Multilin™ G500

Substation Gateway

Instruction Manual

994-0152
Version 2.80 Revision 0

cURus CE IEC 61850 REGISTERED ISO 9001 GE MULTILIN WORLDWIDE **10** YEAR WARRANTY

Building a world that works

G500 Substation Gateway

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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 Technical Support library
- Contact Technical Support

Also covered are:

- The G500 address
- Instructions on returning a G500

Access the GE 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: http://www.gegridsolutions.com

Search GE 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:
Visit us on the Web at: http://sc.ge.com/*SASTechSupport

Contact GE Grid Solutions technical support

GE Grid Solution Technical Support is open 24 hours a day, seven days a week for you to talk directly to a GE representative.
In the U.S. and Canada, call toll-free: 1 800-547-8629
International customers, please call: + 1 905-927-7070

Or e-mail to G500 Local region contact support:
- ga.supportNAM@ge.com - North America
- ga.supportLAM@ge.com - Latin America
- ga.supportCEAP@ge.com - China, East Asia, Pacific
- ga.supportERCIS@ge.com - Europe, Russia, Commonwealth of Independent States
- ga.supportIND@ge.com - India
- ga.supportMENAT@ge.com - Middle East, North Africa, Turkey

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 Grid Solutions address

The GE Grid Solutions company address is:

GE 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's 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.

NOTE

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 part number SWM0101).

For the current version of the G500 Instruction Manual, please download a copy from: http://www.gegridsolutions.com/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 See "Order code" on page 14.

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:

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

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

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

NOTICE   **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
- MCP Spares and Accessories

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

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

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 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.
⚠	**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 two CPU modules, either an 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, or an 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). 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

Order code

Order Code Item	G500	Hardware configuration	Software configuration	Code	Description
CPU and Memory Option				A	2.20 GHz 2 core APU, 8 GB DDR3 SDRAM
				B	2.70 GHz 4 core APU, 16 GB DDR3 SDRAM
Power Supply Option - Primary and Redundant				H	110-270 VDC/100-240 VAC (Conformal Coated)
				L	20-54 VDC (Conformal Coated)
				U	Not Required
Serial Port Option				8	8x Serial Ports, RS-232/RS-485 independently configurable and isolated
Ethernet Interface - SFP type				T	100/1000BASE-TX (RJ45 copper medium) [580-3786]
				F	100BASE-FX (LC fiber multimode) [580-3784]
				S	1000BASE-SX (LC fiber multimode) [580-3785]
				L	1000BASE-LX (LC fiber single-mode) [580-3787]
				U	Not Required
Storage M.2 SATA SED				A	128 GB Self encrypted Solid State Drive
				B	256 GB Self encrypted Solid State Drive
				U	Not Required
PCIe Expansion Module				4	4x Serial Ports, RS-232/RS-485 independently configurable and isolated
				D	2x D.20 Link Ports [528-1002LF]
				U	Not Required
Future Use				U	Not Required
Future Use				U	Not Required
Future Use				U	Not Required
1st Application				S	Single OS, no Hypervisor
				CA	Universal Gateway
Firmware Version				00	Latest Firmware Version (Default)
				A0	v1.0 firmware version
				A1	v1.1 firmware version (Limited release)
				B0	v2.0 firmware version
				B1	v2.1 firmware version
				B5	v2.5 firmware version
				B6	v2.6 firmware version
				B7	v2.7 firmware version (Projects release)
				B8	v2.8 firmware version
Application License				xxx	License (ARRM, IEC61850-Client, IEC61850-Server, LogicLinx, D2x Legacy)
				UU	Not Available
2nd Application				UU	Not Available
				UUU	Not Available

Table 2: Software Licenses

Value	Assignment
2	ARRM
4	IEC61850 Client
8	IEC61850 Server
16	LogicLinx
64	D2x Legacy (Tejas V Server)

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-    -    -    -    -  -  -        -
```

* Storage option A is only available with CPU option A and storage option B is only available with CPU option B.
** 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.

MCP Spares and Accessories

	MCP-S	-	*	-	*	Description	
Spare type							
			1			SFP Transceiver	
			2			Power Supply	
			3			PCIe Card	
			L			Upgrade License	
			4			Termination Panel	
SFP Transceiver options							
					F	SFP Module 100BASE-FX LC TRANSCEIVER OPTICAL MULTI-MODE 1300nm -40 TO 85C [580-3784]	These options are only available when Spare type is **SFP Transceiver**
					S	SFP Module 1000BASE-SX LC TRANSCEIVER OPTICAL MULTI-MODE 1310nm -40 TO 85C [580-3785]	
					T	SFP Module 100/1000BASE-T RJ45 TRANSCEIVER COPPER -40 TO 85C W/WO RX_LOS [580-3786]	
					L	SFP Module 1000BASE-LX LC TRANSCEIVER OPTICAL SINGLE-MODE 1310nm -40 TO 85C (580-3787)	

	MCP-S	-	*	-	*	Description	
Power Supply Options							
					H	MCP PSU, HV 90-264 VAC/88-330VDC [528-2001LF-CC]	These options are only available when Spare type is **Power Supply**
					L	MCP PSU, LV 18-60VDC [528-2002LF-CC]	
PCIe Card Options							
					S	MCP PCIe UART CARD, 4x PORT (RJ45) RS232/485 [528-1001LF]	These options are only available when Spare type is **PCIe Card**
					R	MCP BUILT-IN UART CARD, 4x PORT (RJ45) RS232/485 [528-1003LF]	
					D	G500 PCIe D.20 HDLC CARD, 2x D.20 Link Ports (528-1002LF]	
Upgrade License							
					A	Automated Record Retrieval Manager (ARRM) (SGA0069)	These options are only available when Spare type is **Upgrade License**
					B	IEC61850 (Client) (SGA0074)	
					C	LogicLinx Executor (SGA0067)	
					D	IEC61850 (Server) (SGA0088)	
					E	D2x Legacy - Tejas V Server (SGA0089)	
Termination Panel							
					A	RJ45 to DB9 Adapter Panel with Cables (528-1006LF [1], 977-0546/2.5 [4], 977-0563/3.0 [4])	These options are only available when Spare type is **Termination Panel**

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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.

⚠ WARNING **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.

ATTENTION
STATIC SENSITIVE DEVICES
HANDLE ONLY AT
STATIC SAFE WORK STATIONS

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 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!

⚠️**WARNING**

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 Technical Support as soon as possible.

NOTE

PCIe Cards and storage devices may also have temperature restrictions

Retain all packing material in case of future need.

⚠️**WARNING**

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

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Chapter 3: Installing the G500

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

⚠CAUTION **Before you install and operate the G500, read and follow the safety guidelines and instructions in "Safety precautions" on page 11.**

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:
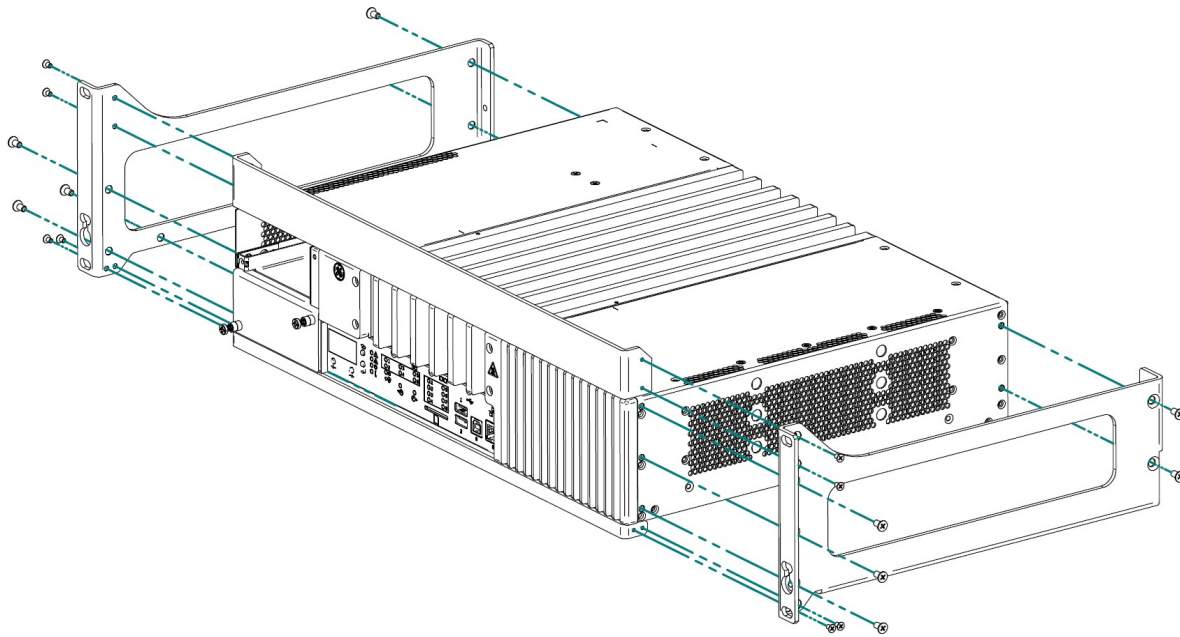
NOTE

For screw torque specification, refer to "General Torque Values for Screws" on page 99.

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.
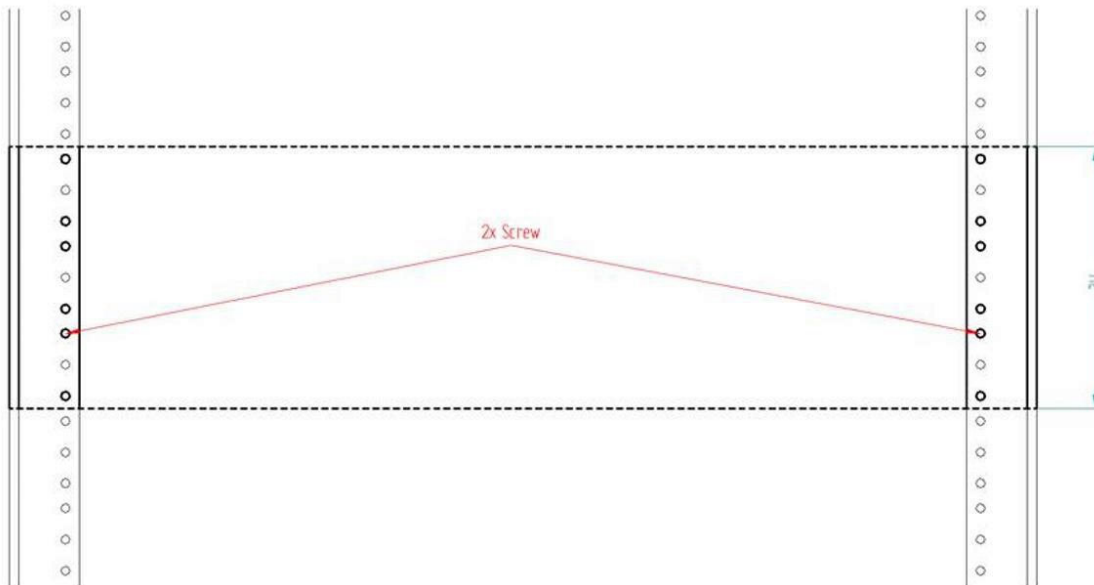
3. Attach the unit by aligning the two screws with the keyhole mounting points of the brackets.
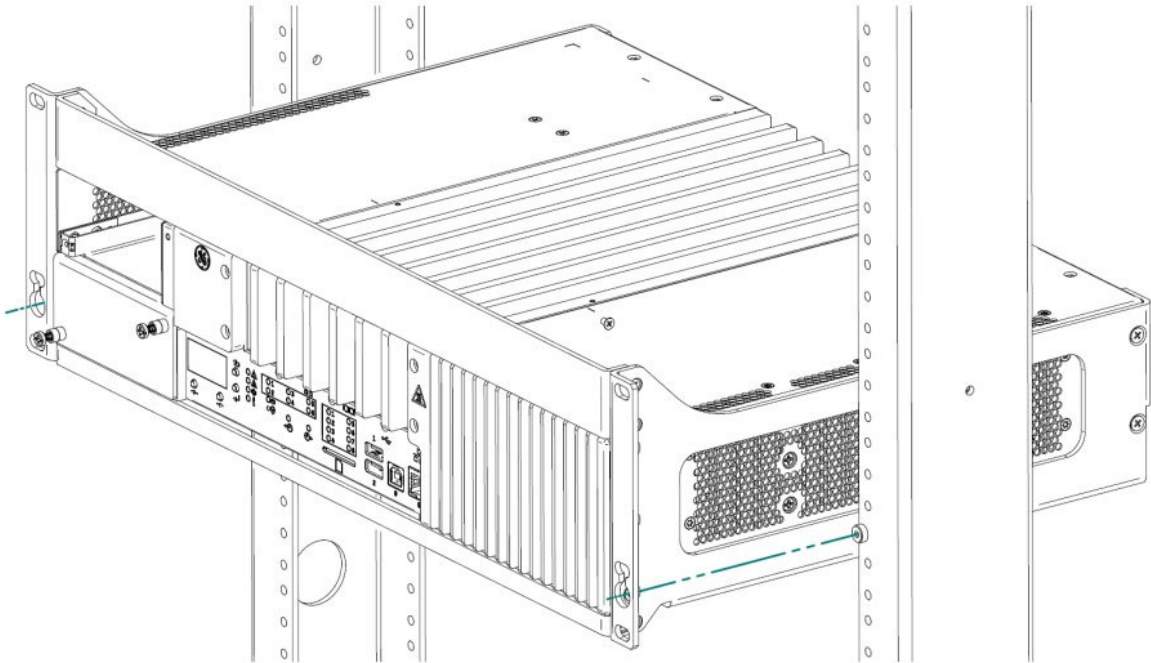
4. Once aligned, set down the unit and then tighten the screws.
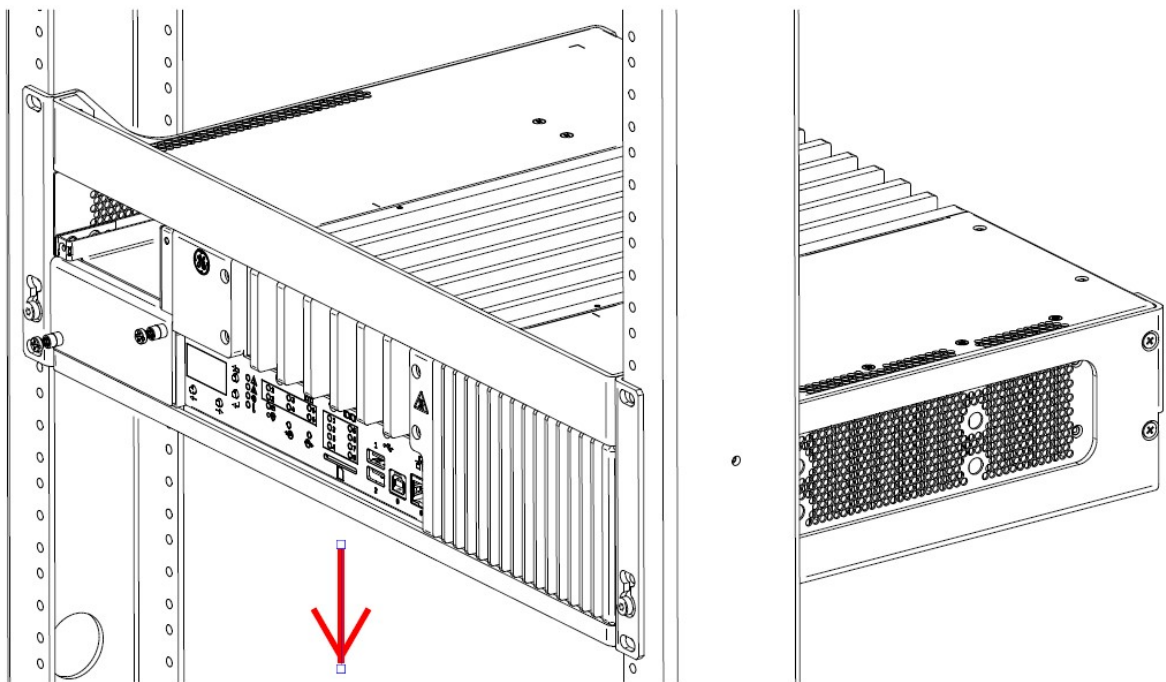
The recommended tool torque settings for zinc-plated mounting screws are:
- 10-32 UNF screws use 22.2 in-lb [2.50 Nm]
- 12-24 UNC screws use 31.0 in-lb [3.51 Nm]
- M5x0.45 screws use 18.1 in-lb [2.04 Nm]

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

NOTE

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.
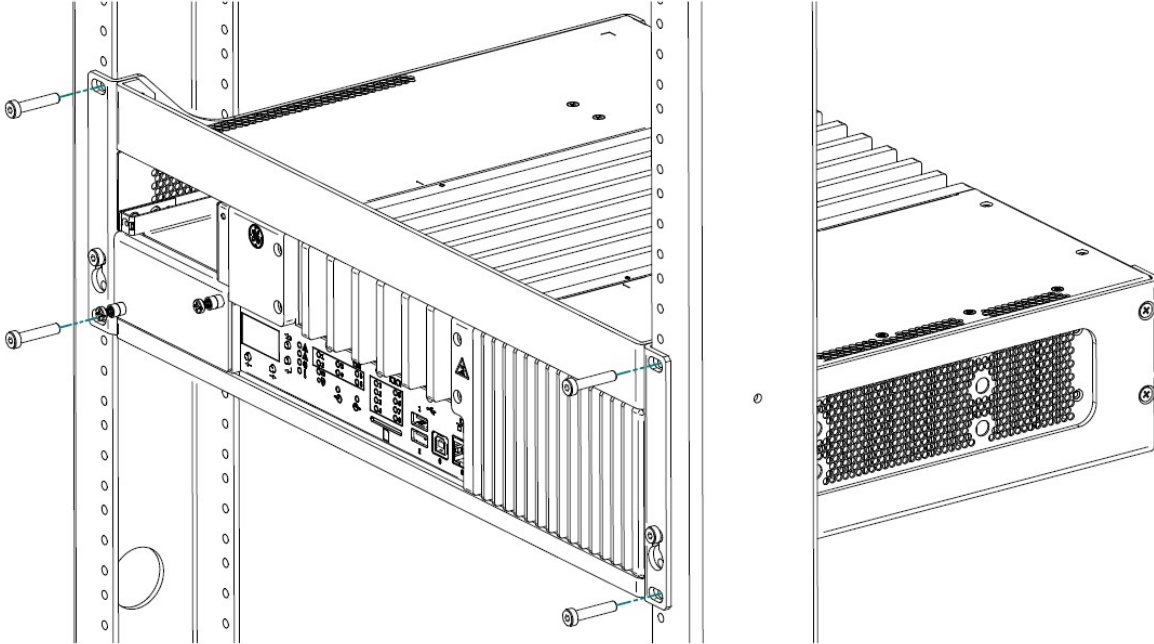
Spacing for air circulation

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.
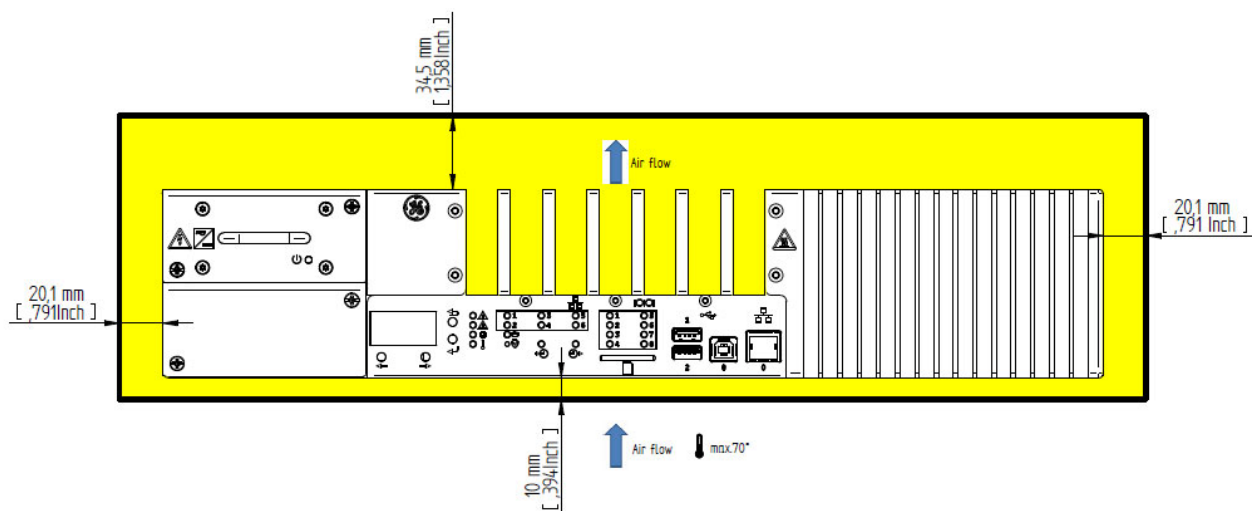
NOTE

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.

⚠ DANGER

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 Item) with back shell (GE Item) may be requested.
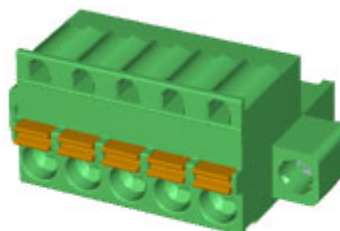
Power Supply Unit (PSU)

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.
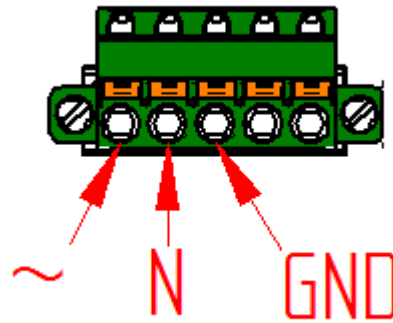
When using DC power, connect the "+"and "- wires according to the following figure. The GND wire is optional.
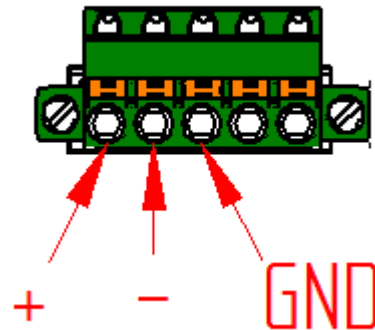
The inrush current is typically limited to 35A when powering up.

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.

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

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.

NOTE

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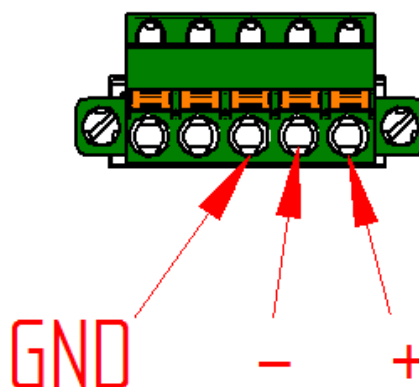
Wires

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.

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

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.

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

## 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's Grid Solution support with the hexadecimal code in this case.

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 81.
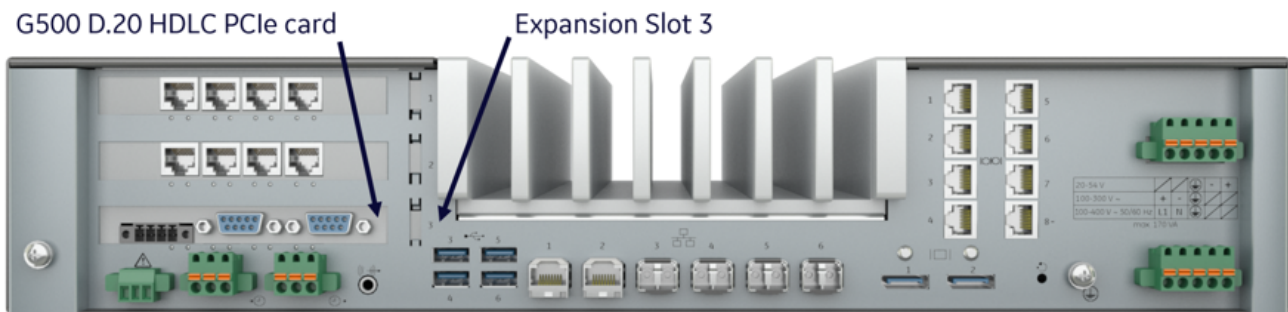
G500 D.20 HDLC PCIe card

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.
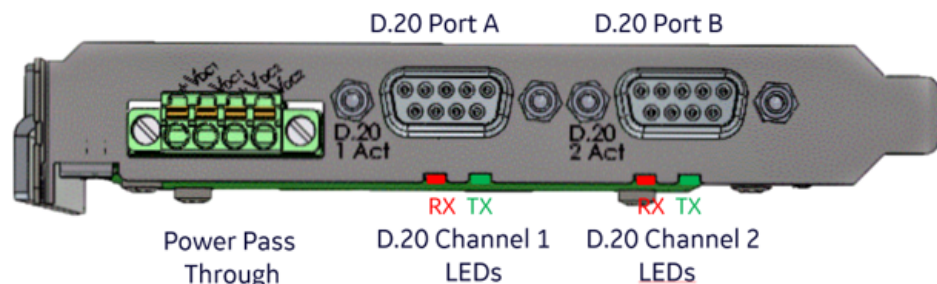
The Power Pass Through connector allows the D.20 peripheral connected to the D.20 Link to be powered through the D.20 port. The Power Pass Through requires one or two external power supplies to be connected. Refer to "Supplying power through the D.20 Link" on page 29 section for further details.

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}

NOTE

The Power Pass Through connections are protected to 2.5A.
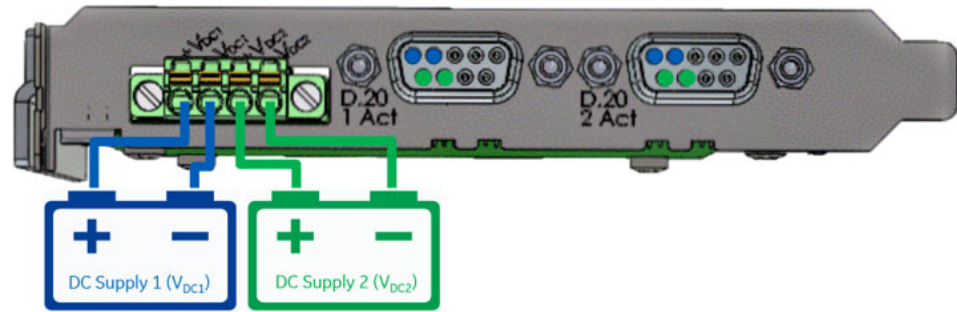
Peripherals

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 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	

Component	GE Item #	Description	Compatible release	Date of release
	306	PCOMMON v3.06	All	
	305	PCOMMON v3.05	All	
	301	PCOMMON v3.01	All	
PCOMMON	300	PCOMMON v3.00	All	

Table 4: D20S Status Input Module Compatibility

Component	GE 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	
	306	PCOMMON v3.06	All	
	305	PCOMMON v3.05	All	
	301	PCOMMON v3.01	All	
PCOMMON	300	PCOMMON v3.00	All	

Table 5: D20K Control Output Module Compatibility

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

Table 6: D20C Combination Input/Output Module Compatibility

Component	GE 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	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 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
- Single D.20 link, redundant LAN
- Redundant D.20 link, redundant LAN
- Single D.20 link with redundant G500
- Single D.20 link, redundant LAN with redundant G500
- Redundant D.20 link, redundant LAN with redundant G500

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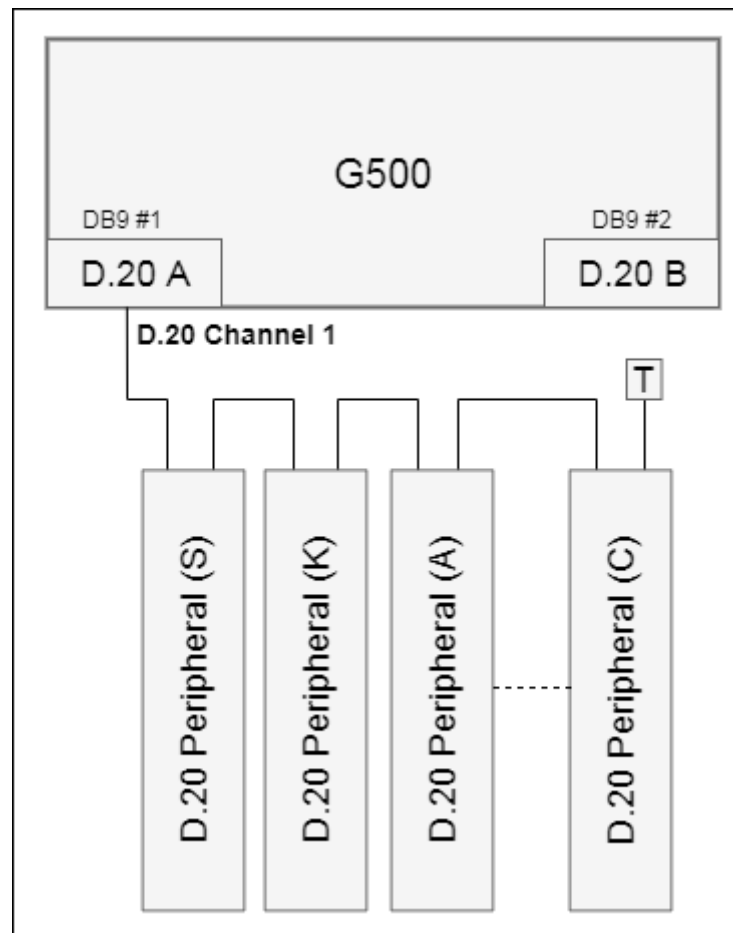
D.20 redundant LAN daughter card can optionally be installed with the corresponding configuration (Single Link) in DSAS.

The last D.20 peripheral must be terminated with D.20 terminator (GE part#: 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
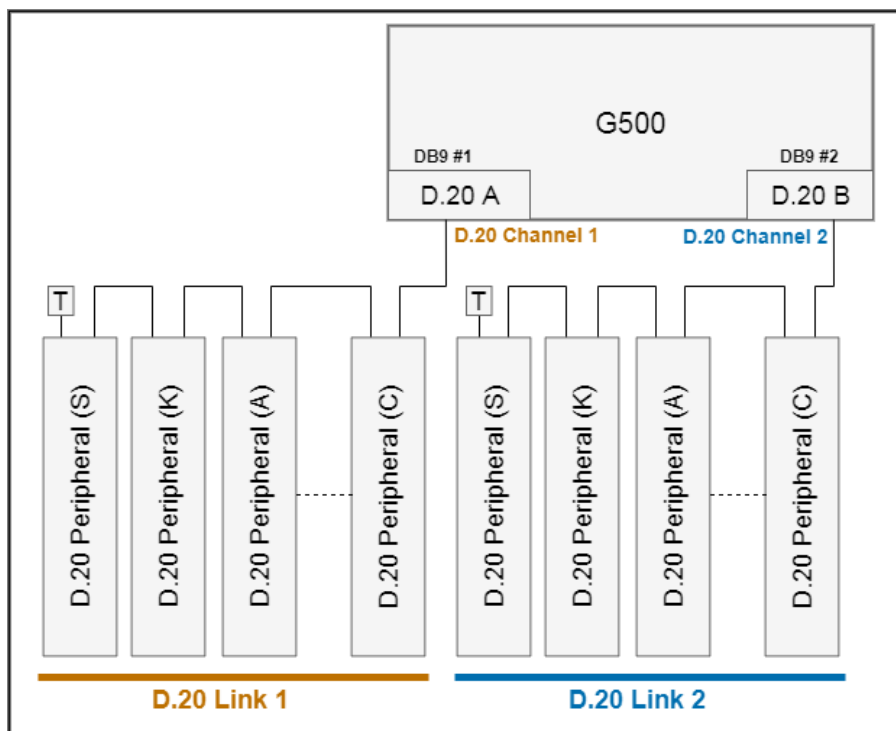
D.20 redundant LAN daughter card can optionally be installed with the corresponding configuration (Redundant Link) in DSAS.

The last D.20 peripheral must be terminated with D.20 terminator (GE part#: 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

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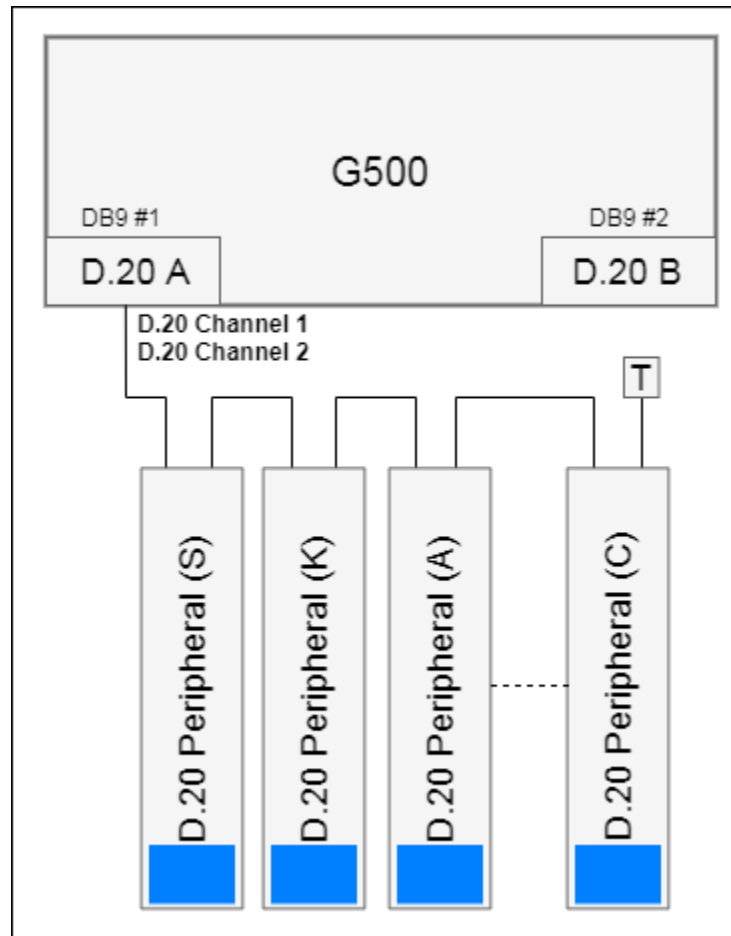
D.20 redundant LAN daughter card (GE part#: 540-0209 for D.20C and GE part#: 540-0207 for D.20A,S,K) must be installed with the corresponding configuration (Redundant Link) in DSAS.

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

Table 10: Single D.20 link, redundant LAN

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

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

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

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

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

Table 11: Redundant D.20 Link, Redundant LAN

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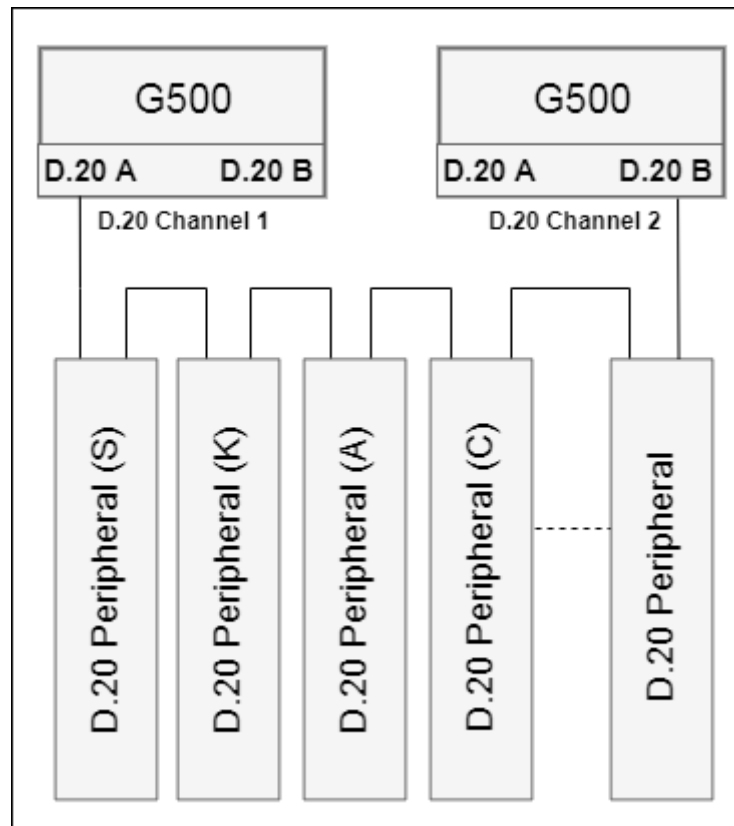
D.20 redundant LAN daughter card are not supported in Loop mode and must NOT be installed.

Table 12: Single D.20 link with redundant G500

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

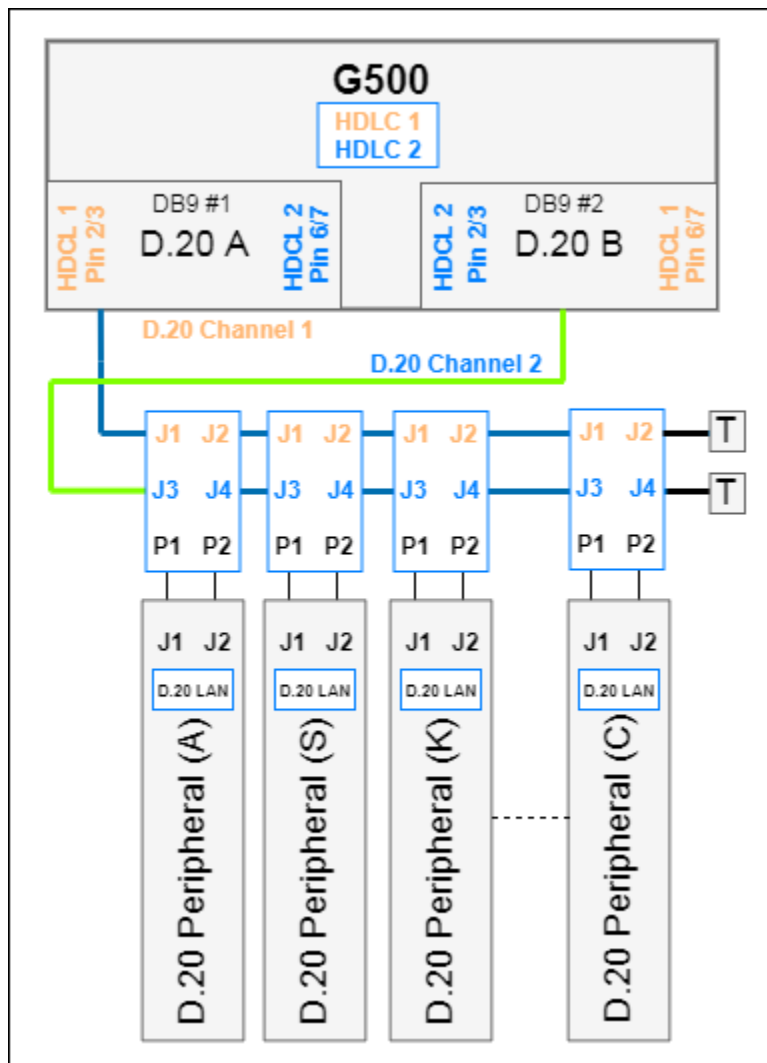**Single D.20 link, redundant LAN with redundant G500**
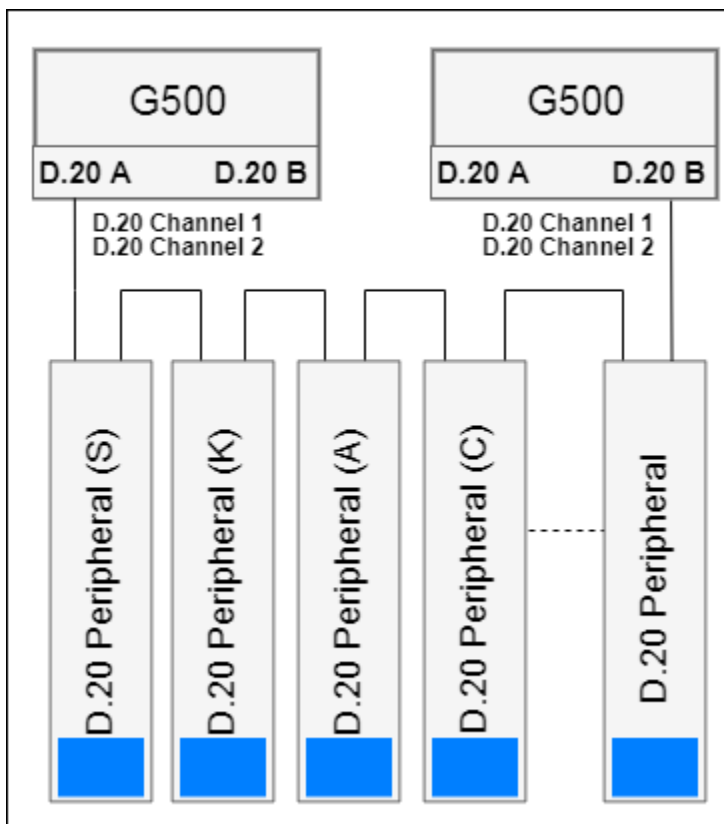
D.20 redundant LAN daughter card (GE part#: 540-0209 for D.20C and GE part#: 540-0207 for D.20A,S,K) must be installed with the corresponding configuration in DSAS.

Table 13: Single D.20 link, redundant LAN with redundant G500

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 with redundant G500
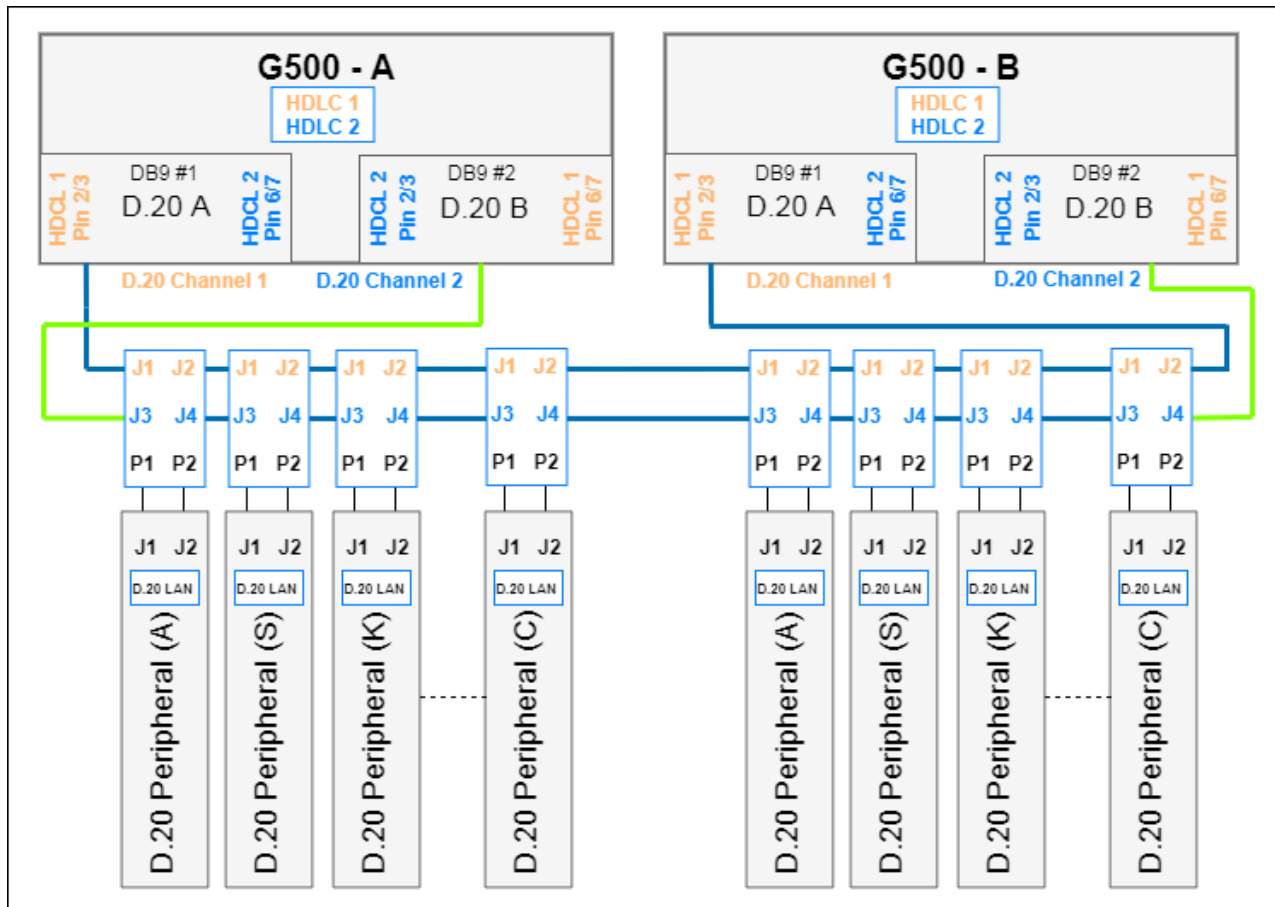
D.20 redundant LAN daughter card (GE part#: 540-0209 for D.20C and GE part#: 540-0207 for D.20A,S,K) must be installed.

D.20 link splitter must be installed on each D.20 peripheral (GE part#: 540-0313)

The D.20 Link crossover cable must be installed from G500 D.20 Port B to peripheral link (GE part#: 977-0561)

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

Table 14: Redundant D. 20 link, redundant LAN with redundant G500

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

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 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 58.

When using the G500 in hot-hot 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, to ensure correct assignment of the hot-hot communications.

NOTE

The RS-232 switch panel 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 units is currently active. If the hardware or software of the active unit fails, it is automatically switched offline and serial connections to the field are transferred to the standby unit. A toggle switch on the RS232 switch panel can be used to manually switch the G500 devices between active and standby modes.

NOTE

To view the Redundancy statuses, refer to Status 1 and Status 2 LED Indicators on page 90.

Fail over sequence

If the active G500 unit fails, the following actions occur:

1. The standby G500 unit detects the failure through the lack of a heartbeat signal on the ping cable or through a status change on the watchdog cable.

2. The standby G500 unit attempts to pull the RS232 switch panel to assume the active state.

3. The RS232 switch panel transfers all serial field connections to the standby G500, which then becomes the active G500.

Required components

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

Component	Function	GE 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.

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

NOTE 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.

NOTE Pins 4 on switch panel connectors J2 through J9 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.

NOTE 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.

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

NOTE 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 43.

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 part number 977-0557/LLL) to a serial port (RJ45 connector) on the first G500 (CCU A).

4. Plug the connector of watchdog cable B (GE part number 977-0558/LLL) to a serial port (RJ45 connector) on the second G500 (CCU B). This cable must be connected to the same serial port number on both units.

5. Connect the bare leads of both watchdog cables to TB1 on the RS232 switch panel as shown in Figure 1 on page 43.

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 a 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 a 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 44 and Figure 2 on page 44.

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 part number 977-0557/LLL) to a serial port (RJ45 connector) on the first G500 (CCU A).

4. Plug the connector of watchdog cable B (GE part number 977-0558/LLL) to a serial port (RJ45 connector) on the second G500 (CCU B). This cable must be connected to the same serial port number on both 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 44.

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 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 a 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 a 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 panel:

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 43.
- 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 44.
    - For the right side of the drawing, see "Redundancy Wiring - Dual RS232 Switch Panel (2 of 2)" on page 45.

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 46.
    - For the left side of the drawing, see "Redundancy Wiring - Redundant RS232 Switch Panel (2 of 2)" on page 47.

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

NOTE: 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 41.

Figure 1: Redundancy Wiring - Single RS232 Switch Panel
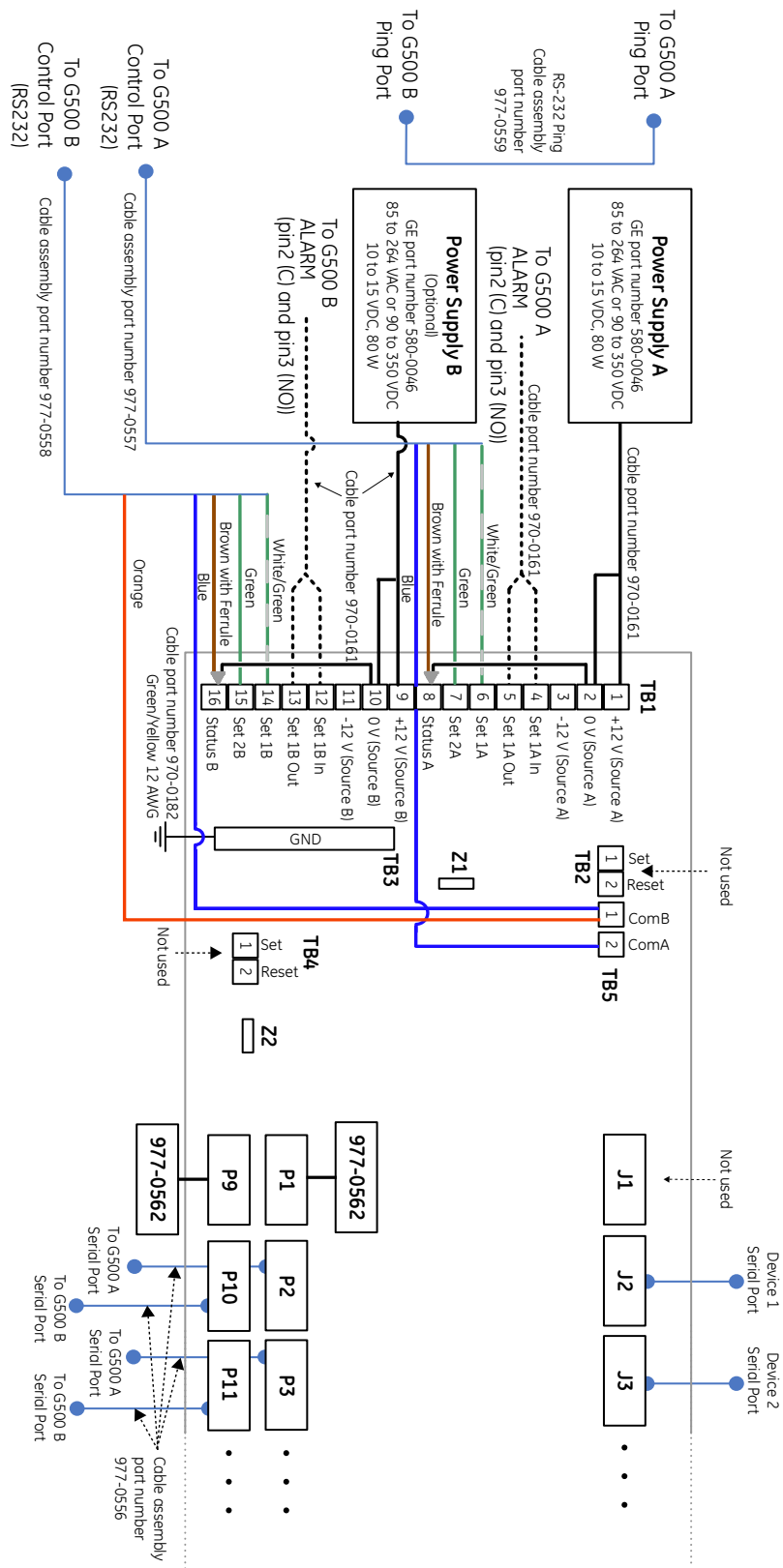
Figure 2: Redundancy Wiring - Dual RS232 Switch Panel (1 of 2)
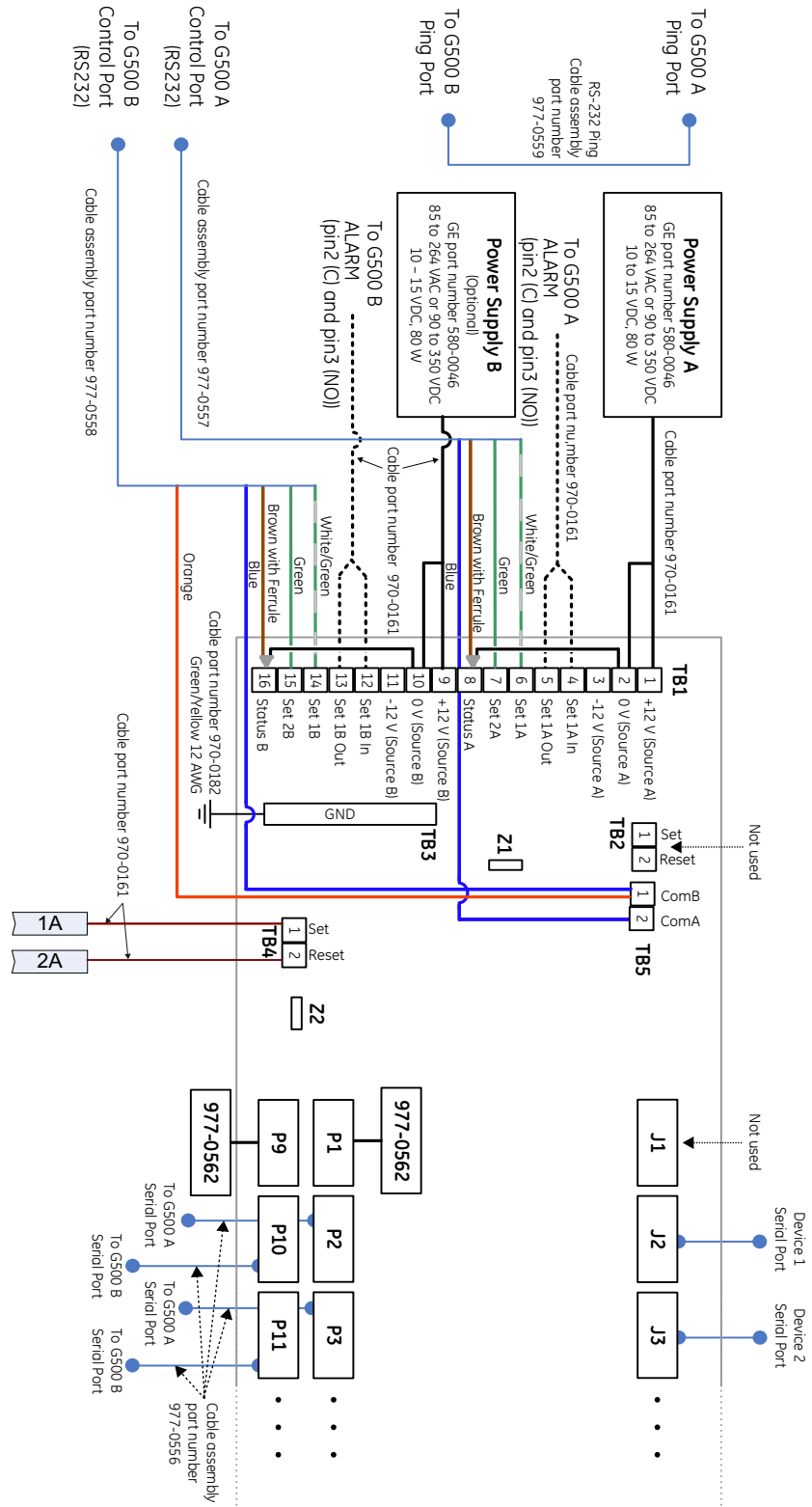
Figure 3: Redundancy Wiring - Dual RS232 Switch Panel (2 of 2)
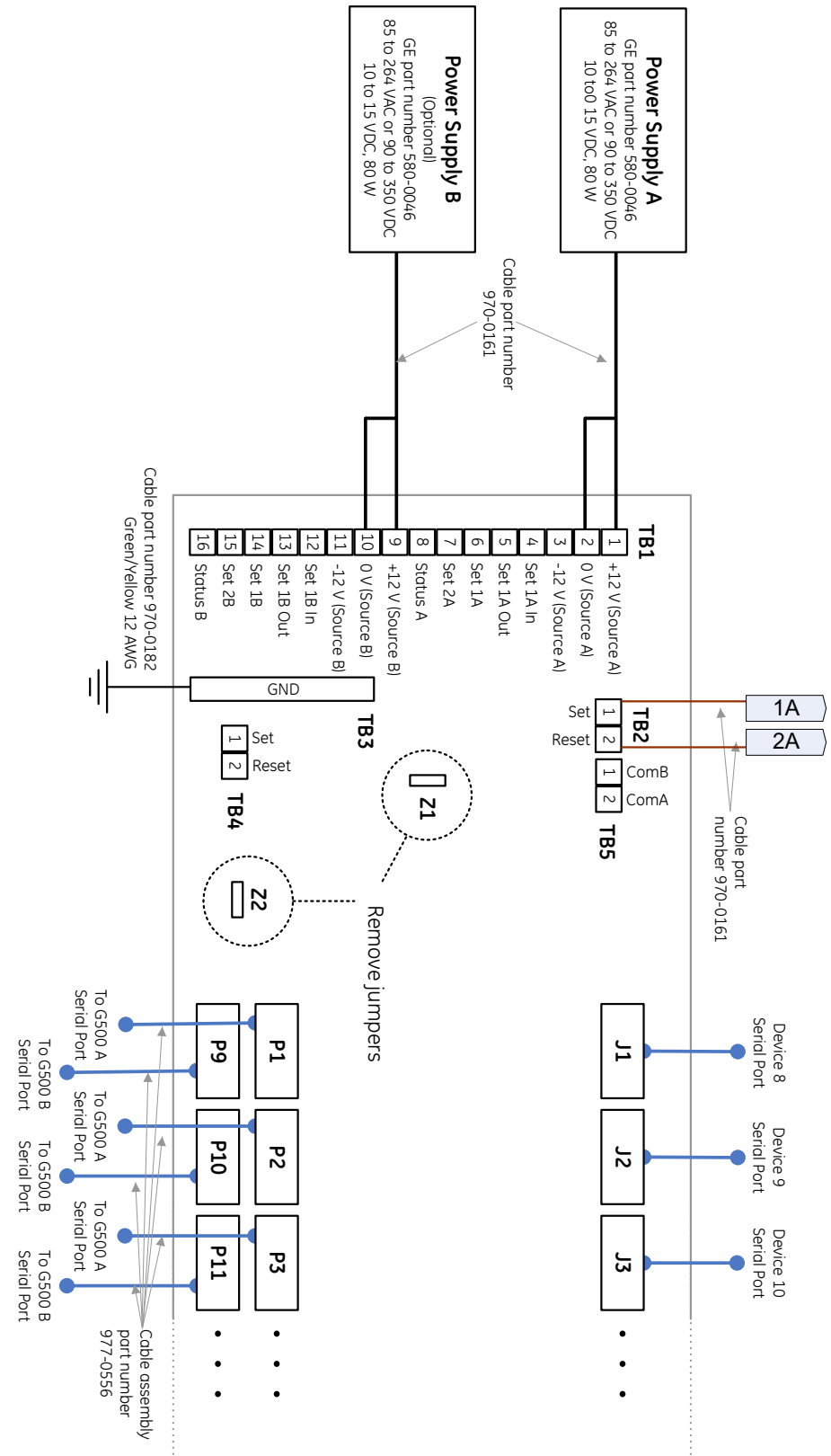
Figure 4: Redundancy Wiring - Redundant RS232 Switch Panel (1 of 2)
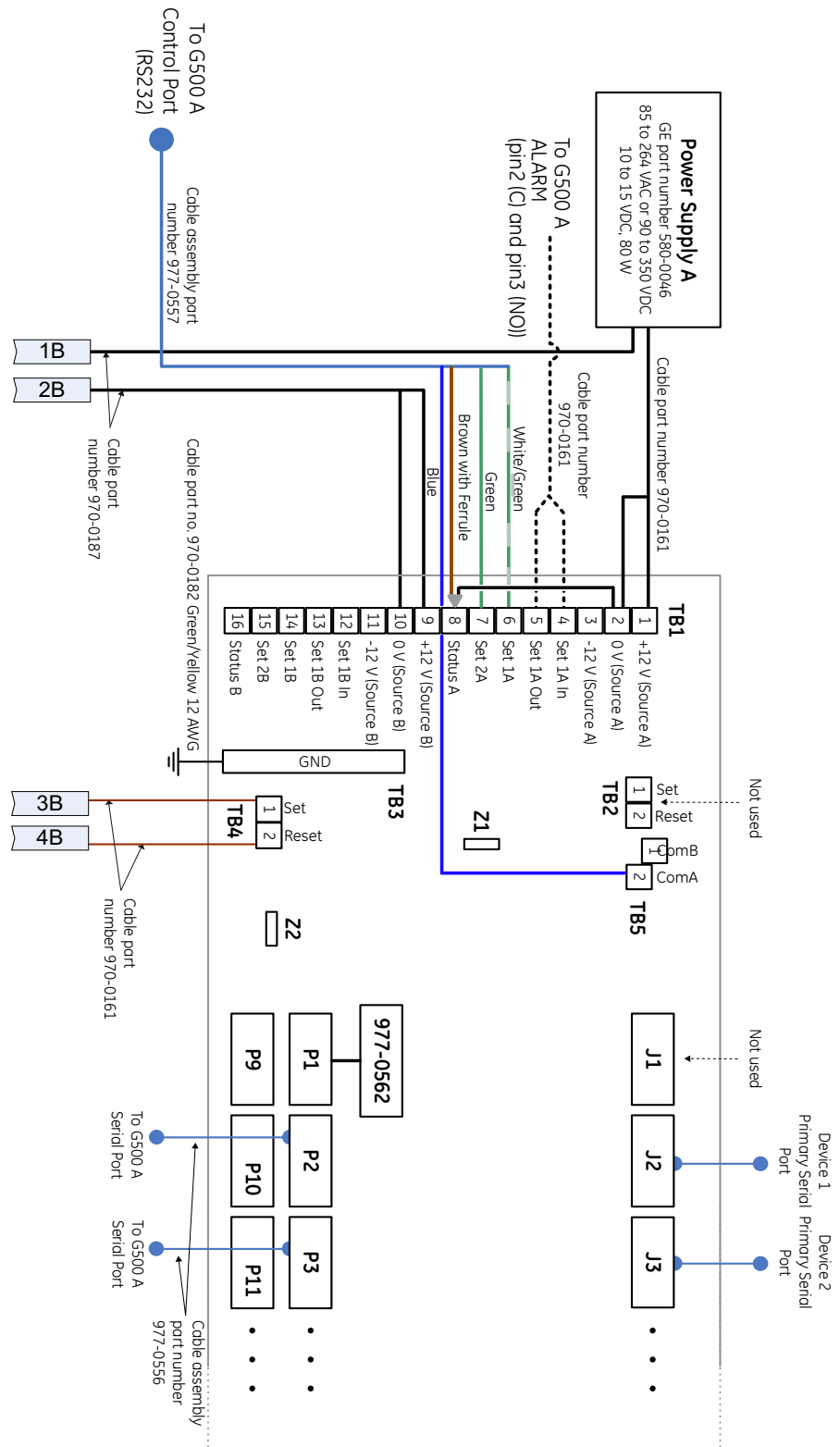
Figure 5: Redundancy Wiring - Redundant RS232 Switch Panel (2 of 2)
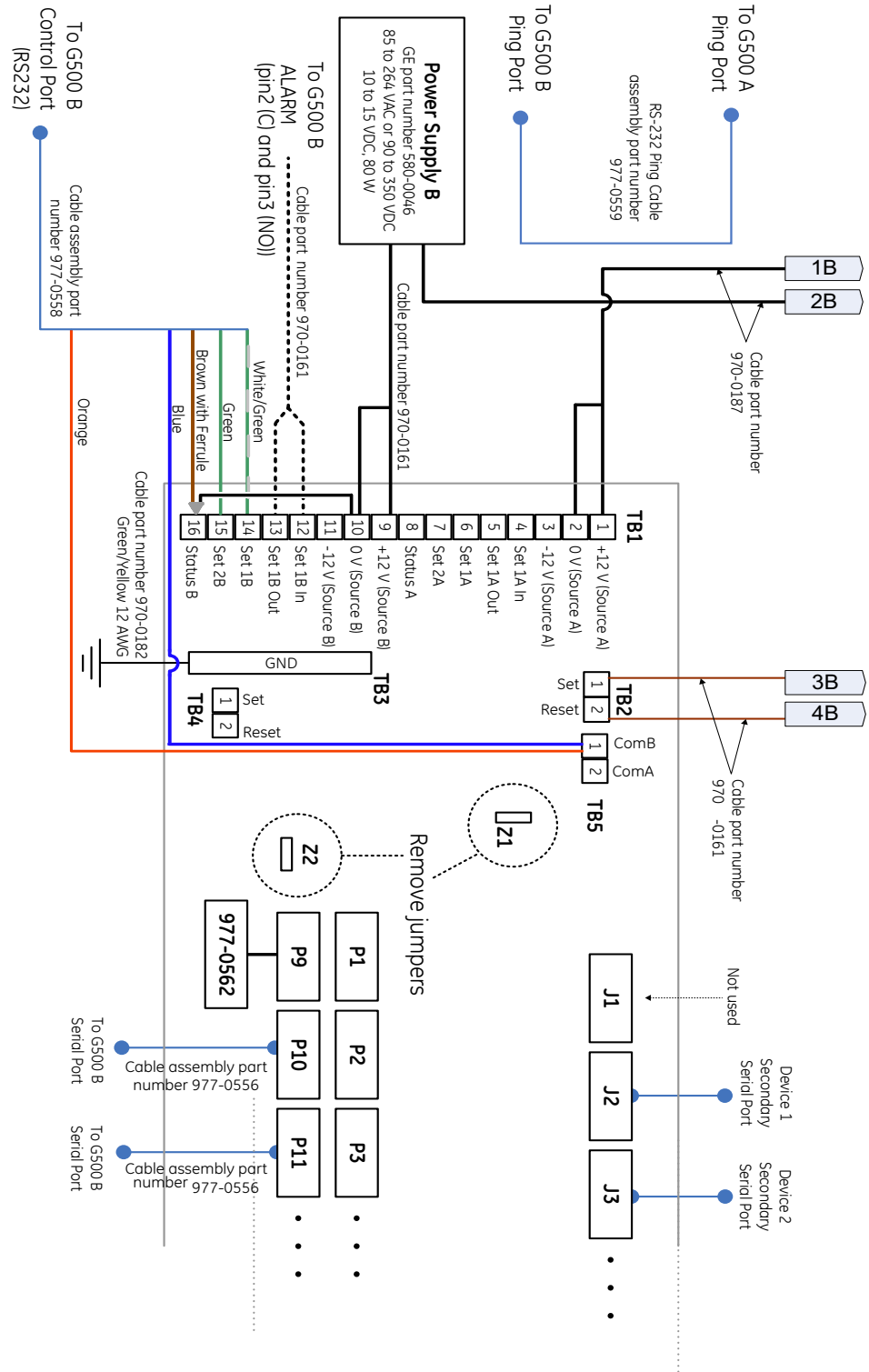
G500 Substation Gateway

Chapter 4: Interfaces

This chapter covers the interfaces of the Multilin^{TM} 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

Modular, Hot Swappable
Redundant Power Supplies
20-54 VDC@10.2A
110-270VDC@1.8A
100-240VAC@2.1A

Power Supply LED Indication
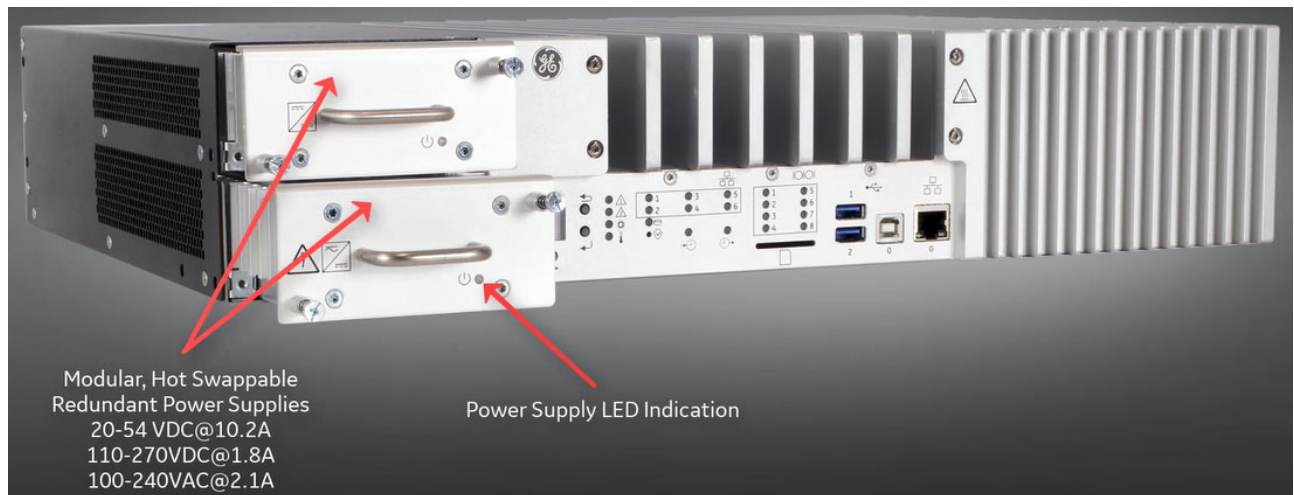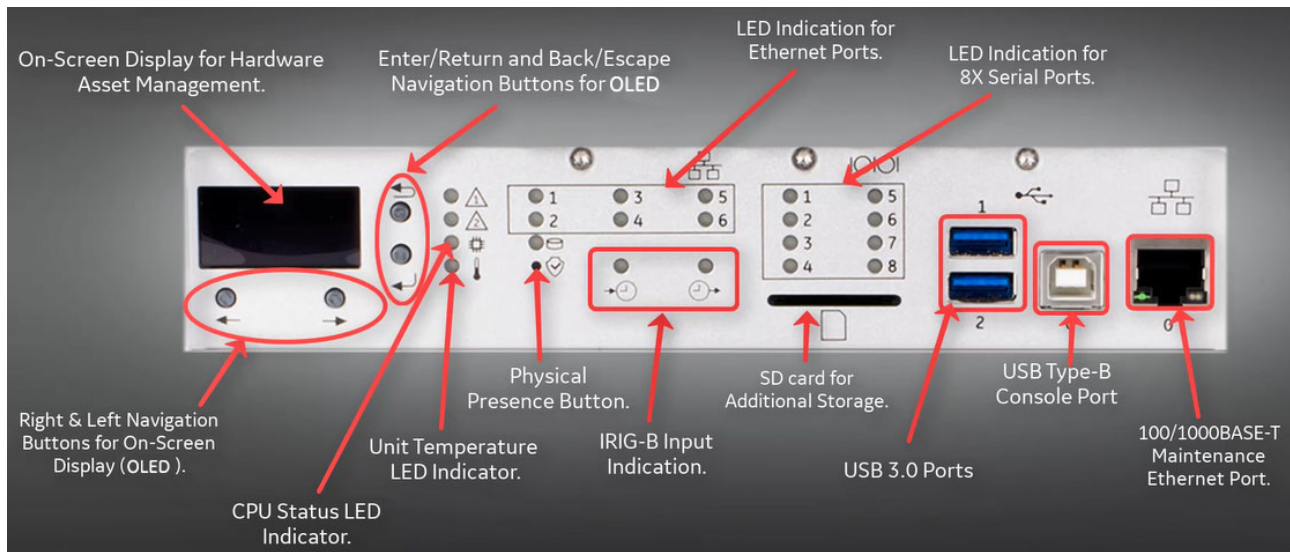
Rear panel

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

Figure 2: G500 rear panel
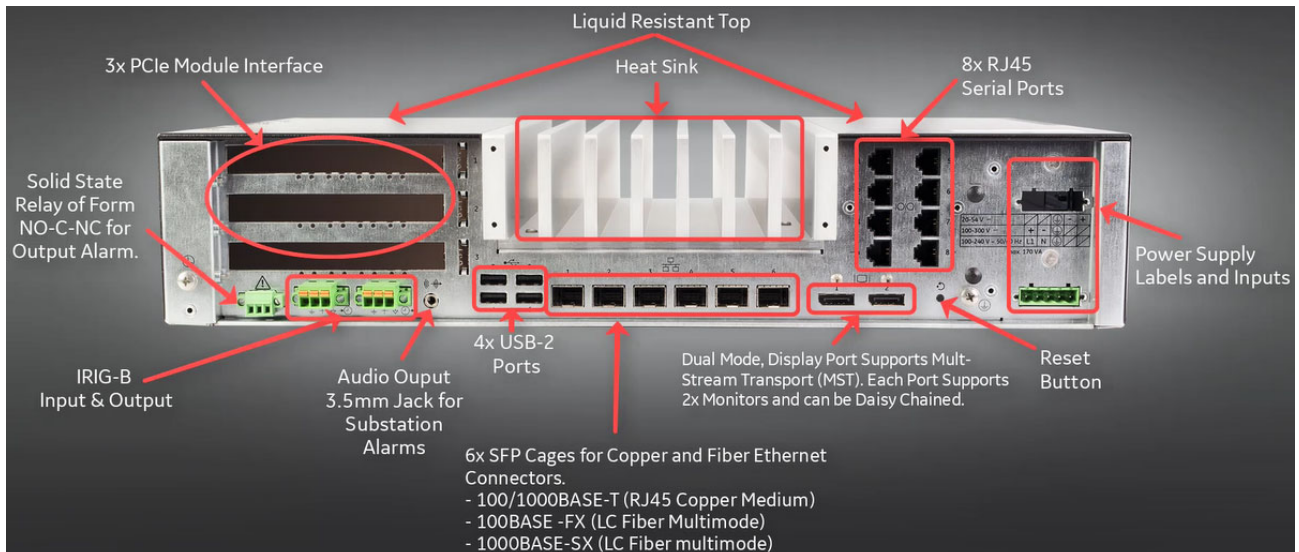
The G500 contains serial (8 factory-installed and expandable to 20 through PCIe expandable cards) ports for the communication cards. The communication cards are powered from the G500. The types of communication cards included in your G500 depend on what was ordered for your substation application.

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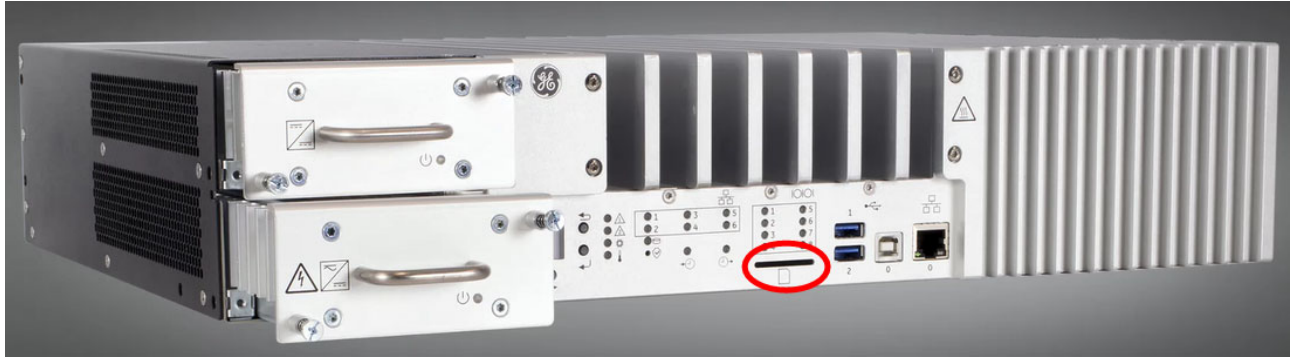
The maximum cable length for USB 3.0 cables is 3m (=118in).

NOTE

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.

NOTE

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^{TM}

At the rear of the unit two DisplayPort^{TM} connectors are located. The interfaces are DisplayPort^{TM} 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^{TM} is capable of supporting two suitable displays via Multi Stream Transport (MST).

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

Each DisplayPort^{TM} 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.

> **NOTE**
>
> 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.

> **NOTE**
>
> G500 doesn't support Touch Screen Panel controls due to the absence of external vendor USB drivers. It's recommended to use a 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. This 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.
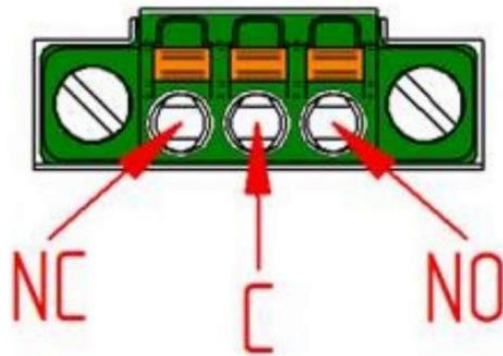
The mating connector is the 3-pin "Phoenix 1748367". This connector type is required for IP30 compliance.

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

⚠ DANGER

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.

NOTE

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 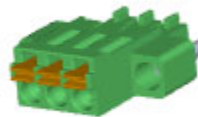detected, the Status 1 LED will be RED and the NO of the alarm output will be opened to indicate system failure. Examples of critical failures are:

- – 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.

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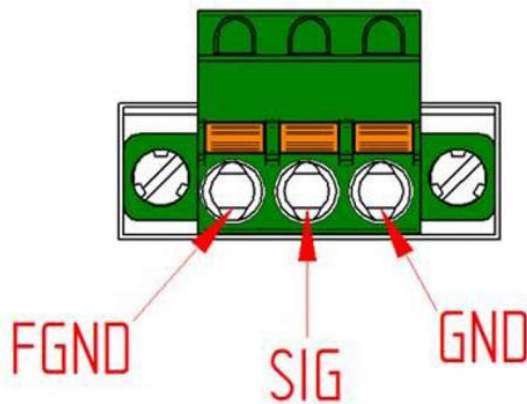
The mating connector is the 3-pin "Phoenix 1732975". This connector type is required for IP30 compliance.

NOTE 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 25Ohm 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.
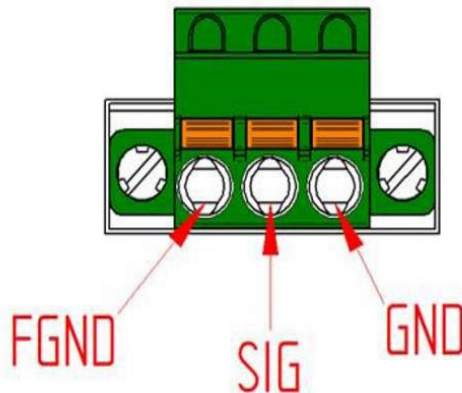
The mating connector is the 3-pin "Phoenix 1732975". This type is required to use for IP30 compliance.

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.

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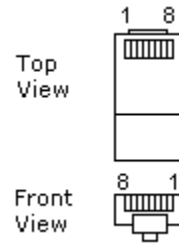
The VCC (Pin 7) is available on port 4 and port 8 from the Built-in slots and port 4 of each PCIe Expansion card installed in Expansion slots 1, 2 and 3. It is a 12V power output that is limited to 6W. If a higher load is applied to the output the output shuts down.

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.

NOTE

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 39.

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.

NOTE

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 57.

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.

NOTE

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

NOTE

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

NOTE

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
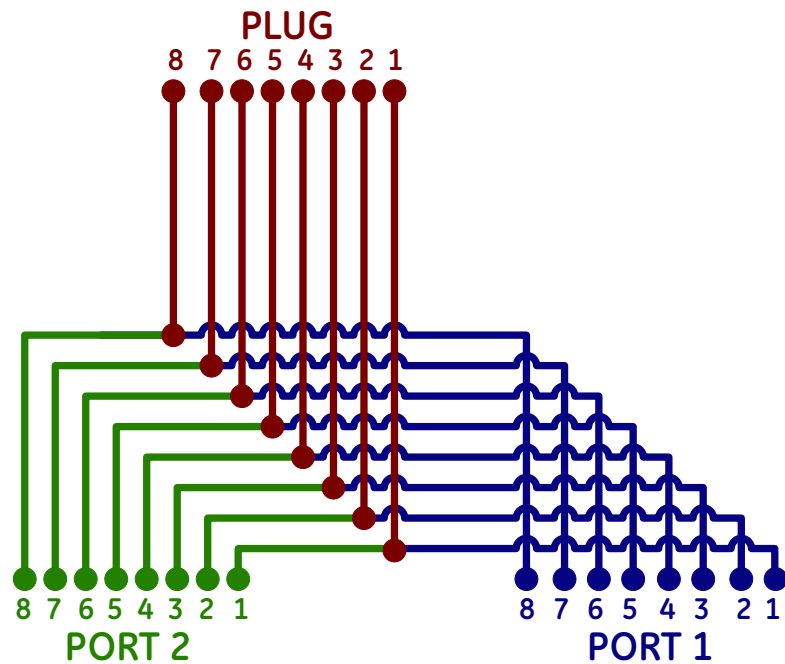
RS-485 2-wire mode wiring approaches

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

Figure 6: RS-485 (2-wire) - Single Link
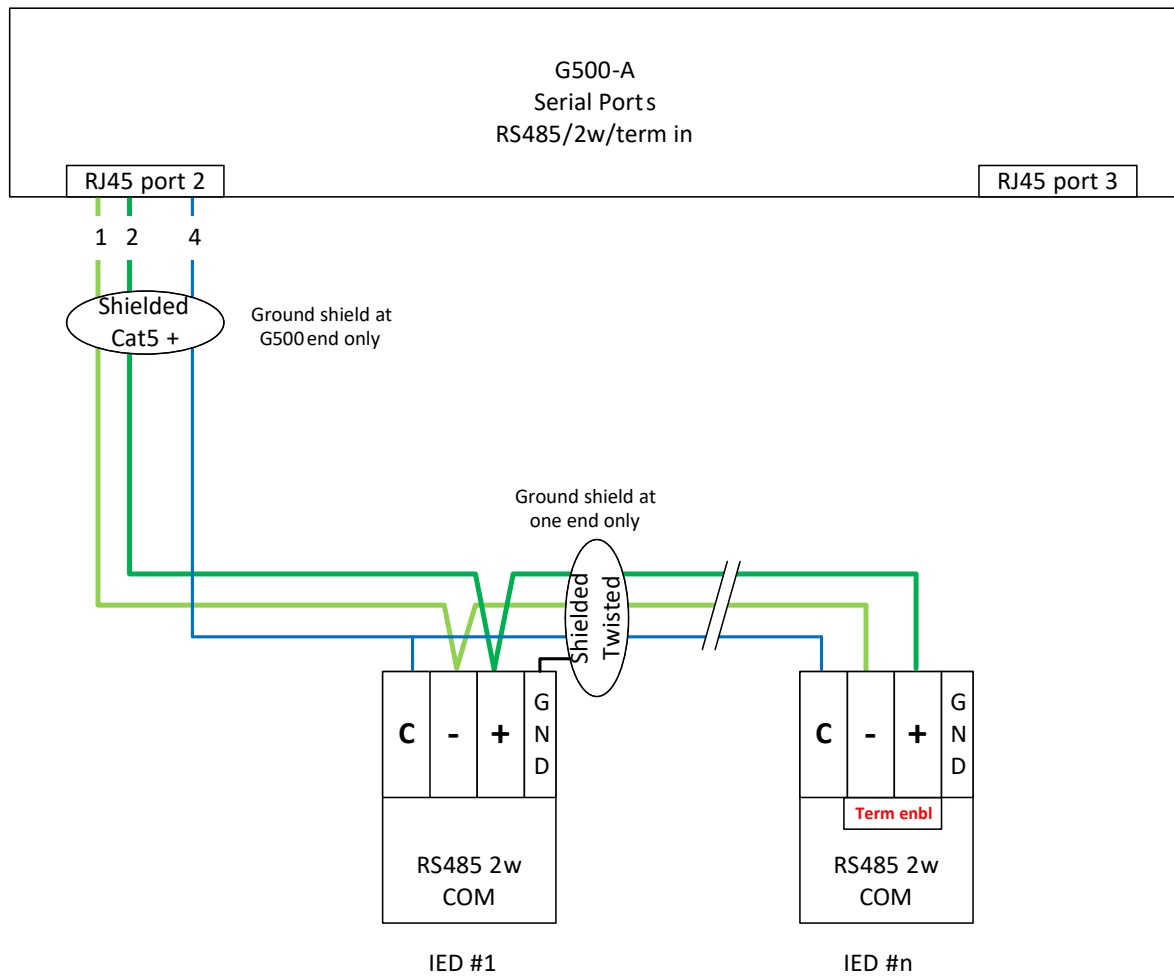
Figure 7: RS-485 (2-wire) - Single Loop
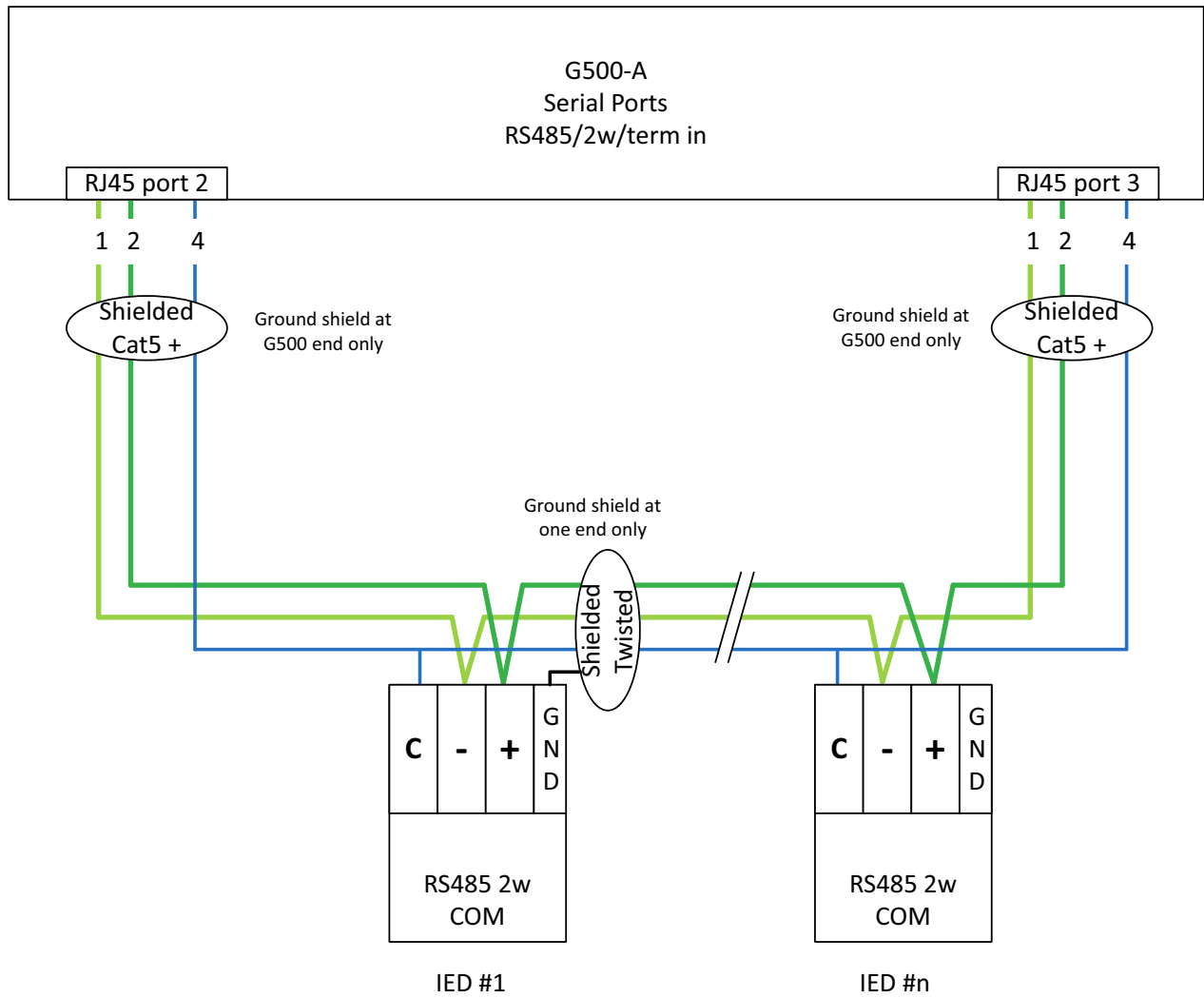
Figure 8: RS-485 (2-wire) - Single Loop with Redundancy
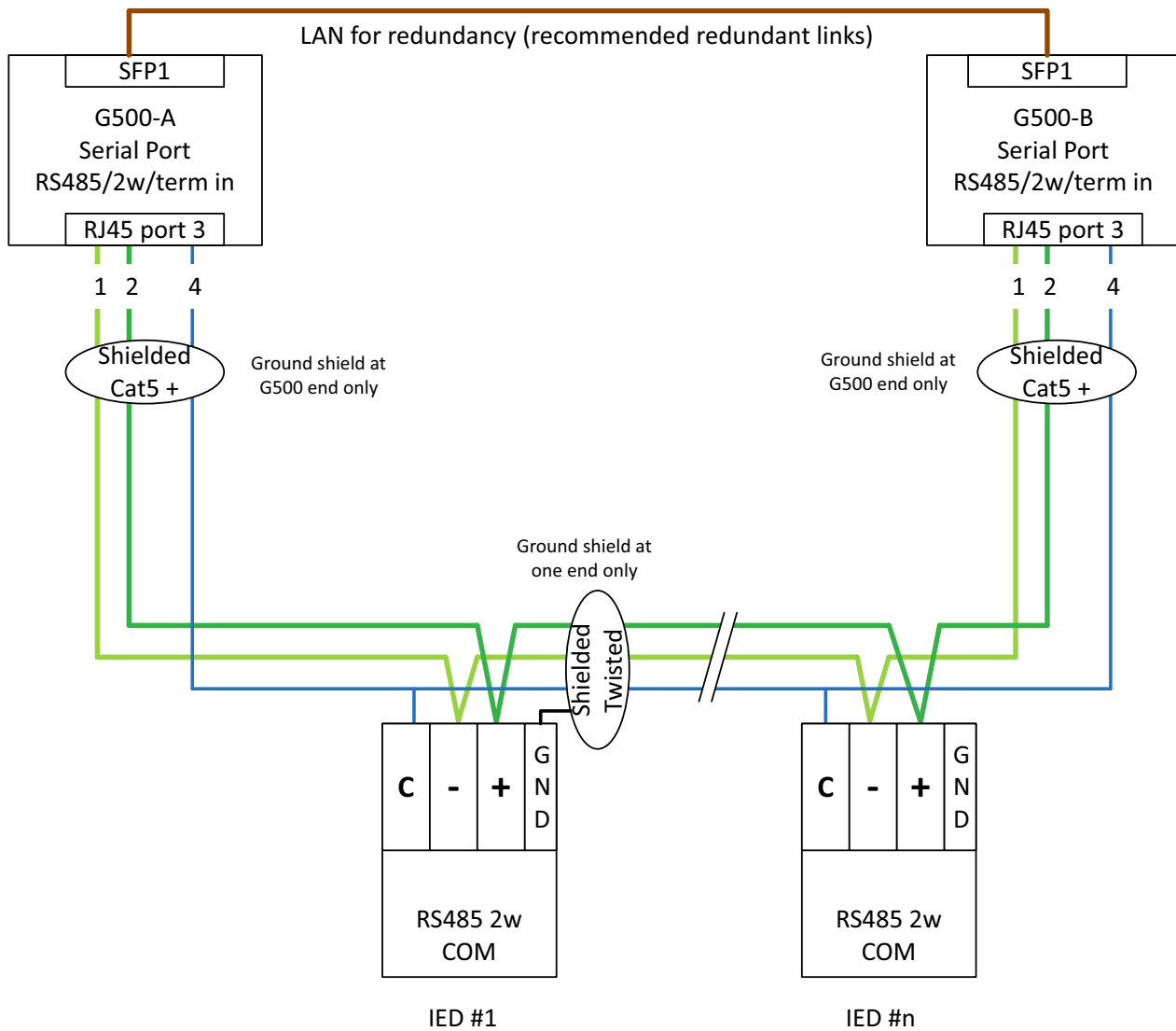
Figure 9: RS-485 (2-wire) - Redundant Link with Redundant CCU

LAN for redundancy (recommended redundant links)

| SFP1 | SFP1 |

G500-A
Serial Port
RS485/2w

G500-B
Serial Port
RS485/2w

| RJ45 port 3 | RJ45 port 3 |
| Term disable | Term enable |

1 2 4

1 2 4

Shielded Cat5 +

Shielded Cat5 +

Ground shield at G500 end only

Ground shield at G500 end only

Y-splitter **NOT** grounded

Ground shield at one end only

Ground shield at one end only

Shielded Twisted

Shielded Twisted

C	-	+	G N D

RS485 2w COM

C	-	+	G N D

Term enbl

RS485 2w COM

IED #1

IED #n

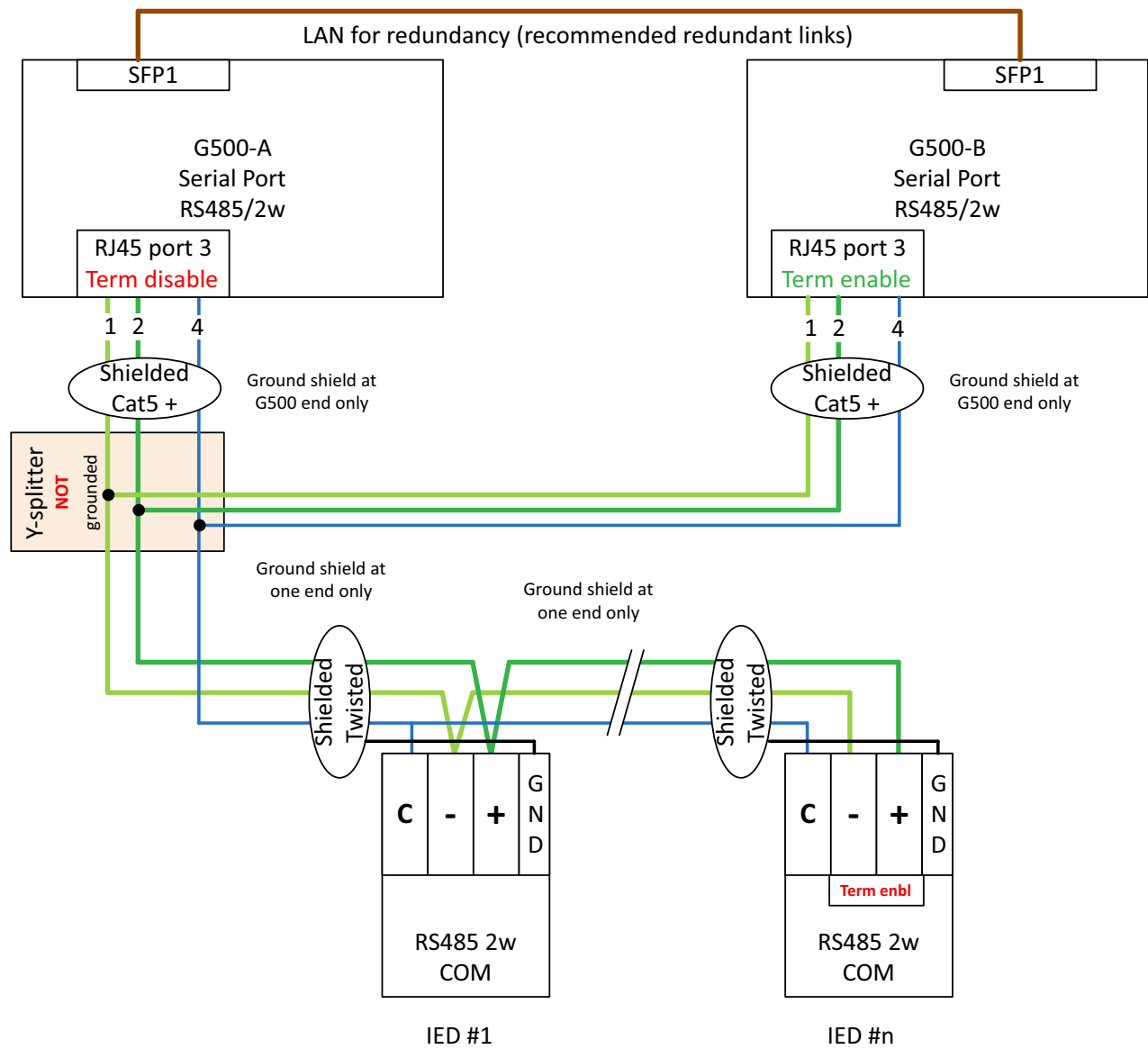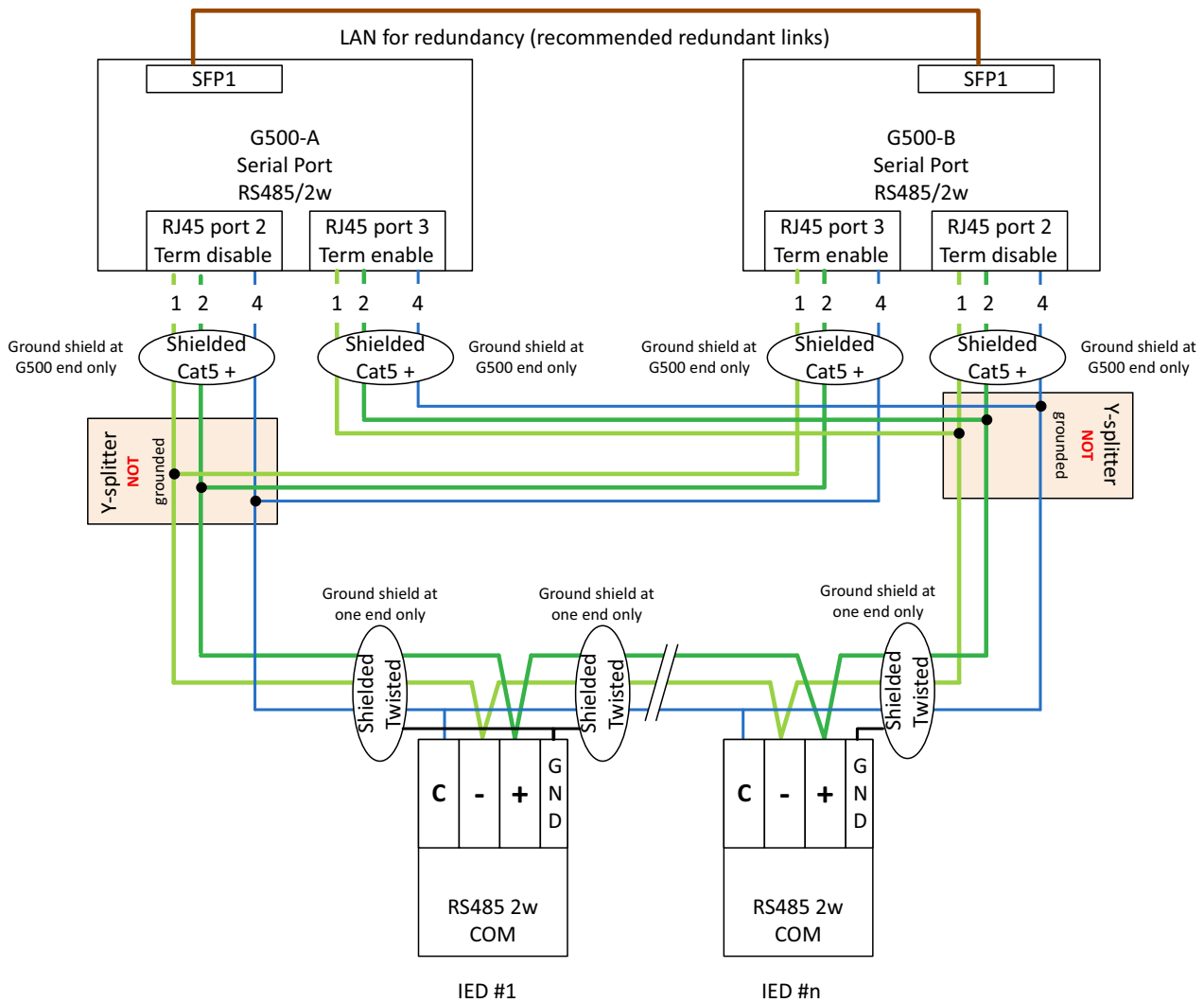**Figure 10: RS-485 (2-wire) - Redundant Loop with Redundant CCU**

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.
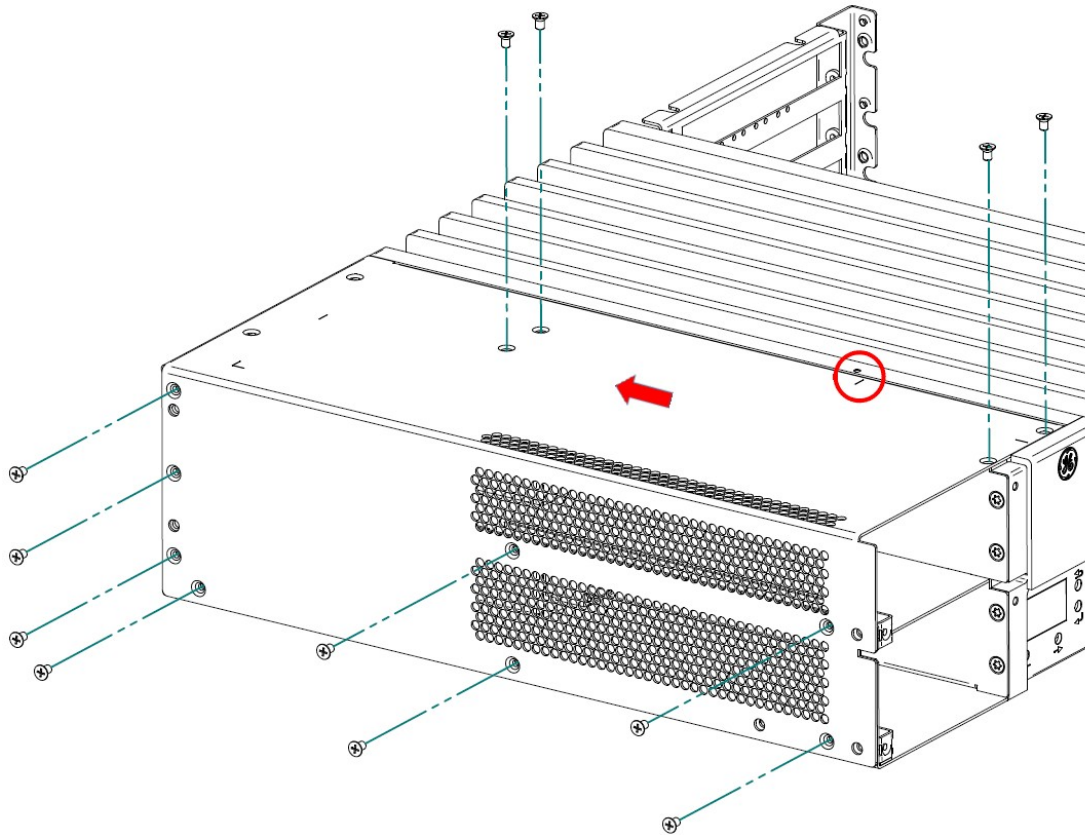
5. Pull lid to outside until second marking aligns.
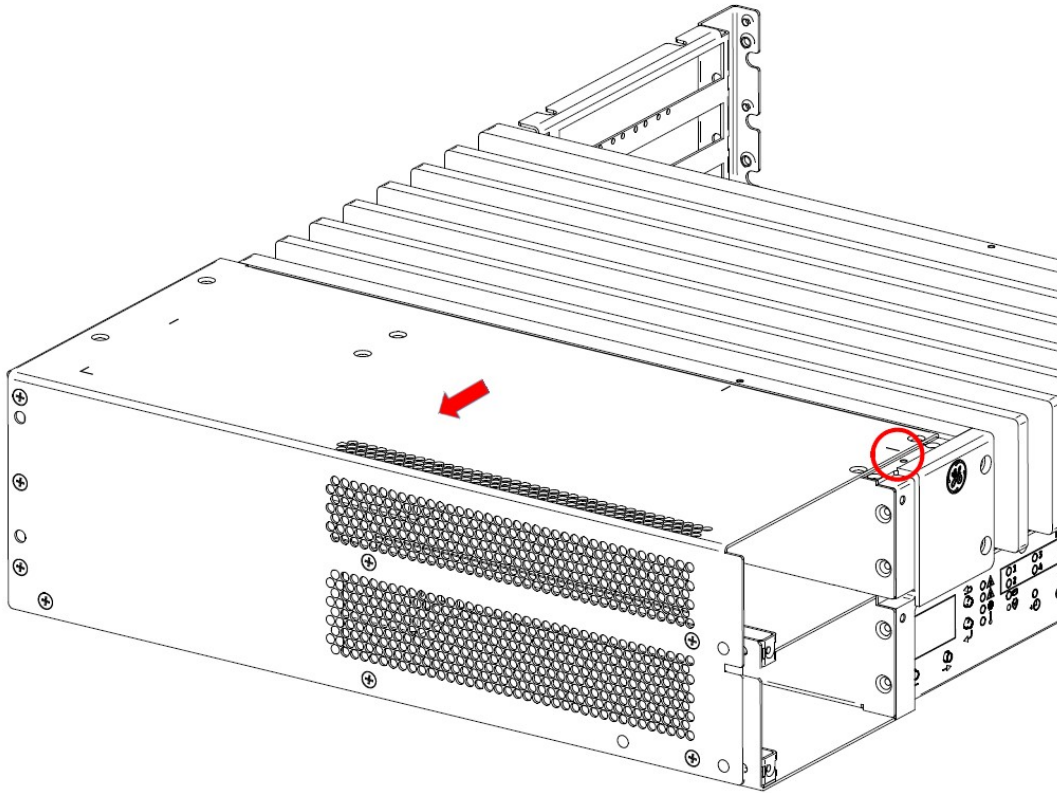
6. Lift lid to remove.
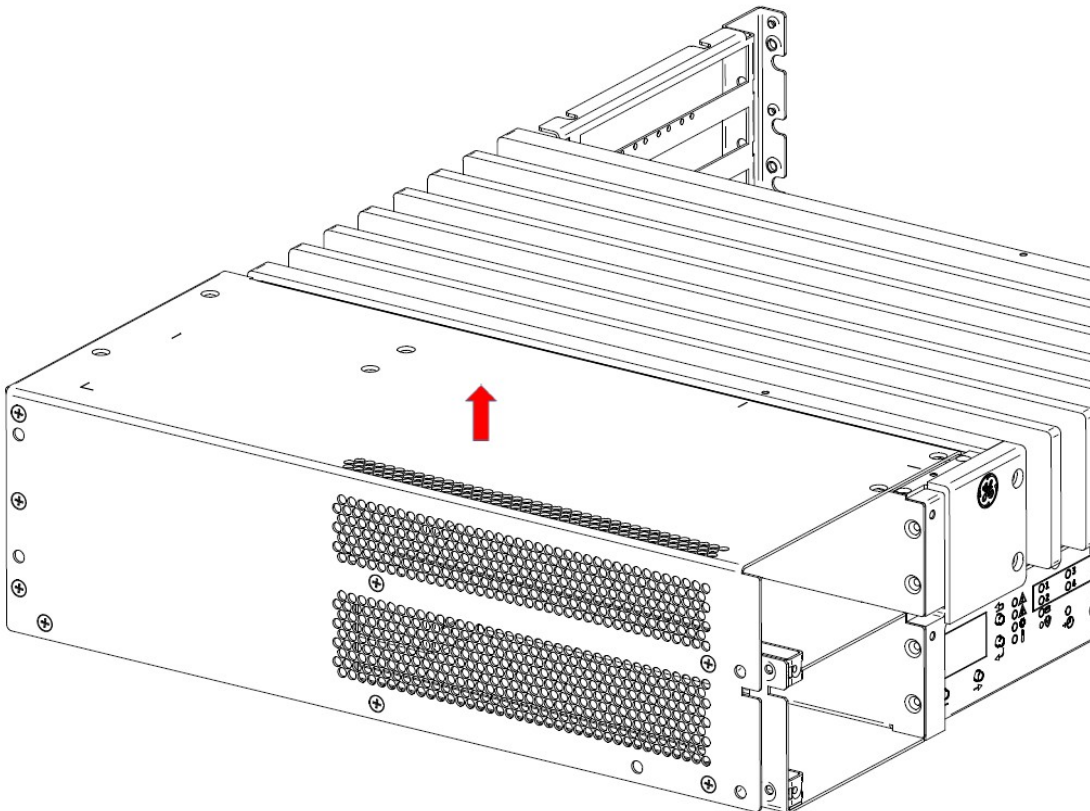
7. Remove attachment screws.
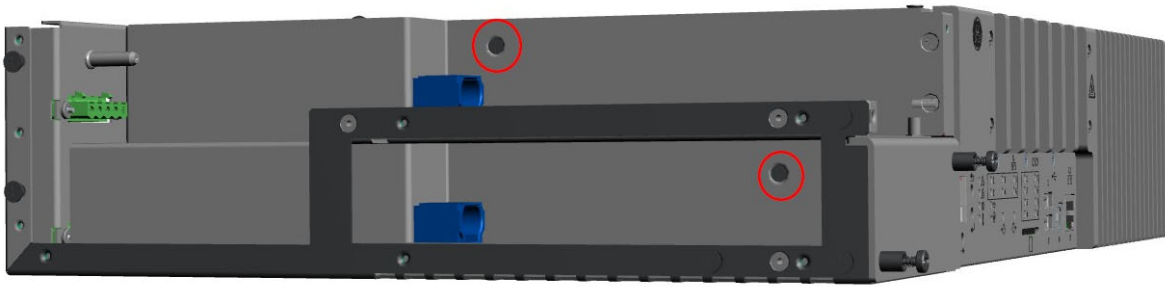
8. Pull UART package out of slots (be careful, do not to damage ESD gasket at the rear).
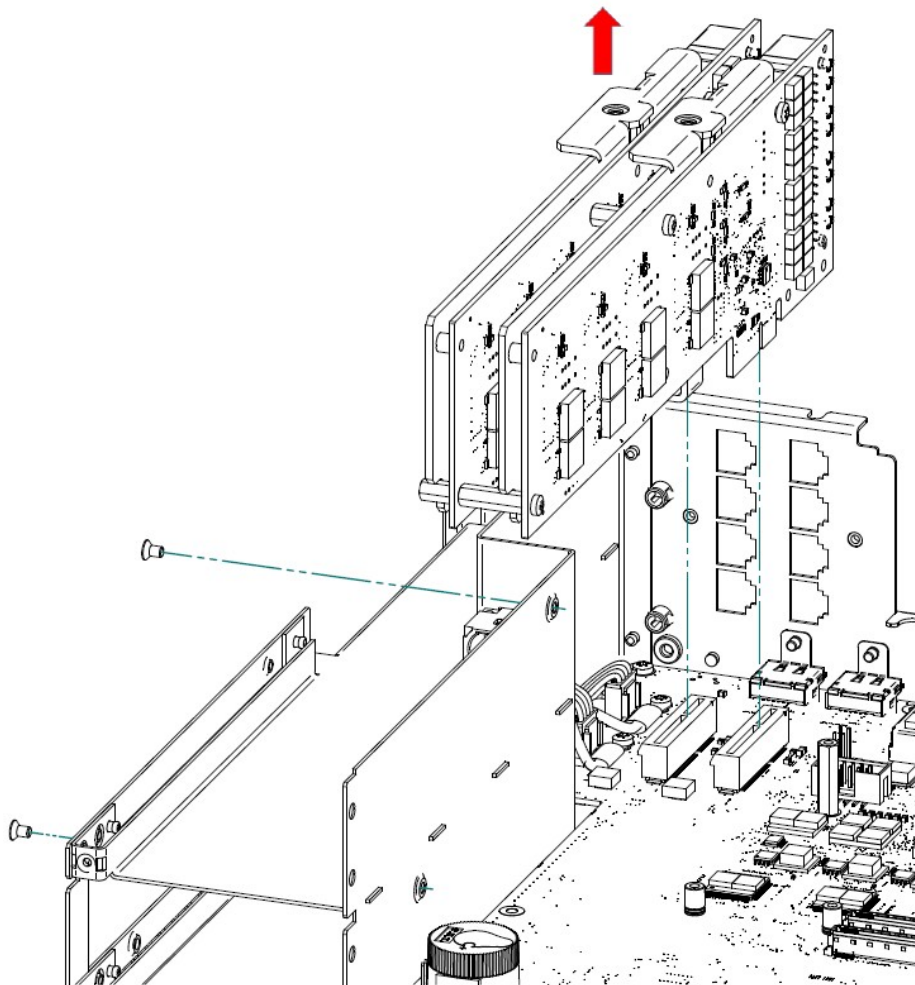
9. Exchange the UART module.
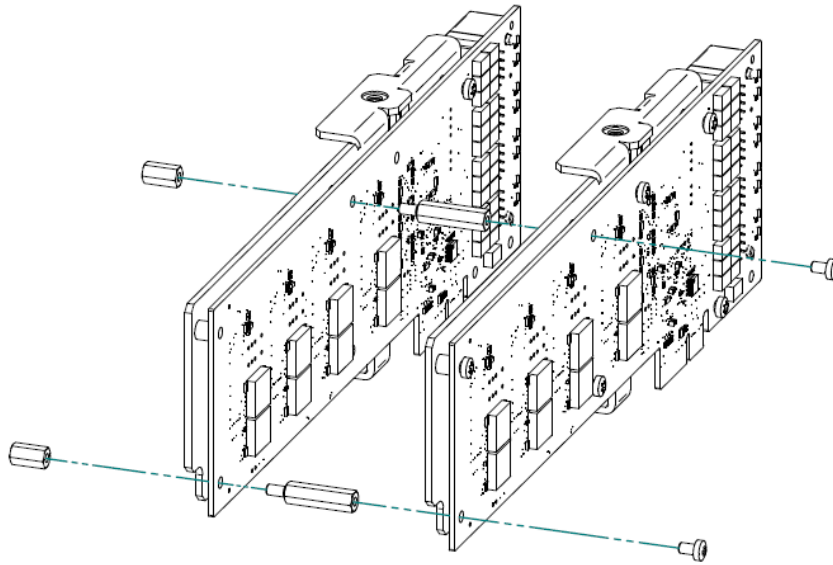
10. Check that the thermal connector pads on the PCB are still in place. If the thermal pads are damaged or missing, contact GE for replacements.

Thermal connector pads
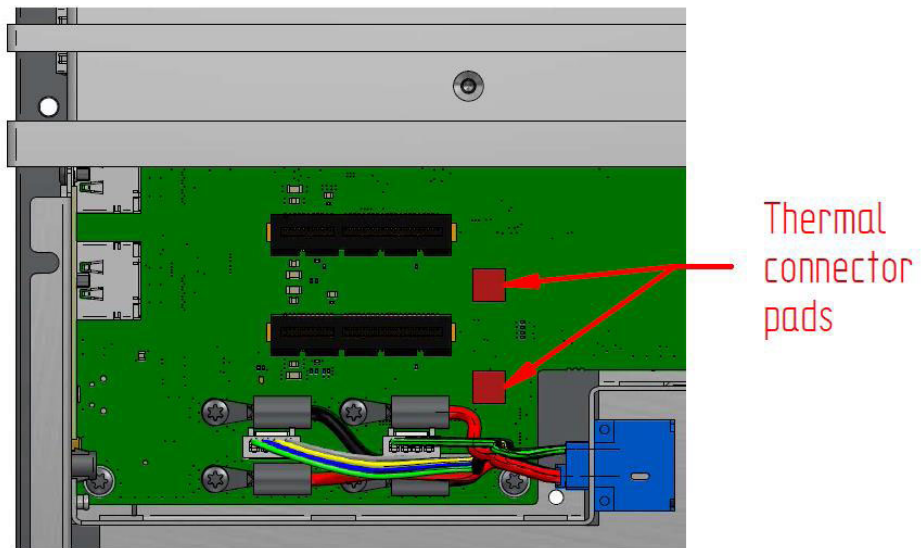
11. Insert the UART module into slots and attach the UART module by re-installing the screws from the power supply bay.
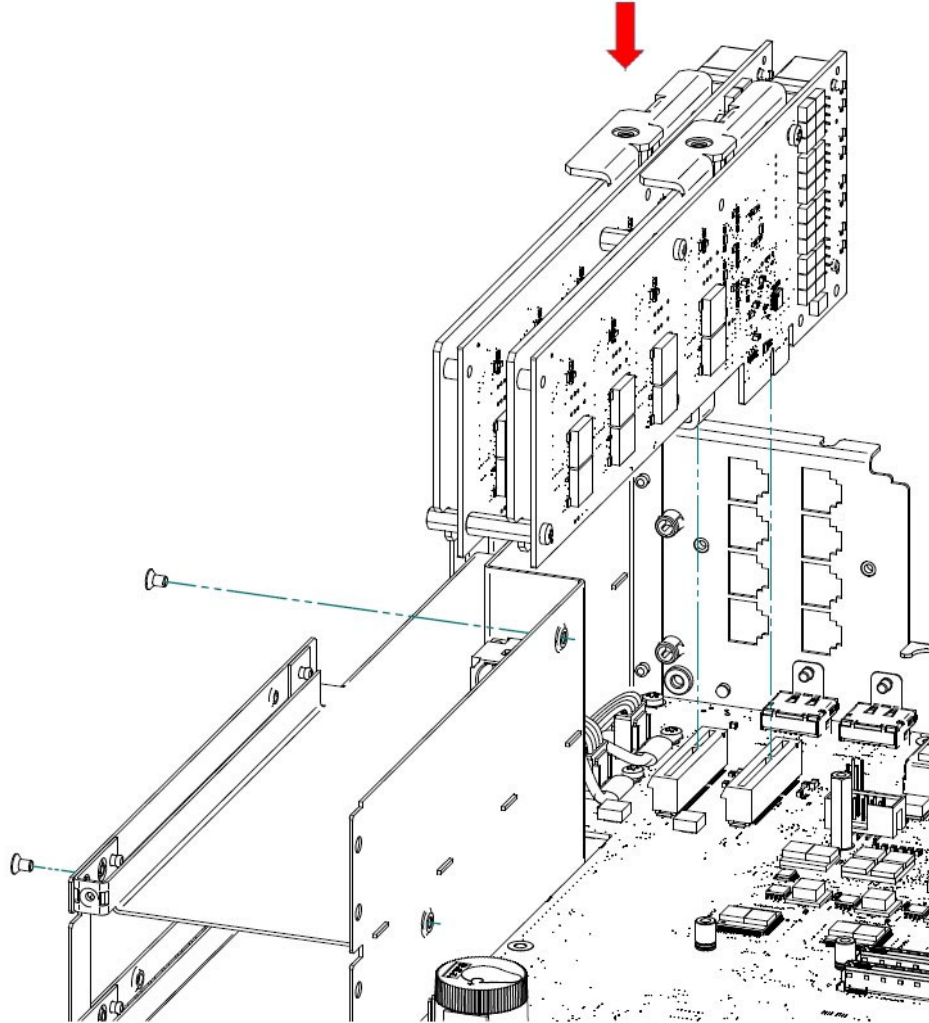
NOTE Be careful, do not damage the EMI gasket on the rear of the unit. Otherwise, since damage may result in reduced ESD protection.

12. Attach the lid a little to the rear and out of position (In the right position both lid and chassis markings align).
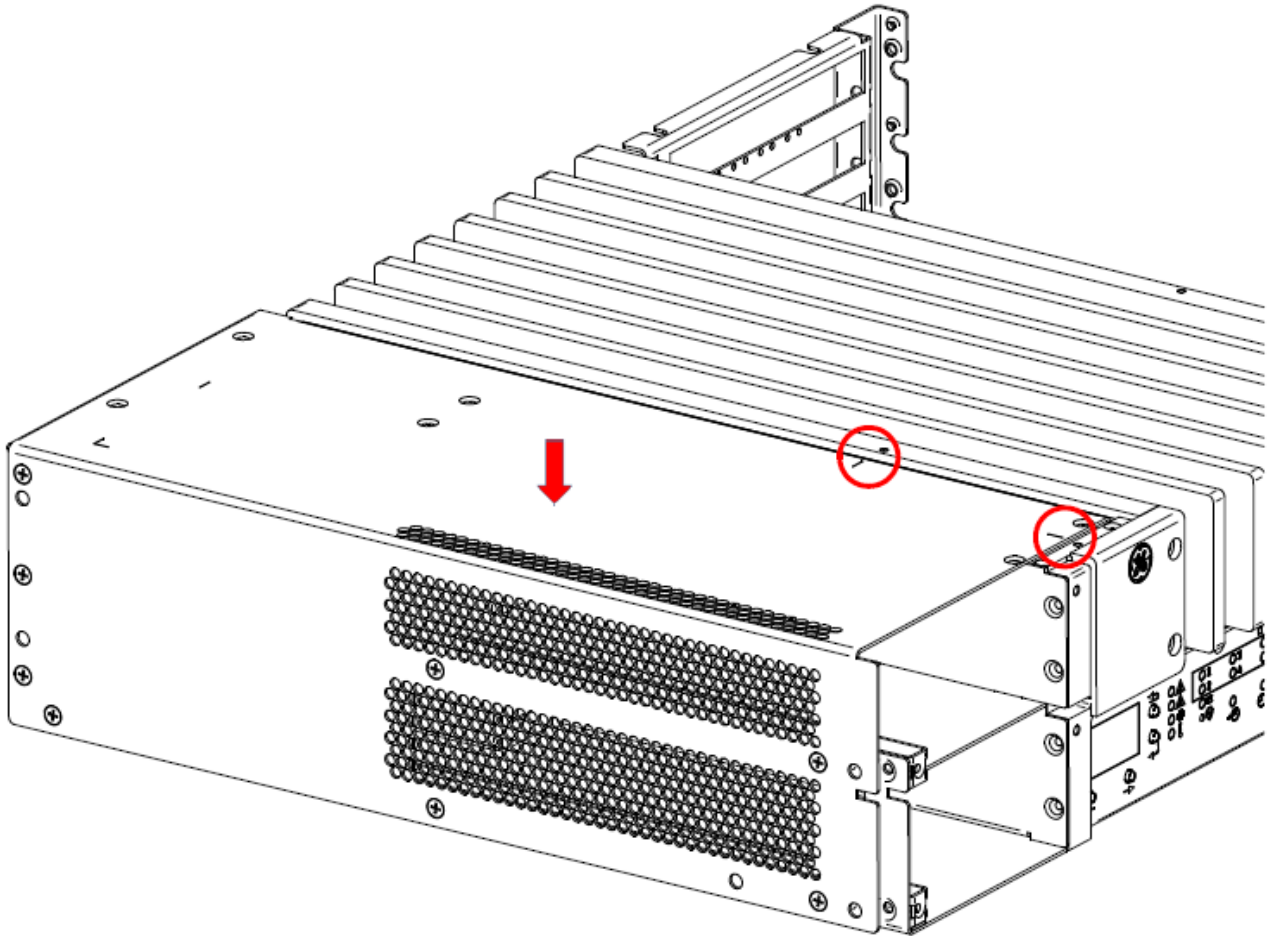
13. Push the lid inwards.
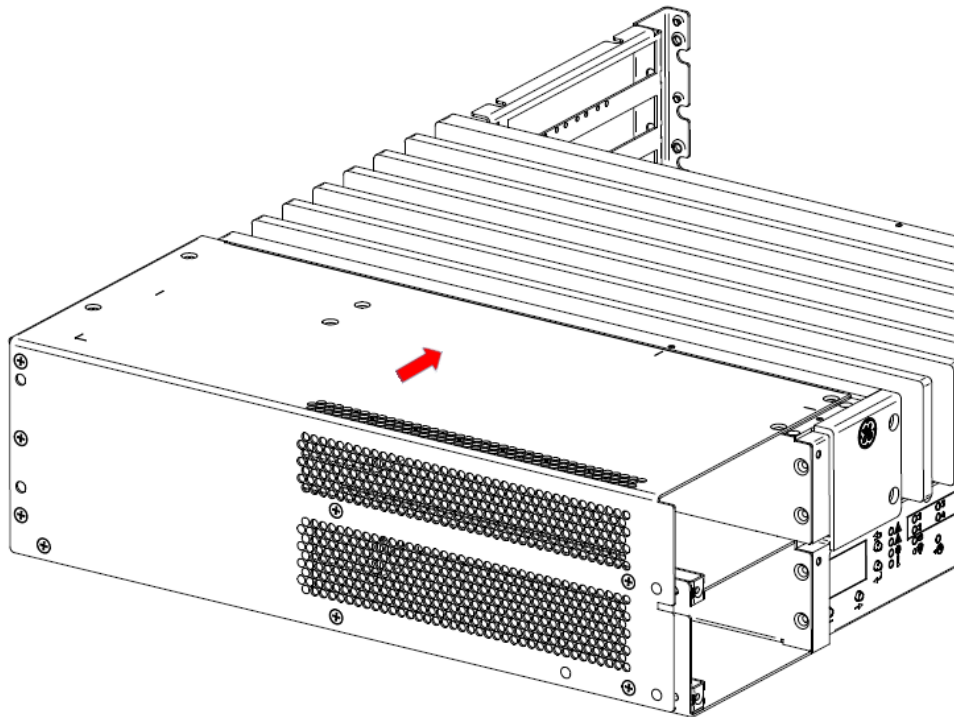
14. Push the lid to the front and attach all screws.

NOTE

For screw torque specification, refer to "General Torque Values for Screws" on page 99.
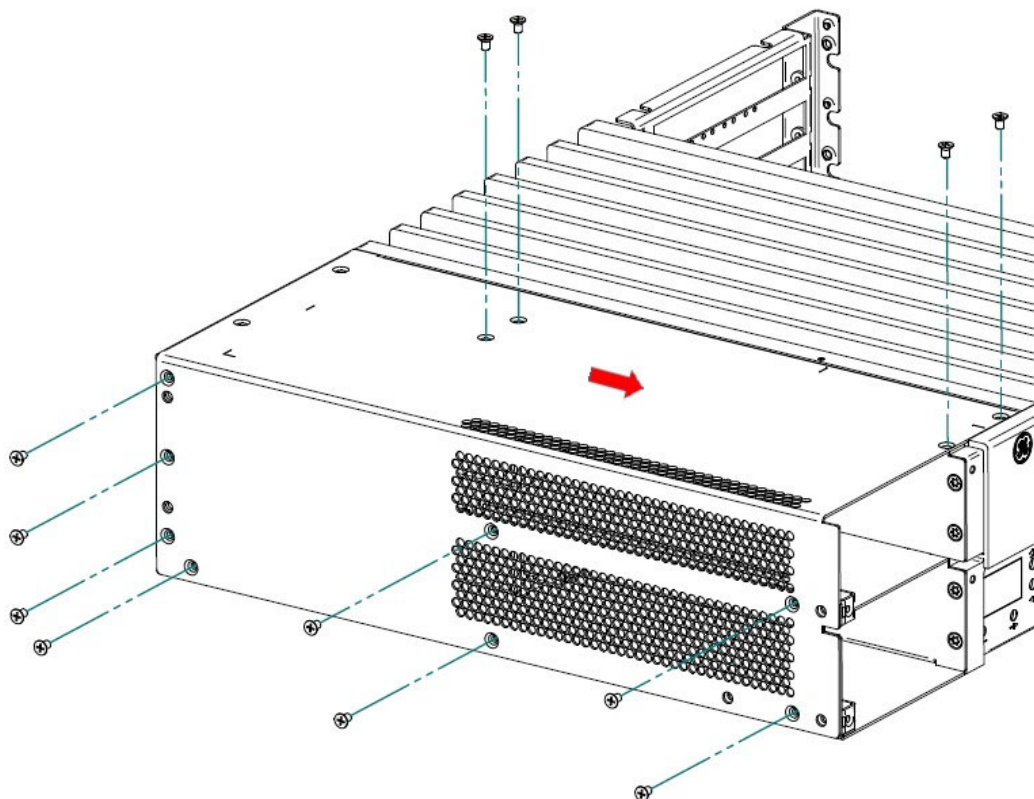
Ethernet Ports

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 72.

Inserting an SFP module selects the appropriate transmitter protocol for the corresponding switch port.
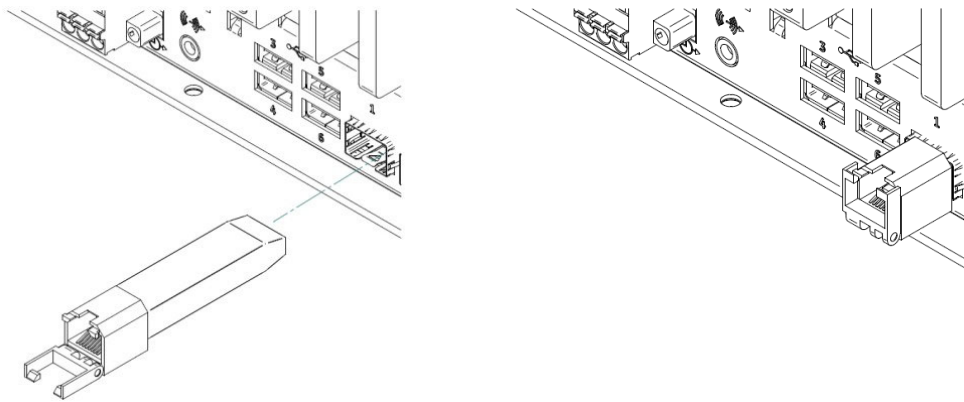
G500 external Accessories

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.

⚠ DANGER **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.
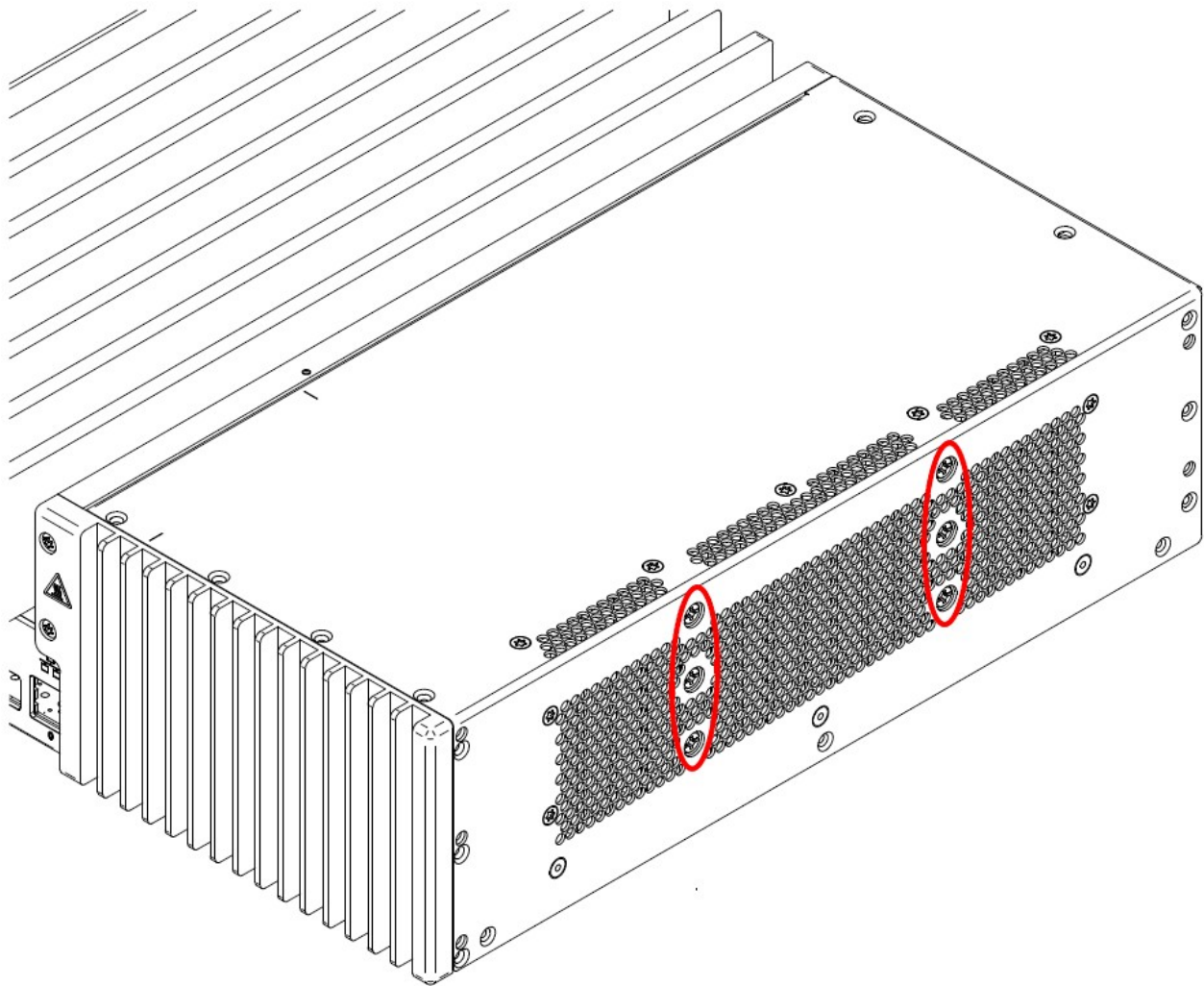
2. Remove the screws and push the cover to the rear until markings on the lid and chassis align.
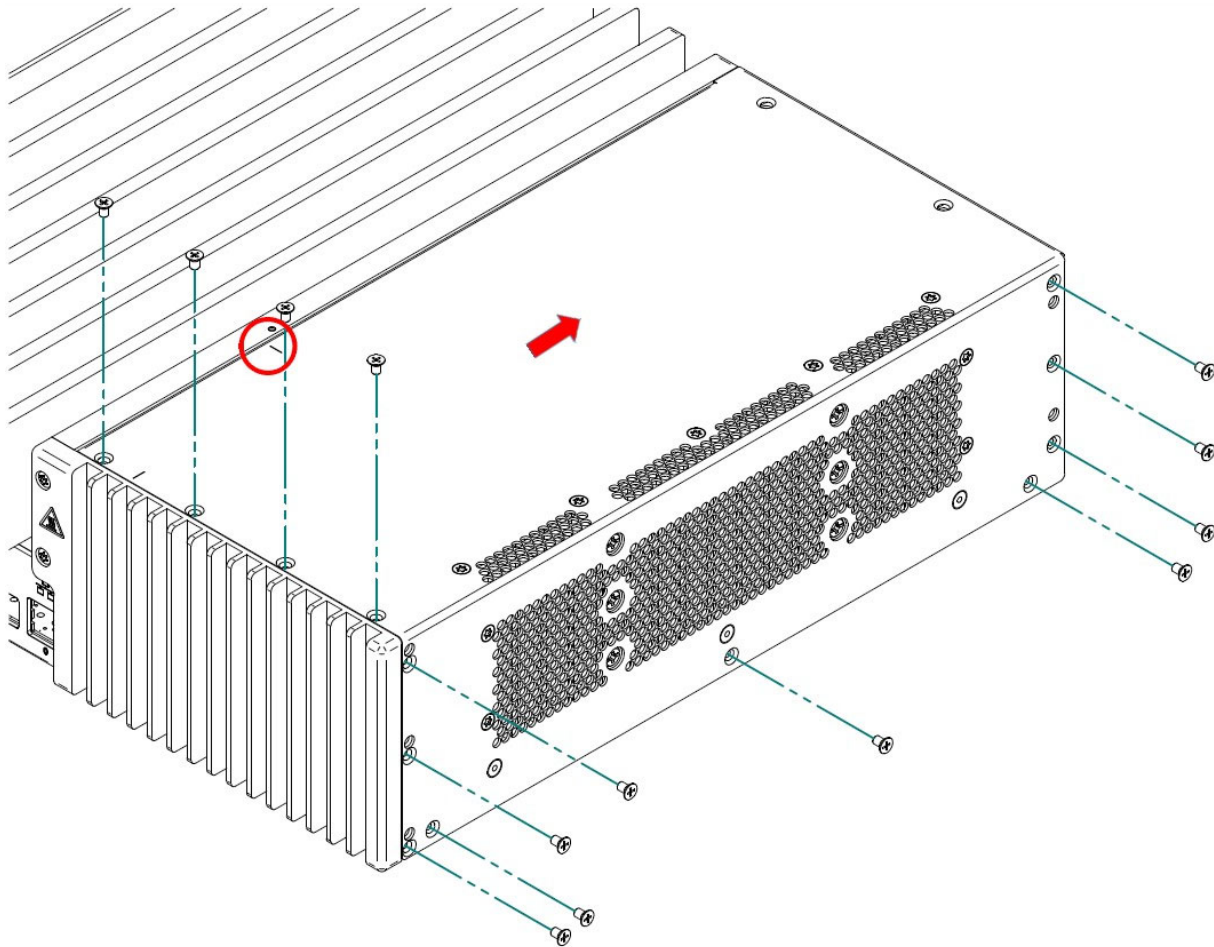
3. Pull the cover outwards until the second markings on the lid and chassis align.
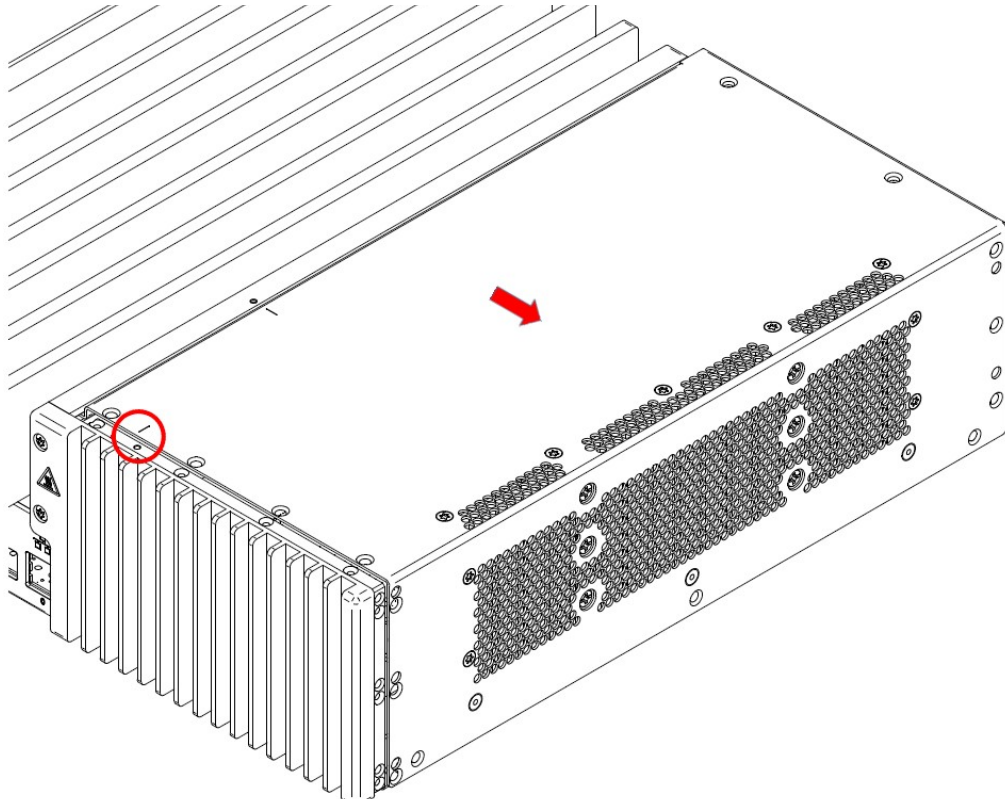
4. Lift the lid to remove.
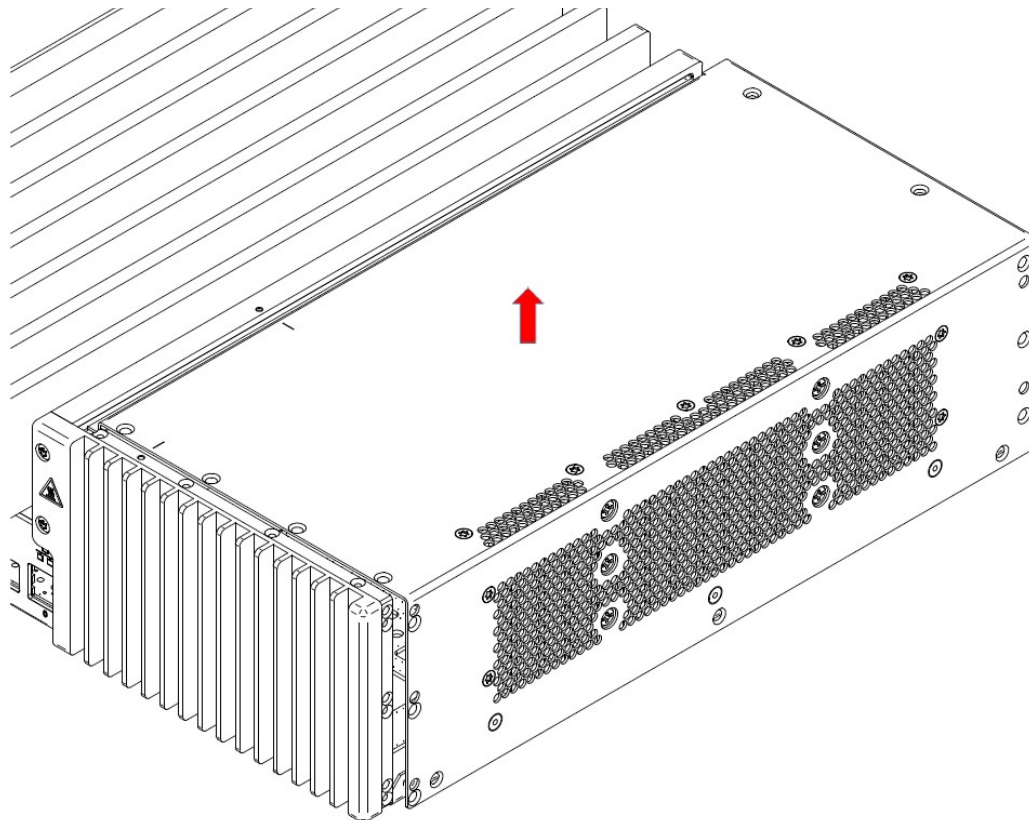
⚠ DANGER

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.
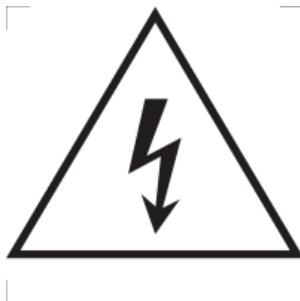
This Unit is to be serviced by trained personnel only.

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).
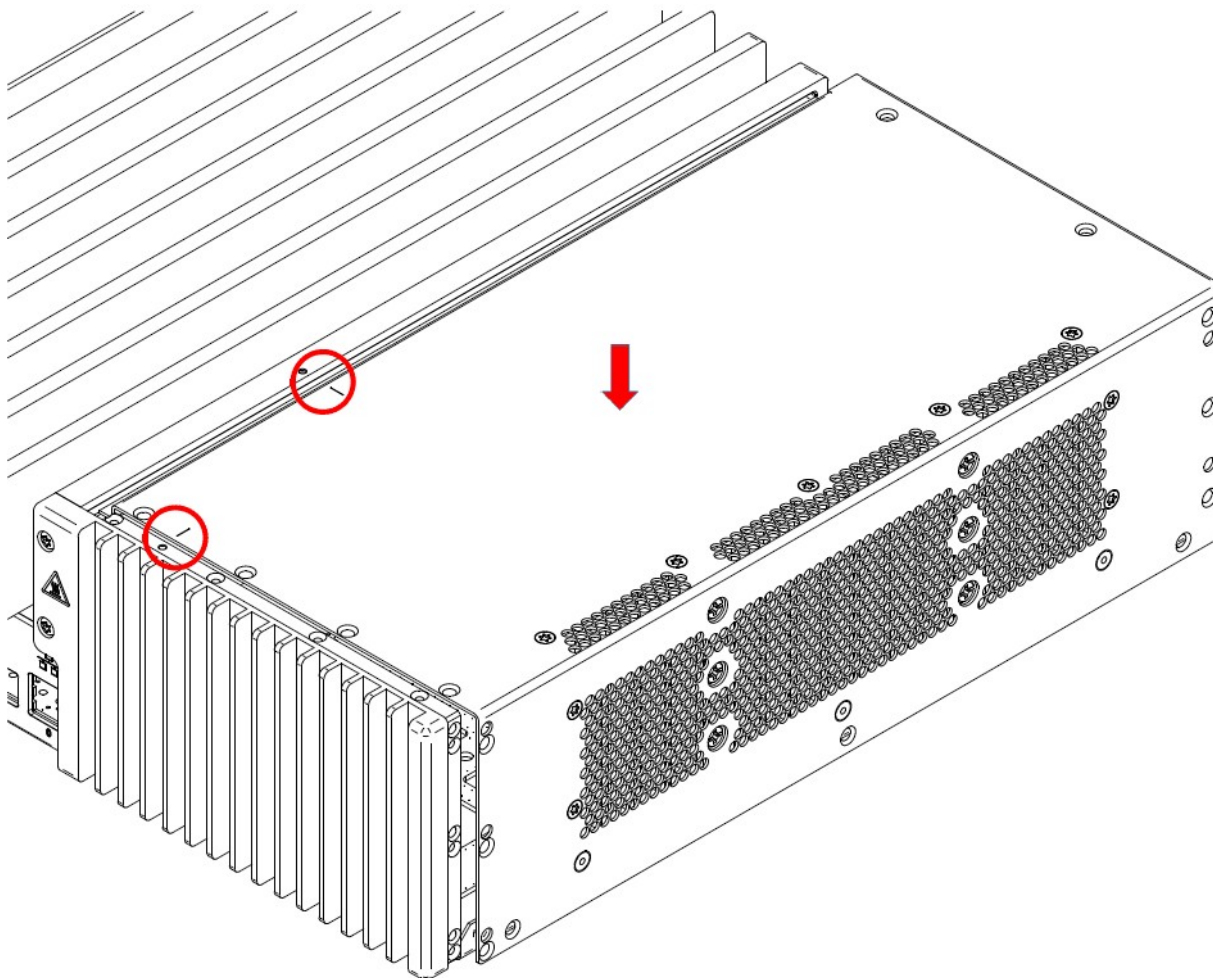
2. Then push lid inwards.
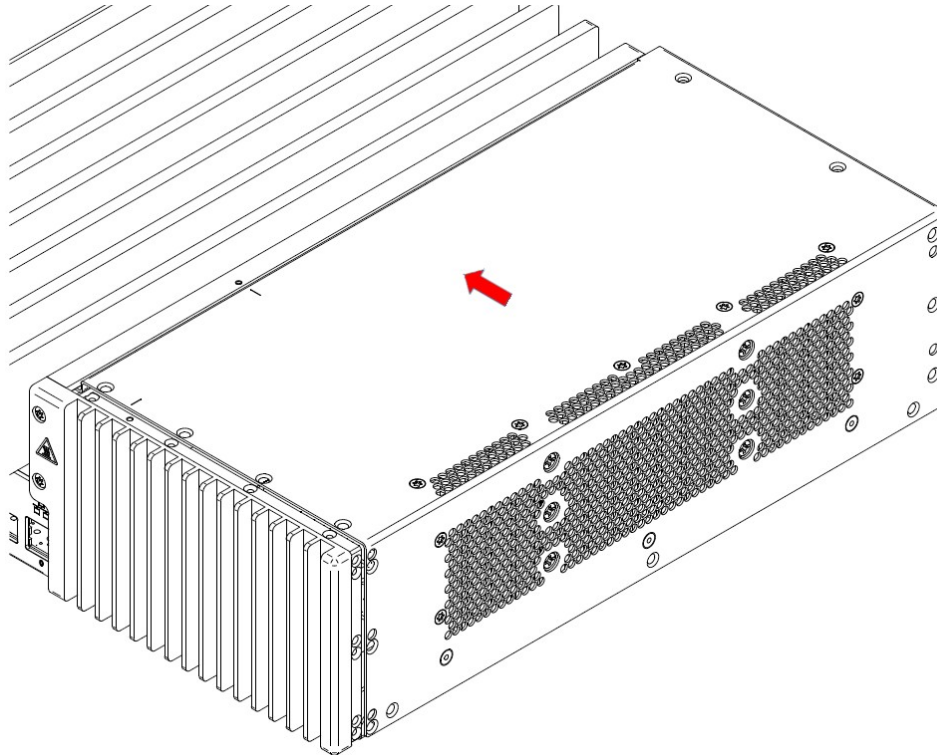
3. Push the lid to the front and attach all screws.

NOTE

For screw torque specification, refer to "General Torque Values for Screws" on page 99.
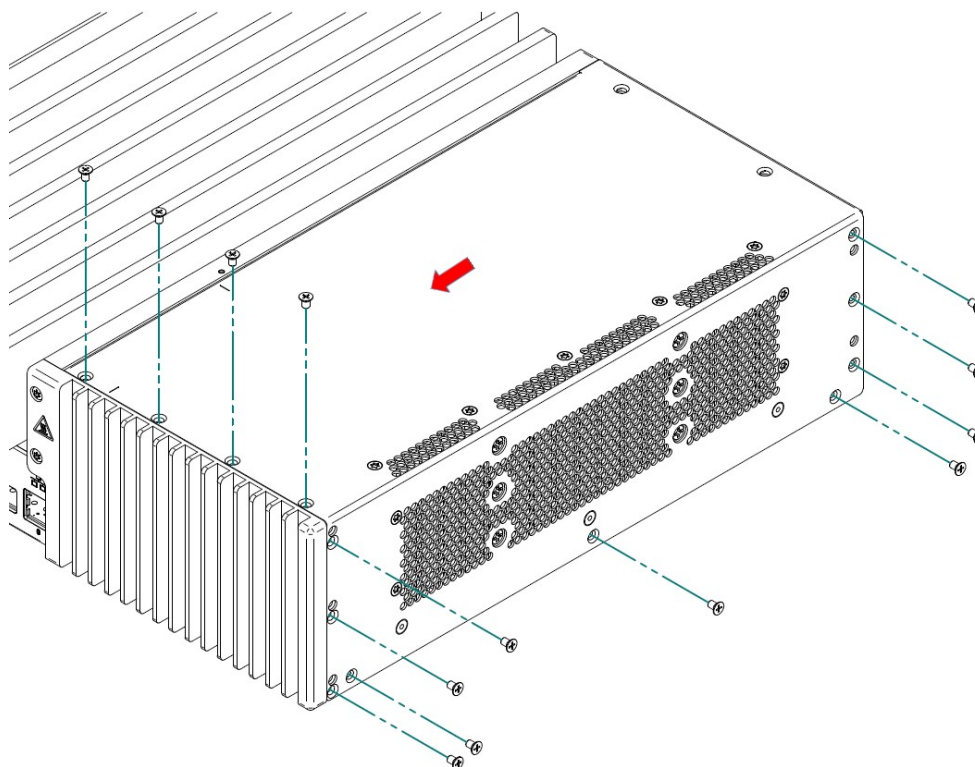
M.2 SSD

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

The G500 SSD is shipped protected with user password **u123@MCPGE** (set in UEFI).

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 73:

1. Loosen the M.2 heat sink screws, pull heat sink up until the keyholes allow removal of the heat sink.
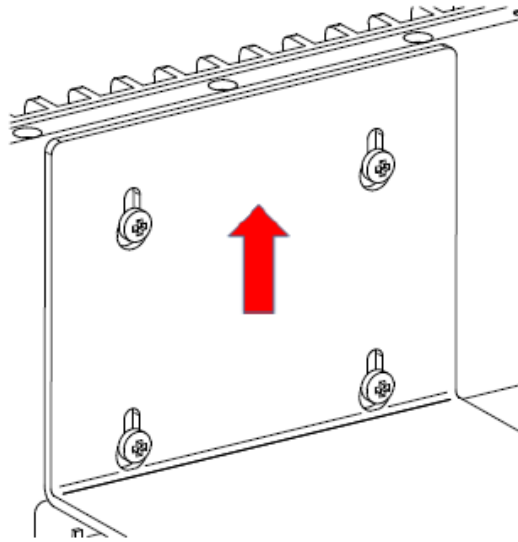
2. Unscrew the M.2 module and remove the module.
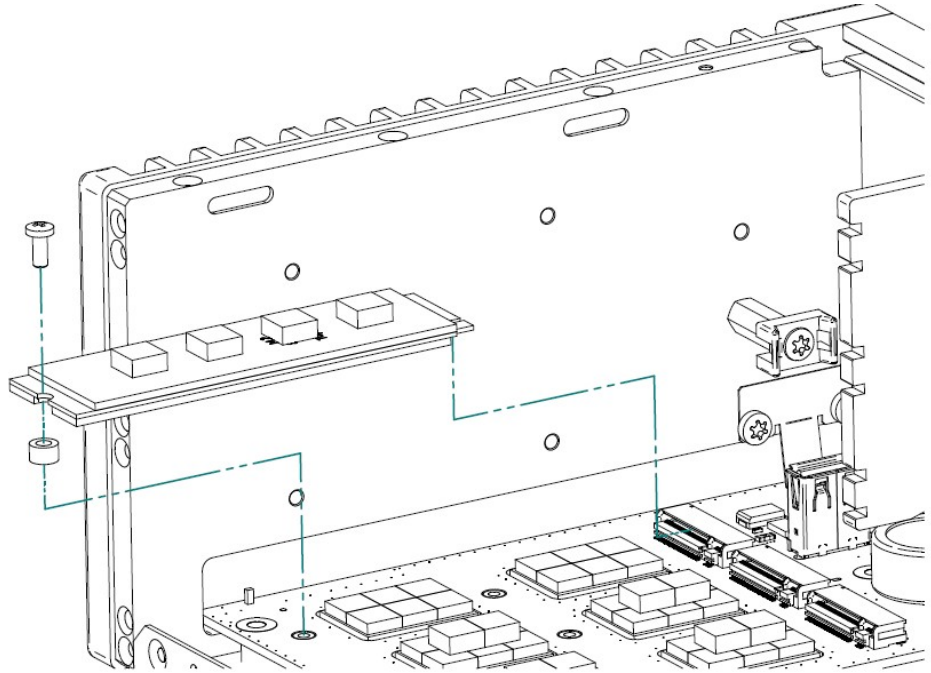
3. Attach the piggyback gap pads on the top of the new module. Use an M2.5 screw to fasten the M.2 module in the empty G500 slot.
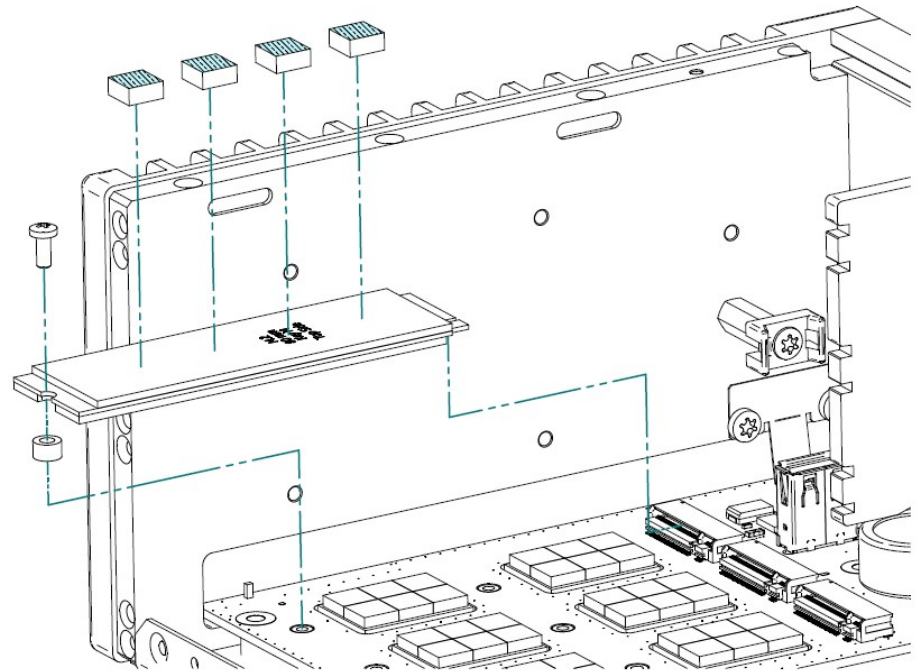
4. Align the heat sink keyholes with the screws and push the heat sink keyholes over the screws.
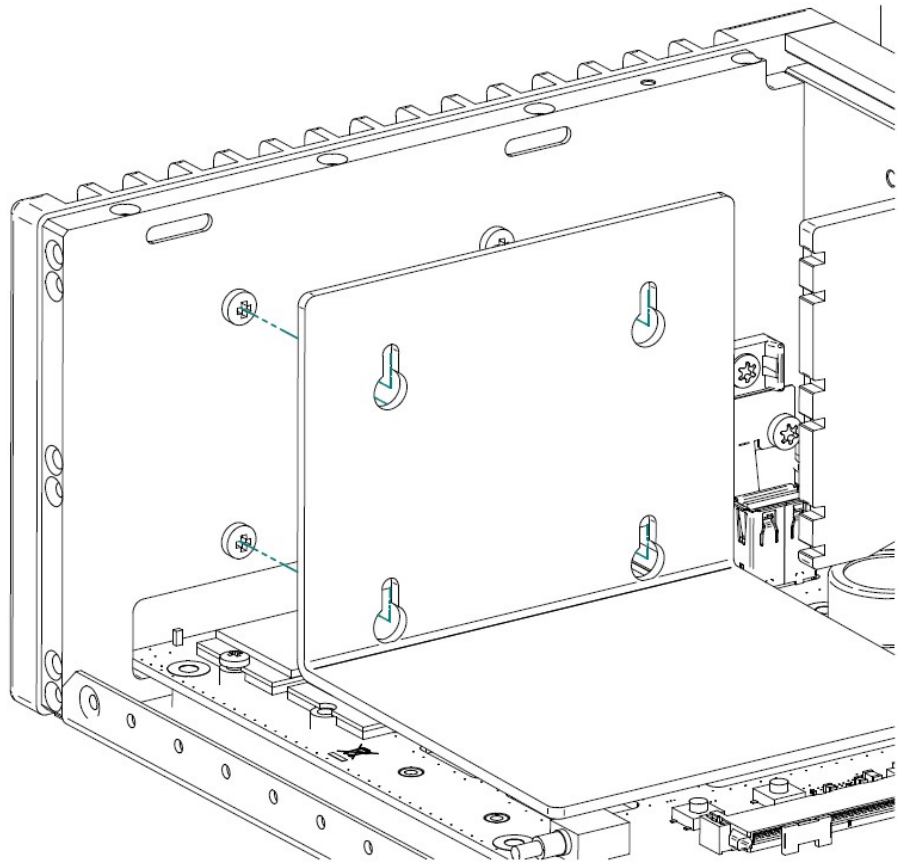
5. Partially fasten the lower screws and push the heat sink down until marking align before fastening all screws completely.
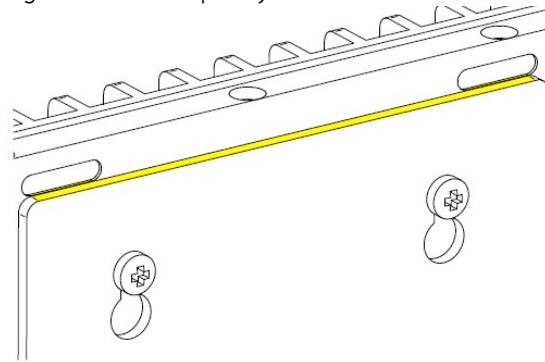
If no further changes are required, install the G500 cover following the steps from "Closing cover" on page 76.

PCIe Slots

By default the G500 comes without any PCIe extension cards installed. Additional PCIe cards can be configured, refer the Order code section on page 14.

The G500 supports up to three PCIe cards.

NOTE

Only PCIe cards supplied with the G500 or ordered from GE 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 ¾ 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 ¾ 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 ¾ 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 section on page 73. Plug the PCIe card into the appropriate PCIe slot and fasten in place using the PCIe faceplate screws.
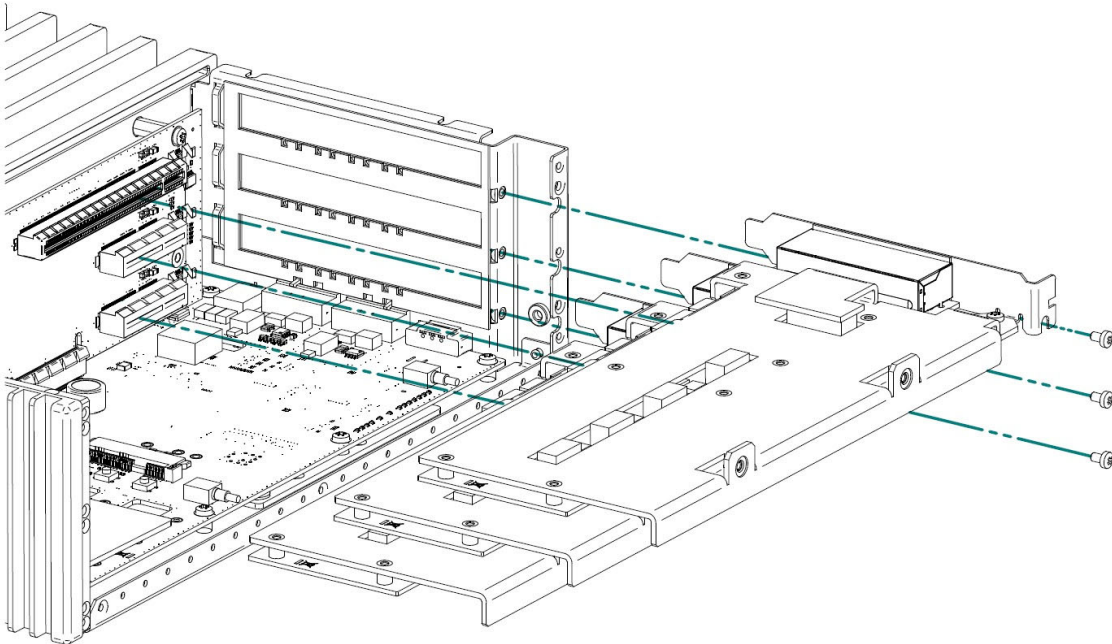
2. If no further changes are required, install the G500 cover following the steps from Closing cover on page 76.

3. After closing the G500 cover, tighten all heat contact screws that now correspond to occupied PCIe slots.

NOTE

For screw torque specification, refer to "General Torque Values for Screws" on page 99.
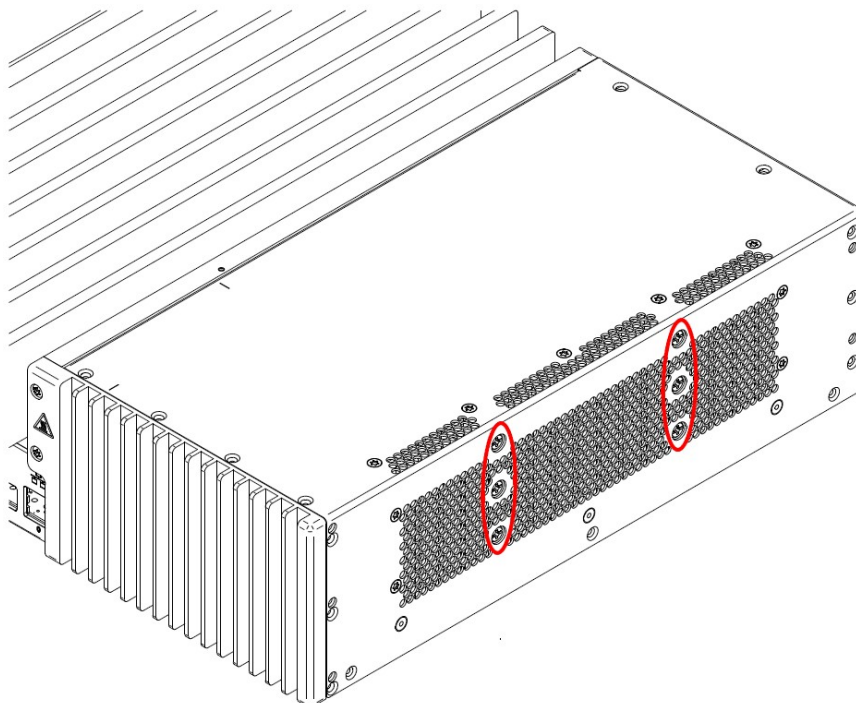
USB 2 dongle slot

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: 53mm×22mm×13mm) see the figure below.

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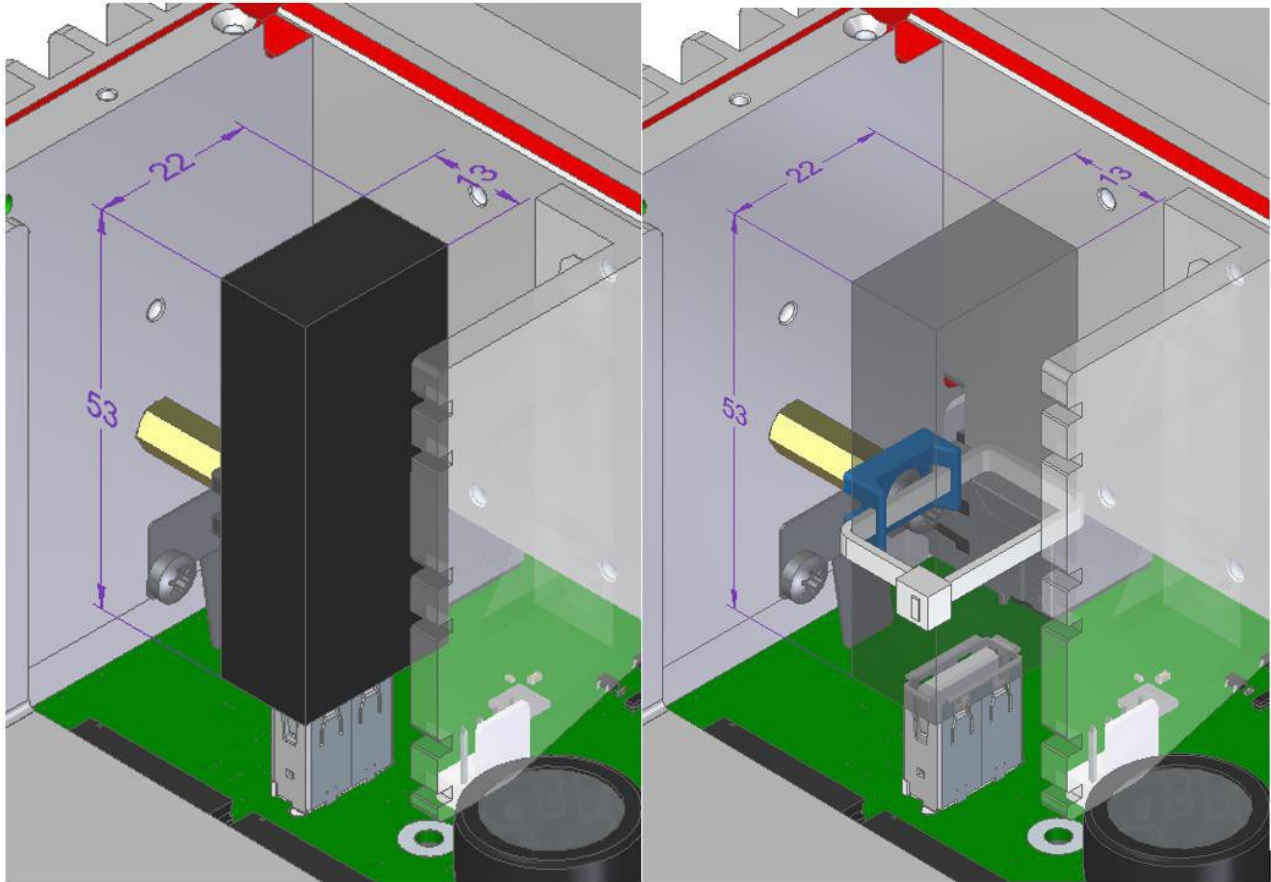
In order to withstand standard shock and vibration levels the dongle must be tie-wrapped to the pre-installed mounting structure as shown above.

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
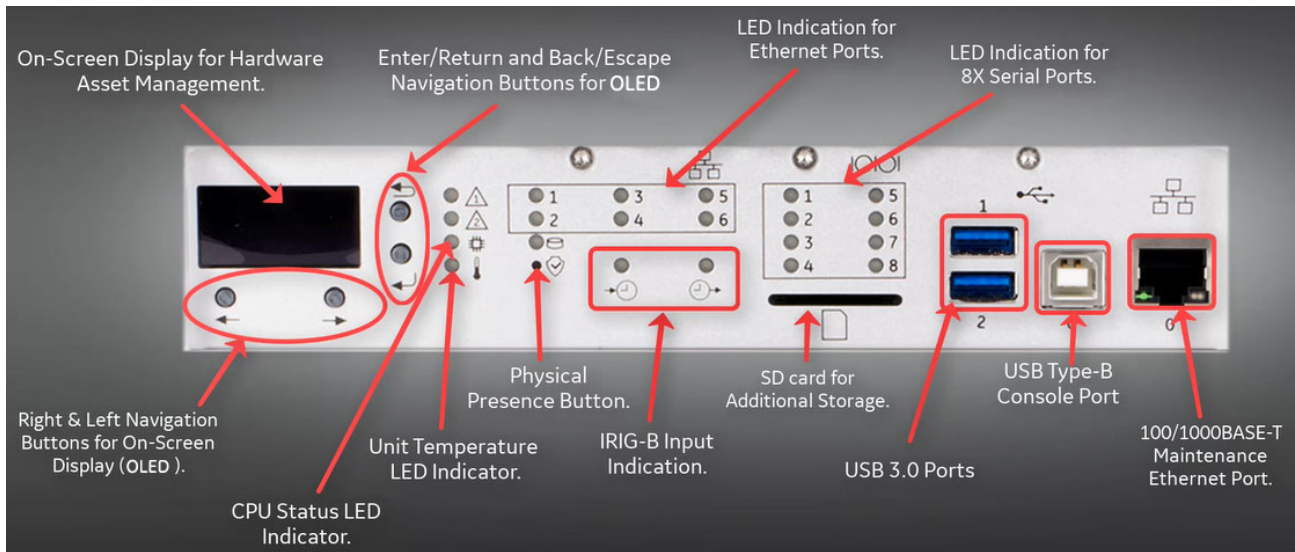
Ethernet

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
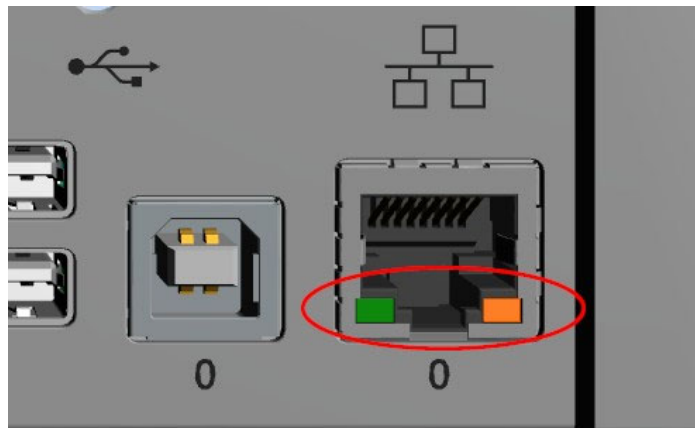
Ethernet Port (SFP) LEDs

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

STATUS	INDICATOR
100 MBit with activity	Orange blinking
1000 MBit no activity	Green
1000 MBit with activity	Green blinking
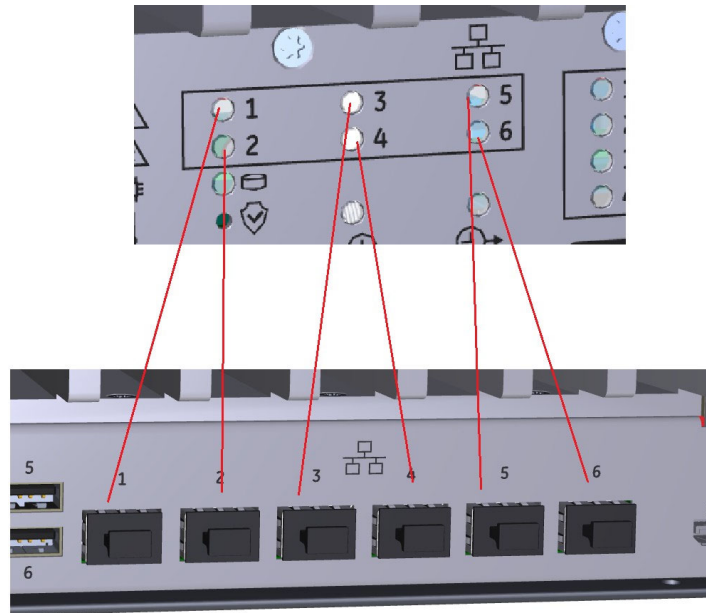
Serial Port LEDs

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
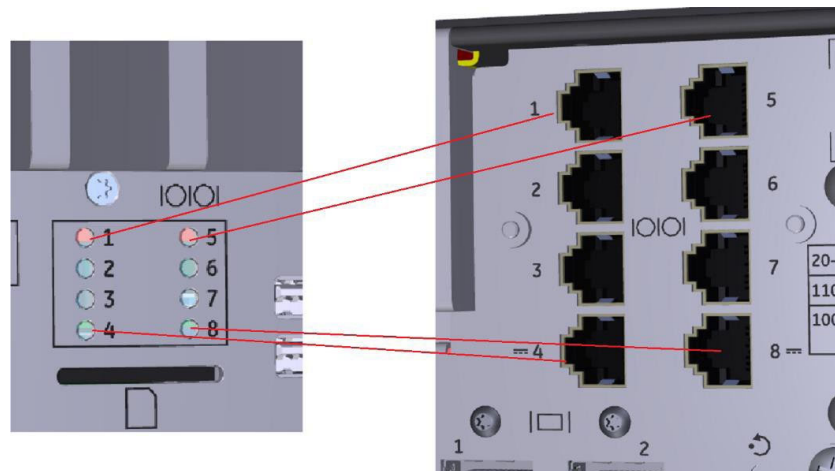
IRIG-B input

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
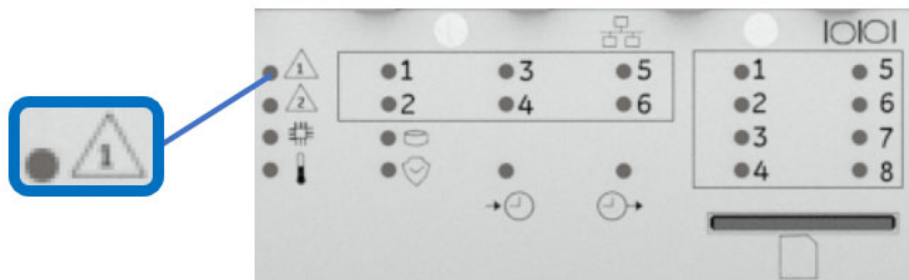
Status 2 - Peer Gateway (when redundant)
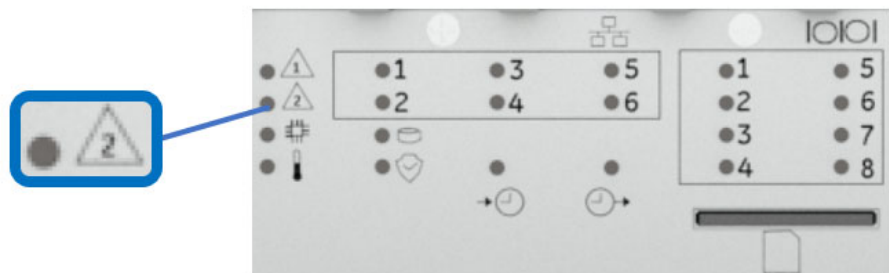
Status 1 and Status 2 LED Indicators

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 the G500 v2.10 release.
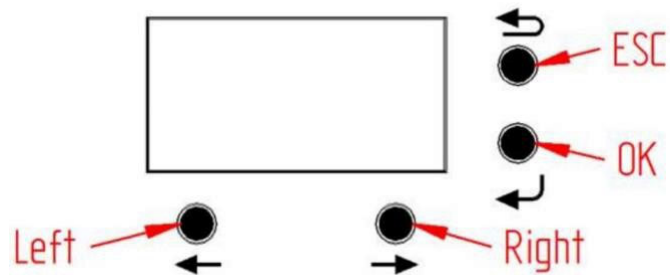
Rear indicators

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	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 **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
Memory	DDR3 ECC SDRAM (8GB(Dual core) / 16GB(Quad core)) soldered on board for improved reliability. NVRAM - 2Mbyte nvSRAM with 8bit parallel interface.
Storage	Self-encrypted Solid State Drive (128GB SLC / 256GB SLC) expandable to 3. Larger sizes to 1TB may be available upon request.
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.
Operating system	Predix Edge OS (Kernel 4.14)
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 1000BASE-LX 850nm 5km (LC fiber single-mode) 100BASE-FX 1300nm 2km (LC fiber single-mode) 100BASE-FX 1300nm 15km (LC fiber single-mode) 100/1000BASE-T (RJ45 copper medium) 100BASE-FX (LC fiber multimode) 1000BASE-SX (LC fiber multimode)
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 300, 600, 1200, 2400, 4800, 9600, ... 921k. 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 120 D20 Peripherals per channel. Each channel communicates at 250kbps. Channels are isolated from each other by 1000VAC and from other internal circuits.
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 (Windows only). **Resolution:** Up to UHD (4k, 3840x2160) for single displays connected to each port Up to QHD (2560x1440) for 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 ±10%, 10.2A Max **High Voltage power supply:** 100-300VDC Nominal +10%/-12%, 1.8A Max 100-240VAC Nominal ±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.

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.

NOTE

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]

446 [17,56]

313 [12,32]

482,6 [19,00]

19 [,75]

91 [3,58]

336,07 [13,23]
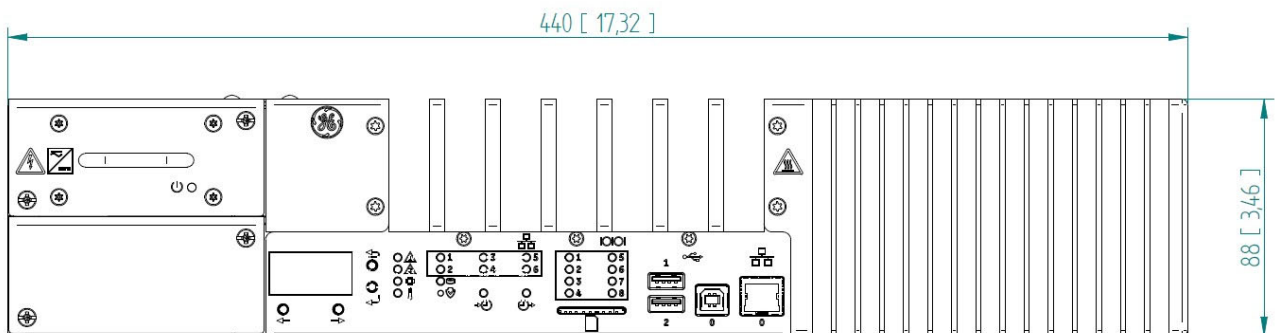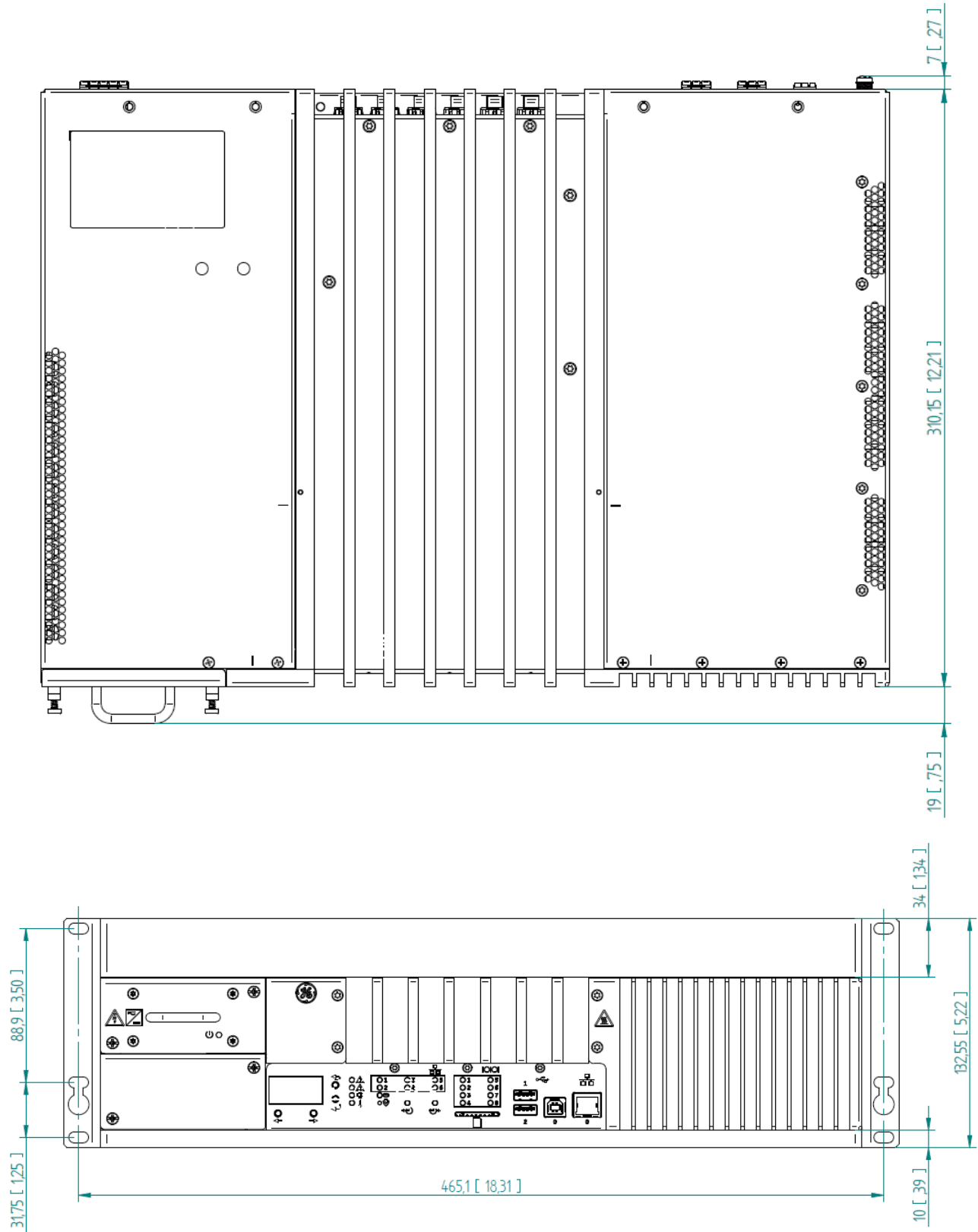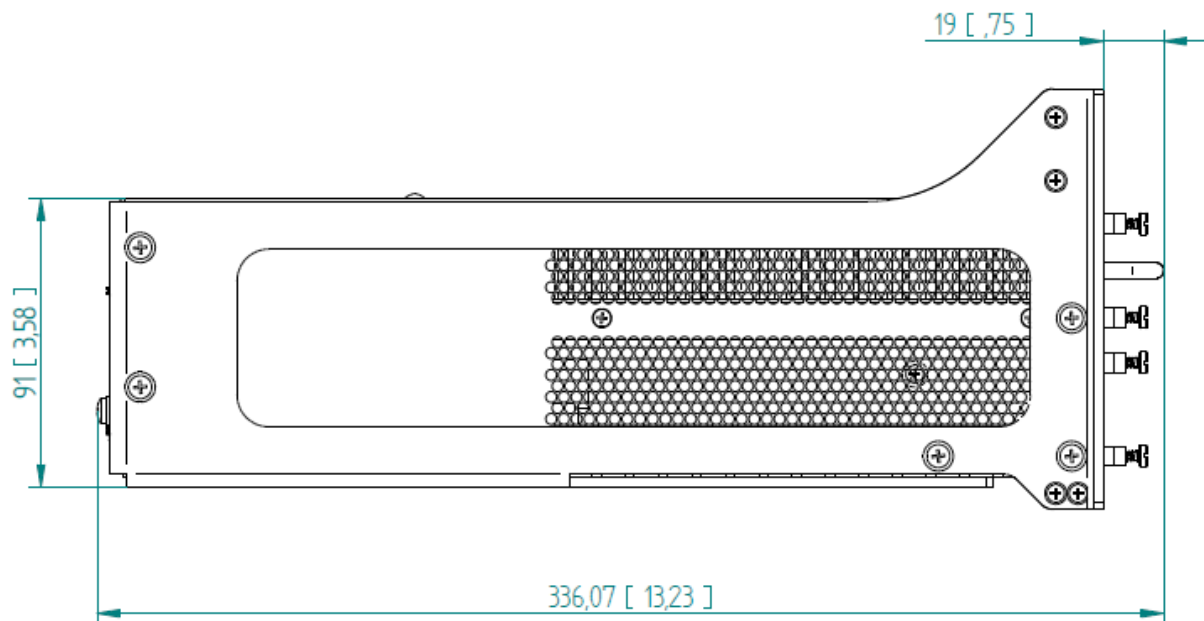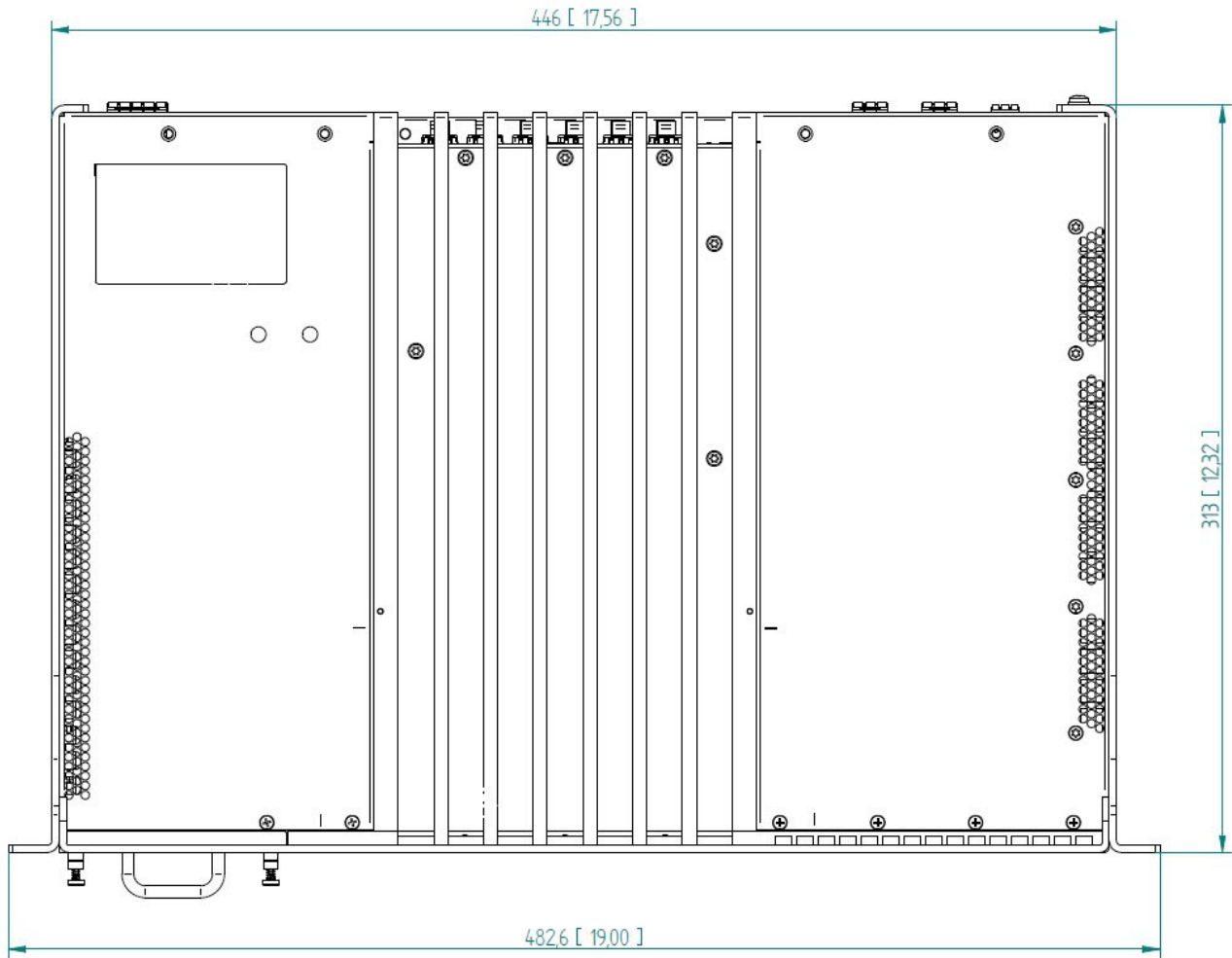
General Torque Values for Screws

Use a 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°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.

The G500 SSD is shipped protected with user password u123@MCPGE (set in UEFI).

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 and safekeep the drive. If the drive is faulty, GE recommends destroying the old drive as per NIST* recommendations.

2. **For hardware decommissioning and disposal:** Remove the G500 Solid State Drive. GE 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).

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Chapter 8: Restore the G500 to factory default

In the event that it is necessary to restore the G500 to factory default (for example, the username, password or both are unavailable), this chapter provides the procedure.

This chapter provides the following information:

- "Prerequisites" on page 103
- "Procedure to restore the G500 to factory default" on page 104

Prerequisites

For restoring the G500 to factory default (or "clean"), you require:

- A G500 device with:
    - Keyboard, Mouse and Monitor (or)
    - Type A to B USB cable connecting G500 front Type B USB port to laptop/PC.
- A portable 4 GB or larger USB Flash Drive.
- A Windows 7 or 10 PC loaded with the following:
    - DS Agile Studio v2.1 or higher.
    - The G500 upgrade image file in ISO format. E.g.: G500v2.0firmware.iso, which can be retrieved from the GE Customer Support Portal or the G500 Documentation CD (Part no. 588-0100).
    - Rufus 3.8 or higher executable, which can be downloaded from: https://rufus.ie/
- If G500 monitor is not available, G500 front serial USB driver (CDM21228_Setup.exe which can be found on the G500 Documentation CD (Part no. 588-0100) in the folder "G500 Front Serial USB Driver")

Procedure to restore the G500 to factory default

Verify and Extract the Signed Firmware

1. Insert the G500 Documentation CD in to the computer's DVD/CD drive, or Extract the G500 Documentation CD ZIP file on to the root of your C: drive

Result : The Documentation CD home page appears in your default Web Browser.

Alternate result : If the home page doesn't appear in your default Web Browser. In this case, navigate to the CD in File Explorer, and double click the **readme.html** file on the root of the CD.

2. Click on the link named **G500 Firmware files.**

Result : The Firmware Files folder appears. It contains the files named **G500v2.0FactoryDefault.sfc** and **VerifyAssembly.exe**

3. Copy the files named **VerifyAssembly.exe** and **G500v2.0FactoryDefault.sfc** to C:\G500.
    Where "C:\G500" can be any writable folder on your PC.

4. Run the executable **VerifyAssembly.exe**.

Result: The Verify Assembly Wizard dialog appears.

5. Browse to the C:\G500 folder and select the signed firmware container file **G500v2.0FactoryDefault.sfc** under the Select Assembly or Container.

6. Click Verify to verify the authenticity of the firmware.

    6.1. If the Firmware is valid, "The selected container or assembly is valid and signed by GE Canada" message will pop up.
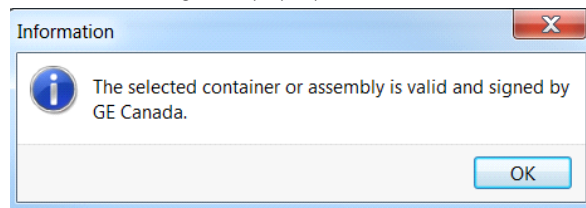
    6.2. If the verification fails, this means the integrity of the firmware cannot be verified and the following message will appear.
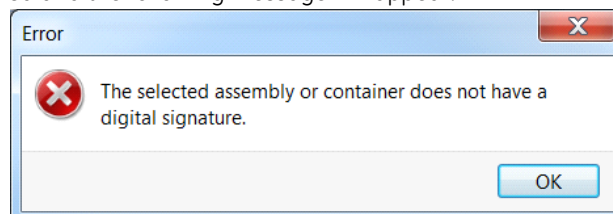
    When this happens, it means that the signed image has been modified either accidentally or deliberately by a malicious attacker.

    To ensure the integrity problem was not caused by the file transfer mechanism you can try to download the signed firmware again and proceed to verify it once more. If that still fails, this means you may be targeted by a cyber-attack. In this case please report the incident to General Electric security (PSIRT https://www.ge.com/security).

    NOTE: It is not possible to extract a firmware with invalid/no signature.

7. After the verification, select C:\G500 folder which you want to extract validated firmware using select folder to which contents should be extracted.

8. Click Extract.
   Result : If the firmware has been extracted successfully,
   "**G500v2.0FactoryDefault.out** extracted to the folder selected to which contents
   should be extracted successfully" message will pop up.
   NOTE: Extraction should not fail if verification is successful. If there is a bug during
   extraction or the use of Verify Assembly software, please report problem to GE Grid
   Solutions Technical Support as shown in Product Support section.

9. Rename **G500v2.0FactoryDefault.out** to **appl.out**.

Prepare the USB Drive

1. Insert the USB drive into your PC and start Rufus.

2. Select the G500 upgrade image file for Boot selection and other yellow highlighted
   options, as shown below:
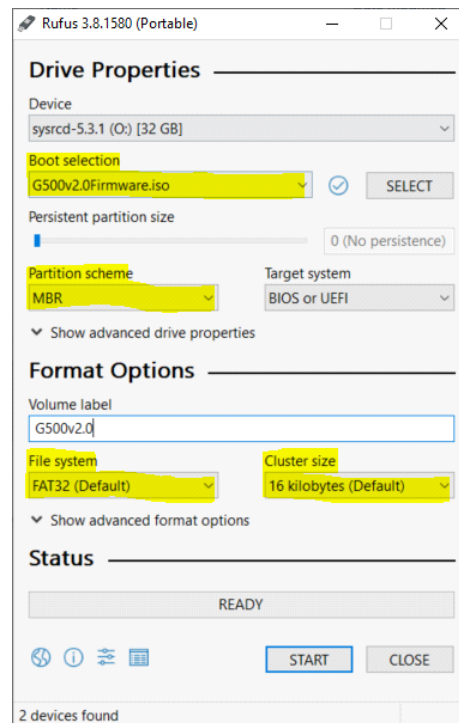
3. Ensure your USB drive is selected in the Device drop-down,

4. Click START.

5. You will get a warning like the following, click OK to continue or Cancel to abort.
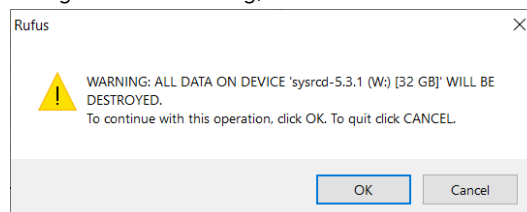
6. The Status will change to Copying ISO files. It will take about 5 minutes.
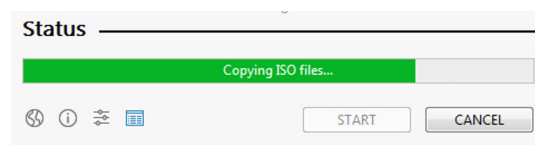
7. Once the copy is complete, the USB Drive is ready to use.

8. Copy the firmware image file (ends with *hddirect.zip) to the root of the USB.

Steps to Restore Factory Default configuration

1. Run the DS Agile Studio DSAS 2.1 or later.

2. Create a G500 device from a template with the target G500 firmware version.

3. Create firmware upgrade USB for this device.

4. Now, insert the prepared USB Drive into one of the front USB ports of the G500 to be updated to the Factory Default or clean configuration.

5. (Optional) If using the front serial port to perform the upgrade, then start DS Agile Terminal Emulator and connect to the COM port connected to the G500. Set the baud rate to 115200, with no parity.

6. Press the physical presence button with a paper clip. The physical presence button is shown in the following picture:
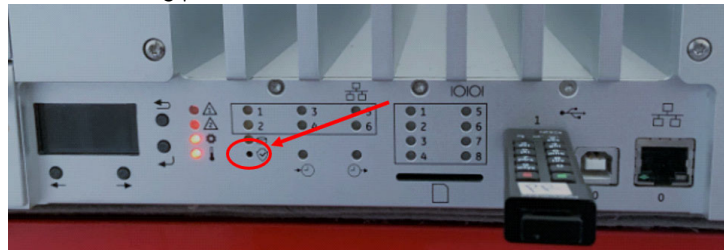
7. Reboot the G500 without removing the paper clip.

8. Wait until the CPU and Temp LEDs are flashing.
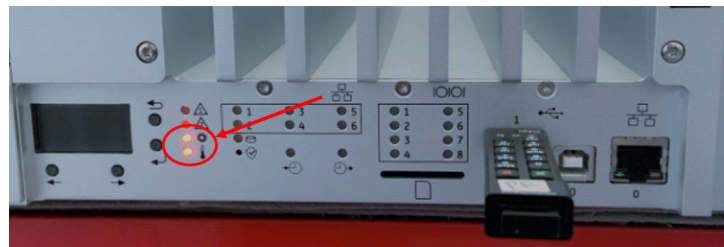
9. Remove the paper clip from the physical presence button.

10. Press F7 repeatedly until the Boot Menu appears.

11. Select the UEFI option for Partition 1 of your USB Drive (e.g. UEFI: ApricornSecure Key 3.0 0441, Partition 1).

```
             Please select boot device:

G500 Predix EdgeOS (P0: M.2 (S80) 3MG2-P)
P0: M.2 (S80) 3MG2-P
P1: M.2 (S80) 3MG2-P
ApricornSecure Key 3.0 0441
UEFI: Built-in EFI Shell
UEFI: ApricornSecure Key 3.0 0441, Partition 1
Enter Setup

          ↑ and ↓ to move selection
         ENTER to select boot device
          ESC to boot using defaults
```

12. A Boot screen will be displayed. Select the first option "G500 Image Upgrade (64bit)", if using a monitor. Select the second option "G500 Image Upgrade (64bit, serial console)", if using the front USB serial port.

```
                    GNU GRUB  version 2.02

+------------------------------------------------------------------+
|*G500 Image Upgrade (64bit)                                       |
| G500 Image Upgrade (64bit, serial console)                       |
|                                                                  |
|                                                                  |
|                                                                  |
|                                                                  |
|                                                                  |
|                                                                  |
|                                                                  |
|                                                                  |
|                                                                  |
+------------------------------------------------------------------+

    Use the ^ and v keys to select which entry is highlighted.
    Press enter to boot the selected OS, `e' to edit the commands
    before booting or `c' for a command-line.
 The highlighted entry will be executed automatically in 88s.
```
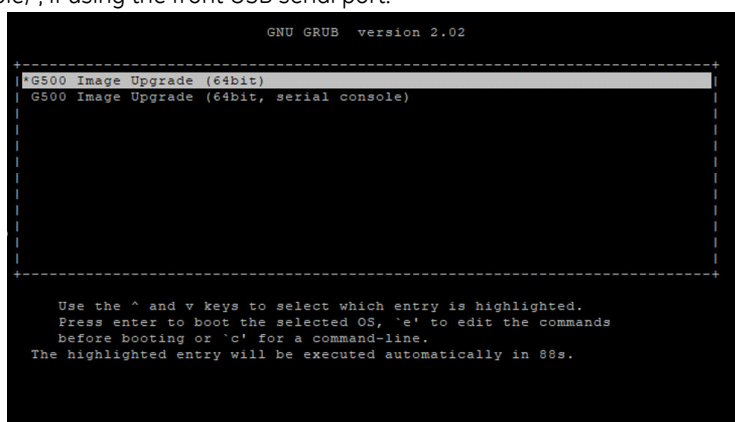
13. A Linux OS will startup and first verify the zip file. Once the zip file is verified, it won't be verified again. The verify takes about 2 minutes.

14. Select zip file to restore predix_edge_OS.hddirect.

```
Select zip file to restore predix_edge_OS.hddirect from

        develop_20200330_EdgeOS_2.2.1_MCP_2.0.62_hddirect.zip


              <  OK  >              <Cancel>
```
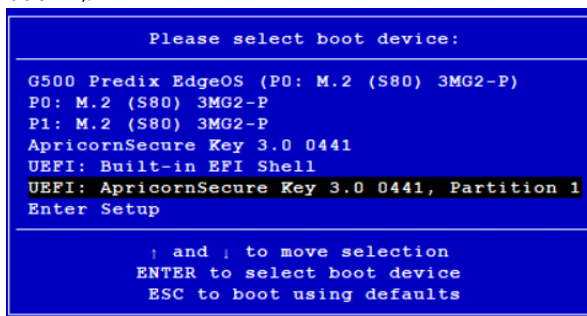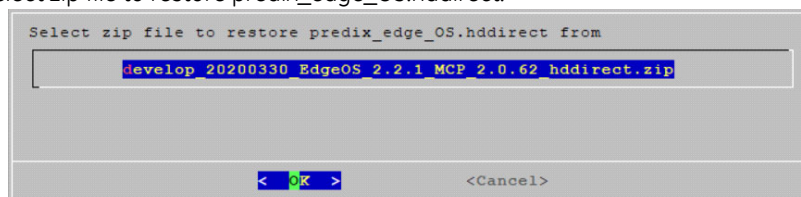
15. The Linux OS will then prompt whether to install the image on the first disk of your G500. Press Yes or No:
   – If you press Yes, the firmware upgrade will proceed.
   – If you press No, the firmware upgrade will be aborted: you will be prompted to remove the USB drive. Afterwards, the system will reboot and come up with the original firmware and configuration.

```
Are you sure you want to
deploy G500 v2.0.62 to the
first drive of this
device?

   < Yes >    < No  >
```
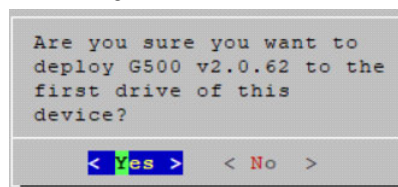
16. The Linux OS will then restore the image to the first disk. The image will be verified on the drive. It will take about 6 minutes.

NOTE

All shipped G500 units have only one self-encrypting drive (SED) disk, so it is of no concern that the image is always deployed on the first disk.

17. When done, you will be prompted to remove the USB Drive and close the dialog to reboot the unit. Remove your USB Drive and click OK.

18. The system will now boot Predix Edge OS and finalize the installation. This will take about 5 minutes. You will see the Predix Edge OS boot up messages. Once installation is finalized, the system will reboot automatically.

19. Wait for the system to come up again and the G500 product name to appear on the front OLED with the default or clean configuration.

20. The G500 will start the same way it came from the factory, with the default user defadmin and the default IP.

21. Login with a default administrator (defadmin) user to connect to the G500.

22. Verify the firmware version number by typing the command "ver".

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, 250/300cycle interrupts
Conducted RF Immunity 0-150khz	IEC 61000-4-16	Level 4
Voltage Ripple	IEC 61000-4-17	15% ripple
Ingress Protection	IEC 60529	IP30
Environmental (Cold)	IEC 60068-2-1	-40°C 16 hrs. (Storage and Operational)

TEST	REFERENCE STANDARD	TEST LEVEL
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 2nd Ed /CSA C22.2 60950-1-07	NWGQ2 & NWGQ8

G500 Substation Gateway

Appendix B: Certificates

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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 Mahrenholz, 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 http://ul.com/aboutul/locations/

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	• Clock Synchronization
• Cyclic data transmission	• Command transmission
• Data acquisition through read	• Transmission of Integrated Totals
• Acquisition of events	• Parameter Loading
• General Interrogation	• 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:

• Station initialization	• Clock Synchronization
• Cyclic data transmission	• Command transmission
• Acquisition of events	• Transmission of Integrated Totals
• General Interrogation	• 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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T +31 26 356 9111 F +31 26 351 36 83 salesdesk@dnvgl.com www.dnvgl.com

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

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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:

• Station initialization • Data acquisition by polling • Cyclic data transmission • Acquisition of events • General Interrogation	• 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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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

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

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

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:

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Davood Sooran
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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 manufactured products for 10 years. For warranty details including any limitations and disclaimers, see the GE Grid Solutions Terms and Conditions at

https://www.gegridsolutions.com/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
IRIG	Inter Range Instrumentation Group

Acronym	Definition
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
SLC	Single Level per Cell
SPI	Serial Peripheral Interface
SSD	Solid State Disk
STD	Standard
UART	Universal Asynchronous Receiver Transmitter
UEFI	Universal Extensible Firmware Interface
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^{TM} 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 Panel • 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 Table 6 in Chapter 3. Mean Time Between Failure (MTBF) specifications tables are moved to a standalone document.

G500 Substation Gateway

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