37444A

WOODWARD

MSLC-2
Master Synchronizer and Load Control

Manual
Software Version 1.14xx

MSLC-2

Manual 37444A

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: Master synchronizer and load control (MSLC-2)with software revision 1.1404 or higher and device revision A or higher.* • Synchronizer description: Manual synchronizing. Refer to “Manual Synchronizing” on page 140 for details. • Modbus communication: Loss of connection. Refer to “Loss Of Connection” on page 165 for details.

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Chapter 1. General Information

Document Overview

This manual describes the Woodward MSLC-2™ Master Synchronizer and Load Control.

	Type		English	German
MSLC-2				
	DSLC-2 – User Manual		37443	-
	MSLC-2 – User Manual	this 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 MSLC-2™ control is the direct successor of the former MSLC™ master synchronizer and load control. The MSLC-2™ is a microprocessor-based overall plant load control designed for use in a system with Woodward DSLC-2™ ("Digital Synchronizer and Load Control") controls on each generator to provide utility synchronizing, paralleling, loading and unloading of a three-phase generating system.

Applications allow up to 32 generators to be paralleled and controlled in conjunction with up to 16 MSLC-2. 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. Additionally a Modbus RTU is available through a separate RS-485 port.

MSLC-2 function summary

Original MSLC functions include:

- Selectable for phase matching or slip frequency synchronizing between the utility and a local bus with voltage matching
- Automatic system loading and unloading for bumpless load transfer
- Import/export level control capability
- Process control for cogeneration, pressure, maintenance or other process
- Proportional loading of associated DSLC-2 controls in isochronous load sharing
- Adjustable power factor control
- Built in diagnostics with relay output
- Multifunction adjustable high and low limit alarms and adjustable load switches with relay outputs
- Digital communications network to provide loading and power factor control of individual DSLC-2 equipped generators

Additional MSLC-2 functions include:

- Automatic dead bus closure capability for tie-breakers
- Multiple utility breaker and tie-breaker MSLC-2s on the same bus segment
- One dedicated Ethernet line for precise system communications between all DSLC-2s and MSLC-2s 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)
- 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 ensures that the initial flow of power will be either out of the local system (export) or into the local system (import), depending on whether a positive or negative slip is chosen. For both synchronizing methods, the MSLC-2 uses actual slip frequency and breaker delay values to anticipate an adjustable minimum phase difference between the utility and the local bus. Additional synchronizer functions 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.

The MSLC-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.

The MSLC-2, configured as tie-breaker control, allows selecting different closure modes or all modes:
- Alive bus A -> dead bus B
- Dead bus A -> dead bus B
- Alive bus B -> dead bus A

Load Control

The MSLC-2 has 4 load control modes available:
- Base load
- Import/export
- Process
- Utility unload

Load control begins with the breaker closure of the utility and another discrete input selecting the load control mode wanted. If no load control mode is selected the MSLC-2 will be in the offline mode. The system load immediately prior to breaker closure is used as the starting base load reference. On command, the adjustable ramp allows smooth, timecontrolled loading into a set import/export level. A ramp pause switch is provided to stop the ramp at any point.

The import/export control is an integrating control. It adjusts the percentage of rated load carried by the individual generators, operating in isochronous load sharing, in order to maintain a set import/export or base load level. The MSLC-2 will maintain a constant base load or import/export level even with changing utility frequencies. The MSLC-2 provides switch inputs to allow raising or lowering the internal digital base load or import/export reference. The control also provides a remote analog signal input for reference setting, if desired. (signal variety: 0 to 20mA, 4 to 20mA, 0 to 5V, 1 to 5V and 0 to 10V)

The MSLC-2 is equipped with a utility unload switch, which provides an adjustable time controlled ramp to lower the base load or import/export level. When the level is below an adjustable threshold, the MSLC-2 issues a breaker open command to separate the utility from the local bus. The ramp pause switch can be used to stop the utility unload at any point. The maximum load that the MSLC-2 can tell the individual generators to carry is their rated loads. So, in the event that the plant load is greater than the capacity of the operating generators, the utility unload will stop when 100% rated load is reached on each of the operating generators. This prevents accidental overloading of the local generators.

The MSLC-2 also includes two adjustable load switches which can be used for external functions or warnings when chosen system load levels are attained. The high and low limit switches may also be activated when 100% or 0% load signal to the generators is reached.

Process Control

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

An analog signal input (signal variety: 0 to 20mA, 4 to 20mA, 0 to 5V, 1 to 5V and 0 to 10V) provides the process signal to the MSLC-2. The MSLC-2 includes an internal digital process reference which may be controlled by the raise and lower switch contact inputs or by an external analog input signal as remote process reference. The MSLC-2 also has a Modbus address for process reference control. The output of the process control, like the import/export control, is the percentage of rated load setpoint to the individual generators in isochronous load sharing.

An adjustable ramp allows smooth entry and exit from the process control mode. When the process control mode is selected, the load reference is ramped in a direction to reduce the error between the process input and the process reference. When the error is minimized or the reference first reaches either the high or low specified limits, the process controllers PID loop is activated. When the load reference output reaches either 100% or 0%, the control will maintain that load reference until process control is established. The MSLC-2 is not capable of overloading or reverse powering the generators in an attempt to meet the process reference. The high and low limit switches mentioned above can be used to indicate that either too many or too few generators are online to maintain the process within its limits.

Var/PF Control

The var/PF function controls the power factor on all of the DSLC-2 equipped machines operating in isochronous load sharing. The PF control begins on breaker closure. The MSLC-2 has three modes of Var/PF control (which are selected in Menu 4):

- Constant generator power factor – sets the power factor reference on all of the DSLC-2 controls to the internal reference chosen in the MSLC-2. The power factor can then be adjusted using the voltage raise and lower inputs. The voltage raise command will make the power factor more lagging. Conversely, the voltage lower command will make the power factor more leading.
- Utility tie power factor control – adjusts the power factor reference on all of the DSLC-2 controls in isochronous load sharing in order to maintain the power factor across the utility tie.
- Utility tie var control – adjusts the power factor reference on all of the DSLC-2 controls in isochronous load sharing in order to maintain the level of vars being imported or exported from the utility.

The var/PF control mode begins with the load control mode selected. The constant generator power factor and the utility tie power factor control can have the reference setting controlled by an analog input (see Menu 6). By closing the voltage raise and lower discrete inputs you can select the analog remote input for reference control.

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:

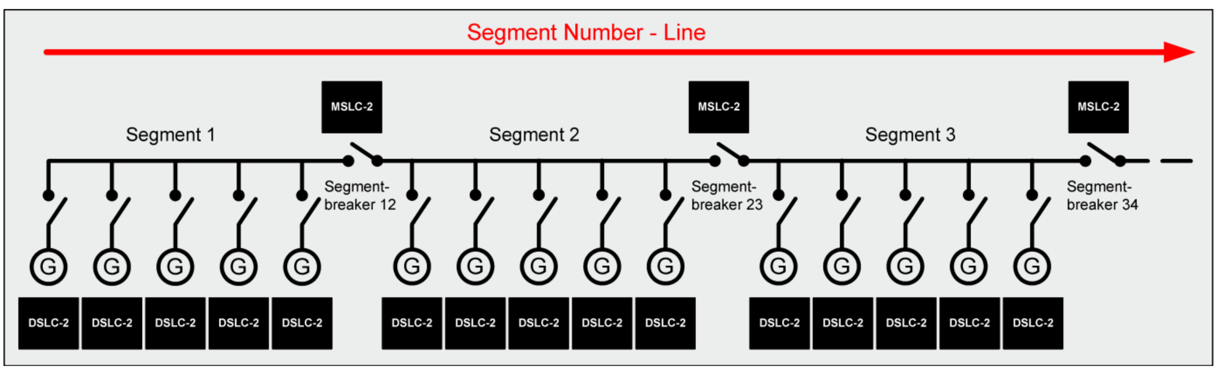


Figure 1-2: Multiple generators in isolated operation with tie-breaker

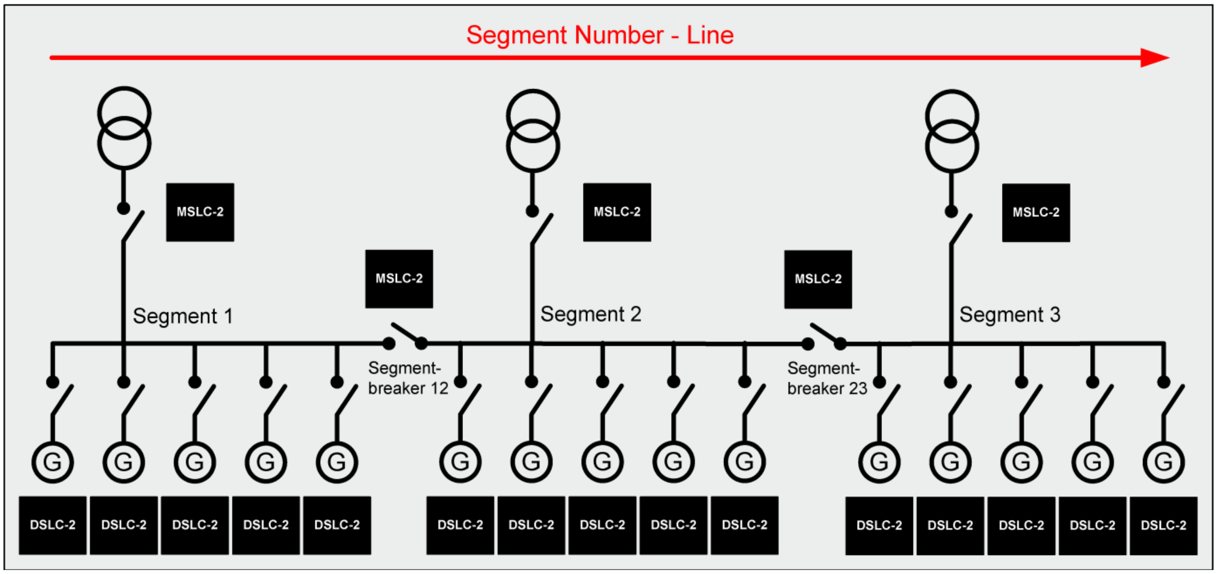


Figure 1-3: Multiple generators in isolated and utility parallel operation with utility- and tie-breaker

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 MSLC-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 MSLC-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

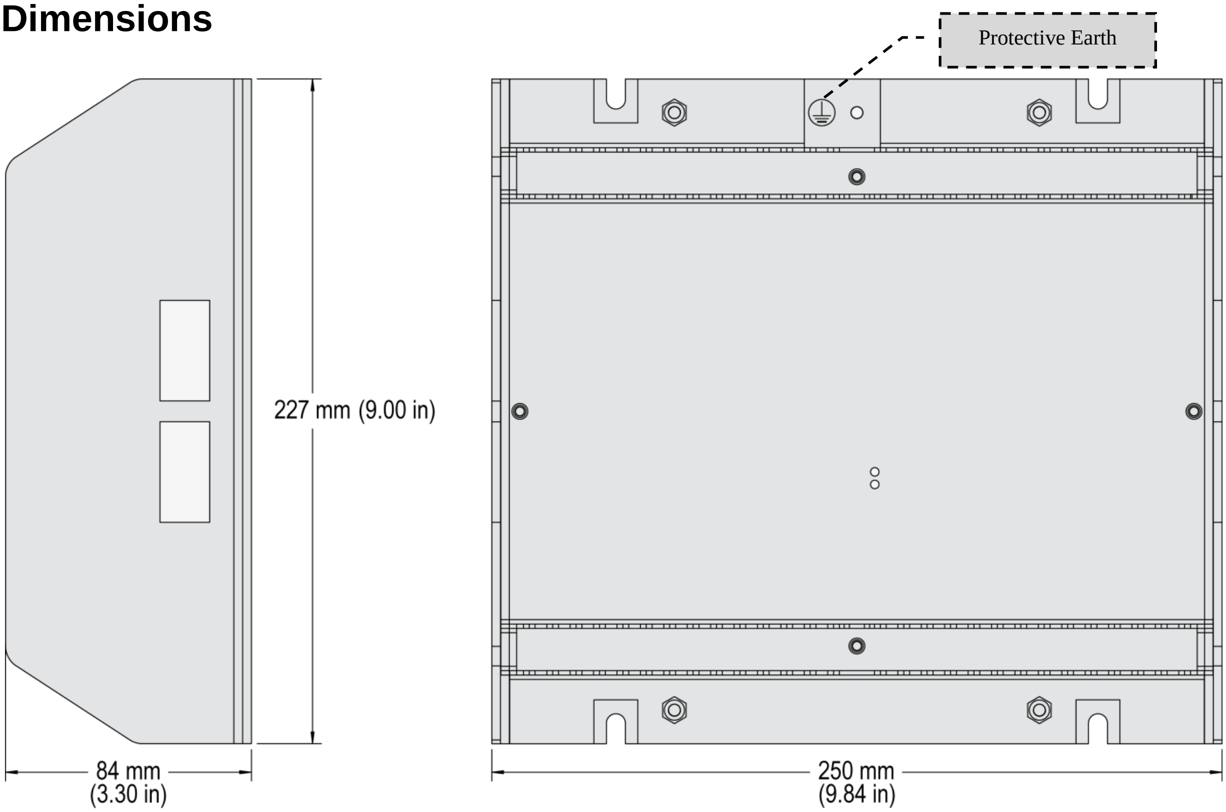


Figure 2-1: Housing MSLC-2 - dimensions

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).

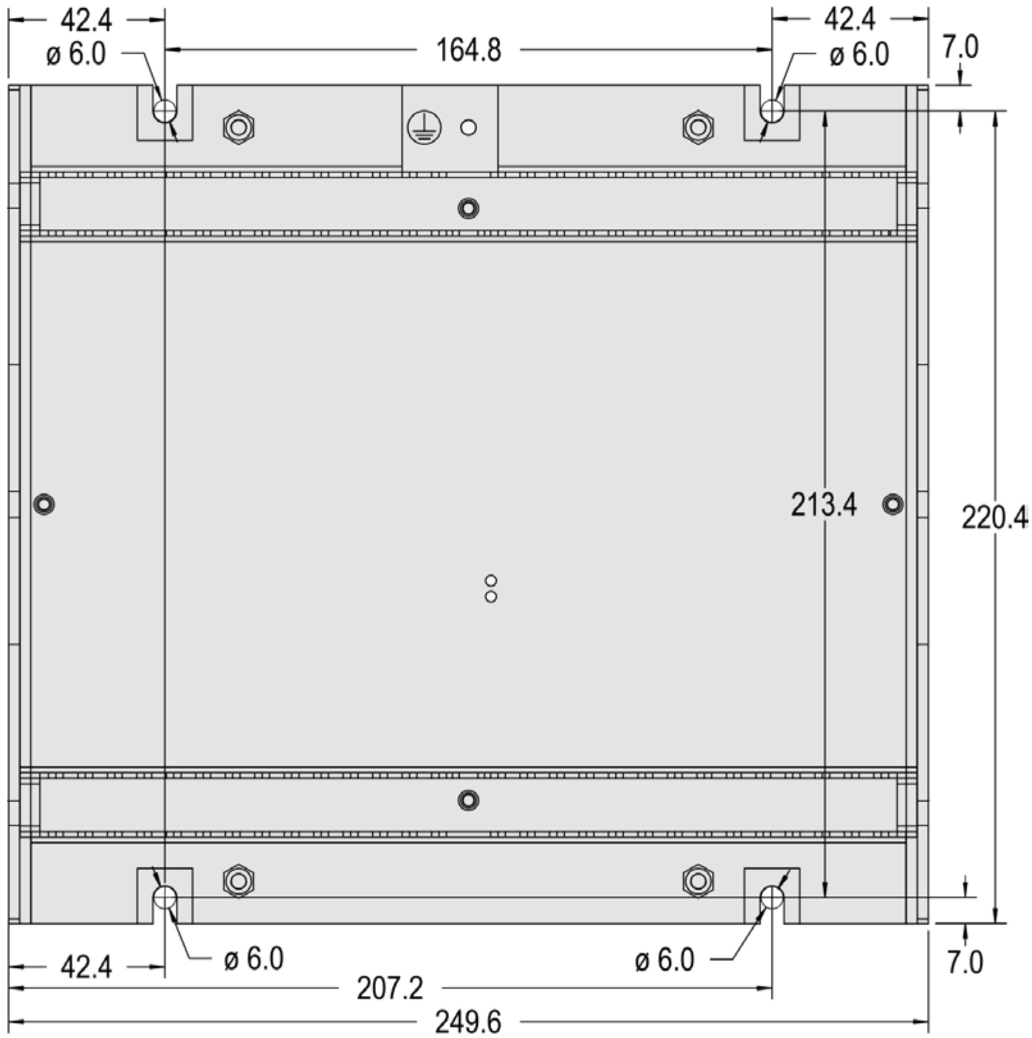


Figure 2-2: Housing - drill plan

Terminal Arrangement

NOTE

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

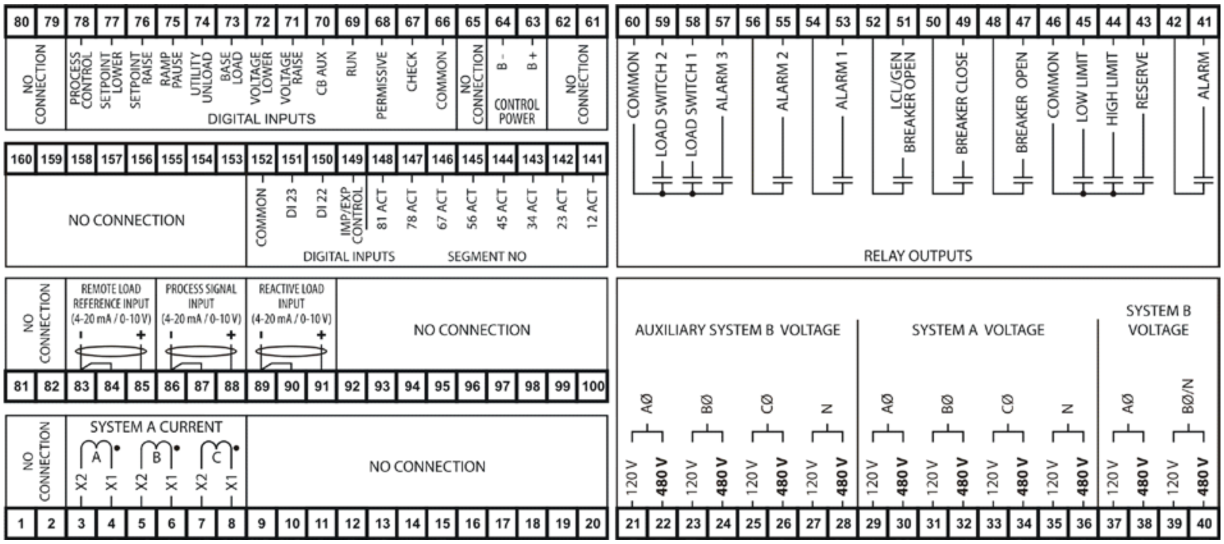


Figure 2-3: MSLC-2 - terminal arrangement

Wiring Diagrams

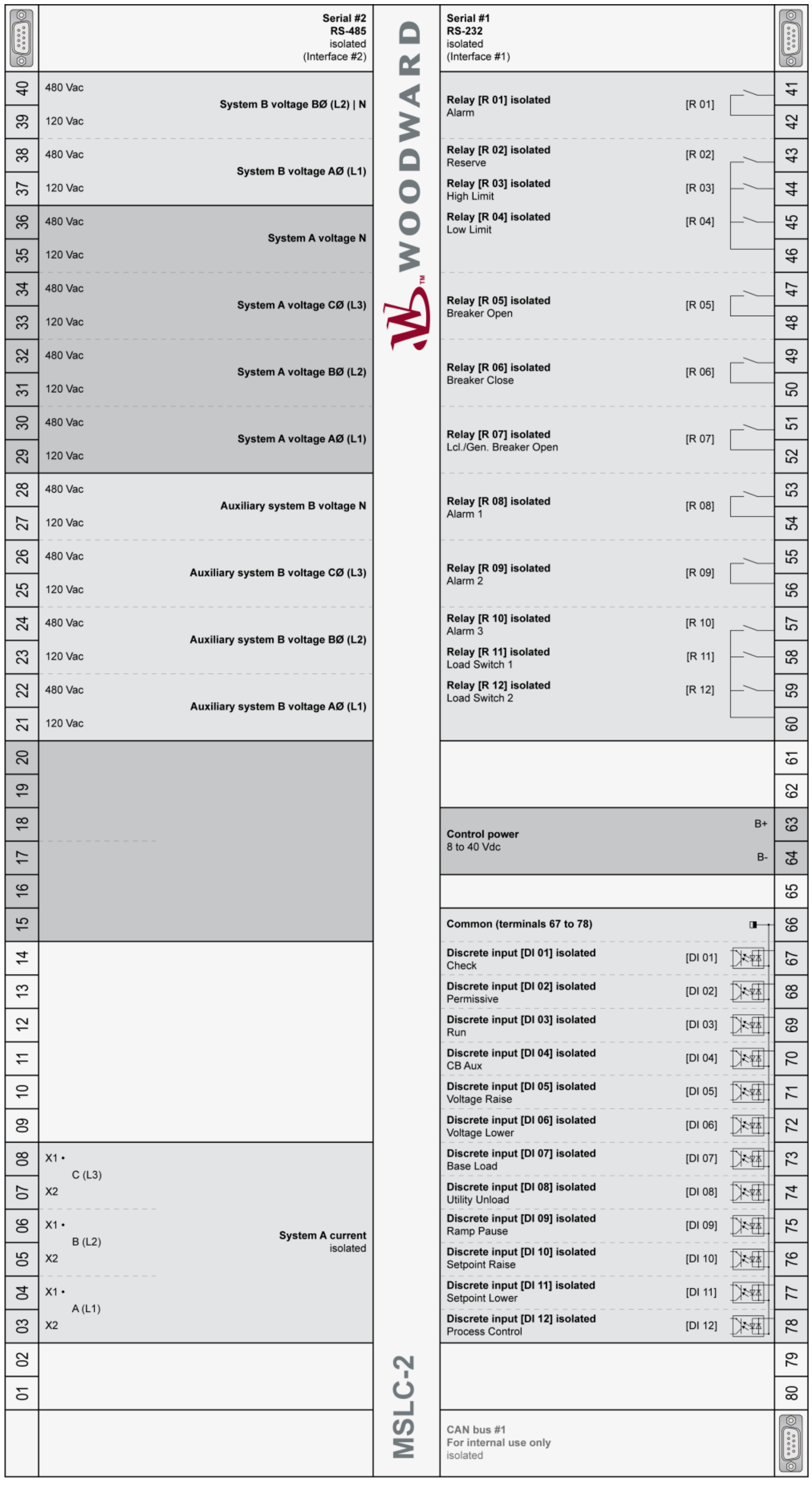


Figure 2-4: Wiring diagram - MSLC-2 - 1/2

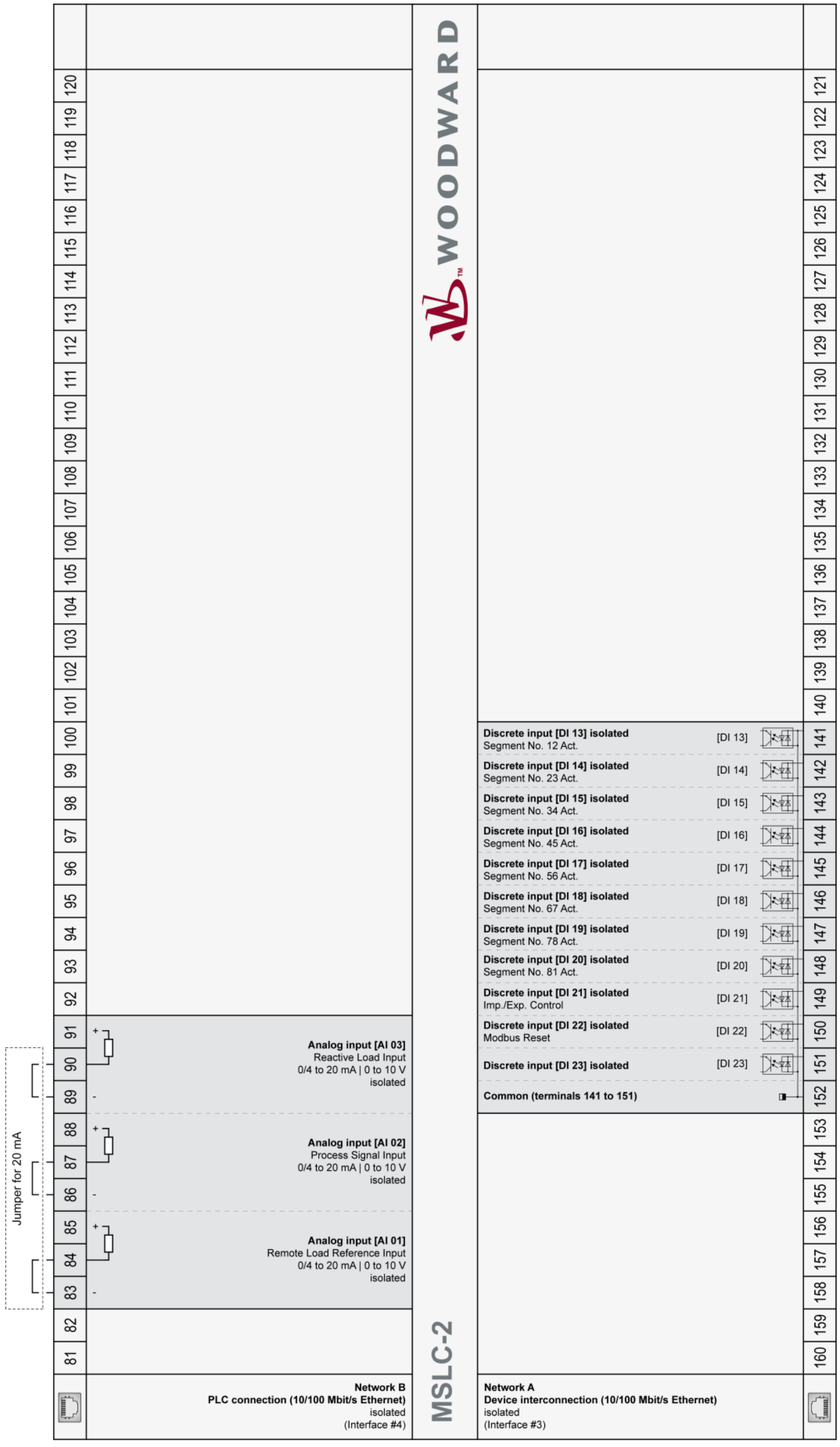


Figure 2-5: Wiring diagram - MSLC-2 - 2/2

Connections

WARNING

All technical data and ratings indicated in this chapter are not definite! Only the values indicated in paragraph Appendix A. Technical Data on page 174 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).

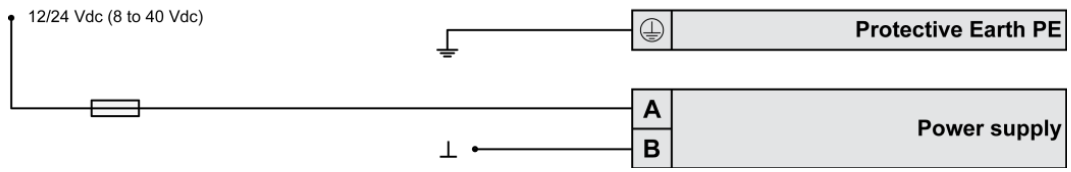


Figure 2-6: Power supply

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

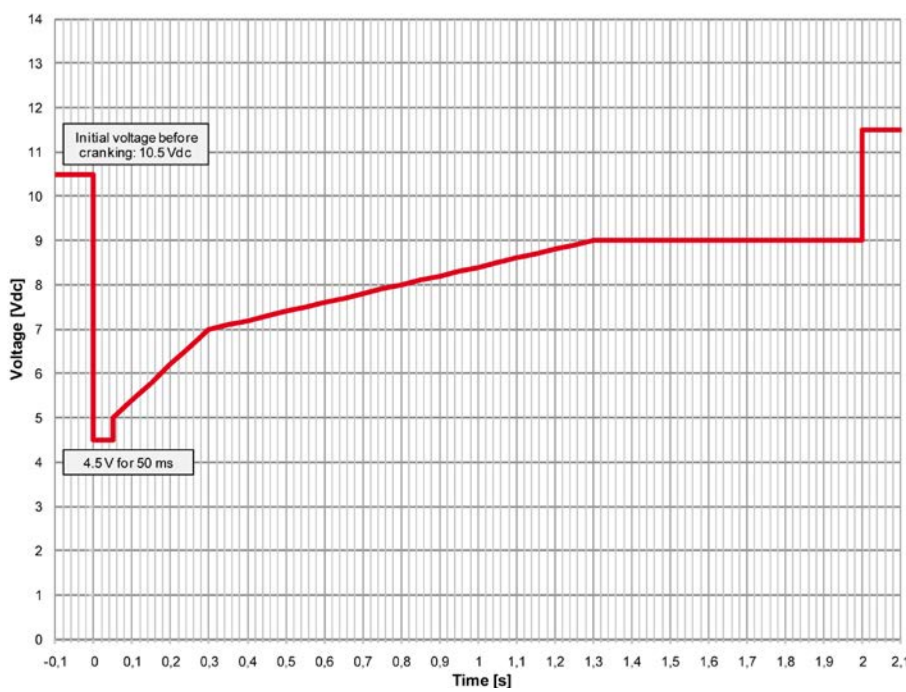


Figure 2-7: Power supply - crank waveform at maximum load

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: System A

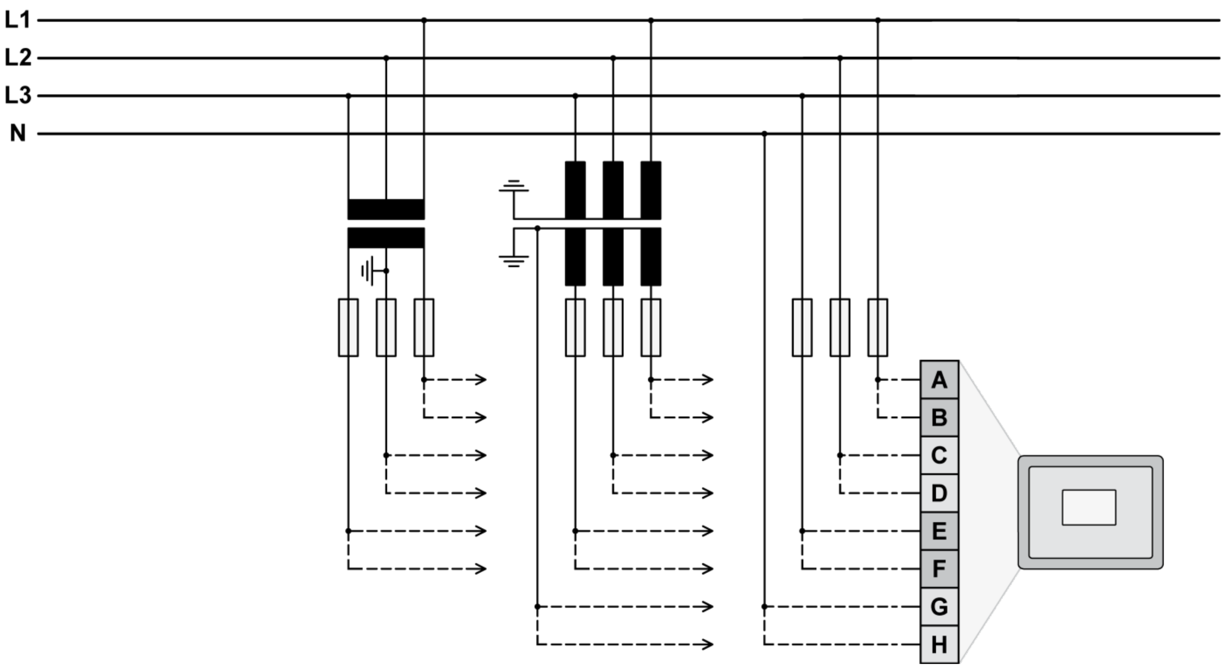


Figure 2-8: Voltage measuring – system A

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

Table 2-3: Voltage measuring – terminal assignment – system A voltage

NOTE

If parameter 1800 ("System A 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 ("System A 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: System A

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.

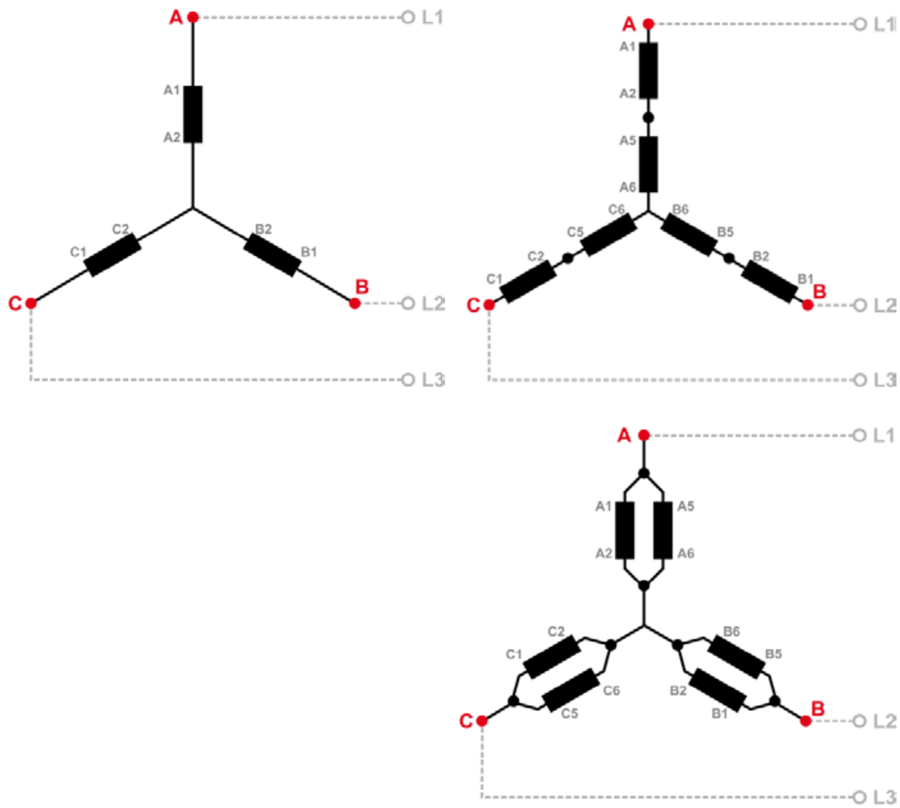


Figure 2-9: VVoltage measuring – system A windings, 3Ph 4W OD

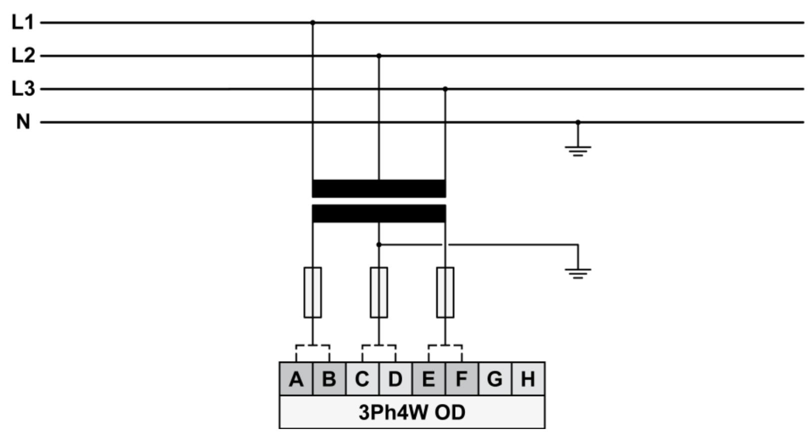


Figure 2-10: Voltage measuring – system A measuring inputs, 3Ph 4W OD

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	
MSLC-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 – system A, 3Ph 4W OD

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

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

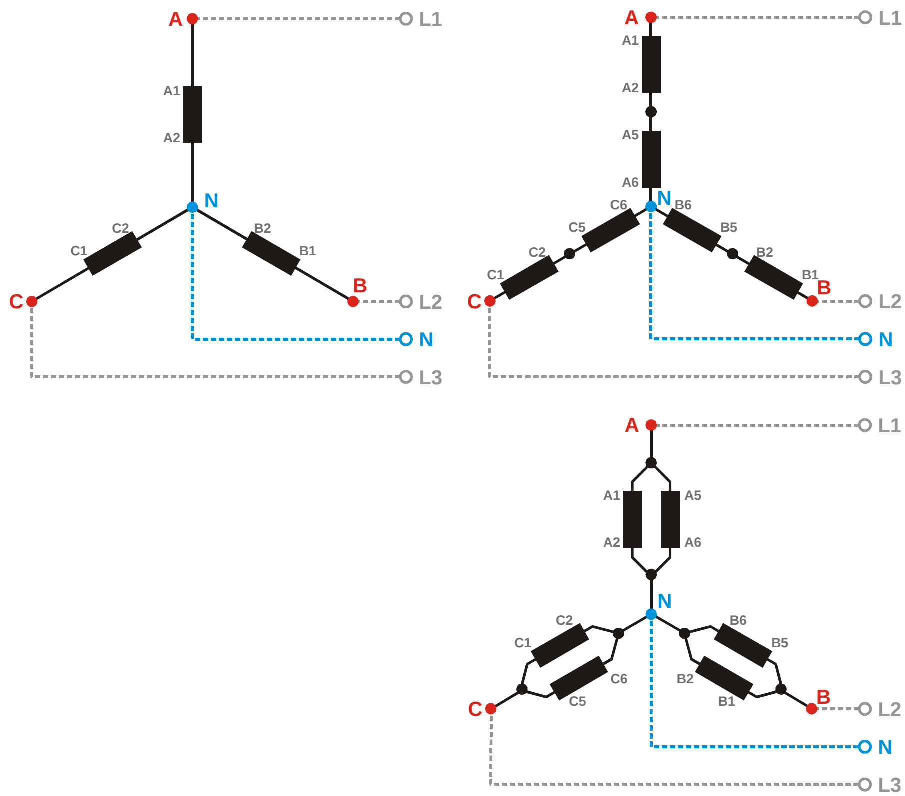


Figure 2-11: Voltage measuring – system A windings, 3Ph 4W

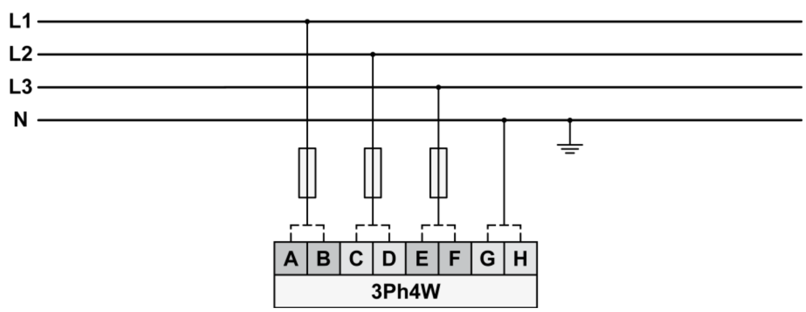


Figure 2-12: Voltage measuring – system A measuring inputs, 3Ph 4W

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	
MSLC-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 – system A, 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: System A, Parameter Setting '3Ph 3W' (3-phase, 3-wire)

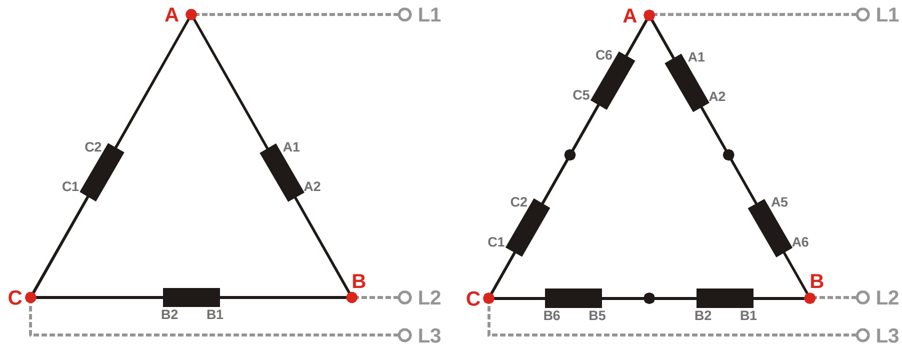


Figure 2-13: Voltage measuring – system A windings, 3Ph 3W

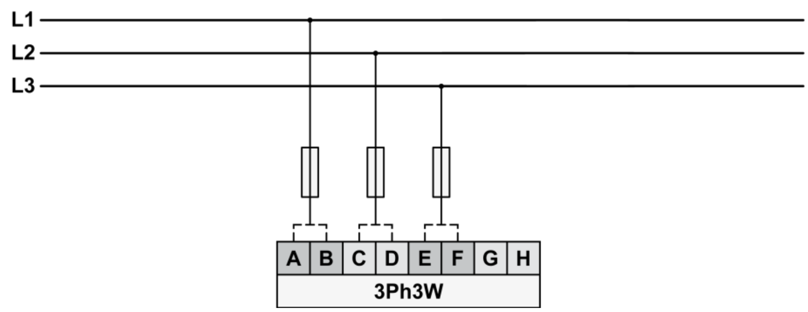


Figure 2-14: Voltage measuring – system A measuring inputs, 3Ph 3W

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	
MSCL-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 – system A, 3Ph 3W

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

Voltage Measuring: System B

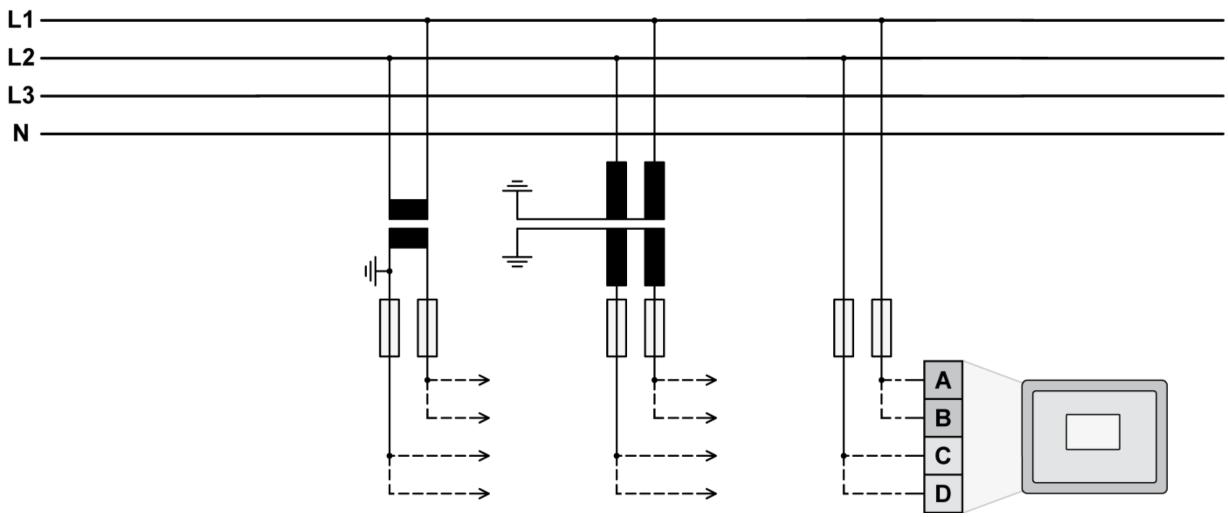


Figure 2-15: Voltage measuring – system B

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

Table 2-7: Voltage measuring - terminal assignment – system B voltage

NOTE

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

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

Voltage Measuring: System B, 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 MSLC-2 consistently. Refer to the chapter Configuration & Operation.

'1Ph 2W' Phase-Neutral Measuring

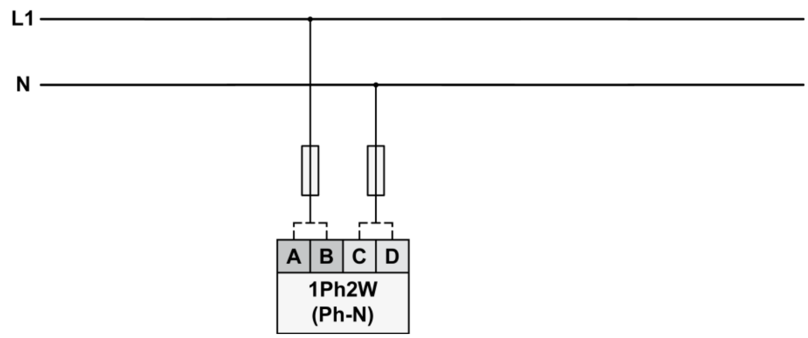


Figure 2-16: Voltage measuring – system B measuring inputs, 1Ph 2W (phase-neutral)

1Ph 2W	Wiring terminals								Note
Rated voltage (range)	[1] 120 V (50 to 130 $V_{eff.}$)				[4] 480 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	---	---	
MSLC-2 terminal	37	39	---	---	38	40	---	---	
Phase	L1 / AØ	N	---	---	L1 / AØ	N	---	---	

Table 2-8: Voltage measuring - terminal assignment – system B, 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

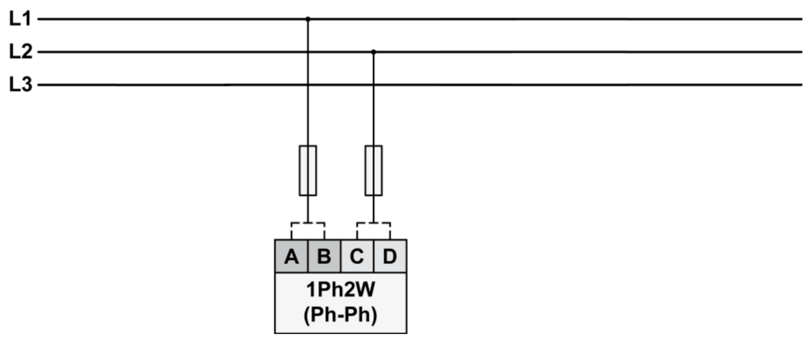


Figure 2-17: Voltage measuring – system B measuring inputs, 1Ph 2W (phase-phase)

1Ph 2W	Wiring terminals								Note
Rated voltage (range)	[1] 120 V (50 to 130 $V_{eff.}$)				[4] 480 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	---	---	
MSLC-2 terminal	37	39	---	---	38	40	---	---	
Phase	L1 / AØ	L2 / BØ	---	---	L1 / AØ	L2 / BØ	---	---	

Table 2-9: Voltage measuring - terminal assignment – system B, 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 System B

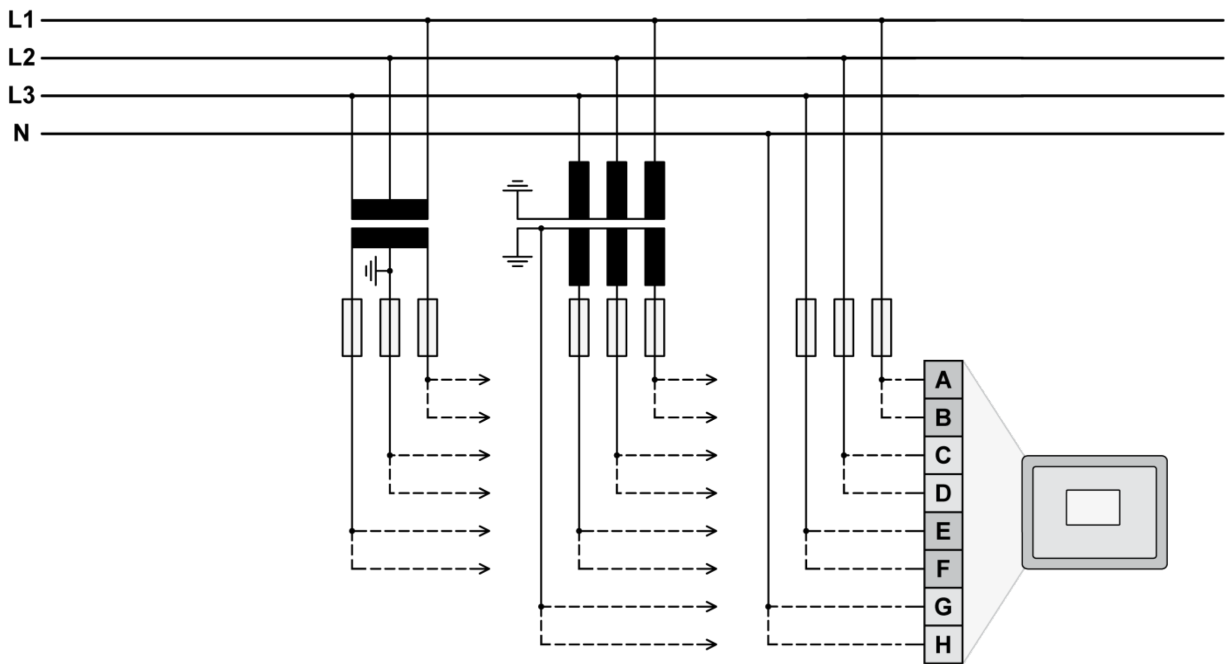


Figure 2-18: Voltage measuring – auxiliary system B

Figure	Terminal	Description		A_{max}
A	21	Auxiliary System B Voltage AØ (L1)	120 Vac	2.5 mm²
B	22		480 Vac	2.5 mm²
C	23	Auxiliary System B Voltage BØ (L2)	120 Vac	2.5 mm²
D	24		480 Vac	2.5 mm²
E	25	Auxiliary System B Voltage CØ (L3)	120 Vac	2.5 mm²
F	26		480 Vac	2.5 mm²
G	27	Auxiliary System B Voltage N	120 Vac	2.5 mm²
H	28		480 Vac	2.5 mm²

Table 2-10: Voltage measuring - terminal assignment - auxiliary system B voltage

NOTE

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

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

NOTE

If the MSLC-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 system B and auxiliary system B voltage measuring inputs may be installed.

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

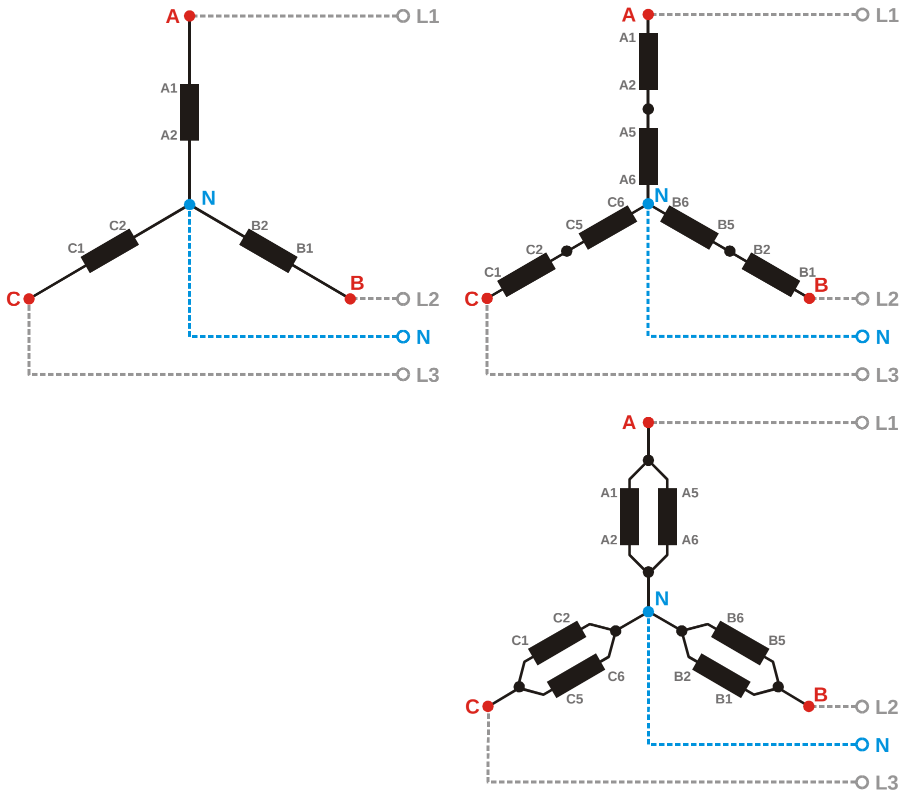


Figure 2-19: Voltage measuring - auxiliary system B PT windings, 3Ph 4W

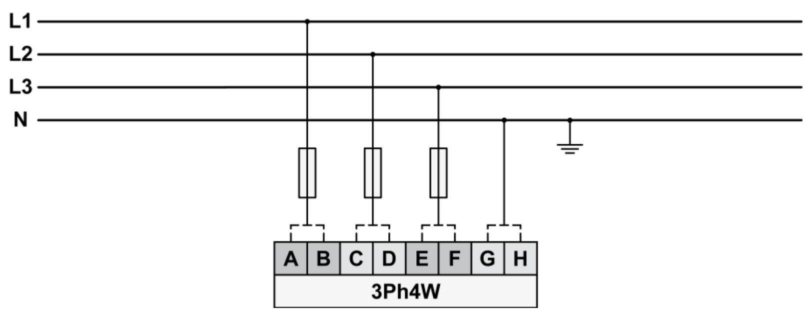


Figure 2-20: Voltage measuring - auxiliary system B measuring inputs, 3Ph 4W

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	
MSLC-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 system B, 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 System B, Parameter Setting '3Ph 3W' (3-phase, 3-wire)

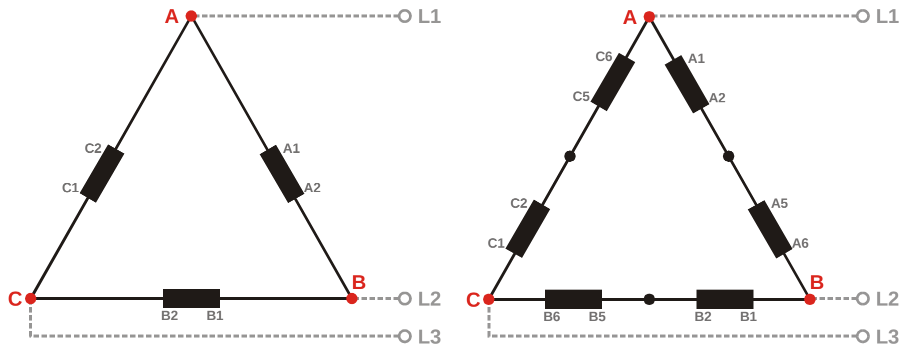


Figure 2-21: Voltage measuring - auxiliary system B PT windings, 3Ph 3W

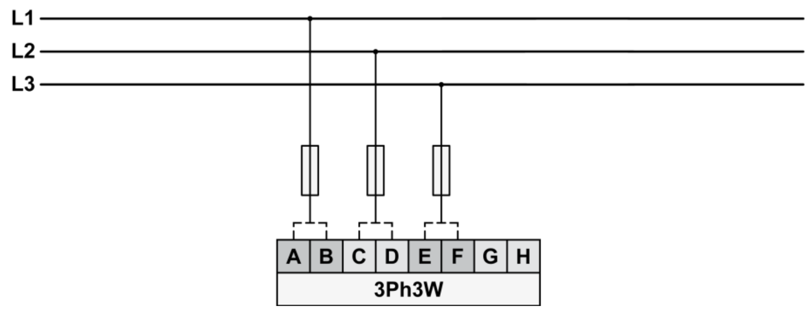


Figure 2-22: Voltage measuring - auxiliary system B measuring inputs, 3Ph 3W

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	
MSLC-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 system B, 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.

System A Current

NOTE

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

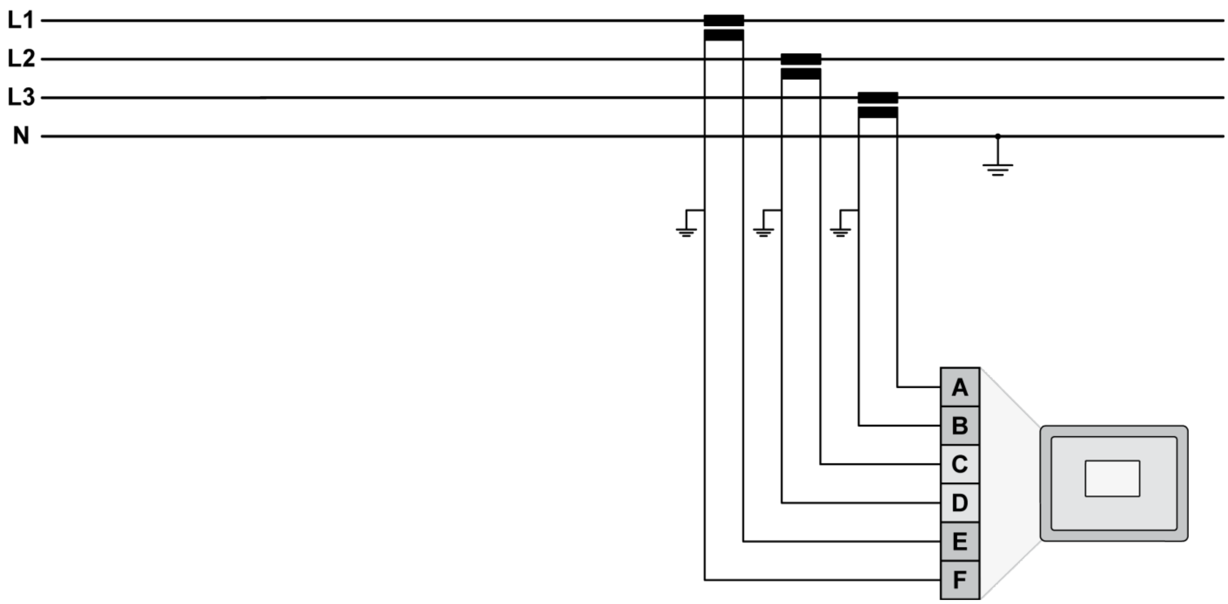


Figure 2-23: Current measuring – system A

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

Table 2-13: Current measuring - terminal assignment – system A current

Current Measuring: System A, Parameter Setting 'L1 L2 L3'

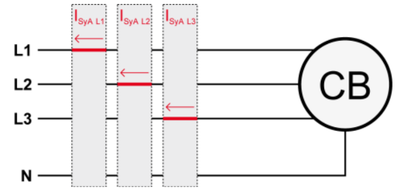


Figure 2-24: Current measuring – system A, L1 L2 L3

L1 L2 L3	Wiring terminals						Notes
MSLC-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 – system A, L1 L2 L3

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

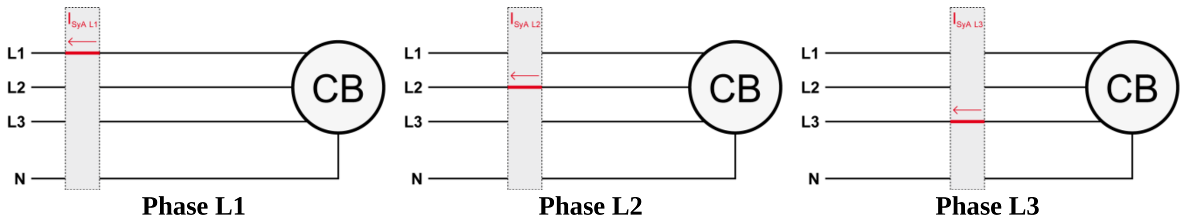


Figure 2-25: Current measuring - system A, phase Lx

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

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

Power Measuring

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

Utility Breaker MSLC-2		
Parameter	**Description**	**Sign displayed**
Mains real power	Importing Kw (from Utility) Powerflow from System A to System B	+ Positive KW
Mains real power	Exporting Kw (to Utility) Powerflow from System A to System B	- Negative KW
Mains power factor (cos φ)	Inductive / lagging	+ Positive
Mains power factor (cos φ)	Capacitive / leading	- Negative
Tie-Breaker MSLC-2		
Parameter	**Description**	**Sign displayed**
System A real power	Powerflow from System A to System B in kW	+ Positive
System A real power	Powerflow from System A to System B in kW	- Negative
System A power factor (cos φ)	Inductive / lagging reactive-powerflow from System A to System B	+ Positive
System A power factor (cos φ)	Capacitive / leading reacti-vepowerflow from System A to System B	- Negative

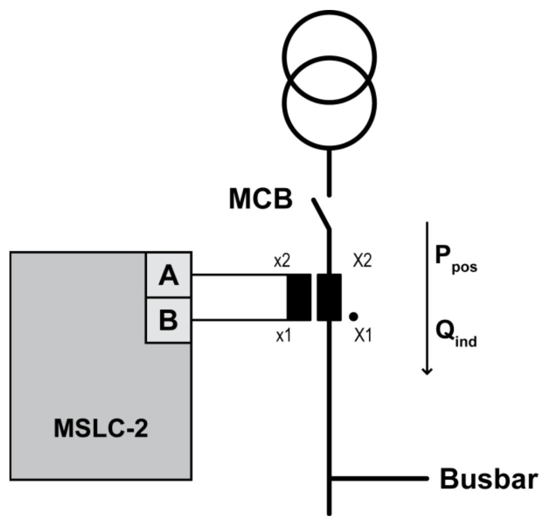


Figure 2-26: Power measuring - direction of power

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

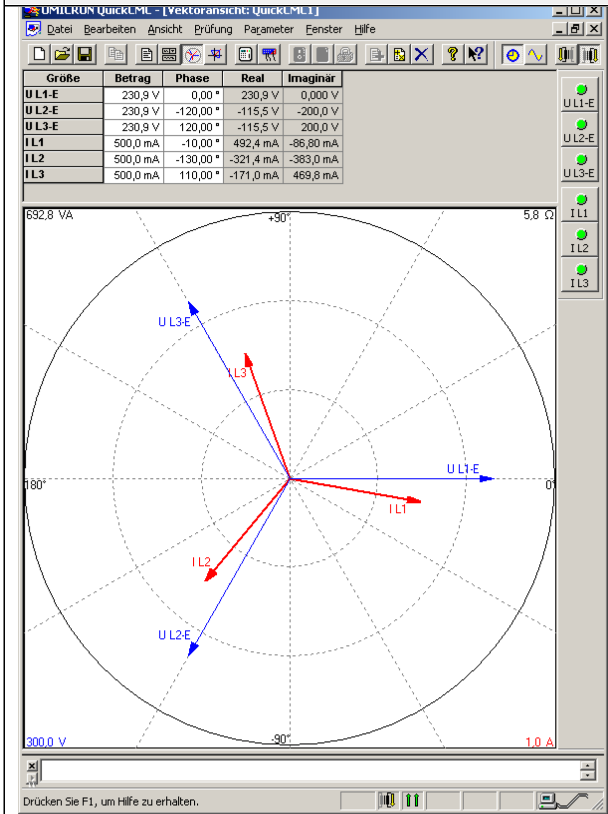
over excited	under excited

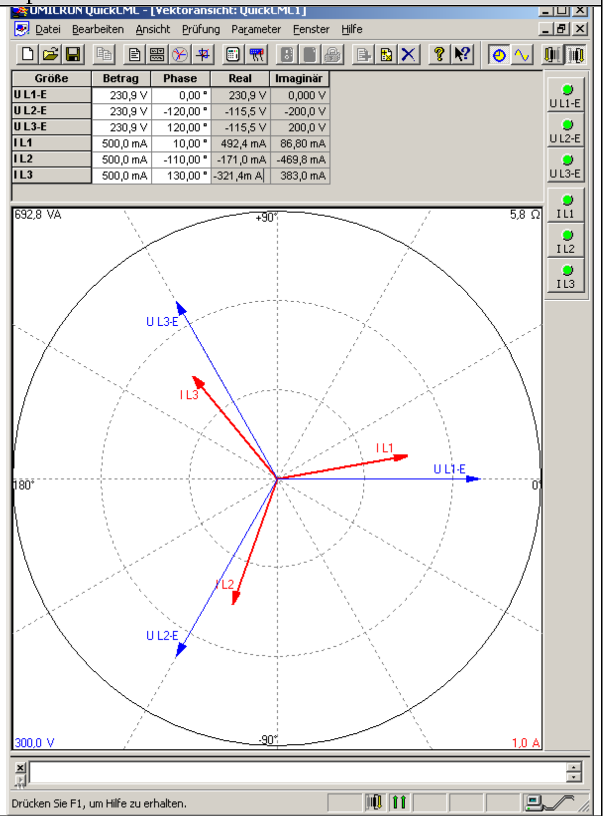
Control: If the control unit is equipped with a power factor controller while in parallel with the utility:

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

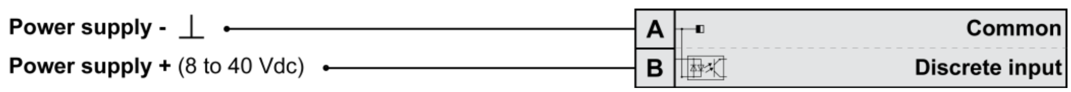


Figure 2-27: Discrete inputs - alarm/control input - positive signal

Discrete Inputs: Negative Polarity Signal

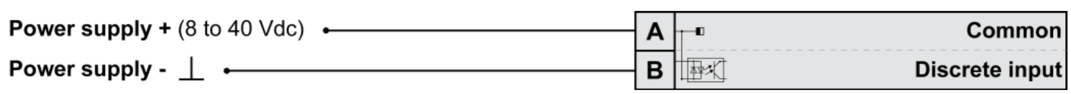


Figure 2-28: Discrete inputs - alarm/control input - negative signal

Terminal Term.	Com.	Description			A_{max}
A	B				
66 GND common 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}	Utility Unload	2.5 mm²
	75	Discrete input [DI 09]	{all}	Ramp Pause	2.5 mm²
	76	Discrete input [DI 10]	{all}	Setpoint Raise	2.5 mm²
	77	Discrete input [DI 11]	{all}	Setpoint Lower	2.5 mm²
	78	Discrete input [DI 12]	{all}	Process Control	2.5 mm²

Table 2-17: Discrete input - terminal assignment 1/2

Terminal Term.	Com.	Description			A_{max}
A	B				
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}	Imp./Exp. Control	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 Utility Unload	DI Base Load	DI Imp/Exp Control	DI Process Control	DI Ramp Pause	DI Setpoint Raise	DI Setpoint Lower
Off Line	0	x	x	x	x	x	x	x
Base Load	1	0	1	0	0	0	0	0
Base Load Raise	1	0	1	0	0	0	1	0
Base Load Lower	1	0	1	0	0	0	0	1
Base Load [1] Remote	1	0	1	0	0	0	1	1
Utility Unload [2]	1	1	x	x	x	0	x	x
Local Unload [3]	1	0	1	0	0	0	0	1
Ramp Pause [4]	1	x	x	x	x	1	x	x
Import/ Export mode	1	0	x	1	0	0	0	0
I/E Raise	1	0	x	1	0	0	1	0
I/E Lower	1	0	x	1	0	0	0	1
I/E Remote [1]	1	0	x	1	0	0	1	1
Process Control	1	0	x	x	1	0	0	0
Process Raise	1	0	x	x	1	0	1	0
Process Lower	1	0	x	x	1	0	0	1
Process Remote [1]	1	0	x	x	1	0	1	1

Table 2-19: Load control modes MSLC-2

[1] Remote reference is activated by closing both setpoint raise and setpoint lower switches at the same time.

[2] The MSLC-2 can only load the associated generators to 100%. If this is not enough capacity to unload the utility, the unload ramps stops at 100% rated load on the associated generators. The generator high limit alarm, if enabled, will activate at this time.

[3] The local plant unload is accomplished by switching to base load mode and supplying a continuous setpoint lower command.

[4] The ramp pause command will pause all ramps in any mode.

Relay Outputs

Figure 2-29: Relay outputs

Terminal Term.	Com.	Description				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		Relay output [R 02]	{all}	Reserve	N.O.	2.5 mm²
44	46	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	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}	Lcl./Gen. Breaker Open	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		Relay output [R 10]	{all}	Alarm 3	N.O.	2.5 mm²
58	60	Relay output [R 11]	{all}	Load Switch 1	N.O.	2.5 mm²
59		Relay output [R 12]	{all}	Load Switch 2	N.O.	2.5 mm²

N.O.-normally open (make) contact

Table 2-20: Relay outputs - terminal assignment

	DO Alarm	DO Reserve	DO High Limit	DO Low Limit	DO Breaker Open	DO Breaker Close	DO LCL/ Gen Breaker Open	DO Alarm 1	DO Alarm 2	DO Alarm 3	DO Load switch 1	DO Load switch 2
Self Test	x											
Reserve		x										
High load limit High process limit High voltage limit			x									
Low load limit Low process limit Low voltage limit				x								
Utility Unload (DI 8)					x							
Synchronization-dead bus closure						x						
Local Generator Breaker open (DI 11)							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 CB open fail								x	x	x		
Load switch 1											x	
Load switch 2												x

NOTE

Refer to Appendix B: Connecting 24 V Relays on page 178 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

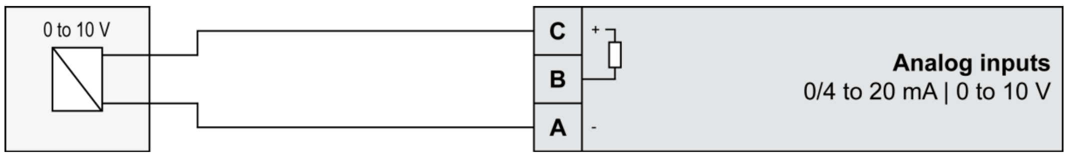


Figure 2-30: Analog inputs - wiring two-pole senders using a voltage signal

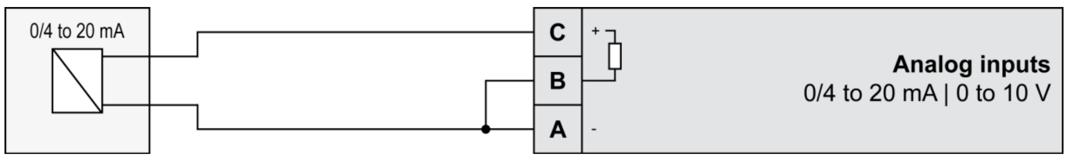


Figure 2-31: Analog inputs - wiring two-pole senders (external jumper used for current signal)

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

Interfaces

RS-485 Serial Interface (Serial Interface #2)

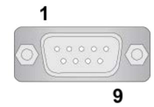


Figure 2-32: RS-485 interface #1 - overview

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 2-22: RS-485 interface #1 - pin assignment

Half-Duplex with Modbus on RS-485

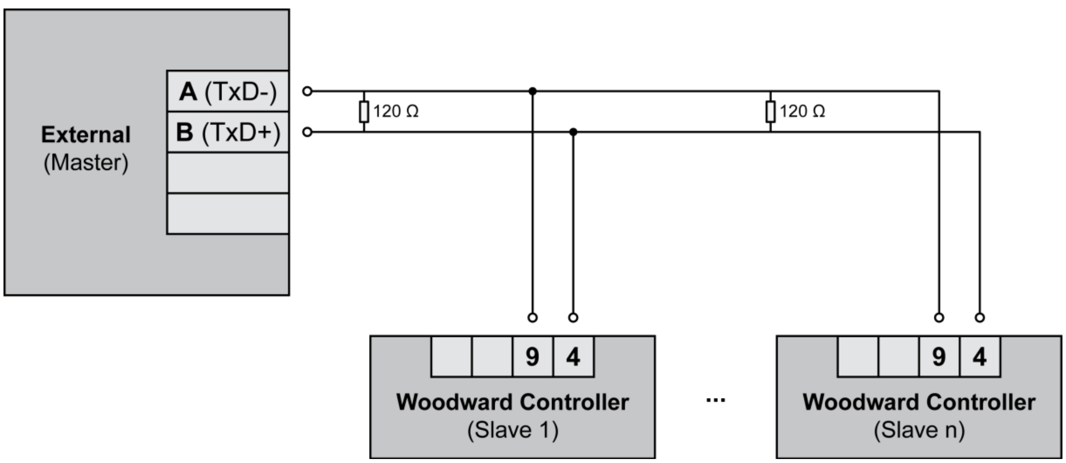


Figure 2-33: RS-485 Modbus - connection for half-duplex operation

Full-Duplex with Modbus on RS-485

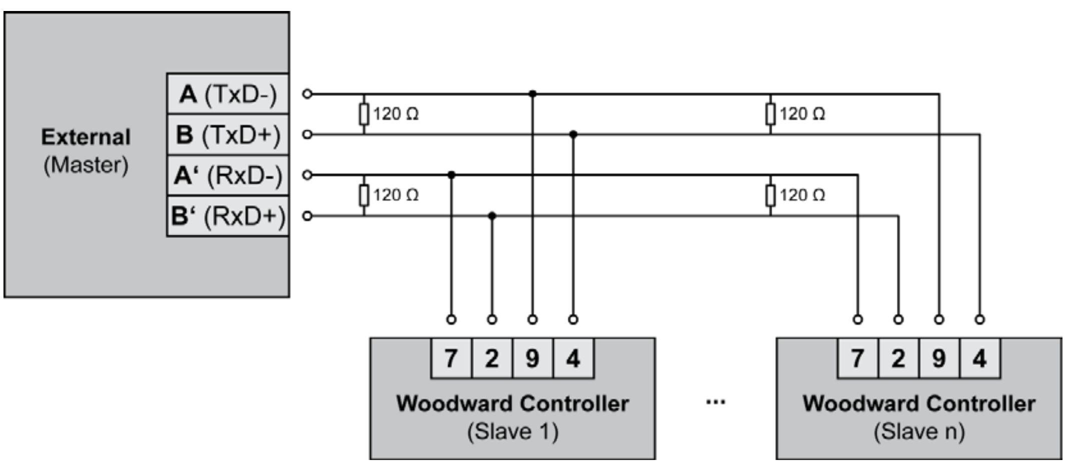


Figure 2-34: RS-485 Modbus - connection for full-duplex operation

NOTE

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

RS-232 Serial Interface (Serial Interface #1)

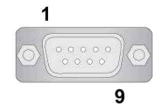


Figure 2-35: RS-232 interface - overview

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 2-23: RS-232 interface - pin assignment

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

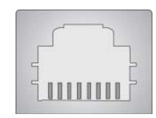


Figure 2-36: RJ-45 interfaces - overview

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 2-24: RJ-45 interfaces - pin assignment

Chapter 3. Configuration & Operation

Configuration Via PC

Install ToolKit Configuration and Visualization Software

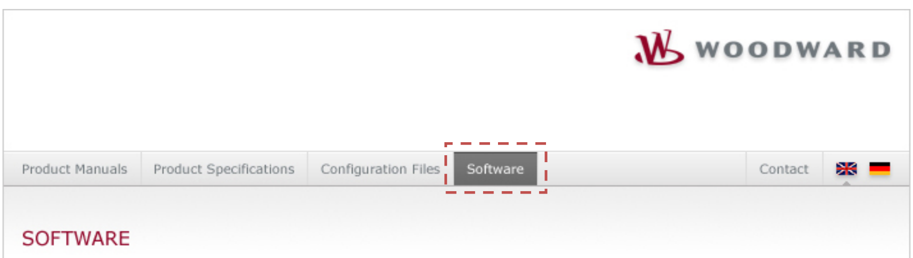
NOTE

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:

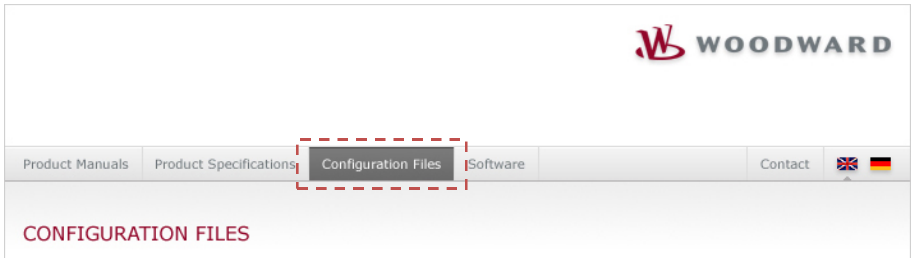
- Microsoft Windows® 7, Vista, XP (32- & 64-bit)
- Microsoft .NET Framework Ver. 3.5
- 600 MHz Pentium® CPU
- 96 MB of RAM
- Minimum 800 by 600 pixel screen with 256 colors
- Serial Port
- CD-ROM drive

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

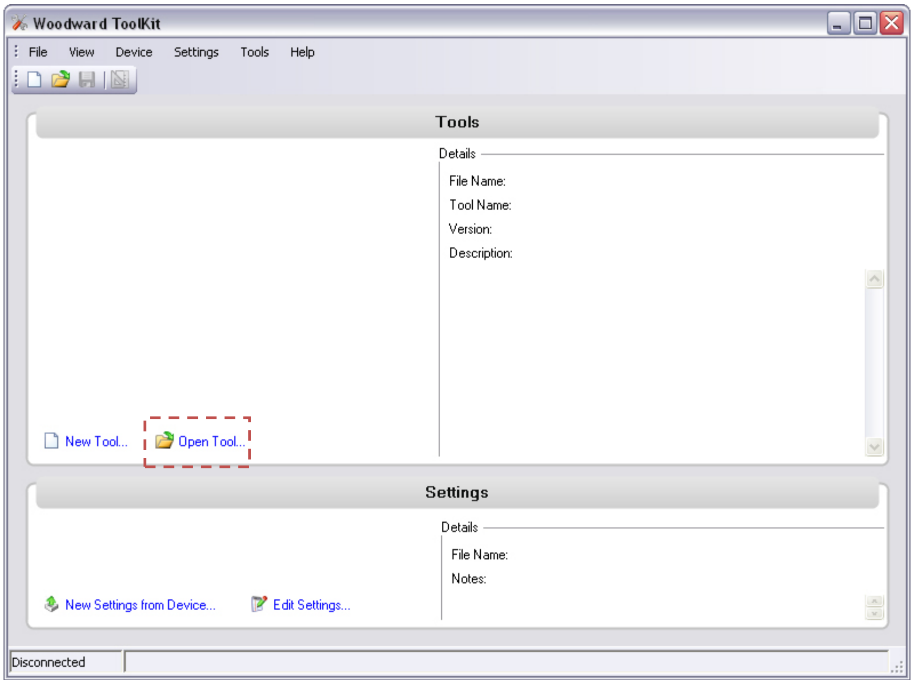
***.SID**
File name composition: [P/N2]*[2]-[Revision].SID
Example file name: 5418-1234-NEW.SID
Content of the file: All display and configuration parameters available in ToolKit

***.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.

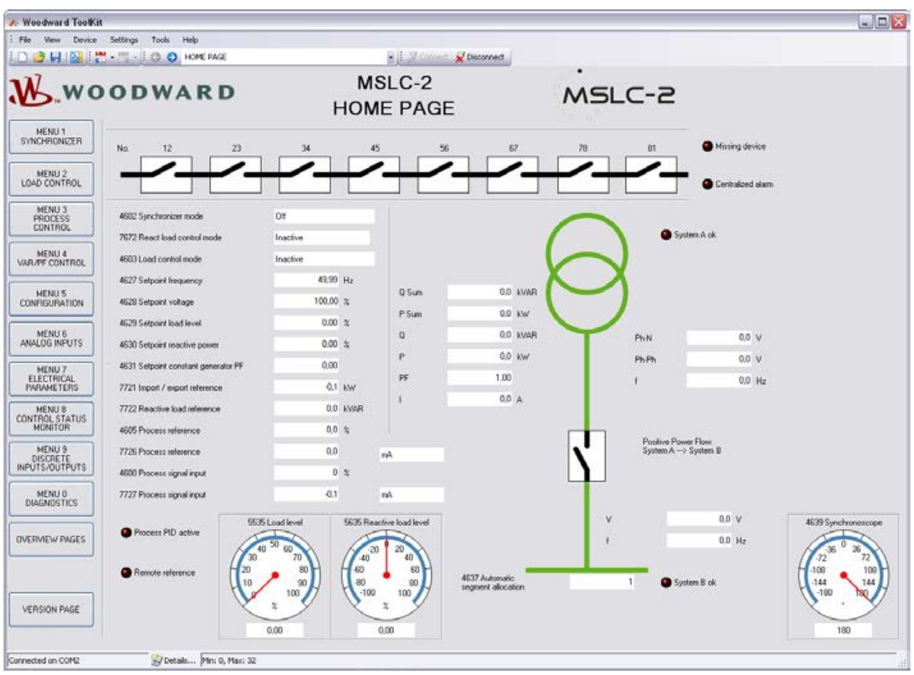
***[1] P/N1 = Part number of the unit**
***[2] P/N2 = Part number of the software in the unit**

Starting ToolKit Software

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

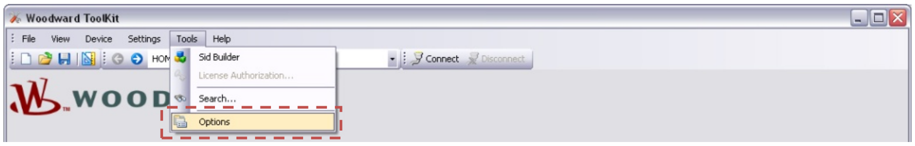


3. Go to the “Application” folder and open then the folder equal to the part number (P/N) of your device (e.g. 8440-1234). Select the wtool file (e.g. 8440-1234-NEW_US_5418-1234-NEW.wtool) and click “Open” to start the configuration file
4. Now the home page of the ToolKit configuration screen appears

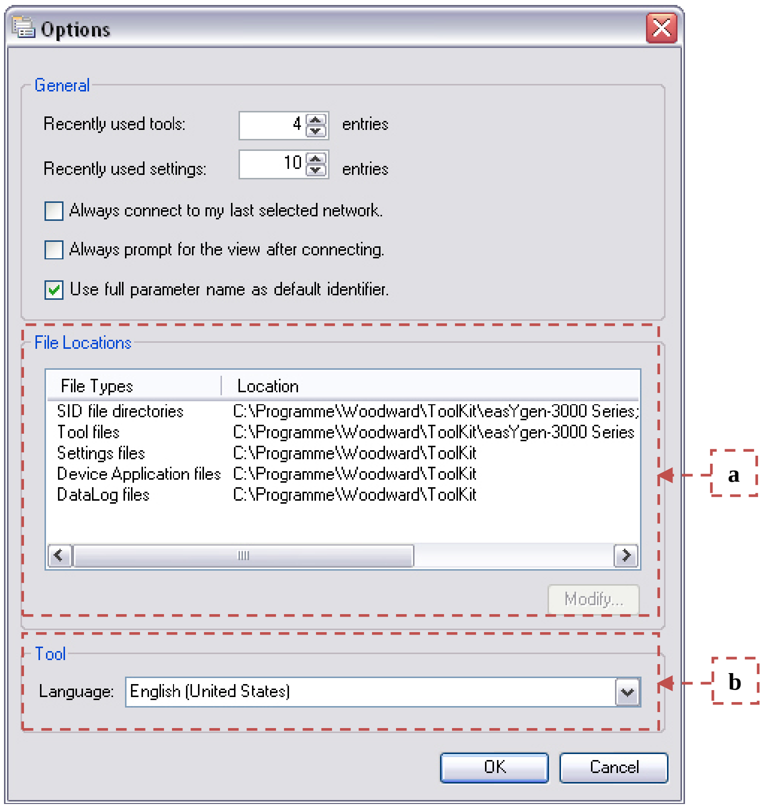


Configure ToolKit Software

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”

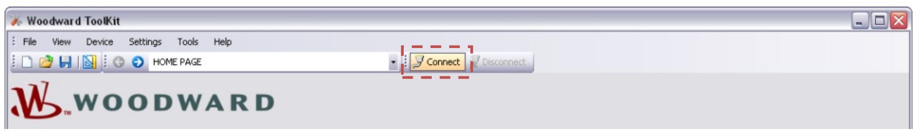
NOTE

Please use the ToolKit online help for further information.

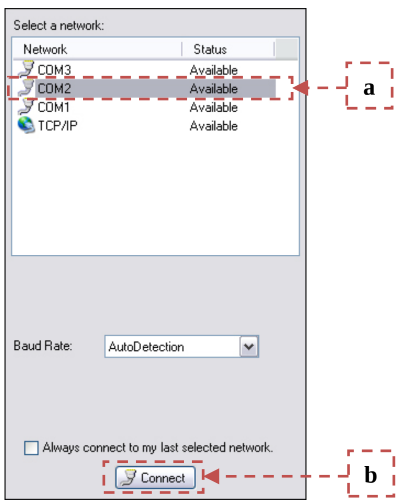
Connect ToolKit and the MSLC-2 Unit

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

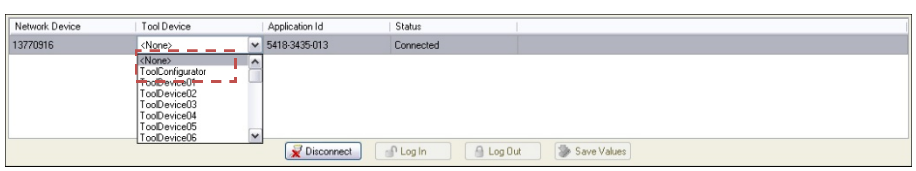
1. Connect the null modem communications cable between your PC and the control unit. Plug the null modem cable into the RS-232 serial port on unit and the other side to a serial COM port of the PC. If the PC does not have a serial port to connect the null modem cable to, use a USB to serial adapter.
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. Now you are able to edit the MSLC-2 parameters in the main window. Any changes made are written to the control memory automatically.

View MSLC-2 Data with ToolKit

The following figure shows an example visualization screen of ToolKit:

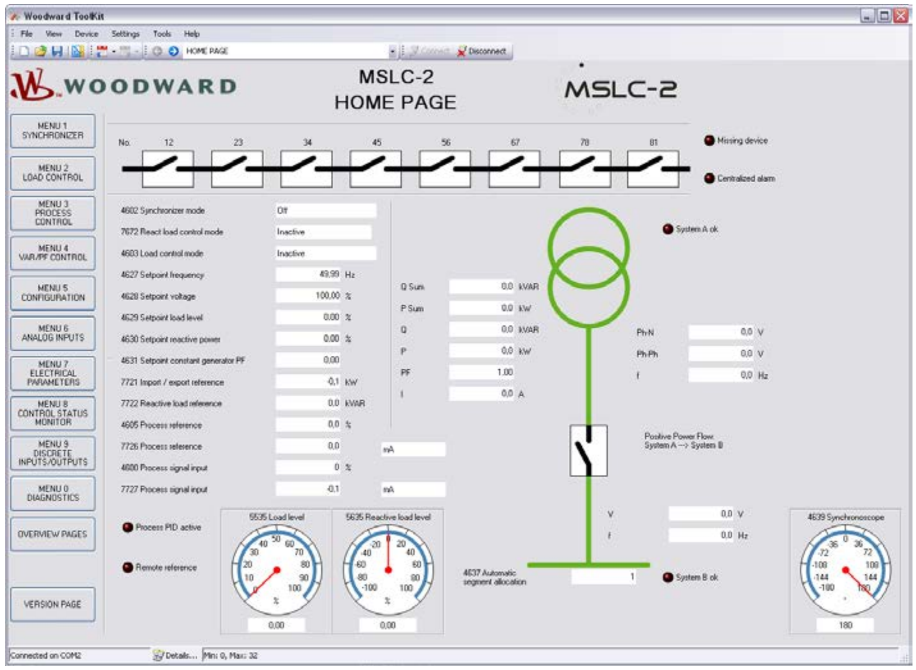


Figure 3-1: ToolKit - visualization screen

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:

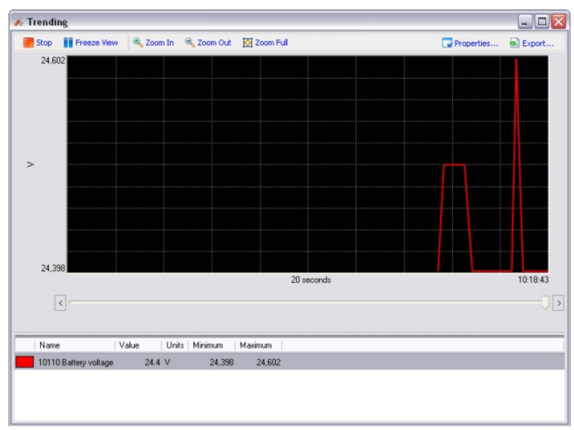


Figure 3-2: ToolKit - analog value trending screen

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 MSLC-2 with ToolKit

The following figure shows an example configuration screen of ToolKit:

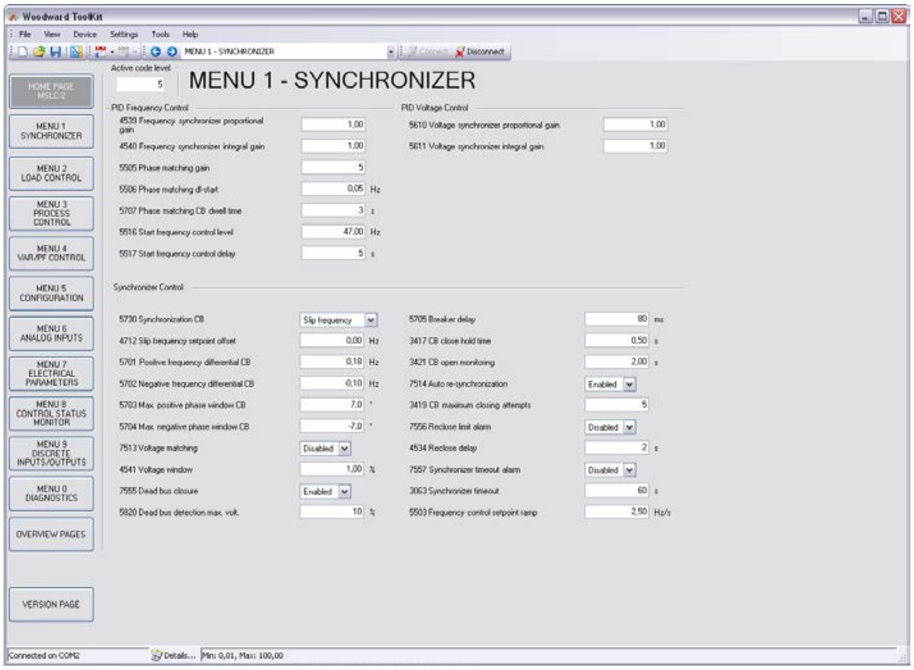


Figure 3-3: ToolKit - configuration screen

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.), or by selecting a screen from the drop-down list to the right of the arrow icons.

The MSLC-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.

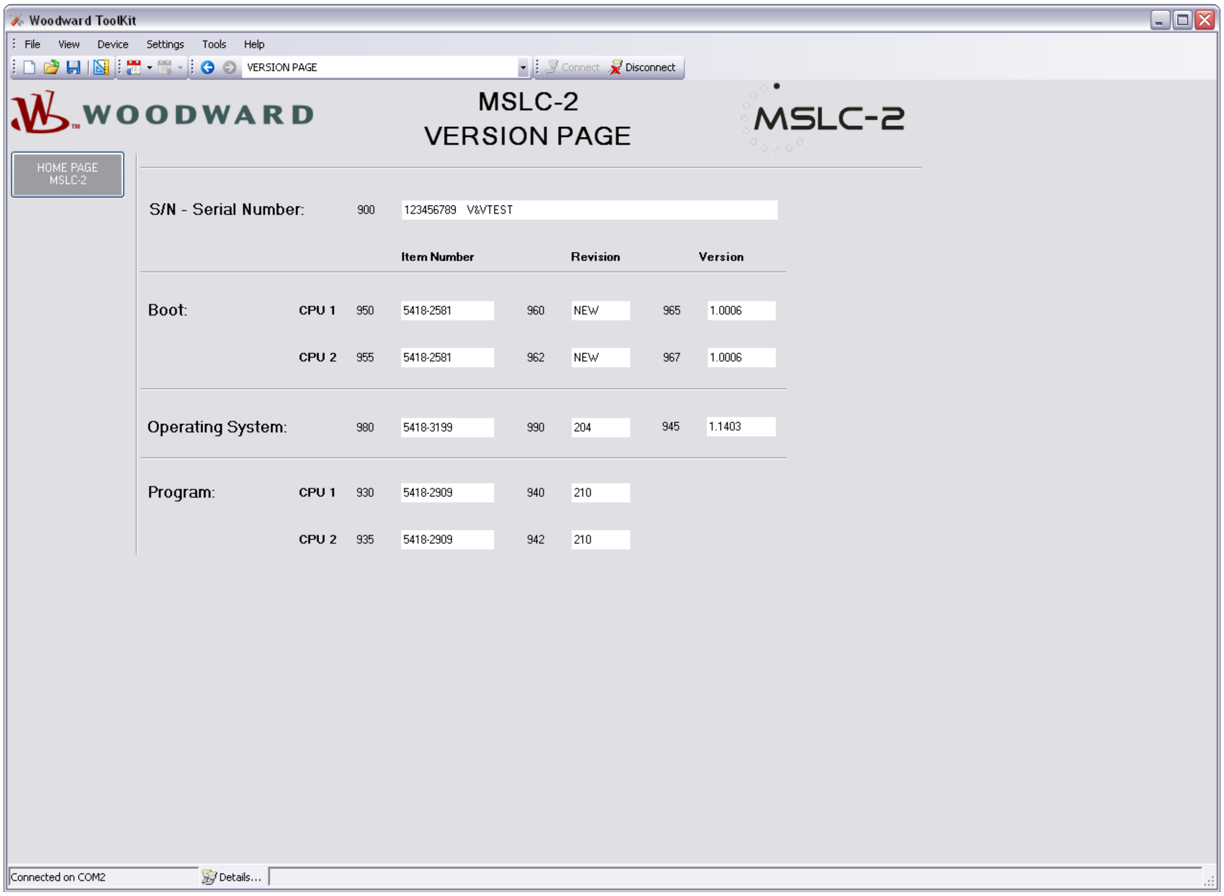


Figure 3-4: ToolKit -version page

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.

MSLC-2 – Homepage

The appearance of the MSLC-2 Homepage depends on the configuration. If the MSLC-2 type is configured as "Utility" MSLC-2 (parameter 7628), values and pictures are displayed in the sense being located at the utility. On the other side, the "Tie" configured MSLC-2 shows values and pictures related to a tie-breaker sense.

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

- The system A condition
- The system B (busbar) condition
- The condition of the breaker
- The current operating action
- The load and reactive load output to the DSLC-2
- The segment breaker state

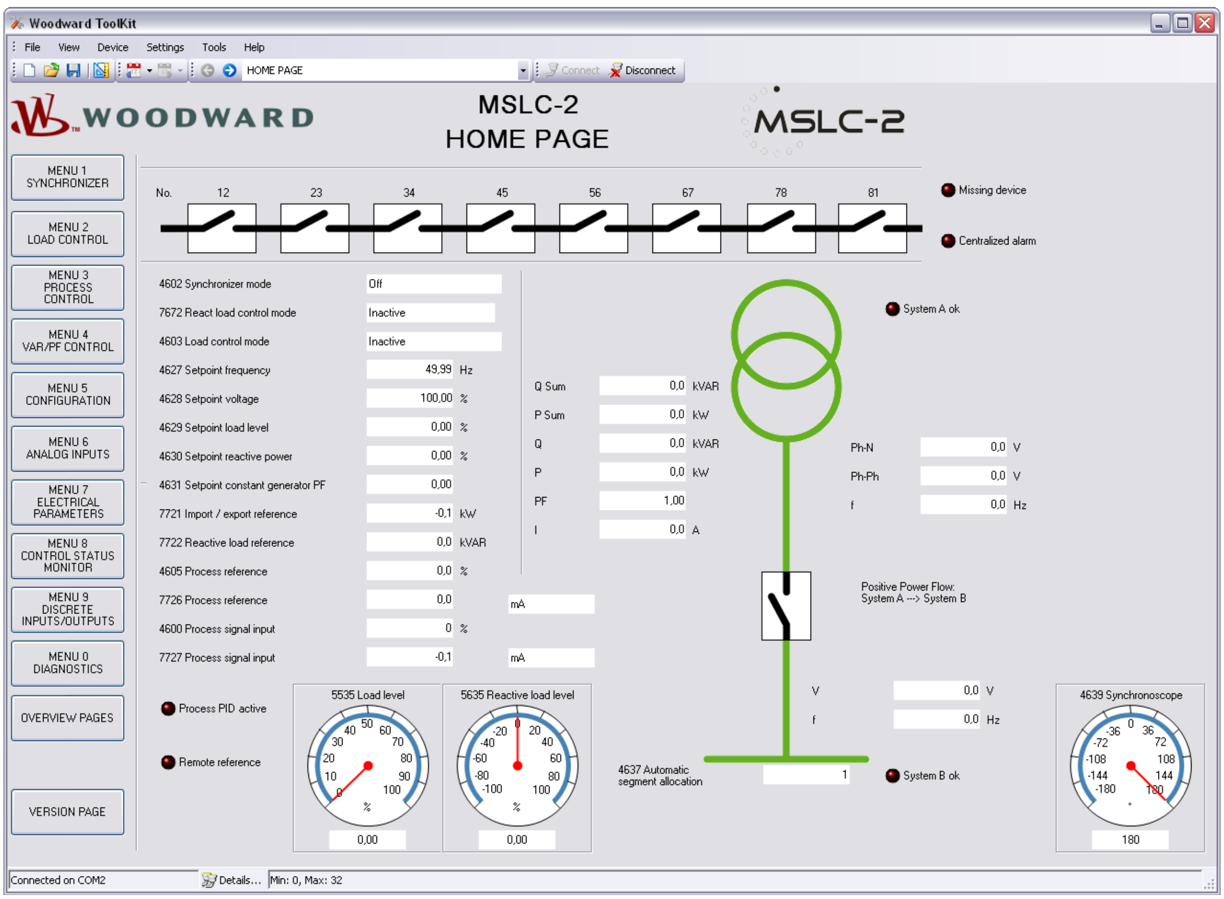


Figure 3-5: ToolKit - home page (MSLC-2 configured as utility breaker control)

Figure 3-6: ToolKit - home page (MSLC-2 configured as tie-breaker control)

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 CB 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 CB. (resync is disabled). **Close Timer:** This is the CB close command.
7672	**Reactive load control mode**	-	Off / Inactive / Voltage Control / VAR Control / Power Factor Control / Const Gen 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. **Voltage Control:** The voltage control is active. **VAR Control:** The reactive load control with kvar reference is ac-tive. **Power Factor Control:** Power factor control is active. **Const Gen PF Control:** The reactive load control with a constant power factor reference is active.

ID	Parameter	CL	Setting range	Format	Description
4603	**Load control mode**	-	Off Line / Inactive / Base Load / Base Load Lower / Base Load Raise / Base Load Re-mote / Process Control / Process Lower / Process Raise / Process Remote / Process Ramp / Import Export Control / Import Export Ramp / Import Export Remote / Imp Exp Lower / Imp Exp Raise / Utility Unload	-	Display of the different *Load control modes*: **Off Line:** The load control mode is disabled. **Inactive:** The load control mode is inactive. **Base Load:** The Load control is in base load. **Base Load Lower:** A base load lower command is active. **Base Load Raise:** A base load raise command is active. **Base Load Remote:** The load reference is controlled by an ana-log remote input. **Process Control:** The process control is full active **Process Lower:** A process reference lower command is active. **Process Raise:** A process reference raise command is active. **Process Remote:** The process reference is controlled by an ana-log remote input **Process Ramp:** The generators are ramped into process control **Import Export Control:** The Import Export control is active. **Import Export Ramp:** The generators are being ramped into Im / Ex control **Import Export Remote:** The Import Export reference is controlled by an analog remote input **Imp Exp Lower:** A Import Export lower command is active. **Imp Exp Raise:** A Import Export raise command is active. **Utility Unload:** The utility or tie-breaker is being unloaded.
4627	**Setpoint frequency**	-	Info	0.00 Hz	The field indicates the current *Setpoint Frequency* in Hz.
4628	**Setpoint voltage**	-	Info	0.00 %	The field indicates the current *Setpoint Voltage* in percentage.
4629	**Setpoint load level**	-	Info	0.00 %	Indicates the load level setpoint in percentage.
4630	**Setpoint reactive power**	-	Info	0.00 %	Indicates the reactive load level setpoint in percentage.
4631	**Setpoint constant generator PF**	-	Info	0.00	The field indicates the constant generator power factor setpoint sent to the DSLC-2.
7721	**Import / export reference**		Info	0.0 kW	The field indicates the current import / export setpoint for the MSLC-2 in kW.
7722	**Reactive load reference**	-	Info	0.0 kvar	The field indicates the current reactive load setpoint for the MSLC-2 in kvar.
4605	**Process reference**	-	Info	0.0 %	The field indicates the current *Process reference* value of the MSLC-2 process control in percentage.
7726	**Process reference**	-	Info	0.0 kW	The field indicates the current *Process reference* value of the MSLC-2 process control in engineering units.
4600	**Process signal input**	-	Info	0.0 %	The field indicates the real *Process signal input* value of the MSLC-2 process control in percentage.
7727	**Process signal input**	-	Info	0.0 kW	The field indicates the real *Process signal input* value of the MSLC-2 process control in engineering units.
5535	**Load level**		Info	0.00 %	The gage indicates the load setpoint going to the DSLC-2.
5635	**Reactive load level**		Info	0.00 %	The gage indicates the reactive load setpoint going to the DSLC-2.
4639	**Synchro scope**	-	Info	0°	The gage illustrates a *Synchroscope* for the relation system A vol-tage to system B voltage in degrees.
4637	**Automatic segment allocation**	-	Info	0	The field indicates the segment number for this unit.

Table 3-7: Parameter - homepage

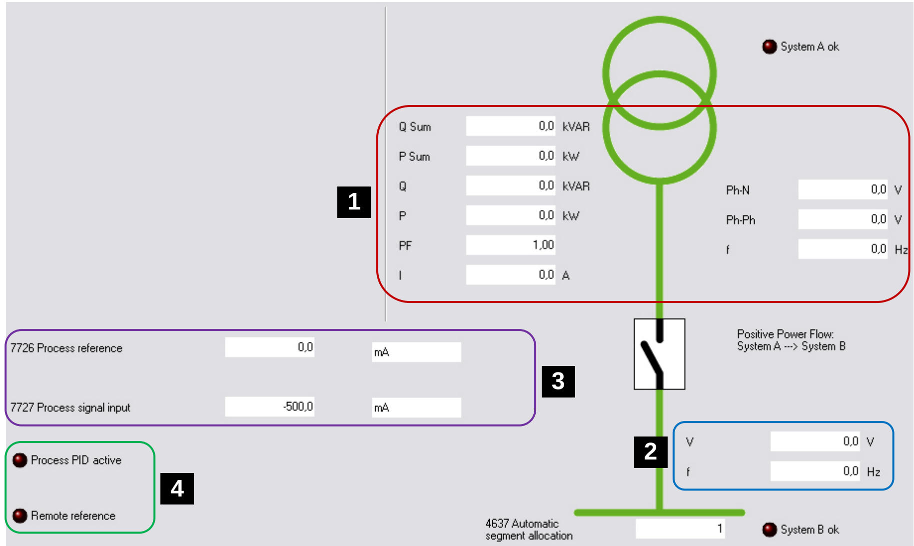


Figure 3-8: ToolKit - home page - MSLC-2 configured as utility breaker control

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 Sum: Sum of all real reactive load in the same segment in kvar.
P Sum: Sum of all real load in the same segment in kW.
Q: Real reactive load of this path in kvar.
P: Real load of this path in kW.
PF: Power factor in this path.
I: Average current of this path in A.
Ph-N: Average Phase-neutral voltage of system A in Volt.
Ph-Ph: Average Phase-phase voltage of system A in Volt.
f: Real frequency of system A in Hz.

2

V: System B voltage Volt.
f: Real frequency of system B 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.

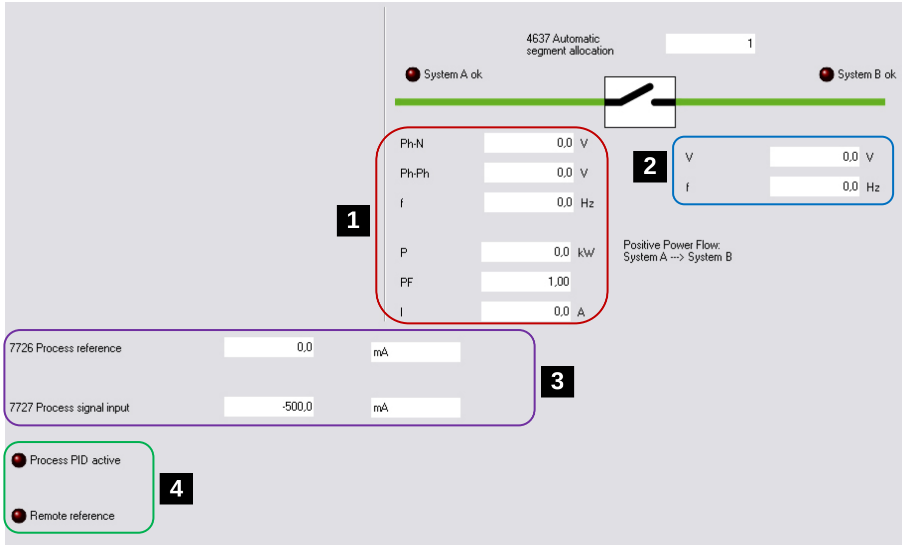


Figure 3-9: ToolKit - home page - MSLC-2 configured as tie-breaker control

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

Ph-N: Average Phase-neutral voltage of system A in Volt.
Ph-Ph: Average Phase-phase voltage of system A in Volt.
f: Real frequency of system A in Hz.
P: Real load of this path in kW.
PF: Power factor in this path.
I: Average current of this path in A.

2

V: System B voltage Volt.
f: Real frequency of system B 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.

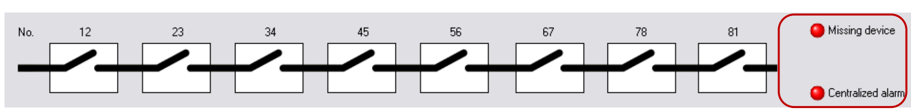


Figure 3-10: ToolKit - home page - segments

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.

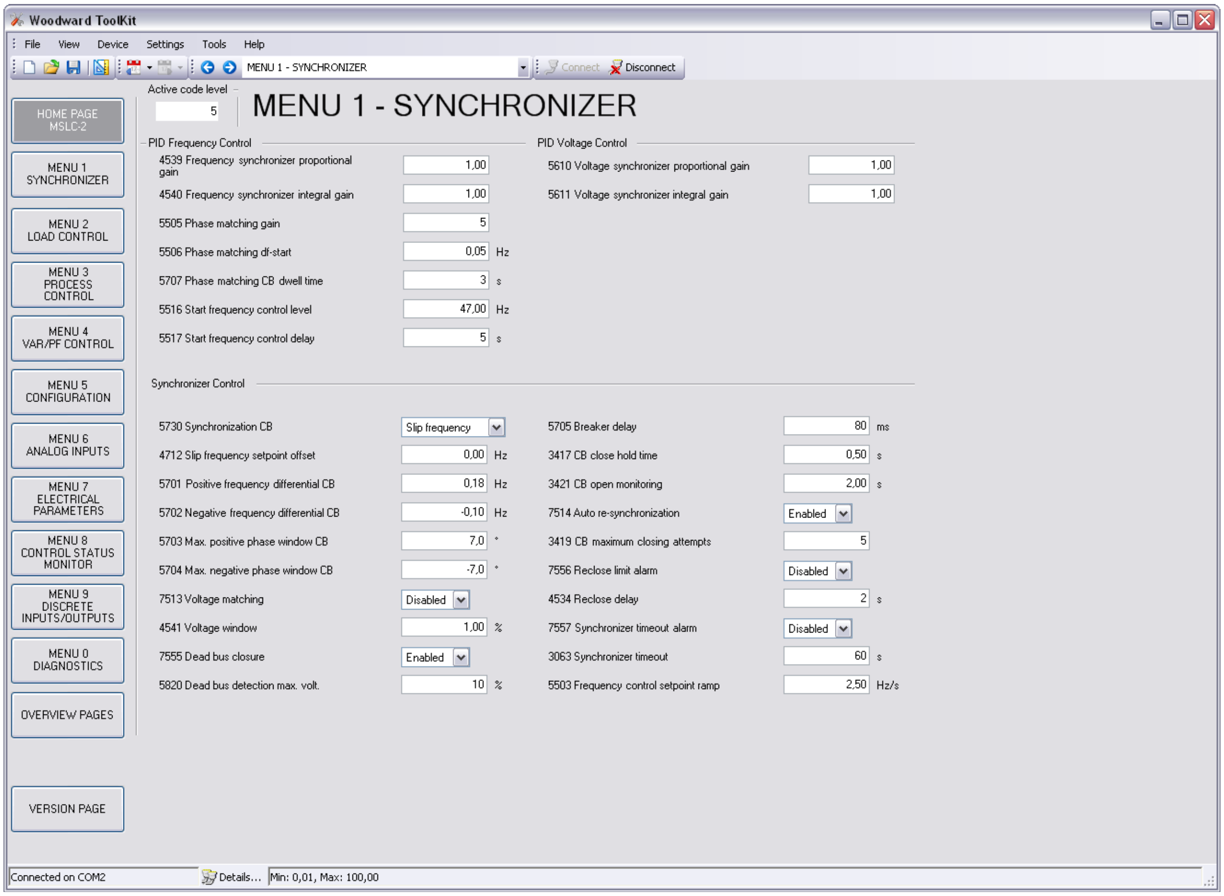


Figure 3-11: ToolKit – synchronizer

PID Frequency Control

ID	Parameter	CL	Setting range	Default	Description
4539	**Frequency synchronizer proportional gain**	2	0.01 to 100.00	0.80	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	0.50	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 CB dwell time**	2	0 to 60.0 s	0.5 s	Dwell Time: This is the minimum time that the system A 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.
5516	**Start frequency control level**	1	0.00 to 70.00 Hz	55.00 Hz	The frequency controller is activated when the monitored system B frequency has exceeded the value configured in this parameter. This prevents the MSLC-2 from attempting to control the frequency while the engine is completing its start sequence.

ID	Parameter	CL	Setting range	Default	Description
5517	**Start frequency control delay**	1	0 to 999 s	1 s	The frequency controller is enabled after the configured time for this parameter expires.

PID Voltage Control

ID	Parameter	CL	Setting range	Default	Description
5610	**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.
5611	**Voltage synchronizer integral gain**	2	0.01 to 100.00	0.50	Voltage sync integral gain 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
5730	**Synchronization CB**	2	Slip frequency./. Phase matching	Slip frequency	**Slip frequency:** The frequency controller adjusts the frequency in a way, that the frequency of the variable system is marginal greater than the fixed system. When the synchronizing conditions are reached, a close command will be issued. The slipping frequency depends on the setting of *Slip frequency setpoint offset* (parameter 5502). **Phase matching:** The frequency controller adjusts the phase angle of the system B to that of the system A.
4712	**Slip frequency setpoint offset**	2	-0.50 to 0.50 Hz	0.10 Hz	This value is the offset for the synchronization to the variable system to the fixed system. With this offset, the unit synchronizes with a positive or negative 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. If this parameter is configured to -0.10 Hz and the busbar/mains frequency is 60.00 Hz, the synchronization setpoint is 59.90 Hz.
5701	**Positive frequency differential CB**	2	0.02 to 0.49 Hz	0.18 Hz	The prerequisite for a close command being issued for the CB is that the differential frequency is below the configured differential frequency. This value specifies the upper frequency (positive value corresponds to positive slip > system B frequency is higher than system A frequency).
5702	**Negative frequency differential CB**	2	-0.49 to 0.00 Hz	-0.10 Hz	The prerequisite for a close command being issued for the CB is that the differential frequency is above the configured differential frequency. This value specifies the lower frequency limit (negative value corresponds to negative slip > system B frequency is less than system A frequency).
5703	**Max. positive phase window CB**	2	0.0 to 60.0 °	5.0 °	The prerequisite for a close command being issued for the CB is that the leading phase angle between system B and system A is below the configured maximum permissible angle.
5704	**Max. negative phase window CB**	2	-60.0 to 0.0 °	-5.0 °	The prerequisite for a close command being issued for the CB is that the lagging phase angle between system B and system A 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.

ID	Parameter	CL	Setting range	Default	Description
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 system A and system B voltage does not exceed the value configured here and the system A/B 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) ***NOTE:*** *In Menu 5 you find more settings related to the dead busbar closure.*
5820	**Deadbus detection max. volt.**	2	0 to 30 %	10 %	Adjustable voltage in percentage of system A or B rated voltage for deadbus detection.
5705	**Breaker delay**	2	40 to 300 ms	80 ms	The inherent closing time of the CB 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.
3417	**CB 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.
3421	**CB 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 "CB fail to open" alarm is issued. This timer initiates as soon as the "Open breaker" sequence begins.
7514	**Auto resynchronization**	2	Disabled / Enabled	Enabled	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.
3419	**CB 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.
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 MSLC-2 control will remain in the selected operating mode (run, check, or permissive) during the reclose delay interval.
7556	**Reclose limit alarm**	2	Disabled / Enabled	Enabled	Enables or disables the alarm generated when reaching the maximum close attempts.
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 system A 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.

ID	Parameter	CL	Setting range	Default	Description
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 3-12: Parameter – synchronizer

Menu 2 – Load Control

This menu contains the adjustments for load control.

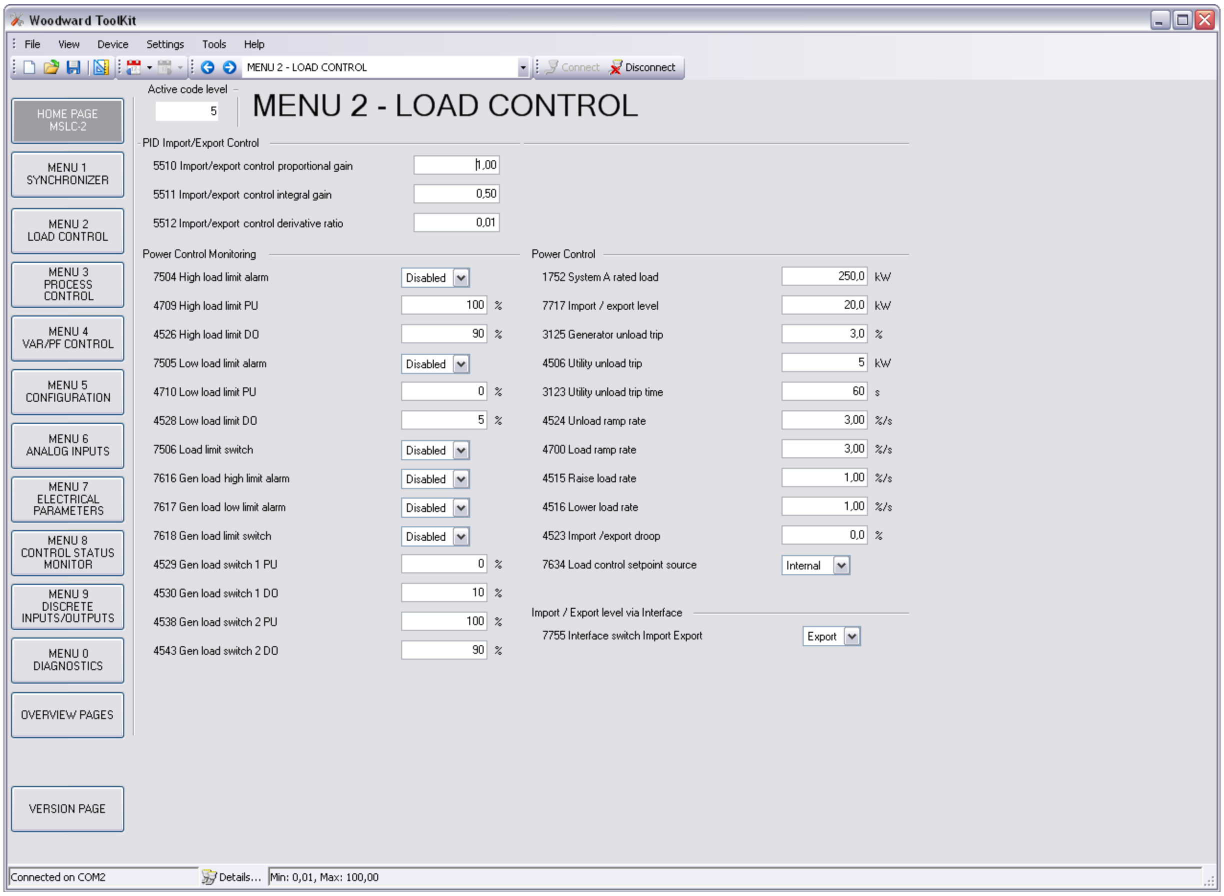


Figure 3-13: ToolKit – load control

PID Import/Export Control

ID	Parameter	CL	Setting range	Default	Description
5510	**Import/ export control proportional gain**	2	0.01 to 100.00	1.00	*Import/export control proportional gain* determines how fast the load control responds to an import/export load error. Gain is set to provide stable control. Lower the value for slower response.
5511	**Import/ export control integral gain**	2	0.01 to 100.00	0.50	*Import/export control 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 the value for slower response.
5512	**Import/ export control derivative ratio**	2	0.01 to 100.00	0.01	*Import/export control derivative ratio* adjusts the rate of change in the load command during a load transient.

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).
4709	**High load limit PU**	2	-150 to 150 %	100 %	The *High load limit PU* is the import/export load level where (if enabled) the “High Limit” relay is energized and the high limit alarm is activated. The percentage value relates to system A rated load (parameter 1752).
4526	**High load limit DO**	2	-150 to 150 %	90 %	The *High load limit DO* is the import/export load level where (if enabled) the “High Limit” relay is de-energized and the high limit alarm is deactivated. The percentage value relates to system A rated load (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).
4710	**Low load limit PU**	2	0 to 100 %	0 %	The *Low load limit PU* is the import/export load level where (if enabled) the “Low Limit” relay is energized and the low limit alarm is activated. The percentage value relates to system A rated load (parameter 1752).
4528	**Low load limit DO**	2	-2 to 150 %	5 %	The *Low load limit DO* is the import/export load level where (if enabled) the “Low Limit” relay is de-energized and the low limit alarm is deactivated. The percentage value relates to system A rated load (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.
7616	**Gen load high limit alarm**	2	Disabled / Enabled	Disabled	*Generator load high limit alarm* specifies if the generator high load limit alarm will activate the “High Limit” relay (Terminal 44). The generator high limit alarm is activated when the MSLC-2 is required to output a system load of 100% to the DSLC-2 controls in order to meet its reference. ***NOTE:*** *The “Alarm” relay includes additional the self-test function. Alarm active means relay open.*
7617	**Gen load low limit alarm**	2	Disabled / Enabled	Disabled	*Generator load low limit alarm* specifies if the generator low load limit alarm will activate the “Low Limit” relay (Terminal 45). The generator low limit alarm is caused when the MSLC-2 is required to output a system load of 0% to the DSLC-2 controls in order to meet its reference.
7618	**Gen load limit switch**	2	Disabled / Enabled	Disabled	*Generator load limit switch* specifies if the high and low limit alarms will activate the “Load Switch 1” or “Load Switch 2” relay when the system load setpoint reaches 100% or respectively 0%.
4529	**Gen Load switch 1 PU**	2	0 to 100 %	0 %	*Generator Load switch 1 PU* is the system load level where the “Load Switch1” relay is energized.
4530	**Gen Load switch 1 DO**	2	0 to 100 %	10 %	*Generator Load switch 1 DO* is the system load level where the “Load Switch1” relay is de-energized.
4538	**Gen Load switch 2 PU**	2	0 to 100 %	100 %	*Generator Load switch 2 PU* is the system load level where the “Load Switch2” relay is energized.
4543	**Gen Load switch 2 DO**	2	0 to 100 %	90 %	*Generator Load switch 2 DO* is the system load level where the “Load Switch2” relay is de-energized.

Power Control

ID	Parameter	CL	Setting range	Default	Description
1752	**System A rated load**	2	1 to 999999.9 kW	200.0 kW	This value specifies a rated power at the interchange point or over the tie-breaker. This real power rating is the reference for several functions, like power control monitoring or ramp scaling. ***NOTE:*** *During active power control, the* System A rated load *value (parameter 1752) may not be changed. The power plant has to be shut down and the MCB has to be opened.*
7717	**Import / export level**	0	-999999.9 to 999999.9 kW	20.0 kW	This value is the load setpoint for the import export control. The value gets active when the load control setpoint source (parameter 7634) is configured for "Internal". ***Note:*** *This value is bypassed in the moment of using the raise / lower setpoint function by DI. The value is triggered, if the "CB Aux" goes open and close or another load setting is configured.*
3125	**Generator unload trip**	2	0.5 to 99.9 %	3.0 %	*Generator unload trip* is the percentage limit of the system load level sent to the DSLC-2s, which must be reached before issuing the local/gen bus breaker open command. ***NOTE:*** *The local/gen bus unload mode will be activated, if the "Load Lower" DI is given continuously while in the base load control mode.*
4506	**Utility unload trip**	2	0 to 30000 kW	5 kW	*Utility unload trip* is the load level that the MSLC-2 must be below before issuing the utility breaker open command during a utility unload.
3123	**Utility unload trip time**	2	3 to 999 s	60 s	If the monitored system A 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	*Unload ramp rate* is the rate at which the control ramps between modes in %/sec. Remember, this refers to unloading the utility, which is then loading the generator set.
4700	**Load ramp rate**	2	0.01 to 100.00 %s	3.00 %/s	*Load ramp rate* is the rate at which the control ramps between modes in %/sec. Remember, this refers to loading the utility, which is then unloading the generator set.
4515	**Raise load rate**	2	0.01 to 100.00 %ss	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	**Import / export droop**	2	0.0 to 100.0 %	0.0 %	*Import / export droop* is the droop setting for the import/export controller. The effect of droop is to make the control more resistant to variations from the import/export reference. This droop has the effect of causing the target import/export level to go towards a zero power transfer situation with increasing load. When set to the default value of zero the import/export control has no droop.
7634	**Load control setpoint source**	2	Internal / Interface	Internal	This setting determines from which source the load reference for the import / export power control comes: **Internal:** The setpoint parameter 7717 is valid or the analog input. The analog remote load reference input is valid, when DI "Load Raise" and DI "Load Lower" are closed. **Interface:** The setpoint comes via RS-485 Modbus or TCP/IP Modbus Interface.

ID	Parameter	CL	Setting range	Default	Description
7755	**Interface switch import export**	2	Export / Import	Export	This setting defines the setpoint argument for the power control setpoint transferred by interface. This setting gets active when the *Load control setpoint source* (parameter 7634) is configured to “Interface”. **Export:** The value send by interface is an export kW setpoint. **Import:** The value send by interface is an import kW setpoint.

Table 3-14: Parameter – load control

Menu 3 – Process Control

This menu contains the adjustments for process control.

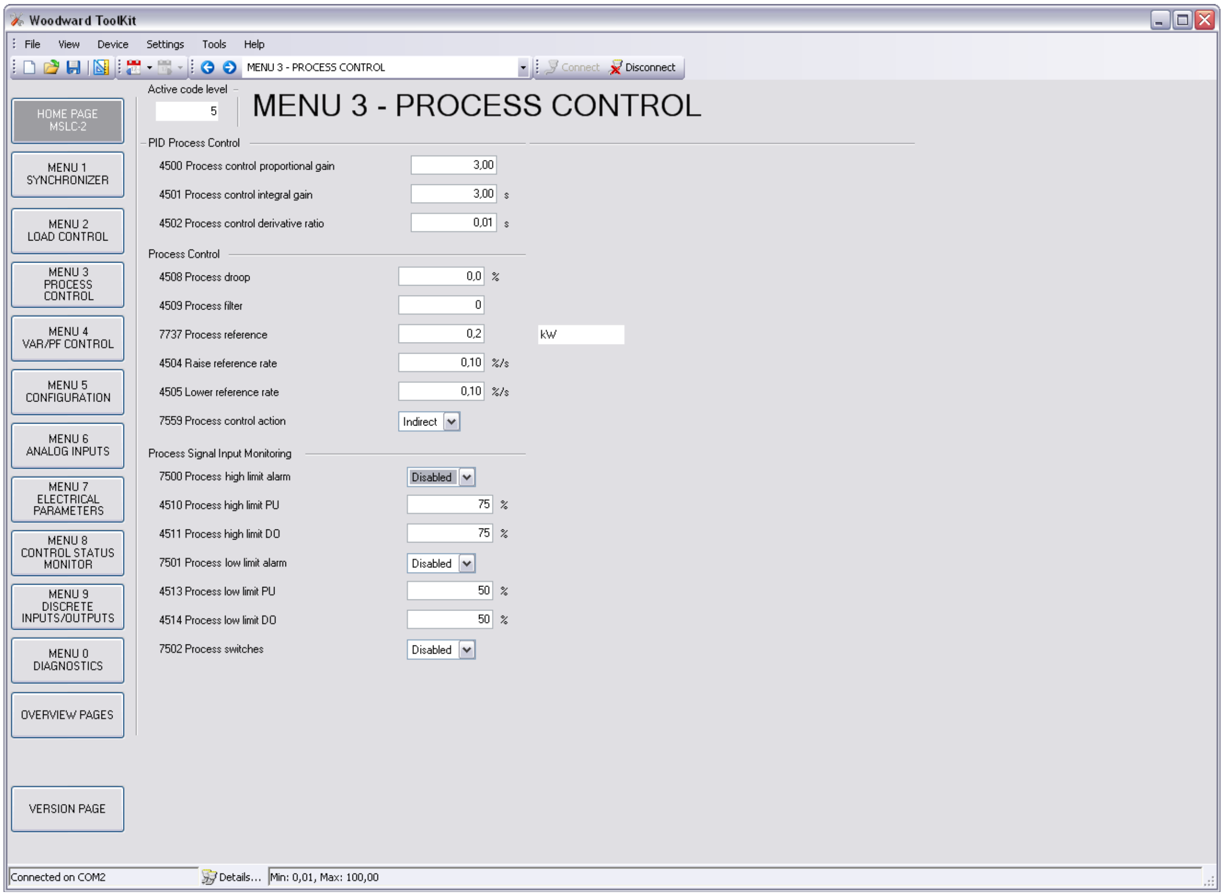


Figure 3-15: ToolKit – process control

PID Process Control

ID	Parameter	CL	Setting range	Default	Description
4500	**Process control proportional gain**	2	0.01 to 100.00	3.00	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 the value to slow the response.
4501	**Process control integral gain**	2	0.01 s to 100.00 s	3.00 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 the value to slow the 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 the value to slow the 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**	0	-999999.9 to 999999.9	0.2	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 3-16: Parameter – process control

Menu 4 – Voltage/Var/PF Control

This menu contains the adjustments for reactive load control.

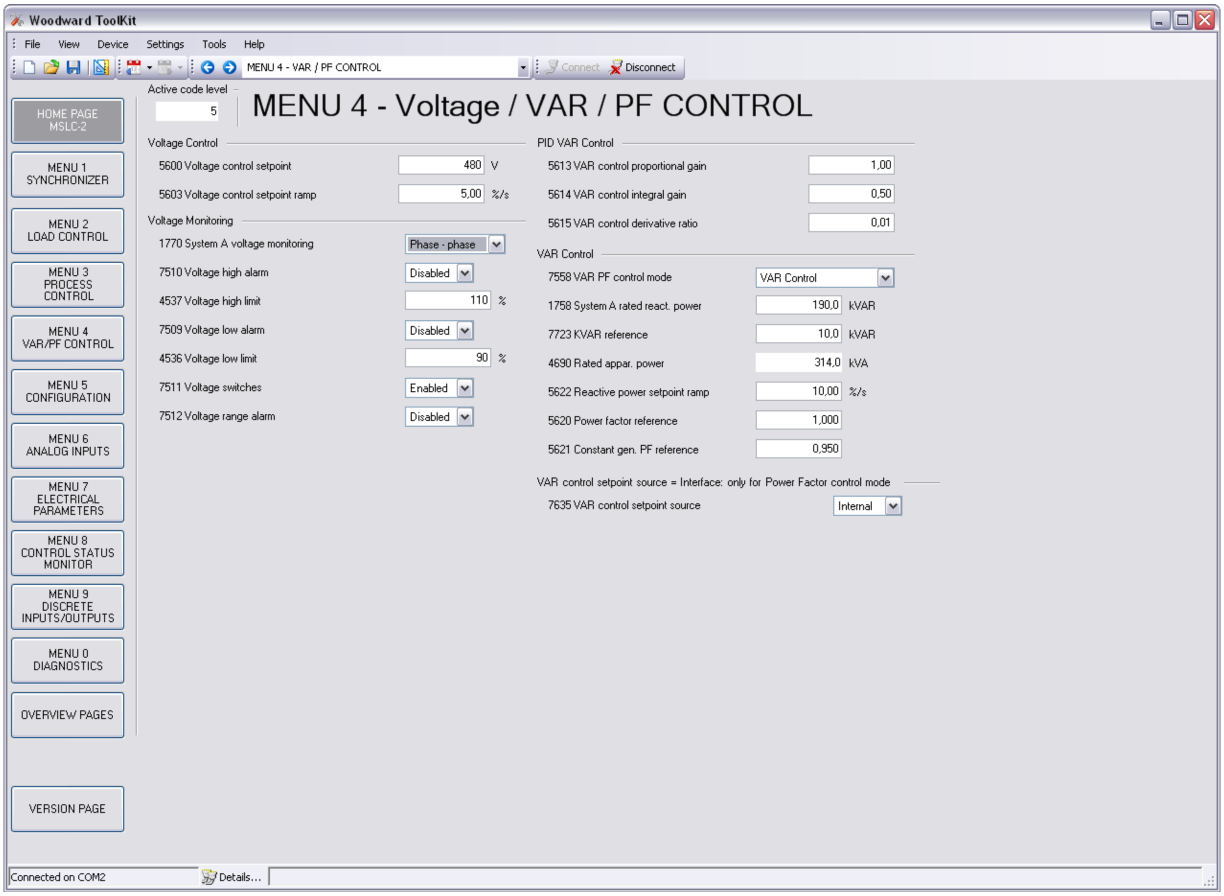


Figure 3-17: ToolKit – voltage/var/pf control

Voltage Control

ID	Parameter	CL	Setting range	Default	Description
5600	**Voltage control setpoint**	1	50 to 650.000 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 like 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.

Voltage Monitoring

ID	Parameter	CL	Setting range	Default	Description
1770	**System A 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%.

PID Var Control

ID	Parameter	CL	Setting range	Default	Description
5613	**VAR control proportional gain**	2	0.01 to 100.00	1.00	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 Utility MSLC-2 is operating in • Import/export control • Process control mode
5614	**VAR control integral gain**	2	0.01 to 100.00	0.50	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 Utility MSLC-2 is operating in • Import/export control • Process control mode
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 Utility MSLC-2 is operating in • Import/export control • Process control mode

Var Control

ID	Parameter	CL	Setting range	Default	Description
7558	**VAR PF control mode**	2	PF Control / VAR Control / Constant Generator PF	VAR Control	This setting specifies the reactive load controller: **PF Control:** The control will maintain a constant PF across the utility tie by varying the reactive load on the generators to maintain the PF reference level. **VAR Control:** The control will maintain a constant var load level across the utility tie by varying the reactive load on the generators to maintain the kvar reference level. **Constant Generator PF:** The control will maintain a constant PF on any generators operating under the MSLC-2 command. The generators will use the constant gen PF reference of the MSLC-2 as their individual generator PF reference value.
1758	**System A rated react. power**	2	0.1 to 999999.9 kvar	190.0 kvar	This value specifies the system A reactive power rating, which is used as a reference figure for related functions. 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”.
4690	**Rated appar. power**	-	Info	kVA	This field indicates the internal calculated appearance power which is calculated out of the kW and kvar rating.
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 (+) – system A supplying vars • Capacitive/leading (-) – system A absorbing vars
5621	**Constant gen. PF reference**	1	-0.999 to 1.000	0.950	This is the constant reference the MSLC-2 sends to the DSLC-2 controls (the reference level at which to maintain each DSLC-2 controls generator) when in constant generator power factor control mode. In this mode the DSLC-2 control will maintain a constant generator PF level regardless of the amount of vars being absorbed / generated across the utility tie. This setpoint is active when the *VAR PF control mode* (parameter 7558) is configured on “Constant Generator PF”. ***NOTE:*** *The designations “+” stands for generate inductive/lagging reactive power with the generator. The designations “-” stands for absorb capacitive/leading reactive power with the generator.* ***NOTE:*** *It is recommended that the constant generator power factor control mode be used in applications where the total generator kvar capacity is less than the kvar load of the system.*

ID	Parameter	CL	Setting range	Default	Description
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) at the interchange point when *VAR PF control mode* (parameter 7558) is configured on "VAR control". o *Power factor reference* (parameter 5620) at the interchange point when *VAR PF control mode* (parameter 7558) is configured on "PF control". o Power factor reference at the interchange point over analog input (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" set). **Interface** The setpoint comes from the interface (via RS-485 Modbus or TCP/IP Modbus, Address 7640). The setpoint is a power factor setpoint. Therefore the *VAR PF control mode* (parameter 7558) has to be configured to one of the PF settings. • "PF Control": The Modbus parameter 7640 will be the power factor reference value at the interchange point. • "Constant Generator PF": The Modbus parameter 7640 will be the power factor reference for a constant power factor reference sent to the DSLC-2s.

Table 3-18: Parameter – voltage/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 MSLC-2.

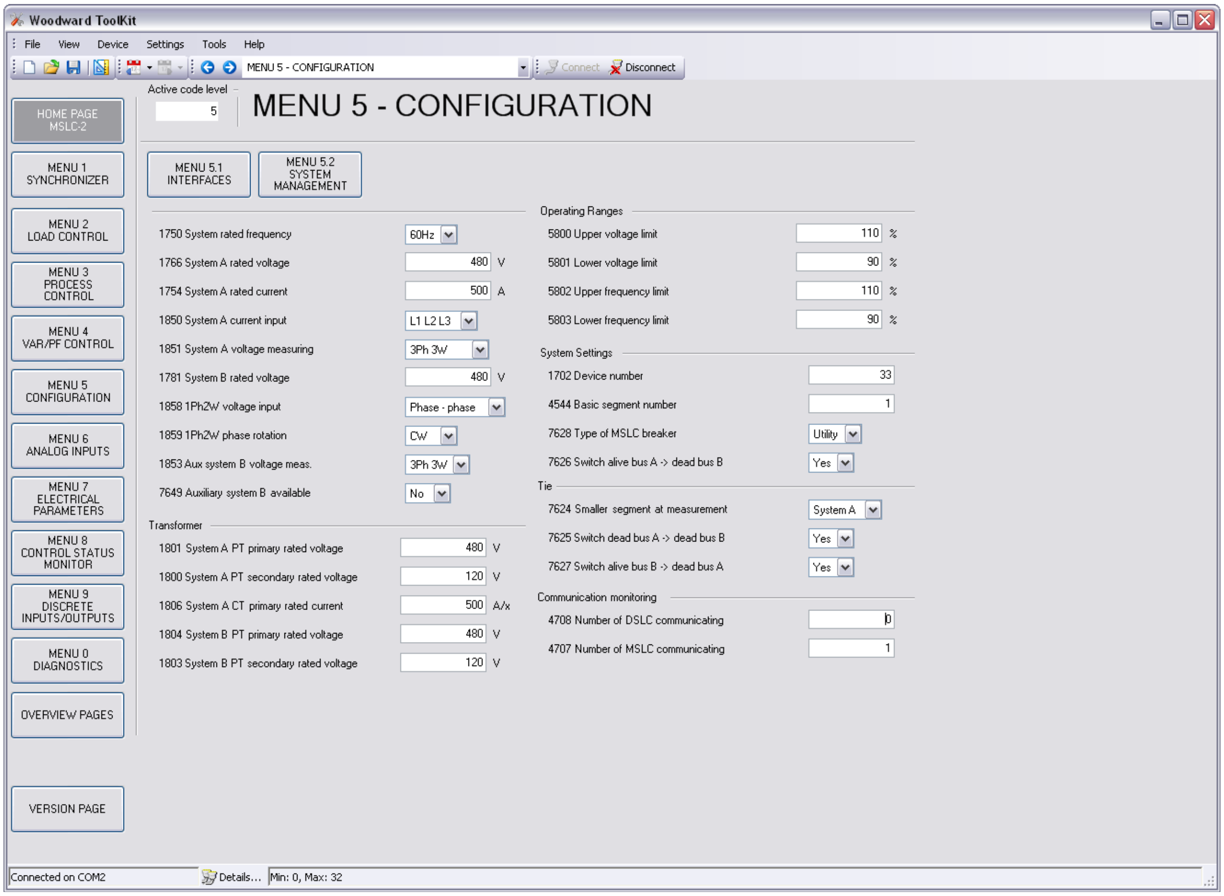


Figure 3-19: ToolKit – configuration

General

NOTE

Beside the System A 3-phase or 1-phase measurement the MSLC-2 provides a busbar 1-phase measurements and an auxiliary busbar 3-phase measurement. The busbar 1-phase measurement at the terminals 37-40 is obligatory and 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 MSLC-2 can determine correct voltages on all 3 phases and becomes a 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 and frequency monitoring.
1766	**System A rated voltage**	2	50 to 650000 V	480 V	This voltage is always entered as a “Phase - phase” value. The rated system A potential transformer primary voltage is used as a reference figure for all system A voltage related functions, which use a percentage value, like operating range limits and voltage monitoring. ***NOTE:*** *This value refers to the rated voltage of the system A (system A voltage on data plate) and is the voltage measured on the potential transformer primary.*

ID	Parameter	CL	Setting range	Default	Description
1754	**System A rated current**	2	1 to 32000 A	500 A	This value specifies the *System A rated current*.
1850	**System A 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* System A voltage measuring *(parameter 1851) is configured to "3Ph 4W", "3Ph 3W" or "3Ph 4W OD".*
1851	**System A voltage measuring**	2	3Ph 4W / 3Ph 3W / 1Ph 2W / 3Ph 4W OD	3Ph 3W	**3Ph 4W: Wye connected voltages** System A 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 "Voltge/VAR/PF Menu 4", parameter 1770. This setting determines if the MSLC-2 uses "Phase - phase" or "Phase - neutral" voltage for protection. **3Ph 3W: Delta connected voltages** System A voltage is connected using all 3 phases. This measurement can be directly connected or through potential transformers (PTs). This configuration is used when: • The system A is connected to the load using 3-phase and neutral • The system A voltage is connected to the MSLC-2 using 3-wire, "Phase - phase" • The L2 phase is **not** grounded on the input of the MSLC-2 And when: • The system A is connected to the load using 3 phases and **no** neutral • The system A voltage is connected to the DSLC-2 using 3 wire, "Phase - phase" • The L2 phase can be grounded or left ungrounded **1Ph 2W: Wye or delta connected system** System A is connected using L2 phase and neutral or L1 phase and L2. This selection should be used when the MSLC-2 will function only as a synchronizer, such as an MSLC-2 in the tie-breaker mode. **3Ph 4W OD: Delta connected voltages** System A 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 system A is connected to the load using 3-phase and neutral • The system A voltage is connected to the MSLC-2 using 3 wire, "Phase - phase" • The L2 phase is **grounded** on the input of the MSLC-2 ***NOTE:*** *Please refer to the comments on measuring principles in the installation chapter ("Voltage Measuring: System A" on page 26)*
1781	**System B rated voltage**	2	50 to 650000 V	480 V	The system B potential transformer primary voltage is entered in this parameter. This value can be: • Phase - phase • Phase - neutral They dependent on the *1Ph 2W voltage input* (parameter 1858) setting. The system B rated voltage is used as a reference figure for all system B voltage related functions. ***NOTE:*** *This value refers to the rated voltage of system B and is the voltage measured on the potential transformer primary.*

ID	Parameter	CL	Setting range	Default	Description
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 system A <-> Bus would be wrong calculated.*
1859	**1Ph2W phase rotation**	2	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 system B voltage meas.**	2	3Ph 4W / 3Ph 3W /	3Ph 3W	In case of a 3-phase measurement connection of auxiliary system B, the connection has to be defined. **3Ph 4W: Wye connected voltages** Auxiliary system B voltage is connected using all 3 phases and neutral. This measurement can be directly connected or through potential transformers (PTs). Voltage monitoring is configured in the “Voltage/VAR/PF Control Menu 4”, parameter 1770. This setting determines if the MSLC-2 uses the “Phase - phase” or “Phase - neutral” voltage measurement for protection. **3Ph 3W: Delta connected voltages** Auxiliary system B voltage is connected using all 3 phases. This measurement can be directly connected or through potential transformers (PTs). Voltage monitoring is configured in the “Voltage/VAR/PF Control Menu 4”, parameter 1770. This settings must be configured for “Phase - phase”.
7649	**Auxiliary system B available**	2	No / Yes	No	**No:** The auxiliary system B measurement is not used. **Yes:** The auxiliary system B measurement is used and becomes a part of the operating range- and the phase rotation monitoring. The auxiliary system B measurement is displayed in Menu 7.

Transformer

ID	Parameter	CL	Setting range	Default	Description
1801	**System A PT primary rated voltage**	2	50 to 650000 V	480 V	The value is always entered as the “Phase - phase” measurement. Some system A applications may require the use of potential transformers to facilitate measuring the voltages produced by the system A. The rating of the primary side of the potential transformer must be entered into this parameter. If the system A 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.

ID	Parameter	CL	Setting range	Default	Description
1800	**System A PT secondary rated voltage**	2	50 to 480 V	120 V	The value is always entered as the "Phase - phase" measurement. Some system A applications may require the use of potential transformers to facilitate measuring the voltages produced by the system A. The rating of the secondary side of the potential transformer must be entered into this parameter. If the system A 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) – System A voltage: Terminals 29/31/33/35 • Rated voltage: 480 Vac (this parameter configured between 131 and 480 V) – System A 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	**System A 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	**System B 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.
1803	**System B PT secondary rated voltage**	2	50 to 480 V	120 V	This voltage is always entered as a "Phase – phase" measurement. Some applications may require the use of potential transformers to facilitate measuring the system B 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 System B voltage: Terminals 37/39 o Auxiliary System B voltage: Terminals 21/23/25/27 • Rated voltage: 480 Vac (this parameter configured between 131 and 480 V) o System B voltage: Terminals 38/40 o Auxiliary System B 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.*

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 *System B rated voltage* (parameter 1768) is configured here.
5801	**Lower voltage limit**	2	50 to 100 %	90 %	The maximum permissible negative deviation of the voltage from the *System B rated voltage* (parameter 1768) 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	33 to 48	33	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 MSLC-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 MSLC-2s, the parameter can be remain on "1". Tie-breaker MSLC-2s should have the basic segment number that is on the system A side. ***NOTE:*** *In case there are different segments available in the application please follow the rules on page 105.*
7628	**Type of MSLC breaker**	2	Utility / Tie	Utility	Specifies the type of MSLC-2. **Utility:** The MSLC-2 controls the utility breaker. The parameters 7624, 7625 and 7627 are ignored. **Tie:** The MSLC-2 controls a tie-breaker (no direct segment connection to utility). The parameters 7624, 7625 and 7627 are active.

ID	Parameter	CL	Setting range	Default	Description
7626	**Switch alive bus A -> dead bus B**	2	Yes / No	Yes	There could come up a situation that a live busbar at measurement A shall be closed on a dead busbar at measurement B. This configuration is allowing the closure in such a case. If this closure is not allowed, the MSLC-2 would not close the breaker in this case. **Yes:** The closure is allowed in such a situation, if: • *Dead busbar closure* is enabled (Menu 5, parameter 7555) AND • The live busbar A is within the operating ranges (parameter 5800 to parameter 5803) AND • The busbar B is dead in the sense of the parameter *Dead bus detection max. volt.* (Menu 5, parameter 5820). **No:** The closure is not allowed in such a situation. ***NOTE:** This parameter is only effective, if parameter 7628 is configured to "Tie".*

Tie-breaker

ID	Parameter	CL	Setting range	Default	Description
7624	**Smaller segment at measurement**	2	System A / System B	System A	The measurement connections A and B could be turned depending on the application. The MSLC-2 needs this information for the automatic segment allocation. **System A:** The segment number of the bar at which the measurement system A is connected is smaller than the segment number at measurement B. **System B:** The segment number of the bar at which the measurement system B is connected is smaller than the segment number at measurement A. ***NOTE:** For further information refer to the description in Chapter 8 “Network / System Description”.* ***NOTE:** This parameter is only effective, if parameter 7628 is configured to "Tie".*
7625	**Switch deadbus A -> dead bus B**	2	Yes / No	Yes	There could come up a situation that both sides of the breaker are dead and a close command is given to the tie MSLC-2. This configuration is allowing the closure in such a case. If this closure is not allowed, the MSLC-2 would not close the breaker in this case. **Yes:** The closure is allowed in such a situation, if: • *Dead busbar closure* is enabled (Menu 5, parameter 7555) AND • Both busbars are dead in the sense of the parameter *Dead bus detection max. volt.* (Menu 5, parameter 5820). **No:** The closure is not allowed in such a situation. ***NOTE:** This parameter is only effective, if parameter 7628 is configured to "Tie".*

ID	Parameter	CL	Setting range	Default	Description
7627	**Switch alive bus B -> dead bus A**	2	Yes / No	Yes	There could come up a situation that a live busbar at measurement B shall be closed on a dead busbar at measurement A. This configuration is allowing the closure in such a case. If this closure is not allowed, the MSLC-2 would not close the breaker in this case. **Yes:** The closure is allowed in such a situation, if: • *Dead busbar closure* is enabled (Menu 5, parameter 7555) AND • The a live busbar B is within the operating ranges (parameter 5800 to parameter 5803) AND • The dead busbar A is dead in the sense of the parameter *Dead bus detection max. volt.* (Menu 5, parameter 5820). **No:** The closure is not allowed in such a situation. ***NOTE:** This parameter is only effective, if parameter 7628 is configured to "Tie".*

Communication Monitoring

ID	Parameter	CL	Setting range	Default	Description
4708	**Number of DSLC communicating**	2	0 to 32	0	The unit monitors the number of communicating DSLC-2. With recognizing a missing member the DSLC-2 sets the missing device flag, which can be used for an alarm output.
4707	**Number of MSLC communicating**	2	1 to 16	1	The unit monitors the number of communicating MSLC-2. With recognizing a missing member the MSLC-2 sets the missing device flag, which can be used for an alarm output.

Table 3-20: Parameter – configuration

Menu 5.1 – Interfaces

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

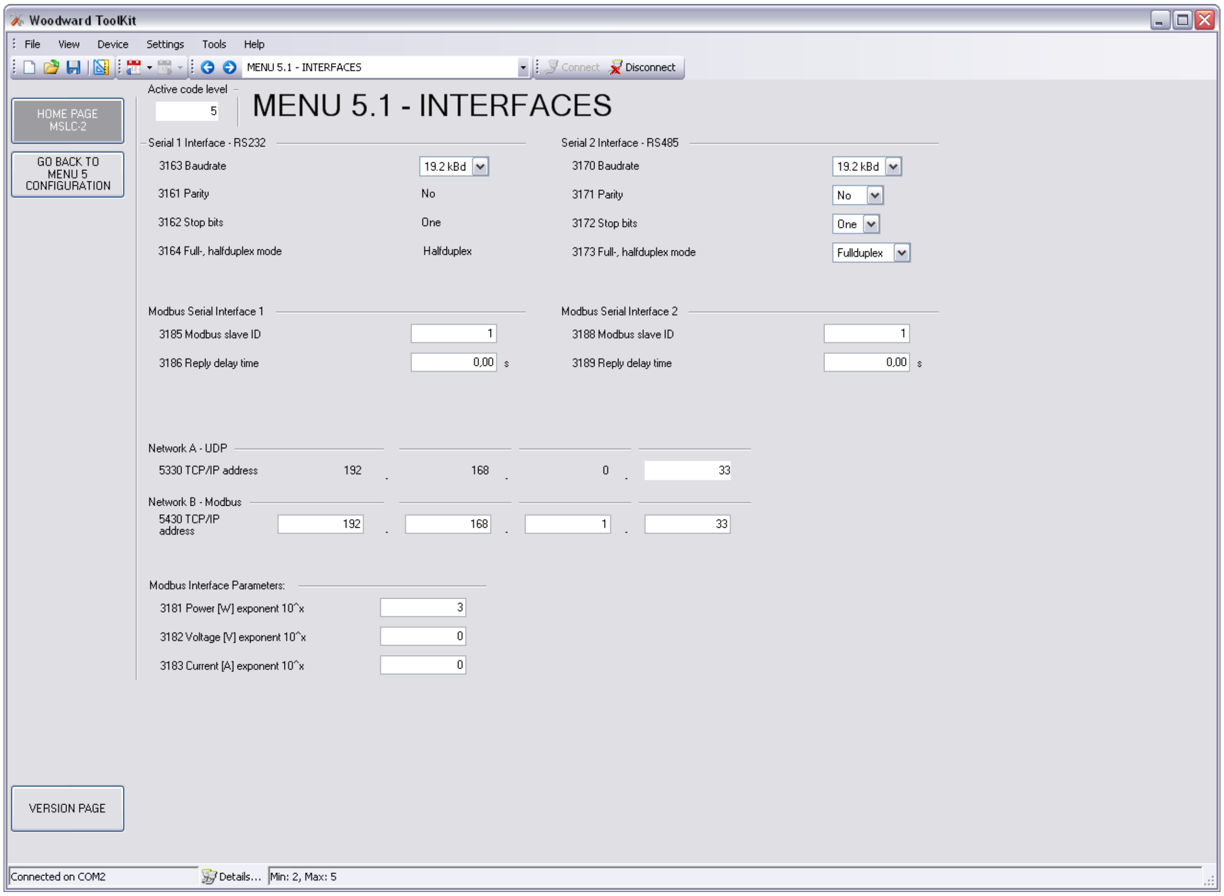


Figure 3-21: ToolKit – interfaces

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 the access by Modbus protocol with fixed parity, stop bits and full-, halfduplex mode. The unit acts here as 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.

ID	Parameter	CL	Setting range	Default	Description
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 – RS-485 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 set 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	192.168.0.33	Ethernet Channel Network A: Type UDP. The IP address of Channel A is fixed to: 192.168.0.Device-ID, where Device-ID = 33 to 48 for MSLC-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)	192.168.1.33	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 = 33 to 48 for MSLC-2.

Modbus Interface Definitions

The unit offers a Modbus address table with for visualizing systems. The table contains 16bit integer (short) and 32bit 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 3-22: Parameter – configuration – interfaces

Menu 5.2 – System Management

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

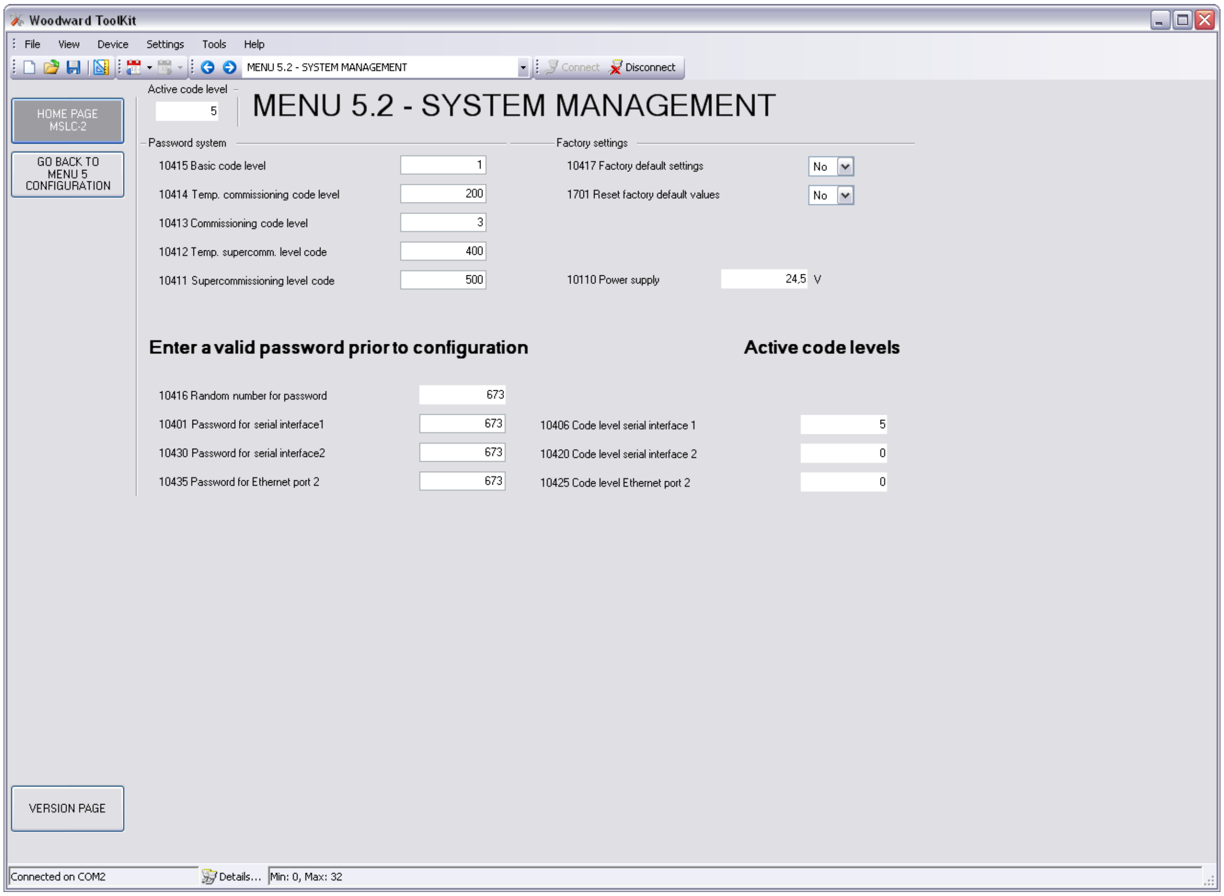


Figure 3-23: ToolKit – system management

Password System

The MSLC-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 one-time access to a parameter without having to give him a reusable password. The user may also change the password for 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 3-24: Parameter – configuration – system management

Menu 6 – Analog Inputs

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

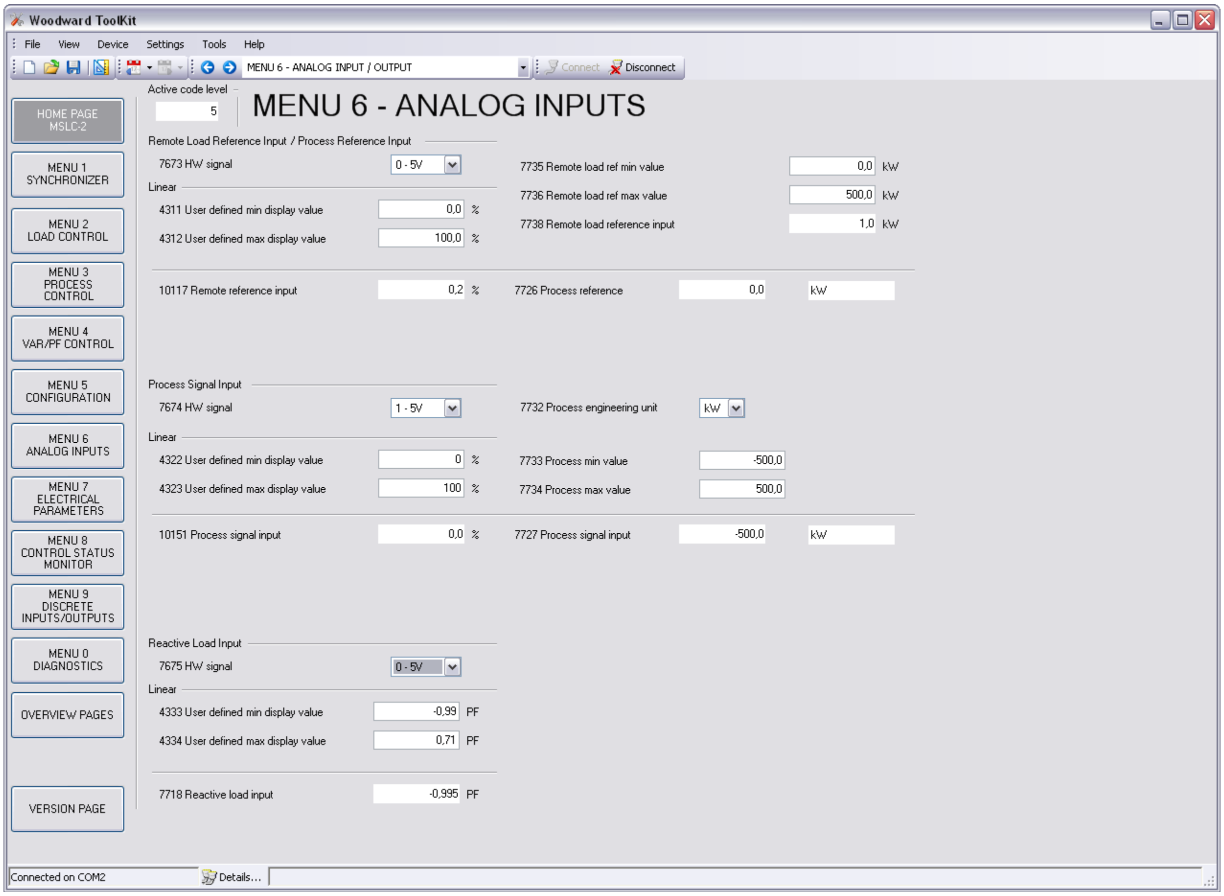


Figure 3-25: ToolKit – analog inputs

Remote Load Reference Input / Process Reference Input

This analog input can be used for two functionalities:

1. Remote load reference input. The input becomes active, if the DI "Setpoint Raise" / "Setpoint Lower" (remote) are closed and the DI "Base Load" or "Imp/Exp Control" is closed.

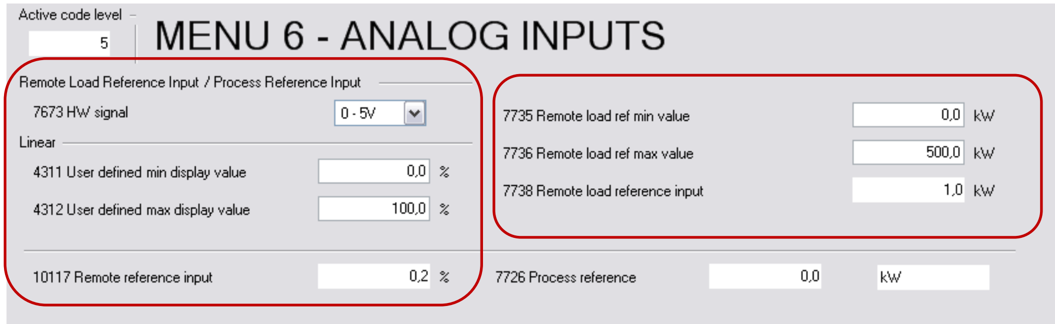


Figure 3-26: ToolKit – relevant fields for remote load reference input

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 "Setpoint Raise" / "Setpoint Lower" (remote) are closed and the DI "Process Control" is closed.

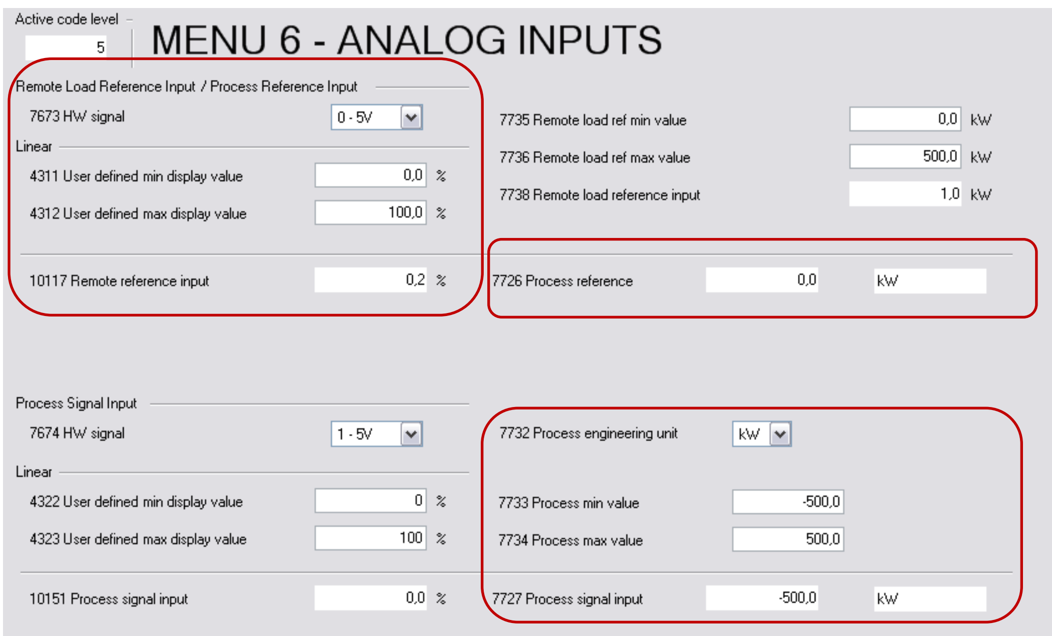


Figure 3-27: ToolKit – relevant fields for remote process reference input

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
7673	**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	-100.0 to 100.0 %	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 analog input 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 analog input 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 parameter 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.

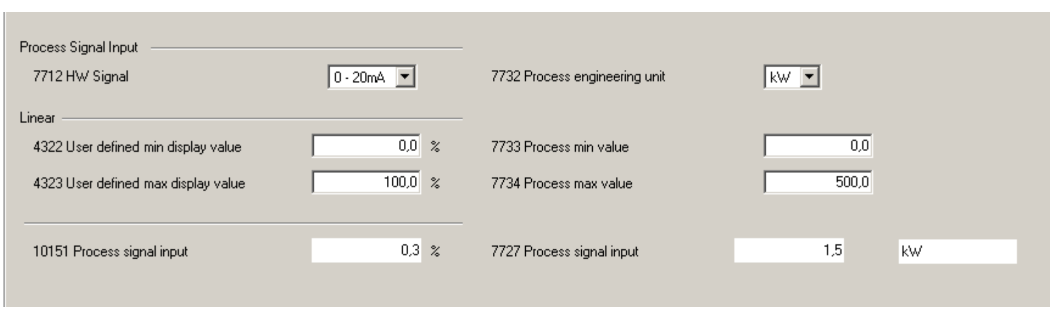


Figure 3-28: ToolKit – process signal input

ID	Parameter	CL	Setting range	Default	Description
7674	**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	-500.0	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 parameter 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.

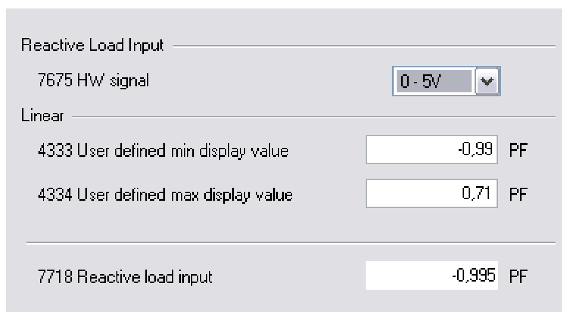


Figure 3-29: ToolKit – reactive load input

ID	Parameter	CL	Setting range	Default	Description
7675	**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
4333	**User defined min display value**	2	-0.999 to 0.999 PF	-0.990 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 parameter 4334.

Table 3-30: Parameter – analog inputs

Menu 7 – Electrical Parameters

This menu contains the general electrical parameters of the MSLC-2.

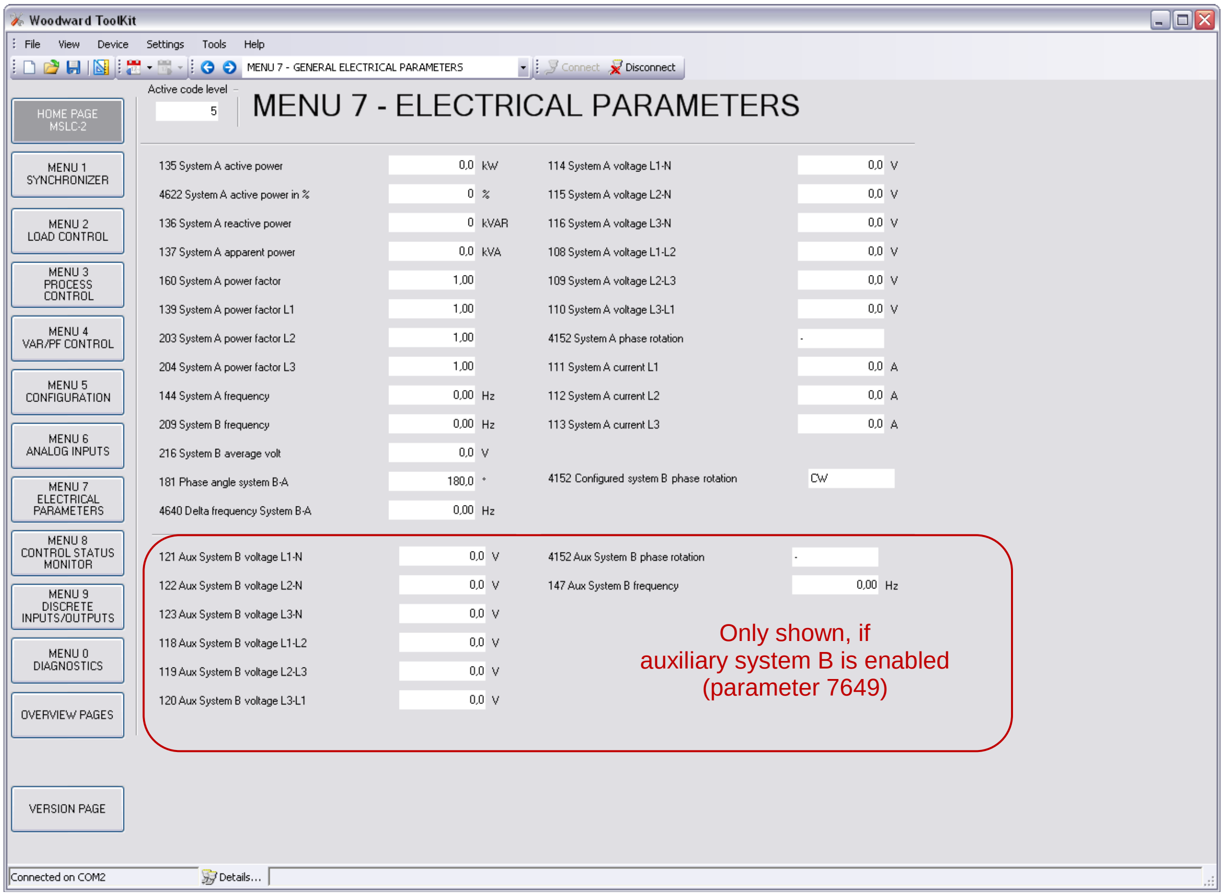


Figure 3-31: ToolKit – electrical parameters

Menu 7 provides all the AC measurement, voltage, current, power and reactive power. The system A is always a 3-phase measurement and the system B is measured as a single phase. A configuration in Menu 5, *Auxiliary system B available* (parameter 7649), allows additionally the measurement of the system B with 3 phases. The option of the 3-phase system B measurement allows the monitoring of all 3 phases and detection of the system B phase rotation. Menu 7 will display the auxiliary system B measurement values when parameter 7649 is configured to"Yes".

ID	Parameter	CL	Setting range	Format	Description
135	**System A active power**	-	Info	0.0 kW	Display of *System A active power* in kW.
4622	**System A active power**	-	Info	0 %	Display of *System A active power* in %.
136	**System A reactive power**	-	Info	0.0 kvar	Display of *System A reactive power* in kvar.
137	**System A apparent power**	-	Info	0.0 kVA	Display of *System A apparent power* in kVA.
160	**System A power factor**	-	Info	1.00	Display of *System A power factor*.
139	**System A power factor L1**	-	Info	1.00	Display of *System A power factor L1*.

ID	Parameter	CL	Setting range	Format	Description
203	**System A power factor L2**	-	Info	1.00	Display of *System A power factor L2*.
204	**System A power factor L3**	-	Info	1.00	Display of *System A power factor L3*.
144	**System A frequency**	-	Info	0.00 Hz	Display of *System A frequency* in Hz.
209	**System B frequency**	-	Info	0.00 Hz	Display of *System B frequency* in Hz.
216	**System B average volt**	-	Info	0.0 V	Display of *System B average voltage* in V.
181	**Phase angle system B-A**	-	Info	180.0°	Display of *Phase angle system B-A* in degrees.
4640	**Delta frequency system B-A**	-	Info	0.00 Hz	Display of *Delta frequency system B-A* in Hz.
114	**System A voltage L1-N**	-	Info	0.0 V	Display of *System A voltage L1-N* in V.
115	**System A voltage L2-N**	-	Info	0.0 V	Display of *System A voltage L2-N* in V.
116	**System A voltage L3-N**	-	Info	0.0 V	Display of *System A voltage L3-N* in V.
108	**System A Voltage L1-L2**	-	Info	0.0 V	Display of *System A voltage L1-L2* in V.
109	**System A Voltage L2-L3**	-	Info	0.0 V	Display of *System A voltage L2-L3* in V.
110	**System A Voltage L3-L1**	-	Info	0.0 V	Display of *System A voltage L3-L1* in V.
4152	**System A phase rotation**	-	Info	- / CW / CCW	Display of *System A phase rotation*: **-:** The phase rotation is not measurable **CW:** Clock Wise = phase rotation right **CCW:** Counter Clock Wise = phase rotation left
111	**System A current L1**	-	Info	0.0 A	Display of *System A current L1* in A.
112	**System A current L2**	-	Info	0.0 A	Display of *System A current L2* in A.
113	**System A current L3**	-	Info	0.0 A	Display of *System A current L3* in A.
4152	**Configured system B phase rota-tion**	-	Info	CW / CCW	Display of the *Configured system B 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 System B Measurement

ID	Parameter	CL	Setting range	Format	Description
121	**Aux System B voltage L1-N**	-	Info	0.0 V	Display of *Auxiliary System B voltage L1-N* in V.
122	**Aux System B voltage L2-N**	-	Info	0.0 V	Display of *Auxiliary System B voltage L2-N* in V.
123	**Aux System B voltage L3-N**	-	Info	0.0 V	Display of *Auxiliary System B voltage L3-N* in V.
118	**Aux System B voltage L1-L2**	-	Info	0.0 V	Display of *Auxiliary System B voltage L1-L2* in V.
119	**Aux System B voltage L2-L3**	-	Info	0.0 V	Display of *Auxiliary System B voltage L2-L3* in V.
120	**Aux System B voltage L3-L1**	-	Info	0.0 V	Display of *Auxiliary System B voltage L3-L1* in V.
4152	**Aux System B phase rotation**	-	Info	- / CW / CCW	Display of *Auxiliary System B phase rotation*: **-:** The phase rotation is not measurable **CW:** Clock Wise = phase rotation right **CCW:** Counter Clock Wise = phase rotation left
147	**Aux System B frequency**	-	Info	0.00 Hz	Display of *Auxiliary System B 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 MSLC-2 showing the actual modes, references and alarms.

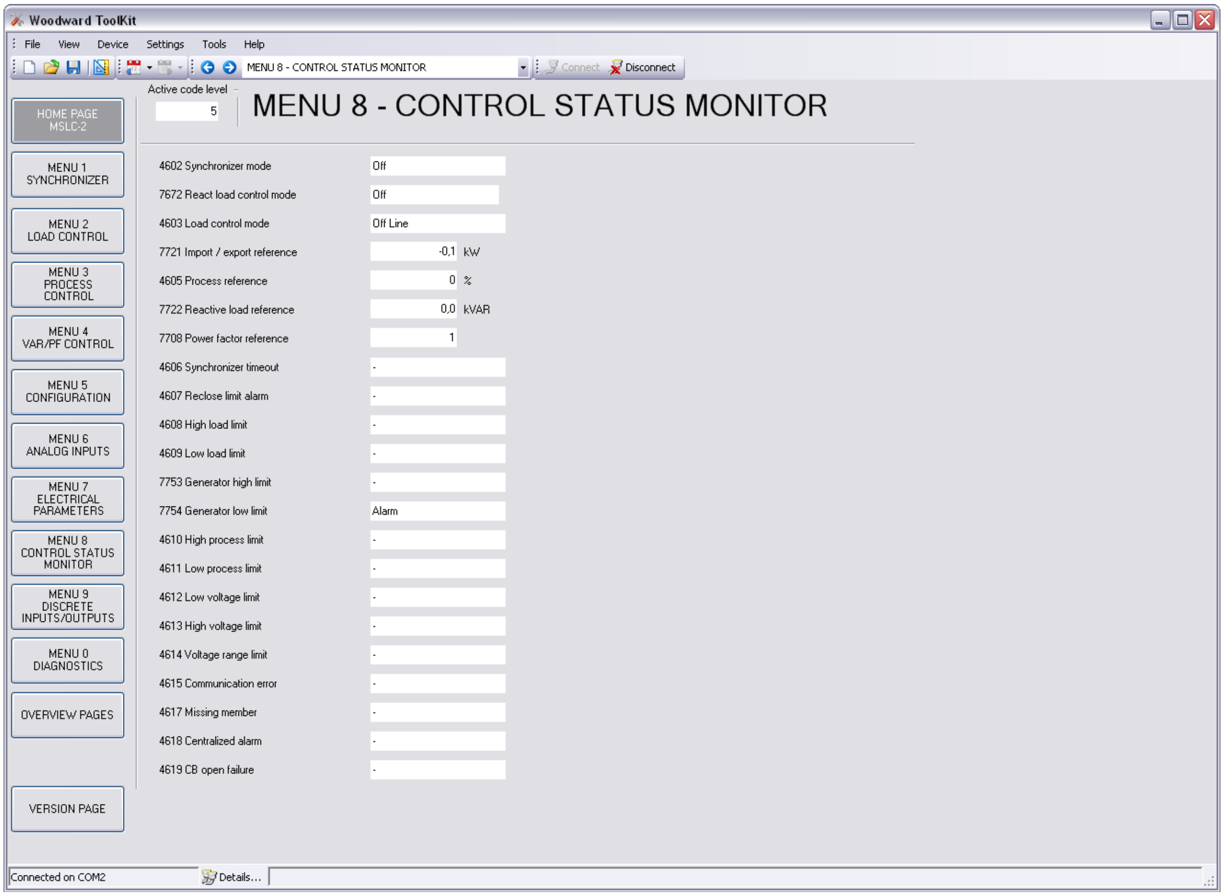


Figure 3-33: ToolKit – control status monitor

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 CB 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 CB. (resync is disabled). **Close Timer:** This is the CB close command.
7672	**Reactive load control mode**	-	Off / Inactive / Voltage Control / VAR Control / Power Factor Control / Const Gen 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. **Voltage Control:** The voltage control is active. **VAR Control:** The reactive load control with kvar reference is active. **Power Factor Control:** Power factor control is active. **Const Gen PF Control:** The reactive load control with a constant power factor reference is active.

ID	Parameter	CL	Setting range	Format	Description
4603	**Load control mode**	-	Off Line / Inactive / Base Load / Base Load Lower / Base Load Raise / Base Load Remote / Process Control / Process Lower / Process Raise / Process Remote / Process Ramp / Import Export Control / Import Export Ramp / Import Export Remote / Imp Exp Lower / Imp Exp Raise / Utility Unload	-	Display of the different *Load control modes*: **Off Line:** The load control mode is disabled. **Inactive:** The load control mode is inactive. **Base Load:** The Load control operates in base load. **Base Load Lower:** A base load lower command is active. **Base Load Raise:** A base load raise command is active. **Base Load Remote:** The load control setpoint comes remotely. **Process Control:** The process control is full active **Process Lower:** A process reference lower command is active. **Process Raise:** A process reference raise command is active. **Process Remote:** The process reference comes remotely **Process Ramp:** The Process ramps toward the reference setting before it hands off to the Process Control. **Import Export Control:** The Import Export control is active. **Import Export Ramp:** A ramp to a new Import Export reference is active. **Import Export Remote:** The Import Export reference value comes remotely **Imp Exp Lower:** The Import Export lower command is active. **Imp Exp Raise:** The Import Export raise command is active. **Utility Unload:** The utility (tie-breaker) is unloaded.
7721	**Import / export reference**	-	Info	0.0 kW	Display of Import / export 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*.
7753	**Generator high limit**	-	Info	- / Alarm	Display of Alarm: *Generator high limit*.
7754	**Generator low limit**	-	Info	- / Alarm	Display of Alarm: *Generator low 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	**Communication error**	-	Info	- / Alarm	Display of Alarm: *Communication error*.
4617	**Missing member**	-	Info	- / Alarm	Display of Alarm: Missing loadshare member.

ID	Parameter	CL	Setting range	Format	Description
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 MSLC-2.

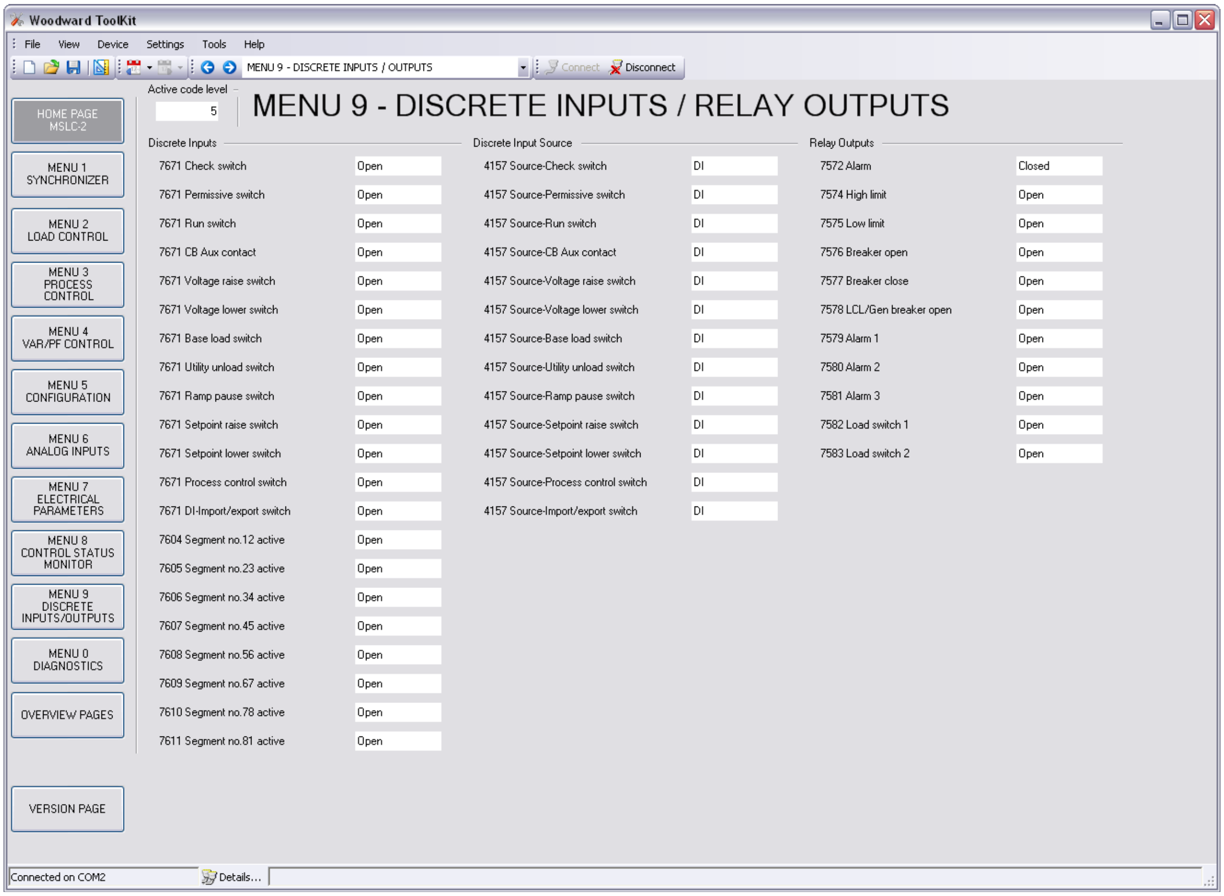


Figure 3-35: ToolKit – discrete inputs / relay outputs

Discrete Inputs

ID	Parameter	CL	Setting range	Default	Description
7671	**Check switch**	-	Open / Closed	Open	Display of discrete input state for [DI 01]: Check.
7671	**Permissive switch**	-	Open / Closed	Open	Display of discrete input state for [DI 02]: Permissive.
7671	**Run switch**	-	Open / Closed	Open	Display of discrete input state for [DI 03]: Run.
7671	**CB Aux contact**	-	Open / Closed	Open	Display of discrete input state for [DI 04]: CB Aux.
7671	**Voltage raise switch**	-	Open / Closed	Open	Display of discrete input state for [DI 05]: Voltage raise
7671	**Voltage lower switch**	-	Open / Closed	Open	Display of discrete input state for [DI 06]: Voltage lower
7671	**Base load switch**	-	Open / Closed	Open	Display of discrete input state for [DI 07]: Base load.
7671	**Utility unload**	-	Open / Closed	Open	Display of discrete input state for [DI 08]: Utility unload.
7671	**Ramp pause switch**	-	Open / Closed	Open	Display of discrete input state for [DI 09]: Ramp pause.
7671	**Setpoint raise switch**	-	Open / Closed	Open	Display of discrete input state for [DI 10]: Setpoint raise

ID	Parameter	CL	Setting range	Default	Description
7671	**Setpoint lower switch**	-	Open / Closed	Open	Display of discrete input state for [DI 11]: Setpoint lower
7671	**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.
7671	**Import /Export switch**	-	Open / Closed	Open	Display of discrete input state for [DI 21]: Import/Export control.

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 communication interface.
4157	**Source-Run switch**	-	DI / COM	DI	Indicates the source of “Run” switch either DI or communication interface.
4157	**Source-CB Aux contact**	-	DI / COM	DI	Indicates the source of “CB Aux” switch either DI or communication interface.
4157	**Source-Voltage raise switch**	-	DI / COM	DI	Indicates the source of “Voltage Raise” switch either DI or communication interface.
4157	**Source-Voltage lower switch**	-	DI / COM	DI	Indicates the source of “Voltage Lower” switch either DI or communication interface.
4157	**Source-Base load switch**	-	DI / COM	DI	Indicates the source of “Base Load” switch either DI or communication interface.
4157	**Source-Utility unload switch**	-	DI / COM	DI	Indicates the source of “Utility Unload” switch either DI or communication interface.
4157	**Source Ramp pause switch**	-	DI / COM	DI	Indicates the source of “Ramp Pause” switch either DI or communication interface.
4157	**Source-Setpoint raise switch**	-	DI / COM	DI	Indicates the source of “Setpoint Raise” switch either DI or communication interface.

ID	Parameter	CL	Setting range	Default	Description
4157	**Source-Setpoint lower switch**	-	DI / COM	DI	Indicates the source of "Setpoint Lower" switch either DI or communication interface.
4157	**Source-Process control switch**	-	DI / COM	DI	Indicates the source of "Process Control" switch either DI or communication interface.
4157	**Source-Import/Export switch**	-	DI / COM	DI	Indicates the source of "Imp./Exp. Control" 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.
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	**LCL/Gen breaker open**	-	Open / Closed	Open	Display of relay output state for [R 07]: LCL/Gen breaker open.
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	**Load switch 1**	-	Open / Closed	Open	Display of relay output state for [R 11]: Load switch 1.
7583	**Load switch 2**	-	Open / Closed	Open	Display of relay output state for [R 12]: Load switch 2.

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.

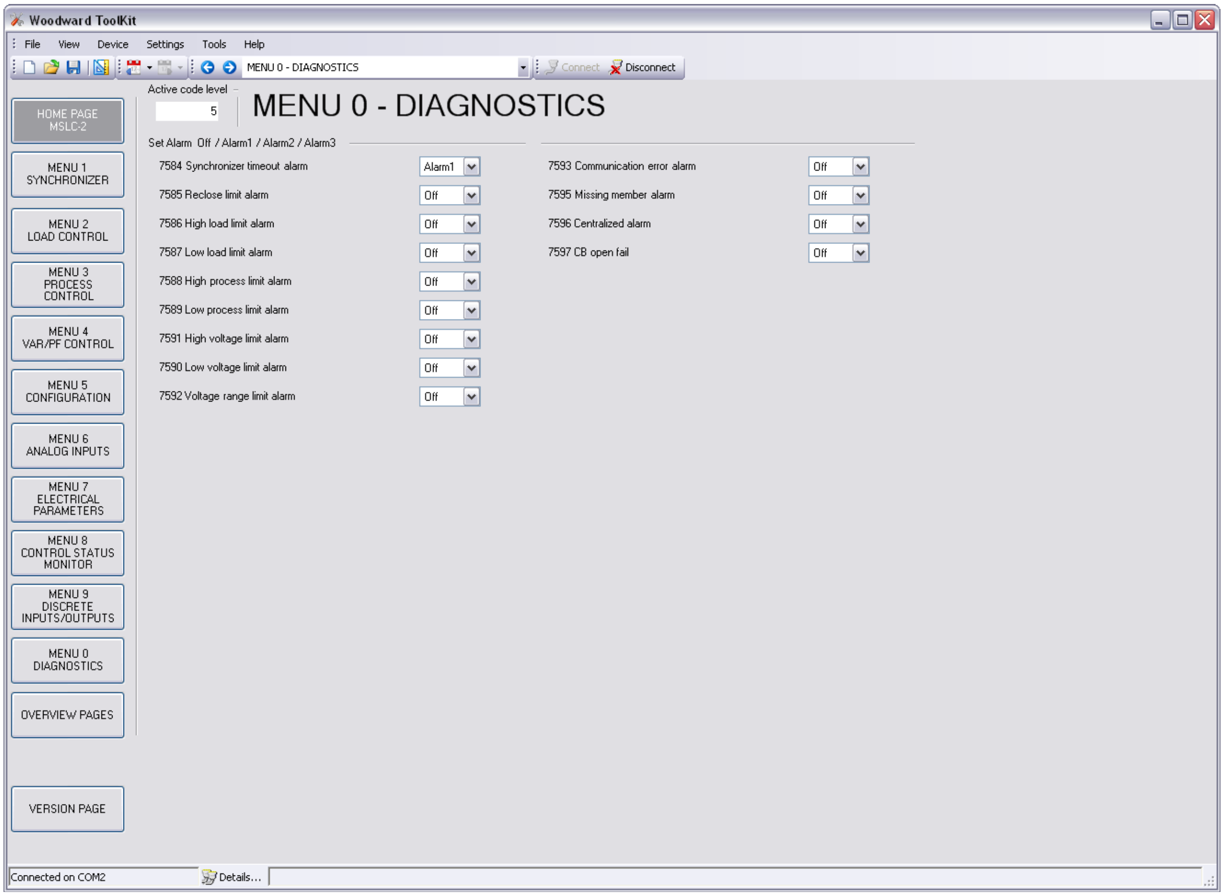


Figure 3-37: ToolKit – diagnostics

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.
7591	**High 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
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	**CB 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 MSLC-2 provides 2 overview pages showing information from up to 32 DSLC-2 and up to 16 MSLC-2.

DSLC-2 Overview Page

The DSLC-2 overview page 1 informs about the conditions of the DSLC-2 number 1 to 32 connected to the network. This helps for commissioning a DSLC-2 / MSLC-2 system.

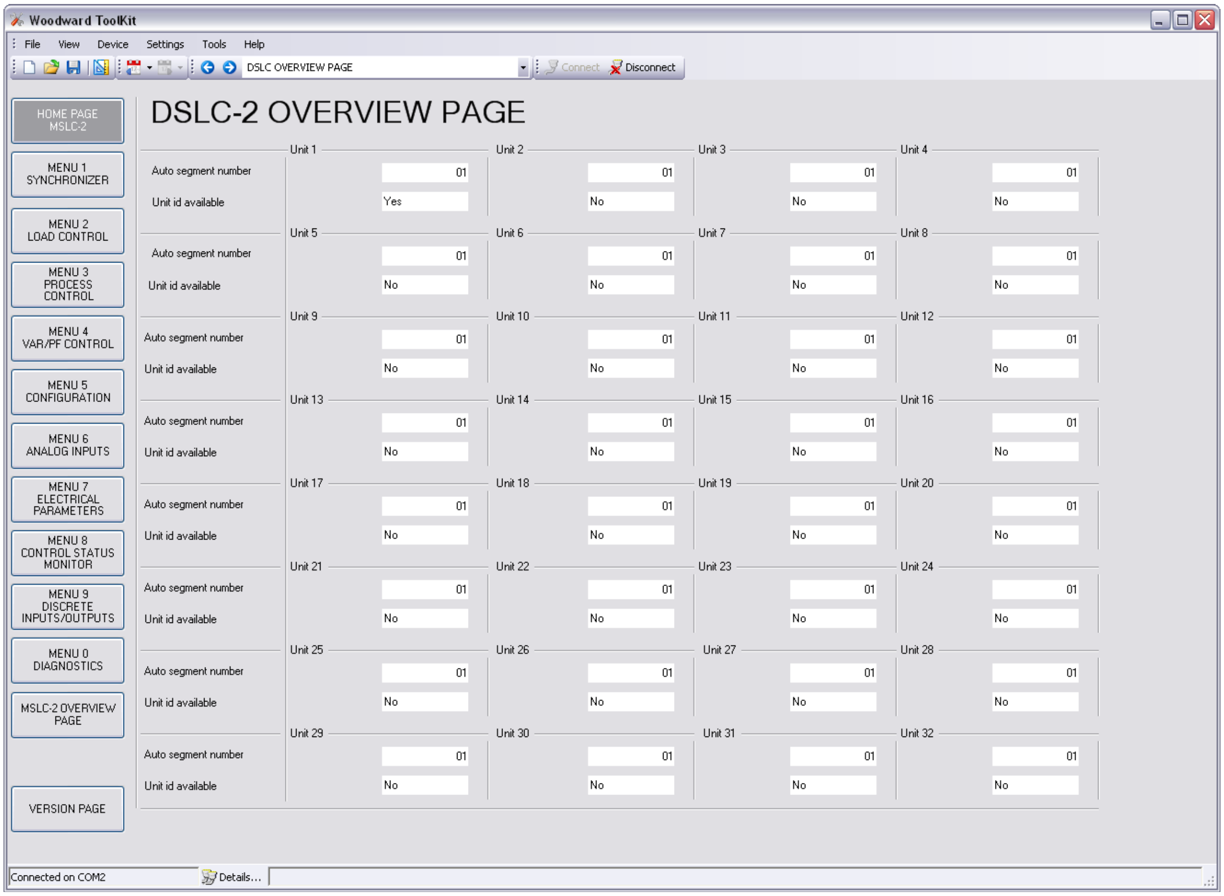


Figure 3-39: ToolKit – DSLC-2 overview page

ID	Parameter	CL	Setting range	Default	Description
	Auto segment number	-	1 to 8	-	This field indicates what each DSLC-2 recognizes to which segment number it is accorded to.
	Unit id available	-	No / Yes	-	This field indicates the availability in the system. **No:** Not available in the system. **Yes:** Available in the system.

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

MSLC-2 Overview Page

The MSLC-2 overview 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.

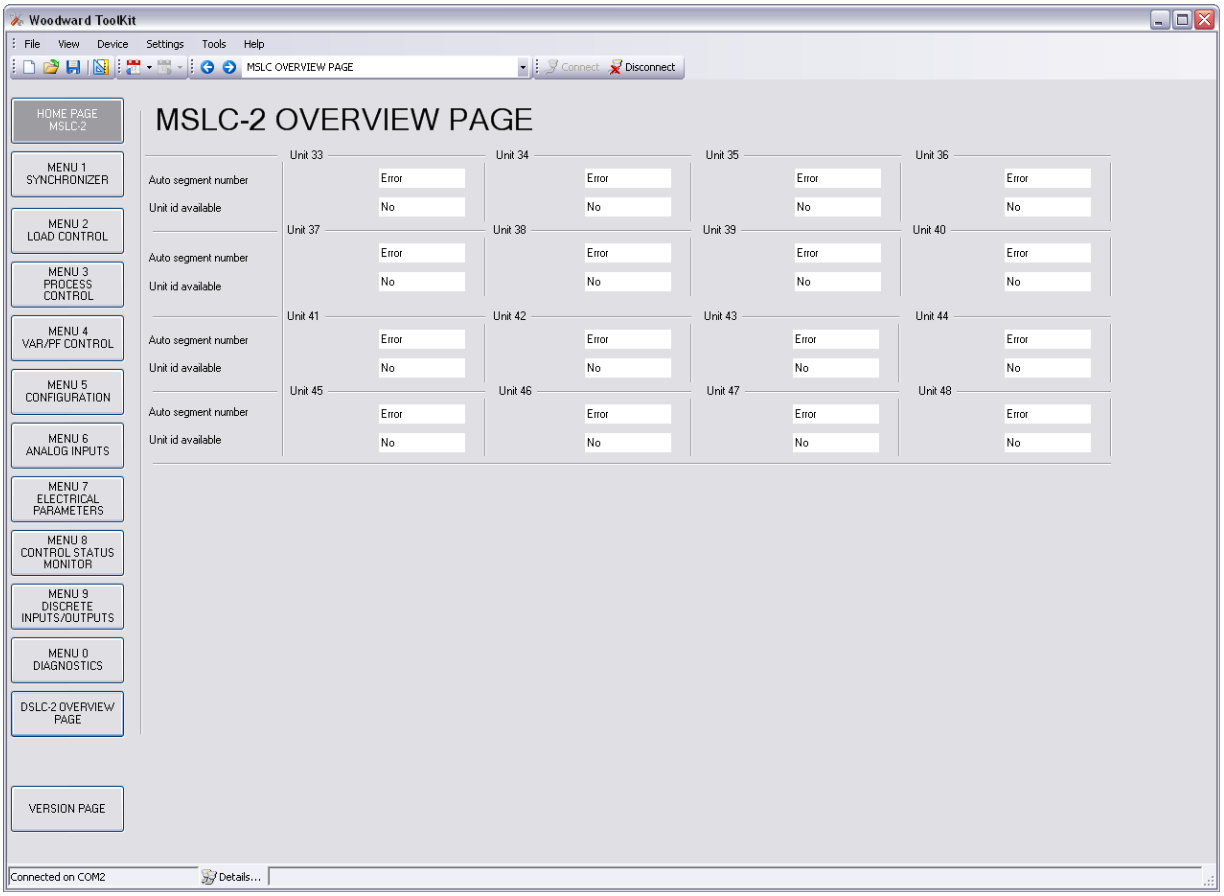


Figure 3-40: ToolKit – MSLC-2 overview page

ID	Parameter	CL	Setting range	Default	Description
	Auto segment number	-	1 to 8	-	This field indicates what each MSLC-2 recognizes to which segment number it is accorded to.
	Unit id available	-	No / Yes	-	This field indicates the availability in the system. **No:** Not available in the system. **Yes:** Available in the system.

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

Prestart Setup Procedure

Apply power to the MSLC-2 control. Verify that the MSLC-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 MSLC-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 3-41.

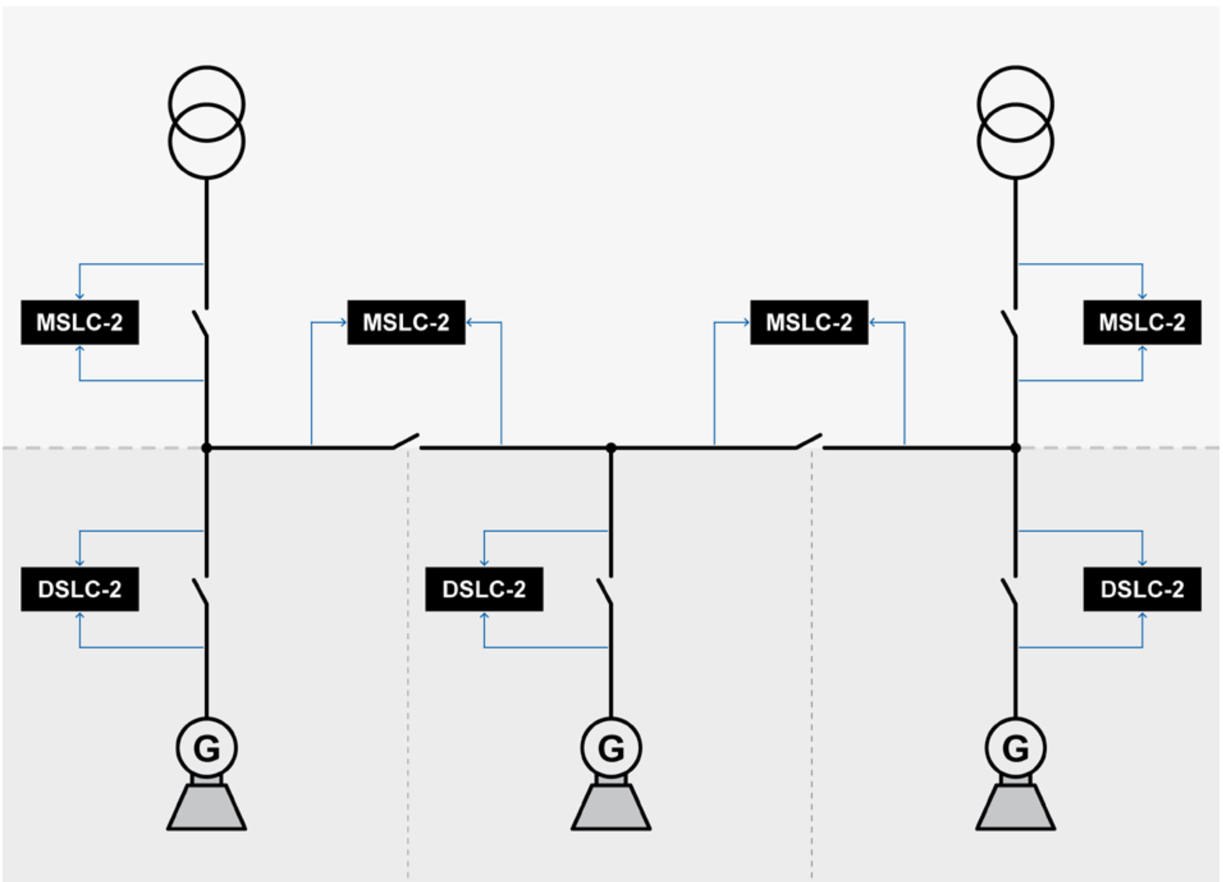


Figure 3-41: Example of an online diagram

2. Draw the measurement systems arrows between unit and bars (refer to Figure 3-42).
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 usually has 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 3-42).
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 3-42).
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 3-42).
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.

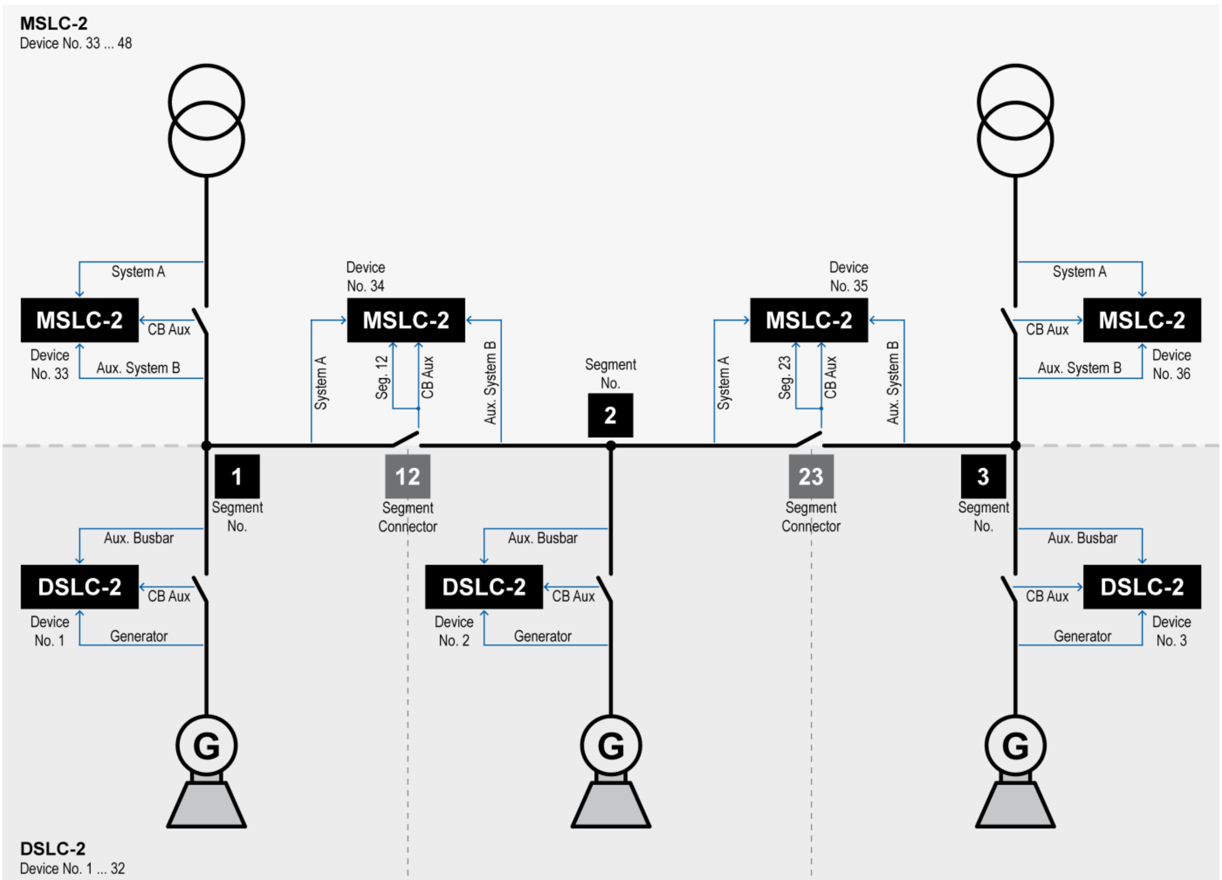


Figure 3-42: Example of an online diagram with segment numbers and segment connector feedbacks

6. Draw the switch and its network for Ethernet channel A and B, if used, in your online diagram (refer to Figure 3-43).

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.

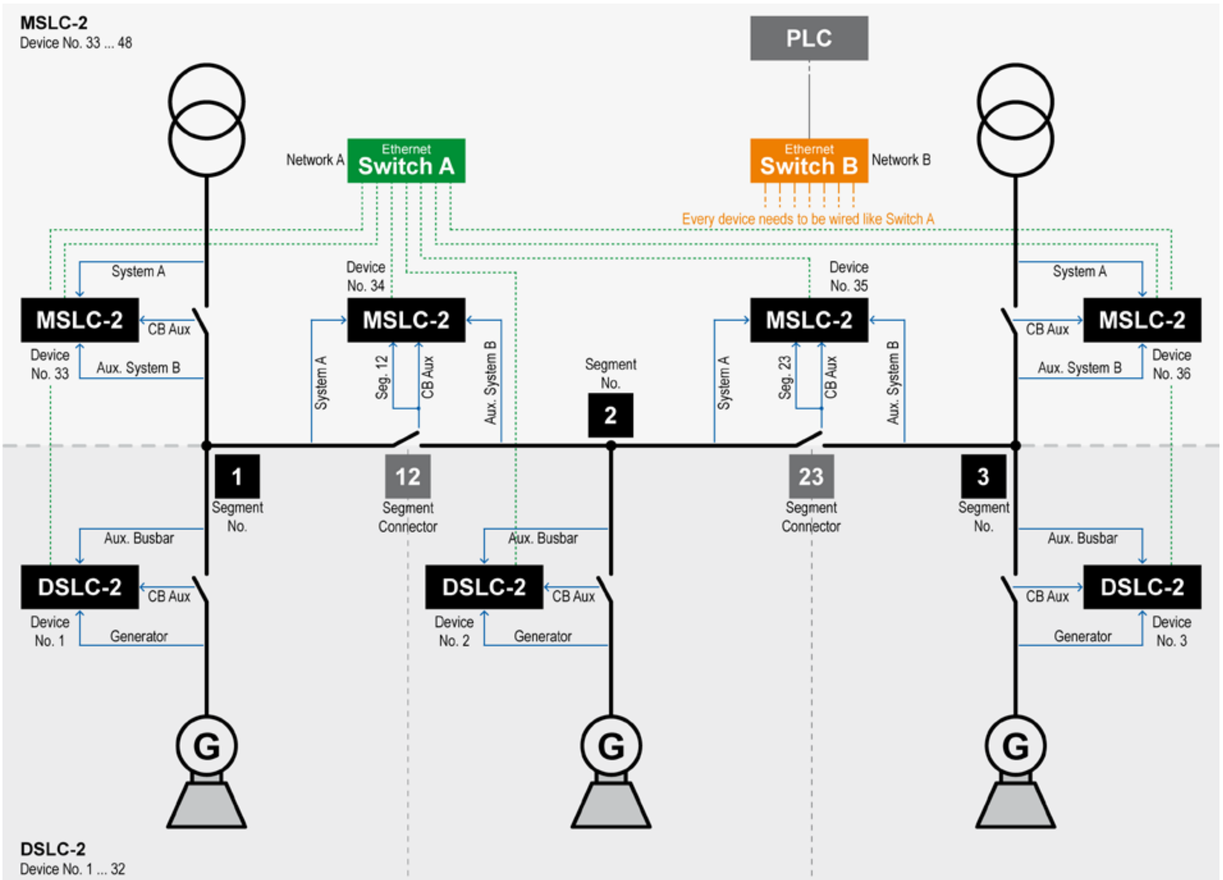


Figure 3-43: Example of an online diagram with according network

7. You can optionally draw the current measurement and the amount of phases in your online diagram (refer to Figure 3-44).

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 executed. Please remark this with lines over the busbar / system B measurement.

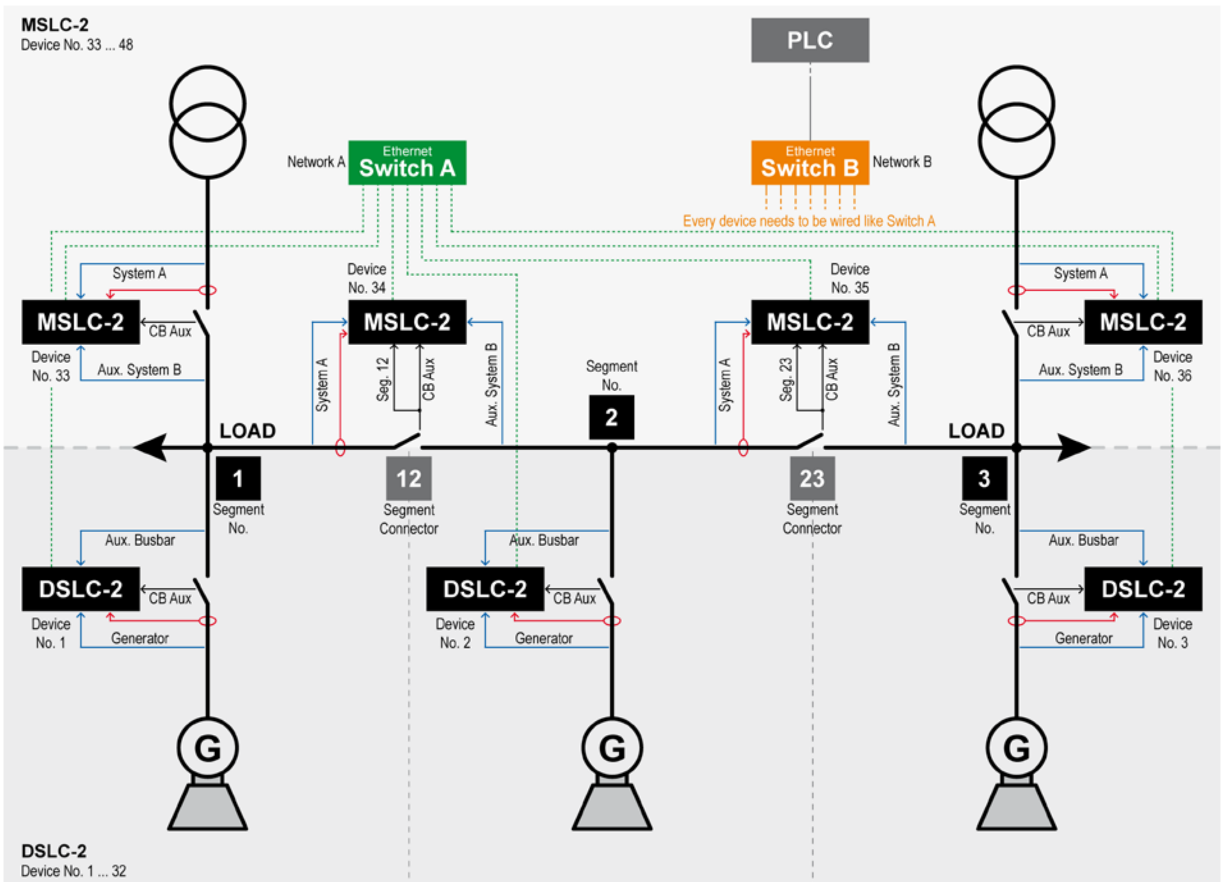


Figure 3-44: Example of an online diagram with all required information to setup the units

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.

MSLC-2 Control Adjustments

When the prestart setup procedures above have been completed, the MSLC-2 may be installed into the system and the following adjustment procedures must be followed. After the unit has been installed and before applying power to the PT and CT inputs, verify the following:

1. The MSLC-2s see the proper number of DSLC-2 and MSLC-2 controls on the network (see overview page DSLC-2 and MSLC-2 in ToolKit).
2. The DSLC-2s see the proper number of DSLC-2 and MSLC-2 controls on the network (see overview page DSLC-2 and MSLC-2 in ToolKit).
3. The MSLC-2 recognizes the synchronizer switch inputs (see Menu 9).
4. The synchronizer is in the “OFF” mode.

Calibration Check

Load the system up to a typical import/export level. Check Menu 7 to ensure that the MSLC-2 is sensing the proper voltages, currents, power levels and power factor. Power must measure positive when being imported from the utility. Use Figure 3-45 to help verify all measurements.

- Break the parallel with the utility.
- Ensure that the MSLC-2 synchronizer mode is “Off” (Menu 8).
- Verify that the MSLC-2 sees the proper number of MSLC-2 / DSLC-2 controls (overview pages).
- Verify that the MSLC-2 shows active and reactive power flow in the right signing (Homepage).

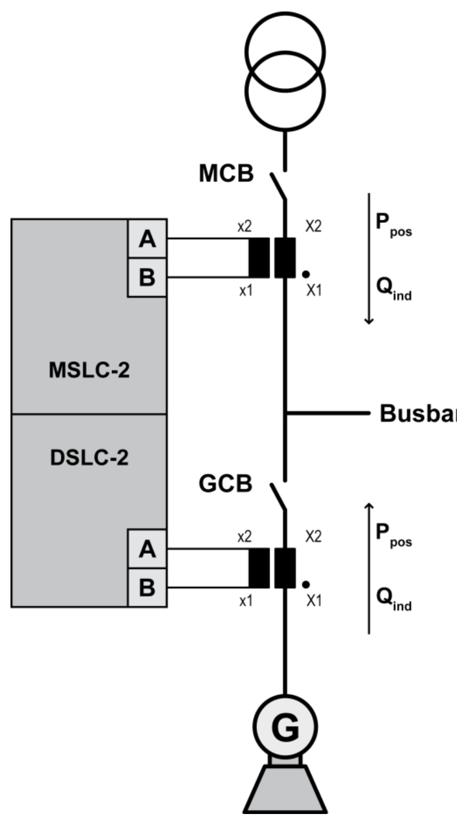


Figure 3-45: Power measurement

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 gain* (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 *CB close hold time* (parameter 3417) to the time desired for the MSLC-2 control to hold the breaker closure signal. This time should at least exceed the breaker delay time.
6. Set the close attempts (parameter 3419) 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 MSLC-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 CB* (parameter 5730) to “Phase matching”.
2. Close the synchronizer “Check” mode switch.
3. With system A active (mainly utility) system B active (mainly generator bus), adjust the synchronizer proportional gain setpoint for stable control of the utility frequency as indicated by synchroscope holding steady at zero phase.

NOTE

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

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 4712) 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 system A 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 or the var/PF control is to be used, do the setup in the voltage matching adjustment section below.

Proceed with final synchronizer setup.

Final Synchronizer Setup

1. Open the circuit breaker to disconnect the system A (usually mains) from system B.
2. Set close attempts (parameter 3419) 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.
3. 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.
4. If an alarm is desired when the maximum close attempts has been reached, set sync reclose alarm to "Enabled".
5. 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.
6. If an alarm is desired when the sync timeout interval expires, set the *Synchronizer timeout alarm* (parameter 7557) setpoint to "Enabled".
7. 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 MSLC-2 control synchronizer setup.

Voltage Matching Adjustments

The following steps will verify the correct operation of the synchronizer voltage matching function. With the breaker open and at least one generator on line, momentarily raise and lower the voltage on the local generator bus.

NOTE

Individual DSLC-2 controls must be setup for proper voltage regulator control prior to adjusting the MSLC-2 control (See the DSLC-2 manual).

Preliminary Voltage Matching Setup

1. Select Menu 1 and set the *Voltage matching* (parameter 7513) setpoint to "Enabled".
2. Select Menu 7 and display both system A and system B voltages.
3. With the synchronizer "Off", manually raise the local bus (system B) voltage until it is approximately 5% higher than the utility voltage.
4. Set the synchronizer mode to "Check". The MSLC-2 should adjust the local bus voltage until it is within the voltage window selected in Menu 1.
5. If the voltage cycles through the window without settling into it, use the V*oltage synchronizer proportional gain* (parameter 5610) and integral gain to obtain the response you want. Lowering these values will slow the response. It might be that the DSLC-2s will have to be adjusted to obtain the response needed.
6. Set the synchronizer to "Off", manually lower the local bus voltage until it is approximately 5% lower than the utility voltage.
7. Set the synchronizer mode to "Check". The MSLC-2 should adjust the local bus voltage until it is within the voltage window selected in Menu 1.

NOTE

If the slip frequency reference is set to zero, the voltage window is ± the setpoint chosen in Menu 1. If the slip frequency reference is set to a negative or slow slip, the voltage window is such that the local bus voltage must be less than the utility voltage. Conversely, if the slip frequency reference is set to a positive or fast slip, the voltage window is such that the local bus voltage must be greater than the utility voltage. This ensures that the initial flow of reactive power is in the same direction as the initial flow of real power.

Final Voltage Matching Setup

1. Set the voltage high/low limits in Menu 3 to their desired values.
2. Enable the voltage alarms and voltage switches in Menu 3 if it is desired to activate the alarm or the high/low limit relay drivers upon exceeding a setpoint.

Load Control Adjustment

This section contains the instructions for setup of the MSLC-2 load control. Set all load control setpoints (Menu 2) according to the descriptions above and the work sheet. The Homepage or Menu 8 displays the load control mode, import/export reference and load command outputs are provided to assist in setup and verification of correct operation.

Base Load Mode Setup

The base load mode is used when manual control of the operating generators is required, or whenever the generators are desired to be maintained at a set percentage of their rated load without regard to plant loading or import/export levels.

1. Adjust the setpoints in Menu 2 as described above. Set the parameter *Load control setpoint source* (parameter 7634) to “Internal”. Check that the DIs setpoint raise and lower are not energized.
2. Switch the MSLC-2 in base load master control. This is done by energizing the DI “Base Load” and the “CB Aux”.
3. Break the parallel between the local bus (system A) and the utility (system B). Place at least one generator in isochronous load sharing (isolated run).
4. Watch the *Load control mode* field (parameter 4603) in the Homepage. Re-synchronize and parallel the local bus (system B) to the utility (system A). Verify that, when the breaker at the MSLC-2 closes, the load command assumes the value of system load immediately prior to paralleling.
5. Temporarily issue a lower setpoint command and then a raise setpoint command. Verify that the load command changes appropriately and that the engines running in base load respond appropriately. You can watch in the Homepage the setpoint load level going down to the DSLC-2s (parameter 4629).

Remote Base Load

Do the following steps if the analog *Remote load reference input* (parameter 7738) is used in base load control.

1. As a basic do the base load mode setup described above.
2. The value of the remote input is to configure and can be viewed in Menu 6. Before you start the engine check over the displaying field in Menu 6 (parameter 7738) if the analog input is right transformed in a base load reference value in kW.
3. Switch the MSLC-2 in base load master control. This is done by energizing the DI “Base Load”.
4. Synchronize and parallel the local bus (system B) to the utility (system A) in the base load mode. Adjust the signal input to a level different from the present base load level.
5. Close both the raise and lower setpoint contacts to select the remote mode. The *Load control mode* (parameter 4603) in Menu 8 or in the Homepage should indicate base load and the load command should ramp to the specified level.
6. Raise and lower the analog signal. The load will ramp at the rates chosen in Menu 2 load and unload ramp rates. These rates may be adjusted to achieve satisfactory performance.
7. Open the raise and lower setpoint contacts. The *Load control mode* (parameter 4603) should indicate base load and the control remains at the last base load level chosen by the analog input.

This completes the remote base load reference setup procedure.

Import/Export Mode Setup

1. As a basic do the base load mode setup described above.
2. An important assumption for setup this mode is the right connection of the CT´s of the MSLC-2. Be sure that incoming real power (power flow from system A to system B) is displayed positive (see Homepage) and incoming lagging reactive power is displayed positive as well. Do not proceed if you have not clarified the right measurement.
3. Check Menu 2 setpoints for *Import/export control proportional gain* (parameter 5510), *Import/export control integral gain* (parameter 5511), *Import/export control derivative ratio* (parameter 5512) whether they are adjusted to their default values.
4. Adjust the setpoints in Menu 2 as described in the parameter setup chapter above. Set the parameter *Load control setpoint source* (parameter 7634) to “Internal”. Check that the DI´s setpoint raise and lower are not energized. Configure an import/export reference (parameter 7717), positive value is importing power from mains, negative value is exporting power to mains.

NOTE

Do not chose an export level if it is not allowed by the utility.

5. Switch the MSLC-2 in import/export load master control. This is done by energizing the DI “Import/Export Control”.
6. Break the parallel between the local bus (system A) and the utility (system B). Place at least one generator in isochronous load sharing.
7. Re-synchronize and parallel the local bus (system B) to the utility (system A). Verify that, when the breaker at the MSLC-2 closes, the load command assumes the value of system load immediately prior to paralleling. The control will ramp the *Setpoint load level* (parameter 4629) output until the import/export level is within its target.
8. If the import/export control is unstable when taking control, decrease the import/export proportional gain to achieve stability. If the chosen import/export level is not obtainable within the 0 to 100% load command range, the control will stop at 0% or 100%. If a slow hunt is observed or excessive overshoot of the export/import value occurs, decrease the process integral gain.
9. Temporarily issue a lower setpoint command and then a raise setpoint command. Verify that the import/export reference changes appropriately and that the running engines respond appropriately. You can watch in the Homepage the *Setpoint load level* (parameter 4629) decreasing to the DSLC-2s.

This completes the import/export setup.

Remote Import/Export Setup

Do the following steps if analog remote load reference input is to be used. The value of the remote input is configured and viewed in Menu 6.

1. As a basic do the import/export load mode setup described above.
2. Set the scaling of the analog signal according to the instructions of the Menu 6. The remote load reference signal will be interpreted as an import/export load reference when the DI import/export control is given.
3. Close both the raise and lower setpoint contacts to select the remote mode. The load control mode in Menu 8 or the Homepage should indicate import/export remote and the load command of the MSLC-2 to DSLC-2 ramps to the needed level.
4. Raise and lower the analog signal. The load will ramp at the rates chosen in Menu 2 load and unload ramp rates. These rates may be adjusted to achieve satisfactory performance. Open the raise and lower setpoint contacts the load control mode indicates import/export control and the control keeps the last import/export level.

This completes the remote import/export reference setup procedure.

Final Load Control Setup

1. Set Menu 2 Load ramp rate (parameter 4700) 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 the *Utility unload trip* (parameter 4506) and *Generator unload trip* (parameter 3125) levels to their desired values.
4. The import real load can be monitored by the high load Limit PU (pick up) and DO (drop out) setpoints. The settings are related on a rated power system A (parameter 1752).
5. The export real load can be monitored by the low load limit PU (pick up) and DO (drop out) setpoints. The settings are related on a rated power at the interchange point (parameter 1752).
6. If it is desired that the alarm output *High load limit* (parameter 4608) alarm is activated 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* (parameter 4609) alarm is activated 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 also activate the “High Limt” and “Low Limit” relays, set the *Load limit switch* (parameter 7506) setpoint to “Enabled”.
9. Set the load switch PU and load switch DO setpoints to their desired operating levels.

Process Control Adjustment

This section contains instructions for setup of the MSLC-2 process control. Menu 6 provides the setting for the process input signal and the according engineering units. Menu 6 and the Homepage displays the resulting real signal in percentage and in engineering units. Menu 8 shows the process control setpoint in percentage. The Homepage displays the setpoint process control in perentage and engineering units.

1. Configure in Menu 6 the *Process signal input* (parameter 7727) according to the chapter setup description Menu 6 in this manual. Don't forget to scale engineering units according to the real process signal. This is the base that the process control reference signal can be interpreted.
2. Check Menu 3 setpoints for *Process control proportional gain* (parameter 4500), *Process control integral gain* (parameter 4501), *Process control derivative ratio* (parameter 4502) and *Process filter* (parameter 4509) whether they are adjusted to their default values.
3. Set Menu 3 *Process control action* (parameter 7559) to "Direct" or "Indirect" as required for the process. If increasing load also increases the process input signal level, use "Direct". If increasing load decreases the process input signal level, use "Indirect".
4. Set the internal *Process reference* (parameter 7737) setpoint Menu 3 to a value requiring approximately 50% load to maintain the process signal level. If the required process reference is not known at start-up, operate the MSLC-2 in base load mode. Use the raise and lower setpoint inputs to adjust the load until the desired process level is obtained. Observe the process input in Menu 6 or the Homepage to determine the required process reference value.
5. Close the process switch. Select "Run" on the MSLC-2 to parallel the local bus with the utility. The MSLC-2 will ramp into process control.
6. If the process control is unstable when taking control, decrease the *Process control proportional gain* to achieve stability. If decreasing *Process control proportional gain* (parameter 4500) increases instability, increase *Process control integral gain* (parameter 4501). If the process control gain is too slow, increase the *Process control proportional gain* (parameter 4500) by a factor of two. If a slow hunt is observed or excessive overshoot of the process reference settings occurs, increase the process integral gain by a factor of two.
7. In systems experiencing rapid fluctuations of the process input, increasing the process filter will provide a slower but more stable response.
8. Introduce *Process droop* (parameter 4508) if required.
9. The real process value can be monitored by the *Process high limit PU* (parameter 4510) and DO setpoints to issue an alarm.
10. The real process value can be monitored by the *Process low limit PU* (parameter 4513) and DO setpoints to issue an alarm.
11. If it is desired that the alarm output *High process limi*t (parameter 4610) alarm 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.
12. 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.
13. If it is desired that the high and low limit switches also activate the "High Limit" and "Low Limit" relays, set the *Process switches* (parameter 7502) setpoint to "Enabled".

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

Var/PF Control Adjustment

This section describes the setup and adjustment of the MSLC-2 voltage/var/PF control functions. The voltage control is used in case of voltage matching for the synchronizer. The var/PF control is used, if the DSLC- 2 / MSLC-2 system runs parallel to the utility. The values of kvars and average power factor are available in Menu 7 or the Homepage.

NOTE

Var/PF control effectiveness depends on var/PF control in the DSLC-2s. Because of that commission the DSLC-2 var/PF control first.

1. Verify that the voltage matching adjustments above have been done.
2. Select Menu 4 and set *VAR control proportional gain* (parameter 5613), *VAR control integral gain* (parameter 5614) and *VAR control derivative ratio* (parameter 5615) to their default values.

Constant Generator Power Factor Setup

The MSLC-2 can send a constant generator power factor setpoint to the DSLC-2s. The power factor reference is configured in Menu 4 (parameter 5621). The constant generator power factor will be executed, if:

- The MSLC-2 runs in base load mode OR
  - When in Base load mode, the MSLC-2 can only operate in the constant generator PF mode.
- The MSLC-2 runs in export/import mode and the *VAR PF control mode* (parameter 7558) in Menu 4 is configured to "Constant Generator PF".

1. Set the *VAR control setpoint source* (parameter 7635) to "Internal". Set the desired constant generator power factor reference in Menu 4 (parameter 5621).
2. Run the DSLC-2 / MSLC-2 system parallel to the utility. For test purposes change between different constant generator power factors to validate the functionality. When the power factor at the DSLC-2 begins to swing check the settings at the DSLC-2s.

This completes setup of the MSLC-2 constant generator power factor function.

PF Control At The Utility - Setup

The MSLC-2 can regulate a power factor at the interchange point. A PID control compares the power factor reference with the real value and sends a reactive load setpoint to the DSLC-2 to run the error signal to zero. Whatever is sent for reactive load level to the DSLC-2s, the DSLC-2 allows not more than 10% rated vars for leading and do not allow more than 100% rated vars for lagging.

1. Set the *VAR control setpoint source* (parameter 7635) to "Internal". Set the *VAR PF control mode* (parameter 7558) to "PF Control". Set the desired *Power factor reference* (parameter 5620) in Menu 4.
2. An important assumption for setup is the right connection of the CTs of the MSLC-2. Be sure that incoming power is displayed positive (refer to ToolKit Homepage) and incoming lagging reactive power is displayed positive as well. Do not proceed if you have not clarified the right measurement.
3. Check Menu 4 setpoints for *VAR control proportional gain* (parameter 5613), *VAR control integral gain* (parameter 5614), *VAR control derivative ratio* (parameter 5615) whether they are adjusted to their default values.
4. Switch to base load at the MSLC-2.
5. Run the DSLC-2 / MSLC-2 system parallel to the utility. For test purposes change between different setpoints for the constant generator power factor reference. When the power factor at the DSLC-2 begins to swing check the settings at the DSLC-2s.
6. Run a base load and a generator constant power factor with the DSLC-2 which gives the generators the capability to run the desired power factor at the interchange point. Prepare an import/export control reference which can be maintained by the engines.

NOTE

Do not chose a power factor level if it is not allowed by the utility.

7. Check that the DIs "Voltage Lower" and "Voltage Raise" are not energized and switch the MSLC-2 in import/export load master control. This is actively done by energizing the DI "Imp./Exp. Control".
8. The MSLC-2 should influence the reactive load of the DSLC-2 so that the desired power factor is matched at the utility. If the control action is too fast decrease *VAR control proportional gain* (parameter 5613). If the control action is too slow to bring the PF into control, increase the *VAR control proportional gain* (parameter 5613). If overshoot of the setpoint occurs, decrease *VAR control integral gain* (parameter 5614).
9. Check the regulating behavior by switching several times between base load mode and import/export control mode and watch the guidance of the power factor by the MSLC-2.

This completes setup of the PF control at the interchange point.

Remote PF Control At The Utility - Setup

Do the following steps if the analog "Reactive Load" input signal is used. The analog signal can only be used for the power factor setpoint at the utility.

1. First do the "PF Control At The Utility – Setup", before you proceed with this topic.
2. The value of the remote input needs to be configured and can be viewed in Menu 6. Before you start the engine check over the displaying field in Menu 6 (parameter 7718) if the analog input is right transformed in a power factor reference value.
3. Set the *VAR control setpoint source* (parameter 7635) to "Internal".
4. The power factor reference will be accepted from the MSLC-2 when the "Voltage raise" and "Voltage lower" commands are given and the MSLC-2 runs in export/import mode and the *VAR PF control mode* (parameter 7558) in Menu 4 is configured to "PF Control".
5. Run the DSLC-2 / MSLC-2 system parallel to the utility. For test purposes change the setpoint over the analog input to validate the functionality. When the power factor at the utility begins to swing check the PID settings in the MSLC-2.

This completes setup of the remote PF control at the interchange point.

Var Control At The Utility - Setup

The MSLC-2 can regulate kvars at the interchange point. A PID control compares the kvar reference with the real value and sends a reactive load setpoint to the DSLC-2 to run the error signal to zero. Whatever is sent for reactive load level to the DSLC-2s, the DSLC-2 allows not more than 10% rated vars for leading and do not allow more than 100% rated vars for lagging.

1. First do the “PF Control At The Utility – Setup”, before you proceed with the vars.
2. Set the *VAR control setpoint source* (parameter 7635) to “Internal”. Set the *VAR PF control mode* (parameter 7558) to “VAR Control”.
3. Set the desired *KVAR reference* (parameter 7723) in Menu 4. For a correct and universal regulating configure the rated kvar for the MSLC-2 system. If unknown take the same amount as for the rated active power (parameter 1752).
4. An important assumption for setup this mode is the right connection of the CTs of the MSLC-2. Be sure that incoming power is displayed positive (refer to ToolKit Homepage) and incoming lagging reactive power is displayed positive as well. Do not proceed if you have not clarified the right measurement.
5. Check Menu 4 setpoints for *VAR control proportional gain* (parameter 5613), *VAR control integral gain* (parameter 5614), *VAR control derivative ratio* (parameter 5615) whether they are adjusted to their default values.
6. Switch to base load at the MSLC-2. Run the DSLC-2 / MSLC-2 system parallel to the utility. For test purposes change between different setpoints for the constant generator power factor reference. When the power factor at the DSLC-2 begins to swing check the settings at the DSLC-2s.
7. Run a base load and a generator constant power factor with the DSLC-2 which gives the generators the capability to run the desired kvars at the interchange point. Prepare an import/export control reference which can be maintained by the engines.

NOTE

Do not chose a var level if it is not allowed by the utility.

8. Check that the DIs “Voltage Lower” and “Voltage Raise” are not energized and switch the MSLC-2 in import/export load master control. This is actively done by energizing the DI “Imp./Exp. Control”.
9. At next the MSLC-2 influences the reactive load of the DSLC-2 so that the desired kvars are matched at the utility. If the control action is too fast decrease *VAR control proportional gain* (parameter 5613). If the control action is too slow to bring the var into control, increase the *VAR control proportional gain* (parameter 5613). If overshoot of the setpoint occurs, decrease *VAR control integral gain* (parameter 5614).
10. Check the regulating behavior by switching several times between base load mode and import/export control mode and watch the guidance of the kvars by the MSLC-2.

This completes var 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 124 demonstrate the AC measurement connection and configuration of the MSLC-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 47, 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 *CB close hold time* (3417) setting. It does not stay closed for the complete time you are within the proper limits.

NOTE

In case of power loss, the MCB breaker must be opened manually, because the MSLC-2s output cannot be energized.

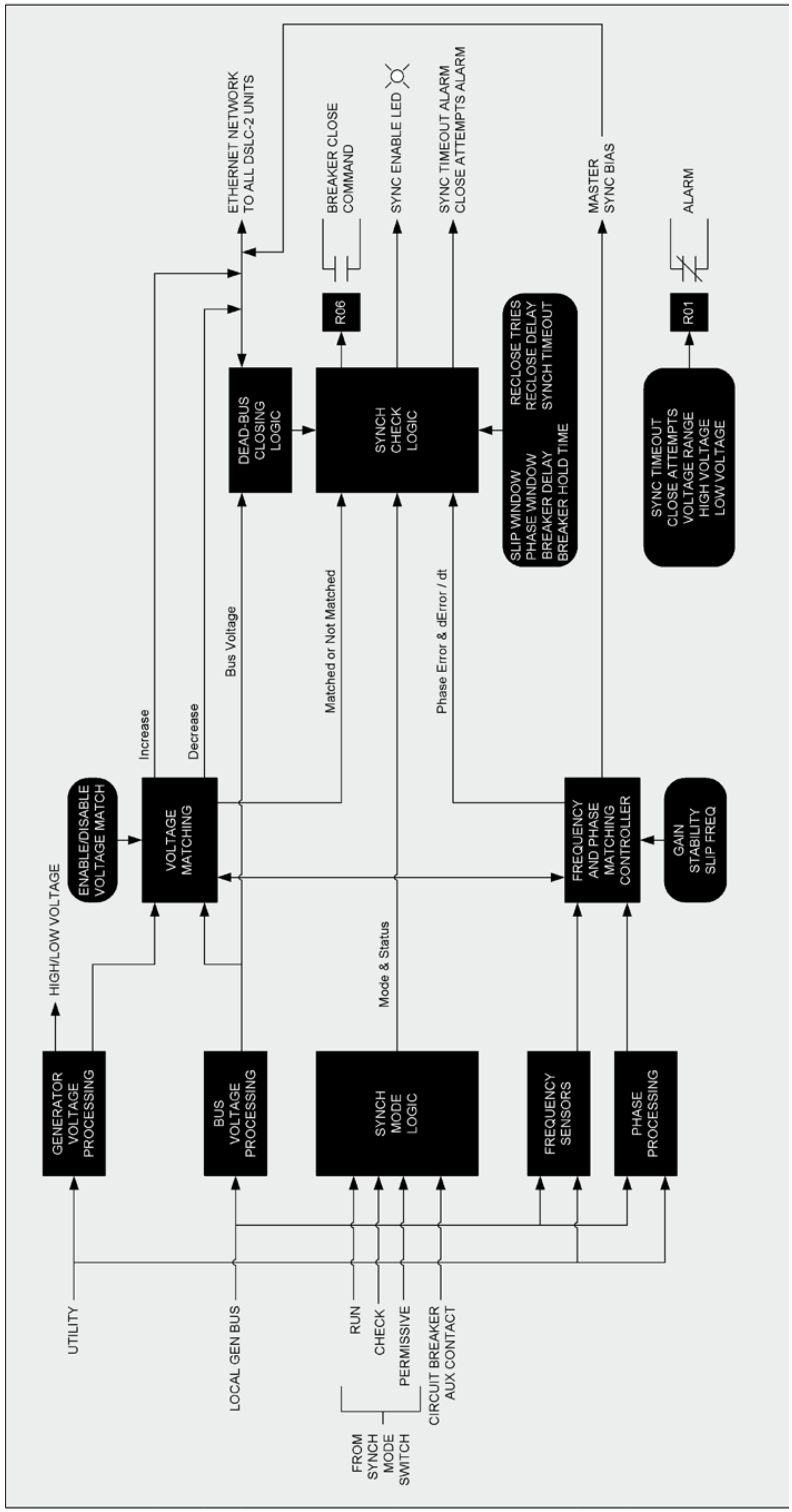


Figure 4-1: Synchronizer block diagram

Measurement Connections (Examples)

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

- Phase rotation clockwise
- System A measurement: 3-Phase with neutral
- System B measurement : **L1-L2 (“Phase – phase”)**

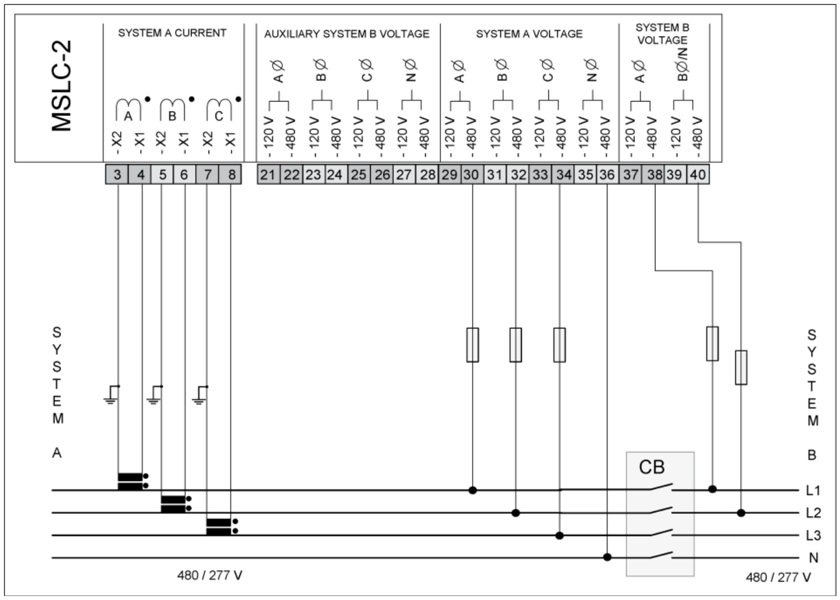


Figure 4-2: Low voltage system 480 V / 277 V – 3-phase with neutral

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

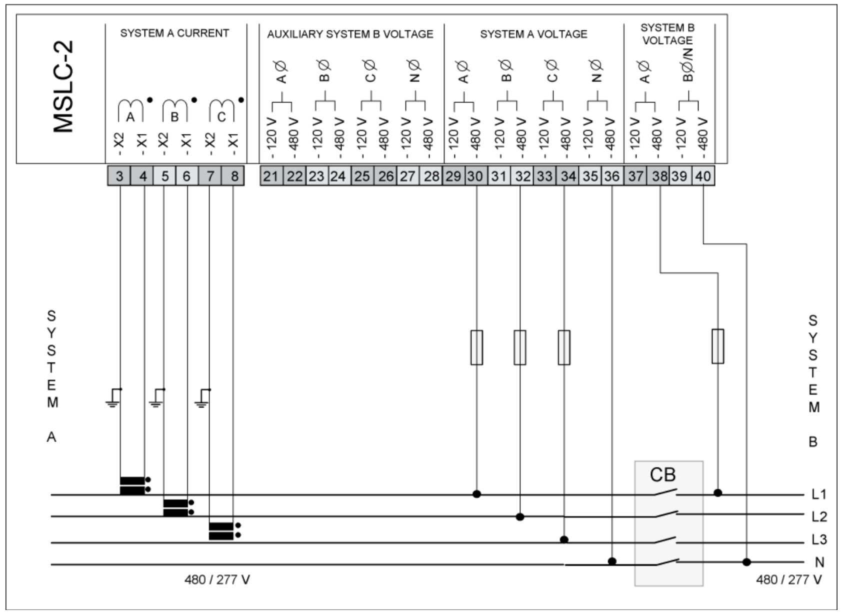


Figure 4-3: Low voltage system 480 V / 277 V – 3-phase with neutral

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

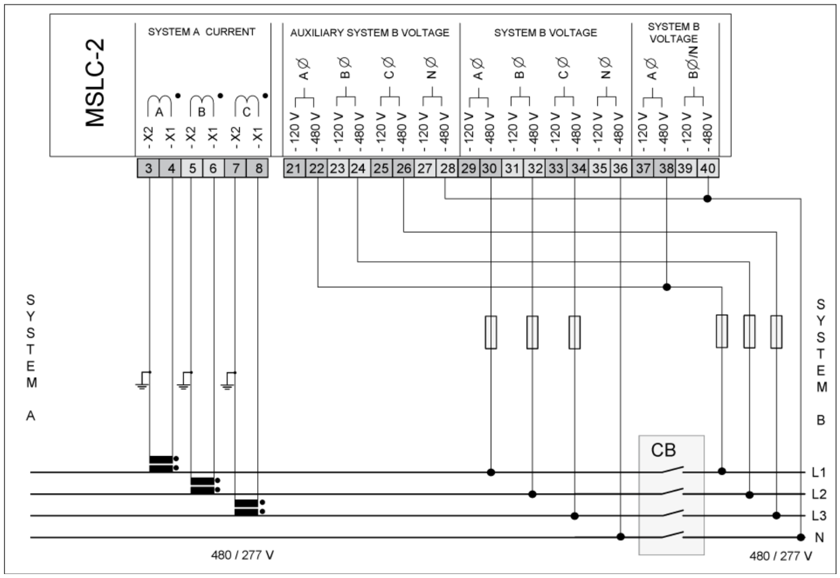


Figure 4-4: Low voltage system 480 V – 3-phase with neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *System A rated voltage* (parameter 1766): "480 V" • *System A current input* (parameter 1850): "L1 L2 L3" • *System A voltage measuring* (parameter 1851): "3Ph 4W" • *System B rated voltage* (parameter 1781): "277 V" • *1Ph2W voltage input* (parameter 1858): "Phase – neutral" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary Sytem B available* (parameter 7629): "Yes" • *Aux System B voltage measuring* (parameter 1853): "3Ph 4W" Transformer • *System A PT primary rated voltage* (parameter 1801): "480 V" • *System A PT secondary rated volt.* (parameter 1800): "480 V" • *System B PT primary rated voltage* (parameter 1804): "480 V" • *System B PT secondary rated volt.* (parameter 1803): "480 V"	• Systen A [V] L1 • Systen A [V] L2 • Systen A [V] L3 • Systen A [V] L1-L2 • Systen A [V] L2-L3 • Systen A [V] L3-L1 • Systen A [A] L1 • Systen A [A] L2 • Systen A [A] L3 • Systen A [kW] • Systen A [KVA] • Systen A [kvar] • Systen A [PF] L1 • Systen A [PF] L2 • Systen A [PF] L3 • Systen A [Hz] • Systen A Phase rotation • System B [V] L1 • System B [Hz] • Phase-Angle • System B-A • Aux System B [V] L1 • Aux System B [V] L2 • Aux System B [V] L3 • Aux System B [V] L1-L2 • Aux System B [V] L2-L3 • Aux System B [V] L3-L1 • Aux System B phase rotation • Aux System B [Hz]	• System A [V] L1 • System A [V] L2 • System A [V] L3 OR • System A [V] L1-L2 • System A [V] L2-L3 • System A [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
- System A measurement: 3-Phase PT “Open Delta” (Phase L2 (B) is grounded at the MSLC-2 connection)
- System B measurement: 1-Phase PT **L1-L2 (“Phase – phase”)**

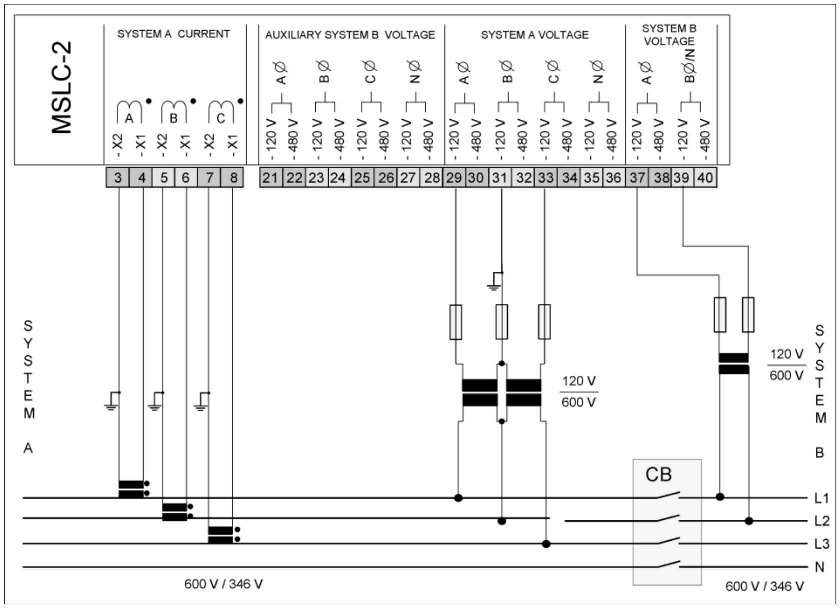


Figure 4-5: Low voltage system 600 V / 346 V – 3-phase

Configuration	Measurement	Voltage Monitoring
Menu 5 • *System A rated voltage* (parameter 1766): “600 V” • *System A current input* (parameter 1850): “L1 L2 L3” • *System A voltage measuring* (parameter 1851): “3Ph 4W OD” • *System B rated voltage* (parameter 1781): “600 V” • *1Ph2W voltage input* (parameter 1858): “Phase – phase” • *1Ph2W phase rotation* (parameter 1859): “CW” • *Auxiliary Sytem B available* (parameter 7629): “No” Transformer • *System A PT primary rated voltage* (parameter 1801): “600 V” • *System A PT secondary rated volt.* (parameter 1800): “120 V” • *System B PT primary rated voltage* (parameter 1804): “600 V” • *System B PT secondary rated volt.* (parameter 1803): “120 V”	• Systen A [V] L1-L2 • Systen A [V] L2-L3 • Systen A [V] L3-L1 • Systen A [A] L1 • Systen A [A] L2 • Systen A [A] L3 • Systen A [kW] • Systen A [KVA] • Systen A [kvar] • Systen A [PF] L1 • Systen A [PF] L2 • Systen A [PF] L3 • Systen A [Hz] • Systen A Phase rotation • System B [V] L1-L2 • System B [Hz] • Phase-Angle • System B-A	• System A [V] L1-L2 • System A [V] L2-L3 • System A [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
- System A measurement: 3-Phase PT "Open Delta" (Phase L2 (B) is grounded at the MSLC-2 connection)
- System B measurement: 1-Phase PT **L1-N ("Phase – neutral")**

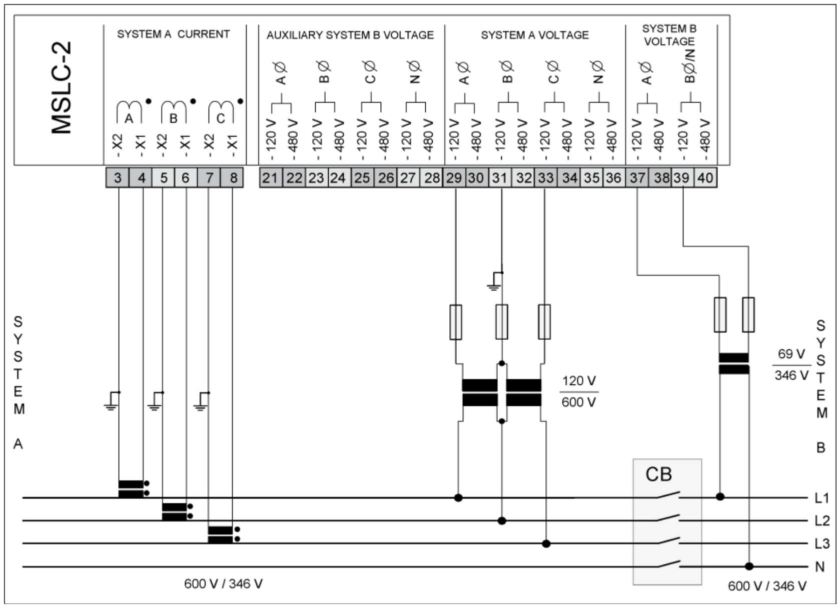


Figure 4-6: Low voltage system 600 V / 346 V – 3-phase

Configuration	Measurement	Voltage Monitoring
Menu 5 • *System A rated voltage* (parameter 1766): "600 V" • *System A current input* (parameter 1850): "L1 L2 L3" • *System A voltage measuring* (parameter 1851): "3Ph 4W OD" • *System B rated voltage* (parameter 1781): "346 V" • *1Ph2W voltage input* (parameter 1858): "Phase – neutral" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary Sytem B available* (parameter 7629): "No" Transformer • *System A PT primary rated voltage* (parameter 1801): "600 V" • *System A PT secondary rated volt.* (parameter 1800): "120 V" • *System B PT primary rated voltage* (parameter 1804): "600 V" • *System B PT secondary rated volt.* (parameter 1803): "120 V"	• Systen A [V] L1-L2 • Systen A [V] L2-L3 • Systen A [V] L3-L1 • Systen A [A] L1 • Systen A [A] L2 • Systen A [A] L3 • Systen A [kW] • Systen A [KVA] • Systen A [kvar] • Systen A [PF] L1 • Systen A [PF] L2 • Systen A [PF] L3 • Systen A [Hz] • Systen A Phase rotation • System B [V] L1 • System B [Hz] • Phase-Angle • System B-A	• System A [V] L1-L2 • System A [V] L2-L3 • System A [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
- System A measurement: 3-Phase PT "Open Delta" (Phase L2 (B) is grounded at the MSLC-2 connection)
- System B measurement: 1-Phase PT **L1-L2 ("Phase – phase")**
- Auxiliary system B measurement: 3-Phase "Open Delta"

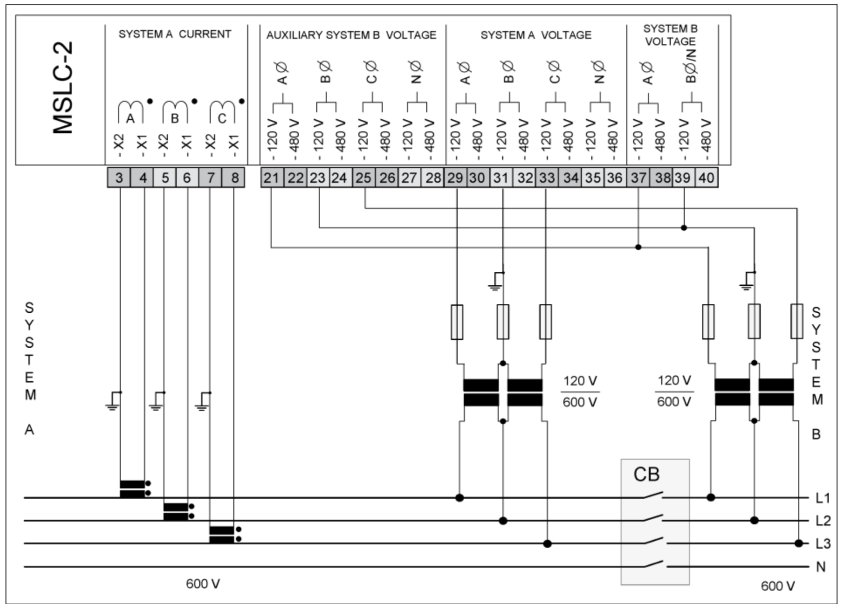


Figure 4-7: Low voltage system 600 V / 346 V – 3-phase

Configuration	Measurement	Voltage Monitoring
Menu 5 • *System A rated voltage* (parameter 1766): "600 V" • *System A current input* (parameter 1850): "L1 L2 L3" • *System A voltage measuring* (parameter 1851): "3Ph 4W OD" • *System B rated voltage* (parameter 1781): "600 V" • *1Ph2W voltage input* (parameter 1858): "Phase – phase" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary Sytem B available* (parameter 7629): "Yes" • *Aux System B voltage measuring* (parameter 1853): "3Ph 3W" Transformer • *System A PT primary rated voltage* (parameter 1801): "600 V" • *System A PT secondary rated volt.* (parameter 1800): "120 V" • *System B PT primary rated voltage* (parameter 1804): "600 V" • *System B PT secondary rated volt.* (parameter 1803): "120 V"	• Systen A [V] L1-L2 • Systen A [V] L2-L3 • Systen A [V] L3-L1 • Systen A [A] L1 • Systen A [A] L2 • Systen A [A] L3 • Systen A [kW] • Systen A [KVA] • Systen A [kvar] • Systen A [PF] L1 • Systen A [PF] L2 • Systen A [PF] L3 • Systen A [Hz] • Systen A Phase rotation • System B [V] L1-L2 • System B [Hz] • Phase-Angle • System B-A	• System A [V] L1-L2 • System A [V] L2-L3 • System A [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
- System A measurement: 3-Phase PT "wye" (Phase L2 (B) is grounded at the MSLC-2 connection)
- System B measurement: 1-Phase PT **L1-L2 ("Phase – phase")**

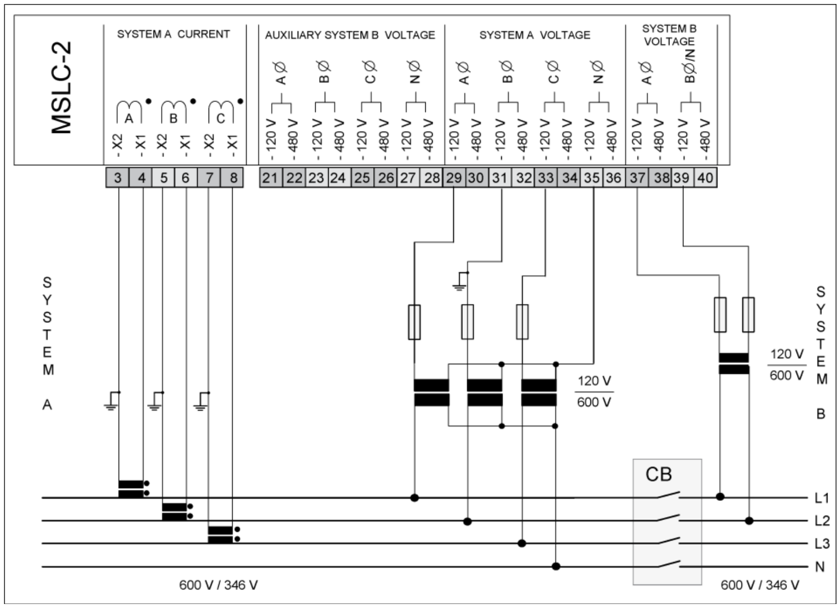


Figure 4-8: Low voltage system 600 V / 346 V – 3-phase with neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *System A rated voltage* (parameter 1766): "600 V" • *System A current input* (parameter 1850): "L1 L2 L3" • *System A voltage measuring* (parameter 1851): "3Ph 4W" • *System B rated voltage* (parameter 1781): "600 V" • *1Ph2W voltage input* (parameter 1858): "Phase – phase" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary Sytem B available* (parameter 7629): "No" Transformer • *System A PT primary rated voltage* (parameter 1801): "600 V" • *System A PT secondary rated volt.* (parameter 1800): "120 V" • *System B PT primary rated voltage* (parameter 1804): "600 V" • *System B PT secondary rated volt.* (parameter 1803): "120 V"	• Systen A [V] L1-L2 • Systen A [V] L2-L3 • Systen A [V] L3-L1 • Systen A [A] L1 • Systen A [A] L2 • Systen A [A] L3 • Systen A [kW] • Systen A [KVA] • Systen A [kvar] • Systen A [PF] L1 • Systen A [PF] L2 • Systen A [PF] L3 • Systen A [Hz] • Systen A Phase rota-tion • System B [V] L1-L2 • System B [Hz] • Phase-Angle • System B-A	• Systen A [V] L1-L2 • Systen A [V] L2-L3 • Systen A [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
- System A measurement: 3-Phase PT "wye" (Phase L2 (B) is grounded at the MSLC-2 connection)
- System B measurement: 1-Phase PT **L1-N ("Phase – neutral")**

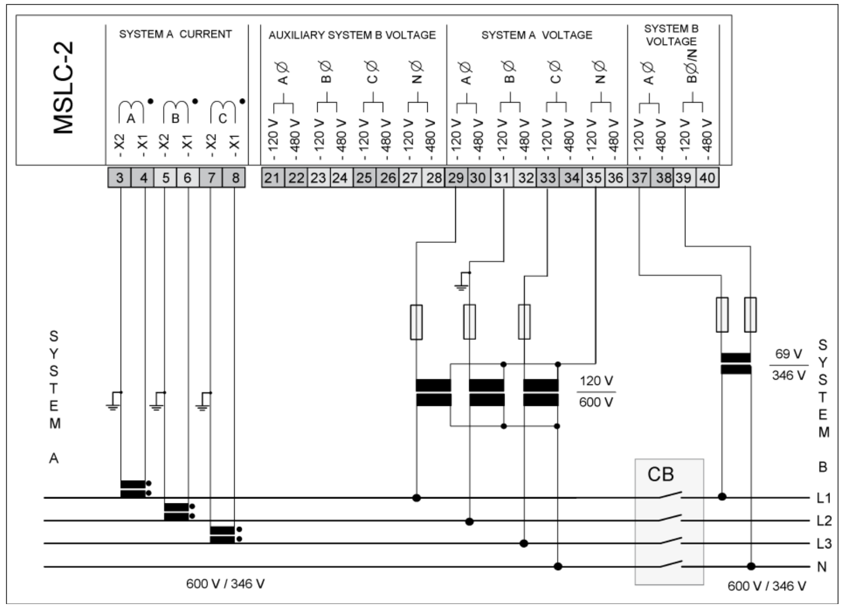


Figure 4-9: Low voltage system 600 V / 346 V – 3-phase with neutral

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

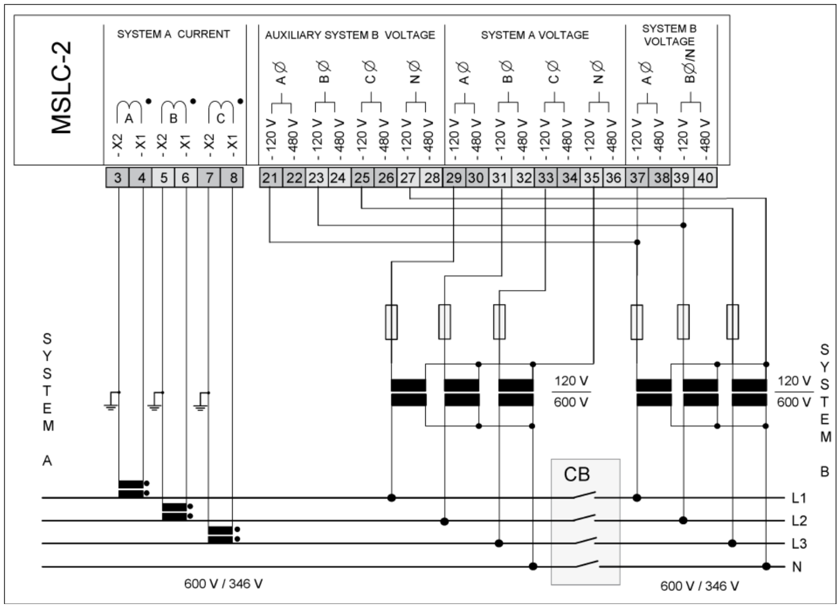


Figure 4-10: Low voltage system 600 V / 346 V – 3-phase with neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *System A rated voltage* (parameter 1766): "600 V" • *System A current input* (parameter 1850): "L1 L2 L3" • *System A voltage measuring* (parameter 1851): "3Ph 4W" • *System B rated voltage* (parameter 1781): "600 V" • *1Ph2W voltage input* (parameter 1858): "Phase – phase" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary Sytem B available* (parameter 7629): "Yes" • *Aux System B voltage measuring* (parameter 1853): "3Ph 4W" Transformer • *System A PT primary rated voltage* (parameter 1801): "600 V" • *System A PT secondary rated volt.* (parameter 1800): "120 V" • *System B PT primary rated voltage* (parameter 1804): "600 V" • *System B PT secondary rated volt.* (parameter 1803): "120 V"	• Systen A [V] L1-L2 • Systen A [V] L2-L3 • Systen A [V] L3-L1 • Systen A [A] L1 • Systen A [A] L2 • Systen A [A] L3 • Systen A [kW] • Systen A [KVA] • Systen A [kvar] • Systen A [PF] L1 • Systen A [PF] L2 • Systen A [PF] L3 • Systen A [Hz] • Systen A Phase rota-tion • System B [V] L1-L2 • System B [Hz] • Phase-Angle • System B-A	• System A [V] L1-L2 • System A [V] L2-L3 • System A [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
- System A measurement: 3-Phase PT “wye”
- System B measurement: 1-Phase PT **L1-N (“Phase – neutral”)**
- Auxiliary system B measurement: 3-Phase PT “wye”

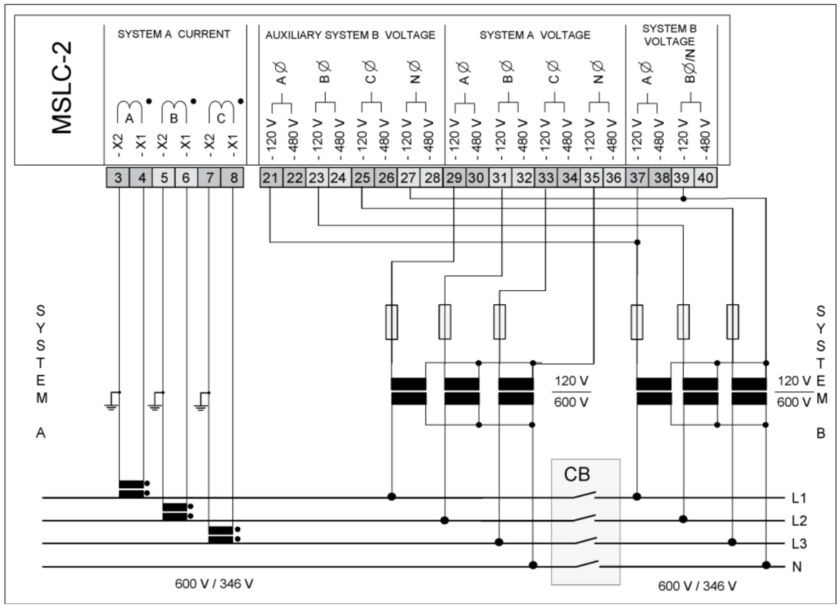


Figure 4-11: Low voltage system 600 V / 346 V – 3-phase with neutral

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

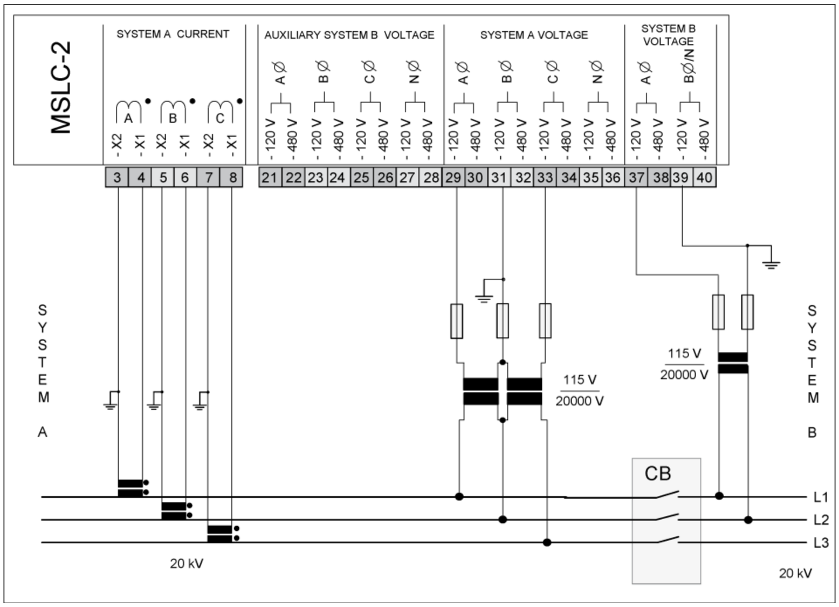


Figure 4-12: Middle voltage system 20 kV – 3-phase without neutral

Configuration	Measurement	Voltage Monitoring
Menu 5 • *System A rated voltage* (parameter 1766): "20000 V" • *System A current input* (parameter 1850): "L1 L2 L3" • *System A voltage measuring* (parameter 1851): "3Ph 3W" • *System B rated voltage* (parameter 1781): "20000 V" • *1Ph2W voltage input* (parameter 1858): "Phase – phase" • *1Ph2W phase rotation* (parameter 1859): "CW" • *Auxiliary Sytem B available* (parameter 7629): "No" Transformer • *System A PT primary rated voltage* (parameter 1801): "20000 V" • *System A PT secondary rated volt.* (parameter 1800): "115 V" • *System B PT primary rated voltage* (parameter 1804): "20000 V" • *System B PT secondary rated volt.* (parameter 1803): "115 V"	• Systen A [V] L1-L2 • Systen A [V] L2-L3 • Systen A [V] L3-L1 • Systen A [A] L1 • Systen A [A] L2 • Systen A [A] L3 • Systen A [kW] • Systen A [KVA] • Systen A [kvar] • Systen A [PF] L1 • Systen A [PF] L2 • Systen A [PF] L3 • Systen A [Hz] • Systen A Phase rota-tion • System B [V] L1-L2 • System B [Hz] • Phase-Angle • System B-A	• System A [V] L1-L2 • System A [V] L2-L3 • System A [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
- System A measurement: 3-Phase PT "Open Delta"
- System B measurement: 1-Phase PT **L1-L2**
- Auxiliary system B measurement: 3-Phase PT "Open Delta"

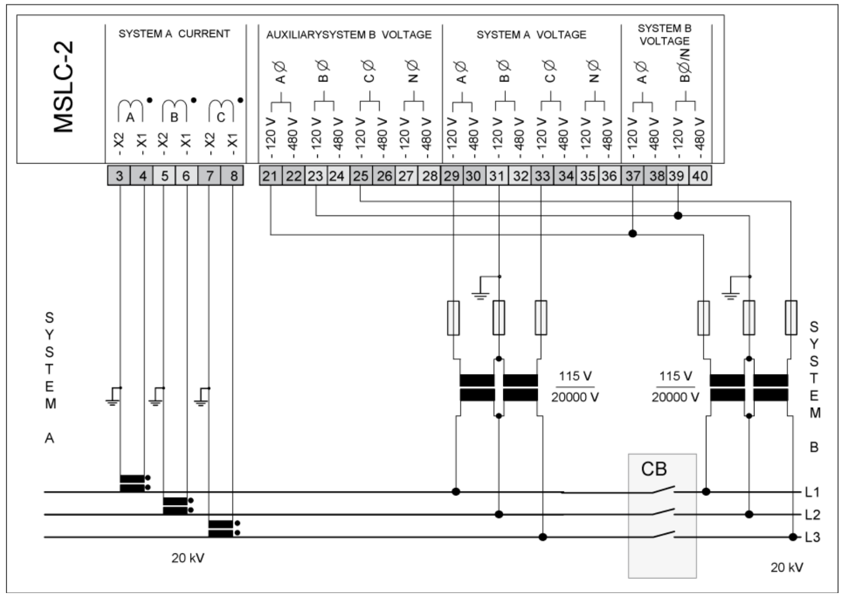


Figure 4-13: Middle voltage system 20 kV – 3-phase without neutral

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

To provide this security, the active MSLC-2 is listening on the network, if any other DSLC-2 or MSLC-2 wants already close its breaker:

- If yes, the active MSLC-2 cancels the wish for breaker closure, remains passive and still listen on the network, if the situation changes.
- If no, the active MSLC-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 MSLC-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 MSLC-2 closes its breaker.
    - **Scenario 3:** Another control with a smaller Device-ID announces a desire for dead bus closure, so the MSLC-2 cancels the wish for breaker closure, remains passive and still listen on the network, if the situation changes.

NOTE

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

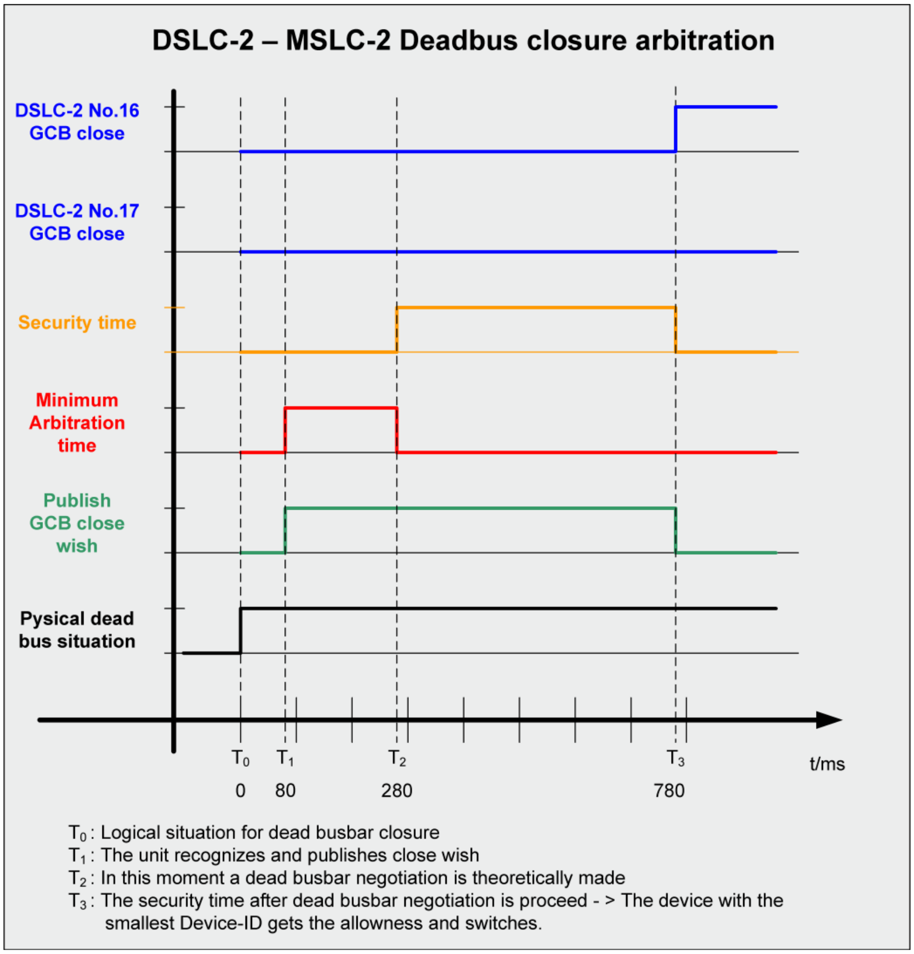


Figure 4-14: Dead bus closing – Example of dead busbar closure arbitration

Voltage Matching

The voltages of two systems in parallel must be matched within a small percentage to minimize the reactive power flow in the system. If a local plant is paralleled to the main grid with unequal voltages, the local plant will, in most cases, follow the utility voltage.The difference in voltages results in reactive currents flowing in the system with subsequent lowered system efficiency.

If the system is initially at a lower voltage than the utility, reactive power will be absorbed by the system. If the system voltage was initially higher, the local plant will provide extra reactive power to the utility. In either case the breaker across which the parallel is made will experience unnecessary wear and tear created by the arcing across different voltages.

The MSLC-2 measures the RMS values of the voltages. The synchronizer issues appropriate raise or lower commands, or voltage bias adjustment to all of the DSLC-2 controls over the Ethernet network. The MSLC-2 will continue this process until the difference between system B and system A voltage is within a specified window. The automatic voltage matching function may be enabled or disabled with a configuration setpoint. When enabled, voltage matching will occur in both the “Check” and “Run” modes and is verified to be within the window in the “Permissive” mode.

Phase Matching Synchronizing

The phase matching synchronizer mode corrects the frequency and phase of the system A to lock it to the system B frequency and phase. Phase matching synchronizing can be configured (parameter 5730) in the unit. With activation of the synchronizer the MSLC-2 begins to control at first the frequency to minimize the frequency difference between system B and system A. When the frequency window comes into the range of phase matching start, see configuration *Phase matching df-start* (parameter 5506), the synchronizer watches the phase relation. Therefore the frequency setpoint to the DSLC-2 increases or decreases and result in speed biasing to the engine depending on whether the slip is faster or slower than the system A. 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

In certain applications the initial power flow can be either from or to the utility. Depending on the requirement, the local bus can be brought into parallel with a slightly higher or lower frequency than the mains. This can be provided by the parameter *Slip frequency setpoint offset* (parameter 4712). The slip frequency method is configured by the configuration *Synchronization CB* (parameter 5730). The synchronizer automatically controls the connected generator at the specified slip frequency. The MSLC-2 outputs an error signal over the network to the DSLC-2 controls to change their bias on the speed controls. Gain and stability adjustments to the slip frequency proportional and integral gain controller are provided to allow stable operation of the automatic synchronizer function over a wide range of system dynamics (parameter 4539, parameter 4540).

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 *Setpoint frequency* (parameter 4627) and *Setpoint voltage* (parameter 4628) are not used to drive system B into synchronization. The MSLC-2 can be manually controlled using the setpoint raise/ lower and voltage raise/ lower discrete inputs. The system A and system B 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 *CB close hold time* (parameter 3417), 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 3419) 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 utilities attempting to close to a dead bus. The MSLC-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 utilityapplication.

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 MSLC-2 to attempt to reclose the breaker if the “CB Aux” feedback is opened and the MSLC-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 MSLC-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 MSLC-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 3419) 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 MSLC-2. If the *Reclose limit alarm* (parameter 7556) is “Disabled”, the MSLC-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 3417) 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 MSLC-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

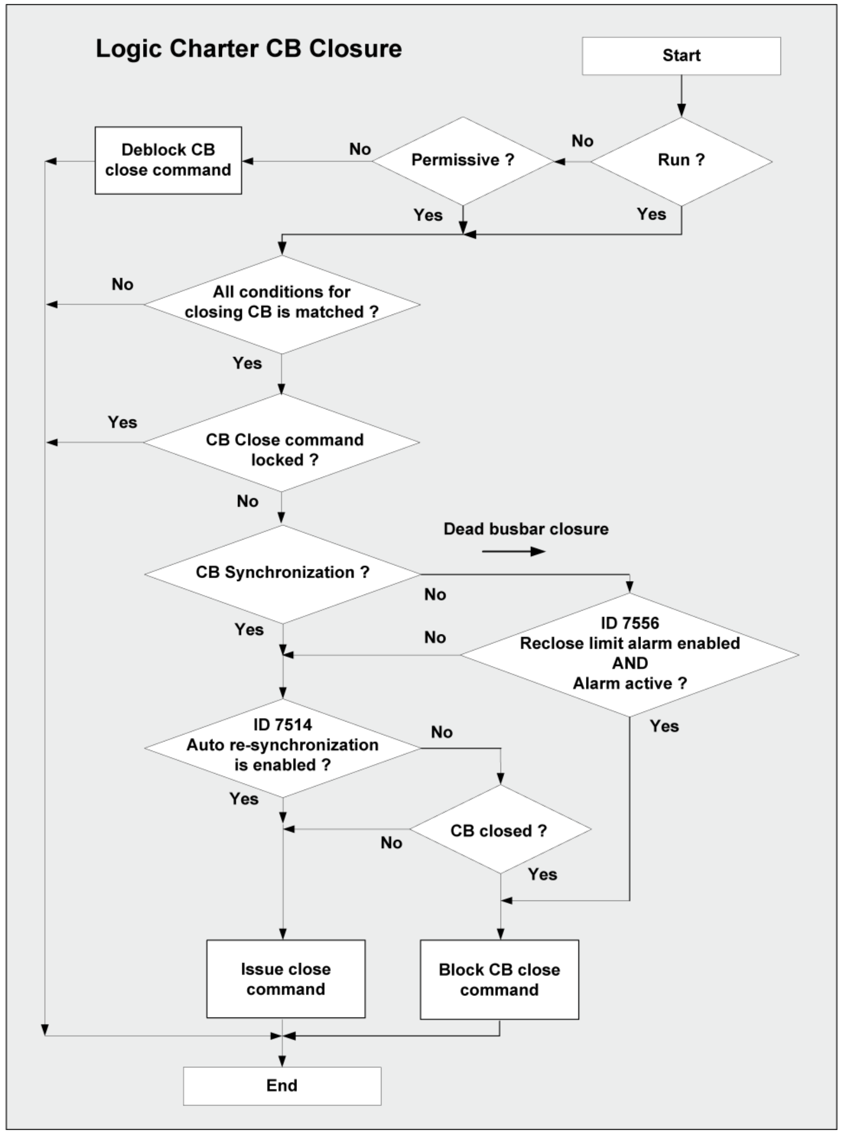


Figure 4-15: Logic charter CB closure

Manual Synchronizing

The manual synchronizer is activated / deactivated under the following conditions.

Activated	Deactivated
• MCB/tie-breaker = open *AND* • DI "Setpoint Raise" *OR* • DI "Setpoint Lower" *OR* • DI "Voltage Raise" *OR* • DI "Voltage Lower"	• Breaker feedback DI "CB Aux" = closed *OR* • Synchronization Run *OR* • Synchronization Check *OR* • Synchronization Permissive

The MSLC-2 is before and during the manual synchronization in *Load control mode* (parameter 4603) "Off Line", and in the *Synchronizer mode* (parameter 4602) "Off", independent if the MSLC-2 is configured to utilitiy or tie.

Frequency Setpoint

It is possible with discrete input "Setpoint Raise" or discrete input "Setpoint Lower" to adjust the *Setpoint frequency* (parameter 4627) of connected DSLCs, which are in the same segment, up and down (ramp rate fixed to 0.01 Hz/s). The setpoint frequency is the direct output of the parameter *Setpoint frequency* (parameter 4627) is transferred in Hz to the DSLCs. The setpoint frequency is limited due to the parameters *Upper frequency limit* (parameter 5802) and *Lower frequency limit* (paramater 5803). The operating ranges of these parameters are adjustable in Menu 5.

- *Upper frequency limit* (parameter 5802) | Range: 100 to 150 % | Default: 110 % = 66 Hz (with rated frequency = 60 Hz)
- *Lower frequency limit* (parameter 5803) | Range: 50 to 100 % | Default: 90 % = 54 Hz (with rated frequency = 60 Hz)

NOTE

Frequency setpoint DSLC-2:

Received via parameter *Setpoint frequency* (parameter 4627) | Range: 54 to 66 Hz (limited 90 to 110 % from rated frequency, for example 60 Hz)

Voltage Setpoint

It is possible with discrete input "Voltage Raise" or discrete input "Voltage Lower" to adjust the *Setpoint voltage* (parameter 4628) of connected DSLCs, which are in the same segment, up and down (ramp rate fixed to 0.05 %/s). The setpoint voltage is the direct output of the parameter *Setpoint voltage* (parameter 4628) is transferred in % to the DSLCs. The setpoint frequency is limited due to the parameters *Upper voltage limit* (parameter 5800) and *Lower voltage limit* (paramater 5801). The operating ranges of these parameters are adjustable in Menu 5.

- *Upper voltage limit* (parameter 5800) | Range: 100 to 150 % | Default: 110 % = 66 Hz (of rated voltage)
- *Lower voltage limit* (parameter 5801) | Range: 50 to 100 % | Default: 90 % = 66 Hz (of rated voltage)

NOTE

Voltage setpoint DSLC-2:

Received via parameter *Setpoint voltage* (parameter 4628) | Range: 90 to 110 % (limited 80 to 120 % from rated voltage)

Breaker Close

The MCB/tie-breaker can be closed manually when system B frequency and voltage are in range.

CAUTION

The rotation field of system A and system B must be measured. They must have the same direction – CW or CCW.

Reset Frequency / Voltage Setpoints Back To Rated (50 Hz or 60 Hz)

- **MSLC-2 configured as utility breaker control:** MCB/tie-breaker = closed and breaker feedback mains parallel operation
- **MSLC-2 configured as tie-breaker control:** Manual synchronizer = off and MCB/tie-breaker = closed

Chapter 5. Real Power Control Description

Introduction

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

- Base loading
  - Automatic control of generators kW and constant generator PF control
- Import/export level control
  - Automatic control of the systems import or export power and either var or power factor control or constant generator PF control
- Process control
  - Automatic control of a process signal with either var or power factor control or constant generator PF control
- Utility unload
  - The ability to transfer the system load from the utility to the generators with the utility breaker being opened at the *Utility unload trip* (parameter 4506) level

MSLC-2 / DSLC-2 Interface

The MSLC-2 is able to control load and reactive load with only active DSLC-2 controls which are connected to the same bus segment and are in the load sharing mode. DSLC-2s that are in base load or process control cannot be controlled by a MSLC-2. The MSLC-2 can synchronize multiple DSLC-2s to the utility. Once the utility breaker is closed, the MSLC-2 must be placed in a load control mode. These are base load, import/export process control or utility unload. MSLC-2s in the tie-breaker mode will synchronize and close the tie-breaker to connect different bus segments but will not have any load control capabilities.

NOTE

The DSLC-2 will show it is in the base load mode (parameter 4603) when being controlled by a MSLC-2.

Base Load Mode

The MSLC-2 takes the system load percentage immediately upon entering the base load mode for the initial base load reference setting. This is true when synchronizing to the utility or transferring from import/export mode to base load. The base load reference can be moved by using the setpoint "Raise" or "Lower" discret inputs with an option to use the remote analog input to control the reference. The DSLC-2 controls will maintain the system load percentage being provided by the MSLC-2 with the utility picking up all load swings. Using the setpoint lower input will decrease the system load percentage, thus unloading the generators and transferring the load to the utility. The MSLC-2 has a *Generator unload trip* (parameter 3125) level that activates the Lcl. / generator breaker open relay. This ouput can be used to open a group breaker or to signal the DSLC-2s to open the generator breaker. This breaker stays active for 400 milliseconds. When in base load control the reactive power control will automatically be the constant generator PF mode. While unloading the kW of the generators you will need to unload the reactive power. The MSLC-2 will change the constant generator PF control reference to 1.0 when the system load percentage reaches the *Generator unload trip* (parameter 3125) setpoint.

Import / Export Mode

The MSLC-2 measures the real power flow to or from the main power grid. It then controls all active DSLC-2s by controlling the system load percentage signal. The individual DSLC-2 controls will control to this percentage of their rated loads and the MSLC-2 will adjust this system load up or down to achieve the proper import/export level. The system load percentage is limited to a 0 to 100% signal so that overload or reverse power of the generators will never occur. When in import / export mode the PID control is located in Menu 2. The DSLC-2 controls are using the base load PID (Menu 2) to control at the reference signal being sent from the MSLC-2. The reactive power can be configured for var, PF, or constant generator PF control.

NOTE

Any DSLC-2 set for base loading will maintain it´s individually set base load, regardless of the MSLC-2 signal. Therefore, a sufficient number of generators must be in isochronous load sharing in order to handle plant load swings and still maintain the import/export level. The DSLC-2s *Load control mode* (parameter 4603) will indicate base load mode when being controlled by the MSLC-2.

Process Control Mode

The MSLC-2 controls the DSLC-2 equipped generators by adjusting the system load. The MSLC-2 will control the system load to maintain the process input signal is equal to the process reference The MSLC-2 is limited to changing the reference signal to the DSLC-2 controls between 0 and 100%. The reactive power can be configured for var, PF, or constant generator PF control.

Remote Control

In any of the above modes, the reference can be determined by an analog signal input at terminals 83 to 85. The remote mode is selected by activating both the setpoint raise and lower at the same time. Menu 6 determines the scaling and the engineering units. The remote load reference signal can be a base load, import / export or a process control value.

The reactive load analog input at terminals 89 to 91 can be used for a power factor setpoint control or a constant generator power factor control reference. Menu 6 determines the scaling.

Automatic Power Transfer Control Functions

Ramping Between Modes

Whenever the mode of load control is changed, the MSLC-2 will ramp at a user chosen rate until it is within 5% of its new reference. Then, it will begin dynamic control. This provides smooth (bumpless) transitions between all modes.

Utility Unload

The utility unload feature is available with the MSLC-2 in base load, import / export or process mode. When the utility unload command is issued, the MSLC-2 will adjust the *Setpoint load level* (parameter 4629) until a specified level around the zero power transfer point is obtained. It will then issue a utility breaker open command. The *Utility unload trip* (parameter 4506) determines at which power value the tolerance for opening the breaker is reached. If the local plant is initially operating at some export level, supplying power to the utility, the MSLC-2 will lower the system load setpoint to obtain a zero power transfer condition. If the local plant is initially operating at some import level, absorbing power from the utility, the MSLC-2 will raise the system load setpoint to obtain a zero power transfer condition. If the MSLC-2 cannot bring the import/export level within the chosen band prior to reaching a system load setpoint of 0% or 100%, the unload will stop and if enabled the appropriate high/low limit alarms will activate. When the *Utility unload trip time* (parameter 3123) is reached the breaker will be opened independent on the trip level.

Local Unload

When the MSLC-2 is in base load mode and the setpoint lower command is continuously activated, the control will lower the *Setpoint load level* (parameter 4629), which is sent to the DSLC-2s. When the system level reaches the *Generator unload trip* (parameter 3125) level, the Lcl. / generator breaker open relay will energize. This relay will energize for 400 milliseconds. This will transfer the plant load back to the utility power grid. During unloading, the MSLC-2 is in the constant generator PF mode. When the *Generator unload trip* (parameter 3125) level is reached, the MSLC-2 will change the contant generator PF level to 1.0.

	DI CB AUX	DI Utility Unload	DI Base Load	DI Imp/Exp Control	DI Process Control	DI Ramp Pause	DI Setpoint Raise	DI Setpoint Lower
Off Line	0	x	x	x	x	x	x	x
Base Load	1	0	1	0	0	0	0	0
Base Load Raise	1	0	1	0	0	0	1	0
Base Load Lower	1	0	1	0	0	0	0	1
Base Load [1] Remote	1	0	1	0	0	0	1	1
Utility Unload [2]	1	1	x	x	x	0	x	x
Local Unload [3]	1	0	1	0	0	0	0	1
Ramp Pause [4]	1	x	x	x	x	1	x	x
Import/ Export mode	1	0	x	1	0	0	0	0
I/E Raise	1	0	x	1	0	0	1	0
I/E Lower	1	0	x	1	0	0	0	1
I/E Remote [1]	1	0	x	1	0	0	1	1
Process Control	1	0	x	x	1	0	0	0
Process Raise	1	0	x	x	1	0	1	0
Process Lower	1	0	x	x	1	0	0	1
Process Remote [1]	1	0	x	x	1	0	1	1

Table 5-1: Load control modes MSLC-2

NOTE

[1] Remote reference is activated by closing both setpoint raise and setpoint lower switches at the same time.

[2] The MSLC-2 can only load the associated generators to 100%. If this is not enough capacity to unload the utility, the unload ramps stops at 100% rated load on the associated generators. The generator high limit alarm, if enabled, will activate at this time.

[3] The local plant unload is accomplished by switching to base load mode and supplying a continuous setpoint lower command.

[4] The ramp pause command will pause all ramps in any mode.

Chapter 6.
Var/Power Factor Control Description

Introduction

The MSLC-2 offers 3 modes of reactive power control. Var or power factor modes will control the reactive power at the utility breaker while constant generator PF control will provide a power factor setpoint to all DSLC-2 controls on the system.

When a utility unload command is issued, the control automatically shifts from var control to power factor control in order to ensure a minimum amount of current flow across the utility tie when it is opened. It is important to note that, as with the real load functions, the var/PF control in the MSLC-2 controls only those DSLC-2 controls which are in isochronous load sharing. Any DSLC-2 controls which are in base load mode will control the reactive power on their associated generators in accordance with their own internal reference and chosen mode of var/PF control.

Constant Generator Power Factor

The MSLC-2 sets the power factor reference of the generators according to the value chosen by:

- **Base Configuration**: *VAR PF control mode* (parameter 7558) configured to "Constant Generator PF" and reference value *Constant gen. PF reference* (parameter 5621).
- **ToolKit**: Changing the *Constant gen. PF reference* (parameter 5621) in ToolKit will change the reference value being controlled.
- **Adaptation:** With the settings of the base configuration the constant gen PF reference can be influenced by voltage raise and voltage lower commands.
- **Remote:** With the settings of the base configuration the *Constant gen PF reference* (parameter 5621) can be influenced by an analog signal ("Reactive Load Input"). The voltage raise and voltage lower signal must be energized simultaneously.
- **Interface:** With the settings of the base configuration the *Constant gen PF reference* (parameter 5621) can be influenced by interface, when the configuration *VAR control setpoint source* (parameter 7635) is set to "Interface".
- **Control:** The DSLC-2s PID var control will effect the stability of the power factor control.

Power Factor Control

The MSLC-2 adjusts the power factor references of the generators in order to maintain a chosen power factor level across the utility tie. The MSLC-2 sends a system reactive power percentage value to the DSLC-2s. Following procedures are possible:

- **Base Configuration**: *VAR PF control mode* (parameter 7558) configured to "PF Control" and *Power factor reference* (parameter 5620) is configured.
- **ToolKit**: Changing the *Power factor reference* (parameter 5620) in ToolKit will change the reference value being controlled.
- **Remote:** With the settings of the base configuration the *Power factor reference* (parameter 5620) at the MSLC-2 can be influenced by an analog signal ("Reactive Load Input"). The voltage raise and voltage lower signal must be energized simultaneously.
- **Interface:** With the settings of the base configuration the *Power factor reference* (parameter 5620) at the MSLC-2 can be influenced by interface, when the configuration *VAR control setpoint source* (parameter 7635) is set to "Interface".
- **Control:** The PID var control setting in the MSLC-2, Menu 4, will effect the stability of the power factor control.

Var Control

The MSLC-2 adjusts the power factor reference of the generators in order to maintain a chosen var level across the utility tie. The MSLC-2 sends a system reactive power percentage value to the DSLC-2s. The unit allows only one basic setting:

- **Base Configuration**: *VAR PF control mode* (parameter 7558) configured to "VAR Control" and *KVAR reference* (parameter 7723) is configured.
- **ToolKit**: Changing the *KVAR reference* (parameter 7723) in ToolKit will change the reference value being controlled.
- **Control**: The PID var control settings in the MSLC-2, Menu 4, will effect the stability of the var control.

Chapter 7. Process Control Description

Introduction

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

NOTE

The MSLC-2 system load command is obeyed only by the associated DSLC-2 controls which are in isochronous load sharing. DSLC-2s in Base load or process control mode will ignore the MSLC-2 load command signal and maintain its set load reference. The DSLC-2s *Load Control mode* (parameter 4603) will display Base load mode when being controlled by a MSLC-2.

Description

Figure 7-1 shows a block diagram of the process control function. The process control mode is selected when the "Process Control"and "CB Aux" switch contacts are closed. The process input signal is compared with the process reference, which may be either the internal *Process reference* (parameter 4605) or the analog remote process reference input (Configurable in Menu 6). 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 4605). 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 Process PID function becomes active. The process PID function also becomes 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 MSLC-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 or the Homepage.

The *Process signal input* (parameter 10151) and the *Remote reference input* (parameter 10117) is displayed in Menu 6 in %.

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

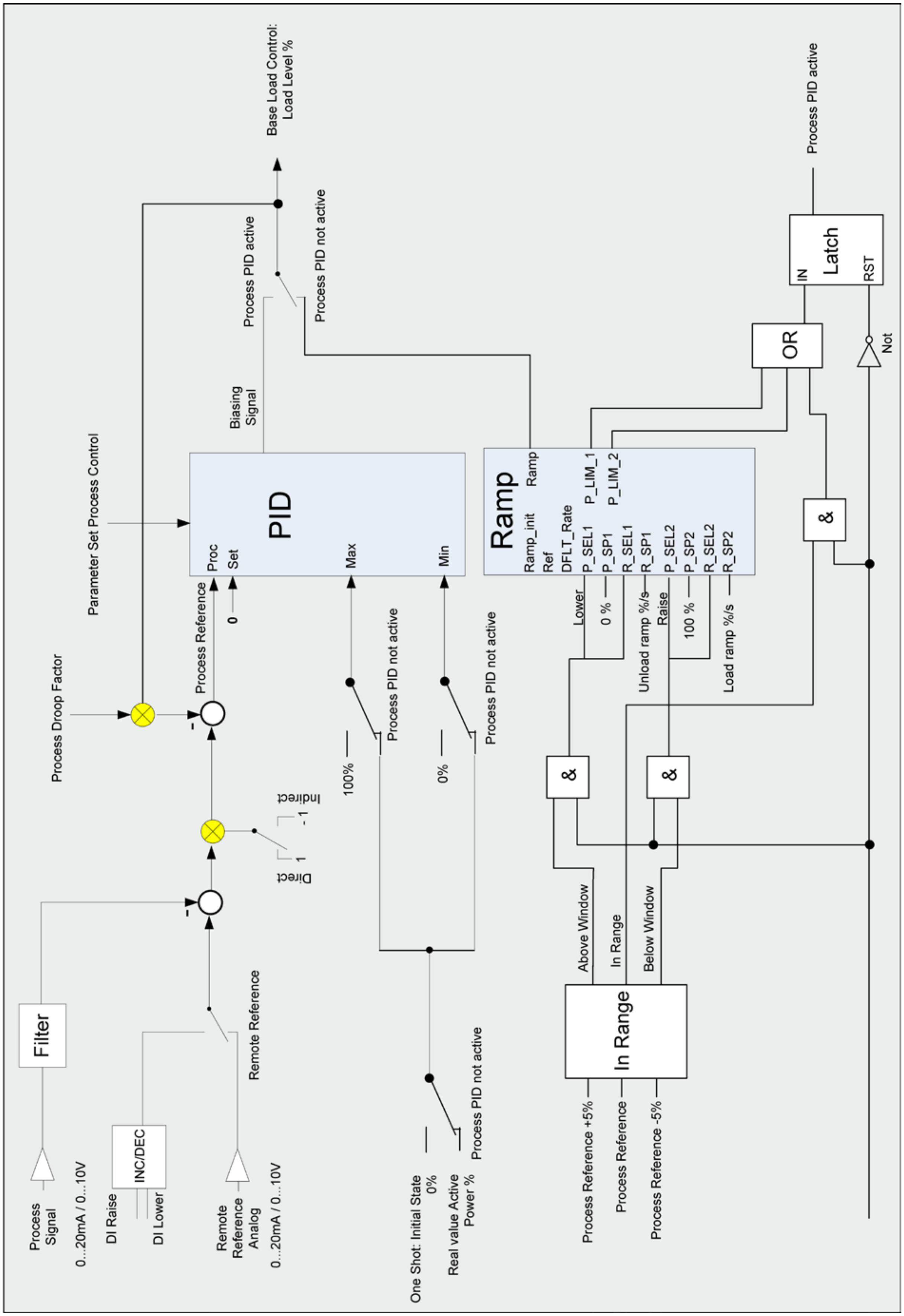


Figure 7-1: Diagram process control

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.

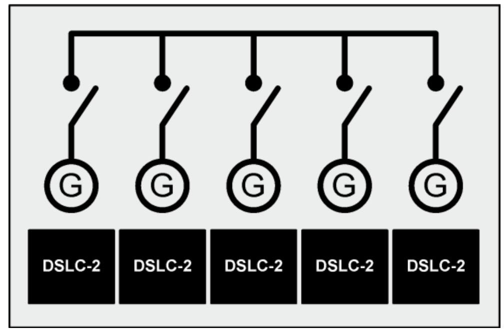


Figure 8-1: Multiple generators in isolated operation without tie-breakers

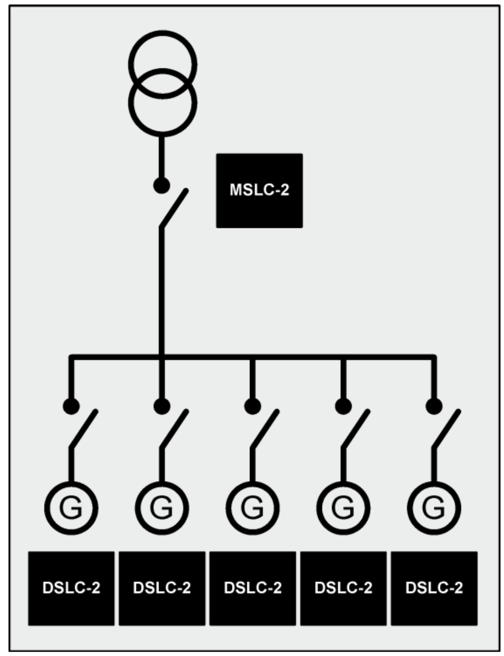


Figure 8-2: Multiple generators in isolated / parallel to utility operation without tie-breakers

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 105.

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

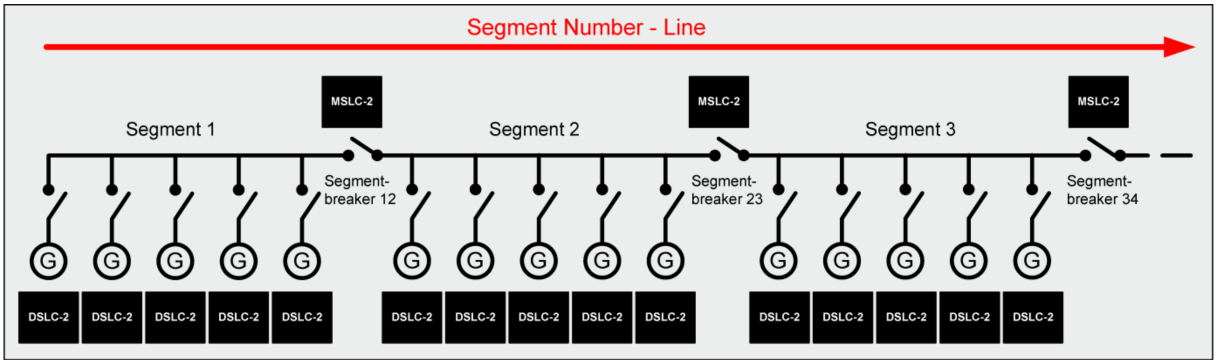


Figure 8-3: Isolated operation with multiple generator and tie-breaker

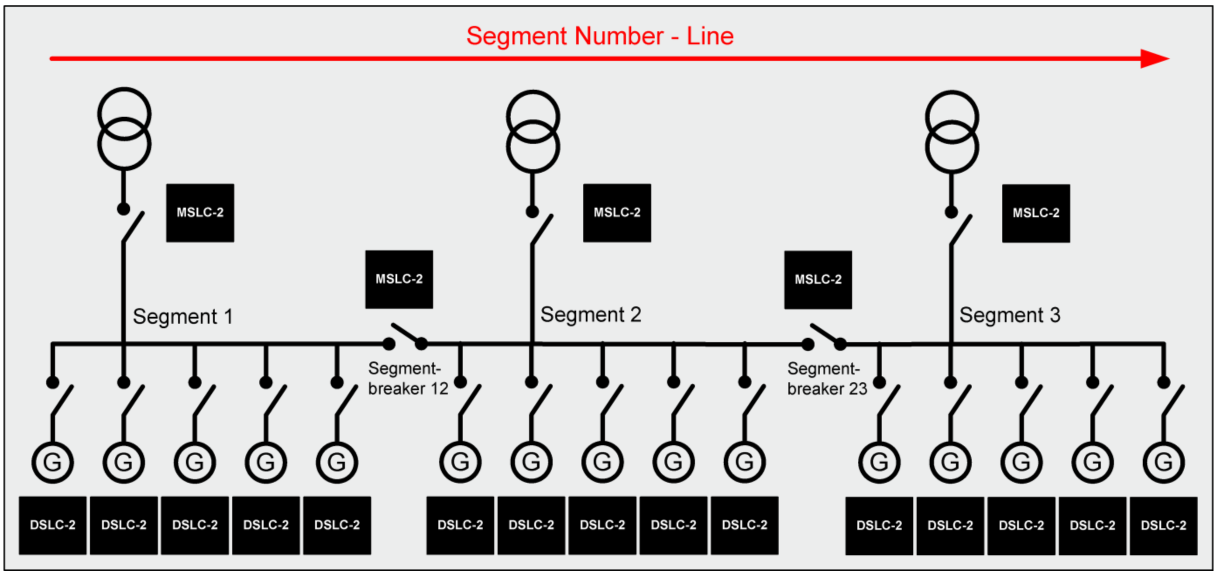


Figure 8-4: Isolated / utility parallel operation with multiple generator and tie-breaker

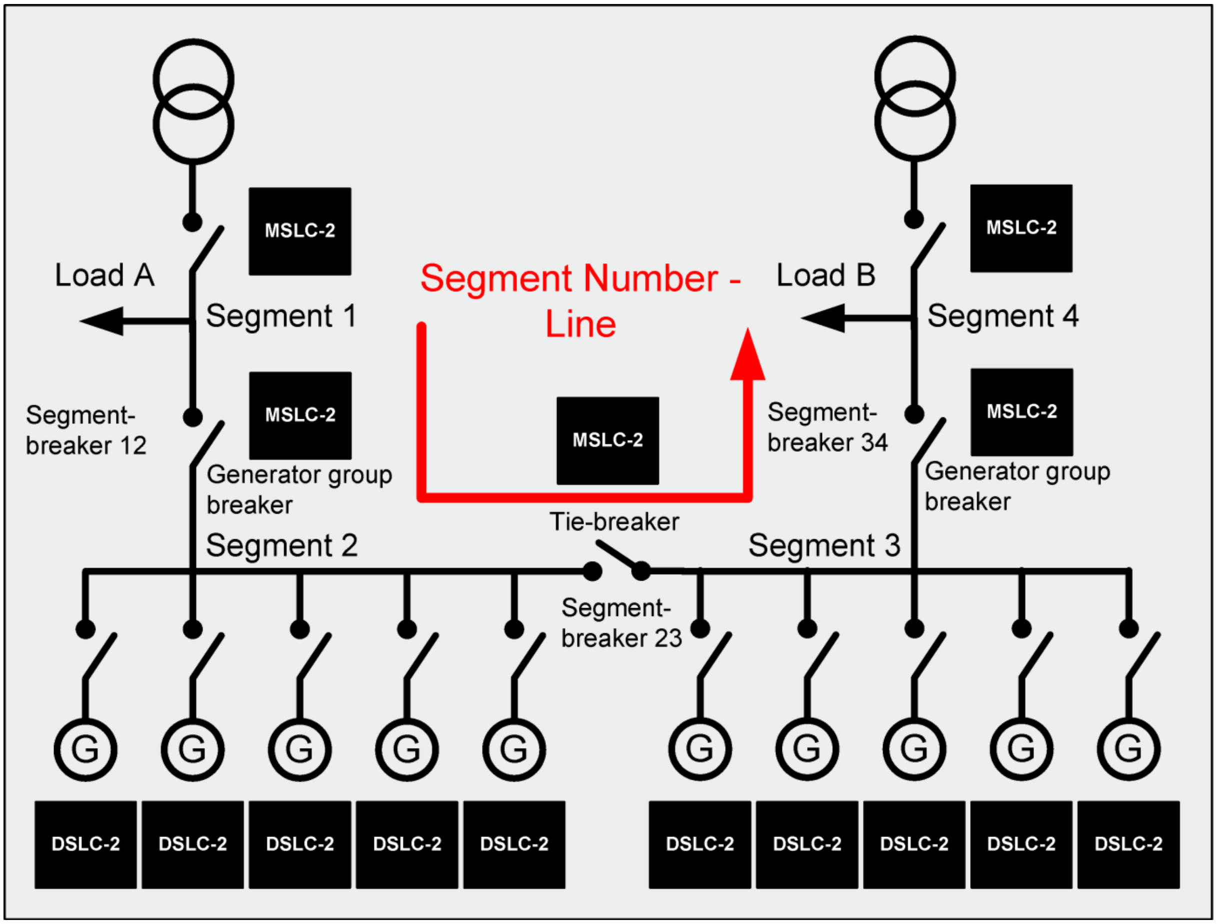


Figure 8-5: Isolated / utility parallel operation with multiple generator, tie-breaker and generator group breaker

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.

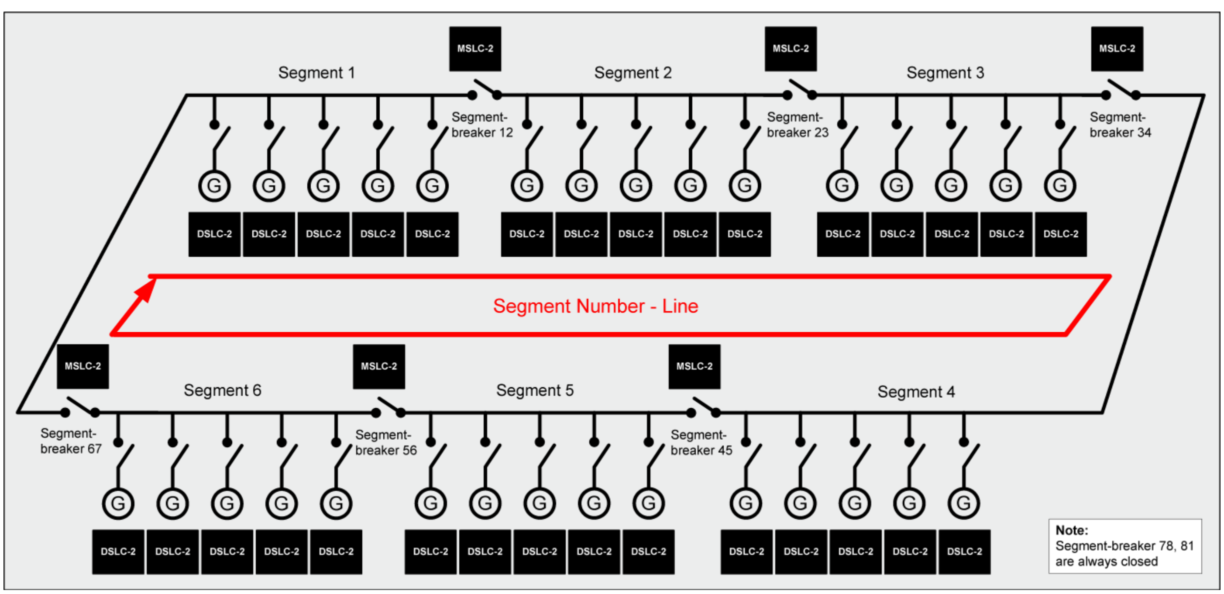


Figure 8-6: Isolated operation with multiple generator and tie-breaker (ring option)

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.

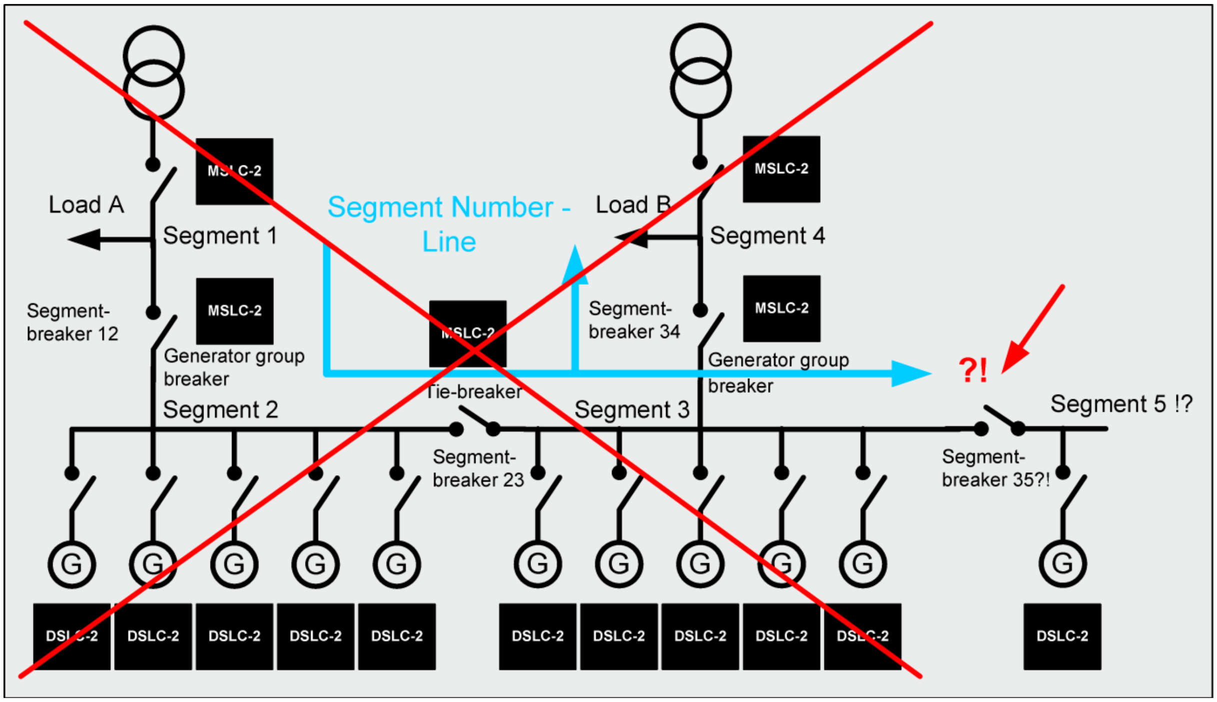


Figure 8-7: Not supported application

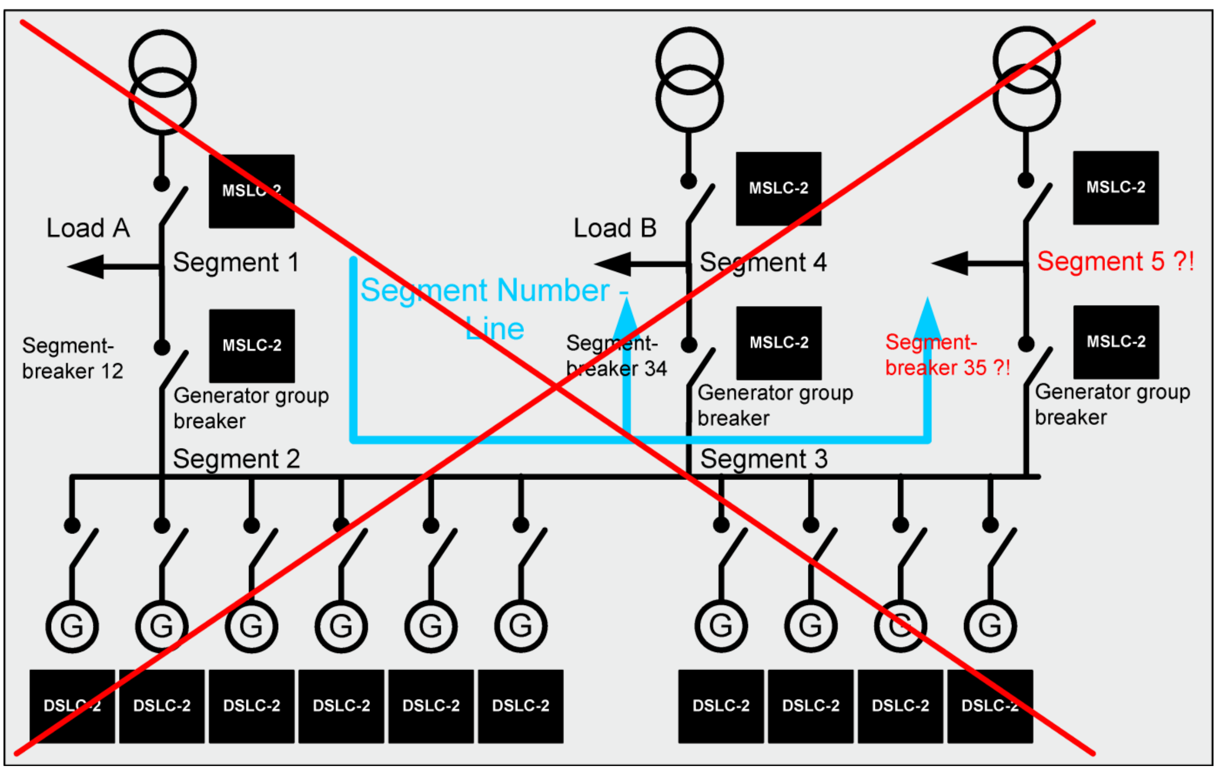


Figure 8-8: Not supported application

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 179.

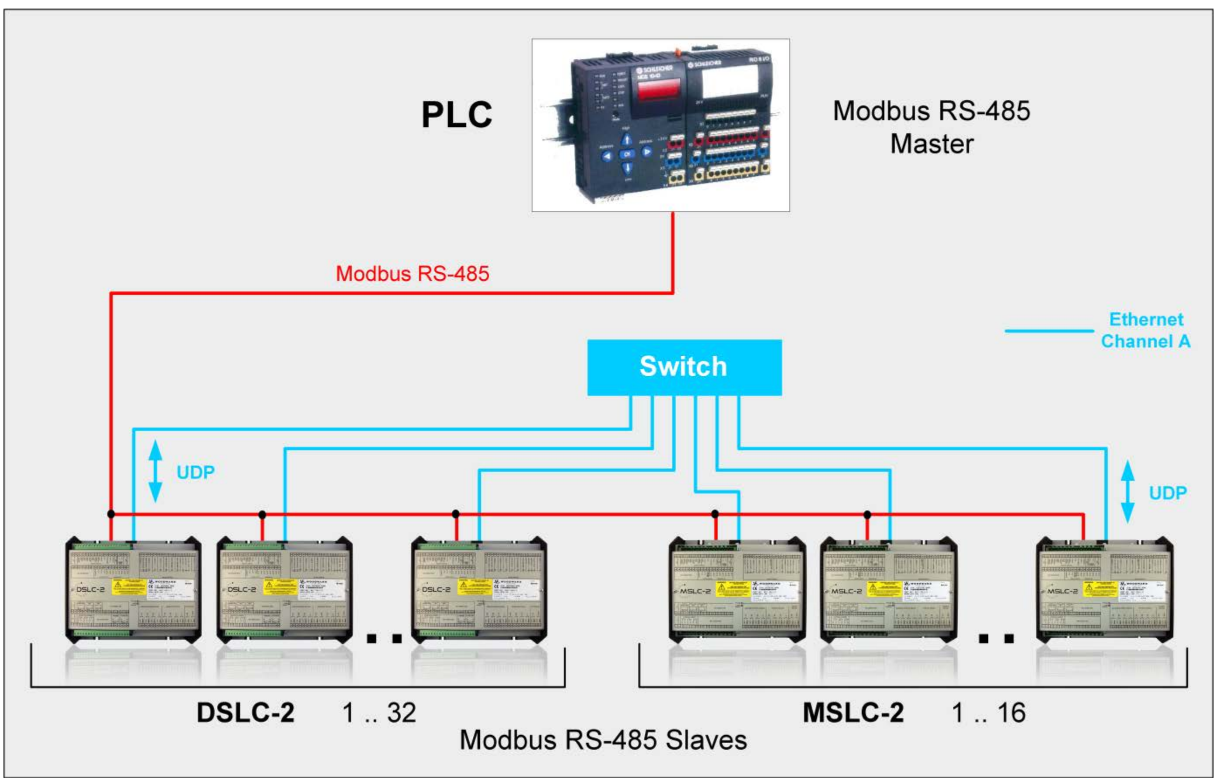


Figure 8-9: Visualization and remote control by PLC via RS-485 interface

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.

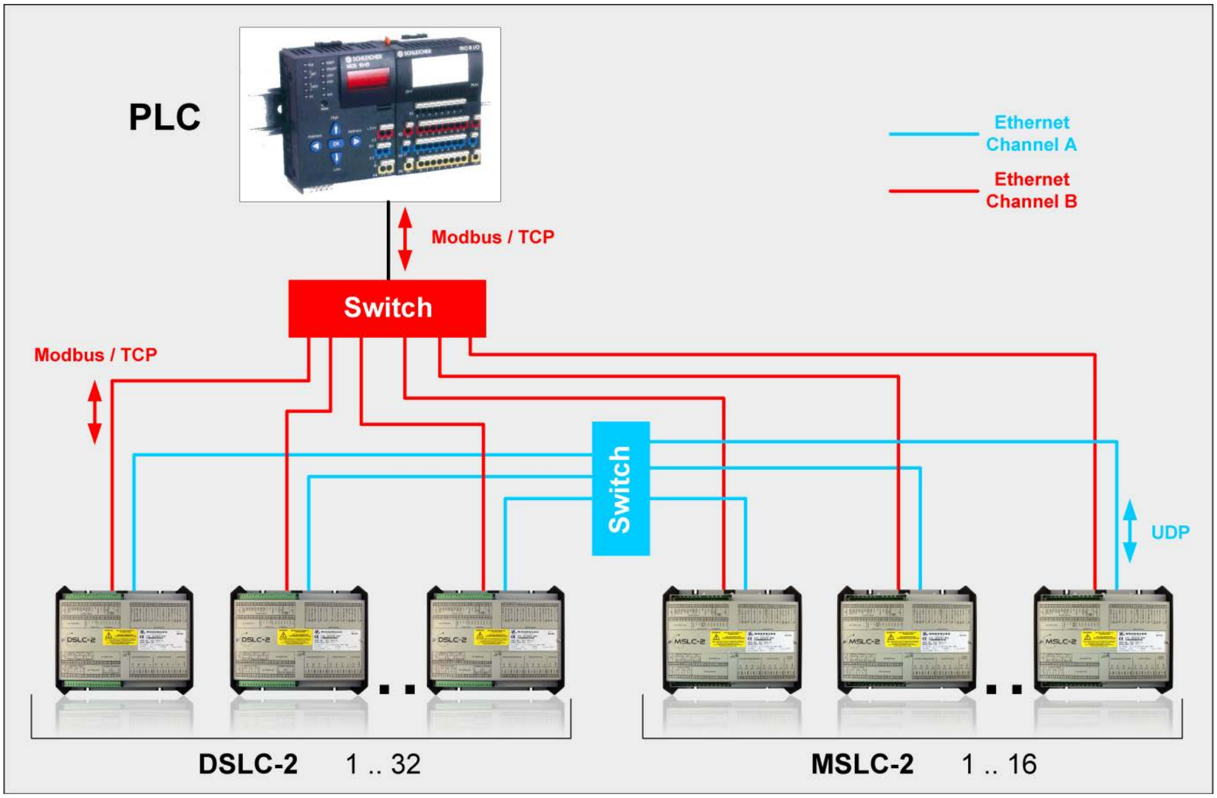


Figure 8-10: Visualization and remote control by PLC via Ethernet Modbus/TCP interface

Chapter 9.
Interface

Interface Overview

The device has several communication interfaces which are described below.

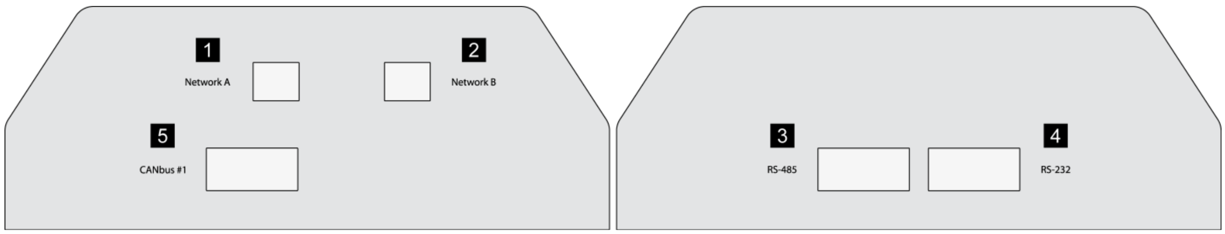


Figure 9-1: MSLC-2 - interface overview (housing - side view)

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 9-1: MSLC-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 MSLC-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 MSLC-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 9-2).

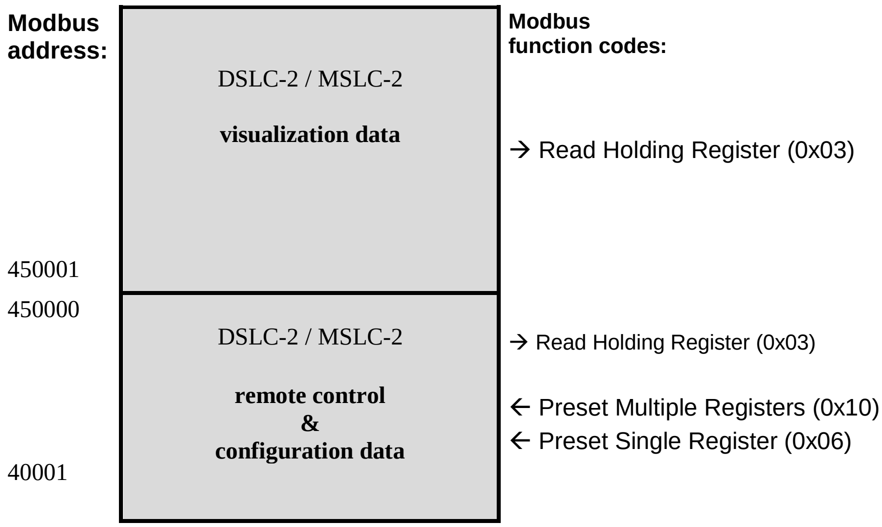


Table 9-2: Modbus - address range

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 9-3: Modbus - address range block read

NOTE

Table 9-3 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 179 for the complete protocol.

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

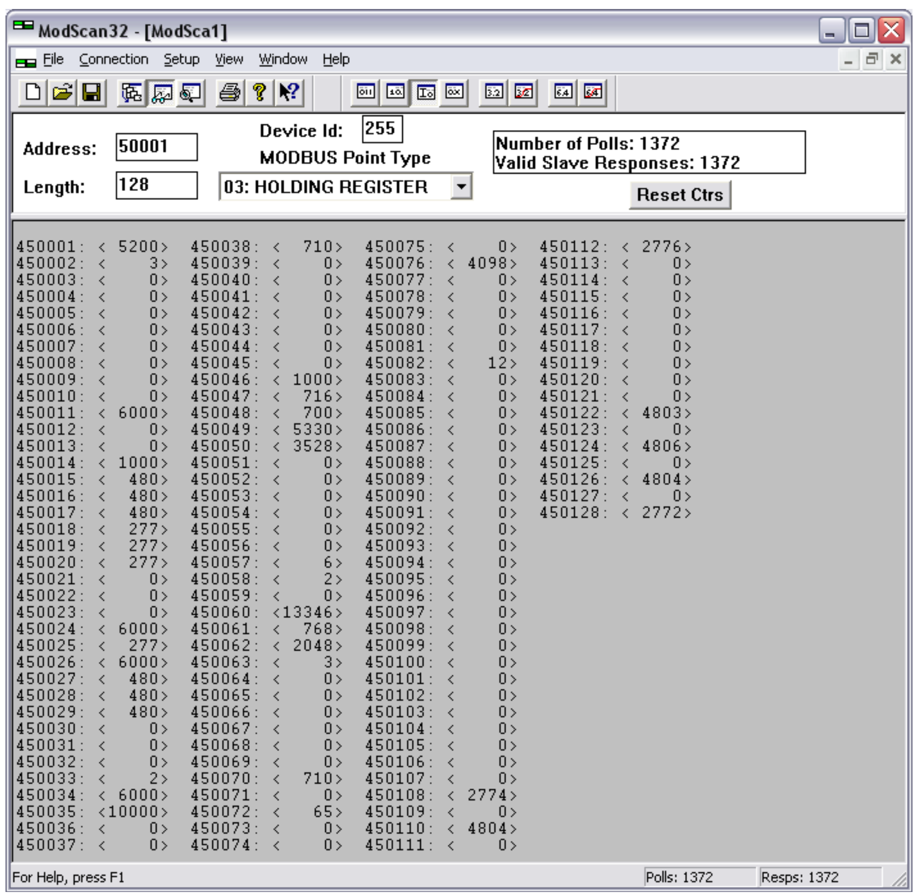


Figure 9-2: Modbus - visualization configurations

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 9-4: 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 9-5 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 9-5: Modbus - data types

MSLC-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 import/ export 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 import/ export**	-	-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 9-6: 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
Utility Unload	74	Discrete input or communication interface
Ramp Pause	75	Discrete input or communication interface
Setpoint Raise	76	Discrete input or communication interface
Setpoint 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
Imp./Exp. Control	149	Discrete input or communication interface

Table 9-7: Modbus – sending binary digital orders over interface

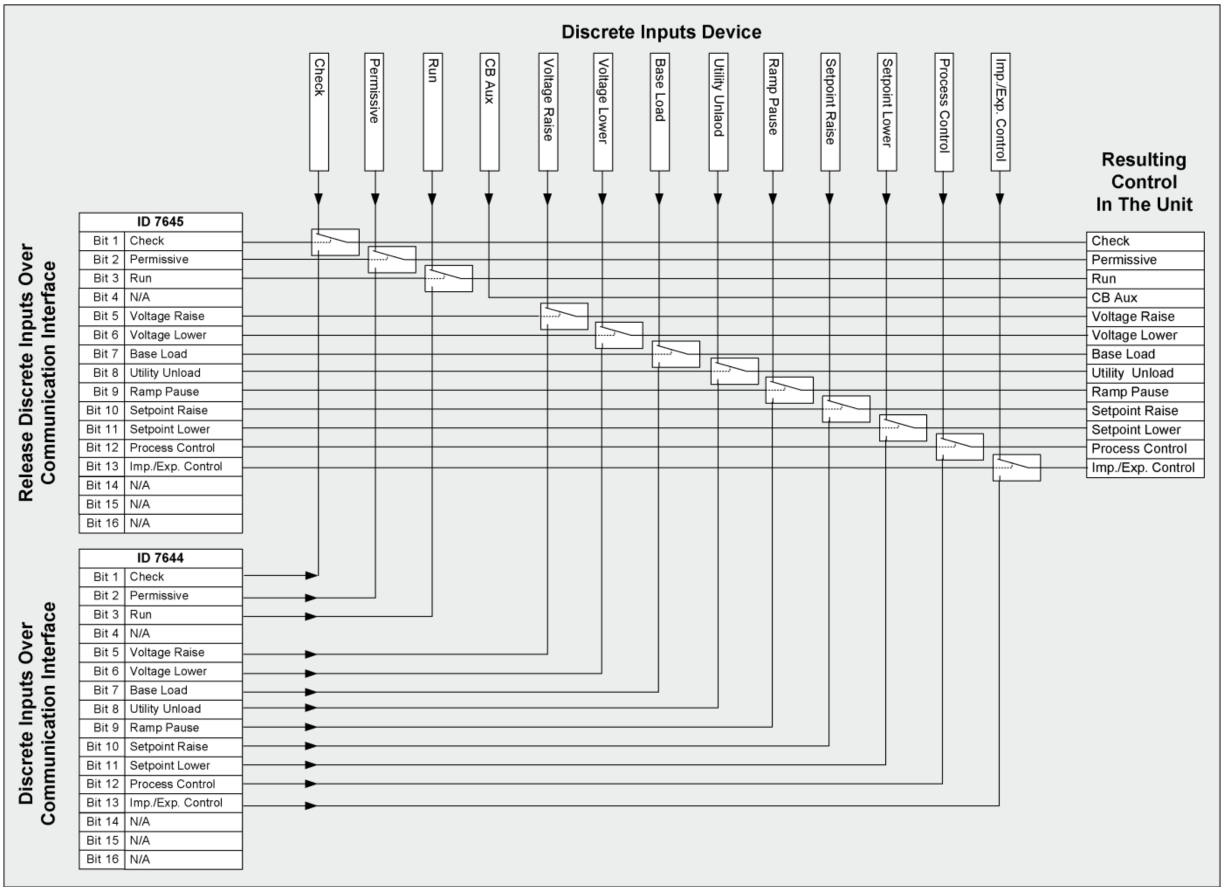


Figure 9-3: Modbus - sending binary digital orders over interface

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 Utility Unload Bit 09 = 1 Ramp Pause Bit 10 = 1 Setpoint Raise Bit 11 = 1 Setpoint Lower Bit 12 = 1 Process Bit 13 = 1 Imp./Exp. Control 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 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 Utility Unload Bit 09 = 1 Ramp Pause Bit 10 = 1 Setpoint Raise Bit 11 = 1 Setpoint Lower Bit 12 = 1 Process Bit 13 = 1 Imp./Exp. Control 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 9-8: 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.

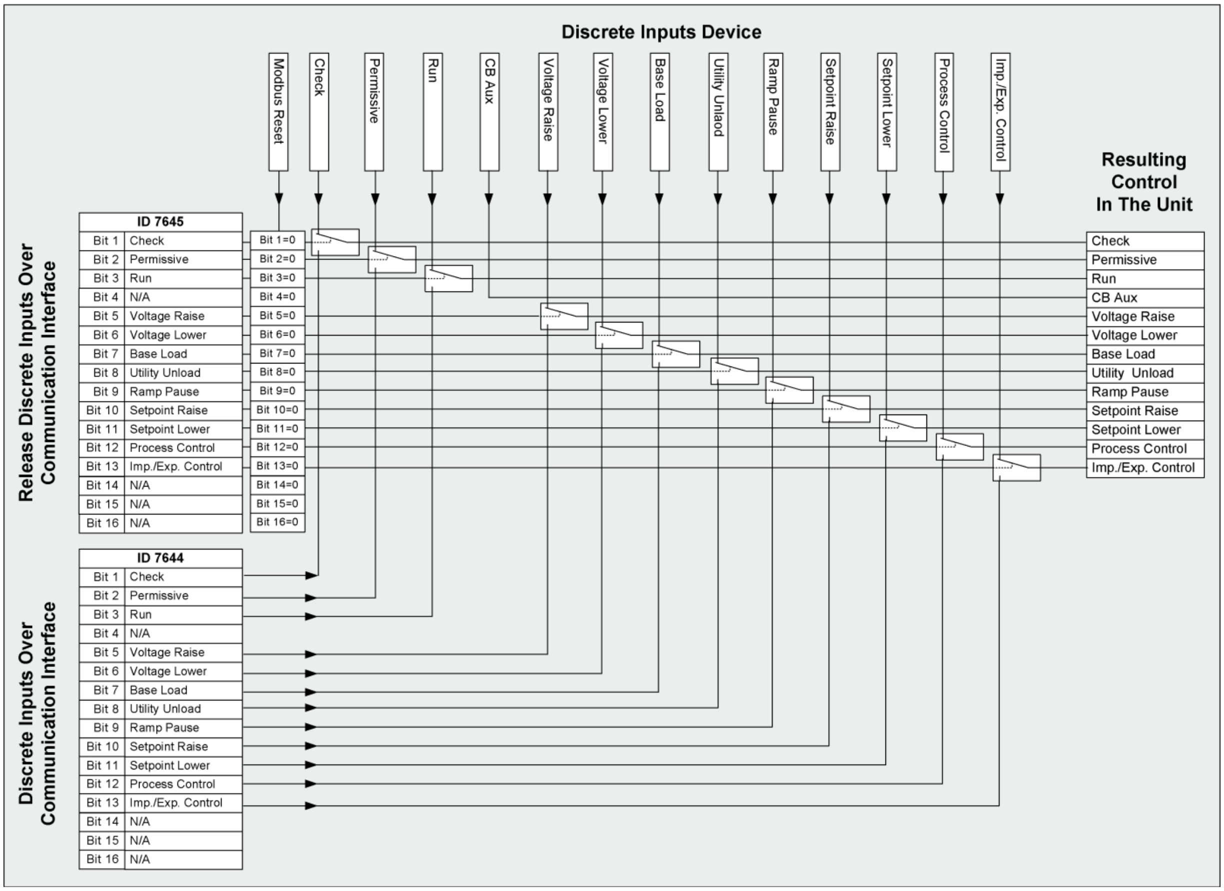


Figure 9-4: Modbus – loss of connection

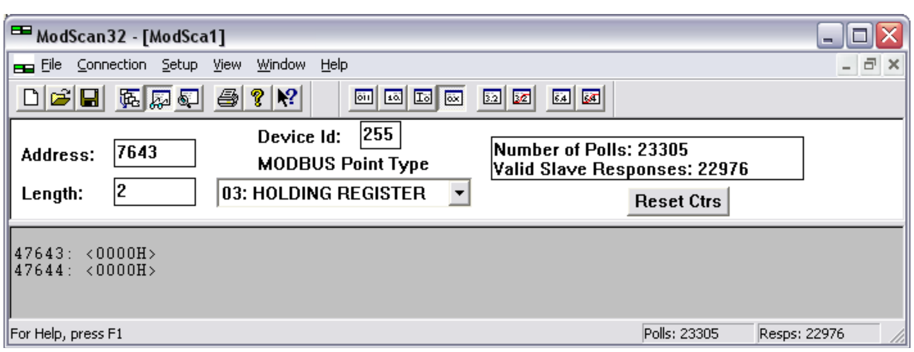
Example 1: Active Power Interface Setpoint Baseload

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 setpoint through.

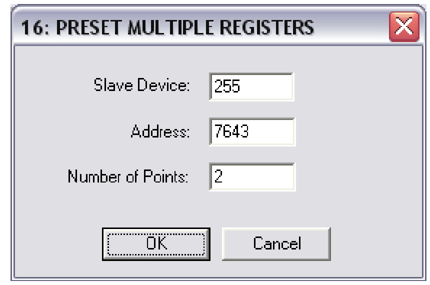
The active power setpoint value must be written to parameter 7642.

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.

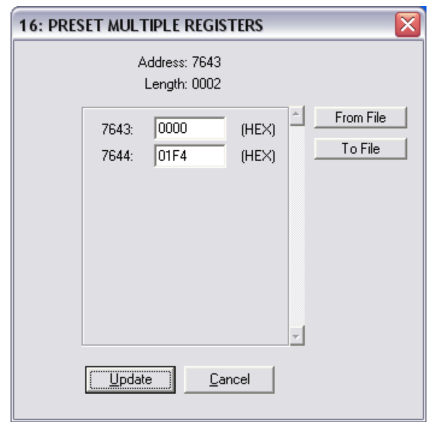
The following ModScan32 screenshots show how to set the parameter address 7642 in ModScan32.



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.

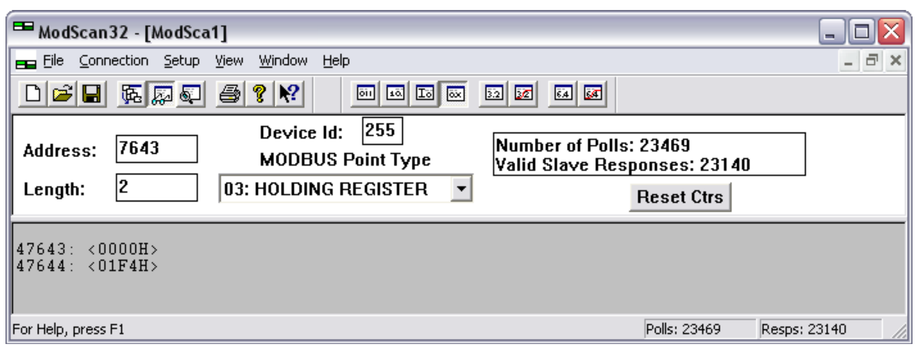


Figure 9-5: Modbus - configuration example 1 - active power

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.

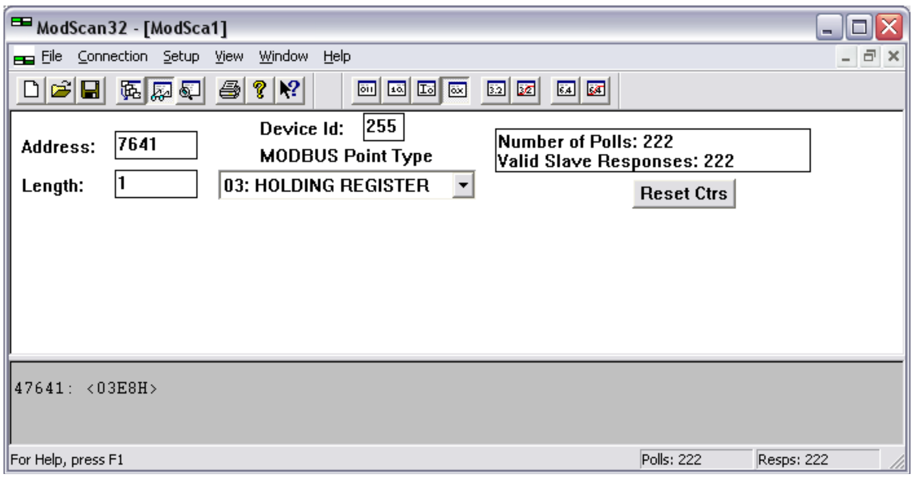


Figure 9-6: Modbus - configuration example 2 – power factor

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 9-9: 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.

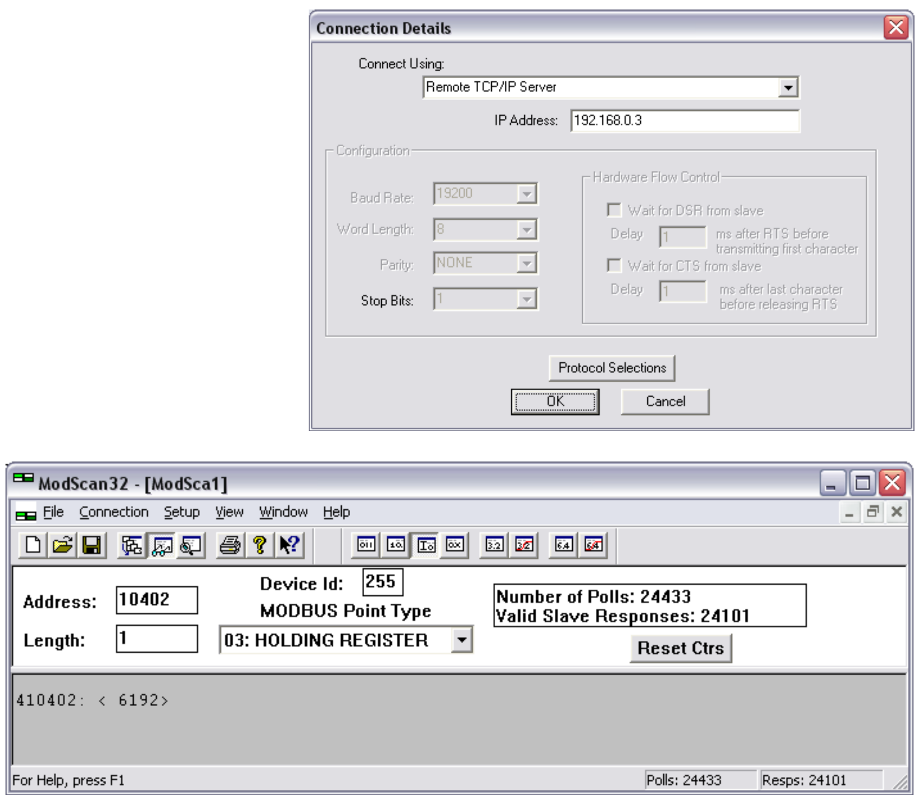


Figure 9-7: Modbus - configuration example 1

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 9-10: 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.

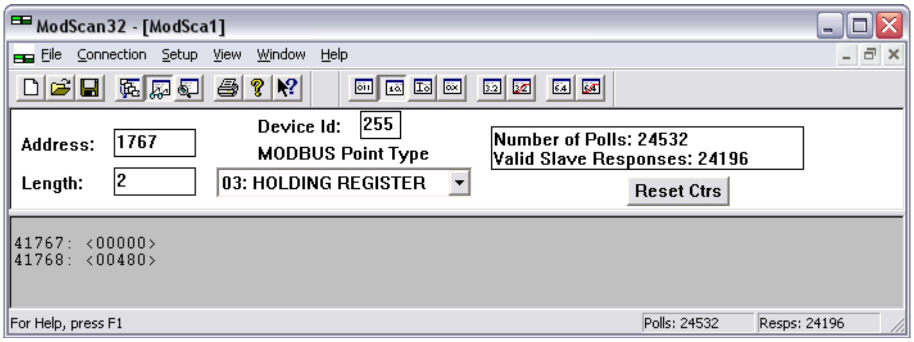


Figure 9-8: Modbus - configuration example 2

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 9-11: 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".

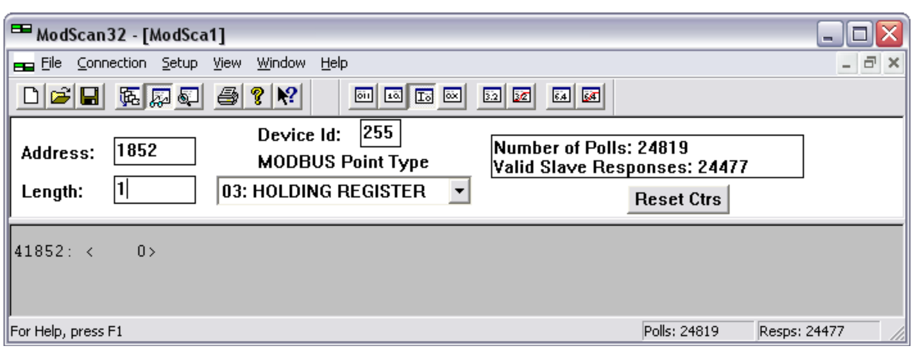


Figure 9-9: Modbus - configuration example 3

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 9-12: 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".

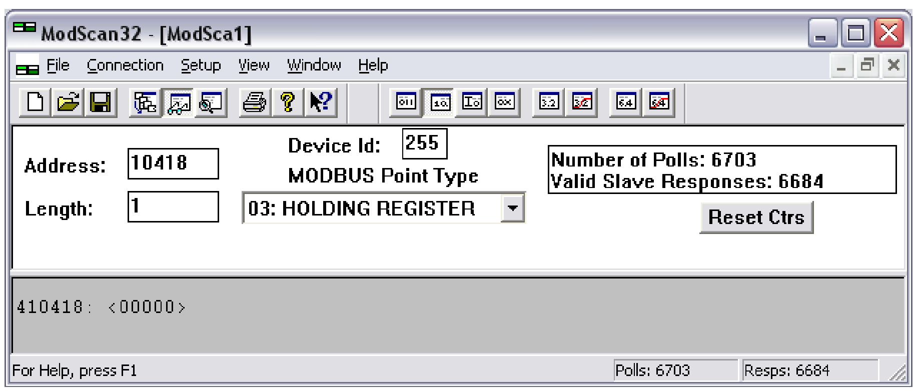


Figure 9-10: Modbus - remote control parameter 1701

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.

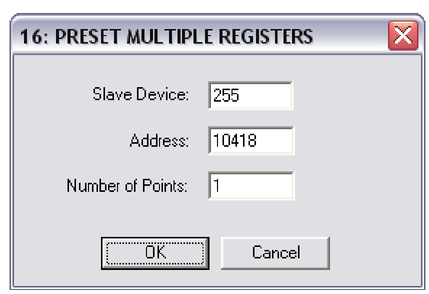


Figure 9-11: Modbus - write register - enable the resetting procedure via RS-232 or Modbus TCP/IP

In order to reset the default values, parameter 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".

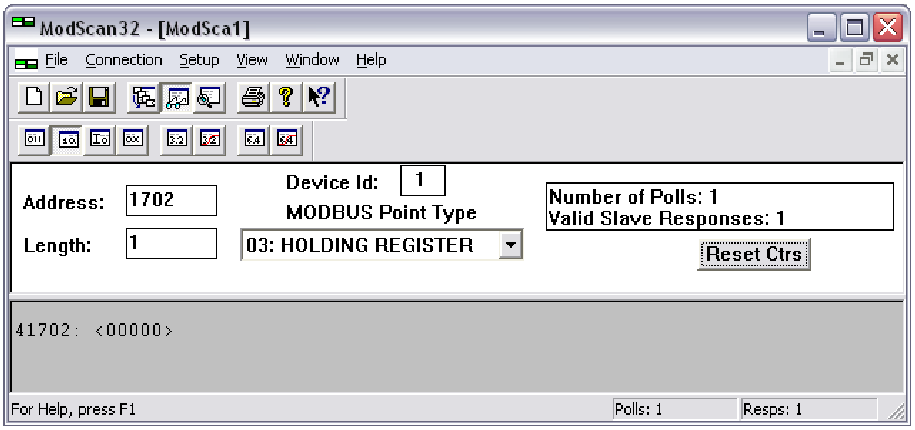


Figure 9-12: Modbus - remote control parameter 1701

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 9-13: 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 9-13: 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 9-14: Modbus - serial interface 2 – parameters

Network B – Modbus

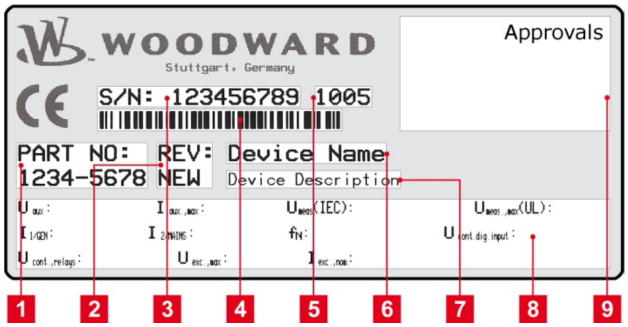
Parameter table

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 MSLC-2 = 33 to 48)	0 to 255	33

Table 9-15: 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 %	
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	0.015G² / 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 9-14 shows the exemplary connection of a diode as an interference suppressing circuit.

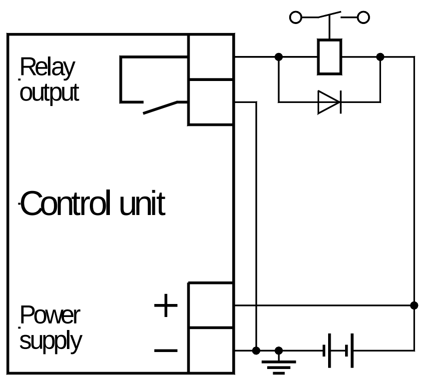


Figure 9-14: Interference suppressing circuit - connection

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

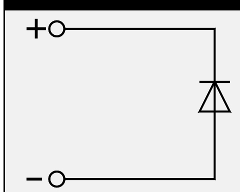
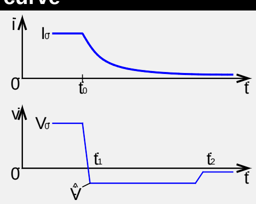
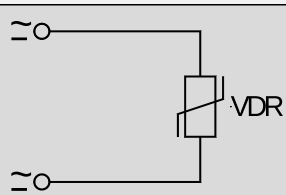
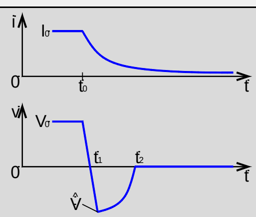
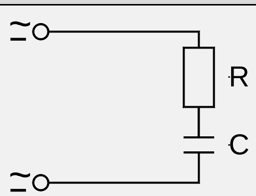
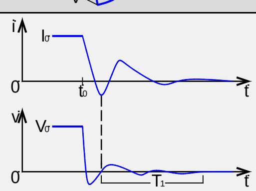
Connection diagram	Load current / voltage curve	Advantages	Disadvantages
		• Uncritical dimensioning • Lowest possible induced voltage • Very simple and reliable	• High release delay
		• Uncritical dimensioning • High energy absorption • Very simple setup • Suitable for AC voltage • Reverse polarity 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 9-16: Interference suppressing circuit for relays

Appendix C.
Data Protocols

Data Protocol 5200

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

Modbus Adress	Modicon Adress	Size	Format	Parameter ID	Description MSLC-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 MSLC-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 MSLC-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 MSLC-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 MSLC-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 MSLC-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 Permis-sive 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 MSLC-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 input	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:

NamespaceX

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

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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	CB 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	-	3417	CB close hold time	0.10 to 0.50 s	0.50 s	UNSIGNED 16	2
MENU 1	-	3419	CB maximum closing attempts	01 to 10	5	UNSIGNED 16	2
MENU 1	-	3421	CB 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	000.80	INTEGER 16	2
MENU 1	-	4540	Frequency synchronizer integral gain	000.00 to 020.00	000.50	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	-	4712	Slip frequency setpoint off-set	-00.50 to 00.50 Hz	00.10 Hz	INTEGER 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	-	5516	Start frequency control lev-el	00.00 to 70.00 Hz	55.00 Hz	UNSIGNED 16	1
MENU 1	-	5517	Start frequency control de-lay	000 to 999 s	001 s	UNSIGNED 16	1
MENU 1	-	5610	Voltage synchronizer pro-portional gain	000.01 to 100.00	001.00	UNSIGNED 16	2
MENU 1	-	5611	Voltage synchronizer integral gain	000.01 to 100.00	000.50	UNSIGNED 16	2
MENU 1	-	5701	Positive frequency differential CB	00.02 to 00.49 Hz	00.18 Hz	INTEGER 16	2
MENU 1	-	5702	Negative frequency differential CB	-00.49 to 00.00 Hz	-00.10 Hz	INTEGER 16	2
MENU 1	-	5703	Max. positive phase window CB	000.0 to 060.0 °	005.0 °	INTEGER 16	2
MENU 1	-	5704	Max. negative phase win-dow CB	-060.0 to 000.0 °	-005.0 °	INTEGER 16	2
MENU 1	-	5705	Breaker delay	040 to 300 ms	080 ms	UNSIGNED 16	2
MENU 1	-	5707	Phase matching CB dwell time	00.0 to 60.0 s	00.5 s	UNSIGNED 16	2
MENU 1	-	5730	Synchronization CB	Slip frequency ; 0 Phase matching ; 1	0	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	1	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	System A rated load	000000.1 to 999999.9 kW	000250.0 kW	UNSIGNED 32	2
MENU 2	-	3123	Utility unload trip time	003 to 999 s	060 s	UNSIGNED 16	2
MENU 2	-	3125	Generator unload trip	00.5 to 99.9 %	03.0 %	UNSIGNED 16	2
MENU 2	-	4506	Utility unload trip	00000 to 30000 kW	00005 kW	INTEGER 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	-	4523	Import /export droop	000.0 to 100.0 %	000.0 %	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	-150 to 150 %	90%	INTEGER 16	2
MENU 2	-	4528	Low load limit DO	002 to 100 %	5%	INTEGER 16	2
MENU 2	-	4529	Gen load switch 1 PU	000 to 100 %	0%	INTEGER 16	2
MENU 2	-	4530	Gen load switch 1 DO	000 to 100 %	10%	INTEGER 16	2
MENU 2	-	4538	Gen load switch 2 PU	000 to 100 %	100%	INTEGER 16	2
MENU 2	-	4543	Gen load switch 2 DO	000 to 100 %	90%	INTEGER 16	2
MENU 2	-	4700	Load ramp rate	000.01 to 100.00 %/s	003.00 %/s	INTEGER 16	2
MENU 2	-	4709	High load limit PU	-150 to 150 %	100%	INTEGER 16	2
MENU 2	-	4710	Low load limit PU	000 to 100 %	0%	INTEGER 16	2

Namespace1	Namespace2	ID	Parameter Text	Setting Range	Default Value	Data Type	CL
MENU 2	-	5510	Import/export control proportional gain	000.01 to 100.00	001.00	UNSIGNED 16	2
MENU 2	-	5511	Import/export control integral gain	000.01 to 100.00	000.50	UNSIGNED 16	2
MENU 2	-	5512	Import/export control derivative ratio	000.01 to 100.00	000.01	UNSIGNED 16	2
MENU 2	-	5522	Load control setpoint ramp	000.10 to 100.00 %/s	003.00 %/s	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	-	7616	Gen load high limit alarm	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 2	-	7617	Gen load low limit alarm	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 2	-	7618	Gen load limit switch	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 2	-	7634	Load control setpoint source	Internal ; 0 Interface ; 1	0	UNSIGNED 16	2
MENU 2	-	7717	Import / export level	-999999.9 to 999999.9 kW	000020.0 kW	SIGNED 32	0
MENU 2	-	7755	Interface switch Import Export	Export ; 0 Import ; 1	0	UNSIGNED 16	2
MENU 3	-	4500	Process control proportional gain	000.01 to 100.00	003.00	INTEGER 16	2
MENU 3	-	4501	Process control integral gain	000.01 to 100.00 s	003.00 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	1	UNSIGNED 16	2
MENU 4	-	1758	System A rated react. power	000000.1 to 999999.9 kvar	000190.0 kvar	UNSIGNED 32	2
MENU 4	-	1770	System A 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	-	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	-	5613	VAR control proportional gain	000.01 to 100.00	001.00	UNSIGNED 16	2
MENU 4	-	5614	VAR control integral gain	000.01 to 100.00	000.50	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	0
MENU 4	-	5621	Constant gen. PF reference	-00.999 to 01.000	00.950	INTEGER 16	0

Namespace1	Namespace2	ID	Parameter Text	Setting Range	Default Value	Data Type	CL
MENU 4	-	5622	Reactive power setpoint ramp	000.01 to 100.00 %/s	010.00 %/s	UNSIGNED 16	2
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 switches	Disabled ; 0 Enabled ; 1	1	UNSIGNED 16	2
MENU 4	-	7512	Voltage range alarm	Disabled ; 0 Enabled ; 1	0	UNSIGNED 16	2
MENU 4	-	7558	VAR PF control mode	PF Control ; 0 VAR Control ; 1 Constant Generator PF ; 2	1	UNSIGNED 16	2
MENU 4	-	7635	VAR control setpoint source	Internal ; 0 Interface ; 1	0	UNSIGNED 16	2
MENU 4	-	7723	KVAR reference	-999999.9 to 999999.9 kvar	000010.0 kvar	SIGNED 32	0
MENU 5	System management	1701	Reset factory default values	No ; 0 Yes ; 1	0	UNSIGNED 16	0
MENU 5	-	1702	Device number	033 to 048	33	UNSIGNED 16	2
MENU 5	-	1750	System rated frequency	50Hz ; 0 60Hz ; 1	1	UNSIGNED 16	2
MENU 5	-	1754	System A rated current	00001 to 32000 A	00500 A	UNSIGNED 16	2
MENU 5	-	1766	System A rated voltage	000050 to 650000 V	000480 V	UNSIGNED 32	2
MENU 5	-	1781	System B rated voltage	000050 to 650000 V	000480 V	UNSIGNED 32	2
MENU 5	Transformer	1800	System A PT secondary rated voltage	050 to 480 V	120 V	UNSIGNED 16	2
MENU 5	Transformer	1801	System A PT primary rated voltage	000050 to 650000 V	000480 V	UNSIGNED 32	2
MENU 5	Transformer	1803	System B PT secondary rated voltage	050 to 480 V	120 V	UNSIGNED 16	2
MENU 5	Transformer	1804	System B PT primary rated voltage	000050 to 650000 V	000480 V	UNSIGNED 32	2
MENU 5	Transformer	1806	System A CT primary rated current	00001 to 32000 A/x	00500 A/x	UNSIGNED 16	2
MENU 5	Transformer	1812	System B PT secondary rated voltage	050 to 480 V	120 V	UNSIGNED 16	2
MENU 5	Transformer	1813	System B PT primary rated voltage	000050 to 650000 V	000480 V	UNSIGNED 32	2
MENU 5	-	1850	System A current input	L1 L2 L3 ; 0 Phase L1 ; 1 Phase L2 ; 2 Phase L3 ; 3	0	UNSIGNED 16	2
MENU 5	-	1851	System A 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 system B voltage meas.	3Ph 4W ; 0 3Ph 3W ; 1	1	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

Namespace1	Namespace2	ID	Parameter Text	Setting Range	Default Value	Data Type	CL
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	-	4544	Basic segment number	00001 to 00008	1	INTEGER 16	2
MENU 5	-	4707	Number of MSLC communicating	00001 to 00016	1	INTEGER 16	2
MENU 5	-	4708	Number of DSLC communicating	00000 to 00032	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	33	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 16	2
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	-	7624	Smaller segment at measurement	System A ; 0 System B ; 1	0	UNSIGNED 16	2
MENU 5	Tie	7625	Switch dead bus A -> dead bus B	No ; 0 Yes ; 1	1	UNSIGNED 16	2
MENU 5	-	7626	Switch alive bus A -> dead bus B	No ; 0 Yes ; 1	1	UNSIGNED 16	2
MENU 5	Tie	7627	Switch alive bus B -> dead bus A	No ; 0 Yes ; 1	1	UNSIGNED 16	2
MENU 5	-	7628	Type of MSLC breaker	Tie ; 0 Utility ; 1	1	UNSIGNED 16	2
MENU 5	-	7649	Auxiliary system B 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 config.	0000 to 9999	1805	UNSIGNED 16	0
MENU 5	System management	10411	Supercommissioning level code	0000 to 9999		UNSIGNED 16	5

Namespace1	Namespace2	ID	Parameter Text	Setting Range	Default Value	Data Type	CL
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 Reference Input	4311	User defined min display value	-100.0 to 100.0 %	000.0 %	INTEGER 16	2
MENU 6	Remote Load Reference Input	4312	User defined max display value	-100.0 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 Input	4333	User defined min display value	-00.999 to 00.999 PF	-00.990 PF	INTEGER 16	2
MENU 6	Reactive Load Input	4334	User defined max display value	-00.999 to 00.999 PF	00.710 PF	INTEGER 16	2
MENU 6	Remote Load Reference Input	7673	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	7674	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	7675	HW signal	0 - 20mA ; 0 4 - 20mA ; 1 0 - 10V ; 2 0 - 5V ; 3 1 - 5V ; 4	3	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	-000500.0	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	000000.2	SIGNED 32	0

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.

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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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