WOODWARD

SEG

PCL1/PCM1-G/PCM1-M

Automatic control/Gen-set control for emergency power and isolated operations/operations parallel with the mains

Version 4.3

CE

NOTE

With the exception of the following differences, the versions described in this manual are completely identical:

Described products

PCL1 Genset control with two circuit breakers without operation in mains parallel.
PCM1-G Genset control with one circuit breaker for operation in mains parallel.
PCM1-M Genset control with two circuit breakers for operation in mains parallel.

Code of types:

PCx-Ia-Ub-y1-y2-z

[x = L1/M1-G/M1-M]		Item type PCL1, PCM1-G and PCM1-M
[y1 = L/H]	Variations	Low-/High-Variation
[y2 = I/E]	Variations	{PCM1-G} internal/external voltage tracing
[z = A]	Analog controller output	selectable
[a = 1/5]	Current measuring, prim.	1 = ../1 A; 5 = ../5 A
[b = ¼]	Voltage measuring, prim.	1 = 100 Vac; 4 = 400 Vac

xxx/L Low variation of one type (***[xxx = PCL/PCM]***; e.g. PCL1/L, PCM1-G/L or PCM1-M/L)
xxx/H High variation of one type (***[xxx = PCL/PCM]***; e.g. PCL1/H, PCM1-G/H or PCM1-M/H).

NOTE

These manual have been developed for an item fitted with all available options. Inputs/outputs, functions, configuration screens and other details described, which do not exist on your item may be ignored.

CAUTION !

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

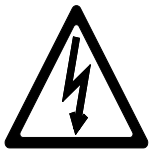
1 Introduction

1.1 Safety technical note for the user

This documentation contains the relevant information for the normal use of the product described herein. It is intended to be read by qualified staff.

Danger notice

The following instructions are useful for both personal safety and safety from damage to the described product or items connected to it. Safety notes and warnings to avoid any danger to the life and health of users or maintenance staff and to avoid any damage to property will be identified in this documentation by means of the symbols and terms defined in the following. Within the framework of this documentation, the signals and terms which are used have the following meaning:



DANGER!!!

The DANGER symbol draws your attention to dangers while the description indicates how to handle and/or avoid such hazards. Any non-observance may cause fatal or serious injuries as well as considerable damage to property.

WARNING!

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

CAUTION!

This symbol points to important notes concerning the mounting, installation, and connection of the item. These notes should absolutely be observed when connecting the item.

NOTE

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

Normal use

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

1.2 Connection of the item

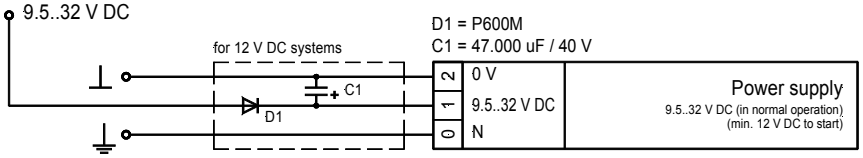
WARNING

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

NOTE

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

1.2.1 Power supply



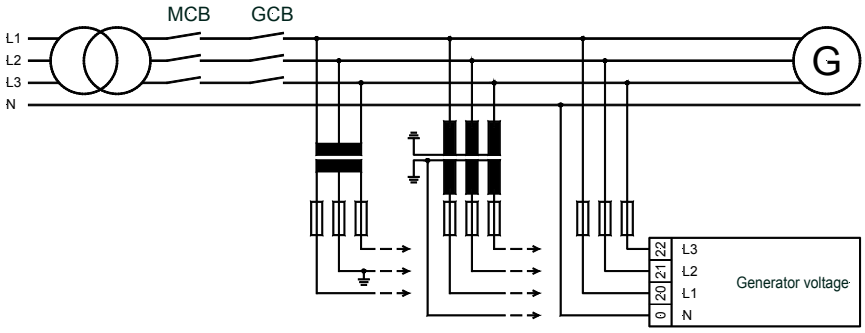
Terminal	Description	A_{max}
0	Neutral point of the three-phase system or neutral terminal of the voltage transformer (Measuring reference point)	Solder lug
1	9,5..32 V DC, 15 W	2.5 mm²
2	0 V reference point	2.5 mm²

Note: On use in a 12 Vdc system, please wire the power supply as described above.

1.2.2 Measuring inputs

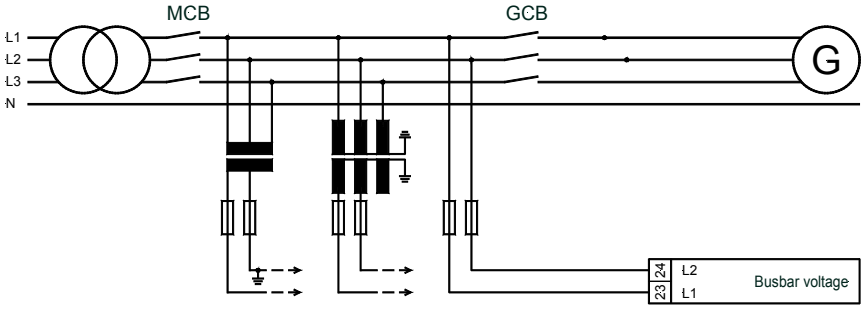
a.) Voltage measuring inputs

• ***Generator***



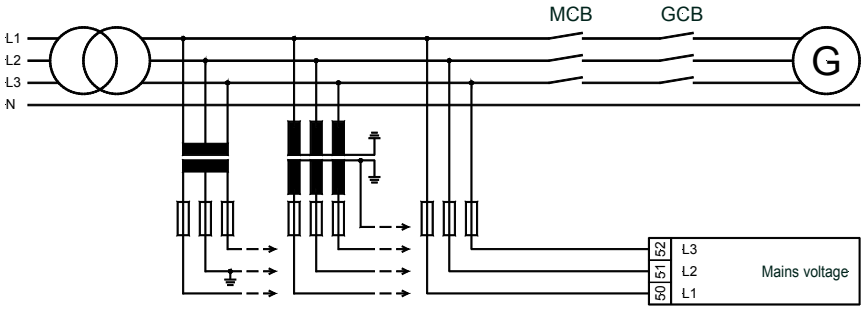
Terminal	Measurement	Description	A_{max}
20	400 V direct or via ../100 V measurement transducer	Generator voltage L1	2.5 mm²
21		Generator voltage L2	2.5 mm²
22		Generator voltage L3	2.5 mm²
0		Neutral point of the 3-phase system/transformer	Sold. lug

• ***Bus bar***



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

• ***Mains***



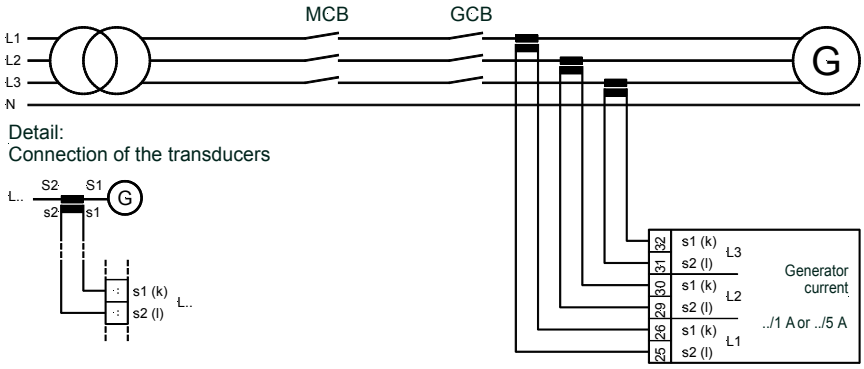
Terminal	Measurement	Description	A_{max}
50	400 V direct or via ../100 V measurement transducer	Mains voltage L1	2.5 mm²
51		Mains voltage L2	2.5 mm²
52		Mains voltage L3	2.5 mm²
0		Neutral point of the 3-phase system / transformer	Sold.lug

b.) Current measuring inputs

WARNING !

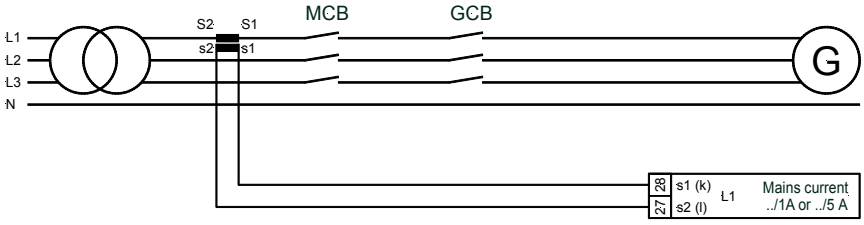
Before disconnecting the secondary terminals of the transformer or the connections of the transformer at the item, make sure that the transformer is short-circuited.

- ***Generator***



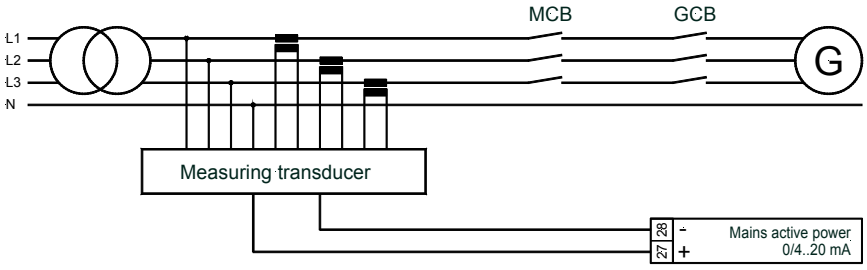
Terminal	Measurement	Description	A_{max}
25	Transformer ../1 A or ../5 A	Generator current L1, transformer terminal s2 (l)	2.5 mm²
26		Generator current L1, transformer terminal s1 (k)	2.5 mm²
29		Generator current L2, transformer terminal s2 (l)	2.5 mm²
30		Generator current L2, transformer terminal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

- ***Mains*** [PCM1x]



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

- ***Mains*** [PCM1x] 20 mA configured as mains real power actual value measuring



Terminal	Measurement	Description	A_{max}
configurable	Analog signal 0/4..20 mA	Mains real power actual value measurement via 0/4..20 mA signal of an external measuring transducer	1.5 mm²

1.2.3 Auxiliary and control inputs

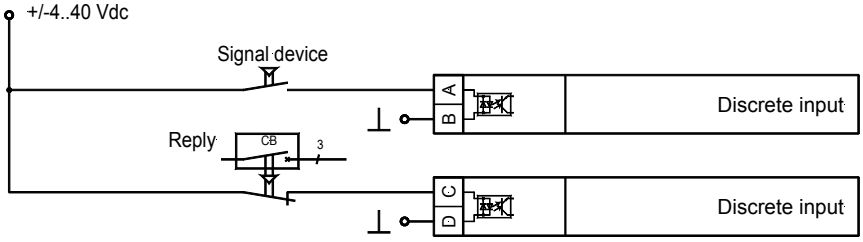
a.) Discrete inputs

WARNING !

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

4..40 Vdc.

- Control inputs

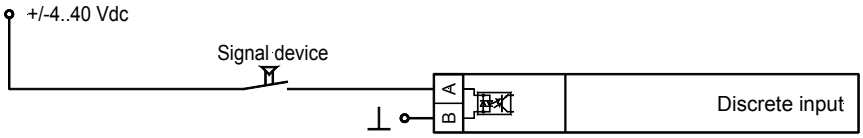


Terminal	Associated Common	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
A	***B***	***NO contact***	
3	7	Automatic 1	2.5 mm²
5		Automatic 2	2.5 mm²
6		Multi function: Sprinkler operation / Engine enable external acknowledgement / Engine stop / STOP mode / start without CB	2.5 mm²
53		*[PCM1-G]* Enable externally *[PCM1-M & PCL1]* Enable MCB (mains power circuit breaker)	2.5 mm²
C	***D***	***NC contact***	
4	7	Reply: Generator power circuit breaker is open	2.5 mm²
54		*[PCM1-G]* Status: Isolated operation *[PCM1-M & PCL1]* Reply: MCB is open	2.5 mm²

The discrete inputs can be connected in positive or negative logic:

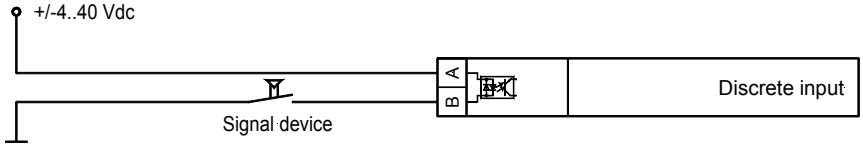
Positive logic The discrete input is wired to +/-24 Vdc.
Negative logic The discrete input is wired to GND.

• Alarm inputs (positive logic)



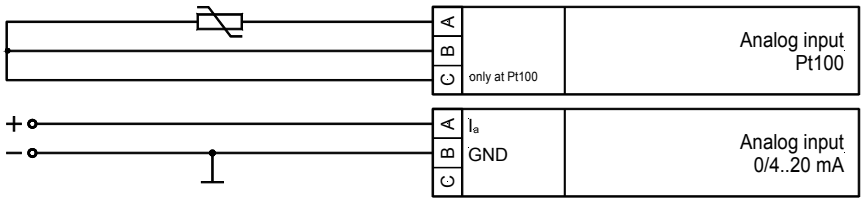
Terminal	Associated Common	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
A	***B***	***Normally open contact***	
61	60	Discrete input 1 (if sprinkler = EMERGENCY STOP)	2.5 mm²
62		Discrete input 2 or Control input "Dynamo"	2.5 mm²
63		Discrete input 3 or Control input "Operation mode selector blocked"	2.5 mm²
64		Alarm input 4 or Control input "CB logic"	2.5 mm²
65		Alarm input 5	2.5 mm²
66		Alarm input 6 or Control input "Manual synchronization"	2.5 mm²
67		Alarm input 7 or Control input "Close GCB without delayed engine monitoring"	2.5 mm²
68		Alarm input 8	2.5 mm²
69		Alarm input 9	2.5 mm²
70		Alarm input A	2.5 mm²
71		Alarm input B	2.5 mm²
72		Alarm input C	2.5 mm²
73		Alarm input D	2.5 mm²
125	124	Alarm input E	2,5 mm²
126		Alarm input F only PCM1x	2,5 mm²
127		Alarm input G only PCM1x	2,5 mm²

Example for negative logic



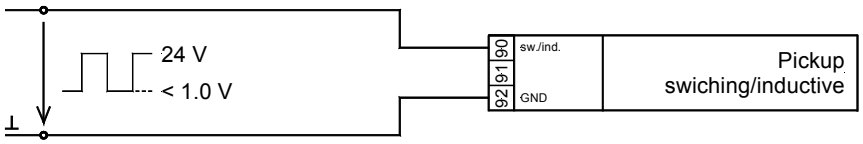
Associated Common	Terminal	Description (according to DIN 40 719 Part 3, 5.8.3)	A_{max}
A	***B***	***Normally open contact***	
60	61	Alarm input 1 (sprinkler = EMERGENCY STOP)	2.5 mm²
	62	Alarm input 2	2.5 mm²
	63	Alarm input 3	2.5 mm²

b.) Analog inputs



Terminal A	Terminal B	Terminal C	Description	A_{max}
93	94	95	Analog input 1 - Pt100	1.5 mm²
96	97	98	Analog input 2 - Pt100	1.5 mm²
99	100	101	Analog input 3 - 20 mA; configurable function: - Alarm input, - Set value generator power, - Actual value mains interchange power	1.5 mm²
102	103	104	Analog input 4 - Pt100	1.5 mm²
105	106	107	Analog input 5 - Pt100 only PCM1x/H	1.5 mm²
108	109	110	Analog input 6 - Pt100 only PCM1x/H	1.5 mm²
111	112	113	Analog input 7 - 20 mA; only PCM1x/H configurable function: - Alarm input, - Set value generator power, - Actual value mains interchange power	1.5 mm²

c.) Pickup input



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

Specification of the input circuit for inductive speed sensors

Ambient temperature: 25 °C

Signal shape	Sinusoidal
Minimum input voltage of 200 ..10,000 Hz	< 0.5 V_{eff}
Minimum input voltage of 300 .. 5,000 Hz	< 0.3 V_{eff}

Note
As the ambient temperature increases, the minimum input temperature increases at a rate of approximately 0.3 V/°C an.

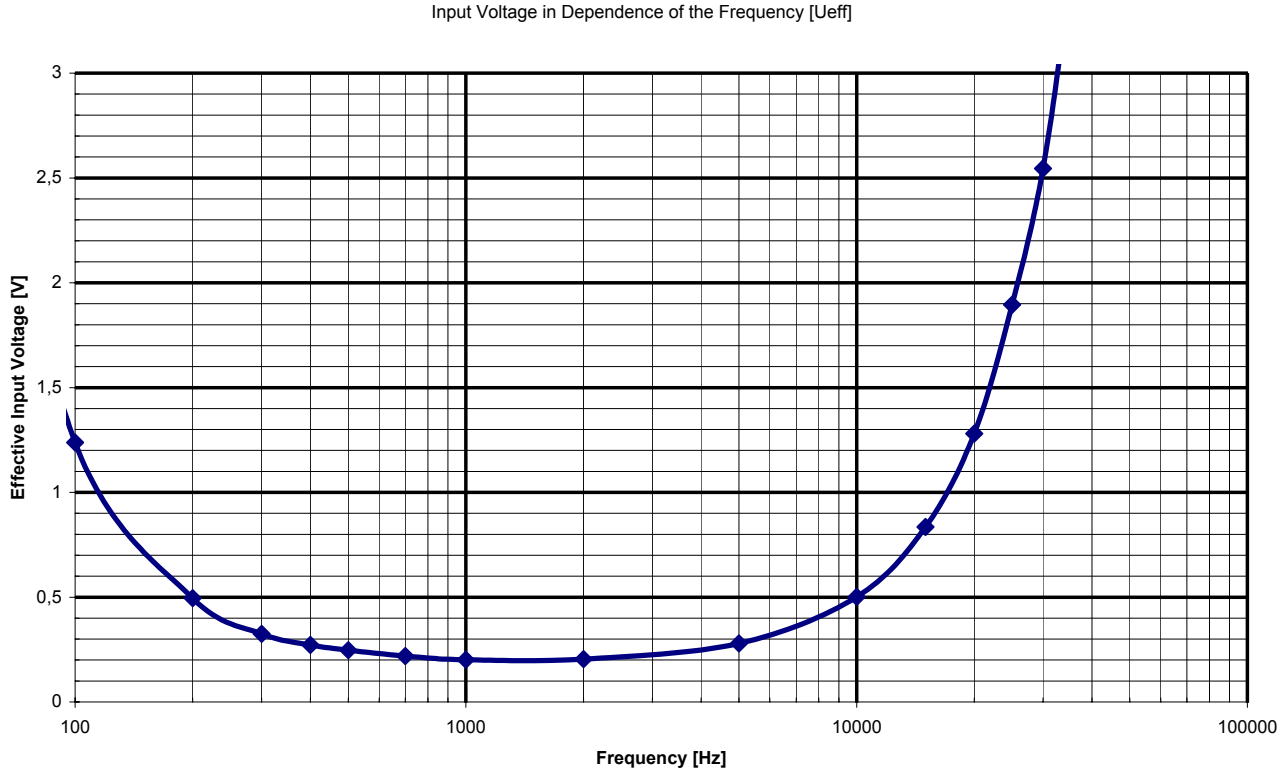
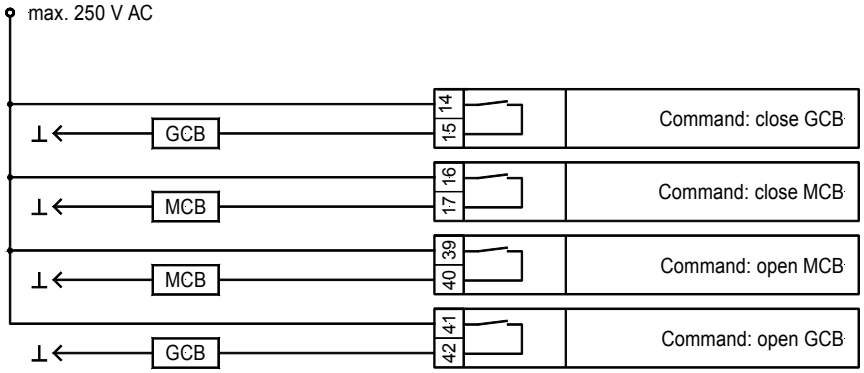


Figure 1: Typical behavior of the input voltage sensitivity at an ambient temperature of 25°C.

1.2.4 Auxiliary and control outputs

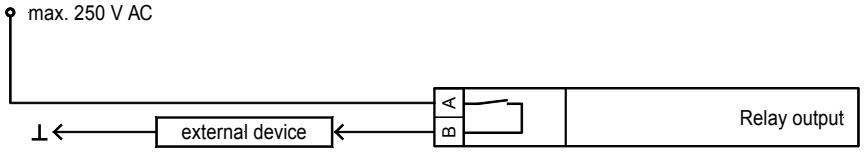
a.) Relay outputs

• Power circuit breaker



Root	Switched	Description	A_{max}
14	15	Generator power circuit breaker → close	2.5 mm²
16	17	PCM1-M and PCL1: Mains power circuit breaker → close PCM1-G-..-I: Power circuit breaker → close	2.5 mm²
39	40	PCM1-M and PCL1: Mains power circuit breaker → open PCM1-G-..-I: Power circuit breaker → open	2.5 mm²
41	42	Generator power circuit breaker → open	2.5 mm²

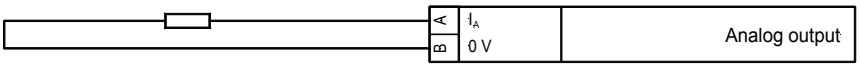
• Relay (general)



Root	Switched	Description	A_{max}
A	***B***		
18	19	Readiness for operation	2.5 mm²
43	44	Fuel relay/gas valve	2.5 mm²
45	46	Starter	2.5 mm²
PCL1			
33	34	Relay 1 (RM)	2.5 mm²
35	36	Relay 2 (RM)	2.5 mm²
37	38	Relay 3 (RM; pre-assigned: Preheat / Ignition ON)	2.5 mm²
47	48	Relay 4 (RM; pre-ass.: Centralized alarm)	2.5 mm²
PCM1x			
74	75	Relay 1 (RM)	2.5 mm²
76	77	Relay 2 (RM)	2.5 mm²
78	79	Relay 3 (RM)	2.5 mm²
80	81	Relay 4 (RM)	2.5 mm²
82	83	Relay 5 (RM)	2.5 mm²
37	38	Relay 6 (RM; pre-assigned: Preheat / Ignition ON)	2.5 mm²
47	48	Relay 7 (RM; pre-ass.: Centralized alarm)	2.5 mm²
33	34	Relay 8 (RM)	2.5 mm²
35	36	Relay 9 (RM)	2.5 mm²

(RM)..configurable via the relay manager

b.) Analog outputs



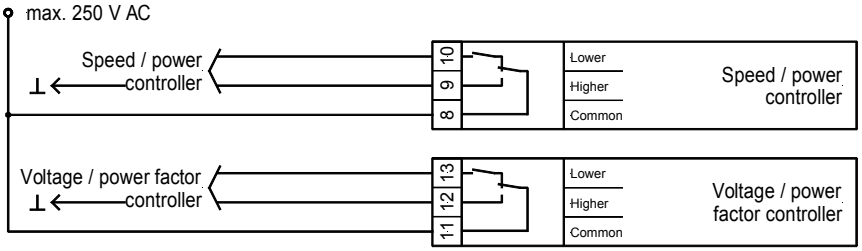
⊥ A	0 V B	Description	A_{max}
120	121	Analog output 0/4..20 mA	1.5 mm²
122	123	Analog output 0/4..20 mA	1.5 mm²

1.2.5 Controller outputs (standard/option ..-A)

The controllers are configured in the standard version as three-position controllers (made up of a changeover contact and a normally open contact). In option A these are optionally available in different versions dependent on external bridges/jumpers as well as parameters.

a.) Three-position controller (standard)

The three-position controller is only in standard version included.



Terminal	Assignment	Description	A_{max}
8	common	Speed/power controller	2.5 mm²
9	higher		2.5 mm²
10	lower		2.5 mm²
11	common	Voltage-/power factor φ controller	2.5 mm²
12	higher		2.5 mm²
13	lower		2.5 mm²

b.) Multi Functional Controller Outputs (Option A)

The multi functional controller outputs can be changed by configuration and external jumpers. These are only included in option A.

Versions

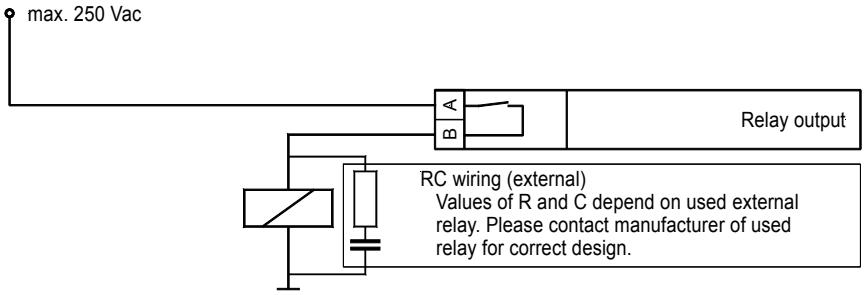
- **Three-position controller** via relay manager
  - Control of n/f/P: Parameter "F/P contr.type" = THREESTEP
    n+/f+/P+ = relay manger parameter 114
    n-/f-/P- = relay manager parameter 115
  - Control of V/Q: Parameter "V/Q contr.output" = THREESTEP
    V+/Q+ = relay manager parameter 116
    V-/Q- = relay manager parameter 117

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

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

Wiring Of Controller

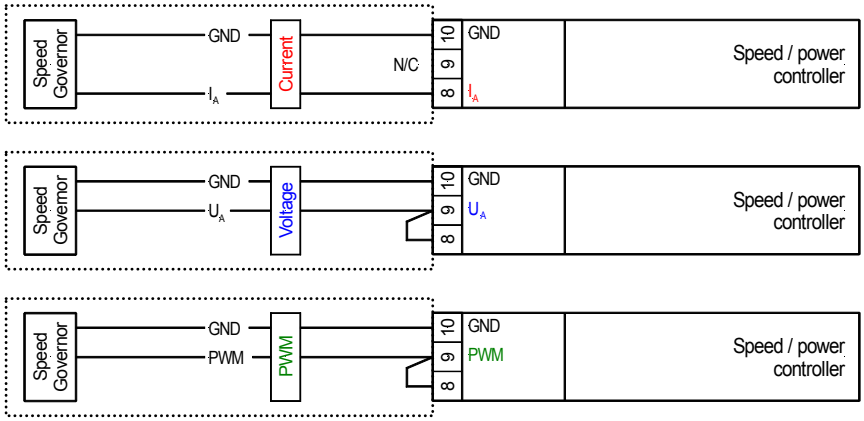
- Setting: THREE-POSITION (Three-position controller)



Terminal		Description	A_{max}
A	higher	Speed / Frequency / Real power (RM: "+" = 114, "-" = 115)	2.5 mm²
B			2.5 mm²
C	lower	or Voltage/Reactive power (RM: "+" = 116, "-" = 117)	2.5 mm²
D			2.5 mm²

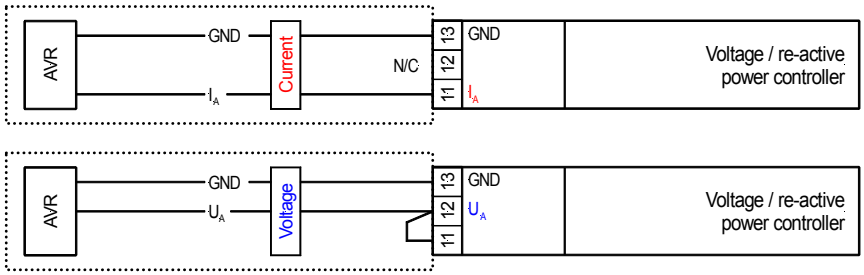
The selection and programming occurs via the relay manager (RM).

- Setting: ANALOG or PWM (Analog controller) - Frequency-/Power controller



Type	Terminal		Description	A_{max}
I Current	8	I_A	Speed controller / Frequency controller / Real power controller	2.5 mm²
	9			2.5 mm²
	10	GND		2.5 mm²
V Voltage	8			2.5 mm²
	9	V_A		2.5 mm²
	10	GND		2.5 mm²
PWM	8			2.5 mm²
	9	PWM		2.5 mm²
	10	GND		2.5 mm²

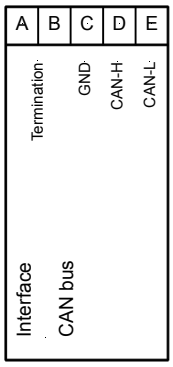
- Setting: ANALOG (Analog controller) - Voltage-/Reactive power controller



Type	Terminal		Description	A_{max}
I Current	11	I_A	Voltage controller / Reactive power controller	2.5 mm²
	12			2.5 mm²
	13	GND		2.5 mm²
V Voltage	11			2.5 mm²
	12	V_A		2.5 mm²
	13	GND		2.5 mm²

1.2.6 Interface [PCL1/H & PCM1x]

a.) Interface wiring



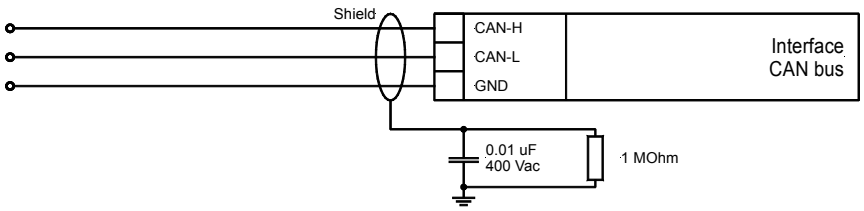
Terminal					Description
Whether the terminals are designated X or Y depends on the configuration of the system. Please refer to the wiring diagram (A = X/Y, B = X/Y, etc.)					
A (X1/Y1)	B (X2/Y2)	C (X3/Y3)	D (X4/Y4)	E (X5/Y5)	
CAN-H [1]	CAN-L [1]	GND	CAN-H	CAN-L	CAN bus

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

NOTE

Please note that the CAN bus must be terminated with an impedance which corresponds to the wave impedance of the cable (e.g. 120 Ohm).

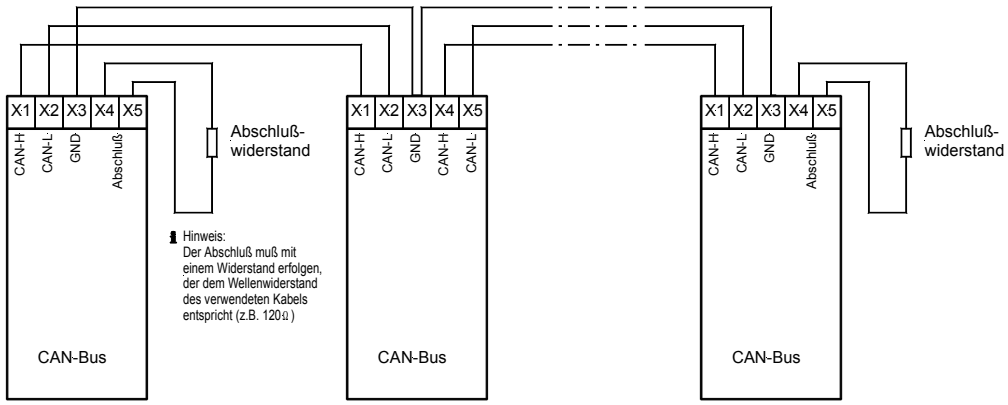
b.) CAN bus screen



1.2.7 Loop The CAN Bus

NOTE

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



a.) DPC - Configuration interface

NOTE

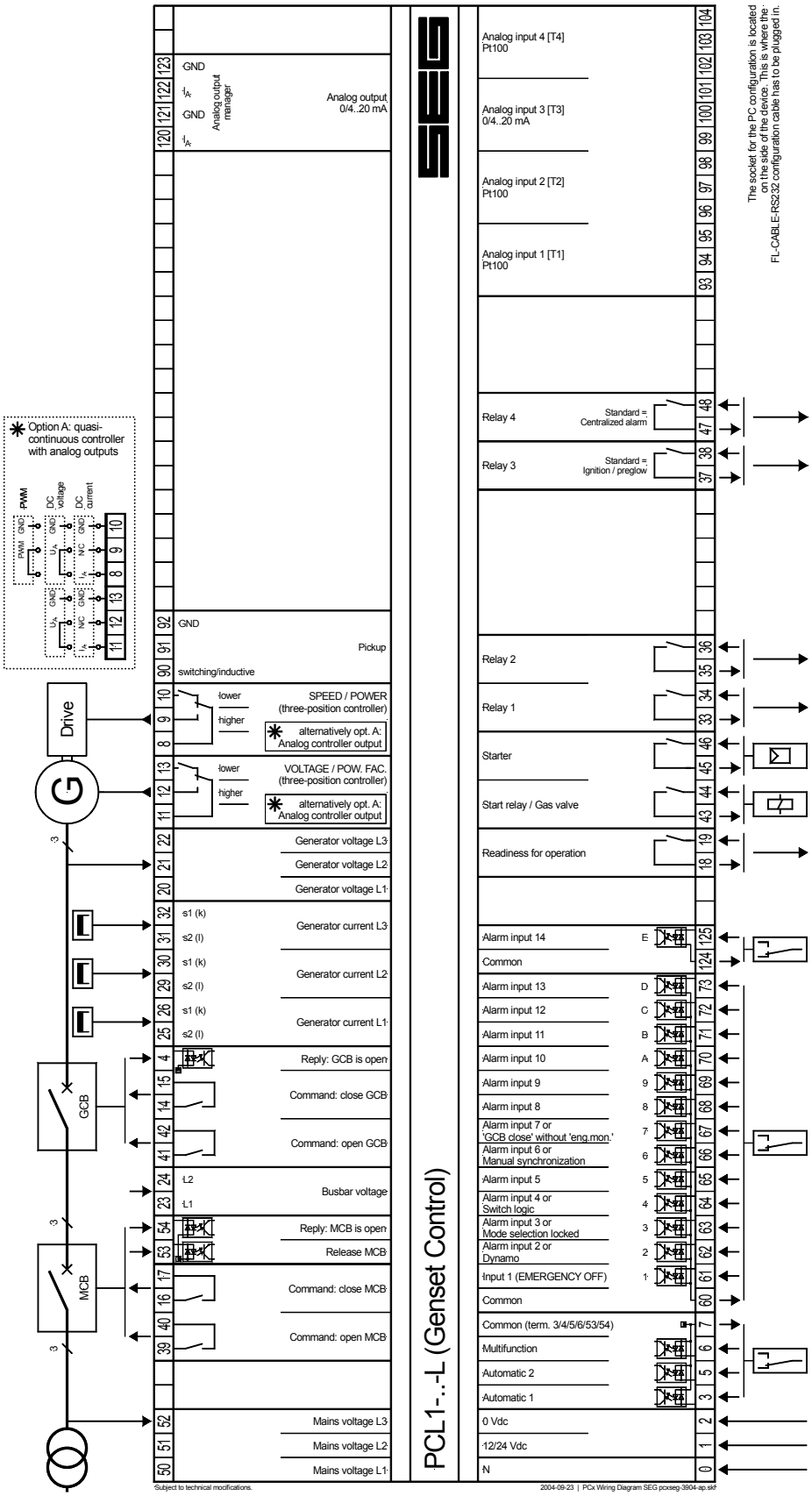
For configuration via the configuration plug (direct configuration) you need the configuration cable, the PC program (is delivered with the cable) and the corresponding configuration files. Please consult the online help installed when the program is installed for a description of the PC program and its setup.

If the parameter "Direct config." is switched to ON a communication via the interface on terminals X1-X5 is switched off.

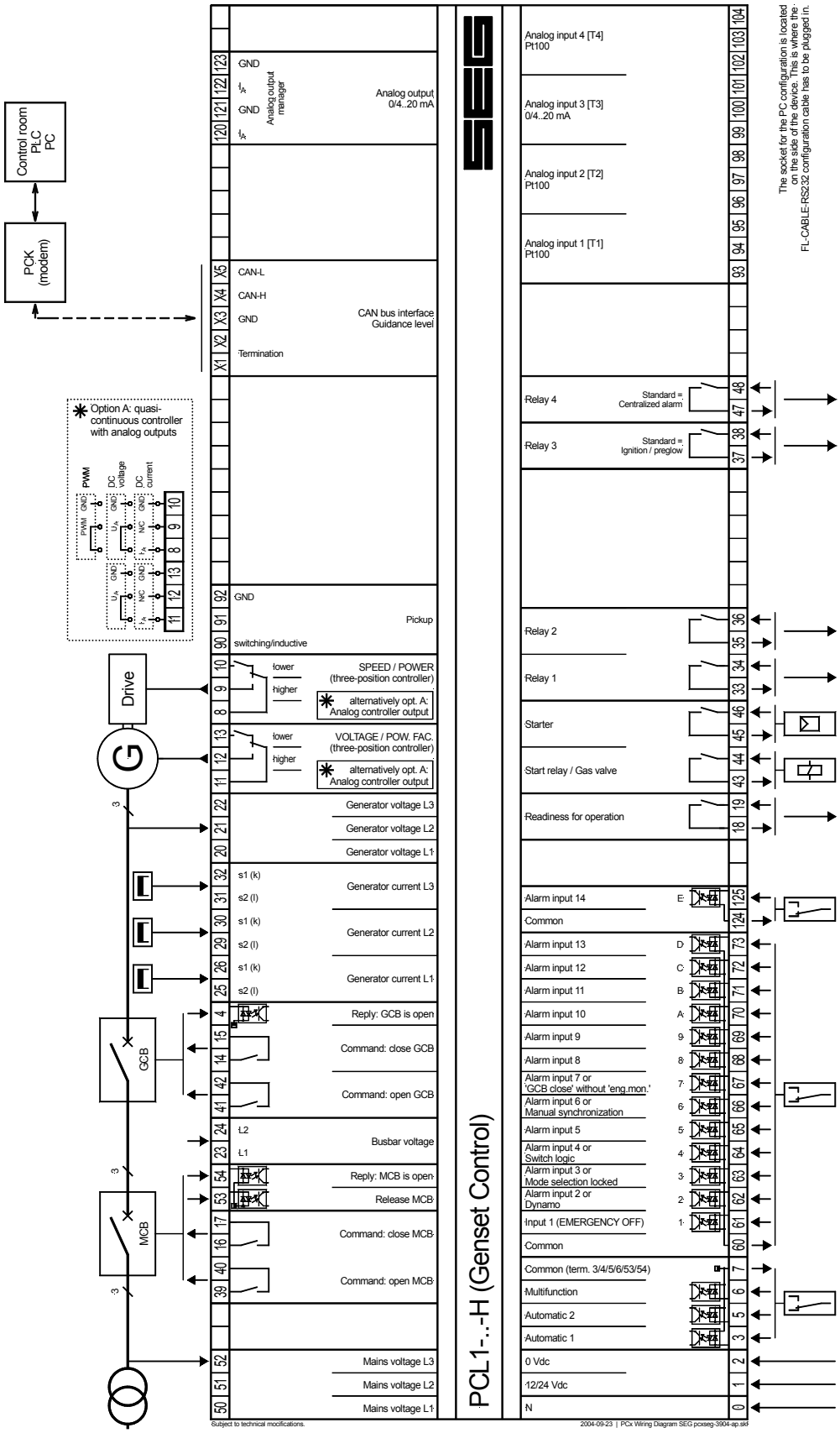
If the device detects that the engine is running (ignition speed exceeded), the direct configuration is disabled.

1.3 Connection diagram

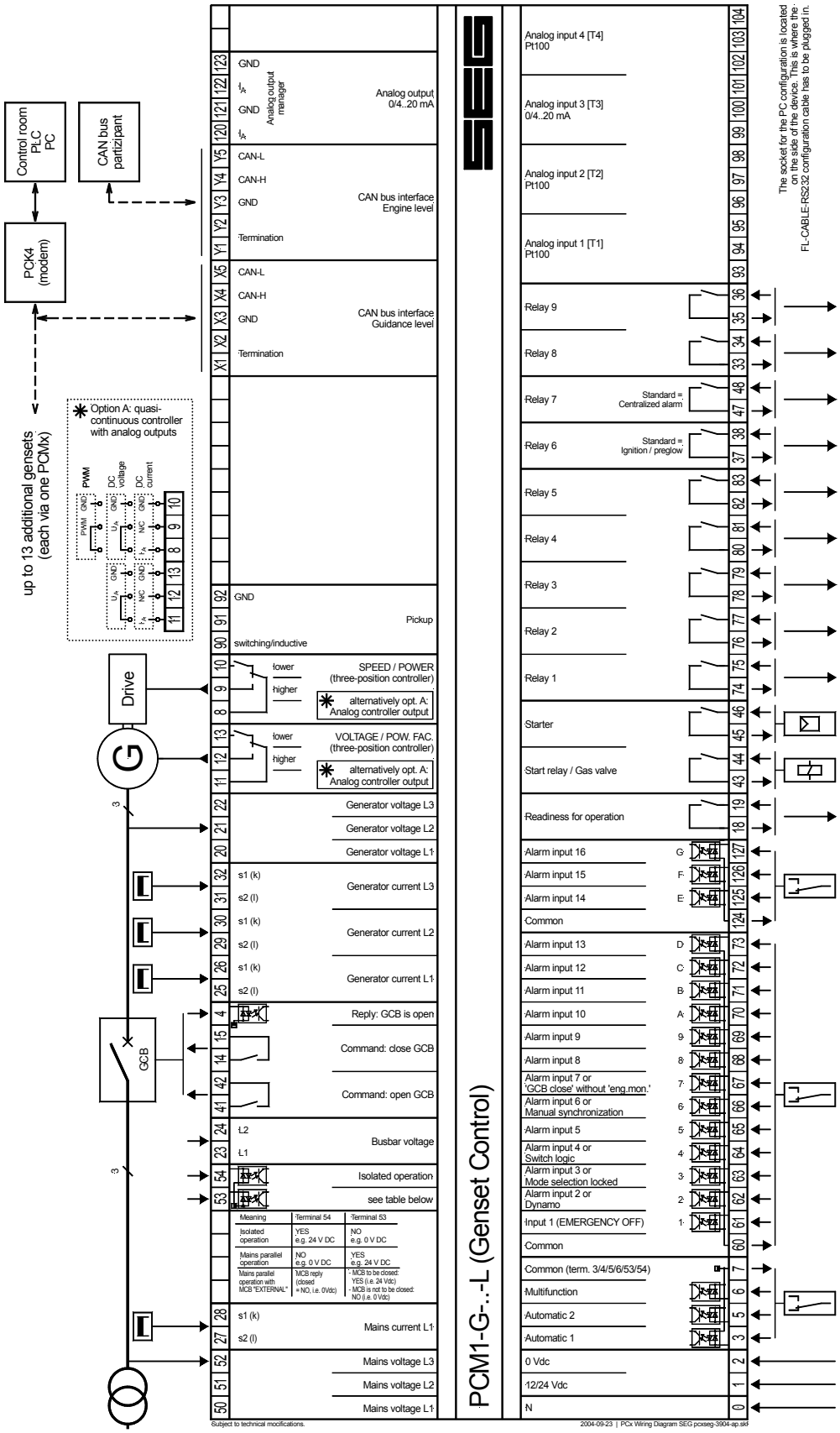
1.3.1 Version PCL1/L



1.3.2 Version PCL1/H

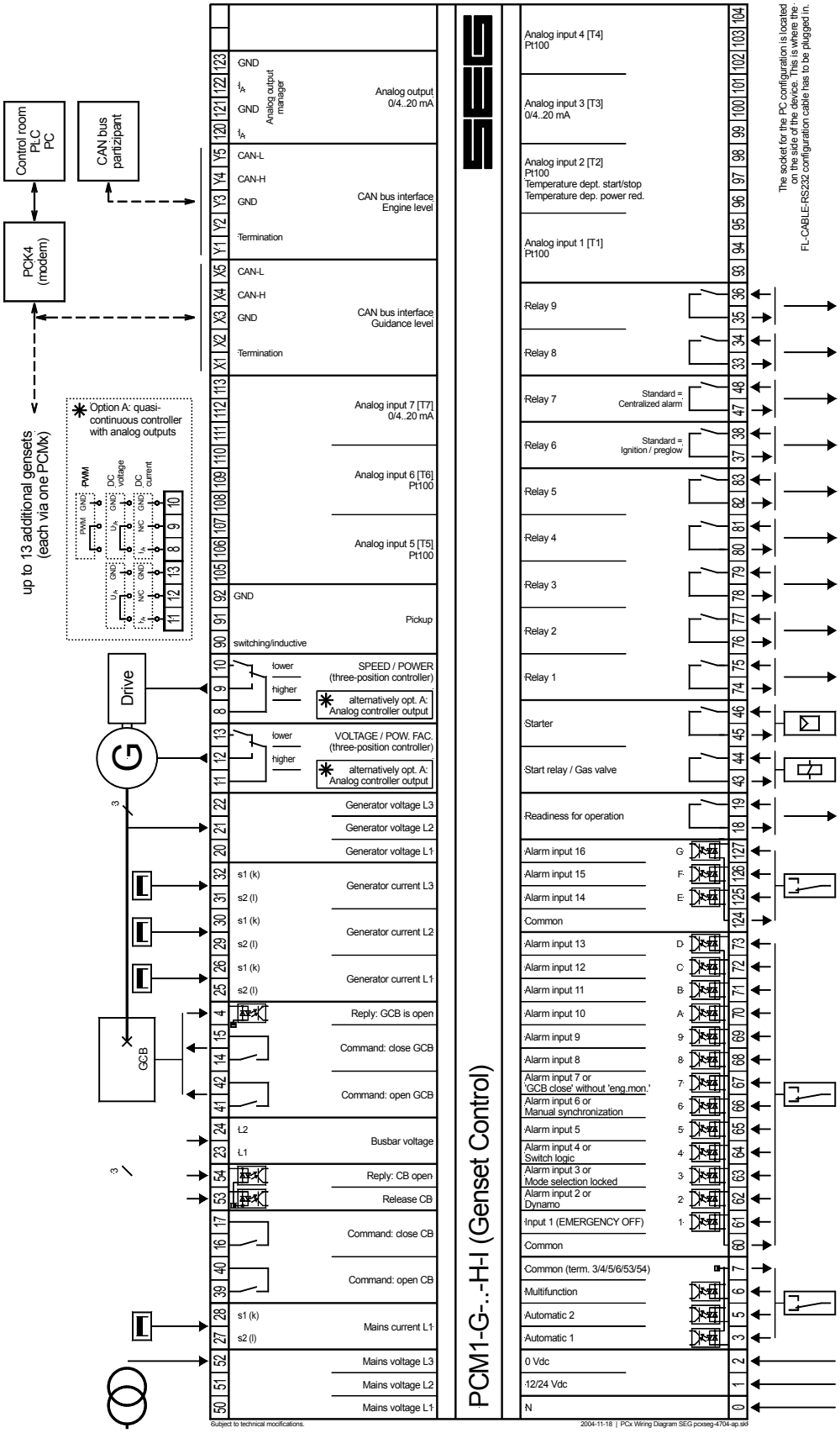


1.3.3 Version PCM1-G/L

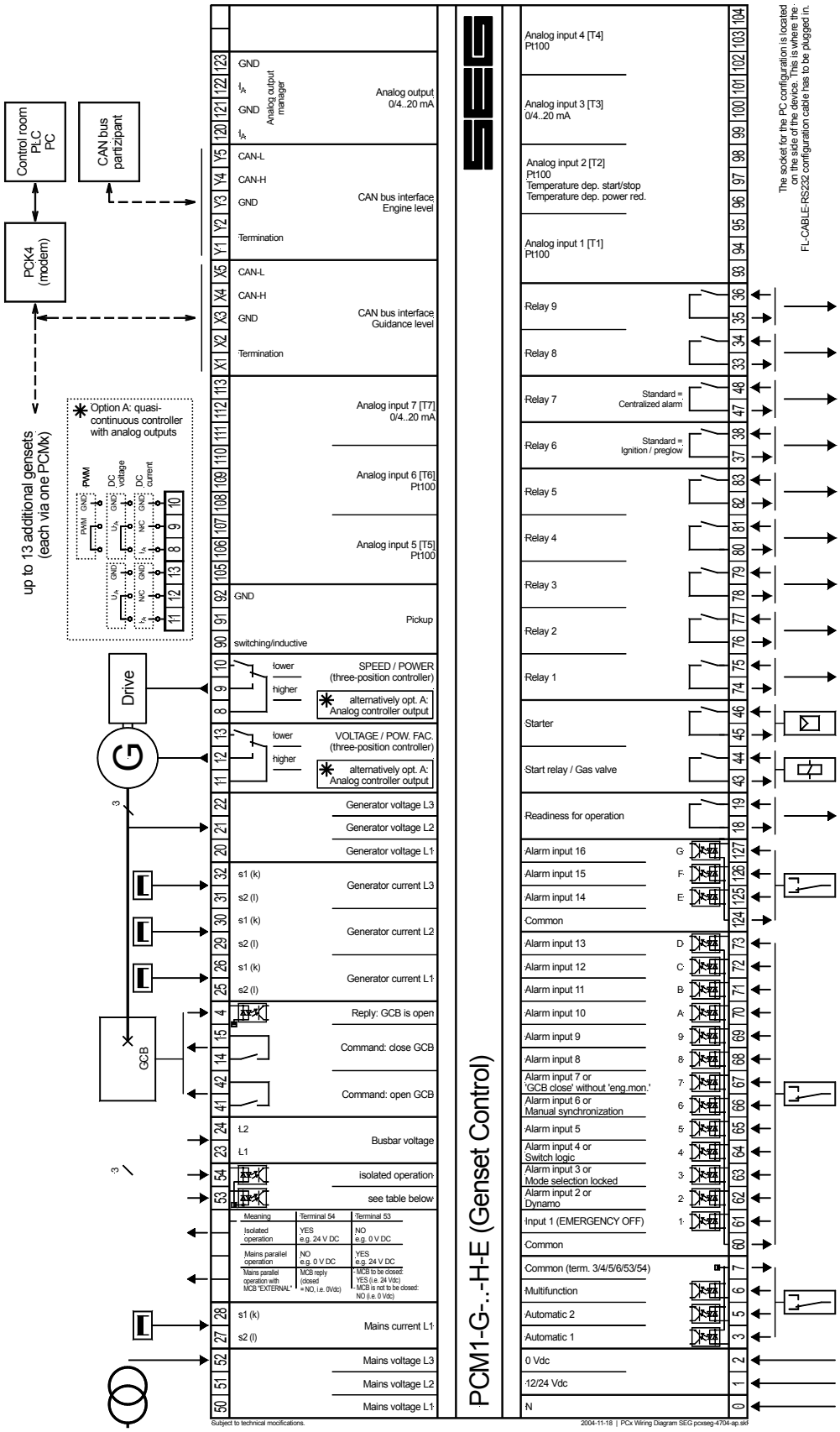


Meaning	Terminal 54	Terminal 53
Isolated operation	YES e.g. 24 V DC	NO e.g. 0 V DC
Mains parallel operation	NO e.g. 0 V DC	YES e.g. 24 V DC
Mains parallel operation with MCB "EXTERNAL"	MCB reply (closed = NO, i.e. 0Vdc)	- MCB to be closed: YES (i.e. 24 Vdc) - MCB is not to be closed: NO (i.e. 0 Vdc)

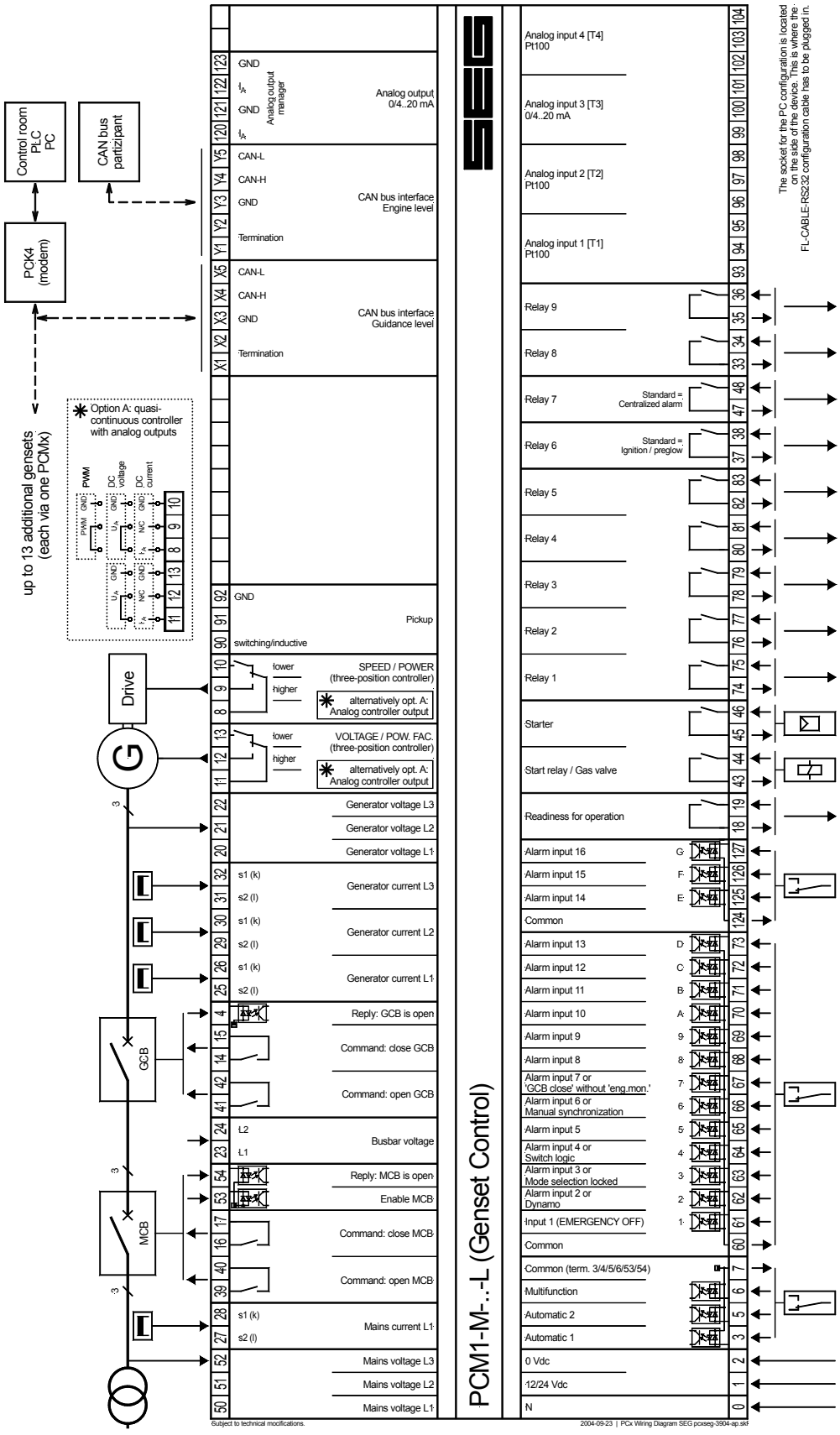
1.3.4 Version PCM1-G/H-I



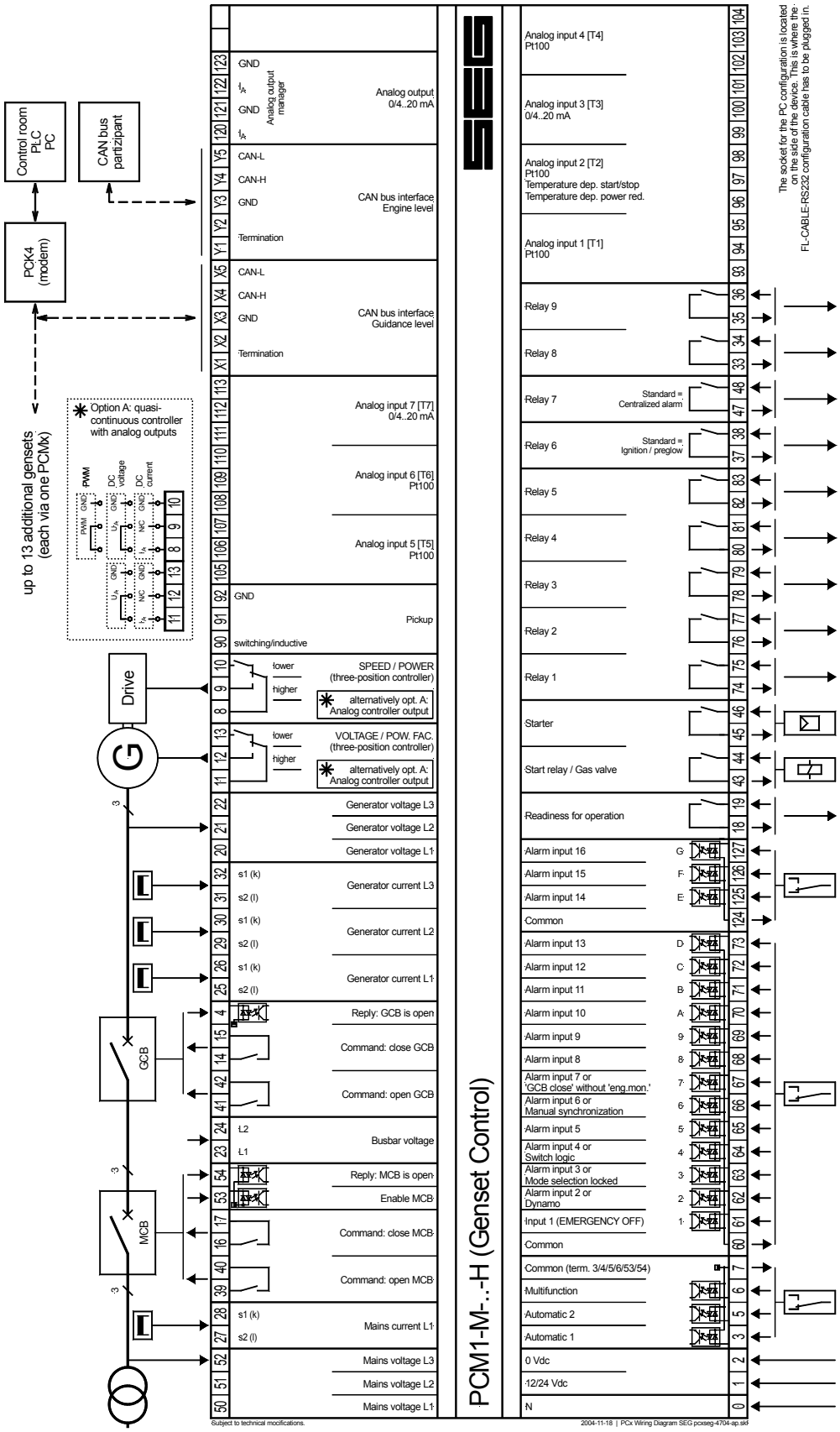
1.3.5 Version PCM1-G/H-E



1.3.6 Version PCM1-M/L



1.3.7 Version PCM1-M/H



2 Functional description

2.1 What must one pay attention to in the event of ...

2.1.1 ... different options

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

- The inputs and outputs are present or not present, corresponding to the item configuration (depending on your order). Please refer to the wiring diagram and the notes on the options contained in these. Refer to the type plate to see whether or not the corresponding option is contained in the item. If the type plate has been removed, all configuration screens can be called up in succession and the options can be compiled with the assistance of this manual.
- There are different screens for the various types of interfaces.

2.1.2 ... systems with one power circuit breaker

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

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

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

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

2.2 Table of setpoint values

Automatic 1	Automatic 2	Control via Interface ON	Setpoint value External ON	Specification of Setpoint value through
1	X	X	X	Setpoint 1
0	1	OFF	OFF	Setpoint 2
0	1	X	ON	Externally via 0/4..20 mA input
0	1	EIN	AUS	Externally via serial interface
0	0	AUS	AUS	Standby only emergency power

x..optionally

2.3 Control inputs

NOTE

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

Automatic 1
Terminal 3

Selection of the operating mode "AUTOMATIC" with **"Active power setpoint value 1"** as well as starting/stopping of the engine.

Set.....If the item is in "AUTOMATIC" mode (selected using the mode selection switch on the front side) the "active power setpoint value 1" is adjusted in mains parallel mode. In the case of a fixed power (F), the engine is started immediately and operation in parallel with the mains is commenced following the synchronization of the generator power circuit breaker. In the case of incoming/import (B) or outgoing/export power (L), starting is determined by automatic start/stop (start/stop) operation. If no automatic start/stop operation is enabled, the engine is started immediately. The setpoint value can be modified via both the configuration mode and via the "up/down" push-buttons in "AUTOMATIC" mode. AUTOSTART

Reset.....If the engine does not run either in sprinkler mode or emergency power mode, it is stepped. Then a coasting is carried out and the engine is stopped.

Automatic 2
Terminal 5

Selection of the "AUTOMATIC" mode with **"Active power setpoint value 2"** as well as starting/stopping of the engine.

Set.....If the item is in "AUTOMATIC" mode (selected using the mode selection switch on the front side) the "Active power setpoint value 2" is adjusted in mains parallel mode. In the case of a fixed power (F), the engine is started immediately and operation in parallel with the mains is commenced following the synchronization of the generator power circuit breaker. In the case of incoming/import (B) or outgoing/export power (L), starting is determined by automatic start/stop operation. If no automatic start/stop operation is enabled, the engine is started immediately. The setpoint value can be modified via both the configuration mode and via the "up/down" push-buttons in "AUTOMATIC" mode. AUTOSTART

Reset.....If the engine does not run either in sprinkler mode or emergency power mode, it is stopped. Then a coasting is carried out and the engine is stopped.

If a setpoint value is specified externally (e. g. via an analog input 0/4..20 mA or a bi-directional interface), the external setpoint value is adjusted with the discrete input (see Table of setpoint values).

Multifunction Terminal 6

Discrete input terminal 6 may reveal different functions according to the following description. Please note that, when used as a sprinkler input, the discrete input reveals negative functional logic. The selection of the logic circuit is made using a configuration screen (Chapter 4.15.3 "Setting the control inputs ", Page 135).

• Sprinkler

By **resetting** terminal 6 (setting a low level) sprinkler operation is activated in accordance with the functional description. This is terminated by **setting** terminal 6 (application of a High signal). Attention: Negative functional logic! (for the function of the sprinkler operation, please also observe Chapter 2.11 "Sprinkler operation" on page 53.)

• Engine enable

Terminal 6 in this case has the same function as the STOP push-button: Resetting terminal 6 (application of a LOW signal) prevents the engine's starting, and stops the engine if this is already running; the application of a HIGH signal enables the starting of the engine; the application of a high signal enables the engine for startup. Caution: Via this function, emergency power operation is also prevented or aborted. Emergency power is **not** possible without this enable signal! The engine enable function is only possible in "AUTOMATIC" operating mode.

• Ext. acknowledge

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

••STOP mode

By setting terminal 6 (application of a HIGH signal) the STOP mode is chosen. If you remove this signal the mode will change into the mode which was activated before terminal 6 was set.

• Engine stop

By setting terminal 6 (application of a HIGH signal) a start of the engine can be prevented. If the engine is running because emergency current is present, it is stopped by setting this discrete input. The discrete input is **not** inverted. The engine block function is only possible in "AUTOMATIC" operating mode.

• No CB by start

If the terminal 6 is set, the engine starts; no synchronization is carried out and the generator power circuit breaker is not engaged (no switching to black busbar). The GCB is then inserted only if emergency current is present. After return of the mains, there is a switchover to the mains according to the set CB logic. The start of terminal 6 is of a higher value than the start via terminals 3/5. If terminal 6 was selected, terminals 3/5 are ignored. If the genset is in mains parallel mode with power circuit breaker logic "Parallel" and if terminal 6 is activated, the GCB is opened after a reduction in power. The genset continues to operate without load with the GCB open.

Reply: GCB is open
Terminal 4

With this input (logical "1") the item is signaled that the generator power circuit breaker is open (the "GCB ON" LED is off).

[PCL1 / PCM1-M]
Reply: MCB is open
Terminal 54

With this input (logical "1") the item is signaled that the mains power circuit breaker is open (the LED "MCB ON" is off).

[PCM1-G]
Reply: CB is open
Terminal 54

With this input (logical "1") the item is signaled that the power circuit breaker is open.

[PCM1-G]
Isolated operation
Terminal 54

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

[PCL1/PCM1-M]
Enable MCB
Terminal 53

Set.....A mains parallel operation becomes possible and the MCB is operated.
Reset.....The MCB is not operated. Depending on the reply of the MCB, an isolated operation or an operation in parallel with the mains is performed.

[PCM1-G]
Enable CB
Terminal 53

Set.....A mains parallel operation becomes possible and the CB is operated.
Reset.....The CB is not operated. Depending on the reply of the CB, an isolated operation or an operation in parallel with the mains is performed.

Discrete inputs
[PCL1] Terminal 61-73/125
[PCM1] Terminal 61-73/125-127

Freely programmable alarm inputs with message text, alarm class, time delay, engine start delay and NO/NC shunt enable (description starting on page 132).

2.4 Control outputs

Readiness for operation
Terminals 18/19

Setting the relay signals the readiness for operation of the item. If this relay drops out, the perfect function of the item can no longer be guaranteed. Appropriate measure must be introduced if this relay has dropped out (e.g. open GCB, shut down engine).

Preheating (Diesel engine)
[PCL1] pre-ass. to relay 3, term. 37/38
[PCM1x] pre-ass. to relay 6, term. 37/38

When this relay is set the diesel engine is preheated (see functional description of diesel engine start cycle, pages 37/145).

Ignition "ON" (Gas engine)
[PCL1] pre-ass. to relay 3, term. 37/38
[PCM1x] pre-ass. to relay 6, term. 37/38

When this relay is set, the ignition of the gas engine is switched on (see functional description of gas engine start cycle, pages 39/145).

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

a) Diesel engine: fuel relay

a.1) Operating magnet

Setting this relay will initiate the starting sequence of the diesel engine. If the engine is to be shut-down the relay will immediately drop out. If the speed of the engine drops below the adjustable ignition speed, the relay also drops out (note chapter "Diesel engine").

a.2) Stopping magnet

Setting this relay will stop the engine.

b) Gas engine: Gas valve

Setting this relay will open the gas valve for the gas engine. If the engine shall be shut down, the relay drops out directly. If the engine speed falls below the adjustable firing speed, the relay drops out as well (please note the description in chapter „Gas engine").

Starter
Terminals 45/46

By setting this relay the starter will be engaged. When the firing speed is reached or when there is a stoppage or after the flow of the engagement time the starter is disengaged (see chapter 2.6 "Description starting/stopping process" starting at page 37).

Centralized alarm
[PCL1] pre-ass. to relay 4, term. 47/48
[PCM1x] pre-ass. to relay 7, term. 47/48

By setting this relay, a centralized alarm is output. In this case e. g. a horn or buzzer is triggered. The operator can reset the relay by pressing the push-button "RESET/CLEAR" for a short period. The relay will be set again in the event of another alarm. The centralized alarm is set for alarms of alarm class F1 through F3 (see page 62).

Command: close GCB
Terminals 14/15

By setting this relay the generator power circuit breaker (GCB) will be closed. If the GCB connection is configured to continuous pulse, in response to a missing discrete input "Reply: GCB is open" the relay is maintained in its closed state; this is also the case if the voltages of the generator and the generator busbar are identical. In the event of an alarm of the alarm class 2 or 3, or the GCB is to be opened, this relay drops out. In the event of an alarm of alarm class 2 the relay does not drop out immediately, but only if the power is less than 3.125 % of the generator power rating (see page 84). If the switching of the GCB is not configured to continuous pulse, the relay drops back out after a pulse is output. Then, the self-holding of the GCB must be carried out externally.

Command: open GCB
Terminals 41/42

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

[PCL1 / PCM1-M]
Command: close MCB
Terminals 16/17

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

[PCM1-G]
Command: close CB
Terminals 16/17

By setting this relay the CB will be closed. This output is always a connect pulse, i. e., the self-holding of the power circuit breaker must be externally carried out.

[PCL1 / PCM1-M]
Command: open MCB
Terminals 39/40

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

[PCM1-G]
Command: open CB
Klemmen 39/40

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

Additional relays R1 through R9
[PCL1] Terminal 33..38/47..48
[PCM1x] Terminal 33..38/47..48/74..83

These relays are managed by the "relay manager" (see page 143).

Pre-settings:
- Relay 1-5 = Relay number (e. g. Relay 1 = Alarm class 1, Relay 2 = Alarm class 2, etc.)
- Relay 6 = Ignition / preheating (e.g. Relay 3 in the PCL1)
- Relay 7 = Centralized alarm (e.g. Relay 4 in the PCL1)

2.5 Text in the display

Operating and alarm messages are displayed in the bottom row in the display. Using the "message" push-button, one can switch to the following screens: "Gen. power", "current slave pointer", etc.

2.5.1 Item messages in the display

Relay messages

The following relay outputs for the engine and generator control system are additionally shown in the display:

- Synchronization GCB or MCB,
- Switching to black busbar GCB or MCB,
- Start,
- Preheat (Diesel engine),
- Purging operation (Gas engine),
- Ignition (gas engine),
- Initial state (Diesel engine): f- continuous speed governor signal is set prior to starting the engine,
- Auxiliary operations run/coasting.

"Start - Pause"

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

"Testmode"

If "TEST" operating mode is selected, this message is output.

"Load Test"

If, in "TEST" mode, a load test is selected following the actuation of the "GCB ON" push-button, this message is output.

"Emergency run"

This message displays a current case of emergency power.

"Mains sett. 000s "

This message in the display shows the mains settling time following a mains fault.
There is also shown the remaining mains settling time.

"Sprinklermode"

This message is shown in the display during sprinkler operation.

"Sprinkler shutd."

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

"Cool down 000s "

No-load operation (engine cooling) prior to engine shutdown is displayed with this message. There is also shown the remaining coasting time.

"Stop engine !"

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

"Power reduction"

A stopping of the engine is desired: The power must be reduced.

"Sprinkler+Emerg."

Both the sprinkler operation and the emergency power functions are active.

"Start without CB"

Using terminal 6 the function "Start without GCB" was selected.

NOTE

The following message is no allarm message in the true sense, but an informative message, which doesn not have to be acknowledged and results no engine shutdown. The message disappears after correcting the phase rotation.

Phase sequence! **Alarm message: Rotating field generator/mains different** **Alarm class: 3**

The rotating fields of generator and mains are different. Closing GCB/MCB is blocked.

NOTE

The texts "Sprinkler operation", "Emergency power", "Test", "Load test" and "Sprinkler+Emergency power" are alternately displayed with the basic display screen. If one of these texts is active, the actuation of the "Select" push-button switches to the continuous display of the basic display screen. This can be undone again by actuating the "Acknowledge" push-button.

2.5.2 Alarm messages in the display

Alarm messages

The following messages are output by the protection functions:

- Generator or mains undervoltage
- Generator or mains overvoltage
- Generator or mains underfrequency
- Generator or mains overfrequency
- Phase/vector shift
- Overspeed (Pickup triggering)
- Generator overload
- Reverse/reduced power
- Load imbalance
- Generator overcurrent 1
- Generator overcurrent 2
- Battery undervoltage

Alarm input messages

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

Analog input messages

The text assigned in the relevant screen is output as an alarm message. A "!" (for GW 1 "Warning" and GW 2 "Shutoff") appears in front of the configured text. In the case of a wire break, the measuring value is overwritten with "- -". At the same time, alarm output for the alarm class which has been set occurs.

"Pickup/Gen.Freq"

This alarm message is shown in the display if the Pickup speed deviates excessively (≈10 Hz) from the generator frequency.

"Interf.err.Y1Y5"

Interface Y1..Y5 malfunction. External control signals cannot be received.

"Interf.err.X1X5"

Interface X1..X5 malfunction. External control signals cannot be received.

"GCB syn. failure"

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

"MCB syn. failure"

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

"GCB open failure"
"GCB close failure "

If closing of the GCB was not successful following 5 switching attempts, the message "GCB close failure" is shown in the display. If it is present 2 seconds following the "Command: GCB open" pulse, "Reply: GCB is open" is still present, the message "GCB open failure" is displayed. At the same time, an alarm class F1 alarm is output.

"MCB open failure"
"MCB close failure"

If closing of the MCB was not successful following 5 switching attempts, the message "MCB close failure" is shown in the display. If it is present 2 seconds following the "Command: MCB open" pulse, "Reply: MCB is open" is still present, the message "MCB open failure" is displayed. At the same time, an alarm class F1 alarm is output.

"Power not zero"

The power circuit breaker logic "CLOSED TRANSIT." (softloading/interchange synchronization) has been selected and the MCB is to be opened. If the incoming power zero cannot be adjusted within the time set in the "Max. start/stop ramp time" screen, this message is displayed.

"Fault df/dVmax." If, following starting and the expiration of the set time "GCB black start max. time" the generator does not reach the voltage and frequency window allocated to it, this message is displayed.

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

"Stop failure" If speed is still detected 30 seconds following the stop signal, (acquired by the generator frequency, the Pickup or the discrete input "Dynamo") the message "Stop failure" is output with an F3 alarm shutoff.

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

"Not wanted stop" The engine's starting process was completed and the engine should run. This message is displayed if the generator frequency suddenly drops to 0 Hz, e.g. due to mechanical damage. (Background note: Since the delayed engine monitoring is deactivated when the firing speed is not reached, no underfrequency can be detected. This message is not suppressed due to the delayed engine monitoring.)

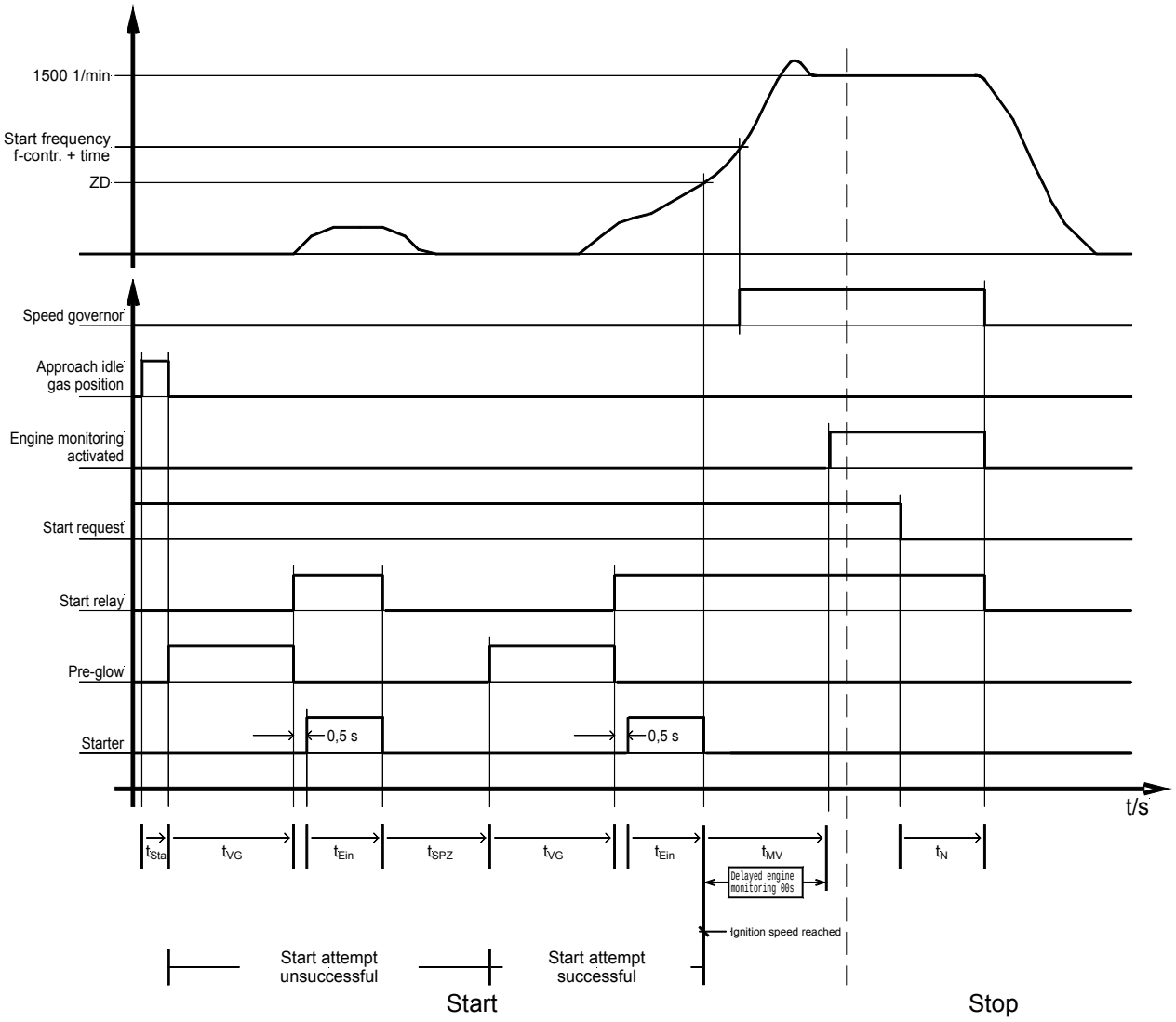
"P-Ramp: GCB open" If the GCB can not be opened after stopping the engine in the time range of "add/stop ramp max. time" this alarm message will be displayed (this message shows that the P control potentially has a fault).

EXT open failure **Alarm message: Malfunction when opening an external breakerAlarm clas**

With a changeover of the mains decoupling in the GCP-31: Malfunction on mains decoupling via relay terminals 39/40.

2.6 Description starting/stopping process

2.6.1 Diesel engine



The formula signs and indices mean:

t_{Sta} ..... Approach idle gas position [s]
t_{VG} ..... Preheating time [s]
t_{Ein} ..... Engagement time [s]
t_{SPZ} ..... Time between two start attempts [s]
t_{MV} ..... Delayed engine monitoring [s]
t_N ..... Coasting time [s]

a.) Starting process

Explanation with reference to entered data (see page 144, "

Engine configuration")

Approach idle gas position	(ON/OFF)	ON
Preheating time	(0..99 s)	t_{VG} = 3 s
Engagement time	(0..99 s)	t_{Ein} = 5 s
Time between two start attempts	(0..99 s)	t_{SPZ} = 10 s

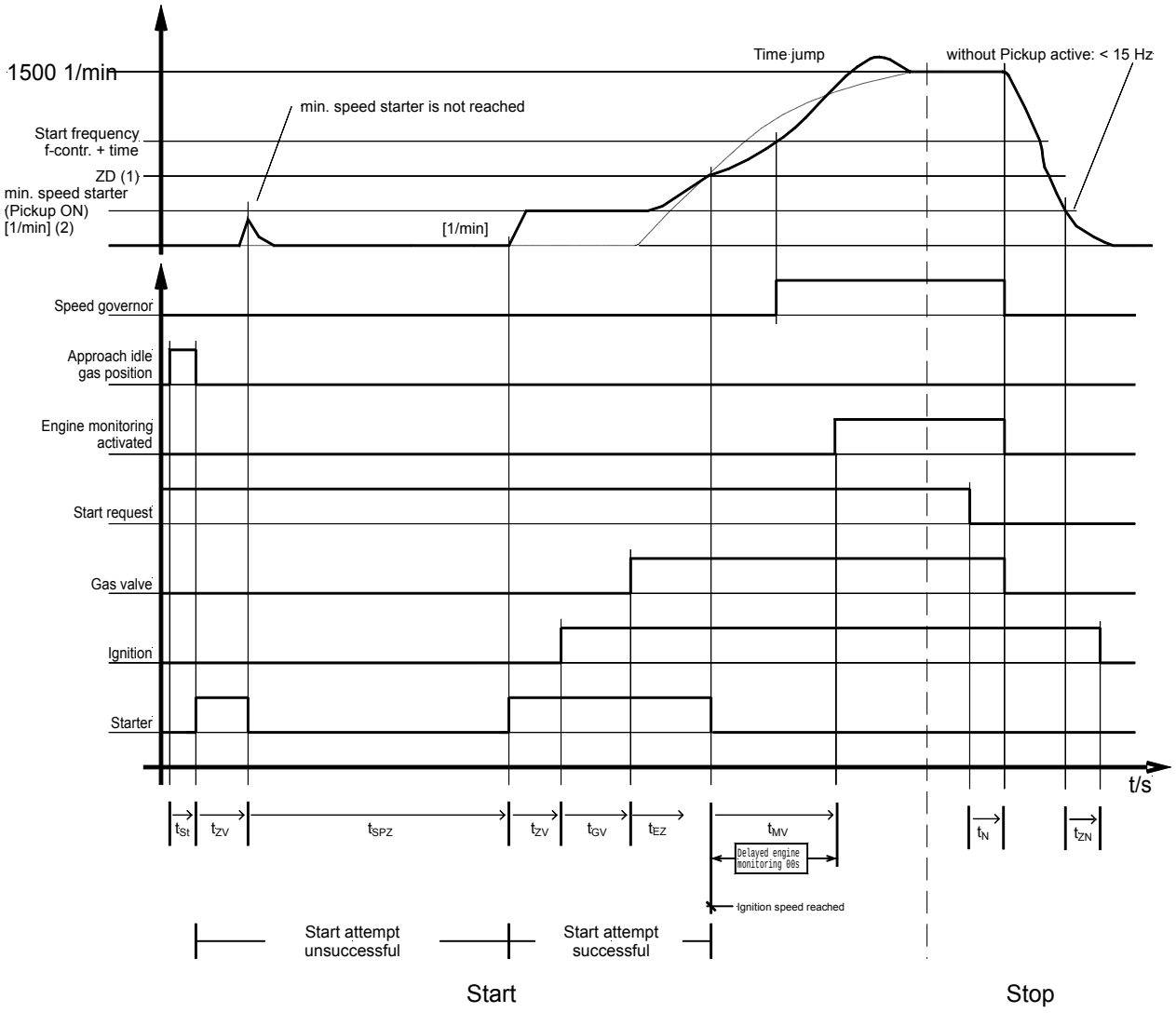
Function If the item is equipped with a three-position frequency controller, the relay "Frequency lower" is output prior to the starting process for the "Frequency controller initial state" time. Then the relay "Preheating" will be set for the period of the preheating time. Following preheating, the operating magnet is first set, and then the starter. When the adjustable firing speed is exceeded, the starter is disengaged again, and the operating magnet is held via the firing speed. After reaching "start frequency f-controller" of the speed controller and after expiration of the delay time, the speed controller is activated.

b.) Stopping process

Coasting time	(0..999 s)	t_N = 3 s

Function Upon resetting the operating bit, power reduction (if the active load controller is switched on) is carried out. After opening the generator power circuit breaker, the coasting time is started, and the engine rotates without load. On termination of the coasting time, the operating magnet is reset. The engine is stopped. If the firing speed is not reached, engine starting is prevented for a firmly pre-specified time of 10 seconds. If the engine cannot be stopped via the operating magnet, after 30 s, the "Shutoff malfunction" alarm message appears; a class 3 alarm is output.

2.6.2 Gas engine



The formula signs and indices mean:

t_{Sta} ..... Approach idle gas position [s]
t_{ZV} ..... Firing delay [s]
t_{GV} ..... Gas delay [s]
t_{EZ} ..... Engagement time [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} ..... Coasting time [s]
(1)..... Disengagement of the starter; Ignition and gas also ON
(2)..... Switching ON the ignition

a.) Starting process

Explanation using entered data (see page 144, "Engine configuration")

Approach idle gas position	(ON/OFF)	ON
Firing delay	(0..99 s)	t_{ZV} = 3 s
Gas delay	(0..99 s)	t_{GV} = 8 s
Engagement time	(0..99 s)	t_{EZ} = 15 s
Time between two start attempts	(0..99 s)	t_{SPZ} = 10 s

Function

If the item is equipped with a three-position frequency controller, a continuous signal (time adjustable) is output prior to starting the engine at the "Frequency down" relay output. The starter is then set. Following the expiration of the firing delay time and if the engine is rotating with at least the set "minimum speed start", the ignition is switched on. Following the expiry of the gas delay, the gas valve is then switched on. If the starting attempt is successful, i.e., the firing speed was exceeded, the starter is disengaged again. The gas valve and the ignition are held via the firing speed. After reaching the "starting frequency f-controller" and after expiration of the delay time, the speed controller is activated.

b.) Stopping process

Coasting time	(0..999 s)	T_{ZN} = 3 s

Function

On resetting the starting request, power reduction (if the active load controller is switched on) is carried out. After opening the generator power circuit breaker, the coasting time is started, and the engine rotates without load. On termination of the coasting time, the gas valve is closed. The engine is stopped. If the firing speed is not reached, engine starting is prevented for a firmly pre-specified time of 10 seconds. If the engine cannot be stopped, the "Shutoff malfunction" alarm message appears after 30 s, a class 3 alarm is output.

Following negative deviation from the firing speed, the ignition remains set for a further 5 seconds so that the remaining gas is able to combust.

2.7 Operation of the power circuit breaker

Permissible preset limits

Generator:
- Voltage U_{Gen} 75..115 % $U_{nominal}$
- Frequency f_{Gen} 80..110 % $f_{nominal}$

Busbar:
- Voltage U_{Gen} 85..112.5 % $U_{nominal}$
- Frequency f_{Gen} 90..110 % $f_{nominal}$

NOTE

For the description of the CB logic, please refer to Chapter 4.11.6 "Power circuit breaker logic" starting at page 110.

2.7.1 Synchronization of the GCB

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

Automatic mode:
- the operating mode "AUTOMATIC" is selected;
- one of the circuit breaker logics "PARALLEL" (operation in parallel with the mains), "INTERCHANGE" (interchange synchronization) or "CLOSED TRANSIT." (no-break-transfer/overlap synchronization) has been switched ON in configuration mode;
- no alarm class 2 or 3 alarm is present;
- an "Automatic 1" (terminal 3) or "Automatic 2" (terminal 5) input has been applied, or a remote starting signal has be activated via the interface or one more engine will be applied in the emergency mode (and will be synchronized on the busbar).
- the busbar has been energized;
- the engine is running, and the generator voltage and frequency are within the pre-specified limits (see page 41);
- the delayed engine monitoring 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 operating mode "MANUAL" has been selected;
- one of the circuit breaker logics "PARALLEL" (operation in parallel with the mains), "INTERCHANGE" (interchange synchronization) or "CLOSED TRANSIT." (no-break-transfer/overlap synchronization) has been switched ON in configuration mode;
- no alarm class 2 or 3 alarm is present;
- the busbar has been energized;
- the engine is running, and the generator voltage and frequency are within the pre-specified limits (see page 41);
- the push-button "GCB ON" was pressed.
- the rotating field of the generator and the mains voltages are identical (and no alarms are displayed).

Load test mode:

- the operating mode "TEST" has been selected;
- one of the circuit breaker logics "PARALLEL" (operation in parallel with the mains), "INTERCHANGE" (interchange synchronization) or "CLOSED TRANSIT." (no-break-transfer/overlap synchronization) has been switched ON in configuration mode;
- no alarm class 2 or 3 alarm is present;
- the busbar has been energized;
- the engine is running, and the generator voltage and frequency are within the pre-specified limits (see page 41);
- 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).

2.7.2 Closing the GCB without synchronization (GCB black start)

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

Automatic mode:

- the operating mode "AUTOMATIC" has been selected;
- no alarm class 2 or 3 alarm is present;
- the option "GCB black start" has been set to "ON" in configuration mode;
- the busbar has not been energized;
- the engine is running, and the generator voltage and frequency are within the pre-specified limits (see page 41);
- the "Reply: MCB is open" exists (the MCB is open);
- if the load is distributed via the CAN bus
  - no GCB may be closed in the event of possible isolated operation in parallel with other gensets,
  - the genset with the lowest item number will be the first to close its GCB (see chapter 4.9 "Basic settings configuration" on page 82).

Manual mode:

- the operating mode "MANUAL" has been selected;
- no alarm class 2 or 3 alarm is present;
- the busbar has not been energized;
- the engine is running, and the generator voltage and frequency are within the pre-specified limits (see page 41);
- the "Reply: MCB is open" exists (the MCB is open);
- if the load is distributed via the CAN bus
  - no GCB may be closed in the event of possible isolated operation in parallel with other gensets,
  - the genset with the lowest item number will be the first to close its GCB (see chapter 4.9 "Basic settings configuration" on page 82).
- the push-button "GCB ON was pressed.

Switched-off generator monitors:
If the generator monitors are switched off, the CB logic and the control system are controlled by internally defined limit values.

Generator monitors	Voltage	Frequency
ON	Monitor values	Monitor values
OFF	$U_{Gen.} < 75\ \% U_{Rated}$ $U_{Gen.} > 115\ \% U_{Rated}$	$f_{Gen.} < 80\ \% f_{rated}$ $f_{Gen.} > 110\ \% f_{rated}$

2.7.3 Synchronization of the MCB [PCL1/PCM1-M]

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

Automatic mode:

- the operating mode "AUTOMATIC" has been selected;
- one of the circuit breaker logics "PARALLEL" (operation in parallel with the mains), "INTERCHANGE" (interchange synchronization) or "CLOSED TRANSIT." (no-break-transfer/overlap synchronization) has been switched ON in configuration mode;
- no alarm class 2 or 3 alarm is present;
- the busbar has been energized;
- the mains voltage is present and within the permissible limits;
- the engine is running, and the generator busbar voltage and frequency are within the pre-specified limits (see page 41);
- the "Reply: GCB is open" is not present (the GCB is closed);
- the input "Enable MCB" has been set;
- the rotating field of the generator and the mains voltages are identical (and no alarms are displayed).

Manual operation:

- the operating mode "MANUAL" has been selected;
- one of the circuit breaker logics "PARALLEL" (operation in parallel with the mains), "INTERCHANGE" (interchange synchronization) or "CLOSED TRANSIT." (no-break-transfer/overlap synchronization) has been switched ON in configuration mode;
- no alarm class 2 or 3 alarm is present;
- the busbar has been energized;
- the mains voltage is available;
- the engine is running, and the generator busbar voltage and frequency are within the pre-specified limits (see page 41);
- the" Reply: GCB is open" is not present (the GCB is closed);
- the input "Enable MCB" has been set;
- the "MCB ON" has been pressed;
- Load test: On termination of the load test (circuit breaker logics "INTERCHANGE" (interchange synchronization) or "CLOSED TRANSIT. (no-break-transfer/overlap synchronization), the GCB is opened;
- the rotating field of the generator and the mains voltages are identical (and no alarms are displayed).

2.7.4 Closing the MCB without synchronization (MCB black start) [PCL1 / PCM1-M]

The mains power circuit breaker (MCB) is closed without synchronization if the following conditions are met simultaneously:

Automatic mode:
- the operating mode "AUTOMATIC" has been selected;
- the option "MCB black start" has been set to "ON" in configuration mode;
- the busbar has not been energized;
- the mains voltage is available;
- the "Reply: GCB is open" is present (the GCB is open);
- the input "Enable MCB" has been set.
- if the load is distributed via the CAN bus
  - no MCB must be closed in the event of possible isolated operation in parallel with other gensets,
  - the item with the lowest item number will be the first to close its MCB (see chapter 4.9 "Basic settings configuration" on page 82).

Manual mode:
- the operating mode "MANUAL" has been selected;
- the busbar has not been energized;
- the mains voltage is available;
- the "Reply: GCB is open" is present (the GCB is open);
- the input "Enable MCB" has been set;
- the "MCB ON" push-button has been pressed.
- if the load is distributed via the CAN bus
  - no MCB must be closed in the event of possible isolated operation in parallel with other gensets,
  - the item with the lowest item number will be the first to close its MCB (see chapter 4.9 "Basic settings configuration" on page 82).

Operation mode STOP
- The MCB will be closed when the "Enable MCB" (terminal 53) is set if this has been enabled via the configuration.

2.7.5 Open GCB

The generator power circuit breaker (GCB) is opened both when the relay "Command: GCB close" drops out (only if "continuous pulse" has been selected in configuration mode), and via the closure of the relay "Command: GCB open". The GCB will be opened under the following circumstances:

- if a mains watchdog is triggered and the GCB is uncoupled;
- in the operating mode "STOP";
- in the case of alarm class 2 or 3;
- upon pressing the "GCB OFF" or "MCB ON" push-button (depending on the CB logic which has been set) in manual operating mode;
- upon pressing the "STOP" push-button in manual operating mode;
- upon pressing the "GCB OFF" or "MCB ON" push-button (depending on the CB logic which has been set) in load test mode;
- in the event of automatic stopping in "AUTOMATIC" operating mode;
- following the "CLOSED TRANSIT." (no-break-transfer/overlap synchronization) of the MCB;
- before the MCB is switched to the black busbar in the case of "OPEN TRANSIT." (ATS/break-before-make/changeover) logic;
- in sprinkler operation, provided that no case of emergency power is present;
- following the "INTERCHANGE" (interchange synchronization) of the MCB.

2.7.6 Open MCB [PCL1/PCM1-M]

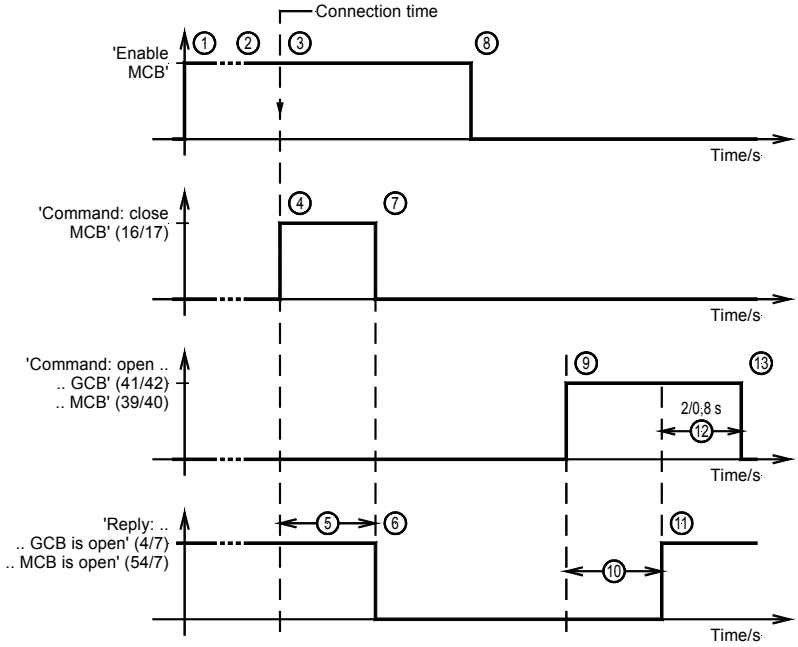
The mains power circuit breaker (MCB) is opened via the closure of the relay "Command: MCB open" (the "continuous pulse" setting is not possible in the case of the MCB). The MCB will be opened under the following circumstances:

- when the mains watchdog is triggered, if mains decoupling is set to MCB;
- if emergency power is triggered (mains failure);
- following the "CLOSED TRANSIT." (no-break-transfer/overlap synchronization) of the GCB;
- prior to the closure of the GCB in the case of "OPEN TRANSIT." (ATS/break-before-make/changeover) logic;
- upon pressing the "MCB OFF" or "GCB ON" push-button (depending on the CB logic which has been set) in manual operating mode;
- upon pressing the "MCB OFF" or "GCB ON" push-button (depending on the CB logic which has been set) in load test mode;
- following the "INTERCHANGE" (interchange synchronization) of the MCB.

2.7.7 GCB Pulse/Continuous Pulse

Closing and opening of the GCB and the MCB are described in the following figures. Changing of the breaker control logic is configured via the parameter "GCB close relay" and has the described effect on the signal sequence (the operation of the MCB cannot be carried out by means of the continuous pulse). If the "Automatic breaker deblocking" is configured to "ON", an open pulse is issued prior to each close pulse. The discrete input "Enable MCB" disables the closure of the MCB. A closed MCB is not opened.

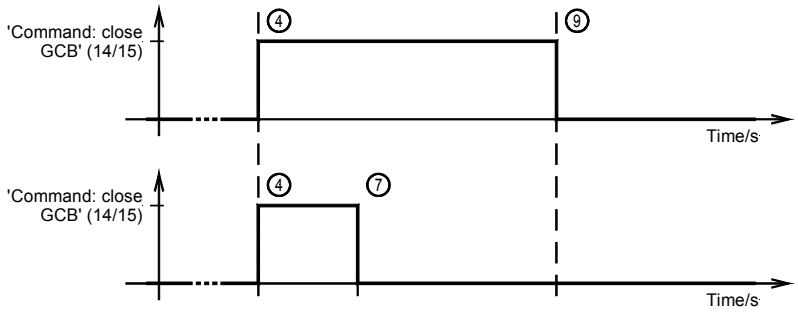
• Breaker logic: 'Impulse'



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

- close GCB/MCB: ***4*** Closing pulse for GCB/MCB set; ***5*** Inherent delay; ***6*** Reply GCB/MCB; ***7*** Closing pulse deleted;
- open GCB/MCB: ***9*** Opening pulse GCB/MCB set; ***10*** Inherent delay; ***11*** Reply GCB/MCB; ***12*** Time delay (GCB: 2 s; MCB: 0.8 s); ***13*** Opening pulse deleted.

• Beaker logic: 'Continuous'



'Continuous' logic (GCB only): ***1*** Enable; ***2*** Synchronization; ***3*** Connect time reached:

- close GCB: ***4*** Continuous pulse GCB set; ***5*** Inherent delay; ***6*** Reply GCB;
- open GCB: ***9*** Continuous pulse deleted and switch off pulse GCB set; ***10*** Switcher time element; ***11*** Reply GCB; ***12*** Opening pulse deleted.

2.8 Monitoring power circuit breakers

2.8.1 Breaker connect time monitoring

If, in the case of synchronous generators, the "synchronization time monitoring" mask or, in the case of asynchronous generators, the "breaker connection monitoring" mask is set to "ON", synchronization time monitoring (connection monitoring in the case of asynchronous generators) is carried out: If the synchronization of the GCB or MCB is started, the time counter is started following the expiry of delayed engine monitoring. If, following the expiry of the set time, the power circuit breaker has not been activated, a warning message "GCB synchronization time exceeded" ("GCB connect time exceeded" in the case of asynchronous generators) or "MCB synchronization time exceeded" is output as an F1 alarm.

2.8.2 Circuit breaker monitoring

NOTE

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

Upon CLOSING

If the " GCB monitoring" or "MCB monitoring" is set to "ON", generator and mains power circuit breaker monitoring is carried out (exception: the power circuit breaker logic is set to "EXTERNAL"). If the circuit breaker cannot be activated by the fifth attempt, an alarm class F1 "GCB malfunction" or "MCB malfunction" alarm message is output. If the relay manager is available (see chapter 4.17.2 "Relay manager" starting at page 132) a relay is set with the parameter *74* or *75*.

Upon OPENING

If the reply is still detected 2 seconds after a CLOSE pulse (opening of GCB or MCB) that the GCB or MCB is closed, an alarm message of alarm class F1 "GCB malfunction" or "MCB malfunction" is also output. If a relay manager is available, a relay is set with parameter *76* or *77*.

2.9 Power circuit breaker logic

NOTE

For a description of CB logics, please refer to chapter 4.11.6 "Power circuit breaker logic" starting at page 110. The synchronization conditions as described in chapter 0 "

Synchronization of the " starting on page 41 and chapter 2.7.3 "Synchronization of the MCB" starting on page 43 are applicable.

2.9.1 CB logic "PARALLEL" [PCM1x]

NOTE

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

In the event of an engine request,
- the GCB is synchronized and closed, and
- the necessary generator real power or re-active power is adjusted.

Following the withdrawal of the engine request,
- the generator power is reduced, the generator power factor φ is adjusted to "1",
- the GCB is opened and
- the engine is shut off following coasting.

The mains power circuit breaker is synchronized and closed if
- terminal 53 "Enable MCB" is set and
- the GCB is closed.

The mains power circuit breaker is switched to the black busbar if
- the GCB and
- the MCB are open and
- the busbar is de-energized and
- terminal 53 "Enable MCB" is available.

NOTE

On stopping the engine (no F3 alarm), power reduction is carried out before opening the GCB.

2.9.2 CB logic "INTERCHANGE" [PCM1-M]

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

NOTE

In order to perform this function correctly, you have to obey that the mains power measurement is connected properly. The sign of the power measurement has to be determined correctly as well.

In the event of a engine request, a switch is made from mains to generator supply. In order to achieve this,
- the GCB is synchronized and closed,
- the mains interchange is adjusted to "zero" and
- the MCB is opened.

After the engine request has been reset, a switch is made from generator to mains supply. In order to achieve this,
- the MCB is synchronized and closed,
- the generator power is adjusted to "zero" and
- the GCB is opened.

2.9.3 CB logic "CLOSED TRANSIT." [PCL1/PCM1-M]

Closed transition (no-break-transfer/overlap synchronization) is activated via the "CLOSED TRANSIT." screen input.

In the event of a engine request, a switch is made from mains to generator supply. In order to achieve this,
- the GCB is synchronized and closed and
- the MCB is opened.

After the engine request has been reset, a switch is made from generator to mains supply. In order to achieve this,
- the MCB is synchronized and closed and
- the GCB is opened.

NOTE

The power circuit breakers are opened regardless of the power.

2.9.4 CB logic "OPEN TRANSIT." [PCL1/PCM1-M]

The open transition/break-before-make/changeover logic is activated via the "OPEN TRANSIT." screen input.

In the event of a engine request, a switch is made from mains to generator supply. In order to achieve this,
- the MCB is opened and
- the GCB is closed.

After the engine request has been reset, a switch is made from generator to mains supply. In order to achieve this,
- the GCB is opened and
- the MCB is closed.

2.9.5 CB logic "EXTERNAL"

The external CB logic is activated via the "EXTERNAL" screen input. All switch control must be carried out via a superordinate controller (e. g. PLC). Closing and opening pulses to the MCB and the GCB are only output by this control system (PCx) in the "MANUAL" operating mode. In the event of an alarm, the switches are opened by this control system (PCx) under all circumstances.

2.10 Emergency power [PCL1/PCM1-M]

Prerequisite

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

NOTE

If the "Engine enable" or "Engine block" function is assigned to terminal 6, emergency power can be discretely prevented or interrupted from an external source. Please refer also to the description in chapter 4.15.3 "Setting the control inputs " on page 135on this.

Activation of emergency power

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

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

Emergency power is also triggered via the detection of a switch fault when the MCB is switched on. In order to achieve this, the "Emergency power" (page 117) and "MCB monitoring" screens must be set to "ON" .

The following principles are observed in the case of emergency power:

- If emergency power is triggered, the engine is started under all circumstances, unless the procedure is interrupted via an alarm or a change in operating mode.
- If the mains returns during starting, the MCB is not opened. The engine starts under all circumstances, and waits without load until the mains settling time has expired. If a further mains fault occurs during this time, the MCB is opened, and the GCB is switched to the black busbar. The engine otherwise shuts off following the double expiry of the mains settling time.
- The GCB is closed regardless of the engine delay time after the black starting limits have been reached.
- If the mains returns during emergency power (GCB is closed), the mains settling time must pass before reverse synchronization of the MCB occurs.

Emergency power

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

2.10.1 Emergency power with "PARALLEL" CB logic [PCM1-M]

Emergency power

Following the recognition of the emergency power case, the emergency power delay time expires before the engine is started. Once reaching the voltage and frequency limit values, the MCB is opened, and the GCB is then switched to the black busbar. The genset takes over the supply of the isolated network.

Return of the mains

Following the return of the mains voltage, the item waits until the mains settling time has expired (0.0..999.9 s, framework: 0.1 seconds, shown in the display), before carrying out reverse synchronization of the mains power circuit breaker. After closing the mains power circuit breaker, the genset assumes its original operating mode. If the generator is shut off, power reduction is carried out provided that the real power controller is activated.

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

2.10.2 Emergency power with "OPEN TRANSIT." CB logic

Emergency power

Following the recognition of the emergency power case, the emergency power delay time expires before the engine is started. On reaching the voltage and frequency limit values, the MCB is opened, and the GCB is then switched to the black busbar. The genset takes over the supply of the isolated network.

Return of the mains

Following the return of the mains voltage, the genset waits until the mains settling time has expired (0..999 s, framework: 1 seconds, shown in the display), before it switches the mains power circuit breaker back via a voltage-free ("black") busbar. If, following the expiry of the mains settling time, an operating request is present, the genset remains in isolated operation.

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

2.10.3 Emergency power with "CLOSED TRANSIT." CB logic

Emergency power

Following the recognition of the emergency power case, the emergency power delay time expires before the engine is started. On reaching the voltage and frequency limit values, the MCB is opened, and the GCB is then switched to the black busbar. The genset takes over the supply of the isolated network.

Return of the mains

Following the return of the mains voltage, the genset waits until the mains settling time has expired (0..999 s, framework: 1 seconds, shown in display). If no operating request is present, reverse synchronization of the MCB is carried out following the expiry of this time. Following the closure of the mains power circuit breaker, the generator power circuit breaker is opened immediately and without any reduction in power.

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

2.10.4 Emergency power with "INTERCHANGE" CB logic [PCM1-M]

Emergency power

Following the recognition of the emergency power case, the emergency power delay time expires before the engine is started. On reaching the voltage and frequency limit values, the MCB is opened, and the GCB is then switched to the black busbar. The genset takes over the supply of the isolated network.

Return of the mains

Following the return of the mains voltage, the genset waits until the mains settling time has expired (0..999 s, framework: 1 seconds, shown in the display). If no operating request is present, reverse synchronization of the MCB is carried out following the expiry of this time. Following the closure of the mains power circuit breaker, the generator power circuit breaker is opened following the reduction in power.

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

2.10.5 Emergency power with "EXTERNAL" CB logic

ATTENTION

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

Emergency power

Following the recognition of the emergency power case, the emergency power delay time expires before the engine is started. On reaching the voltage and frequency limit values, the MCB is opened, the GCB is not activated. The GCB and the MCB are not otherwise operated. Not even following the return of the mains.

2.10.6 Emergency power with MCB malfunction

MCB malfunction

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

2.11 Sprinkler operation

NOTE

The function "Sprinkler operation" must be assigned to terminal 6. Please refer also to the description in Chapter 4.15.3 "Setting the control inputs " on page 135 on this issue.

ATTENTION!

Please note that a High signal must be applied at terminal 6 so that **no** sprinkler operation is carried out. A Low signal informs the control system that the conditions for sprinkler operation have been met.

→ Negative functional logic

Sprinkler "ON"

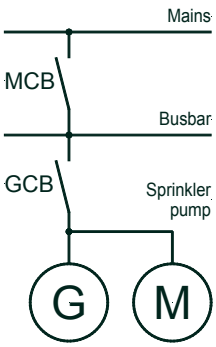
If the signal at terminal 6 drops off, the sprinkler ON command is triggered. The message "Sprinkler operation" is shown on the display. Up to 6 attempts are made to start the engine (otherwise 3) if it is not yet in operation. All malfunctions which cause shutoff become messages. Exception: Terminal 34 or 61 and overspeed. Terminal 34 (alarm input) retains its set alarm class (if terminal 34 is not present, this is terminal 61). It is advisable to assign the EMERGENCY OFF here.

NOTE

Via the activation of "Sprinkler operation" (terminal 6), alarm classes F2 and F3 are converted to alarm class F1 (exception: terminal 34 or 61 and overspeed).

Alarm class F2 and alarm class F3 → alarm class F1

"Sprinkler shutd. F1 active"



In the mask "Sprinkler shutd. F1 active" you can choose whether the sprinkler alarm classes are still active during the sprinkler coasting or if the primary alarm class will be active after reset of the sprinkler request (terminal 6).

A distinction is made between three operating conditions:

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

2.) MCB is open
(mains voltage available) and the parameter "Emergency mode" is ON.
a) The GCB will be closed or remains closed.
b) In the event of a generator overload, the GCB will be opened; following the alarm acknowledgement the GCB will be closed again.

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

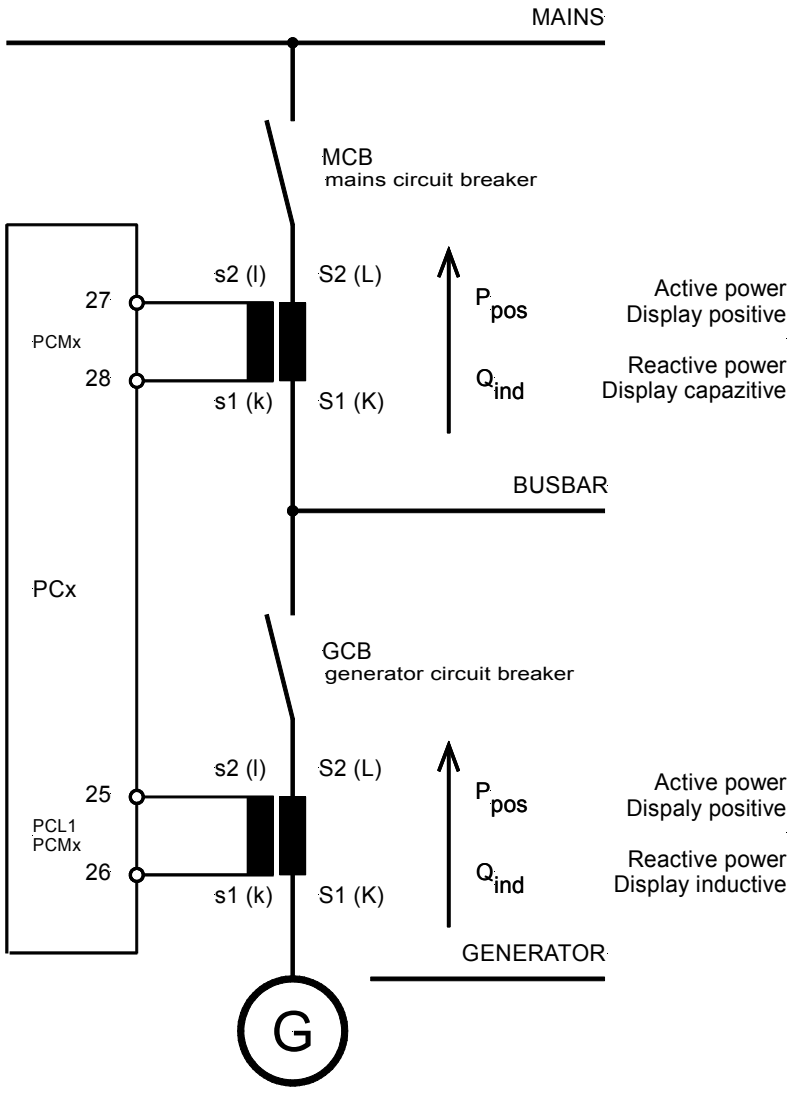
Sprinkler "OFF"

Via the completion of the sprinkler input circuit, the sprinkler ON command is withdrawn; however, sprinkler operation is retained. The message "Sprinkler coasting" appears. Sprinkler operation is automatically terminated 10 minutes later. Earlier termination can be achieved via the "STOP" operating mode. On termination of sprinkler operation, malfunctions which cause shutoffs become active again.

2.12 Direction of power

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

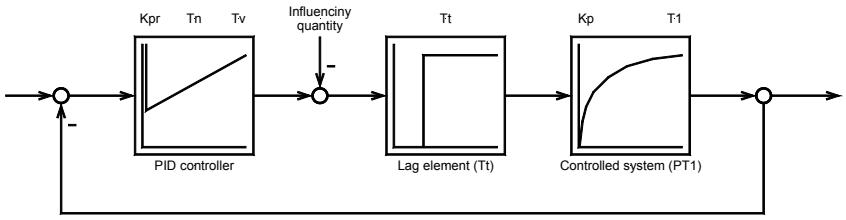
- Positive generator real power — The generator supplies real power.
- Inductive gen. power factor φ — The generator is overexcited and supplies inductive re-active power.
- Positive mains real power — Real power is supplied to the mains.
- Inductive mains power factor φ — The mains receives inductive re-active power.



2.13 Analog controller outputs (option ..-A)

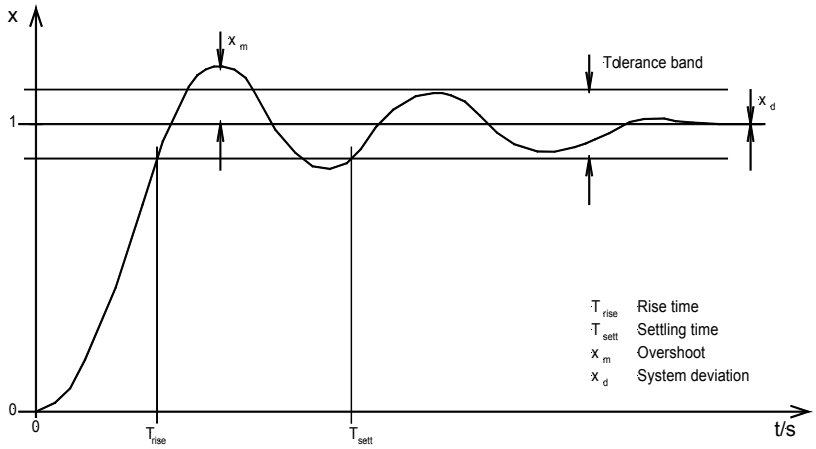
As an alternative to a three-position controller output, the item may also be equipped with an analog controller output. Other configuration masks then appear in configuration mode. The analog PID controller forms a closed-loop control loop together with the controlled system (usually a first-order lag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

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).

Step response (Example)



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

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

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

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

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

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

2.13.1 Controller setting

CAUTION!

The following must be observed regarding the controller setting:

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

→ EMERGENCY SHUTDOWN

a.) Initial state

Initial state

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

Initial state
Frequency = 000%

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

Analog controller output setting with controller switched off. This value is also used as the initial value.

b.) General settings

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

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

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

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

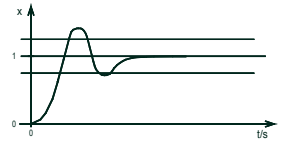
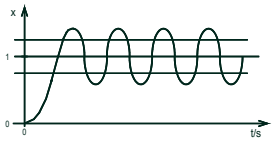
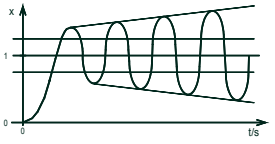
3. At the same time: measure the critical cycle duration T_{crit}
4. Set the parameters:

PID-controller

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

PI-controller

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

Step response		
Controller setting Optimal ($x_m \leq 10$ %)	Conroller setting T_{crit}	Controller setting Incorrect
		

P-gain
Kpr=000

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

The proportional-action coefficient K_{PR} indicates the closed-loop control system gain. The variable to be controlled is achieved more rapidly by increasing the P-gain.

Reset time
Tn=00.0s

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

The reset time T_n represents the I-component of the PID controller. The I-component results in permanent control deviation being eliminated in the controlled state.

Derivative time
Tv=0.00s

Derivative-action time (T_V) **0.00..6.00 s**

The derivative-action time T_V represents the D-component of the PID controller. An increase in the phase reserve (stability) and the attenuation results from increasing this parameter.

2.14 Load and/or var sharing [PCM1x]

Control guarantees that, in every operating condition (operation in parallel with the mains, isolated operation in parallel with other gensets or reverse synchronization of the busbar to the mains), the real power (in reference to the relevant nominal load) is evenly shared over the gensets operating in parallel to the busbar. Those items that are found in the "Test" or "Automatic" operating mode are involved in the load or var sharing. Moreover, a start command has been issued and there are no alarms present that would shut down the system.

Operation in parallel with the mains with mains interchange control

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

Isolated operation in parallel with other gensets

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

Reverse synchronization of the busbar to the mains

Distribution is carried out according to the type of isolated operation. However, the setpoint value for the frequency is formed from the mains frequency (+/-0.1 Hz). The relay outputs "Command: close GCB" for all items can be switched in parallel.

Prerequisites

It is imperative that the rated system frequencies (page 82), the start/stop parameters (page 100) and the circuit breaker logics (page 110) are set to the same values for all items involved in distribution control.

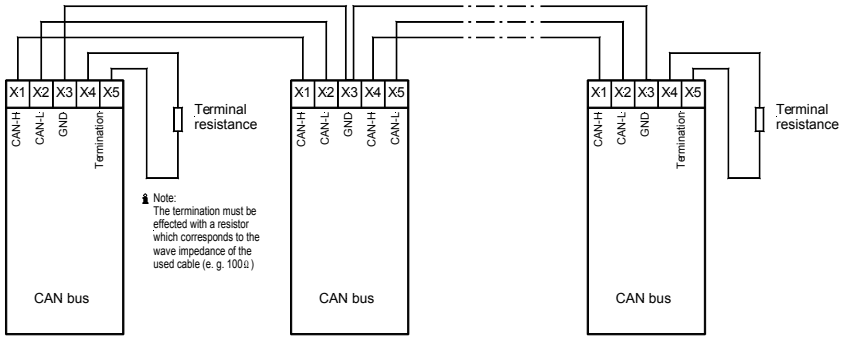
Description of the interface for distribution control

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

The following must be noted to ensure trouble-free operation:

1. The maximum bus length must not exceed 250 meters.
2. The bus must be terminated at each end with terminating resistors which correspond to the wave impedance of the bus cable (approx. 80..120 Ω).
3. The bus must be of a linear structure. Dead-end feeders are not permissible.
4. Screened "Twister-Pairs" are preferable for use as the bus cable (Ex.: Lappkabel Unitronic LIYCY (TP) 2×2×0.25, UNITRONIC-Bus LD 2×2×0.22).
5. The bus cable must not be routed in the vicinity of heavy current power lines.

Wiring diagram

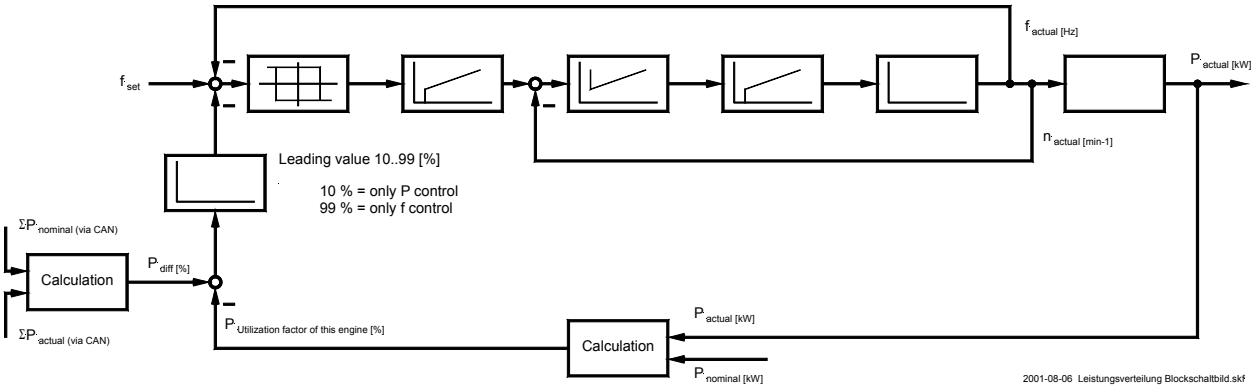


2.14.1 Load/var sharing via the CAN bus

Whether, and the manner in which, a genset carries out real power or frequency control in isolated operation in parallel with other gensets, is defined by the "real power distribution reference variable." parameter in % in chapter 4.10.6 "Load/var sharing" on page 99 of this manual. In this case, 10 % means increased real power control, and 99 % increased frequency control. This parameter must be set individually for each genset.

In the case of the following control system, it must be noted that each item calculates the mean utilization factor of all items from the data transmitted via the CAN bus, and then compares this with its own utilization factor. The utilization factor is compared with the reference variable, and results in the new reference variable. Frequency and real power control are simultaneously carried out in these items (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 an actual control value to the secondary controller.



2.15 Language manager

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

1.) Establish a connection between your PC and the control via the direct configuration cable (FI-CABLE-RS232) or via a PCK4. To do this insert one end into the COM port of your PC and the other end into the respective socket of the control.

2.) Enter the password for code level 2 into the control.

3.) If you use the FI-CABLE-RS232, the parameter „Direct. Para" has to be set "YES". If you use the PCK 4, the parameter „Direct. Para" has to be set "NO".

4.) Please enter the number (1..14) into the mask "Generator number", with which you address the PCx via FI-SOFT3.

5.) Now, scroll to the configuration mask "Language" and select the basic language by selecting "first".

6.) Start the program FI-SOFT3 and enter the password.

7.) Open the respective .cfg file via menu "File", "open".

8.) Start the communication via the menu "Communication", "Connect".

9.) Select "Parameterize" in the menu item "Devices".

10.) Enter the password for the code level 2.

11.) Close the Parameterization window.

12.) Select the menu item "Devices" and "Load language".

13.) Load the respective language file using the button "Load language file ..."

14.) Check "All texts" and afterwards select "Transfer language".

15.) If an additional language is to be loaded after transmission of the first language, the second language has to be selected in the configuration mask "Language" by selecting "second". Repeat steps 12.) through 14.).

Language

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

2.16 Connection to external components

2.16.1 Pickup input

See also chapter 4.18.4 "Pickup" on page 148.

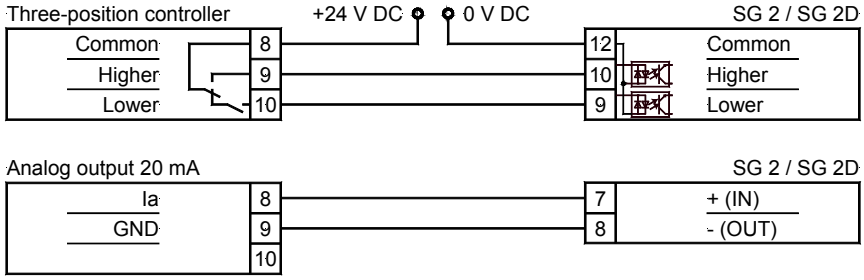
In order to configure the Pickup input, the following values must be configured:

- Rated speed (min^{-1})
- Number of teeth of the Pickup speed sensor per revolution of the engine or number of Pickup impulses per revolution of the engine.

2.16.2 Speed governor

NOTE

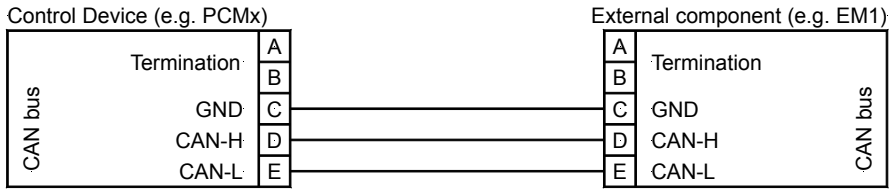
Please note the wiring diagram of the speed governor. For configuration of the speed governor you need the PC program.



2.16.3 Digital I/O expansion board EM1-D [PCM1x]

NOTE

Please note the wiring diagram of the EM1-D. For configuration of the digital expansion board you need the PC program. To the CAN bus there can be max. two EM1-D simultaneously be connected and be activated by the PCM1x Please note the description of the configuration masks of the EM1-D linking at page 134/143.



2.17 Alarms

2.17.1 Alarm classes

The monitoring functions are divided into four alarm classes:

F0	Warning alarm	This alarm does not lead to an interruption of the operation. An alarm message is displayed without a centralized alarm. → Alarm text.
F1	Warning alarm	This alarm does not lead to an interruption of the operation. A centralized alarm will be output. → Alarm text + flashing "alarm" LED + group alarm relay (horn).
F2	Triggering alarms	This alarm leads to the shutdown of the engine. First the real power is reduced before the GCB is opened. A coasting is carried out. → Alarm text + flashing "alarm" LED + group alarm relay (horn) + coasting.
F3	Triggering alarm	This alarm leads to the immediate opening of the GCB and to the shutdown of the engine. → Alarm text + flashing "alarm" LED + group alarm relay (horn) + shutdown.

NOTE

Via the activation of "Sprinkler operation" (terminal 6), alarm classes F2 and F3 are converted to alarm class F1. Exception: terminal 34 (or terminal 61, if terminal 34 is not available) and overspeed.

Alarm class F2 and alarm class F3 → alarm class F1

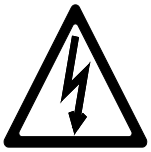
2.17.2 Internally detected alarms

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

Type of alarm	see chapter	Alarm class	Alarm text	Relay output (terminal)
Engine overspeed (Pickup)	4.13.7	F3	Over speed	F1, F2, F3 Group alarm via the Relay manager with the parameter 85 F0: No output of a group alarm
Generator overfrequency	4.13.7	F3	Over frequency	
Generator underfrequency	4.13.7	F3	Low frequency	
Generator overvoltage	4.13.8	F3	Gen.overvolt.	
Generator undervoltage	4.13.8	F3	Gen.undervolt.	
Generator overcurrent level 1	4.13.6	F3	Gen.overcurr. 1	
Generator overcurrent level 2	4.13.6	F3	Gen.overcurr. 2	
Reverse/reduced load	4.13.4	F3	Revers/min.power	
Overload	4.13.4	F2	Gen.overload	
Load imbalance	0	F3	Asymmetric load	
Mains overvoltage	4.13.11	F0	Mains-overvolt.	
Mains undervoltage	4.13.11	F0	Mains-undervolt.	
Mains overfrequency	4.13.9	F0	Mains-overfreq.	
Mains underfrequency	4.13.9	F0	Mains-underfreq.	
Mains phase/vector shift	4.13.12	F0	Vectorjump	
Battery undervoltage	0	F1	Batt.undervolt.	
GCB synchronization time monitoring	4.11.9	F1	GCB syn.failure	
MCB synchronization time monitoring	4.11.9	F1	MCB syn.failure	
Switching to black busbar time monitoring	4.11.10	F1	Failure df/dVmax.	
fault P control, GCB will be opened after time "Boost/Settle ramp openedt	–	F1	P ramp: GCB opened	
Mechanical GCB malfunction on closing	4.11.11	F1	GCB close failure	
Mechanical MCB malfunction on closing	4.11.11	F1	MCB close failure	
Mechanical GCB malfunction on opening	4.11.11	F1	GCB open failure	
Mechanical MCB malfunction on opening	4.11.11	F1	MCB open failure	
Faulty ref. power zero control with interch. syn. GCB	4.11.8	F1	Power not zero	
Maintenance call	4.19.1	F1	Service	
Interface monitoring X1..X5	4.11.3	F1	Interf.err.X1X5	
Interface monitoring Y1..Y5	4.11.3	F1	Interf.err.Y1Y5	
Plausibility control Pickup/generator frequency	4.13.7a.)	F3	Pickup/Gen.freq.	
Shutoff malfunction	–	F3	Stop failure	
Start failure	–	F3	Startfail	
Unintended stop	–	F3	Not wanted stop	

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

2.17.3 Alarm acknowledgement



DANGER!!!

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

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

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

NOTE

In order to acknowledge alarm messages via terminal 6, the "acknowledgement" function must be assigned to this terminal. Please see also the description in chapter "Adjust function of terminal 6" on page 136.

Horn After 2 minutes the horn is reset regardless of the acknowledgement of an alarm.

Interface All internal errors are conveyed via the interface.

NOTE

By acknowledging the alarms via the interface there is no difference of "short acknowledge" and "long acknowledge". After 0.1 s it will be "long acknowledged".

a.) Short acknowledgement (< 2.5 s)

Meaning The "QUIT" push-button is pressed for 0.5 s < t < 2.5 s or the terminal 6 is set for 0.5 s < t < 2.5 s.

Result - The LED "alarm" is continually illuminated.

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

x..no meaning

b.) Long acknowledgement (> 2.5 s)

Meaning The "QUIT" push-button is pressed for t > 2.5 s or
terminal 6 is set for t > 2.5 s or
the acknowledgement bit via the interface is set.

Result - The LED "alarm" switches off,
- the group alarm relays F1, F2 and F3 are reset and
- the display messages are acknowledged.

Tables for **Warning alarms** (alarm classes 0 and 1), if there are no alarms of alarm class 2 or 3 present

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

x..no meaning

Tables for **alarms causing a shutdown** (alarm classes 2 and 3)

Acknowledgement via			Operating mode			
RESET button	Terminal 6	Interface	STOP	AUTO	TEST	MANUAL
1	x	x	1	0	0	1
0	1	x	1	1	0	0
0	0	1 *)	0	1	0	0

x..no meaning

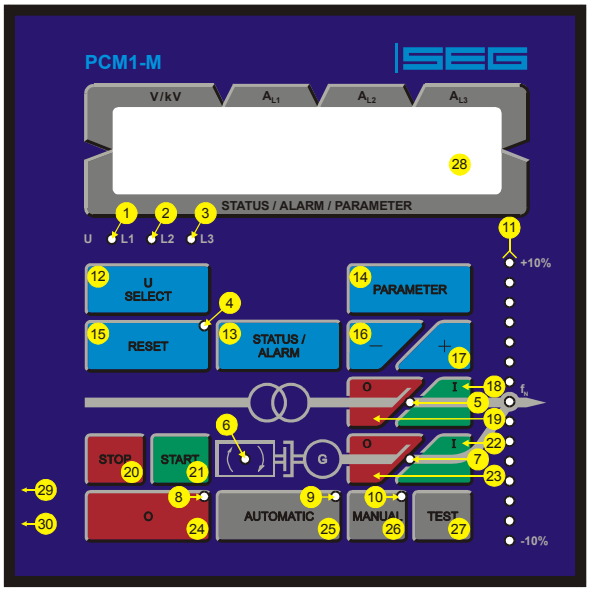
*) only if parameter "Quit F2, F3 via interface" is enabled

3 Display elements and push-buttons

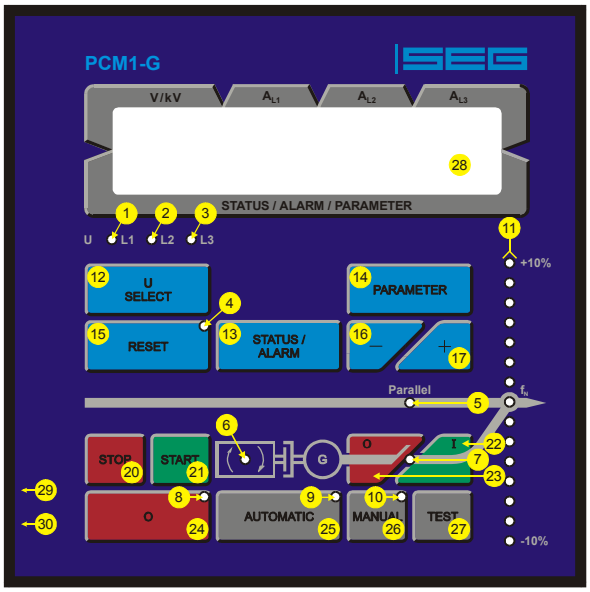
3.1 Pressure-sensitive front membrane

The pressure-sensitive membrane of the front panel consists of a plastic coating. All keys have been designed as touch-sensitive membrane switch elements. The display is an LC display, comprising 2 ×16 characters, which are indirectly illuminated in red. The contrast of the display can be infinitely adjusted via a rotary potentiometer positioned on the left. The configuration bushing is located on the left side of the item. Please connect the direct configuration cable there (FL-CABLE-RS232).

3.1.1 PCL1 & PCM1-M



3.1.2 PCM1-G



3.1.3 Short description of LEDs and push-buttons

Light-emitting diodes

1 "UL1" ..... Voltage L1
2 "UL2" ..... Voltage L2
3 "UL3" ..... Voltage L3
4 "Alarm" ..... Alarm message present
5 "NLS closed" ..... Reply: MCB is closed
5"Parallel" ..... Status message "Mains parallel"
6 "Monitoring" ..... Monitoring function active
7 "GLS closed" ..... Reply: GCB is closed
8 " 0 " ..... Mode "STOP" selected
9 "AUTOMATIC" ..... Mode "AUTOMATIC" selected
10 "MANUAL" ..... Mode "MANUAL" selected
11 "-10%..fn..+10%" ..... Synchroscope

Display

28 "LC display" LC display
29 "Connector" ..... Configuration socket
30 "Potentiometer" ..... adjust contrast

Buttons

12 "U SELECT" ..... Switch display
12 "U SELECT" ..... Increase digit
13 "STATUS / ALARM" ..... Route message
13 "STATUS / ALARM " ..... Confirm selection
14 "PARAMETER" ..... Activate setpoint value
14 "PARAMETER " ..... Move one position to the right
15 "RESET" ..... Acknowledge alarm messages
16 " - " ..... Reduce setpoint value
17 " + " ..... Increase setpoint value
18 " I " (MCB ON) ..... Close mains CB manually
19 " O " (MCB OFF) ..... Open mains CB manually
20 "STOP" ..... Stop engine manually
21 "START" ..... Start engine manually
22 " I " (GCB ON) ..... Close generator CB manually
23 " O " (GCB OFF) ..... Open generator CB manually
24 " 0 " (STOP) ..... Stop engine manually
25 "AUTOMATIC" ..... Activate "AUTOMATIC" mode
26 "MANUAL" ..... Activate "MANUAL" mode
27 "TEST" ..... Activate "TEST" mode

3.1.4 Overview of key functions

Automatic operating mode									Engine		GCB		MCB		Setpoint	
	STATUS / ALARM	U SELECT	PARAMETER	RESET	O	MANUAL	AUTOMATIC	TEST	START	STOP	I	O	I	O	+	−
	annunciation	voltage display	Setpoint value	QUIT	STOP	MAN	AUTO	TEST	Start	STOP	ON	OFF	ON	OFF	raise	lower
MANUAL																
start engine						1st			2nd							
stop engine						1st				2nd						
close GCB						1st					2nd					
open GCB						1st						2nd				
close MCB						1st							2nd			
open MCB						1st								2nd		
raise setpoint value			2nd			1st									3rd	
lower setpoint value			2nd			1st										3rd
AUTOMATIC																
start engine	and DI or operating mode						1st									
stop engine	and DI or operating mode				Yes		1st									
close GCB	and DI or operating mode						1st									
open GCB	and DI or operating mode						1st									
close MCB	and DI or operating mode						1st									
open MCB	and DI or operating mode						1st									
raise setpoint value			2nd				1st								3rd	
lower setpoint value			2nd				1st									3rd
TEST								1st								
start engine								1st								
start load test								1st			2nd					
end load test												1st				
end load test (depends on the type of switch)													1st			
raise setpoint value			2nd					1st							3rd	
lower setpoint value			2nd					1st								3rd
STOP					1st											
LED test															1st	1st

Operating mode "configuration"			
	STATUS / ALARM	U SELECT	PARAMETER
	Select	Digit	Cursor
start configuration		1st	1st
Confirm and next screen	1st		
previous screen	1st		1st
next pos./change text			1st
raise position		1st	
end configuration		1st	1st

3.2 LEDs

Lamp test — The LED's can be checked via a lamp test. In order to achieve this, the "Setpoint↑" and "Setpoint↓" push-buttons must be pressed simultaneously.

1 2 3 ..... LED "U L1 .. U L2 .. U L3"

Voltage control — **Color "GREEN"**

The LED's "UL1", "UL2" and "UL3" show which voltage (U_{L1N}, U_{L2N}, U_{L3N}, U_{L12}, U_{L23} or U_{L31}) is currently being displayed. This applies both to the generator and the rated voltage display.

4 ..... LED "RESET" (Alarm)

Alarm — **Color "RED"**

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

5 ..... LED
[PCL1 or PCM1-M] **"MCB ON"**
[PCM1-G] **"Mains parallel"**

Reply: MCB is closed / Mains parallel — **Color "GREEN"**

[PCL1 or PCM1-M] Items with two power circuit breakers: The "MCB ON" LED indicates that the mains power circuit breaker is closed.

[PCM1-G].. Items with one power circuit breaker or items which have been made into 1-CB items via external wiring [see chapter 2.1.2 "... systems with one power circuit breaker" on page 27]: The "Mains parallel" LED indicates that the genset is operating in parallel with the mains.

6 ..... LED "Monitoring"

Engine monitoring — **Color "GREEN"**

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

7 ..... LED "GCB ON"

Reply: GCB is closed — **Color "GREEN"**

The "GCB ON" LED signals that the generator power circuit breaker is closed.

8 ..... LED " 0 " (STOP)"

Operating mode "STOP" — **Color "RED"**

If the LED " 0 " (STOP) is illuminated, the "STOP" mode has been selected. If this LED flashes, a firing speed is detected in "STOP" mode.

9 ..... LED "AUTOMATIC"

Operating mode "AUTOMATIC" — **Color "YELLOW"**

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

10 ..... LED "MANUAL"

Operating mode "MANUAL" — **Color "YELLOW"**

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

11 ..... *LED "-10%..f_N..+10%"*

Phase position/synchroscope **Colors "RED/YELLOW/GREEN"**

Normal operation .....The LED's between -10 % and +10 % serve to visualize the generator frequency. The rated frequency (f_N) is entered in the "generator rated frequency" screen. If the frequency is greater than +10 % or less than -10 %, the corresponding outer LED flashes LED.

Configuration .....If, in configuration mode, the service display is "ON" and the double voltage/double frequency display is active, the LED's show the current phase angle between the two displayed voltages. The green LED in the center of the 15 LED's indicates that the measured phase angle between the voltage systems displayed is less than 12 ° electrical. The phase angle is only displayed if the frequencies of the two voltages are within the following permissible ranges:

Generator..... 88..112 % f_N
Mains ..... 96..104 % f_N

A distinction is made between two directions of rotation:

-10 % → +10 %
On running the LED's from left to right, the generator frequency is too high, i. e., the generator is turning too fast;

+10 % → -10 %
On running the LED's from right to left, the generator frequency is too low, i. e., the generator is turning too slowly.

3.3 Push-buttons

3.3.1 Display touch

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

12 .....*PUSH-BUTTON "U SELECT"*

U SELECT **Color "BLUE"**

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

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

13 .....PUSH-BUTTON "STATUS / ALARM"

STATUS/ALARM **Color "BLUE"**

Normal operation..."STATUS / ALARM" - By pressing this push-button, the display of the operating and alarm messages can be advanced.

Configuration ....."STATUS / ALARM" - A jump is made to the next input screen. If the value originally displayed has been changed via the "U SELECT" or "PARAMETER" push-buttons the newly set value is saved by pressing the "STATUS / ALARM" push-button once. By pressing this push-button again, the user causes the system to display the next entry screen.

14 .....PUSH-BUTTON " PARAMETER"

PARAMETER **Color "BLUE"**

Normal operation..."PARAMETER" - By pressing this push-button, the individual setpoint values are displayed. The displayed setpoint values can be adjusted with the "Setpoint +" or "Setpoint –" push-buttons. Certain setpoint values, which are entered into the item from external sources, can only be viewed.

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

DANGER!!!

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

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

15 .....PUSH-BUTTON "RESET"

Acknowledgement **Color "NONE"/"BLUE"**

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

16 *17* .....PUSH-BUTTON "Setpoint •..•"

Setpoint +..Setpoint – **Color "BLUE"**

By pressing the "Setpoint +" or "Setpoint - push-buttons, the setpoint selected via the "Setpoint" push-button is changed accordingly. Only those values which are available in the relevant operating mode and which were switched on during configuration can be changed. If the two push-buttons are depressed simultaneously, the lamp test is activated.

3.3.2 Operation of the power circuit breakers

18 19.....PUSH-BUTTON "I/O" (MCB ON/OFF)

MCB "ON/OFF" **Color "RED"/"GREEN"**

(only enabled if manual operating mode ("MANUAL" push-button) or test mode ("TEST" push-button) has been selected).

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

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

20..21 .....PUSH-BUTTONS "START / STOP"

Engine "Start/Stop" **Color "GREEN"/"RED"**

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

STOP.....This push-button is used to stop the engine by de-activating the operating magnet.

22 23.....PUSH-BUTTON [PCL1/PCM1-M] "I/O" (GCB ON/OFF)

GCB "ON/OFF" **Color "RED"/"GREEN"**

(only enabled if manual operating mode ("MANUAL" push-button) or test mode ("TEST" push-button) has been selected).

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

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

3.3.3 Operating mode selector switch

24 .....PUSH-BUTTON STOP

"STOP" mode **Color "RED"**

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

Stopping process

- the "STOP" mode is selected,
- the real power is reduced,
- the GCB is opened at 5 % of the rated generator real power,
- coasting is carried out according to the parameters in order to cool the engine.

25 .....PUSH-BUTTON "AUTOMATIC"

Operating mode "AUTOMATIC" **Color "GREY"**

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

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

26 .....PUSH-BUTTON "MANUAL"

Operating mode "MANUAL" **Color "GREY"**

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

27 .....PUSH-BUTTON "TEST"

Operating mode "TEST" **Color "GREY"**

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

Start of a "LOAD TEST" A load test is enabled via the actuation of the " I " (GCB ON) push-button. In addition to the functions of "TEST" mode, the GCB is synchronized or the MCB is opened according to the CB logic and the GCB is then switched to the black busbar. The power can be changed by actuating the setpoint value push-buttons.

End of a "LOAD TEST" The "LOAD TEST" can be terminated by actuating the " O " (GCB OFF) or " I " (MCB ON) push-button (depending on power circuit breaker logic). In "STOP" or "AUTOMATIC" mode without request signal, the genset is stopped with a reduction of power.

28 .....DISPLAY "LC display"

LC display

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

Top line

- In the "V/kV" field, the generator voltage is displayed depending on the LED's UL1, UL2 and UL3.
- In the fields "A(L1)", "A(L2)" and "A(L3)" the generator line currents are displayed separately for each phase.

Bottom line

The following screens appear in the "operating and alarm messages" field:

Basic screen

- Display of the generator power factor φ and the generator actual real power

or

- the action of the genset that is currently being carried out (synchronization, starting, etc.)

Subordinate screens: Depending on the item's equipment,

- the engine speed,
- the mains voltage,
- [PCM1x] the mains current/the mains power, mains power factor φ,
- the analog input variables,
- the generator's active energy,
- the generator re-active power (is determined via the current of phase L1; also if "three-phase" power measurement was selected),
- the operating hours,
- the time remaining until the next maintenance call,
- the engine start counter,
- the battery voltage (supply voltage),
- [PCM1x] the number of subscribers participating in load sharing,
- the maximum generator current (slave pointer),
- the four alarm messages which occurred first and
- [PCM1x] the time/the date

are displayed.

These display screens are displayed in succession by pressing the "STATUS / ALARM" push-button. When the last display screen has been reached, the basic screen is displayed. If alarms have occurred, their message texts are displayed in the sequence of their occurrence in the display screens before the basic screen. If item functions are active (e. g. synchronization of the GCB), the basic screen is superimposed with the corresponding message (e. g. "synchronization"). Following the termination of the item function, the basic screen is displayed again.

4 Configuration screens (input of the parameters)

Configuration can be performed using a PC and the PC program FL-SOFT3 via the serial interface or via the front panel push-buttons and the front panel LC display. Additionally it is possible to configure the unit via CAN bus. The following Baudrate are therefore usable:

- Configuration via direct configuration plug = 9,600 Baud (8 Bit, no parity, 1 Stoppbit) and
- CAN bus (CiA) = 125, 250 or 500 kBaud configurable via the serial interface.

CAUTION

For configuration of this control (firmware software version starting with 4.1xxx) a PC software with the following version number:

FL-SOFT3 ab 3.0.015

Because of functional enhancements within the controls of the PCx Series it is necessary (beginning with firmware version 4.1.xxx of the PCx) to use a newer version of the configuration software FL-SOFT3. This version at least has to be 3.0.015 or higher.

Once you successfully finished the installation older project files still can be used.

WARNING

Please note that configuration only should be performed in a standstill of the system.

NOTE

Please take into account the list of parameters at the end of this manual.

The configuration screens, if they are in input mode (simultaneously pressing of "U SELECT" and "PARAMETER"), can be scrolled via "STATUS / ALARM". If the "STATUS / ALARM" push-button is pressed for a longer period of time, the scroll function will be activated, and the screens will be browsed rapidly. Simultaneously pressing the "STATUS / ALARM" and "PARAMETER" push-buttons allows you to scroll through the last four configuration screens. (exception: change from the first to the last parameter as well as backwards in the service screen is not possible). If no entry, modification or any other action is carried out for 60 seconds, the item automatically returns to the automatic mode.

NOTE

There are two different types of hardware, which are described in this manual: A 100 Vac version [1] and a 400 Vac version [4]. The configuration screens and parameters differ in both versions, and the setting limits also differ. The two types are identified by the preceding voltage values ([1] ... or [4] ...).

4.1 Load basic values

WARNING!

By loading the standard values all parameters are overwritten. Thereby the customer settings get lost and shall be saved necessarily by FL-SOFT3.

Procedure:

- Enter code level 2.
- Select "operation mode STOP"
- Press the 3 buttons "U SELECT", "PARAMETER" and "STATUS / ALARM" for at least 5 seconds at the same time.
- Message "Default Values loading 000%" is displayed.
- Wait until value reaches 100%.
- Standard values are successfully loaded.

NOTE

If the device is equipped with a language manager, the first language is selected by loading the standard values. Therefore the language has to be changed by hand.

4.2 Version number

Software version
Vx.xxxx

Software version

Software version display.

4.3 Password protection

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

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

Code level 1 (CS1) User: Customer
This code level entitles the user to change a few selected parameters (e. g. rated real power, etc.). Changing a password is not possible in this case.

Code level 2 (CS2) User: Commissioner
With code level 2 the user acquires all access rights, and therefore has direct access to all parameters (displaying and changing). In addition, the user may also set the password for levels 1 and 2 in this level.

NOTE

Once the code level is set, this is not changed, even if the configuration mode is accessed steady. When an incorrect code number is entered, the code level is set to CS0 and the item is therefore locked for external users (set of password on page 86). Two hours after the final operation of the item, code level CS0 is automatically set. By inputting the corresponding code number, the corresponding level is accessed again.

Enter code
0000

Enter code number **0..9999**

On accessing the configuration mode, a code number, which identifies the various users, is first requested. The displayed number XXXX is a random number (RN) and is confirmed with the "Select" push-button. If the random number has been confirmed with "Select" without being changed, the item's code level remains as it was. Two four-digit code numbers (0000..9999) exist for changing the code level and setting up new code words for the users. No assignment is required for the "third party" user level, as the user does not usually receive access to the configuration level (protected via the code).

4.4 Direct configuration

NOTE

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

Remote configuration

For remote configuration, the password of level 2 must be entered via the parameter "password level 2", otherwise, the values can only be read but not written. Inputting via the bus has no influence on the displayed screen; this means, if the item itself is in code level 0, it also behaves as described in the previous section; only configuration via the bus is permissible. The isolation for the configuration via the bus is valid for 10 minutes from the point in time at which configuration or readout has not occurred; afterwards, the password must be configured again. The password must also be entered in advance to load the language. If the code for level 2 is entered on the item itself, the configuration is automatically isolated via the bus.

WARNING !

If the following parameter "direct para." is set to "YES", communication via the interface with terminals X1..X5 is locked. If communication is to be re-established via interface X1..X5 after configurating the item (e. g. CAN bus connection via a Gateway), the following parameter must be set to "NO"!

Direct configuration is switched off for safety reasons once the firing speed has been reached. That means that further setting of the item parameters is only possible using the display and push-buttons, directly or via the CAN bus interface. The screen is switched from YES to NO (this is done using the software). The deactivation of the direct configuration is for safety reasons, so that in the case of multiple systems starting simultaneously (e. g. emergency power situation) a simultaneous switching of the generator switches to the black busbar is prevented.

Direct para.
YES

Direct configuration **YES/NO**

YES ..... A configuration via the lateral plug is possible, and any CAN bus connection that may be available via terminals X1..X5 is de-activated. The following conditions must be met in order to carry out configuration via the lateral plug:
- A connection must be established via the direct configuration cable between the item and the PC,
- the baud rate of the FL-Soft3 program must be set to 9,600 Baud and
- the corresponding configuration file must be used (file name: "xxxx-xxxx-yyy-zz.asm", initiated by xxxx-xxxx-yyy-zz.cfg).

NO ..... Configuration via the lateral plug cannot be carried out, and any available CAN bus connection via the terminals X1..X5 is activated.

4.5 Generator number

Generator number
0

Generator/item number **1..8**

If several generators are available and these are coupled via a can bus, a different number must be assigned to each generator for differentiation purposes. The generator number 1 should be assigned even in the case of individual items. The generator number entered here corresponds to the genset number in the program.

4.6 Load language

Language
first

Language **first/second**

First .....All texts are displayed in the base language.
Second .....All texts are displayed in the second language that is available in the item.

4.7 Service display

Service display
ON

Service display **ON/OFF**

ON .....The following three screens are displayed (the voltages and frequencies of the mains, the busbar and the mains are displayed). In addition, the controller outputs and the switching statuses of the power circuit breakers during synchronization are displayed. According to the used hardware (with or without voltage transducer) different screens are displayed.
OFF.....The service screens are not displayed.

B 00.0kV 00.00Hz
G 00.0kV 00.00Hz

Double voltage and double frequency display

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

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

Double voltage and double frequency display

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

Rel.: MCB
F / U GCB

Status of power circuit breakers and relays

The display shows the actual relay state of the three-position controller output respectively the direction of the analog controller and the signals of the power circuit breakers during synchronization:

f.....	+	Frequency controller RAISE	Terminal 8/9
	-	Frequency controller LOWER	Terminal 8/10
U	+	Voltage controller RAISE	Terminal 11/12
	-	Voltage controller LOWER	Terminal 11/13
MCB.....	ON	Connect pulse of the MCB	Terminal 16/17
	OFF	Disconnect pulse of the MCB	Terminal 39/40
GCB.....	ON	Connect pulse of the GCB	Terminal 14/15
	OFF	Disconnect pulse of the	Terminal 41/42

4.8 Event logging [PCM1x..-H-..]

NOTE

The viewing and acknowledgement of alarms depends on access authorization:

Viewing of alarms..... Access authorization CL[1] 0, CS[1] 1 and CL[1] 2
Acknowledgment of alarms.... Access authorization CL[1] 2

1 ..... CL = Code level (see chapter 2.17.1 "Alarm classes" on page 62

If an event that is stored in the item occurs in the item, there is an entry into the event log. The following functions are supported:

- Event
- Date of occurrence
- Time of occurrence

Stored in the alarm log are the last 50 alarms, beginning with the most current window (FIFO). By pressing the "RESET" push-button, the window that is displayed can be canceled. The alarms are displayed on two lines. The top line indicates the date and time of the alarm that has occurred; the lower line shows the type of alarm.

check event list
YES

Event logging **YES/NO**

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

4.8.1 Internal events and discrete inputs

YY-MM-DD ss:mm
xxxxxxxxxxxxxxxx

50 × alarm log

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

	xxxxxxxxxxxxxxxx	
	German	English
Internal alarm		
Engine overspeed (Pickup)	Überdrehzahl	Over speed
Generator overfrequency	Überfrequenz	Over frequency
Generator underfrequency	Unterfrequenz	Low frequency
Generator overvoltage	Gen.-Überspg.	Gen.overvolt.
Generator undervoltage	Gen.-Unterspg.	Gen.undervolt.
Generator overcurrent, level 1	Gen.-Überstrom 1	Gen.overcurr. 1
Generator overcurrent, level 2	Gen.-Überstrom 2	Gen.overcurr. 2
Reverse/reduced load	Rück/Minderleist	Revers/min.power
Overload	Gen.-Überlast	Gen.overload
Load imbalance	Schieflast	Asymmetric load
Mains overvoltage	Netz-Überspg.	Mains-overvolt.
Mains undervoltage	Netz-Unterspg.	Mains-undervolt.
Mains overfrequency	Netz-Überfreq.	Mains-overfreq.
Mains underfrequency	Netz-Unterfreq.	Mains-underfreq.
Mains vector jump	Phasensprung	Phase shift
Battery undervoltage	Batt.-Unterspg.	Batt.undervolt.
GCB synchronization time monitoring	Synch.Zeit GLS	GCB syn.failure
MCB synchronization time monitoring	Synch.Zeit NLS	MCB syn.failure
Switching to black busbar time monitoring	Stör. df/dt-max.	Failure df/dVmax
Fault P-control: GCB will be opened after time boost/settle	R-Ramope:GLS auf	P-ramp:open GCB
Mechanical GCB malfunction on closing	Störung GLS ZU	GCB close fail.
Mechanical MCB malfunction on closing	Störung NLS ZU	MCB close fail.
Mechanical GCB malfunction on opening	Störung GLS AUF	GCB open fail.
Mechanical MCB malfunction on opening	Störung NLS AUF	MCB open fail.
Faulty reference power zero control with inter-change synchronization on GCB	Bezugsleist. <>0	Import power<>0
Maintenance call	Wartung	Service
Interface monitoring X1..X5	Fehl.Schnit.X1X5	Interf.err.X1X5
Plausibility control Pickup/generator frequency	Freq.Gen/Pickup	Pickup/Gen.freq.
Plausibility control power (optionally)	L.-Plausibilität	P.-Plausibility
Shutoff malfunction	Abstellstörung	Stop failure
Start failure	Fehlstart	Start failure
Unintentional stop	ungewollter Stop	Not wanted stop
Discrete Inputs		
Discrete input 1	freely configurable	freely configurable
Discrete input 2		
Discrete input 3		
Discrete input 4		
Discrete input 5		
Discrete input 6		
Discrete input 7		
Discrete input 8		
Discrete input 9		
Discrete input [A]		
Discrete input [B]		
Discrete input [C]		
Discrete input [D]		
Discrete input [E]		
Discrete input [F]		
Discrete input [G]		

	xxxxxxxxxxxxxxxx	
	German	English
EM1-D.1 – Discrete inputs		
Discrete input [1]	freely configurable	freely configurable
Discrete input [2]		
Discrete input [3]		
Discrete input [4]		
Discrete input [5]		
Discrete input [6]		
Discrete input [7]		
Discrete input [8]		
EM1-D.2 – Discrete inputs		
Discrete input [1]	freely configurable	freely configurable
Discrete input [2]		
Discrete input [3]		
Discrete input [4]		
Discrete input [5]		
Discrete input [6]		
Discrete input [7]		
Discrete input [8]		
Other		
Switch into "Load-TEST" mode	BAW Lastprobe	Load-test mode
Switch into "STOP" mode	BAW Stop	Stop mode
Switch into "TEST" mode	BAW Probe	Test mode
Switch into "MANUAL" mode	BAW Hand	Manual mode
Switch into "AUTOMATIC" mode	BAW Automatik	Automatic 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	Fernstart	Remote start
Remote stop	Fernstop	Remote stop
Remote acknowledgment via interface	Fernquittierung	Remote acknowl.
Remote acknowledgment via Terminal 6	Quittierung Kl.6	Acknowledge-ter6
Acknowledgment via "RESET" button	Quittierg. Taste	Ackn.button QUIT
Mains failure	Netzausfall	Mains faildown
Return of the mains	Netzwiederkehr	Mains o.k.
Emergency power start	Notstrom Anfang	Emerg. run start
Emergency power end	Notstrom Ende	Emerg. run stop
Engine successfully started (engine enabled, firing speed exceeded)	Aggr. gestartet	Start of engine
Engine stopped (engine not enabled, firing speed was undershot)	Aggregatestop	Stop of engine

4.8.2 Analog inputs

The name of the analog inputs is moved to the right. The alarm type is written in the space that has become open.

WIRE_ ..... Wire break
ALARM_ ... Limit value 1
STOP_ ..... Limit value 2

JJ-MM-TT SS:MM
STOP Analog input

Example

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

4.9 Basic settings configuration

Configure measuring	YES

Configuration of the basic settings **YES/NO**

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

YES ..... The configuration screens in the next block are displayed and can either be viewed ("STATUS / ALARM" push-button) or modifications can be made to the parameters ("PARAMETER", "U SELECT" or "STATUS / ALARM" push-buttons). A decision is not made on whether the parameters are processed or not.

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

WARNING !

Incorrect entries may lead to wrong measured results and cause the destruction of the generator!

4.9.1 Generator and mains environment

Generator freq. f set	00.0Hz

Generator setpoint frequency **40.0..70.0 Hz**

The generator setpoint frequency is entered in this screen. This is required for the frequency controller in isolated and no-load operation. In most cases, the values entered into this screen will be 50 Hz or 60 Hz. Of course different values are possible.

Rated system frequency	00.0Hz

Rated system frequency **50.0..60.0 Hz**

The rated frequency of the system is transferred to the genset. This parameter depends on the three-phase system in the relevant country.

WARNING !

If the value of the following parameter is changed, the values of the following masks have to be proved:

- Generator nominal voltage (see on page 82),
- Voltage controller insensitivity (see on page 92),
- Synchronizing dUmax (see on page 113),
- Black start GCB dUmax (see on page 115),
- Threshold generator overvoltage (see on page 126), as well as
- Threshold generator undervoltage (see on page 126).

Gen.volt.transf. secondary	000V

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

The secondary voltage is set here in V. This entry serves to indicate the secondary voltages in the display.

Gen.volt.transf. primary	00.000kV

Primary gen. voltage transformer **0.050..65.000 kV**

The primary voltage is set her in kV. The entry is used to output the primary voltages on the display. In the case of measured voltages of 100 V without a measurement transducer, 0.1 kV must be set here; for 400 V = 0.4 kV.

Bus.volt.transf. secondary	000V

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

The secondary voltage is set here in V. This entry serves to indicate the secondary voltages in the display.

Bus.volt.transf.
primary 00.000kV

Primary busbar voltage transformer **0.050..65.000 kV**

The primary voltage is set here in kV. The entry is used to output the primary voltages on the display. In the case of measured voltages of 100 V without a measurement transducer, 0.1 kV must be set here; for 400 V = 0.4 kV.

WARNING !

If the value of the following parameter is changed, the values of the following masks have to be proved:

- Threshold mains overvoltage (chapter 4.13.11 at page 129) as well as
- Threshold mains undervoltage (chapter 4.13.11 at page 129).

mains volt.trans
secondary 000V

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

The secondary voltage is set here in V. This entry serves to indicate the secondary voltages in the display.

mains volt.trans
primary 00.000kV

Primary mains voltage transformer **0.050..65.000 kV**

The primary voltage is set here in kV. The entry is used to output the primary voltages on the display. In the case of measured voltages of 100 V without a measurement transducer, 0.1 kV must be set here; for 400 V = 0.4 kV.

Gen.voltage
U set 000V

Generator setpoint voltage **[1] 50..125 V; [4] 50..530 V**

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

Rated voltage in
system 000V

Rated voltage in system **[1] 50..125 V; [4] 50..480 V**

The rated voltage (U_{L1}) is preset with this value.
The proportional entries of the following parameters refer to this value:

- Generator voltage monitoring
- Mains voltage monitoring
- Insensitivity voltage controller
- Synchronization dU max
- Black start GCB dU max

NOTE

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

Volt.meas./mon.

Voltage measuring/voltage monitoring **4/4; 4/3; 3/3**

Ph-neut/Ph-neut (4/4) - The electrical system(generator, busbar and main) consists of the three outer conductors and a neutral conductor. Thus, the N lug (terminator 0) has to be connected. The outer conductor voltages and the phase-neutral voltages are displayed in the display. The voltage monitoring entries are referred to the phase-neutral voltages (VL-N).

Ph-neut/Ph-Ph (4/3) - The electrical system(generator, busbar and main) consists of the three outer conductors and a neutral conductor. Thus, the N lug (terminator 0) has to be connected. The outer conductor voltages and the phase-neutral voltages are displayed in the display. The voltage monitoring entries are referred to the phase-phase voltages (VL-L).

Ph-Ph/Ph-Ph (3-/3) - The electrical system(generator, busbar and main) consists only of the three outer conductors (without neutral conductor). Thus, the N lug (terminator 0) can not be connected. Only the outer conductor voltages are displayed in the display. The voltage monitoring entries are referred to the phase-phase voltages (VL-L).

Voltage systems Threewire

Voltage system **Threewire/Fourwire**

Threewire ..The star voltages of the generator and the mains will not be shown.
Fourwire ...The star voltages of the generator and the mains will be shown.

4.9.2 Transformer and measuring variables

Current transf. generator 0000/x

Generator current transformer **10..7,000/x A**

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

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

Power measuring gen.

Generator power measurement **singlephase/threephase**

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

- single phase power measurement: $P = \sqrt{3} \cdot U_{L12} \cdot I_{L1} \cdot \cos \varphi$.
- three phase power measurement:

$P = U_{L1N} \times I_{L1} \times \cos\varphi + U_{L2N} \times I_{L2} \times \cos\varphi + U_{L3N} \times I_{L3} \times \cos\varphi$.

Rated power generator 0000kW

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

On inputting the value into this screen, the generator rated power is pre-specified. The exact input of the generator rated power is absolutely vital, as very many measurement, control and monitoring functions refer to this value.

Rated current generator 0000A

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

On inputting the value into this screen, the generator rated current is pre-specified. The exact input of the generator rated current is absolutely vital, as very many measurement functions refer to this value.

4.9.3 Mains Current/Mains Power Measurement

a.) Mains power actual value measurement via analog input (only PCM1-..H-..)

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

Analog in Pmains
OFF

only PCM1-..H-..

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

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

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

Note

Please note that the selected analog input T{x}

- has to be configured to OFF in chapter "Analog inputs" and that this analog input
- must not be configured as generator real power **setpoint value** in chapter "Controller".
- T{x}: Dependent on the control model these analog inputs are included and possibly built as 0/4-20 mA type. For this function only 0/4-20 mA inputs can be used (only these inputs are displayed for selection at this parameter).
- A change of the function of the analog inputs is updated in the visualization of FL-CABLE-RS232 once the PC program has been restarted after the dynamic configuration has been started.

Priority of the functions of the analog inputs

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

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

Analog in Pmains
0-00mA

only PCM1-..H-..

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

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

Note

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

NOTE

In case of an import/export real power control you have to take care that the setpoint value is set in the middle of the measuring range. By this setting the controller dynamic can be used to full capacity.

Analog in Pmains	
0%	0000kW

only PCM1-..H-..

Mains real power 0/4 mA[1] –9,990..0..+9,990 kW; [4] –6,900..0..+6,9(

To the scaleable analog input a numerical value is assigned which corresponds to the smallest input value → Definition of the lower value with minimum analog input value (0 % corresponds to, e. g. -500 kW; 0 or 4 mA).

Analog in Pmains	
100%	0000kW

only PCM1-..H-..

Mains real power 20 mA[1] –9,990..0..+9,990 kW; [4] –6,900..0..+6,90(

To the scaleable analog input a numerical value is assigned which corresponds to the greatest input value → Definition of the higher value with maximum analog input value (100 % corresponds to e. g. 500 kW; 20 mA).

b.) Mains current measurement via mains CT (only PCMx)

Current transf. mains	0000/1

[PCM1x]

Mains current transformer (terminals 27/28) 5..7,000/x A

The input of the current conversion ratio is necessary in order to display and control the actual values. The ratio must be selected in such a manner that, at maximum power, at least 60 % of the converter's nominal current flow. A lower percentage may lead to malfunctions. Additional inaccuracies in the control and monitoring functions also occur.

{X} / 1 A.....Secondary rated current = 1 A at primary rated current = {X} A;
{X} / 5 A.....Secondary rated current = 5 A at primary rated current = {X} A;
{X}.....e. g. from the main series 10, 15, 20, 30, 50 or 75 A and the decimal fractions and multiples of these or the corresponding secondary series with 12.5, 25, 40 or 60 A.

PCN4 modus	
	ON

only PCM1-G-..-E-..

PCN4 modus ON/OFF

ON .....The PCM is operating in PCN4mode. The control PCM expects CAN bus messages from the PCN4 and reacts accordingly. Additionally the control PCM transmits messages to the PCN4.
OFF.....The control PCM operates without PCN4 functionality as a normal genset control.

Rated power in system

only PCM1-G-..-E-..

Rated power in the system 0..16,000 kW

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

Note
This configuration is valid only if parameter " PCN4 modus" is configured to ON.

ATTENTION
Since the PCN4is only able to transmit a percentage value related to the rated value it is absolutely necessary to configure the rated power in all units (PCN4 and PCM; in the PCM) to the same value.

4.9.4 Changing passwords

NOTE

Once the code level is set, this is not changed, even if the configuration mode is accessed steady. If an incorrect code number is input, the code level is set to CL0, and the item is thereby blocked for third parties. If the supply voltage is present, uninterrupted, at the item for 2 hours, code level 0 is automatically set.

Define level 1 code	**0000**

Code level 1 (Customer) **0..9999**

This screen first appears in code level 2. Following the input of digits in this screen, the code level for level 1 (Customer) is set. After inputting his code, the customer possesses only the access rights with which he has been assigned.
The default setting for this code level (CL) is CS1 = 0 0 0 1

Define level 2 code	**0000**

Code level 2 (Commissioner) **0..9999**

This screen first appears in code level 2. Following the input of digits in this screen, the code level for level 2 (mechanic) is set. After inputting his code, the mechanic possesses the access rights with which he has been assigned.
The default setting for this code level (CL) is CS2 = 0 0 0 2

4.10 Controller configuration

WARNING !

An incorrect input can lead to uncontrolled controller actions and destroy the generator!

Configure controller	**YES**

Configuration of the controller **YES/NO**

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

YES ..... The configuration screens in the next block are displayed and can either be viewed ("STATUS / ALARM" push-button) or modifications can be made to the parameters ("PARAMETER", "U SELECT" or "STATUS /ALARM"). A decision is not made on whether the parameters are processed or not.

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

4.10.1 Constant and interchange (import/export) power controller [PCM1x]

These screens appear only if the real power controller (see "Real power controller [PCM1x]" on page 96) is set to "ON".

NOTE

The fixed-value power control does not take into account the mains interchange point, i. e., the mains will be supplied in the event of excessive power (power export); in the event of a power deficit, differential power coverage will be provided by the mains (power import).

Power controller
Pset1 I0000kW

Setpoint 1 real power controller **C/I/E 0..6,900 kW**

Setpoint 1 is active when Automatic 1 (voltage applied to terminal 3) is enabled. The mains interchange power is then regulated to the set value.

The real power is regulated to the input value.

F ..... The letter F stands for fixed setpoint control (= constant power). I. e., the generator always supplies a constant real power value. The genset is always started on activation of fixed setpoint power.

The mains interchange power is regulated to the set value.

I ..... The letter I stands for import power (power supplied by the mains). I. e., the power set here is always supplied by the mains, whereby the minimum and maximum generator real power are adhered to.

E ..... The letter E stands for export power (power supplied to the mains). I. e., power set here is always supplied to the mains, whereby the minimum and maximum generator real power are adhered to.

Power controller
Pset2 L0000kW

Setpoint 2 real power controller **C/I/E 0..6,900 kW**

Setpoint 2 is active if Automatic 2 (voltage applied to terminal 5) is enabled and no external setpoint parameter (0/4..20 mA or interface) has been selected. The mains interchange power is then regulated to the set value.

The real power is regulated to the input value.

F ..... The letter F stands for fixed setpoint control (= constant power). I. e., the generator always supplies a constant real power value. The genset is always started on activation of fixed setpoint power.

The mains interchange power is regulated to the set value.

I ..... The letter I stands for import power (power supplied by the mains). I. e., the power set here is always supplied by the mains, whereby the minimum and maximum generator real power are adhered to.

E ..... The letter E stands for export power (power supplied to the mains). I. e., power set here is always supplied to the mains, whereby the minimum and maximum generator real power are adhered to.

NOTE

Engine starting depends on whether an automatic start/stop operation has been selected. If not, the engine is always started (description starting on page 100).

4.10.2 Frequency controller

Alternatively, the following screens become visible.

a.) Three-position controller (standard)

Freq.controller ON

Frequency controller **ON/OFF**

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

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

f-contr. active at: 00.0Hz

Frequency controller starting frequency **0.0..70.0 Hz**

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

Delay time for f-contr. 000s

Delayed start of the frequency controller **0..999 s**

The starting frequency of the frequency controller must well exceed the time set here, before the frequency controller is active.

Freq.controller ramp 00Hz/s

Frequency controller setpoint ramp **1..50 Hz/s**

The change in setpoint is supplied to the controller via a ramp. The slope of the ramp is used to alter the rate at which the controller modifies the setpoint value. The more rapidly the change in the setpoint is to be carried out, the greater the value input here must be.

NOTE

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

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

only Option A

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

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

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

Please note to wire an external RC protection.

ANALOG .. A control is done via the analog controller outputs to terminals 8/9/10. Selection of the type of the signal (mA or V) is carried out by the parameter and an external jumper that has to be added

PWM ..... A control of speed/frequency/real power is carried out via a PWM signal. The settings in the parameter "Level PWM" are to be used. An additional jumper is to be added

b.) Three-position controller (Standard; Option A, Setting 'THREE POSITION')

Freq.controller deadband 0.00Hz

Frequency controller insensitivity **0.02..1.00 Hz**

Isolated operation .... The generator setpoint frequency is controlled in such a manner that, in its adjusted state, the actual value deviates from the generator setpoint frequency setting (setpoint from mask setting) by the set sensitivity value at most.

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

Freq.controller time pulse >000ms

Minimum frequency controller ON period **10..250 ms**

The minimum ON period of the relay should be selected in such a manner that the downstream adjustment facility responds reliably to the pulse which has been set according to the set time. The smallest possible time must be set in order to ensure optimum control behavior.

Freq.controller gain Kp 00.0

Frequency controller gain **0.1..99.9**

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

Analog controller output (only Option A, Setting 'ANALOG' und 'PWM')

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

f controller: output range **see below**

If the parameter has been configured to "ANALOG" this parameter is to be taken into account. Here you configure the range of the analog output. To switch between current and voltage analog controller output please add/do not add an external jumper between terminals 8/9. Please note that this setting also affects the PWM signal. Following ranges apply.

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

NOTE

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

- Select "F/P contr.type" = ANALOG.
- Select with "F/P contr.output" any of above inverted control outputs

(e.g. "10-0mA (5-0V)", "4.5V-0.5V", "20-0mA (10-0V)" or "20-4mA").

- Step one mask back; by pressing "Select" and "Cursor→" simultaneously).
- Select "F/P contr.type" = PWM.

Now the PWM signal is inverted.

Level PWM
----

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

If PWM has been selected via the above the level of the PWM signal can be adjusted here.

Stepper sign.frq (min.) 000%

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

Lower limit of the analog controller output.

Stepper sign.frq (max.) 000%

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

Upper limit of the analog controller output.

Freq.controller gain Kpr 000

P gain of the frequency controller **1..240**

The proportional coefficient specifies the gain (see analog controller).

Freq.controller reset Tn 00.0s

Reset time load frequency controller **0.0..60.0 s**

The reset time T_n identifies the I part of the PID controller (see analog controller).

Freq.controller derivat. Tv 0.00s

Derivative-action time load frequency controller **0.00..6.00 s**

The derivative-action time T_v identifies the D part of the PID controller (see analog controller).

4.10.3 Voltage controller

Starting point voltage 000%

only Option A.

Voltage controller initial state **0..100 %**

Analog controller output setting with controller switched off. This value is also used as a starting value, e. g. for a switch from a power factor φ- to a voltage controller.

Volt.controller ON

Voltage controller **ON/OFF**

ON .....Generator voltage control is carried out. The subsequent screens of this option are displayed.

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

Start voltage U control. 000.0%

Start voltage of voltage controller **12.0..100.0 %**

The voltage controller will be active, if the generator voltage has exceeded the set value. This prevents an unintentional change of the setpoint of an under classified controller while starting the engine.

Delayed. Start U contr. 000s

Delayed start of the voltage controller **0..999 s**

The start voltage of the voltage controller has to exceed the here set value of time.

NOTE

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

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

only Option A

V controller: type **THREESTEP/ANALOG**

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

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

Please note to wire an external RC protection..

ANALOG..A control is done via the analog controller outputs to terminals 11/12/13. Selection of the type of the signal (mA or V) is carried out by the parameter and an external jumper that has to be added.

a.) Three-position controller (Standard, Option A: Setting 'THREE POSITION')

Volt.controller
dead band 00.0%

Voltage controller insensitivity **0.1..15.0 %**

This value refers to the parameter „Rated voltage in system".

Isolated operation ..The voltage is controlled in such a manner that, in its adjusted state, the actual value deviates from the setpoint voltage setting (setpoint from mask setting) by the set sensitivity value at most.

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

Volt.controller
time pulse >000ms

Minimum voltage controller ON period **20..250 ms**

The minimum ON period of the relay should be selected in such a manner that the downstream adjustment facility responds reliably to the pulse which has been set according to the set time. The smallest possible time must be set in order to ensure optimum control behavior.

Volt.controller
gain Kp 00.0

Voltage controller gain factor **0.1..99.9**

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

b.) Analog controller (Option A: Setting 'ANALOG')

V/Q contr.output

V controller: range — see below

If the parameter "V/Q controller type" has been configured to "ANALOG" this parameter is to be taken into account. Here you configure the range of the analog output. To switch between current and voltage analog controller output please add/do not add an external jumper between terminals 11/12. Following ranges apply.

Type	Setting in above configuration screen	Jumper between term. 11/12	Range	Lower level	Upper level
Current	+/-20mA (+/-10V)	nein	+/-20mA	-20 mA	+20 mA
	+/-10mA (+/-5V)		+/-10mA	-10 mA	+20 mA
	0-10mA (0-5V)		0-10mA	0 mA	10 mA
	0-20mA (0-10V)		0-20mA	0 mA	20 mA
	4-20mA		4-20mA	4 mA	20 mA
	10-0mA (5-0V)		10-0mA	10 mA	0 mA
	20-0mA (10-0V)		20-0mA	20 mA	0 mA
	20-4mA		20-4mA	20 mA	4 mA
Voltage	+/-20mA (+/-10V)	ja	+/-10V	-10 Vdc	+10 Vdc
	+/-10mA (+/-5V)		+/-5V	-5 Vdc	+5 Vdc
	+/-3V		+/-3V	-3 Vdc	+3 Vdc
	+/-2.5V		+/-2.5V	-2.5Vdc	+2.5 Vdc
	+/-1V		+/-1V	-1 Vdc	+1 Vdc
	0-10mA (0-5V)		0-5V	0 Vdc	5 Vdc
	0.5V-4.5V		0.5-4.5V	0.5 Vdc	4.5 Vdc
	0-20mA (0-10V)		0-10V	0 Vdc	10 Vdc
	10-0mA (5-0V)		5-0V	5 Vdc	0 Vdc
	4.5V-0.5V		4.5-0.5V	4.5 Vdc	0.5 Vdc
	20-0mA (10-0V)		10-0V	10 Vdc	0 Vdc

Stepper sign.vol
(min.) 000%

V controller: minimum value — 0..100%

Lower limit of the analog controller output.

Stepper sign.vol
(max.) 000%

V controller: maximum value — 0..100%

Upper limit of the analog controller output.

Volt.controller
gain Kpr 000

P-gain voltage controller — 1..240

The proportional coefficient specifies the gain (see analog controller).

Volt.controller
reset Tn 00.0s

Voltage controller reset time — 0.0..60.0 s

The reset time T_n identifies the I part of the PID controller (see analog controller).

Volt.controller
derivat. Tv 0.00s

Derivative-action time voltage controller — 0.00..6.00 s

The derivative-action time T_v identifies the D part of the PID controller (see analog controller).

4.10.4 Power-factor controller [PCM1x]

Pow.fact.contr. ON

Power-factor controller **ON/OFF**

ON ..... In operation in parallel with the mains a load independent automatic control of the power factor φ is carried out. In the case of excessively low currents (secondary current less than 5 % I_N) the power factor can only be measured very inaccurately. In order to avoid power swings, the controller is automatically locked in such cases. The subsequent screens of this option are displayed.

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

Pow.fact.contr. setpoint 0.00

Power-factor controller setpoint **i0.70..1.00..c0.70**

The amount of the re-active power is controlled in such a manner that, when regulated, this results in the pre-specified power factor φ. The designations "i" and "c" stand for inductive (generator overexcited) and capacitive (generator underexcited) re-active power. This setpoint is active in operation in parallel with the mains.

NOTE

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

a.) Three-position controller (Standard; Option A: Setting 'THREE POSITION')

Pow.fact.contr. dead band 00.0%

Power factor controller insensitivity **0.5..25.0 %**

The item automatically calculates the amount of re-active power which belongs to the power factor $\varphi_{setpoint}$. In operation in parallel with the mains, the re-active power is controlled in such a manner that, in its regulated state, the actual value deviates from the internally calculated setpoint (setpoint 1) percentage value of the insensitivity setting at most. In this case, the percentage value refers to the generator rated power.

Pow.fact.contr. gain Kp 00,0

Power-factor controller gain **0.1..99.9**

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

b.) Analog controller (Option A: Setting 'ANALOG')

Pow.fact.contr. gain Kpr 000

Power-factor controller P-gain **1..240**

The proportional coefficient specifies the gain (see analog controller).

Pow.fact.contr. reset Tn 00.0s

Power-factor controller reset time **0.0..60.0 s**

The reset time T_n identifies the I part of the PID controller (see analog controller).

Pow.fact.contr. derivat. Tv 0.00s

Power-factor controller derivative-action time **0.0..6.0 s**

The derivative-action time T_V identifies the D part of the PID controller (see analog controller).

4.10.5 Real power controller [PCM1x]

Power controller ON

Real power controller **ON/OFF**

ON ..... In operation in parallel with the mains, the real power is automatically adjusted to the pre-selected setpoint (page 88/96) when the real power controller is switched on. The subsequent screens of this option are displayed.

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

Power controller ramp 000%/s

Real power controller setpoint ramp **0..100 %/s**

The setpoint change is supplied to the controller via a ramp in percent per second in reference to the generator rated power (see page 84). The slope of the ramp is used to alter the rate at which the controller modifies the setpoint value. The more rapidly the change in the setpoint is to be carried out, the greater this value has to be.

a.) Power limitation

Power limit P max. 000%

Real power controller maximum power limitation **10..120 %**

If the maximum real generator load is to be limited, a percentage, based on the rated generator power (see page 84), will be entered into this screen, in accordance with the specified setting limits. The controller adjusts the genset in such a manner that this value is not exceeded. The value "Pmax" only limits the setpoint of the real power controller, and is without significance in isolated operation.

Power limit P min. 00%

Real power controller minimum power limitation **0..50 %**

If the maximum real generator load is to be limited, a percentage, based on the rated generator power (see page 84), will be entered into this screen, in accordance with the specified setting limits. The controller adjusts the genset in such a manner that no negative deviation from this value occurs. This parameter is ignored in the case of fixed-setpoint control or in isolated operation.

b.) External setpoint value

The generator real power **setpoint value** via an analog input T{x} [x = 1-7] is possible at the time when minimum one of the analog inputs T{x} [x = 1-7] is carried out as 0/4-20 mA input. The selection of the analog input is done using the following parameters.

Power setpoint external OFF

P setpoint value: external setpoint value **OFF/T{x}**

OFF.....If this parameter is configured to "OFF" a generator real power **setpoint value** can not be fed via the 0/4-20 mA input to the control. The analog inputs can be used either as mains interchange (import/export) real power **actual** value or as free configurable alarm inputs. In case of selection of terminal 5 the internal setpoint value 2 "P_{set2}" is used as setpoint value. The subsequent screens of this function are not displayed.

T{x}.....The generator real power **setpoint value** can be fed to the control via an external signal using the 0/4-20 mA inputs (T{x}, {x} = 1-7; other types of analog inputs cannot be used). This setpoint value is used when automatic 2 (terminal 5) is set. The subsequent screens of this function are displayed.

Note

Please note that the selected analog input T{x}

- has to be configured to OFF in chapter "Analog inputs" and
- must not be configured as mains interchange real power **actual value** in chapter "Measuring".
- T{x}: Dependent on the configuration of the control these analog inputs are included and possibly a 0/4-20 mA type. For this function only 0/4-20 mA analog inputs can be used.
- A change of the function of the analog inputs is updated in the visualization of FL-CABLE-RS232 once the PC program has been restarted after the dynamic configuration has been started.

Priority of the functions of the analog inputs

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

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

Analog input 0-00mA

Real power setpoint value specification analog input **0-20 / 4-20 mA**

The analog input of the real power controller (terminals 93, 94 and 95 - see wiring diagram; in exceptional cases, the setpoint is applied to terminals 91 and 92) can be switched here between 0-20 mA and 4-20 mA depending on the setpoint source.

0-20 mA ...Minimum value of the setpoint at 0 mA; maximum value at 20 mA.

4-20 mA ...Minimum value of the setpoint at 4 mA; maximum value at 20 mA.

CAUTION!

The interchange power setpoint (import/export power)can also be scaled. When controlling interchange power, it is vital to ensure that no F power is entered simultaneously with I or E power when scaling the external analog input.

External setpoint	0/4 mA	F	I	E	I	E
External setpoint	20 mA	F	I	E	E	I

Ext.setpoint 0% F0000kW

Scaling the minimum value (fixed power) **C/I/E 0..9,999 kW**

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

Ext.setpoint 100% F0000kW

Scaling the maximum value (fixed power) **C/I/E 0..9,999 kW**

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

c.) Three-position controller (Standard; Option A: Setting 'THREE POSITION')

Power controller dead band 00.0%

Real power controller insensitivity **0.1..25.0 %**

In operation in parallel with the mains, the real power is controlled in such a manner that, in its regulated state, the actual value deviates from the real power setpoint by the percentage value of the sensitivity setting at the most. In this case, the percentage value refers to the generator rated power (see page 84).

Power controller gain Kp 00.0

Real power controller gain factor **0.1..99.9**

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

Powercontr. dead band ratio *0.0

Real power controller insensitivity reduction **1.0..9.9**

If, following the adjustment of the controller, no further adjusting pulse has been output for at least 5 s, the insensitivity is reduced by the input factor.
For example: In the case of an insensitivity of 2.5 % and a factor of 2.0 the insensitivity is increased after 5 s to 5.0 %. If the control deviation subsequently exceeds 5.0 %, again, the controller's original sensitivity is automatically reset (2.5 %). This input can be used, in the event of small control deviations, to avoid unnecessarily frequent actuation processes, thereby protecting the adjustment facility.

d.) Analog controller (Option A: Setting 'ANALOG')

Power controller gain Kpr 000

Real power controller P gain **1..240**

The proportional coefficient specifies the gain (see analog controller).

Power controller reset Tn 00.0s

Real power controller reset time **0.0..60.0 s**

The reset time T_n identifies the I part of the PID controller (see analog controller).

Power controller derivat. Tv 0.00s

Real power controller derivative-action time **0.0..6.0 s**

The derivative action time T_v identifies the D part of the PID controller (see analog controller).

e.) Part-load lead

Warm up load limit value 000%

Part-load lead limit value **5..110 %**

If the engine needs a warm-up run, a lower fixed value power can be entered so that the engine can first warm up. The setting for the generator real power that is to be adjusted during this warm-up run phase is made in this screen. A fixed value power in terms of the rated power input (see page 84) will be adjusted.

Warm up load time 000s

Period of part-load lead **0..600 s**

Input of the holding time with part-load following the initial closure of the generator power circuit breaker in operation in parallel with the mains. If engine warming-up is not desired, this parameter must be set to zero.

4.10.6 Load/var sharing [PCM1x]

Active power load-share	ON

Load sharing **ON/OFF**

ON ..... Real power is distributed to several generators operating in parallel. The generator outputs are distributed depending on the set value. The subsequent screens of this option are displayed.

OFF ..... No distribution is carried out, and the subsequent screens of this option are not displayed.

Act. load share factor	00%

Load sharing reference variable **10..99 %**

This factor refers to the primary control variable.

Definition "Primary control variable"

- Isolated operation = frequency
- Mains parallel operation = real power (at the mains interchange point)

Definition "Secondary control variable"

- Isolated operation = real power related to the other generators
- Mains parallel operation = real power related to the other generators

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

Reactive power load share	ON

var sharing **ON/OFF**

ON ..... Re-active power is distributed to several generators operating in parallel. The generator outputs are distributed depending on the set value. The subsequent screens of this option are displayed.

OFF ..... No distribution is carried out, and the subsequent screens of this option are not displayed.

React.load share factor	00%

var sharing reference variable **10..99 %**

Increasing the weighting factor increases the influence of the primary control variable (the voltage) to the control. The smaller the factor which is configured, the greater the influence of the secondary control variable (generator reactive power). Var sharing is activated during isolated parallel operating only.

4.11 Load management configuration [PCM1x]

Configure automatic YES

Configuration of load management **YES/NO**

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

YES ..... The configuration screens in the next block are displayed and can either be viewed ("STATUS / ALARM" push-button) or modifications can be made to the parameters ("PARAMETER", "U SELECT" or "STATUS / ALARM" push-button). A decision is not made on whether the parameters are processed or not.

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

4.11.1 Load-dependent start/stop in operation in parallel

NOTE

Please be aware that load sharing must remain configured to "ON", regardless of whether an additional generator is available for a load sharing, in order to enable a automatic start/stop to be carried out .

NOTE

To carry out an automatic start/stop of the engine, all participating controls have to be configured with the identical rated power.

Loadd.start/stop at ter.3 ON

Load-dependent start/stop on terminal 3 **ON/OFF**

ON ..... If this mask is active, and the control input "Automatic 1" is connected to terminal 3, an automatic start/stop operation is carried out on the basis of the generator setpoint power 1 (see page 88). If terminal 5 is simultaneously connected 3 has priority.

OFF..... No automatic start/stop operation is carried out; the adjustment of the prespecified setpoint value is carried out under all circumstances.

Loadd.start/stop at ter.5 ON

Load-dependent start/stop on terminal 5 **ON/OFF**

ON ..... If this mask is active, and the control input "Automatic 2" is connected to terminal 5, an automatic start/stop operation is carried out on the basis of the generator setpoint power 2 (see page 88). If terminal 3 is simultaneously connected, terminal 3 has priority.

OFF..... No automatic start/stop operation is carried out; the adjustment of the prespecified setpoint value is carried out under all circumstances.

a.) Single genset in operation in parallel with the mains

The load-dependent start/stop function is activated when

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

Minimum load generator 0000kW

Generator minimum setpoint power 0..6,900 kW

Interchange real power control (import/export power) requires a generator setpoint power value. In many cases, starting the engine is only sensible after reaching a certain generator setpoint power value, in order therefore to operate the genset with a reasonable degree of efficiency. For example, at least 40 kW of real power must be supplied by the genset in order for it to start.

Add-on delay mains oper. 000s

Start delay for load-dependent start/stop 0..999 s

Starting may be delayed even if the generator start power has been reached. In order to avoid starting the engine in the event of short-term load switch-ons, a start delay time may be input here in seconds. The start power must therefore be present without interruption during this period of time, in order to ensure that the engine is started.

Shed-off delay mains oper. 000s

Stop delay for load-dependent start/stop 0..999 s

Stopping can be delayed even if the generator stop power has been reached. In order to avoid switching the engine off in the event of short-term load interruptions, a stop delay time may be input here in seconds. The stop power must therefore be present without interruption during this period of time, in order to ensure that the engine is stopped.

b.) Stopping hysteresis

NOTE

The following screen is used to determine stopping hysteresis for single gensets in operation in parallel with the mains, for gensets connected to other gensets in operation in parallel with the mains and in isolated operation in parallel with other gensets. However, the screen appears only once at this point.

Hysteresis add-. on/off op.0000kW

Hysteresis of load-dependent start/stop 0..9,999 kW

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

c.) Operation in parallel with the mains (interchange power control with one genset)

The following generally applies:

Case 1: Engine start — If [$P_{NT.setpoint}$ - $P_{NT.actual}$ > P_{start}] the engine starts. (a)

Case 2: Engine stop — If [$P_{NT.setpoint}$ - $P_{NT.actual}$ + $P_{GN.actual.tot}$ < P_{start} - P_{Hyst}] the engine stops. (b)

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

$P_{NT.setpoint}$ = -50 kW..... Incoming/import power must be entered as a negative number, output/export power as a positive number.
P_{start} = 30 kW ..... The minimum power requested by the genset.
P_{Hyst} = 10 kW ..... The power hysteresis for stopping.

When inserted into the above mentioned formulae, this means:

Example for case 1 — The engine starts with the following incoming mains power: If formula (a) is inverted, this results in

[$P_{NT.actual}$ < $P_{NT.setpoint}$ - P_{start}] ⇒ $P_{NT.actual}$ < - 50 kW - 30 kW = <u>-80 kW</u> ⇒ "B0080 kW".

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

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

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

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

d.) Interconnection with other gensets in operation in parallel with the mains

The load-dependent start/stop function is activated when, for every genset,

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

NOTE

The following parameter only becomes effective if another engine is to be started in operation in parallel with the mains. The first engine is started as described under individual operation on the basis of minimum generator power.

Reserve power mains op. 0000kW

Reserve power for load-dependent start/stop (mains) 0..9,999 kW

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

Total generator ***rated*** real power
\- *Total* currently available generator ***actual*** real power

= ***Reserve*** power

Priority of generators 00

Priority of gensets 0..14

This priority specifies the sequence in which the individual engines are started. The item for which the smallest number was set has the highest priority. This engine is the first to be started and the last to be stopped. In the event of identical priorities, the starting sequence is determined by the operating hours. In this case, the engine with fewer operating hours takes priority. In the event of the same number of operating hours, the engine with the smaller item number is permitted to start.

e.) Operation in parallel with the mains (interchange power control with several gensets)

The following generally applies:

Case 3: Start first genset. There is still no GCB connected in the group.

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

Case 4: Starting additional gensets. At least one GCB in the group is closed.

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

Case 5: Stoping At least two GCBs in the group are closed.

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

Case 6: Stoping last genset Only one more GCBs in the group are closed.

If $P_{NT.setpoint}$ - $P_{NT.actual}$ + $P_{GN.actual.tot}$ < P_{start} - P_{hyst}] the last engine stops.

Example The real power supplied by the mains, which is to be adjusted, is 0 kW. This value is entered into the setpoint value screen (see chapter "Controllers") as "B0000kW" (corresponds to "L0000kW"). The reserve power in the system should be 40 kW. The power hysteresis should be 20 kW. Three gensets are to be operated within the group. he rated power of a genset is 200 kW. The minimum power of a genset should be 30 kW.

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

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

$P_{NT.actual}$ < $P_{NT.setpoint}$ - $P_{start.gen}$.
$P_{NT.actual}$< 0 kW - 30 kW = <u>-30 kW</u> ⇒ B0030 kW.

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

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

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

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

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

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

If the generator real power of both gensets exceeds 360 kW (each genset supplies more than 180 kW), negative deviation from the pre-specified reserve power has occurred. As a result of this, the next engine is started.

Example for Case 5 Generator real power of each individual genset, at which one genset is stopped:

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

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

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

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

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

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

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

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

f.) Isolated operation

The load-dependent start/stop function is activated when, for every genset

- the "AUTOMATIC" mode has been selected and
- all inputs, such as start/stop power, start/stop delays, frequency setpoint values are identical for all gensets involved and
- one or both input screens "Load-dependent stop/start on terminal 3/5" has been set to "ON" and
- the input screens "Load sharing" or "var sharing" have been set to "ON" and
- the same rated power is available to all gensets.

Reserve power isol.op. 0000kW

Reserve power for load-dependent start/stop (isol. op.) 0..9,999 kW

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

Total generator ***rated*** real power
\- *Total* currently available generator ***actual*** real power
= ***Reserve*** power

NOTE

The reserve power should be selected in such a manner that the expected load surges can be covered by the genset.

Add-on delay isol.op. 000s

Start delay for load-dependent start/stop 0..999 s

Starting may be delayed even if the engine's start power has been reached. In order to avoid starting the engine in the event of short-term load switch-ons, a start delay time may be input in seconds. The start power must therefore be present without interruption during this period of time, in order to ensure that the engine is started.

Shed-off delay isol.op. 000s

Stop delay for load-dependent start/stop 0..999 s

Stopping can be delayed even if the engine's stop power has been reached. In order to avoid switching the engine off in the event of short-term load interruptions, a stop delay time may be input in seconds. The stop power must therefore be present without interruption during this period of time, in order to ensure that the engine is stopped.

The following generally applies:

Case 7: Engine start If [$P_{GN.actual.tot}$ + $P_{reserve.isolated}$ + > $P_{rated.tot}$] the engine starts. (f)

Case 8: Engine stop If [$P_{GN.actual.tot}$ + $P_{reserve.isolated}$ + P_{hyst} + P_{rated} + < $P_{rated.tot}$] the engine stops.

Example Two gensets are used in isolated operation in parallel with other gensets. One genset should always be in operation.

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

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

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

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

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

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

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

4.11.2 Temperature dependent start/stop [PCM1x/H]

a.) Automatic start/stop

CHP temp.depend. at ter.3 ON

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

ON ..... If this mask is active and the control input "Automatic 1" is connected to terminal 3 a temperature dependent start/stop operation is carried out. If terminal 5 is simultaneously connected, terminal 3 has priority. The start/stop is performed via analog input 2.

OFF ..... No automatic start/stop operation is carried out via terminal 3 depending on the temperature.

CHP temp.depend. at ter.5 ON

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

ON ..... If this mask is active and the control input "Automatic 2" is connected to terminal 5 a temperature dependent start/stop operation is carried out. If terminal 3 is simultaneously connected, terminal 3 has priority. The start/stop is performed via analog input 2.

OFF ..... No automatic start/stop operation is carried out via terminal 5 depending on the temperature.

Even if temperature dependent start/stop is switched off on both terminals, the subsequent screens of this option are displayed.

CHP start-up temperat. 000°C

CHP switch-on temperature 0..255 °C

The temperature at which the engine is to be started is set in this mask. If this value is not reached, the engine starts automatically and runs until the switch-off temperature is reached.

CHP shut-down temperat. 000°C

CHP switch-off temperature 0..255 °C

The temperature at which the engine is to be stopped is set in this mask. If the value is reached or exceeded, the engine stops automatically.

CHP start-up delay 000s

CHP switch-on delay 0..255 s

In order for the engine to be started, uninterrupted, negative deviation from the switch-on temperature must occur for at least the period of time set in this mask. If the actual value exceeds the threshold value within this period of time, calculation of the time is re-started (this delay time applies both to switching on and switching off).

b.) Temperature dependent power reduction

reduce of load step 1 at 000°C

Temperature level 1 for the power reduction **0..255 °C**

If the value set here is reached, the first level of the temperature dependent power reduction takes effect. The power reduction is performed via analog input 2.

reduce of load step 2 at 000°C

Temperature level 2 for the power reduction **0..255 °C**

If the value set here is reached, the second level of temperature dependent power reduction takes effect. The power reduction is performed via analog input 2.

reduce of load per step 000%

Magnitude of the power reduction, level 1 and level 2 **0..100 %**

If the set value for temperature dependent power reduction is reached (level 1 and level 2), the generator power is reduced each by the value set here as a percentage of the generator rated power. The power reduction is performed via analog input 2.

4.11.3 Stop of the engine at mains failure [PCM1-G]

Mains error - stop eng. ON

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

ON .....If the mains fails for at least the time of the emergency power start delay and the discrete input "Enable MCB" (terminal 53) is set (the mains parallel operation is enabled), the engine is stopped. Once the mains returns and the mains settling time has expired, the engine is started and the GCB is synchronized.

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

4.11.4 Remote control via interface - Guidance bus [PCx/H]

NOTE

For remote acknowledgement of alarms you have to carry out first a remote stop in idle mode. If this control is in isolated operation, an acknowledgement combined with a remote start must be sent..

Control via COM X1X5 ON

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

ON ..... Control via the interface is activated if the item contains this option, direct configuration is set to "OFF", the control system is set to "ON" the operating mode is set to "AUTOMATIC" and the discrete input "Automatic 2" (terminal 5) has been selected. The engine can be started and stopped via "Remote start" description of the serial interface in the appendix). The generator setpoint real power and the generator setpoint power factor φ may also be transmitted. If unsuccessful data exchange is determined, an alarm class 1 alarm is triggered.

OFF ..... The acceptance of control data is rejected. The internally set power "$P_{setpoint2}$" is activated with the discrete input "Automatic 2". At the same time, the internally set power factor φ setpoint is accessed. Interface monitoring is deactivated.

Supervision COMX1X5 EIN

only if COMX1X5 = ON

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

ON ..... Remote monitoring of the interface is enabled. If no control signal is received within 90 seconds (ID 503), a warning alarm of alarm class 1 will be issued.

OFF ..... Remote monitoring of the interface is disabled.

Ackn. F2,F3 via COM interf ON

only if COMX1X5 = ON

Acknowledgment of F2/F3 alarms via the interface **ON/OFF**

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

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

4.11.5 Power circuit breaker configuration

Configurebreaker
YES

Configuration of the power circuit breakers **ON/OFF**

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

YES ..... The configuration screens in the next block are displayed and can either be viewed ("STATUS / ALARM" push-button) or modifications can be made to the parameters ("PARAMETER", "U SELECT" or "STATUS / ALARM" push-button). A decision is not made on whether the parameters are processed or not.

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

4.11.6 Power circuit breaker logic

NOTE

You can change between two breaker logics via the discrete input "Breaker logic via discrete input" (description on page 132). The desired standard breaker logic is configured via the following mask. If the discrete input terminal 62 is configured to "Control input" (parameter is ON) and if is there is a signal to the terminal the described breaker logic is used (see chapter 4.15.3 "Setting the control inputs" at page 135). If the signal is reset, the breaker logic of the following mask is valid again. Therefore it is possible during the operation i.e. to change between the breaker logic "PARALLEL" (automatic synchronizing) and "EXTERNAL" (manual synchronizing).

Breaker logic:
PARALLEL

The item automatically controls the two power circuit breakers (MCB and GCB). In this case, up to five control functions (modes) may be selected. These are: EXTERNAL, PARALLEL, OPEN TRANSIT, CLOSED TRANSIT and INTERCHANGE.

a.) Version PCL1 & PCM1-M

STOP	TEST	MANUAL	AUTOMATIC
EXTERNAL	CB logic "External" In this operating mode, the MCB and the GCB are operated in "MANUAL" mode only. In operation in parallel with the mains, uncoupling from the mains is carried out via the MCB or the GCB in the event of mains faults. The power circuit breakers are not automatically closed in emergency power operation. Emergency power operation in accordance with DIN VDE 0108 is not therefore possible in this power circuit breaker logic.		
The GCB is opened.	The GCB and the MCB are not operated. Exception: The circuit breakers are opened for decoupling from the mains.	The MCB and the GCB can be manually switched on and off without synchronization. The circuit breakers are opened for decoupling from the mains.	The GCB is opened for stopping or for decoupling from the mains, but is not closed for starting. The MCB is only opened for decoupling from the mains, and is never closed.
PARALLEL [PCM1-M]	CB logic "Mains parallel" This operating mode represents continuous operation in parallel with the mains.		
The GCB is opened, the MCB is not operated.	The GCB and the MCB are not operated. Exception: Load test by actuating the "GCB ON" push-button. Termination of the load test with the "GCB OFF" push-button. Emergency power: Automatic setting of the GCB. Black busbar and current release MCB will be closed.	Operation in parallel with the mains can be assumed via the "GCB ON" or "MCB ON" push-button.	Via a engine request, the GCB is synchronized and operation in parallel with the mains is assumed. On enabling of the engine request, the generator power is reduced, the GCB is opened and the engine is shut off with coasting. Emergency power operation is terminated following the expiry of a mains settling time with the reverse synchronization of the MCB.
OPEN TRANSIT.	CB logic "Open transition / ATS / change-over / brake-before-make" In this operating mode, the MCB and GCB are never synchronized.		
The GCB is opened, the MCB is not operated.	The GCB and the MCB are not operated. Exception: Load test by actuating the "GCB ON" push-button. Termination of the load test via the "GCB OFF" or "MCB ON" push-button. Emergency power: Automatic setting of the GCB.	Via the "GCB ON" and "MCB ON" push-button, a switch can be made to either generator or mains operation. The "STOP" push-button opens the GCB and simultaneously stops the engine.	A switch is made to generator operation via an engine request. On enabling of the engine request a switch is made back to mains operation. Even if no engine request is present, the MCB is closed when the busbar is voltage-free. Emergency power operation is terminated following the expiry of a mains settling time with the reverse synchronization of the MCB.
CLOSED TRANSIT.	CB logic "Closed transition / make-before-brake / no-break-transfer / overlap synchronization" In this operating mode, the MCB and the GCB are synchronized, in order to avoid a voltage-free busbar. Immediately after the synchronization of one power circuit breaker, the other is opened. Continuous operation in parallel with the mains is not possible.		
The GCB is opened, the MCB is not operated.	The GCB and the MCB are not operated. Exception: Load test by actuating the "GCB ON" push-button. Termination of the load test via the "GCB OFF" or "MCB ON" push-button. Emergency power: Automatic setting of the GCB.	Via the "GCB ON" and "MCB ON" push-button, synchronization to either generator or mains operation can be carried out.	The GCB is synchronized via a engine request. The MCB is then opened. Following the enabling of the engine request, the MCB is reverse synchronized and the GCB is then opened. Emergency power operation is terminated following the expiry of a mains settling time with the reverse synchronization of the MCB.
INTERCHANGE [PCM1-M]	CB logic "Softloading / interchange synchronization" In this operating mode, the MCB and the GCB are synchronized, in order to avoid a voltage-free busbar. The actuation of a power circuit breaker under load is avoided. Otherwise, the other power circuit breaker is opened immediately following the synchronization of the one power circuit breaker. Continuous operation in parallel with the mains is not possible. Following the reset of the engine request, the MCB is synchronized, the engine is stopped with a reduction in power.		
The GCB is opened, the MCB is not operated.	The GCB and the MCB are not operated. Exception: Load test by actuating the "GCB ON" push-button. Termination of the load test via the "GCB OFF" or "MCB ON" push-button. Emergency power: Automatic setting of the GCB. Black busbar and current release MCB will be closed.	Via the "GCB ON" and "MCB ON" push-button, synchronization to either generator operation or operation with the mains can be carried out.	Via a engine request, the GCB is synchronized and the generator power is reduced. The MCB is then opened. Following the enabling of the engine request, the MCB is reverse synchronized and the GCB is then opened. Emergency power operation is terminated following the expiry of a mains settling time with the reverse synchronization of the MCB.

b.) Version PCM1-G

STOP	TEST	MANUAL	AUTOMATIC
EXTERNAL	CB logic "External" In this operating mode, the GCB is never synchronized. In operation in parallel with the mains, decoupling from the mains is carried out via the GCB in the event of mains faults. The power circuit breaker is not automatically closed in emergency power operation.		
The GCB is opened.	The GCB is not operated. Exception: The circuit breaker is opened for decoupling from the mains.	The GCB can be manually switched on and off without synchronization. The circuit breaker is opened for decoupling from the mains.	The GCB is opened for stopping or for decoupling from the mains, but is not closed in the event of a engine request.
PARALLEL	CB logic "Mains parallel" This operating mode may be used both in the case of an isolated system, an isolated parallel system and a system which is operated in parallel with the mains.		
The GCB is opened.	The GCB is not operated. Exception: Load test by actuating the "GCB ON" push-button. Termination of the load test with the "GCB OFF" push-button. Emergency power: The GCB is opened for decoupling from the mains.	Operation in parallel with the mains can be assumed via the "GCB ON" push-button.	Via a engine request, the GCB is synchronized and operation in parallel with the mains is assumed. On enabling of the engine request, the generator power is reduced, the GCB is opened and the engine is shut off with coasting.

Add-on/off ramp
max.time 000s

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

This time can be used to influence two functions:

Stop
The power of the genset is reduced, at most, for the time set here. If, within this time, negative deviation from 3 % of the generator rated power (see page 84) does not occur, the GCB is still opened.

Start with interchange synchronization
If, in interchange synchronization, the reference power level to be supplied by the mains of "zero" is not reached within the time set here, a "Reference power.<>0" message and an alarm class 1 alarm is issued. At the same time, the relay manager relay, which is programmed with parameter 78 is set.

Open GCB with F2
max.time 000s

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

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

If an alarm class 2 alarm occurs, switching the engine off may be delayed by this time. Another engine is therefore given the opportunity to start in order to assume the load. Shutdown is activated following the expiry of this time.

4.11.7 GCB pulse/continuous pulse

GCB close.relay

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

Constant ... The relay "Command: close GCB" can be looped directly into the self-holding circuit of the power circuit breaker. After the connect pulse has been output and the reply of the power circuit breaker has been received, the relay "Command: close GCB" remains picked up. As long as the following conditions are fulfilled:
"Reply: GCB is closed" is active.
The angle between generator voltage and busbar voltage is within ±14°.
If the power circuit breaker has to be opened, the relay drops out.

Impulse ..... The relay "Command: close GCB" outputs a connect pulse. Generator power circuit breaker self-holding must be carried out via an external self-holding circuit. The reply of the generator power circuit breaker is used to detect the closed contacts.

In both cases, the relay "Command: open GCB" remains picked up.

GCB open relay

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

NC-cont. ... If the generator power circuit breaker is to be opened, the relay "Command: open GCB" (terminal 41/42) remains picked up. Following "Reply: GCB is open" the relay drops off again.

NO-cont.... If the generator power circuit breaker is to be opened, the relay "Command: open GCB" (terminal 41/42) drops off. Following "Reply: GCB is open" the relay picks up again.

4.11.8 Synchronization

Synchronize
df max 0.00Hz

Max. perm. differential frequency for synchron. (pos. slip)0.02..0.49 Hz

The prerequisite of a connect command's being output is negative deviation from this set differential frequency. This value specifies the upper frequency (positive value corresponds to positive slip → generator frequency is greater than the busbar frequency on connection of the GCB; busbar frequency is greater than the mains frequency in the case of MCB synchronization).

Synchronize
df min -0.00Hz

Max. perm. differential frequency for syn. (neg. slip) 0.00..-0.49 Hz

The prerequisite of a connect command's being output is negative deviation from this set differential frequency. This value specifies the lower frequency (negative value corresponds to negative slip → generator frequency is less than the busbar frequency in the case of GCB synchronization; busbar frequency of smaller mains frequency for MCB synchronization).

Synchronize
dV max 00,0%

Max. perm. differential voltage for synchronization 0.1..20.0 %

This value refers to the parameter "Rated voltage in System". To ensure that a connect command will be issued, the actual value must fall below the entered differential voltage.

Synchronize
time pulse >0.00s

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

The duration of the connect pulse can be adjusted to the downstream switching item (valid for synchronization and black start).

Closing time
GCB 000ms

Inherent delay of GCB for synchronization 40..300 ms

The inherent switching time of the generator power circuit breaker corresponds to the lead-time of the connect command. The connect command will be issued independently of the differential frequency at the entered time (before the synchronous point).

Closing time MCB 000ms

[PCL1 & PCM1-M]

Inherent delay of MCB for synchronization **40..300 ms**

The inherent switching time of the mains power circuit breaker corresponds to the lead-time of the connect command. The connect command will be issued independently of the differential frequency at the entered time (before the synchronous point).

Automat.breaker deblocking ON

Automatic circuit breaker enabling **ON/OFF**

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

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

4.11.9 Synchronization time monitoring

Sync.time contr. ON

Monitoringw of synchronization time **ON/OFF**

ON ..... This setting ensures that the synchronization time will be monitored. The subsequent screens of this option are displayed.

OFF ..... The synchronization will not be monitored. A synchronization will be tried again and again until it can be carried out. The subsequent screens of this option are not displayed.

Sync.time contr. delay 000s

Final value for synchronization time monitoring **10..999 s**

If the synchronization of the GCB or MCB is started, the time counter is started following the expiry of delayed engine monitoring. If the power circuit breaker is not inserted once the set time has elapsed, the warning messages "GCB sync. time" or "MCB sync. time" are displayed. A further attempt is made to close the power circuit breaker. The relay with function 16 (GCB) and/or 70 (MCB) is set.

Tripping of alarm class 1

4.11.10 Dead start

If the busbar is in its voltage-free state, the direct connection (black start) of the generator power circuit breaker (GCB) or the mains power circuit breaker (MCB) may be carried out. If both connect commands are issued simultaneously, priority is given to the MCB if the input "Enable MCB" is set.

NOTE

The mains power circuit breaker is never opened except in the mains protection function or in the event of emergency power operation.

GCB dead bus op.
ON

Black start of GCB **ON/OFF**

ON ..... A black start is carried out in the event of a voltage-free busbar and an open mains power circuit breaker. The prerequisite of this is the detection of an operating condition which corresponds to the specifications. The subsequent screens of this option are displayed.

OFF ..... No black start is carried out (not even in operation mode MANUAL), and the subsequent screens of this option are not displayed.

GCB dead bus op.
df max 0,00Hz

Maximum differential frequency for GCB black start **0.05..5.00 Hz**

The prerequisite of the output of the connect command is that the generator frequency may, at most, deviate from the setpoint by the set value.

GCB dead bus op.
dV max. 00.0%

Maximum differential voltage for GCB black start **0.1..15.0 %**

This value refers to the parameter "Rated voltage in system". The prerequisite of the output of the connect command is that the generator voltage may, at most, deviate from the setpoint by the set value.

GCB dead bus op
max.time 000s

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

If the generator power circuit breaker (GCB) is to be closed, this time counter is started after the procedure of switching to the black busbar has been started. If, following the expiry of this time counter, connection has not yet been carried out, an alarm message is output.

Tripping of alarm class 1

MCB dead bus op.
ON

[PCL1 & PCM1-M]

Black start of MCB **ON/OFF**

ON ..... A black start is carried out in the event of a voltage-free busbar and an open generator power circuit breaker. The prerequisite of this is the detection of an operating condition which corresponds to the specifications. The subsequent screens of this option are displayed.

OFF ..... No black start is carried out, and the subsequent screens of this option are not displayed.

4.11.11 Circuit breaker monitoring (switch pulses)

Supervision GCB
ON

GCB monitoring **ON/OFF**

ON .....Monitoring of the generator power circuit breaker is carried out (except in the "EXTERNAL") CB logic. If the circuit breakers cannot be closed by the fifth attempt, the alarm class alarm message "GCB CLOSED malfunction" is output. The relay is set with the parameter 75. Following an alarm message, further attempts are made to connect the GCB. If load sharing has been enabled the closing command to the breaker is deleted in the case of an alarm to enable another control to close its breaker. If, 2 seconds following a "Command: open GCB" pulse, the "Reply: GCB is open" is not detected, an alarm with the message "GCB OFF malfunction" is output. the relay is set with parameter 77.

Tripping of alarm class 1

OFF.....No GCB monitoring is carried out.

Supervision MCB
ON

[PCL1 & PCM1-M]

MCB monitoring **ON/OFF**

ON .....Monitoring of the mains power circuit breaker is carried out (except in the "EXTERNAL" CB logic). If the circuit breakers cannot be closed by the fifth attempt, an alarm message "MCB CLOSED malfunction" is output. The relay is set with parameter 74. If load sharing has been enabled the closing command to the breaker is deleted in the case of an alarm to enable another control to close its breaker. Following an alarm message, further attempts are made to connect the MCB. If 2 seconds following a "Command: open MCB" pulse the "Reply: MCB is open" is not detected, an alarm with the message "MCB OPEN malfunction" is output. the relay is set with parameter 76.

Tripping of alarm class 1

OFF.....No MCB monitoring is carried out.

4.11.12 Mains decoupling

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

only on PCM1-G

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

GCB..... In case of a mains failure the GCB will be opened. (The mains failure is detected via the mains voltage [terminals 50/51/52]).

GCB->EXT . In case of a mains failure the GCB will be opened. (The mains failure is detected via the mains voltage [terminals 50/51/52]). If there is no reply detected via terminal 4 that the GCB has been opened, an alarm message will be issued with the expire of the delay time. The relay 76 of the relay manager will be set, too. The "Command: open GCB" relay will be reset (terminal 41/42) and therefore the relay with terminals 39/40 is set.

Tripping of alarm class 1

EXT..... In case of a mains failure the relay with the terminals 39/40 will be set. (The mains failure is detected via the mains voltage [terminals 50/51/52]).

EXT->GCB . In case of a mains failure the relay with the terminals 39/40 will be set. (The mains failure is detected via the mains voltage [terminals 50/51/52]). If there is no reply detected via terminal 54 that the breaker has been opened, an alarm message will be issued with the expire of the delay time. The function 77 of the relay manager will be set, too. The relay with the terminals 39/40 will be reset and therefore the relay "Command: open GCB" (terminals 41/42) is set.

Tripping of alarm class 1

Paramet

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

only on PCM1-M

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

GCB..... In case of a mains failure the GCB will be opened. (The mains failure is detected via the mains voltage [terminals 50/51/52]).

GCB -> MCB In case of a mains failure the GCB will be opened. (The mains failure is detected via the mains voltage [terminals 50/51/52]). If there is no reply detected via terminal 4 that the GCB has been opened, an alarm message will be issued with the expire of the delay time. The function 76 of the relay manager will be set, too. The "Command: open GCB" relay will be reset (terminal 41/42) and therefore the relay "Command: open MCB" (terminals 39/40) is set.

Tripping of alarm class 1

MCB..... In case of a mains failure (**Fehler! Verweisquelle konnte nicht gefunden werden.** to **Fehler! Verweisquelle konnte nicht gefunden werden.**) the MCB will be opened. (The mains failure is detected via the mains voltage [terminals 50/51/52]).

MCB->GCB In case of a mains failure the MCB will be opened. (The mains failure is detected via the mains voltage [terminals 50/51/52]). If there is no reply detected via terminal 54 that the MCB has been opened, an alarm message will be issued with the expire of the delay time. The function 77 of the relay manager will be set, too. The "Command: open MCB" relay will be reset (terminals 39/40) and therefore the relay "Command: open GCB" (terminals 41/42) is set.

Tripping of alarm class 1

Parameter 1

Mains decoupling
-> after 0,00s

Mains decoupling after 0.10..5.00 s

Time after which the change of the type of the mains decoupling should be performed.

WARNING

During maintenance at the busbar take into account that an open MCB will be closed by the GCP with the expire of the mains settling time when the following parameter is configured to "YES". Configure the parameter to "NO" or prevent the busbar to be energized.

Switch MCB in STOP mode NO

Operate MCB in operation mode STOP **YES/NO**

YES ..... The MCB will be operated by the GCP in operation mode STOP, i.e. the busbar will be supplied also in case of changing into this operation mode. Thereto it is necessary that the "Enable MCB" is set.

NO ..... The MCB will not be operated by the GCP in operation mode STOP, i.e. the busbar will not be supplied or remains unsupplied in case of changing into this operation mode.

4.12 Emergency power configuration [PCL1 & PCM1-M]

NOTE

Emergency power is only possible with synchronous generators with 2 power circuit breakers.

Configure emergency YES

Configuration of the emergency power **YES/NO**

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

YES ..... The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modifications can be made to the parameters ("Cursor→", "Digit↑" or "Select" push-button). A decision is not made on whether the parameters are processed or not.

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

HINWEIS

Emergency power is possible only with synchronous generators with 2 breakers, i.e. PCM1-M and the PCM1-G with PCN4 coupling.

Emergency power ON

Emergency power **ON/OFF**

ON ..... If the item is set to "AUTOMATIC" or "TEST" mode and a mains failure occurs, the engine is started and automatic emergency power operation is carried out. The subsequent screens of this option are displayed. Emergency power is also triggered via the detection of a switch fault when the MCB is switched on. In order to achieve this, the "MCB monitoring" screen must additionally be set to "ON".

OFF ..... Emergency power operation is not carried out and the subsequent screens of this option are not displayed.

CAUTION !

Emergency power in accordance with DIN VDE 0108 s not possible in "EXTERNAL" CB logic!

Emergency power	
start del.	00.0s

Starting delay for emergency power **0.5..99.9 s**

In order to start the engine and to carry out emergency power operation, the mains must have failed for a minimum period of time.

4.13 Watchdog configuration

Configure	
monitoring	YES

Configuration of the watchdog **YES/NO**

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

YES ..... The configuration screens in the next block are displayed and can either be viewed ("STATUS / ALARM" push-button) or modifications can be made to the parameters ("PARAMETER", "U SELECT" or "STATUS / ALARM" push-button). A decision is not made on whether the parameters are processed or not.

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

4.13.1 Generator power monitoring

Monitoring the generator power's exceeding two values, which can be configured, is possible. Via the relay manager (parameter 56 and 80) tripping can be set to each one of the relays, which can be freely configured. The execution of load shutoff is therefore possible with an external circuit.

Note With this function **no** centralized alarm is output and no message is output on the display. Only a relay output, which has to be externally evaluated, is carried out.

CAUTION !

This function does not represent generator protection.

If generator protection is necessary, either the generator protection of this control or an external protection device can be used.

Gen.power monit.
ON

Generator power monitoring **ON/OFF**

ON ..... The generator power is monitored with regard to its exceeding two values, which can be freely configured. In order to enable output, the following values must be set in the relay manager: level 1 = 56; level 2 = 80. The subsequent screens of this option are displayed.

OFF ..... Monitoring is not carried out, and the subsequent screens of this option are not displayed.

Gen.power monit.
resp.val1 0000kW

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

The value as of which the watchdog is triggered is specified here. If the value has been exceeded, the relay assigned via the relay manager (parameter 56).

Gen.power monit.
hyst.lv1 000kW

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

If negative deviation from the threshold value by the hysteresis value occurs, the relay drops off again.

Gen.power monit.
delay lv1 000s

Power monitoring delay, level 1 **0..999 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

Gen.power monit.
resp.val2 0000kW

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

The value as of which the watchdog is triggered is specified here. If the value has been exceeded, the relay assigned via the relay manager (parameter 80).

Gen.power monit.
hyst.lv2 000kW

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

If negative deviation from the threshold value by the hysteresis value occurs, the relay drops off again.

Gen.power monit.
delay lv2 000s

Power monitoring delay, level 2 **0..999 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

4.13.2 Mains power monitoring [PCM1x]

Monitoring the mains power's exceeding a value, which can be configured, is possible. Via the relay manager (parameter 67) tripping can be set to one of the relays, which can be freely configured. The execution of load shutoff is therefore possible with an external circuit.

Note With this function no centralized alarm is output and no message is output on the display. Only a relay output, which has to be externally evaluated, is carried out.

CAUTION!

This function does not represent generator protection.

If generator protection is necessary, either the generator protection of this control or an external protection device can be used.

Mains power mon.
ON

Mains power monitoring **ON/OFF**

ON ..... Switching mains power monitoring on. One relay must be occupied with parameter 56 of the relay manager. The subsequent screens of this option are displayed.

OFF ..... Monitoring is not carried out, and the subsequent screens of this option are not displayed.

Mains power mon.
res.val. I0000kW

Power monitoring threshold value **I/E 0..9,999 kW**

The value as of which the watchdog is triggered is input here. If the value is exceeded, the relevant relay picks up. Incoming power is input with a "-", before the value, outgoing power is input with a "+" before the value. If this value is saved, the "-" becomes " I " and the "+" becomes " E ".

Mains power mon.
hysteresis 000kW

Power monitoring hysteresis **0..999 kW**

If negative deviation from the threshold value by the hysteresis value occurs, the relay drops off again.

Mains power mon.
delay 000s

Power monitoring delay **0..650 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

4.13.3 Generator overload monitoring

Overload monit.
ON

Generator overload monitoring **ON/OFF**

ON ..... Switching generator overload monitoring on. The subsequent screens of this option are displayed.
OFF..... Monitoring is not carried out, and the subsequent screens of this option are not displayed.

Gen.overload MOP
resp.value 000%

Generator overload monitoring threshold value **80..150 %**

The threshold value refers to the input rated power of the generator (see page 84). Tripping is carried out without delay (MOP..operation in parallel with the mains).
Generator overload..... Tripping if the generator real power exceeds the limit value.

Tripping of alarm class 2
without power reduction

Gen.overload MOP
delay 00s

Generator overload monitoring delay (mains parallel operation) **0..99 s**

For a tripping the threshold must be exceeded continuously minimum for the time shown in this mask.. A coasting is made. (MOP..mains parallel operation).

Gen.overload IOP
resp.value 000%

Generator overload monitoring threshold value **80..150 %**

The threshold value refers to the generator rated power input (see page 84) (IOP..isolated operation in parallel with other gensets, also for single plants in isolated operation).
Generator overload..... Tripping, if the generator real power exceeds the limit value.

Tripping of alarm class 2
without power reduction

Gen.overload IOP
delay 00s

Generator overload monitoring delay (isolated operation) **0..99 s**

In order for tripping to occur, the threshold value must be exceeded without interruption for at least the period of time specified in this screen (IOP..isolated operation in parallel with other gensets).

4.13.4 Generator reverse/reduced power monitoring

Rev./red.power monitoring ON

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

ON ..... Switching reverse/reduced power monitoring on. The subsequent screens of this option are displayed.

OFF ..... Monitoring is not carried out, and the subsequent screens of this option are not displayed.

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

Reverse/reduced power monitoring threshold value **-99..0..+99 %**

The threshold value refers to the rated power of the generator (see page 84).

Reduced power monitoring ..... Tripping when the real power falls below the (positive) limit value.

Reverse power monitoring ..... Tripping when the real power falls below the (negative) limit value.

Tripping of alarm class 3

Rev./red.power delay 0.0s

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

In order for tripping to occur, negative deviation from the threshold value must occur without interruption for at least the period of time specified in this screen.

4.13.5 Load imbalance monitoring

The percentage threshold value specifies the permissible deviation of a conductor current from the arithmetic mean value of all three conductor currents. If generator load imbalance occurs, the engine is immediately shut down with alarm class 3 and the alarm message "Load imbalance" is displayed.

Load unbalanced monitoring ON

Load imbalance monitoring **ON/OFF**

ON ..... Generator load imbalance monitoring is carried out. The subsequent screens of this option are displayed.

OFF ..... Monitoring is not carried out, and the subsequent screens of this option are not displayed.

Load unbalanced max. 000%

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

Monitoring of the set maximum load imbalance is carried out in reference to the generator rated current which has been set (see page 84). If the load imbalance value exceeds the set percentage value due, for example, to asymmetrical generator load, shutoff occurs.

Tripping of alarm class 3

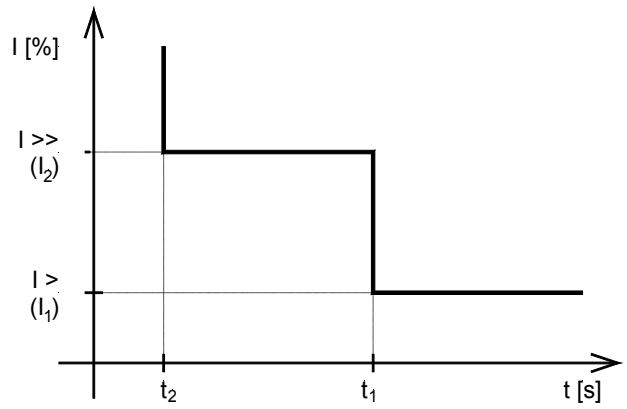
Load unbalanced delay 00.00s

Load imbalance monitoring delay **0.02..99.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

4.13.6 Generator overcurrent monitoring

If generator overcurrent occurs, the engine is immediately shut down (alarm class 3, and the alarm message "Overcurrent" is displayed.



Gen.overcurrent monitoring ON

Independent time overcurrent monitoring **ON/OFF**

ON .....Generator current monitoring is carried out, and the following screens of this option are displayed.
OFF.....Monitoring is not carried out, and the subsequent screens of this option are not displayed.

Gen.overcurrent limit 1 000%

Independent time overcurrent, threshold value, limit 1 **0..300 %**

If the value of the generator current exceeds the set percentage value, with reference to the generator rated current (see page 84), shut-off occurs.

Tripping of alarm class 3

Gen.overcurrent delay 1 00.00s

Independent time overcurrent, delay, limit 1 **0.02..99.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

Gen.overcurrent limit 2 000%

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

If the value of the generator current exceeds the set percentage value, with reference to the generator rated current (see page 84), shut-off occurs.

Tripping of alarm class 3

Gen.overcurrent delay 2 00.00s

Independent time overcurrent, delay, limit 2 **0.02..99.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

4.13.7 Generator frequency monitoring

Function "Generator frequency not within the permissible range"
The generator frequency lies outside of the limit values set for overfrequency and underfrequency. The engine is immediately shut down (alarm class 3), and the malfunction message "Gen.overfreq" or "Gen.underfreq" appears. The activation of generator underfrequency monitoring is delayed via "Delayed engine monitoring" in order to enable correct generator start-up.

Gen.frequency-monitoring ON

Generator frequency monitoring **ON/OFF**

ON .....Generator frequency monitoring is carried out. The subsequent screens of this option are displayed.
OFF.....Monitoring is not carried out, and the subsequent screens of this option are not displayed.

Gen.overfreq. f > 000.0Hz

Generator overfrequency threshold value **50.0..140.0 %**

This value refers to the parameter "Rated frequency in system". The overfrequency value which is to be monitored is set in this screen. The overfrequency value which is to be monitored is set in this screen.

Tripping of alarm class 3

Gen.overfreq. delay 0.00s

Generator overfrequency delay **0.02..9.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

Gen.underfreq. f < 000.0Hz

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

This value refers to the parameter "Rated frequency in system". The underfrequency value which is to be monitored is set in this screen. If the value is reached or fallen below, the item outputs a message and opens the generator power circuit breaker.

Tripping of alarm class 3

Gen.underfreq. delay 0.00s

Generator underfrequency delay **0.02..9.98 s**

In order for tripping to occur, negative deviation from the threshold value must occur without interruption for at least the period of time specified in this screen.

a.) Engine overspeed monitoring

Engine overspeed > 0000 rpm

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

Overspeed monitoring is independently carried out by the Pickup in addition to generator frequency monitoring. If the Pickup input is switched off, this monitoring is also deactivated. The alarm message "overspeed" is output.

Tripping of alarm class 3

4.13.8 Generator voltage monitoring

The line-to-line voltage is monitored in each case.

Function "Generator voltage not within the permissible range"
At least one phase of the generator voltage lies outside of the limit values set for overvoltage or undervoltage. The engine is immediately shut down (alarm class 3), the malfunction message "Gen.overvolt." or "Gen.undervolt." appears. The activation of generator undervoltage monitoring is delayed via "Delayed engine monitoring" in order to enable correct generator start-up.

Gen.voltage monitoring ON

Generator voltage monitoring **ON/OFF**

ON ..... Generator voltage monitoring is carried out. The subsequent screens of this option are displayed.
OFF ..... Monitoring is not carried out, and the subsequent screens of this option are not displayed.

Gen.overvoltage U > 000.0%

Generator overvoltage threshold value **20.0..150.0 %**

This value refers to the parameter "Rated voltage in system". The overvoltage value which is to be monitored is set in this screen. If the value is reached or exceeded, the item outputs a message and opens the generator power circuit breaker.

Tripping of alarm class 3

Gen.overvoltage delay 0.00s

Generator overvoltage delay **0.02..9.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

Gen.undervoltage U < 000,0%

Generator undervoltage threshold value **20.0..150.0 %**

This value refers to the parameter "Rated voltage in system". The undervoltage value which is to be monitored is set in this screen. If the value is reached or fallen below, the item outputs a message and opens the generator power circuit breaker.

Tripping of alarm class 3

Gen.undervoltage delay 0.00s

Generator undervoltage delay **0.02..9.98 s**

In order for tripping to occur, negative deviation from the threshold value must occur without interruption for at least the period of time specified in this screen.

4.13.9 AMF (emergency power) limits [PCL1]

The following limits are used to determine a AMF (automatic mains failure/emergency power case). Following this limits it is calculated if the mains is available or not. If one level for f or U is reached (higher or lower) a message is displayed. Relay manager parameter number 5 is calculated out of this values, too.

Mains overfreq. **f > 000.0%**

Limit for mains overfrequency **80.0..140.0 %**

This value refers to the parameter "Rated voltage in system". The limit value to be monitored for overfrequency is entered here.

Mains underfreq. **f < 000.0%**

Limit for mains underfrequency **80.0..140.0 %**

This value refers to the parameter "Rated voltage in system". The limit value to be monitored for underfrequency is entered here.

Mains overvolt. **U > 000.0%**

Limit for mains overvoltage **20.0..150.0 %**

This value refers to the parameter "Rated voltage in system". The limit value to be monitored for overvoltage is entered here.

Mains undervolt. **U < 000.0%**

Limit for mains undervoltage **20.0..150.0 %**

This value refers to the parameter "Rated voltage in system". The limit value to be monitored for undervoltage is entered here.

4.13.10 Mains frequency monitoring [PCM1x]

Monitoring the mains frequency is absolutely vital if a generator is operated within a public network. In the event of mains failure (e. g. short interruption) the generator which is operating in parallel with the mains must be automatically disconnected from the mains. Decoupling from the mains is only activated when both power circuit breakers (mains and generator power circuit breaker) are closed.

The here fixed limit values are used for assessment of the emergency power operation in case that the following protective items are switched to "ON". On the basis of the here fixed limit values it is defined whether mains is present or not. The tripping times will not be noticed.

Function "Mains frequency not within the permissible range"
The mains frequency lies outside of the limit values set for overfrequency or underfrequency. The power circuit breaker, which is to carry out decoupling from the mains, is immediately opened. The prerequisite of mains frequency monitoring is operation in parallel with the mains (both power circuit breakers closed). The malfunction message "Mains overfreq." or "Mains underfreq" appears. Output via an alarm relay is always possible.

Mains frequency monitoring ON

Mains frequency monitoring **ON/OFF**

ON .....Mains frequency monitoring is carried out. The subsequent screens of this option are displayed.
OFF.....Monitoring is not carried out, and the subsequent screens of this option are not displayed.

Mains overfreq. f > 000.0%

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

This value refers to the parameter "Rated voltage in system". The overfrequency value which is to be monitored is set in this screen. If the value is reached or exceeded, the item outputs a message and opens the generator or the mains power circuit breaker regardless of the nature of decoupling from the mains.

Tripping of alarm class 0

Mains overfreq. delay 0.00s

Mains overfrequency delay **0.02..9.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

Mains underfreq. f < 000.0%

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

This value refers to the parameter "Rated voltage in system". The underfrequency value which is to be monitored is set in this screen. If the value is reached or fallen below, the item outputs a message and opens the generator or the mains power circuit breaker regardless of the nature of decoupling from the mains.

Tripping of alarm class 0

Mains underfreq. delay 0.00s

Mains underfrequency delay **0.02..9.98 s**

In order for tripping to occur, negative deviation from the threshold value must occur without interruption for at least the period of time specified in this screen.

4.13.11 Mains voltage monitoring [PCM1x]

Monitoring the mains voltage is absolutely vital if a generator is operated within a public network. In the event of mains failure (e. g. short interruption) the generator which is operating in parallel with the mains must be automatically disconnected from the mains.

The line-to-line voltage is monitored in each case.

The here fixed limit values are used for assessment of the emergency power operation in case that the following protective items are switched to "ON". On the basis of the here fixed limit values it is defined whether mains is present or not. The tripping times will not be noticed.

Function "Mains voltage not within the permissible range"
At least one phase of the mains voltage lies outside of the limit values set for overvoltage or undervoltage. The power circuit breaker, which is to carry out decoupling from the mains, is immediately opened. The prerequisite of mains voltage monitoring is operation in parallel with the mains (both power circuit breakers closed). The malfunction message "Mains overfreq." or. "Mains underfreq. appears" Output via an alarm relay is always possible.

Mains voltage monitoring ON

Mains voltage monitoring **ON/OFF**

ON .....Mains voltage monitoring is carried out. The subsequent screens of this option are displayed.
OFF.....Monitoring is not carried out, and the subsequent screens of this option are not displayed.

Mains overvolt. U > 000.0%

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

This value refers to the parameter "Rated voltage in system". The overvoltage value which is to be monitored is set in this screen. If the value is reached or exceeded, the item outputs a message and opens the generator or the mains power circuit breaker regardless of the nature of decoupling from the mains.

Tripping of alarm class 0

Mains overvolt. delay 0.00s

Mains overvoltage delay **0.02..9.98 s**

In order to trip monitoring, the threshold value must be exceeded without interruption for at least the period of time specified in this screen.

Mains undervolt. U < 000.0%

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

This value refers to the parameter "Rated voltage in system". The undervoltage value which is to be monitored is set in this screen. If the value is reached or fallen below, the item outputs a message and opens the generator or the mains power circuit breaker regardless of the nature of decoupling from the mains.

Tripping of alarm class 0

Mains undervolt. delay 0.00s

Mains undervoltage delay **0.02..9.98 s**

In order for tripping to occur, negative deviation from the threshold value must occur without interruption for at least the period of time specified in this screen.

4.13.12 Phase/vector shift monitoring [PCM1x]

Function A phase/vector shift is a sudden change in the voltage curve, and may be caused by a major generator load change. In this case, the measuring circuit detects a change in the cycle duration once. This change in the cycle duration is compared with a calculated mean value from previous measurements. Monitoring encompasses all three phases. The threshold value in degrees specifies the difference in time between the mean and the current value in reference to a full cycle. Monitoring can be set in various manners. The phase/vector shift watchdog may be used as an additional facility for decoupling from the mains.

Phase shift monitoring	**ON**

Phase/vector shift monitoring **ON/OFF**

ON .....Mains frequency monitoring is carried out, and any phase/vector shift within the defined range is registered. The subsequent screens of this option are displayed.

OFF.....Monitoring is not carried out, and the subsequent screens of this option are not displayed.

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 specified threshold value 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 is taken into consideration; if a phase/vector shift occurs in all three phases, the three-phase threshold value is taken into consideration. His type of monitoring is very sensitive, and may lead to false 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 in all three phases within 2 cycles.

Tripping of alarm class 0

NOTE

If monitoring is set to "threephase", only the bottom of the two following screens is visible; if monitoring is set to "one-/threephase", both configuration screens are visible.

Phase shift one-phase	**00°**

This mask is only visible if monitoring is set to "one-/threephase".

Maximum phase difference **3..30 °**

Tripping occurs if the electrical angle of the voltage curve shifts by more than the specified angle. In this case, tripping depends on the type of monitoring which has been set:

Phase shift three-phase	**00°**

Maximum phase difference **3..30 °**

Tripping occurs if the electrical angle of the voltage curve shifts by more than the specified angle. In this case, tripping depends on the type of monitoring which has been set

4.14 Mains settling time

Mains settling time	000s

Mains settling time **0..999 s**

In order to disable the reverse synchronization of the generator to the mains for a certain time, the delay time for which the generator is to remain in idle or isolated (parallel) operation can be configured with this parameter. The following applies in the case of generators with 1-power circuit breaker, which are to be operated in parallel with the mains: If the mains fails for the duration of the mains settling time, the engine is stopped. If the mains is available for at least 5 seconds without any interruption, the engine is started.

Note

If both circuit breakers (PCM1-M und PCL1) are open, the mains settling time is reduced to 2 seconds when the mains return, for the case that this is configured longer.

4.14.1 Battery voltage monitoring

Batt.undervolt. U <	00,0V

Threshold value **9.5..30.0 V**

Battery undervoltage threshold value. Continuous negative deviation from the set limit value for at least x seconds (see next screen) leads to the output of the alarm message "Batt. undervolt." in the LC display and to the output of the centralized alarm.

Tripping of alarm class 1

Batt.undervolt. delay	00s

Battery undervoltage delay **0..99 s**

In order for tripping to occur, negative deviation from the threshold value must occur without interruption for at least the period of time specified in this screen.

Note: Regardless of the set battery voltage watchdog, readiness for operation is withdrawn and the message "Battery undervolt." is output if

- the supply voltage falls below 17.7 V or if
- the supply voltage falls below 11 V during the start procedure.

4.14.2 Time of active horn

Horn self reset	0000s

Horn acknowledgment after **1..9,999 s**

If the horn (centralized alarm) has been active for this time it will be deactivated (acknowledged) automatically.

4.15 Discrete input configuration

Configure dig.inputs	YES

Configuration of discrete inputs **YES/NO**

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

YES ..... The configuration screens in the next block are displayed and can either be viewed ("STATUS / ALARM" push-button) or modifications can be made to the parameters ("PARAMETER", "U SELECT" or "STATUS / ALARM" or "Select" push-button). A decision is not made on whether the parameters are processed or not.

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

NOTE

The discrete inputs can be used as alarm inputs and alternatively as control inputs. If they were configured as alarm inputs (parameter is "OFF") the masks in chapter 4.15.1 Setting the alarm inputs

Setting the alarm inputs" at page 132 are valid. If they were configured as control inputs the masks in chapter "Setting the control inputs " at page 135 are valid. The choice whether a discrete input is an alarm or a control input occurs directly after the input of the alarm text of the according discrete input.

4.15.1 Setting the 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	61	62	63	64	65	66	67	68	69	70	71	72	73	125	126	127
PCL1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-
PCM1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Function	Alarm or control input (depends on configuration)															

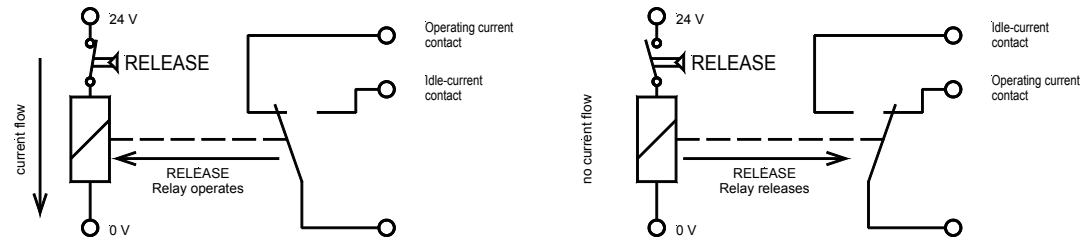
NOTE

NO (operation current) The relay picks up after tripping, i. e., in the operative state, current flows through the coil.

→ There will be no change in the state of the relay in the event of a power outage and the relay will not trip. In this case, the relay's readiness for operation should be monitored.

NC (idle current)..... The relay drops out after tripping, i. e., in the idle state, current flows through the coil. The relay is pulled in the idle state (= no tripping).

→ There will be no change in the state of the relay in the event of a power outage and the relay will trip.



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

Dig.input	1234
function	EEEE

Discrete alarm input, function **E/D**

The alarm inputs can be triggered via whether an operating current (NO) or an idle current (NC) contact. The idle current input enables an open circuit to be monitored. Either a positive or a negative voltage difference may be applied. Terminals 34 (input 1), 35 (input 2), 36 (input 3) and 61 (input 4) are assigned.

E ..... Enable to operate (NO) The discrete alarm input is triggered via the application of a voltage difference.

D ..... Disable to operate (NC) The discrete alarm input is triggered by the drop-off of a voltage difference.

Dig.input	1234
delay	0000

Discrete alarm input, delay **0..9 s**

A delay can be assigned to each alarm input. The delay is input in the form of delay stages. The individual stages are listed below. The input must be present, without interruption, throughout the delay time in order for tripping to occur.

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

Delayed by	1234
eng.speed	YYYY

Discrete alarm input, delayed by firing speed **Y/N**

For the alarm inputs the question of whether the input is only to be monitored when the engine is rotating ("firing speed reached") is specified here.

Y ..... After engine monitoring has been activated (the green "Monitoring" LED illuminates), the discrete input is evaluated.

N ..... The discrete input is always evaluated.

Dig.input	1234
error class	3000

Discrete alarm input, alarm class **0..3**

Different alarm classes are assigned to discrete alarm inputs 1 to 4. The alarm classes are listed following.

The monitoring functions are divided into four alarm classes:

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

F1 Warning alarm
This alarm does not lead to an interruption of the operation. A centralized alarm will be output.
→ Alarm text + flashing "alarm" LED + group alarm relay (horn).

F2 Triggering alarms
This alarm leads to the shutdown of the engine. First the real power is reduced before the GCB is opened. A coasting is carried out.
→ Alarm text + flashing "alarm" LED + group alarm relay (horn) + coasting.

F3 Triggering alarm
This alarm leads to the immediate opening of the GCB and to the shutdown of the engine.
→ Alarm text + flashing "alarm" LED + group alarm relay (horn) + shutdown.

4.15.2 Setting of the texts of the alarm inputs

a.) Texts of the discrete inputs in the PCx

NOTE

If terminal 6 is allocated as "Sprinkler operation" function (see chapter 4.15.4 on page 136) or if a gas engine is selected (see chapter 4.18.2 Engine type definition on page 145

Engine configuration" on page 144), the EMERGENCY OFF function must always be assigned to terminal 61.

NOTE

If the device is equipped with a 2. interface (via Y1-Y5), the alarm texts can only be configured using the PC program.

Example Alarm text terminal 61

Errortxt.term.61
EMERGENCY OFF

Setting the alarm texts

These screens are used to input the alarm texts (in this example for terminal 61 the alarm text "EMERGENCY OFF"). The EMERGENCY OFF function should generally be assigned to terminal 61.

NOTE

Certain special characters, numbers, high case and low case letters may be set.

b.) Texts of the discrete inputs of the EM1-D

The discrete inputs of the EM1-D can be configured only by using the PC program. The parameter of the EM1-D are listed at the end in the configuration file of the PCx. Please note that you have to put on additional adjustments directly at the EM1-D. Please use the separate configuration file for the EM1-D.

Alarm text DIx EM1-Dy (terminal z)
[x = 1..8] / [y = 1/2] / [z = 5..12]

Settings of the alarm texts of EM1-D.y

The discrete input x (terminal y) on the EM1-D.z displays the here adjusted text on the LCD of the PCx.

Example Discrete input 5 on the EM1-D.1

Alarm text DI5 EM1-D (terminal 9)

Settings of the alarm texts of EM1-D.1

The discrete input 5 (terminal 9) on the EM1-D.1 displays the here adjusted text on the LCD of the PCx.

4.15.3 Setting the control inputs

Firing speed by Term. 62 ON

Firing speed reached via terminal 62 **ON/OFF**

OFF ..... The discrete input terminal 62 is used as a normal alarm input.

ON ..... The logic to be set applies to the starting procedure:
If the input is set to operating current (NO), the starter is dis-engaged when a signal is applied. After the termination of the delayed engine monitoring, the "operating current" is still programmed, however, internally, the device switches over to the "closed-circuit current" logic (NO), in order to enable the generation of an alarm tripping in the event of a voltage loss (including set time lag). The same principle, inverted, also applies to the closed-circuit current (NC) tripping. The discrete input is programmed for closed-circuit current (NC), to dis-engage the starter in the event of a voltage loss. After the delayed engine monitoring, the discrete input is internally set to operating current (NO) and is therefore tripped as soon as voltage is applied. The here adjusted logic applies for the start operation.

Op.mode blocked by Ter.63 ON

Disabling the change of the mode using the front folio **ON/OFF**

ON ..... Terminal 63 is used as control input. If terminal 63 applies to a high level, the operation mode can no longer be changed using the front folio push-buttons.

OFF ..... This terminal is evaluated as alarm input.

Breaker logic by Term64 ON

CB logic via terminal 64 **ON/OFF**

ON ..... This terminal is used as control input.

- High level — If this terminal applies to a high level, the power circuit breaker logic configured using the next mask will be activated.
- Low level — If this terminal applies to a low level, the power circuit breaker logic configured in this item will be activated (see chapter 4.11.6 "Power circuit breaker logic" at page 110).

OFF ..... Terminal 64 is evaluated as alarm input.

Breaker logic: EXTERNAL

Only visuable if CB logic via terminal 64 is set to "ON".

CB logic via discrete input **see page 110**

In this mask the CB logic is selected which is activated using terminal 64. This parameter is only visible if parameter „Breaker logic" has been configured to ON (for the description of the breaker logic note chapter "Breaker logic").

Manual synchr. by Ter.66 ON

Manual synchronization via terminal 66 **ON/OFF**

ON ..... Terminal 66 would be used as control input:
- breaker and synchronization time monitoring is disabled
- no control output or control to base position is disabled

OFF ..... Terminal 66 would be used as alarm input.

Close GLS asap by Ter.67 ON

Close GCB prior to delayed engine protection via term. 67 **ON/OFF**

ON ..... Terminal 67 would be used as control input: Closing of the GCB would be enabled prior to completion of the delayed engine monitoring and after reaching the window of the possible range for generator voltage and frequency.

AUS ..... Terminal 67 would be used as alarm input.

4.15.4 Adjust function of terminal 6

ATTENTION!

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

Function term.6
Sprinklermode

Function of terminal 6

This screen is used to assign a function to the discrete control input terminal 6. A selection may be made from among the following functions:

- Sprinkler operation,
- Engine enabling,
- External acknowledgment,
- STOP mode,
- Engine blocked or
- Start without CB.

• Sprinkler — By **resetting** terminal 6 (setting a low level) sprinkler operation is activated in accordance with the functional description. This is terminated by **setting** terminal 6 (application of a High signal). Attention: Negative functional logic! (for the function of the sprinkler operation, please also observe Chapter 2.11 "Sprinkler operation" on page 53.)

• Engine enable — Terminal 6 in this case has the same function as the STOP push-button: Resetting terminal 6 (application of a LOW signal) prevents the engine's starting, and stops the engine if this is already running; the application of a HIGH signal enables the starting of the engine; the application of a high signal enables the engine for startup. Caution: Via this function, emergency power operation is also prevented or aborted. Emergency power is **not** possible without this enable signal! The engine enable function is only possible in "AUTOMATIC" operating mode.

• Ext. acknowledge — In "STOP" and "AUTOMATIC" modes alarms can be acknowledged externally by setting terminal 6 (Change of slope from a LOW to a HIGH signal). In order to achieve further acknowledgement, terminal 6 must accordingly first be reset and then set again. If a continuous HIGH signal is present at terminal 6, this has no effect on the acknowledgement and suppression of alarm messages.

• ΣΤΟΠ mode — By setting terminal 6 (application of a HIGH signal) the STOP mode is chosen. If you remove this signal the mode will change into the mode which was activated before terminal 6 was set.

• Engine stop — By setting terminal 6 (application of a HIGH signal) a start of the engine can be prevented. If the engine is running because emergency current is present, it is stopped by setting this discrete input. The discrete input is **not** inverted. The engine block function is only possible in "AUTOMATIC" operating mode.

• No CB by start — If the terminal 6 is set, the engine starts; no synchronization is carried out and the generator power circuit breaker is not engaged (no switching to black busbar). The GCB is then inserted only if emergency current is present. After return of the mains, there is a switchover to the mains according to the set CB logic. The start of terminal 6 is of a higher value than the start via terminals 3/5. If terminal 6 was selected, terminals 3/5 are ignored. If the genset is in mains parallel mode with power circuit breaker logic "Parallel" and if terminal 6 is activated, the GCB is opened after a reduction in power. The genset continues to operate without load with the GCB open.

Start withno GCB cool down ON

Only if terminal 6 was configured to "start without CB".

Costing if starting without CB **ON/OFF**

ON ..... After removing the start request, a coasting is carried out for the time period set in the "coasting" screen.

OFF ..... After removing the start request, no coasting is carried out and the engine is stopped immediately.

Sprinkler shutd. F1 aktive ON

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

ON ..... If terminal 6 "sprinkler operation" is configured, the primary alarm classes will be active after sprinkler demand has been finished (setting terminal 6).

OFF ..... If terminal 6 is configured as "sprinkler operation", the primary alarm classes will be again active after sprinkler coasting has been finished (setting terminal 6 and sprinkler coasting 10 minutes).

4.16 Analog inputs configuration

Analog input	1	2	3	4	5	6	7
Type	Pt100	Pt100	0/4..20mA	Pt100	Pt100	Pt100	0/4..20mA
Terminals	93-95	96-98	99-101	102-104	105-107	108-110	111-113
PCL1	✓	✓	✓	✓	-	-	-
PCM1/L	✓	✓	✓	✓	-	-	-
PCM1/H	✓	✓*	✓	✓	✓	✓	✓

*This analog input is also used for the temperature dependent start/stop and the temeperature dependent power reduction.

Configure analg.inp. YES

Configuration of analog inputs **YES/NO**

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

YES ..... The configuration screens in the next block are displayed and can either be viewed ("STATUS / ALARM" push-button) or modifications can be made to the parameters ("PARAMETER", "U SELECT" or "STATUS /ALARM" or "Select" push-button). A decision is not made on whether the parameters are processed or not.

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

NOTE

If you want to visualize the analog inputs via the PC programm FL-SOFT3 starting with Firmware 3.1.xxx of PCx please note the following:

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

4.16.1 Setting the analog inputs

a.) Pt100 input

The temperature input Pt100 is designed for temperatures up to 240 °C. A name may be assigned to each Pt100 input. Each input is displayed with its name, and can be monitored in two stages. The first stage triggers alarm class 1, the second stage triggers alarm class 3.

Example Temperature 4:

Temperature 4
Pt100 ON

Activation/de-activation of Pt100 input **ON/OFF**

ON .....The temperature value of this input is displayed, temperature monitoring is activated. The subsequent screens of this option are displayed.
OFF.....No display or monitoring are carried out, and the subsequent screens of this option are not displayed.

name*
000°C

Assignment of a name to the analog input **Characters [any]**

An arbitrary name with a maximum of 11 characters is assigned to temperature 4. In the event of an alarm, the name and the trigger temperature are faded in, whereby an exclamation mark is blended in before the temperature.

Limit
warning 000°C

Warning limit value **0..200 °C**

The limit value at which a warning occurs is configured here.

Tripping of alarm class 1

Limit
shutdown 000°C

Shutdown limit value **0..200 °C**

The limit value at which shutdown occurs is configured here.

Tripping of alarm class 3

Delay
limit 1/2 000s

Delay time for warning and shutdown **0..650 s**

In order for tripping to occur, the limit value must be exceeded or fallen below without interruption for at least the period of time specified in this screen. If the actual value falls below or exceeds the threshold value within this period of time, the delay time is restarted (this delay time applies to both limit values).

Monitoring for
high limit mon.

Monitoring for ... **high limit mon./low limit mon.**

Temperature input 4 is monitored in different manners:
high limit mon. .....The set value must be exceeded;
low limit mon. .....The set value must fall below.

NOTE

If temperature limit value monitoring is not required, a limit value which is higher than the expected temperature must be set in the corresponding screen (e. g. for the ambient temperature: 100 °C).

b.) Scaleable analog input 0/4..20 mA

NOTE

The scalable analog inputs 0/4-20 mA can be configured alternatively for the following functions:
- Mains interchange (import/export) real power actual value, or
- real power setpoint value.

If one of the both functions is assigned to an available 0/4-20 mA input T{x}, the corresponding analog input T{x} has to be configured to OFF. The analog input can no longer be used as an alarm input.

Priority of the functions of the analog inputs
The following priority is valid if more than one function has been assigned to a analog input:
- Highest priority: Mains interchange (import/export) real power actual value measurement
- Middle priority: Real power setpoint value
- Lowest priority: Measuring input as common analog value

Example Scaleable analog input 7:

Analog input 7
scalable ON

Scaleable analog input **ON/OFF**

ON.....The display of this input appears, monitoring is activated. The subsequent screens of this option are displayed.
OFF.....No display or monitoring are carried out, and the subsequent screens of this option are not displayed.

Name and unit
°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°

Assignment of a name to the analog input **any**

The input may be assigned with an arbitrary name in this screen. A maximum of four zeros may be used to reserve places for the numerical measuring values. In this case, the placeholders may be divided by any characters, e. g. comma. The measuring values subsequently appear wherever the zeros are placed.

Analog input 7
0-00mA

Measuring range of the analog input **0-20 mA/4-20mA**

The measuring range 0..20 mA or 4..20 mA is selected in this screen. If, in the case of the 4..20 mA setting, a current of less than 2 mA is measured, this is evaluated as a wire break (see below).

Value at
O% **-0000**

Smallest input value of the analog input **-9,999..0..9,999**

The scaleable analog input is assigned a numerical value which corresponds to the smallest input value → Definition of the lower value (0 %, e. g. 0 kW, 0 V) with minimum analog input value (0 mA or 4 mA).

Value at
100% **-0000**

Largest input value of the analog input **-9,999..0..9,999**

The scaleable analog input is assigned a numerical value which corresponds to the largest input value → Definition of the upper value (100 %, e. g. 500 kW, 400 V) with maximum analog input value (20 mA).

Limit warning value -0000

Warning limit value **-9,999..0..9,999**

The limit value at which a warning occurs is configured here.

Tripping of alarm class 1

Limit shutdown value -0000

Shutdown limit value **-9,999..0..9,999**

The limit value at which shutdown occurs is configured here.

Tripping of alarm class 3

Delay limit 1/2 000s

Delay time for warning and shutdown limit values **0..650 s**

In order for tripping to occur, the limit value must be exceeded or fallen below without interruption for at least the period of time specified in this screen. If the actual value falls below or exceeds the threshold value within this period of time, the delay time is restarted (this delay time applies to both limit values).

Monitoring for high limit mon.

Monitoring for ... **high limit mon./low limit mon.**

Temperature input 7 is monitored in different manners:
high limit mon. .....The set value must be exceeded;
low limit mon. .....The set value must fall below.

NOTE

If a temperature limit monitoring is not required, a threshold value which is higher than the expected temperature has to be configured to the corresponding parameter (e. g. for the ambient temperature: 100 °C).

4.16.2 Measuring range monitoring

Ana.input !----

Measuring range monitoring

This message appears when positive or negative deviation from the measuring range occurs. Tripping occurs depending on the values specified below.

NOTE

If positive measuring range deviation (wire break) has been determined and tripping has occurred, limit value monitoring for this analog input is deactivated.

Measuring range monitoring, tripping at:

4..20 mA	2 mA	(negative deviation)
Pt100	216 °C	(positive deviation)

4.16.3 Analog input delay using the delayed engine speed

Ana.in	**12345678**
Sv.del.	**NNNNNNNN**

[PCMx/H]

Ana.in	**1234**
Sv.del.	**NNNN**

[PCLx/PCMx/L]

Analog inputs, engine delayed monitoring **Y/N**

The analog inputs may be disabled until the engine has reached rated speed ("firing speed reached"). This parameter specifies which analog inputs are to be constantly enabled and temporarily disabled by configuring a "Y" or an "N" below the input number.

Y.....Once the firing speed has been reached monitoring of the analog input is enabled (the green LED "Protection" illuminates).

N.....The analog input is monitored always.

NOTE

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

4.16.4 Analog inputs selectable as control inputs

Ana.in	**12345678**
control	**NNNNNNNN**

[PCMx/H]

Ana.in	**1234**
control	**NNNN**

[PCLx/PCMx/L]

Analog input as control input **Y/N**

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

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

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

NOTE

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

4.17 Configure outputs

Configure outputs	YES

Configuration of the outputs **YES/NO**

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

YES ..... The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modifications can be made to the parameters ("Cursor→","Digit↑" or "Select" push-button). A decision is not made on whether the parameters are processed or not.

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

4.17.1 Analog outputs

The analog output manager can be used to apply a very specific measurement variable to the available analog outputs. Output may be carried out as a 0-20 mA or as a 4-20 mA value. A list of the possible parameters is contained in the appendix. A separate number is assigned to each variable. The variable may be scaled via an upper and a lower input value. The inputs may also be assigned with prefixes (for further details, see "Analog output manager" in the appendix).

NOTE

The list of values and setting limits for the analog output manager is contained in chapter 6.1 "Analog output manager" starting on page 160.

Example Analog output 120/121:

Analg.out.12O121 parameter	00

Parameter for analog output **0..22**

The number of the desired measurement variable output is entered here. A list of all selectable parameters, together with output and limit value ranges, is contained in the appendix.

Analg.out.12O121	0-00mA

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

The outputs 0-20 mA or 4-20 mA may be selected.

Analg.out.12O121 O%	0000

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

The setting range for inputting the 0 % value is contained in the appendix. If the generator actual real power is to be displayed with an decimal point the input has to occur as follows: for example "10.0 kW" ➔ "100".

Analg.out.12O121 1OO%	0000

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

The setting range for inputting the 100 % value is contained in the appendix. If the generator actual real power is to be displayed with an decimal point the input has to occur as follows: for example "10.0 kW" ➔ "100".

4.17.2 Relay manager

The relay manager enables the assignment of an arbitrary combination of functions to each relay of the relay manager (PCL1: terminals 33-38 and 47..48; PCM1: 33..38, 47..48, 74..83). In order to achieve this, each function which is possible in the item has its own number. A text, which describes a logical condition for this relay's picking up, must now be entered in the configuration menu for each relay. Up to three numbers may be involved in this link. The length of the text must not exceed 16 characters. The item detects incorrect function numbers or incorrect formula constructions, and does not accept these.

NOTE

The list of functions and numbers for the relay manager is contained in chapter 6.2 "Relay manager (list of parameters with explanations)" starting on page 162.

Permissible letters for such texts and their meaning include:

+ ..... OR operator (logical function)
★ ..... and-Operator (logical function)
-..... EMERGENCY operator (logical function)
1, 2, 3, ... Function numbers
+/★..... the following applies "★" before "+"

Example of logical conditions and relevant texts

Relay picks up if function 22 is applied.	⇒ 22
Relay picks up if function 22 is not applied.	⇒ - 22
Relay picks up if both function 2 and function 27 are applied.	⇒ 2 ★ 27
Relay picks up if function 2 or function 27 is applied.	⇒ 2 + 27
Relay picks up if function 5 or function 3 or function 13 is not applied.	⇒ 3 + -5 + 13
Relay picks up if function 4 or 7 or 11 is applied.	⇒ 4 + 7 + 11
Relay picks up if function 4 and function 7 and function 11 are not applied.	⇒ - 4 ★ -7 ★ -11
Relay picks up if function 4 and 7 and 11 are applied.	⇒ 4 ★ 7 ★ 11
Relay picks up if function 7 and 11 are simultaneously applied or function 4 is applied.	⇒ 4 + 7 ★ 11
Relay picks up if function 4 or function 7 or function 11 is not applied.	⇒ -4 + -7 + -11

NOTE

The input line is deleted via the input of an illogical parameter.

4.17.3 Relay outputs programming in the PCx

Example Relay 2

Assignm.relay 2
3+-8+13

Programming relay outputs **see parameter list**

Relay 2 picks up if the logical condition in the second line is met.
Example: 3 + -8 + 13 (OR link)

3 ..... Alarm class 3 has occurred
-8..... "MANUAL" operating mode has not been selected
13 ... "Generator underspeed" alarm is present

4.17.4 Relay outputs programming in the EM1-D

The relay outputs of the EM1-D can be programmed only by using the PC program FL-SOFT3. The parameter of the EM1-D are listed at the end in the configuration file of the PCx. Please note, that you have to make additional adjustments directly at the EM1-D. Please use the separate configuration file for the EM1-D.

Assignm. x. Relais on EM1-Dy
[x = 1..8] / [y = 1/2]

Programming the relay outputs on the EM1-D.y **see parameter list**

The relay x on EM1-D.y picks up if the programmed logic condition is fulfilled.

Example Relay 2 on the EM1-D.2

Assignm. 2. Relay on EM1-D.2

Programming the relay outputs on the EM1-D.2 **see parameter list**

The relay 2 on the EM1-D.2 picks up, if the programmed logic condition is fulfilled.
Example: 3 + -8 + 13 (OR link)

3..... alarm class 3 has occurred
-8 ..... "MANUAL" operating mode has not been selected
13 .... "Generator underspeed" alarm is present

4.18 Engine configuration

Configure engine	YES

Configuration of the engine **YES/NO**

Various groups of parameters are placed together in blocks to allow you to navigate through the large number of configuration screens more rapidly. Selecting "YES" or "NO" has no effect on whether control or monitoring etc., is performed. The input merely has the following effects:

YES ..... The configuration screens in the next block are displayed and can either be viewed ("STATUS / ALARM" push-button) or modifications can be made to the parameters ("PARAMETER", "U SELECT" or "STATUS / ALARM" push-button). EA decision is not made on whether the parameters are processed or not.

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

4.18.1 Auxiliaries

Aux.services prerun	000s

Auxiliary advance (start preparation) **0..999 s**

Prior to each starting process, a relay output (relay manager parameter 52) can be output for an adjustable time (e. g. opening of a shutter). By setting the relay output, the message "Aux. advance." is displayed. This relay output is immediately set in "MANUAL" operating mode. The signal remains present until the operating mode is changed. Caution: In the event of emergency power operation, this delay is not taken into consideration. The engine is started immediately.

Aux.services postrun	000s

Auxiliary coasting **0..999 s**

The relay output (relay manager parameter 52) can be output for an adjustable time after each engine coasting (e. g. in order to operate a cooling water pump). If the operating mode is switched from "MANUAL" to "STOP" or to "AUTOMATIC" without a start request, the relay remains set for this coasting time. The message "Aux. coasting." is shown in the display.

4.18.2 Engine type definition

Start-stop-logic for DIESELENGINE

Start/stop logic for ... DIESEL/GAS/EXTERNAL

DIESEL	Start-stop-procedure for a diesel engine.
GAS	Start-stop-procedure for a gas engine.
EXTERNAL	External start-stop-procedure (start-stop-procedure disabled).

The start procedure is described in "Description starting/stopping process" starting on page 37.

a.) Start/stop logic for gas engines

NOTE

The starting process for the gas engine is described in chapter "Gas engine" starting on page 39. The configured attempts at starting are made.

Min.speed for ignit. 000 rpm

This mask is only visible if the parameter "Pickup" is set ON.

Minimum speed at start 0..999 rpm

The minimum starter speed can only be detected using an enabled pick-up. After expiration of the firing delay, at least the speed entered here must be reached in order to set the relay "ignition" (parameter 84) (see also the following parameters).

Ignition delay 00s

Ignition delay 0..99 s

In the case of gas engines, a so-called purging operation is frequently desired prior to starting. Firing delay is started when the starter is engaged. If, following the expiration of this period of time, the "Starter minimum speed" has been reached, ignition is set.

Gasvalve delay 00s

Gas valve activation delay 0..99 s

The gas delay time is started when the firing relay is set. Following the expiry of the period of time set here, the gas valve is set as long as the speed still exceeds 150 rpm. On reaching the firing speed, this relay holds itself until the engine comes to a stop.

Max. attempts to start 0

Gas engine; maximum number of start attempts 1..6

The control initiates this maximum of start sequences. If the engine could not started within this maximum of start attempts, an alarm message is issued.

Starter time 00s

Engagement time: the gas valve is opened 2..99 s

Maximum time, during which the starter starts the engine.

Start pause time 00s

Time between two start attempts 1..99 s

Time between the individual attempts at starting.

f lower before start ON

[only with three-position controllers]

Approach idle gas position ON/OFF

If this function is activated via "ON" and the item is equipped with a three-position frequency controller, "Speed down" is output for the period of time specified below before the starter is engaged. The idle gas position must either be protected via a limit switch, or the engine potentiometer must be equipped with a slipping clutch. The message "Initial state" is shown in the display. Caution: In the event of emergency power operation, engine starting is delayed via the idle gas position.

time f lower bef.start 000s

[only with three-position controllers]

Approach idle gas position (time) **0..999 s**

The duration of the "Speed down" output is entered here.

b.) Start/stop logic for diesel engines

NOTE

The starting process for the diesel engine is described in chapter "Diesel engine" starting on page 37. The configured number of start attempts will be performed.

Preglow time 00s

Preheating time **0..99 s**

Prior to each starting procedure, the diesel engine is preheated for this period of time.

Max. attempts to Start 0

Maximum number of start attempts **1..6**

The control initiates this maximum of start sequences. If the engine could not started within this maximum of start attempts, an alarm message is issued.

Starter time 00s

Engagement time of the starter **2..99 s**

Maximum time, during which the starter tries to start the engine.

Start pause time 00s

Time between two start attempts **1..99 s**

Time between the individual attempts at starting.

f lower before start OFF

[only with three-position controllers]

Approach idle gas position **ON/OFF**

If this function is activated via "ON" and the item is equipped with a three-position frequency controller, a continuous "Speed down" signal is output before the starter is engaged. The idle gas position must either be protected via a limit switch, or the engine potentiometer must be equipped with a slipping clutch. The message "Initial state" is shown in the display. Caution: In the event of emergency power operation, engine starting is delayed via this idle gas position.

time f lower bef.start 000s

[only with three-position controllers]

Approach idle gas position (time) **0..999 s**

The duration of the "Speed down" output is input here.

Fuel relay ----------

Start/stop logic **operating magnet/stop magnet**

Operating magnet..... The operating magnet is set prior to each start procedure. In order to switch the engine off, the operating magnet is withdrawn.

Stop magnet..... In order to switch the engine off, the stop magnet is set. The stop magnet remains set for an additional 30 seconds after negative deviation from the firing speed has occurred and the generator voltage is less than 20 V.

4.18.3 Coasting, delayed engine monitoring and firing speed

a.) Coasting

Cool down time 000s

Coasting time **0..999 s**

In the event of normal engine shutdown (change to "STOP" mode) or stoppage via an alarm class 2, coasting with frequency control is carried out with an open GCB for this time. This time can be set. If coasting has been terminated (coasting time is exceeded) and if a firing speed is nevertheless detected, the message "Shutoff malfunction is output after 30 s. Note: Coasting will be carried out only if there is the reply, GCB was closed (terminal 4) for at least 5 seconds.

b.) Delayed engine monitoring

Delayed engine monitoring 00s

Delayed engine monitoring **1..99 s**

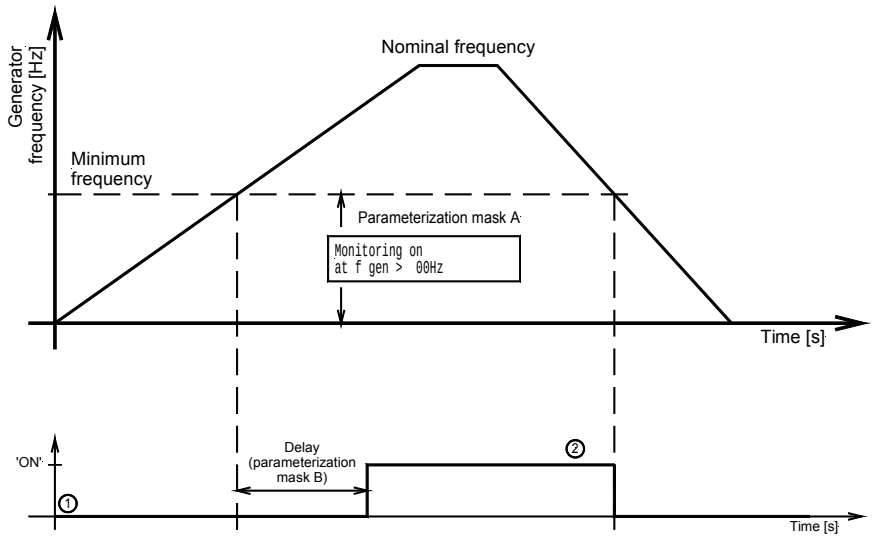
The delay between reaching the firing speed and monitoring associated alarms (e. g. oil pressure, generator underfrequency, etc.).

c.) Ignition speed

Firing speed reached f >00Hz

Firing speed reached **5..70 Hz**

Setting the firing speed: After firing speed has been reached, the starter is switched off and the frequency controller takes over the speed control.
Note: Measurement is only possible up to 15 Hz, even if 5 Hz are displayed. If the Pickup measurement is set to "ON", values up to 5 Hz are measured.



① Monitoring: generator undervoltage, generator underfrequency, (generator underspeed; only option N), (reverse/reduced power; only option R1)

② In addition the "Monitoring" LED is illuminated

Parameterization mask B

Monitoring ON after 00s

4.18.4 Pickup

Pickup input ON

Pickup measurement **ON/OFF**

ON ..... Engine speed monitoring is carried out via the Pickup. The disengagement of the starter after the firing speed has been reached is additionally carried out via Pickup measurement.

OFF ..... Frequency monitoring/control is carried out via the generator frequency measurement. The disengagement of the starter after the firing speed has been reached is carried out via the generator frequency.

Gen.rated speed 0000 rpm

Rated speed at rated frequency **0..3,000 rpm**

The number of revolutions carried out by the generator at rated frequency is specified here.

Number of pickup teeth 000

Number of Pickup teeth **30..280**

The number of pulses per revolution.

Plausibility control

Plausibility control is carried out continuously; this compares the measured electrical frequency (determined from the generator voltage) with the measured "mechanical" speed (determined from the Pickup signal). If the two frequencies are not identical, an alarm is output (alarm class 1). This is only activated following the expiry of the engine delay time.

4.19 Counter configuration

Configure counters YES

Configuration of the counters YES/NO

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

YES ..... The configuration screens in the next block are displayed and can either be viewed ("STATUS / ALARM" push-button) or modifications can be made to the parameters ("PARAMETER", "U SELECT" or "STATUS / ALARM" push-button). A decision is not made on whether the parameters are processed or not.

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

4.19.1 Maintenance call

Service interval	
in	0000h

Maintenance call **0..9,999 h**

A maintenance interval can be specified via this screen. After the engine has been in operation for the number of hours set here, a maintenance message (alarm class 1, "Maintenance") is displayed. Following the acknowledgement of the message, the counter is reset to this value.

Note: The maintenance call can be disabled by setting it to "0".

NOTE

In order to acknowledge the maintenance call prematurely (no maintenance call is present yet), please proceed as follows:
- Navigate to the display "Maintenance in 000h" using "Select".
- Press the button "Digit" für 10 seconds.
- The new maintenance interval is displayed.

4.19.2 Operating hour counter

NOTE

The number of operating hours can be set to a maximum of 65,000 hours.

Set oper.hours	
counter	00000h

Operating hour counter **0..65,000 h**

This screen can be used to specify data regarding hours during which operation has already been carried out. This may be necessary, e. g. if an old engine is used or if this control item is to be replace by a newer one.

NOTE

If a certain number of operating hours is to be pre-specified, the item must be in code level 2. For safety reasons, the counter is set in a 2-step procedure. The following procedure applies:

1. Step: Setting and storage of the desired operating hours.
2. Step: Integration of the value which has been saved by ...
   - terminating the configuration mode and switching to automatic mode,
   - display of the operating hours and by
   - pressing the "Digit" push-button for at least 5 seconds.

4.19.3 Set start counter

NOTE

After 32,000 starts, the counter is automatically reset.

Set start counter	00000

Number of engine starts **0..32,000**

The start counter can only be adjusted by the system maintenance personnel! The start counter is used to display how often the engine has already been started. Following each attempt at starting, the start counter is increased by one.

NOTE

If a certain value of operating hours is to be pre-specified, this control must be in code level 2. For safety reasons, the counter is set in a 2-step sequence.
The following sequence applies:
1. Step: Setting and storage of the desired operating hours.
2. Step: Integration of the value which has been saved by …
   - terminating the configuration mode and switching to automatic mode,
   - display of the operating hours and by
   - pressing the "Digit" push-button for at least 5 seconds.

4.19.4 kWh counter

NOTE

The real energy can be set to a maximum of 65,500 MWh. After this, the kWh counter is automatically reset to "0".

kWh counter set in	kWh

kWh counter **kWh/MWh**

This screen is used to select whether the kWh counter is to be pre-loaded with kWh or MWh. This may be the case, e.. g. if an old control item is to be replaced.

kWh counter set	00000MWh

kWh counter **0..65,500 kWh/MWh**

The value with which the kWh counter is to be pre-loaded is specified here. In this case, the input is dependent on the setting in the top screen. Positioning may be necessary, e. g., if an old genset is used or if this control item is to replace a newer one.

NOTE

If a particular kWh counter value is to be predetermined, the device has to be in code level 2. The counter is set in a two-step procedure due to safety reasons.

1. Step: Setting and storing of the desired counter value
2. Step: Taking over the stored value by ……
   - ending the configuration mode and changing to automatic mode,,
   - displaying the kWh counter and
   - pressing the button "U SELECT" for at least 5 seconds.

4.19.5 Real time clock [PCM1x/H]

NOTE

If there are several PCM working in parallel on one common CAN bus all clocks are synchronized every day at 12:00 o'clock (noon) to the time of the control with the lowest control/generator number. Therefore it is necessary that the controls have different control numbers.

Time
00:00

Clock display

The hours and minutes in the internal clock are set.

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

Year,month
00.00

Date display

Setting the year and month of the internal clock.

Setting	
Year	
98	Year 1998
99	Year 1999
00	Year 2000
...	...
Month	
01	January
02	February
..	
12	December

Day/weekday
00/0

Date display

The day and weekday in the internal clock are set here.

Setting	
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

4.19.6 Current slave pointer

A current slave pointer, which records and stores the maximum generator current, is implemented in the item. The display of the maximum generator current can be selected in Automatic mode via the "Message" push-button. The following screen appears in the display:

000 000 000 000
max. Gen.current

Display of the maximum generator current

The maximum generator current in the three conductors is displayed and stored in this screen.

Reset The current slave pointer is reset by pressing the "QUIT" push-button for 2.5 s. In order to achieve this, the screen described in the above must be visible in the display.

4.20 Engine bus [PCMx]

Configure engine bus	JA

Configuration of the engine bus **YES/NO**

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

YES ..... The configuration screens in the next block are displayed and can either be viewed ("Select" push-button) or modifications can be made to the parameters ("Cursor→", "U SELECT" or "SELECT" push-buttons). A decision is not made on whether the parameters are processed or not.

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

CAN-Baudrate	000kBd

Baudrate of the engine bus **100/125/250/500 kBaud**

Baudrate of the engine CAN bus. Please note, that all participants on the engine CAN bus must use the same Baud rate.

4.20.1 EM1-D – Digital Expansion Board

NOTE

For the function as well as for the configuration of the EM1-D please see in the separate manual. This parameter can only be configured using FL-SOFT3.

EM1-D on bus	JA

[x = 1/2]

EM1-D on bus **YES/NO**

YES ..... The functions of the EM1-D are active. And there is a monitoring whether the EM1-D {x} is on engine bus. If this parameter is set to YES but the EM1-D is not connected to the CAN bus the PCx releases an interface fault.

NO ..... The functions of the EM1-D are blocked and there is no communication monitoring to the EM1-D.

Notes to EM1-D-Interface fault – The "Interface fault Y1Y5" of the alarm class 1 will be released when the PCx receives no messages from the EM1-D for about 5 s. Furthermore the relais drops-out (or picks up according to the configuration). The relay picks up again, when the PCx receives data from the EM1-D.

4.20.2 Lambda controller 'PCR3'

NOTE

This parameter can only be configured using FL-SOFT3.

PCR3 on bus	NO

PCR3 on bus **YES/NO**

YES ..... The functions of the PCR3 are active. And there is a monitoring whether the PCR3 is on engine bus. If this parameter is set to YES but the PCR3is not connected to the CAN bus the PCx releases an interface fault.

NO ..... The functions of the PCR3 are blocked and there is no communication monitoring to the PCR3.

Notes to the PCR3 interface faults – The "Interface fault Y1Y5" of the alarm class 1 will be released when the PCx receives no messages from hte PCR3 for about 5 s. The measuring values of PCR3 are overwritten with "0". Furthermore the relais drops-out (or picks up according to the configuration). When the PCx receives again data from the PCR3, the relay picks up and the measuring values from the PCR3 were displayed again. (If an interface fault Y1Y5 will be released for example by a faulty EM1-D communication, the data of the PCR3 will be furthermore displayed correct.)

4.20.3 Engine control 'General'

NOTE

Simultaneous CAN bus interconnection of MDEC and J1939 components is not possible.

Description	Display/Messages		J1939			MDEC
	German	English	Std.	EMR2	S6	
Display: Engine speed	Mot.Drehz.0000,0	Eng.speed 0000.0	✓	✓	✓	✓
Display: Oil pressure /#4	Öldruck 00,00b	Oil pres. 00.00b	✓	✓	✓	✓
Display: Fail codes	Fehlercodes 0000	Fail.codes 0000				✓
Display: ECU Operating hours	ECUBetrstd00000h	ECU OpHrs 00000h				✓
Display: Coolant temperature /#4	Kühlmit. 000,0C	Coolant 000.0C	✓ /#1	✓	✓	✓
Display: Oil temperature /#4	Öl 000,0C	Oil 000.0C	✓		✓	✓
Display: Fuel temperature /#4	Kraftst. 000,0C	Fuel ü000.0C	✓ /#1	✓	✓	✓
Display: Feedback speed	Feedb.Drz.0000,0	Feedb.spd.0000.0				✓
Display: Coolant level	Kühlm.Stand 000%	Cool. level 000%	✓	✓	✓	
Alarm: ECU defect	AL ECU defekt	AL ECU defect				✓
Alarm: Coolant temperature	Kühlmitteltemp.	Coolant temp.			✓	✓
Alarm: ST Coolant temperature	ST Kühlmitt.temp	ST Coolant temp.		✓		✓
Alarm: Oil temperature too high	Öltemp. zu hoch	HI Oil temp.				✓
Alarm: SD Coolant level	SD Kühlm.stand	SD Coolant level	✓	✓	✓	✓
Alarm: SD Coolant charging air	SDKühlm.Ladeluft	SD Cool.chrg.air				✓
Alarm: ST Oil level	ST Ölstand	ST oil level		✓	✓ /#2	
Alarm: ST Engine protection	ST Motorschutz	ST Eng. protect.		✓		
Alarm: ST Overspeed	ST Überdrehzahl	ST overspeed				✓
Alarm: ECU Red Alarm	ECU Rot-Alarm	ECU red alarm				✓
Alarm: Oil pressure to low	Öldruck niedrig	Low oil pressure			✓	✓
Alarm: ST Oil pressure	ST Öldruck	ST oil pressure		✓		✓
Alarm: ECU Yellow Alarm	ECU Gelb-Alarm	ECU yell. alarm				✓
Alarm: Coolant level	Kühlmittelstand	Coolant level		✓ /#3		✓ /#3
Alarm: Coolant temperature	Kühlmittelvorh.	Preheat Temp low				✓
Alarm: ST Coolant charging air	STKühlm.Ladeluft	ST Cool.chrg.air		✓		✓
Alarm: SD Speed demand	SD Solldrehzahl	SD Speed demand				✓
Alarm: SD Engine speed	SD Agg.Drehzahl	SD Engine speed	✓	✓	✓	✓
Alarm: SD Oil pressure	SD Öldruck	SD Oil pressure	✓	✓	✓	✓
Alarm: SD Failure codes	SD Fehler Codes	SD failure codes				✓
Alarm: SD Operating hours	SD Betr.Std.	SD oper. hours				✓
Alarm: SD Coolant temperature	SD Kühlmitteltmp	SD Coolant temp.	✓	✓	✓	✓
Alarm: SD Oil temperature	SD Öltemperatur	SD Oil temp.			✓	✓
Alarm: SD Fuel temperature	SD Kraftst.Tmp.	SD Fuel temp.	✓	✓	✓	✓

SD..Sensor defect, ST..Stop/Shut down, AL..Alarm; #1 the unit amount is 1 °C; #2 may be as well as "Oil pressure to high" as also "Oil pressure to low";
#3 On EMR2 this display means Shutdown because of too low coolant level, on MDEC it means Warning because of too low coolant level,
#4 changeable bar ↔ psi, bzw. °C ↔ °F.

Notes to J1939 protocol – In the above table (J1939 'Standard') the messages are listed which can be displayed of the PCx. If a value cannot be send from the used ECU, a FFxx'h is sent according to the SAE J1939 standard. The PCx identifies this and the according value will not be displayed. According to the SAE J1939 standard a priority is defined in the CAN-ID of a SAE J1939 message. This will not be regarded from the PCx. The PCx receives messages of all priorities.

Notes to "Interface fault engine bus" – Basically the "Interface fault Y1Y5" is released in alarm class 1 and is shown in the display if the PCx does not receive CAN data of an active subunit for a certain time. As perhaps several devices are connected to the bus the relay manager can be configured additionally for every subunit which signals the missing/existing connection to the subunit.

NOTE

Please refer to the manufacturer's manual for information about the functionality of the MDEC.

ECU interface monitoring **YES/NO**

YES ..... If the connection MDEC – PCM or J1939-PCM is interrupted for a certain time, the message "interf,err. Y1Y5" is displayed with alarm class 1.

NO ..... If the connection MDEC-PCM or J1939-PCM is interrupted, this message is not displayed. (This setting makes sense, if an engine shutdown is only possible by disconnecting the power supply of the engine control. Otherwise, an interface error would be triggered with shutdown).

NOTE

This setting has no effect on the interface error triggering for EM1-D and PCR3. It has also no influence on the relays with the parameters 134 to 138.

a.) Engine control 'MDEC'

NOTE

Please refer to the manufacturer's manual for information about the functionality of the MDEC.

MDEC

Note
MDEC and J1939 cannot be operated simultaneous!

MDEC **OFF/Visual/Control/Visualization/Control**

OFF.....The coupling to the mtu MDEC is disabled and no MDEC data is processed. The MDEC cannot trigger an interface error Y1Y5.

Visual/Control - The coupling to the mtu MDEC is enabled, MDEC values and the following parameters are displayed, and values are sent to the MDEC. The MDEC can trigger an interface error Y1Y5.

Visualization - The coupling to the mtu MDEC is enabled and MDEC values and the following parameters are displayed. The MDEC can trigger an interface error Y1Y5.

Control.....The coupling to the mtu MDEC is enabled, the following parameters are displayed, and values are sent to the MDEC. The MDEC can trigger an interface error Y1Y5.

(The display values are overwritten with question marks in case of an interface error, triggered by the CCM.)

Note
The MDEC cannot be used together with J1939.

MDEC protocol

MDEC protocol **V302/V303/V304**

Firmware software version of the MDEC.

max.speed loop
000 rpm

MDEC speed loop **0..999 rpm**

The setting of this mask will be attended, if the setpoint value to the MDEC controller occurs via the CAN bus. For a power control the rated real power will be regulated by the nominal speed value. The entered speed loop depends on the droop characteristics of the engine. As an adjustment help, you can determine the speed loop as follows:

Without setpoint value at the MDEC speed governor the engine will be loaded half or full. The occurred speed break-in can be entered on full load directly as speed loop. If you measure under half load you have to enter the double value. For more information please not the manual of the MDEC:

A speed control is only possible if the frequency controller is set to ANALOG. If the control is not active yet, the set rated speed is calculated as follows:

$$n_{Ausgabe} = n_{Nenn} + \frac{((GS - 50\%) \times n_{maxHub}) \times 2}{100\%}$$

nAusgabe	output value [min-1]
nNenn	rated speed [min-1]
GS	initial setting [%]
nmaxHub	maximum speed loop [min-1] (this parameter)

Note to the MDEC interface error – The "interface error Y1Y5" with alarm class 1 is triggered, if the PCx does not receive an "Alive" message for about 0,5 s from the MDEC. The measurement values of the MDEC are overwritten with question marks and the MDEC alarm messages are suppressed. Moreover, the relay with the parameter 137 de-energizes (or energizes depending on programming). If the PCx receives the "Alive" message again, the relay energizes again and the measurement values as well as the alarm messages of the MDEC are displayed again. (If an interface error Y1Y5 is triggered, which was caused by e.g. a faulty EM1-D communication, the data of the MDEC is still displayed correctly.)

b.) Engine control 'SAE J1939'

NOTE

The J1939 data coupling, parameter setting 'Standard', is performed according to the standard SAE J1939.

NOTE

Please take the description of the functonality of the units, which can be connected to the SAE J1939 engine CAN bus, from the manufacturer's manual.

J1939

Notes
J1939 and MDEC cannot be operated simultaneous!

J1939 **Off/Standard/EMR2/S6**

Off .....The coupling to J1939 is disabled and no J1939 data is processed. The J1939 cannot trigger an interface error Y1Y5.

Standard ...The coupling to J1939 is enabled, the J1939 values are displayed according to the SAE J1939 standard and the following parameters are displayed. The J1939 can trigger an interface error Y1Y5. (The display values are overwritten with question marks in case of an interface error, triggered by the J1939.)

EMR2 .....The coupling to Deutz EMR2 is enabled and EMR2 values and the following parameters are displayed. The EMR2 can trigger an interface error Y1Y5.

S6 .....The coupling to Scania EMS/S6 is enabled and EMS/S6 values and the following parameters are displayed. The EMS/S6 can trigger an interface error Y1Y5.

Note
The J1939 coupling cannot be used together with the MDEC.

J1939 unit numb.
000

J1939 device number **0..255**

The PCx processes only data of a J1939 device, which sends using this CAN device number.

Note to the J1939 interface error – The "interface error Y1Y5" with alarm class 1 is triggered, if the PCx does not receive an "Alive" message for about 0,5 s via the J1939 CAN bus. The measurement values of the J1939 participant are overwritten with question marks and the J1939 alarm messages are suppressed. Moreover, the relay with the parameter 138 de-energizes (or energizes depending on programming). If the PCx receives the "Alive" message again, the relay energizes again and the measurement values as well as the alarm messages of the J1939 participant are displayed again. (If an interface error Y1Y5 is triggered, which was caused by e.g. a faulty EM1-D communication, the data of the J1939 participant is still displayed correctly.)

5 Commissioning

DANGER !!!WI

When commissioning the item, please observe the five safety rules that apply to the handling of live equipment. Make sure that you know how to provide first aid in current-related accidents and that you know where the first aid kit and the nearest telephone are. Never touch any live components of the system or on the back of the system:

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

WARNING !

The item may only be commissioned by a qualified technician. The "EMERGENCY OFF function must function safely before the commissioning and must not depend on the particular engine.

CAUTION !

1. Prior to commissioning, check that all measuring voltages are correctly connected with regard to phases. The connect commands for the power circuit breakers must be disconnected at the power circuit breakers. The rotating field must be measured. Any lack or incorrect connection of measuring voltages or other signals may lead to incorrect functions and damage the item as well as engines and components connected to the item.

Procedure

2. After checking to ensure that all measuring voltages have been connected to the correct phases, the supply voltage (12/24 Vdc) has to be connected.

3. By simultaneously pressing the two push-buttons " U SELECT" and "PARAMETER", the configuration and test mode is accessed. After entering the code number, all parameters are first set (see the chapter regarding the parameters).

4. Following the application of the supply voltage, please check that all measuring values (voltages, currents, wattages, power circuit breakers replies) are correctly displayed. The engine must only be started if the power circuit breaker replies are correct.

5. First start the engine via the **"MANUAL"** operating mode (press the "MANUAL" push-button) ("START") and then stop it ("STOP"). All generator measuring values must be checked. Please also check any messages caused by alarms.

6. Check the automatic start procedure via the **"TEST"** operating mode (press the "TEST" push-button). Test protection caused by alarms with shutdown.

7. Operating mode **"AUTO"** (press the push-button "AUTOMATIC"): Automatic starting with subsequent synchronization can now be carried out by applying the automatic control inputs and the engine request.
   Check synchronization: Check the generator and the generator busbar rotating field. Check the connect command with a zero voltmeter (determination of the phase angle) at the generator power circuit breaker. If several correct synchronizing pulses have been output, switch the operating mode to "STOP" and reconnect the connect pulse "Command: close GCB" with the engine at a standstill.

8. If Points 1 to 7 have been carried out successfully, you may now initially commence operation in parallel with the mains with a constant power (approx. 25 % of the generator rated power). Whilst this is being carried out, the displayed measuring values must be checked. Check GCB shutdown. Check the real power controller and, if necessary, the power factor **φ** controller. Pre-specify various setpoint values and check control.

9. If operation in parallel with the mains is carried out in a satisfactory manner, the synchronization of the mains power circuit breaker must be checked:

   At this point, at the latest, it must be ensured that a power failure in the system has been clarified or registered. During operation in parallel with the mains, the item must be switched to "MANUAL" operating mode; the mains power circuit breaker is then de-activated ("MCB ON" LED is extinguished). The item must then be switched back to "AUTOMATIC" operating mode.

   Check the generator busbar and the mains rotating field. Check the connect command with a zero voltmeter (determination of the phase angle) at the mains power circuit breaker. If several correct synchronizing pulses have been output, switch the operating mode to "STOP" and re-connect the connect pulse "Command: close MCB" with the engine at a standstill.

10. Test emergency power operation functions.

NOTE

The function in automatic mode is influenced via the available input signals "Automatic 1" and "Automatic 2". Make sure that the reply messages of the power circuit breakers are processed inverted, i. e., when the power circuit breaker is closed there must be a "reply message applied on the inputs: CB is open" 0 V (auxiliary contact of the power circuit breaker as a break contact (NC)! - note the description of the auxiliary and control inputs at the beginning of this manual). It is vital that these replies be connected!

Electrical isolation between voltage supply and discrete control and feedback inputs

Via 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, for example, if the discrete inputs are not to be triggered with 24 Vdc and an electrically isolation of the control voltage (e. g. 220 Vdc, 220 Vac) from the supply voltage must be insured.

6 Appendix

6.1 Analog output manager

NOTE

The parameters listed below can only be output correctly if the existing version of the item permits this.

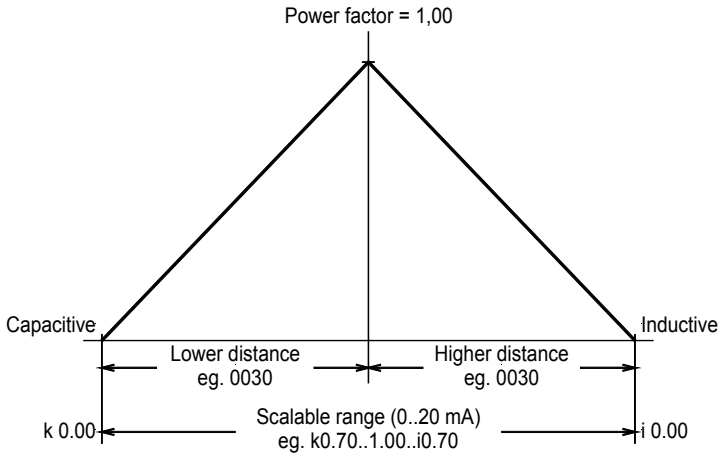
Parameter	Output	Input of the two limit values
0	The analog output is inactive.	Input irrelevant
1	Generator real power [kW]	0% Lower power (can also be negative) e.g. –0050 kW 100% Upper power (can also be negative) e.g. 0200 kW
2	Actual generator power factor φ [e. g. (-070.....+080) /100] (Definition at end of Table) [dimensionless]	0% Lower interval to power factor φ=1 e. g. -0030 corresponds to c0.70 100% Upper interval to power factor φ=1 e. g. 0030 corresponds to i0.70
3	Actual generator frequency [Hz*100]	0% Lower frequency e. g. 0000 corresponds to 00.00 Hz. 100% Upper frequency e. g. 7000 corresponds to 70.00 Hz.
4	Actual generator re-active power [kvar]	0% capacitive re-active power (negative) e. g. -0100 kvar 100% inductive re-active power (positive) e. g. +0100 kvar
5	Rated power of all generators connected to generator busbar minus nominal actual power [kW]	0% Lower power (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]	0% Lower power (can also be negative) e. g. –0050 kW 100% Upper power (can also be negative) e. g. 0200 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]	0% Lower current output e. g. 0000 A 100% Upper current output e. g. 500 A
9	Generator apparent current in L3 [A]	0% Lower current output e. g. 0000 A 100% Upper current output e. g. 500 A
10	Speed via Pickup (terminals 91, 92, 93) [min^{-1}]	0% Lower speed e. g. 0,000 rpm 100% Upper speed e. g. 3,000 rpm
11	Analog input [T1] temperature [°C] or [°F] or freely scaleable analog input	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
12	Analog input [T2] temperature [°C] or [°F] freely scaleable analog input	
13	Analog input [T3] temperature [°C] or [°F] freely scaleable analog 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
14	Analog input [T4] temperature [°C] or [°F] freely scaleable analog input	

Parameter	Output	Input of the two limit values
15	Analog input [T5] temperature [°C] or [°F] freely scaleable analog input	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
16	Analog input [T6] temperature [°C] or [°F] freely scaleable analog input	
17	Analog input [T7] temperature [°C] or [°F] freely scaleable analog input	0% Lower measured value e. g. 0000 corresponds to 00.0 bar oil pressure 100% Upper measuring value e. g. 0100 corresponds to 10.0 bar oil pressure
18	Additional freely scaleable analog input (terminals 91, 92)	
19	Actual mains real power [kW]	0% lower power e. g. -0800 kW 100% upper power e. g. 0800 kW
20	Mains apparent current in L1 [A]	0% Lower current output e. g. 0000 A 100% Upper current output e. g. 500 A
21	Mains power factor φ [e. g. (-070.....+080) /100] (Definition at end of Table) [dimensionless]	0% Lower interval to power factor φ=1 e. g. -0030 corresponds to k0.70 100% Upper interval to power factor φ=1 e. g. 0030 corresponds to i0.70
22	Actual mains re-active power [kvar]	0% capacitive re-active power (negative) e. g. -0100 kvar 100% inductive re-active power (positive) e. g. +0100 kvar

The designation 0 % stands for either 4 mA or 0 mA; the designation 100 % stands for 20 mA. The values may also be assigned with prefixes (see parameter 1).

Definition of power factor φ-scaling

According to the scaling of the analog output, the power factor φ can be output within the range from capacitive values ranging from c0.00 via power factor φ = 1 to inductive values up to i0.00.



6.2 Relay manager (list of parameters with explanations)

Parameter	Output	Explanation
1	Alarm class 1	
2	Alarm class 2	
3	Alarm class 3	
4	Firing speed reached / engine runs	
5	Mains failure; undelayed	The function is evaluated depending on the status of the breakers. The conditions described in chapter "Emergency power" apply.
6	Battery undervoltage	
7	Operating mode AUTOMATIC	
8	Operating mode MANUAL	
9	Operating mode TEST	
10	Operating mode STOP	
11	Generator undervoltage	
12	Generator overvoltage	
13	Generator underfrequency	
14	Generator overfrequency	
15	Generator overcurrent level 1	
16	"Synchronization GCB" or "Connect GCB" time monitoring alarm.	
17	Engine false start	
18	Generator load imbalance	
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 [1]	
37	Discrete input [2]	
38	Discrete input [3]	
39	Discrete input [4]	
40	Discrete input [5]	
41	Discrete input [6]	
42	Discrete input [7]	
43	Discrete input [8]	
44	Discrete input [9]	
45	Discrete input [A]	
46	Discrete input [B]	
47	Discrete input [C]	
48	Discrete input [D]	
49	Discrete input [E]	
50	Discrete input [F]	
51	Discrete input [G]	
52	Auxiliaries	e. g. pump advance/coasting
53	Internal	
54	Group alarm class 1, class 2 or class 3 (remanent up until acknowledgement)	
55	Operating mode TEST or AUTOMATIC selected	
56	Generator power watchdog, level 1	
57	MCB is closed	
58	GCB is closed	
59#	Interface alarm Y1Y5	

Parameter	Output	Explanation
60	Operation in parallel with the mains is desired: blockage of GCB ↔ enable of 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 set prior to connection / synchronization and remains present when circuit breaker is closed.
63	Connection / synchronization MCB carried out or circuit breaker is closed	Signal is set prior to connection / synchronization and remains present when circuit breaker is closed.
64	Overspeed via Pickup	
65	Emergency power is active	
66	Shutdown malfunction	
67	Power watchdog for power supplied by the mains	
68	Maintenance call	
69	Pickup/gen. differential frequency	The electrically determined speed and the speed determined via Pickup are different
70	"Synchronization MCB" or. "Connect MCB" time monitoring alarm.	
71	GCB synchronization carried out	
72	MCB synchronization carried out	
73	Lamp test active	
74	Malfunction "Reply: GCB is open" - fault on closing	The GCB cannot be closed after 5 attempts.
75	Malfunction "Reply: MCB is open" - fault on closing	The MCB cannot be closed after 5 attempts.
76	Malfunction "Reply: GCB is open" - fault on opening	2 s following the "Command: open GCB" a reply continues to be detected.
77	Malfunction "Reply: MCB is open" - fault on opening	2 s following the "Command: open MCB" a reply continues to be detected.
78	Power supplied by the mains <> 0	In the event of interchange synchronization, the incoming power zero cannot be adjusted. As a result of this, the MCB is prevented from opening. Reset via acknowledgment.
79	Connect time on black start exceeded	
80	Generator power watchdog, level 2	
81	Left mains rotating field	
82	Engine enable	Set engine enable As long as there is a start request for the engine and during coasting (as long as the operation of the engine is enabled, e. g. operating mode AUTOMATIC and discrete input 3/5, emergency power, start via interface, manual start, etc.). Reset engine enable If the start request is no longer present, in the event of manual stoppage, with alarm class F3, during the engine stop time (prior to a further attempt at starting) and on detection of "zero" speed if, at the same time, no start request is present and coasting is not taking place.
83	"QUIT" push-button pressed	
84	Preheating/firing ON (pre-assigned to relay [7])	pre-assigned default value
85	Group alarm of alarm class 1, 2 or 3 (pre-assigned to relay [8])	pre-assigned default value Horn: after 2 min independent shutoff
86#	Power reduction level 1 reached	Option Tz, temperature-dependent power reduction
87#	Magnitude of the power reduction level 2 reached	
88	Generator voltage and frequency are not available (undelayed)	
89	Busbar voltage and frequency are not available (undelayed)	

Parameter	Output	Explanation
90	Internal	
91	Pickup has nominal speed (+/-6 %)	
92	Mains voltage fault via protection device	
93	Mains frequency fault via protection device	
94	Phase/vector shift fault via protection device	
95	Internal	
96	Delayed engine monitoring time exceeded	
97	Sprinkler mode is active (included Sprinkler coasting)	
98	EM1-D.[1] – Discrete input [1]	
99	EM1-D.[1] – Discrete input [2]	
100	EM1-D.[1] – Discrete input [3]	
101	EM1-D.[1] – Discrete input [4]	
102	EM1-D.[1] – Discrete input [5]	
103	EM1-D.[1] – Discrete input [6]	
104	EM1-D.[1] – Discrete input [7]	
105	EM1-D.[1] – Discrete input [8]	
106	EM1-D.[2] – Discrete input [1]	
107	EM1-D.[2] – Discrete input [2]	
108	EM1-D.[2] – Discrete input [3]	
109	EM1-D [2] – Discrete input [4]	
110	EM1-D.[2] – Discrete input [5]	
111	EM1-D.[2] – Discrete input [6]	
112	EM1-D.[2] – Discrete input [7]	
113	EM1-D.[2] – Discrete input [8]	
114	Three-position controller: n+ / f+ / P+	
115	Three-position controller: n- / f- / P-	(use an external RC protection circuit)
116	Three-position controller: V+ / Q+	
117	Three-position controller: V- / Q-	
118	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	Internal	
127	Internal	
128	Internal	
129	Fault Lambda sensor (via CAN bus)	
130	Lambda control active	
131	Fuel relay is ON / stop relay is ON / gas valve is ON	
132	Internal	
133	Internal	
134	Communication with EM1-D [1] okay	
135	Communication with EM1-D [2] okay	
136	Communication with PCR3 okay	Direct configuration via FL-SOFT3 possible.
137	Communication with MDEC okay	
138	Communication with J1939 okay	
139	Phase rotation generator/busbar or busbar/mains different	
140	Direction of rotation, mains voltage: CW	
141	Direction of rotation, generator voltage: CCW	
142	Direction of rotation, generator voltage: CW	
143	Starter engaged (cranking)	
144	GCB is to be opened	
145	Internal	
146	Parallel operation CB	from V4.3161
147	Time internal	
148	Unintended stop	from V4.3161
149	Interface error X1/X5	from V4.3161

6.3 Interface [PCL1/H & PCM1x]

6.3.2 Transmission telegram

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

The transmitting rate of this communication is 125 kBaud.

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

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

(The item number is a parameter adjustable on the PCx which influences directly the CAN ID on which the item sends the visualization message).

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

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

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

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

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

MUX	Nr.	Contents (words)	Unit	Note
0/1	1	Generator voltage U_{12}	V × $10^{UGNEXPO}$	
0/2	2	Generator frequency f	Hz × 100	
0/3	3	Generator real power P	W × $10^{PGNEXPO}$	
1/1	4	H.B. Generator power exponent L.B. Generator voltage exponent		PGNEXPO UGNEXPO
1/2	5	Current generator real power setpoint	(steps)	For display in kW: (Value/2800) × PGNWD
1/3	6	Step conversion factor → kW		PGNWD
2/1	7	Busbar voltage chain-linked U_{12}	V × $10^{UGNEXPO}$	
2/2	8	Mains voltage chain-linked U_{12}	V × $10^{UNTEXPO}$	
2/3	9	Currently present alarm class		Bit 15 = 1 Internal Bit 14 = 1 Internal Bit 13 = 1 \ Alarm class 2 or 3 Bit 12 = 1 / Bit 11 = 1 \ "Alarm" LED flashes Bit 10 = 1 / Bit 9 = 1 Internal Bit 8 = 1 Internal Bit 7 = 1 \ Alarm class 3 Bit 6 = 1 / Bit 5 = 1 \ Alarm class 2 Bit 4 = 1 / Bit 3 = 1 \ Alarm class 1 Bit 2 = 1 / Bit 1 = 1 \ Alarm class 0 Bit 0 = 1 /
3/1	10	Control register 2		Bit 15 = 1 \ Terminal 3 is set Bit 14 = 1 / Bit 13 = 1 \ Terminal 5 is set Bit 12 = 1 / Bit 11 = 1 Internal Bit 10 = 1 Internal Bit 9 = 1 \ Enable MCB Bit 8 = 1 / Bit 7 = 1 \ Reply: GCB is closed Bit 6 = 1 / Bit 5 = 1 \ Reply: MCB is closed Bit 4 = 1 / Bit 3 = 1 \ Terminal 6 has been set (High signal) Bit 2 = 1 / Bit 1 = 1 \ Shutoff power reached Bit 0 = 0 / Bit 1 = 0 \ Shutoff power not reached Bit 0 = 1 /
3/2	11	Actual mains real power	W × $10^{PNTEXPO}$	
3/3	12	Control register 1		Bit 15 = 1 \ Starting enabled (in isolated operation or Bit 14 = 1 / operation in parallel with the mains) Bit 13 = 1 Internal Bit 12 = 1 Internal Bit 11 = 1 \ Execution of acknowledgment Bit 10 = 1 / of a F2/F3 alarm Bit 9 = 1 \ Execution of acknowledgment Bit 8 = 1 / of a F1 alarm Bit 7 = 1 \ PMS internal Bit 6 = 1 / Bit 5 = 1 \ PMS internal Bit 4 = 1 / Bit 3 = 1 \ PMS internal Bit 2 = 1 / Bit 1 = 1 Internal Bit 0 = 1 Internal

MUX	Nr.	Contents (words)	Unit	Note				
4/1	13	EM1-D.[1] alarms		Bit 15 = 1	EM1-D.[1] - discrete input [8]			
				Bit 14 = 1	EM1-D.[1] - discrete input [7]			
				Bit 13 = 1	EM1-D.[1] - discrete input [6]			
				Bit 12 = 1	EM1-D.[1] - discrete input [5]			
				Bit 11 = 1	EM1-D.[1] - discrete input [4]			
				Bit 10 = 1	EM1-D.[1] - discrete input [3]			
				Bit 9 = 1	EM1-D.[1] - discrete input [2]			
				Bit 8 = 1	EM1-D.[1] - discrete input [1]			
				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			
4/2	14	Internal alarm 6		Bit 15 = 1	Pickup plausibility fault			
				Bit 14 = 1	Engine shut-off malfunction			
				Bit 13 = 1	GCB time overrun when switching to the black busbar			
				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]			
				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 chain-linked U_{23}	$V \times 10^{UGNEXPO}$					
5/1	16	Generator voltage chain-linked U_{31}	$V \times 10^{UGNEXPO}$					
5/2	17	Generator voltage star U_{1N}	$V \times 10^{UGNEXPO}$					
5/3	18	Generator voltage star U_{2N}	$V \times 10^{UGNEXPO}$					
6/1	19	Generator voltage star U_{3N}	$V \times 10^{UGNEXPO}$					
6/2	20	Configuration [T1]-[T4]	Display in	**#1#**	°C	bar/10	%	keine Einh.
			Analog input [T4]					
			Bit 15 =	0	0	1	1	0
			Bit 14 =	0	1	0	1	0
			Bit 13 =	0	0	0	0	1
			Bit 12 =	0	1	1	0	1
			Analog input [T3]					
			Bit 11	0	0	1	1	0
			Bit 10	0	1	0	1	0
			Bit 9	0	0	0	0	1
			Bit 8	0	1	1	0	1
			Analog input [T2]					
			Bit 7	0	0	1	1	0
			Bit 6	0	1	0	1	0
			Bit 5	0	0	0	0	1
			Bit 4	0	1	1	0	1
			Analog input [T1]					
			Bit 3	0	0	1	1	0
		#1#: The analog input is not available or configured as real power set value or as mains real power actual value.	Bit 2	0	1	0	1	0
			Bit 1	0	0	0	0	1
			Bit 0	0	1	1	0	1

MUX	Nr.	Contents (words)	Unit	Note
6/3	21	Engine speed determined via 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 re-active power	$var \times 10^{PNTEXPO}$	positive = inductive
8/2	26	Generator power factor φ		Example: 0064H power factor φ = 1.00 0063H power factor φ = i0.99 (inductive) FF9EH power factor φ = c0.98 (capacitive)
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 subscribers in 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	H.B. Exponent generator current L.B. Reserve		IGNEXPO
10/2	32	Busbar frequency	Hz × 100	
10/3	33	Konfiguration [T5]-[T8]	Display in	#1# / °C / bar/10 / % / keine Einh.
			Analog input [T8]	
			Bit 15 =	0 / 0 / 1 / 1 / 0
			Bit 14 =	0 / 1 / 0 / 1 / 0
			Bit 13 =	0 / 0 / 0 / 0 / 1
			Bit 12 =	0 / 1 / 1 / 0 / 1
			Analog input [T7]	
			Bit 11 =	0 / 0 / 1 / 1 / 0
			Bit 10 =	0 / 1 / 0 / 1 / 0
			Bit 9 =	0 / 0 / 0 / 0 / 1
			Bit 8 =	0 / 1 / 1 / 0 / 1
			Analogeingang [T6]	
			Bit 7 =	0 / 0 / 1 / 1 / 0
			Bit 6 =	0 / 1 / 0 / 1 / 0
			Bit 5 =	0 / 0 / 0 / 0 / 1
			Bit 4 =	0 / 1 / 1 / 0 / 1
			Analogeingang [T5]	
			Bit 3 =	0 / 0 / 1 / 1 / 0
		#1#: The analog input is not available or configured as real power set value or as mains real power actual value.	Bit 2 =	0 / 1 / 0 / 1 / 0
			Bit 1 =	0 / 0 / 0 / 0 / 1
			Bit 0 =	0 / 1 / 1 / 0 / 1

MUX	Nr.	Contents (words)	Unit	Note
11/1	34	Mains voltage chain-linked U_{23}	V × $10^{UNTEXPO}$	
11/2	35	Mains voltage chain-linked U_{31}	V × $10^{UNTEXPO}$	
11/3	36	Mains voltage star U_{1N}	V × $10^{UNTEXPO}$	
12/1	37	Mains voltage star U_{2N}	V × $10^{UNTEXPO}$	
12/2	38	Mains voltage star U_{3N}	V × $10^{UNTEXPO}$	
12/3	39	Mains frequency out off $U_{N12}/U_{N23}/U_{N31}$	Hz × 100	
13/1	40	Mains current in L1	A × $10^{INTEXPO}$	
13/2	41	Mains re-active power	var × $10^{PNTEXPO}$	
13/3	42	Mains power factor φ		Example: **0064H** power factor cos φ = 1.00 **0063H** power factor cos φ = i0.99 (inductive) **FF9EH** power factor cos φ = c0.98 (capacitive)
14/1	43	**H.B.** Mains power exponent **L.B.** Mains voltage exponent		PNTEXPO UNTEXPO
14/2	44	**H.B.** Mains current exponent **L.B.** Busbar voltage exponent		INTEXPO USSEXPO
14/3	45	Engine operating hours (**H.W.**)	h	Double word
15/1	46	Engine operating hours (**L.W.**)		
15/2	47	Hours until next maintenance	h	
15/3	48	Engine start number		
16/1	49	Operating mode(**H.B.**)		Bit 15 = 1 — Operating mode LOAD TEST Bit 14 = 1 — Operating mode STOP Bit 13 = 1 — Operating mode TEST Bit 12 = 1 — Operating mode MANUAL Bit 11 = 1 — Operating mode AUTOMATIC Bit 10 = 1 — Internal Bit 9 = 1 — Internal Bit 8 = 1 — Internal
		Operating mode (**L.B.**)		Bit 7 = 1 \ 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 Bit 3 = 1 \ Bit 2 = 1 / — Coasting END Bit 1 = 1 \ Bit 0 = 1 / — Internal
16/2	50	Generator active energy (**H.W.**)	kWh	Double word
16/3	51	Generator active energy (**L.W.**)		
17/1	52	Battery voltage	V × 10	
17/2	53	Internal alarm 1		Bit 15 = 1 \ Bit 14 = 1 / — Generator overfrequency Bit 13 = 1 \ Bit 12 = 1 / — Generator underfrequency Bit 11 = 1 \ Bit 10 = 1 / — Generator overvoltage Bit 9 = 1 \ Bit 8 = 1 / — Generator undervoltage Bit 7 = 1 \ Bit 6 = 1 / — Internal Bit 5 = 1 \ Bit 4 = 1 / — Battery undervoltage Bit 3 = 1 \ Bit 2 = 1 / — Generator overload Bit 1 = 1 \ Bit 0 = 1 / — Generator reverse power

MUX	Nr.	Contents (words)	Unit	Note
17/3	54	Internal alarm 2		Bit 15 = 1 \ Bit 14 = 1 / Mains overfrequency
				Bit 13 = 1 \ Bit 12 = 1 / Mains underfrequency
				Bit 11 = 1 \ Bit 10 = 1 / Mains overvoltage
				Bit 9 = 1 \ Bit 8 = 1 / Mains undervoltage
				Bit 7 = 1 \ Bit 6 = 1 / Interface fault X1..X5
				Bit 5 = 1 \ Bit 4 = 1 / Internal
				Bit 3 = 1 \ Bit 2 = 1 / Internal
				Bit 1 = 1 \ Bit 0 = 1 / Mains phase/vector jump
18/1	55	Internal alarm 3		Bit 15 = 1 \ Bit 14 = 1 / Generator overcurrent, level 2
				Bit 13 = 1 \ Bit 12 = 1 / Generator overspeed (Pickup)
				Bit 11 = 1 \ Bit 10 = 1 / Incoming power 0 kW not reached
				Bit 9 = 1 \ Bit 8 = 1 / Generator load imbalance
				Bit 7 = 1 \ Bit 6 = 1 / Generator overcurrent, level 1
				Bit 5 = 1 \ Bit 4 = 1 / Interface fault Y1..Y5
				Bit 3 = 1 \ Bit 2 = 1 / Maintenance call
				Bit 1 = 1 \ Bit 0 = 1 / Start failure
18/2	56	Internal alarm 4		Bit 15 = 1 \ Bit 14 = 1 / Analog input [T1] - level 1
				Bit 13 = 1 \ Bit 12 = 1 / Analog input [T1] - level 2
				Bit 11 = 1 \ Bit 10 = 1 / Analog input [T2] - level 1
				Bit 9 = 1 \ Bit 8 = 1 / Analog input [T2] - level 2
				Bit 7 = 1 \ Bit 6 = 1 / Analog input [T3] - level 1
				Bit 5 = 1 \ Bit 4 = 1 / Analog input [T3] - level 2
				Bit 3 = 1 \ Bit 2 = 1 / Analog input [T4] - level 1
				Bit 1 = 1 \ Bit 0 = 1 / Analog input [T4] - level 2
18/3	57	Internal alarm 5		Bit 15 = 1 \ Bit 14 = 1 / Analog input [T5] - level 1
				Bit 13 = 1 \ Bit 12 = 1 / Analog input [T5] - level 2
				Bit 11 = 1 \ Bit 10 = 1 / Analog input [T6] - level 1
				Bit 9 = 1 \ Bit 8 = 1 / Analog input [T6] - level 2
				Bit 7 = 1 \ Bit 6 = 1 / Analog input [T7] - level 1
				Bit 5 = 1 \ Bit 4 = 1 / Analog input [T7] - level 2
				Bit 3 = 1 \ Bit 2 = 1 / Analog input [T8] - level 1
				Bit 1 = 1 \ Bit 0 = 1 / Analog input [T8] - level 2

MUX	Nr.	Contents (words)	Unit	Note
19/1	58	External alarm 1 If both bits are set the input is active.		Bit 15 = 1 \ Bit 14 = 1 / Discrete input [1] Bit 13 = 1 \ Bit 12 = 1 / Discrete input [2] Bit 11 = 1 \ Bit 10 = 1 / Discrete input [3] Bit 9 = 1 \ Bit 8 = 1 / Discrete input [4] Bit 7 = 1 \ Bit 6 = 1 / Discrete input [5] Bit 5 = 1 \ Bit 4 = 1 / Discrete input [6] Bit 3 = 1 \ Bit 2 = 1 / Discrete input [7] Bit 1 = 1 \ Bit 0 = 1 / Discrete input [8]
19/2	59	External alarm 2 If both bits are set the input is active.		Bit 15 = 1 \ Bit 14 = 1 / Discrete input [9] Bit 13 = 1 \ Bit 12 = 1 / Discrete input [A] Bit 11 = 1 \ Bit 10 = 1 / Discrete input [B] Bit 9 = 1 \ Bit 8 = 1 / Discrete input [C] Bit 7 = 1 \ Bit 6 = 1 / Discrete input [D] Bit 5 = 1 \ Bit 4 = 1 / Discrete input [E] Bit 3 = 1 \ Bit 2 = 1 / Discrete input [F] Bit 1 = 1 \ Bit 0 = 1 / Discrete input [G]
19/3	60	Internal alarm 7		Bit 15 = 1 Internal Bit 14 = 1 Internal Bit 13 = 1 Alarm PCR3: Lambda sensor 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 mech. malfunction Bit 6 = 1 GCB close mech. malfunction Bit 5 = 1 Internal Bit 4 = 1 Internal Bit 3 = 1 Internal Bit 2 = 1 Internal Bit 1 = 1 Internal Bit 0 = 1 Immediate stop

MUX	Nr.	Contents (words)	Unit	Note	
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.	
22/2	68	EM1-D.[2]-Alarms		Bit 15 = 1	EM1-D.[2] – Discrete input [8]
				Bit 14 = 1	EM1-D.[2] – Discrete input [7]
				Bit 13 = 1	EM1-D.[2] – Discrete input [6]
				Bit 12 = 1	EM1-D.[2] – Discrete input [5]
				Bit 11 = 1	EM1-D.[2] – Discrete input [4]
				Bit 10 = 1	EM1-D.[2] – Discrete input [3]
				Bit 9 = 1	EM1-D.[2] – Discrete input [2]
				Bit 8 = 1	EM1-D.[2] – Discrete input [1]
				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	
				Pick up	
				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	
23/1	70	Lambda set value	x 100		
23/2	71	Lambda actual value	x 100		
23/3	72	Actuator position	x 0.01 %		

UGNEXPO	Generator voltage exponent
IGNEXPO	Generator current exponent
PGNEXPO	Generator power exponent
UNTEXPO	Mains voltage exponent
PNTEXPO	Mains power exponent
PGNWD	Step conversion factor → kW

Meaning of the number 69 of the telegram "Currently active display":

Number	Meaning
0	GCB synchronization
1	MCB synchronization
2	GCB black start
3	MCB black start
4	Start
5	Start pause
6	Coasting 000s (000s:the remaining time is displayed.)
7	Engine stop!
8	Preheating
9	Purging operation
10	Initial state
11	Auxiliary coasting
12	Auxiliary advance
13	Mains settling 000s (000s:the remaining time is displayed.)
14	Lambda initial state
15	Sprinkler coasting
16	Firing
17	Internal
18	Internal
19	Internal
20	Internal
21	Internal
22	Internal
23	Internal
24	Phase rotation incorrect!
25	Start without setting GCB and simultaneous emergency power
26	Start without setting GCB
27	Sprinkler operation and simultaneous emergency power
28	Sprinkler operation
29	Emergency power
30	TEST
31	Load test
32	Internal
33	Internal
34	Internal
35	Internal
36	Internal
37	Internal
38	Internal
39	Internal
40	Internal
41	Internal
42	Internal
43	Internal
44	Internal
45	Internal
46	Internal
47	Power reduction
...	
255	No display on the display (basic screen)

a.) MDEC

NOTE

The following data is transferred in the 'extended blocks' of the PCx. The data volume, which is added by the ' extended blocks ', results that a Gateway PCK4 can only transfer the data of the first four PCx anymore. If it is necessary that all data of all PCx is transferred, a second Gateway PCK4 has to be used.

MUX	Nr.	Contents (words)	Unit	Note	
24/1	73	Engine speed	min-1 × 0.1		
24/2	74	Oil pressure	bar × 0.01		
24/3	75	Fail codes			
25/1	76	Operating hours of the ECU	h		
25/2	77	Coolant temperature	°C × 0.1 (+/-)		
25/3	78	Oil temperature	°C × 0.1 (+/-)		
26/1	79	Fuel temperature	°C × 0.1 (+/-)		
26/2	80	Feedback speed	min-1 × 0.1		
26/3	81	ECU-Alarme 1		Bit 15 = 1	ST Coolant charge air
				Bit 14 = 1	Coolant available
				Bit 13 = 1	Coolant level
				Bit 12 = 1	ECU Yellow Alarm
				Bit 11 = 1	ST Oil pressure
				Bit 10 = 1	Oil pressure too low
				Bit 9 = 1	ECU Red Alarm
				Bit 8 = 1	ST Overspeed
				Bit 7 = 1	Internal
				Bit 6 = 1	Internal
				Bit 5 = 1	SD Coolant charge air
				Bit 4 = 1	SD Coolant level
				Bit 3 = 1	Oil temperature too high
				Bit 2 = 1	ST Coolant temperature
				Bit 1 = 1	Coolant temperature
				Bit 0 = 1	AL ECU defect
27/1	82	ECU-Alarm 2		Bit 15 = 1	SD Fuel temperature
				Bit 14 = 1	SD Oil temperature
				Bit 13 = 1	SD Cooling water temperature
				Bit 12 = 1	SD Operating hours
				Bit 11 = 1	SD Fail codes
				Bit 10 = 1	SD Oil pressure
				Bit 9 = 1	SD Engine speed
				Bit 8 = 1	Reserve (MDEC Bit 8)
				Bit 7 = 1	Reserve (MDEC Bit 7)
				Bit 6 = 1	Reserve (MDEC Bit 6)
				Bit 5 = 1	Reserve (MDEC Bit 5)
				Bit 4 = 1	Reserve (MDEC Bit 4)
				Bit 3 = 1	Reserve (MDEC Bit 3)
				Bit 2 = 1	Reserve (MDEC Bit 2)
				Bit 1 = 1	Reserve (MDEC Bit 1)
				Bit 0 = 1	SD Speed demand
27/2	83	Reserve (MDEC Bit 11)			
27/3	84	Reserve (MDEC Bit 12)			
28/1	85	Reserve (MDEC Bit 13)			
28/2	86	Reserve (MDEC Bit 14)			
28/3	87	Reserve (MDEC Bit 15)		Bit 15 = 1	Internal
				…	…
				Bit 9 = 1	Internal
				Bit 8 = 1	Interface fault Y1Y5 by MDEC
				Bit 7 = 1	Internal
				…	…
				Bit 0 = 1	Internal
29/1	88	Reserve (MDEC Bit 16)			
29/2	89	Reserve (MDEC Bit 17)			
29/3	90	Reserve (MDEC Bit 18)			

b.) J1939

NOTE

The following data is transferred in the 'extended blocks' of the PCx. The data volume, which is added by the ' extended blocks ', results that a Gateway PCK4 can only transfer the data of the first four PCx anymore. If it is necessary that all data of all PCx is transferred, a second Gateway PCK4 has to be used.

MUX	Nr.	Contents (words)	Unit	Note
24/1	73	Engine speed	min-1 × 0.1	
24/2	74	Oil pressure	bar × 0.01	
24/3	75	Reserve		
25/1	76	Reserve	h	
25/2	77	Coolant temperature	°C × 0.1 (+/-)	
25/3	78	Oil temperature	°C × 0.1 (+/-)	
26/1	79	Fuel temperature	°C × 0.1 (+/-)	
26/2	80	Reserve	min-1 × 0,1	
26/3	81	ECU-Alarm 1		Bit 15 = 1 ST Coolant charge air /#1
				Bit 14 = 1 Internal
				Bit 13 = 1 Coolant level /#1
				Bit 12 = 1 Internal
				Bit 11 = 1 ST Oil pressure /#1
				Bit 10 = 1 Low oil pressure/#2
				Bit 9 = 1 Internal
				Bit 8 = 1 Internal
				Bit 7 = 1 ST Engine protection /#1
				Bit 6 = 1 ST Oil level /#1/#2
				Bit 5 = 1 Internal
				Bit 4 = 1 SD Coolant level
				Bit 3 = 1 Internal
				Bit 2 = 1 ST Coolant temperature /#1
				Bit 1 = 1 Coolant temperature/#2
				Bit 0 = 1 Internal
27/1	82	ECU Alarm 2		Bit 15 = 1 SD Fuel temperature
				Bit 14 = 1 SD Oil temperature
				Bit 13 = 1 SD Coolant temperature
				Bit 12 = 1 Internal
				Bit 11 = 1 Internal
				Bit 10 = 1 SD Oil pressure
				Bit 9 = 1 SD Engine speed
				Bit 8 = 1 Internal
				Bit 7 = 1 Internal
				Bit 6 = 1 Internal
				Bit 5 = 1 Internal
				Bit 4 = 1 Internal
				Bit 3 = 1 Internal
				Bit 2 = 1 Internal
				Bit 1 = 1 Internal
				Bit 0 = 1 Internal
27/2	83	Reserve		
27/3	84	Reserve		
28/1	85	Coolant level	%	FFxx'h = no value of ECU available FExx'h = Sensor fault
28/2	86	Reserve		
28/3	87	Reserve		Bit 15 = 1 Internal
				… …
				Bit 9 = 1 Intern
				Bit 8 = 1 Interface fault Y1Y5 by J1939
				Bit 7 = 1 Internal
				… …
				Bit 0 = 1 Internal

#1 only Deutz EMR 2, #2 only Scania EMS/S6

6.3.3 Receiving telegram

The CAN protocol for remote control of the PCx is available on request. We however recommend to use a Gateway. The following three data words can be received by the PCx. Please see in the manual of the GW 4 how you can control several PCx.

No.	Contents (words)	Unit	Note
1	Generator real power set value	kW	see below
2	Setpoint for the generator power factor φ		Example: 0064H power factorφ = 1.00 0063H power factorφ = i0.99 (inductive) FF9EH power factorφ = c0.98 (capacitive)
3	Control word		Bit 15 Internal Bit 14 Internal Bit 13 Internal Bit 12 Internal Bit 11 Internal Bit 10 Internal Bit 91 Internal Bit 8 Internal Bit 7 Internal Bit 6 Internal Bit 5 Internal Bit 4 = 1 Remote acknowledgement Bit 3 = 0 Always 0 Bit 2 = 0 Always 0 Bit 1 = 1 Remote stop (high priority) Bit 0 = 1 Remote start

6.3.4 Notes (on interface)

a.) Coding of the current direction

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

b.) Coding of the power default

The following power values may be pre-specified: fixed power (F power), outgoing/export power (E power) and incoming/import power (I power). The real power setpoint 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
F power	**0**	**1**
E power	**0**	**0**
I power	**1**	**1**

Examples:

F power of 150 kW is to be compensated. The value transmitted is then:

01/00 0000 1001 0110 B ➔ 4096 H

L 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

6.4 Measured quantities and technical data

6.4.1 Measured quantities

Measuring variable	Display and range	Note
Frequency		
Generator, busbar $f_{L1Gen/SS}$, $f_{L2Gen/SS}$, f_{L3Gen}	15.0..85.0 Hz	
Mains $f_{L1Mains}$, $f_{L2Mains}$, $f_{L3Mains}$	40.0..85.0 Hz	
Voltage		
U_{L1}, U_{L2}, U_{L3}, U_{L12}, U_{L23}, U_{L31}	0..520 V	Adjustable transformer ratio
current		
Generator, mains $I_{L1Gen/Mains}$, I_{L2Gen}, I_{L3Gen}	0..9,999 A	-
Maximum value I_{L1Gen}, I_{L2Gen}, I_{L3Gen}	0..9,999 A	Slave pointer
Real power		
Total actual real power value	-32.0..32.0 MW	-
Re-active power		
Actual value in L1, L2, L3	-32.0..32.0 Mvar	-
cos		
Actual value of power factor L1 generatorφ,mains	i0.00..1.00..c0.00	-
Miscellaneous		
Active energy	0..4,200 GWh	Not calibrated by PTB
Operating hours	0..65,000 h	-
Maintenance call	0..9,999 h	-
Start counter	0..32,750 → 1	-
Battery voltage	10..30 V	-
Pickup speed	f_N ± 40 %	-
Analog inputs		
Pt100	0..250 °C	Not calibrated by PTB
Pt1000	0..150 °C	Not calibrated by PTB
0..180 Ω	Freely scaleable	For VDO pulsar
0..360 Ω	Freely scaleable	For VDO pulsar
PTC	Freely scaleable	-
0 /4.. 20 mA	Freely scaleable	-
0 ..10 V	Freely scaleable	-
0.. 150 mV	Freely scaleable	-

a.) Reference conditions for the recorded quantities

* The data apply to the following reference conditions:

- Input voltage = sinusoidal rated voltage
- Input current = sinusoidal rated current
- Frequency = rated frequency ± 2 %
- Supply voltage = rated voltage ± 2 %
- Power factor φ = 1
- Ambient temperature 23 °C ± 2 K
- Warm-up period = 20 minutes.

6.4.2 Technical data

Measuring values
- Measuring voltages .....[1] 100..115 V_{AC}, [4] 380..440 V_{AC}
- Measuring voltages ..... [1] max. 150 Vac, [4] max. 300 Vac
- Measuring currents..... ../1 A, ../5 A
- Measuring frequency..... 50/60 Hz (40.0..70.0 Hz)
- Accuracy ..... Class 1

Ambient variables
- Power supply.....12/24 Vdc (9.5..32 V_{DC}), Intrinsic consumption max. 20 W
- Ambient temperature ..... -20..70 °C
- Ambient humidity.....95 %, non-condensing

Measuring inputs

• Voltage .....Resistances 0.1 %
- Continuous input voltage..... 2.0 × U_N
- Linear measuring range up to..... 1.3 × U_N
- Input resistance .....[1] 0.21 MΩ, [4] 0.7 MΩ
- Maximum power consumption per path .....0.15 W

• Current ..... metalically separated
- Maximum continuous current..... I_{Gen} = 3.0 × I_N, I_{Mains} = 1.5 × I_N
- Power consumption.....< 0.15 VA
- Rated short time current (1 s)..... [../ A] 50.0 × I_N, [../5 A] 10.0 × I_N

Discrete inputs
- Electrically isolated
- Input range.....6..32 V_{DC}
- Input resistance ..... ca. 6.8 kΩ

Potential-free outputs
- Electrically isolated
- Contact material.....AgCdO
- Load (GP) ($U_{Cont, relay output}$)
  AC.....2.00 Aac@250 Vac
  DC.....2.00 Adc@24 Vdc
  0.36 Adc@125 Vdc
  0.18 Adc@250 Vdc
- Inductive load (PD) ($U_{Cont, relay output}$)
  AC.....B300
  DC.....1.00 Adc@24 Vdc
  0.22 Adc@125 Vdc
  .....0.10 Adc@250 Vdc

Analog inputs
- Freely scaleable ..... resolution 10 Bit
- Pt100/Pt1000 Input.....for measuring resistances according to IEC 751
  2/3-conductor measurement, 0..200 °C,
- 0/4..20 mA input..... Difference measurement, load 150 Ω

Analog outputs
- at rated output ..... freely scalable,
  electrically isolated, insulation voltage 3,000 V_{DC}
  0..5 V, ±5 V, 0..10 V, 0..20 mA
- Resolution PWM .....8/12 bit (depending on model)
- 0/4..20 mA output .....maximum load 500 Ω

Pickup
- Input .....capacitively separated
- Input impedance .....min. approx. 17 kΩ
- Input voltage..... 875 mV eff

Interface

Service interface
- Version RS232
- Signal level ..... 5 V
  level conversion and separation by FL-CABLE-RS232

CAN bus interface ..... galvanically separated
- Insulation voltage ..... 1,500 Vdc
- Version ..... CAN bus
- Internal line termination ..... n/a

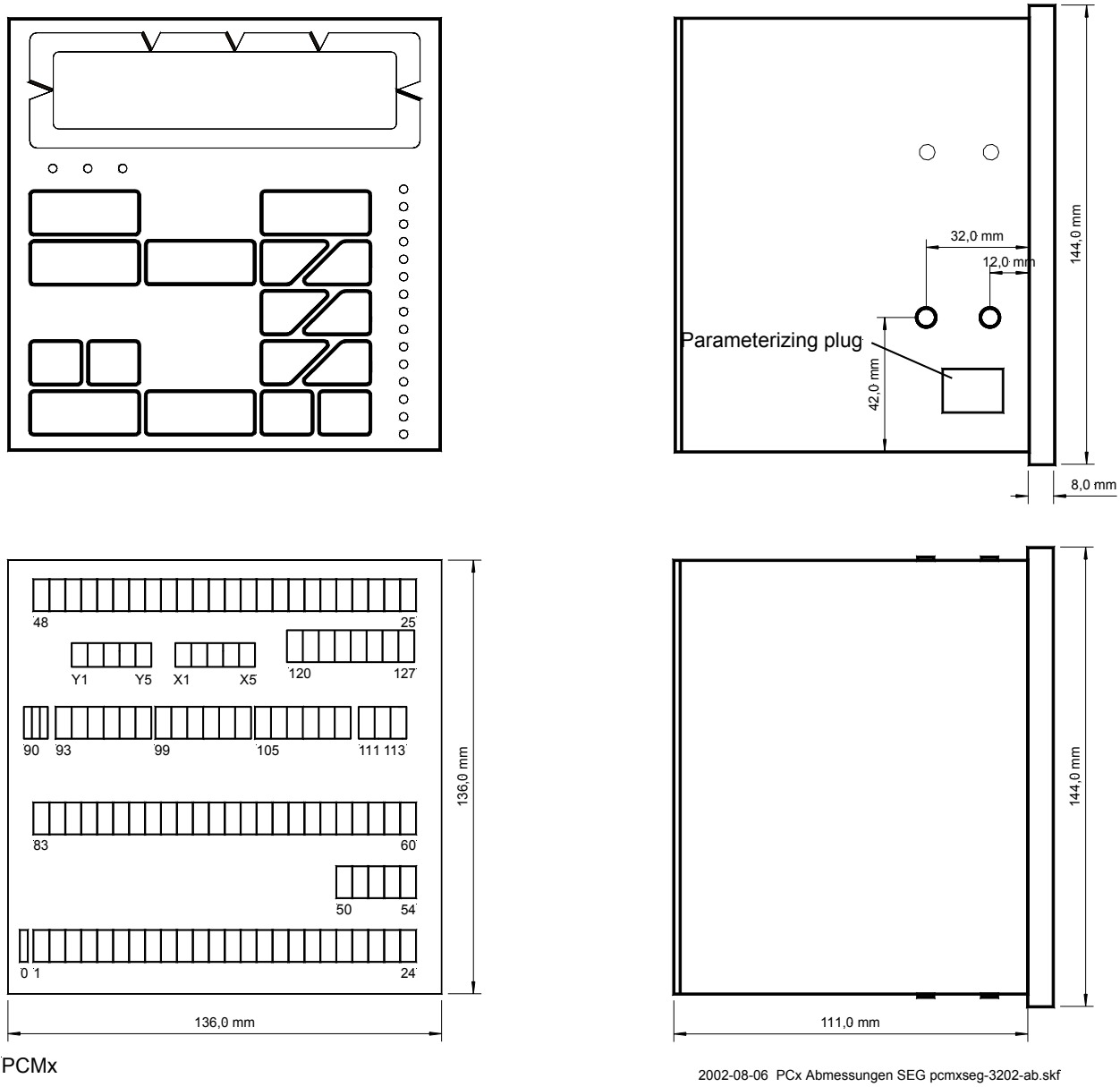
Battery
- Type ..... NiCd
- Life (for operation without power supply) ..... approx. 5 years
- Battery change in place ..... not possible

Housing
- type ..... APRANORM DIN 43 700
- Dimensions (B×H×T) ..... 144 × 144 × 118 mm
- Front cutout (B×H) ..... 138 [+1,0] × 138 [+1,0] mm
- Connection ... 1.5 mm² or 2.5 mm² screw terminals depending on the plug connector
- Weight ..... depending on model, ca. 1,000 g

Protection
- disturbance test (CE) ..... Tested according to valid EN codes of practice
- Degree of protection ..... IP42 from front with proper installation
  IP54 from front with gasket
  ..... IP21 from behind
- Front foil ..... insulating surface
- Listings ..... CE approved; UL listing for ordinary locations
- Type approval ..... UL-/cUL-Listed, Ordinary Locations

6.5 Dimensions

Housing	Type APRANORM DIN 43 700
Dimensions	(B×H×T) 144 × 144 × 118 mm
Front cutout	(B×H) 138 × 136 mm
Connection	screw terminals depending on the plug connector 1.5 mm² or 2.5 mm²
Degree of protection	IP 21
Weight	depending on model, ca. 1,000 g



PCMx

2002-08-06 PCx Abmessungen SEG pcmxseg-3202-ab.skf

7 Parameter list

PCL1 & PCM1-G & PCM1-M - Genset Control

Version _____

Project _____

Item number _____ Date _____

Option	Parameter 1. line text 2. line	Adjustment range	Standard settings	Customer settings		Code level
	GENERAL					
	Software version	-	V x.xxxx	-	-	0
	Entercode	0..9.999	XXXX			0
PCMx/H	Direct para	YES/NO	YES	☐ Y ☐ N	☐ Y ☐ N	2
..	Generator-Nummer	1..14	1			2
PCMx/H	Language	first/second	first	☐ f ☐ s	☐ f ☐ s	0
	Service display	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	0
PCMx/H	check event list	YES/NO	YES	☐ Y ☐ N	☐ Y ☐ N	2
	GENERATOR AND MAINS ENVIRONMENT CONFIGURATION					
	Configure measuring	YES/NO	Yes	☐ Y ☐ N	☐ Y ☐ N	2
	Generator number	1..8	1			2
	Generator freq. f set	40.0..70.0 Hz	50.0 Hz			2
	Rated system frequency	50.0..60.0 Hz	50.0 Hz			2
	Gen.volt.transf. secondary	50..125/50..480 V	400 V			2
	Gen.volt.transf. primary	0.05..65.0 kV	0.40 kV			2
	Bus.volt.transf. secondary	50..125/50..480 V	400 V			2
	Bus.volt.transf. primary	0.05..65.0 kV	0.40 kV			2
	mains volt.trans secondary	50..125/50..480 V	400 V			2
	mains volt.trans primary	0.05..65.0 kV	0.40 kV			2
	Gen.voltage U set	50..125/50..480 V	100/400 V			2
	Rated voltage in system	50..125/50..480 V	100/400 V			2
	Volt.meas./mon. Threewire	4/4 4/3 3/3	4/4	☐ 4/4 ☐ 4/3 ☐ 3/3	☐ 4/4 ☐ 4/3 ☐ 3/3	2
	Current transf. generator	10..7,000/x A	500/x A			2
	Power measuring gen.	singlephase/threephase	threepase			2
	Rated power generator	5..9,999 kW	200 kW			2
	Rated current generator	10..7,000 A	300 A			2
	Analog in Pmains	OFF / T{x}	OFF			
	Analog in Pmains	0-20 mA / 4-20 mA	0-20 mA			
	Analog in Pmains 0%	-9,990..0..+9,990kW/ 6,900..0..+6,900 kW	-200 kW			
	Analog in Pmains 100%	-9,990..0..+9,990kW/ 6,900..0..+6,900 kW	200 kW			
	Current transf. mains	5..7,000/x A	500/x A			2
	PCN4 mode	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Rated power in system	0..16,000kW	1,600 kW			2
	Define level 1 code	0..9999	0001			2
	Define level 2 code	0..9999	0002			2

	CONTROLLER CONFIGURATION						
	Configure	controller	YES/NO	YES	☐ Y ☐ N	☐ Y ☐ N	2
PCMx	Power controller	Pset1	C/I/E 0..6,900 kW	F 50 kW			1
PCMx	Power controller	Pset2	C/I/E 0..6,900 kW	F 80 kW			1
A	Initial state	Frequency	0..100 %	0 %			2
	Freq.controller		ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	f-contr. active	at	0.0..70.0 Hz	40.0Hz			2
	Delay time for	f-contr.	0...999 s	5 s			2
	Freq.controller	ramp	1..50 Hz/s	10 Hz/s			2
	F/P contr.type		Three-step/Analog/PWM	Analog			2
	Freq.controller	deadband	0.02..1.00 Hz	0.03 Hz			2
	Freq.controller	time pulse>	10.. 250 ms	80 ms			2
	Freq.controller	gain Kp	0.1..99.9	20.0			2
	F/P contr.output		see table	+/-10 V			2
	Level PWM		3.0..10.0V	3,0 V			
	Stepper sign.frq	(min.)	0..100%	0%			
	Stepper sign.frq	(max.)	0..100%	100%			
A	Freq.controller	gain Kpr	1..240	20			2
..	Freq.controller	reset Tn	0.0..60.0 s	1.0 s			2
A	Freq.controller	derivat.Tv	0.00..6.00 s	0.00 s			2

Option	Parameter 1. line	text	2. line	Adjustment range	Standard settings	Customers settings		Code level
	CONTROLLER CONFIGURATION							
A	Starting point	voltage		0..100 %	0 %			2
	Volt.controller			ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Start voltage	U control.		50..400 V				2
	Delayed. Start	U contr.		0..999 s				2
	V/Q contr.type			Three-step/Analog	Analog			2
	Volt.controller	dead band		0.1..15.0/0.5..60.0 V	3.5 V			2
	Volt.controller	time pulse>		20.. 250 ms	80 ms			2
	Volt.controller	gain Kp		0.1..99.9	20.0			2
	V/Q contr.output			see table	+/-10 V			2
	Stepper sign.vol.	(min.)		0..100%	0%			
	Stepper sign.vol.	(max.)		0..100%	100%			
A	Volt.controller	gain Kpr		1..240	20.0			2
..	Volt.controller	reset Tn		0.0..60.0 s	1.0 s			2
A	Volt controller	derivat.Tv		0.00..6.00 s	0.0 s			2
PCMx	Pow.fact.contr.			ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	Pow.fact.contr.	setpoint		i0.70..1.00..c0.70	1.00			1
..	Pow.fact.contr.	dead band		0.5..25.0 %	0.5 %			2
..	Pow.fact.contr.	gain Kp		0.1..99.9	20.0			2
PCMx/A	Pow.fact.contr.	gain Kpr		1..240	20			2
..	Pow.fact.contr.	reset Tn		0.0..60.0 s	1.0 s			2
PCMx/A	Pow.fact.contr.	derivat.Tv		0.0..6.0 s	0.0 s			2
PCMx	Power controller			ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	power controller	ramp		0..100 %/s	10 %/s			2
..	Power limit	P max.		10..120 %	100 %			2
..	Power limit	P min.		0..50 %	0 %			2
..	Power setpoint	external		OFF / T{x}		☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	Analog input			0-20/4-20 mA	4-20 mA			2
..	Ext.setpoint	0%		C/I/E 0..9,999 kW	F0 kW			2
..	Ext.setpoint	100%		C/I/E 0..9,999 kW	F200 kW			2
..	Power controller	dead band		0.1..25.0 %	0.5 %			2
..	Power controller	gain Kp		0.1..99.9	20.0			2
..	Powercontr. dead	band ratio		1.0..9.9	2.0			2
PCMx/A	Power controller	gain Kpr		1..240	20			2
..	Power controller	reset Tn		0.0..60.0 s	1.0 s			2
PCMx/A	Power controller	derivat. Tv		0.0..6.0 s	0.0 s			2
PCMx	Warm up load	limit value		5..110 %	15 %			2
..	Warm up load	time		0..600 s	0 s			2
..	Active power	load-share		ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	Act. load share	factor		10..99 %	50 %			2
..	Reactive power	load share		ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
PCMx	React.load share	factor		10..99%	50 %			2
	LOAD MANAGEMENT CONFIGURATION							
PCMx	Configure	automatic		YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
..	Loadd.start/stop	at ter.3		ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	Loadd.start/stop	at ter.5		ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	Minimum load	generator		0..6,900 kW	15 kW			2
..	Add-on delay	mains oper.		0..999 s	1 s			2
..	Shed-off delay	mains oper.		0..999 s	3 s			2
..	Hysteresis add-	on/off op.		0..9,999 kW	5 kW			2
..	Reserve power	mains op.		0..9,999 kW	10 kW			2
..	Priority of	generators		0..14	0			2
..	Reserve power	isol.op.		0..9,999 kW	20 kW			2
..	Add-on delay	isol.op.		0..999 s	1 s			2
PCMx	Shed-off delay	isol.op.		0..999 s	4 s			2

Option	Parameter 1. line	text	2. line	Adjustment range	Standard setting	Customer settings		Code level
	LOAD MANAGEMENT CONFIGURATION							
PCMx/H	CHP temp.depend.	at ter.3		ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	CHP temp.depend.	at ter.5		ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	CHP start-up	temperat.		0..255 °C	30 °C			2
..	CHP shut-down	temperat.		0..255 °C	60 °C			2
..	CHP start-up	delay		0..255 s	1 s			2
..	reduce of load	step 1 at		0..255 °C	60 °C			2
..	reduce of load	step 2 at		0..255 °C	70 °C			2
PCMx/H	reduce of load	per step		0..100 %	10 %			2
	Mains error	stop eng.		ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
PCx/H	Control via	COM X1X5		ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Supervision	COM X1X5		ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Ackn. F2,F3 via	COM interf		ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	
	CIRCUIT BREAKER CONFIGURATION							
	Configure	breaker		YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	Breaker logic			EXTERNAL PARALLEL OPEN TRANSIT. CLOSED TRANSIT. INTERCHANGE	PARALLEL	☐ external ☐ parallel ☐ open tran. ☐ closed tran. ☐ interchange	☐ external ☐ parallel ☐ open tran. ☐ closed tran. ☐ interchange	2
	Add-on/off ramp	max.time		0..999 s	20 s			2
	Open GCB with F2	max.time		0..999 s	10 s			2
	GCB close.relay	Impulse		Impulse/Constant	Impulse	☐ i ☐ c	☐ i ☐ c	2
	GCB open relay			NO-/NC-contact	NC-contact			2
	Synchronize	df max		.0.02...0.49 Hz	0.20 Hz			2
	Synchronize	df min		0.0..-0.49 Hz	-0.10 Hz			2
	Synchronize	dV max		1..20/2..60 V	10 V			2
	Synchronize	time pulse>		0.02..0.26 s	0.24.s			2
	Closing time	GCB		40.. 300 ms	80 ms			2
	Closing time	MCB		40.. 300 ms	80 ms			2
	Automat.breaker	deblocking		ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Sync.time contr.			ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	1
	Sync.time contr.	delay		10..999 s	180 s			1
	GCB dead bus op.			ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	GCB dead bus op.	df max		0.05..5.00 Hz	0.45 Hz			2
	GCB dead bus op.	dV max		1..15/2..60 V	40 V			2
	GCB dead bus op.	max.time		0..999 s	10 s			2
	MCB dead bus op.			ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Supervision GCB			ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Supervision MCB			ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Mains decoupling	via		GCB/MCB	GCB			2
	Mains settling	time		0..999 s	10 s			2
	Switch MCB in	STOP mode		YES/NO		☐ Y ☐ N	☐ Y ☐ N	
	EMERGENCY POWER CONFIGURATION							
	Configure	emergency		YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	Emergency power			ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Emergency power	start del.		0.5..99.9 s	3.0.s			2
	Mains settling	time		0..999 s	10 s			2

Option	Parameter 1. line	Text	2. line	Adjustment range	Standard setting	Customer settings		Code level
	WATCHDOG CONFIGURATION							
	Configure		monitoring	YES/NO	Yes	☐ Y ☐ N	☐ Y ☐ N	2
	Gen.power monit.			ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Gen.power monit.		resp.val1	0..9,999 kW	100 kW			2
	Gen.power monit.		hyst.lv1	0..999 kW	10 kW			2
	Gen.power monit.		delay lv1	0..999 s	1 s			2
	Gen.power monit.		resp.val2	0..9,999 kW	100 kW			2
	Gen.power monit.		hyst.lv2	0..999 kW	10 kW			2
	Gen.power monit.		delay lv2	0..999 s	1 s			2
	Mains power mon.			ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Mains power mon.		res.val.	I/E 0..9,999 kW	100 kW			2
	Mains power mon.		hysteresis	0..999 kW	10 kW			2
	Mains power mon.		delay	0..650 s	1 s			2
	Overload monit.			ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Gen.overload MOP		resp.value	80..150 %	120 %			2
	Gen.overload MOP		delay	0..99 s	1 s			2
	Gen.overload IOP		resp.value	80..150 %	120 %			2
	Gen.overload IOP		delay	0..99 s	1 s			2
	Rev./red.power		monitoring	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Rev./red.power		resp.value	-99..0..+99 %	-10 %			2
	Rev./red.power		delay	0.0..9.9. s	1.0 s			2
	Load unbalanced		monitoring	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Load unbalanced		max.	0..100 %	30 %			2
	Load unbalanced		delay	0.02..99.98 s	1.00 s			2
	Gen.overcurrent		monitoring	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Gen.overcurrent		limit 1	0..300 %	110 %			2
	Gen.overcurrent		delay 1	0.02..99.98 s	1.00 s			2
	Gen.overcurrent		limit 2	0..300 %	120 %			2
	Gen.overcurrent		delay 2	0.02..99.98 s	0.04.s			2
	Gen.frequency-		monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Gen.overfreq.		f >	xxx	xxx			2
	Gen.overfreq.		delay	0.02..9.98 s	0.30 s			2
	Gen.underfreq.		f <	xxx	xxx			2
	Gen.underfreq.		delay	0.02..9.98 s	0.30 s			2
	Engine overspeed		>	0..9,999 rpm	1,900 rpm			2
	Gen.voltage		monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Gen.overvoltage		U >	xxx	xxx			2
	Gen.overvoltage		delay	0.02..9.98 s	0.30 s			2
	Gen.undervoltage		U <	xxx	xxx			2
	Gen.undevoltage		delay	0.2..9.98 s	0.30 s			2
	Mains frequency		monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Mains overfreq.		f >	xxx	xxx			2
	Mains overfreq.		delay	0.02..9.98 s	0.06 s			2
	Mains underfreq.		f <	xxx	xxx			2
	Mains underfreq.		delay	0.02..9.98 s	0.06 s			2
	Mains voltage		monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Mains overvolt.		U >	xxx	xxx			2
	Mains overvolt.		delay	0.02..9.98 s	0.06 s			2
	Mains undervolt.		U <	xxx	xxx			2
	Mains undervolt.		delay	0.02..9.98 s	0.06 s			2
	Phase shift		monitoring	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Monitoring		one-/threephase	three-..one-/threephase	threephase			2
	Phase shift		one-phase	3..30 °	9 °			2
	Phase shift		three-phase	3..30 °	9 °			2
	Mains settling		time	0..999 s				
	Batt.undervolt.		U <	9.5..30.0 V	10.0 V			2
	Batt.undervolt.		delay	0..99 s	10 s			2

Option	Parameter 1. line	Text	2. line	Adjustment range	Standard setting	Customer settings		Code level
	DISCRETE INPUTS CONFIGURATION							
	Configure		dig.inputs	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	Dig.input 1234		function	E/D	EEEE			2
	Dig.input 1234		delay	0..9 s	0000			2
	Delayed by 1234		eng.speed	Y/N	NNNN			2
	Dig.input 1234		error class	0..3	3210			2
	Dig.input 5678		function	E/D	EEEE			2
	Dig.input 5678		delay	0..9	0000			2
	Delayed by 5678		eng.speed	Y/N	NNNN			2
	Dig.input 5678		error class	0..3	3210			2
	Dig.input 9ABC		function	E/D	EEEE			2
	Dig.input 9ABC		delay	0..9	0000			2
	Delayed by 9ABC		eng.speed	Y/N	NNNN			2
	Dig.input 9ABC		error class	0..3	3210			2
	Dig.input DEFG		function	E/D	EEEE			2
	Dig.input DEFG		delay	0..9	0000			2
	Delayed by DEFG		eng.speed	Y/N	NNNN			2
	Dig.input DEFG		error class	0..3	3210			2
	Errortxt.term.61			Any	EMERGENCY OFF			2
	Errortxt.term.62			Any	Terminal 62			2
	Errortxt.term.63			Any	Terminal 63			2
	Errortxt.term.64			Any	Terminal 64			2
	Errortxt.term.65			Any	Terminal 65			2
	Errortxt.term.66			Any	Terminal 66			2
	Errortxt.term.67			Any	Terminal 67			2
	Errortxt.term.68			Any	Terminal 68			2
	Errortxt.term.69			Any	Terminal 69			2
	Errortxt.term.70			Any	Terminal 70			2
	Errortxt.term.71			Any	Terminal 71			2
	Errortxt.term.72			Any	Terminal 72			2
	Errortxt.term.73			Any	Terminal 73			2
	Errortxt.term.125			Any	Terminal 125			2
PCMx	Errortxt.term.126			Any	Terminal 126			2
PCMx	Errortxt.term.127			Any	Terminal 127			2
	Firing speed by		by Term.62	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Op.mode blocked		by Term.63	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Breaker logic		by Term.64	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Breaker logic			EXTERNAL PARALLEL OPEN TRANSIT. CLOSED TRANSIT. INTERCHANGE	EXTERNAL	☐ external ☐ parallel ☐ open tran. ☐ closed tran. ☐ interchange	☐ external ☐ parallel ☐ open tran. ☐ closed tran. ☐ interchange	2
	Manual synchr.		by Ter.66	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Close GLS asap		by Ter.67	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Function term.6			Sprinkler Engine enable ext. acknowledge Engine block No CB by start	Ext. acknowledge	☐ Sprinkler ☐ Engine rel. ☐ ext. ackn. ☐ Engine blk. ☐ No CB start	☐ Sprinkler ☐ Engine rel. ☐ ext. ackn. ☐ Engine blk. ☐ No CB start	2
	Start withno GCB		cool down	ON/OFF				2
	Sprinkler shutd.		F1 aktive	ON/OFF				2

Option	Parameter 1. line	Text	2. line	Adjustment range	Standard setting	Customer settings		Code level
	ANALOG INPUTS CONFIGURATION							
	Configure		analg.inp.	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	Temperature 1		Pt100	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	name*		OOO°C	Any				2
	Limit		warning	0..200 °C	80 °C			2
	Limit		shutdown	0..200 °C	90 °C			2
	Delay		limit 1/2	0..650 s	1 s			2
	Monitoring for			high/low limit mon.	high limit mon.	☐ h ☐ l	☐ h ☐ l	2
	Temperature 2		Pt100	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	name*		OOO°C	Any				2
	Limit		warning	0..200 °C	80 °C			2
	Limit		shutdown	0..200 °C	90 °C			2
	Delay		limit 1/2	0..650 s	1 s			2
	Monitoring for			high/low limit mon.	high limit mon.	☐ h ☐ l	☐ h ☐ l	2
	Analog input 3		scalable	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Name and unit			Any				2
	Analog input 3			0-20mA/4-20mA	4-20 mA			2
	Value at		0%	-9,999..0..9,999	0			2
	Value at		100%	-9,999..0..9,999	100			2
	Limit warning		value	-9,999..0..9,999	80			2
	Limit shutdown		value	-9,999..0..9,999	90			2
	Delay		limit 1/2	0..650 s	1 s			2
	Monitoring for			high/low limit mon.	high limit mon.	☐ h ☐ l	☐ h ☐ l	2
	Temperature 4		Pt100	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	name*		OOO°C	Any				2
	Limit		warning	0..200 °C	80 °C			2
	Limit		shutdown	0..200 °C	90 °C			2
	Delay		limit 1/2	0..650 s	1 s			2
	Monitoring for			high/low limit mon.	high limit mon.	☐ h ☐ l	☐ h ☐ l	2
PCMx/H	Temperature 5		Pt100	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	***name****		OOO°C	Any				2
..	Limit		warning	0..200 °C	80 °C			2
..	Limit		shutdown	0..200 °C	90 °C			2
..	Delay		limit 1/2	0..650 s	1 s			2
..	Monitoring for			high/low limit mon.	high limit mon.	☐ h ☐ l	☐ h ☐ l	2
..	Temperature 6		Pt100	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	***name****		OOO°C	Any				2
..	Limit		warning	0..200 °C	80 °C			2
..	Limit		shutdown	0..200 °C	90 °C			2
..	Delay		limit 1/2	0..650 s	1 s			2
..	Monitoring for			high/low limit mon.	high limit mon.	☐ h ☐ l	☐ h ☐ l	2
..	Analog input 7		scalable	ON/OFF	ON	☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	Name and unit			Any				2
..	Analog input 7			0-20mA/4-20mA	4-20 mA			2
..	Value at		0%	-9,999..0..9,999	0			2
..	Value at		100%	-9,999..0..9,999	100			2
..	Limit warning		value	-9,999..0..9,999	80			2
..	Limit shutdown		value	-9,999..0..9,999	90			2
..	Delay		limit 1/2	0..650 s	1 s			2
PCMx/H	Monitoring for			high/low limit mon.	high limit mon.	☐ h ☐ l	☐ h ☐ l	2
PCLx	Ana.in	1234	Sv.del.	Y/N	NNNN			2
PCMx/L	Ana.in	1234	control	Y/N	NNNN			2
PCMx/H	Ana.in	12345678	Sv.del.	Y/N	NNNNNNNN			2
PCMx/H	Ana.in	12345678	control	Y/N	NNNNNNNN			2

Option	Parameter 1. line Text 2. line		Adjustment range	Standard setting	Customer settings		Code level
	ANALOG OUTPUTS CONFIGURATION						
	Configure	outputs	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	Analg.out.120121	parameter	0..22	1			2
	Analg.out.120121	0-00mA	0-20mA/4-20mA	0-20 mA			2
	Analg.out.120121	0%	0..9,990	0			2
	Analg.out.120121	100%	0..9,990	200			2
	Analg.out.122123	Parameter	0..22	1			2
	Analg.out.122123	0-00 mA	0-20mA/4-20mA	0-20 mA			2
	Analg.out.122123	0%	0..9,990	0			2
	Analg.out.122123	100%	0..9,990	200			2
	Assignm.relay 1		According to list	1			2
	Assignm.relay 2		According to list	2			2
	Assignm.relay 3		According to list	3			2
	Assignm.relay 4		According to list	4			2
PCMx	Assignm.relay 5		According to list	5			2
..	Assignm.relay 6		According to list	84			2
PCMx	Assignm.relay 7		According to list	85			2
	ENGINE CONFIGURATION						
	Configure	engine	YES/NO	Yes	☐ Y ☐ N	☐ Y ☐ N	2
	Aux.services	prerun	0..999 s	0 s			2
	Aux.services	postrun	0..999 s	0 s			2
	Start-stop-logic	for	DIESEL GAS EXTERNAL	DIESEL	☐ DIESEL ☐ GAS ☐ EXTERNAL	☐ DIESEL ☐ GAS ☐ EXTERNAL	2
	Min.speed for	ignit.	0..999 rpm	100			2
Gas	Ignition delay		0..99 s	3 s			2
..	Gasvalve delay		0..99 s	5 s			2
	Max. attempts to	start	1..6				
	Max. numbers	unint.Stops	0..25				
..	Starter time		2..99 s	5 s			2
..	Start pause time		1..99 s	8 s			2
..	f lower before	start	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
Gas	time f lower	bef.start	0..999 s	5 s			2
Diesel	Preglow time		0..99 s	3 s			2
	Max. attempts	Start	1..6				
	Max. numbers	unint.Stops	0..25				
..	Starter time		2..99 s	5 s			2
..	Start pause time		1..99 s	8 s			2
..	f lower before	start	ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
..	time f lower	bef.start	0..999 s	5 s			2
Diesel	Start-stop-logic		operating/stop magn.	operating magnet	☐ op ☐ st	☐ op ☐ st	2
	Cool down time		0..999 s	30 s			2
	Delayed engine	monitoring	1..99 s	8 s			2
	Firing speed	reached f >	5..70 Hz	15 Hz			2
	Pickup input		ON/OFF	OFF	☐ ON ☐ OFF	☐ ON ☐ OFF	2
	Gen.rated speed		0..3,000 rpm	1,500 rpm			2
	Number of pickup	teeth	30..280	96			2
	COUNTER CONFIGURATION						
	Configure	counters	YES/NO	Yes	☐ Y ☐ N	☐ Y ☐ N	2
	Service interval	in	0..9,999 h	300 h			1
	Set oper.hours	counter	0..65,000 h	0 h			2
	Set start	counter	0..32,000	0			2
	kWh counter	set in	kWh/MWh	kWh			2
	kWh counter	set	0..65,500 kWh/MWh	0 kWh			2
PCMx/H	Time		00:00..23:59	00:00			2
..	Year,month		00..99.01..12	00.00			2
PCMx/H	Day/weekday		01..31/1..7	00.0			2
	000 000 000 000	max. Gen.strom	-				

INTERFACE ENGINE BUS CONFIGURATION

s	Configure engine bus	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	CAN-Baudrate	100/125/250/500	250			1
	EM1-D on bus	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	PCR3 on bus	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	ECU interface monitoring	YES/NO	NO	☐ Y ☐ N	☐ Y ☐ N	2
	MDEC	Off / Vis./Ct. / Vis. / Ct.	OFF			2
	MDEC protocol	V302 / V303 / V304	V302			2
	max. speed loop	0..999 min^{-1}	100			2
	J1939	AUS/Stand./EMR2/S6	OFF			2
	J1939 unit numb.	0..255	0			2

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