

Marine Engineering ATD IS3

Automation on Ships

Generator Protect and Synchronizing Unit GENOP 71

System Description

Edition	Date	Change
1.0	01/1999	New production
1.1	09/1999-09-21	Program structure
1.2	09/2000	Description Portable PC

The content of this brochure is subject to changes, improvements and revisions without notice.

DANGER

For the purpose of this system description and product labels, "Danger" indicates death, severe personal injury or substantial property damage will result if proper precautions are not taken.

WARNING

For the purpose of this system description and product labels, "Warning" indicates death, severe personal injury or substantial property damage can result if proper precautions are not taken.

CAUTION

For the purpose of this system description and product labels, "Caution" indicates minor personal injury or property damage can result if proper precautions are not taken.

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NOTE

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the Purchaser's purposes, the matter should be referred to the local Siemens Sales Office. The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The Sales Contract contains the entire obligations of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens.. Any statements contained herein do not create further warranties or modify the existing warranty.



WARNING

Hazardous voltages are present in this electrical equipment during operation.

Non-observance of the safety instructions can result in severe personal injury or property damage.

Only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all warnings, safety notices, and maintenance procedures contained herein.

The successful and safe operation of this equipment is dependent on proper handling, installation, operation and maintenance.

QUALIFIED PERSON

For the purpose of this instruction manual and product labels, a "qualified person" is one who is familiar with the installation, construction and operation of the equipment and the hazards involved.

In addition, he has the following qualifications:

- a) Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
- b) Is trained in the proper care and use of protective equipment in accordance with established safety practices.
- c) Is trained in rendering first aid.

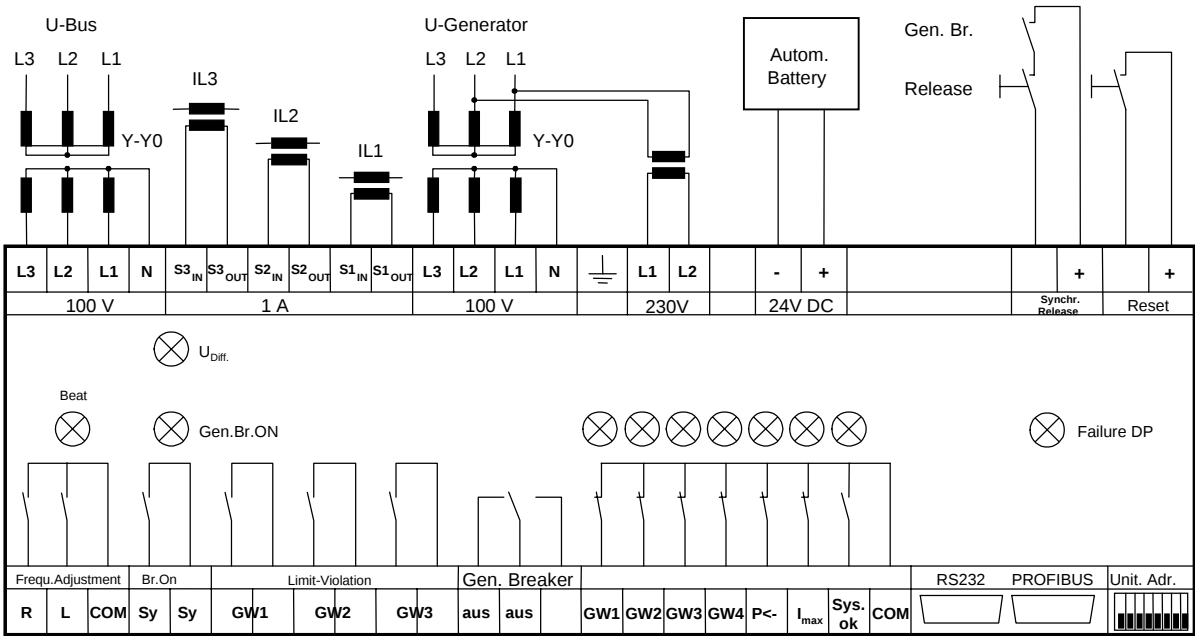
1 General

The generator protection and synchronising unit has the following duties:

- monitoring of short circuit
- monitoring of overcurrent in every phase
- monitoring of reverse power
- disconnecting of unessential consumers
- automatic synchronising of the generator to the busbar
- collecting, processing and transfer of different measuring values via the PROFIBUS-DP

The GENOP 71 can be parameterised via the PLC of the PMA 71.

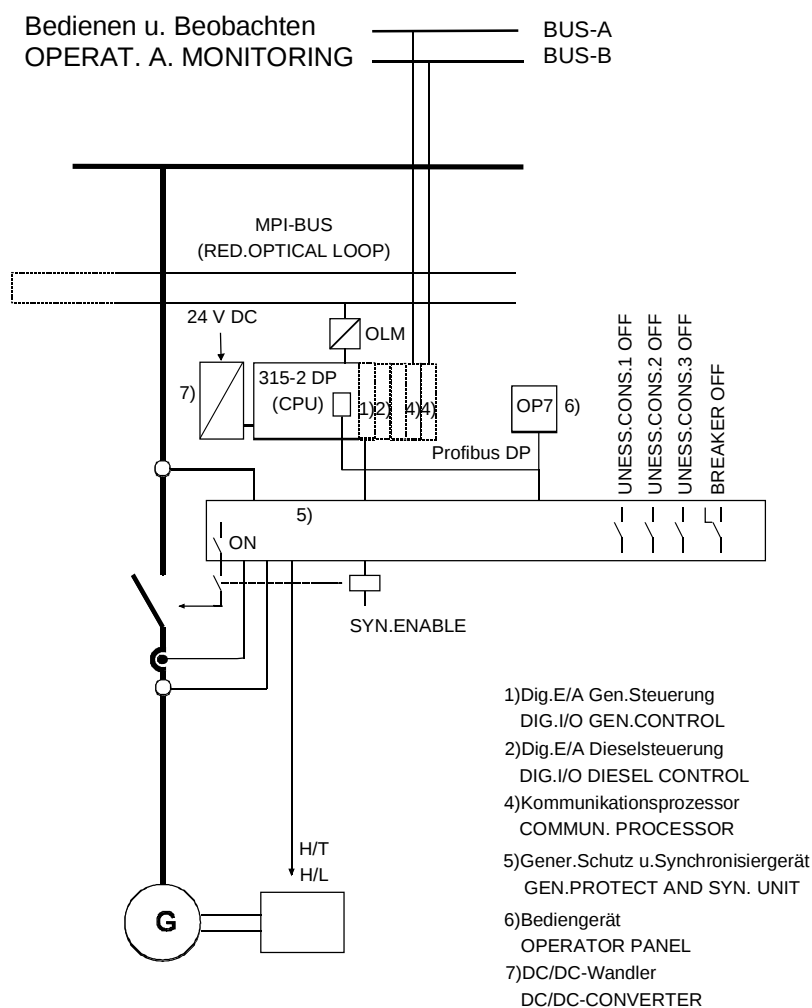
1.1 Overview of the GENOP 71



2 CONSTRUCTION OF PLANT

2.1 Genop integrated in the PMA 71 System

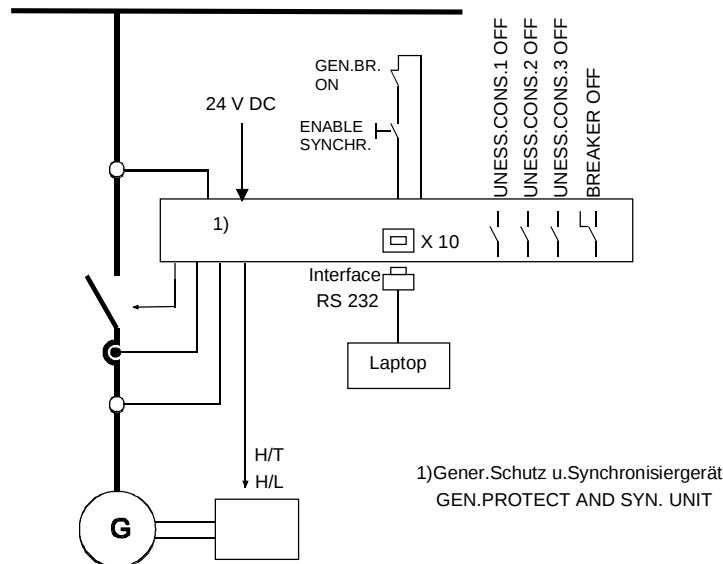
The following picture shows the configuration of the Genop integrated the PMA 71 System. The communication between the Genop and the Simatic-S7 takes place via the Profibus-DP. The parameters for synchronising and generator protect can be changed via the operation panel OP7. For more information see SIMOS PMA 71 System Description chapter 14



2.2 Use of the Genop as stand alone unit

The GENOP 71 can be used as stand alone unit .

The parameters for synchronising and generator protect can be changed via a portabel PC (Laptop)



2.3 Test of the unit

The device should be tested once a year for correct function. If the generator control is configured according the standard layout, a testing plug is available. The cable from the testing device is plugged into the testing plug. Now one lamp is lit at the testing device for each phase. Behind the lamps there is a fuse each that secure the testing device.

In secondary circuit a current of 1A or 5A can be preselected in each phase and set at the rotary button. This switches the instrument at the same time. The current may be read at the respective scale. By means of a second switch the direction of the current is set. In the setting „Normal“ the direction from the generator to the network and in the setting „Reverse“ the direction from the network to the generator is simulated. The ammeter in the switchgear indicates the correct value if the switch for the ammeter is set to the correct position.

By raising the current in each phase now for each phase the triggering point for throwing off the unessential consumers and for turning off the generator breaker can be approached.

When checking the power setting values please take care that the currents in the single phases are all raised equally in order to avoid a wrong triggering by a current that has probably been set too large.

2.4 Parameterizing of the unit via portable PC

If the Genop is used as stand alone unit the settings will be fed by an portable PC. The PC cable is plugged into the RS 232 plug. By mouseclick of the start-button „Genop71“ the program will be started.

The standard menu is displayed:

Load

The stored setup of a genop can be transfered into the parameterize program. There is no automatic transfer to the Genop.

Save

The updated program will be stored into the parameterize program. If the program was not saved before a file name of the new program will be asked. The extension is always .gen

Save As

A path and a file name can be filled in where the data will be transfered

Transmit Data

With this command the updated parameter will be transfered to the Genop.

Receive Data

The actual datas in the Genop available will be transfered into the parametrize program.

Print

A printout of all the parameter can be started.

Exit

Finished the program

2.4.1 Edit

Limit-Values + Delay -Times

Parameter	Description
Current 1	Reference value generator current With exceeding the reference value the unessential consumers 1 – 3 will be switched off step by step time delayed
Current 2	Reference value generator current (Not used)
Current 3	Reference value generator current With exceeding the reference value the unessential consumers 1 – 3 will be switched off short time delayed (1sec.)
Current 4	Reference value generator current With exceeding the reference value the generator breaker will be switched off time delayed (standard time 15sec.)
Reverse Power	Reference value generator active power With exceeding the reference value the generator breaker will be switched off time delayed (standard time 6sec.)
Short Circuit	Reference value generator short circuit current With exceeding the reference value the generator breaker will be switched off short time delayed (0.2 – 0.6sec.)
Delay Time 1 (Current 1)	Delay time With exceeding the reference value Current 1 the delay time will be started and the unessential consumers step 1 will be switched off after elapsing
Delay Time 2 (Current 1)	Delay time With exceeding the reference value Current 1 the delay time will be started and the unessential consumers step 2 will be switched off after elapsing
Delay Time 3 (Current 1)	Delay time With exceeding the reference value Current 1 the delay time will be started and the unessential consumers step 3 will be switched off after elapsing

Delay Time 3.1 (Current 3)	Delay time With exceeding the reference value "Current 3" the delay time will be started and the unessential consumers step 1 - 3 will be switched off after elapsing
Delay Time 4 (Current 4)	Delay time With exceeding the reference value "Current 4" the delay time will be started and the generator breaker will be switched off after elapsing
Delay Time 5 (Reverse Power)	Delay time (reverse power) With exceeding the reference value "Reverse Power" the delay time will be started and the generator breaker will be switched off after elapsing
Delay Time 6 (Short Circuit)	Delay time (short circuit) With exceeding the reference value "Short Circuit" the delay time will be started and the generator breaker will be switched off after elapsing

Internal Parameters

Parameter	Description
Limits	
Sync.Short-Impulse Lenght	Timer Short-pulse lenght
Short-Impulse Pulse Ratio	Factor for setting the ratio of the pulse/pause time of the short pulses for synchronising
Sync.Long-Impulse Lenght	Timer Long-pulse lenght
Long-Impulse Pulse Ratio	Factor for setting the ratio of the pulse/pause time of the long pulses for synchronising
Frequ.Limit Switching from Permanent to Long Impulse Lenght	Reference value for switch over from steady- to longe pulse
Frequ.Limit Switching from Long to Short Impulse Lenght	Reference value for switch over from long- to short pulse

Sync.Enable Limits

Parameter	Description
Limits	
Sync.Diff.Frequency Limit	Reference value Difference between the generator and the busbar-frequency. With exceeding the reference value the output of higher/lower pulses for frequency detuning will be blocked.
Sync.Diff.Voltage Limit	Reference value Voltage difference between the generator and the busbar-voltage. With exceeding the reference value the output of higher/lower pulses for frequency detuning and the switch on of the generator breaker will be blocked.
Sync.Connecting Limit	Reference value Difference between the generator and the busbar-frequency. With exceeding the reference value the switch on of the generator breaker will be blocked. The output of higher/lower pulses for frequency detuning is enabled.
Pre-Switching Time	Timer Calculated time between the ON command from the Genop and closing of the generator breaker.
Switch ON Impuls Lenght	Timer Generator breaker ON pulse lenght

U+I Transformation

Parameter	Description
Primary Voltage Transformer	Nominal voltage of the busbar
Primary Current Transformer	Nominal current of the generator

2.4.2 Extras

Trigger controlling

With this function the trigger of Current 1-4, Reverse Power and Short Circuit can be disabled. (Only possible if the portable PC is connected to a Genop)

Generator Frequ.

The generator frequency can be changed by mouse click.

Precondition:

- The voltage difference between the generator and the busbar-voltage is lower as the reference value "Sync.Diff.Voltage Limit"
- The frequency difference between the generator and the busbar-frequency is lower as the reference value "Sync.Diff.Frequency Limit".

PC-Interface

The PC-Interface (COM Port 1-3) can be selected.

? About GENOP 71

This menu shows the version no. of the parameterize program and the firmware of the connected Genop

3 Generator Protection

3.1.1 Overcurrent Time Protection

The three generator-currents IL1, IL2, IL3 are detected via a current transformer. The extreme value out of the three currents is calculated and checked for limits.

The function of the generator protection is shown in the following table:

GENERATOR CURRENT

REF.VALUE (GW)	I IN %	DEL.TIME	RELAY GW1	RELAY GW2	RELAY GW3	RELAY GEN.BR. OFF
GW1	100	5 S	x			
		10 S		x		
		15 S			x	
GW3	120	1 S	x	x	x	
GW4	110	30 S				x

REVERSE POWER

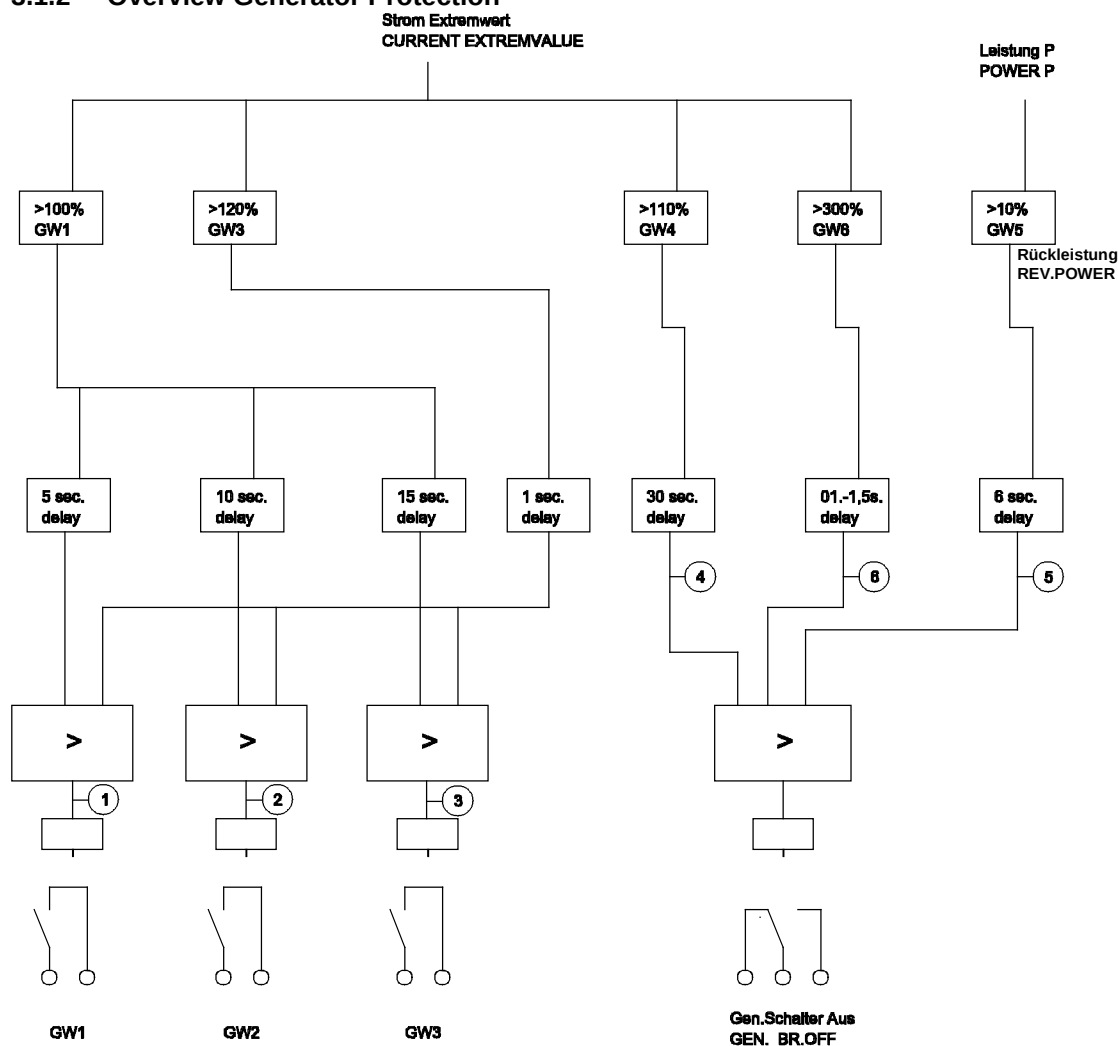
REF.VALUE (GW)	P IN %	DEL.TIME	RELAY GW1	RELAY GW2	RELAY GW3	RELAY GEN.BR. OFF
GW5	10	6 S				x

SHORT CIRCUIT

REF.VALUE (GW)	I IN A	DEL.TIME	RELAY GW1	RELAY GW2	RELAY GW3	RELAY GEN.BR. OFF
GW6	>300	0.1-1.5 S				x

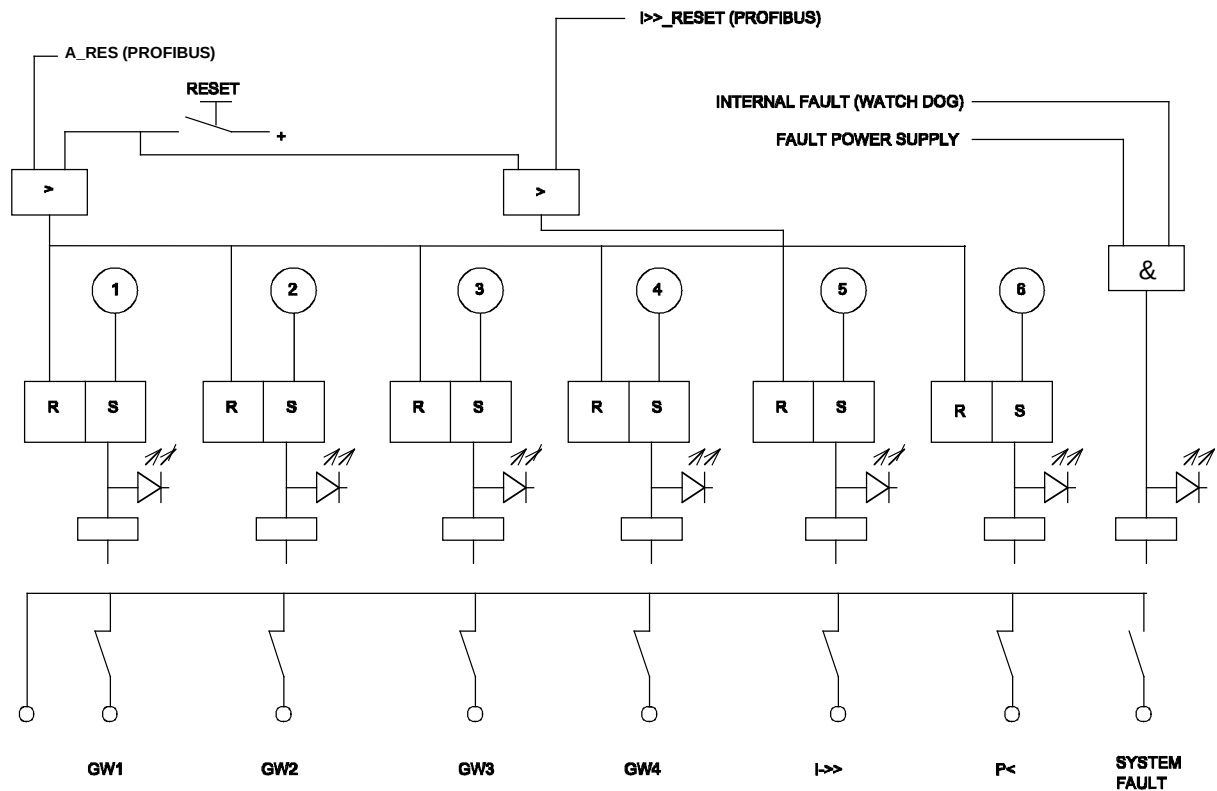
Please note: Delay times and reference values are standard values and can be different in the projects

3.1.2 Overview Generator Protection



Please note: Delay times and reference values are standard values and can be different in the projects

3.1.3 Overview Fault Diagnosis



All alarms caused by the generator protection will be stored and indicated via LED's. The alarms will be acknowledged either from the operating system or via a separate acknowledgement pushbutton.

3.2 Synchronising

3.2.1 Frequency Adjustment

After starting of the generator set the generator frequency is first led close to the busbar frequency with a continuous adjustment command. The comparison, if the generator frequency is $<$ or $>$ than the busbar frequency, is done in the synchronising unit.

If $F\text{-gen.} < \text{than } F\text{-busbar}$, signal "1" appears at the output "HIGHER".

If $F\text{-gen.} > \text{than } F\text{-busbar}$, signal "1" appears at the output "LOWER".

The length of the higher/lower commands are changeable via the operator panel.

3.2.2 Beat voltage

In order to synchronise the generator circuit breaker the beat voltage obtained from the measuring transducer is evaluated. The beat voltage is generated by comparing the busbar and the generator voltage.

According to the difference between $F\text{-gen.}$ and $F\text{-busbar}$ also the slope of the beat voltage changes. The slope of the beat voltage is evaluated and the synchronisation command is given before the zero passage of the beat voltage with the appropriate lead time.

3.2.3 Lead Time

The lead time (the time between ON command and closing of the breaker) has to be set according to the data of the generator circuit breaker.

The following table shows the allowed lead time related to the difference frequency $F\text{-gen}/F\text{-busbar}$.

Generator/Bus difference frequency [HZ]	Lead Time Max. [msec]
0.2	456
0.3	276
0.4	192
0.5	204
0.6	146
0.7	128
0.8	88
0.9	60
1.0	58

3.2.4 Deviation of Frequency

The deviation between generator frequency and busbar frequency is also derived from the beat voltage. In case of a frequency deviation >0.5 Hz the closing of the generator breaker is blocked. In case of a frequency deviation >10 Hz the higher/lower commands are blocked, because in this case there can only be a fault on the generator set.

3.2.5 Frequency Detuning

If the generator frequency is led very closely to the busbar frequency by a control command and a continuous beat in phase opposition occurs (at a smooth busbar), a greater ΔF is generated by a control command of the synchronising unit in the detection of higher/lower in order to make fast

synchronising possible. For this the zero passages of the beat are evaluated. Unless a zero passage of the beat occurs within a certain time, the higher/lower passage command is given again.

3.2.6 Voltage Difference Monitoring

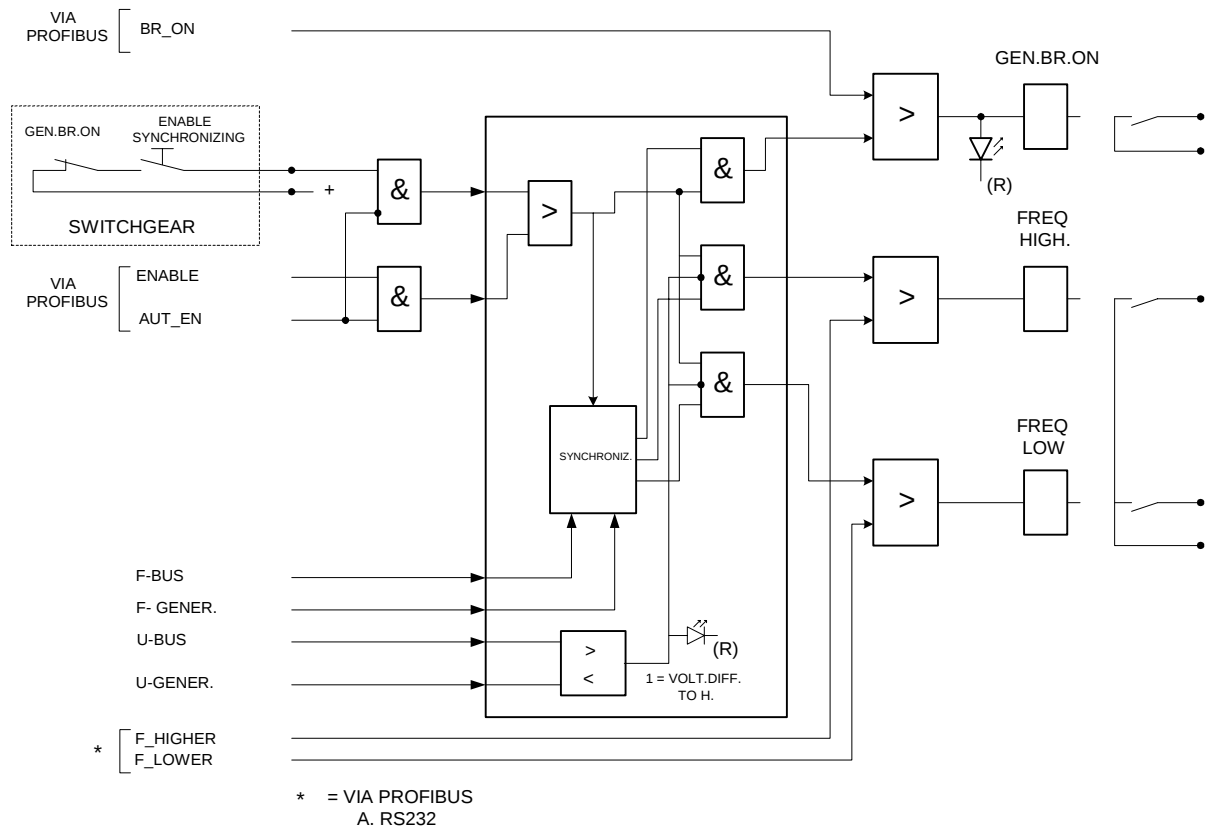
If the voltage of the oncoming generator does not match the bus bar voltage within set limits, the synchroniser will not allow the generator breaker closing. Exceeding of the limits will be indicated by a LED arranged at the front side of the synchronising unit.

3.2.7 Changeable Values for Synchronisation

Some values for the synchronisation can be changed via the operator panel. Is the Generator protection/synchronising unit used standalone, these values can be set with a PC program.

- Limit for differential frequency for release of the frequency adjustment (e.g. 10 Hz)
- Limit for differential frequency for change over from continuous signal to long pulse (e.g. 1.5 Hz)
- Limit for differential frequency for change over from long pulse to short pulse (e.g. 0.6 Hz)
- Limit for differential frequency for release of the generator breaker closing in case of passage through zero (e.g. 0.5 Hz)
- Pulse length for short pulses
- Pulse length for long pulses
- Lead time before passage through zero of the beat voltage (closing time of the generator breaker)
- Length of the generator breaker closing command
- Delay time before release of the frequency detuning
- Pulse length of the Higher/Lower pulses for frequency detuning
- Limit for voltage difference between generator voltage and busbar voltage for the blocking of the speed setting pulses and the generator breaker closing (e.g. 10% voltage difference)

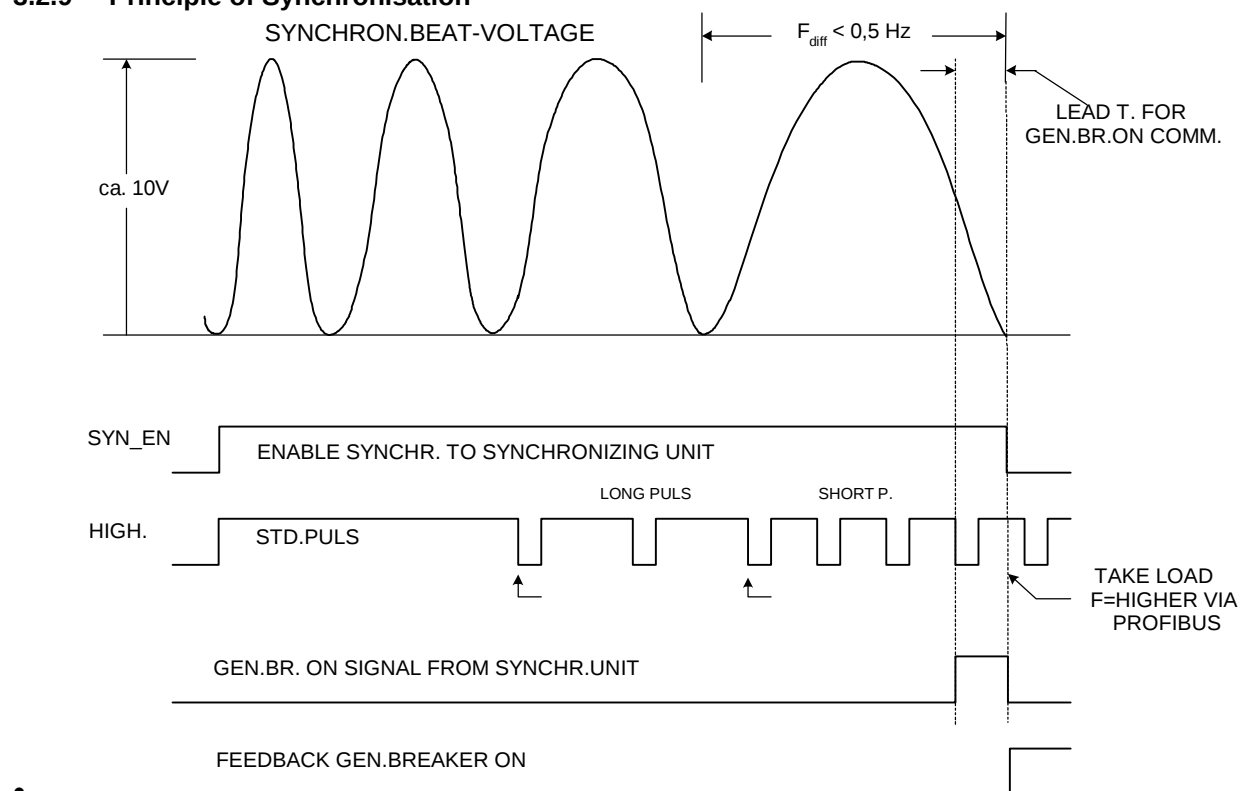
3.2.8 Overview Synchronising



Meaning of the Parameter:

BR_ON	Generator breaker on signal
SYN_EN	Enable Synchronising
AUT_EN	Automatic-mode
F_HIGHER	Frequency adjustment puls higher
F_LOWER	Frequency adjustment puls lower

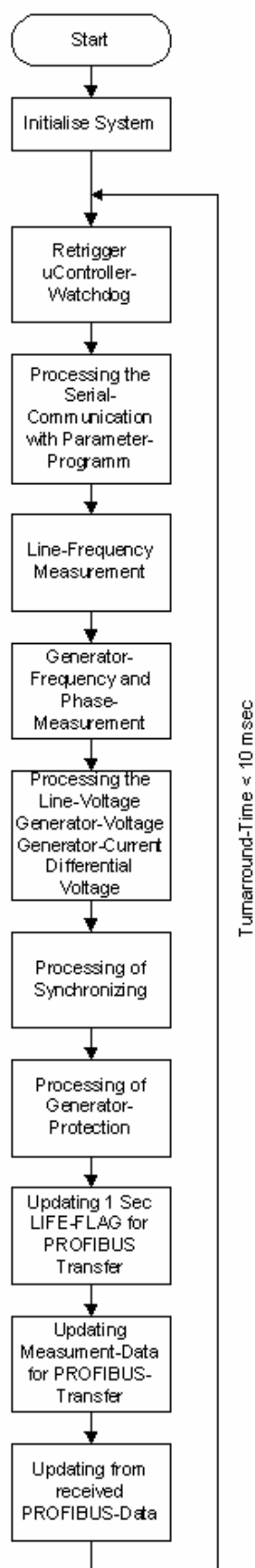
3.2.9 Principle of Synchronisation



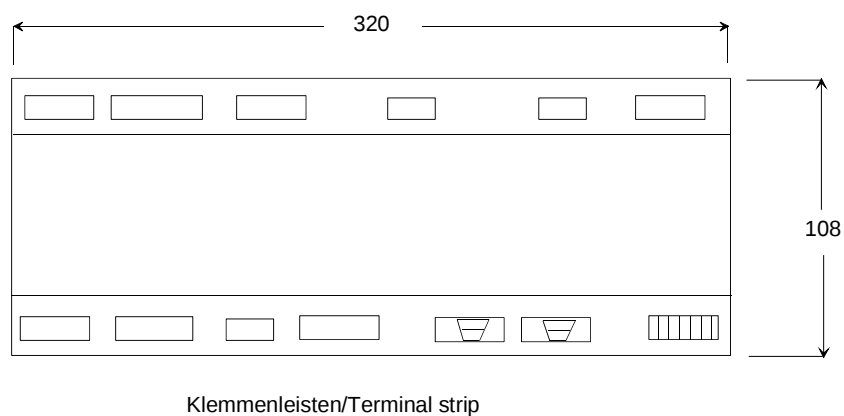
3.3 Technical Data

Degree of protection	IP 20 in accordance with IEC 529
Temperature range Operation Transport, storage	0 to 60 °C -40 to +70 °C
Relative humidity	5% to 95%, no condensation (RH-stress rating 2 in accordance with IEC 1131-2)
Air pressure	795 to 1080 hPa
Insulation	Testing voltage DC 500 V (DC 24 V circuits)
Supply voltage (from ship's battery) - Rated value - Acceptable range	DC 24 V DC 19.2 to 31.2V (-20% to +30%)
Supply voltage (from generator) - Rated value - Acceptable range	AC 230 V AC 207 to 253 V (-10% to +10%)
Current consumption DC 24V, typ.	0.52A
Input voltage (Generator voltage, busbar voltage)	AC 100 V (phase to phase), 50/60 Hz
Power consumption AC 100V, typ.	1 VA
Input current (Generator current)	AC 0 to 1 A
Digital inputs	DC 0 to 32 V
Load capacity of the output relay contacts Max. making voltage Max. making current Max. continuous current	AC 250 V / DC 110 V 5 A 1 A
Max. breaking capacity (resistive load)	up to AC 250 V, 500 VA
Dimensions (W x H x D)	230 x 100 x 100 mm
Weight	approx. 1.0 kg

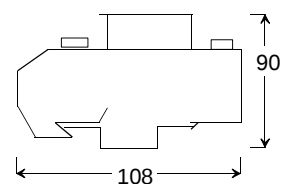
3.4 Program structure



4 Dimensions



Metallgehäuse/Metal cover



Generatorschutzgerät/Generator protection unit
GENOP 71