



## MSLC-2™ Master Synchronizer and Load Control

### DESCRIPTION

Woodward's MSLC-2™ functions with the DSLC-2™ control to provide synchronization and load control across Utility and Intertie breakers. The MSLC-2/DSLC-2 combination operates over an Ethernet communication network to control simple or complex generator system applications. This combination, 32 DSLC-2's and 16 MSLC-2's, provide multiple unit, multiple segment, utility and intertie power management for complex power systems. Controls plant wide Import / Export levels while always providing bump-less load transfers with utility.

The MSLC-2 control combines synchronization, dead bus closing, utility/intertie load sensor, base-load control, import/export control, VAR, power factor, and a master process control in one powerful package.

The MSLC-2 provides phase matching or slip frequency synchronization, with voltage matching, across a utility or intertie breaker. The MSLC-2/DSLC-2 combination can handle multiple utility connections with a maximum of 8 bus segments in one application.

The MSLC-2's load sensor and load control sense true RMS power and provide a bump-less loading and unloading against a utility grid. Baseload, import/export, process, and utility unload modes control the KW power between different power sources at the same time controlling the reactive power, VAR and power factor. Reactive power is also ramped on and off for the smoothest load transactions between power grids.

The MSLC-2 communicates via Ethernet, with redundant Ethernet now available, to control real and reactive loading against the utility by DSLC-2 equipped generators.

The tie breaker mode allows synchronization between multiple generator systems. Segments are connected and power can be measured across an intertie, but no load control is functional when in Tie breaker operation.

### FEATURES

- One MSLC-2 can provide master control for up to 32 DSLC and an additional 15 MSLC-2 in a system.
- Two dedicated Ethernet lines for precise system communications between all DSLC-2's and MSLC-2's on the system.
- Ethernet Modbus TCP for remote control and monitoring by PLC or DCS system.
- Redundant Ethernet communications for enhanced reliability.
- Master MSLC-2 redundancy, loss of communications with the designated MSLC-2 master initiates control hand off to the next designated MSLC-2 master.
- The MSLC-2 hardware is adjustable for multiple applications.
- Slip frequency or voltage phase matching synchronizing fully selectable with dead bus option in both directions provide full flexibility for intertie and main-tie-main applications.
- Having functions integrated into one box eliminates the need for redundant sensors (like PTs, CTs, and MOPs) that connect to individual modules such as the load sensor and synchronizer.
- Digital signal processing makes the MSLC-2 resistant to power line distortions and harmonics.
- Three-phase true RMS power sensing provides accurate readings even with unbalanced phase loading and voltage fluctuations.
- Export/import control over multiple utility MSLC-2's in same segment.
- The Woodward ToolKit™ software allows flexible setup using the same basic menu tree as the original MSLC plus an overview screen. No hand held programmer is required. Graphical overview of generators and bus bar parameters with trending makes the MSLC-2 commissioning friendly.
- The Toolkit can be accessed either via one of the Ethernet ports or via RS-232 port.
- Phase angle compensation provides adjustment for additional deviation correction across a transformer.
- The system update feature allows for system reconfiguration.

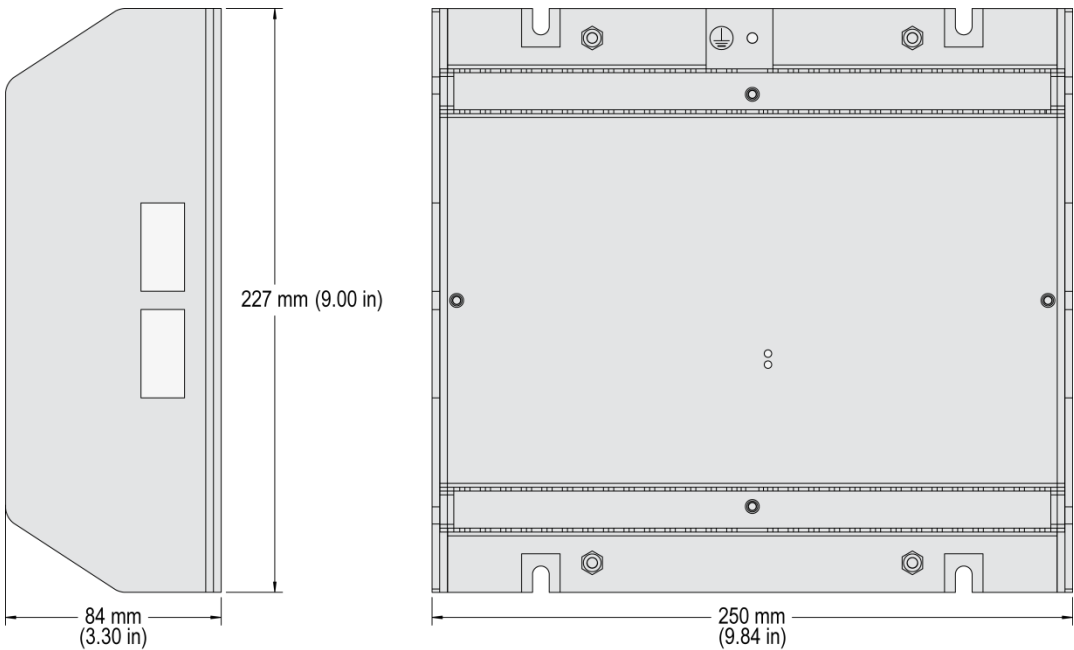
- Applications for up to 32 generators with 16 mains and/or tie breakers
- Configurable for mains and tie breaker applications
- Complex applications with up to 8 bus segments
- Automatic segment recognition
- Redundant Ethernet communication for enhanced reliability
- The "system update" feature allows for system reconfiguration
- PLC and DCS compatible via Modbus RTU or Modbus TCP
- Automatic plant loading and unloading for bump-less load transfer to and from the utility
- Controls plant wide import/export levels against the utility
- Overall plant Power Factor control
- Ethernet or RS-232 port for configuration of device using Woodward ToolKit software
- UL/cUL & CE Listed

# SPECIFICATIONS

|                                           |                                               |                                     |                                                       |
|-------------------------------------------|-----------------------------------------------|-------------------------------------|-------------------------------------------------------|
| Power supply                              | 12/24 Vdc (8 to 40 Vdc)                       | Setting range                       | 0.0 to 999,999.9 MW/kvar                              |
| Intrinsic consumption                     | max. 15 W                                     | <b>Discrete inputs</b>              | galvanically isolated                                 |
| Ambient temperature (operation)           | -40°C to 70°C / -40 to 158°F                  | Input range                         | 12/24 Vdc (8 to 40 Vdc)                               |
| Ambient temperature (storage)             | -40°C to 85°C / -40 to 185°F                  | Input resistance                    | approx. 20 kOhms                                      |
| Ambient humidity                          | 95 %, non-condensing                          | <b>Relay outputs</b>                | galvanically isolated / potential free                |
| <b>Voltage</b>                            | ( $\lambda/\Delta$ )                          | Contact material                    | AgCdO                                                 |
| 120 Vac [1]                               | Rated ( $V_{rated}$ ) 69/120 Vac              | Load (GP)                           | 2.00 Aac@250 Vac                                      |
|                                           | Max. value ( $V_{max}$ ) 86/150 Vac           |                                     | 2.00 Adc@24 Vdc / 0.36 Adc@125 Vdc / 0.18 Adc@250 Vdc |
|                                           | Rated voltage phase - ground 150 Vac          | Pilot duty (PD)                     |                                                       |
|                                           | Rated surge volt. ( $V_{surge}$ ) 2.5 kV      |                                     | 1.00 Adc@24 Vdc / 0.22 Adc@125 Vdc / 0.10 Adc@250 Vdc |
| <b>and 480 Vac [4]</b>                    | Rated ( $V_{rated}$ ) 277/480 Vac             | <b>Analog inputs (not isolated)</b> | freely scalable                                       |
|                                           | Max. value ( $V_{max}$ ) 346/600 Vac          | Type                                | 0 to 10 V / 0 to 20 mA                                |
|                                           | Rated voltage phase - ground 300 Vac          | Resolution                          | 11 Bit                                                |
|                                           | Rated surge volt. ( $V_{surge}$ ) 4.0 kV      | <b>Housing</b>                      | Powder coated aluminum for back panel mounting        |
| Accuracy                                  | Class 0.5                                     | Dimensions WxHxD                    | 250 × 227 × 84 mm (9.84 × 9.00 × 3.30 in)             |
| Measurable alternator windings            | 3p-3w, 3p-4w, 3p-4w OD                        | Connection                          | screw/plug terminals 2.5 mm <sup>2</sup>              |
| Setting range                             | primary 50 to 650,000 Vac                     | Protection system                   | IP 20                                                 |
| Linear measuring range                    | 1.25× $V_{rated}$                             | Weight                              | approx. 1,900 g (4.2 lbs)                             |
| Measuring frequency                       | 50/60 Hz (40 to 85 Hz)                        | <b>Disturbance test (CE)</b>        | tested according to applicable EN guidelines          |
| High Impedance Input; Resistance per path | [1] 0.498 MΩ, [4] 2.0 MΩ                      | <b>Listings</b>                     | UL, cUL, GOST-R, CSA                                  |
| Max. power consumption per path           | < 0.15 W                                      | <b>Marine</b>                       | LR (Type Approval), ABS (Type Approval)               |
| <b>Current (galvanically isolated)</b>    | Rated ( $I_{rated}$ ) [1] ..1 A or [5] ..15 A |                                     |                                                       |
| Linear measuring range                    | $I_{gen} = 3.0 \times I_{rated}$              |                                     |                                                       |
|                                           | $I_{mains/ground} = 1.5 \times I_{rated}$     |                                     |                                                       |
| Setting range                             | 1 to 32,000 A                                 |                                     |                                                       |
| Burden                                    | < 0.15 VA                                     |                                     |                                                       |
| Rated short-time current (1 s)            | [1] 50× $I_{rated}$ , [5] 10× $I_{rated}$     |                                     |                                                       |
| Accuracy                                  | Class 0.5                                     |                                     |                                                       |
| <b>Power</b>                              |                                               |                                     |                                                       |

# DIMENSIONS

Powder coated aluminum for back panel mounting



# TERMINAL DIAGRAM

|                |                                |                                |                     |                     |                     |                     |               |               |               |                |               |               |                  |               |               |               |               |               |               |
|----------------|--------------------------------|--------------------------------|---------------------|---------------------|---------------------|---------------------|---------------|---------------|---------------|----------------|---------------|---------------|------------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 80             | 79                             | 78                             | 77                  | 76                  | 75                  | 74                  | 73            | 72            | 71            | 70             | 69            | 68            | 67               | 66            | 65            | 64            | 63            | 62            | 61            |
| NO CONNECTION  | PROCESS CONTROL SETPOINT LOWER | PROCESS CONTROL SETPOINT RAISE | RAMP PAUSE          | UTILITY UNLOAD      | BASE LOAD           | VOLTAGE LOWER       | VOLTAGE RAISE | CB AUX        | MAN           | PERM           | CHECK         | COMMON        | NO CONNECTION    | NO CONNECTION | B -           | B +           | NO CONNECTION | NO CONNECTION | NO CONNECTION |
| DIGITAL INPUTS |                                |                                |                     |                     |                     |                     |               |               |               | DIGITAL INPUTS |               |               |                  |               |               |               |               |               |               |
| 160            | 159                            | 158                            | 157                 | 156                 | 155                 | 154                 | 153           | 152           | 151           | 150            | 149           | 148           | 147              | 146           | 145           | 144           | 143           | 142           | 141           |
| NO CONNECTION  |                                |                                |                     |                     |                     |                     |               |               |               | COMMON         | SYSTEM UPDATE | MODBUS RESET  | IMP/EXP. CONTROL | 81 ACT        | 78 ACT        | 67 ACT        | 56 ACT        | 45 ACT        | 34 ACT        |
|                |                                |                                |                     |                     |                     |                     |               |               |               | SEGMENT NO     |               |               |                  |               |               |               |               |               |               |
| 81             | 82                             | 83                             | 84                  | 85                  | 86                  | 87                  | 88            | 89            | 90            | 91             | 92            | 93            | 94               | 95            | 96            | 97            | 98            | 99            | 100           |
| NO CONNECTION  | SYSTEM A CURRENT X2            | SYSTEM A CURRENT X1            | SYSTEM A CURRENT X2 | SYSTEM A CURRENT X1 | SYSTEM A CURRENT X2 | SYSTEM A CURRENT X1 | NO CONNECTION | NO CONNECTION | NO CONNECTION | NO CONNECTION  | NO CONNECTION | NO CONNECTION | NO CONNECTION    | NO CONNECTION | NO CONNECTION | NO CONNECTION | NO CONNECTION | NO CONNECTION | NO CONNECTION |
| 1              | 2                              | 3                              | 4                   | 5                   | 6                   | 7                   | 8             | 9             | 10            | 11             | 12            | 13            | 14               | 15            | 16            | 17            | 18            | 19            | 20            |

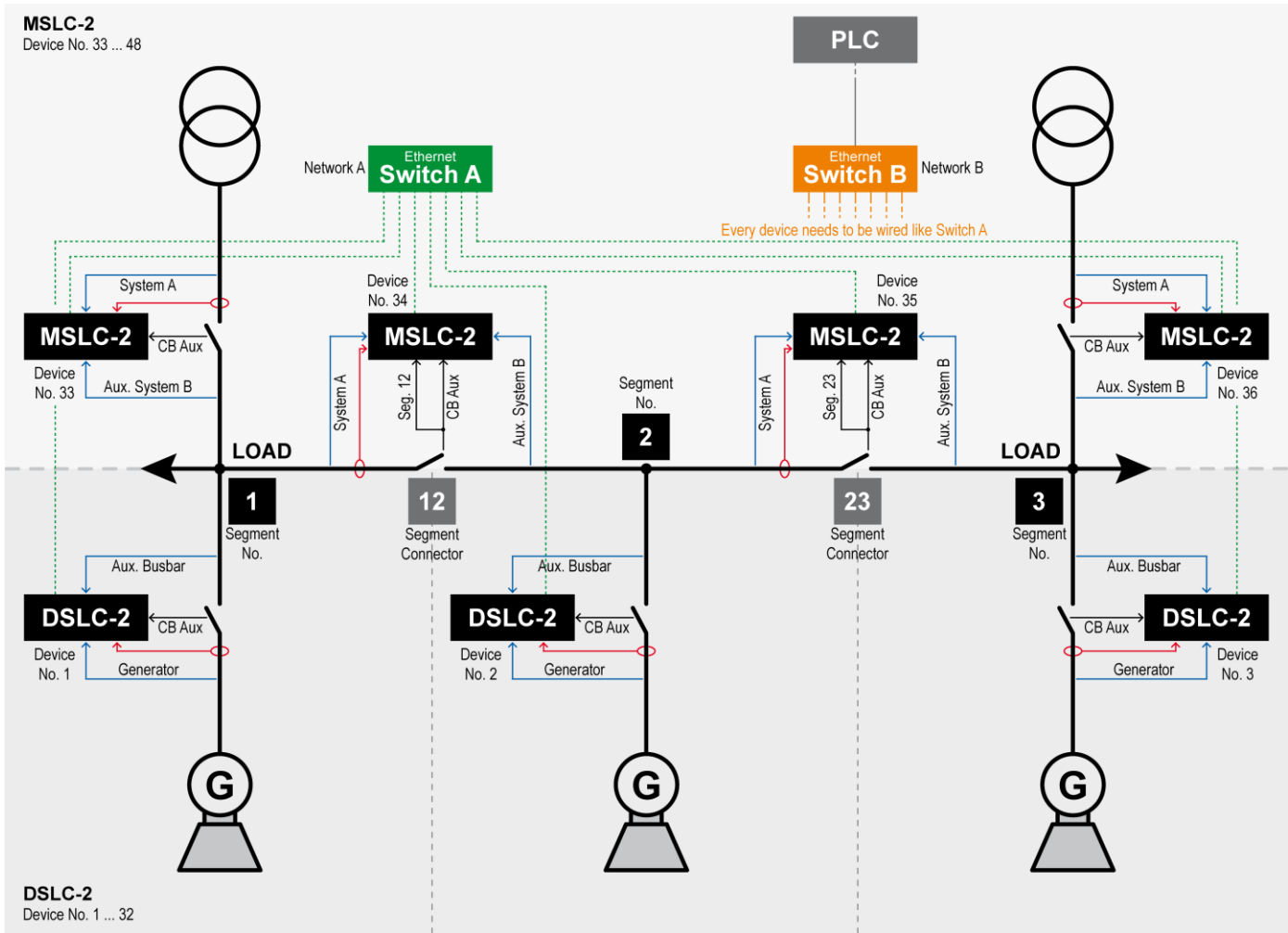
|               |               |               |         |         |         |                      |               |              |        |           |            |         |              |    |    |    |    |    |    |
|---------------|---------------|---------------|---------|---------|---------|----------------------|---------------|--------------|--------|-----------|------------|---------|--------------|----|----|----|----|----|----|
| 60            | 59            | 58            | 57      | 56      | 55      | 54                   | 53            | 52           | 51     | 50        | 49         | 48      | 47           | 46 | 45 | 44 | 43 | 42 | 41 |
| COMMON        | LOAD SWITCH 2 | LOAD SWITCH 1 | ALARM 3 | ALARM 2 | ALARM 1 | LCL/GEN BREAKER OPEN | BREAKER CLOSE | BREAKER OPEN | COMMON | LOW LIMIT | HIGH LIMIT | RELAY 2 | SELF TEST OK |    |    |    |    |    |    |
| RELAY OUTPUTS |               |               |         |         |         |                      |               |              |        |           |            |         |              |    |    |    |    |    |    |

CPU OK  
SYNC  
ENABLE

|                            |       |       |       |       |       |       |       |                  |       |       |       |       |       |       |       |                  |       |    |    |
|----------------------------|-------|-------|-------|-------|-------|-------|-------|------------------|-------|-------|-------|-------|-------|-------|-------|------------------|-------|----|----|
| AUXILIARY SYSTEM B VOLTAGE |       |       |       |       |       |       |       | SYSTEM A VOLTAGE |       |       |       |       |       |       |       | SYSTEM B VOLTAGE |       |    |    |
| L1                         | L2    | L3    | N     | L1    | L2    | L3    | N     | L1               | L2    | L3    | N     | L1    | L2    | L3    | N     | L1               | L2/N  |    |    |
| 120 V                      | 480 V | 120 V | 480 V | 120 V | 480 V | 120 V | 480 V | 120 V            | 480 V | 120 V | 480 V | 120 V | 480 V | 120 V | 480 V | 120 V            | 480 V |    |    |
| 21                         | 22    | 23    | 24    | 25    | 26    | 27    | 28    | 29               | 30    | 31    | 32    | 33    | 34    | 35    | 36    | 37               | 38    | 39 | 40 |

MSLC-2 – terminal diagram

# TYPICAL CONFIGURATION



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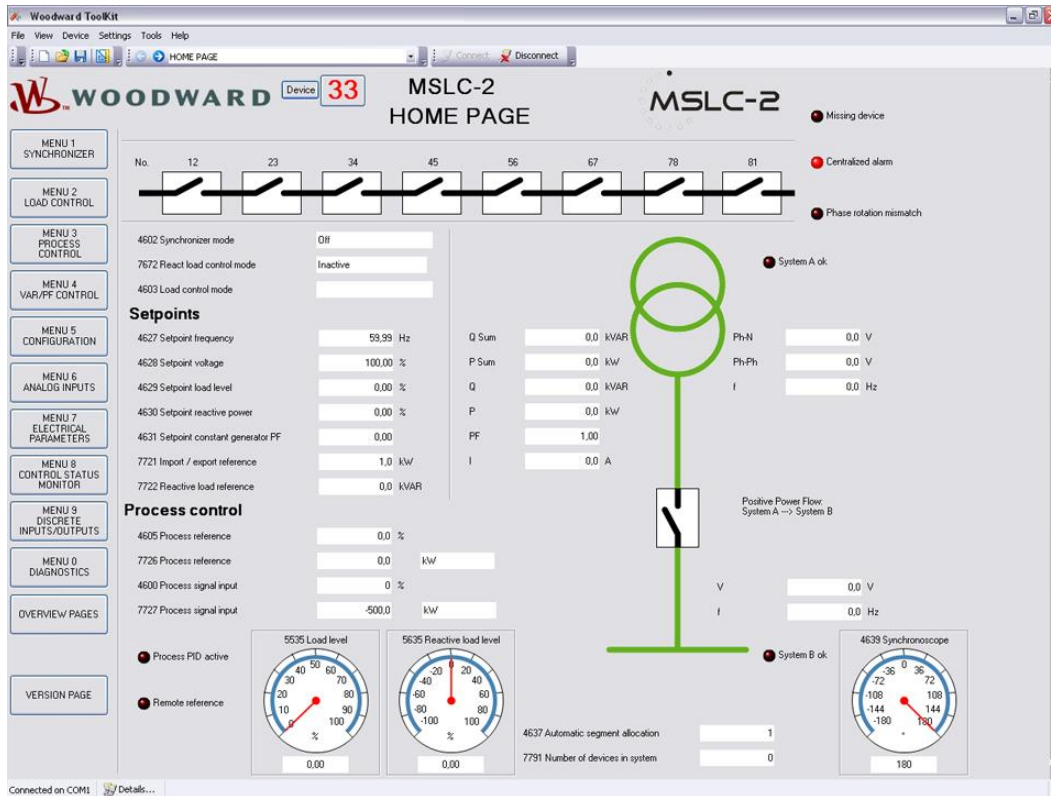
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# TOOLKIT CONFIGURATION SOFTWARE

Woodward's ToolKit provides user friendly configuration, commissioning assistance, displays all operating modes, and the overview pages show what other controls the MSLC-2 is communicating with. The MSLC-2 Home Page is shown below.

**Note:** The menu tree illustrated on the left side is similar to the original MSLC structure.



## FEATURES OVERVIEW

|                                     | MSLC-2                                         | DSL-2                                          |
|-------------------------------------|------------------------------------------------|------------------------------------------------|
| <b>I/Os</b>                         |                                                |                                                |
| Discrete inputs                     | 23                                             | 23                                             |
| Relay outputs                       | 12                                             | 12                                             |
| Analog inputs                       | 3                                              | 3                                              |
| Analog outputs                      | -                                              | 2                                              |
| RS-232 Interface                    | 1                                              | 1                                              |
| RS-485 Interface                    | 1                                              | 1                                              |
| Ethernet Interfaces (10/100 Mbit/s) | 2                                              | 2                                              |
| LED 1 "CPU OK"                      | Off / not ready / ready / system update active | Off / not ready / ready / system update active |
| LED 2 "Sync Enable"                 | Off / ready / not OK                           | Off / ready / not OK                           |
| <b>Listings/Approvals</b>           |                                                |                                                |
| UL / cUL Listing                    | ✓                                              | ✓                                              |
| GOST-R & CSA                        | ✓                                              | ✓                                              |
| LR & ABS Marine                     | ✓                                              | ✓                                              |
| CE Marked                           | ✓                                              | ✓                                              |

## PART NUMBERS

| MSLC-2                              |                               | DSL-2                         |                               |
|-------------------------------------|-------------------------------|-------------------------------|-------------------------------|
| 1A CT inputs<br>P/N 8440-1977       | 5A CT inputs<br>P/N 8440-1877 | 1A CT inputs<br>P/N 8440-1978 | 5A CT inputs<br>P/N 8440-1878 |
| <b>Accessories</b>                  |                               |                               |                               |
| Spare connector kit - P/N 8923-1806 |                               |                               |                               |