37367A

GCP-30 Series
Rental Package Genset Control

Configuration
Software version starting from 4.3046

Manual 37367A

WARNING

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

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

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

CAUTION

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

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

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

OUT-OF-DATE PUBLICATION

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, be sure to check the Woodward website:

http://www.woodward.com/pubs/current.pdf

The revision level is shown at the bottom of the front cover after the publication number. The latest version of most publications is available at:

http://www.woodward.com/publications

If your publication is not there, please contact your customer service representative to get the latest copy.

Important definitions

WARNING

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

CAUTION

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

NOTE

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

Woodward reserves the right to update any portion of this publication at any time. Information provided by Woodward is believed to be correct and reliable. However, Woodward assumes no responsibility unless otherwise expressly undertaken.

© Woodward
All Rights Reserved.

Revision History

Rev.	Date	Editor	Changes
NEW	06-01-11	TP	Release
A	07-02-07	TP	Minot corrections; linguistic review

Contents

 © Woodward

Illustrations And Tables

Illustrations

Tables

 © Woodward

Chapter 1.
General Information

Type		English	German
GCP-31/32 Series			
GCP-31/RPQ - Installation		37366	GR37366
GCP-31/RPQ - Configuration	this manual ⇨	37367	GR37367
GCP-31/32 - Function/Operation		37238	GR37238
GCP-31/32 - Application		37240	GR37240
GCP-31/32 Packages - Installation		37364	GR37364
GCP-31/32 Packages - Configuration		37365	GR37365
Option SC09/SC10 - CAN bus coupling		37382	GR37382
Additional Manuals			
SYNCONpanel - Manual		37187	-
Transportable remote synchronizing panel that transfers a local measured difference between two voltage systems via CAN bus to the rental package genset control.			
LeoPC1 - Manual		37146	GR37146
PC program for visualization, configuration, remote control, data logging, language upload, alarm and user management and management of the event recorder. This manual describes the use of the program.			
LeoPC1 - Manual		37164	GR37164
PC program for visualization, configuration, remote control, data logging, language upload, alarm and user management and management of the event recorder. This manual describes the programming of the program.			
IKD 1 - Manual		37135	GR37135
Discrete expansion board with 8 discrete inputs and 8 relay outputs that can be coupled via the CAN bus to the control unit. Assessment of the discrete inputs as well as control of the relay outputs is done via the control unit.			
GW 4 - Manual		37133	GR37133
Gateway for transferring the CAN bus to any other interface or bus.			

Table 1-1: Manual - Overview

Functional Overview

The GCP-31/RPQ+SC09 provides the following functions:

Common functions:

- 1× readyfor operation relay
- 4/6× control relay (form A, make contact)
- 7× freely configurable relay outputs (form A, make contact)
- 2× three position controller for speed (n) / frequency (f) / voltage (V) / real power (P) / power factor via relay manager
- 2× analog controller outputs for speed (n) / frequency (f) / voltage (V) / real power (P) / reactive power (Q) and PWM output
- 14× discrete control inputs
- 12× discrete alarm inputs
- SYNCON Panel coupling via CAN to the guidance bus
- CAN bus interface 'guidance level'
- CAN bus interface to 2× IKD 1
- CAN bus communications with mtu MDEC and Scania EMS/S6
- CAN bus communications with SAE J1939
- 7× analog inputs
- 1× Magnetic Pick-Up input
- 2× analog outputs + external operation mode selection by term. 127/128
- Password system
- Configuration via DPC possible (direct configuration)
- Event recorder with real-time clock
- Language manager for LCD texts
- Running hours, maintenance, start, and kWh counter
- Additional running hours counter w. minute resolution (rental duty time)

Control and synchronization functions:

- Synchronization of 1 breaker with voltage and frequency correction
- Closing to a dead/voltage free busbar (dead bus start)
- Voltage control
- Power factor control
- Speed/frequency control
- Phase control, voltage/frequency droop control
- Generator real power control & import/export real power control
- Real & var sharing
- Analog set point value for real power
- Analog mains interchange (import/export) real power measuring
- "Parallel operation" Breaker logic
- "External" breaker logic
- Remote control via CAN bus interface

Protective functions:

- Over-/undervoltage monitoring, generator V_{Gen} > / <
- Over-/undervoltage monitoring, mains V_{Mains} > / <
- Over-/underfrequency monitoring f > / <
- dφ/dt vector/phase jump monitoring dφ/dt
- Reverse/reduce power monitoring $+/-P_{Gen}$ <
- Overload monitoring P_{Gen} >
- Unbalanced load monitoring ΔP_{Gen} >
- Independent time-overcurrent monitoring I> / I>>
- Battery voltage monitoring V_{Bat} <

 © Woodward

Chapter 2.
Function

Signals

Discrete Inputs

NOTE

All emergency power (Parameter 137 "Emergency power" has to be configured to ON) or Critical (Sprinkler) mode operations (terminal 6 must be configured accordingly; Parameter 208) 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

Enabling this input while the control is in the AUTOMATIC operation mode will result in the GCP-30 controlling the real power in accordance with how "P controller: set point 1" is configured and may be used to initiate the engine start/stop sequence.

Energize ..... If the AUTOMATIC operation mode has been enabled the real power is controlled in the manner configured in "P controller: set point 1" (Parameter 30) while in parallel with the mains. If "P controller: set point 1" is configured for baseload (C), import (I), or export (E) the engine will start when terminal 3 is energized and a mains parallel operation will be performed following the synchronization of the GCB. If the generator is not connected to the mains, the generator will start, perform a dead bus closure, and assume the load. Additional generators will synchronize and share the load proportionally.

If the controller is in the AUTOMATIC operation mode and "P controller: set point 1" (Parameter 30) is configured for 000kW and "Loadd.start/stop at ter.3" (Parameter 92) is configured OFF, the engine will start and the GCB will synchronize. The load may be increased or decreased by raising or lowering the load set point manually. The load for the control is changed by pressing the SETPOINT button until the "P set 1" screen is displayed and increasing or decreasing the load set point to the desired value by pressing either the Setpoint raise or lower buttons.

De-energize ... The generator will unload, the GCB will open, and the engine will perform a cool down and stop unless an emergency power or critical/sprinkler mode operation is active. The generator will shutdown after the emergency power or critical/sprinkler mode operation has terminated.

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

Enabling this input while the control is in the AUTOMATIC operation mode will result in the GCP-30 controlling the real power in accordance with how " P controller: set point 2" is configured and may be used to initiate the engine start/stop sequence.

Energize..... If the AUTOMATIC operation mode has been enabled the real power is controlled in the manner configured in "P controller: set point 2" (Parameter 31) while in parallel with the mains. If "P controller: set point 2" is configured for baseload (C), import (I), or export (E) the engine will start when terminal 5 is energized and a mains parallel operation will be performed following the synchronization of the GCB. If the generator is not connected to the mains, the generator will start, perform a dead bus closure, and assume the load. Additional generators will synchronize and share the load proportionally.
If the controller is in the AUTOMATIC operation mode and "P controller: set point 2" (Parameter 31) is configured for 000kW and "Loadd.start/stop at ter.5" (Parameter 93) is configured OFF, the engine will start and the GCB will synchronize. The load may be increased or decreased by raising or lowering the load set point manually. The load for the control is changed by pressing the SETPOINT button until the "P set 2" screen is displayed and increasing or decreasing the load set point to the desired value by pressing either the Setpoint raise or lower buttons.

De-energize .. The generator will unload, the GCB will open, and the engine will perform a cool down and stop unless an emergency power or critical/sprinkler mode operation is active. The generator will shutdown after the emergency power or critical/sprinkler mode operation has terminated.

If a set point value is specified externally (e.g. via an 0/4 to 20 mA analog input or a bi-directional interface), the external set point value is the discrete input enabled by energizing terminal 5 (refer to Table 3-3: Set point value table).

Multifunction Terminals 6/7

Terminal 6 may be configured to perform one of several functions. Parameter 208 lists the available functions.

Note: When the Critical (Sprinkler) mode is configured, the input operates on negative logic. The Critical (Sprinkler) mode is disabled when terminal 6 is energized and enabled when terminal 6 is de-energized.

Reply: GCB is open Terminals 4/7

When this input is energized, the controller recognizes that the GCB is open (the "GCB ON" LED is not illuminated).

Isolated operating / reply external breaker Terminals 54/7

When this input is energized, the controller recognizes that the genset is operating isolated from the mains (the "Mains parallel" LED is not illuminated). This discrete input determines if the controller performs frequency control (terminal 54 = energized) or real power control(terminal 54 = de-energized) after the GCB has been closed.

Enable MCB Terminals 53/7

Energized ..... The MCB has been enabled and a mains parallel operation will be performed. The GCP-31 uses the LS-4 or an external controller to operate the MCB.

De-energized The MCB is disabled and cannot be closed. The controller will operate as an isolated or mains parallel operation dependent upon the state of the input "Reply MCB is open".

Discrete inputs Terminals 34 to 36/33 and 61 to 73/60

These freely programmable alarm inputs may be configured with user defined text, alarm classes, time delays, whether alarm monitoring should be delayed by the engine speed, and if the contacts are N.O. or N.C. contacts.

 © Woodward

Control Outputs

Ready for operation Terminals 18/19

This relay output is used to ensure that the internal functions of the controller are operating properly. If this relay is bypassed or disabled, proper functionality of the control cannot be guaranteed. This relay should be used in conjunction with an alarm that ensures proper actions are initiated upon activation of this relay output (i.e. GCB opening, engine shutdown). It is recommended that this contact be put in series with an emergency stop function.

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

When this relay is enabled, the diesel engine's glow plugs are energized (refer to the "Diesel Engine" section). This function only occurs if the control has been configured for diesel engine start/stop logic.

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

When this relay is enabled, the ignition of the gas engine is energized (refer to the "Gas Engine" section). This function only occurs if the control has been configured for gas engine start/stop logic.

Fuel relay / gas valve Terminals 43/44

a) Diesel engine: fuel relay (Parameter 269)

a.1) Open to stop

A start/run command will initiate the start sequence for the diesel engine and close the contacts for this relay energizing the fuel solenoid relay. This relay will disable (contacts open) when a stop command is issued or the engine speed drops below the configured firing speed (Parameter 272). Refer to the "Diesel Engine" section.

a.2) Close to stop

A start/run command will initiate the start sequence for the diesel engine and open the contacts for this relay. This relay will enable (contacts close) when a stop command is issued or the engine speed drops below the configured firing speed (Parameter 272). Refer to the "Diesel Engine" section.

b) Gas engine: gas valve

A start/run command will initiate the start sequence for the gas engine and close the contacts for this relay energizing the gas valve relay. This relay will disable (contacts open) when a stop command is issued or the engine speed drops below the configured firing speed (Parameter 272). Refer to the "Gas Engine" section.

Starter Terminals 45/46

The starter relay is enabled when a start command is issued. The starter relay output is de-energized when firing speed (Parameter 272) has been achieved, the configured crank time (Parameter 260 or Parameter 265) has expired, or the STOP mode is enabled.

Centralized alarm pre-assigned to terminals 47/48

This relay is enabled when a centralized alarm is issued. An external horn, buzzer, or beacon may be operated by this relay output during a fault condition. Pressing the "RESET" button will reset the relay. The relay will re-energize if another alarm condition is detected. The centralized alarm is issued for fault 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 112), 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 immedately. 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

The "Command: open GCB" relay issues the signal to open the GCB. After the open command has been issued this relay is de-energized.

Relay manager Terminals 74 to 83, 37/38, 47/48

The "Relay Manager" (Parameter 252) permits specific logical functions to be assigned to specific relay outputs.

Default values:
- Relay 1 to 5 = relay number (e.g. relay 1 = alarm class F1, relay 2 = alarm class F2, etc.)
- Relay 6 = Ignition / preheating
- Relay 7 = Centralized alarm

Refer to Appendix B for a description of the Relay Manager functions.

 © Woodward

Chapter 3.
Configuration

Configuration may be performed via the front panel keys or using a PC and the LeoPC1 program via the serial interface. LeoPC1 version 3.1 or higher is required to perform this. Configuration via a CAN bus converter is also possible. The following communication protocols require the following baud rates:

- Direct configuration (RS-232) = 9,600 Baud (8 Bit, no parity, 1 Stop bit)
- CAN bus (CiA) (RS-485) = 125 kBaud

CAUTION

A PC with configuration software with the following revision number or higher is required to configure this control (applies to firmware versions 4.3xxx or higher):

LeoPC1 from 3.1

Not all parameters may be configured directly at the GCP. Therefore, it is recommended to have LeoPC1 and the correct configuration files available when commissioning.

Due to functional enhancements of the GCP-30 control series, it is necessary (beginning with firmware version 4.3xxx) to use a newer version of the configuration software LeoPC1. This requires that LeoPC1 version 3.1 or higher be used. If your current LeoPC1 software is an earlier version, the latest version can be ordered from our technical sales or can be downloaded from our homepage at **http://www.woodward.com/software**.

Older project files may still be used with the updated version of LeoPC1 after installation has been completed. These files should be transferred to the appropriate file locations within the updated version of LeoPC1.

WARNING

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

NOTE

Prior to configuring a control unit, familiarize yourself with the parameters listed in this manual.

You can advance through the individual parameter screens if you are in configuration mode (simultaneously pressing of "Digit↑" and "Cursor→" push buttons permits access to the configuration mode) by using the "Select" button. If you press and hold the "Select" push button, the scroll function will be activated, allowing for the parameter screens to be advanced through more rapidly. The control unit will permit the operator to reverse up to four previous screens (exception: it is not possible to reverse from the first parameter to the last parameter 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

Two hardware versions are described in this manual. The differences between these versions are 120 Vac and 480 Vac voltage-measuring inputs. Configuration screens and permissible limits of these units will differ as well. These models are differentiated by numerals in the applicable text. The 120 Vac model is identified by a [1] and the 480 Vac is identified by a [4] in front of the text that applies to the unit.

Basic Data

Version Number (Software Version)

Parameter 1

```
Software version
     Vx.xxxx
```

Software version

This screen displays the software version loaded into the control (the last two xx are for software revisions which do not affect the function of the unit).

Password

The unit is equipped with a three-level code and configuration hierarchy, which allows different user access to the control. A distinction is made between:

Code level CS0 ***(User Level)*** Factory password = none
This code level allows for monitoring of the system and does not permit access to the parameters. Configuration is blocked.

Code level CS1 ***(Basis Service Level)*** Factory password = "**0 0 0 1**"
This code level entitles the user to change selected parameters, like setting Bar/PSI, °C/°F, and clock adjustment. Changing a password is not permitted at this level. This password expires two hours after entering the password and the user is returned to the CS0 level.

Code level CS2 ***(Commissioning Level)*** Factory password = "**0 0 0 2**"
Allows direct access to all parameters (displaying and changing). In addition, the user may also set the password for levels CS1 and CS2. This password expires two hours after entering the password and the user is returned to the CS0 level.

NOTE

Once the code level is entered, access to the configuration menus will be allowed for two hours or until another password is entered into the control. If a user needs to exit a code level, then code level CS0 should be entered. This will block any configuration of the control.

Specific code levels may also be accessed using the LeoPC1 program.

Parameter 2

```
Enter code
          0000
```

Enter code number **0000 to 9999**

Upon enabling the configuration mode, the user is required to enter an access code number, which identifies the various users. The displayed number 0000 is a randomly generated number. If the random number is confirmed by pressing the "Select" button without being changed, the current level of access maintained. Upon entering either a level 1 or level 2 access code, the corresponding level of access is granted. If an incorrect access code is entered the control unit changes to code level 0 and all access is blocked until a code level 1 or 2 access code is entered.

© Woodward

Direct Configuration

NOTE

A direct configuration cable DPC (P/N 5417-557), the LeoPC1 program (supplied with the cable), and the corresponding configuration files are required to perform direct configuration. After the program has been installed, consult the online help for a description of the PC program and its setup.

Configuration files may be downloaded from the Woodward homepage at:

http://www.woodward.com/software/ConfigFiles/

The unit part number and revision number will be required to locate the appropriate configuration files.

Remote configuration: For remote configuration, the level CS2 password of must be entered via the parameter "Enter code", otherwise, the values can only be read but not written. Configuring via the communication bus has no effect on the unit display screen. This means that the control unit remains in code level 0and configuration is only permitted via the communication bus. The control may remain idle for 2 hours before configuration via the communication bus is disabled. The password must be re-entered to re-enable configuration via the communication bus again. The password must also be entered prior to loading a language file. If the code for level 2 is entered on the unit itself, configuration via the communication bus is automatically enabled.

WARNING

If Parameter 3 "Direct para." is configured to "YES", communication via the interface terminals X1 to X5 is disabled. If the interface communication is to be re-established after the unit is configured, Parameter 3 must be configured to "NO"!

The GCP-30 will automatically disable the direct configuration port (Parameter 3 is automatically switched from YES to NO) when the unit detects that firing speed has been achieved (Parameter 272). Additional configuration may be performed while the generator is running through the display panel or via a CAN bus converter (i.e. IXXAT USB to CAN 1 converter). The direct configuration port is disabled and the communication interface is re-enabled upon detection firing speed as a safety precaution. This is done to prevent a simultaneous closing of GCBs to the de-energized bus bar in the event conditions for a multiple unit start-up (i.e. emergency power situation) are detected.

Parameter 3

```
Direct para.
                YES
```

Direct configuration **YES/NO**

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

NO..... The direct configuration port is disabled and CAN bus communications via X1 to X5 terminals are enabled.

Generator Number

Parameter 4

```
Generator number
              0
```

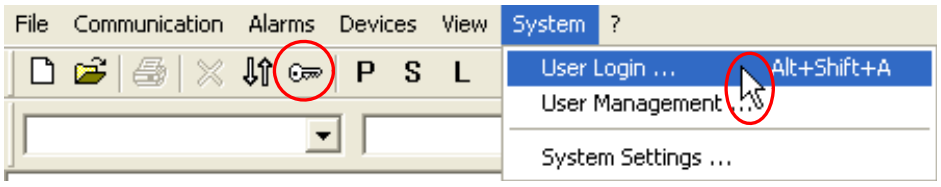
Generator number (controller CAN bus address) **1 to 8**

If a power plant is composed of multiple generators with controllers, the controllers must be coupled via a CAN bus. Each controller must be assigned a unique CAN bus address to differentiate the units. Generator address number 1 should be assigned even if the power plant is composed of only a single generator and controller. The address assigned in this parameter corresponds to the control number used in the LeoPC1 program.

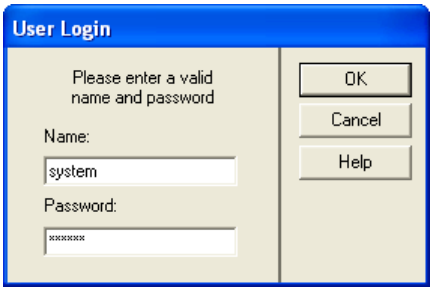
Language Manager

The following steps must be accomplished in order to load a different language into the control:

1.) A communication link between your PC and the control unit must be established via the direct configuration cable (DPC). 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 (communication via the CAN bus or a GW 4 is also possible).
2.) Enter the CS 2 level password into the control (Parameter 2).
3.) If the direct configuration cable (DPC) is to be utilized, Parameter 3 "Direct para." must be configured as "YES". If a GW 4 or the CAN bus is to be utilized for configuration, Parameter 3 "Direct para." must be configured as "NO".
4.) If a language is to be loaded via the CAN bus, enter the desired CAN bus address (1 to 14) into the "Generator number" screen (Parameter 4), so that LeoPC1 is able to communicate with the correct control unit.
5.) Scroll the configuration screen on the controller to "Language" (Parameter 5) and select either the primary language for the control unit by selecting "first" or the secondary language by selecting "second".
6.) Start the program LeoPC1, and log into the program by selecting "System" from the tool bar and "User login…" from the drop down menu or clicking on the key icon.

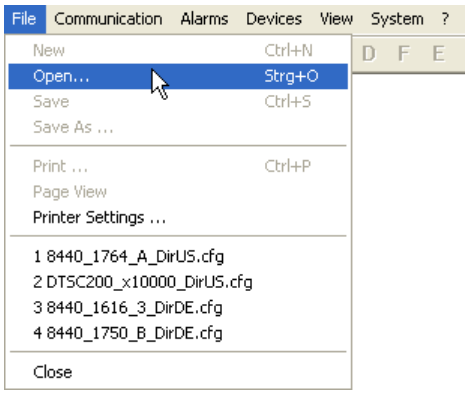


7.) Enter the user name and password and click the "OK" button. The default user ID is "system" and the default password is "system".



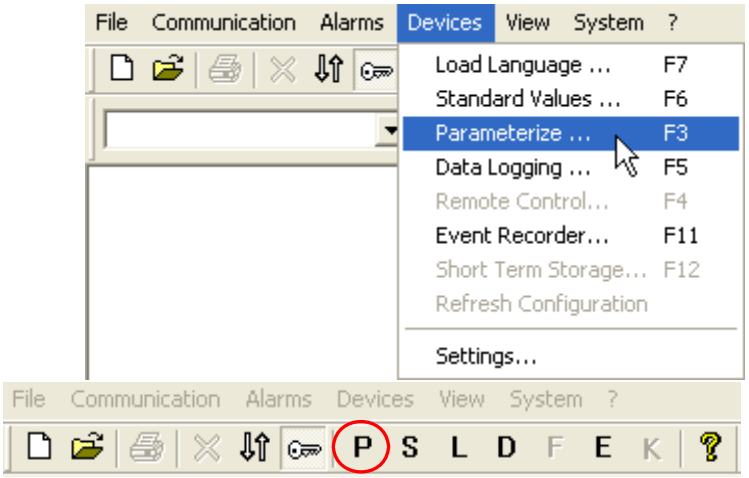
© Woodward

8.) 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.

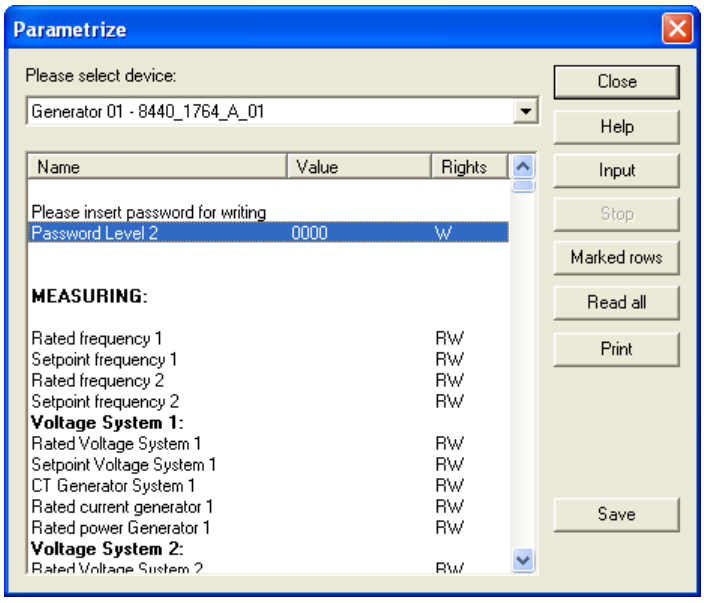


9.) To start communication between the control unit and LeoPC1 select "Communication" from the tool bar and "Connect" from the drop down menu or click on the up and down arrow icon.

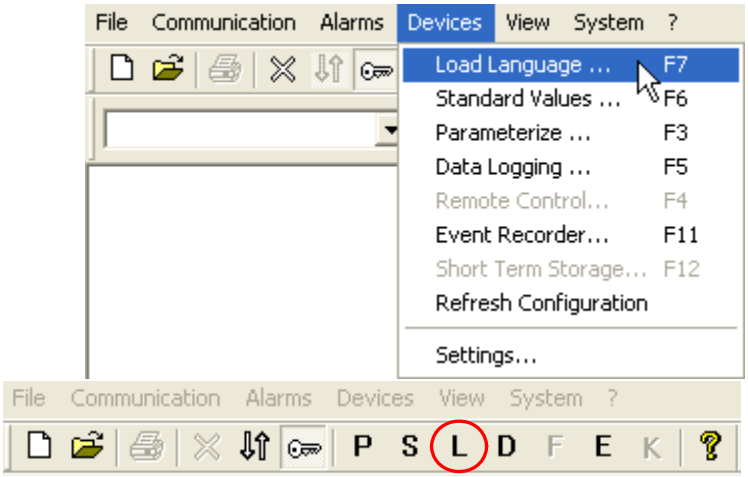
10.) Select "Devices" from the tool bar and "Parameterize…" from the drop down menu or click on the letter P icon.



11.) A window will appear with all the tunable parameters in it. Move the cursor over the numbers for the password and double click.

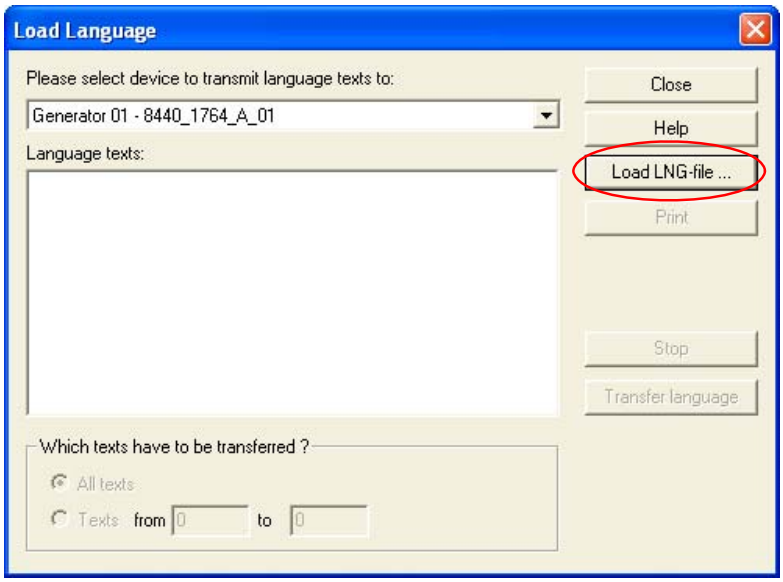


12.) Enter the password for code level CS 2 (Parameter 2).
13.) Close the parameterization window.
14.) Select "Devices" from the tool bar and "Load language…" from the drop down menu or click on the letter L icon.

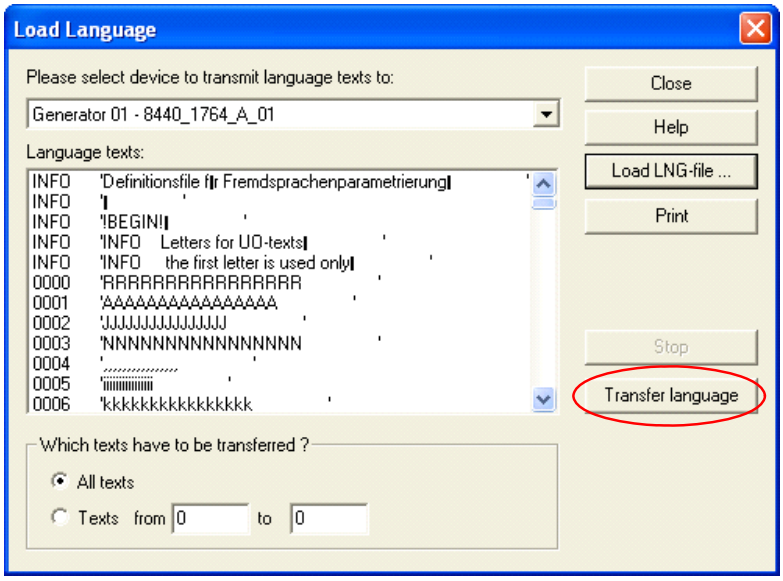


© Woodward

15.) Load the desired language file using the button "Load LNG file ..."



16.) Select the desired language and click the "Transfer language" button.



17.) If an additional language is to be loaded into the control unit, return to step 5 and change the language selection from the currently active language to the inactive language and acknowledge the change with the "Select" button. This is cannot be accomplished via LeoPC1. Repeat the sequence of step use to load the previous language.

Parameter 5

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

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

Service Display

Refer to manual 37238 for a description of these screens.

Event Logger

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 "Password" on page 14.

When an event listed on Table 3-1 or Table 3-2 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. The stored events are listed in chronological order starting with the most recent event. The oldest event entries are automatically deleted when the event log reaches 50 entries and a new event is recorded. Pressing the "RESET" button while an event is displayed will clear the event from the event log. 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 .....Events can be viewed and acknowledged.
NO .....Events cannot be viewed and acknowledged.

NOTE

Starting from version 4.3010, the event logger can also be read via CAN. This makes it possible for the event logger to be read via a GW4/modem for example.

If the event logger is to be read via CAN, the respective connection protocol (i.e. Gateway-RS232, IX-XAT VCI2-CAN, etc.), must be selected in LeoPC1. Reading the event logger is then performed in the same manner as for direct configuration.

Possible Event Logger Entries

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

50 × alarm log

YY-MM-DD ss:mm..... Display of date and time of the event.
xxxxxxxxxxxxxxxx... Refer to Table 3-1 or Table 3-2 for event text.

© Woodward

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 power	Rück/Minderleist	Revers/min.power
Overload	Gen.-Überlast	Gen.overload
Unbalanced(asymmetrical load	Schieflast	Load unbalance
Mains overvoltage	Netz-Überspg.	Mains-overvolt.
Mains undervoltage	Netz-Unterspg.	Mains-undervolt.
Mains overfrequency	Netz-Überfreq.	Mains-underfreq.
Mains underfrequency	Netz-Unterfreq.	Mains-overfreq.
Mains phase/vector jump	Phasensprung	Phase shift
Battery undervoltage	Batt.-Unterspg.	Batt.undervolt.
GCB synchronization time monitoring expired	Synch.Zeit GLS	GCB syn.failure
MCB synchronization time monitoring expired	Synch.Zeit NLS	MCB syn.failure
CB closure to dead busbar time monitoring expired	Stör. df/dU-max.	Failure df/dVmax
The unload ramp rate timer has expired and the breaker was opened prior to the load reaching the minimum load	R-Rampe:GLS auf	P-ramp:open GCB
GCB closing malfunction	Störung GLS ZU	GCBclose failure
MCB closing malfunction	Störung NLS ZU	MCBclose failure
GCB opening malfunction	Störung GLS AUF	GCB open failure
MCB opening malfunction	Störung NLS AUF	MCB open failure
Zero power transfer control failure at GCB interchange synchronization	Bezugsleist. <>0	Power not zero
Maintenance call timer expired	Wartung	Service
Control unit CAN bus (X1 to X5) interface monitoring failure	Fehl.Schnit.X1X5	Interf.err. X1X5
ECU CAN bus (Y1 to Y5) interface monitoring failure	Fehl.Schnit.Y1Y5	Interf.err. Y1Y5
Magnetic Pickup/generator frequency mismatch	Pickup/Gen.Freq.	Pickup/Gen.freq.
Engine failed to stop	Abstellstörung	Stop failure
Engine failed to start	Fehlstart	Start failure
Engine stopped unintentionally	ungewollter Stop	unintended stop
GCP Discrete Inputs		
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

External expansions			
Discrete input [D1.01] of IKD1.1	when connecting an IKD1	frei parametrierbar	freely configurable
Discrete input [D1.02] of IKD1.1	when connecting an IKD1		
Discrete input [D1.03] of IKD1.1	when connecting an IKD1		
Discrete input [D1.04] of IKD1.1	when connecting an IKD1		
Discrete input [D1.05] of IKD1.1	when connecting an IKD1		
Discrete input [D1.06] of IKD1.1	when connecting an IKD1		
Discrete input [D1.07] of IKD1.1	when connecting an IKD1		
Discrete input [D1.08] of IKD1.1	when connecting an IKD1		
Discrete input [D2.01] of IKD1.2	when connecting two IKD1s		
Discrete input [D2.02] of IKD1.2	when connecting two IKD1s		
Discrete input [D2.03] of IKD1.2	when connecting two IKD1s		
Discrete input [D2.04] of IKD1.2	when connecting two IKD1s		
Discrete input [D2.05] of IKD1.2	when connecting two IKD1s		
Discrete input [D2.06] of IKD1.2	when connecting two IKD1s		
Discrete input [D2.07] of IKD1.2	when connecting two IKD1s		
Discrete input [D2.08] of IKD1.2	when connecting two IKD1s		
Other Events			
MANUAL operation mode enabled		**BAW Hand**	**Manual mode**
AUTOMATIC operation mode enabled		**BAW Automatik**	**Automatic mode**
STOP operation mode enabled		**BAW Stop**	**Stop mode**
TEST operation mode enabled		**BAW Probe**	**Test mode**
Load TEST operation mode enabled		**BAW Lastprobe**	**Loadtest mode**
"MCB OFF" button pressed (in MANUAL MODE)		**Taste NLS AUS**	**Button MCB OFF**
"GCB OFF" button pressed (in MANUAL MODE)		**Taste GLS AUS**	**Button GCB OFF**
"GCB ON" button pressed (in MANUAL MODE)		**Taste GLS EIN**	**Button GCB ON**
"MCB ON" button pressed (in MANUAL MODE)		**Taste NLS EIN**	**Button MCB ON**
"START" button pressed (in MANUAL MODE)		**Taste Hand START**	**Button START**
"STOP" button pressed (in MANUAL MODE)		**Taste Hand STOP**	**Button STOP**
Remote start initiated		**Fernstart**	**Remote start**
Remote stop initiated		**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**
Mains settling time has 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 intentionally stopped		**Aggregatestop**	**Stop of engine**

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

Analog Inputs

The display of the control unit is the analog alarm texts. Six digits on the left side of the screen are reserved for the monitored analog values. If the texts for these alarms are expanded to the complete message, the monitored values will be overwritten and not displayed. The text below is displayed when the controller detects the listed fault conditions.

WIRE__.....Wire break (Analog input wire broken)
ALARM_.....Limit 1 value exceeded
STOP__.....Limit 2 value exceeded

```
YY-MM-DD ss:mm
STOP Analog inpu
```

Example

Limit 2 value (STOP) of analog input 1 was exceeded. The text for the analog input shifts 6 digits to the right. This results in the measured value not being displayed. Ensure you take the text displacement into account when configuring the analog input!

 © Woodward

Measuring

WARNING

It is absolutely necessary for correct rated values to be entered in the following parameters, as numerous measurements and monitoring functions refer to these values. Failure to do so may lead to incorrect measuring of parameters resulting in damage to or destruction of the generator and/or personal injury or death.

NOTE

The parameters for this control are grouped together in blocks to permit navigation through the large number of configuration screens more rapidly. Selecting "YES" or "NO" has no effect whether or not control or monitoring is carried out for the parameters located in that block. Selecting "YES" or "NO" only determines if the individual parameters may be accessed and changed or are bypassed.

Parameter 7

```
Configure
measuring     YES
```

Configuration of the measuring values **YES/NO**

The basic generator measuring values are configured in this block of parameters. This parameter has the following effect:

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

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

Rated Frequency

Parameter 8

```
Rated Frequency1
System 1   00.0Hz
```

only configurable via LeoPC1

System 1 rated frequency **50.0 to 60.0 Hz**

The rated frequency of system 1 must be configured in this parameter. This parameter becomes active if the discrete input at terminal 71 is not energized (refer to Discrete Input section in Installation Manual 37366).

Parameter 9

```
Setpoint Frequ.
System 1   00.0Hz
```

only configurable via LeoPC1

Generator frequency set point system 1 **45.0 to 65.0 Hz**

The generator frequency set point of system 1 is configured here. This is the reference frequency that the generator will control at when operating in an isolated and/or no-load applications. In most cases, the value entered into this screen will be 50 Hz or 60 Hz. It is possible to configure a value other than 50 Hz or 60 Hz into this parameter. This parameter becomes active if the discrete input at terminal 71 is not energized (refer to Discrete Input section in Installation Manual 37366).

Parameter 10

```
Rated Frequency2
System 2   00.0Hz
```

only configurable via LeoPC1

System 2 rated frequency **50.0 to 60.0 Hz**

The rated frequency of system 2 must be configured in this parameter. This parameter becomes active if the discrete input at terminal 71 is energized (refer to Discrete Input section in Installation Manual 37366).

Parameter 11

```
Setpoint Frequ.
System 2   00.0Hz
```

only configurable via LeoPC1

Generator frequency set point system 2 **45.0 to 65.0 Hz**

The generator frequency set point of system 2 is configured here. This parameter becomes active if the discrete input at terminal 71 is energized (refer to Discrete Input section in Installation Manual 37366).

Rated Voltage

The respective system is activated using the discrete input at the terminals 72 and 73. Refer to the Discrete Input section in Installation Manual 37366 for further information about this.

Parameter 12

```
Rated Voltage
System y    000V
```

[y = 1 to 4]

Rated system voltage in system y [y = 1 to 4] **[4] 50 to 480 V**

The system rated voltage (V_{L-L}) is defined in this parameter.
The following parameters use the value configured here as a protection and control reference point:
- Generator voltage monitoring
- Mains voltage monitoring
- Voltage controller dead band
- Maximum voltage differential (dV max) for synchronization
- Maximum voltage differential (dV max) for a GCB dead bus closure

Parameter 13

```
Setpoint Voltage
System y    000V
```

[y = 1 to 4]

only configurable via LeoPC1

Generator voltage set point in system y [y = 1 to 4] **[4] 50 to 530 V**

The generator voltage set point is configured here. This is the reference voltage that the generator will control at when operating in an isolated and/or no-load applications. The voltage controller enable set point (Parameter 61) refers to the value configured in this parameter.

Parameter 14

```
CT generator
System y 0000/x
```

[y = 1 to 4]

only configurable via LeoPC1

Current transformer generator system y [y = 1 to 4] **10 to 7.000/{x} A**

The input of the current transformer ratio is necessary for the indication and control of the actual monitored value. The current transformers ratio should be selected so at least 60% of the secondary current rating can be measured when the monitored system is at 100% of operating capacity (i.e. at 100% of system capacity a 5A CT should output 3A). If the current transformers are sized so that the percentage of the output is lower, the loss of resolution may cause inaccuracies in the monitoring and control functions and may affect the functionality of the control.
The control may be ordered with either ../1 A or ../5 A current transformer inputs. The CT inputs will dictate how this parameter is displayed on the control. Information about the current transformers inputs may be found on the unit data plate.

{x} = 1 A.....GCP30x**1**B/xxx = Current transformer inputs rated for ../1 A
{x} = 5 A.....GCP30x**5**B/xxx = Current transformer inputs rated for ../5 A

Parameter 15

```
Gen Rated curr.
System y   0000A
```

[y = 1 to 4]

only configurable via LeoPC1

Generator rated current system y [y = 1 to 4] **10 to 7.000 A**

The generator rated current is configured here. The percentages configured for the protective function refer to the value input in this parameter.

Parameter 16

```
Gen rated power
System y  0000kW
```

[y = 1 to 4]

only configurable via LeoPC1

Generator rated power system y [y = 1 to 4] **5 to 9.999 kW**

The generator rated power is configured here. It is crucial to ensure that the correct generator power rating is entered. Multiple measuring, control, and protective functions refer to the value configured in this parameter (i.e. the percentage configured for generator overload).

© Woodward

NOTE

When the generator is supplying positive real power to a load, the current should flow from the generator to the load through the CT in the "S1 to S2" direction. When positive real power is being supplied, the inductive reactive (lagging) power flows in the same direction through the CT. If the S1 terminal/polarity dot is facing the generator and the s1 terminal of the CT is connected to the s1 terminal of the GCP-30, the control will display that positive real power is being supplied. If a CT is installed backwards, that phase will display negative real power for that phase.

Parameter 17

```
Volt.meas./mon.
---------------
```

This parameter affects the display.

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

The control can monitor either the phase-neutral voltages (four-wire system) or the phase-phase voltages (three-wire system). Generally, low-voltage systems are configured to monitor the phase-neutral voltages, while medium- and high-voltage systems are configured to monitor the phase-phase voltages only. The monitoring of the phase-phase voltages is recommended to avoid a phase-earth fault in a compensated or isolated mains resulting in the voltage protection tripping.

Ph-neut/Ph-neut System voltage measurement is performed phase-neutral (WYE connected system). The phase voltages and the neutral must be connected for proper calculation. This requires that the neutral terminal (terminal 0) be connected to the ground reference. The voltage measurement and protection functions are performed in accordance with WYE connected systems. The phase-phase and phase-neutral voltages are displayed.

Ph-neut/Ph-Ph System voltage measurement is performed phase-neutral (WYE connected system). The phase voltages and the neutral must be connected for proper calculation. This requires that the neutral terminal (terminal 0) be connected to the ground reference. The phase-phase and phase-neutral voltages are displayed. The voltage protection is performed phase-phase only.

Ph-Ph/Ph-Ph System voltage measurement is performed phase-phase (Delta connected system). Phase voltages must be connected for proper calculation. This does not require the neutral terminal (terminal 0) be connected to the ground reference. The voltage measurement and protection functions performed in accordance with Delta connected systems. Only the phase-phase voltages are displayed.

Note:
Ph-neut = Four-wire system (3ph 4w)/Wye
Ph-Ph = Three-wire system (3ph 3w)/Delta

NOTE

If a three-wire system is connected, terminal 0 must remain disconnected. If terminal 0 is connected, the control may monitor a voltage that exceeds the permissible limits.

Parameter 18

```
Single phase
                OFF
```

only configurable via LeoPC1

Single-phase operation (1ph 2w) **OFF / Always ON / Via term. 61**

OFF .....The unit operates in three-phase operation. The voltage and control inputs must be wired accordingly (refer to installation manual 37366).

Always ON...The unit operates in single-phase operation (1ph 2w). The unit uses only the voltage V_{L1-N} and the current I_{L1}.
The voltage and control inputs must be wired accordingly (refer to installation manual 37366). The setting in Parameter 17 is not effective.

Via term. 61. If the discrete input at terminal 61 **is not** energized, the unit operates as described under "OFF".
If the discrete input at terminal 61 **is** energized, the unit operates as described under "Always ON".

Note: With this setting, terminal 61 **cannot** be used as alarm input. Additionally, it must be observed that **the measuring inputs for voltage and current must be wired differently** when changing between three- and single-phase operation.

© Woodward

Generator Current

Parameter 19

```
Power measuring
gen.------------
```

Generator power measurement **singlephase / threephase**

This controller may be configured to measure generator power single-phase or three-phase. If "single-phase power measurement" is selected, only the voltage and current from L1 phase will be used to calculate power. If "three-phase power measurement" is selected, the voltage and current from all three phases will be used to calculate power.

- single-phase power measurement: $P = \sqrt{3} \times V_{L12} \times I_{L1} \times$ power factor
- three-phase power measurement:
  $P = (V_{L1N} \times I_{L1} \times \text{power factor}) + (V_{L2N} \times I_{L2} \times \text{power factor}) + (V_{L3N} \times I_{L3} \times \text{power factor})$.

Mains Current/Mains Power Measurement

Mains current measurement via mains CT

Parameter 20

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

only configurable via LeoPC1

Mains current transformer **5 to 7,000/{x} A**

The input of the current transformer ratio is necessary for the indication and control of the actual monitored value. The current transformers ratio should be selected so at least 60% of the secondary current rating can be measured when the monitored system is at 100% of operating capacity (i.e. at 100% of system capacity a 5A CT should output 3A). If the current transformers are sized so that the percentage of the output is lower, the loss of resolution may cause inaccuracies in the monitoring and control functions and may affect the functionality of the control.
The control may be ordered with either ../1 A or ../5 A current transformer inputs. The CT inputs will dictate how this parameter is displayed on the control. Information about the current transformers inputs may be found on the unit data plate.

{x} = 1 A ..... GCP30x**1**B/xxx = Current transformer inputs rated for ../1 A
{x} = 5 A ..... GCP30x**5**B/xxx = Current transformer inputs rated for ../5 A

Mains power actual value measurement via analog input

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

Parameter 21

```
Analog in Pmains
            OFF
```

only configurable via LeoPC1

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

OFF .....The mains power analog input functionality is not used. The **actual value** for the mains interchange (import/export) real power is calculated from the measured mains current and the measured mains voltage. The analog inputs can either be used as real power **set point inputs** 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 as a 0/4 to 20 mA signal to the control from a measuring transducer and measured via the configured scalable 0/4 to 20 mA input T{x} ({x} = 1 to 7). The controller will not accept other types of analog signals for this function (i.e. 0 to 5 Vdc). The following screens of this function are displayed.

Note

The analog input used (T{x}) for the mains power analog input must be configured as follows:

- "Generator external power set point" (Parameter 75) must be configured as OFF.
- "Analog input {x} scalable" (Parameter 210) must be configured as OFF (refer to the "Analog inputs" section in this manual).
- The GCP-30 may be purchased with various types of analog inputs. If the controller being configured has analog inputs, only a 0/4 to 20 mA input may be used for this input.
- Due to the fact that LeoPC1 is not a dynamic program, the graphic display of the generator/plant does not automatically update to reflect any changes made during reconfiguration. To update the program's graphical display, LeoPC1 must be shutdown and restarted.

Priority of the functions of the analog inputs

If more than one function has been assigned to a analog input, the following is the priority that the control assigns to functions:

- 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

© Woodward

Parameter 22

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

only configurable via LeoPC1

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

The mains power analog input measuring range is defined here. 0 to 20 mA or 4 to 20 mA may be selected for this parameter. If the 4 to 20 mA range is selected and the current for the input drops below 2 mA, a broken wire alarm is issued.

Note

The text and number of significant digits to be displayed for the mains interchange analog input are defined in "name and unit" (Parameter 211). Refer to the "Analog Inputs" section starting on page 112.

NOTE

When determining the measuring range for an import/export real power control application, ensure that the the measuring range is in the middle of the of the selected set point values. This will utilize the unit control dynamics to the fullest extent.

Parameter 23

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

only configurable via LeoPC1

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

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

Parameter 24

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

only configurable via LeoPC1

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

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

Measurement Units

NOTE

LeoPC1 is not a dynamic program. Changes made to a controller during configuration will not be automatically updated in the graphic display of LeoPC1. LeoPC1 must be shutdown and restarted for any changes to be reflected in the graphic display.

Parameter 25

```
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 communicating with the GCP-30.

°C ⇨ °F	°F ⇨ °C
T [°F] = (T [°C] x 1.8) + 32	T [°C] = (T [°F] – 32) / 1.8

Parameter 26

```
Pressure in
---------------
```

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

The analog input for pressure 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 HMIs communicating with the GCP-30.

bar ⇨ psi	psi ⇨ bar
P [psi] = P [bar] x 14.5	P [bar] = P [psi] / 14.5

Password Configuration

NOTE

Once the code level is entered, access to the configuration menus will be allowed for two hours or until another password is entered into the control. If a user needs to exit a code level, then the control should have the CS0 code level enabled. This will block access to all of the control's parameters. A user may re-enable the CS0 code level by changing any one digit of the randomly generated number on the password screen and entering it into the unit.

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 27

```
Define level 1
code        0000
```

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

Access to this parameter is only enabled when the CS2 access code has been entered into the controller. Personnel assigned the CS1 password will be permitted access only to select parameters.
The default access code for this code level (CS) is **CS1 = 0 0 0 1**

Parameter 28

```
Define level 2
code        0000
```

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

Access to this parameter is only enabled when the CS2 access code has been entered into the controller. Personnel assigned the CS2 password will be permitted access to all parameters.
The default access code for this code level (CS) is **CS2 = 0 0 0 2**

© Woodward

Controller

WARNING

The following parameters dictate how the GCP-30 controls voltage, frequency, load, and power factor. It is vital that the correct setting be entered in these parameters. Failure to do so may lead to incorrect measurements and failures within the control unit resulting in damage to or destruction of the generator and/or personal injury or death.

NOTE

The parameters for this control are grouped together in blocks to permit navigation through the large number of configuration screens more rapidly. Selecting "YES" or "NO" has no effect whether or not control or monitoring is carried out for the parameters located in that block. Selecting "YES" or "NO" only determines if the individual parameters may be accessed and changed or are bypassed.

Parameter 29

```
Configure
controller    YES
```

Configuration of the controller **YES/NO**

The basic generator control functions are configured in this block of parameters. This parameter has the following effects:

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

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

Analog Controller Outputs

The control offers an alternative to a three-position controller output to a voltage regulator or speed control. If this option is selected, additional configuration screens are displayed for tuning. The analog PID controller is a closed-loop control loop with the controlled system (usually a first-order lag element). The PID loop parameters (gain K_{PR}, reset T_N, and derivative T_V) can each be modified individually.

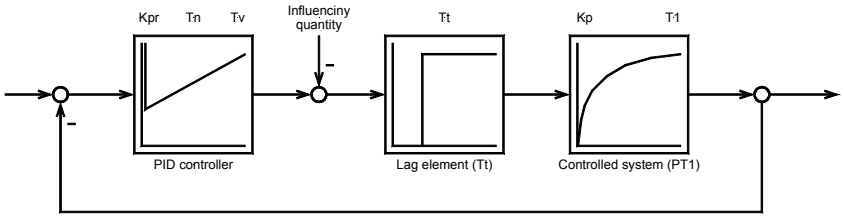


Figure 3-1: Control loop

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).

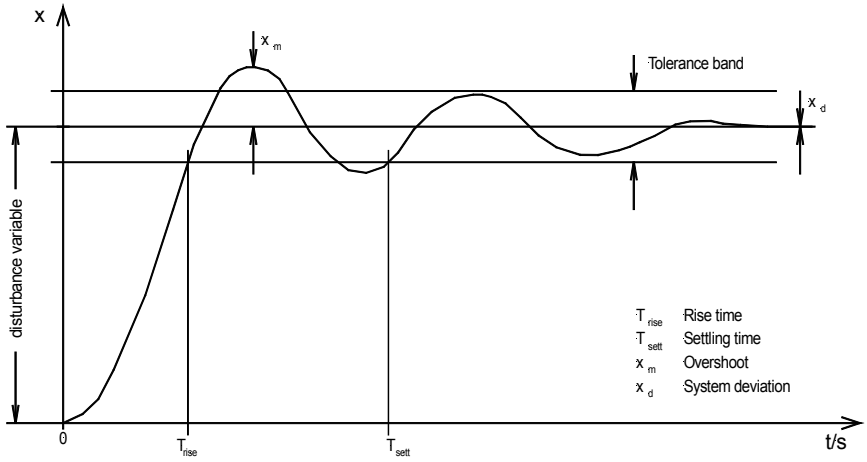


Figure 3-2: Step response (Example)

The step response consists of multiple values; these are required for adjusting the controller to its optimum setting:

Rise time T_{rise}: The period of time it takes for a control variable to re-enter a predefined tolerance range after a disturbance has been applied or the reference input has been changed. The time starts when the control variable leaves the predefined tolerance range and ends when the control variable first re-enters the predefined tolerance range.

Settling time T_{sett}: The period of time it takes for a control variable to permanently re-enter a predefined tolerance range after a disturbance has been applied or the reference input has been changed. The time starts when the control variable leaves the predefined tolerance range and ends when the control variable permanently re-enters the predefined tolerance range.

Overshoot x_m: The greatest deviation passed the defined set point value when the system is transitioning from one steady-state condition to a new steady-state condition following the application of a disturbance to the system or reference input variable ($x_{m\ Optimal} \leq 10$ %).

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

 © Woodward

CAUTION

The following must be ensured when tuning a controller:

- **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, initiate**

➔ EMERGENCY SHUTDOWN ←

Initial state: The start position of the speed or voltage controller is determined using the initial state of the controller. If the controller output is disabled, the basic setting can be used to output a fixed controller position. If the MANUAL operation mode has been selected, the initial state signal is output only after the engine "START" button has been pressed. Even when the analog controller output is disabled, the initial state can be freely adjusted (e.g. the speed controller can be controlled in a linear manner). When the "STOP" button is been pressed, the analog controller is turned off.

```
Controller outp.
Init.state= 000%
```

Initial state of the actuator **0 to 100 %**

The value entered for the initial state is the start reference point for a speed or voltage controller. If the output to that particular controller has been disabled, the output will act as a control position reference point.

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. The controller is operated as a P-loop only controller (where $T_n = \infty$ [screen setting: $T_n = 0$], $T_V = 0$).
2. Increase gain K_{PR} (P-gain) until $K_P = K_{Pcrit}$ and 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 × K_{Pcrit}
T_n = 0.5 × T_{crit}
T_V = 0.125 × T_{crit}

PI-controller

K_{PR} = 0.45 × K_{Pcrit}
T_n = 0.83 × T_{crit}

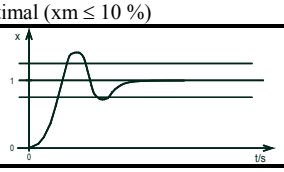
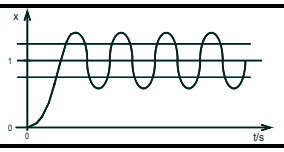
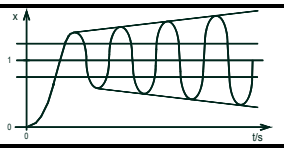
Step response		
Controller setting Optimal (xm ≤ 10 %)	Controller setting Tcrit	Controller setting Incorrect
		

Figure 3-3: Step responds - governor configuration

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

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

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

```
Reset time
      Tn = 00.0s
```

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

The reset time T_n represents the I-component of the PID controller. The reset time corrects for any offset (between 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 an excessive amount of time to settle at a steady state.

```
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.

© Woodward

Real Power Controller, Set Point Values

These screens appear only if the generator real power controller (Parameter 71) has been configured to "ON".

NOTE

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

Engine starting depends on whether an automatic start/stop operation has been enabled or disabled (Parameter 92 or Parameter 93). If it has been disabled, the engine will always start.

Parameter 30

```
Power controller
Pset1    I0000kW
```

Power controller: set point 1 **C/I/E 0 to 9,999 kW**

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

Generator real power control

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

Mains interchange (import/export) real power control

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

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

Parameter 31

```
Power controller
Pset2    I0000kW
```

Power controller: set point 2 **C/I/E 0 to 9,999 kW**

Set point 2 is enabled when **Automatic 2** (terminal 5) is energized and the external set point value (0/4 to 20 mA or interface) has not been enabled. If set point 1 and set point 2 are enabled at the same time, the power will be controlled in the manner specified by set point 1. The mains interchange (import/export) real power is controlled to the configured value.

Generator real power control

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

Mains interchange (import/export) real power control

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

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

Table Of Set Point Values

Automatic 1 (terminal 3)	Automatic 2 (terminal 5)	Control via interface	External set point value	Specification of the set point value through
energized	insignificant	insignificant	insignificant	Set point 1 (Parameter 30)
de-energized	energized	OFF	OFF	Set point 2 (Parameter 31)
de-energized	energized	insignificant	ON	Externally via 0/4-20 mA input (Parameter 75 cont.)
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

© Woodward

Frequency Controller

NOTE

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

Parameter 32

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

only configurable via LeoPC1

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

THREESTEP The signal to the speed control to increase/decrease the speed/frequency/real power is output via the relay manager to any two configurable relays. The following relay functions must be assigned to the individual relays.

- function 114 = increase RPM (n+) / frequency (f+) / power (P+)
- function 115 = decrease RPM (n-) / frequency (f-) / power (P-)

Refer to the Controller Outputs section of manual 37366 for wiring an external Resistive/Capacitive protection circuit.

ANALOG .... Speed control is performed via the analog outputs (terminals 8/9/10). The control of speed/frequency/real power is performed via either a voltage or current signal. The amplitude and signal type (mA or V) to be utilized is configured in "F/P contr.output" (Parameter 33). If a voltage signal is used, a jumper must be installed between terminals 8/9 (refer to the wiring diagram in manual 37366).

PWM ..... Speed control is performed via the analog outputs (terminals 8/9/10). The control of speed/frequency/real power is performed via a PWM signal. The amplitude of the PWM signal to be utilized is configured in "Level PWM" (Parameter 34). If a PWM signal is used, a jumper must be installed between terminals 8/9 (refer to the wiring diagram in manual 37366).

Parameter 33

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

only configurable via LeoPC1

Frequency controller: output range **see below**

If "F/P contr.type" (Parameter 32) has been configured as "ANALOG", this parameter must be configured to the appropriate type of analog controller signal. The range of the analog output is configured here. To switch from a current to a voltage or PWM signal output a jumper must be installed between terminals 8/9. The available 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 to 10mA (0 to 5V)		0-10mA	0 mA	10 mA
	0 to 20mA (0 to 10V)		0-20mA	0 mA	20 mA
	4 to 20mA		4-20mA	4 mA	20 mA
	10 to 0mA (5 to 0V)		10-0mA	10 mA	0 mA
	20 to 0mA (10 to 0V)		20-0mA	20 mA	0 mA
	20 to 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 to 10mA (0 to 5V)		0 to 5V	0 Vdc	5 Vdc
	0.5V to 4.5V		0.5 to 4,5V	0.5 Vdc	4.5 Vdc
	0 to 20mA (0 to 10V)		0 to 10V	0 Vdc	10 Vdc
	10 to 0mA (5 to 0V)		5 to 0V	5 Vdc	0 Vdc
	4.5V to 0.5V		4.5 to 0,5V	4.5 Vdc	0.5 Vdc
	20 to 0mA (10 to 0V)		10 to 0V	10 Vdc	0 Vdc

NOTE

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

- **Configure "F/P contr.type" (Parameter 32) as ANALOG.**
- **Configure "F/P contr.output" (Parameter 33 "F/P contr.output") with any of above inverted control outputs (i.e. "10 to 0mA (5 to 0V)", "4.5V to 0.5V", "20 to 0mA (10 to 0V)" or "20 to 4mA").**
- **Return to "F/P contr.type" (Parameter 32) by pressing "Select" and "Cursor→" simultaneously.**
- **Configure "F/P contr.type" (Parameter 32) as PWM.**

The PWM signal is now inverted.

Parameter 34

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

only configurable via LeoPC1

Frequency controller: PWM level **3.0 to 10.0 V**

If PWM has been selected in Parameter 32 the amplitude of the PWM signal can be adjusted here.

Parameter 35

```
Initial state
Frequency   000%
```

only configurable via LeoPC1

Frequency controller: initial state of the actuator **0 to 100 %**

The value entered for this parameter is the start reference point for the analog output to the speed controller. If the output to the speed control has been disabled, the output will act as a control position reference point. The percentage value configured here refers to the range of the analog signal configured by "Stepper sign.frq (min.)" (Parameter 40) and "Stepper sign.frq (max)" (Parameter 41).

Example: If a 0 to 10 V signal is configured with a min. limit of 10% and a max. limit of 90%, the reference range is 1 to 9 V. A setting of 25% would result a start reference point of 3 V. Refer to the Special Applications chapter of the Application Manual 37240 for more detailed information about this setting.

Parameter 36

```
Freq.controller
             ON
```

Frequency controller: activation **ON/OFF**

ON .....The generator frequency is controlled by the GCP-30. The method of generator frequency is determined by the application (isolated operation / synchronization). The subsequent screens of this function are displayed.

OFF .....The generator frequency is not controlled by the GCP-30 The subsequent screens of this function are not displayed.

© Woodward

Three-Position Controller (Setting 'THREESTEP')

Parameter 37

```
Freq.controller
deadband  0.00Hz
```

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

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

Synchronization The generator frequency is controlled in such a manner that the measured frequency does not deviate from the monitored reference (mains or busbar) frequency by more than the value configured in this parameter without the controller issuing a frequency raise/lower signal to the frequency control. This prevents unneeded wear on the frequency bias output control or the raise/lower relay contacts. The value configured for this parameter must be less than the value configured for the df max (maximum frequency differential) for synchronization.

Parameter 38

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

Frequency controller: three-step minimum pulse **10 to 250 ms**

When "F/P contr.type" (Parameter 32) has been configured as THREESTEP, a minimum pulse on time must be configured. The shortest possible pulse time should be configured to limit overshoot of the desired speed reference point.

Parameter 39

```
Freq.controller
gain Kp     00.0
```

Frequency controller: gain **0.1 to 99.9**

The gain factor K_p influences the operating time of the relays. By increasing the number configured in this parameter, the operating time of the relay will be increased in response to a deviation from the power factor reference. 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 con-figured too high, the result is excessive overshoot/undershoot of the desired value.

Analog Controller Output (Setting 'ANALOG' and 'PWM')

Parameter 40

```
Stepper sign.frq
(min.)      000%
```

Frequency controller: minimum value **0 to 100%**

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

Example: A 1 to 4V analog output is needed for the voltage controller to operate properly. A jumper is installed on terminals 8/9 as described above and the analog output signal of 0 to 5V is selected. The number to be configured as the minimum output signal in this parameter is determined by dividing the desired lower limit by the range of the signal (1V/5V = 0.20 or 20%). 20% is the value to be configured in this parameter.

Parameter 41

```
Stepper sign.frq
(max.)      000%
```

Frequency controller: maximum value **0 to 100%**

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

Example: A 1 to 4V analog output is needed for the voltage controller to operate properly. A jumper is installed on terminals 8/9 as described above and the analog output signal of 0 to 5V is selected. The number to be configured as the maximum output signal in this parameter is determined by dividing the desired upper limit by the range of the signal (4V/5V = 0.80 or 80%). 80% is the value to be configured in this parameter.

Parameter 42

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

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

The gain coefficient K_{pr} specifies the Proportional portion of the PID control loop. 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 43

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

Frequency controller: reset time (integration) **0.0 to 60.0 s**

The reset time T_n identifies the Integral portion of the PID control 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 an excessive amount of time to settle at a steady state.

Parameter 44

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

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

The derivative-action time T_V identifies the Derivative portion of the PID control 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.

© Woodward

Frequency Controller General (Setting 'THREESTEP, 'ANALOG', and 'PWM')

Parameter 45

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

Frequency controller: activation **0.0 to 70.0 Hz**

The frequency controller is activated when the monitored generator frequency has exceeded the value configured in this parameter. This prevents the GCP-30 from attempting to control the frequency while the engine is completing its start sequence.

Parameter 46

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

Frequency controller: activation delay **0 to 999 s**

The frequency controller is enabled after the configured time for this parameter expires.

Parameter 47

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

Frequency controller: set point ramp **1 to 50 Hz/s**

Different sized generators and applications require different ramp rates for the speed control when starting. The rate at which theGCP-30 changes the speed reference point is defined by this parameter. A more rapid change to the speed reference requires a larger value to be configured here.

Parameter 48

```
Freq.controller
droop      00,0%
```

Frequency controller: droop **0 to 20 %**

If the droop control is active, the droop portion configured here is considered for frequency control.

Voltage Controller

NOTE

The following parameters for the voltage controller influence the power factor is controlled.

Parameter 49

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

only configurable via LeoPC1

Voltage controller: type **THREESTEP / ANALOG**

THREESTEP The signal to the voltage control to increase/decrease the voltage/power factor is output via the relay manager to any two configurable relays. The following relay functions must be assigned to the individual relays.

- function 116 = increase voltage (V+) / power factor (Q+)
- function 117 = decrease voltage (V-) / power factor (Q-)

Refer to the Controller Outputs section of manual 37366 for wiring an external Resistive/Capacitive protection circuit.

ANALOG.....Voltage control is performed via the analog outputs (terminals 11/12/13). The control of voltage/reactive power is performed via either a voltage or current signal. The amplitude and signal type (mA or V) to be utilized is configured in "V/Q contr.output" (Parameter 50). If a voltage signal is use, a jumper must be installed between terminals 11/12 (refer to the wiring diagram in manual 37366).

Parameter 50

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

only configurable via LeoPC1

Voltage controller: range **see below**

If "V/Q contr.type" (Parameter 49) has been configured as "ANALOG", this parameter must be configured to the appropriate type of analog controller signal. The range of the analog output is configured here. To switch from a current to a voltage signal output, a jumper must be installed between terminals 11/12. The available ranges are listed below.

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

© Woodward

Parameter 51

```
Initial state
voltage     000%
```

Voltage controller: initial state of the actuator **0 to 100 %**

The value entered for this parameter is the start reference point for the analog output to the voltage controller. If the output to the voltage control has been disabled, the output will act as a control position reference point. The percentage value configured here refers to the range of the analog signal configured by "Stepper sign.vol (min.)" (Parameter 53) and "Stepper sign.vol (max.)" (Parameter 54).

Example: If a 0 to 10 V signal is configured with a min. limit of 10% and a max. limit of 90%, the reference range is 1 to 9 V. A setting of 25% would result a start reference point of 3 V. Refer to the Special Applications chapter of the Application Manual 37240 for more detailed information about this setting.

Parameter 52

```
Volt.controller
             ON
```

Voltage controller: activation **ON/OFF**

ON..... Generator voltage control is performed by the GCP-30. The subsequent screens of this function are displayed.
OFF..... Generator voltage control is not performed by the GCP-30. The subsequent screens of this function are not displayed.

Analog Controller (Setting 'ANALOG')

Parameter 53

```
Stepper sign.vol
(min.)      000%
```

Voltage controller: minimum value **0 to 100%**

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

Example: A 1 to 4V analog output is needed for the voltage controller to operate properly. A jumper is installed on terminals 8/9 as described above and the analog output signal of 0 to 5V is selected. The number to be configured as the minimum output signal in this parameter is determined by dividing the desired lower limit by the range of the signal (1V/5V = 0.20 or 20%). 20% is the value to be configured in this parameter.

Parameter 54

```
Stepper sign.vol
(max.)      000%
```

Voltage controller: maximum value **0 to 100%**

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

Example: A 1 to 4V analog output is needed for the voltage controller to operate properly. A jumper is installed on terminals 8/9 as described above and the analog output signal of 0 to 5V is selected. The number to be configured as the maximum output signal in this parameter is determined by dividing the desired upper limit by the range of the signal (4V/5V = 0.80 or 80%). 80% is the value to be configured in this parameter.

Parameter 55

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

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

The gain coefficient K_{pr} specifies the Proportional portion of the PID control loop. 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 56

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

Voltage controller: reset time (integration) **0.0 to 60.0 s**

The reset time T_n identifies the Integral portion of the PID control 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 an excessive amount of time to settle at a steady state.

Parameter 57

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

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

The derivative-action time T_V identifies the Derivative portion of the PID control 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.

Three-Position Controller (Setting 'THREESTEP')

Parameter 58

```
Volt.controller
dead band  00.0%
```

Voltage controller: dead band **00.1 to 15.0 %**

ⓘ This value refers to the rated system voltage (Parameter 12).

Isolated operation The generator voltage is controlled in such a manner that the measured voltage does not deviate from the configured set point by more than the value configured in this parameter without the controller issuing a voltage raise/lower signal to the voltage regulator. This prevents unneeded wear on the voltage bias output control or the raise/lower relay contacts.

Synchronization The generator voltage is controlled in such a manner that the measured voltage does not deviate from the monitored reference (mains or busbar) voltage by more than the value configured in this parameter without the controller issuing a voltage raise/lower signal to the voltage regulator. This prevents unneeded wear on the voltage bias output control or the raise/lower relay contacts. The value configured for this parameter must be less than the value configured for the dV max (maximum voltage differential) for synchronization.

Parameter 59

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

Voltage controller: minimum voltage **20 to 250 ms**

When "V/Q contr.type" (Parameter 49) has been configured as THREESTEP, a minimum pulse on time must be configured. The shortest possible pulse time should be configured to limit overshoot of the desired speed reference point.

Parameter 60

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

Voltage controller: gain **0.1 to 99.9**

The gain factor K_p influences the operating time of the relays. By increasing the number configured in this parameter, the operating time of the relay will be increased in response to a deviation from the power factor reference. 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.

© Woodward

Voltage Controller General (Setting 'THREESTEP' and 'ANALOG')

Parameter 61

```
Start voltage
V control.  000V
```

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

ⓘ This value refers to the voltage set point (Parameter 13).

The voltage controller is activated when the monitored generator voltage has exceeded the value configured in this parameter. This prevents the GCP-30 from attempting to control the voltage while the engine is completing its start sequence.

Parameter 62

```
Delayed. Start
V contr.    000s
```

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

The voltage controller is enabled after the configured time for this parameter expires.

Parameter 63

```
Volt.controller
droop      00,0%
```

Voltage controller: droop **0 to 20 %**

If the droop control is active, the droop portion configured here is considered for voltage control.

Power Factor Controller

Parameter 64

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

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

ON..... Power factor control is automatically performed by the GCP-30 when in a mains parallel operation. The power factor cannot be accurately measured if the monitored current is excessively low (secondary current less than 5 % I_{rated}). The GCP-30 will lock the power factor at the value configured in Parameter 65 if the monitored secondary current is less than 5% of the input rating. The subsequent screens of this function are displayed.

OFF..... Power factor is not controlled by the GCP-30 The subsequent screens of this function are not displayed.

Parameter 65

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

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

The GCP-30 is capable of producing power at a specified power factor when in parallel with the mains. The desired power factor is 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 under excited) reactive power. The power factor is only controlled to the value configured here when the generator is in a mains parallel operation.

NOTE

Please note the settings for the voltage controller will also influence the power factor controller. Refer to the "Voltage Controller" section on page 42.

Three-Position Controller (Setting 'THREESTEP')

Parameter 66

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

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

The generator reactive power is controlled in such a manner, when paralleled with the mains, so that the monitored power factor does not deviate from the configured power factor set point by more than the value configured in this parameter without the controller issuing a voltage raise/lower signal to the voltage regulator. This prevents unneeded wear on the raise/lower relay contacts. The configured percentage for the dead band refers to the generator rated power (Parameter 15).

Parameter 67

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

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

The gain factor K_p influences the operating time of the relays. By increasing the number configured in this parameter, the operating time of the relay will be increased in response to a deviation from the power factor reference. By increasing the gain, the response is increased to permit larger corrections to the variable to be controlled. The farther out of tolerance the process is the larger the response action is to return the process to the tolerance band. If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value.

Analog Controller (Setting 'ANALOG')

Parameter 68

```
Pow.fact.contr.
gain Kpr     000
```

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

The gain coefficient K_{pr} specifies the Proportional portion of the PID control loop. 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 69

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

Power factor controller: reset time (integration) **0.0 to 60.0 s**

The reset time T_n identifies the Integral portion of the PID control 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 an excessive amount of time to settle at a steady state.

Parameter 70

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

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

The derivative-action time T_V identifies the Derivative portion of the PID control 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.

© Woodward

Real Power Controller

Parameter 71

```
Power controller
             ON
```

Power controller: enable **ON/OFF**

ON..... Real power control is enabled. The generator will automatically load with real power to the level configured in Pset1 (Parameter 30) or Pset2 (Parameter 31) when the corresponding inputs (terminal 3 or 5) are energized and the system is in parallel with the mains. 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 72

```
power controller
ramp    000.0%/s
```

Power controller: set point ramp %/s **0.1 to 100.0 %/s**

The GCP-30 controller has the ability to softly load and unload when paralleled. The load reference point is changed by the control at the rate of a configured percent per second. This percentage refers to the generator rated power (Parameter 16). A smaller configured percentage for the ramp rate will result in a slower ramp rate. Conversely a larger configured percentage will result in a faster ramp rate.

NOTE

Please note the settings for the frequency controller in chapter "Frequency Controller" at page 37. The settings there for the frequency controller also influence the real power controller.

Power Limitation

Parameter 73

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

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

If the maximum generator real load is to be limited, a percentage based on the generator rated power (Parameter 16) is entered here. The GCP-30 will not permit the load to exceed the configured power limitation value. This parameter is only functional when the generator is in a mains parallel operation.

Parameter 74

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

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

If the generator minimum real load is to be limited, a percentage based on the generator rated power (Parameter 16) is entered here. The GCP-30 will not permit the load to drop below the configured power limitation value. This parameter is only functional when the generator is in a mains parallel operation.

External Generator Power Set Point Value

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

Parameter 75

```
Power setpoint
external     OFF
```

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

OFF .....External regulation of the generator real power **set point value** via the 0/4 to 20 mA input is disabled. 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 "Pset2" (Parameter 31) is used as set point value. The subsequent screens of this function are not displayed.

T{x} .....External regulation of the generator real power **set point value** via the 0/4 to 20 mA input is enabled. If terminal 5 is utilized, the internal set point value 2 "Pset2" (Parameter 31) is used as the set point value. The subsequent screens of this function are displayed.

Note

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

- "Analog in Pmains" (Parameter 21) in the "Measuring" section must be configured as OFF.
- "Analog input {x} scalable" (Parameter 210) in the "Analog inputs" section must be configured as OFF.
- The GCP-30 is may be purchased with various types of analog inputs. If the controller being configured has analog inputs, only a 0/4 to 20 mA input may be used for this input.
- Due to the fact that LeoPC1 is not a dynamic program, the graphic display of the generator/plant does not automatically update to reflect any changes made during reconfiguration. To update the program's graphical display, LeoPC1 must be shutdown and restarted.

Priority of the functions of the analog inputs

If more than one function has been assigned to an analog input, the following is the priority that the control assigns to functions:

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

© Woodward

Parameter 76

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

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

The analog input measurement range is selected in this parameter. The user may select from 0 to 20 mA or 4 to 20 mA to match the source of the input.
0 to **20 mA** ... Minimum set point value corresponds to 0 mA;
maximum set point value corresponds to 20 mA.
4 to **20 mA** ... Minimum set point value corresponds to 4 mA;
maximum set point value corresponds to 20 mA.

CAUTION

It is possible to scale the real power interchange set point. Do not configure a base load operation (C) with an import (I) or export (E) operation. The chart below shows permissible combinations of the analog input current levels and import, export, and base load power operations.

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

Parameter 77

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

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

The minimum value of the generator real power that corresponds to 0/4 mA is defined here (e. g. 0 kW).

Parameter 78

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

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

The maximum value of the generator real power that corresponds to 20 mA is defined here (e. g. 100 kW).

Three-Position Controller (Setting 'THREESTEP')

Parameter 79

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

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

The generator real power is controlled in such a manner, when paralleled with the mains, so that the monitored real power does not deviate from the configured real power set point by more than the value configured in this parameter without the controller issuing a frequency raise/lower signal to the speed control. This prevents unneeded wear on the raise/lower relay contacts. The configured percentage for the dead band refers to the generator rated power (Parameter 16).

Parameter 80

```
Power controller
gain Kp     00.0
```

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

The gain factor K_p influences the operating time of the relays. By increasing the gain, the response is increased to permit larger corrections to the 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 81

```
Powercontr. dead
band ratio  *0.0
```

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

The GCP-30 has the capability to increase the power controller dead band. This function may be desired as a method of reducing wear on the voltage regulator as a result of frequent actuation due to minor fluctuation of the load. If adjusting pulses have not been output for at least 5 seconds, the dead band is increased by this factor.

Example: A dead band of 2.5 % and a factor of 2.0 have been configured and the GCP-30 has not issued an adjustment pulse in the last 5 seconds. The dead band is increased to 5.0 % of the rated power. If the monitored power deviates from the 5% dead band, the controller automatically returns to the original dead band (2.5 %) and controls the power at that level.

Analog Controller (Setting 'ANALOG')

Parameter 82

```
Power controller
gain Kpr     000
```

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

The gain coefficient K_{pr} specifies the Proportional portion of the PID control loop. 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 83

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

Power controller: reset time (integration) **0.0 to 60.0 s**

The reset time T_n identifies the Integral portion of the PID control 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 an excessive amount of time to settle at a steady state.

Parameter 84

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

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

The derivative action time T_V identifies the Derivative portion of the PID control 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.

Partial Load Lead

Parameter 85

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

Power controller: partial-load limit **5 to 110 %**

The GCP-30 is capable of partially loading the generator to a specified limit for a designated time period to permit warming up of the prime mover prior assuming service loads. The partial load level is specified as a percentage in this parameter. The configured percentage for the partial load limit refers to the generator rated power (Parameter 16).

Parameter 86

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

Power controller: partial-load limite **0 to 600 s**

The GCP-30 is capable of partially loading the generator to a specified limit for a designated time period so the prime mover may be warmed up prior assuming service loads. The length of the warm-up period with partial 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.

 © Woodward

Load And/Or Var Sharing

The GCP-30 performs proportional load and/or var sharing. This means each generator will share the load at the same percentage level of the generator rated power when paralleled against the mains, in an isolated operation with multiple generators paralleled, or when re-synchronizing the common bus to the mains. Proportional load/var sharing will not be performed when the GCP-30 has the GCB closed and is in the constant power/base load mode. The GCP-30 is capable of controlling up to 8 generators. The GCP-30 is also capable of controlling any generator rated up to 10 MW. The total rated system power for all generators may not exceed 32 MW.

Mains parallel operation with mains interchange real power control (import/export): The GCP-30 controllers maintain the real load level on the individually controlled generators at a level so that the real power set point at the mains interchange remains at the configured set point. The real power set point for the mains interchange must be configured identically for each GCP.
The GCP-30 controller communicates with other controls in the system via a CAN bus. This enables the controllers to adjust the real power generated by the generator while remaining within the rated power of the generator. A smaller generator will contribute less real power as compared to a large generator, but they will both be utilized to the same capacity factor. An example of this would be a 100 kW generator with a configured 1000 kW generator and a mains interchange of 825 kW. The 100 kW generator would contribute 75 kW and the 1000 kW generator would contribute 750 kW or both generators would be at 75% of their rated capacity.
Reactive load sharing is not performed when operating in parallel with the mains. The reactive power control will be defined by the configured power factor set point of the individual controllers. If "Pow.fact.contr. setpoint" (Parameter 65) is configured as i0.95, the GCP will proportionally share the real load with all generators in parallel with the mains while controlling the reactive power at a 0.95 lagging power factor regardless of the what power factor the mains is operating at.

The parameter "kW/kvar sharing: reference variable kW" (Parameter 88) can be used now to define the priority of the real power sharing reference variable (real power at interchange). A higher configured percentage influences the control more towards maintaining the real power set point for the interchange. A lower configured percentage influences the control more towards maintaining real power sharing between units.
The parameter "kW/kvar sharing: reference variable kvar" (Parameter 90) has no influence here.

Isolated operation in parallel: The GCP-30 controllers maintain the voltage and frequency of the individually controlled generators at a constant level. This makes it imperative that the voltage and frequency set points are configured identically for each GCP.
The GCP-30 controller communicates with other controls in the system via a CAN bus. This enables the controllers to adjust the real power generated by the generator while remaining within the rated power of the generator. A smaller generator will contribute less real power as compared to a large generator, but they will both be utilized to the same capacity factor. An example of this would be a 100 kW generator and a 1000 kW generator with an 825 kW load. The 100 kW generator would contribute 75 kW and the 1000 kW generator would contribute 750 kW or both generators would be at 75% of their rated capacity.
The reactive power will be shared proportionally among all generators involved.

The parameter "kW/kvar sharing: reference variable kW" (Parameter 88) can be used to define the priority of the reference variable for real power sharing. A higher configured percentage influences the control more towards frequency control. A lower configured percentage influences the control more towards real power sharing.
The parameter "kW/kvar sharing: reference variable kvar" (Parameter 90) can be used now to define the priority of the reference variable for reactive power sharing. A higher configured percentage influences the control more towards voltage control. A lower configured percentage influences the control more towards reactive power sharing.

Re-synchronization of the busbar to the mains: The system is operating as an isolated system, for synchronization to be performed the voltage and frequency differentials of the mains and bus must be within the configured windows.
The bus frequency reference point is dictated by the monitored mains frequency and the configured frequency differential (+ $df_{max}/2$).
Example: If $+df_{max}$ = 0.2 Hz, the GCP-30 will calculate the bus frequency reference point as:
[monitored mains frequency] + [$df_{max}/2$] = bus frequency reference point
A practical example of this would be:
The monitored mains frequency is 60 Hz
Configured + df_{max} = 0.2 Hz
[60 Hz] + [0.2Hz/2] = 60.1 Hz bus frequency reference point

The differential voltage is configured as a window. The monitored voltage from the potential transformers secondary for the mains and the bus must be within the configured voltage differential limit. This means that if the secondary voltage inputs have been configured for 120 V and a dV of 2 V is configured, then synchronization will be permitted when the monitored voltage on the secondary of the main and bus are within 2 V of each other.

When the monitored bus frequency and voltage are within the configured differential limits, the "Command: close MCB" relay will enable, closing the MCB, and the system will be paralleled to the mains.

Prerequisites: All GCP-30 controllers connected to the system must have rated system frequencies, start/stop parameters, and breaker logic configured identically and the parameter "Active power load-share" (Parameter 87) must be enabled.

Description of the load-share interface: The GCP-30 utilizes a peer relationship between units to control the system. This permits for parallel applications of up to 8 generators.

NOTE

Refer to the Interface section of the Installation Manual 37366 for information about the CAN bus connection.

Diagram of load/var sharing via the CAN bus (refer to Figure 3-4 on page 53)**:** The parameter "Active load sharing factor" determines if and how a generator performs real power or frequency control when paralleled with other generators in an isolated operation. This parameter is defined as a percentage. In the 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 set point. 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 control value to the secondary controller.

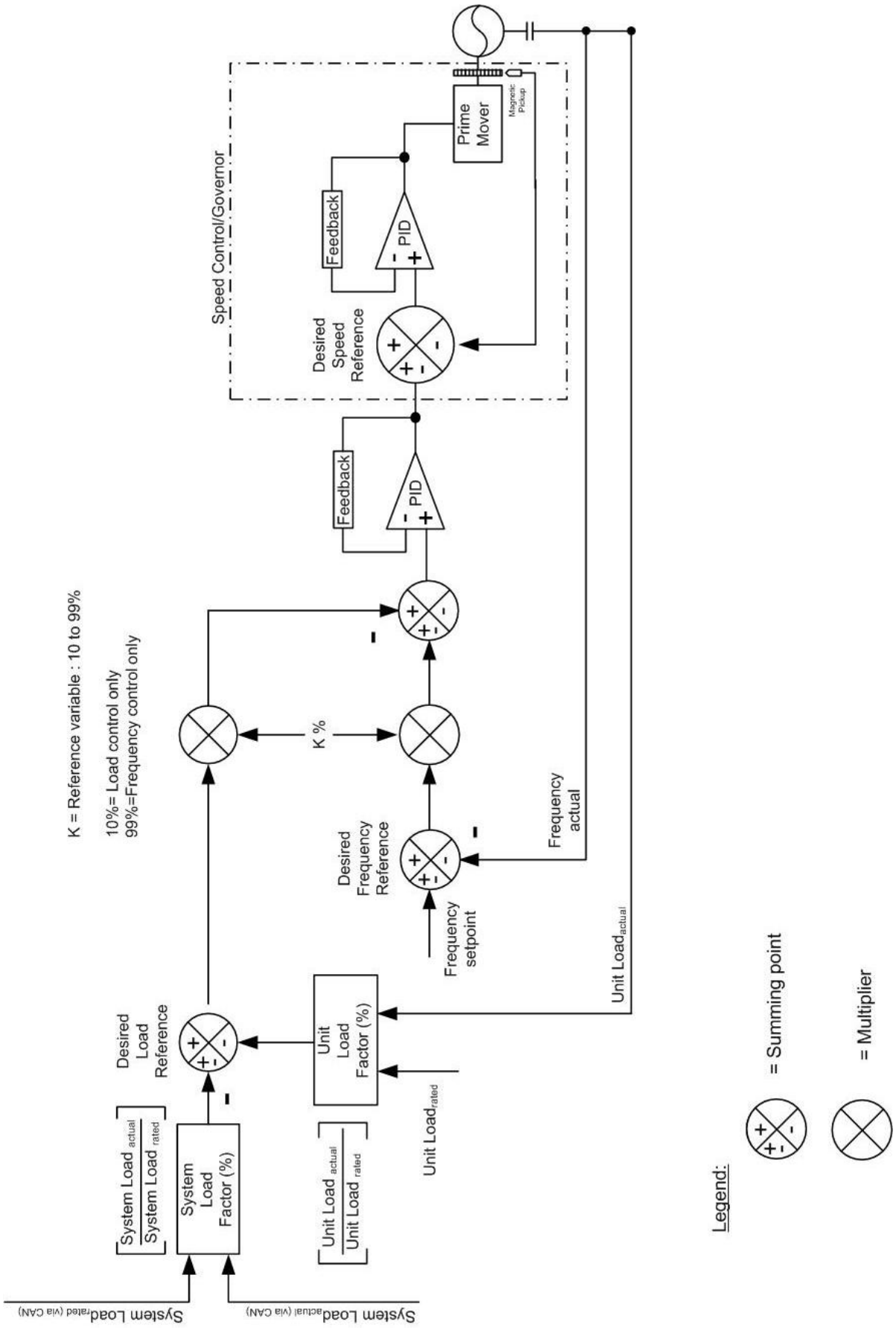


Figure 3-4: CAN bus load/var sharing, diagram

Parameter 87

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

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

ON .....Real power sharing is enabled. When multiple generators are operating in parallel, the real power is shared proportionally. The subsequent screens of this function are displayed.
OFF .....Real power sharing is disabled. The subsequent screens of this function are not displayed.

Parameter 88

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

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

It is possible to change the emphasis placed on maintaining control variables. By increasing or decreasing the percentage value in this parameter, the control places a higher priority on maintaining the primary or secondary control reference variable. If the value for this parameter is configured higher, maintaining the primary control variable has more priority. If the value for this parameter is configured lower, maintaining the secondary control variable has a greater priority.

Primary control variable
- Isolated operation = frequency maintained
- Mains parallel operation = real power level at the mains interchange point maintained

Secondary control variable
- Isolated operation = real power sharing with other generators maintained
- Mains parallel operation = real power sharing with other generators maintained

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

Parameter 89

```
Reactive power
load share   ON
```

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

ON .....Reactive power sharing is enabled. When multiple generators are operating in parallel, the reactive power is shared proportionally. The subsequent screens of this function are displayed.
OFF .....Reactive power sharing is disabled. The subsequent screens of this function are not displayed.

Parameter 90

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

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

It is possible to change the emphasis placed on maintaining control variables. By increasing or decreasing the percentage value in this parameter, the control places a higher priority on maintaining the primary or secondary control reference variable. If the value for this parameter is configured higher, maintaining the primary control variable has a greater priority. If the value for this parameter is configured lower, maintaining the secondary control variable has a greater priority.

Primary control variable
- Isolated operation = voltage maintained
- Mains parallel operation = power factor maintained

Secondary control variable
- Isolated operation = reactive power sharing with other generators maintained
- Mains parallel operation = power factor maintained

 © Woodward

Automatic

Parameter 91

```
Configure
automatic     YES
```

Configuration of automatic **YES/NO**

The automatic control functions are configured in this block of parameters. This parameter has the following effects:

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

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

Load Management

NOTE

To enable the automatic start/stop function, "Active power load-share" (Parameter 87) must be configured to “ON”, regardless if additional generators are available for load sharing.

NOTE

The automatic start/stop functionality of the engine, requires that identical rated power (Parameter 16) be configured in all participating controls.

Load-Dependent Start/Stop in Mains Parallel Operation

Parameter 92

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

only configurable via LeoPC1

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

ON..... The automatic start/stop functionality is enabled. When the discrete input "Automatic 1" (terminal 3) is energized, the GCP-30 will automatically start/stop dependent upon the measured load in accordance with how generator real power set point 1 (Parameter 30) is configured. If terminal 5 is energized simultaneously, terminal 3 has priority and will override terminal 5. The subsequent screens of this function are displayed.

OFF..... The automatic start/stop functionality is disabled. The generator will start only when terminal 3 is energized and stop when de-energized. The generator is loaded in accordance with how generator real power set point 1 (Parameter 30) is configured. The subsequent screens of this function are not displayed.

Parameter 93

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

only configurable via LeoPC1

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

ON..... The automatic start/stop functionality is enabled. When the discrete input "Automatic 2" (terminal 5) is energized, the GCP-30 will automatically start/stop dependent upon the measured load in accordance with how generator real power set point 2 (Parameter 31) is configured. If terminal 3 is energized simultaneously, terminal 3 has priority and will override terminal 5. The subsequent screens of this function are displayed.

OFF..... The automatic start/stop functionality is disabled. The generator will start only when terminal 3 is energized and stop when de-energized. The generator is loaded in accordance with how generator real power set point 1 (Parameter 30) is configured. The subsequent screens of this function are not displayed.

Single generator in mains parallel operation

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

- The control has been placed in the AUTOMATIC operation mode
- The mains interchange power control (import/export power) has been enabled by either the "Automatic 1" or "Automatic 2" discrete inputs (terminals 3 or 5) and are configured for import or export operations
- One or both parameters "Load-dependent start/stop on terminal 3/5" (Parameter 92 or Parameter 93) has been configured to "ON".

Parameter 94

```
Minimum load
generator 0000kW
```

only configurable via LeoPC1

Load dependent start/stop: generator minimum power start set point **0 to 6,900 kW**

For the mains interchange (import/export) real power control to function, a minimum generator power set point value is required. In many cases, it is desirable that the engine is prevented from starting unless the generator will operate at a specific kW level or higher to ensure a reasonable degree of efficiency.

Example: The mains interchange must reach a level that will permit an 80kW generator to operate at a minimum load of 40kW prior to the engine starting.

Parameter 95

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

only configurable via LeoPC1

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

Load swings may exceed the "Minimum load generator" (Parameter 94) set point momentarily. In order to prevent the engine from starting due to short-term load swings, a delay time may be configured. The load must remain above the minimum load set point without interruption for the delay time, configured in seconds, prior to a start command being issued. If the load falls below the minimum load set point before the delay time expires, the delay time is reset and a start command is not issued.

Parameter 96

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

only configurable via LeoPC1

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

Load swings may fall below the "Hysteresis add on/off op." (Parameter 97) set point momentarily. In order to prevent the engine from stopping due to short-term load swings, a delay time may be configured. The load must remain below the hysteresis set point without interruption for the delay time, configured in seconds, prior to a stop command being issued. If the load exceeds the hysteresis set point before the delay time expires, the delay time is reset and a stop command is not issued.

Stopping hysteresis

NOTE

Parameter 97 is used to determine the stopping hysteresis for a single generator in a mains parallel operation and multiple paralleled generators in an isolated operation.

Parameter 97

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

only configurable via LeoPC1

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

The shutdown power limit of the generator is determined via a hysteresis. The hysteresis is used to prevent the engine continuously starting and shutting down due to minor load swings. The hysteresis should be configured so that the system has time to bring an additional generator online during the largest possible load swing that the plant may experience.

 © Woodward

Single generator mains parallel operation (mains interchange (import/export) real power control)

NOTE

The "desired mains interchange power level" will equal 0 in the formulas below if the breaker logic is configured as Open Transition, Closed Transition, Interchange, or External. The desired mains interchange power level is utilized for import and export power operations.

General

Formula A: Determining the start set point
An engine start command is issued when:
Desired mains interchange power level – Minimum load generator = Mains power level when generator started

Formula B: Stop of the engine
An engine stop command is issued when:
Desired mains interchange power level + Monitored mains power + Minimum load generator – Generator hysteresis = Mains power level when generator stopped

Example

Situation: A customer wants to import only 50kW from the utility. The minimum efficient load to start the generator is 30kW. The generator should be shut down when the generator load drops below 20kW.
Desired mains interchange power level = the power to be imported or exported to the mains
Imported power is always calculated as a negative number since the generator does not produce it. Exported power is always calculated as a positive number since the generator produces it. The desired import level should be entered as "I0050kW" for Pset1 or Pset2 (Parameter 30 or Parameter 31).
Desired mains interchange power level = -50 kW
Minimum load generator = the minimum efficient load that a start request will be issued
"Minimum load generator" (Parameter 94) should be configured as "0030kW".
Minimum load generator = 30 kW
Generator hysteresis = the power level that a stop command will be issued
This value is calculated by subtracting the minimum generator load for a shut down command from the minimum load that a start command is issued. In this example the calculation would be [30kW – 20kW = 10kW]. "Hysteresis add on / off op." (Parameter 97) should be configured as "10kW".
Generator hysteresis = 10 kW
Monitored mains power = the monitored power level and direction at the mains breaker

The situation above will be calculated as follows:
Case 1:
An engine start command is issued when the monitored mains power reaches a specified level. Formula A is used as follows:
Desired mains interchange power level – minimum load generator = mains power level when generator starts
- 50 kW - 30 kW = -80 kW
The power supplied by the mains must be equal to or greater than 80 kW in order for the GCP-30 to issue a start command. After the engine starts and the GCB closes, the generator will assume load until the mains interchange is importing 50kW.

Case 2:
An engine stop command is issued when the monitored mains power falls to a specified level. Formula B is used as follows:
Desired mains interchange power level + monitored mains power + minimum load generator – generator hysteresis = generator power level when generator stops
- 50 kW + 50 kW + 30 kW - 10 kW = 20 kW
The power supplied by the generator must be equal to or less than 20 kW for the delay time without interruption prior to the GCP-30 issuing a stop command. After the GCP-30 issues the stop command, the generator will transfer the remaining load to the mains (increasing the mains import level to 70kW), open the GCB, and shutdown the engine.

Load sharing with multiple generators in a mains parallel operation

The load-dependent start/stop functionality is enabled when the following conditions have been met for all controls:

- The control has been placed in the AUTOMATIC operation mode
- The mains interchange power control (import/export power) has been enabled by energizing either the "Automatic 1" or "Automatic 2" discrete inputs (terminals 3 or 5) and are these discrete inputs are configured for import or export operations
- All parameters, such as start power (Parameter 94), stop power (Parameter 97), start delay (Parameter 95), stop delay (Parameter 96), and the frequency set point value (Parameter 9) are configured identically for all generators that will be load sharing
- One or both parameters "Load-dependent stop/start on terminal 3/5" (Parameter 92 and/or Parameter 93) has been configured "ON"
- The parameters "Load sharing" (Parameter 87) and/or "var sharing" (Parameter 89) have been configured "ON"
- All generators are configured for the **same rated power** (Parameter 16)

NOTE

"Reserve power mains op." (Parameter 98) is only utilized when multiple generators are to be paralleled with the mains. The first engine will be started as described in the section: Single generator mains parallel operation (mains interchange (import/export) real power control) on page 57.

Parameter 98

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

only configurable via LeoPC1

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

The value configured for the reserve power determines when an additional generator will be started. The reserve power is the desired spinning reserve of a generator or generators. The reserve power is usually configured as the largest load swing that a power plant may encounter during the time it takes to bring an additional generator online. The available generator power is calculated by multiplying the number of generators with closed GCBs by the generator real power rating of a generator. The reserve generator power is calculated by subtracting the power currently being produced by all generators with closed GCBs from the total available generator power. If the actual reserve power of the generators is less than the value configured in this parameter, the next generator will be started.

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

Parameter 99

```
Priority of
generators     0
```

only configurable via LeoPC1

Load dependent start/stop: priority of generators **0 to 14**

This parameter specifies the sequence in which the individual generators are started. The control with the lowest configured number has the highest priority. This generator will be the first started and the last stopped. In the event two or more generators have been assigned identical priorities, the starting sequence is determined by the operating hours. In this case, the generator with the lowest operating hours will be started first. In the event the generators have the same number of operating hours, the generator with the lowest generator number (CAN bus address, Parameter 4) is started.

 © Woodward

Mains parallel operation(mains interchange (import/export) real power control with multiple generators)

NOTE

The "desired mains interchange power level" will equal 0 in the formulas below if the breaker logic is configured as Open Transition, Closed Transition, Interchange, or External. The desired mains interchange power level is utilized for import and export power operations.

General

Formula C: Start of the first generator
All GCBs are open.
The first engine is started when:
desired mains interchange power level – minimum load generator = mains power level when generator starts

Formula D: Starting of additional generators
At least one GCB in the group is closed.
The next engine is started when:
[(generator rating)(number of closed GCBs) – parallel reserve power] / number of closed GCBs = individual generator power level at next start

Formula E: Stopping a generator
At least two GCBs in the group are closed.
An engine is stopped when:
(number of generators needed for load – 1)(generator rating) – parallel reserve power – generator hysteresis = power level next generator stopped

Formula F: Stopping of the last generator
Only one GCB in the group is closed.
The last engine is stopped when:
[desired mains interchange power level + monitored mains power + minimum load generator – generator hysteresis = mains power level when generator stops

Example

When the generators are running the customer wishes to remain paralleled with the mains but does not want the mains to supply any power to the system. This value has been configured as "I0000kW" (refer to "Real Power Controller, Set Point Values on page 35"). The same functionality may be achieved by configuring the main interchange power as "E0000kW". The largest load swing the system will encounter is 40 kW. The customer wants a 20 kW buffer to prevent restarting of generators due to load swings. A reserve power for the system of 40 kW and a generator hysteresis of 20 kW is desired for this application. The power plant consists of three generators capable of paralleling. Each generator is rated for 200 kW of real power. It is not economical to start a generator unless it will carry 30 kW of load.

Variables

Generator rating = the power rating for an individual generator (all generators used in this application must be of the same power rating). "Rated power generator" (Parameter 16) should be configured as "200 kW".
Generator rating = 200 kW
Number of closed GCBs = all generator that are used to calculate available generation power must have their circuit breaker closed.
Number of closed GCBs = varies
Desired mains interchange power level = the power to be imported or exported to the mains
Imported power is always calculated as a negative number since the generator does not produce it. Exported power always calculated as a positive number since the generator produces it. The desired import level should be entered as "I0000 kW" for Automatic 1 or 2 (Parameter 30 or Parameter 31).
Desired mains interchange power level = 0 kW
Minimum load generator = the minimum load that the first start request will be issued
"Minimum load generator" (Parameter 94) should be configured as "0030kW".
Minimum load generator = 30 kW
Generator hysteresis = the power level that a stop command will be issued
This value is calculated by subtracting the minimum generator load for a shut down command to be issued from the minimum load that a start command is issued. In this example the calculation would be [30 kW – 10 kW = 20 kW]. "Hysteresis add on / off op." (Parameter 97) should be configured as "20 kW".
Generator hysteresis = 20 kW
Parallel reserve power = the real load that a generator or generators are able to absorb while the next generator is started. The reserve power is usually configured as the largest load swing that a power plant may encounter during the time it takes to bring an additional generator online. "Reserve power mains op." (Parameter 98) should be configured as "40 kW".
Reserve power = 40 kW
Monitored mains power = the monitored power level and direction at the mains breaker

Case 3:
An engine start command is issued when the monitored mains power reaches a specified level. Formula C is used as follows:
Desired mains interchange power level – Minimum load generator = Mains power level when generator starts
0 kW - 30 kW = -30 kW
The power supplied by the mains must be at equal to or greater than 30 kW in order for the GCP-30 to issue a start command. After the engine starts and the GCB closes, the generator will assume load until the mains interchange is importing 0 kW.

Case 4:
An engine start command is issued to the second generator when the monitored mains power reaches a specified level. Formula D is used as follows:
[(generator rating)(number of closed GCBs) – parallel reserve power] / number of closed GCBs = generator power level at next start
[(200 kW)(1) – 40 kW] / 1 = 160 kW
The single generator that is providing power has a total load rating of 200 kW (200 kW x 1). This generator has an available load of 160 kW (200 kW – 40 kW). When the individual generator load exceeds 160 kW, the next generator will be started and brought online to share the load.

 © Woodward

Case 5:
An engine start command is issued to the second generator when the monitored mains power reaches a specified level. Formula D is used as follows:
[(generator rating)(number of closed GCBs) – parallel reserve power] / number of closed GCBs = generator power level at next start
[(200 kW)(2) – 40 kW] / 2 = 180 kW.
The two generators that are providing power have a total load rating of 400 kW (200 kW x 2). Both generators combined have an available load of 360 kW (400 kW – 40 kW). The reserve power limit is split equally between the two generators giving each generator an effective load of 180 kW each. When the individual generator loads exceed 180 kW, the next generator will be started and brought online to share the load.

Case 6:
An engine stop command is issued to the first generator when the monitored system power falls to a specified level. Formula E is used as follows:
(number of generators needed for load – 1 generator)(generator rating) – reserve power – generator hysteresis = Power level next generator stopped
(3 – 1)(200 kW) – 40 kW – 20 kW = 340 kW(3 – 1)(200 kW) – 40 kW – 20 kW = 340 kW
System power level / number of closed GCBs = individual generator load level
340 kW / 3 = 113.3 kW
The three generators that are providing power have a total load rating of 600 kW (200 kW x 3). Before a generator can be shut down as the load decreases, the two generators that will remain online must be able to sustain the remaining load. This requires that the above formula be used to determine the load level that a shutdown command is issued. According to the calculations above that level is 340 kW. This load is shared equally among the online generators. To determine the individual generator load levels the shut down power level must be divided by the number of generators online (340 / 3 = 113.3 kW). When the individual loads for the generators drop below 113.3 kW, a stop command will be issued and a generator will shed its load to the remaining generators, open its GCB, and shut down.

Case 7:
An engine stop command is issued to the second generator when the monitored system power falls to a specified level. Formula E is used as follows:
(number of generators needed for load – 1 generator)(generator rating) – parallel reserve power – generator hysteresis = system power level next generator stopped
(2 – 1)(200 kW) – 40 kW – 20 kW = 140 kW.
System power level / number of closed GCBs = individual generator load level
140 kW / 2 = 70 kW
The two generators that are providing power have a total load rating of 400 kW (200 kW x 2). Before a generator can be shut down as the load decreases, the generator that will remain online must be able to sustain the remaining load. This requires that the above formula be used to determine the load level that a shutdown command is issued. According to the calculations above that level is 140 kW. This load is shared equally among the online generators. To determine the individual generator load levels the shut down power level must be divided by the number of generators online (140 / 2 = 70 kW). When the individual loads for the generators drop below 70 kW, a stop command will be issued and a generator will shed its load to the remaining generator, open its GCB, and shut down.

Case 8:
An engine stop command is issued to the last generator when the monitored system power falls to a specified level. Formula F is used as follows:
desired mains interchange power level + monitored mains power + minimum load generator – generator hysteresis = mains power level when generator stops
0 kW + 0 kW + 30 kW - 20 kW = 10 kW
The final remaining generator will be taken offline after the load supplied by the generator drops below the configured mains interchange level plus the monitored power at the mains interchange minus the minimum configured load for the generator minus the generator hysteresis or 10 kW in this case. When the load drops to 10 kW, the load is shed from the generator to the mains, the GCB is opened, and the generator is shut down. The mains will now import 10 kW. If the load increases again, the previous steps are repeated.

Isolated operation in parallel with other generators

The load-dependent start/stop functionality is enabled when the following conditions have been met for all controls:

- The control has been placed in the AUTOMATIC operation mode
- The mains interchange power control (import/export power) has been enabled by either the "Automatic 1" or "Automatic 2" discrete inputs (terminals 3 or 5) and are configured for import or export operations
- All parameters, such as start power (Parameter 94), stop power (Parameter 97), start delay (Parameter 95), stop delay (Parameter 96), and the frequency set point value (Parameter 9 or Parameter 11) are configured identically for all generators that will be load sharing
- One or both parameters "Load-dependent stop/start on terminal 3/5" (Parameter 92 and/or Parameter 93) has been configured to "ON"
- The parameters "Load sharing" (Parameter 87) and/or "var sharing" (Parameter 89) have been configured to "ON"
- **All generators** are configured for the **same rated power** (Parameter 16)

NOTE

In order to prevent a generator from becoming overloaded, ensure that the value configured for the reserve power (Parameter 100) is larger than the largest load swing any one generator might endure while an additional generator is brought online.

Parameter 100

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

only configurable via LeoPC1

Load dependent start/stop: reserve power (isolated operation) **0 to 9,999 kW**

The value configured for the reserve power determines when an additional generator will be started. The reserve power is the desired spinning reserve of a generator or generators. The reserve power is usually estimated as the largest load swing that a power plant may encounter during the time it takes to bring an additional generator online. The available generator power is calculated by multiplying the number of generators with closed GCBs by the generator real power rating of a generator. The reserve generator power is calculated by subtracting the power currently being produced by all generators with closed GCBs from the total available generator power. If the actual reserve power of the generators is less than the value configured in this parameter, the next generator will be started.

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

Parameter 101

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

only configurable via LeoPC1

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

Load swings may exceed the "Reserve power isol. op." (Parameter 94) set point momentarily. In order to prevent the engine from starting due to short-term load swings, a delay time may be configured. The load must remain above the reserve power set point without interruption for the delay time, configured in seconds, prior to a start command being issued. If the load falls below the reserve power set point before the delay time expires, the delay time is reset and a start command is not issued.

Parameter 102

```
Shed-off delay
isol.op.    000s
```

only configurable via LeoPC1

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

Load swings may fall below the "Hysteresis add on/off op." (Parameter 97) set point momentarily. In order to prevent the engine from stopping due to short-term load swings, a delay time may be configured. The load must remain below the hysteresis set point without interruption for the delay time, configured in seconds, prior to a stop command being issued. If the load exceeds the hysteresis set point before the delay time expires, the delay time is reset and a stop command is not issued.

 © Woodward

General

Formula G: Start of the engine

[(generator rated power)(number of closed GCBs) – isolated reserve power] / number of closed GCBs = generator power level that a generator is started

Formula H: Stop of the engine

(number of generators needed for load – 1 generator)(generator rating) – isolated reserve power – generator hysteresis = generator power level that a generator is stopped

Example

Two generators are in an isolated parallel operation application. One generator will always be in operation. The second generator is used to share large loads.
Generator rating = the power rating for an individual generator (all generators used in this application must be of the same power rating). "Rated power generator" (Parameter 16) should be configured as "200 kW".
Generator rating = 200 kW
Number of closed GCBs = all generator that are used to calculate available generation power must have their circuit breaker closed.
Number of closed GCBs = varies
Isolated reserve power = the real load that a generator or generators are able to absorb while the next generator is started. The reserve power is usually configured as the largest load swing that a power plant may encounter during the time it takes to bring an additional generator online. "Reserve power isol.op." (Parameter 100) should be configured as "60 kW".
Isolated reserve power = 60 kW
Generator hysteresis = the power level that a stop command will be issued
This value is calculated by subtracting the minimum generator load for a shut down command to be issued from the minimum load that a start command is issued. In this example the calculation would be [60 kW – 30 kW = 30 kW]. "Hysteresis add on / off op." (Parameter 97) should be configured as "30 kW".
Generator hysteresis = 30 kW

Case 11:
An engine start command is issued to the second generator when the monitored system power reaches a specified level. Formula G is used as follows:
[(generator rating)(number of closed GCBs) – isolated reserve power] / number of closed GCBs = generator power level that a generator is started
(200 kW)(1) - 60 kW/1 = 140 kW
The generator that is providing power has a total load rating of 20 0kW (20 0kW x 1). The online generator has an available load of 140 kW (200 kW – 60 kW). When the online generator load exceeds 140 kW, the second generator will be started and brought online to share the load.

Case 12:
An engine stop command is issued to a generator when the monitored system power falls to a specified level. Formula H is used as follows:
(Number of generators needed for load – 1 generator)(generator rating) – isolated reserve power – generator hysteresis = system power level next generator stopped 400 kW - 60 kW - 200 kW - 30 kW = 110 kW
system power level / number of closed GCBs = individual generator load level
110 kW / 2 = 55 kW
The two generators providing power have a total load rating of 400 kW (200 kW x 2). Before a generator can be shut down as the load decreases, the generator that will remain online must be able to sustain the remaining load. This requires that the above formula be used to determine the load level that a shutdown command is issued. According to the calculations above that level is 110 kW. This load is shared equally among the online generators. To determine the individual generator load levels the shut down power level must be divided by the number of generators online (110 / 2 = 55 kW). When the individual loads for the generators drop below 55 kW, a stop command will be issued and a generator will shed its load to the remaining generator, open its GCB, and shut down.

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 103

```
Control via
COM X1X5      ON
```

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

ON .....The remote control interface via the CAN bus (X1X5 terminals) is enabled. This parameter requires that "Direct configuration" (Parameter 3) be configured "OFF", the AUTOMATIC operation mode must be enabled, and the discrete input "Automatic 2" (terminal 5) has been energized.
When remote control of a unit has been enabled, it is possible to start and stop the engine, acknowledge alarms, and change the real power and power factor set points via CAN bus communication. The measured values and states of the controller may be monitored as well.

OFF .....The remote control interface via the CAN bus (X1X5 terminals) is disabled. The generator real power is controlled in the accordance with how "Automatic 2" (Parameter 31) and the "Power factor control set point" (Parameter 65) are configured when the "Automatic 2" discrete input is energized.

Parameter 104

```
Supervision
COMX1X5       ON
```

if COMX1X5 = ON only

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

ON .....Monitoring of the remote control interface is enabled. The controller monitors to ensure the control signal (CAN ID 503) is received every 90 seconds. If the control signal is not received every 90 seconds, a class 1 (warning) alarm is issued.

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

Parameter 105

```
Ackn. F2,F3 via
COM interf    ON
```

if COMX1X5 = ON only

Remote acknowledgment of F2/F3 alarms via the interface **ON/OFF**

ON .....Acknowledgement of class F2/F3 alarms via the remote control interface is enabled.

OFF .....Acknowledgement of class F2/F3 alarms via the remote control interface is disabled. Acknowledgment of alarms is performed by energizing the "Acknowledgment" discrete input (terminal 6) or by pressing the "RESET" push button.

NOTE

For the description of the second interface (Option SC09) refer to the Option SC09 Parameters section on page 138 or to manual 37382.

Parameter 106

```
Power On Mode:
          STOP
```

only configurable via LeoPC1

Start in mode: **STOP, MANUAL, AUTOMATIC, as before**

STOP.....The unit is in STOP operating mode after applying battery voltage.

MANUAL ....The unit is in MANUAL operating mode after applying battery voltage.

AUTOMATIC The unit is in AUTOMATIC operating mode after applying battery voltage.

as before.....The unit is in the same operating mode after applying battery voltage as it was before disconnecting the battery voltage.

Note: The operating mode may be changed with the terminals 127, and 128.

© Woodward

Parameter 107

```
Interchange Mode
in Manual     ON
```

only configurable via LeoPC1

Interchange mode in manual **ON/OFF**

OFF..... Interchange mode (enabled by the DI at terminal 126) may also be performed in AUTOMATIC operating mode.
ON..... Interchange mode (enabled by the DI at terminal 126) may **only** be performed in AUTOMATIC operating mode.

Breaker

NOTE

The parameters for this control are grouped together in blocks to permit navigation through the large number of configuration screens more rapidly. Selecting "YES" or "NO" has no effect whether or not control or monitoring is carried out for the parameters located in that block. Selecting "YES" or "NO" only determines if the individual parameters may be accessed and changed or are bypassed.

Parameter 108

```
Configure
breaker       YES
```

Configuration of the breakers **YES/NO**

The breaker control functions are configured in this block of parameters. This parameter has the following effects:
YES..... The parameters in this block are displayed and can either be viewed ("Select" button), or modifications can be made to the parameters ("Cursor→", "Digit↑" or "Select" buttons).
NO..... The parameters in this block are not displayed, cannot be modified, and are skipped.

Functional Description

Permissible Limits

If the generator or mains monitoring for over-/undervoltage (Parameter 170) or over-/underfrequency (Parameter 164) is disabled, the CB logic (Parameter 109), the control uses internally defined default limits for generator and mains monitoring.

The internally defined default limits always are used to monitor the busbar.

	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 % $V_{RatedSystem}$	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, such as system rated voltage (Parameter 8 or Parameter 10) and the system rated frequency (Parameter 12).

Synchronization

Synchronization of the GCB

GCB synchronization will be performed with frequency and voltage correction when the following conditions have been met:

NOTE

The GCP-30series controller does not have maximum phase angle limit for synchronization. The GCP-30 uses the parameters "Closing time GCB" (Parameter 118) and/or "Closing time MCB" (Parameter 119) to calculates the optimum time for a breaker closure signal to be issued with the measured frequency differential. The typical maximum tolerances are 1.5° to 3.5° with a frequency differential ranging of 0.2 Hertz to 0.49 hertz. If the parameters "Closing time GCB" and/or "Closing time MCB" are not configured accurately, these tolerances will increase due to inaccurate information being provided for the close command calculation resulting in a larger phase angle at closing.

Automatic mode

- The control has been placed in the AUTOMATIC operation mode
- The circuit breaker logic (Parameter 109) is configured as "PARALLEL" (mains parallel operation), "INTERCHANGE" (mains interchange (import/export) real power control), or "CLOSED TRANSIT." (make-before-break/overlap synchronization)
- An F2 or F3 class alarm has not been detected
- The "Automatic 1" (terminal 3) or "Automatic 2" (terminal 5) discrete input has been energized, a remote starting signal has be activated via the interface, or an emergency power operation has been initiated resulting in additional engines being started
- The busbar is energized (the control measures voltage on the bus)
- The engine is running and the generator voltage and frequency are within the permissible limits
- The delayed engine monitoring (Parameter 271) 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 control has been placed in the MANUAL operation mode
- The circuit breaker logic (Parameter 109) is configured as "PARALLEL" (mains parallel operation), "INTERCHANGE" (mains interchange (import/export) real power control), or "CLOSED TRANSIT." (make-before-break/overlap synchronization)
- An F2 or F3 class alarm has not been detected
- The busbar is energized (the control measures voltage on the bus)
- The engine is running and the generator voltage and frequency are within the permissible limits
- The "GCB ON" push-button has been pressed
- The rotating field of the generator and the mains voltages are identical and no alarms are displayed

Load test mode

- The control has been placed in the MANUAL operation mode
- The circuit breaker logic (Parameter 109) is configured as "PARALLEL" (mains parallel operation), "INTERCHANGE" (mains interchange (import/export) real power control), or "CLOSED TRANSIT." (make-before-break/overlap synchronization)
- An F2 or F3 class alarm has not been detected
- The busbar is energized (the control measures voltage on the bus)
- The engine is running and the generator voltage and frequency are within the permissible limits
- The "GCB ON" push-button has been pressed
- The rotating field of the generator and the mains voltages are identical and no alarms are displayed

 © Woodward

Synchronization of the MCB

MCB synchronization will be performed with frequency and voltage correction when the following conditions have been met:

Automatic mode
- The control has been placed in the AUTOMATIC operation mode
- The circuit breaker logic (Parameter 109) is configured as "PARALLEL" (mains parallel operation), "INTERCHANGE" (mains interchange (import/export) real power control), or "CLOSED TRANSIT." (make-before-break/overlap synchronization)
- An F2 or F3 class alarm has not been detected
- The busbar is energized (the control measures voltage on the bus)
- 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" is not energized (the GCB is closed)
- The discrete input "Enable MCB" is energized
- The rotating field of the generator and the mains voltages are identical and no alarms are displayed

Dead Bus Start

Dead bus start of the GCB

The GCB will close without synchronization when the following conditions have been met:

Automatic mode
- The control has been placed in the AUTOMATIC operation mode
- An F2 or F3 class alarm has not been detected
- "GCB dead bus start" (Parameter 127) has been configured as "ON"
- The busbar is de-energized (the control does not measure voltage on the bus)
- The engine is running and the generator voltage and frequency are within the permissible limits
- The discrete input "Reply: MCB is open" is energized (the MCB is open)
- If load sharing is performed via the CAN bus
  - All GCBs must be open if the system has multiple generators in an isolated parallel application
  - The generator with the lowest CAN bus address/generator number (Parameter 4) will be the first to close its GCB

Manual mode
- The control has been placed in the MANUAL operation mode
- An F2 or F3 class alarm has not been detected
- The busbar is de-energized (the control does not measure voltage on the bus)
- The engine is running and the generator voltage and frequency are within the permissible limits
- The discrete input "Reply: MCB is open" is energized (the MCB is open)
- If load sharing is performed via the CAN bus
  - All GCBs must be open if the system has multiple generators in an isolated parallel application
  - The generator with the lowest CAN bus address/generator number (Parameter 4) will be the first to close its GCB
- The "GCB ON" push-button has been pressed

Disabled generator monitoring:
If the generator monitoring for over-/undervoltage (Parameter 170) or over-/underfrequency (Parameter 164) is disabled, the control uses internally defined default limits for generator monitoring.

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, such as system rated voltage (Parameter 8 or Parameter 10) and the system rated frequency (Parameter 12).

Dead bus start of the MCB

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

Automatic mode
- The control has been placed in the AUTOMATIC operation mode
- "MCB dead bus start" (Parameter 131) has been configured as "ON"
- The busbar is de-energized (the control does not measure voltage on the bus)
- The mains voltage is present and within the permissible limits
- The discrete input "Reply: GCB is open" is energized (the GCB is open)
- The discrete input "Enable MCB" is energized

Disabled mains monitoring:
If the mains monitoring for over-/undervoltage (Parameter 180) or over-/underfrequency (Parameter 175) is disabled the control uses internally defined default limits for generator monitoring.

Mains monitors	Voltage	Frequency
ON	Monitor values	Monitor values
OFF	$V_{Mains} > 85\ \%\ V_{RatedSystem}$ $V_{Mains} < 112.5\ \%\ V_{RatedSystem}$	$f_{Mains} > 90\ \%\ f_{RatedSystem}$ $f_{Mains} < 110\ \%\ f_{RatedSystem}$

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

The permissible limits refer to the respective rated values in the system, such as system rated voltage (Parameter 8 or Parameter 10) and the system rated frequency (Parameter 12).

© Woodward

Open Breaker

Open GCB

The GCB will be opened though one of two methods that is dependent upon how the breaker closure signal is configured. If the breaker closure signal is configured as a "continuous pulse" (Parameter 113), the "Command: GCB close" relay output will be de-energized. If the breaker closure signal is configured as a "momentary pulse" (Parameter 113), the GCB will open when the "Command: GCB open" relay is energized. The GCB will be opened under the following circumstances:

- If a mains failure is detected and the mains decoupling is configured to occur at the GCB (Parameter 134)
- In the STOP operation mode
- If a F2 or F3 class alarm is detected
- Upon pressing the "GCB OFF" push-button in the MANUAL operation mode
- Upon pressing the "STOP" push-button in the MANUAL operation mode
- Upon pressing the "GCB OFF" push-button in the LOAD TEST operation mode
- In the event of an automatic shutdown in the AUTOMATIC operation mode
- After the MCB has closed when the breaker logic is configured as "CLOSED TRANSIT." (make-before-break/overlap synchronization)
- Prior to closing the MCB to the dead busbar when the breaker logic is configured as "OPEN TRANSIT." (break-before-make/changeover)
- In a critical mode/sprinkler operation, provided that an emergency power operation is not enabled
- Following the load transfer from the generator(s) to the mains so that a zero power transfer occurs at the GCB when the breaker logic is configured for "INTERCHANGE" (mains interchange (import/export) real power control)

Open MCB

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

- If a mains fault is detected and the mains decoupling is configured to EXT (Parameter 134)
- If emergency power (AMF) is enabled (mains failure)
- After the GCB has closed when the breaker logic is configured as "CLOSED TRANSIT." (make-before-break/overlap synchronization)
- Before the GCB is closed to the dead busbar when the breaker logic is configured as "OPEN TRANSIT." (break-before-make/changeover)
- Upon pressing the "GCB ON" push-button in the MANUAL operation mode
- Upon pressing the "GCB ON" push-button in the LOAD TEST operation mode
- Following the load transfer from the mains to the generator(s) so that a zero power transfer occurs at the MCB when the breaker logic is configured for "INTERCHANGE" (mains interchange (import/export) real power control)

Breaker Logic

NOTE

Using the discrete input "Change breaker logic via terminal 64" (Parameter 203), the breaker logic may be switched between two different breaker logics (description on page 108). The primary breaker logic is configured in Parameter 109. If Parameter 202 is configured as "ON", the discrete input terminal 64 is used as a control input. When terminal 64 is energized, the secondary breaker logic configured in Parameter 203 is enabled. When terminal 64 is de-energized, the primary breaker logic configured in Parameter 109 is enabled. Therefore it is possible during operation to change between the breaker logic "PARALLEL" (automatic synchronizing) and "EXTERNAL" (manual synchronizing) with the flip of a switch.

Parameter 109

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

only accessible via LeoPC1

Breaker logic **see below**

The GCP may be configured to utilized two different breaker logics. The available breaker logic modes are:

EXTERNAL
PARALLEL
OPEN TRANSIT.
CLOSED TRANSIT.
INTERCHANGE

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

 © Woodward

"PARALLEL" Breaker Logic

Configuring Parameter 109 to "PARALLEL" enables parallel operation.

NOTE

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

- **Isolated operation**
- **Isolated operation with multiple generators in parallel**
- **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 and/or reactive power is controlled

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

The MCB is synchronized with the energized common bus and closed if:
- Terminal 53 "Enable MCB" is energized
- The GCB is closed

The MCB is closed onto the de energized common bus and closed if:
- The GCB is open
- The MCB is open
- The busbar is dead (de-energized)
- Terminal 53 "Enable MCB" is energized

NOTE

Soft unloading (power reduction) is carried out prior to opening the GCB when a stop command is issued to the engine unless an F3 class alarm has been detected.

"INTERCHANGE" Breaker Logic

Configuring Parameter 109 to "INTERCHANGE" enables real power control (import/export) through a mains interchange operation.

NOTE

For this breaker logic to function correctly, the mains power measurement must be connected properly. The power controller 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 an add-off request has been issued, the load is transferred from the generator to the mains supply. The following occurs:
- The MCB is synchronized and closed
- The generator sheds load until a "zero" power transfer is measured across the GCB
- The GCB is opened

"CLOSED TRANSIT." Breaker Logic

Configuring Parameter 109 to "CLOSED TRANSIT." enables the MCB and GCB to perform a closed transition (make-before-break/overlap synchronization) when transferring from the mains to the generator and back.

NOTE

The GCP does not perform a "zero" power transfer when opening or closing the MCB or GCB. The circuit breakers will be opened regardless of the monitored power.

In the event of an add-on request, the load is transferred from mains to the generator. 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, the load is transferred from the generator to mains. The following occurs:
- The MCB is synchronized and closed
- The GCB is opened and the mains assume all load

NOTE

When the GCP is configured for a closed transition, the maximum time of the transition between the MCB and the GCB is 500ms. This time is measured from the moment that the breaker closure reply is received until the moment that the CB open command is issued.

 © Woodward

"OPEN TRANSIT." Breaker Logic

Configuring Parameter 109 to " OPEN TRANSIT." enables the MCB and GCB to perform an open transition (break-before-make/change over logic) when transferring from the mains to the generator and back.

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

After the add-off request has been issued, the load is transferred from generator to mains supply. The following occurs:
- The GCB is opened
- The MCB is closed

"EXTERNAL" Breaker Logic

Configuring Parameter 109 to "EXTERNAL" enables the MCB and GCB breaker logic to be controlled from an external source.

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

STOP	TEST	MANUAL	AUTOMATIC
Breaker logic: **EXTERNAL** (External breaker control) The MCB and the GCB are primarily operated by an external control such as a PLC. The breakers may be operated through the GCP only if the MANUAL operation mode has been enabled when this breaker logic is used. In a mains parallel operation, decoupling from the mains is carried out via the MCB or the GCB in the event of a mains failure. The GCP will not automatically close the breakers in an emergency power operation. Emergency power operations are not possible when this circuit breaker logic is utilized in accordance with European Community Specification DIN VDE 0108.			
The GCB is opened.	The GCB and the MCB are not operated. Exception: The breakers are opened to decouple from the mains.	The GCB may be manually opened and closed without synchronization. The circuit breakers are opened to decouple 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 unless given a close command from an external controller. The MCB is opened only if decoupling from the mains and is never closed unless given a close command from an external controller.
Breaker logic: **PARALLEL**: (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: Pressing the "GCB ON" push-button enables load tests. Pressing the "GCB OFF" push-button terminates the load test. Emergency power: If a mains failure occurs while in the TEST mode, the control initiates an emergency power operation. The respective breaker enable discrete inputs must be energized.	Synchronization of either the generator or the mains can be initiated by pressing the "GCB ON" push-button.	The GCB is synchronized via an add-on request and a mains parallel operation is performed. When an add-off request is issued, the generator sheds load and opens the GCB and the engine is shut down following completion of the configured cool down period. Emergency power: The emergency power operation is terminated after mains voltage is detected without interruption for the entire mains settling time. The MCB is synchronized and closed, returning the system to a mains parallel operation.
Breaker logic: **OPEN TRANSIT.:** (Open transition / 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: Pressing the "GCB ON" push-button enables load tests. Pressing the "GCB OFF" push-button terminates the load test. Emergency power: If a mains failure occurs while in the TEST mode, the control initiates an emergency power operation. The respective breaker enable discrete inputs must be energized.	Pressing the "GCB ON" push-button will open the MCB and close the GCB. Pressing the "STOP" push-button will open the GCB and shut the engine down.	A generator is started and brought online through an add-on command. When an add-off command is initiated, the load is returned to the mains. If the bust bar is de-energized and an add-on command has not been issued, the MCB will be closed. Emergency power: The emergency power operation is terminated after mains voltage is detected without interruption for the entire mains settling time. The GCB is opened and the MCB closed, returning the load back to then mains.

STOP	TEST	MANUAL	AUTOMATIC
Breaker logic: **CLOSED TRANSIT.:** (Closed transition / make-before-brake / overlap synchronization) The MCB and the GCB are synchronized; preventing the busbar from being de-energized while the load is transferred. 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: Pressing the "GCB ON" push-button enables load tests. Pressing the "GCB OFF" push-button terminates the load test. Emergency power: If a mains failure occurs while in the TEST mode, the control initiates an emergency power operation. The respective breaker enable discrete inputs must be energized.	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, transferring the load to the generator. Following the add-off request being issued, the MCB is synchronized and closed. The GCB is opened immediately after the MCB closure, returning the load to the mains. Emergency power: The emergency power operation is terminated after mains voltage is detected without interruption for the entire mains settling time. The MCB is synchronized to the generator and the MCB is closed. The GCB is opened immediately after the MCB closure, returning the load to the mains.
Breaker logic: **INTERCHANGE:** (Soft loading / interchange synchronization) The MCB and the GCB are synchronized; preventing the busbar from being de-energized while the load is transferred. The operation of a breaker under load is avoided by utilizing the ability to softly transfer the load from one source to the other. Continuous mains parallel operation is not possible with this breaker logic. Following the add-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: Pressing the "GCB ON" push-button enables load tests. Pressing the "GCB OFF" push-button terminates the load test. Emergency power: If a mains failure occurs while in the TEST mode, the control initiates an emergency power operation. The respective breaker enable discrete inputs must be energized.	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. The MCB is opened after the load has been softly transferred from the mains to the generator and a "zero" power condition has been achieved at the MCB. Following the add-off request being issued, the MCB is synchronized to the generator and the MCB is closed. The GCB is opened after the load has been softly transferred to the mains and a "zero" power condition has been achieved at the GCB. Emergency power: The emergency power operation is terminated after mains voltage is detected without interruption for the entire mains settling time. The MCB is synchronized to the generator and the MCB is closed. The GCB is opened after the load has been softly transferred to the mains and a "zero" power condition has been achieved at the GCB.

Start/Stop Ramp, Open GCB With F2 Alarm

Parameter 110

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

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

The add-on/add-off timer can be used to influence two functions:

Stopping: The maximum amount of time generator should take to shed all load is configured here. If the generator load fails to drop below 3 % of the generator rated power (Parameter 16) within the amount of time configured, the GCB is opened regardless of the load.

Start with soft loading: If the mains interchange (import/export) real power value fails to reach 0 kW while in the "INTERCHANGE" breaker logic within the time configured here, an F1 class alarm and alarm message are issued. Concurrently the relay, which is programmed with relay manager function 78 (Appendix B), is enabled and the MCB is prevented from opening.

Parameter 111

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

Max. permissible time with F2 alarms for starting an additional engine **0 to 999 s**

Prerequisite: Load sharing (Parameter 87) and automatic start/stop (Parameter 92 or Parameter 93) are configured to "ON". The generator is operating in an isolated parallel application and at least one additional generator is connected to a busbar.

If an F2 class alarm occurs, the engine shutdown may be delayed by the time configured here. This delay time should be configured so that an additional engine may be started and brought online to assume the load from the generator with the F2 alarm. After the configured delay time expires the engine with the F2 alarm condition will shutdown regardless if an additional engine was able to start and assume the load.

 © Woodward

GCB/MCB Pulse/Continuous Pulse

The closing and opening processes of the GCB and the MCB are described in Figure 3-5 and Figure 3-7. Changing of the generator breaker control logic to either a momentary pulse or a continuous signal is configured using Parameter 112 (the MCB can only be configured for a momentary pulse). Energizing the discrete input "Enable MCB" (terminal 54) enables/disables closing the MCB. De-energizing terminal 54 will not result in a closed MCB being opened.

• **Breaker logic: 'Impulse' for MCB**

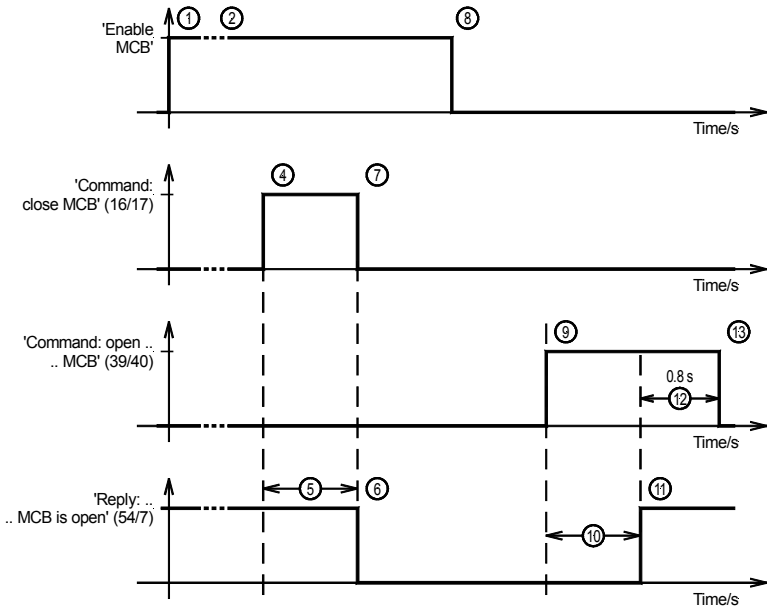


Figure 3-5: Breaker control logic 'Impulse' for MCB

'Impulse' logic (MCB):

- Enable MCB: ***1*** Terminal 53 (Enable MCB) energized; ***2*** Systems synchronizing; ***8*** Terminal 53 (Enable MCB) de-energized
- Close MCB: ***4*** Closing pulse for MCB issued; ***5*** Inherent breaker closure delay; ***6*** Reply MCB closed received; ***7*** Closing pulse terminated
- Open MCB: ***9*** Opening pulse MCB issued; ***10*** Inherent breaker opening delay; ***11*** Reply MCB open received; ***12*** Time delay (MCB: 0.8 s); ***13*** Opening pulse terminated

• **Breaker logic: 'Impulse' for GCB**

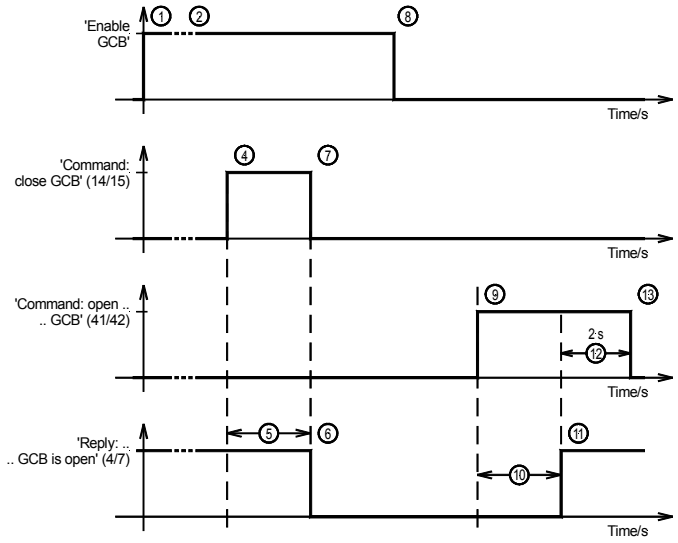


Figure 3-6: Breaker control logic 'Impulse' for GCB

'Impulse' logic (GCB):

- Enable GCB: ***1*** GCB enabled internally; ***2*** Systems synchronizing
- Close GCB: ***4*** Closing pulse for GCB issued; ***5*** Inherent breaker closure delay; ***6*** Reply GCB closed received; ***7*** Closing pulse terminated
- Open GCB: ***9*** Opening pulse GCB issued; ***10*** Inherent breaker opening delay; ***11*** Reply GCB open received; ***12*** Time delay (GCB: 2 s); ***13*** Opening pulse terminated

• **Beaker logic: 'Continuous'**

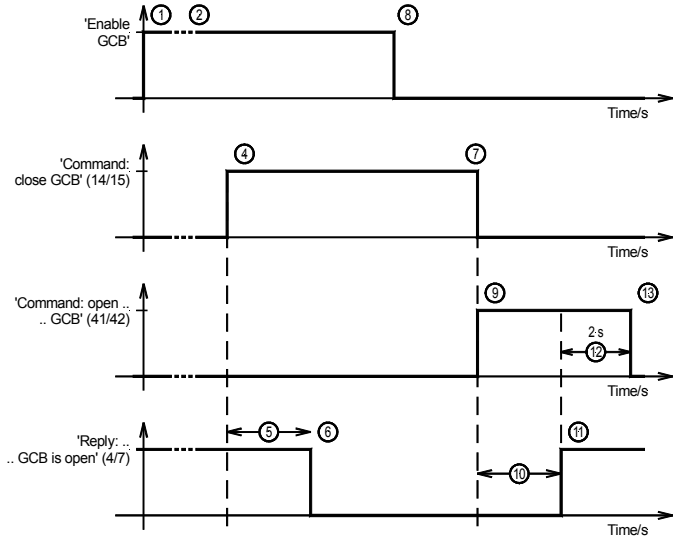


Figure 3-7: Breaker control logic 'Continuous'

'Continuous' logic (GCB only):

- GCB enabled: ***1*** GCB enabled internally; ***2*** Systems synchronizing
- Close GCB: ***4*** Continuous GCB close pulse issued; ***5*** Inherent breaker closure delay; ***6*** Reply GCB closed received; ***7*** Closing pulse terminated
- Open GCB: ***9*** Continuous GCB pulse disabled and GCB open pulse issued; ***10*** Inherent breaker opening delay; ***11*** Reply GCB open received; ***12*** Time delay (GCB: 2 s); ***13*** Opening pulse terminated

 © Woodward

Parameter 112

```
GCB close.relay
---------------
```

only configurable via LeoPC1

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

Constant..... The "Command: close GCB" relay can be utilized as part of the holding circuit of the breaker. The "Command: close GCB" relay remains energized after the connect impulse has been issued and the circuit breaker closed reply has been received provided the following conditions are met:

- The "Reply: GCB is open" discrete input (terminal 4) is de-energized when the GCB is closed
- The phase angle between generator voltage and busbar voltage does not exceed +/-14°.
- The "Command: close GCB" relay de-energizes if the GCB must be opened

Impulse..... The "Command: close GCB" relay issues a momentary pulse. An external holding circuit keeps the GCB closed. The "Reply: GCB is open" discrete input (terminal 4) is de-energized when the GCB is closed to signal that the GCB is closed.

The "Command: open GCB" relay (terminals 41/42) is energized to open the GCB regardless of how the breaker closing logic is configured.

Open/Close GCB

Parameter 113

```
GCB open relay
---------------
```

only configurable via LeoPC1

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

NC-contact.. The "Command: open GCB" relay (terminals 41/42) energizes when the GCB is to be opened. Following the "Reply: GCB is open" the relay de-energizes.

NO-contact . The "Command: open GCB" relay (terminals 41/42) de-energizes when the GCB is to be opened. Following the "Reply: GCB is open" the relay energizes again.

Synchronization

Parameter 114

```
Synchronize
df max    0.00Hz
```

Max. permissible synchronization frequency differential (positive slip) 0.02 to 0.49 Hz

The prerequisite for a breaker closure command being issued is that the monitored frequency differential of the two systems being synchronized is less than the configured frequency differential. The value configured in this parameter specifies the upper limit of the frequency differential.
A positive value corresponds to positive slip → the generator frequency is greater 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 115

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

Max. permissible synchronization frequency differential (negative slip) 0.00 to -0.49 Hz

The prerequisite for a breaker closure command being issued is that the monitored frequency differential of the two systems being synchronized is greater than the configured frequency differential. The value configured in this parameter specifies the lower limit of the frequency differential.
A negative value corresponds to negative slip → the generator frequency is less than the busbar frequency in the case of GCB synchronization; busbar frequency is less than the mains frequency for MCB synchronization.

Parameter 116

```
Synchronize
dV max     00.0%
```

Max. permissible synchronization voltage differential 01.0 to 20.0 %

ⓘ This value refers to the parameter "Rated voltage system" (Parameter 12).

A breaker closure command will only be issued when the measured voltage differential of the systems being synchronized falls below the configured voltage differential.

Parameter 117

```
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 118

```
Closing time
GCB        000ms
```

Inherent closing 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 being issued. The GCP uses the frequency differential to calculate when the breaker closure command should be issued. The value configured in this parameter dictates how many milliseconds at the measure frequency differential that the breaker closure command is issued prior to the two systems reaching the synchronous point.

Parameter 119

```
Closing time
MCB        000ms
```

Inherent closing 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 being issued. The GCP uses the frequency differential to calculate when the breaker closure command should be issued. The value configured in this parameter dictates how many milliseconds at the measure frequency differential that the breaker closure command is issued prior to the two systems reaching the synchronous point.

© Woodward

Phase Matching

Parameter 120

```
Phase matching
            ON
```

Phase matching **ON/OFF**

ON..... Synchronization will be performed with phase matching.
OFF..... Synchronization will be performed with slightly positive slip.

Parameter 121

```
Phase matching
gain         00
```

Phase matching gain **1 to 36**

The phase matching effect on the frequency control may be affected with this gain factor.

Parameter 122

```
Phase matching
df start  00.0Hz
```

Phase matching df start **0.02 to 0.25 Hz**

Phase matching will only be enabled if the frequency difference of the voltages to be synchronized is below the value configured here.

Parameter 123

```
Detection Mains
connected <  00°
```

Mains connection detection (angle) **1 to 15°**

If the phase angle between busbar and mains is below the angle configured here for at least the time configured in the next parameter (Parameter 124), the unit detects the connection between busbar and mains and indicates this with the message "Mains connected".

Parameter 124

```
Detection Mains
conn. after 000s
```

Mains connection detection (time) **0 to 999 s**

If the phase angle between busbar and mains is below the angle configured above (Parameter 123) for at least the time configured here, the unit detects the connection between busbar and mains and indicates this with the message "Mains connected".

Synchronization Time Monitoring

If parameter Parameter 125 is configured to "ON", synchronization time monitoring is enabled: The synchronization time monitoring will be activated after the delayed engine monitoring has terminated. The synchronization time monitoring will start when synchronization of the GCB or MCB is initiated. If the time configured for the synchronization time monitoring expires prior to the breaker closing, an F1 alarm is issued.

NOTE

If "MCB monitoring" (Parameter 133) is enabled and an alarm is detected while closing the MCB, an emergency power operation will be performed if "Emergency power" (Parameter 137) has been configured as ON.

Parameter 125

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

Monitoring of synchronization time **ON/OFF**

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

OFF .....Synchronization time monitoring is disabled. Synchronization will be attempted until the breaker closes. The subsequent screens of this function are not displayed.

Parameter 126

```
Sync.time contr.
delay       000s
```

Maximum synchronization time **10 to 999 s**

When synchronization of the GCB or MCB is initiated, the synchronization timer is started following the termination of the delayed engine monitoring. If the breaker cannot be closed prior to the expiration of this time, 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 F1 class alarm

© Woodward

Dead Bus Start

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 energized.

Parameter 127

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

only configurable via LeoPC1

GCB dead bus start **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 will not be performed. The subsequent screens of this function are not displayed.

Parameter 128

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

Maximum frequency differential for GCB dead bus start **0.05 to 5.00 Hz**

Prior to issuing a breaker close command, the frequency differential between the monitored generator frequency and the rated generator frequency must be less than the value configured here. The higher the frequency differential is configured, the more rapidly a generator may be permitted to close to a dead bus.

Parameter 129

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

Maximum voltage differential for GCB dead bus start **01.0 to 15.0 %**

ⓘ This value refers to the parameter "Rated voltage system" (Parameter 12).

Prior to issuing a breaker close command, the voltage differential between the monitored generator voltage and the rated generator voltage must be less than the value configured here. The higher the voltage differential is configured, the more rapidly a generator may be permitted to close to a dead bus.

Parameter 130

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

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

This timer is initiated at the start of the breaker closing sequence when the GCB is to be closed to a dead busbar. If the breaker fails to close prior to the configured time expiring, an F1 class alarm is issued.

Issuing of F1 class alarm

Parameter 131

```
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 will not be performed. The subsequent screens of this function are not displayed.

Breaker Monitoring

Upon CLOSING - The GCP monitors the GCB and/or the MCB to ensure that the respective breaker has closed if "GCB monitoring" (Parameter 132) and/or "MCB monitoring" (Parameter 133) have been configured "ON" unless the breaker logic is configured "EXTERNAL" (Parameter 109). If the breaker has not 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. A breaker is considered as closed, if the reply is present for 5s. This resets the internal counter.

Upon OPENING - The GCP-30 monitors the GCB and/or the MCB to ensure that the respective breaker has opened if "GCB monitoring" (Parameter 132) and/or "MCB monitoring" (Parameter 133) have been configured "ON". If the GCP-30 does not receive a reply that the respective breaker has opened within 2 seconds of the open command being issued, an F1 class alarm is issued. If a relay has been assigned relay manager functions 76 or 77, it will be energized.

Parameter 132

```
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 and the relay assigned relay manager function 75 is energized. The GCP will continue to attempt to close the GCB after the alarm has been issued unless load sharing (Parameter 87) has been enabled. If load sharing has been enabled (Parameter 87) and several GCPs are connected to the CAN bus, the breaker close command is cancelled upon issuing of the alarm so that another GCP may start up and 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 and the relay assigned relay manager function 77 is energized.

Issuing of F1 class alarm

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

Parameter 133

```
Supervision MCB
            ON
```

[GCP-32]

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 and the relay assigned relay manager function 74 is energized. The GCP will continue to attempt to close the MCB after the alarm has been issued unless load sharing (Parameter 87) has been enabled. If load sharing has been enabled (Parameter 87) and several GCPs are connected to the CAN bus, the closing command to the breaker is cancelled if an alarm is issued so that another GCP 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 and the relay assigned relay manager function 76 is energized.

Issuing of F1 class alarm

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

© Woodward

Mains Decoupling

NOTE

If the mains monitoring (frequency and voltage) is disabled, decoupling from the mains is not performed.

Parameter 134

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

Decoupling from the mains via ... **GCB; GCB→MCB; MCB; MCB→GCB**

GCB..... If a mains failure (Parameter 175 through Parameter 189) occurs the GCB will be opened. A mains failure is detected by means of the mains voltage (terminals 50/51/52).

GCB→MCB If a mains failure (Parameter 175 through Parameter 189) occurs the "Command: Open GCB " relay (terminals 41/42) will be energized. A mains failure is detected by means of the mains voltage (terminals 50/51/52). If the GCP does not receive the reply that the GCB has opened (terminal 4 energizes) prior to the time configured in Parameter 135 expiring, an F1 alarm will be issued and the relay assigned relay manager function 76 will be energized. The "Command: Open GCB " relay (terminals 41/42) will de-energize and the "Command: open MCB" relay (terminals 39/40) will energize.

Issuing of F1 class alarm

MCB ..... If a mains failure (Parameter 175 through Parameter 189) occurs the MCB will be opened. A mains failure is detected by means of the mains voltage (terminals 50/51/52).

MCB→GCB If a mains failure (Parameter 175 through Parameter 189) occurs the "Command: Open MCB " relay (terminals 39/40) will be energized. A mains failure is detected by means of the mains voltage (terminals 50/51/52). If the GCP does not receive the reply that the MCB has opened (terminal 54 energizes) prior to the time configured in Parameter 135 expiring, an F1 alarm will be issued and the relay assigned relay manager function 77 will be energized. The "Command: Open MCB " relay (terminals 39/40) will de-energize and the "Command: open GCB" relay (terminals 41/42) will energize.

Issuing of F1 class alarm

Parameter 135

```
Mains decoupling
-> after   0.00s
```

only configurable via LeoPC1

Mains decoupling after **0.10 to 5.00 s**

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

Emergency Power (AMF)

NOTE

The parameters for this control are grouped together in blocks to permit navigation through the large number of configuration screens more rapidly. Selecting "YES" or "NO" has no effect whether or not control or monitoring is carried out for the parameters located in that block. Selecting "YES" or "NO" only determines if the individual parameters may be accessed and changed or are bypassed.

Parameter 136

Configure emergency YES

Configuration of the emergency power (AMF) **YES/NO**

The emergency power control functions are configured in this block of parameters. This parameter has the following effects:

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

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

Prerequisite: The emergency power function (AMF) may only be enabled with synchronous generators by configuring "Emergency power" (Parameter 136) as "ON". Emergency power operations are only performed in the AUTOMATIC or TEST operation modes regardless of the status of the "Automatic 1" and "Automatic 2" discrete inputs..

NOTE

If the "Engine enable" or "Engine block" function is assigned to terminal 6 (Parameter 209), emergency power operations can be prevented or interrupted from an external source through a discrete input. Refer to "Terminal 6" on page 111.

If Parameter 206 is configured ON and discrete input 11 (terminal 68) is energized, emergency power operation will also be prevented or interrupted (refer to Enable 'Emergency OFF' via terminal 68 on page 109).

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 continuously for the duration of the emergency power start delay time (Parameter 138), an emergency power operation is activated. A mains voltage fault is defined as follows: If the mains voltage and frequency monitoring (Parameter 175 and/or Parameter 180) are enabled and the configured limit has been exceeded. If either or both the mains voltage and frequency monitoring are not enabled, the internal default limits will be used for protective limits. The internal protective limits are defined as follows:

Mains watchdogs	Voltage	Frequency
ON	Monitoring values (see Parameter 175)	Monitoring values (see Parameter 180)
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

An emergency power operation (AMF) may also be initiated through the detection of a breaker fault when the MCB is closed. This protection will only occur if "Emergency power" (Parameter 137) and "MCB monitoring" (Parameter 133) are configured as "ON".

© Woodward

The following actions occur in an emergency power operation:

- If emergency power operation is initiated, the engine is started provided the sequence is not interrupted by an alarm or the operation mode is not changed
- If the mains are restored during the start cycle, the MCB remains closed. The engine starts and continues running until the mains settling time (Parameter 190) 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 restoration of the main and the expiration of the mains settling time (Parameter 190) provided 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 are restored while an emergency power operation is being performed and the GCP will wait for the mains settling time (Parameter 190) to expire. After the mains settling time has expired, the MCB will be synchronized and closed.

Emergency power: In the event an emergency power operation is being performed, the message "Emergency power" is displayed on the screen of the GCP.

Emergency Power With Breaker Logic "PARALLEL"

Emergency power: After detecting a mains fault, the GCP-30 will wait until the "emergency power start delay" (Parameter 138) has expired before starting an engine. Once the engine has started and the monitored generator voltage and frequency have exceeded the dead bus start limits (Parameter 128 and Parameter 129), the MCB is opened and the GCB is closed to the dead busbar. The generator is now supplying power to the load.

Return of the mains: Following the termination of the mains fault, the GCP will continue the emergency power operation until the mains settling time has expired (Parameter 190) 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 has terminate, a power reduction (soft unloading) is carried out provided the real power controller (Parameter 71) is configured as "ON".

If the GCP has initiated the start cycle and the mains are restored, the GCP completes the start cycle but the MCB is not opened. The engine remains in idle mode during the mains settling time (Parameter 190). The engine remains running while the mains settling time expires so the GCB can be closed and the MCB opened immediately in the event of another mains failure.

Emergency Power With Breaker Logic "OPEN TRANSIT."

Emergency power: After detecting a mains fault, the GCP will wait until the "emergency power start delay" (Parameter 138) has expired before starting an engine. Once the engine has started and the monitored generator voltage and frequency have exceeded the dead bus start limits (Parameter 128 and Parameter 129), the MCB is opened and the GCB is closed to the dead busbar. The generator is now supplying power to the load.

Return of the mains: Following the termination of the mains fault, the GCP will continue the emergency power operation until the mains settling time has expired (Parameter 190) before the open transition back to main supply is performed. If an engine request is present following the expiration of the mains settling time (Parameter 190), the generator will maintain the isolated operation.

If the GCP has initiated the start cycle and the mains are restored, the GCP completes the start cycle but the MCB is not opened. The engine remains in idle mode during the mains settling time (Parameter 190). The engine remains running while the mains settling time expires so the GCB can be closed and the MCB opened immediately in the event of another mains failure.

Emergency Power With Breaker Logic "CLOSED TRANSIT."

Emergency power: After detecting a mains fault, the GCP will wait until the "emergency power start delay" (Parameter 138) has expired before starting an engine. Once the engine has started and the monitored generator voltage and frequency have exceeded the dead bus start limits (Parameter 128 and Parameter 129), the MCB is opened and the GCB is closed to the dead busbar. The generator is now supplying power to the load.

Return of the mains: Following the termination of the mains fault, the GCP will continue the emergency power operation until the mains settling time has expired (Parameter 190) before synchronization of the MCB is initiated. After closing the MCB, a power reduction (soft unloading) is carried out provided the real power controller (Parameter 71) is configured as "ON", and the GCB is opened. After opening the GCB the engine continues to run for the amount of time configured in "Cool down time" (Parameter 270) and is then shut down. If an engine request is present following the expiration of the mains settling time (Parameter 190), the generator will maintain the isolated operation.

If the GCP has initiated the start cycle and the mains are restored, the GCP completes the start cycle but the MCB is not opened. The engine remains in idle mode during the mains settling time (Parameter 190). The engine remains running while the mains settling time expires so the GCB can be closed and the MCB opened immediately in the event of another mains failure.

Emergency Power With Breaker Logic "INTERCHANGE"

Emergency power: After detecting a mains fault, the GCP will wait until the "emergency power start delay" (Parameter 138) has expired before starting an engine. Once the engine has started and the monitored generator voltage and frequency have exceeded the dead bus start limits (Parameter 128 and Parameter 129), the MCB is opened and the GCB is closed to the dead busbar. The generator is now supplying power to the load.

Return of the mains: Following the termination of the mains fault, the GCP will continue the emergency power operation until the mains settling time has expired (Parameter 190) before synchronization of the MCB is initiated. After closing the MCB, a power reduction (soft unloading) is carried out provided the real power controller (Parameter 71) is configured as "ON", and the GCB is opened. After opening the GCB the engine continues to run for the amount of time configured in "Cool down time" (Parameter 270) and is then shut down. If an engine request is present following the expiration of the mains settling time (Parameter 190), the generator will maintain the isolated operation.

If the GCP has initiated the start cycle and the mains are restored, the GCP completes the start cycle but the MCB is not opened. The engine remains in idle mode during the mains settling time (Parameter 190). The engine remains running while the mains settling time expires so the GCB can be closed and the MCB opened immediately in the event of another mains failure.

Emergency Power With Breaker Logic "EXTERNAL"

ATTENTION

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

Emergency power: After detecting a mains fault, the GCP will wait until the "emergency power start delay" (Parameter 138) has expired before starting an engine. Once the engine has started and the monitored generator voltage and frequency have exceeded the dead bus start limits (Parameter 128 and Parameter 129), the MCB is opened and the GCB is closed to the dead busbar. The generator is now supplying power to the load. Further operations of the GCB and the MCB are not operated performed regardless if the mains are restored.

 © Woodward

Emergency power With MCB Malfunction

MCB malfunction: If the MCB opens without an open command from the GCP while in the AUTOMATIC mode and the control is configured for emergency power standby, the GCP will attempt to reclose the breaker. If the MCB cannot be reclosed due to an MCB failure and "Emergency power" (Parameter 136) and "Supervision MCB" (Parameter 133) are configured "ON", the engine is started and the alarm message "MCB malfunction" is displayed. Once the engine has started and the monitored generator voltage and frequency have exceeded the dead bus start limits (Parameter 128 and Parameter 129), the GCB is closed to the dead busbar. After the condition that caused the MCB fault has been corrected and the "MCB malfunction" alarm has been acknowledged, the emergency power operation is terminated and the load is transferred to the mains in the manner prescribe by the configured circuit breaker logic detailed above.

Emergency Power Operation; Parameters

Parameter 137

```
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 emergency power operation is performed. The subsequent parameters of this function are displayed. Emergency power operations may also be initiated by the detection of a breaker failure when the MCB is to be closed. In order to enable this, the Parameter 133 ("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 138

```
Emergency power
start del. 00.0s
```

Start delay for emergency power **0.5 to 99.9 s**

In order to start the engine and to carry out an emergency power operation, the mains must fail for at least this delay time.

Protection

NOTE

The parameters for this control are grouped together in blocks to permit navigation through the large number of configuration screens more rapidly. Selecting "YES" or "NO" has no effect whether or not control or monitoring is carried out for the parameters located in that block. Selecting "YES" or "NO" only determines if the individual parameters may be accessed and changed or are bypassed.

Parameter 139

```
Configure
monitoring    YES
```

Configuration of the protection **YES/NO**

The generator and system protective functions are configured in this block of parameters. This parameter has the following effects:

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

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

Generator Power Monitoring

It is possible for the GCP to monitor two independently configured generator power limits. If one of these configured limits is surpassed, it is possible to energize a relay output by assigning a relay manager function (relay manager function 56 and 80) to one of the freely configurable relays. This functionality makes it possible to initiate external load shedding.

NOTE

This functionality does not initiate a centralized alarm or issue a message to be displayed. An external device must evaluate the relay output.

WARNING

This function does not provide generator protection.

Parameter 147 and Parameter 152 or an external protection device must be used if generator protection is required.

Parameter 140

```
Gen.power monit.
              ON
```

Generator power monitoring **ON/OFF**

ON .....Generator power monitoring is enabled. Relay manager function 56 must be assigned to one relay and relay manager function 80 must be assigned to a second relay. The subsequent screens of this function are displayed.

OFF .....Generator power monitoring is disabled. The subsequent screens of this function are not displayed.

© Woodward

Parameter 141

```
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 143), the relay assigned relay manager function 56 energizes.

Parameter 142

```
Gen.power monit.
hyst.lv1   000kW
```

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

To prevent the relay assigned relay manager function 56 from energizing and de-energizing continuously due to minor load swings, a hysteresis is configured in this parameter. The value configured here is the amount the monitored power must drop below the configured threshold in Parameter 141 before the corresponding relay output will de-energize.

Parameter 143

```
Gen.power monit.
delay lv1   000s
```

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

For the control unit to recognize that the level 1 power monitoring threshold has been exceed, the threshold value configured in Parameter 141 must be exceeded without interruption for this period of time.

Parameter 144

```
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 146), the relay assigned relay manager function 80 energizes.

Parameter 145

```
Gen.power monit.
hyst.lv2   000kW
```

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

To prevent the relay assigned relay manager function 80 from energizing and de-energizing continuously due to minor load swings, a hysteresis is configured in this parameter. The value configured here is the amount the monitored power must drop below the configured threshold in Parameter 144 before the corresponding relay output will de-energize.

Parameter 146

```
Gen.power monit.
delay lv2   000s
```

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

For the control unit to recognize that the level 2 power monitoring threshold has been exceedn, the threshold value configured in Parameter 144 must be exceeded without interruption for this period of time.

Generator Overload Monitoring

NOTE

All percentage values refer to a percentage of the generator rated power (Parameter 16).

Function: "Positive real power not within the permissible limits" - The single-phase or three-phase measured generator real power is above the configured limit value of the real power.

Parameter 147

```
Overload monit.
            ON
```

Generator overload monitoring **ON/OFF**

ON .....Monitoring of the generator real power is enabled. The subsequent screens of this function are displayed.
OFF .....Monitoring of the generator real power is disabled. The subsequent screens of this function are not displayed.

Parameter 148

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

Generator overload monitoring threshold value MOP **80 to 150 %**

For the control unit to recognize that a generator overload fault while in a mains parallel operation (MOP) has occurred, the monitored generator power must exceed the configured percentage of the rated generator power without interruption for the delay time configured in Parameter 149. An F2 class alarm is issued when the delay time expires.

Issuing of F2 class alarm
without power reduction

Parameter 149

```
Gen.overload MOP
delay       00s
```

Generator overload monitoring delay MOP **0 to 99 s**

For the control unit to recognize that a generator overload fault has occurred while in a mains parallel operation (MOP) has occurred, the threshold value configured in Parameter 148 must be exceeded without interruption for this period of time.

Parameter 150

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

Generator overload monitoring threshold value IOP **80 to 150 %**

For the control unit to recognize that a generator overload fault has occurred while in an isolated parallel operation (IOP), the monitored generator power must exceed the configured percentage of the rated generator power without interruption for the delay time configured in Parameter 151. An F2 class alarm is issued when the delay time expires.

Issuing of F2 class alarm
without power reduction

Parameter 151

```
Gen.overload IOP
delay       00s
```

Generator overload monitoring delay **0 to 99 s**

For the control unit to recognize that a generator overload fault has occurred while in a mains parallel operation, the threshold value configured in Parameter 150 must be exceeded without interruption for this period of time.

© Woodward

Generator Reverse/Reduced Power Monitoring

NOTE

All percentage values refer to a percentage of the generator rated power (Parameter 16).

Function: "Real power not within the permissible limits" - 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 152

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

Reverse/reduced power monitoring **ON/OFF**

ON..... Monitoring of the generator reverse/reduced power is enabled. The subsequent screens of this function are displayed.

OFF..... Monitoring of the generator reverse/reduced power is disabled. The subsequent screens of this function are not displayed.

Parameter 153

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

Reverse/reduced power monitoring threshold value **-99 to 99 %**

Reverse power monitoring: If a negative threshold value is configured and the monitored power falls below the threshold value for at least the delay time (Parameter 154), an F3 class alarm is issued.

Reduced power monitoring: If a positive threshold value is configured and the monitored power falls below the threshold value for at least the delay time (Parameter 154), an F3 class alarm is issued

Issuing of F3 class alarm

Parameter 154

```
Rev./red.power
delay       0.0s
```

Reverse power monitoring delay **0.0 to 9.9 s**

For the control unit to recognize that a reverse or reduced power fault has occurred, the threshold value configured in Parameter 153 must be exceeded without interruption for this period of time.

Unbalanced Load Monitoring

NOTE

All percentage values refer to a percentage of the generator rated current (Parameter 15).

Function: "Generator load imbalance not within the permissible limits" - The percentage threshold value specifies the permissible deviation of any single phase current to the arithmetic mean value of all three phase currents.

Parameter 155

```
Load unbalanced
monitoring   ON
```

Unbalanced load monitoring **ON/OFF**

ON .....Monitoring for unbalanced load of the generator real power is enabled. The subsequent screens of this function are displayed.

OFF .....Monitoring for unbalanced load of the generator real power is disabled. The subsequent screens of this function are not displayed.

Parameter 156

```
Load unbalanced
max.        000%
```

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

For the control unit to recognize that an unbalanced load fault has occurred, the monitored phase load must exceed the configured load differential percentage without interruption for the delay time configured in Parameter 157. An F3 class alarm is issued when the delay time expires.

Issuing of F3 class alarm

Parameter 157

```
Load unbalanced
delay     00.00s
```

Unbalanced load monitoring delay **0.02 to 9.98 s**

For the control unit to recognize that an unbalanced load fault has occurred, the threshold value configured in Parameter 156 must be exceeded without interruption for this period of time.

© Woodward

Independent Time-Overcurrent Monitoring

NOTE

All percentage values refer to a percentage of the generator rated current (Parameter 15).

Function: The GCP utilizes a two tier independent 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 to overcurrent below level 2 but above permissible limits that are present over a longer period of time.

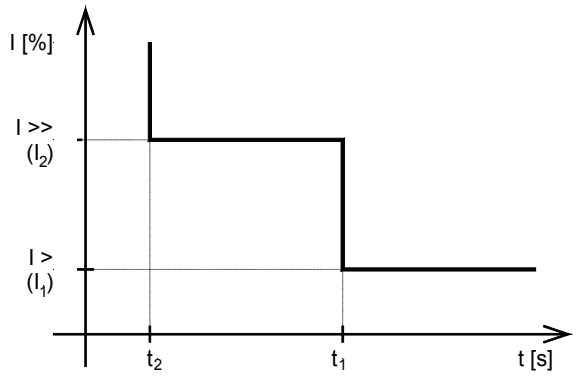


Figure 3-8: Characteristic of the time-overcurrent monitoring

Parameter 158

```
Gen.overcurrent
monitoring   ON
```

Independent time-overcurrent monitoring **ON/OFF**

ON..... Independent time-overcurrent monitoring of the generator is enabled. The subsequent screens of this function are displayed.

OFF..... Independent time-overcurrent monitoring of the generator is disabled. The subsequent screens of this function are not displayed.

Parameter 159

```
Gen.overcurrent
limit 1     000%
```

Threshold value independent time-overcurrent limit 1 **0 to 300 %**

If the monitored generator current exceeds the configured percentage of the rated generator current for at least the delay time configured in Parameter 160, an F3 class alarm is issued.

Issuing of F3 class alarm

Parameter 160

```
Gen.overcurrent
delay 1   00.00s
```

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

For the control unit to recognize that a time-overcurrent fault has occurred, the threshold value configured in Parameter 159 must be exceeded without interruption for this period of time.

Parameter 161

```
Gen.overcurrent
limit 2     000%
```

Independent time-overcurrent, threshold value, limit 2 **0 to 300 %**

If the monitored generator current exceeds the configured percentage of the rated generator current for at least the delay time configured in Parameter 162, an F3 class alarm is issued.

Issuing of F3 class alarm

Parameter 162

```
Gen.overcurrent
delay 2   00.00s
```

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

For the control unit to recognize that a time-overcurrent fault has occurred, the threshold value configured in Parameter 161) must be exceeded without interruption for this period of time.

Parameter 163

```
Gen.overcurrent
Cool down     ON
```

Open GCB with engine cool down 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.

© Woodward

Generator Frequency Monitoring

Function: "Generator frequency not within the permissible limits" - 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 271) in order to enable correct generator start-up.

Parameter 164

```
Gen.frequency-
monitoring   ON
```

Generator frequency monitoring **ON/OFF**

ON..... Monitoring of the generator frequency is enabled. The subsequent screens of this function are displayed.
OFF..... Monitoring of the generator frequency is disabled. The subsequent screens of this function are not displayed.

Parameter 165

```
Gen.overfreq.
f >       000.0%
```

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

ⓘ This value refers to the parameter "Rated Frequency System" (Parameter 8 or Parameter 10).

If the monitored generator frequency exceeds the configured percentage of the rated generator frequency for at least the delay time configured in Parameter 166, an F3 class alarm is issued.

Issuing of F3 class alarm

Parameter 166

```
Gen.overfreq.
delay      0.00s
```

Generator overfrequency delay **0.02 to 9.98 s**

For the control unit to recognize that a generator overfrequency fault has occurred, the threshold value configured in Parameter 165 must be exceeded without interruption for this period of time.

Parameter 167

```
Gen.underfreq.
f <       000.0%
```

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

ⓘ This value refers to the parameter "Rated Frequency System" (Parameter 8 or Parameter 10).

If the monitored generator frequency falls below the configured percentage of the rated generator frequency for at least the delay time configured in Parameter 1682, an F3 class alarm is issued.

Issuing of F3 class alarm

Parameter 168

```
Gen.underfreq.
delay      0.00s
```

Generator underfrequency delay **0.02 to 9.98 s**

For the control unit to recognize that a generator underfrequency fault has occurred, the threshold value configured in Parameter 167 must be exceeded without interruption for this period of time.

Engine Overspeed Monitoring

Parameter 169

```
Engine overspeed
   > 0000 rpm
```

Engine overspeed monitoring **0 to 9,999 rpm**

If the monitored engine speed exceeds the generator rated speed (Parameter 275) for at 0.1 s, an F3 class alarm is issued. The engine overspeed monitoring is performed in addition to and independent of the generator frequency. The Magnetic Pickup Unit (MPU) must be enabled (Parameter 273) for engine speed monitoring to be performed. If the MPU input is disabled, engine speed monitoring is disabled. If the monitored engine speed exceeds the rated speed, an F3 class alarm is issued.

Issuing of F3 class alarm

© Woodward

Generator Voltage Monitoring

The line-to-line (wye) voltage is monitored.

Function: "Generator voltage not within the permissible limits" - If one or more phases of the generator voltage exceeds the limit values set for overvoltage or undervoltage, the engine is shut down immediately (F3 class alarm) and an alarm message is displayed. Monitoring of generator undervoltage is delayed by means of "Delayed engine monitoring" (Parameter 271) in order to enable generator start-up.

Parameter 170

```
Gen.voltage
monitoring   ON
```

Generator voltage monitoring **ON/OFF**

ON..... Monitoring of the generator voltage is enabled. The subsequent screens of this function are displayed.
OFF..... Monitoring of the generator voltage is disabled. The subsequent screens of this function are not displayed.

Parameter 171

```
Gen.overvoltage
V >        000.0%
```

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

ⓘ This value refers to the parameter "Rated volt. in system" (Parameter 12).

If the monitored generator voltage exceeds the configured percentage of the rated generator frequency for at least the delay time configured in Parameter 172, an F3 class alarm is issued.

Issuing of F3 class 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 172

```
Gen.overvoltage
delay       0.00s
```

Generator overvoltage delay **0.02 to 9.98 s**

For the control unit to recognize that a generator overvoltage fault has occurred, the threshold value configured in Parameter 171 must be exceeded without interruption for this period of time.

Parameter 173

```
Gen.undervoltage
V <        000.0%
```

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

ⓘ This value refers to the parameter "Rated volt. in system" (Parameter 12).

If the monitored generator voltage falls below the configured percentage of the rated generator frequency for at least the delay time configured in Parameter 174, an F3 class alarm is issued.

Issuing of F3 class alarm

Parameter 174

```
Gen.undervoltage
delay       0.00s
```

Generator undervoltage delay **0.02 to 9.98 s**

For the control unit to recognize that a generator undervoltage fault has occurred, the threshold value configured in Parameter 173 must be exceeded without interruption for this period of time.

Mains Frequency Monitoring

Monitoring the mains frequency is absolutely vital if a generator is operated in parallel with the infinite grid. In the event of a 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 the MCB and GCB are closed.

If the following parameters are enabled, the limit values are used to assess if an emergency power operation should be initiated. 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 limits" - If the mains frequency exceeds the limit values configured for overfrequency or underfrequency a mains failure is recognized. The circuit breaker configured to disconnect from the mains is immediately opened. The prerequisite of mains frequency monitoring is that the generator is operating in parallel with the mains (the MCB and GCB are both closed).

Parameter 175

```
Mains frequency
monitoring   ON
```

Mains frequency monitoring **ON/OFF**

ON .....Monitoring of the mains frequency is enabled. The subsequent screens of this function are displayed.
OFF .....Monitoring of the mains frequency is disabled. The subsequent screens of this function are not displayed.

Parameter 176

```
Mains overfreq.
f >       000.0%
```

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

ⓘ This value refers to the parameter "Rated Frequency System" (Parameter 8 or Parameter 10).

If the monitored mains frequency exceeds the configured percentage of the rated system frequency for at least the delay time configured in Parameter 177, an F0 class alarm is issued. The MCB, GCB, or an external CB is opened depending on how the GCP is configured to decouple from the mains.

Issuing of F0 class alarm

Parameter 177

```
Mains overfreq.
delay      0.00s
```

Mains overfrequency delay **0.02 to 9.98 s**

For the control unit to recognize that a mains overfrequency fault has occurred, the threshold value configured in Parameter 176 must be exceeded without interruption for this period of time.

Parameter 178

```
Mains underfreq.
f <       000.0%
```

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

ⓘ This value refers to the parameter "Rated Frequency System" (Parameter 8 or Parameter 10).

If the monitored mains frequency falls below the configured percentage of the rated system frequency for at least the delay time configured in Parameter 179, an F0 class alarm is issued. The MCB, GCB, or an external CB is opened depending on how the GCP is configured to decouple from the mains.

Issuing of F0 class alarm

Parameter 179

```
Mains underfreq.
delay      0.00s
```

Mains underfrequency delay **0.02 to 9.98 s**

For the control unit to recognize that a mains underfrequency fault has occurred, the threshold value configured in Parameter 178 must be exceeded without interruption for this period of time.

© Woodward

Mains Voltage Monitoring

Monitoring the mains voltage is absolutely vital if a generator is operated in parallel 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 the MCB and GCB are closed.

The phase-to-neutral (wye) voltage is always monitored.

If the following parameters are enabled, the limit values are used to assess if an emergency power operation should be initiated. 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 limits" - If one or more phases of the generator voltage exceeds the limit values set for overvoltage or undervoltage, a mains failure is recognized. The circuit breaker configured to disconnect from the mains is immediately opened. The prerequisite of mains voltage monitoring is that the generator is operating in parallel with the mains (the MCB and GCB are both closed).

Parameter 180

```
Mains voltage
monitoring   ON
```

Mains voltage monitoring **ON/OFF**

ON..... Monitoring of the mains voltage is enabled. The subsequent screens of this function are displayed.
OFF..... Monitoring of the mains voltage is disabled. The subsequent screens of this function are not displayed.

Parameter 181

```
Mains overvolt.
V >       000.0%
```

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

ⓘ This value refers to the parameter "Rated voltage system" (Parameter 12).

If the monitored mains voltage exceeds the configured percentage of the rated system frequency for at least the delay time configured in Parameter 182, an F0 class alarm is issued. The MCB, GCB, or an external CB is opened depending on how the GCP is configured to decouple from the mains.

Issuing of F0 class alarm

Parameter 182

```
Mains overvolt.
delay      0.00s
```

Mains overvoltage delay **0.02 to 9.98 s**

For the control unit to recognize that a mains overvoltage fault has occurred, the threshold value configured in Parameter 181 must be exceeded without interruption for this period of time.

Parameter 183

```
Mains undervolt.
V <       000.0%
```

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

ⓘ This value refers to the parameter "Rated voltage system" (Parameter 12).

If the monitored mains voltage falls below the configured percentage of the rated system frequency for at least the delay time configured in Parameter 185, an F0 class alarm is issued. The MCB, GCB, or an external CB is opened depending on how the GCP is configured to decouple from the mains.

Issuing of F0 class alarm

Parameter 184

```
Mains undervolt.
Hysteresis 00.0%
```

Mains undervoltage hysteresis **0.0 to 50.0 %**

The value configured here is the amount the monitored voltage must exceed the configured threshold in Parameter 183 before the corresponding relay output will de-energize.

Parameter 185

```
Mains undervolt.
delay      0.00s
```

Mains undervoltage delay **0.02 to 9.98 s**

For the control unit to recognize that a mains undervoltage fault has occurred, the threshold value configured in Parameter 183 must be exceeded without interruption for this period of time.

Phase/Vector Shift Monitoring dφ/dt

A phase/vector shift is a sudden change in the voltage curve that is caused by a large generator load change. The measuring circuit detects a change in a single sine wave. This sine wave is compared with a calculated mean value from previous measurements. Monitoring encompasses all three phases. The threshold value in degrees specifies the difference in time between the mean and the measured value in reference to a full cycle. Monitoring can be set in various manners. The phase/vector shift watchdog may be used as an additional means for decoupling from the mains. The minimum voltage that the phase shift is activated is 70 % of the rated secondary voltage.

Function: "Voltage cycle duration not within the permissible limits" - A fault is recognized if one or more phases of the generator voltage cycle duration exceeds the configured limit value for the phase/vector shift. The circuit breaker configured to disconnect 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 parallel with the mains operation (the MCB and GCB are both closed).

Parameter 186

```
Phase shift
monitoring   ON
```

Phase/vector shift monitoring **ON/OFF**

ON .....Monitoring of the mains frequency for a phase/vector shift is enabled. The subsequent screens of this function are displayed.
OFF .....Monitoring of the mains frequency for a phase/vector shift is disabled. The subsequent screens of this function are not displayed.

Parameter 187

```
Monitoring
---------------
```

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

one-/threephase..During single-phase voltage phase/vector shift monitoring, tripping occurs if the phase/vector shift exceeds the configured threshold value (Parameter 188) 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 188) is taken into consideration; if a phase/vector shift occurs in all three phases, the three-phase threshold value (Parameter 189) 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.
threephase ...During three-phase voltage phase/vector shift monitoring, tripping occurs only if the phase/vector shift exceeds the specified threshold value (Parameter 189) in all three phases within 2 cycles.

Issuing of F0 class alarm

© Woodward

NOTE

If monitoring is configured to "threephase", only Parameter 188 is displayed; if monitoring is configured to "one-/threephase", Parameter 188 and Parameter 189 are dispalyed.

Parameter 188

```
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 monitored electrical angle of the mains voltage shifts more than this configured value in any single phase, an F0 class alarm is initiated. The MCB, GCB, or an external CB is opened depending on how the GCP is configured to decouple from the mains.

Parameter 189

```
Phase shift
three-phase  00°
```

Phase/vector shift monitoring threshold value three-phase **3 to 30 °**

If the monitored electrical angle of the mains voltage shifts more than this configured value in all three phases, an F0 class alarm is initiated. The MCB, GCB, or an external CB is opened depending on how the GCP is configured to decouple from the mains.

Mains Settling Time

Parameter 190

```
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
If the MCB and the GCB are 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.

Battery Voltage Monitoring

Parameter 191

```
Batt.undervolt.
V <         00.0V
```

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

If the monitored battery voltage falls below the configured percentage of the configured threshold for at least the delay time configured in Parameter 192, an F1 class alarm is issued.

Issuing of F1 class alarm

Parameter 192

```
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 191 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 during normal operation or if the power supply voltage falls below 11 Vdc during the start sequence.

Time Of Active Horn

Parameter 193

```
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.

Discrete Inputs

NOTE

The parameters for this control are grouped together in blocks to permit navigation through the large number of configuration screens more rapidly. Selecting "YES" or "NO" has no effect whether or not control or monitoring is carried out for the parameters located in that block. Selecting "YES" or "NO" only determines if the individual parameters may be accessed and changed or are bypassed.

Parameter 194

```
Configure
dig.inputs    YES
```

Configuration of discrete inputs **YES/NO**

The discrete inputs functionality and logic are configured in this block of parameters. This parameter has the following effects:

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

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

NOTE

The discrete inputs can be used as alarm inputs or control inputs. If they were configured as alarm inputs (Parameter 200 to Parameter 207 are configured to "OFF") the parameters in "Alarm Inputs" (page 106) are valid. If they have been configured as control inputs (Parameter 200 to Parameter 207 are configured to "ON") the parameters in "Control Inputs" (page 108) are valid.

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	S	A*	A/C	A/C	A/C	A	A	A/C	A	A	A/C	A	A	A

A..Alarm input; C..Control input; A/C..Alarm or control input (dependent on the configuration)
*..If Parameter 18 "Single phase" is configured to "vie term. 61", this DI may not be used as alarm input.

NOTE

Normally Open (N.O.): Energizing the discrete input will enable the relay.
This does not provide wire break monitoring!

Normally Closed (N.C.): De-energizing the discrete input will enable the relay.
This may provide wire break monitoring.

Example: Discrete inputs 1 through 4 (use the same procedure for inputs 5 to 16)

Parameter 195

```
Dig.input   1234
function    EEEE
```

Function of the discrete alarm inputs 1 to 4 **E/D**

The discrete inputs may be operated by a normally open contact or a normally closed contact. The normally closed contact input may be used to monitor for a wire break. A positive or negative voltage polarity may be utilized.

D .....The discrete input is normally de-energized and analyzed as "enabled" by energizing the input (N.O.; D = normally de-energized).

E .....The discrete input is normally energized and analyzed as "enabled" by de-energizing the input (N.C.; E = normally energized).

Parameter 196

```
Dig.input   1234
delay       0000
```

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

A delay time can be assigned to each alarm input. The delay times are configured as stages. The individual stages are listed below. The discrete input must be energized/de-energized, depending on how it is configured, without interruption throughout the delay time in order to be "enabled".

Delay stage	Delay stage
0	100 ms
1	200 ms
2	500 ms
3	1 s
4	2 s
5	5 s
6	10 s
7	20 s
8	50 s
9	100 s

Table 3-9: Discrete alarm inputs - delay stages

Parameter 197

```
Delayed by  1234
eng.speed   YYYY
```

Delayed by firing speed of the discrete alarm inputs 1 to 4 **Y/N**

It is possible to configure the GCP to ignore discrete inputs until the engine has achieved firing speed. This parameter defines if the discrete input, which is being used as an alarm input, is only to be monitored after the engine is running ("firing speed reached").

Y .....The discrete input is only monitored after the engine firing speed has been achieved and monitoring of the engine protections have been enabled.

N .....The discrete input is always monitored.

 © Woodward

Parameter 198

```
Dig.input   1234
error class 0000
```

Alarm class of the discrete alarm inputs 1 to 4 **F0 to F3**

The discrete inputs, which have been designated as alarm inputs, may be assigned an alarm class. This parameter defines what action is to be taken by the GCP when an alarm discrete input is enabled. 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) + soft shutdown.
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) + hard shutdown.

Configuring The Text For The Discrete Inputs

NOTE

If terminal 6 is configured to "Sprinkler operation" (override or critical mode; Parameter 208) or if a gas engine is selected (Parameter 256), the EMERGENCY STOP function must be assigned to terminal 34. If terminal 34 is not used as a discrete input, the EMERGENCY STOP function is assigned to the discrete input with the lowest terminal number (terminal 61).

NOTE

Special characters, numbers, upper and lower case letters may be configured for the alarm text.

NOTE

The alarm texts can only be configured via LeoPC1.

Parameter 199

```
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.

Control Inputs

Acknowledge firing speed via terminal 62

Parameter 200

```
Firing speed by
Term. 62     ON
```

only accessible via LeoPC1

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 195 is configured to "E", the discrete input utilizes "N.O." contacts and the starter disengages when this discrete input becomes TRUE/energized. 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 195 is configured to "D", the discrete input utilizes "N.C." logic to disengage the starter in the event of a voltage loss. Once the delayed engine monitoring has expired, the discrete input changes to "N.O." logic internally even though "N.C." logic is still programmed and will initiate an alarm as soon as voltage is applied.

Block operation mode selector switch via terminal 63

Parameter 201

```
Op.mode blocked
by Ter.63   ON
```

only accessible via LeoPC1

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 buttons of the face of the control are disabled and cannot be used to operating mode.

If this input is configured as control input **and** energized, it is possible to change the operation mode externally using terminals 127 and 128 as control inputs. 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 on the face of the GCP. (The terminals 127/128 have no effect.)
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 on the face of the GCP are disabled.
energized	de-energized	energized	The AUTOMATIC operation mode is activated. After connecting the supply voltage, the unit changes to AUTOMATIC operation mode via STOP. The operation mode selection buttons on the face of the GCP are disabled.
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 on the face of the GCP are disabled.

Table 3-10: Function - external operation mode selection

© Woodward

Change breaker logic via terminal 64

Parameter 202

```
Breaker logic
by Term64    ON
```

only accessible via LeoPC1

Breaker logic via terminal 64 **ON/OFF**

OFF..... This terminal is used as an alarm input.
ON..... This terminal is used as control input.
- Energized When this terminal is energized, the breaker logic of Parameter 203 is used.
- De-energized When this terminal is de-energized, the breaker logic of Parameter 109 is used.

Parameter 203

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

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

Breaker logic via terminal 64 **see page 70**

Selection of the breaker logic that is to be used when terminal 64 is energized. This parameter is only displayed if Parameter 202 has been configured to ON (for the description of the breaker logic refer to the "Breaker logic" section on page 70).

Frequenz/Leistungs-Sollwertvorgabe über Klemmen 65 und 66

Parameter 204

```
f/P setpoint by
term.65/66   ON
```

only configurable via LeoPC1

Frequency/power set point via terminals 65/66 **ON/OFF**

OFF..... These terminals are evaluated as alarm inputs.
ON..... These terminals are used as control inputs to change the frequency or power set point (depending on the currently active control).
The set point value will be lowered if terminal 65 is energized.
The set point value will be raised if terminal 66 is energized.

Note: If several of the terminals 65, 66, 67, 69 are energized in their function as control input, the terminal with the lowest number is prioritized.

Spannung/Leistungsfaktor-Sollwertvorgabe über Klemmen 67 und 69

Parameter 205

```
V/Q setpoint by
term.67/69   ON
```

only configurable via LeoPC1

Frequency/power set point via terminals 67/69 **ON/OFF**

OFF..... These terminals are evaluated as alarm inputs.
ON..... These terminals are used as control inputs to change the voltage or power factor set point (depending on the currently active control).
The set point value will be lowered if terminal 67 is energized.
The set point value will be raised if terminal 69 is energized.

Enable 'Emergency OFF' via terminal 68

Parameter 206

```
Emergency OFF
by Ter.68    OFF
```

only accessible via LeoPC1

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.
- Energized When this terminal is energized, an emergency power operation is prevented or terminated. The unit operates as if Parameter 137 "Emergency power" is disabled.
- De-energized When this terminal is de-energized, an emergency power operation may be performed. The unit operates in the manner prescribed by Parameter 137 "Emergency power".

Enable 'Idle mode' via terminal 70

Parameter 207

```
Idle Mode
by term.70   ON
```

only accessible via LeoPC1

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 discrete output programmed with the relay manager function 133 ("idle mode active") enables/disables in accordance with the logical status of terminal 70 according to the configured NO/NC logic. Generally this discrete output from the GCP must be wired to the "idle input" of the speed governor normally.

- Energized 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 post-run time so long as there are no other message with a higher display priority (i.e. pre-glow). The generator undervoltage and underfrequency protections are disabled and the warning limit value for the oil pressure input is suppressed while in the idle mode. 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, which ever occurs first.
- De-energized The idle mode is disabled and the protections are enabled again (refer to the description above).

 © Woodward

Terminal 6

Terminal 6 Function

ATTENTION

Specific terminal 6 functionality require different input signals!

Parameter 208

```
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:

• Engine enabled

Terminal 6 has the same function as the STOP button: De-energizing terminal 6 prevents the engine from starting and stops the engine if it is already running. Energizing terminal 6 enables the starting of the engine

Attention: Use of this function makes it possible to abort or prevent an emergency power operation. An emergency power operation is not possible without enabling this function! The enable engine function only operates when the GCP is in the AUTOMATIC operation mode.

• Engine blocked

Energizing terminal 6 can prevent starting of the engine. If the engine is running due to an active emergency power operation, energizing this discrete input will stop it. The engine-blocked functionality is only possible when the GCP is in the AUTOMATIC operation mode. The function of this mode is the opposite of the function of the "Engine enabled" mode.

• Ext. acknowledgment

Alarms can be acknowledged externally by momentarily energizing terminal 6 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 re-energized, any alarm messages generated after terminal 6 was energized will not be acknowledged.

• STOP mode

By energizing terminal 6 the STOP mode is activated. If terminal 6 is de-energized, the operation mode will revert back to the mode that was active prior to terminal 6 being energized.

• Start without CB

If the terminal 6 is energized, the engine starts. Synchronization is not performed and the GCB is not closed (no closing to dead busbar). The GCB will only close if an emergency power operation is enabled. After the mains return, the load is transferred back to the mains according to the configured breaker logic. An engine start command from terminal 6 has a higher priority than a start command from terminals 3/5. If terminal 6 is energized, 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 will be opened following a power reduction. The generator will continue to run without load and the GCB open.

Note: Load-dependent starting and stopping is not possible in sprinkler operation.

Starting Without Closing GCB

Parameter 209

```
Start without CB
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 (terminal 6 has been de-energized), an engine cool down is performed for the time configured in Parameter 270.

OFF..... After removing the start request (terminal 6 has been de-energized), the engine is stopped immediately without an engine cool down.

Analog Inputs

NOTE

All parameters for configuring the analog inputs may only be accessed via LeoPC1.

Setting The Analog Inputs

Note

The analog input types and specification for the analog inputs [T1] to [T7] are as follows:

- Scaleable analog input 0/4 to 20 mA (page 113)
- Pt100 input (page 115)
- 0 to 400 Ohms input (page 116)
- VDO input (temperature, page 117, or pressure, page 118)

Analog input	1	2	3	4	5	6	7
Assignment	0/4 to 20 mA			Pt100	0 to 400 Ω	VDO #1	VDO #2
Terminal	**93**/94/95	**96**/97/98	**99**/100/101	**102**/103/104	**105**/106/107	**108**/109/110	**111**/112/113

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

NOTE

If you want to visualize the analog inputs via the PC program LeoPC1 the following must occur:

1. **Establish a connection between LeoPC1 and the GCP.**
2. **Select in the menu "Devices" the topic "Refresh Configuration".**
3. **Restart LeoPC1 according to the requests.**

© Woodward

Scaleable Analog Input 0/4 to 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 (Parameter 21)**
- **Real power set point value (Parameter 75)**

If one of the both functions is assigned to an available 0/4 to 20 mA input T{x} (refer to Parameter 21 and Parameter 75), that 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 the 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 210

```
Input term.   xx
              YES
```

[xx = 93/96/99]

0/4 to 20 mA input; enable **YES/NO**

YES..... The value of this input appears in the display and monitoring is enabled. The subsequent parameters of this function are displayed.

NO..... The value of this input does not appear in the display and monitoring is disabled. The subsequent parameters of this function are not displayed.

Parameter 211

```
Input term.   xx
text
```

[xx = 93/96/99]

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 212

```
Input term.   xx
range
```

[xx = 93/96/99]

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 213

```
Input term.   xx
value at 0%
```

[xx = 93/96/99]

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 % equals 0 kW, 0 V, etc.) at the minimum analog input value of 0 mA or 4 mA.

Parameter 214

```
Input term.   xx
value at 100%
```

[xx = 93/96/99]

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 % equals 500 kW, 400 V, etc.) at the maximum analog input value of 20 mA.

Parameter 215

```
Input term.   xx
limit warning
```

[xx = 93/96/99]

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 (dependent upon Parameter 218) for at least the delay time (Parameter 217), the following alarm class is initiated.

Issuing of F1 class alarm

Parameter 216

```
Input term.   xx
limit shutdown
```

[xx = 93/96/99]

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 218) for at least the delay time (Parameter 217), the following alarm class is initiated.

Issuing of F3 class alarm

Parameter 217

```
Input term.   xx
delay time
```

[xx = 93/96/99]

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 must be over or under (dependent upon Parameter 218) the configured threshold value (Parameter 215 or Parameter 216) without interruption for at least this time.

Parameter 218

```
High limit
monitoring   YES
```

0/4 to 20 mA input; monitoring for high limit **YES/NO**

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 215 or Parameter 216).
YES .....The measured value must exceed the threshold value.
NO .....The measured value must fall below the threshold value.

 © Woodward

Pt100 Input (Analog Input [T4])

Pt100 inputs may be measured here. The analog input is displayed with its description. Two threshold limits can be monitored. The first level initiates a class F1 alarm, the second level initiates a class F3 alarm.

Parameter 219

```
Input term. 102
            YES
```

Pt100 input; enable **YES/NO**

YES..... The value of this input appears in the display and monitoring is enabled. The subsequent parameters of this function are displayed.
NO..... The value of this input does not appear in the display and monitoring is disabled. The subsequent parameters of this function are not displayed.

Parameter 220

```
Input term.  102
text
```

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 221

```
Input term.  102
limit warning
```

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 224) for at least the delay time (Parameter 223), the following alarm class is initiated.

Issuing of F1 class alarm

Parameter 222

```
Input term.  102
limit Shutdown
```

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 224) for at least the delay time (Parameter 223), the following alarm class is initiated.

Issuing of F3 class alarm

Parameter 223

```
Input term.  102
delay time
```

Pt100 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 must exceed or fall below (dependent upon Parameter 224) the configured threshold value (Parameter 221 or Parameter 222) without interruption for at least this time.

Parameter 224

```
High limit
monitoring   YES
```

Pt100 input; monitoring for high limit **YES/NO**

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 221 or Parameter 222).
YES..... The measured value must exceed the threshold value.
NO..... 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 monitored temperature, must be configured to the corresponding parameter (e.g. the ambient temperature is 100 °C).

0 to 400 Ohms Input (Analog Input [T5])

This 0 to 400 Ohms input is usually utilized as an input for a **tank gauge**.

Parameter 225

```
Input term. 105
           YES
```

0 to 400 Ohms input; enable **YES/NO**

YES .....The value of this input appears in the display and monitoring is enabled. The subsequent parameters of this function are displayed.
NO .....The value of this input does not appears in the display and monitoring is disabled. The subsequent parameters of this function are not displayed.

Parameter 226

```
Input term.  105
text
```

0 to 400 Ohms input; description **User defined text**

This parameter is used to configure a custom name for the input. Digits for the measured values may be reserved with a maximum of four zeros. The placeholders may be interrupted by any symbol, for example a comma. The measured values appear then where the zeros have been placed before as placeholders.

Parameter 227

```
Input term.  105
value at 0%
```

0 to 400 Ohms input; smallest input value **-9999 to 9999**

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 %, e.g. 0 liters) at the minimum analog input value (0 Ohms).

Parameter 228

```
Input term.  105
value at 100%
```

0 to 400 Ohms input; largest input value **-9999 to 9999**

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 %, e.g. 1000 liters) at the maximum analog input value (400 Ohms).

Parameter 229

```
Input term.  105
limit warning
```

0 to 400 Ohms input; limit value for class F1 alarm **-9999 to 9999**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 232) for at least the delay time (Parameter 231), the following alarm class is initiated.

Issuing of F1 class alarm

Parameter 230

```
Input term.  105
limit shutdown
```

0 to 400 Ohms input; limit value for class F3 alarm **-9999 to 9999**

If the measured value exceeds or falls below this configured threshold value (dependent upon Parameter 232) for at least the delay time (Parameter 231), the following alarm class is initiated.

Issuing of F3 class alarm

Parameter 231

```
Input term.  105
delay time
```

0 to 400 Ohms 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 must be over or under (dependent upon Parameter 232) the configured threshold value (Parameter 228 or Parameter 229) without interruption for at least this time.

Parameter 232

```
High limit
monitoring   YES
```

0 to 400 Ohms input; monitoring for high limit **YES/NO**

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 228 or Parameter 229).
YES .....The measured value must exceed the threshold value.
NO .....The measured value must fall below the threshold value.

 © Woodward

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

NOTE

The default threshold values are configured in "bar". If the engineering unit "psi" is configured (Parameter 144), the display of the measured values as well as the transmission via the interface appears in "psi".

VDO inputs for pressure may be monitored 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 233

```
Input term. 108
            YES
```

VDO input, pressure; enable/disable **YES/NO**

YES..... The value of this input appears in the display and monitoring is enabled. The subsequent parameters of this function are displayed.
NO..... The value of this input does not appears in the display and monitoring is disabled. The subsequent parameters of this function are not displayed.

Parameter 234

```
Input term.  108
text
```

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 235

```
VDO ter.108 as:
         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 236

```
Input term.  108
limit warning
```

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 239) for at least the delay time (Parameter 238), the following alarm class is initiated.

Issuing of F1 class alarm

Parameter 237

```
Input term.  108
limit shutdown
```

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 239) for at least the delay time (Parameter 238), the following alarm class is initiated.

Issuing of F3 class alarm

Parameter 238

```
Input term.  108
delay time
```

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 exceed or fall below (dependent upon Parameter 239) the threshold value (Parameter 236 or Parameter 238) without interruption for at least this time.

Parameter 239

```
High limit
monitoring   YES
```

VDO input, pressure; monitoring for high limit **YES/NO**

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 236 or Parameter 238).
YES .....The measured value must exceed threshold.
NO .....The measured actual value must fall below the threshold value.

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

VDO inputs may be measured here (the input has been calibrated to the VDO sender 323.425 or 323.478 (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 F1 class alarm, the second level initiates a class F3 alarm.

NOTE

Prior to ordering any VDO sender, ensure that the proper thread (metric or SAE) is ordered for your application.

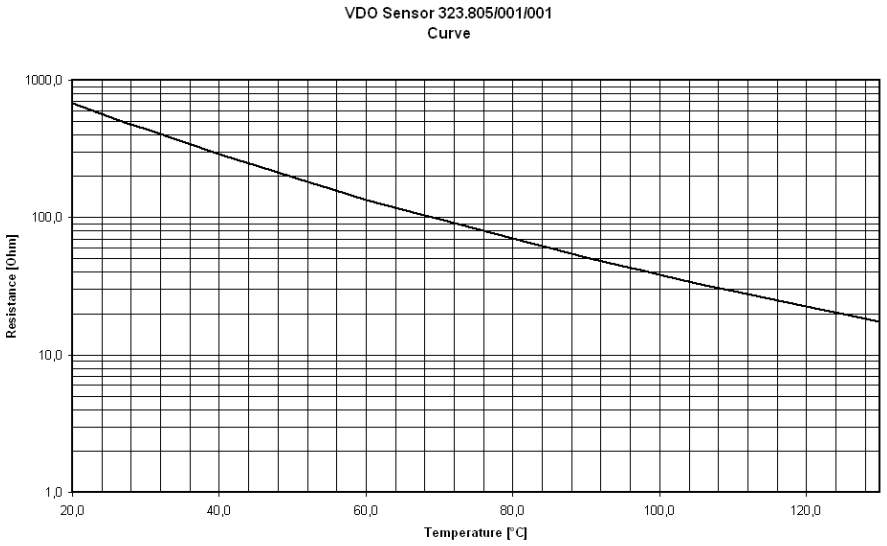


Figure 3-11: VDO transmitter 323.425 (slope)

Parameter 240

```
Input term. 111
            YES
```

VDO input, temperature; enable/disable **YES/NO**

YES .....The value of this input appears in the display and monitoring is enabled. The subsequent parameters of this function are displayed.
NO .....The value of this input does not appear in the display and monitoring is disabled. The subsequent parameters of this function are not displayed.

Parameter 241

```
Input term.  111
text
```

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.

 © Woodward

Parameter 242

```
Input term.  111
limit warning
```

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 245) for at least the delay time (Parameter 244), the following alarm class is issued.

Issuing of F1 class alarm

Parameter 243

```
Input term.  111
limit shutdown
```

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 245) for at least the delay time (Parameter 244), the following alarm class is issued.

Issuing of F3 class alarm

Parameter 244

```
Input term.  111
delay time
```

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 exceed or fall below (dependent upon Parameter 245) the threshold value (Parameter 242 or Parameter 243) without interruption for at least this time.

Parameter 245

```
High limit
monitoring   YES
```

VDO input, temperature; monitoring for high limit **YES/NO**

A fault condition is recognized when the measured value has exceeded or fallen below the threshold value (Parameter 242 or Parameter 243).
YES..... The measured value must exceed threshold value.
NO..... The measured value must fall below the threshold value.

Monitoring Of The Measuring Range (All Analog Inputs)

```
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

The GCP has the ability to monitor for possible wire break conditions if the measuring range has been exceeded. If the configured measuring range is exceeded, an alarm will be issued and the affected analog input will be deactivated.

Fault conditions are recognized when the measuring range exceeds the following values for each type of input:

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**

Engine Delayed Monitoring Of The Analog Inputs

Parameter 246

```
Ana.in  12345678
SV.del. NNNNNYNN
```

Analog inputs; engine delayed monitoring **Y/N**

The analog inputs may be disabled until the engine has reached the configured firing speed (Parameter 272). This parameter specifies which analog inputs are to be constantly enabled or disabled until firing speed has been achieved by configuring a "Y" or an "N" below the input number.

Y .....Monitoring of the analog input is enabled after firing speed has been reached (the green LED "Protection" illuminates).

N .....The analog input is always monitored.

Note: The setting for analog input 8 has no effect since this does not exist.

Analog Inputs Selectable as Control Inputs

Parameter 247

```
Ana.in 12345678
control NNNNNNNN
```

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

This parameter defines if specific analog inputs operate as control inputs or not.

Y .....The analog input operates as control input: The analog value is displayed and the configured relays are enabled when the configured limits has been reached. However, an alarm will not be issued and a message will not be transmitted on the CAN bus.
(A wire break will not effect the behavior of the control)

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

Note: The setting for analog input 8 has no effect since this does not exist.

 © Woodward

Outputs

NOTE

All parameters for configuring the analog inputs may only be accessed via LeoPC1.

Analog Outputs

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 output value. The outputs 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 145.

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

Parameter 248

```
Analg.out.120121
Parameter     00
```

Function for analog output **0 to 24**

The analog output function 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 249

```
Analg.out.120121
          0-00mA
```

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

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

Parameter 250

```
Analg.out.120121
  0%          0000
```

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

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

Parameter 251

```
Analg.out.120121
100%          0000
```

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

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

Relay Manager

The relay manager enables the assignment of a logical combination of functions to each relay. Each function has been assigned a number. The numbers for these functions are entered into the configuration screen and are combined to create a logical condition that energizes the assigned relay. Up to three function numbers may be combined in this link. The length of the text for the logical condition 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 148.

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 "*" has precedence over "+"

Example of logical conditions and relevant texts

Function Relay is enabled, if ...	**Programmed text**
... function 22 is true.	22
... function 22 is not true.	- 22
... both function 2 is true and function 27 is true.	2 * 27
... function 2 is true or function 27 is true.	2 + 27
... function 3 is true or function 5 is not true or function 13 is true.	3 + -5 + 13
... function 4 or 7 or 11 is true.	4 + 7 + 11
... function 4 is not true and function 7 is not true and function 11 is not true.	- 4 * -7 * -11
... function 4 and 7 and 11 are true.	4 * 7 * 11
... function 7 and 11 are true or function 4 is true.	4 + 7 * 11
... function 4 is not true or function 7 is not true or function 11 is not true.	-4 + -7 + -11

NOTE

Entering an illegal logical combination will delete the equation.

Parameter 252

```
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

 © Woodward

Engine

NOTE

The parameters for this control are grouped together in blocks to permit navigation through the large number of configuration screens more rapidly. Selecting "YES" or "NO" has no effect whether or not control or monitoring is carried out for the parameters located in that block. Selecting "YES" or "NO" only determines if the individual parameters may be accessed and changed or are bypassed.

Parameter 253

```
Configure
engine          YES
```

Configuration of the engine **YES/NO**

The engine functionality and protection are configured in this block of parameters. This parameter has the following effects:

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

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

Parameter 254

```
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 (i.e. pre-lube pumps run) for the time configured in this parameter. A message is displayed when the relay output is enabled. This relay output is automatically enabled in MANUAL operation mode. The relay output will remain enabled until the operation mode is changed from MANUAL.

CAUTION

This delay is ignored in the event of emergency power operation. The engine is started immediately.

Parameter 255

```
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 AUTOMATIC without an engine start request, the relay output remains enabled for the configured time and a message is displayed.

Parameter 256

```
Start-stop-logic
----------------
```

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 Start/stop logic is performed externally (the start/stop sequence is disabled).

Start/Stop Sequence 'Gas Engine'

NOTE

A maximum of 3 start attempts will be performed.

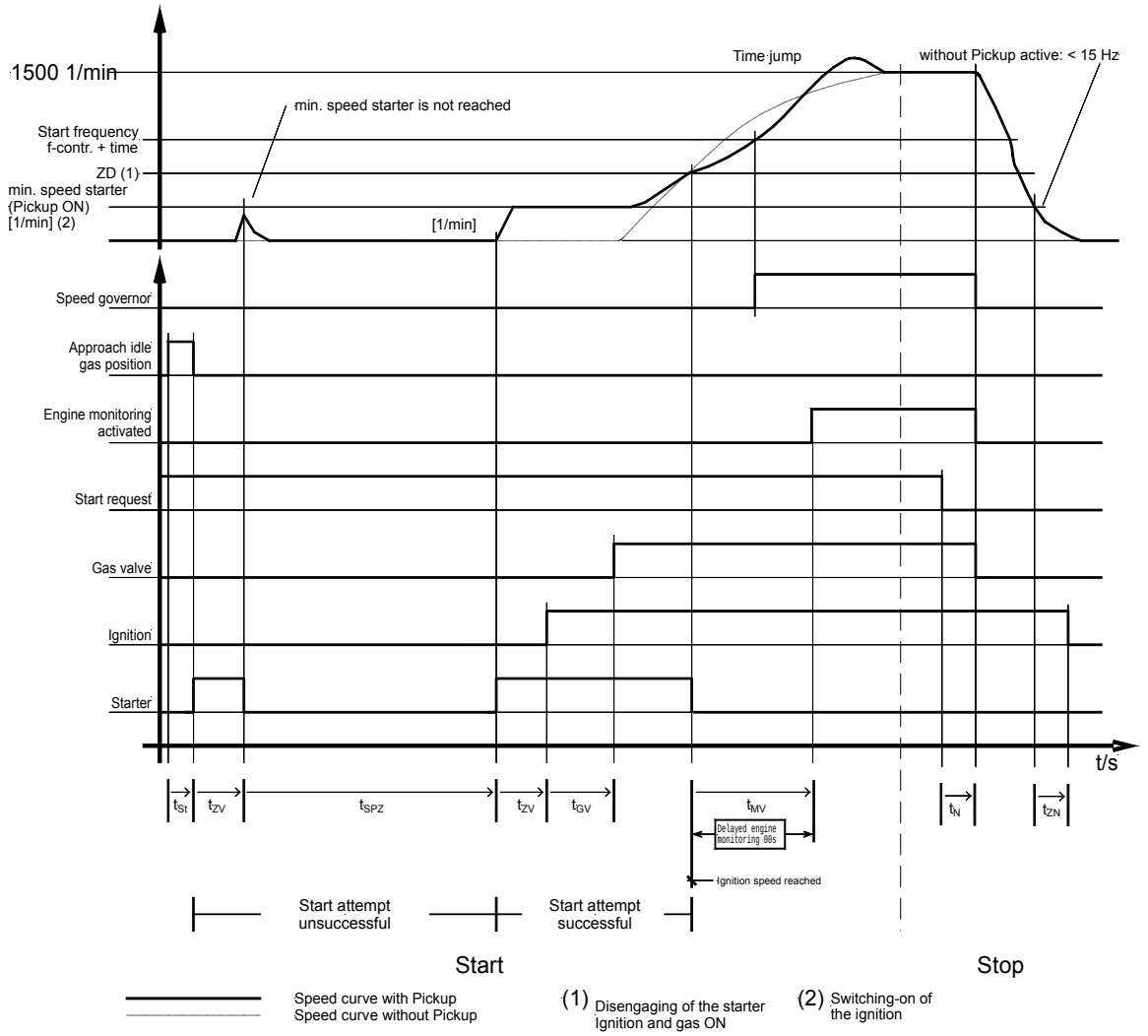


Figure 3-12: Start-Stop sequence: Gas engine

The signs and indices mean:
t_{Sta} ..... Approach idle gas position [s]
t_{ZV} ..... Firing delay [s]
t_{GV} ..... Gas valve delay [s]
t_{SPZ} ..... Time between two start attempts [s]
t_{MV} ..... Delayed engine monitoring [s]
t_{ZN} ..... Ignition coasting [s]; pre-specified: 5 s
t_N ..... Engine cool down time [s]
(1) ..... Disengagement of the starter; Ignition and gas also ON
(2) ..... Switching ON the ignition

 © Woodward

Starting Sequence

If the control is equipped with a three-position frequency controller, a continuous "Frequency lower prior to start" signal (time adjustable via Parameter 263) is output before starting the engine. The starter is enabled after the time configured in parameter 262 expires. The ignition is enabled following the expiration of the ignition delay time (Parameter 258) and if the engine is rotating with at least the configured "minimum speed for ignit." (Parameter 257). Following the expiration of the gas valve delay (Parameter 259), the gas valve is enabled. If the starting sequence finishes successfully (the firing speed (Parameter 272) 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 271), the speed controller is enabled.

Stopping Sequence

When the start request is terminated, a power reduction is performed (if the real power controller is enabled, Parameter 71). After the GCB has opened, an engine cool down is performed (Parameter 270). When the engine cool down period expires, the gas valve is closed, and the engine is stopped. When the engine speed falls below the firing speed (Parameter 272), the engine starting sequence is disabled for 10 seconds. If the engine fails to stop after 30 seconds, an alarm message is issued and a F3 class alarm is initiated.

After the engine speed has fallen below the firing speed, the ignition will remain enabled for an additional 5 seconds so that any gas remaining in the cylinders is able to combust.

Safety Instructions To Control Gas Valves

In order to ensure a safe shutdown of the gas valves, a separate shutdown circuit must be utilized.
The following is recommended to prevent the gas valve from failing to close due to stuck relays.

Controlling gas valves with the GCP

The GCP relay manager from V4.1001 and on contains function 131 ("fuel valve ON"). This function exists in the GCP 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.

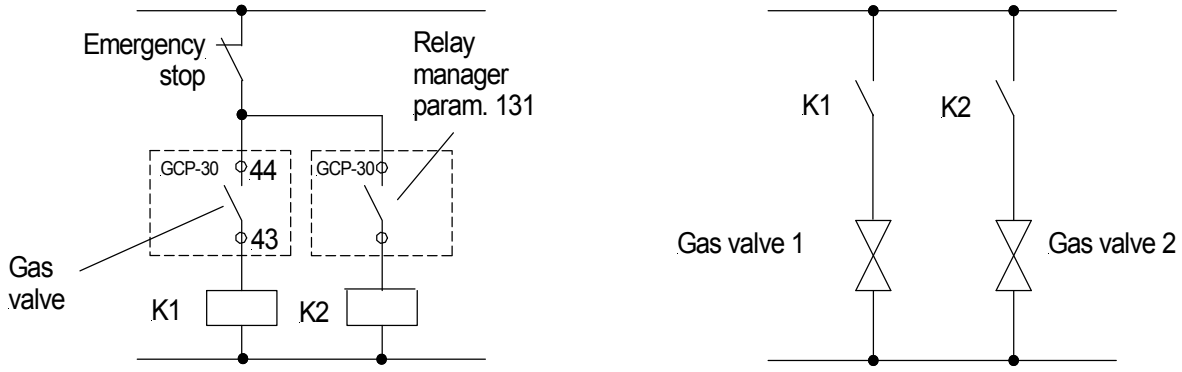


Figure 3-13: Wiring diagram for opening gas valves with the GCP-30 from V4.1001

Parameter

Parameter 257

```
Min.speed for
ignit. 000 rpm
```

only configurable via LeoPC1

Gas engine; minimum start speed **0 to 999 rpm**

ⓘ The minimum starter speed can only be detected if the magnetic pick-up has been enabled (Parameter 280).

Once the ignition delay (Parameter 258) has expired, the engine must exceed the speed configured with this parameter in order to enable the ignition relay (relay manager function 84).

Parameter 258

```
Ignition delay
           00s
```

only configurable via LeoPC1

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 257) has been exceeded, the ignition is enabled.

Parameter 259

```
Gasvalve delay
           00s
```

only configurable via LeoPC1

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 272) the relay remains energized until the engine stops.

Parameter 260

```
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 261

```
Start pause time
           00s
```

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

The delay time between the individual start attempts.

Parameter 262

```
f lower before
start        ON
```

with three-step controllers only

only configurable via LeoPC1

Gas engine; frequency lower prior to start **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 263 before the starter is engaged. The low-idle position must either be equipped with a limit switch or the engine potentiometer must be equipped with a slipping clutch to protect the device once the lowest possible setting has been achieved. A message is displayed while this function is active.

CAUTION

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

Parameter 263

```
time f lower
bef.start   000s
```

with three-step controllers only

only configurable via LeoPC1

Gas engine; frequency lower prior to start (time) **0 to 999 s**

The duration that the "lower engine speed" signal (Parameter 262) is output.

© Woodward

Start/Stop Sequence 'Diesel Engine'

NOTE

A maximum of 3 start attempts will be performed.

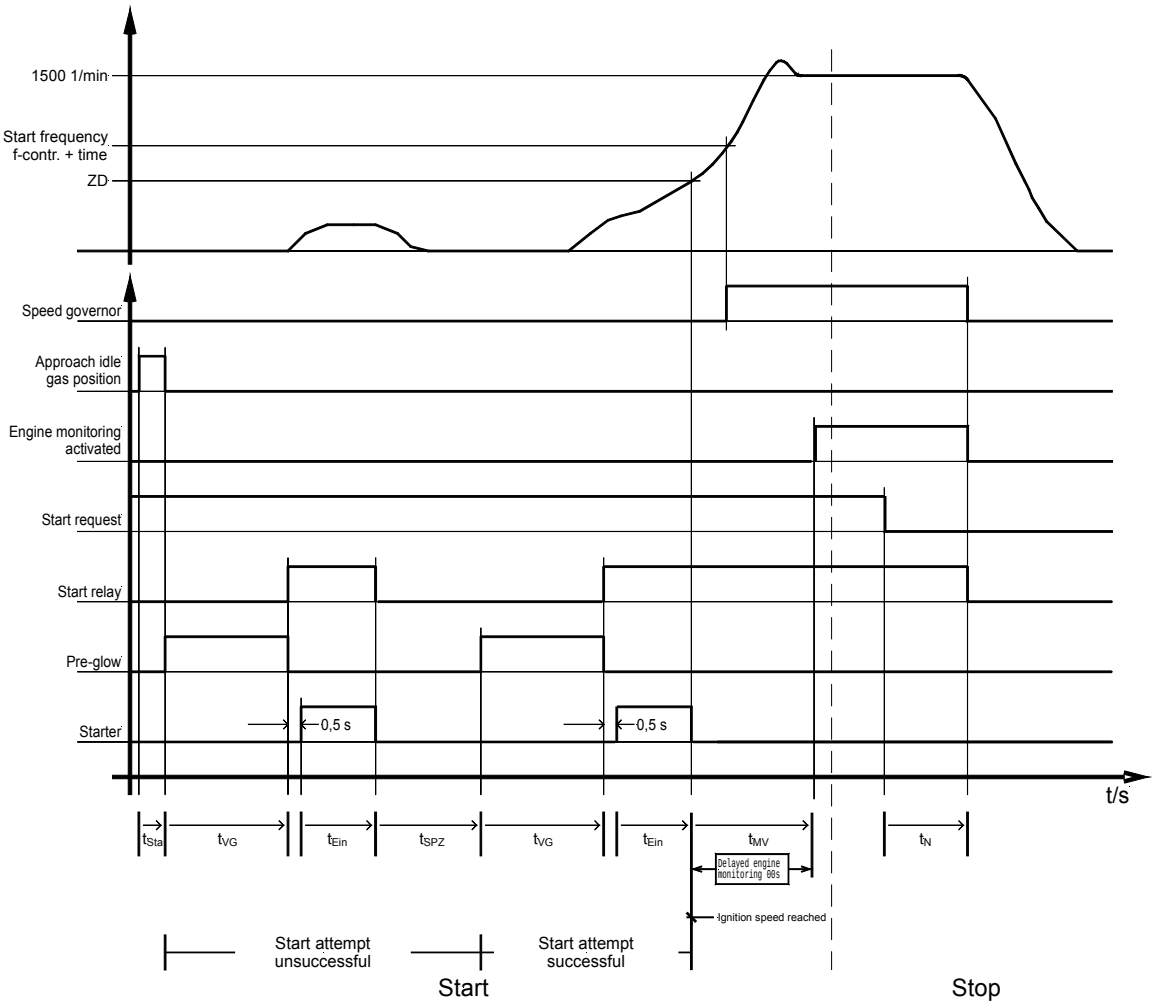


Figure 3-14: Start-stop sequence: Diesel engine

The signs and indices mean:
t_{Sta} ..... Approach idle fuel position [s]
t_{VG}..... Pre-glow time [s]
t_{Ein}..... Crank time [s]
t_{SPZ} ..... Time between two start attempts [s]
t_{MV} ..... Delayed engine monitoring [s]
t_{N}..... Engine cool down time [s]

Starting Sequence

If the control is equipped with a three-position frequency controller, a continuous "Frequency lower prior to start" signal (time adjustable via Parameter 268) is output before starting the engine. The "Pre-glow" relay is enabled for the time configured in Parameter 264 after the frequency lower signal terminates. After the pre-glow cycle terminates, the fuel relay is enabled (Parameter 269), followed by the crank relay. Once the firing speed (Parameter 272) 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 271), the speed controller is enabled.

Stopping Sequence

When the start request is terminated, a power reduction is performed (if the real power controller is enabled, Parameter 71). Once the GCB has opened, an engine cool down is performed (Parameter 270). When the engine cool down period expires, the fuel relay is de-energized and the engine is stopped. When the engine speed falls below the firing speed (Parameter 272), the engine starting sequence is disabled for 10 seconds. If the engine fails to stop after 30 seconds, an alarm message is issued and a F3 class alarm is initiated.

Parameter

Parameter 264

```
Preglow time
             00s
```

only configurable via LeoPC1

Diesel engine; pre-glow time **0 to 99 s**

Prior to each starting sequence, the engine glow plugs are energized for this time period.

Parameter 265

```
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 266

```
Start pause time
             00s
```

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

The delay time between the individual start attempts.

Parameter 267

```
f lower before
start        OFF
```

with three-step controllers only

only configurable via LeoPC1

Diesel engine; frequency lower prior to start **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 268 before the starter is engaged. The low-idle position must either be equipped with a limiting switch, or the engine potentiometer must be equipped with a slipping clutch to protect the devices. A message is displayed.

CAUTION

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

© Woodward

Parameter 268

```
time f lower
bef.start   000s
```

with three- step controllers only

only configurable via LeoPC1

Diesel engine; frequency lower prior to start (time) **0 to 999 s**

The duration that the "lower engine speed" signal (see Parameter 267) is output.

Parameter 269

```
Fuel relay logic
```

only configurable via LeoPC1

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

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

close to stop In order to stop the engine, the fuel shutdown solenoid is energized. The fuel shutdown solenoid remains energized for an additional 30 seconds once the engine speed drops below firing speed (Parameter 272) **and** the generator voltage is less than 20 V.

Cool Down

Parameter 270

```
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 an F2 class alarm has been initiated, an engine cool down period with frequency control is performed for the time configured here after the GCB opens. The engine will shutdown following the conclusion of the engine cool down period. If the engine cool down has terminated (cool down time has been expired) and engine speed (Parameter 272) is still detected after 30 seconds, an engine failure to stop message is displayed.

Note

The GCP will not perform a cool down period unless the GCB reply (terminal 4) has been de-energized for at least 5 seconds, indicating that the breaker has been closed.

Delayed Engine Monitoring And Firing Speed

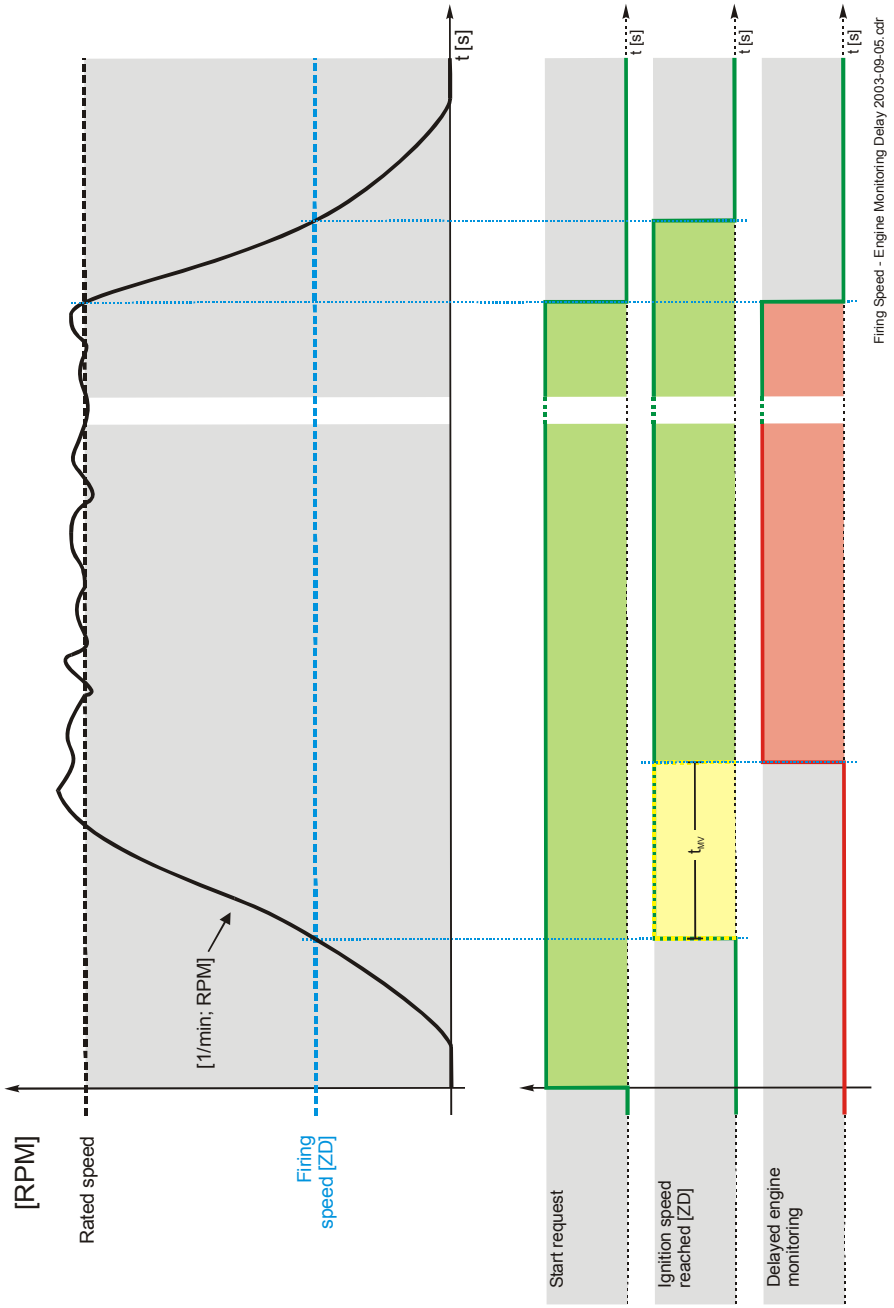


Figure 3-15: Delayed engine monitoring

© Woodward

Parameter 271

```
Delayed engine
monitoring   00s
```

Engine; delayed engine monitoring **1 to 99 s**

A delay may be configured to prevent the GCP from monitoring for selected alarms (e.g. oil pressure, generator underfrequency, etc.) for a specific time period after the engine has reached the firing speed.

Parameter 272

```
Firing speed
reached  f >00Hz
```

only configurable via LeoPC1

Engine; firing speed reached **5 to 70 Hz**

Once the engine has achieved this configured firing speed, the starter is disengaged (switched off) and the frequency controller is enabled.

Note

The GCP may be configured to monitor for firing speed via the MPU input or the frequency of the generated voltage. If the MPU input has been enabled, the GCP is able to monitor frequencies as low as 5Hz accurately. If the MPU input has not been enabled, the GCP will monitor that firing speed has been achieved when the monitored frequency has achieved 15Hz or greater depending upon the configured value.

Magnetic Pick-Up Input

Measuring the engine speed may be performed by means of a Magnetic Pickup. The use of an alternator or a tacho generator to detect engine speed are alternate methods of monitoring if the engine has achieved firing speed. If an alternate means of detecting engine speed is utilized, then the GCP must receive a signal via terminal 62 (refer to Acknowledge firing speed via terminal 62 on page 108). Refer to the Installation Manual 37364 for the wiring diagram that pertains to your specific controller.

Parameter 273

```
Pickup input
          ON
```

only configurable via LeoPC1

Magnetic pickup; measurement **ON/OFF**

ON .....The Magnetic Pickup input is enabled to monitor engine speed. The GCP utilizes the signal from the MPU to detect when firing speed has been achieved. The engine speed signal monitored via the MPU is used to disengage the starter.

OFF .....The MPU input is disabled. All speed and frequency monitoring/control is performed via generator frequency. The GCP utilizes the frequency of the monitored generator voltage to detect when firing speed has been achieved. The starter will disengage when the GCP detects that the frequency has exceeded 15Hz or higher (dependent upon how "Firing speed reached f> 00Hz" (Parameter 272) is configured).

Parameter 274

```
Number of pickup
teeth       000
```

only configurable via LeoPC1

Magnetic pickup; number of teeth on flywheel **30 to 280**

Number of pulses per revolution.

Plausibility monitoring:
The GCP performs plausibility checks to ensure that the frequency of the voltage and engine speed match. This is performed by comparing the frequency of the generated voltage and the mechanical speed of the engine as determined by the MPU signal. If the two frequencies are not identical, a F1 class alarm is issued. Plausibility monitoring is enabled after the delayed engine monitoring (Parameter 271) expires and is performed continuously while the generator is operating.

Parameter 275

```
Gen.rated speed1
      0000 rpm
```

only configurable via LeoPC1

Magnetic pickup; rated speed at rated frequency 1 **0 to 3,000 rpm**

The number of revolutions per minute that the engine will turn at while the generator is producing voltage at the rated frequency 1 (Parameter 8).

Note
In normal direct drive applications the following are typical settings. These values will vary if a transmission is used.
60Hz = 1800 RPM
50Hz = 1500 RPM

Parameter 276

```
Gen.rated speed2
      0000 rpm
```

only configurable via LeoPC1

Magnetic pickup; rated speed at rated frequency 2 **0 to 3,000 rpm**

The number of revolutions per minute that the engine will turn at while the generator is producing voltage at the rated frequency 2 (Parameter 10).

Note
In normal direct drive applications the following are typical settings. These values will vary if a transmission is used.
60Hz = 1800 RPM
50Hz = 1500 RPM

 © Woodward

Counter / Real Time Clock

NOTE

The parameters for this control are grouped together in blocks to permit navigation through the large number of configuration screens more rapidly. Selecting "YES" or "NO" has no effect whether or not control or monitoring is carried out for the parameters located in that block. Selecting "YES" or "NO" only determines if the individual parameters may be accessed and changed or are bypassed.

Parameter 277

```
Configure
counters      YES
```

Configuration of the counters **YES/NO**

The counters are configured in this block of parameters. This parameter has the following effects:

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

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

Maintenance Call

Parameter 278

```
Service interval
in          0000h
```

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

A maintenance counter may be desired to alert the operator that the generator has run for a specified number of hours and preventive maintenance should be performed. This parameter defines the length of the time period for the maintenance call. This timer functions as a count down timer. When this time expires, a message is issued (F1 class alarm) to alert the operator.

Note

The maintenance call counter may be disabled, preventing the maintenance alarm from being issued, by configuring the time for 0000h.

Proceed as follows to acknowledge the maintenance call:

- After the maintenance interval has expired, the message "**Service**" is displayed, the alarm LED is flashing, and the horn (if present) is enabled.
- The horn may be silenced by pressing the RESET button. The maintenance call may not be acknowledged at this point in time.
- The maintenance will be performed now.
- After successful maintenance, acknowledge the message by navigating to the display screen "**Service in 000h**" using the "Select" button.
- Press and hold the "Digit" button for 10 seconds.
- The time remaining in the new maintenance interval is displayed, but the message "**Service**" remains active.
- Acknowledge the message by pressing the RESET button.

NOTE

If a maintenance is to be performed before the maintenance interval expires, the new maintenance interval may also be reset as described bove.

Operating Hours Counter

NOTE

If the MDEC or J1939 coupling is enabled, the operating hours will be taken over from the engine control unit. Please refer to manual 37382 for further information.

Parameter 279

```
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 the controller is retrofitted to an older engine or the controller is replacing an older controller.

Note:
The operating hours counter may only be accessed from code level 2.

NOTE

If the operating hours counter is to be changed from the factory default value, the controller must be in code level CS2 before the change can be made. For safety reasons, the counter is set in a 2-step sequence.

The following sequence applies:

Step 1: **Configure new value**
-- Set and store the desired operating hours

Step 2: **Integrate the new operating hours**
-- Terminate the configuration mode and switch to AUTOMATIC mode
-- Display the operating hours
-- Press and hold the "Digit" button for at least 5 seconds.

Rental Duty Time Counter

The RPQ Rental Package provides an rental duty time counter with minute resolution (max. 9999:59h). It may be accessed in every code level. This counter is an additional operating hours counter which may be used for charging the cost when renting the unit.

The rental duty time counter may be reset to 0 before utilization for example. In order to perform this, the unit must be in code level 2, the rental duty time counter must be displayed, and then the Digit button must be pressed for at least 5 s.

NOTE

The rental duty time counter cannot be used to count the actual operating hours because it may be reset independently from the operating hours counter.

 © Woodward

Start Counter

Parameter 280

```
Set start
counter    00000
```

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

The start counter is used to display how many starts of the engine have been attempted. Following each starting attempt (successful or not) the start counter is increased by one. This parameter permits the user to display the correct number of starts if this controller is retrofitted to an older engine, a starter is replaced, or this controller is replacing 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 value, the controller must be in code level CS2 before the change can be made. For safety reasons, the counter is set in a 2-step sequence.

The following sequence applies:

Step 1: **Configure new value**
-- Set and store the desired number of starts

Step 2: **Integrate the new number of starts**
-- Terminate the configuration mode and switch to AUTOMATIC mode
-- Display the number of engine starts
-- Press and hold the "Digit" button for at least 5 seconds

kWh Counter

Parameter 281

```
kWh counter
set in       ---
```

Counter; power measurement scaling **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 282

```
kWh counter
set     00000---
```

Counter; kWh **0 to 65,500 kWh/MWh**

The kWh/MWh counter (depending on Parameter 281) is used to display how much power the generator has produced. This parameter permits the user to display the correct kWh/MWh if this controller retrofitted to an older generator or this controller is replacing an older controller.

NOTE

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

The following proceeding is valid:

Step 1: **Configure new value**
-- Set and store the desired counter values for the parameters 293 and 294

Step 2: **Integrate the new value**
-- Terminate the configuration mode and change to AUTOMATIC mode
-- Display the kWh counter
-- Press and hold the "Digit" button for at least 5 seconds

Real Time Clock

NOTE

If multiple GCP control units are on a common CAN bus, all clocks are synchronized daily at 12:00 o'clock (noon) to the time of the control with the lowest CAN bus ID/generator number (Parameter 4). This makes it essential that each GCP has a different control number.

Parameter 283

```
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 (midnight)
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 284

```
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 285

```
Day/weekday
          01/1
```

Real time clock; day/day of week

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

© Woodward

Timer Switch

The relay with relay manager function 147 may be enabled time-dependent. There are two parameters to configure an enable and a disable time for this relay. Another parameter is available to configure the weekdays at which these times are enabled.

If you want to perform a time-dependent genset start for example, this relay output may be connected to the input at terminal 3.

Parameter 286

```
Timer on
at        00:00
```

Timer enable time **00:00 to 23:59**

The time at which the relay with relay manager function 147 is to be enabled must be configured here.

Parameter 287

```
Timer off
at        00:00
```

Timer disable time **00:00 to 23:59**

The time at which the relay with relay manager function 147 is to be disabled must be configured here. (The time configured here must be later than the enable time because the enable and disable time must always be within one day.)

Parameter 288

```
Week      M     S
days      NNNNNNN
```

Weekdays **Y/N**

Y(es)..... The switch times configured above are considered on the assigned weekdays.
N(o)..... No switch times are considered on the assigned weekdays.

NOTE

Since this function affects a relay only, it cannot be enabled and disabled separately. If the function shall not be used, relay manager function 147 must not be configured in the Relay Manager.

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" button. The following screen appears in the display:

Parameter 289

```
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.

Option SC09 Parameters

NOTE

Refer to the Option SC09 manual 37382 for a detailed description of the functions and parameters.

NOTE

The following parameters may only be configured with LeoPC1 and not directly at the unit.

NOTE

The parameters for this control are grouped together in blocks to permit navigation through the large number of configuration screens more rapidly. Selecting "YES" or "NO" has no effect whether or not control or monitoring is carried out for the parameters located in that block. Selecting "YES" or "NO" only determines if the individual parameters may be accessed and changed or are bypassed.

Engine Bus

Parameter 290

```
Configure
engin.bus     YES
```

Configuration of the engine bus **YES/NO**

The engine bus is configured in this block of parameters. This parameter has the following effects:

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

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

Parameter 291

```
CAN baud rate
          000kBd
```

Baud rate of the engine CAN bus **100/125/250/500 kBaud**

Baud rate of the engine CAN bus. Please note that **all** participants at the engine CAN bus have to be operated with the same baud rate.
The default value is 250 kBaud.
(If an MDEC unit is to be connected, 125 kBaud is to be configured here.)

 © Woodward

IKD 1 - Digital Expansion Card

Parameter 292

```
IKDx on bus
          NO
```

[x = 1/2]

IKD 1.x on bus **YES/NO**

YES..... The IKD 1 functions are activated. Moreover, it is monitored whether the IKD 1.{x} is connected to the engine bus. If this parameter is set to YES, but the IKD 1.{x} is not connected to the CAN bus, an interface error will be triggered in the GCP.

NO..... The functions of the IKD 1 are locked and no communication monitoring to IKD1.{x} is performed.

Parameter 293

```
Assignment x.
relay on IKDy
```

[x = 1 to 8], [y = 1/2]

Configuration of the relay outputs on the IKD 1.y **refer to Relay Manager**

The relay {x} on the IKD 1.{y} energizes if the configured logical condition is fulfilled.
Refer to Relay Manager on page 122 for programming details.

Parameter 294

```
Error text DIx
IKDy (term. z)
```

[x = 1 to 8], [y = 1/2]
[z = 5 to 12]

Configuration of the IKD 1.y alarm texts

The discrete input {x} (term. {y}) on the IKD 1.{z} displays the text configured here at the GCP display.

MDEC Engine Control

Parameter 295

```
MDEC
----------------
```

Note
MDEC cannot be operated simultaneously with J1939 coupling

MDEC **OFF / Visual/Control / Visualization / Control**

OFF..... The mtu MDEC coupling is disabled and no MDEC data is processed. A faulty MDEC connection cannot trigger an interface error Y1Y5.

Visual/Control - The mtu MDEC coupling is enabled, MDEC values and the following parameters are displayed, and values are sent to the MDEC.

Visualization - The mtu MDEC coupling is enabled and MDEC values and the following parameters are displayed.

Control ..... The mtu MDEC coupling is enabled, the following parameters are displayed, and values are sent to the MDEC.

Note: This parameter should be set to "Visual/Control" in MDEC operation, since MDEC expects the speed setting even if the control is performed via analog or three-step controllers.
If the parameter is **not** set to "OFF", a faulty MDEC connection can trigger an interface error Y1Y5 depending on the setting of the parameter interface monitoring.

(If an interface error is triggered by the MDEC, the display values are overwritten with question marks.)

Parameter 296

```
MDEC protocol
          ---
```

MDEC protocol **V302 / V303 / V304**

Firmware version of the MDEC.
Configure the protocol implemented in the MDEC here.

SAE J1939 Engine Control

Parameter 297

```
J1939
---------------
```

Note
J1939 coupling cannot be operated simultaneously with MDEC!

J1939 **AUS / Standard / EMR2 / S6**

OFF .....The J1939 coupling is disabled and no J1939 data is processed. A faulty J1939 connection cannot trigger an interface error Y1Y5.

Standard .....The J1939 coupling is enabled, J1939 data is displayed according to the SAE J1939 standard and the following parameters are displayed. A faulty J1939 connection can trigger an interface error Y1Y5. (If an interface error is triggered by the J1939 component, the display values are overwritten with question marks.)

EMR2.....The Deutz EMR2 coupling is enabled and EMR2 specific data and the following parameters are displayed. A faulty J1939 connection can trigger an interface error Y1Y5.

S6.....The Scania EMS/S6 coupling is enabled and EMS/S6 specific data and the following parameters are displayed. A faulty J1939 connection can trigger an interface error Y1Y5.

Parameter 298

```
Remote con.J1939
             ON
```

Note
The setting is only effective with **Scania S6**!

Remote control **ON/OFF**

OFF .....Remote control is disabled. The GCP sends **no** control commands to the ECU.

ON.....The GCP sends a rated speed, a speed offset, as well as a start or stop command to the Scania ECU (refer to the following text for details). In addition, the GCP may also command an idle and override mode.

Parameter 299

```
J1939 unit numb.
             000
```

J1939 unit number **0 to .255**

The GCP processes only data from a J1939 device, which sends using this CAN device number.

© Woodward

Speed Offset

Parameter 300

```
max speed offset
      000 1/min
```

This parameter is only important if the set value pre-setting to the MDEC has to be performed via the CAN bus. The nominal power is controlled via a nominal speed for a power control. The speed offset to be configured here depends on the droop characteristics of the engine. To simplify the adjustment, the speed offset can be determined as follows:

A speed control is only possible if the frequency controller is set to ANALOG. If the control is not active yet, the output is calculated as follows:

$$n_{output} = n_{rated} + \frac{\left(\left(IP - 50\%\right) \times n_{\max Offset}\right) \times 2}{100\%}$$

$n_{maxOffset}$ ..... **maximum speed offset** [min^{-1}]
n_{output} ..... output value [min^{-1}]
n_{rated} ..... rated speed [min^{-1}]
IP ..... initial position [%]

Examples:
Initial position = 50% -> output value = rated speed
Initial position = 0% -> output value = rated speed - maximum speed offset
Initial position = 100% -> output value = rated speed + maximum speed offset

MDEC:
The speed offset indicates the maximum speed deviation from the rated speed here. The speed offset may be determined as follows to ease setting:
Without set point pre-setting at the MDEC, the engine will be loaded half or full. The speed drop occurring with this can be entered directly as speed offset with full load. When determining under half load, the double value is to be entered. Please refer to the MDEC manual for more information.

Scania:
The speed offset is an additional "controller gain" here. This should be 1. Therefore, the same value, which is configured in the Scania ECU, must be configured here. It is required for this function to work that the max. deviation from the rated value is configured symmetrically in the ECU, i.e. the positive and the negative speed deviation has the same value.
(The value configured in the ECU may be read out using the Scania configuration tool.)

Note:
In order to utilize the speed output for MDEC via CAN, the analog controller for frequencies has to be configured with maximum output range.

ECU Interface Monitoring

Parameter 301

```
ECU interface
monitoring   YES
```

ECU interface monitoring **YES/NO**

YES .....If the connection MDEC-GCP or J1939-GCP or the power supply is interrupted for approx. 6 s, the message "interf.err. Y1Y5" is displayed with alarm class 1. Additionally, the display values will be overwritten with question marks.
Some ECUs show the behavior that the CAN bus is only active if the ignition is energized, i.e: **disabling the ignition results a faulty display**.

No .....If the connection MDEC-GCP or J1939-GCP is interrupted, this message is not displayed.

Note: This setting has no effect on the interface error triggering for IKD and ST3. It has also no influence on the relays with the parameters 134 to 138.

Monitoring Function (J1939 and MDEC)

Parameter 302

```
Monitoring ECU
Values      ON
```

Monitoring ECU values (oil pressure, coolant temp., speed) **ON/OFF**

ON .....The values for oil pressure, coolant temperature, and speed, sent by the ECU via CAN, may be monitored for exceeding configurable limits by the GCP. The watchdogs and the display screens of the analog inputs T6, T7 and the pickup input evaluate the ECU values with this setting. **Therefore, the input signals of the analog inputs T6, T7 and the pickup input are not displayed and not monitored**.

The ECU oil pressure value is displayed for "analog input" T6, coolant temperature for "analog input" 7, and speed instead of the standard speed display. For this, these "inputs" must be **enabled** under analog inputs or engine.
The monitoring will be performed with the monitoring parameters configured for these "inputs".

The analog inputs T6 and T7 should be configured with the respective name and the respective unit (pressure: 00,0bar or 000,0psi.; temp.: 000°C or 000°F).

OFF .....No monitoring of the ECU values will be performed. The analog inputs T6, T7 and the pickup input of the GCP may be used as usual.

Note - The monitoring will be suppressed in case of a CAN bus fault. Since a reliable monitoring cannot be guaranteed anymore, it must be ensured that the engine shuts down automatically when reaching critical values!

 © Woodward

Chapter 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:

LIFE THREATENING

WARNING

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

WARNING

A discrete Input assigned to an "Emergency Stop" function is only a signaling input. This input may only be used to signal that an external emergency stop button has been actuated. According to EN 60204, this input is not approved to be used as the emergency stop function. The emergency stop function must be implemented external to the control and cannot rely on the control to function properly.

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. Simultaneously pressing the "Digit↑" and "Cursor→" buttons will enable the configuration mode. After entering the proper access code number, the unit may be configured according to the application requirements (refer to the parameters section).

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" button). Start the engine ("START" button) and then stop it ("STOP" 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" button): Applying the automatic control inputs and the engine start request can now carry out automatic starting with subsequent synchronization.

   Check synchronization: Disable the GCB from being able to close onto the two systems. 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 re-enable the GCB closing circuit ("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 mode button to return the controller back to the AUTOMATIC operation mode.

   Check the generator busbar and the mains rotating field. Disable the MCB from being able to close onto the two systems. 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-enable the GCB closing circuit ("Command: close MCB") with the engine in "STOP" mode.

9. Test the emergency power operation functions

NOTE

The MCB and GCB reply messages are processed as negative logic. When the breaker is open, the breaker reply (terminal 4/54) input should be energized (12/24Vdc). When the breaker is closed, the corresponding breaker reply input is de-energized (0Vdc). The circuit breaker auxiliary contacts should be configured as normally closed! The CB aux contacts should be configured as normally closed! Refer to the description of the auxiliary and control inputs starting on page 9. 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.

 © Woodward

Appendix A.
Analog output manager

NOTE

The functions listed below can only be output correctly if the existing version of the control permits this.

Function	Output	Value	Input of the two limit values
0	The analog output is disabled.	N/A	N/A
1	Actual generator real power	[dimensionless]	0% Lower power limit (can also be negative) e.g. -0050 kW 100% Upper power limit (can also be negative) e.g. 0200 kW
2	Actual generator power factor φ [e.g. (-070 to +080) /100] (Definition at end of Table)	[dimensionless]	0% Lower interval to power factor φ=1 e.g. -0030 corresponds to c0.70 100% Upper interval to power factor φ=1 e.g. 0030 corresponds to i0.70
3	Actual generator frequency	[Hz∗100]	0% Lower frequency e.g. 0000 corresponds to 00.00 Hz. 100% Upper frequency e.g. 7000 corresponds to 70.00 Hz.
4	Actual generator reactive power	[kvar]	0% capacitive reactive power (negative) e.g -0100 kvar 100% inductive reactive power (positive) e.g. +0100 kvar
5	Rated power of all generators connected to generator busbar minus nominal actual power	[kW]	0% Lower power (can also be negative) e.g.-0050 kW 100% Upper power (can also be negative) e.g. 0200 kW
6	Total actual power of all generators connected to generator busbar	[kW]	
7	Generator apparent current in L1	[A]	0% Lower current output e.g. 0000 A 100% Upper current output e.g. 500 A
8	Generator apparent current in L2	[A]	
9	Generator apparent current in L3	[A]	
10	Speed via MPU	[min^{-1}]	0% Lower speed e.g. 0000 rpm 100% Upper speed e.g. 3000 rpm

Function	Output	Value	Input of the two limit values
11	Analog input [T1]	[°C] or [°F] or freely scaleable	0% Lower measured value e.g. 0000 corresponds to 000 °C at temperature input 100% Upper measuring value e.g. 0255 corresponds to 255 °C at temperature input 0% Lower measured value e.g. 0000 corresponds to 00.0 bar oil pressure 100% Upper measured value e.g. 0100 corresponds to 10.0 bar oil pressure
12	Analog input [T2]	[°C] or [°F] or freely scaleable	
13	Analog input [T3]	[°C] or [°F] or freely scaleable	
14	Analog input [T4]	[°C] or [°F] or freely scaleable	
15	Analog input [T5]	[°C] or [°F] or freely scaleable	
16	Analog input [T6]	[Bar] or [PSI] or freely scaleable	
17	Analog input [T7]	[Bar] or [PSI] or freely scaleable	
18	--free--	[°C] or [°F] or freely scaleable	
19	Actual mains interchange (import/export) real power	[kW]	0% lower power e.g. -0800 kW 100% upper power e.g. 0800 kW
20	Mains apparent current in L1	[A]	0% Lower current output e.g. 0000 A 100% Upper current output e.g. 500 A
21	Mains power factor φ [e. g. (-070 to +080) /100] (Definition at end of Table)	[dimensionless]	0% Lower interval to power factor φ=1 e.g. -0030 corresponds to k0,70 100% Upper interval to power factor φ=1 e.g. 0030 corresponds to i0,70
22	Actual mains reactive power	[kvar]	0% capacitive reactive power (negative) e.g. -0100 kvar 100% inductive reactive power (positive) e.g. +0100 kvar
23	--free--		
24	Generator real power set point, which is currently issued by the ramp of the real power controller (Parameter 72) The actual value of the generator real power is issued in isolated operation	[kW]	0% lower set point e.g. 0000 kW 100% higher set point e.g. 0800 kW

© Woodward

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 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.

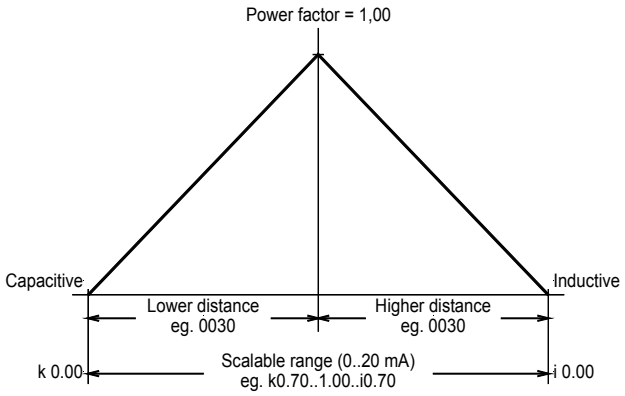


Figure 4-1: Analog outputs - power factor scaling

Appendix B.
Relay Manager

No.	Output	Explanation
1	Alarm class 1	
2	Alarm class 2	
3	Alarm class 3	
4	Firing speed reached (engine running)	
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	AUTOMATIC operation mode	
8	MANUAL operation mode	
9	TEST operation mode	
10	STOP operation mode	
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 unbalanced load	
19	Generator overload	
20	Generator reverse/reduced power	
21	Readiness for operation	Output via relay manager
22	Analog input [T1], level 1	
23	Analog input [T1], level 2	
24	Analog input [T2], level 1	
25	Analog input [T2], level 2	
26	Analog input [T3], level 1	
27	Analog input [T3], level 2	
28	Analog input [T4], level 1	
29	Analog input [T4], level 2	
30	Analog input [T5], level 1	
33	Analog input [T5], level 2	
32	Analog input [T6], level 1	
33	Analog input [T6], level 2	
34	Analog input [T7], level 1	
35	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]	

 © Woodward

No.	Output	Explanation
51	Discrete input [D16]	
52	Auxiliary services	i.e. prelube/cooling pumps
53[#1]	--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	Interface fault Y1/Y5	
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	MCB connected / synchronization 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	MPU speed/generator frequency mismatch	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 will be performed	
72	MCB synchronization will be performed	
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 not able to achieve zero power (P>0<P)	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 for dead bus start exceeded	
80	Generator power watchdog, level 2	

[#1] special versions only

No.	Output	Explanation
81	CCW mains rotating field	
82	Engine enable	**Set engine enable** As long as there is a start request for the engine and during cool down, the operation of the engine is enabled (i.e. AUTOMATIC operation mode and discrete input 3/5, emergency power, start via interface, manual start, etc. are energized/enabled). **Reset engine enable** The engine enable will be reset if a start request is no longer present due to a manual stop, an F3 alarm class, or during the engine stop time, and if "zero" speed is detected and a start request is not present or coasting is not taking place.
83	"RESET" 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 shu-toff
86[#1]	--Internal--	
87[#1]	--Internal--	
88	Generator voltage and/or frequency are not in range (undelayed)	
89	Busbar voltage and/or frequency are not in range (undelayed)	
90[#1]	--Internal--	
91	MPU detects 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	IKD1 discrete input 1	
99	IKD1 discrete input 2	
100	IKD1 discrete input 3	
101	IKD1 discrete input 4	
102	IKD1 discrete input 5	
103	IKD1 discrete input 6	
104	IKD1 discrete input 7	
105	IKD1 discrete input 8	
106	IKD2 discrete input 1	
107	IKD2 discrete input 2	
108	IKD2 discrete input 3	
109	IKD2 discrete input 4	
110	IKD2 discrete input 5	
111	IKD2 discrete input 6	
112	IKD2 discrete input 7	
113	IKD2 discrete input 8	

[#1] special versions only

 © Woodward

No.	Output	Explanation
114	Three-position controller: n+ / f+ / P+	(use an external Resistive/Capacitive protection circuit)
115	Three-position controller: n- / f- / P-	
116	Three-position controller: V+ / Q+	
117	Three-position controller: V- / Q-	
118[#1]	--Internal--	
119	Wire break Analog input [T1]	
120	Wire break Analog input [T2]	
121	Wire break Analog input [T3]	
122	Wire break Analog input [T4]	
123	Wire break Analog input [T5]	
124	Wire break Analog input [T6]	
125	Wire break Analog input [T7]	
126[#1]	--Internal--	
127[#1]	--Internal--	
128[#1]	--Internal--	
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	IKD1 communication OK	
135	IKD2 communication OK	
136[#1]	--Internal--	
137	MDEC communication OK	
138	J1939 communication OK	
139	Phase rotation generator and 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[#1]	--Internal--	
146	Parallel operation CB	from V4.3010
147	Timer switch	
148	Unintended stop	from V4.3010
149	Interface error X1/X5	from V4.3010
150	ECU yellow alarm	from V4.3030
151	ECU red alarm	from V4.3030
152	Mains connected detected by angle	
153	Mains power measurement active via cable-type current transformer at SYNCONpanel	
154[#1]	--Internal--	
155[#1]	--Internal--	
156[#1]	--Internal--	
157	Engine cool down	from V4.3046
158	Mains settling time is running	from V4.3046

[#1] special versions only

NOTE

Relay Manager functions with a number above 128 may only be configured with LeoPC1 Version 3.0.015 or later.

Appendix C.
Interface Protocol

NOTE

Only selected parameters are transmitted via the interface depending on the Package configuration.

Transmission Telegram

MUX	No.	Contents (words)	Unit	Note
0/1	1	Generator voltage delta V_{12}	$V \times 10^{UGNEXPO}$	
0/2	2	Generator frequency f	Hz × 100	
0/3	3	Actual generator real power P	$W \times 10^{PGNEXPO}$	
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}	$V \times 10^{UGSSEXPO}$	
2/2	8	Mains voltage delta V_{12}	$V \times 10^{UNTEXPO}$	
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, reply: GCB is closed Bit 5 = 1 \ Bit 4 = 1 / Terminal 54, 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

© Woodward

MUX	No.	Contents (words)	Unit	Note	
3/2	11	Actual mains interchange (import/export) real power	$W \times 10^{PNTEXPO}$		
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		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}	$V \times 10^{UGNEXPO}$		
5/1	16	Generator voltage delta V_{31}	$V \times 10^{UGNEXPO}$		
5/2	17	Generator voltage wye V_{1N}	$V \times 10^{UGNEXPO}$		
5/3	18	Generator voltage wye V_{2N}	$V \times 10^{UGNEXPO}$		
6/1	19	Generator voltage wye V_{3N}	$V \times 10^{UGNEXPO}$		

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 power factor cos φ		Example: `FF9EH` cos φ = c 0.98 (capacitive/lagging) `FF9DH` cos φ = c 0.99 (capacitive/lagging) `0064H` cos φ = 1.00 `0063H` cos φ = i 0.99 (inductive/leading) `0062H` cos φ = i 0.98 (inductive/leading)						
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							

© Woodward

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/lagging) FF9DH cos φ = c 0.99 (capacitive/lagging) 0064H cos φ = 1.00 0063H cos φ = i 0.99 (inductive/leading) 0062H cos φ = i 0.98 (inductive/leading)						
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.`)	$kWh \times 2^{16}$	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 add-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

© Woodward

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 unbalanced load
				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--
				Bit 3 = 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 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.	

© Woodward

MUX	No.	Contents (words)	Unit	Note	
22/2	**68**	Alarm messages IKD2 ***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	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--
				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
IGNEXPO Exponent Generator current
PGNEXPO Exponent Generator power
PGNWD Step conversion factor → kW

USSEXPO Exponent Busbar voltage
UNTEXPO Exponent Mains voltage
PNTEXPO Exponent Mains power

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	Pre-glow
9	Purging operation
10	Initial state
11	Auxiliary prerun
12	Auxiliary post-run
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	Idle run
45	--Internal--
46	--Internal--
47	Power reduction
...	
255	No message on the display (basic screen)

 © Woodward

Receiving Telegram

A Gateway GW 4 may be used for remote starting the GCP. The following three data words can be received by the GCP. Refer to the GW 4 manual on how to control several GCP control units.

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

CAN Bus Structure

Transmission Telegram

The data of the following table can be handled by a Gateway GW 4 or a PLC and can be transferred to other communication busses. A GCP is sending the data via circular CAN messages.

The transmitting rate of this communication is 125 kBaud.

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

CAN ID = 800 + item/generator number (or 320 + ID/generator number)

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

A visualization message, which is sent out of a GCP, has 8 Bytes and is assembled as follows:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
H‘DD	MUX number	data word 1 High-Byte	data word 1 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 GCP includes more than three words byte 1 sends an additional 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 cannot be larger than H’FF.

Current Direction Message

The current direction can be recognized via the code word prefix. A positive transmitted value indicates exported power (power supplied to the mains, supply) and a negative transmitted value indicates imported power (power supplied by the mains, consumption).

 © Woodward

Power Set Point Value Message

The following power values may be pre-specified: constant/baseload power (C power), outgoing/export power (E power) and incoming/import power (I power). The real power set point value is transmitted in binary form using bits 0-13. The control argument must be transmitted in the basis of bits 14 and 15. In this case, the following coding applies:

Control argument	Bit 15	Bit 14
C power	0	1
E power	0	0
I power	1	1

Example:
C power of 150 kW is to be compensated. The value transmitted is then:

01/00 0000 1001 0110 B ⇨ 4096 H

E power of 300 kW is to be compensated. The value transmitted is then:

00/00 0001 0010 1100 B ⇨ 012C H

I power of 600 kW is to be compensated. Negative power is transmitted. The value transmitted is then:

11/11 1101 1010 1000 B ⇨ FDA8 H

CAN Bus Address Requirements

The IDs given in the following are reserved for the data exchange between GCPs and LS4s. If third-party devices are connected to the bus, third-party device addresses must not conflicts with these addresses.

	CAN-ID in [hex]	[decimal]
GCP sends		
Distribution message to other GCPs	180 + GENNO	384 + GENNO
Control message to LS4 (the GCP with the lowest ID)	311	785
Visualization	320 + GENNO	800 + GENNO
GCP receives		
Distribution message from other GCP	180 + GENNO	384 + GENNO
Control message from an LS4	300 + GENNO	768 + GENNO
Configuration messages from a higher control	33F	831
LS4 sends		
Logic message to other LS4s	180 + LS4NO	384 + LS4NO
Control message to GCP (the LS4 with the lowest ID)	300 + GENNO	768 + GENNO
LS4 receives		
Logic message from other LS4	180 + LS4NO	384 + LS4NO
Control message from a GCP	311	785
Configuration messages and Configuration messages from a higher control	33F	831

	[hex]	[decimal]
GENNO =	1 to E	1 to 14
LS4NO =	11 to 1E	17 to 30

GENNO = Generator number
LS4NO = LS4 number

Appendix D.
List of Parameters

Unit number P/N _____ Rev _____

Version GCP-30 _____

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
L	**Rated Frequency System 1**	50.0 to 60.0 Hz	50.0 Hz		
L	**Setpoint Frequ. System 1**	45.0 to 65.0 Hz	50.0 Hz		
L	**Rated Frequency System 2**	50.0 to 60.0 Hz	60.0 Hz		
L	**Setpoint Frequ. System 2**	45.0 to 65.0 Hz	60.0 Hz		
	Rated Voltage System 1	50 to 500 V	400 V		
L	**Setpoint Voltage System 1**	50 to 530 V	400 V		
L	**CT generator System 1**	10 to 7,000/{X} A	500/{X} A		
L	**Gen Rated curr. System 1**	10 to 7,000 A	300 A		
L	**Gen rated power System 1**	5 to 9,999 kW	200 kW		
	Rated Voltage System 2	50 to 500 V	200 V		
L	**Setpoint Voltage System 2**	50 to 530 V	200 V		
L	**CT generator System 2**	10 to 7,000/{X} A	500/{X} A		
L	**Gen Rated curr. System 2**	10 to 7,000 A	520 A		
L	**Gen rated power System 2**	5 to 9,999 kW	180 kW		
	Rated Voltage System 3	50 to 500 V	440 V		
L	**Setpoint Voltage System 3**	50 to 530 V	440 V		
L	**CT generator System 3**	10 to 7,000/{X} A	500/{X} A		
L	**Gen Rated curr. System 3**	10 to 7,000 A	270 A		
L	**Gen rated power System 3**	5 to 9,999 kW	200 kW		
	Rated Voltage System 4	50 to 500 V	220 V		
L	**Setpoint Voltage System 4**	50 to 530 V	220 V		
L	**CT generator System 4**	10 to 7,000/{X} A	500/{X} A		
L	**Gen Rated curr. System 4**	10 to 7,000 A	480 A		
L	**Gen rated power System 4**	5 to 9,999 kW	180 kW		

© Woodward

	Parameter	Setting range	Default value	Customer setting	
GENERATOR AND MAINS ENVIRONMENT CONFIGURATION					
	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
L	Single phase	OFF Always ON via term. 61	OFF	☐ OFF ☐ A. ON ☐ via t. 61	☐ OFF ☐ A. ON ☐ via t. 61
L	Power measuring gen.	singlephase [1] threephase [3]	threephase	☐ 1 ☐ 3	☐ 1 ☐ 3
L	Analog in Pmains	OFF/T{x}	OFF		
L	Analog in Pmains	0 to 20 mA 4 to 20 mA	4 to 20 mA	☐ 0-20 mA ☐ 4-20 mA	☐ 0-20 mA ☐ 4-20 mA
L	Analog in Pmains 0%	0 to +/-9,990 0 to +/-6,900 kW	-200 kW		
L	Analog in Pmains 100%	0 to +/-9,990 0 to +/-6,900 kW	200 kW		
L	Current transf. mains	5 to 7,000/{X} A	500 {X} A		
	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		
CONTROLLER CONFIGURATION					
	Configure controller	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
	Power controller Pset1	C/I/E 0 to 9,999 kW	C 50 kW		
	Power controller Pset2	C/I/E 0 to 9,999 kW	C 80 kW		
L	F/P contr.type	Three-step Analog PWM	Analog	☐ Three-st. ☐ Analog ☐ PWM	☐ Three-st. ☐ Analog ☐ PWM
L	F/P contr.output	Refer to Parameter 33	+/-10 V		
L	Level PWM	3.0 to 10.0 V	3.0 V		
L	Initial state Frequency	0 to 100 %	50 %		
	Freq.controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
L	Freq.controller deadband	0.02 to 1.00 Hz	0.03 Hz		
L	Freq.controller time pulse>	10 to 250 ms	80 ms		
L	Freq.controller gain Kp	0.1 to 99.9	20.0		
L	Stepper sign.frq (min.)	0 to 100 %	0 %		
L	Stepper sign.frq (max.)	0 to 100 %	100 %		
L	Freq.controller gain Kpr	1 to 240	20		
L	Freq.controller reset Tn	0.0 to 60.0 s	1.0 s		
L	Freq.controller derivat.Tv	0.00 to 6.00 s	0.00 s		
	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		
	Frequ.controller droop	0 to 20 %	2 %		
L	V/Q contr.type	Three-step Analog	Analog	☐ Three-st. ☐ Analog	☐ Three-st. ☐ Analog
L	V/Q contr.output	Refer to Parameter 50	+/-10 V		
	Initial state voltage	0 to 100 %	50 %		
	Volt.controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	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		
	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		
	Start voltage U control.	12.0 to 100.0 %	75 %		
	Delayed. Start U contr.	0 to 999 s	3 s		
	Volt.controller droop	0.5 to 20 %	10 %		

	Parameter	Setting range	Default value	Customer setting	
CONTROLLER CONFIGURATION					
	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		
	Power controller	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	power controller ramp	0.1 to 100.0 %/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	C/I/E 0 to 9,999 kW	C 0 kW		
	Ext.setpoint 20mA	C/I/E 0 to 9,999 kW	C 200 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
L	Loadd.start/stop at ter.3	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
L	Loadd.start/stop at ter.5	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
L	Minimum load generator	0 to 6,900 kW	15 kW		
L	Add-on delay mains oper.	0 to 999 s	1 s		
L	Shed-off delay mains oper.	0 to 999 s	3 s		
L	Hysteresis add-. on/off op.	0 to 9,999 kW	5 kW		
L	Reserve power mains op.	0 to 9,999 kW	10 kW		
L	Priority of generators	0 to 14	0		
L	Reserve power isol.op.	0 to 9,999 kW	20 kW		
L	Add-on delay isol.op.	0 to 999 s	1 s		
L	Shed-off delay isol.op.	0 to 999 s	4 s		
	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
L	Power On Mode	STOP / MANUAL / AUTO-MATIC / as before	STOP	☐ S ☐ M ☐ A ☐ b	☐ S ☐ M ☐ A ☐ b
L	Interchange Mode in Manual	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N

© Woodward

	Parameter	Setting range	Default value	Customer setting	
BREAKER CONFIGURATION					
	Configure breaker	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	Breaker logic:	EXTERNAL [EXT] PARALLEL [PAR] OPEN TRANSIT [OPEN] CLOSED TRANSIT [CLOSE] INTERCHANGE [CHANG]	PARALLEL	☐ EXT ☐ PAR ☐ OPEN ☐ CLOSE ☐ CHANG	☐ EXT ☐ PAR ☐ OPEN ☐ CLOSE ☐ CHANG
	Add-on/off ramp max.time	0 to 999 s	20 s		
	Open GCB with F2 max.time	0 to 999 s	10 s		
L	GCB close.relay	Impulse [I] Constant [C]	Constant	☐ I ☐ C	☐ I ☐ D
L	GCB open relay	NO-contact [NO] NC-contact [NC]	NO-contact	☐ NO ☐ NC	☐ NO ☐ NC
	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		
	Phase matching	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Phase matching gain	1 to 36	2		
	Phase matching df start	0.02 to 0.25 Hz	0,20 Hz		
	Detection Mains connected <	1 to 15 °	5 °		
	Detection Mains conn. after	0 to 999 s	10 s °		
	Sync.time contr.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Sync.time contr. delay	10 to 999 s	180 s		
L	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		
	MCB dead bus op.	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Supervision GCB	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Supervision MCB	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	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
L	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		

	Parameter	Setting range	Default value	Customer setting	
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		
	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		
	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. Hysteresis	0.0 to 50.0 %	0.8 %		
	Mains undervolt. delay	0.02 to 9.98 s	0.06 s		
	Phase shift monitoring	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
	Monitoring	one-/threephase [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		

© Woodward

	Parameter	Setting range	Default value	Customer setting	
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		
L	Errortxt.term.34	freely configurable	EMERGENCY OFF		
L	Errortxt.term.35	freely configurable	terminal 35		
L	Errortxt.term.61	freely configurable	terminal 61		
L	Errortxt.term.62	freely configurable	terminal 62		
L	Firing speed by Term. 62	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
L	Errortxt.term.63	freely configurable	terminal 63		
L	Op.mode blocked by Ter.63	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
L	Errortxt.term.64	freely configurable	terminal 64		
L	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
L	Errortxt.term.65	freely configurable	terminal 65		
L	f/P setpoint by term.65/66	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
L	Errortxt.term.66	freely configurable	terminal 66		
L	Errortxt.term.67	freely configurable	terminal 67		
L	V/Q setpoint by term.67/69	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
L	Errortxt.term.68	freely configurable	terminal 68		
L	Emergency OFF by Ter.68	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
L	Errortxt.term.69	freely configurable	terminal 69		
L	Errortxt.term.70	freely configurable	terminal 70		
L	Idle mode by Term.70	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
	Function term.6	Engine enabled [EE] ext.acknowledgment [ExA] STOP mode [SM] Engine blocked [EB] Start without CB [SwB]	ExA	☐ EE ☐ ExA ☐ SM ☐ EB ☐ SwB	☐ EE ☐ ExA ☐ SM ☐ EB ☐ SwB
	Start withno GCB cool down	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off

	Parameter	Setting range	Default value	Customer setting	
ANALOG INPUTS CONFIGURATION					
L	**Input terminal 93**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 93 text**	freely configurable	Analog 1		
L	**Input terminal 93 range**	0 to 20 mA 4-20 mA	4 to 20 mA	☐ 0-20 mA ☐ 4-20 mA	☐ 0-20 mA ☐ 4-20 mA
L	**Input terminal 93 value at 0%**	-9999 to +9999	0		
L	**Input term. 93 value at 100%**	-9999 to +9999	100		
L	**Input term. 93 limit warning**	-9999 to +9999	80		
L	**Input term. 93 limit shutdown**	-9999 to +9999	90		
L	**Input terminal 93 delay time**	0 to 650 s	1 s		
L	**High limit monitoring**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 96**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 96 text**	freely configurable	Analog 1		
L	**Input terminal 96 range**	0 to 20 mA 4-20 mA	4 to 20 mA	☐ 0-20 mA ☐ 4-20 mA	☐ 0-20 mA ☐ 4-20 mA
L	**Input terminal 96 value at 0%**	-9999 to +9999	0		
L	**Input term. 96 value at 100%**	-9999 to +9999	100		
L	**Input term. 96 limit warning**	-9999 to +9999	80		
L	**Input term. 96 limit shutdown**	-9999 to +9999	90		
L	**Input terminal 96 delay time**	0 to 650 s	1 s		
L	**High limit monitoring**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 99**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 99 text**	freely configurable	Analog 1		
L	**Input terminal 99 range**	0 to 20 mA 4-20 mA	4 to 20 mA	☐ 0-20 mA ☐ 4-20 mA	☐ 0-20 mA ☐ 4-20 mA
L	**Input terminal 99 value at 0%**	-9999 to +9999	0		
L	**Input term. 99 value at 100%**	-9999 to +9999	100		
L	**Input term. 99 limit warning**	-9999 to +9999	80		
L	**Input term. 99 limit shutdown**	-9999 to +9999	90		
L	**Input terminal 99 delay time**	0 to 650 s	1 s		
L	**High limit monitoring**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 102**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 102 text**	freely configurable	Analog 4		
L	**Input term. 102 limit warning**	0 to 200 °C	80 °C		
L	**Input term. 102 limit shutd.**	0 to 200 °C	90 °C		
L	**Input terminal 102 delay time**	0 to 650 s	1 s		
L	**High limit monitoring**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 105**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 105 text**	freely configurable	Analog 5		
L	**Input term. 105 value at 0%**	-9999 to +9999	0		
L	**Input term. 105 value at 100%**	-9999 to +9999	100		
L	**Input term. 105 limit warning**	-9999 to +9999	80		
L	**Input term. 105 limit shutd.**	-9999 to +9999	90		
L	**Input terminal 105 delay time**	0 to 650 s	1 s		
L	**High limit monitoring**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 108**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 108 text**	freely configurable	Analog 6		
L	**VDO Ter.108 as:**	0 to 5 bar 0 to 10 bar	0 to 5 bar	☐ 0-5 bar ☐ 0-10 bar	☐ 0-5 bar ☐ 0-10 bar
L	**Input term. 108 limit warning**	0.0 to 10.0 bar	2.0 bar		
L	**Input term. 108 limit shutd.**	0.0 to 10.0 bar	1.0 bar		
L	**Input terminal 108 delay time**	0 to 650 s	1 s		
L	**High limit monitoring**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 111**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Input terminal 111 text**	freely configurable	Analog 7		
L	**Input term. 111 limit warning**	40 to 120 °C	80 °C		
L	**Input term. 111 limit shutd.**	40 to 120 °C	90 °C		
L	**Input terminal 111 delay time**	0 to 650 s	1 s		
L	**High limit monitoring**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Ana.in 12345678 del.by speed**	Y/N	NNNNNYNN		
L	**Ana.in 12345678 control inp.**	Y/N	NNNNNNNN		

© Woodward

	Parameter	Setting range	Default value	Customer setting	
OUTPUT CONFIGURATION					
L	Analg.out.12O121 Parameter	0 to 24	1		
L	Analg.out.12O121 0-00 mA	0 to 20 mA 4 to 20 mA	0 to 20 mA	☐ 0-20mA ☐ 4-20 mA	☐ 0-20mA ☐ 4-20 mA
L	Analg.out.12O121 0%	0 to 9,990	0		
L	Analg.out.12O121 100%	0 to 9,990	200		
L	Analg.out.122123 Parameter	0 to 24	1		
L	Analg.out.122123 0-00 mA	0 to 20 mA 4 to 20 mA	0 to 20 mA	☐ 0-20mA ☐ 4-20 mA	☐ 0-20mA ☐ 4-20 mA
L	Analg.out.122123 0%	0 to 9,990	0		
L	Analg.out.122123 100%	0 to 9,990	200		
L	Assignm.relay 1	refer to page 122 for more info	1		
L	Assignm.relay 2	refer to page 122 for more info	2		
L	Assignm.relay 3	refer to page 122 for more info	3		
L	Assignm.relay 4	refer to page 122 for more info	4		
L	Assignm.relay 5	refer to page 122 for more info	5		
L	Assignm.relay 6	refer to page 122 for more info	84		
L	Assignm.relay 7	refer to page 122 for more info	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		
L	Start-stop-logic for	DIESEL GAS EXTERNAL [EXT]	DIESEL	☐ DIESEL ☐ GAS ☐ EXT	☐ DIESEL ☐ GAS ☐ EXT
L	Min.speed for ignit.	0 to 999 rpm	100 rpm		
L	Ignition delay	0 to 99 s	3 s		
L	Preglow time	0 to 99 s	3 s		
L	Gasvalve delay	0 to 99 s	5 s		
	Starter time	2 to 99 s	10 s		
	Start pause time	1 to 99 s	8 s		
L	f lower before start	ON/OFF	OFF	☐ on ☐ off	☐ on ☐ off
L	time f lower bef.start	0 to 999 s	5 s		
L	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		
L	Firing speed reached f>	5 to 70 Hz	15 Hz		
L	Pickup input	ON/OFF	ON	☐ on ☐ off	☐ on ☐ off
L	Number of pickup teeth	30 to 280	160		
L	Gen.rated speed 1	0 to 3,000 rpm	1,500 rpm		
L	Gen.rated speed 2	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		
	Timer on at 00:00	00:00 to 23:59	00:00		
	Timer off at 00:00	00:00 to 23:59	00:00		
	Week M S days NNNNNNN	Y(es)/N(o)	NNNNNNN		

	Parameter	Setting range	Default value	Customer setting	
ENGINE BUS CONFIGURATION					
L	**Baud rate**	100/125/250/500 kBaud	250 kBaud		
L	**IKD1 on bus**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Assignment 1. relay on IKD1**				
L	**Assignment 2. relay on IKD1**				
L	**Assignment 3. relay on IKD1**				
L	**Assignment 4. relay on IKD1**				
L	**Assignment 5. relay on IKD1**				
L	**Assignment 6. relay on IKD1**				
L	**Assignment 7. relay on IKD1**				
L	**Assignment 8. relay on IKD1**				
L	**Error text DI1 IKD1 (term.5)**				
L	**Error text DI2 IKD1 (term.6)**				
L	**Error text DI3 IKD1 (term.7)**				
L	**Error text DI4 IKD1 (term.8)**				
L	**Error text DI5 IKD1 (term.9)**				
L	**Error text DI6 IKD1 (term.10)**				
L	**Error text DI7 IKD1 (term.11)**				
L	**Error text DI8 IKD1 (term.12)**				
L	**IKD2 on bus**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**Assignment 1. relay on IKD2**				
L	**Assignment 2. relay on IKD2**				
L	**Assignment 3. relay on IKD2**				
L	**Assignment 4. relay on IKD2**				
L	**Assignment 5. relay on IKD2**				
L	**Assignment 6. relay on IKD2**				
L	**Assignment 7. relay on IKD2**				
L	**Assignment 8. relay on IKD2**				
L	**Error text DI1 IKD2 (term.5)**				
L	**Error text DI2 IKD2 (term.6)**				
L	**Error text DI3 IKD2 (term.7)**				
L	**Error text DI4 IKD2 (term.8)**				
L	**Error text DI5 IKD2 (term.9)**				
L	**Error text DI6 IKD2 (term.10)**				
L	**Error text DI7 IKD2 (term.11)**				
L	**Error text DI8 IKD2 (term.12)**				
L	**MDEC**	OFF Visualis./control. only visualis. only controlling	OFF	☐ OFF ☐ V/C ☐ V ☐ C	☐ OFF ☐ V/C ☐ V ☐ C
L	**MDEC protocol**	V302 / V303 / V304	V302		
L	**J1939**	OFF / Standard / EMR2 / S6			
L	**Remote control J1939**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**J1939 unit number**	0 to 255			
L	**Max.speed derivat. gen. [rpm]**	0 to 999			
L	**Monitoring ECU Values**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N
L	**ECU Interface Monitor.**	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N

L This parameter may only be accessed via LeoPC1

© Woodward

Appendix E.
Service Options

Product Service Options

The following factory options are available for servicing Woodward equipment, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is purchased from Woodward or the service is performed. If you are experiencing problems with installation or unsatisfactory performance of an installed system, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In most cases, your problem can be resolved over the phone. If not, you can select which course of action you wish to pursue based on the available services listed in this section.

Returning Equipment For Repair

If a control (or any part of an electronic control) is to be returned to Woodward for repair, please contact Woodward in advance to obtain a Return Authorization Number. When shipping the unit(s), attach a tag with the following information:

- Name and location where the control is installed
- Name and phone number of contact person
- Complete Woodward part numbers (P/N) and serial number (S/N)
- Description of the problem
- Instructions describing the desired repair

CAUTION

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

Packing A Control

Use the following materials when returning a complete control:

- Protective caps on any connectors
- Antistatic protective bags on all electronic modules
- Packing materials that will not damage the surface of the unit
- At least 100 mm (4 inches) of tightly packed, industry-approved packing material
- A packing carton with double walls
- A strong tape around the outside of the carton for increased strength

Return Authorization Number RAN

When returning equipment to Woodward, please telephone and ask for the Customer Service Department in Stuttgart, Germany [+49 (0) 711 789 54-0]. They will help expedite the processing of your order through our distributors or local service facility. To expedite the repair process, contact Woodward in advance to obtain a Return Authorization Number, and arrange for issue of a purchase order for the unit(s) to be repaired. No work will be started until a purchase order is received.

NOTE

We highly recommend that you make arrangement in advance for return shipments. Contact a Woodward customer service representative at +49 (0) 711 789 54-0 for instructions and for a Return Authorization Number.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- The part numbers P/N (XXXX-XXX) that is on the enclosure nameplate
- Tthe unit serial number S/N, which is also on the nameplate

© Woodward

How To Contact Woodward

Please contact following address if you have questions or if you want to send a product for repair:

Woodward GmbH
Handwerkstrasse 29
70565 Stuttgart - Germany

Phone: +49 (0) 711 789 54-0 (8.00 - 16.30 German time)
Fax: +49 (0) 711 789 54-100
e-Mail: sales-stuttgart@woodward.com

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

Facility	Phone number
USA	+1 (970) 482 5811
India	+91 (129) 409 7100
Brazil	+55 (19) 3708 4800
Japan	+81 (476) 93 4661
The Netherlands	+31 (23) 566 1111

You can also contact the Woodward Customer Service Department or consult our worldwide directory on Woodward's website (**www.woodward.com**) for the name of your nearest Woodward distributor or service facility. [For worldwide directory information, go to **www.woodward.com/ic/locations**.]

Engineering Services

Woodward Industrial Controls Engineering Services offers the following after-sales support for Woodward products. For these services, you can contact us by telephone, by e-mail, or through the Woodward website.

- Technical support
- Product training
- Field service during commissioning

Technical Support is available through our many worldwide locations, through our authorized distributors, or through GE Global Controls Services, depending on the product. This service can assist you with technical questions or problem solving during normal business hours. Emergency assistance is also available during non-business hours by phoning our toll-free number and stating the urgency of your problem. For technical engineering support, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference technical support.

Product Training is available on-site from several of our worldwide facilities, at your location, or from GE Global Controls Services, depending on the product. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability. For information concerning training, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference ***customer training***.

Field Service engineering on-site support is available, depending on the product and location, from our facility in Colorado, or from one of many worldwide Woodward offices or authorized distributors. Field engineers are experienced on both Woodward products as well as on much of the non-Woodward equipment with which our products interface. For field service engineering assistance, please contact us via our toll-free or local phone numbers, e-mail us, or use our website and reference ***field service***.

 © Woodward

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Contact

Your company _____

Your name _____

Phone number _____

Fax number _____

Control (see name plate)

Unit no. and revision: P/N: _____ REV: _____

Unit type GCP-_____

Serial number S/N _____

Description of your problem

_____

_____

_____

_____

_____

_____

Please be sure you have a list of all parameters available. You can print this using LeoPC1. Additionally you can save the complete set of parameters (standard values) and send them to our Service department via e-mail.

We appreciate your comments about the content of our publications.

Please send comments to: stgt-documentation@woodward.com

Please include the manual number from the front cover of this publication.

Woodward
Handwerkstrasse 29 - 70565 Stuttgart - Germany
Phone +49 (0) 711 789 54-0 • Fax +49 (0) 711 789 54-100
sales-stuttgart@woodward.com

Homepage

http://www.woodward.com/power

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address/phone/fax/e-mail information for all locations is available on our website (www.woodward.com).

2008/5/Stuttgart