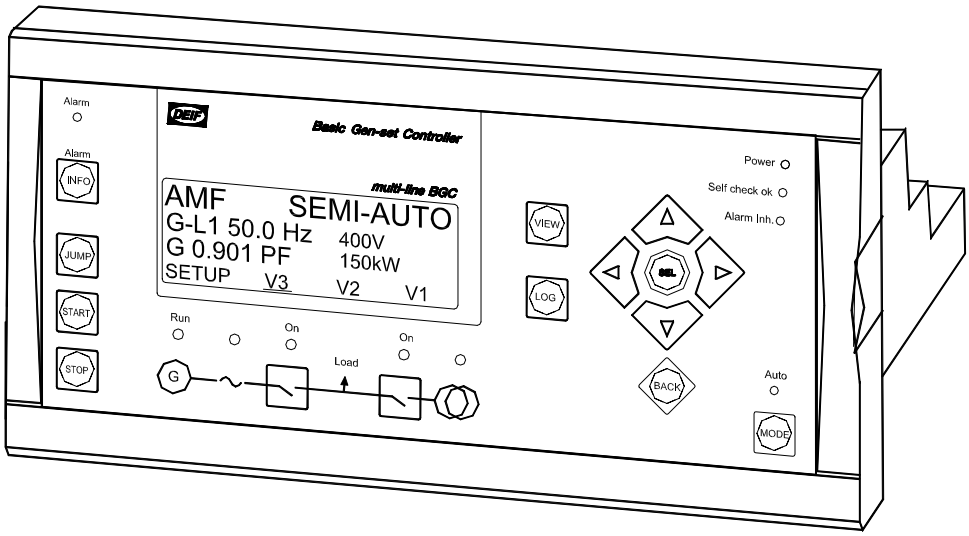
DEIF A/S

Description of options

Option G3,
Load sharing and synchronising
Basic Gen-set Controller

4189340309C



- *Description of option*
- *Functional description*
- *Etc.*

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Table of contents

1. Warnings and legal information

This chapter includes important information about general legal issues relevant in the handling of DEIF products. Furthermore, some overall safety precautions will be introduced and recommended. Finally, the highlighted notes, which will be used throughout this document, are presented.

Legal information and responsibility

DEIF takes no responsibility for installation or operation of the generator set. If there is any doubt about how to install or operate the generator controlled by the BGC unit, the company responsible for the installation or the operation of the set must be contacted.

The BGC units are not to be opened by unauthorized personnel. If opened anyway, the warranty will be lost.

Electrostatic discharge awareness

Sufficient care must be taken to protect the terminals against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

Safety issues

Installing the BGC unit implies work with dangerous currents and voltages. Therefore, the installation of the BGC should only be carried out by authorized personnel who understand the risks involved in the working with live electrical equipment.

Notes

Throughout this document a number of notes with helpful user information will be presented. To ensure that these notes are noticed, they will be highlighted in order to separate them from the general text.

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2. Description of option

This option includes synchronising with analogue lines and load sharing.

Terminal description

Option sync. loadshare			
Slot #4	**Function**	**Technical data**	**Description**
80	-5…0…5V DC	Analogue I/O	Active load sharing line
79	Com.	Common	Common for load sharing line
78	-5…0…5V DC	Analogue I/O	Reactive load sharing
77	-10…0…10V DC	Analogue input	Frequency/active load set point. Passive (requires external power supply)
76	Com.	Com.	Common for terminals 75 and 77
75	-10…0…10V DC	Analogue input	Voltage/var/power factor/reactive load set point. Mains power input. Passive (requires external power supply)
74	Binary input	Optocoupler	Configurable/de-load
73	Binary input	Optocoupler	Configurable/manual raise speed
72	Binary input	Optocoupler	Configurable/manual lower speed
71	Binary input	Optocoupler	Configurable/manual raise voltage
70	Com.	Com.	Common for terminals 71-74
69	Relay out	NO contact	Configurable speed / AVR raise
68	Relay out	NO contact	Configurable speed / AVR lower
67	Com.	Com.	Common for relay outputs 68-69
66	+/-20mA out	Speed governor controller output	
65	0		
64	+/-20mA out	AVR controller output	
63	0		

Option M14 4 relay outputs			
Slot #2/3		**Function**	**Description**
Term.			
47	55	Relay 6	250V, 8A, configurable
48	56	Com.	Gov up
49	57	Relay 7	250V, 8A, configurable
50	58	Com.	Gov down
51	59	Relay 8	250V, 8A, configurable
52	60	Com.	AVR up
53	61	Relay 9	250V, 8A, configurable
54	62	Com.	AVR down

See the unit label to identify the actual position of the relay PCB. The position is either slot #2 or slot #3.

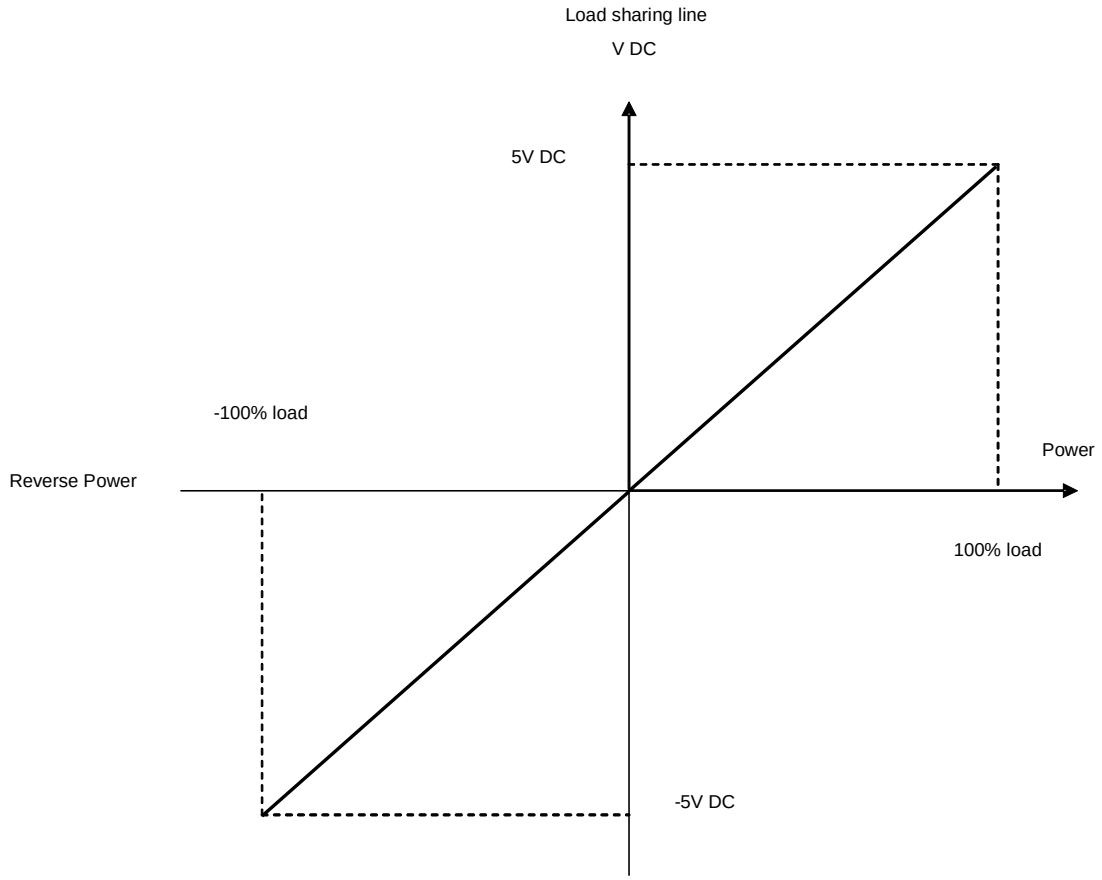
Functional description

Option G3, load sharing

The option G3 is an option that enables the BGC to share the active (and reactive load (option D1)) equally in a percentage of the nominal power. The load sharing is active when the gen-set is running, and the generator breaker is closed.

A voltage signal equal to the load it produces is sent to the load sharing line. When the generator load is 0%, 0V DC is sent to the load share line. (At 100% load the voltage will be 5V DC).

This is illustrated in the drawing below.



The illustration above indicates the characteristics of the active load sharing line. The characteristics of the reactive load sharing line are equivalent to the illustration above.

Working principle

The BGC will supply a voltage on the load sharing line equal to the actual load. This voltage comes from an internal power transducer. At the same time, the actual voltage on the load sharing line will be measured.

> *If the measured voltage is higher than the voltage from the internal power transducer, then the BGC will increase its load in order to match the voltage on the load sharing line.*
>
> *If the measured voltage is lower than the voltage from the internal power transducer, then the BGC will decrease its load in order to match the voltage on the load sharing line.*

The voltage on the load sharing line will only be different from the voltage from the internal power transducer, if two or more multi-line 2 units are connected to the load share line.

Example 1:

Two generators are running in parallel. The load of the generators are:

Generator	Actual load	Voltage on loadsharing line
Generator 1	100%	5V DC
Generator 2	0%	0V DC

The voltage level on the load sharing line can be calculated to:

U_{LS}: (5 + 0) / 2 = 2.5V DC

Now generator 1 will decrease the load in order to match the voltage on the load sharing line (in this example 2.5V DC). Generator 2 will increase the load in order to match the 2.5V DC.

The new load share situation will be:

Generator	Actual load	Voltage on loadsharing line
Generator 1	50%	2.5V DC
Generator 2	50%	2.5V DC

In case of generators of different size, the load sharing will still be carried out on the basis of a percentage of the nominal power.

Example 2:

Two generators supply the busbar. The total load is 550kW.

Generator	Nominal power	Actual load	Voltage on load sharing line
Generator 1	1000kW	500kW	2.5V DC
Generator 2	100kW	50kW	2.5V DC

Both generators are supplying 50% of their nominal power.

Functional description

2010 Synchronising type

No.	Setting		First setting	Second setting	Factory setting
2010	Sync. type	Selection display	-	-	-
2011	Sync. type	Sync. type	Static sync.	Dynamic sync.	Dynamic sync.

2020 Synchronising parameters, dynamic sync.

No.	Setting		Min. setting	Max. setting	Factory setting
2020	Dynamic sync.	Selection display	-	-	-
2021	Dynamic sync.	df max.	0.0Hz	0.5Hz	0.3Hz
2022	Dynamic sync.	df min.	-0.5Hz	0.5Hz	0.0Hz
2023	Dynamic sync.	dU max.	2%	10%	5%
2024	Dynamic sync.	Breaker delay	40ms	300ms	50ms

Setting	Description	Note
df max.	The df max. setting indicates the maximum allowed slip frequency when synchronising	
df min.	The df min. setting indicates the minimum allowed slip frequency when synchronising	
dU max.	The “dU max.” setting is the maximum allowed voltage difference between the generator and the busbar	+/- value
Breaker delay	Response time of the breaker	

The synchronisation pulse is 400ms or continuous signal.

2030 Synchronising parameters, static sync.

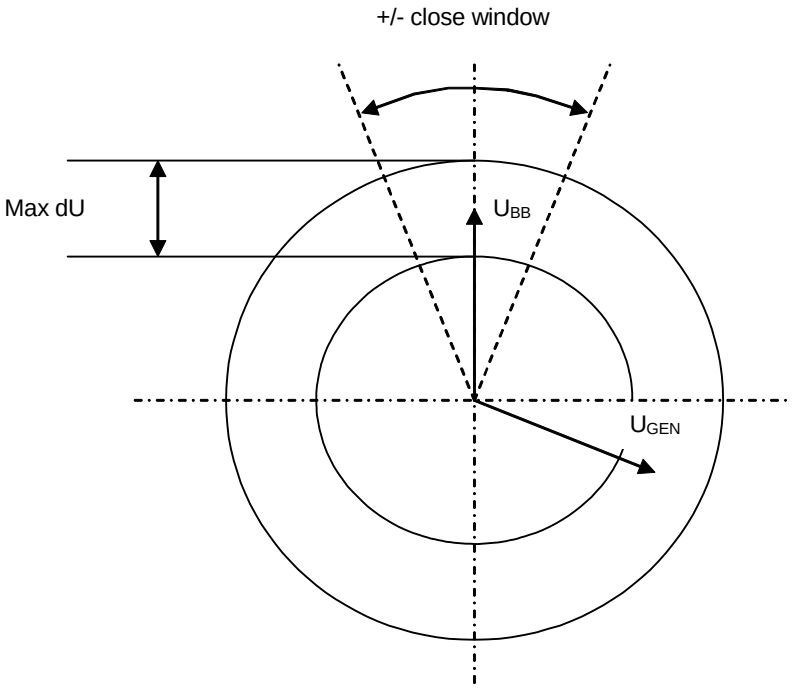
No.	Setting		Min. setting	Max. setting	Factory setting
2030	Static sync.	Selection display	-	-	-
2031	Static sync.	Maximum df	0.00Hz	1.00Hz	0.25Hz
2032	Static sync.	Maximum dU	2%	10%	5%
2033	Static sync.	Close window	0.1 deg.	20.0 deg.	10.0 deg.
2034	Static sync.	Phase K_P	0	400	250
2035	Static sync.	Phase K_I	0	400	160

The following parameters are used for the static synchronisation:

Setting	Description	Note
Maximum df	The maximum allowed frequency difference between the busbar/mains and the generator	+/- value
Maximum dU	The maximum allowed voltage difference between the busbar/mains and the generator	+/- value, related to the generator nominal voltage (setting 4014)
Close window	The size of the window where the synchronisation pulse can be released	+/- value
Phase K_P	Adjustment of the proportional factor of the PI phase controller	Only used during static synchronisation
Phase K_I	Adjustment of the integral factor of the PI phase controller	

The synchronising pulse is 400ms or continuous signal.

Synchronising will initiate when the generator voltage is within the close window, and the frequency difference is within the df and dU settings.



General failure alarms

2060 GB general failure

- Synchronisation time — Adjustable time delay channel 2061/2071
- Breaker ON/OFF feedback fail. — 1 second fixed time delay
- Phase sequence error — 1 second fixed time delay

No.	Setting		Min. setting	Max. setting	Factory setting
2060	GB general fail.	Selection display	-	-	-
2061	GB general fail.	Delay	30.0 s	300.0 s	60.0 s
2062	GB general fail.	Relay output A	R0 (none)	R3 (relay3)	R0 (none)
2063	GB general fail.	Relay output B	R0 (none)	R3 (relay3)	R0 (none)

The general failure alarms cannot be disabled.

2070 MB general failure

- Synchronisation time — Adjustable time delay channel 2061/2071
- Breaker ON/OFF feedback fail. — 1 second fixed time delay
- Phase sequence error — 1 second fixed time delay

No.	Setting		Min. setting	Max. setting	Factory setting
2070	MB general fail.	Selection display	-	-	-
2071	MB general fail.	Delay	30.0 s	300.0 s	60.0 s
2072	MB general fail.	Relay output A	R0 (none)	R3 (relay3)	R0 (none)
2073	MB general fail.	Relay output B	R0 (none)	R3 (relay3)	R0 (none)

The general failure alarms cannot be disabled.

Controller parameters

2090 Frequency controller

No.	Setting		Min. setting	Max. setting	Factory setting
2090	Freq. control	Selection display	-	-	-
2091	Freq. control	Deadband	0.2%	10.0%	1.0%
2092	Freq. control	F K_P	0	1000	250
2093	Freq. control	F K_I	0	1000	160

Frequency % settings relate to nominal generator frequency (setting 4011). It is used for frequency control (fixed frequency or load sharing) when the breaker is closed, and for synchronising if the breaker is open.

2100 Power controller

No.	Setting		Min. setting	Max. setting	Factory setting
2101	Power control	Deadband	0.2%	10.0%	2.0%
2102	Power control	P K_P	0	1000	250
2103	Power control	P K_I	0	1000	160

Power % settings relate to nominal generator power.

2110 Power ramp up

No.	Setting		Min. setting	Max. setting	Factory setting
2111	Power ramp up	Speed	1.0%/s	20.0%/s	2.0%/s
2112	Power ramp up	Delay point	1%	100%	10%
2113	Power ramp up	Delay time	0.0 s	180.0 s	10.0 s

The delay point and time is the point where the generator stops ramping after closing of generator breaker to pre-heat the engine before commencing to take load. The time duration of the point is determined by the delay time setting. If the delay function is not needed, set the time to 0.

Power % settings relate to nominal generator power.

2120 Power ramp down

No.	Setting		Min. setting	Max. setting	Factory setting
2121	Power ramp down	Speed	0.1%/s	20.0%/s	10.0%/s
2122	Power ramp down	Breaker open set point	1%	20%	5%

The breaker open point is where a relay output is activated to open the generator breaker before reaching 0kW.

Power % settings relate to nominal generator power.

PI controller

The BGC includes controllers for the different running modes, and they control either a relay output (optional) or an analogue output.

Each controller consists of a proportional factor K_P and an integral factor K_I.

The proportional factor K_P determines the size of the proportional part at a regulation deviation, whereas the integral factor K_I determines the integral part. The individual function of K_P and K_I is illustrated in the drawings below. The drawings show the change of the output, when the input value deviates from the set point, e.g. because of a frequency change.

Illustration 1

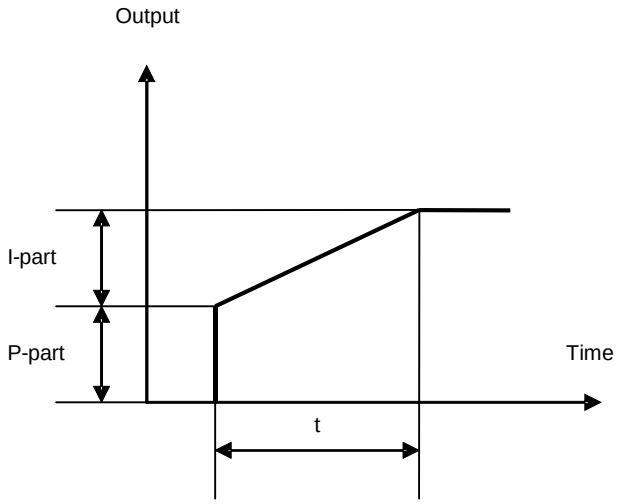
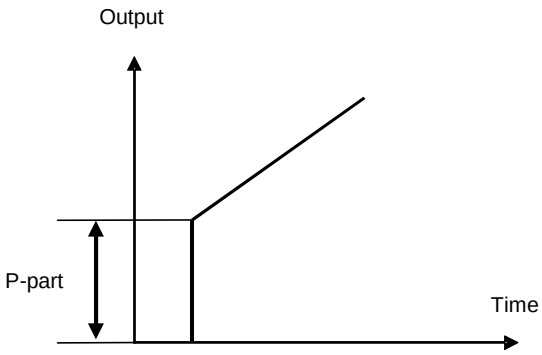


Illustration 1 indicates the effect of the K_P factor and of the K_I factor at a regulation deviation.

The proportional part takes immediate effect. The integrational part neutralizes the remaining regulation deviation.

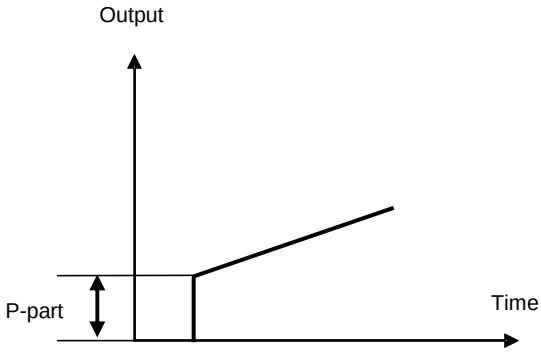
The illustrations below illustrate the effect changes of the K_P and K_I will have on the regulation output.

Illustration 2, high K_P setting



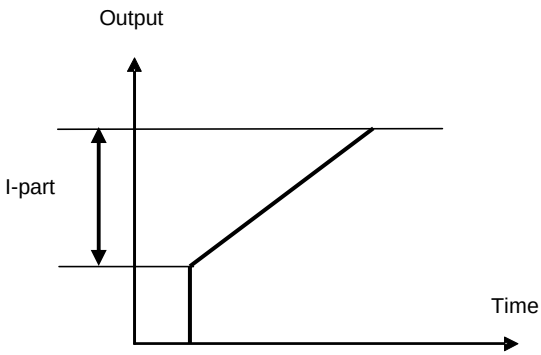
The P-part of the output can be changed by changing the K_P factor. Increasing K_P increases the P-part.

Illustration 3, low K_P setting



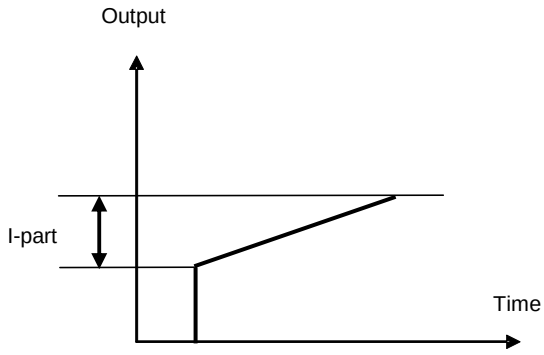
The P-part of the output can be changed by changing the K_P factor. Decreasing K_P decreases the P-part of the regulation.

Illustration 4, high K_I setting



The I-part of the output can be changed by changing the K_I factor. Increasing the K_I factor makes the regulation faster.

Illustration 5, low K_I setting



The I-part of the output can be changed by changing the K_I factor. Decreasing the K_I factor makes the regulation slower.

Controller	When?	Output
Frequency controller	Island mode	Frequency
Power controller	Parallel to mains or load sharing	Power
Voltage controller	Island mode	Voltage
var controller	Parallel to mains or var's sharing	var's or power factor

It is necessary to tune in all the present controllers in the relevant running modes.

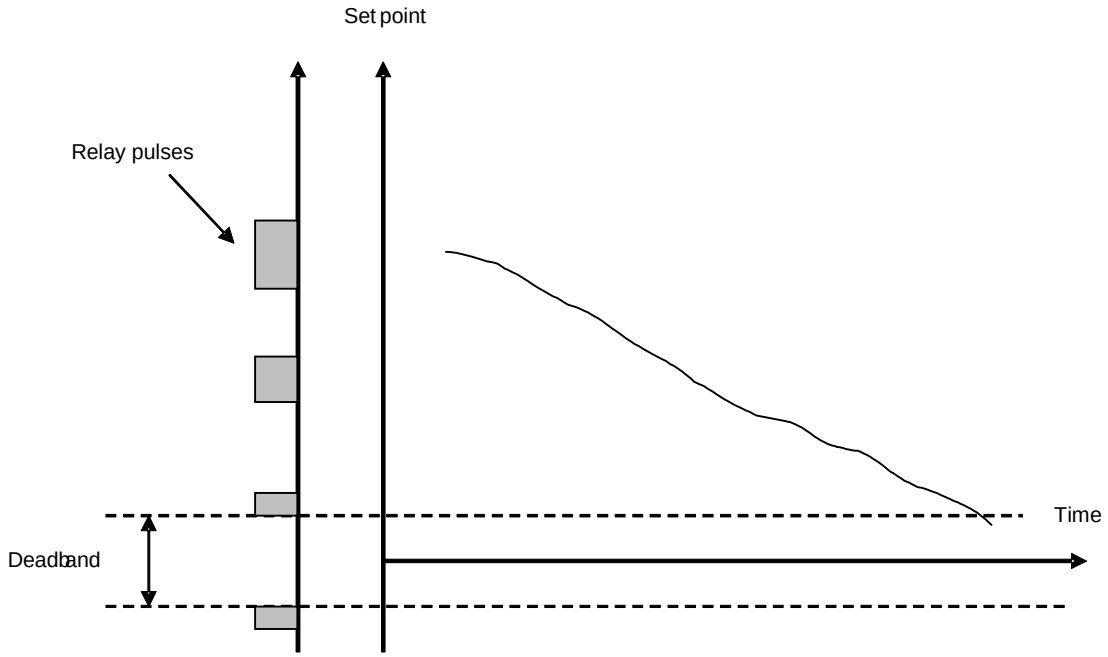
Relay control

Relay control

This setting is used to tune in the GOV/AVR ON time, when relay outputs are being used for control. The total relay ON time will depend on the deviation from the set point. t_N is the minimum time, the relay can be activated.

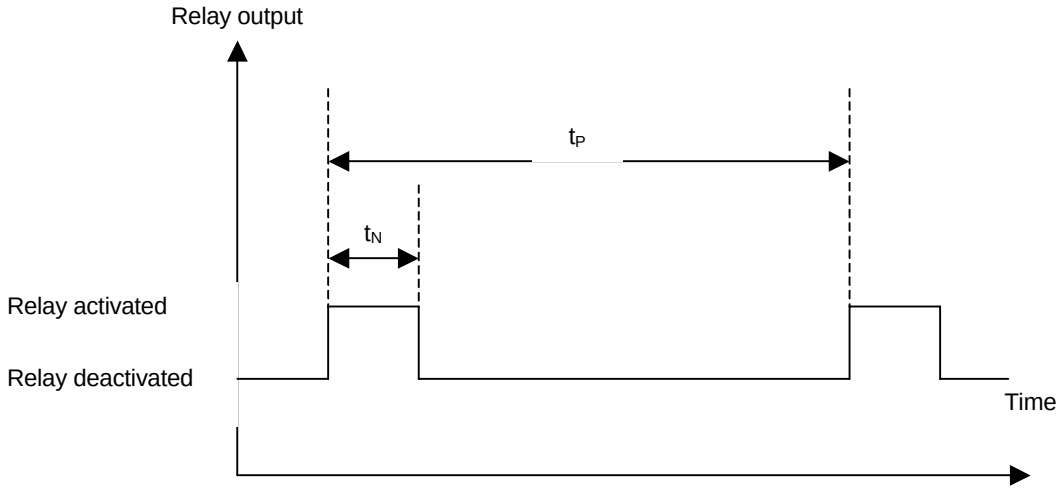
No.	Setting		Min. setting	Max. setting	Factory setting
2231	Relay control	GOV ON time t_N	10 ms	3000 ms	500 ms
2232	Relay control	GOV per. time t_P	50 ms	15000 ms	2500 ms
2233	Relay control	AVR ON time t_N	10 ms	3000 ms	100 ms
2234	Relay control	AVR per. time t_P	50 ms	15000 ms	500 ms

Illustration 6, relay control signals



The illustration indicates that the length of the relay pulses depends on the deviation from the set point. The minimum relay output (close to the deadband) is equal to the setting t_N.

Illustration 7, relay control signals



Relay controls selection

The governor and AVR control can freely be selected to any configurable relay not used by any other function. If one M14 option is selected, the max. setting will be relay 9. If M14 is selected twice, the max. relay setting will be relay 13. The AVR up/down is only possible, if D1 or D2 is selected.

4800 Governor and AVR relay setting

No.	Setting		Min. setting	Max. setting	Factory setting
4801	GOV up relay	Output	Relay 0	Relay 5	Relay 0
4802	GOV down relay	Output	Relay 0	Relay 5	Relay 0
4803	AVR up relay	Output	Relay 0	Relay 5	Relay 0
4804	AVR down relay	Output	Relay 0	Relay 5	Relay 0

Governor regulation failure

2180 Governor regulation failure

No.	Setting		Min. setting	Max. setting	Third setting	Factory setting
2181	Governor reg. failure	Reg. error	1.0%	100.0%	-	30.0%
2182	Governor reg. failure	Timer	10.0 s	360.0 s	-	60.0 s
2183	Governor reg. failure	Output A	R0 (none)	R3 (relay3)	-	R0 (none)
2184	Governor reg. failure	Output B	R0 (none)	R3 (relay3)	-	R0 (none)
2185	Governor reg. failure	Enable	1 OFF	2 ON	3 RUN	2 ON

The alarm is activated if the difference between the measured value and the set point is outside the set point for a longer time period than specified by the timer set point.

Analogue GOV offset

2220 Analogue GOV offset

No.	Setting		Min. setting	Max. setting	Factory setting
2221	Analogue GOV	Offset	-100%	100%	0%