

Multilin™ G500

Substation Gateway



Instruction Manual

994-0152

Version 5.20 Revision 1



GE VERNOVA

GE Vernova Information

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G500 Substation Gateway

Table of contents

PRODUCT SUPPORT	Access the GE Vernova Grid Solutions web site 7
	Search GE Vernova Grid Solutions technical support library 7
	Contact Technical Support 8
	GE Vernova Grid Solutions address 8
	Product returns 9
ABOUT THIS DOCUMENT	Purpose 11
	Intended audience 11
	Additional documentation 11
	How to use this guide 12
	Safety words and definitions 12
INTRODUCTION	Disclaimer 13
	Safety precautions 14
	Warning symbols 14
	Hardware overview 15
	Ordering guides 16
	Order code 17
	Changes to G500 Model Number 18
	G500 as MCP Function 18
	G500 as D2x Function 18
	G500 as MCP/D2x Function 18
	As-Built model number digits 19
	As-Is model number 19
	MCP Spares and Accessories 21
	MCP Redundancy Kit (K) - Single RS 232 SWITCH PANEL (SW PNL) for firmware v2.80 and lower and G500 D2X in Function D 23
	MCP Redundancy Kit (N) - Single RS 232 SWITCH PANEL (SW PNL) for firmware v3.00 and higher 25

UNPACKING AND INSPECTION	Electro Static Discharge - ESD	27
	Initial inspection	28
	Unpacking	28
INSTALLING THE G500	Installation	29
	Mounting instructions	29
	General advice	33
	Grounding	33
	Power Supply Unit (PSU)	34
	High Voltage Power Supply	34
	Low Voltage Power Supply	36
	Power-On Self-Test (POST)	37
	Super Capacitor	38
	D.20 Link Connections	38
	G500 D.20 HDLC PCIe card	39
	Supplying power through the D.20 Link	40
	D.20 Link features	40
	D.20 Communications Interface	41
	D.20 Termination	41
	D.20 Fiber Optic Splitter	41
	GFO adapters	41
	D.20 DC interface	41
	Peripherals	41
	Peripheral compatibility with the G500 D.20 HDLC PCIe card	42
	Connection Scenarios	43
	G500 system redundancy	54
	MCP Redundancy Operation	54
	Active vs. Standby States	54
	A vs B Designation	55
	Runtime behavior	56
	Switchover initiated in database	57
	Switchover initiated from RS232 Switch Panel	58
	Failover event	58
	G500 versions up to and including v2.80	60
	Required components	60
	RS232 switch panel	62
	Redundancy wiring diagrams	62
	G500 versions v3.00	68
	Required components	68
	RS232 switch panel	70
	Redundancy wiring diagrams	70
	G500 running as D2x system redundancy	76
	G500-D Redundancy Operation	76
	Active vs. Standby States	76
	A vs B Designation	77
	Runtime behavior	77
	Switchover initiated in database	77
	Switchover initiated from RS232 Switch Panel	78
	Failover event	78
	Required components	79
	RS232 switch panel operation	80
	Redundancy wiring diagrams	80

INTERFACES	First look at the G500.....	83
	Front panel	83
	Rear panel	84
	External Interfaces	85
	USB Slave	85
	Ethernet Port	85
	Reset Button	86
	USB 3.0	86
	SD Card	87
	USB 2.0	87
	DisplayPortTM	87
	Alarm	88
	IRIG - IN	90
	IRIG - OUT	90
	Serial Ports	91
	Ethernet Ports	107
	Internal Interfaces	108
	Opening cover	108
	Closing cover	111
	M.2 SSD	113
	PCIe Slots	116
	USB 2 dongle slot	118
INDICATORS	Front Indicators	119
	Ethernet	120
	Ethernet Port (SFP) LEDs	120
	Serial Port LEDs	121
	IRIG-B input	122
	IRIG-B output	122
	CPU	122
	TEMP	123
	SSD	123
	STATUS	123
	Power	124
	OLED Display	125
	Rear indicators	125
SPECIFICATIONS	Product specifications	127
	Environmental specifications	129
	Temperature and Humidity	129
	Altitude	130
	Ingress Protection (IEC 60529)	130
	Liquid Protection	130
	Mechanical Specifications	130
	Weight	130
	Dimensions	131
	General Torque Values for Screws	133
	Storage recommendations	133
	Storage conditions	133

REMOVING THE G500 FROM SERVICE	Remove configuration data and sensitive information from the G500..... 135 Removing configuration data on a PC..... 136
STANDARDS & COMPLIANCE	Compliance Standards 137
CERTIFICATES	cUL 139 IEC 60870-5-101 Edition 2 - Balanced Controlled station (Slave) 140 IEC 60870-5-101 Edition 2 - Balanced Controlling station (Master) 141 IEC 60870-5-101 Edition 2 - Unbalanced Controlled station (Slave) 142 IEC 60870-5-101 Edition 2 - Unbalanced Controlling station (Master)..... 143 IEC 60870-5-104 Edition 2 - Controlling station (Master) 144 IEC 60870-5-104 Edition 2 - Controlled station (Slave) 145
WARRANTY	Warranty 147
LIST OF ACRONYMS	Acronym Definitions..... 149
REVISION HISTORY	Revision History 153

G500 Substation Gateway

Product Support

If you need help with any aspect of your G500 product, you can:

- Access the G500 Web site
- Search the GE Vernova Technical Support library
- Contact Technical Support

Also covered are:

- The GE Vernova Grid Solutions address
- Instructions on returning a G500

Access the GE Vernova Grid Solutions web site

The G500 Web site provides fast access to technical information, such as manuals, release notes and knowledge base topics.

Visit us on the Web at: <https://www.gevernova.com/grid-solutions/>

Search GE Vernova Grid Solutions technical support library

This site serves as a document repository for post-sales requests. To get access to the Technical Support Web site, go to:

<https://www.gevernova.com/grid-solutions/events/signup.asp?sid=208>

Contact Technical Support

GE Vernova Grid Solution Technical Support is open 24 hours a day, seven days a week for you to talk directly to a GE Vernova representative.

Region	E-mail	Telephone
Global Contact Centre	GA.support@GEVernova.com	+44 1785 250070
Central, East Asia, Pacific	GA.supportCEAP@GEVernova.com	+65 6749 0777
India	GA.supportIND@GEVernova.com	No Phone Line
Middle East, North Africa, Turkey	GA.supportMENAT@GEVernova.com	+971 4 375 6950
Europe, Russia, CIS, Sub-Saharan Africa	ERCIS: GA.supportERCIS@GEVernova.com France: SAM_Aftersales@gevernova.com Poland: support.PLS@gevernova.com Russia: support.AMR@gevernova.com (not in use) UK: support.AGS@gevernova.com	+34 94 4858854
North America	GA.supportNAM@GEVernova.com	+1-877-605-6777 (Global toll-free) +1-800-547-8629 (NAM toll-free) +1-678-844-6777 (Direct)
Latin America	GA.supportLAM@GEVernova.com	+55 48 2108 0300

Have the following information ready to give to Technical Support:

- Ship to address (the address that the product is to be returned to)
- Bill to address (the address that the invoice is to be sent to)
- Contact name
- Contact phone number
- Contact fax number
- Contact e-mail address
- Product number / serial number
- Description of problem

Technical Support will provide you with a case number for your reference.

GE Vernova Grid Solutions address

The GE Vernova Grid Solutions company address is:

GE Vernova Grid Solutions
650 Markland Street
Markham, Ontario
Canada L6C 0M1

Product returns

A Return Merchandise Authorization (RMA) number must accompany all equipment being returned for repair, servicing, or for any other reason. Before you return a product, please contact GE Vernova Grid Solutions to obtain an RMA number and instructions for return shipments.

You are sent the RMA number and RMA documents via fax or e-mail. Once you receive the RMA documents, attach them to the outside of the shipping package and ship to GE Vernova Grid Solutions.



Product returns are not accepted unless accompanied by the Return Merchandise Authorization number.

G500 Substation Gateway

About this Document

Purpose

This manual provides information about installing, setting up, using and maintaining your G500 Substation Gateway. This manual does not provide any procedures for configuring the G500 software.

Intended audience

This manual is intended for use by field technicians and maintenance personnel who are responsible for the installation, wiring and maintenance of SCADA equipment. This guide assumes that the user is experienced in:

- Electrical utility applications
- Electrical wiring and safety procedures
- Related other manufacturers' products, such as protective relays and communications equipment

Additional documentation

For further information about the G500, refer to the following documents.

- G500 Online Help
- Module layouts, as available
- MCP Software Configuration Guide (GE Vernova part number SWM0101)

For the current version of the G500 Instruction Manual, please download a copy from:

<https://www.gevernova.com/grid-solutions/app/viewfiles.aspx?prod=G500&type=3>

How to use this guide

This guide describes how to install the G500.

Procedures are provided for all component options available for the G500. The components included in your G500 depend on what was ordered for your substation application. Follow only the procedures that apply to your G500 model. To check what options are included in your G500, see [Order code](#) on page 17.

Safety words and definitions

Before attempting to install or use the device, review all safety indicators in this document to help prevent injury, equipment damage or downtime.

The following safety and equipment symbols are used in this document:



Indicates a hazardous situation which, if not avoided, result in death or serious injury.



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



Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



Indicates practices that are not related to personal injury.

G500 Substation Gateway

Chapter 1: Introduction

Before you begin installing and using the G500, review the information in this chapter, including the following topics:

- Safety precautions
- Warning symbols
- Hardware overview
- Order code. For order code details, see <https://store.gegridsolutions.com/ViewProduct.aspx?Model=G500>

Read and thoroughly understand this guide before installing and operating the unit. Save these instructions for later use and reference.



Failure to observe the instructions in this manual may result in serious injury or death.

Disclaimer

It is the responsibility of the user to verify and validate the suitability of all GE Vernova Grid Automation products. This equipment must be used within its design limits. The proper application including the configuration and setting of this product to suit the power system assets is the responsibility of the user, who is also required to ensure that all local or regional safety guidelines are adhered to. Incorrect application of this product could risk damage to property/the environment, personal injuries or fatalities and shall be the sole responsibility of the person/entity applying and qualifying the product for use.

The content of this document has been developed to provide guidance to properly install, configure and maintain this product for its intended applications. This guidance is not intended to cover every possible contingency that may arise during commissioning, operation, service, or maintenance activities. Should you encounter any circumstances not clearly addressed in this document, please contact your local GE Vernova service site. The information contained in this document is subject to change without notice.

IT IS THE SOLE RESPONSIBILITY OF THE USER TO SECURE THEIR NETWORK AND ASSOCIATED DEVICES AGAINST CYBER SECURITY INTRUSIONS OR ATTACKS. GE VERNOVA GRID AUTOMATION AND ITS AFFILIATES ARE NOT LIABLE FOR ANY DAMAGES AND/OR LOSSES ARISING FROM OR RELATED TO SUCH SECURITY INTRUSION OR ATTACKS.

Safety precautions

Follow all safety precautions and instructions in this manual.

Only qualified personnel should work on the G500. Maintenance personnel should be familiar with the technology and the hazards associated with electrical equipment.

- *Never work alone.*
- Before performing visual inspections, tests, or maintenance on this equipment, isolate or disconnect all hazardous live circuits and sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of back feed.
- Turn off all power supplying the equipment in which the G500 is to be installed before installing and wiring the G500.
- Operate only from the power source specified on the installed power supply module.
- Beware of potential hazards and wear personal protective equipment.
- The successful operation of this equipment depends upon proper handling, installation, and operation. Neglecting fundamental installation requirements may lead to personal injury as well as damage to electrical equipment or other property.
- All electronic components within the G500 are susceptible to damage from electrostatic discharge. To prevent damage when handling this product use approved static control procedures.
- Hazardous voltages can cause shock, burns or death. To prevent exposure to hazardous voltages, disconnect and lock out all power sources before servicing and removing components.
- If the G500 is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.
- Changes or modifications made to the unit not authorized by GE Vernova could void the warranty.

Warning symbols

Table 1 explains the meaning of warning symbols that may appear on the G500 or in this manual.

Table 1: Warning symbols that appear on the G500 and in this manual

Symbol	Description
==	The relevant circuit is direct current.
~	The relevant circuit is alternating current.

Symbol	Description
	Caution: Refer to the documentation for important operation and maintenance instructions. Failure to take or avoid specified actions could result in loss of data or physical damage.
	Warning: Dangerous voltage constituting risk of electric shock is present within the unit. Failure to take or avoid specified actions could result in physical harm to the user.
	Earth/Ground Terminal
	Protective Ground Terminal
	Caution: Hot Surface

Hardware overview

The G500 is built on a flexible, high-performance, upgradeable COM express platform powered by one of the following CPU modules:

- Option A: AMD RX-225FB 2 core 2.2 GHz (max turbo frequency 3.0 GHz) CPU with 8 Gigabytes of soldered on DDR3 ECC for a wider operating temperature (+70°C).
- Option B: AMD RX-427BB 4 core 2.7GHz (max turbo frequency 3.6 GHz) CPU with 16 Gigabytes of soldered on DDR3 ECC memory for best performance at a limited (+60°C) maximum operating temperature,
- Option C: Intel i3-7102E 2 cores 4 threads 2.1 GHz (no turbo) CPU with 8 Gigabytes of soldered on DDR4 ECC for a wider operating temperature (+70°C).
- Option D: Intel E3-1505Lv6 (Xeon) 4 cores 8 threads 2.2GHz (max turbo frequency 3.0 GHz) CPU with 16 Gigabytes of soldered on DDR4 ECC memory for best performance at a limited (+60°C) maximum operating temperature.

The G500 is distinguished by the noticeable lack of a hard drive and fan, employing instead the rugged and reliable Solid State Drive (SSD) mass storage and engineered heat sink.

The G500 supports various communication media types through a choice of input/output (I/O):

- Serial: 8 factory installed ports, expandable up to 20 ports, RS-232 and RS-485 are accessible via individual RJ45 connectors.
- Ethernet: Six Ethernet interfaces available through SFP cages. Each cage supports: 100/1000BaseT, 100BaseFX or 1000BaseSX.
- D.20 Link HDLC ports: A dual channel card for communication with up to 120 - D20 Peripherals per channel or in redundant configuration.

Figure 1: G500

Ordering guides

The latest ordering guides are available on the GE Vernova Grid Solutions website:

<https://www.gevernova.com/grid-solutions/multilin/catalog/g500.htm>

You can select the required options from the available Product Option items. The Order Code automatically updates as each option is selected.

Intel CPU Options C and D require firmware version 5.00 and later.

The following ordering guides are available:

- [Order code](#) on page 17
- [MCP Spares and Accessories](#) on page 21
- [MCP Redundancy Kit \(K\) - Single RS 232 SWITCH PANEL \(SW PNL\) for firmware v2.80 and lower and G500 D2X in Function D](#) on page 23
- [MCP Redundancy Kit \(N\) - Single RS 232 SWITCH PANEL \(SW PNL\) for firmware v3.00 and higher](#) on page 25

The Ordering Guide information provided in this manual does not reflect the full complexity of the ordering options provided on the GE Vernova Grid Solutions Online Store; the Online Store provides the full set of G500 options and their sub-option interdependencies while this manual shows all sub-options, regardless of the parent option chosen.

Order code

Order Code Item	G500	Hardware configuration										Software configuration										Description
CPU and Memory Option	A	*	*	*	8	-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	AMD 2.20 GHz 2 core APU, 8 GB DDR3 SDRAM
	B	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	AMD 2.70 GHz 4 core APU, 16 GB DDR3 SDRAM
	C	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Intel i3 2.1 GHz 2 core CPU, 8 GB DDR4 SDRAM
	D	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Intel Xeon 2.2 GHz 4 core CPU, 16 GB DDR4 SDRAM
Power Supply Option - Primary and Redundant	H	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	110-270 VDC / 100-240 VAC (Conformal Coated)
	L	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	20-54 VDC (Conformal Coated)
	L	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Not Required
	U	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	8x Serial Ports, RS-232/ RS-485 independently configurable and isolated
Serial Port Option Ethernet Interface - SFP type	8	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	100/1000BASE-TX (RJ45 copper medium) [580-3786]
	T	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	100BASE-FX (LC fiber multimode) [580-3784]
	T	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	100BASE-SX (LC fiber multimode) [580-3785]
	T	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	100BASE-LX (LC fiber single-mode) [580-3787]
Storage M.2 SATA SED	A	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Not Required
	B	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	128 GB Self encrypted Solid State Drive
	B	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	256 GB Self encrypted Solid State Drive
	C	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	1 TB Self encrypted Solid State Drive
PCIe Expansion Module	4	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Not Required
	4	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	4x Serial Ports, RS-232/ RS-485 independently configurable and isolated
	4	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	2x D20 Link Ports [528-1002LF]
	D	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Not Required
Future Use Function	U	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Not Required
	U	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Single OS: MCP
	U	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Single OS: D2x
	U	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Single OS: Combined MCP and D2x
1st Application Firmware Version	CA	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Universal Gateway
	00	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Latest Firmware Version (Default)
	A0	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v1.0 firmware version
	B0	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v2.0 firmware version
	B1	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v2.1 firmware version
	B5	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v2.5 firmware version
	B6	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v2.6 firmware version
	B8	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v2.8 firmware version
	C0	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v3.0 firmware version
	C1	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v3.1 firmware version
	D0	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v4.0 firmware version
	D1	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v4.1 firmware version
	E0	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v5.0 firmware version
Application License D2x Applications Firmware D2x Firmware Version D2x Licenses	E1	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v5.1 firmware version
	E2	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v5.2 firmware version
	xxx	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	License (ARM, IEC61850-Client, IEC61850-Server, LogicLinux IEC 61131-3, TEJAS V Server)
	UU	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Not Applicable
D2x Applications Firmware D2x Firmware Version D2x Licenses	A0	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	SMX20
	UUU	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	Not Applicable
	401	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v401 firmware version
	410	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v410 firmware version
D2x Licenses	411	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	v411 firmware version
	xx	*	*	*		-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	D2x Licenses (D2x Classic Applications, Advanced Automation)

Changes to G500 Model Number

G500 model number always had the functional designation “S” and the last digits present and set to UUUUUUUU.

Starting with V4.00 – the G500 model number and order code makes use of the last group of digits for the purpose of tracking the D2x function attributes as below:

G500-BHU8-TTUUUU-BUUU-UUD-UUU-**S**-CAD0094-**NNVVVLL**

G500 as MCP Function

S indicates MCP functionality and in this case NNVVVLL == “UUUUUUUU” (i.e. D2x part is not used).

This is identical to previous G500 model number structure, ensuring backwards compatibility.

For e.g.:

G500-BHU8-TTUUUU-BUUU-UUD-UUU-S-CAD0094-UUUUUUUU

G500 as D2x Function

D indicates D2x functionality, and in this case:

- **NN** denotes the NAME of the D2x SMX firmware (equivalent to SAN0001 in D20MX). First public release is A0.
- **VVV** denotes the VERSION of the SMX firmware (equivalent to 00 or 2.10 in D20MX). First public release is 400.
- **LL** denotes the two digit number associated with D2x licenses.

For e.g.:

G500-BHL8-TTUUUU-BUUU-UUD-UUU-D-CAD0000-A010003

G500 as MCP/D2x Function

This is available only on G500 with CPU options B and D.

- **C** indicates both MCP and D2x (Combined) functionality, and in this case:
- **NN** denotes the NAME of the D2x SMX firmware (equivalent to SAN0001 in D20MX). First public release is A0.
- **VVV** denotes the VERSION of the SMX firmware (equivalent to 00 or 2.10 in D20MX). First public release is 400.
- **LL** denotes the two digit number associated with D2x licenses.

For e.g.:

G500-BHU8-TTUUUU-BUUU-UUD-UUU-C-CAD0095-A010003

As-Built model number digits

The “as built” model number remains always the one set from factory.

As-Is model number

An embedded MCP application runs every time when the MCP and D2x applications start and updates the “As-Is” MCP Model number to reflect what is installed and configured in the device – regardless of the functional personality.

The generation of **HW digits** is according to the Instruction Manual.

G500-BHU8-TUUUUF-BUUU-UUD-UUU-S-CAD0000-UUUUUUUU

The Function Type (S, C, D) is read from the set Function.

G500-BHU8-TUUUUF-BUUU-UUD-UUU-**S**-CAD0000-UUUUUUUU

The generation of **SW digits related to MCP function** is according to the Instruction Manual.

G500-BHU8-TUUUUF-BUUU-UUD-UUU-S-**CAD0000**-UUUUUUUU

The generation of **SW digits related to D2x function** is always performed regardless of the function type and follows the rules below (all CAPS letters for the digits).

G500 v4.00 has the following possible combinations for the last group of 7 digits:

G500-BHU8-TUUUUF-BUUU-UUD-UUU-S-CAD0000-**UUUUUUUU**

To know the Order Code of your G500, run “**mcpsi**” command through mcpcfg utility.

```

GE Multilin MCP Firmware Release      Production Build

admin@G500:~$ mcpsi

Retrieving the GE Multilin MCP system information, please wait ...

=====
                        GE Multilin MCP System Information
=====

Model Number:
  As-Built:      G500-  -  -  -  -  -
  As-Is   :      G500-  -  -  -  -  -

```

** Visit the online store for application licenses ordering codes.

For latest configuration and options, please visit the online store:

<https://store.gegridsolutions.com/ViewProduct.aspx?Model=G500>

Table 2: Software Licenses

Value	Assignment
1	Remote Desktop HMI (not available after June 1, 2024)
2	ARRM
4	IEC61850 Client
8	IEC61850 Server
16	LogicLinx
64	Tejas V Server

Table 3: D2x Software Licenses

Value	Assignment
1	D2x Applications
2	Advanced Automation Applications

MCP Spares and Accessories

Description	Applicable Products	Previous P/N (until 2025)	New P/N (starting 2025)
SFP Transceiver options			
SFP Module 100BASE-FX LC TRANSCEIVER OPTICAL MULTI-MODE 1300nm -40 TO 85C [580-3784]	G100/G500	MCP-S-1-F	MCPS-1-Q
SFP Module 1000BASE-SX LC TRANSCEIVER OPTICAL MULTI-MODE 850nm -40 TO 85C [580-3785]	G100/G500	MCP-S-1-S	MCPS-1-B
SFP Module 1000BASE-TX RJ45 TRANSCEIVER COPPER -40 TO 85C W/WO RX_LOS [580-3786]	G100/G500	MCP-S-1-T	MCPS-1-T
SFP Module 1000BASE-LX LC TRANSCEIVER OPTICAL SINGLE-MODE 1310nm -40 TO 85C [580-3787]	G100/G500	MCP-S-1-L	MCPS-1-I
SFP Module 10/100BASE-TX RJ45 TRANSCEIVER COPPER -40 TO 85C W/WO RX_LOS [0123-0004]	G100	MCP-S-1-C	MCPS-1-C
Power Supply			
G500 PSU, HV 90-264VAC/88-330VDC [528-2001LF-CC]	G500	MCP-S-2-H	MCPS-2-H
G500 PSU, LV 18-60VDC [528-2002LF-CC]	G500	MCP-S-2-L	MCPS-2-L
DIN Mount Power Supply IP 85-264VAC/90-350VDC OP 24VDC/5A [580-3466]	G100	N/A	MCPS-2-X
DIN Mount Power Supply IP 85-264VAC/90-350VDC OP 48VDC/3.75A [580-3484]	G100	N/A	MCPS-2-Y
PCIe Card options			
G500 PCIe UART CARD, 4x PORT (RJ45) RS232/485 [528-1001LF]	G500	MCP-S-3-S	MCPS-3-F
G500 BUILT-IN UART CARD, 4x PORT (RJ45) RS232/485 [528-1003LF]	G500	MCP-S-3-R	MCPS-3-G
G500/G100 PCIe D.20 HDLC CARD, 2x D.20 Link Ports [528-1002LF]	G100/G500	MCP-S-3-D	MCPS-3-D
Termination Panel			
RJ45 to DB9 Adapter Panel with Cables (528-1006LF [1], 977-0546/2.5 [4], 977-0563/3.0 [4])	G500	MCP-S-4-A	MCPS-4-A
Mounting Kit			
G500 19 INCH RACK MOUNT KIT [528-1010]	G500	N/A	MCPS-5-R
G100 MOUNT KIT [528-1011]	G100	N/A	MCPS-5-S
G100 19 INCH MOUNT PANEL, 4U [E952-4136]	G100	N/A	MCPS-5-Z

Description	Applicable Products	Previous P/N (until 2025)	New P/N (starting 2025)
Upgrade License			
Automated Record Retrieval Manager (ARRM) [SGA0069]	G100/G500	MCP-S-L-A	MCPS-L-J
IEC61850 Client [SGA0074]	G100/G500	MCP-S-L-B	MCPS-L-K
LogicLinx Executor [SGA0067]	G100/G500	MCP-S-L-C	MCPS-L-M
IEC61850 Server [SGA0088]	G100/G500	MCP-S-L-D	MCPS-L-N
Tejas V Server [SGA0089]	G100/G500	MCP-S-L-E	MCPS-L-O
Change from D2x to MCP	G500	N/A	MCPS-L-E
Change from MCP to D2x	G500	N/A	MCPS-L-U
Add D2x to MCP	G500	N/A	MCPS-L-V
Add MCP to D2x	G500	N/A	MCPS-L-W
Add D2x Classic Applications License	G500	N/A	MCPS-L-1
Add D2x Advanced Automation License	G500	N/A	MCPS-L-2
Add D2x Classic Applications and Advanced Automation Licenses	G500	N/A	MCPS-L-3

MCP Redundancy Kit (K) - Single RS 232 SWITCH PANEL (SW PNL) for firmware v2.80 and lower and G500 D2X in Function D



Please check the online webstore for latest updated available cable lengths.

Order Code Item	MCP-RED	*_	*	*	***	***	***	***	***	Description
Kit Type										
	K									MCP version v2.8 and lower Included: • RS232 SWITCH PANEL RoHS [517-0247LF] qty 1 • Power/ALARM Cable [970-0161] qty 180 inch • Ground Cable [970-0182] qty 180 inch • MCP A/B RS232 DB9F SWITCH JUMPER (P1/P9) [977-0562] qty 2
Power Supply										
		U								None
		A								PS, Input range 100-240VAC/90-350VDC, Output 10-15VDC@8A, DIN Rail Mt
Power Supply										
		U								None
		A								PS, Input range 100-240VAC/90-350VDC, Output 10-15VDC@8A, DIN Rail Mt
MCP Watchdog Cable to Connect MCP A to RS232 Switch Panel Options										
		036								MCP-A Watchdog cable, 36" [977-0557/36]
		048								MCP-A Watchdog cable, 48" [977-0557/48]
		060								MCP-A Watchdog cable, 60" [977-0557/60]
		072								MCP-A Watchdog cable, 72" [977-0557/72]
		096								MCP-A Watchdog cable, 96" [977-0557/96]
		120								MCP-A Watchdog cable, 120" [977-0557/120]
MCP Watchdog Cable to Connect MCP B to RS232 Switch Panel Options										
		036								MCP-B Watchdog cable, 36" [977-0558/36]
		048								MCP-B Watchdog cable, 48" [977-0558/48]
		060								MCP-B Watchdog cable, 60" [977-0558/60]
		072								MCP-B Watchdog cable, 72" [977-0558/72]
		096								MCP-B Watchdog cable, 96" [977-0558/96]
		120								MCP-B Watchdog cable, 120" [977-0558/120]

Order Code Item	MCP-RED	*_	*	*	***	***	***	***	***	Description	
MCP Ping Cables											
							012			MCP-A/B RJ45 Ping Cable, 12" [977-0559/012]	
							018			MCP-A/B RJ45 Ping Cable, 18" [977-0559/018]	
							024			MCP-A/B RJ45 Ping Cable, 24" [977-0559/024]	
							030			MCP-A/B RJ45 Ping Cable, 30" [977-0559/030]	
							036			MCP-A/B RJ45 Ping Cable, 36" [977-0559/036]	
							042			MCP-A/B RJ45 Ping Cable, 42" [977-0559/042]	
							048			MCP-A/B RJ45 Ping Cable, 48" [977-0559/048]	
							054			MCP-A/B RJ45 Ping Cable, 54" [977-0559/054]	
							060			MCP-A/B RJ45 Ping Cable, 60" [977-0559/060]	
MCP Serial Cable MCP A to RS232 Switch Panel Options (qty 1)											
							036			MCP-A to RS232 Switch Panel Transition Cable, 36" [977-0556/036]	
							048			MCP-A to RS232 Switch Panel Transition Cable, 48" [977-0556/048]	
							060			MCP-A to RS232 Switch Panel Transition Cable, 60" [977-0556/060]	
MCP Serial Cable MCP B to RS232 Switch Panel Options (qty 1)											
								036			MCP-B to RS232 Switch Panel Transition Cable, 36" [977-0556/036]
								048			MCP-B to RS232 Switch Panel Transition Cable, 48" [977-0556/048]
								060			MCP-B to RS232 Switch Panel Transition Cable, 60" [977-0556/060]

MCP Redundancy Kit (N) - Single RS 232 SWITCH PANEL (SW PNL) for firmware v3.00 and higher



Please check the online webstore for latest updated available cable lengths.

Order Code Item	MCP-RED	*_	*	*	***	***	***	***	***	Description
Kit Type										
	N									MCP version v3.0 and higher Included: • RS232 SWITCH PANEL RoHS [517-0247LF] qty 1 • Power/ALARM Cable [970-0161] qty 180 inch • Ground Cable [970-0182] qty 180 inch • MCP A/B RS232 DB9F SWITCH JUMPER (P1/P9) [977-0562] qty 2
Power Supply										
		U								None
		A								PS, Input range 100-240VAC/90-350VDC, Output 10-15VDC@8A, DIN Rail Mt
Power Supply										
		U								None
		A								PS, Input range 100-240VAC/90-350VDC, Output 10-15VDC@8A, DIN Rail Mt
MCP Watchdog Cable to Connect MCP A to RS232 Switch Panel Options										
		036								MCP Watchdog cable, 36" [977-0568/36]
		048								MCP Watchdog cable, 48" [977-0568/48]
		060								MCP Watchdog cable, 60" [977-0568/60]
		072								MCP Watchdog cable, 72" [977-0568/72]
		096								MCP Watchdog cable, 96" [977-0568/96]
		120								MCP Watchdog cable, 120" [977-0568/120]
MCP Watchdog Cable to Connect MCP B to RS232 Switch Panel Options										
		036								MCP Watchdog cable, 36" [977-0568/36]
		048								MCP Watchdog cable, 48" [977-0568/48]
		060								MCP Watchdog cable, 60" [977-0568/60]
		072								MCP Watchdog cable, 72" [977-0568/72]
		096								MCP Watchdog cable, 96" [977-0568/96]
		120								MCP Watchdog cable, 120" [977-0568/120]

Order Code Item	MCP-RED	*_	*	*	***	***	***	***	***	Description
MCP Ping Cables										
										012 MCP-A/B RJ45 Ping Cable, 12" [977-0559/012]
										018 MCP-A/B RJ45 Ping Cable, 18" [977-0559/018]
										024 MCP-A/B RJ45 Ping Cable, 24" [977-0559/024]
										030 MCP-A/B RJ45 Ping Cable, 30" [977-0559/030]
										036 MCP-A/B RJ45 Ping Cable, 36" [977-0559/036]
										042 MCP-A/B RJ45 Ping Cable, 42" [977-0559/042]
										048 MCP-A/B RJ45 Ping Cable, 48" [977-0559/048]
										054 MCP-A/B RJ45 Ping Cable, 54" [977-0559/054]
										060 MCP-A/B RJ45 Ping Cable, 60" [977-0559/060]
MCP Serial Cable MCP A to RS232 Switch Panel Options (qty 1)										
										036 MCP-A to RS232 Switch Panel Transition Cable, 36" [977-0556/036]
										048 MCP-A to RS232 Switch Panel Transition Cable, 48" [977-0556/048]
										060 MCP-A to RS232 Switch Panel Transition Cable, 60" [977-0556/060]
MCP Serial Cable MCP B to RS232 Switch Panel Options (qty 1)										
										036 MCP-B to RS232 Switch Panel Transition Cable, 36" [977-0556/036]
										048 MCP-B to RS232 Switch Panel Transition Cable, 48" [977-0556/048]
										060 MCP-B to RS232 Switch Panel Transition Cable, 60" [977-0556/060]

G500 Substation Gateway

Chapter 2: Unpacking and Inspection

This chapter covers the suggested inspection and preparation considerations and background information necessary prior to using the G500. Unpacking, initial inspection, and first time operation of the G500 are covered. Following the procedures given in the chapter is recommended, and they will verify proper operation before the product is integrated into your system.



Hot Surface: During operation of the G500 the surface of the heat sink, can reach a temperature of 60°C and above. Therefore, be careful and do not touch it with bare fingers.

Electro Static Discharge - ESD

The discharge of static electricity, known as Electro Static Discharge or ESD, is a major cause of electronic component failure. The Industrial Computer has been packed in a static-safe bag which protects it from ESD while it is in the bag. Before removing the Boards or any other electronic product from its static-safe bag, be prepared to handle it in a static-safe environment.



You should wear a properly-functioning anti-static strap and ensure you are fully grounded. Any surface upon which you place on the unprotected G500 should be static-safe, usually facilitated by the use of anti-static mats. From the time the board is removed from the anti-static bag until it is in the card cage and functioning properly, extreme care should be taken to avoid “zapping” the board with ESD. You should be aware that you could “zap” the board without you knowing it; a small discharge, imperceptible to the eye and touch, can often be enough to damage electronic components. Extra caution should be taken in cold and dry weather when electrostatic charge easily builds up.

Only after ensuring that both you and the surrounding area are protected from ESD, carefully remove the board or module from the shipping carton by grasping the module on its edges. Place the board, in its anti-static bag, flat down on a suitable surface. You may then remove the board from the anti-static bag by tearing the ESD warning labels.

Initial inspection

After unpacking the products, you should inspect it for visible damage that could have occurred during shipping or unpacking. If damage is observed (usually in the form of bent component leads or loose socketed components), contact GE Vernova Technical Support for additional instructions. Depending on the severity of the damage, it may be necessary to return the product to the factory for repair.

DO NOT apply power to the board if it has visible damage!



Doing so may cause further, possibly irreparable damage, as well as introduce a fire or shock hazard.

Unpacking

Please read the manual carefully before unpacking the board or module or fitting the device into your system. Also adhere to the following:

- Observe all precautions for electrostatic sensitive modules
- Do not place the board on conductive surfaces, anti-static plastic, or sponge, which can cause shocks and lead to board trace damage.
- Do not exceed the specified operational temperatures.
- Keep all original packaging material for future storage or warranty shipments of the board.

Although the products are carefully packaged to protect against the rigors of shipping, it is still possible that shipping damage can occur. Careful inspection of the shipping carton should reveal some information about how the package was handled by the shipping service. If evidence of damage or rough handling is found, you should notify the shipping service and GE Vernova Technical Support as soon as possible.



PCIe Cards and storage devices may also have temperature restrictions

Retain all packing material in case of future need.



Before installing or removing any board, please ensure that the system power and external supplies have been turned off!

G500 Substation Gateway

Chapter 3: Installing the G500

This chapter covers the installation of the Industrial Computer and initial power-on operations.



Before you install and operate the G500, read and follow the safety guidelines and instructions in [Safety precautions](#) on page 14.

Installation

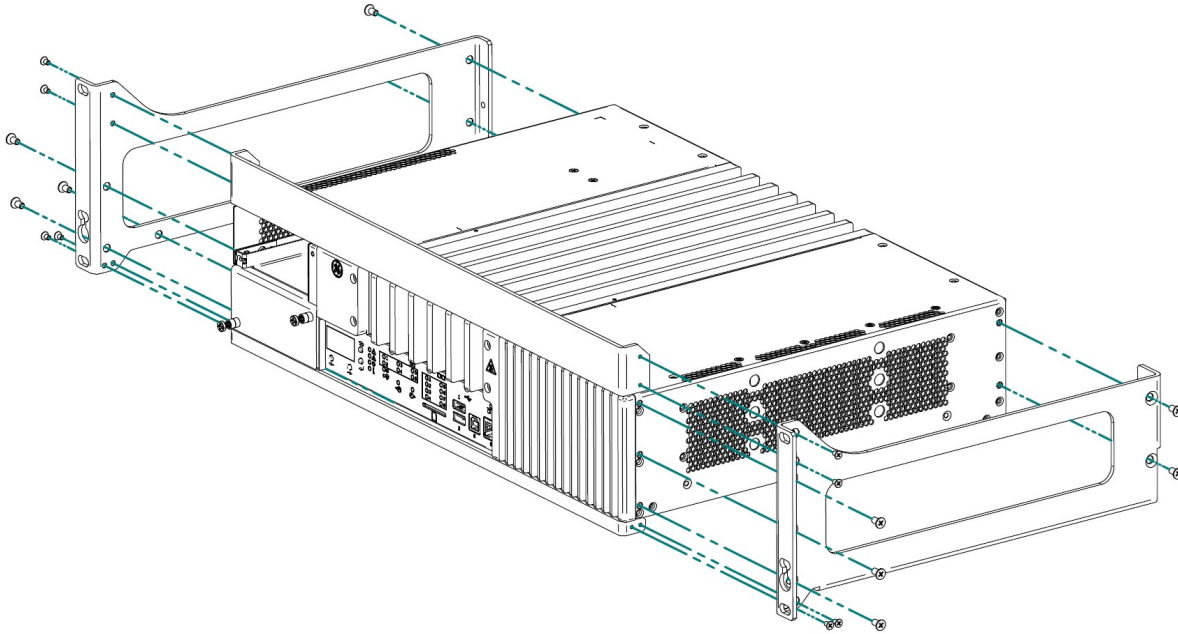
Mounting instructions

The G500 is mounted in 3U slot of a 19" rack by use of 6 screws compliant to IEC60297-3 with STD hole Pattern.

Screws Use screws with a shaft diameter ranging from M5 to M6, or SAE screws UNF 10-32 to UNC 12-24.

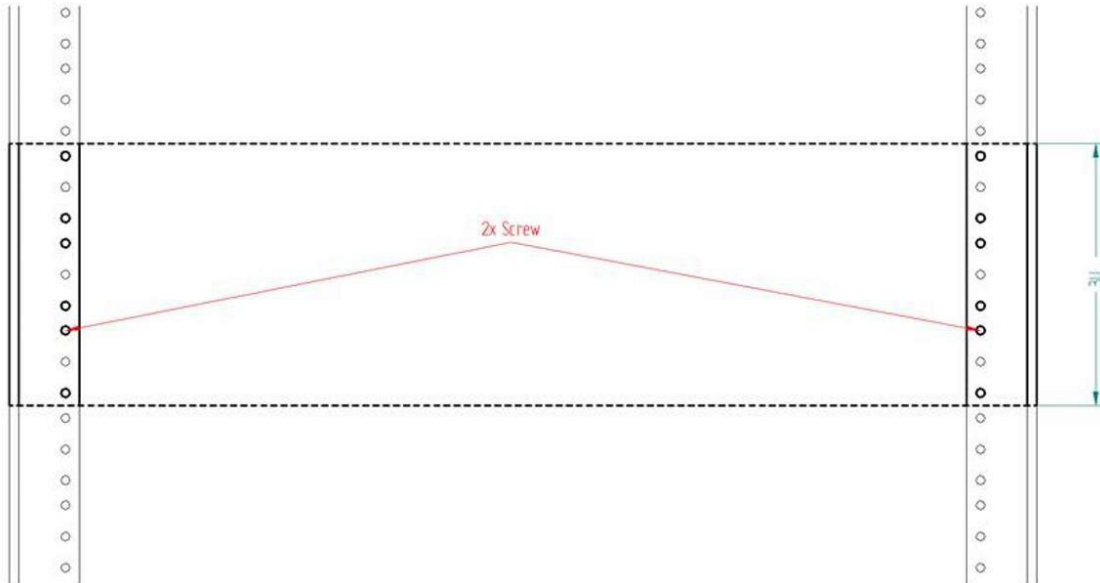
Mounting Diagram

1. Mount the brackets on the unit:

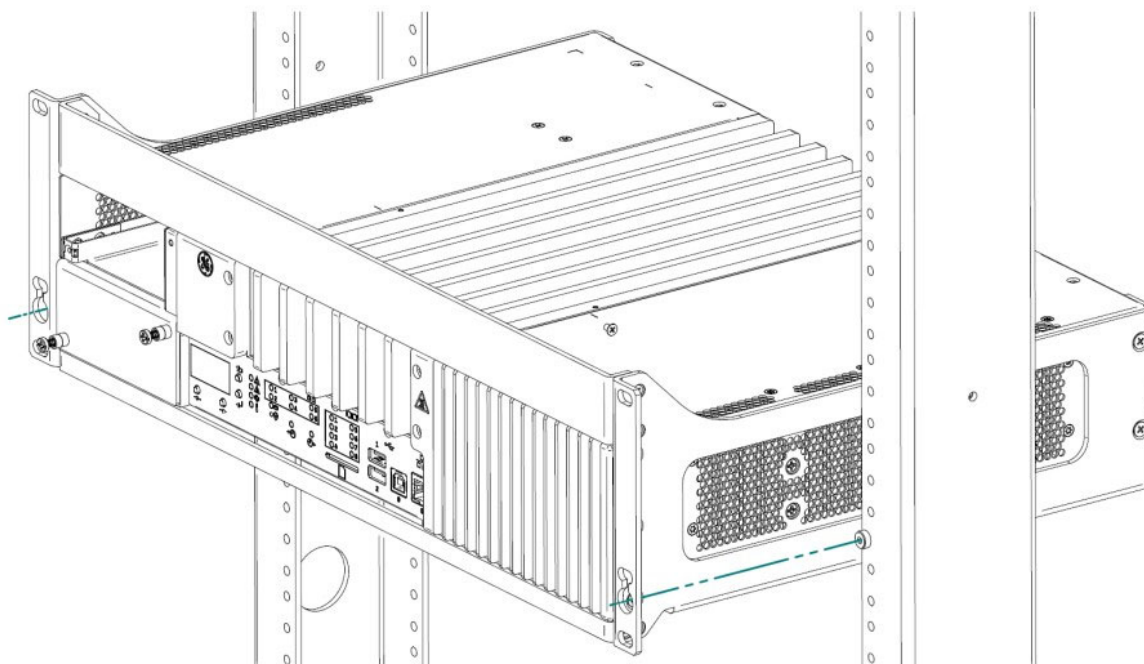


For screw torque specification, refer to [General Torque Values for Screws](#) on page 133.

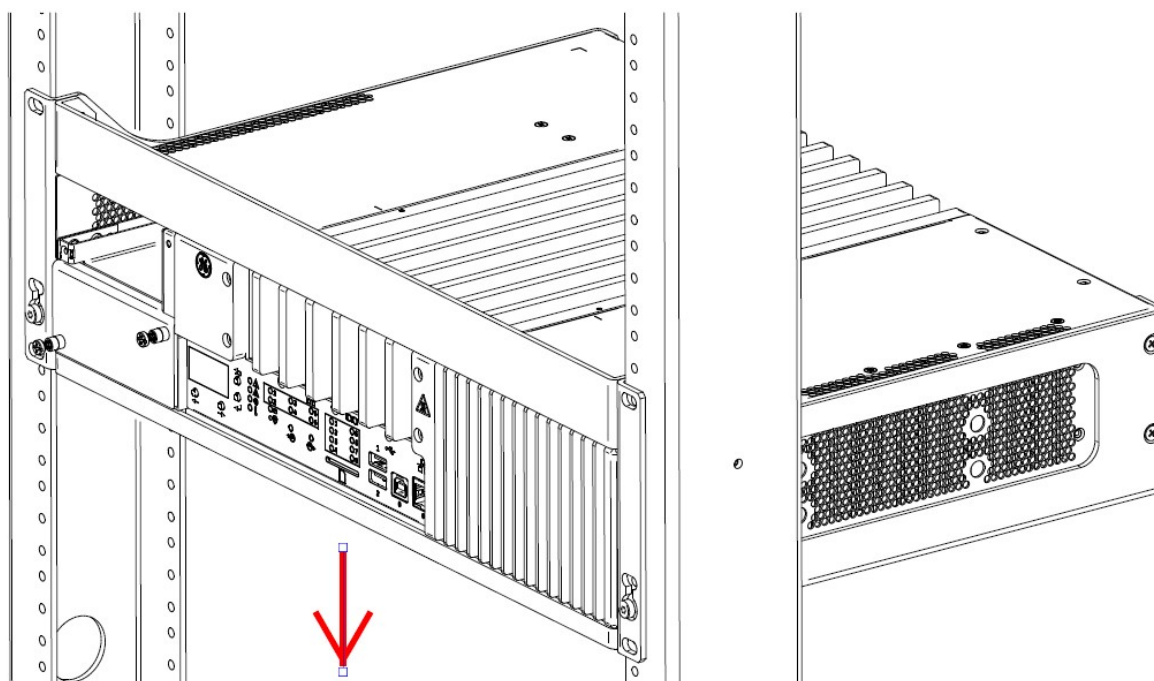
2. Install 2 of the screws at the same height in the 19" rack. The screws should be screwed in to a distance of about 3 mm between screw head and rack.



3. Attach the unit by aligning the two screws with the keyhole mounting points of the brackets.



4. Once aligned, set down the unit and then tighten the screws.



The recommended tool torque settings for zinc-plated mounting screws are:

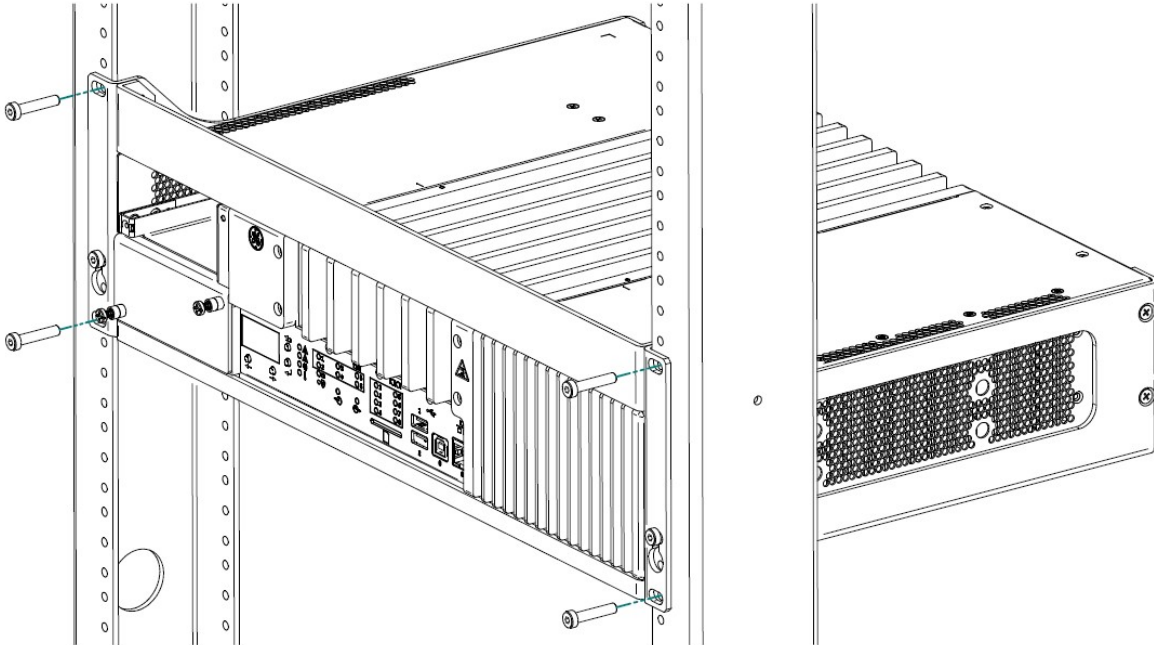
- 10-32 UNF screws use 22.2 in-lb [2.50 Nm]
- 12-24 UNC screws use 31.0 in-lb [3.51 Nm]
- M5x0.45 screws use 18.1 in-lb [2.04 Nm]

- M6x0.5 screws use 33.3 in-lb [3.76 Nm]



It is not recommended to ship the G500 installed in a rack without support brackets and adequate conductive foam blocking in place.

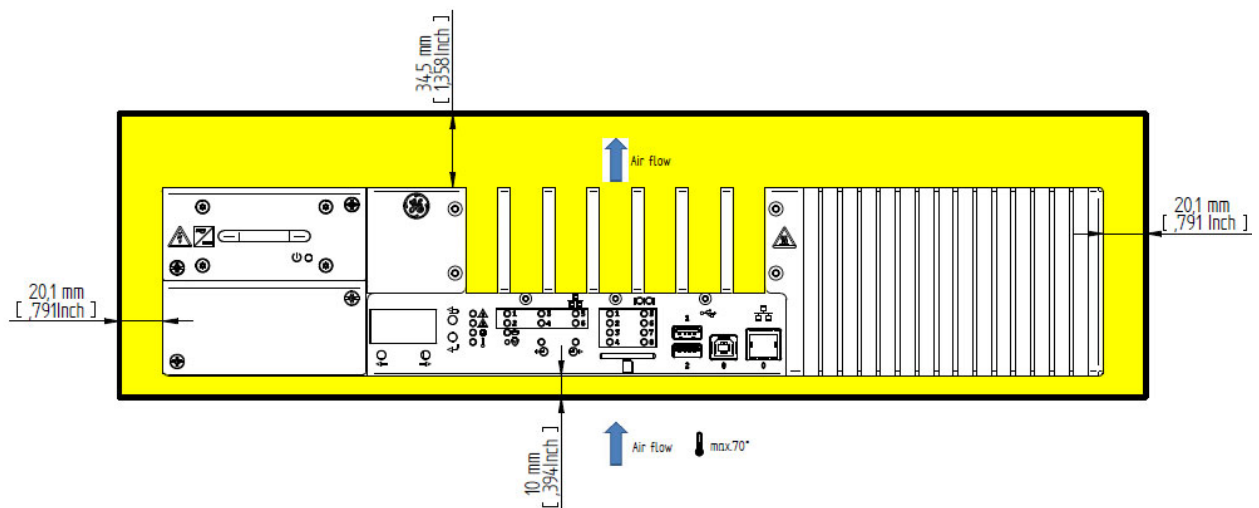
5. Install the 4 other screws and tighten to recommended torque.



Spacing for air circulation

To guarantee sufficient air circulation, the specified spacing above, below, to the sides, in front and behind the G500 must be met or exceeded. The thermal impact on devices next to each other is negligible (1°C) with the mounting spaces below, assuming the adjacent devices are also G500s or devices dissipating a similar amount of power.

The minimum specified spacing to the front and behind the G500 is 5cm (2"). Other spacing requirements are indicated in the following diagram. These requirements are met when the G500 is installed using the provided rack mounting kit.





The spacing specifications for air circulation are based on the worst-case scenario for operation at the maximum specified ambient temperature.

If the spacing specifications for air circulation cannot be adhered to, then the maximum specified temperatures cannot be guaranteed.

General advice

Please observe all safety procedures to avoid damaging system and protect operators and users.



Electric shock can cause injury and may be fatal.

Before installing or removing any board, please ensure that the system power and external supplies as well as power to devices connected to the ALARM Relay output have been turned off and/or are unplugged from the device.

Grounding

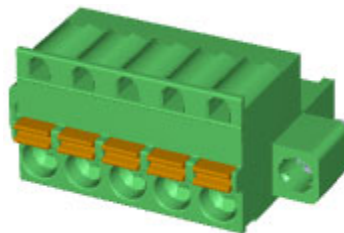
It is required to connect the chassis to cabinet ground, which then MUST BE CONNECTED TO Building Protective Earth (PE) ground using at minimum the M5 ground connection screw in point located near the G500 power supply. The second screw in point can also be connected to cabinet ground. For proper connection, the recommended tool torque settings for ground terminal screws are 18 in-lb [2.0 Nm]. A Phillips (#1) screwdriver tip is recommended.



The cabinet grounding wire should be AWG 12 or lower and not longer than 1 meter.

Power input connector

The mating connector is the 5-pin "Phoenix 1942293". This connector type is required for IP30 compliance. Alternate connector (GE Vernova Item) with back shell (GE Vernova Item) may be requested.



Power Supply Unit (PSU)

The G500 can be powered by one or by two redundant power supplies. The maximum power requirement is 170 VA.

There are two different power supplies available:

1. High Voltage Power Supply
2. Low Voltage Power Supply

The power supply units are secured to the chassis using two M3 screws in opposite corners on the power supply faceplate. The recommended torque setting for the screws on the power supplies are 5.3 in-lb [0.6 Nm].

High Voltage Power Supply

The High Voltage Power Supply handles both AC and DC input.

The AC input voltage range is 100 to 240V @50 to 60 Hz. The PSU tolerates a 10% variation in these values (90 to 265V @ 47 to 63Hz).

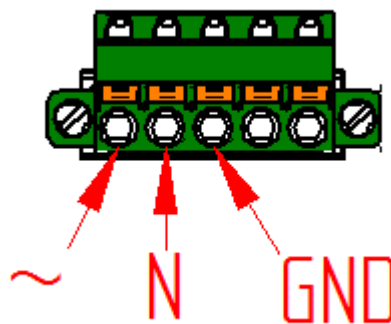
With AC input, the PSU has a maximum current consumption of 2.1A.

The DC input voltage is 100 to 300V. The PSU tolerates a +10%/-12% variation in these values (88 to 330V).

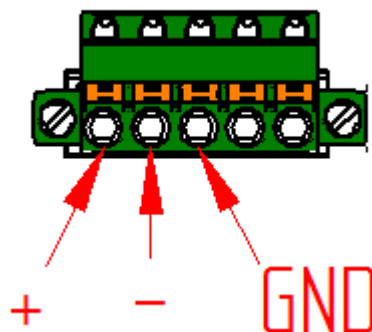
With DC input, the PSU has a maximum current consumption of 1.8A.



When using AC power, connect the “~”, “N” and “GND” wires according to the following figure.



When using DC power, connect the “+” and “-” wires according to the following figure. The GND wire is optional.



The inrush current is typically limited to 35A when powering up.

Wires

The conductor size is from 16 AWG to 12 AWG and strip length is 10mm.

When using ferrules, 16 AWG to 20 AWG ferrules are recommended by Phoenix Contact, no larger. When properly inserted, the connector has been demonstrated to exceed the 10N (~1kg) pull requirement.

After plugging cable lines into the mating connector, plug the mating connector to the product and secure the mating connector using the two screws. For proper connection, the recommended tool torque settings for connector flange screws are 2.7 in-lb [0.3 Nm]. A Flathead screwdriver with 0.4 mm by 2.5 mm blade is recommended.

Breaker Circuit

A 16A IEC or 20A USA/Canada breaker circuit is required as a pre-fuse.

Disconnect Device

A readily accessible disconnect device shall be incorporated external to the unit.

Overcurrent protection

The overcurrent protection function interrupts an uncontrolled fault current or overcurrent before serious damage can occur, such as overheating of the equipment.

The PSU included fuse is rated for 6.3A continuous current. If that current is exceeded by factor 10 the fuse will blow in between 10ms and 100ms.

The fuse is placed in “N”/ “-” connection of the power supply.

The fuse is soldered directly onto the product. There is no fuse holder. The fuse should only be replaced by GE Vernova personnel.



NOTE

Overvoltage protection

The voltage to the inner loads is protected by a varistor. High increase of the voltage will cause the internal current fuse to blow and/or the Varistor to break.



The varistor is soldered directly on the product. There is no fuse holder. The varistor should only be replaced by GE Vernova personnel.

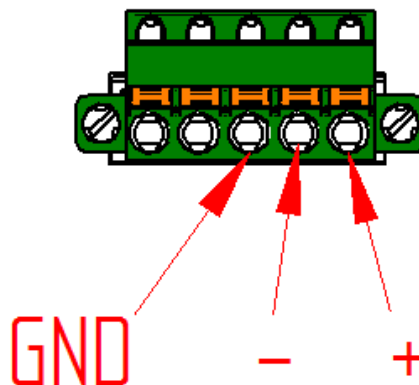
Low Voltage Power Supply

The Low Voltage Power Supply only handles DC input, with DC input voltage from 20 to 54V. The PSU tolerates a 10% variation in these values (18 to 60V).

The PSU has a maximum current consumption of 10.2A.



Connect the “+” and “-” wires according to the following figure. The GND wire is optional.

**Wires**

The conductor size is from 16 AWG to 12 AWG and Strip Length is 7mm.

After plugging cable lines into the mating connector, plug the mating connector to the product and secure the plug with the two screws.

Breaker circuit

A 20A IEC/USA/Canada breaker circuit is required as pre fuse.

Disconnect device	A readily accessible disconnect device shall be incorporated external to the unit.
Inrush current	The inrush current is typically 13A when powering up.
Reverse polarity protection	The product is equipped with built-in reverse polarity protection. If + and - are swapped the unit will not power-up and harm to neither the power supply nor the unit will occur.
Overcurrent protection	The overcurrent protection function interrupts an uncontrolled fault current or overcurrent before serious damage can occur, such as overheating of the equipment. The PSU included fuse is rated for 16A continuous current. If that current is exceeded by factor 10 the fuse will blow in between 10ms and 100ms. The fuse is placed in “-“connection of the power supply. The fuse is soldered directly onto the product. There is no fuse holder. The fuse should only be replaced by GE Vernova personnel.
 NOTE	
Overvoltage protection	The voltage to the inner loads is protected by a varistor. High increase of the voltage will cause the internal current fuse to blow and/or the Varistor to break. The varistor is soldered directly onto the product. There is no fuse holder. The varistor should only be replaced by GE Vernova personnel.
 NOTE	

Power-On Self-Test (POST)

Each time the G500 boots up it must pass the POST (Power-On Self-Test). The following tests make up the POST:

- CPU must exit the reset status and be able to execute instructions
- SPI Flash ROM and NVRAM is accessible
- Checksum must be valid
- CMOS is readable, CMOS checksum must be valid
- CPU must be able to access all forms of memory such as the memory controller, memory bus, and memory module
- The first 64 KB of memory must be operational and must be capable of holding the POST code
- I/O bus / controller must be accessible
- I/O bus must be able to write / read from the video subsystem and be able to access all video RAM

If the G500 does not pass one or more of the above tests, the board will fail the POST and display a hexadecimal value on the lower right corner of the screen. Please contact GE Vernova Grid Solution support with the hexadecimal code in this case.

To interrupt the POST process and to access UEFI settings - please refer to documents “SWM0110 Configuring UEFI Settings on G500 User Guide” or “SWM0125 Configuring UEFI Settings on G500 with Intel Hardware User Guide”.

To interrupt the POST process and to boot from an already inserted USB drive - please refer to document “TN0116 MCP Firmware Upgrade and Restore to Defaults Workflows”.



POST messages are shown only on the DisplayPort™.

First time after a firmware upgrade - full completion of the POST may take up to 10 minutes. This is why is recommended to perform this process via KVM, or - if the serial maintenance port was used for the firmware upgrade - to connect a monitor to the DisplayPort™.

Full completion of the POST may take up to 4 minutes after a first boot.

Super Capacitor

The G500 does not include a battery. Instead, the G500 contains two super capacitors.

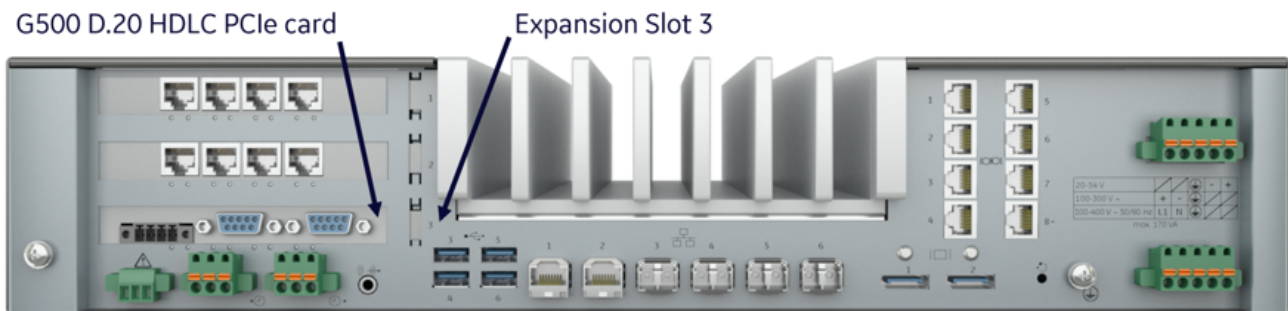
The real-time clock (RTC) is powered by one of the super capacitors. This super capacitor will power the RTC for at least 7 days with no connection to power. After this super capacitor discharges, the RTC will be reset to an invalid time (e.g. 12:00 AM, 01-10-2000). When the system is subsequently powered up, the system time will be initialized to the RTC time and require re-adjustment.

The chassis intrusion detection circuit is powered by the other super capacitor. Chassis intrusion will only be detected if this super capacitor is charged. The charge will be retained for at least 10 days with no connection to power. After this time, a chassis intrusion event will not be detected. However, if the event was detected prior to this time, it will be held indefinitely and reported on power up.

D.20 Link Connections

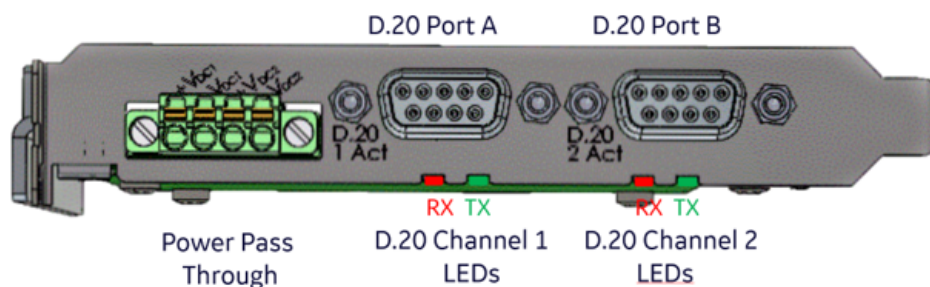
D.20 Communications between the G500 D.20 HDLC PCIe card and the D20 peripheral I/O modules are carried over a proprietary high-speed, high-level data link control (HDLC) protocol called the D.20 Link. To communicate with D20 peripheral I/O modules the G500 requires the installation and configuration of the D.20 HDLC PCIe card.

The D.20 HDLC PCIe card supports two D.20 Link communications ports which are accessible from the rear of the G500 chassis. The G500 system can be ordered from the factory with the D.20 HDLC PCIe card pre-installed using the Product configurator through the Online Store or can be installed infield by ordering the D.20 HDLC PCIe card as an accessory from the MCP Substation Gateway Spare Parts and following the [PCIe Installation](#) on page 116.



G500 D.20 HDLC PCIe card

The G500 D.20 HDLC PCIe card is installed in G500 Expansion slot 3 and is equipped with a Power Pass Through connector, two D.20 ports and four LEDs.



The Power Pass Through connector allows the D.20 peripheral connected to the D.20 Link to be powered through the D.20 port. The Power Pass Through requires one or two external power supplies to be connected. Refer to [Supplying power through the D.20 Link](#) on page 40 section for further details.

Two sets of LEDs are present on the D.20 HDLC PCIe card to indicate activity status. The first set of LEDs, on the left labeled D.20 1 Act, shows the transmit and receive activity on D.20 Channel 1 and the second set to show activity on D.20 Channel 2 on the right labeled D.20 2 Act. The receive LEDs will flash red and the transmit LEDs will flash green.

The G500 D.20 HDLC PCIe card has two D.20 ports. Each port contains D.20 Channel 1, D.20 Channel 2, DC Supply 1, and DC Supply 2. For D.20 port A, the above signals are always available. For D.20 port B, D.20 Channel 1 and D.20 Channel 2 are configurable but DC Supply 1 and DC Supply 2 are always available. Refer to Table 1: D.20 Port A and B pin out and configuration options and Table 2: Default D.20 Relay settings. D.20 Port B settings are software controlled and are accessible through the Settings GUI on your G500. Refer to SWM0101 for further details on configuration.

Table 1: D.20 Port A and B pin out and configuration options

Pin Number	D.20 port A	D.20 Port B	
1	No Connection	No Connection	
2	D.20 Channel 1 TX/RX +	D.20 Channel 2 TX/RX +	OPEN
3	D.20 Channel 1 TX/RX -	D.20 Channel 2 TX/RX -	OPEN
4	V _{DC1} +	V _{DC1} +	
5	V _{DC1} -	V _{DC1} -	
6	D.20 Channel 2 TX/RX +	D.20 Channel 1 TX/RX +	OPEN
7	D.20 Channel 2 TX/RX -	D.20 Channel 1 TX/RX -	OPEN
8	V _{DC2} +	V _{DC2} +	
9	V _{DC2} -	V _{DC2} -	

End of link termination is required at each end of the D.20 Link and is critical for proper operation. The G500 D.20 HDLC PCIe card has two relays which control the End of Link termination, one for each D.20 Channel. Refer to Table 2: Default D.20 Relay settings. End of Link termination settings are software controlled and are accessible through the Settings GUI on your G500. Refer to SWM0101 for further details on configuration.

Table 2: Default D.20 Relay settings

D.20 Relay setting	Default setting
End of Link termination on channel 1	Enabled
End of Link termination on channel 2	Enabled
D.20 channel 1 to D.20 port B connection	Disabled
D.20 channel 2 to D.20 port B connection	Disabled

Supplying power through the D.20 Link

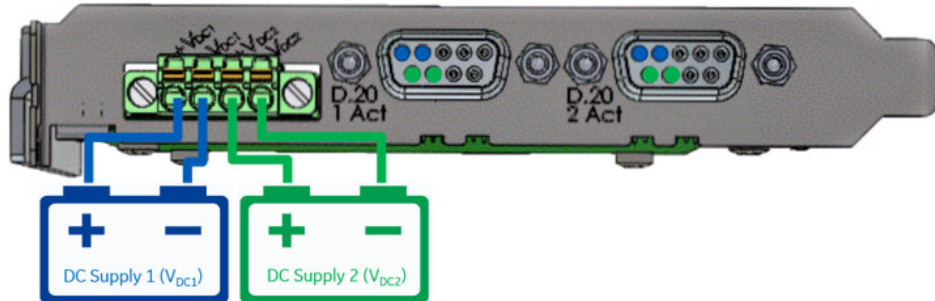
Power is typically supplied to peripheral devices directly through the WESTERM boards or inject power into the D.20 link using the D.20 DC Interface module (520-0154). However, with the G500 D.20 HDLC PCIe card the Power Pass Through connections can be utilized to inject power into the D.20 link to supply power to peripheral devices through the D.20 ports.

One or two independent power supplies can be connected to DC Supply 1 (V_{DC1}) and DC Supply 2 (V_{DC2}). DC Supply 1 (V_{DC1}) is connected through to pins 4 and 5 on both D.20 ports (DB9 connector), respectively DC Supply 2 (V_{DC2}) is connected to pins 8 and 9.

The DC supply load on the D.20 port by the peripheral link must not to exceed 2.5A and 20-60 V_{DC}



The Power Pass Through connections are protected to 2.5A.



The mating connector is the 4-pin “Phoenix 1827729”. This connector type is required for IP30 compliance.

D.20 Link features

The D.20 Link has the following features:

- D.20 frame using HDLC protocol format with Manchester encoding.
- RS-485 serial link, half duplex at 250 kbps, 24 AWG twisted pair, for applications up to 330 meters, and maximum 32 devices in total:
 - one single G500 counts as one device,
 - redundant G500 count as two devices,
 - each I/O Peripheral module counts as one device.
- Repeater/extension modules may be used to extend this limit to a maximum of 100 peripheral I/O modules, considering the RS-485 serial link limits listed above.
 - Multi-Mode Glass Fiber (GFO), up to 2 km (each GFO counts as one device in the RS-485 serial link).

- Each set of RS-485 D.20 Link wiring must be terminated at both ends (the termination does not count as a device).

D.20 Communications Interface

Use the D.20 Communication Interface module (520-0117) when you require one-to-one communication links with peripherals.

D.20 Termination

Use the D.20 Termination (977-0049) when you need to terminate the RS-485 serial links outside of the G500.

D.20 Fiber Optic Splitter

Use the D.20 Fiber Optic Splitter (520-0118) when you require one-to-four communication links with peripherals, especially if peripherals are clustered in different areas of the substation.

GFO adapters

Glass Fiber Optic (GFO, 520-0148) adapters are used to provide glass fiber optical cable extensions to the D.20 Link. These allow interference free links to peripherals that are sited at a remote distance from the main D20 installation.

D.20 DC interface

When power requirements for multiple peripherals exceed the basic system limitations, or when necessary to power peripherals connected via GFO use the D.20 DC Interface module (520-0154).

Peripherals

D.20 Peripheral I/O modules are intelligent modules containing an on-board microprocessor. They are configured as slaves to the G500. In this way, specific I/O processing is distributed throughout the G500 to the appropriate I/O module.

There are four types of I/O peripherals supported by the G500:

- D20A analog input
- D20S digital inputs
- D20K digital output
- D20C combination input/output

Optional high-voltage peripherals are also available.

Redundant D.20 communication channels are available on all peripherals. To utilize this function redundant D.20 LAN cards are required to be installed on the D.20 Peripheral I/O modules. D.20 A, S and K Peripheral I/O modules require 540-0207 and D.20 C requires 540-0209.

The G500 D.20 HDLC PCIe card is only compatible with CCU BASE and PCOMMON v3.00 or higher.



NOTE

Refer to Peripheral compatibility with the G500 D.20 HDLC PCIe card section in this manual for complete list of D.20 Peripheral I/O compatibility.

For further information on I/O peripherals, see the D20/D200 Installation and Operations Guide (part number 994-0078); see section: Connections and Configuration.

Peripheral compatibility with the G500 D.20 HDLC PCIe card

Use the tables in this section to check compatibility with existing D.20 Peripheral I/O modules and devices.

Table 3: D20A Analog Input Module Compatibility

Component	GE Vernova Item #	Description	Compatible release	Date of release
WESDAC	511-0101	WESDAC D20A TYPE 1 VERSION 1	REL 21-higher	April 1998
WESDAC	511-0102	WESDAC D20AHV	All	
WESDAC	511-0103	WESDAC D20AHV2	All	
WESTERM	517-0163	WESTERM D20A TYPE 1 VERSION 1	All	
	517-0178	WESTERM D20 AD	All	
Redundant D.20 LAN	540-0207	WESDAC D20 ASK D.20 I/F	All	
PCOMMON	306	PCOMMON v3.06	All	
	305	PCOMMON v3.05	All	
	301	PCOMMON v3.01	All	
	300	PCOMMON v3.00	All	

Table 4: D20S Status Input Module Compatibility

Component	GE Vernova Item #	Description	Compatible release	Date of release
WESDAC	507-0101	WESDAC D20S TY 1 VER 1	REL 18-higher	March 1998
WESDAC	507-0103	WESDAC D20SHV2	All	
WESTERM	517-0165	WESTERM D20S TYPE 1 VERSION 1	All	
Redundant D.20 LAN	540-0207	WESDAC D20 ASK D.20 I/F	All	
PCOMMON	306	PCOMMON v3.06	All	
	305	PCOMMON v3.05	All	
	301	PCOMMON v3.01	All	
	300	PCOMMON v3.00	All	

Table 5: D20K Control Output Module Compatibility

Component	GE Vernova Item #	Description	Compatible release	Date of release
WESDAC	508-0101	WESDAC D20K TYPE 1 VERSION 1	REL 17-higher	April 1998
WESDAC	508-0102	WESDAC D20KHV	All	

Component	GE Vernova Item #	Description	Compatible release	Date of release
WESTERM	517-0164	WESTERM D20K TYPE 1 VERSION 1	All	
Redundant D.20 LAN	540-0207	WESDAC D20 ASK D.20 I/F	All	
PCOMMON	306	PCOMMON v3.06	All	
	305	PCOMMON v3.05	All	
	301	PCOMMON v3.01	All	
	300	PCOMMON v3.00	All	

Table 6: D20C Combination Input/Output Module Compatibility

Component	GE Vernova Item #	Description	Compatible release	Date of release
WESDAC	504-0002	WESDAC D20C+	REL 27-higher	November 1998
WESDAC	504-0003	WESDAC D20CHV	All	
WESTERM	517-0169	WESTERM C Type 1 Version 1	All	
	517-0180	WESTERM D20 CD	All	
Redundant D.20 LAN	540-0209	WESDAC D20C D.20/WESMAINT I/F	All	
PCOMMON	305	PCOMMON v3.05	All	
	300	PCOMMON v3.00	All	

Table 7: Repeater/Splitter Compatibility

Component	GE Vernova Item #	Description	Compatible release	Date of release
REPEATER	520-0117	D.20 COMMUNICATION INTERFACE	REL 13 - higher	April 1999
SPLITTER	520-0118	D.20 FIBER OPTIC SPLITTER 4-WA	REL 11 - higher	April 1999
GFO	520-0148	WESDAC D.20 RS485/GFO I/F 48V	REL 12 - higher	May 1996

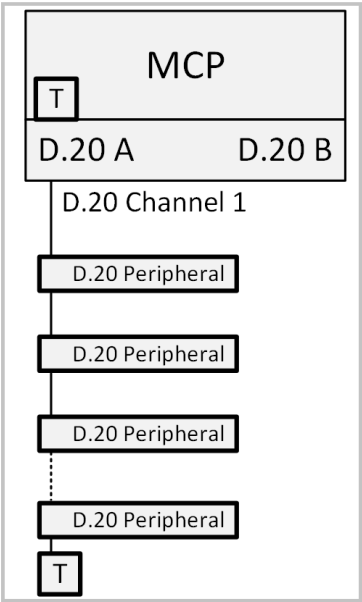
Connection Scenarios

G500 with the D.20 HDLC PCIe card will support the below D.20 architectures:

- Single D.20 terminated, single link
- Dual D.20 link terminated
- Dual D.20 terminated, Ch 1 only
- Single D.20 link, redundant LAN
- Redundant D.20 link, redundant LAN
- Single D.20 link with redundant G500
- Dual D.20 terminated, with redundant G500
- Single D.20 link, redundant LAN with redundant G500
- Single Ring and Fiber Optic (FO) D.20 link with redundant G500

- Single Ring and Fiber Optic (FO) D.20 link, redundant LAN with redundant G500
- G500 system redundancy

Single D.20 terminated, single link



Up to 31 D.20 Peripherals in total can be present.

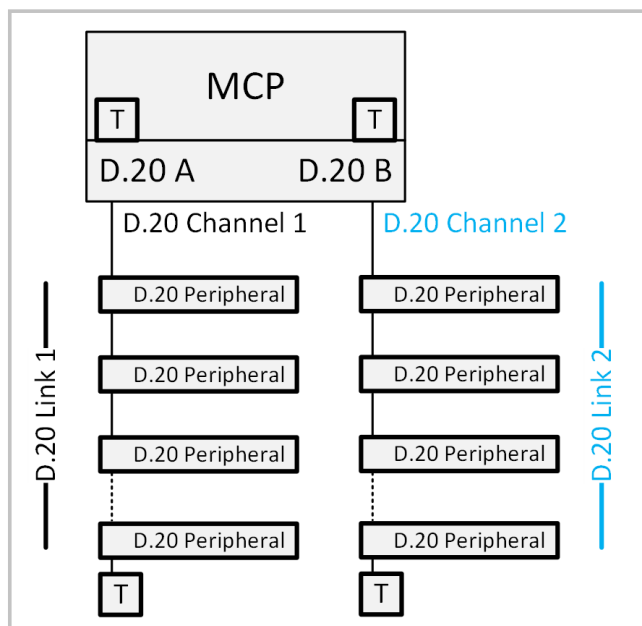
D.20 redundant LAN daughter card can optionally be installed with the corresponding configuration (Single Link) in DSAS.

The last D.20 peripheral must be terminated with D.20 terminator (GE Vernova part number 977-0049)

Table 8: Single D.20 terminated, Single Link - Default settings

Function	State
End of Link - D.20 Channel 1	ON
End of Link - D.20 Channel 2	ON
Port B - D.20 Channel 1 (pin 6/7)	OFF
Port B - D.20 Channel 2 (pin 2/3)	OFF

Dual D.20 link terminated



Up to 30 D.20 Peripherals in total can be present.

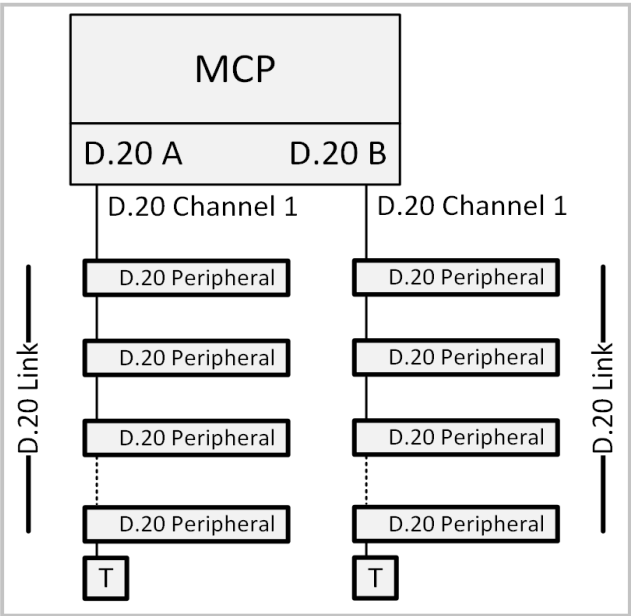
D.20 redundant LAN daughter card can optionally be installed with the corresponding configuration (Redundant Link) in DSAS.

The last D.20 peripheral must be terminated with D.20 terminator (GE Vernova part number 977-0049)

Table 9: Single D.20 terminated, Dual Link - Default settings

Function	State
End of Link - D.20 Channel 1	ON
End of Link - D.20 Channel 2	ON
Port B - D.20 Channel 1 (pin 6/7)	OFF
Port B - D.20 Channel 2 (pin 2/3)	ON

Dual D.20
terminated, Ch 1
only



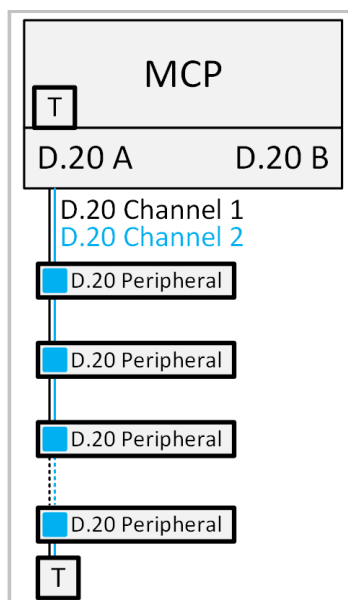
Up to 30 D.20 Peripherals in total can be present.

The last D.20 peripheral must be terminated with D.20 terminator (GE Vernova part number 977-0049)

Table 10: Dual D.20 terminated, Ch 1 only - Default settings

Function	State
End of Link - D.20 Channel 1	OFF
End of Link - D.20 Channel 2	OFF
Port B - D.20 Channel 1 (pin 6/7)	OFF
Port B - D.20 Channel 2 (pin 2/3)	ON

Single D.20 link, redundant LAN



Up to 31 D.20 Peripherals in total can be present.

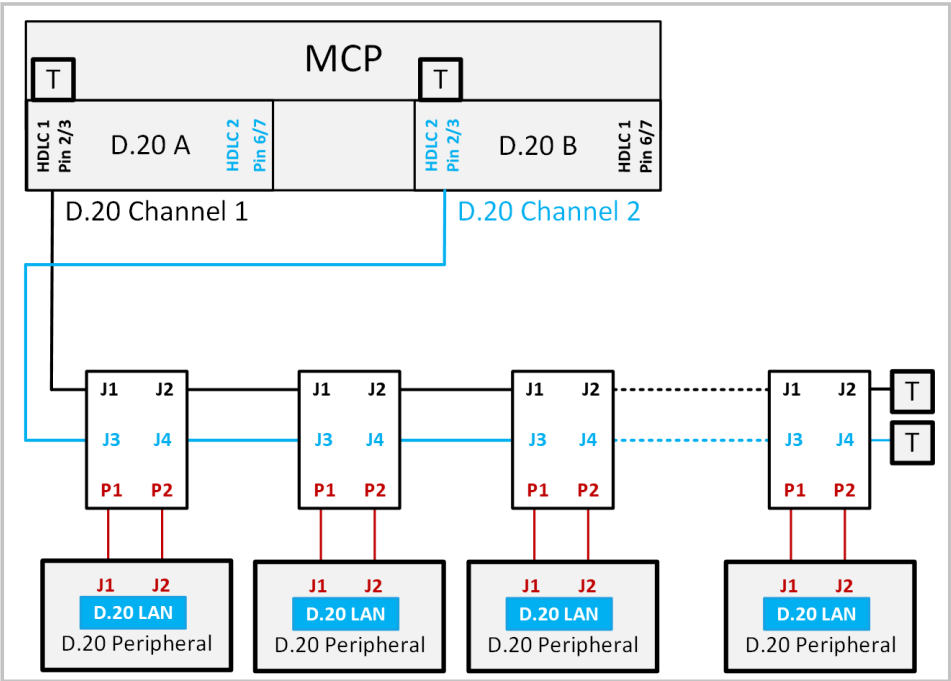
D.20 redundant LAN daughter card (GE Vernova part number 540-0209 for D.20C and GE Vernova part number 540-0207 for D.20A,S,K) must be installed with the corresponding configuration (Redundant Link) in DSAS.

The last D.20 peripheral must be terminated with D.20 terminator (GE Vernova part number 977-0049)

Table 11: Single D.20 link, redundant LAN - Default settings

Function	State
End of Link - D.20 Channel 1	ON
End of Link - D.20 Channel 2	ON
Port B - D.20 Channel 1 (pin 6/7)	OFF
Port B - D.20 Channel 2 (pin 2/3)	OFF

Redundant D.20 link, redundant LAN



Up to 30 D.20 Peripherals in total can be present.

D.20 redundant LAN daughter card (GE Vernova part number 540-0209 for D.20C and GE Vernova part number 540-0207 for D.20A,S,K) must be installed.

D.20 link adapter must be installed on each D.20 peripheral (GE Vernova part number 540-0313)

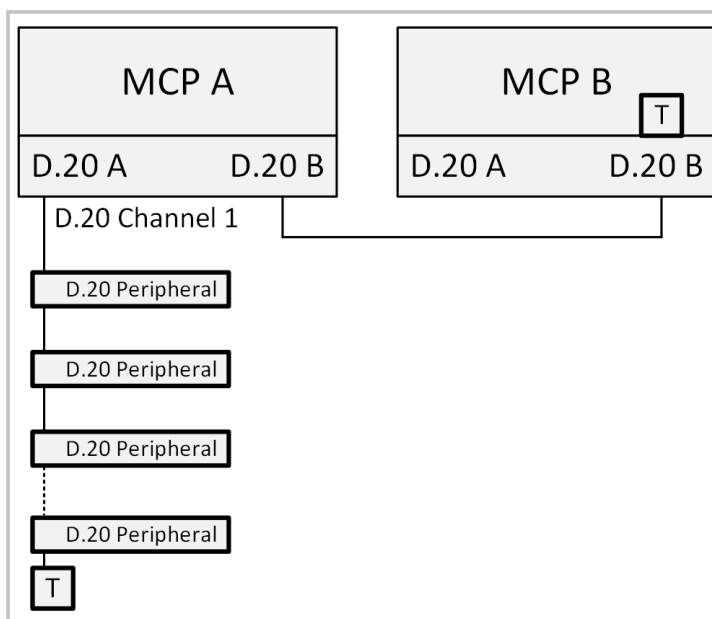
The D.20 Link crossover cable must be installed from CCU D.20 Port B to peripheral link (GE Vernova part number 977-0561)

The last D.20 peripheral must be terminated with D.20 terminator (GE Vernova part number 977-0049)

Table 12: Redundant D.20 Link, Redundant LAN - Default settings

Function	State
End of Link - D.20 Channel 1	ON
End of Link - D.20 Channel 2	ON
Port B - D.20 Channel 1 (pin 6/7)	ON
Port B - D.20 Channel 2 (pin 2/3)	ON

Single D.20 link with redundant G500



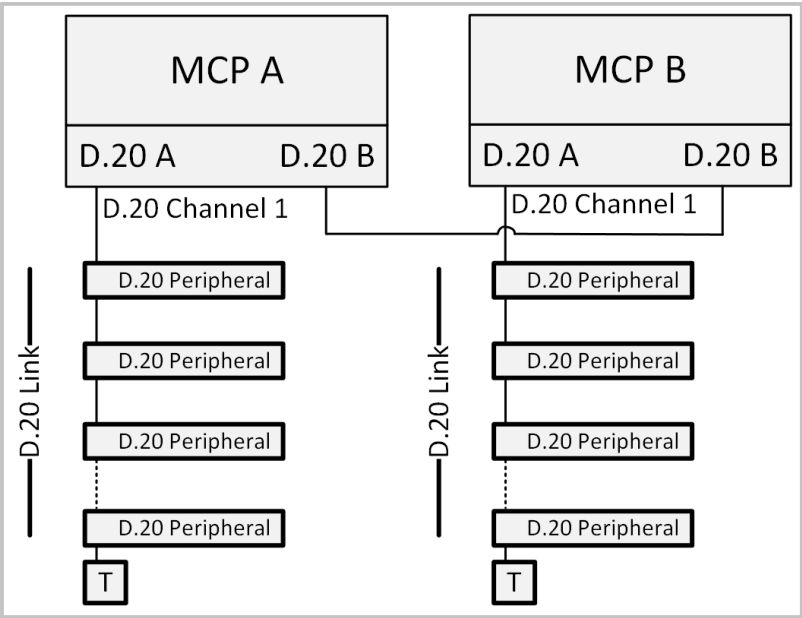
Up to 30 D.20 Peripherals in total can be present.

D.20 redundant LAN daughter card are not supported in Loop mode and must NOT be installed.

Table 13: Single D.20 link with redundant G500 - Default settings

Function	State MCP A	State MCP B
End of Link - D.20 Channel 1	OFF	ON
End of Link - D.20 Channel 2	OFF	ON
Port B - D.20 Channel 1 (pin 6/7)	ON	ON
Port B - D.20 Channel 2 (pin 2/3)	ON	ON

Dual D.20 terminated, with redundant G500



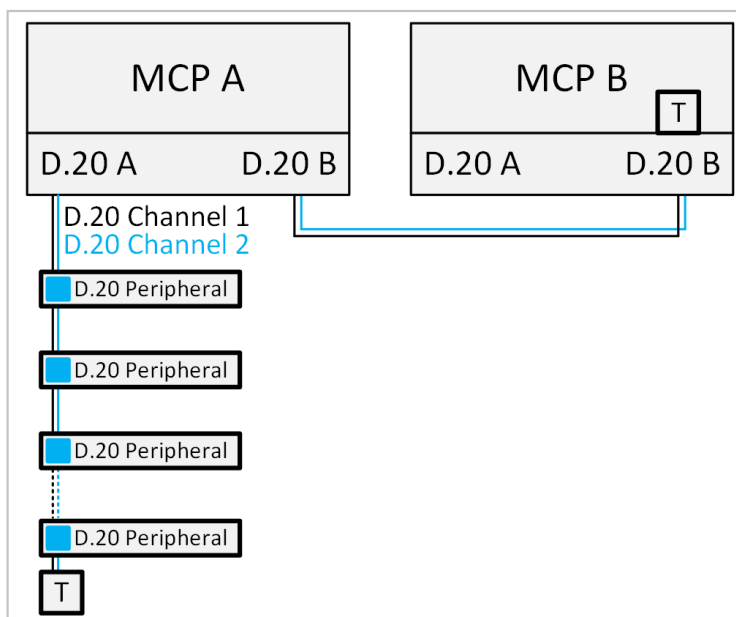
Up to 30 D.20 Peripherals in total can be present.

The last D.20 peripheral must be terminated with D.20 terminator (GE Vernova part number 977-0049).

Table 14: Dual D.20 terminated, with redundant MCP - Default settings

Function	State MCP
End of Link - D.20 Channel 1	OFF
End of Link - D.20 Channel 2	OFF
Port B - D.20 Channel 1 (pin 6/7)	ON
Port B - D.20 Channel 2 (pin 2/3)	ON

**Single D.20 link,
redundant LAN with
redundant G500**



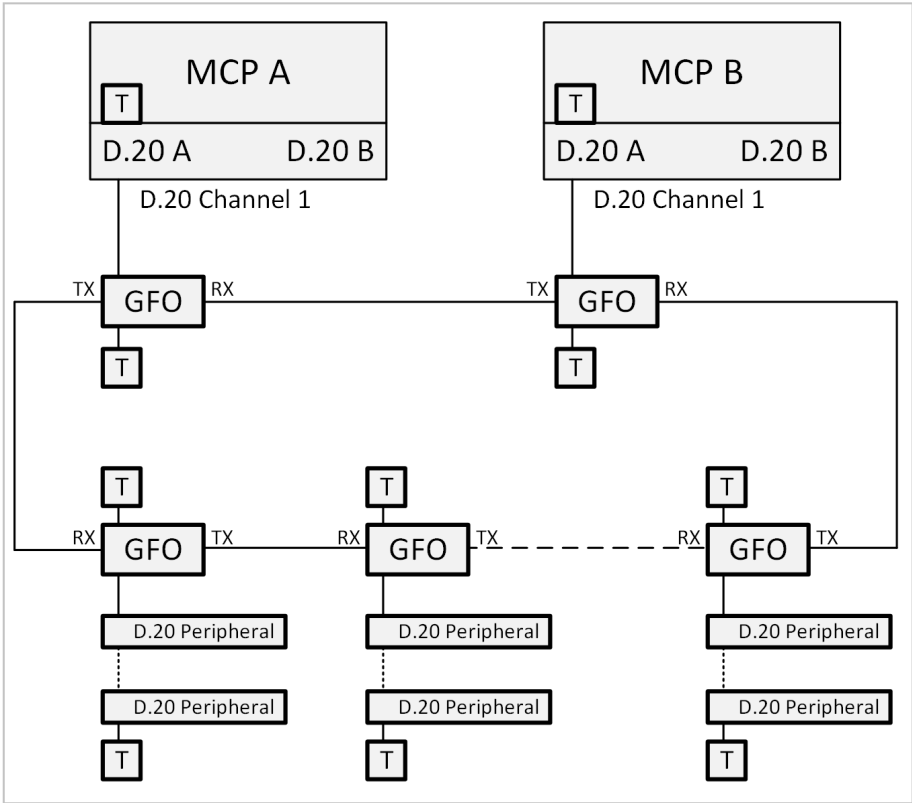
Up to 30 D.20 Peripherals in total can be present.

D.20 redundant LAN daughter card (GE Vernova part number 540-0209 for D.20C and GE Vernova part number 540-0207 for D.20A,S,K) must be installed with the corresponding configuration in DSAS.

Table 15: Single D.20 link, redundant LAN with redundant G500 - Default settings

Function	State MCP A	State MCP B
End of Link - D.20 Channel 1	OFF	ON
End of Link - D.20 Channel 2	OFF	ON
Port B - D.20 Channel 1 (pin 6/7)	ON	ON
Port B - D.20 Channel 2 (pin 2/3)	ON	ON

Single Ring and
Fiber Optic (FO)
D.20 link with
redundant G500



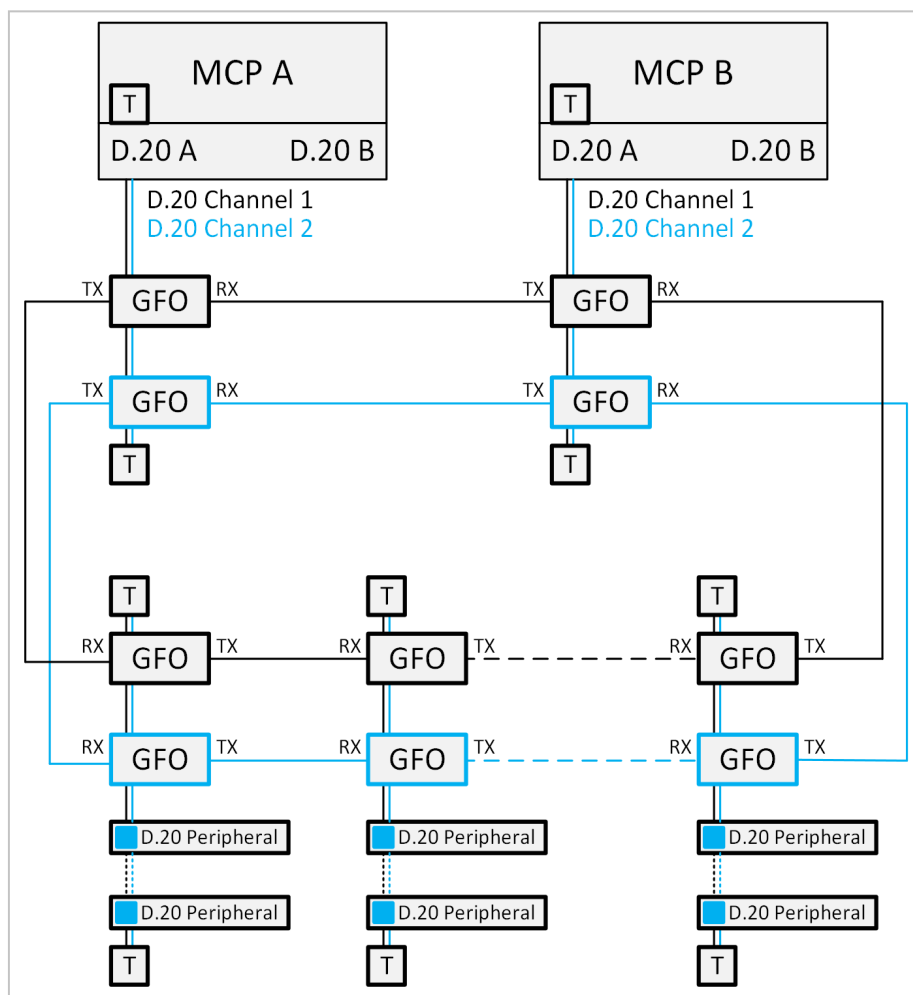
Up to 30 D.20 Peripherals can be present on a single copper D.20 link, subject to total maximum of 120.

This ring was tested with up to 8 D.20 Peripheral GFO drops.

Table 16: Single Ring and Fiber Optic (FO) D.20 link with redundant G500 - Default settings

Function	State MCP A	State MCP B
End of Link - D.20 Channel 1	ON	ON
End of Link - D.20 Channel 2	ON	ON
Port B - D.20 Channel 1 (pin 6/7)	OFF	OFF
Port B - D.20 Channel 2 (pin 2/3)	OFF	OFF

**Single Ring and
Fiber Optic (FO)
D.20 link, redundant
LAN with redundant
G500**



Up to 30 D.20 Peripherals can be present on a single copper D.20 link, subject to total maximum of 120.

D.20 redundant LAN daughter card (GE Vernova part number 540-0209 for D.20C and GE Vernova part number 540-0207 for D.20A,S,K) must be installed with the corresponding configuration in DSAS.

This ring was tested with up to 8 D.20 Peripheral GFO drops.

Table 17: Single Ring and Fiber Optic (FO) D.20 link, redundant LAN with redundant G500 - Default settings

Function	State MCP A	State MCP B
End of Link - D.20 Channel 1	ON	ON
End of Link - D.20 Channel 2	ON	ON
Port B - D.20 Channel 1 (pin 6/7)	OFF	OFF
Port B - D.20 Channel 2 (pin 2/3)	OFF	OFF

G500 system redundancy

A redundant G500 setup allows a secondary G500 to automatically take over operations from a paired G500 unit that has failed.

G500 redundancy requires two identical model and configuration G500 units and zero, one, or two RS232 switch panels when connecting to RS232 devices. RS232 switch panels are not required when connecting to RS-485 devices. For RS-485 redundant wiring approaches, refer to [RS485 Connections](#) on page 93.

When using the G500 in redundant mode, and wiring the RS232 switch panel, you must ensure the switch panel cables connected to A and B units match the A and B designations in software.



The RS-232 switch panel and associated connected wiring is optional for Warm-Standby, Hot-Standby and Hot-Hot redundancy.

Using the redundancy configurations given in this section, a pair of LEDs on the RS232 switch panel marked *CCU A* and *CCU B* indicate which of the G500 unit is currently active. A toggle switch on the RS232 switch panel can be used to manually switch the G500 devices between active and standby states, if the switch panel is configured as Master.



To view the Redundancy statuses, refer to [Status 1 and Status 2 LED Indicators](#) on page 124.



Starting with MCP **V4.00** release, **Warm-Standby** and **Hot-Standby** redundancy modes are no longer available and have been superseded by **Hot-Hot** redundancy mode. **Hot-Hot** redundancy mode has the same functionality as the superseded modes.

MCP Redundancy Operation

Please refer to **SWM0101 MCP Software Configuration Guide**, section **MCP System Redundancy** for a detailed explanation of MCP redundant modes.

RS232 Switch Panel(s) may be installed for the purpose of switching serial communications to external devices from the active MCP device. The RS232 Switch Panel is either in state (position) A or B and cannot be physically in both states.

At runtime, with a correctly configured G500 redundant system: only one MCP device is in an “active” state, the other MCP device is considered to be in “standby” state. Even when configured as hot-hot redundancy - the “standby” state and designation still applies for all subsystems not running as hot-hot.

Active vs. Standby States

If RS232 Switch Panel is not installed, or if is installed and configured as Slave: the runtime active and standby states are given by mutual arbitration in software.

If RS232 Switch Panel is installed and configured as Master: the runtime active and standby states are given by the DCD signal (STATUS, BROWN wire) on the watchdog cable serial port. When DCD is positive voltage level - the device is in Active state.

There is no functional preference on which MCP device should be active; this is a function of what was the last negotiated value.

A vs B Designation

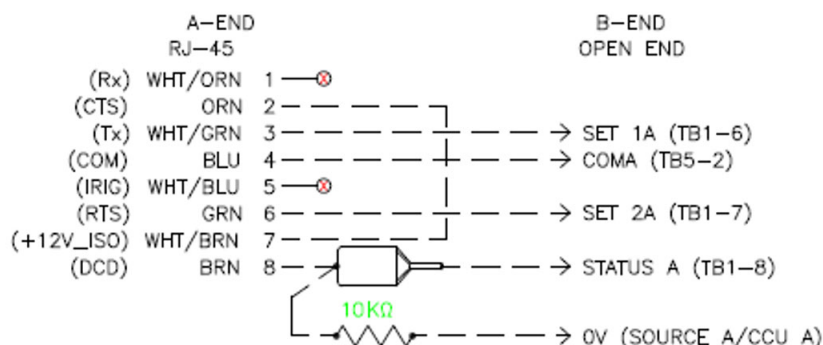
For MCP versions up to and including 2.80: The runtime A and B designation in the MCP database is given by the CTS signal (ORANGE wire) on the watchdog cable serial port if RS232 Switch Panel is installed and in addition the configured A and B setting must match the connected watchdog cable type. When CTS is positive voltage level - the device is assigned as A, this is tied internally to the +12 V pin inside cable 977-0557. This is also the reason why watchdog cables are different for devices A and B and must be connected to serial ports that provide internal +12 V.

For redundant MCP devices without RS232 Switch Panel installed - the runtime A and B designation in the MCP database is given by the configured A and B setting in the redundancy configuration.

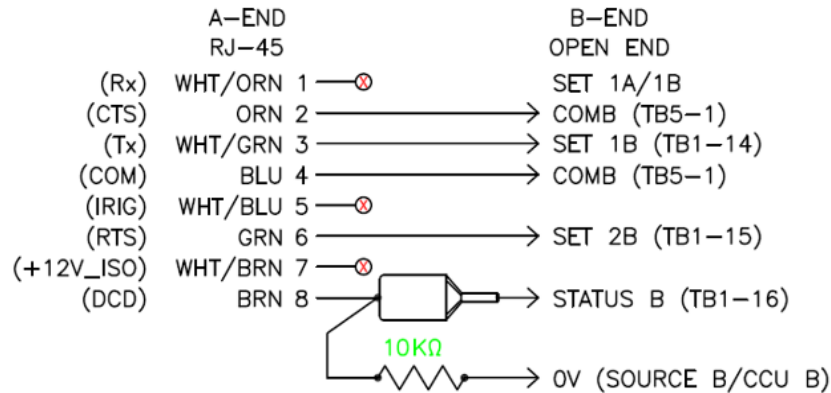
For MCP versions 3.00 and after: The runtime A and B designation in the MCP database is given by the configured A and B setting in the redundancy configuration regardless of RS232 Switch Panel being installed or not. This simplifies the RS232 Switch Panel connections, allows usage of the same watchdog cable for both devices A and B, and removes the restriction to connect only to serial ports that provide internal +12 V.

Upgrading from a previous G500 version to v3.00 does not require redundancy RS232 watchdog cable changes, however the A and B designation assignment is now mandatory.

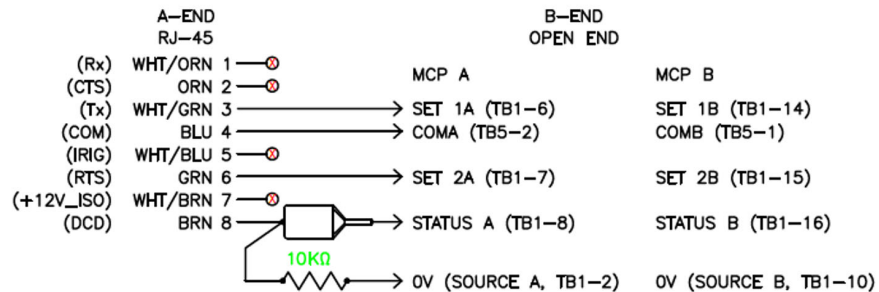
Pinout of watchdog cable 977-0557:



Pinout of watchdog cable 977-0558:



Pinout of watchdog cable 977-0568:



Runtime behavior

MCP devices A and B communicate constantly with each other to confirm each one's state, using what we call a "heartbeat" signal. If this communication stops - it triggers the standby device to become active. This is why it is critical that Heart Beat Communication does not have a single point of failure in itself and is implemented using at least two separate mediums: **Serial PING** and **LAN**. If serial is not possible, then implement **LAN1** and **LAN2**.

Disconnecting **all** Heart Beat Communications while both MCP devices are healthy and powered on will result in either of:

- One MCP will fail if RS232 Switch Panel is present and configured as Master.
 - In this case Human Intervention is required to restore the MCP redundancy after the Heart Beat Communications are restored.
- Both MCP devices become active if RS232 Switch Panel is present and configured as Slave, with serial communications being questionable since the RS232 Switch Panel cannot switch and follow both units as active.
 - In this case MCP redundancy should recover itself after the Heart Beat Communications are restored, with the last active MCP before the interruption remaining active, and the RS232 Switch Panel switched towards the active MCP.
- Both MCP devices become active if an RS232 Switch Panel is not present.
 - In this case MCP redundancy should recover itself after the Heart Beat Communications are restored, with the last active MCP before the interruption remaining active.



After experiencing both MCP being in active state, and after correcting the Heart Beat communication defects, and if the D.20 IO is configured: it is required to power cycle both MCP devices to clear this state on the D.20 PCIe card.

In general, after recovering from any redundancy failures there should be comprehensive checks performed to ensure the active device is operating as required, D.20 IO (if configured) are online and the standby device shows online in the active device. And then same checks should be performed after a switchover, with the second device being active.

Switchover initiated in database

Switchover initiated in database is when both MCP devices operate as Active-Standby and there is a database initiated request to change the Active MCP device, e.g. using the Redundancy Manager DO point "Start Change Over".

In this case, the Active MCP sends to the Standby a request to become active, over the Heartbeat Communication channel(s).

This is followed by different actions, depending on the RS232 Switch Panel configuration - see next:

If an RS232 Switch Panel is configured as Master and installed:

The Standby MCP device asserts both TX (SET 1) and RTS (SET 2) signals on the serial port connected to the watchdog cable, for a duration of approximately 50 ms.

As a result, the RS232 Switch Panel will change positions (should occur within 25 ms and with a maximum timeout of 50 ms), resulting in a swap of the STATUS A and STATUS B signal levels. The Standby MCP device confirms this change by monitoring the DCD (STATUS) signal, de-asserts the TX (SET 1) and RTS (SET 2) signals and initiates the actions to run the applications as Active.

The RS232 Switch Panel transfers all serial field connections to the new Active MCP.

If the DCD (STATUS) signal did not change to reflect the new RS232 Switch Position even after the duration 50 ms - the Standby MCP will fail and will not become active.

If the Standby MCP confirms becoming active and communicates this to the former Active MCP which made the request - the former Active MCP will have its applications restart in standby mode or change the applications to standby mode, as a result of the agreements exchanged over the Heartbeat Communication channel(s).

The switchover is finalized.

If an RS232 Switch Panel is configured as Slave and installed:

The Standby MCP device acknowledge the request and initiates the actions to run the applications as Active, without checking the DCD (STATUS) signal.

Once the Standby MCP confirms becoming active and communicates this to the former Active MCP which made the request - the former Active MCP will have its applications restart in standby mode, as a result of the agreements exchanged over the Heartbeat Communication channel(s).

The Standby MCP device also asserts both TX (SET 1) and RTS (SET 2) signals on the serial port connected to the watchdog cable, for a duration of approximately 50 ms. As a result, the RS232 Switch Panel will change positions, resulting in a swap of the STATUS A and STATUS B signal levels. The Standby MCP device confirms this change by monitoring the DCD (STATUS) signal.

If the DCD (STATUS) signal did not change to reflect the new RS232 Switch Position even after the duration of 50 ms - the Standby MCP will log an error and continue to operate as Active now. The RS232 Switch Panel did not transfer the serial field connections to the new Active MCP.

If the Standby MCP confirms becoming active and communicates this to the former Active MCP which made the request - the former Active MCP will have its applications restart in standby mode or change the applications to standby mode, as a result of the agreements exchanged over the Heartbeat Communication channel(s).

The switchover is finalized.

If an RS232 Switch Panel is not present:

The Standby MCP device acknowledge the request and initiates the actions to run the applications as Active, without checking the DCD (STATUS) signal.

Once the Standby MCP confirms becoming active and communicates this to the former Active MCP which made the request - the former Active MCP will have its applications restart in standby mode or change the applications to standby mode, as a result of the agreements exchanged over the Heartbeat Communication channel(s).

The switchover is finalized.

Switchover initiated from RS232 Switch Panel

Switchover initiated from the button located on the RS232 Switch Panel applies only when an RS232 Switch Panel is configured as Master and installed.

In this case the DCD (STATUS) signal swaps the STATUS A and STATUS B signal levels as a result of the RS232 Switch Panel initiated action.

The Standby MCP device observes this change by monitoring the DCD (STATUS) signal and initiates the actions to run the applications as Active.

The Active MCP device observes this change by monitoring the DCD (STATUS) signal and initiates the actions to have its applications restart in Standby mode or change the applications to Standby mode.

The two MCP devices also confirm the switchover to each other over the Heartbeat Communication channel(s).

The RS232 Switch Panel transfers all serial field connections to the new Active MCP.

The switchover is finalized.

Failover event

A Failover event occurs when the Standby MCP can no longer communicate with the Active MCP.

In this case, after exhausting the configured number of retries over the Heartbeat Communication channel(s) - the following actions occur, depending on the RS232 Switch Panel configuration:

If an RS232 Switch Panel is configured as Master and installed:

The Standby MCP device asserts both TX (SET 1) and RTS (SET 2) signals on the serial port connected to the watchdog cable, for a duration of approximately 50 ms.

As a result, the RS232 Switch Panel will change positions (should occur within 25 ms and with a maximum timeout of 50 ms), resulting in a swap of the STATUS A and STATUS B signal levels. The Standby MCP device confirms this change by monitoring the DCD (STATUS) signal, de-asserts the TX (SET 1) and RTS (SET 2) signals and initiates the actions to run the applications as Active.

The RS232 Switch Panel transfers all serial field connections to the new Active MCP.

If the DCD (STATUS) signal did not change to reflect the new RS232 Switch Position - the Standby MCP will fail and will not become active.

The failover is finalized.

If an RS232 Switch Panel is configured as Slave and installed:

The Standby MCP device initiates the actions to run the applications as Active, without checking the DCD (STATUS) signal.

The Standby MCP device also asserts both TX (SET 1) and RTS (SET 2) signals on the serial port connected to the watchdog cable, for a duration of approximately 50 ms. As a result, the RS232 Switch Panel will change positions, resulting in a swap of the STATUS A and STATUS B signal levels. The Standby MCP device confirms this change by monitoring the DCD (STATUS) signal.

The RS232 Switch Panel transfers all serial field connections to the new Active MCP.

If the DCD (STATUS) signal did not change to reflect the new RS232 Switch Position - the Standby MCP will log an error and continue to operate as Active now. The RS232 Switch Panel did not transfer the serial field connections to the new Active MCP.

The failover is finalized.

If an RS232 Switch Panel is not present:

The Standby MCP device initiates the actions to run the applications as Active, without checking the DCD (STATUS) signal.

The failover is finalized.



NOTE

To provide robustness against accidental switchovers during transient MCP device states - there are two signals TX (SET 1) and RTS (SET 2). In addition, by routing SET 1 signal through the ALARM N.O. contact of the MCP device requesting the RS232 Switch change - a successful RS232 Switch request is fulfilled only if the MCP device operates normally and ALARM relay is energized.

G500 versions up to and including v2.80

Required components

To implement a redundant G500 system, you need the following components:

Component	Function	GE Vernova part number
RS232 Switch Panel	Communications switch.	517-0247
Power Supply	Power supply to power the RS232 switch panel. Input: 85 – 264 VAC or 90 – 350 VDC.	580-0046
G500 RJ45 to RS232 Serial Cable	Connects the G500 to the RS232 switch panel which is then connected to external field devices.	977-0556/LLL
Watchdog Cable Assembly	Connects G500 A to the RS232 switch panel.	977-0557/LLL
	Connects G500 B to the RS232 switch panel.	977-0558/LLL
Ping Cable Assembly	Links both G500 units to facilitate a heartbeat message that determines the status of the active unit.	977-0559/LLL
G500 A/B RS232 Switch panel Jumper (P1/P9)	Connects the isolates common of serial port to the signal used in switch panel so G500 (A or B) can make itself the active unit.	977-0562
Power/ALARM Cable	Connects the RS232 switch panel to an external power supply and to the G500 ALARM terminal block.	970-0161
Ground Cable	Provides a ground connection for the RS232 switch panel.	970-0182

(/LLL) is length of the cable in inches, i.e. 36inches is /036.



The G500 A and G500 B Watchdog cables are not interchangeable and must be connected to the correct G500 unit.



The serial ports on the G500 are galvanically isolated from each other, however, when the RS232 switch panel is used, the serial common of all ports are tied together. CCU A ports are tied together, CCU B ports are tied together, CCU A and CCU B remain separate.



Pins 4 on switch panel connectors J2 through J8 are tied together and to the panel's power supply. Any loading from field devices on these pins, loads the RS232 panel power supply and should be taken into consideration when sizing power supplies.



The G500 watchdog (control) port must be configured for port 4 or 8 on the Built-in ports or port 4 on the Expansion port. The watchdog (control) must be configured to be the same port number on both G500A and G500B.



The G500 heartbeat (ping) port is software configurable, but must be configured to the same port number on both G500A and G500B.



For serial heartbeat interconnection of 2 redundant G500, a half crossed Ethernet cable can be used, in either RS-232 or RS-485-4W modes. RS-485-2W mode is not allowed. Do not use ports 4 or 8.

To set up a redundant system:

It is recommended that you install and configure one standalone G500 unit to ensure that your configuration is valid and that device communications are operating properly. Once this is done, proceed with the installation of the redundant system as shown in Figure 1 on page 63.

1. Mount the G500 units in a rack and connect power and ground.
2. Mount the RS232 switch panel.
3. Plug the connector of watchdog cable A (GE Vernova part number 977-0557/LLL) to the watchdog (control) serial port 4 or 8, RJ45 connector) on the first G500 (CCU A).
4. Plug the connector of watchdog cable B (GE Vernova part number 977-0558/LLL) to the watchdog (control) serial port (4 or 8, RJ45 connector) on the second G500 (CCU B). This cable must be connected to the same watchdog (control) serial port number (4 or 8) on both G500 units.
5. Connect the bare leads of both watchdog cables to TB1 on the RS232 switch panel as shown in Figure 1 on page 63.
6. Connect one end of the ping cable to the first G500 and the other end to the second G500. This ping cable must be connected to the same serial port number on both units.
7. Use G500 RJ45 to RS232 Serial Cable (977-0556/LLL) to connect the G500 serial communication ports to the serial ports on the RS232 switch panel. P2 through P8 are connected to the first G500, P10 through P16 are connected to the second G500. Connections from the switch panel to both G500 units should be made in the same order. For example, if P2 is connected to port 3 on the first G500, P10 should also be connected to port 3 on the second G500.
8. Use two RS232 DB9F SWITCH JUMPER A/B 977-0562 installed on P1 and P8 to connect the switched CCU ground for control and detection to the Currently active CCU.
9. Connect field devices to J2 through J8 on the RS232 switch panel.

To set up a redundant system with two RS232 switch panels:

In cases where more than 7 serial connection ports are required, a second RS232 panel can be added to the redundancy setup as shown in Figure 2 on page 64 and Figure 2 on page 64.

1. Mount the G500 units in a rack and connect power and ground.
2. Mount the two RS232 switch panels.
3. Plug the connector of watchdog cable A (GE Vernova part number 977-0557/LLL) to the watchdog (control) serial port 4 or 8, RJ45 connector) on the first G500 (CCU A).
4. Plug the connector of watchdog cable B (GE Vernova part number 977-0558/LLL) to the watchdog (control) serial port (4 or 8, RJ45 connector) on the second G500 (CCU B). This cable must be connected to the same watchdog (control) serial port number (4 or 8) on both G500 units.
5. Connect the bare leads of both watchdog cables to TB1 on the master RS232 switch panel as shown in Figure 2 on page 64.
6. Connect TB4 pins 1 (SET) and 2 (RESET) on the master RS232 switch panel to TB2 pins 1 and 2 on the slave RS232 switch panel using the cable specified (GE Vernova part number 970-0161) or similar.
7. Remove jumpers Z1 and Z2 from the slave RS232 switch panel.
8. Connect one end of the ping cable to the first G500 and the other end to the second G500. This ping cable must be connected to the same serial port number on both units.
9. Use G500 RJ45 to RS232 Serial Cable (977-0556/LLL) to connect the G500 serial communication ports to the serial ports on the RS232 switch panels. P2 through P8 are connected to the first G500, P10 through P16 are connected to the second G500. Connections from the switch panel to both G500 units should be made in the same order. For example, if P2 is connected to port 3 on the first G500, P10 should also be connected to port 3 on the second G500.

10. Use two RS232 DB9F SWITCH JUMPER A/B 977-0562 installed on P1 and P8 to connect the switched CCU ground for control and detection to the Currently active CCU. Only one panel required these jumpers, either panel can contain the jumpers.
11. Connect field devices to J2 through J8 on the first RS232 switch panel and to J1 through J8 on the second panel.

RS232 switch panel

The RS232 switch panel has two sets of indicator LEDs:

- PWR A/PWR B: When lit, power and communications are received from the connected units. Normally, both LEDs are lit.
- CCU A/CCU B: Normally, one LED is lit, indicating which unit is active.

The active/standby switch on the front of the RS232 switch panel is used to:

- Restore a previously failed unit to active status once it has been repaired.
- Manually force a unit to active status so that routine maintenance can be performed on the other unit.

To manually operate the RS232 switch as Master:

1. Pull the active/standby switch straight out to release it from the locked position.
2. Switch it up to make unit A active or down to make unit B active.

The CCU A/CCU B LED indicator indicates which unit has been activated.

Redundancy wiring diagrams

The following diagrams illustrate how to wire the G500 units and RS232 switch panels to enable system redundancy:

- Redundancy Wiring - Single RS232 Switch Panel see “Redundancy Wiring - Single RS232 Switch Panel” on page 63.
- Redundancy Wiring - Dual RS232 Switch Panel. The wiring drawing is provided in two parts: left and right.
 - For the left side of the drawing, see “Redundancy Wiring - Dual RS232 Switch Panel (1 of 2)” on page 64.
 - For the right side of the drawing, see “Redundancy Wiring - Dual RS232 Switch Panel (2 of 2)” on page 65.

This configuration is used to provide up to 15 serial connections to the redundant G500 units.

- Redundancy Wiring - Redundant RS232 Switch Panel. The wiring drawing is provided in two parts: left and right.
 - For the left side of the drawing, see “Redundancy Wiring - Redundant RS232 Switch Panel (1 of 2)” on page 66.
 - For the left side of the drawing, see “Redundancy Wiring - Redundant RS232 Switch Panel (2 of 2)” on page 67.

This configuration is used to provide RS232 panel redundancy for up to 7 serial connections.



When connecting to more than 8 field devices, you must double the number of RS232 switch panels used. When using this configuration, follow the instructions in [To set up a redundant system with two RS232 switch panels](#) on page 61.

Figure 1: Redundancy Wiring - Single RS232 Switch Panel

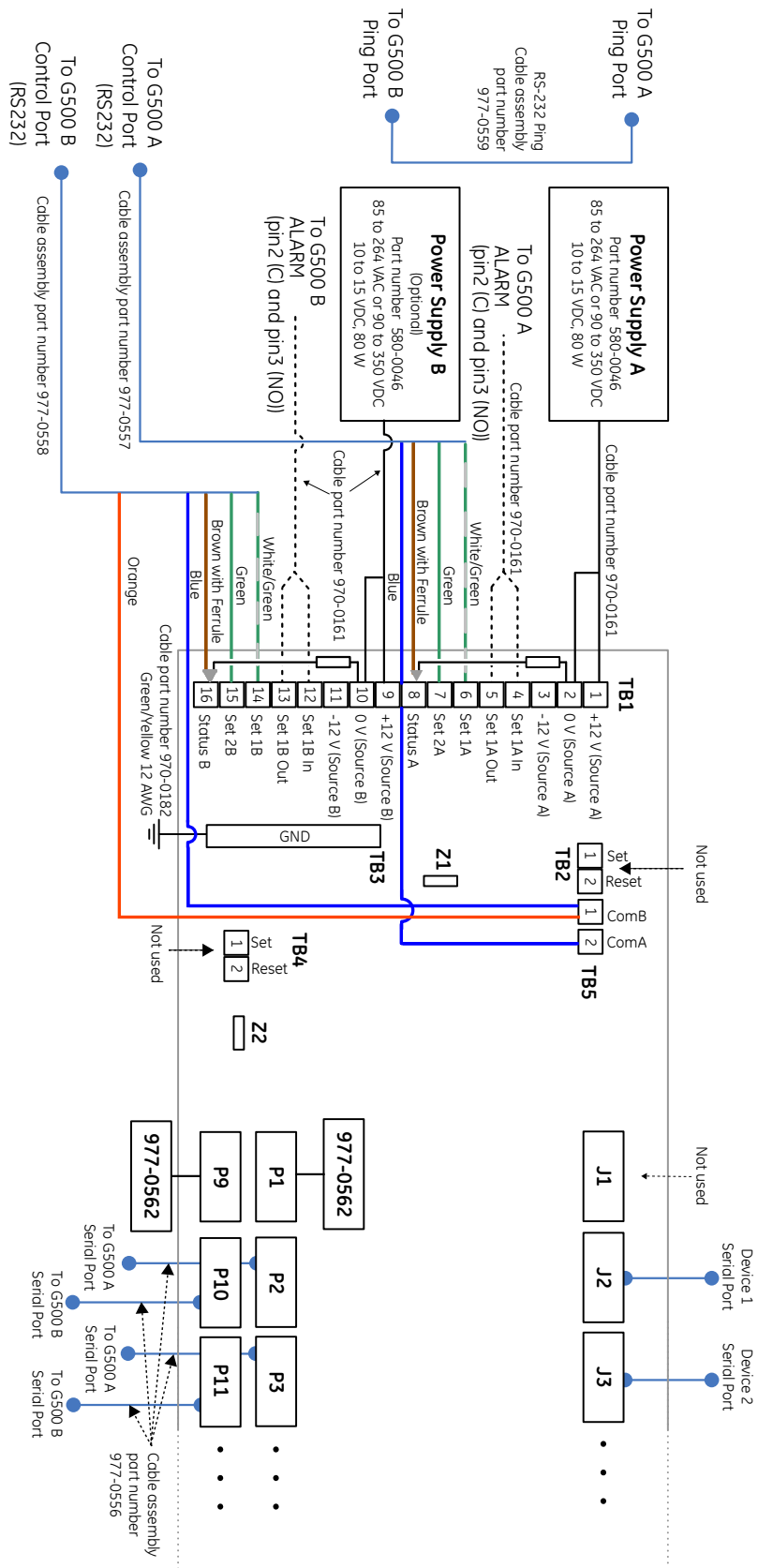


Figure 2: Redundancy Wiring - Dual RS232 Switch Panel (1 of 2)

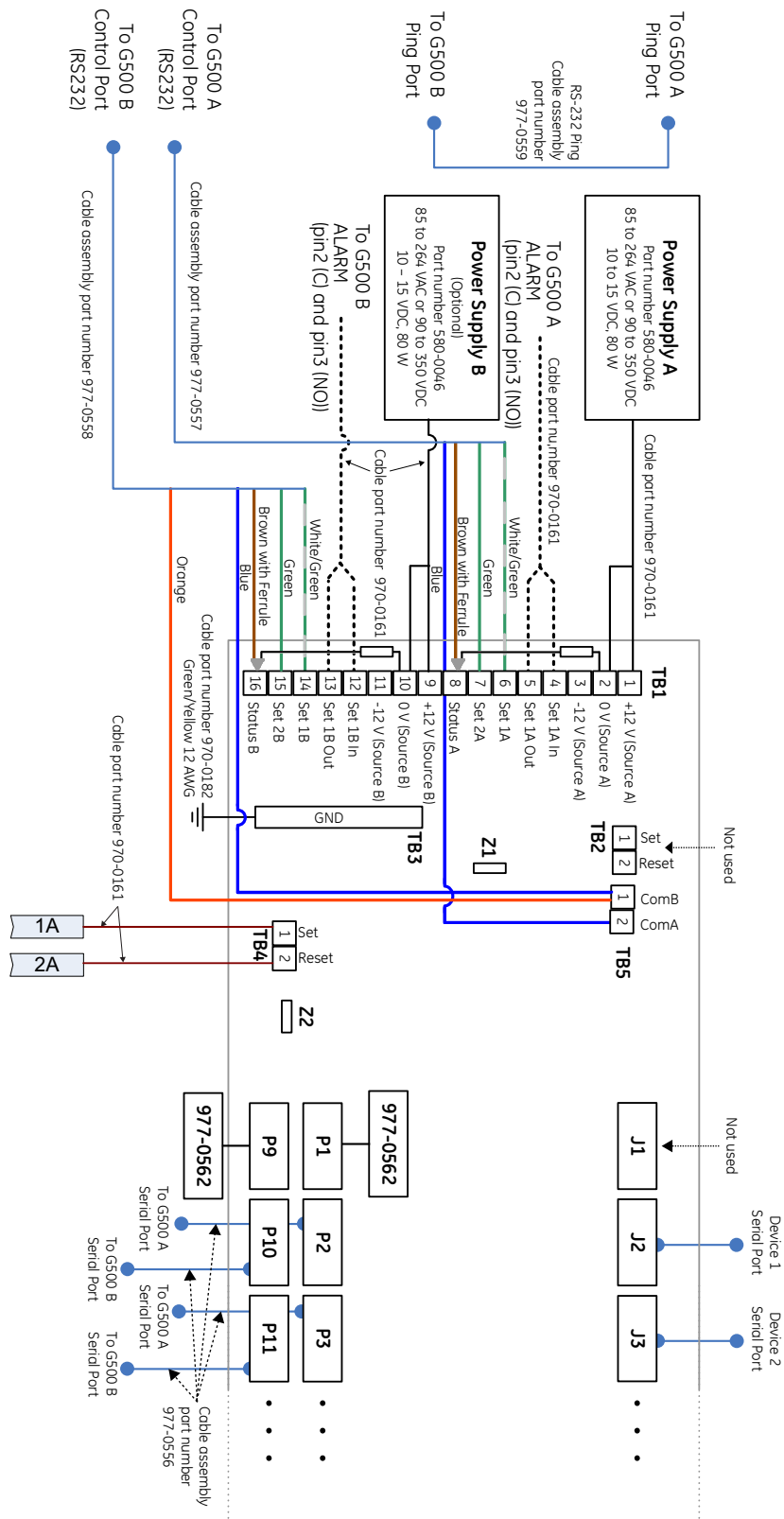


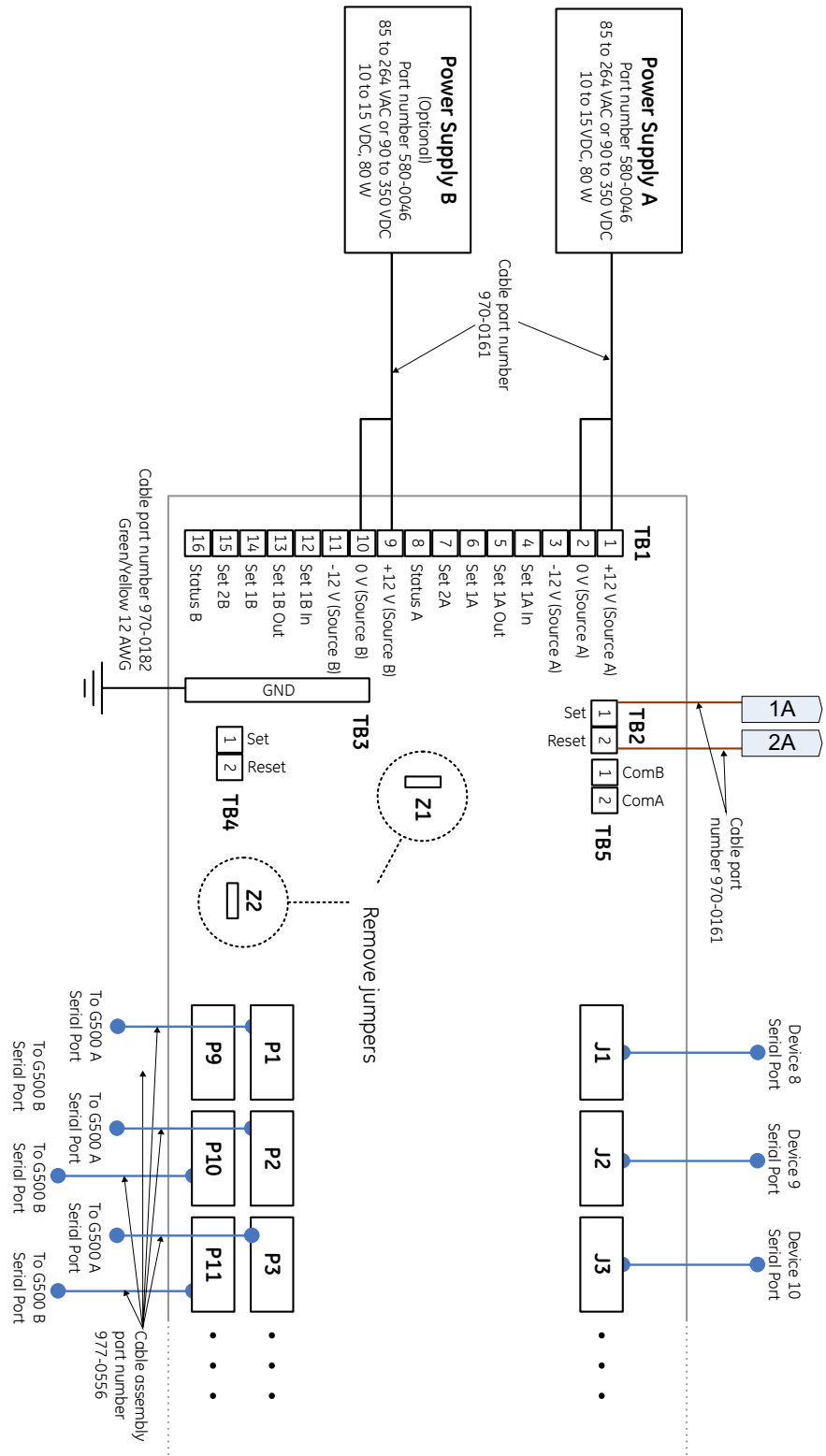
Figure 3: Redundancy Wiring - Dual RS232 Switch Panel (2 of 2)

Figure 4: Redundancy Wiring - Redundant RS232 Switch Panel (1 of 2)

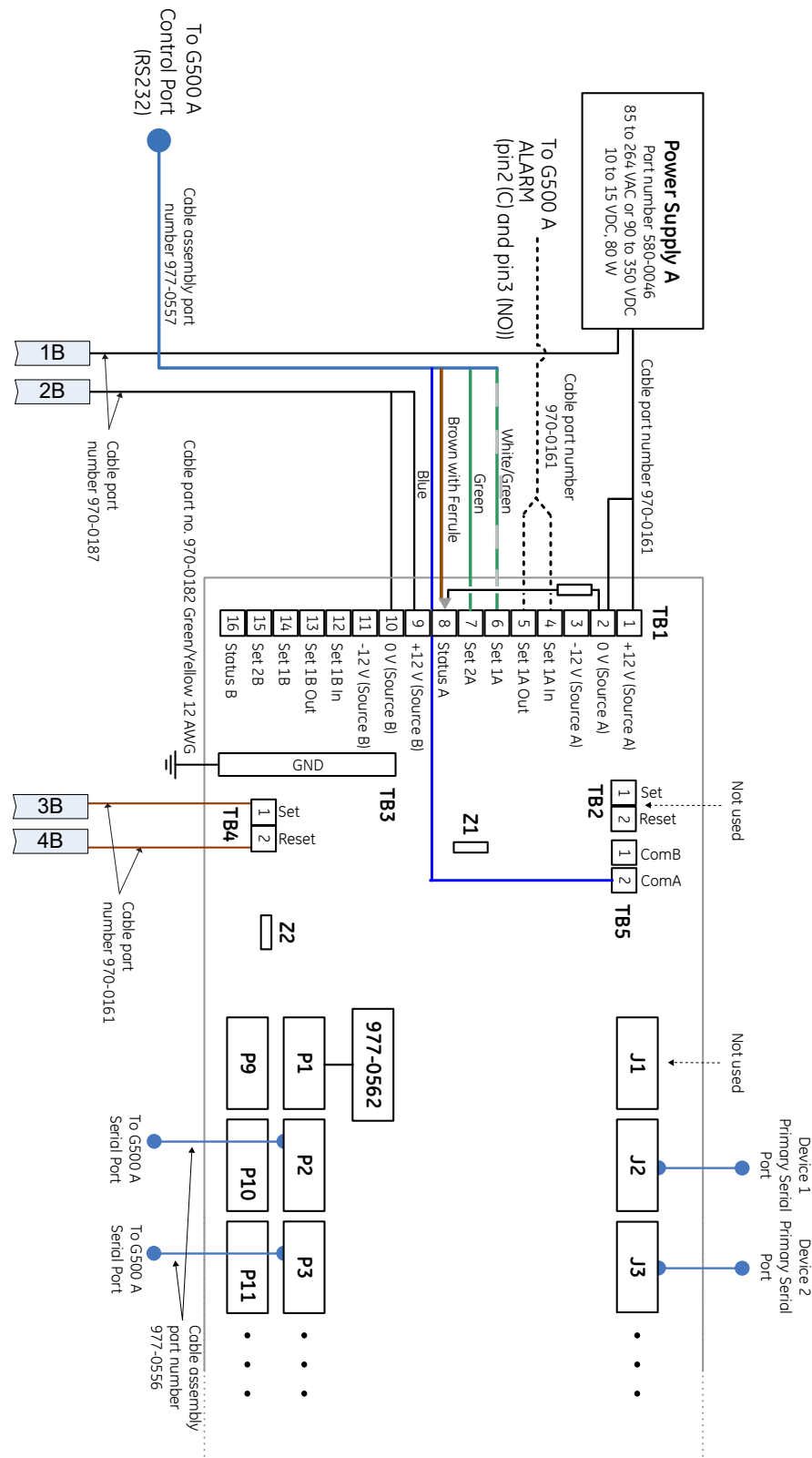
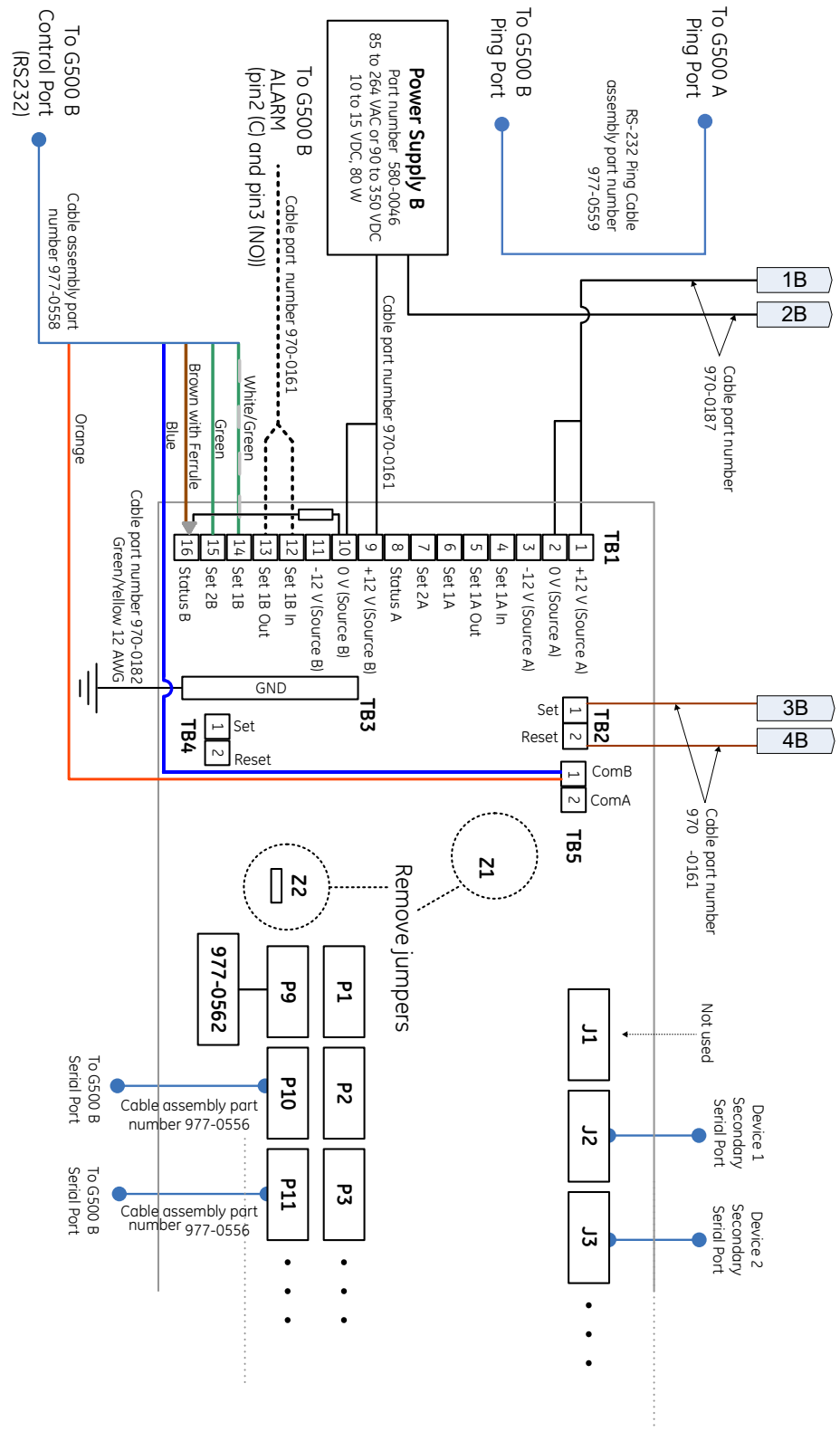


Figure 5: Redundancy Wiring - Redundant RS232 Switch Panel (2 of 2)



G500 versions v3.00

Required components

To implement a redundant G500 system, you need the following components:

Component	Function	GE Vernova part number
RS232 Switch Panel	Communications switch.	517-0247
Power Supply	Power supply to power the RS232 switch panel. Input: 85 – 264 VAC or 90 – 350 VDC.	580-0046
G500 RJ45 to RS232 Serial Cable	Connects the G500 to the RS232 switch panel which is then connected to external field devices.	977-0556/LLL
Watchdog Cable Assembly	Connects G500 A to the RS232 switch panel.	977-0568/LLL
	Connects G500 B to the RS232 switch panel.	977-0568/LLL
Ping Cable Assembly	Links both G500 units to facilitate a heartbeat message that determines the status of the active unit.	977-0559/LLL
G500 A/B RS232 Switch panel Jumper (P1/P9)	Connects the isolates common of serial port to the signal used in switch panel so G500 (A or B) can make itself the active unit.	977-0562
Power/ALARM Cable	Connects the RS232 switch panel to an external power supply and to the G500 ALARM terminal block.	970-0161
Ground Cable	Provides a ground connection for the RS232 switch panel.	970-0182

(/LLL) is length of the cable in inches, i.e. 36inches is /036.



The serial ports on the G500 are galvanically isolated from each other, however, when the RS232 switch panel is used, the serial common of all ports are tied together. CCU A ports are tied together, CCU B ports are tied together, CCU A and CCU B remain separate.



Pins 4 on switch panel connectors J2 through J8 are tied together and to the panel's power supply. Any loading from field devices on these pins, loads the RS232 panel power supply and should be taken into consideration when sizing power supplies.



The watchdog (control) must be configured to be the same port number on both G500A and G500B.



The G500 heartbeat (ping) port is software configurable, but must be configured to the same port number on both G500A and G500B.



For serial heartbeat interconnection of 2 redundant G500, a half crossed Ethernet cable can be used, in either RS-232 or RS-485-4W modes. RS-485-2W mode is not allowed. Do not use ports 4 or 8.



The assignment of G500A and G500B must be done in Settings.

To set up a redundant system:

It is recommended that you install and configure one standalone G500 unit to ensure that your configuration is valid and that device communications are operating properly. Once this is done, proceed with the installation of the redundant system as shown in Figure 6 on page 71.

1. Mount the G500 units in a rack and connect power and ground.
2. Mount the RS232 switch panel.
3. Plug the connector of watchdog cable A (GE Vernova part number 977-0568/LLL) to the watchdog (control) serial port RJ45 connector on the first G500 (CCU A).
4. Plug the connector of watchdog cable B (GE Vernova part number 977-0568/LLL) to the watchdog (control) serial port RJ45 connector on the second G500 (CCU B). This cable must be connected to the same watchdog (control) serial port number on both G500 units.
5. Connect the bare leads of both watchdog cables to TB1 on the RS232 switch panel as shown in Figure 6 on page 71.
6. Connect one end of the ping cable to the first G500 and the other end to the second G500. This ping cable must be connected to the same serial port number on both units.
7. Use G500 RJ45 to RS232 Serial Cable (977-0556/LLL) to connect the G500 serial communication ports to the serial ports on the RS232 switch panel. P2 through P8 are connected to the first G500, P10 through P16 are connected to the second G500. Connections from the switch panel to both G500 units should be made in the same order. For example, if P2 is connected to port 3 on the first G500, P10 should also be connected to port 3 on the second G500.
8. Use two RS232 DB9F SWITCH JUMPER A/B 977-0562 installed on P1 and P8 to connect the switched CCU ground for control and detection to the Currently active CCU.
9. Connect field devices to J2 through J8 on the RS232 switch panel.

To set up a redundant system with two RS232 switch panels:

In cases where more than 7 serial connection ports are required, a second RS232 panel can be added to the redundancy setup as shown in Figure 7 on page 72.

1. Mount the G500 units in a rack and connect power and ground.
2. Mount the two RS232 switch panels.
3. Plug the connector of watchdog cable A (GE Vernova part number 977-0568/LLL) to the watchdog (control) serial port RJ45 connector on the first G500 (CCU A).
4. Plug the connector of watchdog cable B (GE Vernova part number 977-0568/LLL) to the watchdog (control) serial port RJ45 connector on the second G500 (CCU B). This cable must be connected to the same watchdog (control) serial port number on both G500 units.
5. Connect the bare leads of both watchdog cables to TB1 on the master RS232 switch panel as shown in Figure 7 on page 72.
6. Connect TB4 pins 1 (SET) and 2 (RESET) on the master RS232 switch panel to TB2 pins 1 and 2 on the slave RS232 switch panel using the cable specified (GE Vernova part number 970-0161) or similar.
7. Remove jumpers Z1 and Z2 from the slave RS232 switch panel.
8. Connect one end of the ping cable to the first G500 and the other end to the second G500. This ping cable must be connected to the same serial port number on both units.
9. Use G500 RJ45 to RS232 Serial Cable (977-0556/LLL) to connect the G500 serial communication ports to the serial ports on the RS232 switch panels. P2 through P8 are connected to the first G500, P10 through P16 are connected to the second

G500. Connections from the switch panel to both G500 units should be made in the same order. For example, if P2 is connected to port 3 on the first G500, P10 should also be connected to port 3 on the second G500.

10. Use two RS232 DB9F SWITCH JUMPER A/B 977-0562 installed on P1 and P8 to connect the switched CCU ground for control and detection to the Currently active CCU. Only one panel required these jumpers, either panel can contain the jumpers.
11. Connect field devices to J2 through J8 on the first RS232 switch panel and to J1 through J8 on the second panel.

RS232 switch panel

The RS232 switch panel has two sets of indicator LEDs:

- PWR A/PWR B: When lit, power and communications are received from the connected units. Normally, both LEDs are lit.
- CCU A/CCU B: Normally, one LED is lit, indicating which unit is active.

The active/standby switch on the front of the RS232 switch panel is used to:

- Restore a previously failed unit to active status once it has been repaired.
- Manually force a unit to active status so that routine maintenance can be performed on the other unit.

To manually operate the RS232 switch as Master:

1. Pull the active/standby switch straight out to release it from the locked position.
2. Switch it up to make unit A active or down to make unit B active.

The CCU A/CCU B LED indicator indicates which unit has been activated.

Redundancy wiring diagrams

The following diagrams illustrate how to wire the G500 units and RS232 switch panels to enable system redundancy:

- Redundancy Wiring - Single RS232 Switch Panel see “Redundancy Wiring - Single RS232 Switch Panel” on page 71.
- Redundancy Wiring - Dual RS232 Switch Panel. The wiring drawing is provided in two parts: left and right.
 - For the left side of the drawing, see “Redundancy Wiring - Dual RS232 Switch Panel (1 of 2)” on page 72.
 - For the right side of the drawing, see “Redundancy Wiring - Dual RS232 Switch Panel (2 of 2)” on page 73.

This configuration is used to provide up to 15 serial connections to the redundant G500 units.

- Redundancy Wiring - Redundant RS232 Switch Panel. The wiring drawing is provided in two parts: left and right.
 - For the left side of the drawing, see “Redundancy Wiring - Redundant RS232 Switch Panel (1 of 2)” on page 74.
 - For the left side of the drawing, see “Redundancy Wiring - Redundant RS232 Switch Panel (2 of 2)” on page 75.

This configuration is used to provide RS232 panel redundancy for up to 7 serial connections.



When connecting to more than 8 field devices, you must double the number of RS232 switch panels used. When using this configuration, follow the instructions in [To set up a redundant system with two RS232 switch panels](#) on page 69.

Figure 6: Redundancy Wiring - Single RS232 Switch Panel

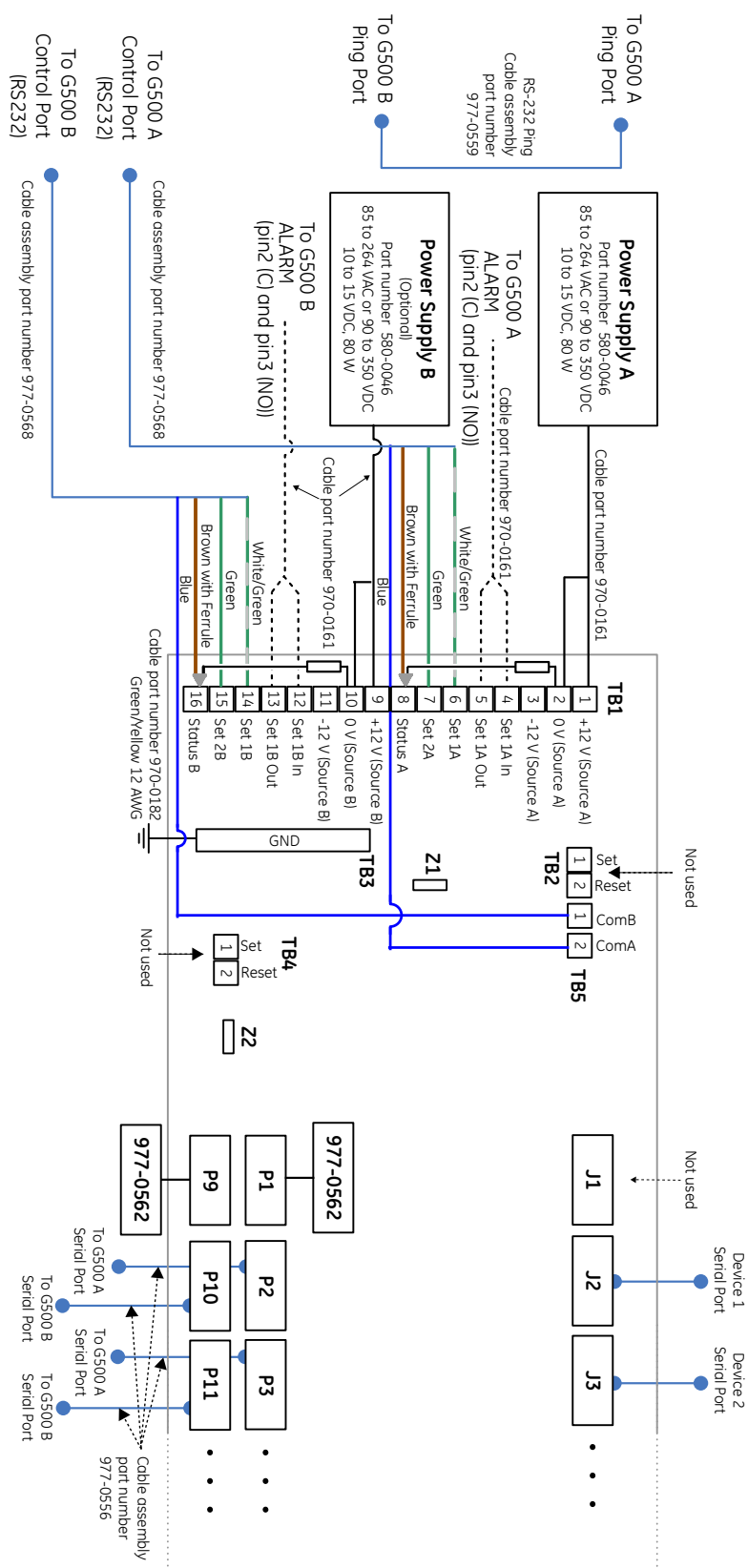


Figure 7: Redundancy Wiring - Dual RS232 Switch Panel (1 of 2)

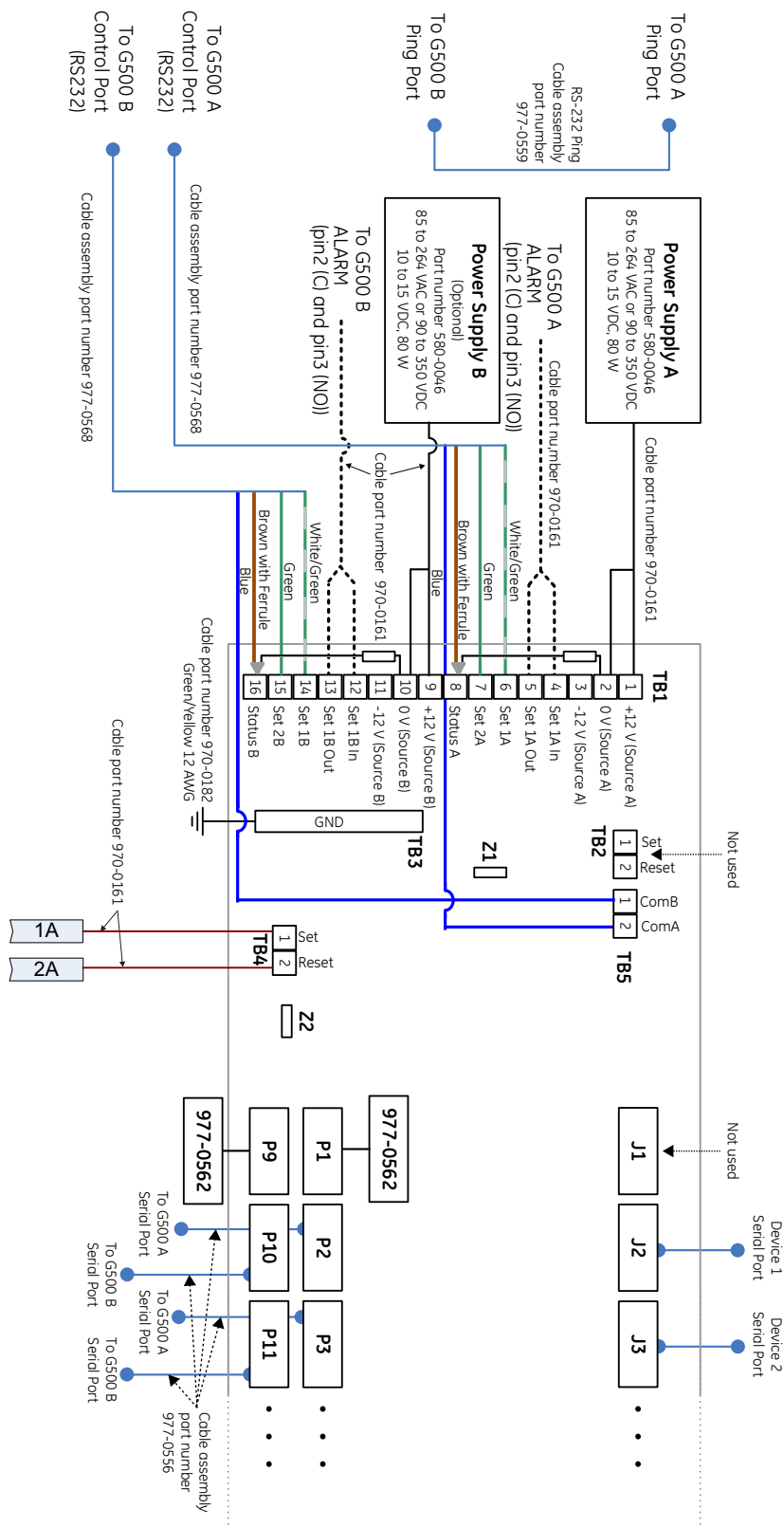


Figure 8: Redundancy Wiring - Dual RS232 Switch Panel (2 of 2)

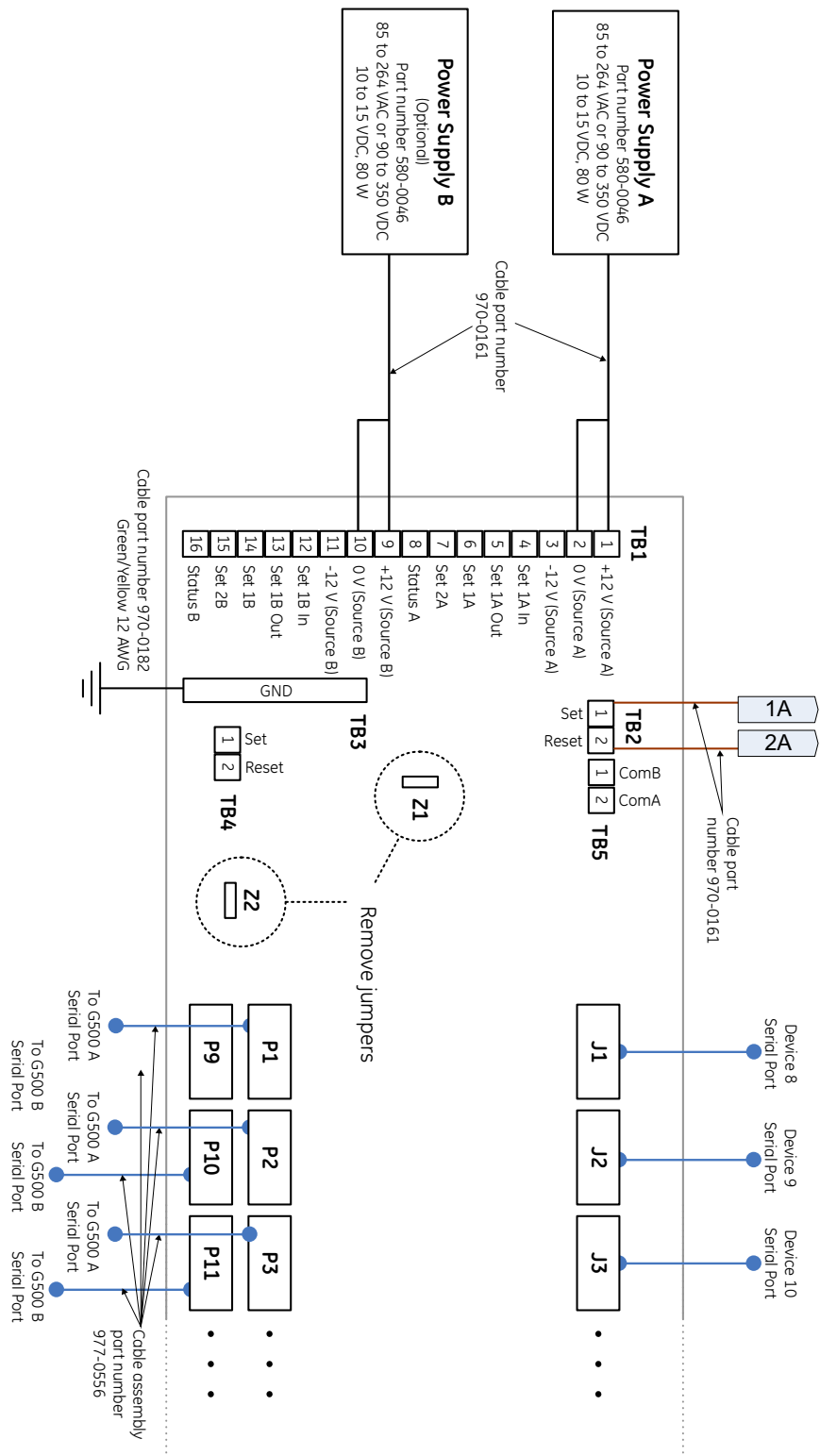


Figure 9: Redundancy Wiring - Redundant RS232 Switch Panel (1 of 2)

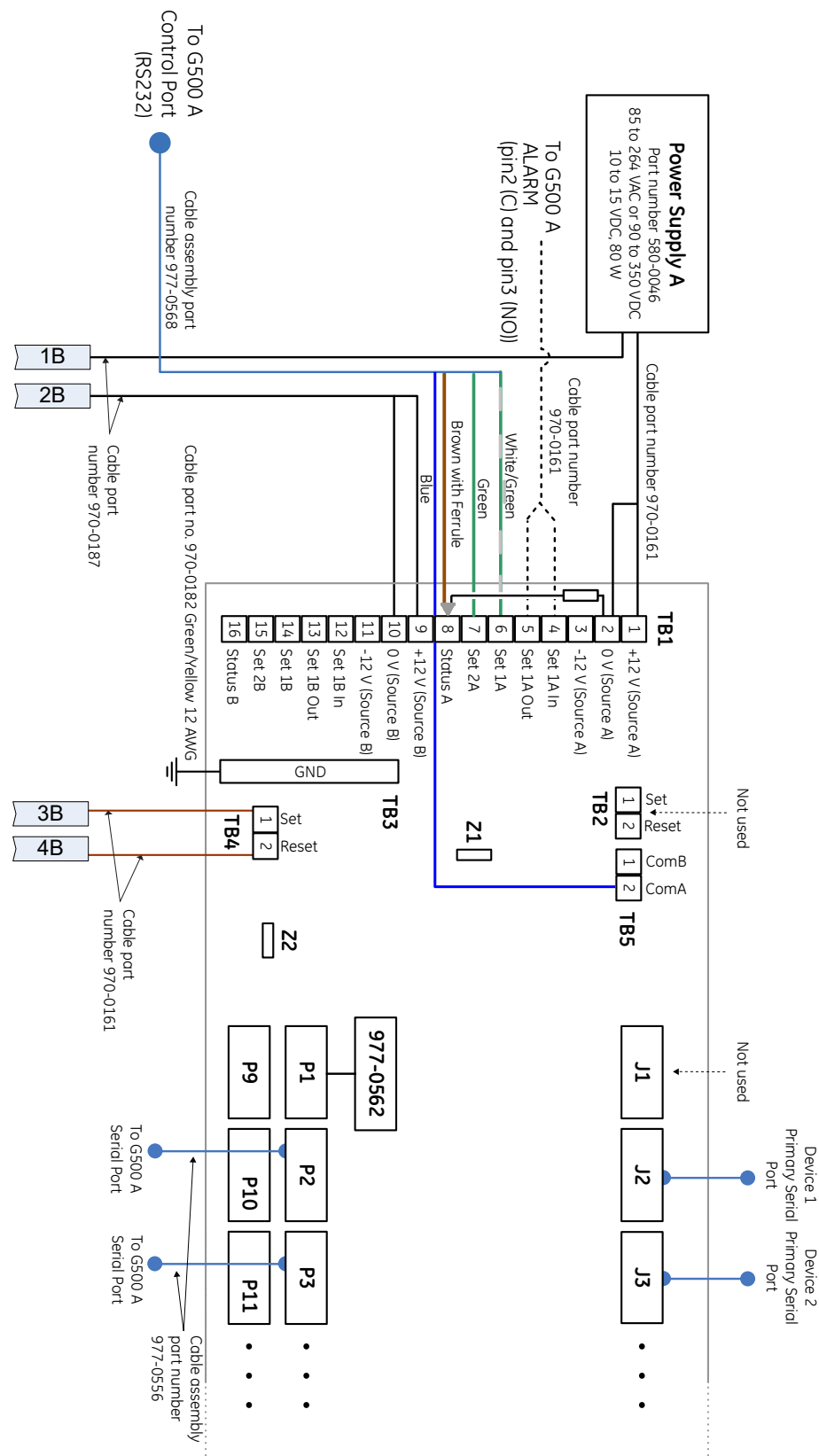
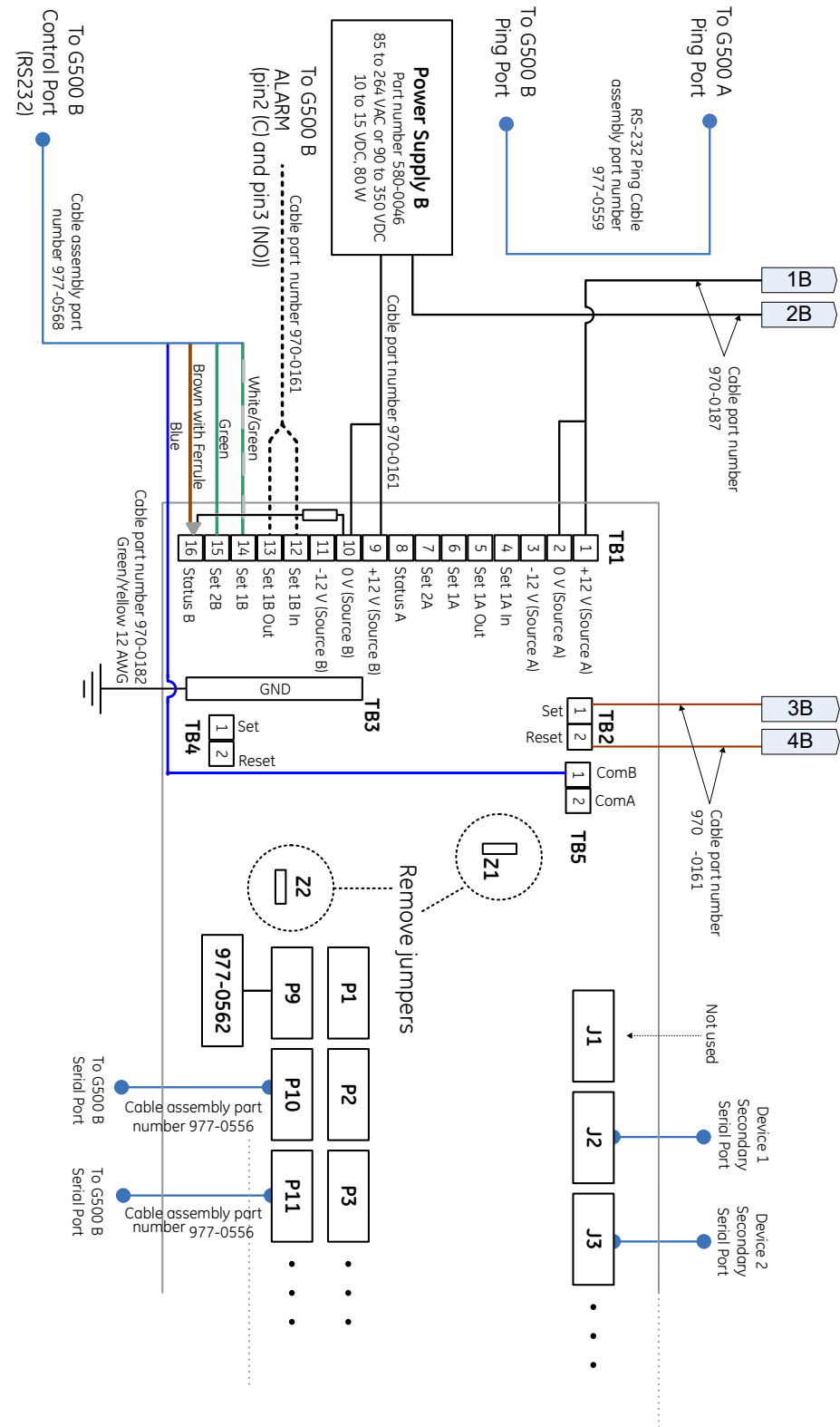


Figure 10: Redundancy Wiring - Redundant RS232 Switch Panel (2 of 2)



G500 running as D2x system redundancy

G500 running as D2x includes:

- G500 with “D” function that runs only D2x functionality on the MCP platform
- G500 with “C” function that runs both MCP and D2x functionality on the MCP platform



For G500 with “C” function, please refer to “G500 versions v3.00” on page 68 in previous G500 System Redundancy section

In the context of this section, G500-D refers to G500 with “D” function.

A redundant G500-D setup allows a secondary G500-D to automatically take over operations from a paired G500-D unit that has failed. This functionality is same as a D20 or D20MX RTU and is labelled as “Warm-Standby D2x” in the DS Agile MCP Studio Device Properties.

G500-D redundancy requires two identical model and configuration G500-D units and one RS232 switch panel.

An RS-232 switch panel and associated connected wiring are mandatory for G500-D redundancy (“Warm-Standby D2x”).

When using the G500-D in redundant mode, and wiring the RS232 switch panel, you must ensure the switch panel cables connected to A and B units match the A and B designations in your setup.

Using the redundancy configurations given in this section, a pair of LEDs on the RS232 switch panel marked *CCU A* and *CCU B* indicate which of the G500-D unit is currently active. A toggle switch on the RS232 switch panel can be used to manually switch the G500-D devices between active and standby states, if the switch panel Z2 jumper is inserted to enable this.

G500-D Redundancy Operation

An RS232 Switch Panel must be installed for the purpose of arbitrating active and standby G500-D states and for switching serial communications to external devices from the active G500-D device. The RS232 Switch Panel is either in state (position) A or B and cannot be physically in both states.

At runtime, with a correctly configured G500-D redundant system: only one G500-D device is in an “active” state, the other G500-D device is considered to be in “standby” state.

Active vs. Standby States

The runtime active and standby states are given by the DCD signal (STATUS, BROWN wire) on the watchdog cable serial port. When DCD is positive voltage level - the device is in Active state.

There is no functional preference on which G500-D device should be active; this is a function of what was the last negotiated value.

You can select which of the G500-D devices is Active via the toggle switch located on the RS232 Switch Panel, if the switch panel Z2 jumper is inserted to enable this.

A vs B Designation

The runtime A and B designation in the database is given by the CTS signal (ORANGE wire) on the watchdog cable serial port. When CTS is positive voltage level - the device is assigned as A, this is tied internally to the +12 V pin inside cable 977-0557. When CTS is common voltage level - the device is assigned as B, this is tied to the RS232 Switch Panel COMB (TB5-1).

This is the reason why watchdog cables are different for devices A and B and both must be connected to **Serial Port 8** which provides internal +12 V.

The G500-D device using watchdog cable 977-0557 will have A designation; the G500-D device using watchdog cable 977-0558 will have B designation.



1. Redundant G500-D (as MCP “D” function) uses always **Serial Port 8** for RS232 Switch Panel control and this port assignment cannot be changed in configuration.
2. The G500-D watchdog cables can be used in backward compatible mode with MCP functions “S” or “C” redundancy - however the A and B designation assignment in mcpcfg / Settings GUI must be done.
3. If the watchdog cables associated with MCP v3.00 and later are used in G500-D redundancy - then the G500-D database will not set the A and B designations, and both devices will show the same designation at runtime.

Runtime behavior

G500-D devices A and B communicate constantly with each other to confirm each one's state, using what we call a “heartbeat” signal (called also “PING” in D20 terminology), configured in the D2x application Redundant Monitor (B034-0S) - and assigned to one of the G500-D serial ports. If PING communication stops - it triggers the standby device to request to become active.

Disconnecting the Heart Beat Communication while both G500-D devices are healthy and powered on will result in one of the G500-D devices to fail (there can be only one active device set by the relay in the RS232 Switch Panel). In this case, G500-D redundancy requires user intervention to recover, after the Heart Beat Communications are restored.

In general, after recovering from any redundancy failures there should be comprehensive checks performed to ensure the active device is operating as required, D.20 IO (if configured) are online and the standby device shows online in the active device. And then same checks should be performed after a switchover, with the second device being active.

Switchover initiated in database

Switchover initiated in database is when both G500-D devices operate as Active-Standby and there is a database initiated request to switchover the Active G500-D device, using the D2x application Failover DTA (A118).

In this case, the Active G500-D sends to the Standby a request for the Standby to become active, over the PING Heartbeat Communication channel.

The Standby G500-D device asserts both TX (SET 1) and RTS (SET 2) signals on the serial port connected to the watchdog cable, for a duration of approximately 50 ms.

As a result, the RS232 Switch Panel will change positions (should occur within 25 ms and with a maximum timeout of 50 ms), resulting in a swap of the STATUS A and STATUS B signal levels. The Standby G500-D device confirms this change by monitoring the DCD (STATUS) signal, de-asserts the TX (SET 1) and RTS (SET 2) signals and initiates the actions to run the applications as Active.

The RS232 Switch Panel transfers all serial field connections to the new Active G500-D.

If the DCD (STATUS) signal did not change to reflect the new RS232 Switch Position even after the duration 50 ms - the Standby G500-D will fail and will not become active.

If the Standby G500-D confirms becoming active and communicates this to the former Active G500-D which made the request - the former Active G500-D will have its applications restart in standby mode.

The switchover is finalized.

Switchover initiated from RS232 Switch Panel

Switchover can be initiated from the toggle switch located on the RS232 Switch Panel if the Z2 jumper is inserted to allow this.

In this case the DCD (STATUS) signal swaps the STATUS A and STATUS B signal levels as a result of the RS232 Switch Panel initiated action.

The Standby G500-D device observes this change by monitoring the DCD (STATUS) signal and initiates the actions to run the applications as Active.

The Active G500-D device observes this change by monitoring the DCD (STATUS) signal and initiates the actions to have its applications restart in Standby mode.

The two G500-D devices also confirm the switchover to each other over the PING Heartbeat Communication channel.

The RS232 Switch Panel transfers all serial field connections to the new Active G500-D.

The switchover is finalized.

Failover event

A Failover event occurs when the Standby G500-D can no longer communicate with the Active G500-D via the PING serial cable.

In this case, after exhausting the configured number of retries over the PING Heartbeat Communication channel (configured in the D2x application Redundant Monitor B034-0S) - the following actions occur:

- The Standby G500-D device asserts both TX (SET 1) and RTS (SET 2) signals on the serial port connected to the watchdog cable, for a duration of approximately 50 ms.
- As a result, the RS232 Switch Panel will change positions (should occur within 25 ms and with a maximum timeout of 50 ms), resulting in a swap of the STATUS A and STATUS B signal levels. The Standby G500-D device confirms this change by monitoring the DCD (STATUS) signal, de-asserts the TX (SET 1) and RTS (SET 2) signals and initiates the actions to run the applications as Active.
- The RS232 Switch Panel transfers all serial field connections to the new Active G500-D.

If the DCD (STATUS) signal did not change to reflect the new RS232 Switch Position even after the duration 50 ms - the Standby G500-D will fail and will not become active; this typically indicates wiring issues.

The failover is finalized.



To provide robustness against accidental switchovers during transient G500-D device states at power up - there are two signals TX (SET 1) and RTS (SET 2). In addition, by routing SET 1 signal through the ALARM N.O. contact of the G500-D device requesting the RS232 Switch change - a successful RS232 Switch request is fulfilled only if the G500-D device operates normally and ALARM relay is energized.

Required components

To implement a redundant G500-D system, you need the following components:

Component	Function	GE Vernova part number
RS232 Switch Panel	Communications switch.	517-0247
Power Supply	Power supply to power the RS232 switch panel. Input: 85 – 264 VAC or 90 – 350 VDC.	580-0046
G500 RJ45 to RS232 Serial Cable	Connects the G500 to the RS232 switch panel which is then connected to external field devices.	977-0556/LLL
Watchdog Cable Assembly	Connects G500-D A COM8 to the RS232 switch panel.	977-0557/LLL
	Connects G500-D B COM8 to the RS232 switch panel.	977-0558/LLL
Ping Cable Assembly	Links both G500 units to facilitate a heartbeat message that determines the status of the active unit.	977-0559/LLL
G500 A/B RS232 Switch panel Jumper (P1/P9)	Connects the isolates common of serial port to the signal used in switch panel so G500 (A or B) can make itself the active unit.	977-0562
Power/ALARM Cable	Connects the RS232 switch panel to an external power supply and to the G500 ALARM terminal block.	970-0161
Ground Cable	Provides a ground connection for the RS232 switch panel.	970-0182

(/LLL) is length of the cable in inches, i.e. 36inches is /036.



The G500-D A and G500-D B Watchdog cables are not interchangeable and must be connected to the correct G500-D unit.



The serial ports on the G500-D are galvanically isolated from each other, however, when the RS232 switch panel is used, the serial common of all ports are tied together. CCU A ports are tied together, CCU B ports are tied together, CCU A and CCU B remain separate.



Pins 4 on switch panel connectors J2 through J8 are tied together and to the panel's power supply. Any loading from field devices on these pins, loads the RS232 panel power supply and should be taken into consideration when sizing power supplies.



The G500-D watchdog (control) port must be wired for port 8 on the Built-in ports on both G500-D A and G500-D B.



For serial heartbeat interconnection of 2 redundant G500-D, a half crossed Ethernet cable can be used, in either RS-232 or RS-485-4W modes. RS-485-2W mode is not allowed. Do not use port 4 due to its internal power supply being connected across.

To set up a redundant system:

It is recommended that you install and configure one standalone G500-D unit to ensure that your configuration is valid and that device communications are operating properly. Once this is done, proceed with the installation of the redundant system.

1. Mount the G500-D units in a rack and connect power and ground.
2. Mount the RS232 switch panel.
3. Plug the connector of watchdog cable A (GE Vernova part number 977-0557/LLL) to the watchdog (control) serial port 8, (RJ45 connector) on the first G500-D (CCU A).
4. Plug the connector of watchdog cable B (GE Vernova part number 977-0558/LLL) to the watchdog (control) serial port 8, (RJ45 connector) on the second G500-D (CCU B).
5. Connect the bare leads of both watchdog cables to TB1 on the RS232 switch panel as shown in "G500-D Redundancy Wiring - Single RS232 Switch Panel" on page 81.
6. Connect one end of the ping cable to the first G500-D and the other end to the second G500-D. This ping cable must be connected to the same serial port number on both units, as configured in D2x application B034-0S.
7. Use G500-D RJ45 to RS232 Serial Cables (977-0556/LLL) to connect the G500 serial communication ports to the serial ports on the RS232 switch panel. P2 through P8 are connected to the first G500-D, P10 through P16 are connected to the second G500-D. Connections from the switch panel to both G500-D units should be made in the same order. For example, if P2 is connected to port 3 on the first G500-D, P10 should also be connected to port 3 on the second G500-D.
8. Use two RS232 DB9F SWITCH JUMPER A/B 977-0562 installed on P1 and P8 to connect the switched CCU ground for control and detection to the Currently active CCU.
9. Connect field devices to J2 through J8 on the RS232 switch panel

RS232 switch panel operation

The RS232 switch panel has two sets of indicator LEDs:

- PWR A/PWR B: When lit, power and communications are received from the connected units. Normally, both LEDs are lit.
- CCU A/CCU B: Normally, one LED is lit, indicating which unit is active.

If enabled by the jumper Z2 on the RS232 Switch Panel - the active/standby switch on the front of the RS232 switch panel is used to:

- Restore a previously failed unit to active status once it has been repaired.
- Manually force a unit to active status so that routine maintenance can be performed on the other unit.

To manually operate the RS232 switch:

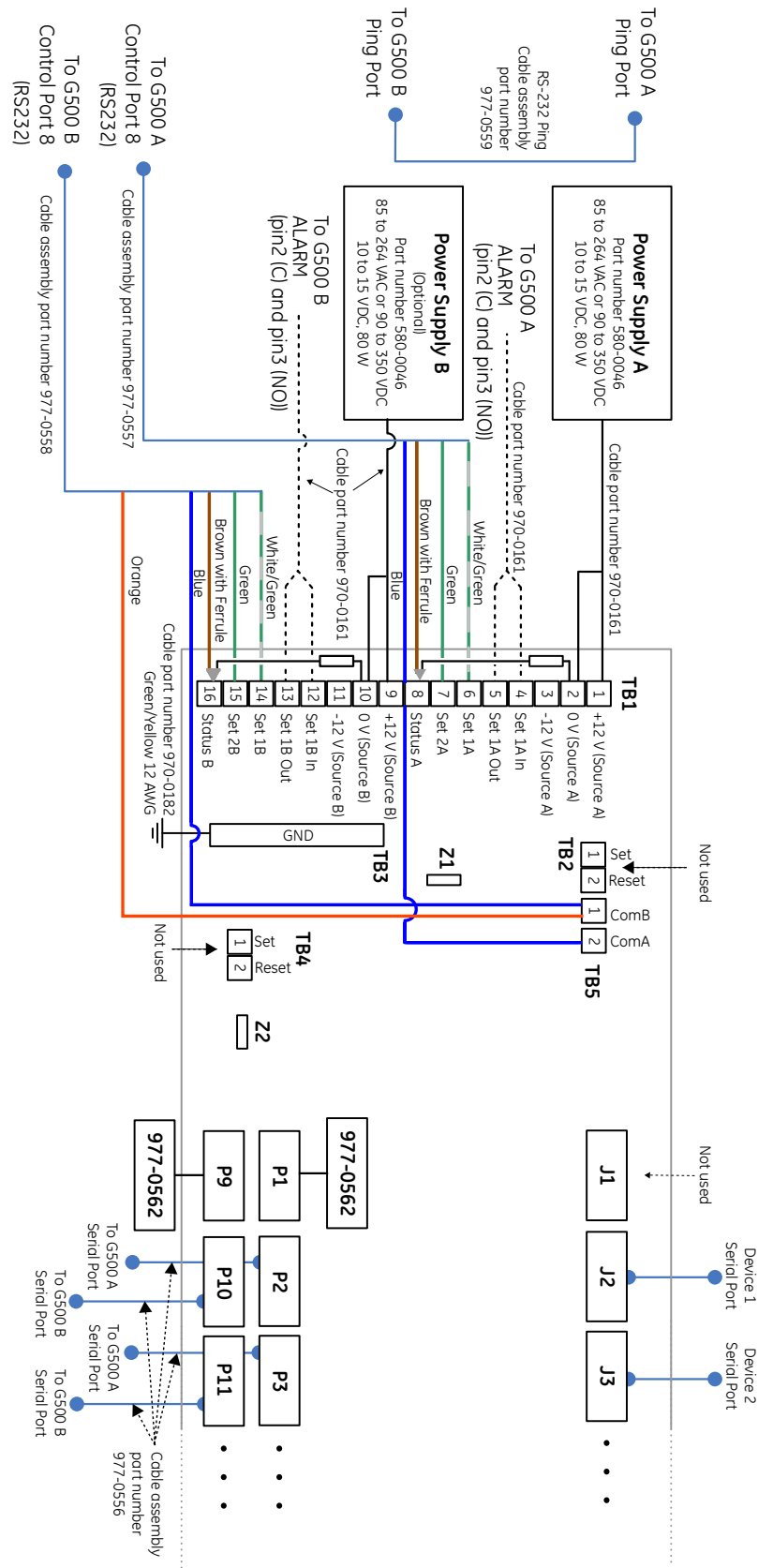
1. Pull the active/standby switch straight out to release it from the locked position.
2. Switch it up to make unit A active or down to make unit B active.

The CCU A/CCU B LED indicator indicates which unit has been activated.

Redundancy wiring diagrams

The following diagram illustrate how to wire the G500-D units and RS232 switch panel to enable system redundancy:

Figure 11: G500-D Redundancy Wiring - Single RS232 Switch Panel



G500 Substation Gateway

Chapter 4: Interfaces

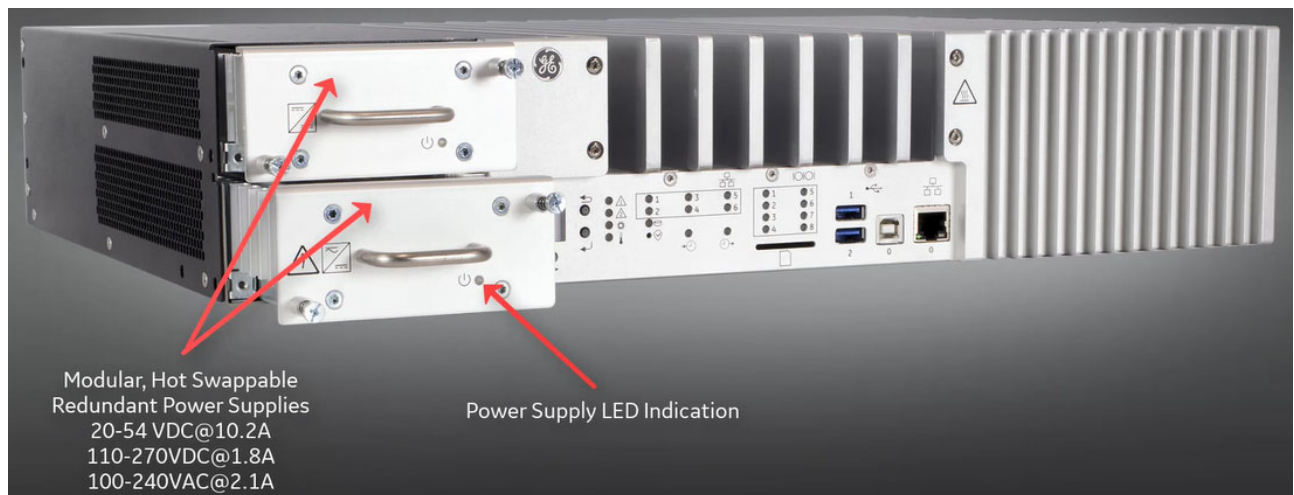
This chapter covers the interfaces of the Multilin™ G500 Substation Gateway.

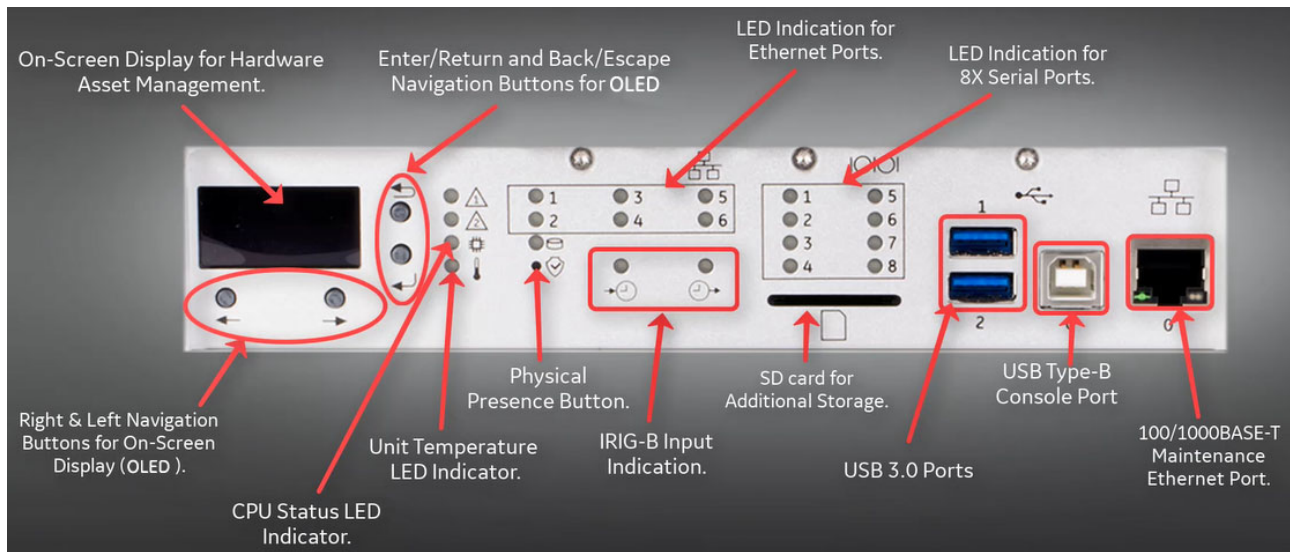
First look at the G500

Front panel

The front panel of the G500 provides easy access to the status indicators, user connections and power supply units.

Figure 1: G500 front panel

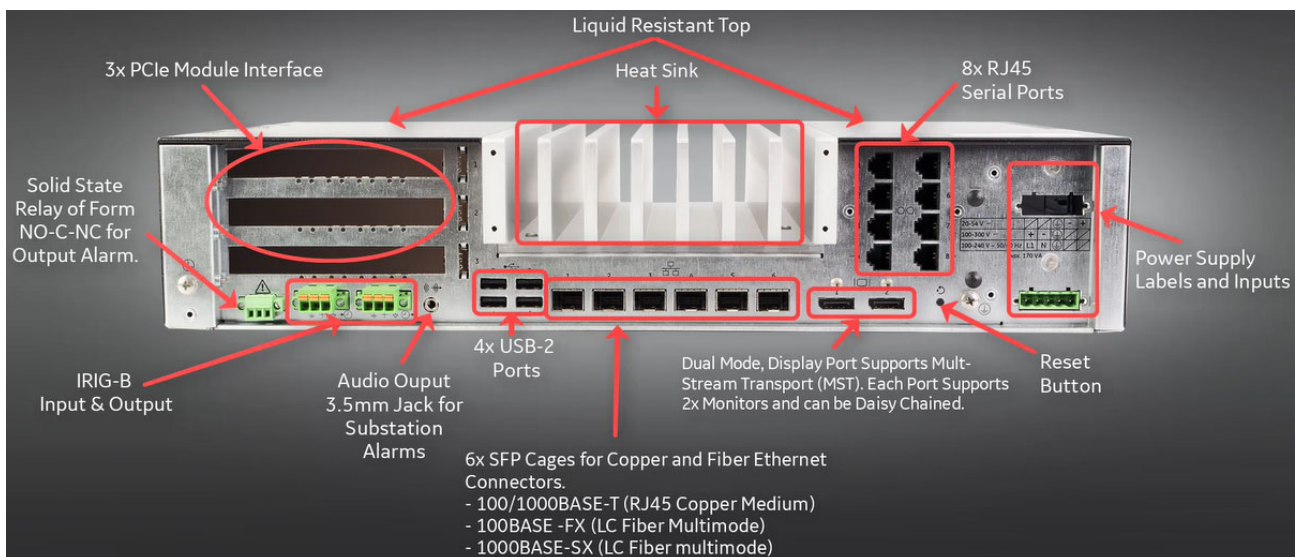




Rear panel

The rear panel provides access to the communication ports, field wiring connections and power connections.

Figure 2: G500 rear panel



The G500 contains serial (8 factory-installed and expandable to 20 through PCIe expandable cards) ports for the communication cards. The communication cards are powered from the G500. The types of communication cards included in your G500 depend on what was ordered for your substation application.

External Interfaces

These interfaces are directly accessible from front or rear of the Unit.

USB Slave

The front of the unit includes a USB B port. The G500 behaves as a USB Serial device on this port. This is to connect a debug device, for example a service personnel laptop. If enabled this port can show boot and OS output to Serial console. Configure the Host device to the same parameters as the G500.



The USB serial port can, when enabled in UEFI-Setup, redirect the UEFI-Setup screen. This is useful in cases where no display is available or the DisplayPort™ is disabled.

The USB serial port default settings are 115 kBaud, 8 data bits, no parity and 1 stop bit (abbreviated as 115200 8N1).

Ethernet Port

The front of the unit includes a single RJ45 Ethernet connector, used to connect the management network. If enabled the DASH functionality is available via this connection.

- DASH:**
- SOL port
 - Remote USB
 - Remote power control
 - Remote board info



The port uses an RTL8111EP network. Drivers are freely available for several operating systems on the Realtek website.

Reset Button

The G500 has a Reset Button located on the rear of the unit. The reset button is recessed to prevent accidental pressing of the button and can only be activated by inserting a pin through the opening in the chassis.



A momentary press (1 second) of the reset button will gracefully shutdown the G500 and remain off for 120 seconds, the front CPU LED will be orange for this duration. After 120 seconds the G500 will automatically restart and the front CPU LED will turn green. The 120 seconds off period is to allow users time to disconnect power from the G500.

A press and hold (5 second) of the reset button will abruptly shutdown the G500 and remain off for 120 seconds, the front CPU LED will be orange for this duration. After 120 seconds the G500 will automatically restart and the front CPU LED will turn green.

USB 3.0

The front of the unit includes two USB 3.0 A connectors mainly used to enable maintenance personnel to connect their equipment and storage devices for software updates.



Each USB 3.0 A port is fused separately. For normal operation don't exceed 0.9 A per connector. The cumulative current draw of both ports is limited to 1A due to thermal and power budget restrictions.

The maximum cable length for USB 3.0 cables is 3m (=118in).



Using longer cables than specified for each port might result in data loss.

SD Card

At the front of the unit a SD card slot is available.



The SD card slot supports SD, SDHC and SDXC SD-Cards according to Version 1.0, Version 2.0 and Version 3.0.

The SD-Card slot has a push-pull mechanism. Put the card into slot and push it until you feel some resistance. Push the card again, if you want to remove it from the slot.



The SD Card is supported only for the Windows Operating System.

USB 2.0

At the rear of the unit four USB 2.0 A connectors are located. Main purpose of these connectors is to enable installation personnel to connect Mouse, Keyboard and equivalent equipment for initial configuration of the device.



Each USB 2.0 A connector is fused separately. For normal operation don't exceed 0.9 A per connector. The cumulative current draw of all four ports is limited to 1A due to thermal and power budget restrictions.

The maximum cable length for USB 2.0 cables is 3m (=118in).

DisplayPort™

At the rear of the unit two DisplayPort™ connectors are located. The interfaces are DisplayPort™ Version 1.2 and DP++ compliant which are used mainly to enable installation personnel to connect a display for the initial configuration of the device.

Each DisplayPort™ is capable of supporting two suitable displays via Multi Stream Transport (MST) - up to 4 in total for AMD CPU Options and up to 3 in total for Intel CPU Options.



The Multi-Stream Transport (MST) feature in DisplayPort™, for daisy-chaining monitors, is supported only for the Windows Operating System.



Each DisplayPort™ is fused separately. For normal operation don't exceed 0.5 A per connector. The cumulative current draw of the two ports is limited to 0.5A due to Thermal and power budget restrictions.



Users are recommended to use passive DP++ to HDMI and passive DP++ to DVI-D. Use of active adapters is not encouraged as they limit higher frequency refresh rates, and limit display sizes.

Refer: DP-Marketing Guidelines for more details.



G500 doesn't support Touch Screen Panel controls due to the absence of external vendor USB drivers. It's recommended to use Windows Panel PC and the Remote HMI application instead.

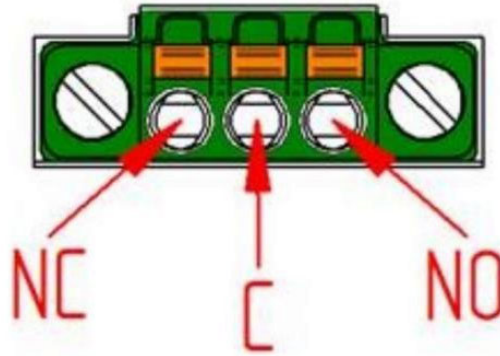
Alarm

At the rear of the unit an Alarm output connector is located.



This connector has three contacts NO, C and NC. These are the contacts of a solid state relay controlled by the watchdog and software. The relay voltage should be limited to switching up to 48VAC or 75VDC with maximum 100mA to comply with IEC 61850-3. If 61850-3 Compliance is not required, the relay may switch up to 300VAC or 300VDC.

This Port is isolated from the rest of system in accordance to IEC62368/IEC60950 for use with mains.



The mating connector is the 3-pin "Phoenix 1748367". This connector type is required for IP30 compliance.



Please observe all safety procedures to avoid damaging the system and to protect operators and users.



Electric shock can cause injury and may be fatal.

Before installing, removing or wiring this connector, please ensure that the external device is power off.



After the G500 starts up, the hardware watchdog will be enabled. The Status 1 LED will be GREEN and NO of the alarm output will be closed. After a critical failure is detected, the Status 1 LED will be RED and the NO of the alarm output will be opened to indicate system failure. Examples of critical failures are:

- Too many child restarts of a critical process
- Out of memory

If the system operating system freezes, the system will reboot after 10 seconds. Six seconds prior to reboot, the Status 1 LED will be ORANGE.

The Status 1 LED and Alarm Relay are controlled by the MCP Core watchdog application, even if the configured G500 functions is "C" or "D". This means that D2x Applications are not monitored by Status 1 LED or Alarm Relay - and alternate monitoring should be implemented (e.g., use of separate DO under the control of D2x applications).

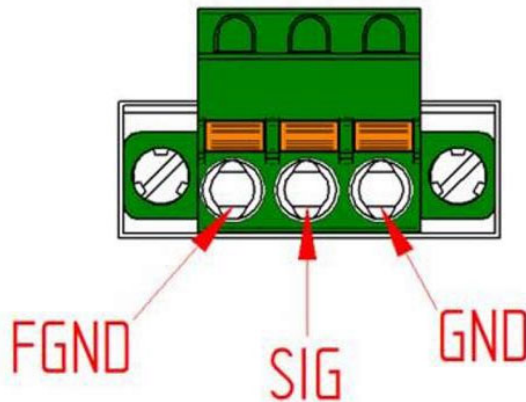
IRIG - IN

There is a IRIG-B input connector available at the rear of the unit. This input can be used to synchronize the precision timer of the unit. The supported IRIG-B formats are 002 and 006. When configured as B002, the INPUT LED will show Orange when valid IRIG signal is present.

When configured as B006, the INPUT LED will show Green when valid IRIG signal is present and the clock requires a corresponding configuration where the year and quality are included in the IRIG-B signal. If the clock is not configured to provide the year the G500 will show the year 2000.

The supported levels are compliant to TTL.

This Port is isolated from the rest of system with an isolation voltage of 2kV AC.



The mating connector is the 3-pin “Phoenix 1732975”. This connector type is required for IP30 compliance.



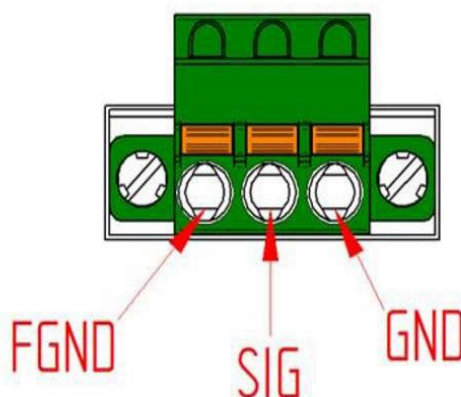
A shielded twisted pair cabling shall be used for wiring.

IRIG - OUT

There is a IRIG-B output connector available at the rear of the unit. This output can be used to synchronize external equipment or other units to this unit. The supported IRIG-B formats are 002 and 006. The supported levels are compliant to TTL by a load of 250hm or higher.

This port is current limited and protected against damage by short of both contacts.

This Port is isolated to the rest of system with an isolation voltage of 2kV AC. The current carrying capacity of IRIG-B OUT is 120mA and it's capable of supplying up to 16 IED's.



The mating connector is the 3-pin “Phoenix 1732975”. This type is required to use for IP30 compliance.

For proper connection, the recommended tool torque settings for connector flange screws are 2.7 in-lb [0.3 Nm]. A Flathead screwdriver with 0.4 mm by 2.5 mm blade is recommended.



A shielded twisted pair cabling shall be used for wiring.

Serial Ports

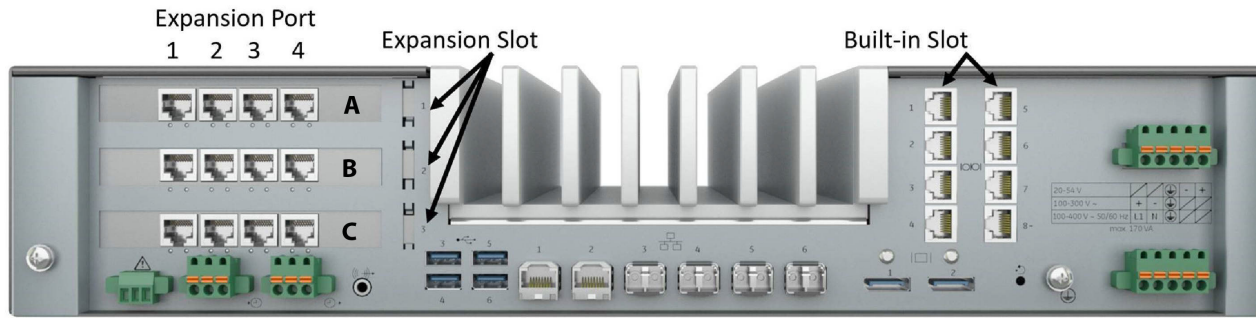
The G500 has 8 Built-in Serial ports available as RJ45 connectors on the rear of the unit and an additional 4, 8 or 12 can be configured through the PCIe Expansion slots. The physical communication ports are shown in the figure below and the corresponding configuration tool references in the table below. The Ports are isolated from the rest of the system and from each other by a 2 kV isolation Voltage.

DS Agile Studio Port range	Slot	Physical Com Ports
1 through 4	Built-in	1 through 4
5 through 8	Built-in	5 through 8
9 through 12	Expansion Slot 1	1 through 4
13 through 16	Expansion Slot 2	1 through 4
17 through 20	Expansion Slot 3	1 through 4

The serial ports support 4 communication modes

- RS232
- RS422
- RS485 4-Wire
- RS485 2-Wire

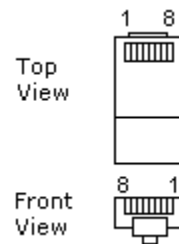
For every port an Rx Termination Resistor of 120 Ohms can be enabled through the software interface. This termination persists even when power is lost.

Figure 3: G500 rear view with UART and expansion slots

The pin assignment of the Serial Interfaces is dependent on the operation mode selected for the interface:

Table 1: RJ45 Pin outs for Serial Port Signals

EIA568	TIA/EIA 568A	RJ45 Pin out	RS232	RS422	RS485 4-Wire	RS485 2-Wire
		1	Rx	Rx-	Rx-	D-
		2	CTS	Rx+	Rx+	D+
		3	Tx	Tx-	Tx-	-
		4	GND	GND	GND	GND
		5	IRIG-B	IRIG-B	IRIG-B	IRIG-B
		6	RTS	Tx+	Tx+	-
		7	VCC*	VCC*	VCC*	VCC*
		8	DCD	-	-	-
*only on port 4 and 8						

Figure 4: Modular connector 8P8C (RJ45) pin

The VCC (Pin 7) is available on port 4 and port 8 from the Built-in slots and port 4 of each PCIe Expansion card installed in Expansion slots 1, 2 and 3. It is a 12V power output that is limited to 6W. If a higher load is applied to the output the output shuts down.

The IRIG-B (Pin 5) is available on ports 1 through 8 of the Built-in slots and is not available on any of the ports from the Expansion slots. The IRIG-B signal is a copy of the IRIG-B time signal output on the rear of the system. This output can be used to synchronize external equipment or other units to this unit. The supported levels are compliant to TTL by a load of 120Ohm or higher. It is current limited and protected against damage by short to GND (Pin 4).

For interconnection of 2 G500 in 485-2W mode a standard 1:1 patch cable can be used. For all other modes a standard crossover is suitable.



Shielded twisted pair cables shall be used for wiring. For users preferring to or requiring to terminate using D-Sub miniature 9 pin-female connectors, please refer to [G500 system redundancy](#) on page 54.

RS485 Connections

The G500 can be configured to communicate with RS-485 2-wire or 4-wire type devices using the 8 Built-in Serial Ports or additional serial ports installed in the PCIe Expansion slots. Each serial port can be independently configured through the Settings GUI and is galvanically isolated. All port configurations persist through a power cycle and when power is lost.

In RS-485 mode End of Link Termination (120 Ohm) can be enabled through the Settings GUI.



In RS-485 mode, it is important to configure the end of link termination option depending on the RS-485 wiring approach.

The RJ45 pin out for the corresponding communication protocol can be viewed from Table 1 on page 92.

The cables must be shielded and the shield of each RS-485 cable section should be grounded at one end only. This prevents circulating currents and can reduce surge-induced current on long communication lines.



Signal ground on pin4 is to be considered different then shield on cable.



When creating custom cables, it is recommended to only wire the required pins.



When a serial port is configured for RS485, modem control handshaking signals (RTS, CTS and DCD) generally do not apply. The exception is with the DNP Server where the RTS Pre-Trans Delay can be used to slow down the server response. This is sometimes necessary in 2-wire setups to prevent the DNP Server from responding while the master is still driving the line.

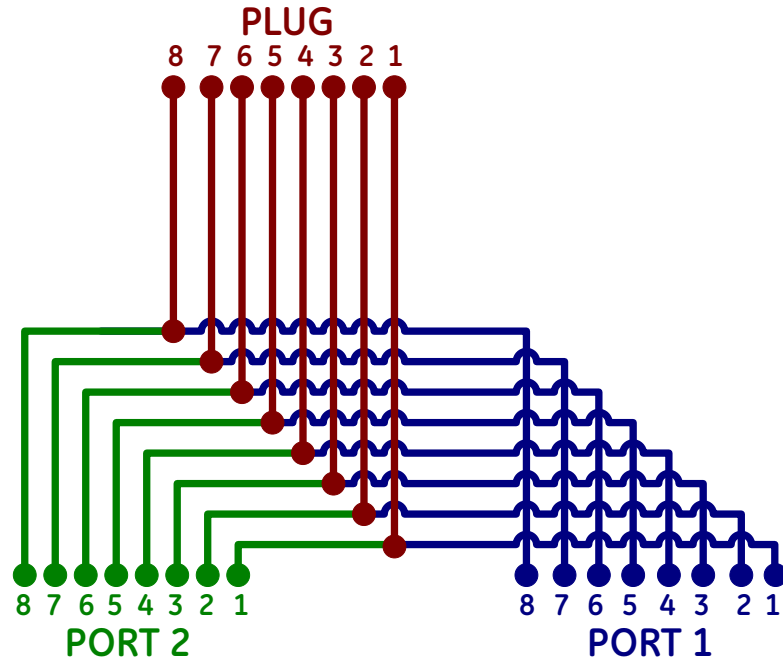
RS-485 4-wire mode should only be used for point to point connections, not for serial port redundancy or CCU redundancy.

RS-485 Splitter

The RS-485/RJ45 splitter or Y splitter referred to in this Instruction Manual (994-0152) must be of the type where all signals are connected straight through from the plug to all jacks as shown in Figure 5.

To eliminate ground loops, the RJ45 splitter cannot have the cable shields connected. The cable length from the RJ45 splitter to the G500 serial port should be kept short.

Figure 5: RS-485 splitter



RS-485 2-wire mode wiring approaches

The following diagrams illustrate how to wire the G500 units and RS485 2-wire:

Figure 6: RS-485 (2-wire) - Single Link

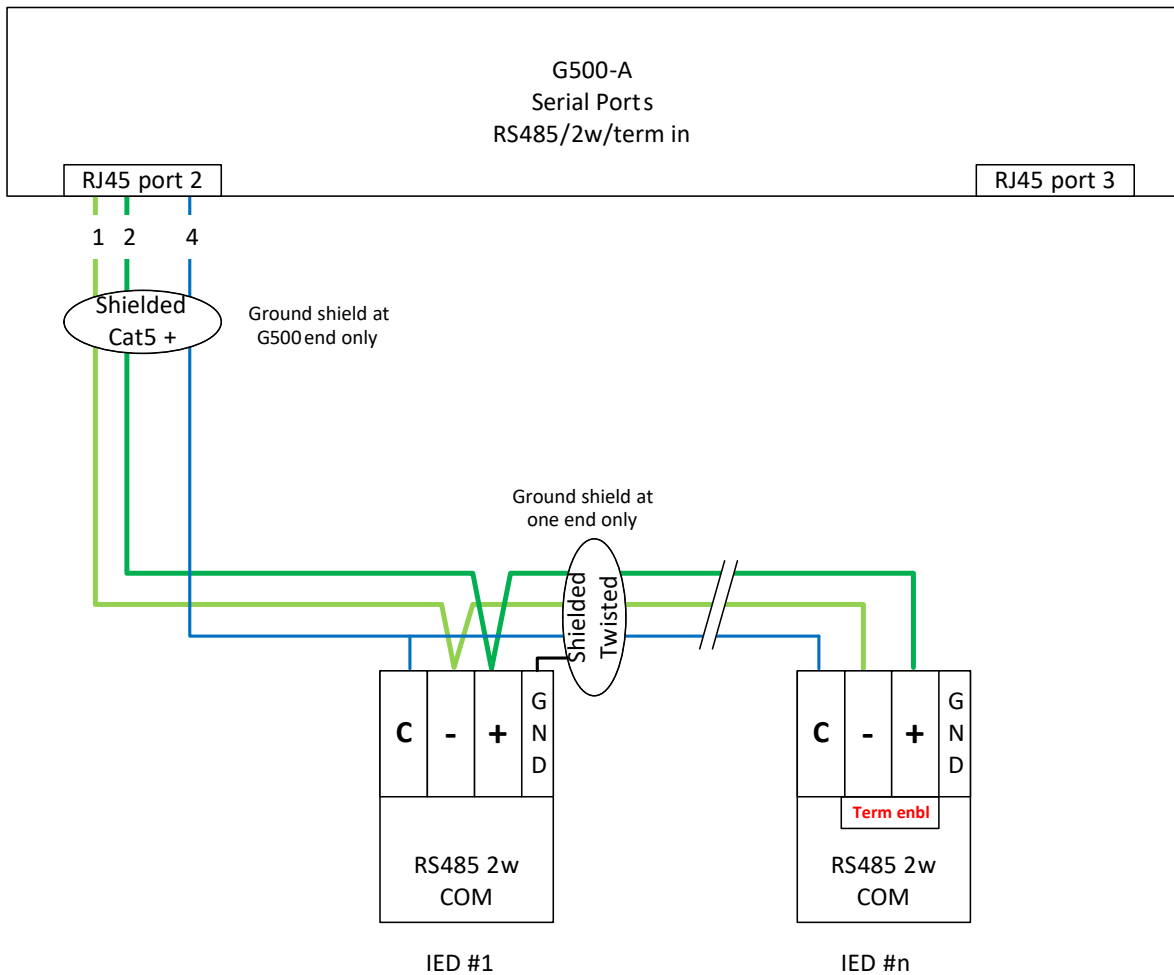


Figure 7: RS-485 (2-wire) - Single Loop

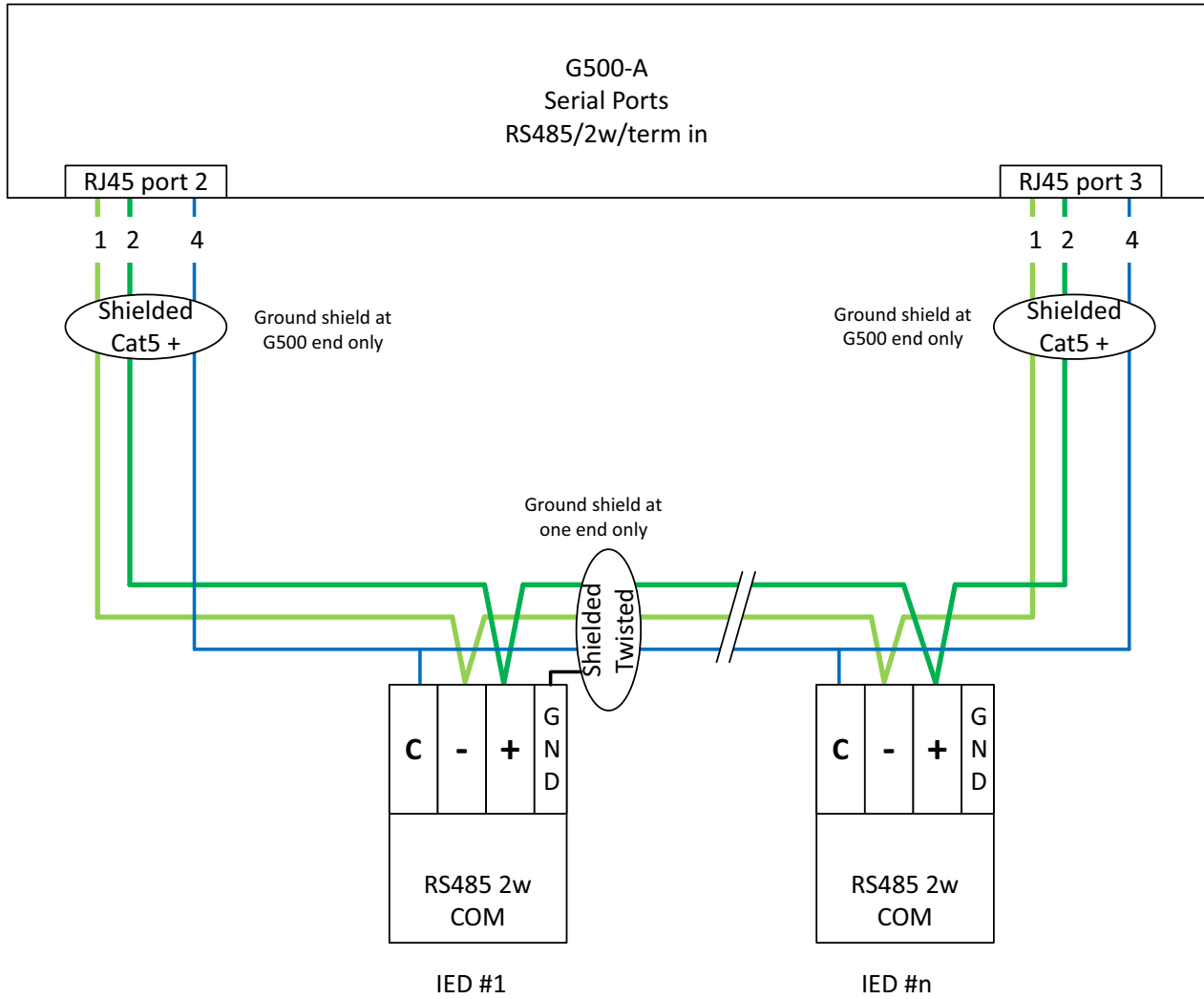


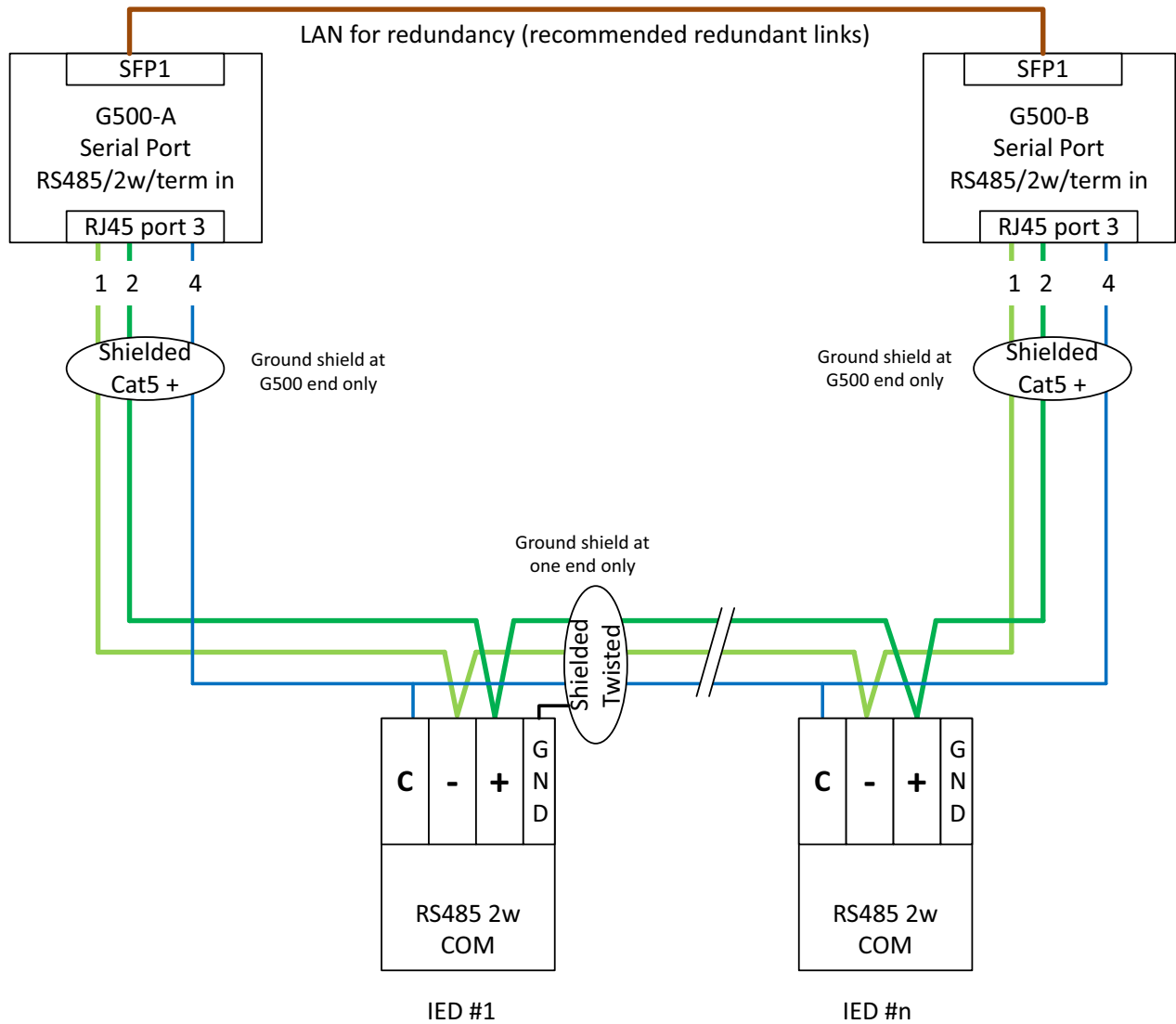
Figure 8: RS-485 (2-wire) - Single Loop with Redundancy

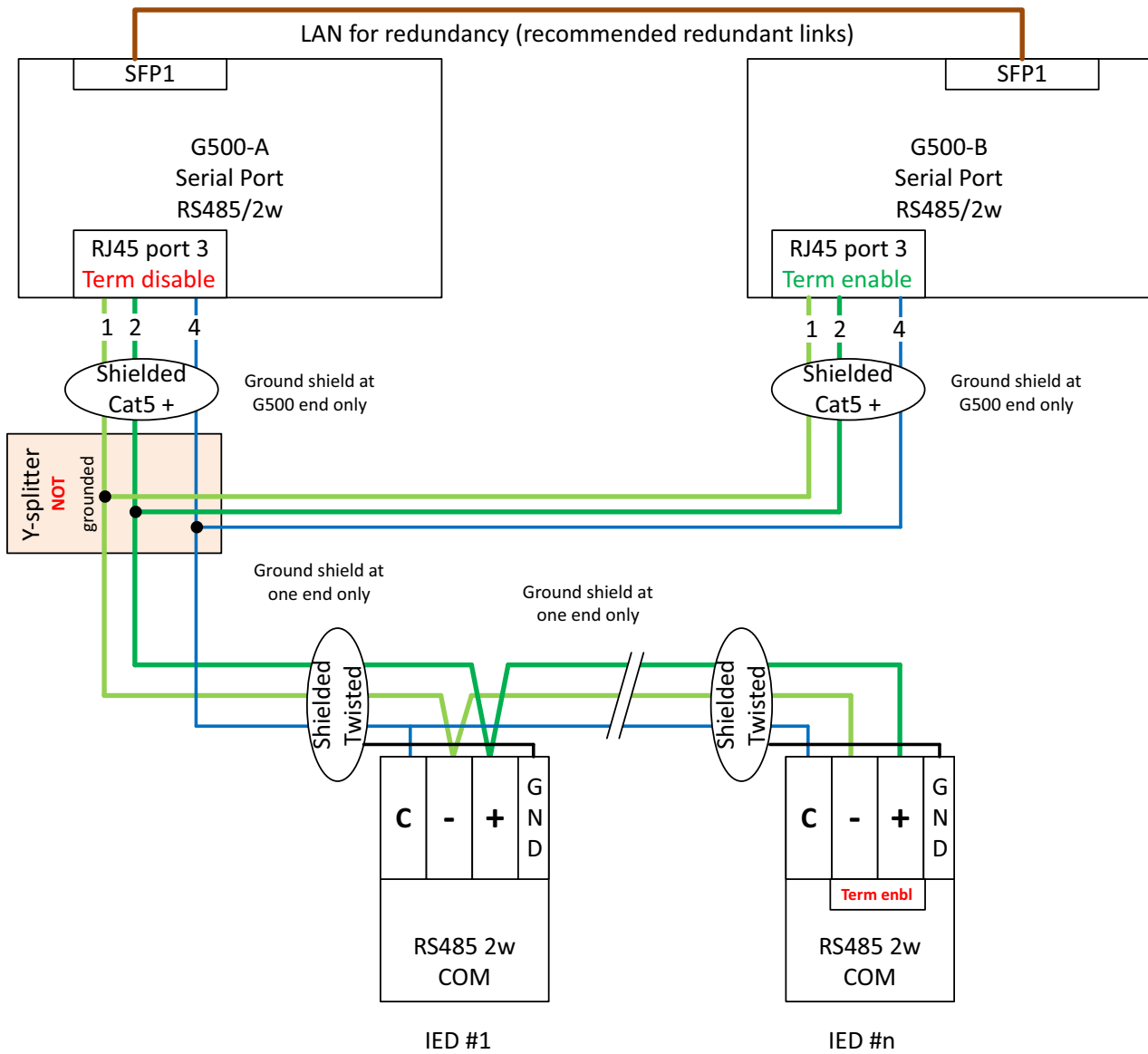
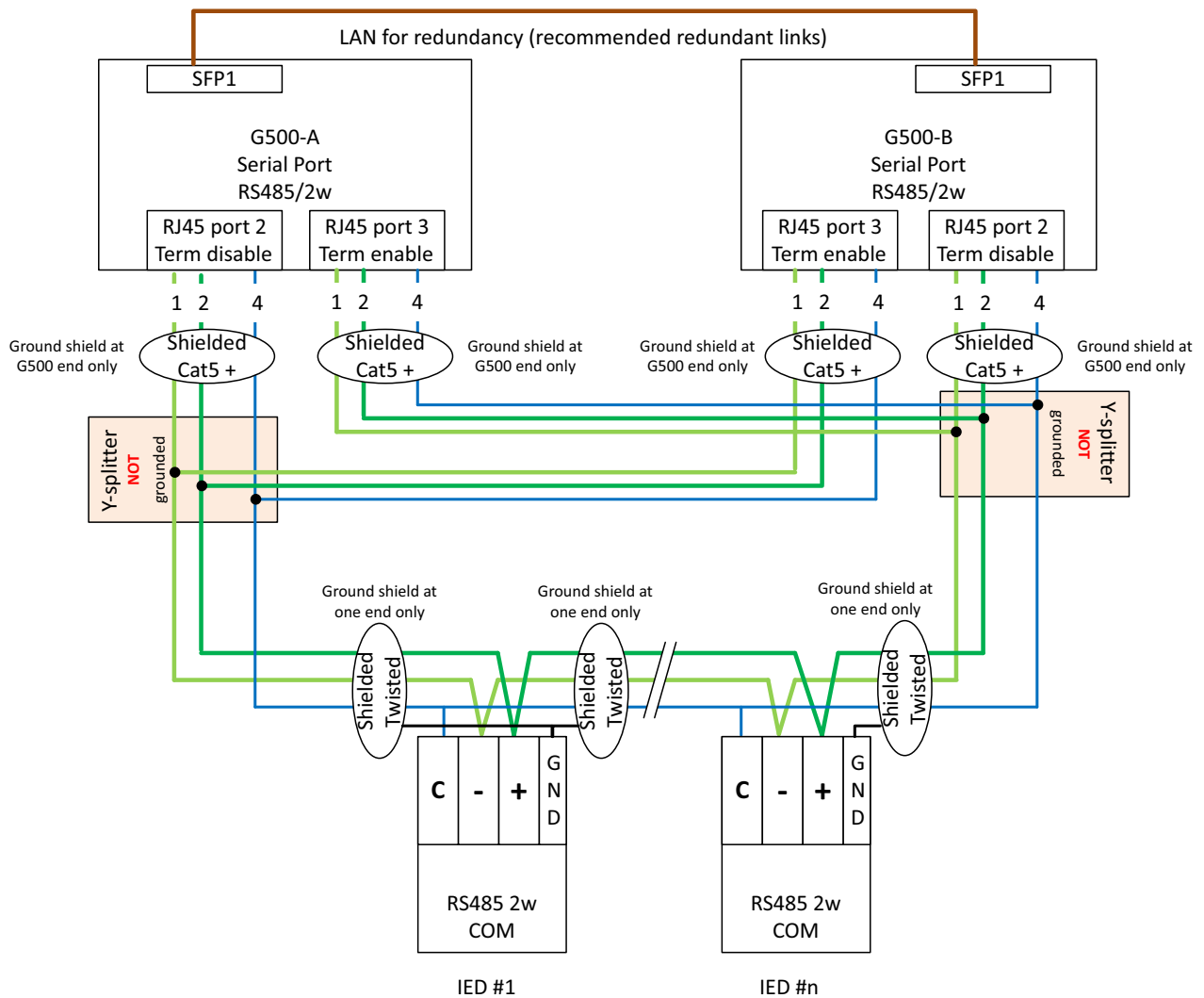
Figure 9: RS-485 (2-wire) - Redundant Link with Redundant CCU

Figure 10: RS-485 (2-wire) - Redundant Loop with Redundant CCU

High-voltage installations

To provide higher EMC immunity and maintain CE Mark radiated emission compliance, the serial cables used for permanent RS-232 and RS-485 connections must comply with the following requirements:

- Cables must be shielded.
- D-type connector covers must provide EMC shielding (e.g. metalized plastic or die cast metal covers).

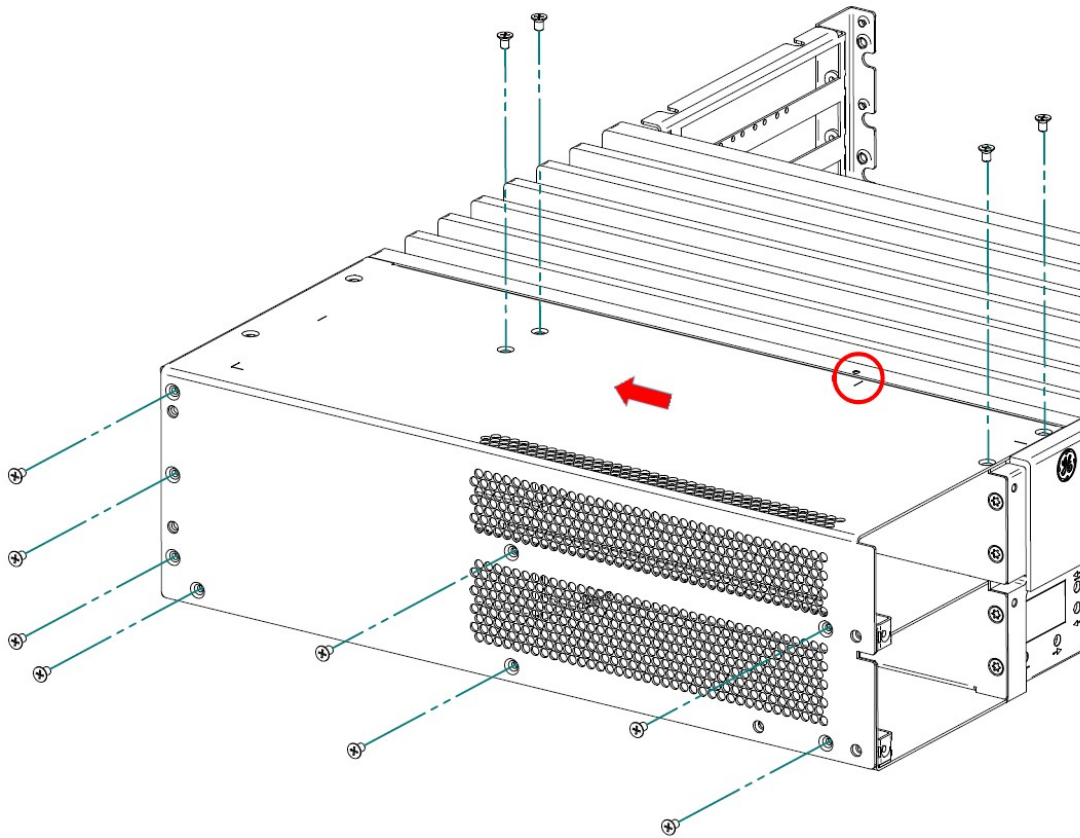
Service of serial (UART) modules

⚠ CAUTION

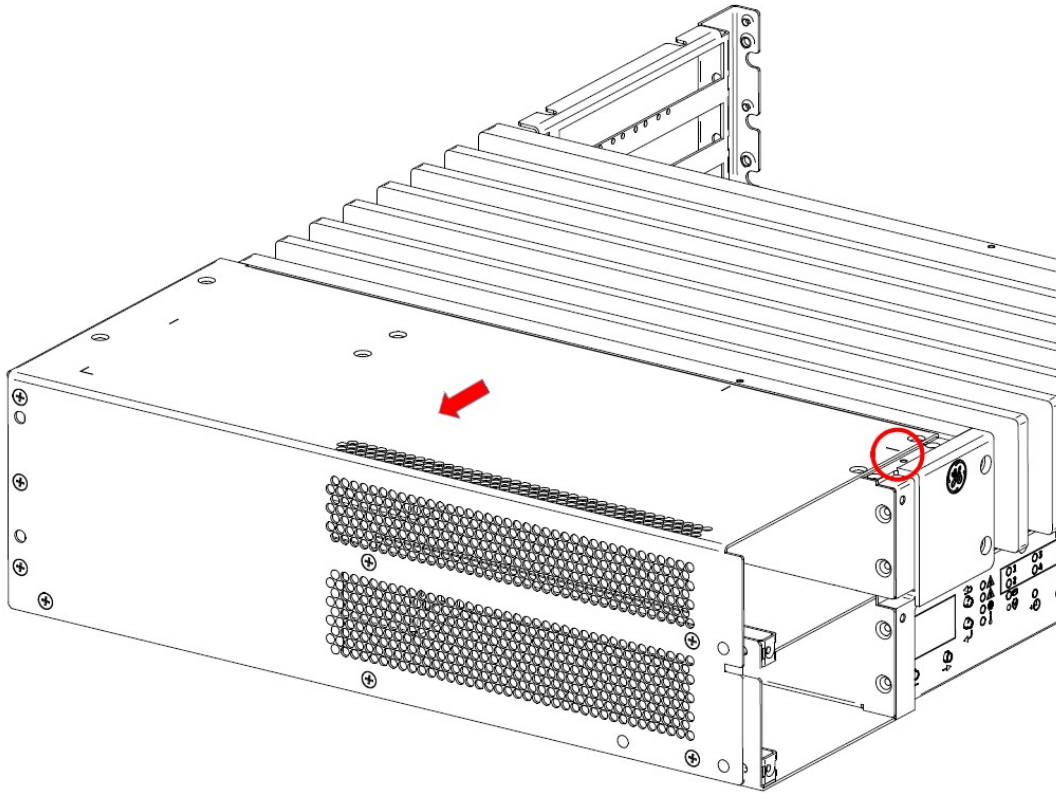
The information described in this section is for service technicians only!

The built-in Serial (UART) modules are field replaceable. It is not allowed to increase or decrease number of Serial (UART) ports by this method.

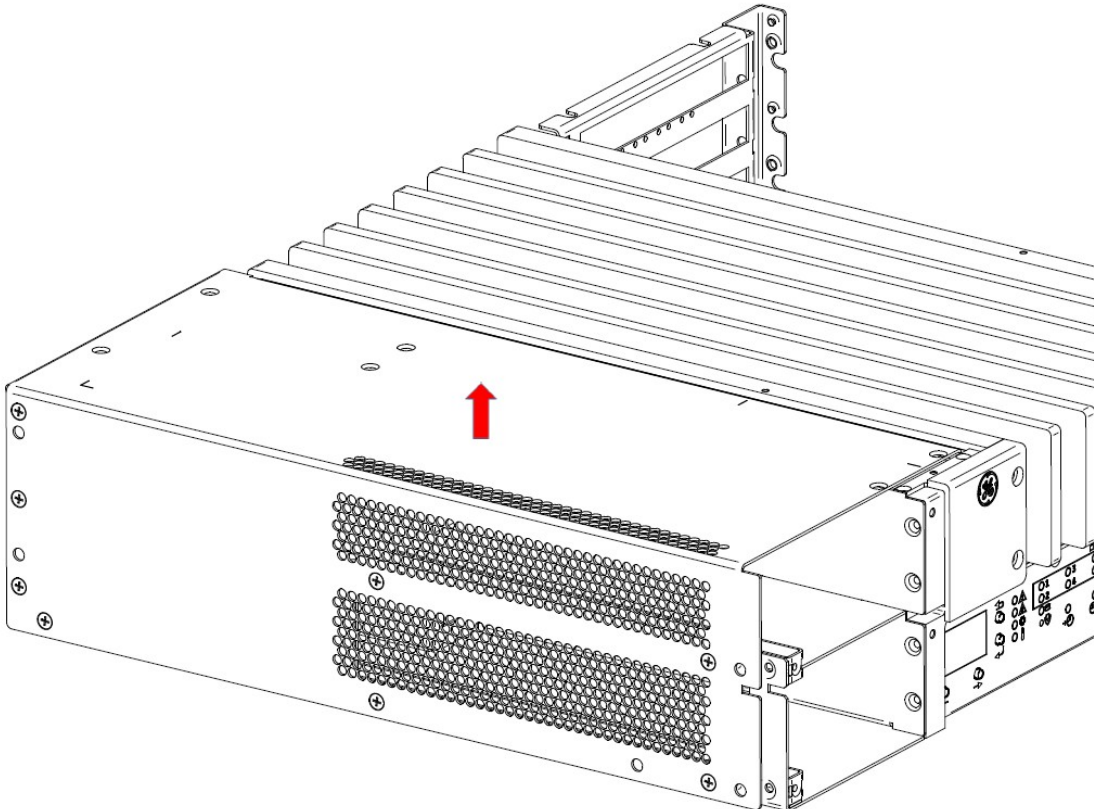
1. Power down system gracefully.
2. Disconnect all hazardous live circuits and sources of electrical power.
3. Remove both power supplies.
4. Remove screws and push lid to the rear until markings on lid and chassis align.



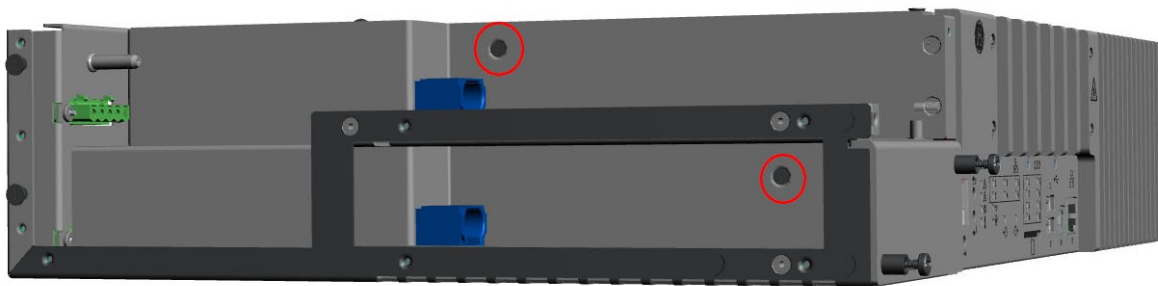
5. Pull lid to outside until second marking aligns.



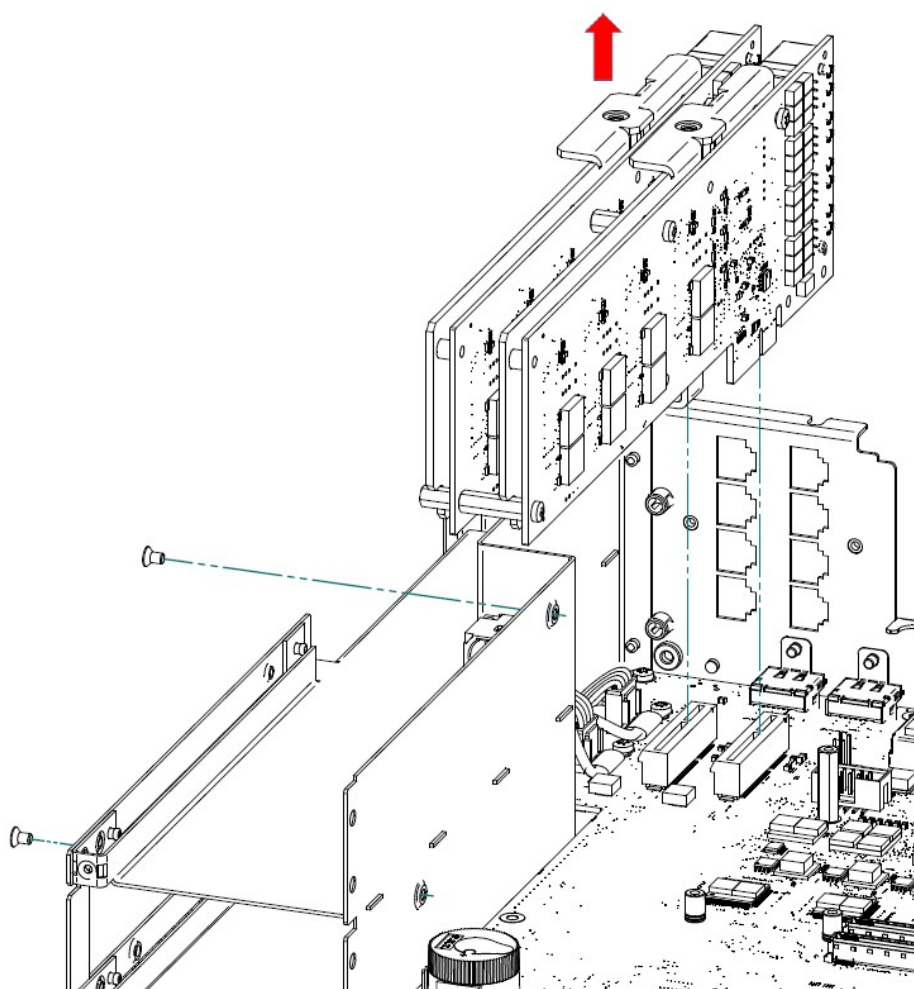
6. Lift lid to remove.



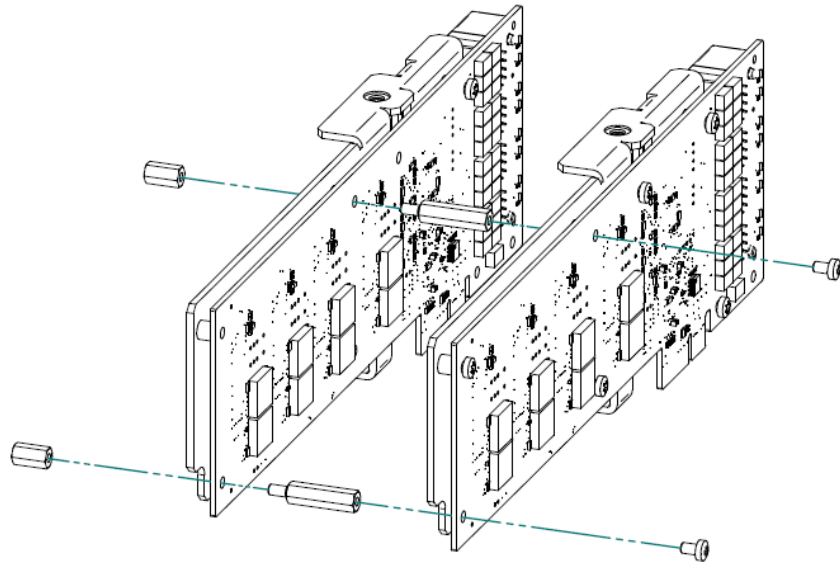
7. Remove attachment screws.



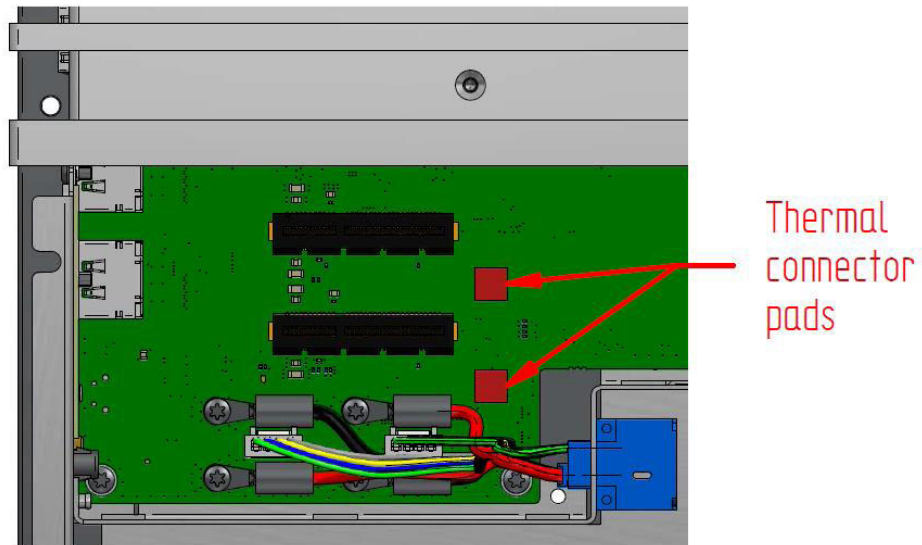
8. Pull UART package out of slots (be careful, do not to damage ESD gasket at the rear).



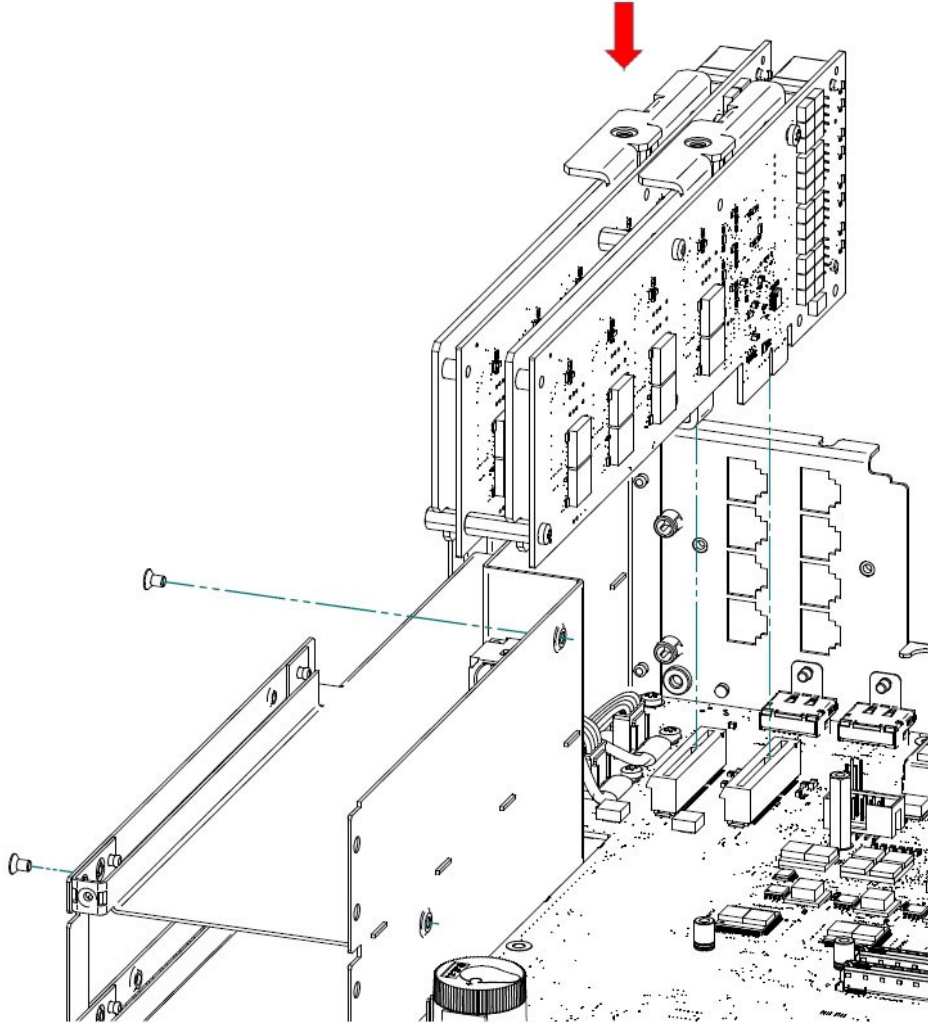
9. Exchange the UART module.



10. Check that the thermal connector pads on the PCB are still in place. If the thermal pads are damaged or missing, contact GE Vernova for replacements.

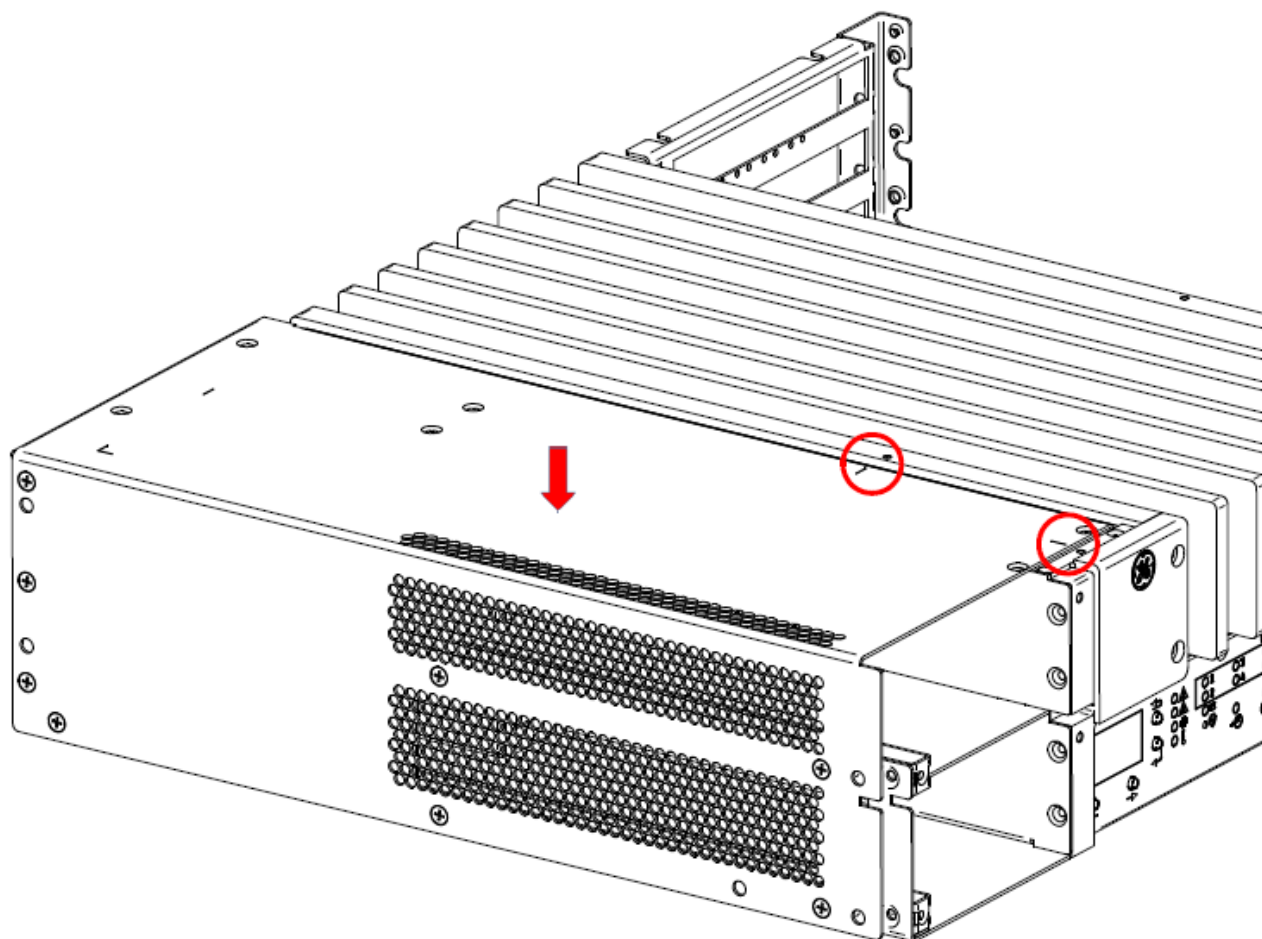


11. Insert the UART module into slots and attach the UART module by re-installing the screws from the power supply bay.

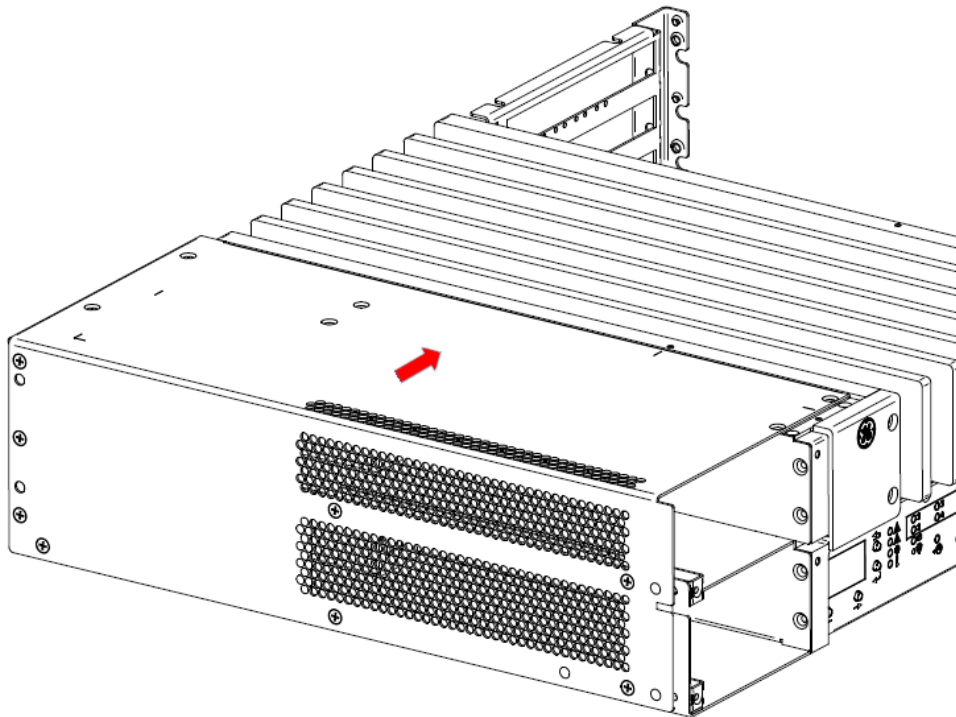


Be careful, do not damage the EMI gasket on the rear of the unit. Otherwise, since damage may result in reduced ESD protection.

12. Attach the lid a little to the rear and out of position (In the right position both lid and chassis markings align).



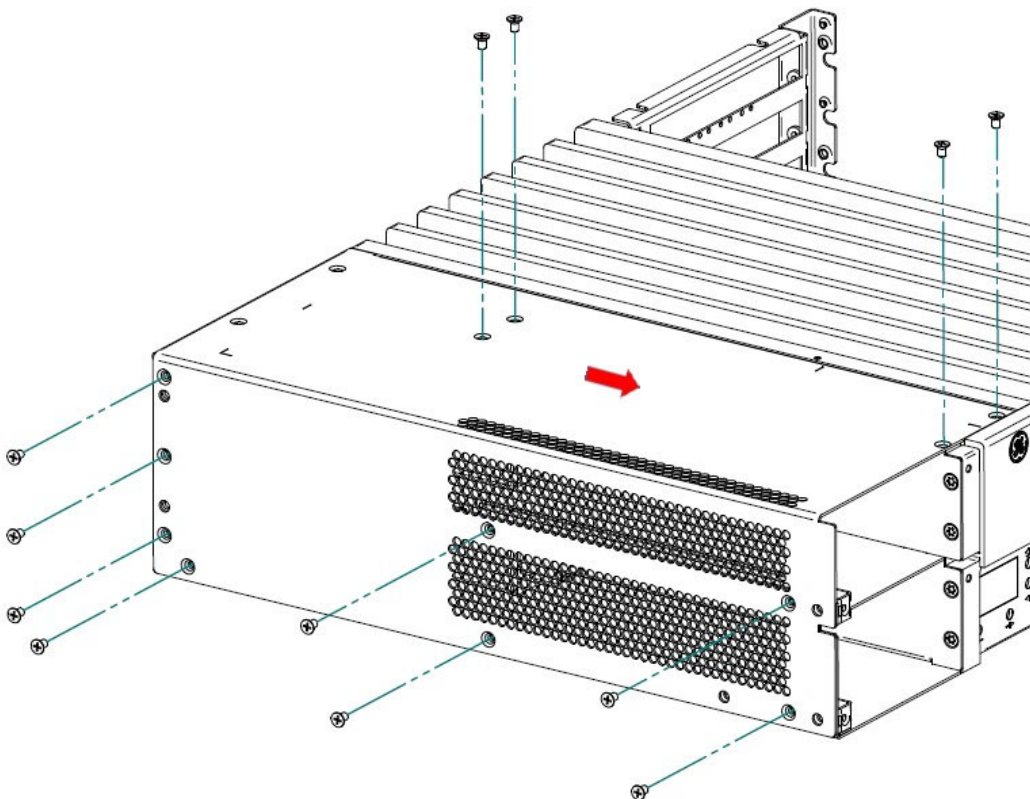
13. Push the lid inwards.



14. Push the lid to the front and attach all screws.



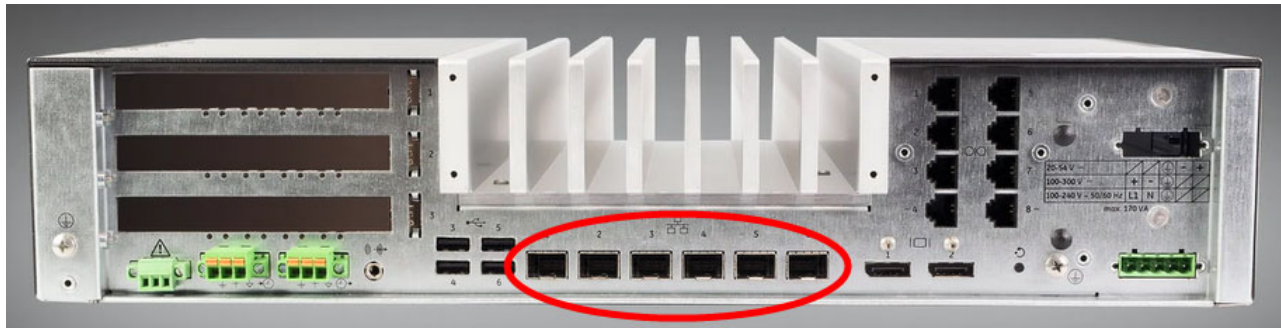
For screw torque specification, refer to [General Torque Values for Screws](#) on page 133.



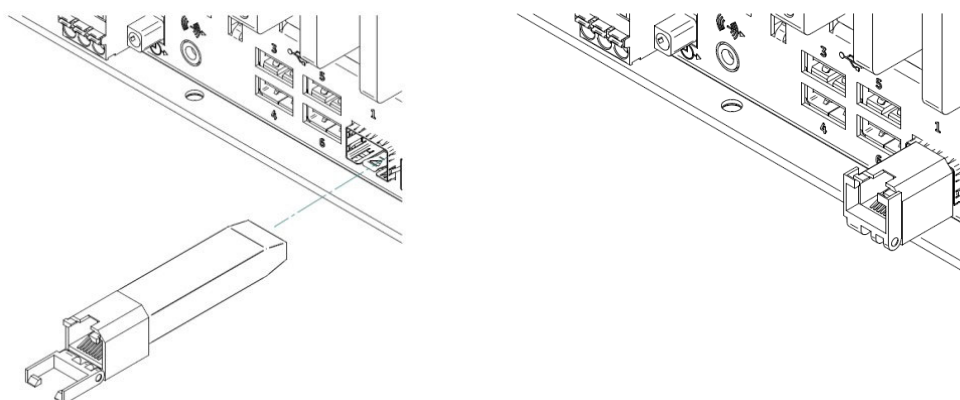
Ethernet Ports

There are six SFP slots available for Ethernet Interfaces at the rear of the G500 unit. Into each slot an SFP module can be inserted.

For corresponding SFP modules and order codes, see [G500 external Accessories](#) on page 107



Inserting an SFP module selects the appropriate transmitter protocol for the corresponding switch port.



G500 external Accessories

The following SFP modules are supported by G500:

Item	Description	Manufacturer	Mfg Part number
580-3784	SFP Module 100BASE-FX LC TRANSCEIVER OPTICAL	AVAGO	HFBR-57E0APZ
580-3785	SFP Module 1000BASE-SX LC TRANSCEIVER OPTICAL	AVAGO	AFBR-5710ALZ
		FINISAR	FTLF8519P3BTL
580-3786	SFP Module 100/1000BASE-T RJ45 TRANSCEIVER COPPER	FINISAR	FCLF8522P2BTL
		FOXCONN	ABCU-5730ARZ
		FOXCONN	ABCU-5731ARZ
580-3787	SFP Module 1000Base-LX LC TRANSCEIVER OPTICAL SINGLE-MODE 5km 1310nm -40 to 85C	FOXCONN (AVAGO)	AFCT-5715ALZ

General cable requirements

The cables required to make physical connections to the G500 are as follows:

Media	Designation	Cable	Connector
Twisted Pair Ethernet	100/1000Base-T	UTP (Unshielded Twisted Pair) – CAT 5 or better	RJ45
Fiber optic	100BASE-FX	Fiber optic cable multimode	LC
Fiber optic	1000BASE-SX	Fiber optic cable multimode	LC

Internal Interfaces

The G500 has internal installation options for three M.2 SSD's, three PCIe Cards and a USB Dongle Slot.



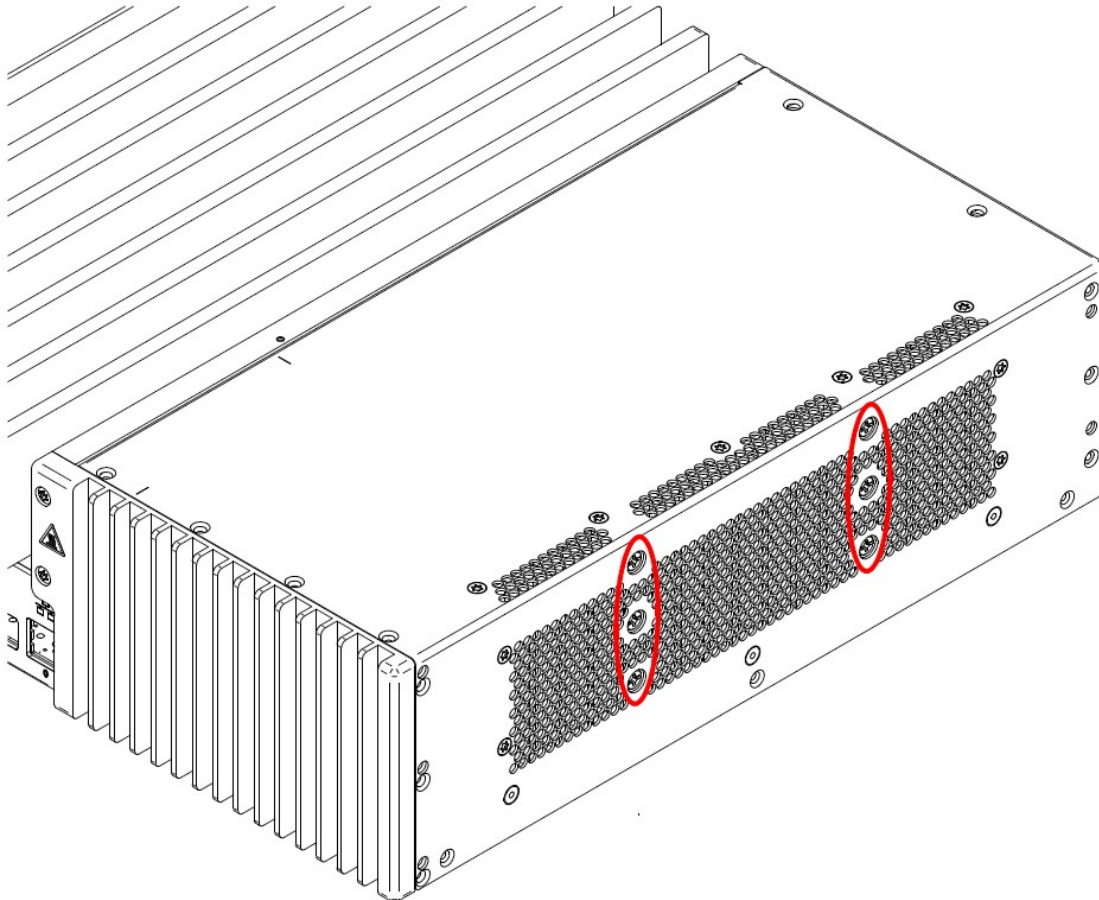
Electric shock can cause injury and may be fatal.

The ALARM connector and the both power supply connectors have to be disconnected before housing is opened!

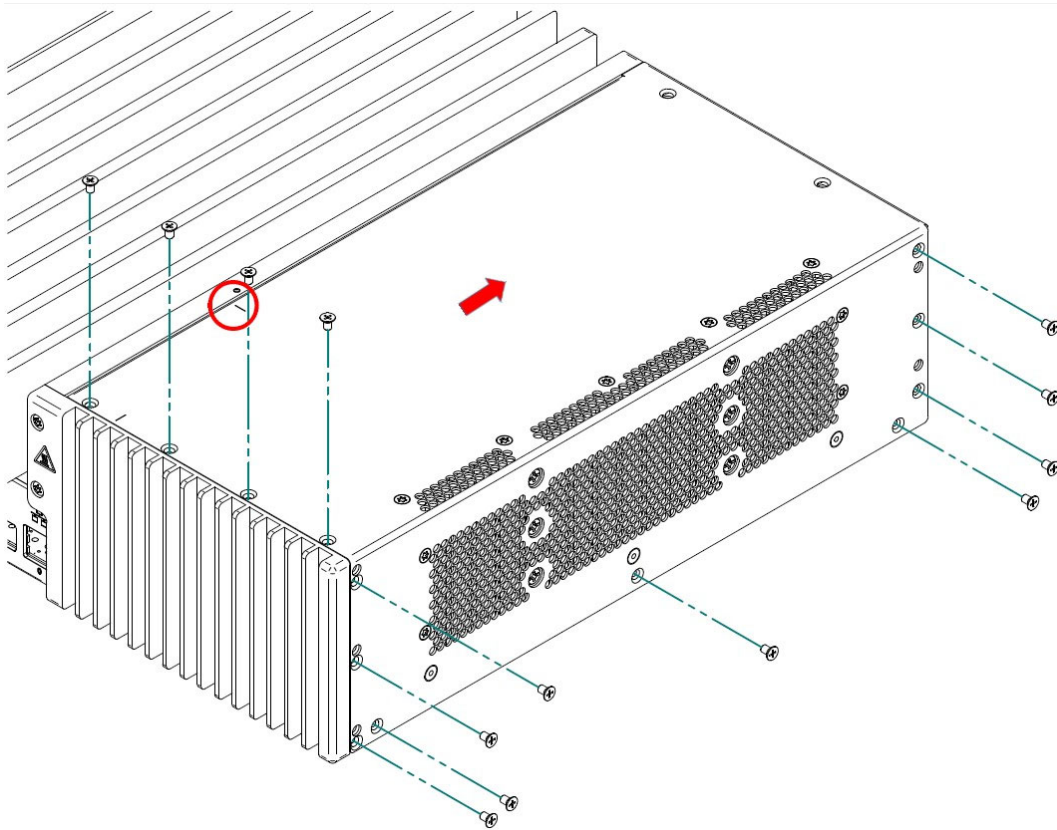
Opening cover

To change or add the cards open the chassis by performing following steps:

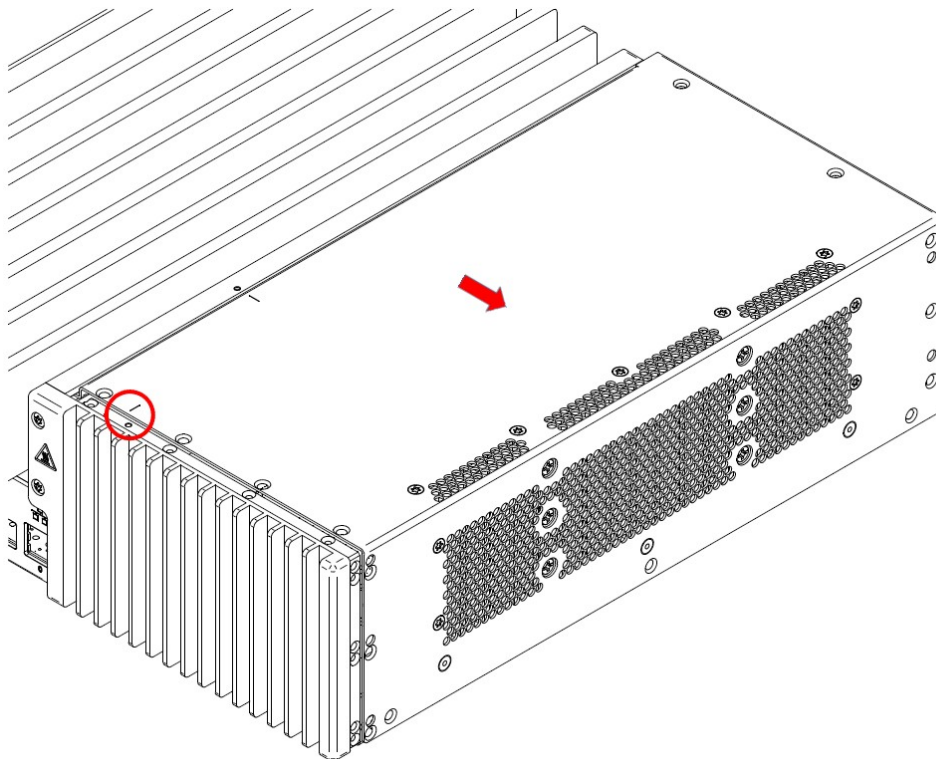
1. Undo the PCIe heat sink screws if tightened.



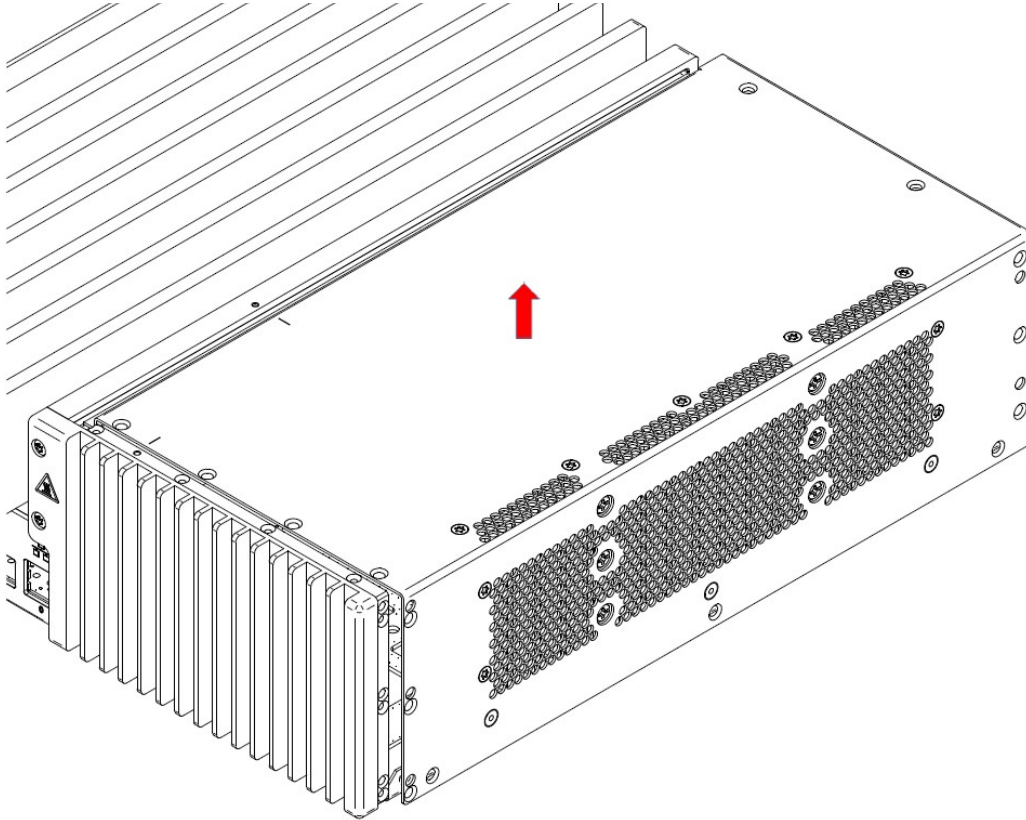
2. Remove the screws and push the cover to the rear until markings on the lid and chassis align.



3. Pull the cover outwards until the second markings on the lid and chassis align.

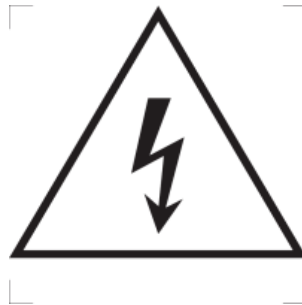


4. Lift the lid to remove.



Electric shock can cause injury and may be fatal.

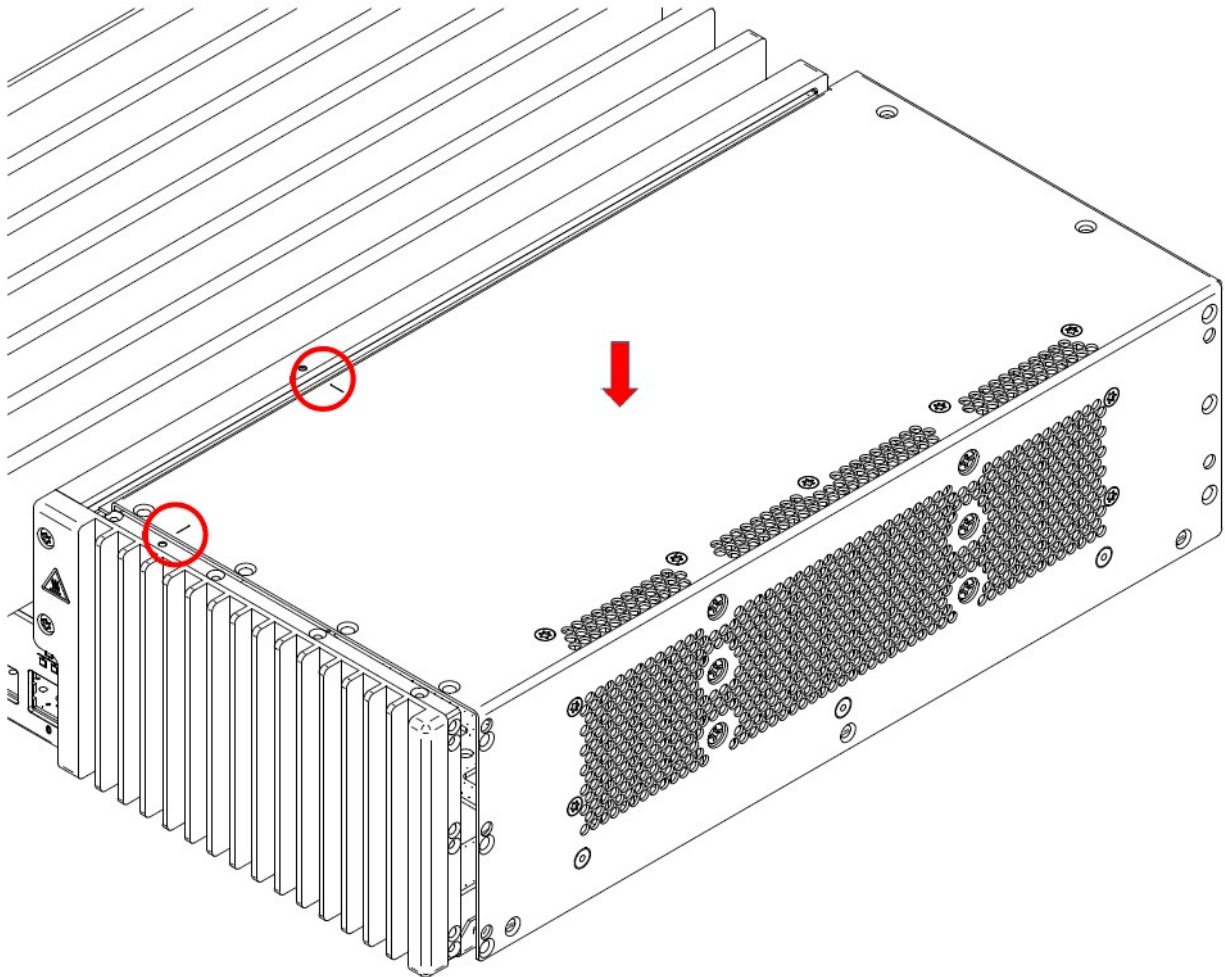
The ALARM connector can be connected to voltages up to 300V and its contacts are accessible if chassis is open. The dangerous area is marked with the electric hazard symbol.



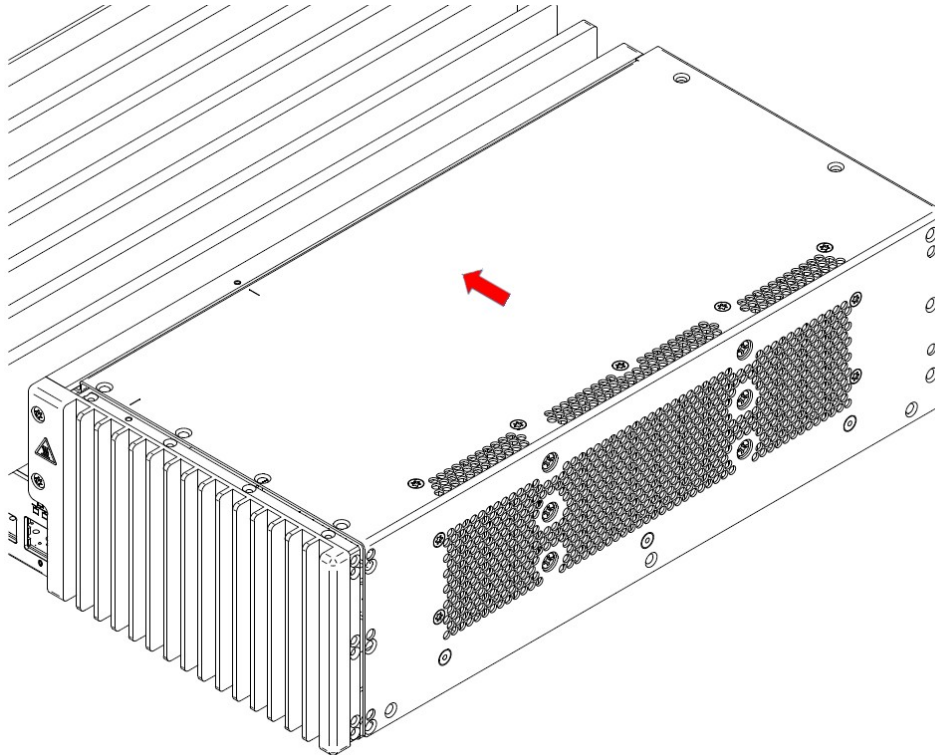
This Unit is to be serviced by trained personnel only.

Closing cover

1. Attach the lid a little to the rear and out of position (In the right Position both lid and chassis markings align).



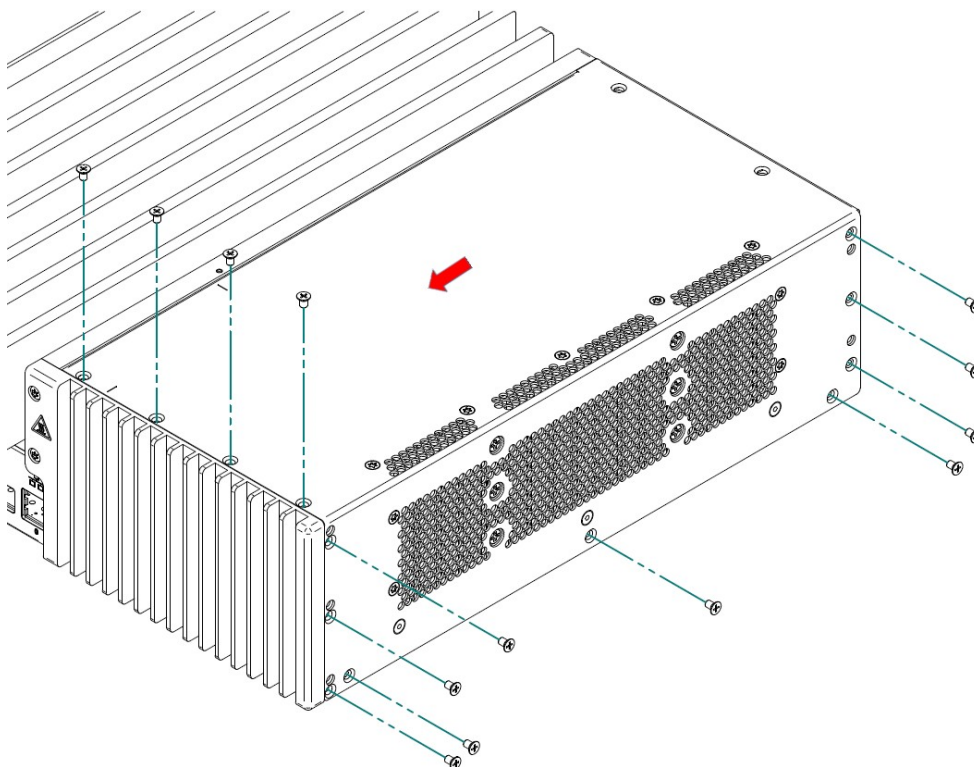
2. Then push lid inwards.



3. Push the lid to the front and attach all screws.



For screw torque specification, refer to [General Torque Values for Screws](#) on page 133.



M.2 SSD

G500 comes with a 128GB or 256GB or 1TB M.2 SSD pre-installed.

G500 Units manufactured before 2025 were shipped with a default SSD user password u123@MCPGE applied in the UEFI.

G500 Units manufactured starting in 2025 have no default SSD password applied..

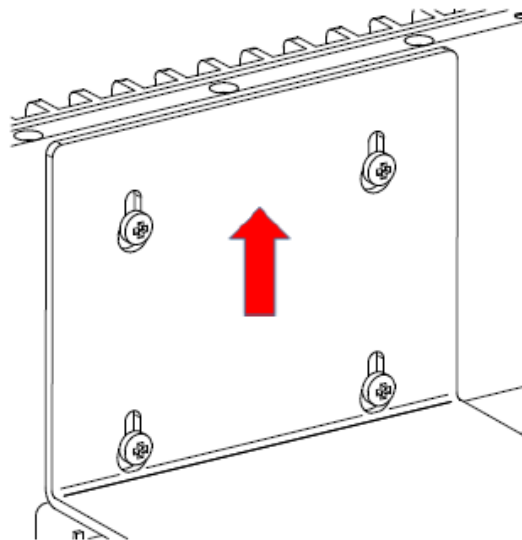
For additional information, please refer to “SWM0105 G500 Secure Deployment User Guide”.

For normal operation don't exceed 1 A per slot due to Thermal and power budget restrictions.

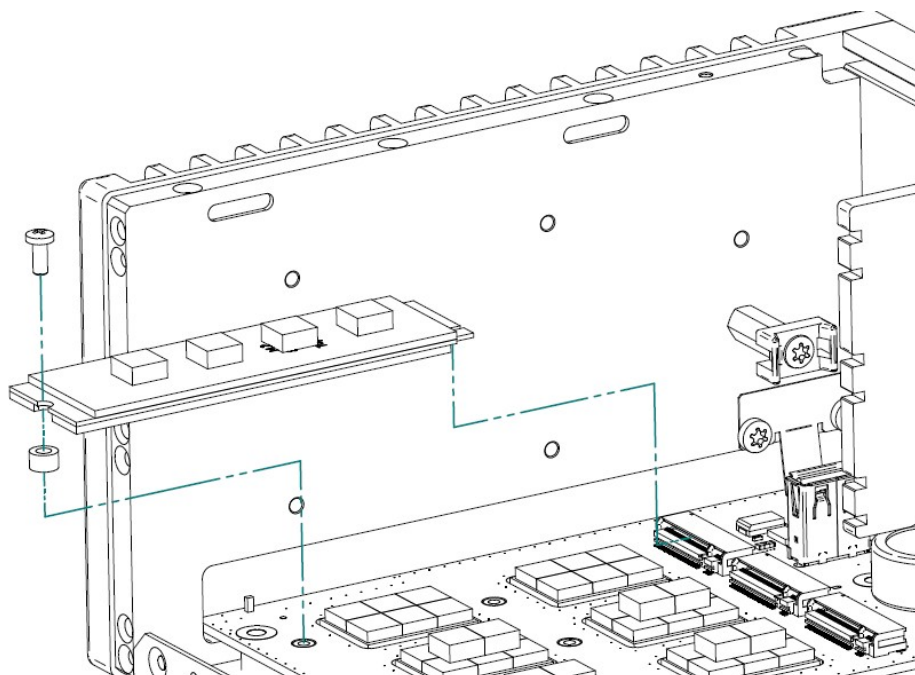
Installation of M.2 device

Open the cover by following the steps from [Opening cover](#) on page 108:

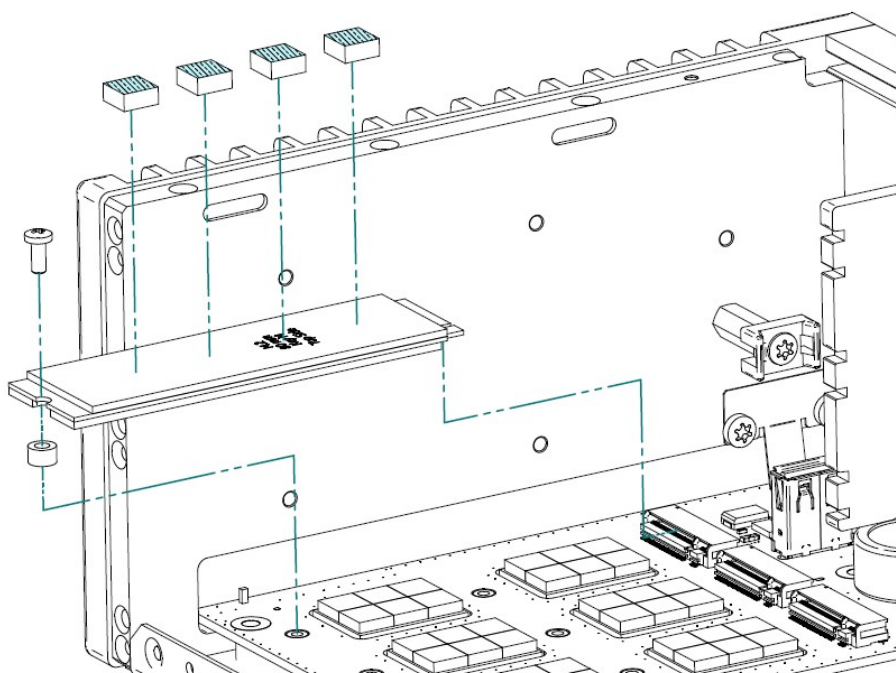
1. Loosen the M.2 heat sink screws, pull heat sink up until the keyholes allow removal of the heat sink.



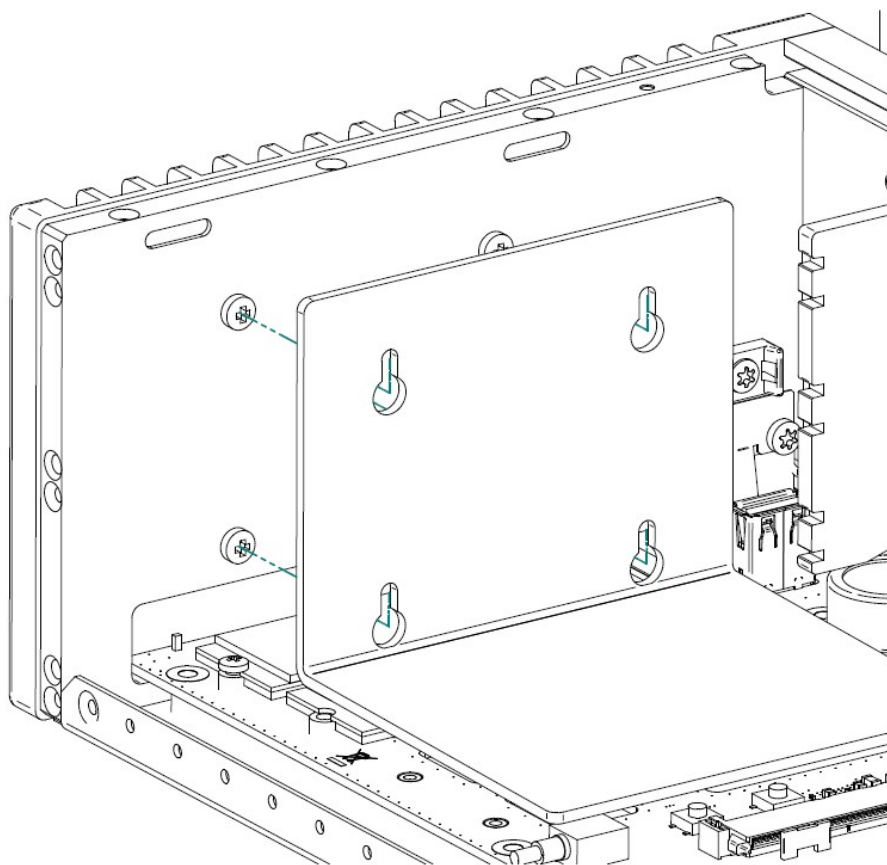
2. Unscrew the M.2 module and remove the module.



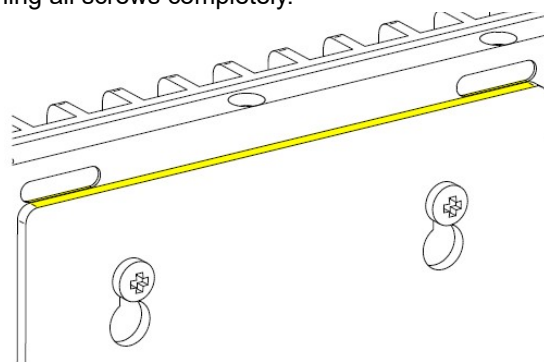
3. Attach the piggyback gap pads on the top of the new module. Use an M2.5 screw to fasten the M.2 module in the empty G500 slot.



4. Align the heat sink keyholes with the screws and push the heat sink keyholes over the screws.



5. Partially fasten the lower screws and push the heat sink down until marking align before fastening all screws completely.



If no further changes are required, install the G500 cover following the steps from [Closing cover](#) on page 111.

PCIe Slots

By default the G500 comes without any PCIe extension cards installed. Additional PCIe cards can be configured, refer the [Order code](#) on page 17.

The G500 supports up to three PCIe cards.



Only PCIe cards supplied with the G500 or ordered from GE Vernova should be used.

Use of non-G500 PCIe cards can result in unexpected behavior and may cause permanent damage to the equipment.

For normal operation do not exceed 10W per slot OR 25W in one slot with the other slots empty, due to thermal and power budget restrictions.

SLOT 1 – GEN2 by 4

PCIe Slot 1 is the upper slot and can carry a $\frac{3}{4}$ length, full height PCIe Card. It is possible to insert cards with up to 16 lanes but only 4 lanes are supported with PCIe Generation 2 speed.

SLOT 2 – GEN2 by 2

PCIe Slot 2 is the middle slot and can carry a $\frac{3}{4}$ length, full height PCIe Card. It is possible to insert cards with up to 4 lanes but only 2 lanes are supported with PCIe Generation 2 speed.

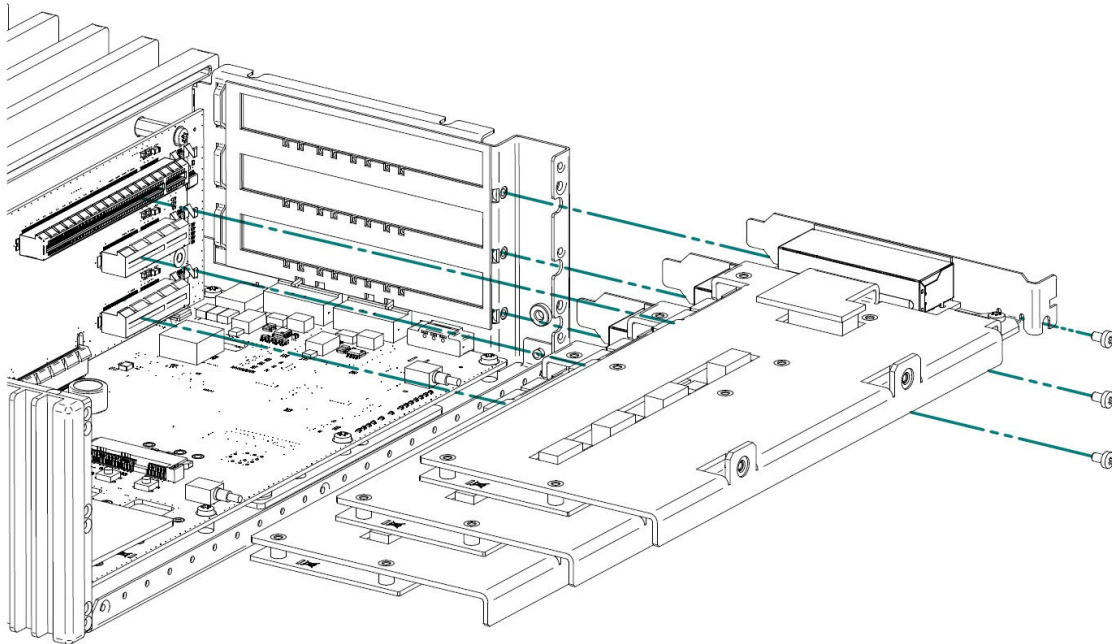
SLOT 3 – GEN2 by 1

PCIe Slot 3 is the bottom slot and can carry a $\frac{3}{4}$ length, full height PCIe Card. It is possible to insert cards with up to 4 lanes but only 1 lane is supported with PCIe Generation 2 speed.

PCIe Installation

Extension cards can be added as follows:

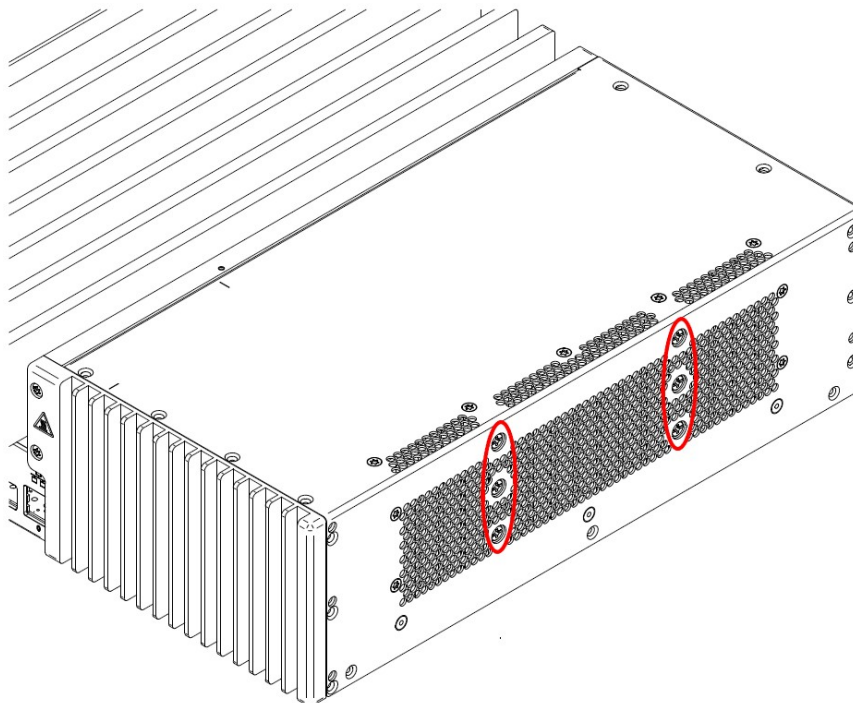
1. Open the cover following the steps from [Opening cover](#) on page 108. Plug the PCIe card into the appropriate PCIe slot and fasten in place using the PCIe faceplate screws.



2. If no further changes are required, install the G500 cover following the steps from [Closing cover](#) on page 111.
3. After closing the G500 cover, tighten all heat contact screws that now correspond to occupied PCIe slots.



For screw torque specification, refer to [General Torque Values for Screws](#) on page 133.



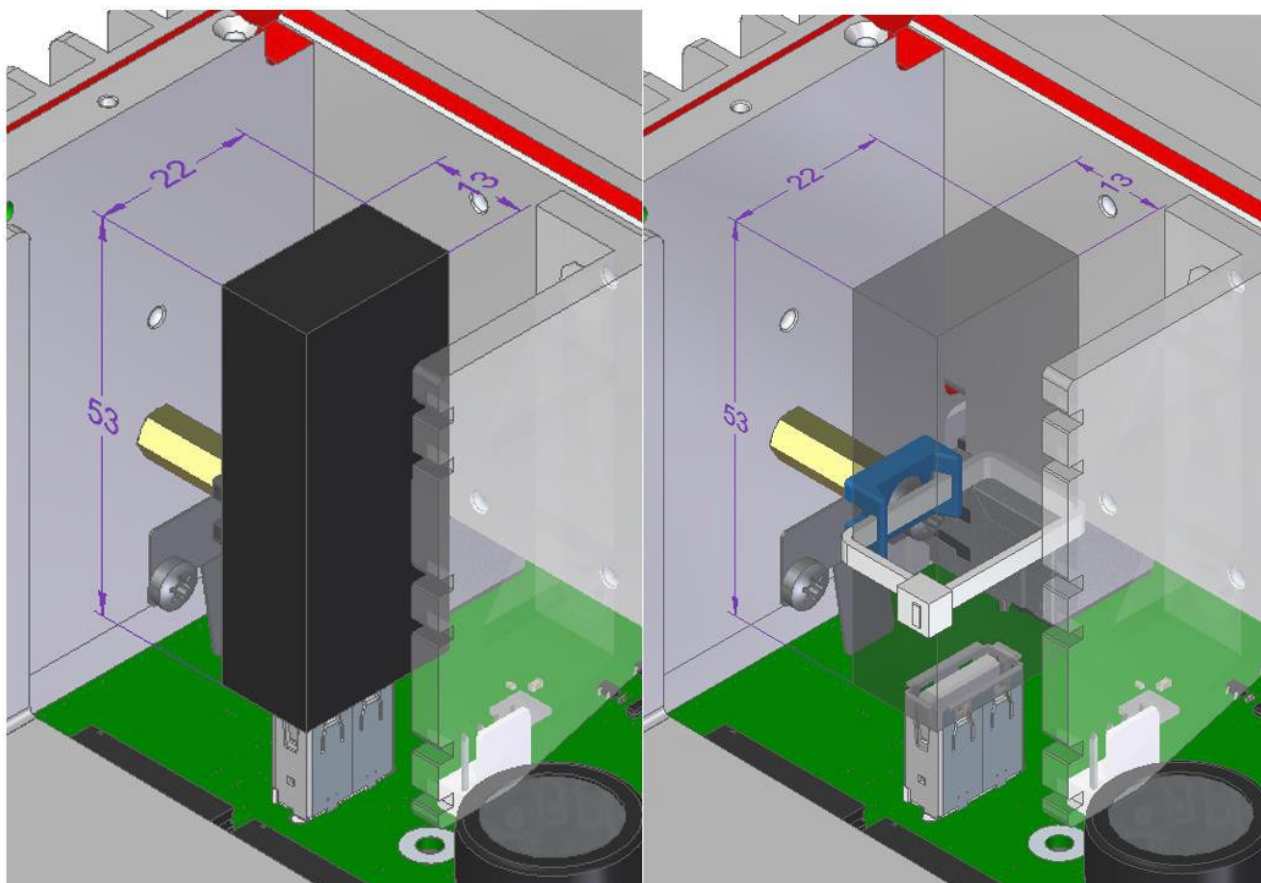
USB 2 dongle slot

The G500 includes one USB 2.0 A dongle slot.

The dongle slot is fused. For normal operation don't exceed 0.5 A in this slot due to power budget restrictions. The dongle must be capable of operating at an ambient temperature of 85°C.

Installation of USB dongle

For the mounting position of a USB dongle (maximum dimensions: 53mmx22mmx13mm) see the figure below.



In order to withstand standard shock and vibration levels the dongle must be tie-wrapped to the pre-installed mounting structure as shown above.

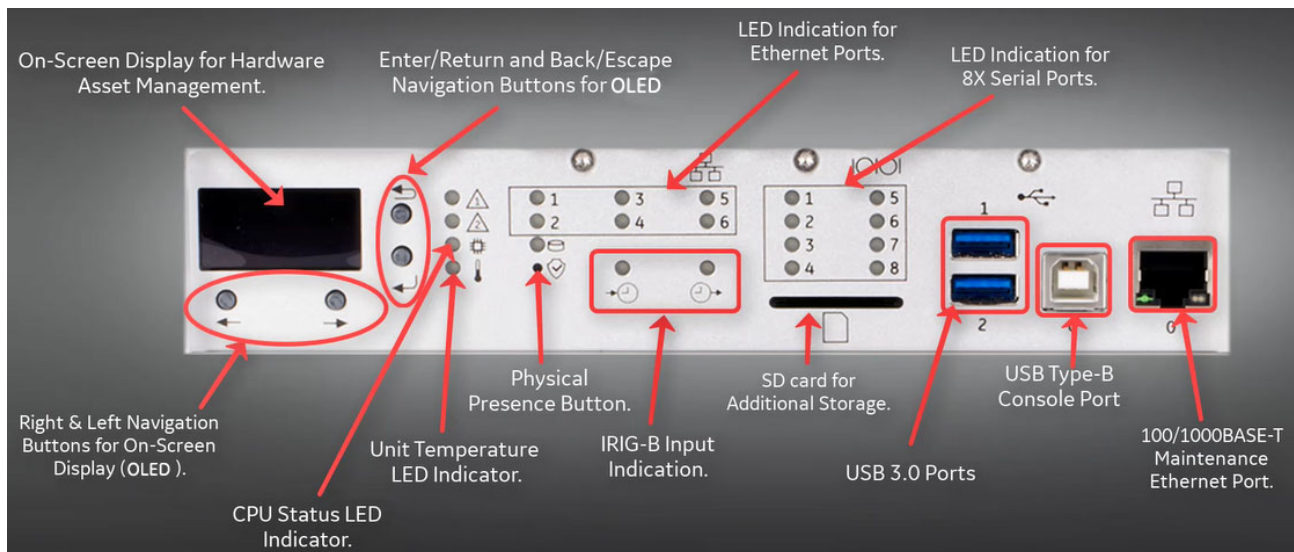
G500 Substation Gateway

Chapter 5: Indicators

The G500 includes LED indicators for communication interfaces as well as additional indicators for different operational states.

Front Indicators

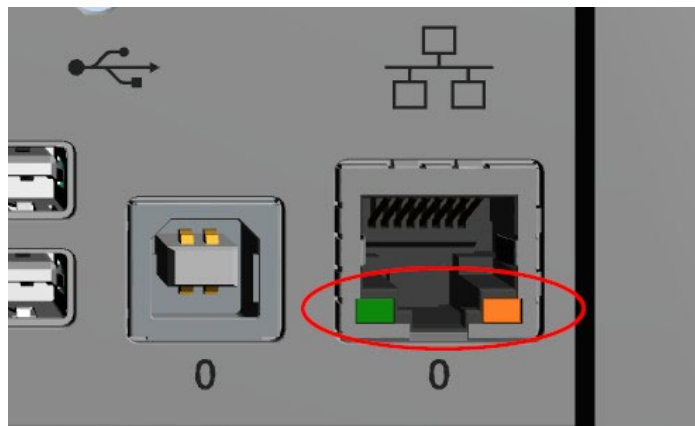




Ethernet

Orange and green LEDs located on the front of the unit in the Ethernet connector housing indicate the status of the Ethernet link:

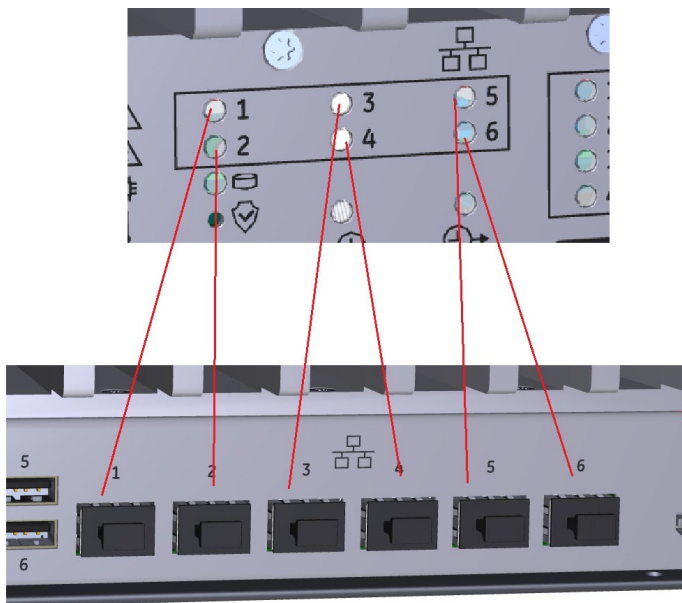
STATUS	INDICATOR
No Link	Off
100 MBit no activity	Orange
100 MBit with activity	Orange blinking
1000 MBit no activity	Green
1000 MBit with activity	Green blinking



Ethernet Port (SFP) LEDs

There are six LEDs located on the front of the unit indicate the status of the corresponding rear SFP links:

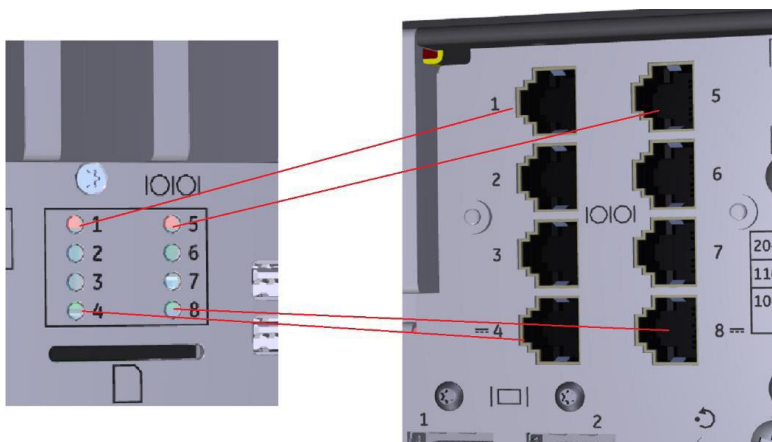
STATUS	INDICATOR
No Link	Off
100 MBit no activity	Orange
100 MBit with activity	Orange blinking
1000 MBit no activity	Green
1000 MBit with activity	Green blinking



Serial Port LEDs

Up to 8 numbered LEDs located on the front of the unit indicate the status of the corresponding rear UART ports:

STATUS	INDICATOR
No traffic	Off
Transmitting	Green
Receiving	Red
Transmitting and receiving	Orange



IRIG-B input

STATUS	INDICATOR
A valid IRIG-B signal is present at input	Green
No IRIG-B signal is present at input	Off
A valid IRIG-B signal is present at input, but the flag indicating “out of synch” is set or the G500 is configured as B002 with valid signal present.	Orange
IRIG-B input invalid signal	Red



IRIG-B output

STATUS	INDICATOR
IRIG-B output is present and the internal clock is synch'ed from an external source	Green
No IRIG-B output is present (disabled)	Off
Time synchronization for selected input is lost and there is IRIG-B output present	Orange



CPU

STATUS	INDICATOR
All power rails OK, CPU running	Green
All power rails OK, CPU standby/off	Orange
One or more power rails has failed	Red



TEMP

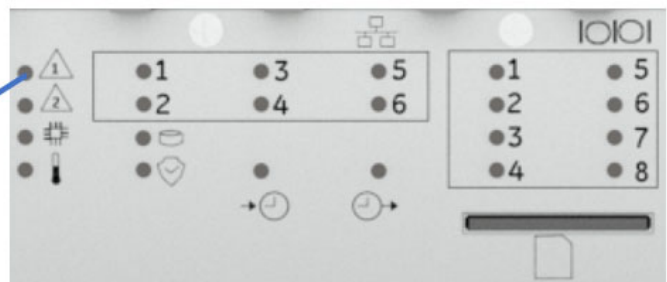
STATUS	INDICATOR
No thermal alert	Off
Application controlled (temperature warning)	Orange
Critical temperature	Red

**SSD**

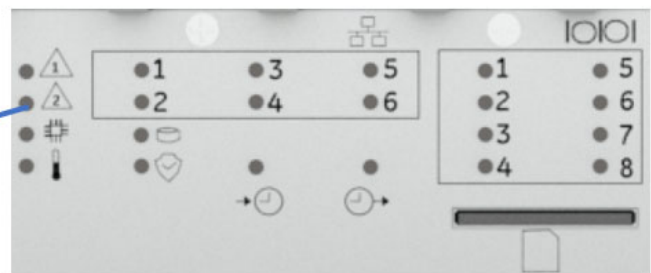
Green light indicates activity

**STATUS**

Status 1 - This Gateway



Status 2 - Peer Gateway (when redundant)



Status 1 and Status 2 LED Indicators

G500 Status	G500 System State	Status 1 LED "State of This Gateway"			Status 2 LED "State of Peer Gateway"		
		Color 1	Color 2	Blinking	Color 1	Color 2	Blinking
	None / powered off	OFF	OFF		OFF	OFF	
Not redundant	This is Active and Not Redundant	G			OFF	OFF	
This is Active	This is Active in redundant mode, peer is Standby and all else OK	G			O		
	This is Active in redundant mode, peer is Standby and DB/Code are not in synch	G			O	OFF	SLOW 2s / 2s
	This is Active and Config Synch is in Progress	G			O	G	NORMAL 1s / 1s
	This is Active and Database synch is not yet finalized (for hot-standby/hot-hot)	G			O	G	NORMAL 1s / 1s
	This is Active in redundant mode and Comm Failed with Standby	G			R	OFF	NORMAL 1s / 1s
This is Standby	This is Standby in redundant mode, peer is Active and all else OK	O			G		
	This is Standby in redundant mode, peer is Active and DB/Code are not in synch	O	OFF	SLOW 2s / 2s	G		
	This is Standby and Config Synch is in Progress	O	G	NORMAL 1s / 1s	G		
	This is Standby and Database synch is not yet finalized (for hot-standby/hot-hot)	O	G	NORMAL 1s / 1s	G		
Other modes	This is Failed	R			ANY		
	This has HW Suspended	R			ANY		
	This unit is in Service mode	R	O	SLOW 2s / 2s	ANY		
	This unit requires cold restart	G	R	FAST 0.5s / 0.5s	ANY		
Note	G - Green						
	R - Red						
	O - Orange						

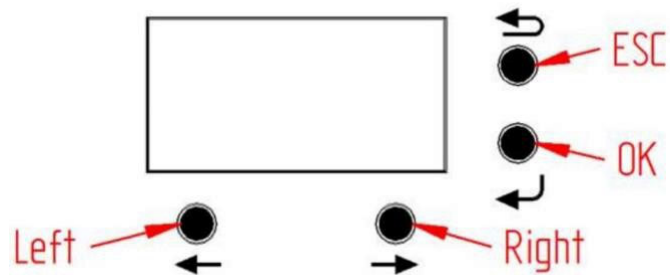
Power

Green light indicates output 12Vd.c. is within acceptable range for proper operation of the power supply.



OLED Display

The G500 provides a monochrome/white OLED display. The OLED display will show the model number "G500" when any button is pressed for five minutes and then will turn off. The OLED display incorporates four buttons which are not supported in current G500 releases.



Rear indicators

If PCIe cards are installed which support indicator lights, the status lights are visible through the holes at the rear of the G500 unit.



G500 Substation Gateway

Chapter 6: Specifications

This chapter gives some useful information when using a G500 for the first time. It might be also useful to read this chapter carefully, when problems arise using the G500.

Product specifications

System

Processor	CPU Option A: 2-Core Variant AMD RE225FECH23JA CPU 2x x86 cores @ 3.0 GHz max turbo frequency, 2.2 GHz base 3x GPUs @ 533 MHz max, 464 MHz base 2 shared L2 cache, 2MB total CPU Option B: Multi-core AMD Embedded R-Series Bald Eagle APU 4-Core Variant AMD RE427BDGH44JA CPU 4x x86 cores @ 3.6 GHz max turbo frequency, 2.7 GHz base 8x GPUs @ 686 MHz max, 600 MHz base 4 shared L2 cache, 4MB total CPU Option C: Intel i3-7102E CPU 2 Cores 4 Threads 2 x86 cores @ 2.1 GHz frequency, no turbo Intel HD 630 GPU @ 950 MHz max, 350 MHz base 3 MB shared L3 cache, 2x 256KB L2 CPU Option D: Intel E3-1505Lv6 (Xeon) CPU 4 Cores 8 Threads 4 x86 cores @ 3.0 GHz max turbo frequency, 2.2 GHz base Intel HD P630 GPU @ 1.0 GHz max, 350 MHz base 8 MB shared L3 cache, 4x 256 KB L2
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Memory	DDR3 ECC SDRAM [8GB (AMD Dual core) / 16GB (AMD Quad core)] soldered on board for improved reliability. DDR4-2400 ECC SDRAM [8GB (Intel i3 Dual core) / 16GB (Intel E3 Xeon Quad core)] soldered on board for improved reliability. NVRAM - 2Mbyte nvSRAM with 8bit parallel interface. (HW available but not enabled in G500)
Storage	Self-encrypted Solid State Drive (128GB / 256GB) expandable to 3.1TB available with CPU Option D and v5.2 minimum.
Real Time Clock	When powered off, the real-time clock remains active for 7 days On power down, last known real time is stored in non-volatile. When configured for PTP / IRIG-B - the real time clock provides no more than 0.4 second drift in 24 hours when not synchronized with an external source.
Operating system	Predix Edge OS
LED indicators	Power supply indicators, CPU Status indicator, Unit Temperature indicator, IRIG-B Input indicators, Ethernet port indicators, 8X Serial port indicators, Power Supplies Power on (Green)
Physical Presence	The physical presence button (recessed on front of the unit) and optionally configured password shall be required to enter UEFI mode. The timeout time for flashing the Physical Presence LED's is four hours, but the user can again press the button to disable it anytime.

Communications

Ethernet connections	6 Rear Ethernet ports, accessible via SFP modules: 100/1000BASE-TX (RJ45 copper medium, Cat-5 or better) 100BASE-FX 1300nm (LC fiber multimode) 1000BASE-SX 850nm (LC fiber multimode) 1000BASE-LX 1310nm (LC fiber single-mode)
Serial communications	8x serial interfaces accessible via individual RJ45 connectors on rear of the unit. Additional serial interfaces can be adding using PCIe expansion cards. Serial interfaces use 16550 compatible UART. Support baud rates 200, 300, 600, 1200, 2400, 4800, 9600, 19.2k, 38.4k, 57.6k, 115.2k. RS232 mode supports flow control and handshaking signals. Software controlled mode of operation between RS232 or RS485. Software controlled termination resistor (120 ohm) for RS485 mode. All software selection persist when power cycled. IRIG-B available on all serial interfaces. +12V output available on 2x serial interfaces Port 4 and Port 8. It is limited to 0.5A (6W) with short circuit protection and auto recovery.
D.20 Link HDLC Communications	A dual channel card is available to communicate D.20 Link protocol to up 100 D20 Peripherals per channel. Each channel communicates at 250kbps. Channels are isolated from each other by 1000VAC and from other internal circuits. - RS-485 serial link, half duplex at 250 kbps, 24 AWG twisted pair, for applications up to 330 meters, and maximum 32 devices in total: - one single G500 counts as one device, - redundant G500 count as two devices, - each I/O Peripheral module counts as one device.
Time synchronization	Precision Time Protocol Can be configured for IEEE 1588 PTP, IRIG-B or NTP IRIG-B Input Connector Available as 3 positions removable Phoenix terminal block on rear of the unit IRIG-B Output Connector Can be configured and enabled only when the IRIG-B Input is enabled.

Video Output	DisplayPort (DP) 2x DP++ (Dual-mode DisplayPort) with Multi Stream Transport (MST), available on the rear of the chassis. Each DP++ supports up to two multi-stream Dell P2415Q monitor or similar displays, for up to 4 in total with AMD CPU Options and up to 3 in total with Intel CPU Options (MST is available only in Windows OS). Linux OS units allow for only one display to be connected to each DP++ port, and do not support MST. Resolution: Up to UHD (4k, 3840x2160) for single displays connected to each port. Up to QHD (2560x1440) for 2x multi-stream connected displays. Up to FHD (1920x1080) for more than 2x multi-stream connected displays. G500 doesn't support Touch Screen Panel controls.
Audio Output	3.5 mm audio jack for substation alarms Built in high (+90dB) pitch audio buzzer
USB Ports	2x USB 3.0 Type A (male) on front of the unit 4x USB 2.0 Type A (male) on rear of the unit 1x USB 2.0 Type A internal - for software license keys
SD Card	SD, SDHC and SDXC SD-Cards according to Version 1.0, Version 2.0 and Version 3.0 (Windows only). Maximum SDXC size 64GB. SD card slot accessible on front of the unit, uses push-pull mechanism.
Maintenance Ports	Console port 1x USB 2.0 Type B port on front of chassis connected to internal USB to Serial bridge, allows access to Console for debug. Local Ethernet 100/1000BASE-T maintenance Ethernet port accessible via front of the unit, separate from 6 Ethernet ports on the back.

Electrical

Power Supply	Dual/ Redundant hot-swappable power supplies each with individual removable Phoenix 1942293 terminal block Low Voltage power supply: 20-54VDC Nominal $\pm 10\%$, 10.2A Max High Voltage power supply: 100-300VDC Nominal $+10\%/-12\%$, 1.8A Max 100-240VAC Nominal $\pm 10\%$, 2.1A Max NOTE: To meet 61850-3 compliance, LV power supply must be supplied by 48V nominal to meet 50ms hold up time.
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Environmental specifications

Temperature and Humidity

Relative Humidity for operation is up to 95%, non condensing. Ambient temperature values for the product:

Operation Condition	
Storage	-40°C to 85°C
Operation 2 core	-40°C to 70°C
Operation 4 core	-40°C to 60°C
Operation with PCIe Cards installed *	-40°C to 60°C

* If PCIe Cards are installed the operating temperature of the system is reduced to 60°C. If non-compliant PCIe Cards are used the user has to take care of proper operation of the plug-in card and the operating temperature of the System may be decreased.



These tests were conducted with all interfaces loaded at typical load conditions.

Altitude

Maximum operating altitude is 2000m.

Above this altitude the isolation requirements must be de-rated by dividing by factor in EN/ IEC 60255-27 Table C11.

Table 1: Voltage de-rating due to altitude

Altitude	Insulation Voltage De-rating Multiplier
2000m	1
3000m	0.87
4000m	0.77
5000m	0.67

Table 2: Thermal de-rating due to altitude

Altitude	Temperature de-rating
2500m	5°C
3000m	10°C
4500m	15°C

Ingress Protection (IEC 60529)

IP30 (protected from tools and wires greater than 2.5 millimeters).

Liquid Protection

The G500 is designed to protect the internal electronics from small amounts of liquid falling vertically or which may accumulate on the top surface of the chassis.

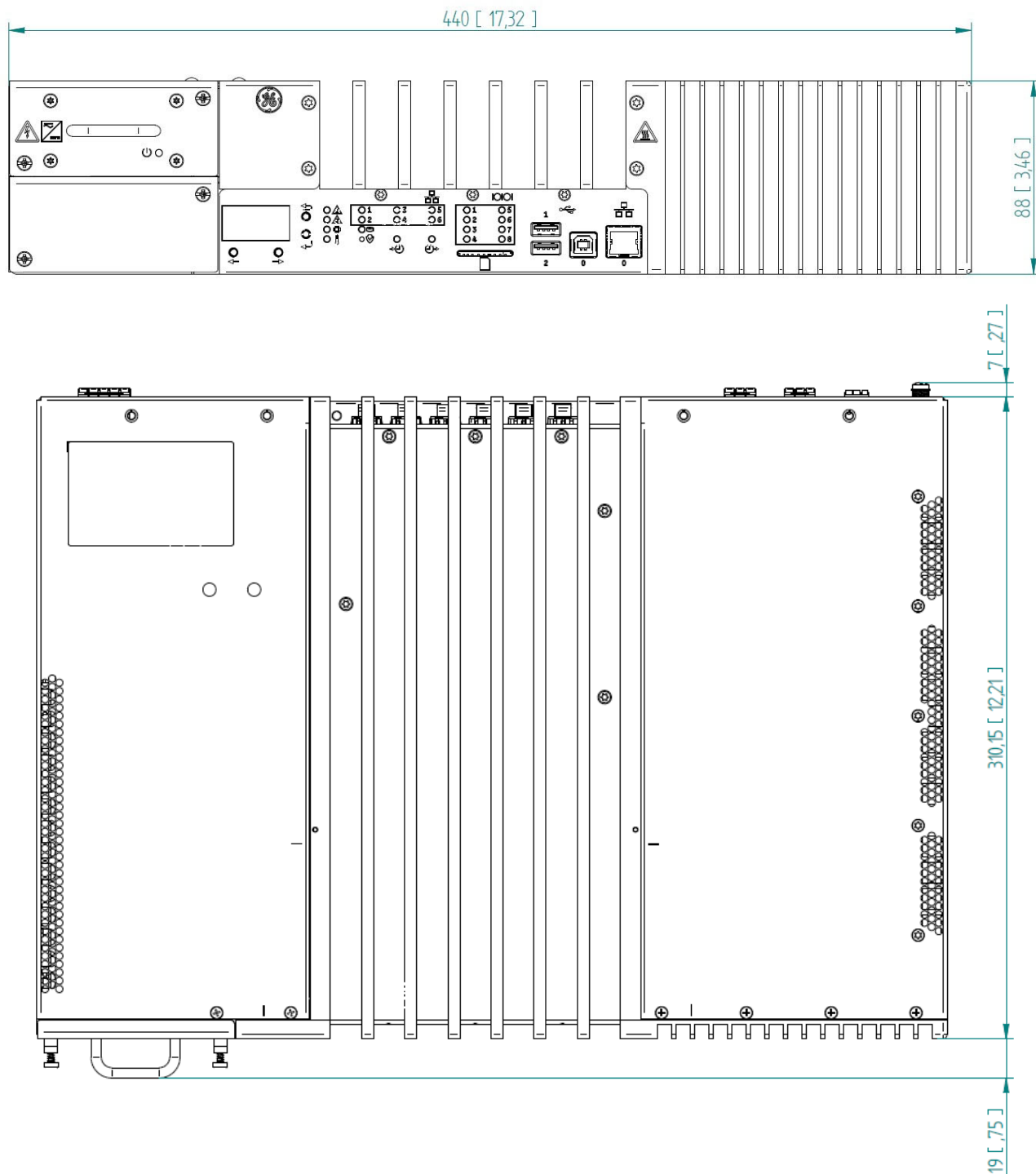
Mechanical Specifications

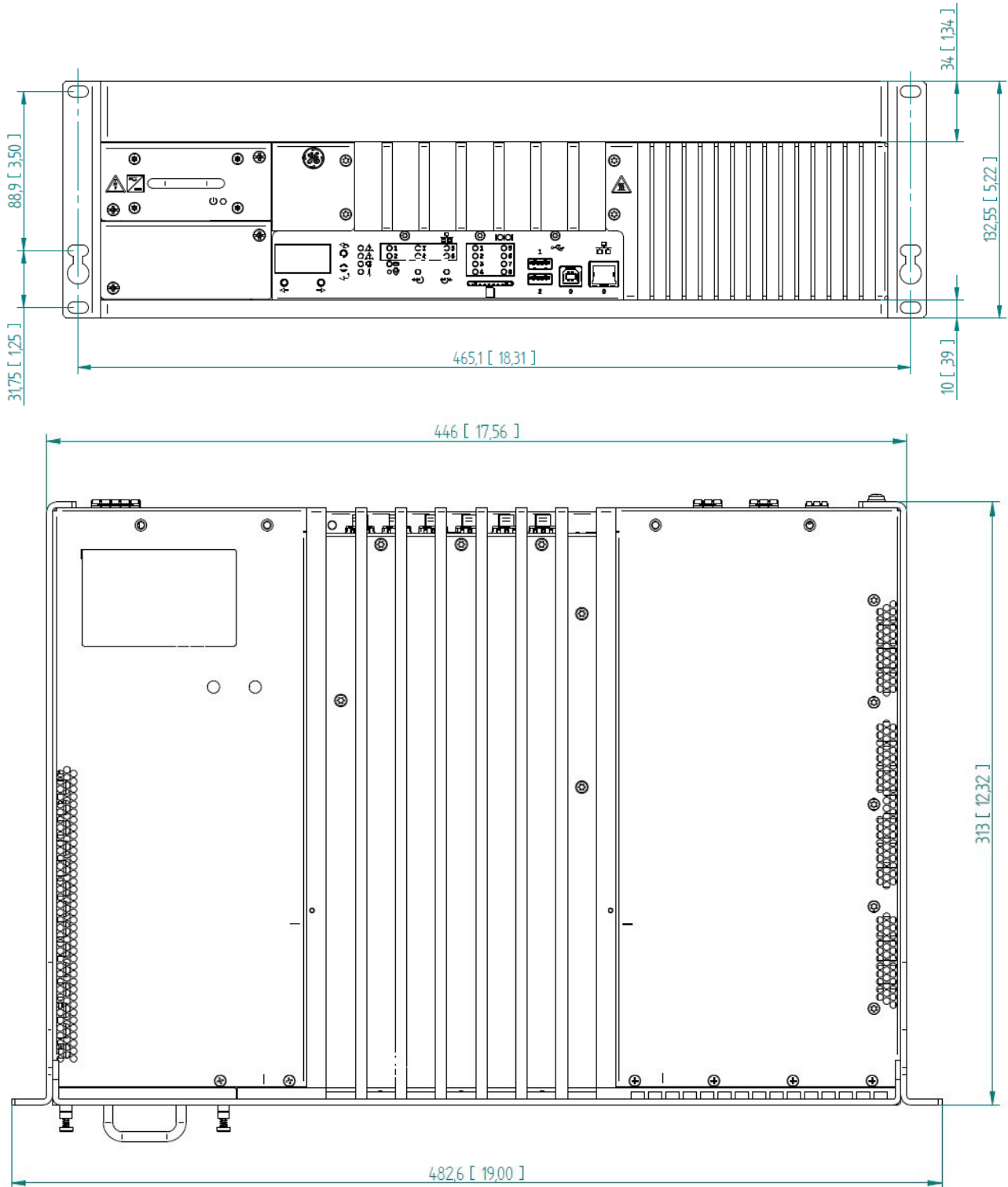
Weight

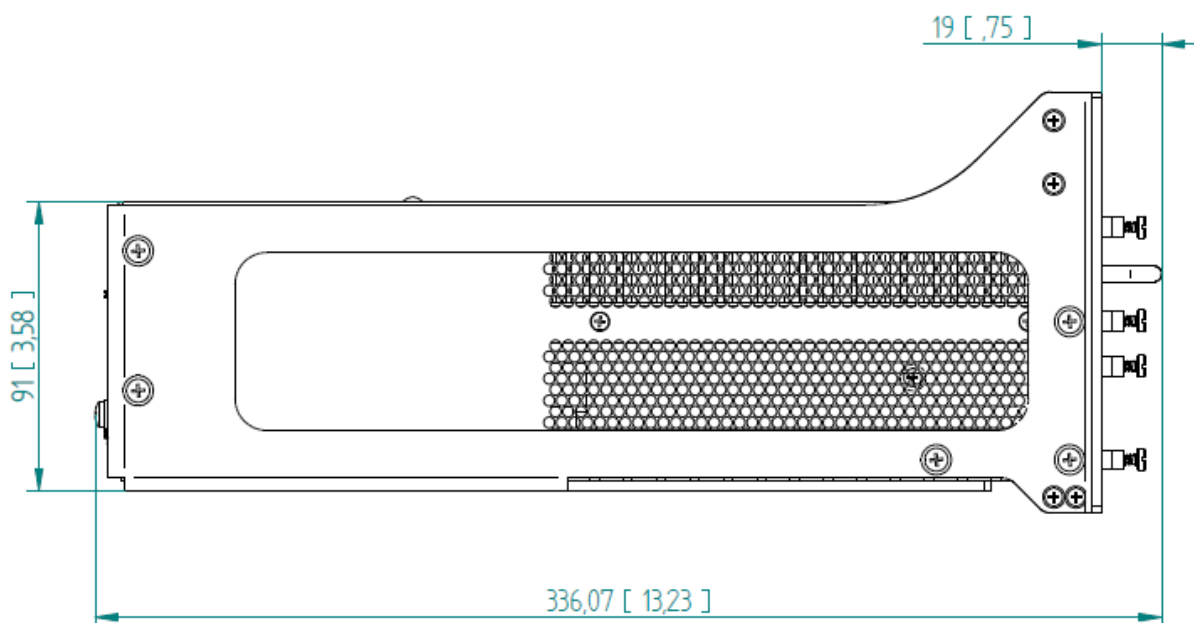
Part	Weight in kg
G500, 0 serial ports, without PSU	9.1
G500, 4 serial ports	9.3
G500, 8 serial ports	9.5
Mounting bracket	1.6
HV PSU	1.0
LV PSU	0.9
4 port Serial PCIe Card	0.27
D.20 Link HDLC PCIe Card	0.18

Dimensions

All dimensions in mm [inch]







General Torque Values for Screws

Use Phillips PH1 screw driver for screws of the G500. Unless otherwise specified, use the following torque values when tightening screws:

Screw Size	Torque in Nm	Torque in lbf in
M2.5	0.6	5.3
M3	0.6	5.3
M4	1	8.8
M5	1.5	13.3



NOTE

Screws with Torx head are not for service and shall not be unscrewed.

Storage recommendations

Storage conditions

Always store the G500 in an environment compatible with operating conditions. Recommended environmental conditions for storage are:

- Temperature: -40°C to $+85^{\circ}\text{C}$
- Relative humidity: 5% to 95%, non-condensing

Exposure to excessive temperature or other extreme environmental conditions might cause damage and/or unreliable operation.

To avoid deterioration and early failure of electrolytic capacitors, power up units that are stored in a de-energized state once every 12 months, for one hour continuously.

G500 Substation Gateway

Chapter 7: Removing the G500 from Service

When the G500 is to be removed from service, it is necessary to:

- Remove the configuration data and sensitive information from:
 - The G500
 - The PC used to remotely configure the G500
- Dispose of the equipment.

Remove configuration data and sensitive information from the G500

In the event that it is necessary to remove the configuration data and sensitive information from the G500 (for example, the G500 is being disposed of or being returned for maintenance [i.e., RMA]), this chapter provides the data removal procedure.

G500 Units manufactured before 2025 were shipped with a default SSD user password u123@MCPGE applied in the UEFI.

G500 Units manufactured starting in 2025 have no default SSD password applied.

For additional information, please refer to “SWM0105 G500 Secure Deployment User Guide”.

To remove configuration data and sensitive information from the G500:

1. **For an RMA:** Remove the Solid State Drive (SSD) from the G500 using the reverse of the SSD installation procedure found earlier in this manual; send the G500 unit to GE Vernova and safekeep the drive. If the drive is faulty, GE Vernova recommends destroying the old drive as per NIST* recommendations.
2. **For hardware decommissioning and disposal:** Remove the G500 Solid State Drive. GE Vernova recommends that you destroy the drive as per NIST* recommendations.

* Publication 800-88 Revision 1. Guidelines for Media Sanitization, Recommendations of the National Institute of Standards and Technology:

<http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-88r1.pdf>

Removing configuration data on a PC

When a PC application is used to configure the G500, configuration data resides on the data storage media (e.g., hard drives, memory cards, etc.) of the PC running the configuration application.

The G500 configuration data can be removed from the PC by either:

- Recommended: Physically removing and destroying the data storage media, or
- Using a program to securely wipe (that is, completely erase) the data storage media (that is, not just reformat or remove the names of the files from the file allocation table).

G500 Substation Gateway

Appendix A: Standards & Compliance

Compliance Standards

The G500 complies with the tests listed below. The test methods covered, provide compliance to IEC61850-3 Location H or G when equipped with a Low voltage power supply (48Vdc) or High voltage power supply (full nominal range). The G500 is also fully compliant to IEEE1613: Class 1.

TEST	REFERENCE STANDARD	TEST LEVEL
Gradual shutdown/start-up (for d.c. power supply)	EN60255-27 SS 4.8/TP.7.2.13	Criteria B, Shutdown at 69Vd.c., startup 78Vd.c.
Insulation Resistance Test	EN 60255-27	500 Vdc
Dielectric voltage withstand	EN 60255-27	2.0 kV
Impulse voltage withstand	EN 60255-27	5 kV
Damped Oscillatory	IEC 61000-4-18	100kHz & 1Mhz 2.5kV CM, 1kV DM
Electrostatic Discharge	IEC 61000-4-2	Level 4
RF immunity	IEC 61000-4-3	Level 3
Fast Transient Disturbance	IEC 61000-4-4	Level 4
Surge Immunity	IEC 61000-4-5	Level 3 & 4
Conducted RF Immunity	IEC 61000-4-6	Level 3
Radiated & Conducted Emissions	CISPR22 & CISPR32	Class A
Sinusoidal Vibration	IEC 60255-21-1	Class 1
Shock & Bump	IEC 60255-21-2	Class 1
Seismic	IEC 60255-21-3	Class 2
Power magnetic Immunity	IEC 61000-4-8	Level 5
Voltage Dip & interruption	IEC 61000-4-11	0,40,70,80% dips, 250/300 cycle interrupts
Conducted RF Immunity 0-150khz	IEC 61000-4-16	Level 4
Voltage Ripple	IEC 61000-4-17	15% ripple

TEST	REFERENCE STANDARD	TEST LEVEL
Ingress Protection	IEC 60529	IP30
Environmental (Cold)	IEC 60068-2-1	-40°C 16 hrs. (Storage and Operational)
Environmental (Dry heat)	IEC 60068-2-2	60°C 16hrs for Quad Core 70°C 16 hrs. Dual Core 85°C 16 hrs. Storage (both models)
Voltage Dip and interruption D.C.	IEC 61000-4-29	ΔU 100% 0.005, 0.05, 0.1 sec. (48Vd.c., 110Vd.c., 120Vd.c.) Criteria A ΔU 40%, 0.1 sec (48Vd.c., 110Vd.c.,) Criteria A ΔU 50%, 0.2 sec (120Vd.c.) Criteria A ΔU 70%, 0.2 sec (48Vd.c., 110Vd.c.,) Criteria A ΔU 100% 1 sec, 5 Sec. (48Vd.c., 110Vd.c., 120Vd.c.) Criteria C
Relative Humidity Cyclic	IEC 60068-2-30	6day, variant 2, 55°C/95%RH
Change of Temperature	IEC 60068-2-14	Dual Core:-40°C to 70°C Quad Core: -40°C to 60°C Method Nb
Damp Heat Steady State	IEC 60068-2-78	40°C & 93%RH for 240 hrs (10 days)
Damped Oscillatory	IEEE/ANSI C37.90.1	2.5kV@1MHz CM/DM
RF Immunity	IEEE/ANSI C37.90.2	20V/m 80-1GHz + Spot Freq s
ESD	IEEE/ANSI C37.90.3	8kV CD, 15kV AD
IEEE Standard Environmental and Testing Requirements for Communications Networking Devices Installed in Electric Power Substations	IEEE 1613:2009	Per Standard
Communication Networks and systems for power Utility Automation-Part 3	IEC 61850-3:2013	Per Standard
SAFETY	EN/IEC 62368-1: 2018 EN/IEC 60950-1: 2005	Per standard
UL marking	UL60950-1 2 nd Ed /CSA C22.2 60950-1-07	NWQG2 & NWQG8

G500 Substation Gateway

Appendix B: Certificates

cUL

CERTIFICATE OF COMPLIANCE

Certificate Number	20190130-E355166
Report Reference	E355166-A2-UL
Issue Date	2019-January-30

Issued to: GE MULTILIN
650 MARKLAND ST
MARKHAM
ON L6C 0M1 CANADA

This certificate confirms that representative samples of

COMPONENT - INFORMATION TECHNOLOGY EQUIPMENT INCLUDING ELECTRICAL BUSINESS EQUIPMENT
Industrial PC
G500, M500, P500, X500, C500, H500 and A500

Have been investigated by UL in accordance with the component requirements in the Standard(s) indicated on this Certificate. UL Recognized components are incomplete in certain constructional features or restricted in performance capabilities and are intended for installation in complete equipment submitted for investigation to UL LLC.

Standard(s) for Safety: UL 60950-1 and CAN/CSA C22.2 No. 60950-1-07- Information Technology Equipment - Safety - Part 1: General Requirements

Additional Information: See the UL Online Certifications Directory at <https://iq.ulprospector.com> for additional information.

This Certificate of Compliance does not provide authorization to apply the UL Recognized Component Mark.
Only those products bearing the UL Recognized Component Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.
Look for the UL Recognized Component Mark on the product.


Bruce Haimenholz, Director North American Certification Program
UL LLC

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL. For questions, please contact a local UL Customer Service Representative at info@ulprospector.com



IEC 60870-5-101 Edition 2 - Balanced Controlled station (Slave)

ATTESTATION OF CONFORMITY

No. 10250861-INC 20-2735

Issued to:

GE Multilin
650 Markland Street
Markham ON, L6C 0M1
Ontario, CANADA

for the product:

G500
Advanced Substation Gateway
Type: IEC 101 Balanced Controlled station
System software version 210 revision 000
Application iec101+104dpa version 100 revision 009
Interface Type: Serial Cable

With the implemented communication protocol:

IEC 60870-5-101 Edition 2 (IS 2003)

Companion Standard for basic telecontrol tasks in standard direction and the GE Multilin IEC 60870-5-101-104 Server (DPA) for the Multifunction Controller Platform for IEC 60870-5-101 V1.00, Revision 2.

The product has not been shown to be non-conforming to the specified protocol standard, including the interface requirements.

End-to-End data element tests for the information and control points as described in manufacturer Protocol Implementation Conformance Statement (PICS) have been performed on the product's protocol implementation. Functional tests in controlled mode are performed for the following compatible Basic Application Functions:

• Station initialization • Cyclic data transmission • Data acquisition through read • Acquisition of events • General Interrogation	• Clock Synchronization • Command transmission • Transmission of Integrated Totals • Parameter Loading • Test procedure • Delay acquisition procedure
---	--

The test campaign did not reveal any errors in the product's protocol implementation.

This attestation is granted on account of tests made at location of DNV GL in Arnhem, the Netherlands and performed with DNV GL UniGrid Telecontrol Simulator version 2.3.0 and UniGrid Telecontrol 101 Analyser version 1.0.3. The results, including remarks and limitations, are laid down in DNV GL Report no. 10250861-INC 20-2734.

The test has been carried out on one single specimen of the product as referred above and submitted to DNV GL by GE Multilin. The manufacturer's production process has not been assessed. This attestation does not imply that DNV GL has verified any product other than the specimen tested.

Arnhem, October 9, 2020


N. Heijker
Business Leader
Interoperability of smart power systems

Issued by:

DNV GL

DNV KEMA is now DNV GL


Davood Sooran
Test Consultant

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T +31 26 356 9111 F +31 26 351 36 83 salesdesk@dnvgl.com www.dnvgl.com

IEC 60870-5-101 Edition 2 - Balanced Controlling station (Master)

ATTESTATION OF CONFORMITY

No. 10250861-INC 20-2737

Issued to:

GE Multilin
650 Markland Street
Markham ON, L6C 0M1
Ontario, CANADA

for the product:

G500
Advanced Substation Gateway
Type: IEC 101 Balanced Controlling station
System software version 210 revision 000
Application iec101-104dca version 100 revision 005
Interface Type: Serial Cable

With the implemented communication protocol:

IEC 60870-5-101 Edition 2 (IS 2003)

Companion Standard for basic telecontrol tasks in standard direction and the GE Multilin IEC 60870-5-101-104 Client (DCA) for the Multifunction Controller Platform for IEC 60870-5-101 V1.00, Revision 2.

The product has not been shown to be non-conforming to the specified protocol standard, including the interface requirements.

End-to-End data element tests for the information and control points as described in manufacturer Protocol Implementation Conformance Statement (PICS) have been performed on the product's protocol implementation. Functional tests in controlled mode are performed for the following compatible Basic Application Functions:

- | | |
|--|---|
| <ul style="list-style-type: none"> • Station initialization • Cyclic data transmission • Acquisition of events • General Interrogation | <ul style="list-style-type: none"> • Clock Synchronization • Command transmission • Transmission of Integrated Totals • Delay acquisition procedure |
|--|---|

The test campaign did not reveal any errors in the product's protocol implementation.

This attestation is granted on account of tests made at location of DNV GL in Arnhem, the Netherlands and performed with DNV GL UniGrid Telecontrol Simulator version 2.3.0 and UniGrid Telecontrol 101 Analyser version 1.0.3. The results, including remarks and limitations, are laid down in DNV GL Report no. 10250861-INC 20-2736.

The test has been carried out on one single specimen of the product as referred above and submitted to DNV GL by GE Multilin. The manufacturer's production process has not been assessed. This attestation does not imply that DNV GL has verified any product other than the specimen tested.

Arnhem, October 20, 2020


N. Heijker
Business Leader
Interoperability of smart power systems

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Davood Sooran
Test Consultant

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IEC 60870-5-101 Edition 2 - Unbalanced Controlled station (Slave)

ATTESTATION OF CONFORMITY

No. 10250861-INC 20-2739

Issued to:

GE Multilin
650 Markland Street
Markham ON, L6C 0M1
Ontario, CANADA

for the product:

G500
Advanced Substation Gateway
Type: IEC 101 Unbalanced Controlled station
System software version 210 revision 000
Application iec101+104dpa version 100 revision 009
Interface Type: Serial Cable

With the implemented communication protocol:

IEC 60870-5-101 Edition 2 (IS 2003)

Companion Standard for basic telecontrol tasks in standard direction and the GE Multilin IEC 60870-5-101-104 Server (DPA) for the Multifunction Controller Platform for IEC 60870-5-101 V1.00, Revision 2.

The product has not been shown to be non-conforming to the specified protocol standard, including the interface requirements.

End-to-End data element tests for the information and control points as described in manufacturer Protocol Implementation Conformance Statement (PICS) have been performed on the product's protocol implementation. Functional tests in controlled mode are performed for the following compatible Basic Application Functions:

• Station initialization • Data acquisition by polling • Cyclic data transmission • Data acquisition through read • Acquisition of events • General Interrogation	• Clock Synchronization • Command transmission • Transmission of Integrated Totals • Parameter Loading • Test procedure • Delay acquisition procedure
--	--

The test campaign did not reveal any errors in the product's protocol implementation.

This attestation is granted on account of tests made at location of DNV GL in Arnhem, the Netherlands and performed with DNV GL UniGrid Telecontrol Simulator version 2.3.0 and UniGrid Telecontrol 101 Analyser version 1.0.3. The results, including remarks and limitations, are laid down in DNV GL Report no. 10250861-INC 20-2738.

The test has been carried out on one single specimen of the product as referred above and submitted to DNV GL by GE Multilin. The manufacturer's production process has not been assessed. This attestation does not imply that DNV GL has verified any product other than the specimen tested.

Arnhem, October 7, 2020


N. Heijker
Business Leader
Interoperability of smart power systems

Issued by:

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David Booran
Test Consultant

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IEC 60870-5-101 Edition 2 - Unbalanced Controlling station (Master)

ATTESTATION OF CONFORMITY

No. 10250861-INC 20-2741

Issued to:

GE Multilin
650 Markland Street
Markham ON, L6C 0M1
Ontario, CANADA

for the product:

G500
Advanced Substation Gateway
Type: IEC 101 Unbalanced Controlling station
System software version 210 revision 000
Application iec101-104dca version 100 revision 005
Interface Type: Serial Cable

With the implemented communication protocol:

IEC 60870-5-101 Edition 2 (IS 2003)

Companion Standard for basic telecontrol tasks in standard direction and the GE Multilin IEC 60870-5-101-104 Client (DCA) for the Multifunction Controller Platform for IEC 60870-5-101 V1.00, Revision 2.

The product has not been shown to be non-conforming to the specified protocol standard, including the interface requirements.

End-to-End data element tests for the information and control points as described in manufacturer Protocol Implementation Conformance Statement (PICS) have been performed on the product's protocol implementation. Functional tests in controlled mode are performed for the following compatible Basic Application Functions:

- | | |
|---|---|
| <ul style="list-style-type: none"> • Station initialization • Data acquisition by polling • Cyclic data transmission • Acquisition of events • General Interrogation | <ul style="list-style-type: none"> • Clock Synchronization • Command transmission • Transmission of Integrated Totals • Delay acquisition procedure |
|---|---|

The test campaign did not reveal any errors in the product's protocol implementation.

This attestation is granted on account of tests made at location of DNV GL in Arnhem, the Netherlands and performed with DNV GL UniGrid Telecontrol Simulator version 2.3.0 and UniGrid Telecontrol 101 Analyser version 1.0.3. The results, including remarks and limitations, are laid down in DNV GL Report no. 10250861-INC 20-2740.

The test has been carried out on one single specimen of the product as referred above and submitted to DNV GL by GE Multilin. The manufacturer's production process has not been assessed. This attestation does not imply that DNV GL has verified any product other than the specimen tested.

Arnhem, October 16, 2020


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Business Leader
Interoperability of smart power systems

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Davood Sooran
Test Consultant

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T +31 26 356 9111 F +31 26 351 36 83 salesdesk@dnvgl.com www.dnvgl.com

IEC 60870-5-104 Edition 2 - Controlling station (Master)

ATTESTATION OF CONFORMITY

No. 10250861-INC 20-2743

Issued to:

GE Multilin
650 Markland Street
Markham ON, L6C 0M1
Ontario, CANADA

for the product:

G500
Advanced Substation Gateway
Type: IEC 104 Controlling station
System software version 210 revision 000
Application iec101-104dca version 100 revision 005
Interface Type: Ethernet

With the implemented communication protocol:

IEC 60870-5-104 ed.2 (IS 2006)

Network Access for IEC 60870-5-104 using standard transport profiles in Standard direction and the GE Multilin IEC 60870-5-101-104 Client (DCA) for the Multifunction Controller Platform for IEC 60870-5-104 V1.00, Revision 2.

The product has not been shown to be non-conforming to the specified protocol standard, including the interface requirements.

End-to-End data element tests for the information and control points as described in manufacturer Protocol Implementation Conformance Statement (PICS) have been performed on the product's protocol implementation. Functional tests in controlling mode are performed for the following levels:

• Station initialization • Redundancy • Cyclic data transmission • Acquisition of events • General interrogation	• Clock synchronization • Command transmission • Transmission of Integrated Totals
--	--

The test campaign did not reveal any errors in the product's protocol implementation.

This Attestation is granted on account of tests made at location of DNV GL in Arnhem, the Netherlands and performed with DNV GL UniGrid Telecontrol Simulator version 2.3.0 running CS104 Test Suite version 1.41 and UniGrid Telecontrol 104 Analyser version 3.2.0. The results, including remarks and limitations, are laid down in DNV GL report no. 10250861- INC 20-2742.

The tests have been carried out on one single specimen of the product, submitted by GE Multilin. The Attestation does not include an assessment of the manufacturer's production process. Conformity of his production with the specimen tested by DNV GL is not the responsibility of DNV GL.

Arnhem, October 9, 2020



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Business Leader
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IEC 60870-5-104 Edition 2 - Controlled station (Slave)

ATTESTATION OF CONFORMITY

No. 10250861-INC 20-2745

Issued to:

GE Multilin
650 Markland Street
Markham ON, L6C 0M1
Ontario, CANADA

for the product:

G500
Advanced Substation Gateway
Type: IEC 104 Controlled station
System software version 210 revision 000
Application iec101+104dpa version 100 revision 009
Interface Type: Ethernet

With the implemented communication protocol:

IEC 60870-5-104 ed.2 (IS 2006)

Network Access for IEC 60870-5-104 using standard transport profiles in Standard direction and the GE Multilin IEC 60870-5-101-104 Server (DPA) for the Multifunction Controller Platform for IEC 60870-5-104 V1.00, Revision 2.

The product has not been shown to be non-conforming to the specified protocol standard, including the interface requirements.

End-to-End data element tests for the information and control points as described in manufacturer Protocol Implementation Conformance Statement (PICS) have been performed on the product's protocol implementation. Functional tests in controlled mode are performed for the following levels:

• Station initialization • Redundancy • Cyclic data transmission • Data acquisition through read • Acquisition of events • General interrogation	• Clock synchronization • Command transmission • Transmission of Integrated Totals • Parameter Loading • Test procedure
---	---

The test campaign did not reveal any errors in the product's protocol implementation.

This Attestation is granted on account of tests made at location of DNV GL in Arnhem, the Netherlands and performed with DNV GL UniGrid Telecontrol Simulator version 2.3.0 running CS104 Test Suite version 1.41 and UniGrid Telecontrol 104 Analyser version 3.2.0. The results, including remarks and limitations, are laid down in DNV GL report no. 10250861- INC 20-2744.

The tests have been carried out on one single specimen of the product, submitted by GE Multilin. The Attestation does not include an assessment of the manufacturer's production process. Conformity of his production with the specimen tested by DNV GL is not the responsibility of DNV GL.

Arnhem, October 5, 2020


N.A. Heijker
Business Leader
Interoperability of smart power systems

Issued by:

DNV GL
DNV KEMA is now DNV GL


David Suoran
Test Consultant

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G500 Substation Gateway

Appendix C: Warranty

Warranty

For products shipped as of October 1st, 2013, G500 warrants most of its GE Vernova manufactured products for 10 years. For warranty details including any limitations and disclaimers, see the GE Vernova Grid Solutions Terms and Conditions at

<https://www.gevernova.com/grid-solutions/multilin/warranty.htm>

G500 Substation Gateway

Appendix D: List of Acronyms

Acronym Definitions

This Appendix lists and defines the acronyms used in this manual.

Acronym	Definition
AC	Alternating Current
AWG	American Wire Gauge, standardized logarithmic wire gauge
CE	Conformite Europeene (European conformity)
CMOS	Complementary Metal-Oxide Semiconductor
COMe	Computer On Module express
CPU	Central Processing Unit
DC	Direct Current
DoC	Declaration of Conformity
DP	Display Port
EC	ACPI Embedded Controller
ECC	Error Correction Checking
ECCN	Export Control Classification Number
EMI	Electro-Magnetic Interference
ESD	Electro-Static Discharge
ft.	foot
FCC	Federal Communication Commission (USA)
GE	General Electric
GND	Ground, Electrical Grounding
GPIO	General Purpose I/O
GPU	Graphics Processing Unit
HSR	High Availability Seamless Redundancy
HV	High Voltage

Acronym	Definition
IRIG	Inter Range Instrumentation Group
IRIG-B	IRIG time code B (bit rate of 100 pulses-per-second with a bit time of 10 milliseconds over 1 second time frame)
I2C	two wire communication bus
I/O	Input / Output
IMR	Installation and Maintenance Requirements
IR	Interrupt Request
LAN	Local Area Network
LC	Little Connector
LED	Light Emitting Diode
LV	Low Voltage
m	meter
ms	Milliseconds
MCP	Multifunction Control Platform
MFG	Manufacturer
MLC	Multi-level cell
MMF	Multi-Mode Fiber
MUX	Multiplexer
M.2	a standardized module format for plug in cards, storage or interface
NVSRAM	Non-Volatile Static Random-Access Memory
OEM	Original Equipment Manufacturer
OLED	Organic Light Emitting Diode
P-state	Performance states of CPU
PCI	Peripheral Component Interconnect
PCIe	Peripheral Component Interconnect Express
POST	Power-On Self-Test
PSU	Power Supply Unit
PTP	Precision Time Protocol
PRP	Parallel Redundancy Protocol
RAM	Random Access Memory
ROM	Read Only Memory
RMA	Return Material Authorization
RoHS	Restriction of hazardous substances directive
RTC	Real-Time Clock
SATA	Serial Advanced Technology Attachment, a storage interface
SD	Secure Digital, a storage device format
SFP	Small Form Factor, a standardized plug in module for network interfaces
S/N	Serial Number
SPI	Serial Peripheral Interface
SSD	Solid State Disk
STD	Standard
UART	Universal Asynchronous Receiver Transmitter
UEFI	Universal Extensible Firmware Interface

APPENDIX D: LIST OF ACRONYMS

Acronym	Definition
USB	Universal Serial Bus, a peripheral bus
VA	Volt Ampere, Power
VGA	Video Graphics Array
8P8C	Connector with eight Positions eight contacts, also known as RJ-45

G500 Substation Gateway

Revision History

Revision History

Version	Revision	Date	Change Description
1.00	0	March 25, 2019	Document created.
	1	April 02, 2019	Order Code and Redundancy wiring drawings are updated.
	2	June 11, 2019	Updated the Baud rate setting in the USB Slave section.
	3	July 17, 2019	Updated the Super Capacitor section and Wires section.
1.10	0	Feb 14, 2020	Updated document for Version 1.10.
2.00	0	May 29, 2020	Updated document for Version 2.00.
	1	June 04, 2020	Updated the Cable Assembly part number for Redundancy Wirings.
2.10	0	Dec 09, 2020	Updated the Redundancy Wiring drawings and DisplayPort™ section and Copyrights information. Updated document for Version 2.10.
	1	June 07, 2021	Updated SFP Modules information.
2.50	0	Oct 01, 2021	Updated GE logo. Updated Order Code and MCP Spares tables in Chapter 1. Updated the Peripheral compatibility with “Date of Release” column. Updated D20C compatibility Table 6. Updated the IM with RS485 Modem Control Signal Clarification. Updated D.20 Repeater/Splitter Compatibility Table 7. Added Hot-Hot Redundancy content in Chapter 3. Modified figures in Chapter 3: - Redundancy Wiring - Single RS232 Switch Panel - Redundancy Wiring - Dual RS232 Switch Panel (1 of 2) - Redundancy Wiring - Redundant RS232 Switch Panel (2 of 2) Added Status 1 and Status 2 LED Indicators table in Chapter 5.

Version	Revision	Date	Change Description
2.60	0	Dec 03, 2021	Updated Order Code table.
	1	Jan 28, 2022	Updated Redundancy wiring section in Chapter 3: - Redundancy Wiring - Single RS232 Switch Pane - Redundancy Wiring - Dual RS232 Switch Panel (1 of 2) - Redundancy Wiring - Redundant RS232 Switch Panel (1 of 2) - Redundancy Wiring - Redundant RS232 Switch Panel (2 of 2) Added a note stating G500 A and B watchdog cables are not interchangeable.
2.70	0	Feb 16, 2022	Updated Order Code and MCP Spares tables in Chapter 1. Added Software Licenses table in Chapter 1. Updated D20 port supply load from 3.5A to 2.5A in Chapter 3. Updated text "IRIG-B input watchdog signal" to "IRIG-B input invalid signal" in Chapter 5.
2.80	0	June 21, 2022	Updated Order Code table in Chapter 1. Updated Software Licenses table and MCP Spares table in Chapter 1. Updated GE Item # (517-0169) in Table 6 - Chapter 3. Mean Time Between Failure (MTBF) specifications tables are moved to a standalone document.
3.00	0	April 17, 2023	In Chapter 1 : - Updated Order Code - Added MCP Redundancy Kit (K) Switch Panel (SW PNL) table for firmware v2.80 and lower - Added MCP Redundancy Kit (N) Switch Panel (SW PNL) table for firmware v3.00 and higher In Chapter 3 : - Clarified redundancy operation - Added Redundancy wiring for v3.00 In Chapter 6 : - Updated Real Time Clock in the Product Specification section Removed Chapter 8: Restore the G500 to factory default. Note: Restore the G500 to factory default topic is described in the document TN0116 MCP Firmware Upgrade and Restore to Defaults Workflows
	1	July 18, 2023	In Chapter 3 : Updated Power-On Self-Test (POST) section
3.10	0	Aug 23, 2023	Updated Order Code.

REVISION HISTORY

Version	Revision	Date	Change Description
4.00	0	April 03, 2024	GE Vernova Logo is added on the first page. In Chapter 1: - Updated Order Code - Added sections Changes to G500 Model Number, As-Built model number digits and As-is model number - Added a table to show software digits for D2x Function - Removed D2x Legacy references from Software Licenses and MCP Spares and Accessories tables In Chapter 3: - In the Supplying power through the D.20 Link section, added 4-pin mating connector P/N for D.20 HDLC connectors - Updated connection of D.20 link for G500 B in sections - Single D.20 link with redundant G500 and Single D.20 link, redundant LAN with redundant G500 - In the G500 system redundancy section, Note is added describing the redundancy mode available for V4.0 - Added a section G500 running as D2x system redundancy In Chapter 4: - In the Alarm section, added clarification for Status 1 LED and Alarm Relay In Chapter 6: - In Communications table, updated the baud rates for Serial Communications
4.10	0	Aug 02, 2024	Updated Company name, Copyright Notice and Trademark Notice. In Chapter 1: - Updated Order Code - Remote Desktop HMI functionality and license are no longer available In Chapter 3: - Added section to specify D.20 Link Capabilities and Restrictions In Chapter 6: - In Communications table, updated the Ethernet connections and D.20 Link HDLC Communications

Version	Revision	Date	Change Description
5.00	0	Nov 11, 2024	In Chapter 1: - Updated Order Code - Update Hardware overview section to show AMD and Intel CPU modules In Chapter 3: - Updated Power-On Self-Test (POST) section - Updated connections of D.20 link for G500 (A & B) for the following: - Single D.20 link with redundant G500 layout and - Single D.20 link, redundant LAN with redundant G500 layout - Updated Table 12 and Table 13 - Removed Redundant D.20 link, redundant LAN with redundant G500 section and Table 14 In Chapter 4: - Updated sections - DisplayPort™ - M.2 SSD - OLED Display In Chapter 6: - In System table, updated the Processor, Memory and Operating system - In Communications table, updated the Video Output
5.10	0	Dec 17, 2024	In Chapter 1: - Updated Order Code In Chapter 3: - Added sections - Single Ring and Fiber Optic (FO) D.20 link with redundant G500 and Single Ring and Fiber Optic (FO) D.20 link, redundant LAN with redundant G500

REVISION HISTORY

Version	Revision	Date	Change Description
5.20	0	May 08, 2025	In Product Support, - Updated GE Vernova email addresses and phone numbers in Contact Technical Support section In Chapter 1, - Updated Order Code - Updated MCP Spares and Accessories table In Chapter 3, - In Connection Scenarios section, updated all D.20 layouts In Chapter 4, - In M.2 SSD section, added 1TB to the G500 supported storage capacity - Removed G500 SSD default password In Chapter 6, - In System table, updated the Storage with CPU Option D and clarified the minimum version In Chapter 7, - Removed G500 SSD default password
	1	June 24, 2025	In Chapter 3, - Added clarification for each D.20 layout with maximum supported peripherals - Added new layouts - Dual D.20 terminated, Ch 1 only - Dual D.20 terminated, with redundant G500