Released

Group Controller – GC-3400XT-P1

Manual | easYgen | GC-3000XT

Group Controller – GC-3400XT-P1

Release 1.1

37689

This is no translation but the original Technical Manual in English.

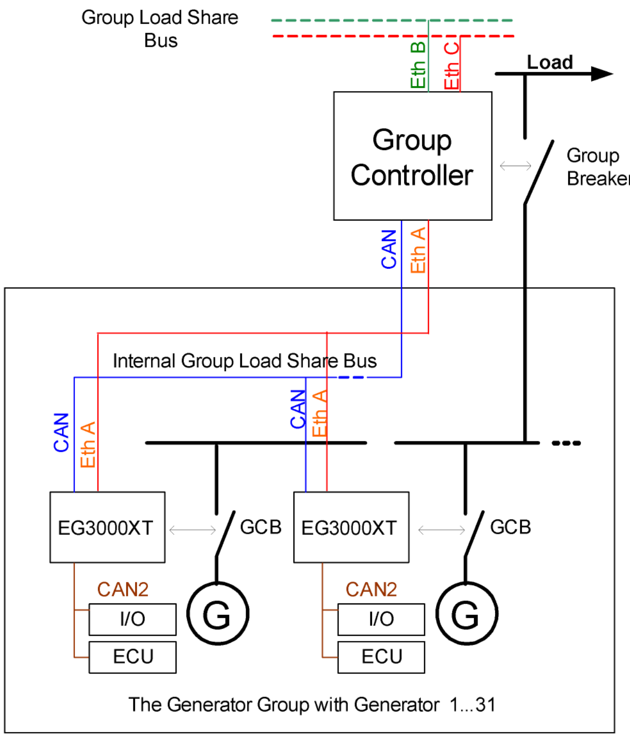
Designed in Germany and Poland

Woodward GmbH
Handwerkstrasse 29
70565 Stuttgart
Germany
Telephone: +49 (0) 711 789 54-510
Fax: +49 (0) 711 789 54-101
E-mail: stgt-info@woodward.com
Internet: http://www.woodward.com

Brief Overview

The group controller concept is based on the idea to combine up to 31 easYgen3000XT with one group controller into a group. In release 1 up to 8 groups can be connected on a common load busbar. Therefore it is possible to run up to 248 generators together.

Through a provided mains AC measurement of the group controller the device can support a synchronization of a circuit breaker at the interchange point to utility.



The Generator Group is defined as follows:

- 1 Group Controller GC3000XT (GC) per Group
- A group contains up to 31 easYgens
- Theoretically up to 31 groups are possible (Release 1 provides up to 8 GC)
- The GC manages a Generator Group Breaker (GGB) with synchronization and dead busbar closure
- The GC participates on the Internal Group Load Share communication by CAN/Ethernet
- The GC participates on the Group Load Share communication to other GC by redundant Ethernet
- The GC provides Toolkit as HMI for service purposes
- The GC provides relevant data for PLC and SCADA systems (Modbus TCP)
- Load share communications are performed with redundant communication channels.
- The GC contains the LDSS algorithm and starts/stops up to 248 easYgens.
- The LDSS algorithm can be emulated with a PC program
- The outcome of the emulation can be a parameter transfer to the GC devices

- The group controller leads its own easYgens in voltage and frequency to support a tie- or MCB synchronization.
- The group controller leads its own easYgens in active and reactive power to unloading the MCB at the interchange point.

Schematic GC-3400XT-P1

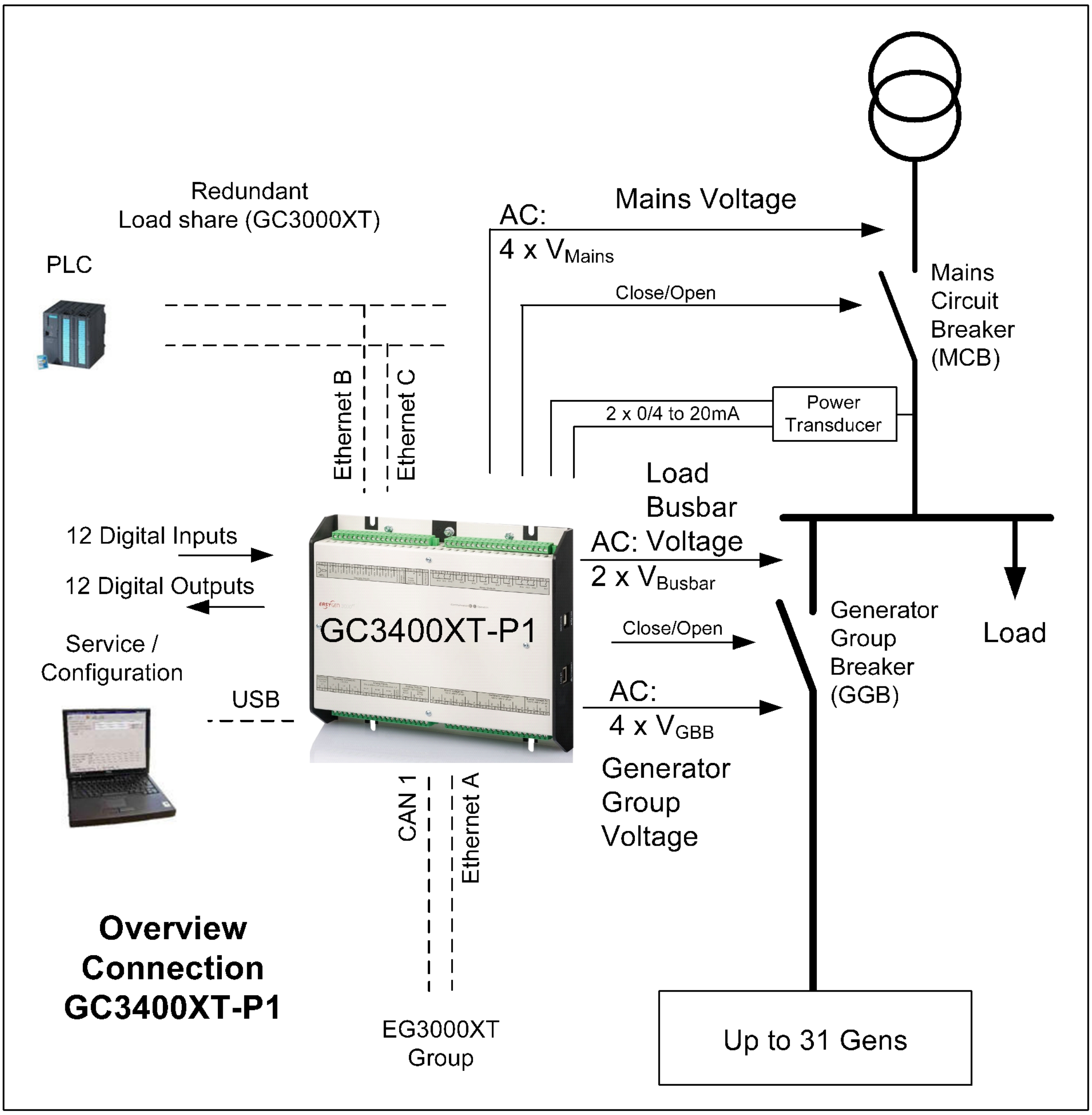


Fig. 1: GC-3400XT-P1 – connectivity overview

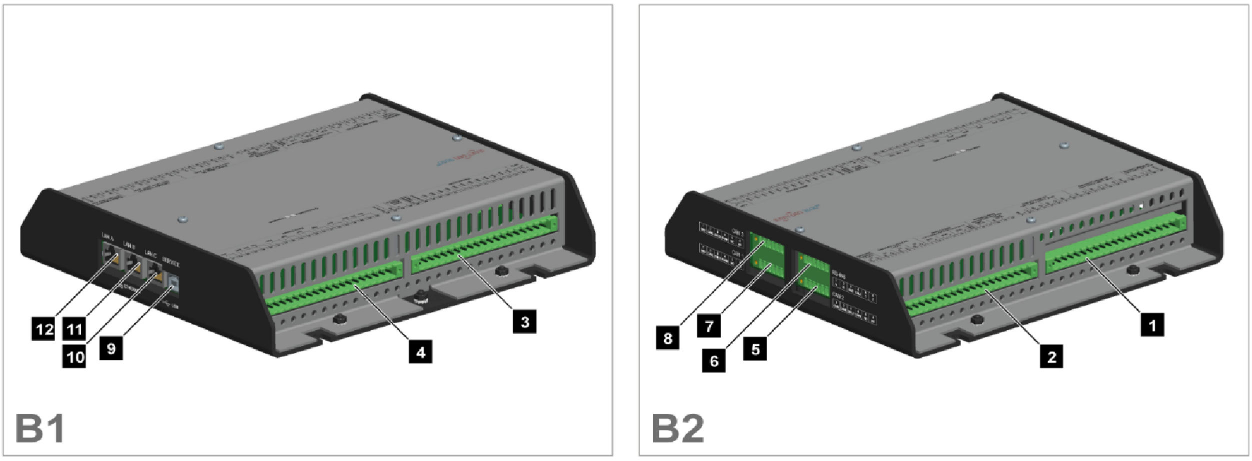


Fig. 2: GC-3400XT-P1 (sheet metal housing)

1 Mains/generator/busbar PT terminal
2 Analog inputs/outputs, generator CT, and mains/GND current terminal
3 Discrete inputs, MPU, power supply, and D+ terminal
4 Relay outputs terminal
5 CAN bus interface connector CAN #2 (not supported)
6 RS-485 interface connector RS-485 #1 (not supported)
7 CAN bus interface connector CAN #1
8 CAN bus interface connector CAN #3 (not supported)
9 USB interface connector (2.0, slave) SERVICE port
10 ETHERNET interface connector (RJ-45) LAN C
11 ETHERNET interface connector (RJ-45) LAN B
12 ETHERNET interface connector (RJ-45) LAN A

The GC-3400XT-P1 is a control unit for engine-generator system management applications. It is only usable in conjunction with ***easYgen3500XT-P2 K51*** *devices.*

The GC3000XT is designed for use with a dedicated easYgen3500XT device. All function described in this manual are only performable, if the easYgen3500XT-P1/P2 K51 is used.

Scope of delivery

The following parts are included in the scope of delivery. Please check prior to the installation that all parts are present.

Fig. 3: Scope of delivery - schematic

A Device GC-3400XT-P1 (sheet metal housing). All screwable terminal connectors are delivered with plug and jack.
B Product CD (configuration software) and manual.

Sample application setup

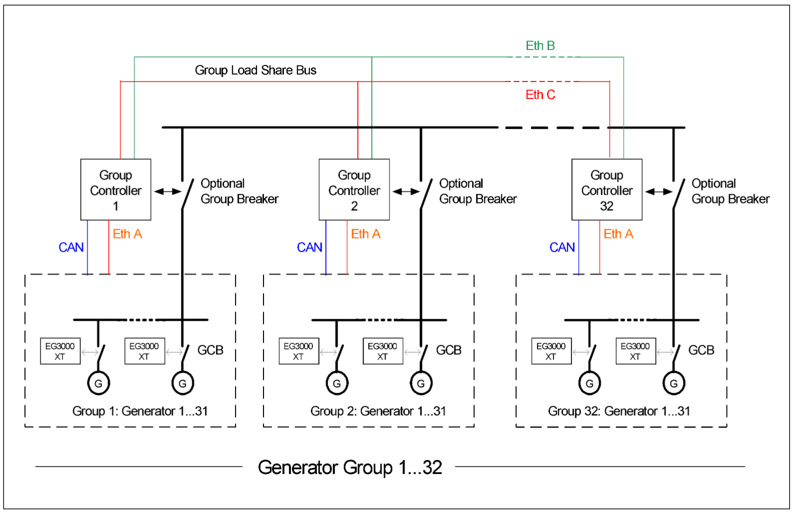


Fig. 4: Sample application setup

The group controller concept is based on the idea to combine up to 31 easYgen3000XT with one group controller in a group. The data flow within this group shall be handled either by CAN or Ethernet or CAN/Ethernet. This communication bus is named as “Internal Group Load Share Bus”. The group controller collects and sorts the data of its group and acts itself as a “Big Genset” control to other group controller(s). The group controller shares therefore the needed data over a second communication bus, here named as “Group Load Share Bus”. Through the decoupling of the overall data, the bus band width can be kept low and the single genset operation can be kept alive, even if a group controller fails. Further features of the group controller concept is the handling of a group breaker, which is often required. So the group controller can synchronize or serve the breaker in dead busbar situations accordingly.

Additionally the group controller supports the synchronization of a tie- or MCB breaker, if the own group is involved.

Table of contents

1 General Information

1.1 About This Manual

1.1.1 Revision history

Build	Date	Editor	Changes
1.1-0 39641	2018-10-01	SM	■ Removing of experimental status. ■ Added Parameter for Missing easYgen Self Acknowledge. ■ ToolKit: Providing different texts and logic for the LED on homepage “GGB open”.

Up to date documentation?
Please check Woodward web site for latest revision of this Technical Manual (search for "39641") and if there is an Errata Sheet with latest information (search for: "37901").

1.1.2 Depiction Of Notes And Instructions

Safety instructions

Safety instructions are marked with symbols in these instructions. The safety instructions are always introduced by signal words that express the extent of the danger.

DANGER!
This combination of symbol and signal word indicates an immediately-dangerous situation that could cause death or severe injuries if not avoided.

WARNING!
This combination of symbol and signal word indicates a possibly-dangerous situation that could cause death or severe injuries if it is not avoided.

CAUTION!
This combination of symbol and signal word indicates a possibly-dangerous situation that could cause slight injuries if it is not avoided.

NOTICE!
This combination of symbol and signal word indicates a possibly-dangerous situation that could cause property and environmental damage if it is not avoided.

Tips and recommendations

This symbol indicates useful tips and recommendations as well as information for efficient and trouble-free operation.

Additional markings

To emphasize instructions, results, lists, references, and other elements, the following markings are used in these instructions:

Marking	Explanation
⮡	Step-by-step instructions
⇨	Results of action steps
↯	References to sections of these instructions and to other relevant documents
■	Listing without fixed sequence
[Buttons]	Operating elements (e.g. buttons, switches), display elements (e.g. signal lamps)
"Display"	Screen elements (e.g. buttons, programming of function keys)
"Screen xx ➔ *Screen xy* ➔ *Screen xz"* ...	Menu path. The following information and setting refer to a page in ToolKit located as described here.
TKit	Some parameters/settings/screens are available only in ToolKit.

Dimensions in Figures
All dimensions shown with no units specified are in mm.

1.2 Copyright And Disclaimer

Disclaimer

All information and instructions in this manual have been provided under due consideration of applicable guidelines and regulations, the current and known state of the art, as well as our many years of in-house experience. Woodward assumes no liability for damages due to:

- Failure to comply with the instructions in this manual
- Improper use / misuse
- Willful operation by non-authorized persons
- Unauthorized conversions or non-approved technical modifications
- Use of non-approved spare parts

The originator is solely liable to the full extent for damages caused by such conduct. The agreed upon obligations in the delivery contract, the general terms and conditions, the manufacturer's delivery conditions, and the statutory regulations valid at the time the contract was concluded, apply.

Copyright

1.3 Service And Warranty

Our Customer Service is available for technical information.

For regional support, please refer to: http://www.woodward.com/Support_pgd.aspx.

In addition, our employees are constantly interested in new information and experiences that arise from usage and could be valuable for the improvement of our products.

Warranty terms

Please enquire about the terms of warranty from your nearest Woodward representative.

For our contact search webpage please go to: http://www.woodward.com/Directory.aspx

1.4 Safety

1.4.1 Intended Use

The GC3000XT is designed for use with a dedicated easYgen3500XT device. All functions described in this manual are only performable, if the correct easYgen3500XT are incorporated. Please refer to Woodward for the correct easYgen device.

NOTICE!

Damage due to improper use!

Improper use of the genset control unit may cause damage to the control unit as well as connected components.

Improper use includes, but is not limited to:

– Storage, transport, and operation outside the specified conditions.

1.4.2 Personnel

WARNING!

Hazards due to insufficiently qualified personnel!

If unqualified personnel perform work on or with the control unit hazards may arise which can cause serious injury and substantial damage to property.

– Therefore, all work must only be carried out by appropriately qualified personnel.

This manual specifies the personnel qualifications required for the different areas of work, listed below:

- Well trained for electrical installations.
- Skilled and competent to be aware especially of the local safety regulations.
- Experienced in working on electronic measuring and control devices.
- Allowed to manage the controlled (engine/generator) system.

The workforce must only consist of persons who can be expected to carry out their work reliably. Persons with impaired reactions due to, for example, the consumption of drugs, alcohol, or medication are prohibited.

When selecting personnel, the age-related and occupation-related regulations governing the usage location must be observed.

1.4.3 General Safety Notes

Electrical hazards

DANGER!

Life-threatening hazard from electric shock!

There is an imminent life-threatening hazard from electric shocks from live parts. Damage to insulation or to specific components can pose a life-threatening hazard.

- Only a qualified electrician should perform work on the electrical equipment.
- Immediately switch off the power supply and have it repaired if there is damage to the insulation.
- Before beginning work at live parts of electrical systems and resources, cut the electricity and ensure it remains off for the duration of the work. Comply with the five safety rules in the process:
  - cut electricity;
  - safeguard against restart;
  - ensure electricity is not flowing;
  - earth and short-circuit; and
  - cover or shield neighboring live parts.
- Never bypass a fuse or render it inoperable. Always use the correct amperage when changing a fuse.
- Keep moisture away from live parts. Moisture can cause short circuits.

Prime mover safety

WARNING!

Hazards due to insufficient prime mover protection

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

Device implemented self test

this Woodward device has a self test check implemented. Permanently under control are processor function and supply voltage.

The output command Relay 1 (“Selftest Ok” Terminals 41/42) is in series with a hardware watchdog timer release. So the relay can be de-energized by software in conjunction with the WDT feature. In cases the WDT module is not frequently retriggered by the CPU, the relay is de-energized always.

Be careful in changing safety relevant settings!

CAUTION!

Uncontrolled operation due to faulty configuration

The discrete output "Ready for operation" must be wired in series with an emergency stop function.

This means that it must be ensured that the generator circuit breaker is opened and the engine is stopped if this discrete output is de-energized.

If the availability of the plant is important, this fault must be signaled independently from the unit.

Modifications

WARNING!

Hazards due to unauthorized modifications

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment.

Any unauthorized modifications:

– constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage
– invalidate product certifications or listings.

Use of batteries/alternators

NOTICE!

Damage to the control system due to improper handling

Disconnecting a battery from a control system that uses an alternator or battery-charging device whilst the charging device is still connected causes damage to the control system.

– Make sure the charging device is turned off before disconnecting the battery from the system.

Unit includes a lithium backup battery for Real Time Clock. Field replacement of the battery is not allowed.

In case of battery replacement please contact your Woodward service partner.

Electrostatic discharge

Protective equipment:
- ESD wrist band

NOTICE!

Damage from electrostatic discharge

All electronic equipment sensitive to damage from electrostatic discharge, which can cause the control unit to malfunction or fail.

– To protect electronic components from static damage, take the precautions listed below.

1. Avoid build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as easily as synthetics.

2. Before working on terminals on the control unit, ground yourself by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.) to discharge any static electricity.

   Alternatively wear an ESD wrist band connected to ground.

3. Before any maintenance work on the control unit, ground yourself by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.) to discharge any static electricity.

   Alternatively wear an ESD wrist band connected to ground.

4. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, etc.) away from the control unit, modules and work area.

5. Opening the control cover may void the unit warranty. Do not remove the printed circuit board (PCB) from the control cabinet unless instructed by this manual.

If instructed by this manual to remove the PCB from the control cabinet, follow these precautions:

– *Ensure that the device is completely voltage-free (all connectors have to be disconnected).*

– *Do not touch any part of the PCB except the edges.*

– *Do not touch the electrical conductors, connectors, or components with conductive devices or with bare hands.*

– *When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.*

For additional information on how to prevent damage to electronic components caused by improper handling, read and observe the precautions in:

– *"Woodward manual 82715, Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules".*

1.4.4 Protective Equipment And Tools

Protective gear

Personal protective equipment serves to protect risks to the safety and health of persons as well as to protect delicate components during work.

Certain tasks presented in this manual require the personnel to wear protective equipment. Specific required equipment is listed in each individual set of instructions.

The cumulative required personal protective equipment is detailed below:

ESD wrist band

The ESD (electrostatic discharge) wrist band keeps the user's body set to ground potential. This measure protects sensitive electronic components from damage due to electrostatic discharge.

Tools

Use of the proper tools ensures successful and safe execution of tasks presented in this manual.

Specific required tools are listed in each individual set of instructions.

The cumulative required tools are detailed below:

Torque screwdriver

A torque-screwdriver allow fastening of screws to a precisely specified torque.

Note the required torque range individually specified in the tasks listed in this manual.

2 System Overview

2.1 Function overview

2.1.1 Group Controller Concept

High-level Architecture attributes

- A generator group is always realized as one segment (electrically connected area)
- Group Controllers can be switched into different segments
- The genset controls in the groups are EG3400XT/3500XT with minor software enhancements (K51 - special part number)
- The Group Controller (GC) is based on the hardware of EG3400XT-P1
- The Group Controller accepts the group breaker commands and operates the group breaker (close, synchronization, open).
- Up to 31 gensets are supported per Group Controller
- Up to 8 Group Controller are supported in the first release
- Configuration of the group controller is provided by the Woodward Toolkit PC software
- Testing the LDSS settings and load scenarios are possible via an emulation program running on a computer
- The Group Controller supports the synchronization of its group or the whole segment together with another Group Controller while doing the load sharing
- The group controller supports an unloading mains function with opening MCB, if power flow comes into a configurable window.

2.1.2 Load Share

Communication Interface

- Standard Load share procedure by load percentage active and reactive power
- The load share- and control communication within a genset group is maintained by 1xCAN / 1xEthernet (redundant) communication.
- The load share- and control communication between group controls is maintained by 2xEthernet communication (redundant). See Figure Fig. 51.
- When any single device or group controller is , each genset control goes into droop.
- The GC provides a Communication Diagnostic function to locate the issue.
- The GC provides a system update function to teach-in the new communication situation after isolating the broken device.

2.1.3 Dead busbar Closure

General

The Group Controllers guide the dead busbar sequence. As long the communication interfaces are working correctly, the device coordinates the dead bus closure of the single sources.

2.1.4 Load Dependent Start Stop (LDSS)

Feature Overview

- The LDSS algorithm runs inside the Group Controller and supports up to 248 gensets (8x31) in the first release.
- If the load busbar drops into separated segments, each segment gets its own LDSS master.
- Each genset will be directed with start and stop commands by the LDSS master.
- The Group Controller with the smallest Device ID and closed GGB within the segment makes the LDSS master.
- The series LDSS function in the easYgens is bypassed.
- A LDSS emulation tool will be provided for playing through the different scenarios and settings.
- The LDSS provides two modes:
  – Start/Stop related to Generator Load
  – o Start/Stop related to Reserve Power
- Additional in comparison to the LDSS easYgen series the LDSS in the GC provides:
  – a configurable “Minimum Power” consideration
  – o a configurable “Group Distribution” consideration

2.1.5 Breaker Logic

Feature Overview

- Breaker logic is handled by the upper level PLC.
- Open/close commands for the GGB are given to the GC3000XT via discrete inputs (DI)
- The PLC does the segmenting logic, following is to adhere:
  – Generally the PLC assigns segment numbers to the group controllers according to the segmenting rules provided by Woodward.
  – Generally the PLC assigns segment numbers to the group controllers according to the segmenting rules provided by Woodward.
- Operating the MCB is maintained through different DIs:
  – Feedback MCB open
  – Enable MCB
  – Unload Mains / MCB open

2.1.6 Supporting the Synchronization of the MCB

Feature Overview

- The Group Controller supports the synchronization of the MCB through its Mains AC voltage measurement.
- The Group Controller gets the condition of the load busbar to mains connection by a DI (MCB open)
- The Group Controller gets the command "Enable MCB" to determine the frequency and voltage control according to the AC mains measurement in order to get the MCB synchronized. The MCB synch command MCB is executed by the device.

2.1.7 Assign Segment Number to Devices

GC3000XT

Group Load Share Bus

- By communication interface: The basic segment number in the GC will be overridden.
- By DI: The basic segment number is overridden. 3 Dis, binary encoded, determining 8 configurable segment numbers.

Group internal Load Share Bus: The basic segment number is always 1

easYgen3500XT K51

Connected to the internal Load Share Bus

The segment number is 1 by default setting.

Note: Do not change the segment number in the easYgen K51 as long the device is used in GC mode.

2.1.8 SCADA Data Acquisition

General

An independent SCADA system reads required data directly from the single easYgen genset controllers via Modbus TCP. Group Controller data for the SCADA system is provided by the PLC which pulls out the relevant data from the Group Controller(s).

Under special circumstances, if the Group Load Share communication is not redundant performed the SCADA system can also pull data from the GC directly.

2.1.9 The LDSS Emulation Tool

General

For the GC device a LDSS emulation tool can be ordered. The LDSS emulation tool is running on a PC and can be taken to playing through the different scenarios in regards to load, configuration, engine hours, genset size and priorities. This is a powerful test program which helps to find the correct set up for the LDSS algorithm. Tested LDSS settings can be transferred afterwards with the PC program directly into the devices, if a Ethernet connection is set up.

2.2 Status Indicators (on housing)

The unit is equipped with 2 LEDs on top view:

- LED (green/red) signed as "Operation"
- LED (green) signed as "Sync Enable"

LED "Operation":

- Prio1: Is disabled, if device is not ready for operation.
- Prio2: Is green blinking, if the unit is included in the "System Update Procedure" process.
- Prio3: Is red continuously, if the unit detects an critical alarm.
- Prio4: Lights green and red alternate, if an warning alarm is active.
- Prio5: Is green continuously, if the unit is ready for operation.

LED "Sync Enable":

- Prio1: Is disabled, if device is not ready for operation.
- Prio2: Indicates the GGB or the MCB synchronization close pulse.

Note:

During boot-up and firmware update procedures the LEDs are acting different.

2.3 HOME PAGE (ToolKit)

Home Page and starting point for all HMI relevant purposes.

It gives a short overview about the connected GC. From here the operator can navigate to the different Visualization- and configuration screens. Refer to ToolKit for more information.

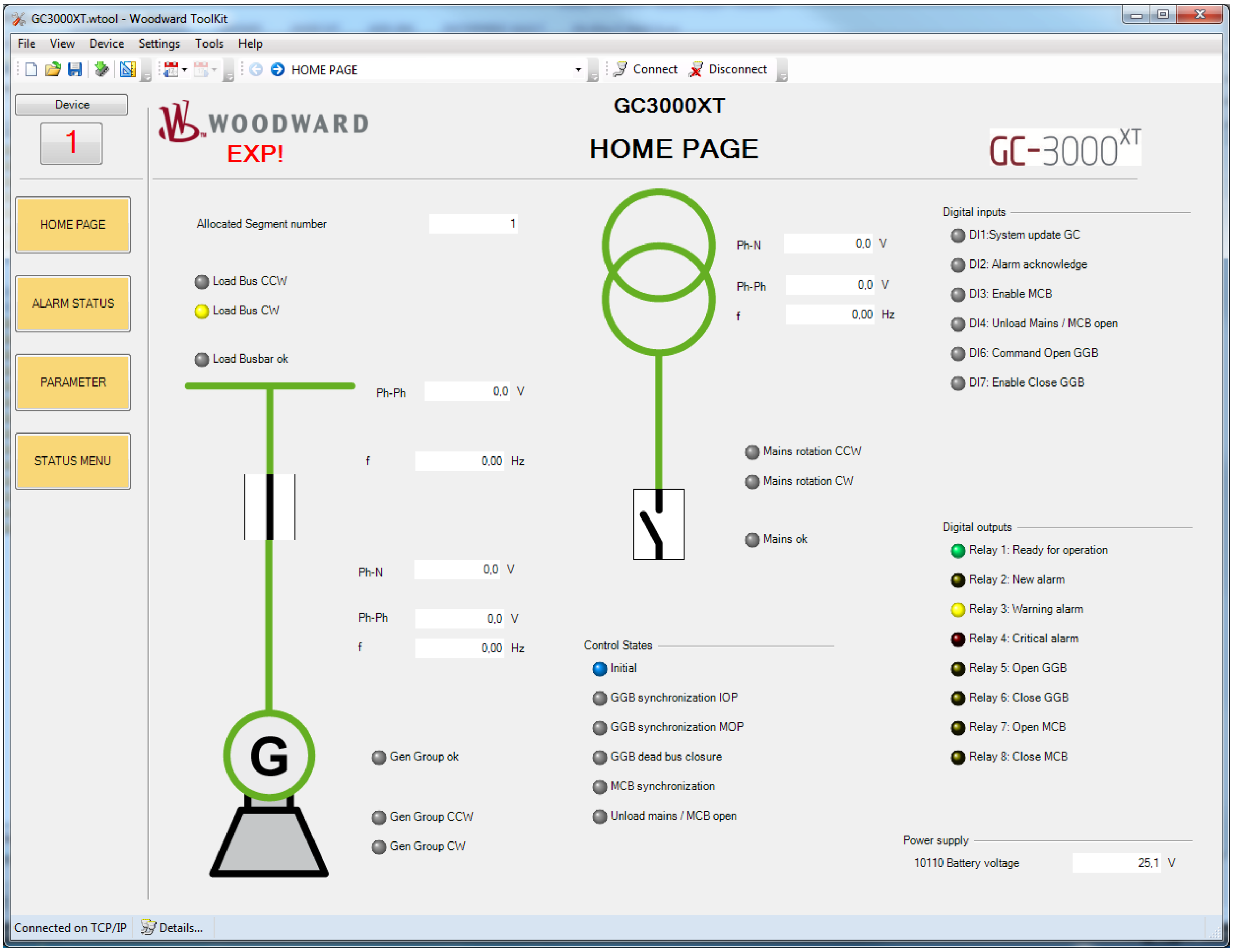


Fig. 5: Example Home Page screen

2.4 States easYgens (ToolKit)

Navigation by Status Menu/Multi-unit/States easYgen

This screen gives information about the current situation within the own generator group. The group breaker is the device 32. The power flow of the group breaker can be observed.

Groups which are not recognized are faded out.

Each Device (1-32) is visualized through:

- Operation Mode
- Breaker feedback
- Active power in kW
- Reactive power in kvar
- LDSS command On/-/Off
- Current active segment (usually always 1)

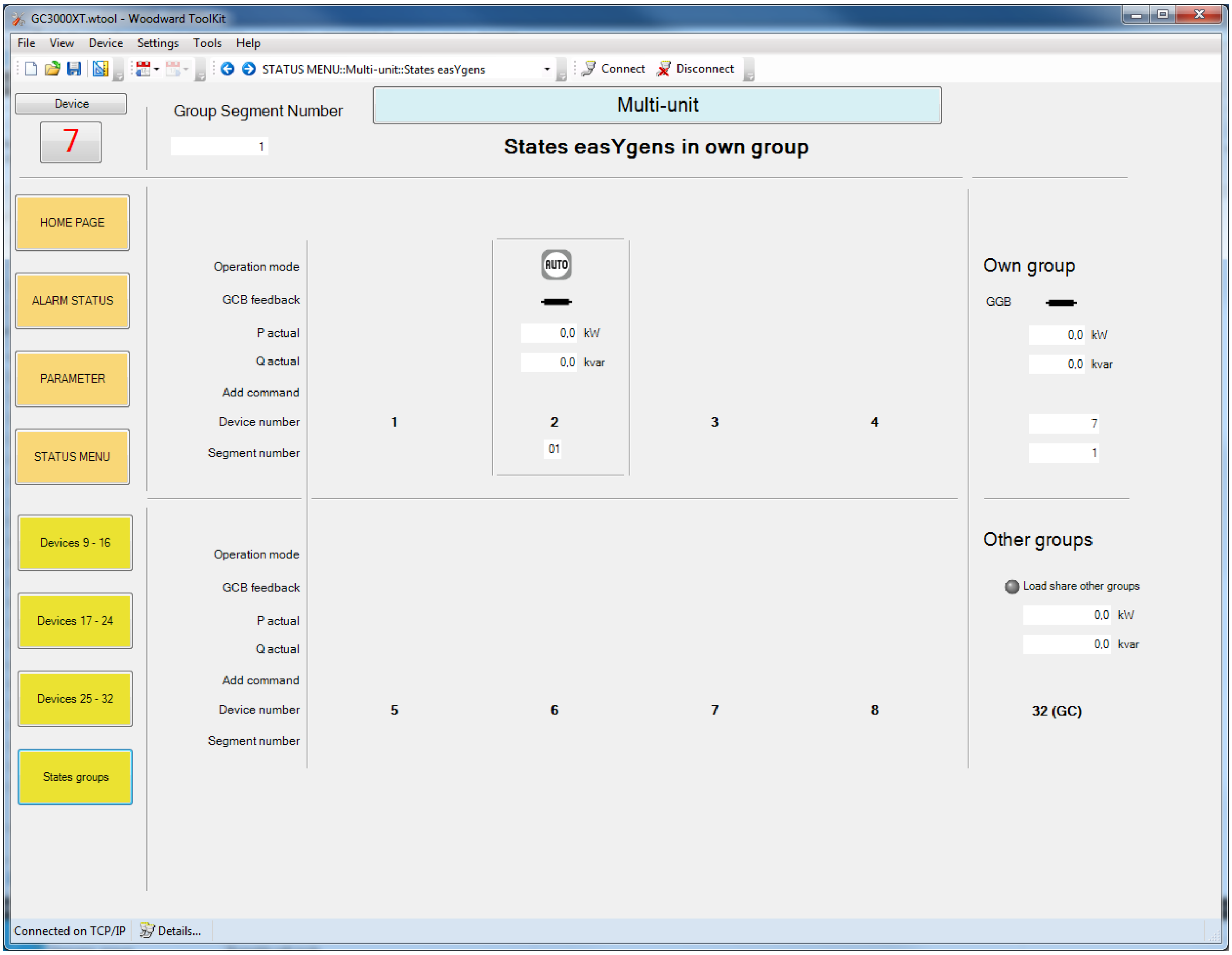


Fig. 6: Example of a State easYgen Screen

States easYgens in own group

These fields indicate from each easYgen the operation mode, the breaker condition, the load situation and the segment number.

Note: The easYgen segment number must be always 1 otherwise this easYgen is not accepted as a group member.

Own group

Indicates the GGB condition, the active and reactive power flow over the GGB (calculated out of the easYgen values).

The device number of the GC (group number). The current allocated segment number.

Other groups

Indicates with a LED symbol the linkage to at least one easYgen outside the group. The active and reactive power of the outside connected easYgen(s) are indicated.

2.5 States groups (ToolKit)

Navigation by Status Menu/Multi-unit/States easYgen

This screen gives information about the group controller system. Currently up to 8 groups are visualized.

Group controllers which are not recognized are faded out.

Each Device (1-8) is visualized through:

- Breaker feedback
- Nominal Power active in kW
- Active power in kW
- Load in %
- Reactive power in kvar
- Reactive power in %
- Current active segment

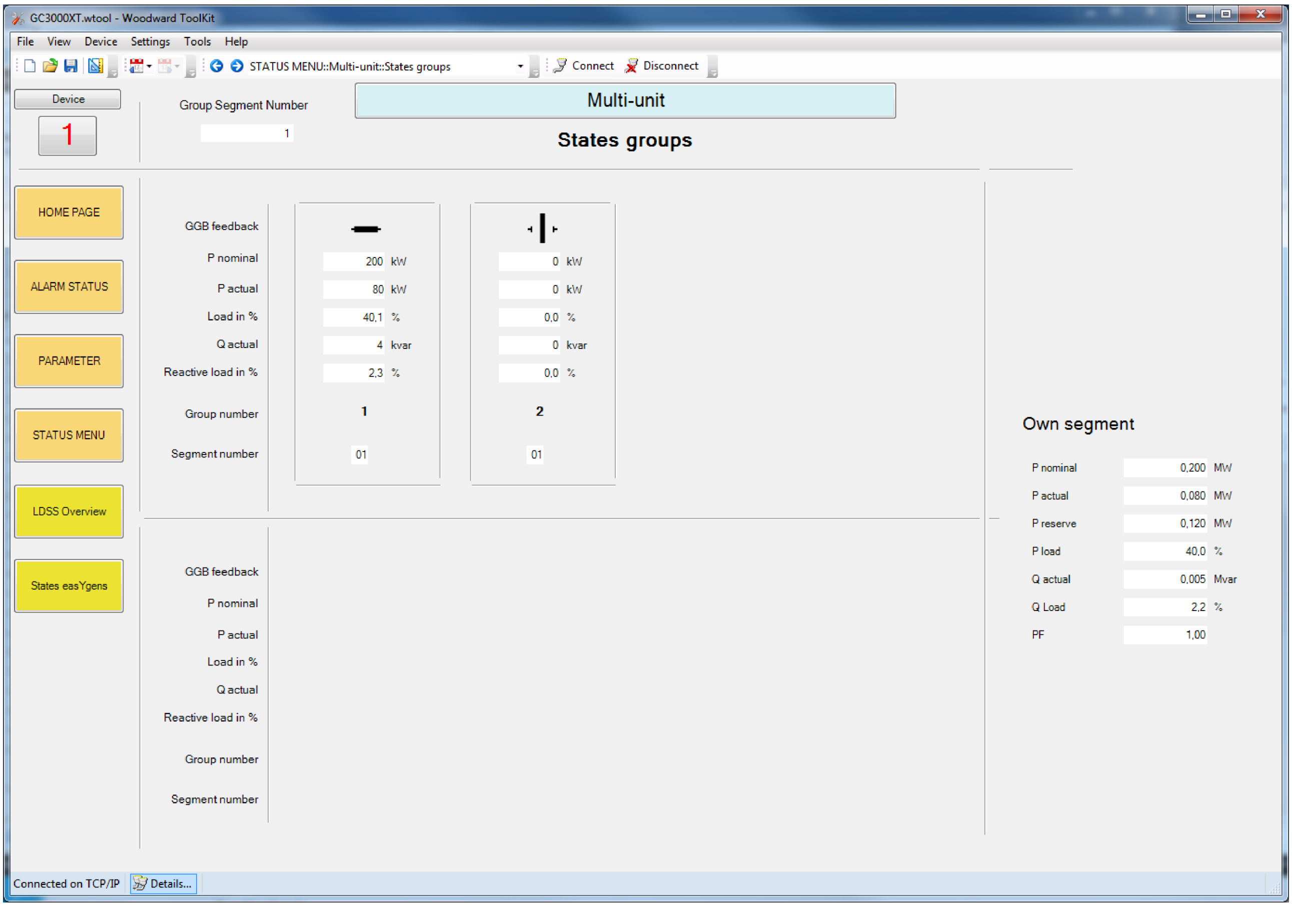


Fig. 7: Example of a State GC Screen

States groups

These fields indicate from each Group Controller the breaker condition, the load situation and the segment number.

Own Segment

Own segment shows the load sums of all groups which are in the same segment, like the GC from which the ToolKit is taken.

2.6 LDSS Overview Screen (ToolKit)

This page informs about the important conditions relating to the load dependent start stop feature. Shown is the condition of all GCs and its easYgens which are in the same segment. Each GC device (1-8) is visualized among other through:

- LDSS Master role
- easYgen operating modes
- LDSS start/stop information
- Own segment load values
- LDSS settings

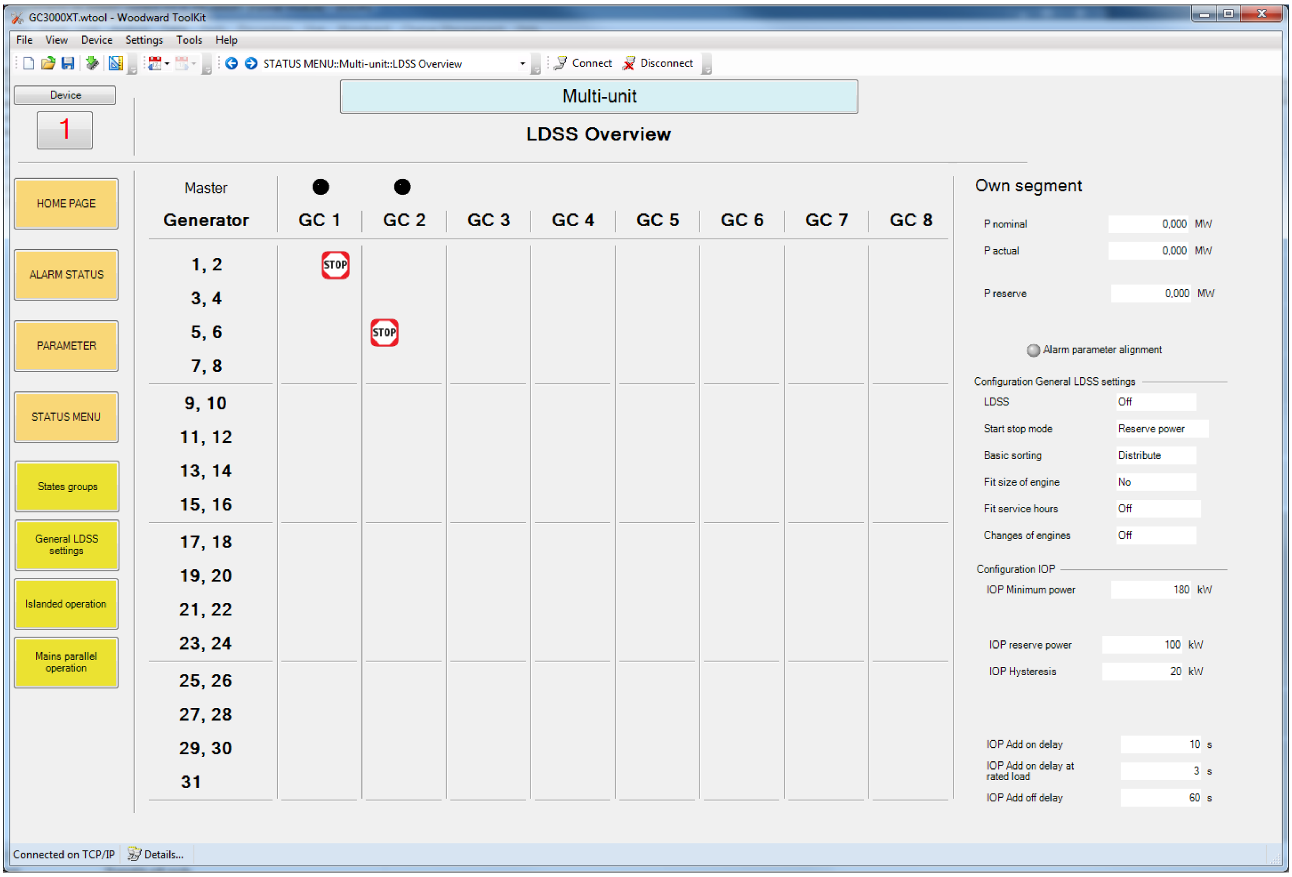


Fig. 8: Example of an LDSS Overview Screen

3 Installation

> **NOTICE!**
> **Avoid electrostatic discharge!**
> Before working with terminals please read and follow the instructions of chapter ↳ *"Electrostatic discharge" on page 18*.
>
> For CAN and RS485 shielded cabling, no more than 25 mm wiring exposed without shield coverage are allowed at terminal plug side.

3.1 Mount Unit (Sheet Metal Housing)

Dimensions

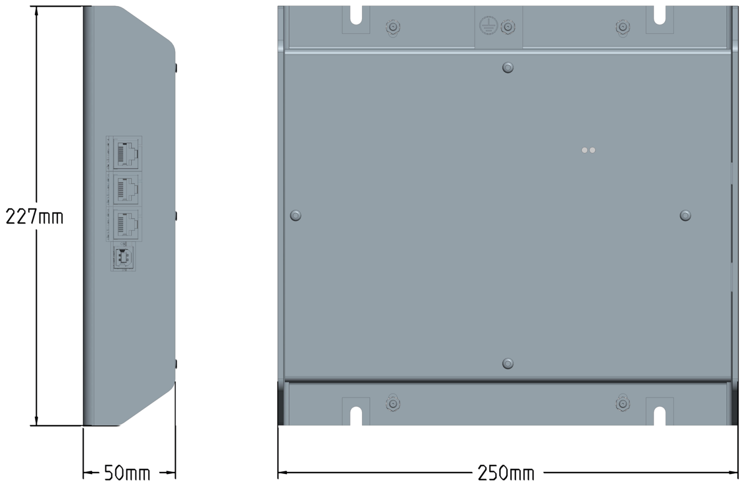


Fig. 9: Sheet metal housing - dimensions

Mounting into a cabinet

Special tool: ■ Torque screwdriver

Proceed as follows to install the unit using the screw kit:

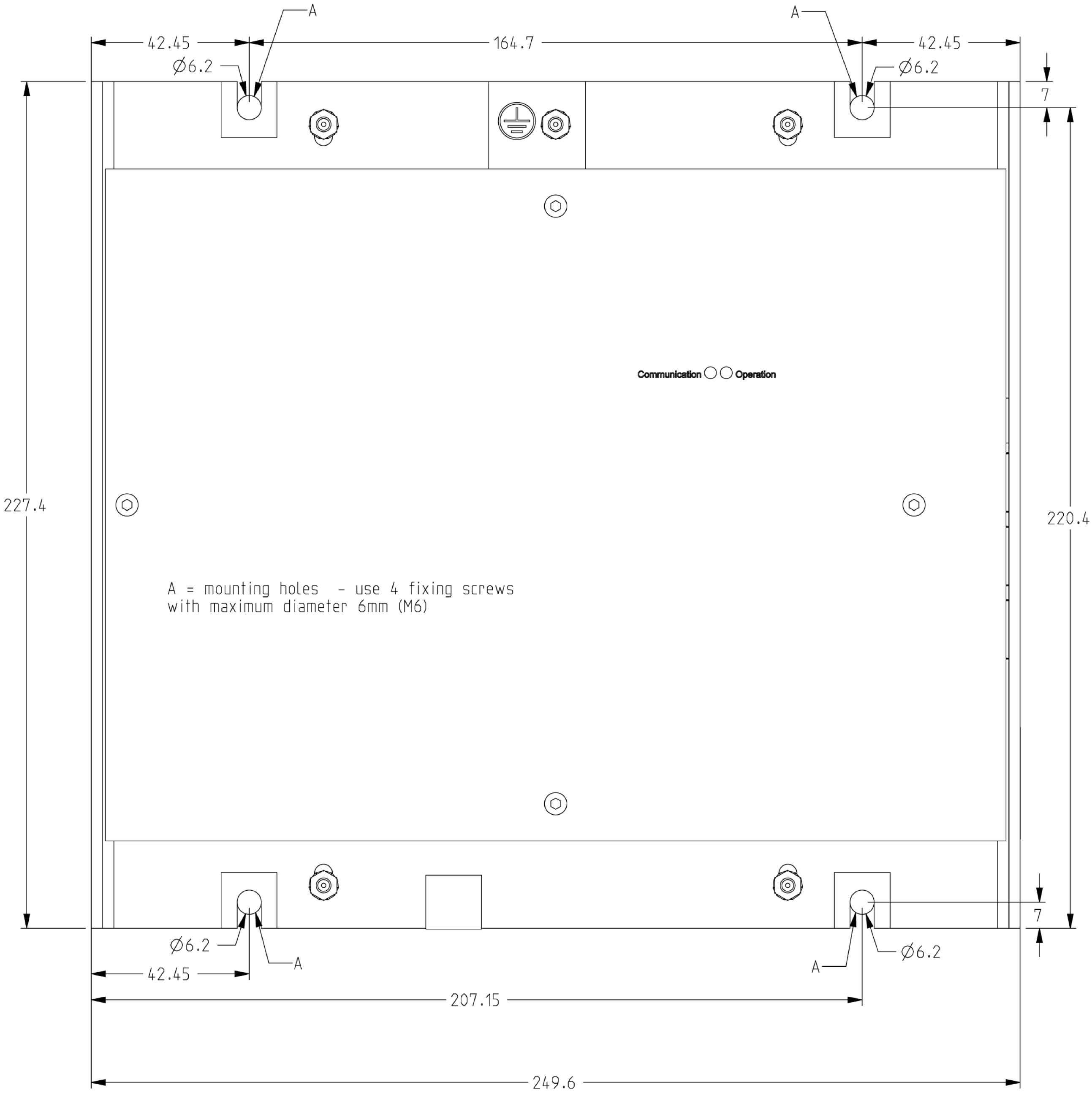


Fig. 10: Sheet metal housing - drill plan

1. Drill the holes according to the dimensions in the figure above (dimensions shown in mm).

> *Ensure sufficient clearance for access to the terminals (top and bottom) and connectors located at the sides.*

2. Mount the unit to the back panel and insert the screws.

3. Tighten the screws to a torque according to the quality class of the used screws.

Tighten the screws with a crosswise pattern to ensure even pressure distribution.

3.2 Setup Connections

NOTICE!

Avoid electrostatic discharge!

Before working with terminals please read and follow the instructions of chapter *“Electrostatic discharge” on page 18*.

For CAN and RS485 shielded cabling, no more than 25 mm wiring exposed without shield coverage are allowed at terminal plug side.

General notes

NOTICE!

Malfunctions due to literal use of example values

All technical data and ratings indicated in this chapter are merely listed as examples. Literal use of these values does not take into account all actual specifications of the control unit as delivered.

– For definite values please refer to chapter *Chapter 8.1 “Technical Data” on page 157*.

Wire sizes

Field wiring shall be made with use of cables which have temperature rating not less than 90 °C.

AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²
30	0.05	21	0.38	14	2.5	4	25	3/0	95	600MCM	300
28	0.08	20	0.5	12	4	2	35	4/0	120	750MCM	400
26	0.14	18	0.75	10	6	1	50	300MCM	150	1000MCM	500
24	0.25	17	1.0	8	10	1/0	55	350MCM	185		
22	0.34	16	1.5	6	16	2/0	70	500MCM	240		

Table 1: Conversion chart - wire sizes

3.2.1 Terminal Allocation

NOTICE!
Avoid electrostatic discharge!
Before working with terminals please read and follow the instructions of chapter *"Electrostatic discharge" on page 18*.

For CAN and RS485 shielded cabling, no more than 25 mm wiring exposed without shield coverage are allowed at terminal plug side.

The max. possible conductor cross-section of the terminals used is A_{max} = 2.5 mm^2!

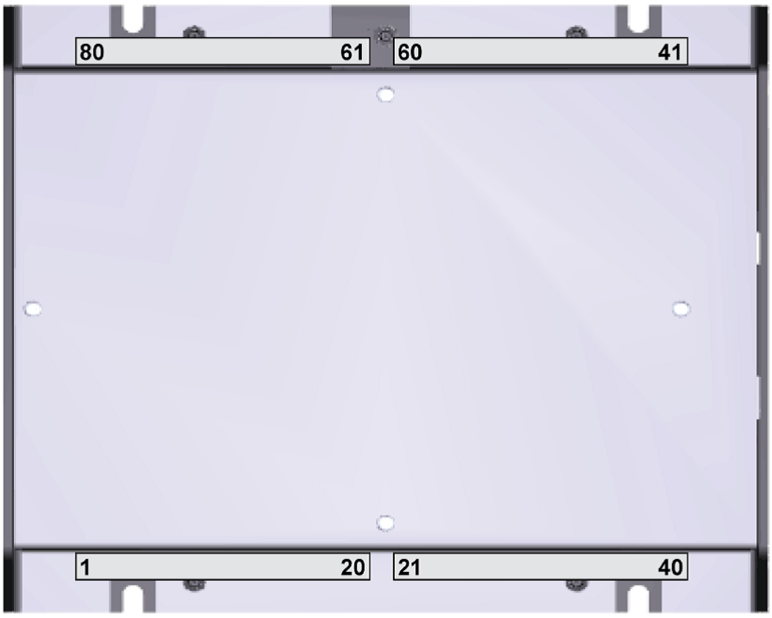


Fig. 11: Terminals Group Controller sheet metal housing

3.2.2 Wiring Diagram

The Protective Earth terminal 61 is not connected on the sheet metal housing.

– *Use the protective earth (PE) connector located at the bottom center of the sheet metal housing instead.*

General recommendations

Ensure appropriate cable cross sections following the local standards and restrictions.

The maximum cable cross section of the terminal blocks is 2.5 mm^2.

For every type of signal lines like power supply, I/O:

- *Return line has to be close to forward signal line.*
- *Use cables instead of single wires.*
  - *In case of using single wires please do at least one twist per meter to keep wires together closely.*

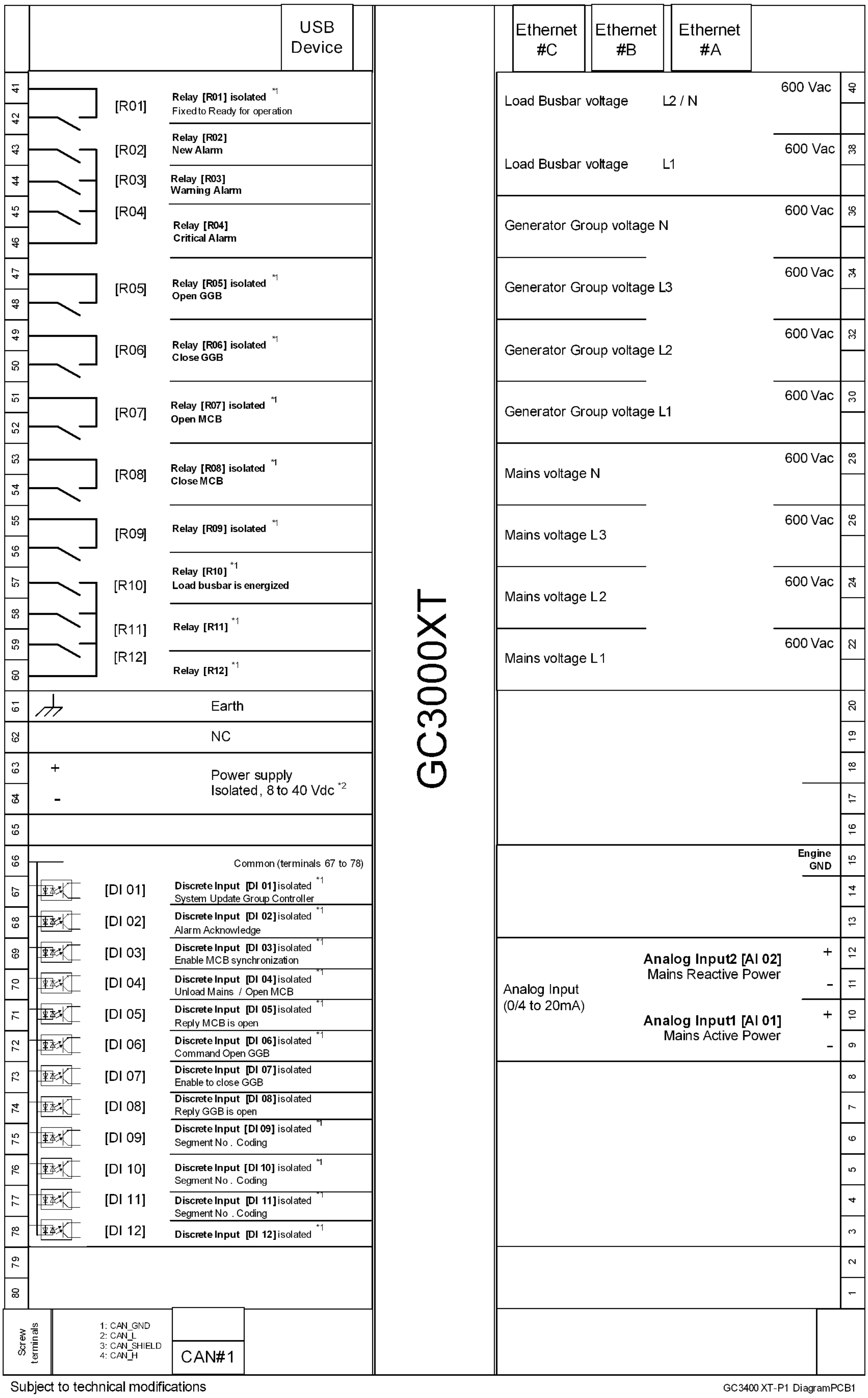


Fig. 12: Wiring diagram GC-3400XT-P1

Pin 61: don't use

3.2.3 Power Supply

General notes

WARNING!
Risk of electric shock - sheet metal housing

– Connect Protective Earth (PE) to the unit to avoid the risk of electric shock.
  Use the protective earth (PE) connector located at the bottom center of the sheet metal housing.
– The conductor providing the connection must have a wire larger than or equal to 2.5 mm² (14 AWG). The cable length should be as short as possible.
– The connection must be performed properly.

WARNING!
Permissible differential voltage

The maximum permissible differential voltage between terminal 64 (B-) and terminal 61 (PE) is 100 V_{RMS}. On engines where a direct connection between battery minus and PE is not possible, it is recommended to use an isolated external power supply if the differential voltage between battery minus and PE exceeds 100 V_{RMS}.

Woodward strictly recommends to use a power supply that is fulfilling the SELV restrictions (SELV = separated or safety extra-low voltage, see IEC)

Woodward recommends to use one of the following slow-acting protective devices in the supply line to terminal 63:

– *Fuse NEOZED D01 6A or equivalent* **or**
– *Miniature Circuit Breaker 6A / Type C*
  (for example: ABB type: S271C6 or equivalent)

Schematic and terminals

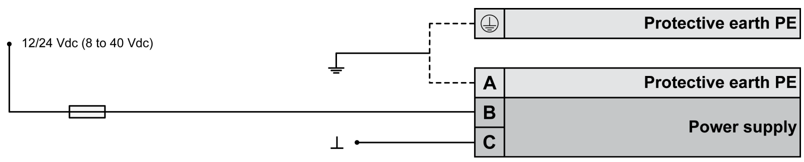


Fig. 13: Power supply - wiring

Terminal		Description
A	61	Don't use
B	63	12/24Vdc (8 to 40.0 Vdc)
C	64	0 Vdc

Table 2: Power supply - terminal assignment

Characteristics

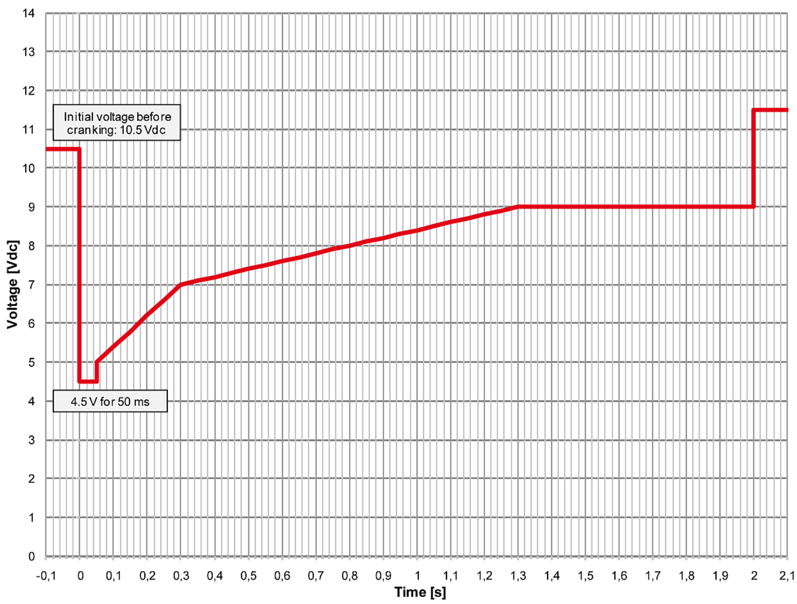


Fig. 14: Power supply - crank waveform

3.2.4 Voltage Measuring

Woodward recommends protecting the voltage measuring inputs with slow-acting fuses rated for 2 to 6 A.

The wide range terminals allow several voltages. The current voltage (range) of the application must be "told" to the controller device. Settings are described in chapter .

3.2.4.1 Generator Group Voltage

General notes

The voltage measuring inputs for 120 V, 480 V, and 690 V are using the same terminals 30 to 36. The current voltage range must be selected by the corresponding settings via HMI and/or ToolKit.

Parameter 1800 ↳ p. 115 ("Gen. PT secondary rated volt.") must be configured to the correct value to ensure proper measurement.

Schematic and terminals

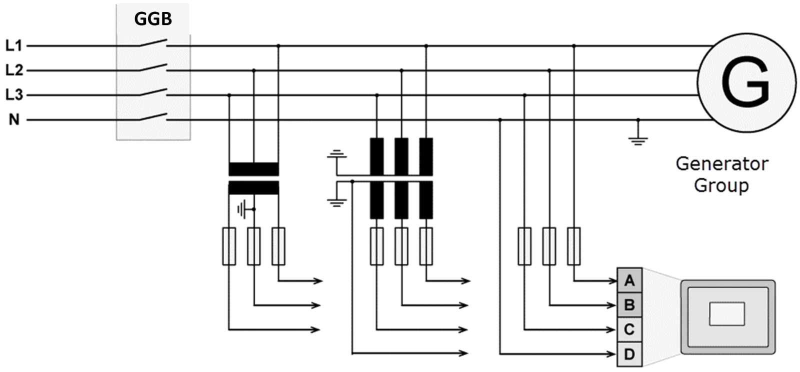


Fig. 15: Voltage measuring - generator - wiring

Measuring input / Phase	Terminal	
Generator Group voltage - L1	A	30
Generator Group voltage - L2	B	32
Generator Group voltage - L3	C	34
Generator Group voltage - N	D	36

Table 3: Voltage measuring - generator - terminal assignment

3.2.4.1.1 Parameter Setting '3Ph 4W OD' (3-phase, 4-wire, Open delta)

Generator windings

A generator group system that is connected to the load through a 3-phase, 4-wire connection but have the device wired for a 3-phase, 3-wire installation may have the L2 phase grounded on the secondary side. In this application the device will be configured for 3-phase, 4-wire OD for correct power measurement.

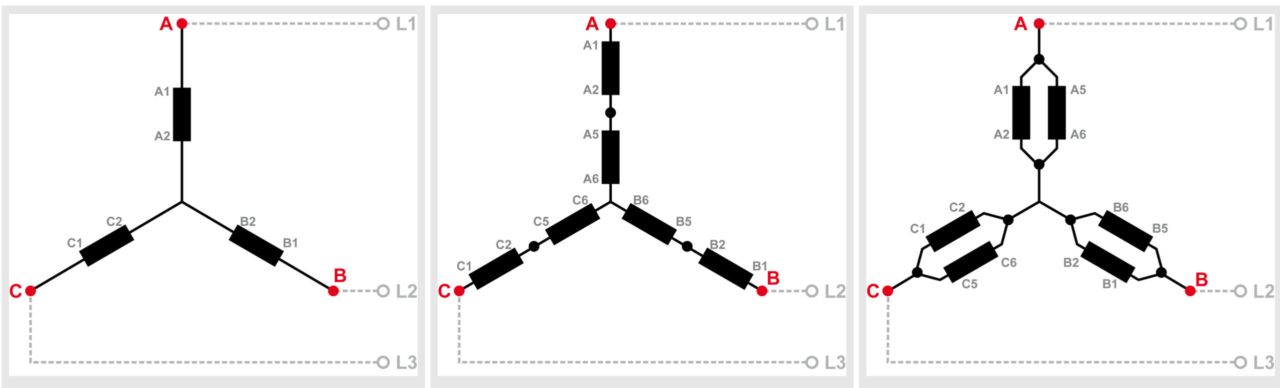


Table 4: Generator windings - 3Ph 4W OD

Measuring inputs

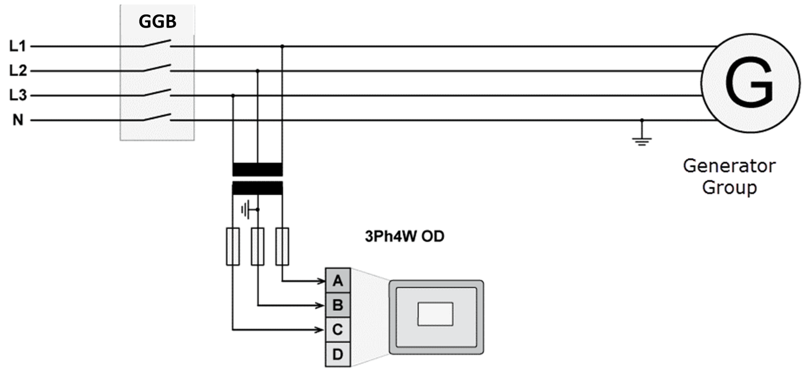


Fig. 16: Measuring inputs - 3Ph 4W OD

Terminal assignment

Measuring input / Phase	Terminal	
Generator Group voltage - L1	A	30
Generator Group voltage - L2	B	32
Generator Group voltage - L3	C	34
Generator Group voltage - N	-/-	

Table 5: Generator terminal assignment 3Ph 4W OD

3.2.4.1.2 Parameter Setting '3Ph 4W' (3-phase, 4-wire)

Generator windings

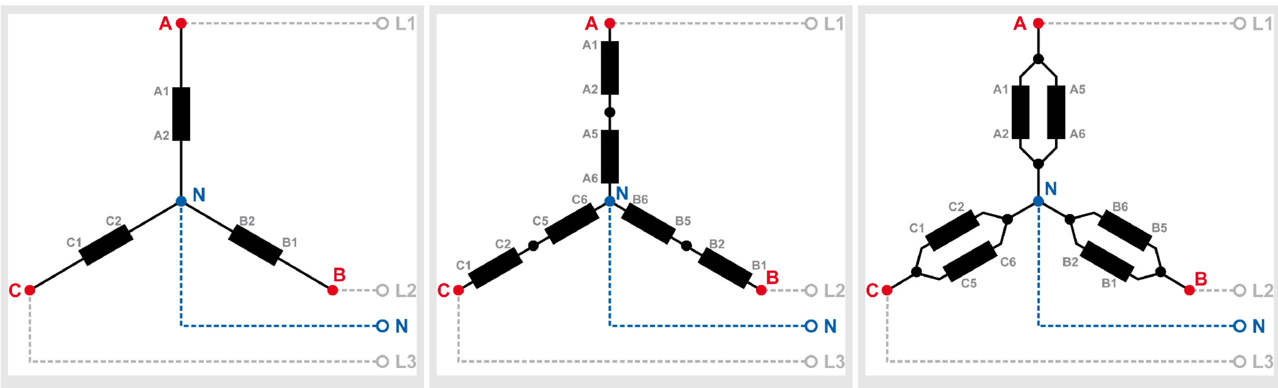


Table 6: Generator windings - 3Ph 4W

Measuring inputs

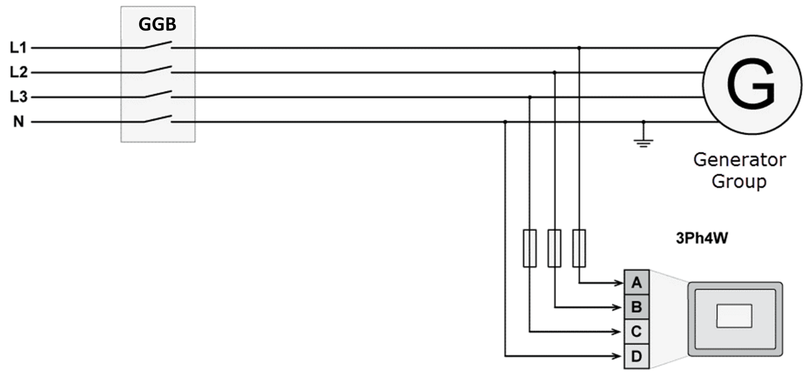


Fig. 17: Measuring inputs - 3Ph 4W

Terminal assignment

Measuring input / Phase	Terminal	
Generator Group voltage - L1	A	30
Generator Group voltage - L2	B	32
Generator Group voltage - L3	C	34
Generator Group voltage - N	D	36

Table 7: Generator terminal assignment 3Ph 4W

3.2.4.1.3 Parameter Setting '3Ph 3W' (3-phase, 3-wire)

Generator windings

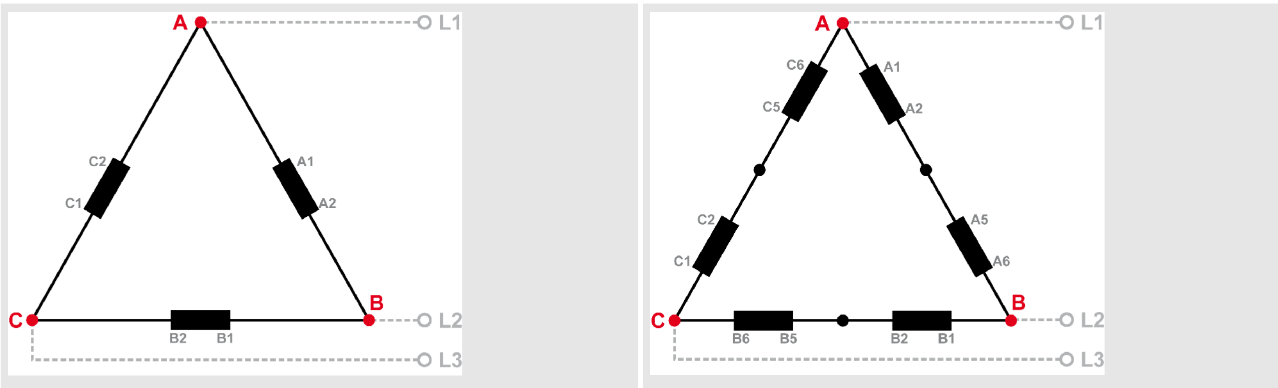


Table 8: Generator windings - 3Ph 3W

Measuring inputs

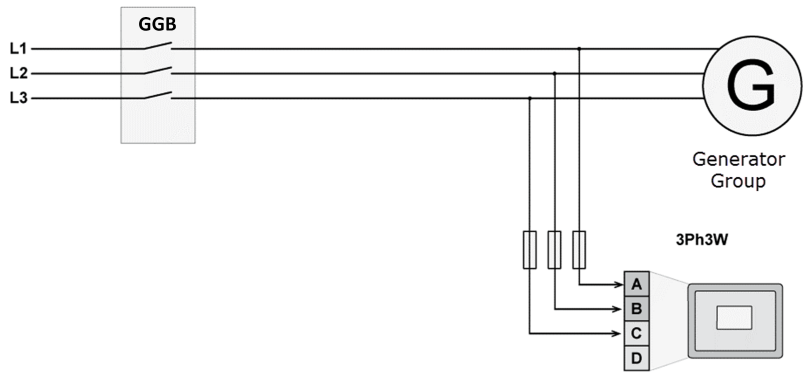


Fig. 18: Measuring inputs - 3Ph 3W

Terminal assignment

Measuring input / Phase	Terminal	
Generator Group voltage - L1	A	30
Generator Group voltage - L2	B	32
Generator Group voltage - L3	C	34
-/-	-/-	36

Table 9: Generator terminal assignment 3Ph 3W

3.2.4.1.4 Parameter Setting '1Ph 3W' (1-phase, 3-wire)

Generator windings

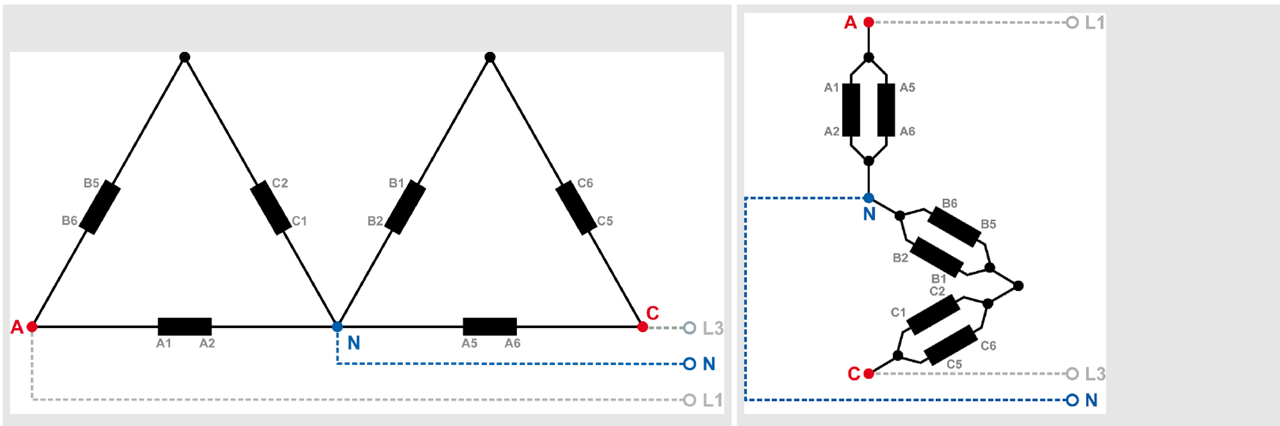


Table 10: Generator windings - 1Ph 3W

Measuring inputs

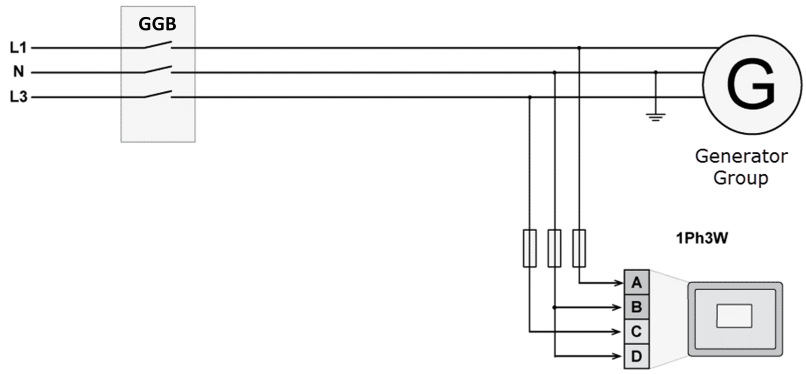


Fig. 19: Measuring inputs - 1Ph 3W

Terminal assignment

Measuring input / Phase	Terminal	
Generator Group voltage - L1	A	30
Generator Group voltage - L3	C	34
Generator Group voltage - N	D	36
	B	32

Table 11: Generator terminal assignment 1Ph 3W

3.2.4.1.5 Parameter Setting '1Ph 2W' (1-phase, 2-wire)

*The 1-phase, 2-wire measurement may be performed **phase-neutral** or **phase-phase**.*

– *Please note to configure and wire the Group Controller consistently.*

'1Ph 2W' Phase-Neutral Measuring

Generator windings

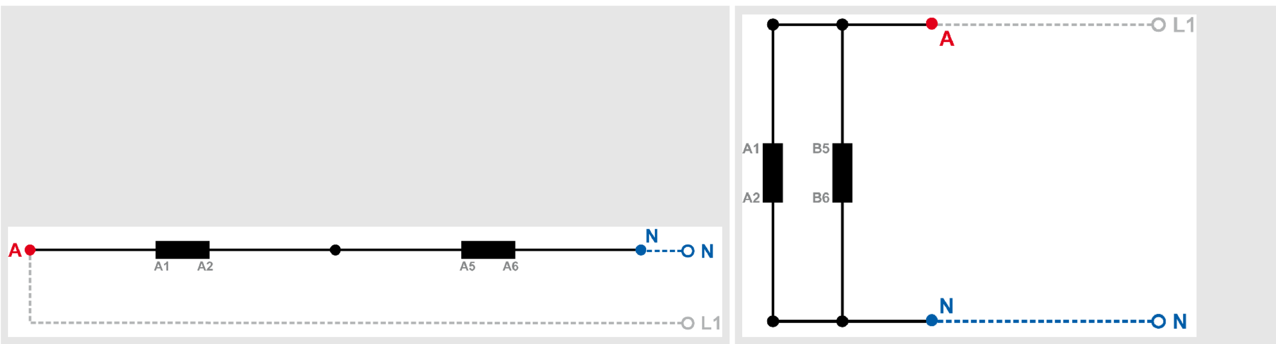


Table 12: Generator windings - 1Ph 2W (phase neutral)

Measuring inputs

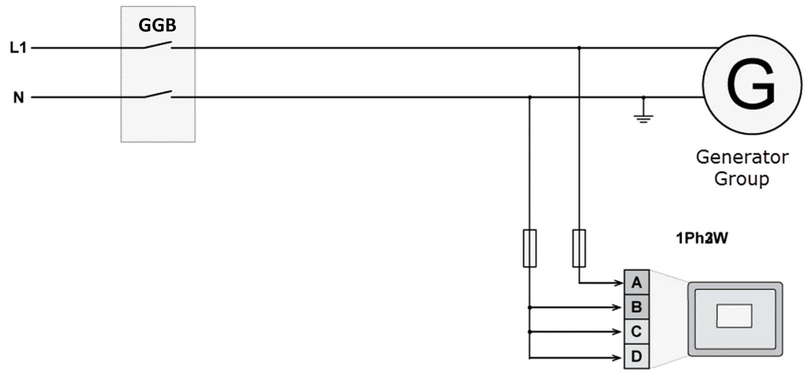


Fig. 20: Measuring inputs - 1Ph 2W (phase neutral)

Terminal assignment

Measuring input / Phase	Terminal	
Generator Group voltage - L1	A	30
Generator Group voltage - N	B	32
	C	34
	D	36

Table 13: Generator terminal assignment 1Ph 2W (phase neutral)

> *Never configure the busbar measurement for phase-neutral, if the other systems like mains and generator are configured as 3ph 3W or 4ph 4W without being the neutral in the middle of the triangle.*
>
> *The phase angle for synchronization would be incorrect.*

'1Ph 2W' Phase-Phase Measuring

Generator windings

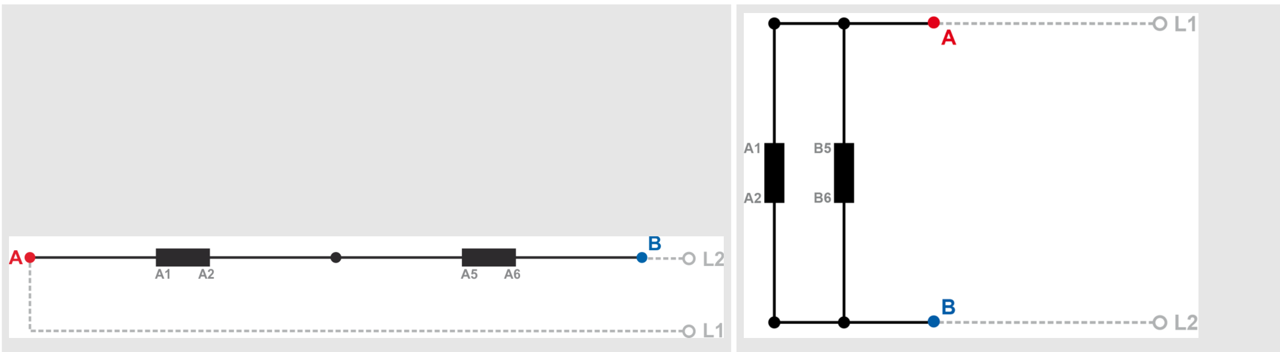


Table 14: Generator windings - 1Ph 2W (phase-phase)

Measuring inputs

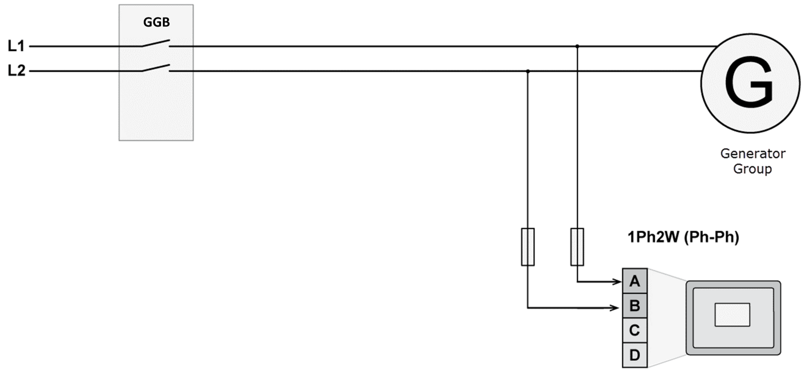


Fig. 21: Measuring inputs - 1Ph 2W (phase-phase)

Terminal assignment

Measuring input / Phase	Terminal	
Generator Group voltage - L1	A	30
Generator Group voltage - L2	B	32
Generator Group voltage - L3	-/-	
-/-	-/-	34, 36

Table 15: Generator terminal assignment 1Ph 2W (phase-phase)

3.2.4.2 Mains Voltage

General notes

The voltage measuring inputs for 120 V, 480 V, and 690 V are using the same terminals 22 to 28. The current voltage range must be selected by the corresponding settings via HMI and/or ToolKit.

Parameter 1803 ⇨ p. 118 ("Mains PT secondary rated volt.") must be configured with the correct value to ensure proper measurement.

If the GC is intended to be operated in parallel with the mains, the mains voltage measuring inputs must be connected.

If an external mains decoupling is performed, jumpers between busbar and mains voltage measuring inputs may be installed.

Schematic and terminals

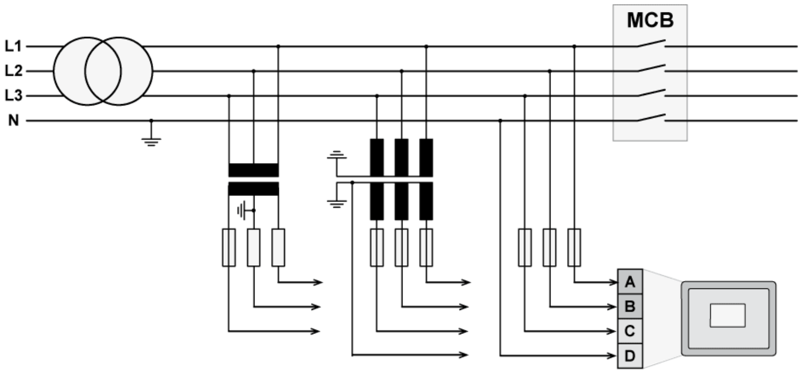


Fig. 22: Voltage measuring - mains - wiring

Measuring input / Phase	Terminal	
Mains voltage - L1	A	22
Mains voltage - L2	B	24
Mains voltage - L3	C	26
Mains voltage - N	D	28

Table 16: Voltage measuring - mains - terminal assignment

3.2.4.2.1 Parameter Setting '3Ph 4W' (3-phase, 4-wire)

Mains windings

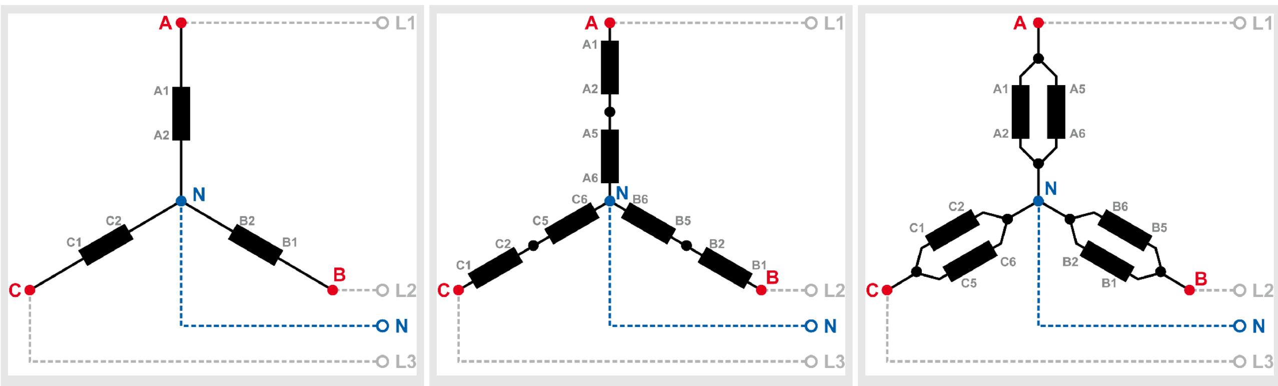


Table 17: Mains windings - 3Ph 4W

Measuring inputs

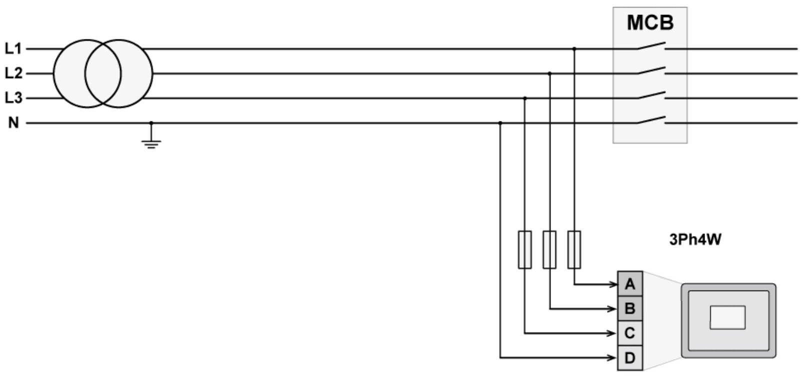


Fig. 23: Measuring inputs - 3Ph 4W

Terminal assignment

Measuring input / Phase	Terminal	
Mains voltage - L1	A	22
Mains voltage - L2	B	24
Mains voltage - L3	C	26
Mains voltage - N	D	28

Table 18: Mains terminal assignment 3Ph 4W

3.2.4.2.2 Parameter Setting '3Ph 3W' (3-phase, 3-wire)

Mains windings

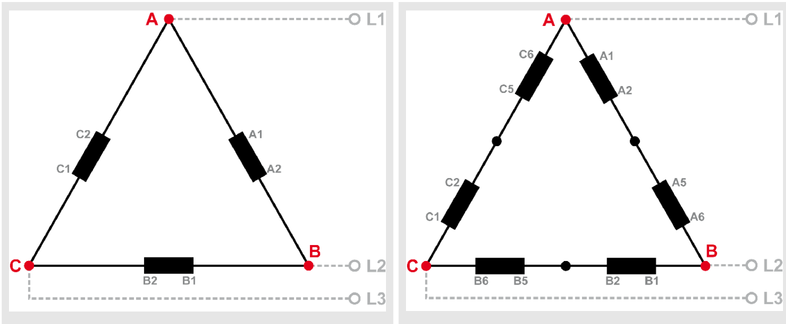


Table 19: Mains windings - 3Ph 3W

Measuring inputs

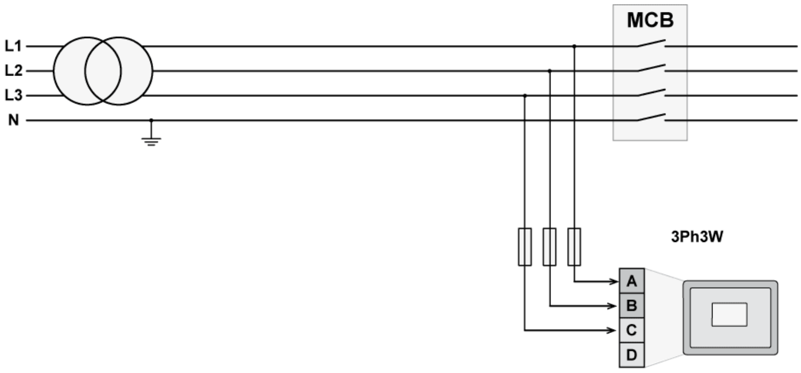


Fig. 24: Measuring inputs - 3Ph 3W

Terminal assignment

Measuring input / Phase	Terminal	
Mains voltage - L1	A	22
Mains voltage - L2	B	24
Mains voltage - L3	C	26
-/-	-/-	28

Table 20: Mains terminal assignment 3Ph 3W

3.2.4.2.3 Parameter Setting '1Ph 3W' (1-phase, 3-wire)

Mains windings

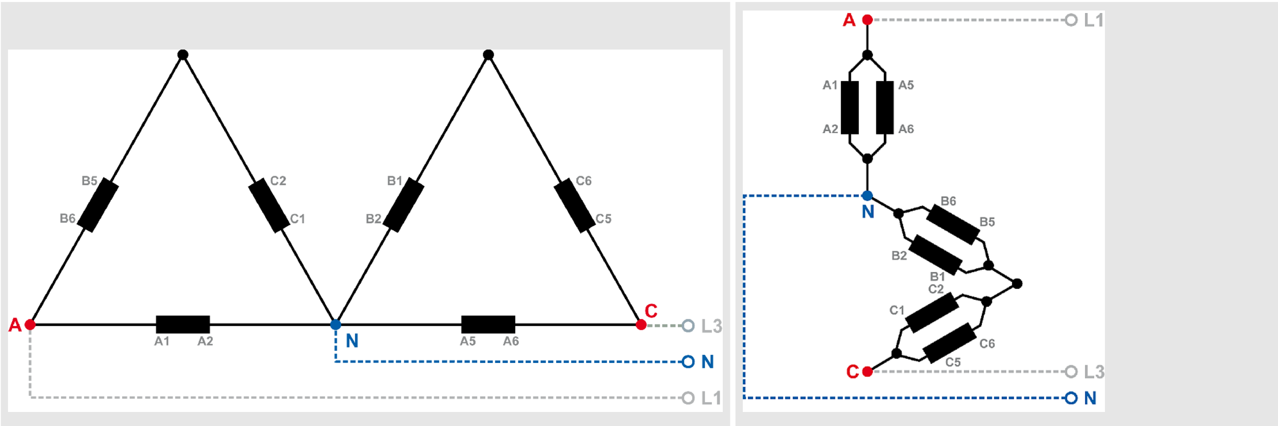


Table 21: Mains windings - 1Ph 3W

Measuring inputs

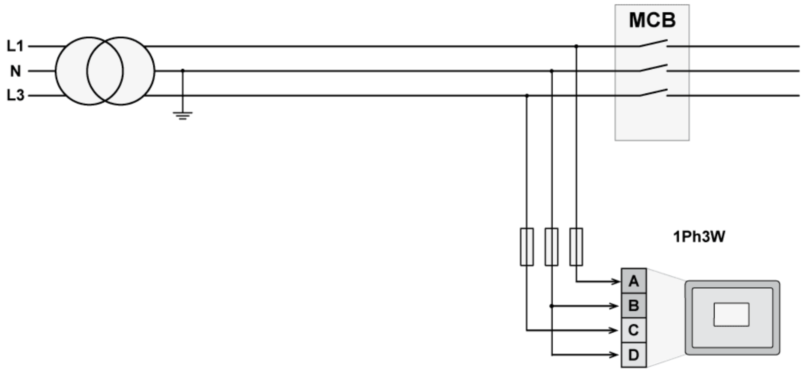


Fig. 25: Measuring inputs - 1Ph 3W

Terminal assignment

Measuring input / Phase	Terminal	
Mains voltage - L1	A	22
Mains voltage - L3	C	26
Mains voltage - N	B	24
	D	28

Table 22: Mains terminal assignment 1Ph 3W

3.2.4.2.4 Parameter Setting '1Ph 2W' (1-phase, 2-wire)

*The 1-phase, 2-wire measurement may be performed **phase-neutral** or **phase-phase**.*

– *Please note to configure and wire the Group Controller consistently.*

'1Ph 2W' Phase-Neutral Measuring

Mains windings

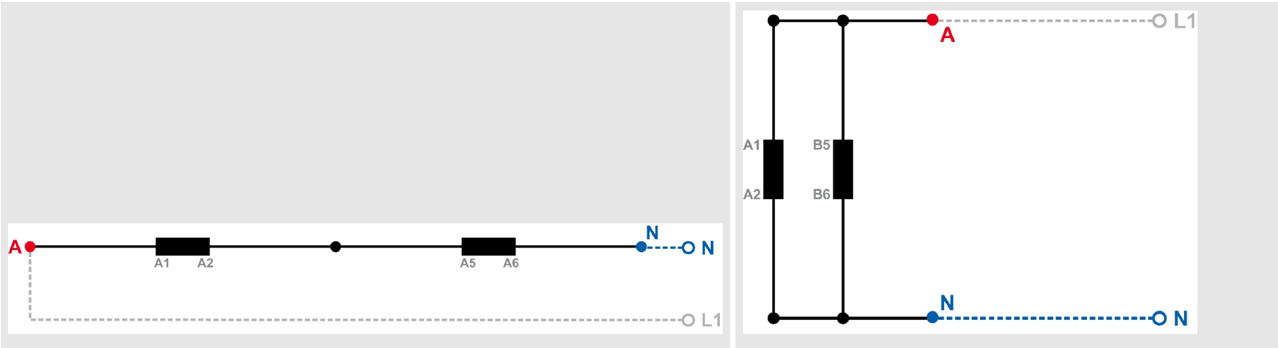


Table 23: Mains windings - 1Ph 2W (phase neutral)

Measuring inputs

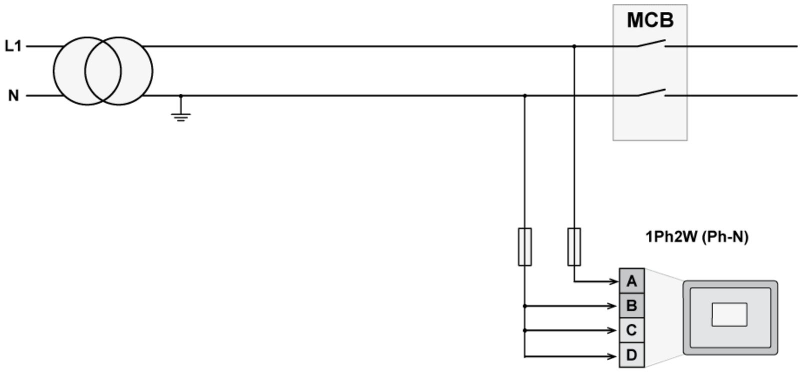


Fig. 26: Measuring inputs - 1Ph 2W (phase neutral)

Terminal assignment

Measuring input / Phase	Terminal	
Mains voltage - L1	A	22
Mains voltage - N	B	24
	C	26
	D	28

Table 24: Mains terminal assignment 1Ph 2W phase neutral

'1Ph 2W' Phase-Phase Measuring

Mains windings

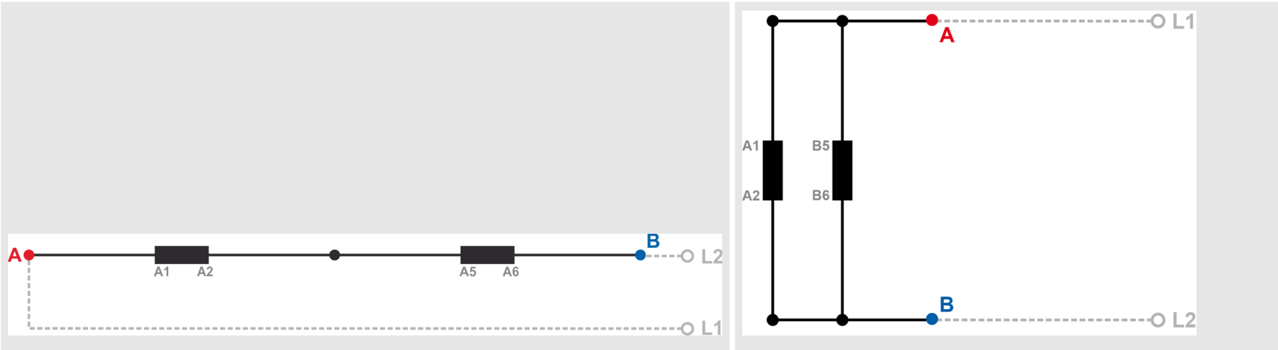


Table 25: Mains windings - 1Ph 2W (phase-phase)

Measuring inputs

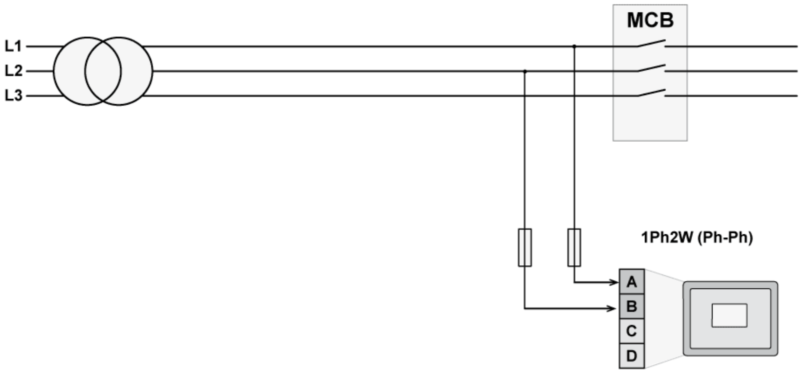


Fig. 27: Measuring inputs - 1Ph 2W (phase-phase)

Terminal assignment

Measuring input / Phase	Terminal	
Mains voltage - L1	A	22
Mains voltage - L2	B	24
Mains voltage - L3	-/-	-/-
-/-	-/-	26, 28

Table 26: Mains terminal assignment 1Ph 2W phase-phase

3.2.4.3 Load Busbar Voltage

General notes

The voltage measuring inputs for 120 V, 480 V, and 690 V are using the same terminals 38 to 40. The current voltage range must be selected by the corresponding settings via HMI and/or ToolKit.

Parameter 1812 ⇘ p. 116 ("Busb1 PT secondary rated volt.") must be configured to the correct value to ensure proper measurement.

Schematic and terminals

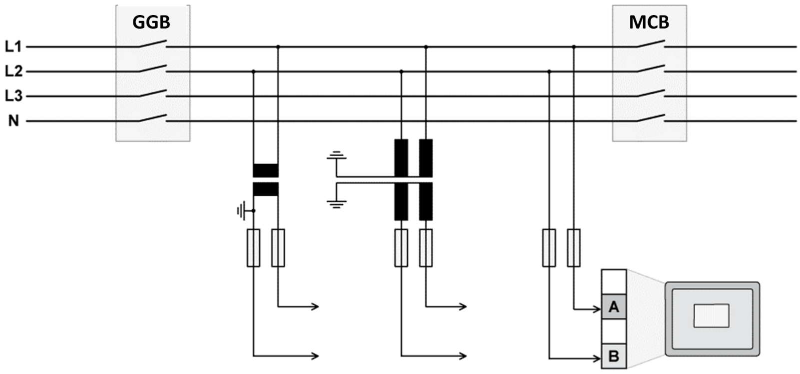


Fig. 28: Voltage measuring - busbar - wiring

Measuring input / Phase	Terminal		A_{max}
Load Busbar voltage - L1	A	38	2.5 mm²
Load Busbar voltage - L2/N	B	40	2.5 mm²

Table 27: Voltage measuring - load busbar - terminal assignment

3.2.4.3.1 Parameter Setting '1Ph 2W' (1-phase, 2-wire)

*The 1-phase, 2-wire measurement may be performed **phase-neutral** or **phase-phase**.*

– *Please note to configure and wire the GC3000 consistently.*

'1Ph 2W' Phase-Neutral Measuring

Busbar windings

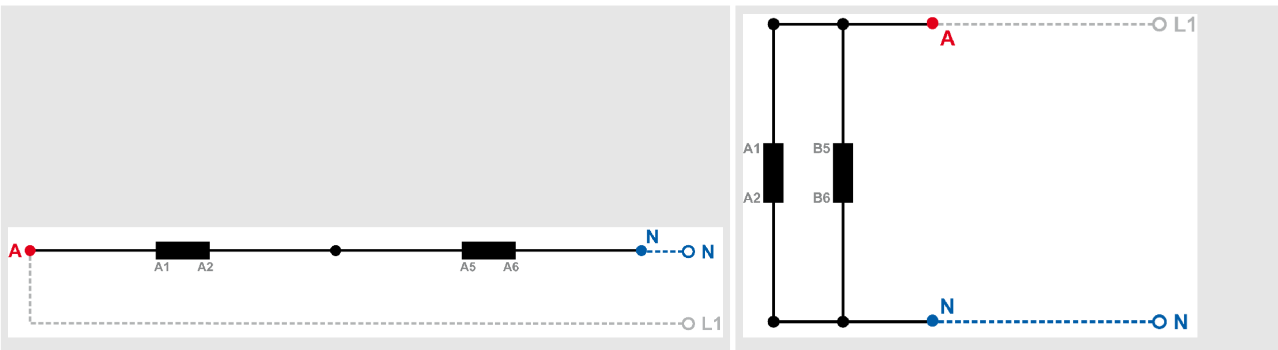


Table 28: Busbar windings - 1Ph 2W (phase neutral)

Measuring inputs

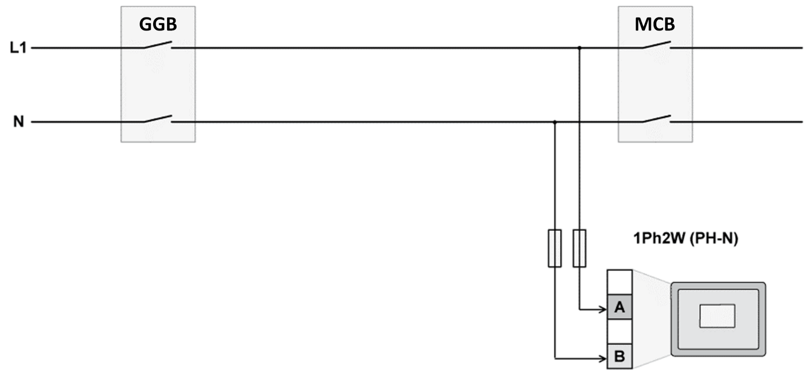


Fig. 29: Measuring inputs - 1Ph 2W (phase neutral)

Terminal assignment

Measuring input / Phase	Terminal	
Load Busbar voltage - phaseL1	A	38
Load Busbar voltage - N	B	40

Table 29: Busbar terminal assignment 1Ph 2W phase neutral

'1Ph 2W' Phase-Phase Measuring

Busbar windings

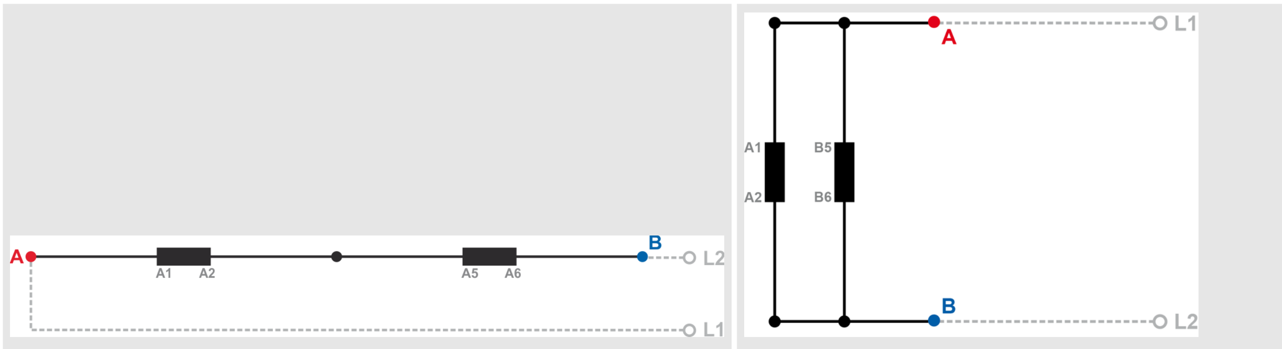


Table 30: Busbar windings - 1Ph 2W (phase-phase)

Measuring inputs

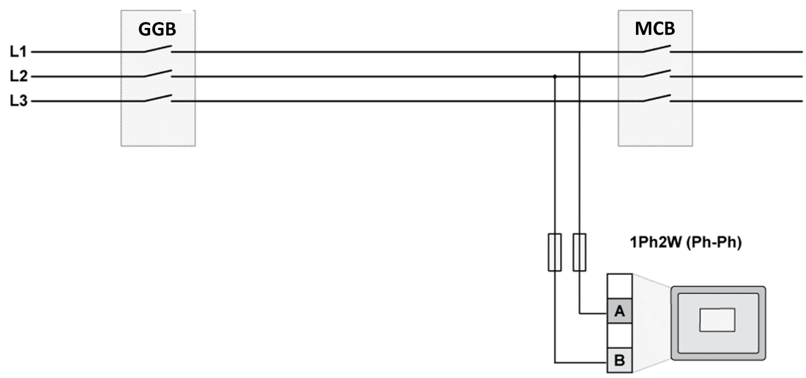


Fig. 30: Measuring inputs - 1Ph 2W (phase-phase)

Terminal assignment

Measuring input / Phase	Terminal	
Load Busbar voltage - phase L1	A	38
Load Busbar voltage - phase L2	B	40
Load Busbar voltage - phase L3	-/-	

Table 31: Busbar terminal assignment 1Ph 2W phase-phase

3.2.5 Discrete Inputs

General notes

The discrete inputs are electrically isolated which permits the polarity of the connections to be either positive or negative.

All discrete inputs must use the same polarity, either positive or negative signals, due to the common ground.

Schematic and terminal assignment

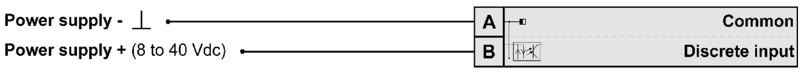


Fig. 31: Discrete input - positive polarity signal

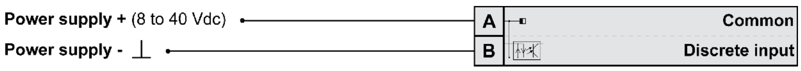


Fig. 32: Discrete input - negative polarity signal

Terminal		Description	
A	B		
66	67	Discrete Input [DI 01]	System update GC
GND	68	Discrete Input [DI 02]	Alarm acknowledge
Common ground	69	Discrete Input [DI 03]	Enable MCB synchronization
	70	Discrete Input [DI 04]	Unload mains / MCB open
	71	Discrete Input [DI 05]	Reply: MCB is open
	72	Discrete Input [DI 06]	Command Open Group Breaker
	73	Discrete Input [DI 07]	Enable to close Group Breaker
	74	Discrete Input [DI 08]	Reply: Group Breaker (GGB) is open
	75	Discrete Input [DI 09]	Segment No. Coding Bit 1
	76	Discrete Input [DI 10]	Segment No. Coding Bit 2
	77	Discrete Input [DI 11]	Segment No. Coding Bit 3
	78	Discrete Input [DI 12]	

Table 32: DI 01-12

3.2.6 Relay Outputs

Schematic and terminals

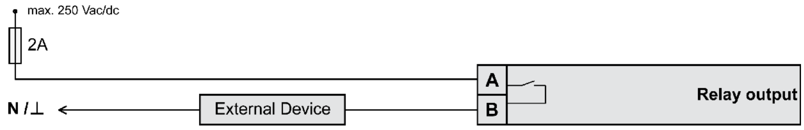


Fig. 33: Relay outputs - schematic

Terminal		Description	
N.O.	Common		
A	B	Form A	
PCB 1 identical for all GC3000XT :			
42	41	Relay output [R 01]	Ready for operation (Self-test OK)
43	46	Relay output [R 02]	New Alarm pulse
44		Relay output [R 03]	Warning Alarm
45		Relay output [R 04]	Critical Alarm
48	47	Relay output [R 05]	Open Group Breaker
50	49	Relay output [R 06]	Close Group Breaker
52	51	Relay output [R 07]	Open MCB
54	53	Relay output [R 08]	Close MCB
56	55	Relay output [R 09]	
57	60	Relay output [R 10]	Load busbar is energized
58		Relay output [R 11]	
59		Relay output [R 12]	

3.2.6.1 Connecting 24 V Relays

!

NOTICE!

Damage to adjacent electronic components due to induced voltages

– Implement protection circuits as detailed below.

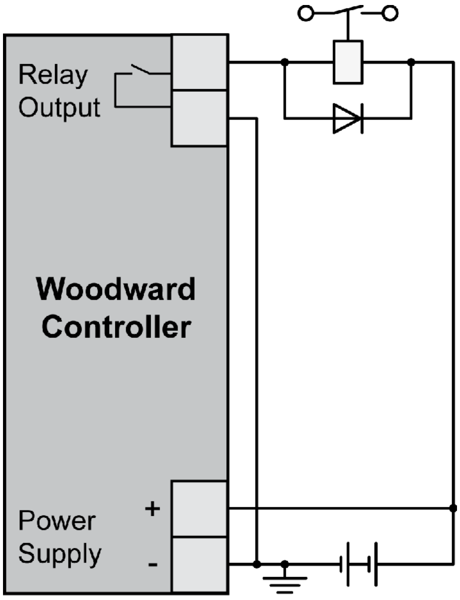


Fig. 34: Protection circuit (example)

Interferences in the interaction of all components may affect the function of electronic devices. One interference factor is disabling inductive loads, like coils of electromagnetic switching devices.

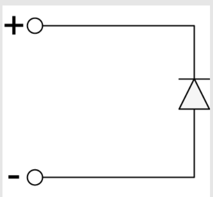
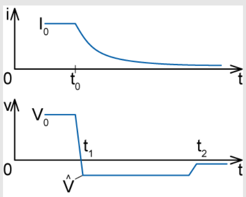
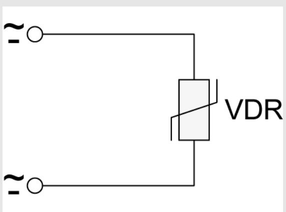
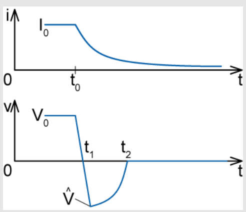
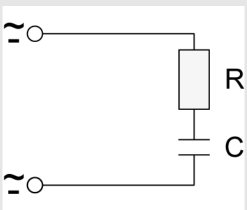
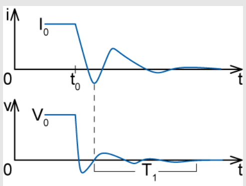
When disabling such a device, high switch-off induced voltages may occur, which might destroy adjacent electronic devices or result interference voltage pulses, which lead to functional faults, by capacitive coupling mechanisms.

Since an interference-free switch-off is not possible without additional equipment, the relay coil is connected with an interference suppressing circuit.

If 24 V (coupling) relays are used in an application, it is required to connect a protection circuit to avoid interferences.

Fig. 34 shows the exemplary connection of a diode as an interference suppressing circuit.

Advantages and disadvantages of different interference suppressing circuits are as follows:

Connection diagram	Load current / voltage curve	Advantages	Disadvantages
		Uncritical dimensioning Lowest possible induced voltage Very simple and reliable	High release delay
		Uncritical dimensioning High energy absorption Very simple setup Suitable for AC voltage Reverse polarity protected	No attenuation below VVDR
		HF attenuation by energy storage Immediate shut-off limiting Attenuation below limiting voltage Very suitable for AC voltage Reverse polarity protected	Exact dimensioning required

3.3 Setup Connections

NOTICE!

Avoid electrostatic discharge!

Before working with terminals please read and follow the instructions of chapter *"Electrostatic discharge" on page 18*.

For CAN and RS485 shielded cabling, no more than 25 mm wiring exposed without shield coverage are allowed at terminal plug side.

3.3.1 Interfaces overview

Unshielded cable length

For CAN:

– *Cabling without shield coverage should be less than 25 mm.*

The following drawing shows all available interfaces of the device:

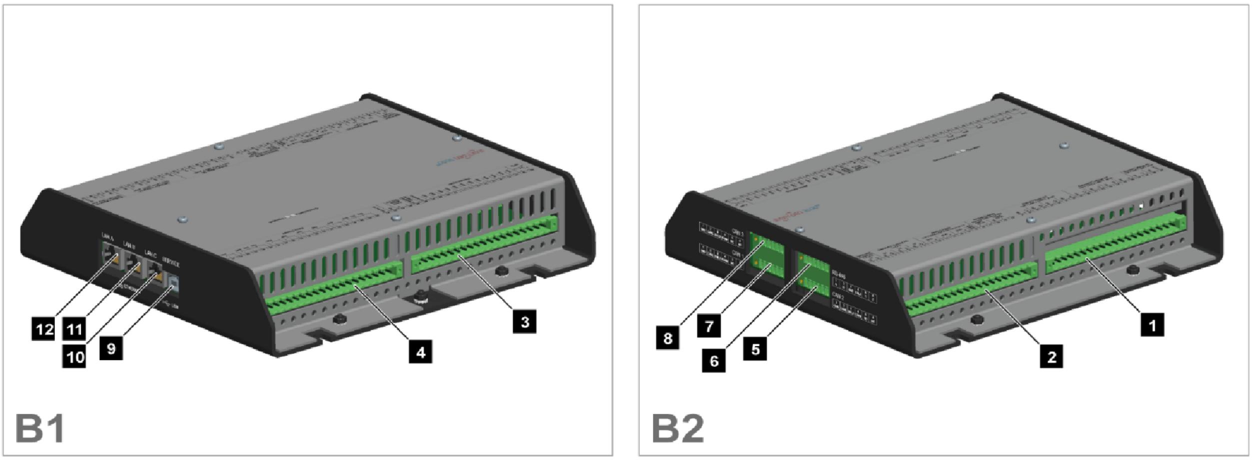


Fig. 35: GC-3400XT-P1 (sheet metal housing)

1 Mains/generator/busbar PT terminal
2 Analog inputs/outputs, generator CT, and mains/GND current terminal
3 Discrete inputs, MPU, power supply, and D+ terminal
4 Relay outputs terminal
5 CAN bus interface connector CAN #2 (not supported)
6 RS-485 interface connector RS-485 #1 (not supported)
7 CAN bus interface connector CAN #1
8 CAN bus interface connector CAN #3 (not supported)
9 USB interface connector (2.0, slave) SERVICE port
10 ETHERNET interface connector (RJ-45) LAN C
11 ETHERNET interface connector (RJ-45) LAN B
12 ETHERNET interface connector (RJ-45) LAN A

3.3.2 USB (2.0 slave) interface - Service Port

General notes

> ***Avoid electrostatic discharge!***
> *Avoid electrostatic discharge during USB cable connection to the unit.*

> *To connect this USB 2.0 (slave) device a USB cable with USB Type A (PC/laptop side) and Type B (Woodward device side) connectors is necessary.*
>
> *USB cable length shall be limited up to 3 m. It is recommended to use professional (high quality) USB cable: 28AWG/1P+24AWG/2C with good shielding.*

> ***Use USB service port for ToolKit connection***
> *The USB interface is a service port and the preferred ToolKit connection!*

'Read only' USB interface

For location see ↳ *Chapter 3.3.1 "Interfaces overview" on page 52*.

For others than ToolKit connection the USB interface is read-only!

It can be used for further service tasks from manufacturer's side.

Connecting it to a PC/laptop will display the USB interface available and all files prepared from Woodward manufacturing side. Read/write attributes of this service port are restricted to read only.

3.3.3 CAN Bus Interfaces

> ***Avoid electrostatic discharge!***
> *Avoid electrostatic discharge during cable connection to the unit.*

Pin assignment

For location of interface 5, 7, and 8 see ↳ *Chapter 3.3.1 "Interfaces overview" on page 52*.

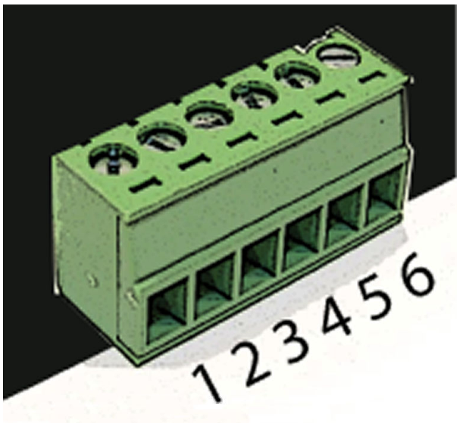


Fig. 36: screwable 6-terminal connector - CAN bus

Terminal	Description	A_{max}
1	GND - local galvanically isolated	1.5 mm²
2	CAN-L	1.5 mm²
3	Shield	1.5 mm²
4	CAN-H	1.5 mm²
5	Not connected	1.5 mm²
6	Not connected	1.5 mm²

Table 33: Pin assignment

Topology

Please note that the CAN bus must be terminated with a resistor, which corresponds to the impedance of the cable (e.g. 120 Ω, 1/4 W) at both ends.

The termination resistor is connected between CAN-H and CAN-L.

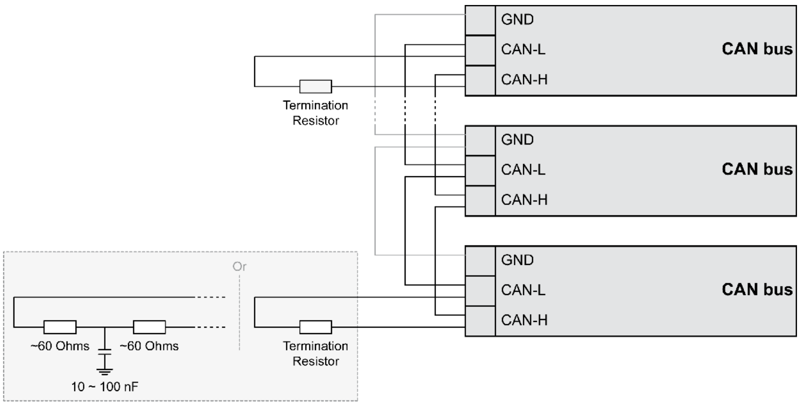


Fig. 37: CAN bus - termination

For very critical EMC conditions (many noise sources with high noise levels) and for high transmission rates we recommend to use the 'Split termination concept' as shown.

- Divide the termination resistance into 2x60 Ohms with a center tap connected to ground via a capacitor of 10 to 100 nF.

Maximum CAN bus length

The maximum length of the communication bus wiring is dependent on the configured baud rate. Observe the maximum bus length.

(Source: CANopen; Holger Zeltwanger (Hrsg.); 2001 VDE VERLAG GMBH, Berlin und Offenbach; ISBN 3-8007-2448-0).

Baud rate	Max. length
1000 kbit/s	25 m
800 kbit/s	50 m

Baud rate	Max. length
500 kbit/s	100 m
250 kbit/s	250 m
125 kbit/s	500 m
50 kbit/s	1000 m
20 kbit/s	2500 m

Bus shielding

All bus connections of the easYgen are internally grounded via an RC element. Therefore, they may either be grounded directly (recommended) or also via an RC element on the opposite bus connection.

A shielded cable with shielded plug is required.

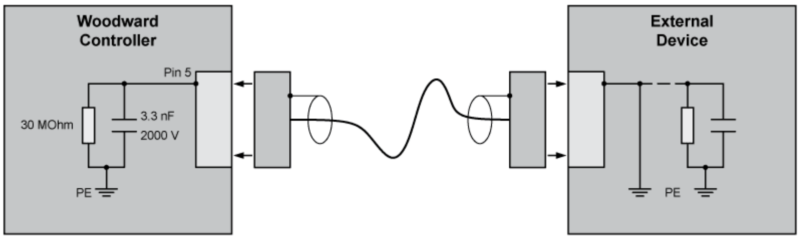


Fig. 38: Bus shielding (internal RC element)

Troubleshooting

If there is no data transmission on the CAN bus, check for the following common CAN bus communication problems:

- *A T-structure bus is utilized*
- *CAN-L and CAN-H are switched*
- *Not all devices on the bus are using identical baud rates*
- *Termination resistor(s) are missing*
- *The configured baud rate is too high for wiring length*
- *The CAN bus cable is routed in close proximity with power cables*

Woodward recommends the use of shielded, twisted-pair cables for the CAN bus (see examples).

- *Lappkabel Unitronic Bus CAN UL/CSA*
- *UNITRONIC-Bus LD 2×2×0.22*

3.3.4 Ethernet Interface (incl. Remote Panel)

This Ethernet interface 10/100Base-T/-XT complies with the IEEE 802.3 specifications.

> *Avoid electrostatic discharge!*
> *Avoid electrostatic discharge during Ethernet cable connection to the unit.*

Pin assignment

For location of interfaces 10, 11, and 12 see ✎ *Chapter 3.3.1 "Interfaces overview" on page 52*.

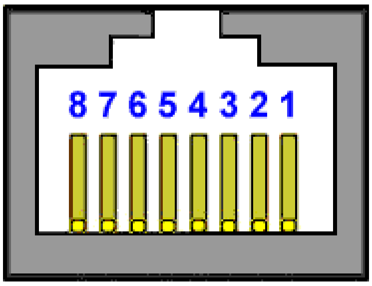


Fig. 39: RJ-45 connector - Ethernet

Pin	Description	10Base-T	100Base-T
1	Transmit Data+	TX+	TX+
2	Transmit Data-	TX-	TX-
3	Receive Data+	RX+	RX+
4	Not connected	NC	NC
5	Not connected	NC	NC
6	Receive Data-	RX-	RX-
7	Not connected	NC	NC
8	Not connected	NC	NC
		Notes NC: Not connected	

Table 34: Pin assignment

Visualization

Two LEDs (green and yellow) indicate communication status as well known by the standard.

- The green LED indicates the link activity: blinking during data transmission.
- The yellow LED indicates the link (speed) status:
  - 10MB – LED switched-OFF
  - 100MB – LED switched-ON

General notes

Ethernet category 5 (STP CAT 5) shielded cable is required with shielded plug RJ45. The chosen switch shall support a transmission speed of 10/100 Mb/s with a network segment expansion capability of 100 m.

> *Flexibility*
> *All Ethernet ports have auto MDI/MDI-X functionality, which allows to connect straight-through or crossover Ethernet cable.*
>
> *The Ethernet ports are named twice but mean the same: Ethernet #1 or Ethernet A; Ethernet #2 or B; and Ethernet #3 or C .*

Cable length / distance

The maximum length from connection to connection is 100 m. Some third party suppliers offer technology to expand the connection.

Troubleshooting

Check first the power supply of the switches.

Check the IP addresses of the single devices.

3.4 The I/O Function

3.4.1 AC Measurement

3.4.1.1 AC Voltage Measurement

AC value calibration by customer:

The AC measurement calibration is done by the EOL procedure always.

When the customer want compensate its CTs and PTs he can adjust the ratio settings of PTs and CTs.

- Measurement of 3 Voltages Mains L1-N, L2-N, L3-N (with the calculation of L1-L2, L2-L3, L3-L1)
- Measurement of 3 Voltages Generator Group L1-N, L2-N, L3-N (with the calculation of L1-L2, L2-L3, L3-L1)
- Measurement of 1 Voltage Load Busbar 1 (L1-L2) - This is the Busbar measurement type I.
- In case of a three phase measurement the phase rotation detection is based on the angles of the phase-phase voltages.

3.4.1.2 Measurement Ranges

Voltages

The unit offers three input ranges for AC voltages which can be used alternatively. The different ranges are automatically configured by the voltages rated setting. These ranges define the accuracy data.

If PTs are used, the primary and secondary voltages are individually configurable for each measurement system.

The primary voltage input is configurable from 50V until 650kV.

Measurement applications

- 3 phase / 4 wire

  measurement is performed Line-Neutral (WE connected system). Phase voltages and the neutral must be connected for proper calculation. The measurement and protection are adjusted according to the rules for WE connected systems. Monitoring refers to the following voltages: VL12, VL23 and VL31 or VL1N, VL2N and VL3N. The monitoring depends on the setting of Parameter monitoring phase-phase/phase-neutral
- 3 phase / 4 wire open delta

  measurement is performed Line-Neutral (WE connected system). Phase voltages for proper calculation. The measurement are adjusted according to the rules for WE connected systems. The protection are adjusted according to the rules for Delta connected systems. Monitoring refers to the following voltages:

  VL12, VL23 and VL31.

- 3 phase / 3 wire
  measurement is performed Line-Line (Delta connected system). Phase voltages must be connected for proper calculation. The measurement and protection are adjusted according to the rules for Delta connected systems. Monitoring refers to the following voltages:
  VL12, VL23 and VL31.
  Hint: 3Ph 3W - The values of single active power, reactive power, and power factor in L1, L2 and L3 are not displayed. These values cannot be determined through this connection type.
  Originally it was desired to have these values indicated for commissioning purposes. (PT calibration). The suggest there for in the future would be than either to switch over to 3ph4W setting during commissioning.
- 1 phase / 2 wire
  measurement is performed for single phase systems. The measurement and protection are adjusted according to the rules for single phase systems.
  Monitoring refers to VL12.
  Monitoring refers to VL1N or VL12 configurable.
- 1 phase / 3 wire
  measurement is performed Line-Neutral (WYE connected system). The measurement and protection are adjusted according to the rules for WYE connected systems. Monitoring refers to the following voltages:
  VL1N, VL3N.
  VL13
  The monitoring depends on the setting of Parameter monitoring phase-phase/phase-neutral

3.4.1.3 Frequency

General

- The unit measures mains frequency from 10Hz to 85Hz.
- Frequencies **under 10Hz** are set to 0Hz.
- The unit measures generator group frequency from 10Hz to 85Hz.
- Frequencies **under 10Hz** are set to 0Hz.
- The unit shall measure Load Busbar frequency from 10Hz to 85Hz.
- Frequencies **under 10Hz** are set to 0Hz.
- The device can theoretically detect frequencies of up to 6 voltages (L1-N, L2-N, L3-N, L1-L2, L2-L3 and L3-L1).

The GC3000XT takes only the phase-phase voltages to determine the frequency.

3.4.1.4 Phase Angle Measurement

General

The GC measures one phase angle related on L1-L2 or L1-N between Generator Group and Load Busbar.

The GC measures one phase angle related on L1-L2 or L1-N between Load Busbar and Mains.

3.4.1.5 Generator Group Measurement

AC Voltage Measurement

- True RMS L-L Voltage, per phase
- True RMS L-L Voltage, average
- True RMS L-N Voltage, per phase
- True RMS L-N Voltage, average
- Phase Sequence detection (CW, CCW)

Phase Angle Measurement

- Phase Angle L1-L2 Gen Busbar to L1-L2 Load Busbar
- Phase Angle L2-L3 Gen Busbar to L2-L3 Load Busbar
- Phase Angle L3-L1 Gen Busbar to L3-L1 Load Busbar

Frequency Measurement

- Frequency in L1-L2 (not visualized in HMI)
- Frequency in L2-L3 (not visualized in HMI)
- Frequency in L3-L1 (not visualized in HMI)
- Frequency, average (total)

3.4.1.6 Load Busbar Measurement

AC Voltage Measurement

- True RMS L1-L2 Voltage busbar (if parameter ID 1858 Configure 1Ph2W measuring is set to phase-phase)
- True RMS L1-N voltage busbar (if parameter ID 1858 Configure 1Ph2W measuring is set to phase-neutral

Frequency Measurement

- Frequency in L1-L2 or L1-N

3.4.1.7 Mains Measurement

AC Voltage Measurement

- True RMS L-L Voltage, per phase
- True RMS L-L Voltage, average
- True RMS L-N Voltage, per phase
- True RMS L-N Voltage, average
- Phase Sequence detection

Frequency Measurement

- Frequency in L1-L2 (not visualized in HMI)
- Frequency in L2-L3 (not visualized in HMI)
- Frequency in L3-L1 (not visualized in HMI)
- Frequency, average (total)

3.4.2 Digital Inputs

Digital Inputs

The discrete inputs are defined with fix functionalities. (Refer to wiring diagram)

The digital inputs are realized with positive logic. With energizing the input the described function on the terminal diagram is activated.

3.4.3 Relay Outputs

Relay Outputs

The relay outputs are defined with fix functionalities.

The digital outputs are realized with positive logic. With described function on the terminal diagram the relay is activated.

4 Configuration

4.1 Access Via PC (ToolKit)

Version

> *Woodward's ToolKit software is required to access the unit via PC*
> – *Required version: 5.6 or higher*
> – *Please use the latest available version!*

4.1.1 Configure ToolKit

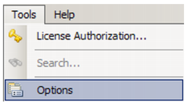


Fig. 40: Tools menu

To change ToolKit settings:

1. Select *"Tools → Options"*.

⇨ The *"Options"* windows is displayed.

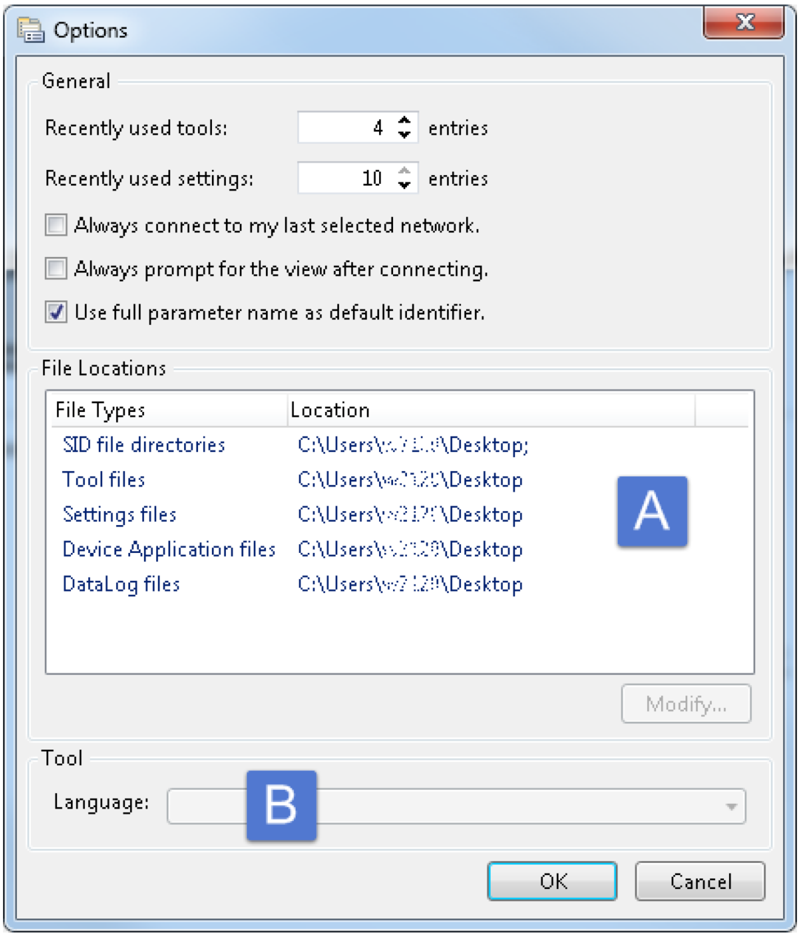


Fig. 41: ToolKit Options window

A File locations (default location is C:\Users\[users's name]\Documents\Woodward\ToolKit\Applications)

B Language (selection) setting for tools

2. Adjust settings as required.

For more information on the individual settings refer to the ToolKit help.

⇨ Changes take effect after clicking *"OK"*.

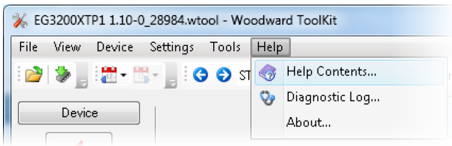


Fig. 42: Help

Please do not change the default installation folder! Otherwise the language selection will not work properly.

4.1.2 Connect ToolKit via USB Service Port

A USB cable with USB 2.0 Type A and (at Woodward device side) Type B connector is necessary. It is not part of delivery.

Local ports
The number of the COM port used for USB connection depends on your configuration. *This sample is using COM4.*

Sample configuration procedure

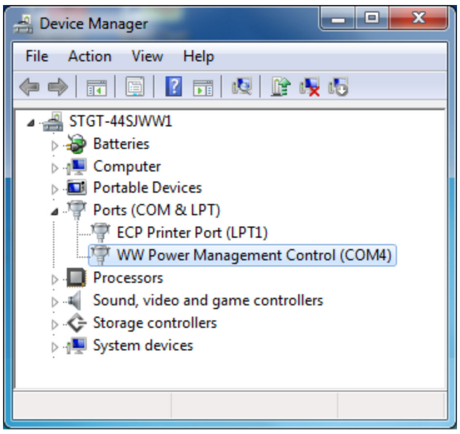


Fig. 43: USB device @ COM4

1. Install the USB driver delivered by Woodward
2. Check
3. Start GC3000 and wait for "normal operation"
4. Connect the Woodward device and the PC/laptop ToolKit is running on with the USB cable

   ⇨ USB drive will be automatically detected: WINDOWS offers pre-selected next step e.g., open in explorer what would display files on the easYgen-XT device but is not needed now
5. Open ToolKit

   ⇨ wtool selection window opens
6. Select the .wtool file for your device by double click

   ⇨ ToolKit Home Page (empty) opens

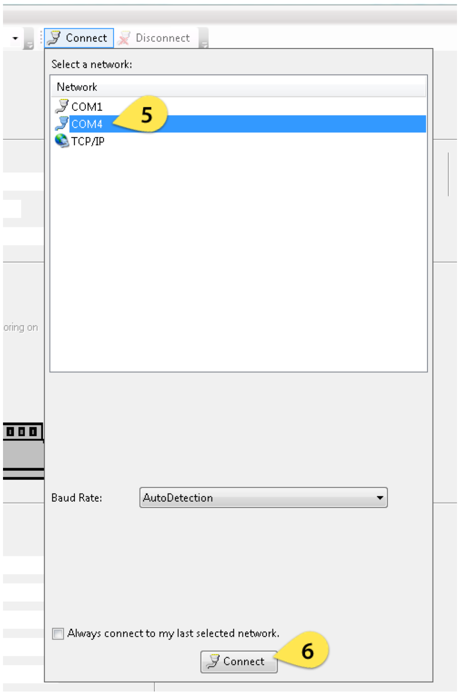


Fig. 44: Select COM4 for ToolKit USB connection

7. Click on *"Connect"*

   ⇨ Network selection window opens

8. Select COM4 - the USB port

9. Click on *"Connect"*

   ⇨ Connection will be established

   Security Login window opens

> ***USB connection fails?***
>
> *If USB connection fails please try the following methods before you contact your IT expert:*
>
> – *disconnect and reconnect USB cable*
> – *use another USB port*
> – *use a proper USB cable (for reference see)*
> – *re-start ToolKit two or three times*

10. Log in with your *"Username"* and *"Password"*

    ⇨ ToolKit is opened and homepage is displayed. Access (code) level depends on the password typed in.

> *Without entering username and password (correctly): Values are displayed (read) only.*

> *In case ToolKit doesn't open correctly please close ToolKit and open it a second time.*

4.1.3 Connect ToolKit via Ethernet Port

> *Ethernet category 5 (STP CAT 5) shielded cable is required with shielded plug RJ45. It is not part of delivery.*
>
> *Description below exemplarily is done for Ethernet A.*
>
> *Connection is also possible via Ethernet B or Ethernet C, please note the changed IP address.*

> ***During connecting ...***
>
> *Don't work with event history or *.wset files while connecting to ToolKit.*

1. Connect the Woodward device with the Ethernet cable to the network.

> ***Network restrictions***
>
> *Both the Group Controller and your ToolKit running computer/laptop (PC) must be in the same IP address range. For example if the IP address of GC3000XT is 10.31.140.20, the IP address of the PC must be 10.31.140.xxx.*
>
> *It is as well recommended to use an isolated/dedicated network for ToolKit communication (Anti-virus software sometimes may interfere with the Ethernet network). Please consult your IT team for adjustment help.*

2. Check that the "ToolKit device" is in the same network but with a different device address
3. Click on the .wtool file for your device
   - ⇨ ToolKit Home Page for easYgen-XT (empty) opens
4. Click on *"Connect"*
   - ⇨ Network selection window opens
5. Select Ethernet port "TCP/IP"
   - ⇨ Check that device address is the host name address otherwise add the host address and select it for (preferred) use

> *Don't use leading "0" zero in address! This would lead to no connection.*
>
> *Sample: If displayed "Actual IP address" is 169.254.114.002 type 169.254.114.2 (instead of "... . 002").*
>
> *Second sample - valid for every three-numbers-block: Type 169.54.14.2 if displayed "Actual IP address" is 169.054.014.002.*

6. Click on *"Connect"*
   - ⇨ Connection will be established

     Security Login window opens
7. Log in with your *"Username"* and *"Password"*
   - ⇨ ToolKit is opened and homepage is displaying current states and values

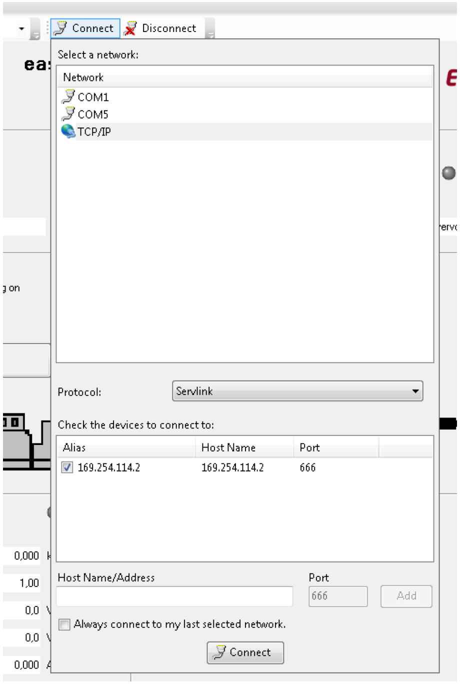


Fig. 45: Select TCP/IP for ToolKit connection

CAUTION!

Avoid using the same IP address twice!

By mistake it is possible to assign the same IP address twice to two different devices e.g. for Remote Panel RP-3000XT as in the system is configured for the easYgen-3000XT so far.

In this case the last configured device (RP-3000XT) will work properly but the so far configured device (easYgen-XT) will be invisible on the Ethernet: **Load Share and ToolKit do not work on this device!** ... and cannot be found for remote connection.

Solution:

– Apply again properly IP addresses for devices A and B
  or
– reset easYgen-XT (power cycle)

Network mismatch using the same IP address twice with other devices can be handled similarly.

4.1.4 View And Set Values In ToolKit

Basic navigation

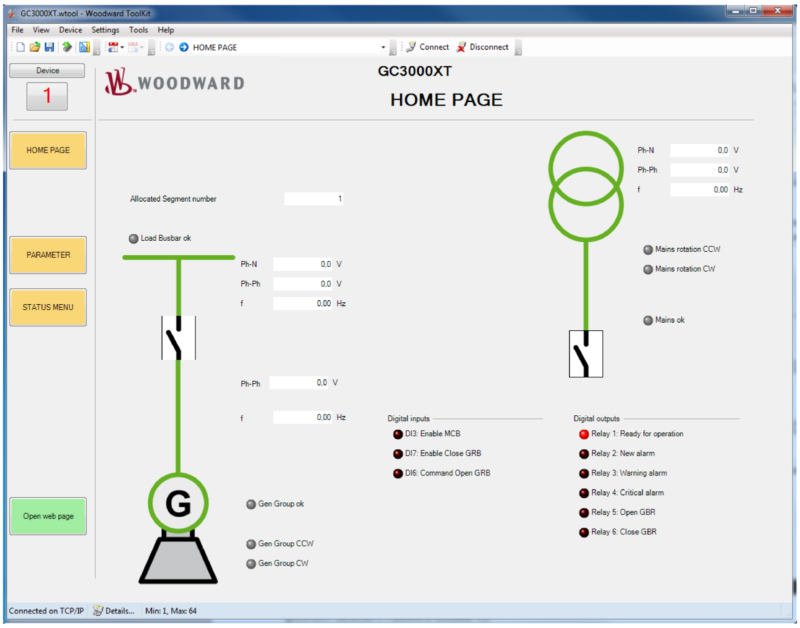


Fig. 46: ToolKit home screen

ToolKit offers the following graphical elements for basic navigation:

Graphical element	Caption	Description
PARAMETER Configure system management	On top of the page/screen	One level back in menu hierarchy (Visible at menu level 2 and higher)

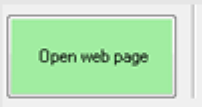
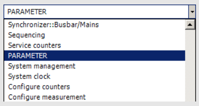
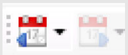
Graphical element	Caption	Description
		Main Buttons in orange. Permanently visible
		Yellow buttons depend on current menu/page and guide to further pages "beside" the current page. This pages can be opened by *"Previous page"* / *"Next page"* and as result of a search *[Ctrl] [F]*
		Both *"HOME PAGE"* and page *"PARAMETER"* offer a green button *[Open web page]* to open product web page containing product information and links to additional information
	Navigation list	Directly select a configuration page based on its name
	Buttons *"Previous page"* and *"Next page"*	Go to the previous/next configuration page (as ordered in the list)
	Buttons *"Previous visited page"* and *"Next (already) visited page"*	Go to the previous/next visited page (as ordered in the list)

Table 35: Toolkit graphical elements for basic navigation

Value and status fields

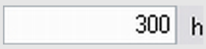
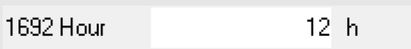
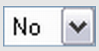
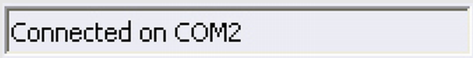
Graphical element	Caption	Description
	Value field	To directly input (alpha)numeric values
		Display (read) only
	Option field	To select from a preset list of options
	Connection status field	Displays active port and unit connection status

Table 36: Toolkit value and status fields

To change the value of a value or option field:

1. Enter the value or select an option from the drop-down list.
2. Press *[Enter]* to confirm.

   ⇨ The new value is written directly to the unit.

Visualization

Values displayed by visualization graphical elements cannot be changed.

Search

> *[Ctrl][F]*
>
> *The short cut ctrl-F works to open ToolKit search window.*

To find specific parameters, settings and monitoring values more easily, ToolKit includes a full-text search function.

To find a parameter/setting/monitoring value:

1. Select *"Tools ➔ Search"* from the menu.
   ⇨ The *"Search"* dialog opens.
2. Enter a search term and press *[Enter]*.
   ⇨ The results are displayed in the table.

   > *Column width can be adjusted as usual (e.g. to read full path).*
   >
   > *"May not be visible": display (on not) of this value depends on settings.*

3. Double-click a table entry to go to the visualization/configuration page that includes this parameter/setting/monitoring value.

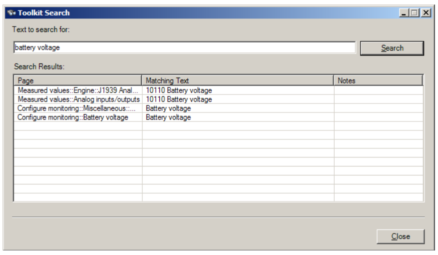


Fig. 47: Search dialog

Value trending

The value trending view can chart up to eight values over time.

To select values for trending screen:

1. Right-click an analog value field on any configuration/visualization page and select *"Add to trend"* from the context-menu.
   ⇨ The trending screen opens.
2. Click the *"Start"* button to initiate charting.
3. Click the *"Stop"* button to stop charting the values.

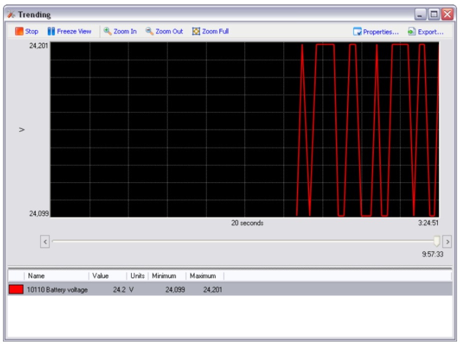


Fig. 48: Trending screen

> ***Viewed range!***
>
> *The range to be exported depends on the view and the start position of the time bar but is always reported until the end of charting.*
>
> *To export all (complete report) time marker must be at start position or the complete graph must be viewed.*

4. To store the tracked data select *"Export"*

   ⇨ The tracked data are exported as a time/value table to a `.htm` file. This file can be opened and viewed with a web browser. A copy of the web page content can be inserted and edited/analyzed in external applications (e.g. MS Excel/OpenOffice.org Calc).

Graphical element	Caption	Description
Start	*"Start"*	Start value charting
Stop	*"Stop"*	Stop value charting
Zoom In Zoom Out Zoom Full	Zoom controls	Adjust detail of value chart
Export...	*"Export"*	Export to `.htm` file
Properties...	*"Properties"*	Change scale limits, sample rate, time span, colors

Table 37: Trending screen controls

Details ... of connection

The bottom of the ToolKit screen comes with information about connection and a button for more *"Details ..."*.

With a click on *"Details ..."* a list of all current connections will be displayed and further buttons appear:

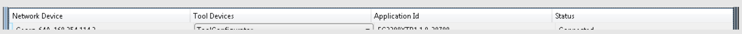
Graphical element	Caption	Description
		Table/list of all connected devices
Disconnect	Disconnect	Dissolving connection between ToolKit and device (same function as at the top of ToolKit page/screen)
Log In	Log In	Opens *"Security login"* window
Log Out	Log Out	Reset of security level to "0"
Save Values	Save values	Opens *"Save values"* window to save values/settings (same function as at the top of ToolKit page/screen)

Table 38: Toolkit connection controls

4.2 Basic Setup

4.2.1 Configure Language/Clock

General notes

The following parameters are used to set the unit language, the current date and time, and the daylight saving time feature.

> *Update Clock*
>
> *HMI/display and ToolKit differ in updating the clock settings*
>
> – *HMI/displays the actual value and enables direct change of each parameter*
>
> – *ToolKit displays the "Actual values" (ID 1690 to 1695) beside and the time values and date values can be prepared each as a set before transfer*

ID	Parameter	CL	Setting range [Default]	Description
"Values to be set"				
1710	Hour	0	hour 0 to 23 h [real-time clock]	The hour of the clock time is set here. Example ■ 0 = 0th hour of the day (midnight). ■ 23 = 23rd hour of the day (11 pm).
1709	Minute	0	0 to 59 min [real-time clock]	The minute of the clock time is set here. Example ■ 0 = 0th minute of the hour ■ 59 = 59th minute of the hour
1708	Second	0	0 to 59 s [real-time clock]	The second of the clock time is set here. Example ■ 0 = 0th second of the minute ■ 59 = 59th second of the minute
1698	Transfer time to clock TKit	2	Yes [No]	`Yes` transfers the time values to the clock. Notes ALL values are transferred and overwritten - even if you want to change only one.
1711	Day	0	day 1 to 31 [real-time clock]	The day of the date is set here. Example ■ 1 = 1st day of the month. ■ 31 = 31st day of the month.
1712	Month	0	month 1 to 12 [real-time clock]	The month of the date is set here. Example ■ 1 = 1st month of the year. ■ 12 = 12th month of the year.
1713	Year	0	year 0 to 99 [real-time clock]	The year of the date is set here.

ID	Parameter	CL	Setting range [Default]	Description
				Example ■ 0 = Year 2000 ■ 99 = Year 2099
1699	Transfer data to clock	2	Yes [No]	`Yes` transfers the date values to the clock. **Notes** ALL values are transferred and overwritten - even if you want to change only one.
4589	Time zone	2	-12 to 14 [0.00]	Time shift in hours between the time zone in which the device is used compared to the absolutely Greenwich Mean Time (GMT). This information is needed to transfer the general time signal into the local real-time clock setting.
"Daylight saving time"				
4591	Daylight saving time	2	On [Off]	`On` enables the Daylight saving time. The daylight saving time feature enables to automatically adjust the real-time clock to local daylight saving time (DST) provisions. If daylight saving time is enabled, the real-time clock will automatically be advanced by one hour when the configured DST begin date and time is reached and falls back again by one hour when the configured DST end date and time is reached. If the unit is used in the southern hemisphere, the DST function will be inverted automatically, if the DST begin month is later in the year than the DST end month. **Notes** Do not change the time manually during the hour of the automatic time change if DST is enabled to avoid a wrong time setting. Events or alarms, which occur during this hour might have a wrong time stamp.
4594	DST begin time	2	0 to 23 [0]	The real-time clock will be advanced by one hour when this time is reached on the DST begin date. Example ■ 0 = 0th hour of the day (midnight) ■ 23 = 23rd hour of the day (11 pm) **Notes** This parameter is only displayed, if Daylight saving time (parameter 4591 ⤷ p. 70) is set to "On".
4598	DST begin weekday	2	Sunday to Saturday [Sunday]	The weekday for the DST begin date is configured here **Notes** This parameter is only displayed, if Daylight saving time (parameter 4591 ⤷ p. 70) is set to "On".
4592	DST begin nth. weekday	2		The order number of the weekday for the DST begin date is configured here.
			[1st]	DST starts on the 1st configured weekday of the DST begin month.
			2nd	DST starts on the 2nd configured weekday of the DST begin month.
			3rd	DST starts on the 3rd configured weekday of the DST begin month.
			4th	DST starts on the 4th configured weekday of the DST begin month.
			Last	DST starts on the last configured weekday of the DST begin month.
			LastButOne	DST starts on the last but one configured weekday of the DST begin month.
			LastButTwo	DST starts on the last but two configured weekday of the DST begin month.
			LastButThree	DST starts on the last but three configured weekday of the DST begin month.

ID	Parameter	CL	Setting range [Default]	Description
				Notes This parameter is only displayed, if Daylight saving time (parameter 4591 ↪ p. 70) is set to "On".
4593	DST begin month	2	1 to 12 [1]	The month for the DST begin date is configured here.
				Example ■ 1 = 1st month of the year ■ 12 = 12th month of the year
				Notes This parameter is only displayed, if Daylight saving time (parameter 4591 ↪ p. 70) is set to "On".
4597	DST end time	2	0 to 23 [0]	The real-time clock will fall back by one hour when this time is reached on the DST end date
				Example ■ 0 = 0th hour of the day (midnight). ■ 23 = 23rd hour of the day (11 pm).
				Notes This parameter is only displayed, if Daylight saving time (parameter 4591 ↪ p. 70) is set to "On".
4599	DST end weekday	2	Sunday to Saturday [Sunday]	The weekday for the DST end date is configured here
				Notes This parameter is only displayed, if Daylight saving time (parameter 4591 ↪ p. 70) is set to "On".
4595	DST end nth. weekday	2		The order number of the weekday for the DST begin date is configured here.
			[1st]	DST ends on the 1st configured weekday of the DST begin month.
			2nd	DST ends on the 2nd configured weekday of the DST begin month.
			3rd	DST ends on the 3rd configured weekday of the DST begin month.
			4th	DST ends on the 4th configured weekday of the DST begin month.
			Last	DST ends on the last configured weekday of the DST begin month.
			LastButOne	DST ends on the last but one configured weekday of the DST begin month.
			LastButTwo	DST ends on the last but two configured weekday of the DST begin month.
			LastButThree	DST ends on the last but three configured weekday of the DST begin month.
				Notes This parameter is only displayed, if Daylight saving time (parameter 4591 ↪ p. 70) is set to "On".
4596	DST end month	2	1 to 12 [1]	The month for the DST begin date is configured here.
				Example ■ 1 = 1st month of the year ■ 12 = 12th month of the year
				Notes This parameter is only displayed, if Daylight saving time (parameter 4591 ↪ p. 70) is set to "On".

Table 39: Parameters Language/Clock Configuration

Example

If daylight saving time starts at 2:00 am on the 2nd Sunday in March and ends at 2:00 am on the 1st Sunday in November, the unit has to be configured like shown in *Table 40 "Daylight saving time - configuration example" on page 72* to enable an automatic change to daylight saving time and back to standard time.

ID	Parameter	Setting
4591	Daylight saving time	On
4594	DST begin time	2
4598	DST begin weekday	Sunday
4592	DST begin nth weekday	2nd
4593	DST begin month	3
4597	DST end time	2
4599	DST end weekday	Sunday
4595	DST end Sunday	1st
4596	DST end month	11

Table 40: Daylight saving time - configuration example

	USA, Canada		European Union	
Year	DST Begins 2 a.m. (Second Sunday in March)	DST Ends 2 a.m. (First Sunday in November)	DST Begins 1 a.m. UTC=GMT (Last Sunday in March)	DST Ends 1 a.m. UTC=GMT (Last Sunday in October)
2008	March 9, 2008	November 2, 2008	March 30, 2008	October 26, 2008
2009	March 8, 2009	November 1, 2009	March 29, 2009	October 25, 2009
2010	March 14, 2010	November 7, 2008	March 28, 2010	October 31, 2010

Table 41: Daylight saving time - exemplary dates

4.2.2 Lamp Test

All lights on the controller may be tested for correct operation with this function.

"Parameter ➔ Lamp test"

Lamp test is available via ToolKit.

Both lamps on the GC device must shine "orange" (Green and red LED simultaneously).

4.2.3 Enter Password

General notes

The controller utilizes a password protected multi-level access hierarchy to prevent unauthorized access to parameters, configuration and calibration items. This permits varying degrees of access to the parameters being granted by assigning unique passwords to designated personnel.

Password protection covers direct and remote access through all methods and interfaces of interconnectivity of the device.

> ***Password security***
> *Configure password security before handing over the device to the customer!*
>
> *Note your password on a secure location. The next higher password level (2 and 4) allows to reset the password of the level below (1 and 3).*
>
> *To restore the according User Name Account needs support from Woodward (authorized partner).*

Access via channel ...

The following table and drawing provide an overview about the possible access channels to the GC-3400XT-P1.

Access to the GC-3000XT by a/an ...	# used in Fig. 49below
PC running ToolKit servlink, connected over USB	②
3rd party Remote Panel (i.e. Proface, Sütron, ...) running Modbus TCP	④
PLC running Modbus TCP	④
PC running ToolKit servlink, connected over Ethernet	⑤
Netbiter® Easy Connect gateway running Servlink TCP (ToolKit via internet)	⑤

> *Each channel has its own independent access level.*
>
> *The according password handling for each of this access is defined afterwards.*

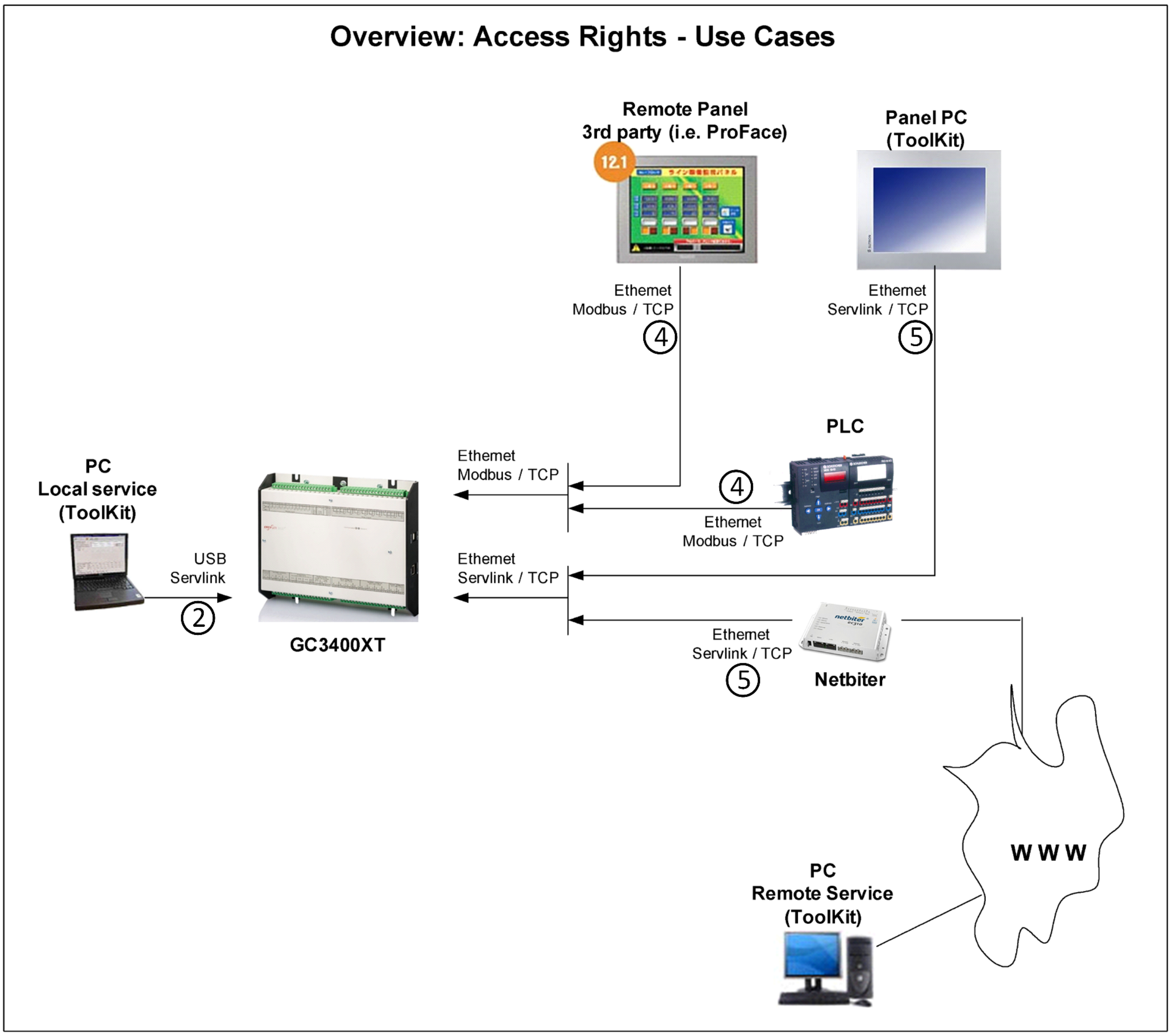


Fig. 49: Access to the GC3000-XT device - Overview

Two login procedures cover all access channel variants: The ...

- Basic Code Entry
- User Account Entry

> ***Hidden entry for more security***
> *The currently selected entry number is visible only - all other numbers are hidden and a "*" asterisk is displayed instead.*

LOGIN procedure "User Account Entry"

The User Account Entry is valid for access ②, ④, and ⑤.

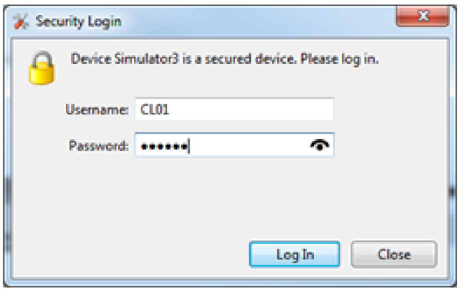


Fig. 50: Password entry: HMI

The User Account Entry comes with more security as requested for internet access. It asks for *"Username:"* and *"Password:"* ("Alpha-numeric Password"). To open the related password level, both rows entries need the correct alphanumeric strings.

The already existing User names cannot be changed. They are fixed for the desired code level, which shall be entered.

Check you Password entry

View hidden password entry by pushing the symbol on the right side of the "Password:" box.

Enter Password for level ... (Overview)

A distinction is made between the access levels as follows:

Code Level	User Account Entry		Basic Code Entry	Comment
	User Name (fix)	Password (default)	Password (default)	
5	CL05	CL0500	500	**The Super Commissioning Level** Access to nearly all parameters and configurations, except calibration and super user items. The firmware updating is released. The own code level and the levels below can be indicated and configured.
4	AC04	Algorithm Code	Algorithm Code	**The temporary Super Commissioning Level** The same access rights like in the Super Commissioning Level but with the following exceptions: ■ The password for this level is not visible. ■ The access is dismissed afterwards.
3	CL03	CL0003	3	**The Commissioning Level** Access to well defined parameters and configurations, which are usually needed on a commissioning level. The own code level and the levels below can be indicated and configured.

Code Level	User Account Entry		Basic Code Entry	Comment
	User Name (fix)	Password (default)	Password (default)	
2	AC02	Algorithm Code	Algorithm Code	**The temporary Commissioning Level** The same access rights like in the Commission Level. The Code level is entered in an algorithm code. The access is dismissed afterwards. Only the code levels below can be indicated and configured.
1	CL01	CL0001	1	**The Basic Level** Access to a limited number of parameters and configurations. The own code level can be indicated and configured.
0				No access rights to change, even viewed information is restricted.

Active Code Level

A code level always belongs to an access channel. Each access channel has its own password level. This password level can be different to others (other channels) at the same time.

The access related code level is available and visible beside the access related interface settings.

The Algorithm Code

The "Algorithm Code" is an implemented procedure to give an external user temporarily access to the device but without being able to see or change the according passwords. This temporary access needs a random number produced by the device. The actual password then is calculated from this random number using a secret formula. The secret formula is provided by a higher instance.

Access Channels

Maximum Security

Each of these channels have their own independent access level. That has the advantage that e.g. a HMI channel password level opens not automatically the access rights for the other channels.

The device provides different access channels via ...	Remarks
USB	ToolKit Servlink
Ethernet	Modbus TCP
	ToolKit Servlink TCP, 8 sub channels are possible **Note:** Each of the 8 sub channels has its own independent password access level!

The different Password Code Levels

This chapter defines the properties of the single password code levels. The device differentiates several password levels. Generally with a higher reached password level the access rights increases.

Code Level 0

The Level 0 means there are no access rights enabled. All configurations are blocked.

Code Level 1 - The Basic Level CL01

- **General:**
  This level releases the access to a limited number of parameters and configurations
- **User Account Entry:**
  This level is selected with the User Name CL01 and the according password can only be changed being in code level CL01.
  Being in code level AC02 or higher the password of the Basic Level CL01 can be reset to its default by the Yes/No parameter 10434 ⇘ p. 83.

Code Level	User Account Entry	
	User Name (fix)	Password (default)
1	CL01	CL0001

Code Level 2 - The temporary Commissioning Level AC02

- **General:**
  This Level allows temporary access to parameters of the Commission Level.
  The access is dismissed automatically (see ⇘ *"Automatic Logout from Password level (Fall into level 0)" on page 80*).
- **User Account Entry:**
  This level is selected with the User Name AC02 and the according algorithm for the password can only be changed being in the Commissioning code level CL03.
  Being in code level AC02 or higher the password of the Basic Level CL01 can be reset to its default by the Yes/No parameter 10434 ⇘ p. 83.

Code Level	User Account Entry	
	User Name (fix)	Password
2	AC02	The entry procedure: The operator connects ToolKit with the device and closes the upcoming security login window **without entering** username and password (Code level 0). The operator navigates with ToolKit to the page *"Parameter ➔ Configure system management"*. The operator reads on that page 10416 ↳ p. 83 *"Random number for password"*. He tells it to a higher instance. The higher instance calculates: (10414 *"Code temp. commissioning"* + 10416 *"Random Number"*) x 3. The higher instance takes the lower four digits of the result and puts the according algorithm string 10437 *"Alphanumeric code temp. comm."* as prefix in front. The higher instance tells the result to the operator, who enters the result as password into the control.

Code Level 3 - The Commissioning Level CL03

- General:
  In this Level, the operator has access to all parameters and configurations, which are usually needed on a commissioning level
- User Account Entry:
  This level is selected with the User name CL03 and the according password can only be changed being in the Commissioning Level CL03
  Being in code level AC04 or higher the password of the Commissioning Level CL03 can be reset to its default by the Yes/No parameter ID 10435 ↳ p. 83

Level	User Account Entry	
	User Name (fix)	Password (default)
3	CL03	CL0003

Code Level 4 - The temporary Super Commissioning Level

- General:
  This Level allows temporary access to nearly all parameters and configurations, except calibration and super user items.
  The access is dismissed automatically
- User Account Entry:
  This level is selected with the User name AC03 and the according algorithm for the password can only be changed being in the Super Commissioning Level CL05
  Being in code level AC04 or higher the password of the Commissioning Level CL03 can be reset to its default by the Yes/No parameter ID 10435 ↳ p. 83

Level	User Account Entry	
	User Name	Password
4	AC04	The entry procedure: The operator connects ToolKit with the device and closes the upcoming security login window **without entering** user-name and password (Code level 0). The oper-ator navigates with ToolKit to the page *"Parameter ➔ Configure system management"*. The operator reads on that page 10416 ↳ p. 83 *"Random number for password"*. He tells it to a higher instance. The higher instance cal-culates: (10412 *"Code temp. commissioning"* + 10416 *"Random Number"*) x 5. The higher instance takes the lower four digits of the result and puts the according algorithm string 10438 *"Alphanumeric code super temp. comm."* as prefix in front. The higher instance tells the result to the operator, who enters the result as password into the control.

Code Level 5 - The Super Commissioning Level CL05

- **General:**
  In this Level, the operator has access to nearly all parameters and configurations, except calibration items
  The firmware updating is released
- **User Account Entry:**
  This level is selected with the User name CL05 and the according password can only be changed being in the Super Commissioning Level CL05
  Being in a higher level as CL05 the password of the Super Commissioning Level CL05 can be reset to its default by the Yes/No parameter ID 10436 ↳ p. 84

If you have forgotten your password for the Super Commissioning Level, please contact Woodward or a representative for help.

Level	User Account Entry	
	User Name (fix)	Password (default)
5	CL05	CL0500

Automatic Logout from Password level (Fall into level 0)	The Modbus TCP access channel denies after 2h Generally with power supply cycling the password level is denied. The ToolKit Servlink access never logout
What forces the Logout from Password levels (Fall into level 0)	The ToolKit Servlink access with logout function The Modbus TCP (in all channels) with wrong password
Definition of the password	Alpha numeric Password of the User Account entry ■ The maximum length of the alpha numeric password is 20 characters ■ The maximum length of the alpha numeric prefix (ID 10437 ⇘ p. 82; 10438 ⇘ p. 82) is 6 characters
The Random Number	Each time a password is entered, the random number is calculated at new. This guarantees max. security.
Password handling in ToolKit	The ToolKit supports the User Account entry and in case of CANopen connection the Basic Code entry. Ethernet Connection: The ToolKit password level is visible in the menu *"STATUS MENU ➔ Diagnostic ➔ Interfaces ➔ Ethernet ➔ Servlink"*. Refer to your IP-address (PC). USB Connection: The ToolKit password level is visible in the menu *"STATUS MENU ➔ Diagnostic ➔ Interfaces ➔ USB"*. CAN Connection: The ToolKit password level is visible in the menu *"STATUS MENU ➔ Diagnostic ➔ Interfaces ➔ CAN ➔ CANx"*.
Password handling via Modbus TCP using Ethernet connection	The easYgen must be a member of an Ethernet network and both user name and password have to be transferred (from PLC) to the device.
Set GC3000-XT to code level CL05 via Modbus TCP	With factory settings username is expected to be "CL05" and password to be "CL0500" for code level CL05. With setting the Code Level all five communication channels (sockets) are released. 1. Write and transfer *[CL05]* as hex: 43-4C-30-35-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00 for "User name" to parameter 7490 ⇘ p. 81 (40 bytes). 2. Write and transfer *[CL0500]* as hex: 43-4C-30-35-30-30-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00 for "Password" to parameter 7491 (40 bytes). ⇨ Code level can be read with parameter 10427
	The password level is visible in the Ethernet interface diagnostic screen.

ID	Parameter	CL	Setting range [Default]	Description
10400	Password display	0	0000 to 9999 [random number]	The password for configuring the control via the front panel must be entered here.
10405	Code level display	0	(display only) [0]	This value displays the code level which is currently enabled for access via the front panel display or the Woodward Remote Panel with screen share mode.

Code level interfaces

The password and/or User name for access via interface cannot be entered via HMI.

ID	Parameter	CL	Setting range [Default]	Description
7486	Code level for USB	0	[0]	This value displays the code level, which is currently enabled for access via the USB interface. The password is entered via the ToolKit login window.
7490	User name Modbus TCP	0		The user name for configuring the control via the Modbus TCP/IP interface must be entered here. Not visible but can be accessed by interface!
7491	Password Modbus TCP/IP	0	0000 to 9999 [random number]	The password for configuring the control via the Modbus TCP/IP interface must be entered here. Not visible but can be accessed by interface!
10427	Code level Modbus TCP/IP	0	[0]	This value displays the code level, which is currently enabled for access via the Modbus TCP/IP interface.
7816	IP Servlink Master 1	0	[0]	This is the IP address of the PC that is connected via ToolKit with the device as Servlink Master 1.
7824	Code level Servlink Master 1	0	[0]	This value displays the code level, which is currently enabled for access as Servlink Master 1.
7817	IP Servlink Master 2	0	[0]	This is the IP address of the PC that is connected via ToolKit with the device as Servlink Master 2.
7825	Code level Servlink Master 2	0	[0]	This value displays the code level, which is currently enabled for access as Servlink Master 2.
7818	IP Servlink Master 3	0	[0]	This is the IP address of the PC that is connected via ToolKit with the device as Servlink Master 3.
7826	Code level Servlink Master 3	0	[0]	This value displays the code level, which is currently enabled for access as Servlink Master 3.
7819	IP Servlink Master 4	0	[0]	This is the IP address of the PC that is connected via ToolKit with the device as Servlink Master 4.
7827	Code level Servlink Master 4	0	[0]	This value displays the code level, which is currently enabled for access as Servlink Master 4.
7820	IP Servlink Master 5	0	[0]	This is the IP address of the PC that is connected via ToolKit with the device as Servlink Master 5.
7828	Code level Servlink Master 5	0	[0]	This value displays the code level, which is currently enabled for access as Servlink Master 5.
7821	IP Servlink Master 6	0	[0]	This is the IP address of the PC that is connected via ToolKit with the device as Servlink Master 6.
7829	Code level Servlink Master 6	0	[0]	This value displays the code level, which is currently enabled for access as Servlink Master 6.

ID	Parameter	CL	Setting range [Default]	Description
7822	IP Servlink Master 7	0	[0]	This is the IP address of the PC that is connected via ToolKit with the device as Servlink Master 7.
7830	Code level Servlink Master 7	0	[0]	This value displays the code level, which is currently enabled for access as Servlink Master 7.
7823	IP Servlink Master 8	0	[0]	This is the IP address of the PC that is connected via ToolKit with the device as Servlink Master 8.
7831	Code level Servlink Master 8	0	[0]	This value displays the code level, which is currently enabled for access as Servlink Master 8.

4.2.3.1 Password System - Parameter Overview

General notes

The following passwords grant varying levels of access to the parameters.

Each individual password can be used to access the appropriate configuration level through multiple access methods and communication protocols (via the front panel, via the CAN bus).

ID	Parameter	CL	Setting range [Default]	Description
10415	Password Basic	1	1 to 9999 [-]	The password for the code level "Basic" is defined in this parameter. Refer to *Chapter 4.2.3 "Enter Password" on page 73* for default values.
10413	Password commissioning	3	1 to 9999 [-]	The password for the code level "Commissioning" is defined in this parameter. Refer to *Chapter 4.2.3 "Enter Password" on page 73* for default values.
10414	Code temp. commissioning	3	1 to 9999 [200]	The algorithm for calculating the password for the code level "Temporary Commissioning" is defined in this parameter.
10412	Code temp. super commissioning	5	1 to 9999 [400]	The algorithm for calculating the password for the code level "Temporary Super commissioning" is defined in this parameter.
10411	Password super commissioning	5	1 to 9999 [500]	The password for the code level "Super commissioning" is defined in this parameter. Refer to *Chapter 4.2.3 "Enter Password" on page 73* for default values.
10437	Alphanumeric code temp. comm.	3	(up tp 6 characters) [a9t5]	Alphanumeric code for temporary commissioning level. This is the alphanumeric algorithm value for the formula to reach the temporary commissioning code level (Level 02), entered as string here.
10438	Alphan. code temp. super comm.	5	(up tp 6 characters) [xk38]	Alphanumeric code for temporary super commissioning level This is the alphanumeric algorithm value for the formula to reach the temporary commissioning code level (Level 04), entered as string here.

4.2.3.1.1 Random Number for Password

ID	Parameter	CL	Setting range [Default]	Description
10416	Random number for password		[(random four letters number)]	Random number generated by the GC3000-XT device. Needed to get an alphanumeric password by Woodward support.

4.2.3.1.2 Change/Reset Alphanumeric Password

ID	Parameter	CL	Setting range [Default]	Description
Change password basic level				
10439	Old password basic level	1	((empty))	Enter here your old alphanumeric password to release the password change for the basic code level (CL01)
10440	New password basic level	1	((empty))	Enter here your new alphanumeric password string for the basic code level (CL01)
10441	Confirm password basic level	1	((empty))	Repeat here your new alphanumeric password string for the basic code level (CL01)
10442	Change password basic level	1	[No] Yes	With switching this parameter to yes, the control checks the entries for changing the password and executes the password change, if the entries are correct. The visualization 10443 indicates the successful execution.
				Notes If the parameters 10439, 10440, and 10441 are not correct, the password change is not executed.
10443	Change passw. error basic level	0		Flag: illuminated LED
			[green]	Password was not changed or successfully changed
			red	Error: password could not be changed
10434	**Reset password basic level**	2	Yes	The control resets the password of the basic level to "CL0001".
			[No]	
Change password commissioning level				
10444	Old password commiss. level	3	((empty))	Enter here your old alphanumeric password to release the password change for the commissioning code level (CL03)
10445	New password commiss. level	3	((empty))	Enter here your new alphanumeric password string for the commissioning code level (CL03)
10446	Confirm password commiss.level	3	((empty))	Repeat here your new alphanumeric password string for the commiss. code level (CL03)
10447	Change password commiss. level	3	[No] Yes	With switching this parameter to *"Yes"*, the control checks the entries for changing the password and executes the password change, if the entries are correct. The visualization 1048 indicates the successful execution.
				Notes If the parameters 10444, 10445, and 1046 are not correct, the password change is not executed.
10448	Change passw. error commiss. level	0		Flag: illuminated LED
			[green]	Password was not changed or successfully changed
			red	Error: password could not be changed
10435	**Reset password commiss. level**	4	Yes	The control resets the password of the commissioning level to "CL0003".

ID	Parameter	CL	Setting range [Default]	Description
			[No]	
Change password super commissioning level				
10449	Old passw. super comm. level	5	((empty))	Enter here your old alphanumeric password to release the password change for the super comm. code level (CL05)
10450	New passw. super comm. level	5	((empty))	Enter here your new alphanumeric password string for the super comm. code level (CL05)
10451	Confirm passw.super comm.level	5	((empty))	Repeat here your new alphanumeric password string for the super comm. code level (CL05)
10452	Change passw.super comm. level	5	[No] Yes	With switching this parameter to *"Yes"*, the control checks the entries for changing the password and executes the password change, if the entries are correct. The visualization 1053 indicates the successful execution.
				Notes If the parameters 10449, 10450, and 1051 are not correct, the password change is not executed.
10453	Change passw. super error comm. level	0		Flag: illuminated LED
			[green]	Password was not changed or successfully changed
			red	Error: password could not be changed
10436	**Reset passw. super comm. level**	11	Yes	The control resets the password of the commissioning level to "CL0005" e.g., if you forgot your password.
				Notes The code level to execute the password reset is provided by your Woodward sales support partner.
			[No]	

4.2.4 System Management

CAUTION!

Don't initiate *"Set factory default settings"* during controlling a genset! This causes easYgen rebooting.

Parameter 1701 ↬ p. 85 *"Set factory default values"* causes a reboot of the control. During this time the genset system is not controlled by the easYgen! An uncontrolled operation can lead into life-threatening hazard or damage.

After settings changed: Please wait 30 seconds to be sure changes are saved before power cycling the device.

ID	Parameter	CL	Setting range [Default]	Description
1702	Device number	2	1 to 8 [1]	A unique address is assigned to the control though this parameter. This unique address permits the controller to be correctly identified on the CAN bus. The address assigned to the controller may only be used once. All other bus addresses are calculated on the number entered in this parameter. The device number is also important for the device assignment in load sharing and load-dependent start/stop.
				Notes The unit must be restarted after changing the device number to ensure proper operation. For multiple genset applications please make sure to change parameter 8952 as well
1889	Device name preset	2	[Device_name] 12 to 38 characters but varies on font	After set with parameter 1893 this customer specific device name is used e.g. as device name in Ethernet network.
				Notes Recommended are 19 ASCII characters max. Blanks and special characters will be replaced.
1890	Device name	2	["displayable characters of parameter 1889"] up to 38 characters but varies on font	(Pre)view of device name.
1893	Set device name	2	[No] Yes	YES: Device name typed in as value of parameter 1889 taken, processed, and displayable characters saved as parameter 1890.
10417	Factory default settings	0	Yes	The following three parameters are visible and restoring the configured parameters to factory default values is enabled.
			[No]	The following three parameters are invisible and restoring the configured parameters to factory default values is not enabled.
1701	Set factory default values	4	Yes	All parameters, with the exception of customer defined passwords, will be restored to factory default values. If the default setting is initiated the alarm LED starts twinkling with a higher rate (ca. 5 Hz).
				Notes The device is power cycled and rebooting after approx. 20 seconds! In case of ToolKit connected via USB service port: USB connection will be lost!
			[No]	All parameters will remain as currently configured.
				Notes This parameter is only displayed, if factory default settings (parameter 10417 ➪ p. 85) is set to "Yes".

4.3 Interfaces

Introduction

The GC allows to enable/disable the single interface channels. Accordingly the Interface monitoring functions are served.

Latched alarm flags must be reset, even the communication channel was meanwhile disabled.

4.3.1 Overview

The GC3000XT is equipped with 5 interfaces:

- Interface USB slave (Service port)
- Interface CAN #1 (CANopen EG3000XT load share bus)
- Interface Ethernet A (UDP EG3000XT load share bus, Servlink TCP ToolKit)
- Interface Ethernet B (UDP GC3000XT load share bus, Modbus TCP, Servlink TCP ToolKit)
- Interface Ethernet C (UDP GC3000XT load share bus, Modbus TCP, Servlink TCP ToolKit)

4.3.2 All load share lines are redundant

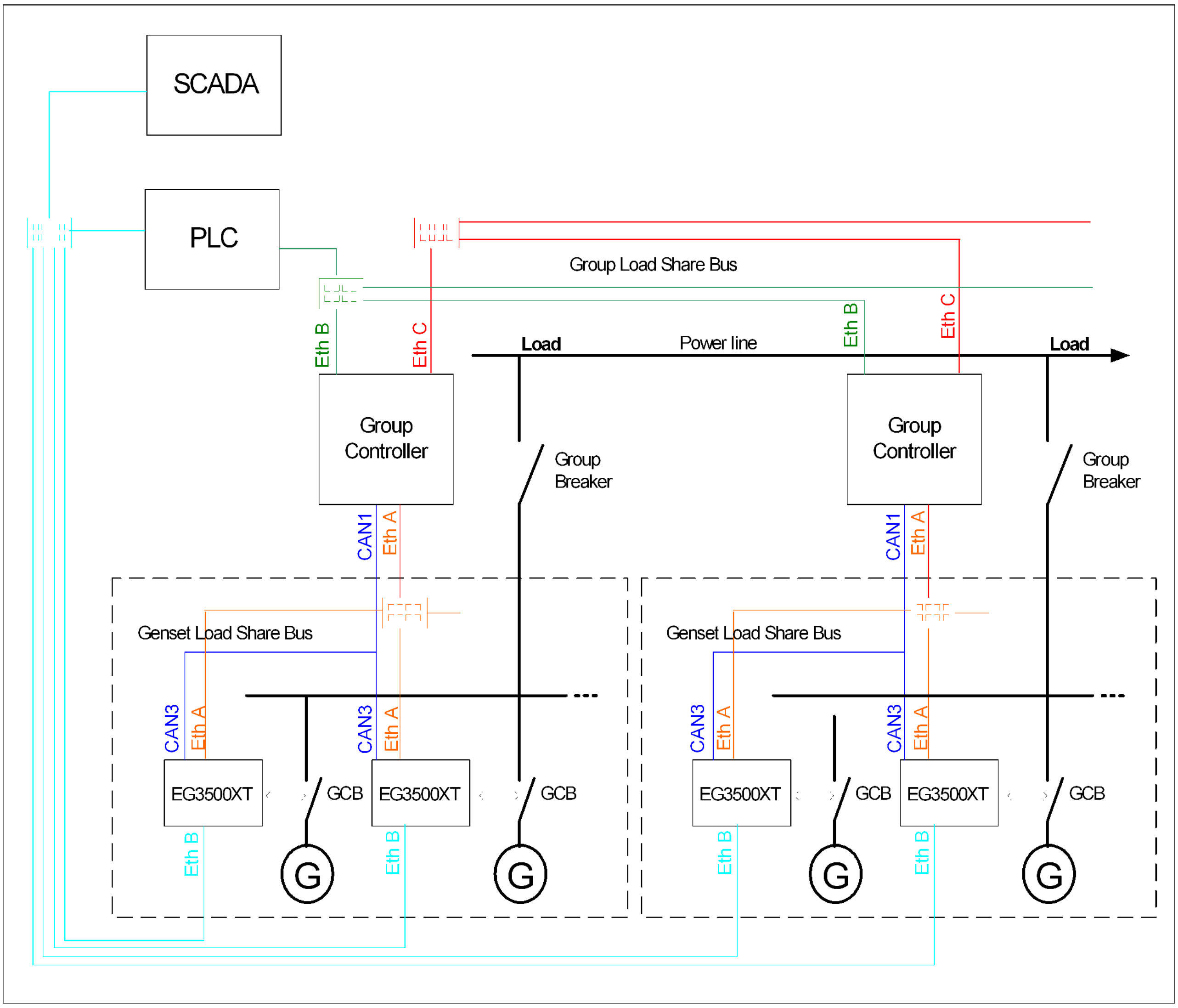


Fig. 51: Example: GC3000XT system with full load share line redundancy on all load share busses.

The example shows a system in which all load share lines (Genset Load share bus and group load share bus) shall be redundant designed. In this case the GC is configured to CAN1/Ethernet A respectively Ethernet B/C. The easYgen K51 is configured to CAN/ Ethernet A.

If a SCADA system with Modbus master functionality shall be installed over the whole system following items shall be adhered:

- The easYgens must get an own Ethernet network on Ethernet B in conjunction with the SCADA
- A PLC pulls data from its GC either redundant or single Ethernet connected
- The PLC provides an additional individual Ethernet port on the SCADA network

Device	Network	Configuration
GC3000XT	Ethernet A (Ethernet Network 1)	Load share data
	CAN1	Load share data
	Ethernet B (Ethernet Network 2)	Load share data
	Ethernet C (Ethernet Network 3)	Load share data
easYgenXT K51	Ethernet A (Ethernet Network 1)	Load share data
	CAN3	Load share data
	Ethernet B (Ethernet Network 4)	Modbus TCP / Toolkit Servlink
	Ethernet C (Ethernet Network 5)	Modbus TCP / Toolkit Servlink

4.3.3 Only Group Controller with redundant load share line

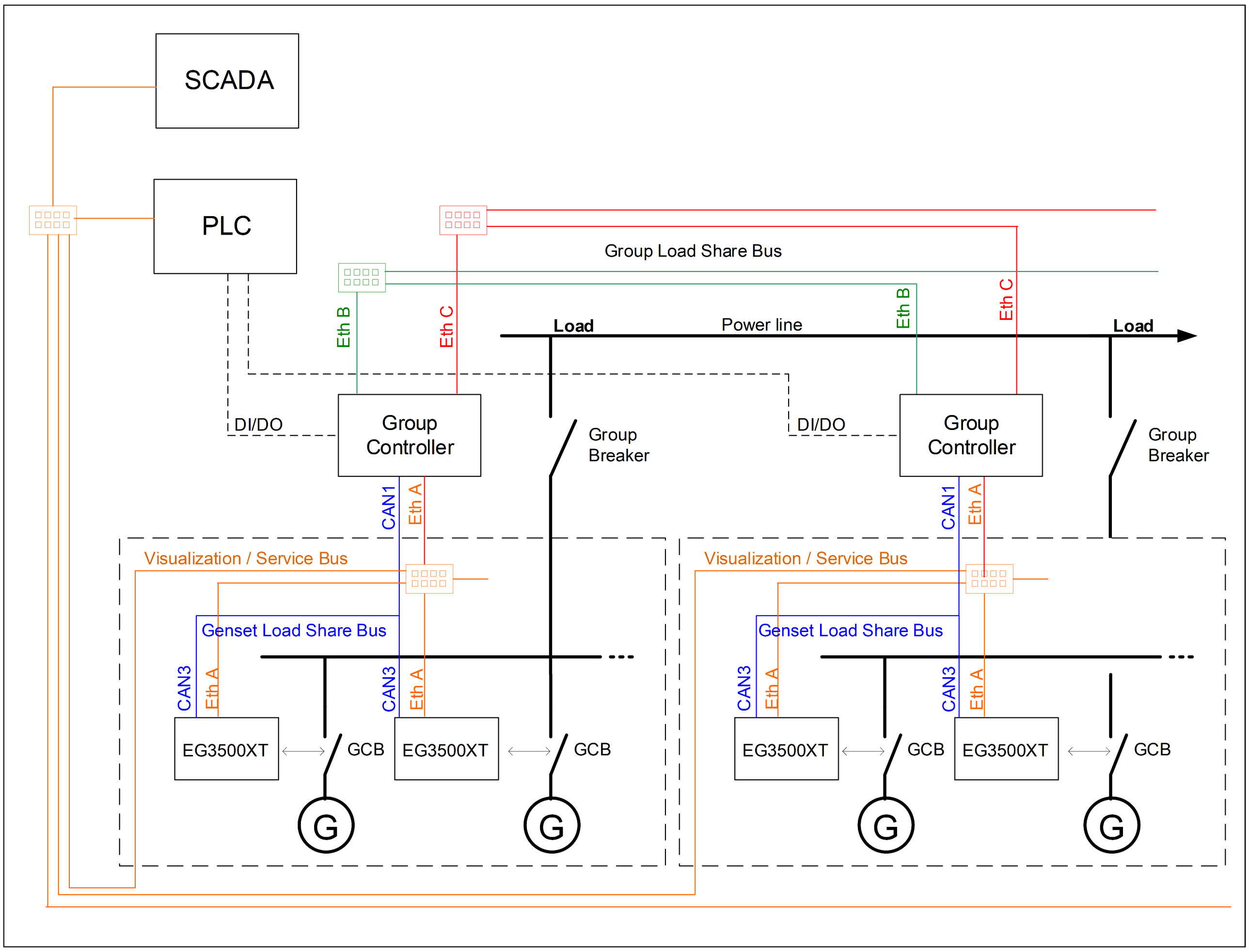


Fig. 52: Example: GC3000XT system with single line CAN on easYgen level and load share line redundancy on GC level

The example shows a system in which only the group load share bus shall be redundant designed. In this case the GC is configured to CAN1 only for the genset load share bus and Ethernet B/C for the group load share bus. The easY-gen K51 is configured to CAN only for load share.

This application allows to use a common Ethernet A bus for visualization data or connecting ToolKit to a common point in the system.

If a SCADA system with Modbus master functionality shall be installed over the whole system following items shall be adhered:

- The easYgens must get an own Ethernet network on Ethernet B in conjunction with the SCADA
- A PLC pulls data from its GC either redundant or single Ethernet connected

The PLC provides an additional individual Ethernet port on the SCADA network

Device	Network	Configuration
GC3000XT	Ethernet A (Ethernet Network 1)	Load share data disabled
	CAN1	Load share data

Device	Network	Configuration
	Ethernet B (Ethernet Network 2)	Load share data
	Ethernet C (Ethernet Network 3)	Load share data
easYgenXT K51	Ethernet A (Ethernet Network 1)	Load share data disabled Used for: SCADA data Modbus TCP / Toolkit Servlink
	CAN3	Load share data

4.3.4 Interface GC to easYgen

ID	Parameter	CL	Setting range [Default]	Description
9924	LS interface GC to easYgen	2		This configuration determines the communication interface between Generator Group Controller and its easYgens.
			Off	There is no Interface enabled to transport load share and control data between GC and easYgen. The interface monitoring is accordingly disabled.
			CAN1	Only Interface CAN1 transports load share and control data between GC and easYgen. The interface monitoring is accordingly adapted.
			[Ethernet A]	Only Interface Ethernet A transports load share and control data between GC and easYgen. The interface monitoring is accordingly adapted.
			[CAN1/Ethernet A]	CAN1 and Ethernet A interface 1 is used to transport load share and control data between GC and easYgen. The redundancy with both busses is maintained. The interface monitoring is accordingly adapted.
				Note: Each change of this parameter requires a new system update procedure for the interfaces.

4.3.5 Interface GC to GC

ID	Parameter	CL	Setting range [Default]	Description
9929	LS interface GC to GC	2		This configuration determines the communication interface between Generator Group Controller.
			Off	There is no Interface enabled to transport load share and control data between GCs. The interface monitoring is accordingly disabled.
			Ethernet B	Only Interface Ethernet B transports load share and control data between GCs. The interface monitoring is accordingly adapted.
			[Ethernet C]	Only Interface Ethernet C transports load share and control data between GCs. The interface monitoring is accordingly adapted.
			[Ethernet B/C]	Ethernet B and Ethernet C is used to transport load share and control data between GCs. The redundancy with both busses is maintained. The interface monitoring is accordingly adapted.
				Note: Each change of this parameter requires a new system update procedure for the interfaces.

4.3.6 Modbus Protocol

> *Data Format(s)*
> *Modbus registers are read and written according to the Modbus standard as Big-endian.*

ID	Parameter	CL	Setting range [Default]	Description
3184	Modbus protocol number	2	[5022]	The protocol number is fixed in GC-3400XT-P1 release 1. The protocol file is located on the product CD in the Product Manuals directory.
3179	Detect a gap in a Modbus frame	2	[On]	If a received Modbus command has a gap between its byte of more than 5 ms, this command is ignored.
			Off	The Modbus message is not checked.
3181	Power [W] exponent 10^x	2	2 to 5 [3]	This setting adjusts the format of the 16 bit power values in the data telegram.
				Notes Valid for data telegram 5010 only! Refer to for examples.
3182	Voltage [V] exponent 10^x	2	-1 to 2 [0]	This setting adjusts the format of the 16 bit voltage values in the data telegram.
				Notes Valid for data telegram 5010 only! Refer to for examples.

Power measurement example

How to use “Power exponent ” 3181

Power measurement:

- The measurement range is 0…250 kW
- Momentary measurement value = 198.5 kW (198.500 W)

Setting value 3181	Meaning	Calculation	Transfer value (16 Bit, max. 32767)	Possible display format
2	10^2	198500 W / 10^2 W	1985	198.5 kW
3	10^3	198500 W / 10^3 W	198	198 kW
4	10^4	198500 W / 10^4 W	19	N/A
5	10^5	198500 W / 10^5 W	1	N/A

Table 42: Power measurement example

Voltage measurement example

How to use “Voltage exponent ” 3182

Voltage measurement:

- The measurement range is 0…480 V
- Momentary measurement value = 477.8 V

Setting	Meaning	Calculation	Transfer value (16 Bit, max. 32767)	Possible display format
-1	10^{-1}	477.8 V / 10^{-1} W	4778	477.8 V
0	10^{0}	477.8 V / 10^{0} V	477	477 V
1	10^{1}	477.8 V / 10^{1} V	47	N/A
2	10^{2}	477.8 V / 10^{2} V	4	N/A

Table 43: Voltage measurement example

4.4 Breaker Operation

4.4.1 Operating the GGB (Generator Group Breaker)

Introduction

The GC is able to operate the GGB. With this functionality following items are included:

- Measurement AC Voltage Generator Group and Load Busbar
- Relay output commands
- Synchronization function with all its configurations
- Synchroscope by Toolkit
- Phase Angle compensation function
- Dead busbar closure modes
- Breaker Diagnostics
- Plausibility Checks

4.4.2 Serving the Group Breaker

Serving the Group Breaker

The initial order to close or to open the GGB is maintained by DI commands:

- DI 07 "Enable to close GGB"
- DI 06 "Command Open GGB

The command open GCB has more priority as the enable to close GGB signal. The open GGB command is always getting through.

The GC3000XT controls its Group Breaker (GGB) with following functions:

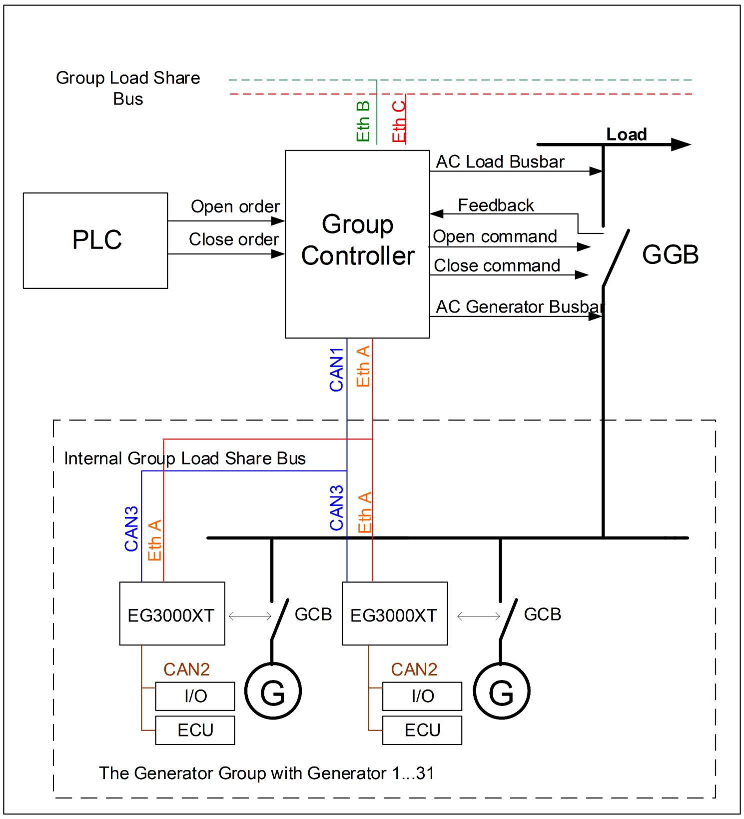
- Synchronization of Generator Group onto Load Busbar
- Dead busbar closure Group Breaker including dead busbar negotiation

The relay 6 is the dedicated output for the GGB close pulse.

The relay 5 is the dedicated output for the GGB open pulse.

The command open GCB is configurable as normally opened (N.O.), normally closed (N.C.) or as not used. The not used setting is prepared for future purposes.

The GC3000XT expects a GGB feedback signal acting on DI 08 "Reply GGB is open".



ID	Parameter	CL	Setting range [Default]	Description
5726	GGB time pulse	2	0.10 to 0.50 s [0.50 s]	The time of the pulse output may be adjusted to the breaker being utilized.
5669	GGB open relay	2	Not used [N.O.] N.C.	Not used: In preparation for future purposes. The relay GGB open will be never energized.
				N.O.: Normally open The relay "command: GGB open" will be energized to open the GGB and will be de-energized again after the discrete input "Reply GGB" is energized to signal the control that the GGB is open.
				N.C.: Normally closed The relay "command: GGB open" will be de-energized to open the GGB and will be energized again after the discrete input "Reply GGB" is energized to signal the control that the GGB is open.
5731	Synchronization GGB	2	[Slip frequency]	Type of Synchronization. Slip frequency: The frequency controller adjusts the frequency in a way, that the frequency of the source (generator) is marginal greater than the target (load busbar). When the synchronizing conditions are reached, a close command will be issued. The slipping frequency depends on the setting of "Slip frequency offset" (parameter 5502).

ID	Parameter	CL	Setting range [Default]	Description
			Phase matching	The frequency controller adjusts the phase angle of the source (generator) to that of the target (load busbar), in view of turning the phase difference to zero.
				Notes Please consider that the "Phase angle compensation MCB" (parameter 8841) influences the GGB synchronization as well. In both synchronisations the phase angle between generator busbar and mains is used.
5720	Voltage differential GGB	2	0.50 to 20.00% [5.00%]	The maximum permissible voltage differential for closing the generator group breaker is configured here. If the difference between generator busbar and mains voltage does not exceed the value configured here and the mains voltage is within the operating voltage window (parameters 5810 and 5811), the "Command: GGB close" may be issued. Notes Please consider that the "Phase angle compensation MCB" (parameter 8841) influences the GGB synchronization as well. In both synchronisations the phase angle between generator busbar and mains is used.
5721	Positive frequency differential GGB	2	0.0 to 0.49 Hz [+0.18 Hz]	The prerequisite for a close command being issued for the GGB is that the differential frequency is below the configured differential frequency. This value specifies the upper frequency (positive value corresponds to positive slip → generator frequency is higher than the load busbar frequency).
5722	Negative frequency differential GGB	2	-0.49 to 0.00 Hz [-0.10 Hz]	The prerequisite for a close command being issued for the GGB is that the differential frequency is above the configured differential frequency. This value specifies the lower frequency limit (negative value corresponds to negative slip → generator frequency is less than the load busbar frequency).
5723	Maximum positive phase angle GGB	2	0.0 to 60.0° [7.0°]	The prerequisite for a close command being issued for the GGB is that the leading phase angle between generator and load busbar is below the configured maximum permissible angle.
5724	Maximum negative phase angle GGB	2	-60.0 to 0.0° [-7.0°]	The prerequisite for a close command being issued for the GGB is that the lagging phase angle between generator and load busbar is below the configured maximum permissible angle.
5727	Phase matching GGB dwell time	2	0.0 to 60.0 s [3.0 s]	This is the minimum time that the generator voltage, frequency, and phase angle must be within the configured limits before the breaker will be closed.
3445	Dead bus closure GGB	2	[On]	Enabling generator over frequency 1 monitoring. A dead busbar closure is allowed if the required conditions are met.
			Off	A GGB close command to a dead load busbar is prevented. Synchronization is still possible.
5725	Closing time GGB	2	40 to 300 ms [80 ms]	The inherent closing time of the GGB corresponds to the lead-time of the close command. The close command will be issued independent of the differential frequency at the entered time before the synchronous point.
4558	GC missing member delay	2	0.00 to 9.99 s [0.5 s]	If a GC missing member alarm occurs, the dead busbar closure will be delayed under the multiple GCs. This shall reduce the probability that multiple GCs closing their GGB onto a dead busbar to the exact same time. The time entered here is differently permuted in the single GC devices. So the GC device no.1 has no delay as the GC device no.2 is delayed with 0.5 seconds, the GC no.2 is delayed with 1 second and so on. Refer also to the dead busbar closure rules. Each device calculates its delay according the formula: (Device number -1) x Configurable Delay Time.

4.4.3 Operating the MCB

Introduction

The Group Controller provides an additional AC measurement (Mains) to support the synchronization of an MCB at the interchange point to mains or to any other voltage source.

As example for "any other voltage source" could be the voltage of the other side of a tie-breaker over the load busbar.

Supporting the synchronization means that the group controller passes the frequency and voltage of the mains down to its gensets with the command to synchronize its generators on that frequency and voltage.

The GC checks over AC mains and load busbar voltage measurement delta frequency, delta voltage and phase angle. If the values are matching according to the configuration the GC executes the closure of the CB, if all relevant criteria are matched.

With this functionality following items are included:

- Measurement AC Voltage Generator Group, Load Busbar and Mains
- Relay output commands
- Synchronization function with all its configurations
- Unloading Mains including command MCB open
- Synchroscope by Toolkit
- Phase Angle compensation function
- Breaker Diagnostics

4.4.4 Serving the Mains Breaker

The initial order to close or to open the MCB is maintained by DI commands:

- DI 03 "Enable MCB synchronization"
- DI 04 "Unload Mains / Open MCB"

The commands "Enable MCB synchronization" and "Unload Mains / MCB open" cannot be active to the same time. No related function will be performed, if both signals are active.

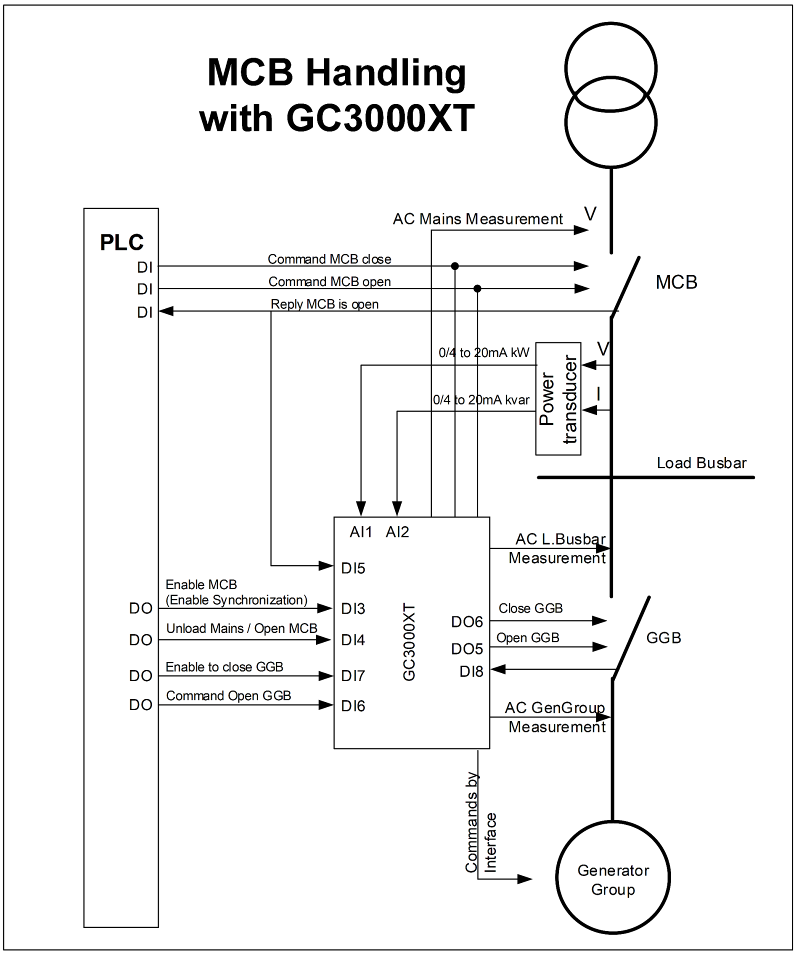
The GC3000XT controls a Mains Breaker (MCB) with following functions:

- Synchronization of Load Busbar onto Mains (Own GGB is closed).
- Open MCB, if the unload function is enabled (Own GGB closed).

The relay 8 is the dedicated output for the MCB close pulse.

The relay 7 is the dedicated output for the MCB open pulse.

The GC3000XT expects a GGB feedback signal acting on DI 05 "Reply MCB is open".



Example of a single group interacting with mains

Configuration

ID	Parameter	CL	Setting range [Default]	Description
3417	**MCB time pulse**	2	0.10 to 0.50 s [0.50 s]	Breaker pulse duration to close the MCB. The time of the pulse output may be adjusted to the breaker being utilized.
5730	**Synchronization MCB**	2	[Slip frequency]	Type of Synchronization. Slip frequency: The frequency controller adjusts the frequency in a way, that the frequency of the source (busbar) is marginal greater or smaller than the target (mains). When the synchronizing conditions are reached, a close command will be issued.
			Phase matching	The frequency controller adjusts the phase angle of the source (busbar) to that of the target (mains), in view of turning the phase difference to zero.
5711	**Pos. freq. Differential MCB** (Positive frequency differential MCB)	2	0.02 to 0.49 Hz [0.18 Hz]	The prerequisite for a connect command being issued for the MCB is that the differential frequency is below the configured differential frequency. This value specifies the upper frequency (positive value corresponds to positive slip → busbar frequency is higher than the mains frequency).
5712	**Neg. freq. Differential MCB** (Negative frequency differential MCB)	2	-0.49 to 0.00 Hz [-0.10 Hz]	The prerequisite for a connect command being issued for the MCB is that the differential frequency is above the configured differential frequency. This value specifies the lower frequency limit (negative value corresponds to negative slip → busbar frequency is less than the mains frequency).
5710	**Voltage differential MCB**	2	0.00 to 20.00%	The maximum permissible voltage differential for closing the mains circuit breaker is configured here.

ID	Parameter	CL	Setting range [Default]	Description
			[5.00%]	Notes\ This value refers to the generator rated voltage (parameter 1766) and mains rated voltage (parameter 1768). If the difference between mains and busbar voltage does not exceed the value configured here and the mains voltage is within the operating voltage window (parameters 5810 and 5811), the "Command: MCB close" may be issued.
5713	**Max positive phase angle MCB** (Maximum permissible positive phase angle MCB)	2	0.0 to 60.0° [7.0°]	The prerequisite for a connect command being issued for the MCB is that the leading phase angle between busbar and mains is below the configured maximum permissible angle.
5714	**Max negative phase angle MCB** (Maximum permissible negative phase angle MCB)	2	-60.0 to 0.0° [-7.0°]	The prerequisite for a connect command being issued for the MCB is that the leading phase angle between busbar and mains is below the configured maximum permissible angle.
5717	**Phase matching MCB dwell time**	2	0.0 to 60.0 s [3.0 s]	This is the minimum time that the generator/busbar voltage, frequency, and phase angle must be within the configured limits before the breaker will be closed.
5715	**Closing time MCB**	2	40 to 300 ms [80 ms]	The inherent closing time of the MCB corresponds to the lead-time of the close command. The close command will be issued independent of the differential frequency at the entered time before the synchronous point.

4.4.5 GGB Dead Bus Closure Negotiation

Introduction

It must be insured in a Group Controller system that all dead busbar closure actions are coordinated. Otherwise it can lead to a simultaneous closure of different sources under each other. If generators are involved it can lead to damages. Therefore it is required to include a dead busbar closure negotiation or ranking into the system in addition to the already existing dead busbar negotiation of the easYgens.

General

If the GC3000XT receives a GGB close command under dead busbar conditions, it runs a dead busbar negotiation with the other GC3000XTs.

The GC3000XT performs the GGB dead busbar closure only, if the switching source matches the operating ranges.

The GC3000XT performs the GGB dead busbar closure only, if the target dead busbar is dead according to the configurable dead busbar limit.

If the GC3000XT receives a GGB close command which causes a GGB dead busbar closure from an alive load busbar to a dead gen group, the GC will have higher priority as its easYgens.

The GGB dead bus closure in the GC3000XT is blocked, if the GCB fail to close alarm is tripped.

Note:

Please go sure that when you handle the dead bus closure configuration "Dead bus closure GCB" ID3432 or the LogicsManager "Inhibit dead bus GCB" ID15161 at all devices to the same time in dead bus situation. It could come to a simultaneous closure at the running devices.

Function

The Group Controllers and easYgens follow rules to prevent uncoordinated closure:

Rule 1: The GC3000XT which has on both sides of the GGB a dead busbar and there is at least one connection to any source (mains, genset), inhibits their GGB dead busbar closure.

Rule 3: The GC3000XT which gets a "Missing GC alarm" caused by other GC(s) missing, delays its operation mode dead bus closure depending on its GC device number. This is cascaded through: (Device number -1) x Configurable Delay Time. The default setting of the configurable delay time is 0.5s. (Parameter 4558 ↳ p. 93 "GC missing member delay"). *This procedure cannot prevent a wrong dead busbar closure but it minimizes the probability that this happens.*

Rule 4: The easYgen3000XT K51 (GC mode enabled) which has triggered a "Missing easYgen alarm", delays its operation mode dead bus closure depending on its device number. This is cascaded through: (Device number easYgen) x 0.5s The GC is not delayed, if the "Missing easYgen alarm" is triggered. This procedure cannot prevent a wrong dead busbar closure but it minimizes the probability that this happens.

Rule 5: The GC3000XT which sees a dead generator busbar (GenGroup is dead) but recognizes at least one easYgen in its group with a closed GCB, inhibits their GGB dead busbar closure.

Rule 8: The GC3000XT which executes its GGB dead busbar closure, inhibits the dead busbar closure of all its easYgens first before it performs the GGB dead busbar closure. (800ms)

This is done by the "Inhibit Dead busbar closure" bit sent to the easYgens (see LogicsManager flag 02.41).

Rule 9: The GC3000XT which recognize a dead load busbar but still sees a linkage to any generator of other groups, inhibits their GGB dead busbar closure. This rule requires a correct segmenting.

(Situation: GenGroup voltage is alive, load busbar is dead).

Rule 10: The GC3000XT which recognize a dead load busbar but still sees any MCB closed, inhibits their GGB dead busbar closure. This rule requires a correct segmenting.

(Situation: GenGroup voltage is alive, load busbar is dead).

Rule 11: The GC3000XT which recognize a dead load busbar and sees no linkage to any generator of other groups, negotiates the dead busbar closure with the neighbor GCs in the same segment. The GC with smallest device no. will be usually the first. This rule requires a correct segmenting.

(Situation: GenGroup is alive, load busbar is dead).

Rule12: If the GC3000XT has an closed GGB, and it recognizes a GGB dead busbar closure of a GC in the same segment, it blocks generally the GCB dead busbar closure of its easYgens.

This is done by the "Inhibit Dead busbar closure" bit sent to the easYgens (see LogicsManager flag 02.41).

Rule 13: If the own GGB is closed and there is recognized that an own easYgen is willing to do a dead busbar closure, the GC publishes this dead busbar closure request and negotiates the desire with other GCs in the same segment.

Negotiation: Lower GC device no. wins.

If the own group has lower priority, the GC inhibits the dead busbar closure of its easYgens

If the own group has higher priority, the GC does not inhibit the dead busbar closure of its easYgens.

4.5 Setpoint for Export/Import Control at the Interchange Point

Introduction

The GC is receiving the real power at the interchange point (AI1 0/4 to 20mA). It can provide the export/import power setpoint for the own easYgen group. The setpoint is configured over ToolKit. This value can be changed by a PLC over Modbus TCP also. The input is in kW. This setpoint configuration in the GC is mandatary for the LDSS function running parallel to mains applications (MOP).

The setpoint is entered over ToolKit into the GC. The export/import setpoint is related to the GC segment. In cases the GC system falls into two or more groups the different segments must be treated accordingly. So the mains power at the interchange point will be different and/or the export/import power will be different.

Function

The setpoint is transferred from the GC to its easYgens.

- The input is in kW
- Negative input means: Regulate Import Power at the interchange point to mains
- Positive input means: Regulate Export Power at the interchange point to mains.

This setpoint in transferred as absolute value to all easYgens in the same group. So there is no signing incorporated in the setpoint variable. The easYgen itself takes this "GC Power setpoint" as an sign less value. Only through the import or export setting in the easYgen the value stands for a setpoint at the interchange point to mains.

Note: A negative setpoint in the GC requires an import setup in the easYgen. A positive setpoint in the GC requires an export setup in the easYgen.

The easYgenXT K51 accepts this setpoint, if:

1 - The easYgen is configured in GC-Mode
2 - The setpoint from the GC is selected over the AnalogManager (05.90 GC P setp [kW])
3 - The setpoint is configured on export or import character
4 - The easYgen runs in AUTO with start request in AUTO (with or without LDSS)
5 - The easYgen recognizes parallel to mains operation
6 - The load control is activated

ID	Parameter	CL	Setting range [Default]	Description
5089	Exp./imp. load setpoint	2	-999999 to 999999 kW [0 kW]	This is the export / import power setpoint for the generator group. The value is sent to the single easYgens in the own group. In the easYgenXT K51 the set-point is provided as AnalogManager (05.90 GC P setp [kW]). **Note:** The setpoint is to allocate in the easYgen through the according load control setpoint AnalogManager.

4.6 Load Dependent Start Stop (LDSS) in GC3000XT

4.6.1 Introduction

Due to the fact that the GC is coordinating its group anyway the LDSS function is provided in the GC. The LDSS algorithm runs inside the Group Controller and will support up to 248 gensets. If the main bus drops into separated segments, each segment gets its own LDSS master. The Group Controller with the smallest Device ID within the segment makes the LDSS master. Each genset will be directed with start and stop commands by the LDSS master. The LDSS algorithm in the single genset controls are disabled.

The LDSS in the GC provides two modes:

- Start/Stop related to Generator Load
- Start/Stop related to Reserve Power

In comparison to the LDSS in the easYgen the GC provides additionally:

- a configurable “Minimum Power” consideration
- a configurable “Base Sorting” consideration

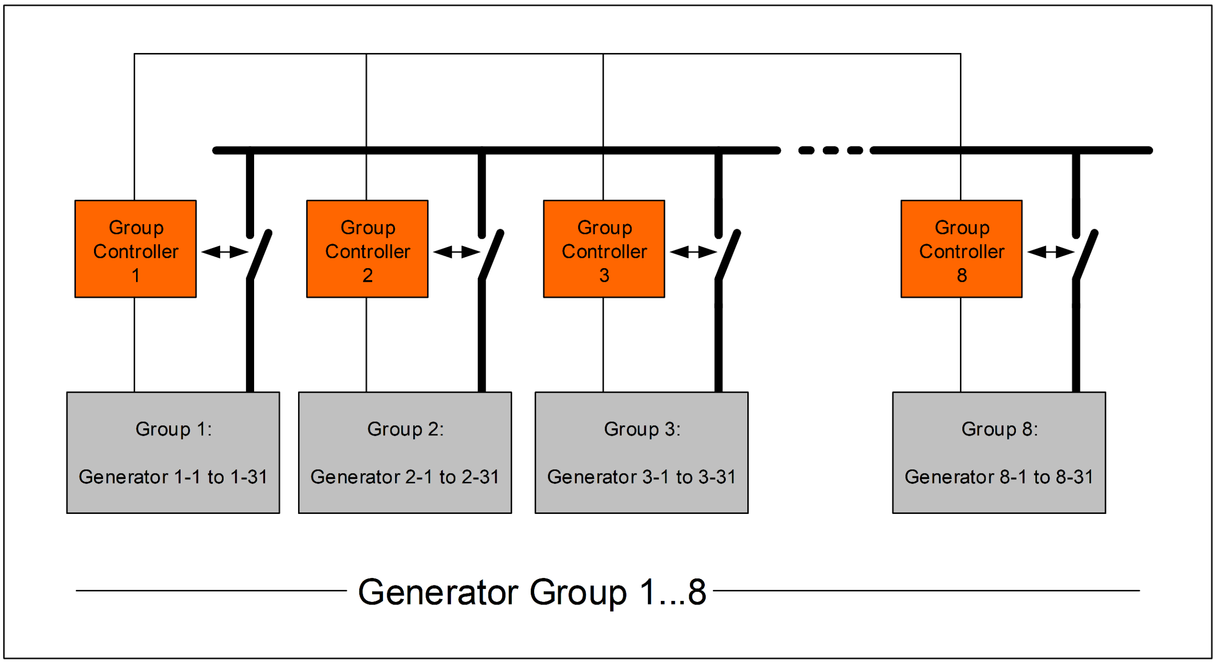
Woodward offers an LDSS emulation tool running on PC for testing different scenarios. A settings manager inside the tool helps to transfer the tested settings into real GCs on site afterwards.

4.6.2 Function

4.6.2.1 The LDSS System

In an easYgen system with group controller the LDSS algorithm is transferred to the group controller device. The principle of the LDSS function remains essentially the same like in the easYgen but the algorithm is designed so that much more gensets can be handled. The current LDSS release controls up to 248 generators.

The algorithm is located in each group controller. But only one algorithm per load segment is enabled. The current release supports 8 groups. The output of the LDSS algorithm starts / stops the gensets 1 to 248. The naming of the generators are 1-1 to 8-31. The generator number is absolute.

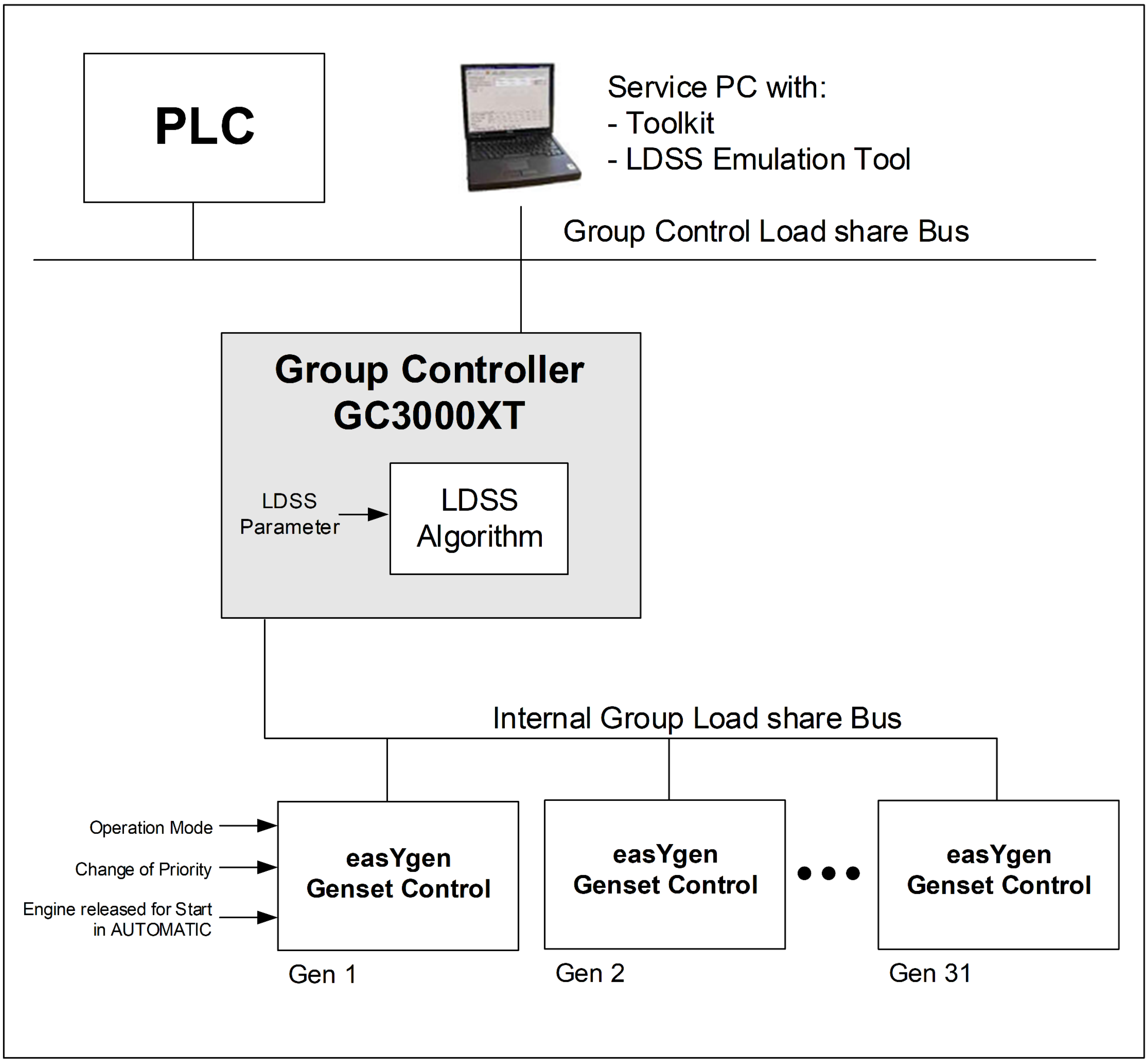


Schematic: The Group Controllers and its generators

As long Group Breaker Controls working on the same segment (same segment number), the LDSS algorithm of the group controller with the smallest Device number will be the control for the group segment. But if the system falls into different segments, multiple Group Controllers becoming active in regards of LDSS.

Example

All 8 Group Controllers are connected on the same segment. The LDSS outputs of the Group Controller No.1 determines the whole fleet of gensets 1-1 to 8-31. The LDSS of the other Group Controllers are in stand-by. Assumption: A tie-breaker between Group Controller 1 and 2 is opened and the load segment falls into two segments. The LDSS outputs of the Group Controller No.1 will determine now only the generators 1-1 to 1-31. The LDSS of the Group Controller 2 becomes now the master for the gensets 2-1 to 8-31.



Schematic: The Group Controller with its group and its setting

Note: Each GC in the same Communication Network must have a unique ID number. Having the same ID number multiple times in the same segment or in different segments lead to unexpected behavior.

4.6.2.2 Fit size of engines

The LDSS offers like in the easYgen the function "Fit size of engine". Through this setting different sized engines can be treated as efficiency as possible. Two main rules are followed:

- Figure out the closest genset combination to match the requested power. (In-crease the reserve power as less as possible)
- Select possible combinations, which have preferably a minimized number of gensets

To run a proper LDSS functionality with the enabled "Fit Size of Engine" function, only LDSS controlled generators are allowed to run on busbar. Generators with steady power operation are allowed to add.

4.6.2.3 Engine Hours

Like in the LDSS of the easYgen engine hours of the single engines can be considered. This can be the absolute engine hours (Period of use hours) or re-maining engine hours until service. The mentioned hours are usually considered, if the load situation has changed. In cases the load is relatively stable a forced change of engine can be configured.

4.6.2.4 Basic Sorting

In cases there is no differentiation between gensets evaluable (engine hours, size of engine,…) the configurable basic sorting takes place. The LDSS algo-rithm provides a parameter to it. Two base sorts are configurable.

The basic sorting configuration allows the customer to start the available gensets either in regards to fill-up one group after each other or to distribute them evenly over all groups.

4.6.2.5 Principle Order Priority

The principle order priority is the rule how the LDSS sorting is consider the single argue for starting or stopping a next generator. The order is usually:

1 - Genset Priority

2 - Size of Engines (only if “Fit size of Engine” is active)

3 - Service Hours (only if “Fit service Hours” is active)

4 - Basic Sorting

4.6.2.6 LDSS in Islanded Operation (IOP) General

Isolated operation (MCB is open)

In case of an islanded parallel operation (MCB open), the first genset will be connected to the de-energized busbar.

The isolated operation uses dedicated parameters, like:

- Individual Reserve Power or Min/Max. Load level
- Individual Hysteresis (only Reserve Power Mode)
- Individual Add On/Off delays

Note: At least one genset must be in operation in islanded operation.

4.6.2.7 LDSS in Mains Operation (MOP) General

Parallel to Mains operation (MCB is closed)

In case of a mains parallel operation (MCB closed), load dependent start stop is only enabled, if the gensets participates in load sharing at the interchange point (all participating gensets must be configured to the same setpoint). The load dependent Start/Stop function is active in mains to parallel operation during Export/Import control. The first engine is started dependent on a minimum load demand. This prevents an unloaded run, which can damage the engine.

During base load the Start/Stop function is switched off for this particular easY-gen. Allowed is to run Gensets with export/import control and base load control simultaneously. The base loading gens will not be started or stopped by the load dependent start/stop function.

The parallel to mains operation uses dedicated parameters, like:

- Minimum power
- Individual Reserve Power or Min/Max. Load level
- Individual Hysteresis (only Reserve Power Mode)
- Individual Add On/Off delays

Note:

A minimum load threshold must be exceeded to start the first genset, i.e. a gen-set will only be started if a minimum load would be demanded from the generator.

There are dedicated LDSS parameters for mains parallel operation.

4.6.2.8 LDSS Mode "Generator Power"

If the "Start stop mode" is configured to "Generator load", load-dependent start stop is performed in a way that the next genset will be started if all gensets in operation reach the maximum generator load (parameter "IOP/MOP Max. gen-erator load"), a configured percentage (e.g. 80%) of the rated power. In order to stop one generator, the load of all gensets in operation must fall below the minimum generator load (parameter "IOP/MOP Min. generator load"), a configured percentage (e.g. 30%) of the rated power. There are different setpoints for is-landed and mains parallel operation.

If the minimum level is surpassed the LDSS function checks additionally whether there is no generator cycling*1) takes place. In these cases the minimum level may become lower.

The procedure considers also a configurable **Minimum Power** to maintain in all situations a minimum of rated power even though the upper mentioned mini-mum level is surpassed.

**1): In some situations a generator cycling can occurs, if with removing of a generator the resulting maximum level is exceeded even though the load didn’t change.*

4.6.2.9 Island Operation (IOP)

If the configured maximum generator capacity utilization is exceeded, another genset will be added.

$P_{\text{GN real active}}$ [%] > $P_{\text{max. load islanded}}$ [%]

If the configured minimum generator capacity utilization has fallen below, a genset stop will be considered.

$P_{\text{GN real active}}$ [%] <$P_{\text{min. load islanded}}$ [%]

4.6.2.10 Mains Parallel Operation (MOP)

If the required generator load setpoint for the control at the mains interchange point exceeds the MOP minimum load threshold parameter "MOP Minimum load", the first genset will be added.

$P_{\text{MN setpoint}}$ [kW] – $P_{\text{MN real}}$ [kW] > $P_{\text{MOP minimum}}$ [kW]

If at least one genset is supplying the load in parallel with the mains and the total generator load exceeds the MOP maximum generator load threshold parameter "MOP Max. generator load", another genset will be added.

$P_{\text{GN real active}}$ [%] > $P_{\text{max. load parallel}}$ [%]

If at least two gensets are supplying the load in parallel with the mains and the configured minimum generator capacity utilization has been fallen below, a genset will be stopped.

$P_{\text{GN real active}}$ [%] < $P_{\text{min. load parallel}}$ [%]

If one genset is supplying the load in parallel with the mains and the generator load exceeds the MOP minimum load threshold parameter MOP Minimum load" minus the hysteresis (parameter "MOP Hysteresis"), the genset will be stopped.

The hysteresis is intended to prevent frequent starting and stopping of gensets in case of small load variations.

$P_{\text{MN setpoint}}$ [kW] – $P_{\text{MN real}}$[kW] + $P_{\text{GN real active}}$ [kW] < $P_{\text{MOP minimum}}$[kW] – $P_{\text{hyst.MOP}}$ [kW]

4.6.2.11 The LDSS Mode "Reserve Power"

If the "Start stop mode" is configured to "Reserve power", load-dependent start stop is performed in a way that a configured minimum reserve power is main-tained in the system. This means that there is always enough reserve power for load swings on the busbar regardless of the generator load. The actual reserve power in the system is the total rated power of all gensets on the busbar minus the actual total generator real power.

This functionality provides high system reliability and is intended for applications that require a dedicated reserve power on the busbar, independent of the num-ber of gensets on the busbar.

4.6.2.12 Island Operation (IOP)

$P_{Reserve} = P_{rated\ active} - P_{GN\ real\ active}$.

$P_{rated\ active} = P_{RatedGen[1]} + P_{RatedGen\ [2]} + \dots + P_{RatedGen\ [n]}$

(Total rated power of all gensets on the busbar in the system)

$P_{GN\ real\ active} = P_{ActualGen\ [1]} + P_{ActualGen\ [2]} + \dots + P_{ActualGen\ [n]}$

(Total actual load of all gensets on the busbar in the system)

If the reserve power falls below the IOP reserve power threshold (parameter "IOP Reserve power"), another genset will be added.

$P_{Reserve} < P_{Reserve\ IOP}$

If the reserve power exceeds the IOP reserve power threshold (parameter "IOP Reserve power") plus the hysteresis (parameter "IOP Hysteresis") plus the rated load of the genset, the genset will be stopped.

The hysteresis is intended to prevent frequent starting and stopping of gensets in case of small load variations.

$P_{reserve} > P_{reserve\ islanded\ IOP} + P_{hysteresis\ IOP} + P_{RatedGen}$

4.6.2.13 Mains Operation (MOP)

$P_{Reserve} = P_{rated\ active} - P_{GN\ real\ active}$.

$P_{rated\ active} = P_{RatedGen[1]} + P_{RatedGen\ [2]} + \dots + P_{RatedGen\ [n]}$

(Total rated power of all gensets on the busbar in the system)

$P_{GN\ real\ active} = P_{ActualGen\ [1]} + P_{ActualGen\ [2]} + \dots + P_{ActualGen\ [n]}$

(Total actual load of all gensets on the busbar in the system)

If the required generator load setpoint for the control at the mains interchange point exceeds the MOP minimum load threshold (parameter "MOP Minimum load"), the first genset will be added.

$P_{MN\ setpoint} - P_{MN\ real} > P_{MOP\ minimum}$

If at least one genset is supplying the load in parallel with the mains and the reserve power falls below the reserve power threshold (parameter "MOP Re-serve power"), another genset will be added.

$P_{Reserve} < P_{Reserve\ parallel}$

If at least two gensets are supplying the load in parallel with the mains and the reserve power exceeds the MOP reserve power threshold (parameter "MOP Reserve power") plus the hysteresis (parameter "MOP Hysteresis") plus the rated load of the genset, the genset will be stopped.

The hysteresis is intended to prevent frequent starting and stopping of gensets in case of small load variations.

$P_{reserve} > P_{reserve\ parallel} + P_{hysteresis\ MOP} + P_{RatedGen}$

If one genset is supplying the load in parallel with the mains and the generator load exceeds the MOP minimum load threshold (parameter "MOP Minimum load") minus the hysteresis (parameter "MOP Hysteresis"), the genset will be stopped.

The hysteresis is intended to prevent frequent starting and stopping of gensets in case of small load variations.

$P_{MN\ setpoint} - P_{MN\ real} + P_{GN\ real\ active} < P_{MOP\ minimum} - P_{hysteresis\ MOP}$

4.6.2.14 The Minimum Power Feature

The LDSS offers a configuration to have a minimum power always supported. The idea of this feature is to be prepared for a big load, which is much higher than the usual desired Reserve Power, which is needed once the big load is switched on. When the mentioned load is on load busbar the classical reserve power or generator load approach will take place. This increases the availability and saves fuel.

To be prepared for a big load which will come in, a Minimal Power can be con-figured.

Requested Power for Mode “Generator Load”

Requested Power -> max [[(Actual load * 100) / (((Max-Min)*Dynamic/100) + Min)],[Minimal Power]]

Requested Power for Mode “Reserve Power”

Requested Power -> max [[The actual load + Reserve Power],[Minimal Power]]

4.6.2.15 Configuration LDSS General

ID	Parameter	CL	Setting range [Default]	Description
5776	LDSS	2	On [Off]	This is the general parameter to enable the LDSS function in the GC. **On:** The LDSS algorithm in the GC is enabled. The GC sends start or-ders to the own easYgens and to easYgens whose GC is in the same segment. **Off:** The LDSS algorithm is disabled. All start orders are removed. *To empower the easYgens to be guided by the GC in regards of LDSS, the GC-Mode in the easYgen must be enabled and the according LogicsManager start stop needs to be TRUE. Refer to the K51 operation manual for more information.*
5752	Start stop mode	2		This parameter determines the load criteria for start and stopping a next generator.
			[Reserve power]	Load-dependent start stop is performed in a way that a configured mini-mum reserve power is maintained in the system. The reserve power is the total generator rated power minus the total actual generator power.
			Generator load	Load-dependent start stop is performed in a way that a configured max-imum generator capacity utilization is not exceeded. If the generator capacity utilization exceeds this threshold, another genset will be started. If the generator capacity utilization is low enough to stop one genset, a genset will be stopped.

ID	Parameter	CL	Setting range [Default]	Description
5804	IOP Minimum Power	2	0 to 999999 kW [180 kW]	The minimum power setting is only active in island operation. The minimum power setting shall ensure to keep always a minimum of rated power on the load busbar even the usual required rated power (Reserve Power or current generator load) is in tune. According to the application this minimum expected power is to configure. Required Rated Power = max[Minimum Power, (Actual Load + Reserve Power)] *With switching the "big" load onto the busbar, the Required Rated Power changes from Minimum Power to (Actual Load + Reserve Power). This allows to keep the Reserve Power smaller as the Minimum Load and finally saves fuel consumption.*
5806	Basic Sort-ing	2		In cases a next starting or stopping genset is to choose and there is no clear definition currently valid to differentiate the gensets (Engine hours, Size of engine,…), the LDSS follows the basic sorting.
			Fill-up	According to the load the smallest available generator number of the smallest Group (GC) number will be started first until all available gens of this group are running. Then the next higher Group number takes place and so on. Run order: GC1 EG1; GC1 EG2; GC1 EG3;…;GC2 EG1; GC2 EG2;….;
			[Distribute]	According to the load the smallest available generator number of the smallest Group (GC) number will be started first. Then the next genset will be the smallest available generator number of the next higher Group number. If the load still increase the next genset will be the smallest available generator number of the next higher Group number and so on.
5754	Fit size of engine	2		This parameter defines whether the start/stop priority order considers the size of the engine (generator rated power) or not. In case of different sized gen-sets, the control can start a genset combination which results in optimum effi-ciency. The fuel efficiency may be optimized when this parameter is enabled. This parameter may be disabled if all generators have the same size.
			Yes	The priority order considers the engine size for the start of the next en-gine for gensets with the same priority.
			[No]	The priority order does not consider the rated power of the engines to fit the best size of engines.
				Note: The algorithm tries preferably using large engines, even if it is not matched the best possible efficiency. If an engine selection yields a condition, in which multiple small engines with their rated power cover exactly the rated power of an possible bigger engine, the bigger engine is preferred.
5755	Fit service hours	2		With this parameter the LDSS function can be configured so that redun-dant engines can be started and stopped according to their engine run-ning hours with different methods.
			[Off]	The engine running hours are not considered when evaluating the en-gines to be started for gensets with same priority. The parameter 5756 "Changes of engines" has no influence and can be ignored.
			Staggered	The remaining hours until the next service are considered when evaluat-ing the engines to be started for gensets with same priority. The gensets are uti-lized in a way that the maintenance may be performed at different times to ensure that not all gensets have a downtime due to a mainte-nance at the same time. The genset with the lowest hours until the next service will be started first. **Note:** To run this functionality properly the maintenance call must be acknowl-edged accordingly.
			Equal	The remaining hours until the next service is required are considered when evaluating the engines to be started for gensets with same priority. The gen-sets are utilized in a way that the maintenance may be per-formed at the same time for all gensets. The genset with the highest hours until the next service will be started first. **Note:** To run this functionality properly the maintenance call must be acknowl-edged accordingly.

ID	Parameter	CL	Setting range [Default]	Description
			Period of use hours:	The period of use hours are considered when evaluating the engines to be started for gensets with same priority. The gensets are utilized in a way that the period of use hours are equalized over time for all participat-ing gensets. The genset with the lowest period of use hours will be started first.
5756	Changes of engines	2	Off	Note: If the LDSS function "Fit service hours" is enabled with "Equal" or "Period of use" hours, this configuration gets valid. Otherwise this param-eter can be ignored. If LDSS is configured to act on best possible equal maintenance hours or "period of use" hours, the change of engines can be determined by given time slots. The LDSS creates therefor for each engine an individual unit’s time group. Refer to manual chapter Engine time groups for better un-derstanding. With setting "Off" no time slot is considered and the change of engine is relating directly on the passed engine hours. With a configured time slot (2/4/8/16/32h/64h/128h) a minimum of passed engine running hours is taken into account before changing the gensets.
			[Off]	No special grouping. The engines are selected according to its priority with 1 hour spacing in case of new sorting.
			All 2h	All relevant engines are changed with a 2 hour spacing.
			All 4h	All relevant engines are changed with a 4 hour spacing.
			All 8h	All relevant engines are changed with a 8 hour spacing.
			All 16h	All relevant engines are changed with a 16hour spacing.
			All 32h	All relevant engines are changed with a 32 hour spacing.
			All 64h	All relevant engines are changed with a 64hour spacing.
			All 128h	All relevant engines are changed with a 128 hour spacing.

4.6.2.16 Configuration LDSS “Island Operation”

ID	Parameter	CL	Setting range [Default]	Description
5760	IOP Reserve power	2	1 to 999999 kW [100 kW]	This parameter is only effective if start stop mode is configured to "Re-serve power". The value configured for the reserve power determines when an additional generator will be started. The reserve power is the desired spinning reserve of a generator or generators. The reserve power is usually estimated as the largest load swing that a power plant may encounter during the time it takes to bring an additional generator online. The available generator power is cal-culated by adding up the generator real power ratings of all generators with closed GCBs. The reserve generator power is calculated by subtracting the power currently being pro-duced by all generators with closed GCBs from the total available generator power. If the actual reserve power of the generators is less than the value con-fig-ured in this parameter, the next generator will be started.
5761	IOP Hysteresis	2	1 to 65000 kW [20 kW]	The hysteresis here determines how much the real reserve power must be increased in comparison to the configured reserve power to stop again a genset. Usually the hysteresis is adjusted so that small load changes not causing continuous engine start stop cycles.
				Notes This parameter is only effective if start stop mode is configured to "Reserve power".
5762	IOP Max. gener-ator load	2	0 to 100% [70%]	This parameter is only effective if start stop mode is configured to "Gen-erator load". The maximum generator load must be configured higher than the min-imum generator load for proper operation. If the generator load exceeds the threshold configured here, the load dependent start/stop function will start another genset.

ID	Parameter	CL	Setting range [Default]	Description
				Note The IOP Max. generator load can be overwritten by communication interface ID562. During the device startup procedure of the device this value is entered as a basic setting.
5763	IOP Min. gener-ator load	2	0 to 100% [30%]	If the generator load falls below the threshold configured here and a gener-ator cycling is not possible, the LDSS function will stop a genset. If with surpassing this limit a generator cycle takes place, the LDSS func-tion keeps the genset constellation until an according minimum power is reached, which prevents a generator cycling. *A generator cycling occurs, if with removing of a generator the resulting max-imum level is reached to start a generator even though the load didn't change.*
				Note: The IOP Min. generator load can be overwritten by communication interface ID565. During the device startup procedure of the device this value is entered as a basic setting.
5764	IOP Add on delay	2	0 to 32000s [10s]	Load swings may exceed the threshold momentarily. In order to prevent the engine from starting due to short-term load swings, a delay time may be con-figured. The LDSS criterion for adding load must be exceeded without interrup-tion for this delay time, configured in seconds, prior to a start command being issued. If the LDSS criterion for adding load is fallen below before the delay time expires, the delay time is reset and a start command is not issued.
5765	IOP Add on delay at rated load	2	0 to 32000s [3s]	In case the already running genset(s) have reached rated load a special IOP Add-on delay time can be configured here. Usually the time config-ured here is shorter as the “IOP Add on delay time” to achieve a faster start in this crit-ical situation
5766	IOP Add off delay	2	0 to 32000s [60s]	Load swings may fall below the threshold momentarily. In order to pre-vent the engine from stopping due to short-term load swings, a delay time may be configured. The load must remain below the hysteresis setpoint without interruption for the delay time, configured in seconds, prior to a stop command being issued. If the load exceeds the hysteresis setpoint before the delay time expires, the delay time is reset and a stop command is not issued.

4.6.2.17 Configuration LDSS “Mains Parallel Operation”

ID	Parameter	CL	Setting range [Default]	Description
5767	MOP Mini-mum load	2	1 to 650000 kW [10 kW]	For the mains interchange (import/export) real power control to function, a minimum generator power setpoint value is required to start the first genset. In many cases, it is desirable that the engine is prevented from starting unless the generator will operate at a specific kW level or higher to ensure a reason-able degree of efficiency.
5768	MOP Re-serve power	2	0 to 999999 kW [50 kW]	This parameter is only effective if start stop mode is configured to "Re-serve power". The minimum reserve power in mains parallel operation is configured here. This is the maximum expected load swing on the inter-change point, which shall be supported by the gensets. If the reserve power falls below this value, the load-dependent start/stop function will start another genset.
				Note: The MOP Reserve power can be overwritten by communication inter-face ID563. During the device startup procedure this value is entered as a basic setting.
5769	MOP Hyste-resis	2	1 to 65000kW [10 kW]	Start stop mode configured to "Reserve power". If the reserve power is suffi-cient to stop one genset without falling below the reserve power threshold and the hysteresis configured here, a genset will be stopped. If the generator load falls below the minimum load threshold minus the hysteresis configured here, the last genset will be stopped.

ID	Parameter	CL	Setting range [Default]	Description
5770	MOP Max. gen-erator load	2	0 to 100% [70%]	This parameter is only effective if start stop mode is configured to "Gen-erator load". The maximum generator load must be configured higher than the min-imum generator load for proper operation. If the generator load exceeds the threshold configured here, the load dependent start/stop function will start another genset. **Note:** The MOP Max. generator load can be overwritten by communica-tion interface ID566. During the device startup procedure this value is entered as a basic setting.
5771	MOP Min. gen-erator load	2	0 to 100% [30%]	This parameter is only effective if start stop mode is configured to "Gen-erator load". The maximum generator load must be configured higher than the min-imum generator load for proper operation. If the generator load falls below the threshold configured here and a generator cycling is not possible, the LDSS function will stop a genset. If with surpassing this limit a generator cycle takes place, the LDSS func-tion keeps the genset constellation until an according minimum power is reached, which prevents a generator cycling. *A generator cycling occurs, if with removing of a generator the resulting max-imum level is reached to start a generator even though the load didn't change.* **Note:** The MOP Min. generator load can be overwritten by communica-tion interface ID567. During the device startup procedure this value is entered as a basic setting.
5772	MOP Add on delay	2	0 to 32000s [20s]	Load swings may exceed the threshold momentarily. In order to prevent the engine from starting due to short-term load swings, a delay time may be con-figured. The LDSS criterion for adding load must be exceeded without interrup-tion for this delay time, configured in seconds, prior to a start command being issued. If the LDSS criterion for adding load is fallen below before the delay time expires, the delay time is reset and a start command is not issued.
5773	MOP Add on delay at rated load	2	0 to 32000s [5s]	In case the already running genset(s) have reached rated load a special MOP Add-on delay time can be configured here. Usually the time con-figured here is shorter as the "MOP Add on delay time" to achieve a faster start in this crit-ical situation.
5774	MOP Add off delay	2	0 to 32000s [60s]	Load swings may fall below the threshold momentarily. In order to pre-vent the engine from stopping due to short-term load swings, a delay time may be configured. The load must remain below the hysteresis setpoint without inter-ruption for the delay time, configured in seconds, prior to a stop command being issued. If the load exceeds the hysteresis setpoint before the delay time expires, the delay time is reset and a stop com-mand is not issued.

4.6.2.18 LDSS Parameter Alignment Check

The LDSS in the GC provides a LDSS parameter alignment check like the easYgen. Even there is only one LDSS master engaged, it is important to ensure that the other potential GCs are well pre-pared.

The aligned parameters are:

ID	Parameter	Comment
5776	LDSS enabled	Always considered
5752	Load dependent start stop mode	Always considered
5806	Load dependent start stop basic sorting	Always considered
5754	Load dependent start stop Fit size of engine	Always considered
5755	Load dependent start stop Fit service hours	Always considered
5756	Engine change 2h - 128h	Always considered

ID	Parameter	Comment
5760	Load dependent start stop IOP Reserve power	Only Start-up configuration considered
5804	Load dependent start stop IOP Minimum Power	Only Start-up configuration considered
5761	Load dependent start stop IOP Hysteresis	Always considered
5762	Load dependent start stop IOP Max. Generator Load	Only Start-up configuration considered
5763	Load dependent start stop IOP Min. Generator Load	Only Start-up configuration considered
5764	Load dependent start stop IOP Add on Delay	Always considered
5765	Load dependent start stop IOP – Add-on delay rated	Always considered
5766	Load dependent start stop IOP - Add-off Delay	Always considered
5767	Load dependent start stop MOP minimum load	Always considered
5768	Load dependent start stop MOP Reserve Power	Only Start-up configuration considered
5769	Load dependent start stop MOP Hysteresis	Always considered
5770	Load dependent start stop MOP Max. Generator Load	Only Start-up configuration considered
5771	Load dependent start stop MOP Min. Generator Load	Only Start-up configuration considered
5772	Load dependent start stop MOP - Add on Delay"	Always considered
5773	Load dependent start stop MOP – Add on delay rated	Always considered
5774	Load dependent start stop MOP - Add off Delay	Always considered
9921	Transfer rate LS fast message	Always considered

4.6.2.19 LDSS Overview Screen

Through the capability to run up to 248 gensets with LDSS the GC provides on a ToolKit page a LDSS Overview Screen. The idea is to get all relevant data into one screen.

Different colors of bitmaps help to recognize what is going on with the particular genset.

The according information are also provided for PLCs and SCADA systems.

Enumeration	Condition	HMI / ToolKit Field Indication:
0	Generator does not exist or is not in the same Segment like our GC	Solid Grey Field (Nothing visible)
1	Generator is in operation mode STOP	
2	Generator is in operation mode MANUAL	
3	Generator is in operation mode TEST	
4	Generator is in operation mode AUTO and for LDSS not available	

Enumeration	Condition	HMI / ToolKit Field Indication:
5	Generator is for LDSS available and wait for LDSS commands	
6	Generator have a LDSS Start Wish	
7	Generator is running over LDSS and breaker is closed	
8	Generator have a LDSS Stop Wish	
10-15	reserve	

Table 44: Genset states information in Toolkit

LDSS Overview in Toolkit

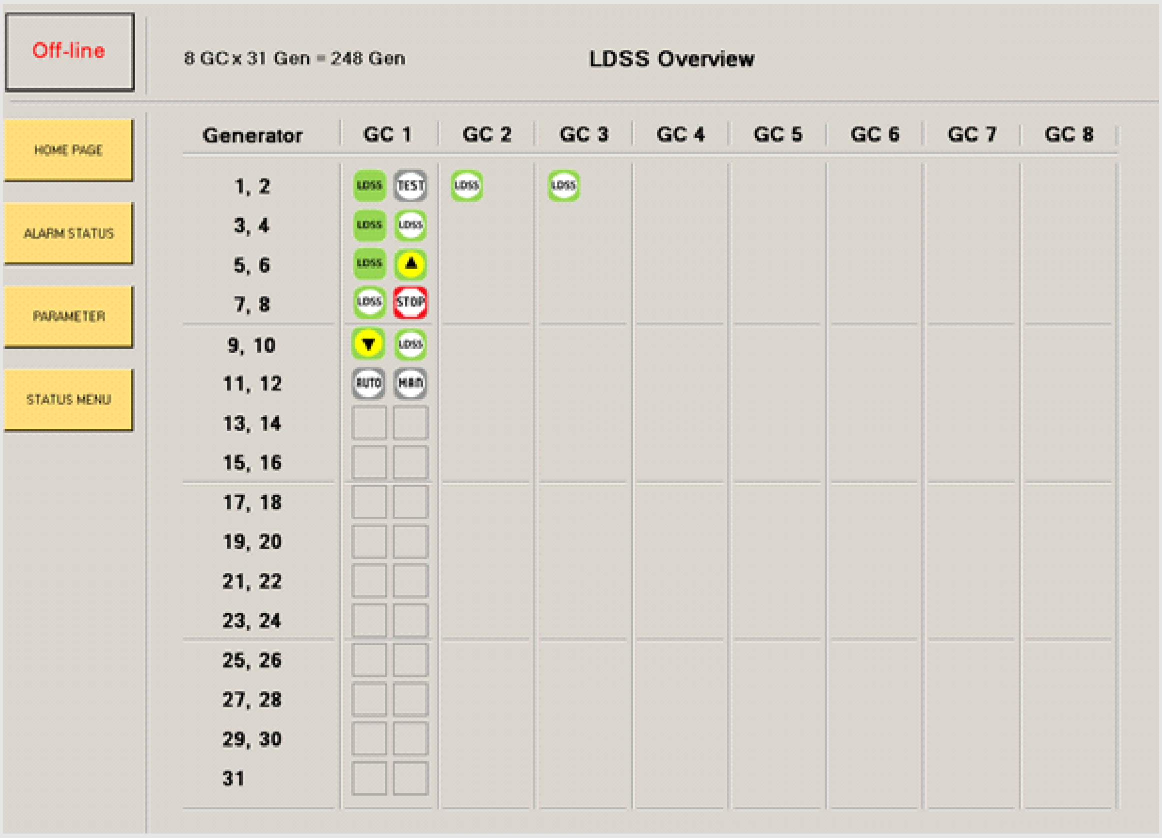


Fig. 53: Example overview GC and genset states in Toolkit

4.6.2.20 The LDSS Remote Settings (Remotely adjustable)

The LDSS remote settings are values which can be written fre-quently by com-munication interface to the device. The differentia-tion to already existing param-eter is that the sent value replaces the start-up configuration and is kept on a non-volatile memory until power down the device. Additionally the remotely written values are not included in the LDSS parameter alignment check. The values can be written in all Code levels.

Remote Settings			
ID	Name	According LDSS Parameter	Format
560	Remote Exp./Imp. Power Setpoint [kW]	5089 Exp./Imp. setpoint	SINT32
561	Remote Minimum Power [kW]	5804 Minimum Power	UINT32
562	Remote IOP Reserve power [kW]	5760 IOP Reserve power	UINT32
563	Remote MOP Reserve power [kW]	5768 MOP Reserve power	UINT32
564	Remote IOP Max. generator load [%]	5762 IOP Max. generator load	UINT16
565	Remote IOP Min. generator load [%]	5763 IOP Min. generator load	UINT16
566	Remote MOP Max. generator load [%]	5770 MOP Max. generator load	UINT16
567	Remote MOP Min. generator load [%]	5771 MOP Min. generator load	UINT16

4.7 Configure Measurement

General notes

If the genset control is intended to operate a genset in parallel to the mains, the mains voltage measuring inputs must be connected.

Dependencies

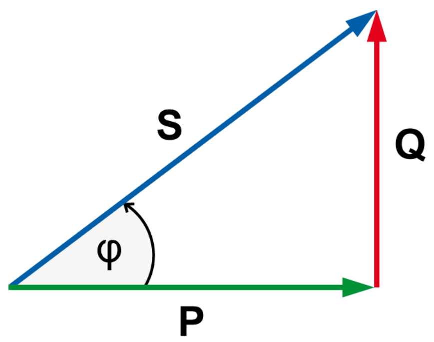


Fig. 54: AC power triangle

PF Power Factor
P Active Power [kW]
S Apparent power [kVA]
Q Reactive Power [kvar]

The AC power triangle illustrates the dependencies between active power, apparent power, reactive power and power factor.

- PF = P/S = cos Φ
- $Q = \sqrt{(S^2-P^2)}$
- $S = \sqrt{(P^2+Q^2)}$
- P = S * PF

4.7.1 General measurement settings

ID	Parameter	CL	Setting range [Default]	Description
1750	System rated frequency	2	50 / 60 Hz [50 Hz]	The rated frequency of the system is used as a reference figure for all frequency related functions, which use a percentage value, like frequency monitoring, breaker operation windows or the AnalogManager.
1858	1Ph2W voltage measuring	3	[Phase - phase]	The unit is configured for measuring phase-phase voltages if 1Ph 2W measuring is selected.
			Phase - neutral	The unit is configured for measuring phase-neutral voltages if 1Ph 2W measuring is selected.
				Notes For information on measuring principles refer to ↪ *Chapter 3.2.4.1 “Generator Group Voltage” on page 34*. Never configure the busbar measurement for phase-neutral, if the other systems like mains and generator are configured as 3Ph 3W or 3Ph 4W. The phase angle for synchronization would not be correct.
1859	1Ph2W phase rotation	3	[CW]	A clockwise rotation field is considered for 1Ph 2W measuring .
			CCW	A counter-clockwise rotation field is considered for 1Ph 2W measuring.
				Notes For information on measuring principles refer to ↪ *Chapter 3.2.4.1 “Generator Group Voltage” on page 34*.
5820	Dead bus detection max. volt.	2	0 to 30% [10%]	If the busbar voltage falls below this percentage of the busbar 1 rated voltage (parameter 1781 ↪ p. 116), a dead bus condition is detected and the logical command variable 02.21 (Busbar 1 is dead) becomes TRUE.

4.7.2 Generator

ID	Parameter	CL	Setting range [Default]	Description
1766	Generator rated voltage	2	50 to 650000 V [400 V]	This value refers to the rated voltage of the generator (generator voltage on the data plate) and is the voltage measured on the potential transformer primary. The generator rated voltage is used as a reference figure for all generator voltage related functions, which use a percentage value, like generator voltage monitoring, breaker operation windows or the AnalogManager.
1851	Generator voltage measuring	2	3Ph 4W OD	Measurement is performed Line-Neutral (Open Delta connected system). The voltage is connected via transformer with 3 Wire. Phase voltages and the neutral must be connected for proper calculation. Measurement, display and protection are adjusted according to the rules for Open Delta connected systems. Monitoring refers to the following voltages: ■ VL12, VL23 and VL31
			1Ph 3W	Measurement is performed Line-Neutral (WYE connected system) and Line-Line (Delta connected system). The protection depends on the setting of parameter 1770 . Measurement, display, and protection are adjusted according to the rules for single-phase systems. Monitoring refers to the following voltages: ■ VL13 (parameter 1770 configured to "Phase-phase") ■ VL1N, VL3N (parameter 1770 configured to "Phase-neutral")

ID	Parameter	CL	Setting range [Default]	Description
			1Ph 2W	Measurement is performed Line-Neutral (WYE connected system) if parameter 1858 ⇘ p. 114 is configured to "Phase - neutral" and Line-Line (Delta connected system) if parameter 1858 ⇘ p. 114 is configured to "Phase - phase". Measurement, display and protection are adjusted according to the rules for phase-phase systems. Monitoring refers to the following voltages: ■ VL1N, VL12
			3Ph 3W	Measurement is performed Line-Line (Delta connected system). Phase voltages must be connected for proper calculation. Measurement, display and protection are adjusted according to the rules for Delta connected systems. Monitoring refers to the following voltages: ■ VL12, VL23, VL31
			[3Ph 4W]	Measurement is performed Line-Neutral (WYE connected system) and Line-Line (Delta connected system). The protection depends on the setting of parameter 1770 . Phase voltages and the neutral must be connected for proper calculation. Measurement, display and protection are adjusted according to the rules for WYE connected systems. Monitoring refers to the following voltages: ■ VL12, VL23 and VL31 (parameter 1770 configured to "Phase-phase") ■ VL1N, VL2N and VL3N (parameter 1770 configured to "Phase-neutral")
				Notes If this parameter is configured to 1Ph 3W, the generator and mains rated voltages (parameters 1766 ⇘ p. 114 and 1768 ⇘ p. 117) must be entered as Line-Line (Delta) and the busbar 1 rated voltage (parameter 1781 ⇘ p. 116) must be entered as Line-Neutral (WYE). For information on measuring principles refer to ⇘ *Chapter 3.2.4.1 "Generator Group Voltage" on page 34*.

4.7.2.1 Configure transformer

ID	Parameter	CL	Setting range [Default]	Description
1801	**Gen. PT primary rated voltage** (Generator potential transformer primary voltage rating)	2	50 to 650000 V [400 V]	Some generator applications may require the use of potential transformers to facilitate measuring the voltages produced by the generator. The rating of the primary side of the potential transformer must be entered into this parameter. If the application does not require potential transformers (i.e. the measured voltage is 690 V or less), then the measured voltage will be entered into this parameter.
1800	**Gen. PT secondary rated volt.** (Generator potential transformer secondary voltage rating)	2	50 to 690 V [400 V]	Some generator applications may require the use of potential transformers to facilitate measuring the voltages produced by the generator. The rating of the secondary side of the potential transformer must be entered into this parameter. If the application does not require potential transformers (i.e. the measured voltage is 690 V or less), then the measured voltage will be entered into this parameter.

4.7.3 Busbar

The busbar parameters in the device are often named with the affix "1". This preparation is done to avoid confusion e.g., if a model with a second busbar measurement is introduced.

ID	Parameter	CL	Setting range [Default]	Description
1781	**Busbar 1 rated voltage**	2	50 to 650000 V [400 V]	This value refers to the rated voltage of busbar 1 and is the voltage measured on the potential transformer primary. If voltage measuring is configured to 1Ph 3W, the WYE voltage (VL1N) must be entered here. The busbar 1 potential transformer primary voltage is entered in this parameter. The busbar rated voltage is used as a reference figure for all busbar voltage related functions, which use a percentage value, like synchronization.

4.7.3.1 Configure transformer

ID	Parameter	CL	Setting range [Default]	Description
1813	**Busb1 PT primary rated voltage** (Busbar 1 potential transformer primary voltage rating)	2	50 to 650000 V [400 V]	Some applications may require the use of potential transformers to facilitate measuring the voltages to be monitored. The rating of the primary side of the potential transformer must be entered into this parameter.
				Notes If the application does not require potential transformers (i.e. the measured voltage is 690 V or less), then the measured voltage will be entered into this parameter.
1812	**Busb1 PT secondary rated volt.** (Busbar 1 potential transformer secondary voltage rating)	2	50 to 690 V [400 V]	Some applications may require the use of potential transformers to facilitate measuring the busbar voltages. The rating of the secondary side of the potential transformer must be entered into this parameter. If the application does not require potential transformers (i.e. the measured voltage is 690 V or less), then the measured voltage will be entered into this parameter.

4.7.4 Mains

ID	Parameter	CL	Setting range [Default]	Description
1768	**Mains rated voltage**	2	50 to 650000 V [400 V]	This value refers to the rated voltage of the mains and is the voltage measured on the potential transformer primary. The mains potential transformer primary voltage is entered in this parameter. The mains rated voltage is used as a reference figure for all mains voltage related functions, which use a percentage value, like mains voltage monitoring, breaker operation windows or the AnalogManager.
1853	**Mains voltage measuring**	2	[3Ph 4W]	Measurement is performed Line-Neutral (WYE connected system) and Line-Line (Delta connected system). The protection depends on the setting of parameter 1771. Phase voltages and the neutral must be connected for proper calculation. Measurement, display and protection are adjusted according to the rules for WYE connected systems. Monitoring refers to the following voltages: ■ VL12, VL23 and VL31 (parameter 1771 configured to "Phase-phase") ■ VL1N, VL2N and VL3N (parameter 1771 configured to "Phase-neutral") ■ VL12, VL23, VL31, VL1N, VL2N and VL3N (parameter 1771 configured to "All")
			3Ph 3W	Measurement is performed Line-Line (Delta connected system). Phase voltages must be connected for proper calculation. Measurement, display and protection are adjusted according to the rules for Delta connected systems. Monitoring refers to the following voltages: ■ VL12, VL23, VL31
			1Ph 2W	Measurement is performed Line-Neutral (WYE connected system) if parameter 1858 ➫ p. 114 is configured to "Phase - neutral" and Line-Line (Delta connected system) if parameter 1858 ➫ p. 114 is configured to "Phase - phase". Measurement, display and protection are adjusted according to the rules for phase-phase systems. Monitoring refers to the following voltages: ■ VL1N, VL12
			1Ph 3W	Measurement is performed Line-Neutral (WYE connected system) and Line-Line (Delta connected system). The protection depends on the setting of parameter 1771. Measurement, display, and protection are adjusted according to the rules for single-phase systems. Monitoring refers to the following voltages: ■ VL13 (parameter 1771 configured to "Phase-phase") ■ VL1N, VL3N (parameter 1771 configured to "Phase-neutral") ■ VL1N, VL3N (parameter 1771 configured to "All")
				Notes If this parameter is configured to 1Ph 3W, the generator and mains rated voltages (parameters 1766 ➫ p. 114 and 1768 ➫ p. 117) must be entered as Line-Line (Delta) and the busbar 1 rated voltage (parameter 1781 ➫ p. 116) must be entered as Line-Neutral (WYE).

4.7.4.1 Configure transformer

ID	Parameter	CL	Setting range [Default]	Description
1804	**Mains PT primary rated voltage** (Mains potential transformer primary voltage rating	2	50 to 650000 V [400 V]	Some applications may require the use of potential transformers to facilitate measuring the voltages to be monitored. The rating of the primary side of the potential transformer must be entered into this parameter.
				Notes If the application does not require potential transformers (i.e. the measured voltage is 690 V or less), then the measured voltage will be entered into this parameter.
1803	**Mains PT secondary rated volt.** (Mains potential transformer secondary voltage rating)	2	50 to 690 V [400 V]	Some applications may require the use of potential transformers to facilitate measuring the mains voltages. The rating of the secondary side of the potential transformer must be entered into this parameter. If the application does not require potential transformers (i.e. the measured voltage is 690 V or less), then the measured voltage will be entered into this parameter.

4.8 Monitoring Function

4.8.1 Alarm acknowledge

The GC provides 3 alarm outputs

- DO2: New Alarm
  Is closed for 1 second with each new raising alarm
- DO3: Warning Alarm
  Is closed with minimal one unacknowledged warning alarm
- DO4: Critical Alarm
  Is closed with minimal one unacknowledged critical alarm

The ToolKit alarm page informs about the condition of the single alarms. Usually an alarm is only acknowledgeable, if the alarm is not active anymore.

Alarms are always common acknowledged. This can be executed in different ways:

- Through DI1 "Alarm acknowledge"
- Through the Alarm RESET button
- Through the easYgen K51 of the own group

4.8.2 Generator Group / Load Busbar Monitoring

Operating Voltage and Frequency

Different operations like synchronize GGB or dead bus closure GGB require the condition of the Generator Group and the Load Busbar. Whether a generator group and load busbar are in the correct range is configurable. The outcome of the monitor are flags for logical purposes and HMI indication.

Usually the monitored sources are the phase-phase voltages.

An exception is, if phase-neutral voltage are only available (1Ph2W = Phase-neutral). Then the Phase-Neutral voltage is taken.

These control bits are created with the limit settings:

- Generator Group voltage and frequency in range
- Generator group voltage dead busbar detected

- Load Busbar voltage and frequency in range
- Load Busbar dead busbar detected

The flags are used for logical purposes internally.

ID	Parameter	CL	Setting range [Default]	Description
5800	**Upper voltage limit** Maximum operating voltage limit	2	100 to 150% [110%] (Hysteresis: 1%)	The maximum permissible positive deviation of the generator voltage from the generator rated voltage (parameter 1766) is configured here.
5801	**Lower voltage limit** (Minimum operating voltage limit)	2	50 to 100% [90%] (Hysteresis: 1%)	The maximum permissible negative deviation of the generator voltage from the generator rated voltage (parameter 1766) is configured here.
5802	**Upper frequency limit** (Maximum operating frequency limit)	2	100.0 to 150.0% [105.0%] (Hysteresis: 0.05%)	The maximum permissible positive deviation of the generator frequency from the rated system frequency (parameter 1750) is configured here.
5803	**Lower frequency limit** (Minimum operating frequency limit)	2	50.0 to 100.0% [95.0%] (Hysteresis: 0.05%)	The maximum permissible negative deviation of the generator frequency from the rated system frequency (parameter 1750) is configured here.

4.8.3 Mains Monitoring

Operating Voltage and Frequency

Different operations like synchronize MCB or considering mains settling time require the condition of the mains. Whether the mains is in the correct range is configurable. The outcome of the monitor are flags for logical purposes and HMI indication.

Usually the monitored sources are the phase-phase voltages.

An exception is, if phase-neutral voltage are only available (1Ph2W = Phase-neutral). Then the Phase-Neutral voltage is taken.

Three control bits shall be created out of the parameters:

- Mains voltage in range
- Mains frequency in range
- Mains voltage and frequency in range

The flags are used for logical purposes internally.

ID	Parameter	CL	Setting range [Default]	Description
5810	**Upper voltage limit**	2	100 to 150% [110%]	The maximum permissible positive deviation of the mains voltage from the mains rated voltage (parameter 1768) is configured here.
5814	**Hysteresis upper voltage limit**	2	0 to 50% [2%]	If the mains voltage has exceeded the limit configured in parameter 5810, the voltage must fall below the limit and the value configured here, to be considered as being within the operating limits again.
5811	**Lower voltage limit**	2	50 to 100% [90%]	The maximum permissible negative deviation of the mains voltage from the mains rated voltage (parameter 1768) is configured here.

ID	Parameter	CL	Setting range [Default]	Description
5815	Hysteresis lower voltage limit	2	0 to 50% [2%]	If the mains voltage has fallen below the limit configured in parameter 5811, the voltage must exceed the limit and the value configured here, to be considered as being within the operating limits again.
5812	Upper frequency limit	2	66.7[1] to 150.0% [110.0%]	The maximum permissible positive deviation of the mains frequency from the rated system frequency (parameter 1750) is configured here. Notes [1] The lowest measurable frequency is 40 Hz. 66.7 % of 60 Hz is 40 Hz. Equivalent for 50 Hz don't go below 80 %.
5816	Hysteresis upper frequency limit	2	0 to 50.0% [0.5%]	If the mains frequency has exceeded the limit configured in parameter 5812, the frequency must fall below the limit and the value configured here, to be considered as being within the operating limits again.
5813	Lower frequency limit	2	66.7[1] to 100.0% [90.0%]	The maximum permissible negative deviation of the mains frequency from the rated system frequency (parameter 1750) is configured here. Notes [1]The lowest measurable frequency is 40 Hz. 66.7 % of 60 Hz is 40 Hz. Equivalent for 50 Hz don't go below 80 %.
5817	Hysteresis lower frequency limit	2	0 to 50.0% [0.5%]	If the mains frequency has exceeded the limit configured in parameter 5813, the frequency must raise above the limit and the value configured here, to be considered as being within the operating limits again.

4.8.4 GGB feedback check

Function

The function checks, if the feedback of the GGB is plausible to the measured AC voltages connected on the breaker.

So if the GGB is closed and Generator Group and Load Busbar are in range, the phase angle will be checked. If the phase angle is outside +/-12° an alarm will be tripped.

The intention of this monitor is to detect wiring failures or blown fuses.

The delay time is 2 seconds.

This monitor is always enabled.

Alarm Indication

- Critical alarm (Relay)
- Alarm bit active (Toolkit red LED)
- Alarm bit latched (Toolkit red LED)
- Entry protocol 5022

4.8.5 Voltage / Frequency Plausibility Check (Plausibility AC Wiring)

These parameters are effective for generator group, load busbar and mains frequency

Function

It might occur that for example generator frequency is measured even if the generator is not running.

This could happen e.g. if PE (terminal 61) is not connected, the generator neutral connection is broken and the mains is energized with 1 phase 2 wire connection. In this case a potential shift occurs which could lead to "ghostly" voltages at the generator phase-neutral system. This voltages lead to a frequency measurement even if no voltage is detected in the generator phase-phase system. (Similar situation are possible for busbar and mains.)

For this reason the "Plausibility AC wiring" monitoring is introduced to indicate such situations at generator, busbar, or mains measurement. These alarms are tripping if only "Phase-Phase" or only "Phase-Neutral" frequency is detected.

If such an alarm

- "Gen. AC wiring"
- "Busbar 1 AC wiring
- "Mains AC wiring"

has tripped please check all "Phase-Phase" and "Phase-Neutral" voltages via HMI or Toolkit to get more information and check the AC wiring.

Note: This monitor function is only active if the wiring can provide "Phase-Phase" and "Phase-Neutral" values.

The delay time is 2 seconds.

This monitor is always enabled.

Plausibility AC Wiring

ID	Parameter	CL	Setting range [Default]	Description
1964	Monitoring	2		Enabling Plausibility AC Wiring.
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled

Alarm Indication

Gen. AC wiring:

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

Load Busbar AC wiring:

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

Mains AC wiring:

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

4.8.6 GGB Close / Open Monitoring

Introduction

Configure GGB

Circuit breaker monitoring contains two alarms: A breaker reclose alarm and a breaker open alarm.

Reclose Alarm: If the control initiates a close of the breaker and the breaker fails to close after the configured number of attempts the monitoring CB alarm will be initiated.

(Refer to parameter "GGB max. closing attempts", parameter 3087).

If this protective function is triggered, the HMI indicates "GGB fail to close".

The close attempt counter is reset, if:

- The close command by the internal logic is removed for more than 5 seconds
- A successful feedback is active for more than 5 seconds

Breaker Open Alarm: If the control initiates a close of the breaker and the breaker fails to close after the configured number of attempts the monitoring CB alarm will be initiated. (Refer to parameter "GGB open monitoring", parameter 3088).

If this protective function is triggered, the display indicates "GGB fail to open".

Configuration

ID	Parameter	CL	Setting range [Default]	Description
3085	Monitoring	2		Enabling GGB monitoring. Circuit breaker monitoring contains two alarms: A "breaker reclose" alarm and a "breaker open" alarm.
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled
3087	GGB maximum closing attempts	2	1 to 10 [5]	The maximum number of breaker closing attempts is configured in this parameter (relay output "Command: close GGB"). When the breaker reaches the configured number of attempts, a "GGB fail to close" alarm is issued. The counter for the closure attempts will be reset as soon as the "Reply GGB" is de-energized for at least 5 seconds to signal a closed GGB.
3088	GGB open monitoring	2	0.10 to 5.00 s [2.00 s]	If the "Reply GGB" is not detected as energized once this timer expires, a "GGB fail to open" alarm is issued. This timer initiates as soon as the "open breaker" sequence begins. The alarm configured is issued.

Alarm Indication

GGB fail to close:

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

GGB fail to open:

- Critical alarm (Relay)
- Alarm bit active (Toolkit red LED)
- Alarm bit latched (Toolkit red LED)
- Entry protocol 5022

4.8.7 MCB Close / Open Monitoring

Introduction

Configure MCB

Circuit breaker monitoring contains two alarms: A breaker reclose alarm and a breaker open alarm.

Reclose Alarm: If the control initiates a close of the breaker and the breaker fails to close after the configured number of attempts the monitoring CB alarm will be initiated.

(Refer to parameter "MCB max. closing attempts", parameter 3419).

If this protective function is triggered, the HMI indicates "MCB fail to close".

The close attempt counter is reset, if:

- The close command by the internal logic is removed for more than 5 seconds
- A successful feedback is active for more than 5 seconds

Breaker Open Alarm: If the control initiates a close of the breaker and the breaker fails to close after the configured number of attempts the monitoring CB alarm will be initiated. (Refer to parameter "MCB open monitoring", parameter 3421).

If this protective function is triggered, the HMI indicates "MCB fail to open".

Configuration

ID	Parameter	CL	Setting range [Default]	Description
2620	Monitoring	2		Enabling MCB monitoring. Circuit breaker monitoring contains two alarms: A "breaker reclose" alarm and a "breaker open" alarm.
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled
3419	MCB maximum closing attempts	2	1 to 10 [5]	The maximum number of breaker closing attempts is configured in this parameter (relay output "Command: close GGB"). When the breaker reaches the configured number of attempts, a "MCB fail to close" alarm is issued. The counter for the closure attempts will be reset as soon as the "Reply MCB" is de-energized for at least 5 seconds to signal a closed MCB.
3421	MCB open monitoring	2	0.10 to 5.00 s [2.00 s]	If the "Reply MCB" is not detected as energized once this timer expires, a "MCB fail to open" alarm is issued. This timer initiates as soon as the "open breaker" sequence begins. The alarm configured is issued.

Alarm Indication

MCB fail to close:

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

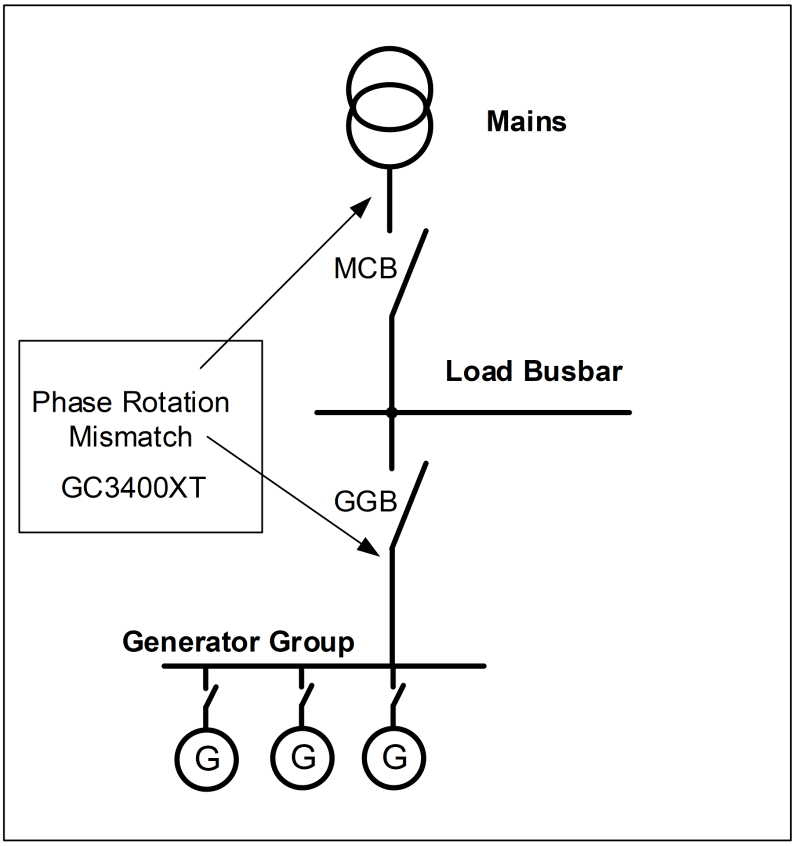
MCB fail to open:

- Critical alarm (Relay)
- Alarm bit active (Toolkit red LED)
- Alarm bit latched (Toolkit red LED)
- Entry protocol 5022

4.8.8 Phase Rotation Mismatch diagnostic

Function

The unit observes, if the phase rotation are equal between the measured voltage systems. I.e.: If the unit detects for mains a CCW rotation and for the Generator group a CW rotation, an alarm shall be issued and the breaker synchronization shall be inhibited.



Example

The delay time is 2 seconds.

This monitor is always enabled.

Alarm Indication

- Critical alarm (Relay)
- Alarm bit active (Toolkit red LED)
- Alarm bit latched (Toolkit red LED)
- Entry protocol 5022

- The GGB synchronization is inhibited, if the MCB is closed

4.8.8.1 Generator Group Voltage Rotation Mismatch Monitoring

Function

The unit observes the phase rotation of generator and mains and issue an alarm, if the phase rotation do not match the desired rotation type (CW or CCW).

Correct phase rotation of the phase voltages ensures that damage will not occur during a breaker closure to either the mains or the generator. The voltage phase rotation alarm checks the phase rotation of the measured voltages and the configured phase rotation to ensure they are identical. The directions of rotation are differentiated as "clockwise" and "counter clockwise". With a clockwise field the direction of rotation is "L1-L2-L3"; with a counter clockwise field the direction of rotation is "L1-L3-L2". If the control is configured for a clockwise rotation and the measured voltages are monitored as counterclockwise, the alarm will be initiated. The direction of configured rotation being monitored by the control unit is displayed on Toolkit Homepage.

This monitoring function is only enabled if Generator voltage measuring (parameter **1851**) is configured to "3Ph 4W", "3Ph 3W" or "3Ph 4W OD".

The Phase Rotation Monitor is internally configured with a 2 seconds delay. The recognition of a changed phase rotation will cause additionally up to 1 second.

So the alarm shall be issued within 3 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
3950	Monitoring	2		Enabling generator group voltage phase rotation monitoring.
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled
3954	Generator phase rotation	2	[CW]	Expected generator group phase rotation. CW: The three-phase measured generator voltage is rotating CW (clockwise; that means the voltage rotates in L1-L2-L3 direction; standard setting).
			CCW	CCW: The three-phase measured generator group voltage is rotating CCW (counter clockwise; that means the voltage rotates in L1-L3-L2 direction).

Alarm Indication

- Critical alarm (Relay)
- Alarm bit active (Toolkit red LED)
- Alarm bit latched (Toolkit red LED)
- Entry protocol 5022

4.8.8.2 Mains Phase Rotation Mismatch Monitoring

Function

Configure Monitoring: Mains, Voltage Phase Rotation:

Correct phase rotation of the phase voltages ensures that damage will not occur during a breaker closure to either the mains or the generator. The voltage phase rotation alarm checks the phase rotation of the voltages and the configured phase rotation to ensure they are identical. The directions of rotation are differentiated as "clockwise" and "counter clockwise". With a clockwise field the direction of rotation is "L1-L2-L3"; with a counter clockwise field the direction of rotation is "L1-L3-L2". If the control is configured for a clockwise rotation and the voltages into the unit are calculated as counterclockwise the alarm will be initiated. The direction of configured rotation being monitored by the control unit is displayed in the Toolkit Homepage.

This monitoring function is only enabled if Mains voltage measuring (parameter **1853**) is configured to "3Ph 4W" or "3Ph 3W".

The Phase Rotation Monitor is internally configured with a 2 seconds delay. The recognition of a changed phase rotation will cause additionally up to 1 second.

So the alarm shall be issued within 3 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
3970	Monitoring	2		Enabling mains voltage phase rotation monitoring.
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled
3954	Mains phase rotation	2	[CW]	Expected mains phase rotation. CW: The three-phase measured mains voltage is rotating CW (clockwise; that means the voltage rotates in L1-L2-L3 direction; standard setting).
			CCW	CCW: The three-phase measured mains voltage is rotating CCW (counter clockwise; that means the voltage rotates in L1-L3-L2 direction).

Alarm Indication

- Critical alarm (Relay)
- Alarm bit active (Toolkit red LED)
- Alarm bit latched (Toolkit red LED)
- Entry protocol 5022

4.8.9 Monitoring Interfaces

4.8.9.1 CAN1 Monitoring

Function

If the device does not recognize any CAN message on CAN1, the device indicates an alarm.

The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
3956	Monitoring	2		Enabling CAN1 monitoring.
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled

Alarm Indication

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

4.8.9.2 Ethernet Port A Monitoring

Function

- If the device recognizes that the Ethernet Port A does not receives anything, the device indicates an alarm.
- The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
3962	Monitoring	2		Enabling Ethernet A monitoring.
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled

Alarm Indication

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

4.8.9.3 Ethernet Port B Monitoring

Function

If the device recognizes that the Ethernet Port B does not receives anything, the device indicates an alarm.

The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
3976	Monitoring	2		Enabling Ethernet B monitoring.
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled

Alarm Indication

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

4.8.9.4 Ethernet Port C Monitoring

Function

If the device recognizes that the Ethernet Port C does not receives anything, the device indicates an alarm.

The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
3982	Monitoring	2		Enabling Ethernet C monitoring.
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled

Alarm Indication

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)

- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

4.8.9.5 CAN1/EthA Redundancy Monitoring

Function

If the device recognizes that the EthA or CAN1 is interrupted, the device indicates an alarm.

The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
3988	Monitoring	2		Enabling CAN1 / Ethernet A Redundancy Monitoring.
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled

Alarm Indication

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

4.8.9.6 EthB/EthC Redundancy Monitoring

Function

If the device recognizes that the EthB or EthC is interrupted, the device indicates an alarm.

The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
3994	Monitoring	2		Enabling Ethernet B / Ethernet C Redundancy Monitoring.
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled

Alarm Indication

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

4.8.9.7 System Update easYgen Monitoring

Function

The device observes the communication within the own easYgen group. If the communication situation does not adapt to the last taught-in constellation, an alarm is issued.

Refer to "Diagnostic easYgens" for better information.

The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
7832	Monitoring	2		System update easYgen monitoring can be switched on
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled

Alarm Indication

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

4.8.9.8 System Update Group Controllers Monitoring

Function

The device observes the communication between the Group Controllers. If the communication situation does not adapt to the last taught-in constellation, an alarm is issued.

Refer to "Diagnostic Group Controllers" for more information.

The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
7866	Monitoring	2		System update group controller monitoring can be switched on
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled

Alarm Indication

- Warning alarm (Relay)
- Alarm bit active (Toolkit yellow LED)
- Alarm bit latched (Toolkit yellow LED)
- Entry protocol 5022

4.8.9.9 Missing Member easYgen Monitoring

Function

The device observes the communication within the own easYgen group.

The multi-unit communication monitoring function checks whether all participating units are available (sending data on the load share line).

If the number of available units is smaller than the number of members updated internally for at least 1 second, the device raises the alarm.

Refer to "Diagnostic easYgens" for better information.

The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
4060	Monitoring	2		Enabling multi-unit missing member monitoring. The multi-unit missing members monitoring function checks whether all participating units (easYgen) are available (sending data on the load share line within the group). If the number of available units is less than the number of taught-in devices for at least the delay time, the display indicates "Missing members easYgen".
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled

Alarm Indication

- Critical alarm (Relay)
- Alarm bit active (Toolkit red LED)
- Alarm bit latched (Toolkit red LED)
- Entry protocol 5022

4.8.9.10 Missing Member Group Monitoring

Function

The device observes the communication between the Group Controllers.

The multi-unit communication monitoring function checks whether all participating units are available (sending data on the load share line).

If the number of available units is smaller than the number of members updated internally for at least 1 second, the device raises the alarm.

Refer to "Diagnostic Group Controllers" for better information.

The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
4136	Monitoring	2		Enabling multi-unit missing member monitoring. The multi-unit missing members monitoring function checks whether all participating units (easYgen) are available (sending data on the load share line within the group). If the number of available units is less than the number of taught-in devices for at least the delay time, the display indicates "Missing members easYgen".
			[On]	On: Monitoring is enabled
			Off	Off: Monitoring is disabled

Alarm Indication

- Critical alarm (Relay)
- Alarm bit active (Toolkit red LED)
- Alarm bit latched (Toolkit red LED)
- Entry protocol 5022

4.8.9.11 Group Not Ok Monitoring

Function

The device observes the communication between the Group Controllers. If any group is recognized with a communication diagnostic failure the alarm is issued.

The single failures are:

- System update easYgen
- Missing easYgen
- CAN1/EthA redundancy

Refer to "Diagnostic Group Controllers" for more information.

This failure is reported to all other GCs. So that the operator is always informed when he looks onto any other GC communication diagnostic.

Note: Before the system update on the group controller level is executed, all single GC groups must be okay. If not check first what is the root cause of this single group not okay issue and solve it first.

The delay time is 2 seconds.

The alarm is only active, if the **System Update GC** Monitoring is enabled.

The alarm is fixed programmed on self-acknowledge.

It is more practical if a single group is with trouble that the whole system is automatically acknowledged if this alarm does not exist anymore.

Alarm Indication

- Critical alarm (Relay)
- Alarm bit active (Toolkit red LED)
- Alarm bit latched (Toolkit red LED)
- Entry protocol 5022

4.8.9.12 Monitoring AI Wire break

Function

The wire break monitoring informs the operator that there is something wrong with the 0/4 to 20mA signal of AI1 and AI2.

Monitoring wire break:

The following configurations are used to monitor for a wire break:

- Off: No wire break monitoring is performed.
- High: If the actual value rises over the maximum value (over shoot), this is identified as a wire break.
- Low: If the actual value falls below the minimum value (under shoot), this is identified as a wire break.
- High/Low: If the actual value rises over the maximum value (over shoot) or falls below the minimum value (undershoot), this is identified as a wire break.

Note: If the control unit detects that the measuring range for an analog input has been exceeded and an alarm is issued, the limit value monitoring of this analog input is disabled and an error message is displayed.

The measuring range is recognized as being exceeded and an alarm is issued:

0 to 20 mA

Minimum value 2 mA Undershooting

Maximum value 20.5 mA Overshooting

The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
1003 1053	Monitoring	2		Enabling the wire break monitoring on AI 1,2 If this protective function is triggered, the GC indicates "Wb: Analog input 1,2".
			[Off]	No wire break monitoring is performed.
			High	If the actual value rises over the maximum value (overshoot), this is identified as a wire break.
			Low	If the actual value falls below the minimum value (undershoot), this is identified as a wire break.
			High/Low	If the actual value rises over the maximum value (overshoot) or falls below the minimum value (undershoot), this is identified as a wire break.

Alarm Indication

- Warning character (Relay)
- Alarm bit active (Toolkit LED)
- Alarm bit latched (Toolkit LED)
- Entry protocol 5022

4.8.9.13 LDSS Parameter Alignment Monitoring

Introduction

The LDSS algorithm must be enabled in all GCs, if the LDSS function is desired. This implies that the LDSS parameter must be all the same. To help the commissioner to have equal LDSS parameter in all GCs he can use the parameter alignment monitoring. The monitoring triggers an alarm, if the own LDSS parameter set does not match the set of any other GC device.

A visualization screen in ToolKit informs which devices are different in relation to the own GC device.

Refer to the LDSS chapter to get more information regarding LDSS master handling.

Function

The GC device calculates a LDSS parameter checksum of the own LDSS parameter and sends this value to the neighbor GCs. The parameter alignment monitor of each device compares its checksum with the others. A different checksum occurs an alarm.

A LDSS parameter alignment overview screen shows that GC, which differs to the own GC device.

The delay time is 2 seconds.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
4070	Monitoring	2		Enabling multi-unit parameter alignment monitoring. All LDSS parameter of the GCs are checked here. Therefore a CRC checksum is exchanged between the GC devices.
			[Off]	Monitoring is disabled
			On	Monitoring is enabled
4076	Delay	2	0.02 to 999.99s [3 s]	If the parameter alignment error occurs, the alarm output can be delayed here.

ID	Parameter	CL	Setting range [Default]	Description
4077	Self acknowledge	2	[Yes]	The control unit automatically clears the alarm if the fault condition is no longer detected.
			No	The control unit does not automatically reset the alarm when the fault condition is no longer detected.

Alarm Indication

- Warning character (Relay)
- Alarm bit active (Toolkit LED)
- Alarm bit latched (Toolkit LED)
- Entry protocol 5022

5 Operation

6 Application Field

6.1 Breaker Application Examples

6.1.1 Initial Setup

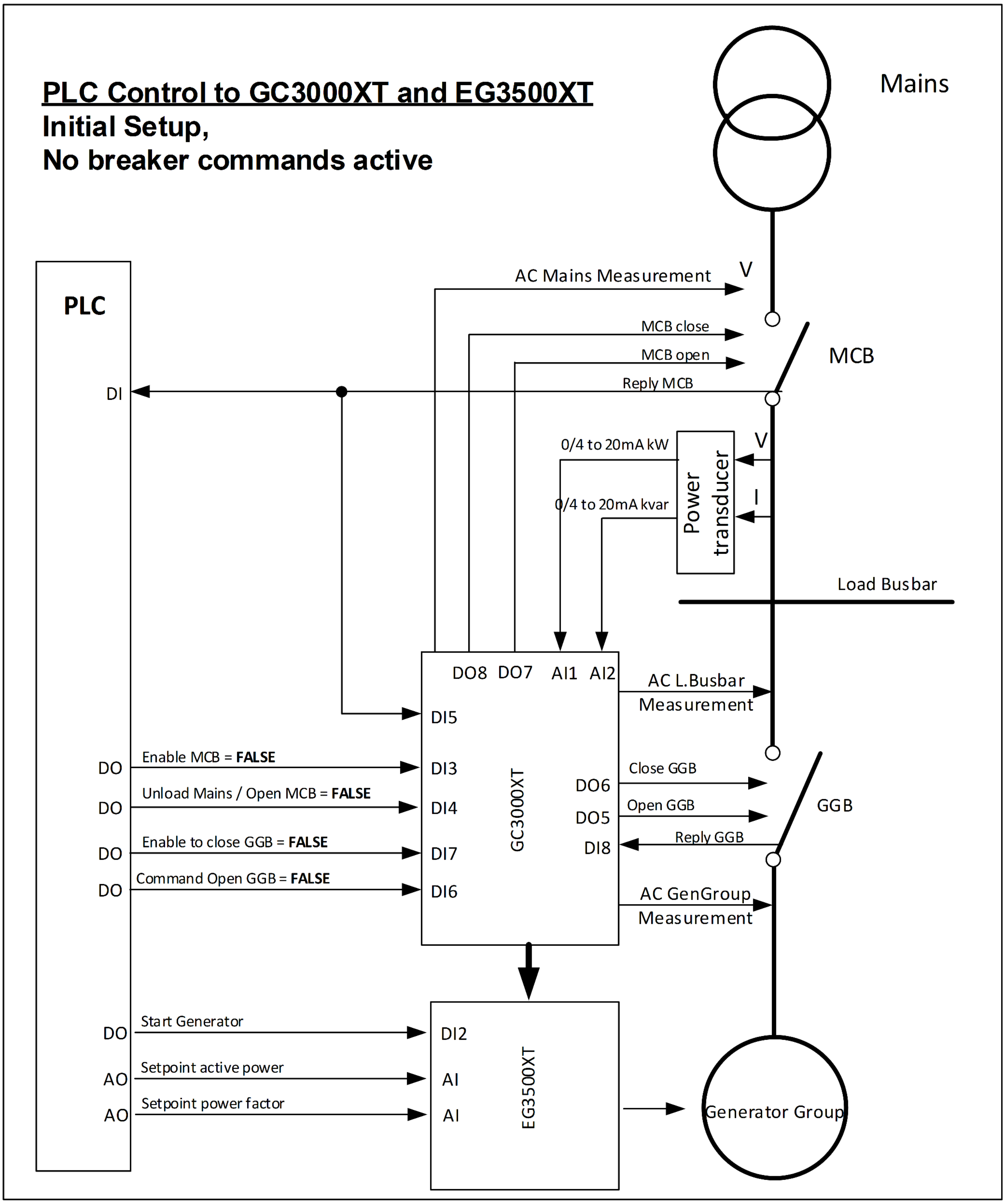


Fig. 55: Initial Setup controlling breaker via the GC3000XT in conjunction with a PLC

As long no breaker commands from the PLC are active the GC behaves passive. The breaker feedbacks are accepted and will be passed to the easYgen group in following manner:

With closed GGB and MCB the GC passes the information "Mains linked" to the easYgens. As long nothing special is configured, the easYgen executing an active and reactive power control after closing their MCB.

(The easYgen shows on display, if the mains linkage is detected.

The command "Open GGB" usually coming from the PLC is always directly accepted and will be transformed into a GGB open command.

6.1.2 Mains Operation - GGB shall be synchronized

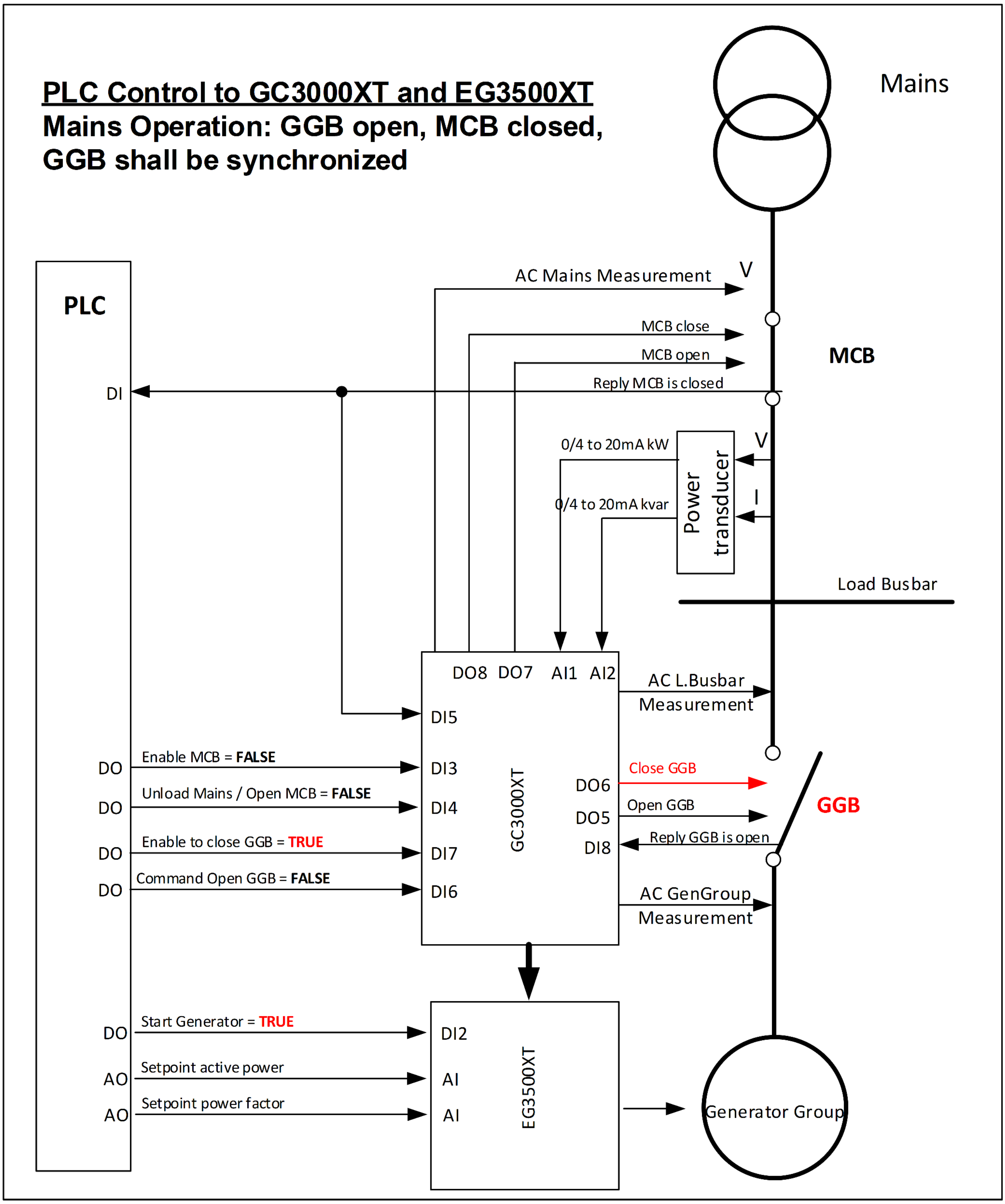


Fig. 56: Synchronization of the GGB initiated by PLC.

In Mains Operation (MCB is closed), when the GGB shall be synchronized, the GC leads its generator group to match the synchronization of the GGB. If all configured conditions are matched, the GC issues a GGB close pulse.

A synchronization can only be maintained, if at least one GCB of the own group is closed. With closed GGB the easYgen(s) switches to active and reactive power control.

6.1.3 Island Operation - GGB shall be synchronized

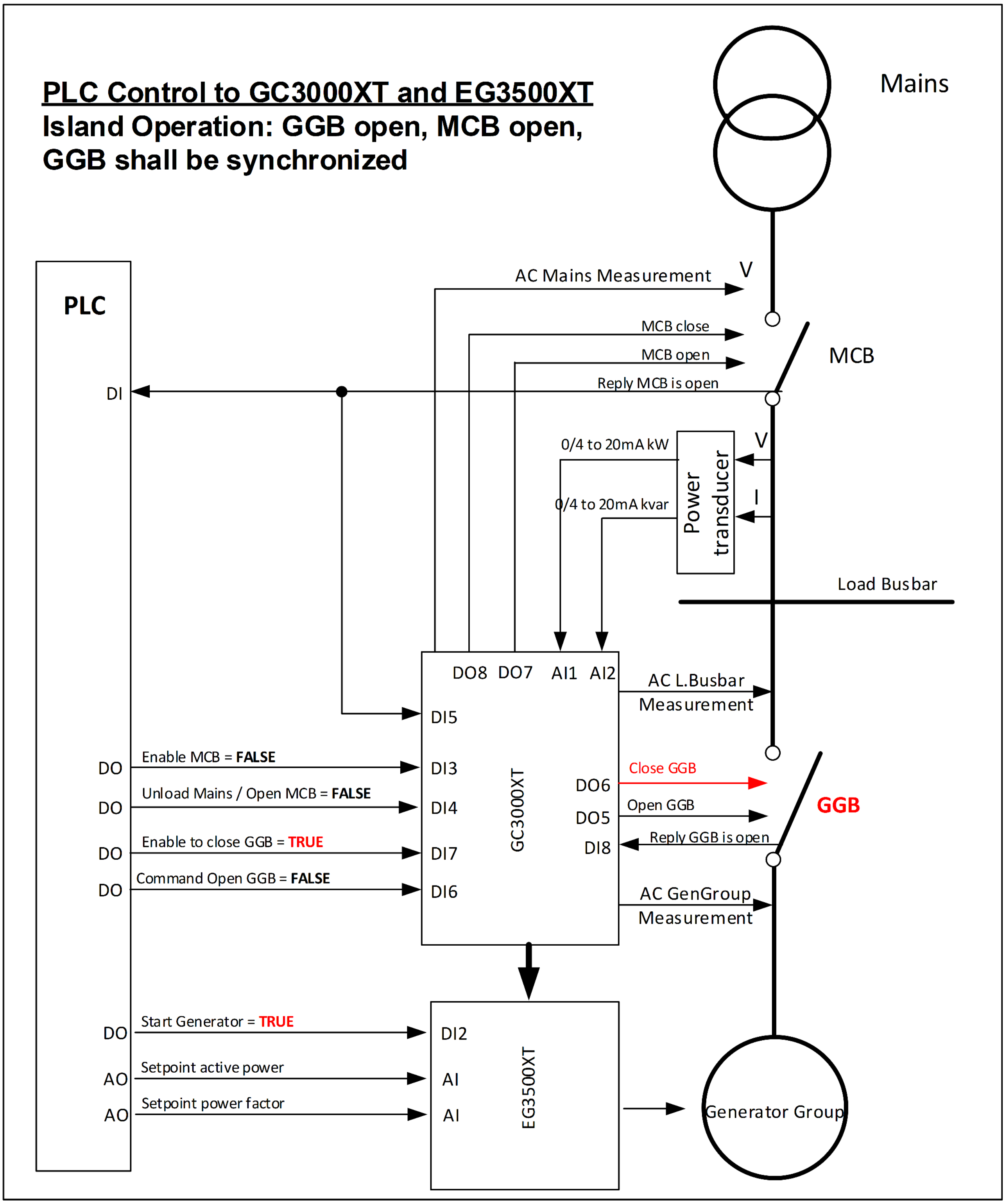


Fig. 57: Synchronization of the GGB initiated by PLC.

In island operation (MCB is open), when the GGB shall be synchronized, the GC leads its generator group to match the synchronization of the GGB. If all configured conditions are matched, the GC issues a GGB close pulse.

A synchronization can only be maintained, if at least one GCB of the own group is closed. With closed GGB the easYgen(s) remain on frequency and voltage control.

6.1.4 Island Operation - MCB shall be synchronized

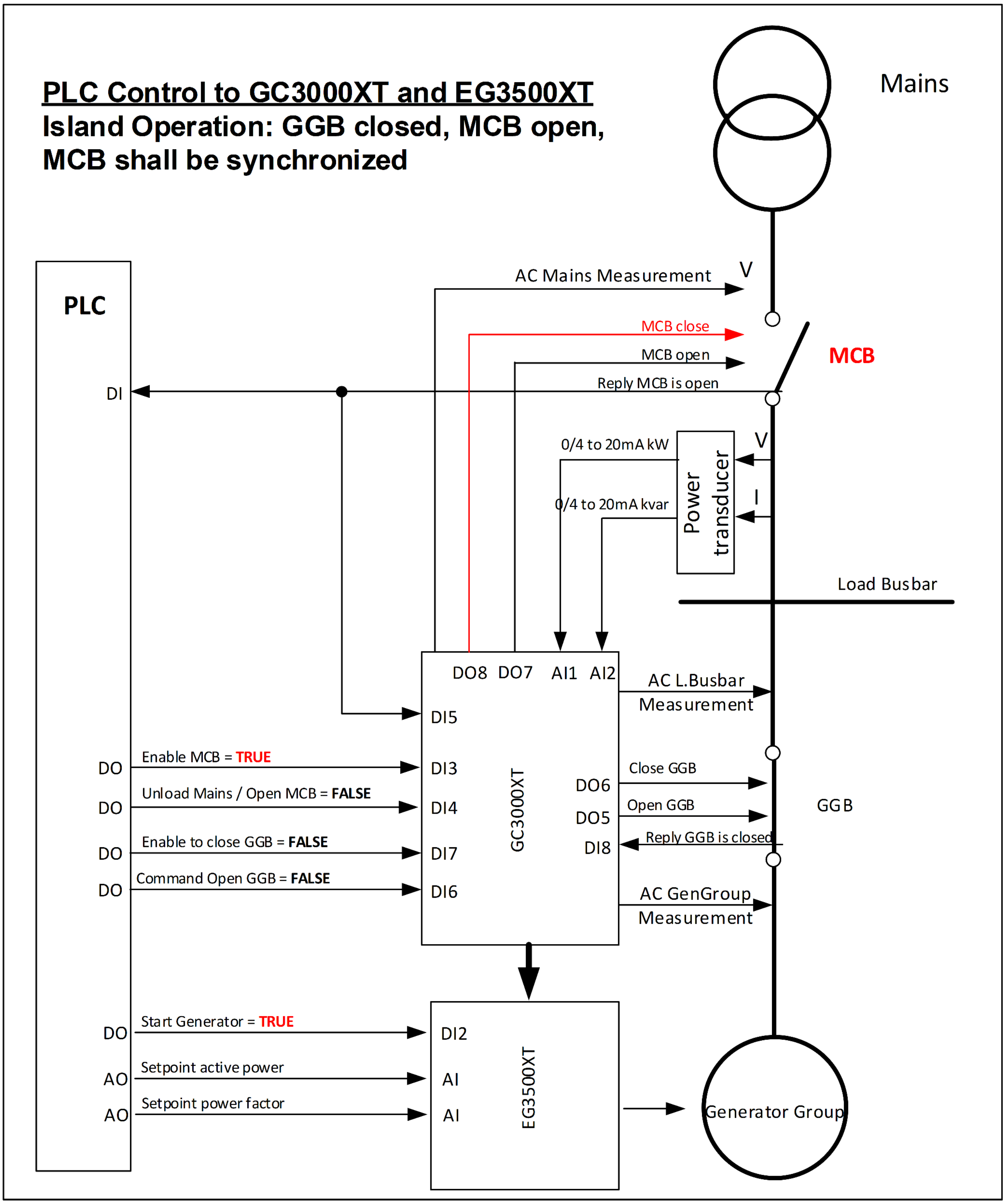


Fig. 58: Synchronization of the MCB initiated by PLC.

In island operation (MCB is open), the own GGB is closed, the GC(s) lead their generator groups to match the synchronization of the GGB. If all configured conditions are matched, the GC issues a MCB close pulse.

A synchronization can only be maintained, if at least one GCB of the own group is closed. With closed MCB the easYgen(s) switches from frequency and voltage control to active and reactive power control.

Note: If segments between GCs are placed refer additionally to chapter "Multiple GC handling with PLC".

6.1.5 Mains Operation - Unload Mains / MCB shall be opened

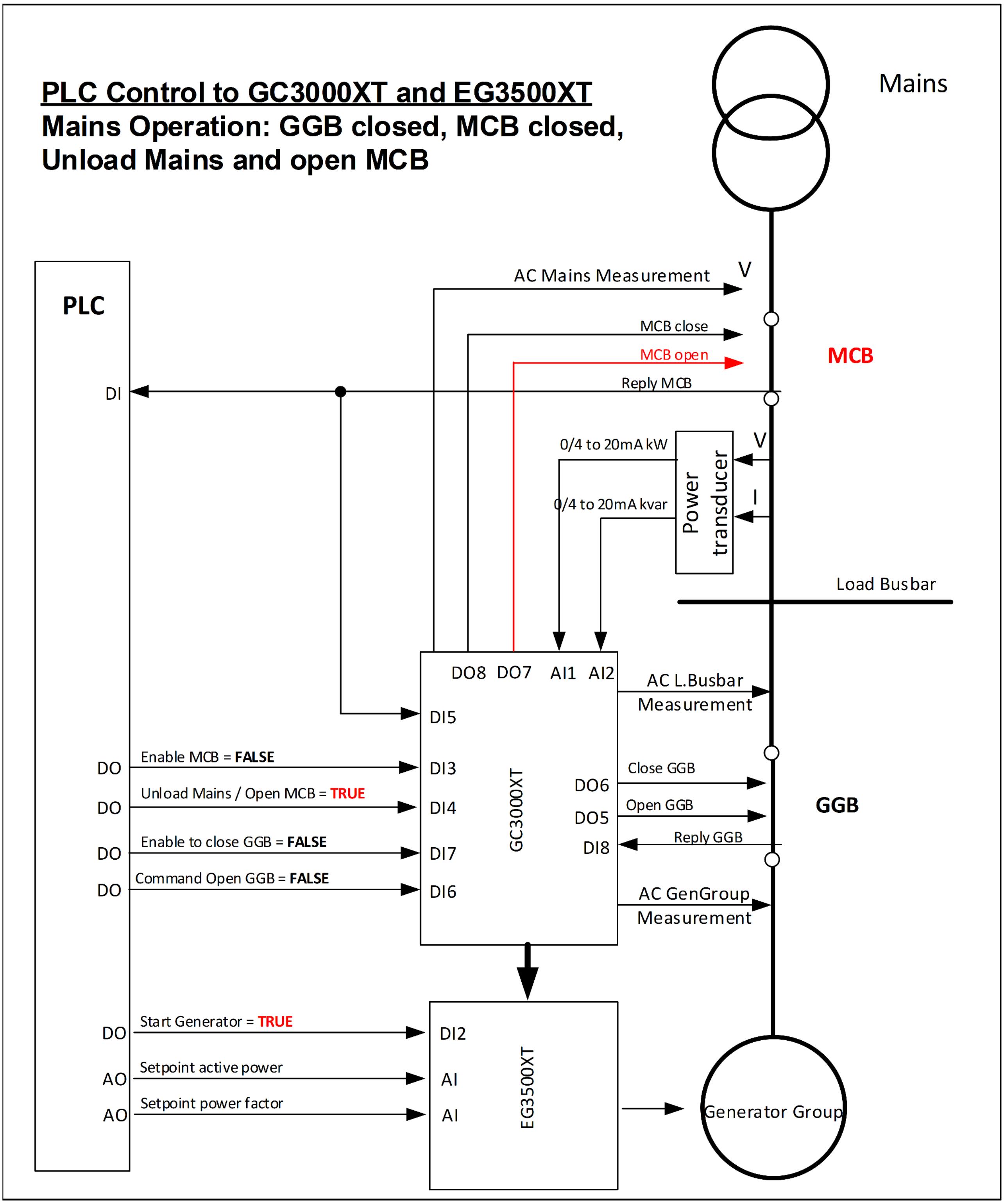


Fig. 59: Synchronization of the MCB initiated by PLC.

There is a situation in which generator shall overtake the load from the mains. This can be done by:

1. Starting the needed amount of generators to support the island load

2. With the correct amount of generators on load busbar the PLC enables the function "Unload Mains / Open MCB" through the DI 4 on the GC.

Then the easYgens with closed GCB executing an Import/Export power control with setpoint 0kW and 0kvar at the interchange point. If the power reaches the power window, the GC(s) issue an open MCB pulse. With open MCB the easYgen(s) continue with frequency and voltage control doing island operation.

6.2 Phase Angle Compensation (Vector Group Adjustment)

Introduction

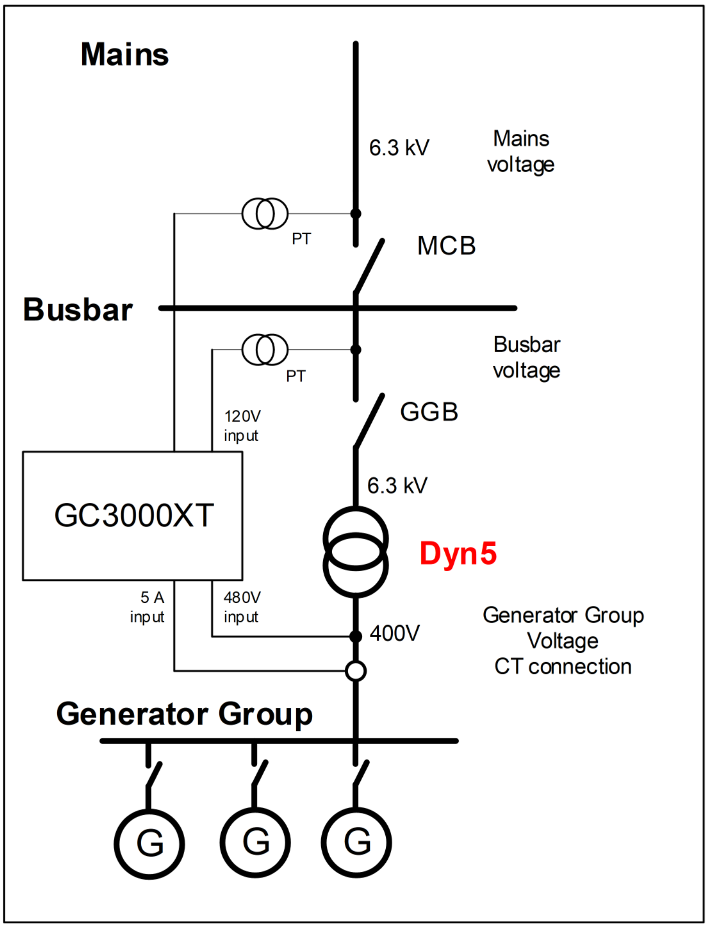
With a special parameter the customer shall get the possibility to adapt the GC3400XT phase angle measurement system according to the transformer type. This shall be provided for the phase angle generator group voltage to the Load Busbar and the phase angle Load Busbar to Mains.

The unit provides a tunable for a phase angle deviation in a range of +/- 180.0°

This parameter compensates phase angle deviations, which can be caused by power transformers (i.e. a delta to wye transformer) located within the electrical system.

Note: Incorrect wiring of the system cannot be compensated for with this parameter!

6.2.1 Generator Group Voltage to Load Busbar voltage



Example 1

The generator group voltage is connected to the low voltage side of a transformer with the vector group *Dyn5*. The GC3000XT load busbar voltage is connected to the high voltage side.

Because of the transformer the phase angles between Generator group voltage and busbar differs due closed GGB. The synchronization function of the GC can compensate this by a configurable phase angle deviation.

Using the vector group 5 (Dyn**5**) it counts α = 5 ×30 ° = 150 °.

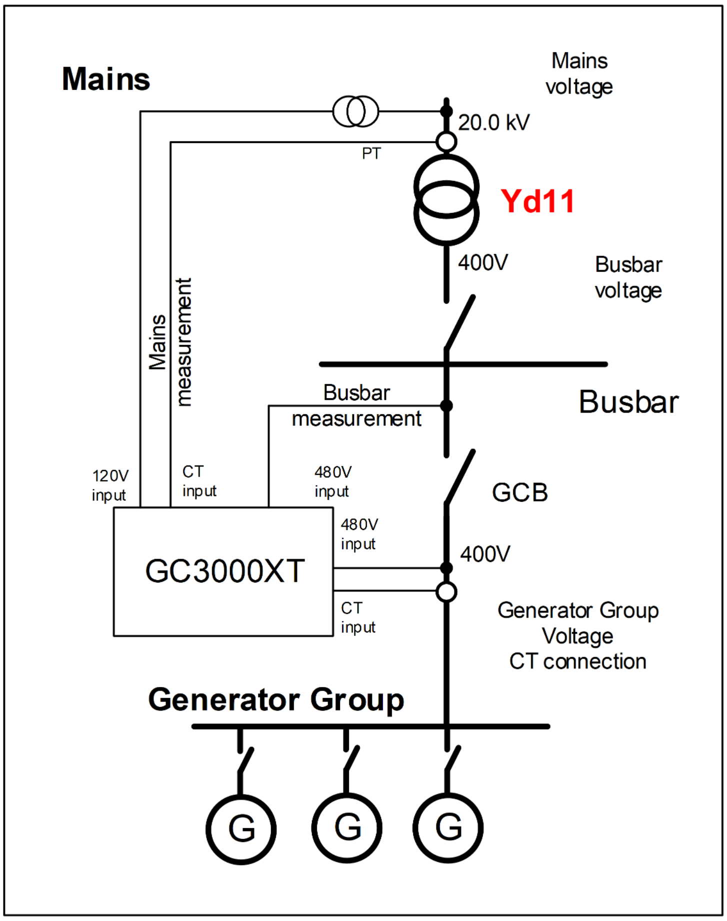
Because 150° < 180 ° and GC load busbar measurement is connected to the high voltage side this results into α to be used as phase difference. Enter **150 °** into as parameter for the phase difference Gen/Busbar.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
8825	Phase angle compensation GGB	2		The phase angle between generator voltage and generator busbar voltage can be compensated according to an installed power transformer between generator and busbar.
			On	The compensation is active. The phase will be compensated according the value configured in parameter 8824 ↳ p. 143.

ID	Parameter	CL	Setting range [Default]	Description
				Notes Measured values 181 'Ph.ang.busb1-gen.L12' and 184 'Ph.ang.mns.busb1 L12' are not changed but the compensated (8824 ⇘ p. 143) values are taken for synchronization control and synchroscope display.
			[Off]	The compensation is inactive. The phase angle is directly taken from the measurement.
				Notes WARNING: Ensure the following parameters are configured correctly to prevent erroneous synchronization settings. Incorrect wiring of the system cannot be compensated for with this parameter! Please check during initial commissioning the phase angle and the synchronization with a zero voltmeter. **Recommendation:** For safety reasons, please mark the easYgen with a label showing the configured phase angle compensation. Refer to ⇘ *Chapter 6.2 "Phase Angle Compensation (Vector Group Adjustment)" on page 141* for details.
8824	Phase angle GGB	2	-180 to 180° [0°]	The phase angle compensation corrects the degree between generator voltage and busbar voltage. The configured degree is added to the real measured phase angle. Visible only, if parameter 8825 ⇘ p. 142 is "On".
				Notes Ensure correct configuration to prevent erroneous synchronization settings to avoid **generator destructive power**. Incorrect wiring cannot be compensated for with this parameter!

6.2.2 Load Busbar voltage to Mains voltage



Example 2

Using the vector group 11 (Yd**11**) it counts α = 11 ×30 ° = 330 °. Because 330 ° > 180 ° and Group Controller Mains measurement is connected to the high voltage side this results into (-360 ° + α) to be used as phase difference. Enter **-30 °** into as parameter for the phase difference Mains/Busbar.

Configuration

ID	Parameter	CL	Setting range [Default]	Description
8841	**Phase angle compensation MCB**	2		The phase angle between load busbar voltage and mains voltage can be compensated according to an installed power transformer between load busbar and mains.
			On	The compensation is active. The phase will be compensated according the value configured in parameter .
				Notes Measured values 181 'Ph.ang.busb1-gen.L12' and 184 'Ph.ang.mns.busb1 L12' are not changed but the compensated (8842 ➪ p. 144) values are taken for synchronization control and synchro-scope display.
			[Off]	The compensation is inactive. The phase angle is directly taken from the measurement.
				Notes WARNING: Ensure the following parameters are configured correctly to prevent erroneous synchronization settings. Incorrect wiring of the system cannot be compensated for with this parameter! Please check during initial commissioning the phase angle and the synchronization with a zero volt-meter. **Recommendation:** For safety reasons, please mark the easYgen with a label showing the configured phase angle compensation. Refer to ➪ *Chapter 6.2 "Phase Angle Compensation (Vector Group Adjustment)" on page 141* for details.
8842	Phase angle MCB	2	-180 to 180° [0°]	The phase angle compensation corrects the degree between busbar voltage and mains voltage. The configured degree is added to the real measured phase angle.
				Notes This parameter **only** applies to application mode and . Ensure correct configu-ration to prevent erroneous synchronization settings to avoid generator **destructive power**. Incorrect wiring cannot be compensated for with this parameter!

Documentation

(Specific warning notifications in the documentation are required !!)

WARNING!

Ensure the following parameters are configured correctly to prevent erroneous synchronization set-tings. Incorrect wiring of the system cannot be compensated for with this parameter.

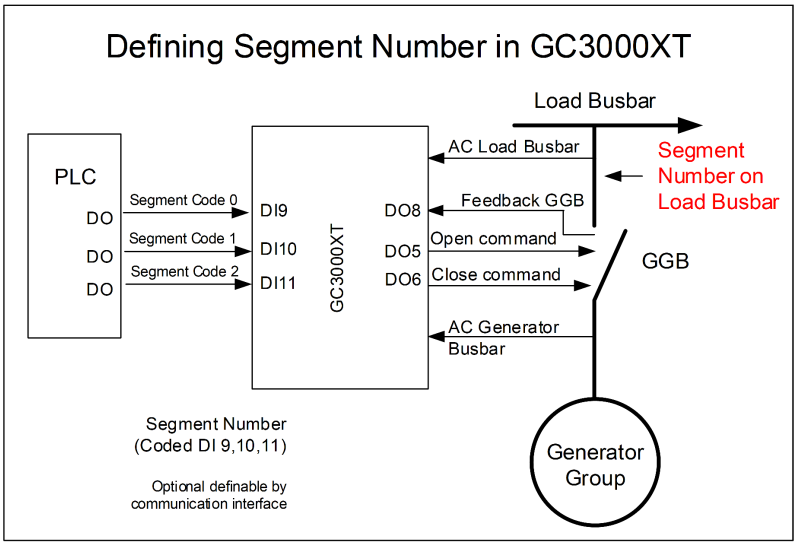
6.3 Segment Control

Introduction

segment is defined as a section of the bus, feeder, or interconnec-tion, which cannot electrically be isolated to a smaller section and is connected to a circuit breaker or an isolation switch which is operated or supervised by a GC3000XT. A transformer is not to be considered as a segment or a point of isolation. Each segment, feeder, or interconnection must be assigned with a number that is unique to that segment.

Segment Number

Each Group Controller needs the information with which other Group Controllers he is connected if he closes its Group Breaker. This is defined with a segment number information coming from outside. In simple cases it can be created with a tie-breaker feed-back or in more complex application it is determined by a PLC.



The Segment number handling defines the Load Busbar Segment.

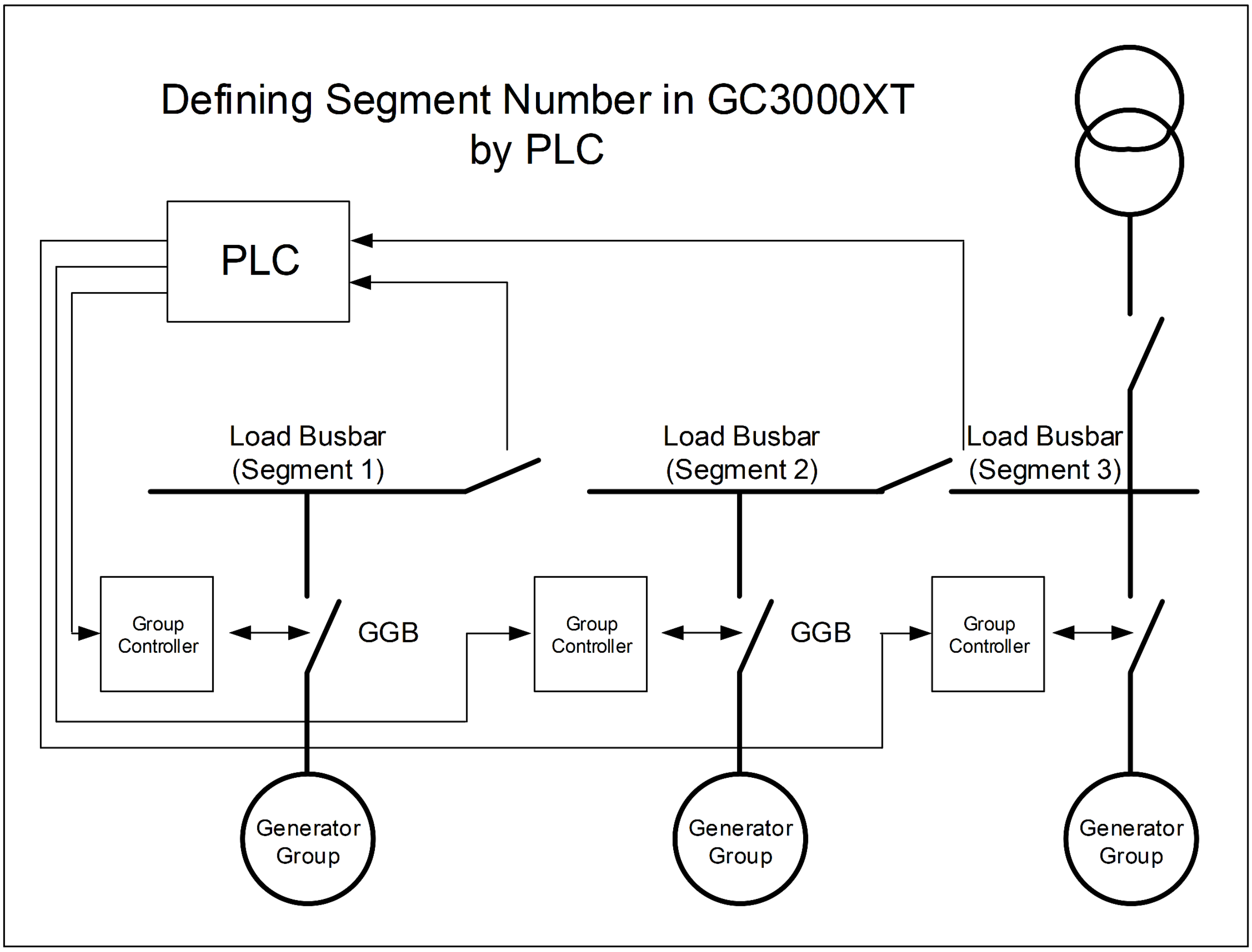
The generator group segment is not splitable into different segments and is therefore always indicated as segment no. 1.

The devices provides a configuration to determine the source of the segment number definition:

- DI
- Parameter
- Communication Interface (Fallback is parameter)

Logic table for segment number:

DI 11	DI 10	DI 9	Segment Number
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8



Example: The segment number for each Group Controller (Generator Group) is defined by PLC.

ID	Parameter	CL	Setting range [Default]	Description
1723	**Segment number**	2	0 to 8 [1]	This is the dedicated segment number for the GC3000XT. It is also the initial segment number after reboot the device.
1724	**Source segment number**			The parameter determines from which source the segment number information comes from.
			Internal	The segment number is defined by parameter ID1723.
			[External]	The segment number is defined by Digital Inputs 9,10,11 (refer to logic table segment number).

6.4 Enable LDSS function in the GC-easYgen System

There is no LDSS required:

1. Configure in the GC: ID5776 LDSS “Off”
2. Configure in the easYgenXT: ID12930 LDSS LogicsManager “FALSE”

The LDSS function is required:

1. Configure in the GC: ID5776 LDSS “On”
2. Configure all LDSS parameter in the GC

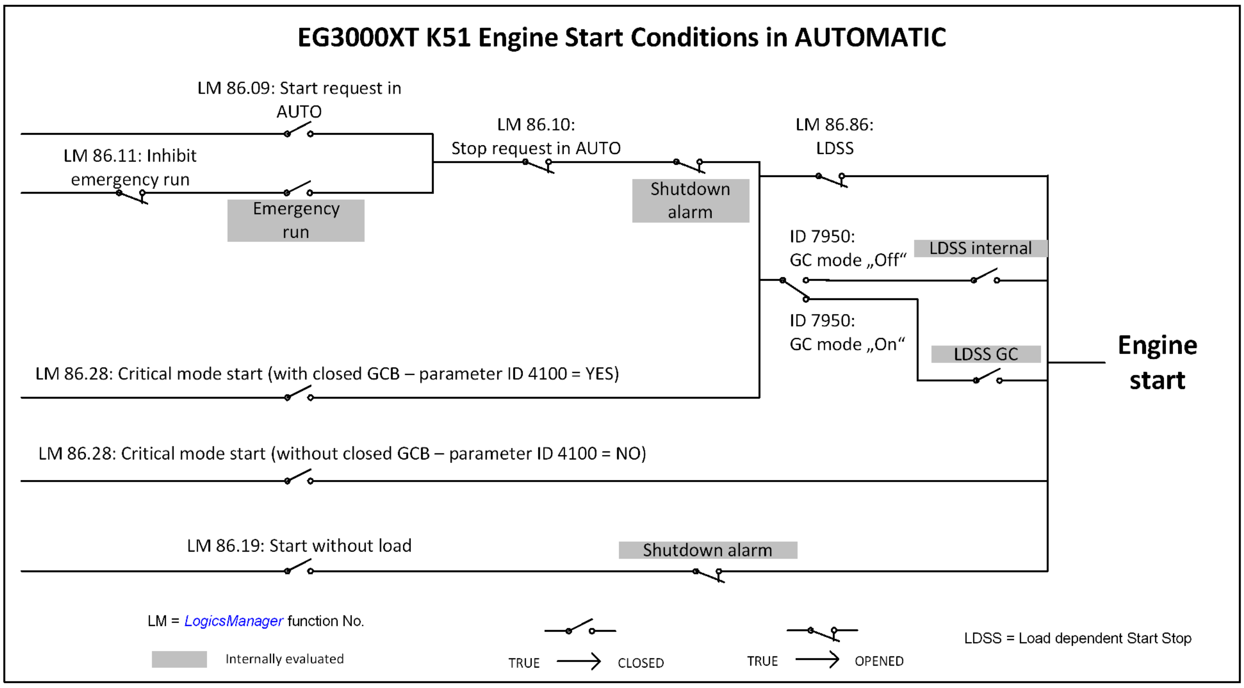
Configure in the easYgenXT:

1. ID7950 GC mode “On”
2. ID12930 LDSS LogicsManager “TRUE”
3. ID5751 Base Priority (12926, 12925, 12924)
4. ID5759 Minimum Running Time
5. ID5805 LDSS transition time

The LDSS function is realized in a PLC:

1. Configuration in the GC: ID5776 LDSS “Off”
2. Configuration in the easYgenXT: ID12930 LDSS LogicsManager “FALSE”

The single start stop commands are sent by interface or by DIs directly on the easYgenXT .



7 Interfaces and Protocols

7.1 Communication Network

7.1.1 Overview

The interface ports

- Interface USB slave (Service port)
- Interface CAN #1 (CANopen load share bus)
- Interface Ethernet A (UDP load share bus, Servlink TCP ToolKit)
- Interface Ethernet B (UDP GC3000XT load share bus, Modbus TCP, Servlink TCP ToolKit)
- Interface Ethernet C (UDP GC3000XT load share bus, Modbus TCP, Servlink TCP ToolKit)

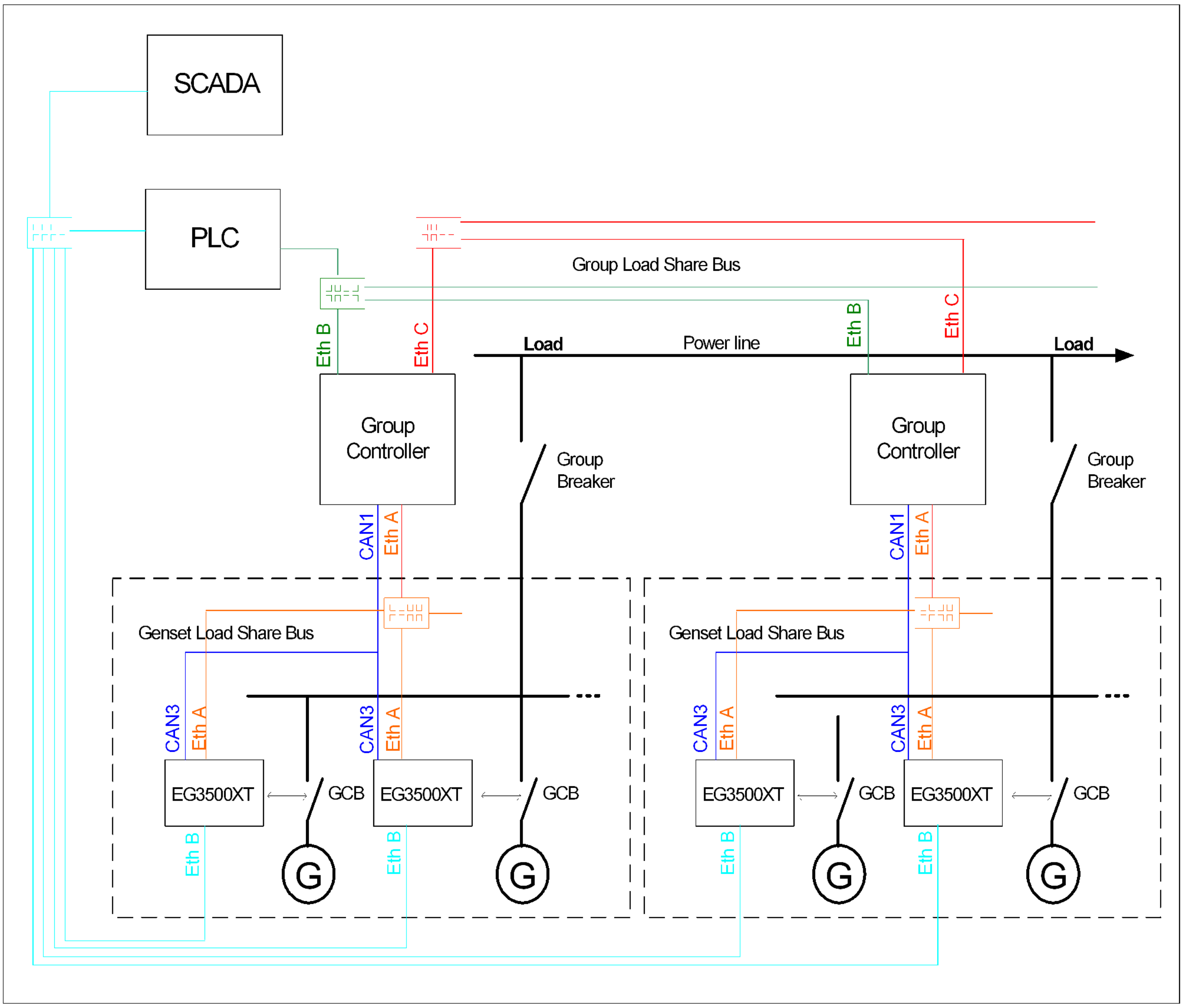


Fig. 60: Example of a GC3000XT system including load share line redundancy

7.1.2 Data Protocols

GC3000XT	CAN1	ETH A	ETH B	ETH C
CANopen protocols	x	-	-	-
Modbus Slave	-	TCP	TCP	TCP
Genset Load share	x	x	x	x

Group Controller Load share			x	x
Servlink - ToolKit	-	x	x	x

7.1.3 Data Telegram

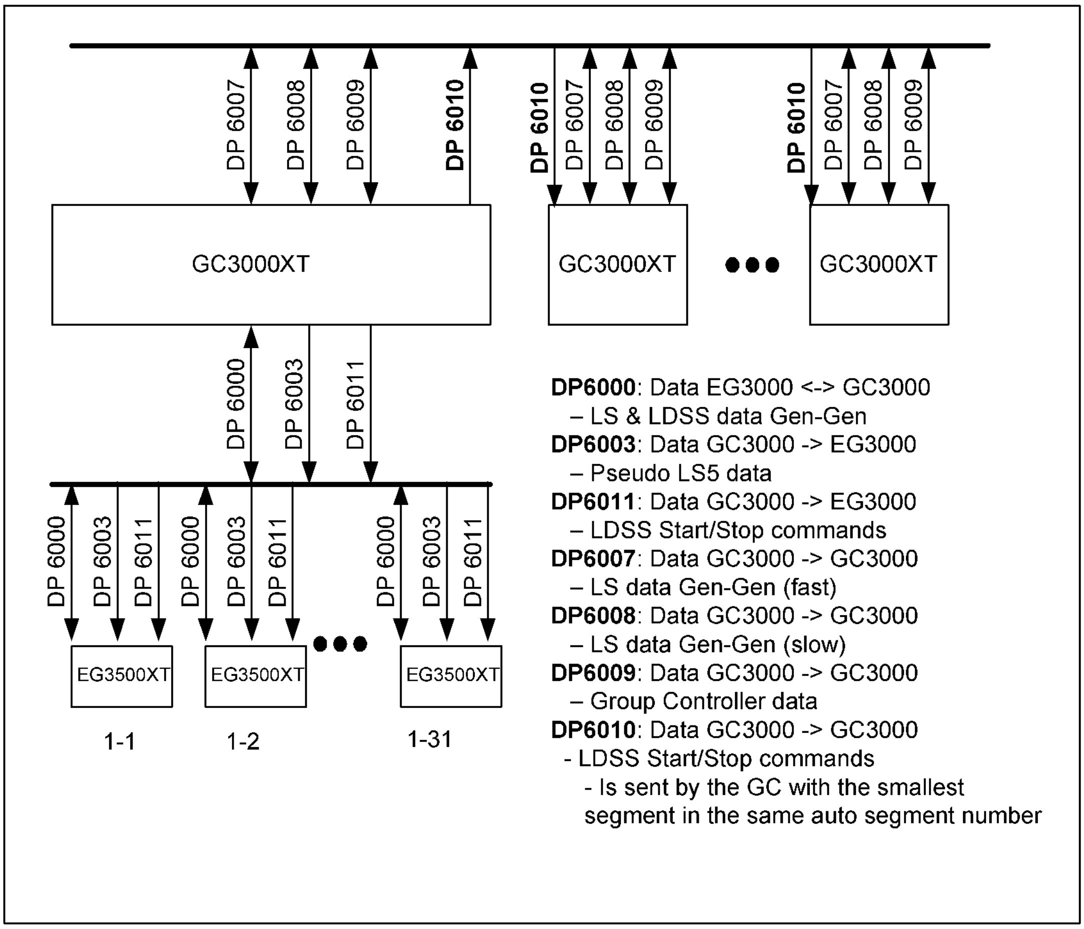


Fig. 61: Data Telegram

7.1.4 The Modbus Visualization Protocol 5022

GC3000XT Visualization Data

The GC3000XT provides data for control and visualization purposes. Therefor the protocol 5022 is introduced to provide all relevant data. These data are:

- AC measurement
- DI condition
- DO condition
- Current operating task
- Warning alarms
- Critical alarms
- Communication Diagnostic
- LDSS Start/Stop matrix
- .....

(Refer to excel file protocol 5022 for more information, located on the product CD in the Product Manuals directory.)

7.1.5 Ethernet General

Configuration Ethernet IP Addresses

The Ethernet IP-Addresses are configured by Toolkit in a 2-pass way:

1. Enter the IP-Address
2. Transfer the IP-Address into non-volatile memory with according "Set IP address"

The Ethernet IP-Addresses are not changed by:

- Wset- file loading
- Performer Factor default setting
- A software update

General notes

The Ethernet network provides a fast communication capability to different devices, like remote panel, PLC or SCADA systems. The common protocol Modbus TCP is there for the preferred communication protocol. Additionally the Ethernet connection supports the Woodward protocol Servlink for ToolKit and other Woodward own monitoring tools (like remote panel and SCADA visualization tool). At least the easYgen provides a UDP protocol for system relevant and time discrete information exchange.

Do not connect the Group Controller with the internet as long the security aspects are not considered. Consider an IP responsible person to discuss proper security procedures like placing routers and fire walls.

If the Group Controller (or -system) shall be connected to an already existing Ethernet network, a network responsible person must arrange and allocate the IP Addresses. He takes care about IP-Address, the subnet mask, and when needed the gateway IP Address.

ID	Parameter	CL	Setting range [Default]	Description
7485	Modbus/TCP Slave ID	2	[1] 1 to 255	Your local Modbus device address, which is used to identify the device via Modbus/TCP (Ethernet), must be entered here.
9129	Password protection	5	Off	Password protection for Ethernet is **not active.** **Notes** Take care for a protected access!
			[On]	Password protection for Ethernet is active.

7.1.5.1 Ethernet Network A

The actual IP address, subnet mask, gateway IP address (all hex values) can be viewed in ToolKit under Status Menu / Diagnostic / Interfaces / Ethernet / Ethernet A.

IP address

Each port within the Ethernet network must have its own network address. As long the Ethernet network is only used by the GC3000-XT system, the address range is free configurable. For better troubleshooting use the default Ethernet address range and configure the single IP addresses according to their device numbers.

Device part: Restrictions

The "device part" is the logical result of “IP Address” AND NOT “Network Mask”. The bits (dual system $0_2/1_2$) of the device part must be different from being all the same - neither all zero 0_2 nor all 1_2 (broadcast).

Please select your IP address accordingly.

HEX values

The addresses and subnet masks are known as hex values but are displayed in ToolKit as decimal values.

ID	Parameter	CL	Setting range [Default]	Description
5330 5331 5332 5333	IP address	2	[10, 31, 140, 0]	Field 1,2,3,4 for IP address Ethernet port A. This setting will be not valid automatically. The *“Set IP address”* parameter must be set to *[ON]* for enabling. **Notes** Device part bits are not allowed to be either **all** *00...*$_2$ or **all** *11...*$_2$ (broadcast).
7412	Set IP address	2	Off	Set IP-Address Ethernet port A.
5334 5335 5336 5337	Subnet mask	2	[255, 255, 240, 0]	Set byte 1,2,3,4 of the subnet mask Ethernet port A. This setting will be not valid automatically. The *“Set subnet mask”* parameter must be set to *[ON]* for enabling.
7413	Set subnet mask	2	Off	Set subnet mask Ethernet port A.
5338 5339 5340 5341	Gateway IP	2	[0, 0, 0, 0]	Field 1,2,3,4 for gateway IP-Address for Ethernet port A. This setting will be not valid automatically. The *“Set IP address”* parameter must be set to *[ON]* for enabling. If 0.0.0.0 is set, the gateway's functionality is switched off.
5342	Set Gateway IP address	2	Off	Set Gateway IP Address for Ethernet port A

7.1.5.2 Ethernet Network B

The actual IP address and subnet mask (all hex values) can be viewed in ToolKit under Status Menu / Diagnostic / Interfaces / Ethernet / Ethernet B.

IP address

Each port within the Ethernet network must have its own network address. As long the Ethernet network is only used by the GC3000-XT system, the address range is free configurable. For better troubleshooting use the default Ethernet address range and configure the single IP addresses according to their device numbers.

Device part: Restrictions

The "device part" is the logical result of "IP Address" AND NOT "Network Mask". The bits (dual system $0_2/1_2$) of the device part must be different from being all the same - neither all zero 0_2 nor all 1_2 (broadcast).

Please select your IP address accordingly.

HEX values

The addresses and subnet masks are known as hex values but are displayed in ToolKit as decimal values.

ID	Parameter	CL	Setting range [Default]	Description
5430 5431 5432 5433	IP address	2	[10, 31, 140, 0]	Field 1,2,3,4 for IP address Ethernet port B. This setting will be not valid automatically. The *"Set IP address"* parameter must be set to *[ON]* for enabling. **Notes** Device part bits are not allowed to be either **all** *00...*$_2$ or **all** *11...*$_2$ (broadcast).
7414	Set IP address	2	Off	Set IP-Address Ethernet port B.
5434 5435 5436 5437	Subnet mask	2	[255, 255, 240, 0]	Set byte 1,2,3,4 of the subnet mask Ethernet port B. This setting will be not valid automatically. The *"Set subnet mask"* parameter must be set to *[ON]* for enabling.
7415	Set subnet mask	2	Off	Set subnet mask Ethernet port B.

7.1.5.3 Ethernet Network C

The actual IP address and subnet mask (all hex values) can be viewed in ToolKit under Status Menu / Diagnostic / Interfaces / Ethernet / Ethernet C.

IP address

Each port within the Ethernet network must have its own network address. As long the Ethernet network is only used by the GC3000-XT system, the address range is free configurable. For better troubleshooting use the default Ethernet address range and configure the single IP addresses according to their device numbers.

Device part: Restrictions

The "device part" is the logical result of "IP Address" AND NOT "Network Mask". The bits (dual system $0_2/1_2$) of the device part must be different from being all the same - neither all zero 0_2 nor all 1_2 (broadcast).

Please select your IP address accordingly.

HEX values

The addresses and subnet masks are known as hex values but are displayed in ToolKit as decimal values.

ID	Parameter	CL	Setting range [Default]	Description
7418 7419 7420 7421	IP address	2	[10, 31, 140, 0]	Field 1,2,3,4 for IP address Ethernet port C. This setting will be not valid automatically. The *"Set IP address"* parameter must be set to *[ON]* for enabling. **Notes** Device part bits are not allowed to be either **all** $00..._2$ or **all** $11..._2$ (broadcast).
7416	Set IP address	2	Off	Set IP-Address Ethernet port C.
7422 7423 7424 7425	Subnet mask	2	[255, 255, 240, 0]	Set byte 1,2,3,4 of the subnet mask Ethernet port C. This setting will be not valid automatically. The *"Set subnet mask"* parameter must be set to *[ON]* for enabling.
7417	Set subnet mask	2	Off	Set subnet mask Ethernet port C.

7.1.5.4 Overview

Introduction

The GC3000XT device supports the communication management system with all easYgens and neighbor GCs. This can be executed with Toolkit connected on the GC or with easYgenXT HMIs. This is mainly interesting for the commissioner.

Due the lack of an HMI on the group controller, the operator can go to the easYgen (K51) HMI for checking the communication system or the group-to-group controller communication. Therefore the easYgen will provide in addition to its original easYgen diagnostic screens a group controller diagnostic screen.

Refer to easYgen3500XT-P2 K51 option manual for more information.

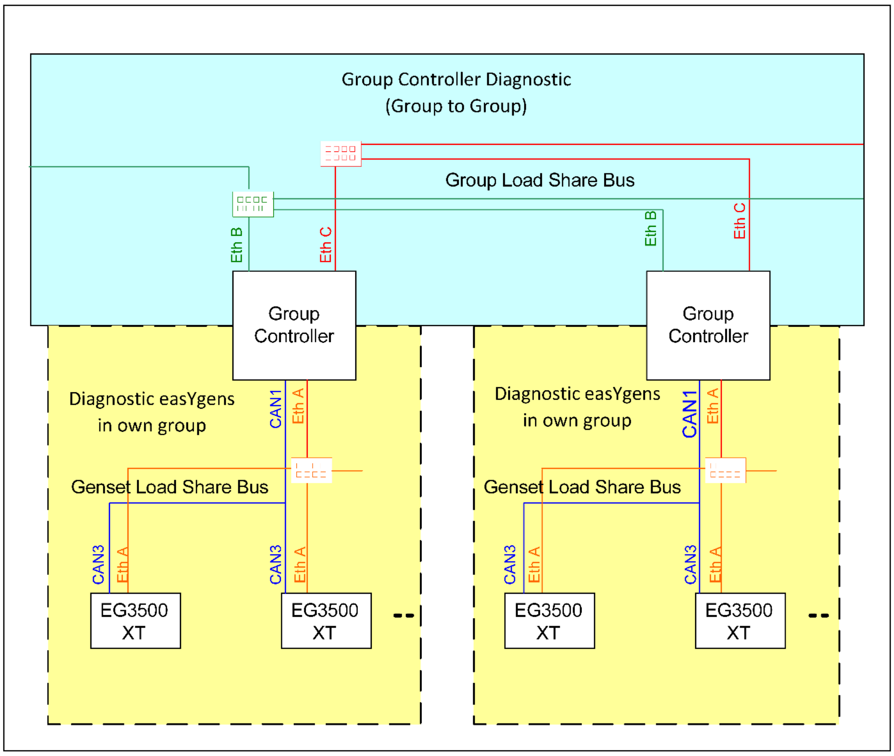


Fig. 62: The different communication levels

The toolkit of GC3000XT indicates in a special diagnostic screen its group controller overview.

The GC3000XT monitors the system communication network. It runs an own communication diagnostic on the group controller level and passes its diagnostic information to the easYgens in the own group.

The monitoring of the system communication network is easily adaptable to the intended system by a "System Update" procedure. The system update order is devided into two parts:

1. The system update between the easYgen and its GC (Diagnostic easYgens). It accords to the usual easYgen system update order. This teach-in order is only valid for the update within the group and does not care about the group to group level outside.
2. The group controller update (Diagnostic Group Controllers). This teach-in order handles the group to group communication.

The procedure of teaching a communication configuration works as follows:

The operator checks individually all groups on proper communication and executes accordingly the system update button to teach-in the single systems. The number of monitored members are displayed on either the easYgen or the GC3000XT controller of that group. Then, if no alarm exist anymore, he changes to the group to group level diagnostic screen and checks the recognized groups with its condition. If this matches his expectations he can push the "Group controller" update button.

7.1.5.4.1 Function

GC3000XT

Introduction

The GC3000XT runs a group to group controller network diagnostic and an easYgen network diagnostic. Each diagnostic is visualized by an own diagnostic screen. The screens shall give the operator all information he needs to do the teach-in for the communication network topology. Out of this teach-in procedure (system update and group controller update) all devices are monitoring themselfs and giving out an alarm, if someone is lost or overdetermined.

Diagnostic easYgens in own group

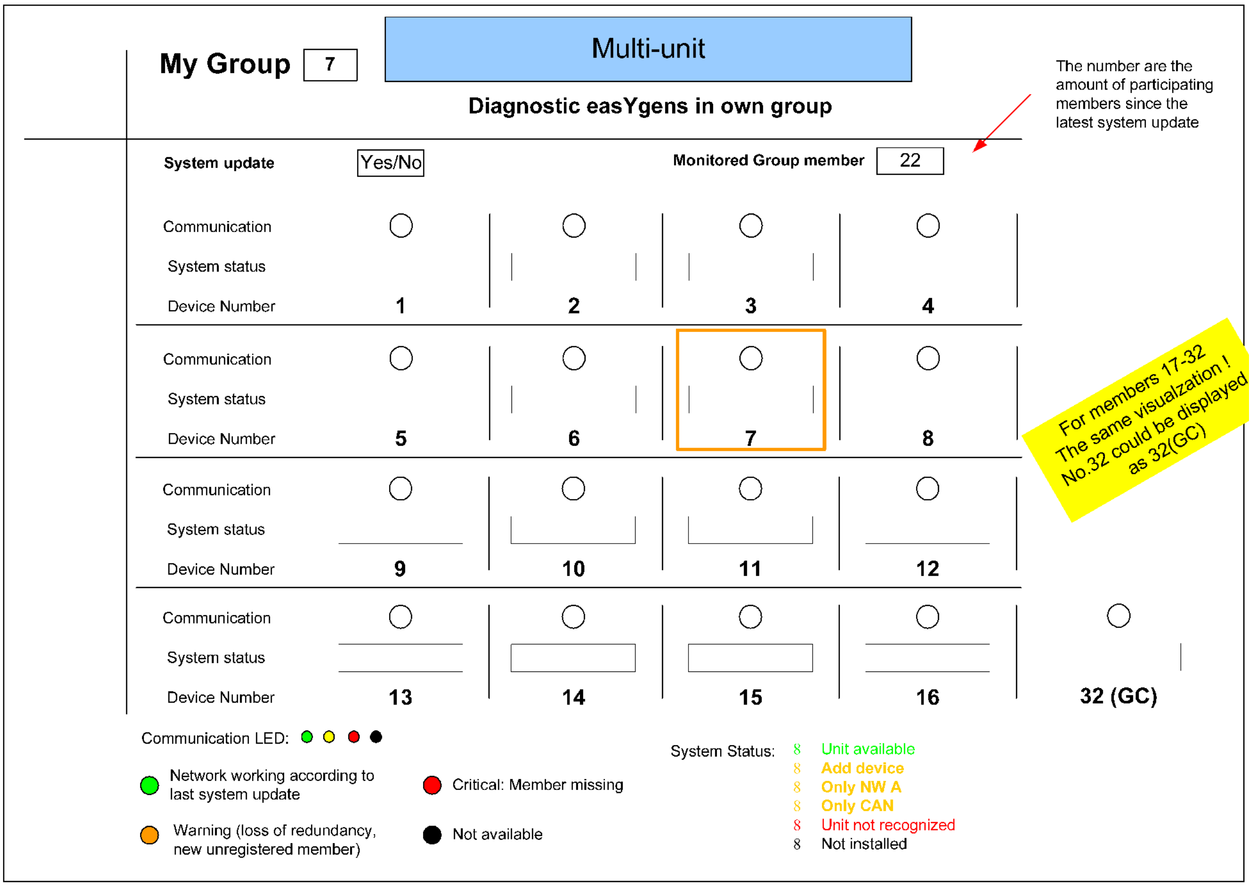


Fig. 63: Example: Diagnostic screen for easYgens and their group controller

The „System update“ is a system update especially for the easYgen group. It has no impact on other easYgen groups or the group-to-group instance.

Group Controller Diagnostic (Group to Group)

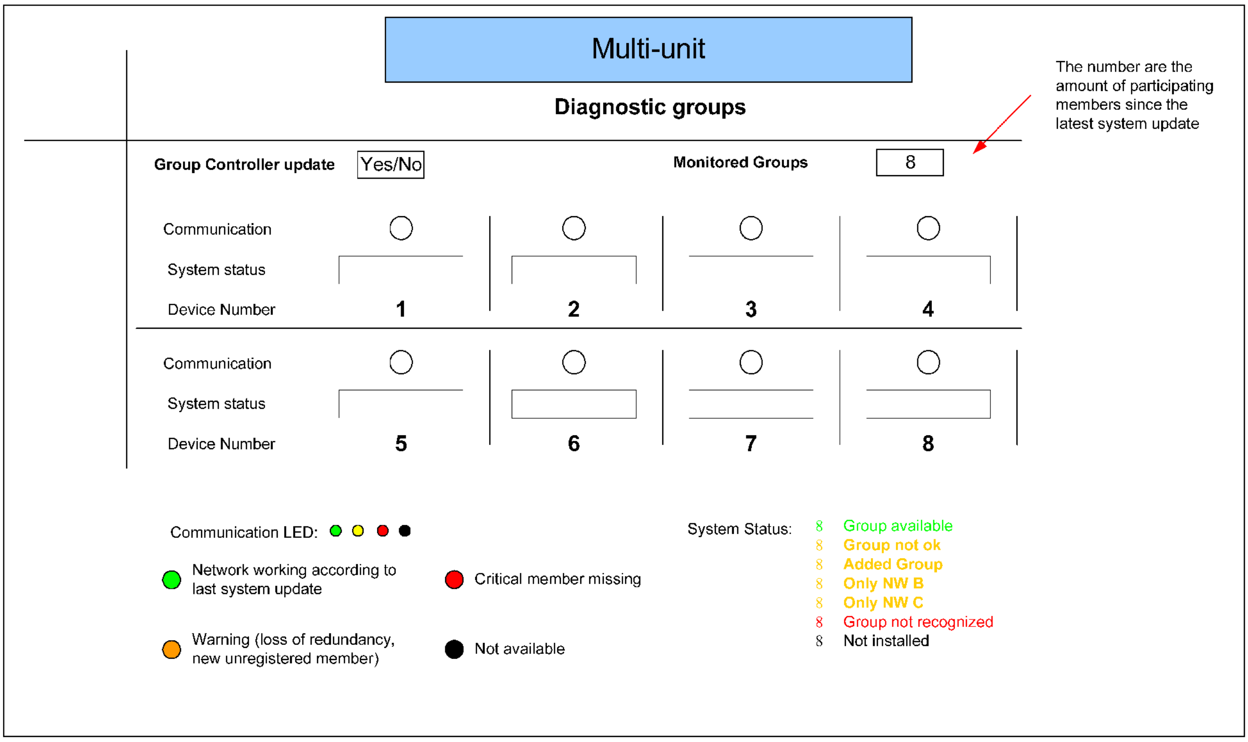
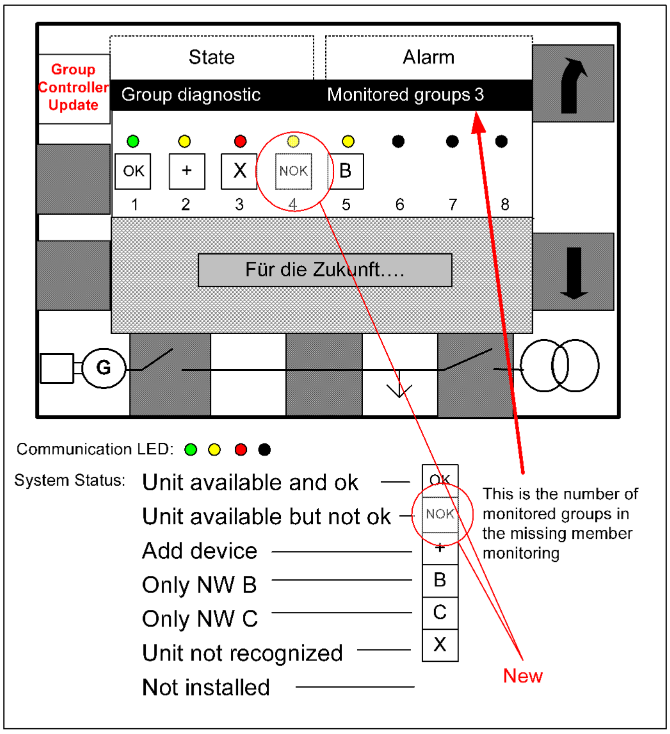


Fig. 64: Example: Diagnostic screen for group communication

EG3500XT

The EG3500XT provides an additional diagnostic screen to indicate the group controller network. This diagnostic screen is not only showing the availability of group controllers. It also shows the condition within the single groups.

The group controller diagnostic screen will also provide a system update button for teach-in the current group controller network.



8 Technical Specifications

8.1 Technical Data

Product label

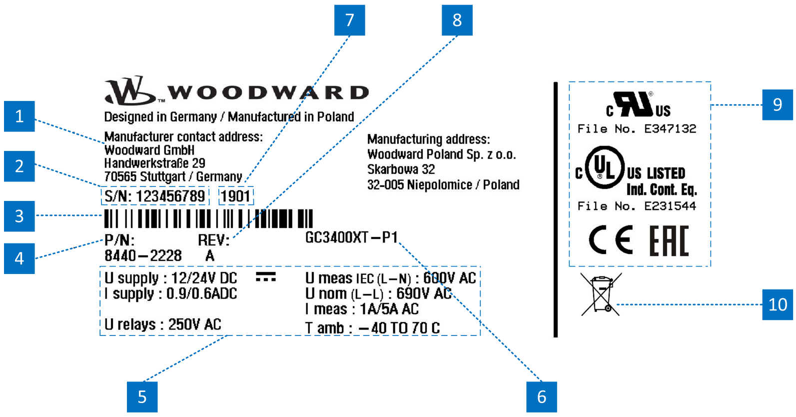


Fig. 65: Product label

Number	Name	Description
1	Address	Manufacturer and manufacturing addresses
2	S/N	Serial number (numerical)
3	S/N	Serial number (barcode)
4	P/N	Item number
5	Details	Technical data
6	Type Description	Description (product name)
7	S/N	Date of production (year-month)
8	REV	Item revision number
9	Approval	Approvals
10	Environment	Separate collection symbol

Battery inside

Fig. 66: Waste Disposal

This device contains a battery, and therefore it is labeled with the symbol shown beside according to the EU Directive 2006/66/EC.

> **WARNING!**
>
> Batteries can be harmful to the environment. Damaged or unusable batteries must be disposed of in a container specially reserved for this purpose.
>
> In general, appropriate local guidelines and regulations must be followed when disposing of electrical devices and batteries.

8.1.1 Measuring Values

Voltages

Measuring values, voltages	
Measuring voltages ⅄ / △	398/690 V_{AC}
: Range rated value ($V_{LLrated}$)	100 V_{AC} up to 690 V_{AC}

: Maximum value (V_{LLmax})	max. 897 V_{AC}
: Rated voltage phase – ground	600 V_{AC}
: Rated surge voltage	6.0 kV
Input resistance per path	2.5 MΩ
Maximum power consumption per path	< 0.15 W
Linear measuring range	1.3 × V_{rated}
Measuring frequency	50/60 Hz (30.0 to 85.0 Hz)

Battery Voltage

Measuring values, battery voltage	Galvanically isolated
Input voltage range	8 to 40 V_{DC}

8.1.2 Ambient Variables

CAUTION!

Device Operating Voltage

Connect the unit only to a DC power source that complies with the safety extra-low voltage (SELV) requirements.

Power supply	12/24 V_{DC} (8 to 40.0 V_{DC}), SELV
Intrinsic consumption	max. 32 W
Degree of pollution	2
Maximum elevation	4,000 m ASL
Insulation voltage	100 V_{DC} Marine applications: 40 V_{DC}
Overvoltage (≤ 2 min)	80 V_{DC}
Reverse voltage protection	Over the full supply range
Input capacitance	5,000 µF
Unit Power Supply	Negative potential grounded or positive potential grounded or ungrounded

8.1.3 Inputs/Outputs

Discrete inputs 'DI xx'

Discrete inputs	Galvanically isolated
Input range ($V_{cont. dig. input}$)	Rated voltage 12/24 V_{DC} (8 to 40.0 V_{DC})
Input resistance	approx. 20 kΩ

Discrete outputs 'R xx' (relay outputs)

Discrete/relay outputs		Galvanically isolated
Contact material		AgCdO
General purpose (GP) ($V_{cont, relays}$)	AC	2.00 A_{AC}@250 V_{AC}
	DC	2.00 A_{DC}@24 V_{DC}
		0.36 A_{DC}@125 V_{DC} Not suitable for USA and Canada applications. Not evaluated by UL.
		0.18 A_{DC}@250 V_{DC} Not suitable for USA and Canada applications. Not evaluated by UL.
Pilot Duty	AC	B300

8.1.4 Interfaces

USB (slave)

USB 2.0 interface	Galvanically isolated
Type	USB 2.0 standard; slave (Type B)
Data rate	max. 12 Mbit/s
Insulation	Galvanically isolated
Bus Voltage	5 V
Current consumption	approx. 10 mA

CAN bus interface

CAN bus interface	Galvanically isolated
Insulation voltage (continuously)	100 V_{AC}
Insulation test voltage (1 s)	1700 V_{DC}
Version	CAN bus
Internal line termination	Not available

Ethernet interface

Ethernet bus interface	Galvanically isolated Only one MAC ID is required
Insulation voltage (continuously)	100 V_{AC}
Insulation test voltage (1 s)	1700 V_{DC}
Version	Ethernet 10/100Base-T/TX
Ethernet plug socket	RJ45 standard, shielded 2 LEDs to indicate communication.
Ethernet cable	CAT 5 or 5e (class D) Shielding: F/UTP according to ISO/IEC 11801 (foil overall shielding, pairs unshielded)
Green LED	Indicates link activity (blinking during data transmission)

Yellow LED	Indicates link status (regarding speed): 10 Mb/s: LED switched-off 100 Mb/s: LED switched-on
Internal shield termination	Available

8.1.5 Real Time Clock Battery

Type	Lithium
Life span (operation without power supply)	approx. 5 years
Battery field replacement	Not allowed. Please contact your Woodward service partner.

8.1.6 Housing

Housing type

Type		**Sheet metal**
		Custom
Dimensions (W × H × D)		250 × 227 × 84 mm
Front cutout (W × H)		-/-
Weight		approx. 2,150 g
Wiring	Screw-plug-terminals 2.5 mm²	
Recommended locked torque	4 inch pounds / 0.5 Nm. Use 90 °C copper wire or better. Use class 1 wire only or equivalent.	

Protection

Protection system	Sheet metal	IP20

8.2 Environmental Data

Vibration

Frequency range - sine sweep	5 Hz to 100 Hz
Acceleration	4 G
Standards	IEC 60068-2-6, Fc
	Lloyd’s Register, Vibration Test2
	SAEJ1455 Chassis Data
Frequency range - random	10 Hz to 2000 Hz
Power intensity	0.04 G²/Hz
RMS value	8.2 Grms
Standards	MIL-STD 202F, M214A, SAE J1455

Shock

Shock	40 G, Saw tooth pulse, 11 ms
Standards	MIL-STD 810F, M516.5, Procedure 1

Temperature

Housing type			
Sheet metal	Cold, Dry Heat (storage)	-40 °C (-40 °F) / 80 °C (176 °F)	
	Cold, Dry Heat (operating)	-40 °C (-40 °F) / 70 °C (158 °F)	
Standards	IEC 60068-2-2, Test Bb and Bd		
	IEC 60068-2-1, Test Ab and Ad		

Humidity

Humidity	60 °C, 95% RH, 5 days
Standards	IEC 60068-2-30, Test Db

Electromagnetic Compatibility

EN 61000-6-2	2005 - Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environment
EN 61000-6-4	2007 + A1: 2011 - Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments
EN 61326-1	2013 - Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements (according to industrial electromagnetic environment)

8.3 Accuracy

The accuracy declaration is defined by the according measurement ranges. The rated maximum of the single ranges are taken as 100%.

This results in the definitions:

- Range 1: 69/120 V rated = 100%
- Range 2: 277/480 V rated = 100%
- Range 3: 400/690 V rated = 100%

Measuring value	Display	Accuracy	Measuring start	Notes
Frequency				
Generator	15.0 to 85.0 Hz	0.1% (of 85 Hz)	5% (of PT secondary voltage setting)[1]	
Mains	30.0 to 85.0 Hz			
Voltage				
Wye generator / mains / busbar	0 to 650 kV	0.5% , Class 0.5 [2] related to: 69/277/400 V (Wye)	1.5% (of PT secondary voltage setting)[1]	

Measuring value	Display	Accuracy	Measuring start	Notes
Delta generator / mains / busbar		120/480/690 V (Delta)	2% (of PT secondary voltage setting)[1]	
Power supply/Battery	0 to 40 V_{DC}	±0.5% related to 40 V	Related on the measure-ment range 8 to 40 V	0.5% equals 0.2 V (±0.2 V)
Miscellaneous				
Battery voltage	8 to 40 V	±0.5% (of measurement range 0 to 40 V_{DC})		
Phase angle	-180 to 180°	± 1 degree	1.25% (of PT secondary volt. setting)	180° is displayed for measuring values below measuring start

[1] Setting of the parameter for the PT secondary rated voltage

[2] Depending on the used measuring range (120/480/690 V)

Reference conditions

The reference conditions for measuring the accu-racy are listed below.

Input voltage	Sinusoidal rated voltage
Input current	Sinusoidal rated current
Frequency	Rated frequency
Power supply	Rated voltage ± 2%
Ambient temperature	23 °C ± 2 K
Warm-up period	20 minutes

9 Appendix

10 Glossary And List Of Abbreviations

CB	Circuit Breaker
CL	Code Level
CT	Current Transformer
DI	Discrete Input
DO	Discrete (Relay) Output
GCB	Generator Circuit Breaker
GGB	Generator Group Breaker
HMI	Human Machine Interface e.g., a front panel with display and buttons for interaction
I	Current
IOP	Islanded Operation in Parallel ("Islanded Parallel Operation")
LDSS	Load-Dependent Start/Stop operation
MCB	Mains Circuit Breaker
MOP	Mains Operation in Parallel
MPU	Magnetic Pickup Unit
N.C.	Normally Closed (break) contact
N.O.	Normally Open (make) contact
NC	Neutral Contactor
Operation	In (general) operation. State when the genset is running according to the selected mode, all parameters are in allowed values and ranges, and without OPEN requests or alarms. Somehow "waiting for next occurrence".
P	Real power
P/N	Part Number
PF	Power Factor
PID	Proportional Integral Derivative controller
PLC	Programmable Logic Control
PT	Potential (Voltage) Transformer
Q	Reactive power
S	Apparent power
S/N	Serial Number
Sequencer	A sequencer file is carrying specific settings e.g. to enable communication with and/or control of an expansion module. Such files can be prepared by Woodward.
V	Voltage

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Woodward GmbH
Handwerkstrasse 29 - 70565 Stuttgart - Germany
Phone +49 (0) 711 789 54-510
Fax +49 (0) 711 789 54-101
stgt-info@woodward.com