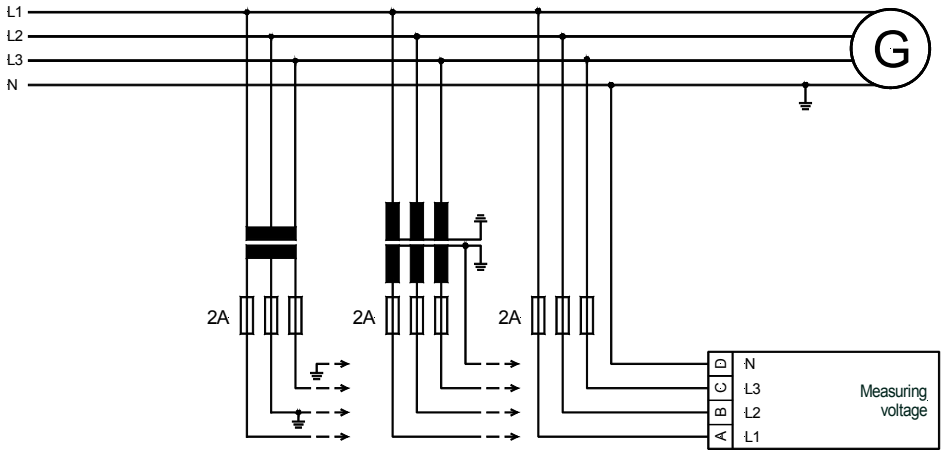


Figure 4-4: Measuring inputs - voltage 100 V

NOTE

Refer to Technical Data on page 56 for detailed information.

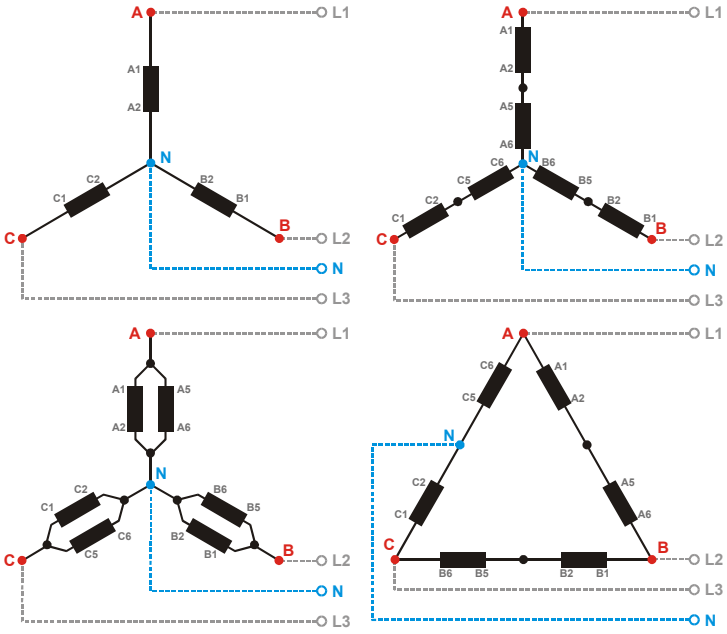
Terminal		Measuring	Description	A_{max}
A	21	100 V directly or via measurement transformer	Measuring voltage L1	2.5 mm²
B	19		Measuring voltage L2	2.5 mm²
C	17		Measuring voltage L3	2.5 mm²
D	15		Neutral point of the 3-phase wye system/transformer	2.5 mm²

Table 4-3: Terminal assignment - voltage measuring 100 V

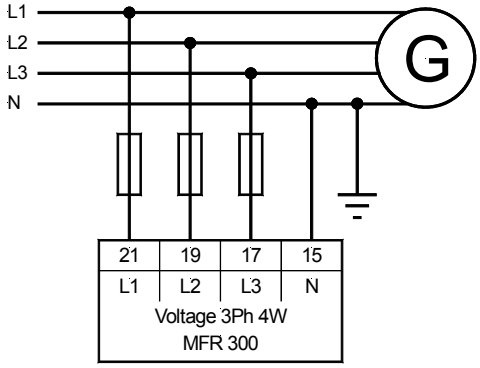
Voltage Measuring Connection

Voltage measuring may be performed in various ways depending on the configuration of parameter 1851. Please note to configure and wire the MFR 300 consistently. Refer to the Measuring section of the Configuration chapter on page 25 for more information.

Voltage Measuring: Parameter Setting '3Ph 4W' (3-phase, 4-wire)



Generator winding configuration



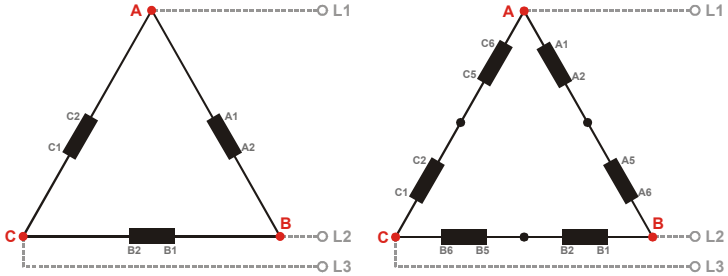
Measuring input connection

Figure 4-5: Voltage measuring - 3Ph 4W

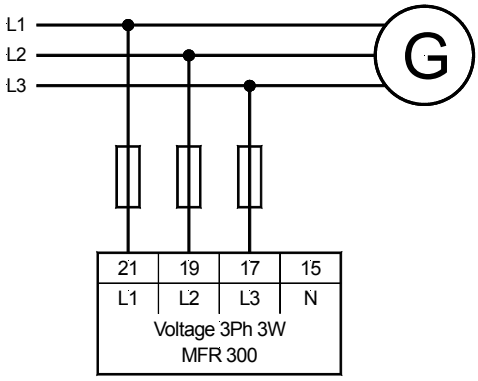
3Ph 4W	Wiring terminals			
MFR 300	21	19	17	15
Phase	L1	L2	L3	N

Table 4-4: Voltage measuring - terminal assignment - 3Ph 4W

Voltage Measuring: Parameter Setting '3Ph 3W' (3-phase, 3-wire)



Generator winding configuration



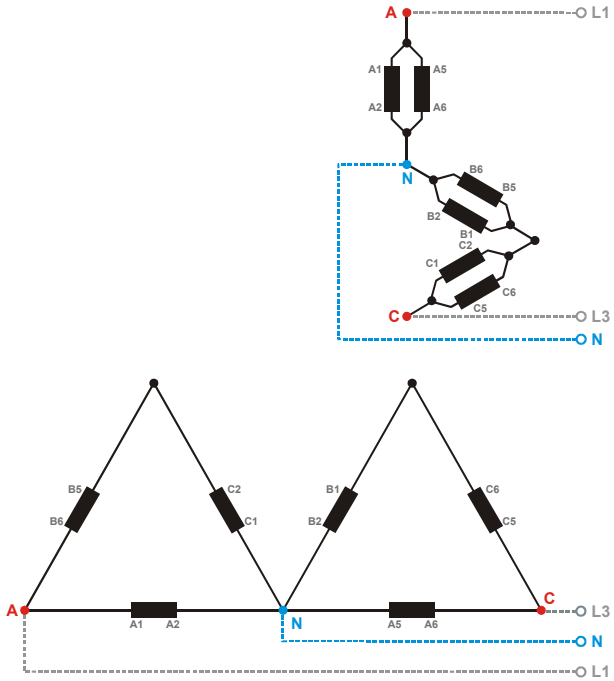
Measuring input connection

Figure 4-6: Voltage measuring - 3Ph 3W

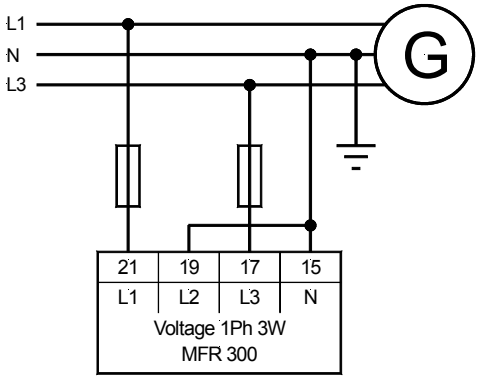
3Ph 3W	Wiring terminals			
MFR 300	21	19	17	15
Phase	L1	L2	L3	---

Table 4-5: Voltage measuring - terminal assignment - 3Ph 3W

Voltage Measuring: Parameter Setting '1Ph 3W' (1-phase, 3-wire)



Generator winding configuration



Measuring input connection

Figure 4-7: Voltage measuring - 1Ph 3W

1Ph 3W	Wiring terminals			
MFR 300	21	19	17	15
Phase	L1	N	L3	N

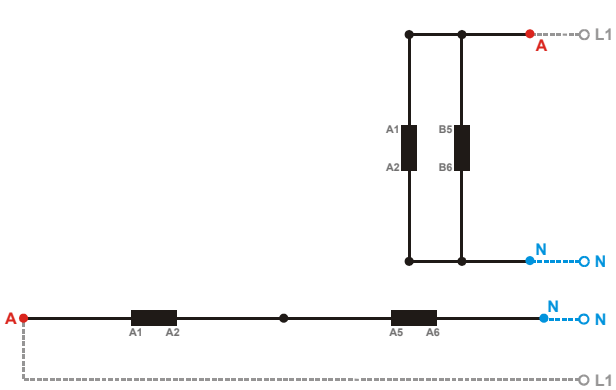
Table 4-6: Voltage measuring - terminal assignment - 1Ph 3W

Voltage Measuring: Parameter Setting '1Ph 2W' (1-phase, 2-wire)

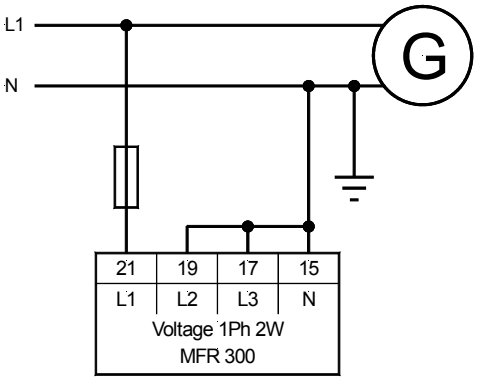
NOTE

The 1-phase, 2-wire measurement may be performed phase-neutral or phase-phase depending on the configuration of parameter 1858. Please note to configure and wire the MFR 300 consistently. Refer to the Measuring section of the Configuration chapter on page 25 for more information.

'1Ph 2W' Phase-Neutral Measuring



Generator winding configuration



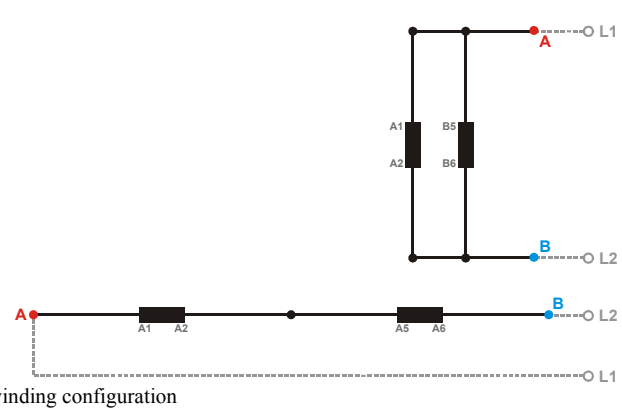
Measuring input connection

Figure 4-8: Voltage measuring - 1Ph 2W (phase-neutral)

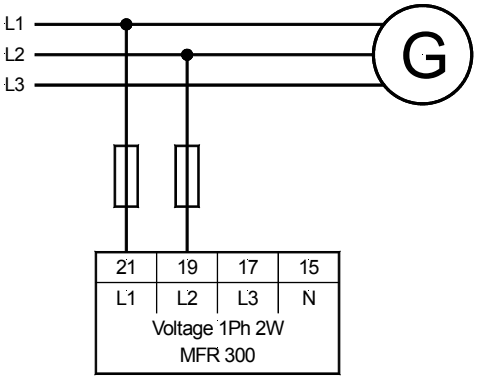
1Ph 2W	Wiring terminals			
MFR 300	21	19	17	15
Phase	L1	N	N	N

Table 4-7: Voltage measuring - terminal assignment - 1Ph 2W (phase-neutral)

'1Ph 2W' Phase-Phase Measuring



Generator winding configuration



Measuring input connection

Figure 4-9: Voltage measuring - 1Ph 2W (phase-phase)

1Ph 2W	Wiring terminals			
MFR 300	21	19	17	15
Phase	L1	Ls	---	---

Table 4-8: Voltage measuring - terminal assignment - 1Ph 2W (phase-phase)

Current Measuring

WARNING

The unit described here is available in several versions with different PT/CT combinations (100 Vac or 690 Vac PTs and 1 A or 5 A CTs).

Refer to the data plate on the unit and Table 3-1 to determine, how your two unit is configured. Mistaking the unit may cause personal injury and/or damage to the product.

WARNING

Before disconnecting the secondary terminals of the current transformer or the connections of the current transformer at the control, ensure that the transformer is short-circuited.

NOTE

Current transformers are generally to be grounded on one side of the secondary.

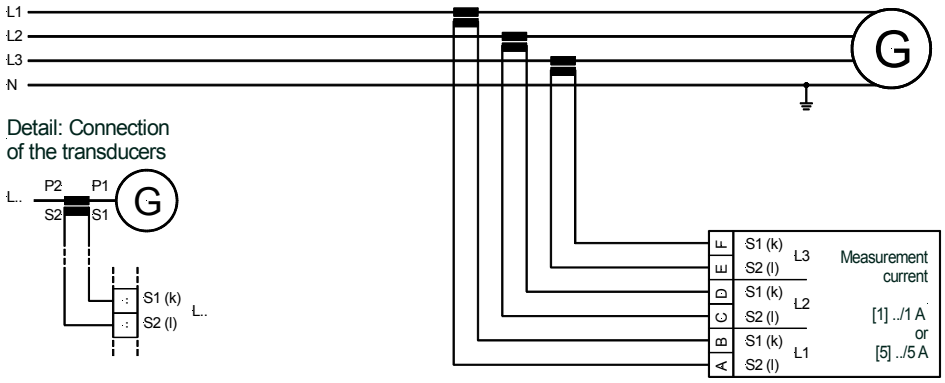


Figure 4-10: Measuring inputs - current

Terminal		Measuring	Description	A_{max}
A	26	Transformer ../1 A or ../5A	Generator current L1, transformer terminal s2 (l)	2.5 mm²
B	27		Generator current L1, transformer terminal s1 (k)	2.5 mm²
C	24		Generator current L2, transformer terminal s2 (l)	2.5 mm²
D	25		Generator current L2, transformer terminal s1 (k)	2.5 mm²
E	22		Generator current L3, transformer terminal s2 (l)	2.5 mm²
F	23		Generator current L3, transformer terminal s1 (k)	2.5 mm²

Table 4-9: Terminal assignment - current measuring

Current Measuring Connection

Current measuring may be performed in various ways depending on the configuration of parameter 1850. Please note to configure and wire the MFR 300 consistently. Refer to the Measuring section of the Configuration chapter on page 25 for more information.

Current Measuring: Parameter Setting 'L1 L2 L3'

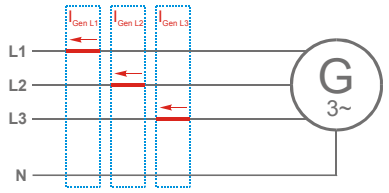


Figure 4-11: Current measuring - L1 L2 L3

L1 L2 L3	Wiring terminals						Notes
MFR 300	27	26	25	24	23	22	
Phase	s1 (k) L1	s2 (l) L1	s1 (k) L2	s2 (l) L2	s1 (k) L3	s2 (l) L3	

Table 4-10: Current measuring - terminal assignment - L1 L2 L3

Current Measuring: Parameter Setting 'Phase L1', 'Phase L2' & 'Phase L3'

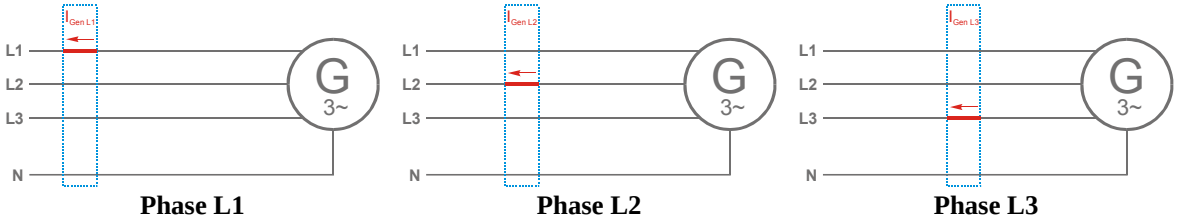


Figure 4-12: Current measuring - phase Lx

	Wiring terminals						Notes
Phase L1							
MFR 300	27	26	25	24	23	22	
Phase	s1 (k) L1	s2 (l) L1	---	---	---	---	
Phase L2							
MFR 300	27	26	25	24	23	22	
Phase	---	---	s1 (k) L2	s2 (l) L2	---	---	
Phase L3							
MFR 300	27	26	25	24	23	22	
Phase	---	---	---	---	s1 (k) L3	s2 (l) L3	
Phase L1 and L3							**1**
MFR 300	27	26	25	24	23	22	
Phase	s1 (k) L1	s2 (l) L1	---	---	s1 (k) L3	s2 (l) L3	

Table 4-11: Current measuring - terminal assignment - phase Lx

1 This is valid if voltage measurement is configured to 1Ph 3W (refer to Voltage Measuring: Parameter Setting '1Ph 3W' (1-phase, 3-wire) on page 15).

Auxiliary and Control Outputs

Relay Outputs

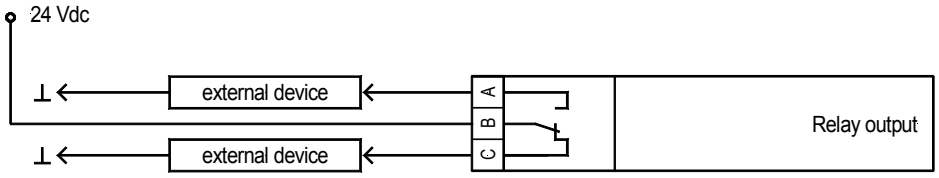


Figure 4-13: Relay outputs - control outputs

Change-over			Description	A_{max}
make ***A***	common ***B***	break ***C***		
28	29	30	Relay 1	2.5 mm²
31	32	33	Relay 2	2.5 mm²
34	35	36	Relay 3	2.5 mm²
37	38	39	Relay 4	2.5 mm²
40	41	42	Relay 5 (ready for operation)	2.5 mm²

Table 4-12: Terminal assignment - relay outputs

Interface

Interface Connection

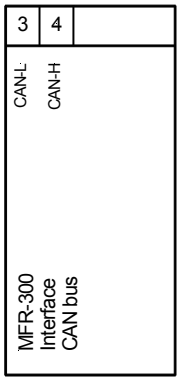


Figure 4-14: Interface - terminals

Terminal					Description
all					
4	3				
CAN-H	CAN-L				CAN bus

Table 4-13: Terminal assignment - interface

CAN Bus Connection

Shielding

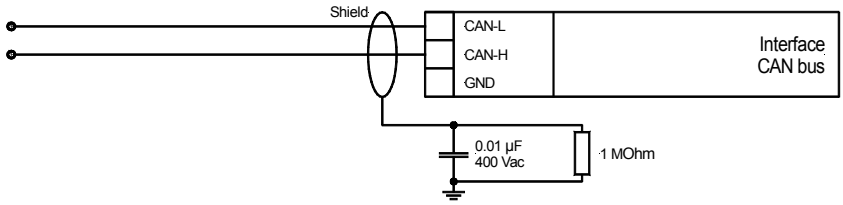


Figure 4-15: Interface - CAN bus shielding

NOTE

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

CAN Bus Topology

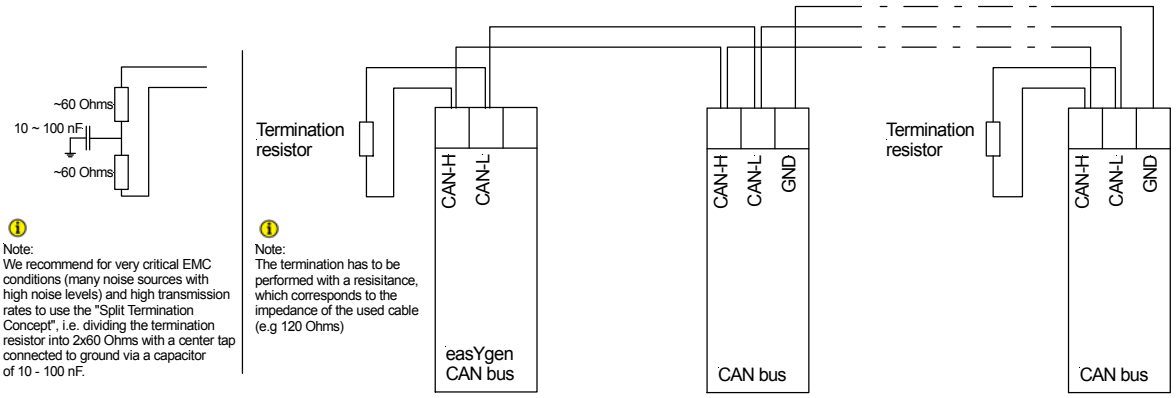


Figure 4-16: Interface - CAN bus topology

Possible CAN Bus Problems

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

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

Woodward recommends the use of twisted-pair cables for the CAN bus (i.e.: Lappkabel Unitronic LIYCY (TP) 2×2×0.25, UNITRONIC-Bus LD 2×2×0.22).

Maximum CAN Bus Length

The maximum length of the communication bus wiring is dependent on the configured Baud rate. The default baud rate is 1000 kBaud. Refer to Table 4-14 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 kbit/s	1000 m
20 kbit/s	2500 m

Table 4-14: Maximum CAN bus length

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

Chapter 5.
Functional Overview

Measuring Value Acquisition

Measuring principle:
The MFR 300 measures alternating voltage/current utilizing a sampling measuring method. All values are sampled for each phase with a rate of 5 kHz, integrated over one period, and the r.m.s. value is calculated. The real power r.m.s. value is calculated by multiplying and integrating the current and voltage values. The frequency is established from the time intervals of the voltage passing through zero. The reactive power is calculated from the phase shift between current and voltage.

Voltage:
- Three-phase r.m.s. value measuring of the wye and delta voltages

Frequency:
Frequency measurement is extracted from the digitally filtered measuring voltages. The frequency is measured if the measured voltage exceeds 5% of the rated voltage (100 V or 690 V). If the system is configured for three phases, all three phases are used for measurement. However the frequency is still measured correctly even if voltage is only applied to one phase.

Current:
- Three-phase r.m.s. value measuring
- Instantaneous value of the current

Real power:
The real power r.m.s. value is measured though real time multiplication of the instantaneous values of the wye voltage and the conductor current.

Reactive power:
Three-phase measurement, calculated from the r.m.s. values of voltage and current and the phase angle between voltage and current.

Power factor:
Calculated from the phase angle between voltage and current.

Active energy:
Active energy combines a time measurement with the measured positive and negative real power. The counter is incorporated in the non-volatile memory and only computes positive energy. The memory is updated every 3 minutes with a resolution of 0.1 kWh. This counter is not calibrated by the Physikalisch-Technische Bundesanstalt (PTB).

Inductive reactive energy:
Reactive energy combines a time measurement with the measured positive and negative reactive power. The counter is incorporated in the non-volatile memory and only computes positive energy. The memory is updated every 3 minutes with a resolution of 0.1 kvarh. This counter is not calibrated by the Physikalisch-Technische Bundesanstalt (PTB).

Angle measuring:
Measuring of the angle between the single wye voltages.

General Functions

Function

- 4 freely configurable relay outputs (change-over)
- 1 relay output (change-over) fixed configured to "ready for operation"
- Interface CAN bus

Protective Functions

- Over/underfrequency protection f<<, f<, f>, f>>
  The protective function is triggered if the frequency is out of the configured limits.
- Three phase over/undervoltage protection V<<, V<, V>, V>>
  Either the wye or the delta voltage is monitored. The protective function is triggered if at least one phase is out of the configured limits.
- Unbalanced load protection Ias>, Ias>>
  Unbalanced load is determined by calculating the negative sequence component of a three phase system. This value is derived from the three current components and the angle between them. Unbalanced load monitoring is only active if the current measuring is set to "L1 L2 L3". The threshold is defined as the percentage of that value relative to the nominal current. The protective function is triggered if this percentage value is exceeded.
- Voltage asymmetry protection Vas>
  Voltage asymmetry is determined by calculating the negative sequence component of a three phase system. This value is derived from the three delta voltages. Voltage asymmetry monitoring is only active if voltage measuring is configured to "3 phase 4 wire" or "3 phase 3 wire". The threshold is defined as the percentage of that value relative to the rated delta voltage. The protective function is triggered if this percentage value is exceeded.
- Load overrun/underrun protection P<<, P<, P>, P>>
  The percentage threshold defines the permissible deviation of the load from defined thresholds. The protective function is triggered if this percentage value is exceeded or fallen below.
- Phase shift protection dφ/dt
  The threshold defines the permissible phase shift angle deviation in any one or all three phases. The protective function is triggered if this angle limit value is exceeded.
- ROCOF protection df/dt
  The threshold defines the permissible rate of change of frequency (ROCOF). The protective function is triggered if this rate limit value is exceeded.
- Configurable time-dependent undervoltage protection $V_{timeA}<$, $V_{timeB}<$
  Either the wye or the delta voltage is monitored. The protective function is triggered if at least one phase falls below the configured time-dependent curve.

LEDs

LED1:
LED1 is illuminated green if the unit is ready for operation.

LED2:
LED2 is illuminated red if the three CAN transmission PDOs are configured for SYNC messages and no CAN SYNC message is received for at least three seconds.

Chapter 6.
Configuration

Measuring

1750 System rated system **50 / 60 Hz**

The rated frequency of the system is used as a reference figure for all frequency related functions, which use a percentage value, like frequency monitoring.

1766 Rated voltage **50 to 650000 V**

ⓘ This value refers to the rated voltage of the source and is the voltage measured on the potential transformer primary.

The source potential transformer primary voltage (delta) is entered in this parameter. The rated voltage is used as a reference figure for all voltage related functions, which use a percentage value, like voltage monitoring.

1754 Rated current **1 to 32000 A**

This value specifies the source rated current, which is used as a reference figure for related functions.

1752 Rated active power **0.5 to 99999.9 kW**

This value specifies the source rated active power, which is used as a reference figure for related functions. The rated active power is the power factor (typically ~0.8) multiplied by the apparent power. These values are indicated in the source data plate.

1850 **Current measuring** **L1 L2 L3 / Phase L1 / Phase L2 / Phase L3**

ⓘ This parameter is only effective if the Voltage measuring (parameter 1851) is configured to "3Ph 4W" or "3Ph 3W".

L1 L2 L3..... All three phases are monitored. The measurement, display and protection are adjusted according to the rules for 3-phase measurement. Monitoring refers to the following currents:
- I_{L1}, I_{L2}, I_{L3}

Phase L{1/2/3}.. Only one phase is monitored. The measurement, display and protection are adjusted according to the rules for single-phase measurement. Monitoring refers to the selected phase.

1851 **Voltage measuring** **3Ph 4W / 3Ph 3W / 1Ph 2W / 1Ph 3W**

3Ph 4W..... Measurement is performed Line-Neutral (WYE connected system) and Line-Line (Delta connected system). The protection depends on the setting of parameter 1770 on page 27. Phase voltages and the neutral must be connected for proper calculation. Measurement and protection are adjusted according to the rules for WYE connected systems. Monitoring refers to the following voltages:
- V_{L12}, V_{L23}, and V_{L31} (parameter 1770 configured to "Phase-phase")
- V_{L1N}, V_{L2N} and V_{L3N} (parameter 1770 configured to "Phase-neutral")

3Ph 3W..... Measurement is performed Line-Line (Delta connected system). Phase voltages must be connected for proper calculation. Measurement and protection are adjusted according to the rules for Delta connected systems. Monitoring refers to the following voltages:
- V_{L12}, V_{L23}, V_{L31}

1Ph 2W..... Measurement is performed Line-Neutral (WYE connected system) if parameter 1858 is configured to "Phase - neutral" and Line-Line (Delta connected system) if parameter 1858 is configured to "Phase - phase". Measurement and protection are adjusted according to the rules for phase-phase systems. Monitoring refers to the following voltages:
- V_{L1N}, V_{L12}

1Ph 3W..... Measurement is performed Line-Neutral (WYE connected system) and Line-Line (Delta connected system). The protection depends on the setting of parameter 1770 on page 27. Measurement and protection are adjusted according to the rules for single-phase systems. Monitoring refers to the following voltages:
- V_{L1N}, V_{L3N} (parameter 1770 configured to "Phase-phase")
- V_{L13} (parameter 1770 configured to "Phase-neutral")

NOTE: If this parameter is configured to 1Ph 3W, the rated voltage (parameter 1766) must be entered as Line-Line (Delta).

3954 **Phase rotation** **CW / CCW**

ⓘ This parameter is important for a correct unbalanced load monitoring (refer to Unbalanced Load (Limits 1 & 2) ANSI# 46 on page 37).

CW ..... The three-phase measured voltage is rotating CW (clock-wise; that means the voltage rotates in direction L1-L2-L3; standard setting).
CCW ..... The three-phase measured voltage is rotating CCW (counter clock-wise; that means the voltage rotates in direction L1-L3-L2).

1858 **1Ph 2W voltage measuring** **Phase - phase / Phase - neutral**

ⓘ This setting is only important if parameter 1851 is configured to "1Ph2W".

Phase - phase .... The phase-phase voltages are monitored for 1Ph 2W measuring.
Phase - neutral.. The phase-neutral voltages are monitored for 1Ph 2W measuring.

1859 **1Ph 2W phase rotation** **CW / CCW**

ⓘ This setting is only important if parameter 1851 is configured to "1Ph2W".

CW ..... The single-phase measured voltage is rotating CW (clock-wise; that means the voltage rotates in direction L1-L2-L3; standard setting).
CCW ..... The single-phase measured voltage is rotating CCW (counter clock-wise; that means the voltage rotates in direction L1-L3-L2).

NOTE: This parameter is important for power factor and reactive power calculation.

1770 **Voltage monitoring** **Phase - phase / Phase - neutral**

The unit can either monitor the wye voltages (phase-neutral) or the delta voltages (phase-phase). The monitoring of the wye voltage is above all necessary to avoid earth-faults in a compensated or isolated network resulting in the tripping of the voltage protection.

! **WARNING:**
This parameter influences the protective functions.

Phase - phase.... The phase-phase voltage will be measured and all subsequent parameters concerning voltage monitoring are referred to this value (V_{L-L}).
Phase - neutral . The phase-neutral voltage will be measured and all subsequent parameters concerning voltage monitoring are referred to this value (V_{L-N}).

1801 **Voltage transformer, primary** **50 to 650000 V**

The primary source voltage in V. The control utilizes the value entered in this parameter along with the measured voltage of the PT secondaries to calculate the voltage.

1800 **Voltage transformer, secondary** **50 to 800 V**

The secondary source voltage in V, which is used as a reference figure for related functions.

NOTE

This controller is available in two different hardware version with either 1A [../1] or 5A [../5] current transformer inputs. Both versions are discussed in this manual. The set points for specific parameters will differ depending upon the hardware version, indicated on the data plate.

- **[1] MFR 300-x1B = Current transformer with ../1 A rated current**
- **[5] MFR 300-x5B = Current transformer with ../5 A rated current**

1806 **Current transformer** **1 to 32000/5 A**

ⓘ Current transformer ratio for the source.

The input of the current transformer ratio is necessary for the indication and control of the actual monitored value. The current transformers ratio should be selected so that at least 60% of the secondary current rating can be measured when the monitored system is at 100% of operating capacity (i.e. at 100% of system capacity a 5 A CT should output 3 A). If the current transformers are sized so that the percentage of the output is lower, the loss of resolution may cause inaccuracies in the monitoring and control functions and affect the functionality of the control.

1808 **Current transformer** **1 to 32000/1 A**

ⓘ Current transformer ratio for the source.

The input of the current transformer ratio is necessary for the indication and control of the actual monitored value. The current transformers ratio should be selected so at least 60% of the secondary current rating can be measured when the monitored system is at 100% of operating capacity (i.e. at 100% of system capacity a 1 A CT should output 0.6 A). If the current transformers are sized so that the percentage of the output is lower, the loss of resolution may cause inaccuracies in the monitoring and control functions and affect the functionality of the control.

Counters

2515 **Set point value for counters** **0 to 99,999,999**

This value is utilized to set the hours in the following parameters:
- kWh counter
- kvarh counter

The number entered into this parameter is the number that will be set to the parameters listed above when they are enabled.

2510 **Set positive kWh counter** **YES / NO**

YES ..... The current value of this counter is overwritten with the value configured in "Set point value for counters" (parameter 2515). After the counter has been (re)set, this parameter changes back to "NO" automatically.
NO ..... The value of this counter is not changed.

2512 **Set negative kWh counter** **YES / NO**

YES ..... The current value of this counter is overwritten with the value configured in "Set point value for counters" (parameter 2515). After the counter has been (re)set, this parameter changes back to "NO" automatically.
NO ..... The value of this counter is not changed.

2511 **Set positive kvarh counter** **YES / NO**

YES ..... The current value of this counter is overwritten with the value configured in "Set point value for counters" (parameter 2515). After the counter has been (re)set, this parameter changes back to "NO" automatically.
NO ..... The value of this counter is not changed.

2513 **Set negative kvarh counter** **YES / NO**

YES ..... The current value of this counter is overwritten with the value configured in "Set point value for counters" (parameter 2515). After the counter has been (re)set, this parameter changes back to "NO" automatically.
NO ..... The value of this counter is not changed.

Monitoring

Overfrequency (Limits 1 & 2) ANSI# 81O

There are two overfrequency alarm levels available in the control. Both alarms are definite time alarms and are illustrated in the figure below. The figure diagrams a frequency trend and the associated pickup times and length of the alarms. Monitoring of the frequency is accomplished in two steps.

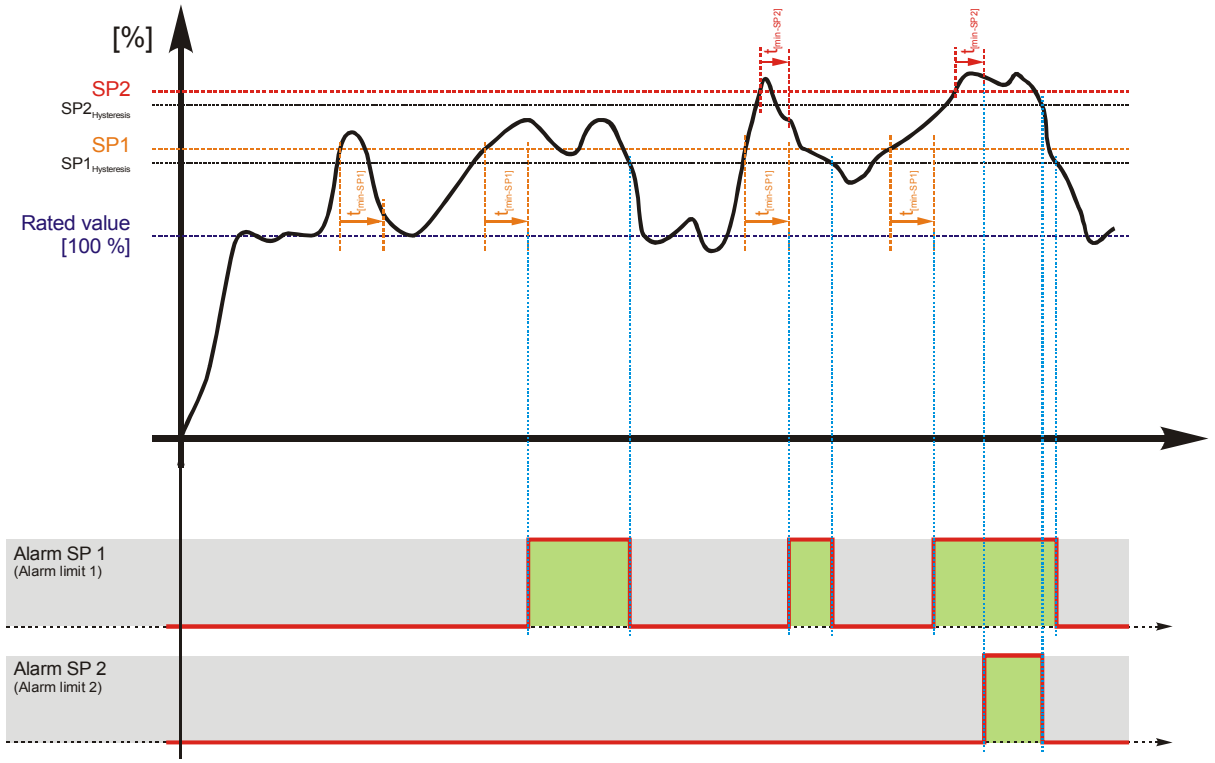


Figure 6-1: Monitoring - overfrequency

Parameter table

The parameters represented in this table are specified in the following, whereas the description is identical for all limits; the limits may only differ in their setting ranges.

Limit	Text	Setting range	Default value
Overfrequency (the hysteresis is 0.05 Hz.)			
Limit 1	Monitoring	ON / OFF	ON
	Limit	50.0 to 130.0 %	110.0 %
	Delay	0.02 to 99.99 s	1.50 s
	Relay	None / Relay 1/2/3/4	1
Limit 2	Monitoring	ON / OFF	ON
	Limit	50.0 to 130.0 %	115.0 %
	Delay	0.02 to 99.99 s	0.30 s
	Relay	None / Relay 1/2/3/4	2

Table 6-1: Monitoring - standard values - overfrequency

1900 / 1906 **Overfrequency monitoring (limit 1 / limit 2)** **ON / OFF**

ON ..... Overfrequency monitoring is carried out according to the following parameters. Monitoring is performed at two levels. Both values may be configured independent from each other.
OFF ..... Monitoring is disabled for limit 1 and/or limit 2.

1904 / 1910 **Overfrequency threshold (limit 1 / limit 2)** **50.0 to 130.0 %**

ⓘ This value refers to the 1750 System rated system (parameter 1750 on page 25).

The percentage values that are to be monitored for each threshold limit are defined here. If this value is reached or exceeded for at least the delay time without interruption, the specified relay will be energized.

1905 / 1911 **Overfrequency delay (limit 1 / limit 2)** **0.02 to 99.99 s**

If the monitored frequency value exceeds the threshold value for the delay time configured here, an alarm will be issued. If the monitored frequency falls below the threshold (minus the hysteresis) before the delay expires the time will be reset.

1901 / 1907 **Overfrequency relay (limit 1 / limit 2)** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

Underfrequency (Limits 1 & 2) ANSI# 81U

There are two underfrequency alarm levels available in the control. Both alarms are definite time alarms and are illustrated in the figure below. The figure diagrams a frequency trend and the associated pickup times and length of the alarms. Monitoring of the frequency is performed in two steps.

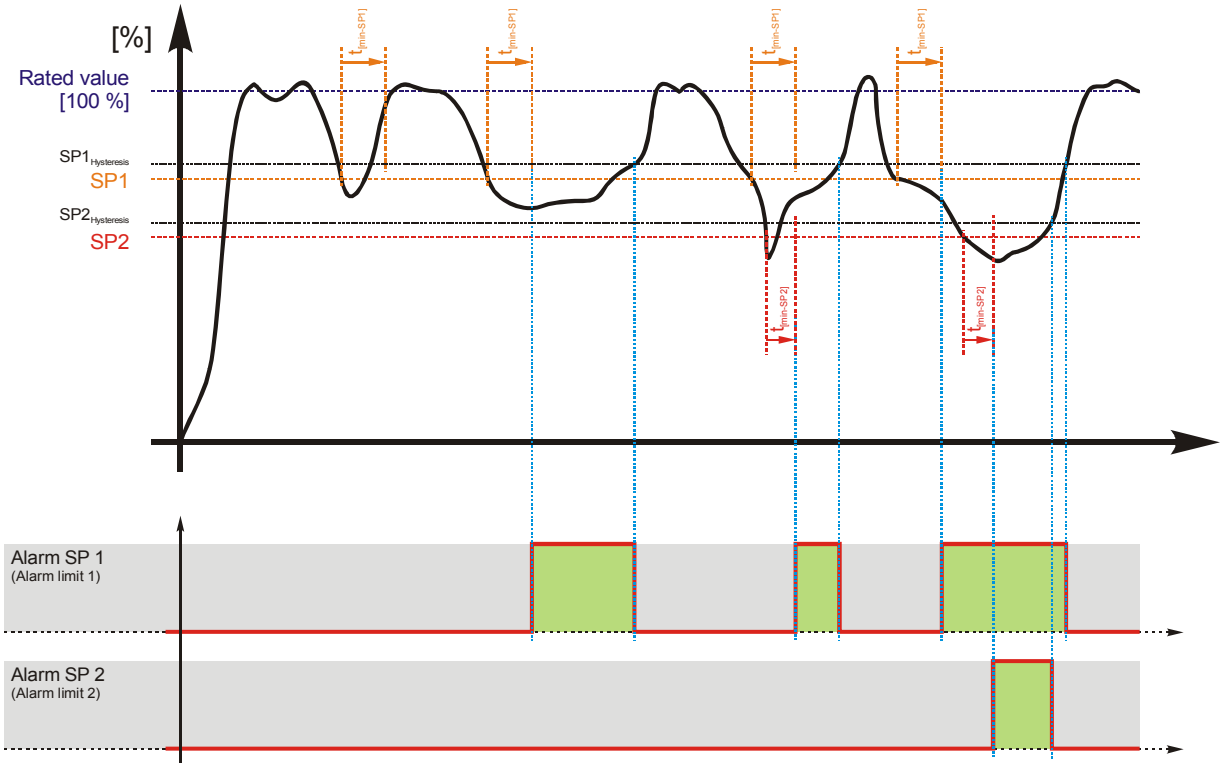


Figure 6-2: Monitoring - underfrequency

Parameter table

The parameters represented in this table are specified in the following, whereas the description is identical for all limits; the limits may only differ in their setting ranges.

Limit	Text	Setting range	Standard value
Underfrequency (the hysteresis is 0.05 Hz.)			
Limit 1	Monitoring	ON / OFF	ON
	Limit	50.0 to 130.0 %	90.0 %
	Delay	0.02 to 99.99 s	5.00 s
	Relay	None / Relay 1/2/3/4	1
Limit 2	Monitoring	ON / OFF	ON
	Limit	50.0 to 130.0 %	84.0 %
	Delay	0.02 to 99.99 s	0.30 s
	Relay	None / Relay 1/2/3/4	2

Table 6-2: Monitoring - standard values - underfrequency

1950 / 1956 **Underfrequency monitoring (limit 1 / limit 2)** **ON / OFF**

ON ..... Underfrequency monitoring is carried out according to the following parameters. Monitoring is performed at two levels. Both values may be configured independent from each other.
OFF ..... Monitoring is disabled for limit 1 and/or limit 2.

1954 / 1960 **Underfrequency threshold (limit 1 / limit 2)** **50.0 to 130.0 %**

ⓘ This value refers to the 1750 System rated system (parameter 1750 on page 25).

The percentage values that are to be monitored for each threshold limit are defined here. If this value is reached or fallen below for at least the delay time without interruption, the specified relay will be energized.

1955 / 1961 **Underfrequency delay (limit 1 / limit 2)** **0.02 to 99.99 s**

If the monitored frequency value falls below the threshold value for the delay time configured here, an alarm will be issued. If the monitored frequency exceeds the threshold (plus the hysteresis) again before the delay expires the time will be reset.

1951 / 1957 **Underfrequency relay (limit 1 / limit 2)** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

Overvoltage (Limits 1 & 2) ANSI# 59

Voltage is monitored depending on parameter "Voltage measuring" (parameter 1851 on page 26). There are two overvoltage alarm levels available in the control. Both alarms are definite time alarms and are illustrated in the below figure. The figure diagrams a frequency trend and the associated pickup times and length of the alarms. Monitoring of the voltage is done in two steps.

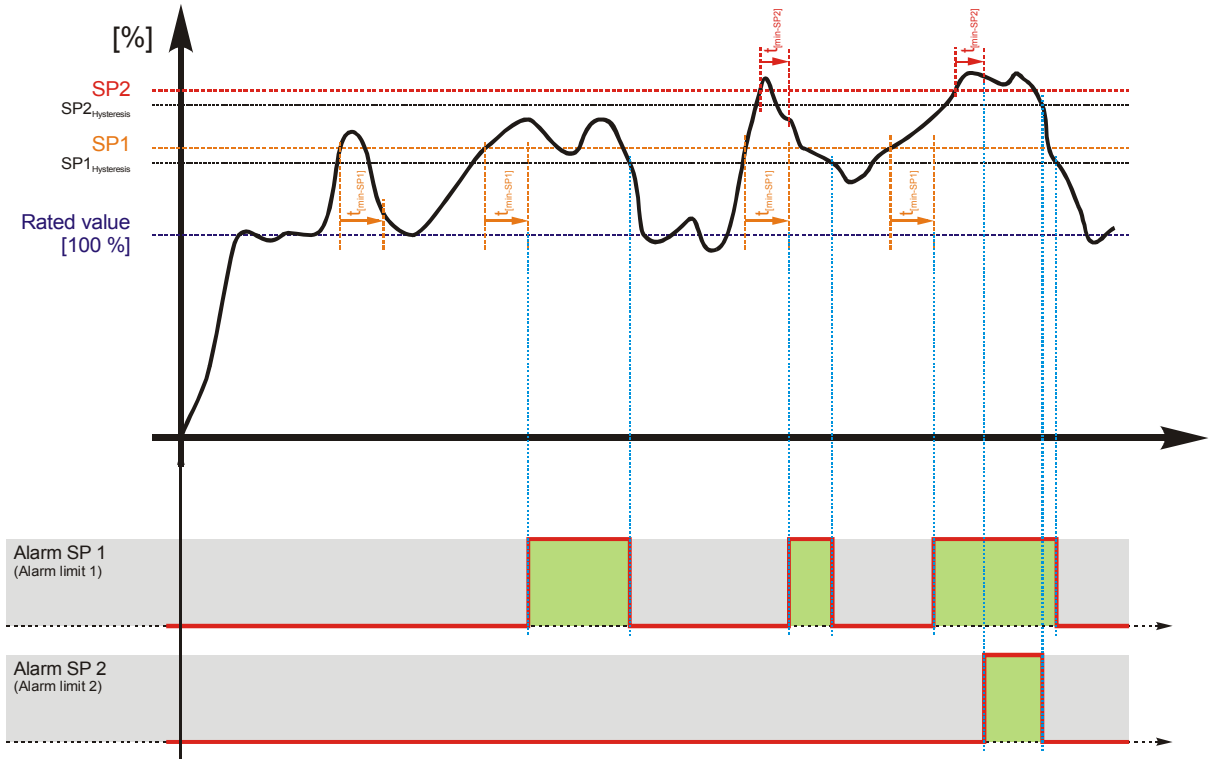


Figure 6-3: Monitoring - overvoltage

Parameter table

The parameters represented in this table are specified in the following, whereas the description is identical for all limits; the limits may only differ in their setting ranges.

Limit	Text	Setting range	Standard value
Overvoltage (the hysteresis is 0.7 % of the rated value)			
Limit 1	Monitoring	ON / OFF	ON
	Limit	50.0 to 125.0 %	108.0 %
	Delay	0.02 to 99.99 s	5.00 s
	Relay	None / Relay 1/2/3/4	1
Limit 2	Monitoring	ON / OFF	ON
	Limit	50.0 to 125.0 %	112.0 %
	Delay	0.02 to 99.99 s	0.30 s
	Relay	None / Relay 1/2/3/4	2

Table 6-3: Monitoring - standard values - overvoltage

2000 / 2006 **Overvoltage monitoring (limit 1 / limit 2)** **ON / OFF**

ON ..... Overvoltage monitoring is carried out according to the following parameters. Monitoring is performed at two levels. Both values may be configured independent from each other.
OFF ..... Monitoring is disabled for limit 1 and/or limit 2.

2004 / 2010 **Overvoltage threshold (limit 1 / limit 2)** **50.0 to 125.0 %**

ⓘ This value refers to the Rated voltage (parameter 1766 on page 25).

The percentage values that are to be monitored for each threshold limit are defined here. If this value is reached or exceeded for at least the delay time without interruption, the specified relay will be energized.

2005 / 2011 **Overvoltage delay (limit 1 / limit 2)** **0.02 to 99.99 s**

If the monitored voltage exceeds the threshold value for the delay time configured here, an alarm will be issued. If the monitored voltage falls below the threshold (minus the hysteresis) before the delay expires the time will be reset.

2001 / 2007 **Overvoltage relay (limit 1 / limit 2)** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

Undervoltage (Limits 1 & 2) ANSI# 27

Voltage is monitored depending on parameter "Voltage measuring" (parameter 1851 on page 26). There are two undervoltage alarm levels available in the control. Both alarms are definite time alarms and are illustrated in the below figure. The figure diagrams a frequency trend and the associated pickup times and length of the alarms. Monitoring of the voltage is done in two steps.

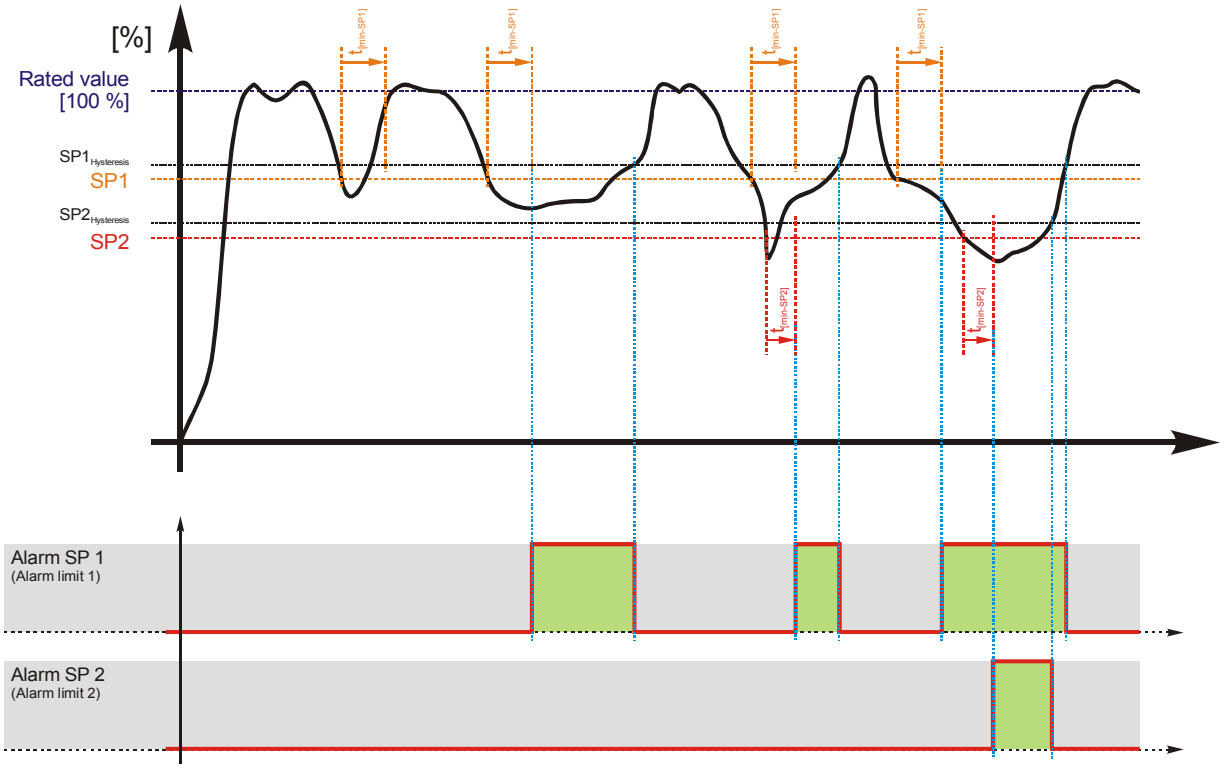


Figure 6-4: Monitoring - undervoltage

Parameter table

The parameters represented in this table are specified in the following, whereas the description is identical for all limits; the limits may only differ in their setting ranges.

Limit	Text	Setting range	Standard value
Undervoltage (the hysteresis is 0.7 % of the rated value)			
Limit 1	Monitoring	ON / OFF	ON
	Limit	50.0 to 125.0 %	92.0 %
	Delay	0.02 to 99.99 s	5.00 s
	Relay	None / Relay 1/2/3/4	1
Limit 2	Monitoring	ON / OFF	ON
	Limit	50.0 to 125.0 %	88.0 %
	Delay	0.02 to 99.99 s	00.30 s
	Relay	None / Relay 1/2/3/4	2

Table 6-4: Monitoring - standard values - undervoltage

2050 / 2056 **Undervoltage monitoring (limit 1 / limit 2)** **ON / OFF**

ON ..... Undervoltage monitoring is carried out according to the following parameters. Monitoring is performed at two levels. Both values may be configured independent from each other.
OFF ..... Monitoring is disabled for limit 1 and/or limit 2.

2054 / 2060 **Undervoltage threshold (limit 1 / limit 2)** **50.0 to 125.0 %**

ⓘ This value refers to the Rated voltage (parameter 1766 on page 25).

The percentage values that are to be monitored for each threshold limit are defined here. If this value is reached or fallen below for at least the delay time without interruption, the specified relay will be energized.

2055 / 2061 **Undervoltage delay (limit 1 / limit 2)** **0.02 to 99.99 s**

If the monitored voltage falls below the threshold value for the delay time configured here, an alarm will be issued. If the monitored voltage exceeds the threshold (plus the hysteresis) again before the delay expires the time will be reset.

2051 / 2057 **Undervoltage relay (limit 1 / limit 2)** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

Unbalanced Load (Limits 1 & 2) ANSI# 46

Unbalanced load is monitored depending on parameter "Phase rotation" (parameter 3954 on page 26), parameter "Current measuring" (parameter 1850 on page 25), and parameter "Voltage measuring" (parameter 1851 on page 26). The unbalanced load alarm is a phase imbalance alarm. Unbalanced load is determined by calculating the negative sequence component of a three phase system. This value is derived from the three current components and the angle between them. Unbalanced load monitoring is only active if current measuring is configured to "L1 L2 L3" and voltage measuring is either configured to "3Ph 4W" or "3Ph 3W". The threshold is defined as the percentage of that value relative to the nominal current. The protective function is triggered if this percentage value is exceeded.

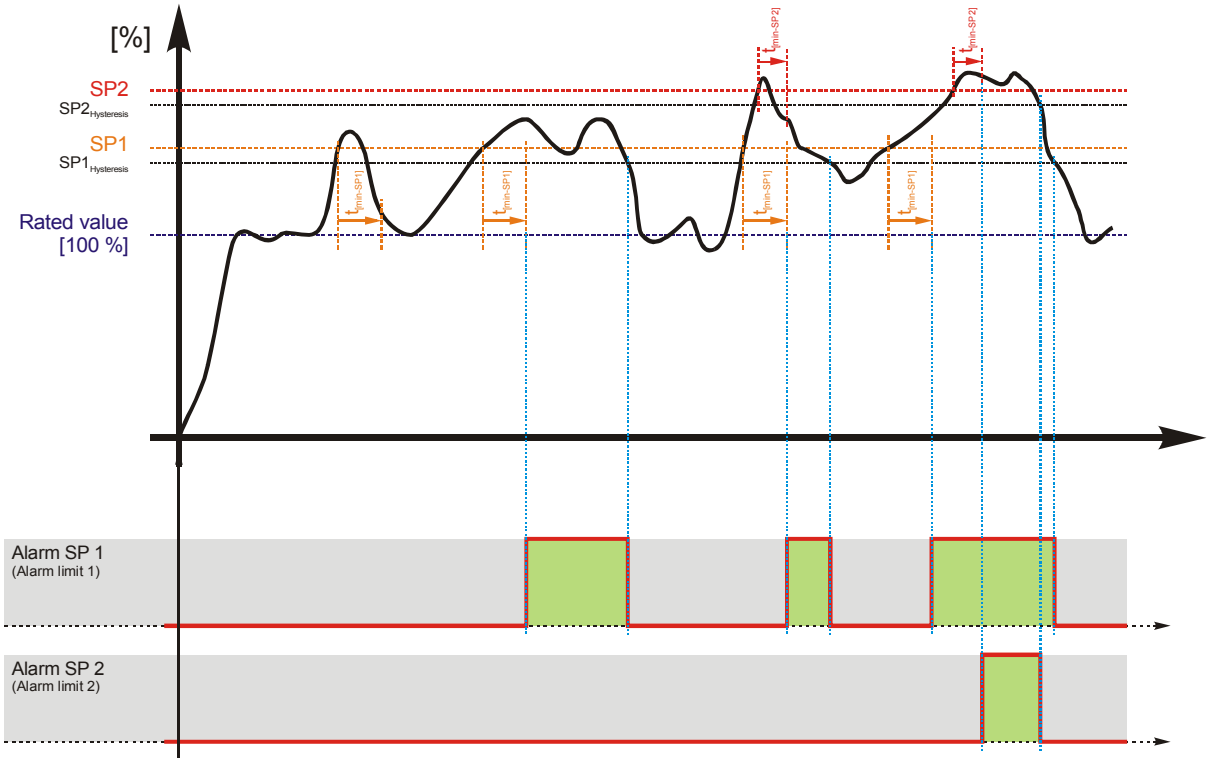


Figure 6-5: Monitoring - unbalanced load

Parameter table

The parameters represented in this table are specified in the following, whereas the description is identical for all limits; the limits may only differ in their setting ranges.

Limit	Text	Setting range	Standard value
Unbalanced load (the hysteresis is 0.5 % of the rated current)			
Limit 1	Monitoring	ON / OFF	ON
	Limit	5.0 to 100.0 %	10.0 %
	Delay	0.02 to 99.99 s	10.00 s
	Relay	None / Relay 1/2/3/4	1
Limit 2	Monitoring	ON / OFF	ON
	Limit	5.0 to 100.0 %	15.0 %
	Delay	0.02 to 99.99 s	1.00 s
	Relay	None / Relay 1/2/3/4	2

Table 6-5: Monitoring - standard values - unbalanced load

NOTE

This monitoring function is only enabled if current measuring (parameter 1850) is configured to "L1 L2 L3" and voltage measuring (parameter 1851) is configured either to "3Ph 4W" or "3Ph 3W".

Phase rotation (parameter 3954) must be configured correctly for a proper operation.

Parameters

2400 / 2406 **Unbalanced load monitoring (limit 1 / limit 2)** **ON / OFF**

ON ..... Unbalanced load monitoring is carried out according to the following parameters. Monitoring is performed at two levels. Both values may be configured independent from each other.
OFF ..... Monitoring is disabled for limit 1 and/or limit 2.

2404 / 2410 **Unbalanced load threshold (limit 1 / limit 2)** **5.0 to 100.0 %**

ⓘ This value refers to the Rated current (parameter 1754 on page 25).

The percentage values that are to be monitored for each threshold limit are defined here. If this value is reached or exceeded for at least the delay time without interruption, the specified relay will be energized.

2405 / 2411 **Unbalanced load delay (limit 1 / limit 2)** **0.02 to 99.99 s**

If the monitored load exceeds the threshold value for the delay time configured here, an alarm will be issued. If the monitored load exceeds or falls below the threshold (minus the hysteresis) before the delay expires the time will be reset.

2401 / 2407 **Unbalanced load relay (limit 1 / limit 2)** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

Voltage Asymmetry

Voltage asymmetry is determined by calculating the negative sequence component of a three phase system. This value is derived from the three delta voltages. Voltage asymmetry monitoring is only active if voltage measuring is configured to "3Ph 4W" or "3Ph 3W". The threshold is defined as the percentage of that value relative to the nominal delta voltage. The protective function is triggered if this percentage value is exceeded.

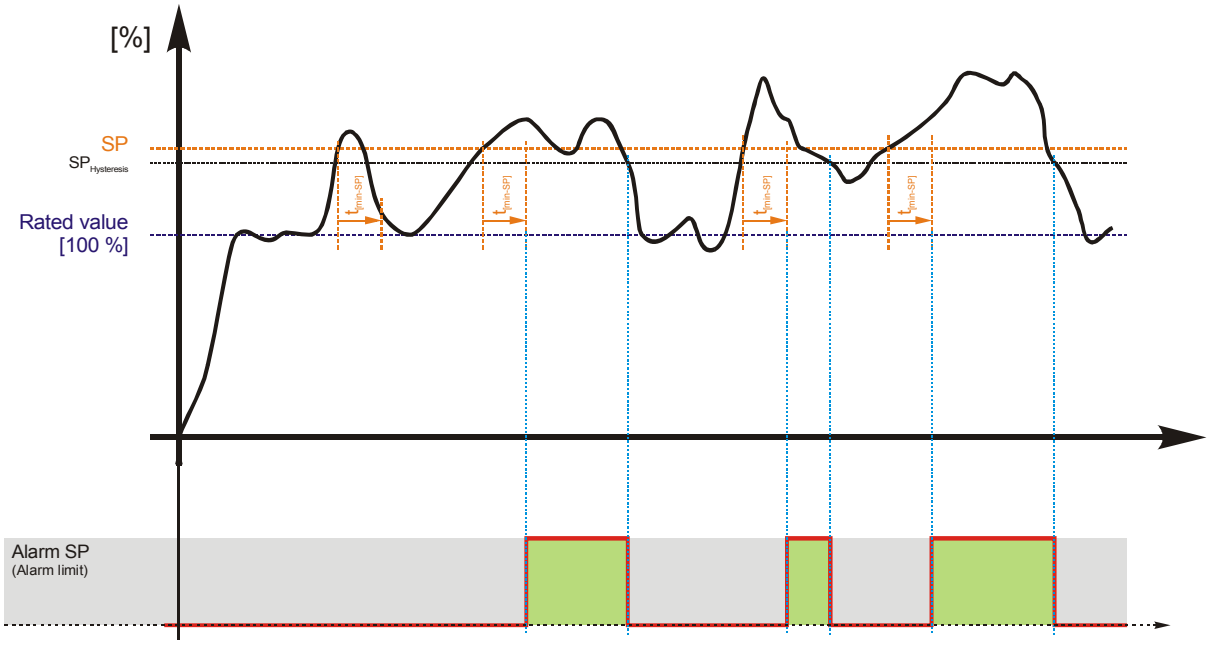


Figure 6-6: Monitoring - voltage asymmetry

Parameter table

The parameters represented in this table are specified in the following, whereas the description is identical for all limits; the limits may only differ in their setting ranges.

Limit	Text	Setting range	Standard value
Voltage asymmetry (the hysteresis is 0.7 % of the rated value).			
	Monitoring	ON / OFF	ON
	Limit	0.5 to 99.9 %	10.0 %
	Delay	0.02 to 99.99 s	5.00 s
	Relay	None / Relay 1/2/3/4	1

Table 6-6: Monitoring - standard values - voltage asymmetry

NOTE

This monitoring function is only enabled if voltage measuring (parameter 1851) is configured to "3Ph 4W" or "3Ph 3W".

3900 **Voltage asymmetry monitoring** **ON / OFF**

ON ..... Voltage asymmetry monitoring is carried out according to the following parameters.
OFF ..... No monitoring is carried out.

3903 **Voltage asymmetry threshold** **0.5 to 99.9 %**

ⓘ This value refers to Rated voltage (parameter 1766 on page 25).

The percentage values that are to be monitored for each threshold limit are defined here. If this value is reached or exceeded for at least the delay time without interruption, the specified relay will be energized.

3904 **Voltage asymmetry delay** **0.02 to 99.99 s**

If the monitored voltage asymmetry exceeds the threshold value for the delay time configured here, an alarm will be issued. If the monitored voltage asymmetry falls below the threshold (minus the hysteresis) before the delay expires the time will be reset.

3901 **Voltage asymmetry relay** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

Load Underrun (Limits 1 & 2) ANSI# 32R/F

Power is monitored depending on parameter "Voltage measuring" (parameter 1851 on page 26) and parameter "Current measuring" (parameter 1850 on page 25). If the single- or three-phase measured real power is below the adjusted limit of the reduced load, the alarm will be issued. Both alarm limits may either be positive or negative. A negative load is considered as a reverse load and a positive load is considered as a reduced load.

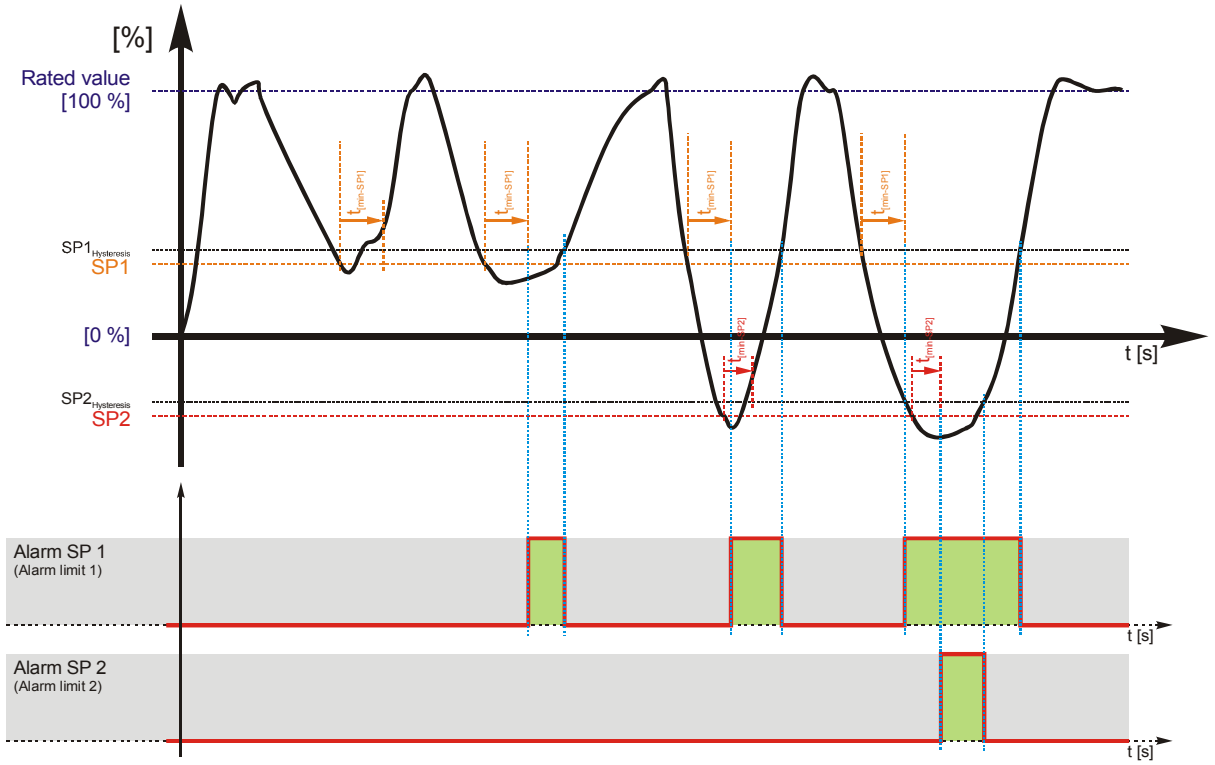


Figure 6-7: Monitoring - load underrun

Parameter table

The parameters represented in this table are specified in the following, whereas the description is identical for all limits; the limits may only differ in their setting ranges.

Limit	Text	Setting range	Standard value
Reverse / reduced power (the hysteresis is 1 % of the rated value)			
Limit 1	Monitoring	ON / OFF	ON
	Limit	-300.0 to300.0 %	-3.0 %
	Delay	0.02 to 99.99 s	5.00 s
	Relay	None / Relay 1/2/3/4	1
Limit 2	Monitoring	ON / OFF	ON
	Limit	-300.0 to300.0 %	-5.0 %
	Delay	0.02 to 99.99 s	3.00 s
	Relay	None / Relay 1/2/3/4	2

Table 6-7: Monitoring - standard values - load underrun

2250 / 2256 **Load underrun monitoring (limit 1 / limit 2)** **ON / OFF**

ON ..... Load underrun monitoring is carried out according to the following parameters. Monitoring is performed at two levels. Both values may be configured independent from each other and may either be positive or negative.
OFF ..... Monitoring is disabled for limit 1 and/or limit 2.

2254 / 2260 **Load underrun threshold (limit 1 / limit 2)** **-300.0 to300.0 %**

ⓘ This value refers to the Rated active power (parameter 1752 on page 25).

ⓘ A negative value refers to a negative load, i.e. reverse load and a positive load is considered as a reduced load.

The percentage values that are to be monitored for each threshold limit are defined here. If this value is reached or fallen below for at least the delay time without interruption, the specified relay will be energized.

2255 / 2261 **Load underrun delay (limit 1 / limit 2)** **0.02 to 99.99 s**

If the monitored load falls below the threshold value for the delay time configured here, an alarm will be issued. If the monitored load exceeds the threshold (plus the hysteresis) again before the delay expires the time will be reset.

2251 / 2257 **Load underrun relay (limit 1 / limit 2)** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

Load Overrun (Limits 1 & 2) ANSI# 32

Power is monitored depending on parameter "Voltage measuring" (parameter 1851 on page 26) and parameter "Current measuring" (parameter 1850 on page 25). If the single- or three-phase measured real power exceeds the adjusted limit of the reduced load, the alarm will be issued. Both alarm limits may either be positive or negative.

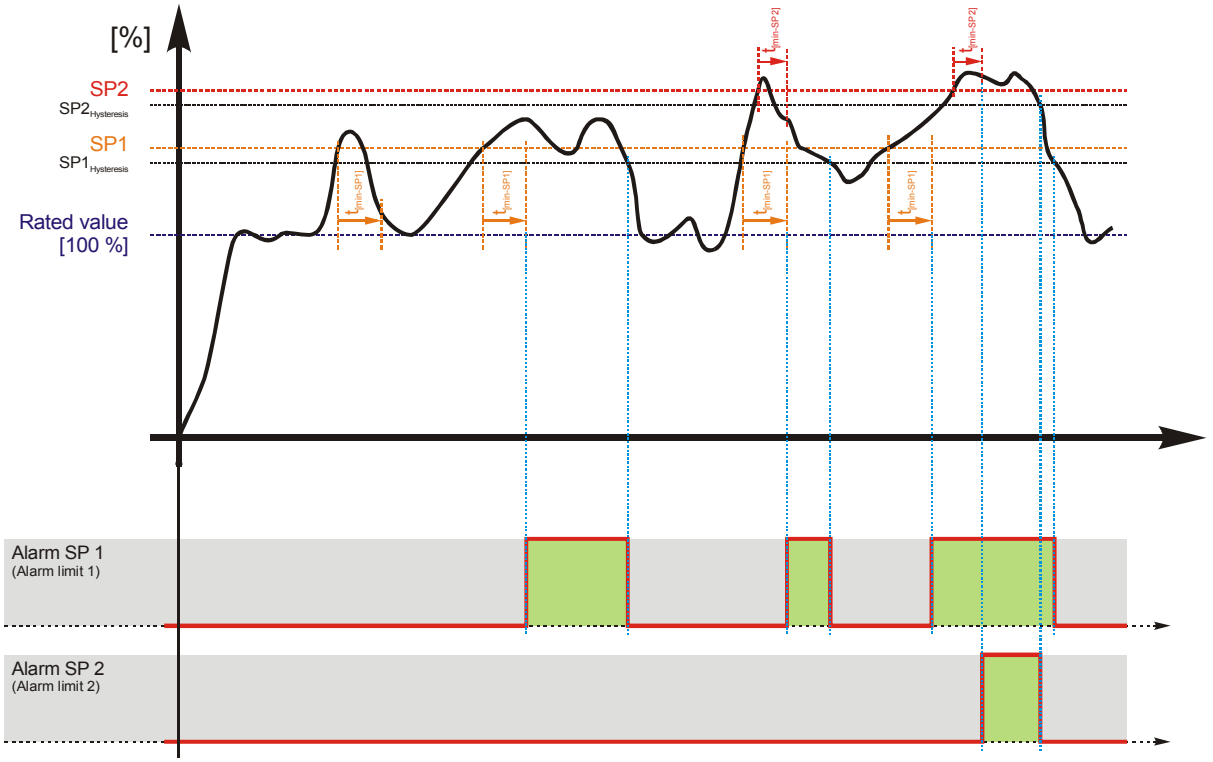


Figure 6-8: Monitoring - load overrun

Parameter table

The parameters represented in this table are specified in the following, whereas the description is identical for all limits; the limits may only differ in their setting ranges.

Limit	Text	Setting range	Standard value
Reverse / reduced power (the hysteresis is 1 % of the rated value)			
Limit 1	Monitoring	ON / OFF	ON
	Limit	-300.0 to300.0 %	110.0 %
	Delay	0.02 to 99.99 s	11.00 s
	Relay	None / Relay 1/2/3/4	1
Limit 2	Monitoring	ON / OFF	ON
	Limit	-300.0 to300.0 %	120.0 %
	Delay	0.02 to 99.99 s	0.10 s
	Relay	None / Relay 1/2/3/4	2

Table 6-8: Monitoring - standard values - load overrun

2300 / 2306 **Load overrun monitoring (limit 1 / limit 2)** **ON / OFF**

ON ..... Load overrun monitoring is carried out according to the following parameters. Monitoring is performed at two levels. Both values may be configured independent from each other and may either be positive or negative.
OFF ..... Monitoring is disabled for limit 1 and/or limit 2.

2304 / 2310 **Load overrun threshold (limit 1 / limit 2)** **-300.0 to300.0 %**

ⓘ This value refers to the Rated active power (parameter 1752 on page 25).

The percentage values that are to be monitored for each threshold limit are defined here. If this value is reached or exceeded for at least the delay time without interruption, the specified relay will be energized.

2305 / 2311 **Load overrun delay (limit 1 / limit 2)** **0.02 to 99.99 s**

If the monitored exceeds the threshold value for the delay time configured here, an alarm will be issued. If the monitored load falls below the threshold (minus the hysteresis) again before the delay expires the time will be reset.

2301 / 2307 **Load overrun relay (limit 1 / limit 2)** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

Phase Shift

A vector/phase shift is defined as the sudden variation of the voltage curve which may be caused by a major source load change.

The unit measures the duration of a cycle, where a new measurement is started with each voltage passing through zero. The measured cycle duration will be compared with an internal quartz-calibrated reference time to determine the cycle duration difference of the voltage signal. A vector/phase shift as shown in Figure 6-9 causes a premature or delayed zero passage. The determined cycle duration difference corresponds with the occurring phase shift angle.

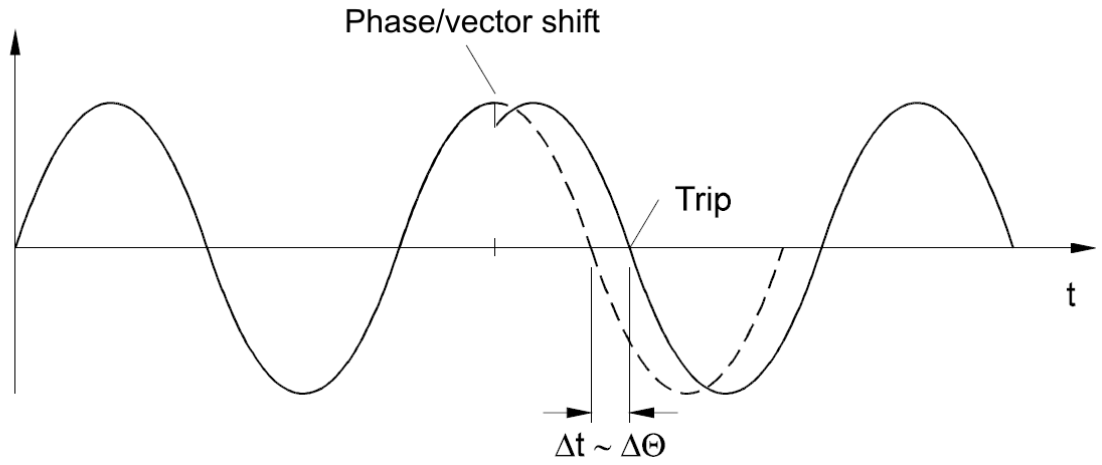


Figure 6-9: Monitoring - phase shift

The monitoring may be carried out three-phase or one/three-phase. The monitoring can be configured in different ways. The vector/phase shift monitor can also be used as an additional method to decouple from the grid. Vector/phase shift monitoring is only enabled after the monitored voltage exceeds 50% of the PT secondary rated voltage.

Function: "Voltage cycle duration not within the permissible range" - The voltage cycle duration exceeds the configured limit value for the phase/vector shift.

Parameter table

The parameters represented in this table are specified in the following, whereas the description is identical for all limits; the limits may only differ in their setting ranges.

Limit	Text	Setting range	Standard value
Mains phase shift			
	Monitoring	ON / OFF	ON
	Monitoring	1- and 3 phase / 3 phase	1- and 3 phase
	Limit 1 phase	3 to 30 °	20 °
	Limit 3 phase	3 to 30 °	8 °
	Relay	None / Relay 1/2/3/4	1

Table 6-9: Monitoring - standard values - phase shift

3050 **Phase shift monitoring** **ON / OFF**

ON ..... Phase shift monitoring is carried out according to the following parameters.
OFF ..... Monitoring is disabled.

3053 **Phase shift monitoring** **1- and 3 phase / 3 phase**

1- and 3 phase ... During single-phase voltage phase/vector shift monitoring, tripping occurs if the phase/vector shift exceeds the configured threshold value (parameter 3054) in at least one of the three phases. Note: If a phase/vector shift occurs in one or two phases, the single-phase threshold value (parameter 3054) is taken into consideration; if a phase/vector shift occurs in all three phases, the three-phase threshold value (parameter 3055) is taken into consideration. Single phase monitoring is very sensitive and may lead to nuisance tripping if the selected phase angle settings are too small.
3 phase ..... During three-phase voltage phase/vector shift monitoring, tripping occurs only if the phase/vector shift exceeds the specified threshold value (parameter 3055) in all three phases within 2 cycles.

NOTE

3 phase phase shift monitoring is only enabled if voltage measuring (parameter 1851) is configured to "3Ph 4W" or "3Ph 3W".

3054 **Phase shift threshold 1 phase** **3 to 30 °**

ⓘ This parameter is only active, if "Phase shift monitoring" (parameter 3053) is configured to "1- and 3-phase". Since one phase monitoring is more sensible than three phase monitoring, it should be always be configured to a significantly higher threshold than "Phase shift threshold 3 phase" (parameter 3055).

If the electrical angle of the voltage shifts more than this configured value in any single phase, the relay configured in parameter 3051 energizes.

3055 **Phase shift threshold 3 phase** **3 to 30 °**

If the electrical angle of the voltage shifts more than this configured value in all three phases, the relay configured in parameter 3051 energizes.

3051 **Phase shift relay** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

df/dt (ROCOF) Monitoring

Function: "Rate Of Change Of Frequency (ROCOF) is not within permissible limits"
Rate of Change Of Frequency (ROCOF) monitoring measures the stability of the frequency. The frequency of a source will vary due to changing loads and other effects. The rate of these frequency changes due to the load variances is relatively high compared to those of a large network. The control unit calculates the unit of measure per unit of time. The df/dt is measured over 4 sine waves to ensure that it is differentiated from a phase shift. This results in a minimum response time of approximately 100ms.

Parameter table

The parameters represented in this table are specified in the following, whereas the description is identical for all limits; the limits may only differ in their setting ranges.

Limit	Text	Setting range	Standard value
df/dt (ROCOF)			
	Monitoring	ON / OFF	OFF
	Limit	1.0 to 9.9 Hz/s	2.6 Hz/s
	Delay	0.10 to 2.00 s	0.1 s
	Relay	None / Relay 1/2/3/4	1

Table 6-10: Monitoring - standard values - df/dt (ROCOF) monitoring

3100 **df/dt monitoring** **ON / OFF**

ON..... df/dt monitoring is carried out according to the following parameters.
OFF..... No monitoring is carried out.

3104 **df/dt threshold** **1.0 to 9.9 Hz/s**

The rate of change of frequency threshold is defined here. If this value is reached or exceeded for at least the delay time without interruption, the relay configured in parameter 3101 will be energized.

3105 **df/dt delay** **0.10 to 2.00 s**

If the monitored rate of change of frequency exceeds the threshold value for the delay time configured here, the relay configured in parameter 3101 energizes. If the monitored rate of change of frequency falls below the threshold (minus the hysteresis) before the delay expires the time will be reset.

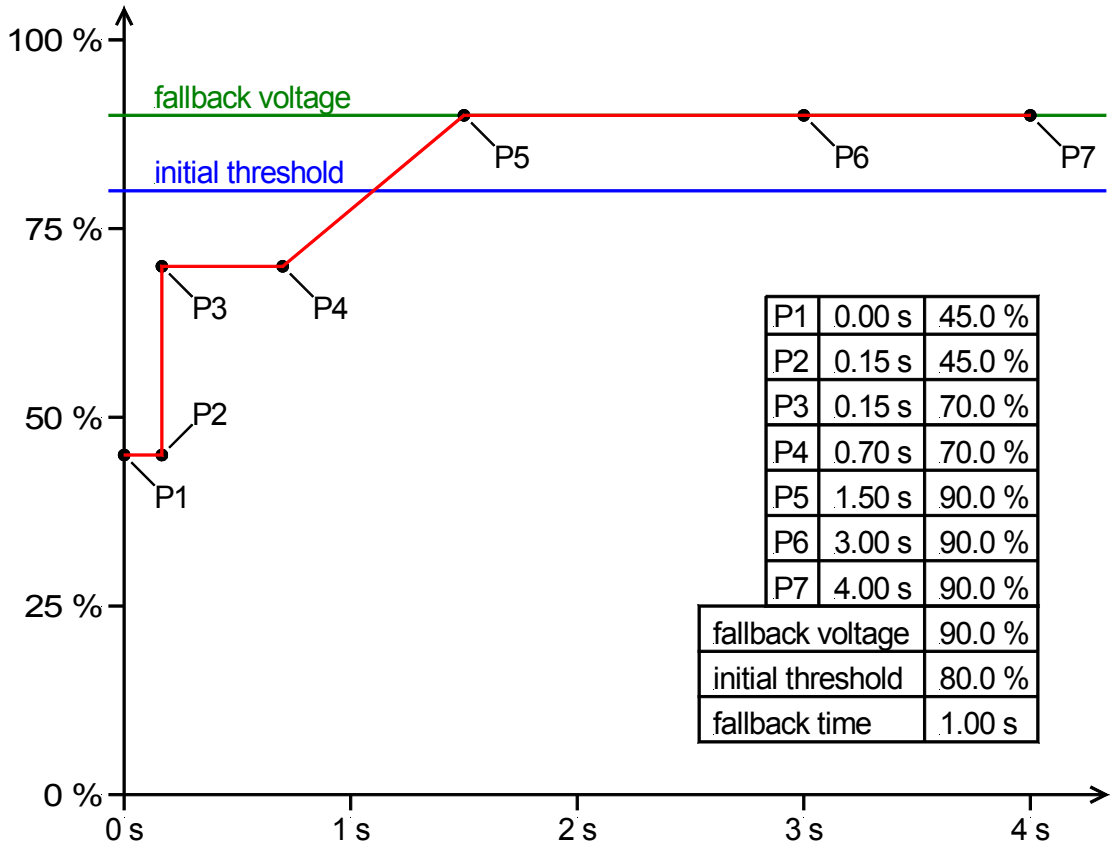
3101 **df/dt relay** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

Time-Dependent Undervoltage Monitoring A

Voltage is monitored depending on parameter "Voltage measuring" (parameter 1851 on page 26). If the measured voltage of at least one phase falls below the configured initial threshold (parameter 4970), the time-dependent undervoltage monitoring sequence starts and the undervoltage threshold will change in time according to the configured threshold curve points. If the measured voltage falls below this curve, the monitoring function triggers and the configured relay will energize. If the measured voltage exceeds the configured fallback voltage (parameter 4978) for at least the configured fallback time (parameter 4968), the time-dependent undervoltage monitoring sequence will be reset.

The threshold curve results from seven configurable points and a linear interpolation between these points. Figure 6-10 shows a threshold curve with standard values for time-dependent undervoltage monitoring A. These standard values form an FRT (fault ride-through) monitoring function according to the grid code requirements for wind turbines. The time points should always have an ascending order. The fallback threshold should always be configured to a value higher than the init threshold.



P1	0.00 s	45.0 %
P2	0.15 s	45.0 %
P3	0.15 s	70.0 %
P4	0.70 s	70.0 %
P5	1.50 s	90.0 %
P6	3.00 s	90.0 %
P7	4.00 s	90.0 %
fallback voltage		90.0 %
initial threshold		80.0 %
fallback time		1.00 s

Figure 6-10: Monitoring - time-dependent undervoltage monitoring A threshold curve

4950 **Monitoring** **ON / OFF**

ON..... Time-dependent undervoltage monitoring A is carried out according to the following parameters.
OFF..... No monitoring is carried out.

4951 **Relay** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

4970 **Init threshold** **0.0 to 200.0 %**

The time-dependent undervoltage monitoring initial threshold is configured here. If the measured voltage of at least one phase falls below this threshold, the monitoring sequence starts and the undervoltage threshold will change in time according to the configured threshold curve points. If the measured voltage falls below this curve, the monitoring function triggers and the configured relay will energize.

4978 **Fallback threshold** **0.0 to 200.0 %**

The time-dependent undervoltage monitoring fallback voltage is configured here. If the measured voltage exceeds the voltage configured here for at least the configured fallback time (parameter 4968), the monitoring sequence will be reset. This parameter should always be configured to a value higher than the init threshold (parameter 4970) for proper operation.

4968 **Fallback time** **0.0 to 320.0 s**

The time-dependent undervoltage monitoring fallback time is configured here. If the measured voltage exceeds the configured fallback voltage (parameter 4978) for at least the time configured here, the monitoring sequence will be reset.

4961 **Threshold curve point 1 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here. This parameter is to be set to 0 normally.

4971 **Threshold curve point 1 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4962 Threshold curve point 2 time **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4972 Threshold curve point 2 voltage **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4963 **Threshold curve point 3 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4973 **Threshold curve point 3 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4964 **Threshold curve point 4 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4974 **Threshold curve point 4 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4965 **Threshold curve point 5 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4975 **Threshold curve point 1 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4966 **Threshold curve point 6 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4976 **Threshold curve point 6 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4967 **Threshold curve point 7 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

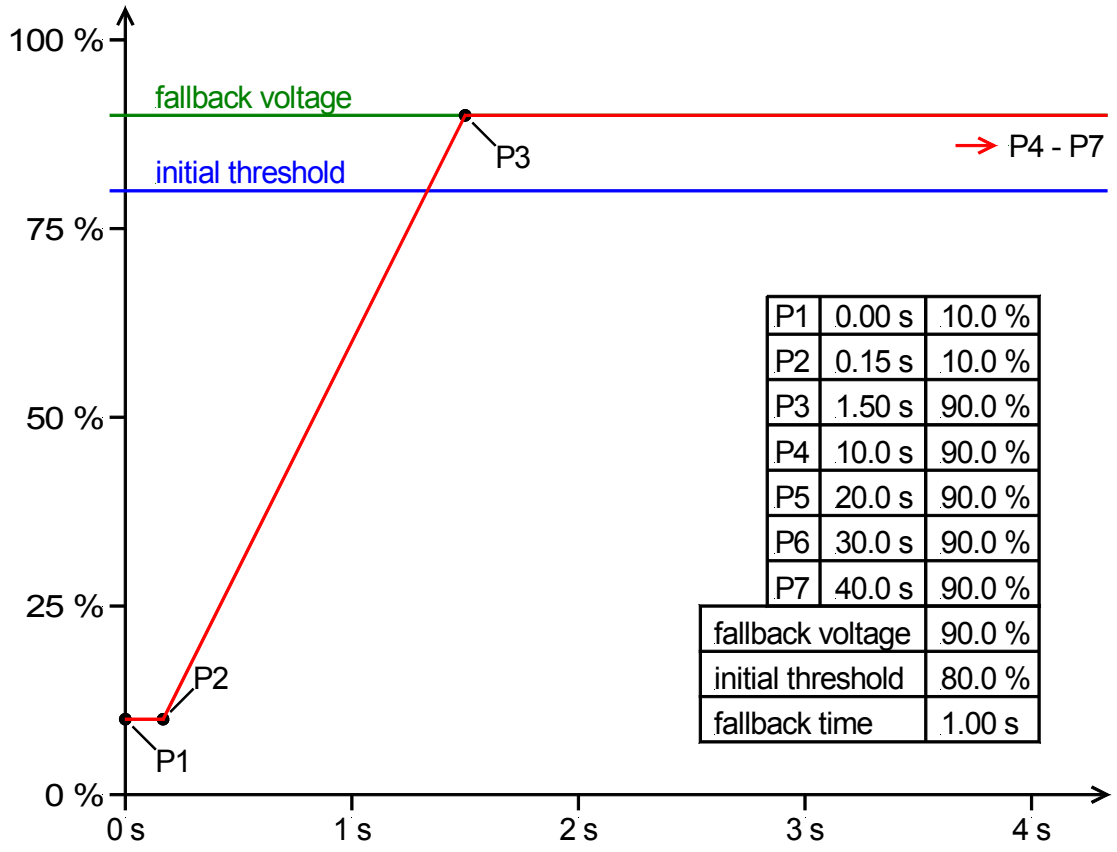
4977 **Threshold curve point 7 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

Time-Dependent Undervoltage Monitoring B

Voltage is monitored depending on parameter "Voltage measuring" (parameter 1851 on page 26). If the measured voltage of at least one phase falls below the configured initial threshold (parameter 4970), the time-dependent undervoltage monitoring sequence starts and the undervoltage threshold will change in time according to the configured threshold curve points. If the measured voltage falls below this curve, the monitoring function triggers and the configured relay will energize. If the measured voltage exceeds the configured fallback voltage (parameter 4978) for at least the configured fallback time (parameter 4968), the time-dependent undervoltage monitoring sequence will be reset.

The threshold curve results from seven configurable points and a linear interpolation between these points. Figure 6-11 shows a threshold curve with standard values for time-dependent undervoltage monitoring B. These standard values form an STI (short-term interruption) monitoring function according to the grid code requirements for wind turbines. The time points should always have an ascending order. The fallback threshold should always be configured to a value higher than the init threshold.



P1	0.00 s	10.0 %
P2	0.15 s	10.0 %
P3	1.50 s	90.0 %
P4	10.0 s	90.0 %
P5	20.0 s	90.0 %
P6	30.0 s	90.0 %
P7	40.0 s	90.0 %
fallback voltage		90.0 %
initial threshold		80.0 %
fallback time		1.00 s

Figure 6-11: Monitoring - time-dependent undervoltage monitoring B threshold curve

4954 **Monitoring** **ON / OFF**

ON ..... Time-dependent undervoltage monitoring B is carried out according to the following parameters.
OFF ..... No monitoring is carried out.

4955 **Relay** **None / Relay 1 / Relay 2 / Relay 3 / Relay 4**

The relay configured here is energized if the respective monitoring functions triggers. If "0" is configured here, no relay energizes in this case.

4990 **Init threshold** **0.0 to 200.0 %**

The time-dependent undervoltage monitoring initial threshold is configured here. If the measured voltage of at least one phase falls below this threshold, the monitoring sequence starts and the undervoltage threshold will change in time according to the configured threshold curve points. If the measured voltage falls below this curve, the monitoring function triggers and the configured relay will energize.

4998 **Fallback threshold** **0.0 to 200.0 %**

The time-dependent undervoltage monitoring fallback voltage is configured here. If the measured voltage exceeds the voltage configured here for at least the configured fallback time (parameter 4988), the monitoring sequence will be reset. This parameter should always be configured to a value higher than the init threshold (parameter 4990) for proper operation.

4988 **Fallback time** **0.0 to 320.0 s**

The time-dependent undervoltage monitoring fallback time is configured here. If the measured voltage exceeds the configured fallback voltage (parameter 4998) for at least the time configured here, the monitoring sequence will be reset.

4981 **Threshold curve point 1 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here. This parameter is to be set to 0 normally.

4991 **Threshold curve point 1 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4982 Threshold curve point 2 time **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4992 Threshold curve point 2 voltage **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4983 **Threshold curve point 3 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4993 **Threshold curve point 3 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4984 **Threshold curve point 4 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4994 **Threshold curve point 4 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4985 **Threshold curve point 5 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4995 **Threshold curve point 1 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4986 **Threshold curve point 6 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4996 **Threshold curve point 6 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4987 **Threshold curve point 7 time** **0.0 to 320.0 s**

The time value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

4997 **Threshold curve point 7 voltage** **0.0 to 200.0 %**

The voltage value of time-dependent undervoltage monitoring threshold curve point 1 is configured here.

CAN Interface

3156 **Baud rate** **20 / 50 / 100 / 125 / 250 / 500 / 800 / 1,000 kBaud**

This parameter defines the used Baud rate. Please note, that all participants on the CAN bus must use the same Baud rate. The Baud rate can be configured via the CAN interface. However, the configuring CAN master must change its Baud rate to be able to reconnect. If the baud rate has been changed, the unit continues to operate with its current baud rate until it is shut down. The new baud rate will be enabled after a re-start.

1702 **Node ID** **1 to 32**

A number that is unique to the control must be set in this parameter so that this control unit can be correctly identified on the CAN bus. This address number may only be used once on the CAN bus. All additional addresses are calculated based on this unique device number.

9100 **COB ID SYNC message** **1 to 2047**

This parameter defines the COB ID of the synchronization object (SYNC). Further it defines whether the unit generates the SYNC.

9117 **Producer heartbeat time** **1 to 65535 ms**

Independent from the CANopen Master configuration, the unit transmits a heartbeat message with this configured heartbeat cycle time. If the producer heartbeat time is equal 0, the heartbeat will only be sent as response to a remote frame request. The time configured here will be rounded up to the next 20 ms step.

9600 **COB ID of transmit PDO 1** **1 to 2047**

This parameter contains the communication parameters for the PDOs the unit is able to transmit. The unit transmits data (i.e. visualization data) on the CAN ID configured here.

9602 **Transmission type of PDO 1** **0 to 255**

This parameter contains the communication parameters for the PDOs the unit is able to transmit. This parameter defines whether the unit broadcasts all data automatically (value 254 or 255) or only upon request with the configured address of the COB ID SYNC message (Parameter 9100).
A value between 1 and 240 means that the PDO is transferred synchronously and cyclically. The transmission type indicates the number of SYNC messages, which are necessary to trigger PDO transmissions.

9610 **COB ID of transmit PDO 2** **1 to 2047**

Refer to parameter 9600.

9612 **Transmission type of PDO 2** **0 to 255**

Refer to parameter 9602.

9620 **COB ID of transmit PDO 3** **1 to 2047**

Refer to parameter 9600.

9622 **Transmission type of PDO 3** **0 to 255**

Refer to parameter 9602.

Chapter 7.
Commissioning

DANGER - HIGH VOLTAGE

When commissioning the control, please observe all safety rules that apply to the handling of live equipment. Ensure that you know how to provide first aid in the event of an uncontrolled release of energy and that you know where the first aid kit and the nearest telephone are. Never touch any live components of the system or on the back of the system:

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

WARNING

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

CAUTION

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

Chapter 8.
Technical Data

Measuring values, voltage ---------- **⅄/Δ**

- Measuring voltage **[1] 100 Vac**
  - Rated value (V_{Rated}) ..... 66/115 Vac
  - Rated voltage $V_{Phase-Ground}$ ..... 150 Vac
  - Max. continuous voltage $V_{Phase-Phase}$ ..... 150 Vac
  - Rated surge voltage ..... 2,5 kV
- **[7] 690 Vac**
  - Rated value (V_{Rated}) ..... 400/690 Vac
  - Rated voltage $V_{Phase-Ground}$ ..... 600 Vac
  - Max. continuous voltage $V_{Phase-Phase}$ ..... 800 Vac
  - Rated surge voltage ..... 6,0 kV
- Linear measuring range ..... $1.25 \times V_{Rated}$
- Input resistance ..... **[1]** > 0.5 MΩ
  [7] > 2.0 MΩ
- Max. power consumption per path ..... 0.15 W
- Accuracy 0.5
- Measuring frequency ..... 45.0 to 65.0 Hz

Measuring values, current ---------- **isolated**

- Measuring current Rated value (I_{Rated}) ..... **[1]** ../1 A
  [5] ../5 A
- Linear measuring range ..... $3.0 \times I_{Rated}$
- Rated short-time current (1 s) ..... **[1]** 10 Aac
  [5] 50 Aac
- Power consumption ..... < 0.15 VA
- Accuracy 0.5

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

- Power supply ..... 12/24 Vdc (8 to 32 Vdc)
  negative terminal (terminal 12) must be grounded
- Intrinsic consumption ..... max. 5 W
- Ambient temperature Operation ..... -20 to 70 °C
  Storage ..... -20 to 85 °C
- Ambient humidity ..... 95 %, not condensing
- Degree of pollution 2
- Maximum altitude ..... 2000 m

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

- Contact material ..... AgCdO
- General purpose (GP) ($V_{Cont, relay output}$) DC ..... 2.00 Adc@24 Vdc
- Pilot duty (PD) ($V_{Cont, relay output}$) DC ..... 1.00 Adc@24 Vdc

Interface ----------

Service interface

- Version RS-232
- Signal level ..... 5 V

  Signal level adjustment and isolation by using the DPC (P/N 5417-557)

CAN bus interface **isolated**

- Insulation voltage ..... 500 Vac
- Version ..... CAN bus
- Internal line termination ..... not available

Housing ----------

- Type ..... Extrusion profile Um122
  for DIN rail snap-on assembly
- Dimensions (W×H×D) ..... 146 × 128 × 50 mm
- Connection ..... Screw-type terminals 2.5 mm²
- Recommended tightening torque ..... 0.5 Nm
  use 60/75 °C copper wire only
  use class 1 wire only or equivalent
- Weight ..... approx. 300 g

Protection----------

- Protection system ..... IP 20
- EMC test (CE) ..... tested according to applicable EN guidelines
- Listings ..... CE marking; UL listing for ordinary locations
- Type approval ..... UL/cUL listing, Ordinary Locations

Appendix A.
Interface

CAN Bus MFR 300

The interface has the following parameters and settings:

Parameter	Value
Physical interface type	CAN
Baud rate	20, 50, 100, 125, 250, 500, 800, 1000 kBaud
Protocol	CANopen

The default Baud rate is 1000 kBaud.

General

A Woodward measuring transducer shall transmit measuring data via a CAN bus. The protocol utilized is CANopen.

Measuring data is transmitted via synchronized PDOs. A Sync message can be sent by the master every 500µsec, upon which the measuring transducer sends the synchronized PDOs back within a defined time window. A multiple of the Sync pulse is adjustable for each PDO, i.e. for which Sync message a reply is expected. There are three PDOs in all. These PDOs are multiplexed.

The configuration is performed using the SDOs.
A heartbeat message is supported.

PDOs

NOTE

All multi-byte values in the PDOs are arranged with the low byte first.

Power Factor Scaling

The power factor is transmitted in the PDOs with a value range between -999 and 1000, where a value of -999 corresponds with a power factor of 0.999 leading, a value of 999 corresponds with a power factor of 0.999 lagging, and a value of 1000 corresponds with a power factor of 1.0.

Examples: -850 corresponds with 0.85 leading
900 corresponds with 0.90 lagging

PDO1: Short telegram for transmission of fast unformatted data

By default, this PDO is sent back upon each Sync pulse.

CAN		Para-meter ID	Description	Type	Multiplier (to multiply the received value with)	Units
Byte 0 (Mux)	Data bytes					
0	1,2		Protocol ID, always 4600	uint		
0	3,4		Total active power This value is calculated new after every voltage cycle of each phase. It is not filtered. If the voltage is lower than 1.5% of the PT primary voltage, the power value has to be considered as zero. This is a two's complement value and may be positive or negative.	int	PT Primary voltage * CT primary voltage / 1616.58	W
0	5,6		Total reactive power This value is calculated new after every voltage cycle of each phase. It is not filtered. If the voltage is lower than 1.5% of the PT primary voltage, the reactive power value has to be considered as zero. This is a two's complement value and may be positive or negative.	int	PT Primary voltage * CT primary voltage / 1616.58	var
1	1,2		Voltage L1-L2 This value is calculated new after every voltage cycle. It is not filtered. Values smaller than 1.5% of the PT primary voltage have to be considered as zero.	uint	PT Primary voltage / 4000	V
1	3,4		Voltage L2-L3 This value is calculated new after every voltage cycle. It is not filtered. Values smaller than 1.5% of the PT primary voltage have to be considered as zero.	uint	PT Primary voltage / 4000	V
1	5,6		Voltage L3-L1 This value is calculated new after every voltage cycle. It is not filtered. Values smaller than 1.5% of the PT primary voltage have to be considered as zero.	uint	PT Primary voltage / 4000	V
2	1,2		Current L1 This value is calculated new after every voltage cycle. It is not filtered.	uint	CT primary current / 5000	A
2	3,4		Current L2 This value is calculated new after every voltage cycle. It is not filtered.	uint	CT primary current / 5000	A
2	5,6		Current L3 This value is calculated new after every voltage cycle. It is not filtered.	uint	CT primary current / 5000	A
3	1,2		Frequency	uint	0.01	Hz
3	3,4		Power factor	int	0.001	
3	5,6	1912	Overfrequency 1 triggered	bit	Mask: 8000h	Bit
		1913	Overfrequency. 2 triggered	bit	Mask: 4000h	Bit
		1962	Underfrequency 1 triggered	bit	Mask: 2000h	Bit
		1963	Underfrequency 2 triggered	bit	Mask: 1000h	Bit
		2012	Overvoltage 1 triggered	bit	Mask: 0800h	Bit
		2013	Overvoltage 2 triggered	bit	Mask: 0400h	Bit
		2062	Undervoltage 1 triggered	bit	Mask: 0200h	Bit
		2063	Undervoltage 2 triggered	bit	Mask: 0100h	Bit
		2262	Load underrun 1 triggered	bit	Mask: 0010h	Bit
		2263	Load underrun 2 triggered	bit	Mask: 0008h	Bit
		2314	Load overrun 1 triggered	bit	Mask: 0004h	Bit
		2315	Load overrun 2 triggered	bit	Mask: 0002h	Bit
4	1.2	2412	Unbalanced load 1 triggered	bit	Mask: 8000h	Bit
		2413	Unbalanced load 2 triggered	bit	Mask: 4000h	Bit
		3907	Voltage asymmetry triggered	bit	Mask: 2000h	Bit
4	3,4	3057	Phase shift triggered	bit	Mask: 0080h	Bit
4	5,6	3106	df/dt (ROCOF) triggered	bit	Mask: 0080h	Bit
		4958	Time-dependent undervoltage monitoring A triggered	bit	Mask: 0020h	Bit
		4959	Time-dependent undervoltage monitoring B triggered	bit	Mask: 0010h	Bit

PDO2: Unused telegram

This PDO is not used at the moment.

PDO3: Long telegram for transmission of formatted data

A factor of 10 for the Sync object is set by default here. This means that this PDO is sent back upon each tenth Sync pulse. The messages of Mux=0 to Mux=26 are sent cyclically.

CAN Byte 0 (Mux)	Data bytes	Para-meter ID	Description	Type	Multiplier (to multiply the received value with)	Units
0	1,2		Protocol ID, always 4500	uint		
0	3,4,5,6	170	Average wye voltage	uint	0.1	V
1	1,2	144	Frequency	uint	0.01	Hz
1	3,4,5,6	171	Average delta voltage	uint	0.1	V
2	1,2	162	Angle wye voltage L1-L2	uint	0.1	°
2	3,4,5,6	135	Total power	int	1	W
3	1,2	163	Angle wye voltage L2-L3	uint	0.1	°
3	3,4,5,6	136	Total reactive power	int	1	var
4	1,2	164	Angle wye voltage L3-L1	uint	0.1	°
4	3,4,5,6	137	Total apparent power	uint	1	VA
5	1,2	139	Power factor L1	int	0.001	
5	3,4,5,6	108	Voltage L1-L2	uint	0.1	V
6	1,2		Power factor L2	int	0.001	
6	3,4,5,6	109	Voltage L2-L3	uint	0.1	V
7	1,2		Power factor L3	int	0.001	
7	3,4,5,6	110	Voltage L3-L1	uint	0.1	V
8	1,2	10107	Digital outputs and LEDs	bit	Mask 8000h: Relay1	Bit
				bit	Mask 4000h: Relay2	Bit
				bit	Mask 2000h: Relay3	Bit
				bit	Mask 1000h: Relay4	Bit
				bit	Mask 0800h: Relay5	Bit
				bit	Mask 0004h: unused	Bit
				bit	Mask 0002h: LED2	Bit
				bit	Mask 0001h: LED1	Bit
8	3,4,5,6	114	Voltage L1-N	uint	0.1	V
9	1,2	1912	Overfrequency 1 triggered	bit	Mask: 8000h	Bit
		1913	Overfrequency. 2 triggered	bit	Mask: 4000h	Bit
		1962	Underfrequency 1 triggered	bit	Mask: 2000h	Bit
		1963	Underfrequency 2 triggered	bit	Mask: 1000h	Bit
		2012	Overvoltage 1 triggered	bit	Mask: 0800h	Bit
		2013	Overvoltage 2 triggered	bit	Mask: 0400h	Bit
		2062	Undervoltage 1 triggered	bit	Mask: 0200h	Bit
		2063	Undervoltage 2 triggered	bit	Mask: 0100h	Bit
		2262	Load underrun 1 triggered	bit	Mask: 0010h	Bit
		2263	Load underrun 2 triggered	bit	Mask: 0008h	Bit
		2314	Load overrun 1 triggered	bit	Mask: 0004h	Bit
		2315	Load overrun 2 triggered	bit	Mask: 0002h	Bit
9	3,4,5,6	115	Voltage L2-N	uint	0.1	V
10	1,2	2412	Unbalanced load 1 triggered	bit	Mask: 8000h	Bit
		2413	Unbalanced load 2 triggered	bit	Mask: 4000h	Bit
		3907	Asymmetry triggered	bit	Mask: 2000h	Bit
10	3,4,5,6	116	Voltage L3-N	uint	0.1	V
11	1,2	3057	Phase shift triggered	bit	Mask: 0080h	Bit
11	3,4,5,6	111	Current L1	uint	0.001	A
12	1,2	3106	df/dt (ROCOF) triggered	bit	Mask: 0080h	Bit
		4958	Time-dependent undervoltage monitoring A triggered	bit	Mask: 0020h	Bit
		4959	Time-dependent undervoltage monitoring B triggered	bit	Mask: 0010h	Bit
12	3,4,5,6	112	Current L2	uint	0.001	A
13	1,2	160	Power factor	int	0.001	
13	3,4,5,6	113	Current L3	uint	0.001	A
14	1,2		free	uint		
14	3,4,5,6	2520	Positive energy	uint	0.01	MWh
15	1,2		free	uint		
15	3,4,5,6	2524	Negative energy	uint	-0.01	MWh
16	1,2		free	uint		
16	3,4,5,6	2522	Positive reactive energy	uint	0.01	Mvarh

CAN		Para-meter ID	Description	Type	Multiplier (to multiply the received value with)	Units
Byte 0 (Mux)	Data bytes					
17	1,2		free	uint		
17	3,4,5,6	2526	Negative reactive energy	uint	-0.01	Mvarh
18	1,2		free	uint		
18	3,4,5,6	125	Power L1	int	1	W
19	1,2		free	uint		
19	3,4,5,6	126	Power L2	int	1	W
20	1,2		free	uint		
20	3,4,5,6	127	Power L3	int	1	W
21	1,2		free	uint		
21	3,4,5,6	125	Reactive power L1	int	1	var
22	1,2		free	uint		
22	3,4,5,6	126	Reactive power L2	int	1	var
23	1,2		free	uint		
23	3,4,5,6	127	Reactive power L3	int	1	var
24	1,2		free	uint		
24	3,4,5,6	125	Apparent power L1	uint	1	VA
25	1,2		free	uint		
25	3,4,5,6	126	Apparent power L2	uint	1	VA
26	1,2		free	uint		
26	3,4,5,6	127	Apparent power L3	uint	1	VA

SDOs

Configuration and resetting of counters is performed via SDOs. The CAN ID of the receive SDO is 0x600 + "Node ID". The CAN ID of the response SDO is 0x5800 + "Node ID". Here, "Node ID" is the value of the respective parameter 1702 (Node ID).

NOTE

If the SDOs are addressed via CAN interface, an offset of 2000 hex (8192 decimal) must be added to the parameter ID.

Measuring

ID	name	unit	remarks	default
1750	> Rated system frequency		For frequency monitoring 0=50Hz 1=60Hz	0
1766	> Rated voltage	V	For voltage monitoring	[1] 100 [7] 690
1754	> Rated current	A	For current monitoring	1
1752	> Rated active power	kW	For active power monitoring	
1850	> Current measuring		For current monitoring 0=L1 L2 L3 1=L1 2=L2 3=L3	0
1851	> Voltage measuring		Defines connection of voltage: 0= 3phases 4 wires (3 phases and N)	0
3954	> Phase rotation		Defines phase rotation 0=CW (clockwise 1=CCW (counter-clockwise)	0
1858	> 1Ph2W voltage measuring		Defines 1Ph2W voltage measuring 0=phase-neutral 1=phase-phase	1
1859	> 1Ph2W phase rotation		Defines 1Ph2W phase rotation 0=CW (clockwise 1=CCW (counter-clockwise)	0
1770	> Voltage monitoring		Defines voltage measuring 0=phase-phase 1=phase-neutral	0
1801	> Voltage transf. primary	V	Primary voltage at voltage transformer	[1] 100 [7] 690
1800	> Voltage transf. secondary		Secondary voltage at voltage transformer.	[1] 100 [7] 690
1806	> Current transformer	A	Primary current at current transformer (5A units only)	500
1808	> Current transformer	A	Primary current at current transformer (1A units only)	500

Counters

ID	name	unit	remarks	default
2515	> Value to set counters to	0.1kWh/kvarh	To set a counter, the desired value has to be written here. After that, a reset command must be written into one of the 4 parameters below. The selected counter is then set to the desired value.	0
2510	> reset pos. kWh		0=no 1=yes	0
2512	> reset neg. kWh		0=no 1=yes	0
2511	> reset pos. kvarh		0=no 1=yes	0
2513	> reset neg. kvarh		0=no 1=yes	0

Overfrequency level 1

ID	name	unit	remarks	default
1900	> Monitoring		Activates monitoring 0=off 1=on	1
1904	> Limit	0.1%	Tripping limit relative to rated value	110.0%
1905	> Delay	0.01s	Tripping delay	1.5s
1901	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	1

Overfrequency level 2

ID	name	unit	remarks	default
1906	> Monitoring		Activates monitoring0=off1=on	1
1910	> Limit	0.1%	Tripping limit relative to rated value	115.0%
1911	> Delay	0.01s	Tripping delay	0.3s
1907	> Relay		activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	2

Underfrequency level 1

ID	name	unit	remarks	default
1950	> Monitoring		Activates monitoring 0=off 1=on	1
1954	> Limit	0.1%	Tripping limit relative to rated value	90.0%
1955	> Delay	0.01s	Tripping delay	5.0s
1951	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	1

Underfrequency level 2

ID	name	unit	remarks	default
1956	> Monitoring		Activates monitoring 0=off 1=on	1
1960	> Limit	0.1%	Tripping limit relative to rated value	84.0%
1961	> Delay	0.01s	Tripping delay	0.3s
1957	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	2

Overvoltage level 1

ID	name	unit	remarks	default
2000	> Monitoring		Activates monitoring 0=off 1=on	1
2004	> Limit	0.1%	Tripping limit relative to rated value	108.0%
2005	> Delay	0.01s	Tripping delay	5.0s
2001	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	1

Overvoltage level 2

ID	name	unit	remarks	default
2006	> Monitoring		Activates monitoring 0=off 1=on	1
2010	> Limit	0.1%	Tripping limit relative to rated value	112.0%
2011	> Delay	0.01s	Tripping delay	5.0s
2007	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	2

Undervoltage level 1

ID	name	unit	remarks	default
2050	> Monitoring		Activates monitoring0=off1=on	1
2054	> Limit	0.1%	Tripping limit relative to rated value	92.0%
2055	> Delay	0.01s	Tripping delay	5.0s
2051	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	1

Undervoltage Level 2

ID	name	unit	remarks	default
2056	> Monitoring		Activates monitoring 0=off 1=on	1
2060	> Limit	0.1%	Tripping limit relative to rated value	88.0%
2061	> Delay	0.01s	Tripping delay	5.0s
2057	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	2

Unbalanced load level 1

ID	name	unit	remarks	default
2400	> Monitoring		Activates monitoring 0=off 1=on	1
2404	> Limit	0.1%	Tripping limit. Describes the deviation from the mean value of the three currents.	10.0%
2405	> Delay	0.01s	Tripping delay	10.0s
2401	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	1

Unbalanced load level 2

ID	name	unit	remarks	default
2406	> Monitoring		Activates monitoring 0=off 1=on	1
2410	> Limit	0.1%	Tripping limit. Describes the deviation from the mean value of the three currents.	15.0%
2411	> Delay	0.01s	Tripping delay	1.0s
2407	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	2

Voltage asymmetry

ID	name	unit	remarks	default
3900	> Monitoring		Activates monitoring 0=off 1=on	1
3903	> Limit	0.1%	Tripping limit. Describes the deviation from the mean value of the three voltages (wye)	10.0%
3904	> Delay	0.01s	Tripping delay	5.0s
3901	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	1

Load underrun level 1

ID	name	unit	remarks	default
2250	> Monitoring		Activates monitoring 0=off 1=on	1
2254	> Limit	0.1%	Tripping limit. Describes the deviation from the rated load.	-3.0%
2255	> Delay	0.01s	Tripping delay	5.00s
2251	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	1

Load underrun level 2

ID	name	unit	remarks	default
2256	> Monitoring		Activates monitoring 0=off 1=on	1
2260	> Limit	0.1%	Tripping limit. Describes the deviation from the rated load.	-5.0%
2261	> Delay	0.01s	Tripping delay	3.00s
2257	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	2

Load overrun level 1

ID	name	unit	remarks	default
2300	> Monitoring		Activates monitoring 0=off 1=on	1
2304	> Limit	0.1%	Tripping limit. Describes the deviation from the rated load.	10.0%
2305	> Delay	0.01s	Tripping delay	10.00s
2301	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	1

Load overrun level 2

ID	name	unit	remarks	default
2306	> Monitoring		Activates monitoring 0=off 1=on	1
2310	> Limit	0.1%	Tripping limit. Describes the deviation from the rated load.	15.0%
2311	> Delay	0.01s	Tripping delay	1.00s
2307	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	2

Phase shift

ID	name	unit	remarks	default
3050	> Monitoring		Activates monitoring 0=off 1=on	1
3053	> Monitoring for		Configures monitoring for 0=3-phase 1=1-and 3-phase	1
3054	> Limit 1 phase	00°	Tripping limit.	20°
3055	> Limit 3 phase	00°	Tripping limit.	8°
3051	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	1

df/dt

ID	name	unit	remarks	default
3100	> Monitoring		Activates monitoring 0=off 1=on	0
3104	> Limit	0.1Hz/s	Tripping limit.	2.6Hz/s
3105	> Delay	0.1s	Tripping delay	0.1s
3101	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	1

Time-dependent under voltage monitoring A

ID	name	unit	remarks	default
4950	> Monitoring		Activates monitoring 0=off 1=on	1
4951	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	1
4970	> Init threshold	0.1%	Threshold for starting this function as percentage of the rated voltage.	80.0%
4978	> Fallback threshold	0.1%	Threshold for resetting this function.	90.0%
4968	> Fallback time	0.01s	Delay for resetting this function.	1.00s
4961	> Time 1	0.01s	Curve definition point 1 time axis	0.00s
4971	> Voltage 1	0.1%	Curve definition point 1 voltage axis	45.0%
4962	> Time 2	0.01s	Curve definition point 2 time axis	0.15s
4972	> Voltage 2	0.1%	Curve definition point 2 voltage axis	45.0%
4963	> Time 3	0.01s	Curve definition point 3 time axis	0.15s
4973	> Voltage 3	0.1%	Curve definition point 3 voltage axis	70.0%
4964	> Time 4	0.01s	Curve definition point 4 time axis	0.70s
4974	> Voltage 4	0.1%	Curve definition point 4 voltage axis	70.0%
4965	> Time 5	0.01s	Curve definition point 5 time axis	1.50s
4975	> Voltage 5	0.1%	Curve definition point 5 voltage axis	90.0%
4966	> Time 6	0.01s	Curve definition point 6 time axis	3.00s
4976	> Voltage 6	0.1%	Curve definition point 6 voltage axis	90.0%
4967	> Time 7	0.01s	Curve definition point 7 time axis	4.00s
4977	> Voltage 7	0.1%	Curve definition point 7 voltage axis	90.0%

Time-dependent under voltage monitoring B

ID	name	unit	remarks	default
4954	> Monitoring		Activates monitoring 0=off 1=on	1
4955	> Relay		Activated relay when tripped 0: no relay 1: relay 1 2: relay 2 3: relay 3 4: relay 4	2
4990	> Init threshold	0.1%	Threshold for starting this function as percentage of the rated voltage.	80.0%
4998	> Fallback threshold	0.1%	Threshold for resetting this function.	90.0%
4988	> Fallback time	0.01s	Delay for resetting this function.	1.00s
4981	> Time 1	0.01s	Curve definition point 1 time axis	0.00s
4991	> Voltage 1	0.1%	Curve definition point 1 voltage axis	10.0%
4982	> Time 2	0.01s	Curve definition point 2 time axis	0.15s
4992	> Voltage 2	0.1%	Curve definition point 2 voltage axis	10.0%
4983	> Time 3	0.01s	Curve definition point 3 time axis	1.5s
4993	> Voltage 3	0.1%	Curve definition point 3 voltage axis	90.0%
4984	> Time 4	0.01s	Curve definition point 4 time axis	10s
4994	> Voltage 4	0.1%	Curve definition point 4 voltage axis	90.0%
4985	> Time 5	0.01s	Curve definition point 5 time axis	20s
4995	> Voltage 5	0.1%	Curve definition point 5 voltage axis	90.0%
4986	> Time 6	0.01s	Curve definition point 6 time axis	30s
4996	> Voltage 6	0.1%	Curve definition point 6 voltage axis	90.0%
4987	> Time 7	0.01s	Curve definition point 7 time axis	40s
4997	> Voltage 7	0.1%	Curve definition point 7 voltage axis	90.0%

The parameters in this group can be also accessed via the standard CANopen system.

	ID	name	unit	remarks	default
CANopen	3156	Baudrate		Defines the used baud rate 0=20 kBd 1=50 kBd 2=100 kBd 3=125 kBd 4=250 kBd 5=500 kBd 6=800 kBd 7=1000 kBd	7
	1702	Node-ID		Node-ID	1
	9100	COB-ID SYNC Message		COB-ID of the SYNC Message.	128
	9117	Producer Heartbeat Time		Producer Heartbeat Time.	240
PDO1	9600	COB-ID of transmit		Pdo1 COB-ID.	385
	9602	Transmission type		Pdo1Transmission type	1
PDO2	9610	COB-ID of transmit		Pdo2 COB-ID	641
	9612	Transmission type		Pd02 Transmission type	240
PDO3	9620	COB-ID of transmit		Pd03 COB-ID	987
	9622	Transmission type		Pdo3 Transmission type	10

	ID	name	unit	remarks	default
versions	930	program item no		12 chars program identifier	
	940	program revision		4 chars program revision	
	945	program version		8 chars program version	
	950	boot item no		12 chars bootloader identifier	
	960	boot revision		4 chars bootloader revision	
	965	boot version		8 chars bootloader version	
	900	serial number		16 chars serial number of device. E20	

	ID	name	unit	remarks	default
internal	1701	> set default values	0=no 1=yes	This parameter is used to reset the device to factory default values	0

NOTE

Do not configure the baud rate (parameter 3156) via CANopen to avoid communication problems.

However, if the Baud rate is configured via the CAN interface, the configuring CAN master must change its Baud rate to be able to reconnect.

Heartbeat Message

A heartbeat message will be sent cyclically. This is all 240 msec by default. The CAN ID of the heartbeat message is 0x700 + "Node ID". Here, "Node ID" is the value of the respective parameter 1702 (Node ID).

Appendix B.
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
e-mail: stgt-info@woodward.com

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

Facility	Phone number
USA	+1 (970) 482 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 300 _____

Serial number S/N _____

Description of your problem

_____

_____

_____

_____

_____

_____

Please be sure you have a list of all parameters available.

We appreciate your comments about the content of our publications.

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