37443A

WOODWARD

DSLC-2
Digital Synchronizer and Load Control

Manual
Software Version 1.14xx

DSLC-2

Manual 37443A

WARNING

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

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

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

CAUTION

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

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

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

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Important definitions

WARNING

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

CAUTION

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

NOTE

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

Revision History

Rev.	Date	Editor	Changes
NEW	11-03-24	TE	New Release
A	11-05-13	TE	• Minor corrections **New features** *Requirements: Digital synchronizer and load control (DSLC-2)with software revision 1.1404 or higher and device revision A or higher.* • Modbus communication: Loss of connection. Refer to “Loss Of Connection” on page 192 for details.

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Chapter 1.
General Information

Document Overview

This manual describes the Woodward DSLC-2™ Digital Synchronizer and Load Control.

	Type		English	German
DSLC-2				
	DSLC-2 – User Manual	this manual ⇨	37443	-
	MSLC-2 – User Manual		37444	-

Table 1-1: Manual - overview

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

NOTE

This manual has been developed for a unit fitted with all available options. Inputs/outputs, functions, configuration screens and other details described, which do not exist on your unit, may be ignored.

The present manual has been prepared to enable the installation and commissioning of the unit. Due to the large variety of parameter settings, it is not possible to cover every combination. The manual is therefore only a guide.

Application

The Woodward DSLC-2™ control is the direct successor of the microprocessor-based DSLC™ synchronizer and load control designed for use on three-phase AC generators. The DSLC-2™ control combines synchronizer, load sensor, load control, dead bus closing system, var, power factor and process control, all integrated into one powerful package.

Applications allow up to 32 generators to be paralleled and controlled. A dedicated Ethernet system provides seamless communications between DSLC-2™ and MSLC-2™ units. A second Ethernet port is provided for customer remote control and monitoring capability using Modbus TCP allowing DCS and PLC interfacing. Modbus RTU is available through a separate RS-485 port.

DSLC-2 function summary

Original DSLC functions include:

- Selectable for phase matching or slip frequency synchronizing with voltage matching and automatic dead bus closure capability
- Automatic generator loading and unloading for bumpless load transfer
- Droop, base load and isochronous load control capability
- Process control for cogeneration, import/export, pressure control or other processes
- Isochronous load sharing with other sets equipped with DSLC controls
- Var or power factor (PF) control
- Built in diagnostics
- Multifunction adjustable high and low limit alarms and load switch with relay outputs
- Digital communications network to provide load sharing, var/PF sharing and other information exchange between controls
- Reverse power relay

Additional DSLC-2 functions include:

- One dedicated Ethernet line for precise system communications between all DSLC-2's and MSLC-2's on the system
- Ethernet Modbus/TCP for remote control and monitoring
- Serial Modbus RS-485 for remote control and monitoring
- Applications with up to 32 DSLC-2 and 16 MSLC-2
- Automatic segment control (self recognizing of the segment)
- Process control with up to 32 DSLC-2 or 1 Master MSLC-2
- Full setup, metering and diagnostic capability through the PC program ToolKit

Synchronizer

Either phase matching or slip frequency synchronizing may be selected. Phase matching provides rapid synchronizing for critical standby power applications. Slip frequency synchronizing guarantees that initial power flow is positive for all generators. For both synchronizing methods, the DSLC-2 control uses actual slip frequency and breaker delay values to anticipate a minimum phase difference between bus and generator at actual breaker closure. The DSLC-2 control provides a safe automatic dead-bus closure function. Deadbus closing permission is granted to only one DSLC-2 or MSLC-2 control in the whole system, through locking techniques done over the communications network. This assures that a race condition will not cause two or more breakers to close simultaneously on the dead bus. Additional synchronizer features include voltage matching, time delayed automatic multi-shot reclosing, auto-resynchronizing and a synchronizer timeout alarm. Each of these features may be enabled or disabled during setup.

Load Control

Load control begins at breaker closure when the load control function takes control of the DSLC-2 speed bias output directly from the synchronizer. The matching of synchronizer slip frequency to initial load (unload trip level) can result in a bumpless transfer to load control. On command, the adjustable ramp allows smooth, time-controlled loading into base load, isochronous load sharing or process control. A ramp pause switch input allows holding of the load ramp for warm-up or other purposes. The base load control is an integrating controller. The integrating base load control provides accurate load control when in parallel with a bus where frequency may vary. The DSLC-2 control provides switch inputs to allow raising or lowering the internal digital base load reference. The control also provides an analog input for remote load setting.

When unloading, an adjustable unload ramp provides time controlled unloading to the unload trip level. When load reaches the unload trip level, the control issues a breaker open command to separate the generator set from the system. The ramp pause switch input is in effect while unloading to allow holding of the unload ramp for cool-down or other purposes.

The load and unload ramps also provide smooth transition between base load, isochronous load sharing and process control any time the operating mode is changed.

The DSLC-2 control includes several additional load control features:

- Load droop operation provides safe operation in parallel bus applications in the event of a circuit breaker aux contact failure.
- A frequency trimmer function provides accurate frequency control in isochronous load sharing systems by compensating for small variations in speed setting between units.
- Adjustable load switch output with independent pick-up and drop-out points provides a signal when the specified load is exceeded. The load switch output can be selected as a reverse power trip.
- Load raise and lower inputs can be used to adjust speed before synchronizing.
- Voltage raise and lower inputs can be used to adjust voltage before synchronizing.
- A droop tracking function is available automatically by a network fault or by a discrete input.

Process Control

A cascade PID process controller is provided for cogeneration, import/export control, pond level maintenance, pressure maintenance or other application. An adjustable bandwidth signal input filter, flexible PID controller adjustments and control selectable for direct or indirect action, allow the process control to be used in a wide variety of applications.

The analog input “Process Signal Input” provides the real value for the DSLC-2 control. The control includes an internal digital process reference which may be controlled by raise and lower load switch contact inputs or by the analog input “Process Signal”.

Adjustable ramps allow smooth entry to or exit from the process control mode. When the process control mode is selected, an adjustable ramp moves the load reference in a direction to reduce the process control error. When the error is minimized or the reference first reaches either the specified high or low load pick-up limits, the process controller is activated. When a limit is reached, the control will hold the load reference at that limit until process control is obtained.

When unloading from the process control, an adjustable unload ramp provides time controlled unloading to the unload trip level. When load reaches the unload trip level, the DSLC-2 control automatically issues a breaker open command to remove the generator set from the system. The ramp pause switch input allows holding of the unload ramp for cool-down or other purposes.

Additional functions include selectable and adjustable process high and low limit switches and alarm activation.

Var/PF Control

The var/PF functions control the reactive power component of the generator in parallel systems. In an infinite bus system, the controller compares either the kvar load or power factor (selectable) on the generator with an adjustable internal reference and makes corrections to the voltage regulator until the desired kvar load or power factor is obtained. For higher performance, the “Voltage Bias” output, can be directly connected to compatible voltage regulators with analog voltage setting input. The control has raise and lower voltage discrete inputs for manual voltage adjustment. The control also has raise and lower contact outputs to activate a voltage regulator MOP when an analog input is not provided on the AVR.

The var/PF controller will limit the generators kvar output to the generator rated reactive power setpoint when connected to an infinite bus. A DSLC-2 must be in baseload or process control or a MSLC-2 must be in control. This will protect the generator when connected to an infinite source. This feature is not active when the DSLC-2 is in the load sharing mode (isolated).

The DSLC-2 control provides var sharing between multiple units when in an isolated bus application. The control computes an average var value for the system and uses it as the reference input to the var controller. The control includes an adjustable voltage reference and voltage trim function in the sharing function to maintain system voltage. The analog input “Reactive Load” is activated by closing both the voltage raise and lower discrete inputs. This allows remote control of the PF reference setpoint when in power factor control. Each power factor setpoint either external or internal is calculated to a var load setpoint. var load setpoints are restricted within the range -10 % to 100 % generator rated reactive power.

The DSLC-2 control has a selectable voltage range alarm which is activated if the analog output to the voltage regulator reaches high or low saturation. The DSLC-2 control also has selectable and adjustable high and low voltage limit switches and alarm outputs.

DSLC-2 / MSLC-2 Systems

The network addressing of the DSLC-2 / MSLC-2 allows up to 32 DSLC-2s and 16 MSLC-2s in an application. A DSLC-2 and MSLC-2 application can handle 8 segments. Discrete inputs inform the DSLC-2s and MSLC-2s which segments each generator and utilities are operating on. If a MSLC-2 receives a discrete input to activate segment 1 and 2, it will share this information with all controls over the Ethernet bus. It is not necessary to provide a segment activation discrete input to all controls. Segmenting allows the DSLC-2s and MSLC-2s to remain connected thru the Ethernet bus, but be operating on separate load buses.

The DSLC-2 / MSLC-2 system can be applied according to following rules:

- The maximum number of DSLC-2s (Gen-CB) is 32.
- The maximum number of MSLC-2s (Utility- or Tie-CB) is 16.
- The maximum number of segments is 8.
- The segment numbers have to follow a line, which can finally be closed to a ring.
- Only one MSLC-2 can be used as master control, when multiple MSLC-2 are resided in one segment.
    - The MSLC-2 with the lower device number will control if multiple Utility MSLC-2s are active on the same segment
- The generator is not counted as a segment.
- The utility is not counted as a segment.

NOTE

If different MSLC-2s, located in different segments, are connected via a tie-MSLC-2, more than one MSLC-2 is now located in the same segment. The result is the MSLC-2 with the lowest device number becomes the master of all MSLC-2s located in this segment.

Examples:

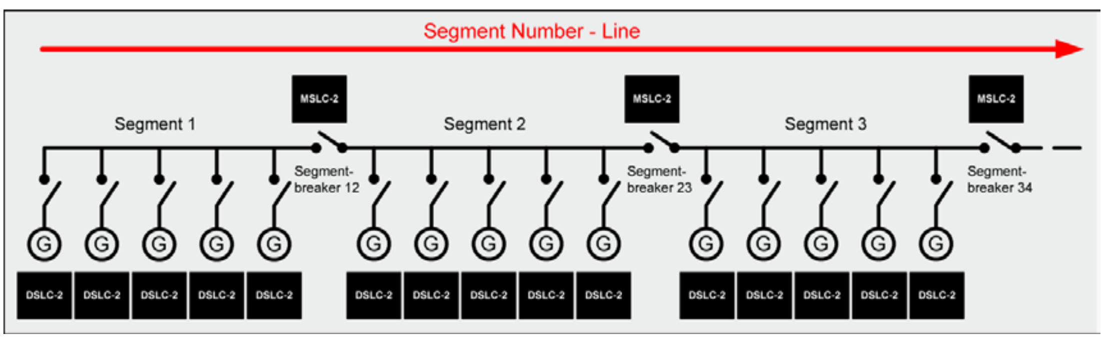


Figure 1-2: Multiple generators in isolated operation with tie-breaker

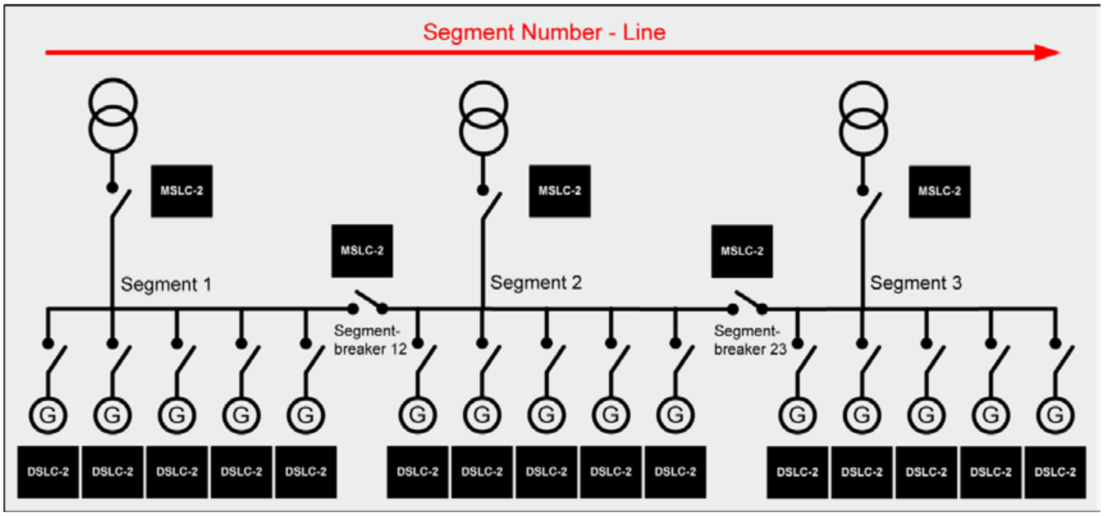


Figure 1-3: Multiple generators in isolated and utility parallel operation with utility- and tie-breaker

Chapter 2. Installation

Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).

Avoid the 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.

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, modules and work area as much as possible.

Opening the control cover may void the unit warranty.

Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must 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.

CAUTION

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards and Modules.*

NOTE

The unit is capable to withstand an electrostatic powder coating process with a voltage of up to 85 kV and a current of up to 40 µA.

Unpacking

Before unpacking the control, refer to the inside front cover of this manual for WARNINGS and CAUTIONS. Be careful when unpacking the control. Check for signs of damage such as bent or dented panels, scratches, loose or broken parts. If any damage is found, immediately notify the shipper.

Location

When selecting a location for mounting the DSLC-2 control, consider the following:

- Protect the unit from direct exposure to water or to a condensation-prone environment.
- The continuous operating range of the DSLC-2 control is –40 to +70 °C (–40 to +158 °F).
- Provide adequate ventilation for cooling. Shield the unit from radiant heat sources.
- Do not install near high-voltage, high-current devices.
- Allow adequate space in front of the unit for servicing.
- Do not install where objects can be dropped on the terminals.
- Ground the chassis for proper safety and shielding.
- The control must NOT be mounted on the engine.

Housing

Dimensions

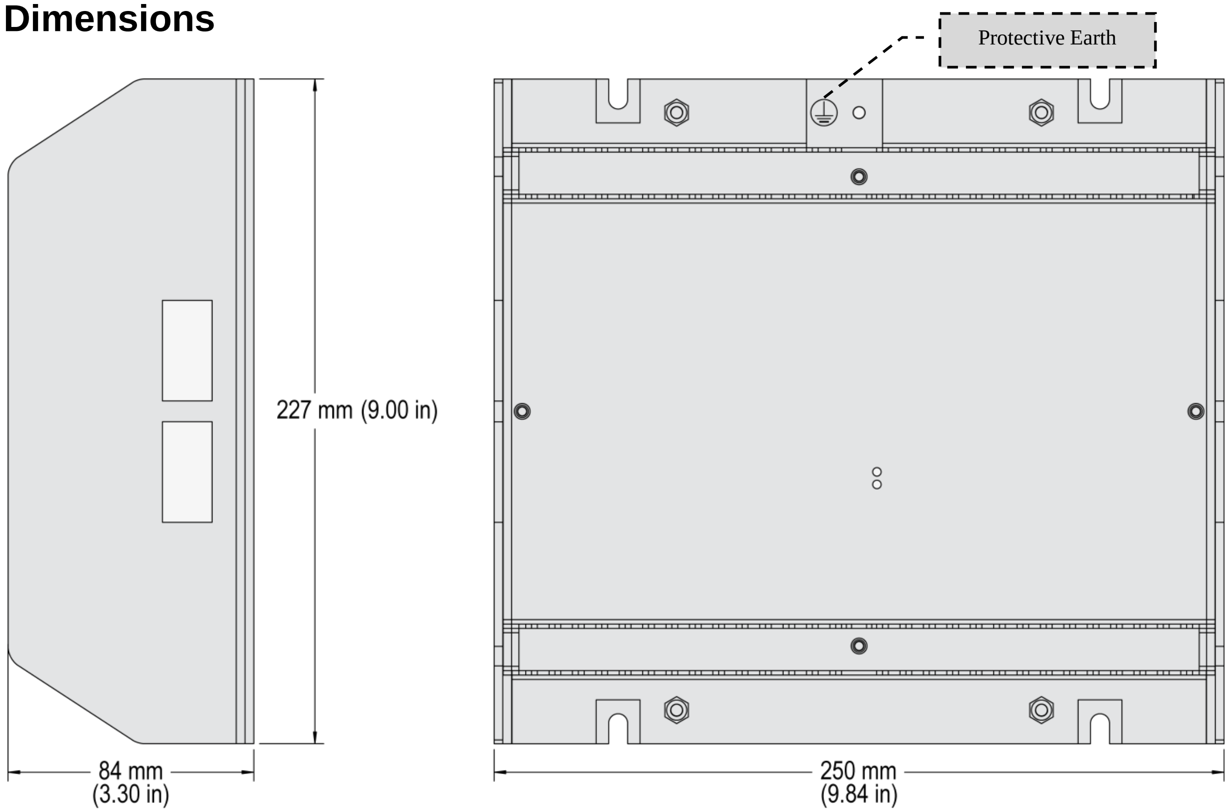


Figure 2-1: Housing DSLC-2 - dimensions

Installation

The unit is to be mounted to the switch cabinet back using four screws with a maximum diameter of 6 mm. Drill the holes according to the dimensions in Figure 2-2 (dimensions shown in mm).

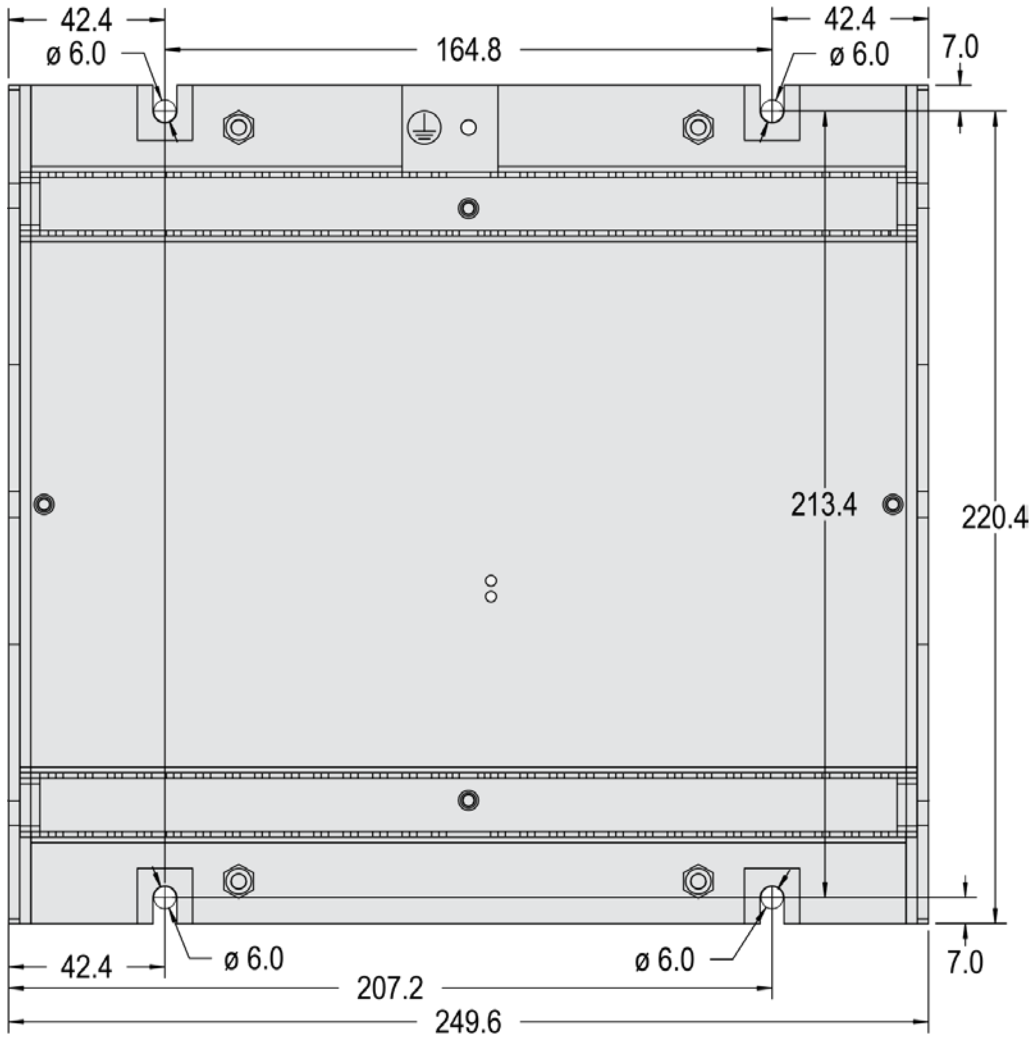


Figure 2-2: Housing - drill plan

Terminal Arrangement

NOTE

The Protective Earth terminal 61 is not connected on the DSLC-2. The protective earth connection at the sheet metal housing must be used instead (refer to Figure 1-2).

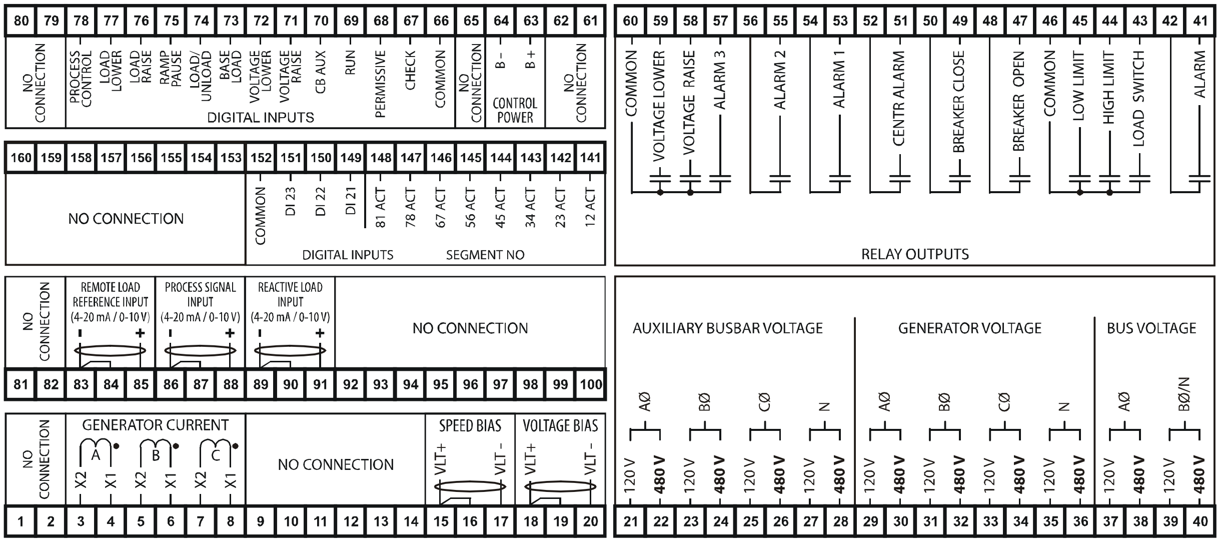


Figure 2-3: DSLC-2 - terminal arrangement

Wiring Diagrams

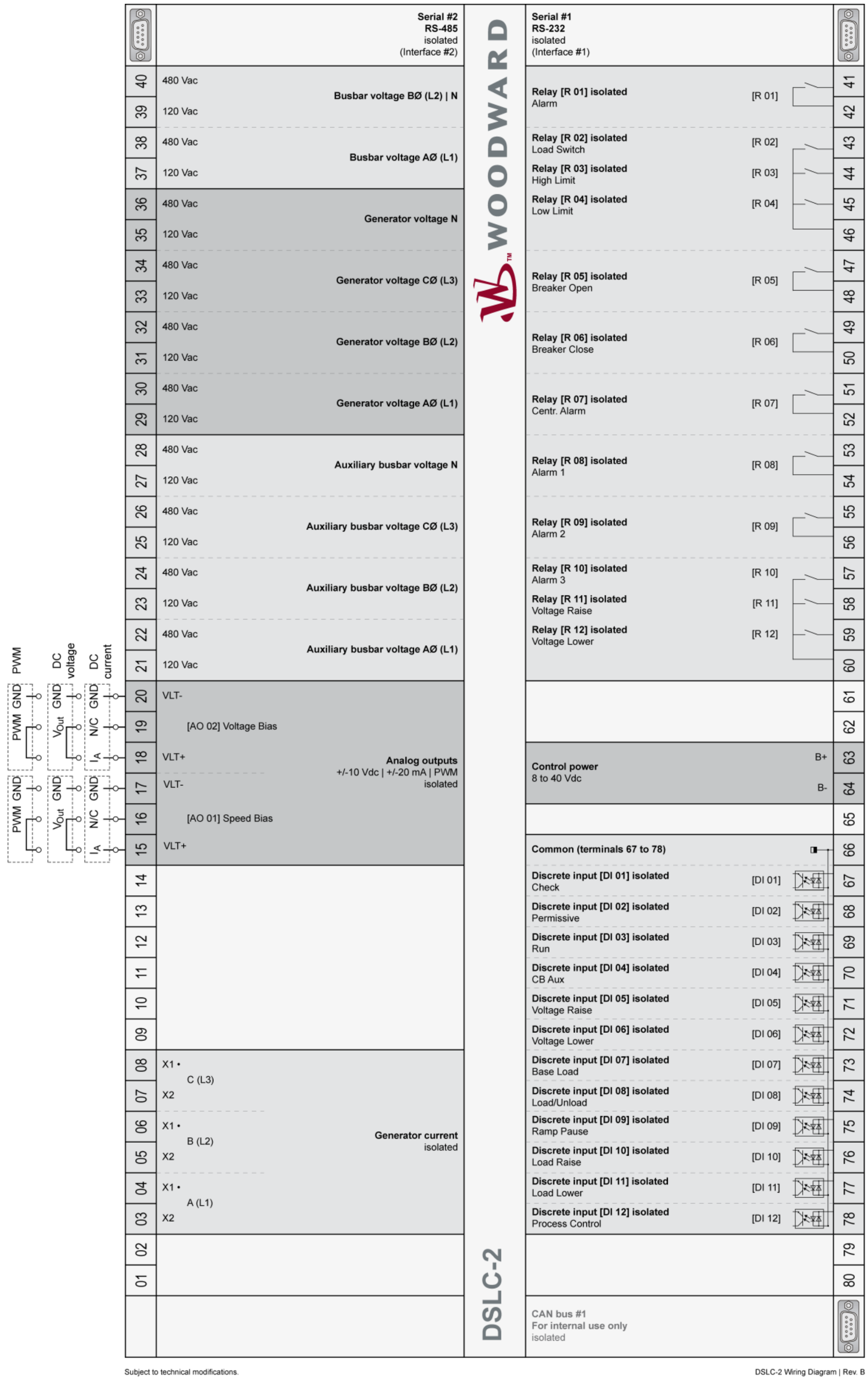


Figure 2-4: Wiring diagram - DSLC-2 - 1/2

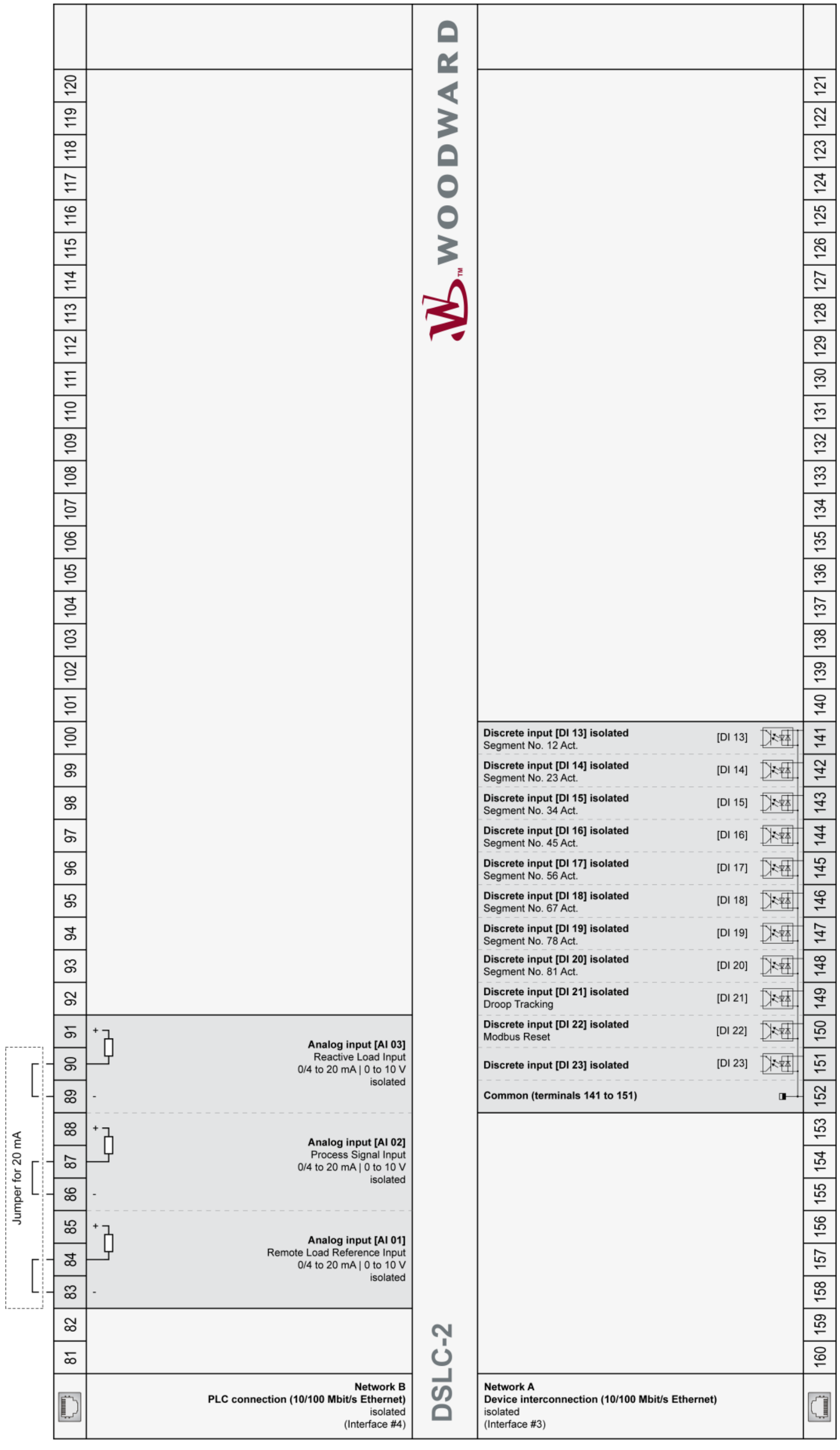


Figure 2-5: Wiring diagram - DSLC-2 - 2/2

Connections

WARNING

All technical data and ratings indicated in this chapter are not definite! Only the values indicated in Appendix A. Technical Data on page 201 are valid!

The following chart may be used to convert square millimeters [mm²] to AWG and vice versa:

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 2-1: Conversion chart - wire size

Power Supply

WARNING – Protective Earth

Protective Earth (PE) must be connected to the unit to avoid the risk of electric shock. The conductor providing the connection must have a wire larger than or equal to 2.5 mm² (14 AWG). The connection must be performed properly.

Please use the protective earth connection at the sheet metal housing (refer to Figure 2-1 on page 19).

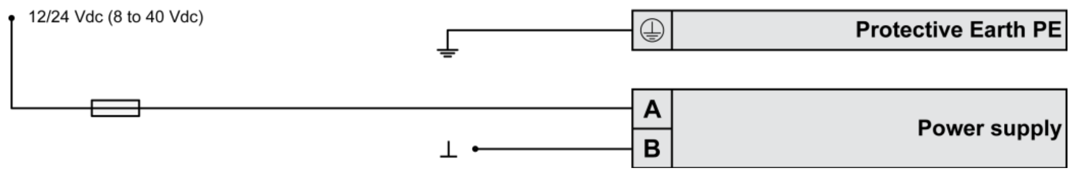


Figure 2-6: Power supply

Figure	Terminal	Description	A_{max}
A	63	12/24Vdc (8 to 40.0 Vdc)	2.5 mm²
B	64	0 Vdc	2.5 mm²

Table 2-2: Power supply - terminal assignment

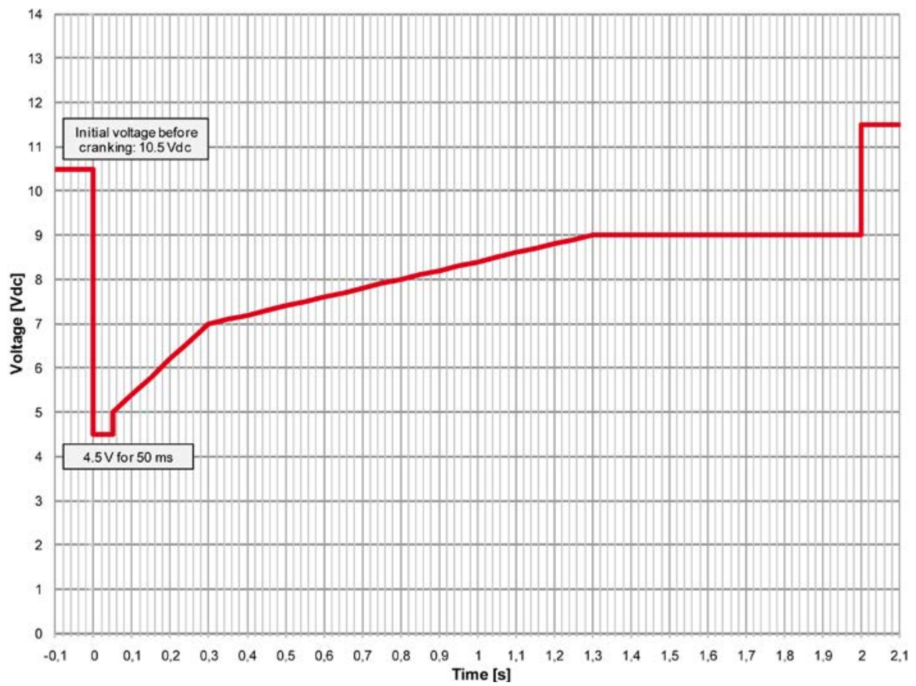


Figure 2-7: Power supply - crank waveform at maximum load

NOTE

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)**

Voltage Measuring

NOTE

DO NOT use both sets of voltage measuring inputs. The control unit will not measure voltage correctly if the 120 V and 480 V inputs are utilized simultaneously.

NOTE

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

Voltage Measuring: Generator

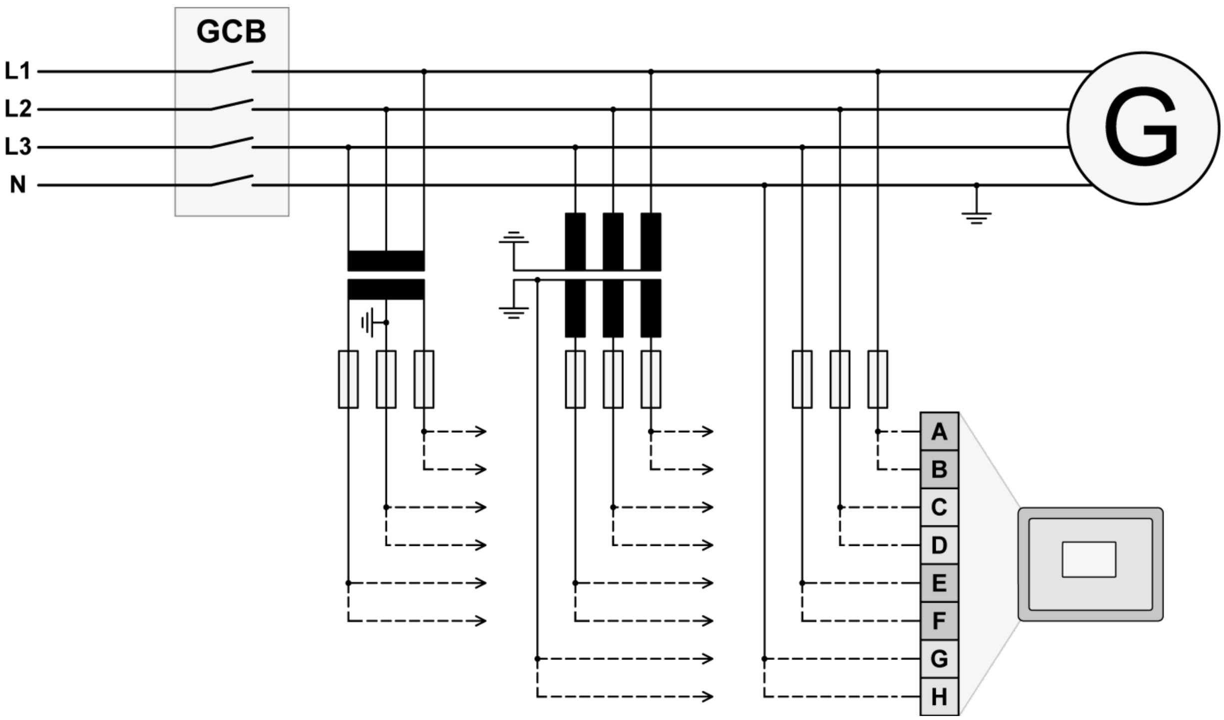


Figure 2-8: Voltage measuring - generator

Figure	Terminal	Description		A_{max}
A	29	Generator Voltage AØ (L1)	120 Vac	2.5 mm²
B	30		480 Vac	2.5 mm²
C	31	Generator Voltage BØ (L2)	120 Vac	2.5 mm²
D	32		480 Vac	2.5 mm²
E	33	Generator Voltage CØ (L3)	120 Vac	2.5 mm²
F	34		480 Vac	2.5 mm²
G	35	Generator Voltage N	120 Vac	2.5 mm²
H	36		480 Vac	2.5 mm²

Table 2-3: Voltage measuring - terminal assignment - generator voltage

NOTE

If parameter 1800 ("Gen. PT secondary rated volt.") is configured with a value between 50 and 130 V, the 120 V input terminals must be used for proper measurement.

If parameter 1800 ("Gen. PT secondary rated volt.") is configured with a value between 131 and 480 V, the 480 V input terminals must be used for proper measurement.

Voltage Measuring: Generator

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

A generator 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 open delta for correct power measurement.

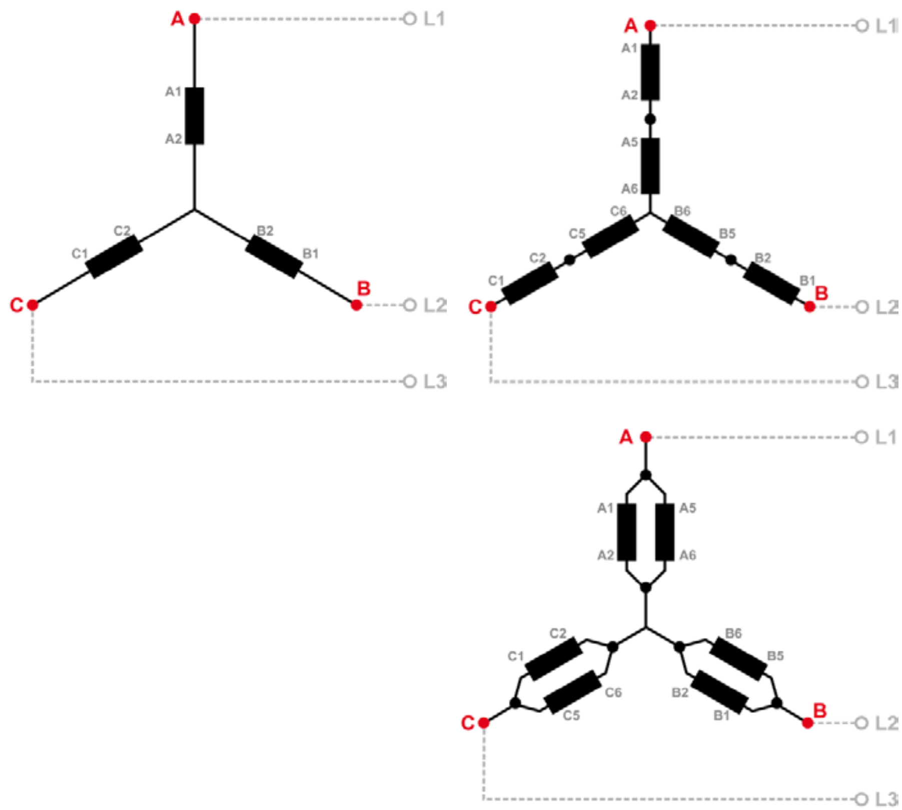


Figure 2-9: Voltage measuring - generator windings, 3Ph 4W OD

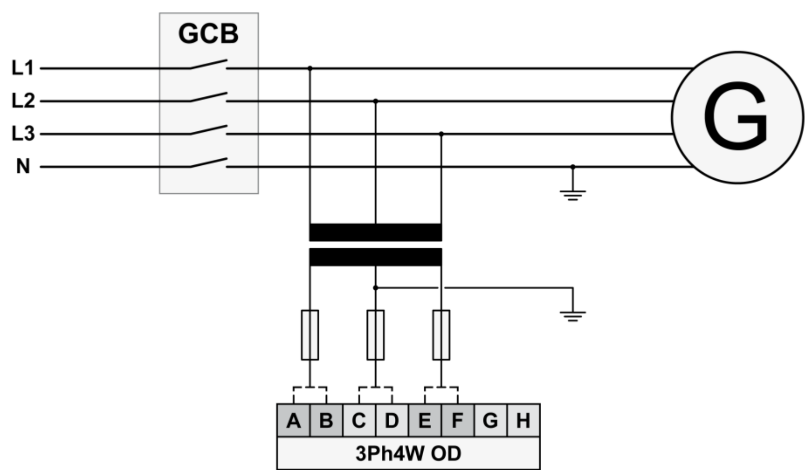


Figure 2-10: Voltage measuring - generator measuring inputs, 3Ph 4W OD

3Ph 4W OD	Wiring terminals								Note
Rated voltage (range)	[1] 120 V (50 to 130 $V_{eff.}$)				[4] 480 V (131 to 480 $V_{eff.}$)				1
Measuring range (max.)	[1] 0 to 150 Vac				[4] 0 to 600 Vac				
Figure	A	C	E	G	B	D	F	H	
DSLC-2 terminal	29	31	33	35	30	32	34	36	
Phase	L1 / AØ	L2 / BØ	L3 / CØ	---	L1 / AØ	L2 / BØ	L3 / CØ	---	

Table 2-4: Voltage measuring - terminal assignment - generator, 3Ph 4W OD

1 For different voltage systems, different wiring terminals have to be used.

Voltage Measuring: Generator, Parameter Setting '3Ph 4W' (3-phase, 4-wire)

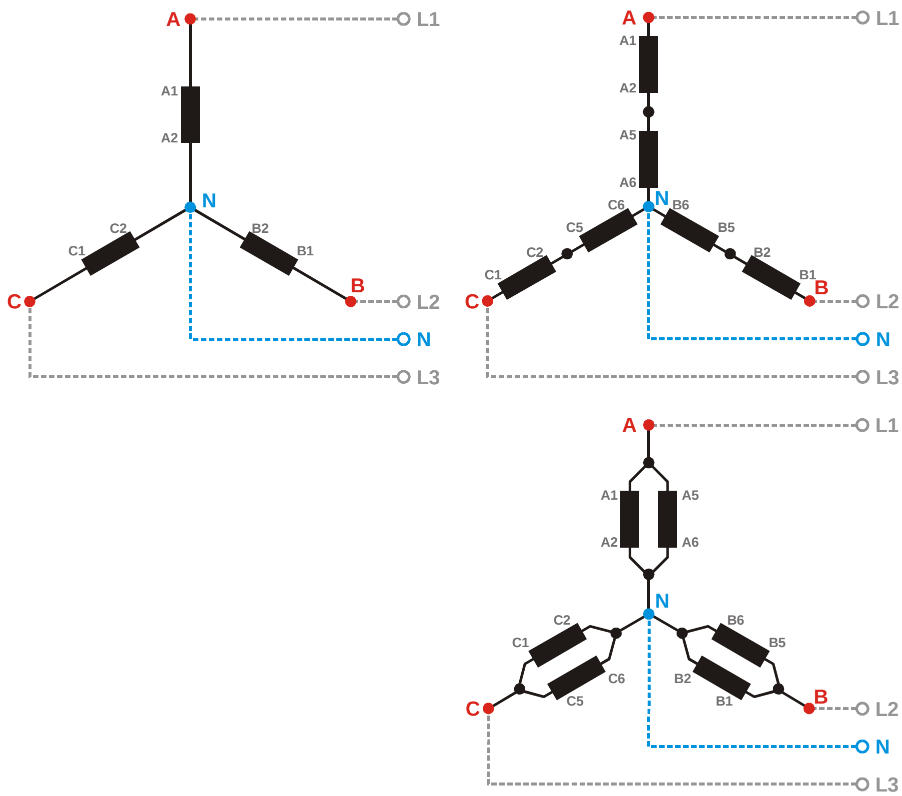


Figure 2-11: Voltage measuring - generator windings, 3Ph 4W

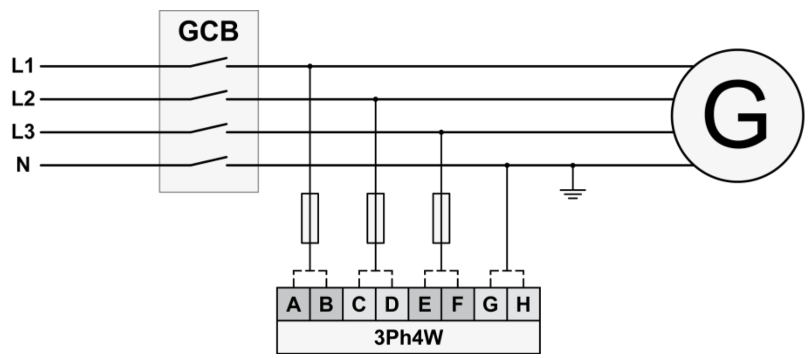


Figure 2-12: Voltage measuring - generator measuring inputs, 3Ph 4W

3Ph 4W	Wiring terminals								Note
Rated voltage (range)	[1] 120 V (50 to 130 $V_{eff.}$)				[4] 480 V (131 to 480 $V_{eff.}$)				2
Measuring range (max.)	[1] 0 to 150 Vac				[4] 0 to 600 Vac				
Figure	A	C	E	G	B	D	F	H	
DSLC-2 terminal	29	31	33	35	30	32	34	36	
Phase	L1 / AØ	L2 / BØ	L3 / CØ	N	L1 / AØ	L2 / BØ	L3 / CØ	N	

Table 2-5: Voltage measuring - terminal assignment - generator, 3Ph 4W

2 For different voltage systems, different wiring terminals have to be used. Incorrect measurements are possible if both voltage systems use the same N terminal.

Voltage Measuring: Generator, Parameter Setting '3Ph 3W' (3-phase, 3-wire)

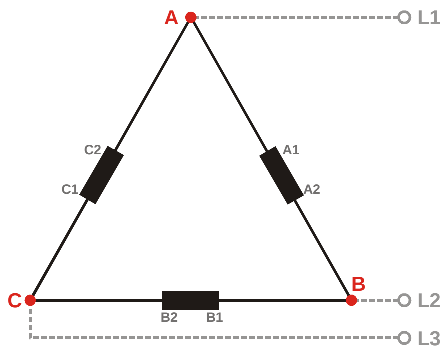


Figure 2-13: Voltage measuring - generator windings, 3Ph 3W

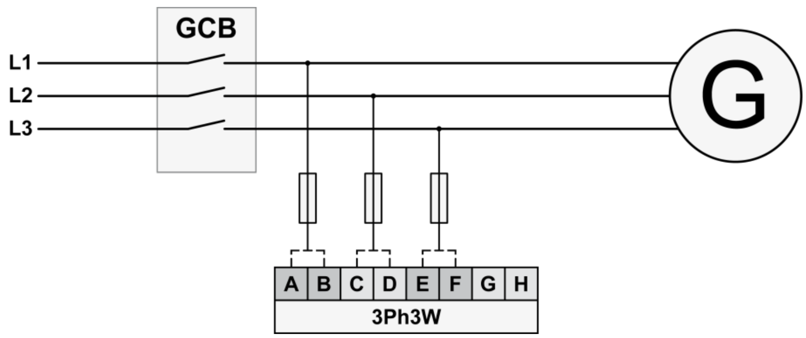


Figure 2-14: Voltage measuring - generator measuring inputs, 3Ph 3W

3Ph 3W	Wiring terminals								Note
Rated voltage (range)	[1] 120 V (50 to 130 $V_{eff.}$)				[4] 480 V (131 to 480 $V_{eff.}$)				3
Measuring range (max.)	[1] 0 to 150 Vac				[4] 0 to 600 Vac				
Figure	A	C	E	G	B	D	F	H	
DSCL-2 terminal	29	31	33	35	30	32	34	36	
Phase	L1 / AØ	L2 / BØ	L3 / CØ	---	L1 / AØ	L2 / BØ	L3 / CØ	---	

Table 2-6: Voltage measuring - terminal assignment - generator, 3Ph 3W

3 For different voltage systems, different wiring terminals have to be used.

Voltage Measuring: Busbar

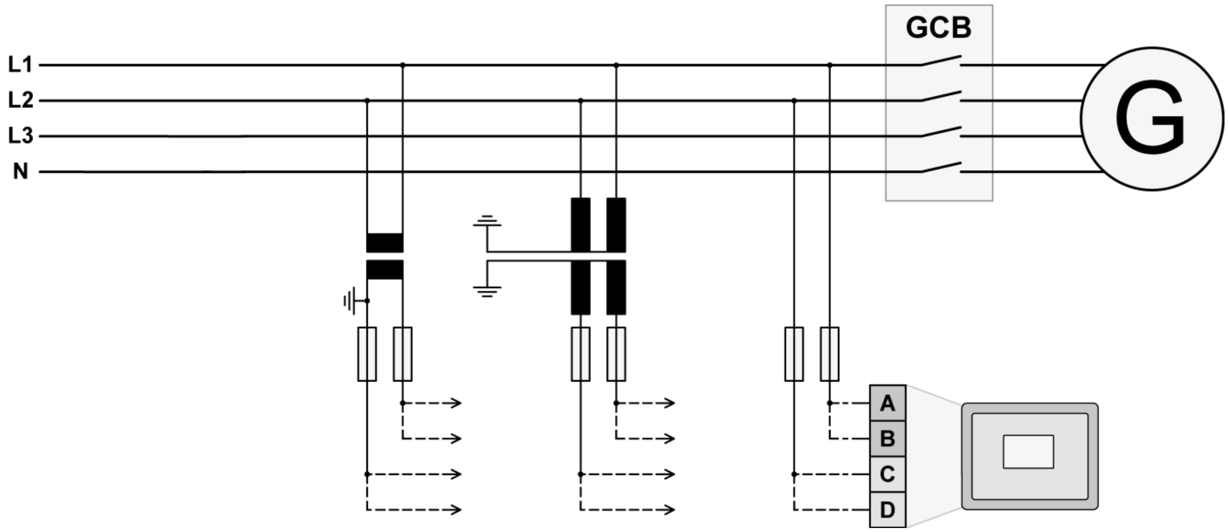


Figure 2-15: Voltage measuring - busbar

Figure	Terminal	Description		A_{max}
A	37	Busbar Voltage AØ (L1)	120 Vac	2.5 mm²
B	38		480 Vac	2.5 mm²
C	39	Busbar Voltage BØ (L2) | N	120 Vac	2.5 mm²
D	40		480 Vac	2.5 mm²

Table 2-7: Voltage measuring - terminal assignment - busbar voltage

NOTE

If parameter 1803 ("Bus PT secondary rated volt.") is configured with a value between 50 and 130 V, the 120 V input terminals must be used for proper measurement.

If parameter 1803 ("Bus PT secondary rated volt.") is configured with a value between 131 and 480 V, the 480 V input terminals must be used for proper measurement.

Voltage Measuring: Busbar, Parameter Setting '1Ph 2W' (1-phase, 2-wire)

NOTE

The 1-phase, 2-wire measurement may be performed phase-neutral or phase-phase. Please note to configure and wire the DSLC-2 consistently. Refer to the chapter Configuration & Operation.

'1Ph 2W' Phase-Neutral Measuring

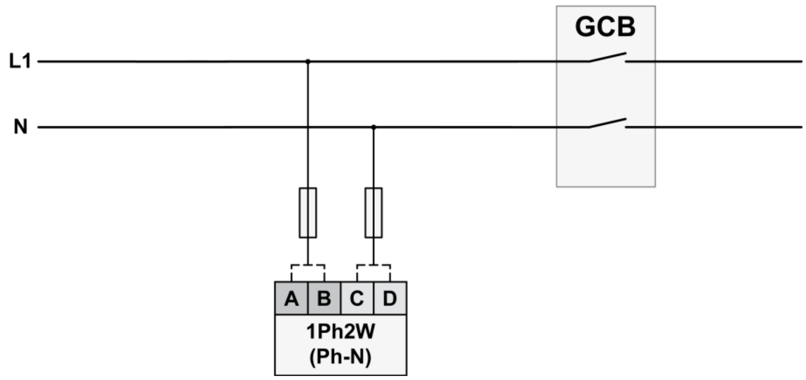


Figure 2-16: Voltage measuring - busbar measuring inputs, 1Ph 2W (phase-neutral)

1Ph 2W	Wiring terminals								Note
Rated voltage (range)	[1] 100 V (50 to 130 $V_{eff.}$)				[4] 400 V (131 to 480 $V_{eff.}$)				4
Measuring range (max.)	[1] 0 to 150 Vac				[4] 0 to 600 Vac				
Figure	A	C	---	---	B	D	---	---	
DSLC-2 terminal	37	39	---	---	38	40	---	---	
Phase	L1 / AØ	N	---	---	L1 / AØ	N	---	---	

Table 2-8: Voltage measuring - terminal assignment - busbar, 1Ph 2W (phase-neutral)

4 For different voltage systems, different wiring terminals have to be used.Incorrect measurements are possible if both voltage systems use the same N terminal.

'1Ph 2W' Phase-Phase Measuring

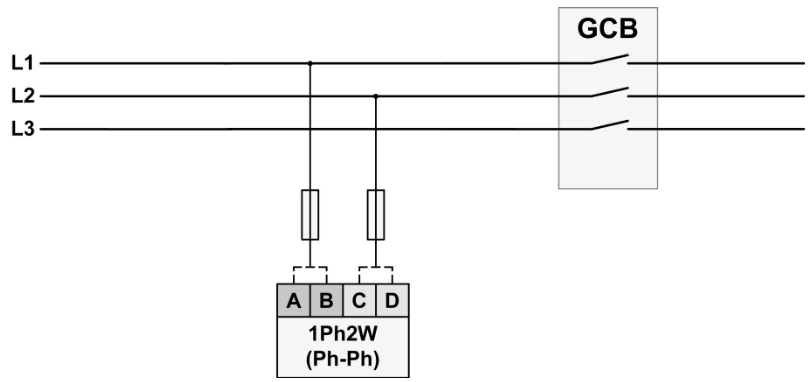


Figure 2-17: Voltage measuring - busbar measuring inputs, 1Ph 2W (phase-phase)

1Ph 2W	Wiring terminals								Note
Rated voltage (range)	[1] 100 V (50 to 130 $V_{eff.}$)				[4] 400 V (131 to 480 $V_{eff.}$)				5
Measuring range (max.)	[1] 0 to 150 Vac				[4] 0 to 600 Vac				
Figure	A	C	---	---	B	D	---	---	
DSLC-2 terminal	37	39	---	---	38	40	---	---	
Phase	L1 / AØ	L2 / BØ	---	---	L1 / AØ	L2 / BØ	---	---	

Table 2-9: Voltage measuring - terminal assignment - busbar, 1Ph 2W (phase-phase)

5 For different voltage systems, different wiring terminals have to be used.Incorrect measurements are possible if both voltage systems use the same N terminal.

Voltage Measuring: Auxiliary Busbar

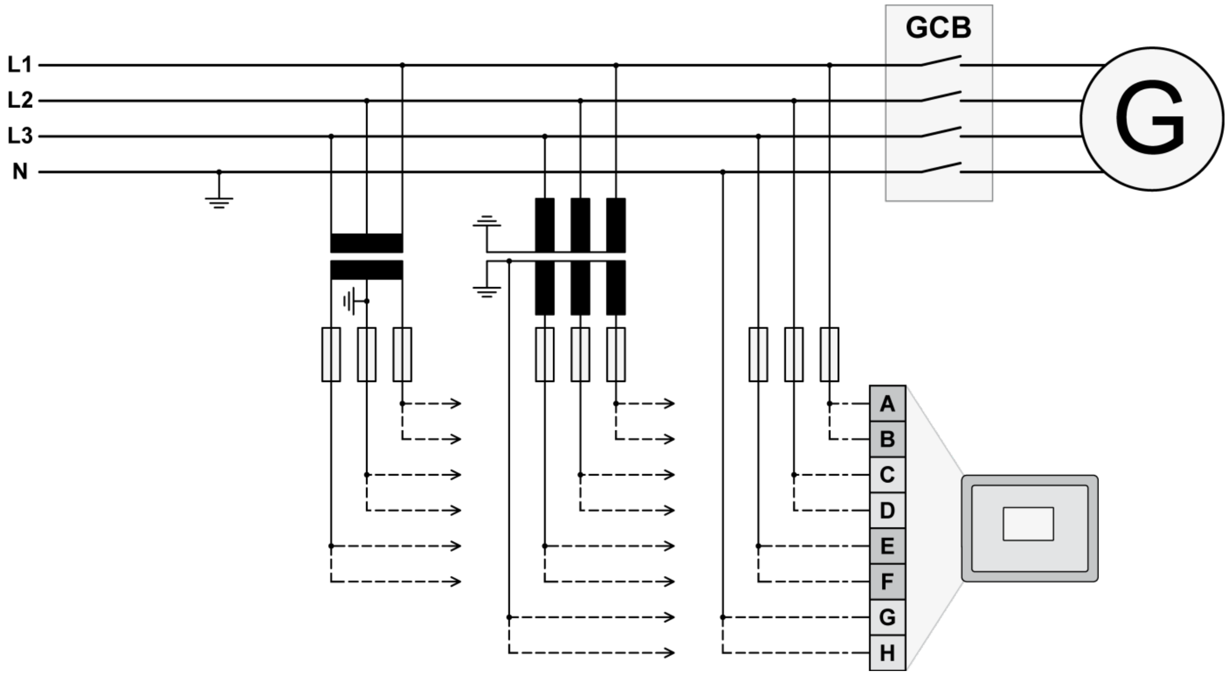


Figure 2-18: Voltage measuring – auxiliary busbar

Figure	Terminal	Description		A_{max}
A	21	Auxiliary Busbar Voltage AØ (L1)	100 Vac	2.5 mm²
B	22		480 Vac	2.5 mm²
C	23	Auxiliary Busbar Voltage BØ (L2)	100 Vac	2.5 mm²
D	24		480 Vac	2.5 mm²
E	25	Auxiliary Busbar Voltage CØ (L3)	100 Vac	2.5 mm²
F	26		480 Vac	2.5 mm²
G	27	Auxiliary Busbar Voltage N	100 Vac	2.5 mm²
H	28		480 Vac	2.5 mm²

Table 2-10: Voltage measuring - terminal assignment - auxiliary busbar voltage

NOTE

If parameter 1803 ("Bus PT secondary rated volt.") is configured with a value between 50 and 130 V, the 120 V input terminals must be used for proper measurement.

If parameter 1803 ("Bus PT secondary rated volt.") is configured with a value between 131 and 480 V, the 480 V input terminals must be used for proper measurement.

NOTE

If the DSLC-2 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 auxiliary busbar voltage measuring inputs may be installed.

Voltage Measuring: Auxiliary Busbar, Parameter Setting '3Ph 4W' (3-phase, 4-wire)

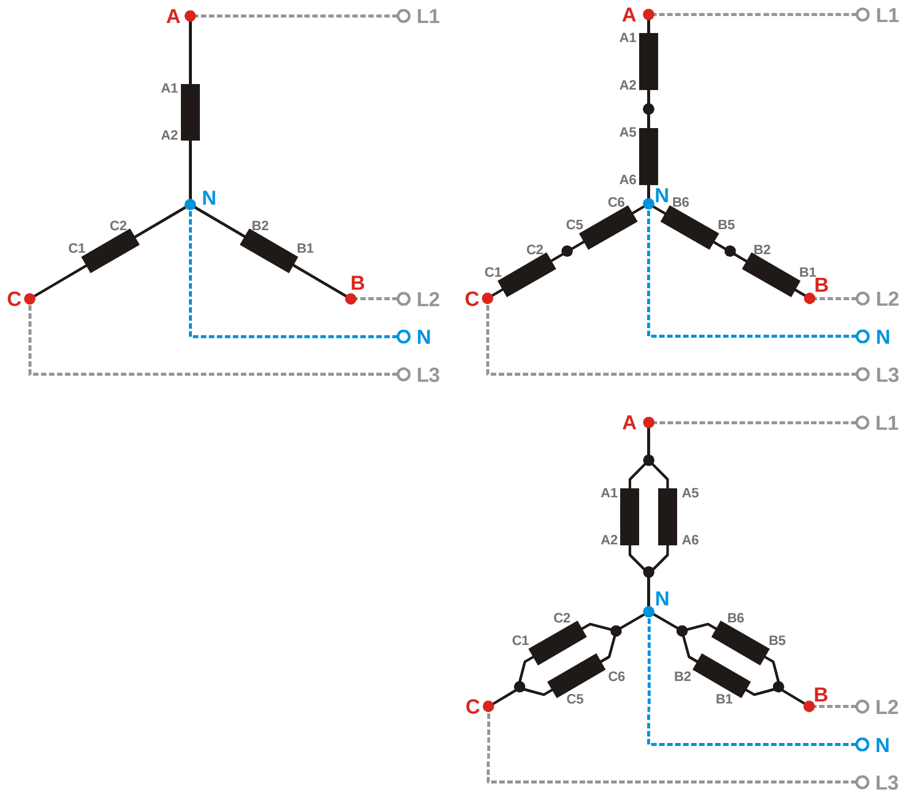


Figure 2-19: Voltage measuring - auxiliary busbar PT windings, 3Ph 4W

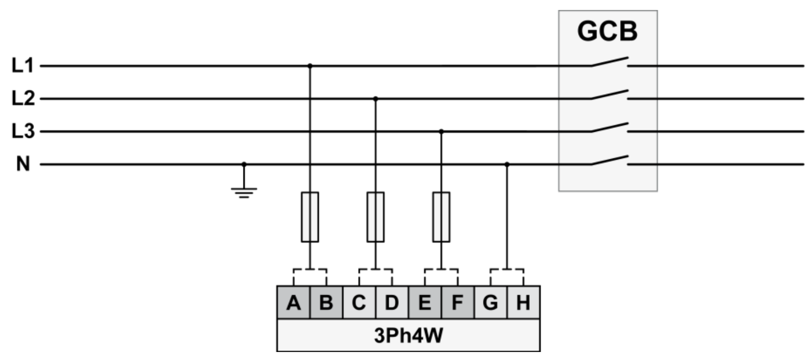


Figure 2-20: Voltage measuring - auxiliary busbar measuring inputs, 3Ph 4W

3Ph 4W	Wiring terminals								Note
Rated voltage (range)	[1] 120 V (50 to 130 $V_{eff.}$)				[4] 480 V (131 to 480 $V_{eff.}$)				6
Measuring range (max.)	[1] 0 to 150 Vac				[4] 0 to 600 Vac				
Figure	A	C	E	G	B	D	F	H	
DSLC-2 terminal	21	23	25	27	22	24	26	28	
Phase	L1 / AØ	L2 / BØ	L3 / CØ	N	L1 / AØ	L2 / BØ	L3 / CØ	N	

Table 2-11: Voltage measuring - terminal assignment - auxiliary busbar, 3Ph 4W

6 For different voltage systems, different wiring terminals have to be used.Incorrect measurements are possible if both voltage systems use the same N terminal.

Voltage Measuring: Auxiliary Busbar, Parameter Setting '3Ph 3W' (3-phase, 3-wire)

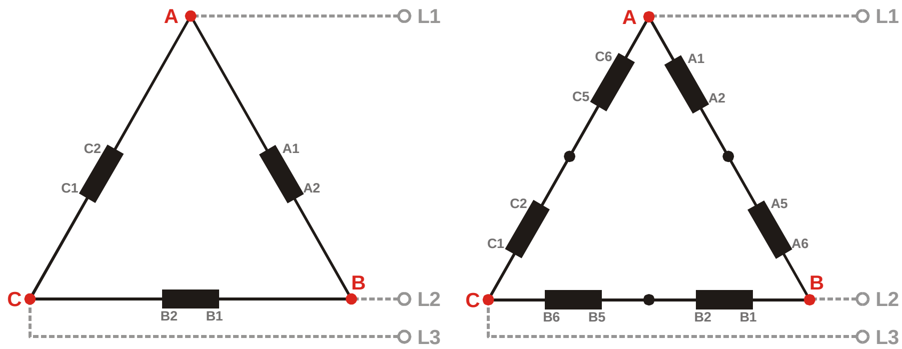


Figure 2-21: Voltage measuring - auxiliary busbar PT windings, 3Ph 3W

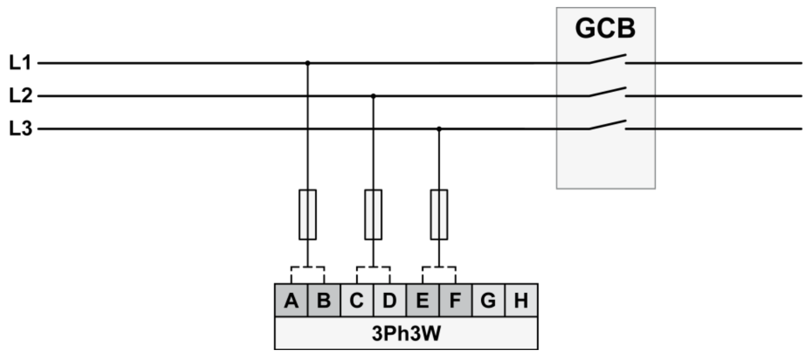


Figure 2-22: Voltage measuring - auxiliary busbar measuring inputs, 3Ph 3W

3Ph 3W	Wiring terminals								Note
Rated voltage (range)	[1] 120 V (50 to 130 $V_{eff.}$)				[4] 480 V (131 to 480 $V_{eff.}$)				7
Measuring range (max.)	[1] 0 to 150 Vac				[4] 0 to 600 Vac				
Figure	A	C	E	G	B	D	F	H	
DSLC-2 terminal	21	23	25	27	22	24	26	28	
Phase	L1 / AØ	L2 / BØ	L3 / CØ	---	L1 / AØ	L2 / BØ	L3 / CØ	---	

Table 2-12: Voltage measuring - terminal assignment - auxiliary busbar, 3Ph 3W

7 For different voltage systems, different wiring terminals have to be used.

Current Measuring

CAUTION

Before disconnecting the device, ensure that the current transformer/CT is short-circuited.

Generator Current

NOTE

Generally, one line of the current transformers secondary is to be grounded close to the CT.

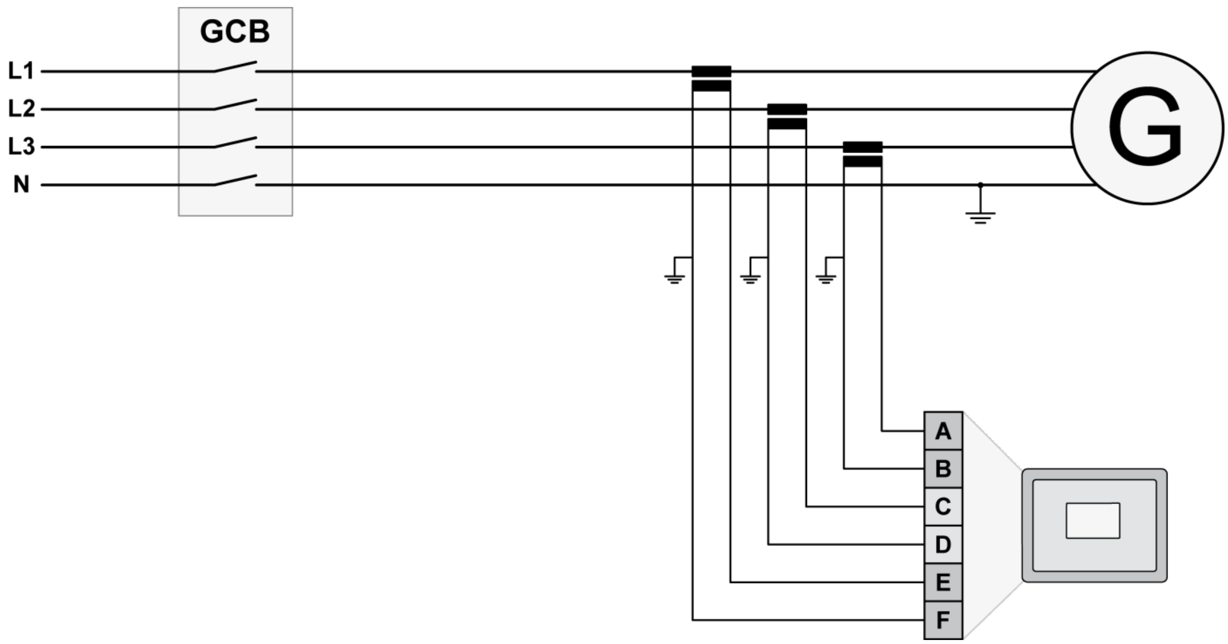


Figure 2-23: Current measuring - generator

Figure	Terminal	Description	A_{max}
A	8	Generator current C (L3) – X1	2.5 mm²
B	7	Generator current C (L3) – X2	2.5 mm²
C	6	Generator current B (L2) – X1	2.5 mm²
D	5	Generator current B (L2) – X2	2.5 mm²
E	4	Generator current A (L1) – X1	2.5 mm²
F	3	Generator current A (L1) – X2	2.5 mm²

Table 2-13: Current measuring - terminal assignment - generator current

Current Measuring: Generator, Parameter Setting 'L1 L2 L3'

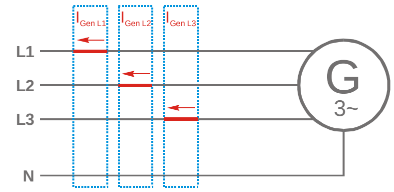


Figure 2-24: Current measuring - generator, L1 L2 L3

L1 L2 L3	Wiring terminals						Notes
DSLC-2 terminal	3	4	5	6	7	8	
Phase	X2 - A(L1)	X1 - A(L1)	X2 - B(L2)	X1 - B(L2)	X2 - C(L3)	X1 - C(L3)	

Table 2-14: Current measuring - terminal assignment - generator, L1 L2 L3

Current Measuring: Generator, Parameter Setting 'Phase L1', 'Phase L2' & 'Phase L3'

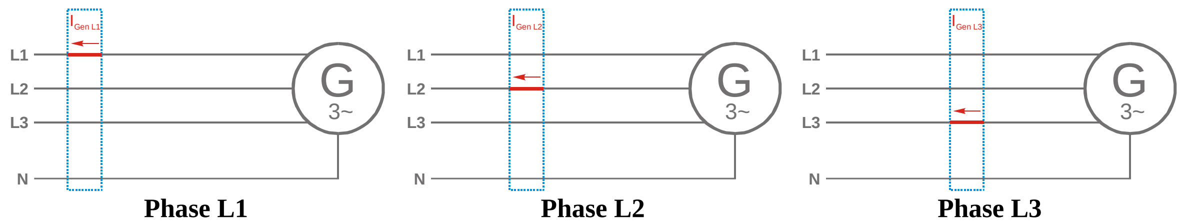


Figure 2-25: Current measuring - generator, phase Lx

	Wiring terminals						Notes
Phase L1							
DSLC-2 terminal	3	4	5	6	7	8	
Phase	X2 - A(L1)	X1 - A(L1)	---	---	---	---	
Phase L2							
DSLC-2 terminal	3	4	5	6	7	8	
Phase	---	---	X2 - B(L2)	X1 - B(L2)	---	---	
Phase L3							
DSLC-2 terminal	3	4	5	6	7	8	
Phase	---	---	---	---	X2 - C(L3)	X1 - C(L3)	

Table 2-15: Current measuring - terminal assignment - generator, phase Lx

Power Measuring

If the unit's current transformers are wired according to the diagram shown, the following values are displayed.

Parameter	Description	Sign displayed
Generator real power	Genset generating kW	+ Positive
Generator real power	Genset in reverse power	- Negative
Generator power factor (cos φ)	Inductive / lagging	+ Positive
Generator power factor (cos φ)	Capacitive / leading	- Negative

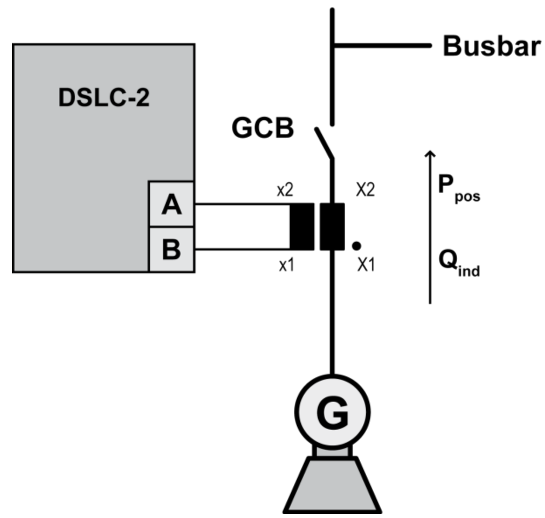


Figure 2-26: Power measuring - direction of power

Figure	Terminal	Description	A_{max}
A	3	X2 A (L1) Generator Current	2.5 mm²
B	4	X1 A (L1) Generator Current	2.5 mm²

Table 2-16: Power measuring - terminal assignment

Power Factor Definition

The phasor diagram is used from the generator's view. Power factor is defined as follows.

Power Factor is defined as a ratio of the real power to apparent power. In a purely resistive circuit, the voltage and current waveforms are instep resulting in a ratio or power factor of 1.00 (often referred to as unity). In an inductive circuit the current lags behind the voltage waveform resulting in usable power (real power) and unusable power (reactive power). This results in a positive ratio or lagging power factor (i.e. 0.85lagging). In a capacitive circuit the current waveform leads the voltage waveform resulting in usable power (real power) and unusable power (reactive power). This results in a negative ratio or a leading power factor (i.e. 0.85leading).

Inductive: Electrical load whose current waveform lags the voltage waveform thus having a lagging power factor. Some inductive loads such as electric motors have a large startup current requirement resulting in lagging power factors.	Capacitive: Electrical load whose current waveform leads the voltage waveform thus having a leading power factor. Some capacitive loads such as capacitor banks or buried cable result in leading power factors.

Different power factor displays at the unit:

i0.91 (inductive) lg.91 (lagging)	c0.93 (capacitive) ld.93 (leading)

Reactive power display at the unit:

70 kvar (positive)	-60 kvar (negative)

Output at the interface:

+ (positive)	- (negative)

In relation to the voltage, the current is

lagging	leading

The generator is

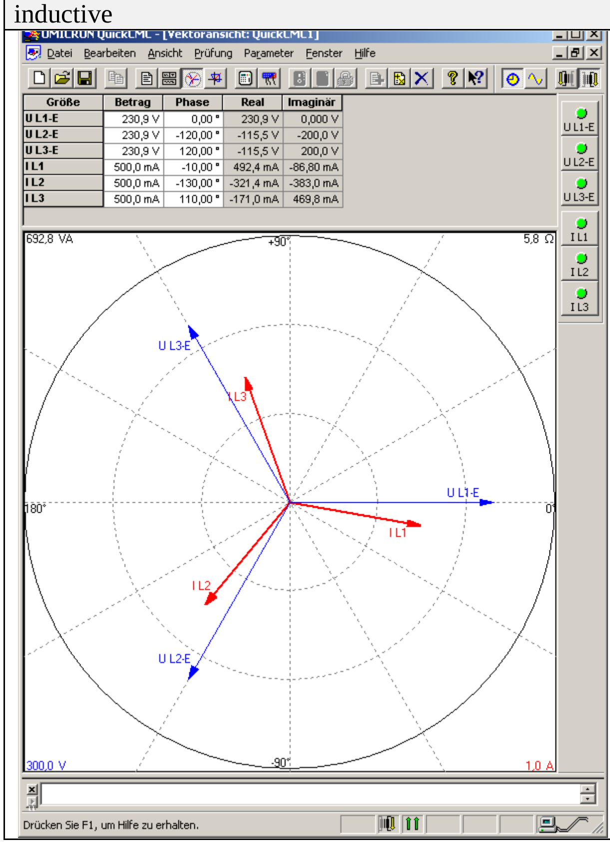
over excited	under excited

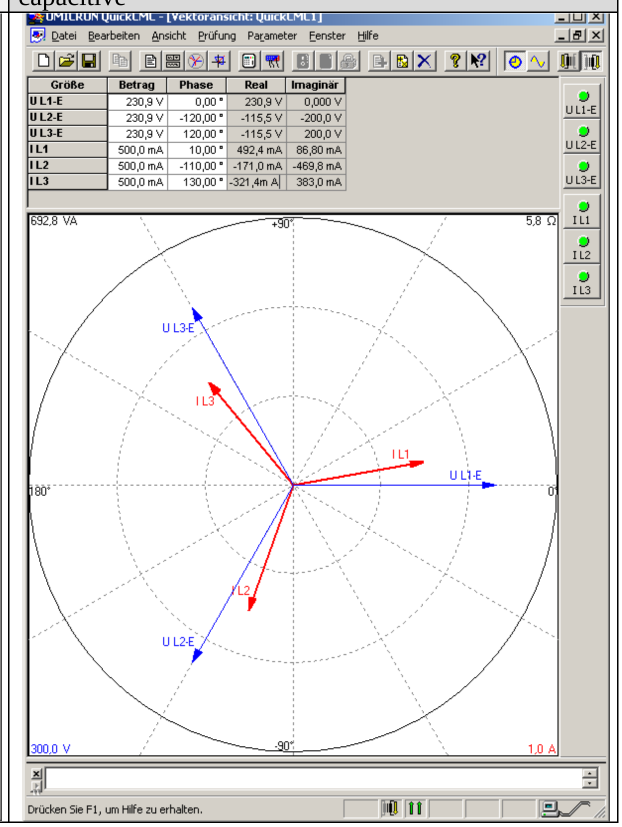
Control: If the control unit is equipped with a power factor controller while in parallel with the utility:

A voltage lower "-" signal is output as long as the measured value is "more inductive" than the reference setpoint Example: measured = i0.91; setpoint = i0.95	A voltage raise "+" signal is output as long as the measured value is "more capacitive" than the reference setpoint Example: measured = c0.91; setpoint = c0.95

Phasor diagram:

inductive	capacitive





Discrete Inputs

Discrete Inputs: Signal Polarity

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

NOTE

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

Discrete Inputs: Positive Polarity Signal

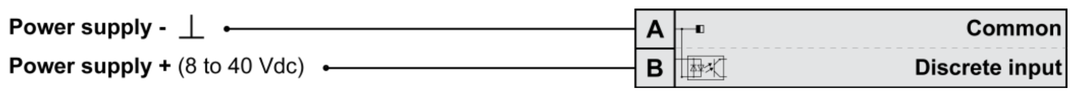


Figure 2-27: Discrete inputs - alarm/control input - positive signal

Discrete Inputs: Negative Polarity Signal

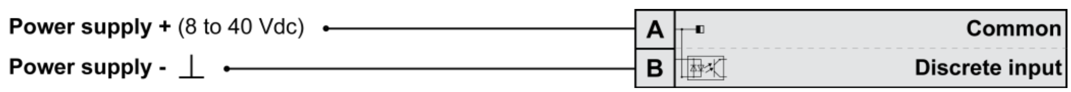


Figure 2-28: Discrete inputs - alarm/control input - negative signal

Terminal		Description			A_{max}
Term.	Com.				
A	B				
66 GND com-mon ground	67	Discrete input [DI 01]	{all}	Check	2.5 mm²
	68	Discrete input [DI 02]	{all}	Permissive	2.5 mm²
	69	Discrete input [DI 03]	{all}	Run	2.5 mm²
	70	Discrete input [DI 04]	{all}	CB Aux	2.5 mm²
	71	Discrete input [DI 05]	{all}	Voltage Raise	2.5 mm²
	72	Discrete input [DI 06]	{all}	Voltage Lower	2.5 mm²
	73	Discrete input [DI 07]	{all}	Base Load	2.5 mm²
	74	Discrete input [DI 08]	{all}	Load/Unload	2.5 mm²
	75	Discrete input [DI 09]	{all}	Ramp Pause	2.5 mm²
	76	Discrete input [DI 10]	{all}	Load Raise	2.5 mm²
	77	Discrete input [DI 11]	{all}	Load Lower	2.5 mm²
	78	Discrete input [DI 12]	{all}	Process Control	2.5 mm²

Table 2-17: Discrete input - terminal assignment ½

Terminal Term. A	Terminal Com. B	Description			A_{max}
152 GND common ground	141	Discrete input [DI 13]	{all}	Segment No. 12 Act.	2.5 mm²
	142	Discrete input [DI 14]	{all}	Segment No. 23 Act.	2.5 mm²
	143	Discrete input [DI 15]	{all}	Segment No. 34 Act.	2.5 mm²
	144	Discrete input [DI 16]	{all}	Segment No. 45 Act.	2.5 mm²
	145	Discrete input [DI 17]	{all}	Segment No. 56 Act.	2.5 mm²
	146	Discrete input [DI 18]	{all}	Segment No. 67 Act.	2.5 mm²
	147	Discrete input [DI 19]	{all}	Segment No. 78 Act.	2.5 mm²
	148	Discrete input [DI 20]	{all}	Segment No. 81 Act.	2.5 mm²
	149	Discrete input [DI 21]	{all}	Droop Tracking	2.5 mm²
	150	Discrete input [DI 22]	{all}	Modbus Reset	2.5 mm²
	151	Discrete input [DI 23]	{all}	Reserved	2.5 mm²

Table 2-18: Discrete input - terminal assignment 2/2

	DI CB AUX	DI Load/ (Unload)	DI Base Load	DI Process Control	DI Ramp Pause	DI Setpoint Raise	DI Setpoint Lower	DI Droop Tracking
Droop	0	x	x	x	x	x	x	0
Load Sharing (at unload trip)	1	0	0	0	0	x	x	0
Load Sharing	1	1	0	0	0	x	x	0
Base Load (at unload trip)	1	0	1	0	0	x	x	0
Base Load	1	1	1	0	0	x	x	0
Base Load Raise	1	1	1	0	0	1	0	0
Base Load Lower	1	1	1	0	0	0	1	0
Ramp Pause	1	x	x	x	1	x	x	0
Base Load Remote	1	1	1	0	0	1	1	0
Process Control	1	1	x	1	0	x	x	0
Process Raise	1	1	x	1	0	1	0	0
Process Lower	1	1	x	1	0	0	1	0
Process Remote	1	1	x	1	0	1	1	0
Droop Tracking	1	x	x	x	x	x	x	1

Table 2-19: Load control modes DSLC-2

Relay Outputs

Figure 2-29: Relay outputs

Terminal Term.	Com.	Description			Type	A_{max}
A	B	Form A, N.O. make contact			Type ⇩	
42	41	Relay output [R 01]	{all}	Alarm (Self Test OK)	N.O.	2.5 mm²
43	46	Relay output [R 02]	{all}	Load Switch	N.O.	2.5 mm²
44		Relay output [R 03]	{all}	High Limit	N.O.	2.5 mm²
45		Relay output [R 04]	{all}	Low Limit	N.O.	2.5 mm²
48	47	Relay output [R 05]	{all}	Breaker Open *1	N.O.	2.5 mm²
50	49	Relay output [R 06]	{all}	Breaker Close	N.O.	2.5 mm²
52	51	Relay output [R 07]	{all}	Centr. Alarm	N.O.	2.5 mm²
54	53	Relay output [R 08]	{all}	Alarm 1	N.O.	2.5 mm²
56	55	Relay output [R 09]	{all}	Alarm 2	N.O.	2.5 mm²
57	60	Relay output [R 10]	{all}	Alarm 3	N.O.	2.5 mm²
58		Relay output [R 11]	{all}	Voltage Raise	N.O.	2.5 mm²
59		Relay output [R 12]	{all}	Voltage Lower	N.O.	2.5 mm²

N.O.-normally open (make) contact *1 = inverted relay

Table 2-20: Relay outputs - terminal assignment

CAUTION

The discrete output "Alarm (Self Test OK)" can be wired in series with an emergency stop function. This means that it must be ensured that the generator circuit breaker can be opened, if this discrete output is de-energized. We recommend to signal this fault independently from the unit if the availability of the plant is important.

NOTE

The relay output [R 05] "Breaker Open" opens the breaker by opening the contacts. The contacts are closed if the generator voltage and frequency are in operating range and no open command is active.

	DO Alarm	DO Load Switch	DO High Limit	DO Low Limit	DO Breaker Open	DO Breaker Close	DO Centr. Alarm	DO Alarm 1	DO Alarm 2	DO Alarm 3	DO Voltage Raise	DO Voltage Lower
Self Test	x											
Load switch alarm **Reverse power**		x										
High load limit **High process limit** **High voltage limit**			x									
Low load limit **Low process limit** **Low voltage limit**				x								
Gen. out of range **Gen. Unload (DI 8)**					x							
Synchronization-dead bus closure						x						
Synchronizer timeout **Reclose limit** **High load limit** **Low load limit** **High process limit** **Low process limit** **Low voltage limit,** **High voltage limit** **Voltage range limit** **Communication error** **Missing member** **Centralized alarm** **GCB open fail**							x	x	x	x		
3pos voltage increase **3pos pf increase**											x	x
3pos voltage lower **3pos pf lower**											x	x

NOTE

Refer to Appendix B: “Connecting 24 V Relays“ on page 205 for interference suppressing circuits when connecting 24 V relays.

Analog Inputs

The following senders may be used for the analog inputs:

- 0 to 20mA
- 4 to 20mA
- 0 to 10V
- 0 to 5V
- 1 to 5V

Wiring Examples

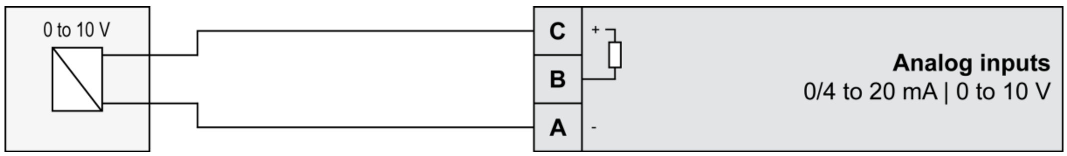


Figure 2-30: Analog inputs - wiring two-pole senders

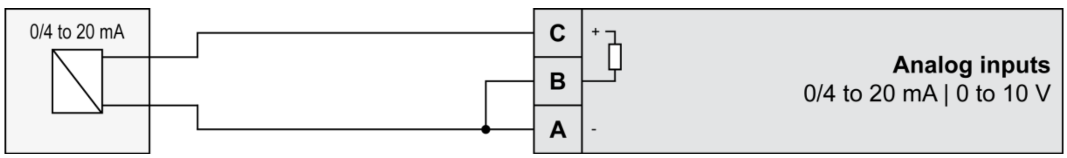


Figure 2-31: Analog inputs - wiring two-pole senders, external jumper used for current input.

Figure	Terminal	Description	A_{max}
A	83	**Analog input [AI 01]** Remote Load Reference Input	2.5 mm²
B	84		2.5 mm²
C	85		2.5 mm²
A	86	**Analog input [AI 02]** Process Signal Input	2.5 mm²
B	87		2.5 mm²
C	88		2.5 mm²
A	89	**Analog input [AI 03]** Reactive Load Input	2.5 mm²
B	90		2.5 mm²
C	91		2.5 mm²

Table 2-21: Analog inputs - terminal assignment - wiring two-pole senders

Analog Outputs

Controller speed and voltage bias output signals. Jumper configuration will change the function for a voltage output signal. Configuration for the speed and voltage bias outputs is done in Menu 6.2.

Controller Wiring

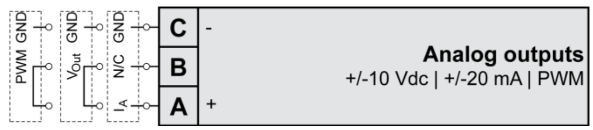


Figure 2-32: Analog controller output - Wiring and external jumper setting

Type	Terminal			Description	A_{max}
I Current	A	15	I_A	**Analog output [AO 01]** Speed Bias	2.5 mm²
	B	16			2.5 mm²
	C	17	GND		2.5 mm²
V Voltage	A	15			2.5 mm²
	B	16	V_A		2.5 mm²
	C	17	GND		2.5 mm²
PWM	A	15			2.5 mm²
	B	16	PWM		2.5 mm²
	C	17	GND		2.5 mm²
I Current	A	18	I_A	**Analog output [AO 02]** Voltage Bias	2.5 mm²
	B	19			2.5 mm²
	C	20	GND		2.5 mm²
V Voltage	A	18			2.5 mm²
	B	19	V_A		2.5 mm²
	C	20	GND		2.5 mm²
PWM	A	18			2.5 mm²
	B	19	PWM		2.5 mm²
	C	20	GND		2.5 mm²

Table 2-22: Bias signal outputs - analog or PWM

Interfaces

RS-485 Serial Interface (Serial Interface #2)

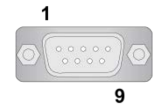


Figure 2-33: RS-485 interface #1 - overview

Terminal	Description	A_{max}
1	not connected	N/A
2	B (TxD+)	N/A
3	not connected	N/A
4	B' (RxD+)	N/A
5	not connected	N/A
6	not connected	N/A
7	A (TxD-)	N/A
8	not connected	N/A
9	A' (RxD-)	N/A

Table 2-23: RS-485 interface #1 - pin assignment

Half-Duplex with Modbus on RS-485

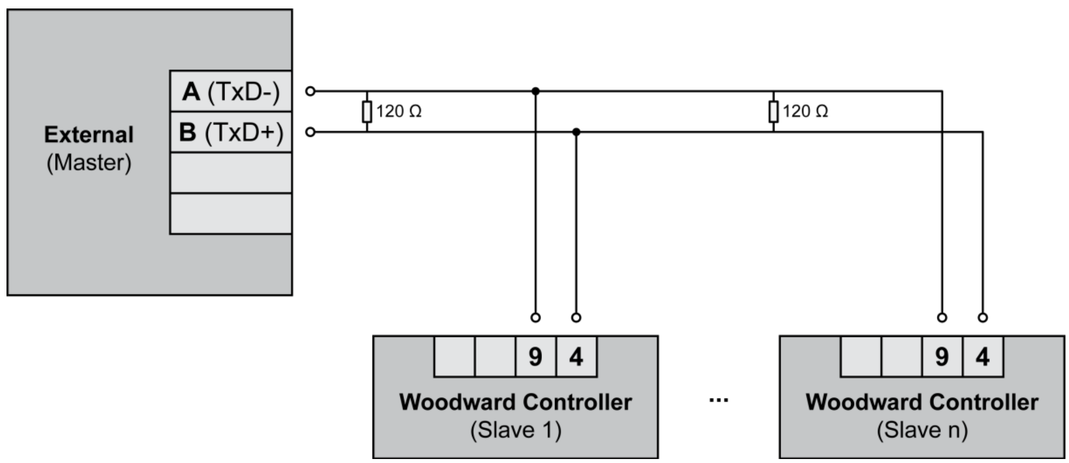


Figure 2-34: RS-485 Modbus - connection for half-duplex operation

Full-Duplex with Modbus on RS-485

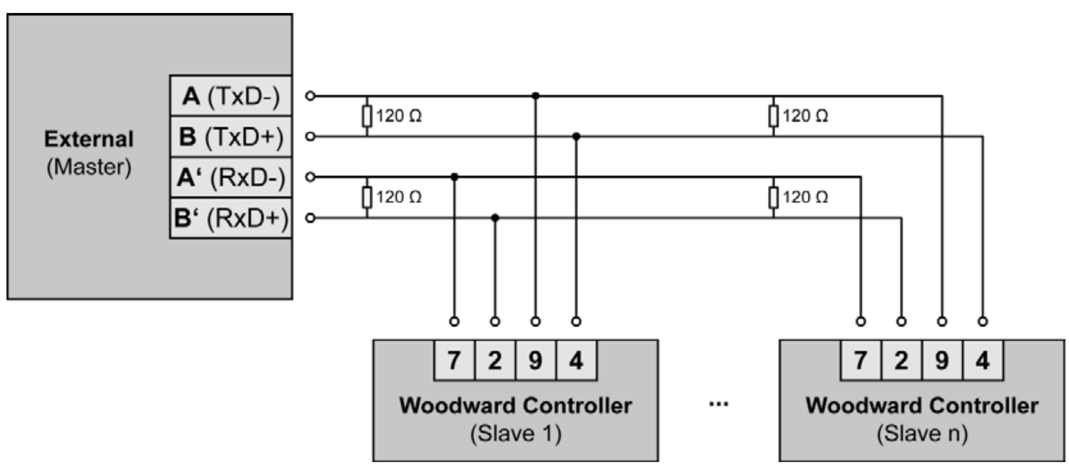


Figure 2-35: RS-485 Modbus - connection for full-duplex operation

NOTE

Please note that the DSLC-2 must be configured for half- or full-duplex configuration (parameter 3173).

RS-232 Serial Interface (Serial Interface #1)

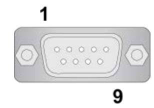


Figure 2-36: RS-232 interface - overview

Terminal	Description	A_{max}
1	not connected	N/A
2	RxD (receive data)	N/A
3	TxD (transmit data)	N/A
4	not connected	N/A
5	GND (system ground)	N/A
6	not connected	N/A
7	RTS (request to send)	N/A
8	CTS (clear to send)	N/A
9	not connected	N/A

Table 2-24: RS-232 interface - pin assignment

RJ-45 Ethernet Interfaces (Network A, Network B)

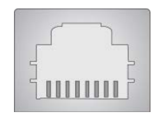


Figure 2-37: RJ-45 interfaces - overview

Terminal	Description	A_{max}
1	Tx+	N/A
2	Tx-	N/A
3	Rx+	N/A
4	not connected	N/A
5	not connected	N/A
6	Rx-	N/A
7	not connected	N/A
8	not connected	N/A

Table 2-25: RJ-45 interfaces - pin assignment

Chapter 3.
Configuration & Operation

Configuration Via PC

Install ToolKit Configuration And Visualization Software

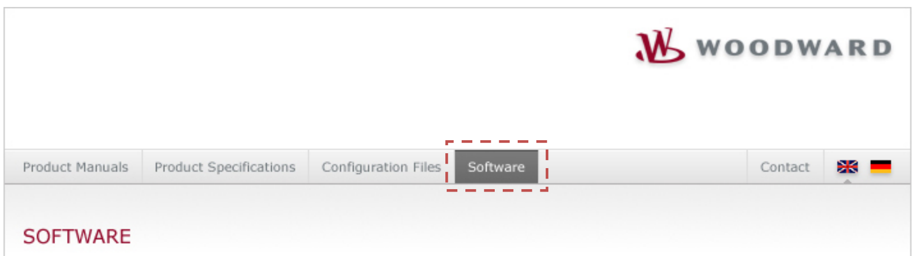
NOTE

Woodward's ToolKit software is required to configure the unit via PC.

ToolKit Version 3.6.0 or higher

Install ToolKit Software

1. Please insert the enclosed Product CD in the CD-ROM drive of your computer
2. The CD is going to start automatically (autostart function needs to be activated)
3. Please go to the section "Software" and follow the instructions described there



Alternatively ToolKit can be downloaded from our Website. Please proceed as follows:

1. Go to http://www.woodward.com/software
2. Select ToolKit in the list and click the "Go" button
3. Click "More Info" to get further information about ToolKit
4. Choose the preferred software version and click "Download"
5. Now you need to login with your e-mail address or register first
6. The download will start immediatly

Minimum system requirements for ToolKit:

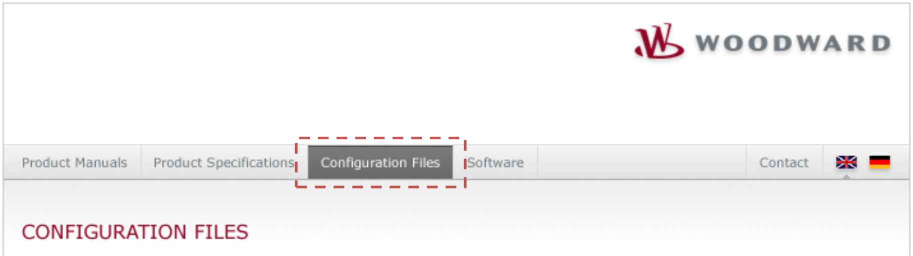
- Microsoft Windows® 7, Vista, XP (32- & 64-bit)
- Microsoft .NET Framework Ver. 3.5
- 600 MHz Pentium® CPU
- 96 MB of RAM
- Minimum 800 by 600 pixel screen with 256 colors
- Serial Port
- CD-ROM drive

NOTE

Microsoft .NET Framework 3.5 must be installed on your computer to be able to install ToolKit. If not already installed, Microsoft .NET Framework 3.5 will be installed automatically. You must be connected to the internet for this. Alternatively you can use the .NET Framework 3.5 installer which can be found on the Product CD.

Install ToolKit Configuration Files

1. *Please insert the enclosed Product CD in the CD-ROM drive of your computer*
2. *The CD is going to start automatically (autostart function needs to be activated)*
3. Please go to the section “Configuration Files” and follow the instructions described there



Alternatively ToolKit configuration files can be downloaded from our Website. Please proceed as follows:

1. Go to http://www.woodward.com/software/configfiles/
2. Please insert the part number (P/N) and revision of your device into the corresponding fields
3. Select ToolKit in the application type list
4. Click “Search”

NOTE

ToolKit is using the following files:

***.WTOOL**

File name composition:	**[P/N1]*[1]-[Revision]_[Language ID]_[P/N2]*[2]-[Revision]_[# of visualized gens].WTOOL**
Example file name:	**8440-1234-NEW_US_5418-1234-NEW.WTOOL**
Content of the file:	**Display screens and pages for online configuration, which are associated with the respective *.SID file**

***.SID**

File name composition:	**[P/N2]*[2]-[Revision].SID**
Example file name:	**5418-1234-NEW.SID**
Content of the file:	**All display and configuration parameters available in ToolKit**

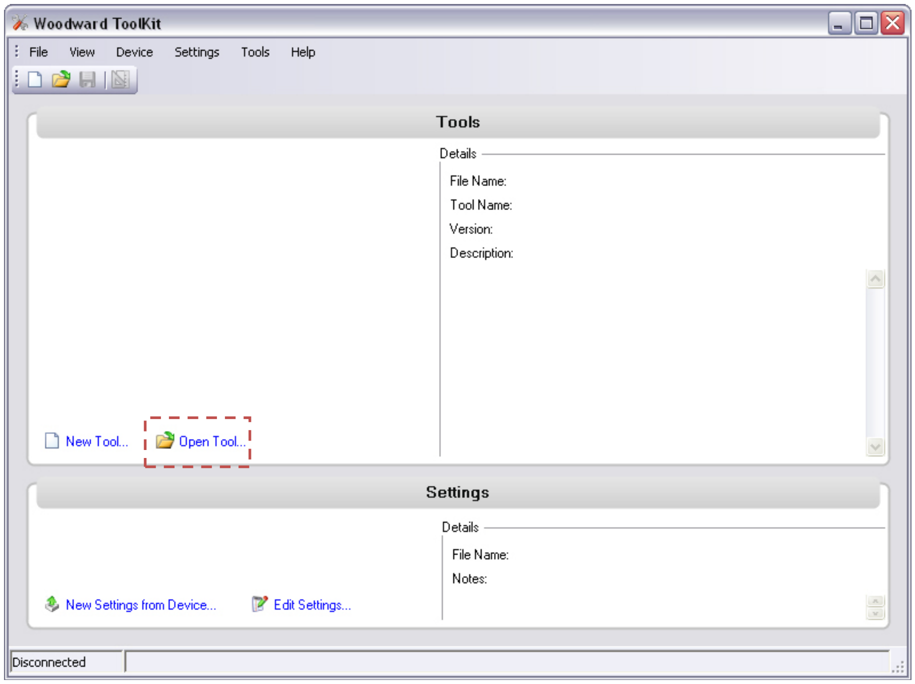
***.WSET**

File name composition:	**[user defined].WSET**
Example file name:	**easYgen_settings.WSET**
Content of the file:	**Default settings of the ToolKit configuration parameters provided by the SID file or user-defined settings read out of the unit.**

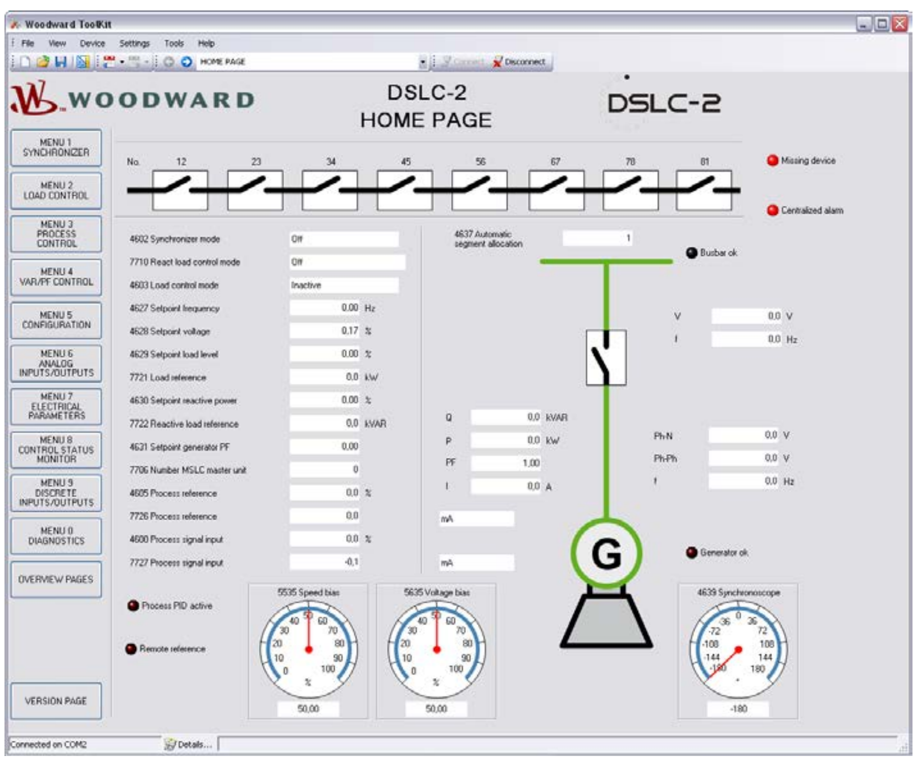
***[1] P/N1 = Part number of the unit**
***[2] P/N2 = Part number of the software in the unit**

Starting ToolKit Software

1. Start ToolKit via Windows Start menu -> Programs ->Woodward -> ToolKit 3.x
2. Please press the button “Open Tool”

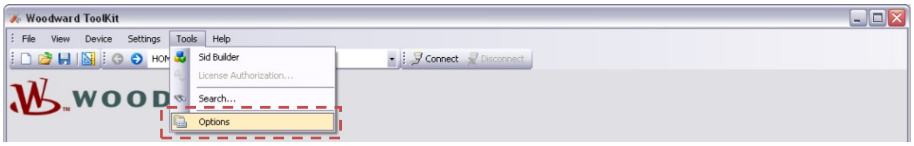


3. Go to the “Application” folder and open then the folder equal to the part number (P/N) of your device (e.g. 8440-1234). Select the wtool file (e.g. 8440-1234-NEW_US_5418-1234-NEW.wtool) and click “Open” to start the configuration file
4. Now the home page of the ToolKit configuration screen appears

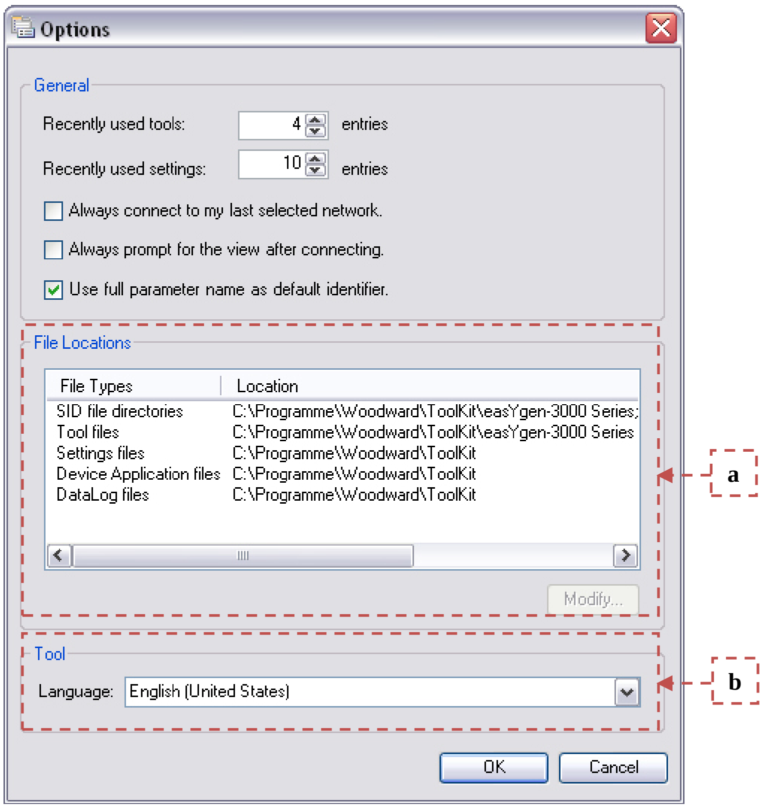


Configure ToolKit Software

1. Start the configuration by using the toolbar. Please go to Tools -> Options



2. The options window will be displayed



   a. Adjust the default locations of the configuration files
   b. The displayed language can be selected here

3. The changes become effective after clicking “OK”

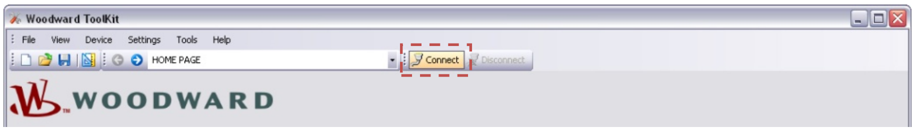
NOTE

Please use the ToolKit online help for further information.

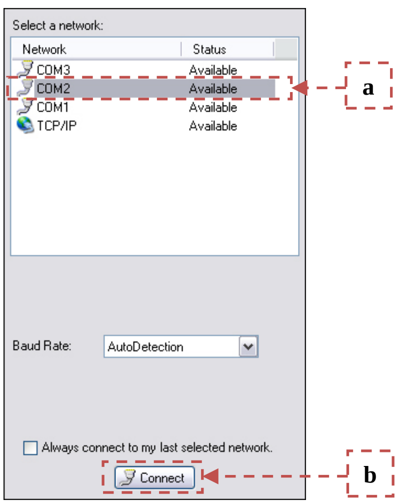
Connect ToolKit And The DSLC-2 Unit

For configuration of the unit via ToolKit please proceed as follows:

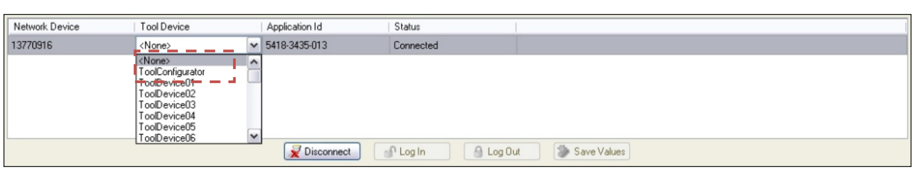
1. Connect the null modem communications cable between your PC and the control unit. Plug the null modem cable into the RS-232 serial port on unit and the other side to a serial COM port of the PC. If the PC does not have a serial port to connect the null modem cable to, use a USB to serial adapter.
2. *Open ToolKit via Windows Start menu -> Programs -> Woodward -> ToolKit 3.x*
3. *From the main ToolKit window, click File then select "Open Tool"... or click the Open Tool icon on the tool bar.*
4. *Locate and select the desired tool file (*.WTOOL) in the ToolKit data file directory and click Open.*
5. From the main ToolKit window, click Device then click "Connect" or select the Connect icon on the toolbar.



6. The connect dialog window will open if the option is enabled.



   a. Select the COM port that is connected to the communication cable.
   b. Click the "Connect" button.
7. The identifier of the device that ToolKit is connected to, will display in the status bar.
8. If the Communications window opens, select "ToolConfigurator" under Tool Device and close the Communications window.



9. If the device is security enabled, the Login dialog will appear.
10. Enter password
11. Now you are able to edit the DSLC-2 parameters in the main window. Any changes made are written to the control memory automatically.

View DSLC-2 Data With ToolKit

The following figure shows an example visualization screen of ToolKit:

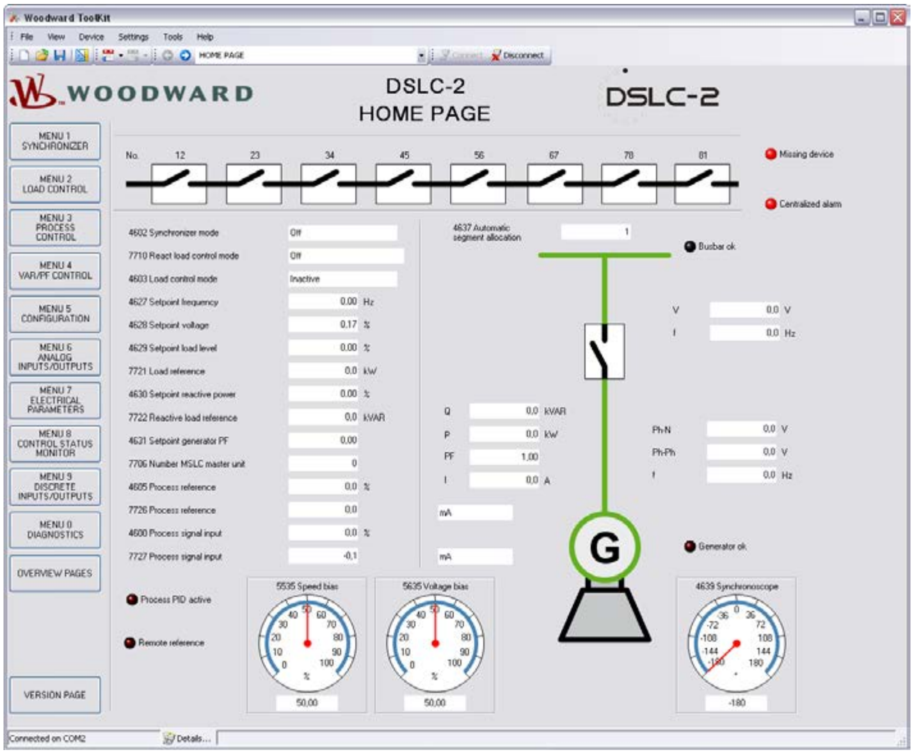


Figure 3-1: ToolKit - visualization screen

Navigation through the various visualization and configuration screens is performed by clicking on the and icons, by selecting a navigation button (e.g. STATUS MENU) or by selecting a screen from the drop-down list to the right of the arrow icons.

It is possible to view a trend chart of up to eight values with the trending tool utility of ToolKit. The following figure shows a trending screen of the measured battery voltage value:

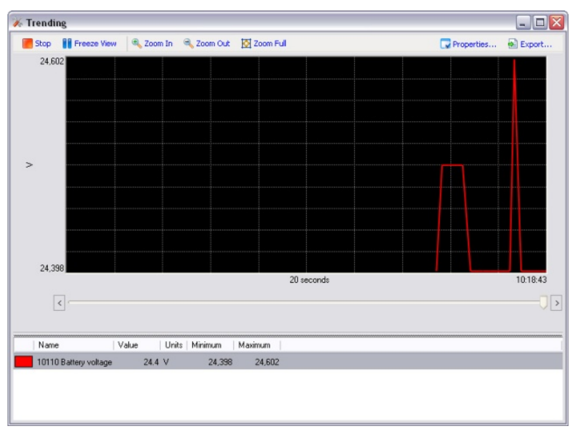


Figure 3-2: ToolKit - analog value trending screen

Each visualization screen provides for trending of monitored values by right-clicking on a value and selecting the "Add to trend" function. Trending is initiated by clicking on the Start button. Clicking the Export… button will save the trend data to a Comma Separated Values (CSV) file for viewing, editing or printing with office software, like Microsoft Excel, etc. The Properties… button is used to define high and low limits of the scale, sample rate, displayed time span and color of the graph.

Configure The DSLC-2 With ToolKit

The following figure shows an example configuration screen of ToolKit:

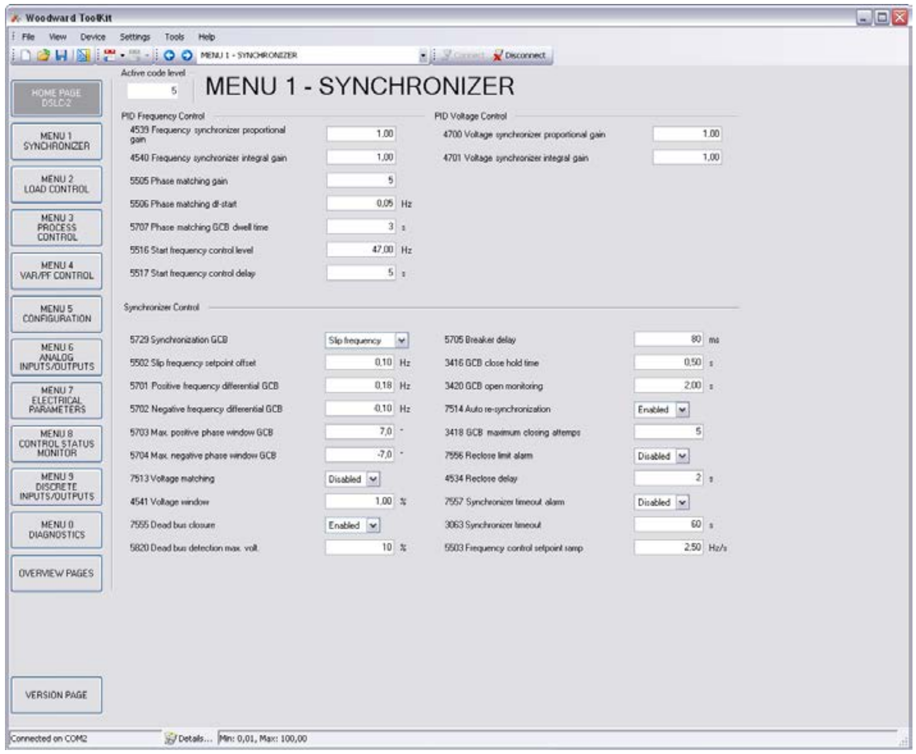


Figure 3-3: ToolKit - configuration screen

Entering a new value or selecting a value from a defined list will change the value in a field. The new value is written to the controller memory by changing to a new field or pressing the Enter key.

Navigation through the various configuration and visualization screens is performed by clicking on the and icons, by selecting a navigation button (e.g. STATUS MENU) or by selecting a screen from the drop-down list to the right of the arrow icons.

The DSLC-2 Version Page

The ToolKit version page allows you to check the serial number of the unit and versions of the bootloader, operating system and GAP application.

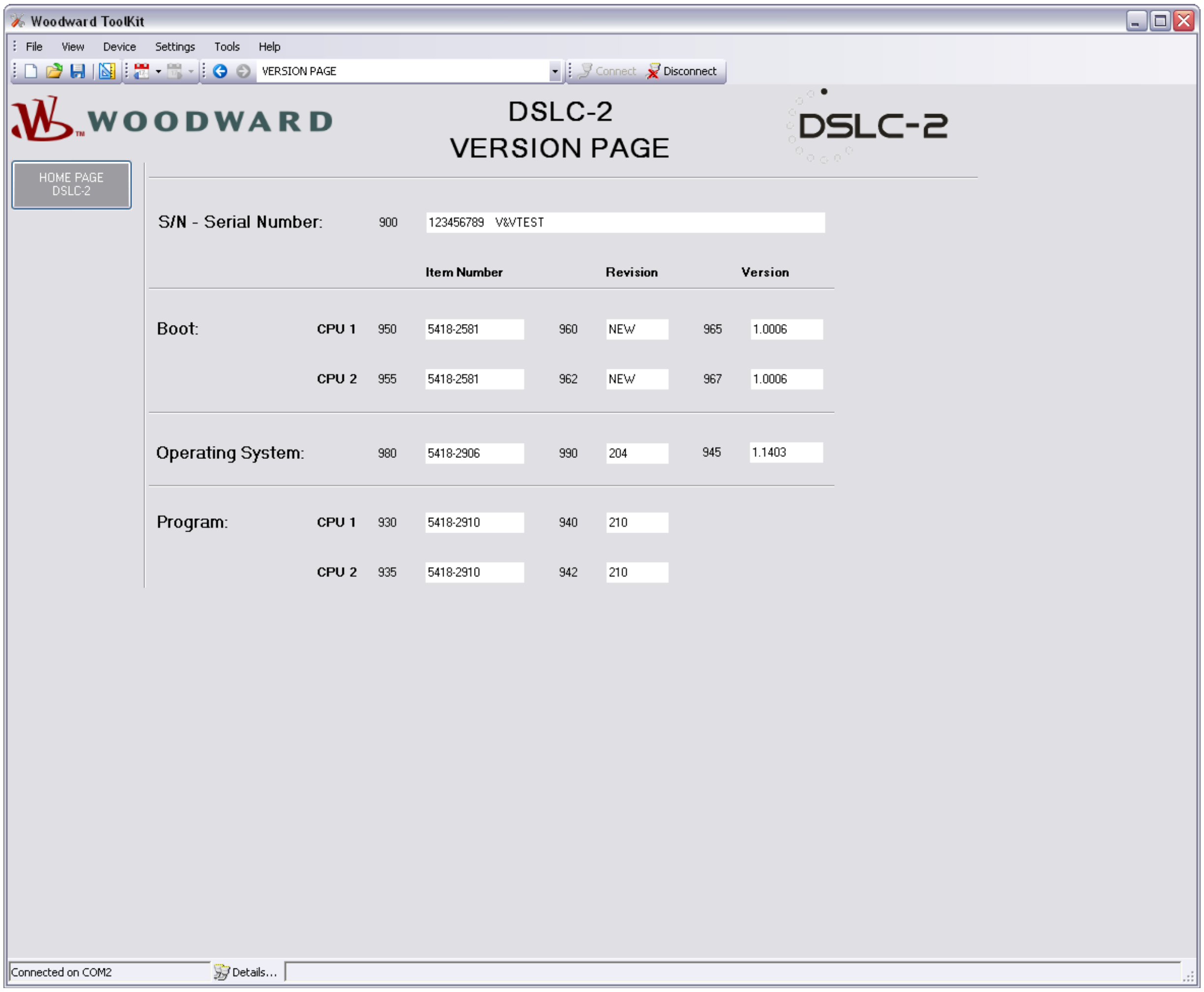


Figure 3-4: ToolKit -version page

Menu (Setpoint) Description

All parameters are assigned a unique parameter identification number (ID). The parameter identification number may be used to reference individual parameters listed in this manual. This parameter identification number is also displayed in the ToolKit configuration screens next to the respective parameter.

DSLC-2 – Homepage

This is the basic page of the DSLC-2. It gives general information, such as:

- The generator condition
- The busbar condition
- The condition of the breaker
- The mode of operation
- The speed and voltage output
- The segment breaker state

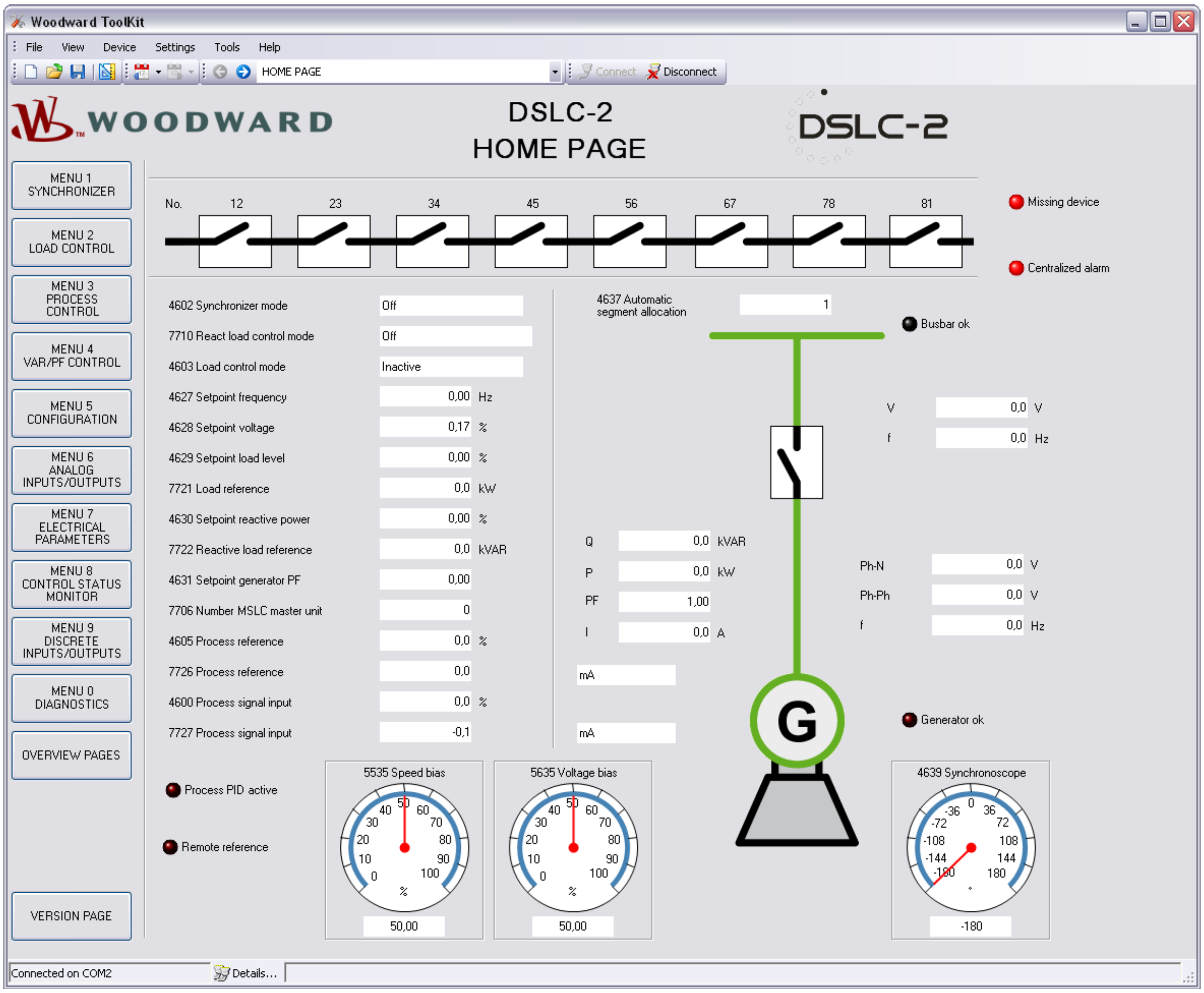


Figure 3-5: ToolKit - home page

General

ID	Parameter	CL	Setting range	Format	Description
4602	**Synchronizer mode**	-	Off / Synchronized / Permissive / Check / Run / Sync Timer / Auto-Off / Close Timer	-	Display of the different *Synchronizer modes*: **Off:** The synchronizer is not active. **Synchronized:** The GCB is closed. **Permissive:** The synchronizer runs in permissive mode. **Check:** The synchronizer runs in check mode. **Run:** The synchronizer is full active. **Sync Timer:** The synchronizer is stopped, because of a sync time-out. **Auto-Off:** The synchronizer is stopped, because of an unsuccess-ful closure of the GCB. (resync is disabled). **Close Timer:** This is the GCB close command.
7710	**Reactive load control mode**	-	Off / Inactive / Droop / VAR sharing / VAR control / PF control	-	Display of the different *Reactive load control modes*: **Off:** The reactive load control mode is disabled. **Inactive:** The reactive load control is not active. **Droop:** The reactive load control runs in droop or droop tracking. **VAR sharing:** The reactive load sharing is active. **VAR control:** The reactive load control with kvar reference is ac-tive. **PF control:** The reactive load control with power factor reference is active.
4603	**Load control mode**	-	Droop / At Unload Trip / Base Load / Base Load Ramp / Base Load Lower / Base Load Raise / Load share unload / Load share Ramp / Load sharing / Base Load Unload / Process Ramp / Process Control / Process Lower / Process Raise / Inactive	-	Display of the different *Load control modes*: **Droop:** The Load control runs in droop or droop tracking. **At Unload Trip:** The Load control or the load share control re-sides in unloaded condition. **Base Load:** The Load control runs in base load. **Base Load Ramp:** The Load control ramps to a reference value. **Base Load Lower:** A base load lower command is active. **Base Load Raise:** A base load raise command is active. **Load share unload:** The load sharing unloads the generator and the GCB will be opened. **Load share Ramp:** The load sharing loads the generator. **Load sharing:** The load sharing mode is active. **Base Load Unload:** The load control unloads the generator. **Process Ramp:** The generator is ramped to the process control reference. **Process Control:** The process control mode is active. **Process Lower:** A process reference lower command is active. **Process Raise:** A process reference raise command is active. **Inactive:** The load control is inactive.
4627	**Setpoint frequency**	-	Info	0.00 Hz	Indicates the S*etpoint Frequency* in Hz.
4628	**Setpoint voltage**	-	Info	0.00 %	Indicates the *Setpoint Voltage* in percentage.
4629	**Setpoint load level**	-	Info	0.00 %	Indicates the load level setpoint in percentage.
7721	**Load reference**	-	Info	0.0 kW	Indicates the load level setpoint in kW.
4630	**Setpoint reactive power**	-	Info	0.00 %	Indicates the reactive load level setpoint in percentage.
7722	**Reactive load refer-ence**	-	Info	0.0 kvar	Indicates the reactive load level setpoint in kvar.
4631	**Setpoint generator PF**	-	Info	0.00	Indicates the power factor setpoint.
7706	**Number MSLC Master Unit**	-	Info	0	Indicates the device number of the master MSLC-2. If no master MSLC-2 is available, 0 is displayed.

ID	Parameter	CL	Setting range	Format	Description
4605	**Process reference**	-	Info	0.0 %	Indicates the *Process reference* value in percentage.
7726	**Process reference**	-	Info	0.0 kW	Indicates the *Process reference* value in engineering units.
4600	**Process signal input**	-	Info	0.0 %	Indicates the *Process signal input* value in percentage.
7727	**Process signal input**	-	Info	0.0 kW	Indicates the *Process signal input* value in engineering units.
5535	**Speed bias**	-	Info	0.00 %	The gage indicates the *Speed Bias* signal output.
5635	**Voltage bias**	-	Info	0.00 %	The gage indicates the *Voltage Bias* signal output.
4639	**Synchro scope**	-	Info	0°	The gage illustrates a *Synchroscope* for the relation generator voltage to busbar voltage in degrees.
4637	**Automatic segment allocation**	-	Info	0	The field indicates the segment number for this unit.

Table 3-6: Parameter - homepage

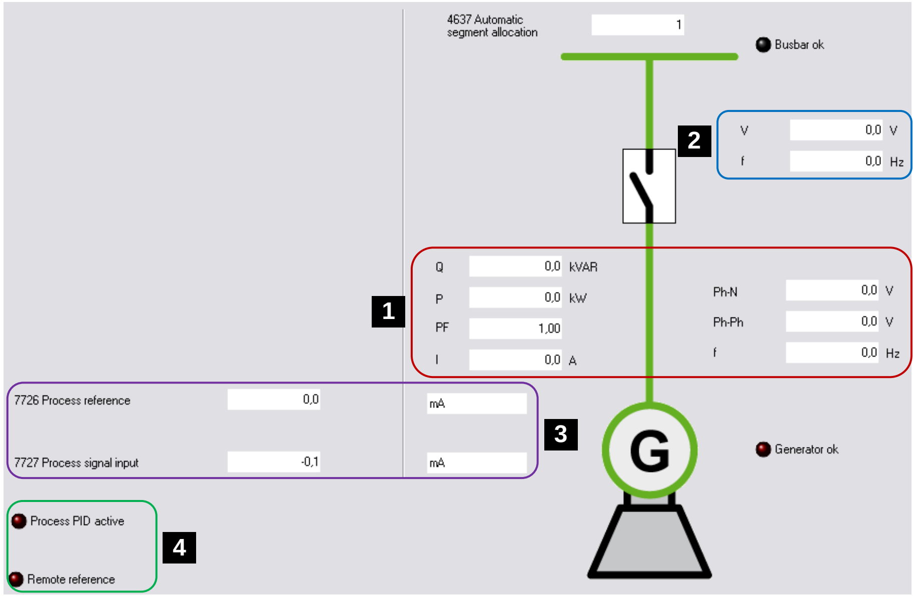


Figure 3-7: ToolKit - home page - generator

If the electrical diagram is shown in "Red" the electrical bar is live. Respectively an electrical diagram shown in "Green" means a dead bar. *1

1

Q: Real reactive load of the generator in kvar.
P: Real load of the generator in kW.
PF: Power factor of the generator.
I: Average current of the generator in A.
Ph-N: Average Phase-neutral voltage of the generator in Volt.
Ph-Ph: Average Phase-phase voltage of the generator in Volt.
f: Real frequency of the generator in Hz.

2

V: Busbar voltage in Volt.
f: Real frequency of the busbar in Hz.

3

7726 Process reference: mA - Example of a configurable engineering unit.
7727 Process signal input: mA - Example of a configurable engineering unit.

4

LED: *Process PID active* – Indicates that the process control PID is activated.
LED: *Remote Reference* – Indicates that the load control or the reactive load control setpoint comes by analog input.

*1 The parameter *Dead bus detection max. volt.* (parameter 5820) defines the dead bus condition.

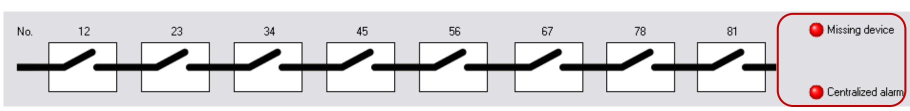


Figure 3-8: ToolKit - home page - segments

This figure indicates which segments in the DSLC-2 / MSLC-2 system are interconnected.

LED: *Missing device* – Indicates that the configured number of connected members (DSLC-2 and MSLC-2) is not recognized on the network.
LED: *Centralized alarm* – Any configured alarm is active.

Menu 1 – Synchronizer

This menu contains the adjustments of the synchronizer.

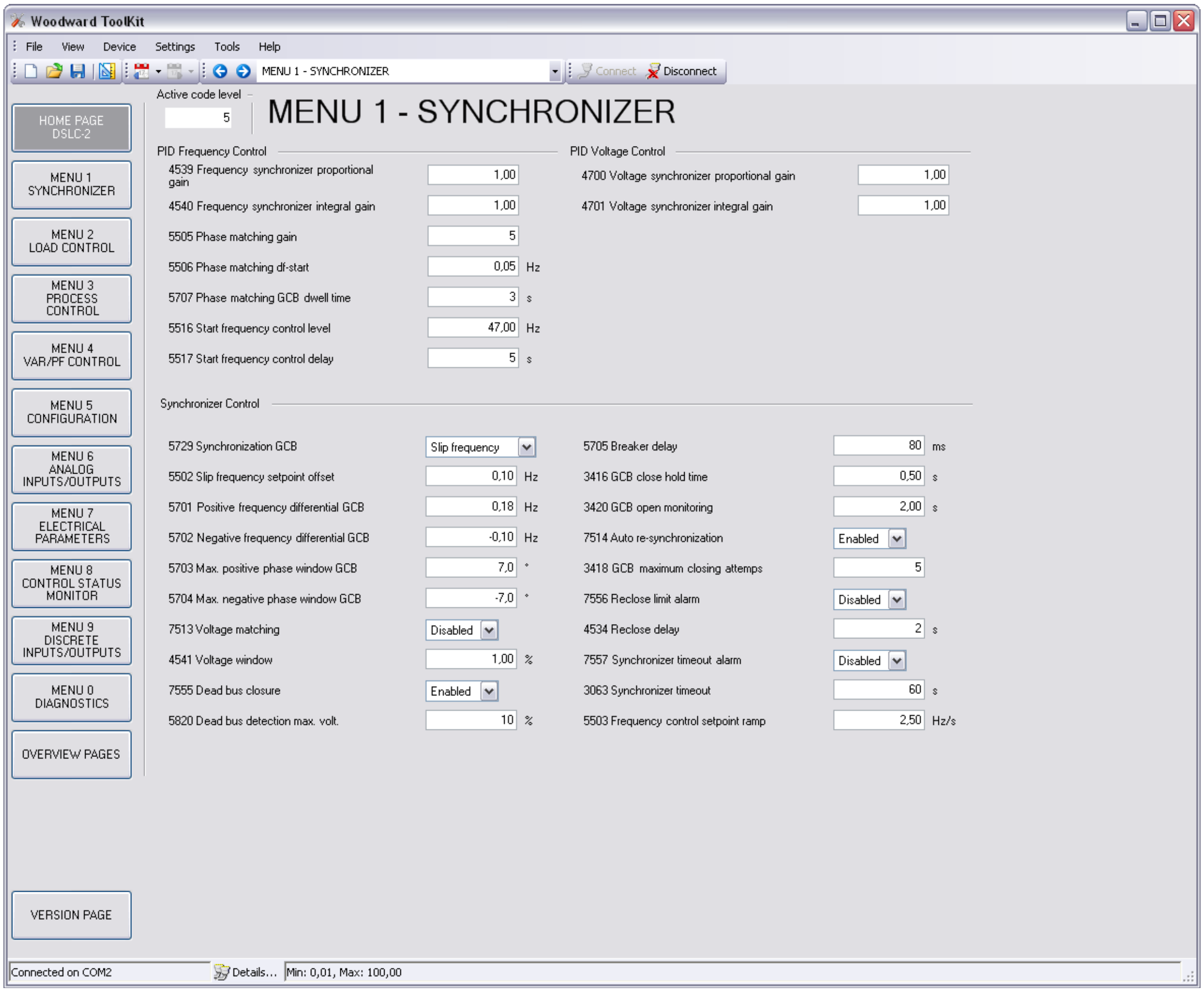


Figure 3-9: ToolKit – synchronizer

PID Frequency Control

ID	Parameter	CL	Setting range	Default	Description
4539	**Frequency synchronizer proportional gain**	2	0.01 to 100.00	1.00	Frequency sync gain determines how fast the synchronizer responds to an error in speed or phase. Adjust gain to provide stable control during synchronizing. Lower value to slow response.
4540	**Frequency synchronizer integral gain**	2	0.00 to 20.00	1.00	Frequency sync integral gain compensates for delay in the synchronizer control loop. Prevents low frequency hunting and damping (overshoot or undershoot). Lower value to slow response.
5505	**Phase matching gain**	2	1 to 99	5	The *Phase matching gain* increases or decreases the influence of the phase angle deviation to the frequency control. Prevents frequency hunting and damping (overshoot or undershoot) when the synchronizer is enabled with phase matching function.
5506	**Phase matching df-start**	2	0.02 to 0.25 Hz	0.05 Hz	Phase matching is started if the frequency difference between the systems to be synchronized is below the configured value.
5707	**Phase matching GCB dwell time**	2	0 to 60.0 s	0.5 s	Dwell Time: 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. Set to lower time for quicker breaker closure commands.

ID	Parameter	CL	Setting range	Default	Description
5516	**Start frequency control level**	1	15.00 to 70.00 Hz	58.00 Hz	The frequency controller is activated when the monitored generator frequency has exceeded the value configured in this parameter. This prevents the DSLC-2 from attempting to control the frequency while the engine is completing its start sequence.
5517	**Start frequency control delay**	1	0 to 999 s	2 s	The frequency controller is enabled after the configured time for this parameter expires.

PID Voltage Control

ID	Parameter	CL	Setting range	Default	Description
4700	**Voltage synchronizer proportional gain**	2	0.01 to 100.00	1.00	Voltage sync gain determines how fast the synchronizer responds to a voltage deviation. Adjust gain to provide stable control during synchronizing. Lower value to slow response.
4701	**Voltage synchronizer integral gain**	2	0.01 to 100.00	1.00	Voltage sync stability compensates for delay in the synchronizer voltage control loop. Prevents low voltage hunting and damping (overshoot or undershoot) when the synchronizer is enabled. Lower value to slow response.

Synchronizer Control

ID	Parameter	CL	Setting range	Default	Description
5729	**Synchronization GCB**	2	Slip frequency./. Phase matching	Phase matching	**Slip frequency:** The synchronizer adjusts the generator frequency to a point greater than the busbar. The slip frequency is determined by the setting of *Slip frequency setpoint offset* (parameter 5502). The generator will always close to the bus at a higher frequency, eliminating the possibility of reverse power. **Phase matching:** The frequency controller adjusts the phase angle of the generator to that of the busbar.
5502	**Slip frequency setpoint offset**	2	0.00 to 0.50 Hz	0.10 Hz	The offset for the synchronization to the busbar. With this offset, the unit synchronizes with a positive slip. **Example:** If this parameter is configured to 0.10 Hz and the busbar/mains frequency is 60.00 Hz, the synchronization setpoint is 60.10 Hz.
5701	**Positive frequency differential GCB**	2	0.02 to 0.49 Hz	0.18 Hz	The prerequisite for a close command being issued for the GCB 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 busbar frequency).
5702	**Negative frequency differential GCB**	2	-0.49 to 0.00 Hz	-0.10 Hz	The prerequisite for a close command being issued for the GCB 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 busbar frequency).
5703	**Max. positive phase window GCB**	2	0.0 to 60.0 °	7.0 °	The prerequisite for a close command being issued for the GCB is that the leading phase angle between generator and busbar is below the configured maximum permissible angle.
5704	**Max. negative phase window GCB**	2	-60.0 to 0.0 °	-7.0 °	The prerequisite for a close command being issued for the GCB is that the lagging phase angle between generator and busbar is above the configured minimum permissible angle.
7513	**Voltage matching**	2	Disabled / Enabled	Enabled	Enables or disables the synchronizer voltage matching function. Independent on this setting the voltage control is still executed but the synchronizer does not care about the voltage matching.
4541	**Voltage window**	2	0.50 to 10.00 %	0.50 %	The maximum permissible voltage differential for closing the breaker is configured here. If the difference between generator and busbar voltage does not exceed the value configured here and the generator- and busbar voltages are within the according operating voltage windows, the "Command: Breaker Close" may be issued. ***NOTE:*** *When* Voltage matching *(parameter 7513) is “Disabled”, the voltage window is set to the maximum value of 10 %.*
7555	**Dead bus closure**	2	Disabled / Enabled	Enabled	Enables or disables the synchronizer's automatic deadbus detection and breaker closure functions. When enabled, the synchronizer will insure a breaker closure signal when a dead-bus is detected. (This incorporates the dead busbar closure negotiation to potential other DSLC-2 or MSLC-2 devices)
5820	**Deadbus detection max. volt.**	2	0 to 30 %	10 %	Adjustable voltage in percentage of busbar rated voltage for deadbus detection.
5705	**Breaker delay**	2	40 to 300 ms	80 ms	The inherent closing time of the GCB 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.
3416	**GCB close hold time**	2	0.10 to 0.50 s	0.50 s	The time of the pulse output may be adjusted to the breaker being closed.
3420	**GCB open monitoring**	2	0.10 to 5.00 s	2.00 s	If the "Reply: Breaker Open" is not detected as energized once this timer expires, a "GCB fail to open" alarm is issued. This timer initiates as soon as the "Open breaker" sequence begins.

ID	Parameter	CL	Setting range	Default	Description
7514	**Auto resynchronization**	2	Disabled / Enabled	Disabled	Enables or disables the synchronizer function after achieving synchronization. Synchronization is assumed to have been achieved if one *Reclose delay* time interval passes with the “CB Aux” contact closed. **Disabled:** If this setpoint is set to disabled, the synchronizer is set to auto-off mode after synchronizing. Has no effect on the control. **Enabled:** If the “CB Aux” contact opens and an operating mode is selected (Run, Check or Permissive), the synchronizer will automatically restart in the selected operating mode. On restart, the synch timeout timer and close attempts count are reset to their specified values.
3418	**GCB maximum closing attempts**	2	1 to 10	5	The maximum number of breaker closing attempts if the *Reclose limit alarm* (parameter 7556) is “Enabled”. If “Disabled” this parameter is disregarded. See chapter 4, “Synchronizer Description”, for close command information.
7556	**Reclose limit alarm**	2	Disabled / Enabled	Enabled	Enables or disables the alarm generated when reaching the maximum close attempts.
4534	**Reclose delay**	2	1 to 1000 s	2 s	Is the number of seconds between attempts to close the circuit breaker. If the “CB Aux” contact remains closed for one reclose delay interval, synchronization is assumed to have occurred. If the “CB Aux” contact opens during the reclose delay interval, it is considered a failed closed attempt. The DSLC-2 control will remain in the selected operating mode (run, check or permissive) during the reclose delay interval.
7557	**Synchronizer timeout alarm**	2	Disabled / Enabled	Disabled	This setting enables or disables the alarm generated by exceeding the synch timeout interval without achieving synchronization.
3063	**Synchronizer timeout**	2	3 to 999 s	60 s	This is the interval over which the synchronizer will attempt to achieve synchronization. The interval begins when generator voltage is in operating range and either the run or permissive mode is activated. Failure to get a “CB Aux” contact closure within the specified time will result in a synch timeout alarm. The synchronizer must be set to “Off” mode to clear the interval timer and alarm.
5503	**Freq. control setpoint ramp**	2	0.10 to 60.00 Hz/s	2.50 Hz/s	The slope of the ramp is used to alter the rate at which the controller modifies the setpoint value. The greater the value, the faster the change.

Table 3-10: Parameter – synchronizer

Menu 2 – Load Control

This menu contains the adjustments for load control.

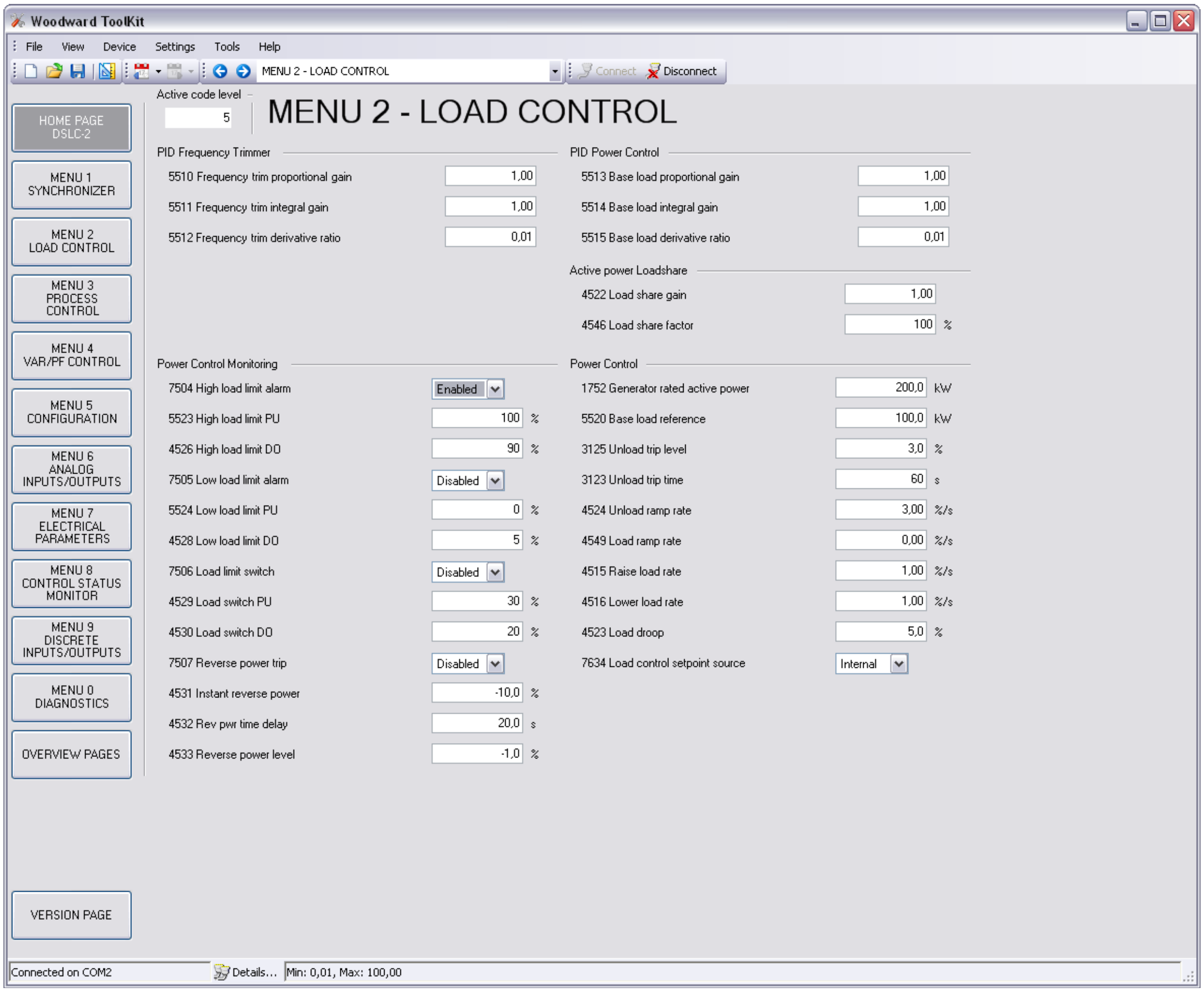


Figure 3-11: ToolKit – load control

PID Frequency Trimmer

ID	Parameter	CL	Setting range	Default	Description
5510	**Frequency trim proportional gain**	2	0.01 to 100.00	0.50	The setpoint for the frequency trim is the system rated frequency (parameter 1750). When in isochronous or load sharing mode, increasing the proportional gain, increases the sensitivity to the error between the system frequency and the desired frequency (parameter 1750). If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value. Remember the frequency trim PID is active during load sharing. Setting the proportional gain to high may cause instability with the load sharing function. ***NOTE:*** *Not active during synchronization.*
5511	**Frequency trim integral gain**	2	0.01 to 100.00	1.00	The integral gain corrects for any offset between the system rated frequency (parameter 1750) and the actual system frequency. If the integral gain constant is too large, the engine will continually oscillate. If the integral gain constant is too small, the engine will take too long to settle. Remember the frequency trim PID is active during load sharing. Setting the integral gain to high may cause instability with the load sharing function. ***NOTE:*** *The integral gain constant must be greater than the derivative time constant. Not active during synchronization.*

ID	Parameter	CL	Setting range	Default	Description
5512	**Frequency trim derivative ratio**	2	0.01 to 100.00	0.01	The derivative ratio identifies the "D" part of the PID controller. By decreasing this parameter, the stability of the system is increased. The controller will attempt to slow down the error correction in an attempt to prevent excessive overshoot or undershoot. Essentially this is the brake for the process. This portion of the PID loop operates anywhere within the range of the process unlike reset. Remember the frequency trim PID is active during load sharing. Setting the derivative ratio to high may cause instability with the load sharing function. ***NOTE:*** *The derivative ratio constant must be smaller than the integral gain constant.*

PID Power Control

ID	Parameter	CL	Setting range	Default	Description
5513	**Base load proportional gain**	2	0.01 to 100.00	1.00	Base load proportional gain determines how fast the load control responds to a load error. Lower value to slow response. ***NOTE:*** *PID power control loop is active:* • *Base load mode – always integral control* • *Active MSLC-2 – always integral control*
5514	**Base load integral gain**	2	0.01 to 100.00	0.50	Base load integral gain compensates for lags in the load control loop. It prevents slow hunting and controls damping (overshoot or undershoot) after a load disturbance. Lower value to slow response. ***NOTE:*** *PID power control loop is active:* • *Base load mode – always integral control* • *Active MSLC-2 – always integral control*
5515	**Base load derivative ratio**	2	0.01 to 100.00	0.01	Base load derivative ratio adjusts the rate of change in speed bias output during a load transient. This value is normally set very small. ***NOTE:*** *PID power control loop is active:* • *Base load mode – always integral control* • *Active MSLC-2 – always integral control*

Active Power Loadshare

ID	Parameter	CL	Setting range	Default	Description
4522	**Load share gain**	2	0.00 to 100.00	0.50	Load share gain is adjusted to provide stable load sharing. When load sharing is unstable, lower the gain value. Remember the frequency trim PID is active during load sharing mode.
4546	**Load share factor**	2	10 to 90 %	50 %	Adjusts the weighting between load share error signal and frequency error signal. **Example:** 60 % - Will influence load sharing more than frequency trim 40 % - Will influence frequency trim more than load sharing

Power Control Monitoring

ID	Parameter	CL	Setting range	Default	Description
7504	**High load limit alarm**	2	Disabled./. Enabled	Disabled	The *High load limit alarm* specifies if the high load limit alarm will activate (energize) the “High Limit” relay (terminal 44).
5523	**High load limit PU**	2	0 to 150 %	100 %	The *High load limit PU* is the load level where (if enabled) the “High Limit” relay is energized and the high limit alarm is activated. The percentage value relates to generator rated power (parameter 1752).
4526	**High load limit DO**	2	0 to 150 %	90 %	The *High load limit DO* is the load level where (if enabled) the “High Limit” relay is de-energized and the high limit alarm is deactivated. The percentage value relates to generator rated power (parameter 1752).
7505	**Low load limit alarm**	2	Disabled./. Enabled	Disabled	The *Low load limit alarm* specifies if the low load limit alarm will activate (energize) the “Low Limit” relay (terminal 45).
5524	**Low load limit PU**	2	0 to 100 %	0 %	The *Low load limit PU* is the load level where (if enabled) the “Low Limit” relay is energized and the low limit alarm is activated. The percentage value relates to generator rated power (parameter 1752).
4528	**Low load limit DO**	2	0 to 100 %	5 %	The *Low load limit DO* is the load level where (if enabled) the “Low Limit” relay is de-energized and the low limit alarm is deactivated. The percentage value relates to generator rated power (parameter 1752).
7506	**Load limit switch**	2	Disabled./. Enabled	Disabled	*Load limit switch* specifies if the “High Limit” and “Low Limit” relays will activate on high or low limit alarm.
4529	**Load switch PU**	2	-150 to 150 %	30 %	*Load switch PU* is the load level where the load switch will activate the “Load Switch” relay, if reverse power trip is disabled.
4530	**Load switch DO**	2	-150 to 150 %	20 %	*Load switch DO* is the load level where the load switch will deactivate the “Load Switch” relay, if reverse power trip is disabled.

Power Control

ID	Parameter	CL	Setting range	Default	Description
1752	**Generator rated active power**	2	1 to 999999.9 kW	200.0 kW	This value specifies the generator real power rating, which is used as a reference figure for related functions. The *Generator rated active power* is the generator apparent power multiplied by the generator power factor (typically ~0.8). These values are indicated in the generator data plate. ***NOTE:*** *During active power control, the* Generator active power value *(parameter 1752) may not be changed. The generator has to be shut down and the GCB has to be opened.*
5520	**Base load reference**	1	0 to 999999.9 kW	100.0 kW	This value is the reference for the base load controller when in base load and the load control setpoint source is configured for internal. ***NOTE:*** *This value is bypassed in the moment of using the discrete inputs raise / lower load function..*
3125	**Unload trip level**	2	0.5 to 99.9 %	3.0 %	The percentage load level where the breaker open command is given when the DSLC-2 is in the “Unload” mode. ***NOTE:*** *This value refers to the generator rated active power (parameter 1752).*
3123	**Unload trip time**	2	3 to 999 s	60 s	If the monitored generator power does not fall below the limit configured in parameter 3125 before the time configured here expires, a "Breaker open" command will be issued together with an alarm.
4524	**Unload ramp rate**	2	0.01 to 100.00 %/s	3.00 %/s	The *Unload ramp rate* is valid when unloading the generator. ***NOTE:*** *This value refers to the generator rated active power (parameter 1752).*

ID	Parameter	CL	Setting range	Default	Description
4549	**Load ramp rate**	2	0.01 to 100.00 %/s	3.00 %/s	The *Load ramp rate* is valid when loading the generator. ***NOTE:*** *This value refers to the generator rated active power (parameter 1752).*
4515	**Raise load rate**	2	0.01 to 100.00 %/s	1.00 %/s	This is the rate the internal load reference increases, when the discrete input raise load command is activated. ***NOTE:*** *Modbus reference changes will follow this value.*
4516	**Lower load rate**	2	0.01 to 100.00 %/s	1.00 %/s	This is the rate the internal load reference decreases, when the discrete input lower load command is activated. ***NOTE:*** *Modbus reference changes will follow this value.*
4523	**Load droop**	2	0 to 100.0 %	3.0 %	The *Load droop* is calculated from the speed biasing signal. The influence of the level of droop is dependent on the speed control and the speed bias configuration. In three situations the load droop gets actived: 1. The “CB Aux” contact is open. 2. Discrete input 21 “Droop Tracking” is closed, the current speed biasing output will stay at it’s present value. 3. Droop tracking missing device (parameter 4060) is “On” and the communication monitoring detects an error (Menu 5). The speed bias output will stay at it’s present value. ***NOTE:*** *The droop setting influences the speed biasing signal and cannot be directly calculated into a speed deviation.*
7634	**Load control setpoint source**	2	Internal / Interface	Internal	This setting determines from which source the load reference comes: **Internal:** The setpoint parameter 5520 is valid or the analog remote load reference input. Remote input activated by closing the raise and lower load inputs. **Interface:** The setpoint comes via RS-485 Modbus or TCP/IP Modbus Interface.
7507	**Reverse power trip**	2	Disabled / Enabled	Disabled	When “Enabled”, changes the “Load Switch” (terminal 43) to be the *Reverse power trip* output. Time to trip = Reverse pwr level (%kW) * Rev pwr time delay / Actual load (%kW)
4531	**Instant reverse power**	2	-50.0 to -1.0 %	-10.0 %	If the generator active power decreases below this value an instant reverse power trip (“Load Switch” output) is received. ***NOTE:*** *Reverse power trip is “enabled”.*
4532	**Rev pwr time delay**	2	0.1 to 20.0 s	20.0 s	This timer starts when the power level decreases below the reverse power level. ***NOTE:*** *Reverse power trip is “enabled”.*
4533	**Reverse power level**	2	-50.0 to -1.0 %	-1.0 %	The *Reverse power level* is defined in percentage generator rated power. ***NOTE:*** *Reverse power trip is “enabled”.*

Table 3-12: Parameter – load control

Menu 3 – Process Control

This menu contains the adjustments for process control.

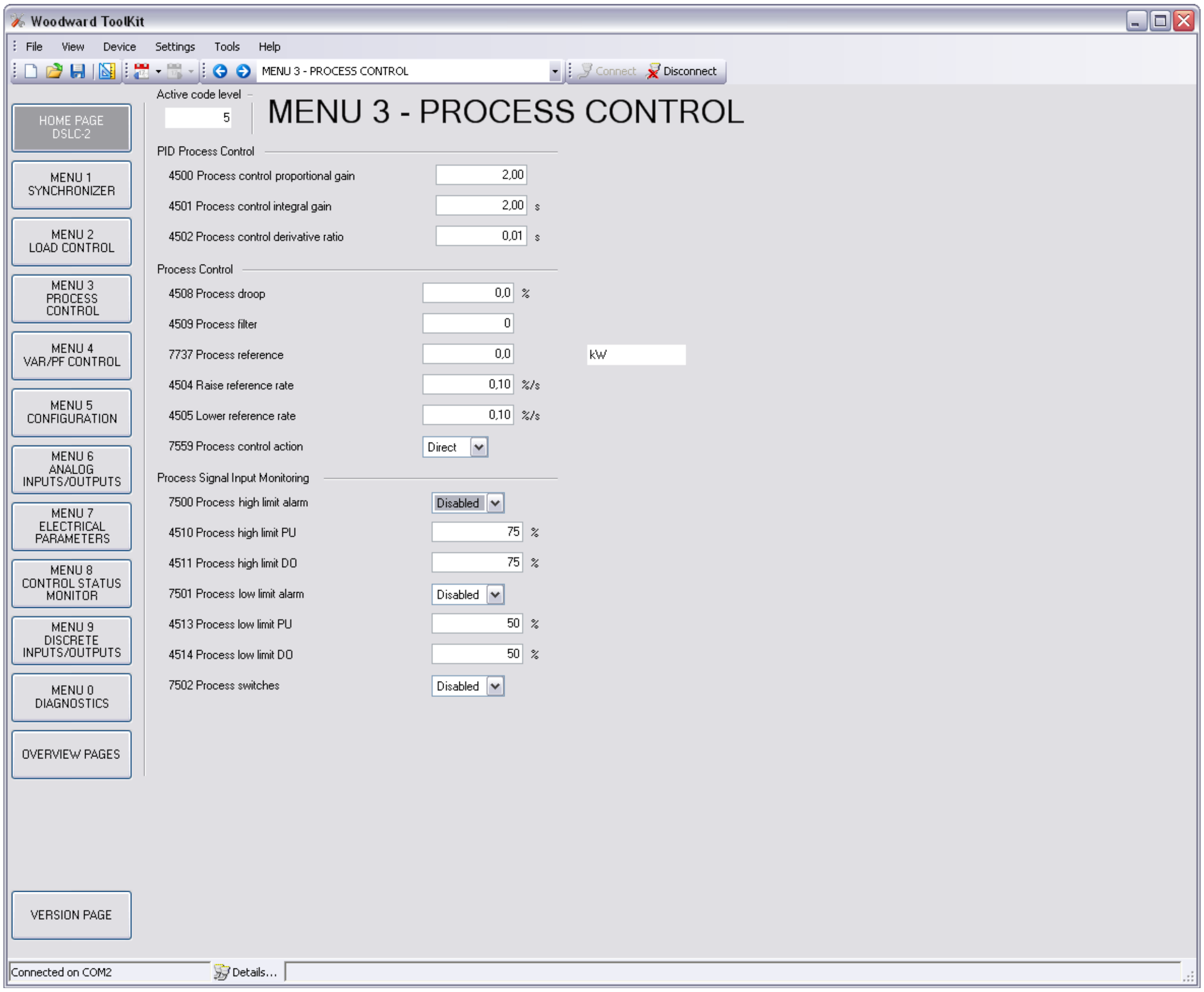


Figure 3-13: ToolKit – process control

PID Process Control

ID	Parameter	CL	Setting range	Default	Description
4500	**Process control proportional gain**	2	0.01 to 100.00	2.00	The *Process control proportional gain* determines how fast the process control responds to an error between the process variable and reference. The gain is set to provide stable control of the process. Lower value to slow response.
4501	**Process control integral gain**	2	0.01 s to 100.00 s	2.00 s	The *Process control integral gain* compensates for delay in the process control loop. It prevents low frequency hunting and damping (overshoot or undershoot) when a process disturbance occurs. Lower value to slow response.
4502	**Process control derivative ratio**	2	0.01 to 100.00 s	0.01 s	The *Process control derivative ratio* adjusts the rate of change in speed bias output during a process level transient. Lower value to slow response.

Process Control

ID	Parameter	CL	Setting range	Default	Description
4508	**Process droop**	2	0.0 to 100.0 %	0.0 %	The *Process droop* is the load droop desired based on process level.
4509	**Process filter**	2	0 to 8	0	The *Process filter* adjusts the bandwidth of the filter on the process input. Higher frequency settings result in faster control response, but also more response to process noise.
7737	**Process reference**	2	-999999.9 to 999999.9	0.0	The *Process reference* is the internal reference for the process control. The process engineering units are determined by the selection and settings in Menu 6.1.
4504	**Raise reference rate**	2	0.01 to 20.00 %/s	0.10 %/s	The *Raise reference rate* is the rate at which the process reference is increased when the DI “Load Raise” command is activated.
4505	**Lower reference rate**	2	0.01 to 20.00 %/s	0.10 %/s	The *Lower reference rate* is the rate at which the process reference is decreased when the DI “Load Lower” command is activated.
7559	**Process control action**	´2	Direct / Indirect	Direct	The *Process control action* specifies if the process variable is direct or indirect acting. **Direct:** If the process variable increases when generator load increases. **Indirect:** If the process variable decreases when generator load increases.

Process Control Monitoring

ID	Parameter	CL	Setting range	Default	Description
7500	**Process high limit alarm**	2	Disabled./. Enabled	Disabled	The *Process high limit alarm* specifies if the high process limit alarm is activated.
4510	**Process high limit PU**	2	0.0 to 150.0 %	75.0 %	The *Process high limit PU* is the process input level where (if enabled) the “High Limit” relay output is energized and the high limit alarm is activated.
4511	**Process high limit DO**	2	0.0 to 150.0 %	75.0 %	The *Process high limit DO* is the process input level where (if enabled) the “High Limit” relay output is de-energized and the high limit alarm is deactivated.
7501	**Process low limit alarm**	2	Disabled./. Enabled	Disabled	The *Process low limit alarm* specifies if the low process limit alarm is activated.
4513	**Process low limit PU**	2	0.0 to 150.0 %	50.0 %	The *Process low limit PU* is the process input level where (if enabled) the “Low Limit” relay output is energized and the low limit alarm is activated.
4514	**Process low limit DO**	2	0.0 to 150.0 %	50.0 %	The *Process low limit DO* is the process input level where (if enabled) the “Low Limit” relay output is de-energized and the low limit alarm is deactivated.
7502	**Process switches**	2	Disabled./. Enabled	Disabled	The *Process switch* specifies if the process high and low limits will activate the “High Limit” and “Low Limit” relay outputs.

Table 3-14: Parameter – process control

Menu 4 – Var / PF Control

This menu contains the adjustments for reactive load control.

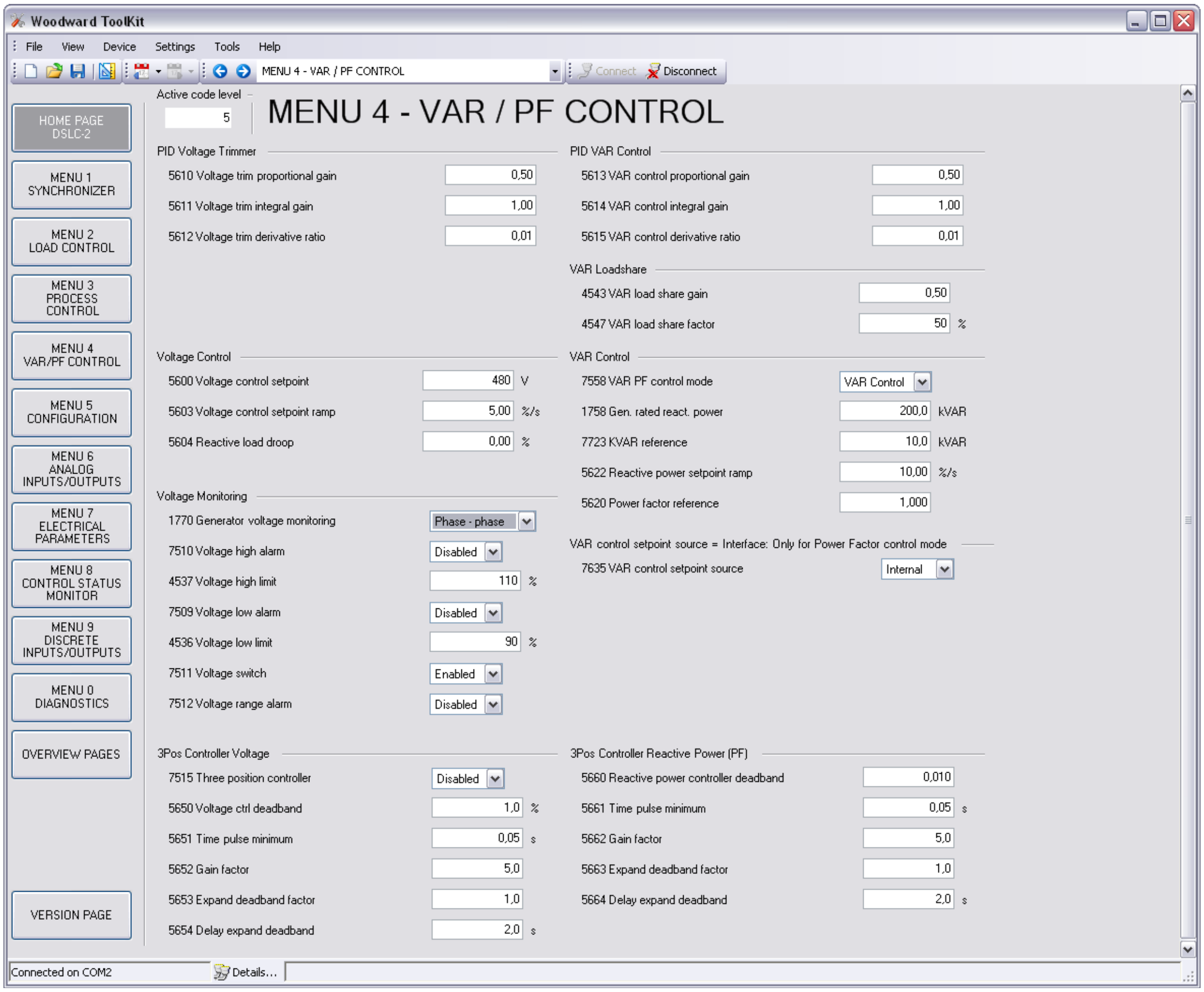


Figure 3-15: ToolKit – var / pf control

PID Voltage Trimmer

ID	Parameter	CL	Setting range	Default	Description
5610	**Voltage trim proportional gain**	2	0.01 to 100.00	0.50	The setpoint for the voltage trim is the voltage control setpoint (parameter 5600). When in Isochronous or load sharing mode, increasing the proportional gain, increases the sensitivity to the error between the generator voltage and the desired voltage (parameter 5600). If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value. Remember the voltage trim PID is active during load sharing. Setting the proportional gain to high may cause instability with the var sharing function. ***NOTE:*** *Not active during synchronization.*
5611	**Voltage trim integral gain**	2	0.01 to 100.00	1.00	The integral gain corrects for any offset between the system rated voltage (parameter 5600) and the generator voltage. If the integral gain constant is too large, the voltage will continually oscillate. If the integral gain constant is too small, the voltage will take too long to settle. **The integral gain constant must be greater than the derivative time constant.** Remember the voltage trim PID is active during var sharing. Setting the integral gain to high may cause instability with the var sharing function. ***NOTE:*** *Not active during synchronization.*

ID	Parameter	CL	Setting range	Default	Description
5612	**Voltage trim derivative ratio**	2	0.01 to 100.00	0.01	The derivative ratio identifies the “D” part of the PID controller. By decreasing this parameter, the stability of the system is increased. The controller will attempt to slow down the error correction in an attempt to prevent excessive overshoot or undershoot. Essentially this is the brake for the process. This portion of the PID loop operates anywhere within the range of the process unlike reset. **The derivative ratio constant must be smaller than the integral gain constant.** Remember the voltage trim PID is active during var sharing. Setting the derivative ratio to high may cause instability with the var sharing function. ***NOTE:*** *Not active during synchronization.*

PID Var Control

ID	Parameter	CL	Setting range	Default	Description
5613	**VAR control proportional gain**	2	0.01 to 100.00	0.50	Var/PF proportional gain determines how fast the var/PF control responds to an error signal between kvar/PF reference and kvar/PF actual measurement. The gain is set to provide stable control of kvars or power factor. Lower value to slow response. **PID var control loop is active:** *VAR PF control mode* (parameter 7558) • Var control • PF control DSLC-2 is operating in • Base load mode • Process control mode • Active MSLC-2
5614	**VAR control integral gain**	2	0.01 to 100.00	1.00	Var/PF integral gain compensates for delay in the reactive power control loop. This prevents low frequency overshoot or undershoot when a change in reactive power occurs. Lower value to slow response. **PID var control loop is active:** *VAR PF control mode* (parameter 7558) • Var control • PF control DSLC-2 is operating in • Base load mode • Process control mode • Active MSLC-2
5615	**VAR control derivative ratio**	2	0.01 to 100.00	0.01	Var/PF derivative ratio adjusts the rate of change of the voltage bias output during a load transient. Lower value to slow response. **PID var control loop is active:** *VAR PF control mode* (parameter 7558) • Var control • PF control DSLC-2 is operating in • Base load mode • Process control mode • Active MSLC-2

Var Loadshare

ID	Parameter	CL	Setting range	Default	Description
4543	**VAR load share gain**	2	0.00 to 100.00	0.50	*VAR load share gain* is adjusted to provide stable var sharing. If var sharing is unstable, lower the gain value. Remember the voltage trim PID is active during var sharing mode.
4547	**VAR load share factor**	2	10 to 90 %	50 %	Adjusts the weighting between var share error signal and voltage trim error signal. **Example:** 60 % - Will influence var sharing more than voltage trim 40 % - Will influence voltage trim more than var sharing

Voltage Control

ID	Parameter	CL	Setting range	Default	Description
5600	**Voltage control setpoint**	1	50 to 650000 V	480 V	This value is the reference for the voltage controller when performing isolated and/or no-load operations. Usually the voltage control setpoint is the same as the rated voltage setting. In some cases it could be desired to have another setpoint in isolation operation.
5603	**Voltage control setpoint ramp**	2	1.00 to 300.00 %/s	5.00 %/s	The different setpoint values are supplied to the controller via this ramp. The slope of the ramp is used to alter the rate at which the controller modifies the setpoint value. A greater value will create a faster change in the setpoint.
5604	**Reactive load droop**	2	0.0 to 20.0 %	0.0 %	Woodward recommends having around 3 % droop in the voltage regulator. Reactive load droop is not needed when the voltage regulator has droop. Reactive load droop must be added if the voltage regulator does not have droop. In three situations the reactive load droop gets actived: 1. The “CB Aux” contact is open. 2. Discrete input 21 “Droop Tracking” is closed, the current voltage biasing output is locked in at it’s present value. 3. Droop tracking missing device (parameter 4060) is “On” and the communication monitoring detects an error (Menu 5). The voltage bias output is locked at it’s present value. ***NOTE:*** *The droop setting influences the voltage biasing signal and cannot directly calculated into a voltage deviation.*

Var Control

ID	Parameter	CL	Setting range	Default	Description
7558	**VAR PF control mode**	2	Disabled./ PF control / VAR control	VAR Control	This setting specifies the reactive load controller. **Disabled:** The reactive load control is generally disabled. **PF control:** The reactive load control is enabled and will control the power factor reference setpoint or operate in var sharing. **VAR control:** The reactive load control is enabled and will control the kvar reference setpoint or operate in var sharing.
1758	**Gen. rated react. power**	2	0.1 to 999999.9 kvar	200.0 kvar	This value specifies the generator reactive power rating, which is used as a reference figure for related functions. The DSLC-2 limits the var output from -10 to 100 % of the rated setting when in base load mode, process mode and with an active MSLC-2. If unknown, set to 60 % of the kVA or 80 % of the kW rating, which is the kvar load at 0.8 lagging power factor.
7723	**KVAR reference**	2	-999999.9 to 999999.9 kvar	10.0 kvar	This is the setpoint for the reactive load control when the *VAR PF control mode* is configured for “VAR control”.
5622	**Reactive power setpoint ramp**	2	0.01 to 100.00 %/s	10.00 %/s	When issuing of different setpoints or during ramp up and ramp down of the reactive load.The ramp setting is related to rated reactive power (parameter 1758).
5620	**Power factor reference**	1	-0.999 to 1.000	1.000	This is the setpoint for the reactive load control when the *VAR PF control mode* (parameter 7558) is configured for “PF control”. The designations “-” and “+” stand for: • Inductive/lagging (+) - generator supplying vars • Capacitive/leading (-) - generator absorbing vars
7635	**VAR control setpoint source**	2	Internal / Interface	Internal	This parameter determines the reactive load control setpoint source: **Internal** The setpoint comes from: o *KVAR reference* (parameter 7723) when *VAR PF control mode* (parameter 7558) is configured on “VAR control”. o *Power factor reference* (parameter 5620) when *VAR PF control mode* (parameter 7558) is configured on “PF control”. o Remote analog *Power factor reference* (parameter 7718) when *VAR PF control mode* (parameter 7558) is configured on “PF control” and the remote function is activated. DI “Voltage Raise” / “Voltage Lower” are closed. **Interface** The setpoint comes from the interface (via RS-485 Modbus or TCP/IP Modbus, Address 7640). The setpoint is a power factor setpoint. Only active when the *VAR PF control mode* (parameter 7558) is configured for “PF control”.

Voltage Monitoring

ID	Parameter	CL	Setting range	Default	Description
1770	**Generator voltage monitoring**	2	Phase - phase / Phase - neutral	Phase - phase	This configuration determines the monitored voltage type. **Phase – phase:** Only the phase - phase voltages VL12, VL23 and VL31 are monitored. **Phase – neutral:** Only the phase - neutral voltages VL1N, VL2N and VL3N are monitored.
7510	**Voltage high alarm**	2	Disabled / Enabled	Disabled	The *Voltage high alarm* specifies if the high voltage limit alarm is activated.
4537	**Voltage high limit**	2	0 to 150 %	110 %	The *Voltage high limit* setting specifies the voltage high limit alarm trip point. The input is related to the rated voltage input configurable in Menu 5 (parameter 1766).
7509	**Voltage low alarm**	2	Disabled / Enabled	Disabled	The *Voltage low alarm* specifies if the low voltage limit alarm is activated.
4536	**Voltage low limit**	2	0 to 150 %	90 %	The *Voltage low limit* specifies the voltage low limit alarm trip point. The input is related to the rated voltage input configurable in Menu 5 (parameter 1766).
7511	**Voltage switch**	2	Disabled / Enabled	Enabled	The *Voltage switch* specifies if the voltage high and low limits will activate the “High Limit” and “Low Limit” relays.
7512	**Voltage range alarm**	2	Disabled / Enabled	Disabled	Enables or disables the voltage regulator bias output limit alarm. The alarm voltage range limit will be activated if the limit of the voltage bias output reaches 100 %.

3pos Controller Voltage

ID	Parameter	CL	Setting range	Default	Description
7515	**Three position controller**	2	Disabled / Enabled	Disabled	**Enabled:** The relay outputs “Voltage Raise” and “Voltage Lower” are active. The three position controller will be used with a voltage regulator that cannot accept the analog voltage bias output. **Disabled:** Voltage raise and lower relay contacts are not active.
5650	**Voltage ctrl deadband**	1	0.1 to 9.9 %	1.0 %	**Isolated operation:** The generator voltage is controlled in such a manner that the measured voltage does not deviate from the configured setpoint by more than the value configured in this parameter without the controller issuing a voltage raise/lower signal to the voltage regulator. This prevents unneeded wear on the voltage bias output control or the raise/lower relay contacts. **Synchronization:** Voltage matching - the generator voltage is controlled in such a manner that the measured voltage does not deviate from the monitored reference bus voltage by more than the value configured in this parameter without the controller issuing a voltage raise/lower signal to the voltage regulator. The value configured for this parameter **must be less** than the value configured for the *Voltage window* for synchronization (parameter 4541).
5651	**Time pulse minimum**	1	0.01 to 2.00 s	0.05 s	This is the time the relay output will stay closed when providing a voltage raise or lower command to the voltage regulator. The shortest possible pulse time should be configured to limit overshoot of the desired voltage reference point.
5652	**Gain factor**	1	0.1 to 10.0	5.0	The *Gain factor* influences the operating time of the relays. Increasing the *Gain factor* will increase the response to drive the voltage within the tolerance for the mode it is in (voltage matching or voltage control). If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value.
5653	**Expand deadband factor**	1	1.0 to 9.9	1.0	If the measured generator voltage is within the deadband range (parameter 5650) and the configured *Delay expand deadband* time (parameter 5654) expires, the deadband will be multiplied with the factor configured here.
5654	**Delay expand deadband**	1	1.0 to 9.9 s	2.0 s	The measured generator voltage must be within the deadband range for the time configured here in order to multiply the dead band with the factor configured in parameter 5653.

3pos Controller Reactive Power

ID	Parameter	CL	Setting range	Default	Description
5660	**Reactive power controller deadband**	1	0.001 to 0.300	0.010	This configures a deadband around the power factor reference value. The generator power factor is controlled in such a manner, when paralleled with the mains, so that the monitored power factor does not deviate from the configured power factor setpoint by more than the value configured in this parameter without the controller issuing a raise/lower signal to the voltage regulator. This prevents unneeded wear on the raise/lower relay contacts.
5661	**Time pulse minimum**	1	0.01 to 2.00 s	0.05 s	This is the time the relay output will stay closed when providing a voltage raise or lower command to the voltage regulator. The shortest possible pulse time should be configured to limit overshoot of the desired reactive power reference point.
5662	**Gain factor**	1	0.1 to 10.0	5.0	The *Gain factor* influences the operating time of the relays. Increasing the *Gain factor* will increase the response to drive the voltage within the tolerance for the mode it is in (voltage matching or voltage control). If the gain is configured too high, the result is excessive overshoot/undershoot of the desired value.
5663	**Expand deadband factor**	1	1.0 to 9.9	1.0	If the measured generator power factor is within the deadband range (parameter 5660) and the configured *Delay expand deadband* time (parameter 5664) expires, the deadband will be multiplied with the factor configured here.
5664	**Delay expand deadband**	1	1.0 to 9.9 s	2.0 s	The measured generator power factor must be within the deadband range for the time configured here in order to multiply the deadband with the factor configured in parameter parameter 5663.

Table 3-16: Parameter – var / pf control

Menu 5 – Configuration

This menu contains system rated frequency, generator rated voltage, PT and CT settings, with operating range and device number for the configuration of the DSLC-2.

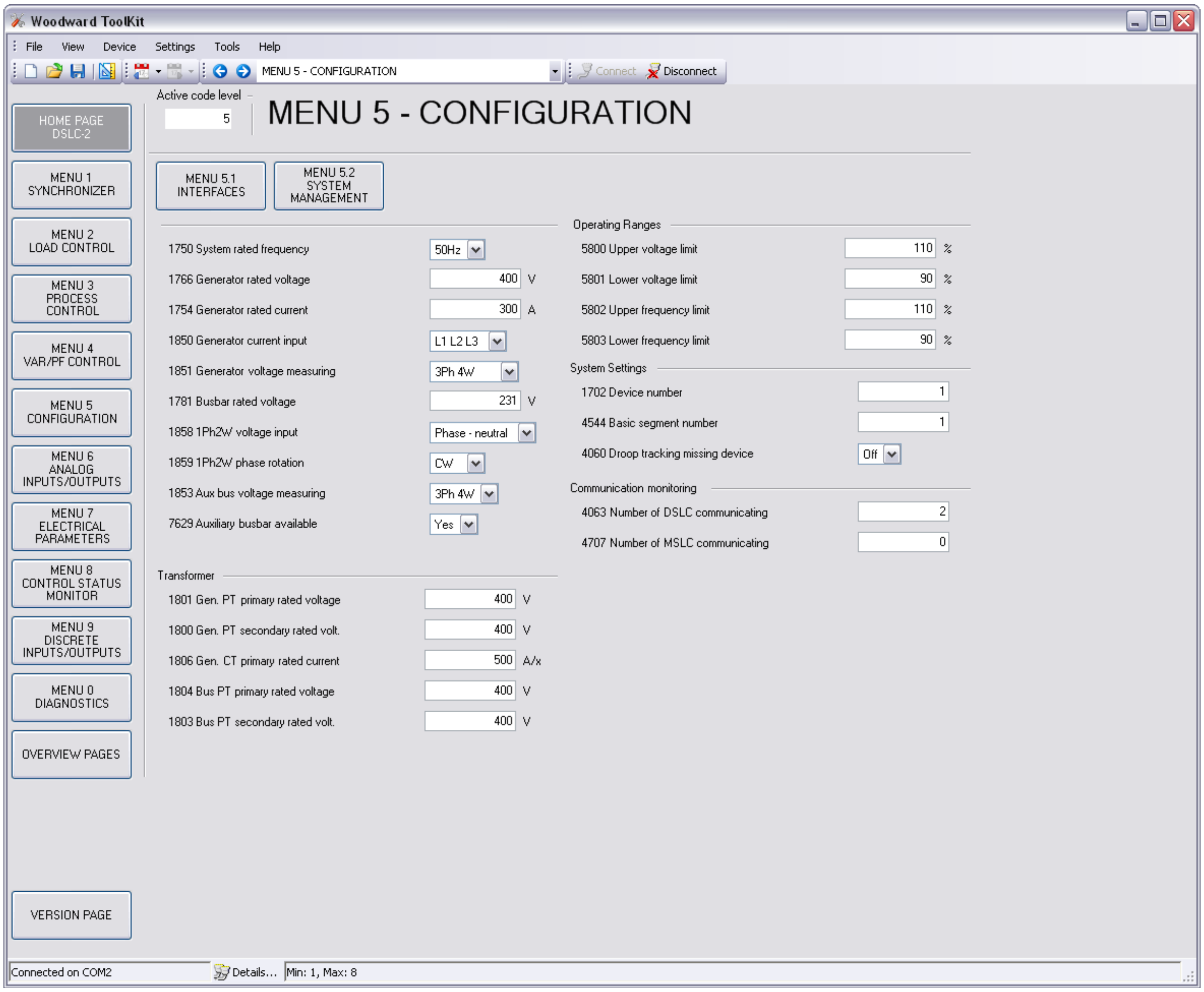


Figure 3-17: ToolKit – configuration

General

NOTE

Beside the generator 3-phase measurement the DSLC-2 provides a busbar 1-phase measurements and an auxiliary busbar 3-phase measurement. The busbar 1-phase measurement at the terminals 37-40 has to be connected in each application. The auxiliary busbar 3-phase AC measurement at the terminals 21-28 can additionally be used. When both measurements are used the busbar voltage has to be connected to both inputs. With the parallel use of the auxiliary busbar measurement, the DSLC-2 can determine correct voltages on all 3 phases on the bus and becomes part of the operating range- and the phase rotation monitoring.

ID	Parameter	CL	Setting range	Default	Description
1750	**System rated frequency**	2	50 / 60 Hz	60 Hz	The rated frequency of the system is used as a reference figure for all frequency related functions. This is used for operating range limits, frequency trim reference and frequency monitoring.

ID	Parameter	CL	Setting range	Default	Description
1766	**Generator rated voltage**	2	50 to 650000 V	480 V	This voltage is always entered as a “Phase - phase” value. The rated generator potential transformer primary voltage is used as a reference figure for all generator voltage related functions, which use a percentage value, like operating range limits, voltage trim and voltage monitoring. ***NOTE:*** *This value refers to the rated voltage of the generator (generator voltage on data plate) and is the voltage measured on the potential transformer primary.*
1754	**Generator rated current**	2	1 to 32000 A	300 A	This value specifies the *Generator rated current*.
1850	**Generator current input**	2	L1 L2 L3 / Phase L1 / Phase L2 / Phase L3	L1 L2 L3	**L1 L2 L3:** All three phases are monitored. Measurement, display and protection are adjusted according to the rules for 3-phase measurement. **Phase L {1/2/3}:** Only one phase is monitored. Measurement, display and protection are adjusted according to the rules for single-phase measurement. Monitoring refers to the selected phase. ***NOTE:*** *Please refer to the comments on measuring principles in the installation chapter. This parameter is only effective if* Generator voltage measuring *(parameter 1851) is configured to “3Ph 4W”, “3Ph 3W” or “3Ph 4W OD”.*
1851	**Generator voltage measuring**	2	3Ph 4W / 3Ph 3W / 3Ph 4W OD	3Ph 3W	**3Ph 4W: Wye connected voltages** Generator voltage is connected using all 3 phases and a neutral. This measurement can be directly connected or through potential transformers (PTs). Voltage monitoring is configured in the “VAR/PF Menu 4”, parameter 1770. This setting determines if the DSLC-2 uses “Phase - phase” or “Phase - neutral” voltage for protection. **3Ph 3W: Delta connected voltages** Generator voltage is connected using all 3 phases. This measurement can be directly connected or through potential transformers (PTs). This configuration is used when: • The generator is connected to the load using 3-phase and neutral • The generator voltage is connected to the DSLC-2 using 3-wire, “Phase - phase” • The L2 phase is **not** grounded on the input of the DSLC-2 And when: • The generator is connected to the load using 3 phases and **no** neutral • The generator voltage is connected to the DSLC-2 using 3 wire, “Phase - phase” • The L2 phase can be grounded or left ungrounded **3Ph 4W OD: Delta connected voltages** Generator voltage is connected using all 3 phases without a neutral connection. This measurement can be directly connected or through potential transformers (PTs). This configuration is used when: • The generator is connected to the load using 3-phase and neutral • The generator voltage is connected to the DSLC-2 using 3 wire, “Phase - phase” • The L2 phase is **grounded** on the input of the DSLC-2 ***NOTE:*** *Please refer to the comments on measuring principles in the installation chapter (“Voltage Measuring: Generator” on page 26)*

ID	Parameter	CL	Setting range	Default	Description
1781	**Busbar rated voltage**	2	50 to 650000 V	480 V	The busbar potential transformer primary voltage is entered in this parameter. The value can be: • Phase - phase • Phase - neutral They dependent on the *1Ph 2W voltage input* (parameter 1858) setting. The busbar rated voltage is used as a reference figure for all busbar voltage related functions. ***NOTE:*** *This value refers to the rated voltage of busbar and is the voltage measured on the potential transformer primary.*
1858	**1Ph2W voltage input**	2	Phase – phase / Phase – neutral	Phase – phase	**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. ***NOTE:*** *When this parameter is configured wrong the synchronization phase angle Gen <-> Bus would be wrong calculated.*
1859	**1Ph2W phase rotation**	3	CW / CCW	CW	**CW:** A clockwise rotation field is considered for 1Ph 2W measuring. **CCW:** A counter-clockwise rotation field is considered for 1Ph 2W measuring.
1853	**Aux bus voltage measuring**	2	3Ph 4W / 3Ph 3W /	3Ph 4W	In case of a 3-phase measurement connection of the auxiliary busbar, the connection has to be defined. **3Ph 4W: Wye connected voltages** Generator voltage is connected using all 3 phases and a neutral. This measurement can be directly connected or through potential transformers (PTs). Voltage monitoring is configured in the "VAR/PF Menu 4", parameter 1770. This settings determines if the DSLC-2 uses "Phase - phase" or "Phase - neutral" voltage for protection. **3Ph 3W: Delta connected voltages** Generator voltage is connected using all 3 phases. This measurement can be directly connected or through potential transformers (PTs). Voltage monitoring is configured in the "VAR/PF Menu 4", parameter 1770. This settings must be configured for "Phase - phase".
7629	**Auxiliary busbar available**	2	No / Yes	No	**No:** The auxiliary busbar measurement is not used. **Yes:** The auxiliary busbar measurement is used and becomes a part of the operating range- and the phase rotation monitoring. The auxiliary busbar measurement is displayed in Menu 7.

Transformer

ID	Parameter	CL	Setting range	Default	Description
1801	**Gen. PT primary rated voltage**	2	50 to 650000 V	480 V	The value is always entered as the “Phase - phase” measurement. 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 generator application does not require potential transformers (i.e. the generated voltage is 480 V or less), then the generated voltage will be entered into this parameter.
1800	**Gen. PT secondary rated volt.**	2	50 to 480 V	120 V	The value is always entered as the “Phase - phase” measurement. 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 generator application does not require potential transformers (i.e. the generated voltage is 480 V or less), then the generated voltage will be entered into this parameter. • Rated voltage: 120 Vac (this parameter configured between 50 and 130 V) - Generator voltage: Terminals 29/31/33/35 • Rated voltage: 480 Vac (this parameter configured between 131 and 480 V) - Generator voltage: Terminals 30/32/34/36 ***NOTE:*** *The control is equipped with dual voltage measuring inputs. The voltage range of these measurement inputs is dependent upon what terminals are used. This value refers to the secondary voltages of the potential transformers, which are directly connected to the control.* ***WARNING:*** *Only connect the measured voltage to either the 120 Vac or the 480 Vac inputs.*
1806	**Gen. CT primary rated current**	2	1 to 32000 A/x	500 A/x	The input of the current transformer ratio is necessary for the indication and control of the actual monitored value. The current transformers ratio should be selected so that at least 60 % of the secondary current rating can be measured when the monitored system is at 100 % of operating capacity (i.e. at 100 % of system capacity a 5 A CT should output 3 A). If the current transformers are sized so that the percentage of the output is lower, the loss of resolution may cause inaccuracies in the monitoring and control functions and affect the functionality of the control.
1804	**Bus PT primary rated voltage**	2	50 to 650000 V	480 V	The value is always entered as the “Phase - phase” measurement. 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. If the application does not require potential transformers (i.e. the measured voltage is 480 V or less), then the measured voltage will be entered into this parameter.

ID	Parameter	CL	Setting range	Default	Description
1803	**Bus PT secondary rated volt.**	2	50 to 480 V	120 V	The value is always entered as the "Phase - phase" measurement. 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 480 V or less), then the measured voltage will be entered into this parameter. • Rated voltage: 120 Vac (this parameter configured between 50 and 130 V) o Busbar voltage: Terminals 37/39 o Auxiliary busbar voltage: Terminals 21/23/25/27 • Rated voltage: 480 Vac (this parameter configured between 131 and 480 V) o Busbar voltage: Terminals 38/40 o Auxiliary busbar voltage: Terminals 22/24/26/28 ***NOTE:*** *The control is equipped with dual voltage measuring inputs. The voltage range of these measurement inputs is dependent upon what terminals are used. This value refers to the secondary voltages of the potential transformers, which are directly connected to the control.* ***WARNING:*** *Only connect the measured voltage to either the 120 Vac or the 480 Vac inputs.*

Table 3-18: Parameter – configuration

Operating Ranges

NOTE

The operating ranges are settings, which are used for determining the generator is operating at the correct voltage and frequency. Drop out of the operating range is not monitored with an alarm. The operating ranges are valid for generator, busbar and auxiliary busbar measurement, if used. It is recommended to configure the operating limits within the monitoring limits.

NOTE

For monitoring the operating ranges respectively, the information can be read by interface or the Home page in ToolKit and is also displayed by the LEDs conditions.

ID	Parameter	CL	Setting range	Default	Description
5800	**Upper voltage limit**	2	100 to 150 %	110 %	The maximum permissible positive deviation of the voltage from the *Generator rated voltage* (parameter 1766) is configured here.
5801	**Lower voltage limit**	2	50 to 100 %	90 %	The maximum permissible negative deviation of the voltage from the *Generator rated voltage* (parameter 1766) is configured here.
5802	**Upper frequency limit**	2	100.0 to 150.0 %	110.0 %	The maximum permissible positive deviation of the frequency from the rated system frequency (parameter 1750) is configured here.
5803	**Lower frequency limit**	2	50.0 to 100.0 %	90.0 %	The maximum permissible negative deviation of the frequency from the rated system frequency (parameter 1750) is configured here.

System Settings

ID	Parameter	CL	Setting range	Default	Description
1702	**Device Number**	2	1 to 32	1	A unique address is assigned to the control though this parameter. This unique address permits the controller to be correctly identified on the network. The address assigned to the controller may only be used once. All other network addresses are calculated on the number entered in this parameter. The device number is also important for the device assignment in load sharing.
4544	**Basic segment number**	2	1 to 8	1	The *Basic segment number* describes where the DSLC-2 is placed in relation to other DSLC-2 or MSLC-2. As long as no tie-breaker is located between the busbar voltage measurement of multiple DSLC-2s, the parameter can remain on "1". ***NOTE:*** *In case there are different segments available in the application please follow the rules on page 117.*
4063	**Number of DSLC communicating**	2	1 to 32	2	The unit monitors the number of communicating DSLC-2s. When the DSLC-2 falls below this number, the missing device flag is set. This can be used for an alarm output and the control mode, of the DSLC-2, can be changed to droop tracking, dependent on the *Droop tracking missing device* (parameter 4060) setting.The unit automatically resets this flag when communication is restored.
4707	**Number of MSLC communicating**	2	0 to 16	0	The unit monitors the number of communicating MSLC-2s. When the MSLC-2 falls below this number, the missing device flag is set. This can be used for an alarm output and the control mode, of the DSLC-2, can be changed to droop tracking, dependent on the *Droop tracking missing device* (parameter 4060) setting. The unit automatically resets this flag when communication is restored.
4060	**Droop tracking missing device**	2	Off / On	Off	The unit can internally set the droop tracking mode, when the missing device flag is set. The unit automatically resets this flag when communication is restored.

Menu 5.1 – Interfaces

This menu contains the parameters for the configuration of the interfaces of the DSLC-2.

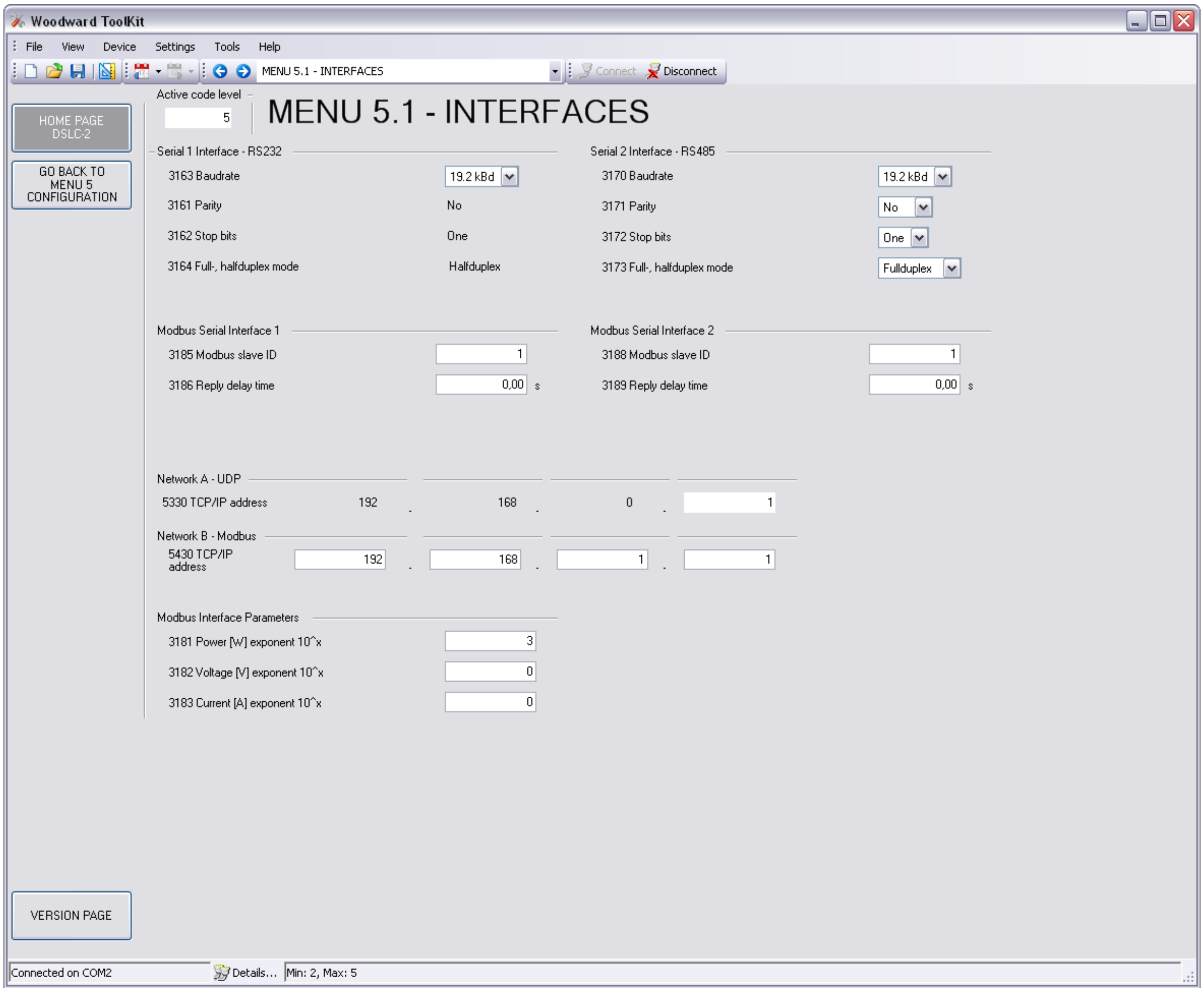


Figure 3-19: ToolKit – interfaces

Serial Interface 1 – RS-232

The serial interface 1 – RS-232 is mainly used for the configuration tool, ToolKit. This is executed with the Woodward own Servlink protocol. The RS-232 also allows access by Modbus protocol with fixed parity, stop bits and full-, halfduplex mode. The unit acts here as a RTU slave.

ID	Parameter	CL	Setting range	Default	Description
3163	**Baudrate**	2	9.6 / 14.4 / 19.2 / 38.4 / 56.0 / 115.0 kBaud	19.2 kBd	This parameter defines the baud rate for communications. Please note, that all participants on the bus must use the same baud rate.
3161	**Parity**	-	fixed	No	-
3162	**Stop bits**	-	fixed	One	-
3164	**Full-, half-duplex mode**	-	fixed	Halfdup-lex	-

Modbus Serial Interface 1

ID	Parameter	CL	Setting range	Default	Description
3185	**Modbus slave ID**	2	0 to 255	1	The Modbus device address, which is used to identify the device via Modbus, is entered here. If "0" is configured here, the Modbus is disabled.
3186	**Reply delay time**	2	0.00 to 1.00 s	0.00 s	This is the minimum delay time between a request from the Modbus master and the response of the slave. This time is also required if an external interface converter to RS-485 is used for example.

Serial Interface 2 – RS-485

The serial interface 2 – RS485 allows exclusively access by Modbus protocol with configurable parity, stop bits and full-, halfduplex mode. The unit acts here as a RTU slave.

ID	Parameter	CL	Setting range	Default	Description
3170	**Baudrate**	2	9.6 / 14.4 / 19.2 / 38.4 / 56.0 / 115.0 kBaud	19.2 kBd	This parameter defines the baud rate for communications. Please note, that all participants on the bus must use the same baud rate.
3171	**Parity**	2	No / Even / Odd	No	The used parity of the interface is set here.
3172	**Stop bits**	2	One / Two	One	The number of stop bits is set here.
3173	**Full-, half-duplex mode**	2	Fullduplex / Halfduplex	Fullduplex	**Fullduplex:** Fullduplex mode is enabled. **Halfduplex:** Halfduplex mode is enabled.
3188	**Modbus slave ID**	2	0 to 255	1	The Modbus device address, which is used to identify the device via Modbus, is entered here. If "0" is configured here, the Modbus is disabled.
3189	**Reply delay time**	2	0.00 to 2.55 s	0.00 s	This is the minimum delay time between a request from the Modbus master and the sent response of the slave. This time is required in halfduplex mode.

Network A – UDP

The network A – UDP Ethernet bus is reserved for internal communication between all DSLC-2 and MSLC-2 in one system independent on the busbar segment. Up to 32 DSLC-2 and up to 16 MSLC-2 can communicate over the 100ms – UDP messages.

ID	Parameter	CL	Setting range	Default	Description
5330	**TCP/IP address**	-	Info	192.168.0.1	Ethernet Channel Network A: Type UDP. The IP address of Channel A is fixed to: 192.168.0.Device-ID, where Device-ID = 1 to 32 for DSLC-2. ***NOTE:*** *In this field is usually entered the device number of the unit (parameter 1702).*

Network B – Modbus/TCP

The network B – Modbus/TCP Ethernet bus is provided for external communication purposes between all DSLC-2 / MSLC-2 in one system and a PLC. Up to 10 TCP/IP stacks can be built up per unit.

ID	Parameter	CL	Setting range	Default	Description
5430	**TCP/IP address**	2	xxx.xxx.xxx. (1 to 32)	192.168.1.1	Ethernet Channel Network B: Type Modbus /TCP. A PLC can be able to open up to 64 Modbus/TCP channels. The IP address of Channel B is adjustable in ToolKit: xxx.xxx.xx.Device-ID, where xxx = 0 to 255 and Device-ID = 1 to 32 for DSLC-2.

Modbus Interface Definitions

The unit offers a Modbus address table with for visualizing systems. The table contains 16 bit integer (short) and 32 bit integer (long) variables. The contents of some measurement long variables are also available as short variables. To cover all measurement ranges in a satisfying resolution, the engineering unit “Watt”, “Volt” and “Ampere” can be adjusted according to the application.

<table>
<tr><th>ID</th><th>Parameter</th><th>CL</th><th>Setting range</th><th>Default</th><th>Description</th></tr>
<tr><td>3181</td><td>Power [W] exponent 10^x</td><td>2</td><td>2 to 5</td><td>3</td><td>This setting adjusts the format of the 16 bit power values in the data telegram.

Example power measurement:
The measurement range is 0 to 250 kW.
Momentarily measurement value = 198.5 kW (198,500 W)
<table>
<tr><th>Setting</th><th>Meaning</th><th>Calculation</th><th>Transfer value (16Bit, max. 32767)</th><th>Possible Display Format</th></tr>
<tr><td>2</td><td>10^2</td><td>$\frac{198500\,W}{10^2\,W}$</td><td>1985</td><td>198.5 kW</td></tr>
<tr><td>3</td><td>10^3</td><td>$\frac{198500\,W}{10^3\,W}$</td><td>198</td><td>198 kW</td></tr>
<tr><td>4</td><td>10^4</td><td>$\frac{198500\,W}{10^4\,W}$</td><td>19</td><td>N/A</td></tr>
<tr><td>5</td><td>10^5</td><td>$\frac{198500\,W}{10^5\,W}$</td><td>1</td><td>N/A</td></tr>
</table></td></tr>
<tr><td>3182</td><td>Volts [V] exponent 10^x</td><td>2</td><td>-1 to 2</td><td>0</td><td>This setting adjusts the format of the 16 bit voltage values in the data telegram.

Example voltage measurement:
The measurement range is 0 to 480 V.
Momentarily measurement value = 477.8 V
<table>
<tr><th>Setting</th><th>Meaning</th><th>Calculation</th><th>Transfer value (16Bit, max. 32767)</th><th>Possible Display Format</th></tr>
<tr><td>-1</td><td>10^{-1}</td><td>$\frac{477.8\,V}{10^{-1}\,V}$</td><td>4778</td><td>477.8 V</td></tr>
<tr><td>0</td><td>10^0</td><td>$\frac{477.8\,V}{10^0\,V}$</td><td>477</td><td>477 V</td></tr>
<tr><td>1</td><td>10^1</td><td>$\frac{477.8\,V}{10^1\,V}$</td><td>47</td><td>N/A</td></tr>
<tr><td>2</td><td>10^2</td><td>$\frac{477.8\,V}{10^2\,V}$</td><td>4</td><td>N/A</td></tr>
</table></td></tr>
<tr><td>3183</td><td>Current [A] exponent 10^x</td><td>2</td><td>-1 to 0</td><td>0</td><td>This setting adjusts the format of the 16 bit current values in the data telegram.

Example current measurement:
The measurement range is 0 to 500 A.
Momentarily measurement value = 345.4 A
<table>
<tr><th>Setting</th><th>Meaning</th><th>Calculation</th><th>Transfer value (16Bit, max. 32767)</th><th>Possible Display Format</th></tr>
<tr><td>-1</td><td>10^{-1}</td><td>$\frac{345.4\,A}{10^{-1}\,V}$</td><td>3454</td><td>345.4 A</td></tr>
<tr><td>0</td><td>10^0</td><td>$\frac{345.4\,V}{10^0\,V}$</td><td>345</td><td>345 A</td></tr>
</table></td></tr>
</table>

Table 3-20: Parameter – configuration – interfaces

Menu 5.2 – System Management

This menu contains the parameters for the system management of the DSLC-2.

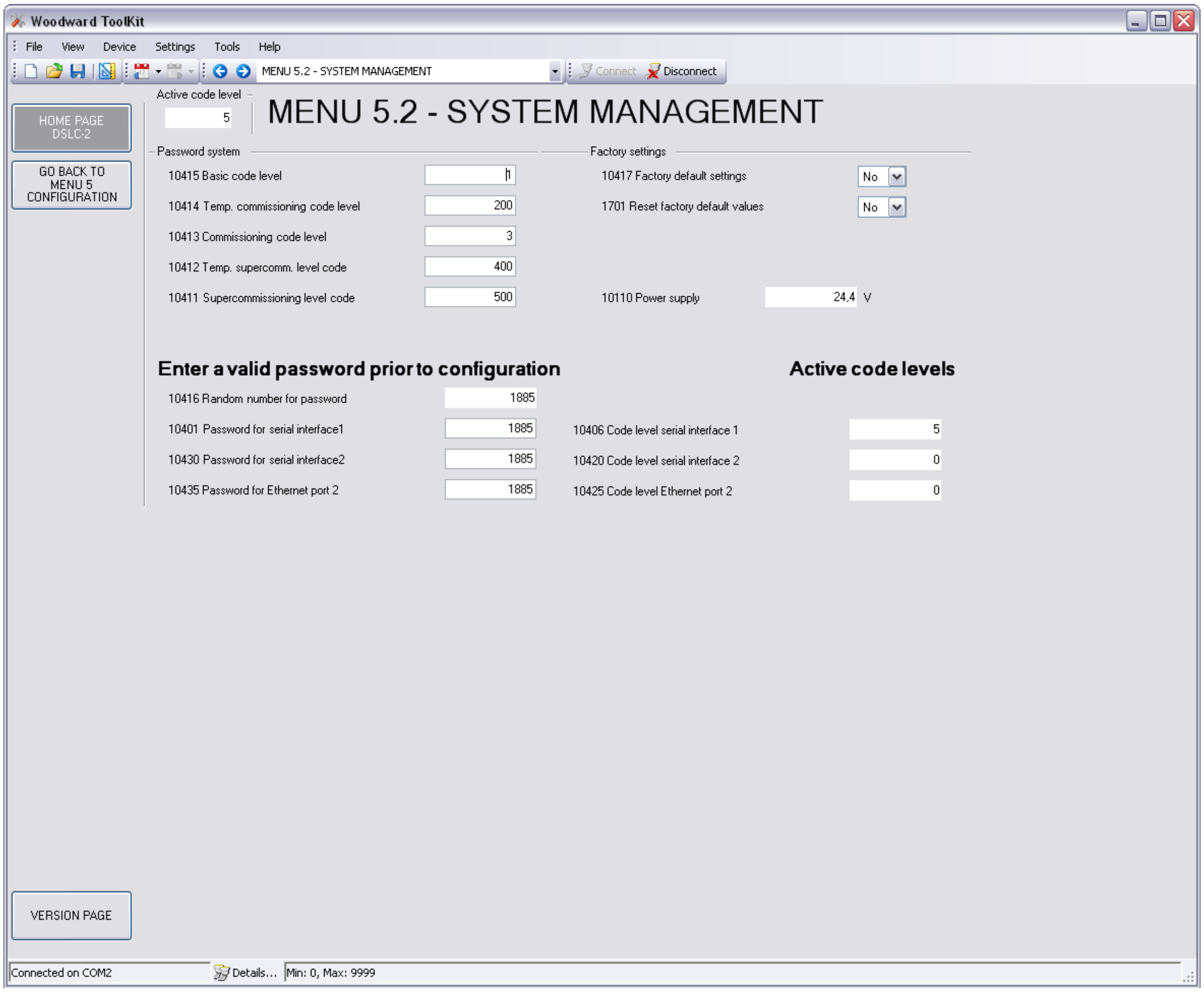


Figure 3-21: ToolKit – system management

Password System

The DSLC-2 utilizes a password protected multi-level configuration access hierarchy. This permits varying degrees of access to the parameters being granted by assigning unique passwords to designated personnel. A distinction is made between the access levels as follows:

Code level CL0 *(User Level)* Standard password = none

This code level permits for monitoring of the system and limited access to the parameters. Configuration of the control is not permitted. The unit powers up in this code level.

Code level CL1 *(Service Level)* Standard password = "**0 0 0 1**"

This code level entitles the user to change selected non-critical parameters. The user may also change the password for level CL1. Access granted by this password expires two hours after the password has been entered and the user is returned to the CL0 level.

Code level CL2 ***(Temporary Commissioning Level)*** No standard password available

This code level grants temporary access to most of the parameters. The password is calculated from the random number generated when the password is initially accessed. It is designed to grant a user a one-time access to a parameter without having to provide a reusable password. The user may also change the password for level CL1. Access granted by this password expires two hours after the password has been entered and the user is returned to the CL0 level. The password for the temporary commissioning level may be obtained from the vendor.

Code level CL3 ***(Commissioning Level)*** Standard password = "**0 0 0 3**"

This code level grants complete and total access to most of the parameters. In addition, the user may also change the passwords for levels CL1, CL2 and CL3. Access granted by this password expires two hours after the password has been entered and the user is returned to the CL0 level.

NOTE

Once the code level is entered, access to the configuration menus will be permitted for two hours or until another password is entered into the control. If a user needs to exit a code level, the user would enter "Details" and select "Log Off". This will block unauthorized configuration of the control. A user may return to CL0 by allowing the entered password to expire after two hours or by changing any one digit on the random number generated on the password screen and entering it into the unit.

It is possible to disable expiration of the password by entering "0000" after the CL1 or CL3 password has been entered. Access to the entered code level will remain enabled until another password is entered. Otherwise, the code level would expire when loading the standard values (default 0000) via ToolKit.

ID	Parameter	CL	Setting range	Default	Description
10415	**Basic code level**	1	0000 to 9999	-	The password for the code level "Service (CL1)" is defined in this parameter.
10414	**Temp. commissioning code level**	3	0000 to 9999	-	The algorithm for calculating the password for the code level "Temporary Commissioning (CL2)" is defined in this parameter.
10413	**Commissioning code level**	3	0000 to 9999	-	The password for the code level "Commission (CL3)" is defined in this parameter.
10412	**Temp. supercomm. level code**	5	0000 to 9999	-	The algorithm for calculating the password for the code level "Temporary Supercommissioning (CL4)" is defined in this parameter.
10411	**Supercommissioning level code**	5	0000 to 9999	-	The password for the code level "Supercommissioning (CL5)" is defined in this parameter.
10416	**Random number for password**	-	Info	-	When somebody enters a temporary password level.
10401	**Password for serial interface 1**	0	0000 to 9999	-	The password for configuring the control via the serial interface #1 must be entered here.
10430	**Password for serial interface 2**	0	0000 to 9999	-	The password for configuring the control via the serial interface #2 must be entered here.
10435	**Password for Ethernet port 2**	0	0000 to 9999	-	The password for configuring the control via the Ethernet port #2 (Network B) must be entered here.
10406	**Code level serial interface 1**	-	Info	-	This value displays the code level, which is currently enabled for access via RS-232 serial interface #1.
10420	**Code level serial interface 2**	-	Info	-	This value displays the code level, which is currently enabled for access via RS-485 serial interface #2.
10425	**Code level Ethernet port 2**	-	Info	-	This value displays the code level, which is currently enabled for access via Ethernet port #2 (Network B).

Factory Settings

ID	Parameter	CL	Setting range	Default	Description
10417	**Factory default settings**	0	No / Yes	No	Selecting “Yes” will allow the reset back to *Factory default settings* by selecting “Yes” for the *Reset factory default values* parameter (parameter 1701).
1701	**Reset factory default values**	0	No / Yes	No	**No:** All parameters will remain as currently configured. **Yes:** All parameters, which the enabled access code grants privileges to, will be restored to factory default values. This value returns to “No” when factory defaults are set.

Table 3-22: Parameter – configuration – system management

Menu 6 – Analog Inputs / Outputs

This menu contains the parameters for the configuration of the analog inputs and analog outputs of the DSLC-2.

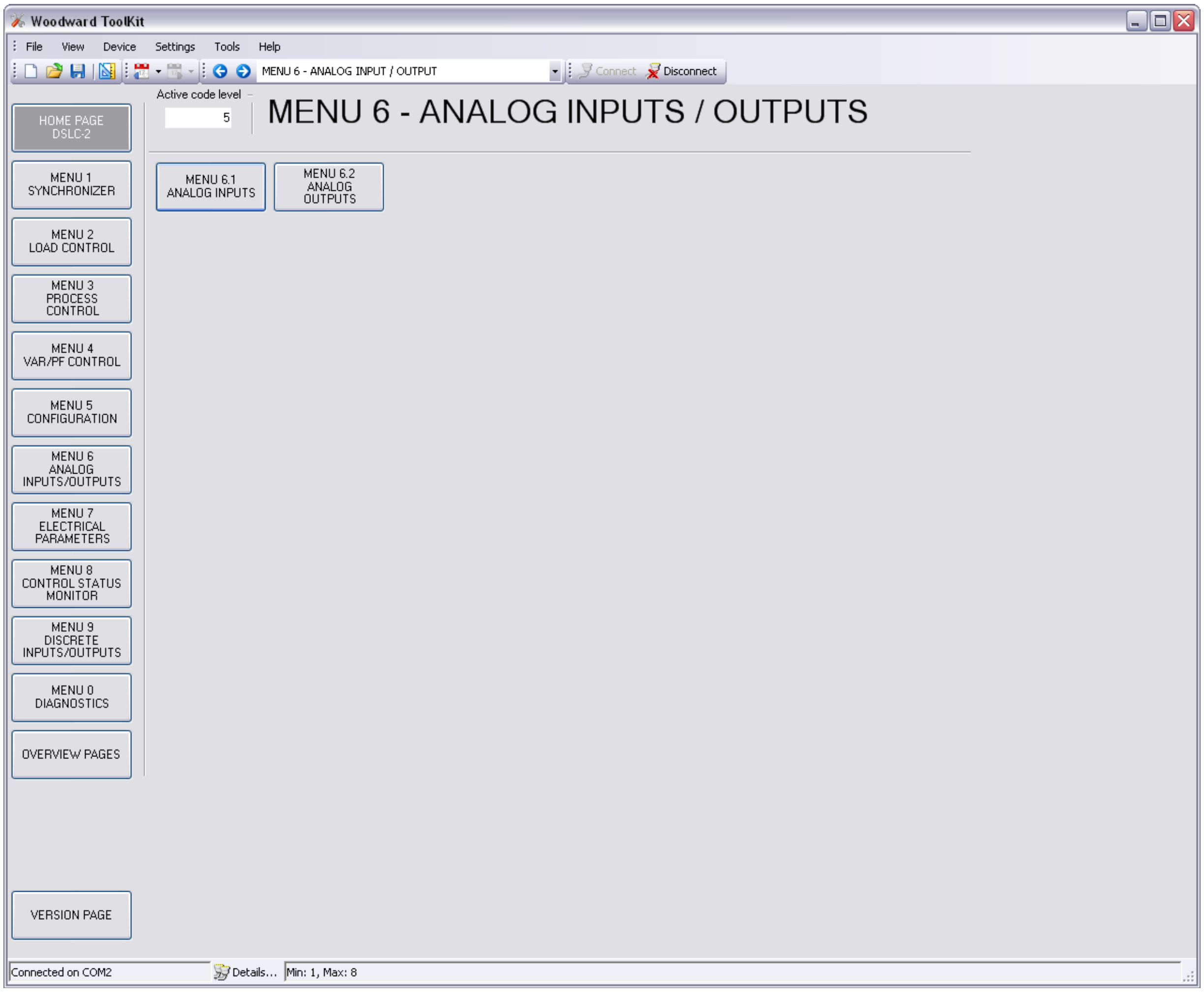


Figure 3-23: ToolKit – analog inputs / outputs

Menu 6.1 – Analog Inputs

This menu contains the parameters for the configuration of the analog inputs of the DSLC-2.

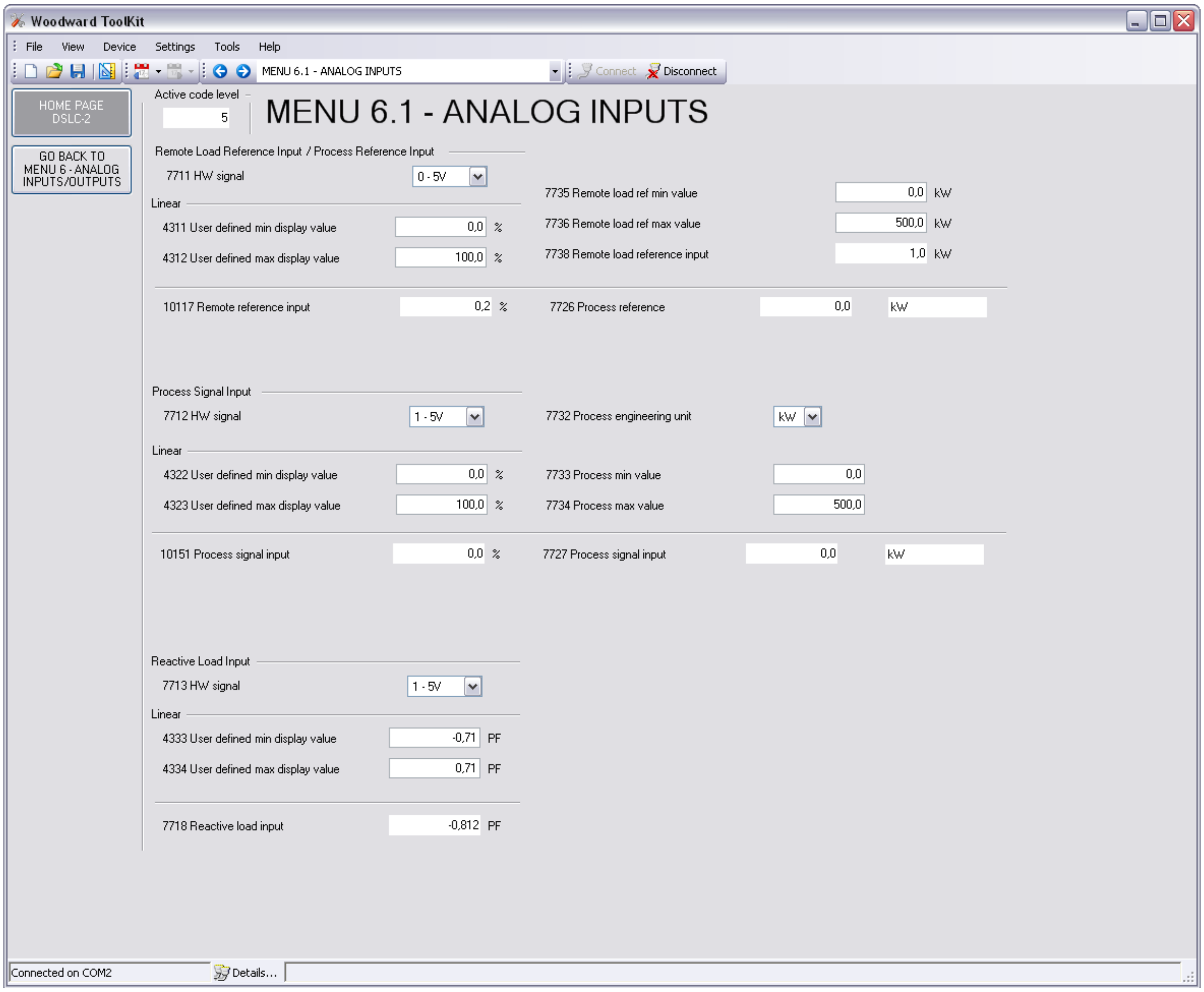


Figure 3-24: ToolKit – analog inputs

Remote Load Reference Input / Process Reference Input

This analog input can be used for two functionalities:

1. Remote load reference (baseload) input. The input becomes active, if the DI "Load Raise"/"Load Lower" are closed and the DI "Process Control" is not closed.

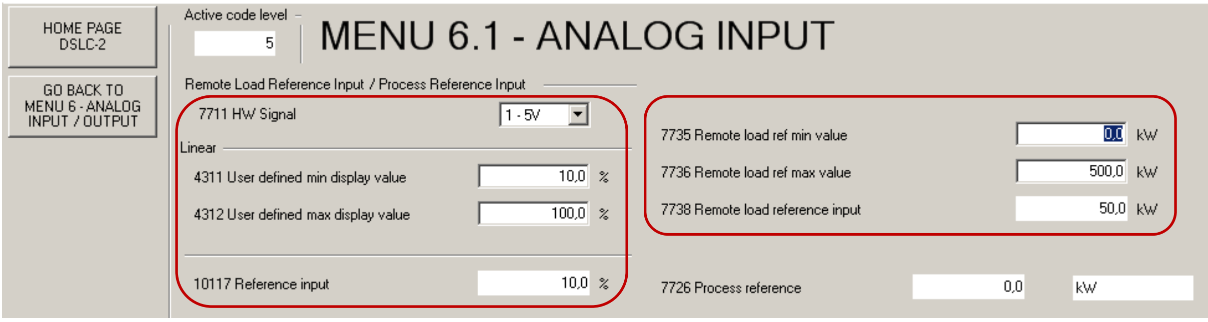


Figure 3-25: ToolKit – relevant fields for remote load reference input

The load control interacts with the percentage input value shown in field *Reference input* (parameter 10177). The setting on the right side is the scaling for a minimum and maximum load value while displaying the actual kW setting, which is shown in the field *Remote load reference input* (parameter 7738).

2. Process reference input. The input becomes active, if the DI "Load Raise"/"Load Lower" are closed and the DI "Process Control" is closed.

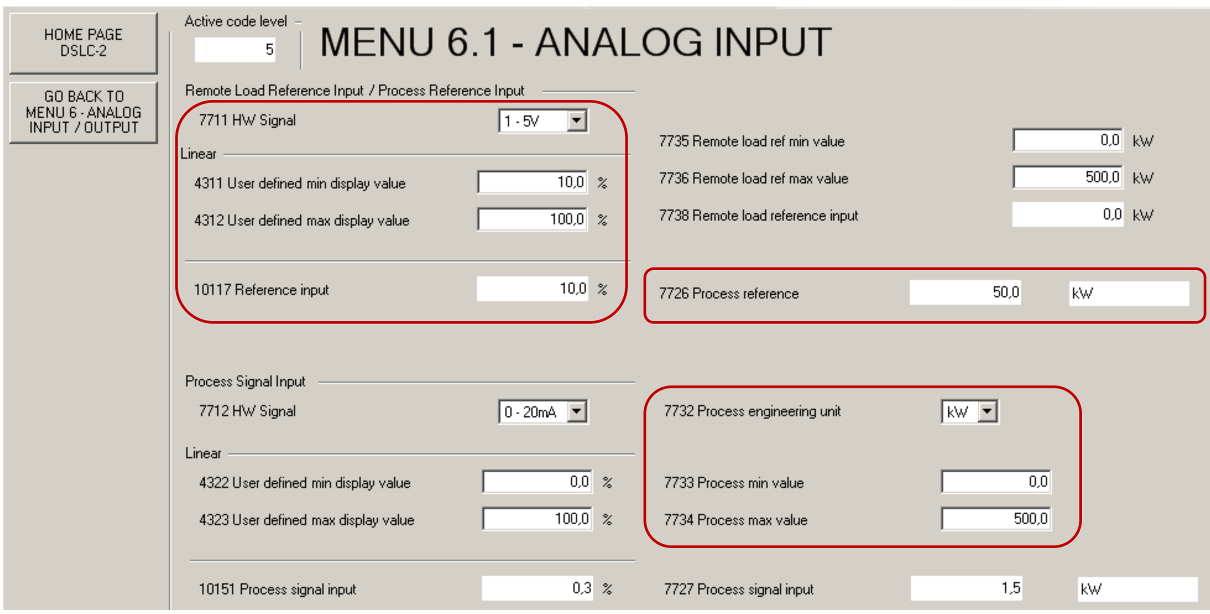


Figure 3-26: ToolKit – relevant fields for remote process reference input

The process control interacts with the percentage input value shown in field *Remote reference input* (parameter 10117). The setting on the right side will display the actual *Process reference* (parameter 7726). The process engineering unit will allow you to display a 4 to 20 mA input as a kW value (Example, there are many engineering units to select). The process signal input and the process reference (remote) will both display the engineering units selected.

ID	Parameter	CL	Setting range	Default	Description
7711	**HW signal**	2	0 to 20 mA./ 4 to 20 mA./ 0 to 10 V./ 0 to 5 V./ 1 to 5 V	0 to 5 V	Selection of hardware signal range.

Linear

ID	Parameter	CL	Setting range	Default	Description
4311	**User defined min display value**	2	-100.0 to 100.0 %	0.0 %	Remote load reference input / process reference input. Linear scaling: This is the percentage value according to the lowest hardware signal.
4312	**User defined max display value**	2	0.0 to 100 %	100.0 %	Remote load reference input / process reference input. Linear scaling: This is the percentage value according to the highest hardware signal.
10117	**Remote reference input**	-	Info	-	This is the resulting percentage value calculated out of the minimum and maximum scaling as to what the remote input actually has connected.
7735	**Remote load ref min value**	2	-999999.9 to 999999.9 kW	0.0 kW	This setting is only in use, if the remote load reference input is in use (see description above). This value is the according kW value to the percentage value according to the lowest hardware signal (parameter 4311).This setting is used to display the base load reference in kW.
7736	**Remote load ref max value**	2	-999999.9 to 999999.9 kW	500.0 kW	This setting is only in use, if the remote load reference input is in use (see description above). This value is the according kW value to the percentage value according to the highest hardware signal (parameter 4312). This setting is used to display the base load reference in kW.
7738	**Remote load reference input**	-	Info	-	This is the resulting kW value calculated out of the minimum and maximum scaling.
7726	**Process reference**	-	Info	-	This is the resulting *Process reference* value calculated out of the minimum and maximum scaling, adjusted in parameter 7733 and 7734.
7732	**Process engineering unit**	2	kW / °C / kPA / bar / V / mA	kW	The process control engineering units are selected here. With this input the reference and the real value can be defined in engineering units for easier customer use.

Process Signal Input

This analog input stands for the process control real signal. The input comes as a hardware signal but the engineering values can be selected here. The process engineering units are adjustable and used for visualizing purposes. The regulation of the process is done with the percentage value.

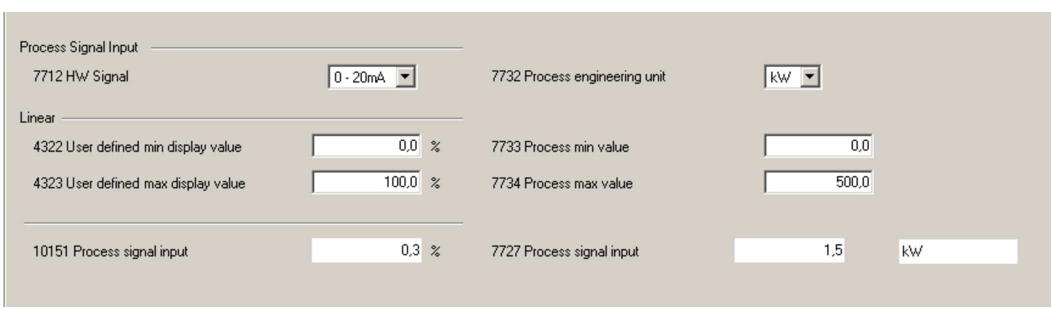


Figure 3-27: ToolKit – process signal input

ID	Parameter	CL	Setting range	Default	Description
7712	**HW signal**	2	0 to 20 mA./ 4 to 20 mA./ 0 to 10 V./ 0 to 5 V./ 1 to 5 V	1 to 5 V	Selection of hardware signal range.

Linear

ID	Parameter	CL	Setting range	Default	Description
4322	**User defined min display value**	2	-100.0 to 100.0 %	0.0 %	Process signal input (real value). Linear scaling: This is the percentage value according to the lowest hardware signal.
4323	**User defined max display value**	2	0.0 to 100.0 %	100.0 %	Process signal input (real value). Linear scaling: This is the percentage value according to the lowest hardware signal.
10151	**Process signal input**	-	Info	-	This is the resulting percentage value calculated out of the minimum and maximum scaling.
7732	**Process engineering unit**	2	kW / °C / kPA / bar / V / mA	kW	The process control engineering units can be determined here. With this input the reference and the real value can be defined in engineering units.
7733	**Process min value**	2	-999999.9 to 999999.9	0.0	This value is the engineering unit value to the percentage value according to the lowest hardware signal (parameter 4322).
7734	**Process max value**	2	-999999.9 to 999999.9	500.0	This value is the engineering unit value to the percentage value according to the highest hardware signal (parameter 4323).
7727	**Process signal Input**	-	Info	-	This is the resulting process signal input value calculated out of the minimum and maximum scaling, adjusted in parameter 7733 and 7734.

Reactive Load Input

This analog input stands for the power factor reference signal. Remote var reference control is not available at this time. To activate the remote reactive load input, the discret inputs "Voltage raise" and "Voltage lower" must be closed.

NOTE

Independent on the setting here the resulting var setpoint for the generator is restricted from +100 % to -10 % rated reactive power, when in base load mode, process mode or there is an active MSLC-2. Restriction is not active in isochronous or load sharing modes.

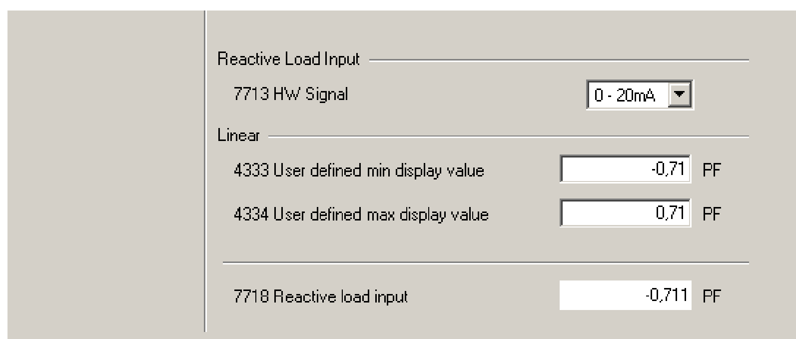


Figure 3-28: ToolKit – reactive load input

ID	Parameter	CL	Setting range	Default	Description
7713	**HW signal**	2	0 to 20 mA./ 4 to 20 mA./ 0 to 10 V./ 0 to 5 V./ 1 to 5 V	1 to 5 V	Selection of hardware signal range.

Linear

ID	Parameter	CL	Setting range	Default	Description
4333	**User defined min display value**	2	-0.999 to 0.999 PF	-0.710 PF	Power factor reference signal input. Linear scaling: This is the power factor value according to the lowest hardware signal.
4334	**User defined max display value**	2	-0.999 to 0.999 PF	0.710 PF	Power factor reference signal input. Linear scaling: This is the power factor value according to the highest hardware signal.
7718	**Reactive load input**	-	Info	-	This is the resulting power factor reference calculated out of the minimum and maximum scaling, adjusted in parameter 4333 and 4334.

Menu 6.2 – Analog Outputs

This menu contains the parameters for the configuration of the analog outputs of the DSLC-2.

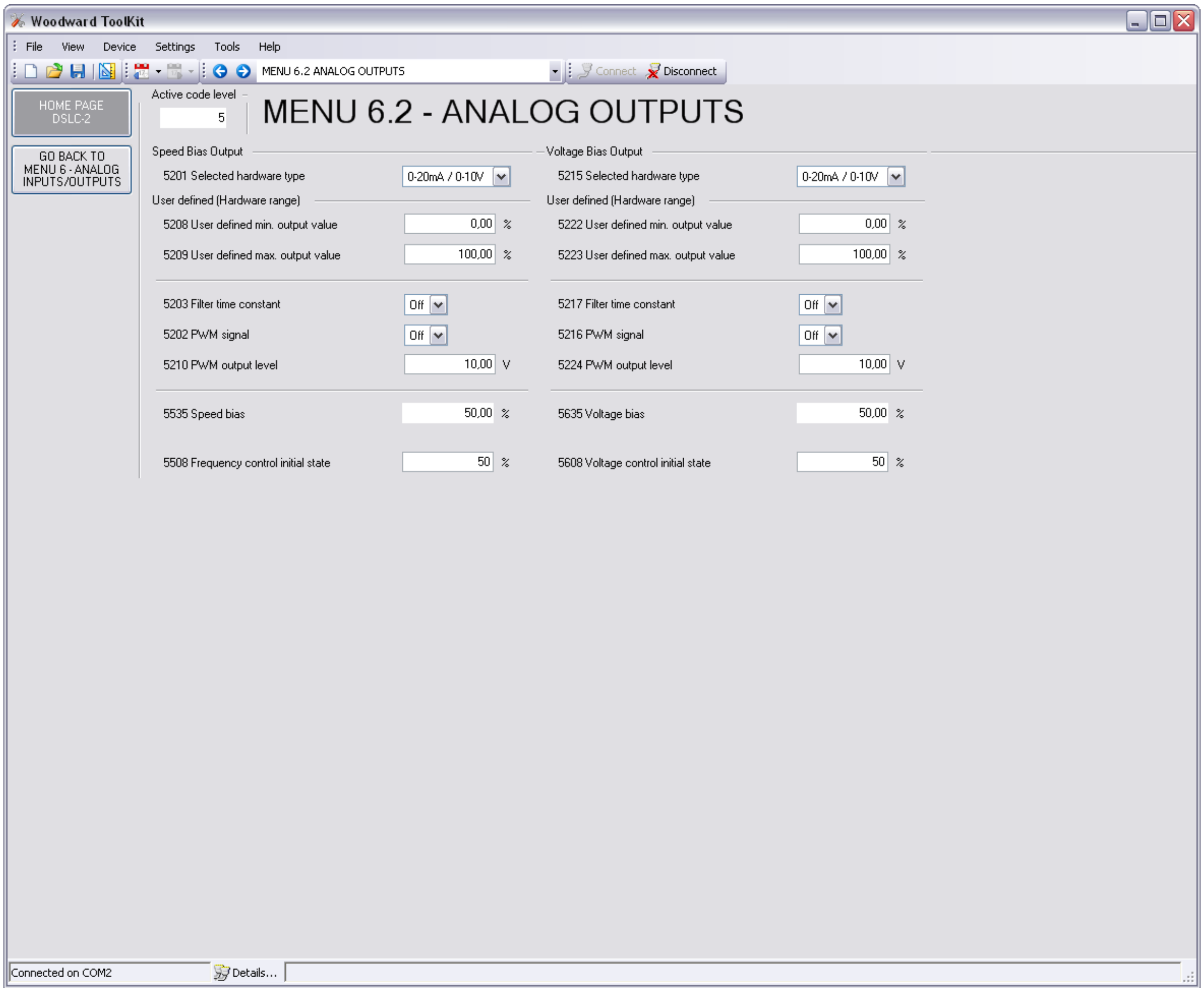


Figure 3-29: ToolKit – analog output

Speed Bias Output

The hardware of the speed bias output is able to drive signals between +/-20mA. Out of this range different signals can be created. The switching from a current output to a voltage output is achieved by adding a jumper between terminals 15 and 16.

ID	Parameter	CL	Setting range	Default	Description
5201	**Selected hardware type**	2	select from list below	0 to 20mA / 0 to 10V	This parameter is used to configure the appropriate type of analog controller signal. The range of the analog output is configured here. The available ranges are listed below. It is possible to configure the following settings. **Off:** No analog output signal will be issued. **User defined:** A maximum range of +/-20 mA / +/-10 V may be limited using the parameter 5208 and 5209.

Type	Setting	Jumper necessary	Range	Lower level	Upper level
Current	+/-20mA (+/-10V)	No	+/-20mA	-20 mA	+20 mA
	+/-10mA (+/-5V)		+/-10mA	-10 mA	+20 mA
	0 to 10mA (0 to 5V)		0-10mA	0 mA	10 mA
	0 to 20mA (0 to 10V)		0-20mA	0 mA	20 mA
	4 to 20mA		4-20mA	4 mA	20 mA
	10 to 0mA (5 to 0V)		10-0mA	10 mA	0 mA
	20 to 0mA (10 to 0V)		20-0mA	20 mA	0 mA
	20 to 4mA		20-4mA	20 mA	4 mA
Voltage	+/-20mA (+/-10V)	Yes	+/-10V	-10 Vdc	+10 Vdc
	+/-10mA (+/-5V)		+/-5V	-5 Vdc	+5 Vdc
	+/-3V		+/-3V	-3 Vdc	+3 Vdc
	+/-2.5V		+/-2.5V	-2.5Vdc	+2.5 Vdc
	+/-1V		+/-1V	-1 Vdc	+1 Vdc
	0 to 10mA (0 to 5V)		0 to 5V	0 Vdc	5 Vdc
	0.5V to 4.5V		0.5 to 4,5V	0.5 Vdc	4.5 Vdc
	0 to 20mA (0 to 10V)		0 to 10V	0 Vdc	10 Vdc
	10 to 0mA (5 to 0V)		5 to 0V	5 Vdc	0 Vdc
	4.5V to 0.5V		4.5 to 0,5V	4.5 Vdc	0.5 Vdc
	20 to 0mA (10 to 0V)		10 to 0V	10 Vdc	0 Vdc

User defined (Hardware range)

ID	Parameter	CL	Setting range	Default	Description
5208	**User defined min. output value**	2	0.00 to 100.00 %	0.00 %	The minimum output value, which shall correspond with the minimum value of the output range, must be entered here. This parameter is only active, if parameter 5201 is configured to "user defined". **Example:** If the value configured here is 25 %, the maximum output range of +/-20 mA / +/-10 V has a lower limit of -10 mA / -5 V.
5209	**User defined max. output value**	2	0.00 to 100.00 %	100.00 %	The maximum output value, which shall correspond with the maximum value of the output range, must be entered here. This parameter is only active, if parameter 5201 is configured to "user defined". **Example:** If the value configured here is 75 %, the maximum output range of +/-20 mA / +/-10 V has a upper limit of 10 mA / 5 V.

ID	Parameter	CL	Setting range	Default	Description
5203	**Filter time constant**	2	Off / 1 to 7	Off	A filter time constant may be used to reduce the fluctuation of an analog output reading. This filter time constant assesses the average of the signal according to the following formula: $Cut-off-frequency = \frac{1}{20ms \times 2 \times \pi \times 2^{N-1}}$, whereby "N" is the parameter. **Off**................... The analog output is displayed without filtering. **1**...................... Cut-off-frequency = 7.96 Hz (filter time constant = 0.02 s) **2**...................... Cut-off-frequency = 3.98 Hz (filter time constant = 0.04 s) **3**...................... Cut-off-frequency = 1.99 Hz (filter time constant = 0.08 s) **4**...................... Cut-off-frequency = 0.99 Hz (filter time constant = 0.16 s) **5**...................... Cut-off-frequency = 0.50 Hz (filter time constant = 0.32 s) **6**...................... Cut-off-frequency = 0.25 Hz (filter time constant = 0.64 s) **7**...................... Cut-off-frequency = 0.13 Hz (filter time constant = 1.28 s)
5202	**PWM signal**	2	Off / On	Off	**Off:** An analog signal is selected. **On:** A PWM signal will be supplied on the speed bias output. This is a voltage signal, so the hardware output must have a jumper between terminals 15 and 16. The amplitude of the PWM signal to be utilized is configured in *PWM output level* (parameter 5210). *Selected Hardware type* (parameter 5201) can be set to: • 0/20 mA / 0 to 10 V or parameter 5201 is set for “User Defined”, the *PWM signal* will be limited by: • Parameter 5208 • Parameter 5209
5210	**PWM output level**	2	0.00 to 10.00 V	10.00 V	If PWM has been enabled in parameter 5202, the level of the PWM signal may be adjusted here. ***NOTE:*** *Use 10.00 V for the Caterpillar diesel ADEM control.*
5535	**Speed bias**	-	Info	-	Display speed bias [0 to 100.00 %]. Frequency and active power controller output.
5508	**Frequency control initial state**	2	0.0 to 100.0 %	50.0 %	This is the initial state of the speed biasing output. The speed bias output functions from 0 to a 100 %. **Example:** Selected Hardware type (parameter 5201) of 0 to 20 mA / 0 to 10 V • A setting of 50 % will provide a 5 V output • A setting of 25 % will provide a 2.5 V output • A setting of 75 % will provide a 7.5 V output

Voltage Bias Output

ID	Parameter	CL	Setting range	Default	Description
5215	**Selected hardware type**	2	select from list below	0 to 20mA / 0 to 10V	This parameter is used to configure the appropriate type of analog controller signal. The range of the analog output is configured here. The available ranges are listed below. It is possible to configure the following settings. **Off:** No analog output signal will be issued. **User defined:** A maximum range of +/-20 mA / +/-10 V may be limited using the parameter 5222 and 5223 to obtain a user defined range.

Type	Setting	Jumper necessary	Range	Lower level	Upper level
Current	+/-20mA (+/-10V)	No	+/-20mA	-20 mA	+20 mA
	+/-10mA (+/-5V)		+/-10mA	-10 mA	+20 mA
	0 to 10mA (0 to 5V)		0-10mA	0 mA	10 mA
	0 to 20mA (0 to 10V)		0-20mA	0 mA	20 mA
	4 to 20mA		4-20mA	4 mA	20 mA
	10 to 0mA (5 to 0V)		10-0mA	10 mA	0 mA
	20 to 0mA (10 to 0V)		20-0mA	20 mA	0 mA
	20 to 4mA		20-4mA	20 mA	4 mA
Voltage	+/-20mA (+/-10V)	Yes	+/-10V	-10 Vdc	+10 Vdc
	+/-10mA (+/-5V)		+/-5V	-5 Vdc	+5 Vdc
	+/-3V		+/-3V	-3 Vdc	+3 Vdc
	+/-2.5V		+/-2.5V	-2.5Vdc	+2.5 Vdc
	+/-1V		+/-1V	-1 Vdc	+1 Vdc
	0 to 10mA (0 to 5V)		0 to 5V	0 Vdc	5 Vdc
	0.5V to 4.5V		0.5 to 4,5V	0.5 Vdc	4.5 Vdc
	0 to 20mA (0 to 10V)		0 to 10V	0 Vdc	10 Vdc
	10 to 0mA (5 to 0V)		5 to 0V	5 Vdc	0 Vdc
	4.5V to 0.5V		4.5 to 0,5V	4.5 Vdc	0.5 Vdc
	20 to 0mA (10 to 0V)		10 to 0V	10 Vdc	0 Vdc

User defined (Hardware range)

ID	Parameter	CL	Setting range	Default	Description
5222	**User defined min. output value**	2	0 to 100 %	0.00 %	The minimum output value, which shall correspond with the minimum value of the output range, must be entered here. This parameter is only active, if parameter 5215 is configured to "user defined". **Example:** If the value configured here is 25 %, the maximum output range of +/-20 mA / +/-10 V has a lower limit of -10 mA / -5 V.
5223	**User defined max. output value**	2	0 to 100 %	100.00 %	The maximum output value, which shall correspond with the maximum value of the output range, must be entered here. This parameter is only active, if parameter 5215 is configured to "user defined". **Example:** If the value configured here is 75 %, the maximum output range of +/-20 mA / +/-10 V has a upper limit of 10 mA / 5 V.
5217	**Filter time constant**	2	Off / 1 to 7	0	A filter time constant may be used to reduce the fluctuation of an analog output reading. This filter time constant assesses the average of the signal according to the following formula: $Cut-off-frequency = \frac{1}{20ms \times 2 \times \pi \times 2^{N-1}}$, whereby "N" is the parameter. **Off**.................. The analog output is displayed without filtering. **1**...................... Cut-off-frequency = 7.96 Hz (filter time constant = 0.02 s) **2**...................... Cut-off-frequency = 3.98 Hz (filter time constant = 0.04 s) **3**...................... Cut-off-frequency = 1.99 Hz (filter time constant = 0.08 s) **4**...................... Cut-off-frequency = 0.99 Hz (filter time constant = 0.16 s) **5**...................... Cut-off-frequency = 0.50 Hz (filter time constant = 0.32 s) **6**...................... Cut-off-frequency = 0.25 Hz (filter time constant = 0.64 s) **7**...................... Cut-off-frequency = 0.13 Hz (filter time constant = 1.28 s)
5216	**PWM signal**	2	Off / On	Off	**Off:** An analog signal is selected. **On:** A PWM signal will be supplied on the voltage bias output. This is a voltage signal, so the hardware output must have a jumper between terminals 18 and 19. The amplitude of the PWM signal to be utilized is configured in *PWM output level* (parameter 5224). The PWM signal will also be limited by parameter 5215 or 5222 and parameter 5223 if parameter 5215 is user defined.
5224	**PWM output level**	2	0.00 to 10.00 V	10.00 V	If PWM has been enabled in parameter 5216, the level of the PWM signal may be adjusted here.
5635	**Voltage bias**	-	Info	-	Display voltage bias [0 to 100.00 %]. Voltage and reactive power controller output.
5608	**Voltage control initial state**	2	0.0 to 100.0 %	50.0 %	This is the initial state of the voltage (AVR) biasing output. The voltage bias output functions from 0 to a 100 %. **Example:** Selected Hardware type (parameter 5251) of +/-3 V • A setting of 50 % will provide a 0 V output. • A setting of 25 % will provide a -1.5 V output • A setting of 75 % will provide a +1.5 V output

Table 3-30: Parameter – analog input / output

Menu 7 – Electrical Parameters

This menu contains the electrical parameters of the DSLC-2.

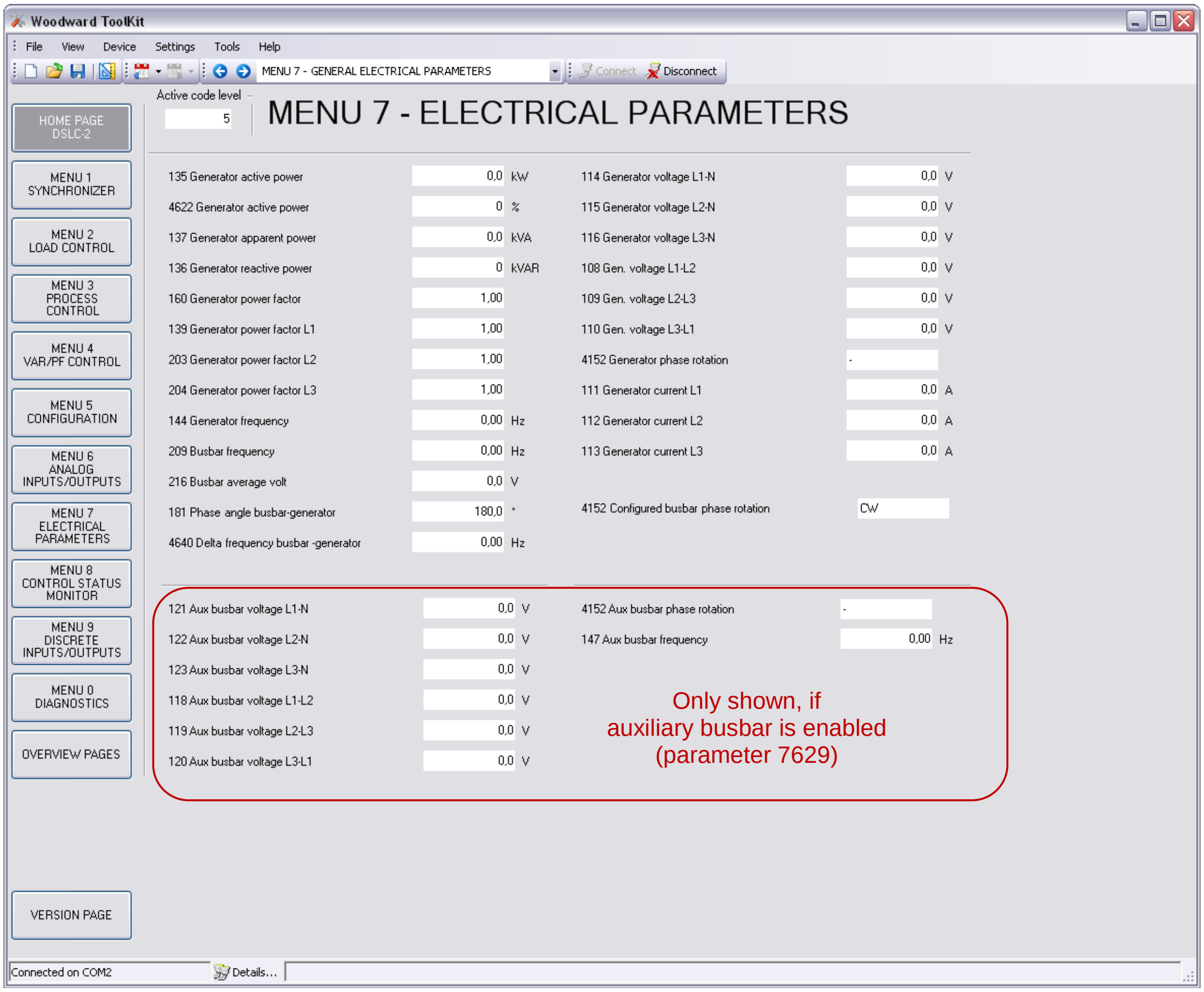


Figure 3-31: ToolKit – electrical parameters

Menu 7 provides all the AC measurement, voltage, current, power and reactive power. The generator is always a 3-phase measurement and the busbar is measured as a single phase. A configuration in Menu 5, *Auxiliary busbar available* (parameter 7629), allows additionally the measurement of the busbar with 3 phases. The option of the 3-phase busbar measurement allows the monitoring of all 3 phases and detection of the busbars phase rotation. Menu 7 will display the auxiliary busbar measurement values when parameter 7629 is configured to“Yes”.

ID	Parameter	CL	Setting range	Format	Description
135	**Generator total power**	-	Info	0.0 kW	Display of *Generator total power* in kW.
4622	**Generator active power**	-	Info	0 %	Display of *Generator active power* in %.
137	**Generator apparent power**	-	Info	0.0 kVA	Display of *Generator apparent power* in kVA.
136	**Generator reactive power**	-	Info	0 kvar	Display of *Generator reactive power* in kvar.
160	**Generator power factor**	-	Info	1.00	Display of *Generator power factor*.

ID	Parameter	CL	Setting range	Format	Description
139	**Generator power factor L1**	-	Info	1.00	Display of *Generator power factor L1*.
203	**Generator power factor L2**	-	Info	1.00	Display of *Generator power factor L2*.
204	**Generator power factor L3**	-	Info	1.00	Display of *Generator power factor L3*.
144	**Generator frequency**	-	Info	0.00 Hz	Display of *Generator frequency* in Hz.
209	**Busbar frequency**	-	Info	0.00 Hz	Display of *Busbar frequency* in Hz.
216	**Busbar average volt**	-	Info	0.0 V	Display of *Busbar average voltage* in V.
181	**Phase angle busbar - generator**	-	Info	180.0°	Display of *Phase angle busbar-generator* in degrees.
4640	**Delta frequency busbar - generator**	-	Info	0.00 Hz	Display of *Delta frequency busbar-generator* in Hz.
114	**Generator voltage L1-N**	-	Info	0.0 V	Display of *Generator voltage L1-N* in V.
115	**Generator voltage L2-N**	-	Info	0.0 V	Display of *Generator voltage L2-N* in V.
116	**Generator voltage L3-N**	-	Info	0.0 V	Display of *Generator voltage L3-N* in V.
108	**Gen. Voltage L1-L2**	-	Info	0.0 V	Display of *Generator voltage L1-L2* in V.
109	**Gen. Voltage L2-L3**	-	Info	0.0 V	Display of *Generator voltage L2-L3* in V.
110	**Gen. Voltage L3-L1**	-	Info	0.0 V	Display of *Generator voltage L3-L1* in V.
4152	**Generator phase rotation**	-	Info	- / CW / CCW	Display of *Generator phase rotation*: **-:** The phase rotation is not measurable **CW:** Clock Wise = phase rotation right **CCW:** Counter Clock Wise = phase rotation left
111	**Generator current L1**	-	Info	0.0 A	Display of *Generator current L1* in A.
112	**Generator current L2**	-	Info	0.0 A	Display of *Generator current L2* in A.
113	**Generator current L3**	-	Info	0.0 A	Display of *Generator current L3* in A.
4152	**Configured busbar phase rotation**	-	Info	CW / CCW	Display of the *Configured busbar phase rotation*: **CW:** Clock Wise = phase rotation right **CCW:** Counter Clock Wise = phase rotation left ***NOTE:*** *This is no measurement displaying. This field shows the configuration of the 1Ph 2W phase rotation (parameter 1859) in Menu 5.*

Auxiliary Busbar Measurement

ID	Parameter	CL	Setting range	Format	Description
121	**Aux busbar voltage L1-N**	-	Info	0.0 V	Display of *Auxiliary busbar voltage L1-N* in V.
122	**Aux busbar voltage L2-N**	-	Info	0.0 V	Display of *Auxiliary busbar voltage L2-N* in V.
123	**Aux busbar voltage L3-N**	-	Info	0.0 V	Display of *Auxiliary busbar voltage L3-N* in V.
118	**Aux busbar voltage L1-L2**	-	Info	0.0 V	Display of *Auxiliary busbar voltage L1-L2* in V.
119	**Aux busbar voltage L2-L3**	-	Info	0.0 V	Display of *Auxiliary busbar voltage L2-L3* in V.
120	**Aux busbar voltage L3-L1**	-	Info	0.0 V	Display of *Auxiliary busbar voltage L3-L1* in V.
4152	**Aux busbar phase rotation**	-	Info	- / CW / CCW	Display of *Auxiliary busbar phase rotation*: **-:** The phase rotation is not measurable **CW:** Clock Wise = phase rotation right **CCW:** Counter Clock Wise = phase rotation left
147	**Aux busbar frequency**	-	Info	0.00 Hz	Display of *Auxiliary Busbar frequency* in Hz.

Table 3-32: Parameter – electrical parameters

Menu 8 – Control Status Monitor

This menu contains the parameters of the control status monitor of the DSLC-2 showing the actual modes, references and alarms.

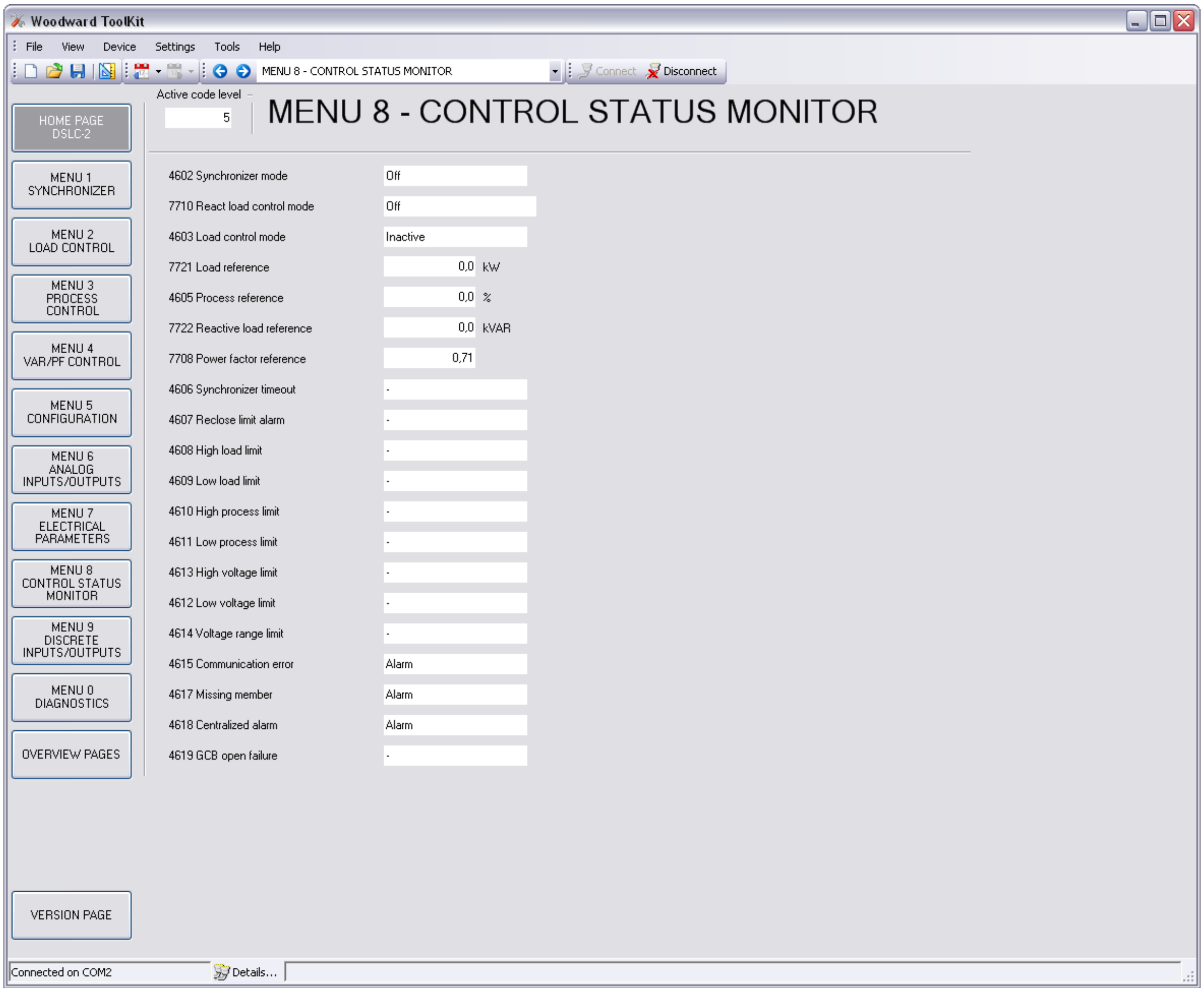


Figure 3-33: ToolKit – control status monitor

ID	Parameter	CL	Setting range	Format	Description
4602	**Synchronizer mode**	-	Off / Synchronized / Permissive / Check / Run / Sync Timer / Auto-Off / Close Timer	-	Display of the different *Synchronizer modes*: **Off:** The synchronizer is not active. **Synchronized:** The GCB is closed. **Permissive:** The synchronizer runs in permissive mode. **Check:** The synchronizer runs in check mode. **Run:** The synchronizer is full active. **Sync Timer:** The synchronizer is stopped, because of a sync time-out. **Auto-Off:** The synchronizer is stopped, because of an unsuccessful closure of the GCB. (resync is disabled). **Close Timer:** This is the GCB close command.

ID	Parameter	CL	Setting range	Format	Description
7710	**Reactive load control mode**	-	Off / Inactive / Droop / VAR sharing / VAR control / PF control	-	Display of the different *Reactive load control modes*: **Off:** The reactive load control mode is disabled. **Inactive:** The reactive load control is not active. **Droop:** The reactive load control runs in droop or droop tracking. **VAR sharing:** The reactive load sharing is active. **VAR control:** The reactive load control with kvar reference is active. **PF control:** The reactive load control with power factor reference is active.
4603	**Load control mode**	-	Droop / At Unload Trip / Base Load / Base Load Ramp / Base Load Lower / Base Load Raise / Load share unload / Load share Ramp / Load sharing / Base Load Unload / Process Ramp / Process Control / Process Lower / Process Raise / Inactive	-	Display of the different *Load control modes*: **Droop:** The Load control runs in droop or droop tracking. **At Unload Trip:** The Load control or the load share control resides in unloaded condition. **Base Load:** The Load control runs in base load. **Base Load Ramp:** The Load control ramps to a reference value. **Base Load Lower:** A base load lower command is active. **Base Load Raise:** A base load raise command is active. **Load share unload:** The load sharing unloads the generator and the GCB will be opened. **Load share Ramp:** The load sharing loads the generator. **Load sharing:** The load sharing mode is active. **Base Load Unload:** The load control unloads the generator. **Process Ramp:** The generator is ramped to the process control reference. **Process Control:** The process control mode is active. **Process Lower:** A process reference lower command is active. **Process Raise:** A process reference raise command is active. I**nactive:** The load control is inactive.
7721	**Load reference**	-	Info	0.0 kW	Display of Load control reference in kW. This field indicates the momentarily load control setpoint.
4605	**Process reference**	-	Info	0.0 %	Display of process control reference in percentage. This field indicates the momentarily process control setpoint.
7722	**Reactive load reference**	-	Info	0.0 kvar	Display of *Reactive load reference* in kvar. This field indicates the momentarily reactive load control setpoint.
7708	**Power factor reference**	-	Info	0.00	Display of the *Power factor reference*.
4606	**Synchronizer timeout**	-	Info	- / Alarm	Display of Alarm: *Synchronizer timeout*.
4607	**Sync reclose limit**	-	Info	- / Alarm	Display of Alarm: *Synchronizer reclose limit*.
4608	**High load limit**	-	Info	- / Alarm	Display of Alarm: *High load limit*.
4609	**Low load limit**	-	Info	- / Alarm	Display of Alarm: *Low load limit*.
4610	**High process limit**	-	Info	- / Alarm	Display of Alarm: *High process limit*.
4611	**Low process limit**	-	Info	- / Alarm	Display of Alarm: *Low process limit*.
4613	**High voltage limit**	-	Info	- / Alarm	Display of Alarm: *High voltage limit*.
4612	**Low voltage limit**	-	Info	- / Alarm	Display of Alarm: *Low voltage limit*.
4614	**Voltage range limit**	-	Info	- / Alarm	Display of Alarm: *Voltage range limit*.
4615	**Communica-tion error**	-	Info	- / Alarm	Display of Alarm: *Communication error*.

ID	Parameter	CL	Setting range	Format	Description
4617	**Missing member**	-	Info	- / Alarm	Display of Alarm: Missing loadshare member.
4618	**Centralized alarm**	-	Info	- / Alarm	Display of Alarm: *Centralized alarm*.
4619	**GCB open failure**	-	Info	- / Alarm	Display of Alarm: *GCB open failure*.

Table 3-34: Parameter – control status monitor

Menu 9 – Discrete Inputs / Relay Outputs

This menu contains the parameters for the discrete inputs, the discrete input source (hardware or communication interface) and the discrete outputs (relays) of the DSLC-2.

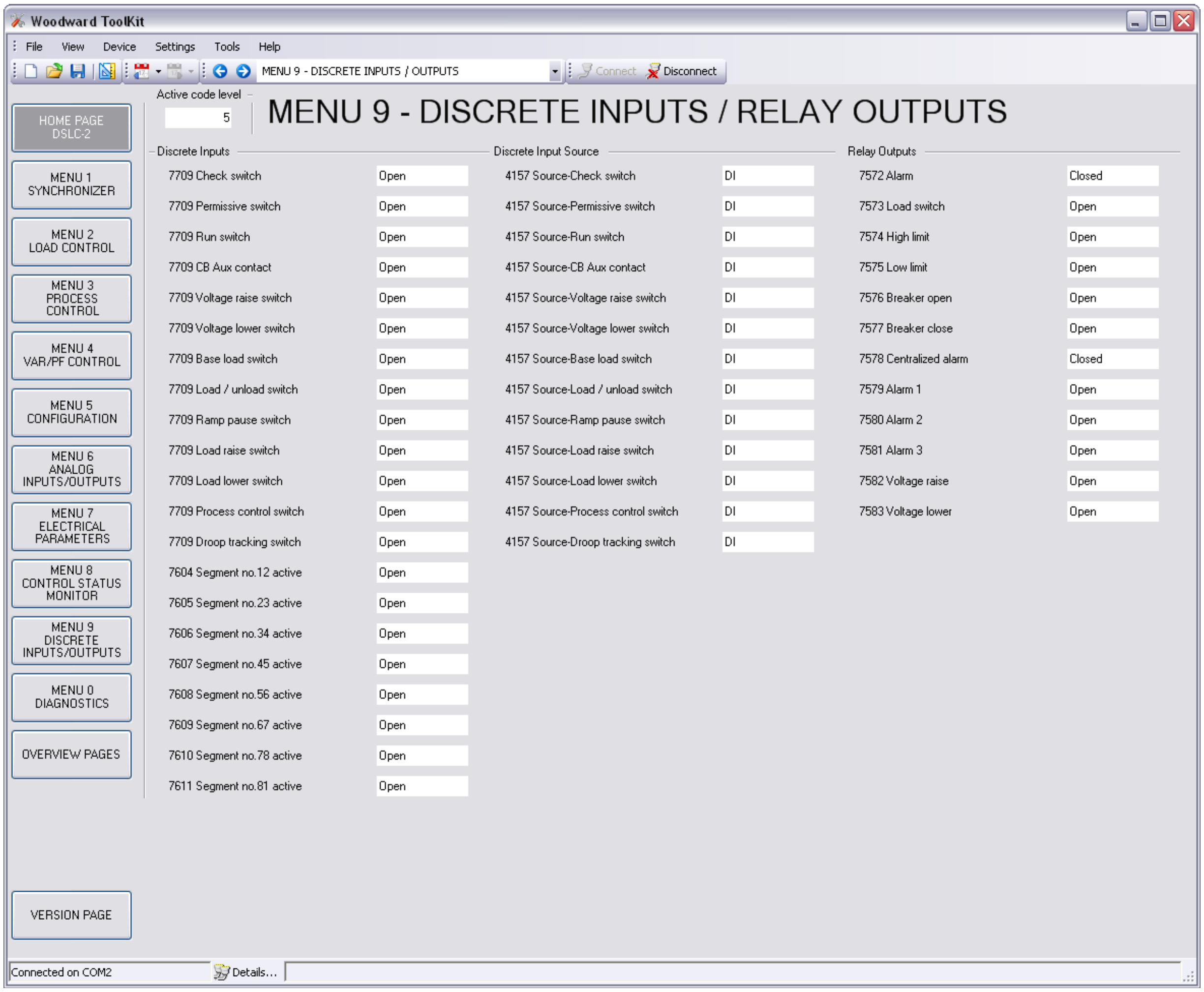


Figure 3-35: ToolKit – discrete inputs / relay outputs

Discrete Inputs

ID	Parameter	CL	Setting range	Default	Description
7709	**Check switch**	-	Open / Closed	Open	Display of discrete input state for [DI 01]: Check.
7709	**Permissive switch**	-	Open / Closed	Open	Display of discrete input state for [DI 02]: Permissive.
7709	**Run switch**	-	Open / Closed	Open	Display of discrete input state for [DI 03]: Run.
7709	**CB Aux contact**	-	Open / Closed	Open	Display of discrete input state for [DI 04]: CB Aux.
7709	**Voltage raise switch**	-	Open / Closed	Open	Display of discrete input state for [DI 05]: Voltage raise
7709	**Voltage lower switch**	-	Open / Closed	Open	Display of discrete input state for [DI 06]: Voltage lower
7709	**Base load switch**	-	Open / Closed	Open	Display of discrete input state for [DI 07]: Base load.
7709	**Load / un-load switch**	-	Open / Closed	Open	Display of discrete input state for [DI 08]: Load / unload.

ID	Parameter	CL	Setting range	Default	Description
7709	**Ramp pause switch**	-	Open / Closed	Open	Display of discrete input state for [DI 09]: Ramp pause.
7709	**Load raise switch**	-	Open / Closed	Open	Display of discrete input state for [DI 10]: Load raise
7709	**Load lower switch**	-	Open / Closed	Open	Display of discrete input state for [DI 11]: Load lower
7709	**Process control switch**	-	Open / Closed	Open	Display of discrete input state for [DI 12]: Process control
7604	**Segment no .12 active**	-	Open / Closed	Open	Display of discrete input state for [DI 13]: Segment no 12 active.
7605	**Segment no .23 active**	-	Open / Closed	Open	Display of discrete input state for [DI 14]: Segment no 23 active.
7606	**Segment no .34 active**	-	Open / Closed	Open	Display of discrete input state for [DI 15]: Segment no 34 active.
7607	**Segment no .45 active**	-	Open / Closed	Open	Display of discrete input state for [DI 16]: Segment no 45 active.
7608	**Segment no .56 active**	-	Open / Closed	Open	Display of discrete input state for [DI 17]: Segment no 56 active.
7609	**Segment no .67 active**	-	Open / Closed	Open	Display of discrete input state for [DI 18]: Segment no 67 active.
7610	**Segment no .78 active**	-	Open / Closed	Open	Display of discrete input state for [DI 19]: Segment no 78 active.
7611	**Segment no .81 active**	-	Open / Closed	Open	Display of discrete input state for [DI 20]: Segment no 81 active.
7709	**Droop track-ing switch**	-	Open / Closed	Open	Display of discrete input state for [DI 21]: Droop tracking switch active.

Discrete Input Source

ID	Parameter	CL	Setting range	Default	Description
4157	**Source-Check switch**	-	DI / COM	DI	Indicates the source of “Check” switch either DI or communication interface.
4157	**Source-Permissive switch**	-	DI / COM	DI	Indicates the source of “Permissive” switch either DI or communi-cation interface.
4157	**Source-Run switch**	-	DI / COM	DI	Indicates the source of “Run” switch either DI or communication interface.
4157	**Source-Aux contact switch**	-	DI / COM	DI	Indicates the source of “CB Aux” switch either DI or communica-tion interface.
4157	**Source-Voltage raise switch**	-	DI / COM	DI	Indicates the source of “Voltage Raise” switch either DI or com-munication interface.
4157	**Source-Voltage low-er switch**	-	DI / COM	DI	Indicates the source of “Voltage Lower” switch either DI or com-munication interface.
4157	**Source-Base load switch**	-	DI / COM	DI	Indicates the source of “Base Load” switch either DI or communi-cation interface.
4157	**Source-Load / unload switch**	-	DI / COM	DI	Indicates the source of “Load/Unload” switch either DI or commu-nication interface.

ID	Parameter	CL	Setting range	Default	Description
4157	**Source Ramp pause switch**	-	DI / COM	DI	Indicates the source of ramp pause switch either DI or communication interface.
4157	**Source-Load raise switch**	-	DI / COM	DI	Indicates the source of raise load switch either DI or communication interface.
4157	**Source-Load lower switch**	-	DI / COM	DI	Indicates the source of lower load switch either DI or communication interface.
4157	**Source-Process control switch**	-	DI / COM	DI	Indicates the source of process switch either DI or communication interface.
4157	**Source-Droop tracking switch**	-	DI / COM	DI	Indicates the source of droop tracking switch either DI or communication interface.

Relay Outputs

ID	Parameter	CL	Setting range	Default	Description
7572	**Alarm**	-	Open / Closed	Closed	Display of relay output state for [R 01]: Alarm.
7573	**Load switch**	-	Open / Closed	Open	Display of relay output state for [R 02]: Load switch.
7574	**High limit**	-	Open / Closed	Open	Display of relay output state for [R 03]: High limit.
7575	**Low limit**	-	Open / Closed	Open	Display of relay output state for [R 04]: Low limit.
7576	**Breaker open**	-	Open / Closed	Open	Display of relay output state for [R 05]: Breaker open.
7577	**Breaker close**	-	Open / Closed	Open	Display of relay output state for [R 06]: Breaker close.
7578	**Centralized alarm**	-	Open / Closed	Open	Display of relay output state for [R 07]: Centralized alarm.
7579	**Alarm 1**	-	Open / Closed	Open	Display of relay output state for [R 08]: Alarm 1.
7580	**Alarm 2**	-	Open / Closed	Open	Display of relay output state for [R 09]: Alarm 2.
7581	**Alarm 3**	-	Open / Closed	Open	Display of relay output state for [R 10]: Alarm 3.
7582	**Voltage raise**	-	Open / Closed	Open	Display of relay output state for [R 11]: Voltage raise.
7583	**Voltage lower**	-	Open / Closed	Open	Display of relay output state for [R 12]: Voltage lower.

Table 3-36: Parameter – discrete inputs / outputs

Menu 0 – Diagnostics

This menu contains the alarms that can be connected to output either for relays 8, 9 or 10.

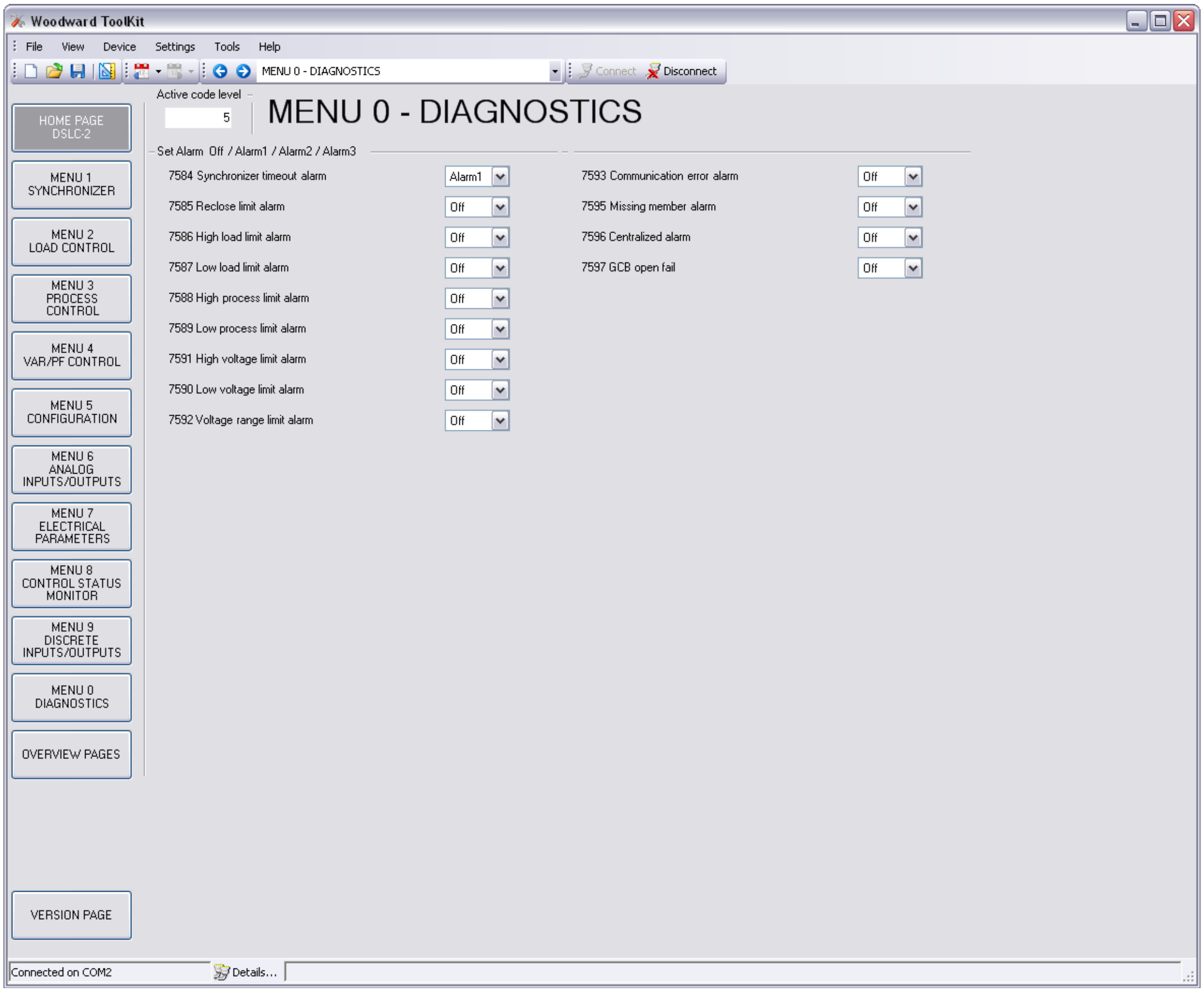


Figure 3-37: ToolKit – diagnostics

Set Alarm to Off / Alarm1 / Alarm2 / Alarm3

Each alarm can be set on relay 8 (Alarm 1), relay 9 (Alarm 2) or relay 10 (Alarm 3). Multiple parameters can be selected for the same alarm.

ID	Parameter	CL	Setting range	Default	Description
7584	**Synchronizer timeout alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.
7585	**Reclose limit alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.
7586	**High load limit alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.
7587	**Low load limit alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.
7588	**High process limit alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.
7589	**Low process limit alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.
7590	**Low voltage limit alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.

ID	Parameter	CL	Setting range	Default	Description
7591	**High voltage limit alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.
7592	**Voltage range limit alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.
7593	**Communica-tion error alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.
7595	**Missing member alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.
7596	**Centralized alarm**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.
7597	**GCB open fail**	2	Off / Alarm1 / Alarm2 / Alarm3	Off	Passing the alarm to relay Alarm 1, Alarm 2 or Alarm 3.

Table 3-38: Parameter – diagnostics

NOTE

Communication error alarm (parameter 7593) is activated when no other devices can be found. The Missing member alarm (parameter 7595) is activated by a setting in Menu 5, parameter 4063 and 4707). Both alarms refer to the Ethernet A interface.

Overview Pages

The DSLC-2 provides finally 3 overview pages showing information from up to 32 DSLC-2 and up to 16 MSLC-2.

DSLC-2 Overview Page 1

The DSLC-2 overview page 1 informs about the conditions of the DSLC-2 number 1 to 16 connected to the network. This helps for commissioning a DSLC-2 / MSLC-2 system.

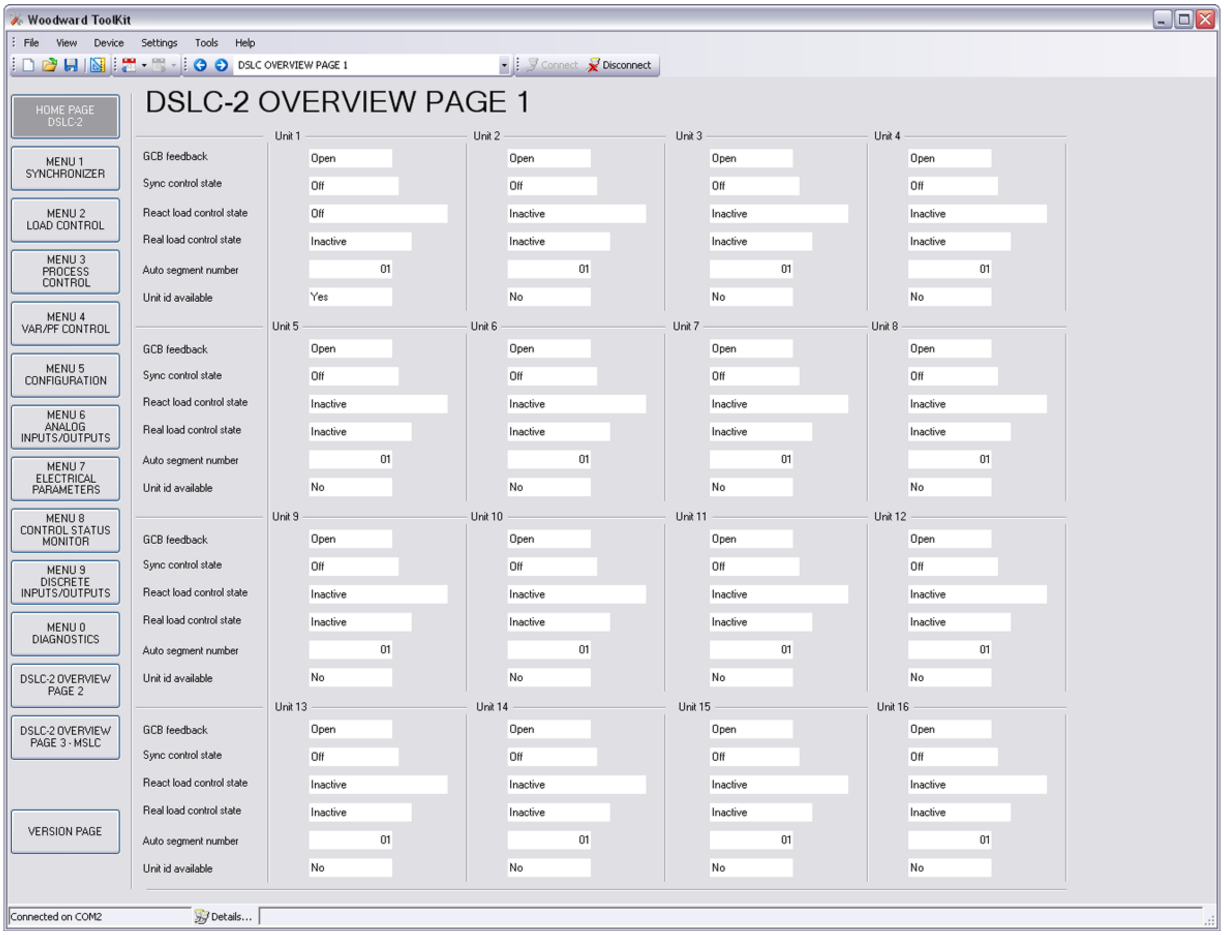


Figure 3-39: ToolKit – DSLC-2 overview page 1

ID	Parameter	CL	Setting range	Default	Description
	GCB feedback	-	Open / Closed	-	This field indicates the GCB state of the DSLC-2 unit 1 to 16.
	Sync control state	-	Off / Check / Permissive / Run / Close Timer / Sync Timer / Synchronized / Auto-Off	-	This field indicates the *Synchronizer control state* of DSLC-2 unit 1 to 16: **Off:** The synchronizer is not active. **Check:** The synchronizer runs in check mode. **Permissive:** The synchronizer runs in permissive mode. **Run:** The synchronizer is full active. **Close Timer:** This is the GCB close command. **Sync Timer:** The synchronizer is stopped, because of a sync time-out. **Synchronized:** The GCB is closed. **Auto-Off:** The synchronizer is stopped, because of an unsuccessful closure of the GCB. (resync is disabled).

ID	Parameter	CL	Setting range	Default	Description
	React load control state	-	Inactive / Off / Droop / VAR sharing / Reactive load control	-	This field indicates the *Reactive load control state* of DSLC-2 unit 1 to 16: **Inactive:** The reactive load control mode is inactive. **Off:** Var control is generally disabled. **Droop:** Droop is active. **VAR sharing:** The var sharing is active. **Reactive load control:** Var or PF control is active.
	Real load control state	-	Inactive / Droop / At Unload trip / Load sharing / Baseload / Process Control	-	This field indicates the *Real load control state* of DSLC-2 unit 1 to16: **Inactive:** The load control mode is inactive. **Droop:** Droop is active. **At Unload trip:** The Load control or the load share control resides in unloaded condition. **Load sharing:** The load sharing is active. **Baseload:** Base load control is active. **Process control:** Process control is active.
	Auto segment number	-	1 to 8	-	Display of *Auto segment number* of DSLC-2 unit 1 to 16.
	Unit id available	-	Yes / No	-	Display if *Unit Id available* or not of DSLC-2 unit 1 to 16.

Table 3-29: Parameter – DSLC-2 overview page 1

DSLC-2 Overview Page 2

The DSLC-2 overview page 2 informs about the conditions of the DSLC-2 number 17 to 32 connected to the network. This helps for commissioning a DSLC-2 / MSLC-2 system.

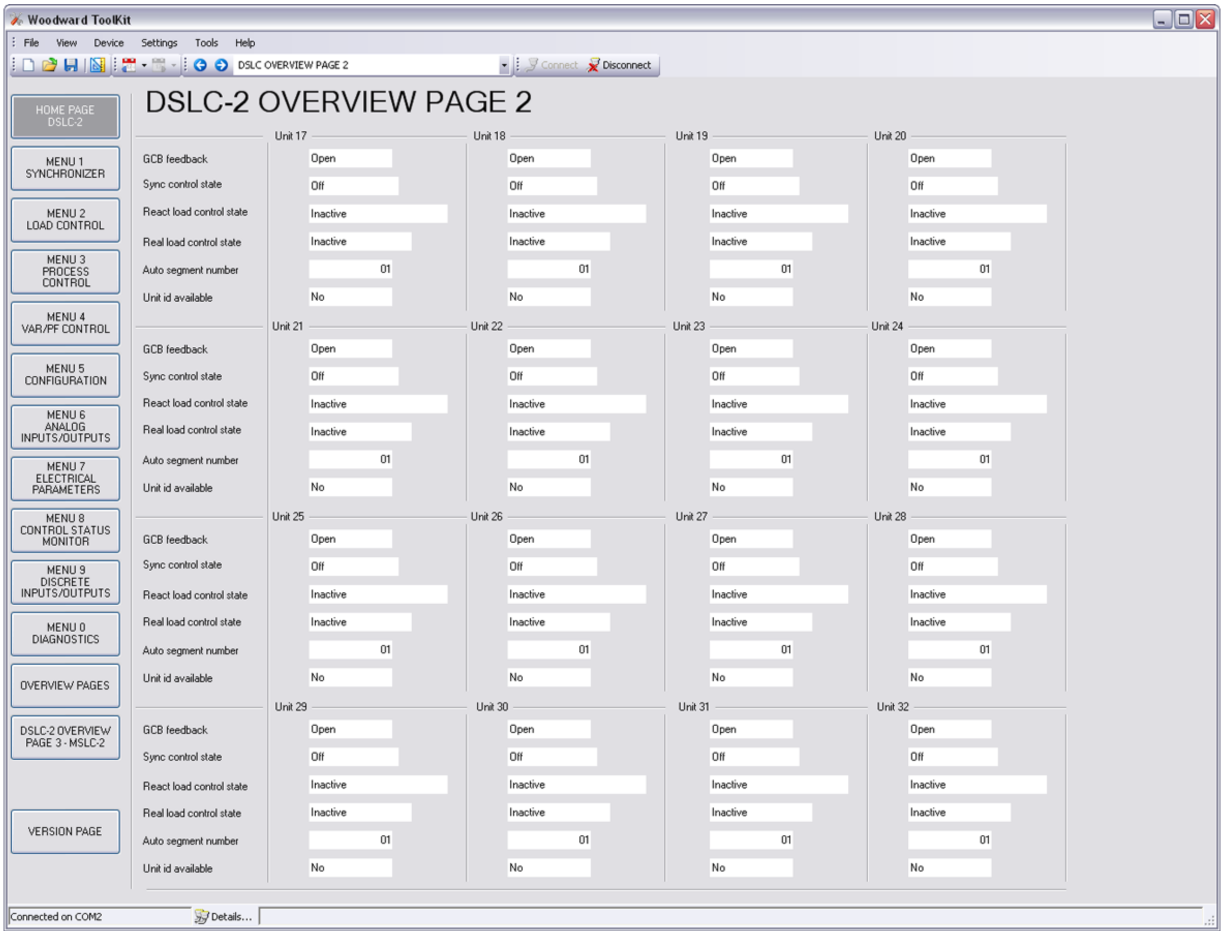


Figure 3-40: ToolKit – DSLC-2 overview page 2

ID	Parameter	CL	Setting range	Default	Description
	GCB feed-back	-	Open / Closed	-	This field indicates the GCB state of the DSLC-2 unit 17 to 32.
	Sync control state	-	Off / Check / Permissive / Run / Close Timer / Sync Timer / Synchronized / Auto-Off	-	This field indicates the *Synchronizer control state* of DSLC-2 unit 17 to 32: **Off:** The synchronizer is not active. **Check:** The synchronizer runs in check mode. **Permissive:** The synchronizer runs in permissive mode. **Run:** The synchronizer is full active. **Close Timer:** This is the GCB close command. **Sync Timer:** The synchronizer is stopped, because of a sync time-out. **Synchronized:** The GCB is closed. **Auto-Off:** The synchronizer is stopped, because of an unsuccess-ful closure of the GCB. (resync is disabled).
	React. load control state	-	Inactive / Off / Droop / VAR sharing / Reactive load control	-	This field indicates the *Reactive load control state* of DSLC-2 unit 17 to 32: **Inactive:** The reactive load control mode is inactive. **Off:** Var control is generally disabled. **Droop:** Droop is active. **VAR sharing:** The var sharing is active. **Reactive load control:** Var or PF control is active.

ID	Parameter	CL	Setting range	Default	Description
	Real load control state	-	Inactive / Droop / At Unload trip / Load sharing / Baseload / Process Control	-	This field indicates the *Real load control state* of DSLC-2 unit 17 to 32: **Inactive:** The load control mode is inactive. **Droop:** Droop is active. **At Unload trip:** The load control or the load share control resides in unloaded condition. **Load sharing:** The load sharing is active. **Baseload:** Base load control is active. **Process control:** Process control is active.
	Auto segment number	-	1 to 8	-	Display of *Auto segment number* of DSLC-2 unit 17 to 32.
	Unit id avail-able	-	Yes / No	-	Display if *Unit Id available* or not of DSLC-2 unit 17 to 32.

Table 3-30: Parameter – DSLC-2 overview page 2

DSLC-2 Overview Page 3 – MSLC-2

The DSLC-2 overview page 3 informs about the conditions of the MSLC-2 number 33 to 48 connected to the network. This helps for commissioning a DSLC-2 / MSLC-2 system.

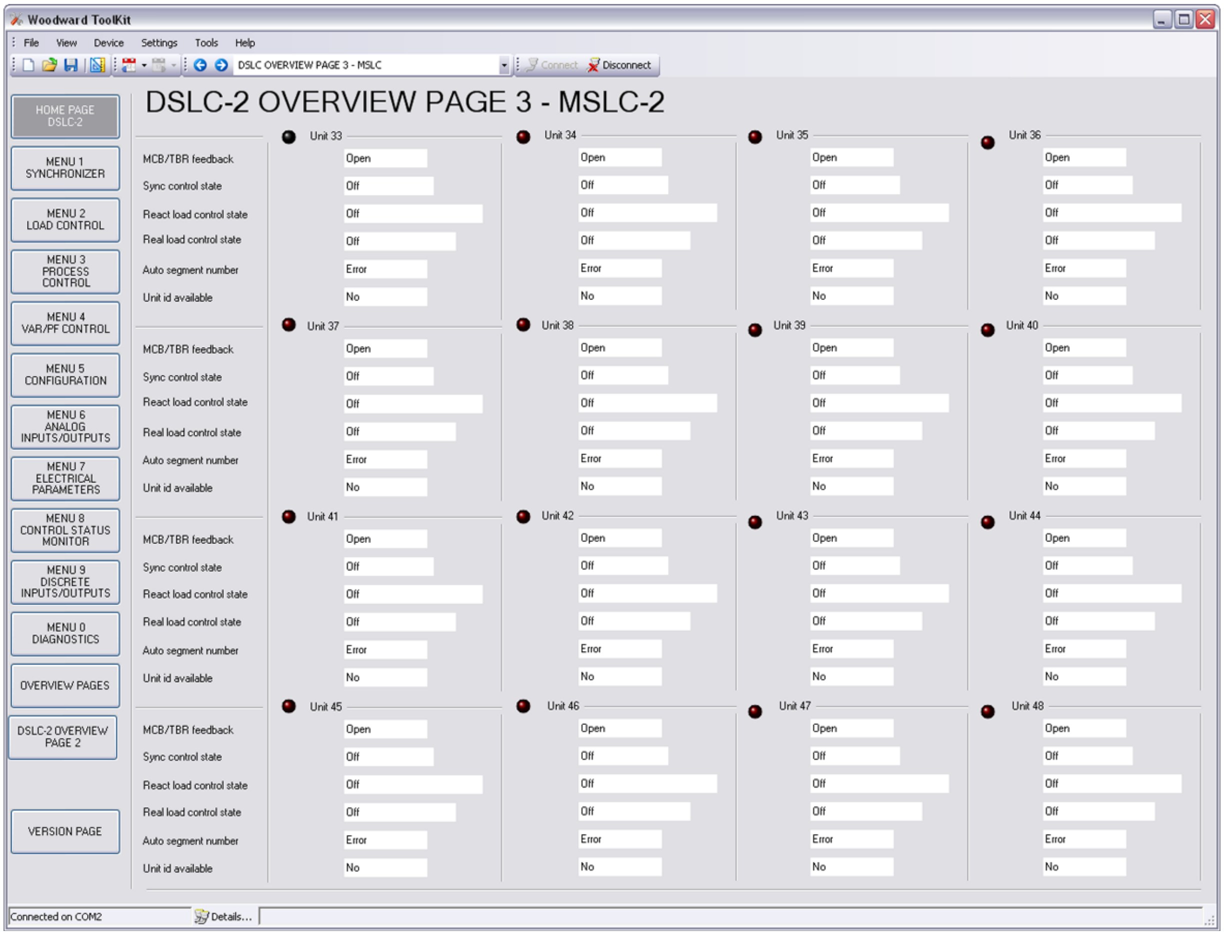


Figure 3-41: ToolKit – DSLC-2 overview page 3 – MSLC-2

ID	Parameter	CL	Setting range	Default	Description
	MCB/TBR feedback	-	Open / Closed	-	This field indicates the tie-/utility breaker state of the MSLC-2 unit 33 to 48.
	Sync control state	-	Off / Check / Permissive / Run / Close Timer / Sync Timer / Synchronized / Auto-Off	-	This field indicates the *Synchronizer control state* of MSLC-2 unit 33 to 48. **Off:** The synchronizer is not active. **Check:** The synchronizer runs in check mode. **Permissive:** The synchronizer runs in permissive mode. **Run:** The synchronizer is full active. **Close Timer:** This is the GCB close command. **Sync Timer:** The synchronizer is stopped, because of a sync time-out. **Synchronized:** The GCB is closed. **Auto-Off:** The synchronizer is stopped, because of an unsuccess-ful closure of the GCB. (resync is disabled).

ID	Parameter	CL	Setting range	Default	Description
	React load control state	-	Off / Inactive / Off Line / Voltage Control / Reactive Load Control / Export/Import Control / Constant Gen PF Control	-	This field indicates the *Reactive load control* state of MSLC-2 unit 33 to 48. **Off:** No information received. **Inactive:** The reactive load control mode is inactive. **Off Line:** The reactive load control is inactive. **Voltage Control:** Voltage control during synchronization. **Reactive Load Control:** Reactive load control through MSLC-2. **Export/Import Control:** Reactive Export/Import control through MSLC-2. **Constant Gen PF Control:** Generator constant power factor control through MSLC-2.
	Real load control state	-	Off / Inactive / Offline / Frequency Control / Baseload / Import/Export Control / Process Control / Remote Process	-	This field indicates the *Real load control state* of MSLC-2 unit 33 to 48. **Off:** No information received. **Inactive:** The load control mode is inactive. **Off Line:** The load control mode is off. **Frequency Control:** Frequency control during synchronization. **Baseload:** Load control through MSLC-2. **Export/Import Control:** Export/import control [kW] through MSLC-2. **Process Control:** Process control through MSLC-2. **Remote Process:** Remotely guided process control through MSLC-2. Analog input for process reference used.
	Auto segment number	-	1 to 8	-	Display of *Auto segment number* of MSLC-2 unit 33 to 48.
	Unit id available	-	Yes / No	-	Display if *Unit Id available* or not of MSLC-2 unit 33 to 48.

Table 3-30: Parameter – DSLC-2 overview page 3 – MSLC-2

Prestart Setup Procedure

Apply power to the DSLC-2 control. Verify that the DSLC-2 control passes its power up diagnostics by checking that self-test relay (terminal 41 / 42) is energized. If the unit fails see Appendix B. Service Options for instructions on getting service for the control. Connect the PC configuration software ToolKit via RS-232 connection to the DSLC-2.

Configuration Menu

Select Menu 5 and adjust all measurement and system relevant configuration items. Set the following setpoints to their appropriate value as described in menu (setpoint) descriptions.

1. Operating Ranges
2. Transformer
3. System Settings

If you have an application with multiple units please check the device number (parameter 1702) of each:

- The DSLC-2s getting device numbers from 1 to 32
- The MSLC-2s getting device numbers from 33 to 48

Prestart Segmenting Setup

The Menu 5 contains a configuration named *Basic Segment Number* (parameter 4544).

In the following cases the basic segment number is configured to the default value (1):

- There is only one single DSLC-2 in use
- There are multiple DSLC-2 / MSLC-2 installed, which work on a common bus, which cannot be separated. (only one segment available)

When the application contains switching elements between DSLC-2s and/or MSLC-2s proceed with following rules:

1. Draw an online diagram of your application with all generators, breakers and utility inputs. Then arrange the DSLC-2 (and MSLC-2) at the according breaker. Refer to Figure 3-42.

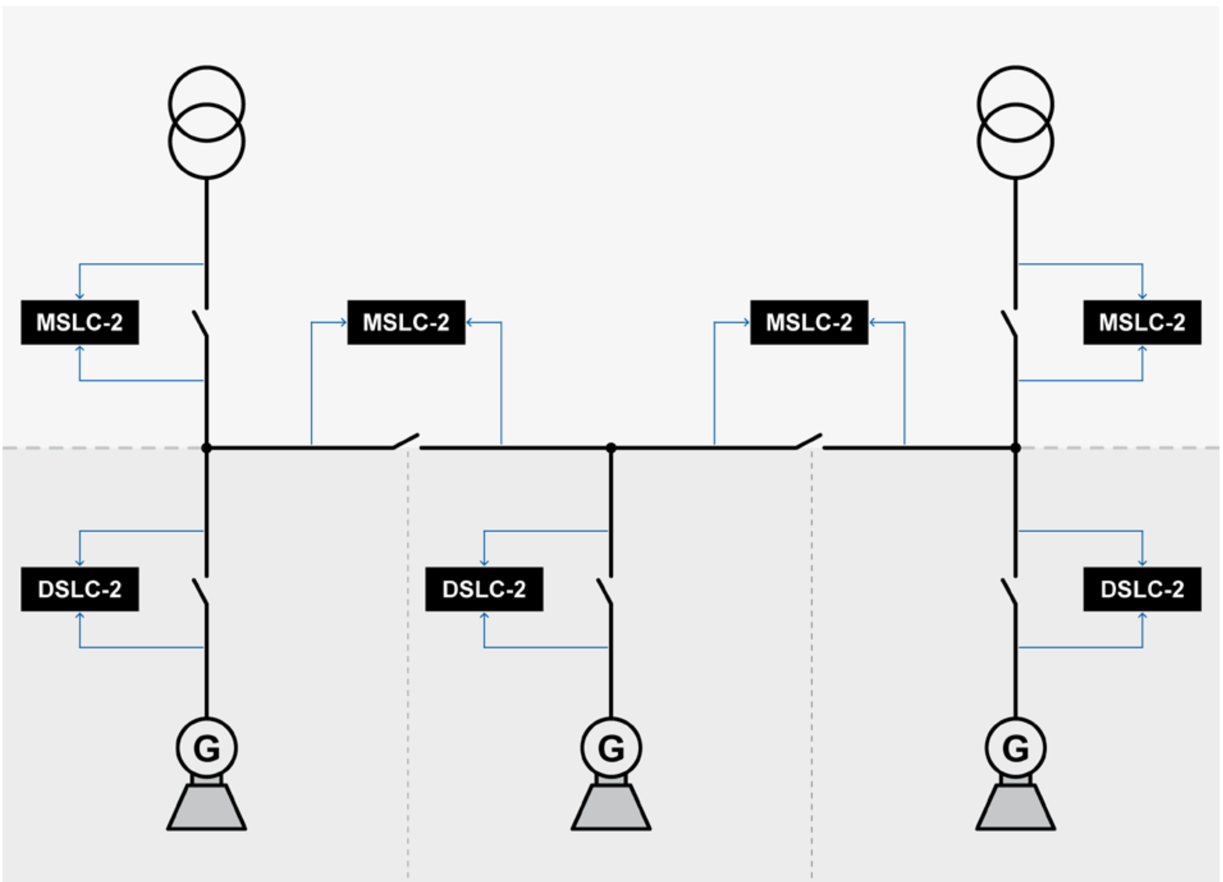


Figure 3-42: Example of an online diagram

2. Draw the measurement systems arrows between unit and bars (refer to Figure 3-43).
Please consider following rules:

- The DSLC-2 is placed at the generator breaker.
- The MSLC-2 can be placed at the tie-breaker and at the utility breaker.
- The MSLC-2 at the utility is doing the utility voltage measurement always with system A measurement. The system B measurement is connected to the busbar.
- The MSLC-2 at the tie-breaker has usually the system A on the left side and the system B on the right side.

3. Draw the segment numbers into your online diagram (refer to Figure 3-43).
Please consider following rules:

- Begin on the left side with segment number 1.
- The utility and the generators are not segments in sense of the DSLC-2 / MSLC-2 system.
- The segment numbers have to follow a line and shall not branch. (Please refer there for to the chapter Network/System) for a better understanding.

4. Draw the device numbers of your units in your online diagram (refer to Figure 3-43).
Please consider following rules (for a better overview and understanding):

- The DSLC-2 on the left side should begin with device number 1.
- The DSLC-2s getting device numbers between 1 and 32.
- The MSLC-2 on the left side should begin with device number 33.
- The MSLC-2s getting device numbers between 33 and 48.

5. Draw the “CB Aux” feedbacks and segment connection feedbacks in your online diagram (refer to Figure 3-43).
Please consider following rules (for a better overview and understanding):

- The DSLC-2 getting usually only their generator breaker feedback.
- The MSLC-2 at the utility breaker getting usually only their utility breaker feedback.
- The MSLC-2 at the tie-breaker getting usually their tie-breaker feedback and parallel the according segment connector feedback.

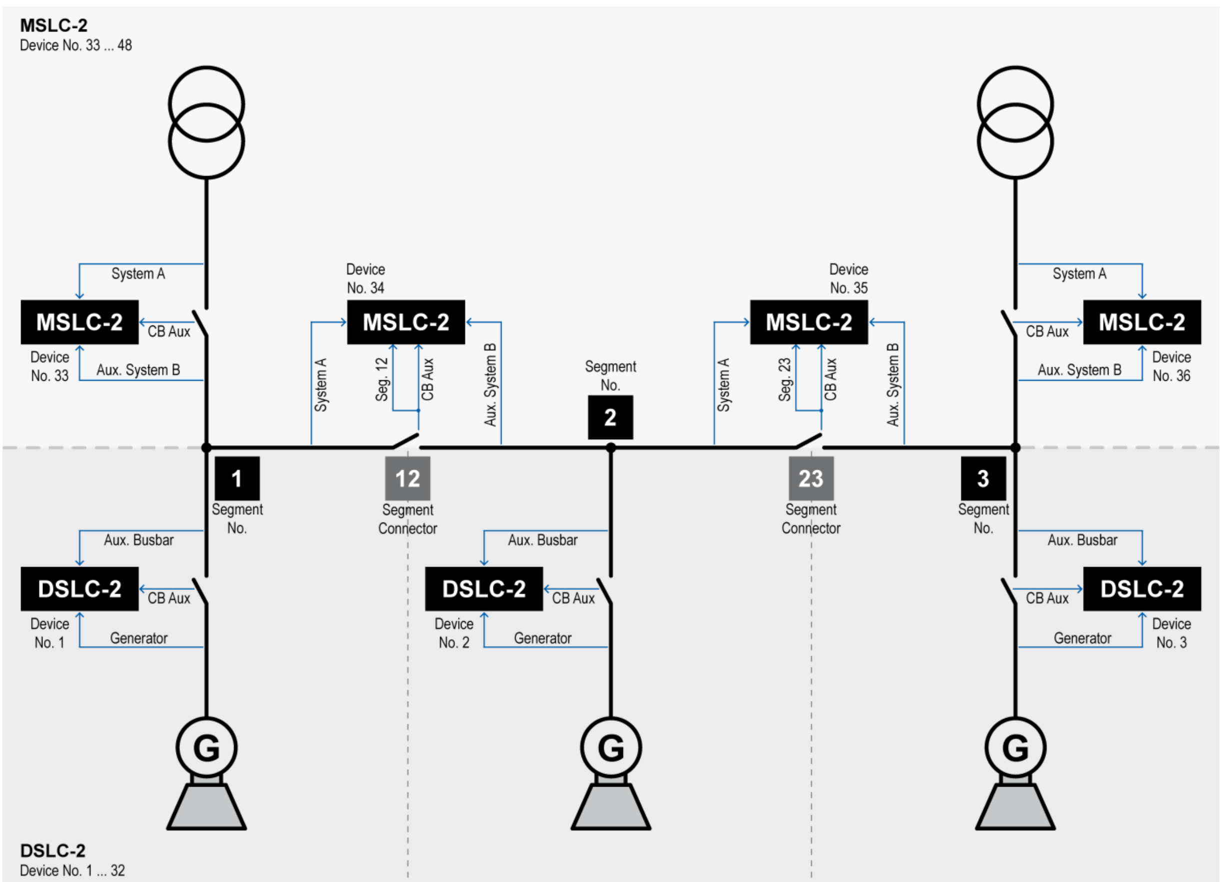


Figure 3-43: Example of an online diagram with segment numbers and segment connector feedbacks

6. Draw the switch and its network for Ethernet channel A and B, if used, in your online diagram (refer to Figure 3-44).
Please consider following rules (for a better overview and understanding):

- Ethernet A is for the device interconnection. Each Ethernet channel A connection gets an own individual UDP TCP/IP address.
- Ethernet B is for the PLC connection. Each Ethernet channel B connection gets an own individual Modbus TCP/IP address.

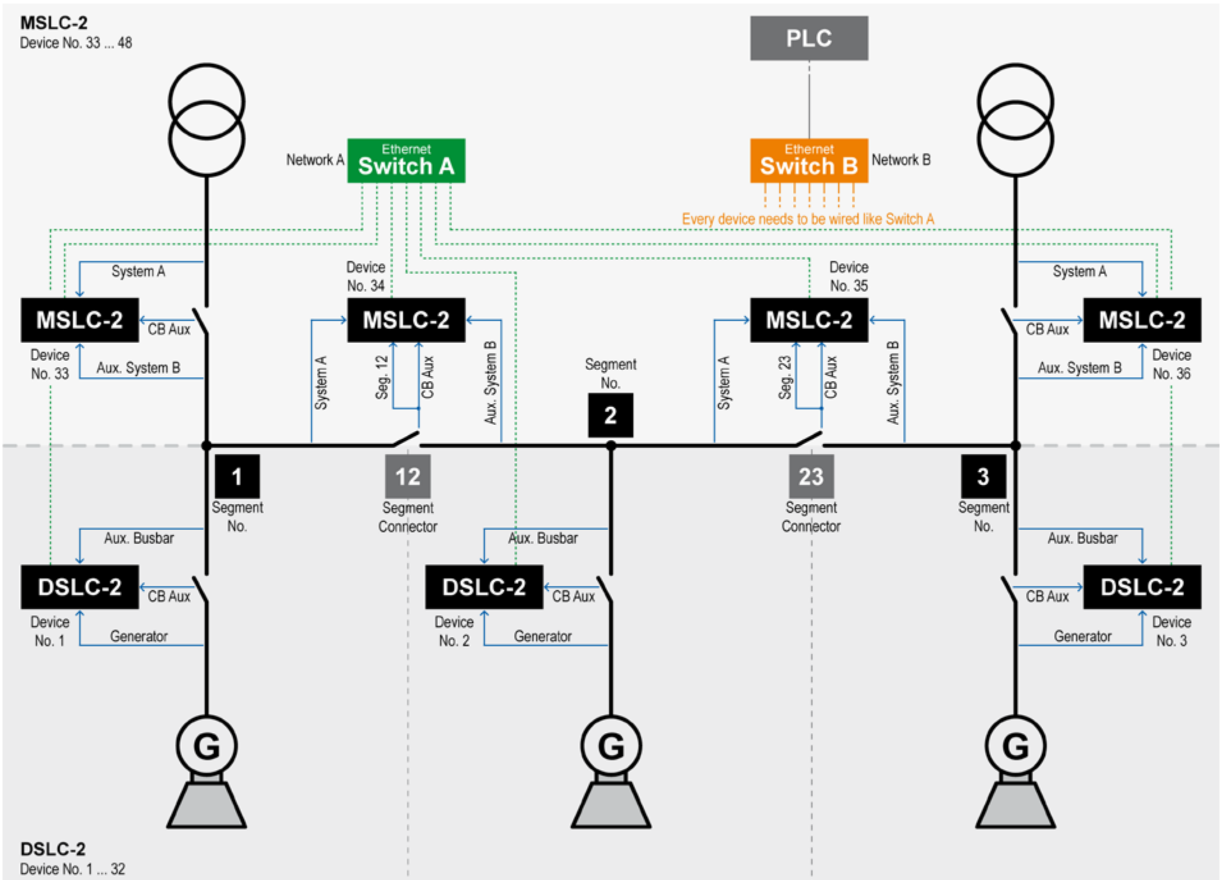


Figure 3-44: Example of an online diagram with according network

7. You can optionally draw the current measurement and the amount of phases in your online diagram (refer to Figure 3-45).
Please consider following rules (for a better overview and understanding):

- The current measurement is always on system A. So the locations for the CT are fixed for DSLC-2 and MSLC-2 (only located at the utility).
- MSLC-2 located at tie-breaker: When the CT at the tie-breaker is located on the right side it is allowed to turn system A and system B measurement at the tie-MSLC-2. But please draw this clear in your on-line diagram.
- The positive power flow for MSLC-2 power measurement is defined from A to B.
- The busbar measurement can be 1-phase or 3-phase. Please remark this with lines over the busbar / system B measurement.

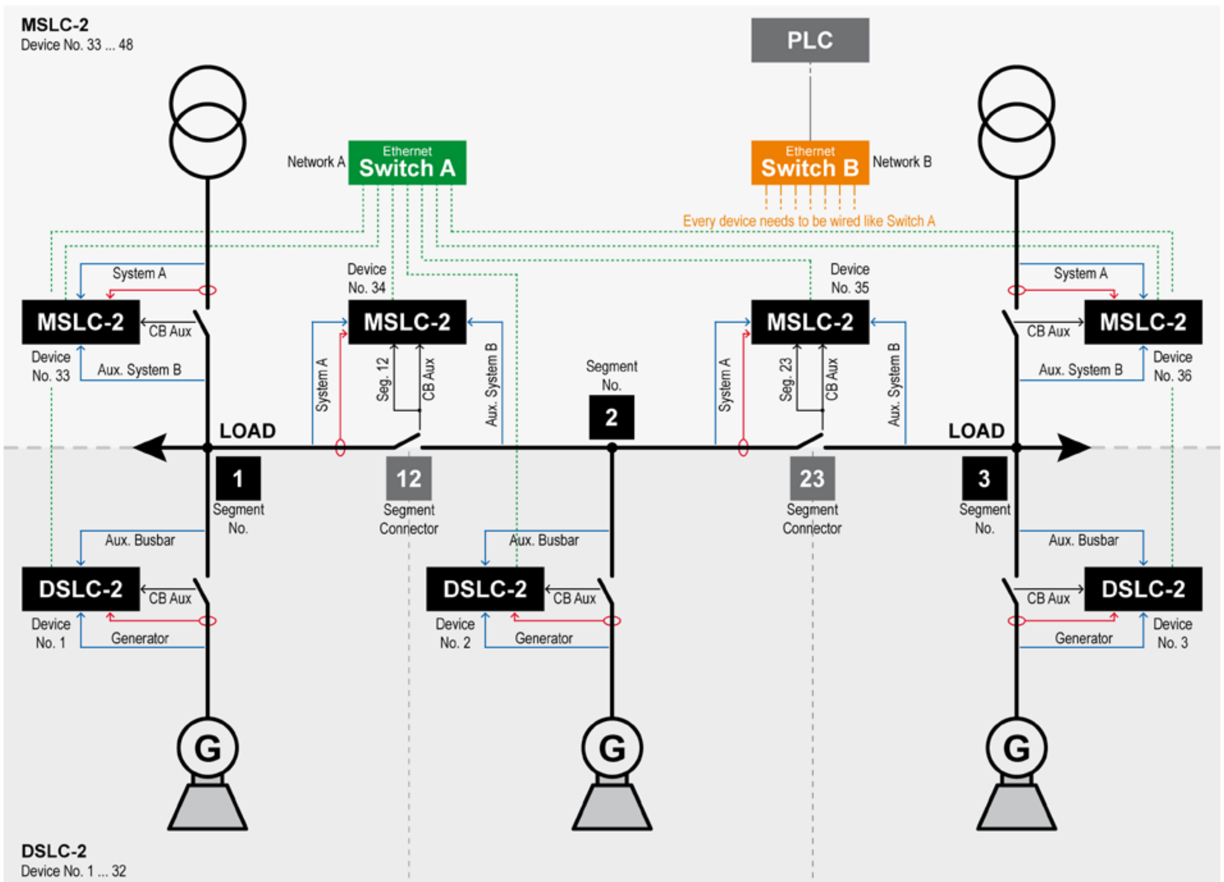


Figure 3-45: Example of an online diagram with all required information to setup the units

8. With the information out of the online diagram, following parameters shall be configurable now:

1. Menu 5 *Device number* (parameter 1702): Enter the according device number in the particular units
2. Menu 5 *Basic segment number* (parameter 4544):
    - DSLC-2: Enter the according segment number of the particular unit.
    - MSLC-2 at the utility breaker: Enter the according segment number of the particular unit.
    - MSLC-2 at the tie-breaker: Enter the according segment number which is resided on the left side.
3. Setting in MSLC-2 Menu 5 *Type of MSLC breaker* (parameter 7628): Enter “Utility” or “Tie”.
4. Setting in the tie-MSLC-2 Menu 5 *Smaller number at measurement* (parameter 7624): “System A” or “System B”.

Now you should have all segment related settings in all units. Please store your pictures for better trouble shooting later.

Prestart Synchronizer Setup

Set all synchronizer (Menu 1) setpoints according to the descriptions above and the work sheet. Leave unknown values, such as gain and stability, at their default values.

Prestart Load Control Setup

Set all load control (Menu 2) setpoints according to the descriptions above and the work sheet. Proportional load control mode should be used during initial setup of the DSLC-2 control. Set the unload trip setpoint to approximately 10 % of rated load.

Prestart Process Control Setup

Set all process control (Menu 3) setpoints according to the descriptions above and the work sheet. If gain and stability values are unknown, leave at their default values.

Prestart Var/Power Factor Control Setup

Set all var/power factor control (Menu 4) setpoints according to the descriptions above and the work sheet. Set *VAR PF control mode* to “Disabled” until doing the var/PF control adjustment section below.

DSLC-2 Control Adjustments

==========================

When the prestart setup procedures described above have been completed, the generator set may be activated. A resistive load bank is preferred to do some of the following adjustment procedures.

Verification of speed and voltage bias connections:
Speed bias

- In Menu 6.2 verify
  - *Selected hardware type* (parameter 5201)
  - *Frequency control initial state* (parameter 5508)

Voltage bias

- In Menu 6.2 verify
  - *Selected hardware type* (parameter 5215)
  - *Voltage control initial state* (parameter 5608)

The generator set will be started without the speed and voltage bias output connected for verification the speed control and voltage regulator are adjusted to operate at rated speed and rated voltage. The voltage regulator should have a droop CT connected with around a 3 % droop setting.

1. The speed and voltage can now be connected
   a. In the var/PF control Menu 4
   b. *VAR PF control mode* (parameter 7558) will be set to "Disabled"
2. DSLC-2 discrete inputs
   a. Close the "Load / Unload" input, terminal 74
   b. Verify the "CB Aux" feedback, terminal 70, is available
3. The Homepage will be used for verification of speed and voltage. Menu 7, 8 and 9 will also be observed for verification of all electrical parameters, alarms and discrete input and outputs.
4. Depending how Menu 5 was configured, you may have a *Missing member* alarm (parameter 4617) as seen on Menu 8. This alarm needs to be cleared for initial testing.
   a. Menu 5
   b. *Number of DSLC communicating* (parameter 4063)
   c. Set to "1"
   d. *Number of MSLC communicating* (parameter 4707)
   e. Set to "0"
   f. Alarm clears automatically
5. The DSLC-2 has a frequency trim and voltage trim feature that is active in isochronous and load sharing modes. The DSLC-2 will be in the droop mode with no "CB Aux" feedback. Once the engine is started, the DSLC-2 will not be in any PID loop trying to control speed or voltage.
6. Start the generator set
7. Verify speed and voltage on the Homepage
8. Speed Bias
   a. Menu 6.2
   b. Adjust the *Frequency control initial state* (parameter 5508)
      i. Change from 50 % to 60 %
      ii. Speed should increase
      iii. If speed decreased, it tells us that the connection going to the speed control is reversed (backwards)
      iv. Change from 60 % back to 50 %
      v. Shutdown the generator set and correct the wiring
      vi. Start the generator set and repeat the change from 50 % to 60 %
      vii. Speed should increase
      viii. Change from 60 % to 40 %
      ix. Speed should decrease below rated speed
      x. Change back to 50 %
      xi. Speed bias connection is now correct
      xii. If the generator speed is not at rated, adjust the frequency control initial state setting until at rated speed. This setting will be saved as your new initial state value.

9. Voltage bias
    a. Menu 6.2
    b. Adjust the*Voltage control initial state* (parameter 5608)
        i. Change from 50 % to 60 %
        ii. Voltage should increase
        iii. If voltage decreased, it tells us that the connection to the voltage regulator is reversed (backwards)
        iv. Change initial state back to 50 %
        v. Shutdown the generator set and correct the wiring
        vi. Start the generator set and repeat the change from 50 % to 60 %
        vii. Voltage should increase
        viii. Change from 60 % to 40 %
        ix. Voltage should decrease below rated voltage
        x. Change back to 50 %
        xi. Voltage bias connection is now correct
        xii. If the generator voltage is not at rated, adjust the voltage control initial state until rated voltage is achieved. This setting will be saved as your new initial state value.
10. The adjustment of the frequency and voltage trim PIDs need the DSLC-2 in the isochronous load sharing mode. This is accomplished by closing the “CB Aux” input. If possible to close the generator breaker and get the true “CB Aux” feedback or to jumper terminal 70 to transfer into the isochronous load sharing mode.
11. Homepage
    a. *Load control mode* (parameter 4603)
        i. Will change from “Droop” to “Load sharing”
    b. *Reactive load control mode* (parameter 7710)
        i. Will change from “Inactive” to “Disabled”
12. Frequency trim PID, Menu 2
    a. Is actively controlling the frequency of the generator set
    b. If unstable, lower the *Frequency trim proportional gain* (parameter 5510) until stable
    c. If stable , increase the proportional gain until some instability is seen
        i. Increase at 0.5 increments, wait 30 seconds between changes
        ii. If 3.0 is reached and still stable, back down to 2.0
            1. The *Frequency trim integral gain* (parameter 5511) may need adjusted for faster recovery back to rated frequency, this is best adjusted when performing load transient testing on the generator set
            2. The lower the integral gain setting, the slower the response to return to rated speed
        iii. This PID loop is active when load sharing. If adjusted for very fast response as a single generator, may cause unstability when multiple generators are connected
13. Voltage trim PID, Menu 4
    a. Configure *VAR PF control mode* (parameter 7558) for “VAR control”
    b. Voltage Trim is now active
        i. Voltage trim settings are affected by the droop setting in the voltage regulator
        ii. If the voltage regulator is changed, this settings may need re-adjusted
    c. If voltage is unstable, lower the *Voltage trim proportional gain* (parameter 5610) until stable
    d. If stable, increase the Proportional gain until some instability is seen
        i. Increase at 0.5 increments, wait 30 seconds between changes
        ii. If 3.0 is reached and still stable, back down to 2.0 and leave
            1. The *Voltage trim integral gain* (parameter 5611) may need adjusted for faster recovery back to rated voltage, this is best adjusted when performing load transient testing on the generator set
            2. The lower the integral gain setting, the slower the response to return to rated voltage
        iii. This PID loop is active when in the var sharing mode. If adjusted for very fast response as a single generator, may cause unstability when multiple generators are connected.

Load Control Droop Adjustment

It is important to setup the DSLC-2 control for correct kW droop operation first. This will verify correct wiring and operation of the unit in the safest possible manner. The preferred procedure uses a load bank. Only use a utility or other bus of sufficient capacity for a load if a load bank is not available.

With Load Bank

Do the following steps to verify correct wiring and operation between the DSLC-2 control and the engine speed control when an artificial load bank is available.

1. Select Menu 2 and the *Load droop* setpoint. Set droop value to 5.0 %.

NOTE

The load droop setting is approximate as it depends on the actual gain of the input circuits of the engine speed control.

2. Open the isoch/droop switch in series with the “CB Aux” contact input to terminal 70 of the DSLC-2 control. If such a switch is not installed, temporarily remove the connection to terminal 70.
3. Close the circuit breaker to the load bank. Apply kW load to at least 50 % of rated. Observe that engine speed decreases as load increases. Verify correct load sensor operation by observing for correct voltage, current and power readings on Menu 7. If incorrect load sensor operation is observed, verify configuration values on Menu 6 and wiring connections to the DSLC-2 control. If load sensor values are correct and a decrease in speed does not occur when the unit is loaded, verify wiring between the DSLC-2 control and engine speed control.
4. Apply full load to the generator. Adjust the load droop setpoint as necessary to get the correct speed droop.

   Example: Operating at 60 Hz, 57 Hz at full load indicates 5 % droop. If only 50 % load is possible, then 58.5 Hz indicates 5 % droop. [The load droop setting is only approximate due to dependence on the gain of the speed control's bias input.]

Without Load Bank

Use this procedure for droop setting when an artificial load bank is not available.

WARNING

CT/PT Phasing - Operation of the engine/generator set with incorrect CT and PT phasing could cause serious injury or damage to equipment. If the load on the unit increases rapidly when you close the breaker, immediately open the breaker and shut the unit down. Check the phasing of the CTs and PTs. DO NOT permit the unit to continue to pick up load or to operate the system without correcting this condition.

1. Select Menu 2 and the *Load droop* setpoint. Set to the desired value or use 5.0 %.

NOTE

The load droop setting is approximate as it depends on actual gain of the input circuits of the engine speed control.

2. Open the isoch/droop switch in series with the “CB Aux” contact input to terminal 70 of the DSLC-2 control. If such a switch is not installed, temporarily remove the connection to terminal 70.
3. Calculate the engine speed required to pick up 50 % and 100 % of rated load.
   Example:
   Rated frequency = 60.0 Hz
   Desired droop = 5 % (0.05) or 3.0 Hz
   Desired test frequency = 60.0 Hz + %Load x 3.0 Hz
   (at 50 % [0.5] load) = 60.0 + 0.5 x 3.0 = 61.5 Hz
   (at 100 % [1.0] load) = 60.0 + 1.0 x 3.0 = 63.0 Hz

4. Use “Load Raise” and “Load Lower” inputs (terminals 76 and 77) to set the desired speed with the generator circuit breaker open. Record the speed bias output percentage at the engine speed required to pick up 50 % and 100 % load.
5. Use the “Load Raise” and “Load Lower” inputs to manually synchronize to the bus and increase the engine load to 10 %.
6. Verify correct load sensor operation by observing for correct voltage, current and power readings on Menu 7. If incorrect load sensor operation is observed, verify configuration values on Menu 6, phasing and other wiring connections to the DSLC-2 control.
7. Increase the engine speed setting to increase load. When the speed bias output reaches the value required for 50 % load as measured in step 4. Trim the *Load droop* (parameter 4523) setpoint for 50 % load.
8. Increase the engine speed setting to the speed bias output value required for 100 % load as measured in step 4. Trim the *Load droop* (parameter 4523) setpoint to get 100 % load.

Synchronizer Adjustments

This section is for adjusting the synchronizer functions including procedures for phase matching and slip frequency synchronizing. Note that dynamic adjustments for gain and stability will be different for each method. To assist in setup and adjustments, you can monitor synchronizer mode of operation on Homepage or Menu 8 and synchronizer mode and slip frequency and synchroscope values on Menu 7.

Preliminary Synchronizer Adjustments

1. Set the *Voltage Matching* setpoint (parameter 7513) to "Disabled".
2. Select Menu 1 and verify that the *Frequency synchronizer proportional gain* (parameter 4539) and *Frequency synchronizer integral gainy* (parameter 4540) setpoints are set to their default values.
3. Set the maximum phase window (parameter 5703, parameter 5704) and maximum slip window (parameter 5701, parameter 5702) setpoints to the desired values or use the default values if unknown.
4. Set *Breaker delay* (parameter 5705) to the closure time specified by the breaker manufacturer. Add delay time for any interposing relays if required.
5. Set *GCB close hold time* (parameter 3416) to the time desired for the DSLC-2 control to hold the breaker clo-sure signal. This time should exceed the breaker delay time.
6. Set the close attempts (parameter 3418) setpoint to "1".
7. Set the *Synchronizer timeout* (parameter 3063) setpoint to "0".
8. Set *Auto re-synchronize* (parameter 7514) to "Disabled".

Proceed to the phase matching synchronizer or slip frequency synchronizer section as required.

Phase Matching Synchronizer

Do the following steps to setup the synchronizer dynamics for use as a phase matching synchronizer. For slip frequency synchronizing, see the procedure below. The DSLC-2 control indicates the phase angle with the Synchroscope on the ToolKit Homepage (parameter 4639).

NOTE

The synchroscope on the Homepage will show the right phase angle, when all electrical settings are correctly done and the wire connections to the unit are correct. Double check the phase angle across the breaker with a voltmeter or other phase testing device.

1. Set the *Synchronization GCB* (parameter 5729) to "Phase matching".
2. Close the synchronizer "Check" mode switch.
3. With generator and bus active, adjust the synchronizer gain setpoint for stable control of the generator frequency as indicated by the synchroscope holding steady at zero phase.

NOTE

If the system (not the DSLC-2 control) synchroscope does not lock close to zero phase, but at some other value (such as 30, 60, 180, 210, etc. degrees), verify bus and generator potential wiring to either the synchroscope or DSLC-2 control.

DO NOT PROCEED WITH ANY ACTION RESULTING IN BREAKER CLOSURE UNTIL THE PROBLEM IS DETERMINED AND CORRECTED.

4. Turn the synchronizer mode to "Off" (open discrete inputs). Allow the phase to drift until the synchroscope indicates approximately 150 degrees fast. It may be necessary to adjust the engine speed setting slightly fast to achieve the desired phase drift.
5. Turn the synchronizer mode to "Check". The synchronizer should pull the generator smoothly into phase lock. If the synchronizer action is too slow, increase *Frequency synchronizer proportional gain* (parameter 4539) by a factor of two. If increasing sync gain results in unstable operation, reduce the value by at least one-half and proceed to step 6. Otherwise, repeat steps 4 and 5.

6. Do step 4 and then turn the synchronizer mode to “Check”. The synchronizer should pull the generator smoothly into phase lock. If the synchronizer is too slow or “over-damped”, increase integral gain (parameter 4540) by a factor of two to decrease damping and increase sync proportional gain by a factor of two. If the synchronizer is too fast or “under-damped” as indicated by excessive overshoot of zero phase when pulling in, decrease sync proportional gain by a factor of two and decrease integral gain by a factor of two to increase damping.
7. Repeat steps 4, 5 and 6 with smaller adjustment steps until satisfactory performance is obtained.
8. Turn the synchronizer mode to “Off”. Allow the phase to drift until the synchroscope indicates approximately 150 degrees slow. It may be necessary to adjust the engine speed setting slightly slow to achieve the phase drift. Repeat steps 5 and 6 if necessary to get the desired performance.
9. Verify synchronizer performance under all expected operating conditions, such as synchronizing at higher or lower speeds.
10. If voltage matching is to be used, do the setup in the voltage matching section below.
11. If correct droop mode operation described above has been obtained, proceed to step 12. Otherwise, verify correct droop operation described above.
12. Open the isoch/droop switch in series with the “CB Aux” contact input to terminal 70 of the DSLC-2 control. If such a switch is not installed, temporarily remove the connection to terminal 70 to select droop mode.
13. Turn the synchronizer mode switch to “Run”. The synchronizer should pull the generator smoothly into phase lock and issue a breaker closure command. Increase the generator load by using the “Load Raise” input.

Proceed to final synchronizer setup.

Slip Frequency Synchronizer

Do the following steps to setup the synchronizer dynamics for use as a slip frequency synchronizer.

1. Complete the phase matching synchronizer setup before continuing.
2. Turn the synchronizer mode to “Off”. Set the *Slip frequency setpoint offset* (parameter 5502) to the desired slip rate. Set engine speed slightly slow.
3. Turn the synchronizer mode to “Check”. The synchronizer should drive engine speed so that phase rotation is smooth and at the correct rate as indicated on a synchroscope or by observing the slip frequency value on Menu 7 (parameter 4640). If the synchronizer is too slow to react when switched from off to check mode, increase *Frequency synchronizer proportional gain* (parameter 4539) by a factor of two. If the synchronizer action is too aggressive when switched to check mode, reduce the sync proportional gain by half of what your last adjustment.
   Example:
   If you moved from a proportional gain of 1 to 2, reduce to 1.5. Repeat until the synchronizer controls the generator at your desired rate.
4. Observe the smoothness of phase rotation. If a slow hunt is observed, as indicated by slowing and speeding up of the synchroscope during rotation, increase *Frequency synchronizer integral gain* (parameter 4540) by a factor of two and repeat step 3. If rapid changes in slip frequency occur, decrease sync integral gain.
5. Repeat steps 3 and 4 with smaller adjustment steps until satisfactory performance is obtained. Note that it may not be possible to remove all slow hunting in slip frequency and this will not adversely affect synchronization.
6. Verify synchronizer performance under all expected operating conditions, such as synchronizing from higher or lower speeds.
7. If voltage matching is to be used, do the setup in the voltage matching adjustment section below.
8. If correct droop operation described above has been obtained, proceed to step 9. Otherwise, verify correct droop operation described above.
9. Open the isoch/droop switch in series with the “CB Aux” contact input to terminal 70 of the DSLC-2 control. If such a switch is not installed, temporarily remove the connection to terminal 70 to select droop mode.
10. Turn the synchronizer mode switch to run. The synchronizer should pull the generator smoothly into the correct slip rate and issue a breaker closure command. If the synchronizer will not issue a closure command, verify that the maximum slip window and maximum phase window setpoints are set correctly. Wider window settings will decrease the time required to synchronize.

Proceed with final synchronizer setup.

Final Synchronizer Setup

1. Open the circuit breaker to disconnect the generator from the bus.
2. Close the isoch/droop switch in series with the “CB Aux” contact input to terminal 70 of the DSLC-2 control. If such a switch is not installed, verify that the connection to terminal 70 is restored.
3. Select Menu 1 and set the *Dead bus closure* (parameter 7555) setpoint to “Enabled” or “Disabled” as desired.
4. Set close attempts (parameter 3418) to the desired number of times the synchronizer should attempt to close the circuit breaker. Set to “1” if only one close attempt should be made.
5. Set *Reclose delay* (parameter 4534) to the desired interval between close attempts. This should be greater than the time required to recharge the circuit breaker arming mechanism.
6. If an alarm is desired when the maximum close attempts has been reached, set sync reclose alarm to “Enabled”.
7. Set the *Synchronizer timeout* (parameter 3063) to the maximum number of seconds the synchronizer should attempt to achieve synchronization. Set to “0” for no timeout.
8. If an alarm is desired when the sync timeout interval expires, set the *Synchronizer timeout alarm* (parameter 7557) setpoint to “Enabled”.
9. If it is desired to automatically attempt to reclose the circuit breaker on loss of synchronization (CB Aux opens after a successful closure has been accomplished), set the *Auto re-synchronize* (parameter 7514) setpoint to “Enabled”. If set to “Disabled”, the synchronizer will enter an auto-off mode when synchronization is obtained. It will be necessary to set the synchronizer mode switch to “Off” and back to the desired operating mode to restart the synchronizer.

This completes the DSLC-2 control synchronizer setup.

Voltage Matching Adjustments

The following steps will verify the correct operation of the synchronizer voltage matching function. Two procedures are given. The first is for systems where voltage adjustment is done with a MOP using the “Voltage Raise” and “Voltage Lower” relay output contacts. The second adjustment procedure is for systems using the voltage bias output from the DSLC-2 control directly connected to the voltage regulator.

Preliminary Voltage Matching Setup

1. Select Menu 1 and set the *Voltage matching* (parameter 7513) setpoint to “Enabled”.
2. Select Menu 4 and set the *Voltage high limit* 5 % higher than the final expected value. Set the *Voltage low limit* 5 % lower than the final expected value.

Voltage Matching With MOP Driven Voltage Regulator

1. Set the synchronizer mode switch to “Off”. Set the voltage ramp setpoint on Menu 4 to a value 10 % greater than the time required to slew the voltage regulator MOP through its full range.
2. Select Menu 7 and monitor the voltages for generator and busbar.
3. Use the voltage raise input to adjust the generator voltage until generator phase L1 (A) voltage is approximately 5 % higher than bus voltage.
4. Set the synchronizer mode switch to “Check”. The DSLC-2 lower voltage relay output should energize the lower voltage relay to drive the voltage regulator MOP in the decrease voltage direction. The lower voltage discrete output should de-energize the lower voltage relay when phase A voltage enters the voltage window as determined by the voltage window setpoint.
5. If generator voltage drops below the bus voltage and out of the voltage matching window, the DSLC-2 will provide a raise voltage relay output. If cycling above and below the voltage matching window occurs, adjust the 3pos controller in Menu 4. This would be the *Time pulse minimum* (parameter 5651) and the *Gain Factor* (parameter 5652). If you cannot get the desired results you may have to increase the voltage window.
6. Set the synchronizer mode switch to “Off”. Manually lower the generator voltage until generator phase L1 (A) voltage is approximately 5 % lower than bus voltage.
7. Set the synchronizer mode switch to “Check”. The DSLC-2 raise voltage relay output will energize to drive the voltage regulator MOP in the increase voltage direction. The raise voltage relay output should de-energize the raise voltage relay when phase L1 (A) voltage reaches bus voltage.
8. If generator voltage increases above the bus voltage and out of the voltage matching window, the DSLC-2 will provide a lower voltage relay output. If cycling above and below the voltage matching window occurs, adjust the 3pos controller in Menu 4. This would be the *Time pulse minimum* (parameter 5651) and the *Gain Factor* (parameter 5652). If you cannot get the desired results you may have to increase the voltage window.

Proceed to final voltage matching setup.

Voltage Matching Using Voltage Bias Output

1. Set the synchronizer mode switch to “Off”.
2. Set the voltage regulator for rated voltage without the voltage bias connected.
3. Connect the voltage bias output to the voltage regulator. The voltage bias output should be configured for the voltage regulator being used (Menu 6.2)
   a. **Example:**
      A Caterpillar CDVR requires a +/-10 Vdc signal to drive the generator voltage
      +/-10 %. The Voltage control initial state will be set at 50 %, providing a “0” Vdc signal to the voltage regulator.

4. Start the generator. Should be operating at rated speed and voltage.
    a. Adjust the voltage control intial state from 50 % to 60 %. The generator voltage should increase. If the generator voltage decreases, the voltage bias output connections are reversed. Please correct and repeat test.
    b. Adjust the voltage control initial state from 50 % to 40 %. The generator voltage should decrease.
    c. This verifies the “Voltage bias” output is connected correctly.
5. Enable *Voltage matching* (parameter 7513) and set the *Voltage window* (parameter 4541) for 0.5 %.
    a. Synchronizer mode can be phase matching or slip frequency.
6. To test the voltage matching another source must be available for the busbar voltage.
7. With the generator at rated speed and voltage and the busbar energized. Verify the electrical parameters readings in Menu 7. If the generator or busbar is reading incorrectly, verify wiring and configuration to correct the problem.
8. Observing the Homepage
    a. Generator OK led is “On”
    b. Busbar OK led is “On”
    c. The generator should be “Red” in color, indicating it is operating
    d. The busbar should be “Red” in color indicating it has voltage
    e. *Synchronizer mode* (parameter 4602) should indicate “Off”
9. Place the DSLC-2 into the check mode
    a. Synchronizer mode should indicate “Check”
    b. DSLC-2 will be driving the speed bias for phase matching or slip
        i. Observe “Speed bias” gage
    c. DSLC-2 will be driving the voltage bias to get the generator voltage to match the busbar voltage
        i. Observe “Voltage bias” gage
    d. No breaker closure command will be received
10. Remove the check mode input, synchronizer will go to “Off” mode
11. Use the voltage raise input to increase generator voltage to 3 or 4 % above busbar voltage. This can be observed on the Homepage meters.
12. Place the DSLC-2 in the check mode and observe how the generator voltage is driven into the voltage matching window. To adjust the synchronizer soltage control use Menu 1.
    a. *Voltage synchronizer proportional gain* (parameter 4700)
        i. Increase the proportional gain to bring the voltage into the matching window faster
    b. *Voltage synchronizer integral gain* (parameter 4701)
        i. Decreasing the integral gain will slow down the response and bring the voltage into the matching window smoother, but will take longer
13. Repeat test until desired results are achieved.
14. Use the voltage lower input to decrease generator voltage to 3 or 4 % below busbar voltage. This can be observed on the Homepage meters.
    a. Verify settings for voltage matching from the high side also work for matching from a lower voltage
    b. If not, use adjustments to get desired results
    c. Repeat the high voltage test if adjustments were made
15. Verify that the phasing for L1, L2 and L3 is correct across the generator breaker before placing the DSLC-2 into the run mode.

Continue with final voltage matching setup.

Final Voltage Matching Setup

1. Set the *Voltage low limit* (parameter 4536) and *Voltage high limit* (parameter 4537) setpoints on Menu 4 to the desired values. Voltage adjustments by the synchronizer and var/PF control will not adjust voltage beyond these limits.
2. If the *Voltage high alarm* (parameter 7510) or the *Voltage low alarm* (parameter 7509) is desired when generator voltage exceeds the above specified limit values, set the alarm setpoints to “Enabled”.
3. If generator voltage exceeds the *Voltage high limit* and *Voltage low limit* range and it is desired to operate the “High Limit” and “Low Limit” relay driver outputs, set the *Voltage switch* (parameter 7511) setpoint to “Enabled”.
4. If the voltage bias output reaches either end of its operating range, indicating its range of control has

been exceeded and it is desired to activate an alarm, set the *Voltage range alarm* (parameter 7512) set-point to “Enabled”.

Load Control Adjustment

This section contains the instructions for setup of the DSLC-2 load control. Set all load control setpoints (Menu 2) according to the descriptions above and the work sheet. The Homepage and Menu 2 settings are provided to assist in setup and verification of correct operation.

Preliminary Setup

Do the following steps prior to activating the generator and load control.

1. Select Menu 2 and set *Load control setpoint source* (parameter 7634) to "Internal".
2. Verify the *Generator rated active power* (parameter 1752) is set to the generator kW rating.
3. Set *Base load reference* (parameter 5520) to 25 %.
4. Set *Unload trip level* (parameter 3125) to 3 %.
5. If the load droop setup procedure described above has not been done, do the load control droop adjustment before proceeding.
6. Set *Load share gain* (parameter 4522) to 0.50.
7. Set load time and unload time as desired. If times faster than 20 seconds will be required in normal service, use 20 seconds during the following setup procedures to allow time to react if the control fails to operate as expected. Faster load and unload times may be specified after setup is complete.
8. Set *Raise load rate* (parameter 4515) and *Lower load rate* (parameter 4516) as desired. During setup, 1.0 % per second or slower is recommended.
9. Set high limit PU to a 100 % and low limit PU to 0.0 %.

Isochronous Load Sharing Adjustment

Read the complete procedure before operating the generator. This section sets up and verifies the isochronous load sharing mode of operation. In isochronous load sharing, the unit load is compared to the system load to generate a proportional error signal to safely operate in parallel with other generator sets. An isolated load sharing bus should be used to do this setup. Resistive load banks should be available for adjustment of PID loops before proceeding with using the plant load.

1. Verify in Menu 2 the *Generator rated active power* setpoint (parameter 1752) is set to the desired 100 % load rating of the machine. Load sharing is on a per-unit basis to allow for differences in the kW rating of various machines in the system.
   a. **Example:**
   Assume system load demand is 50 % of the capacity of the units operating in the load sharing mode.
   b. If one unit's rated load is 100 kW, that unit will be operating at 50 kW.
   c. If another unit's rated load is 500 kW, that unit will be operating at 250 kW.
2. Select the Menu 8 or the Homepage to check the active DSLC-2s setpoint. Verify that the number displayed corresponds to the number of DSLC-2 controls currently installed and powered up.

NOTE

It is desirable to power all DSLC-2 controls in the system and verify that all units show the correct number of active DSLC-2 controls. Duplicate Menu 5 network address setpoints, wiring errors, an overloaded network or defective DSLC-2 controls can cause an incorrect result. To aid troubleshooting, a DSLC-2 control can be powered down to determine what effect it had on the other controls.

3. Set *Load share gain* (parameter 4522) to 0.50.
4. Open the "Base Load" input
5. Open the "Load/Unload" input.
6. Select the synchronizer "Run" mode to synchronize and parallel the unit to the load sharing system.
7. When the circuit breaker closes, the DSLC-2 will be in the loadshare unload control mode. See on Homepage (parameter 4603). No kW or kvar will be controlled until the "Load / Unload" input is closed.

8. Close the "Load/Unload" input. The generator will ramp the kW using the *Unload ramp rate* (parameter 4524) until the unit load percentage equals the system load percentage and then enter the isochronous load sharing mode of operation.
    a. Homepage
        i. *Load control mode* (parameter 4603)
            1. Loadshare unload
            2. Loadshare ramp
            3. Loadshare
9. The controlling PID loops are
    a. PID frequency trimmer
    b. *Load share gain* (parameter 4522)
    c. *Load share factor* (parameter 4546)
10. If the load sharing is unstable
    a. Lower the load share gain
    b. If still unstable lower the *Frequency trim proportional gain* (parameter 5510)
    c. When stable verify that the kW is proportional equal on each generator
11. Var sharing
    a. If vars are unstable, use Menu 4 and adjust
        i. Lower *VAR load share gain* (parameter 4543)
        ii. Lower *Voltage trim proportional gain* (parameter 5610)
        iii. If still unstable see the var/PF control Menu 4
12. If sufficient system load is available, close the "Base Load" input. Follow the integrating base load control setup in the following section for PID information.The unit should ramp until unit load matches the *Base load reference* (parameter 5520) level. The DSLC-2 will also be in var control and will ramp reactive power on to control at the *KVAR reference* setting (parameter 7723). If the system load is resistive only, set the kvar reference to 0.0.
13. Open the "Base Load" contact. The unit will ramp back into load sharing and var sharing.
14. Open the "Load/Unload" input. The DSLC-2 control will ramp kW and kvar load to the *Unload trip level* (parameter 3125), provide a breaker open command and disconnect the unit from the system.
15. If system transient testing may be done, with load banks or large loads switching on and off, the *Load share gain* (parameter 4522) and frequency trim settings may be adjusted, if necessary. If the generator picks up load too quickly compared to the system, as may occur on a small, fast generators, operating with large and slower ones, reduce the gain setting. Conversely, if the unit is slow, increase the gain setting.
16. With the unit operating in isochronous parallel, adjust the engine speed setting slightly to cause an error in load sharing percentage. The load will return to the correct sharing percentage.

This completes the isochronous load sharing adjustments.

Integrating Base Load Control Setup

The DSLC-2 is an integrating base load control. A utility bus or an isolated bus with sufficient capacity is required to do this setup.

1. When in base load mode, the PID power control will be active.
2. The *VAR PF control mode* (parameter 7558) should be in the "Disabled" mode.
    a. This allows voltage matching but will not be in an active var or power factor mode. The voltage bias will stay at the value it is at when breaker closure occurs.
    b. If tested in the load sharing section, the *VAR PF control mode* (parameter 7558) can stay in var control mode.
3. PID power control settings
    a. *Base load proportional gain* (parameter 5513) – Set at 1.00 (default value)
    b. *Base load integral gain* (parameter 5514) – Set at 0.50 (default value)
    c. *Base load derivative ratio* (parameter 5515) – Set at 0.01 (default value)
    d. After verification that the speed and voltage bias outputs are operational and the synchronizer has been tested, we will proceed to close the generator breaker and load the generator in a base load control mode. This test is common to perform against the utility.

4. Discrete inputs
    a. Load / Unload input – Closed
    b. Base load input – Closed
    c. Run input – Closed
        i. This will activate the synchronizer and provide a breaker closure command
5. DSLC-2 Homepage
    a. Load control mode – Baseload ramp then just baseload
    b. Reactive load mode – Var control

NOTE

If load instability is observed, it will be necessary to adjust dynamic settings of the load control. Because the integrating load control operates in cascade with the engine speed control, it may also be necessary to adjust the dynamics of the speed control to get the desired performance. The first attempt to get stability will be to reduce the *Base load proportional gain* (parameter 5513) setpoint. If stability decreases when proportional gain is decreased, increase *Base load integral gain* (parameter 5514). If stability cannot be achieved with DSLC-2 control dynamic adjustments, it will be necessary to adjust the engine speed control dynamics. Stable engine control is required to proceed.

6. Load will normally lag slightly behind the reference during ramping. If the lag is excessive, increase the *Base load proportional gain* (parameter 5513) by increments of 0.5.
7. If a slow hunt is observed during the ramp or if overshoot of the base load setting occurs, decrease the *Base load integral gain* (parameter 5514) by a factor of two.
8. Ramp the load up and down by alternately opening and closing the “Load/Unload” input. Be sure to reclose the switch before load drops to the unload trip level or the DSLC-2 control will issue a command to open the circuit breaker. Adjust base load proportional gain and base load integral gain to get the desired performance.
9. The *Load ramp rate* (parameter 4549) and *Unload ramp rate* (parameter 4524) can be changed to assist with the stable loading of the generator.

NOTE

Correct dynamic adjustment may be more easily observed if the *Load ramp rate* (parameter 4549) setpoint is set somewhat faster than what the final setting will be.

10. In most systems it will not be necessary to change the base load derivative ratio from the default value of 0.01 seconds. In higher performance systems the load derivative may be increased to increase the rate of change in speed bias output during a transient.
11. The power control PID is also active when the system has an active MSLC-2.
12. The DSLC-2 will only listen to an MSLC-2 when in isochronous load share mode, the “Base Load” input is closed, the DSLC-2 will control at it’s internal base load and var values.

Remote Load Reference Signal Setup

The analog remote load reference is activated by closing both the “Load Raise” and “Load Lower” inputs. This will ramp the base load reference from the internal setting in Menu 2 to the remote setting on terminals 83, 84 and 85. This can be used to provide dual base load reference settings. The analog remote load reference input is configured in Menu 6.1. The value of the remote input is also displayed in Menu 6.1 and on the Homepage. The analog remote reference can also be configured for a process reference signal.

1. Set in Menu 6.1 the scaling for the analog input remote load reference and configure the related kW values to the analog input. The current or voltage input can be configured to show the kW value.
    a. *HW signal* (parameter 7711)
        i. 0 to5 V
        ii. 1 to 5 V
        iii. 0 to 10 V
        iv. 0 to 20 mA
        v. 4 to 20 mA
    b. Remote load reference minimum value (parameter 7735)
    c. Remote load reference maximum value (parameter 7736)
2. You can monitor the reference value in % and clear defined kW in Menu 6.1 or the Homepage.

3. Synchronize, parallel and load the generator to the internal base load reference. Apply the analog signal to the remote load reference input of the DSLC-2 control. Adjust the remote reference to some level different than base load or use the raise load or lower load contacts to shift the unit load to a different level.
4. Close both the raise load and lower load contacts to select the analog remote load reference input. The load should ramp to the level specified by the analog input.
5. Raise and lower the analog signal. Load will ramp at the rate of change in reference specified by the Menu 2 raise rate and lower rate setpoints. Raise rate and lower rate setpoints may be adjusted to achieve satisfactory performance.
6. Open the raise load and lower load contacts. The load control mode should indicate base load. The load reference will ramp to the internal base load reference. The raise and lower inputs will now raise and lower the base load reference.
7. Momentarily open and close the “Load/Unload” switch contacts. The load should ramp to the *Base load reference* (parameter 5520) setting.
    a. Unload – ramp toward the unload trip level
        i. Uses unload ramp rate
    b. Load – ramp to the base load refence
        i. Uses load ramp rate

This completes the remote load reference setup procedure. Proceed with final load control setup.

Final Load Control Setup

1. Set Menu 2 Load ramp rate (parameter 4549) and *Unload ramp rate* (parameter 4524)to desired values.
2. Set *Raise load rate* (parameter 4515) and *Lower load rate* (parameter 4516) to desired values.
3. Set unload trip and base load setpoints to desired values.
4. Set the high limit PU (pick up) and DO (drop out) setpoints to desired values. The high limit PU setpoint should be set to limit the load reference even if the alarm and high limit switch are “Disabled”.
5. Set the low load limit and DO setpoints to desired values. The low load limit PU setpoint should be set to limit the load reference even if the alarm and low limit switch are “Disabled”.
6. If it is desired that the alarm output *High load limit* alarm is activated (parameter 4608) when load reaches the high limit PU, set the high load limit alarm setpoint to “Enabled”. The alarm will be automatically cleared when load drops below the high load limit DO switch point.
7. If it is desired that the alarm output *Low load limit* alarm is activated (parameter 4609) when load reaches the low limit PU, set the low load limit alarm setpoint to “Enabled”. The alarm will be automatically cleared when load increases to above the low load limit DO switch point.
8. If it is desired that the high and low limit switches are active, this controls the “High Limit” and “Low Limit” relay outputs, set the load limit switches setpoint to “Enabled”.
9. Set the load switch PU and load switch DO setpoints to their desired operating levels or set the *Reverse power trip* (parameter 7507), *Instant reverse power* (parameter 4531), *Rev pwr time delay* (parameter 4532) and *Reverse power level* (parameter 4533) to use the load switch output for a reverse power relay.

Process Control Adjustment

This section contains instructions for setup of the DSLC-2 process control. Menu 6.1 provides the setting for the process input signal. The process control (Menu 3) provides the PID loop and reference settings. The Homepage and Menu 8 are provided to assist in setup and verification of process control operation. When operating multiple generator sets in process control, all DSLC-2s will be in process control with the same reference setting. A control can be placed in the unload mode to separate from the bus, but you cannot place a DSLC-2 in base load or load sharing mode when another DSLC-2 is in process mode.

1. Menu 3 contains the process control PID
    a. *Process control proportional gain* (parameter 4500)
    b. *Process control integral gain* (parameter 4501)
    c. *Process control derivative ratio* (parameter 4502)
    d. *Process droop* (parameter 4508)
    e. *Process filter* (parameter 4509)
    f. *Process control action (parameter 7559)*
        i. Direct action
            1. Generator increase kW, process input signal increases
        ii. Indirect action
            1. Generator increases kW, process input signal decreases
2. Set at default values except for the direct or indirect action, set as needed for control.
3. Set the *Process reference* (parameter 7737) setpoint to a value requiring approximately 50 % generator load to maintain the process signal level. If the required process reference is not known at start-up, operate the DSLC-2 control in base load mode. Use manual adjustment of load with the raise load and lower load switches until the desired process level is obtained. Observe the process input signal on Menu 6.1 or the Homepage to determine the required *Process reference* (parameter 7737) value.
4. Close the "Load / Unload" input
5. Close the "Process" input
6. Close the "Run" input
7. DSLC-2 will synchronize and close the generator breaker. Select the synchronizer run mode to parallel the machine with the bus.
8. The DSLC-2 control will ramp into process control.

NOTE

In a slow pressure or level maintenance system, the load reference may ramp to either limit as defined by the high limit PU or low limit PU on Menu 2 and remain there for some time. It will be necessary to get closed loop control of the process between limits in order to proceed with dynamic adjustments.

9. If the process control is unstable, decrease the process control proportional gain setpoint until stable. If decreasing process control gain results in increased instability, decrease process control integral gain.
10. If the process control action is too slow, increase process control proportional gain by increments of 0.5, waiting 30 seconds between changes. If a slow hunt is observed or excessive overshoot of the process reference setting occurs, decrease the process control integral gain in increments of 0.5 and retest.
11. When stable, the process reference can be adjusted using the "Load Raise" and "Load Lower" inputs. Note that in the process control mode; these switches operate using the *Raise reference rate* (parameter 4504) and *Lower reference rate* (parameter 4505) setpoints in Menu 3.Continue to adjust process control proportional gain and process control integral gain until satisfactory control performance is obtained. Adding and removing plant load will show how quickly the system recovers to the Process reference setting.

NOTE

Correct dynamic adjustment may be more easily observed if the raise reference rate and lower reference rate setpoints are set somewhat faster than will be used in service.

12. In systems experiencing rapid fluctuations in the process reference (such as digester gas fuel pressure maintenance), increasing of the filter value (parameter 4509) may help. This reduces control sensitivity to the fluctuations. Slower, but more stable, performance can be obtained.

13. Introduce *Process droop* (parameter 4508), if required, to increase stability of the process control loop.
14. In most systems it will not be necessary to change process control derivative ratio from the default value of 0.01 seconds or process control filter from the default value. In higher performance systems, the filter frequency may be increased for greater control bandwidth and process derivative may be increased to increase the rate of change in load reference during a transient.
15. Set *Raise reference rate* (parameter 4504) and *Lower reference rate* (parameter 4505) to their final values.
16. Set the *Process high limit PU* (parameter 4510) and DO setpoints to the desired values. The process high limit PU setpoint must be set to limit the range of the process reference even if the alarm will not be used.
17. Set the *Process low limit PU* (parameter 4513) and DO setpoints to the desired values. The *Process low limit PU* (parameter 4513) setpoint must be set to limit the range of the process reference even if the alarm will not be used.
18. If it is desired that the alarm output *High process limit alarm* (parameter 7588) is set when the process input reaches the *Process high limit PU* (parameter 4510), set the *Process high limit alarm* (parameter 7500) setpoint to “Enabled”. The alarm will be automatically cleared when the process input level drops below the *Process high limit DO* (parameter 4511) switch point.
19. If it is desired that the alarm output *Low process limit alarm* (parameter 7589) is set when the process input reaches the *Process low limit PU* (parameter 4513), set the *Process low limit alarm* (parameter 7501) setpoint to “Enabled”. The alarm will be automatically cleared when the process input increases to a level above the *Process low limit DO* (parameter 4514) switch point.
20. If it is desired that the high and low limit switches also activate the “High Limit” and “Low Limit” relay driver outputs, set the *Process switches* (parameter 7502) setpoint to “Enabled”.

This completes setup and adjustment of the DSLC-2 process control function.

Var/PF Control Adjustment

This section describes the setup and adjustment of the DSLC-2 var/PF control function. The var/PF control input is the average of A, B and C phase power factors in PF control and the sum of A, B and C kvars in var control. The values of kvars and average power factor are available on Menu 7.

NOTE

var/PF control effectiveness depends on voltage regulator performance. Adjustment of voltage through raise commands to a MOP will result in slow reference tracking. It may also be necessary to adjust the voltage regulator stability to achieve desired results. Consult the voltage regulator manual for instructions. The voltage regulator must have a droop CT installed and setup for around 3 % droop.

1. The verification of speed and voltage bias connections on page 123 **must be completed** before doing this setup and adjustments.
2. The var/PF control uses an analog voltage bias output signal or a three-position controller that uses raise and lower relay contacts to control voltage and reactive power.
3. The var/PF control has 3 control options
    a. Disabled
    b. Var control
    c. PF control
4. Start with the settings you have from doing the verification section on speed and voltage bias outputs.
    a. The voltage bias connection, generator voltage measurement, busbar voltage measurement and the voltage trim proportional gain have all been verified.
5. Var sharing
    a. Active when in the load sharing control mode and the var/PF mode is either “VAR Control” or “PF Control” (parameter 7558).
    b. Need 2 generators that can be connected on an isolated bus to adjust the load sharing and a resistive and reactive load bank.
    c. If no load banks are available, plant load can be used.
6. The adjustment when in var sharing are
    a. *Voltage Trim proportional gain* (parameter 5610)
    b. *Voltage trim integral gain* (parameter 5611)
    c. *Voltage trim derivative ratio* (parameter 5612)
    d. *VAR load share gain* (parameter 4543)
    e. *VAR load share factor* (parameter 4547)
7. Discrete inputs
    a. Close the “Load / Unload” input
8. Start the generator set (or both generator sets)
9. Verify systems are at rated speed and voltage – and are stable
10. Verify using the Overview Pages that both DSLC-2s are seeing each other
11. Close the “Run” input on only 1 of the DSLC-2 controls
12. DSLC-2 will verify the busbar is dead and provide a breaker closure command
    a. Synchronizer (Menu 1) – *Dead bus closure* (parameter 7555) must be enabled
    b. If a missing member alarm is active (Menu 8), the DSLC-2 will not close to a dead bus
        i. In Menu 5, set *Number of DSLC communicating* (parameter 4063) to “1”
        ii. In Menu 5, set *Number of MSLC communicating* (parameter 4707) to “0”
        iii. Alarm will automatically reset
13. Add load, kW and kvar
14. Verify the DSLC-2 is displaying the correct power, voltage , reactive power, current and frequency
15. The generator that is not on the bus, looking at the Homepage:
    a. Busbar OK led is “On”
    b. Busbar is “Red” in color
    c. Generator OK led is “On”
    d. Generator is “Red” in color
    e. Busbar and generator voltages are being displayed correctly
    f. Synchroscope should be active comparing the generator to the busbar
16. Close the “Run” input

17. DSLC-2 will actively synchronize and voltage match, provide a breaker closure command.
18. Load control mode will show load share ramp.
19. Reactive load control mode will show var sharing.
20. If vars are unstable
    a. Lower the *VAR load share gain* (parameter 4543)
    b. If still unstable lower the *Voltage trim proportional gain* (parameter 5610)
    c. If still unstable lower the *Voltage trim integral gain* (parameter 5611)
    d. Change the *VAR PF control mode* (parameter 7558) to “Disable”
        i. Use voltage raise and lower inputs to adjust vars on this generator
21. Once stable, verify the var sharing between the generators
    a. Voltage trim is also active
    b. If possible add and remove resistive and reactive load to see the response of the voltage and vars
22. Unload the first generator on the bus and then synchronize back on and verify load ramping and stability of the system.
23. If enough load is available, close the “Base Load” input on one generator
    a. Verify base load reference
    b. Verify var reference
24. Close the “Base Load” input – when satisfied with reference settings and bus load
25. The DSLC-2 will ramp into base load and var control mode
26. Var control PID
    a. *VAR control proportional gain* (parameter 5613) – increasing value will provide faster response
    b. *VAR control integral gain* (parameter 5614) – lower value to slow response
    c. *VAR control derivative ratio* (parameter 5615) – derivative ratio may be increased to increase the rate of change in var reference during a transient
    d. Var reference adjustment can be done through ToolKit. This will show response to new var settings
27. With both DSLC-2s in the load / var sharing mode
28. Remove the “Unload” input
29. Change from var mode to PF mode (parameter 7558)
    a. *Power factor reference* (parameter 5620)
    b. Verify setting before going into base load mode
30. Repeat above test
31. Var sharing will have no difference
32. Change to base load mode and PF mode
33. Same adjustment for PF control as were used for var control
34. An alternate, but less convenient, method of creating a reactive power disturbance is to switch *VAR PF control mode* (parameter 7558) to “Disabled”, manually change voltage to get an offset in power factor or kvar load and then set *VAR PF control mode* (parameter 7558) to the desired operating mode of “PF control” or “VAR control”.

This completes var/PF control adjustments.

Chapter 4.
Synchronizer Description

Introduction

Synchronization is the matching of the output voltage wave form of one synchronous alternating current electrical generator with the voltage wave form of another alternating current electrical system. For the two systems to be synchronized and connected in parallel, five conditions must be considered:

- The number of phases in each system
- The direction of rotation of the phases
- The voltage amplitudes of the two systems
- The frequencies of the two systems
- The phase angle of the voltage of the two systems

The first two conditions are determined when the equipment is specified, installed and wired. The synchronizer matches the remaining conditions (voltage, frequency and phase) before the paralleling breakers are closed.

Functional Description

This section describes how generator and bus matching occurs and how all conditions are verified by the synchronizer functions.The examples shown in chapter "Measurement Connections (Examples)" on page 143 demonstrate the AC measurement connection and configuration of the DSLC-2 system.

Operating Modes

The operation of the synchronizer is determined by the mode switch as shown in Figure 4-1. The four modes are "Off", "Run", "Check" and "Permissive". When the switch is off, the synchronizer is out of operation.

Run mode allows normal synchronizer operation and breaker closure signals. The speed bias signal (explained below) is maintained throughout the breaker closure signal. When the specified closure signal time has elapsed or the CB (circuit breaker) aux contact closure signal is received at terminal 70, the synchronizer is disabled. The synchronizer may optionally be reset automatically when the generator is disconnected from the bus.
Check mode allows normal synchronizing and voltage matching, but does not issue a breaker closure signal.
Permissive mode enables the synch-check function for proper synchronization, but synchronizer operation does not affect the engine's speed or generator voltage. If phase, frequency and voltage are within proper limits, the synchronizer issues the breaker closure command. The breaker close command follows the *GCB close hold time* (parameter 3416) setting. It does not stay closed for the complete time you are within the proper limits.

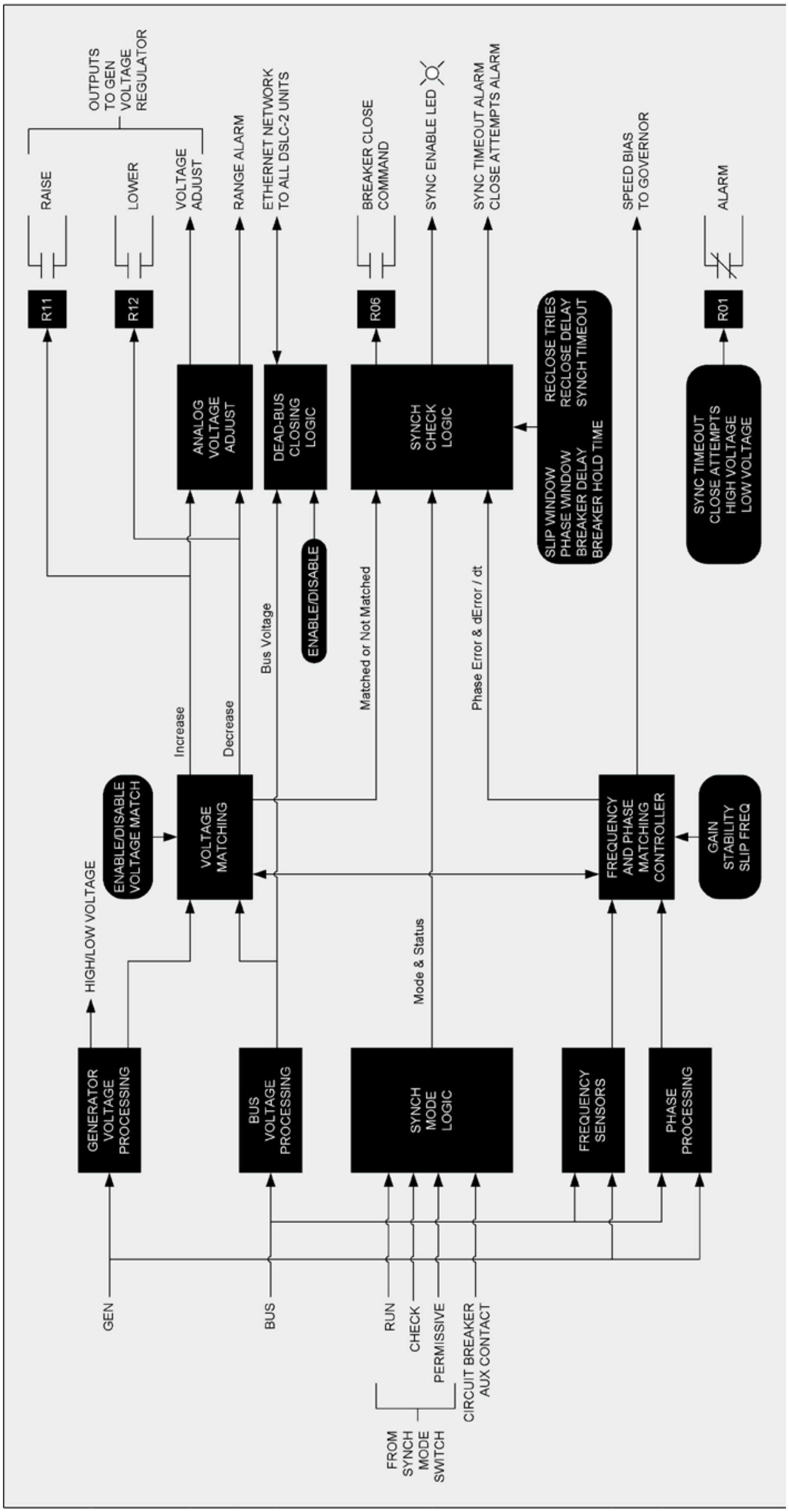


Figure 4-1: Synchronizer block diagram

Measurement Connections (Examples)

Low Voltage System 480 V / 277 V - 3-Phase with Neutral

- Phase rotation clockwise
- Generator measurement: 3-Phase with neutral
- Busbar measurement : **L1-L2 (“Phase – phase”)**

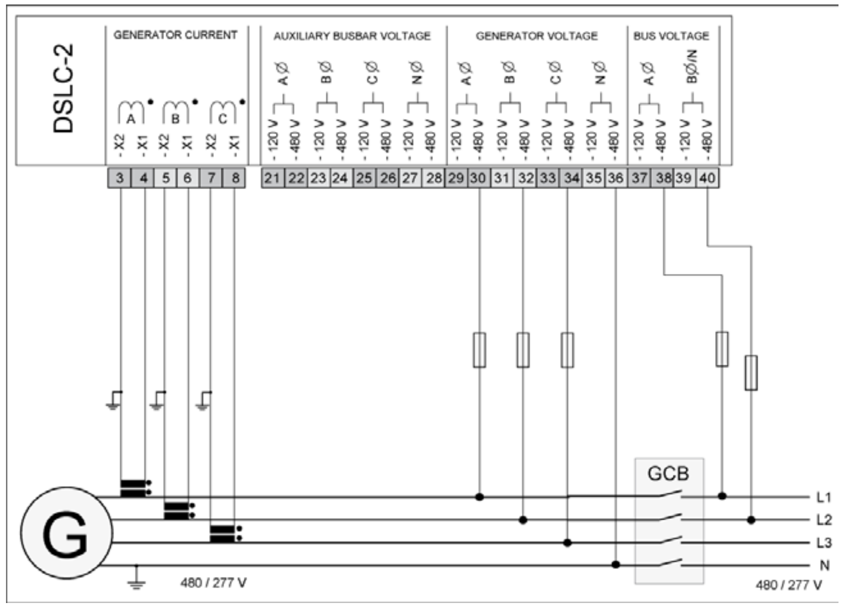


Figure 4-2: Low voltage system 480 V / 277 V – 3-phase with neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): “480 V” • *Generator current input* (parameter 1850): “L1 L2 L3” • *Generator voltage measuring* (parameter 1851): “3Ph 4W” • *Busbar rated voltage* (parameter 1781): “480 V” • *1Ph2W voltage input* (parameter 1858): “Phase – phase” • *1Ph2W phase rotation* (parameter 1859): “CW” • *Auxiliary busbar available* (parameter 7629): “No” **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): “480 V” • *Gen. PT secondary rated volt.* (parameter 1800): “480 V” • *Bus PT primary rated voltage* (parameter 1804): “480 V” • *Bus PT secondary rated volt.* (parameter 1803): “480 V”	• Gen [V] L1 • Gen [V] L2 • Gen [V] L3 • Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen Phase rotation • Bus [V] L1-L2 • Bus [Hz] • Phase-Angle • Bus-Gen	• Gen [V] L1 • Gen [V] L2 • Gen [V] L3 OR • Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-1: Low voltage system 480 V / 277 V – 3-phase with neutral

Low Voltage System 480 V / 277 V - 3-Phase with Neutral

- Phase rotation clockwise
- Generator measurement: 3-Phase with neutral
- Busbar measurement : **L1-N ("Phase – neutral")**

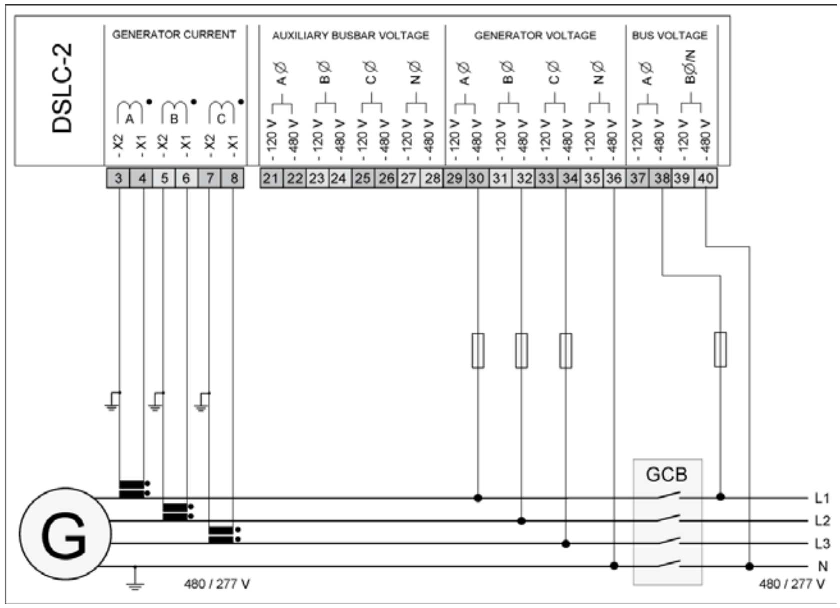


Figure 4-3: Low voltage system 480 V / 277 V – 3-phase with neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): "480 V" • *Generator current input* (parameter 1850): "L1 L2 L3" • *Generator voltage measuring* (parameter 1851): "3Ph 4W" • *Busbar rated voltage* (parameter 1781): "277 V" • *1Ph2W voltage input* (parameter 1858): "Phase – neutral" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary busbar available* (parameter 7629): "No" **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): "480 V" • *Gen. PT secondary rated volt.* (parameter 1800): "480 V" • *Bus PT primary rated voltage* (parameter 1804): "480 V" • *Bus PT secondary rated volt.* (parameter 1803): "480 V"	• Gen [V] L1 • Gen [V] L2 • Gen [V] L3 • Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen Phase rotation • Bus [V] L1 • Bus [Hz] • Phase-Angle • Bus-Gen	• Gen [V] L1 • Gen [V] L2 • Gen [V] L3 OR • Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-2: Low voltage system 480 V / 277 V – 3-phase with neutral

Low Voltage System 480 V - 3-Phase with Neutral

- Phase rotation clockwise
- Generator measurement: 3-Phase with neutral
- Busbar measurement : **L1-N ("Phase – neutral")**
- Auxiliary busbar measurement: 3-Phase with neutral

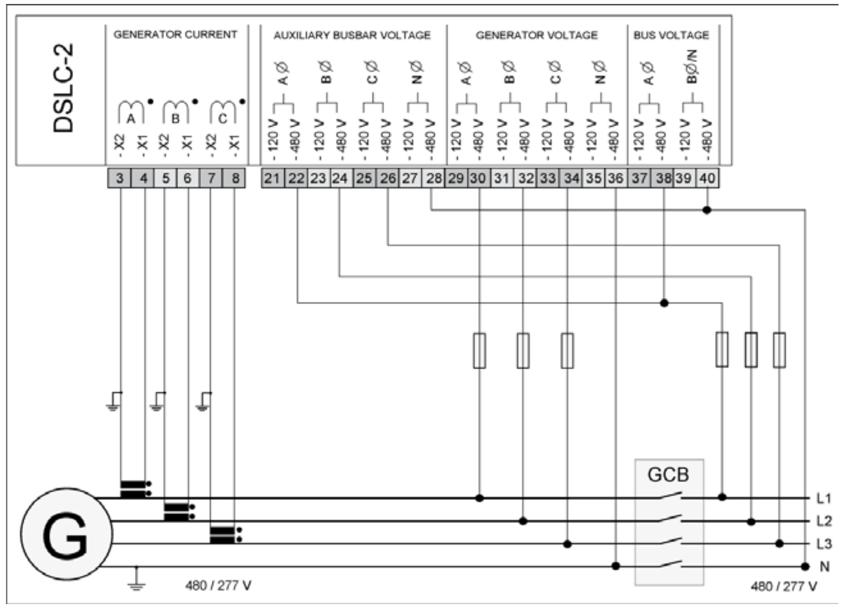


Figure 4-4: Low voltage system 480 V – 3-phase with neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): "480 V" • *Generator current input* (parameter 1850): "L1 L2 L3" • *Generator voltage measuring* (parameter 1851): "3Ph 4W" • *Busbar rated voltage* (parameter 1781): "277 V" • *1Ph2W voltage input* (parameter 1858): "Phase – neutral" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary busbar available* (parameter 7629): "Yes" • *Aux bus voltage measuring* (parameter 1853): "3Ph 4W" **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): "480 V" • *Gen. PT secondary rated volt.* (parameter 1800): "480 V" • *Bus PT primary rated voltage* (parameter 1804): "480 V" • *Bus PT secondary rated volt.* (parameter 1803): "480 V"	• Gen [V] L1 • Gen [V] L2 • Gen [V] L3 • Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen phase rotation • Bus [V] L1 • Bus [Hz] • Phase-Angle • Bus-Gen • Aux busbar [V] L1 • Aux busbar [V] L2 • Aux busbar [V] L3 • Aux busbar [V] L1-L2 • Aux busbar [V] L2-L3 • Aux busbar [V] L3-L1 • Aux busbar phase rotation • Aux busbar [Hz]	• Gen [V] L1 • Gen [V] L2 • Gen [V] L3 OR • Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-3: Low voltage system 480 V – 3-phase with neutral

Low Voltage System 600 V / 346 V - 3-Phase

- Phase rotation clockwise
- Generator measurement: 3-Phase PT "Open Delta" (Phase L2 (B) is grounded at the DSLC-2 connection)
- Busbar measurement: 1-Phase PT **L1-L2 ("Phase – phase")**

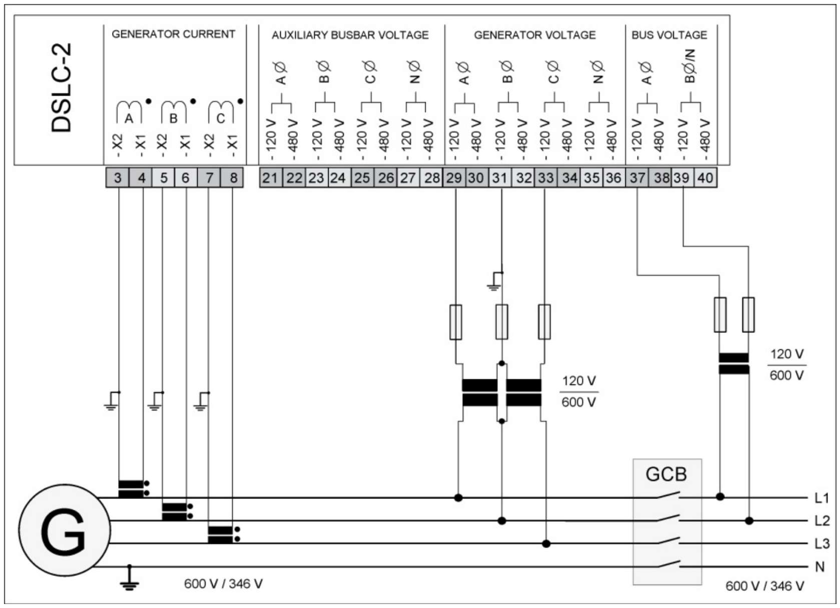


Figure 4-5: Low voltage system 600 V / 346 V – 3-phase

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): "600 V" • *Generator current input* (parameter 1850): "L1 L2 L3" • *Generator voltage measuring* (parameter 1851): "3Ph 4W OD" • *Busbar rated voltage* (parameter 1781): "600 V" • *1Ph2W voltage input* (parameter 1858): "Phase – phase" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary busbar available* (parameter 7629): "No" **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): "600 V" • *Gen. PT secondary rated volt.* (parameter 1800): "120 V" • *Bus PT primary rated voltage* (parameter 1804): "600 V" • *Bus PT secondary rated volt.* (parameter 1803): "120 V"	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen Phase rotation • Bus [V] L1-L2 • Bus [Hz] • Phase-Angle • Bus-Gen	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-4: Low voltage system 600 V / 346 V – 3-phase

Low Voltage System 600 V / 346 V - 3-Phase

- Phase rotation clockwise
- Generator measurement: 3-Phase PT "Open Delta" (Phase L2 (B) is grounded at the DSLC-2 connection)
- Busbar measurement: 1-Phase PT **L1-N ("Phase – neutral")**

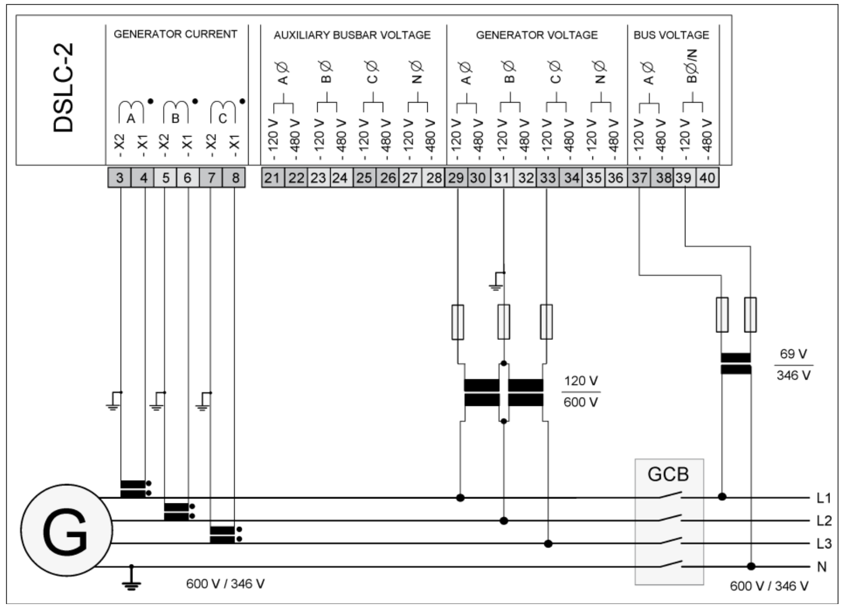


Figure 4-6: Low voltage system 600 V / 346 V – 3-phase

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): "600 V" • *Generator current input* (parameter 1850): "L1 L2 L3" • *Generator voltage measuring* (parameter 1851): "3Ph 4W OD" • *Busbar rated voltage* (parameter 1781): "346 V" • *1Ph2W voltage input* (parameter 1858): "Phase – neutral" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary busbar available* (parameter 7629): "No" **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): "600 V" • *Gen. PT secondary rated volt.* (parameter 1800): "120 V" • *Bus PT primary rated voltage* (parameter 1804): "600 V" • *Bus PT secondary rated volt.* (parameter 1803): "120 V"	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen Phase rotation • Bus [V] L1 • Bus [Hz] • Phase-Angle • Bus-Gen	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-5: Low voltage system 600 V / 346 V – 3-phase

Low Voltage System 600 V / 346 V - 3-Phase

- Phase rotation clockwise
- Generator measurement: 3-Phase PT "Open Delta" (Phase L2 (B) is grounded at the DSLC-2 connection)
- Busbar measurement: 1-Phase PT **L1-L2 ("Phase – phase")**
- Auxiliary busbar measurement: 3-Phase "Open Delta"

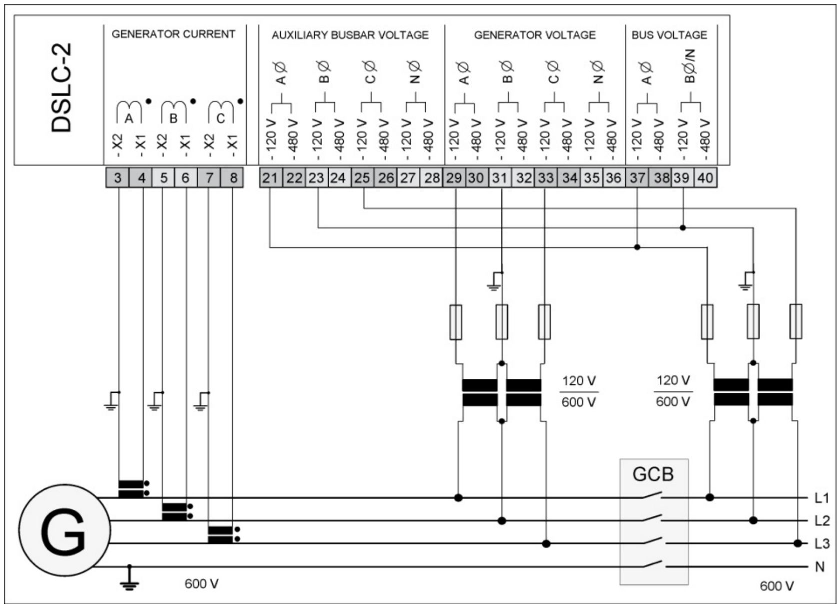


Figure 4-7: Low voltage system 600 V / 346 V – 3-phase

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): "600 V" • *Generator current input* (parameter 1850): "L1 L2 L3" • *Generator voltage measuring* (parameter 1851): "3Ph 4W OD" • *Busbar rated voltage* (parameter 1781): "600 V" • *1Ph2W voltage input* (parameter 1858): "Phase – phase" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary busbar available* (parameter 7629): "Yes" • *Aux bus voltage measuring* (parameter 1853): "3Ph 3W" **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): "600 V" • *Gen. PT secondary rated volt.* (parameter 1800): "120 V" • *Bus PT primary rated voltage* (parameter 1804): "600 V" • *Bus PT secondary rated volt.* (parameter 1803): "120 V"	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen Phase rotation • Bus [V] L1-L2 • Bus [Hz] • Phase-Angle • Bus-Gen	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-6: Low voltage system 600 V / 346 V – 3-phase

Low Voltage System 600 V / 346 V - 3-Phase with Neutral

- Phase rotation clockwise
- Generator measurement: 3-Phase PT "wye" (Phase L2 (B) is grounded at the DSLC-2 connection)
- Busbar measurement: 1-Phase PT **L1-L2 ("Phase – phase")**

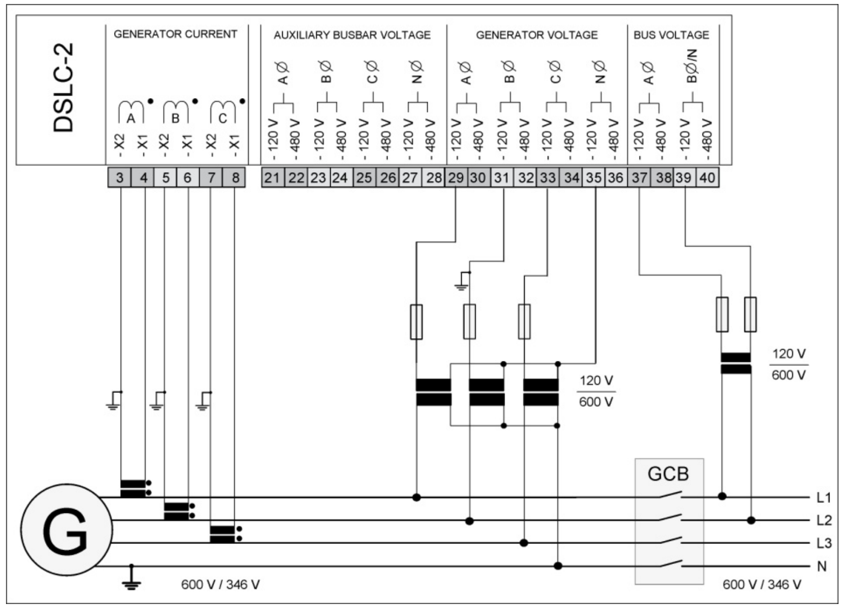


Figure 4-8: Low voltage system 600 V / 346 V – 3-phase with neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): "600 V" • *Generator current input* (parameter 1850): "L1 L2 L3" • *Generator voltage measuring* (parameter 1851): "3Ph 4W" • *Busbar rated voltage* (parameter 1781): "600 V" • *1Ph2W voltage input* (parameter 1858): "Phase – phase" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary busbar available* (parameter 7629): "No" **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): "600 V" • *Gen. PT secondary rated volt.* (parameter 1800): "120 V" • *Bus PT primary rated voltage* (parameter 1804): "600 V" • *Bus PT secondary rated volt.* (parameter 1803): "120 V"	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen Phase rotation • Bus [V] L1-L2 • Bus [Hz] • Phase-Angle • Bus-Gen	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-7: Low voltage system 600 V / 346 V – 3-phase with neutral

Low Voltage System 600 V / 346 V - 3-Phase with Neutral

- Phase rotation clockwise
- Generator measurement: 3-Phase PT "wye" (Phase L2 (B) is grounded at the DSLC-2 connection)
- Busbar measurement: 1-Phase PT **L1-N ("Phase – neutral")**

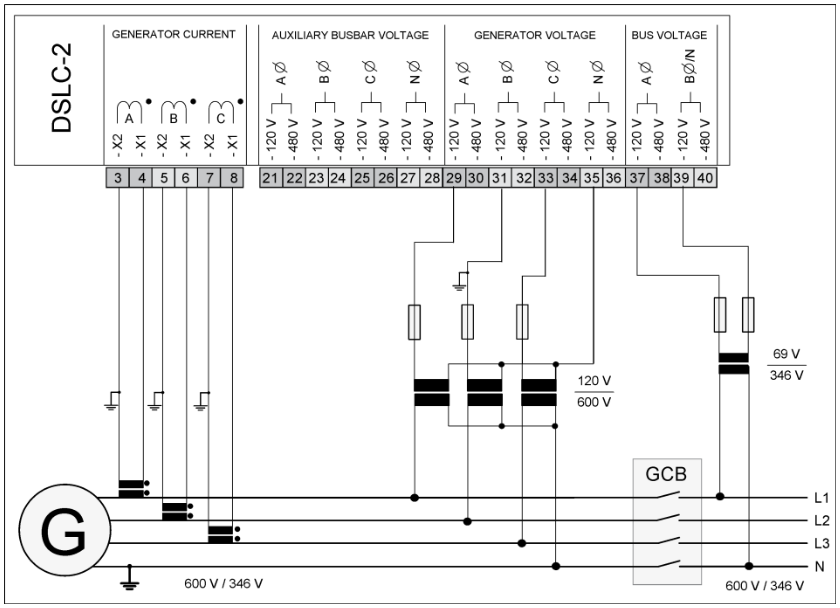


Figure 4-9: Low voltage system 600 V / 346 V – 3-phase with neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): "600 V" • *Generator current input* (parameter 1850): "L1 L2 L3" • *Generator voltage measuring* (parameter 1851): "3Ph 4W" • *Busbar rated voltage* (parameter 1781): "346 V" • *1Ph2W voltage input* (parameter 1858): "Phase – neutral" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary busbar available* (parameter 7629): "No" **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): "600 V" • *Gen. PT secondary rated volt.* (parameter 1800): "120 V" • *Bus PT primary rated voltage* (parameter 1804): "600 V" • *Bus PT secondary rated volt.* (parameter 1803): "120 V"	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen Phase rotation • Bus [V] L1 • Bus [Hz] • Phase-Angle • Bus-Gen	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-8: Low voltage system 600 V / 346 V – 3-phase with neutral

Low Voltage System 600 V / 346 V - 3-Phase with Neutral

- Phase rotation clockwise
- Generator measurement: 3-Phase PT "wye"
- Busbar measurement: 1-Phase PT **L1-L2 ("Phase – phase")**
- Auxiliary busbar measurement: 3-Phase PT "wye"

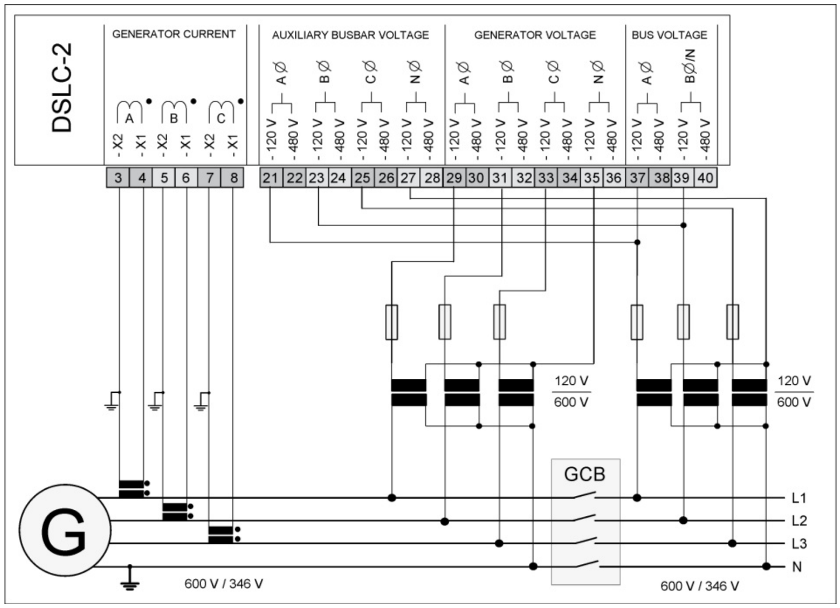


Figure 4-10: Low voltage system 600 V / 346 V – 3-phase with neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): "600 V" • *Generator current input* (parameter 1850): "L1 L2 L3" • *Generator voltage measuring* (parameter 1851): "3Ph 4W" • *Busbar rated voltage* (parameter 1781): "600 V" • *1Ph2W voltage input* (parameter 1858): "Phase – phase" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary busbar available* (parameter 7629): "Yes" • *Aux bus voltage measuring* (parameter 1853): "3Ph 4W" **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): "600 V" • *Gen. PT secondary rated volt.* (parameter 1800): "120 V" • *Bus PT primary rated voltage* (parameter 1804): "600 V" • *Bus PT secondary rated volt.* (parameter 1803): "120 V"	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen Phase rotation • Bus [V] L1-L2 • Bus [Hz] • Phase-Angle • Bus-Gen	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-9: Low voltage system 600 V / 346 V – 3-phase with neutral

Low Voltage System 600 V / 346 V - 3-Phase with Neutral

- Phase rotation clockwise
- Generator measurement: 3-Phase PT "wye"
- Busbar measurement: 1-Phase PT **L1-N ("Phase – neutral")**
- Auxiliary busbar measurement: 3-Phase PT "wye"

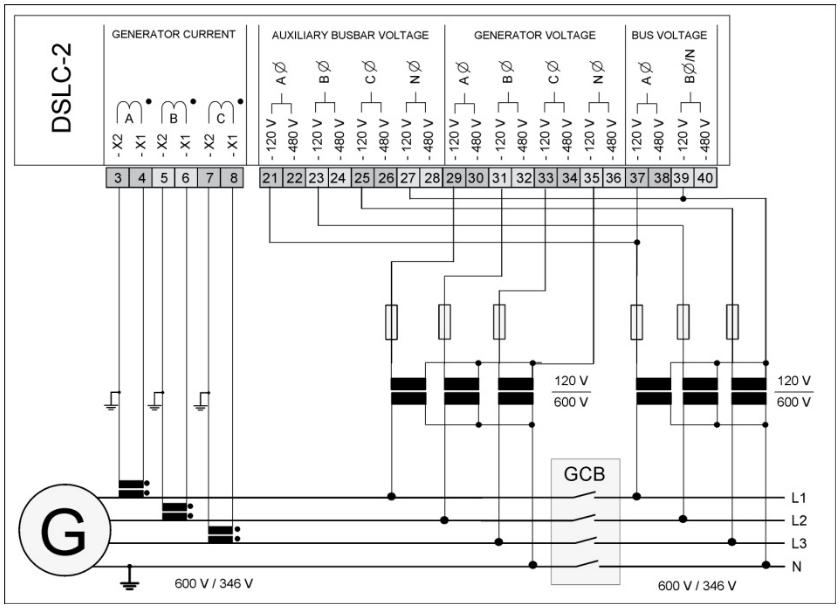


Figure 4-11: Low voltage system 600 V / 346 V – 3-phase with neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): "600 V" • *Generator current input* (parameter 1850): "L1 L2 L3" • *Generator voltage measuring* (parameter 1851): "3Ph 4W" • *Busbar rated voltage* (parameter 1781): "346 V" • *1Ph2W voltage input* (parameter 1858): "Phase – neutral" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary busbar available* (parameter 7629): "Yes" • *Aux bus voltage measuring* (parameter 1853): "3Ph 3W" **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): "600 V" • *Gen. PT secondary rated volt.* (parameter 1800): "120 V" • *Bus PT primary rated voltage* (parameter 1804): "600 V" • *Bus PT secondary rated volt.* (parameter 1803): "120 V"	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen Phase rotation • Bus [V] L1 • Bus [Hz] • Phase-Angle • Bus-Gen	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-10: Low voltage system 600 V / 346 V – 3-phase with neutral

Middle Voltage System 20 kV - 3-Phase without Neutral

- Phase rotation clockwise
- Generator measurement: 3-Phase PT “Open Delta”
- Busbar measurement: 1-Phase PT **L1-L2**

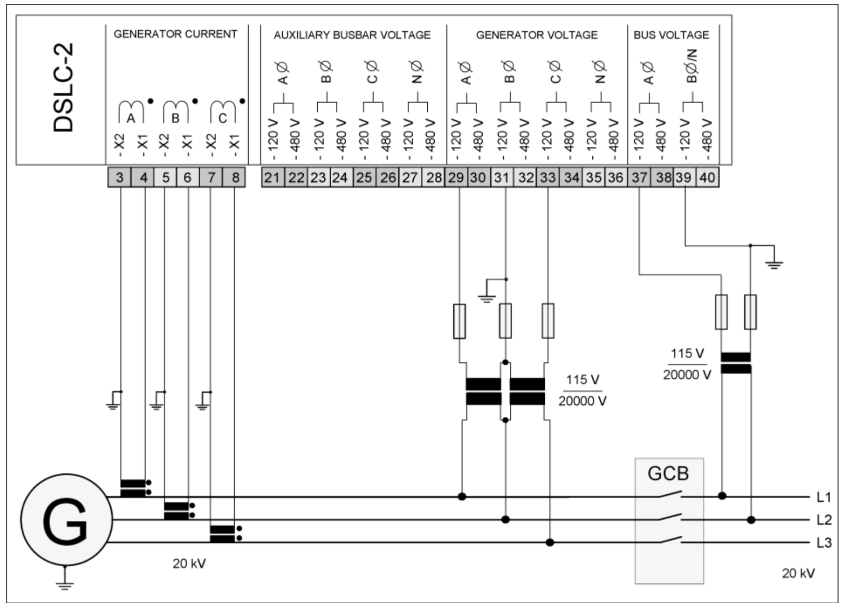


Figure 4-12: Middle voltage system 20 kV – 3-phase without neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): “20000 V” • *Generator current input* (parameter 1850): “L1 L2 L3” • *Generator voltage measuring* (parameter 1851): “3Ph 3W” • *Busbar rated voltage* (parameter 1781): “20000 V” • *1Ph2W voltage input* (parameter 1858): “Phase – phase” • *1Ph2W phase rotation* (parameter 1859): “CW” • *Auxiliary busbar available* (parameter 7629): “No” **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): “20000 V” • *Gen. PT secondary rated volt.* (parameter 1800): “115 V” • *Bus PT primary rated voltage* (parameter 1804): “20000 V” • *Bus PT secondary rated volt.* (parameter 1803): “115 V”	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen Phase rotation • Bus [V] L1-L2 • Bus [Hz] • Phase-Angle • Bus-Gen	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-11: Middle voltage system 20 kV – 3-phase without neutral

Middle Voltage System 20 kV - 3-Phase without Neutral

- Phase rotation clockwise
- Generator measurement: 3-Phase PT "Open Delta"
- Busbar measurement: 1-Phase PT **L1-L2**
- Auxiliary busbar measurement: 3-Phase PT "Open Delta"

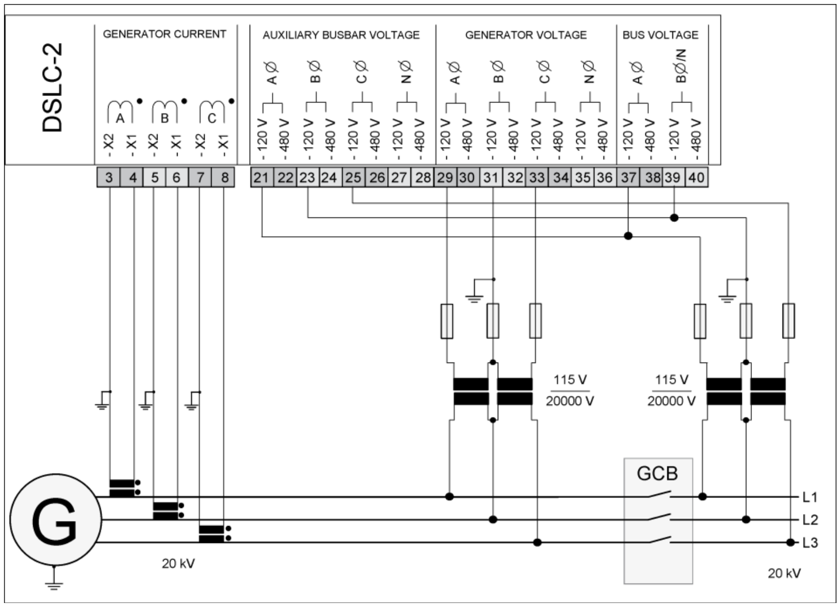


Figure 4-13: Middle voltage system 20 kV – 3-phase without neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *Generator rated voltage* (parameter 1766): "20000 V" • *Generator current input* (parameter 1850): "L1 L2 L3" • *Generator voltage measuring* (parameter 1851): "3Ph 3W" • *Busbar rated voltage* (parameter 1781): "20000 V" • *1Ph2W voltage input* (parameter 1858): "Phase – phase" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary busbar available* (parameter 7629): "Yes" • *Aux bus voltage measuring* (parameter 1853): "3Ph 3W" **Transformer** • *Gen. PT primary rated voltage* (parameter 1801): "20000 V" • *Gen. PT secondary rated volt.* (parameter 1800): "115 V" • *Bus PT primary rated voltage* (parameter 1804): "20000 V" • *Bus PT secondary rated volt.* (parameter 1803): "115 V"	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1 • Gen [A] L1 • Gen [A] L2 • Gen [A] L3 • Gen [kW] • Gen [KVA] • Gen [kvar] • Gen [PF] L1 • Gen [PF] L2 • Gen [PF] L3 • Gen [Hz] • Gen Phase rotation • Bus [V] L1-L2 • Bus [Hz] • Phase-Angle • Bus-Gen • Aux busbar [V] L1-L2 • Aux busbar [V] L2-L3 • Aux busbar [V] L3-L1 • Aux busbar phase rotation • Aux busbar [Hz]	• Gen [V] L1-L2 • Gen [V] L2-L3 • Gen [V] L3-L1

Table 4-12: Middle voltage system 20 kV – 3-phase without neutral

Dead Bus Closing – Multiple Units

When a dead bus is detected and dead bus closing mode is "Enabled", the DSLC-2 is doing a security check before issuing a breaker closure command. This security is required to prevent two or more units from closing their breakers at the same time. If a "Missing Member" or a "Communication Monitoring" error is detected, the DSLC-2 will not close to a dead bus.

To provide this security, the active DSLC-2 is communicating on the network, if any other DSLC-2 or MSLC-2 is requesting to close its breaker:

- If yes, the active DSLC-2 cancels the wish for breaker closure, remains passive and still listen on the network, if the situation changes.
- If no, the active DSLC-2 publish a close wish on the network and listen, if there is any other control wish to close its breaker. Three scenarios are now possible:
  - **Scenario 1:** No other control announces a close desire within the next 500 ms. After that the DSLC-2 closes its breaker.
  - **Scenario 2:** No other control with a smaller Device-ID announces a desire for dead bus closure within the next 500 ms. After that the DSLC-2 closes its breaker.
  - **Scenario 3:** Another control with a smaller Device-ID announces a desire for dead bus closure, so the DSLC-2 cancels the wish for breaker closure, remains passive and still listen on the network, if the situation changes.

NOTE

The DSLC-2s have higher priority for dead bus closure than the MSLC-2s. In other words: If a DSLC-2 wishes to close the GCB on a dead busbar the MSLC-2s are blocked.

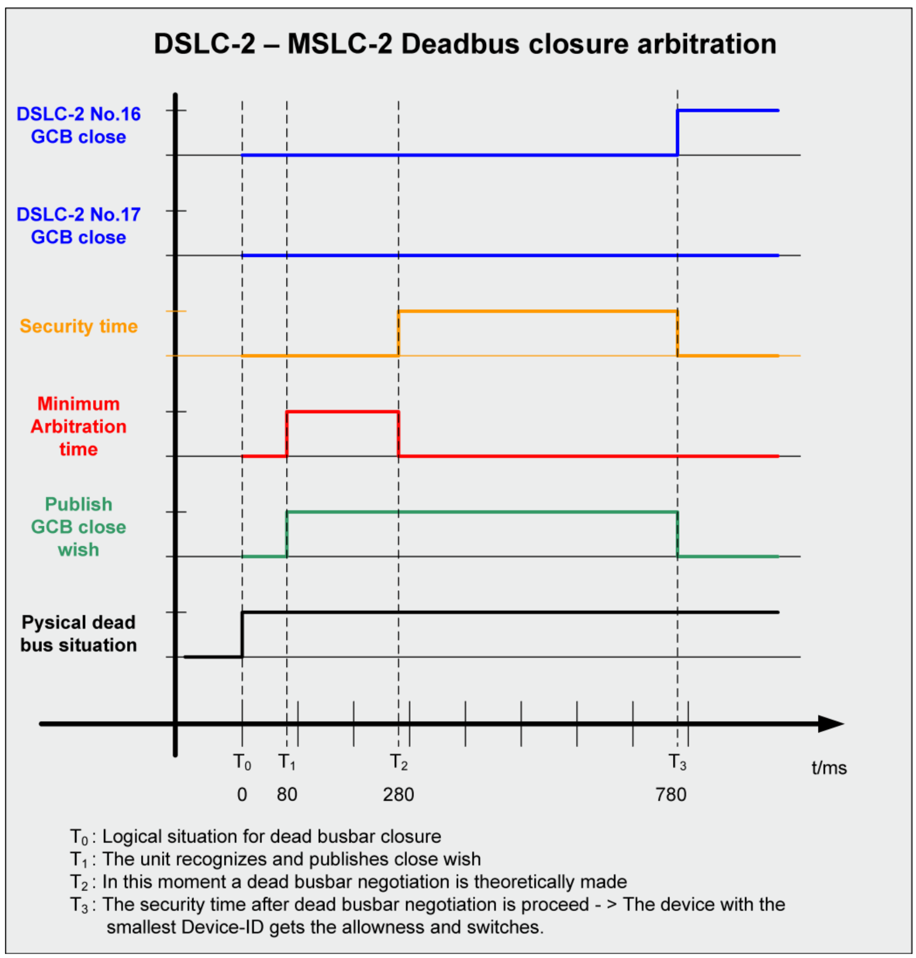


Figure 4-14: Dead bus closing – Example of dead busbar closure arbitration

Dead Bus Closing – Single Unit

When a dead bus is detected and dead bus closing mode is enabled, the DSLC is doing a security check before issuing a breaker closure command. The dead bus arbitration is automatically cancelled, if no other control is recognized on the common network. If a "Missing Member" or a "Communication Monitoring" error is detected, the DSLC-2 will not close to a dead bus.

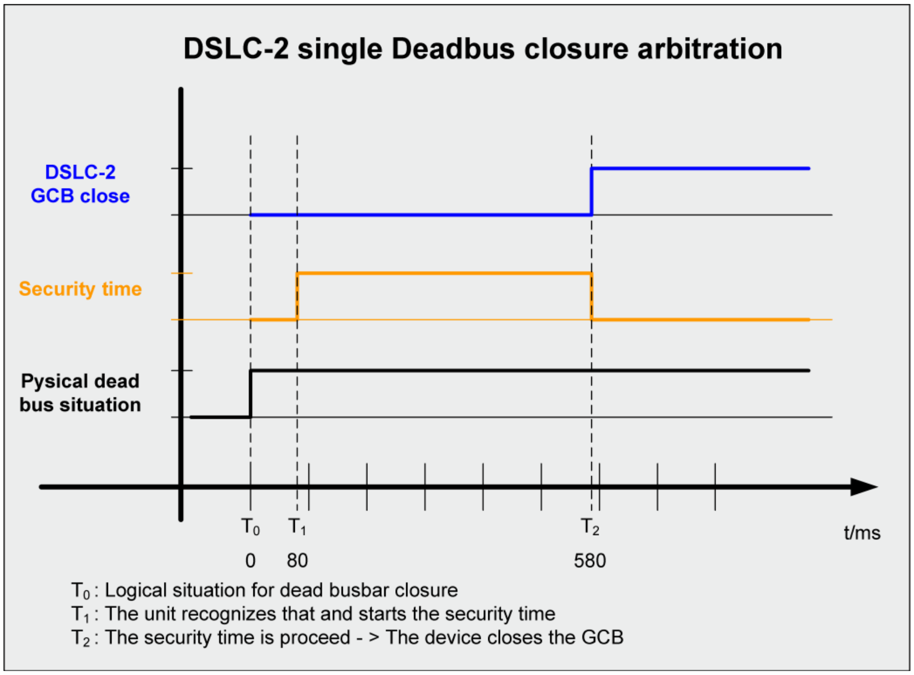


Figure 4-15: Dead bus closing – Example of single dead busbar closure arbitration

Voltage Matching

The voltages of the generators in a parallel system must be matched within a small percentage to minimize the reactive power flow in the system. If two synchronous generators of unequal voltage are paralleled, the combined voltage will have a value different from the voltage generated by either of the generators. The difference in voltages results in reactive currents flowing in the system with subsequent lowered system efficiency.

If a synchronous generator is paralleled to a larger system such as a utility, a difference in voltages before paralleling will not change the voltage of the bus. If the generator voltage is lower than the bus voltage when the breaker is closed, reactive power will be drawn from the bus and used to excite the generator to the higher bus voltage. In the case where the generator voltage is low enough, the reactive power flow could motorize the generator with potential damage to the generator windings.

The DSLC-2 measures the RMS values of the generator and busbar voltages. The synchronizer issues appropriate raise or lower commands to the voltage regulator until the generator voltage is within the specified voltage window. The automatic voltage matching function will occur in both, the "Check" and "Run" modes and is verified only by the sync-check function in "Permissive" mode. A voltage trim function provides accurate voltage control in isochronous load sharing mode.

Phase Matching Synchronizing

The phase matching synchronizing mode corrects the frequency and phase of the generator to lock it to the bus frequency and phase. Phase matching synchronizing can be configured (parameter 5729) in the unit. With activation of the synchronizer, the DSLC-2 will control the frequency to minimize the frequency difference between generator and busbar. When the frequency is within the *Phase matching df-start* (parameter 5506) setting, the phase relationship is controlled. The speed bias output increases or decreases engine speed while controlling the slip frequency and phase relationship between the generator and the bus. Proportional and integral gain adjustments are provided to allow stable operation of the automatic synchronizer over a wide range of system dynamics.

Slip Frequency Synchronizing

It is often desirable for the oncoming generator speed to be slightly higher than the bus when the generator breaker is closed. This assures that power immediately flows out of the generator and into the system. Slip frequency can be selected using parameter 5729 in Menu 1. The synchronizer automatically controls the generator at the specified slip frequency (parameter 5502). The speed bias output increases or decreases engine speed while controlling the slip frequency and phase relationship between the generator and the bus. Proportional and integral gain adjustments are provided to allow stable operation of the automatic synchronizer over a wide range of system dynamics.

Permissive Mode / Synch-Check Function

The synch-check function determines when frequency, phase and voltage are within the configured settings for proper synchronization before issuing a breaker closure command. The speed and voltage bias outputs are not used to drive the generator into synchronization. The generator can be manually controlled using the load raise / lower and voltage raise / lower discrete inputs. The generator and bus voltage comparison is made independent of the voltage matching function being enabled. When all conditions of voltage and phase are met, then the breaker closure command is given for the *GCB close hold time* (parameter 3416), then will wait the *Reclose delay* (parameter 4534) time and if the proper synchronization settings are still met, will issue another breaker closure command.

GCB Maximun Closing Attempts

The synchronizer allows multiple breaker closure attempts to an active or dead bus. The control provides setpoints for the number of close attempts (parameter 3418) and the reclosure delay timing (parameter 4534). The synchronizer feature has 2 alarms, *Reclose limit alarm* (parameter 7556) and the *Synchronizer timeout alarm* (parameter 7557). These alarms will effect the synchronizer differently between an active or dead bus.

Dead bus closing
If both alarms are disabled, you will receive infinite breaker closure attempts. If one or both alarms are enabled, when that alarm setting is reached, an alarm is received and no more breaker close attempts will be given. This is important when you have multiple generator sets attempting to close to a dead bus. The DSLC-2 that receives the dead bus token, will not pass the dead bus token until it receives an alarm. So having 1 or 2 close attempts is preferred in a multiple generator set application.

Active bus closing
If both alarms are disabled, you will receive infinite breaker closure attempts. If one or both alarms are enabled, when that alarm setting is reached, an alarm is received but the synchronizer will keep providing breaker closure commands until a “CB Aux” feedback is received or the “Run” or “Permissive” input is removed.

Auto Re-Synchronization

The *Auto re-synchronization* feature (parameter 7514), when enabled, allows the DSLC-2 to attempt to reclose the breaker if the “CB Aux” feedback is opened and the DSLC-2 still has a “Run” or “Permissive” input closed. The auto re-synchronizer feature becomes active after a successful breaker closure is received. Then if the breaker feedback (CB Aux) is opened and the “Run” or “Permissive” input is still closed, the DSLC-2 will attempt to close the breaker when in the synchronizer specifications. If configured for “Disabled”, no attempt at synchronization will be made until the “Run” or “Permissive” input is then opened and reclosed. This is active even when a utility unload command is given and the DSLC-2 opens the breaker. With auto re-synchronization “Enabled”, the synchronizer will become active.

NOTE

Woodward suggest to remove the “Run” or “Permissive” input after a successful breaker closure has been re-ceived and have the “Run” or “Permissive” input reclosed if the breaker opens and it is safe to reclose it.

Reclose Limit Alarm

When the *Reclose limit alarm* (parameter 7556) is “Enabled” an independent monitor counts in the background the number of close attempts. When the number of close attempts matches the configurable number of closing attempts (parameter 3418) an alarm flag will be issued. This alarm flag is automatically considered when a dead busbar closure is executed. When during the dead busbar closure, the reclose limit alarm becomes active, the dead busbar closure permission will be passed to another DSLC-2. If the *Reclose limit alarm* (parameter 7556) is “Disabled”, the DSLC-2 will have an infinite number of attempts to close the breaker.

Synchronizer Timer

The synchronizer function is equipped with three adjustable timers.

1. The *CB close hold time* (parameter 3416) determines the amount of time the control maintains the breaker close command.
2. The *Synchronizer timeout* (parameter 3063) when the *Synchronizer timeout alarm* (parameter 7557) is “Enabled”. The alarm is removable by de-energized run and permissive signal.
3. The *Reclose delay* (parameter 4534) which is the time delay between the single close commands.

When “Enabled” the synchronizer timer starts when the “Run” switch is closed. It is not active in the check or permissive modes. If no breaker closure is received by the end of the timer, a synchronizer timeout alarm is received and the DSLC-2 will stop the synchronizing process. If the “Run” input is removed, the alarm is reset and when the “Run” input is closed the synchronizer process will be active.

Logic Charter GCB Closure

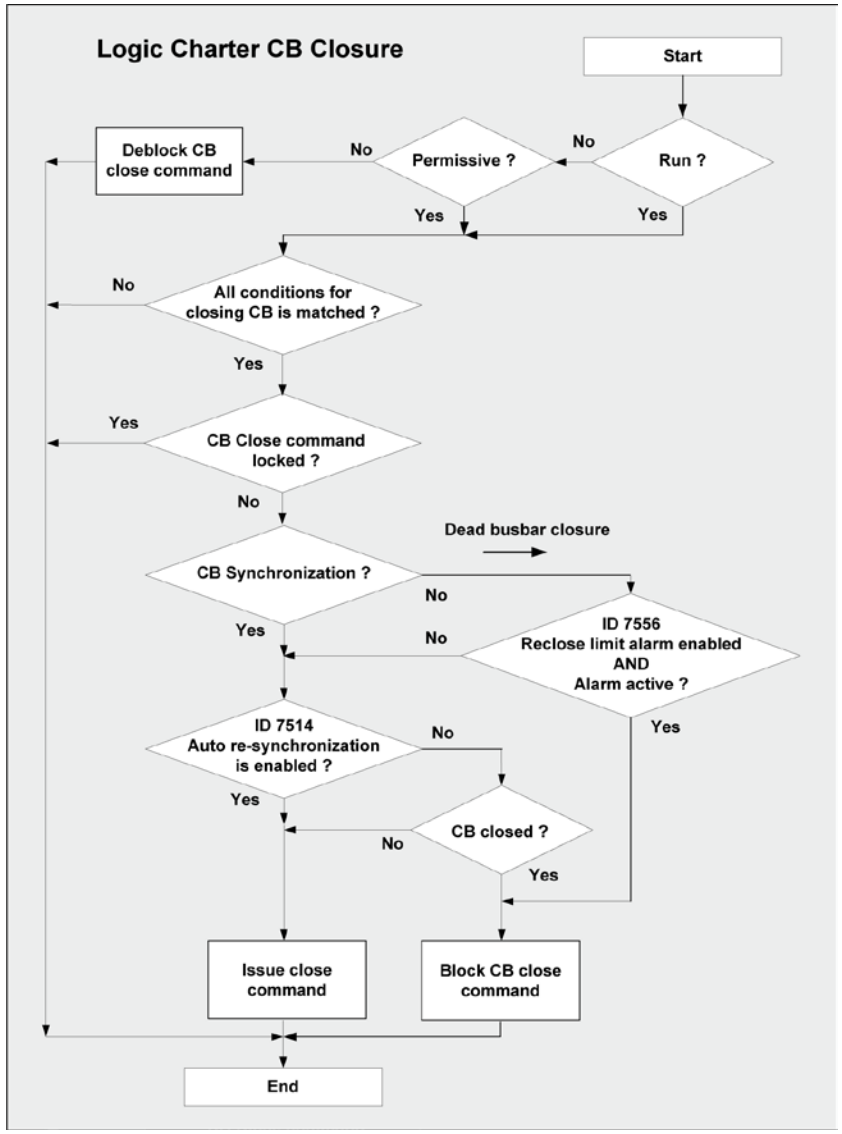


Figure 4-16: Logic charter GCB closure

Chapter 5.
Real Power Control Description

Introduction

The DSLC-2 control provides several modes of generator load operation. These are:

- Droop (Droop tracking)
  - Manual control of generator kW and kvar
- Isochronous load sharing and var sharing
  - Automatic control for proportional kW sharing and var sharing
- Baseload control
  - Automatic control of kW with either var or power factor control
- Process control
  - Automatic control of a process signal with either var or power factor control
  - Multiple DSLC-2s must be configured for the same process reference setting

Power Management Concepts

This section provides a review of the operation of droop, droop tracking, isochronous, droop/isochronous, isochronous load sharing and base load. These concepts provide an understanding for power management.

Droop

Droop is a decrease in speed or frequency, proportional to load. That is, as the load increases, the speed or frequency decreases. This reduction in speed is accomplished with negative feedback. The feedback increases as the system is loaded. Droop is expressed as the percentage reduction in speed that occurs when the generator is fully loaded. With a given droop setting, a generator set will always produce the same power output at a particular speed or frequency. Droop sometimes is called the percent speed regulation.

If all generator sets in a droop system have the same droop setting, they will each share load proportionally. The amount of load will depend on their speed settings. If the system load changes, the system frequency will also change. A change in speed setting will then be required to offset the change in feedback and return the system to its original speed or frequency. In order for each generator set in the system to maintain the same proportion of the shared load, each generator will require the same change in speed setting.

This droop behavior can also be transmitted for the voltage controller. In this case an increasing inductive load (lagging) reduces the voltage or an increasing capacitive load (leading) increases the voltage. The DSLC-2 includes a droop setting for the voltage biasing signal. Woodward recommends that you always use a droop CT on the voltage regulator and set for around 3 % droop for best control.

Droop Tracking

When an active DSLC-2 is placed in the droop tracking mode it keeps the speed and voltage bias settings at their present values. This means that the kW and kvars will remain at their present values. In the past when the control transferred into the droop mode, the generators would unload or the system frequency and voltage values may change. Droop tracking allows all generators to stay at their present values and then will controlled manually to load or unload using the raise and lower inputs for load and voltage. The DSLC-2 is in droop mode. The droop tracking becomes active if:

- The droop tracking is related to the missing member monitor and the monitors recognizes a missing member.
- The discrete input 21 is energized.

Opening the “CB Aux” input will place the DSLC-2 in droop and the generator will unload kW and kvars. This droop deviation depends on the droop setting. In the moment of switching over to droop tracking mode this deviation will be fixed and will then continuously be added to the usual frequency / voltage setpoint. This ensures that in the first moment the frequency / voltage biasing signal does not change. That means for isolated operation the frequency begins to change when the load changes respectively the voltage begins to change, when the reactive load changes. The rate of change depends on the droop setting. When removed from the droop tracking mode, the original frequency / voltage setpoint will be overtaken. If the droop tracking is created by a Missing Members alarm, if the Missing Members alarm is corrected it will switch back to the previous load control mode it was in.

Isochronous

Isochronous means repeating at a single rate or having a fixed frequency or period. A generating set operating in the isochronous mode will operate at the same set frequency regardless of the load it is supplying up to the full load capability of the generator set, as illustrated in Figure 5-1. This mode can be used on one generator set running by itself in an isolated system.

The isochronous mode can also be used on a generator set connected in parallel with other generator sets. Unless the governors are load sharing and speed controls, however, no more than one of the generator sets operating in parallel can be in the isochronous mode. If two generator sets operating in the isochronous mode without load sharing controls are tied together to the same load, one of the units will try to carry the entire load and the other will shed all of its load. In order to share load with other units, some additional means must be used to keep each generator set from either trying to take all the load or from motorizing.

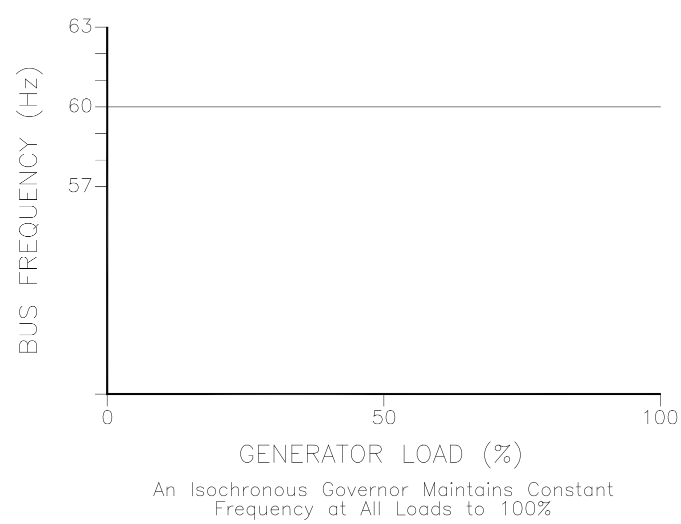


Figure 5-1: Isochronous mode

Droop/Isochronous Load Sharing On An Isolated Bus

Droop/isochronous combines the first two modes. All generator sets in the system except one are operated in the droop mode. The one unit not in droop is operated in the isochronous mode. It is known as the swing machine. In this mode, the droop machines will run at the frequency of the isochronous unit. The droop and speed settings of each droop unit are adjusted so that each generates a fixed amount of power as illustrated in Figure 5-2. The output power of the swing machine will change to follow changes in the load demand.

Maximum load for this type of system is limited to the combined output of the swing machine the total set power of the droop machines. The minimum system load cannot be allowed to decrease below the output set for the droop machines. If it does, the system frequency will change and the swing machine can be motorized.

The machine with the highest output capacity should be operated as the swing machine, so that the system will accept the largest load changes within its capacity.

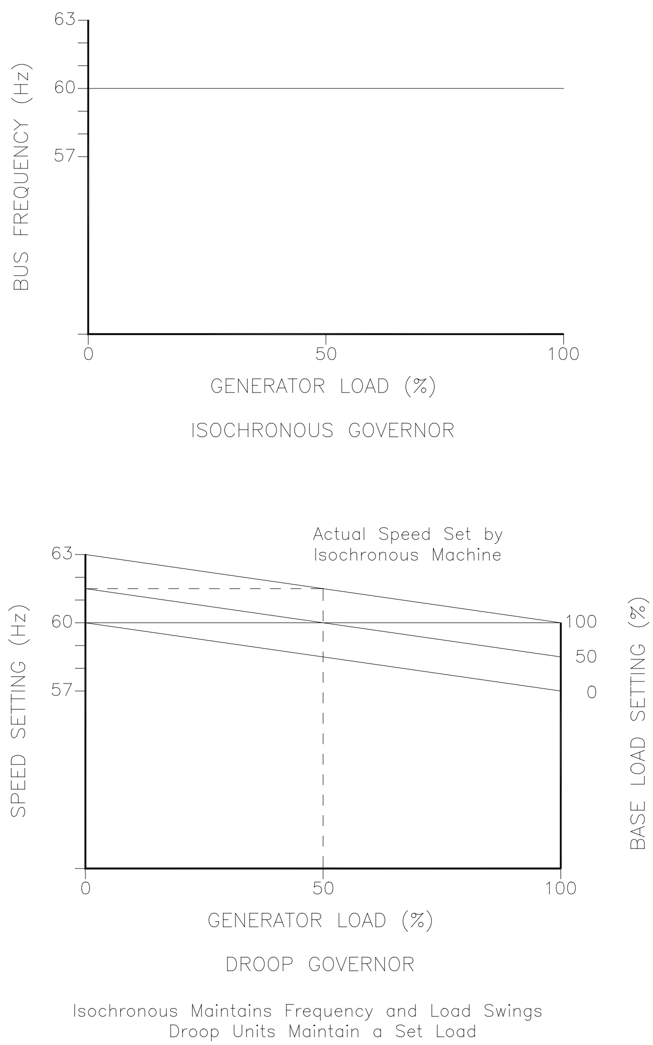


Figure 5-2: Droop/isochronous load sharing

Isochronous Load Sharing On An Isolated Bus

Isochronous load sharing operates all generator sets in a system in the isochronous mode. Load sharing is accomplished by software. All DSLC-2 units are connected via Ethernet channel Network A. Load share is possible for all DSLC-2 units that are in the same segment. Any imbalance in load between units will cause a change to the regulating software in each unit. While each unit continues to run at isochronous speed, these changes force each machine to supply a proportional share of power to meet the total load demand on the system.

Base Load On An Isolated Bus

Base load is a method of setting a base or fixed load on a machine operating in parallel with an isolated bus. This is accomplished by using an isochronous load control and providing a reference at which to control the load. The governor will force the generator output to increase or decrease until the output of the load sensor is equal to the reference setting. At this point, the system is in balance. This method can be used only where other generator sets are producing enough power to meet the change in load demand. This operating mode is ideal for either soft loading additional units into an isochronous system or for unloading a machine.

Base Load

Base load for a system paralleled to an infinite bus or utility is the same as base load in an isolated system. The advantage of base loading over droop is that when separating from a utility, there is no frequency change. Simply remove the bias signal on breaking from the utility returns the system to isochronous.

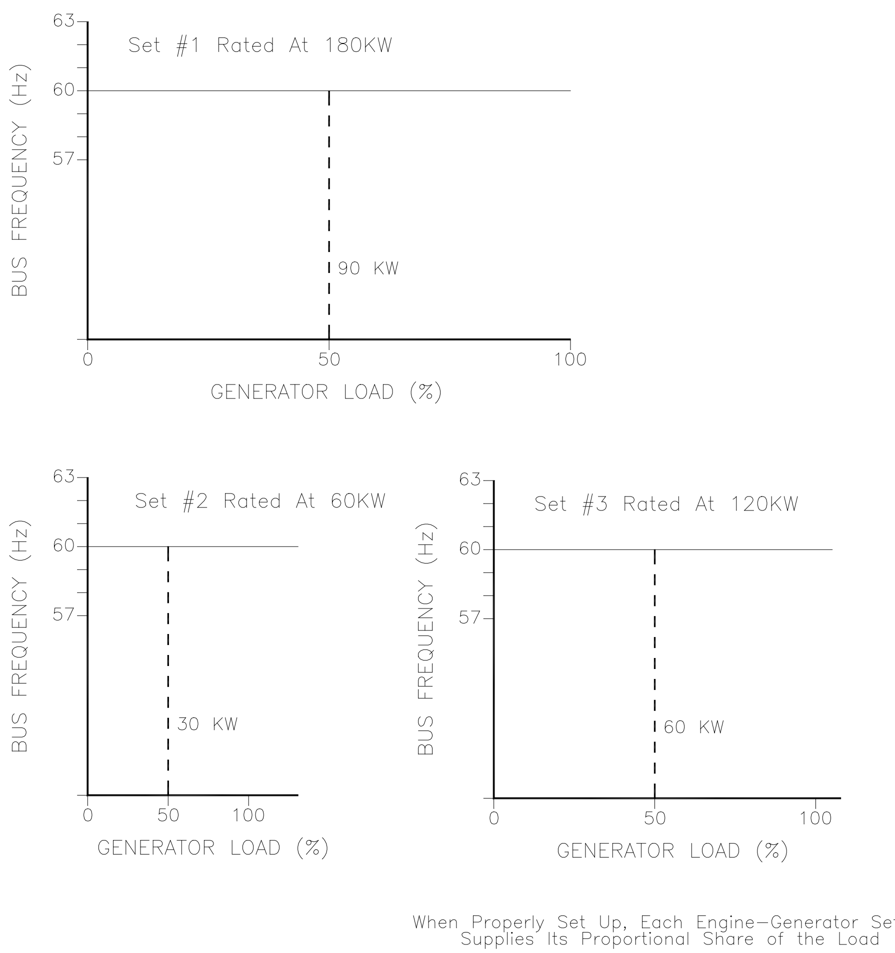


Figure 5-3: Isochronous load sharing

Load Control Modes And Adjustments

The automatic generator loading functions of the DSLC-2 controls will provide a bumpless transfer of kW and vars when:

- Synchronized and connected to the load bus (isolated or infinite)
- Switching between the different load control modes
  - Load sharing to base load / base load to load sharing
  - Droop to load sharing / load sharing to droop
  - Droop to base load / base load to droop
- Unloading a generator for separation from the load bus
  - Unloads kW and kvar

Load Control Mode Switching

Load control operation is determined by the status of the contacts to the “CB Aux” contact input, terminal 70 and the load control mode select contact inputs. When the “CB Aux” contact input is open, droop is the only available operating mode. In single unit operation, speed will decrease as load increases, as described above. In parallel with a bus, the generator is loaded by increasing the speed reference. The DSLC-2 control will provide the droop signal required for stability. When the “CB Aux” contact input is closed, the generator is paralleled to a bus, the load control operating mode contact inputs become effective. These inputs are “Base Load”, terminal 73, “Load/Unload”, terminal 74 and “Process Control”, terminal 78, as shown in Table 5-1.

	DI CB AUX	DI Load/ (Unload)	DI Base Load	DI Process Control	DI Ramp Pause	DI Setpoint Raise	DI Setpoint Lower	DI Droop Tracking
Droop	0	x	x	x	x	x	x	0
Load Sharing (at unload trip)	1	0	0	0	0	x	x	0
Load Sharing	1	1	0	0	0	x	x	0
Base Load (at unload trip)	1	0	1	0	0	x	x	0
Base Load	1	1	1	0	0	x	x	0
Base Load Raise	1	1	1	0	0	1	0	0
Base Load Lower	1	1	1	0	0	0	1	0
Ramp Pause	1	x	x	x	1	x	x	0
Base Load Remote	1	1	1	0	0	1	1	0
Process Control	1	1	x	1	0	x	x	0
Process Raise	1	1	x	1	0	1	0	0
Process Lower	1	1	x	1	0	0	1	0
Process Remote	1	1	x	1	0	1	1	0
Droop Tracking	1	x	x	x	x	x	x	1

Table 5-1: Load control modes DSLC-2

The DSLC-2 control base load mode is selected by a closed “Base Load” contact and a closed “Load/Unload” contact. This function can be used in one of two modes, either as a control to load against a utility or to isolate a single generator set from a load sharing system and operate that set to a specific load. The second mode can also be used when a controlled unload is desired without taking the generator set off line.

The DSLC-2 control also includes a ramp pause function that allows for temperature, oil pressure, etc., to reach the desired operating point. The pause function is activated by an external contact closure to terminal 75. If at any time during the load or unload ramp, the pause contact is closed, the load ramp is held until the pause command is removed.

Soft Loading Into A Load Sharing System

The mode for automatic soft loading into a load sharing system is selected with an open “Base Load” contact input, terminal 73. The “Load/Unload” input, terminal 74, activates the soft loading function after the oncoming generator set is properly synchronized and the paralleling generator breaker closes, which also closes the generator “CB Aux” contacts to terminal 70. When the “CB Aux” contact is closed with the “Base Load” and “Load/Unload” inputs open, isochronous load sharing mode at zero load is automatically selected. If the unit is the only one with a closed breaker in a load sharing system the “Load/Unload” input is ignored and the generator runs purely frequency controlled.

If the “Load/Unload” contact input was closed when the “CB Aux” contact was closed, the soft loading ramp will be started immediately. Otherwise, load sharing at zero load will continue. When the loading ramp is activated, the soft loading function compares the load on the oncoming unit with the load on the load sharing system. The load ramp then linearly increases the load on the unit at the rate set by the load ramp rate setpoint. When the loads match, the ramp is shut off. In the case of an unloaded system or when derated shared load is below the unload trip level, the unit enters load sharing without the ramp function. The pause command may be used to hold the ramp if desired.

Load sharing

Load sharing becomes active when

- CB Aux input is closed
- Load / Unload input is closed

Adjustments when in load share mode

- PID frequency trim
    - *Frequency trim proportional gain* (parameter 5510)
    - *Frequency trim integral gain* (parameter 5511)
    - *Frequency trim derivative ratio* (parameter 5512)
- Load share gain
- Load share factor
- Load ramp rate
- Unload ramp rate

Soft Unloading From A Load Sharing Or A Base Loaded System

The unload sequence is initiated by opening the “Load/Unload” contact. The DSLC-2 control then ramps the load down to zero at the preset rate. When the load reaches the unload trip level setpoint, the “Breaker Open” relay, terminal 47/48, is momentarily deactivated to initiate the opening of the generator breaker. This command can be used to separate the engine generator set from the paralleled system.

Load sharing – unload

- Unload ramp rate
- Unload trip level
- Unload trip time

Base Loading Against A Utility

The base load function is selected by connecting the “Base Load” contact input, terminal 73, to a set of utility breaker auxiliary contacts. The “CB Aux” contact input, terminal 70, is connected to the generator breaker auxiliary contact. When both generator and utility breakers are closed, the unit load will be set to the unload trip level. When the “Load/Unload” contact connected to terminal 74 is closed, the load ramp starts and the unit load is increased to match the base load reference setpoint. The base load reference setting can be adjusted up or down while in the base load mode with the “Load Raise” and “Load Lower” contact inputs. The load raise and lower inputs cannot adjust the base load reference above the rated value or below zero. The load will follow at a rate set by the appropriate raise or lower rate setpoints. When both the raise and lower load contacts are closed, the analog remote reference signal becomes active and will take precedence over the internal base load setpoint. The base load reference will ramp to the remote input setting. If the load raise and lower inputs are removed, the base load reference will ramp to the internal base load reference setting. The “Load/Unload” input, terminal 74, will initiate the unload sequence. Opening the unload switch contacts commands the ramp to decrease the demand on the generator to the unload trip level. When the trip level is reached, the breaker open command relay is momentarily deactivated to separate the generator from the utility. When the “CB Aux” contacts open, the DSLC-2 control goes into droop behavior and keeps the frequency on the initial state.

Base load

Base load is active when

- CB Aux input is closed
- Load / Unload input is closed
- Base load input is closed

Adjustments when in base load mode

- PID power control
  - *Base load proportional gain* (parameter 5513)
  - *Base load integral gain* (parameter 5514)
  - *Base load derivative ratio* (parameter 5515)
- Base load reference
- Load ramp rate
- Unload ramp rate
- Raise load rate
- Lower load rate
- Load control setpoint source

Base Load And Load Sharing Systems

When the generator is isolated paralleled and load sharing, closing the “Base Load” contact to terminal 73 activates the base load function. Load on any parallel load sharing units is disregarded. Load will ramp in the increasing or decreasing direction until the unit load matches the base load reference setpoint. The load will follow at a rate set by the appropriate load or unload ramp rate settings. The base load reference can be adjusted up or down while in the base load mode with the “Load Raise” and “Load Lower” contact inputs. The load will follow at a rate set by the appropriate raise or lower rate setpoints. When both the raise and lower load contacts are closed, the analog remote load reference signal becomes active and will take precedence over the internal base load setpoint. The base load reference will ramp to the remote input setting. If the load raise and lower inputs are removed, the base load reference will ramp to the internal base load reference setting. Opening the “Base Load” contact initiates the return of the system to load sharing. The unit load is ramped up or down until it matches the system load sharing level and then ramps are disabled.

Base load

Base load is active when

- CB Aux input is closed
- Load / Unload input is closed
- Base load input is closed

Adjustments when in base load mode

- PID power control
  - *Base load proportional gain* (parameter 5513)
  - *Base load integral gain* (parameter 5514)
  - *Base load derivative ratio* (parameter 5515)
- Base load reference
- Load ramp rate
- Unload ramp rate
- Raise load rate
- Lower load rate
- Load control setpoint source

Controlled By MSLC-2 Utility Mode

A DSLC-2 only listen to a MSLC-2 when in load sharing mode. This means that the “CB Aux” and the “Load / Unload” inputs are closed. The DSLC-2 will display “Baseload” for the *Load control mode* (parameter 4603). The MSLC-2 provides real and reactive references for the DSLC-2 to control at. The DSLC-2 uses the power control PID for controlling to the real power reference signal it receives from the MSLC-2. If the DSLC-2 is placed in the base load mode by closing the “Base Load” input, it will control at the internal base load and var or power factor reference. If the “Base Load” input is removed, the DSLC-2 will ramp into MSLC-2 control. If multiple MSLC-2s are active, the MSLC-2 with the lowest device number will be in control.

MSLC-2 is active

DSLC-2 is active when

- CB Aux input is closed
- Load / Unload input is closed

Adjustments when in MSLC-2 control

- PID power control
  - *Base load proportional gain* (parameter 5513)
  - *Base load integral gain* (parameter 5514)
  - *Base load derivative ratio* (parameter 5515)
- Load ramp rate
- Unload ramp rate

Reverse Power Relay Description

Setting *Reverse power trip* (parameter 7507) in Menu 2 to “Enabled” selects relay “Load switch” (terminal 43) as the reverse power trip output. The load switch will not operate based on the load switch PU and load switch DO settings when the *Reverse power trip* (parameter 7507) is enabled. The time required to activate the load switch output is calculated using the following formula:

$$\text{Time to trip} = \frac{\text{Reverse Pwr Level (\%kW)} * \text{Rev Pwr Time Delay}}{\text{Actual Load (\%kW)}}$$

Example:
Reverse Power Trip (parameter 7507) = Enabled
Instant Reverse Power (parameter 4531) = –10 %
Rev Pwr Time Delay (parameter 4532) = 20 s
Reverse Power Level (parameter 4533)= –1 %
Actual Load = –4 %

$$\text{Time to trip} = \frac{-1\ \% * 20\ \text{s}}{-4\ \%} = 5\ \text{s}$$

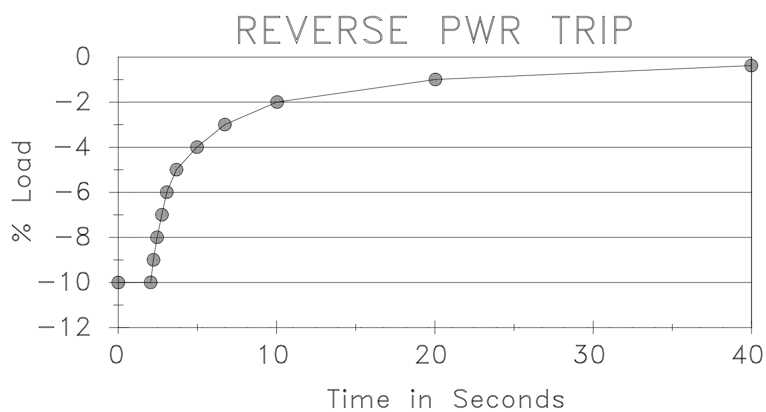


Figure 5-4: Reverse power trip

Chapter 6.
Var/Power Factor Control Description

Introduction

The var/power factor control provides a connection to the voltage regulator using the “Voltage Bias” output (terminals 18, 19 and 20) or by enabling the three position controller using relay outputs (terminals 58 and 59). The “Voltage Bias” output provides a voltage or current signal while the three position controller uses the voltage raise and lower relay contacts to control voltage and reactive power.

The var/power factor menu has 3 control options:

- Disabled
- PF control
- Var control

Disabled
The voltage bias can still be used for voltage matching but will stay at its value when the breaker is closed. The voltage bias can be manually adjusted using the voltage raise and lower discrete inputs.
When the “CB Aux” is closed, two voltage biasing output behaviors are possible:

- The *Reactive load droop* setting, on Menu 4 (parameter 5604), is > 0, then the biasing output reacts with a droop characteristic based on the last biasing level.
- The *Reactive load droop* setting, on Menu 4 (parameter 5604), is = 0, then the biasing output remains on the last biasing level. The voltage regulator must have a droop CT installed with a 1 to 3 % droop adjustment. Woodward always recommends to have a droop CT installed and active on the voltage regulator.

PF control
The power factor control is active in

- Base load control
- Process control
- With an active MSLC-2 control

Adjustments when in PF control

- PID var control
  - *VAR control proportional gain* (parameter 5613)
  - *VAR control integral gain* (parameter 5614)
  - *VAR control derivative ratio* (parameter 5615)

The power factor reference can be changed

- Using ToolKit
- Voltage raise and lower discrete inputs
- Remote reactive load input
  - This is activated by closing both the voltage raise and lower discrete inputs
  - When switching from remote to internal PF reference
    - Ramps from remote reference to internal *Power factor reference* (parameter 5620)
- Modbus address

Var control
The var control is active in

- Base load control
- Process control
- With an active MSLC-2 control

Adjustments when in var control

- PID var control
  - *VAR control proportional gain* (parameter 5613)
  - *VAR control integral gain* (parameter 5614)
  - *VAR control derivative ratio* (parameter 5615)

The var reference can be changed

- Using ToolKit
- Voltage raise and lower discrete inputs
- Modbus address

Var sharing
The var sharing is active when

- PF or var control is selected
- Load sharing mode is active

Adjustments for var sharing mode

- Var loadshare
  - *VAR load share gain* (parameter 4543)
  - *VAR load share factor* (parameter 4547)

Voltage trim
The voltage trim is active

- Isochronous / load sharing mode
- Controls at *Voltage control setpoint* (parameter 5600)

Adjustments for the voltage trim feature

- PID voltage trimmer
  - *Voltage trim proportional gain* (parameter 5610)
  - *Voltage trim integral gain* (parameter 5611)
  - *Voltage trim derivative ratio* (parameter 5612)

MSLC-2 is providing PF reference or controlling var or PF across the utility breaker
Adjustments when in PF or var control mode

- PID var control
  - *VAR control proportional gain* (parameter 5613)
  - *VAR control integral gain* (parameter 5614)
  - *VAR control derivative ratio* (parameter 5615)

NOTE

If cross-current compensation is installed on the voltage regulator, it must be removed prior to using the var/PF mode of control or instabilities may result. The droop CTs must remain connected to their voltage regulator.

Var Control

The var control adjusts the generator voltage to maintain a constant reactive power (kvar) load on the generator throughout the kW operating range. This assures sufficient excitation of the generator field under all load conditions. A setpoint is provided to set the desired VARs. The var control function may be enabled with *VAR PF control mode* selection setpoint (parameter 7558). The setpoint can be configured via ToolKit.

NOTE

Whether var control or power factor control is enabled, internally the var setpoint for the generator is restricted from +100 % to -10 % rated reactive power. When the DSLC-2 is operating in the base load mode, process mode or with an active MSLC-2 control, it will not allow the kvar output of the generator to increase above 100 % or below -10 % of the *Generator rated reactive power* (parameter 1758).

Var Sharing

When either var or power factor control is configured and the DSLC-2 control is operating in isochronous load sharing mode, var sharing is automatically selected. Var sharing adjusts the voltage regulators so that all generators carry the same proportion of reactive load by balancing the kvar on all units. A *Voltage reference setpoint*, Menu 4 (parameter 5600) is provided to define the isolated operating voltage. The voltage trim feature is active in load sharing mode. The DSLC-2 will control the voltage as well as the var sharing.

Power Factor Control

The power factor control adjusts generator voltage to maintain a constant power angle throughout the kW operating range. A setpoint is provided to set the desired *Power factor reference* (parameter 5620). The power factor control function may be enabled with the *VAR PF control mode* selection setpoint (parameter 7558). The current power factor setting can be influenced by the “Voltage Raise” and “Voltage Lower” contacts.

When both the “Voltage Raise” and “Voltage Lower” contacts are closed, the analog reactive load input (power factor setpoint) becomes active. So the reactive load setting input, configurable in Menu 6.1, will take precedence over the internal power factor reference. The input signal is automatically converted into a power factor value between -0,710 (leading) to 1 to 0,710 (lagging).

Chapter 7.
Process Control Description

Introduction

The process control function of the DSLC-2 will control any process where the controlled parameter is determined by the generator load and the controlled parameter can be monitored as an analog input signal (process input). The control compares the input signal to the process reference or the external load reference signal if it is used and adjusts the generator load to maintain the desired setpoint.

Description

Figure 7-1 shows a block diagram of the process control function. The process control mode is selected when the "Process Control", "CB Aux" and "Load/Unload" switch contacts are closed. The process input signal is compared with the process reference, which may be either the internal *Process reference* (parameter 7737) or the analog remote process reference input (Configurable in Menu 6.1). In process control mode, the "Load Raise" and "Load Lower" contact inputs operate on the process control reference. When the internal reference is used, the "Load Raise" and "Load Lower" contacts raise and lower the process reference based on the internal *Process reference* (parameter 7737). The analog remote reference input becomes active on the process reference, when both the "Load Raise" and "Load Lower" contacts are closed.

Each time a new process control begins, the first error signal is checked. If the process error signal is higher than 5 % or lower than -5 % the generator load is guided over a ramp function to leveling the error signal. This shall be a relatively smooth process. When the error signal resides within +/-5 % the PID function becomes active. The process PID function becomes also active, if the ramp function has reached the minimum or the maximum gen load level (0 to 100 %). If the process PID is one time activated, it remains active until the process control is switched off or the CB gets open.

When the process control is enabled, the PID controller operates in cascade with the load control. The output of the controller is a generator load reference within the range 0 to 100 % rated power to prevent overload or reverse power on the generator. The load setting signal is output from the load control to the speed control to set control at the required load to maintain the desired process level. An additional feature of the process control is the adjustable process input signal filter. The adjustable *Process filter*, Menu 3 (parameter 4509) allows reducing bandwidth when controlling a noisy process such as experienced in digester gas fuel applications. The process control function is configurable for direct and inverse action. Direct process control is where the sensed input signal increases as the load increases (such as where the sensed input is exhaust pressure or export power). An inverse action control is where the sensed input signal decreases as the load increases (such as when controlling import power where the import power will decrease as the generating system picks up more of the local load).

The process error is the difference between process signal input and process reference. The controller in the DSLC-2 regulates the percentage values. For a better understanding the engineering unit can be displayed according to the percentage value. Therefore the scaling of the percentage value is to make with according engineering units (parameter 7732, parameter 7733 and parameter 7734). The units are then displayed in fields parameter 7726 and parameter 7727 in Menu 6.1 or the Homepage.

The *Process signal input* (parameter 10151) and the *Remote reference input* (parameter 10117) is displayed in Menu 6.1 in %.

The resulting *Process reference* (parameter 4605) and the resulting *Process signal input* (parameter 4600) is displayed in the Homepage in %.

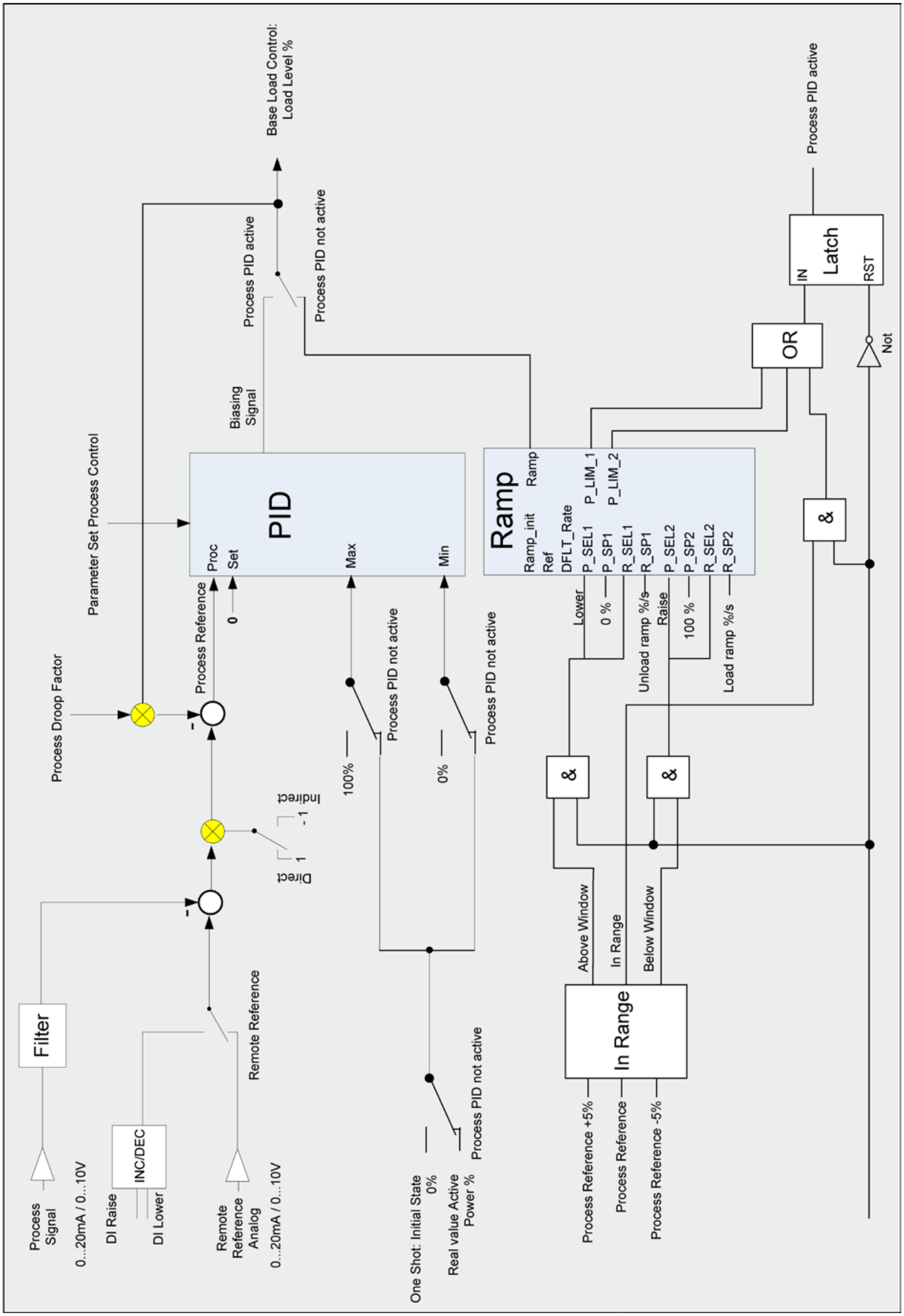


Figure 7-1: Diagram process control

Chapter 8.
Network / System Description

Introduction

The new DSLC-2 / MSLC-2 system provides within one network following features:

- The maximum number of DSLC-2s (Generator) can go up to 32.
- The maximum number of MSLC-2s (Utility- or Tie-breaker) can go up to 16.
- The maximum number of segments is 8.

The DSLC-2 still cares about the generator breaker and the MSLC-2 cares about utility breaker or a tie-breaker. The DSLC-2 and MSLC-2 can reside at different segments. A segment is defined as the smallest undividable bar in a system. Segment connectors inform the DSLC-2s and MSLC-2s which generators and utilities are connected. Through the segmenting the DSLC-2 / MSLC-2 can recognize all the time with which other units they are interconnected. So the DSLC-2s in the same segment are load share together or doing an independent load control.

The MSLC-2s can be configured to utility breaker mode or to tie-breaker mode. In each case it is only allowed to have one MSLC-2 in one segment running as master control. A MSLC-2 gets a master control when base load control, export/import control or process control is activated. If multiple MSLC-2s are in the same segment, the control with the lowest device number will be master.

Description

Beside the upper described restrictions there are existing additional rules for the successful operation of the DSLC-2 / MSLC-2 system. Please read this rules and compare it with your planned application.

- The segment numbers have to follow a line, which can finally be closed to a ring. A segment branch is not allowed.
- There can be placed several MSLC-2 in one segment, but only one MSLC-2 can run as Master control.
- The generator is not counted as a segment.
- The utility is not counted as a segment.

At next will be shown some examples of applications for a better understanding the philosophy of the segmenting.

Applications Without Segmenting

In some applications there is no segmenting to make because the common busbar of DSLC-2 and MSLC-2 cannot be separated. In this case in Menu 5, *Basic segment number* (parameter 4544) is configured to 1 at each unit. The *Device number* (parameter 1702) needs still to be different because it determines the network addressing. See Figure 8-1 and Figure 8-2 for examples which need no segmenting.

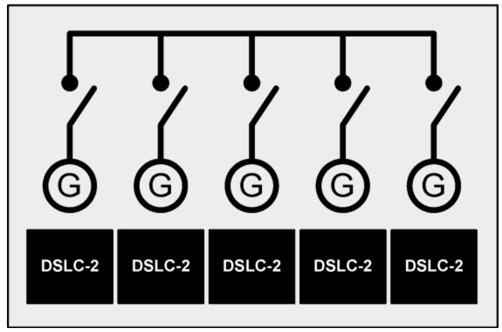


Figure 8-1: Multiple generators in isolated operation without tie-breakers

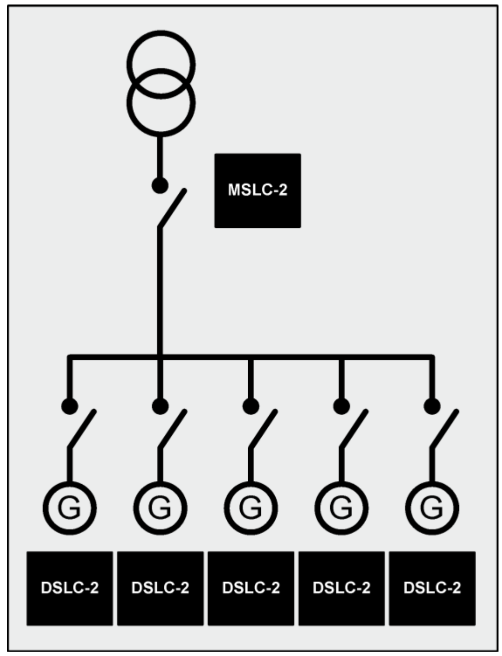


Figure 8-2: Multiple generators in isolated / parallel to utility operation without tie-breakers

Applications With Segmenting

The segmenting is to make in each application where the common busbar can be separated into two or more segments. The segment numbers have to follow a line and shall not branch. The information which segments are connected coming by discrete inputs terminals 141 to 148. All DSLC-2 and MSLC-2 have the same discrete inputs to control the segmenting. The 8 segment connection feedbacks are over-all the same and are logically ORed to each other. The information is exchanged over network. In all these cases in Menu 5, *Basic segment number* (parameter 4544) of each unit is configured according to the location of the unit. The rules for setting up the segment numbers are shown in chapter "Prestart Setup Procedure" on page 117.

At next are shown some examples which are covered by the DSLC-2 / MSLC-2 system.

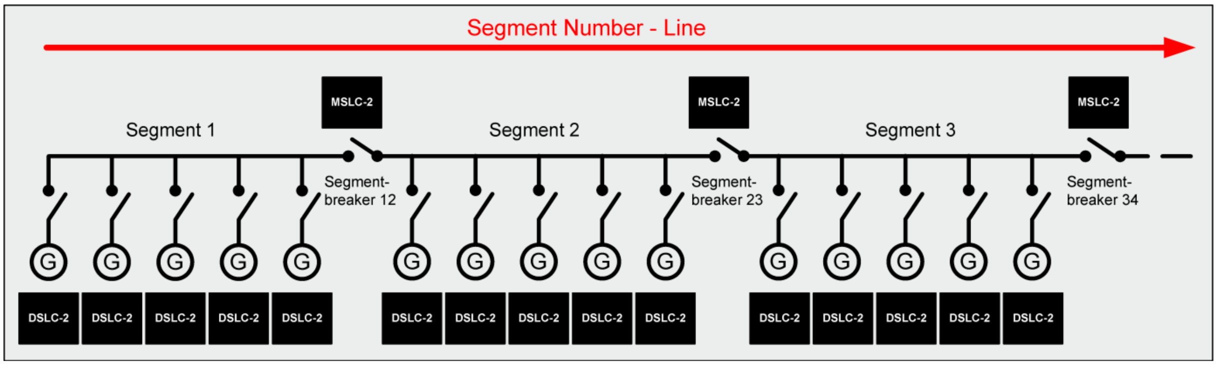


Figure 8-3: Isolated operation with multiple generator and tie-breaker

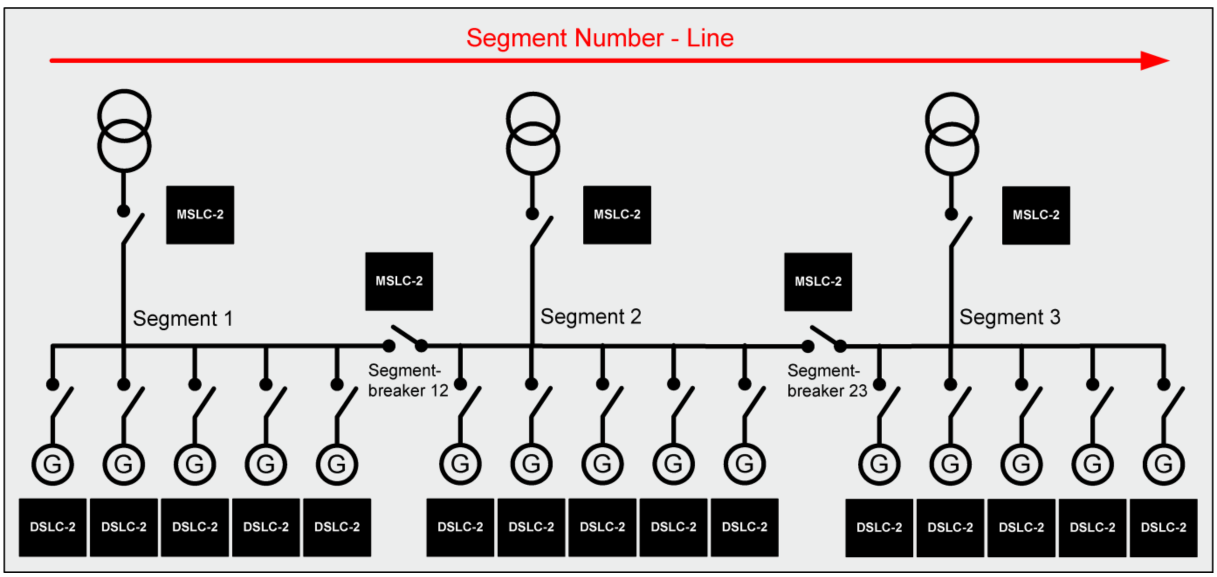


Figure 8-4: Isolated / utility parallel operation with multiple generator and tie-breaker

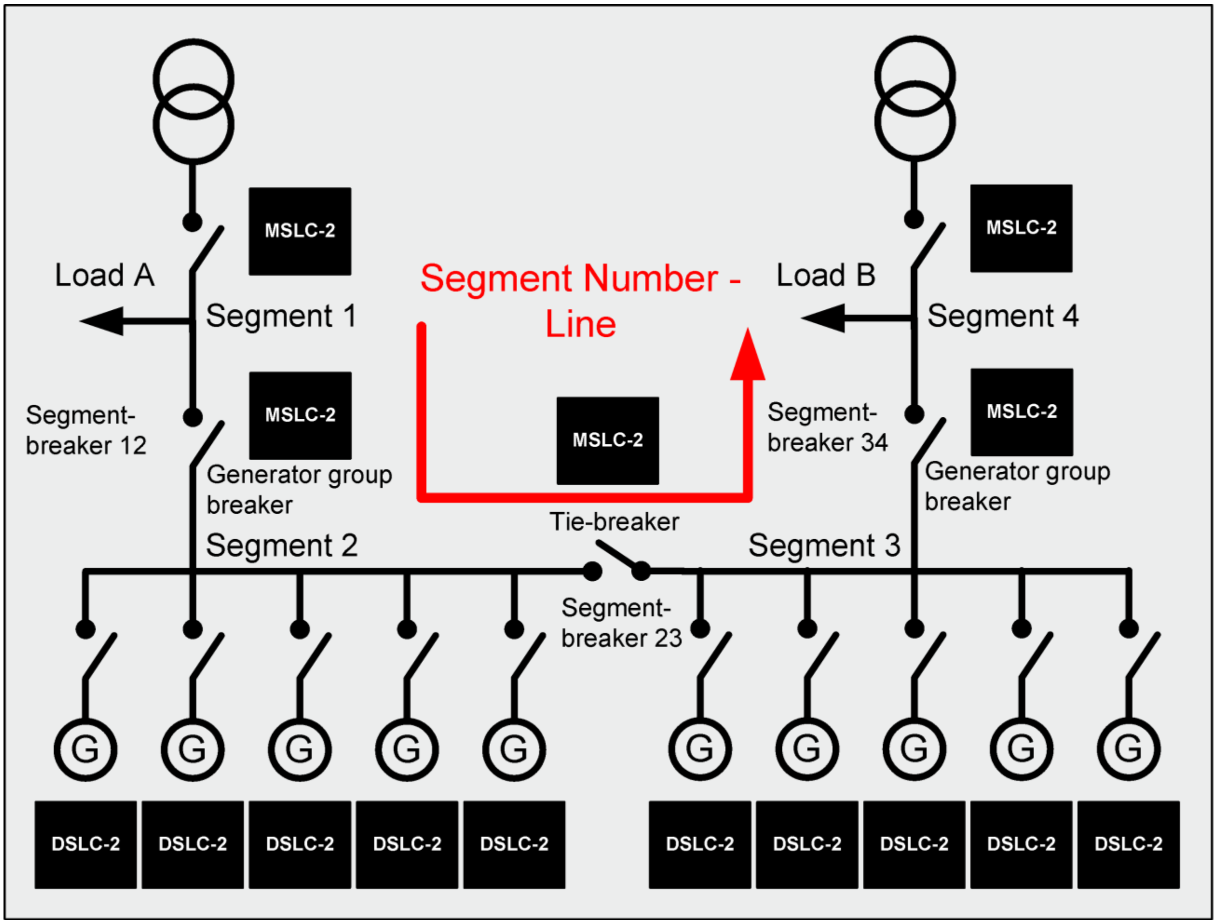


Figure 8-5: Isolated / utility parallel operation with multiple generator, tie-breaker and generator group breaker

Figure 8-5 shows an application with 2 utility feeder breaker, 2 load segments and 2 generator group breaker. The segment line begins at the left side with the load A segment (segment no.1) and ends with the load B segment (segment no.4) at the right side.

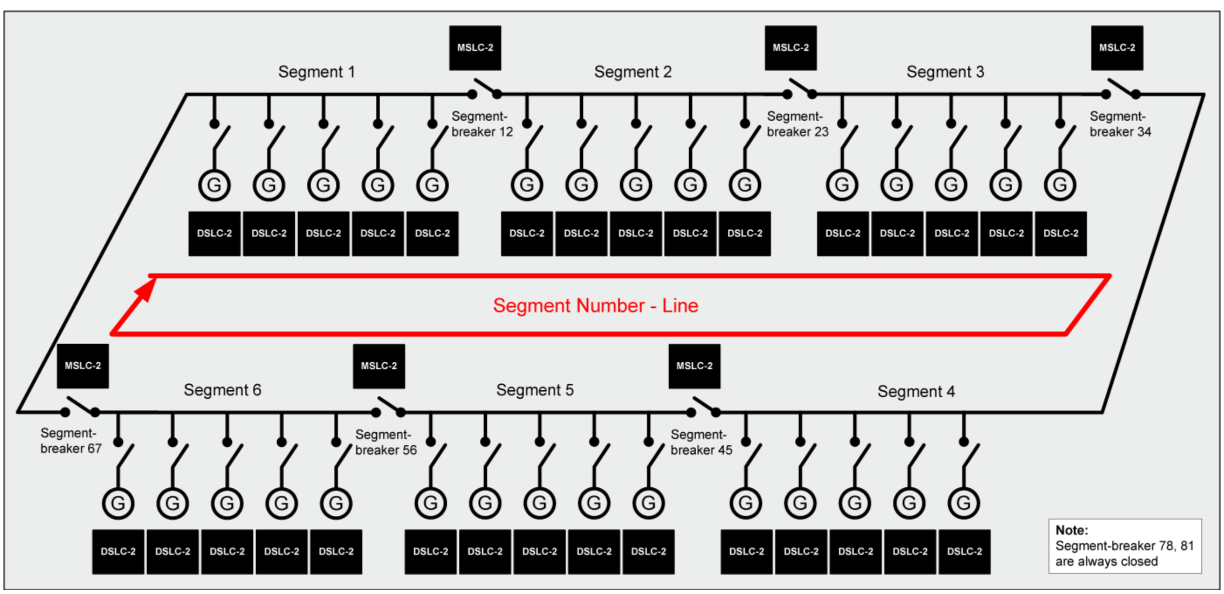


Figure 8-6: Isolated operation with multiple generator and tie-breaker (ring option)

Figure 8-6 shows an application with multiple generators connectable to a ring with tie-breaker. However segments are in use, the last not used segment connectors are be bridged as closed at one of the units.

Not Supported Applications

A main rule in the segmenting is that segment numbers have to follow a line without branches. At next are shown some application examples which are not covered by the DSLC-2 / MSLC-2 system. The application in Figure 8-7 and Figure 8-8 shows how the segment number line can branch. Another indication is the need for a segment breaker between segment 3 and 5, which does not exists.

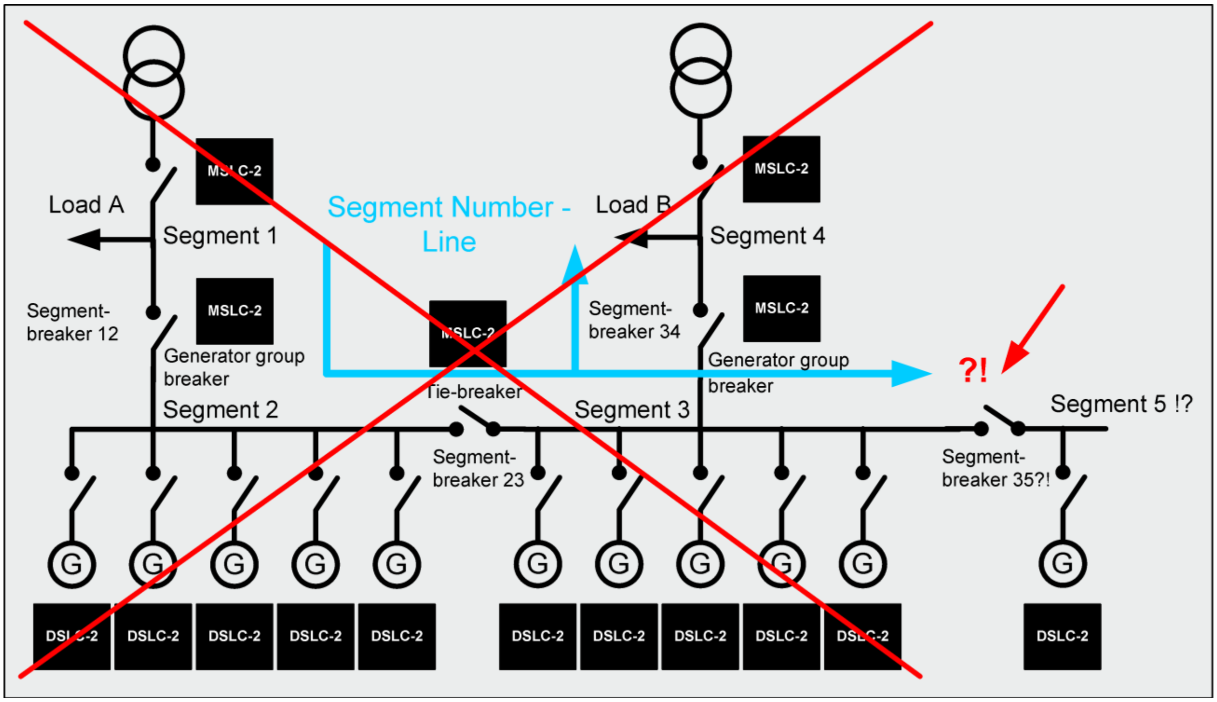


Figure 8-7: Not supported application

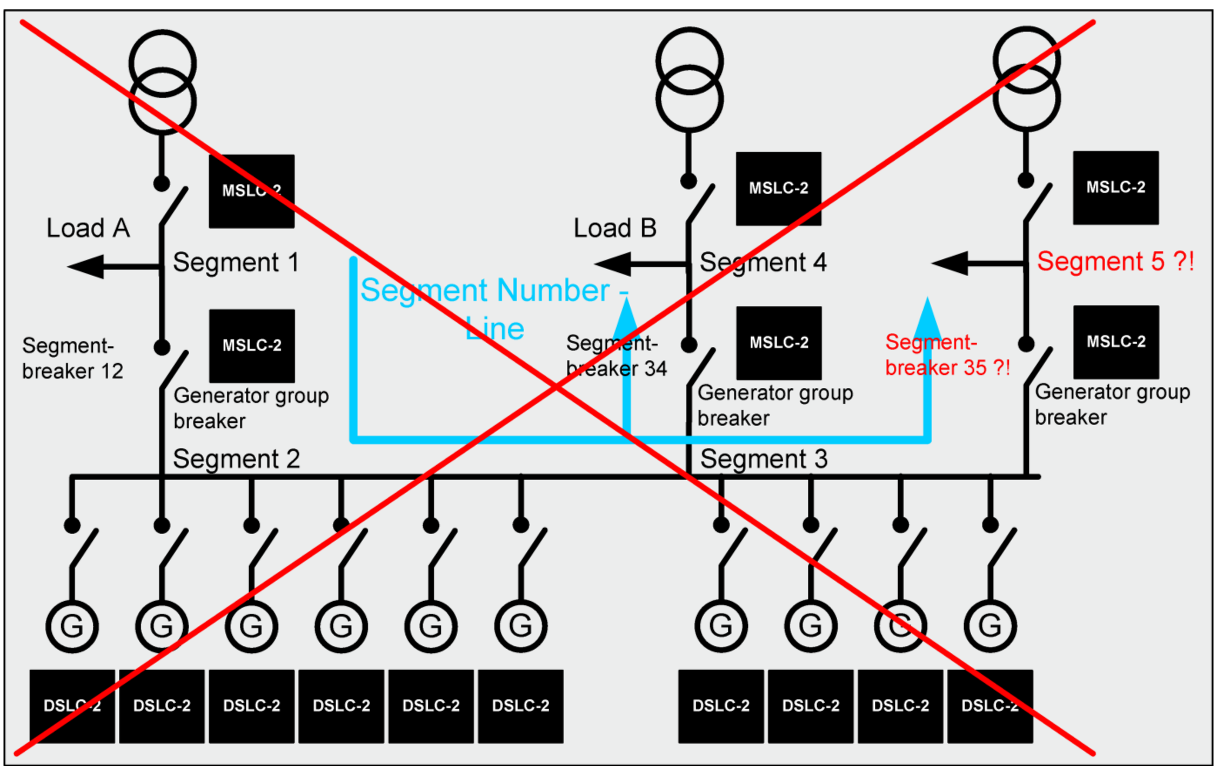


Figure 8-8: Not supported application

Remote Control By PLC

The DSLC-2 / MSLC-2 system offers two channels of Ethernet and one channel serial interface RS-485. Ethernet channel A is the dedicated communication bus for the Woodward own UDP message system, which is used to exchange information between all units in the network. In Menu 5.1 the "Network A –UDP TCP/IP address" (parameter 5330) has to be configured for. Each unit gets its own address usually related to the own *Device number* (parameter 1702).

Ethernet channel B can be used for visualization and remote control of all units. The protocol here used is Modbus/TCP. In Menu 5.1 the "Network B – Modbus TCP/IP address" (parameter 5430) has to be configured for. Each unit gets its own address usually related to the own *Device number* (parameter 1702).

Additionally the unit offers a serial RS-485 connection for visualization and remote control. The visualization can be done simultaneously by Ethernet and RS-485. In Menu 5.1 the "Modbus Serial Interface 2 Modbus slave ID" (parameter 3188) has to be configured for. Each unit gets its own slave ID usually related to the own *Device number* (parameter 1702).

The remote control has to be configured for either RS-485 or Ethernet. Furthermore the DSLC-2 / MSLC-2 allows distribute functions to discrete inputs and to protocol bits.

Interface Connection Via RS-485 With Modbus Protocol

The DSLC-2 / MSLC-2 system provides a RS-485 Modbus connection. Each unit gets an own Modbus slave address. The DSLC-2 as the MSLC-2 allows to configure each parameter or to inform about each measurement value and binary information. For visualization the unit offers a special mapped Modbus table with all important values refer to "Data Protocol 5200" on page 206.

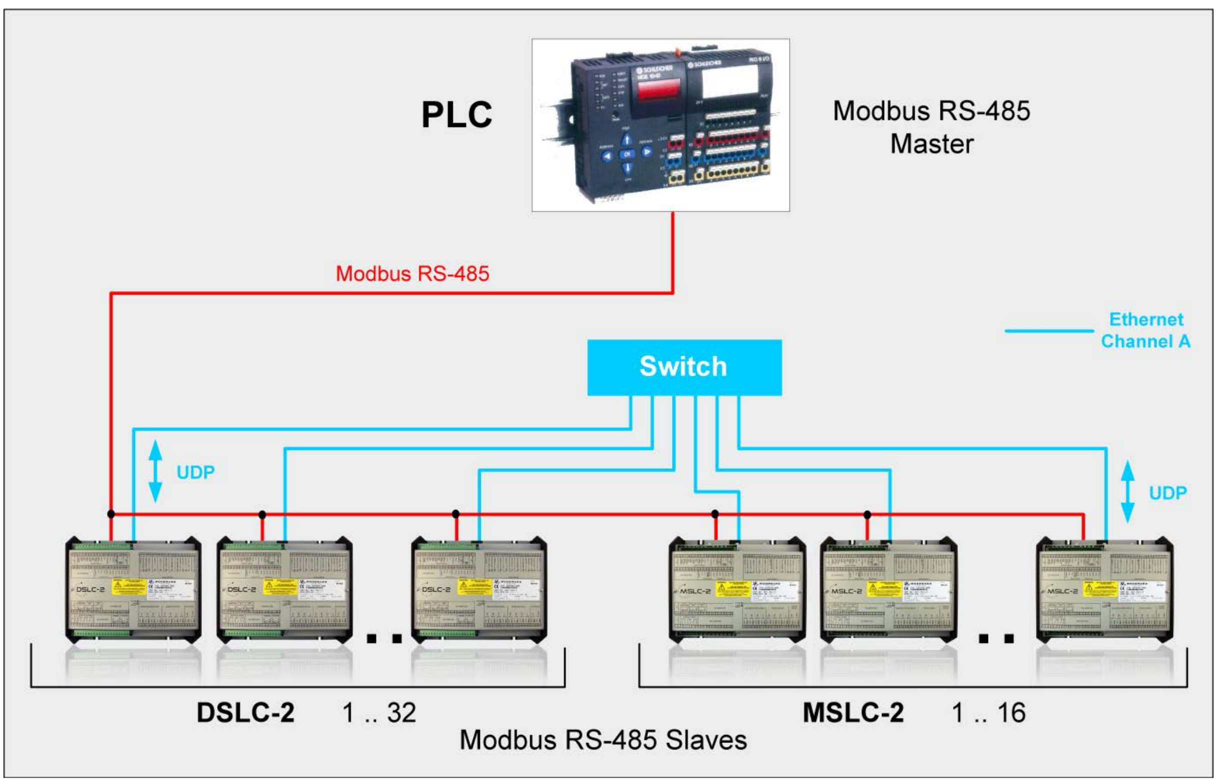


Figure 8-9: Visualization and remote control by PLC via RS-485 interface

Interface Connection Via Ethernet By Modbus/TCP Stack

The DSLC-2 / MSLC-2 system provides the Ethernet channel B for Modbus/TCP connection. Each unit gets an own Modbus slave address. The DSLC-2 as the MSLC-2 allows to configure each parameter or to inform about each measure.

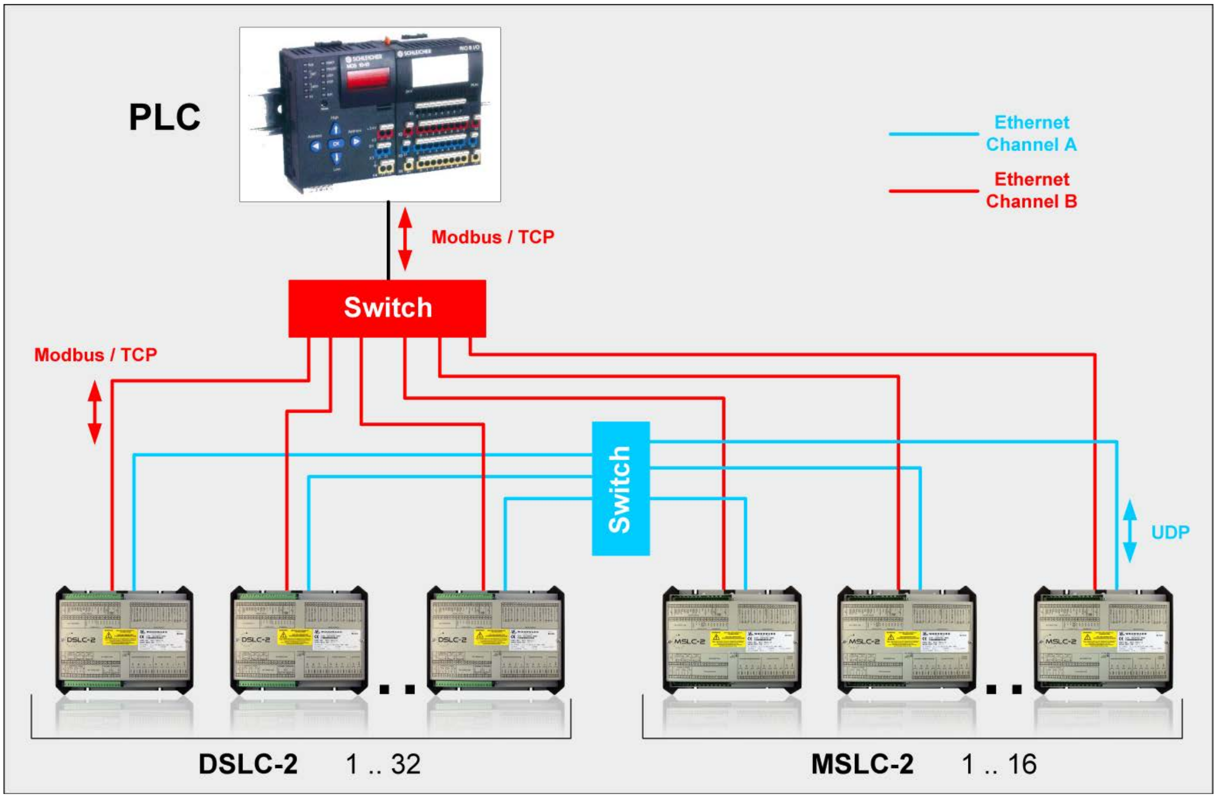


Figure 8-10: Visualization and remote control by PLC via Ethernet Modbus/TCP interface

Chapter 9.
Diagrams

Diagram Frequency / Active Power Controller

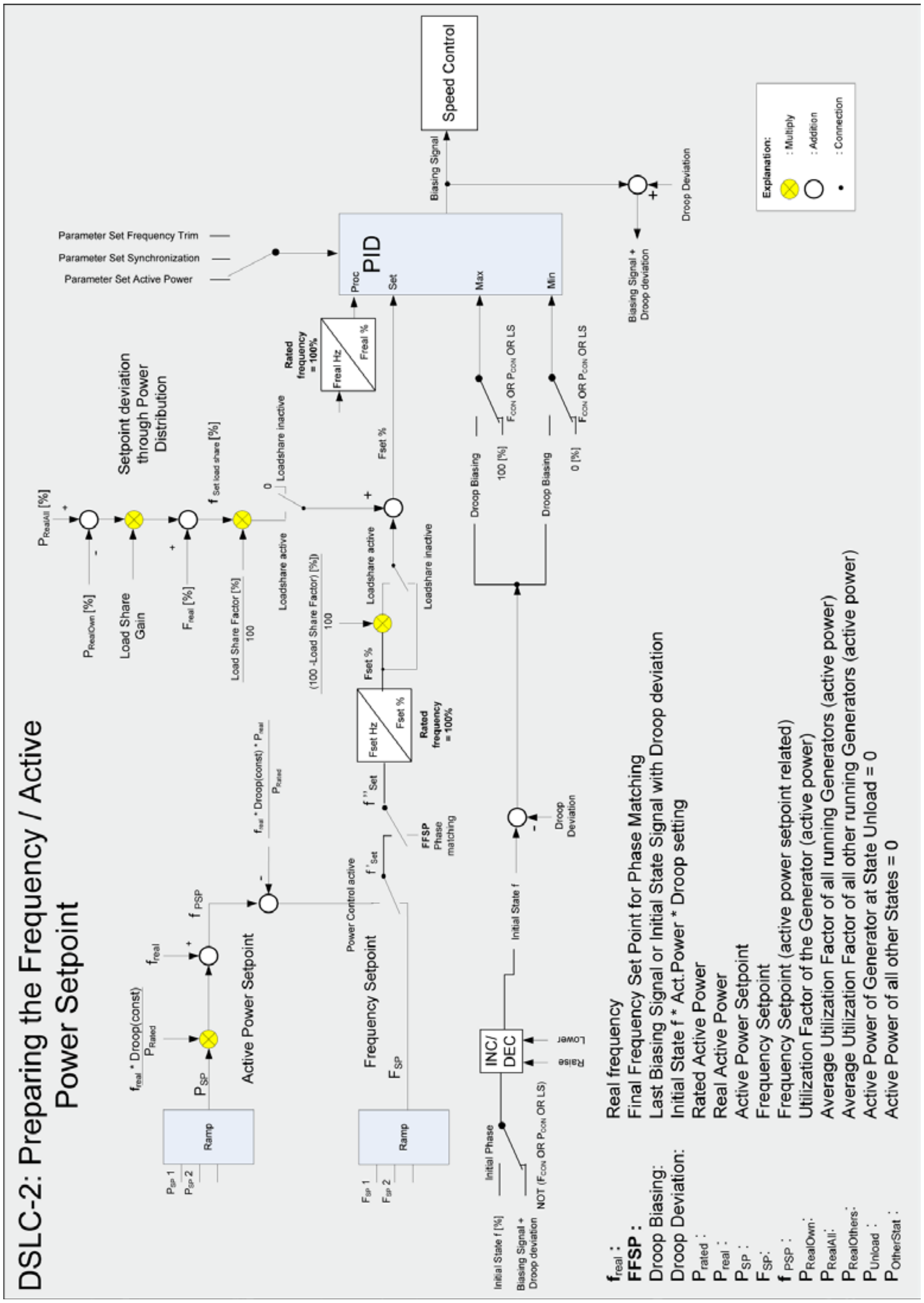


Figure 9-1: Diagram frequency / active power controller

Diagram Voltage / Reactive Power Controller

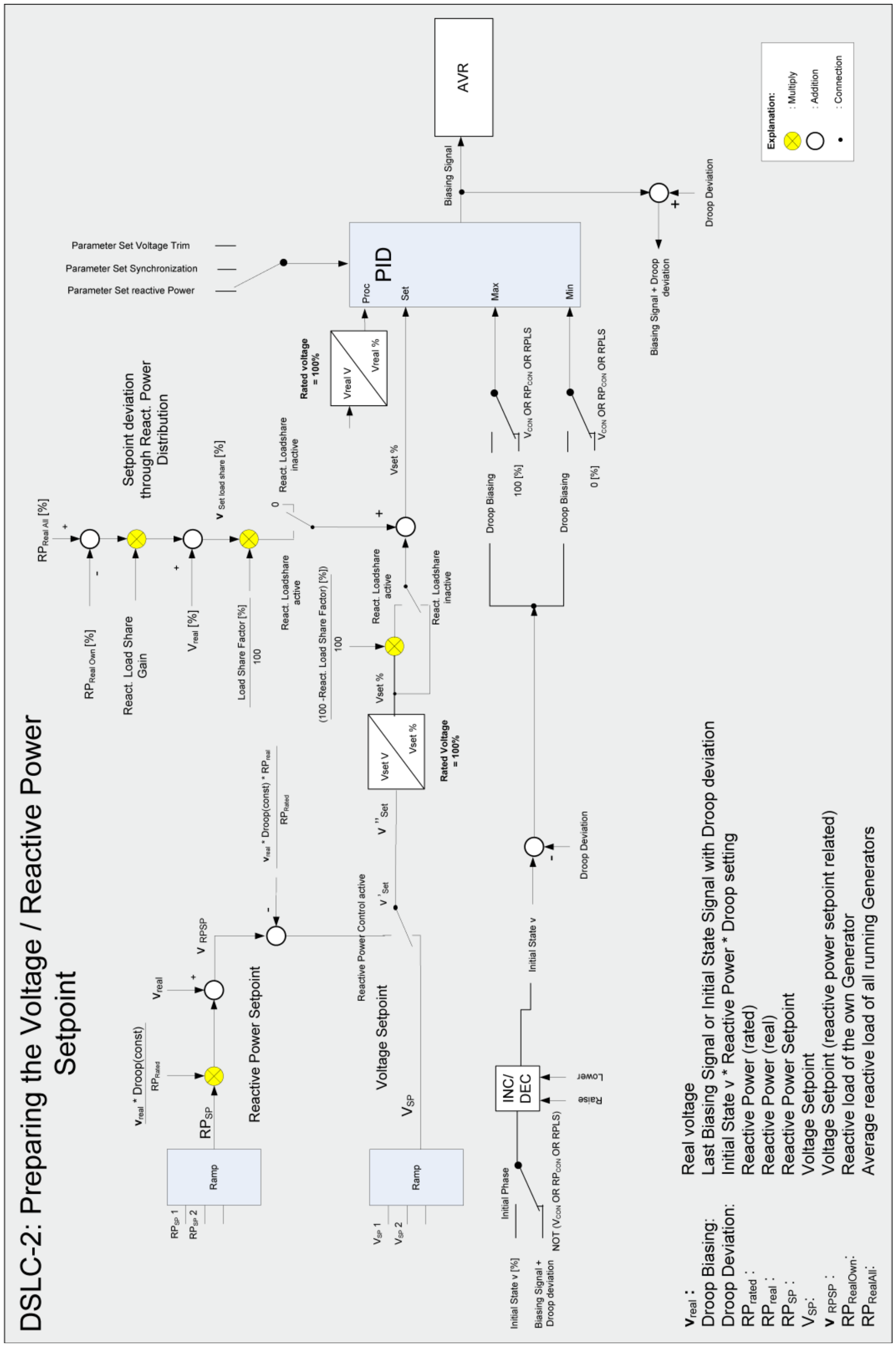


Figure 9-2: Diagram voltage / reactive power controller

Chapter 10. Interface

Interface Overview

The device has several communication interfaces which are described below.

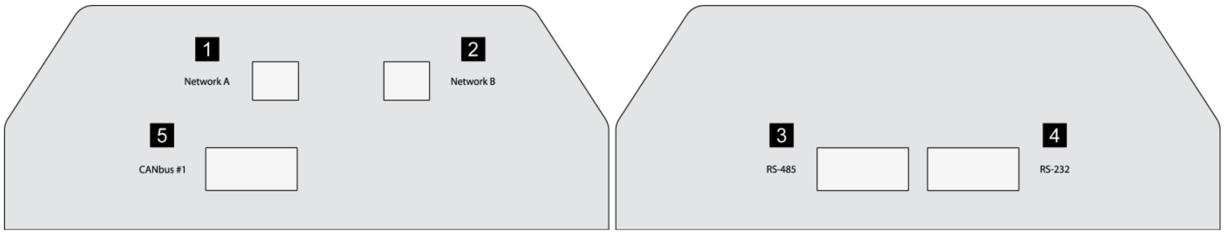


Figure 10-1: DSLC-2 - interface overview (housing - side view)

Number	Labeled	Protocol
1	Network A	UDP
2	Network B	TCP/IP
3	RS-485	Modbus (Protocol 5200)
4	RS-232	ToolKit (ServLink) Modbus (Protocol 5200)
5	CANbus #1	For internal use only

Table 10-1: DSLC-2 - Interfaces - overview

RS-232 Serial Interface (Interface #1)

A freely configurable RS-232 interface is provided to serve as a local service interface for configuring the unit and visualize measured data. It is possible to connect a modem for remote control and alarm signaling. The serial interface 1 provides a ServLink as well as a Modbus protocol.

RS-485 Serial Interface (Interface #2)

A freely configurable RS-485 Modbus RTU Slave interface is provided to add PLC connectivity. It is also possible to configure the unit, visualize measured data and alarm messages and control the unit remotely.

RJ-45 Ethernet Interfaces (Network A, Network B)

Standard Ethernet ports for device interconnection (Network A – UDP Protocol) and PLC connection (Network B – TCP/IP Protocol).

Ethernet Load Sharing

==========================

Multi-Master Principle

It is important to know that the load share and load-dependent start/stop functionality is subject to a multi-master principle. This means that there is no dedicated master and slave function. Each DSLC-2 decides for itself how it has to behave. The benefit is that there is no master control, which may cause a complete loss of this functionality in case it fails. Each control is also responsible for controlling common breakers like a mains circuit or generator group breaker.

Load Share Monitoring

The DSLC-2 provides the following monitoring function for load sharing:

Multi-Unit Missing Members

The multi-unit missing members monitoring function checks whether all participating units are available (sending data on the Ethernet line).

Switches

Please use a 10/100 Mit/s Ethernet switch if more then two devices should be connected.

General Load Share Information

The maximum number of participating DSLC-2 devices for load sharing is 32. The maximum number of MSLC-2 devices is 16.

The following parameters affect the bus load:

- Baud rate
- Transfer rate of load share messages
- Visualization

Modbus Communications

General Information

Modbus is a serial communications protocol published by Modicon in 1979 for use with its programmable logic controllers (PLCs). It has become a de facto standard communications protocol in industry and is now the most commonly available means of connecting industrial electronic devices. The DSLC-2 / MSLC-2 supports a Modbus RTU Slave module. This means that a Master node needs to poll the slave node. Modbus RTU can also be multi-dropped or in other words, multiple Slave devices can exist on one Modbus RTU network, assuming that the serial interface is a RS-485. Detailed Information about the Modbus protocol are available on the following website:
http://www.modbus.org/specs.php

There are also various tools available on the internet. We recommend to use ModScan32 which is a Windows application designed to operate as a Modbus Master device for accessing data points in a connected Modbus Slave device. It is designed primarily as a testing device for verification of correct protocol operation in new or existing systems. It is possible to download a trial version from the following website:
http://www.win-tech.com/html/modscan32.htm

Address Range

The DSLC-2 / MSLC-2 Modbus Slave module distinguishes between visualization data and configuration & remote control data. The different data is accessible over a split address range and can be read via the "Read Holding Register" function. Furthermore, the parameters and remote control data can be written with the "Preset Single Registers" function or "Preset Multiple Registers" (refer to Table 10-2).

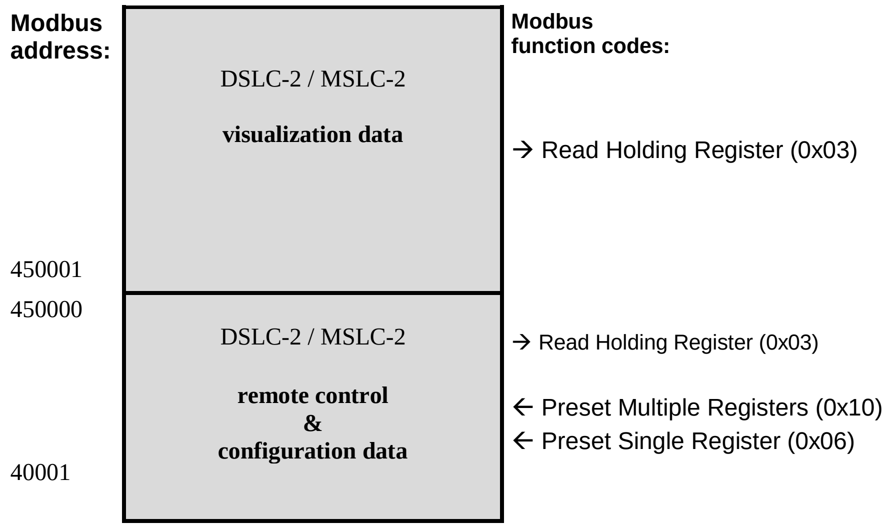


Table 10-2: Modbus - address range

NOTE

All addresses in this document comply with the Modicon address convention. Some PLCs or PC programs use different address conventions depending on their implementation. Then the address must be increased and the leading 4 may be omitted.

Please refer to your PLC or program manual for more information. This determines the address sent over the bus in the Modbus telegram. The Modbus starting address 450001 of the visualization data may become bus address 50000 for example.

Visualization

The visualization over Modbus is provided in a very fast data protocol where important system data like alarm states, AC measurement data, switch states and various other information may be polled. According to the DSLC-2 / MSCL-2 Modbus addressing range, the visualization protocol can be reached on addresses starting at 450001. On this address range it is possible to do block reads from 1 up to 128 Modbus registers at a time.

Modbus Read Addresses	Description	Multiplier	Units
450001	Protocol-ID, always 5200		--
450002	Scaling power		--
....	....	.....	.....
....	....	.....	.....
....	....	.....	.....
....	....	.....	.....
450171	Remote load reference input	0.1	kW

Table 10-3: Modbus - address range block read

NOTE

Table 10-3 is only an excerpt of the data protocol. It conforms to the data protocol 5200 that is also used by Ethernet. Refer to “Data Protocol 5200“ on page 206 for the complete protocol.

The following ModScan32 screenshot shows the configurations made to read the visualization protocol with a block read of 128 registers.

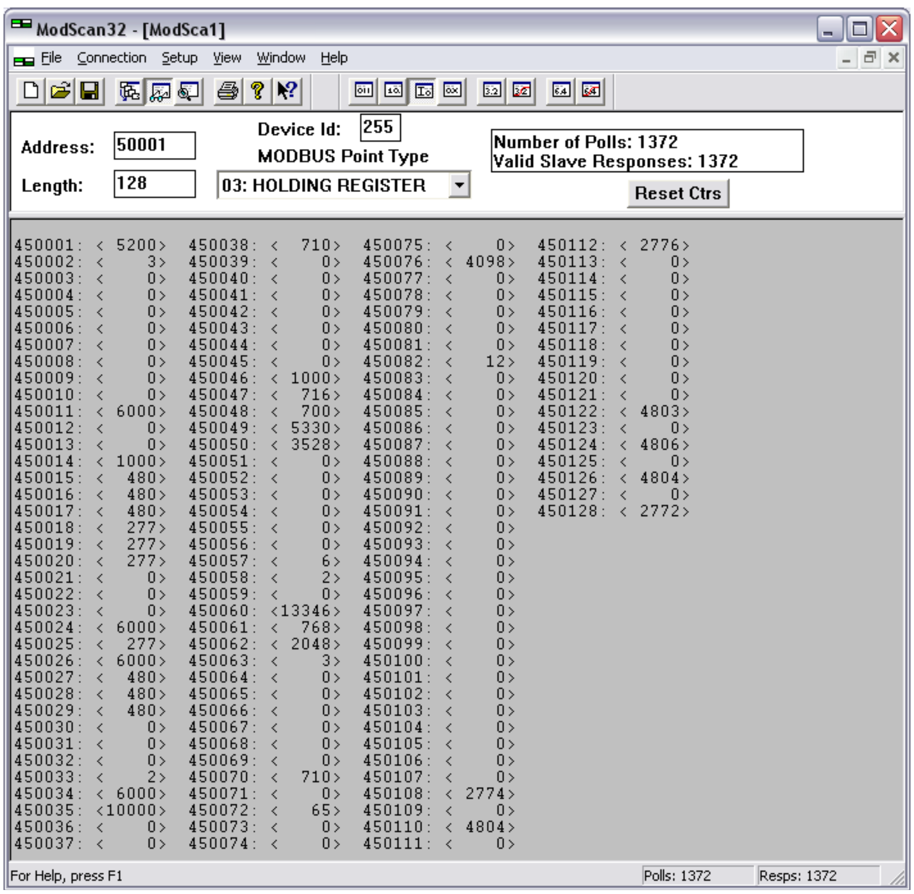


Figure 10-2: Modbus - visualization configurations

Configuration

The Modbus interface can be used to read/write parameters of the DSLC-2 / MSLC-2. According to the DSLC-2 / MSLC-2 Modbus addressing range for the configuration addresses, the range starts at 40001 and ends at 450000. You can always access only one parameter of the system in this address range. The Modbus address can be calculated depending on the parameter ID as illustrated below:

	Parameter ID < 10000	Parameter ID >= 10000
Modbus address =	40000 + (Par. ID+1)	400000 + (Par. ID+1)

Table 10-4: Modbus - address calculation

Block reads in this address range depend on the data type of the parameter. This makes it important to set the correct length in Modbus registers which depends on the data type (UNSIGNED 8, INTEGER 16, etc.). Refer to Table 10-5 for more information.

Device types	Modbus registers
UNSIGNED 8	1
UNSIGNED 16	1
INTEGER 16	1
UNSIGNED 32	2
INTEGER 32	2
LOGMAN	7
TEXT/X	X/2

Table 10-5: Modbus - data types

DSLC-2 Interface Remote Control

For a remote setting of the control setpoints, it is necessary to use the interface setpoints instead of the internal setpoints. No password is required to write this value. All other setpoint sources are configured accordingly. Control orders can be sent via Ethernet (Modbus/TCP) or RS-485 Modbus RTU.

Sending Setpoints Over Interface

Some setpoints can be sent over the communication interface.

ID	Parameter	CL	Setting range	Default	Description
7642	**Active power setpoint for baseload control**	-	1 kW to 999999,9 kW	-	Setpoint for the active power control. The setpoint is a long integer 32 to provide a wide range from 1 kW to 999999,9 kW. Negative values are not allowed. **Example:** 1000 kW = 1000 = 3E8Hex ***Note:*** *This setpoint will be only accepted when the parameter* Load control setpoint source *(parameter 7634) ist configured to "Interface".*
7640	**Setpoint power factor control**	-	-710 to 1000 to 710	-	The power factor is set as a value (integer 16) between -710 to 1000 to 710. A negative value is capacitive, a positive value is inductive, 1000 = cosφ 1. Other values are not accepted by the unit. **Example:** cos φ = c0.71 cap. -710 FD3AHex cos φ = 1.00 1000 03E8Hex cos φ = i 0.71 ind. 710 02C6Hex ***Note:*** *This setpoint will be only accepted when the parameter* VAR control setpoint source *(parameter 7635) ist configured to "Interface".*

Table 10-6: Modbus – sending setpoint sover interface

Sending Binary Digital Orders Over Interface

Some single functions can be passed over from discrete inputs to the communication interface.

Function	Terminal	Controllable by
Check	67	Discrete input or communication interface
Permissive	68	Discrete input or communication interface
Run	69	Discrete input or communication interface
CB Aux	70	Discrete input
Voltage Raise	71	Discrete input or communication interface
Voltage Lower	72	Discrete input or communication interface
Base Load	73	Discrete input or communication interface
Load / Unload	74	Discrete input or communication interface
Ramp Pause	75	Discrete input or communication interface
Load Raise	76	Discrete input or communication interface
Load Lower	77	Discrete input or communication interface
Process Control	78	Discrete input or communication interface
Segment Connection 12 Act.	141	Discrete input
Segment Connection 23 Act.	142	Discrete input
Segment Connection 34 Act.	143	Discrete input
Segment Connection 45 Act.	144	Discrete input
Segment Connection 56 Act.	145	Discrete input
Segment Connection 67 Act.	146	Discrete input
Segment Connection 78 Act.	147	Discrete input
Segment Connection 81 Act.	148	Discrete input
Droop Tracking	149	Discrete input or communication interface

Table 10-7: Modbus – sending binary digital orders over interface

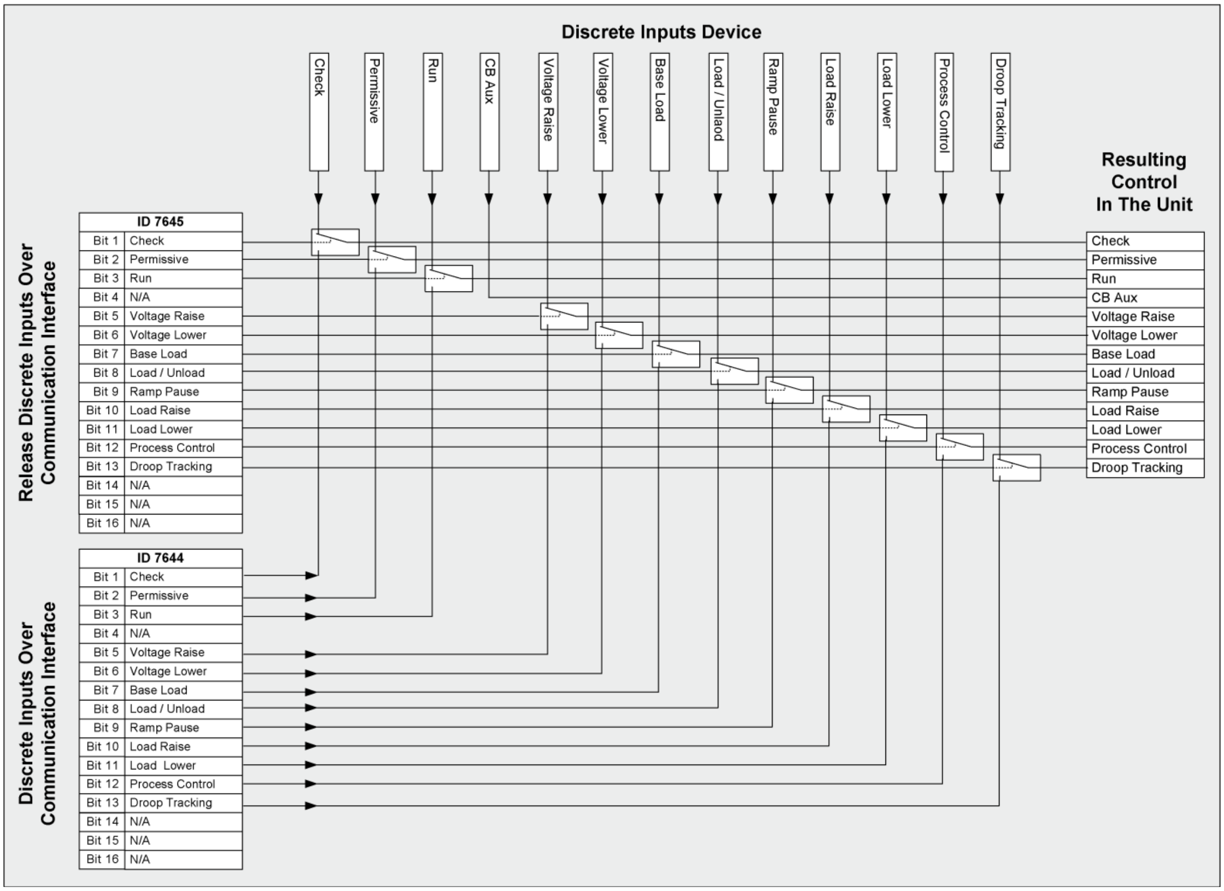


Figure 10-3: Modbus - sending binary digital orders over interface

ID	Parameter	CL	Setting range	Default	Description
7645	**Release discrete inputs over communication interface**	-	-	-	These single bits control if a function shall be switched by discrete input or communication interface. Bit 01 = 1 Check Bit 02 = 1 Permissive Bit 03 = 1 Run Bit 04 = 1 N/A Bit 05 = 1 Voltage Raise Bit 06 = 1 Voltage Lower Bit 07 = 1 Base Load Bit 08 = 1 Load / Unload Bit 09 = 1 Ramp Pause Bit 10 = 1 Load Raise Bit 11 = 1 Load Lower Bit 12 = 1 Process Bit 13 = 1 Droop Tracking Bit 14 = 1 N/A Bit 15 = 1 N/A Bit 16 = 1 N/A ***Note:*** *Bit {x} = 0 -> DI interface = hardware controlled* *Bit {x} = 1 -> DI interface = interface controlled*

ID	Parameter	CL	Setting range	Default	Description
7644	**Discrete inputs over communication interface**	-	-	-	These single bits switch the single functions if they are released by parameter ID 7645. Bit 01 = 1 Check Bit 02 = 1 Permissive Bit 03 = 1 Run Bit 04 = 1 N/A Bit 05 = 1 Voltage Raise Bit 06 = 1 Voltage Lower Bit 07 = 1 Base Load Bit 08 = 1 Load / Unload Bit 09 = 1 Ramp Pause Bit 10 = 1 Load Raise Bit 11 = 1 Load Lower Bit 12 = 1 Process Bit 13 = 1 Droop Tracking Bit 14 = 1 N/A Bit 15 = 1 N/A Bit 16 = 1 N/A ***Note:*** *Bit {x} = 0 -> DI interface = switched "Off"* *Bit {x} = 1 -> DI interface = switched "On"*

Table 10-8: Modbus – sending binary digital orders over interface

Loss Of Connection

The device sends Modbus binary digital orders via interface. The function *Release discrete inputs over communication interface* (parameter 7645) takes care if the DI interfaces are "Hardware" or "Interface" controlled. The parameter *Discrete inputs over communication interface* (parameter 7644) switches the DI interfaces to "On" or "Off". In case of a connection loss (RS-485, RS-232 or Network B) the device can be controlled via "Hardware" control and overrides the original setting of parameter 7645. The following paragraph describes the function in detail.

Interface Control Fails

1. Interface connection loss (RS-485, RS-232 or Network B).
2. The conditions of the discrete inputs (DI) will remain in their current settings, even in the case of interface connection loss.
3. Please configure the discrete inputs via hardware switches to the desired settings.
4. To regain system control, please energize DI 22 "Modbus Reset" via hardware switch (overrides the original settings of parameter 7645; the control bits will reset to value "0").
5. Now all discrete inputs are "Hardware" controlled.

Switch Back To Interface Control

1. The discrete inputs (DI) are currently "Hardware" controlled.
2. The interface connection is working again.
3. Please de-energize DI 22 "Modbus Reset" via hardware switch to be able to configure parameter 7645 to "Interface" control.
4. The settings of parameter 7644 remain in their last configuration if there was no interrupt of the power supply. We highly recommend to doublecheck the settings. Please check the conditions of the DIs in Menu 9 (Notification: DI = "Hardware" controlled; Notification: Com = "Interface" controlled).
5. Now you must configure the discrete inputs in parameter 7645 to "Interface" control.
6. Now the discrete inputs are again "Interface" controlled.

NOTE

The DI´s „CB Aux“ and „Modbus Reset“ are in general hardware controlled and cannot be changed via interface.

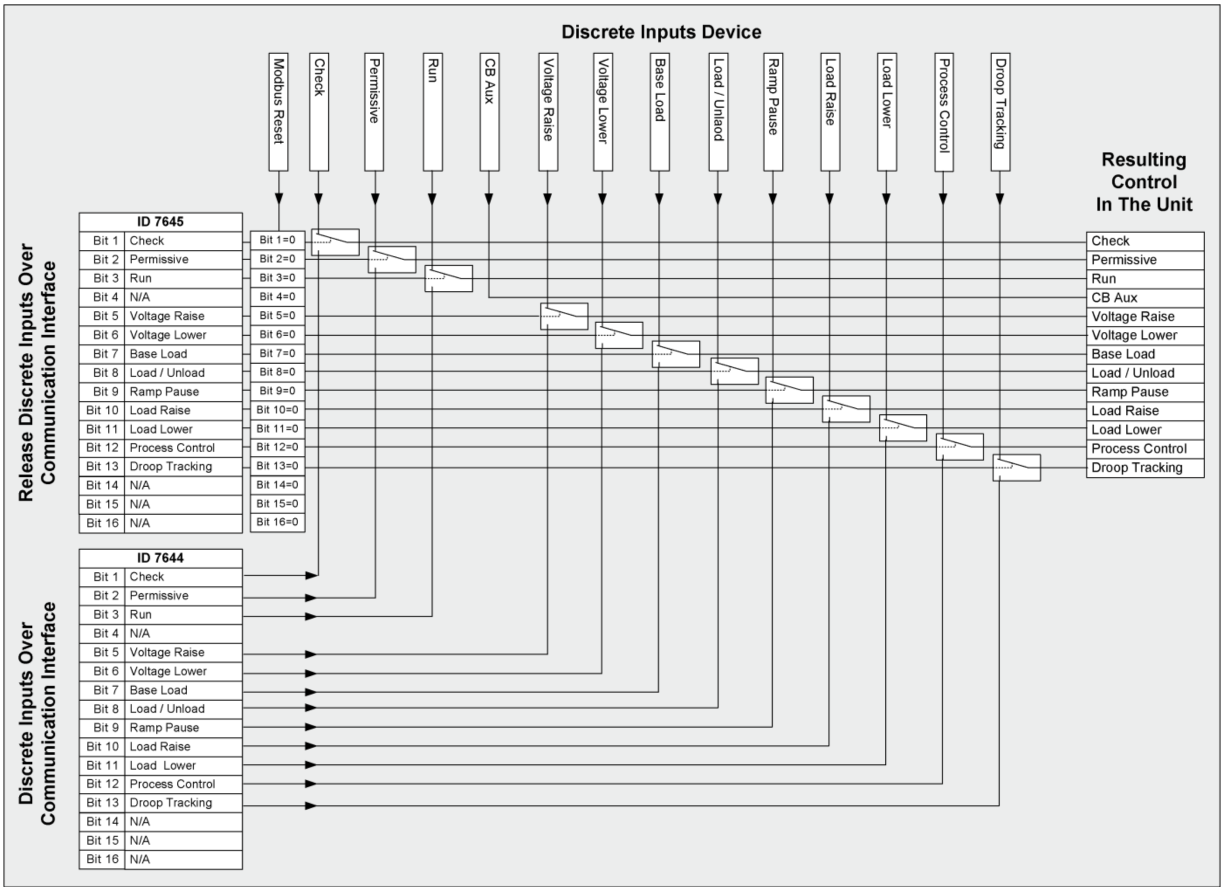


Figure 10-4: Modbus – loss of connection

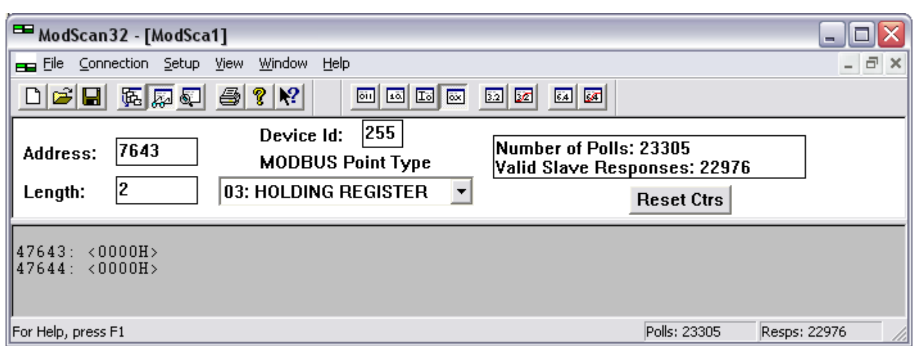
Example 1: Active Power Interface Setpoint Baseload

The setpoint for active power control is a long integer to provide a wide range from 1 to 999999.9 kW. Negative values are not allowed. This setpoint will be accepted, if the power setpoint manager of the unit passes the set-point through.

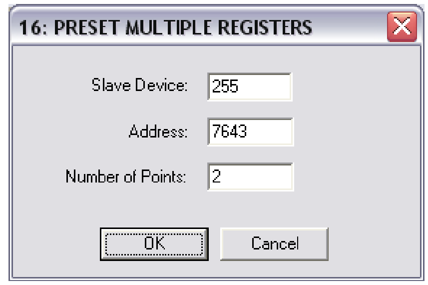
The active power setpoint value must be written to parameter 7642.

Example:
A power value of 500 kW = 500 (dec) = 01F4 (hex) is to be transmitted.
Modbus address = 40000 + (Par. ID + 1) = 407642.
Modbus length = 2 (INTEGER 32).
The high word is to be written to the lower address and the low word is to be written to the higher address.

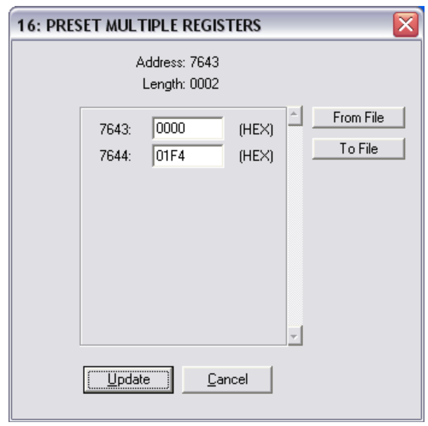
The following ModScan32 screenshots show how to set the parameter address 7642 in ModScan32.



Open the preset multiple registers window by selecting Setup > Extended > Preset Regs from the menu.



Select OK and enter the desired values.



Select Update to take over the entered values.

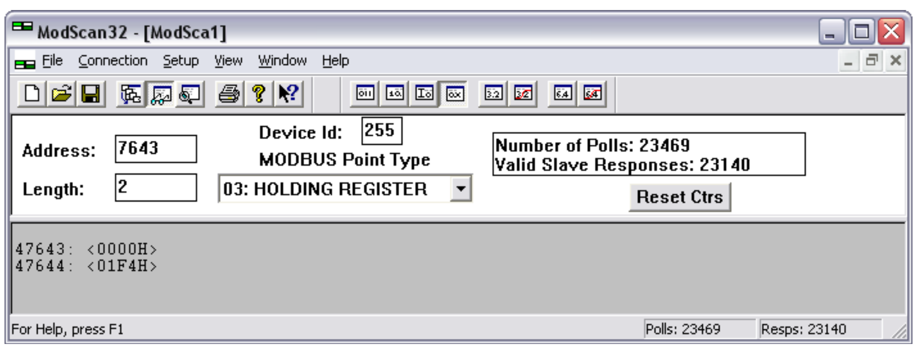


Figure 10-5: Modbus - configuration example 1 - active power

Example 2: Power Factor Interface Setpoint

The setpoint for the power factor control is set as a value between -710 to -999, 1000, 999 to 710. A negative value is capacitive, a positive value is inductive, 1000 = cosphi 1. Other values are not accepted by the unit. This setpoint will be accepted, if the power factor setpoint is selected via ToolKit.

The power factor setpoint value must be written to parameter 7640.

Example:
A power factor of 1 = 1000 (dec) = 03E8 (hex) is to be transmitted.
Modbus address = 40000 + (Par. ID + 1) = 40509.
Modbus length = 1 (UNSIGNED 16).

The following Modscan32 screenshot shows the settings made to parameter address 7640 in ModScan32.

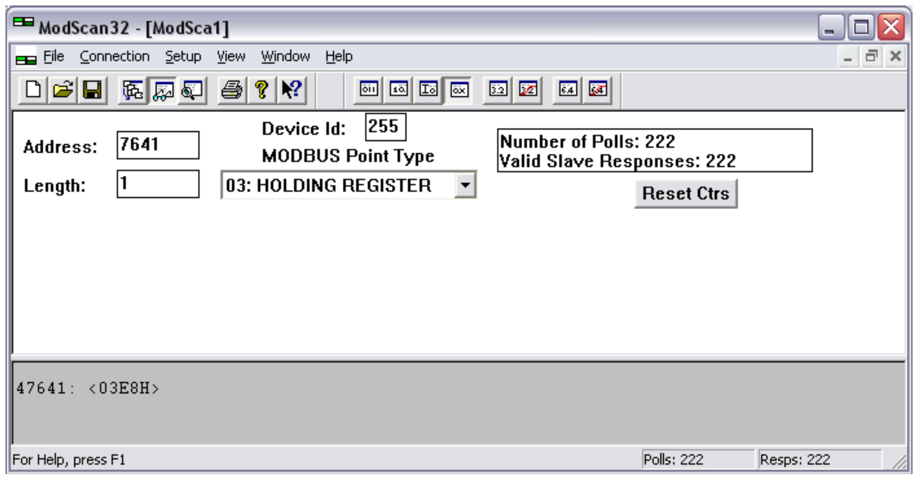


Figure 10-6: Modbus - configuration example 2 – power factor

Changing Parameter Settings Via Modus

Parameter Setting

NOTE

The example tables below are excerpts of the parameter list in Chapter: "Configuration & Operation".

NOTE

Be sure to enter the password for code level 2 or higher for the corresponding interface to get access for changing parameter settings.

NOTE

The new entered value must comply with the parameter setting range when changing the parameter setting.

Example 1: Addressing the password for serial interface1:

Par. ID.	Parameter	Setting range	Data type
10401	Password for serial interface1	0000 to 9999	UNSIGNED 16

Table 10-9: Modbus – password for serial interface 1

Modbus address = 400000 + (Par. ID + 1) = 410402
Modbus length = 1 (UNSIGNED 16)

The following Modscan32 screenshots show the configurations made to address parameter 10401.

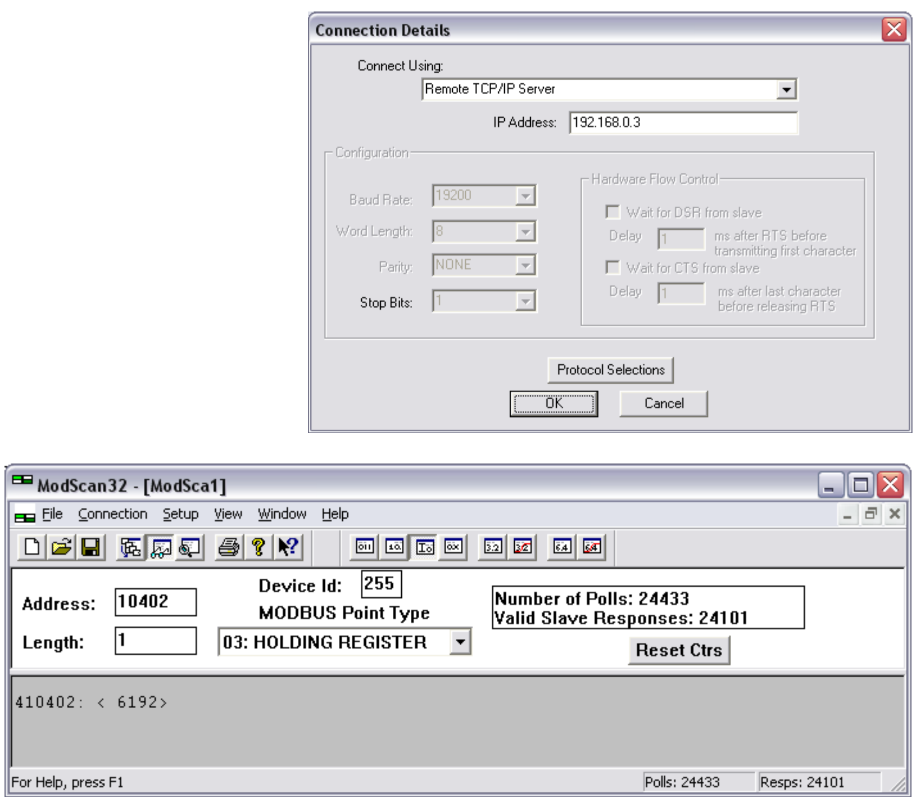


Figure 10-7: Modbus - configuration example 1

Example 2: Addressing the generator rated voltage:

Par. ID.	Parameter	Setting range	Data type
1766	Generator rated voltage	50 to 650000 V	UNSIGNED 32

Table 10-10: Modbus – generator rated voltage

Modbus address = 40000 + (Par. ID + 1) = 41767
Modbus length = 2 (UNSIGNED 32)

The following Modscan32 screenshot shows the configurations made to address parameter 1766.

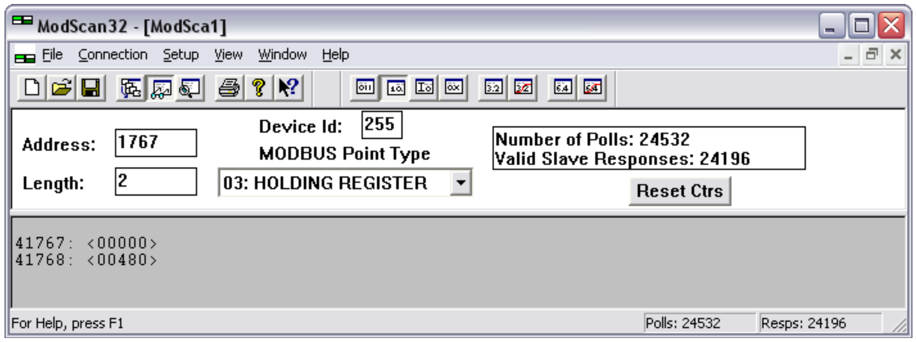


Figure 10-8: Modbus - configuration example 2

Example 3: Addressing the generator voltage measuring:

Par. ID.	Parameter	Setting range	Data type
1851	Generator voltage measuring	3Ph 4W 3Ph 3W n/a n/a 3Ph 4WOD	UNSIGNED 16

Table 10-11: Modbus – generator voltage measuring

Modbus address = 40000 + (Par. ID + 1) = 41852
Modbus length = 1 (UNSIGNED 16)

NOTE

If the setting range contains a list of parameter settings like in this example, the parameter settings are numbered and start with 0 for the first parameter setting. The number corresponding with the respective parameter setting must be configured.

The following Modscan32 screenshot shows the configurations made to address parameter 1851, which is configured to "3Ph 4W".

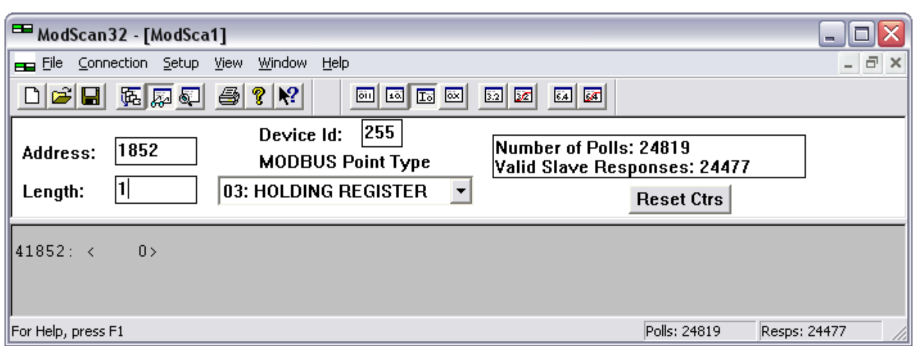


Figure 10-9: Modbus - configuration example 3

Remotely Resetting The Default Values

Modbus Via RS-232 / RS-485 Or Modbus TCP/IP

It is possible to remotely reset the unit to its default values through Modbus (via RS-232 / RS-485) or Modbus TCP/IP using the parameter 10417 and 1701. The required procedure is detailed in the following steps.

Par. ID.	Parameter	Setting range	Data type
10417	Factory default settings	Yes / No	UNSIGNED 16
1701	Reset factory default values	Yes / No	UNSIGNED 16

Table 10-12: Modbus – reset default values

In order to enable the resetting procedure, parameter 10417 must be enabled.

Example:
The resetting procedure has to be enabled.
Modbus address = 40000 + (Par. ID + 1) = 410418
Modbus length = 1 (UNSIGNED 16)

The following Modscan32 screenshot shows the settings made to parameter 10417 in ModScan32. It is possible to set the format to decimal to view the value using the "display options".

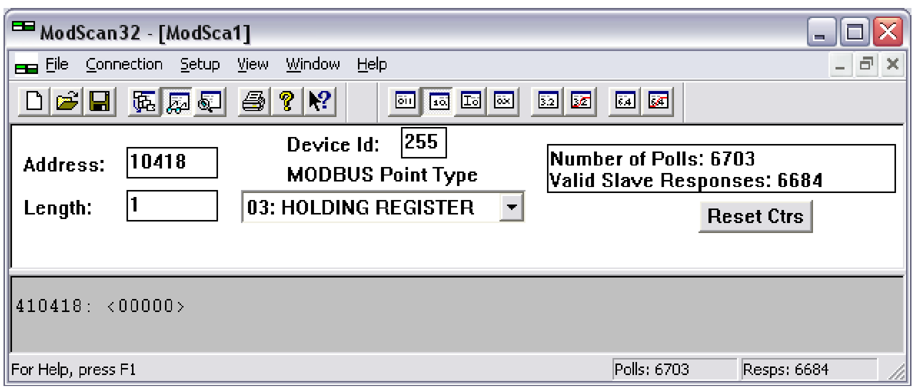


Figure 10-10: Modbus - remote control parameter 1701

By double-clicking the address, a Write Register command is issued. The following screenshot shows how the parameter is enabled using the ModScan32 Software. The value must be set to "1" to enable the parameter.

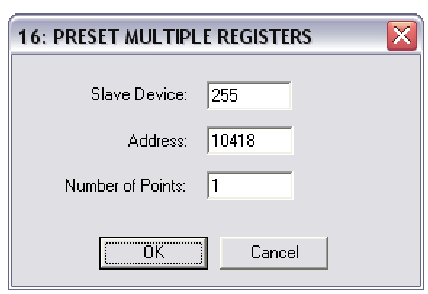


Figure 10-11: Modbus - write register - enable the resetting procedure via RS-232 or Modbus TCP/IP

In order to reset the default values, parameter 1701 must be enabled.

Example:
The default values are to be reset.
Modbus address = 40000 + (Par. ID + 1) = 41702
Modbus length = 1 (UNSIGNED 16)

The following Modscan32 screenshot shows the settings made to parameter 1701 in ModScan32. It is possible to set the format to decimal to view the value using the "display options".

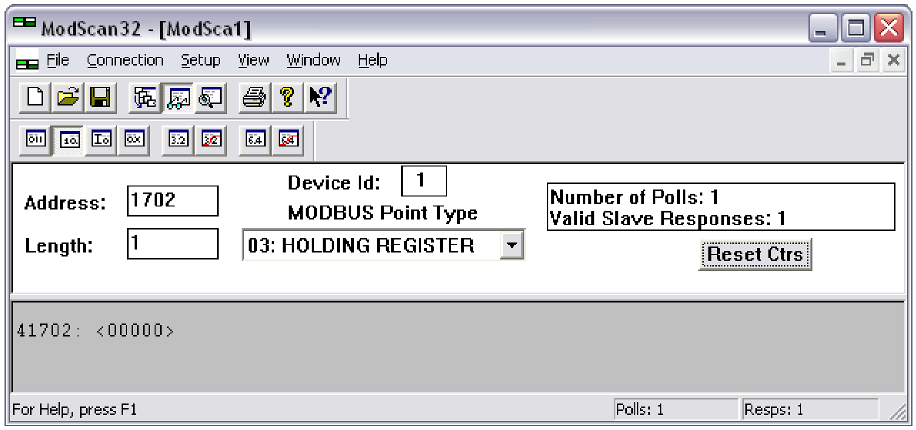


Figure 10-12: Modbus - remote control parameter 1701

By double-clicking the address, a Write Register command may be issued. The following screenshot shows how the parameter is enabled using the ModScan32 Software. The value must be set to "1" to enable the parameter.

Figure 10-13: Modbus - write register - resetting the default values

Modbus Parameters

NOTE

The following parameters are available for configuring the Modbus modules on the serial interfaces. Refer to Chapter: "Configuration & Operation" for detailed information about all parameters.

Serial Interface 1

Parameter table

ID	Text	Setting range	Default value
Configure RS-232 interfaces: serial interface 1			
3185	ModBus Slave ID	0 to 255	1
3186	Reply delay time	0.00 to 1.00 s	0.00 s

Table 10-13: Modbus - serial interface 1 - parameters

Serial Interface 2

Parameter table

ID	Text	Setting range	Default value
Configure RS-485 interfaces: serial interface 2			
3188	ModBus Slave ID	0 to 255	1
3189	Reply delay time	0.00 to 2.55 s	0.00 s

Table 10-14: Modbus - serial interface 2 – parameters

Network B – Modbus

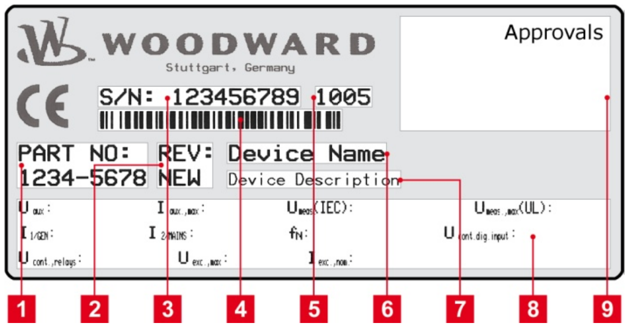
Parameter table

ID	Text	Setting range	Default value
Configure TCP/IP Modbus interfaces: Network B			
5430	TCP/IP address0	0 to 255	192
5431	TCP/IP address1	0 to 255	168
5432	TCP/IP address2	0 to 255	1
5433	TCP/IP address3 (Device number of DSLC-2 = 1 to 32)	0 to 255	1

Table 10-15: Modbus - TCP/IP Network B– parameters

Appendix A. Technical Data

Nameplate



1	P/N	Item number
2	REV	Item revision number
3	S/N	Serial number (numerical)
4	S/N	Serial number (barcode)
5	S/N	Date of production (year-month)
6	Type	Description (short)
7	Type	Description (long)
8	Details	Technical data
9	Approval	Approvals

Measuring values (voltages) – delta-wye voltage		
Measuring voltages	120 V	480 V
• Rated value (V_{rated})	69/120 Vac	277/480 Vac
• Maximum value (V_{max})	Max. 86/150 Vac	Max. 346/600 Vac
• Rated voltage phase – ground	150 Vac	300 Vac
• Rated surge voltage	2.5 kV	4.0 kV
Linear measuring range	1.25 × V_{rated}	
Measuring frequency	50/60 Hz (40.0 to 85.0 Hz)	
Accuracy	Class 0.5	
Input Resistance per path	120V → 0.498 MΩ	480 V → 2.0 MΩ
Maximum power consumption per path	< 0.15 W	
Measuring values (currents) – isolated		
Measuring current	[1] Rated value (I_{rated}) → ../1 A	[5] Rated value (I_{rated}) → ../5 A
Accuracy	Class 0.5	
Linear measuring range	1.5 × I_{rated}	
Maximum power consumption per path	< 0.15 VA	
Rated short-time current (1 s)	[1] → 50.0 × I_{rated}	[5] → 10.0 × I_{rated}
Ambient variables		
Power supply	12/24 Vdc (8 to 40 Vdc)	
Intrinsic consumption	Max. 15W	
Insulation voltage (continuously)	40 Vac	
Insulation test voltage (1 s)	100 Vac	
Overvoltage (≤ 2 min)	80 Vdc	
Reverse voltage protection	Full supply range	
Grounding supply voltage source	Isolated, negative potential or positive potential grounded	
Degree of pollution	2	
Maximum elevation	2000 m ASL	
Discrete inputs – isolated		
Input range ($V_{cont. dig. input}$)	Rated voltage 12/24 Vdc (8 to 40.0 Vdc)	
Input resistance	Approx. 20 kΩ	

Discrete outputs – potential free		
Contact material	AgCdO	
General purpose (GP) ($V_{cont, relays}$)	AC	DC
	2.00 Aac@250 Vac	2.00 Adc@24 Vdc 0.36 Adc@125 Vdc 0.18 Adc@250 Vdc
Pilot duty (PD) ($V_{cont, relays}$)	AC	DC
	B300	1.00 Adc@24 Vdc 0.22 Adc@125 Vdc 0.10 Adc@250 Vdc
Analog inputs (none isolated) – freely scaleable		
Maximum permissible voltage againt PE (Ground)	15 V	
Resolution	11 Bit	
0 to 20 mA input	Internal load 124 Ω	
0 to 10 V input	Input resistance approx. 80 kΩ	
Accuracy	1.0 %	
Analog outputs – isolated		
At rated output	Freely scalable	
Insulation voltage (continuously)	100 Vac	
Insulation test voltage (1 s)	500 Vac	
Versions	±10 Vdc, ±20 mA, PWM	
Resolution	± 20 mA outputs, configured to ±20 mA → 12 bit ± 20 mA outputs, configured to 0 to 20 mA → 11 bit	
0 to 20 mA output	Maximum load 500 Ω	
±10 V output	Internal resistance approx. 500 Ω	
Interface		
RS-232 interface	Isolated	
• Insulation voltage (continuously)	100 Vac	
• Insulation test voltage (1 s)	500 Vac	
• Version	RS-232 Standard	
RS-485 interface	Isolated	
• Insulation voltage (continuously)	100 Vac	
• Insulation test voltage (1 s)	500 Vac	
• Version	RS-485 Standard	
Ethernet interface	Isolated	
• Insulation test voltage (1 s)	500 Vac	
• Version	100 Mbit/s	
Battery		
Type	Lithium	
Life span (operation without power supply)	Approx. 5 years	
Battery field replacement	Not allowed	
Housing		
Type	Sheet metal → Custom	
Dimensions (W × H × D)	Sheet metal → 250 × 227 × 84 mm (9.84 × 9.00 × 3.30 in)	
Wiring	Screw-plug-terminals 2.5 mm²	
Recommended locked torque	4 inch pounds / 0.5 Nm Use 60/75 °C copper wire only Use class 1 wire only or equivalent	
Weight	approx. 1,900 g (4.2 lbs)	
Protection		
Protection system	IP 20	
EMC test (CE)	Tested according to applicable EN guidelines	
Certifications		
Listings	CE marking; cUL/UL ordinary Locations, File No. 231544; GOST-R; CSA	
Marine	Type approval: Lloyds Register (LR) Design Assessment: American Bureau of Shipping (ABS)	
Generic note		
Accuracy	Is referred to full scale value	

Environmental Data

Vibration	
Frequency Range – Sine Sweep	5 Hz to 100 Hz
• Acceleration	4G
Frequency Range – Random	10 Hz to 500 Hz
• Power Intensity	$0.015G^2$ / Hz
• RMS Value	1.04 Grms
Standards	EN 60255-21-1 (EN 60068-2-6, Fc) EN 60255-21-3 Lloyd's Register, Vibration Test2 SAEJ1455 Chassis Data MIL-STD 810F, M514.5A, Cat.4, Truck/Trailer tracked-restrained Cargo, Fig. 514.5-C1
Shock	
Shock	40G, Saw tooth pulse, 11 ms
Standards	EN 60255-21-2 MIL-STD 810F, M516.5, Procedure 1
Temperature	
Cold, Dry Heat (storage)	-40 °C (-40 °F) / 85 °C (185 °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
Marine Environmental Categories	
Lloyd's Register of Shipping (LRS)	ENV1, ENV2, ENV3 and ENV4

Accuracy

Measuring value	Display	Accuracy	Measuring start	Notes
Frequency				
Generator	15.0 to 85.0 Hz	0.2 % (of 85 Hz)	5 % (of PT second-ary voltage setting) [1]	
Busbar	40.0 to 85.0 Hz			
Voltage				
Wye generator / mains / busbar	0 to 650 kV	0.5 % (of 150/600 V) [2]	1.5 % (of PT second-ary voltage setting) [1]	
Delta generator / mains / busbar			2 % (of PT second-ary voltage setting) [1]	
Current				
Generator	0 to 32,000 A	0.5 % (of 1.3/6.5 A) [3]	1 % (of 1/5 A) [3]	
Mains / ground current				
Max. value				
Real power				
Actual total real power value	-2 to 2 GW	1 % (of 150/600 V * 1.3/6.5 A) [2/3]	Starts with detecting the zero passage of current/voltage	
Reactive power				
Actual value in L1, L2, L3	-2 to 2 Gvar	1 % (of 150/600 V * 1.3/6.5 A) [2/3]	Starts with detecting the zero passage of current/voltage	
Power factor				
Actual value power factor L1	Lagging 0.00 to 1.00 to leading 0.00	2 %	2 % (of 1/5 A) [3]	1.00 is displayed for measuring val-ues below the measuring start
Miscellaneous				
Battery voltage	8 to 40 V	1 % (of 24 V)		
Phase angle	-180 to 180 °		1.25 % (of PT sec-ondary volt. setting)	180 ° is displayed for measuring val-ues below measur-ing start
Miscellaneous				
0 to 20 mA / 0 to 10 V	Freely scaleable	1.2 % (of 20 mA) / 1.2 % (of 10 V)		

[1] Setting of the parameter for the PT secondary rated voltage
[2] Depending on the used measuring inputs (100/400 V)
[3] Depending on the CT input hardware (1/5 A) of the respective unit

Reference conditions (for measuring the accuracy):

- Input voltage .... sinusoidal rated voltage
- Input current............................. sinusoidal rated current
- Frequency................................. rated frequency +/-2 %
- Power supply............................ rated voltage +/-2 %
- Power factor (cos φ)................. 1.00
- Ambient temperature................ 23 °C +/-2 K
- Warm-up period....................... 20 minutes

Appendix B. Useful Information

Connecting 24 V Relays

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 induces 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. Figure 10-14 shows the exemplary connection of a diode as an interference suppressing circuit.

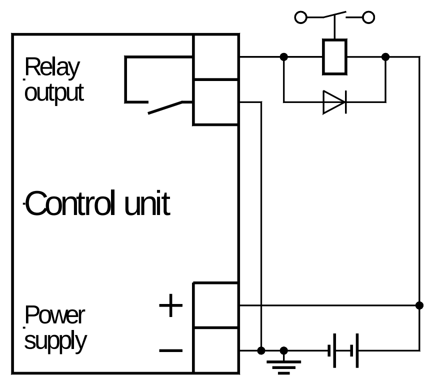


Figure 10-14: Interference suppressing circuit - connection

Advantages and disadvantages of different interference suppressing circuits are described in the following.

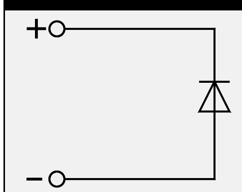
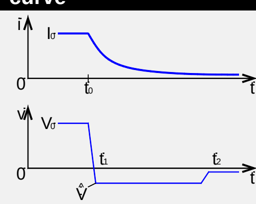
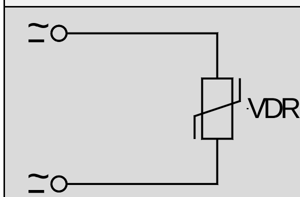
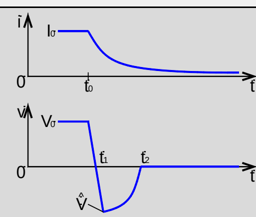
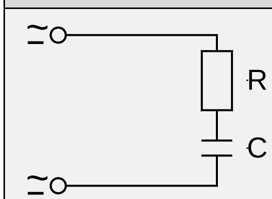
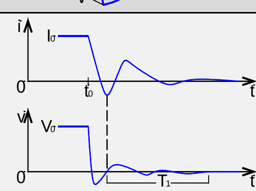
Connection diagram	Load current / voltage curve	Advantages	Disadvantages
		• Uncritical dimensioning • Lowest possible induced voltage • Very simple and reliable	• High release delay
		• Uncritical dimensioning • High energy absorption • Very simple setup • Suitable for AC voltage • Reverse polarity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

Table 10-16: Interference suppressing circuit for relays

Appendix C.
Data Protocols

Data Protocol 5200

Modbus Adress	Modicon Adress	Size	Format	Parameter ID	Description DSLC-2	Multiplier (BUS-data * Multiplier = real value)	Units
50000	450001	16 bits	signed		Protocol-ID, always 5200		--
50001	450002	16 bits	signed	3181	Scaling Power (16 bits) Exponent 10^x W (5;4;3;2)		
50002	450003	16 bits	signed	3182	Scaling Volts (16 bits) Exponent 10^x V (2;1;0;-1)		
50003	450004	16 bits	signed	3183	Scaling Amps (16 bits) Exponent 10^x A (0;-1)		
50004	450005	16 bits	signed	7732	Scaling Process engineering unit		
50005	450006	16 bits			0 (reserve)		
50006	450007	16 bits			0 (reserve)		
50007	450008	16 bits			0 (reserve)		
50008	450009	16 bits			0 (reserve)		
50009	450010	16 bits			0 (reserve)		
AC Measurement values							
50010	450011	16 bits	signed	144	Generator frequency	0.01	Hz
50011	450012	16 bits	signed	246	Generator total power	scaled defined by index 3181 (modicon Adress 450002)	kW
50012	450013	16 bits	signed	247	Generator total reactive power	scaled defined by index 3181 (modicon Adress 450002)	kvar
50013	450014	16 bits	signed	160	Generator power factor	0.001	
50014	450015	16 bits	signed	248	Generator voltage L1-L2	scaled defined by index 3182 (modicon Adress 450003)	V
50015	450016	16 bits	signed	249	Generator voltage L2-L3	scaled defined by index 3182 (modicon Adress 450003)	V
50016	450017	16 bits	signed	250	Generator voltage L3-L1	scaled defined by index 3182 (modicon Adress 450003)	V
50017	450018	16 bits	signed	251	Generator voltage L1-N	scaled defined by index 3182 (modicon Adress 450003)	V
50018	450019	16 bits	signed	252	Generator voltage L2-N	scaled defined by index 3182 (modicon Adress 450003)	V
50019	450020	16 bits	signed	253	Generator voltage L3-N	scaled defined by index 3182 (modicon Adress 450003)	V
50020	450021	16 bits	signed	255	Generator current 1	scaled defined by index 3183 (modicon Adress 450004)	A
50021	450022	16 bits	signed	256	Generator current 2	scaled defined by index 3183 (modicon Adress 450004)	A
50022	450023	16 bits	signed	257	Generator current 3	scaled defined by index 3183 (modicon Adress 450004)	A
50023	450024	16 bits	signed	209	Busbar frequency	0.01	Hz
50024	450025	16 bits	signed	254	Busbar voltage L1-L2 (or L1-N)	scaled defined by index 3182 (modicon Adress 450003)	V
50025	450026	16 bits	signed	147	Auxiliary busbar frequency	0.01	Hz
50026	450027	16 bits	signed	118	Auxiliary busbar voltage L1-L2	scaled defined by index 3182 (modicon Adress 450003)	V
50027	450028	16 bits	signed	119	Auxiliary busbar L2-L3	scaled defined by index 3182 (modicon Adress 450003)	V
50028	450029	16 bits	signed	120	Auxiliary busbar L3-L1	scaled defined by index 3182 (modicon Adress 450003)	V

Modbus Adress	Modicon Adress	Size	Format	Parameter ID	Description DSLC-2	Multiplier (BUS-data * Multiplier = real value)	Units
50029	450030	16 bits	signed	121	Auxiliary busbar L1-N	scaled defined by index 3182 (modicon Adress 450003)	V
50030	450031	16 bits	signed	122	Auxiliary busbar L2-N	scaled defined by index 3182 (modicon Adress 450003)	V
50031	450032	16 bits	signed	123	Auxiliary busbar L3-N	scaled defined by index 3182 (modicon Adress 450003)	V
50032	450033	16 bits	signed	4639	Phase Angle Generator / Busbar	0.1	°
50033	450034	16 bits	signed	4627	Active Setpoint generator frequency	0.01	Hz
50034	450035	16 bits	signed	4628	Active Setpoint generator voltage	0.01	%
50035	450036	16 bits	signed	4629	Active Setpoint generator load level	0.01	%
50036	450037	16 bits	signed	4630	Active Setpoint generator reactive power	0.01	%
50037	450038	16 bits	signed	4631	Active Setpoint generator power factor	(-710…1000...710)	
50038	450039	16 bits			0 (reserve)		
50039	450040	16 bits			0 (reserve)		
50040	450041	16 bits			0 (reserve)		
50041	450042	16 bits			0 (reserve)		
50042	450043	16 bits			0 (reserve)		
50043	450044	16 bits			0 (reserve)		
DC Analogue Values (Engine Values)							
50044	450045	16 bits	signed	10110	Battery voltage	0.1	V
50045	450046	16 bits	signed	10117	Remote Load / Process Reference Input (AI4)	000.0…100.0	%
50046	450047	16 bits	signed	10151	Process Signal Input (AI5)	000.0…100.0	%
50047	450048	16 bits	signed	7718	Power Factor (AI6)	(-710…1000...710)	
50048	450049	16 bits	signed	5535	Speed Biasing (AO1)	0.01	%
50049	450050	16 bits	signed	5635	AVR Biasing (AO2)	0.01	%
50050	450051	16 bits			0 (reserve)		
50051	450052	16 bits			0 (reserve)		
50052	450053	16 bits			0 (reserve)		
50053	450054	16 bits			0 (reserve)		
50054	450055	16 bits			0 (reserve)		
Control and Status							
50055	450056	16 bits			0 (reserve)		
50056	450057	16 bits	signed	4636	Sync Control State	0: Off 1: Check mode active 2: Permissive mode active 3: Run mode active 4: Close Timer runs 5: Sync Timer runs 6: Breaker synchronized 7: Auto-Off position	
50057	450058	16 bits	signed	4634	Load Control Mode	0: Inactive 1: Droop 2: At Unload trip 3: Load sharing 4: Base load control 5: Import/Export control (MSLC only) 6: Process control 7: Remote process control (re-served) 8: Peak load control (reserved) 9: Zero power control (reserved) 10: Load share (reserved) 11: Process slave (reserved)	

Modbus Adress	Modicon Adress	Size	Format	Parameter ID	Description DSLC-2	Multiplier (BUS-data * Multiplier = real value)	Units
50058	450059	16 bits	signed	4635	Reactive Load Control Mode	0: Inactive 1: Off 2: Droop 3: VAR sharing 4: Reactive load control 5: Import/Export reactive load (MSLC only) 6: Const.Gen Power Factor (MSLC only) 7: Remote process control (reserved) 8: - (reserved) 9: Zero power control (reserved) 10: Reactive load share (reserved) 11: Process slave (reserved)	
50059	450060	16 bits	bit array	4151	Condition Flags 1		
					Generator is Dead	Mask: 8000h	Bit
					0 (reserve)	Mask: 4000h	Bit
					Generator is OK	Mask: 2000h	Bit
					Generator breaker is closed	Mask: 1000h	Bit
						Mask: 0800h	Bit
					Busbar is ok (in same segment)	Mask: 0400h	Bit
						Mask: 0200h	Bit
						Mask: 0100h	Bit
						Mask: 0080h	Bit
					Aux. Busbar anti clock wise system is recognized	Mask: 0040h	Bit
					Aux. Busbar clock wise system is recognized	Mask: 0020h	Bit
					Busbar is dead (in same segment)	Mask: 0010h	Bit
						Mask: 0008h	Bit
					Generator counter clock wise system is recognized	Mask: 0004h	Bit
					Generator clock wise system is recognized	Mask: 0002h	Bit
						Mask: 0001h	Bit
50060	450061	16 bits	bit array	4156	Condition Flags 2		
					0 (reserve)	Mask: 8000h	Bit
					0 (reserve)	Mask: 4000h	Bit
					0 (reserve)	Mask: 2000h	Bit
					0 (reserve)	Mask: 1000h	Bit
					0 (reserve)	Mask: 0800h	Bit
					Dead busbar closure request active	Mask: 0400h	Bit
					Active power load share is active	Mask: 0200h	Bit
					Reactive power load share is active	Mask: 0100h	Bit
					0 (reserve)	Mask: 0080h	Bit
					0 (reserve)	Mask: 0040h	Bit
					0 (reserve)	Mask: 0020h	Bit
					0 (reserve)	Mask: 0010h	Bit
					0 (reserve)	Mask: 0008h	Bit
					0 (reserve)	Mask: 0004h	Bit
					0 (reserve)	Mask: 0002h	Bit
					0 (reserve)	Mask: 0001h	Bit
50061	450062	16 bits	bit array	4155	Condition Flags 3		

Modbus Adress	Modicon Adress	Size	Format	Parameter ID	Description DSLC-2	Multiplier (BUS-data * Multiplier = real value)	Units
					0 (reserve)	Mask: 8000h	Bit
					0 (reserve)	Mask: 4000h	Bit
					3-Position Controller Volt./ReactPow raise	Mask: 2000h	Bit
					3-Position Controller Volt./ReactPow lower	Mask: 1000h	Bit
					GCB is closed	Mask: 0800h	Bit
					0 (reserve)	Mask: 0400h	Bit
					0 (reserve)	Mask: 0200h	Bit
					Synchronisation GCB is active	Mask: 0100h	Bit
					Opening GCB is active	Mask: 0080h	Bit
					Closing GCB is active	Mask: 0040h	Bit
					0 (reserve)	Mask: 0020h	Bit
					0 (reserve)	Mask: 0010h	Bit
					0 (reserve)	Mask: 0008h	Bit
					Unloading generator is active	Mask: 0004h	Bit
					0 (reserve)	Mask: 0002h	Bit
					0 (reserve)	Mask: 0001h	Bit
50062	450063	16 bits	signed	4637	Automatic Segment Allocation (ASA)	1...8	
50063	450064	16 bits	signed	4638	Collective Breaker State (CBS)	0…255	
50064	450065	16 bits	signed	7706	Number of the MSLC master unit	1..16	
50065	450066	16 bits	signed	4503	0 (reserve)	000.00…100.0	%
50066	450067	16 bits	signed	4600	Process Signal Input	000.00…100.0	%
50067	450068	16 bits	bit array	4157	Interface Control Switch		
					0 (reserve)	Mask: 8000h	Bit
					0 (reserve)	Mask: 4000h	Bit
					0 (reserve)	Mask: 2000h	Bit
					Source: Droop Tracking switch	Mask: 1000h	Bit
					Source: Process switch	Mask: 0800h	Bit
					Source: Lower load switch	Mask: 0400h	Bit
					Source: Raise load switch	Mask: 0200h	Bit
					Source: Ramp pause switch	Mask: 0100h	Bit
					Source: Load/ Unload switch	Mask: 0080h	Bit
					Source: Base load switch	Mask: 0040h	Bit
					Source: Lower voltage switch	Mask: 0020h	Bit
					Source: Raise voltage switch	Mask: 0010h	Bit
					Source: CB Aux contact switch	Mask: 0008h	Bit
					Source: Synchronization GCB run switch	Mask: 0004h	Bit
					Source: Synchronization GCB permissive switch	Mask: 0002h	Bit
					Source: Synchronization GCB check switch	Mask: 0001h	Bit
50068	450069	16 bits	signed	4605	Process reference	000.00…100.0	%
50069	450070	16 bits	signed	7708	Power factor reference	(-0.710…1.000...0.710)	
50070	450071	16 bits			0 (reserve)		
Relay Outputs							
50071	450072	16 bits	bit array	4626	Relay Outputs 1		

Modbus Adress	Modicon Adress	Size	Format	Parameter ID	Description DSLC-2	Multiplier (BUS-data * Multiplier = real value)	Units
					0 (reserve)	Mask: 8000h	Bit
					0 (reserve)	Mask: 4000h	Bit
					0 (reserve)	Mask: 2000h	Bit
					0 (reserve)	Mask: 1000h	Bit
					Voltage Lower Relay (R12)	Mask: 0800h	Bit
					Voltage Raise Relay (R11)	Mask: 0400h	Bit
					Alarm 3 (R10)	Mask: 0200h	Bit
					Alarm 2 (R9)	Mask: 0100h	Bit
					Alarm 1 (R8)	Mask: 0080h	Bit
					Centralized Alarm (R7)	Mask: 0040h	Bit
					Breaker Close Relay (R6)	Mask: 0020h	Bit
					Breaker Open Relay (R5)	Mask: 0010h	Bit
					Low Limit Relay (R4)	Mask: 0008h	Bit
					High Limit Relay (R3)	Mask: 0004h	Bit
					Load Switch Relay (R2)	Mask: 0002h	Bit
					Alarm Relay (R1)	Mask: 0001h	Bit
50072	450073	16 bits			0 (reserve)		
50073	450074	16 bits			0 (reserve)		
50074	450075	16 bits			0 (reserve)		
Alarm Management							
50075	450076	16 bits	bit array	4623	Alarms 1		
					Alarm 16 Reserve	Mask: 8000h	Bit
					Alarm 15 Reserve	Mask: 4000h	Bit
					GCB Open Failure	Mask: 2000h	Bit
					Centralized Alarms	Mask: 1000h	Bit
					Missing member	Mask: 0800h	Bit
					0 (reserve)	Mask: 0400h	Bit
					Communication Error	Mask: 0200h	Bit
					Voltage Range Limit	Mask: 0100h	Bit
					High Voltage Limit	Mask: 0080h	Bit
					Low Voltage Limit	Mask: 0040h	Bit
					Low Process Limit	Mask: 0020h	Bit
					High Process Limit	Mask: 0010h	Bit
					Low Load Limit	Mask: 0008h	Bit
					High Load Limit	Mask: 0004h	Bit
					GCB Close Failure	Mask: 0002h	Bit
					Synchronizer Timeout	Mask: 0001h	Bit
50076	450077	16 bits			0 (reserve)		
50077	450078	16 bits			0 (reserve)		
50078	450079	16 bits			0 (reserve)		
50079	450080	16 bits			0 (reserve)		
50080	450081	16 bits			0 (reserve)		
Discrete Inputs							
50081	450082	16 bits	bit array	4624	Digital Inputs 1		
					0 (reserve)	Mask: 8000h	Bit
					0 (reserve)	Mask: 4000h	Bit
					0 (reserve)	Mask: 2000h	Bit
					0 (reserve)	Mask: 1000h	Bit
					Process Control Switch (DI12)	Mask: 0800h	Bit
					Load Lower Switch (DI11)	Mask: 0400h	Bit
					Load Raise Switch (DI10)	Mask: 0200h	Bit
					Ramp Pause Switch (DI9)	Mask: 0100h	Bit

Modbus Adress	Modicon Adress	Size	Format	Parameter ID	Description DSLC-2	Multiplier (BUS-data * Multiplier = real value)	Units
					Load/Unload Switch (DI8) (Energized=Load)	Mask: 0080h	Bit
					Base Load Control Switch (DI7)	Mask: 0040h	Bit
					Voltage Lower Switch (DI6)	Mask: 0020h	Bit
					Voltage Raise Switch (DI5)	Mask: 0010h	Bit
					Circuit Breaker Aux. is closed (DI4)	Mask: 0008h	Bit
					Synchronization Run switch is active (DI3)	Mask: 0004h	Bit
					Synchronization Permissive switch is active (DI2)	Mask: 0002h	Bit
					Synchronization Check switch is active (DI1)	Mask: 0001h	Bit
50082	450083	16 bits	bit array	4625	Digital Inputs 2		
					0 (reserve)	Mask: 8000h	Bit
					0 (reserve)	Mask: 4000h	Bit
					0 (reserve)	Mask: 2000h	Bit
					0 (reserve)	Mask: 1000h	Bit
					0 (reserve)	Mask: 0800h	Bit
					0 (reserve)	Mask: 0400h	Bit
					0 (reserve)	Mask: 0200h	Bit
					0 (reserve)	Mask: 0100h	Bit
					Segment connection 81 is closed (DI20)	Mask: 0080h	Bit
					Segment connection 78 is closed (DI19)	Mask: 0040h	Bit
					Segment connection 67 is closed (DI18)	Mask: 0020h	Bit
					Segment connection 56 is closed (DI17)	Mask: 0010h	Bit
					Segment connection 45 is closed (DI16)	Mask: 0008h	Bit
					Segment connection 34 is closed (DI15)	Mask: 0004h	Bit
					Segment connection 23 is closed (DI14)	Mask: 0002h	Bit
					Segment connection 12 is closed (DI13)	Mask: 0001h	Bit
50083	450084	16 bits			0 (reserve)		
50084	450085	16 bits			0 (reserve)		
50085	450086	16 bits			0 (reserve)		
50086	450087	16 bits			0 (reserve)		
50087	450088	16 bits			0 (reserve)		
50088	450089	16 bits			0 (reserve)		
50089	450090	16 bits			0 (reserve)		
50090	450091	16 bits			0 (reserve)		
50091	450092	16 bits			0 (reserve)		
50092	450093	16 bits			0 (reserve)		
50093	450094	16 bits			0 (reserve)		
50094	450095	16 bits			0 (reserve)		
50095	450096	16 bits			0 (reserve)		
50096	450097	16 bits			0 (reserve)		
50097	450098	16 bits			0 (reserve)		
50098	450099	16 bits			0 (reserve)		
50099	450100	16 bits			0 (reserve)		
Int32 (Long)							
AC Measurement values							
50100	450101	32 bits	signed	135	Total generatorpower	1	W

Modbus Adress	Modicon Adress	Size	Format	Parameter ID	Description DSLC-2	Multiplier (BUS-data * Multiplier = real value)	Units
50102	450103	32 bits	signed	136	Total generator reactive power	1	var
50104	450105	32 bits	signed	137	Total generator apparent power	1	VA
50106	450107	32 bits	signed	170	Average generator Wye-Voltage	0.1	V
50108	450109	32 bits	signed	171	Average generator Delta-Voltage	0.1	V
50110	450111	32 bits	signed	216	Average Busbar 1 Delta-Voltage	0.1	V
50112	450113	32 bits	signed	185	Average generator Current	0.001	A
50114	450115	32 bits	signed	111	Generator current 1	0.001	A
50116	450117	32 bits	signed	112	Generator current 2	0.001	A
50118	450119	32 bits	signed	113	Generator current 3	0.001	A
50120	450121	32 bits	signed	108	Generator voltage L1-L2	0.1	V
50122	450123	32 bits	signed	109	Generator voltage L2-L3	0.1	V
50124	450125	32 bits	signed	110	Generator voltage L3-L1	0.1	V
50126	450127	32 bits	signed	114	Generator voltage L1-N	0.1	V
50128	450129	32 bits	signed	115	Generator voltage L2-N	0.1	V
50130	450131	32 bits	signed	116	Generator voltage L3-N	0.1	V
50132	450133	32 bits	signed	125	Generator active power 1-N	1	W
50134	450135	32 bits	signed	126	Generator active power 2-N	1	W
50136	450137	32 bits	signed	127	Generator active power 3-N	1	W
50138	450139	32 bits	signed	182	Busbar voltage (L1-N) L1-L2	0.1	V
50140	450141	32 bits	signed	173	Average Aux.busbar Wye-Voltage	0.1	V
50142	450143	32 bits	signed	174	Average Aux.busbar Delta-Voltage	0.1	V
50144	450145	32 bits	signed	118	Aux.busbar voltage L1-L2	0.1	V
50146	450147	32 bits	signed	119	Aux.busbar voltage L2-L3	0.1	V
50148	450149	32 bits	signed	120	Aux.busbar voltage L3-L1	0.1	V
50150	450151	32 bits	signed	121	Aux.busbar voltage L1-N	0.1	V
50152	450153	32 bits	signed	122	Aux.busbar voltage L2-N	0.1	V
50154	450155	32 bits	signed	123	Aux.busbar voltage L3-N	0.1	V
50156	450157	32 bits	signed	7719	0 (reserve)	0.001	kW
50158	450159	32 bits	signed	7720	0 (reserve)	0.001	kvar
50160	450161	32 bits	signed	7721	Load reference	0.1	kW
50162	450163	32 bits	signed	7722	Reactive load reference	0.1	kvar
50164	450165	32 bits	signed	7726	Process reference input	0.1	
50166	450167	32 bits	signed	7727	Process signal input	0.1	
50168	450169	32 bits	signed	7737	Process reference toolkit	0.1	
50170	450171	32 bits	signed	7738	Remote load reference in-put	0.1	kW

Appendix D.
Parameter Overview

Introduction

Parameter List Columns

The parameter list consists of the following columns, which provide important information for each parameter:

Namespace X

The namespaces 1 and 2 are used to combine all parameters within functional groups.

ID

The parameter ID is a unique identifier for each individual parameter. It is mentioned besides each parameter in ToolKit and also required when configuring the unit via interface.

Parameter Text

The parameter text describes the parameter and appears on the configuration screens of the unit and ToolKit.

Setting Range

The setting range describes the range for possible parameter settings and may either be a range (e.g. 0 to 9) or a selection of different options (e.g. Yes or No). If the respective parameter allows configuring different options, the number behind each option is the number, which needs to be transmitted via interface to select this option.

Default Value

The default value is the parameter setting at delivery of the unit or after resetting the unit to factory settings. If the parameter allows configuring different options, the default value describes the number of the respective option.

Data Type

The data type indicates the data type of the respective parameter. The following data types are possible:

- UNSIGNED8 unsigned 8 bit integer
- UNSIGNED16 unsigned 16 bit integer
- UNSIGNED32 unsigned 32 bit integer
- SIGNED32 signed 32 bit integer
- INTEGER16 16 bit integer

Code Level (CL)

This is the minimum code level, which is required to access the respective parameter.

Parameter List

Namespace1	Namespace2	ID	Parameter Text	Setting Range	Default Value	Data Type	CL
MENU 0	-	7584	Synchronizer timeout alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7585	Reclose limit alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7586	High load limit alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7587	Low load limit alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7588	High process limit alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7589	Low process limit alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7590	Low voltage limit alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7591	High voltage limit alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7592	Voltage range limit alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7593	Communication error alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7595	Missing member alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7596	Centralized alarm	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 0	-	7597	GCB open fail	Off ; 0 Alarm1 ; 1 Alarm2 ; 2 Alarm3 ; 3	0	UNSIGNED 16	2
MENU 1	-	3063	Synchronizer timeout	003 to 999 s	060 s	UNSIGNED 16	2
MENU 1	-	3416	GCB close hold time	0.10 to 0.50 s	0.50 s	UNSIGNED 16	2
MENU 1	-	3418	GCB maximum closing attemps	01 to 10	5	UNSIGNED 16	2
MENU 1	-	3420	GCB open monitoring	0.10 to 5.00 s	2.00 s	UNSIGNED 16	2
MENU 1	-	4534	Reclose delay	0001 to 1000 s	0002 s	INTEGER 16	2
MENU 1	-	4539	Frequency synchronizer proportional gain	000.01 to 100.00	001.00	INTEGER 16	2
MENU 1	-	4540	Frequency synchronizer in-tegral gain	000.00 to 020.00	001.00	INTEGER 16	2

Namespace1	Namespace2	ID	Parameter Text	Setting Range	Default Value	Data Type	CL
MENU 1	-	4541	Voltage window	00.50 to 10.00 %	00.50 %	INTEGER 16	2
MENU 1	-	4700	Voltage synchronizer proportional gain	000.01 to 100.00	001.00	INTEGER 16	2
MENU 1	-	4701	Voltage synchronizer integral gain	000.01 to 100.00	001.00	INTEGER 16	2
MENU 1	-	5502	Slip frequency setpoint offset	00.00 to 00.50 Hz	00.10 Hz	UNSIGNED 16	2
MENU 1	-	5503	Frequency control setpoint ramp	00.10 to 60.00 Hz/s	02.50 Hz/s	UNSIGNED 16	2
MENU 1	-	5505	Phase matching gain	01 to 99	5	UNSIGNED 16	2
MENU 1	-	5506	Phase matching df-start	0.02 to 0.25 Hz	0.05 Hz	UNSIGNED 16	2
MENU 1	-	5508	Frequency control initial state	000.0 to 100.0 %	050.0 %	UNSIGNED 16	2
MENU 1	-	5516	Start frequency control level	00.00 to 70.00 Hz	58.00 Hz	UNSIGNED 16	1
MENU 1	-	5517	Start frequency control delay	000 to 999 s	002 s	UNSIGNED 16	1
MENU 1	-	5701	Positive frequency differential GCB	00.02 to 00.49 Hz	00.18 Hz	INTEGER 16	2
MENU 1	-	5702	Negative frequency differential GCB	-00.49 to 00.00 Hz	-00.10 Hz	INTEGER 16	2
MENU 1	-	5703	Max. positive phase window GCB	000.0 to 060.0 °	007.0 °	INTEGER 16	2
MENU 1	-	5704	Max. negative phase window GCB	-060.0 to 000.0 °	-007.0 °	INTEGER 16	2
MENU 1	-	5705	Breaker delay	040 to 300 ms	080 ms	UNSIGNED 16	2
MENU 1	-	5707	Phase matching GCB dwell time	00.0 to 60.0 s	00.5 s	UNSIGNED 16	2
MENU 1	-	5729	Synchronization GCB	Slip frequency ; 0 Phase matching ; 1	1	UNSIGNED 16	2
MENU 1	-	5820	Dead bus detection max. volt.	000 to 030 %	10%	UNSIGNED 16	2
MENU 1	-	7513	Voltage matching	Disabled ; 0 Enabled ; 1	1	UNSIGNED 16	2
MENU 1	-	7514	Auto re-synchronization	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 1	-	7555	Dead bus closure	Disabled ; 0 Enabled ; 1	1	UNSIGNED 16	2
MENU 1	-	7556	Reclose limit alarm	Disabled ; 0 Enabled ; 1	2	UNSIGNED 16	2
MENU 1	-	7557	Synchronizer timeout alarm	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 2	-	1752	Generator rated active power	000000.1 to 999999.9 kW	000200.0 kW	UNSIGNED 32	2
MENU 2	-	3123	Unload trip time	003 to 999 s	060 s	UNSIGNED 16	2
MENU 2	-	3125	Unload trip level	00.5 to 99.9 %	03.0 %	UNSIGNED 16	2
MENU 2	-	4515	Raise load rate	000.01 to 100.00 %/s	001.00 %/s	INTEGER 16	2
MENU 2	-	4516	Lower load rate	000.01 to 100.00 %/s	001.00 %/s	INTEGER 16	2
MENU 2	-	4522	Load share gain	000.00 to 100.00	000.50	INTEGER 16	2
MENU 2	-	4523	Load droop	000.0 to 100.0 %	003.0 %	INTEGER 16	2
MENU 2	-	4524	Unload ramp rate	000.01 to 100.00 %/s	003.00 %/s	INTEGER 16	2
MENU 2	-	4526	High load limit DO	000 to 150 %	90%	INTEGER 16	2
MENU 2	-	4528	Low load limit DO	000 to 100 %	5%	INTEGER 16	2
MENU 2	-	4529	Load switch PU	-150 to 150 %	30%	INTEGER 16	2
MENU 2	-	4530	Load switch DO	-150 to 150 %	20%	INTEGER 16	2
MENU 2	-	4531	Instant reverse power	-50.0 to-01.0 %	-10.0 %	INTEGER 16	2
MENU 2	-	4532	Rev pwr time delay	00.1 to 20.0 s	20.0 s	INTEGER 16	2
MENU 2	-	4533	Reverse power level	-50.0 to-01.0 %	-01.0 %	INTEGER 16	2
MENU 2	-	4546	Load share factor	010 to 090 %	50%	INTEGER 16	2

Namespace1	Namespace2	ID	Parameter Text	Setting Range	Default Value	Data Type	CL
MENU 2	-	4549	Load ramp rate	000.01 to 100.00 %/s	003.00 %/s	INTEGER 16	2
MENU 2	-	5510	Frequency trim proportional gain	000.01 to 100.00	000.50	UNSIGNED 16	2
MENU 2	-	5511	Frequency trim integral gain	000.01 to 100.00	001.00	UNSIGNED 16	2
MENU 2	-	5512	Frequency trim derivative ratio	000.01 to 100.00	000.01	UNSIGNED 16	2
MENU 2	-	5513	Base load proportional gain	000.01 to 100.00	001.00	UNSIGNED 16	2
MENU 2	-	5514	Base load integral gain	000.01 to 100.00	000.50	UNSIGNED 16	2
MENU 2	-	5515	Base load derivative ratio	000.01 to 100.00	000.01	UNSIGNED 16	2
MENU 2	-	5520	Base load reference	000000.0 to 999999.9 kW	000100.0 kW	UNSIGNED 32	1
MENU 2	-	5523	High load limit PU	000 to 150 %	100%	UNSIGNED 16	2
MENU 2	-	5524	Low load limit PU	000 to 100 %	0%	UNSIGNED 16	2
MENU 2	-	7504	High load limit alarm	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 2	-	7505	Low load limit alarm	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 2	-	7506	Load limit switch	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 2	-	7507	Reverse power trip	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 2	-	7634	Load control setpoint source	Internal ; 0 Interface ; 1	0	UNSIGNED 16	2
MENU 3	-	4500	Process control proportional gain	000.01 to 100.00	002.00	INTEGER 16	2
MENU 3	-	4501	Process control integral gain	000.01 to 100.00 s	002.00 s	INTEGER 16	2
MENU 3	-	4502	Process control derivative ratio	000.01 to 100.00 s	000.01 s	INTEGER 16	2
MENU 3	-	4504	Raise reference rate	00.01 to 20.00 %/s	00.10 %/s	INTEGER 16	2
MENU 3	-	4505	Lower reference rate	00.01 to 20.00 %/s	00.10 %/s	INTEGER 16	2
MENU 3	-	4508	Process droop	000.0 to 100.0 %	000.0 %	INTEGER 16	2
MENU 3	-	4509	Process filter	0 to 8	0	INTEGER 16	2
MENU 3	-	4510	Process high limit PU	000.0 to 150.0 %	075.0 %	INTEGER 16	2
MENU 3	-	4511	Process high limit DO	000.0 to 150.0 %	075.0 %	INTEGER 16	2
MENU 3	-	4513	Process low limit PU	000.0 to 150.0 %	050.0 %	INTEGER 16	2
MENU 3	-	4514	Process low limit DO	000.0 to 150.0 %	050.0 %	INTEGER 16	2
MENU 3	-	7500	Process high limit alarm	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 3	-	7501	Process low limit alarm	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 3	-	7502	Process switches	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 3	-	7559	Process control action	Direct ; 0 Indirect ; 1	0	UNSIGNED 16	2
MENU 4	-	1758	Gen. rated react. power	000000.1 to 999999.9 kvar	000200.0 kvar	UNSIGNED 32	2
MENU 4	-	1770	Generator voltage monitoring	Phase - phase ; 0 Phase - neutral ; 1	0	UNSIGNED 16	2
MENU 4	-	4536	Voltage low limit	000 to 150 %	90%	INTEGER 16	2
MENU 4	-	4537	Voltage high limit	000 to 150 %	110%	INTEGER 16	2
MENU 4	-	4543	VAR load share gain	000.00 to 100.00	000.50	INTEGER 16	2
MENU 4	-	4547	VAR load share factor	010 to 090 %	50%	INTEGER 16	2
MENU 4	-	5600	Voltage control setpoint	000050 to 650000 V	000480 V	UNSIGNED 32	1
MENU 4	-	5603	Voltage control setpoint ramp	001.00 to 300.00 %/s	005.00 %/s	UNSIGNED 16	2
MENU 4	-	5604	Reactive load droop	00.0 to 20.0 %	00.0 %	UNSIGNED 16	2

Namespace1	Namespace2	ID	Parameter Text	Setting Range	Default Value	Data Type	CL
MENU 4	-	5608	Voltage control initial state	000.0 to 100.0 %	050.0 %	UNSIGNED 16	2
MENU 4	-	5610	Voltage trim proportional gain	000.01 to 100.00	000.50	UNSIGNED 16	2
MENU 4	-	5611	Voltage trim integral gain	000.01 to 100.00	001.00	UNSIGNED 16	2
MENU 4	-	5612	Voltage trim derivative ratio	000.01 to 100.00	000.01	UNSIGNED 16	2
MENU 4	-	5613	VAR control proportional gain	000.01 to 100.00	000.50	UNSIGNED 16	2
MENU 4	-	5614	VAR control integral gain	000.01 to 100.00	001.00	UNSIGNED 16	2
MENU 4	-	5615	VAR control derivative ratio	000.01 to 100.00	000.01	UNSIGNED 16	2
MENU 4	-	5620	Power factor reference	-00.999 to 01.000	1.000	INTEGER 16	1
MENU 4	-	5622	Reactive power setpoint ramp	000.01 to 100.00 %/s	010.00 %/s	UNSIGNED 16	2
MENU 4	-	5650	Voltage ctrl deadband	0.1 to 9.9 %	1.0 %	UNSIGNED 16	1
MENU 4	-	5651	Time pulse minimum	0.01 to 2.00 s	0.05 s	UNSIGNED 16	1
MENU 4	-	5652	Gain factor	00.1 to 10.0	05.0	UNSIGNED 16	1
MENU 4	-	5653	Expand deadband factor	1.0 to 9.9	1.0	UNSIGNED 16	1
MENU 4	-	5654	Delay expand deadband	1.0 to 9.9 s	2.0 s	UNSIGNED 16	1
MENU 4	-	5660	Reactive power controller deadband	0.001 to 0.300	0.010	UNSIGNED 16	1
MENU 4	-	5661	Time pulse minimum	0.01 to 2.00 s	0.05 s	UNSIGNED 16	1
MENU 4	-	5662	Gain factor	00.1 to 10.0	05.0	UNSIGNED 16	1
MENU 4	-	5663	Expand deadband factor	1.0 to 9.9	1.0	UNSIGNED 16	1
MENU 4	-	5664	Delay expand deadband	1.0 to 9.9 s	2.0 s	UNSIGNED 16	1
MENU 4	-	7509	Voltage low alarm	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 4	-	7510	Voltage high alarm	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 4	-	7511	Voltage switch	Disabled ; 0 Enabled ; 1	1	UNSIGNED 16	2
MENU 4	-	7512	Voltage range alarm	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 4	-	7515	Three position controller	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 4	-	7558	VAR PF control mode	Disabled ; 0 PF control ; 1 VAR control ; 2	2	UNSIGNED 16	2
MENU 4	-	7635	VAR control setpoint sour-ce	Internal ; 0 Interface ; 1	0	UNSIGNED 16	2
MENU 4	-	7723	KVAR reference	-999999.9 to 999999.9 kvar	000010.0 kvar	SIGNED 32	2
MENU 5	System management	1701	Reset factory default values	No ; 0 Yes ; 1	0	UNSIGNED 16	0
MENU 5	-	1702	Device number	001 to 032	1	UNSIGNED 16	2
MENU 5	-	1750	System rated frequency	50Hz ; 0 60Hz ; 1	1	UNSIGNED 16	2
MENU 5	-	1754	Generator rated current	00001 to 32000 A	00300 A	UNSIGNED 16	2
MENU 5	-	1766	Generator rated voltage	000050 to 650000 V	000480 V	UNSIGNED 32	2
MENU 5	-	1781	Busbar rated voltage	000050 to 650000 V	000480 V	UNSIGNED 32	2
MENU 5	Transformer	1800	Gen. PT secondary rated volt.	050 to 480 V	120 V	UNSIGNED 16	2
MENU 5	Transformer	1801	Gen. PT primary rated vol-tage	000050 to 650000 V	000480 V	UNSIGNED 32	2

Namespace1	Namespace2	ID	Parameter Text	Setting Range	Default Value	Data Type	CL
MENU 5	Transformer	1803	Bus PT secondary rated volt.	050 to 480 V	120 V	UNSIGNED 16	2
MENU 5	Transformer	1804	Bus PT primary rated voltage	000050 to 650000 V	000480 V	UNSIGNED 32	2
MENU 5	Transformer	1806	Gen. CT primary rated current	00001 to 32000 A/x	00500 A/x	UNSIGNED 16	2
MENU 5	-	1850	Generator current input	L1 L2 L3 ; 0 Phase L1 ; 1 Phase L2 ; 2 Phase L3 ; 3	0	UNSIGNED 16	2
MENU 5	-	1851	Generator voltage measuring	3Ph 4W ; 0 3Ph 3W ; 1 n/a ; 2 n/a ; 3 3Ph 4W OD ; 4	1	UNSIGNED 16	2
MENU 5	-	1853	Aux bus voltage measuring	3Ph 4W ; 0 3Ph 3W ; 1	0	UNSIGNED 16	2
MENU 5	-	1858	1Ph2W voltage input	Phase - neutral ; 0 Phase - phase ; 1	1	UNSIGNED 16	2
MENU 5	-	1859	1Ph2W phase rotation	CW ; 0 CCW ; 1	0	UNSIGNED 16	2
MENU 5	Config_Serial1	3163	Baudrate	9600 Bd ; 0 14.4 kBd ; 1 19.2 kBd ; 2 38.4 kBd ; 3 56 kBd ; 4 115 kBd ; 5	2	UNSIGNED 16	2
MENU 5	Config_Serial2	3170	Baudrate	9600 Bd ; 0 14.4 kBd ; 1 19.2 kBd ; 2 38.4 kBd ; 3 56 kBd ; 4 115 kBd ; 5	2	UNSIGNED 16	2
MENU 5	Config_Serial2	3171	Parity	No ; 0 Even ; 1 Odd ; 2	0	UNSIGNED 16	2
MENU 5	Config_Serial2	3172	Stop bits	One ; 0 Two ; 1	0	UNSIGNED 16	2
MENU 5	Config_Serial2	3173	Full-, halfduplex mode	Halfduplex ; 0 Fullduplex ; 1	1	UNSIGNED 16	2
MENU 5	-	3181	Power [W] exponent 10^x	02 to 05	3	INTEGER 16	2
MENU 5	-	3182	Voltage [V] exponent 10^x	-01 to 02	0	INTEGER 16	2
MENU 5	-	3183	Current [A] exponent 10^x	-01 to 00	0	INTEGER 16	2
MENU 5	Config_Serial1	3185	Modbus slave ID	000 to 255	1	UNSIGNED 16	2
MENU 5	Config_Serial1	3186	Reply delay time	0.00 to 1.00 s	0.00 s	UNSIGNED 16	2
MENU 5	Config_Serial2	3188	Modbus slave ID	000 to 255	1	UNSIGNED 16	2
MENU 5	Config_Serial2	3189	Reply delay time	0.00 to 2.55 s	0.00 s	UNSIGNED 16	2
MENU 5	-	4060	Droop tracking missing device	Off ; 0 On ; 1	0	UNSIGNED 16	2
MENU 5	-	4063	Number of DSLC communicating	01 to 32	1	UNSIGNED 16	2
MENU 5	-	4544	Basic segment number	00001 to 00008	1	INTEGER 16	2
MENU 5	-	4707	Number of MSLC communicating	00000 to 00016	0	INTEGER 16	2
MENU 5	Network B	5430	TCP/IP address 0	000 to 255	192	UNSIGNED 16	2
MENU 5	Network B	5431	TCP/IP address 1	000 to 255	168	UNSIGNED 16	2
MENU 5	Network B	5432	TCP/IP address 2	000 to 255	1	UNSIGNED 16	2
MENU 5	Network B	5433	TCP/IP address 3	000 to 255	1	UNSIGNED 16	2
MENU 5	-	5800	Upper voltage limit	100 to 150 %	110%	UNSIGNED 16	2
MENU 5	-	5801	Lower voltage limit	050 to 100 %	90%	UNSIGNED	2

Namespace1	Namespace2	ID	Parameter Text	Setting Range	Default Value	Data Type	CL
						16	
MENU 5	-	5802	Upper frequency limit	100.0 to 150.0 %	110.0 %	UNSIGNED 16	2
MENU 5	-	5803	Lower frequency limit	050.0 to 100.0 %	090.0 %	UNSIGNED 16	2
MENU 5	-	7629	Auxiliary busbar available	No ; 0 Yes ; 1	0	UNSIGNED 16	2
MENU 5	System management	10401	Password for serial interface1	0000 to 9999	1805	UNSIGNED 16	0
MENU 5	System management	10404	Password for remote con-fig.	0000 to 9999	1805	UNSIGNED 16	0
MENU 5	System management	10411	Supercommissioning level code	0000 to 9999		UNSIGNED 16	5
MENU 5	System management	10412	Temp. supercomm. level code	0000 to 9999		UNSIGNED 16	5
MENU 5	System management	10413	Commissioning code level	0000 to 9999		UNSIGNED 16	3
MENU 5	System management	10414	Temp. commissioning code level	0000 to 9999		UNSIGNED 16	3
MENU 5	System management	10415	Basic code level	0000 to 9999		UNSIGNED 16	1
MENU 5	System management	10417	Factory default settings	No ; 0 Yes ; 1	0	UNSIGNED 16	0
MENU 5	System management	10430	Password for serial interface2	0000 to 9999	1805	UNSIGNED 16	0
MENU 5	System management	10435	Password for Ethernet port 2	0000 to 9999	1805	UNSIGNED 16	0
MENU 6	Remote Load Re-ference Input	4311	User defined min display value	-100.0 to 100.0 %	000.0 %	INTEGER 16	2
MENU 6	Remote Load Re-ference Input	4312	User defined max display value	000.0 to 100.0 %	100.0 %	INTEGER 16	2
MENU 6	Process Signal Input	4322	User defined min display value	-100.0 to 100.0 %	000.0 %	INTEGER 16	2
MENU 6	Process Signal Input	4323	User defined max display value	000.0 to 100.0 %	100.0 %	INTEGER 16	2
MENU 6	Reactive Load In-put	4333	User defined min display value	-00.999 to 00.999 PF	-00.710 PF	INTEGER 16	2
MENU 6	Reactive Load In-put	4334	User defined max display value	-00.999 to 00.999 PF	00.710 PF	INTEGER 16	2
MENU 6	Speed Bias	5201	Selected hardware type	Off ; 0 User defined ; 1 0-10mA / 0-5V ; 2 0-20mA / 0-10V ; 3 4 - 20mA ; 4 0.5 - 4.5V ; 5 10-0mA / 5-0V ; 6 20-0mA / 10-0V ; 7 20 - 4mA ; 8 4.5 - 0.5V ; 9 ±1V ; 10 ±2.5V ; 11 ±3V ; 12 ±10mA / ±5V ; 13 ±20mA / ±10V ; 14	3	UNSIGNED 16	2
MENU 6	Speed Bias	5202	PWM signal	Off ; 0 On ; 1	0	UNSIGNED 16	2
MENU 6	Speed Bias	5203	Filter time constant	Off ; 0 1 ; 1 2 ; 2 3 ; 3 4 ; 4 5 ; 5 6 ; 6 7 ; 7	0	UNSIGNED 16	2
MENU 6	Speed Bias	5208	User defined min. output value	000.00 to 100.00 %	000.00 %	UNSIGNED 16	2
MENU 6	Speed Bias	5209	User defined max. output value	000.00 to 100.00 %	100.00 %	UNSIGNED 16	2
MENU 6	Speed Bias	5210	PWM output level	00.00 to 10.00 V	10.00 V	UNSIGNED 16	2

Namespace1	Namespace2	ID	Parameter Text	Setting Range	Default Value	Data Type	CL
MENU 6	Voltage Bias	5215	Selected hardware type	Off ; 0 User defined ; 1 0-10mA / 0-5V ; 2 0-20mA / 0-10V ; 3 4 - 20mA ; 4 0.5 - 4.5V ; 5 10-0mA / 5-0V ; 6 20-0mA / 10-0V ; 7 20 - 4mA ; 8 4.5 - 0.5V ; 9 ±1V ; 10 ±2.5V ; 11 ±3V ; 12 ±10mA / ±5V ; 13 ±20mA / ±10V ; 14	3	UNSIGNED 16	2
MENU 6	Voltage Bias	5216	PWM signal	Off ; 0 On ; 1	0	UNSIGNED 16	2
MENU 6	Voltage Bias	5217	Filter time constant	Off ; 0 1 ; 1 2 ; 2 3 ; 3 4 ; 4 5 ; 5 6 ; 6 7 ; 7	0	UNSIGNED 16	2
MENU 6	Voltage Bias	5222	User defined min. output value	000.00 to 100.00 %	000.00 %	UNSIGNED 16	2
MENU 6	Voltage Bias	5223	User defined max. output value	000.00 to 100.00 %	100.00 %	UNSIGNED 16	2
MENU 6	Voltage Bias	5224	PWM output level	00.00 to 10.00 V	10.00 V	UNSIGNED 16	2
MENU 6	Remote Load Reference Input	7711	HW signal	0 - 20mA ; 0 4 - 20mA ; 1 0 - 10V ; 2 0 - 5V ; 3 1 - 5V ; 4	3	UNSIGNED 16	2
MENU 6	Process Signal Input	7712	HW signal	0 - 20mA ; 0 4 - 20mA ; 1 0 - 10V ; 2 0 - 5V ; 3 1 - 5V ; 4	4	UNSIGNED 16	2
MENU 6	Reactive Load Input	7713	HW signal	0 - 20mA ; 0 4 - 20mA ; 1 0 - 10V ; 2 0 - 5V ; 3 1 - 5V ; 4	4	UNSIGNED 16	2
MENU 6	-	7732	Process engineering unit	kW ; 0 °C ; 1 kPa ; 2 bar ; 3 V ; 4 mA ; 5	0	UNSIGNED 16	2
MENU 6	-	7733	Process min value	-999999.9 to 999999.9	000000.0	SIGNED 32	2
MENU 6	-	7734	Process max value	-999999.9 to 999999.9	000500.0	SIGNED 32	2
MENU 6	-	7735	Remote load ref min value	-999999.9 to 999999.9 kW	000000.0 kW	SIGNED 32	2
MENU 6	-	7736	Remote load ref max value	-999999.9 to 999999.9 kW	000500.0 kW	SIGNED 32	2
MENU 6	-	7737	Process reference	-999999.9 to 999999.9	000000.0	SIGNED 32	2

Appendix E.
Service Options

Product Service Options

The following factory options are available for servicing Woodward equipment, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is purchased from Woodward or the service is performed. If you are experiencing problems with installation or unsatisfactory performance of an installed system, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In most cases, your problem can be resolved over the phone. If not, you can select which course of action you wish to pursue based on the available services listed in this section.

Returning Equipment For Repair

If a control (or any part of an electronic control) is to be returned to Woodward for repair, please contact Woodward in advance to obtain a Return Authorization Number. When shipping the unit(s), attach a tag with the following information:

- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part numbers (P/N) and serial number (S/N);
- description of the problem;
- instructions describing the desired type of repair.

CAUTION

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards and Modules.*

Packing A Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

Return Authorization Number RAN

When returning equipment to Woodward, please telephone and ask for the Customer Service Department in Stuttgart [+49 (0) 711 789 54-0]. They will help expedite the processing of your order through our distributors or local service facility. To expedite the repair process, contact Woodward in advance to obtain a Return Authorization Number and arrange for issue of a purchase order for the unit(s) to be repaired. No work can be started until a purchase order is received.

NOTE

We highly recommend that you make arrangement in advance for return shipments. Contact a Woodward customer service representative at +49 (0) 711 789 54-0 for instructions and for a Return Authorization Number.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part numbers P/N (XXXX-XXX) that is on the enclosure nameplate;
- the unit serial number S/N, which is also on the nameplate.

How To Contact Woodward

Please contact following address if you have questions or if you want to send a product for repair:

Woodward GmbH
Handwerkstrasse 29
70565 Stuttgart - Germany

Phone: +49 (0) 711 789 54-0 (8.00 - 16.30 German time)
Fax: +49 (0) 711 789 54-100
e-mail: stgt-info@woodward.com

For assistance outside Germany, call one of the following international Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Facility	Phone number
USA	+1 (970) 482 5811
India	+91 (129) 409 7100
Brazil	+55 (19) 3708 4800
Japan	+81 (476) 93 4661
The Netherlands	+31 (23) 566 1111

You can also contact the Woodward Customer Service Department or consult our worldwide directory on Woodward's website (**www.woodward.com**) for the name of your nearest Woodward distributor or service facility. [For worldwide directory information, go to **www.woodward.com/ic/locations**.]

Engineering Services

Woodward Industrial Controls Engineering Services offers the following after-sales support for Woodward products. For these services, you can contact us by telephone, by e-mail or through the Woodward website.

- Technical support
- Product training
- Field service during commissioning

Technical Support is available through our many worldwide locations, through our authorized distributors or through GE Global Controls Services, depending on the product. This service can assist you with technical questions or problem solving during normal business hours. Emergency assistance is also available during non-business hours by phoning our toll-free number and stating the urgency of your problem. For technical engineering support, please contact us via our toll-free or local phone numbers, e-mail us or use our website and reference technical support.

Product Training is available on-site from several of our worldwide facilities, at your location or from GE Global Controls Services, depending on the product. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability. For information concerning training, please contact us via our toll-free or local phone numbers, e-mail us or use our website and reference ***customer training***.

Field Service engineering on-site support is available, depending on the product and location, from our facility in Colorado or from one of many worldwide Woodward offices or authorized distributors. Field engineers are experienced on both Woodward products as well as on much of the non-Woodward equipment with which our products interface. For field service engineering assistance, please contact us via our toll-free or local phone numbers, e-mail us or use our website and reference ***field service***.

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Contact

Your company ______________________________

Your name ______________________________

Phone number ______________________________

Fax number ______________________________

Control (see name plate)

Unit no. and revision: P/N: ____________ REV: ____________

Unit type ______________________________

Serial number S/N ______________________________

Description of your problem

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Please be sure you have a list of all parameters available. You can print this using ToolKit. Additionally you can save the complete set of parameters (standard values) and send them to our Service department via e-mail.

We appreciate your comments about the content of our publications.
Please send comments to: stgt-documentation@woodward.com
Please include the manual number from the front cover of this publication.

Woodward GmbH
Handwerkstrasse 29 - 70565 Stuttgart - Germany
Phone +49 (0) 711 789 54-0 • Fax +49 (0) 711 789 54-100
stgt-info@woodward.com

Homepage

http://www.woodward.com

Woodward has company-owned plants, subsidiaries and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address/phone/fax/e-mail information for all locations is available on our website (www.woodward.com).

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