



Gen II Fiber Optic Bridge User Manual



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IMPORTANT

To ensure your success with this product, it is essential that you read this documentation carefully before using the hardware. Damage caused by misuse of the hardware is not covered under product warranty.

When using this manual, please remember the following:

- ❑ This manual may be changed, in whole or in part, without notice.
- ❑ DG assumes no responsibility for any damage resulting from the use of this hardware.
- ❑ Specifications presented herein are provided for illustration purposes only and may not accurately represent the latest revisions of hardware or cabling.
- ❑ No license is granted, by implication or otherwise, for any patents or other rights of DG or of any third party.

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Table of Contents

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|---|-----------|
| TABLE OF CONTENTS | 3 |
| 1 SAFETY FIRST | 4 |
| 2 INTRODUCING THE GENERATION II FIBER OPTIC BRIDGE | 5 |
| 3 GETTING STARTED WITH THE GEN II FIBER OPTIC BRIDGE | 7 |
| 3.1 CONNECTING THE BRIDGES TOGETHER:..... | 7 |
| 3.2 CONNECTING THE VEHICLE BUS TO EACH BRIDGE: | 7 |
| 3.3 CONNECTING POWER: | 7 |
| 3.4 SETTING THE BRIDGE POWER ROTARY SWITCH: | 7 |
| 3.5 SETTING THE HSCAN TERMINATION ROTARY SWITCH: | 8 |
| 3.6 SETTING THE SWCAN TERMINATION ROTARY SWITCH: | 9 |
| 3.7 STARTING COMMUNICATION:..... | 9 |
| 4 TROUBLESHOOTING | 10 |
| 4.1 CHECK YOUR SETUP: | 10 |
| 4.2 DIRECT CONNECTION:..... | 10 |
| 4.3 BATTERY STATUS: | 10 |
| 4.4 FIBER CABLES: | 10 |
| 5 PRODUCT SPECIFICATIONS | 11 |
| 5.1 TECHNICAL SPECIFICATIONS: | 11 |
| 5.2 VEHICLE BUS CONNECTOR PINOUT: | 12 |
| 6 BATTERY REPLACEMENT | 13 |
| 7 LENGTH CALCULATION FOR LONGER CABLES | 14 |
| 8 TECHNICAL SUPPORT AND RETURN MERCHANDISE AUTHORIZATION (RMA) | 15 |
| 8.1 TECHNICAL SUPPORT: | 15 |
| 8.2 RETURN MERCHANDISE AUTHORIZATION (RMA):..... | 15 |
| 9 WARRANTY INFORMATION AND LIMITATION STATEMENTS | 16 |
| 9.1 WARRANTY INFORMATION:..... | 16 |
| 9.2 LIMITATION STATEMENTS: | 16 |

1 Safety First

It is essential that the user read this document carefully before using the hardware.

The Gen II Fiber Optic Bridge devices are for use by individuals with thorough knowledge of Electromagnetic Interference (EMI) and Electromagnetic Chamber (EMC) testing for vehicle systems and components. The user is assumed to have a very good understanding of the electronic systems contained on the vehicles and the potential hazards related to working on a shop-floor or in a EMC lab environment.

1. DG understands that there are numerous safety hazards that cannot be foreseen in a testing or lab environment. We recommend that the user read and follow all safety instructions included in this manual.
 - ❑ Always use caution whether on vehicle or in the environmental chamber. Understand your equipment usage guidelines and operational precautions.
 - ❑ Use extreme caution when working around electricity. When diagnosing any vehicle, there is the risk of electric shock both from vehicle voltages, and from building voltage.
 - ❑ Do not smoke, allow sparks or open flames near any part of the vehicle fuel system or vehicle batteries.
 - ❑ Always work in a well-ventilated area and route vehicle exhaust outdoors.
 - ❑ Do not use this product in an environment where fuel, fuel vapor, exhaust fumes, or other potentially hazardous liquids, solids, or gas/vapors could collect and/or possibly ignite, such as in an unventilated area or other confined space, including below-ground areas.

2 Introducing the Generation II Fiber Optic Bridge

The Gen II Fiber Optic Bridge is used to connect network based vehicle systems and components to exterior testing, monitoring and development equipment using fiber optic communication in place of copper wire communication due to electromagnetic interference (EMI). For example equipment being tested for RF susceptibility would need to be isolated in a shielded chamber. Often there is a need for communication between the DUT and equipment located outside of the chamber.

The Gen II Fiber Optic Bridge provides an optical means of bridging various vehicle networks through a single pair of Polymer Optical Fiber (POF) cable. This product is sold as a kit which contains the following:

- Two Gen II Fiber Optic Bridge units
- 10 Meters of dual POF cable
- One +12V wall power supply

Features for the Gen II Fiber Optic Bridge include:

- Compatibility with SMA 905 terminated multimode fiber
- Compatibility with High Speed CAN up to 1 Mbps
- Compatibility with CAN FD with up to 1 Mbps arbitration phase and 5 Mbps data phase
- Compatibility with SWCAN including high voltage wake up function
- Internal rechargeable battery provides 12 hours of uninterrupted operation
- May be operated with the included power supply
- Can be recharged while in operation

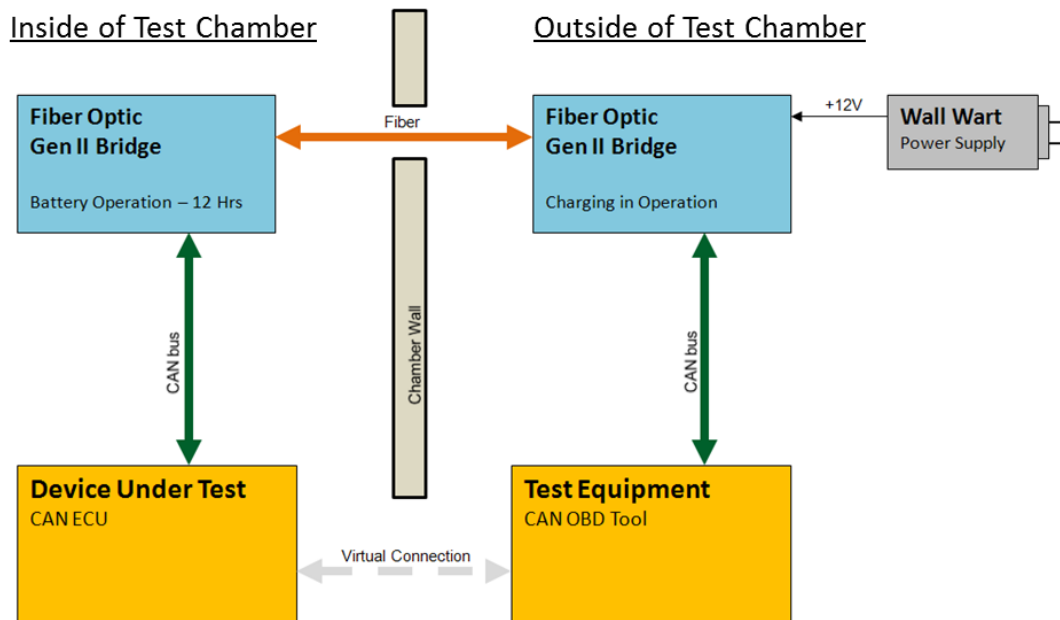


Figure 1: Gen II Fiber Optic Bridge Typical Application

Standards and Protocols Supported

2.1.1 Vehicle Networks Supported

- ❑ CAN ISO 11898 Networks
 - 125k bps
 - 500k bps
 - 1M bps
- ❑ SW CAN SAE J241
 - 33.33k bps (up to 40k bps)
 - 83.33k bps (up to 100 kbps)
 - Accurately pass High Voltage Wakeup Frames
- ❑ CAN FD ISO 11898-7
 - Up to 5 Mbps payload phase using 10 Meter cable

3 Getting Started with the Gen II Fiber Optic Bridge

The following steps will have you up and running in a few short minutes.

3.1 Connecting the bridges together:

Please reference the figure 1 above “Gen II Fiber Optic Bridge Typical Application” when performing these steps.

Note: The Gen II FO Bridge is supplied with a pair of Polymer Optical Fiber (POF) cables. If you wish to use a fiber optic cable other than what was provided with your Gen II Fiber Optic Bridge kit, please consult the specification section at the end of this document to ensure compatibility.

There are two SMA 905 fiber connectors found on each bridge unit. One is light grey and is labeled “Fiber Out”. The other is dark grey and is labeled “Fiber In”. Using the POF cable pair supplied with the Gen II FO Bridge, simply connect the Fiber OUT from one unit to the Fiber IN of the other. Connect both fiber cables this way.

3.2 Connecting the vehicle bus to each bridge:

The Gen II Fiber Optic Bridge connects to vehicle networks through a high density 15 pin socket connector (DE-15S).

The vehicle bus of the Device Under Test (DUT) should be connected to the DE-15S connector located on the bridge inside the test chamber. The vehicle bus of the monitoring equipment should be connected to the DE-15S connector located on the bridge outside the test chamber.

Please consult the specification section of this document for the pin out of the DE-15S connector. For ease and convenience the pin out can also be found on the product labeling located on the unit.

For CAN applications you will need only to connect CAN_H and CAN_L.

For SWCAN applications you will require the connection of the SWCAN bus and Ground signals.

If you will be sending “Wake Up” frames on SWCAN you will need to connect an external +12V battery to the Vbatt pin on the DE-15S connector. This is only necessary if your bridge is running on internal batteries. If the provided power supply powers the Gen II Fiber Optic Bridge you will not need to provide a connection to Vbatt.

If you will be using the bus termination provided by the bridge you are done. If you prefer to wire your own termination, be sure to set the bridge for “no termination” and attach the appropriate termination components to your cables.

3.3 Connecting power:

For use of the Gen II Fiber Optic Bridge unit while located within a test chamber, it is recommended that you use the units’ internal battery power. No external power connection is needed for CAN while Vbatt is needed for SWCAN. If you want to construct your own DC power cable to power the Gen II Fiber Optic Bridge from a battery in the chamber, be sure to use the correct polarity of the DC adapter.

When the provided power supply is connected to the Gen II Fiber Optic Bridge, the internal battery will be charged. It is permissible to leave the wall supply on indefinitely. For this reason it is recommended that the Gen II Fiber Optic Bridge located outside the chamber always be powered by an external power supply. This will allow one bridge to remain charged and ready for battery operation.

3.4 Setting the bridge power rotary switch:

The figure below shows the three rotary switches located on the end cap of each bridge.

The **Power/Mode** switch is labeled OFF, CAN, SWCAN, and Option.

OFF – The unit is powered OFF and will not draw power from the internal battery supply. If the wall power supply is attached the internal battery charger operates and charges the internal battery while the switch is set to OFF.

HSCAN – The unit is powered ON and will operate in the HSCAN mode. This includes the familiar dual wire ISO11898 CAN as well as the newer CAN FD. If the wall supply is attached the internal battery charger will operate. Normal operation can continue while batteries are charging.

SWCAN - The unit is powered ON and will operate in the SWCAN mode. If the wall supply is attached the internal battery charger will operate. Normal operation can continue while batteries are charging.

Option – Your Gen II Fiber Optic Bridge may have been built with an optional vehicle bus interface installed. If so, please consult the documentation for the particular option that you are using.

When the **Power/Mode** switch is set to the **Option** position the unit is powered ON and will operate using the optional vehicle bus interface. The unit will draw power from your battery even if you do not have an option card installed. If the wall supply is attached the internal battery charger will operate. Normal operation can continue while batteries are charging.

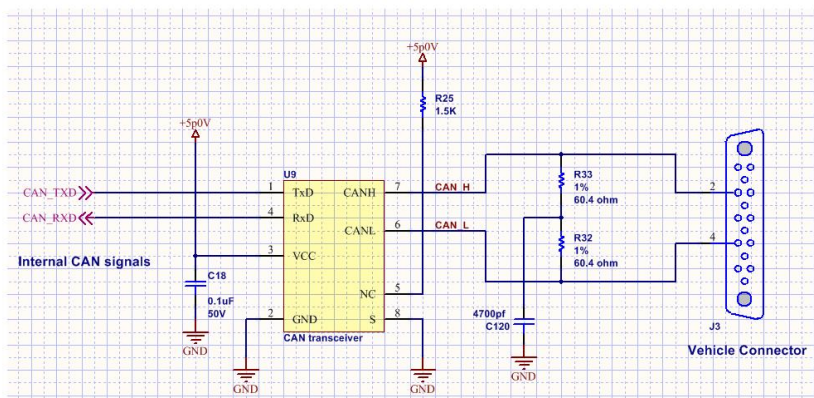
3.5 Setting the HSCAN termination rotary switch:

The rotary switch has meaning only if you are using the HSCAN vehicle bus. The selectable bus termination choices that you may choose are:

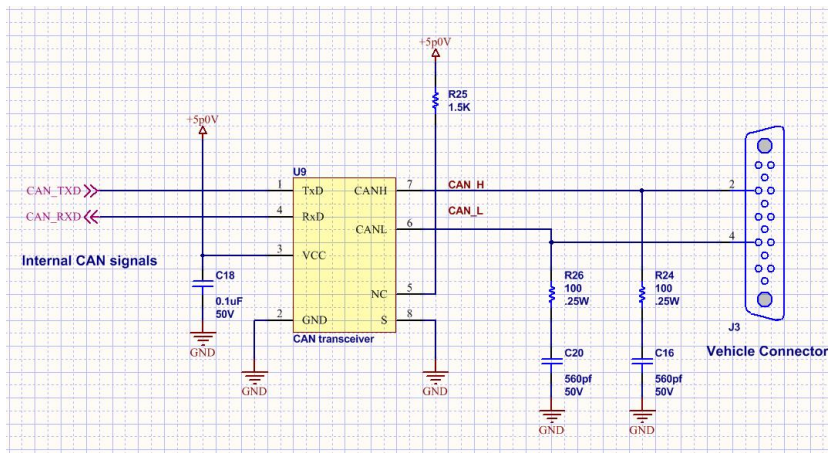
None – There is no additional termination switched onto your bus.

120 Ohm – A 120 Ohm termination resistor is switched onto your vehicle bus from within your Gen II Fiber Optic Bridge.

60 Ohm split - The circuit shown in the figure below is switched onto your vehicle bus from within your Gen II Fiber Optic Bridge.



ISO 15765-4 – The circuit shown in the figure below is switched onto your vehicle bus from within your Gen II Fiber Optic Bridge.



3.6 Setting the SWCAN termination rotary switch:

The SWCAN rotary switch provides functional support only if you are using the SWCAN vehicle bus. The selectable SWCAN bus termination choices that you may choose are:

STD High Speed – Choose this setting if you are running 83.3 KHz or higher SWCAN.

The standard 6.49K Ohm load resistor is in the circuit.

There is no additional termination switched onto your bus. You should add any necessary additional termination to your vehicle bus.

STD low speed – Choose this setting if you are running 33.3 KHz SWCAN.

The standard 6.49K Ohm load resistor is in the circuit.

There is no additional termination switched onto your bus. You should add any necessary additional termination to your vehicle bus.

Tool High Speed – Choose this setting if you are running 83.3 KHz or higher SWCAN. An additional 130 ohms to ground termination is switched onto your vehicle bus from within your Gen II Fiber Optic Bridge.

Tool Low Speed – Choose this setting if you are running 33.3 KHz SWCAN. An additional 130 ohms to ground termination is switched onto your vehicle bus from within your Gen II Fiber Optic Bridge.

3.7 Starting communication:

You may now initialize your network devices and allow communication to proceed.

4 Troubleshooting

The Gen II Fiber Optic Bridge does not require any special connection or power up sequencing.

If you are having trouble setting up the Gen II Fiber Optic Bridges, below are some common items that should be checked prior to contacting technical support:

4.1 Check your setup:

- Fiber connected properly. Fiber OUT on one unit should connect to fiber IN of the other.
- Test your fiber using the built in fiber test feature
- The Bridge units should be powered ON. Look for the green or blue LED indicator
- Check the termination switches on your bridge units.
- If you selected “no termination” be sure the proper termination is added to your vehicle cable.

4.2 Direct connection:

Try connecting your DUT directly to your test equipment. Does it work properly? If not, this needs to be working first.

4.3 Battery status:

The battery is OK when the green or blue LED indicator is lit when the power is turned ON. When the indicator is RED or fails to illuminate, the battery requires charging or replacement.

4.4 Fiber cables:

Are the fiber optic cables supplied with the kit being used? If not, it is recommended that you check the cable compatibility section located at the end of this document. Most SMA905 62.5/100 type HCS cable should work with the Gen II Fiber Optic Bridge unit.

DG guarantees functionality with the 10M-fiber cable supplied. Many Gen II Fiber Optic Bridge configurations will work properly with much longer fiber optic cables. Refer to section 7 for details on fiber optic cable length calculation.

If the fiber optic cables being used are suspect, be sure to test the set up with the supplied 10M fiber cables first. If you are unsure of the condition of your cables, perform the test with verified fiber optic cables.

The Gen II Fiber Optic Bridge has a built-in cable test mode. This will allow you to test continuity between bridges, or continuity of a single cable.

4.4.1 Fiber cable test mode:

Fiber test mode may be selected when two bridges are connected as shown in Figure 1.

Test the fiber optic cables by placing all three rotary switches in the 4th position (the furthest clockwise position). Both bridges will use the same settings. If both cables are connected properly the LED display on each Gen II Fiber Optic Bridge will flash BLUE/RED at approximately 4 Hz.

If one of the LEDs fail to flash (may be stuck either BLUE or RED), replace the fiber cable attached to the port labeled “Fiber IN” (dark grey one) on the back of the non-flashing unit. If the LED fails to flash on both ends, the cables may have been connected incorrectly.

While in fiber test mode you can test a single fiber by using it to temporarily connect the IN and OUT ports on a single Gen II Fiber Optic bridge.

Note: This is not an extensive cable quality test. It may be used to establish correct connection and to check for broken fiber.

5 Product Specifications

The following table shows the technical specifications for the Gen II Fiber Optic Bridge.

5.1 Technical specifications:

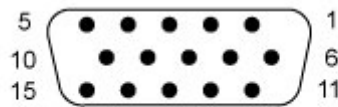
| | |
|------------------------------|--|
| Supported Protocol | CAN 125 Kbps |
| | CAN 500 Kbps |
| | CAN 1 Mbps |
| | CAN FD 5 Mbps Data / 1 Mbps arbitration |
| | SWCAN 33.3 Kbps |
| | SWCAN 33.3 Kbps with high voltage wakeup signaling |
| | SWCAN 83.3 Kbps |
| DC Power Input Jack | 2.5 mm, center positive |
| Power Sources | 100V-240 VAC with wall supply provided (1) |
| | Internal Lithium-Ion non-replaceable battery (2) |
| Vehicle Battery Input (Vbat) | 9 to 26.5 VDC (3) |
| Fiber Optic Cable | Termination: SMA905 |
| | Core Type: HCS, 850nm |
| | Core Refraction: Multimode with graduated index |
| | Core/cladding: 50/125uM, 62.5/125uM, or 100/140uM |
| | Core attenuation: 3dB/Km or better |
| | Length: 10M (4) |
| Battery Endurance | 12 hours continuous operation. 3 hrs charge time |
| Operating Temperature | -20 C to +60 C |
| Storage Temperature | -20C to +70 C |
| Environmental (5) | ALSE - GMW3097 paragraph: 3.3.1 |
| | BCI - GMW3097 paragraph: 3.4.1 |
| | Anechoic Chamber - GMW3097 paragraph: 3.4.2 |
| | ESD handling - GMW3097 paragraph: 3.6.3 |

- 1 - The provided supply produces +12V DC with a tolerance better than 5%. Do not substitute.
- 2 - Not user replaceable. Contact DG for replacement options.
- 3 - Required for SWCAN
- 4 - Optional 20 Meter cable available. Contact DG Technologies
- 5 - Specified environmental parameters apply to battery operation.

5.2 Vehicle bus connector pinout:

The following chart shows the pinout of the female DE-15S connector contained in the Gen II Fiber Optic Bridge. Do not attempt to utilize other pins not listed in the table.

| DE-15S Female | Signal | Comment |
|---------------|-------------------|-------------------------------|
| 1 | SWCAN | Single Wire CAN Bus signal |
| 2 | CAN Hi | HS CAN |
| 4 | CAN Lo | HS CAN |
| 5 | Vehicle Ground | Vehicle Power Ground |
| 7 | Optional Signal 1 | See Option Card Documentation |
| 11 | Chassis | Metal Case |
| 12 | Optional Signal 2 | See Option Card Documentation |
| 15 | Vehicle Power | Vehicle Battery |



DE-15S (Female Socket Front View)

6 Battery Replacement

The Gen II Fiber Optic Bridge contains a Lithium-Ion battery pack. This battery pack is not user serviceable. The one-year battery warranty includes replacement coverage for a defective battery. Contact DG Technologies technical support if warranty service or battery replacement is required.

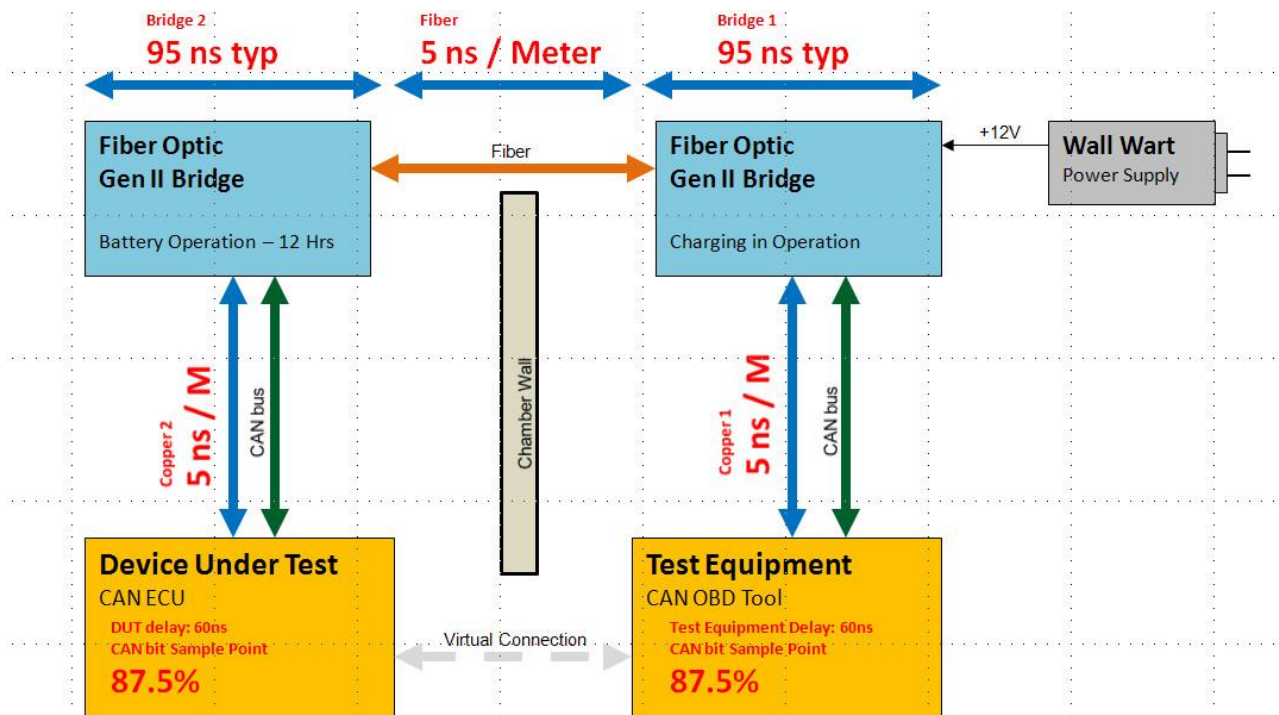
If the Gen II Fiber Optic Bridge is out of warranty, please contact DG Technologies for current pricing of battery replacement service. DG Technologies disposes of all batteries in an environmentally friendly manner.

7 Length Calculation for longer cables

The Gen II Fiber Optic Bridge has been tested to operate with fiber optic cables up to 50M in length. However, it is important to consider the protocol when selecting a fiber length. For example the signaling for 1Mbps CAN cannot afford the delay associated with traversing 50M in *any* media!

If using LOW or HIGH speed SWCAN, the bit timing is slow enough that there is no need to be concerned with a detailed length calculation. 500kbps CAN generally does not tax the Gen II Fiber Optic Bridge and can be connected through 50M of fiber.

Users of 1Mbps CAN and CAN FD should read further. To evaluate a fiber length for an application, comprehension of bit timing including the device delay and programmed CAN sample point timing is required. The following figure shows the delays associated with the Gen II Fiber Optic Bridge and associated devices. Following that is an example calculation for 500kbps CAN showing a typical margin of 535ns when operating over 50M of fiber.



Typical timing budget for 500kbps with 50M of fiber

Spare = .875 bit time - TE dly - Cop 1 dly - FO 1 dly - Fiber delay - FO 2 delay - cop 2 dly - DUT dly - DUT dly - cop 2 dly - FO 2 dly - fiber dly - FO 1 dly - Cop 1 dly - TE dly
 Spare = 1750ns - 60ns - 5ns - 95ns - 250ns - 95ns - 5ns - 60ns - 60ns - 5ns - 95ns - 250ns - 95ns - 5ns - 60ns = 610ns spare.

The above calculation is made for 500kbps CAN with 50 Meters of fiber. The analysis is for the time to send a data frame from the **Test Equipment** to the **DUT** plus the return time for the **ACK**. This all has to happen within the sample period of the CAN bus bit time. In this case, 87.5% of a bit time.

Similar calculations can be made for 1Mbps CAN over 10M fiber or for other fiber lengths. For **CAN FD** timing it is only necessary to consider the more relaxed "response time" so you may observe greater time margin for CAN FD than for 1Mbps CAN!

8 Technical Support and Return Merchandise Authorization (RMA)

8.1 Technical Support:

If users are unable to resolve technical issues using the troubleshooting and validation procedures, please, feel free to contact DG technical support. For users in the United States, technical support is available from 9 a.m. to 5 p.m. Eastern Time. You may also fax or e-mail your questions to us. For prompt assistance, please include your primary telephone number.

Users not residing in the United States should contact their local DG representative.



DG Technologies Technical Support

Phone: (248) 888-2000
Fax: (248) 888-9977
E-mail: techsupp@dgtech.com
Web site: www.dgtech.com

8.2 Return Merchandise Authorization (RMA):

Should technical support determine that there may be a physical problem with the Gen II Fiber Optic Bridge; an RMA number will be issued. Return the product along with any documentation of ownership (proof of purchase/price) to the following address for repair or replacement:



Product Service/Repairs
Attn: RMA# xxxxxxx
DG Technologies
33604 West 8 Mile Road
Farmington Hills, MI 48335

9 Warranty Information and Limitation Statements

9.1 Warranty information:

The DG Technologies Gen II Fiber Optic Bridge is warranted against defects in materials and workmanship for one (1) year following date of shipment. Batteries are warranted for one (1) year. Cables are warranted for ninety (90) days.

DG Technologies will, at its option, repair or replace, at no cost to the customer, products which prove to be defective during the warranty period provided the defect or failure is not due to misuse, abuse, or alteration of the product. The customer is responsible for shipment of the defective product to DG. This warranty does not cover damage to any item that Dearborn Group, Inc. determines has been damaged by the customer's abuse, misuse, negligence, improper assembly, modification, or operation of the product.

A Return Merchandise Authorization (RMA) number must be issued to the customer by our Technical Support Department at (248) 888-2000 and must be included with the product being returned (for more details, see section *Return Merchandise Authorization (RMA)*). A Gen II Fiber Optic Bridge is warranted for 90 days after a warranty repair, or to end of the original factory warranty period, whichever is longer.

9.2 Limitation statements:

9.2.1 General Limitation and Risk Assignment

To the maximum extent permitted by applicable law, Dearborn Group, Inc. and its suppliers provide support services on an "as-is" basis and disclaim all other warranties and conditions not specifically stated herein, whether express, implied or statutory, including, but not limited to, any warranties of merchantability or fitness for a particular purpose, lack of viruses, accuracy or completeness of responses, results, lack of negligence or lack of workmanlike effort, and correspondence to description. The user assumes the entire risk arising out of the use or performance of the device, its operating system components, and any support services.

9.2.2 Exclusion of Incidental, Consequential and Certain Other Damages

To the maximum extent permitted by applicable law, in no event shall Dearborn Group, Inc. or its suppliers be liable for any special, incidental, indirect or consequential damages whatsoever, including but not limited to: damages for loss of profit, loss of confidential or other information; business interruption; personal injury; loss of privacy, failure to meet any duty (including good faith or of reasonable care); negligence; and any other pecuniary or other loss related to the use of or the inability to use the device, components or support services or the provision of or failure to provide support services or otherwise in connection with any provision, even if Dearborn Group, Inc. or any supplier has been advised of the possibility of such damages.

9.2.3 Limitation of Liability and Remedies

Notwithstanding any damages that you might incur for any reason whatsoever (including, without limitation, all damages referenced above and all direct or general damages), in no event shall the liability of Dearborn Group, Inc. and any of its suppliers exceed the price paid for the device. The user assumes the entire risk and liability from the use of this device.

9.2.4 Right to Revise or Update without Notice

Dearborn Group, Inc. reserves the right to revise or update its products, software and/or any or all documentation without obligation to notify any individual or entity.

9.2.5 Governance

The user agrees to be governed by the laws of the State of Michigan, USA, and consents to the jurisdiction of the state court of Michigan in all disputes arising out of or relating to the use of this device.

9.2.6 Contact

Please direct all inquiries to:

DG Technologies
33604 West Eight Mile Road
Farmington Hills, MI 48335
Phone (248) 888-2000
Fax (248) 888-9977