37128A

GCP-20 Series
Genset Control

Operation Manual
Software Version 1.0xxx

Manual 37128A

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.

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.**

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	Change
NEW	03-05-22	Tr	Release
A	05-08-02	TP	Re-release in new format with general update

Content

Illustrations and Tables

Illustrations

Tables

Chapter 1.
General Information

Related Documents

Type		English	German
GCP-20 Series			
GCP-20 – Manual	this manual ⇨	37128	
Additional Manuals			
LeoPC1 – User Manual		37146	GR37146
PC program for configuration, parameter visualization, remote control, data logging, language upload, alarm and user management, and event recorder management. This manual describes the use of LeoPC1 software.			
LeoPC1 – Engineering Manual		37164	GR37164
PC program for configuration, parameter visualization, remote control, data logging, language upload, alarm and user management, and event recorder management. This manual describes the programming of LeoPC1 software.			

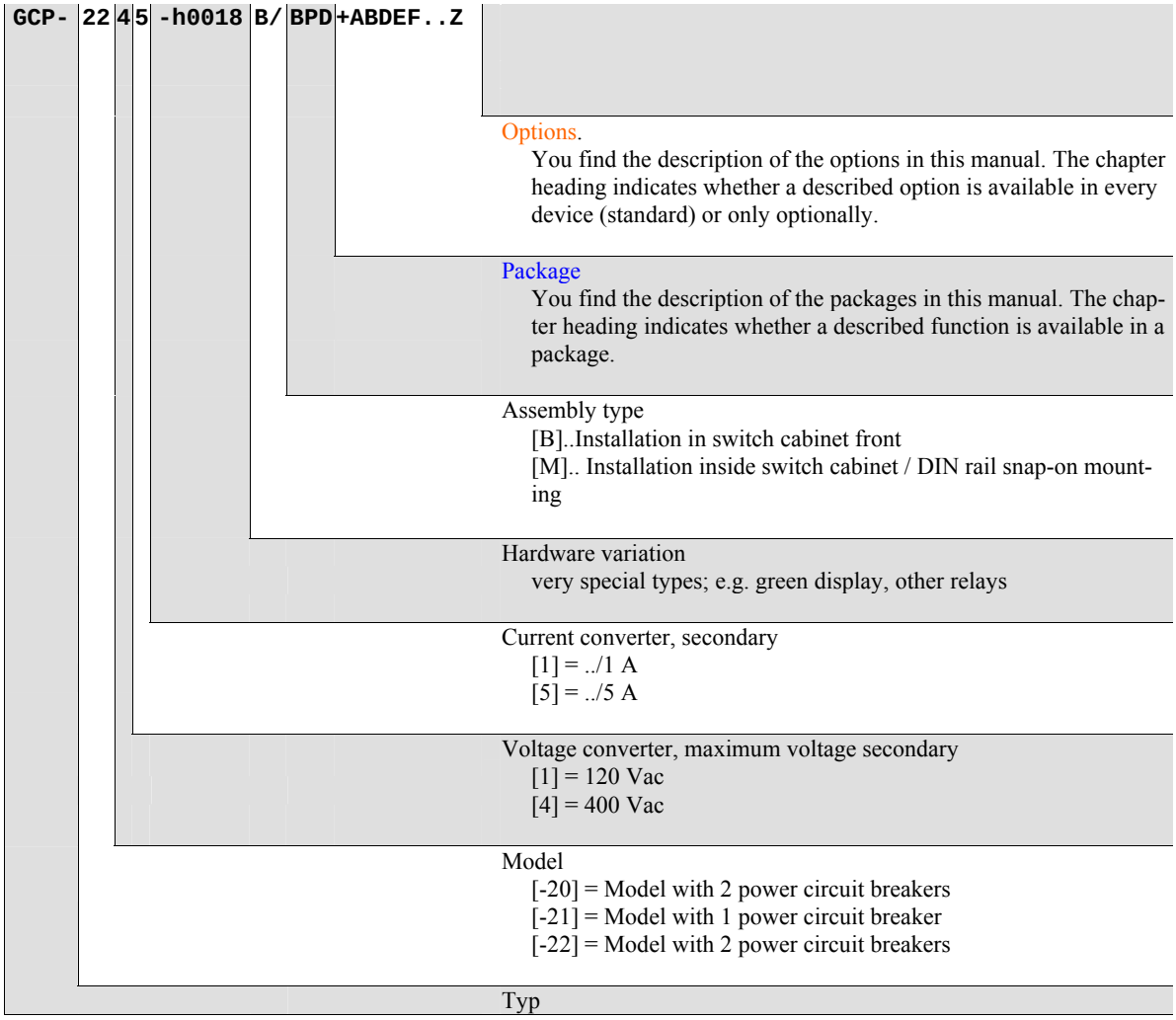
Table 1-1: Manual - overview

Overview

The GCP-20 series generator set controllers provide the following functions:
Gen-set control

- Engine and generator protection
- Engine data measurement -
  - including oil pressure and oil temperature, coolant temperature, battery voltage, speed, service hours, etc.
- Generator data measurement -
  - including. voltage, current, power, kvar, kW, kWh, etc.
- Engine start/stop procedure
- Alarm display with breaker trip and engine shutdown
- Emergency operation with mains failure recognition and automatic engine start incl. change-over-logic
- Control of voltage, frequency, real power and reactive power
- Real power and reactive power load sharing including load management with automatic start/stop of others and redundant gensets.
- Synchronization of one or two power circuit breakers
- CAN bus communications to engine controllers and plant management systems

Type designation is as follows:



Examples:

- GCP-2245B/LSX (GCP-22 with 400 Vac and ../5 A measuring inputs, Package LSX [2 breaker logic; analog controller n/f, V, P, Q; real power set point 0/4 to 20mA; 3 analog inputs, 2 analog outputs])
- GCP-2115B/LS (GCP-21 with 120 Vac and ../5 A measuring inputs, Package LS [1 breaker logic; discrete raise/lower n/f, V, P, Q])

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

NOTE

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

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

Chapter 2.
GCP-20 Series Overview

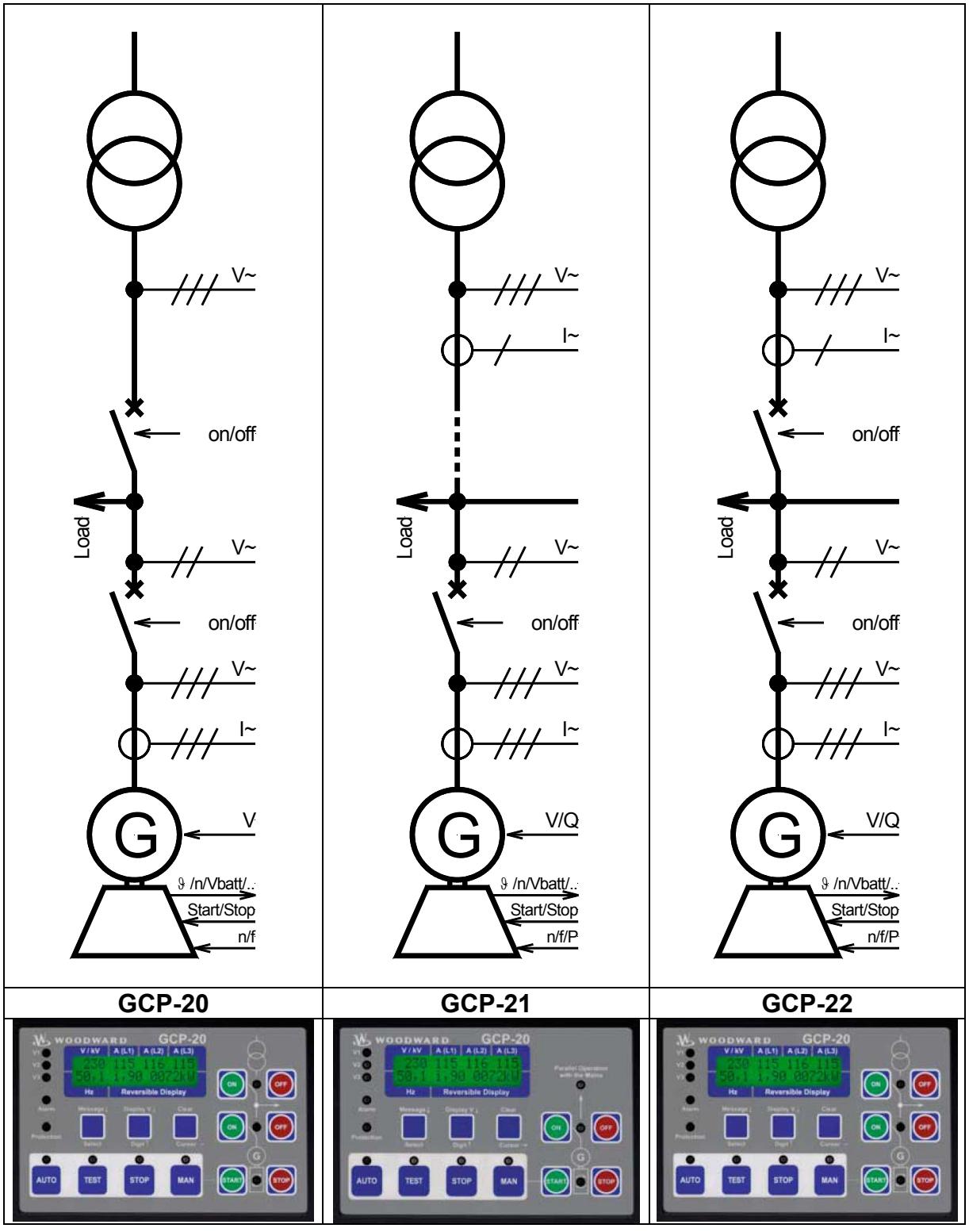


Figure 2-1: Overview

Functional Overview

Function	Option	Package												
		GCP-20					GCP-21				GCP-22			
		T2	LS	B	X	LSX	LS	LSB	LSR	LSX	LS	LSB	LSR	LSX
Common functions														
1× ready for operation relay	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4/6× control relay (form A, make contact)	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4× freely configurable relay outputs (form A, make contact)	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2× three-position controller for n/f/V/P, power factor	Std.	✓	✓	--	--	1	✓	--	1	--	✓	--	1	--
2× analog controller outputs for n/f/V/P/Q		--	--	✓	✓	1	--	✓	1	✓	--	✓	1	✓
6× discrete control inputs	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
14× discrete alarm inputs	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CAN bus interface 'Guidance level'	Std.	--	✓	--	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4× analog inputs		2	--	--	✓	✓	--	--	✓	✓	--	--	✓	✓
1× Pickup input	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2× analog outputs + external op. mode selection by term. 127/128	A2	--	--	--	--	--	--	--	--	✓	--	--	--	✓
Password system	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Configuration via DPC possible (direct configuration)	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Running hours, maintenance, start, and kWh counter	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Control/synchronization														
Synchronization of 1 breaker with V and f correction	Std.	--	--	--	--	--	✓	✓	✓	✓	--	--	--	--
Synchronization of 2 breakers with V and f correction	Std.	✓	✓	✓	✓	✓	--	--	--	--	✓	✓	✓	✓
Closing to a dead/voltage free busbar (dead bus start)	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Voltage control	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
power factor control	Std.	--	--	--	--	--	✓	✓	✓	✓	✓	✓	✓	✓
Speed/frequency control	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Generator real power control & import/export real power control	Std.	--	--	--	--	--	✓	✓	✓	✓	✓	✓	✓	✓
Real & var sharing	Std.		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
Analog set point value for real power	T4	--	--	--	--	--	--	--	--	✓	--	--	--	✓
Breaker logic "open transition" & "closed transition"	Std.	✓	✓	✓	✓	✓	--	--	--	--	✓	✓	✓	✓
Breaker logic "soft loading"	Std.	✓	✓	✓	✓	✓	--	--	--	--	✓	✓	✓	✓
Breaker logic "parallel operation"	Std.						✓	✓	✓	✓	✓	✓	✓	✓
Breaker logic "external"	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Remote control via interface	Std.		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Over-/undervoltage protection, generator V_{gen}>/<	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Over-/undervoltage protection, mains V_{mains}>/<	Std.	--	--	--	--	--	✓	✓	✓	✓	✓	✓	✓	✓
Over-/underfrequency protection f>/<	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
dφ/dt vector/phase jump protection dφ/dt	Std.	--	--	--	--	--	✓	✓	✓	✓	✓	✓	✓	✓
Reverse/reduce power protection +/-P_{gen}<	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Overload protection P_{gen}>	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Load imbalance protection ΔP_{gen}>	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time-overcurrent protection I_{toc}>/>>	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Battery voltage protection V_{bat}<	Std.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

1) n/F analog, V raise/lower
2) only two analog inputs

Table 2-1: Functional overview

The GCP-20 series consists of three models which are intended for different applications and requirements. This manual covers all available versions of the GCP-20. Please take information about the differences between the units from this section.

Chapter 3.
Electrostatic Discharge Awareness

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

Follow these precautions when working with or near the control.

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

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

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

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

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

CAUTION

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

Chapter 4.
Housing

Dimensions

Housing	Type APRANORM DIN 43 700
Dimensions	144 × 96 × 118 mm
Front cut out	138 [+1.0] × 92 [+0.8] mm
Connection	Screw type connector, depending on plug connector 1.5 mm² or 2.5 mm²
Protection system	IP 21
Weight	depending on model, approx. 1,000 g

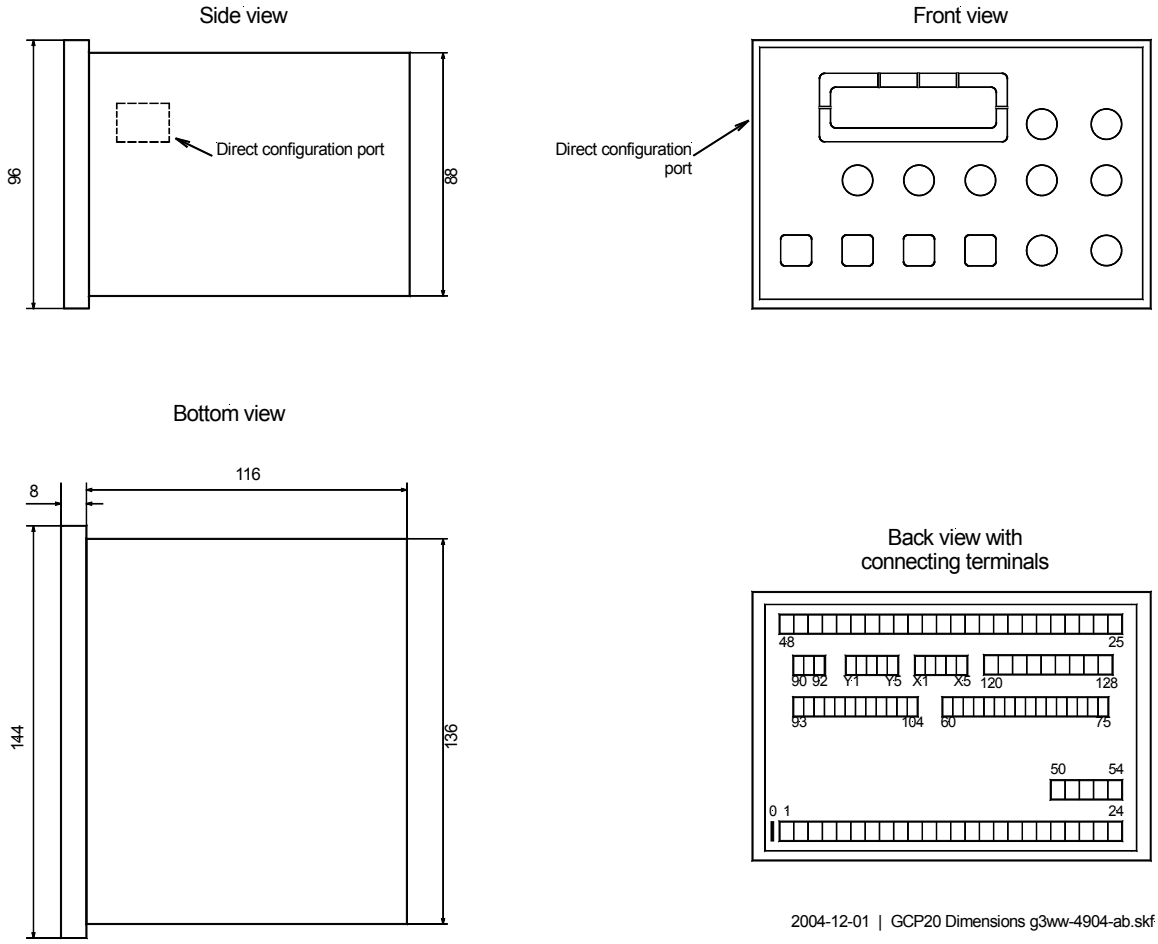


Figure 4-1: Housing - Dimensions

Panel Cut-Out

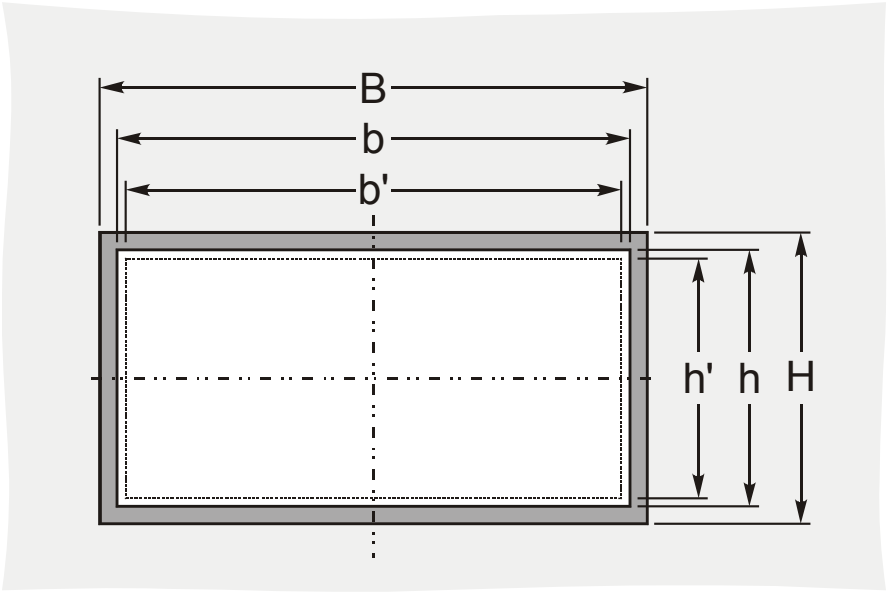


Figure 4-2: Housing - Control panel cut-out

Measure	Description			Tolerance
H	Height	Total	96 mm	---
h		Panel cut-out	92 mm	+ 0.8 mm
h'		Housing dimension	88 mm	
B	Width	Total	144 mm	---
b		Panel cut-out	138 mm	+ 1.0 mm
b'		Housing dimension	136 mm	
	Depth	Total	118	---

Table 4-1: Housing - panel cut-out

Side View

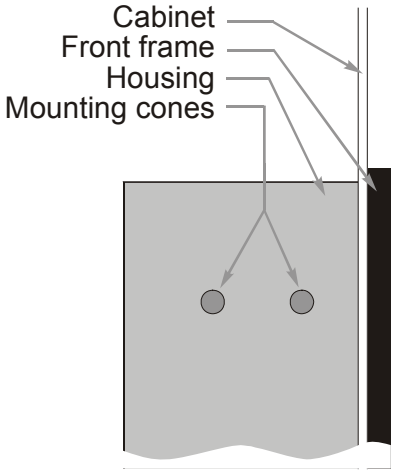


Figure 4-3: Side view - without clamps

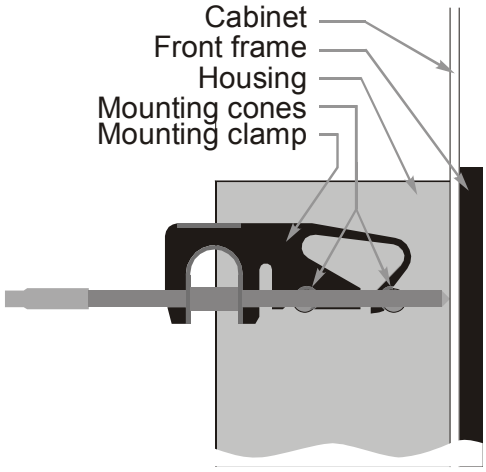
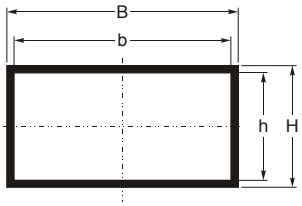


Figure 4-4: Side view - with clamps

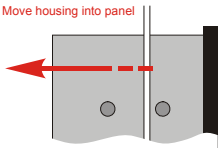
Installation

For installation into a door panel proceed as follows:

1. **Panel cut-out**
   Cut out the panel according to the dimensions in Figure 4-1.



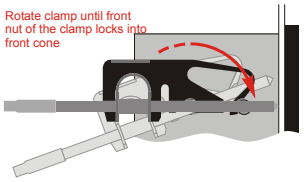
2. **Insert control into cut-out**
   Insert the control into the panel cut-out. Verify that the control fits correctly in the cut-out. If the panel cut-out is not big enough, enlarge it accordingly.



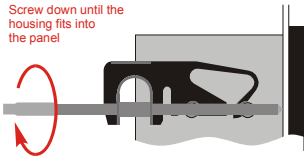
3. **Attach mounting clamps**
   Rotate clamps according to the picture on the right until they snap into the mounting cones.

a)

b)



4. **Screw clamps**
   Tighten the screw clamps until the housing is pressed and fixed against the panel. Be careful not to over tighten the clamps which can unsnap the frame from the housing. If this happens remove the control from the panel and reattach the frame by pressing firmly against the housing.



Note: Using the gasket kit (P/N 8923-1038) increases the IP protection from IP42 to IP54 from front. Mounting of the gasket is described in the manual supplied with the gasket kit.

Chapter 5.
Wiring Diagrams

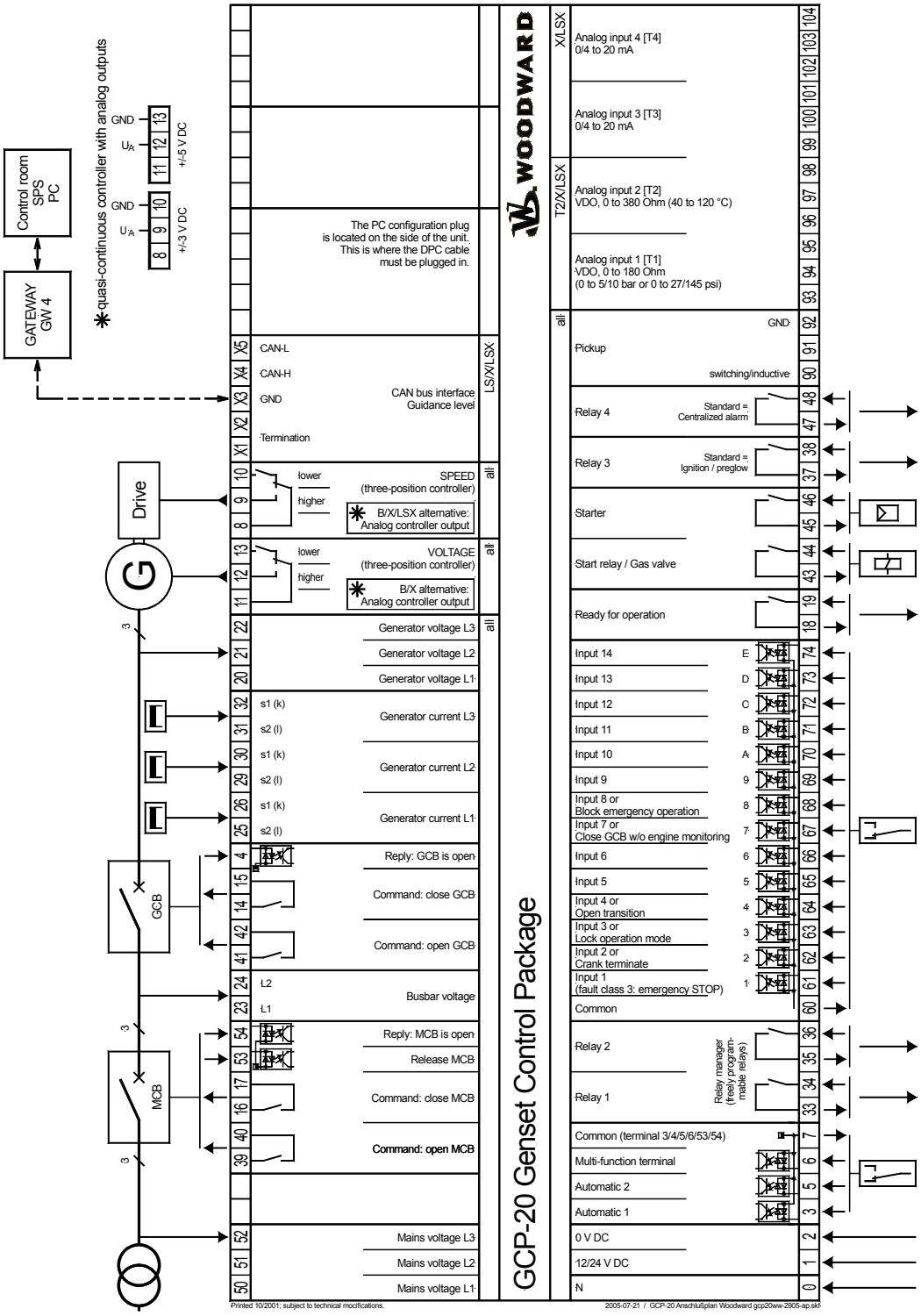


Figure 5-1: Wiring diagram - GCP-20

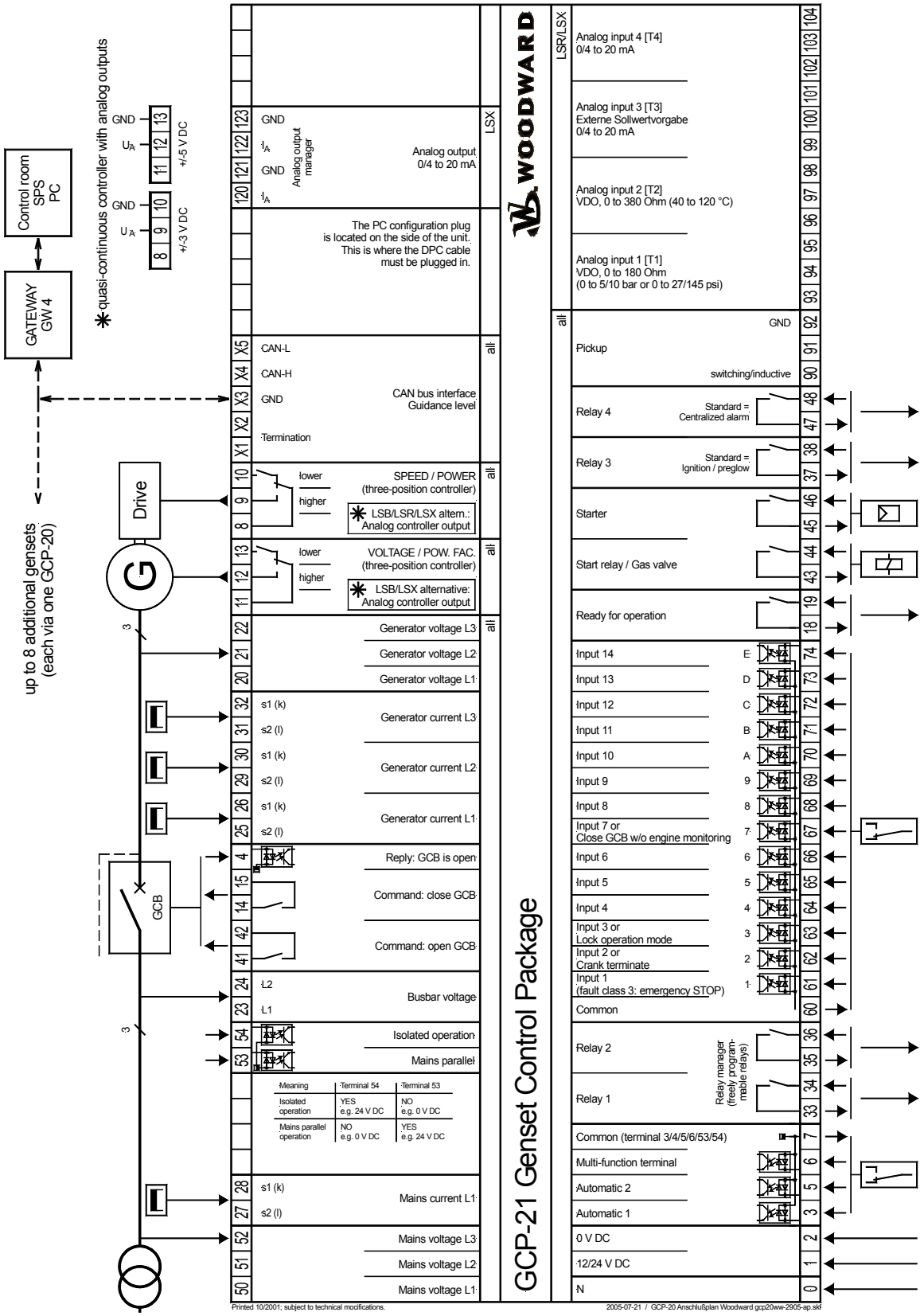


Figure 5-2: Wiring diagram - GCP-21

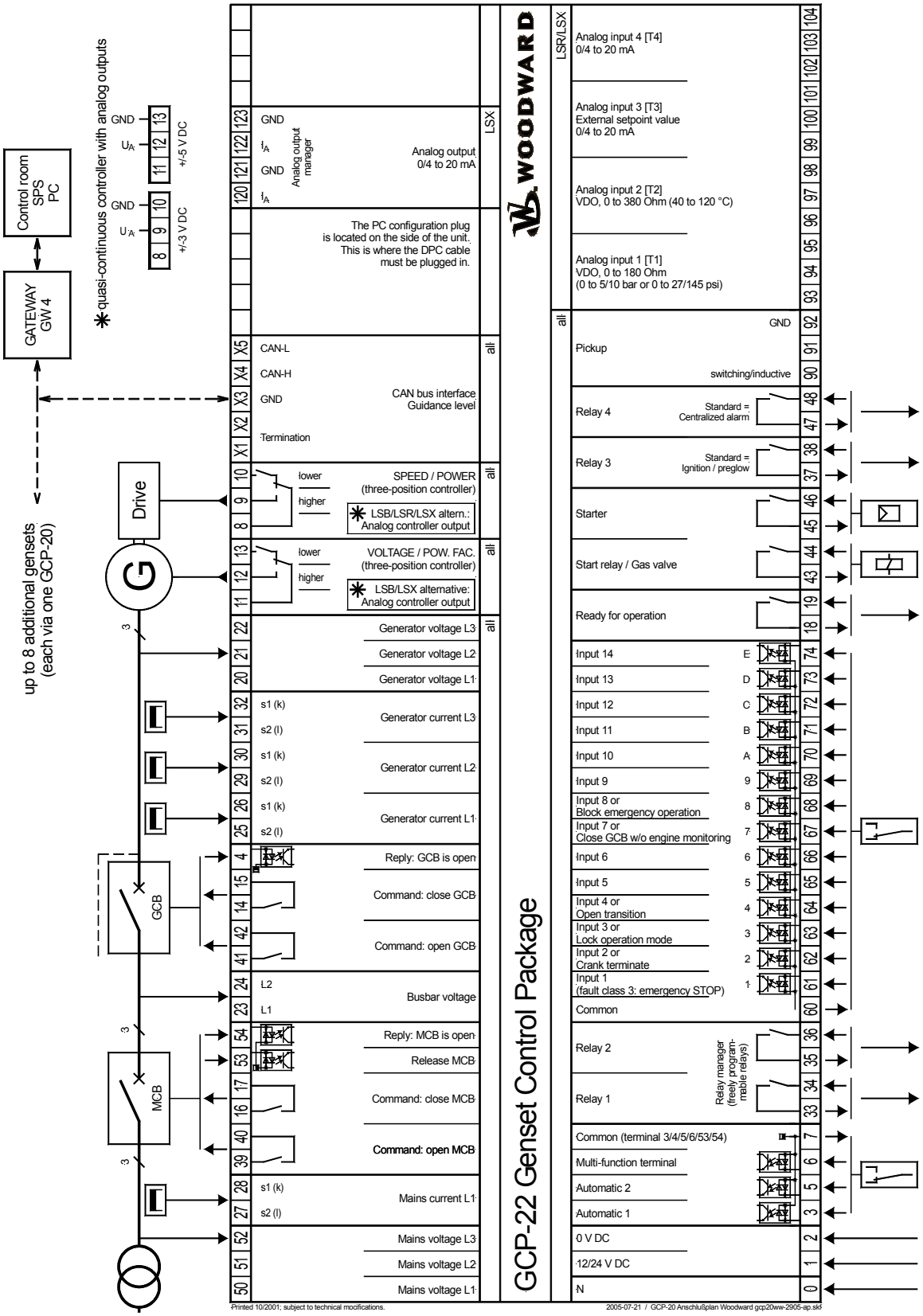


Figure 5-3: Wiring diagram - GCP-22

Chapter 6.
Connections

Power Supply

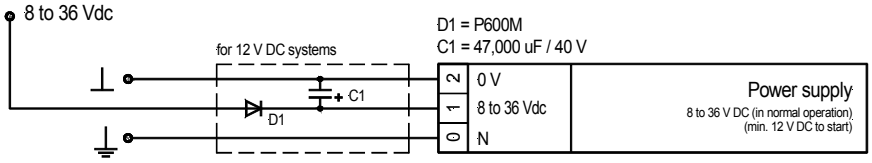


Figure 6-1: Power supply

Terminal	Description	A_{max}
0	Neutral point of the three-phase system or neutral terminal of the voltage transformer (Measuring reference point)	Solder lug
1	0 Vdc reference potential	2.5 mm²
2	8 to 36.0 Vdc, 8 W	2.5 mm²

Table 6-1: Power supply - terminal assignment

NOTE

When using the device in 12 V systems, wire the power supply as indicated above.

CAUTION

Ensure that the engine will be shut down by an external device in case the power supply of the GCP-20 control unit fails. Failure to do so may result in damages to the equipment.

Measuring Inputs

NOTE

The following is valid for units with a software version older than V1.0700:

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

Voltage Measuring: Generator

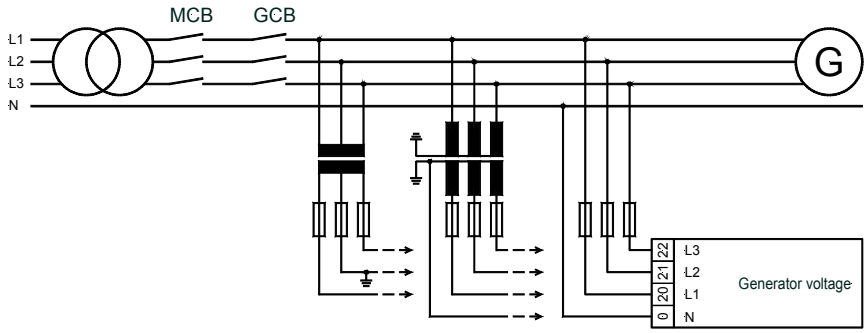


Figure 6-2: Voltage measuring: generator

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

Table 6-2: Voltage measuring: generator - terminal assignment

Voltage Measuring: Busbar / Remanence

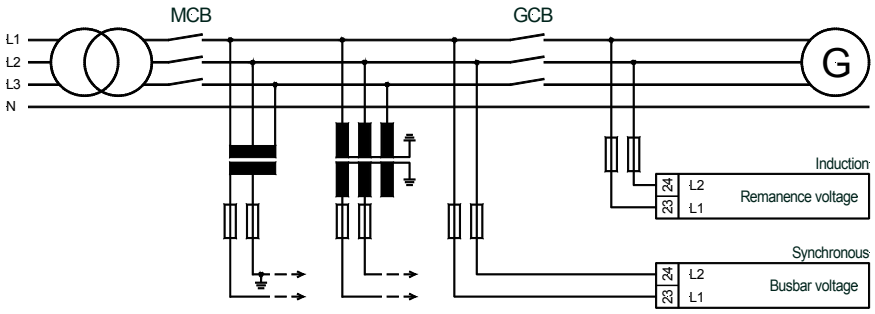


Figure 6-3: Voltage measuring: busbar / remanence

Terminal	Measurement	Description	A_{max}
Induction version			
23	direct	Remanence voltage L1	2.5 mm²
24		Remanence voltage L2	2.5 mm²
Synchronous version			
23	400 V direct or ../100 V	Remanence voltage L1	2.5 mm²
24		Remanence voltage L2	2.5 mm²

Table 6-3: Voltage measuring: busbar / remanence - terminal assignment

Voltage Measuring: Mains

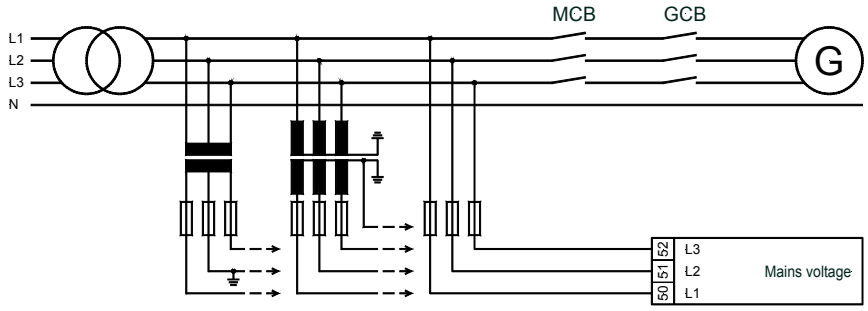


Figure 6-4: Voltage measuring: mains

Terminal	Measurement	Description	A_{max}
50	400 V direct or via../100 V measurement transducer	Mains voltage L1	2.5 mm²
51		Mains voltage L2	2.5 mm²
52		Mains voltage L3	2.5 mm²
0		Neutral point of the 3-phase system/transformer	Solder lug

Table 6-4: Voltage measuring: mains - terminal assignment

Current Measuring: Generator

WARNING

Before disconnecting the secondary current transformer connections or the connections of the current transformer at the unit, make sure that the current transformer is short-circuited.

NOTE

Current transducers are generally to be grounded on the secondary and one side.

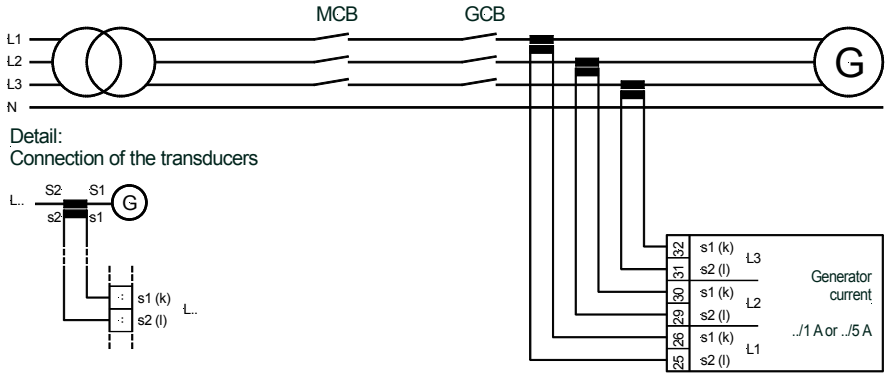


Figure 6-5: Current measuring: generator

Terminal	Measurement	Description	A_{max}
25	Transformer ../1 A or ../5 A	Generator current L1, transformer terminal s2 (l)	2.5 mm²
26		Generator current L1, transformer terminal s1 (k)	2.5 mm²
29		Generator current L2, transformer terminal s2 (l)	2.5 mm²
30		Generator current L2, transformer terminal s1 (k)	2.5 mm²
31		Generator current L3, transformer terminal s2 (l)	2.5 mm²
32		Generator current L3, transformer terminal s1 (k)	2.5 mm²

Table 6-5: Current measuring: generator - terminal assignment

Current Measuring: Mains [GCP-21, GCP-22]

Standard Mains Measuring

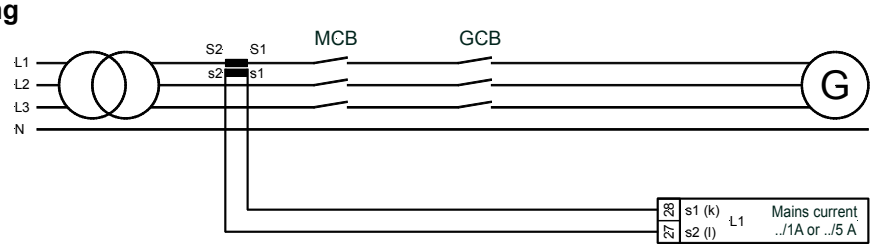


Figure 6-6: Current measuring: mains standard

Terminal	Measurement	Description	A_{max}
27	Transformer ../1 A or ../5 A	Mains current L1, transformer terminal s2 (l)	2.5 mm²
28		Mains current L1, transformer terminal s1 (k)	2.5 mm²

Table 6-6: Current measuring: mains standard - terminal assignment

Mains Measuring with Option In20 (Power measurement via measurement transducer)

NOTE

If several units are connected to form an interconnection, the 20 mA measuring signal must not be looped through all units. At each control, a 0/4 to 20 mA buffer amplifier must be connected to the mains power input (terminals 27/28). When selecting the external measuring transformer, please note that this has to transmit negative ranges on transmission of supply and reference power.

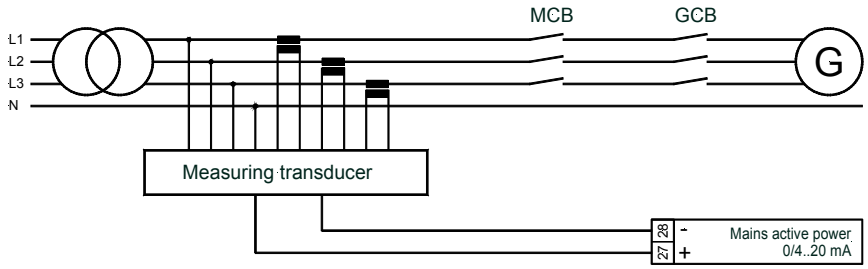


Figure 6-7: Current measuring: mains Option In20

Terminal	Measurement	Description	A_{max}
27	Analog signal 0 /4 to 20 mA	Mains active load via a 0/4 to 20 mA-signal of an external measuring transducer (e.g. UMT 1)	2.5 mm²
28			2.5 mm²

Table 6-7: Current measuring: mains Option In20 - terminal assignment

Auxiliary and Control Inputs

Discrete Inputs

The discrete inputs are galvanically isolated allowing for a bipolar connection. The discrete inputs are able to handle positive or negative signals.

NOTE

All discrete inputs must use the same polarity, either positive or negative signals, due to the common ground.

Control Inputs

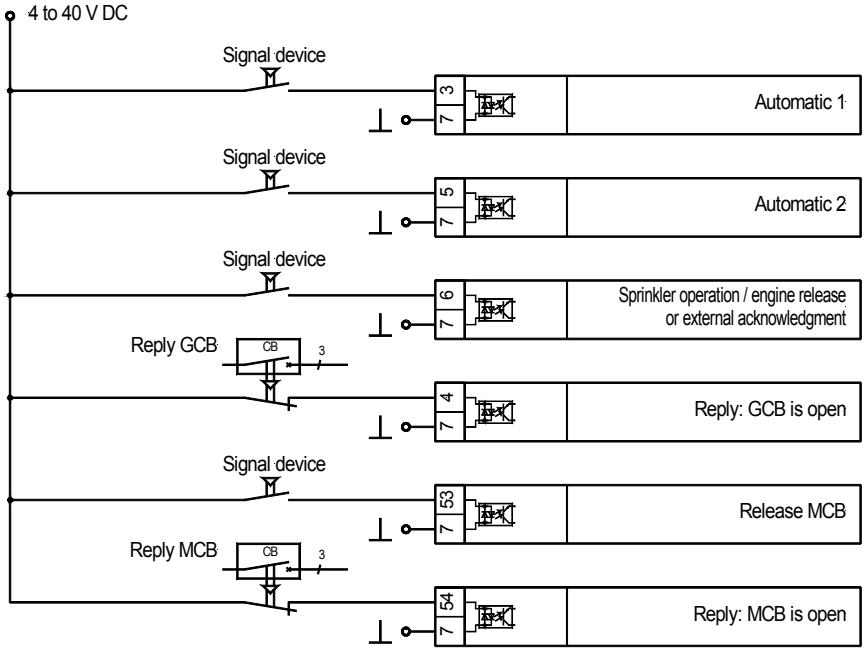


Figure 6-8: Control inputs

Terminal	Associated common	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
NO (make contact)			
3	7	Automatic 1	2.5 mm²
5		Automatic 2	2.5 mm²
6		Multifunction: sprinkler op. / engine release / ext. acknowledgement	2.5 mm²
53		Release MCB (mains power circuit breaker)	2.5 mm²
NC (break contact)			
4	7	Reply: Generator power circuit breaker is open	2.5 mm²
54		Reply: Mains power circuit breaker is open or mains parallel status (in units with 1 CB)	2.5 mm²

Table 6-8: Control inputs - terminal assignment

Alarm Inputs

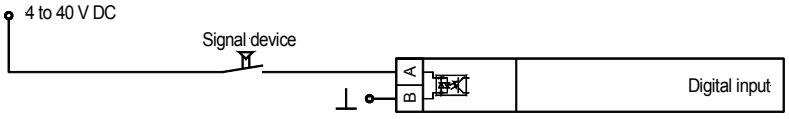


Figure 6-9: Alarm input (positive signal)

Terminal	Associated common	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
A	*B*	*make contact*	
61	60	Discrete input 1 (for sprinkler op. = **EMERG. STOP**)	1.5 mm²
62		Discrete input 2	1.5 mm²
63		Discrete input 3	1.5 mm²
64		Discrete input 4	1.5 mm²
65		Discrete input 5	1.5 mm²
66		Discrete input 6	1.5 mm²
67		Discrete input 7	1.5 mm²
68		Discrete input 8	1.5 mm²
69		Discrete input 9	1.5 mm²
70		Discrete input A	1.5 mm²
71		Discrete input B	1.5 mm²
72		Discrete input C	1.5 mm²
73		Discrete input D	1.5 mm²
74		Discrete input E	1.5 mm²

Table 6-9: Alarml inputs - terminal assignment (positive signal)

Analog Inputs (Option T4)

WARNING

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

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

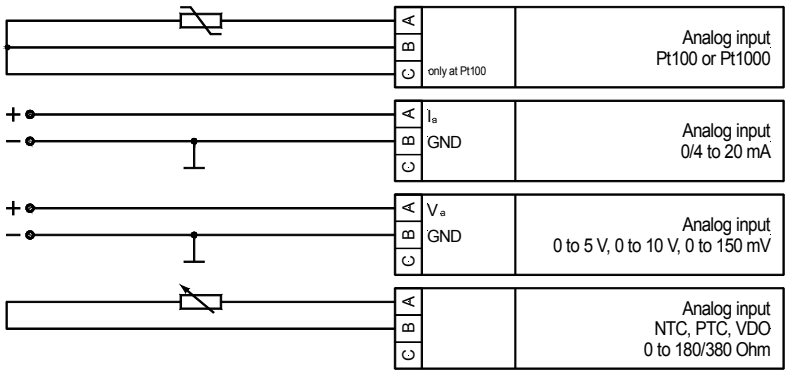


Figure 6-10: Analog inputs

Terminal			Description	A_{max}
A	*B*	*C*		
93	94	95	Analog input 1	1.5 mm²
96	97	98	Analog input 2	1.5 mm²
99	100	101	Analog input 3	1.5 mm²
102	103	104	Analog input 4	1.5 mm²

Table 6-10: Analog inputs - terminal assignment

MPU Input (Pickup)

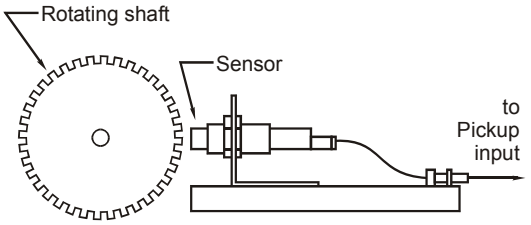


Figure 6-11: MPU - principle overview

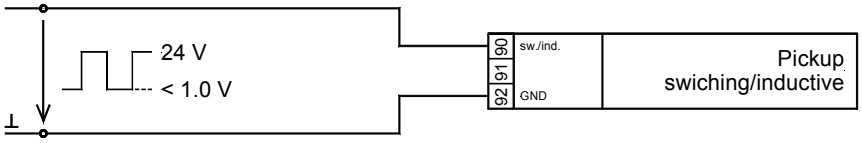


Figure 6-12: MPU input

Terminal	Description		A_{max}
90	MPU input	inductive/switching	2.5 mm²
91			2.5 mm²
92		GND	2.5 mm²

Table 6-11: MPU - terminal assignment

Specification of the input circuit for inductive speed sensors
Ambient temperature: 25 °C

Signal forming	sinusoidal
Minimum input voltage of 200 to 10,000 Hz	< 0.5 V_{eff}
Minimum input voltage of 300 to 5,000 Hz	< 0.3 V_{eff}

Table 6-12: MPU - minimum input voltage

NOTE

When the ambient temperature rises, the minimum input voltage is increased by approx. 0.3 V/°C.

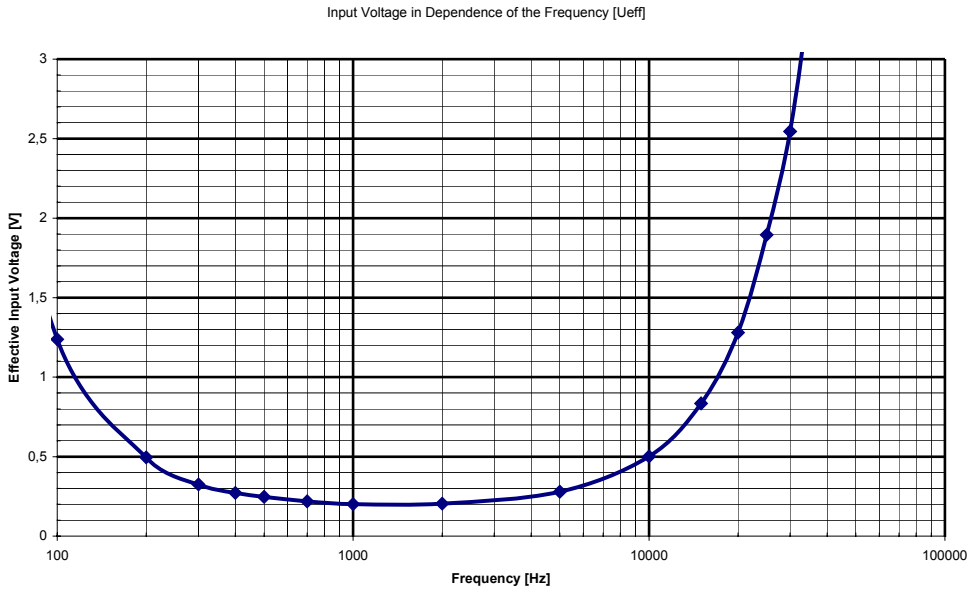


Figure 6-13: Minimum required input voltage depending on frequency at 25°C

Auxiliary and Control Outputs

Power Circuit Breaker Outputs

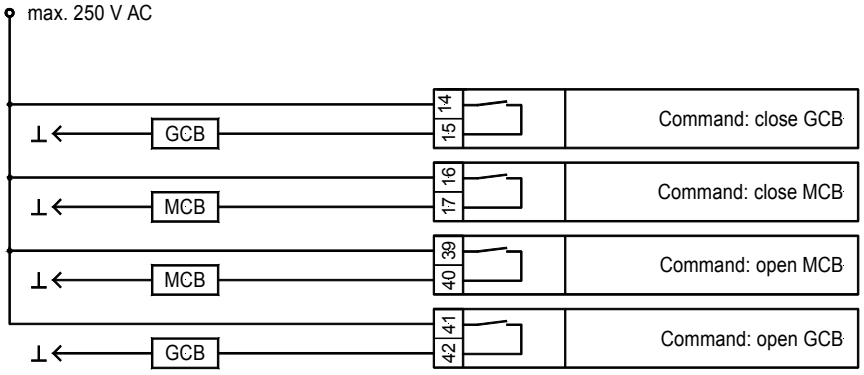


Figure 6-14: Power circuit breaker outputs

Root	Switched	Description	A_{max}
14	15	Close generator power circuit breaker	2.5 mm²
16	17	Close mains power circuit breaker	2.5 mm²
39	40	Open mains power circuit breaker	2.5 mm²
41	42	Open generator power circuit breaker	2.5 mm²

Table 6-13: Power circuit breaker outputs - terminal assignment

Relay Outputs (general)

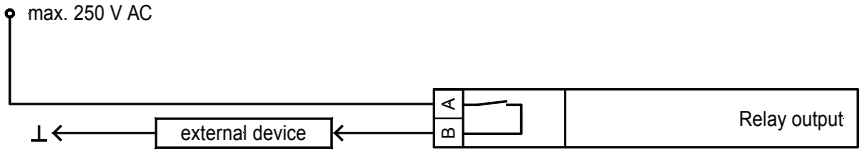


Figure 6-15: General relay outputs

Root *A*	Switched *B*	Description	A_{max}
18	19	Ready for operation	2.5 mm²
43	44	Fuel solenoid	2.5 mm²
45	46	Starter	2.5 mm²
33	34	Relay 1 (RM)	2.5 mm²
35	36	Relay 2 (RM)	2.5 mm²
37	38	Relay 3 (RM; pre-assigned: preheat / ignition ON)	2.5 mm²
47	48	Relay 4 (RM; centralized alarm horn)	2.5 mm²

Table 6-14: General relay outputs - terminal assignment

Analog Outputs (Option A2)

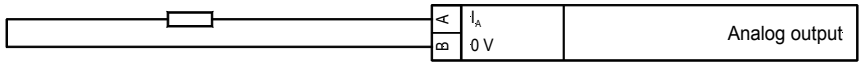


Figure 6-16: Analog outputs

A	0 V *B*	Description	A_{max}
120	121	Analog output 0/4 to 20 mA	2.5 mm²
122	123	Analog output 0/4 to 20 mA	2.5 mm²

Table 6-15: Analog outputs - terminal assignment

Governor Outputs (Standard / Options Qf/Qu)

The governors of the standard version are designed as three-position controllers [composed of a change-over contact and a NO (make) contact; please refer to the description in the following chapters]. If options Qu or Qf are implemented, they are designed as quasi-continuous governors with analog outputs [please refer to the following chapters]. In addition to this, further configuration screens are displayed.

Three-Position Controller Outputs (Standard)

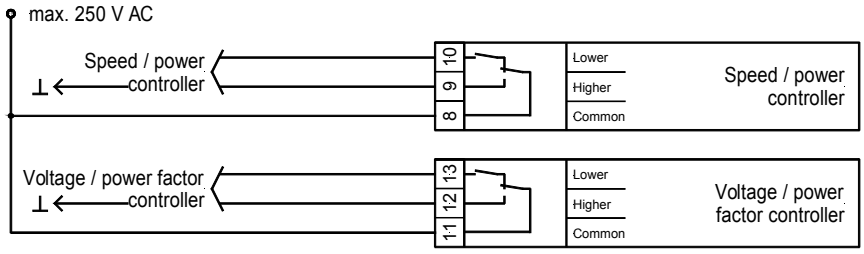


Figure 6-17: Three-position controller outputs

Terminal	Assignment	Description	A_{max}
8	common	Speed/power controller	2.5 mm²
9	higher		2.5 mm²
10	lower		2.5 mm²
11	common	Voltage/power factor controller *(only for "synchronous" version)*	2.5 mm²
12	higher		2.5 mm²
13	lower		2.5 mm²

Table 6-16: Power circuit breaker outputs - terminal assignment

Analog Controller Outputs (Options Qf/Qu)

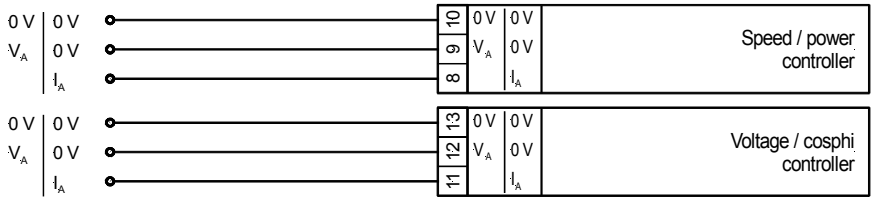


Figure 6-18: Three-position controller outputs

Terminal	Assignment		Description	A_{max}
	I	V_A		
8	I_A		Speed/power controller	2.5 mm²
9	0 V	V_A		2.5 mm²
10	0 V	0 V		2.5 mm²
11	I_A		Voltage/power factor controller *(only for "synchronous" version)*	2.5 mm²
12	0 V	V_A		2.5 mm²
13	0 V	0 V		2.5 mm²

Table 6-17: Power circuit breaker outputs - terminal assignment

Terminal			Description	A_{max}
A	*B*	*C*		
93	94	95	Analog input 1	1.5 mm²
96	97	98	Analog input 2	1.5 mm²
99	100	101	Analog input 3	1.5 mm²
102	103	104	Analog input 4	1.5 mm²

Table 6-18: Analog inputs - terminal assignment

Interfaces (Options Su/Sb/Sf)

Overview

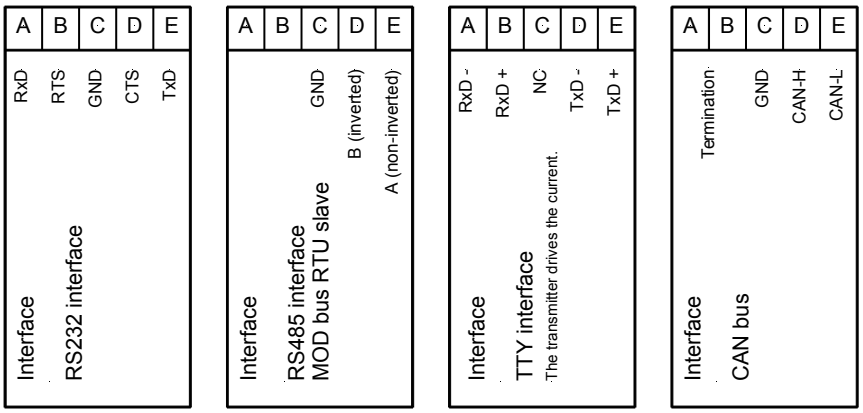


Figure 6-19: Interfaces - overview

Terminal					Description
Whether the terminals are designated X or Y depends on the configuration of the system. Please refer to the wiring diagram (A = X/Y, B = X/Y, etc.)					
A *(X1/Y1)*	***B*** *(X2/Y2)*	***C*** *(X3/Y3)*	***D*** *(X4/Y4)*	***E*** *(X5/Y5)*	
RxD	RTS	GND	CTS	TxD	RS-232
		GND	B	A	RS-485, MOD bus RTU slave
RxD-	RxD+	NC	TxD-	TxD+	TTY (transm. drives the current)
		GND	CAN-H	CAN-L	CAN bus

Table 6-19: Interfaces - connection overview

CAN Bus Shielding

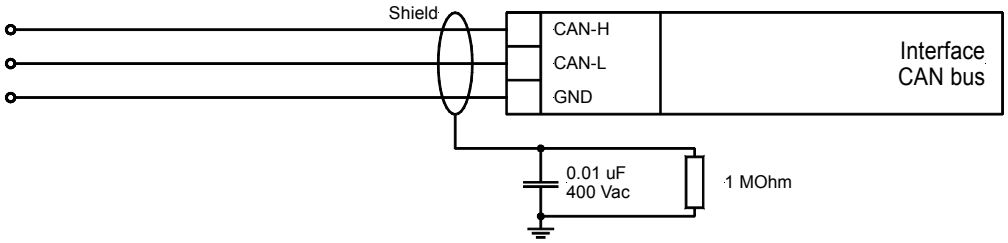


Figure 6-20: Interface - CAN bus shielding

The CAN Bus Loop

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 Ohm). The CAN bus is terminated between CAN-H and CAN-L.

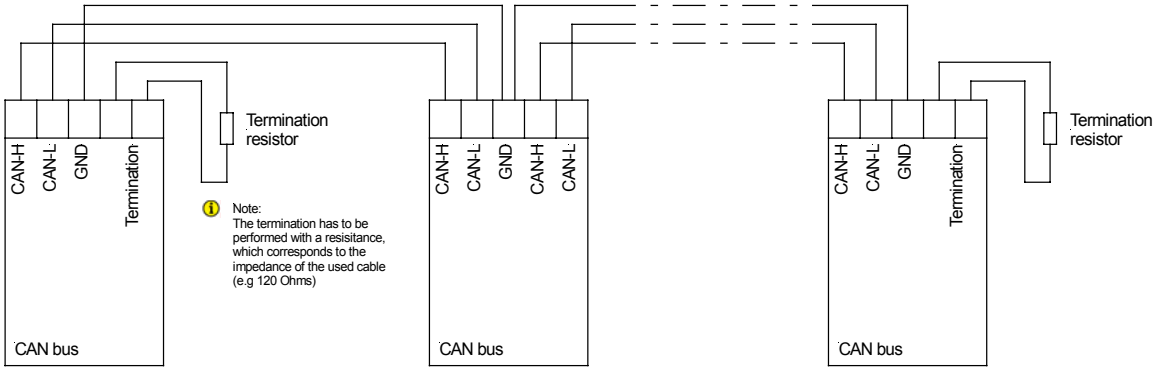


Figure 6-21: Interfaces - Loop the CAN bus

DPC - Direct Configuration Interface

NOTE

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

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

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

NOTE

The DPC cable (P/N 5417-557) is intended for configuration and service operation only. Do not operate the GCP-20 with the DPC plugged into the unit during regular operation.

NOTE

The connection cables delivered with the DPC must be used to connect between the control unit and the computer to ensure a proper function of the GCP-20. Utilization of an extension or different cable types for the connection between GCP-20 and DPC can result in a malfunction of the GCP-20. This may possibly result in damage to components of the system. If an extension of the data connection line is required, only the serial cable between DPC and notebook/PC may be extended.

Unplug the DPC after configuration to ensure a safe operation!

Chapter 7.
Functional Description

Considerations for …

… Different Options

In accordance with its configuration, the unit may differ from the maximum expansion via the following characteristics:

- The inputs and outputs may be installed or not. Please check the wiring diagram and the notes referring to the corresponding options. Refer to the type plate to see whether or not the corresponding option is contained in the unit. If the type plate was removed you can scroll through all configuration masks and combine individual options with the aid of this manual.
- There are various configuration masks for the various types of interfaces.

… Equipment with One Power Circuit Breaker

If a unit with a 2-circuit breaker logic circuit [GCP-22] or with a 1-circuit breaker logic circuit [GCP-21] is used for an application with one power circuit breaker, the following applies:

- If the equipment is to be operated in isolated operation, the following signals must be deposited (as a rule, the following applies: Term. 53 always negated to term. 54):
  - Set mains decoupling to "GCB",
  - "Response: MCB is open" / "isolated operation" (term. 54): HIGH signal (log. "1") and
  - "MCB enable" (terminal 53): LOW signal (logic "0").
  - Condition: The "emergency power" screen must be configured "OFF".
- If the equipment is to be operated in parallel operation, the following signals must be deposited (as a rule, the following applies: Term. 53 always negated to term. 54):
  - "Reply: MCB is open" / "isolated operation" (term. 54): LOW signal (log. "0") and
  - "MCB enable" (terminal 53): HIGH signal (logical "1").
  - Set mains decoupling to "GCB",
  - Condition: The "emergency power" screen must be configured "OFF".

… Equipment with Induction Generators

If systems with induction generators are used, the following must be noted:

- Systems with induction generators are 1-LS-equipments [GCP-21].
- Connect the remanent voltage to the terminals 23/24. Terminal 23/24 has a zoom function as long as the unit is not operated in parallel with the mains, as the unexcited synchronous generator is not yet able to generate voltage. If the unit is operated in parallel with the mains, this input is no longer taken into consideration. Control is carried out on the basis of voltage measurement at terminals 20/21/22 and 50/51/52.
- Connect the terminal 53 " MCB enable" to a continuous HIGH signal (e. g. connect with the terminal 1 "power supply"). This informs the unit that it is in mains parallel operation. Power control is carried out.
- Connect the terminal 54 " MCB reply" to a continuous LOW signal

Set Point Table

Automatic 1	Automatic 2	Control via interface ON	Ext. set point value ON	Specification of Set point value through
1	X	X	X	Set point 1
0	1	OFF	OFF	Set point 2
0	1	OFF	ON	Externally via 0/4 to 20 mA input
0	1	ON	X	Externally via serial interface
0	0	OFF	OFF	Standby only emergency power

Table 7-1: Set point table

Control Inputs

NOTE

Any possible emergency power ("Emergency power" configuration screen must be set to ON) or sprinkler operation (terminal 6 must be configured accordingly) will be carried out in the operating modes "TEST" and "AUTOMATIC" regardless of the discrete inputs "Automatic 1" and "Automatic 2". If terminals 3 and 5 are enabled simultaneously, preference is given to terminal 3.

Automatic 1
Terminal 3

Selection of the operating mode "AUTOMATIC" with the "**set point of the active load 1**"

Set.....If the unit is set to the operating mode "AUTOMATIC" (selected by means of the selector switch for operating modes located at the front side) the "set point of the active load 1" is adjusted while in mains parallel operation. In the case of a fixed power (C), the unit is started immediately and mains parallel operation is commenced following the synchronization of the generator power circuit breaker. In the case of incoming (I) or outgoing power (E), starting is determined by automatic an start/settle operation. If no automatic start/settle operation is carried out, the unit is started immediately. The set point value can be modified via the configuration mode.

Reset.....If neither the sprinkler nor the emergency power operation are activated, the genset is shut down and then switched off after coasting.

Automatic 2
Terminal 5

Selection of the operating mode "AUTOMATIC" with the "**set point of the active load 2**"

Set.....If the unit is set to the operating mode "AUTOMATIC" (selected by means of the selector switch for operating modes located at the front side) the "set point of the active load 2" is adjusted while in mains parallel operation. In the case of a fixed power (C), the unit is started immediately and mains parallel operation is commenced following the synchronization of the generator power circuit breaker. In the case of incoming (I) or outgoing power (E), starting is determined by automatic boost/buck operation. If no automatic boost/buck operation is carried out, the unit is started immediately. The set point value can be modified via the configuration mode.

Reset.....If neither the sprinkler nor the emergency power operation are activated, the genset is shut down and then switched off after coasting.

If the external definition of a set point value is activated (e. g. by an analog input 0/4 to 20 mA or by a bi-directional interface), the external set point is adjusted via the discrete input (see table of set points).

Multifunction
Terminal 6

Discrete input terminal 6 may reveal different functions according to the following description. Please note that, when used as a sprinkler input, the discrete input reveals negative functional logic. The logic circuit is selected by means of a configuration screen

• Sprinkler

By **resetting** the terminal 6 (application of a Low-level) the sprinkler operation is activated according to the description of functions. This is terminated by **setting** terminal 6 (application of a High signal). **Attention:** Negative functional logic!

• Motor release

Here, the terminal 6 has the same function as the STOP-button: Resetting the terminal 6 (application of a LOW level) avoids that the engine is started and stops a genset which is already running; the application of a HIGH level releases the start of the genset. **Attention:** Via this function, emergency power operation is also prevented or aborted. Emergency power is **not** possible without this release signal! The motor release function is only possible in "AUTOMATIC" operating mode.

• ext. acknowledge

While in the operating modes "STOP" and "AUTOMATIC" external alarms may be acknowledged by setting the terminal 6 (change of slope from a LOW to a HIGH level). In order to achieve further acknowledgment, terminal 6 must accordingly first be reset and then set again. If a continuous HIGH signal is present at terminal 6, this has no effect on the acknowledgment and suppression of alarm messages.

no CB by start
Terminal 5

If the terminal 5 is set, the genset starts, no synchronization is carried out and the generator power circuit breaker is not switched on (no switching to the dead busbar). The GCB is only switched on in case of emergency current. After the return of the mains the transfer to the mains is carried out according to the preset switch logic. If, for the circuit breaker logic "Parallel", the genset is set to operation parallel with the mains, and if the terminal 5 is activated, the GCB is opened after a power reduction. The genset keeps on running in no-load operation with the GCB open. By deactivating the terminal 5 the genset is shut down without coasting.

Reply: GCB is open
Terminal 4

With this input (logic "1") the open nature of the generator power circuit breaker is announced to the unit (the LED 11 "GCB ON" is off).

[GCP-20/22]
Reply: MCB is open
Terminal 54

With this input (logic "1") the open nature of the mains power circuit breaker is announced to the unit (the LED 10 "MCB ON" is off).

[GCP-21]
Isolated operation
Terminal 54

With this input (logical "0" → logical "1") the device receives the annunciation that the genset is working in isolated operation (the LED 10 "Mains parallel" is off). This discrete input is used to decide whether, after closing the GCB, frequency control (terminal 54 = logical "1") or power control (terminal 54 = logical "0") is to be carried out.

[GCP-20/22]
Release MCB
Terminal 53

Set ..... An *[GCP-22]* mains parallel operation is possible and the mains circuit breaker is operated.
Reset ..... An isolated operation is carried out (frequency and voltage regulation), and the mains circuit breaker is not operated.

[GCP-21]
Mains parallel operation
Terminal 53

The input signal of this discrete input must always be negated in connection with the discrete input "response: MCB is open" / "isolated operation" (terminal 54).

Discrete Inputs
Terminals 61 to 74

Programmable alarm inputs with clear text display, alarm class, delay, engine start delay and closed /working current release (description starting from page 121).

Control Outputs

Ready for operation
Terminal 18/19

Setting the relay signals the readiness for operation of the unit. If this relay drops off, a faultless operation of the unit cannot be guaranteed. Make sure to take the appropriate measures if this relay has dropped out (e.g. open GCB, switch off the engine).

Preheating (diesel unit)
pre-assigned to relay 3
terminals 37/38

By setting this relay, the diesel unit is preheated (see description of functions starting process diesel unit, page 142).

Ignition "ON" (gas eng.)
pre-assigned to relay 3
terminals 37/38

By setting this relay, the ignition of the gas engine is switched on (see description of functions starting process gas engine, page 139).

Starting relay (diesel unit)
Terminals 43/44

By setting this relay the start will be released for the drive unit. If the unit is to be shut down the relay will immediately drop off. If the speed of the genset drops below the settable ignition speed, the relay also drops out (see description of functions starting process diesel engine, page 142).

Gas valve (gas engine)
Terminals 43/44

By setting this relay the gas valve for the gas unit will be opened. If the unit is to be shut down the relay will immediately drop out. If the speed of the genset drops below the settable ignition speed, the relay also drops out (see description of functions starting process gas engine, page 139).

Starter
Terminals 45/46

By setting this relay the starter will be engaged. When reaching the ignition speed or in case of a STOP the starter is reset.

Centralized alarm
pre-assigned to relay 14
terminals 47/48

By setting this relay, a centralized alarm is output. It is possible to trigger for instance a horn or a buzzer. The operator can reset the relay by pressing the pushbutton "clear" for a short period. The relay will be set again if another alarm occurs. The centralized alarm is set for alarms of the alarm class F1 to F3.

Command: GCB close
Terminals 14/15

By setting this relay the generator power circuit breaker (GCB) will be closed. If the connection of the GCB has been parameterized to continuous pulse, the "Reply: GCB is open" the relay is maintained in its closed state; this is also the case if the voltages of the generator and the generator busbar are identical. In the event of an alarm of the class 2 or 3, or the GCB is to be opened, this relay drops out. If the connection of the GCB was not programmed by means of a continuous pulse the relay drops out again after the pulse is issued.

Command: GCB open
Terminals 41/42

By setting this relay the GCB will be opened. Following "Reply: GCB is open", the relay output is removed.

[GCP-20/22]
Command: MCB close
Terminals 16/17

By setting this relay the MCB will be closed. This output is always a add-on pulse, i. e, the locking of the mains circuit breaker must be carried out externally.

[GCP-20/22]
Command: MCB open
Terminals 39/40

By setting this relay the MCB will be opened. Following "Reply: MCB is open", the relay output is removed.

Addtl. relays R1 to R4

Terminals 74 to 83,
33 to 38, 47/48

These relays are managed by the "relay manager" (see Relay Manager on page 158).

Presetting:
- Number of relay (e. g. relay 1 = alarm class 1, relay 2 = error class 2, etc.)
- Relay 3 = ignition / preheating
- Relay 4 = Centralized alarm

Clear Text Display

Operating and alarm messages are displayed in the bottom row in the display. With the button "Message" it is possible to switch over to the subsequent masks.

Functional Messages of the Unit

Relay messages

The subsequent relay outputs for the engine or generator control are also indicated on the display:

- Synchronization of GCB or MCB "**Synchr.GCB**" / "**Synchr.MCB**"
- Add-on GCB (Induction) "**Connect GCB**"
- Switching todead busbar GCB or. MCB "**Deadbus GCB**" / "**Deadbus MCB**"
- Starting "**Start**"
- Preheating (diesel engine) "**Preglow**"
- Purging operation (gas engine) "**turning**"
- Initial state (diesel engine): f- permanent signal of the speed governor is set prior to the genset start "**goven. down**"
- Auxiliary operations Pre-travel/ coasting "**prerun aux.**" / "**postrun aux.**"

"Start-Pause" An interrupted starting process is displayed with the message "Start pause".

"Testmode" If the operating mode "Test" is selected, this message is output.

"Load Test" If the operating mode "Test" is selected after activating the button "GCB ON", and if a load test is selected, this message is output.

"Emergency" This message displays a current case of emergency power.

"mains settl" This message in the display shows the mains settling time following a mains alarm.

"Sprinkler" This message is shown in the display during sprinkler operation.

"Sprinkler.sd." Following sprinkler operation, the unit operates without load for 10 minutes. This message is shown in the display during this period.

"Cooldown" No-load operation (unit cooling) prior to unit shutdown is displayed with this message.

"Stop Engine" When stopping the unit, a starting block is set for 10 seconds on negative deviation from the firing speed. This message displays the operating condition.

NOTE

The indication of the texts "sprinkler operation", "emergency power", "test" and "load test" alternates with the basic mask. If one of these texts is active, the actuation of the "Select" button switches to the continuous display of the basic display screen. This can be undone again by actuating the "Acknowledge" button.

Operational Messages of the Unit

Messages of the protective device

The following messages are output by the monitor functions:

- Undervoltage generator or mains (only after mains decoupling) "**G-.underv.**" / "**M-undervolt**"
- Overvoltage generator or mains (only after mains decoupling) "**G-Overvolt.**" / "**M-overvolt.**"
- Undervoltage generator or mains (only after mains decoupling) "**low freque.**" / "**M-underfrq.**"
- Overfrequency generator or mains (only after mains decoupling) "**over freq.**" / "**M-overfreq.**"
- phase shift "**phase shift**"
- Overspeed (pickup tripping) "**over speed**"
- Generator overload "**G-overload**"
- Reverse-/reduced load "**power fail**"
- Generator overcurrent 1 "**Gen.curr. 1**"
- Generator overcurrent 2 "**Gen.curr. 2**"
- Battery undervoltage "**Bat.undervo**"

Messages of the discrete inputs

The text assigned in the relevant screen is output as an alarm message. At the same time, alarm output for the alarm class which has been set occurs.

"Pickup/fre." This alarm message is output on the display if the deviation (≈10 Hz) of the pickup speed from the generator frequency is too large.

"Error Y1Y5" Interface Y1 to Y5 malfunction. External control signals cannot be received.

"Error X1X5" Interface X1 to X5 malfunction. External control signals cannot be received.

"GCB syn.fai" If the synchronization time or the connect time for the generator power circuit breaker has been exceeded, this message is shown in the display. At the same time, an alarm class F1 alarm is output.

"MCB syn.fai" If the synchronization time or the connect time for the mains power circuit breaker has been exceeded, this message is shown in the display. At the same time, an alarm class F1 alarm is output.

"GCB failure" If the GCB cannot be activated after 5 attempts, this message is output on the display. If it is present 2 seconds following the "Command: GCB open" pulse, this message is also indicated. At the same time, an alarm class F1 alarm is output. An output of this malfunction via the relay manager is possible.

"MCB failure" If the MCB cannot be activated after 5 attempts, this message is output on the display. If it is still present 2 seconds following the "Command: MCB open" pulse, this message is also indicated. At the same time, an alarm class F1 alarm is output. An output of this malfunction via the relay manager is possible.

"power zero" The (power circuit) breaker logic "interchange" has been selected and the MCB is to be opened. If the incoming power zero cannot be adjusted within the time set in the "Add on/off max. time" screen, this message is displayed.

"Start fail" This message is output following three unsuccessful starting attempts. No further attempt at starting is made. In sprinkler operation, starting is attempted six times before this message is displayed.

"Stop fail" If speed is still detected 30 seconds following the stop signal, the message "Shutoff malfunction" is output with an F3 alarm shutoff.

"Service" Following the expiry of the maintenance interval, the imminence of the next maintenance is displayed with this message.

Start/Stop Procedure

Diesel Engine

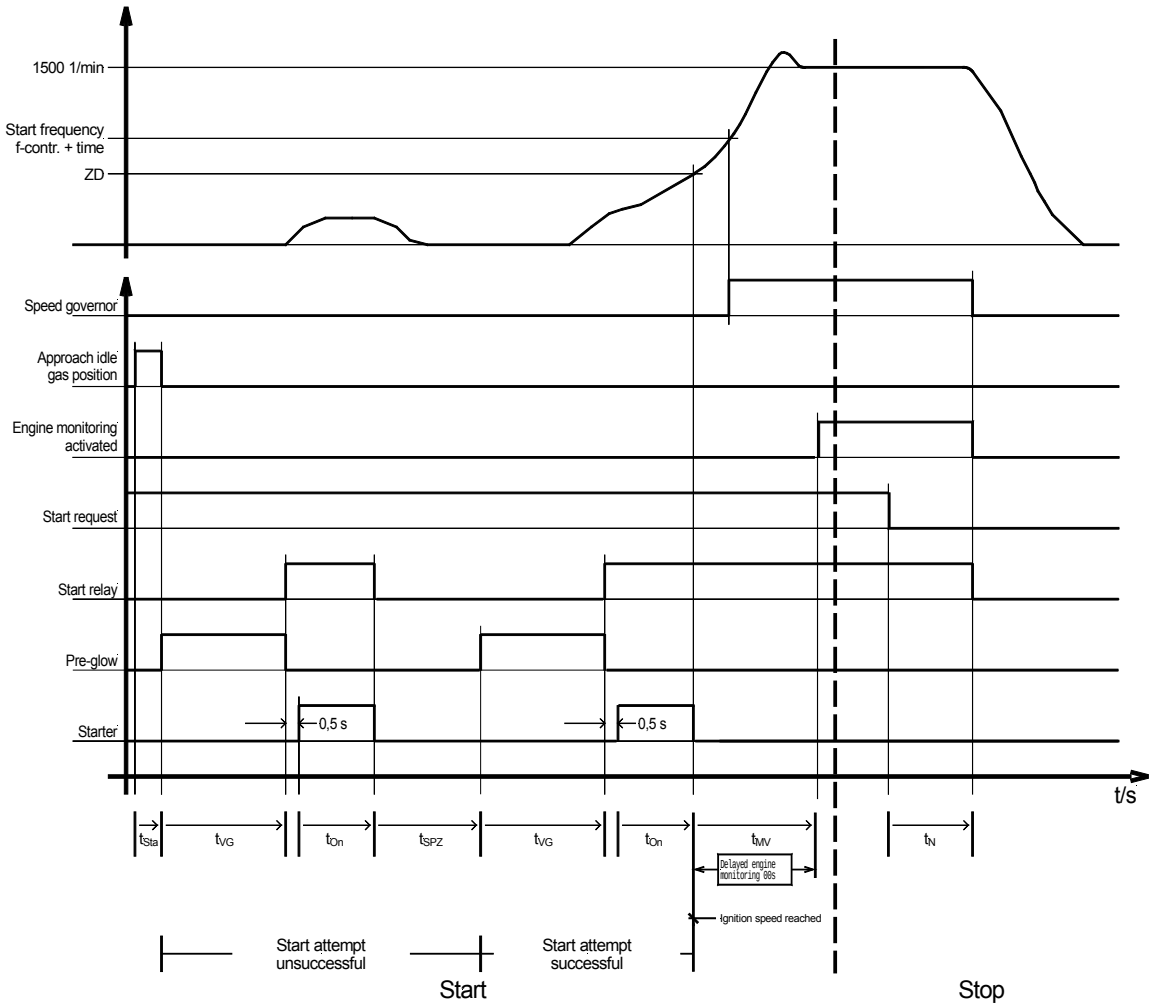


Figure 7-1: Diesel engine start procedure

The abbreviations and indices mean:
- t_{Sta} ..... approach idle gas position [s] -> governor down
- t_{VG} ..... preheating time [s]
- t_{On} ..... engagement time [s] -> cranking
- t_{SPZ} ..... interval between two start attempts [s]
- t_{MV} ..... delayed motor monitoring [s]
- t_{N} ..... coasting time [s] -> cool down

Start Procedure

Explanation by means of entered data

Freq. low before start	(ON/OFF)	ON
Action time for freq. low	(0 to 999 s)	t_{VG} = 0 s
Preglow time	(0 to 99 s)	t_{VG} = 3 s
Starter time	(0 to 99 s)	t_{EZ} = 5 s
Start pause time	(0 to 99 s)	t_{SPZ} = 10 s

Function

If the unit is equipped with a three-position frequency controller, the relay "Freq. low before start" is output for the time "Action time for freq. low" prior to the starting process. Then the relay "Preheating" will be set for the period of the preheating time. Following preheating, the fuel solenoid is first set, and then the starter. When the adjustable firing speed is exceeded, the starter is disengaged again, and the fuel solenoid is held via the firing speed. After reaching "starting frequency f-controller" of the speed governor and following the time lag, the speed governor is activated.

Stop Procedure

Coasting time	(0 to 999 s)	t_N = 3 s -> cool down time

Function

By resetting the operation bit, the power is reduced (provided that the active load controller is switched on). After opening the generator power circuit breaker, the coasting time is started, and the motor rotates without load. After terminating the coasting time, the fuel solenoid is reset. The motor is stopped. If the firing speed is not reached, motor starting is prevented for a firmly pre-configured time of 10 seconds. If the motor cannot be stopped by the fuel solenoid, the "stop fail" alarm message appears after 30 s, a class 3 alarm is output.

Gas Engine

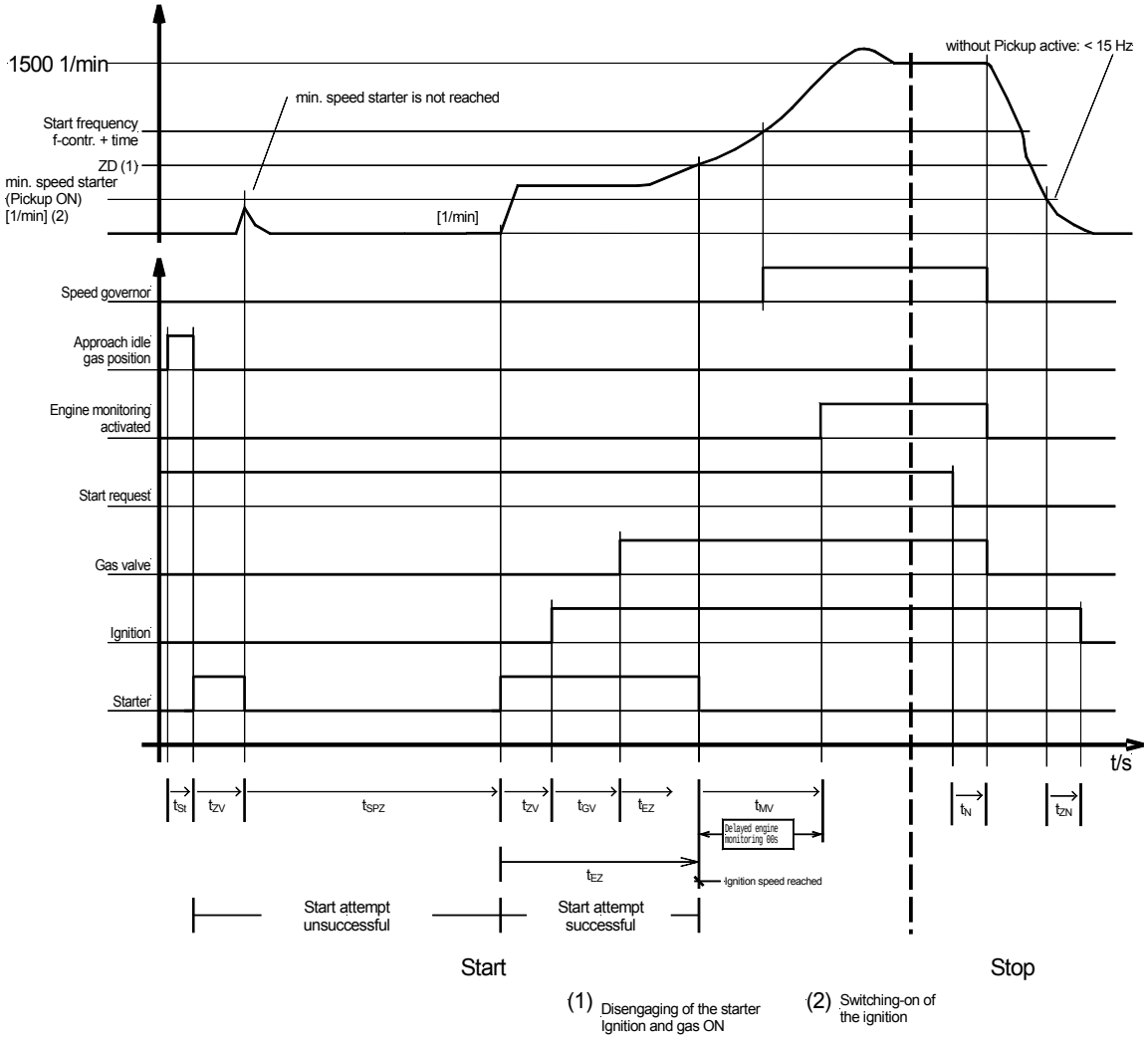


Figure 7-2: Gas engine start procedure

The abbreviations and indices mean:

t_{St} ..... approach idle gas position
t_{ZV} ..... firing delay [s]
t_{GV} ..... gas delay [s]
t_{EZ} ..... engagement time [s]
t_{SPZ} ..... interval between two start attempts [s]
t_{MV} ..... delayed engine monitoring [s]
t_{ZN} ..... ignition coasting [s]
t_{N} ..... coasting time [s]
(1) ..... disengagement of the starter; ignition and gas ON
(2) ..... starting of ignition and gas

Start Procedure

Explanation by means of entered data

Approach idle gas position	(ON/OFF)	ON
Firing delay	(0 to 99 s)	t_{ZV} = 3 s
Gas delay	(0 to 99 s)	t_{GV} = 8 s
Engagement time	(0 to 99 s)	t_{EZ} = 5 s
Interval between two start attempts	(0 to 99 s)	t_{SPZ} = 10 s

Function

If the unit is equipped with a three-position frequency controller, a permanent signal (time adjustable) is output at the relay output "frequency lower". The starter is then set. Following the firing delay time and as soon as the genset is rotating at least at the configured "Ignition speed Starting" the ignition is then switched on. Following the expiry of the gas delay, the gas valve is then switched on. If the starting attempt is successful, i.e., the firing speed was exceeded, the starter is disengaged again. The gas valve and the ignition are held via the firing speed. After reaching the "starting frequency f-controller" and following the time lag, the speed governor is then activated.

Starting process

The gas valve is held via the ignition speed. The ignition is held via the minimum speed (at pickup) or is shut down at < 15 Hz (without pickup).

Stop Procedure

Coasting time	(0 to 999 s)	t_{ZN} = 3 s -> cool down
"Engine stop"	10 s	t_{MST} = 10 s
"Shutdown alarm"	30 s	t_{ab} = 30 s

Function

By resetting the starting request the power is reduced (provided that the active power controller is switched on). After opening the generator power circuit breaker, the coasting time is started, and the motor rotates without load. After terminating the coasting time the gas valve relay is reset. The motor is stopped. If the firing speed is not reached, motor starting is prevented for a firmly pre-configured time of 10 s seconds. If the motor cannot be stopped, the "Stop fail" alarm message appears after 30 s, a class 3 alarm is output.

Without pickup: following a negative deviation of the ignition speed the ignition relay remains set for another 5 seconds for the combustion of the remaining gas.

Circuit Breaker Operation

NOTE

For the description of the switch logics please refer to the chapter Breaker Logic on page 98.

GCB Synchronization

The generator power circuit breaker (GCB) will be synchronized with frequency and voltage correction if the following conditions are met simultaneously:

Preset limits admissible	• voltage	V_{SS} 85 to 112 % $V_{setpoint}$
Busbar	• frequency	f_{SS} 90 to 110 % f_{rated}

Automatic operation

- the "AUTOMATIC" operating mode is selected
- one of the circuit breaker logics "parallel", "interchange" or "closed transition" are activated while in configuration mode
- no alarm class 2 or 3 alarm is present
- on input "Automatic 1" (terminal 3) or "Automatic 2" (terminal 5) is applied, or the remote starting signal is activated via the interface
- voltage is applied to the busbar
- the genset is running, and the generator voltage and frequency are within the range
- the busbar voltage and frequency are within the preset limits
- the delayed engine monitoring has been executed

Manual operation

- "MANUAL" operating mode has been selected
- one of the circuit breaker logics "parallel", "interchange" or "closed transition" is active while in configuration mode
- no alarm class 2 or 3 alarm is present
- voltage is applied to the busbar
- the genset is running, and the generator voltage and frequency are within the range
- the busbar voltage and frequency are within the preset limits
- the button "GCB ON" has been activated

Load test operation

- the "TEST" operating mode is selected
- one of the circuit breaker logics "parallel", "interchange" or "closed transition" are activated while in configuration mode
- no alarm class 2 or 3 alarm is present
- voltage is applied to the busbar
- the genset is running, and the generator voltage and frequency are within the range
- the busbar voltage and frequency are within the preset limits
- the button "GCB ON" has been activated

Close GCB without Synchronization (Dead Bus Operation GCB)

The generator power circuit breaker is closed without synchronization if the following conditions are met simultaneously:

Automatic operation

- the "AUTOMATIC" operating mode is selected
- no alarm class 2 or 3 alarm is present
- the release of "Dead bus operation GCB" is set to "ON" while in configuration mode
- no voltage is applied to the busbar or busbar voltage is below 20V
- the genset is running, and the generator voltage and frequency are within the preset limits (refer to Parameter 120 and Parameter 121)
- the "response: MCB is open" exists (the MCB is open)
- with a load sharing via CAN-Bus (Woodward units)
  - none of the GCBs may be closed if a isolated operation in parallel with other gensets is possible
  - the unit with the lowest unit number will be the first to close its GCB

Manual operation

- "MANUAL" operating mode has been selected
- no alarm class 2 or 3 alarm is present
- no voltage is applied to the busbar or busbar voltage is below 20V
- the genset is running, and the generator voltage and frequency are within the preset limits (refer to Parameter 120 and Parameter 121)
- the "response: MCB is open" exists (the MCB is open)
- with a load sharing via CAN-Bus (Woodward units)
  - none of the GCBs may be closed if an isolated operation in parallel with other gensets is possible,
  - the unit with the lowest unit number will be the first to close its GCB

Generator monitors switched off

If the generator monitors are switched off, the switch logic and the control system are controlled by internally defined limit values.

Generator monitor	Voltage	Frequency
ON	Monitor values	Monitor values
OFF	$V_{Gen.} < 75\ \%\ V_{rated}$ $V_{Gen.} > 115\ \%\ V_{rated}$	$f_{Gen.} < 88\ \%\ f_{rated}$ $f_{Gen.} > 112\ \%\ f_{rated}$

Table 7-2: Generator monitors

MCB Synchronization

The mains power circuit breaker will be synchronized with frequency and voltage correction if the following conditions are met simultaneously:

Automatic operation

- the "AUTOMATIC" operating mode is selected
- one of the circuit breaker logics "parallel", "interchange" or "closed transition" is activated while in configuration mode
- no alarm class 2 or 3 alarm is present
- voltage is applied to the busbar
- the mains voltage is applied and within the admissible limits
- in emergency power operation, the "mains settling time" has finished
- the genset is running, and the busbar voltage and frequency are within the range
- the "response: GCB is open" is not present (the GCB is closed)
- the input "release MCB" is set
- [GCP-21/22] If the mains watchdogs are switched off, the mains values apply as follows:

Mains monitor	Voltage	Frequency
ON	Monitor values	Monitor values
OFF	85 to 112.5 %	90 to 110 %

Table 7-3: Mains monitors

Manual operation

- "MANUAL" operating mode has been selected
- one of the circuit breaker logics "mains parallel operation", softloading" or "no-break-transfer" is activated while in configuration mode
- no alarm class 2 or 3 alarm is present
- voltage is applied to the busbar
- mains voltage is applied
- the genset is running, and the generator voltage and frequency are within the preset limits (refer to Parameter 120 and Parameter 121)
- the "response: GCB is open" is not present (the GCB is closed)
- the input "release MCB" is set
- the button "MCB ON" has been activated
- Load test: with the termination of the load test (circuit breaker logics "softloading" or "no-break-transfer") the GCB opens

Close MCB without Synchronization (Dead Bus Operation MCB)

Automatic operation

- the "AUTOMATIC" operating mode has been selected
- the release "Dead bus operation MCB" is set to "ON"while inconfiguration mode
- no voltage is applied to the busbar
- the mains voltage is applied (in the case of emergency power the mains settling time has been finished)
- the mains voltage and frequency are within the preset limits
- the "response: GCB is open" is present (the GCB is open)
- the input "release MCB" is set
- With a load sharing via CAN-Bus (Woodward units)
  - none of the MCBs may be closed if a isolated operation in parallel with other gensets is possible
  - the unit with the lowest unit number will be the first to close its MCB

Manual operation

- the "MANUAL" operating mode has been selected
- no voltage is applied to the busbar or busbar voltage is below 20V
- the mains voltage is applied
- the "response: GCB is open" is present (the GCB is open)
- the input "release MCB" is set
- the button "MCB ON" has been activated
- with a load sharing via CAN-Bus (Woodward units)
  - none of the MCBs may be closed in case of a isolated operation in parallel with other gensets
  - the unit with the lowest unit number will be the first to close its MCB

Opening the GCB

The generator power circuit breaker is opened both when the relay "Command: Close GCB" de-energizes (only if "constant" has been selected for the GCB closing relay in configuration mode), and via the closure of the relay "Command: Open GCB". The GCB will be opened under the following circumstances:

- In case of a response of a mains monitor with decoupling to GCB
- while in operating mode "STOP"
- if alarm class 2 or 3 occurs
- when actuating the button "GCB OFF" or "MCB ON" (depending on the preset switch logic) while in manual operation or load test operation
- when actuating the button "STOP" while in manual operation
- when settling automatically while in the AUTOMATIC operating mode
- after synchronizing the MCB
- prior to switching to the dead busbar of the MCB in a automatic transfer switching
- while in sprinkler operation, provided that no emergency power case is present

Opening the MCB

The mains power circuit breaker is opened via the closure of the relay "Command: Open MCB" (the "constant" setting is not possible for the MCB). The MCB will be opened under the following circumstances:

- In case of a respond of a mains monitor, provided that the mains decoupling is set to MCB
- In the case that the emergency power (loss of mains) is responding and successful engine start
- following synchronizing of the GCB
- prior to the closing of the GCB in an automatic transfer switching
- when actuating the button "MCB OFF" or "GCB ON" (depending on the preset switch logic) while in manual operation or load test operation

Power Circuit Breaker Control

The closing and opening operations of the generator power circuit breaker (GCB) and the mains power circuit breaker (MCB) are described in the following diagram. The pulses are switched over in the mask described below, with the signal sequence being affected as indicated (the control of the mains circuit breaker ***cannot*** be effected by means of a continuous impulse). If the "Automatic switch release" screen is set to "ON", an open pulse is output prior to each close pulse. The "MCB release" inhibits the switching-on of the mains circuit breaker. A closed mains circuit breaker will not be opened.

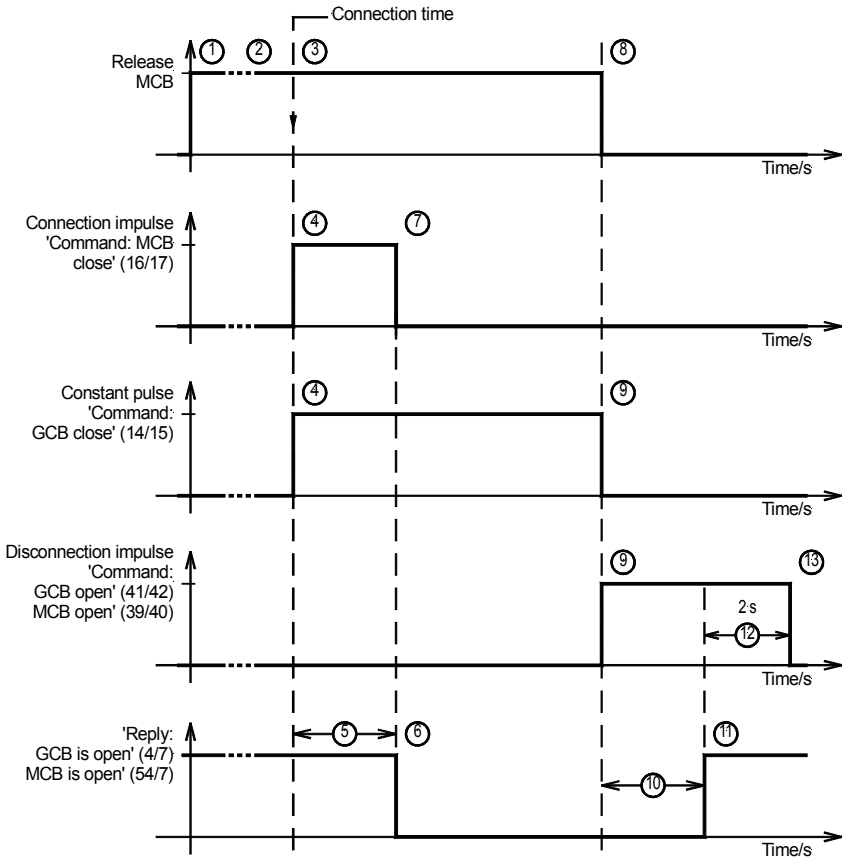


Figure 7-3: CB control

NOTE

Refer to Parameter 108 for more information about the function of the GCB closing relay.

Power Circuit Breaker Monitoring

Add-On Time Monitoring

If the mask "Sync. time control" is set to "ON", time monitoring of the synchronization is effected (monitoring of the connect time for induction generators) : If the synchronization of the GCB or MCB is started, the time counter is started following the expiry of delayed motor monitoring. If after the preset time, the power circuit breaker has not been closed, the warning message "Synchronization time of the GCB exceeded" (for induction generators "Connect time of the GCB exceeded") or "Synchronization time of the MCB exceeded" is output as an F1-alarm.

Circuit Breaker Monitoring

NOTE

If during active "MCB monitoring", circuit breaker monitoring, an alarm is detected on closing the MCB, this is carried out during activated emergency power.

while CLOSING If the screen "Supervision GCB" or "Supervision MCB" is set to "ON", monitoring of the generator and mains circuit breakers is carried out (exception: The power circuit breaker logic is set to "EXTERNAL"). If the circuit breaker cannot be activated by the fifth attempt, an alarm class F1 "GCB failure" or "MCB failure" alarm message is output. In the relay manager (see chapter Relay Manager from page 158) a relay is set with the parameter 74 or 75.

while OPENING If 2 seconds following an OPEN-pulse (opening of the GCB or MCB) the response is detected that the GCB or MCB is closed, this also leads to the output of an alarm with the message "GCB failure" or "MCB failure". In the relay manager, a relay is set with the parameter 76 or 77.

Power Circuit Breaker Logic

NOTE

For the description of the switch logics please refer to the chapter Breaker Logic on page 98.

Parallel Switch Logic [GCP-21/22]

NOTE

This switch logic must be selected for the following operating modes: isolated operation, isolated operation in parallel with other gensets and mains parallel operation.

In the event of a motor request

- the GCB is synchronized and closed
- the required generator active load is adjusted

Following the withdrawal of the motor request

- the generator power is reduced
- the GCB is opened
- the genset is shut down after the coasting (cool down time)

[GCP-22] The mains power circuit breaker is synchronized and closed if

- terminal 53 "Release MCB" is energized
- GCB closed

NOTE

On bucking the unit (no F3 alarm), power reduction is carried out before opening the generator power circuit breaker.

Interchange Switch Logic [GCP-22]

Interchange synchronization is activated via the "INTERCHANGE" screen input.

In the event of a motor request, a switch is made from mains to generator supply. In order to achieve this

- the GCB is synchronized and closed
- the mains reference power "zero" is correspondingly adjusted
- the MCB is opened

After the motor request has been reset, a switch is made from generator to mains supply. In order to achieve this

- the MCB is synchronized and closed
- the generator power "zero" is correspondingly adjusted (generator unloading)
- the GCB is opened

Closed Transition Switch Logic [GCP-20/22]

Closed transition synchronization is activated via the "CLOSED TRANS." screen input.

In the event of a motor request, a switch is made from mains to generator supply. In order to achieve this

- the GCB is synchronized and closed and
- the MCB is opened

After the motor request has been reset, a switch is made from generator to mains supply. In order to achieve this

- the MCB is synchronized and closed
- the GCB is opened

NOTE

The power circuit breakers are opened regardless of the power.

Open Transition Switch Logic [GCP-20/22]

Open transition logic is activated via the "OPEN TRANS." screen input.

In the event of a motor request, a switch is made from mains to generator supply. In order to achieve this

- the MCB is opened
- the GCB is closed

After the motor request has been reset, a switch is made from generator to mains supply. In order to achieve this

- the GCB is opened
- the MCB is closed

External Switch Logic

The external switch logic is activated via the "EXTERNAL" screen input. The entire switch activation must be effected by a master controller (for instance by a PLC). Closing and opening pulses sent to the MCB and the GCB are only output by this controller, if the operating mode is set to "MANUAL". In the event of an alarm the circuit breakers are in any case opened by this controller.

Emergency Power [GCP-20/22]

Prerequisite

The emergency power function can only be activated for synchronous generators by means of the screen "emergency power operation ON". Emergency power is carried out in "AUTOMATIC" or "TEST" operating mode regardless of the status of the discrete inputs "Automatic 1" and "Automatic 2".

NOTE

If the "Motor release" function is assigned to terminal 6, emergency power can be digitally prevented or interrupted from an external source.

Activation of the emergency power operation

If an alarm occurs at least at one of the terminals 50, 51 or 52 during the activation of the input mask "emergency power delay time ON" the emergency power is activated. A mains voltage alarm is defined as follows: If the mains watchdogs are switched on, the limit values set there are used; otherwise, the limits are internally defined as follows:

Mains watchdogs	Voltage	Frequency
ON	Monitor values	Monitor values
OFF	$V_{mains} < 85\ \%\ V_{rated}$ $V_{mains} > 112\ \%\ V_{rated}$	$f_{mains} < 90\ \%\ f_{rated}$ $f_{mains} > 110\ \%\ f_{rated}$

Table 7-4: Mains watchdogs

Emergency power is also triggered via the detection of a switch alarm when the MCB is switched on. For the triggering to occur, the screens "emergency power" (page 109) and "Monitoring MCB" must be set to "ON".

As a rule, the network screens apply for the GCP-20, since in this case, the mains watchdogs cannot be switched off.
The following principles apply for the emergency power operation:

- If an emergency power operation is triggered, the genset is started in any case unless the process is interrupted by an alarm or by changing the operation mode.
- If the mains returns during the starting process, the MCB is not opened. The unit starts under all circumstances, and waits without load until the mains settling time has expired. If a further mains alarm occurs during this time, the MCB is opened, and the GCB is switched to the black busbar. The unit otherwise shuts off following the expiry of the mains settling time.
- After reaching the dead bus operation limits, the GCB is always closed, independent of the motor delay time.
- If the mains returns during the emergency power operation (GCB closed) the mains settling time is first finished before re-synchronizing the MCB.

Emergency power operation

In the case of an active emergency power operation the message "emergency" is displayed.

Emergency Power Operation

The described emergency power operation is valid for the following logics:

- Parallel switch logic [GCP-22]
- Open transition switch logic [GCP-20/22]
- Closed transition switch logic [GCP-20/22]
- Interchange switch logic [GCP-22]

Emergency power operation

Following the detection of an emergency power case, the emergency power delay is first finished before starting the genset. On reaching the voltage and frequency limit values, the MCB is opened, and the GCB is then switched to the dead busbar. The unit takes over the supply of the isolated network.

Return of the Mains

Return of the Mains for Parallel Switch Logic [GCP-22]

Return of the mains

After the return of the mains voltage the mains settling time is still finished before the unit re-synchronizes the mains circuit breaker. After closing the mains power circuit breaker, the unit assumes its original operating mode. If the generator is shut off, power reduction is carried out provided that the active power controller is activated.

If the mains returns during starting, the mains power circuit breaker is not opened. During the mains settling time, the unit operates without load, in order to enable the immediate connection of the GCB in the event of further mains alarms.

Return of the Mains for Open Transition Switch Logic [GCP-20/22]

Return of the mains

After return of the mains voltage, the mains settling time is first finished, before the mains circuit breaker is switched back by the unit via a dead busbar. If, following the expiry of the mains settling time, an operating request is present, the unit remains in isolated operation.

If the mains returns during starting, the mains power circuit breaker is not opened. During the mains settling time, the unit operates without load, in order to enable the immediate connection of the GCB in the event of further mains alarms.

Return of the Mains for Closed Transition Switch Logic [GCP-20/22]

Return of the mains

After the return of the mains voltage the mains settling time is first finished. If no operating request is present, reverse synchronization of the MCB is carried out following the expiry of this time. Following the closure of the mains power circuit breaker, the generator power circuit breaker is opened immediately and without any reduction in power.

If the mains returns during starting, the mains power circuit breaker is not opened. During the mains settling time, the unit operates without load, in order to enable the immediate connection of the GCB in the event of further mains alarms.

Return of the Mains for Interchange Switch Logic [GCP-22]

Return of the mains

After the return of the mains voltage the mains settling time is first finished. If no operating request is present, reverse synchronization of the MCB is carried out following the expiry of this time. Following the closure of the mains power circuit breaker, the generator power circuit breaker is opened following the reduction in power.

If the mains returns whilst the unit is starting, the mains power circuit breaker is not opened. During the mains settling time, the unit operates without load, in order to enable the immediate connection of the GCB in the event of further mains alarms.

Emergency Power for External Switch Logic

CAUTION

Emergency power in accordance with DIN VDE 0108 is not possible in this switch logic!

Emergency power operation

Following the detection of a loss of mains, the emergency power delay time expires first before starting the genset. On reaching the voltage and frequency limit values, the MCB is opened**, the GCB is not activated**. The GCB and the MCB are not otherwise operated. Not even following the return of the mains.

Emergency Power with MCB Malfunction

MCB failure

In the "AUTOMATIC" operating mode without a starting request, the control system is set to emergency power standby. If the mains power circuit breaker is tripped, the control system attempts to reactivate this. If this is not possible (due to an MCB alarm), the unit is started following the "MCB failure", emergency power subsequently supplies the busbar. Only following the successful acknowledgment of the "MCB failure" alarm, is the MCB synchronized and the unit shut off again on expiry of the mains settling time.

Sprinkler Operation

NOTE

The function "Sprinkler operation" must be assigned to terminal 6.

CAUTION

Please note, that a High-signal must be applied to the terminal 6, in order to make sure that no sprinkler operation is effected. With a Low-signal the controller receives the information that the conditions for the sprinkler operation are given.

NEGATIVE FUNCTIONAL LOGIC!

Sprinkler ON

If the signal drops out at the terminal 6, the sprinkler ON command is triggered. The message "Sprinkler" is shown on the display. Up to 6 attempts are made to start the unit (otherwise 3) if it is not yet in operation. All malfunctions which cause shutoff become messages. Exception: terminal 61 and overspeed.

NOTE

The terminal 61 (alarm input) maintains the alarm class it was adjusted to. It is advisable to assign the EMERGENCY OFF here. Via the activation of "Sprinkler operation" (terminal 6), alarm classes F2 and F3 are converted to alarm class F1. (Exception: terminal 61 and overspeed).

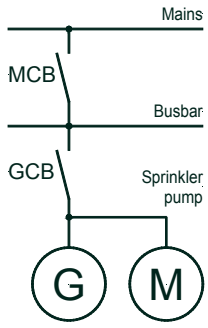
ALARM CLASS F2 AND ALARM CLASS F3 → ALARM CLASS F1

A distinction is made between three different operating conditions

1.) Mains circuit breaker closed (mains voltage applied):
- the genset is started
- the GCB is not closed, or not opened

2.) Mains circuit breaker opened (mains voltage not applied):
- the GCB is closed or remains closed

3.) Mains circuit breaker opened (mains voltage applied):
- the MCB is synchronized
- after the synchronization of one power circuit breaker, the other is opened



Sprinkler OFF

By connecting the sprinkler input, the sprinkler ON-command is reset, but the sprinkler operation is maintained. The message "Sprinkler coasting" appears. Sprinkler operation is automatically terminated 10 minutes later. Earlier termination can be achieved via the "STOP" operating mode. On operation, malfunctions which cause shutoffs become active again.

Power Direction

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

Positive generator active load The generator supplies active load.

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

Positive mains active load Active load is supplied to the mains.

Inductive mains power factor The mains picks up inductive reactive power.

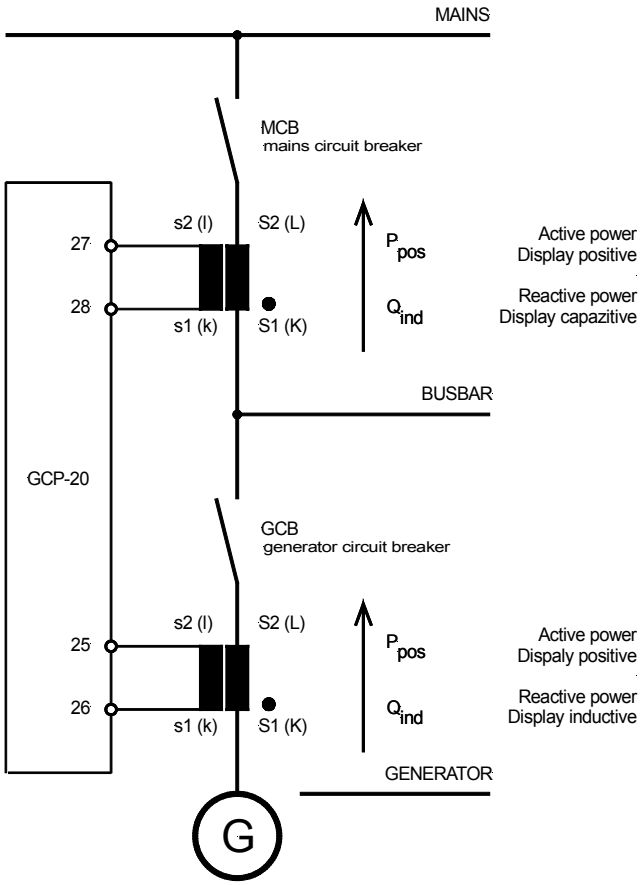


Figure 7-4: Power direction

Load and/or Var Sharing

Control guarantees that, in every operating condition (mains parallel operation, isolated operation in parallel with other gensets or back synchronization of the busbar to the mains), the active power (in reference to the relevant nominal load) is evenly distributed over all gensets operating in parallel to the busbar.

Mains parallel operation with mains transfer regulation

Each controller involved in distribution control influences the genset to which it is assigned in such a manner that the active power set at the mains interchange point (main control variable) remains constant. All units are interlinked via a CAN bus, via which any deviation in active power (generator power) can be determined for each genset. This control variable is taken into consideration on controlling the interchange load. The weighting, with which the secondary and the main control variable (= "reference variable") are processed, can be set via a factor. In controlled state, the set active power flows at the mains interchange point, whereby the total active power is subdivided equally amongst those gensets involved in distribution control. If a constant power C has been input as the set point value for a genset, this is no longer involved in distribution control.

Isolated operation in parallel with other gensets

Each controller involved in distribution control influences the genset to which it is assigned in such a manner that the active power set at the mains interchange point (main control variable) remains constant. All units are interlinked via a CAN bus, via which any deviation in active power (generator power) can be determined for each genset. This control variable is taken into consideration on controlling the frequency. The weighting, with which the secondary and the main control variable (= "reference variable") are processed, can be set via a factor. In controlled state, the isolated system has the set rated frequency, whereby the total active power (in reference to the relevant nominal power) is subdivided equally amongst those gensets involved in distribution control.

Resynchronization of the busbar to the mains

Distribution is carried out according to the type of isolated operation. The set point value for the frequency is however calculated from the mains frequency (df max × 0.5 + f_{mains}, general synchronization argument; 0.1 Hz). The relay outputs "Mains power circuit breaker CLOSE" for all units can be switched in parallel.

Prerequisites

It is mandatory that the rated system frequencies, the add-on/shed-off parameters, and the power circuit breaker logics are always adjusted to the same values for all units of the distribution control system.

Description of the interface for the distribution control system

Distribution control is based on a multi-master-capable bus between the units. This structure enables the parallel operation of up to 8 gensets.

To guarantee a trouble-free operation, please observe the following:

1. The bus length must not exceed 250 mtrs.
2. Each end of the bus must be terminated with terminating resistors which correspond to the wave impedance of the bus cable (approx. 120 Ω).
3. The structure of the bus must be linear. Dead-end feeders are not permissible.
4. Shielded "Twisted-Pair" are to be preferred as bus cables (example: Lappkabel Unitronic LIYCY (TP) 2×2×0.25, UNITRONIC-Bus LD 2×2×0.22).
5. The bus cable must not be installed near power cables.

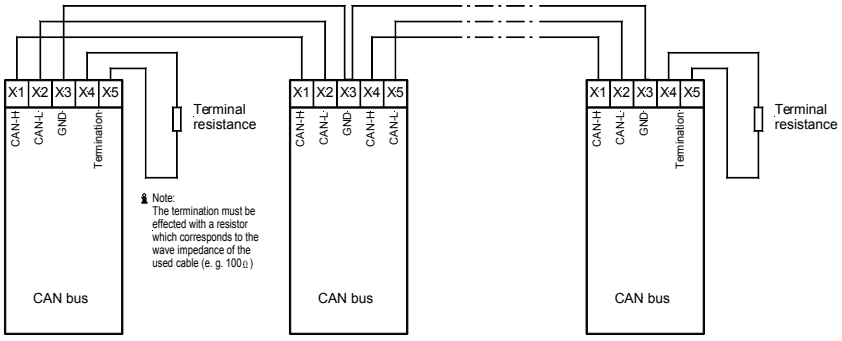


Figure 7-5: CAN bus wiring

Schematic Representation of Load Sharing via CAN Bus

Whether a genset is carrying out a load sharing and frequency control while in isolated operation in parallel with other gensets, and to which extent, is determined by the parameter "load sharing reference input value " which is expressed as a percentage value. In this case, 10 % means increased active power control, and 99 % increased frequency control. This parameter must be input individually for each unit.

In the case of the following control system, it must be noted that each unit calculates the mean utilization factor of all units from the data transmitted via the CAN bus, and then compares this with its own utilization factor. The utilization factor is compared with the reference variable, and results in the new reference variable. Frequency and active power control are simultaneously carried out in these units (corresponding to the reference variable).

Frequency control is carried out via the measured voltage/frequency of the voltage system. The pickup is only used for monitoring functions.

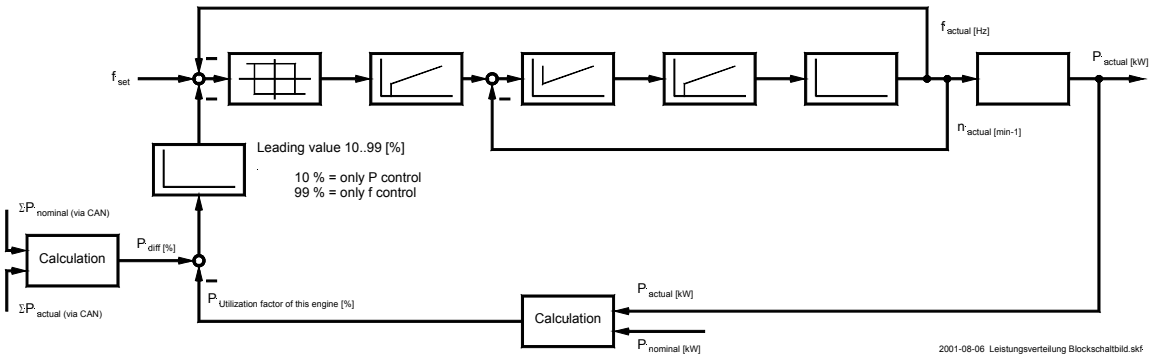


Figure 7-6: CAN bus scheme

Connection of External Components

Speed Governor SG 2/SG 2D

NOTE

Please note the wiring diagram for the SG 2/SG 2D. The LeoPC1 program is required for configuration of the speed governor.

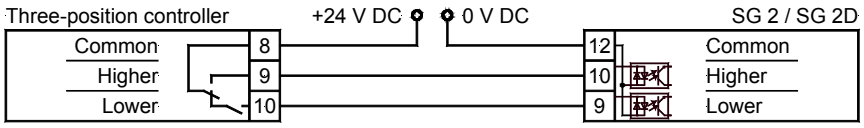


Figure 7-7: SG 2 connection

Alarm

Alarm Classes

The monitoring functions are divided into four alarm classes:

F0 Warning alarm
This alarm does not cause an interruption of the operation. An output is made without centralized alarm.
→ Alarm text display

F1 Warning alarm
This alarm does not cause an interruption of the operation. Output of the centralized alarm.
→ Alarm text + blinking LED "alarm" + relay centralized alarm (horn)

F2 Reacting alarm
This alarm causes a shutoff of the driving genset. Prior to opening the GCB, the active load is first reduced, followed by a coasting.
→ Alarm text + blinking LED "alarm" + relay centralized alarm (horn) + settle

F3 Reacting alarm
This alarm causes an immediate opening of the power circuit breaker as well as the shutdown of the driving genset.
→ Alarm text + blinking LED "alarm" + relay centralized alarm (horn)+ switching-off

NOTE

Via the activation of "Sprinkler operation" (terminal 6), alarm classes F2 and F3 are converted to alarm class F1. (Exception: terminal 61 and overspeed).

ALARM CLASS F2 AND ALARM CLASS F3 → ALARM CLASS F1

Internally Detected Alarms

List of alarms determined internally depending on the variables which are monitored:

Type of alarm	Alarm class	Alarm text	Relay output (terminal)
Generator overspeed	F3	**Over speed**	Centralized alarm via relay manager with parameter 85
Generator overfrequency	F3	**over freq.**	
Generator underfrequency	F3	**low freque.**	
Generator overvoltage	F3	**G-Overvolt.**	
Generator undervoltage	F3	**G-.underv.**	
Generator overcurrent, step 1	F3	**Gen.curr. 1**	
Generator overcurrent, step 2	F3	**Gen.curr. 2**	
Reverse/reduced load	F3	**power fail**	
Monitoring of load unbalance	F3	**asymme.load**	
Overload (GCB is imm. opened, but with coasting)	F2	**G-Overload**	
Mains overvoltage	F0	**M-Overvolt.**	
Mains undervoltage	F0	**M-Undervolt**	
Mains overfrequency	F0	**M-Overfreq.**	
Mains underfrequency	F0	**M-Underfrq.**	
Mains phase shift	F0	**Phase shift**	
Battery undervoltage	F1	**Bat.undervo**	
GCB synchronization time monitoring	F1	**GCB syn.fai**	
MCB synchronization time monitoring	F1	**MCB syn.fai**	
Time monitoring of the GCB add-on	F1	**GCB failure**	
Time monitoring of the MCB add-on	F1	**MCB failure**	
Mechanical malfunction GCB	F1	**GCB failure**	
Mechanical malfunction MCB	F1	**MCB failure**	
Alarm reference power zero control with interchange synchronization on GCB	F1	**power zero**	
Maintenance call	F1	**Service**	
Interface monitoring X1..X5	F1	**fault X1X5**	
Interface monitoring Y1..Y5	F1	**fault Y1Y5**	
Plausibility control pickup/generator monitoring	F3	**Pickup/fre.**	
Shutoff malfunction	F3	**stop fail**	
Start failure	F3	**Startfail**	

Table 7-5: Internal alarms

NOTE

In the event of mains alarms, the GCB or the MCB is opened according to the setting, and is closed again following the mains settling time.

Alarm Acknowledgement

DANGER

The unit may start unintentionally if an alarm, which caused the unit to shut down, is acknowledged and a release is still present. Before acknowledging the alarm, check the cause of the alarm, in order to protect operating personnel located in the vicinity of the system against injuries, and to protect the motor against unintentional destruction.

⇒ **In the event of an alarm whose cause is not or not clearly detectable, NEVER press the acknowledgement button! The destruction of the motor cannot otherwise be ruled out !**

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

NOTE

In order to acknowledge alarm messages via terminal 6, the "Acknowledgment" function must be assigned to this terminal.

Brief Acknowledgement (< 2.5 s)

Description The button "clear" is pressed for 0.5 s < t < 2.5 s
The terminal 6 is set for 0.5 s < t < 2.5 s
The acknowledgement bit via the interface is set for 0.5 s < t < 2.5 s

Result Continuous illumination of the "alarm" LED.

Acknowledgement via			Operating mode			
button "clear"	Terminal 6	Interface	STOP	AUTO	TEST	MANUAL
1	x	x	1	1	1	1
0	1	x	1	1	0	0
0	0	1	0	1	0	0

x = not important

Table 7-6: Brief acknowledgement

Horn After 3 minutes, the horn is reset, independent of the acknowledgement of an alarm.

Long Acknowledgement (> 2.5 s)

Description The button "clear" is pressed for t > 2.5 s
The terminal 6 is set for t > 2.5 s
The acknowledgement bit via the interface is set for t > 2.5 s

Result The "alarm" LED goes out
The centralized alarm F1 and F3 relays are reset
The display messages are acknowledged

Acknowledgement via			Operating mode			
button "clear"	Terminal 6	Interface	STOP	AUTO	TEST	MANUAL
1	x	x	1	1	1	1
0	1	x	1	1	0	0
0	0	1	0	1	0	0

x = not important

Table 7-7: Long acknowledgement (warning alarms F0 and F1)

Acknowledgement via			Operating mode			
button "clear"	Terminal 6	Interface	STOP	AUTO	TEST	MANUAL
1	x	x	1	0	0	1
0	1	x	1	1	0	0
0	0	1	0	1	0	0

x = not important

Table 7-8: Long acknowledgement (shutdown alarms F2 and F3)

Chapter 8.
Display and Operation

Front Panel

The pressure-sensitive membrane of the front panel consists of a plastic coating. All keys have been designed as touch-sensitive membrane switch elements. The display is an LC display, consisting of 2 rows each with 16 characters, with indirect green lighting. The contrast of the display can be infinitely adjusted via a rotary potentiometer positioned on the left. The configuration bushing is located on the left side of the unit. Please connect the direct configuration cable (DPC) there.

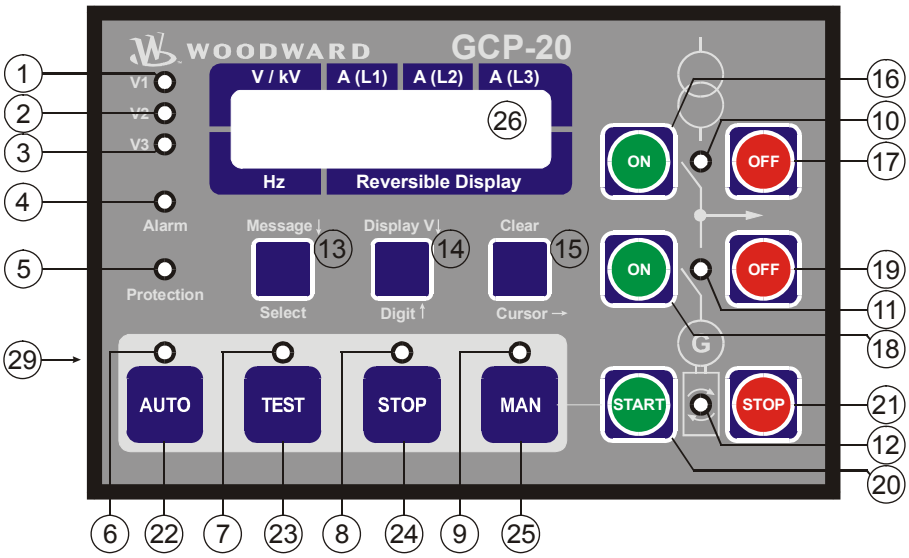


Figure 8-1: GCP-20/22 front panel

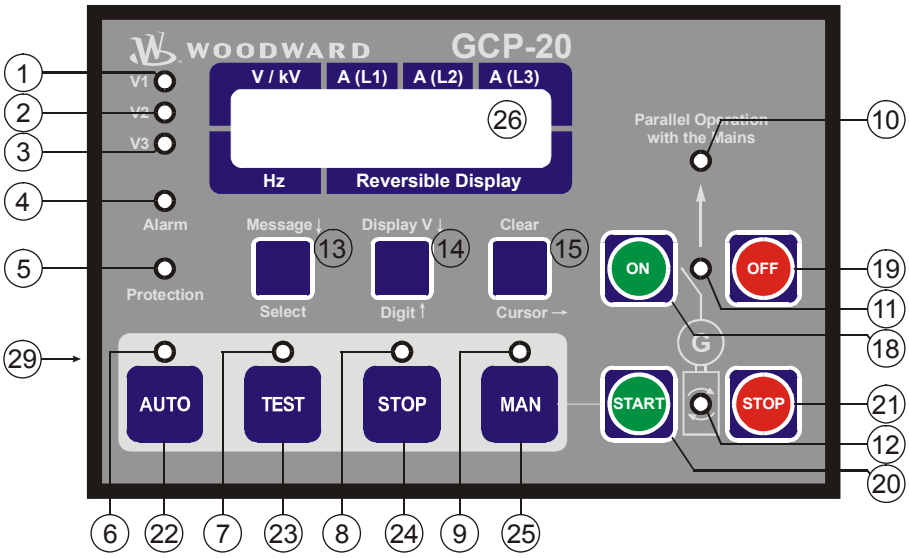


Figure 8-2: GCP-21 front panel

Light emitting diodes

1 > "V1" ..... voltage L1
2 > "V2" ..... voltage L2
3 > "V3" ..... voltage L3
4 > "Alarm" ..... alarm message is present
5 > "Protection" ..... monitoring active
6 > "AUTO" ..... AUTOMATIC operating mode selected
7 > "TEST" ..... TEST operating mode selected
8 > "STOP" ..... STOP operating mode selected
9 > "MAN" ..... MANUAL operating mode selected
10 > "MCB ON" ..... response MCB closed
11 > "GCB ON" ..... response GCB closed
12 > "Genset rotating" .....
.....

Display

26 > "LC Display" ..... LC-display
29 > "DPC port" ..... Configuration port

Buttons

13 > "Message ↓" ..... advance of the message
13 > "Selection" ..... confirm selection
14 > "Display V↓" ..... advance of the display
14 > "Digit ↑" ..... increase digit
15 > "Clear" ..... acknowledge alarm messages
15 > "Cursor →" ..... shift input position 1 to the right
16 > "MCB ON" ..... mains CB manually ON
17 > "MCB OFF" ..... mains CB manually OFF
18 > "GCB ON" ..... generator CB manually ON
19 > "GCB OFF" ..... generator CB manually OFF
20 > "START" ..... start genset manually
21 > "STOP" ..... stop genset manually
22 > "AUTO". activate AUTOMATIC operating mode
23 > "TEST" ..... activate operating mode TEST
24 > "STOP" ..... stop genset automatically
25 > "MANUAL" . activate MANUAL operating mode

Button Functions Overview

Automatic operating mode															
									Engine		GCB		MCB		
	Message ↓	Display V↓	Clear		STOP	MAN	AUTO	TEST	START	STOP	ON	OFF	ON	OFF
MANUAL															
Start engine						❶			❷						
Stop engine						❶				❷					
GCB close						❶					❷				
GCB open						❶						❷			
MCB close						❶							❷		
MCB open						❶								❷	
AUTOMATIC															
Start engine and DI or operating mode							❶								
Stop engine and DI or operating mode					Yes		❶								
GCB close and DI or operating mode							❶								
GCB open and DI or operating mode							❶								
MCB close and DI or operating mode							❶								
MCB open and DI or operating mode							❶								
TEST															
Start engine								❶							
Start load test								❶			❷				
Terminate load test												❶			
Terminate load test (depending on type of switch)													❶		
STOP					❶										
Configuration															
	Select	Digit ↑	Cursor →												
Start configuration		❶	❶												
Confirm input/next mask	❶														
Previous mask	❶		❶												
Next pos./change text			❶												
Increase position		❶													
End configuration		❶	❶												

❶, ❷ .. sequence for pressing the buttons

LEDs

NOTE

The LEDs can be checked via a lamp test. In order to achieve this, press the button "message ↓" and repeat pressing the button until the display "`00.0 LED-TEST`" appears in the bottom line of the display. Then press the button "display V↓". All LEDs are lighting up now. The LEDs "AUTO", "TEST", "STOP", and "MANUAL" light up one after the other.

1 **V1 - V2 - V3**
2 Color: green
3

Voltage control

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

4 **Alarm**
Color: red

Alarm

If the "Alarm" LED illuminates, an alarm is present in the item; this is processed according to its alarm class. The message and the type of alarm are shown on the LC display. If this LED flashes, a new alarm has occurred within the last two minutes. Via brief acknowledgment, this switches to continuous illumination, and the centralized alarm (horn) is ceased.

A list of all alarms you find in the annex of this manual.

5 **Protection**
Color: green

Engine monitoring

If the "Monitoring" LED is lit, engine monitoring is activated, i. e., in addition to the permanently monitored alarm inputs, the delayed programmed alarm inputs are also monitored. Generator underspeed, undervoltage and reverse power are also monitored.

6 **Automatic**
Color: yellow

Operating mode "AUTOMATIC"

If the "Automatic" LED is lit, the "AUTOMATIC" operating mode is active. The push-buttons "GCB ON", "GCB OFF", "MCB ON" and "MCB OFF" (for operation mode MANUAL) and the start / stop push-buttons are deactivated.

7 **Test**
Color: yellow

Operating mode "TEST"

If the LED "Test" is illuminated, the "Test" mode has been selected.

8 **Stop**
Color: red

Operating mode "STOP"

If the LED "Stop" is illuminated, the "STOP" mode has been selected. If this LED flashes, a firing speed is detected in "STOP" mode.

9 **Manual**
Color: yellow

Operating mode "MANUAL"

If the "Manual" LED is lit, the "MANUAL" operating mode is active. The push-buttons for direct activation of the power circuit breaker and the start / stop push-buttons are active.

10 **[GCP-20/22] MCB on**
[GCP-21] Mains parallel
Color: green

Reply: MCB is closed / Mains parallel

[GCP-20/22] Items with two power circuit breakers: The "MCB ON" LED indicates that the mains power circuit breaker is closed.
[GCP-21] ..... Items with one power circuit breaker or items which have been made into 1-CB items via external wiring: The "Mains parallel" LED indicates that the genset is operating in parallel with the mains.

11 **GCB on**
Color: green

Reply: GCB is closed

The "GCB ON" LED signals that the GCB is closed.

12 **Genset rotating**
Color: green

Reply: genset / engine is rotating

If this LED is blinking, the ignition speed has been exceeded. As soon as the speed reaches the frequency band, i.e.±3 % of the preset rated frequency, the LED lights continuously.

Push-Buttons

In order to facilitate the setting of the parameters the buttons are equipped with a "AUTOROLL-function". It allows to switch to the next setting and configuration screens, the digits, or the cursor position. The "AUTOROLL" function will only be enabled when the user depresses the corresponding keys for a certain period of time.

General / Configuration

13 **Message↓ / Select**
Color: blue

Message↓ / Select

Normal operation: Message↓ - By pressing this button, one navigates through the display of operating and alarm messages.

Configuration: Select - A jump is made to the next configuration screen. If the value originally displayed has been changed via the "Digit↑" or "Cursor→" push-buttons the newly set value is saved by pressing the "Select" push-button once. By pressing this push-button again, the user causes the system to display the next configuration screen.

14 **Display V↓ / Digit↑**
Color: blue

Display V↓ / Digit↑

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

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

WARNING

The engine may start unintentionally if an alarm, which caused the engine to shut down, is acknowledged and an enabling is still present. Before acknowledging the alarm, check the cause of the alarm, in order to protect operating personnel located in the vicinity of the system against injuries, and to protect the engine against unintentional destruction.

⇒ If the cause of the alarm is not known or is unclear, NEVER press the Clear push-button! The destruction of the engine cannot otherwise be ruled out !

15 **Clear / Cursor →**
Color: blue

Setpoint / Cursor →

Normal operation Clear - With this button the alarm messages are acknowledged, i. e., the alarm indications on the LC display disappear and the "Alarm" LED goes out. The operating variable display is set on the basic screen. Alarm class F2 and F3 alarms can only be acknowledged in the "STOP" and "MANUAL" operating modes.

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

Operation of The Power Circuit Breakers

16 **MCB ON / MCB OFF** **Close MCB / open MCB** (only available in **[GCP-20/22]**)
17 **only [GCP-20/22]**
Color: green/red

Note: Only enabled if operating mode MANUAL or TEST has been selected.

MCB ON ..... Depending on which power circuit breaker logic has been set, the MCB can be closed by pressing the "MCB ON" push-button. This process can be aborted if the "MCB OFF" or "GCB ON" push-button is actuated or the operating mode is changed.

MCB OFF ... By pressing the "MCB OFF" push-button, the mains power circuit breaker can (depending on the power circuit breaker logic) be opened, or synchronization of the MCB can be aborted if started.

18 **GCB ON / GCB OFF** **Close GCG / open GCB**
19 Color: green/red

Note: Only enabled if operating mode MANUAL or TEST has been selected.

GCB ON ..... Depending on which power circuit breaker logic has been set, the GCB can be closed by pressing the "GCB ON" push-button. This process can be aborted if the "GCB OFF" or "MCB ON" push-button is actuated or the operating mode is changed.

GCB OFF .... By pressing the "GCB OFF" push-button, the generator power circuit breaker can (depending on the power circuit breaker logic) be opened, or synchronization of the GCB can be aborted if started.

Operating Mode Select Switch

20 **START / STOP** **Engine start/stop**
21 Color: green/red

START ..... Using this push-button the engine is started in MANUAL operating mode. The starter and the fuel solenoid are activated by pressing the push-button, whereby the starter is de-activated after the firing speed has been reached, and the operating magnet remains picked up. The push-button can now be enabled.

STOP ..... This push-button is used to stop the engine by de-activating the fuel solenoid.

22 **AUTO** **Operating mode AUTOMATIC**
Color: blue

The engine is automatically started and stopped, and the power circuit breakers are automatically actuated. The two control inputs "Automatic 1" and "Automatic 2" are used to specify various modes in "AUTOMATIC" operating mode (also see description of control inputs). Emergency power and sprinkler operation is carried out regardless of the status of the discrete inputs "Automatic 1" and "Automatic 2".

- Discrete input "Automatic 1" set:
  Active (real) power setpoint 1 is adjusted.
- Discrete input "Automatic 2" set:
  Active (real) power setpoint 2 or an external setpoint (0/4 to 20 mA, 0 to 5/10 Vdc or interface) is adjusted (can be selected in configuration mode).

23 **TEST** Color: blue

Operating mode TEST

By actuating the "TEST" push-button, the engine is started, and engine monitoring is activated. No power circuit breakers are operated. This is carried out in the event of mains failure and when emergency power is switched on.

[GCP-21/22] Start of a load test A load test is enabled via the actuation of the "GCB ON" push-button. In addition to the functions of "TEST" mode, the GCB is synchronized or the MCB is opened according to the CB logic and the GCB is then switched to the dead busbar.

[GCP-21/22] End of a load test The "LOAD TEST" can be terminated by actuating the "GCB OPEN" or "MCB ON" push-button (depending on power circuit breaker logic). In "STOP" or "AUTOMATIC" mode without request signal, the genset is stopped with a reduction of power.

24 **STOP** Color: blue

Operating mode STOP

By selecting the "STOP" mode, the genset is always shut down. The shutdown procedure is as follows:

Stopping process:
- the "STOP" mode is selected,
- the real power is reduced,
- the GCB is opened at 3 % of the rated generator real power,
- coasting is carried out according to the parameters in order to cool the engine.

25 **MAN** Color: blue

Operating mode MANUAL

Using "MANUAL" operating mode, the push-buttons can be activated to control the equipment manually. The automatic control of the power circuit breakers and the genset are blocked. Important automatic processes continue to remain in operation (e. g. engine monitoring and the mains watchdog function for operation in parallel with the mains). Sprinkler and emergency power operation are not active. An emergency or Sprinkler operation which has been activated before changing to operating mode MANUAL will be maintained.

LC Display

26	**LC Display**	**LC display**

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

First Display Line

In the field "V/kV", the generator voltage is indicated in dependence of the LEDs V1, V2 and V3.
In the fields "A(L1)", "A(L2)"and "A(L3)" the generator wire currents are separately indicated for each phase.

Second Display Line

In the field "Reversible Display" the following screens appear:

Basic Display Screen

- Display of the generator power factor and the generator active load
- Display of the current action of the unit (synchronization, starting, etc.)

Subordinate Display Screen (depending on the unit's equipment)

The following screens are displayed:

- Engine speed
- Mains voltage
- Mains voltage/mains performance [GCP-21/22]
- Mains power factor
- Analog input quantities
- Generator active energy
- Operating hours
- Remaining time until the maintenance call
- Genset starting counter
- Battery voltage (supply voltage)
- Number of subscribers of the load sharing
- Maximum generator current (slave pointer)
- Last four alarm messages

These screens are displayed one after the other by pressing the button "Message ↓". When the last display screen has been reached, the basic screen is displayed. If alarms have occurred, their message texts are displayed in the sequence of their occurrence in the display screens before the basic screen. Only the first 4 alarms are indicated. All subsequent alarms are no longer indicated, however normally processed. If any functions of the unit are active (e.g. synchronization of the GCB), the basic display mask is superimposed by the corresponding message (e.g. "Synchronous. synchronization"). Following the termination of the unit function, the basic mask is displayed again.

Chapter 9.
Configuration

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

- Configuration via direct configuration plug (RS-232) = 9,600 Baud (8 Bit, no parity, 1 Stop bit)
- CAN bus (CiA) = 125 kBaud

Because of functional enhancements within the controls of the GCP-20 Series it is necessary to use a new version of the configuration software LeoPC1. This version must be at least 3.1 or higher. If the LeoPC1 software you currently use has an older version the latest version can be ordered at our technical sales or can be downloaded on our homepage at **http://www.woodward.com/software**.

After an updated version of LeoPC1 has been installed older project files may still be used. These can be transferred to the appropriate file locations within the new program.

WARNING

Please note that configuration only should be performed while the system is not operating.

NOTE

Before configuring a control unit, familiarize yourself with the parameters listed at the end of this manual.

You can scroll through the parameters if you are in configuration mode (simultaneously pressing of "Digit ↑" and "Cursor →" push buttons permits access to the configuration mode) using "Select". If you press and hold the "Select" push button the scroll function will be activated, allowing for the parameter screens to be advanced through more rapidly. The control unit will permit the operator to reverse up to four previous screens (exception: it is not possible to reverse from the first parameter to the last parameter or to backup through the service screens). To perform the reverse function through the parameter screens, the "Select" and "Cursor →" push buttons must be pressed and released simultaneously. The control unit will revert to automatic mode, if an entry isn't performed, a change made or any other action performed for 60 seconds.

Basic Data

Version Number (Software Version)

Parameter 1

Software version Vx.xxxx

Software version

Display of the software version.

Service Display

```
Service display
            ON
```

only visible, while configuration mode is active

Service display **ON/OFF**

ON..... The following three screens are displayed (the voltages and frequencies of the busbar, the mains and the generator are displayed). In addition, the controller outputs and the switching states of the power circuit breakers during synchronization are displayed. According to the used hardware (with/without voltage transformer), different screens are displayed.

OFF..... The service screens are not displayed.

Synchronous Generator

```
Sam0000V 00.00Hz
Gen0000V 00.00Hz
```

only visible, while configuration mode is active

Double voltage and double frequency display

The generator and busbar voltage and frequency are displayed:

Sam..... Busbar voltage and frequency

Gen ..... Generator voltage and frequency

```
Net0000V 00.00Hz
Sam0000V 00.00Hz
```

only visible, while configuration mode is active

Double voltage and double frequency display

The generator and busbar voltage and frequency are displayed:

Net..... Mains voltage and frequency

Sam..... Busbar voltage and frequency

Induction Generator

```
Remanenz 00.00Hz
Gen0000V 00.00Hz
```

only visible, while configuration mode is active

Double voltage and double frequency display

The generator and busbar voltage and frequency are displayed:

Remanence.. Frequency of the remanent voltage (only for induction generators)

Gen ..... Generator voltage and frequency

```
Net0000V 00.00Hz
Remanenz 00.00Hz
```

only visible, while configuration mode is active

Double voltage and double frequency display

The generator and busbar voltage and frequency are displayed:

Net..... Mains voltage and frequency

Remanence.. Frequency of the remanent voltage (only for induction generators)

Status of Power Circuit Breakers and Relays

only visible, while configuration mode is active

Status of power circuit breakers and relays of the controllers

The display shows the actual relay states of the controller outputs and the signals to the power circuit breakers.

While in isolated operation (in parallel with other gensets):

f.....+	frequency controller RAISE	Terminal 8/9
.....-	frequency controller LOWER	Terminal 8/10
V .....+	voltage controller RAISE	Terminal 11/12
.....-	voltage controller LOWER	Terminal 11/13

While in mains parallel operation**:**

f.....+	performance RAISE	Terminal 8/9
.....-	performance LOWER	Terminal 8/10
V .....+	power factor RAISE (excitation)	Terminal 11/12
.....-	power factor LOWER (de-excitation)	Terminal 11/13
MCB.....Close	close pulse of the MCB	Terminal 16/17
.....Open	open pulse of the MCB	Terminal 39/40
GCB .....Close	close pulse of the GCB	Terminal 14/15
.....Open	open pulse of the GCB	Terminal 41/42

Basic Configuration

Configuration Access

The control is equipped with a three-level code and configuration hierarchy, which enables it to access various configuration screens for different users. A distinction is made between:

Code level 0 (CS0) - User: Third party
This code level enables no access to the parameters. The configuration is blocked.

Code level 1 (CS1) - User: Customer
This code level entitles the user to change a few selected parameters. Changing passwords is not possible at this level.

Code level 2 (CS2) - User: Commissioner
With code level 2 the user is granted full access rights, and therefore has direct access to all parameters (displaying and changing). Additionally, the user may change the passwords for levels 1 and 2 in this level. In this code level the password protection may be completely disabled (see below).

NOTE

Once a password has been set it will not change unless a person alters that parameter with access to it regardless of how often the configuration mode is accessed. If an incorrect code number is entered, the code level is set to CS0 and the control is therefore locked for external users (setting of password on page 77). The control unit automatically reverts to code level CS0 two hours after the entry of a password. By entering the correct password, the corresponding level may again be accessed.

The code level may also be accessed using the PC program LeoPC1.

Parameter 2

```
Enter code
number      0000
```

Enter code number **0000 to 9999**

Upon accessing the configuration mode a four-digit password is requested which identifies the level of access the user is to be granted. The displayed number XXXX is a randomly generated number that must be changed to the correct password and confirmed with the "Select" push-button. If the random number has been confirmed with "Select" without being changed, the control's access level remains as it was. Two four-digit code numbers (0000-9999) exist for accessing the parameters . Changing the code level and setting up new code words for the users can only be accomplished on the CS2 level. No assignment is required for the "third party" user level, as the user does not usually receive access to the configuration level (protected via the code).

Basic Settings Configuration

Parameter 3

```
Configure
Base ?      YES
```

Configure basic settings **YES/NO**

Various parameters are grouped together in blocks to allow navigation through the large number of configuration screens more rapidly. Selecting "YES" or "NO" has no effect on whether or not control or monitoring is carried out. The input merely has the following effect:

YES..... The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modifications can be made to the parameters ("Cursor →", "Digit " or "Select" push-buttons).

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

Parameter 4

```
Generator number
              0
```

Generator number (number of the control on the CAN bus) **1 to 8**

If several controls are available and these are coupled via a CAN bus, a different number must be assigned to each control for differentiation purposes. The generator number 1 should be assigned even in the case of a single control. The control number entered here corresponds to the control number in the program LeoPC1.

Direct Configuration

NOTE

To carry out direct configuration, you require a direct configuration cable (Part #5417-557), the LeoPC1 1 program (supplied with the cable) and the corresponding configuration files. Please consult the online help installed when the program is installed for a description of the LeoPC1 1 PC program and its setup.

Remote configuration: For remote configuration the level CS2 password must be entered via the parameter "password", otherwise, the values can only be read but not written. Entering via the CAN bus has no influence on the displayed parameters. If the control is in code level CS0, the same level of access will be granted as described in the previous section. The configuration via the bus is enabled for 2 hours from that point in time from the time that the last readout of configuration was performed. After two hours the password must be entered again to access the parameters.

WARNING

If "load conf.direct" is configured to "YES", communication via the interface with terminals X1 to X5 is blocked. If communication is to be re-established via interface X1 to X5 after finishing the configuration of the control (e.g. CAN bus connection via a Gateway GW 4), it must be configured to "NO"!

The direct configuration port is disabled (it is automatically switched from YES to NO) once the firing speed has been reached. This requires any further configuration of the control to be accomplished via the front display and push buttons or via the CAN bus interface. The de-activation of direct configuration is performed as a safety precaution. If multiple systems starting simultaneously (e.g. emergency power situation) a simultaneous switching of the generator breakers to the dead busbar is prevented.

Parameter 5

```
load conf.direct
             YES
```

Direct configuration **YES/NO**

YES .....Configuration via the configuration port is enabled, and any CAN bus connection that may be available via terminals X1 to X5 is disabled. The following conditions must be met in order to carry out configuration via the configuration port:
- A connection must be established via the direct configuration cable between the control and the PC
- The baud rate of the LeoPC1 program must be set to 9,600 Baud
- The corresponding configuration file must be used (file name: "xxxx-xxxx-yyy-zz.asm")

NO .....Configuration via the configuration port is disabled, and any available CAN bus connection via the terminals X1 to X5 is enabled.

Measuring

WARNING

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

Rated Values of The Frequency

Parameter 6

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

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

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

Parameter 7

```
Rated frequency
generator 00.0Hz
```

Rated system frequency **50 to 60 Hz**

The rated system frequency is the value that the generator is going to connect to. This parameter is dependent on the individual country or individual system.

PTs (Voltage Transformers)

WARNING

If the value of the following parameter is changed, the values of the following parameters have to be checked:

- **Generator rated voltage**
- **Voltage controller dead band**
- **Synchronizing dVmax**
- **Dead bus start GCB dVmax**
- **Threshold generator overvoltage**
- **Threshold generator undervoltage**

Parameter 8

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

Secondary gen. voltage transformer **[1] 50 to 125 V; [4] 200 to 440 V**

ⓘ This value corresponds to the **secondary** voltages of the PTs, which are directly connected to the control.

The secondary voltage is set here in V. This parameter is used to display the secondary voltages on the control unit screen.

Parameter 9

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

Primary gen. voltage transformer **[1] 0.050 to 65.000 kV; [4] 0.200 to 65.000 kV**

ⓘ This value corresponds to the **primary** voltages of the PTs.

The primary voltage is set her in kV. This parameter is used to display the primary voltages on the control unit screen. In the case of measured voltages of 100 V without a measurement transducer, 00.100 kV must be set here; for 400 V = 00.400 kV.

Parameter 10

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

Secondary busbar voltage transformer **[1] 50 to 125 V; [4] 200 to 440 V**

ⓘ This value corresponds to the **secondary** voltages of the PTs, which are directly connected to the control.

The secondary voltage is set here in V. This parameter is used to display the secondary voltages on the control unit screen.

Parameter 11

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

Primary busbar voltage transformer **[1] 0.050 to 65.000 kV; [4] 0.200 to 65.000 kV**

ⓘ This value corresponds to the primary **voltages** of the PTs.

The primary voltage is set here in kV. This parameter is used to display the primary voltages on the control unit screen. In the case of measured voltages of 100 V without a measurement transducer, 00.100 kV must be set here; for 400 V = 00.400 kV.

WARNING

If the value of the following parameter is changed, the values of the following parameters have to be checked:

- **Threshold mains overvoltage**
- **Threshold mains undervoltage**

Parameter 12

```
mains volt.trans
secondary   000V
```

Secondary mains voltage transformer **[1] 50 to 125 V; [4] 200 to 440 V**

ⓘ This value corresponds to the **secondary** voltages of the PTs, which are directly connected to the control.

The secondary voltage is set here in V. This parameter is used to display the secondary voltages on the control unit screen.

Parameter 13

```
mains volt.trans
primary 00.000kV
```

Primary mains voltage transformer **[1] 0.050 to 65.000 kV; [4] 0.200 to 65.000 kV**

ⓘ This value corresponds to the primary **voltages** of the PTs.

The primary voltage is set here in kV. This parameter is used to display the primary voltages on the control unit screen. In the case of measured voltages of 100 V without a measurement transducer 00.100 kV must be set here, for 400 V = 00.400 kV.

Rated Voltage Values

Parameter 14

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

Generator set point voltage **[1] 50 to 140 V; [4] 50 to 500 V**

ⓘ This value corresponds to the **secondary** voltages of the PTs, which are directly connected to the control.

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

Generator Current

Parameter 15

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

Generator CTs **10 to 7,000/{X} A**

The input of the CT ratio is necessary in order to display and control the actual values. The CT ratio must be selected so that, at maximum power, at least 60 % of the CT nominal current flows. A lower percentage may lead to malfunctions. Additional inaccuracies in the control and monitoring functions also occur.

{x} = 1 A ..... Secondary current = 1 A at primary rated current = {X} A;
{x} = 5 A ..... Secondary rated current = 5 A at primary rated current = {X} A;
{X} ..... e.g. from the main series 10, 15, 20, 30, 50 or 75 A and the decimal fractions and multiples of these or the corresponding secondary series with 25, 40 or 60 A.

Parameter 16

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

Generator power measurement **singlephase / threephase**

With regard to the measurement of generator power, single-phase or three-phase measurement may be selected. If "single-phase power measurement" is set, the current and the voltage in phase L1 are used for power measurement. If "three-phase power measurement" is set, all three phase currents and the relevant voltages are used for power measurement.

- single-phase power measurement: $P = \sqrt{3} \times V_{L12} \times I_{L1} \times \cos\varphi$.
- threephase power measurement:
  $P = V_{L1N} \times I_{L1} \times \cos\varphi + V_{L2N} \times I_{L2} \times \cos\varphi + V_{L3N} \times I_{L3} \times \cos\varphi$.

NOTE

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

Parameter 17

```
Rated power
Gen.      0000kW
```

Generator rated power **5 to 9,999 kW**

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

Parameter 18

```
Rated current
Gen.       0000A
```

Generator rated current **10 to 2,999 A**

Here the generator rated current is configured (only the percentage inputs for current protection refer to this parameter).

Mains Current/Mains Power Measurement

The two following chapters Mains Power Measurement Via CT and Mains Power Measurement Via Analog Input (Option In20) are displayed alternatively and according to the measurement. If no measurement of the mains power was requested via a 0/4 to 20 mA analog input, the measurement is always effected via a power transformer.

Mains Power Measurement Via CT

Parameter 19

```
Current transf.
Mains     0000/x
```

Mains CTs **10 to 7,000/{X} A**

The input of the CT ratio is necessary in order to display and control the actual values. The CT ratio must be selected so that, at maximum power, at least 60 % of the CT nominal current flows. A lower percentage may lead to malfunctions. Additional inaccuracies in the control and monitoring functions also occur.

{x} = 1 A.....Secondary current = 1 A at primary rated current = {X} A;
{x} = 5 A.....Secondary rated current = 5 A at primary rated current = {X} A;
{X}.....e.g. from the main series 10, 15, 20, 30, 50 or 75 A and the decimal fractions and multiples of these or the corresponding secondary series with 25, 40 or 60 A.

Mains Power Measurement Via Analog Input (Option In20)

Parameter 20

```
Analog in Pmains
          0-00mA
```

Analog input P mains: Range **0 to 20 mA / 4 to 20 mA**

The measuring range 0 to 20 mA or 4 to 20 mA is selected with this parameter. If the range selected is 4 to 20 mA and the current is lower than 2 mA, a broken wire alarm is issued.

NOTE

For an import/export real power control application, ensure that the set point value selected is in the middle of the measuring range. This will allow the controller dynamic to be used to its fullest capacity.

Parameter 21

```
Analog in Pmains
  0%      0000kW
```

Mains real power 0/4 mA **[1] -9,990 to 9,990 kW; [4] -6,900 to 6,900 kW**

The scaleable analog input is assigned a numerical value, which corresponds to the lowest input value → (0 % corresponds to -500 kW; 0 or 4 mA).

Parameter 22

```
Analog in Pmains
100%      0000kW
```

Mains real power 20 mA **[1] -9,990 to 9,990 kW; [4] -6,900 to 6,900 kW**

The scaleable analog input is assigned a numerical value, which corresponds to the highest input value → (100 % corresponds to 500 kW; 20 mA).

Password Configuration

NOTE

Once a password has been set, it will not change unless a person alters that parameter with access to, it regardless of how often the configuration mode is accessed. If an incorrect code number is entered, the code level is set to CS0 and the control is therefore locked for external users.

The control unit automatically reverts to code level CS0 two hours after the entry of a password or if the power supply is disconnected from the control unit. By entering the correct password, the corresponding level may again be accessed.

Parameter 23

```
Define level 1
code          0000
```

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

This parameter is only accessible with code level 2 rights. After the password has been set for this parameter, only the personnel who are assigned this password will have access rights to this code level. When the CS1 (Customer) password is entered, only select parameters may be accessed.
The default setting for this code level (CS) is **CS1 = 0 0 0 1**

Parameter 24

```
Define level 2
code          0000
```

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

This parameter is only accessible with code level 2 rights. After the password has been set for this parameter, only the personnel who are assigned this password will have access rights to this code level. When the CS1 (Customer) password is entered, only select parameters may be accessed.
The default setting for this code level (CS) is **CS2 = 0 0 0 2**

Controller

WARNING

Incorrect settings may lead to the errors in measurements and failures within the control unit resulting in destruction of equipment or injury to personnel.

Parameter 25

```
Configure
controller    YES
```

Configuration of the controller **YES/NO**

Parameters are grouped together in blocks to permit quicker navigation through the large number of configuration screens. Selecting "YES" or "NO" has no effect if controlling or monitoring is performed. This parameter has the following effects:

YES..... The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modified ("Cursor →", "Digit ↑" or "Select" push buttons).

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

Real Power Controller, Set Point Values [GCP-21/22]

These screens appear only if the generator real power controller has been configured to "ON".

NOTE

The fixed-value power control does not take into account the mains interchange point. If excess power is generated, it will be exported to the mains. If there isn't enough power generated, the deficit in power will be imported from the mains.

Engine starting depends on whether an automatic start/stop operation has been enabled or disabled. If it has been disabled, the engine will always start.

Parameter 26

```
Power controller
Pset1    I0000kW
```

P controller: set point 1 **C/I/E 0 to 6,900 kW**

Set point 1 is active when **Automatic 1** (voltage applied to terminal 3) is enabled. The mains interchange (import/export) real power is then controlled to the configured value.

Real generator power is controlled to the entered value.

C .....The letter C stands for fixed set point control (= constant load). The generator will supply a constant level of power. The engine is always started on activation of fixed set point power.

Real mains interch. (import/export) real power is controlled to the entered value.

I .....The letter I stands for import power (power supplied by the mains). The mains always supply the power set here as long as the minimum and maximum generator real power are not exceeded (generator power swings).

E .....The letter E stands for export power (power supplied to the mains). The power set here is always supplied to the mains as long as the minimum and maximum generator real power are not exceeded (generator power swings).

Parameter 27

```
Power controller
Pset2    I0000kW
```

P controller: set point 2 **C/I/E 0 to 6,900 kW**

Set point 2 is active when **Automatic 2** (voltage applied to terminal 5) is enabled and no external set point value (0/4 to 20 mA or interface) has been enabled. The mains interchange (import/export) real power is controlled to the configured value.

Real generator power is controlled to the entered value.

C .....The letter C stands for fixed set point control (= constant load). The generator will supply a constant level of power. The engine is always started on activation of fixed set point power.

Real mains interch. (import/export) real power is controlled to the entered value.

I .....The letter I stands for import power (power supplied by the mains). The mains always supply the power set here as long as the minimum and maximum generator real power are not exceeded (generator power swings).

E .....The letter E stands for export power (power supplied to the mains). The power set here is always supplied to the mains as long as the minimum and maximum generator real power are not exceeded (generator power swings).

Parameter 28

```
Load test via
          Pset1
```

P controller: Load test selection **Pset1 / Pset2 / External**

The set point, which is used in TEST operation mode is selected here.

Frequency Controller

NOTE

The initial state refers always to the complete range of the actuator signal (0 to 100%) regardless of the min/max limitations.

A possible range limitation of the actuator signal is considered for active controllers.

If a controller is enabled, the initial state may change to a new value, defined by the limitations. In case, the initial state is 30% and the minimum and maximum limits are 50% and 100%, the initial state changes from 30% to 50% when enabling the controller.

Parameter 29

```
Initial state
Frequency   000%
```

Option QF only

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

Analog controller output setting with disabled controller. This value is used as an initial state value if the controller is disabled.

Parameter 30

```
Actuating signal
Freq. min   000%
```

Option QF only

f controller: minimum frequency **0 to 100 %**

This parameter permits the operator to clamp or limit the lower analog output value.

Example: A 1 to 4V analog output is needed for the frequency controller to operate properly. A jumper is installed on the terminals as described above and the analog output of 0 to 5V is selected. The number to be configured in this parameter is determined by dividing the desired lower limit by the range (1/5=0.20 or 20%). 20% is the value to be configured in this parameter.

Parameter 31

```
Actuating signal
Freq. max   000%
```

Option QF only

f controller: maximum frequency **0 to 100 %**

This parameter permits the operator to clamp or limit the upper analog output value.

Example: A 1 to 4V analog output is needed for the frequency controller to operate properly. A jumper is installed on the terminals as described above and the analog output of 0 to 5V is selected. The number to be configured in this parameter is determined by dividing the desired upper limit by the range (4/5=0.80 or 80%). 80% is the value to be configured in this parameter.

Parameter 32

```
Freq.controller
             ON
```

f controller: activation **ON/OFF**

ON..... The generator frequency is controlled. The generator frequency is controlled through various methods depending on the task (isolated operation / synchronization). The subsequent screens of this function are displayed.

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

Parameter 33

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

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

The frequency controller is activated when the generator frequency has exceeded the value configured here. The undesired adjustment of the set point value of a lower-level controller can therefore be overridden when starting the engine.

Parameter 34

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

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

The time set in this parameter must expire before the frequency controller is enabled.

Parameter 35

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

f controller: set point ramp **2 to 50 Hz/s**

The different set point values are supplied to the controller via this ramp. The slope of the ramp is used to alter the rate at which the controller modifies the set point value. The faster the change in the set point is to be carried out, the greater the value entered here must be.

Parameter 36

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

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

Isolated operation The generator set point frequency is controlled in such a manner that, in its adjusted state, the current value deviates from the generator set point frequency by this configured dead band at most.

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

Parameter 37

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

f controller: minimum frequency **10 to 250 ms**

This parameter is the minimum ON time for the relays to be able to respond in a reliable manner to the raise/lower signals. The shortest possible time must be set here to ensure optimum control behavior.

Parameter 38

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

f controller: gain **0.1 to 99.9**

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

Parameter 39

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

Option QF only

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

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

Parameter 40

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

Option QF only

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

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

Parameter 41

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

Option QF only

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

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

Voltage Controller

NOTE

The initial state refers always to the complete range of the actuator signal (0 to 100%) regardless of the min/max limitations.

A possible range limitation of the actuator signal is considered for active controllers.

If a controller is enabled, the initial state may change to a new value, defined by the limitations. In case, the initial state is 30% and the minimum and maximum limits are 50% and 100%, the initial state changes from 30% to 50% when enabling the controller.

Parameter 42

```
Initial state
voltage     000%
```

Option QU only

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

Analog controller output setting with disabled controller. This value is used as an initial value (e.g. when changing from a power factor controller to a voltage controller).

Parameter 43

```
Actuating signal
Volt. min   000%
```

Option QU only

V controller: minimum frequency **0 to 100 %**

This parameter permits the operator to clamp or limit the lower analog output value.

Example: A 1 to 4V analog output is needed for the voltage controller to operate properly. A jumper is installed on the terminals as described above and the analog output of 0 to 5V is selected. The number to be configured in this parameter is determined by dividing the desired lower limit by the range (1/5=0.20 or 20%). 20% is the value to be configured in this parameter.

Parameter 44

```
Actuating signal
Volt. max   000%
```

Option QU only

V controller: maximum frequency **0 to 100 %**

This parameter permits the operator to clamp or limit the upper analog output value.

Example: A 1 to 4V analog output is needed for the voltage controller to operate properly. A jumper is installed on the terminals as described above and the analog output of 0 to 5V is selected. The number to be configured in this parameter is determined by dividing the desired upper limit by the range (4/5=0.80 or 80%). 80% is the value to be configured in this parameter.

Parameter 45

```
Volt.controller
            ON
```

V controller: activation **ON/OFF**

ON..... Generator voltage control is carried out. The subsequent screens of this function are displayed.
OFF..... Generator voltage control is not carried out, and the subsequent screens of this function are not displayed.

Parameter 46

```
V-contr. active
at:         000V
```

V controller: start voltage **50 to 400 V**

The voltage controller will be enabled, once the generator voltage has exceeded this value. This prevents an unintentional change of the set point of the voltage regulator when starting the engine.

Parameter 47

```
Delayed time for
V-contr.    000s
```

V controller: delayed time for V controller **0 to 999 s**

The start voltage of the voltage controller must exceed the threshold value for at least this period of time.

Parameter 48

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

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

Isolated operation The generator set point voltage is controlled in such a manner that, in its adjusted state, the current value deviates from the generator set point voltage by this configured dead band at most.

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

Parameter 49

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

V controller: minimum frequency **20 to 250 ms**

This parameter is the minimum ON time for the relays to be able to respond in a reliable manner to the raise/lower signals. The shortest possible time must be set here to ensure optimum control behavior.

Parameter 50

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

V controller: gain **0.1 to 99.9**

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

Parameter 51

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

Option Qu only

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

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

Parameter 52

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

Option Qu only

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

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

Parameter 53

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

Option Qu only

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

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

Power Factor Controller [GCP-21/22]

Parameter 54

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

Power factor controller: activation **ON/OFF**

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

OFF..... Power factor control is not performed, and the subsequent screens of this function are not displayed.

Parameter 55

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

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

The desired power factor may be configured here so that the reactive power is regulated in the system. The designations "i" and "c" stand for inductive/lagging (generator overexcited) and capacitive/leading (generator underexcited) reactive power. This set point is active only in mains parallel operation.

Three-Position Controller (Standard)

Parameter 56

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

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

The control automatically calculates the amount of reactive power which belongs to the power factor $\varphi_{setpoint}$. In a mains parallel operation, the reactive power is controlled in such a manner in its regulated state that the actual value does not deviate from the generator power factor set point value by more than the percentage value of the sensitivity setting. In this case, the percentage value refers to the generator rated power.

Parameter 57

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

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

The gain factor K_p influences the operating time of the relays. By increasing the gain, the response is increased to permit larger corrections to the variable to be controlled. The farther out of tolerance the process is the larger the response action is to return the process to the tolerance band. If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value.

Analog controller (Option Qu)

Parameter 58

```
Pow.fact.contr.
Gain Kpr     000
```

Option Qu only

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

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

Parameter 59

```
Pow.fact.contr.
Reset time 00.0s
```

Option Qu only

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

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

Parameter 60

```
Pow.fact.contr.
Deriv.time 0.00s
```

Option Qu only

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

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

Real Power Controller [GCP-21/22]

Parameter 61

```
Power controller
             ON
```

P controller: activation **ON/OFF**

ON .....In mains parallel operation the real power is automatically adjusted to the pre-selected set point when the real power controller is configured ON. The subsequent screens of this function are displayed.

OFF .....Real power control is not performed, and the subsequent screens of this function are not displayed.

Setpoint Ramp %/s

Parameter 62

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

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

Different set point values are supplied to the controller through this ramp in a percent per second reference to the generator rated power. The slope of the ramp is used to determine the rate at which the controller modifies the set point value. The more rapidly the change in the set point is to be carried out, the greater this value has to be.

Power Limitation

Parameter 63

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

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

If the maximum real generator load is to be limited, a percentage based on the rated generator power must entered here. The controller adjusts the generator in such a manner that this value is not exceeded. This parameter limits the set point of the real power controller when the generator is in a mains parallel operation.

Parameter 64

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

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

If the minimum real generator load is to be limited, a percentage based on the rated generator power must entered here, in accordance with the specified setting limits. The controller adjusts the generator so that the real power generated does not fall below this limit. This parameter is ignored in the case of fixed-set point control or isolated operation.

External Set Point Value (Option X)

The generator real power **set point value** may be monitored via an analog input if this analog inputs is utilized as a 0/4 to 20 mA input.

Parameter 65

```
Power setpoint
external     OFF
```

Option X only

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

ON..... If this parameter is configured to "OFF" a generator real power **set point value** is not monitored via the 0/4 to 20 mA input to the control. The analog inputs can be used either as a mains interchange (import/export) real power **actual** value or as freely configurable alarm inputs. If terminal 5 is utilized, the internal set point value 2 "P_{set2}" (Parameter 27) is used as set point value. The subsequent screens of this function are not displayed.

OFF..... If this parameter is configured to "OFF" a generator real power **set point value** is not monitored via the 0/4 to 20 mA input to the control. The subsequent screens of this function are not displayed.

Parameter 66

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

Option X only

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

The analog input of the real power controller can be switched here between 0 to 20 mA and 4 to 20 mA depending on the set point source.
0 to **20 mA** ... Minimum value of the set point at 0 mA; maximum value at 20 mA.
4 to **20 mA** ... Minimum value of the set point at 4 mA; maximum value at 20 mA.

CAUTION

The interchange real power set point may also be scaled. When controlling the interchange power, it is vital to ensure that C power is not entered simultaneously with I or E power when scaling the external analog input.

External setpoint	**0/4 mA**	**C**	**I**	**E**	**I**	**E**
External setpoint	**20 mA**	**C**	**I**	**E**	**E**	**I**

Parameter 67

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

```
Ext.setpoint
 4mA       0000kW
```

Option X only

P set point value: scaling minimum value **C /I/E 0 to 9,999 kW**

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

Parameter 68

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

Option X only

P set point value: scaling maximum value **C/I/E 0 to 9,999 kW**

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

Three-Position Controller

Parameter 69

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

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

In a mains parallel operation, the real power is controlled in such a manner in its regulated state that the actual value does not deviate from the generator real power set point value by more than the percentage value of the sensitivity setting. In this case, the percentage value refers to the generator rated power (Parameter 17).

Parameter 70

```
Power controller
Gain Kp     00.0
```

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

The gain factor K_p influences the operating time of the relays. By increasing the gain, the response is increased to permit larger corrections to the variable to be controlled. The farther out of tolerance the process is the larger the response action is to return the process to the tolerance band. If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value.

Parameter 71

```
P-contr. dead
band ratio  *0.0
```

P controller: reduce sensitivity **1.0 to 9.9**

If no adjusting pulses have been output for at least 5 seconds after the last adjustment of the controller, the dead band is expanded by this factor.

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

Analog controller (Option Qf)

Parameter 72

```
Power controller
Gain Kpr     000
```

Option Qf only

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

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

Parameter 73

```
Power controller
Reset time 00.0s
```

Option Qf only

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

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

Parameter 74

```
Power controller
Deriv.time 0.00s
```

Option Qf only

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

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

Partial Load Lead

Parameter 75

```
Warm up load
setpoint    000%
```

P controller: part-load lead limit **5 to 110 %**

If the engine requires a warm-up period, a lower fixed load value power may be entered for the engine warm-up period. The setting for the generator load that is to be utilized during this warm-up phase is made with this parameter. The fixed load is a percentage of the generator rated power (Parameter 17).

Parameter 76

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

P controller: part-load lead time **0 to 600 s**

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

Load and/or Var Sharing

Parameter 77

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

kW/kvar sharing: load sharing **ON/OFF**

ON..... Real power is shared between multiple generators operating in parallel. The generator outputs are distributed depending on the configured value. The subsequent screens of this function are displayed.

OFF..... No real power sharing is carried out, and the subsequent screens of this function are not displayed.

Parameter 78

```
Loadshare factor
active pow.  00%
```

kW/kvar sharing: reference variable kW **10 to 99 %**

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

Definition "Primary control variable"
• • Isolated operation = frequency
• • Mains parallel operation = real power (at the mains interchange point)
•
Definition "Secondary control variable"
• • Isolated operation = real power related to the other generators
• • Mains parallel operation = real power related to the other generators

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

Parameter 79

```
Reactive power
Load-share   ON
```

kW/kvar sharing: var sharing **ON/OFF**

ON..... Reactive power is shared between multiple generators operating in parallel. The generator outputs are distributed depending on the configured value. The subsequent screens of this function are displayed.

OFF..... No reactive load sharing is carried out, and the subsequent screens of this function are not displayed.

Parameter 80

```
Loadshare factor
reacte pow.  00%
```

kW/kvar sharing: reference variable kvar **10 to 99 %**

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

Automatic

Parameter 81

Configure automatic	YES

Configuration of automatic **YES/NO**

Parameters are grouped together in blocks to permit quicker navigation through the large number of configuration screens. Selecting "YES" or "NO" has no effect if controlling or monitoring is performed. This parameter has the following effects:

YES .....The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modified ("Cursor →", "Digit ↑" or "Select" push-buttons).

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

Load Management

NOTE

To enable the automatic start/stop function, Parameter 77 “Active power load-share” must be configured to “ON”, regardless if additional generators are available for load sharing.

NOTE

To carry out an automatic start/stop of the engine, all participating controls must be configured with the identical rated power (Parameter 17).

Load-Dependent Start/Stop in Mains Parallel Operation

Parameter 82

```
Loadd.start/stop
at ter.3     ON
```

Load dependent start/stop: enable via terminal 3 **ON/OFF**

ON..... If the control input "Automatic 1" (terminal 3) is enabled, an automatic start/stop is performed on the basis of the generator set point real power 1 (Parameter 26). If terminal 5 is enabled simultaneously, terminal 3 has priority. The subsequent screens of this function are displayed.

OFF..... No automatic start/stop is performed. The adjustment of the prespecified set point value is always carried out. The subsequent screens of this function are not displayed.

Parameter 83

```
Loadd.start/stop
at ter.5     ON
```

Load dependent start/stop: enable via terminal 5 **ON/OFF**

ON..... If the control input "Automatic 2" (terminal 5) is enabled, an automatic start/stop is performed on the basis of the generator set point real power 2 (Parameter 27). If terminal 3 is enabled simultaneously, terminal 3 has priority. The subsequent screens of this function are displayed.

OFF..... No automatic start/stop is performed. The adjustment of the prespecified set point value is always carried out. The subsequent screens of this function are not displayed.

Single Generator in Mains Parallel Operation

The load-dependent start/stop function is activated when all of the following conditions have been met:

- the operation mode AUTOMATIC has been selected
- interchange power control (import/export power) has been activated by one of the two discrete inputs ("Automatic 1" or "Automatic 2") (" I " or " E " power)
- one or both parameters "Load-dependent start/stop on terminal 3/5" (Parameter 82 or Parameter 83) has been configured to "ON".

Parameter 84

```
MOP: gen.minimum
load       0000kW
```

Load dependent start/stop: generator minimum set point power **0 to 2,000 kW**

For the mains interchange (import/export) real power control to function, a generator power set point value is required. In many cases, starting of the engine should only performed once a specific generator power set point value has been reached in order to operate the generator with a reasonable degree of efficiency. For example: At least 40 kW of real power has to be supplied by 80 kW generator before the engine is to be started.

Parameter 85

```
Add-on delay
mains oper. 000s
```

Load dependent start/stop: start delay **0 to 999 s**

Starting may be delayed even if the generator start power limit has been reached. In order to avoid starting the engine in the event of short-term load swings, a start delay may be entered here in seconds. The start power (Parameter 84) must therefore be present without interruption during this period of time, in order to ensure that the engine is started. If the load drops below the set start power limit before the time configured here expires, the counter is reset to 0.

Parameter 86

```
Shed-off delay
mains oper. 000s
```

Load dependent start/stop: stop delay **0 to 999 s**

Stopping can be delayed even if the generator stop power limit has been reached. In order to avoid shutting the engine down in the event of short-term load swings, a stop delay may be entered here in seconds. The stop power (Parameter 87) must therefore be present without interruption during this period of time, in order to ensure that the engine is stopped. If the load rises above the set stop power limit before the time configured here expires, the counter is reset to 0.

Stopping Hysteresis

NOTE

The following Parameter 87 is used to determine stopping hysteresis for single gensets in mains parallel operation, for generators connected to other generators in mains parallel operation, and in isolated operation in parallel with other gensets. However, the parameter appears only once in this text.

Parameter 87

```
Hysteresis add-.
on/off op.0000kW
```

Load dependent start/stop: hysteresis **0 to 9,999 kW**

The stop power value of the generator is determined via a hysteresis. The hysteresis is used to prevent the engine continuously starting and shutting down again.

Mains Parallel Operation (Mains Interchange (Import/Export) Real Power Control with One Generator)

General

Case 1: Start of the engine

If $[P_{NT.Setpoint} - P_{NT.actual} > P_{start}]$ the engine starts. (a)

Case 2: Stop of the engine

If $[P_{NT.setpoint} - P_{NT.actual} + P_{GN.actual.tot} < P_{start} - P_{Hyst}]$ the engine stops. (b)

Example

The power supplied by the mains, which is to be adjusted, is 50 kW. This value is entered into the set point value screen (see chapter "Controller") as "I0050kW". The generator should be operated with at least 30 kW.

$P_{NT.setpoint}$ = -50 kW Incoming/import power has to be entered negative, output/export power positive.
P_{star} = 30 kW The minimum power requested by the generator.
P_{Hyst} = 10 kW The power hysteresis for stopping.

When inserted into the above-mentioned formula, this means:

Case 1: The engine starts with the following import mains power: If formula (a) is inverted, this results in

$[P_{NT.actual} < P_{NT.setpoint} - P_{start}] \Rightarrow P_{NT.actual} < -50\ kW - 30\ kW = -80\ kW \Rightarrow$ "I0080 kW"

The power supplied by the mains must be at least 80 kW in order for the engine to start. This is then operated with a minimum power of 30 kW.

Case 2: The engine stops if it has to supply less than the minimum power minus hysteresis. This is the case with the following generator power: If formula (b) is inverted, this results in

$[P_{GN.actual}$ = stop power engine $< -P_{NT.setpoint} + P_{NT.actual} + P_{start} - P_{hyst}]$.
$[P_{GN.actual} < -50\ kW + 50\ kW + 30\ kW - 10\ kW = 20\ kW$.

If the generator falls below its minimum power minus hysteresis, the engine is stopped. The power imported from the mains therefore remains at the value that is to be controlled until just prior to stopping. Following stopping, the power supplied by the mains increases to 70 kW.

Load Sharing with Other Generators in Mains Parallel Operation

The load-dependent start/stop function is activated for every control when the following criteria has been met:

- the operation mode AUTOMATIC has been selected
- interchange power control (import/export power) has been activated by one of the two discrete inputs ("Automatic 1" or "Automatic 2") (" E " or " I " power)
- all parameters, such as start/stop power, start/stop delays, and selected set point values are identical for all generators involved
- one or both parameters "Load-dependent stop/start on terminal 3/5" has been configured to "ON"
- the parameter "Load sharing" or "var sharing" have been configured to "O N"
- **the same rated power** is available from **all generators**.

NOTE

The following Parameter 88 only applies if more than one generator is to be started in mains parallel operation. The first engine is started as described under single generator in mains parallel operation on the basis of the minimum generator power.

Parameter 88

```
Reserve power
mains op. 0000kW
```

Load dependent start/stop: reserve power **0 to 9,999 kW**

Starting of an additional engine is determined via the reserve power. The reserve power results from the currently available total generator **rated** real power (generator **rated** real power × number of closed GCBs) and the currently available total generator **actual** real power. If the currently available total generator **actual** real power is subtracted from the currently available total generator **rated** real power, this results in the system's reserve power. If negative deviation from this reserve power occurs, the next engine is started.

Currently available total generator **rated** real power
\- Currently available total generator **actual** real power
= Reserve power

Parameter 89

```
Isolated/mains
Priority       0
```

Load dependent start/stop: priority of generators **0 to 8**

This priority specifies the sequence in which the individual engines are started. The control with the lowest configured number has the highest priority. This engine is the first to be started and the last to be stopped. In the event of identical priorities, the starting sequence is determined by the operating hours. In this case, the engine with the lowest operating hours takes priority. In the event of the same number of operating hours, the engine with the lowest control number (generator number, Parameter 4) is started.

Mains Parallel Operation(Mains Interchange (Import/Export) Real Power Control with Several Generators)

General

Case 3: Start of the first engine

All GCBs are open.

If $[P_{NT.setpoint} - P_{NT.actual} > P_{start}]$ the first engine is started. (c)

Case 4: Starting of additional engines

At least one GCB in the group is closed.

If $[P_{GN.actual.tot} + P_{reserve.parallel} > P_{rated.tot}]$ the next engine is started. (d)

Case 5: Stopping

At least two GCB's in the group are closed.

If $[P_{GN.act.tot} + P_{reserve.parallel} + P_{hyst} + P_{rated} < P_{rated.tot}]$ a engine is stopped. (e)

Case 6: Stopping of the last engine

Only one GCB in the group is closed.

If $[P_{NT.setpoint} - P_{NT.actual} + P_{GN.actual.tot} < P_{start} - P_{hyst}]$ the last engine is stopped. (f)

Example

The real power supplied by the mains, which is to be adjusted, is 0 kW. This value is entered as the set point value (see chapter "Controllers") as "I0000kW" (corresponds to "E0000kW"). The reserve power in the system should be 40 kW. The power hysteresis should be 20 kW. Three generators are to be operated within the group. The rated power of a generator is 200 kW. The minimum power of a generator should be 30 kW.

P_{Rated}	= 200 kW	Rated power of a generator.
$P_{Rated.tot}$		Total of the rated power values of the gensets with closed GCB's.
$P_{Start.tot}$	= 30 kW	Minimum power of a generator.
$P_{NT.actual}$		Current mains power.
$P_{NT.setpoint}$	= B0000 kW	Set point mains power
$P_{Reserve.Parallel}$	= 40 kW	Reserve power in mains parallel operation
P_{Hyst}	= 20 kW	Power hysteresis
No. GCB		Number of closed GCB's

Case 3: Power supplied by the mains, with which the first engine is started:

$P_{NT.actual} < P_{NT.setpoint} - P_{start.gen}$.
$P_{NT.actual} < 0$ kW - 30 kW = -30 kW $\Rightarrow$ I0030 kW.

The power supplied by the mains must be at least 30 kW in order for the first engine to start. This is then operated with a minimum power of 30 kW.

Case 4: Generator real power, at which the second engine is started:

$P_{GN.actual} > P_{rated.tot} - (P_{Reserve.Parallel} / \text{No. GCB})$.
$P_{GN.actual} > 200$ kW – (40 kW / 1) = 160 kW.

If the generator real power exceeds 160 kW, negative deviation from the pre-specified reserve power has occurred. As a result of this, the next engine is started.

Case 4: Generator real power of each individual generator, at which the third engine is started:

$P_{GN.actual} > P_{rated.tot} - (P_{reserve.parallel} / \text{No. GCB}) - P_{rated}$.
$P_{GN.actual.} > 400$ kW – (40 kW / 2) - 200 kW = 180 kW.

If the generator real power of both generators exceeds 360 kW (each generator supplies more than

180 kW), negative deviation from the pre-specified reserve power has occurred. As a result of this, the next engine is started.

Case 5: Generator real power of each individual generators, at which one engine is stopped:

$P_{GN.actual.tot} < P_{rated.tot} - P_{reserve.parallel} - P_{rated} - P_{hyst}$.
$P_{GN.actual.tot} < 600$ kW - 40 kW - 200 kW - 20 kW = 340 kW.
$(P_{GN.actual} < P_{GN.actual.tot})$ / No. GCB = 340 kW / 3 = 113.3 kW.

If the generator real power of the three generators falls below 340 kW (each individual generator below 113.3 kW), one engine is stopped. After one engine has been stopped, the reserve power is still available.

Case 5: Generator real power of each individual generator, at which one of the two engines is stopped:

$P_{GN.actual.tot} < P_{rated.tot} - P_{reserve.parallel} - P_{rated} - P_{hyst}$.
$P_{GN.actual.tot} < 400$ kW - 40 kW - 200 kW - 20 kW = 140 kW.
$(P_{GN.actual} < P_{GN.actual.tot})$ / No. GCB = 140 kW / 2 = 70 kW.

If the generator real power of the two generators falls below 140 kW (each individual generator below 70 kW), one engine is stopped. After the engine has been stopped, the reserve power is still available.

Case 6: Generator real power, at which the last engine is stopped:

$P_{GN.actual} < - P_{NT.setpoint} + P_{NT.actual} + P_{start.gen} - P_{hyst}$.
$P_{GN.actual.} < -$ 0 kW + 0 kW + 30 kW - 20 kW = 10 kW.

If the generator falls below its minimum real power minus hysteresis, the engine is stopped. The power imported from the mains therefore remains at the value that is to be controlled until just prior to stopping. Following stopping, the power supplied by the mains increases to 10 kW.

Isolated Operation in Parallel with Other Generators

The load-dependent start/stop function is activated for every control when the following criteria has been met:

- the operation mode AUTOMATIC has been selected
- all parameters, such as start power (Parameter 84), stop power (Parameter 87), start delay (Parameter 85), stop delay (Parameter 86) and the frequency set point values (Parameter 6) are identical for all controls involved
- one or both parameters "Load-dependent stop/start on terminal 3/5" (Parameter 82 or Parameter 83) has/have been configured to "ON"
- the parameters "Load sharing" (Parameter 77) or "var sharing" (Parameter 79) have been configured as "ON"
- **All generators** are configured to **the same rated power** (Parameter 17)

NOTE

The reserve power (Parameter 90) should be selected in such a manner that expected load swings will not overload the generator.

Parameter 90

```
Reserve power
isol. op. 0000kW
```

Load dependent start/stop: reserve power (isolated operation) **0 to 999 kW**

Starting of an additional engine is determined via the reserve power. The reserve power results from the currently available total generator **rated** real power (generator **rated** real power × number of closed GCB's) and the currently available total generator **actual** real power. If the currently available total generator **actual** real power is subtracted from the currently available total generator **rated** real power, this results in the system's reserve power. If negative deviation from this reserve power occurs, the next engine is started.

Currently available total generator **rated** real power
- Currently available total generator **actual** real power
= Reserve power

Parameter 91

```
Add-on delay
isol. op.   000s
```

Load dependent start/stop: start delay (isolated operation) **0 to 999 s**

Starting may be delayed even if the engine's start power (Parameter 84) has been reached. In order to avoid starting the engine in the event of short-term load swings, a start delay may be entered in seconds. The start power (Parameter 84) must therefore be present without interruption during this period of time, in order to ensure that the engine is started. If the load drops below the set start power limit before the time configured here expires, the counter is reset to 0.

Parameter 92

```
Stopdelay
isol. op.   000s
```

Load dependent start/stop: stop delay (isolated operation) **0 to 999 s**

Stopping can be delayed even if the engine's stop power (Parameter 87) has been reached. In order to avoid shutting the engine down in the event of short-term load swings, a stop delay may be entered in seconds. The stop power (Parameter 87) must therefore be present without interruption during this period of time, in order to ensure that the engine is stopped. If the load rises above the set stop power limit before the time configured here expires, the counter is reset to 0.

General

Case 7: Start of the engine

If $[P_{GN.actual.tot} + P_{reserve.isolated} + > P_{rated.tot}]$ the engine is started. (f)

Case 8: Stop of the engine

If $[P_{GN.actual.tot} + P_{reserve.isolated} + P_{hyst} + P_{rated} + < P_{rated.tot}]$ the engine is stopped. (g)

Example

Two generators in an isolated operation are used in parallel with other generators. One generator should always be in operation.

P_{rated} = 200 kW Rated real power of a genset.
$P_{Reserve.isolated}$ = 60 kW
P_{hyst} = 30 kW

Case 8: Generator real power, at which the second engine is started:

$P_{GN.actual} > P_{rated.tot} - P_{reserve.isolated}$.
$P_{GN.actual} > 200\ kW - 60\ kW = 140\ kW$.

If the generator real power exceeds 140 kW negative deviation from the pre-specified minimum reserve power occurs. As a result of this, the next engine is started.

Case 9: Generator real power, at which the second engine is stopped:

$P_{GN.actual.tot} < P_{rated.tot} - P_{reserve.isolated} - P_{rated} - P_{hyst}$.
$P_{GN.actual.tot} < 400\ kW - 60\ kW - 200\ kW - 30\ kW = 110\ kW$.
$P_{GN.actual} < P_{GN.actual.tot}$ / No. GCB = 110 kW / 2 = 55 kW.

If, in the case of outgoing isolated load, the total actual generator real power is reduced to such an extent that one generator is enough to ensure the reserve power, the second engine is stopped.

Temperature-Dependent Start/Stop (Option Tz)

Parameter 93

```
Start/Stop temp.
at ter.3      ON
```

Option Tz only

CHP temperature-dependent start/stop on terminal 3 **ON/OFF**

ON..... If this parameter is enabled and the control input "Automatic 1" is applied to terminal 3, a temperature dependent start/stop is performed. If the terminal 5 is applied simultaneously, the terminal 3 is given preference.
OFF..... No automatic temperature dependent start/stop is effected via the terminal 3.

Parameter 94

```
Start/Stop temp.
at ter.5      ON
```

Option Tz only

CHP temperature-dependent start/stop on terminal 5 **ON/OFF**

ON..... If this parameter is enabled and the control input "Automatic 2" is applied to terminal 5, a temperature dependent start/stop is performed. If the terminal 3 is applied simultaneously, the terminal 3 is given preference.
OFF..... No automatic temperature dependent start/stop is effected via the terminal 5.

NOTE

The following screens are even displayed if the temperature-dependent start/stop has been disabled for both terminals.

Parameter 95

```
Temperature of
Start      000°C
```

Option Tz only

CHP activation temperature **0 to 255°C**

The temperature value at which the genset is to be started, is entered in this screen. If this value is fallen below, the genset starts automatically and runs continuously until reaching the switch-off temperature.

Parameter 96

```
Temperature of
Stop       000°C
```

Option Tz only

CHP deactivation temperature **0 to 255°C**

The temperature value at which the genset is to be stopped is entered in this screen. If the value is reached or exceeded, the genset stops automatically.

Parameter 97

```
Start
Delay time  000s
```

Option Tz only

CHP activation delay **0 to 255 s**

In order to be activated, the activation temperature must be fallen below without interruption for at least the period of time specified in this screen. If the actual value exceeds the threshold within this period of time, the timer is re-started (this time lag applies for both, activation and deactivation time).

Remote Control via Interface (Option Sb/Sf)

NOTE

For remote acknowledgement of alarms, a remote stop while in idle mode must be performed. If the control is in an isolated operation, an acknowledgement combined with a remote start must be performed.

Set Point Specification via Interface Y1 to Y5 (Option SB)

Parameter 98

```
serial Control
com Y1Y5      ON
```

Option SB only

Control via interface COM Y1 to Y5 **ON/OFF**

ON .....Control via the interface is enabled if the control via X1X5 (Parameter 98) has been configured to "ON", the operation mode is set to AUTOMATIC and the discrete input "Automatic 2" (terminal 5) has been enabled. The engine can be started and stopped and the breakers can be opened via a remote signal. The generator real power and the generator power factor φ set point value may also be transmitted.

OFF .....The control via the Y1Y5 interface is disabled. The internally generator real power set point value 2 (Parameter 27) is selected with the discrete input "Automatic 2" and the internal power factor (Parameter 55) set point value is used. Interface monitoring is disabled.

Parameter 99

```
Pulse time
Modbus       0s
```

Option SB only

Waiting time transmission after read request **0 to 9 s**

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

Set Point Specification via Interface X1 to X5 (Option SF)

Parameter 100

```
serial Control
com X1X5      ON
```

Option SF only

Control via interface COM X1 to X5 **ON/OFF**

ON..... Control via the interface is enabled if the direct configuration (Parameter 5) has been configured as "OFF", the control via Y1Y5 (Parameter 81) has been configured to "ON", the operation mode is set to AUTOMATIC and the discrete input "Automatic 2" (terminal 5) has been enabled. The engine can be started and stopped and the breakers can be opened via a remote signal. The generator real power and the generator power factor φ set point value may also be transmitted.

OFF..... The control via the X1X5 interface is disabled. The internally generator real power set point value 2 (Parameter 27) is selected with the discrete input "Automatic 2" and the internal power factor (Parameter 55) set point value is used. Interface monitoring is disabled.

Parameter 101

```
Remote acknow.
COM           ON
```

Remote acknowledgment via interface **ON/OFF**

ON..... Alarm acknowledgement of alarms of the alarm classes F2/F3 via the interface is enabled.

OFF..... Alarm acknowledgement of alarms of the alarm classes F2/F3 via the interface is disabled. Acknowledgment can be performed via the discrete input "Acknowledgment" (terminal 6) or via the push button "RESET".

Parameter 102

```
Supervision
COM           ON
```

Remote monitoring of the interface **ON/OFF**

ON..... Monitoring of the interface is enabled. If control signals are not received (ID 503) every 90 seconds, a warning alarm of class 1 is triggered.

OFF..... Monitoring of the interface is disabled.

Breaker

Parameter 103

```
Configure
breaker        YES
```

Configuration of the breakers **YES/NO**

Parameters are grouped together in blocks to permit quicker navigation through the large number of configuration screens. Selecting "YES" or "NO" has no effect if controlling or monitoring is performed. This parameter has the following effects:

YES .....The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modified ("Cursor →", "Digit ↑" or "Select" push-buttons).

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

Breaker Logic

Parameter 104

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

Breaker logic **see below**

The control automatically controls the two breakers (MCB and GCB). Up to five (5) breaker logic modes may be selected. These are:

GCP-20	GCP-21	GCP-22
EXTERNAL	EXTERNAL	EXTERNAL
OPEN TRANS.	PARALLEL	PARALLEL
CLOSED TRANS.	---	OPEN TRANS.
---	---	CLOSED TRANS.
---	---	INTERCHANGE

A detailed explanation for each mode may be found in the following text.

CAUTION

Please consider that units with a software older than V1.0700 do not have an internal rotating field monitoring.

Units below V1.0700 assume always a clockwise phase rotation direction of all three voltage systems, which are measured.

A rotating field monitoring must be provided by the customer in order to avoid a CB closure with a counter-clockwise rotating field.

Overview [GCP-20/22]

STOP	TEST	MANUAL	AUTOMATIC
EXTERNAL: Breaker logic "External" The MCB and the GCB are operated in MANUAL operation mode only in this breaker logic mode. In a mains parallel operation, uncoupling from the mains is carried out via the MCB or the GCB in the event of a mains failure. The breakers will not automatically close in emergency power operation. Emergency power operation in accordance with European Community Specification DIN VDE 0108 is not possible in this power circuit breaker logic.			
The GCB is opened.	The GCB and the MCB are not operated. , Exception: The breakers are opened for decoupling from the mains.	The MCB and the GCB may be manually opened and closed without synchronization. The circuit breakers are opened for decoupling from the mains.	The GCB is opened if the genset is stopped or if decoupling from the mains, but will not close if the engine is started. The MCB is opened only if decoupling from the mains, and is never closed.
[GCP-22 only] PARALLEL: Breaker logic "Mains parallel operation" The MCB and GCB are synchronized to permit continuous mains parallel operation in this breaker logic mode.			
The GCB is opened; the MCB is not operated.	The GCB and the MCB are not operated. Exception: Load test by actuating the "GCB ON" push-button. Termination of the load test with the "GCB OFF" push-button. Emergency power: Automatic closing of the GCB. If there is a dead busbar and terminal 53 "Enable MCB" is energized, the MCB will be closed.	Mains parallel operation can be initiated by pressing the "GCB ON" or "MCB ON" push-button.	The GCB is synchronized via an add-on request and a mains parallel operation is performed. When a shed-off request is issued, the generator sheds load and opens the GCB and the engine is shut down following the configured cool down period. Emergency power: The emergency power operation is terminated following the expiration of the mains settling time. The MCB is synchronized and closed, putting the system back into a mains parallel operation.
OPEN TRANS.: Breaker logic "Open transition / ATS / change-over / brake-before-make" The MCB and GCB are never synchronized in this breaker logic mode.			
The GCB is opened; the MCB is not operated.	The GCB and the MCB are not operated. Exception: Load test by actuating the "GCB ON" push-button. Termination of the load test via the "GCB OFF" or "MCB ON" push-button(s). Emergency power: Automatic closing of the GCB. If there is a dead busbar and terminal 53 "Enable MCB" is energized, the MCB will be closed.	A change can be made to either generator or mains operation by pressing either the "GCB ON" or "MCB ON" push-button. The "STOP" push-button opens the GCB and simultaneously stops the engine.	A change is made to generator operation through an add-on request. Once the add-on request is terminated, the system changes back to mains operation. The MCB is closed when the busbar is dead, even if there has not been an add-on request. Emergency power operations are terminated following the expiration of the mains settling timer. The GCB opens and the MCB closes, transferring all loads to the mains.

STOP	TEST	MANUAL	AUTOMATIC
CLOSED TRANS.: Breaker logic "Closed transition / make-before-brake / overlap synchronization" The MCB and the GCB are synchronized, in order to avoid a dead busbar in this breaker logic mode. Immediately after the synchronization of one breaker, the other is opened. Continuous mains parallel operation is not possible.			
The GCB is opened; the MCB is not operated.	The GCB and the MCB are not operated. Exception: Load test by actuating the "GCB ON" push-button. Termination of the load test via the "GCB OFF" or "MCB ON" push-button(s). Emergency power: Automatic closing of the GCB. If there is a dead busbar and terminal 53 "Enable MCB" is energized, the MCB will be closed.	Synchronization of either the generator or the mains can be initiated by pressing the "GCB ON" or "MCB ON" push-button.	The GCB is synchronized via an add-on request. After the GCB closes the MCB is opened. Following the shed-off request being issued, the MCB is synchronized and closed. After the MCB has closed the GCB is opened. Emergency power: The emergency power operation is terminated following the expiration of the mains settling time and the MCB synchronizing to the generator. The MCB closes and the GCB opens immediately afterwards.
[GCP-22 only] INTERCHANGE: Breaker logic "Soft loading / interchange synchronization" The MCB and the GCB are synchronized, in order to avoid a dead busbar in this breaker logic mode. The operation of a breaker under load is avoided by utilizing the ability to soft load. Continuous mains parallel operation is not possible with this breaker logic. Following the shed-off request, the MCB synchronizes and closes, the generator soft unloads to the mains and the GCB opens. After the GCB is open the engine is stopped following the expiration of the configured cool down period.			
The GCB is opened; the MCB is not operated.	The GCB and the MCB are not operated. Exception: Load test by actuating the "GCB ON" push-button. Termination of the load test via the "GCB OFF" or "MCB ON" push-button. Emergency power: Automatic closing of the GCB. If there is a dead busbar and terminal 53 "Enable MCB" is energized, the MCB will be closed.	Synchronization of either the generator or the mains can be initiated by pressing the "GCB ON" or "MCB ON" push-button.	Via an engine request, the GCB is synchronized and the generator power is increased. The MCB is then opened. Following the disabling of the engine request, the MCB is reverse synchronized and the GCB is then opened. Emergency power: The emergency power operation is terminated following the expiration of the mains settling time. The MCB closes, the load is transferred, and the GCB opens.

Overview [GCP-21]

STOP	TEST	MANUAL	AUTOMATIC
EXTERNAL: Breaker logic "External" The GCB is never synchronized in this operation mode. Decoupling from the mains when in a mains parallel operation is carried out via the GCB in the event of mains faults. The breaker will not automatically close in emergency power operations.			
The GCB is opened.	The GCB is not operated. Exception: The breaker is opened for decoupling from the mains.	The GCB can be manually opened and closed without synchronization. The breaker is opened for decoupling from the mains.	The GCB is opened for stopping or for decoupling from the mains, but is not closed in the event of an add-on request.
PARALLEL: Breaker logic "Mains parallel" This operation mode may be used both in the case of an isolated system, an isolated parallel system, and a system that is operated in mains parallel.			
The GCB is opened.	The GCB is not operated. Exception: Load test by actuating the "GCB ON" push-button. Termination of the load test with the "GCB OFF" push-button. Emergency power: The GCB is opened for decoupling from the mains.	Mains parallel operation can be performed via the "GCB ON" push-button.	The GCB is synchronized via an add-on request and mains parallel operation is performed. When a shed-off request is issued, the generator sheds load, the GCB is opened, and the engine is shut down following the configured cool down period.

Parameter 105

```
St. with no GCB
at ter. 5    OFF
```

Perform engine start without closing the GCB **ON/OFF**

ON..... If the terminal 5 is energized, the engine starts. No synchronization is performed and the GCB is not closed (no switching to dead busbar). The GCB is closed only if an emergency power operation is enabled. After the return of the mains, the load is transferred to the mains according to the configured breaker logic.

OFF..... The function is disabled. An engine start without closing the GCB cannot be performed by energizing terminal 5.

Start/Stop Ramp, Open GCB with F2 Alarm

Parameter 106

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

Start/stop ramp **0 to 999 s**

This time can be used to influence two functions:

Stop: The maximum amount of time generator will shed load is set here. If the generator load does not drop below 3 % of the generator rated power (Parameter 17) within this time, the GCB is opened.

Start with soft loading: If the mains interchange (import/export) real power value does not reach 0 kW in breaker logic "INTERCHANGE" within the time configured here; a class F1 alarm and an alarm message are issued. At the same time, the relay manager relay, which is programmed with relay manager function 78 (Appendix B) is enabled and the MCB is prevented from opening.

Parameter 107

```
Open GCB with F2
max.time    000s
```

Max. perm. time with F2 alarms for starting a further engine **0 to 999 s**

Prerequisite: Load sharing (Parameter 77) and automatic start/stop (Parameter 82 or Parameter 83) are configured to "ON". The generator is in isolated operation and at least one additional generator is connected to a busbar.

If a class F2 alarm occurs the engine shutdown may be delayed by the time configured here. This permits another engine to attempt to start in order to assume the load. After the configured time expires the engine with the F2 alarm condition will shutdown regardless if another engine was able to start and assume the load.

GCB Impulse/Constant Pulse

Closing and opening of the GCB and the MCB are described in the following figures (Figure 9-1 and **Fehler! Verweisquelle konnte nicht gefunden werden.**). Changing of the breaker control logic is configured using Parameter 108 and has the described effect on the signal sequence (the operation of the MCB cannot be carried out by means of the continuous pulse). If the "Automatic breaker deblocking" (Parameter 116) is configured to "ON", an open pulse is issued prior to each close pulse. The discrete input "Enable MCB" (terminal 54) enables/disables closing the MCB. A closed MCB is not opened.

- **Breaker logic: 'Impulse'**

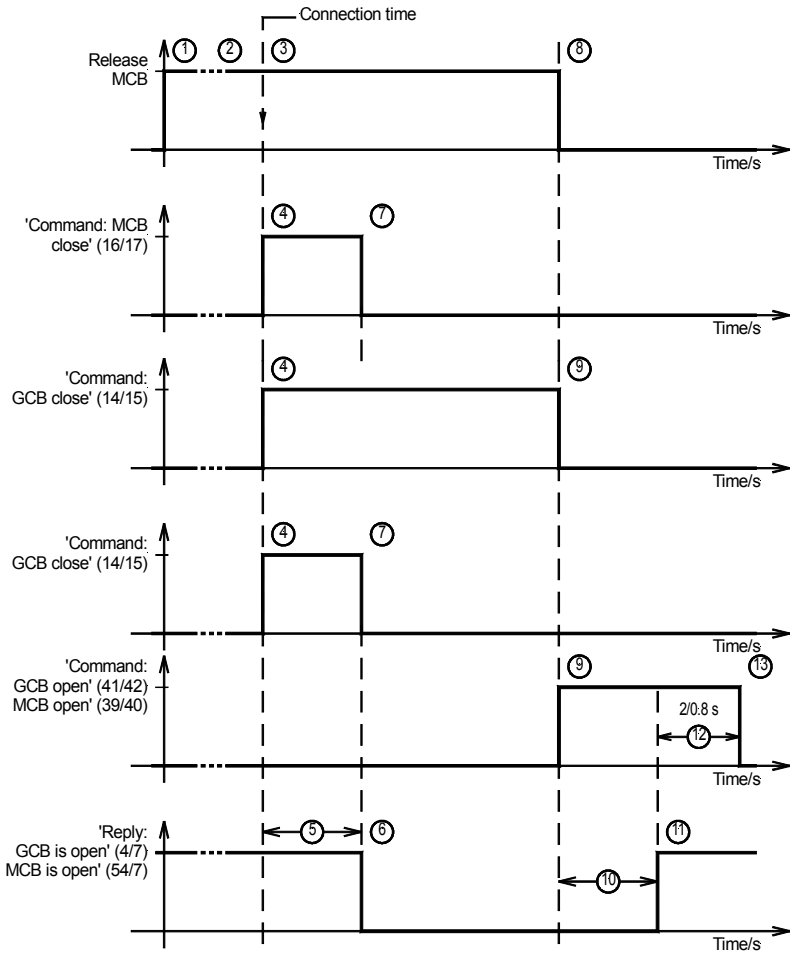


Figure 9-1: Breaker control logic 'Impulse'

'Impulse' logic (GCB and MCB): ***1*** Enable MCB; ***2*** Synchronization; ***3*** Connect time reached:

- close GCB/MCB: ***4*** Closing pulse for GCB/MCB enabled; ***5*** Inherent delay; ***6*** Reply GCB/MCB; ***7*** Closing pulse disabled;

- open GCB/MCB: ***9*** Opening pulse GCB/MCB enabled; ***10*** Inherent delay; ***11*** Reply GCB/MCB; ***12*** Time delay (GCB: 2 s; MCB: 0.8 s); ***13*** Opening pulse disabled.

• **Beaker logic: 'Constant'**

'Constant' logic (GCB only): ***1*** Enable; ***2*** Synchronization; ***3*** Connect time reached:
- close GCB: ***4*** GCB close continuous pulse enabled; ***5*** Inherent delay; ***6*** Reply GCB;
- open GCB: ***9*** Continuous pulse disabled and GCB open pulse enabled; ***10*** Switcher time element; ***11*** Reply GCB; ***12*** Opening pulse disabled.

Parameter 108

```
GCB closeing
relay----------
```

Signal logic for the GCB **constant/impulse**

Constant..... The relay "Command: close GCB" can be looped directly into the self-holding circuit of the breaker. Following the connect impulse has been issued and the reply of the breaker has been received, the relay "Command: close GCB" remains energized as long as the following conditions are fulfilled:
"Reply: GCB is closed" is active.
The angle between generator voltage and busbar voltage is within +/- 14°.
If the breaker must be opened, the relay de-energizes.

Impulse..... The relay "Command: close GCB" outputs a connect impulse. The GCB self-holding function must be performed by an external holding circuit. The reply of the GCB is used to detect the closed breaker.

In both cases, the relay "Command: open GCB" (terminal 41/42) is energized to open the GCB.

Open/Close GCB

Parameter 109

```
GCB open relay
---------------
```

Opening the GCB (terminal 41/42) **NO-contact/NC-contact**

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

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

Synchronization (With Synchronous Generators Only)

CAUTION

Please consider that units with a software older than V1.0700 do not have an internal rotating field monitoring.

Units below V1.0700 assume always a clockwise phase rotation direction of all three voltage systems, which are measured.

A rotating field monitoring must be provided by the customer in order to avoid a CB closure with a counter-clockwise rotating field.

Parameter 110

```
Synchronize
df max    0.00Hz
```

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

The prerequisite for a connect command being issued is that the differential frequency is below the configured differential frequency. This value specifies the upper frequency (positive value corresponds to positive slip → generator frequency is higher than the busbar frequency in the case of GCB synchronization; busbar frequency is higher than the mains frequency in the case of MCB synchronization).

Parameter 111

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

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

The prerequisite for a connect command being issued is that the differential frequency is above the configured differential frequency. This value specifies the lower frequency limit (negative value corresponds to negative slip → generator frequency is less than the busbar frequency in the case of GCB synchronization; busbar frequency is lower than the mains frequency for MCB synchronization).

Parameter 112

```
Synchronize
dV max       00V
```

Max. perm. differential voltage for synchronization **[1] 1 to 20 V; [4] 2 to 60 V**

A connect command will only be issued when the measured voltage falls below the configured differential voltage.

Parameter 113

```
Synchronize
time pul.> 0.00s
```

Min. pulse duration of connect relay for synchronization **0.05 to 0.26 s**

The duration of the close pulse can be adjusted to the breaker (valid for synchronization and dead bus start).

Parameter 114

```
Closing time
GCB          000ms
```

Inherent delay of GCB for synchronization **40 to 300 ms**

The inherent closing time of the GCB corresponds to the lead-time of the close command. The close command will be issued independently of the differential frequency at the entered time before the synchronous point.

Parameter 115

```
Closing time
MCB          000ms
```

Inherent delay of MCB for synchronization **40 to 300 ms**

The inherent closing time of the MCB corresponds to the lead-time of the close command. The close command will be issued independently of the differential frequency at the entered time before the synchronous point.

Parameter 116

```
Automat.breaker
deblocking    ON
```

Automatic circuit breaker deblocking **ON/OFF**

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

OFF .....Initialization of the circuit breaker initialization on closing is performed **only** by the close pulse. No open pulse is issued prior to the close pulse.

Synchronization Time Monitoring (With Synchronous Generators Only)

If the following parameter (Parameter 117) is configured to "ON", synchronization time monitoring is performed: If the synchronization of the GCB or MCB [GCP-20/22] is initiated, the timer is started following the termination of the delayed engine monitoring. If the breaker has not closed following the expiration of the configured time, an F1 alarm message is issued.

NOTE

If during an enabled "MCB monitoring" (Parameter 130) an alarm is detected while closing the MCB, a emergency power operation is performed (if this has been configured to ON; Parameter 134).

Parameter 117

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

Monitoring of synchronization time **ON/OFF**

ON..... Synchronization time will be monitored. The subsequent screens of this function are displayed.

OFF..... Synchronization time will not be monitored. Synchronization will be attempted until it can be accomplished. The subsequent screens of this function are not displayed.

Parameter 118

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

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

If the synchronization of the GCB or MCB is initiated, the timer is started following the termination of the delayed engine monitoring. If the breaker cannot be closed and this time has expired, an alarm message is issued and the control continues to attempt to close the breaker. The relay assigned relay manager function 16 (GCB) and/or 70 (MCB) is energized.

Issuing of class F1 alarm

Dead Bus Start (With Synchronous Generators Only)

If the busbar is de-energized, a dead bus start of the GCB or the MCB is performed. If closing commands for the MCB and the GCB are issued simultaneously, priority is given to the MCB provided the discrete input "Enable MCB" (terminal 54) has been enabled.

Parameter 119

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

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

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

OFF..... A dead bus start is not performed. The subsequent screens of this function are not displayed.

Parameter 120

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

Maximum differential frequency for GCB dead bus start **0.00 to 5.00 Hz**

The prerequisite to issuing a close command is that the monitored generator frequency may deviate from the generator rated frequency by no more than this value.

Parameter 121

```
GCB dead bus op.
dV max.      00V
```

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

The prerequisite to issuing a close command is that the monitored generator voltage may deviate from the generator rated frequency by no more than this value.

Parameter 122

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

[GCP-20/22] only

Dead bus closing of the MCB **ON/OFF**

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

OFF .....A dead bus closing of the MCB is not performed. The subsequent screens of this function are not displayed.

Connection Functions (With Induction/Asynchronous Generators Only)

Parameter 123

```
Connect GCB
            ON
```

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

ON .....Generator frequency control is performed with the set point of the mains frequency. The GCB is closed after meeting all connection criteria listed below. The subsequent screens of this function are displayed.

OFF .....The GCB is not closed. The subsequent screens of this function are not displayed.

Parameter 124

```
Connect GCB
df max    0.00Hz
```

Max. perm. diff. frequency for GCB connection (pos. slip) **0.05 to 9.99 Hz**

The prerequisite for issuing a close command is the monitored generator frequency may deviate from the generator rated frequency by no more than this value. This value specifies the upper frequency limit (positive value corresponds to positive slip → generator frequency is higher than the busbar frequency in the case of GCB synchronization).

Parameter 125

```
Connect GCB
df min   -0,00Hz
```

Min. perm. diff. frequency for GCB connection (neg. slip) **0.0 to -9.99 Hz**

The prerequisite for issuing a close command is the monitored generator frequency may deviate from the generator rated frequency by no more than this value. This value specifies the lower frequency limit (negative value corresponds to negative slip → generator frequency is less than the busbar frequency in the case of GCB synchronization).

Parameter 126

```
Connect GCB
Time pulse>0.00s
```

Time pulse for the GCB **0.05 to 0.26 s**

The duration of the close pulse can be adjusted to the breaker.

Connect Time Monitoring (With Induction/Asynchronous Generators Only)

If Parameter 127 is configured to "ON", closing time monitoring is performed: A timer is started when the closing of the GCB is initiated following the termination of the delayed engine monitoring. If the breaker has not closed following the expiration of the configured time, an F1 alarm message is issued.

Parameter 127

```
Conn.time contr.
            ON
```

Breaker close time monitoring **ON/OFF**

ON..... Connect time monitoring is carried out. The subsequent screen of this function is displayed.

OFF..... Unsuccessful connection is not monitored. The subsequent screen of this function is not displayed.

Parameter 128

```
Conn.time contr.
Delay time  000s
```

Delay of breaker close time monitoring **2 to 999 s**

When the closing of the GCB is initiated, a timer is started. If the GCB has not closed before the expiration of the timer, a warning message "Connect time GCB" is issued. A further attempt is made to connect the power circuit breaker. The relay assigned relay manager function 16 (GCB) and/or 70 (MCB) is energized.

Issuing of class F1 alarm

Breaker Monitoring

Upon CLOSING - If "GCB monitoring" (Parameter 129) and/or "MCB monitoring" (Parameter 130) have been configured "ON", GCB and/or MCB monitoring is performed (exception: the breaker logic is configured "EXTERNAL" (Parameter 104). If the breaker cannot be closed after five attempts, a class F1 alarm is issued.

Upon OPENING - When opening a circuit breaker an open pulse is issued. If a reply is detected 2 seconds after the open pulse was issued that the MCB or GCB has not opened, an class F1 alarm message is issued.

Parameter 129

```
Supervision GCB
            ON
```

GCB monitoring **ON/OFF**

ON..... Monitoring of the GCB is performed except when the breaker logic is configured as "EXTERNAL". If the breaker cannot be closed after five attempts, an alarm message is issued. The relay with the parameter 74 is energized. Following the issuing of the alarm message, further attempts are made to close the GCB. If load sharing has been enabled (Parameter 77), the closing command to the breaker is cancelled if an alarm is issued so that another control may close its breaker. If a "Reply: GCB is open" message is not detected 2 seconds after a "Command: open GCB" pulse is issued, an alarm message is issued. The relay with the parameter 74 is energized.

Issuing of class F1 alarm

OFF..... No GCB monitoring is performed.

Parameter 130

```
Supervision MCB
            ON
```

[GCP-20/22] only

MCB monitoring **ON/OFF**

ON .....Monitoring of the MCB is performed except when the breaker logic is configured as "EXTERNAL". If the breaker cannot be closed after five attempts, an alarm message is issued. The relay with the parameter 75 is energized. Following the issuing of the alarm message, further attempts are made to close the MCB. If load sharing has been enabled (Parameter 77) the closing command to the breaker is cancelled if an alarm is issued so that another control may close its breaker. If a "Reply: MCB is open" message is not detected 2 seconds after a "Command: open MCB" pulse is issued, an alarm message is issued. The relay with the parameter 77 is energized.

Issuing of class F1 alarm

OFF .....No MCB monitoring is performed.

Mains Decoupling

NOTE

If the mains monitoring (frequency and voltage) is disabled, no mains decoupling is performed.

Parameter 131

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

Decoupling from the mains via ... **MCB/GCB**

In case of a response of the mains monitor, a decision may be made as to which power circuit breaker has to be opened if an alarm occurs. If an isolated operation may not be carried out with the generator, the power circuit breaker (GCB) must be opened. If an isolated isolation is allowed, the mains circuit breaker (MCB) may be opened.

Parameter 132

```
Switch MCB in
STOP mode    OFF
```

from V1-0700

Operate MCB in STOP operation mode **YES/NO**

ON .....The MCB will be operated by the GCP in STOP mode (the busbar will be closed onto the mains if the controller is changed into this STOP mode). It is necessary that "Enable MCB" (terminal 53) be energized as well.

OFF .....The MCB will not be operated by the GCP in STOP mod (the busbar will not be connected or remains unconnected if the control unit is changed into STOP mode).

Emergency Power (AMF)

Parameter 133

```
Configure
emerg.run    YES
```

Configuration of the emergency power (AMF) **YES/NO**

Parameters are grouped together in blocks to permit quicker navigation through the large number of configuration screens. Selecting "YES" or "NO" has no effect if controlling or monitoring is performed. This parameter has the following effects:

YES..... The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modified ("Cursor →", "Digit ↑" or "Select" push-buttons).

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

NOTE

Emergency power is only possible with synchronous generators utilizing 2 circuit breakers [GCP-20/22].

Prerequisite: The emergency power (AMF) function may only be enabled with synchronous generators using Parameter 133 ("Emergency power"). Emergency power operations are only performed in AUTOMATIC or TEST mode regardless of the status of the discrete inputs "Automatic 1" and "Automatic 2".

Emergency Power Configuration

Parameter 134

```
Emergency power
            ON
```

Emergency power **ON/OFF**

ON..... If the control is in AUTOMATIC mode and a mains failure occurs, the engine is started and an automatic emergency power operation is performed. The subsequent parameters of this function are displayed. Emergency power is also initiated by the detection of a breaker failure when the MCB is to be closed. In order to enable this, the Parameter 130 ("Supervision MCB") must be configured to "ON".

OFF..... Emergency power operation is not enabled and the subsequent parameters of this function are not displayed.

Parameter 135

```
Emergency power
start del. 00.0s
```

Start delay for emergency power **0.5 to 99.9 s**

In order to start the engine and to carry out an emergency power operation, the mains must fail for at least this delay time.

Parameter 136

```
Mains settling
time        000s
```

Mains settling time **0 to 999 s**

In order to prevent the backspacing synchronization of the generator with the mains for a certain period of time following the detection of the return of the mains after a power failure, the time lag for the no-load operation can be selected with the input of this parameter. The following applies for units which are operated with one power circuit breaker [GCP-21]: In the event of a power failure for a certain period of time, the genset remains in no-load operation with the starting request applied, until after the mains settling time following the return of the mains. In this case, the starting request (via terminal 3/5) may be removed by a programmable relay which is activated due to the mains failure (parameter 5).

Protection

Parameter 137

```
Configure
monitoring   YES
```

Configuration of the protection **YES/NO**

Parameters are grouped together in blocks to permit quicker navigation through the large number of configuration screens. Selecting "YES" or "NO" has no effect if controlling or monitoring is performed. This parameter has the following effects:

YES .....The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modified ("Cursor →", "Digit ↑" or "Select" push-buttons).

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

Generator Power Monitoring

It is possible to monitor a configurable generator power limit value. It is possible to output the tripping to one of these freely configurable relays by means of the relay manager (relay manager function 56). This function makes it possible to initiate external load shedding.

NOTE

With this function no centralized alarm is issued and no message is displayed. A relay output is enabled which must be externally evaluated.

WARNING

This function does not operate as generator protection.

If generator protection is necessary, either the generator protection of this control (Parameter 146 and Parameter 151) or an external protection device should be used.

Parameter 138

```
Gen.power monit.
            ON
```

Generator power monitoring **ON/OFF**

ON .....The generator power is monitored (relay manager function 56 must be assigned to a relay). The subsequent screens of this function are displayed.

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

Parameter 139

```
Power monitoring
resp.value  000%
```

Generator power monitoring threshold value **0 to 150 %**

If this threshold value has been exceeded for at least the delay time (Parameter 141), the relay assigned relay manager function 56 energizes.

Parameter 140

```
Power monitoring
gen.hyst.   000%
```

Generator power monitoring hysteresis **0 to 99 %**

If the monitored generator power level drops below the threshold value configured in Parameter 139 by value configured here, hysteresis occurs and the relay de-energizes.

Parameter 141

```
Power monitoring
Delay time  000s
```

Generator power monitoring delay **0 to 650 s**

For the control unit to recognize a power monitoring fault condition, the threshold value configured in Parameter 139 must be exceeded without interruption for this period of time.

Mains Power Monitoring [GCP-21/22]

It is possible to monitor one configurable mains power limit value. It is possible to output the tripping to one of the freely configurable relays by means of the relay manager (relay manager function 67). This function makes it possible to initiate external load shedding.

NOTE

With this function no centralized alarm is issued and no message is displayed. A relay output is enabled which must be externally evaluated.

WARNING

This function does not operate as generator protection.

If generator protection is necessary, either the generator protection of this control (Parameter 146 and Parameter 151) or an external protection device should be used.

Parameter 142

```
mains power mon.
            ON
```

[GCP-21/22] only

Mains power monitoring **ON/OFF**

ON..... The generator power is monitored (relay manager function 67 must be assigned to one relay). The subsequent screens of this function are displayed.

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

Parameter 143

```
mains power mon.
value    I0000kW
```

[GCP-21/22] only

Power monitoring threshold value **I/E 0 to 9,999 kW**

If this threshold value has been exceeded for at least the delay time (Parameter 145), the relay assigned relay manager function 57 energizes. Imported power is entered with a " - " before the value, exported power is entered with a " + " before the value. If the value is confirmed, the " - " becomes an " I " and the " + " becomes an " E ".

Parameter 144

```
mains power mon.
hyst.      000kW
```

[GCP-21/22] only

Power monitoring hysteresis **0 to 999 kW**

If the monitored generator power level drops below the threshold value configured in Parameter 143 by value configured here, hysteresis occurs and the relay de-energizes.

Parameter 145

```
mains power mon.
Delay time  000s
```

[GCP-21/22] only

Power monitoring delay **0 to 650 s**

For the control unit to recognize a power monitoring fault condition, the threshold value configured in Parameter 143 must be exceeded without interruption for this period of time.

Generator Overload Monitoring

NOTE

All percentage values refer to a percentage of the generator rated power (Parameter 17; page 75).

Function: "Positive real power not within the permissible range" - The single-phase or three-phase measured generator real power is above the configured limit value of the real power.

Parameter 146

```
Overload monit.
            ON
```

Generator overload monitoring **ON/OFF**

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

Parameter 147

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

Generator overload monitoring threshold value MOP **80 to 150 %**

If this threshold value has been exceeded for at least the delay time (Parameter 148), the following alarm class is initiated (MOP = Mains Parallel Operation).

Issuing of class F2 alarm
without power reduction

Parameter 148

```
Gen.overload MOP
delay       00s
```

Generator overload monitoring delay **0 to 99 s**

For the control unit to recognize a generator overload monitoring fault condition, the threshold value configured in Parameter 147 must be exceeded without interruption for this period of time (MOP = Mains Parallel Operation).

Synchronous Generators

Parameter 149

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

Generator overload monitoring threshold value IOP **80 to 150 %**

If this threshold value has been exceeded for at least the delay time (Parameter 150), the following alarm class is initiated (IOP = Isolated Parallel Operation).

Issuing of class F2 alarm
without power reduction

Parameter 150

```
Gen.overload IOP
delay       00s
```

Generator overload monitoring delay **0 to 99 s**

For the control unit to recognize a generator overload monitoring fault condition, the threshold value configured in Parameter 149 must be exceeded without interruption for this period of time (IOP = Isolated Parallel Operation).

Generator Reverse/Reduced Power Monitoring

NOTE

All percentage values refer to a percentage of the generator rated power (Parameter 17; page 75).

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

Parameter 151

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

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

ON..... Monitoring of the generator reverse/reduced power will be performed. The subsequent parameters of this function are displayed.
OFF..... Monitoring is disabled, and the subsequent screens of this function are not displayed.

Parameter 152

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

Reverse/reduced power monitoring threshold value **-99 to 99 %**

Reverse power monitoring: If the current value falls below the negative threshold value for at least the delay time (Parameter 153), the following alarm class is initiated.
Reduced power monitoring: If the current value falls below the positive threshold value for at least the delay time (Parameter 153), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 153

```
Rev./red.power
delay       0.0s
```

Reverse power monitoring delay **0.0 to 9.9 s**

For the control unit to recognize a reverse/reduced power monitoring fault condition, the threshold value configured in Parameter 152 must be exceeded without interruption for this period of time.

Unbalanced Load Monitoring

NOTE

All percentage values refer to a percentage of the generator rated power (Parameter 18; page 75).

Function: "Generator load imbalance not within the permissible range" - The percentage threshold value specifies the permissible deviation of one phase current to the arithmetic mean value of all three phase currents.

Parameter 154

```
Load unbalanced
monitoring   ON
```

Unbalanced load monitoring **ON/OFF**

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

Parameter 155

```
Load unbalanced
max.         000%
```

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

If the threshold value has been exceeded for at least the delay time (Parameter 156; e.g. because of an asymmetric load), the following alarm class is initiated.

Issuing of class F3 alarm

Example 1

I_{rated} = 100 A
$I_{unbalanced}$ = set to 33 %
The monitor responds, if the difference between a phase and the arithmetic mean value of all three phases is (100 A × 33 %)/100 % = 33.3 A. The arithmetic mean value of all three phases is calculated by: 33.3 A × 3 = 100 A. In case of an alarm (one phase defective) the two remaining phases take over 100 A each. The current within the two remaining phases is calculated as follows: 100 A/2 phases = 50 A per healthy phase.
Reading on the display: **0/50/0**; **70/30/0**; **45/55/0**; etc.

Example 2

I_{rated} = 100 A
$I_{unbalanced}$ = set to 90 %
- (100 A × 90 %)/100 % = 90 A
- 90 A × 3 = 270 A
270 A/2 phases = 135 A per healthy phase.
Indication on the display: **135/135/0**; **130/140/0**; **120/150/0**; etc.

Parameter 156

```
Load unbalanced
delay      00.00s
```

Unbalanced load monitoring delay **0.02 to 99.98 s**

For the control unit to recognize an unbalanced load monitoring fault condition, the threshold value configured in Parameter 155 must be exceeded without interruption for this period of time.

Time-Overcurrent Monitoring

NOTE

All percentage values refer to a percentage of the generator rated power (Parameter 18; page 75).

Function: The GCP-20 utilizes a two tier time-overcurrent monitoring with separate adjustable time delays. The threshold values and delays can be selected so that the monitored current level is independent from the tripping time. The level 2 overcurrent is used as a fast-triggering high-current stage for protection against short circuits. The level 1 overcurrent reacts on overcurrent values below level 2 but above permissible limits that are present over a longer period of time.

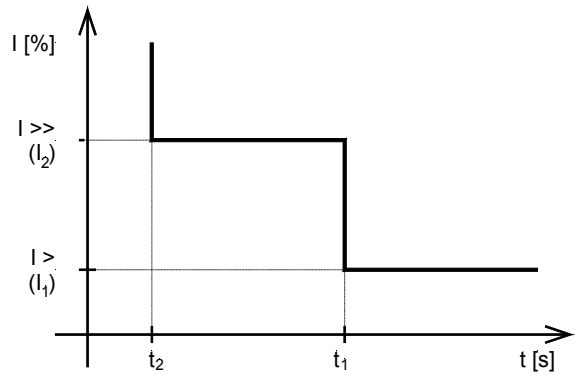


Figure 9-2: Characteristic of the time-overcurrent monitoring

Parameter 157

```
Gen.overcurrent
monitoring   ON
```

Overcurrent monitoring **ON/OFF**

ON..... Monitoring of the generator current will be performed for overcurrent. The subsequent parameters of this function are displayed.
OFF..... Monitoring is disabled, and the subsequent screens of this function are not displayed.

Parameter 158

```
Gen.overcurrent
limit 1     000%
```

Threshold value overcurrent limit 1 **0 to 300 %**

If the threshold value has been exceeded for at least the delay time (Parameter 159), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 159

```
Gen.overcurrent
delay 1   00.00s
```

Independent time overcurrent, delay, limit 1 **0.02 to 99.98 s**

For the control unit to recognize a time-overcurrent fault condition, the threshold value configured in Parameter 158 must be exceeded without interruption for this period of time.

Parameter 160

```
Gen.overcurrent
limit 2     000%
```

Independent time overcurrent, threshold value, limit 2 **0 to 300 %**

If this threshold value has been exceeded for at least the delay time (Parameter 161), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 161

```
Gen.overcurrent
delay 2   00.00s
```

Independent time overcurrent, delay, limit 2 **0.02 to 99.98 s**

For the control unit to recognize a time-overcurrent fault condition, the threshold value configured in Parameter 160) must be exceeded without interruption for this period of time.

Generator Frequency Monitoring

Function: "Generator frequency not within the permissible range" - The generator frequency is outside of the limit values set for overfrequency or underfrequency. The engine is shut down immediately (class F3 alarm), and an alarm message is displayed. The activation of generator underfrequency monitoring is delayed by means of "Delayed engine monitoring" (**Parameter 274**) in order to enable correct generator start-up.

Parameter 162

```
Gen.frequency-
monitoring   ON
```

Generator frequency monitoring **ON/OFF**

ON .....Monitoring of the generator frequency will be performed. The subsequent parameters of this function are displayed.
OFF .....Monitoring is disabled, and the subsequent screens of this function are not displayed.

Parameter 163

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

Threshold value: generator overfrequency **40.0 to 85.0 Hz**

If this threshold value has been exceeded for at least delay time (Parameter 164), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 164

```
Gen.overfreq.
delay      0.00s
```

Generator overfrequency delay **0.02 to 9.98 s**

For the control unit to recognize a generator overfrequency fault condition, the threshold value configured in Parameter 163 must be exceeded without interruption for this period of time.

Parameter 165

```
Gen.underfreq.
f <      00.00Hz
```

Generator underfrequency threshold value **40.0 to 85.0 Hz**

If the current value has been fallen below this threshold value for at least the delay time (Parameter 166), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 166

```
Gen.underfreq.
delay      0.00s
```

Generator underfrequency delay **0.02 to 9.98 s**

For the control unit to recognize a generator underfrequency fault condition, the threshold value configured in Parameter 165 must be exceeded without interruption for this period of time.

Engine Overspeed Monitoring

Parameter 167

```
Motor over speed
    > 0000 rpm
```

Engine overspeed monitoring **0 to 9,999 rpm**

The overspeed monitoring is performed in addition to and independent of the generator frequency if the Magnetic Pickup Unit (MPU) has been enabled (**Parameter 276**). If the MPU has been disabled, the monitoring is disabled. If this threshold value is been exceeded the following alarm class is initiated.

Issuing of class F3 alarm

Generator Voltage Monitoring

The line-to-line (wye) voltage is monitored.

Function: "Generator voltage not within the permissible range" - If one or more phases of the generator voltage exceeds the limit values set for overvoltage or undervoltage, the engine is shut down immediately (class F3 alarm) and an alarm message is displayed. The activation of generator undervoltage monitoring is delayed by means of "Delayed engine monitoring" (**Parameter 274**) in order to enable generator start-up.

Parameter 168

```
Gen.voltage
monitoring   ON
```

Generator voltage monitoring **ON/OFF**

ON..... Monitoring of the generator voltage will be performed. The subsequent parameters of this function are displayed.
OFF..... Monitoring is disabled, and the subsequent screens of this function are not displayed.

Parameter 169

```
Gen.overvoltage
U >          000V
```

Generator overvoltage threshold value **[1] 70 to 130 V; [4] 10 to 520 V**

If this threshold value has been exceeded for at least the delay time (Parameter 170), the following alarm class is initiated.

Issuing of class F3 alarm

NOTE

The threshold value for generator overvoltage may not exceed 149 V [1] or 495 V [4] for delta connections, because higher voltages cannot be detected.

Parameter 170

```
Gen.overvoltage
delay       0.00s
```

Generator overvoltage delay **0.02 to 9.98 s**

For the control unit to recognize a generator overvoltage fault condition, the threshold value configured in Parameter 169 must be exceeded without interruption for this period of time.

Parameter 171

```
Gen.undervoltage
U <          000V
```

Generator undervoltage threshold value **[1] 70 to 130 V; [4] 10 to 520 V**

If the current value has been fallen below this threshold value for the delay time (Parameter 172), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 172

```
Gen.undervoltage
Delay time 0.00s
```

Generator undervoltage delay **0.02 to 9.98 s**

For the control unit to recognize a generator undervoltage fault condition, the threshold value configured in Parameter 171 must be exceeded without interruption for this period of time.

Mains Frequency Monitoring

Monitoring the mains frequency is absolutely vital if a generator is operated in conjunction with the infinite grid. In the event of mains failure (e.g. utility power outage) the generator that is operating in parallel with the utility must be automatically disconnected from the mains. Decoupling from the mains only occurs when both power circuit breakers (MCB and GCB) are closed.

The limit values configured below are utilized for the assessment emergency power operations if the following parameters are enabled. The parameters below define if the mains are or aren't present. The breaker opening times do not affect these parameters.

Function: "Mains frequency not within the permissible range" - The mains frequency exceeds the limit values configured for overfrequency or underfrequency. The power circuit breaker that disconnects from the mains is immediately opened. The prerequisite of mains frequency monitoring is that the generator is operating in mains parallel (the MCB and GCB are both closed).

Parameter 173

```
Mains frequency
monitoring   ON
```

Mains frequency monitoring **ON/OFF**

ON .....Monitoring of the mains frequency will be performed. The subsequent parameters of this function are displayed.
OFF .....Monitoring is disabled, and the subsequent screens of this function are not displayed.

Parameter 174

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

Mains overfrequency threshold value **40.0 to 85.0 Hz**

If this threshold value has been exceeded for at least the delay time (Parameter 175), the following alarm class is issued. Depending on the configured mains decoupling procedure, the GCB, MCB, or an external CB will be opened.

Issuing of class F0 alarm

Parameter 175

```
Mains overfreq.
Delay time 0.00s
```

Mains overfrequency delay **0.02 to 9.98 s**

For the control unit to recognize a mains overfrequency fault condition, the threshold value configured in Parameter 174 must be exceeded without interruption for this period of time.

Parameter 176

```
Mains underfreq.
f <      00.00Hz
```

Mains underfrequency threshold value **40.0 to 85.0 Hz**

If the current value has been fallen below this threshold value for at least the delay time (Parameter 177), the following alarm class is issued. Depending on the configured mains decoupling procedure, the GCB, MCB, or an external CB will be opened.

Issuing of class F0 alarm

Parameter 177

```
Mains underfreq.
Delay time 0.00s
```

Mains underfrequency delay **0.02 to 9.98 s**

For the control unit to recognize a mains underfrequency fault condition, the threshold value configured in Parameter 176 must be exceeded without interruption for this period of time.

Mains Voltage Monitoring

Monitoring the mains voltage is absolutely vital if a generator is operated in conjunction with the infinite grid. In the event of mains failure (e.g. utility power outage) the generator that is operating in parallel with the utility must be automatically disconnected from the mains. Decoupling from the mains only occurs when both power circuit breakers (MCB and GCB) are closed.
The phase-phase (wye) voltage is monitored for units with software below V1.0700.

Parameter 178

```
Mains volt.monit
phase-phase
```

V1.0700 and above only

Mains voltage monitoring **phase-phase / phase-neutral**

This parameter determines how the voltage is to be measured.
This screen only affects the display. The screens of the protective functions are defined below.

The limit values configured below are utilized for the assessment emergency power operations if the following parameters are enabled. The parameters below define if the mains are or aren't present. The breaker opening times do not affect these parameters.

Function: "Mains voltage not within the permissible range" - If one or more phases of the generator voltage exceeds the limit values set for overvoltage or undervoltage, the power circuit breaker that disconnects from the mains is immediately opened. The prerequisite of mains voltage monitoring is that the generator is operating in mains parallel (the MCB and GCB are both closed).

Parameter 179

```
Mains voltage
monitoring   ON
```

Mains voltage monitoring **ON/OFF**

ON..... Monitoring of the mains voltage will be performed. The subsequent parameters of this function are displayed.
OFF..... Monitoring is disabled, and the subsequent screens of this function are not displayed.

Parameter 180

```
Mains overvolt.
U Ph.-Ph. > 000V
```

V1.0700 and above only:

```
Mains overvolt.
U Ph.-N. >  000V
```

Mains overvoltage threshold value **(Ph.-Ph.) [1] 20 to 130 V; [4] 20 to 520 V**
(Ph.-N.) [1] 20 to 75 V; [4] 20 to 300 V

If this threshold value has been exceeded for at least the delay time (Parameter 181), the following alarm class is issued. Depending on the configured mains decoupling procedure, the GCB, MCB, or an external CB will be opened.

Issuing of class F0 alarm

Parameter 181

```
Mains overvolt.
Delay time 0.00s
```

Mains overvoltage delay **0.02 to 9.98 s**

For the control unit to recognize a mains overvoltage fault condition, the threshold value configured in Parameter 180 must be exceeded without interruption for this period of time.

Parameter 182

```
Mains undervolt.
U Ph.-Ph. < 000V
```

V1.0700 and above only:

```
Mains undervolt.
U Ph.-N. <  000V
```

Mains undervoltage threshold value **(Ph.-Ph.) [1] 20 to 130 V; [4] 20 to 520 V**
(Ph.-N.) [1] 20 to 75 V; [4] 20 to 300 V

If this threshold value has fallen below for at least the delay time (Parameter 183), the following alarm class is issued. Depending on the configured mains decoupling procedure, the GCB, MCB, or an external CB will be opened.

Issuing of class F0 alarm

Parameter 183

```
Mains undervolt.
Delay time 0.00s
```

Mains undervoltage delay **0.02 to 9.98 s**

For the control unit to recognize a mains undervoltage fault condition, the threshold value configured in Parameter 182 must be exceeded without interruption for this period of time.

Phase/Vector Shift Monitoring dφ/dt

A phase/vector shift is a sudden change in the voltage curve that is caused by a large generator load change. The measuring circuit detects a change in a single sine wave. This sine wave is compared with a calculated mean value from previous measurements. Monitoring encompasses all three phases. The threshold value in degrees specifies the difference in time between the mean and the measured value in reference to a full cycle. Monitoring can be set in various manners. The phase/vector shift watchdog may be used as an additional means for decoupling from the mains. The minimum voltage that the phase shift is activated is 70 % of the rated secondary voltage.

Function: "Voltage cycle duration not within the permissible range" - The voltage cycle duration exceeds the configured limit value for the phase/vector shift. The result is the power circuit breaker that disconnects from the mains is opened and an alarm message is displayed. The prerequisite for phase/vector shift monitoring is that the generator is operating in a mains parallel operation (the MCB and GCB are both closed).

Parameter 184

```
Phase shifting
monitoring   ON
```

Phase/vector shift monitoring **ON/OFF**

ON .....Monitoring of the mains frequency will be performed for phase/vector shift. The subsequent parameters of this function are displayed.

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

Parameter 185

```
Monitoring
---------------
```

Phase/vector shift monitoring **single-/three / only three-phase**

single-/three .During single-phase voltage phase/vector shift monitoring, tripping occurs if the phase/vector shift exceeds the configured threshold value (Parameter 186) 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 186) is taken into consideration; if a phase/vector shift occurs in all three phases, the three-phase threshold value (Parameter 187) 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.

only three-phase.. During three-phase voltage phase/vector shift monitoring, tripping occurs only if the phase/vector shift exceeds the specified threshold value (Parameter 187) in all three phases within 2 cycles.

Issuing of class F0 alarm

NOTE

If monitoring is configured to "`only three-phase`", only the second of the following two parameters is visible; if monitoring is configured to "`single-/threephase`", both parameters are visible.

Parameter 186

```
Phase shift
(One phase)  00°
```

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

Phase/vector shift monitoring threshold value single-phase **3 to 30 °**

If the electrical angle of the mains voltage shifts more than this configured value in any single phase, a class F0 alarm is initiated. Depending on the configured mains decoupling procedure, the GCB, MCB, or an external CB will be opened.

Parameter 187

```
Phase shift
(3-phase)    00°
```

Phase/vector shift monitoring threshold value three-phase **3 to 30 °**

If the electrical angle of the mains voltage shifts more than this configured value in all three phases, a class F0 alarm is initiated. Depending on the configured mains decoupling procedure, the GCB, MCB, or an external CB will be opened.

Battery Voltage Monitoring

Parameter 188

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

Battery voltage monitoring: Threshold value **8 to 35 V**

If the measured value falls below this threshold value for at least the delay time (Parameter 189), the following alarm class is issued.

Issuing of class F1 alarm

Parameter 189

```
Batt.undervolt.
Delay        00s
```

Battery undervoltage delay **0 to 999 s**

For the control unit to recognize a battery undervoltage fault condition, the threshold value configured in Parameter 188 must be exceeded without interruption for this period of time.

Note: Regardless of the configured battery voltage monitoring threshold, readiness for operation is withdrawn and an alarm message is issued if the power supply voltage falls below 9 Vdc or if the power supply voltage falls below 11 Vdc during the start sequence.

Discrete Inputs

Parameter 190

```
Configure
dig.inputs   YES
```

Configuration of discrete inputs **YES/NO**

Parameters are grouped together in blocks to permit quicker navigation through the large number of configuration screens. Selecting "YES" or "NO" has no effect if controlling or monitoring is performed. This parameter has the following effects:

YES..... The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modified ("Cursor →", "Digit ↑" or "Select" push-buttons).

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

NOTE

The discrete inputs can be used as alarm inputs or control inputs. If they were configured as alarm inputs (Fehler! Verweisquelle konnte nicht gefunden werden. **to** Fehler! Verweisquelle konnte nicht gefunden werden. **are configured to "OFF") the parameters in "Alarm Inputs" (page 121) are valid. If they have been configured as control inputs (**Fehler! Verweisquelle konnte nicht gefunden werden. **to** Fehler! Verweisquelle konnte nicht gefunden werden. **are configured to "ON") the parameters in "**Control Inputs**" (page 124) are valid.**

Alarm Inputs

Discrete input	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Name	1	2	3	4	5	6	7	8	9	A	B	C	D	E
Terminal	61	62	63	64	65	66	67	68	69	70	71	72	73	74
Function	A	A/C	A/C	A/C	A	A	A/C	A/C	A	A	A	A	A	A

A=Alarm input; A/C=Alarm or control input (dependent on the configuration)

NOTE

Operating current (NO): The relay is enabled (i.e. in the operating state) when current flows through the coil. If a loss of the supply voltage occurs, a change of state will not occur in the relay and no triggering of fault conditions occur. In this mode of operation the condition of the system should me

monitored though other means than the state of the relay.

Closed circuit current (NC): The relay is disabled (i.e. in idle state) when current flows through the coil. If a loss of the supply voltage occurs, a change of state will occur in the relay and a triggering of fault conditions will occur.

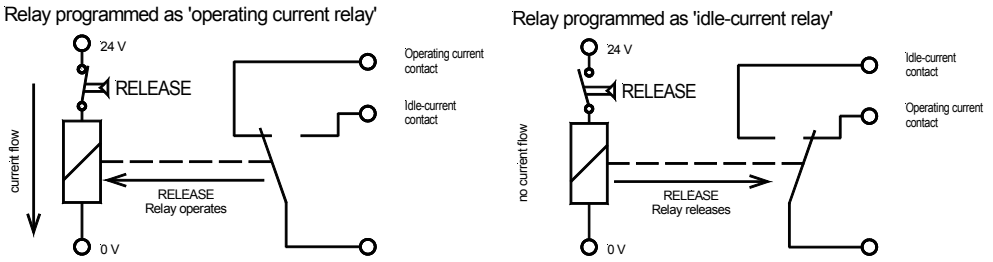


Figure 9-3: NO/NC logic

Example: Discrete inputs 1 through 4 (same procedure for inputs 5 to 14)

Parameter 191

Dig.input function	1234 DDDD

Function of the discrete alarm inputs 1 to 4 **E/D**

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

D .....The discrete input is analyzed as "enabled" by applying of a voltage difference (NO/operating current).

E .....The discrete input is analyzed as "disabled" by removal of a voltage difference (NC/idle current).

Parameter 192

Dig.input delay	1234 0000

Delay time of the discrete alarm inputs 1 to 4 **0 to 9**

A delay time in stages can be assigned to each alarm input. The individual stages are listed below. The discrete input must be present without interruption throughout the delay time in order to be "enabled".

Delay stage	Delay stage
0	100 ms
1	200 ms
2	500 ms
3	1 s
4	2 s
5	5 s
6	10 s
7	20 s
8	50 s
9	100 s

Table 9-4: Discrete alarm inputs - delay stages

Parameter 193

Delayed by eng.speed	1234 YYYY

Delayed by firing speed of the discrete alarm inputs 1 to 4 **Y/N**

If the discrete input used as an alarm input is only to be monitored when the engine is running ("firing speed reached") is specified here.

Y .....After engine monitoring has been enabled the discrete input is monitored.

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

Parameter 194

```
Dig.input   1234
error class 0000
```

Alarm class of the discrete alarm inputs 1 to 4 **F0 to F3**

Different alarm classes can be assigned to each discrete alarm input. The alarm classes are listed below.

The monitoring functions are divided into four alarm classes:

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

F1 - Warning alarm - This alarm does not lead to an interruption of the operation. A centralized alarm is issued.
→ Alarm text + flashing "alarm" LED + group alarm relay (horn).

F2 – Triggering alarm - This alarm leads to the shutdown of the engine. A power reduction is performed prior to the GCB being opened. An engine cool down is performed.
→ Alarm text + flashing "alarm" LED + group alarm relay (horn) + cool down.

F3 – Triggering alarm - This alarm leads to the immediate opening of the GCB and shutdown of the engine.
→ Alarm text + flashing "alarm" LED + group alarm relay (horn) + shutdown.

Configuring the Text for the Discrete Inputs

NOTE

If terminal 6 is configured to "Sprinkler operation" (override or critical mode; Parameter 201) or if a gas engine is selected (Parameter 259**), the EMERGENCY STOP function must always be assigned to terminal 61. If terminal 61 is not a discrete input, the EMERGENCY STOP function is assigned to the discrete input with the lowest terminal number (this discrete input is then normally the input with terminal number 61).**

NOTE

Certain special characters, numbers, upper and lower case letters may be set.

Parameter 195

```
alarmtext ter.61
     EMERG.-STOP
```

Setting the alarm texts **user-defined**

These parameters are used to enter the alarm texts (in this example for terminal 61 the alarm text "EMERGENCY OFF"). The text for these parameters is user defined. Terminal 61 is the recommended terminal to assign EMERGENCY OFF functions to.

The alarm texts for the terminals 62 through 74 may be assigned in the same way in the subsequent configuration screens.

Control Inputs

Acknowledge firing speed via terminal 62

Parameter 196

```
Firing speed by
Term. 62     ON
```

Firing speed reached via terminal 62 **ON/OFF**

OFF .....This terminal is used as an alarm input.
ON .....Configuring the starting sequence logic:
If Parameter 191 is configured to "E", the discrete input utilizes "N.O." contacts and the starter disengages when the status of this discrete input becomes TRUE. Once the delayed engine monitoring time has expired, the discrete input changes to "N.C." logic internally even though "N.O." logic is still programmed This permits the controller to generate an alarm condition in the event of a voltage loss (including a configured time delay). This input will operate on the inverse of this principle as well. If Parameter 191 is configured to "D", the discrete input utilizes "N.C." logic to disengage the starter in the event of a voltage loss. Once the delayed engine monitoring has expired, the discrete input changes to "N.O." logic internally even though "N.C." logic is still programmed and will initiate an alarm as soon as voltage is applied.

Block operation mode selector switch via terminal 63

Parameter 197

```
Op.mode blocked
by Ter.63    ON
```

Disabling the change of the mode using terminal 63 **ON/OFF**

OFF .....This terminal is used as an alarm input.
ON .....Terminal 63 is used as control input.
If terminal 63 is energized, the operation mode cannot be changed using the pushbuttons on the face of the control unit.

If this input is configured as control input **and** energized, it is possible for units with **Option A2** from version 1.0700 to select the operation mode externally using the control inputs at terminals 127 and 128. The functionality is described in the following table:

Operation mode blocked (terminal 63)	Input STOP (terminal 127)	Input AUTOMATIC (terminal 128)	Function
de-energized	not applicable	not applicable	The operation mode can be selected using the buttons at the front of the GCP. (The terminals 127/128 have no effect.)
energized	de-energized	de-energized	No change in operation mode. After connecting the supply voltage, the unit is in STOP operation mode. The operation mode selection buttons at the front of the GCP are blocked.
energized	energized	de-energized	The STOP operation mode is activated. After connecting the supply voltage, the unit is in STOP operation mode. The operation mode selection buttons at the front of the GCP are blocked.
energized	de-energized	energized	The AUTOMATIC operation mode is activated. After connecting the supply voltage, the unit changes to AUTOMATIC operation mode via STOP.
energized	energized	energized	The STOP operation mode is activated. After connecting the supply voltage, the unit is in STOP operation mode. The operation mode selection buttons at the front of the GCP are blocked.

Table 9-5: Function - external operation mode selection

Change breaker logic via terminal 64

Parameter 198

```
Open transition
by Term64    ON
```

Open transition via terminal 64 **ON/OFF**

OFF..... This terminal is used as an alarm input.
ON..... This terminal is used as control input.

- High signal If this terminal utilizes a HIGH signal (energized), the open transition breaker logic will be used.
- Low signal If this terminal utilizes a LOW signal (de-energized), the breaker logic of Parameter 104 will be used.

Enable 'Close GCB without engine delay' via terminal 67

Parameter 199

```
Close GCB asap
by Ter.67   ON
```

V1.0700 and above only

Close GCB before the del. engine monit. expires via terminal 67 **ON/OFF**

OFF..... This terminal is used as an alarm input.
ON..... This terminal is used as control input.

- High signal If this terminal utilizes a HIGH signal (energized), the GCB closes before the delayed engine monitoring expires.
- Low signal If this terminal utilizes a LOW signal (de-energized), the GCB closes after the delayed engine monitoring has been expires.

Enable 'Emergency OFF' via terminal 68

Parameter 200

```
Emergency OFF
by Ter.68    OFF
```

V1.0700 and above only

Prevent an emergency power operation via terminal 68 **ON/OFF**

OFF..... This terminal is used as an alarm input.
ON..... This terminal is used as control input.

- High signal If this terminal utilizes a HIGH signal (energized), an emergency power operation is prevented or terminated. The unit operates as if Parameter 134 "Emergency power" is disabled.
- Low signal If this terminal utilizes a LOW signal (de-energized), the setting of Parameter 134 "Emergency power" is taken over.

Terminal 6

ATTENTION

The various functions of terminal 6 are enabled at different signal levels!

Parameter 201

```
Function term.6
---------------
```

Function of terminal 6

This parameter is used to assign a function to the terminal 6 discrete input. The following functions may be selected for the discrete input:

• Sprinkler operation

By de-energizing terminal 6 (setting a LOW signal), the sprinkler operation (critical mode) is enabled in accordance with the functional description. The sprinkler operation is terminated by energizing terminal 6 (application of a HIGH signal). For a description of the sprinkler operation function read Sprinkler Operation on page 53).

Note: No load-dependent starting and stopping is possible in sprinkler operation.

Attention: This is a negative logic function!

• Engine release

Terminal 6 has the same function as the STOP push-button: De-energizing terminal 6 (application of a LOW signal) prevents the engine from starting and stops the engine if it is already running. Applying a HIGH signal enables the starting of the engine

Attention: By the use of this function, the emergency power operation may be aborted or prevented. The emergency power operation is not possible without enabling this function! The enable engine function only functions in the AUTOMATIC operation mode.

• Ext. acknowledgment

Alarms can be acknowledged externally by energizing terminal 6 (change from a LOW to a HIGH signal) in the STOP and AUTOMATIC operation modes. In order to achieve additional acknowledgements, terminal 6 must first be de-energized and then energized again. If terminal 6 is continuously energized (HIGH signal), there is no effect on the acknowledgement and suppression of alarm messages.

Analog Inputs (Option T4)

Parameter 202

```
Configure
analg.inp.    YES
```

Option T4 only

Configuration of analog inputs **YES/NO**

Parameters are grouped together in blocks to permit quicker navigation through the large number of configuration screens. Selecting "YES" or "NO" has no effect if controlling or monitoring is performed. This parameter has the following effects:

YES..... The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modified ("Cursor →", "Digit ↑" or "Select" push-buttons).

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

Parameter 203

```
Temperature in:
       -------
```

Option T4 only

Temperature measurement in **Celsius / Fahrenheit**

A decision is made in this screen whether the temperature measurement of the analog inputs should be in °C or in °F. This applies only to Pt100 measuring inputs or VDO temperature.

Setting the Analog Inputs

NOTE

The analog inputs [T1] to [T4] are only available in the T4 Option. The following specification for the inputs is possible:

- **Scaleable analog input 0/4 to 20 mA**
- **Pt100/Pt1000 input**
- **VDO input (temperature or pressure)**
- **PTC input**
- **External power set point with 0/4 to 20 mA (OptionX)**

Analog input	1	2	3	4
Assignment	VDO #1	VDO #2	0/4 to 20 mA	0/4 to 20 mA
Terminal	93/94/95	96/97/98	99/100/101	102/103/104
Function	Alarm input	Alarm input	Alarm input	

VDO #1 = 0 to 180 Ohm, VDO #2 = 0 to 380 Ohm

Pt100 Input (Analog Input [T1] to [T4])

Pt100 inputs may be measured here. The analog input is displayed with its description. Two threshold limits can be monitored. The first level initiates a class F1 alarm, the second level initiates a class F3 alarm.

Parameter 204

```
Temperature x
Pt100         ON
```

[x = 1 to 4]

Pt100 input; enable/disable **ON/OFF**

ON .....The value of this input appears in the display, and monitoring is enabled. The subsequent parameters of this function are displayed.
OFF .....No display or monitoring is performed, and the subsequent parameters of this function are not displayed.

Parameter 205

```
***name****
----------000°C
```

Pt100 input; description **User defined text**

The description of the analog input may be programmed using this parameter. A maximum of eleven characters may be used to describe the measured value. In the event of an alarm, the description and the monitored value are displayed with an exclamation mark before the temperature.

Parameter 206

```
limit
warning     000°C
```

Pt100 input; limit value for class F1 alarm **0 to 225 °C / 0 to 437 °F**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 209) for at least the delay time (Parameter 208), the following alarm class is initiated.

Issuing of class F1 alarm

Parameter 207

```
limit
shutdown    000°C
```

Pt100 input; limit value for class F3 alarm **0 to 225 °C / 0 to 437 °F**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 209) for at least the delay time (Parameter 208), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 208

```
Delay
limit 1/2    000s
```

Pt100 input; delay time for limit values of class F1 and F3 alarm **0 to 999 s**

In order to initiate an alarm, the measured value (Parameter 206 or Parameter 207) must be over or under the configured threshold value (dependent upon Parameter 209) without interruption for at least this time.

Parameter 209

```
Monitoring for
---------------
```

Pt100 input; monitoring for ... **high limit mon. / low limit mon.**

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 206 or Parameter 207).
high limit mon.: The measured value must exceed the threshold value.
low limit mon.: The measured value must fall below the threshold value.

NOTE

If temperature limit monitoring is not required, a threshold value, which is higher than the expected temperature must be configured to the corresponding parameter (e.g. the ambient temperature is 100 °C).

Pt1000 Input (Analog Input [T1] to [T4])

Pt1000 inputs may be measured here. The analog input is displayed with its description. Two threshold limits can be monitored. The first level initiates a class F1 alarm, the second level initiates a class F3 alarm.

Parameter 210

```
Temperature x
Pt1000       ON
```

[x = 1 to 4]

Pt1000 input; enable/disable **ON/OFF**

ON..... The value of this input appears in the display, and monitoring is enabled. The subsequent parameters of this function are displayed.
OFF..... No display or monitoring is performed, and the subsequent parameters of this function are not displayed.

Parameter 211

```
***name****
-----------000°C
```

Pt1000 input; description **User defined text**

The description of the analog input may be programmed using this parameter. A maximum of eleven characters may be used to describe the measured value. In the event of an alarm, the description and the monitored value are displayed with an exclamation mark before the temperature.

Parameter 212

```
limit
warning    000°C
```

Pt1000 input; limit value for class F1 alarm **0 to 145 °C / 0 to 293 °F**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 209) for at least the delay time (Parameter 208), the following alarm class is initiated.

Issuing of class F1 alarm

Parameter 213

```
limit
shutdown   000°C
```

Pt1000 input; limit value for class F3 alarm **0 to 145 °C / 0 to 293 °F**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 209) for at least the delay time (Parameter 208), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 214

```
Delay
limit 1/2   000s
```

Pt1000 input; delay time for limit values of class F1 and F3 alarm **0 to 999 s**

In order to initiate an alarm, the measured value (Parameter 206 or Parameter 207) must be over or under the configured threshold value (dependent upon Parameter 209) without interruption for at least this time.

Parameter 215

```
Monitoring for
---------------
```

Pt1000 input; monitoring for ... **high limit mon. / low limit mon.**

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 206 or Parameter 207).
high limit mon.: The measured value must exceed the threshold value.
low limit mon.: The measured value must fall below the threshold value.

NOTE

If temperature limit monitoring is not required, a threshold value, which is higher than the expected temperature must be configured to the corresponding parameter (e.g. the ambient temperature is 100 °C).

PTC Input (Analog Input [T1] to [T4])

PTC inputs may be measured here. The analog input is displayed with its description. Two threshold limits can be monitored. The first level initiates a class F1 alarm, the second level initiates a class F3 alarm.

Parameter 216

```
Analog input x
PTC          ON
```

[x = 1 to 4]

PTC input; enable/disable **ON/OFF**

ON .....The value of this input appears in the display, and monitoring is enabled. The subsequent parameters of this function are displayed.
OFF .....No display or monitoring is performed, and the subsequent parameters of this function are not displayed.

Parameter 217

```
Name and unit
---------------
```

PTC; description **User defined text**

The description of the analog input may be programmed using this parameter. A maximum of four zeros may be used as placeholders for the numerical measured values. Characters may divide the placeholders (i.e. a comma). The measured values subsequently appear wherever the zeros are placed. The measured values subsequently appear wherever the zeros are placed.

Parameter 218

```
limit warning
value      000°C
```

PTC input; limit value for class F1 alarm **0 to 100 %**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 209) for at least the delay time (Parameter 208), the following alarm class is initiated.

Issuing of class F1 alarm

Parameter 219

```
limit shutdown
value      000°C
```

PTC input; limit value for class F3 alarm **0 to 100 %**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 209) for at least the delay time (Parameter 208), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 220

```
Delay
limit 1/2   000s
```

PTC input; delay time for limit values of class F1 and F3 alarm **0 to 999 s**

In order to initiate an alarm, the measured value (Parameter 206 or Parameter 207) must be over or under the configured threshold value (dependent upon Parameter 209) without interruption for at least this time.

Parameter 221

```
Monitoring for
---------------
```

PTC input; monitoring for ... **high limit mon. / low limit mon.**

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 206 or Parameter 207).
high limit mon.: The measured value must exceed the threshold value.
low limit mon.: The measured value must fall below the threshold value.

VDO Input 'Temperature' (Analog Input [T1 to T4])

VDO inputs may be measured here (the input has been calibrated to the VDO sender 323.805/001/001 (0 to 380 ohm, 40 to 120 °C). The analog input is displayed with its description. Two threshold levels can be monitored. The first level initiates a class F1 alarm, the second level initiates a class F3 alarm.

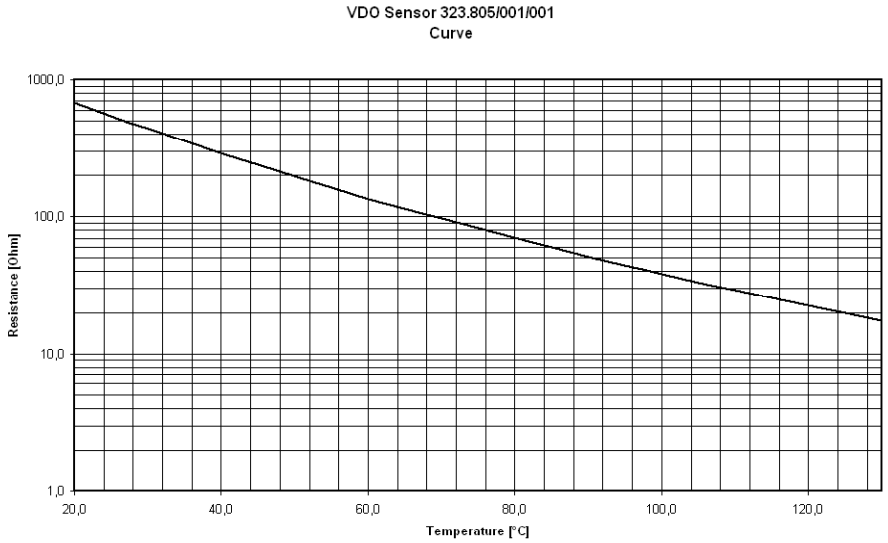


Figure 9-6: VDO transmitter 323.805/001/001 (slope)

Parameter 222

```
Analog input x
VDO          ON
```

[x = 1 to 4]

VDO input, temperature; enable/disable **ON/OFF**

ON..... The value of this input appears in the display, and monitoring is enabled. The subsequent parameters of this function are displayed.
OFF..... No display or monitoring is performed, and the subsequent parameters of this function are not displayed.

Parameter 223

```
Name and unit
---------------
```

VDO input, temperature; description **User defined text**

The description of the analog input may be programmed using this parameter. A maximum of four zeros may be used as placeholders for the numerical measured values. Characters may divide the placeholders (i.e. a comma). The measured values subsequently appear wherever the zeros are placed. The measured values subsequently appear wherever the zeros are placed.

Parameter 224

```
limit
warning    000°C
```

VDO input, temperature; limit value for class F1 alarm **40 to 120°C / 40 to 248°F**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 227) for at least the delay time (Parameter 226), the following alarm class is issued.

Issuing of class F1 alarm

Parameter 225

```
limit
shutdown   000°C
```

VDO input, temperature; limit value for class F3 alarm **40 to 120°C / 40 to 248°F**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 227) for at least the delay time (Parameter 226), the following alarm class is issued.

Issuing of class F3 alarm

Parameter 226

```
Delay
limit 1/2   000s
```

VDO input, temperature; delay for limit values of class F1 and F3 alarm 0 to 999 s

In order to initiate an alarm, the measured value must be over or under (dependent upon Parameter 227) the threshold value (Parameter 224 or Parameter 225) without interruption for at least this time.

Parameter 227

```
Monitoring for
---------------
```

VDO input, temperature; monitoring for ... high limit mon. / low limit mon.

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 224 or Parameter 225).
high limit mon.: The measured value must exceed threshold value.
low limit mon.: The measured value must fall below the threshold value.

VDO Input 'Pressure' (Analog Input [T1 to T4])

VDO inputs for pressure may be measured here. The analog input is displayed with its description. Two threshold levels can be monitored. The first level initiates a class F1 alarm, the second level initiates a class F3 alarm.

Parameter 228

```
Analog input x
VDO          ON
```

[x = 1 to 4]

VDO input, pressure; enable/disable ON/OFF

ON .....The value of this input appears in the display, and monitoring is enabled. The subsequent parameters of this function are displayed.
OFF .....No display or monitoring is performed, and the subsequent parameters of this function are not displayed.

Parameter 229

```
Name and unit
---------------
```

VDO input, pressure; description User defined text

The description of the analog input may be programmed using this parameter. A maximum of four zeros may be used as placeholders for the numerical measured values. Characters may divide the placeholders (i.e. a comma). The measured values subsequently appear wherever the zeros are placed. The measured value will always be displayed and transmitted via the interface in bar [× 0.1] or psi [× 0.1].

Parameter 230

```
Pressure in
            bar
```

optional

VDO input, pressure; unit selection bar/psi

The unit of measurement for the analog input may be changed from "bar" to "psi". The conversion factor is as follows: 1 psi = 14.5 bar.
bar .....The measuring values are monitored and indicated in bar.
psi .....The measuring values are monitored and indicated in psi.

Measurement Unit [bar] (optional)

Parameter 231

```
Analog input x
VDO      0-00bar
```

[x = 1 to 4]

VDO input, pressure; measuring range 0 to 5 / 0 to 10 bar

The measuring range of the analog input can be selected.
0 to **5 bar** .....Measuring range 0 to 180 Ohm
0 to **10 bar** ....Measuring range 0 to 180 Ohm

Parameter 232

```
Limit warning
value    00.0bar
```

VDO input, pressure; limit value for class F1 alarm 0.0 to 10.0 bar

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 238) for at least the delay time (Parameter 237), the following alarm class is initiated.

Issuing of class F1 alarm

Parameter 233

```
Limit shutdown
value    00.0bar
```

VDO input, pressure; limit value for class F3 alarm **0.0 to 10.0 bar**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 238) for at least the delay time (Parameter 237), the following alarm class is initiated.

Issuing of class F3 alarm

Measurement Unit [psi]

Parameter 234

```
Analog input x
VDO     0-000psi
```

[x = 1 to 4]

VDO input, pressure; measuring range **0 to 73 / 0 to 145 psi**

The measuring range of the analog input can be selected.
0 to **73 psi**..... Measuring range 0 to 180 Ohm
0 to **145 psi**... Measuring range 0 to 180 Ohm

Parameter 235

```
Limit warning
value   000.0psi
```

VDO input, pressure; limit value for class F1 alarm **0 to 73 / 0 to 145 psi**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 238) for at least the delay time (Parameter 237), the following alarm class is initiated.

Issuing of class F1 alarm

Parameter 236

```
Limit shutdown
value   000.0psi
```

VDO input, pressure; limit value for class F3 alarm **0 to 73 / 0 to 145 psi**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 238) for at least the delay time (Parameter 237), the following alarm class is initiated.

Issuing of class F3 alarm

Measurement Unit [bar] and [psi]

Parameter 237

```
Delay
limit 1/2   000s
```

VDO input, pressure; delay time for limit values of class F1 and F3 alarm **0 to 999 s**

In order to initiate an alarm, the measured value must be over or under (dependent upon Parameter 238) the threshold value (Parameter 232 or Parameter 237) without interruption for at least this time.

Parameter 238

```
Monitoring for
---------------
```

VDO input, pressure; monitoring for ... **high limit mon. / low limit mon.**

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 232 or Parameter 237).
high limit mon.: The measured value must exceed threshold.
low limit mon.: The measured actual value must fall below the threshold value.

Scaleable analog input 0/4 to 20 mA (analog input [T1] to [T4])

0/4 to 20 mA sensors may be measured here. A description and an engineering unit may be assigned to the input. The analog input is displayed with its description. Two limit levels can be monitored. The first limit level initiates a class F1 alarm, the second limit level initiates a class F3 alarm.

Parameter 239

```
Analog input x
scalable      ON
```

[x = 3 to 4]

0/4 to 20 mA input; enable/disable **ON/OFF**

ON.....The value of this input appears in the display, and monitoring is enabled. The subsequent parameters of this function are displayed.
OFF.....No display or monitoring is performed, and the subsequent parameters of this function are not displayed.

Parameter 240

```
Name and unit
---------------
```

0/4 to 20 mA input; description **User defined text**

The description of the analog input may be programmed using this parameter. A maximum of four zeros may be used as placeholders for the numerical measuring values. Characters may divide the placeholders (i.e. a comma). The measured values subsequently appear wherever the zeros are placed.

Parameter 241

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

[x = 3 to 4]

0/4 to 20 mA input; measuring range **0 to 20 mA / 4 to 20mA**

The measuring range 0 to 20 mA or 4 to 20 mA is selected via this parameter. If 4 to 20 mA is configured and a current of less than 2 mA is measured, the controller assumes a wire break has occurred (see below).

Parameter 242

```
Value at
  0%          0000
```

0/4 to 20 mA input; smallest input value **-9,999 to 9,999**

The user must assign a numeric value to the scaleable analog input that corresponds to the smallest input value → Definition of the lower value (i.e. 0 %, 0 kW, 0 V) at the minimum analog input value of 0 mA or 4 mA.

Parameter 243

```
Value at
100%          0000
```

0/4 to 20 mA input; largest input value **-9,999 to 9,999**

The user must assign a numeric value to the scaleable analog input that corresponds to the largest input value → Definition of the upper value (i.e.100 %, 500 kW, 400 V) at the maximum analog input value of 20 mA.

Parameter 244

```
Limit warning
value       -0000
```

0/4 to 20 mA input; limit value for class F1 alarm **-9,999 to 9,999**

If the measured value exceeds or falls below this configured threshold value (selected by Parameter 247) for at least the delay time (Parameter 246), the following alarm class is initiated.

Issuing of class F1 alarm

Parameter 245

```
Limit shutdown
value       -0000
```

0/4 to 20 mA input; limit value for class F3 alarm **-9,999 to 9,999**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 247) for at least the delay time (Parameter 246), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 246

```
Delay
limit 1/2    000s
```

0/4 to 20 mA input; delay time for limit values of class F1 and F3 alarm **0 to 999 s**

In order to initiate an alarm, the measured value (Parameter 244 or Parameter 245) must be over or under the configured threshold value (selected by Parameter 247) without interruption for at least this time.

Parameter 247

```
Monitoring for
---------------
```

0/4 to 20 mA input; monitoring for ... **high limit mon. / low limit mon.**

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 244 or Parameter 245).
high limit mon.: The measured value must exceed the threshold value.
low limit mon.: The measured value must fall below the threshold value.

Monitoring of the Measuring Range (All Analog Inputs)

Parameter 248

```
Ana.input   --,-
```

Analog inputs; monitoring of the measuring range

This message appears when the measured value exceeds or falls below the measuring range occurs. A fault condition is initiated depending on the values specified below.

NOTE

If it is determined that the measuring range has been exceeded (wire break) and a fault condition has been initiated, limit value monitoring for the affected analog input is deactivated.

Fault conditions initiate when the measuring range is monitored at:

4 to 20 mA	**2 mA and below**
Pt100	**240 °C and above**
Pt1000	**150 °C and above**
PTC	**16 kΩ and above**
180 Ω VDO, 0 to 5 Bar	**193 Ω and above**
180 Ω VDO, 0 to 10 Bar	**193 Ω and above**
380 Ω VDO temperature	**400 Ω (no tripping in the event of a wire break)**

Engine Delayed Monitoring Of The Analog Inputs

Parameter 249

```
Ana input   1234
Superv.del. YYYY
```

Analog inputs; engine delayed monitoring **Y/N**

The analog inputs may be disabled until the engine has reached rated speed ("firing speed reached"). This parameter specifies which analog inputs are to be constantly enabled and temporarily disabled by configuring a "Y" or an "N" below the input number.

Y..... Once the firing speed has been reached monitoring of the analog input is enabled (the green LED "Protection" illuminates).

N..... The analog input is monitored always.

Output Configuration

Parameter 250

```
Configure
outputs      YES
```

Configuration of the outputs **YES/NO**

Parameters are grouped together in blocks to permit quicker navigation through the large number of configuration screens. Selecting "YES" or "NO" has no effect if controlling or monitoring is performed. This parameter has the following effects:

YES .....The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modified ("Cursor →", "Digit ↑" or "Select" push-buttons).

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

Analog Outputs (Option A2)

The analog output manager can be used to apply a specific measurement variable to the available analog outputs. The output may be carried out as a 0 to 20 mA or as a 4 to 20 mA value. A list of the possible functions is contained in Appendix A. Each variable is assigned a unique number. The variable may be scaled via an upper and a lower input value. The inputs may also be assigned with prefixes (for further details, see "Analog output manager" in Appendix A).

NOTE

The list of values and limits for the analog output manager is contained in Appendix A: "Analog Output Manager" starting on page 155.

Possible outputs: Analog outputs terminals 120/121 and 122/123
Example: Analog output terminals 120/121

Parameter 251

```
Analg.out.120121
Parameter    00
```

Function for analog output **0 to 22**

The number of the desired function is configured here. A list of all selectable functions, together with output and limit value ranges, is contained in Appendix A.

Parameter 252

```
Analg.out.120121
          0-00mA
```

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

The output range 0 to 20 mA or 4 to 20 mA is selected using this parameter.

Parameter 253

```
Analg.out.120121
  0%         0000
```

Scaling the lower output value **0 to 9,990**

The configurable limit for the 0% value is contained in Appendix A.

Parameter 254

```
Analg.out.120121
100%         0000
```

Scaling the upper output value **0 to 9,990**

The configurable limit for the 100% value is contained in Appendix A.

Relay Manager

The relay manager enables the assignment of an arbitrary combination of functions to each relay of the terminals 33 to 36, 37, 38 and 47 to 48. In order to achieve this, each function of the control has its own number. A text, which describes a logical condition that energizes the relay, must now be entered in the configuration menu for each relay. Up to three function numbers may be combined in this link. The length of the text must not exceed 11 characters. The control can detect incorrect function numbers or formula constructions and will not accept these.

NOTE

The relay manager functions are listed in Appendix B: "Relay Manager" starting on page 158.

Permissible text/symbols for logic functions and their meaning include:

+..... OR operator (logic function)
*..... AND operator (logic function)
- ..... NOT operator (logic function)
1, 2, 3, ... Function numbers
+/* ..... the following applies "*" before "+"

Example of logical conditions and relevant texts

Function Relay picks up, if ...	**Programmed text**
... function 22 is applied.	22
... function 22 is not applied.	- 22
... both function 2 and function 27 are applied.	2 * 27
... function 2 or function 27 is applied.	2 + 27
... not function 5 or function 3 or function 13 are applied.	3 + -5 + 13
... function 4 or 7 or 11 is applied.	4 + 7 + 11
... not function 4 and not function 7 and not function 11 are applied.	- 4 * -7 * -11
... function 4 and 7 and 11 are applied.	4 * 7 * 11
... function 7 and 11 are simultaneously or function 4 is applied.	4 + 7 * 11
... not function 4 or not function 7 or not function 11 are applied.	-4 + -7 + -11

NOTE

Entering an illegal logical combination deletes the equation.

Parameter 255

```
Assignm.relay x
3+-8+13
```

[x = 1 to 4]

Programming relay outputs

The relay x [x = 1 to 4] energizes, if the logical equation is met.
Example: **3 + -8 + 13** (OR link)

3 a class F3 alarm has occurred
-8 operation mode MANUAL has not been selected
13 "Generator underfrequency" alarm is present

Engine Configuration

Parameter 256

```
Configure
engine        YES
```

Configuration of the engine **YES/NO**

Parameters are grouped together in blocks to permit quicker navigation through the large number of configuration screens. Selecting "YES" or "NO" has no effect if controlling or monitoring is performed. This parameter has the following effects:

YES .....The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modified ("Cursor →", "Digit ↑" or "Select" push-buttons).

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

Parameter 257

```
Aux. services
prerun       000s
```

Engine; auxiliary prerun (start preparation) **0 to 999 s**

Prior to each starting sequence, a relay output (relay manager function 52) can be enabled for this time (i.e. prelube pumps run). A message is displayed when the relay output is enabled. This relay output is automatically enabled in MANUAL operation mode. The relay output is present until the operation mode is changed.

CAUTION

This delay is ignored in the event of emergency power operation. The engine is started immediately.

Parameter 258

```
Aux. services
postrun      000s
```

Engine; auxiliary postrun **0 to 999 s**

The relay output (relay manager function 52) can be enabled for this time following each engine cool down (i.e. operate a coolant pump). If the operation mode is changed from MANUAL to STOP or to AUTOMATIC without an engine start request, the relay remains enabled for this postrun time and a message is displayed.

Parameter 259

```
Start-stop-logic
for ----------
```

Engine; start/stop sequence for ... **DIESEL/GAS**

DIESEL .....Start/stop logic is performed for a diesel engine.

GAS.....Start/stop logic is performed for a gas engine.

Start/Stop Sequence 'Gas Engine'

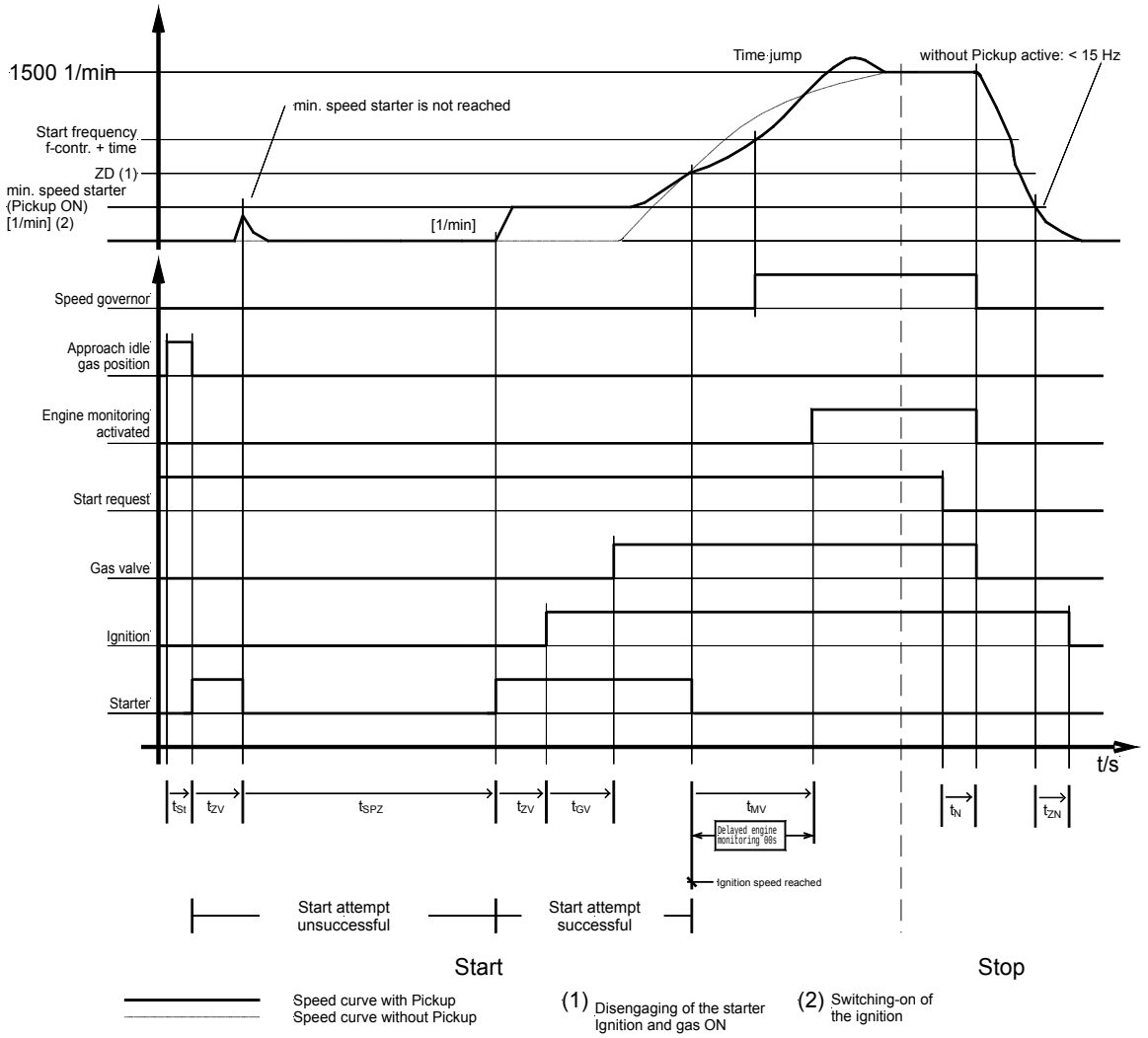


Figure 9-7: Start-Stop sequence: Gas engine

The signs and indices mean:
t_{Sta} ..... Approach idle gas position [s]
t_{ZV} ..... Firing delay [s]
t_{GV} ..... Gas delay [s]
t_{SPZ} ..... Time between two start attempts [s]
t_{MV} ..... Delayed engine monitoring [s]
t_{ZN} ..... Ignition coasting [s]; pre-specified: 5 s
t_{N} ..... Engine cool down time [s]
(1)..... Disengagement of the starter; Ignition and gas also ON
(2)..... Switching ON the ignition

Starting Sequence

If the control is equipped with a three-position frequency controller, a continuous signal (time adjustable via Parameter 266) is output prior to starting the engine at the "Frequency lower" relay output. The starter is then enabled. Following the expiration of the ignition delay time (Parameter 261) and if the engine is rotating with at least the configured "minimum speed for ignit." (Parameter 260), the ignition is enabled. Following the expiration of the gas valve delay (Parameter 262), the gas valve is then enabled. If the starting sequence finishes successfully (the firing speed (Parameter 275) was exceeded) the starter is disengaged. The gas valve and the ignition remain enabled by means of the firing speed. After reaching the "f-controller: starting frequency" (Parameter 33) and the delayed engine monitoring has expired (Parameter 274), the speed controller is enabled.

Stopping Sequence

When the start request is terminated, a power reduction is performed (if the real power controller is enabled, Parameter 61). After the GCB has opened, an engine cool down is performed (Parameter 273). When the engine cool down period expires, the gas valve is closed, and the engine is stopped. If the engine speed falls below the firing speed (Parameter 275), an engine starting sequence is disabled for 10 seconds. If the engine cannot be stopped, an alarm message is issued after 30 s, and a class F3 alarm is initiated.

Following negative deviation from the firing speed, the ignition remains enabled for an additional 5 seconds so that the remaining gas is able to combust.

Safety Instructions To Control Gas Valves

In order to ensure a safe shutdown of the gas valves, a separate shutdown circuit must be utilized.
To prevent gas from escaping through the gas line due to stuck relays the following is recommended.

Parameters

Parameter 260

```
min. speed for
        000 rpm
```

This screen is only visible if the parameter "Pickup" is set "ON".

Gas engine; minimum start speed **0 to 999 rpm**

ⓘ The minimum starter speed can only be detected using an enabled magnetic pick-up (Parameter 280).

Once the ignition delay (Parameter 261) has expired, the engine must exceed the speed configured with this parameter in order to enable the ignition relay (relay manager function 84).

Parameter 261

```
Ignition delay
            00s
```

Gas engine; ignition delay **0 to 99 s**

In gas engine applications a purging operation is frequently desired prior to starting. The ignition delay is initiated when the starter is engaged. If this time has expired and the "Minimum speed for ignition" (Parameter 260) has been exceeded, the ignition is enabled.

Parameter 262

```
Gasvalve delay
            00s
```

Gas engine; gas valve delay **0 to 99 s**

This timer is initiated once the ignition is enabled. Once this timer has expired and the engine speed is at least 150 rpm, the gas valve is opened. Upon reaching the firing speed (Parameter 275) the relay remains energized until the engine stops.

Parameter 263

```
Starter time
            00s
```

Gas engine; engagement time of the starter **2 to 99 s**

The maximum amount of time the starter will crank the engine during a start sequence.

Parameter 264

```
Start pause time
            00s
```

Gas engine; time between two start attempts **1 to 99 s**

The delay time between the individual start attempts.

Parameter 265

```
freq. low before
start          ON
```

with three-step controllers only

Gas engine; approach low-idle position **ON/OFF**

If this function is enabled and the control is equipped with a three-step frequency controller, the command "lower engine speed" is issued for the time configured in Parameter 266 before the starter is engaged. The low-idle position must either be equipped with a limiting switch or the engine potentiometer must be equipped with a slipping clutch to protect the devices. A message is displayed.

CAUTION

The engine starting is delay by means of the low-idle position in the event of emergency power operation.

Parameter 266

```
action time for
freq. low   000s
```

with three-step controllers only

Gas engine; approach low-idle position (time) **0 to 999 s**

The duration that the "lower engine speed" signal (Parameter 265) is output.

Start/Stop Sequence 'Diesel Engine'

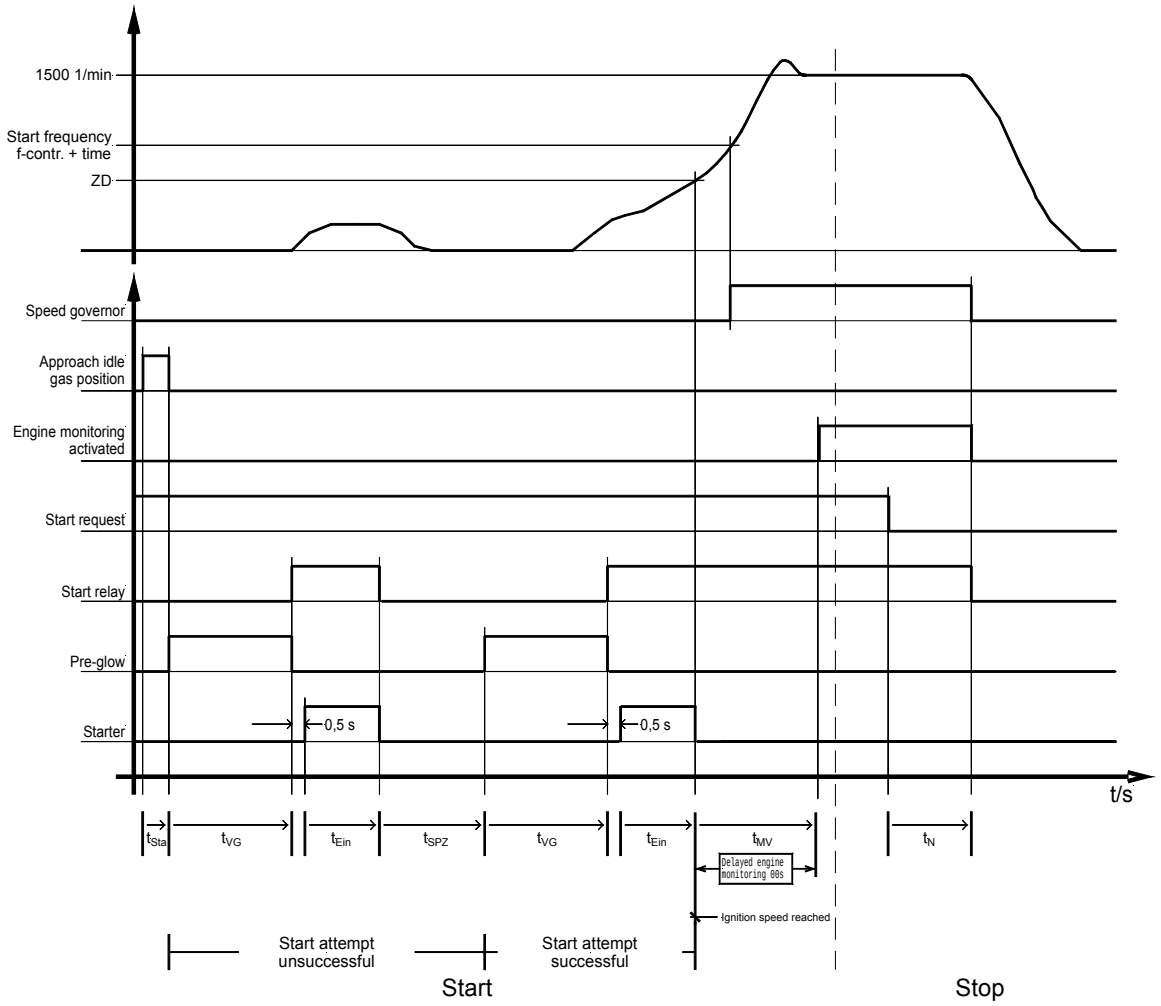


Figure 9-8: Start-stop sequence: Diesel engine

The signs and indices mean:
t_{Sta} ..... Approach idle fuel position [s]
t_{VG} ..... Preglow time [s]
t_{Ein} ..... Crank time [s]
t_{SPZ} ..... Time between two start attempts [s]
t_{MV} ..... Delayed engine monitoring [s]
t_N ..... Engine cool down time [s]

Starting Sequence

If the control is equipped with a three-position frequency controller, a continuous signal (time adjustable via Parameter 271) is output prior to starting the engine at the "Frequency lower" relay output. Following the expiration of this time, the "Pre-glow" relay will be enabled (pre-glow time is configurable via Parameter 267). Following preheating, the fuel relay is enabled (Parameter 272), followed by the crank relay. Once the firing speed (Parameter 275) has been exceeded, the starter disengages, and the fuel relay remains enabled by means of the firing speed. After reaching the "f-controller: starting frequency" (Parameter 33) and the delayed engine monitoring has expired (Parameter 274), the speed controller is enabled.

Stopping Sequence

When the start request is terminated, a power reduction is performed (if the real power controller is enabled, Parameter 61). Once the GCB has opened, an engine cool down is performed (Parameter 273). When the engine cool down period expires, the fuel relay is de-energized and the engine is stopped. If the engine speed falls below the firing speed (Parameter 275), the engine starting sequence is disabled for 10 seconds. If the engine cannot be stopped, an alarm message is issued after 30 s, and a class F3 alarm is initiated.

Parameter

Parameter 267

```
Preglow time
             00s
```

Diesel engine; pre-glow time **0 to 99 s**

Prior to each starting sequence, the engine glow plugs are enabled for this time period.

Parameter 268

```
Starter time
             00s
```

Diesel engine; crank time **2 to 99 s**

The maximum amount of time the starter will crank the engine during a start sequence.

Parameter 269

```
Start pause time
             00s
```

Diesel engine; time between two start attempts **1 to 99 s**

The delay time between the individual start attempts.

Parameter 270

```
freq. low before
start        OFF
```

with three-step controllers only

Diesel engine; approach low-idle position **ON/OFF**

If this function is enabled and the control is equipped with a three-step frequency controller, the command "lower engine speed" is issued for the time configured in Parameter 271 before the starter is engaged. The low-idle position must either be equipped with a limiting switch, or the engine potentiometer must be equipped with a slipping clutch to protect the devices. A message is displayed.

CAUTION

The engine starting is delay by means of the low-idle position in the event of emergency power operation.

Parameter 271

```
action time for
freq. low   000s
```

with three- step controllers only

Diesel engine; approach low-idle position (time) **0 to 999 s**

The duration that the "lower engine speed" signal (see Parameter 270) is output.

Parameter 272

```
Start-Stop-Logic
----------------
```

Diesel engine; fuel solenoid logic **open to stop / close to stop**

open to stop. The fuel solenoid is energized prior to each start sequence. In order to shutdown the engine, the fuel solenoid is de-energized.

close to stop. In order to shutdown the engine, the fuel solenoid is energized. The fuel solenoid remains energized for an additional 10 seconds once the engine speed drops below firing speed (Parameter 275) **and** the generator voltage is less than 20 V.

Cool Down

Parameter 273

```
Cooldown time
          000s
```

Engine; cool down time **0 to 999 s**

If the engine performs a normal shutdown (i.e. STOP mode initiated) or stoppage by means of a class F2 alarm has been initiated, an engine cool down period with an open GCB and frequency control is performed for this time. If the engine cool down has terminated (cool down time has been expired) and engine speed (Parameter 275) is still detected after 30 seconds, an engine failure to stop message is displayed.

Note
An engine cool down is performed only if the reply of a closed GCB (terminal 4) has been enabled for at least 5 seconds.

Delayed Engine Monitoring and Firing Speed

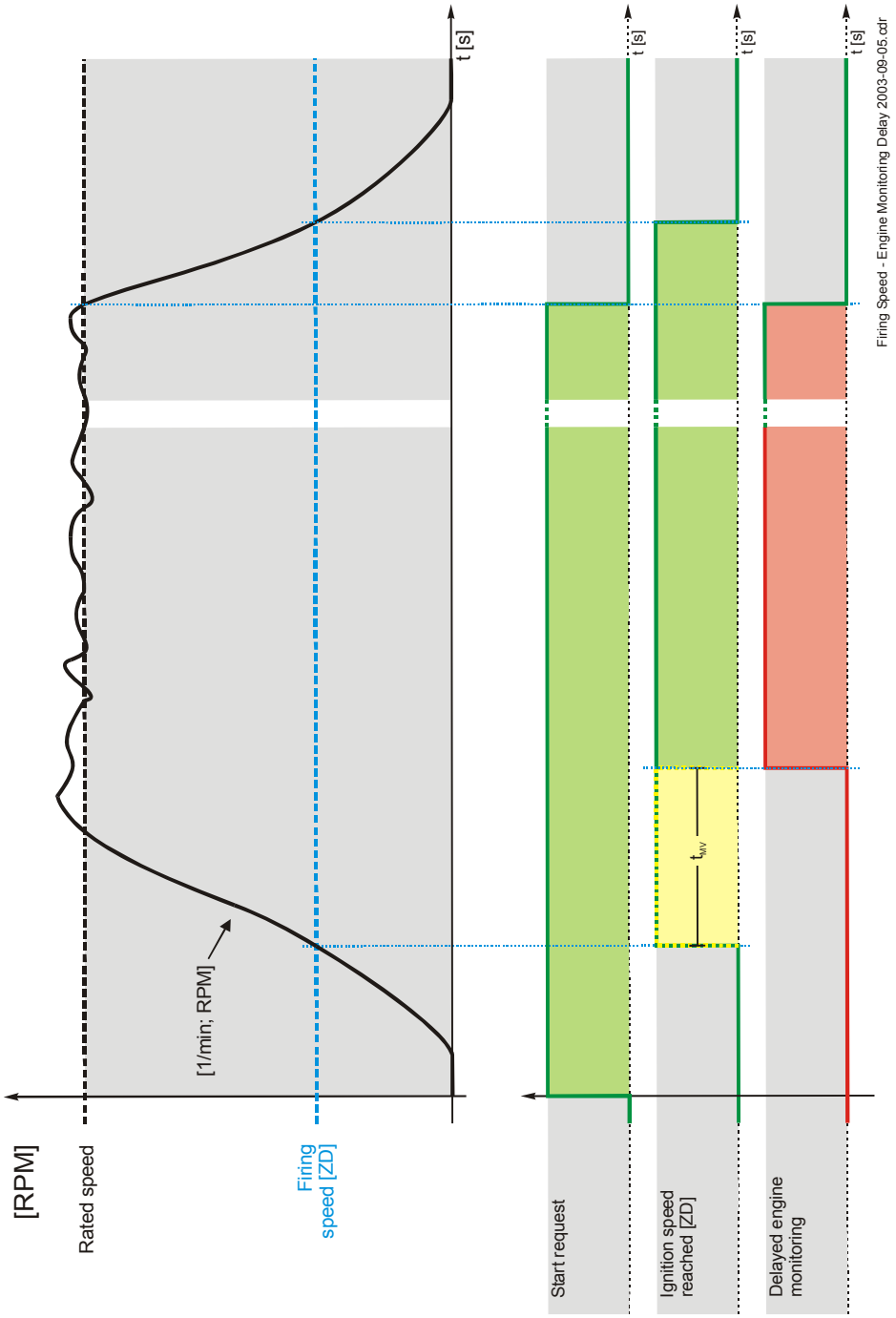


Figure 9-9: Delayed engine monitoring

Parameter 274

```
Delayed engine
monitoring   00s
```

Engine; delayed engine monitoring **1 to 99 s**

Delay between reaching the firing speed and monitoring of selected alarms (e.g. oil pressure, generator underfrequency, etc.).

Parameter 275

```
Firing speed
reached  f >00Hz
```

Engine; firing speed reached **15 to 70 Hz**

Setting of the firing speed: Once this firing speed has been reached, the starter is disengaged (switched off) and the frequency controller starts governing.

Pick-Up (MPU)

Measuring the engine speed can be performed alternatively by means of a Magnetic Pickup, the generator frequency, or a tacho generator. Refer to the wiring diagram that pertains to your specific controller under Wiring Diagrams.

Parameter 276

```
Pickup input
            ON
```

Pickup; Pickup measurement **ON/OFF**

ON .....Engine speed monitoring is performed by means of a Magnetic Pickup. Once firing speed has been achieved, the starter disengagement is initiated by the MPU measurements.

OFF .....Frequency monitoring/control is performed by means of the generator frequency measurement. Once firing speed has been achieved, the starter disengagement is initiated by the generator frequency measurements.

Parameter 277

```
nominal speed
Gen. 1/min  0000
```

Pickup; rated speed at rated frequency **0 to 4,000 rpm**

Number of revolutions per minute at rated frequency speed.

Parameter 278

```
Number of pickup
teeth       000
```

Pickup; number of Pickup teeth **30 to 280**

Number of pulses per revolution.

Plausibility monitoring:
Plausibility monitoring is the comparison of the measured electrical frequency (determined from the generator voltage) and mechanical speed (determined from the Pickup signal). If the two frequencies are not identical, a class F1 alarm is initiated. The plausibility monitoring is enabled by the expiration of delayed engine monitoring (Parameter 274) and performed continuously while the generator is operating.

Counter Configuration

Parameter 279

```
Configure
counters      YES
```

Configuration of the counters **YES/NO**

Parameters are grouped together in blocks to permit quicker navigation through the large number of configuration screens. Selecting "YES" or "NO" has no effect if controlling or monitoring is performed. This parameter has the following effects:

YES..... The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modified ("Cursor →", "Digit ↑" or "Select" push-buttons).

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

Maintenance Call

Parameter 280

```
Service interval
in          0000h
```

Counter; maintenance call **0 to 99,999 h**

A maintenance interval can be specified with this parameter. After the engine has been in operation for the number of hours configured here, a maintenance message (class F1 alarm) is displayed. Following the acknowledgement of the message, the counter is reset to this value.

Note
Entering "0" will disable the maintenance call.

NOTE

In order to reset the maintenance call prior to the configured time (maintenance call alarm not yet initiated), perform the following procedure:

- Press and hold the "Clear" button for at least 5 seconds.

Operating Hours Counter

Parameter 281

```
Set oper.hours
counter    00000h
```

Counter; operating hours counter **0 to 65,000 h**

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

NOTE

If a value is to be input in this parameter other than the factory default, the controller must be in code level CS2. For safety reasons, the counter is set in a 2-step sequence.

The following sequence applies:

1. Step: Set and store the desired operating hours

2. Step: Integrate the value which has been saved by ...
-- Terminate the configuration mode and switch to automatic mode
-- Display of the operating hours
-- Press and hold the "Digit" push-button for at least 5 seconds.

Start Counter

Parameter 282

```
Start counter
set        00000
```

Counter; number of engine starts **0 to 32,749**

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

Only maintenance personnel should configure the start counter!

NOTE

If the engine start counter is to be changed from the factory default setting, the controller must be in code level CS2. For safety reasons, the counter is set in a 2-step sequence.

The following sequence applies:

1. Step: **Set and store the desired number of starts**

2. Step: **Integrate the value which has been saved by ...**
-- Terminate the configuration mode and switch to automatic mode
-- Display the number of engine starts
-- Press and hold the "Digit" push-button for at least 5 seconds

kWh Counter

The kWh-counter sums up the delivered electrical power of the generator, with the greatest possible reading being 999,999 GWh. Afterwards, the kWh-counter must be reset to 0 kWh. The kWh-counter cannot be precharged to a certain value, but can only be reset. The reset is performed as follows:

- Visualize the kWh/MWh counter
- Press the "Digit" button for at least 5 seconds

Current Slave Pointer

A current slave pointer, which records and stores the maximum generator current, is implemented in the control. The display of the maximum generator current can be selected by pressing the "Message" push-button. The following screen appears in the display:

Parameter 283

```
000 000 000 000
max. Gen.current
```

Current slave pointer; display of the maximum generator current

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

Chapter 10.
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:

LIFE THREATENING

CAUTION

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

CAUTION

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

CAUTION

Please consider that units with a software older than V1.0700 do not have an internal rotating field monitoring.

Units below V1.0700 assume always a clockwise phase rotation direction of all three voltage systems, which are measured.

A rotating field monitoring must be provided by the customer in order to avoid a CB closure with a counter-clockwise rotating field.

Commissioning Procedure:

1. After wiring the unit and ensuring all voltage-measuring devices are phased correctly, apply the control system voltage (i.e. 12/24 Vdc). The "Operation" LED will illuminate.

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

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

4. The initial start of the engine should be performed in the **MANUAL operation mode** (press the "MANUAL" push-button). Start the engine ("START" push-button) and then stop it ("STOP" push-button). All generator measured values must be checked. Any alarm messages should be investigated as well.

5. Check the automatic start sequence by means of the **TEST operation mode** (press the "TEST" push-button). Test the protections that result in alarms with shutdowns.

6. **"AUTO" o**peration mode (press the "AUTO" push-button): Applying the automatic control inputs and the engine start request can now carry out automatic starting with subsequent synchronization.

   Check synchronization: Check the generator and the generator busbar rotating fields. Check the connect command with a zero voltmeter (determination of the phase angle) at the generator power circuit breaker (GCB). If several correct synchronizing pulses have been output, switch the operation mode to "STOP" and reconnect the connect pulse "Command: close GCB" with the engine in "STOP" mode.

7. If steps 1 through 6 have been carried out successfully, parallel operations may be commenced. It is recommended to start with a constant power/baseload operation (approx. 25 % of the generator rated power) initially. While this operation is being carried out, the displayed measured values must be verified. Test the GCB shutdown. Check the real power controller and if necessary the power factor controller for proper operation. Enter various set point values and verify proper operation.

8. If the mains parallel operation performs in a satisfactory manner, the synchronization of the mains power circuit breaker (MCB) must be checked:

   A power failure in the system must be simulated or observed by the controller. During a mains parallel operation, change the operation mode from AUTOMATIC to MANUAL. Open the MCB ("MCB ON" LED will turn off). Press the AUTOMATIC push-button to return the controller back to the AUTOMATIC operation mode.

   Check the generator busbar and the mains rotating field. Check the connect command with a zero voltmeter (determination of the phase angle) at the MCB. If several correct synchronizing pulses have been output, switch the operation mode to "STOP" and re-connect the connect pulse "Command: close MCB" with the engine in "STOP" mode.

9. Test the emergency power operation functions

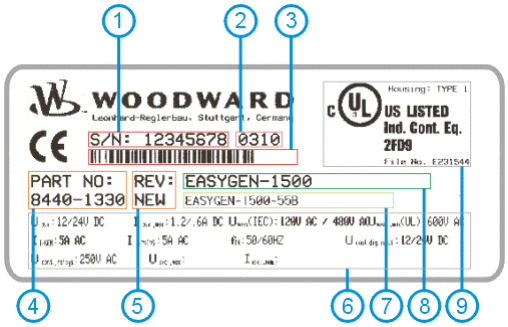
NOTE

The automatic operation mode is influenced by the input signals "Automatic 1" and "Automatic 2". Ensure that the power circuit breaker reply messages are processed as the reverse of the condition (i.e. when the circuit breaker is closed the reply message for the inputs: CB is open (terminal 54) is 0 volts. The CB aux contacts should be configured as normally closed! Refer to the description of the auxiliary and control inputs starting on page 124. It is vital that these replies be connected!

Electrical isolation between voltage supply and discrete control and feedback inputs: By the use of corresponding external wiring, the common reference point of the discrete inputs can be electrically isolated from the supply voltage (0 V, terminal 2). This is necessary if the discrete inputs are not to be triggered with 24 Vdc and electrical isolation of the control voltage (e. g. 220 Vdc, 220 Vac) from the supply voltage must be insured.

Appendix A.
Technical Data

Name plate



(Example of a typical name plate)

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

Measuring values, voltages ---------- ⅄/Δ

- Measuring voltages

[1] 120 Vac
Rated value (V_{rated}) ..... 69/120 Vac
Maximum value (UL max) ..... max. 150 Vac

[4] 400 Vac
Rated value (V_{rated}) ..... 231/400 Vac
Maximum value (UL max) ..... max. 300 Vac

- Setting range (prim) ..... 0.050 to 65.000 kVac
- Setting range (sec)
  [1] ..... ⅄ 50 to 125 Vac ..... Δ 50 to 114 Vac
  [4] ..... ⅄ 50 to 480 Vac ..... Δ 50 to 380 Vac
- Measuring frequency ..... 50/60 Hz (40.0 to 70.0 Hz)
- Accuracy ..... Class 1
- Input resistance per path
  [1] 0.21 MΩ
  [4] 0.7 MΩ
- Maximum power consumption per path ..... < 0.15 W

Measuring values, currents ---------- galvanically isolated

- Measuring current
  [../1] Rated value (I_{rated}) ..../1 A
  [../5] Rated value (I_{rated}) ..../5 A
- Accuracy ..... Class 1
- Linear measuring range
  Generator (terminals x/x) ..... 3.0 × I_{rated}
  Mains/ground current (terminals x/x) ..... 1.5 × I_{rated}
- Maximum power consumption per path ..... < 0.15 VA
- Rated short-time current (1 s)
  [..1/ A] ..... 50.0 × I_{rated}
  [../5 A] ..... 10.0 × I_{rated}

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

- Power supply ..... 12/24 Vdc (9.5 to 32.0 Vdc)
- Intrinsic consumption ..... max. 20 W
- Ambient temperature
  Storage ..... -30 to 80 °C / -22 to 176 °F
  Operation ..... -20 to 70 °C / -4 to 158 °F
- Ambient humidity ..... 95 %, non condensing

Discrete inputs ---------- galvanically isolated
- Input range ($V_{Cont, digital input}$) ..... Rated voltage 12/24 Vdc (4 to 40 Vdc)
- Input resistance ..... approx. 6.8 kΩ

Relay outputs ---------- potential free
- Contact material ..... AgCdO
- General purpose (GP) ($V_{Cont, relay output}$)
  AC ..... 2.00 Aac@250 Vac
  DC ..... 2.00 Adc@24 Vdc
  0.36 Adc@125 Vdc
  0.18 Adc@250 Vdc
- Pilot duty (PD) ($V_{Cont, relay output}$)
  AC B300
  DC ..... 1.00 Adc@24 Vdc
  0.22 Adc@125 Vdc
  0.10 Adc@250 Vdc

Analog inputs ---------- freely scaleable
- Resolution ..... 10 Bit
- 0/4 to 20 mA input ..... Difference measurement, load 150 Ω
- 0 to 5/10 Vdc input ..... Difference measurement, input resistance approx. 16.5 kΩ
- Pt100/Pt1000 input ..... for measuring resistances according to IEC 751
  [Pt100] ..... 2/3-conductor measurement, 0 to 200 °C
  [Pt1000] ..... 2-conductor measurement, -30 to 200 °C
- 0 to 180/380 Ω input ..... difference measurement, sensor current ≤1.9 mA

Analog outputs ---------- galvanically isolated
- at rated output ..... freely scalable,
- Isolation voltage ..... 3,000 Vdc
- Versions ..... 0 to 5 Vdc, +/-5 Vdc, 0 to 10 Vdc, 0 to 20 mA
- Resolution PWM ..... 8/12 Bit (depending on model)
- 0/4 to 20 mA output ..... maximum load 500 Ω
- 0 to 10 V / +/-5 V output ..... internal resistance ≤1 kΩ

Pickup input ---------- capacitive decoupled
- Input impedance ..... min. approx. 17 kΩ
- Input voltage ..... 875 mV eff

Interface ----------

Service interface

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

Level conversion and isolation by using DPC (P/N 5417-557)

CAN bus interface .....**isolated**

- Isolation voltage .....1,500 Vdc
- Version .....CAN bus
- Internal line termination ..... Not available

Housing ----------

- Type.....APRANORM DIN 43 700
- Dimensions (W × H × D) .....144 × 96 × 118 mm
- Front cutout (W × H)..... 138 [+1.0] × 92 [+0.8] mm
- Wiring.....screw-plug-terminals 1.5 mm² or 2.5 mm²
- Recommended locked torque .....0.5 Nm

use 60/75 °C copper wire only
use class 1 wire only or equivalent

- Weight ..... approx. 1,000 g

Protection----------

- Protection system.....IP42 from front for proper installation

IP54 from front with gasket (gasket: P/N 8923-1043)
IP21 from back

- Front folio..... insulating surface
- EMC test (CE) ..... tested according to applicable EN guidelines
- Listings ..... CE marking; UL listing for ordinary locations
- Type approval..... UL/cUL listed, Ordinary Locations, File No.: 231544

Appendix B. Common

Conversion Factors

Conversion Factors: Temperature

°C ⇨ °F	°F ⇨ °C
$1\ °F = \left([\text{Value}\ °C \times 1.8\ °F/°C\right) + 32\ °F$	$1\ °C = \frac{\left([\text{Value}]\ °F - 32\ °F\right)}{1.8\ °F/°C}$

Conversion Factors: Pressure

bar ⇨ psi	psi ⇨ bar
$1\ \text{psi} = [\text{Value}]\ \text{bar} \times 14.501$	$1\ \text{bar} = \frac{[\text{Value}]\ \text{psi}}{14.501}$

Appendix C.
Analog Output Manager
(Option A2)

NOTE

The functions listed below can only be output correctly if the existing version of the control permits this.

Function	Output	Value	Input of the two limit values
0	The analog output is disabled.	N/A	N/A
1	Actual generator real power	[dimensionless]	0% Lower power limit (can also be negative) e.g. ¯0050 kW 100% Upper power limit (can also be negative) e.g. 0200 kW
2	Actual generator power factor φ [e.g. (-070 to +080) /100] (Definition at end of Table)	[dimensionless]	0% Lower interval to power factor φ=1 e.g. ¯0030 corresponds to c0.70 100% Upper interval to power factor φ=1 e.g. 0030 corresponds to i0.70
3	Actual generator frequency	[Hz*100]	0% Lower frequency e.g. 0000 corresponds to 00.00 Hz. 100% Upper frequency e.g. 7000 corresponds to 70.00 Hz.
4	Actual generator reactive power	[kvar]	0% capacitive reactive power (negative) e.g -0100 kvar 100% inductive reactive power (positive) e.g. +0100 kvar
5	Rated power of all generators connected to generator busbar minus nominal actual power	[kW]	0% Lower power (can also be negative) e.g.–0050 kW 100% Upper power (can also be negative) e.g. 0200 kW
6	Total actual power of all generators connected to generator busbar	[kW]	
7	Generator apparent current in L1	[A]	0% Lower current output e.g. 0000 A 100% Upper current output e.g. 500 A
8	Generator apparent current in L2	[A]	
9	Generator apparent current in L3	[A]	

Function	Output	Value	Input of the two limit values
10	Speed via Pickup	[min^{-1}]	0% Lower speed e.g. 0000 rpm 100% Upper speed e.g. 3000 rpm
11	Analog input [T1]	[°C] or [°F] or freely scaleable	0% Lower measured value e.g. 0000 corresponds to 000 °C at temperature input 100% Upper measuring value e.g. 0255 corresponds to 255 °C at temperature input 0% Lower measured value e.g. 0000 corresponds to 00.0 bar oil pressure 100% Upper measured value e.g. 0100 corresponds to 10.0 bar oil pressure
12	Analog input [T2]	[°C] or [°F] or freely scaleable	
13	Analog input [T3]	[°C] or [°F] or freely scaleable	
14	Analog input [T4]	[°C] or [°F] or freely scaleable	
15	--inactive--		
16	--inactive--		
17	--inactive--		
18	Additional freely scaleable analog input (terminals 91, 92)	[°C] or [°F] or freely scaleable	
19	Actual mains interchange (import/export) real power	[kW]	0% lower power e.g. -0800 kW 100% upper power e.g. 0800 kW
20	Mains apparent current in L1	[A]	0% Lower current output e.g. 0000 A 100% Upper current output e.g. 500 A
21	Mains power factor φ [e. g. (-070 to +080) /100] (Definition at end of Table)	[dimensionless]	0% Lower interval to power factor φ=1 e.g. -0030 corresponds to k0,70 100% Upper interval to power factor φ=1 e.g. 0030 corresponds to i0,70
22	Actual mains reactive power	[kvar]	0% capacitive reactive power (negative) e.g. -0100 kvar 100% inductive reactive power (positive) e.g. +0100 kvar

The designation 0 % stands for either 4 mA or 0 mA; the designation 100 % stands for 20 mA. The values may also be assigned with prefixes (see relay manager function 1).

Definition of power factor scaling: According to the scaling of the analog output, the power factor can be output within the range from capacitive values ranging from c0.00 via power factor φ = 1 to inductive values up to i0.00.

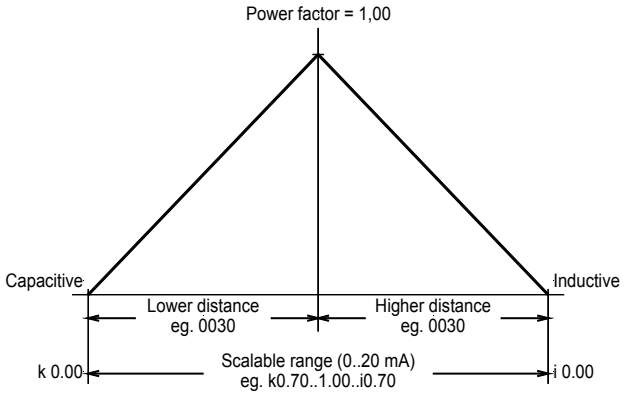


Figure 10-1: Analog outputs - power factor scaling

Appendix D.
Relay Manager

Parameter	Output # **special version**	Explanation
1	Alarm class 1	
2	Alarm class 2	
3	Alarm class 3	
4	Firing speed reached / (motor runs)	
5	Mains failure (alarm)	
6	Battery undervoltage	
7	Operating mode AUTOMATIC	
8	Operating mode MANUAL	
9	Operating mode TEST	
10	Operating mode STOP	
11	Generator undervoltage	
12	Generator overvoltage	
13	Generator underfrequency	
14	Generator overfrequency	
15	Generator overcurrent level 1 UMZ	
16	"Synchronization GCB" or "Connect GCB" time monitoring alarm.	
17	Unit false start	
18	Generator unbalanced load	
19	Generator overload	
20	Generator reverse power/reduced load	
21	Readiness for operation message	Output via relay manager
22	Analog input [T1], level 1	
23	Analog input [T1], level 2	
24	Analog input [T2], level 1	
25	Analog input [T2], level 2	
26	Analog input [T3], level 1	
27	Analog input [T3], level 2	
28	Analog input [T4], level 1	
29	Analog input [T4], level 2	
30	Internal	
31	Internal	
32	Internal	
33	Internal	
34	Internal	
35	Internal	
36	Internal	
37	Internal	
38	Discrete input [E]	
39	Discrete input 1	
40	Discrete input 2	
41	Discrete input 3	
42	Discrete input 4	
43	Discrete input 5	
44	Discrete input 6	
45	Discrete input 7	
46	Discrete input 8	
47	Discrete input 9	
48	Discrete input [A]	
49	Discrete input [B]	
50	Discrete input [C]	
51	Discrete input [D]	
52	Auxiliaries	e.g. pump pretravel/-coasting
53#	Cooling water preheating ON	
54	Group alarm alarm class 1, alarm class 2 or alarm class 3	no brief acknowledg. possible
55	Operating mode TEST or AUTOMATIC selected	
56	Generator power watchdog, level 1	
57	MCB is closed	
58	GCB is closed	
59#	Interface fault Y1Y5	

Parameter	Output # **special version**	Explanation
60	Mains parallel operation is desired: Clear blocking of GCB ↔ MCB	Relay is set if the MCB or the GCB are synchronized and if MCB + GCB are closed (NPB)
61	Overcurrent I/t or generator overcurrent level 2 UMZ	
62	Introduce load-shedding: Add-on / Sync. GCB carried out or circuit breaker is closed	Signal is set prior to connection / synchronization and remains present when circuit breaker is closed.
63	Add-on / Sync. MCB carried out or circuit breaker is closed	Signal is set prior to connection / synchronization and remains present when circuit breaker is closed.
64	Overspeed pickup	
65	Emergency power is active	
66	Shutoff malfunction	
67	Power watchdog for power supplied by the mains	
68	Maintenance call	
69	Pickup/gen. differential frequency	The electrically determined speed and the speed determined via pickup are different
70	Time monitoring alarm "synchronization MCB" or "add-on MCB".	
71	GCB synchronization carried out	
72	MCB synchronization carried out	
73	Lamp test active	
74	Malfunction "Reply: GCB is open" - alarm on closing	The GCB cannot be closed after 5 attempts.
75	Malfunction "Reply: MCB is open" - alarm on closing	The MCB cannot be closed after 5 attempts.
76	Malfunction "Reply: GCB is open" - alarm on opening	2 s following the "Command: GCB open" a reply continues to be detected.
77	Malfunction "Reply: MCB is open" - alarm on opening	2 s following the "Command: MCB open" a reply continues to be detected.
78	Power supplied by the mains <> 0	In the event of interchange synchronization, the incoming power zero cannot be adjusted. As a result of this, the MCB is prevented from opening. Reset via acknowledgment.
79	Isolated operation in parallel with other gensets /operatin in parallel with the mains	
80	Synchronization on MCB and NPB	Relay is set if, 1.) MCB synchronized 2.) if MCB + GCB are closed (NPB) 3.) if GCB synchronized on closed MCB → no synchronization on IPB → for voltage controllers which are only operated in parallel with the mains.
81#	Button "ACKN" depressed	
82	Preheating	
83	Centralized alarm	see centralized alarm
84	Engine release	AUTO: Prerun auxilariy drives -> Engine stop HAND: Start -> Stop
85	free	
86	free	
87	free	
88	Generator voltage and frequency in admissible range	
89	Busbar voltage and frequency in admissible range	
90	free	
91	free	
92	Mains voltage monitoring	
93	Mains frequency monitoring	
94	Phase shift	
95	Load balance monitoring (option)	
96	Alarm class 0	
97	Fuel solenoid	
98	Starter	
99	GCB open	

Appendix E.
Interface Protocol (Options SU/SB/SF)

Transmission Telegram (Options SU/SB) Interface Y1Y5 Only

Number		Content (words)	Unit/Bit	Comment
3964	MOD bus			
00 **01**	**0** (00, 01)	Telegram call sign	900	Telegram type
02 **03**	**1** (02, 03)	Generator voltage L12	V	
04 **05**	**2** (04, 05)	Generator voltage L23	V	
06 **07**	**3** (06, 07)	Generator voltage L31	V	
08 **09**	**4** (08, 09)	Generator frequency	1/ 10 Hz	
10 **11**	**5** (10, 11)	Generator current L1	A	
12 **13**	**6** (12, 13)	Generator current L2	A	
14 **15**	**7** (14, 15)	Generator current L3	A	
16 **17**	**8** (16, 17)	Generator power factor	dim.los	1.00 **0064H** i0.99 (induktiv) **0063H** k0.98 (kapazitiv) **FF9EH**
18 **19**	**9** (18, 19)	Generator active power	kW	
20 **21**	**10** (20, 21)	Generator reactive power	kvar	
22 **23**	**11** (22, 23)	Busbar voltage L12	V	
24 **25**	**12** (24, 25)	Busbar frequency	1/ 10 Hz	
26 **27**	**13** (26, 27)	Mains voltage L12	V	
28 **29**	**14** (28, 29)	Mains voltage L23	V	
30 **31**	**15** (30, 31)	Mains voltage L31	V	
32 **33**	**16** (32, 33)	Mains frequency	1/ 10 Hz	
34 **35**	**17** (34, 35)	Mains current L1	A	
36 **37**	**18** (36, 37)	Mains power factor	dim.los	1.00 **0064H** i0.99 (induktiv) **0063H** k0.98 (kapazitiv) **FF9EH**
38 **39**	**19** (38, 39)	Mains interchange power	kW	
40 **41**	**20** (40, 41)	Status of the power circuit breakers 0000H = all power circuit breakers are open # always closed when asynchronous	Bit 15 = 1 \ Bit 14 = 1 /	Internal
			Bit 13 = 1 \ Bit 12 = 1 /	Internal
			Bit 11 = 0 \ Bit 10 = 0 /	Internal
			Bit 9 = 1 \ Bit 8 = 1 /	Mains circuit breaker closed #
			Bit 7 = 1 \ Bit 6 = 1 /	Internal
			Bit 5 = 1 \ Bit 4 = 1 /	Internal
			Bit 3 = 0 \ Bit 2 = 0 /	Internal
			Bit 1 = 1 \ Bit 0 = 1 /	Generator power circuit breaker closed
42 **43**	**21** (42, 43)	Operating hours	h	
44 **45**	**22** (44, 45)	Maintenance call	h	
46 **47**	**23** (46, 47)	Battery voltage	1/10 V	

Number		Content (words)	Unit	Comment
3964	MOD bus			
48 **49**	**24** (48, 49)	Alarm message 1 internal alarm 0000H = no troubles are present The following applies: Bit 0/bit 1 0/0 = no GW reached 0/1 = GW 1 reached 1/0 = GW 2 reached 1/1 = GW 1+GW 2 reached	Bit 15 = 1 \ Bit 14 = 1 /	Internal
			Bit 13 = 1 \ Bit 12 = 1 /	Internal
			Bit 11 = 1 \ Bit 10 = 1 /	Internal
			Bit 9 = 1 \ Bit 8 = 1 /	Internal
			Bit 7 = 1 \ Bit 6 = 1 /	Analog input 4, WARNING (terminals 102/103/104)
			Bit 5 = 1 \ Bit 4 = 1 /	Analog input 2, WARNING (terminals 99/100/101)
			Bit 3 = 1 \ Bit 2 = 1 /	Analog input 2, WARNING (terminals 96/97/98)
			Bit 1 = 1 \ Bit 0 = 1 /	Analog input 1, WARNING (terminals 93/94/95)
50 **51**	**25** (50, 51)	Alarm message 2 internal alarms 0000H = no malfunctions are present	Bit 15 = 1 \ Bit 14 = 1 /	Mains vector jump
			Bit 13 = 1 \ Bit 12 = 1 /	Plausibility control Pickup/Generator
			Bit 11 = 1 \ Bit 10 = 1 /	Generator overspeed / Pickup/overspeed
			Bit 9 = 1 \ Bit 8 = 1 /	Overcurrent level 2
			Bit 7 = 1 \ Bit 6 = 1 /	Start failure
			Bit 5 = 1 \ Bit 4 = 1 /	Unbalanced load
			Bit 3 = 1 \ Bit 2 = 1 /	GCB synchronization time alarm
			Bit 1 = 1 \ Bit 0 = 1 /	Overcurrent level 1
52 **53**	**26** (52, 53)	Alarm message 3 internal alarm 0000H = no malfunctions are present	Bit 15 = 1 \ Bit 14 = 1 /	Maintenance call
			Bit 13 = 1 \ Bit 12 = 1 /	Battery undervoltage
			Bit 11 = 1 \ Bit 10 = 1 /	Generator overload
			Bit 9 = 1 \ Bit 8 = 1 /	Reverse power
			Bit 7 = 1 \ Bit 6 = 1 /	Generator frequency exceeded-/fallen below
			Bit 5 = 1 \ Bit 4 = 1 /	Generator voltage exceeded-/fallen below
			Bit 3 = 1 \ Bit 2 = 1 /	Mains frequency exceeded-/fallen below
			Bit 1 = 1 \ Bit 0 = 1 /	Mains voltage exceeded-/fallen below

Number		Content (words)	Unit	Comment
3964	MOD bus			
54 **55**	**27** (54, 55)	Alarm message 4 discrete inputs 0000H = no malfunctions are present	Bit 15 = 1 \ Bit 14 = 1 /	Terminal 68
			Bit 13 = 1 \ Bit 12 = 1 /	Terminal 67
			Bit 11 = 1 \ Bit 10 = 1 /	Terminal 66
			Bit 9 = 1 \ Bit 8 = 1 /	Terminal 65
			Bit 7 = 1 \ Bit 6 = 1 /	Terminal 64
			Bit 5 = 1 \ Bit 4 = 1 /	Terminal 63
			Bit 3 = 1 \ Bit 2 = 1 /	Terminal 62
			Bit 1 = 1 \ Bit 0 = 1 /	Terminal 61
56 **57**	**28** (56, 57)	Alarm message 5 discrete inputs 0000H = no malfunctions are present	Bit 15 = 1 \ Bit 14 = 1 /	Internal
			Bit 13 = 1 \ Bit 12 = 1 /	Internal
			Bit 11 = 1 \ Bit 10 = 1 /	Terminal 74
			Bit 9 = 1 \ Bit 8 = 1 /	Terminal 73
			Bit 7 = 1 \ Bit 6 = 1 /	Terminal 72
			Bit 5 = 1 \ Bit 4 = 1 /	Terminal 71
			Bit 3 = 1 \ Bit 2 = 1 /	Terminal 70
			Bit 1 = 1 \ Bit 0 = 1 /	Terminal 69
58 **59**	**29** (58, 59)	Malfunction message 6 Internal fault 0000H = no malfunctions are present	Bit 15 = 1	Internal
			Bit 14 = 1	Internal
			Bit 13 = 1	Internal
			Bit 12 = 1	Internal
			Bit 11 = 1	Range alarm analog input 4
			Bit 10 = 1	Range alarm analog input 3
			Bit 9 = 1	Range alarm analog input 2
			Bit 8 = 1	Range alarm analog input 1
			Bit 7 = 1 \ Bit 6 = 1 /	MCB synchronization time alarm
			Bit 5 = 1 \ Bit 4 = 1 /	Shutoff malfunction
			Bit 3 = 1 \ Bit 2 = 1 /	Sprinkler operation
			Bit 1 = 1 \ Bit 0 = 1 /	Serial interface Y1 to Y5

Number		Content (words)	Unit	Comment
3964	MOD bus			
60 **61**	**30** (60, 61)	Malfunction message 7 Internal fault 0000H = no malfunctions are present	Bit 15 = 1 \ Bit 14 = 1 /	Internal
			Bit 13 = 1 \ Bit 12 = 1 /	Internal
			Bit 11 = 1 \ Bit 10 = 1 /	Internal
			Bit 9 = 1 \ Bit 8 = 1 /	Internal
			Bit 7 = 1 \ Bit 6 = 1 /	Internal
			Bit 5 = 1 \ Bit 4 = 1 /	Internal
			Bit 3 = 1 \ Bit 2 = 1 /	Internal
			Bit 1 = 1 \ Bit 0 = 1 /	Internal
62 **63**	**31** (62, 63)	Operating mode	Bit 15 = 1 \ Bit 14 = 1 /	Terminal 6 set
			Bit 13 = 1 \ Bit 12 = 1 /	Internal
			Bit 11 = 1 \ Bit 10 = 1 /	Operating mode TEST
			Bit 9 = 1 \ Bit 8 = 1 /	Operating mode MANUAL
			Bit 7 = 1 \ Bit 6 = 1 /	Automatic 2
			Bit 5 = 1 \ Bit 4 = 1 /	Automatic 1
			Bit 3 = 1 \ Bit 2 = 1 /	Operating mode AUTOMATIC
			Bit 1 = 1 \ Bit 0 = 1 /	Operating mode STOP
64 **65**	**32** (64, 65)	Alarm class 0000H = no alarm before	Bit 15 = 1 \ Bit 14 = 1 /	Internal
			Bit 13 = 1 \ Bit 12 = 1 /	Internal
			Bit 11 = 1 \ Bit 10 = 1 /	Internal
			Bit 9 = 1 \ Bit 8 = 1 /	Internal
			Bit 7 = 1 \ Bit 6 = 1 /	Internal
			Bit 5 = 1 \ Bit 4 = 1 /	Alarm class 3
			Bit 3 = 1 \ Bit 2 = 1 /	Alarm class 2
			Bit 1 = 1 \ Bit 0 = 1 /	Alarm class 1
66 **67**	**33** (66, 67)	Generator active energy	kWh	High Word
68 **69**	**34** (68, 69)			Low Word

Number		Content (words)	Unit	Comment
3964	MOD bus			
70 **71**	**35** (70, 71)	Reserve		Internal
72 **73**	**36** (72, 73)			Internal
74 **75**	**37** (74, 75)	Analog input 1 (terminals 93/94/95)		alternatively according to setting
76 **77**	**38** (76, 77)	Analog input 2 (terminals 96/97/98)		alternatively according to setting
78 **79**	**39** (78, 79)	Analog input 3 (terminals 99/100/101)		alternatively according to setting
80 **81**	**40** (80, 81)	Analog input 4 (terminals 102/103/104)		alternatively according to setting
82 **83**	**41** (82, 83)	Reserve		
84 **85**	**42** (84, 85)	Reserve		
86 **87**	**43** (86, 87)	Reserve		
88 **89**	**44** (88, 89)	Reserve		

Receiving Telegram (Options SB)

Receiving Telegram via RS-232/DK3964

Number	Content (words)	Unit	Comment
3964			
00 01	Remote start		**00F0H remote start** **000FH no remote start**
02 03	Remote stop		**00F0H remote stop** **000FH no remote stop**
04 05	Active power set point with control argument	kWh	Bit 15/Bit 14 Control argument 0/1 C-power 0/0 E-power 1/x I-power
06 07	Reserve		
08 09	Acknowledgment		**00F0H Acknowledgement** **000FH no acknowledgement**
10 11	Reserve		
12 13	Reserve		
14 15	Reserve		
16 17	Reserve		
18 19	Reserve		

Receiving Telegram via RS-485/MOD bus RTU slave

Number	Content (words)	Unit	Comment
MOD bus			
0 (00, 01)	Active power setpoint with control argument	kWh	Bit 15/Bit 14 Control argument 0/1 C-power 0/0 E-power 1/x I-power
1 (02, 03)	Reserve		
2 (04, 05)	Control word	Bit 15 = 1	Internal
		Bit 14 = 1	Internal
		Bit 13 = 1	Internal
		Bit 12 = 1	Internal
		Bit 11 = 1	Internal
		Bit 10 = 1	Internal
		Bit 9 = 1	Internal
		Bit 8 = 1	Internal
		Bit 7 = 1 \	Internal
		Bit 6 = 1 /	Internal
		Bit 5 = 1 \	Internal
		bits 4	**1 = Acknowledgement** **0 = no acknowledgement**
		Bit 3 = 1 \	Always "0"
		Bit 2 = 1	Always "0"
		Bit 1 = 1	**1 = remote stop** **0 = no remote stop**
		Bit 0 = 1 /	**1 = remote start** **0 = no remote start**

Remote Monitoring and Control via Gateway GW 4 (Option SF) Interface X1X5

Remote Monitoring via Gateway GW 4 (Transmission Telegram)

No.	Content (words)	Unit	Comment
0	CAN-Bus (CAL)-Bus (Watchdog)		Bit 15 = = 1 CAN Bus o.k. Bit 0-2 = generator number - 1
1	Generator voltage V_{12}	V × $10^{UGNEXPO}$	
2	Generator frequency f	Hz × 100	
3	Generator active power P	W × $10^{PGNEXPO}$	
4	**H.B.** Exponent generator power **L.B.** Exponent generator voltage		PGNEXPO UGNEXPO
5	Current generator active power setpoint	(steps)	For display in kW: (Value/2800) × PGNWD
6	Conversion factor steps → kW		PGNWD
7	Phase-to-phase bus bar voltage V_{12}	V × $10^{UGNEXPO}$	
8	Phase-to-phase mains voltage V_{12}	V × $10^{UNTEXPO}$	
9	Currently present alarm class		Bit 15 = 1 Internal
			Bit 14 = 1 Internal
			Bit 13 = 1 \ Bit 12 = 1 / Alarm class 2 or 3
			Bit 11 = 1 \ Bit 10 = 1 / "Alarm" LED flashes
			Bit 9 = 1 Internal
			Bit 8 = 1 Internal
			Bit 7 = 1 \ Bit 6 = 1 / Alarm class 3
			Bit 5 = 1 \ Bit 4 = 1 / Alarm class 2
			Bit 3 = 1 \ Bit 2 = 1 / Alarm class 1
			Bit 1 = 1 \ Bit 0 = 1 / Internal
10	Control register 2		Bit 15 = 1 \ Bit 14 = 1 / $P_{set\ internal1}$ selected
			Bit 13 = 1 \ Bit 12 = 1 / $P_{set\ internal2}$ selected
			Bit 11 = 1 Internal
			Bit 10 = 1 Internal
			Bit 9 = 1 \ Bit 8 = 1 / Release MCB
			Bit 7 = 1 \ Bit 6 = 1 / Response GCB
			Bit 5 = 1 \ Bit 4 = 1 / Response MCB
			Bit 3 = 1 \ Bit 2 = 1 / Terminal 6 has been set (High signal)
			Bit 1 = 1 \ Bit 0 = 1 / Shutoff power reached
11	Actual mains active power	W × $10^{PNTEXPO}$	

No.	Content (words)	Unit	Comment
12	Control register 1		Bit 15 = 1 \ Bit 14 = 1 / Internal
			Bit 13 = 1 Internal
			Bit 12 = 1 Internal
			Bit 11 = 1 \ Bit 10 = 1 / Execution of acknowledgment of a F2/F3 alarm
			Bit 9 = 1 \ Bit 8 = 1 / Execution of acknowledgment of a F1-alarm
			Bit 7 = 1 \ Bit 6 = 1 / Internal
			Bit 5 = 1 \ Bit 4 = 1 / Internal
			Bit 3 = 1 \ Bit 2 = 1 / Internal
			Bit 1 = 1 Internal
			Bit 0 = 1 Internal
13	Reserve		Internal
14	Internal fault 6		Bit 15 = 1 \ Bit 14 = 1 / Pickup plausibility alarm
			Bit 13 = 1 \ Bit 12 = 1 / Unit activation malfunction
			Bit 11 = 1 MCB switch malfunction
			Bit 10 = 1 GCB switch malfunction
			Bit 9 = 1 MCB synchronization time monitoring
			Bit 8 = 1 GCB synchronization time monitoring
			Bit 7 = 1 Internal
			Bit 6 = 1 Internal
			Bit 5 = 1 Internal
			Bit 4 = 1 Internal
			Bit 3 = 1 Range alarm analog input 4
			Bit 2 = 1 Range alarm analog input 3
			Bit 1 = 1 Range alarm analog input 2
			Bit 0 = 1 Range alarm analog input 1
15	Phase-to-phase generator voltage V_{23}	$V \times 10^{UGNEXPO}$	
16	Phase-to-phase generator voltage V_{31}	$V \times 10^{UGNEXPO}$	
17	Generator star voltage V_{1N}	$V \times 10^{UGNEXPO}$	
18	Generator star voltage V_{2N}	$V \times 10^{UGNEXPO}$	
19	Genertor voltage Star V_{3N}	$V \times 10^{UGNEXPO}$	

No.	Content (words)	Unit	Comment
20	Generator frequency determined from pickup	Hz × 256	
21	Unit speed from pickup	min^{-1}	
22	Generator current in L1	A × $10^{IGNEXPO}$	
23	Generator current in L2	A × $10^{IGNEXPO}$	
24	Generator current in L3	A × $10^{IGNEXPO}$	
25	Actual generator reactive power	var × $10^{PNTEXPO}$	positive = inductive
26	Generator power factor		Example: **0064H** PF = 1.00 **0063H** PF = i 0.99 (inductive) **FF9EH** PF = c0.98 (capacitive)
27	Current reserve power in the system	kW	
28	Current actual active power in the system	kW	
29	Number of subscribers in the CAN bus		
30	**H.B.** Status Mains **L.B.** Status Generator		**FFH** voltage and frequency applied **00H** voltage and frequency not applied
31	**H.B.** Exponent generator current **L.B.** Reserve		IGNEXPO
32	Busbar frequency	Hz × 100	
33	**H.B.** Status busbar **L.B.** Reserve		**FFH** voltage and frequency applied **00H** voltage and frequency not applied
34	Phase-to-phase mains voltage V_{23}	V × $10^{UNTEXPO}$	
35	Phase-to-phase mains voltage V_{31}	V × $10^{UNTEXPO}$	
36	Mains voltage Star V_{1N}	V × $10^{UNTEXPO}$	
37	Mains voltage Star V_{2N}	V × $10^{UNTEXPO}$	
38	Mains voltage Star V_{3N}	V × $10^{UNTEXPO}$	
39	Mains frequency from $V_{N12}/V_{N23}/V_{N31}$	Hz × 100	
40	Mains current in L1	A × $10^{INTEXPO}$	
41	Mains reactive power	var × $10^{PNTEXPO}$	
42	Mains power factor		Example: **0064H** PF = 1.00 **0063H** PF = i 0.99 (inductive) **FF9EH** PF = c0.98 (capacitive)
43	**H.B.** Exponent mains power **L.B.** Exponent mains voltage		PNTEXPO UNTEXPO
44	**H.B.** Exponent mains current **L.B.** Reserve		INTEXPO
45	Genset running hours (**H.W.**)	h	Double word
46	Genset running hours (**L.W.**)		
47	Hours until next maintenance	h	
48	Unit start number		
49	Operating mode (**H.B.**)		Bit 15 = 1 Internal Bit 14 = 1 Operating mode STOP Bit 13 = 1 Operating mode TEST Bit 12 = 1 Operating mode MANUAL Bit 11 = 1 Operating mode AUTOMATIC Bit 10 = 1 Internal Bit 9 = 1 Internal Bit 8 = 1 Internal
	Operating mode (**L.B.**)		Bit 7 = 1 \ Emergency power is ON Bit 6 = 0 / Bit 5 = 1 \ Delayed motor monitoring is ON Bit 4 = 1 / Bit 3 = 1 \ Coasting END Bit 2 = 1 / Bit 1 = 1 \ Internal Bit 0 = 1 /

No.	Content (words)	Unit	Comment
50	Generator active energy (**H.W.**)	kWh	Double word
51	Generator active energy (**L.W.**)		
52	Battery voltage	V × 10	
53	Internal fault 1		Bit 15 = 1 \ Bit 14 = 1 / Generator overfrequency
			Bit 13 = 1 \ Bit 12 = 1 / Generator underfrequency
			Bit 11 = 1 \ Bit 10 = 1 / Generator overvoltage
			Bit 9 = 1 \ Bit 8 = 1 / Generator undervoltage
			Bit 7 = 1 \ Bit 6 = 1 / Internal
			Bit 5 = 1 \ Bit 4 = 1 / Battery undervoltage
			Bit 3 = 1 \ Bit 2 = 1 / Generator overload
			Bit 1 = 1 \ Bit 0 = 1 / Generator reverse power
54	Internal fault 2		Bit 15 = 1 \ Bit 14 = 1 / Mains overfrequency
			Bit 13 = 1 \ Bit 12 = 1 / Mains underfrequency
			Bit 11 = 1 \ Bit 10 = 1 / Mains overvoltage
			Bit 9 = 1 \ Bit 8 = 1 / Mains undervoltage
			Bit 7 = 1 \ Bit 6 = 1 / Interface fault X1 to X5
			Bit 5 = 1 \ Bit 4 = 1 / Internal
			Bit 3 = 1 \ Bit 2 = 1 / Internal
			Bit 1 = 1 \ Bit 0 = 1 / Mains vector shift
55	Internal fault 3		Bit 15 = 1 \ Bit 14 = 1 / Overcurrent level 2
			Bit 13 = 1 \ Bit 12 = 1 / Generator overspeed (pickup)
			Bit 11 = 1 \ Bit 10 = 1 / Incoming power 0 not reached
			Bit 9 = 1 \ Bit 8 = 1 / Unbalanced load
			Bit 7 = 1 \ Bit 6 = 1 / Generator overcurrent level 1
			Bit 5 = 1 \ Bit 4 = 1 / Interface fault Y1 to Y5
			Bit 3 = 1 \ Bit 2 = 1 / Maintenance call
			Bit 1 = 1 \ Bit 0 = 1 / Start failure

No.	Content (words)	Unit	Comment
56	Internal fault 4		Bit 15 = 1 \ Bit 14 = 1 / Analog input 1 - level 1
			Bit 13 = 1 \ Bit 12 = 1 / Analog input 1 - level 2
			Bit 11 = 1 \ Bit 10 = 1 / Analog input 2 - level 1
			Bit 9 = 1 \ Bit 8 = 1 / Analog input 2 - level 2
			Bit 7 = 1 \ Bit 6 = 1 / Analog input 3 - level 1
			Bit 5 = 1 \ Bit 4 = 1 / Analog input 3 - level 2
			Bit 3 = 1 \ Bit 2 = 1 / Analog input 4 - level 1
			Bit 1 = 1 \ Bit 0 = 1 / Analog input 4 - level 2
57	Internal fault 5		Bit 15 = 1 \ Bit 14 = 1 / Internal
			Bit 13 = 1 \ Bit 12 = 1 / Internal
			Bit 11 = 1 \ Bit 10 = 1 / Internal
			Bit 9 = 1 \ Bit 8 = 1 / Internal
			Bit 7 = 1 \ Bit 6 = 1 / Internal
			Bit 5 = 1 \ Bit 4 = 1 / Internal
			Bit 3 = 1 \ Bit 2 = 1 / Internal
			Bit 1 = 1 \ Bit 0 = 1 / Internal
58	External faults terminals 61 to 68		Bit 15 = 1 \ Bit 14 = 1 / Terminal 61
			Bit 13 = 1 \ Bit 12 = 1 / Terminal 62
			Bit 11 = 1 \ Bit 10 = 1 / Terminal 63
			Bit 9 = 1 \ Bit 8 = 1 / Terminal 64
			Bit 7 = 1 \ Bit 6 = 1 / Terminal 65
			Bit 5 = 1 \ Bit 4 = 1 / Terminal 66
			Bit 3 = 1 \ Bit 2 = 1 / Terminal 67
			Bit 1 = 1 \ Bit 0 = 1 / Terminal 68

No.	Content (words)	Unit	Comment
59	External alarm		Bit 15 = 1 \ Bit 14 = 1 / Terminal 69
			Bit 13 = 1 \ Bit 12 = 1 / Terminal 70
			Bit 11 = 1 \ Bit 10 = 1 / Terminal 71
			Bit 9 = 1 \ Bit 8 = 1 / Terminal 72
			Bit 7 = 1 \ Bit 6 = 1 / Terminal 73
			Bit 5 = 1 \ Bit 4 = 1 / Terminal 74
			Bit 3 = 1 \ Bit 2 = 1 / Internal
			Bit 1 = 1 \ Bit 0 = 1 / Internal
60	Internal fault 7		Bit 15 = 1 Internal
			Bit 14 = 1 Internal
			Bit 13 = 1 Internal
			Bit 12 = 1 Internal
			Bit 11 = 1 Internal
			Bit 10 = 1 Internal
			Bit 9 = 1 Internal
			Bit 8 = 1 Internal
			Bit 7 = 1 Internal
			Bit 6 = 1 Internal
			Bit 5 = 1 Internal
			Bit 4 = 1 Internal
			Bit 3 = 1 Internal
			Bit 2 = 1 Internal
			Bit 1 = 1 Internal
			Bit 0 = 1 Internal
61	Analog input 1 (terminals 93 to 95)		The measured value is transmitted.
62	Analog input 2 (terminals 96 to 98)		The measured value is transmitted.
63	Analog input 3 (terminals 99 to 101)		The measured value is transmitted.
64	Analog input 4 (terminals 102 to 105)		The measured value is transmitted.
65	Reserve		Internal
66	Reserve		Internal
67	Reserve		Internal
68	Reserve		Internal
69	The currently active display		A number is transmitted; please consult the following table for the meaning of this number.

The next genset is addressed with the number 70
Word 0 CAN-Bus (CAL)-Bus (Watchdog)
Word 1 generator voltage V_{12}
Word 2 etc.

H.B.	High Byte	**L.B.**	Low Byte
H.W.	High Word	**L.W.**	Low Word
UGNEXPO	Exponent Generator voltage	**USSEXPO**	Exponent Busbar voltage
UGNEXPO	Exponent Generator voltage	**USSEXPO**	Exponent Busbar voltage
IGNEXPO	Exponent Generator current	**UNTEXPO**	Exponent Mains voltage
PGNEXPO	Exponent Generator power	**PNTEXPO**	Exponent Mains power
PGNWD	Step conversion factor → kW		

Meaning of the number 69 of the telegram " Currently active display message":

Number	Meaning
0	GCB synchronization
1	MCB synchronization
2	GCB dead bus start
3	MCB dead bus start
4	Crank
5	Start pause
6	Cool down 000s (000s: the remaining time is displayed)
7	Engine stop!
8	Preglow
9	Purging operation
10	Initial state
11	Auxiliary prerun
12	Auxiliary postrun
13	Mains settling 000s (000s: the remaining time is displayed)
14	Lambda initial state
15	Sprinkler coasting
16	Ignition
17	--Internal--
18	--Internal--
19	--Internal--
20	--Internal--
21	--Internal--
22	--Internal--
23	--Internal--
24	Phase rotation incorrect!
25	Start without closing GCB and simultaneous emergency power
26	Start without closing GCB
27	Sprinkler operation (critical mode) and simultaneous emergency power
28	Sprinkler operation (critical mode)
29	Emergency power
30	TEST
31	Load TEST
32	--Internal--
33	--Internal--
34	--Internal--
35	--Internal--
36	--Internal--
37	--Internal--
38	--Internal--
39	--Internal--
40	--Internal--
41	--Internal--
42	--Internal--
43	--Internal--
44	--Internal--
45	--Internal--
46	--Internal--
47	Power reduction
...	
255	No message on the display (basic screen)

Remote Control via Gateway GW 4 (Receiving Telegram)

The remote control data are only accepted by the GCP-20, if the unit is equipped with the corresponding option.

No.	Content (words)	Unit	Comment		
1	Active power setpoint with control argument	kW	see below		
2	Reserve				
3	Control word		Bit 15		Internal
			Bit 14		Internal
			Bit 13		Internal
			Bit 12		Internal
			Bit 11		Internal
			Bit 10		Internal
			Bit 91		Internal
			Bit 8		Internal
			Bit 7		Internal
			Bit 6		Internal
			Bit 5		Internal
			Bit 4	= 1	Acknowledgement
			Bit 3	= 0	always 0
			Bit 2	= 0	always 0
			Bit 1	= 1	Remote stop (high priority)
			Bit 0	= 1	Remote start

The next genset is addressed with the number 4
Word 1 Active energy set point value
Word 2 etc.

Comments

General Data About the Procedure 3964 (TTY, RS-232, RS-485)

Data

Length of characters	8 Bit
Stopbit	1 Bit
Paritybit	1 Bit with even parity
Release condition	Corresponds to the log status. ″1″ (20 mA at TTY)
Data format	16 Bit binary values
Transmitting rate	9600 baud. Other baud rates on request. The records are transferred cyclically.

Procedure Interpreter RK 512

See Siemens documents for procedure 3964.

General Data About the Hardware Handshaking RTS/CTS (RS-232)

Data

Length of characters	8 Bit
Stop bit	1 Bit
Parity bit	1 Bit with even parity
Data format	16 Bit binary values
Transmitting rate	9600 baud. Other baud rates on request. The records are transferred cyclically.

Procedure

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

Encoding of the current direction

The current direction can be recognized via the code word prefix. A positive transmitted value means outgoing supply (power output), a negative transmitted value means power consumption (incoming supply).

Coding of the Power Set Point Value

The following power values may be pre-specified: constant/baseload power (C power), outgoing/export power (E power) and incoming/import power (I power). The real power set point value is transmitted in binary form using bits 0-13. The control argument must be transmitted in the basis of bits 14 and 15. In this case, the following coding applies:

Control argument	Bit 15	Bit 14
C power	0	1
E power	0	0
I power	1	1

Example:

C power of 150 kW is to be compensated. The value transmitted is then:

`01/00 0000 1001 0110 B ⇨ 4096 H`

E power of 300 kW is to be compensated. The value transmitted is then:

`00/00 0001 0010 1100 B ⇨ 012C H`

I power of 600 kW is to be compensated. Negative power is transmitted. The value transmitted is then:

`11/11 1101 1010 1000 B ⇨ FDA8 H`

Appendix F.
List of Parameters

Unit number P/N _____ Rev _____

Version GCP-_____

Project _____

Serial number S/N _____ Date _____

Option	Parameter 1. Line Text 2. Line	Adjustment range	Standard setting	Customer settings		Code level
	software version	-	V x.xxxx	-	-	0
	Service-Display	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	0
	enter code number	0 to 9999	XXXX			0
	GENERATOR AND NETWORK CONFIGURATION					
	Configure Base?	YES/NO	YES	☐ Y ☐ N	☐ Y ☐ N	2
	Generator-number	1 to 8	1			2
	load conf. direct	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	Generator freq. f set	40.0 to 70.0 Hz	50.0 Hz			2
	Rated frequency generator	50.0/60.0 Hz	50.0 Hz			2
	Gen.volt.transf. secondary	50 to 125 200 to 440 V	400 V			2
	Gen.volt.transf. primary	0.050 to 65.000/ 0.200 to 65.000 kV	0.400 kV			2
	Bus.volt.transf. secondary	50 to 125 200 to 440 V	400 V			2
	Bus.volt.transf. primary	0.050 to 65.000/ 0.200 to 65.000 kV	0.400 kV			2
	mains volt.trans secondary	50 to 125 200 to 440 V	400 V			2
	mains volt.trans primary	0.050 to 65.000/ 0.200 to 65.000 kV	0.400 kV			2
	Gen. voltage U set	25 to 140/50 to 500 V	100/400 V			2
	Current transf. Generator	10 to 7,000/x A	500/x A			2
	Rated current Gen.	10 to 2,999 A	300 A			2
	Power measuring Gen.	single-/three-phase	threephase	☐ s ☐ t	☐ s ☐ t	2
	Rated power Gen.	5 to 9,999 5 to 6,900 kW	200 kW			2
	Current transf. Mains	10 to 7,000/x A	500/x A			2
In20	**analog in Pmains**	0 to 20/4 to 20 mA	4 to 20 mA			2
..	**analog in Pmains 0%**	+/- 0 to 9.99 +/- 0 to 6.9 kW	-200 kW			2
In20	**analog in Pmains 100%**	+/- 0 to 9.99 +/- 0 to 6.9 kW	200 kW			2
	Define level 1 code	0 to 9999	0001			2
	Define level 2 code	0 to 9999	0002			2

Option	Parameter 1. Line Text 2. Line	Adjustment range	Standard setting	Customer settings		Code level
	CONTROLLER CONFIGURATION					
	Configure Contr.	YES/NO	YES	☐ Y ☐ N	☐ Y ☐ N	2
	Power controller P set1	C/I/E 0 to 3000 kW	C 50 kW			1
	Power controller P set2	C/I/E 0 to 6,900 kW	C 80 kW			1
	Load test via	Pset1 / Pset2 / Extern	Pset1	☐ P1 ☐ P2 ☐ E	☐ P1 ☐ P2 ☐ E	1
QF	Initial state Freqency	0 to 100 %	50 %			2
..	Actuating signal Freq. min	0 to 100 %	0 %			2
QF	Actuating signal Freq. max	0 to 100 %	100 %			2
	Freq. controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	f-contr. active at:	0.0 to 70.0 Hz	30.0 Hz			2
	Delay time for f-contr.	0 to 999 s	3 s			2
	Freq. controller ramp	1 to 50 Hz/s	10 Hz/s			2
	Freq. controller dead band	0.02 to 1.00 Hz	0.03 Hz			2
	Freq. controller Time pulse>	10 to 250 ms	80 ms			2
	Freq. controller Gain Kp	0.1 to 99.9	20.0			2
QF	Freq. controller Gain Kpr	1 to 240	10			2
..	Freq. controller Reset time	0.0 to 60.0 s	2.0 s			2
QF	Freq. controller Deriv.time	0.00 to 6.00 s	0.00 s			2
QU	Initial state Voltage	0 to 100 %	50 %			2
..	Actuating signal Volt. min	0 to 100 %	0 %			2
QU	Actuating signal Volt. max	0 to 100 %	100 %			2
	Volt. controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	V-contr. active at:	50 to 400 V	75/300 V			2
	Delay time for V-contr.	0 to 999 s	3 s			2
	Volt. controller dead band	0.1 to 15.0 0.5 to 60.0 V	3.5 V			2
	Volt. controller Time pulse>	20 to 250 ms	80 ms			2
	Volt. controller Gain Kp	0.1 to 99.9	20.0			2
QU	Volt. controller Gain Kpr	1 to 240	10.0			2
..	Volt. controller Reset time	0.0 to 60.0 s	2.0 s			2
QU	Volt. controller Deriv.time	0.00 to 6.0 s	0.0 s			2
	Pow.fact. contr.	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	Pow.fact. contr. Setpoint	i0.70 to 1.00 to c0.70	1.00			1
	Pow.fact. contr. Dead band	0.5 to 25.0 %	0.5 %			2
	Pow.fact. contr. Gain Kp	0.1 to 99.9	20.0			2
QU	Pow.fact. contr. Gain Kpr	1 to 240	10			2
..	Pow.fact. contr. Reset time	0.2 to 60.0 s	2.0 s			2
QU	Pow.fact. contr. Deriv.time	0.0 to 6.0 s	0.0 s			2
	Power controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	Power controller ramp	0 to 100 %/s	10 %/s			2
	Power cotroller ramp	0 to 100 kW/s	10 kW/s			2
	Power limit P max.	10 to 120 %	100 %			2
	Power limit P min.	0 to 50 %	0 %			2
X	Setpoint external	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Analog input	0 to 20/4 to 20 mA	4 to 20 mA			2
..	ext. setpoint 0mA	0 to 9,999 kW	F0 kW			2
X	ext. setpoint 4mA	0 to 9,999 kW	F200 kW			2
	Power controller dead band	0.1 to 25.0 %	0.5 %			2
	Power controller Gain Kp	0.1 to 99.9	20.0			2
	P-contr. dead band ratio	1.0 to 9.9	2.0			2
QF	Power controller Gain Kpr	1 to 240	10			2
..	Power controller Reset time	0.2 to 60.0 s	2.0 s			2
QF	Power controller Deriv.time	0.0 to 6.0 s	0.0 s			2
	Warm up load setpoint	5 to 110 %	15 %			2
	Warm up load time	0 to 600 s	0 s			2
	Active power Load-share	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	Loadshare factor active pow.	10 to 99 %	50 %			2
	Reactive power Load share	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	Loadshare factor react. pow.	10 to 99%	50 %			2

Option	Parameter 1. Line Text 2. Line	Adjustment range	Standard setting	Customer settings		Code level
	LOAD MANAGEMENT CONFIGURATION					
	Configure automatic	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	Loadd.Start/Stop at ter.3	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	Loadd.Start/Stop at ter.5	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	MOP: gen.minimum load	0 to 2,000 kW	15 kW			2
	Add-on delay mains oper.	0 to 999 s	1 s			2
	Shed-off delay mains oper.	0 to 999 s	3 s			2
	Hysteresis add- on/off op.	0 to 999 kW	5 kW			2
	Reserve power mains op.	0 to 999 kW	10 kW			2
	Isolated/mains Priority	0 to 8	0			2
	Reserve power isol .op.	0 to 999 kW	20 kW			2
	Add-on delay isol. op.	0 to 999 s	1 s			2
	Stopdelay Isol. op.	0 to 999 s	4 s			2
TZ	Start/Stop temp. at ter.3	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
..	Start/Stop temp. at ter.5	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
..	Temperature of Start	0 to 255 °C	15 °C			2
..	Temperature of Stop	0 to 255 °C	60 °C			2
TZ	Start Delay time	0 to 255 s	1 s			2
SB	serial Control comY1Y5	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
SB	Pulse time Modbus	0 to 9 s	0 s			
SF	serial Control comX1X5	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
..	Remote acknow. COM	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
SF	Supervision COM	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	POWER CIRCUIT BREAKER CONFIGURATION					
	Configure breaker?	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	Breaker logic	EXTERNAL PARALLEL OPEN TRANS. CLOSED TRANS. INTERCHANGE	PARALLEL	☐ external ☐ parallel ☐ open tr. ☐ closed tr. ☐ interch.	☐ external ☐ parallel ☐ open tr. ☐ closed tr. ☐ interch.	2
	Start with no GCB at ter. 5	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	Add-on/off ramp max.time	0 to 999 s	60 s			2
	Open GCB with F2 max.time	0 to 999 s	0 s			2
	GCB closing relay	constant/impulse	constant	☐ c ☐ i	☐ c ☐ i	2
	GCB open relay NC-contact	NO-/NC-contact	NO-contact	☐ no ☐ nc	☐ no ☐ nc	2
Synchr.	Synchronize df max	0.02 to .0.49 Hz	0.20 Hz			2
..	Synchronize df min	0.0 to -0.49 Hz	-0.10 Hz			2
..	Synchronize dU max	1 to 20/2 to 60 V	16 V			2
..	Synchronize time pul.>	0.05 to 0.26 s	0.24.s			2
..	Closing time GCB	40 to 300 ms	80 ms			2
..	Closing time MCB	40 to 300 ms	80 ms			2
..	Automat. breaker deblocking	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
..	Sync.time contr.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	1
..	Sync.time contr. Delay time	10 to 999 s	180 s			1
..	GCB dead bus op.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	GCB dead bus op. df max	0.00 to 5.00 Hz	2.00 Hz			2
..	GCB dead bus op. dU max	1 to 20/2 to 60 V	40 V			2
Synchr.	MCB dead bus op.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
Asyn.	Connect GCB	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Connect GCB df max	.0.05 to 9.99. Hz99	0.20 Hz			2
..	Connect GCB df min	0.0 to -9.99 Hz	-0.10 Hz			2
..	Connect GCB Time pulse>	0.05 to 0.26 s	240 ms			2
..	Conn.time contr.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	1
Asyn.	Conn.time contr. Delay time	2 to 999 s	180 s			1
	Supervision GCB	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	Supervision MCB	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	Mains decoupling via	GCB/MCB	GCB			2
≥V1.0700	Switch MCB in Stop mode	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2

Option	Parameter 1. Line Text 2. Line	Adjustment range	Standard setting	Customer settings		Code level
	EMERGENCY POWER CONFIGURATION					
	Configure emerg.run	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	Emergency power	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	Emergency power start delay	0.5 to 99.9 s	3.0 s			2
	Mains settling time	0 to 999 s	10 s			2
	CONFIGURATION OF THE PROTECTIVE UNITS					
	Configure monitoring	YES/NO	YES	☐ Y ☐ N	☐ Y ☐ N	2
	Gen.power monit.	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	Power monitoring resp.value	0 to 150 %	120 %			2
	Power monitoring gen.hyst.	0 to 100 %	5 %			2
	power monit. gen. Delay time	0 to 999 s	10 s			2
	mains power mon.	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	mains power mon. value	C/E 0 to 9,999 kW	100 kW			2
	mains power mon. hyst.	0 to 999 kW	10 kW			2
	mains power mon. Delay time	0 to 999 s	1 s			2
	Overload monit.	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	Gen.overload MOP resp.value	80 to 150 %	120 %			2
	Gen.overload MOP delay	0 to 99 s	12 s			2
Synchr.	Gen.overload IOP resp.value	80 to 150 %	120 %			2
Synchr.	Gen.overload IOP delay	0 to 99 s	15 s			2
	Rev./red.power monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	Rev./red.power resp.value	-99 to 0 to +99 %	-10 %			2
	Rev./red.power delay	0.0 to 9.9 s	3.5 s			2
	Load unbalanced monitoring	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	Load unbalanced max.	0 to 100 %	30 %			2
	Load unbalanced delay	0.02 to 99.98 s	5.00 s			2
	Gen.overcurrent monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	Gen.overcurrent limit 1	0 to 300 %	120 %			2
	Gen.overcurrent delay 1	0.02 to 99.98 s	0.20 s			2
	Gen.overcurrent limit 2	0 to 300 %	150 %			2
	Gen.overcurrent delay 2	0.02 to 99.98 s	0.04 s			2
	Gen.frequency- Monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	Gen. overfreq. f >	40.0 to 85.0 Hz	55.00 Hz			2
	Gen. overfreq. delay	0.02 to 9.98 s	0.30 s			2
	Gen. underfreq. f <	40.0 to 85.0 Hz	45.00 Hz			2
	Gen. underfreq. delay	0.02 to 9.98 s	0.30 s			2
	Motor over speed >	0 to 9,999 rpm	1,900 rpm			2
	Gen.voltage- Monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	Gen.overvoltage U >	70 to 130 10 to 520 V	440 V			2
	Gen.overvoltage delay	0.02 to 9.98 s	0.30 s			2
	Gen.undervoltage U <	70 to 130 10 to 520 V	360 V			2
	Gen.undervoltage Delay time	0.2 to 9.98 s	0.30 s			2
	Mains frequency Monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	Mains overfreq. f >	40.0 to 70.0 Hz	50.30 Hz			2
	Mains overfreq. Delay time	0.02 to 9.98 s	0.06 s			2
	Mains underfreq. f <	40.0 to 70.0 Hz	49.70 Hz			2
	Mains underfreq. Delay time	0.02 to 9.98 s	0.06 s			2

Option	Parameter 1. Line Text 2. Line	Adjustment range	Standard setting	Customer settings		Code level
	CONFIGURATION OF THE PROTECTIVE UNITS					
≥V1.0700	**Mains volt.monit.**	phase-phase phase-neutral	phase-phase	☐ pp ☐ pn	☐ pp ☐ pn	2
	Mains voltage Monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
<V1.0700	**Mains overvolt. U >**	20 to 130 20 to 520 V	440 V			2
≥V1.0700	**Mains overvolt. U Ph.-Ph. >**	20 to 520 V	440 V			2
≥V1.0700	**Mains overvolt. U Ph.-N. >**	20 to 300 V	254			2
	Mains overvolt. Delay time	0.02 to 9.98 s	0.06 s			2
	Mains undervolt. U <	20 to 130 20 to 520 V	360 V			2
≥V1.0700	**Mains undervolt. U Ph.-Ph. <**	20 to 520 V	360 V			2
≥V1.0700	**Mains undervolt. U Ph.-N. <**	20 to 300 V	208			2
	Mains undervolt. Delay time	0.02 to 9.98 s	0.06 s			2
	Phase shift monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
	Monitoring	single-/only three-phase	only three-phase			2
	Phase shifting (One phase)	3 to 30 °	12 °			2
	Phase shifting (3-phase)	3 to 30 °	8 °			2
	Batt. undervolt. U <	10.0 to 35.0	8.0 V			2
	Batt. undervolt. Delay	0 to 99 s	40 s			2

Option	Parameter 1. Line Text 2. Line	Adjustment range	Standard setting	Customer settings		Code level
	CONFIGURATION OF DISCRETE INPUTS					
	Configure dig.inputs	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	Dig. input 1234 function	D/E	DDDD	☐ D ☐ E	☐ D ☐ E	2
	Dig. input 1234 Delay	0 to 9	0000			2
	Delayed by 1234 eng.speed	Y/N	NNNN	☐Y ☐ N	☐ Y ☐ N	2
	Dig. input 1234 Failclass	0 to 3	3210			2
	Dig. input 5678 function	D/E	DDDD	☐ D ☐ E	☐ D ☐ E	2
	Dig. input 5678 Delay	0 to 9	0000			2
	Delayed by 5678 eng.speed	Y/N	NNNN	☐ Y ☐ N	☐ Y ☐ N	2
	Dig. input 5678 Failclass	0 to 3	1111			2
	Dig. input 9ABC function	D/E	DDDD	☐ D ☐ E	☐ D ☐ E	2
	Dig. input 9ABC Delay	0 to 9	0000			2
	Delayed by 9ABC eng.speed	Y/N	NNNN	☐ Y ☐ N	☐ Y ☐ N	2
	Dig. input 9ABC Failclass	0 to 3	1111			2
	Dig. input DEFG function	D/E	DDDD	☐ D ☐ E	☐ D ☐ E	2
	Dig. input DEFG Delay	0 to 9	0000			2
	Delayed by DEFG eng.speed	Y/N	NNNN	☐ Y ☐ N	☐ Y ☐ N	2
	Dig. input DEFG Failclass	0 to 3	1111			2
	alarmtext ter. 61	Any	Terminal 61			2
	Firing speed by ter. 62	YES/NO	NO			2
	alarmtext ter. 62	Any	Terminal 62			2
	Lock oper. mode via ter. 63	YES/NO	NO			2
	alarmtext ter. 63	Any	Terminal 63			2
	Open transition via ter. 64	YES/NO	NO			2
	alarmtext ter. 64	Any	Terminal 64			2
	alarmtext ter. 65	Any	Terminal 65			2
	alarmtext ter. 66	Any	Terminal 66			2
	Close GCB asap via ter. 67	YES/NO	NO			2
	alarmtext ter. 67	Any	Terminal 67			2
	Emergency Off via ter. 68	YES/NO	NO			2
	alarmtext ter. 68	Any	Terminal 68			2
	alarmtext ter. 69	Any	Terminal 69			2
	alarmtext ter. 70	Any	Terminal 70			2
	alarmtext ter. 71	Any	Terminal 71			2
	alarmtext ter. 72	Any	Terminal 72			2
	alarmtext ter. 73	Any	Terminal 73			2
	alarmtext ter. 74	Any	Terminal 74			2
	Function term. 6:	sprinkler operation engine release ext.acknowledgement engine blocking Start without CB.	Ext. acknowledg.	☐ sprinkl. ☐ eng. rel. ☐ ext. ackn. ☐ eng. bl. ☐ st. woCB	☐ sprinkl. ☐ eng. rel. ☐ ext. ackn. ☐ eng. bl. ☐ st. woCB	2

Option	Parameter 1. Line Text 2. Line	Adjustment range	Standard setting	Customer settings		Code level
	CONFIGURATION OF ANALOG INPUTS					
T4	Configure analg. input	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
T4	Temperature in:	Fahrenheit/Celsius	Celsius	☐ °C ☐ °F	☐ °C ☐ °F	2
T4-1	Temperature 1 Pt100/Pt1000	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	***name****	Any				2
..	limit warning	0 to 255 °C	80 °C			2
..	limit shutdown	0 to 255 °C	90 °C			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog. input 1 PTC	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	limit warning value	0 to 100 %	0 %			2
..	limit shutdown value	0 to 100 %	100 %			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog. input 1 VDO Temp.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	limit warning	0 to 150 °C	80 °C			2
..	limit shutdown	0 to 150 °C	90 °C			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog input 1 VDO Press.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	Pressure in bar	bar/psi	bar	☐ bar ☐ psi	☐ bar ☐ psi	2
..	analog input 1 VDO	0-5/0-10 bar	0-5 bar	☐ 5 ☐ 10	☐ 5 ☐ 10	2
..	Limit warning value	0.0 to 10.0 bar	2.0 bar			2
..	Limit shutdown value	0.0 to 10.0 bar	1.0 bar			2
..	Analog input 1 VDO	0-73/0-145 psi	0-73 psi	☐ 73 ☐ 145	☐ 73 ☐ 145	2
..	Limit warning value	0.0 to 145.0 psi	8.0 psi			2
..	Limit shutdown value	0.0 to 145.0 psi	9.0 psi			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog input 1 scalable	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	analog input 1	0-20mA/4-20mA	4-20 mA			2
..	value at 0 %	-9,999 to 0 to 9,999	0			2
..	value at 100 %	-9,999 to 0 to 9,999	100			2
..	limit warning value	-9,999 to 0 to 9,999	80			2
..	limit shutdown value	-9,999 to 0 to 9,999	90			2
..	Delay limit 1/2	0 to 999 s	1 s			2
T4-1	Monitoring for	high/low limit monit.	high limit mon.	☐ h ☐ l	☐ h ☐ l	2
T4-2	Temperature 2 Pt100/Pt1000	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	***name****	Any				2
..	limit warning	0 to 255 °C	80 °C			2
..	limit shutdown	0 to 255 °C	90 °C			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog. input 2 PTC	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	limit warning value	0 to 100 %	0 %			2
..	limit shutdown value	0 to 100 %	100 %			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog. input 2 VDO Temp.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	limit warning	0 to 150 °C	80 °C			2
..	limit shutdown	0 to 150 °C	90 °C			2
..	Delay limit 1/2	0 to 999 s	1 s			2
T4-2	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2

Option	Parameter 1. Line Text 2. Line	Adjustment range	Standard setting	Customer settings		Code level
	CONFIGURATION OF ANALOG INPUTS					
T4-2	Analog input 2 VDO Press.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	Pressure in bar	bar/psi	bar	☐ bar ☐ psi	☐ bar ☐ psi	2
..	analog input 2 VDO	0-5/0-10 bar	0-5 bar	☐ 5 ☐ 10	☐ 5 ☐ 10	2
..	Limit warning value	0.0 to 10.0 bar	2.0 bar			2
..	Limit shutdown value	0.0 to 10.0 bar	1.0 bar			2
..	Analog input 2 VDO	0-73/0-145 psi	0-73 psi	☐ 73 ☐ 145	☐ 73 ☐ 145	2
..	Limit warning value	0.0 to 145.0 psi	8.0 psi			2
..	Limit shutdown value	0.0 to 145.0 psi	9.0 psi			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog input 2 scalable	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	analog input 2	0-20mA/4-20mA	4-20 mA			2
..	value at 0 %	-9,999 to 0 to 9,999	0			2
..	value at 100 %	-9,999 to 0 to 9,999	100			2
..	limit warning value	-9,999 to 0 to 9,999	80			2
..	limit shutdown value	-9,999 to 0 to 9,999	90			2
..	Delay limit 1/2	0 to 999 s	1 s			2
T4-2	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
T4-3	Temperature 3 Pt100/Pt1000	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	***name****	Any				2
..	limit warning	0 to 255 °C	80 °C			2
..	limit shutdown	0 to 255 °C	90 °C			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog. input 3 PTC	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	limit warning value	0 to 100 %	0 %			2
..	limit shutdown value	0 to 100 %	100 %			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog. input 3 VDO Temp.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	limit warning	0 to 150 °C	80 °C			2
..	limit shutdown	0 to 150 °C	90 °C			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog input 3 VDO Press.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	Pressure in bar	bar/psi	bar	☐ bar ☐ psi	☐ bar ☐ psi	2
..	analog input 3 VDO	0-5/0-10 bar	0-5 bar	☐ 5 ☐ 10	☐ 5 ☐ 10	2
..	Limit warning value	0.0 to 10.0 bar	2.0 bar			2
..	Limit shutdown value	0.0 to 10.0 bar	1.0 bar			2
..	Analog input 3 VDO	0-73/0-145 psi	0-73 psi	☐ 73 ☐ 145	☐ 73 ☐ 145	2
..	Limit warning value	0.0 to 145.0 psi	8.0 psi			2
..	Limit shutdown value	0.0 to 145.0 psi	9.0 psi			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog input 3 scalable	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	analog input 3	0-20mA/4-20mA	4-20 mA			2
..	value at 0 %	-9,999 to 0 to 9,999	0			2
..	value at 100 %	-9,999 to 0 to 9,999	100			2
..	limit warning value	-9,999 to 0 to 9,999	80			2
..	limit shutdown value	-9,999 to 0 to 9,999	90			2
..	Delay limit 1/2	0 to 999 s	1 s			2
T4-3	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2

Option	Parameter 1. Line Text 2. Line	Adjustment range	Standard setting	Customer settings		Code level
	CONFIGURATION OF ANALOG INPUTS					
T4-4	Temperature 4 Pt100/Pt1000	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	***name****	Any				2
..	limit warning	0 to 255 °C	80 °C			2
..	limit shutdown	0 to 255 °C	90 °C			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog. input 4 PTC	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	limit warning value	0 to 100 %	0 %			2
..	limit shutdown value	0 to 100 %	100 %			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog. input 4 VDO Temp.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	limit warning	0 to 150 °C	80 °C			2
..	limit shutdown	0 to 150 °C	90 °C			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog input 4 VDO Press.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	Pressure in bar	bar/psi	bar	☐ bar ☐ psi	☐ bar ☐ psi	2
..	analog input 4 VDO	0-5/0-10 bar	0-5 bar	☐ 5 ☐ 10	☐ 5 ☐ 10	2
..	Limit warning value	0.0 to 10.0 bar	2.0 bar			2
..	Limit shutdown value	0.0 to 10.0 bar	1.0 bar			2
..	Analog input 4 VDO	0-73/0-145 psi	0-73 psi	☐ 73 ☐ 145	☐ 73 ☐ 145	2
..	Limit warning value	0.0 to 145.0 psi	8.0 psi			2
..	Limit shutdown value	0.0 to 145.0 psi	9.0 psi			2
..	Delay limit 1/2	0 to 999 s	1 s			2
..	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
..	Analog input 4 scalable	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off	2
..	Name and unit	Any				2
..	analog input 4	0-20mA/4-20mA	4-20 mA			2
..	value at 0 %	-9,999 to 0 to 9,999	0			2
..	value at 100 %	-9,999 to 0 to 9,999	100			2
..	limit warning value	-9,999 to 0 to 9,999	80			2
..	limit shutdown value	-9,999 to 0 to 9,999	90			2
..	Delay limit 1/2	0 to 999 s	1 s			2
T4-4	Monitoring for	high/low limit monit.	high limit monit.	☐ h ☐ l	☐ h ☐ l	2
T4	Ana input 1234 Superv.del.	Y/N	YYYY			2
T4	Ana input 567 Superv.del.	Y/N	YYY			2
	CONFIGURATION OF THE ANALOG OUTPUTS					
A2	Configure outputs?	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
..	Anal.out 120121 Parameter	0 to 22	1			2
..	Anal.out 120121 0-00mA	0-20mA/4-20mA	0-20 mA			2
..	Anal.out 120121 0 %	0 to 9,990	0			2
..	Anal.out 120121 100 %	0 to 9,990	200			2
..	Anal.out 122123 Parameter	0 to 22	1			2
..	Anal.out 122123 0-00 mA	0-20mA/4-20mA	0-20 mA			2
..	Anal.out 122123 0 %	0 to 9,990	0			2
A2	Anal.out 122123 100 %	0 to 9,990	200			2
	Assignm. relay 1	According to list	1			2
	Assignm. relay 2	According to list	2			2
	Assignm. relay 3	According to list	82			2
	Assignm. relay 4	According to list	83			2

Option	Parameter 1. Line Text 2. Line	Adjustment range	Standard setting	Customer settings		Code level
	CONFIGURATION OF THE ENGINE					
	Configure engine	YES/NO	YES	☐ Y ☐ N	☐ Y ☐ N	2
	Aux. services prerun	0 to 999 s	0 s			2
	Aux. services postrun	0 to 999 s	0 s			2
	Start-Stop-Logic for	DIESEL/GAS	Diesel			2
	min. speed for	0 to 999 rpm	100 rpm			2
Gas	**Ignition delay**	1 to 99 s	3 s			2
..	**Gasvalve Delay**	1 to 99 s	5 s			2
..	**Starter time**	2 to 99 s	5 s			2
..	**Start pause time**	1 to 99 s	8 s			2
..	**freq. low before start**	ON/OFF	OFF	☐ o ☐ c	☐ o ☐ c	2
Gas	**action time for freq. low**	0 to 999 s	5 s			2
Diesel	**Preglow time**	0 to 99 s	3 s			2
..	**Starter time**	2 to 99 s	5 s			2
..	**Start pause time**	1 to 99 s	8 s			2
..	**freq. low before start**	ON/OFF	OFF	☐ o ☐ c	☐ o ☐ c	2
..	**action time for freq. low**	0 to 999 s	5 s			2
Diesel	**Start-Stop-Logic**	open/close to stop	close to stop	☐ o ☐ c	☐ o ☐ c	2
	Cooldown time	0 to 999 s	30 s			2
	firing speed by Term. 62	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	Delayed engine monitoring	1 to 99 s	8 s			2
	Firing speed reached: f>	15 to 70 Hz				2
	Pickup input	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off	2
	nominal speed Gen. 1/min	1,000 to 2,000 rpm	1,500 rpm			2
	Number of pickup teeth	30 to 280	96			2
	COUNTER CONFIGURATION					
	Configure Counter	YES/NO	Yes	☐ Y ☐ N	☐ Y ☐ N	2
	Service Interval in	0 to 99,999 h	300 h			1
	Set oper.hours counter	0 to 65,000 h	0 h			2
	Start counter set	0 to 32,749	0			2

Appendix G.
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 type of 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 Governor Company
Leonhard-Reglerbau GmbH
Handwerkstrasse 29
70565 Stuttgart - Germany

Phone: +49 (0) 711 789 54-0 (8:00 - 16:30 German time)
Fax: +49 (0) 711 789 54-100
eMail: sales-stuttgart@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) 230 7111
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 GCP _____

Serial number S/N _____

Description of your problem

_____

_____

_____

_____

_____

_____

Please be sure you have a list of all parameters available. You can print this using LeoPC1. Additionally you can save the complete set of parameters (standard values) and send them to our Service department via e-mail.

We appreciate your comments about the content of our publications.

Please send comments to: stgt-documentation@woodward.com

Please include the manual number from the front cover of this publication.

Woodward Governor Company
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Homepage

http://www.woodward.com/smart-power

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address/phone/fax/e-mail information for all locations is available on our website (www.woodward.com).

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