WOODWARD

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PCM1x Packages (Pxx) Genset Control Configuration Software Version 4.3

CE

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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 over-pressure, where applicable) shutdown unit(s), that operates totally independently of the prime mover control unit(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 unit(s) fail.

CAUTION

To prevent damage to a control system that uses an alternator or battery-charging unit, make sure the charging unit 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 units.

Important Definitions

WARNING

To avoid the destruction of electric components due to improper handling, please read and adhere to the relevant notes.

CAUTION

Indicates a potentially hazardous situation that, if not avoided, could result in damage to equipment. This note should absolutely be observed when connecting the unit.

NOTE

References to other notes and supplements as well as tables and lists are identified by means of the "i" symbol. Most of the referenced sections are included in the Annex.

1 General Information

Type		English	German
PCM1x Packages (Pxx)			
PCM1x Packages (Pxx) - Installation		PCx Vers. 4.3	PCx Vers. 4.3
PCM1x Packages (Pxx) - Configuration	this manual ⇨	PCx Vers. 4.3	PCx Vers. 4.3
PCM1x Packages (Pxx) - Function/Operation		PCx Vers. 4.3	PCx Vers. 4.3

Table 1-1: Manual - Overview

2 Function

2.1 Considerations To Be Taken:

2.1.1 Different Options

According to a control unit's configuration, different parameters may be displayed and not all parameters will be available:

- Various inputs and outputs will be present or deleted, corresponding to the control configuration (depending on your order). Please refer to the wiring diagram and the notes regarding the packages contained in these. Refer to the data plate to see if the corresponding function is contained in the control. If the data plate has been removed, the configuration screens may be called up in succession and the functions may be determined with the assistance of this manual.
- Specific display screens correspond to specific types of interfaces.

2.1.2 Systems With One Power Circuit Breaker

If a control with a 2-power-circuit-breaker logic [PCM1-M] or a 1-power-circuit-breaker logic [[PCM1-G] is installed for use with one power circuit breaker, the following shall apply:

- If the control unit application is to be operated in an isolated operation or an isolated parallel operation (the MCB is opened), the following signals must be applied:
  - "Reply: MCB is open" / "Isolated operation" (terminal 54): HIGH signal (logical "1") and
  - "Enable MCB" (terminal 53): LOW signal (logical "0").
  - Condition: The Parameter 150 "Emergency power" must be set to "OFF".
- If the control unit application is to be operated in a mains parallel operation (the MCB always is closed if the generator operates in mains parallel), the following signals have to be applied:
  - "Reply: MCB is open" / "Isolated operation" (term. 54): LOW-Signal (log. "0") and
  - "Enable MCB" (terminal 53): HIGH signal (logical "1").
- If the control unit application is to be operated in isolated(parallel) as well as in mains parallel operation (the MCB can be opened or closed), the following signals have to be applied:
  - Reply, that the GCB is closed (terminal 4) and
  - Reply, that the MCB is closed (terminal 54) and
  - "Enable MCB" (terminal 53)

  Case A - The MCB must remain closed (except at an emergency power operation): The "Enable MCB" (terminal 53) always has to be logical "1".

  Case B - The MCB can be opened (also outside an emergency power operation): The "Enable MCB" (terminal 53) must be set logical "1" if a mains parallel operation has to be established (a synchronization of the MCB has to be performed). During the synchronization of the MCB (PCM1-G: this function is performed externally from the controller) the generator frequency is controlled with a slightly higher value than the mains frequency (df max/2). Additionally a message is displayed on the controller. The "Enable MCB" (terminal 53) has to be logically "0", if the system has to be operated in isolated operation (control of set point frequency and set point voltage).

2.1.3 Systems With Asynchronous/Induction Generators (Special Hardware !!)

In the case of systems with asynchronous/induction generators, the following must be noted:

- Systems with asynchronous/induction generators are 1-power-circuit-breaker systems [PCM1-G].
- Connect the remnant voltage to terminals 23/24. Terminals 23/24 are voltage sensitive and can detect voltages from 0.5-480 volts. These terminals are utilized to determine the frequency (rotary speed) of the remnant voltage with small amplitudes. If the GCB is not closed, only the remanence voltage, which is less than 10 volts, is measured instead of the generator voltage. The generator voltage and frequency is monitored only once the GCB is closed. If the control is in mains parallel operation, the inputs from 23/24 are no longer taken into account.

2.2 Signals

2.2.1 Discrete Inputs

NOTE

All emergency power (Parameter 150 "Emergency power" has to be configured to ON) or Critical (Sprinkler) mode operations (terminal 6 must be configured accordingly; Parameter 223) will be carried out in the TEST and AUTOMATIC operation modes regardless of the discrete inputs "Automatic 1" and "Automatic 2". If terminals 3 and 5 are enabled simultaneously, priority is given to terminal 3.

Automatic 1 (Start/Stop the engine) **Terminals 3/7**

Selection of the operation mode AUTOMATIC with "real power set point value 1" as well as starting/stopping of the engine.

Set ..... If the control is in AUTOMATIC mode (selected using the mode selection switch on the front panel) the "real power set point value 1" (Parameter 41) is controlled in mains parallel mode. In the case of baseload (F), the engine is started immediately and mains parallel operation is performed following the synchronization of the generator power circuit breaker GCB. In the case of incoming/import (I) or outgoing/export power (E), starting is performed by automatic start/stop operation. If no automatic start/stop operation is enabled (Parameter 101), the engine is started immediately. The set point value can be modified via both the configuration mode and via the "up/down" push-buttons in AUTOMATIC mode.

Reset..... If the engine does not run either in Critical (Sprinkler) mode or emergency power mode, the GCB is opened, a cool down is performed and the engine is stopped.

Automatic 2 (Start/Stop the engine) **Terminals 5/7**

Selection of the operation mode AUTOMATIC with "real power set point value 2" as well as starting/stopping of the engine.

Set..... If the control is in AUTOMATIC mode (selected using the mode selection switch on the front panel) the "real power set point value 2" (Parameter 42) is controlled in mains parallel mode. In the case of baseload (C), the engine is started immediately and mains parallel operation is performed following the synchronization of the generator power circuit breaker GCB. In the case of incoming/import (I) or outgoing/export power (E), starting is performed by automatic start/stop operation. If no automatic start/stop operation is enabled (Parameter 102), the engine is started immediately. The set point value can be modified via both the configuration mode and via the "up/down" push-buttons in AUTOMATIC mode.

Reset..... If the engine does not run either in Critical (Sprinkler) mode or emergency power mode, the GCB is opened, a cool down is performed and the engine is stopped.

If a set point value is specified externally (e. g. via an 0/4..20 mA analog input or a bi-directional interface), the external set point value is adjusted with the discrete input (see Table 3-3: Set point value table).

Multifunction **Terminals 6/7**

Discrete input terminal 6 may reveal different functions. Please note that, when used as a Critical (Sprinkler) mode input, the discrete input reveals negative functional logic. The selection of the logic is made using Parameter 223.

Reply: GCB is open **Terminals 4/7**

With this input (logical "1") the control is signaled that the GCB is open (the "GCB ON" LED is off).

[PCM1-M] Reply: MCB is open **Terminals 54/7**

With this input (logical "1") the control is signaled that the MCB is open (the LED "MCB ON" is off).

[PCM1-G] Isolated operating / reply external breaker **Terminals 54/7**

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

Enable MCB **Terminals 53/7**

Set .....A mains parallel operation is enabled and the MCB (PCM1-G: this function is performed externally from the controller) is operated.

Reset .....The MCB is not operated. Depending on the reply of the MCB, an isolated operation or a main parallel operation is performed.

Discrete inputs **Terminals 34-36/33 and 61-73/60**

Freely programmable alarm inputs with message text, alarm class, time delay, delayed engine monitoring and NO/NC function.

2.2.2 Control Outputs

Readiness for operation **Terminals 18/19**

Setting this relay signals the readiness for operation of the control. If this relay is disabled, the proper function of the control can no longer be guaranteed. Appropriate actions must be initiated once this relay has been disabled (e.g. open GCB, shut-down engine).

Preheating (Diesel engine) **pre-assigned to terminals 37/38**

When this relay is enabled, the diesel engine's glow plugs are enabled (please note chapter "Diesel Engine").

Ignition "ON" (Gas engine) **pre-assigned to terminals 37/38**

When this relay is enabled, the ignition of the gas engine is switched on (please note chapter "Gas Engine").

Fuel relay/gas valve **Terminals 43/44**

a) Diesel engine: fuel relay (Parameter 282)

a.1) Operating solenoid

Enabling this relay will initiate the starting sequence of the diesel engine. If the engine is to be shutdown the relay will immediately de-energize. If the speed of the engine drops below the adjustable ignition speed, the relay also de-energizes (note chapter "Diesel Engine").

a.2) Stopping solenoid

Enabling this relay will stop the engine.

b) Gas engine: gas valve

Enabling this relay will initiate the starting sequence of the gas engine. The gas valve will be opened. If the engine is to be shut down the relay will immediately de-energize. If the speed of the engine falls below the adjustable firing speed (Parameter 285), the relay also de-energizes (note chapter "Gas Engine").

Starter **Terminals 45/46**

Enabling this relay will engage the starter. When the firing speed is reached (Parameter 285), at STOP mode, or after expiration of the crank time (Parameter 272 or Parameter 278), the starter is disengaged.

Centralized alarm **pre-assigned to terminals 47/48**

Enabling this relay will issue a centralized alarm. This permits a horn or buzzer to be operated by the control unit during a fault condition. The operator can reset the relay by pressing the push-button "RESET" for a short period. The relay will be set again in the event of another alarm. The centralized alarm is set for alarms of alarm classes F1 through F3.

Command: close GCB **Terminals 14/15**

Enabling this relay will close the GCB. If the GCB closing command is configured to continuous current (Parameter 120), in response to a missing discrete input "Reply: GCB is open" the relay is maintained in its closed state; this also applies if the voltages of the generator and the busbar are equal. In the event of a class F3 alarm this relay de-energizes immediately. In the event of a class F2 alarm or for shutdown the relay does not de-energize immediately, it will de-energize if the power is less than 3.125 % of the rated generator power. If operation of the GCB is configured as a momentary pulse, the relay de-energizes after the pulse is output. This function must be used in conjunction with an external holding coil for the GCB.

Command: open GCB **Terminals 41/42**

Enabling this relay will open the GCB. Following "Reply: GCB is open", the relay output is de-energized.

[PCM1-M] Command: close MCB **Terminals 16/17**

Enabling this relay will close the MCB. This output is always a momentary pulse. For the MCB to remain closed an external holding coil must be used.

[PCM1-M] Command: open MCB **Terminals 39/40**

By enabling this relay, the MCB will open. Following "Reply: MCB is open", the relay output is de-energized.

Relay manager **Terminals 74-83, 33-38, 47/48**

The "Relay Manager" manages the relays listed here (Parameter 263).
Default values:

- Relay 1-5 = relay number (e. g. relay 1 = alarm class 1, relay 2 = alarm class 2, etc.)
- Relay 6 = Ignition / preheating
- Relay 7 = Centralized alarm

3 Parameter

Configuration can be performed using a PC and the PC program FL-SOFT3 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) and
- CAN bus (CiA) (RS-485) = 125, 250 or 500 kBaud configurable via the serial interface.

CAUTION

For configuration of this control (firmware software version starting with 4.3xxx) a PC software with the following version number or higher must be used:

FL-SOFT3 from 3.1

Because of functional enhancements within the controls of the PCM Series it is necessary (beginning with firmware version 4.3.xxx of the PCM) to use a newer version of the configuration software FL-SOFT3. This version at least must be 3.1 or higher.

After an updated version of FL-SOFT3 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 90 seconds.

NOTE

There are two different types of hardware, which are described in this manual: A 120 Vac version [1] and a 480 Vac version [4]. The configuration screens and parameters differ in both versions, and the setting limits also differ. The two types are identified by the preceding voltage values ([1] ... or [4] ...).

3.1 Basic Data

3.1.1 Version Number (Software Version)

Parameter 1

Software version **Vx.xxxx**

Software version

Display of the software version.

3.1.2 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 25). 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 FL-SOFT3.

Parameter 2

Enter code **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).

3.1.3 Direct Configuration

NOTE

To carry out direct configuration, you require a direct configuration cable (order code "FL-CABLE-RS232"), the FL-SOFT3 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 FL-SOFT3 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. The password must also be entered prior to loading languages. If the code for level CS2 is entered via the front panel of the control, the access for configuration via the CAN bus is automatically enabled.

WARNING

If Parameter 3 "Direct para." is configured to "YES", communication via the interface with terminals X1-X5 is blocked. If communication is to be re-established via interface X1-X5 after finishing the configuration of the control (e.g. CAN bus connection via a Gateway GW 4), Parameter 3 must be configured to "NO"!

The direct configuration port is diabled (Parameter 3 is automatically switched from YES to NO) once the firing speed (Parameter 285) 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 3

Direct para.
YES

Direct configuration **YES/NO**

YES .....Configuration via the lateral plug is enabled, and any CAN bus connection that may be available via terminals X1-X5 is disabled. The following conditions must be met in order to carry out configuration via the lateral plug:
- A connection must be established via the direct configuration cable between the control and the PC,
- The baud rate of the FL-SOFT3 program must be set to 9,600 Baud and
- The corresponding configuration file must be used (file name: "xxxx-xxxx-yyy-zz.asm").

NO .....Configuration via the lateral plug cannot is disabled, and any available CAN bus connection via the terminals X1-X5 is enabled.

3.1.4 Generator Number

Parameter 4

Generator number
0

Generator number (number of the control on the CAN bus) 1-14

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 FL-SOFT3.

3.1.5 Language Manager (Package P01)

In order to load a different language into the control, follow the steps below:

1.) A communication link between your PC and the control unit must be established via the direct configuration cable (FL-CABLE-RS232). To do this insert the serial cable into the COM port of your PC and the RJ45 plug into the communication port of the control unit (a connection via CAN and PCK 4 is also possible).
2.) Enter the password for code level CS2 into the control (Parameter 2).
3.) If the direct configuration cable (FL-CABLE-RS232) is to be utilized, the Parameter 3 "Direct para." must be configured as "YES". If a PCK 4 or the CAN bus is to be utilized for configuration, the Parameter 3 "Direct para." must be configured as "NO".
4.) If the desired language is to be loaded via the CAN bus, enter the number (1-14) into the "Generator number" screen (Parameter 4), so that FL-SOFT3 is able to communicate with the desired control unit.
5.) Scroll to the configuration screen "Language" (Parameter 5) and select the primary language for the control unit by selecting "first".
6.) Start the program FL-SOFT3, and log into the program by selecting "System" from the tool bar and "User login…" from the drop down menu. Enter the user name and password and click the "OK" button.
7.) Open the applicable *.cfg file for the application by selecting "File" from the tool bar and "open" from the drop down menu. Select the proper *.cfg file from the window that appears.
8.) To start communication between the control unit and FL-SOFT3 select "Communication" from the tool bar and "Connect" from the drop down menu.
9.) Select "Devices" from the tool bar and "Parameterize…" from the drop down menu. A window will appear with all the tunable parameters in it. Move the cursor over the numbers for the password and double click.
10.) Enter the password for the code level CS 2 (Parameter 2).
11.) Close the parameterization window.
12.) Select "Devices" from the tool bar and "Load language…" from the drop down menu.
13.) Load the desired language file using the button "Load LNG file …"
14.) Select the desired language and click the "Transfer language" button.
15.) If an additional language is to be loaded into the control unit, return to step 5 and select "second" (not possible via FL-SOFT3). Repeat all steps in order as when programming the first language.

Parameter 5

Language

Language first/second

first ..... All texts are displayed in the first language.
second ..... All texts are displayed in the second language.

3.1.6 Service Display

Please note the description of these screens in manual "Operation".

3.2 Event Logger (Package P01)

NOTE

Displaying and clearing of events depends on access authorization:

- Displaying of events .....Access authorization CS# 1 und CS# 2
- Clearing of events.....Access authorization CS# 2

CS = Code level (see chapter "

Configuration" on page 13.

When an event (see following table) occurs it is stored in the event logger. The following information is recorded:

- Event
- Date of occurrence
- Time of occurrence

Up to 50 events can be stored in the event logger (beginning with the most current one). For more than 50 entries, the oldest event will be deleted. By pressing the "RESET" push-button, the event that is displayed is cleared. The events are displayed on two lines. The top line indicates the date and time of the event that has occurred; the lower line shows the type of event.

Parameter 6

check event list
YES

Event logging **YES/NO**

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

NOTE

Starting from version 4.3010, the event logger can also be read via CAN. This enables to read the event logger via PCK4/modem for example.

If the event logger is to be read via CAN, the respective connection, e.g. PCK4, has to be selected in FI-SOFT3. Reading the event logger is then performed like for direct configuration.

3.2.1 Possible Event Logger Entries

Parameter 7

YY-MM-DD ss:mm
xxxxxxxxxxxxx

50 × alarm log

YY-MM-DD ss:mm.....Display of day and time of the event.
xxxxxxxxxxxxxxx.....See bottom table.

Event type	xxxxxxxxxxxxxxxx	
	German	English
Internal events		
Engine overspeed (Pickup)	Überdrehzahl	Over speed
Generator overfrequency	Überfrequenz	Overfrequency
Generator underfrequency	Unterfrequenz	Underfrequency
Generator overvoltage	Gen.-Überspg.	Gen.overvolt.
Generator undervoltage	Gen.-Unterspg.	Gen.undervolt.
Generator overcurrent, level 1	Gen.-Überstrom 1	Gen.overcurr. 1
Generator overcurrent, level 2	Gen.-Überstrom 2	Gen.overcurr. 2
Reverse/reduced load	Rück/Minderleist	Revers/min.power
Overload	Gen.-Überlast	Gen.overload
Load imbalance	Schieflast	Load unbalance
Mains overvoltage	Netz-Überspg.	Mains-overvolt.
Mains undervoltage	Netz-Unterspg.	Mains-undervolt.
Mains overfrequency	Netz-Überfreq.	Mains-underfreq.
Mains underfrequency	Netz-Unterfreq.	Mains-overfreq.
Mains phase/vector jump	Phasensprung	Phase shift
Mains df/dt (optional)	df/dt-Fehler	df/dt error
Battery undervoltage	Batt.-Unterspg.	Batt.undervolt.
GCB synchronization time monitoring	Synch.Zeit GLS	GCB syn.failure
MCB synchronization time monitoring	Synch.Zeit NLS	MCB syn.failure
Switching to dead busbar time monitoring	Stör. df/dU-max.	Failure df/dVmax
Fault P-control: GCB will be opened after time boost/settle	R-Rampe:GLS auf	P-ramp:open GCB
GCB malfunction on closing	Störung GLS ZU	GCBclose failure
MCB malfunction on closing	Störung NLS ZU	MCBclose failure
GCB malfunction on opening	Störung GLS AUF	GCB open failure
MCB malfunction on opening	Störung NLS AUF	mCB open failure
Faulty reference power zero control with interchange synchronization on GCB	Bezugsleist. <>0	Power not zero
Maintenance call	Wartung	Service
Interface monitoring X1-X5	Fehl.Schnit.X1X5	Interf.err. X1X5
Interface monitoring Y1-Y5	Fehl.Schnit.Y1Y5	Interf.err. Y1Y5
Pickup/generator frequency mismatch	Pickup/Gen.Freq.	Pickup/Gen.freq.
Plausibilty control power (optional)	L.-Plausibilität	Plausibility ch.
Shutdown malfunction	Abstellstörung	Stop failure
Start failure	Fehlstart	Start failure
Unintentional stop	ungewollter Stop	unintended stop
Discrete Inputs in the PCM		
Discrete input [D01]	frei parametrierbar	freely configurable
Discrete input [D02]		
Discrete input [D03]		
Discrete input [D04]		
Discrete input [D05]		
Discrete input [D06]		
Discrete input [D07]		
Discrete input [D08]		
Discrete input [D09]		
Discrete input [D10]		
Discrete input [D11]		
Discrete input [D12]		
Discrete input [D13]		
Discrete input [D14]		
Discrete input [D15]		
Discrete input [D16]		

Table 3-1: Event recorder - Messages, part 1

Other Events		
Switched into operation mode MANUAL	BAW Hand	Manual mode
Switched into operation mode AUTOMATIC	BAW Automatik	Automatic mode
Switched into operation mode STOP	BAW Stop	Stop mode
Switched into operation mode TEST	BAW Probe	Test mode
Switched into operation mode Load TEST	BAW Lastprobe	Loadtest mode
"MCB OFF" push-button pressed (in MANUAL MODE)	Taste NLS AUS	Button MCB OFF
"GCB OFF" push-button pressed (in MANUAL MODE)	Taste GLS AUS	Button GCB OFF
"GCB ON" push-button pressed (in MANUAL MODE)	Taste GLS EIN	Button GCB ON
"MCB ON" push-button pressed (in MANUAL MODE)	Taste NLS EIN	Button MCB ON
"START" push-button pressed (in MANUAL MODE)	Taste Hand START	Button START
"STOP" push-button pressed (in MANUAL MODE)	Taste Hand STOP	Button STOP
Remote start	Fernstart	Remote start
Remote stop	Fernstop	Remote stop
Remote acknowledgment via interface	Fernquittierung	Remote acknowl.
Remote acknowledgment via terminal 6	Quittierung Kl.6	Acknowledg-ter 6
Acknowledgment via "RESET" button	Quittierg. Taste	Ackn.button QUIT
Mains failure (AMF)	Netzausfall	Mains failure
Return of the mains (this entry occurs once the mains settling time expired)	Netzwiederkehr	Mains o.k.
Emergency power (AMF) started	Notstrom Anfang	Emerg. run start
Emergency power (AMF) ended	Notstrom Ende	Emerg. run stop
Engine successfully started (engine enabled, firing speed exceeded)	Aggr. gestartet	Start of engine
Engine stopped (engine not enabled, firing speed was undershot)	Aggregatestop	Stop of engine

Table 3-2: Event recorder – Messages, part 2

3.2.2 Analog Inputs

The control unit is not able to display the entire text for the analog alarms. The 6 digits on the left side of the screen are reserved for the analog values to be monitored. If the text for these alarms is expanded, the monitored values will be overwritten and not displayed. The text below is the message that is displayed for each of the fault conditions.

WIRE__.....Wire break
ALARM_.....Limit value 1
STOP__.....Limit value 2

Parameter 8

YY-MM-DD ss:mm
STOP Analog inpu

Example

Limit value 2 (STOP) of the analog input 1 was exceeded. The text of the analog alarm input will be moved 6 letters to the right. In this case the measured value disappears. Please note this text displacing already during the configuration of the analog input!

3.3 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.

Parameter 9

Configure measuring	**YES**

Configuration of the measuring **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.

3.3.1 Rated Values Of The Frequency

Parameter 10

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 11

Rated system frequency	**00.0Hz**

Rated system frequency **50/60 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.

3.3.2 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 (Parameter 18),
- Voltage controller insensitivity (Parameter 64),
- Synchronizing dVmax (Parameter 124),
- Dead bus start GCB dVmax (Parameter 133),
- Threshold generator overvoltage (Parameter 188) as well as
- Threshold generator undervoltage (Parameter 190).

Parameter 12

Gen.volt.transf. secondary 000V

Secondary gen. voltage transformer **[1] 50-125 V; [4] 50-480 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

Gen.volt.transf. primary 00.000kV

Primary gen. voltage transformer **0.050-65.000 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 14

Bus.volt.transf. secondary 000V

Secondary busbar voltage transformer **[1] 50-125 V; [4] 50-480 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 15

Bus.volt.transf. primary 00.000kV

Primary busbar voltage transformer **0.050-65.000 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 (Parameter 198) as well as
- Threshold mains undervoltage (Parameter 200).

Parameter 16

mains volt.trans
secondary 000V

Secondary mains voltage transformer **[1] 50-125 V; [4] 50-480 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 17

mains volt.trans
primary 00.000kV

Primary mains voltage transformer **0.050-65.000 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.

3.3.3 Rated Voltage Values

Parameter 18

Gen.voltage
U set 000V

Generator setpoint voltage **[1] 50 to 125 V; [4] 50- to 530 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. The proportional entry of the parameter "Start voltage V controller" (Parameter 61) refers to this value.

Parameter 19

Rated voltage in
system 000V

Rated voltage **[1] 50 to 125 V; [4] 50 to 480 V**

The rated voltage (V_{L-L}) is preset with this value.
The proportional entries of the following parameters refer to this value:

- Generator voltage monitoring
- Mains voltage monitoring
- Dead band voltage controller
- Synchronization dV max
- Dead bus GCB dV max

Parameter 20

Volt.meas./mon.

This parameter affects the display.

Voltage measuring/voltage monitoring **Ph-neut./Ph-Ph**

Ph-neut/Ph-neut The electrical system(generator, busbar, and mains) consists of the three phase conductors and a neutral conductor. Thus the N lug (terminal 0) must be connected.
The phase-phase conductor voltages and the phase-neutral voltages are shown in the display.
The voltage monitoring entries are referred to the phase-neutral voltages (V_{L-N}).

Ph-neut/Ph-Ph The electrical system(generator, busbar, and mains) consists of the three phase conductors and a neutral conductor. Thus the N lug (terminal 0) must be connected.
The phase-phase conductor voltages and the phase-neutral voltages are shown in the display.
The voltage monitoring entries are referred to the phase-phase voltages (V_{L-L}).

Ph-Ph/Ph-Ph The electrical system(generator, busbar, and mains) consists only of the three phase conductors (without neutral conductor). Thus the N lug (terminal 0) cannot be connected.
Only the phase conductor voltages are shown in the display.
The voltage monitoring entries are referred to the phase-phase voltages (V_{L-L}).

NOTE

Terminal 0 must be isolated for the setting 'Ph-Ph/Ph-Ph' (voltage measuring Ph-Ph, voltage monitoring Ph-Ph), since a contact voltage in inadmissible range may occur at terminal 0.

3.3.4 Generator Current

Parameter 21

Current transf. generator 0000/x

Generator CT's **10-7,000/{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 22

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: $P = \sqrt{3} \cdot U_{L12} \cdot I_{L1} \cdot \cos \varphi$
- 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. In this regard, note the explanations in manual 37238.

Parameter 23

Rated power generator 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 24

Rated current generator 0000A

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

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

3.3.5 Mains Current/Mains Power Measurement

a.) Mains power actual value measurement via analog input (Package P01)

Measurement of the mains power **actual value** measurement via an analog input T{x} [x = 1-7] is possible if at least one of the analog inputs T{x} [x = 1-7] is a 0/4-20 input. Selection of the analog input is performed with the following parameters.

Parameter 25

Analog in Pmains
OFF

Package P01 only

Analog input P-mains: Selection **OFF/T{x}**

OFF.....The mains interchange (import/export) real power **actual value** is calculated out of the measured mains current and the measured mains voltage. The analog inputs can either be used as real power **set point values** or as freely configurable alarm inputs. The following screens of this function are not displayed.

T{x}.....The mains interchange (import/export) real power **actual value** can be transmitted to the control by a measuring transducer and can be measured via the configured free scalable 0/4-20 mA input T{x} ({x} = 1-7) (other types of analog inputs cannot be used). The following screens of this function are displayed.

Note

Please note that the selected analog input T{x}

- Must be configured to OFF (Parameter 227) in chapter "Analog inputs" and that this analog input
- Must not be configured as generator real power **set point value** (Parameter 84)
- T{x}: Dependent on the control model these analog inputs are included and possibly built as 0/4-20 mA type. If the controller being configured is an analog input model, only 0/4-20 mA inputs may be used (only these inputs are displayed for selection at this parameter).
- LeoPC1 is not a dynamic program and must be restarted after reconfiguration of a control unit has been started so the changes are reflected in the graphical display of the PC program.

Priority of the functions of the analog inputs

The following priorities are valid if more than one function has been assigned to a analog input:

- Highest priority: Mains interchange (import/export) real power **actual value**
- Middle priority: Generator real power **set point value**
- Lowest priority: Measuring input as common analog value

Parameter 26

Analog in.Pmains
0-00mA

Package P01 only

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

It is possible to adjust the display range of the mains interchange (import/export) real power **actual value.** Thereto the wanted value must be entered and saved using the Parameter 228 "name and unit" of the selected analog input (see chapter "Analog inputs").

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 27

Analog in.Pmains
0% 0000kW

Package P01 only

Mains real power 0/4 mA
[1] -9,990-0-+9,990 kW; [4] 6,900-0-+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 28

Analog in.Pmains
100% 0000kW

Package P01 only

Mains real power 20 mA
[1] -9,990-0-+9,990 kW; [4] -6,900-0-+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).

b.) Mains current measurement via mains CT

Parameter 29

Current transf.
mains 0000/x

Mains current transformer **5-7,000/{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 the CT is at 60 % of the converter's nominal current flow. A lower percentage may lead to malfunctions due to loss of resolution. Additional inaccuracies in the control and monitoring functions also occur.

{x} = 1 A ..... Secondary rated 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 12.5, 25, 40 or 60 A.

Parameter 30

PCN4 mode
ON

PCM1-G-..-P01 only

CB 4 mode **ON/OFF**

ON..... The PCM is operating in PCN4 mode. The PCM controller expects CAN bus messages from an PCN 4 and reacts accordingly. Additionally the PCM controller transmits messages to the PCN 4.
OFF ..... The control PCM operates as a normal genset control without PCN 4 functionality.

Parameter 31

Rated power in
system 00000kW

PCM1-G-..-P01 only

Rated power in the system **0-16,000 kW**

The PCN4 transmits the current mains interchange real power in percent related to the rated power in the system to PCM controller.

Note
This configuration is valid only if Parameter "PCN4 mode" is configured to ON.

ATTENTION
Since the PCN4 is only able to transmit a percentage value related to the rated power, it is absolutely necessary to configure the rated power in all units (PCN4 and PCM; in the PCM the Parameter 23) to the same value.

c.) Measurement Units

NOTE

FL-SOFT3 is not a dynamic program and must be restarted after reconfiguration of a control unit has been started so the changes are reflected in the graphical display of the PC program.

Parameter 32

Temperature in

Analog inputs; temperature measurement in ... Celsius/Fahrenheit

The analog input for temperature measurement may be configured to display in °C or °F. The configured engineering unit is displayed in the LC display or transmitted via the CAN bus to other HMIs within the control system.

°C ⇨ °F	°F ⇨ °C
$1\ °F = \left([\text{value}]\ °C \times 1{,}8\ °F/°C\right) + 32\ °F$	$1\ °C = \frac{\left([\text{value}]\ °F - 32\ °F\right)}{1{,}8\ °F/°C}$

Parameter 33

Pressure in

Analog inputs; pressure measurement in ... bar/psi

The analog input for temperature measurement may be configured to display in bar or phi. The configured engineering unit is displayed in the LC display or transmitted via the CAN bus to other His within the control system.

bar ⇨ psi	psi ⇨ bar
$1\ \text{psi} = [\text{value}]\ \text{bar} \times 14{,}501$	$1\ \text{bar} = \frac{[\text{value}]\ \text{psi}}{14{,}501}$

3.3.6 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 34

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 35

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**

3.4 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 36

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.

3.4.1 Table Of Set Point Values

Automatic 1	Automatic 2	Control via interface	External set point value	Specification of the set point value through
energized	insignificant	insignificant	insignificant	Set point 1 (Parameter 41)
de-energized	energized	OFF	OFF	Set point 2 (Parameter 42)
de-energized	energized	insignificant	ON	Externally via 0/4-20 mA input (Package P01; Parameter 84)
de-energized	energized	ON	OFF	Externally via interface
de-energized	de-energized	OFF	OFF	Standby only: Emergency power (AMF)

Table 3-3: Set point value table

3.4.2 Analog Controller Outputs (Package P01)

As an alternative to a three-position controller output, the control may also be equipped with an analog controller output. If this option is selected, additional screens are displayed in the configuration mode. The analog PID controller forms a closed-loop control loop with the controlled system (usually a first-order lag element). The parameters of the PID controller (proportional-action coefficient K_{PR}, derivative-action time T_V, and reset time T_n) can be modified individually. The additional configuration screens are used for this purpose.

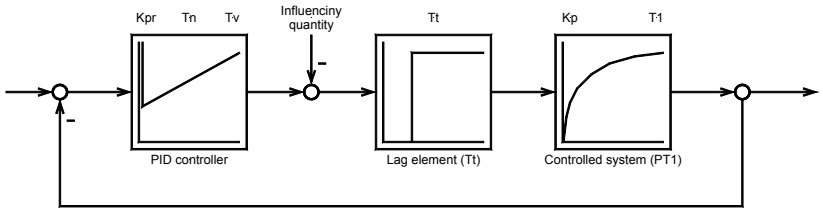


Figure 3-1: Control loop

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

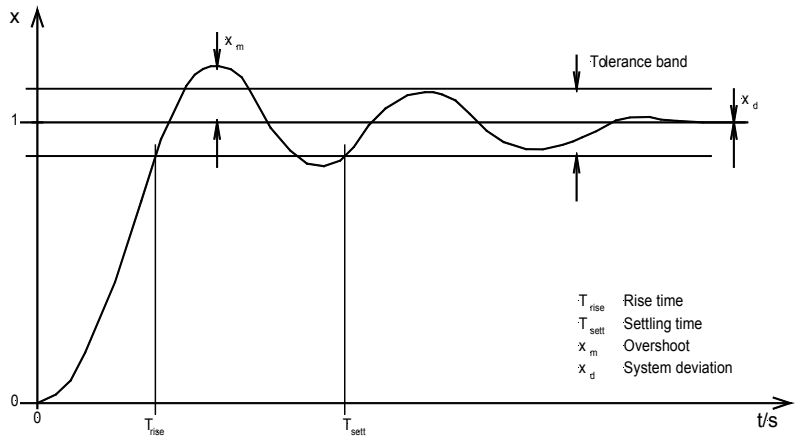


Figure 3-2: Step response (Example)

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

Rise time T_{rise}: Period starting when the value of the control variable leaves a predefined tolerance range for the control variable following a step in the disturbance variable or reference input variable and ending the first time the value re-enters this range.

Settling time $T_{settling}$: Period starting when the value of the control variable leaves a predefined tolerance range for the control variable following a step in the disturbance variable or reference input variable and ending when the value re-enters this range permanently.

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

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

The values for K_{PR}, T_n, and T_V may be determined through various calculations from the values in the table above. Through these calculations (calculating compensation, adjustment of the time constants, T-sum rule, symmetric optimum, and/or Bode-diagram) it is possible to determine the optimal controller settings. Other setting procedures and information may be obtained from current literature.

CAUTION

The following must be observed regarding the controller setting:

- Ensure that the emergency shutdown system is operational.
- While determining the critical frequency, pay attention to the amplitude and frequency.
- If the two values change uncontrollably:

➔ EMERGENCY SHUTDOWN ←

Initial state: The start position of the controller is determined using the initial state of the controller. If the controller is switched off, the basic setting can be used to output a fixed controller position. If operation mode MANUAL has been selected, the initial state signal is output only with the "START" push-button. Even when the analog controller is switched off, the initial state can be freely adjusted (e. g. the speed controller can be controlled in a linear manner). On setting the "STOP" push-button, the analog controller is switched off again.

Parameter 37

Initial state
Frequency = 000%

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

The value input in this parameter represents analog controller output setting with controller switched off. This value is also used as the initial state value.

General settings: The setting rule described below only serves as an example. It cannot be assumed that this is the proper method of control for your system since every system behaves uniquely.

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

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

ATTENTION

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

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

PID-controller

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

PI-controller

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

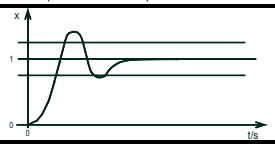
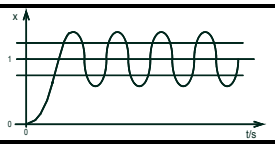
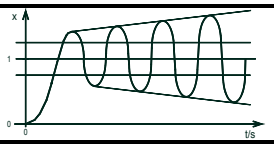
Step response		
Controller setting Optimal (xm ≤ 10 %)	Controller setting Tcrit	Controller setting Incorrect
		

Figure 3-3: Step responds - governor configuration

Parameter 38

P-gain
Kpr = 000

P-gain (K_{PR}) Proportional-action coefficient — 1 to 240

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

Parameter 39

Reset time
Tn = 00.0s

Reset time (T_n) — 0.2 to 60.0 s

The reset time T_n represents the I-component of the PID controller. The reset time corrects for any offset (between 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 40

Derivative time
Tv=0.00s

Derivative-action time (T_V) — 0.00 to 6.00 s

The derivative-action time T_V represents the D-component of the PID controller. By increasing this parameter, the stability of the system is increased. The controller will attempt to slow down the action of the 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.

3.4.3 Real Power Controller, Set Point Values

These screens appear only if the generator real power controller has been configured to "ON" (Parameter 80).

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 (Parameter 101 or Parameter 102). If it has been disabled, the engine will always start.

Parameter 41

Power controller
Pset1 I0000kW

P controller: setpoint 1 **C/I/E 0-6,900 kW**

Setpoint 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 (= base 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 42

Power controller
Pset2 L0000kW

P controller: setpoint 2 **C/I/E 0-6,900 kW**

Setpoint 2 is active when Automatic 2 (voltage applied to terminal 5) is enabled and no external setpoint value (0/4-20 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 (= base 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).

3.4.4 Frequency Controller

Parameter 43

Initial state
Frequency 000%

Package P01 only

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

Analog controller output setting with disabled controller. This value is used as an initial state value when changing from a real power controller to a frequency controller.

Parameter 44

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 45

f-contr. active
at: 00.0Hz

f controller: starting frequency **0.0-70.0 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 46

Delay time for
f-contr. 000s

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

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

Parameter 47

Freq.controller
ramp 00Hz/s

f controller: set point ramp **1-50 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.

NOTE

The parameters for the speed/frequency controller influence the generator real power controller.

Parameter 48

F/P contr.type

Package P01 only

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

THREESTEP The signal to control the speed/frequency/real power is output via the relay manager to any configured relay. You can use the following functions of the relay manager:

- function 114 = n+ / f+ / P+
- function 115 = n- / f- / P-

Please note to wire an external RC protection (manual 37275).

ANALOG .....A control is done via the analog controller outputs to terminals 8/9/10. Selection of the type of the signal (mA or V) to be utilized is determined in Parameter 52. If a voltage output is desired, and jumper must be installed between terminals 8/9.

PWM.....A control of speed/frequency/real power is carried out via a PWM signal. The settings in the Parameter 53 "Level PWM" are to be used. If a PWM output is desired, and jumper must be installed between terminals 8/9.

a.) Three-position controller (standard; Package P01: setting 'THREESTEP')

Parameter 49

Freq.controller deadband 0.00Hz

f controller: insensitivity **0.02-1.00 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 insensitivity at most.

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

Parameter 50

Freq.controller time pulse>000ms

f controller: minimum frequency **10-250 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 51

Freq.controller gain Kp 00.0

f controller: gain **0.1-99.9**

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.

b.) Analog controller output (Package P01: setting 'ANALOG/PWM')

Parameter 52

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

Package P01 only

f controller: output range **see below**

If Parameter 48 has been configured to "ANALOG" this parameter must be configured to the appropriate type of analog controller. The range of the analog output is configured here. To switch from a current to a voltage or PWM output a jumper must be added to terminals 8/9. The ranges are listed below

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

NOTE

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

- Select "F/P contr.type" (Parameter 48) = ANALOG.
- Select with Parameter 52 "F/P contr.output" any of above inverted control outputs (e.g. "10-0mA (5-0V)", "4.5V-0.5V", "20-0mA (10-0V)" or "20-4mA").
- Back up one screen (Parameter 48; by pressing "Select" and "Cursor→" simultaneously).
- Select "F/P contr.type" (Parameter 48) = PWM.

Now the PWM signal is inverted.

Parameter 53

Level PWM

Package P01 only

f controller: PWM level **3.0-10.0 V**

If PWM has been selected in Parameter 52 the level of the PWM signal can be adjusted here.

Parameter 54

Stepper sign.frq
(min.) 000%

Package P01 only

f controller: minimum value **0-100%**

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 55

Stepper sign.frq
(max.) 000%

Package P01 only

f controller: maximum value **0-100%**

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 56

Freq.controller
gain Kpr 000

Package P01 only

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

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 57

Freq.controller
reset Tn 00.0s

Package P01 only

f controller: Reset time **0.0-60.0 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 58

Freq.controller
derivat.Tv 0.00s

Package P01 only

f controller: Derivative-action time **0.00-6.00 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.

3.4.5 Voltage Controller

Parameter 59

Starting point voltage 000%

Package P01 only

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

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 60

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 61

Start voltage U control. 000V

V controller: start voltage **12.0 to 100.0 %**

ⓘ This value refers to the generator set point voltage (Parameter 18).

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 62

Delayed. Start U contr. 000s

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

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

NOTE

The following parameters for the voltage controller influence the power factor cos φ controller.

Parameter 63

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

Package P01 only

V controller: type **THREESTEP / ANALOG**

THREESTEP The signal to control the voltage/power factor is output via the relay manager to any configured relay. You can use the following functions of the relay manager:

- function 116 = U+/Q+
- function 117 = U-/Q-

Please note to wire an external RC protection (manual 37275).

ANALOG ..... Control is performed via the analog controller outputs to terminals 11/12/13. The type of signal (mA or V) to be utilized may be selected in Parameter 67 and along with the instructions on the installation of an external jumper between terminals.

a.) Three-position controller (standard; Package P01: setting 'THREESTEP')

Parameter 64

Volt.controller dead band 00.0%

V controller: insensitivity **00,1-15,0 %**

ⓘ This value refers to the parameter "rated voltage in system" (Parameter 19).

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

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

Parameter 65

Volt.controller time pulse>000ms

V controller: minimum voltage **20-250 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 66

Volt.controller gain Kp 00.0

V controller: gain **0.1-99.9**

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.

b.) Analog controller (Package P01: setting 'ANALOG')

Parameter 67

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

Package P01 only

V controller: range **see below**

If the Parameter 63 has been configured to "ANALOG" this parameter must be configured to the appropriate type of analog controller. The range of the analog output is configured here. If a current analog output is to be utilized do not install a jumper between terminals 11/12. If a voltage analog output is to be utilized, a jumper must be installed between terminals 11/12. The following analog output ranges may be used with this controller.

Type	Setting in above configuration screen	Jumper between term. 11/12	Range	Lower level	Upper level
Current	+/-20mA (+/-10V)	no	+/-20mA	-20 mA	+20 mA
	+/-10mA (+/-5V)		+/-10mA	-10 mA	+20 mA
	0-10mA (0-5V)		0-10mA	0 mA	10 mA
	0-20mA (0-10V)		0-20mA	0 mA	20 mA
	4-20mA		4-20mA	4 mA	20 mA
	10-0mA (5-0V)		10-0mA	10 mA	0 mA
	20-0mA (10-0V)		20-0mA	20 mA	0 mA
	20-4mA		20-4mA	20 mA	4 mA
Voltage	+/-20mA (+/-10V)	yes	+/-10V	-10 Vdc	+10 Vdc
	+/-10mA (+/-5V)		+/-5V	-5 Vdc	+5 Vdc
	+/-3V		+/-3V	-3 Vdc	+3 Vdc
	+/-2.5V		+/-2,5V	-2,5Vdc	+2,5 Vdc
	+/-1V		+/-1V	-1 Vdc	+1 Vdc
	0-10mA (0-5V)		0-5V	0 Vdc	5 Vdc
	0.5V-4.5V		0,5-4,5V	0,5 Vdc	4,5 Vdc
	0-20mA (0-10V)		0-10V	0 Vdc	10 Vdc
	10-0mA (5-0V)		5-0V	5 Vdc	0 Vdc
	4.5V-0.5V		4,5-0,5V	4,5 Vdc	0,5 Vdc
	20-0mA (10-0V)		10-0V	10 Vdc	0 Vdc

Parameter 68

Stepper sign.vol (min.) 000%

Package P01 only

V controller: minimum value **0-100%**

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 69

Stepper sign.vol (max.) 000%

Package P01 only

V controller: maximum value **0-100%**

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 70

Volt.controller gain Kpr 000

Package P01 only

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

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 71

Volt.controller reset Tn 00.0s

Package P01 only

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

The reset time T_n identifies the I portion of the PID loop. 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.

Parameter 72

Volt.controller derivat. Tv 0.00s

Package P01 only

V controller: derivative-action time **0.00-6.00 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.

3.4.6 Power Factor cos φ Controller

Parameter 73

Pow.fact.contr. ON

cos φ 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 74

Pow.fact.contr.
setpoint 0.00

cos φ 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.

NOTE

Please note the settings for the voltage controller in chapter "Voltage Controller" at page 35. The settings there for the voltage controller also influence the cos φ controller.

a.) Three-position controller (standard; Package P01: setting 'THREESTEP')

Parameter 75

Pow.fact.contr.
dead band 00.0%

cos φ controller: insensitivity **0.5-25.0 %**

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 cos φ 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 23).

Parameter 76

Pow.fact.contr.
gain Kp 00.0

cos φ controller: gain **0.1-99.9**

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.

b.) Analog controller (Package P01: setting 'ANALOG')

Parameter 77

Pow.fact.contr.
gain Kpr 000

Package P01 only

cos φ controller:P-gain **1-240**

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 78

Pow.fact.contr.
reset Tn 00.0s

Package P01 only

cos φ controller:reset time **0.0-60.0 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 79

Pow.fact.contr.
derivat.Tv 0.00s

Package P01 only

cos φ controller:derivative-action time **0.00-6.00 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.

3.4.7 Real Power Controller

Parameter 80

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 (Parameter 41 or Parameter 42) 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.

Parameter 81

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 (Parameter 23). 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.

a.) Power Limitation

Parameter 82

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 (Parameter 23) 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 83

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 (Parameter 23) 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.

b.) External set point value (Package P01)

The generator real power **set point value** may be monitored via an analog input T{x} [x = 1 to 7] if one of the analog inputs T{x} [x = 1 to 7] is utilized as a 0/4 to 20 mA input. The selection of the analog input is done using the following parameters.

Parameter 84

Power setpoint external OFF

Package P01 only

P set point value: external set point value **OFF/T{x}**

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 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 42) is used as set point value. The subsequent screens of this function are not displayed.

T{x}.....The generator real power **set point value** is monitored by the control via an external signal using the 0/4 to 20 mA inputs (T{x}, {x) = 1 to 7). If terminal 5 is utilized, the internal set point value 2 "P_{set2}" (Parameter 42) is used as set point value. The subsequent screens of this function are displayed.

Note

Please note the following if analog input T{x} has been selected:

- Parameter 227 in chapter "Analog inputs" must be configured as OFF
- Parameter 25) in chapter "Measuring" must not be configured as mains interchange real power **actual value.**
- T{x}: Depending on the configuration of the control it is possible that various analog inputs other than the 0/4 to 20mA type may be used. For this function, only 0/4 to 20mA may be used.
- LeoPC1 is not a dynamic program and must be restarted after reconfiguration of a control unit has been started so the changes are reflected in the graphical display of the PC program.

Priority of the functions of the analog inputs

The following priority is valid if more than one function has been assigned to a analog input:

- Highest priority: Mains interchange real power **actual value** measurement
- Middle priority: Real power **set point value**
- Lowest priority: Measuring input as common analog value

Parameter 85

Analog input 0-00mA

Package P01 only

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

The analog input of the real power controller can be switched here between 0-20 mA and 4-20 mA depending on the set point source.
0-20 mA..... Minimum value of the set point at 0 mA; maximum value at 20 mA.
4-20 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 86

Ext.setpoint 0mA 0000kW

Package P01 only

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

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

Parameter 87

Ext.setpoint 20mA 0000kW

Package P01 only

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

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

c.) Three-position controller (standard; Package P01: setting 'THREESTEP')

Parameter 88

Power controller dead band 00.0%

P controller: insensitivity **0.1-25.0 %**

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 23).

Parameter 89

Power controller gain Kp 00.0

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

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 90

Powercontr. dead band ratio *0.0

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

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

For example: In the case of an insensitivity of 2.5 % and a factor of 2.0 the insensitivity 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.

d.) Analog controller (Package P01: setting 'ANALOG')

Parameter 91

Power controller gain Kpr 000

Package P01 only

P controller: P gain 1-240

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 92

Power controller reset Tn 00.0s

Package P01 only

P controller: reset time 0.0-60.0 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 93

Power controller derivat.Tv 0.00s

Package P01 only

P controller: derivative-action time 0.00-6.00 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.

e.) Partial load lead

Parameter 94

Warm up load limit value 000%

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

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 23).

Parameter 95

Warm up load time 000s

P controller: part-load lead time 0-600 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.

3.4.8 Load And/Or Var Sharing

Control ensures that under every operating condition (mains parallel operation, isolated operation in parallel with other gensets, or reverse synchronization of the busbar to the mains) the real power (in reference to the relevant rated load) is evenly shared between the generators operating in parallel to the busbar. Those controls that are in the TEST or AUTOMATIC operation mode are load and/or var sharing as long as a start command has been issued and no alarms are present that will result in a system shutdown.

Operating in mains parallel with mains interchange (import/export) real power control: Each controller participating in load/var sharing controls the generator to which it is assigned so that the real power set point at the mains interchange (import/export) real power remains constant. All controls are interlinked via a CAN bus so that any deviation in real power (generator power) may be determined for each generator. This control variable is taken into consideration when controlling the interchange load. The priority that the primary and the secondary control variables are processed may be set via the active load-sharing factor. In a controlled state the configured real power flows at the mains interchange point, and the total real power is divided equally among the generators that are connected to the same CAN bus and are producing the power. If a generator has been configured to produce constant power (C=baseload), the generator is removed from the distribution control process.

Isolated operation in parallel: Each controller involved in load/var sharing influences the generator to which it is assigned in such a manner that the rated frequency that has been configured remains constant. All controls are connected to a CAN bus through which each generator is monitored for any deviation in generator real power. This control variable is taken into consideration on controlling the frequency. The priority that the primary and secondary variable are processed, can be set via the active load-sharing factor. The isolated system has the configured rated frequency and the total real power (in reference to the relevant rated power) is divided equally among the generators that are connected to the same CAN bus and are producing the power.

Reverse synchronization of the busbar to the mains: Distribution is carried out according to the type of isolated operation. However, the set point value for the bus frequency is determined by the mains frequency (+/-0.1 Hz). The relay issues "Command: close GCB" to all controls so they may be paralleled.

Prerequisites: The rated system frequencies, the start/stop parameters, and the breaker logics must all be set to the same values for all controls participating in the distribution control.

Description of the interface for distribution control: Distribution control is based on a multi-master-capable bus between the controls. This structure enables the parallel operation of up to 14 gensets.

The following must be noted to ensure proper operation:
- The maximum bus length must not exceed 250 meters (820 feet).
- The bus must be terminated at each end with terminating resistors that correspond to the wave impedance of the bus cable (approx. 80-120 Ω).
- The bus must be of a linear structure. Dead-end feeders are not permissible.
- Shielded "Twister-Pairs" are recommended for use as the bus cable (e.g.: Lappkabel Unitronic LIYCY (TP) 2×2×0.25, UNITRONIC-Bus LD 2×2×0.22).
- The bus cable must not be routed in the vicinity of heavy current power lines.

Wiring diagram

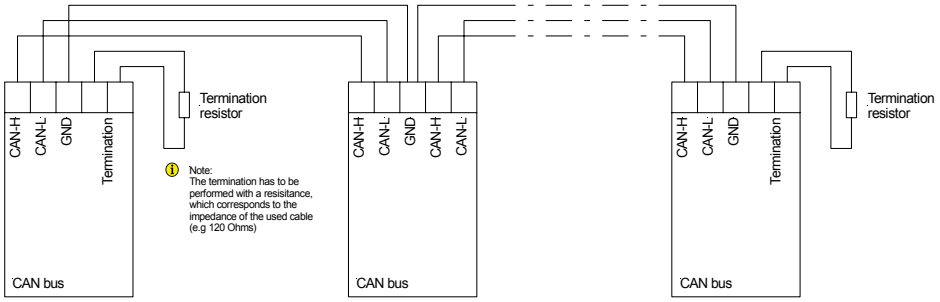


Figure 3-4: CAN bus load/var sharing, wiring diagram

Diagram of load/var sharing via the CAN bus: The parameter "Active load sharing factor" determines if and how a generator carries out real power or frequency control when paralleled with other generators in an isolated operation. This parameter is defined as a percentage. In figure below 10 % means increased real power control and 99 % increased frequency control. This parameter must be configured individually for each generator.

In the illustrated control system, it must be noted that each control calculates the mean utilization factor of all controls 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 a new reference variable. Frequency and real power control are carried out simultaneously in these controls (corresponding to the reference variable).

Frequency control is carried out via the measured voltage/frequency of the voltage system. The Pickup is used merely for monitoring functions, or is available as a current control value to the secondary controller.

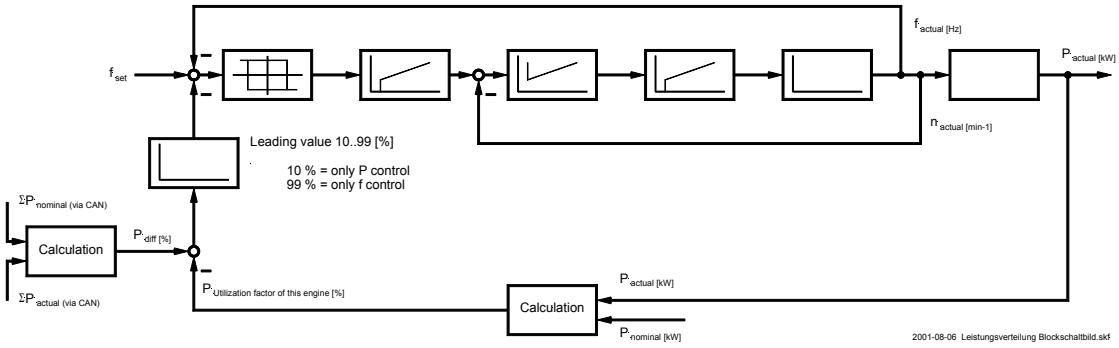


Figure 3-5: CAN bus load/var sharing, diagram

Parameter 96

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 97

Act. load share factor 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 98

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 99

React.load share factor 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.

3.5 Automatic

Parameter 100

Configure automatic	YES

Configuration of automatic **YES/NO**

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

3.5.1 Load Management

NOTE

To enable the automatic start/stop function, Parameter 96 “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 23).

a.) Load-dependent start/stop in mains parallel operation

Parameter 101

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 41). 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 pre-specified set point value is always carried out. The subsequent screens of this function are not displayed.

Parameter 102

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 42). 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 pre-specified 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 101 or Parameter 102) has been configured to "ON".

Parameter 103

Minimum load generator 0000kW

Load dependent start/stop: generator minimum set point power0 to 6,9

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 104

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 103) 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 105

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 106) 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 106 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 106

Hysteresis add-. on/off op.0000kW

Load dependent start/stop: hysteresis 0-9,999 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.

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 107 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 107

Reserve power mains op. 0000kW

Load dependent start/stop: reserve power 0-9,999 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 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 108

Priority of generators 0

Load dependent start/stop: priority of generators 0-14

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.

General

Case 3: Start of the first engine

T 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:

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

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:

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

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 103), stop power (Parameter 106), start delay (Parameter 104), stop delay (Parameter 105) and the frequency set point values (Parameter 10) are identical for all controls involved
- one or both parameters "Load-dependent stop/start on terminal 3/5" (Parameter 101 or Parameter 102) has/have been configured to "ON"
- the parameters "Load sharing" (Parameter 96) or "var sharing" (Parameter 98) have been configured as "ON"
- All generators are configured to the same rated power (Parameter 23)

NOTE

The reserve power (Parameter 109) should be selected in such a manner that expected load swings will not overload the generator.

Parameter 109

Reserve power sloop. 0000kW

Load dependent start/stop: reserve power (isolated operation) 0-9,999 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 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 110

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 103) 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 103) 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 111

Shed-off delay isol.op. 000s

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

Stopping can be delayed even if the engine's stop power (Parameter 106) 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 106) 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 are used 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.

3.5.2 Stop Of The Engine At Mains Failure [PCM1-G]

Parameter 112

Mains error - stop eng.	**ON**

Engine stop at mains failure **ON/OFF**

ON..... If the mains fail for at least the time of the mains settling time (Parameter 151) and the discrete input "Enable MCB" (terminal 53) is enabled (the mains parallel operation is enabled), the engine is stopped. When the mains returns and the mains settling time (Parameter 206) has expired, the engine is started and the GCB is synchronized.

OFF ..... If the mains fail for at least the time of the emergency power start delay (Parameter 151) and the discrete input "Enable MCB" (terminal 53) is enabled (the mains parallel operation is enabled), the GCB is opened. The engine will continue running in idle mode. When the mains returns and the mains settling time (Parameter 206) has expired, the GCB is synchronized.

3.5.3 Interface

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.

Parameter 113

Control via COM X1X5 ON

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

ON .....Control via the interface is enabled if the direct configuration (Parameter 3) has been configured as "OFF", the control via X1X5 (Parameter 113) 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 setpoint value 2 (Parameter 42) is selected with the discrete input "Automatic 2" and the internal power factor cos φ (Parameter 74) set point value is used. Interface monitoring is disabled.

Parameter 114

Supervision COMX1X5 ON

if COMX1X5 = ON only

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.

Parameter 115

Ackn. F2,F3 via COM interf ON

if COMX1X5 = ON only

Remote acknowledgment of F2/F3 alarms via the 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".

3.6 Breaker

Parameter 116

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.

3.6.1 Functional Description

a.) Permissible Limits

If the generator or mains monitoring for over-/undervoltage (Parameter 187) or over-/underfrequency (Parameter 181) is disabled, the CB logic (Parameter 117) and the control system are controlled by internally defined limit values.

For the busbar, always the internally defined limit values are used.

	Voltage	Frequency
Generator	V_{Gen}: 75 to 115 % $V_{RatedSystem}$	f_{Gen}: 80 to 110 % $f_{RatedSystem}$
Busbar	V_{Busbar}: 85 to 112.5 % $V_{RatedSystem}$	f_{Busbar}: 90 to 110 % $f_{RatedSystem}$
Mains	V_{Mains}: 85 to 112,5 % $U_{RatedSystem}$	f_{Mains}: 90 to 110 % $f_{RatedSystem}$

Table 3-4: Limit values, permissible limits

The permissible limits refer to the respective rated values in the system, i.e. the rated system voltage, configured in Parameter 19, and the rated system frequency, configured in Parameter 11.

b.) Synchronization

Synchronization of the GCB

The GCB will be synchronized with frequency and voltage correction if the following conditions are met simultaneously.

Automatic mode
- The operation mode AUTOMATIC is selected
- One of the circuit breaker logics (Parameter 117) "PARALLEL" (mains parallel operation), "INTERCHANGE" (mains interchange (import/export) real power control) or "CLOSED TRANSIT." (make-before-break/overlap synchronization) has been selected
- No class F2 or F3 alarms are present
- An "Automatic 1" (terminal 3) or "Automatic 2" (terminal 5) input has been enabled, a remote starting signal has be activated via the interface, or an additional engine will be started in an emergency power operation and will be synchronized to the busbar
- The busbar has been energized (the control measures a voltage)
- The engine is running and the generator voltage and frequency are within the permissible limits
- The delayed engine monitoring (Parameter 284) has expired (this does not apply in the case of emergency power)
- The rotating field of the generator and the mains voltages are identical and no alarms are displayed

Manual mode
- The operation mode MANUAL has been selected
- One of the circuit breaker logics (Parameter 117) "PARALLEL" (mains parallel operation), "INTERCHANGE" (mains interchange (import/export) real power control) or "CLOSED TRANSIT." (make-before-break/overlap synchronization) has been selected
- No class F2 or F3 alarms are present;
- The busbar has been energized (the control measures a voltage)
- The engine is running and the generator voltage and frequency are within the permissible limits
- The push-button "GCB ON" has been pressed
- The rotating field of the generator and the mains voltages are identical and no alarms are displayed

Load test mode
- The operation mode TEST has been selected
- One of the circuit breaker logics (Parameter 117) "PARALLEL" (mains parallel operation), "INTERCHANGE" (mains interchange (import/export) real power control) or "CLOSED TRANSIT." (make-before-break/overlap synchronization) has been selected;
- No class F2 or F3 alarms are present;
- The busbar has been energized (the control measures a voltage)
- The engine is running and the generator voltage and frequency are within the permissible limits
- The push-button "GCB ON" has been pressed
- The rotating field of the generator and the mains voltages are identical and no alarms are displayed

Synchronization of the MCB [PCM1-M]

The MCB will be synchronized with frequency and voltage correction if the following conditions are met simultaneously:

Automatic mode

- The operation mode AUTOMATIC has been selected
- One of the circuit breaker logics (Parameter 117) "PARALLEL" (mains parallel operation), "INTERCHANGE" (mains interchange (import/export) real power control) or "CLOSED TRANSIT." (make-before-break/overlap synchronization) has been selected
- No class F2 or F3 alarms are present
- The busbar has been energized (the control measures a voltage)
- The mains voltage is present and within the permissible limits
- The engine is running and the generator voltage and frequency are within the permissible limits
- The discrete input "Reply: GCB is open" has not been enabled (the GCB is closed)
- The discrete input "Enable MCB" has been enabled;
- The rotating field of the generator and the mains voltages are identical and no alarms are displayed

Manual operation

- The operation mode MANUAL has been selected;
- One of the circuit breaker logics (Parameter 117) "PARALLEL" (mains parallel operation), "INTERCHANGE" (mains interchange (import/export) real power control) or "CLOSED TRANSIT." (make-before-break/overlap synchronization) has been selected;
- No class F2 or F3 alarms are present;
- The busbar has been energized (the control measures a voltage);
- The mains voltage is present and within the permissible limits;
- The engine is running and the generator voltage and frequency are within the permissible limits;
- The discrete input "Reply: GCB is open" has not been enabled (the GCB is closed);
- The discrete input "Enable MCB" has been enabled;
- The push-button "MCB ON" has been pressed;
- Load test: On termination of the load test (circuit breaker logics (Parameter 117) "INTERCHANGE" (mains interchange (import/export) real power control) or "CLOSED TRANSIT." (make-before-break/overlap synchronization), the GCB is opened;
- The rotating field of the generator and the mains voltages are identical (and no alarms are displayed);

c.) Dead bus start

Dead bus start of the GCB

The GCB will be closed without synchronization if the following conditions are met simultaneously:

Automatic mode
- The operation mode AUTOMATIC has been selected
- No class F2 or F3 alarms are present
- The Parameter 131 "GCB dead bus start" has been configured to "ON"
- The busbar has not been energized (the control measures no voltage)
- The engine is running, and the generator voltage and frequency are within the permissible limits
- The discrete input "Reply: MCB is open" has been enabled (the MCB is open)
- If load is shared via the CAN bus
  - No GCB may be closed if the configured system is isolated operation in parallel with other generators
  - The generator with the lowest control/generator number (Parameter 4) will be the first to close its GCB

Manual mode
- The operation mode MANUAL has been selected
- No class F2 or F3 alarms are present
- The busbar has not been energized (the control measures no voltage)
- The engine is running, and the generator voltage and frequency are within the permissible limits
- The discrete input "Reply: MCB is open" has been enabled (the MCB is open)
- If load is shared via the CAN bus
  - No GCB may be closed if the configured system is isolated operation in parallel with other generators
  - The generator with the lowest control/generator number (Parameter 4) will be the first to close its GCB)
- The push-button "GCB ON" has been pressed

Disabled generator monitoring:
If the generator monitoring for over-/undervoltage (Parameter 187) or over-/underfrequency (Parameter 181) is disabled, the , the internally defined limit values are used.

Generator monitors	Voltage	Frequency
ON	Monitor values	Monitor values
OFF	$V_{Gen} < 75\ \% V_{RatedSystem}$ $V_{Gen} > 115\ \% V_{RatedSystem}$	$f_{Gen} < 80\ \% f_{RatedSystem}$ $f_{Gen} > 110\ \% f_{RatedSystem}$

Table 3-5: Limit values generator, dead bus start

The permissible limits refer to the respective rated values in the system, i.e. the rated system voltage, configured in Parameter 19, and the rated system frequency, configured in Parameter 11.

Dead bus start of the MCB [PCM1-M]

The MCB will close without synchronization if the following conditions are met simultaneously:

Automatic mode
- The operation mode AUTOMATIC has been selected
- The Parameter 135 "MCB dead bus start" has been configured to "ON"
- The busbar is not been energized (the control measures no voltage)
- The mains voltage is present and within the permissible limits
- The discrete input "Reply: GCB is open" has been enabled (the GCB is open)
- The discrete input "Enable MCB" has been enabled
- If load is shared via the CAN bus
  - No MCB may be closed if the configured system is isolated operation in parallel with other generators
  - The generator with the lowest control/generator number (Parameter 4) will be the first to close its MCB

Manual mode
- The operation mode MANUAL has been selected
- The busbar is not been energized (the control measures no voltage)
- The mains voltage is present and within the permissible limits
- The discrete input "Reply: GCB is open" has been enabled (the GCB is open)
- The discrete input "Enable MCB" has been enabled
- The push button "MCB ON" has been pressed
- If load is shared via the CAN bus
  - No MCB may be closed if the configured system is isolated operation in parallel with other generators
  - The generator with the lowest control/generator number (Parameter 4) will be the first to close its MCB

Operation mode STOP
- If "Enable MCB" (terminal 53) has been enabled and "Switch MCB in stop mode" (Parameter 148) is configured "YES", the MCB will close when all generators are in STOP mode

Disabled mains monitoring:
If the mains monitoring for over-/undervoltage (Parameter 187) or over-/underfrequency (Parameter 181) is disabled, the internally defined limit values are used.

Mains monitors	Voltage	Frequency
ON	Monitor values	Monitor values
OFF	$V_{Mains} < 85\ \% V_{RatedSystem}$ $V_{Mains} > 12.5\ \% V_{RatedSystem}$	$f_{Mains} < 90\ \% f_{RatedSystem}$ $f_{Mains} > 110\ \% f_{RatedSystem}$

Table 3-6: Limit values mains, dead bus start

The permissible limits refer to the respective rated values in the system, i.e. the rated system voltage, configured in Parameter 19, and the rated system frequency, configured in Parameter 11.

d.) Open Breaker

Open GCB

The GCB will be opened both when the relay "Command: GCB close" de-energizes (only if "continuous pulse" has been configured; Parameter 121), and relay "Command: GCB open" is energized. The GCB will be opened under the following circumstances:

- If a mains failure is detected and the mains decoupling is configured to the GCB (Parameter 145 or Parameter 146 depending on control unit)
- In the operation mode STOP
- If a class F2 or F3 alarm is present
- Upon pressing the push-button "GCB OFF" or [PCM1-M] "MCB ON" (depending on the breaker logic which has been configured) in operation mode MANUAL;
- Upon pressing the push-button "STOP" in operation mode MANUAL;
- Upon pressing the push-button "GCB OFF" or [PCM1-M] "MCB ON" (depending on the breaker logic which has been configured) in operation mode LOAD TEST;
- In the event of an automatic stopping in the operation mode AUTOMATIC;
- [PCM1-M] following the "CLOSED TRANSIT." (make-before-break/overlap synchronization) of the MCB;
- [PCM1-M] before the MCB is closed to the dead busbar in the case of the breaker logic "OPEN TRANSIT." (ATS/break-before-make/changeover);
- In critical mode/sprinkler operation, provided that no emergency power operation is present;
- [PCM1-M] following the "INTERCHANGE" (mains interchange (import/export) real power control) of the MCB.

Open MCB [PCM1-M]

The MCB will be opened via closing the relay "Command: MCB open" (configuration of "continuous pulse" is not possible for the MCB). The MCB will be opened under the following circumstances:

- If a mains monitoring triggers and the mains decoupling is configured to EXT (Parameter 146)
- If emergency power (AMF) is enabled (mains failure)
- following the "CLOSED TRANSIT." (make-before-break/overlap synchronization) of the GCB
- Before the GCB is closed to the dead busbar in the case of the breaker logic "OPEN TRANSIT." (ATS/break-before-make/changeover)
- Upon pressing the push-button "MCB OFF" or "GCB ON" (depending on the breaker logic which has been configured) in operation mode MANUAL
- Upon pressing the push-button "MCB OFF" or "GCB ON" (depending on the breaker logic which has been configured) in operation mode LOAD TEST
- Following the soft loading (interchange synchronization) of the MCB

3.6.2 Breaker Logic

NOTE

Using the discrete input "Change breaker logic via terminal 64" (Parameter 219), the breaker logic may be switched between two different breaker logics (description on page 94). The desired standard breaker logic is configured via the following parameter (Parameter 117). If Parameter 218 is configured to "ON", the discrete input terminal 64 is used as a Control input. When a signal to terminal 64 is detected, the breaker logic configured in Parameter 219 is used. If the signal is terminated, the breaker logic configured in Parameter 117 is used again. Therefore it is possible during operation to change between the breaker logic "PARALLEL" (automatic synchronizing) and "EXTERNAL" (manual synchronizing).

Parameter 117

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:

PCM1-G	PCM1-M
EXTERNAL	EXTERNAL
PARALLEL	PARALLEL
–	OPEN TRANSIT.
–	CLOSED TRANSIT.
–	INTERCHANGE

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

a.) Breaker Logic "PARALLEL"

Parallel operation is enabled via configuration of the parameter (Parameter 117) to "PARALLEL".

NOTE

Parallel breaker logic must be selected for the following operation modes:

- Isolated operation
- Isolated operation in parallel with other generators
- Mains parallel operation

In the event of an add-on request the following occurs:
- The GCB is synchronized and closed
- The necessary generator assumes load and real power or reactive power is controlled

Following the shed-off request the following occurs:
- The generator sheds load and the generator power factor φ is controlled to "1.00" (unity)
- The GCB is opened
- The engine is shut down following the configured cool down period

[PCM1-M] The MCB is synchronized and closed if
- Terminal 53 "Enable MCB" has been enabled
- The GCB is closed

[PCM1-M] The MCB is closed onto the dead busbar if
- The GCB is open
- The MCB is open
- The busbar is dead (de-energized)
- Terminal 53 "Enable MCB" has been enabled

NOTE

When a stop command is issued to the engine, with the exception of a class F3 alarm, soft loading (power reduction) is carried out before opening the GCB.

b.) Breaker Logic "INTERCHANGE" [PCM1-M]

Mains interchange (import/export) real power control is enabled via configuration of the parameter (Parameter 117) to "INTERCHANGE".

NOTE

For this breaker logic to function correctly, the mains power measurement must be connected properly. The power measurement must also be assigned the properly process identifier (C, I, or E).

In the event of an add-on request, a change is made from mains to generator supply. The following occurs:
- The GCB is synchronized and closed
- The generator assumes load until the mains interchange (import/export) real power is "zero"
- The MCB is opened

When a shed-off request has been issued, a change is made from generator to mains supply. The following occurs:
- The MCB is synchronized and closed
- The generator sheds load until real power is "zero"
- The GCB is opened

c.) Breaker Logic "CLOSED TRANSIT." [PCM1-M]

Closed transition (make-before-break/overlap synchronization) is enabled via configuration of the parameter (Parameter 117) to "CLOSED TRANSIT.".

In the event of an engine request, a change is made from mains to generator supply. The following occurs:
- The GCB is synchronized and closed
- The MCB is opened and the generator assumes all loads

After the engine shed-off request has been issued, a change is made from generator to mains supply. The following occurs:
- The MCB is synchronized and closed
- The GCB is opened and the generator assumes all loads

NOTE

The breakers are opened without a soft loading or soft unloading during a closed transition.

d.) Breaker Logic "OPEN TRANSIT." [PCM1-M]

Open transition (break-before-make/change over logic) is enabled via configuration of Parameter 117 to "OPEN TRANSIT.".

In the event of an engine add-on request, a change is made from mains to generator supply. The following occurs:
- The MCB is opened
- The GCB is closed

After the engine shed-off request has been issued, a change is made from generator to mains supply. The following occurs:
- The GCB is opened
- The MCB is closed

e.) Breaker Logic "EXTERNAL"

External breaker logic is enabled via configuration of Parameter 117 to "EXTERNAL".

All breaker control must be carried out via master controller (e.g. a PLC). The PCM controller will only issue opening and closing pulses to the MCB and GCB when in the MANUAL operating mode. The PCM controller always issues the breaker open command under fault conditions.

f.) Overview PCM1-M

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.
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 TRANSIT.: 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 TRANSIT.: 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.

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 reduced. 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.

g.) Overview PCM1-G

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.

3.6.3 Start/Stop Ramp, Open GCB With F2 Alarm

Parameter 118

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 23) 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 119

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 96) and automatic start/stop (Parameter 101 or Parameter 102) 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.

3.6.4 GCB Pulse/Continuous Pulse

Closing and opening of the GCB and the MCB are described in the following figures (Figure 3-6 and Figure 3-7). Changing of the breaker control logic is configured using parameter (Parameter 120) 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 128) 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'

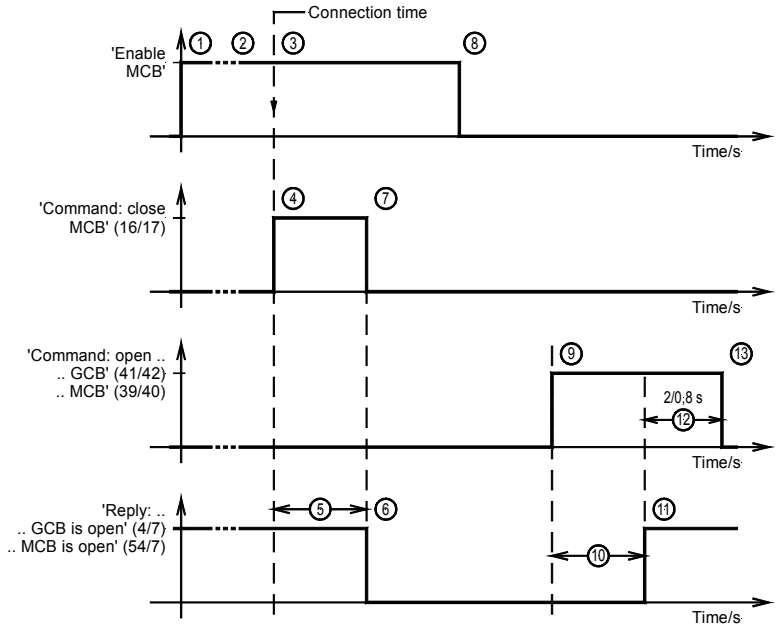


Figure 3-6: Breaker control logic 'Impulse'

'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: 'Continuous'

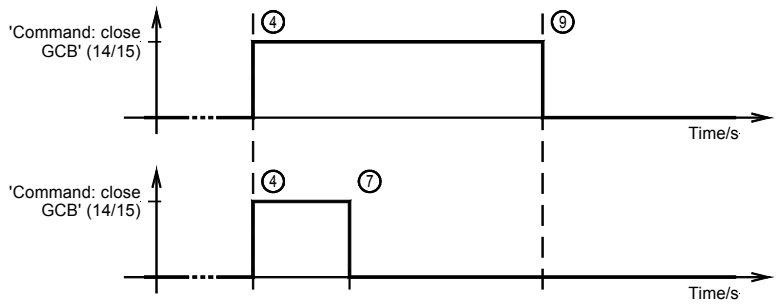


Figure 3-7: Breaker control logic 'Continuous'

'Continuous' 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 120

GCB close.relay

Signal logic for the GCB **Impulse/Constant**

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.

3.6.5 Open/Close GCB

Parameter 121

GCB open relay

Opening the GCB (terminal 41/42) **NO-contact/NC-contact**

NC-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.

NO-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.

3.6.6 Synchronization (With Synchronous Generators Only)

Parameter 122

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 123

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 124

Synchronize
dV max 00.0%

Max. perm. differential voltage for synchronization **01.0 to 20.0 %**

ⓘ This value refers to the parameter "Rated volt. in system" (Parameter 19).

A connect command will only be issued when the measured voltage falls below the configured differential voltage.

Parameter 125

Synchronize
time pulse >0.00s

Min. pulse duration of connect relay for synchronization **0.02 to 0.26 s**

The duration of the close pulse can be adjusted to the breaker (valid for synchronization and dead bus start).

Parameter 126

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 127

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 128

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 close pulse is issued prior to the close pulse.

3.6.7 Synchronization Time Monitoring (With Synchronous Generators Only)

If the following parameter (Parameter 129) is configured to "ON", synchronization time monitoring is performed: If the synchronization of the GCB or [PCM1-M] MCB 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 144) an alarm is detected while closing the MCB, a emergency power operation is performed (if this has been configured to ON; Parameter 150).

Parameter 129

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 130

Sync.time contr.
delay 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

3.6.8 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 131

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 132

GCB dead bus op.
df max 0.00Hz

Maximum differential frequency for GCB dead bus start 0.05 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 133

GCB dead bus op.
dV max. 00,0%

Maximum differential voltage for GCB dead bus start 01,0 to 15,0 %

ⓘ This value refers to the parameter "rated voltage in system" (Parameter 19).

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 134

GCB dead bus op
max.time 000s

Maximum time for closing the GCB **0 to 999 s**

If the GCB is to be closed onto a dead busbar, this timer is initiated at the start of the breaker closing sequence. If the breaker fails to close before the configured time expires, a class 1 alarm is issued.

Issuing of class F1 alarm

Parameter 135

MCB dead bus op.
ON

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.

3.6.9 Connection Functions (With Induction/Asynchronous Generators Only)

Parameter 136

Switching-on GCB ON

Connection 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 137

Switching-on 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 138

Switching-on 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 139

Switching-on GCB T.impuls >0.00s

Time pulse for the GCB **0.02 to 0.26 s**

The duration of the close pulse can be adjusted to the breaker.

Parameter 140

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 closing is performed only by the close pulse. No open pulse is issued prior to the close pulse.

3.6.10 Connect Time Monitoring (With Induction/Asynchronous Generators Only)

If Parameter 140 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 141

Switch.time cntr 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 142

Switch.time cntr delay 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

3.6.11 Breaker Monitoring

Upon CLOSING - If "GCB monitoring" (Parameter 143) and/or "MCB monitoring" (Parameter 144) have been configured "ON", GCB and/or MCB monitoring is performed (exception: the breaker logic is configured "EXTERNAL" (Parameter 117). If the breaker cannot be closed after five attempts, a class F1 alarm is issued. If a relay has been assigned relay manager functions 74 or 75, it will be energized.

Upon OPENING - When opening a circuit breaker an open pulse is issued immediately after a close pulse. If a reply is detected 2 seconds after the close pulse was issued that the MCB or GCB has not opened, an class F1 alarm message is issued. If a relay has been assigned relay manager functions 76 or 77, it will be energized:

Parameter 143

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 assigned relay manager function 75 is energized. Following the issuing of the alarm message, further attempts are made to close the GCB. If load sharing has been enabled (Parameter 96), 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 assigned relay manager function 77 is energized.

Issuing of class F1 alarm

OFF ..... No GCB monitoring is performed.

Parameter 144

Supervision MCB ON

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 assigned relay manager function 74 is energized. Following the issuing of the alarm message, further attempts are made to close the MCB. If load sharing has been enabled (Parameter 96) 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 assigned relay manager function 76 is energized.

Issuing of class F1 alarm

OFF ..... No MCB monitoring is performed.

3.6.12 Mains Decoupling

NOTE

If the mains monitoring (frequency and voltage) is disabled, no mains decoupling is performed.

Parameter 145

Mains decoupling via ------

at PCM1-G only

Decoupling from the mains via ... GCB; GCB->EXT; EXT; EXT->GCB

GCB .....If a mains failure (Parameter 192 to Parameter 205) occurs the GCB will be opened. (The mains failure is detected by means of the mains voltage [terminals 50/51/52]).

GCB->EXT .....If a mains failure (Parameter 192 to Parameter 205) occurs the GCB will be opened. (The mains failure is detected by means of the mains voltage [terminals 50/51/52]). An alarm message will be issued with the end of the delay time (Parameter 147) if terminal 4 does not detect a reply that the GCB has opened. The relay assigned relay manager function 76 will be energized as well. The "Command: open GCB" relay (terminal 41/42) will be de-energized and the "Command: MCB open" relay (terminals 39/40) is energized.

Issuing of class F1 alarm

EXT.....If a mains failure (Parameter 192 to Parameter 205) occurs the relay with the "Command: MCB open" relay (terminals 39/40) will be energized. (The mains failure is detected by means of the mains voltage [terminals 50/51/52]).

EXT->GCB .....If a mains failure (Parameter 192 to Parameter 205) occurs the relay with the "Command: MCB open" relay (terminals 39/40) will be energized. (The mains failure is detected by means of the mains voltage [terminals 50/51/52]). An alarm message will be issued with the end of the delay time (Parameter 147) if terminal 54 does not detect a reply that the breaker has opened. The relay assigned relay manager function 77 will be energized as well. The "Command: MCB open" relay (terminals 39/40) will be de-energized and the "Command: open GCB" relay (terminals 41/42) is energized.

Issuing of class F1 alarm

NOTE

If the mains monitoring (frequency and voltage) is disabled, no mains decoupling is performed.

Parameter 146

Mains decoupling via ------

at PCM1-M only

Decoupling from the mains via ... GCB; GCB->MCB; MCB; MCB->GCB

GCB ..... If a mains failure (Parameter 192 to Parameter 205) occurs the GCB will be opened. (The mains failure is detected by means of the mains voltage [terminals 50/51/52]).

GCB->MCB... If a mains failure (Parameter 192 to Parameter 205) occurs the GCB will be opened. (The mains failure is detected by means of the mains voltage [terminals 50/51/52]). An alarm message will be issued with the end of the delay time (Parameter 147) if terminal 4 does not detect a reply that the GCB has opened. The relay assigned relay manager function 76 will be energized as well. The "Command: open GCB" relay (terminal 41/42) will de-energize and the "Command: open MCB" relay (terminals 39/40) is energized.

Issuing of class F1 alarm

MCB ..... If a mains failure (Parameter 192 to Parameter 205) occurs the MCB will be opened. (The mains failure is detected by means of the mains voltage [terminals 50/51/52]).

MCB->GCB... If a mains failure (Parameter 192 to Parameter 205) occurs the MCB will be opened. (The mains failure is detected by means of the mains voltage [terminals 50/51/52]). An alarm message will be issued with the end of the delay time (Parameter 147) if terminal 54 does not detect a reply that the MCB has opened. The relay assigned relay manager function 77 will be energized as well. The "Command: open MCB" relay (terminals 39/40) will de-energize and the "Command: open GCB" relay (terminals 41/42) is energized.

Issuing of class F1 alarm

Parameter 147

Mains decoupling -> after 0.00s

Mains decoupling after 0.10-5.00 s

The maximum amount of time that the mains decoupling should be completed in.

WARNING

During maintenance of the busbar be aware that an open MCB will be closed by the PCM when the mains settling time (Parameter 206; starts when voltage is detected on the mains) expires if Parameter 148 is configured as "YES". Configuring Parameter 148 as "NO" or take other measures to prevent the busbar from being energized.

Parameter 148

Switch MCB in STOP mode NO

Operate MCB in operation mode STOP YES/NO

YES..... The MCB will be operated by the PCM 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 54) be energized as well.

NO..... The MCB will not be operated by the PCM in STOP mod (the busbar will not be connected or remains unconnected if the control unit is changed into STOP mode).

3.7 Emergency Power (AMF)

Parameter 149

Configure emergency	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 (i.e. PCM1-M or PCM1-G with PCN4 coupling).

Prerequisite: The emergency power (AMF) function may only be enabled with synchronous generators using Parameter 149 ("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".

NOTE

If the "Engine enable" or "Engine block" function is assigned to terminal 6 (Parameter 224), emergency power can be prevented or interrupted from an external source through a discrete input. Refer to "Terminal 6" on page 96.

If Parameter 221 is configured ON and discrete input 11 at terminal 68 is energized, emergency power operation will also be prevented or interrupted (see Enable 'Emergency OFF' via terminal 68 on page 95).

Activation of emergency power: If a mains voltage fault (over-/undervoltage, -frequency or phase/vector jump) is detected on any single phase of terminals 50/51/52 without interruption for the duration of the emergency power start delay time (Parameter 151), emergency power is activated. A mains voltage fault is defined as follows: If the mains watchdogs (Parameter 192 and/or Parameter 197) are configured to ON and the applicable limit values set there are surpassed; otherwise, the limits are internally defined as follows:

Mains watchdogs	Voltage	Frequency
ON	Monitoring values (see Parameter 192ff)	Monitoring values (see Parameter 197ff)
OFF	$V_{mains} < 85\ \% V_{rated}$ $V_{mains} > 112\ \% V_{rated}$	$f_{mains} < 90\ \% f_{rated}$ $f_{mains} > 110\ \% f_{rated}$

Table 3-7: Limit values, Emergency power

Emergency power (AMF) is also initiated through the detection of a breaker alarm when the MCB is closed. In order to enable this, Parameter 150 ("Emergency power) and Parameter 144 ("MCB monitoring") must be configured to "ON".

The following actions occur in an emergency power operation:

- If emergency power is triggered, the engine is started unless the sequence is interrupted by an alarm or the change of the operation mode.
- If the mains return during the start cycle, the MCB is not opened. The engine starts and continues running until the mains settling time (Parameter 206) expires. If another mains fault occurs during this time, the MCB is opened and the GCB is closed to the dead busbar. The engine shuts down following the expiration of the mains settling time (Parameter 206) if no additional mains faults occur.
- The GCB will be closed regardless of the engine delay time once the dead bus limits have been reached.
- If the mains returns during emergency power operation while the GCB is closed, the MCB will be synchronized after the mains settling time (Parameter 206) has expired.

Emergency power: In the event of an active emergency power operation, the message "Emergency power" is displayed.

3.7.1 Emergency Power With Breaker Logic "PARALLEL"

Emergency power: Following a mains fault the "emergency power start delay" (Parameter 151) must expire before the engine is started. Once the voltage and frequency limit values are reached, the MCB is opened and the GCB is closed to the dead busbar. The generator supplies the load.

Return of the mains: Following the return of the mains the control remains in the emergency power operation until the mains settling time has expired (Parameter 206) before synchronization of the MCB is initiated. After closing the MCB, the control returns to its original operation mode. If the engine is to be shut down after the emergency power operation is over, a power reduction (soft unloading) is carried out if the real power controller (Parameter 80) is configured to ON.

If the mains return during the start cycle, the MCB is not opened. The engine remains in idle mode during the mains settling time (Parameter 206) in order to enable the immediate closing of the GCB in the event of further mains faults.

3.7.2 Emergency Power With Breaker Logic "OPEN TRANSIT."

Emergency power: Following a mains fault the "emergency power start delay" (Parameter 151) must expire before the engine is started. Once the voltage and frequency limit values are reached, the MCB is opened and the GCB is closed to the dead busbar. The generator supplies the load.

Return of the mains: Following the return of the mains the control remains in the emergency power operation until the mains settling time has expired (Parameter 206) before transitioning back (via an open transition/over a dead busbar) to mains supply. If an engine request is present following the expiration of the mains settling time (Parameter 206), the generator will remain in isolated operation.

If the mains return during the start cycle, the MCB is not opened. The engine remains in idle mode during the mains settling time (Parameter 206) in order to enable the immediate closing of the GCB in the event of further mains faults.

3.7.3 Emergency Power With Breaker Logic "CLOSED TRANSIT."

Emergency power: Following a mains fault the "emergency power start delay" (Parameter 151) must expire before the engine is started. Once the voltage and frequency limit values are reached, the MCB is opened and the GCB is closed to the dead busbar. The generator supplies the load.

Return of the mains: Following the return of the mains the control remains in the emergency power operation until the mains settling time has expired (Parameter 206). Synchronization of the MCB (via a closed transition/over a live busbar) to mains supply is initiated if no engine request is present. Following the closure of the MCB, the GCB is opened immediately and without any power reduction (soft unloading). If an engine request is present following the expiration of the mains settling time (Parameter 206), the generator will remain in isolated operation.

If the mains return during the start cycle, the MCB is not opened. The engine operates in idle mode during the mains settling time (Parameter 206) in order to enable the immediate closing of the GCB in the event of further mains faults.

3.7.4 Emergency Power With Breaker Logic "INTERCHANGE"

Emergency power: Following a mains fault the "emergency power start delay" (Parameter 151) must expire before the engine is started. Once the voltage and frequency limit values are reached, the MCB is opened and the GCB is closed to the dead busbar. The generator supplies the load.

Return of the mains: Following the return of the mains the control remains in the emergency power operation until the mains settling time has expired (Parameter 206). Synchronization of the MCB (via a closed transition/over a live busbar) to mains supply is initiated if no engine request is present. Following the closure of the MCB, the GCB is opened after a power reduction (soft unloading) is performed if the real power controller (Parameter 80) is configured to "ON". If an engine request is present following the expiration of the mains settling time (Parameter 206), the generator will remain in isolated operation.

If the mains return during the start cycle, the MCB is not opened. The engine operates in idle mode during the mains settling time (Parameter 206) in order to enable the immediate closing of the GCB in the event of further mains faults.

3.7.5 Emergency Power With Breaker Logic "EXTERNAL"

ATTENTION

This breaker logic will not permit emergency power in accordance with DIN VDE 0108!

Emergency power: Following a mains fault the "emergency power start delay" (Parameter 151) must expire before the engine is started. Once the voltage and frequency limit values are reached, the MCB is opened and the GCB is closed to the dead busbar. The generator supplies the load. No further operation of the GCB and the MCB are performed, regardless if the mains return.

3.7.6 Emergency power With MCB Malfunction

MCB malfunction: In the operation mode AUTOMATIC without a starting request, the control is in emergency power standby. If the MCB opens without initiation, the control attempts to reclose the breaker. If the MCB cannot be reclosed due to an MCB failure, the engine is started and the alarm message "MCB malfunction" is displayed, if Parameter 149 ("Emergency power") and Parameter 144 ("Supervision MCB") are configured to "ON". The GCB is closed and emergency power subsequently supplies the busbar. Following acknowledgement of the "MCB malfunction" alarm, the MCB synchronized from generator supply to mains supply and the engine shut down after the expiration of the mains settling time (Parameter 206).

3.7.7 Emergency Power; Parameters

Parameter 150

Emergency power **ON**

Emergency power **ON/OFF**

ON .....If the control is in AUTOMATIC or TEST 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 144 ("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 151

Emergency power start del. 00.0s

Start delay for emergency power **0.5-99.9 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.

3.8 Protection

Parameter 152

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→", "DigitŤ" or "Select" push-buttons).

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

3.8.1 Generator Power Monitoring

It is possible to monitor two independently configurable generator power limit values. It is possible to output the tripping to one of these freely configurable relays by means of the relay manager (relay manager function 56 and 80). 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 164 and Parameter 169) or an external protection device should be used.

Parameter 153

Gen.power monit.
ON

Generator power monitoring — **ON/OFF**

ON..... The generator power is monitored (relay manager function 56 and 80 must each 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 154

Gen.power monit.
resp.val1 0000kW

Power monitoring threshold value, level 1 — **0 to 9,999 kW**

If this threshold value has been exceeded for at least the delay time (Parameter 156), the relay assigned relay manager function 56 energizes.

Parameter 155

Gen.power monit.
hyst.lv1 000kW

Power monitoring hysteresis, level 1 — **0 to 999 kW**

If the monitored generator power level drops below the threshold value configured in Parameter 154 by value configured here, hysteresis occurs and the relay de-energizes.

Parameter 156

Gen.power monit.
delay lv1 000s

Power monitoring delay, level 1 — **0 to 650 s**

For the control unit to recognize a power monitoring fault condition, the threshold value configured in Parameter 154 must be exceeded without interruption for this period of time.

Parameter 157

Gen.power monit.
resp.val2 0000kW

Power monitoring threshold value, level 2 — **0 to 9,999 kW**

If this threshold value has been exceeded for at least the delay time (Parameter 159), the relay assigned relay manager function 80 energizes.

Parameter 158

Gen.power monit.
hyst.lv2 000kW

Power monitoring hysteresis, level 2 — **0 to 999 kW**

If the monitored generator power level drops below the threshold value configured in Parameter 157 by value configured here, hysteresis occurs and the relay de-energizes.

Parameter 159

Gen.power monit.
delay lv2 000s

Power monitoring delay, level 2 — **0 to 650 s**

For the control unit to recognize a power monitoring fault condition, the threshold value configured in Parameter 157 must be exceeded without interruption for this period of time.

3.8.2 Mains Power Monitoring

It is possible to monitor two independently configurable generator power limit values. 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 164 and Parameter 169) or an external protection device should be used.

Parameter 160

Mains power mon. ON

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 161

Mains power mon. res.val. I0000kW

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 163), 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 162

Mains power mon. hysteresis 000kW

Power monitoring hysteresis — **0 to 999 kW**

If the monitored generator power level drops below the threshold value configured in Parameter 161 by value configured here, hysteresis occurs and the relay de-energizes.

Parameter 163

Mains power mon. delay 000s

Power monitoring delay — **0 to 650 s**

For the control unit to recognize a power monitoring fault condition, the threshold value configured in Parameter 161 must be exceeded without interruption for this period of time.

3.8.3 Generator Overload Monitoring

NOTE

All percentage values refer to a percentage of the generator rated power (Parameter 23; page 23).

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 164

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 165

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 166), the following alarm class is initiated (MOP ..Mains Parallel Operation).

Issuing of class F2 alarm
without power reduction

Parameter 166

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 165 must be exceeded without interruption for this period of time (MOP ..Mains Parallel Operation).

Parameter 167

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 168), the following alarm class is initiated (IOP ..Isolated Parallel Operation).

Issuing of class F2 alarm
without power reduction

Parameter 168

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 167 must be exceeded without interruption for this period of time (IOP ..Isolated Parallel Operation).

3.8.4 Generator Reverse/Reduced Power Monitoring

NOTE

All percentage values refer to a percentage of the generator rated power (Parameter 23; page 23).

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 169

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 170

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 171), 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 171), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 171

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 170 must be exceeded without interruption for this period of time.

3.8.5 Load Imbalance Monitoring

NOTE

All percentage values refer to a percentage of the generator rated power (Parameter 24; page 23).

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 172

Load unbalanced monitoring ON

Load imbalance monitoring **ON/OFF**

ON..... Monitoring for load imbalance 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 173

Load unbalanced max. 000%

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

If the threshold value has been exceeded for at least the delay time (Parameter 174; e.g. because of an asymmetric load), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 174

Load unbalanced delay 00.00s

Load imbalance monitoring delay **0.02 to 9.98 s**

For the control unit to recognize a load imbalance monitoring fault condition, the threshold value configured in Parameter 173 must be exceeded without interruption for this period of time.

3.8.6 Time-Overcurrent Monitoring

NOTE

All percentage values refer to a percentage of the generator rated power (Parameter 24; page 23).

Function: The PCM1 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 overcurrents below level 2 but above permissible limits that are present over a longer period of time.

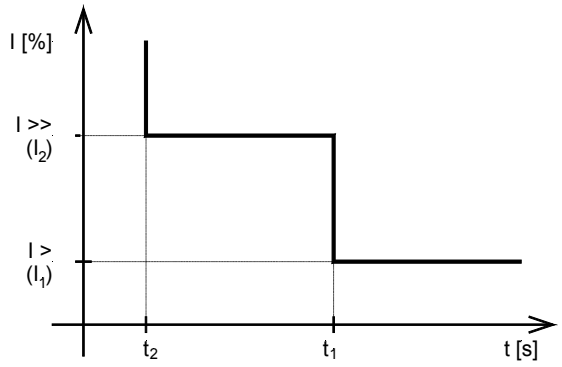


Figure 3-8: Characteristic of the time-overcurrent monitoring

Parameter 175

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 176

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 177), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 177

Gen.overcurrent delay 1 00.00s

Independent time overcurrent, delay, limit 1 **0.02 to 9.98 s**

For the control unit to recognize a time-overcurrent fault condition, the threshold value configured in Parameter 176 must be exceeded without interruption for this period of time.

Parameter 178

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 179), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 179

Gen.overcurrent delay 2 00.00s

Independent time overcurrent, delay, limit 2 **0.02 to 9.98 s**

For the control unit to recognize a time-overcurrent fault condition, the threshold value configured in Parameter 178) must be exceeded without interruption for this period of time.

Parameter 180

Gen.overcurrent Cool down ON

Open GCB with coasting due to overcurrent **ON/OFF**

ON .....If the GCB is opened due to an overcurrent fault condition, an engine cool-down is performed prior to engine stop.
OFF .....The engine is stopped without a cool-down.

3.8.7 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 284) in order to enable correct generator start-up.

Parameter 181

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 182

Gen.overfreq. f > 000.0%

Threshold value: generator overfrequency **50.0 to 140.0 %**

ⓘ This value refers to the parameter "Rated freq. in system" (Parameter 11).

If this threshold value has been exceeded for at least delay time (Parameter 183), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 183

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 182 must be exceeded without interruption for this period of time.

Parameter 184

Gen.underfreq. f < 000.0%

Generator underfrequency threshold value **50.0 to 140.0 %**

ⓘ This value refers to the parameter "Rated freq. in system" (Parameter 11).

If the current value has been fallen below this threshold value for at least the delay time (Parameter 185), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 185

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 184 must be exceeded without interruption for this period of time.

3.8.8 Engine Overspeed Monitoring

Parameter 186

Engine overspeed > 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 286). 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

3.8.9 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 284) in order to enable generator start-up.

Parameter 187

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 188

Gen.overvoltage U > 000.0%

Generator overvoltage threshold value **020,0 to 150,0 %**

ⓘ This value refers to the parameter "Rated volt. in system" (Parameter 19).

If this threshold value has been exceeded for at least the delay time (Parameter 189), 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 189

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 188 must be exceeded without interruption for this period of time.

Parameter 190

Gen.undervoltage U < 000.0%

Generator undervoltage threshold value **020,0 to 150,0 %**

ⓘ This value refers to the parameter "Rated volt. in system" (Parameter 19).

If the current value has been fallen below this threshold value for the delay time (Parameter 191), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 191

Gen.undervoltage delay 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 190 must be exceeded without interruption for this period of time.

3.8.10 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 192

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 193

Mains overfreq. f > 000.0%

Mains overfrequency threshold value **80.0 to 140.0%**

ⓘ This value refers to the parameter "Rated freq. in system" (Parameter 11).

If this threshold value has been exceeded for at least the delay time (Parameter 194), 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 194

Mains overfreq. delay 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 193 must be exceeded without interruption for this period of time.

Parameter 195

Mains underfreq. f < 000.0%

Mains underfrequency threshold value **80.0 to 140.0 %**

ⓘ This value refers to the parameter "Rated freq. in system" (Parameter 11).

If the current value has been fallen below this threshold value for at least the delay time (Parameter 196), 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 196

Mains underfreq. delay 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 195 must be exceeded without interruption for this period of time.

3.8.11 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 line-to-line (wye) voltage is monitored in all cases.

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 197

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 198

Mains overvolt. U > 000.0%

Mains overvoltage threshold value **20.0 to 150.0 %**

ⓘ This value refers to the parameter "Rated volt. in system" (Parameter 19).

If this threshold value has been exceeded for at least the delay time (Parameter 199), 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 199

Mains overvolt. delay 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 198 must be exceeded without interruption for this period of time.

Parameter 200

Mains undervolt. U < 000.0%

Mains undervoltage threshold value **20.0 to 150.0 %**

ⓘ This value refers to the parameter "Rated volt. in system" (Parameter 19).

If the current value has been fallen below this threshold value for the delay time (Parameter 201), 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 201

Mains undervolt. delay 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 200 must be exceeded without interruption for this period of time.

3.8.12 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 202

Phase shift 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 203

Monitoring

Phase/vector shift monitoring **one-/threephase / only threephase**

one-/threephase..During single-phase voltage phase/vector shift monitoring, tripping occurs if the phase/vector shift exceeds the configured threshold value (Parameter 204) 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 204) is taken into consideration; if a phase/vector shift occurs in all three phases, the three-phase threshold value (Parameter 205) 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 threephase..During three-phase voltage phase/vector shift monitoring, tripping occurs only if the phase/vector shift exceeds the specified threshold value (Parameter 205) in all three phases within 2 cycles.

Issuing of class F0 alarm

NOTE

If monitoring is configured to "threephase", only the second of the following two parameters is visible; if monitoring is configured to "one-/threephase", both parameters are visible.

Parameter 204

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 205

Phase shift three-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.

3.8.13 Mains Settling Time

Parameter 206

Mains settling time 000s

Mains settling time **0 to 999 s**

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

Note
For devices with one circuit breaker, refer also to Parameter 112.

If a PCM1-M has both the MCB and GCB open and the mains return, the mains settling time is reduced to 2 seconds when the mains return if the mains settling time is configured for longer.

3.8.14 Battery Voltage Monitoring

Parameter 207

Batt.undervolt. U < 00.0V

Battery voltage monitoring: Threshold value **9.5 to 30.0 V**

If the measured value falls below this threshold value for at least the delay time (Parameter 208), the following alarm class is issued.

Issuing of class F1 alarm

Parameter 208

Batt.undervolt. delay 00s

Battery undervoltage delay **0 to 99 s**

For the control unit to recognize a battery undervoltage fault condition, the threshold value configured in Parameter 207 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.

3.8.15 Time Of Active Horn

Parameter 209

Horn self reset 0000s

Horn acknowledgment after **1 to 9.999 s**

The horn (centralized alarm) will remain active for the time configured and then deactivate (acknowledged) automatically.

3.9 Discrete Inputs

Parameter 210

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 (Parameter 216 to Parameter 222 are configured to "OFF") the parameters in chapter "Alarm Inputs" are valid. If they have been configured as control inputs the parameters in "

Control Inputs" (page 93) are valid.

3.9.1 Alarm Inputs

Discrete input	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Name	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G
Terminal	34	35	36	61	62	63	64	65	66	67	68	69	70	71	72	73
Function	A	A	A	A	A/C	A/C	A/C	A	A	A/C	A	A	A/S	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.

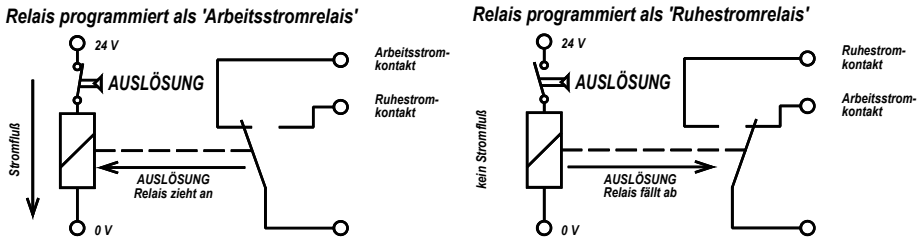


Figure 3-9: NO/NC logic

Example: Discrete inputs 1 through 4 (same procedure for inputs 5-16)

Parameter 211

Dig.input function	1234 EEEE

Function of the discrete alarm inputs 1 - 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.

E..... The discrete input is analyzed as "enabled" by applying of a voltage difference (NO/operating current; E = enable to operate).

D ..... The discrete input is analyzed as "enabled" by removal of a voltage difference (NC/idle current; D = disable to operate).

Parameter 212

Dig.input	**1234**
delay	**0000**

Delay time of the discrete alarm inputs 1-4 **0-9**

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

Parameter 213

Delayed by	**1234**
eng.speed	**YYYY**

Delayed by firing speed of the discrete alarm inputs 1–4 **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 214

Dig.input	**1234**
error class	**0000**

Alarm class of the discrete alarm inputs 1-4 **0-3**

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.

3.9.2 Configuring The Text For The Discrete Inputs

NOTE

If terminal 6 is configured to "Sprinkler operation" (override or critical mode; Parameter 223) or if a gas engine is selected (Parameter 267), the EMERGENCY STOP function must always be assigned to terminal 34. If terminal 34 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.

NOTE

If the unit is equipped with a second interface (Y1-Y5), the alarm texts can only be configured via FL-SOFT3.

Parameter 215

Errortxt.term.34
EMERGENCY STOP

Setting the alarm texts

These parameters are used to enter the alarm texts (in this example for terminal 34 the alarm text "EMERGENCY STOP"). The text for these parameters is user defined. Terminal 34 is the recommended terminal to assign EMERGENCY STOP functions to.

3.9.3 Control Inputs

a.) Acknowledge firing speed via terminal 62

Parameter 216

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 211 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 211 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.

b.) Block operation mode selector switch via terminal 63

Parameter 217

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 **Package P01** from version 4.3010 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 PCM1. (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 PCM1 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 PCM1 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 PCM1 are blocked.

Table 3-10: Function - external operation mode selection

c.) Change breaker logic via terminal 64

Parameter 218

Breaker logic by Term64 ON

Breaker logic 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 breaker logic of Parameter 219 will be used.
- Low signal — If this terminal utilizes a LOW signal (de-energized), the breaker logic of Parameter 117 will be used.

Parameter 219

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

Visible only if breaker logic via terminal 64 is configured to "ON".

Breaker logic via terminal 64 **see page 58**

Selection of the breaker logic that is to be used once terminal 64 is enabled. This parameter is only visible if Parameter 218 has been configured to ON (for the description of the breaker logic note chapter "Breaker logic", page 61).

d.) Enable 'Close GCB without engine delay' via terminal 67

Parameter 220

Close GCB asap	
by Ter.67	**ON**

Close GCB before the del. engine monit. expires via terminal 67ON/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.

e.) Enable 'Emergency OFF' via terminal 68

Parameter 221

Emergency OFF	
by Ter.68	**OFF**

only version 4.3010 or later

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 150 "Emergency power" is disabled.
- Low signal — If this terminal utilizes a LOW signal (de-energized), the setting of Parameter 150 "Emergency power" is taken over.

f.) Enable 'Idle mode' via terminal 70

Parameter 222

Idle Mode	
by term.70	**ON**

Enable idle mode via terminal 70 **ON/OFF**

OFF ..... This terminal is used as an alarm input.
ON..... This terminal is used as control input. The relay programmed with the relay manager function 133 reacts together with the logical status of terminal 70 according to the configured NO/NC logic and inverting the relay output. This relay must be wired to the "idle input" of the speed governor normally.

- High signal — Energizing the terminal 70 discrete input enables the idle mode. The message "Idle Mode" is displayed in all operational modes (except STOP mode) when a start request is initiated and during the postrun time so long as there are no other message with a higher display priority (i.e. preglow). The generator undervoltage and underfrequency protections are disabled while in the idle mode and the warning limit value for the oil pressure VDO input is suppressed. These protections are enabled after terminal 70 is de-energized and the monitored frequency is measured within 1 Hz of the rated generator frequency or after 60 seconds passes, which ever occurs first.
- Low signal — The idle mode is disabled and the protections become active again (see above description).

3.9.4 Terminal 6

ATTENTION

The various functions of terminal 6 are enabled at different signal levels!

Parameter 223

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 (critical) operation" on page 97).

Note: No load-dependent starting and stopping is possible in sprinkler operation.

Attention: This is a negative logic function!

• Engine enabled

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.

• STOP mode

By energizing terminal 6 (application of a HIGH signal) the STOP mode is enabled. If the signal is removed (de-energized), the operation mode will revert back to the mode that was active prior to terminal 6 being energized.

• Engine blocked

By energizing terminal 6 (application of a HIGH signal) a start of the engine can be prevented. If the engine is running due to an active emergency power operation, energizing this discrete input will stop it. The discrete input is not inverted. The engine block function is only possible in the AUTOMATIC operation mode.

• Start without CB

If the terminal 6 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. An engine start command from terminal 6 is a higher priority than a start command from terminals 3/5. If terminal 6 is selected, terminals 3/5 are ignored. If the generator is in a mains parallel operation mode with "Parallel" breaker logic and terminal 6 is energized, the GCB is opened following a power reduction. The generator will continue to operate without load and an open GCB.

Note: No load-dependent starting and stopping is possible in sprinkler operation.

a.) Starting without closing GCB

Parameter 224

Start withno GCB cool down ON

Only if terminal 6 has been configured to "start without CB".

Perform engine cool down if starting without CB has been selected **ON/OFF**

ON..... After removing the start request, an engine cool down is performed for the time configured in Parameter 283.
OFF ..... After removing the start request, the engine is stopped immediately without an engine cool down.

b.) Sprinkler alarm classes during Sprinkler coasting

Parameter 225

Sprinkler shutd. F1 active ON

Only if terminal 6 has been configured to "Sprinkler operation".

Sprinkler alarm classes only active if terminal 6 is active **ON/OFF**

ON..... If terminal 6 is configured as "Sprinkler operation", the primary alarm classes will be enabled again after the sprinkler coasting has expired (energizing terminal 6 and sprinkler coasting 10 minutes).
OFF ..... If terminal 6 has been configured to "Sprinkler operation", the primary alarm classes will be enabled again after the sprinkler demand has concluded (energizing terminal 6).

c.) Sprinkler (critical) operation

NOTE

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

ATTENTION

Please note that terminal 6 must be energized (apply a HIGH signal) so that a Sprinkler (critical) operation is not performed. De-energizing terminal 6 (a LOW signal) initiates a Sprinkler (critical) operation ⇨ negative logic function.

Sprinkler "ON": If the signal at terminal 6 drops to a Low signal (de-energizes), the Sprinkler (critical) operation ON command is initiated. The message "Sprinkler operation" is shown on the display. Up to 6 attempts are made to start the engine if it is not in operation. All fault conditions, which result in a shutdown, become messages with the exceptions of terminals 34 or 61 and overspeed. The alarm input for terminal 34 retains its set alarm class. Terminal 61 is used for this if terminal 34 is not present on the control. It is recommended that EMERGENCY STOP be assigned to one of these terminals.

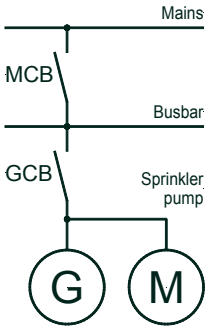
NOTE

If "Sprinkler operation" (terminal 6) has been activated, class F2 and F3 alarms are converted to class F1 alarms (exception: terminal 34 or 61 and overspeed).

Class F2 and class F3 alarms ⇨ Class F1 alarm

"Sprinkler shutdown F1 active": Parameter 225 permits the user to select whether the Sprinkler alarm classes are active during the Sprinkler coasting or if the primary alarm class will be active after the Sprinkler (critical mode) request (terminal 6) has terminated.

A distinction is made between three operating conditions:



1.) MCB is closed
(⇨ mains voltage available):
a) The engine is stopped: The engine will be started and the GCB will not be closed.
b) The engine runs with the GCB open.

2.) MCB is opened
(⇨ mains voltage not available and the Parameter 150 "Emergency power" is ON)
a) The GCB will be closed or remains closed.
b) In the event of a generator overload, the GCB will open
Following the alarm acknowledgement the GCB will be closed again.

Figure 3-11: Sprinkler operation

3.) MCB is open
(⇨ mains voltage available):
a) The MCB will be synchronized,
b) Following the synchronization of the MCB, the GCB will be opened.

Sprinkler "OFF": Disabling the Sprinkler (critical) mode discrete input (energizing terminal 6) terminates the Sprinkler ON command and the message "Sprinkler coasting" appears on the display screen. The message "Sprinkler coasting" appears. The Sprinkler (critical mode) operation is automatically finished 10 minutes later. Earlier termination can be achieved by the changing into the STOP mode. When the Sprinkler (critical mode) operation has concluded, fault conditions that result in shutdowns are enabled again.

3.10 Analog Inputs (Package P01)

Parameter 226

Configure analg.inp.	**YES**

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.

3.10.1 Setting The Analog Inputs

Note

The analog inputs [T1] to [T7] are only available in the packages P01. The following specification for the inputs is possible:

- Scaleable analog input 0/4-20 mA (page 100),
- Pt100 input (page 99), and
- VDO input (temperature, page 102 or pressure, page 103).

Analog input	1	2	3	4	5	6	7
Assignment	0/4-20 mA			Pt100		VDO #1	VDO #2
Terminal	93/94/95	96/97/98	99/100/101	101/102/103	104/105/106	107/108/109	110/111/112
Function	Alarm input/Control input[1]			Alarm input			

VDO #1 = 0-180 Ohm, VDO #2 = 0-380 Ohm

NOTE

If you want to visualize the analog inputs via the PC program FL-SOFT3 (Firmware Version 4.0.xxx or higher) please note the following:

1. Establish a connection between FL-SOFT3 and the PCM.
2. Select in the menu "Devices" the topic "Refresh Configuration".
3. Restart FL-SOFT3 according to the requests.

1 The 0/4..20 mA inputs can be configured with the functions "Real power **set** value", "Mains interchange (import/export) real power **actual** value" or "Alarm input". Read the description in this manual.

a.) Scaleable analog input 0/4-20 mA (analog input [T1]-[T3])

NOTE

The scalable analog inputs 0/4 to 20 mA can be configured alternatively for the following functions:

- Mains interchange (import/export) real power actual value, or
- real power set point value.

If one of the both functions is assigned to an available 0/4 to 20 mA input T{x} (see Parameter 25 and Parameter 84), the corresponding analog input T{x} must be configured to OFF. The analog input can no longer be used as an alarm input.

Priority of the analog input functions

The following priority is valid if more than one function has been assigned to a analog input:

- Highest priority: Mains interchange (import/export) real power actual value measurement
- Middle priority: Real power set point value
- Lowest priority: Measuring input as common analog value

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 227

Analog input x scalable	**ON**

[x = 1 to 3]

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.

NOTE

If the unit is equipped with a second interface (Y1-Y5), this parameter can only be configured via FL-SOFT3.

Parameter 228

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 229

Analog input x
0-00mA

[x = 1 to 3]

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 230

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 231

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 232

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 235) for at least the delay time (Parameter 234), the following alarm class is initiated.

Issuing of class F1 alarm

Parameter 233

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 235) for at least the delay time (Parameter 234), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 234

Delay
limit 1/2 **000s**

0/4 to 20 mA input; delay time for limit values of class F1 and F3 alarm **0 to 650 s**

In order to initiate an alarm, the measured value (Parameter 232 or Parameter 233) must be over or under the configured threshold value (selected by Parameter 235) without interruption for at least this time.

Parameter 235

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 232 or Parameter 233).
high limit mon.: The measured value must exceed the threshold value.
low limit mon.: The measured value must fall below the threshold value.

b.) Pt100 Input (Analog Input [T4]-[T5])

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 236

Temperature x
Pt100 ON

[x = 4 to 5]

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.

NOTE

If the unit is equipped with a second interface (Y1-Y5), the alarm texts can only be configured via FL-SOFT3.

Parameter 237

*****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 238

Limit
warning 000°C

Pt100 input; limit value for class F1 alarm **0 to 200 °C**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 241) for at least the delay time (Parameter 240), the following alarm class is initiated.

Issuing of class F1 alarm

Parameter 239

Limit
shutdown 000°C

Pt100 input; limit value for class F3 alarm **0 to 200 °C**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 241) for at least the delay time (Parameter 240), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 240

Delay
limit 1/2 000s

Pt100 input; delay time for limit values of class F1 and F3 alarm0 to 650

In order to initiate an alarm, the measured value (Parameter 238 or Parameter 239) must be over or under the configured threshold value (dependent upon Parameter 241) without interruption for at least this time.

Parameter 241

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 238 or Parameter 239).
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).

c.) VDO Input 'Pressure' (Analog Input [T6])

NOTE

The default threshold values are configured in "bar". If the unit "psi" is configured (Parameter 157) the display of the measured values as well as the transmission via the interface appears in "psi".

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 242

Analog input 6
VDO ON

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.

NOTE

If the unit is equipped with a second interface (Y1-Y5), the alarm texts can only be configured via LeoPC1.

Parameter 243

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 244

Analog input 6
VDO 0-00bar

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 245

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 248) for at least the delay time (Parameter 247), the following alarm class is initiated.

Issuing of class F1 alarm

Parameter 246

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 248) for at least the delay time (Parameter 247), the following alarm class is initiated.

Issuing of class F3 alarm

Parameter 247

Delay limit 1/2 000s

VDO input, pressure; delay time for limit values of class F1 and F3 alarm **0 to 650 s**

In order to initiate an alarm, the measured value must be over or under (dependent upon Parameter 248) the threshold value (Parameter 245 or Parameter 247) without interruption for at least this time.

Parameter 248

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 245 or Parameter 247).
high limit mon.: The measured value must exceed threshold.
low limit mon.: The measured actual value must fall below the threshold value.

d.) VDO Input 'Temperature' (Analog Input [T7])

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.

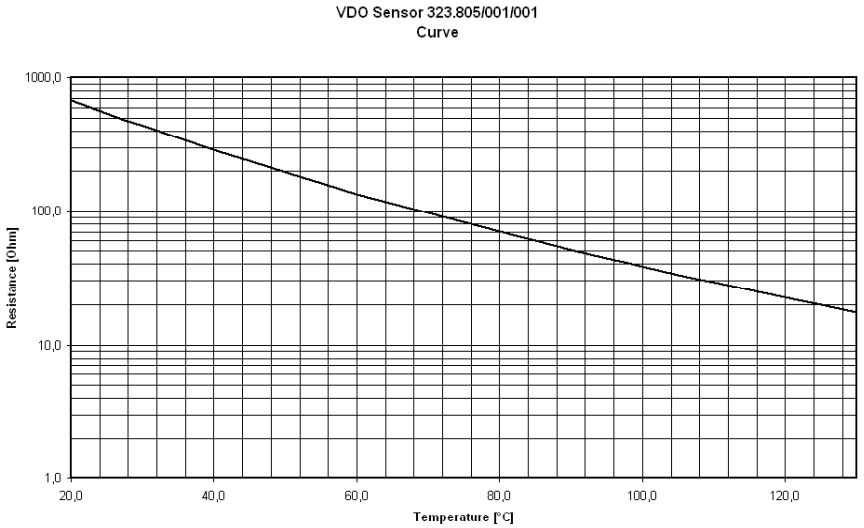


Figure 3-12: VDO transmitter 323.805/001/001 (slope)

Parameter 249

Analog input 7 VDO ON

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.

NOTE

If the unit is equipped with a second interface (Y1-Y5), the alarm texts can only be configured via LeoPC1.

Parameter 250

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 251

Limit warning value 000°C

VDO input, temperature; limit value for class F1 alarm 40 to 120 °C

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 254) for at least the delay time (Parameter 253), the following alarm class is issued.

Issuing of class F1 alarm

Parameter 252

Limit shutdown 000°C

VDO input, temperature; limit value for class F3 alarm 40 to 120 °C

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 254) for at least the delay time (Parameter 253), the following alarm class is issued.

Issuing of class F3 alarm

Parameter 253

Delay limit 1/2 000s

VDO input, temperature; delay time for limit values of class F1 and F3 alarm 0 to 650 s

In order to initiate an alarm, the measured value must be over or under (dependent upon Parameter 254) the threshold value (Parameter 251 or Parameter 252) without interruption for at least this time.

Parameter 254

Monitoring for ----------

VDO input, temperature; monitoring for ...
high limit monitoring/low limit monitoring

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 251 or Parameter 252).
high limit mon.: The measured value must exceed threshold value.
low limit mon.: The measured value must fall below the threshold value.

e.) Monitoring Of The Measuring Range (All Analog Inputs)

Parameter 255

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	216 °C and above
180 Ω VDO, 0 to 5 Bar	305 Ω and above
180 Ω VDO, 0 to 10 Bar	305 Ω and above

f.) Engine Delayed Monitoring Of The Analog Inputs

Parameter 256

Ana.in 12345678
SV.del. NNNNNJNN

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.

Note: Above screen (8 inputs) appears if at least 5 analog inputs are equipped. If less than 5 inputs are equipped, a screen with 4 inputs appears. If less inputs are equipped than inputs appear in the screen, only the entries for the equipped inputs are valid.

g.) Analog Inputs Selectable as Control Inputs

Parameter 257

Ana.in 12345678
control NNNNNNNN

Analog input as control input **J/N**

This parameter defines for each analog input whether it operates as control input or not.

J .....The analog input operates as control input: The analog value is displayed and the configured relays are energized when reaching the configured limits. However, no alarm is issued. No guidance bus output is performed as well.
(This setting has no effect on the behavior in case a wire breaks)

N .....The analog input operates as described for the above settings.

Note: Above screen (8 inputs) appears if at least 5 analog inputs are equipped. If less than 5 inputs are equipped, a screen with 4 inputs appears. If less inputs are equipped than inputs appear in the screen, only the entries for the equipped inputs are valid.

3.11 Outputs

Parameter 258

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.

3.11.1 Analog outputs (Package P01)

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 124.

Possible outputs: Analog outputs terminals 120/121 and 122/123
Example: Analog output terminals 120/121

Parameter 259

Analg.out.12O121	
Parameter	00

Function for analog output **0-22**

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 260

Analg.out.12O121	
	0-00mA

Analog output range **OFF/0-20/4-20 mA**

The output range 0-20 mA or 4-20 mA is selected using this parameter.

Parameter 261

Analg.out.12O121	
0%	0000

Scaling the lower output value **0-9,990**

The configurable limits for the 0 % value is contained in Appendix A.

Parameter 262

Analg.out.12O121	
100%	0000

Scaling the upper output value **0-9,990**

The configurable limits for the 100 % value is contained in Appendix A.

3.11.2 Relay Manager

The relay manager enables the assignment of an arbitrary combination of functions to each relay. 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 16 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 127.

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 263

Assignm.relay x
3+-8+13

[x = 1 to 7]

Programming relay outputs

The relay x [x = 1 to 7] 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 underspeed" alarm is present

3.12 Engine

Parameter 264

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 265

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 (no prerun). 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 266

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 267

Start-stop-logic for ----------

Engine; start/stop sequence for ... **DIESEL/GAS/EXTERNAL**

DIESEL..... Start/stop logic is performed for a diesel engine.

GAS..... Start/stop logic is performed for a gas engine.

EXTERNAL .... External start/stop sequence (the start/stop sequence is disabled).

3.12.1 Start/Stop Sequence 'Gas Engine'

NOTE

The configured number of start attempts (Parameter 271) will be performed.

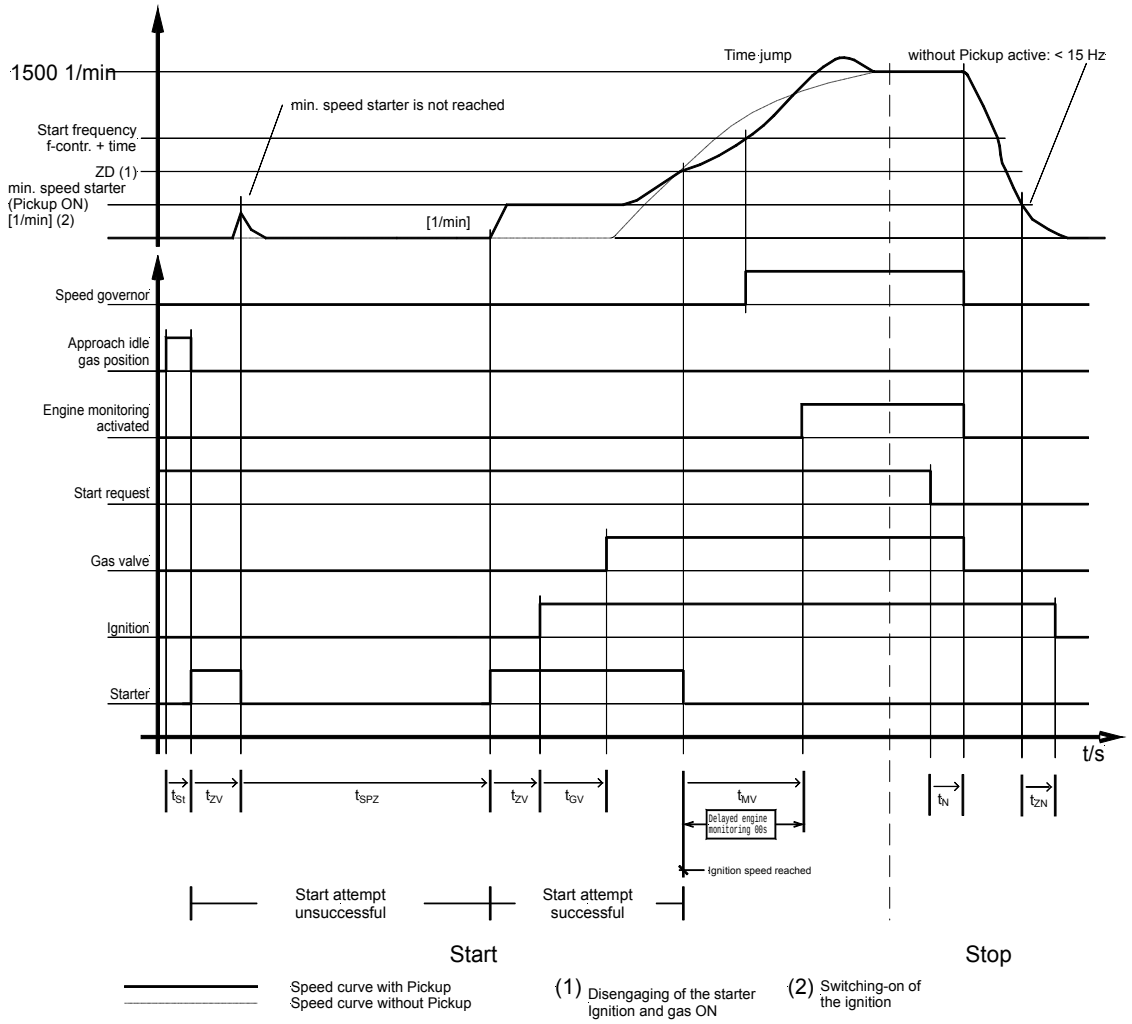


Figure 3-13: Start-Stop sequence: Gas engine

The signs and indices mean:
tSta ..... Approach idle gas position [s]
tZV ..... Firing delay [s]
tGV ..... Gas delay [s]
tSPZ ..... Time between two start attempts [s]
tMV ..... Delayed engine monitoring [s]
tZN ..... Ignition coasting [s]; pre-specified: 5 s
tN ..... Engine cool down time [s]
(1) ..... Disengagement of the starter; Ignition and gas also ON
(2) ..... Switching ON the ignition

a.) Starting Sequence

If the control is equipped with a three-position frequency controller, a continuous signal (time adjustable via Parameter 275) 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 269) and if the engine is rotating with at least the configured "minimum speed for ignit." (Parameter 268), the ignition is enabled. Following the expiration of the gas valve delay (Parameter 270), the gas valve is then enabled. If the starting sequence finishes successfully (the firing speed (Parameter 285) 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 45) and the delayed engine monitoring has expired (Parameter 285), the speed controller is enabled.

b.) Stopping Sequence

When the start request is terminated, a power reduction is performed (if the real power controller is enabled, Parameter 80). After the GCB has opened, an engine cool down is performed (Parameter 283). 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 285), 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.

c.) 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.

Controlling gas valves with the PCM

The PCM relay manager from V4.1001 and on contains function 131. This function exists in the PCM so that a relay configured with this function behaves like the "Gas valve" relay.
The wiring diagram shown below is an example of a recommended gas valve control system in the gas line.

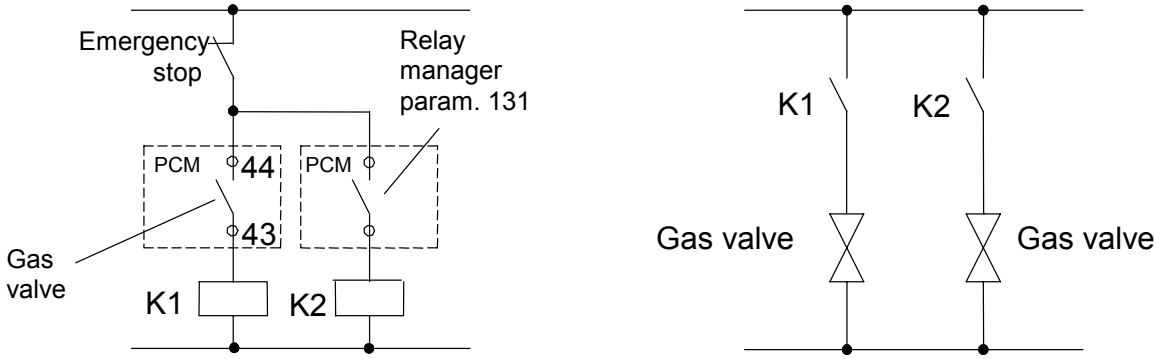


Figure 3-14: Wiring diagram for opening gas valves with the PCM from V4.1001

d.) Parameter

Parameter 268

Min.speed for ignit. 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 269) has expired, the engine must exceed the speed configured with this parameter in order to enable the ignition relay (relay manager function 84).

Parameter 269

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 268) has been exceeded, the ignition is enabled.

Parameter 270

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 285) the relay remains energized until the engine stops.

Parameter 271

Max. attempts to start 0

Gas engine; maximum number of start attempts — 1 to 6

The control will initiate up to this number of start attempts. If the engine cannot be started within this number of start attempts, an alarm message is issued.

Parameter 272

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 273

Start pause time 00s

Gas engine; time between two start attempts — 1 to 99 s

The delay time between the individual start attempts.

Parameter 274

f lower before start ON

with three-step controllers only

Gas engine; approach idle gas 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 275 before the starter is engaged. The idle gas position must either be equipped with a limiting switch or the engine potentiometer must be equipped with a slipping clutch. A message is displayed.

CAUTION
The engine starting is delay by means of the idle fuel position in the event of emergency power operation.

Parameter 275

time f lower bef.start 000s

with three-step controllers only

Gas engine; approach idle gas position (time) — 0 to 999 s

The duration that the "lower engine speed" signal (Parameter 274) is output.

3.12.2 Start/Stop Sequence 'Diesel Engine'

NOTE

The configured number of start attempts (Parameter 277) will be performed.

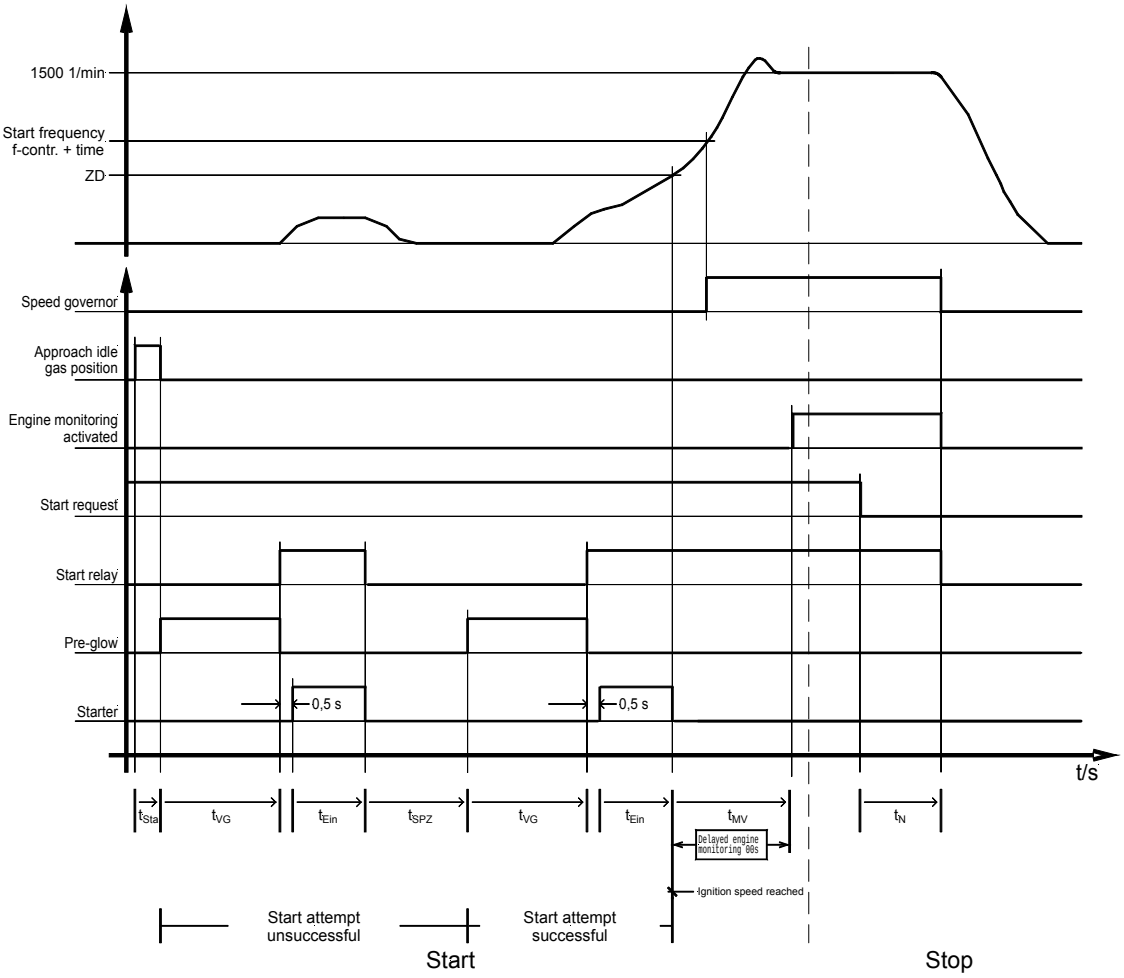


Figure 3-15: Start-stop sequence: Diesel engine

The signs and indices mean:
tSta ..... Approach idle fuel position [s]
tVG..... Preglow time [s]
tEin ..... Crank time [s]
tSPZ ..... Time between two start attempts [s]
tMV ..... Delayed engine monitoring [s]
tN ..... Engine cool down time [s]

a.) Starting Sequence

If the control is equipped with a three-position frequency controller, a continuous signal (time adjustable via Parameter 281) 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 276). Following preheating, the fuel relay is enabled (Parameter 282), followed by the crank relay. Once the firing speed (Parameter 285) 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 45) and the delayed engine monitoring has expired (Parameter 285), the speed controller is enabled.

b.) Stopping Sequence

When the start request is terminated, a power reduction is performed (if the real power controller is enabled, Parameter 80). Once the GCB has opened, an engine cool down is performed (Parameter 283). 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 285), 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.

c.) Parameter

Parameter 276

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 277

Max. attempts to Start 0

Diesel engine; maximum number of start attempts **1 to 6**

The control will initiate up to this number of start attempts. If the engine cannot be started within this number of start attempts, an alarm message is issued.

Parameter 278

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 279

Start pause time 00s

Diesel engine; time between two start attempts **1 to 99 s**

The delay time between the individual start attempts.

Parameter 280

f lower before start OFF

with three-step controllers only

Diesel engine; approach idle gas 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 281 before the starter is engaged. The idle gas position must either be equipped with a limiting switch, or the engine potentiometer must be equipped with a slipping clutch. A message is displayed.

CAUTION
The engine starting is delay by means of the idle fuel position in the event of emergency power operation.

Parameter 281

time f lower bef.start 000s

with three- step controllers only

Diesel engine; approach idle gas position (time) 0 to 999 s

The duration that the "lower engine speed" signal (see Parameter 280) is output.

Parameter 282

Fuel relay logic ----------

Diesel engine; fuel solenoid logic open to stop / close to stop

open to stop.. The operating solenoid is energized prior to each start sequence. In order to shutdown the engine, the operating solenoid is de-energized.

close to stop . In order to shutdown the engine, the stop solenoid is energized. The stop solenoid remains energized for an additional 10 seconds once the engine speed drops below firing speed (Parameter 285) and the generator voltage is less than 20 V.

3.12.3 Cool Down

Parameter 283

Cool down 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 285) 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.

3.12.4 Delayed Engine Monitoring And Firing Speed

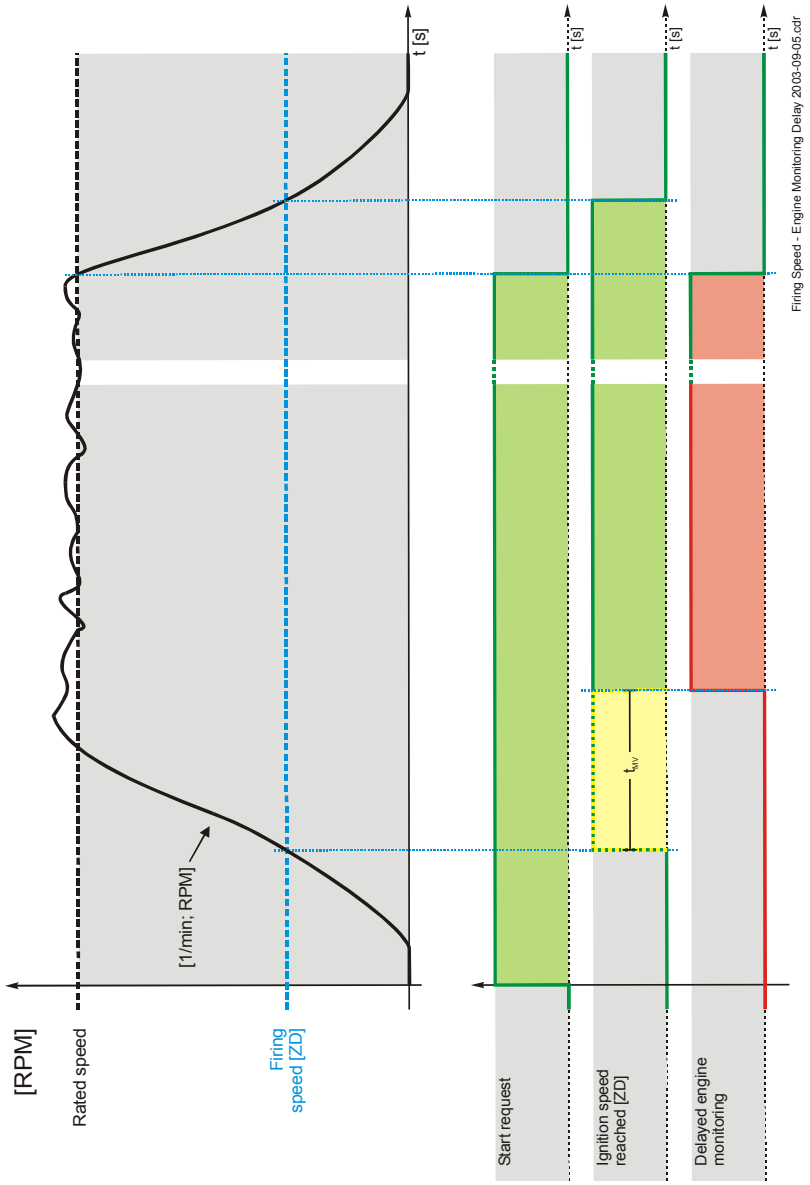


Figure 3-16: Delayed engine monitoring

Parameter 284

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 285

Firing speed reached f >00Hz

Engine; firing speed reached **5 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.

Note

Accurate measurement is possible above 15 Hz, even if 5 Hz are displayed. If the Pickup measurement has been configured to "ON", values down to 5 Hz are displayed.

3.12.5 Pick-Up

Measuring the engine speed can be performed alternatively by means of a Magnetic Pickup, the generator frequency, or a tacho generator.

Parameter 286

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 287

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 284) and performed continuously while the generator is operating.

Parameter 288

Gen.rated speed 0000 rpm

Pickup; rated speed at rated frequency **0 to 3,000 rpm**

Number of revolutions per minute at rated frequency speed.

3.13 Counter / Real Time Clock

Parameter 289

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.

3.13.1 Maintenance Call

Parameter 290

Service interval in 0000h

Counter; maintenance call **0 to 9,999 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:

- Navigate to the display screen "`Service in 000h`" using the "Select" button.
- Press and hold the "Digit" button for 10 seconds.
- The new maintenance interval is displayed.

3.13.2 Operating Hours Counter

Parameter 291

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.

3.13.3 Start Counter

Parameter 292

Set start counter	**00000**

Counter; number of engine starts **0 to 32,000**

The start counter is used to display how many times the engine has been started. Following each starting attempt the start counter is increased by one. This permits the user to display the correct number of starts if this controller is used on an older engine, a starter is replaced, or this controller is to replace an older controller.

Only maintenance personnel should configure the start counter!

NOTE

If the 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 operating hours
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

3.13.4 kWh Counter

Parameter 293

kWh counter set in	**---**

Counter; kWh counter set in ... **kWh/MWh**

The power produced may be measured in kWh or MWh. The user defined which scale is desired for the controller with this parameter.

Parameter 294

kWh counter set	**00000---**

Counter; kWh counter set for ... **0 to 65,500 kWh/MWh**

The user may input values into the kWh/MWh counter (depending on Parameter 293) with this parameter. This permits the user to display the correct number of kWh/MWh for a generator if this controller is used on an older engine or this controller is to replace an older controller.

NOTE

If the kWh counter is to be changed from the factory default setting, the controller must be in code level CS2. The counter is set in a two-step procedure due to safety reasons.

The following proceeding is valid:

1. Step: Set and store the desired counter values for the parameters 287 and 288.
2. Step: Integrate the stored value by …
   - Terminate the configuration mode and change to automatic mode
   - Displaying the kWh counter
   - Press and hold the "Digit" push-button for at least 5 seconds

3.13.5 Real Time Clock (Package P01)

NOTE

If several PCM control units are on one common CAN bus all clocks are synchronized daily at 12:00 o'clock (noon) to the time of the control with the lowest control/generator number. This makes it essential that each control unit has a different control number.

Parameter 295

Time
00:00

Real time clock; time

Setting of the hours and minutes of the internal real time clock.

Hour	
00	0th hour of the day
01	1st hour of the day
...	...
23	23rd hour of the day
Minute	
00	0th minute of the hour
01	1st minute of the hour
...	...
59	59th minute of the hour

Parameter 296

Year,month
00,01

Real time clock; year/month

Setting the year and month of the internal real time clock.

Year	
99	Year 1999
00	Year 2000
01	Year 2001
...	...
Month	
01	January
02	February
...	...
12	December

Parameter 297

Day/weekday
01/1

Real time clock; day/weekday

Setting of the day and weekday of the internal real time clock.

Day	
01	1st of the month
02	2nd of the month
...	...
31	31st of the month, if available
Weekday	
1	Monday
2	Tuesday
...	...
7	Sunday

3.13.6 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 in the Automatic mode by pressing the "Message" push-button. The following screen appears in the display:

Parameter 298

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 "reset" button for 3 seconds while the current slave pointer screen is being displayed will reset the memory.

4 Commissioning

DANGER - HIGH VOLTAGE

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

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

CAUTION

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

CAUTION

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

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" operation 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 at the beginning of thismanual. It is vital that these replies be connected!

Electrical insulation 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.

4.1 Analog output manager (Package P01)

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.....+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]	
10	Speed via Pickup	[min^{-1}]	0% Lower speed e. g. 0000 rpm 100% Upper speed e. g. 3000 rpm

Func-tion	Output	Value	Input of the two limit values
11	Analog input [T1] (Package P01)	[°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] (Package P01)	[°C] or [°F] or freely scaleable	
13	Analog input [T3] (Package P01)	[°C] or [°F] or freely scaleable	
14	Analog input [T4] (Package P01)	[°C] or [°F] or freely scaleable	
15	Analog input [T5] (Package P01)	[°C] or [°F] or freely scaleable	
16	Analog input [T6] (Package P01)	[Bar] or [PSI] or freely scaleable	
17	Analog input [T7] (Package P01)	[Bar] or [PSI] or freely scaleable	
18	–free–	[°C] or [°F] or freely scaleable	
19	Actual mains interchange (im-port/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.....+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 cos φ scaling: According to the scaling of the analog output, the power factor cos φ 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.

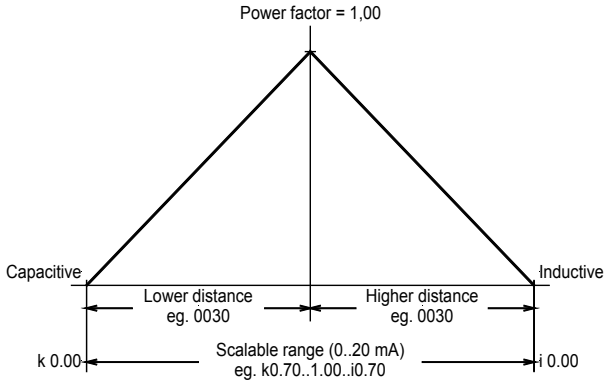


Figure 4-1: Analog outputs - cosφ scaling

4.2 Relay Manager

No.	Output	Explanation
1	Alarm class 1	
2	Alarm class 2	
3	Alarm class 3	
4	Firing speed reached (engine runs)	
5	Mains failure; undelayed	The function reacts according to the status of the breakers. The conditions described in chapter "Emergency power" apply.
6	Battery undervoltage	
7	Operation mode AUTOMATIC	
8	Operation mode MANUAL	
9	Operation mode TEST	
10	Operation mode STOP	
11	Generator undervoltage	
12	Generator overvoltage	
13	Generator underfrequency	
14	Generator overfrequency	
15	Generator overcurrent level 1	
16	"Synchronization GCB" or "Connect GCB" time monitoring alarm	
17	Engine start failure	
18	Generator load imbalance	
19	Generator overload	
20	Generator reverse/reduced power	
21	Readiness for operation	Output via relay manager
22[#1]	Analog input [T1], level 1	
23[#1]	Analog input [T1], level 2	
24[#1]	Analog input [T2], level 1	
25[#1]	Analog input [T2], level 2	
26[#1]	Analog input [T3], level 1	
27[#1]	Analog input [T3], level 2	
28[#1]	Analog input [T4], level 1	
29[#1]	Analog input [T4], level 2	
30[#1]	Analog input [T5], level 1	
33[#1]	Analog input [T5], level 2	
32[#1]	Analog input [T6], level 1	
33[#1]	Analog input [T6], level 2	
34[#1]	Analog input [T7], level 1	
35[#1]	Analog input [T7], level 2	
36	Discrete input [D01]	
37	Discrete input [D02]	
38	Discrete input [D03]	
39	Discrete input [D04]	
40	Discrete input [D05]	
41	Discrete input [D06]	
42	Discrete input [D07]	
43	Discrete input [D08]	
44	Discrete input [D09]	
45	Discrete input [D10]	
46	Discrete input [D11]	
47	Discrete input [D12]	
48	Discrete input [D13]	
49	Discrete input [D14]	
50	Discrete input [D15]	

[#1] (Package P01)

No.	Output	Explanation
51	Discrete input [D16]	
52	Auxiliary services	i.e. prelube/cooling pumps
53[#]	–Internal–	
54	Centralized alarm (class F1, F2, or F3 alarm; enabled until acknowledgement)	
55	TEST or AUTOMATIC operation mode selected	
56	Generator power watchdog, level 1	
57	MCB is closed	
58	GCB is closed	
59[#]	–Internal–	
60	Mains parallel operation is desired: disable interlock of GCB <> MCB	
61	Overcurrent I/t or generator overcurrent, level 2	
62	Introduce load-shedding: Connection / synchronization of GCB is carried out or circuit breaker is closed	Signal is enabled prior to connection / synchronization and remains enabled after circuit breaker is closed.
63	Connection / synchronization MCB carried out or circuit breaker is closed	Signal is enabled prior to connection / synchronization and remains enabled after circuit breaker is closed.
64	Overspeed via Magnetic Pickup	
65	Emergency power is active	
66	Shutdown malfunction	
67	Power watchdog for power supplied by the mains	
68	Maintenance call	
69	Pickup/gen. differential frequency	The monitored generator frequency and the engine speed from the MPU are different
70	"Synchronization MCB" or. "Connect MCB" time monitoring alarm.	
71	GCB synchronization carried out	
72	MCB synchronization carried out	
73	Lamp test active	
74	Malfunction "Reply: GCB is open" - fault on closing	The GCB cannot be closed after 5 attempts.
75	Malfunction "Reply: MCB is open" - fault on closing	The MCB cannot be closed after 5 attempts.
76	Malfunction "Reply: GCB is open" - fault on opening	2 s following the "Command: open GCB" a reply continues to be detected.
77	Malfunction "Reply: MCB is open" - fault on opening	2 s following the "Command: open MCB" a reply continues to be detected.
78	Power supplied by the mains <> 0	In the event of interchange synchronization, the zero incoming power cannot be attained. The MCB is prevented from opening as a result of this. Reset via acknowledgment.
79	Connect time on dead bus start exceeded	
80	Generator power watchdog, level 2	

[#1] special versions only

No.	Output	Explanation
81	Left mains rotating field	
82	Engine enable	Set engine enable As long as there is a start request for the engine and during cool down (as long as the operation of the engine is enabled, i.e. operation mode AUTOMATIC and discrete input 3/5, emergency power, start via interface, manual start, etc.). Reset engine enable If the start request is no longer present, in the event of manual stoppage, with a class F3 alarm, during the engine stop time (prior to a further attempt at starting), and if "zero" speed is detected and there is not a start request present or coasting is not taking place.
83	"RESET" push-button pressed	
84	Preheating/firing ON (pre-assigned to relay [7])	pre-assigned default value
85	Group alarm of class F1, F2, or F3 alarm (pre-assigned to relay [8])	pre-assigned default value Horn: after 2 min independent shut-off
86[#1]	–Internal–	
87[#1]	–Internal–	
88	Generator voltage and frequency are not available (undelayed)	
89	Busbar voltage and frequency are not available (undelayed)	
90[#1]	–Internal–	
91	Pickup has nominal speed (+/-6 %)	
92	Mains voltage fault via protection device	
93	Mains frequency fault via protection device	
94	Phase/vector shift fault via protection device	
95[#1]	–Internal–	
96	Delayed engine monitoring time exceeded	
97	Sprinkler mode is active (included Sprinkler coasting)	
98[#1]	–Internal–	
99[#1]	–Internal–	
100[#1]	–Internal–	
101[#1]	–Internal–	
102[#1]	–Internal–	
103[#1]	–Internal–	
104[#1]	–Internal–	
105[#1]	–Internal–	
106[#1]	–Internal–	
107[#1]	–Internal–	
108[#1]	–Internal–	
109[#1]	–Internal–	
110[#1]	–Internal–	

[#1] special versions only

No.	Output	Explanation
111[#1]	–Internal–	
112[#1]	–Internal–	
113[#1]	–Internal–	
114[#2]	Three-position controller: n+ / f+ / P+	(use an external RC protection circuit)
115[#2]	Three-position controller: n- / f- / P-	
116[#2]	Three-position controller: V+ / Q+	
117[#2]	Three-position controller: V- / Q-	
118[#1]	–Internal–	
119[#3]	Wire break Analog input [T1]	
120[#3]	Wire break Analog input [T2]	
121[#3]	Wire break Analog input [T3]	
122[#3]	Wire break Analog input [T4]	
123[#3]	Wire break Analog input [T5]	
124[#3]	Wire break Analog input [T6]	
125[#3]	Wire break Analog input [T7]	
126[#1]	–Internal–	
127[#1]	–Internal–	
128[#1]	–Internal–	Direct configuration via FL-SOFT3 starting with **Version 3.0.015** possible.
129[#1]	–Internal–	
130[#1]	–Internal–	
131	Fuel relay is ON / stop relay is ON / gas valve is ON	
132[#1]	–Internal–	
133	Idle mode active	
134[#1]	–Internal–	
135[#1]	–Internal–	
136[#1]	–Internal–	
137[#1]	–Internal–	
138[#1]	–Internal–	
139	Phase rotation generator/busbar or busbar/mains mismatch	
140	Direction of rotation, mains voltage: CW	
141	Direction of rotation, generator voltage: CCW	
142	Direction of rotation, generator voltage: CW	
143	Starter engaged (cranking)	
144	GCB is to be opened	
145	–Internal–	from V4.3010
146	Parallel operation CB	
147	–Internal–	
148	Unintended stop	from V4.3010
149	Interface error X1/X5	from V4.3010

[#1] special versions only, [#2] (Package P01), [#3] (Package P01)

4.3 Interface Protocol

4.4 Transmission Telegram

MUX	No.	Contents (words)	Unit	Note
0/1	1	Generator voltage delta V_{12}	V × $10^{UGNEXPO}$	
0/2	2	Generator frequency f	Hz × 100	
0/3	3	Actual generator real power P	W × $10^{PGNEXPO}$	
1/1	4	Exponents		High Byte: PGNEXPO Generator power Low Byte: UGNEXPO Generator voltage
1/2	5	Real power set point value	see note	$W \times \frac{PGNWD}{2.800} \times 10^{PGNEXPO}$
1/3	6	Conversion factor Steps → kW		PGNWD (internal)
2/1	7	Busbar voltage delta V_{12}	V × $10^{UGSSEXPO}$	
2/2	8	Mains voltage delta V_{12}	V × $10^{UINTEXPO}$	
2/3	9	Currently present alarm class ***Note*** *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 15 = 1 –Internal– Bit 14 = 1 –Internal– Bit 13 = 1\ Bit 12 = 1/ Alarm class F2 or alarm class F3 Bit 11 = 1\ Bit 10 = 1/ LED "Alarm" flashes Bit 9 = 1 –Internal– Bit 8 = 1 –Internal– Bit 7 = 1\ Bit 6 = 1/ Alarm class F3 Bit 5 = 1\ Bit 4 = 1/ Alarm class F2 Bit 3 = 1\ Bit 2 = 1/ Alarm class F1 Bit 1 = 1\ Bit 0 = 1/ Alarm class F0
3/1	10	Control register 2 ***Note*** *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 15 = 1\ Bit 14 = 1/ Terminal 3 is energized Bit 13 = 1\ Bit 12 = 1/ Terminal 5 is energized Bit 11 = 1\ Bit 10 = 1/ –Internal– Bit 9 = 1\ Bit 8 = 1/ Terminal 53 is energized DI "Enable MCB" Bit 7 = 1\ Bit 6 = 1/ Terminal 4 is energized DI "Reply GCB is closed" Bit 5 = 1\ Bit 4 = 1/ Terminal 54 is energized DI "Reply MCB is closed" Bit 3 = 1\ Bit 2 = 1/ Terminal 6 is energized Bit 1 = 1\ Bit 0 = 0/ Shutdown power reached Bit 1 = 0\ Bit 0 = 1/ Shutdown power not reached

MUX	No.	Contents (words)	Unit	Note	
3/2	11	Actual mains interchange (import/export) real power	W × $10^{PNTEXPO}$		
3/3	12	Control register 1		Bit 15 = 1\ Bit 14 = 1/	Starting enabled (in isolated operation or mains parallel operation)
				Bit 13 = 1\ Bit 12 = 1/	–Internal–
				Bit 11 = 1\ Bit 10 = 1/	Execution of acknowledgment of a class F2/F3 alarm
				Bit 9 = 1\ Bit 8 = 1/	Execution of acknowledgment of a class F1 alarm
				Bit 7 = 1\ Bit 6 = 1/	–Internal–
				Bit 5 = 1\	State of generator busbar 1 = OK
				Bit 4 = 1/	–Internal–
		Note *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1\ Bit 2 = 1/	–Internal–
				Bit 1 = 1\ Bit 0 = 0/	–Internal–
4/1	13	Alarm message IKD (SC06)		Bit 15 = 1	Failure DI8 of the IKD1
				Bit 14 = 1	Failure DI7 of the IKD1
				Bit 13 = 1	Failure DI6 of the IKD1
				Bit 12 = 1	Failure DI5 of the IKD1
				Bit 11 = 1	Failure DI4 of the IKD1
				Bit 10 = 1	Failure DI3 of the IKD1
				Bit 9 = 1	Failure DI2 of the IKD1
				Bit 8 = 1	Failure DI1 of the IKD1
				Bit 7 = 1	–Internal–
				Bit 6 = 1	–Internal–
				Bit 5 = 1	–Internal–
				Bit 4 = 1	–Internal–
		Note *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1	–Internal–
				Bit 2 = 1	–Internal–
				Bit 1 = 1	–Internal–
				Bit 0 = 1	–Internal–
4/2	14	Internal alarm 6		Bit 15 = 1	MPU plausibility fault
				Bit 14 = 1	Engine shutdown malfunction
				Bit 13 = 1	Time overrun, GCB dead bus switching
				Bit 12 = 1	–Internal–
				Bit 11 = 1	MCB open switch malfunction
				Bit 10 = 1	GCB open switch malfunction
				Bit 9 = 1	MCB synchronization time monitoring
				Bit 8 = 1	GCB synchronization time monitoring
				Bit 7 = 1	Range alarm analog input [T8]
				Bit 6 = 1	Range alarm analog input [T7]
				Bit 5 = 1	Range alarm analog input [T6]
				Bit 4 = 1	Range alarm analog input [T5]
		Note *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1	Range alarm analog input [T4]
				Bit 2 = 1	Range alarm analog input [T3]
				Bit 1 = 1	Range alarm analog input [T2]
				Bit 0 = 1	Range alarm analog input [T1]
4/3	15	Generator voltage delta V_{23}	V × $10^{UGNEXPO}$		
5/1	16	Generator voltage delta V_{31}	V × $10^{UGNEXPO}$		
5/2	17	Generator voltage wye V_{1N}	V × $10^{UGNEXPO}$		
5/3	18	Generator voltage wye V_{2N}	V × $10^{UGNEXPO}$		
6/1	19	Generator voltage wye V_{3N}	V × $10^{UGNEXPO}$		

MUX	No.	Contents (words)	Unit	Note

6/2	20	Configuration [T1]-[T4]	Display in …	**#1#**	°C	°F	bar/10	psi/10	%	no unit
			Analog input [T4]							
			Bit 15 =	0	0	0	1	1	1	0
			Bit 14 =	0	1	1	0	0	1	0
			Bit 13 =	0	0	1	0	1	0	1
			Bit 12 =	0	1	0	1	0	0	1
			Analog input [T3]							
			Bit 11 =	0	0	0	1	1	1	0
			Bit 10 =	0	1	1	0	0	1	0
			Bit 9 =	0	0	1	0	1	0	1
			Bit 8 =	0	1	0	1	0	0	1
			Analog input [T2]							
		***#1#**: The analog input is not available or he has been configured either as real power set point value or as mains (import/export) real power value.*	Bit 7 =	0	0	0	1	1	1	0
			Bit 6 =	0	1	1	0	0	1	0
			Bit 5 =	0	0	1	0	1	0	1
			Bit 4 =	0	1	0	1	0	0	1
			Analog input [T1]							
		***Note** – On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*	Bit 3 =	0	0	0	1	1	1	0
			Bit 2 =	0	1	1	0	0	1	0
			Bit 1 =	0	0	1	0	1	0	1
			Bit 0 =	0	1	0	1	0	0	1
6/3	21	Engine speed measured via the Pickup	min^{-1}							
7/1	22	Generator current in L1	$A \times 10^{IGNEXPO}$							
7/2	23	Generator current in L2	$A \times 10^{IGNEXPO}$							
7/3	24	Generator current in L3	$A \times 10^{IGNEXPO}$							
8/1	25	Actual generator reactive power	$var \times 10^{PGNEXPO}$	positive = inductive						
8/2	26	Generator cos φ		Example: FF9EH cos φ = c 0,98 (capacitive) FF9DH cos φ = c 0,99 (capacitive) 0064H cos φ = 1,00 0063H cos φ = i 0,99 (inductive) 0062H cos φ = i 0,98 (inductive)						
8/3	27	Current reserve power in the system	kW							
9/1	28	Current actual real power in the system	kW							
9/2	29	Number of participants on the CAN bus								
9/3	30	H.B. Mains status L.B. Generator status		FFH Voltage and frequency available 00H Voltage and frequency not available						
10/1	31	Exponents		High Byte: IGNEXPO Generator current Low Byte: – free						
10/2	32	Busbar frequency	Hz × 100							

MUX	No.	Contents (words)	Unit	Note

10/3	33	Configuration [T5]-[T8]	Display in …	**#1#**	°C	°F	bar/10	psi/10	%	no unit
			Analog input [T8]							
			Bit 15 =	0	0	0	1	1	1	0
			Bit 14 =	0	1	1	0	0	1	0
			Bit 13 =	0	0	1	0	1	0	1
			Bit 12 =	0	1	0	1	0	0	1
			Analog input [T7]							
			Bit 11 =	0	0	0	1	1	1	0
			Bit 10 =	0	1	1	0	0	1	0
			Bit 9 =	0	0	1	0	1	0	1
			Bit 8 =	0	1	0	1	0	0	1
			Analog input [T6]							
		***#1#**: The analog input is not available or he has been configured either as real power se tpoint value or as mains (import/export) real power value.*	Bit 7 =	0	0	0	1	1	1	0
			Bit 6 =	0	1	1	0	0	1	0
			Bit 5 =	0	0	1	0	1	0	1
			Bit 4 =	0	1	0	1	0	0	1
			Analog input [T5]							
		***Note** – On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*	Bit 3 =	0	0	0	1	1	1	0
			Bit 2 =	0	1	1	0	0	1	0
			Bit 1 =	0	0	1	0	1	0	1
			Bit 0 =	0	1	0	1	0	0	1
11/1	34	Mains voltage delta V_{23}	$V \times 10^{UNTEXPO}$							
11/2	35	Mains voltage delta V_{31}	$V \times 10^{UNTEXPO}$							
11/3	36	Mains voltage wye V_{1N}	$V \times 10^{UNTEXPO}$							
12/1	37	Mains voltage wye V_{2N}	$V \times 10^{UNTEXPO}$							
12/2	38	Mains voltage wye V_{3N}	$V \times 10^{UNTEXPO}$							
12/3	39	Mains frequency out off $V_{N12}/V_{N23}/V_{N31}$	Hz × 100							
13/1	40	Mains current in L1	$A \times 10^{INTEXPO}$							
13/2	41	Mains reactive power	$var \times 10^{PNTEXPO}$							
13/3	42	Mains power factor φ		Example: FF9EH cos φ = c 0.98 (capacitive) FF9DH cos φ = c 0.99 (capacitive) 0064H cos φ = 1.00 0063H cos φ = i 0.99 (inductive) 0062H cos φ = i 0.98 (inductive)						
14/1	43	Exponents		High Byte: PNTEXPO Mains power Low Byte: UNTEXPO Mains voltage						
14/2	44	Exponents		High Byte: INTEXPO Mains current Low Byte: USSEXPO Busbar voltage						
14/3	45	Engine operating hours (**H.W.**)	$h \times 2^{16}$	Double word						
15/1	46	Engine operating hours (**L.W.**)	h							
15/3	47	Hours until next maintenance	h							
15/3	48	Engine start number								

MUX	No.	Contents (words)	Unit	Note	
16/1	49	Operation mode		Bit 15 = 1	LOAD TEST operation mode
				Bit 14 = 1	STOP operation mode
				Bit 13 = 1	TEST operation mode
				Bit 12 = 1	MANUAL operation mode
				Bit 11 = 1	AUTOMATIC operation mode
				Bit 10 = 1	–Internal–
				Bit 9 = 1	–Internal–
				Bit 8 = 1	–Internal–
				Bit 7 = 1 Bit 6 = 0	Emergency power is ON
				Bit 7 = 0 Bit 6 = 1	Emergency power is OFF
				Bit 5 = 1 Bit 4 = 1	Delayed engine monitoring is ON
		Note *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1 Bit 2 = 1	Cool down expired
				Bit 1 = 1 Bit 0 = 1	–Internal–
16/2	50	Generator active energy (H.W.)	kWh × 2^{16}	Double word	
16/3	51	Generator active energy (L.W.)	kWh		
17/1	52	Battery voltage	V × 10		
17/2	53	Internal alarm 1		Bit 15 = 1\ Bit 14 = 1/	F3: Generator overfrequency 1
				Bit 13 = 1\ Bit 12 = 1/	F3: Generator underfrequency 1
				Bit 11 = 1\ Bit 10 = 1/	F3: Generator overvoltage 1
				Bit 9 = 1\ Bit 8 = 1/	F3: Generator undervoltage 1
				Bit 7 = 1\ Bit 6 = 1/	–Internal–
				Bit 5 = 1\ Bit 4 = 1/	F1: Battery undervoltage
		Note *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1\ Bit 2 = 1/	F3: Generator overload
				Bit 1 = 1\ Bit 0 = 1/	F3: Generator reverse power
17/3	54	Internal alarm 2		Bit 15 = 1\ Bit 14 = 1/	F0: Mains overfrequency
				Bit 13 = 1\ Bit 12 = 1/	F0: Mains underfrequency
				Bit 11 = 1\ Bit 10 = 1/	F0: Mains overvoltage
				Bit 9 = 1\ Bit 8 = 1/	F0: Mains undervoltage
				Bit 7 = 1\ Bit 6 = 1/	Interface fault X1-X5
				Bit 5 = 1	GCB opened; "Time ad-on ramp" expired
				Bit 4 = 1	–Internal–
		Note *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1\ Bit 2 = 1/	–Internal–
				Bit 1 = 1\ Bit 0 = 1/	F0: Mains phase/vector jump

MUX	No.	Contents (words)	Unit	Note	
18/1	55	Internal alarm 3		Bit 15 = 1\ Bit 14 = 1/	F3: Time-overcurrent, level 2 or inverse time-overcurrent, IEC255
				Bit 13 = 1\ Bit 12 = 1/	F3: Generator overspeed (Pickup)
				Bit 11 = 1\ Bit 10 = 1/	Import power 0 kW not reached
				Bit 9 = 1\ Bit 8 = 1/	F3: Generator load imbalance
				Bit 7 = 1\ Bit 6 = 1/	F3: Time-overcurrent, level 1
				Bit 5 = 1\ Bit 4 = 1/	Interface fault Y1-Y5
		Note *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1\ Bit 2 = 1/	F1: Maintenance call
				Bit 1 = 1\ Bit 0 = 1/	Start failure
18/2	56	Internal alarm 4		Bit 15 = 1\ Bit 14 = 1/	F1: Analog input [T1], level 1
				Bit 13 = 1\ Bit 12 = 1/	F3: Analog input [T1], level 2
				Bit 11 = 1\ Bit 10 = 1/	F1: Analog input [T2], level 1
				Bit 9 = 1\ Bit 8 = 1/	F3: Analog input [T2], level 2
				Bit 7 = 1\ Bit 6 = 1/	F1: Analog input [T3], level 1
				Bit 5 = 1\ Bit 4 = 1/	F3: Analog input [T3], level 2
		Note *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1\ Bit 2 = 1/	F1: Analog input [T4], level 1
				Bit 1 = 1\ Bit 0 = 1/	F3: Analog input [T4], level 2
18/3	57	Internal alarm 5		Bit 15 = 1\ Bit 14 = 1/	F1: Analog input [T5], level 1
				Bit 13 = 1\ Bit 12 = 1/	F3: Analog input [T5], level 2
				Bit 11 = 1\ Bit 10 = 1/	F1: Analog input [T6], level 1
				Bit 9 = 1\ Bit 8 = 1/	F3: Analog input [T6], level 2
				Bit 7 = 1\ Bit 6 = 1/	F1: Analog input [T7], level 1
				Bit 5 = 1\ Bit 4 = 1/	F3: Analog input [T7], level 2
		Note *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1\ Bit 2 = 1/	–Internal–
				Bit 1 = 1\ Bit 0 = 1/	–Internal–

MUX	No.	Contents (words)	Unit	Note	
19/1	58	External alarm 1		Bit 15 = 1\ Bit 14 = 1/	Discrete input [D01]
				Bit 13 = 1\ Bit 12 = 1/	Discrete input [D02]
				Bit 11 = 1\ Bit 10 = 1/	Discrete input [D03]
				Bit 9 = 1\ Bit 8 = 1/	Discrete input [D04]
				Bit 7 = 1\ Bit 6 = 1/	Discrete input [D05]
				Bit 5 = 1\ Bit 4 = 1/	Discrete input [D06]
		***Note** – On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1\ Bit 2 = 1/	Discrete input [D07]
				Bit 1 = 1\ Bit 0 = 1/	Discrete input [D08]
19/2	59	External alarm 2		Bit 15 = 1\ Bit 14 = 1/	Discrete input [D09]
				Bit 13 = 1\ Bit 12 = 1/	Discrete input [D10]
				Bit 11 = 1\ Bit 10 = 1/	Discrete input [D11]
				Bit 9 = 1\ Bit 8 = 1/	Discrete input [D12]
				Bit 7 = 1\ Bit 6 = 1/	Discrete input [D13]
				Bit 5 = 1\ Bit 4 = 1/	Discrete input [D14]
		***Note** – On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1\ Bit 2 = 1/	Discrete input [D15]
				Bit 1 = 1\ Bit 0 = 1/	Discrete input [D16]
19/3	60	Internal alarm 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	MCB close malfunction
				Bit 6 = 1	GCB close malfunction
				Bit 5 = 1	–Internal–
				Bit 4 = 1	–Internal–
		***Note** – On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1	–Internal–
				Bit 2 = 1	–Internal–
				Bit 1 = 1	–Internal–
				Bit 0 = 1	Immediate stop
20/1	61	Analog input [T1]		The measured value is transmitted.	
20/2	62	Analog input [T2]		The measured value is transmitted.	
20/3	63	Analog input [T3]		The measured value is transmitted.	
21/1	64	Analog input [T4]		The measured value is transmitted.	
21/2	65	Analog input [T5]		The measured value is transmitted.	
21/3	66	Analog input [T6]		The measured value is transmitted.	
22/1	67	Analog input [T7]		The measured value is transmitted.	

MUX	No.	Contents (words)	Unit	Note	
22/2	68	Alarm messages IKD2 (SC06)		Bit 15 = 1	Failure DI8 of the IKD2
				Bit 14 = 1	Failure DI7 of the IKD2
				Bit 13 = 1	Failure DI6 of the IKD2
				Bit 12 = 1	Failure DI5 of the IKD2
				Bit 11 = 1	Failure DI4 of the IKD2
				Bit 10 = 1	Failure DI3 of the IKD2
				Bit 9 = 1	Failure DI2 of the IKD2
				Bit 8 = 1	Failure DI1 of the IKD2
				Bit 7 = 1	–Internal–
				Bit 6 = 1	–Internal–
				Bit 5 = 1	–Internal–
				Bit 4 = 1	–Internal–
		Note *– On double/fourfold bits the following is valid: If the indicated bit combination is fulfilled (high byte and low byte) ,the message is active (otherwise inactive).*		Bit 3 = 1	–Internal–
				Bit 2 = 1	–Internal–
				Bit 1 = 1	–Internal–
				Bit 0 = 1	–Internal–
22/3	69	LCD-display/Pickup		Currently active display message	
				Bit 15 = x	A number is transmitted, please consult the table for the meaning of the number 69 of the telegram "Monitoring of the active display".
				Bit 14 = x	
				Bit 13 = x	
				Bit 12 = x	
				Bit 11 = x	
				Bit 10 = x	
				Bit 9 = x	
				Bit 8 = x	
				Pickup	
				Bit 7 = 1	Firing speed reached f > parameter
				Bit 6 = 1	
				Bit 5 = 1	
				Bit 4 = 1	
				Bit 3 = 1	Speed existing without pickup (pickup = OFF): f > 15 Hz with pickup (pickup = ON): f > 5 Hz
				Bit 2 = 1	
				Bit 1 = 1	
				Bit 0 = 1	

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)

4.5 Receiving Telegram

The CAN protocol for remote control of the PCM is available upon request. Woodward however recommends the use of a PCK 4. The following three data words can be received by the PCM. Refer to the PCK 4 manual on how to control several PCM control units.

MUX	No.	Contents (words)	Unit	Note
1/1	1	Setpoint value for the generator real power	kW	with control argument; see below
1/2	2	Setpoint value for the generator power factor cos φ		Example: FF9EH cos φ = c 0.98 (capacitive) FF9DH cos φ = c 0.99 (capacitive) 0064H cos φ = 1.00 0063H cos φ = i 0.99 (inductive) 0062H cos φ = i 0.98 (inductive)
1/3	3	Control word		Bit 15 = 1 –Internal– Bit 14 = 1 –Internal– Bit 13 = 1 –Internal– Bit 12 = 1 –Internal– Bit 11 = 1 –Internal– Bit 10 = 1 –Internal– Bit 9 = 1 –Internal– Bit 8 = 1 –Internal– Bit 7 = 1 –Internal– Bit 6 = 1 –Internal– Bit 5 = 1 –Internal– Bit 4 = 1 Remote acknowledgement Bit 3 = 1 Always "0" Bit 2 = 1 Always "0" Bit 1 = 1 Remote stop (high priority) Bit 0 = 1 Remote start

4.6 Framework Conditions To The CAN Bus

4.6.1 Transmission Telegram

The data of the following table can be handled by a Gateway PCK4 or a PLC and can be transferred to other busses. A PCM is sending the data via circular CAN messages.

The transmitting rate of this communication is 125 kBaud.

The CAN ID, on which the PCM is sending is calculated as follows:

CAN-ID = d'800 + item/generator number (or H'320 + item/generator number)

(The item number, Parameter 4, is adjustable and influences directly the CAN ID on which the item sends the visualization message).

A visualization message which is send out of an PCM has got 8 Bytes and is built as follows:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
H'DD	MUX number	data word 1 High-Byte	data word 1 Low Byte	data word 2 High-Byte	data word 2 Low Byte	data word 3 High-Byte	data word 3 Low Byte

In a visualization message the byte 0 is always used to show the hexadecimal value DD. This one defines the message as a visualization message. As the complete transmission telegram of the PCM includes more than three words byte 1 sends additionally a MUX number starting with 0. Therefore it is theoretically possible to send (256 × 3 = 768) words via the CAN ID. The whole telegram is built up as follows:

Line 1: MUX number 0, word 1
Line 2: MUX number 0, word 2
Line 3: MUX number 0, word 3
Line 4: MUX number 1, word 1
Line 5: MUX number 1, word 2
Line 6: MUX number 1, word 3
.
.
Line (n): MUX number (n-1/3), word 1
Line (n+1): MUX number (n-1/2), word 2
Line (n+2): MUX number (n-1/1), word 3

n depends on the total length of the item special telegram and can not be larger than H'FF.

4.6.2 Coding Of The Current Direction

The current direction can be recognized via the code word prefix. A positive transmitted value indicates power export (power output, supply) and a negative transmitted value indicates power import (power input, consumption).

4.6.3 Coding Of The Power Setpoint 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

4.6.4 CAN IDs Guidance Bus

The IDs given in the following are reserved for the data exchange between PCMs and PCN4s. If third-party devices are connected to the bus, it has to be ensured their IDs do not result conflicts with these IDs.

	CAN-ID in [hex]	[decimal]
a.) PCM sends		
Distribution message to other PCMs	180 + GENNO	384 + GENNO
Control message to PCN4 (the PCM with the lowest ID)	311	785
Visualization	320 + GENNO	800 + GENNO
b.) PCM receives		
Distribution message from other PCM	180 + GENNO	384 + GENNO
Control message from an PCN4	300 + GENNO	768 + GENNO
Configuration messages from a higher control	33F	831
c.) PCN4 sends		
Logic message to other PCN4s	180 + PCN4NO	384 + PCN4NO
Control message to PCM (the PCN4 with the lowest ID)	300 + GENNO	768 + GENNO
d.) PCN4 receives		
Logic message from other PCN4	180 + PCN4NO	384 + PCN4NO
Control message from a PCM	311	785
Configuration messages and configuration messages from a higher control	33F	831

	[hex]	[decimal]	
GENNO =	1 to E	1 to 14	GENNO = Generator number
PCN4NO =	11 to 1E	17 to 30	PCN4NO = PCN4 number

5 List of Parameters

Unit number P/N _____ Rev _____

Version PCM _____

Project _____

Serial number S/N _____ Date _____

	Parameter		Setting range	Default value	Customer setting	
	Software version		-	V x.xxxx	-	-
	Enter code		0 to 9.999	XXXX		
	Direct para.		YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Generator number		1 to 14	1		
	Language		first/second	first	☐ f ☐ s	☐ f ☐ s
	Check event list		YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
GENERATOR AND MAINS ENVIRONMENT CONFIGURATION						
	Configure	measuring	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Generator freq.	f set	40.0 to 70.0 Hz	50.0 Hz		
	Rated system	frequency	50.0 to 60.0 Hz	50.0 Hz		
	Gen.volt.transf.	secondary	50 to 125/50 to 480 V	400 V		
	Gen.volt.transf.	primary	0.05 to 65.0 kV	0.4 kV		
	Bus.volt.transf.	secondary	50 to 125/50 to 480 V	400 V		
	Bus.volt.transf.	primary	0.05 to 65.0 kV	0.4 kV		
	mains volt.trans.	secondary	50 to 125/50 to 480 V	400 V		
	mains volt.trans	primary	0.05 to 65.0 kV	0.4 kV		
	Gen.voltage	U set	50 to 125/50 to 530 V	100/400 V		
	Rated voltage in	system	50 to 125/50 to 480 V	100/400 V		
	Volt.meas./mon.		Ph-neut/Ph-Ph [4/3] Ph-Ph/Ph-Ph [3/3] Ph-neut/Ph-neut [4/4]	Ph-neut/Ph-Ph	☐ 4/3 ☐ 3/3 ☐ 4/4	☐ 4/3 ☐ 3/3 ☐ 4/4
	Current transf.	generator	10 to 7,000/{X} A	500/{X} A		
	Power measuring	gen.	singlephase [1] threephase [3]	threephase	☐ 1 ☐ 3	☐ 1 ☐ 3
	Rated power	generator	5 to 9,999 kW	200 kW		
	Rated current	generator	10 to 7,000 A	300 A		
	Analog in Pmains		OFF/T{x}	OFF		
	Analog in Pmains		0 to 20 mA 4 to 20 mA	4 to 20 mA	☐ 0-20mA ☐ 4-20mA	☐ 0-20mA ☐ 4-20mA
	Analog in Pmains	0%	0 to +/-9,990/0 to +/-6,900 kW	200 kW		
	Analog in Pmains	100%	0 to +/-9,990/0 to +/-6,900 kW	200 kW		
	Current transf.	mains	5 to 7,000/{X} A	500 {X} A		
	PCN4 mode		ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Rated power in	system	0 to 16,000 kW	1,600 kW		
	Temperature in		Celsius [°C] Fahrenheit [°F]	Celsius [°C]	☐ °C ☐ °F	☐ °C ☐ °F
	Pressure in		bar psi	bar	☐ bar ☐ psi	☐ bar ☐ psi
	Define level 1	code	0 to 9999	0001		
	Define level 2	code	0 to 9999	0002		

	Parameter		Setting range	Default value	Customer setting	
CONTROLLER CONFIGURATION						
	Configure	controller	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Initial state	Frequency	0 to 100 %	50 %		
	P-gain	Kpr	1 to 240	20		
	Reset time	Tn	0.2 to 60.0 s	1.0 s		
	Derivative time	Tv	0.00 to 6.00 s	0.00 s		
	Power controller	Pset1	F/I/E 0 to 6,900 kW	F 50 kW		
	Power controller	Pset2	F/I/E 0 to 6,900 kW	F 80 kW		
	Freq.controller		ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	f-contr. active	at:	0.0 to 70.0 Hz	40.0 Hz		
	Delay time for	f-contr.	0 to 999 s	5 s		
	Freq.controller	ramp	1 to 50 Hz/s	10 Hz/s		
	F/P contr.type		Three-step Analog PWM	Analog	☐ Three-st. ☐ Analog ☐ PWM	☐ Three-st. ☐ Analog ☐ PWM
	Freq.controller	deadband	0.02 to 1.00 Hz	0.03 Hz		
	Freq.controller	time pulse>	10 to 250 ms	80 ms		
	Freq.controller	gain Kp	0.1 to 99.9	20.0		
	F/P contr.output		See table	+/-10 V		
	Level PWM		3.0 to 10.0 V	3.0 V		
	Stepper sign.frq	(min.)	0 to 100 %	0 %		
	Stepper sign.frq	(max.)	0 to 100 %	100 %		
	Freq.controller	gain Kpr	1 to 240	20		
	Freq.controller	reset Tn	0.0 to 60.0 s	1.0 s		
	Freq.controller	derivat.Tv	0.00 to 6.00 s	0.00 s		
	Starting point	voltage	0 to 100 %	50 %		
	Volt.controller		ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Start voltage	U control.	12.0 to 100.0 %	75 %		
	Delayed. Start	U contr.	0 to 999 s	3 s		
	V/Q contr.type		Three-step Analog	Analog	☐ Three-st. ☐ Analog	☐ Three-st. ☐ Analog
	Volt.controller	dead band	0.1 to 15.0 %	0.9 %		
	Volt.controller	time pulse>	20 to 250 ms	80 ms		
	Volt.controller	gain Kp	0.1 to 99.9	20.0		
	V/Q contr.output		See table	+/-10 V		
	Stepper sign.vol	(min.)	0 to 100 %	0 %		
	Stepper sign.vol	(max.)	0 to 100 %	100 %		
	Volt.controller	gain Kpr	1 to 240	20		
	Volt.controller	reset Tn	0.0 to 60.0 s	1.0 s		
	Volt.controller	derivat.Tv	0.00 to 6.00 s	0.00 s		
	Pow.fact.contr.		ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Pow.fact.contr.	setpoint	i0.70 to 1.00 to k0.70	1.00		
	Pow.fact.contr.	dead band	0.5 to 25.0 %	0.5 %		
	Pow.fact.contr.	gain Kp	0.1 to 99.9	20.0		
	Pow.fact.contr.	gain Kpr	1 to 240	20		
	Pow.fact.contr.	reset Tn	0.0 to 60.0 s	1.0 s		
	Pow.fact.contr.	derivat.Tv	0.0 to 6.0 s	0.0 s		

	Parameter	Setting range	Default value	Customer setting	
CONTROLLER CONFIGURATION					
	Power controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	power controller ramp	0 to 100 %/s	20 %/s		
	Power limit P max.	10 to 120 %	100 %		
	Power limit P min.	0 to 50 %	0 %		
	Power setpoint external	OFF/ T1 / T2 / T3	OFF	☐ OFF ☐ T1 ☐ T2 ☐ T3	☐ OFF ☐ T1 ☐ T2 ☐ T3
	Analog input	0 to 20 mA 4 to 20 mA	4 to 20 mA	☐ 0-20 mA ☐ 4-20 mA	☐ 0-20 mA ☐ 4-20 mA
	Ext.setpoint 0mA	F/I/E 0 to 9,999 kW	F0 kW		
	Ext.setpoint 20mA	F/I/E 0 to 9,999 kW	F200 kW		
	Power controller dead band	0.1 to 25.0 %	0.5 %		
	Power controller gain Kp	0.1 to 99.9	20.0		
	Powercontr. dead band ratio	1.0 to 9.9	2.0		
	Power controller gain Kpr	1 to 240	20		
	Power controller reset Tn	0.0 to 60.0 s	1.0 s		
	Power controller derivat.Tv	0.0 to 6.0 s	0.0 s		
	Warm up load derivat.Tv	5 to 110 %	15 %		
	Warm up load time	0 to 600 s	0 s		
	Active power load-share	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Act. load share factor	10 to 99 %	50 %		
	Reactive power load share	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	React.load share factor	10 to 99%	50 %		
LOAD MANAGEMENT CONFIGURATION					
	Configure automatic	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Loadd.start/stop at ter.3	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Loadd.start/stop at ter.5	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Minimum load generator	0 to 6,900 kW	15 kW		
	Add-on delay mains oper.	0 to 999 s	1 s		
	Shed-off delay mains oper.	0 to 999 s	3 s		
	Hysteresis add-. on/off op.	0 to 9,999 kW	5 kW		
	Reserve power mains op.	0 to 9,999 kW	10 kW		
	Priority of generators	0-14	0		
	Reserve power isol.op.	0 to 9,999 kW	20 kW		
	Add-on delay isol.op.	0 to 999 s	1 s		
	Shed-off delay isol.op.	0 to 999 s	4 s		
	Mains error - stop eng.	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Control via COM X1X5	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Supervision COM X1X5	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Ackn. F2,F3 via COM interf	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
BREAKER CONFIGURATION					
	Configure breaker	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Breaker logic:	EXTERNAL [EXT] PARALLEL [PAR] OPEN TRANSIT [OPEN] CLOSED TRANSIT [CLOSE] INTERCHANGE [CHANG]	PARALLEL	☐ EXT ☐ PAR ☐ OPEN ☐ CLOSE ☐ CHAN-G	☐ EXT ☐ PAR ☐ OPEN ☐ CLOSE ☐ CHAN-G
	Add-on/off ramp max.time	0 to 999 s	20 s		
	Open GCB with F2 max.time	0 to 999 s	10 s		
	GCB close.relay	Impulse [I] Constant [C]	Constant	☐ I ☐ C	☐ I ☐ D
	GCB open relay	NO-contact [NO] NC-contact [NC]	NO-contact	☐ NO ☐ NC	☐ NO ☐ NC

	Parameter		Setting range	Default value	Customer setting	
BREAKER CONFIGURATION						
synch	Synchronize	df max	0.02 to 0.49 Hz	0.20 Hz		
··	Synchronize	df min	0.0 to 0,49 Hz	0.10 Hz		
··	Synchronize	dV max	1.0 to 20.0 %	2.0 %		
··	Synchronize	time pulse>	0.02 to 0.26 s	0.24 s		
··	Closing time	GCB	40 to 300 ms	80 ms		
··	Closing time	MCB	40 to 300 ms	80 ms		
··	Automat.breaker	deblocking	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
··	Sync.time contr.		ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
··	Sync.time contr.	delay	10 to 999 s	180 s		
··	GCB dead bus op.		ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
··	GCB dead bus op.	df max	0.05 to 5.00 Hz	2.0 Hz		
··	GCB dead bus op.	dV max.	1.0 to 15.0 %	10.0 %		
··	GCB dead bus op	max.time	0 to 999 s	30 s		
synch	MCB dead bus op.		ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
induct.	Switching-on GCB		ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
··	Switching-on GCB	df max	0.05 to 9.99 Hz	0.20 Hz		
··	Switching-on GCB	df min	0.0 to 9.99 Hz	0.10 Hz		
··	Switching-on GCB	T.impuls >	0.02 to 0.26 s	0.24 s		
··	Automat.breaker	deblocking	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
··	Switch.time cntr		ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
induct.	Switch.time cntr	delay	2 to 999 s	180 s		
	Supervision GCB		ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Supervision MCB		ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
PCM1-G	Mains decoupling	via	GCB [GCB] GCB->EXT [GCB>EX] EXT [EXT] EXT->GCB [EX>GCB]	GCB	☐ GCB ☐ GCB>EX ☐ EXT ☐ EX>GCB	☐ GCB ☐ GCB>EX ☐ EXT ☐ EX>GCB
PCM1-M	Mains decoupling	via	GCB [GCB] GCB->MCB [GCB>MC] MCB [MCB] MCB->GCB [MC>GCB]	GCB	☐ GCB ☐ GCB>MC ☐ MCB ☐ MC>GCB	☐ GCB ☐ GCB>MC ☐ MCB ☐ MC>GCB
	Mains decoupling	-> after	0.10 to 5.00 s	0.14 s		
	Switch MCB in	STOP mode	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
EMERGENCY POWER CONFIGURATION						
	Configure	emergency	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Emergency power		ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Emergency power	start del.	0.5 to 99.9 s	3.0 s		
MONITORING CONFIGURATION						
	Configure	monitoring	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Gen.power monit.		ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Gen.power monit.	resp.val1	0 to 9,999 kW	100 kW		
	Gen.power monit.	hyst.lv1	0 to 999 kW	10 kW		
	Gen.power monit.	delay lv1	0 to 650 s	1 s		
	Gen.power monit.	resp.val2	0 to 9,999 kW	120 kW		
	Gen.power monit.	hyst.lv2	0 to 999 kW	10 kW		
	Gen.power monit.	delay lv2	0 to 650 s	1 s		
	Mains power mon.		ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Mains power mon.	res.val.	I/E 0 to 9,999 kW	E100 kW		
	Mains power mon.	hysteresis	0 to 999 kW	10 kW		
	Mains power mon.	delay	0 to 650 s	1 s		
	Overload monit.		ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Gen.overload MOP	resp.value	80 to 150 %	120 %		
	Gen.overload MOP	delay	0 to 99 s	1 s		
	Gen.overload IOP	resp.value	80 to 150 %	105 %		
	Gen.overload IOP	delay	0 to 99 s	1 s		

	Parameter	Setting range	Default value	Customer setting	
MONITORING CONFIGURATION					
	Rev./red.power monitoring	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Rev./red.power resp.value	-99 to +99 %	10 %		
	Rev./red.power delay	0,0 to 9,9 s	1.0 s		
	Load unbalanced	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Load unbalanced max.	0 to 100 %	30 %		
	Load unbalanced delay	0.02 to 9.98 s	1.00 s		
	Gen.overcurrent monitoring	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Gen.overcurrent limit 1	0 to 300 %	110 %		
	Gen.overcurrent delay 1	0.02 to 9.98 s	1.00 s		
	Gen.overcurrent limit 2	0 to 300 %	120 %		
	Gen.overcurrent delay 2	0.02 to 9.98 s	0.04 s		
	Gen.overcurrent Cool down	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Gen.frequency- monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Gen.overfreq. f >	50.0 to 140.0 %	110.0 %		
	Gen.overfreq. delay	0.02 to 9.98 s	0.30 s		
	Gen.underfreq. f <	50.0 to 140.0 %	90.0 %		
	Gen.underfreq. delay	0.02 to 9.98 s	0.30 s		
	Engine overspeed >	0 to 9,999 rpm	1,900 rpm		
	Gen.voltage monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Gen.overvoltage U >	20.0 to 150.0 %	110.0 %		
	Gen.overvoltage delay	0.02 to 9.98 s	0.30 s		
	Gen.undervoltage U <	20.0 to 150.0 %	90.0 %		
	Gen.undervoltage delay	0.2 to 9.98 s	0.30 s		
	Mains frequency monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Mains overfreq. f >	80.0 to 140.0 %	110.0 %		
	Mains overfreq. delay	0.02 to 9.98 s	0.06 s		
	Mains underfreq. f <	80.0 to 140.0 %	90.0 %		
	Mains underfreq. delay	0.02 to 9.98 s	0.06 s		
	Mains voltage monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Mains overvolt. U >	20.0 to 150.0 %	110.0 %		
	Mains overvolt. delay	0.02 to 9.98 s	0.06 s		
	Mains undervolt. U <	20.0 to 150.0 %	90.0 %		
	Mains undervolt. delay	0.02 to 9.98 s	0.06 s		
	Phase shift monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Monitoring	one-phase [1] three-phase [3]	three-phase	☐ 1 ☐ 3	☐ 1 ☐ 3
	Phase shift one-phase	3 to 30 °	12 °		
	Phase shift three-phase	3 to 30 °	8 °		
	Mains settling time	0- to 999 s	10 s		
	Batt.undervolt. U <	9.5 to 30.0 V	10.0 V		
	Batt.undervolt. delay	0 to 99 s	10 s		
	Horn self reset	1 to 9,999 s	180 s		
DISCRETE INPUTS CONFIGURATION					
	Configure dig.inputs	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Dig.input 1234 function	E/D	DDDD		
	Dig.input 1234 delay	0 to 9	0000		
	Delayed by 1234 eng.speed	Y/N	NNNN		
	Dig.input 1234 error class	0 to 3	3210		
	Dig.input 5678 function	E/D	DDDD		
	Dig.input 5678 delay	0 to 9	0000		
	Delayed by 5678 eng.speed	Y/N	NNNN		
	Dig.input 5678 error class	0 to 3	3111		
	Dig.input 9ABC function	E/D	DDDD		
	Dig.input 9ABC delay	0 to 9	0000		
	Delayed by 9ABC eng.speed	Y/N	NNNN		
	Dig.input 9ABC error class	0 to 3	1111		
	Dig.input DEFG function	E/D	DDDD		
	Dig.input DEFG delay	0 to 9	0000		
	Delayed by DEFG eng.speed	Y/N	NNNN		
	Dig.input DEFG error class	0 to 3	1111		

	Parameter	Setting range	Default value	Customer setting	
DISCRETE INPUTS CONFIGURATION					
	Errortxt.term.34	any	EMERGENCY OFF		
	Errortxt.term.35	any	terminal 35		
	Errortxt.term.36	any	terminal 36		
	Errortxt.term.61	any	terminal 61		
	Errortxt.term.62	any	terminal 62		
	Errortxt.term.63	any	terminal 63		
	Errortxt.term.64	any	terminal 64		
	Errortxt.term.65	any	terminal 65		
	Errortxt.term.66	any	terminal 66		
	Errortxt.term.67	any	terminal 67		
	Errortxt.term.68	any	terminal 68		
	Errortxt.term.69	any	terminal 69		
	Errortxt.term.70	any	terminal 70		
	Errortxt.term.71	any	terminal 71		
	Errortxt.term.72	any	terminal 72		
	Errortxt.term.73	any	terminal 73		
	Firing speed by Term. 62	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Op.mode blocked by Ter.63	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Breaker logic by Term64	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Breaker logic:	EXTERNAL [EXT] PARALLEL [PAR] OPEN TRANSIT [OPEN] CLOSED TRANSIT [CLOSE] INTERCHANGE [INCHG]	EXTERNAL	☐ EXT ☐ PAR ☐ OPEN ☐ CLOSE ☐ INCHG	☐ EXT ☐ PAR ☐ OPEN ☐ CLOSE ☐ INCHG
	Close GCB asap by Ter.67	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Emergency OFF by Ter.68	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Idle mode by Term.70	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Function term.6	Sprinkler operation [SO] Engine enabled [EE] ext.acknowledgment [ExA] STOP mode [SM] Engine blocked [EB] Start without CB [SwB]	ExA	☐ SO ☐ EE ☐ ExA ☐ SM ☐ EB ☐ SwB	☐ SO ☐ EE ☐ ExA ☐ SM ☐ EB ☐ SwB
	Start withno GCB cool down	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Sprinkler shutd. F1 active	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
ANALOG INPUTS CONFIGURATION					
	Configure analg.inp.	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Analog input 1 scalable	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Name and unit	any	Analog 1		
	Analog input 1	0 to 20 mA 4-20 mA	4 to 20 mA	☐ 0-20 mA ☐ 4-20 mA	☐ 0-20 mA ☐ 4-20 mA
	Value at 0%	-9,999 to+9,999	0		
	Value at 100%	-9,999 to+9,999	100		
	Limit warning value	-9,999 to+9,999	80		
	Limit shutdown value	-9,999 to+9,999	90		
	Delay limit 1/2	0 to 650 s	1 s		
	Monitoring for	High limit mon. [high] low limit mon. [low]	High limit mon.	☐ high ☐ low	☐ high ☐ low
	Analog input 2 scalable	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Name and unit	any	Analog 2		
	Analog input 2	0 to 20 mA 4 to 20 mA	4 to 20 mA	☐ 0-20 mA ☐ 4-20 mA	☐ 0-20 mA ☐ 4-20 mA
	Value at 0%	-9,999 to+9,999	0		
	Value at 100%	-9,999 to+9,999	100		
	Limit warning value	-9,999 to+9,999	80		
	Limit shutdown value	-9,999 to+9,999	90		
	Delay limit 1/2	0 to 650 s	1 s		

	Parameter	Setting range	Default value	Customer setting	
ANALOG INPUTS CONFIGURATION					
	Monitoring for	High limit mon. [high] low limit mon. [low]	High limit mon.	☐ high ☐ low	☐ high ☐ low
	Analog input 3 scalable	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Name and unit	any	Analog 3		
	Analog input 3	0 to 20 mA 4 to 20 mA	4 to 20 mA	☐ 0-20 mA ☐ 4-20 mA	☐ 0-20 mA ☐ 4-20 mA
	Value at 0%	-9,999 to +9,999	0		
	Value at 100%	-9,999 to +9,999	100		
	Limit warning value	-9,999 to +9,999	80		
	Limit shutdown value	-9,999 to +9,999	90		
	Delay limit 1/2	0 to 650 s	1 s		
	Monitoring for	High limit mon. [high] low limit mon. [low]	High limit mon.	☐ high ☐ low	☐ high ☐ low
	Temperature 4 Pt100	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	name* 000°C	any	Analog 4		
	Limit warning	0 to 200 °C	80 °C		
	Limit shutdown	0 to 200 °C	90 °C		
	Delay limit 1/2	0 to 650 s	1 s		
	Monitoring for	High limit mon. [high] low limit mon. [low]	High limit mon.	☐ high ☐ low	☐ high ☐ low
	Temperature 5 Pt100	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	name* 000°C	any	Analog 5		
	Limit warning	0 to 200 °C	80 °C		
	Limit shutdown	0 to 200 °C	90 °C		
	Delay limit 1/2	0 to 650 s	1 s		
	Monitoring for	High limit mon. [high] low limit mon. [low]	High limit mon.	☐ high ☐ low	☐ high ☐ low
	Analog input 6 VDO	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Name and unit	any	Analog 6		
	Analog input 6 VDO	0 to 5 bar 0 to 10 bar	0 to 5 bar	☐ 0-5 bar ☐ 0-10 bar	☐ 0-5 bar ☐ 0-10 bar
	Limit warning value	0.0 to 10.0 bar	2.0 bar		
	Limit shutdown value	0.0 to 10.0 bar	1.0 bar		
	Delay limit 1/2	0 to 650 s	1 s		
	Monitoring for	High limit mon. [high] low limit mon. [low]	low limit mon.	☐ high ☐ low	☐ high ☐ low
	Analog input 7 VDO	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Name and unit	any	Analog 7		
	Limit warning value	40 to 120 °C	80 °C		
	Limit shutdown	40 to 120 °C	90 °C		
	Delay limit 1/2	0 to 650 s	1 s		
	Monitoring for	High limit mon. [high] low limit mon. [low]	High limit mon.	☐ high ☐ low	☐ high ☐ low
	Ana.in 12345678 SV.del.	J/N	NNNNNJNN		
	Ana.in 12345678 control	J/N	NNNNNNNN		

OUTPUT CONFIGURATION						
	Configure	outputs	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Analg.out.12O121	Parameter	0 to 22	1		
	Analg.out.12O121	0-00 mA	OFF 0 to 20 mA 4 to 20 mA	0 to 20 mA	☐ OFF ☐ 0-20mA ☐ 4-20 mA	☐ OFF ☐ 0-20mA ☐ 4-20 mA
	Analg.out.12O121	0%	0 to 9,990	0		
	Analg.out.12O121	100%	0 to 9,990	200		
	Analg.out.122123	Parameter	0 to 22	1		
	Analg.out.122123	0-00 mA	OFF 0 to 20 mA 4 to 20 mA	0 to 20 mA	☐ OFF ☐ 0-20mA ☐ 4-20 mA	☐ OFF ☐ 0-20mA ☐ 4-20 mA
	Analg.out.122123	0%	0 to 9,990	0		
	Analg.out.122123	100%	0 to 9,990	200		
	Assignm.relay 1		See table	1		
	Assignm.relay 2		See table	2		
	Assignm.relay 3		See table	3		
	Assignm.relay 4		See table	4		
	Assignm.relay 5		See table	5		
	Assignm.relay 6		See table	84		
	Assignm.relay 7		See table	85		
ENGINE CONFIGURATION						
	Configure	engine	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Aux.services	prerun	0 to 999 s	0 s		
	Aux.services	postrun	0 to 999 s	0 s		
	Start-stop-logic	for	DIESEL GAS EXTERNAL [EXT]	DIESEL	☐ DIESEL ☐ GAS ☐ EXT	☐ DIESEL ☐ GAS ☐ EXT
	Min.speed for	ignit.	0 to 999 rpm	100 rpm		
Gas	Ignition delay		0 to 99 s	3 s		
··	Gasvalve delay		0 to 99 s	5 s		
··	Max. attempts to	start	1 to 6	3		
··	Starter time		2 to 99 s	10 s		
··	Start pause time		1 to 99 s	8 s		
··	f lower before	start	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
Gas	time f lower	bef.start	0 to 999 s	5 s		
Diesel	Preglow time		0 to 99 s	3 s		
··	Max. attempts to	Start	1 to 6	3		
··	Starter time		2 to 99 s	10 s		
··	Start pause time		1 to 99 s	5 s		
··	f lower before	start	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
··	time f lower	bef.start	0 to 999 s	5 s		
Diesel	Fuel relay logic		Open to stop [OPEN] Close to stop [STOP]	Open to stop	☐ OPEN ☐ STOP	☐ OPEN ☐ STOP
	Cool down time		0 to 999 s	15 s		
	Delayed engine	monitoring	1 to 99 s	8 s		
	Firing speed	reached f>	5 to 70 Hz	15 Hz		
	Pickup input		ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Number of pickup	teeth	30 to 280	160		
	Gen.rated speed		0 to 3,000 rpm	1,500 rpm		
COUNTER CONFIGURATION						
	Configure	counters	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Service interval	in	0 to 9,999 h	300 h		
	Set oper.hours	counter	0 to 65,000 h	0 h		
	Set start	counter	0 to 32,000	0		
	kWh counter	set in	kWh MWh	kWh	☐ kWh ☐ MWH	☐ kWh ☐ MWH
	kWh counter	set	0 to 65,500 kWh/MWh	0 kWh		
	Time		00:00 to 23:59	00:00		
	Year,month		00 to 99,01 to 12	00,00		
	Day/weekday		01 to 31/1 to 7	00,0		

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