openGear Hardware Development Guide

Confidential — For openGear Partners

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   - offer the best product quality and support

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Ross has become well known for the Ross Video Code of Ethics. It guides our interactions and empowers our employees. I hope you enjoy reading it below.

If anything at all with your Ross experience does not live up to your expectations be sure to reach out to us at *solutions@rossvideo.com*.

David Ross
CEO, Ross Video
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Ross Video Code of Ethics

Any company is the sum total of the people that make things happen. At Ross, our employees are a special group. Our employees truly care about doing a great job and delivering a high quality customer experience every day. This code of ethics hangs on the wall of all Ross Video locations to guide our behavior:

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2. We will do our best to understand our customers' requirements.

3. We will not ship crap.

4. We will be great to work with.

5. We will do something extra for our customers, as an apology, when something big goes wrong and it's our fault.

6. We will keep our promises.

7. We will treat the competition with respect.

8. We will cooperate with and help other friendly companies.

9. We will go above and beyond in times of crisis. *If there's no one to authorize the required action in times of company or customer crisis - do what you know in your heart is right. (You may rent helicopters if necessary.)*

openGear Hardware Development Guide

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Patents

Patent numbers US 7,034,886; US 7,508,455; US 7,602,446; US 7,802,802 B2; US 7,834,886; US 7,914,332; US 8,307,284; US 8,407,374 B2; US 8,499,019 B2; US 8,519,949 B2; US 8,743,292 B2; GB 2,419,119 B; GB 2,447,380 B; and other patents pending.

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Introduction

This guide provides information on designing openGear cards and rear modules. Topics such as card dimensions, card-edge controls, module design, and signal descriptions are covered. The specifications are provided for the openGear frames such as frame hardware overview, power supply, dissipation and frame airflow.

Documentation Conventions

Special text formats are used in this guide to identify parts of the user interface, text that a user must enter, or a sequence of menus and sub-menus that must be followed to reach a particular command.

Interface Elements

Bold text is used to identify a user interface element such as a dialog box, menu item, or button. For example:

In the **Network** tab, click **Apply**.

User Entered Text

Courier text is used to identify text that a user must enter. For example:

In the **Language** box, enter `English`.

Referenced Guides

Text set in bold and italic represent the titles of referenced guides, manuals, or documents. For example:

For more information, refer to the ***DashBoard User Manual***.

Menu Sequences

Menu arrows are used in procedures to identify a sequence of menu items that you must follow. For example, if a step reads "**File** > **Save As**," you would click the **File** menu and then click **Save As**.

Important Instructions

Star icons are used to identify important instructions or features. For example:

✶ Contact your IT department before connecting to your facility network to ensure that there are no conflicts. They will provide you with an appropriate value for the IP Address, Subnet Mask, and Gateway for your device.

Before You Begin

Through the openGear® initiative, Ross has opened up the openGear architecture to other companies in the broadcast space. We feel that it is in the best interest of the industry, and subsequently of our customers, to provide an open architecture, providing the industry more freedom and flexibility in choosing compatible terminal equipment.

Platform

The openGear 10-slot frame, the DFR-8310, was launched at NAB 2006. It was originally based on the RossGear frame introduced to the broadcast market at NAB 2005 as the basis for RossGear Multi-Definition product line.

To be competitive in the market place, Ross released a new 20-slot openGear frame, the DFR-8320. This frame was designed in collaboration between Ward-Beck Systems and Ross Video therefore; both companies will have the rights to manufacture the frame.

In 2009, an enhanced version of the 20-slot frame, the DFR-8321, was released. This frame is an enhancement of the DFR-8320 frame, which allowed the development of more complex rear modules. At that time, Ross Video discontinued the DFR-8320 frame in favor of the DFR-8321 frame. The DFR-8320 information is included in this document for completeness. Unless otherwise indicated, all references to the DFR-8321 frame also refer to the DFR-8320.

In 2012, the 20-slot frame was again enhanced as the OG3-FR to handle the higher power density of new cards that were being developed by the partners. All existing cards and rear modules that fit into the DFR-8320/1 frames will work in the new frame. Any new cards that are developed that exceed the power limits of the DFR-8321 must create new rear modules that only fit into the OG3-FR frame to prevent accidental insertion into the older frames.

In 2018, the 20-slot frame was again enhanced as the OGX-FR to handle the even higher power density of new cards. All existing cards and rear modules that fit into the OG3-FR or DFR-8320/1 frames will work in the new frame. Any new cards that are developed that exceed the power limits of the OG3-FR must create new rear modules that only fit into the OGX-FR frame to prevent accidental insertion into the older frames.

To be successful, the openGear platform needs to be stable, robust and reliable. Furthermore, it needs to be compatible with openGear cards. To achieve this, Ross Video has tightly controlled the use of openGear to be applied only to frames that are 100% certified and guaranteed to be compatible.

Communication

The openGear frame provides an internal CAN bus to support card-to-card communications for control, status monitoring, and software upgrades. Refer to the ***openGear Development Guide - Communications and Control*** document for more information.

Related Documentation

An overview of the CAN hardware and protocol specification is provided in references 2-4. Details of the CAN implementation on the Atmel® AT90CAN128 micro-controller (used on openGear cards) is provided in reference 6. Reference 7 provides an introduction to SNMP.

1. ***DashBoard Development Tools User Manual***. Ross Video Specification Report.
2. ***openGear Test Fixture User Manual***. Ross Video Specification Report.
3. ***Introduction to the Controller Area Network (CAN)***. Texas Instruments Application Report SLOA101, August 2002.
4. ***The CAN Protocol***. Kvaser Technical Document. http://www.kvaser.com/can/protocol/.
5. ***Controller Area Network***. ISO 11898.

6. Atmel AT90SAM7x Data Sheet.
7. Mauro, D.R & K.J. Schmidt, ***Essential SNMP***. O'Reilly, 2001

OGX-FR Frame Specifications

This chapter describes the OGX-FR specifications. All components described in this chapter are branded openGear and changes are controlled by Ross Video.

OGX-FR Overview

The OGX-FR is an openGear 2RU Frame, that is capable of housing up to 20 plug-in card modules plus a frame controller card and a Reference distribution card (GFC-8322). This frame is composed of U-shaped aluminum bottom and sides with a steel top. The back of the frame allows for custom rear I/O interface modules that can be application specific. It has exactly the same card spacing as the OG3-FR for total compatibility with existing cards and rear modules. It has however split the power supplies so that they are on the right and left of the card slots. In addition, an extra slot was added beside Slot 1 to hold the GFC-8322.

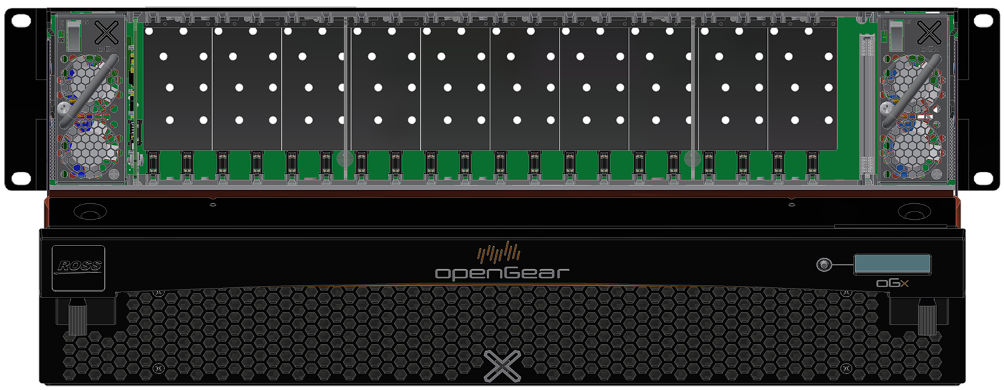


Figure 3.1 OGX-FR — Front View with Door Open

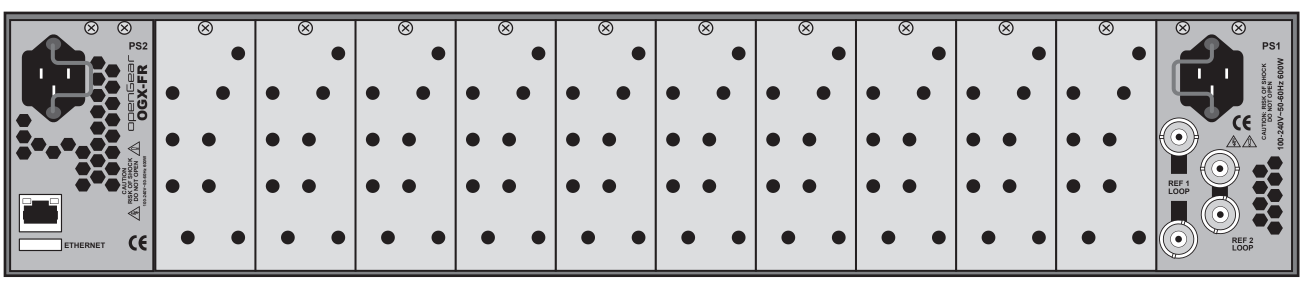


Figure 3.2 OGX-FR — Rear View

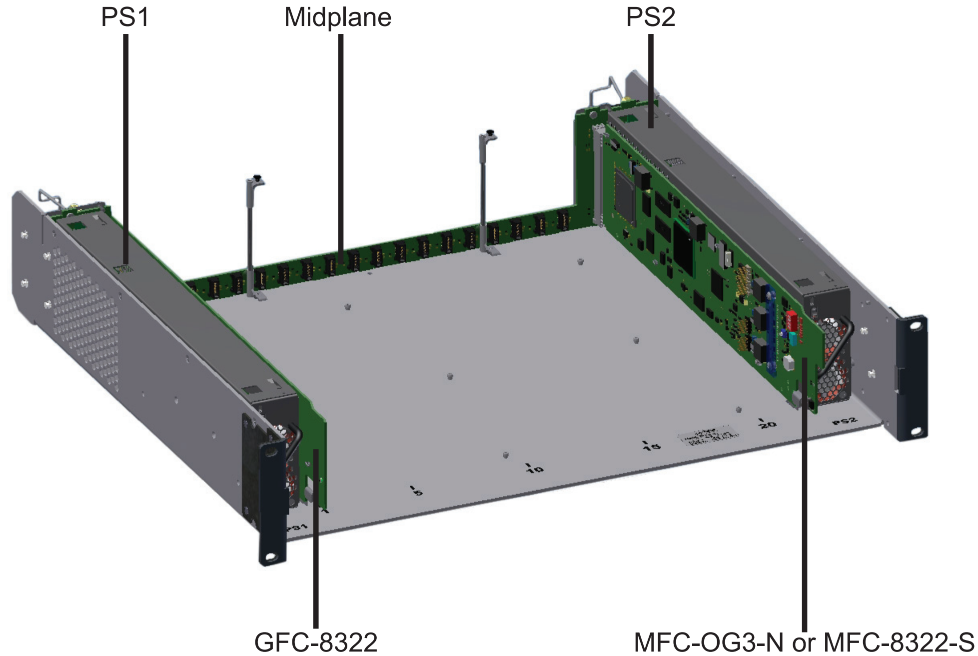


Figure 3.3 OGX-FR — Card Locations (View from Front of Frame)

Front Door

The OGX-FR front door has an outer shell that can be removed by taking out 4 screws on the front and opening the door latches. This exposes the filter so that it can be cleaned without taking the whole door out and stopping the fans. Refer to the ***OGX-FR Series User Manual*** for details on cleaning/replacing the air filter.

The front door has the following features:

- 1” x 1” emboss — To be used by openGear partners to brand their frames.
- Frame Glow — A user-programmable lighting feature that can be configured, via DashBoard, to glow a preset color, or customized color, to indicate different alarms.
- Diagnostic Panel — An LCD Display that reports the frame name, IP address, and a description of any detected faults/errors.
- **Mute** button — To turn off audible alarm and to scroll through the Diagnostic Panel messages.

The OGX-FR frame door can be separated from the frame without the use of tools. This makes replacing the door or servicing the fan boards much easier.

Frame Jewel

To brand the frame, a self-adhesive jewel can be used in the 1” x 1” emboss on the left hand side of the frame door.

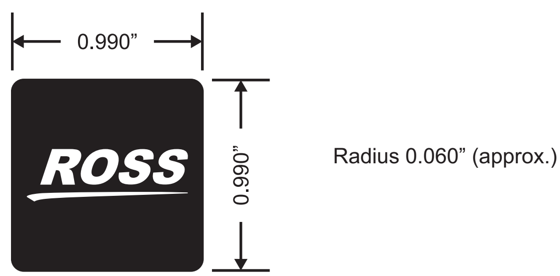


Figure 3.4 Frame Jewel Example

Table 3.1 outlines the specifications for the jewel.

Table 3.1 Jewel Dimensions

Dimension	Specification
Size	0.990" square, with a 0.060" corner radius
Finishing Top Side	Clear Urethane Dome
Substrate Base Material	White 4 mil vinyl
Finishing Bottom Side	3M 7904 - Acrylic 350 Adhesive

OGX-FR Fan Card

The OGX-FR Front Door Assembly was designed to support the higher power capability of the frame. The fans plug into the Fan card which is a narrow card behind the fans. The Fan card plugs into the Display card that holds the LCD Display, pushbutton, as well as the 40mm fan for PS2. Another 40mm fan is mounted to the metalwork in front of PS1. To better cool PS1 in the OGX-FR, we biased the left 40mm fan by a few millimeters in front of PS1.

The Fan card has PWM controllers for controlling the fan speed based on load and temperature as determined by the software on the MFC-8322-S or MFC-OG3-N cards.

Figure 3.5 OGX-FR Frame — Fan Card Location inside Door

The cooling of the frame is performed by the fan board mounted on the front door with air flow running from the front of the frame to the back of the frame. The fan card has four main 70mm fans plus a smaller 40mm fan for the power supplies. Power and variable speed control for the fan board is supplied by any variant of the Frame Controller card.

A filter is installed between the fan board and the front door to keep the inside of the frame free of dust. This filter may require to be cleaned periodically in dusty environments. Refer to the ***OGX-FR Series User Manual*** for details on cleaning and replacing the filter.

The fan board supports variable speed control. Depending on the power in the frame and on the heat rise in the frame, the fan speed will adjust accordingly. Once the frame is running with more than 300W at 20°C, the fan speed reaches its maximum. This feature helps prolong the life of the fans, helps control the noise level and saves energy.

For More Information on...

- thermal management for the openGear frames, refer to the chapter “**Thermal Management**” on page 69.

OGX-FR Midplane

The midplane for the OGX-FR is identical to the OG3-FR midplane except for an increased current carrying capacity on power planes. The card slot spacing remained the same as on the OG3-FR so all the cards and Rear Modules from the DFR-8321 and OG3-FR can be installed in the OGX-FR frame.

The midplane for the OGX-FR frame has 20 HSEC8 card connectors to support up to 20 processing cards. Whether the frame is used with 20 cards or less will depend on the rear modules and not the midplane. Also, there is one HSEC8 connector for the GFC-8322 Reference card between PS1 and Slot 1, a 170 pin connector for the MFC-8322-S or MFC-OG3-N Frame Controller card, and two power supply connectors to supply the +12 volts and -7.5 volts. Refer to the chapter "**Common openGear Parts**" on page 67 for details on the HSEC8 connector.

On the back of the midplane, connections are provided for two looping frame references, an RJ45 connector for 10/100/1000 Ethernet communications to the frame controller and two IEC power connectors. The circuitry to buffer the frame reference to each slot resides on the GFC-8322 Reference card.

The midplane has one large cut-out for all 20 slots for rear module connections. Slot 1 and Slot 2 share the first rear module space, Slot 3 and Slot 4 share the second space, and so on. The exact alignment and dimensions of the cut-out are displayed in **Figure 3.6**.

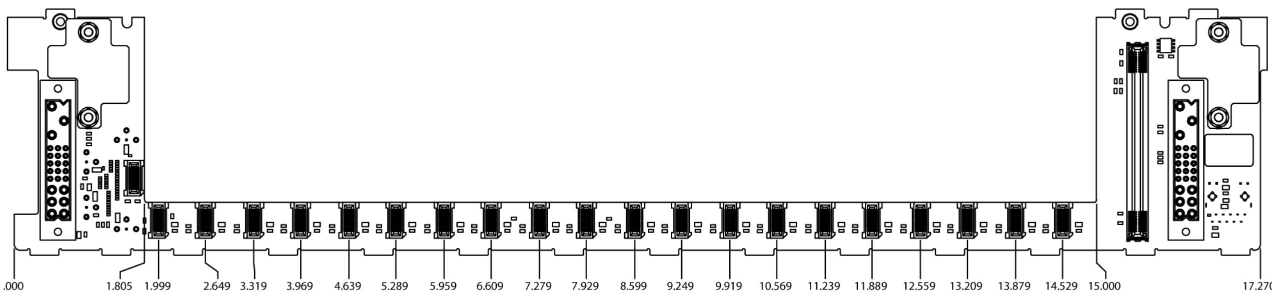


Figure 3.6 OGX-FR Midplane — Physical Layout

There are 2 structural supports in the chassis: between slot 6 and 7 and between slots 16 and 17 that restrict component heights on the Rear Modules.

Midplane to Rear Module Spacing

Because the rear module is attached to the frame behind the midplane, this configuration limits the component height on certain areas on the solder side of rear modules. These areas are the lower portion of the rear module, behind the midplane connector, and the left and right sides. Refer to the section "**OG3-FR Rear Module Design**" on page 56 for details.

Figure 3.7 shows the spacing between the midplane and rear module, which limits the max component height in these areas to 0.080".

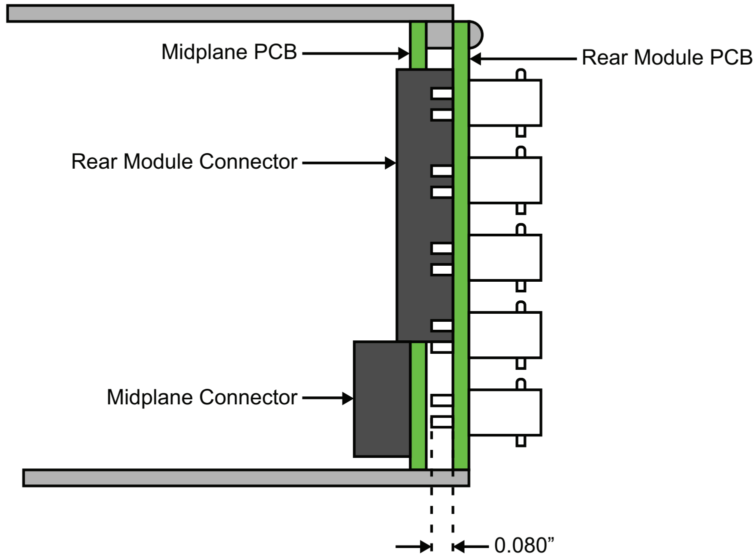


Figure 3.7 OGX-FR Midplane to Rear Module Spacing

openGear Card Clearance for Frame Supports

Note that there are two structural supports in the chassis: between slot 6 and 7, and between slots 16 and 17 that restrict component heights on the rear modules. The supports also restrict component height on the openGear cards that plug into the chassis to 0.20" from the edge of the midplane connector to the end of the card.

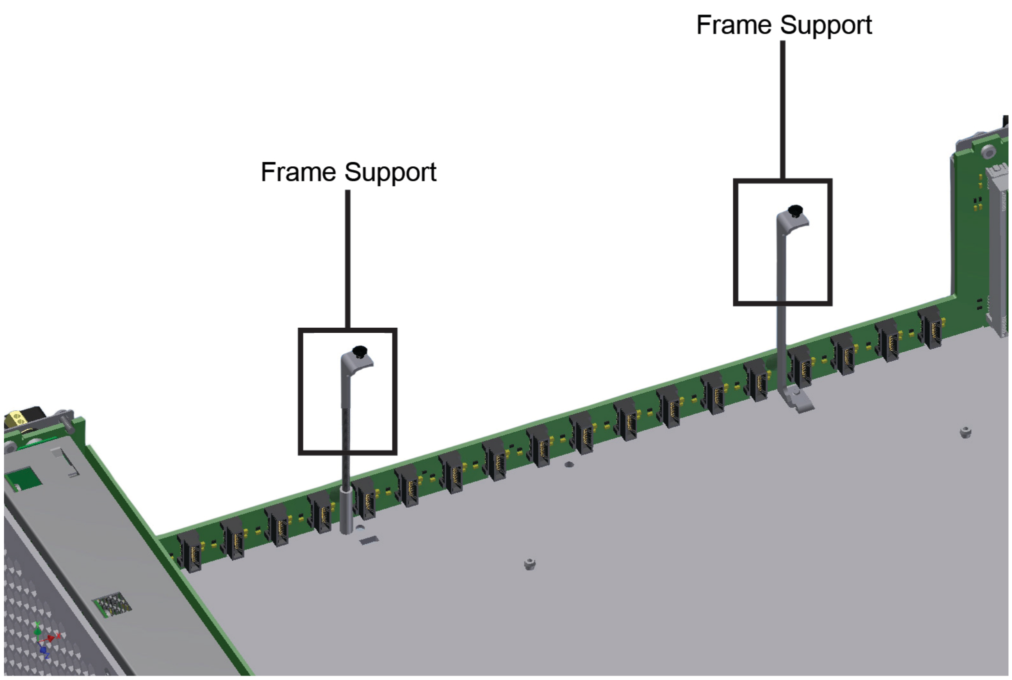


Figure 3.8 OGX-FR Midplane — Structural Supports in the Chassis

Figure 3.10 and **Figure 3.9** summarize the spacing requirements between the openGear card, the midplane, and the rear module. Refer to the section “**Card Dimensions and Connector Locations**” on page 42 for more information on the clearance requirements for an openGear card.

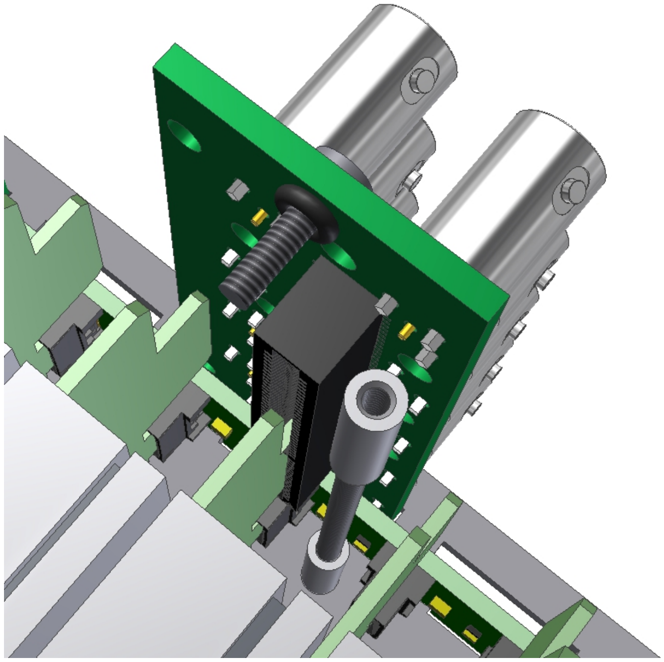


Figure 3.9 OGX-FR Midplane to Rear Module Spacing — 3D View, Top Down

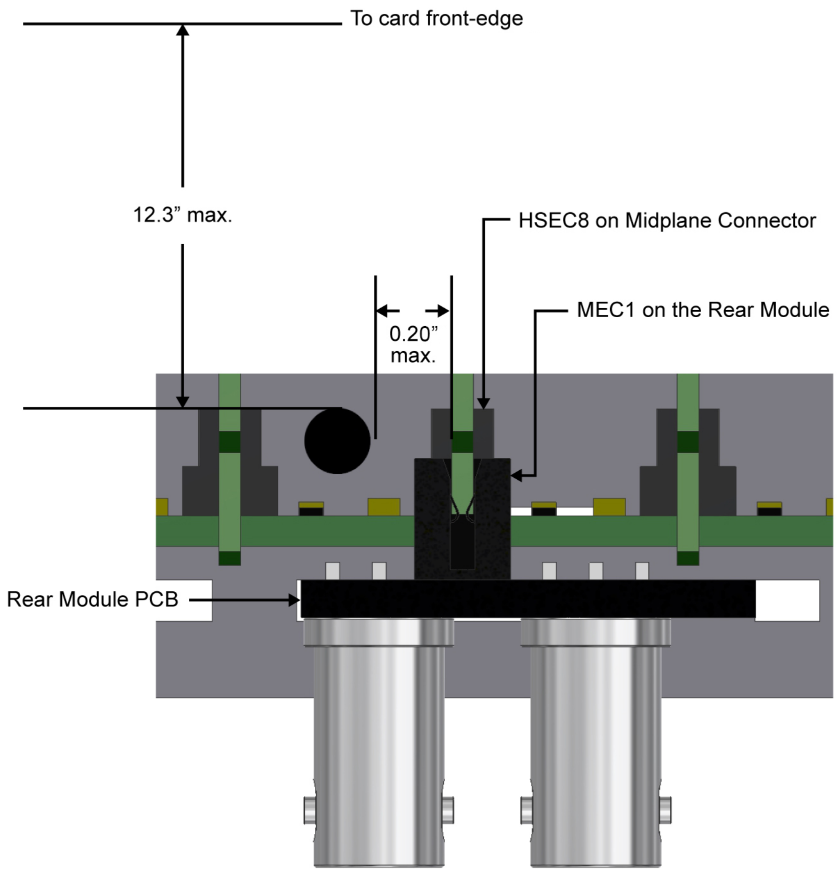


Figure 3.10 OGX-FR — Midplane to Rear Module Spacing (Top View)

Reference Distribution

Each frame has two frame wide, looping reference inputs. These can be used to distribute any reference signal to all the slots in the frame, up to a maximum bandwidth of 10MHz. This can include SD black burst, HD tri-level, or DARS.

In the OGX-FR frames, each reference input is buffered using an opamp and distributed to each of the 20 slots in a star configuration as shown below.

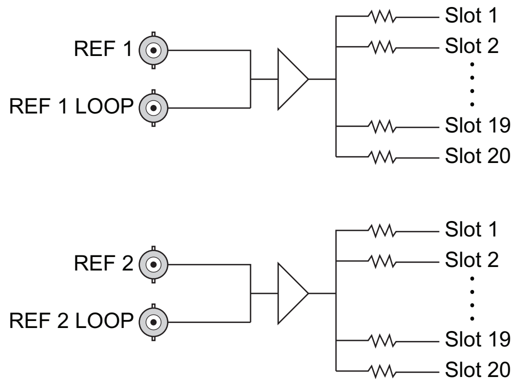


Figure 3.11 OGX-FR — Simplified Reference Distribution

Because these reference signals are shared among all the slots in the frame, it is important that the cards do not terminate the frame reference inputs, but maintain a high impedance input. In addition, the stub length, resistance and capacitance values must be kept to a minimum to ensure that cards do not degrade the signal quality of the reference within the frame.

Frame Connections

Each frame provides several connections that are required for frame operation. These are located on the back of the OGX-FR frame.

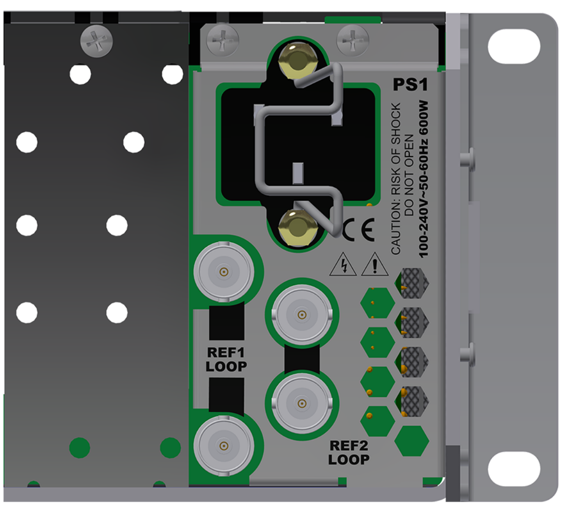


Figure 3.12 OGX-FR Frame Rear Chassis Connections — PS1

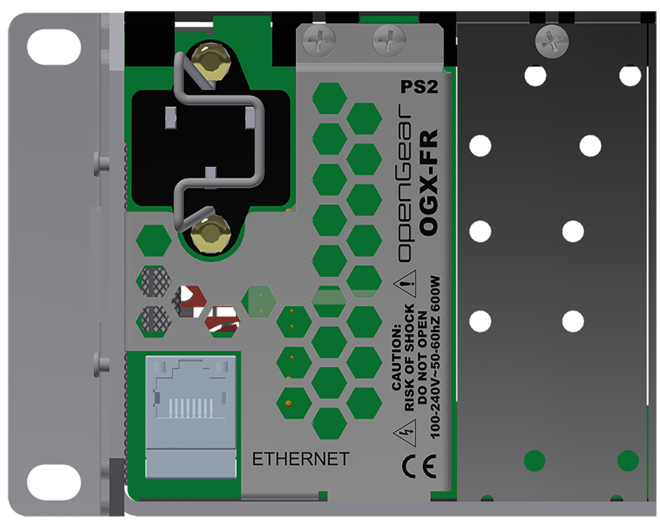


Figure 3.13 OGX-FR Frame Rear Chassis Connections — PS2

Frame Connection Descriptions

PS1 and PS2 - Two independent IEC C14 plugs, which are connected to the PS1 and PS2 power supplies respectively.

REF1 Loop - Two looped BNC connectors that feed the buffer circuitry for frame reference 1. These are high impedance inputs. When not looping a signal through these connections, a 75Ohm terminator should be added.

REF2 Loop - Two looped BNC connectors that feed the buffer circuitry for frame reference 2. These are high impedance inputs. When not looping a signal through these connections, a 75Ohm terminator should be added.

Ethernet - This RJ45 connector is connected to the Network Frame Controller, supporting 10/100/1000 Ethernet. This is the communications port for the frame to communicate to DashBoard and SNMP browsers.

The connections based on the openGear frame model are given in the following table.

Table 3.2 Frame Connections

MFC PIN #	MFC-8322-S 10/100, with auto-MDIX PIN Description	MFC-OG3-N 10/100/1000, with auto-MDIX PIN Description
1	TX+	TD1+
2	TX-	TD1-
3	RX+	TD2+
4	Terminated to GND	TD3+
5	Terminated to GND	TD3-
6	RX-	TD2-
7	Terminated to GND	TD4+
8	Terminated to GND	TD4-

Frame Support Brackets

In high stress environments, frame support brackets (FSB-OG3) are available to support the rear of the OGX-FR frame to the rear of the rack. This section briefly outlines the brackets based on the openGear frame model.

The support brackets consists of two rack mount arms, two rail guides, retaining bolts, Hex nuts, and threaded rubber bumpers to attach the frame to the rack unit. Note that the FSB-OG3 only installs on the OGX-FR frames.

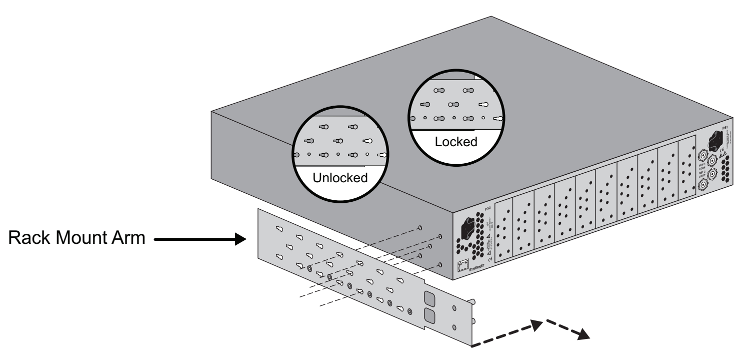


Figure 3.14 FSB-OG3 — Step 1

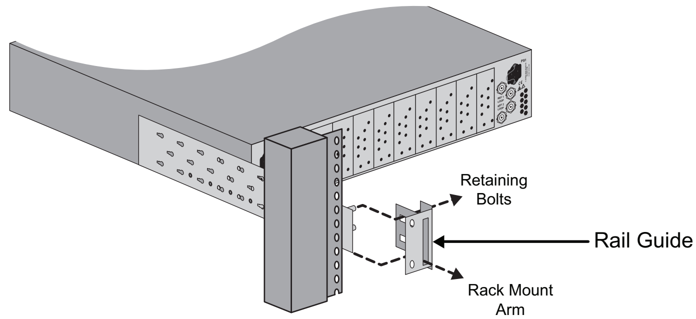


Figure 3.15 FSB-OG3 — Step 2

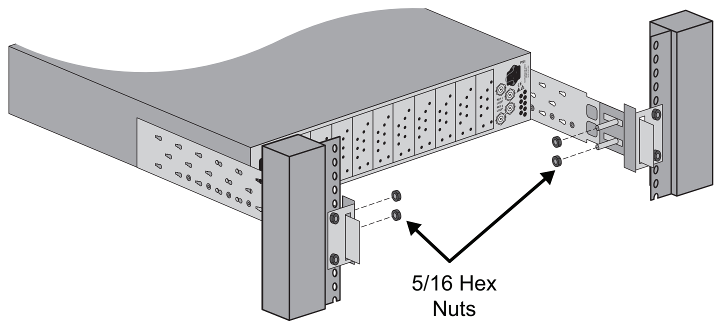


Figure 3.16 FSB-OG3 — Step 3

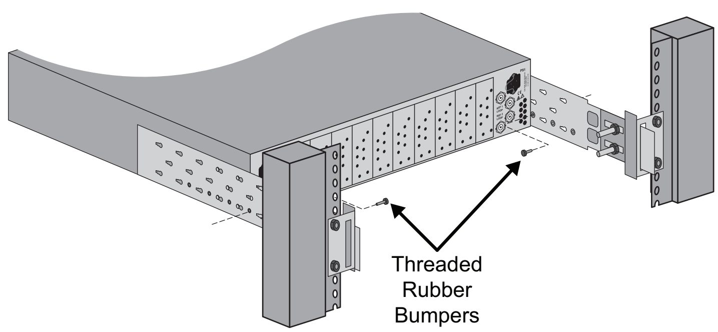


Figure 3.17 FSB-OG3 — Step 4

Power Supply and Dissipation

This section provides information on the power supplies available for each openGear frame model.

PS-OGX Overview

The PS-OGX power supply can only be used in the OGX-FR. These are hot swappable 500W power supplies. The specifications of this power supply are outlined in following sections.

A single power supply can power the entire frame. Two power supplies can be used to provide redundancy on power supply or AC input failure.

Figure 3.18 PS-OGX 500W Power Supply for OGX-FR

The rear of the power supply has a male connector that plugs into matching female connectors on the midplane. The connector provides the following signals:

- AC input
- +12V and -7.5V DC outputs
- Power supply monitoring and alarms

On the front of the power supply are the following:

- On/off switch
- Two Cooling fans
- Bi-color LED that indicates one of the following status:
  - › Green - The power supply is operating normally
  - › Red - When flashing there is either an over or under voltage condition, or there is no AC input when a redundant power supply is operating normally

Power Dissipation

openGear cards are limited in power dissipation due to the cooling design employed by the frame. The OGX-FR supports all existing cards and rear modules that meet the requirements of the OG3-FR and DFR-8321 Power Dissipation.

The OGX-FR has been designed to allow up to a maximum of 15W per slot. This maximum value is valid for a frame with the fan kit. Without moving air, this rating is de-rated to 2watts per slot.

Any openGear module which dissipates more than 15watts should be physically designed in such a way as to occupy more than one card slot, thereby restricting the addition of another module directly adjacent to it. This can be accomplished via the addition of a standoff (or equivalent).

- A module dissipating 15-30W will occupy 2 card slots.
- A module dissipating 30- 60W will occupy 4 card slots.
- Under no circumstances can a module dissipate in excess of 60watts.

✶ The exception is if the cards have additional cooling such as integrated fans augmenting the doors fans (a 2-slot module can dissipate up to 45W and a 4-slot module can dissipate up to 90W) provided no single card/midplane connection exceeds 75W due to maximum allowable current through the power pins on the HSEC8 midplane connector. This allows a maximum of 450W of total card power in an OGX-FR chassis.

- All high power cards must measure and report their current and power to the MFC Network Controller Card.
- All high power cards must use a hot swap controller to minimize the inrush current at power up.
- All high power cards should be designed to run with the door open for 5 minutes to allow for servicing. A fan on an FPGA to prevent overheating is an example solution.
- All high power cards must use a Rear Module with the top cut-outs to ensure adequate air flow across the card. Extra holes may be added but not to the detriment of adjacent cards.
- All high power cards need to be verified with full and almost empty chassis to prove that they can be cooled by the Fan door. The card may need a daughter assembly to provide ducting to keep the air flowing across the card.
- Tall components such as character displays may block air flow, reducing maximum power to much less than specified above.

Power distribution is very important for the success of the openGear frame. The capability of being able to populate a frame with cards from various manufacturers is a very strong point of openGear. To achieve this successfully, we must obey the power limits to avoid frames from being overloaded.

Everyone will agree that one day, a technician somewhere will see an empty slot and want to populate it with a card. How will he know if the card can be plugged in or not? Maybe the frame is already filled with 19 cards that use up more than 15W each and that one slot was kept empty intentionally when the frame was originally installed.

As providers of openGear products, we have a responsibility to protect our customers from such events. Ross Video has decided to create a blocker card that is mounted on the card to physically prevent customers from plugging in another card. We encourage our openGear partners to do the same. Ross Video will gladly share details on the blocker card with anyone interested.

Environmental Specifications

This section provides information on the required environmental conditions, and frame airflow.

Internal Environmental

All openGear products are designed for studio use within the following environmental conditions:

- Frame Ambient Temperature: 5°C to 40°C
- Cooling: Forced air from front of the frame through the back of the rear I/Os.

With an external temperature of 40°C, there will be a temperature increase towards the exhaust end of modules. The allowable temperature rise is defined to be 25°C. Thus, modules within an openGear frame must operate within the following temperature range: 5°C to 65°C.

Frame Airflow

The frames with the cooling fan installed in the front door have a front to rear airflow as shown in the diagram below. Although the frame is specified to support up to 300W in the OGX-FR of processing cards, it is up to the individual cards to manage their thermal requirements across all valid slots in each frame.

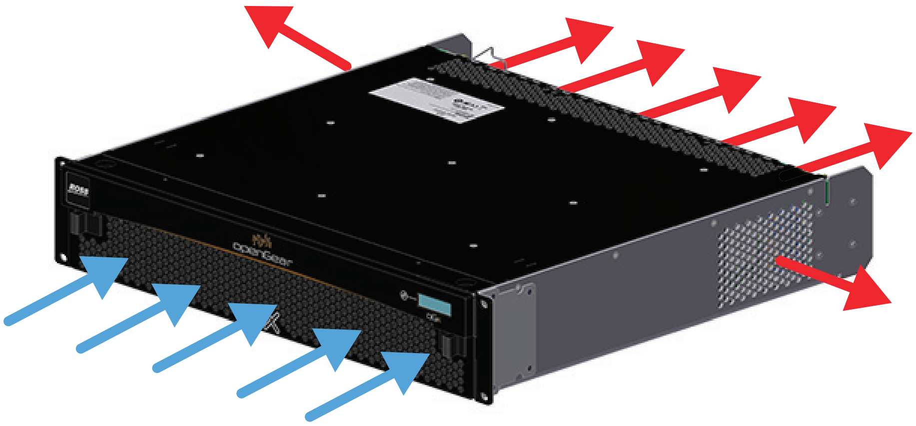


Figure 3.19 OGX-FR — Airflow

OGX-FR Technical Specifications

This section provides the technical specifications for the OG3-FR series frames.

Rack Frame Mechanical

Table 3.3 OGX-FR Technical Specifications — Rack Frame Mechanical

Item	Specifications
Height	3.5” (90mm)
Width	17.45” (444mm) not including rack ears 19” (483mm) including rack ears
Depth	16.82” (427mm)

Frame Card Slots

Table 3.4 OGX-FR Technical Specifications — Frame Card Slots

Item	Specifications
Number of Slots	20
Maximum Card Power	
High-density (Split) Rear Module[a]	15W per card
Standard Rear Module[b]	30W per card[c]
Double-wide Rear Module[d]	60W per assembly[e,f]
Total Frame Power	450W

a. Accommodates two openGear cards and requires two slots in the frame chassis.
b. Accommodates one openGear card and requires two slots in the frame chassis.
c. Or 45W if the openGear card has integrated cooling.
d. Accommodates one or two openGear cards and requires four slots in the frame chassis.
e. Or 75W for a single card with integrated cooling.
f. Or 90W for a multi-slot assembly with integrated cooling and receiving power from two or more midplane connectors.

Frame Controller and Fans

Table 3.5 OGX-FR Technical Specifications — Frame Controller, Display, and Fans

Item	Specifications
Max. Power: +12V Rail	4A, 48W
Max. Power: -7.5V Rail	0.2A (1.5Watt)
Total	50W maximum

Reference Inputs

Table 3.6 OGX-FR Technical Specifications — Reference Inputs

Item	Specifications
Number of Inputs	2 looping
Level	1Vpp nominal
Signal	Analog video sync (black burst or tri-level), or AES/EBU DARS
Impedance	75ohm terminating (external termination required)
Return Loss	>30dB to 10MHz
Max DC on Ref Input	±1V

Fault Reporting

Table 3.7 OGX-FR Technical Specifications — Fault Reporting

Item	Specifications
Alarm Conditions	Loss of AC input power
	DC output voltage error

Table 3.7 OGX-FR Technical Specifications — Fault Reporting

Item	Specifications
PS Monitored Parameters	DC output voltage
	DC output current
	Critical temperature
	PS-OG3 fan failure
Frame Monitored Parameters	Backplane rail voltage
	Cooling fan failure
	Ambient temperature
Alarm Indicators	System fault LED
	LCD Display messages
	Frame controller audio alarm

PS-OGX Power Supply

✶ For safety reasons, Ross power supplies do not fit into rack frames of other manufacturers.

Table 3.8 OGX-FR Technical Specifications — PS-OGX Power Supply

Item	Specifications
Input	6.3A (max. 630W) 100-240VAC, 47-63Hz
Output 1	12V 41.6A, 500W maximum
Output 2	-7.5V 5A, 37.5W maximum
Total	Sum of both outputs not to exceed 500W

Environmental

Table 3.9 OGX-FR Technical Specifications — Environmental

Item	Specifications
Ambient Temperature Range	0ºC to 40ºC (32ºF to 104ºF)
Humidity, Non-condensing	<95%

OG3-FR Frame Specifications

This chapter describes the OG3-FR specifications. All components described in this chapter are branded openGear and changes are controlled by Ross Video.

Overview

The OG3-FR is an openGear 2RU Frame, that is capable of housing up to 20 plug-in card modules plus a frame controller card and a Reference distribution card (GFC-8322). This frame is composed of U-shaped aluminum bottom and sides with a steel top. The back of the frame allows for custom rear I/O interface modules that can be application specific. It has exactly the same card spacing as the DFR-8321 for total compatibility with existing cards and rear modules. It has however split the power supplies so that they are on the right and left of the card slots. In addition, an extra slot was added beside Slot 1 to hold the GFC-8322.

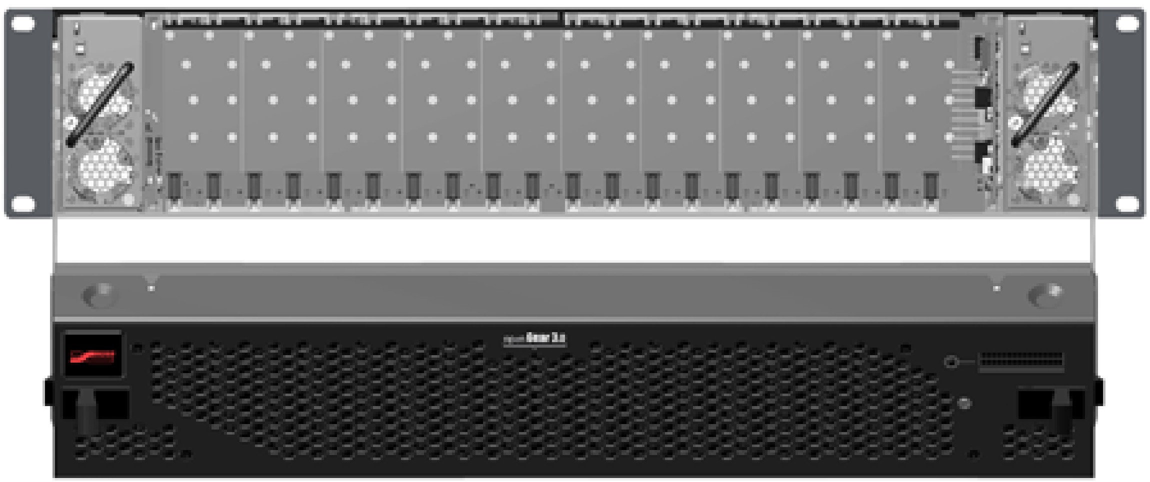


Figure 4.1 OG3-FR — Front View with Door Open

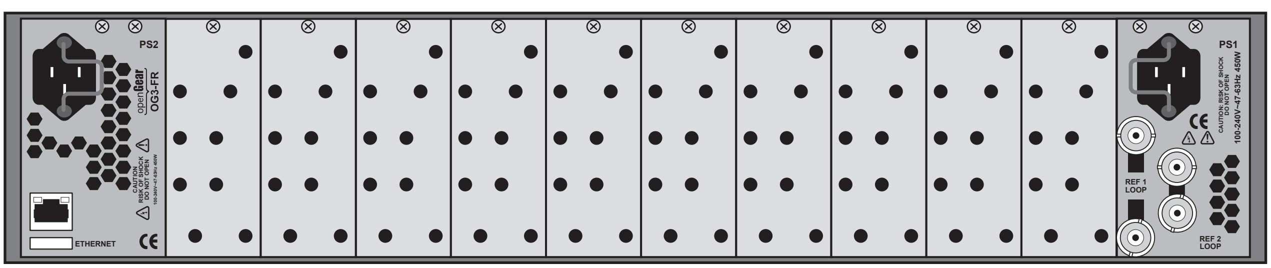


Figure 4.2 OG3-FR — Rear View

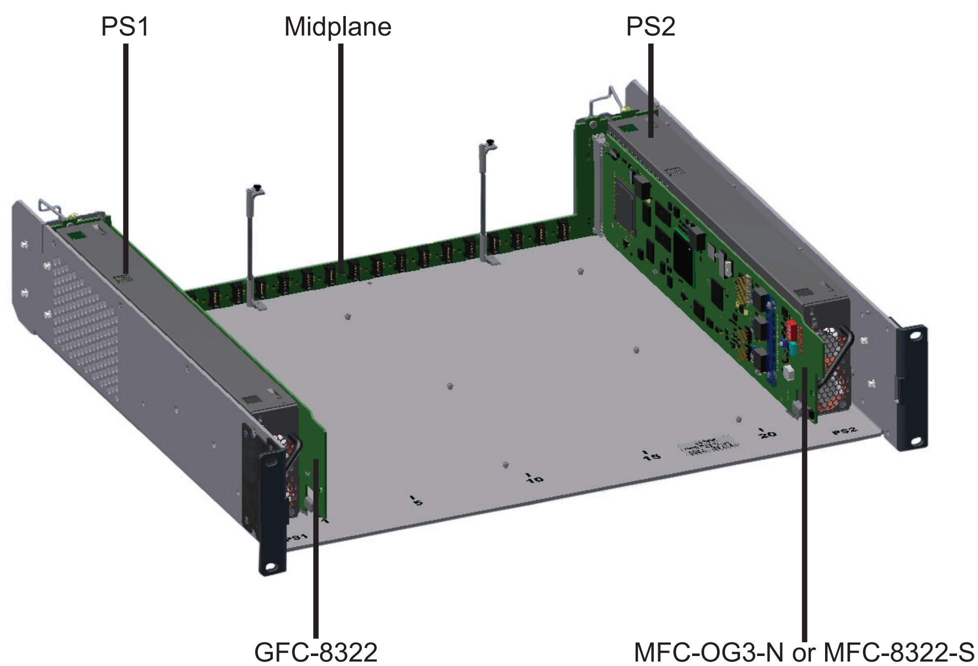


Figure 4.3 OG3-FR — Card Locations (View from Front of Frame)

Front Door

The OG3-FR front door has an outer shell that can be removed by taking out 4 screws on the front and opening the door latches. This exposes the filter so that it can be cleaned without taking the whole door out and stopping the fans. Refer to the ***OG3-FR Series User Manual*** for details on cleaning/replacing the air filter.

The front door has the following features:

- 1” x 1” emboss — To be used by openGear partners to brand their frames.
- FAULT LED — When lit green, this LED indicates correct operation. When lit red, this LED indicates that an alarm condition is present. Note that this LED does not have a silk-screen label.
- LCD Display — To show the frame name, IP address, and the fault cause.
- **Mute** button — To turn off audible alarm and to scroll through the LCD display.

The OG3-FR frame door can be separated from the frame without the use of tools. This makes replacing the door or servicing the fan boards much easier.

Frame Jewel

To brand the frame, a self-adhesive jewel can be used in the 1” x 1” emboss on the left hand side of the frame door.

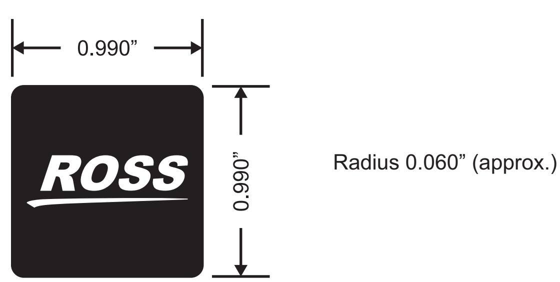


Figure 4.4 Frame Jewel Example

Table 4.1 outlines the specifications for the jewel.

Table 4.1 Jewel Dimensions

Dimension	Specification
Size	0.990" square, with a 0.060" corner radius
Finishing Top Side	Clear Urethane Dome
Substrate Base Material	White 4 mil vinyl
Finishing Bottom Side	3M 7904 - Acrylic 350 Adhesive

OG3-FR Fan Card

The OG3-FR Front Door Assembly was designed to support the higher power capability of the frame. This required using larger 70mm fans that are directly mounted on the metalwork of the door. The fans plug into the Fan card which is a narrow card behind the fans. The Fan card plugs into the Display card that holds the LCD display, pushbutton and Fault LED as well as the 40mm fan for PS2. Another 40mm fan is mounted to the metalwork in front of PS1.

The Fan card has PWM controllers for controlling the fan speed based on load and temperature as determined by the software on the MFC-8322-S or MFC-OG3-N cards.

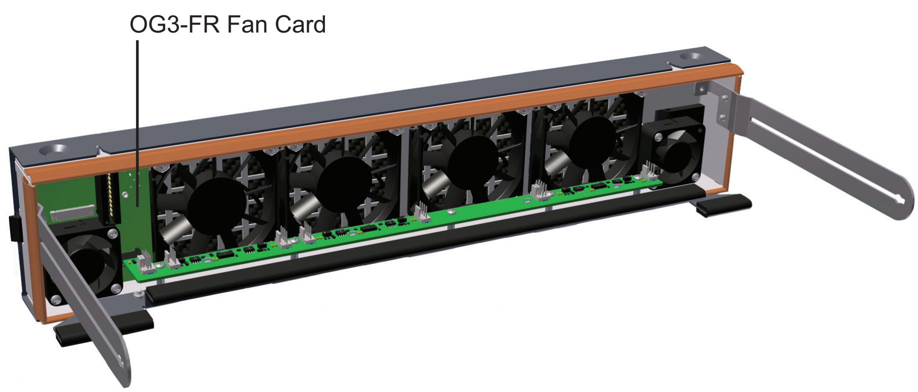


Figure 4.5 OG3-FR Frame — Fan Card Location inside Door

The cooling of the frame is performed by the fan board mounted on the front door with air flow running from the front of the frame to the back of the frame. The fan card has four main 70mm fans plus a smaller 40mm fan for the power supplies. Power and variable speed control for the fan board is supplied by any variant of the Frame Controller card.

A filter is installed between the fan board and the front door to keep the inside of the frame free of dust. This filter may require to be cleaned periodically in dusty environments. Refer to the ***OG3-FR Series User Manual*** for details on cleaning and replacing the filter.

The fan board supports variable speed control. Depending on the power in the frame and on the heat rise in the frame, the fan speed will adjust accordingly. Once the frame is running with more than 300W at 20°C, the fan speed reaches its maximum. This feature helps prolong the life of the fans, helps control the noise level and saves energy.

For More Information on...

- thermal management for the openGear frames, refer to the chapter "**Thermal Management**" on page 69.

OG3-FR Midplane

The midplane for the OG3-FR is similar to the older DFR-8321 midplane except that the power supplies are on the outer edges of the chassis. This caused all the card slots to shift to the right as viewed from the front of the chassis.

The card slot spacing remained the same as on the DFR-8321 so all the cards and Rear Modules from the DFR-8321 can be installed in the OG3-FR frame.

The midplane for the OG3-FR frame has 20 HSEC8 card connectors to support up to 20 processing cards. Whether the frame is used with 20 cards or less will depend on the rear modules and not the midplane. Also, there is one HSEC8 connector for the GFC-8322 Reference card between PS1 and Slot 1, a 170 pin connector for the MFC-8322-S or MFC-OG3-N Frame Controller card, and two power supply connectors to supply the +12 volts and -7.5 volts. Refer to the chapter "**Common openGear Parts**" on page 67 for details on the HSEC8 connector.

On the back of the midplane, connections are provided for two looping frame references, an RJ45 connector for 10/100/1000 Ethernet communications to the frame controller and two IEC power connectors. The circuitry to buffer the frame reference to each slot resides on the GFC-8322 Reference card.

The midplane has one large cut-out for all 20 slots for rear module connections. Slot 1 and Slot 2 share the first rear module space, Slot 3 and Slot 4 share the second space, and so on. The exact alignment and dimensions of the cut-out are displayed in **Figure 4.6**.

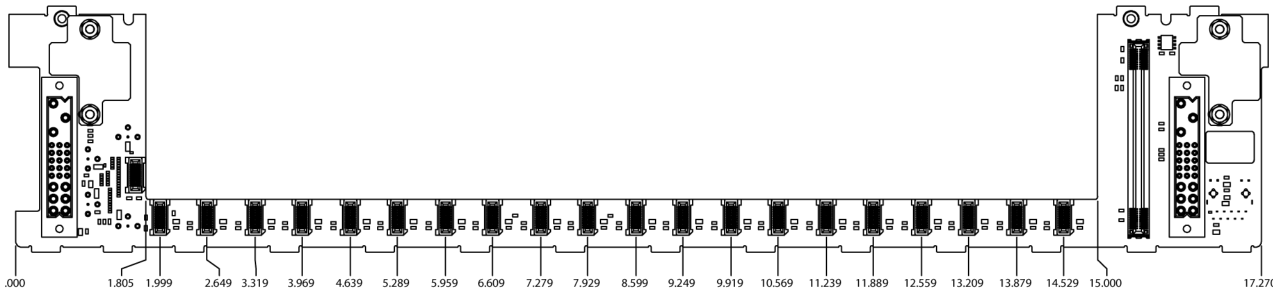


Figure 4.6 OG3-FR Midplane — Physical Layout

There are 2 structural supports in the chassis: between slot 6 and 7 and between slots 16 and 17 that restrict component heights on the Rear Modules.

Midplane to Rear Module Spacing

Because the rear module is attached to the frame behind the midplane, this configuration limits the component height on certain areas on the solder side of rear modules. These areas are the lower portion of the rear module, behind the midplane connector, and the left and right sides. Refer to the section "**OG3-FR Rear Module Design**" on page 56 for details.

Figure 4.7 shows the spacing between the midplane and rear module, which limits the max component height in these areas to 0.080".

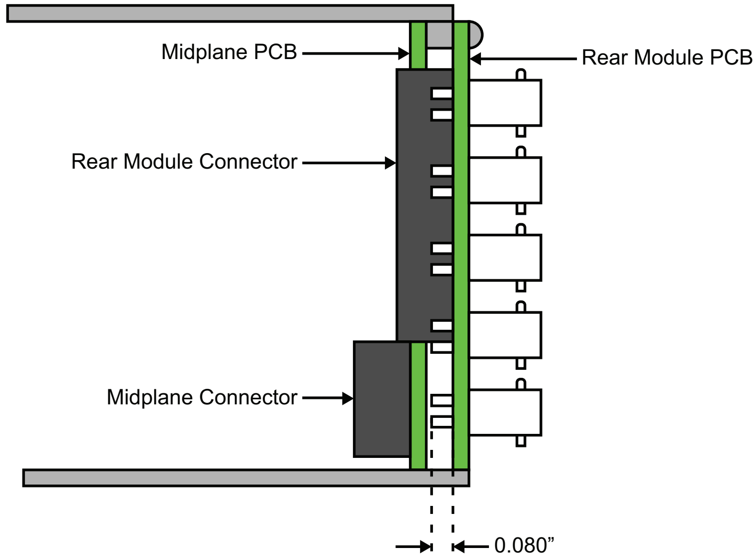
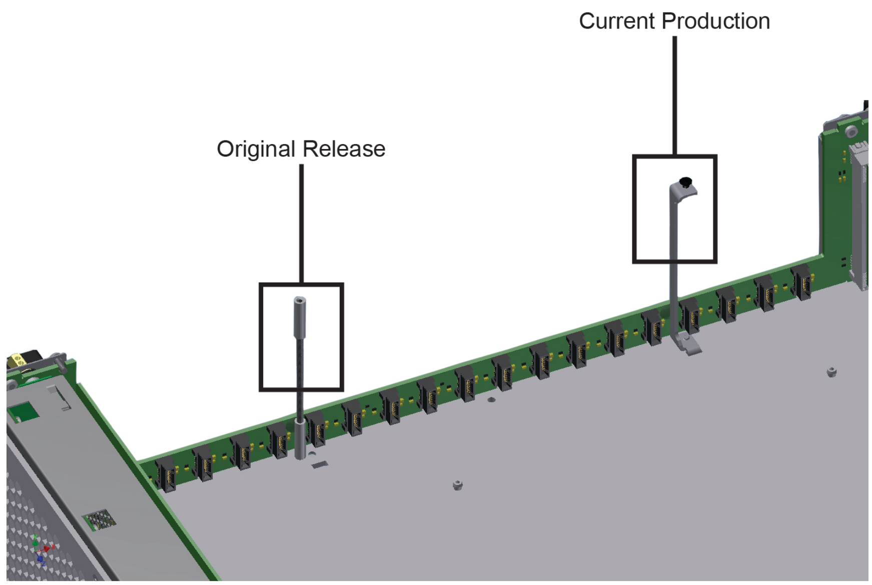


Figure 4.7 OG3-FR Midplane to Rear Module Spacing

openGear Card Clearance for Frame Supports

Note that there are two structural supports in the chassis: between slot 6 and 7, and between slots 16 and 17 that restrict component heights on the rear modules. The supports also restrict component height on the openGear cards that plug into the chassis to 0.20" from the edge of the midplane connector to the end of the card.



OG3-FR Frame Supports
Note that only one support style is installed in a frame.

Figure 4.8 OG3-FR Midplane — Structural Supports in the Chassis

Figure 4.10 and **Figure 4.9** summarize the spacing requirements between the openGear card, the midplane, and the rear module. Refer to the section “**Card Dimensions and Connector Locations**” on page 42 for more information on the clearance requirements for an openGear card.

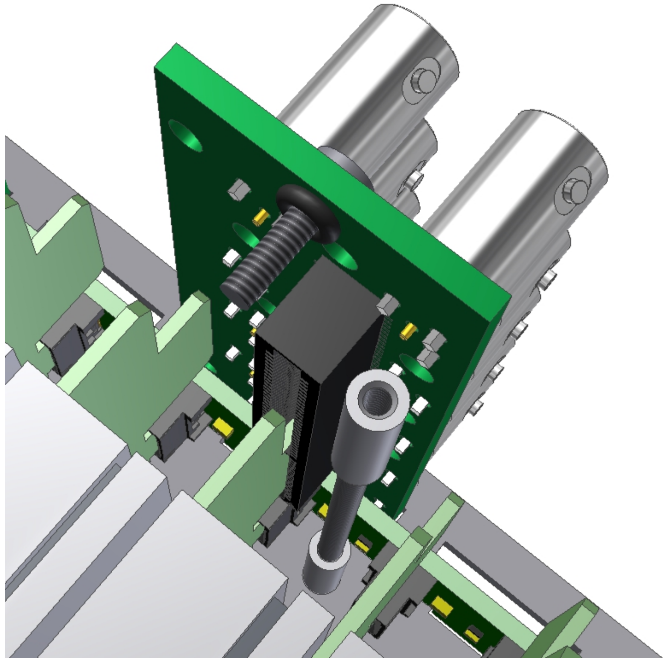


Figure 4.9 OG3-FR Midplane to Rear Module Spacing — 3D View, Top Down

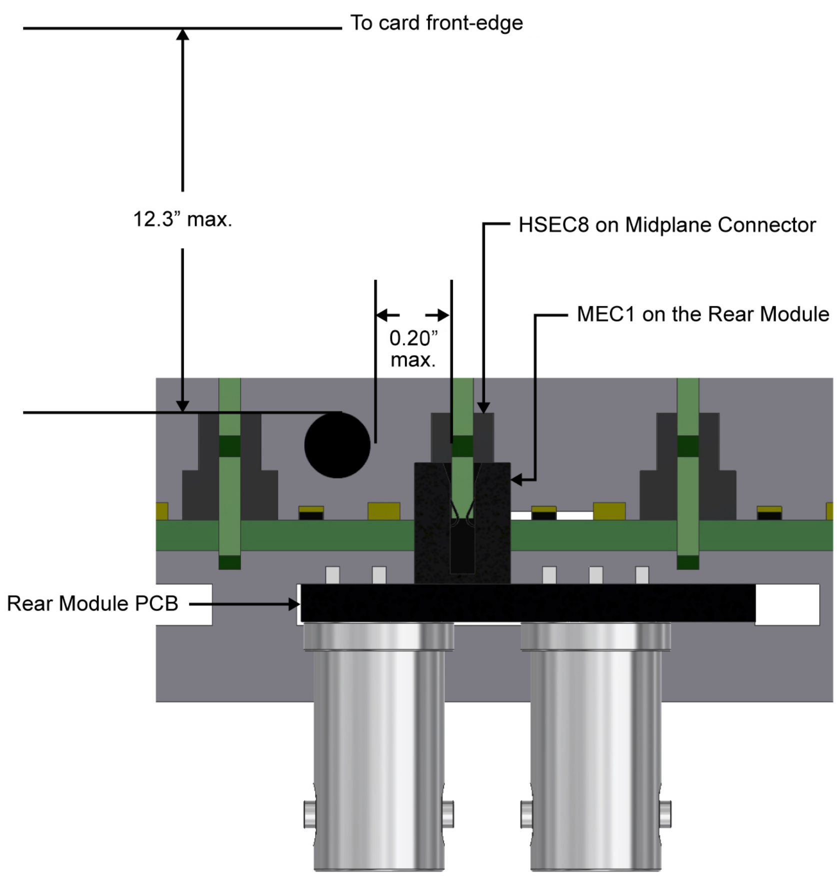


Figure 4.10 OG3-FR — Midplane to Rear Module Spacing (Top View)

Reference Distribution

Each frame has two frame wide, looping reference inputs. These can be used to distribute any reference signal to all the slots in the frame, up to a maximum bandwidth of 10MHz. This can include SD black burst, HD tri-level, or DARS.

In the OG3-FR frames, each reference input is buffered using an opamp and distributed to each of the 20 slots in a star configuration as shown below.

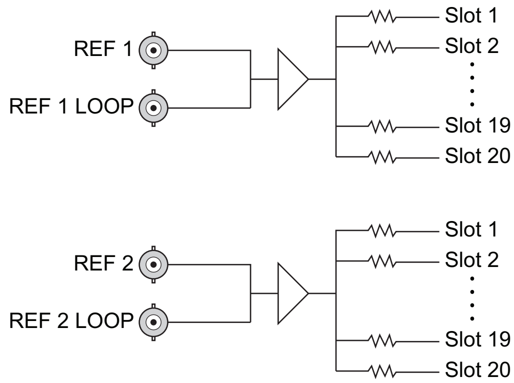


Figure 4.11 OG3-FR — Simplified Reference Distribution

Because these reference signals are shared among all the slots in the frame, it is important that the cards do not terminate the frame reference inputs, but maintain a high impedance input. In addition, the stub length, resistance and capacitance values must be kept to a minimum to ensure that cards do not degrade the signal quality of the reference within the frame.

Frame Connections

Each frame provides several connections that are required for frame operation. These are located on the back of the OG3-FR frame.

Figure 4.12 OG3-FR Frame Rear Chassis Connections — PS1

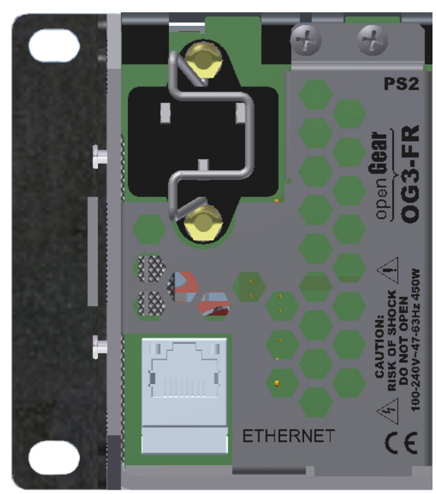


Figure 4.13 OG3-FR Frame Rear Chassis Connections — PS2

Frame Connection Descriptions

PS1 and PS2 - Two independent IEC C14 plugs, which are connected to the PS1 and PS2 power supplies respectively.

REF1 Loop - Two looped BNC connectors that feed the buffer circuitry for frame reference 1. These are high impedance inputs. When not looping a signal through these connections, a 75Ohm terminator should be added.

REF2 Loop - Two looped BNC connectors that feed the buffer circuitry for frame reference 2. These are high impedance inputs. When not looping a signal through these connections, a 75Ohm terminator should be added.

Ethernet - This RJ45 connector is connected to the Network Frame Controller, supporting 10/100/1000 Ethernet. This is the communications port for the frame to communicate to DashBoard and SNMP browsers.

The connections based on the openGear frame model are given in the following table.

Table 4.2 Frame Connections

MFC PIN #	MFC-8322-S 10/100, with auto-MDIX PIN Description	MFC-OG3-N 10/100/1000, with auto-MDIX PIN Description
1	TX+	TD1+
2	TX-	TD1-
3	RX+	TD2+
4	Terminated to GND	TD3+
5	Terminated to GND	TD3-
6	RX-	TD2-
7	Terminated to GND	TD4+
8	Terminated to GND	TD4-

Frame Support Brackets

In high stress environments, frame support brackets (FSB-OG3) are available to support the rear of the OG3-FR frame to the rear of the rack. This section briefly outlines the brackets based on the openGear frame model.

The support brackets consists of two rack mount arms, two rail guides, retaining bolts, Hex nuts, and threaded rubber bumpers to attach the frame to the rack unit. Note that the FSB-OG3 only installs on the OG3-FR frames.

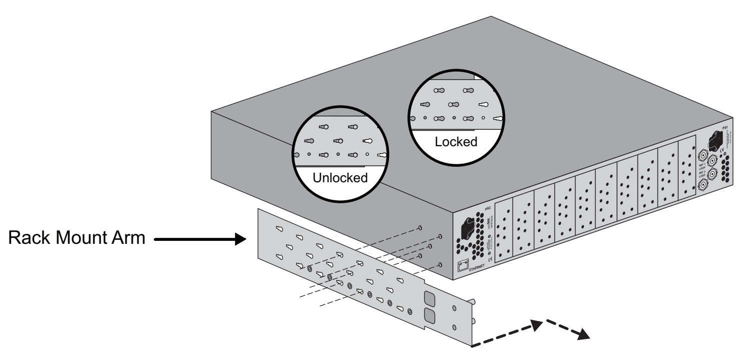


Figure 4.14 FSB-OG3 — Step 1

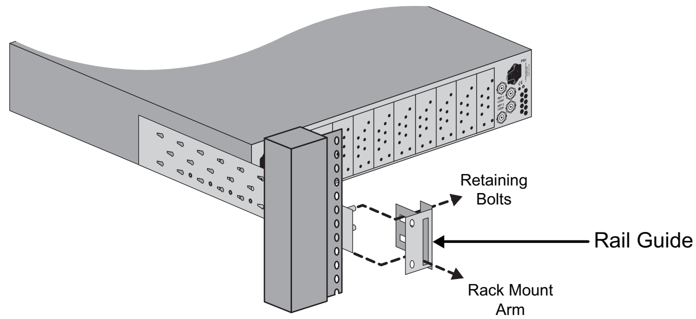


Figure 4.15 FSB-OG3 — Step 2

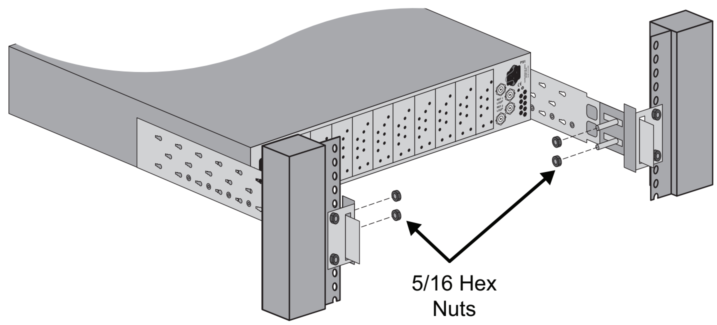


Figure 4.16 FSB-OG3 — Step 3

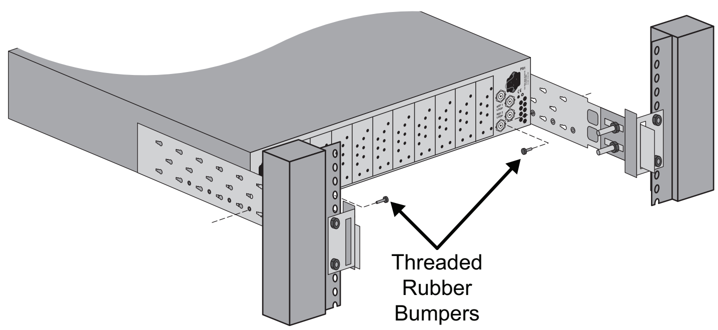


Figure 4.17 FSB-OG3 — Step 4

Power Supply and Dissipation

This section provides information on the power supplies available for each openGear frame model.

PS-OG3 Overview

The PS-OG3 power supply can be used in the OG3-FR. These are hot swappable 375W power supplies. The specifications of this power supply are outlined in following sections.

A single power supply can power the entire frame. Two power supplies can be used to provide redundancy on power supply or AC input failure.

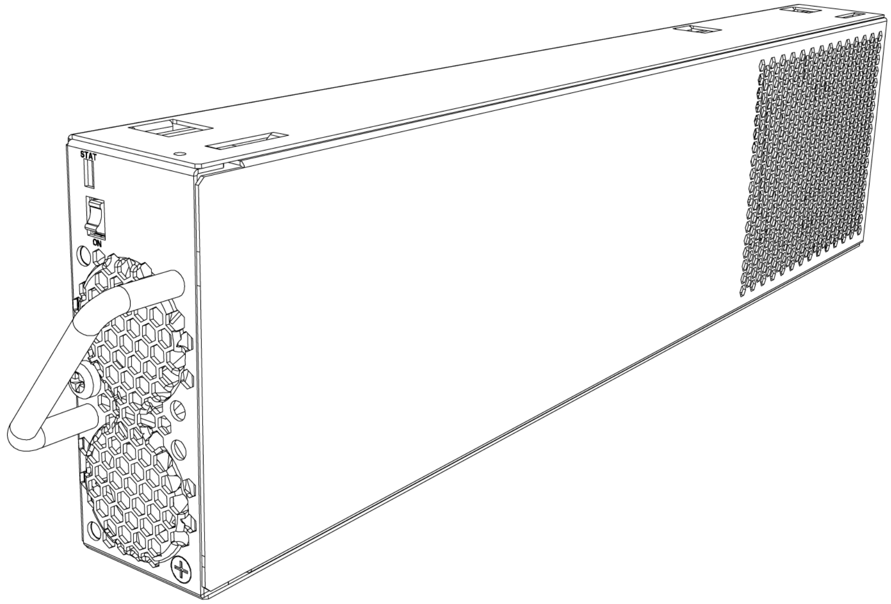


Figure 4.18 PS-OG3 375W Power Supply for OG3-FR

The rear of the power supply has a male connector that plugs into matching female connectors on the midplane. The connector provides the following signals:

- AC input
- +12V and -7.5V DC outputs
- Power supply monitoring and alarms

On the front of the power supply are the following:

- On/off switch
- Two Cooling fans
- Bi-color LED that indicates one of the following status:
  - › Green - The power supply is operating normally
  - › Red - When flashing there is either an over or under voltage condition, or there is no AC input when a redundant power supply is operating normally

Power Dissipation

openGear cards are limited in power dissipation due to the cooling design employed by the frame. The OG3-FR supports all existing cards and rear modules that meet the requirements of the DFR-8321 Power Dissipation.

The OG3-FR has been designed to allow up to a maximum of 15W per slot. This maximum value is valid for a frame with the fan kit. Without moving air, this rating is de-rated to 2watts per slot.

Any openGear module which dissipates more than 15W should be physically designed in such a way as to occupy more than one card slot, thereby restricting the addition of another module directly adjacent to it. This can be accomplished via the addition of a standoff (or equivalent).

- A module dissipating 15-30W will occupy 2 card slots.
- A module dissipating 30- 60W will occupy 4 card slots.
- Under no circumstances can a module dissipate in excess of 60watts.
- All high power cards must measure and report their current and power to the MFC Network Controller Card.
- All high power cards must use a hot swap controller to minimize the inrush current at power up.
- All high power cards should be designed to run with the door open for 5 minutes to allow for servicing. A fan on an FPGA to prevent overheating is an example solution.

- All high power cards must use a Rear Module with the top cut-outs to ensure adequate air flow across the card. Extra holes may be added but not to the detriment of adjacent cards.
- All high power cards need to be verified with full and almost empty chassis to prove that they can be cooled by the Fan door. The card may need a daughter assembly to provide ducting to keep the air flowing across the card.
- Tall components such as character displays may block air flow, reducing maximum power to much less than specified above.

Power distribution is very important for the success of the openGear frame. The capability of being able to populate a frame with cards from various manufacturers is a very strong point of openGear. To achieve this successfully, we must obey the power limits to avoid frames from being overloaded.

Everyone will agree that one day, a technician somewhere will see an empty slot and want to populate it with a card. How will he know if the card can be plugged in or not? Maybe the frame is already filled with 19 cards that use up more than 15watts each and that one slot was kept empty intentionally when the frame was originally installed.

As providers of openGear products, we have a responsibility to protect our customers from such events. Ross Video has decided to create a blocker card that is mounted on the card to physically prevent customers from plugging in another card. We encourage our openGear partners to do the same. Ross Video will gladly share details on the blocker card with anyone interested.

Environmental Specifications

This section provides information on the required environmental conditions, and frame airflow.

Internal Environmental

All openGear products are designed for studio use within the following environmental conditions:

- Frame Ambient Temperature - 5°C to 40°C
- Cooling - Forced air from front of the frame through the back of the rear I/Os.

With an external temperature of 40°C, there will be a temperature increase towards the exhaust end of modules. The allowable temperature rise is defined to be 25°C. Thus, modules within an openGear frame must operate within the following temperature range: 5°C to 65°C.

Frame Airflow

The frames with the cooling fan installed in the front door have a front to rear airflow as shown in the diagram below. Although the frame is specified to support up to 300W in the OG3-FR of processing cards, it is up to the individual cards to manage their thermal requirements across all valid slots in each frame.

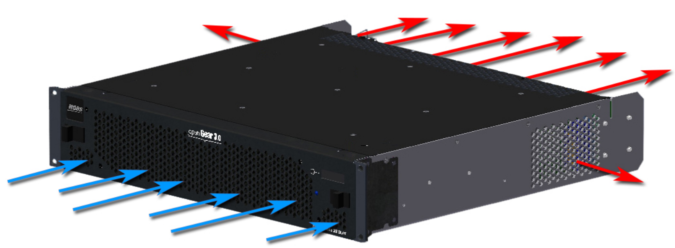


Figure 4.19 OG3-FR — Airflow

OG3-FR Technical Specifications

This section provides the technical specifications for the OG3-FR series frames.

Rack Frame Mechanical

Table 4.3 OG3-FR Technical Specifications — Rack Frame Mechanical

Item	Specifications
Height	3.5” (90mm)
Width	17.45” (444mm) not including rack ears 19” (483mm) including rack ears
Depth	16.82” (427mm)

Frame Card Slots

Table 4.4 OG3-FR Technical Specifications — Frame Card Slots

Item	Specifications
Number of Slots	20
Absolute Max. Power: +12V Rail	Per card occupying 4 slots: 5A, 60W Per card occupying 2 slots: 2.5A, 30W Per card occupying 1 slot: 1.25A, 15W
Absolute Max. Power: -7.5V Rail	Per card occupying 4 slots: 0.8A, 6W Per card occupying 2 slots: 0.4A, 3W Per card occupying 1 slot: 0.2A, 1.5W
Total Frame Power	300Watt

Frame Controller and Fans

Table 4.5 OG3-FR Technical Specifications — Frame Controller and Fans

Item	Specifications
Max. Power: +12V Rail	3A, 36W
Max. Power: -7.5V Rail	0.2A (1.5Watt)
Total	37.5Watt maximum

Reference Inputs

Table 4.6 OG3-FR Technical Specifications — Reference Inputs

Item	Specifications
Number of Inputs	2 looping
Level	1Vpp nominal
Signal	Analog video sync (black burst or tri-level), or AES/EBU DARS
Impedance	75ohm terminating (external termination required)
Return Loss	>30dB to 10MHz
Max DC on Ref Input	±1V

Fault Reporting

Table 4.7 OG3-FR Technical Specifications — Fault Reporting

Item	Specifications
Alarm Conditions	Loss of AC input power
	DC output voltage error
PS Monitored Parameters	DC output voltage
	DC output current
	Critical temperature
	PS-OG3 fan failure
Frame Monitored Parameters	Backplane rail voltage
	Cooling fan failure
	Ambient temperature
Alarm Indicators	System fault LED
	LCD Display messages
	Frame controller audio alarm

PS-OG3 Power Supply

✶ For safety reasons, Ross power supplies do not fit into rack frames of other manufacturers.

Table 4.8 OG3-FR Technical Specifications — PS-OG3 Power Supply

Item	Specifications
Input	100 - 240VAC, 47-63Hz 5A (500W maximum)
Output 1	+12V, ± 10%, 0.5A - 28A
Output 2	-7.5V, ± 10%, 0A - 5A
Total	Sum of both outputs not to exceed 350Watt maximum

Environmental

Table 4.9 OG3-FR Technical Specifications — Environmental

Item	Specifications
Ambient Temperature Range	0ºC to 40ºC (32ºF to 104ºF)
Humidity, Non-condensing	<95%

Card Specifications

This chapter describes the openGear card requirements for the OGX-FR and OG3-FR frames. All components described in this chapter are branded openGear and changes are controlled by Ross Video.

For More Information on...

- card components, refer to the chapter "**Common openGear Parts**" on page 67.

Overview

The openGear cards are approximately 12.8" long, 3" high, and 0.063" thick. They are compatible with both the 10 slot and 20 slot frames. An example of an openGear card is shown in **Figure 5.1**.

Each openGear card must include the following:

- A gold-fingered card-edge connector, located at the rear of the card, to provide a connection to a system midplane. This midplane connection provides power, communications, and frame wide references.
- Connector(s), on the rear of the card, that is compatible with the rear module that the card is designed to operate with.
- A card ejector is used to eject the card from the frame.

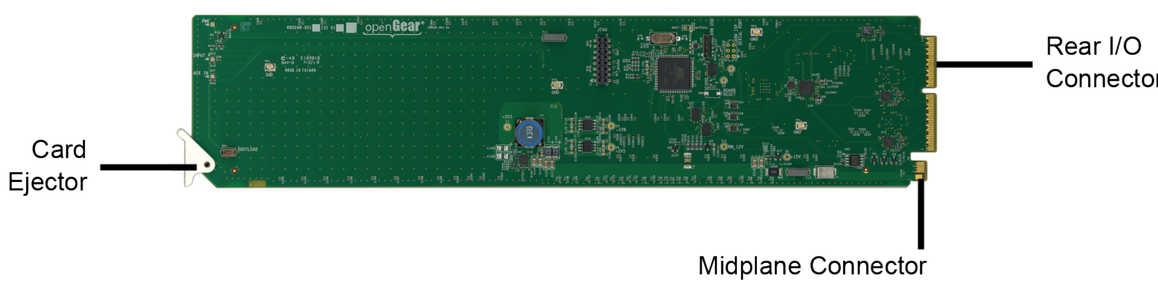


Figure 5.1 Typical openGear Card — Connector Locations

Card Labeling

We are suggesting a standard labeling scheme for openGear cards. This will make the cards more standard and also easier to OEM by openGear partners. Card labeling should include the following:

- an openGear logo is silk-screened near the top of the solder side of the card.
- a label of standard size: 0.25" x 2.00" is placed near the card edge to identify the vendor of the card.
- an ejector with the part number of the card imprinted identifies the card when scanning the frame from the front.

Figure 5.2 Card Labeling Details

Card Dimensions and Connector Locations

Although openGear manufacturers are free to utilize any interconnect they choose between card and rear module, two connectors have been used commonly for the rear I/O interconnection on openGear cards. These are the MEC1 series and HSEC8 series from Samtec. This section specifies the well-defined location for these interconnects, and their application is recommended for use wherever possible.

✶ Pin sequencing is important to ensure a solid ground connection before signals and power are applied to the card.

The standard rear module connector is a Samtec MEC1-150-02-FM-D-A and the midplane connector is the Samtec HSEC8-110-01-S-DV-A. The layout for both edge fingers should follow the recommendations as outlined on the Samtec website.

If the slow speed PSB signals are not used, recess or remove gold fingers on PSB_BUS_IN_x pins 4, 7).

✶ It is recommended to review the plating specifications available on the Samtec website. Some physical differences exist intentionally between Samtec specifications and this guide in order to improve card alignment, optimize the connector wipe, and maintain consistent edge angling. Where the connector specifications disagree, this guide shall supersede.

Card to Rear Module Connections

This section provides a nominal relative vertical position of an OGX-FR and OG3-FR rear module when engaged in the frame.

✶ The rear module is shown rotated sideways for illustration purposes.

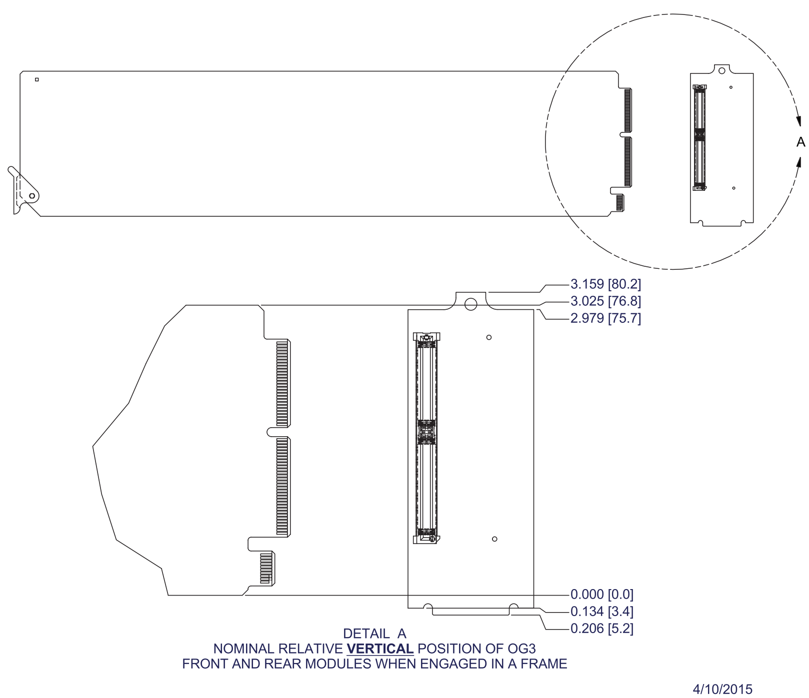
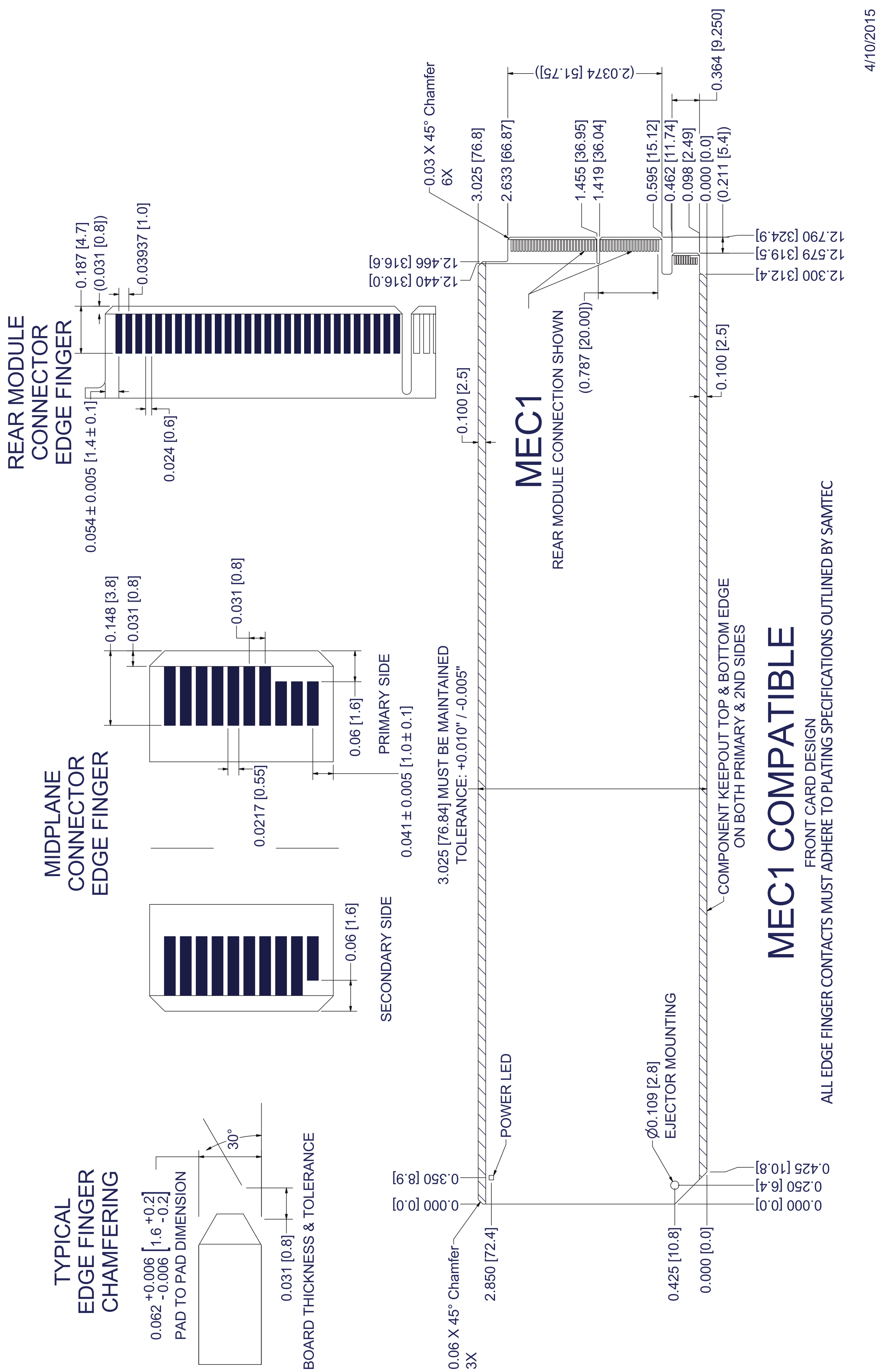
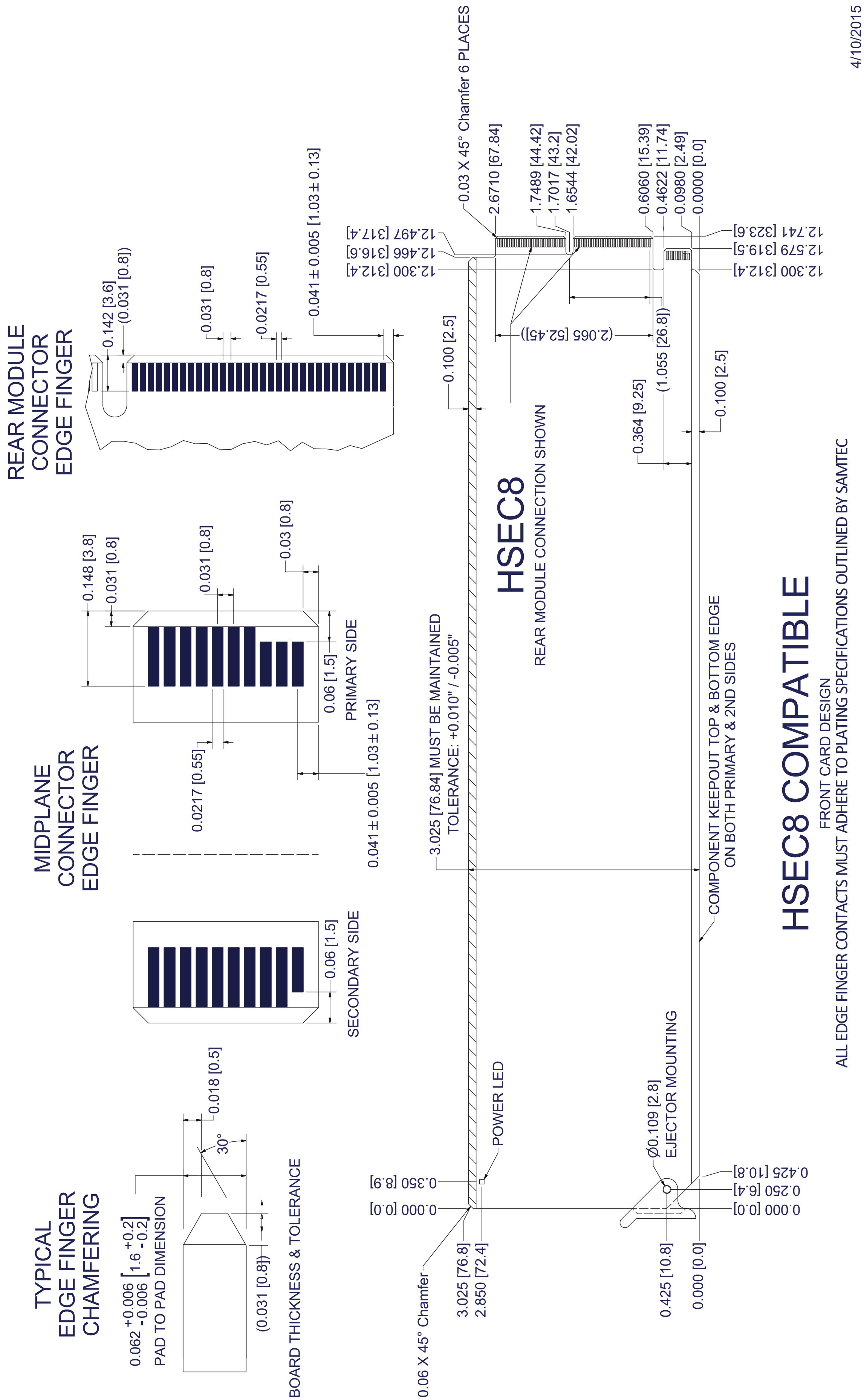


Figure 5.3 Physical Connection of an openGear Card to a Rear Module


TYPICAL
EDGE FINGER
CHAMFERING
0.062 +0.006 -0.006 [1.6 +0.2 -0.2]
PAD TO PAD DIMENSION
30°
0.031 [0.8]
BOARD THICKNESS & TOLERANCE
MIDPLANE
CONNECTOR
EDGE FINGER
0.148 [3.8]
0.031 [0.8]
0.031 [0.8]
0.0217 [0.55]
0.041 ± 0.005 [1.0 ± 0.1]
0.06 [1.6]
PRIMARY SIDE
0.06 [1.6]
SECONDARY SIDE
REAR MODULE
CONNECTOR
EDGE FINGER
0.187 [4.7]
(0.031 [0.8])
0.03937 [1.0]
0.054 ± 0.005 [1.4 ± 0.1]
0.024 [0.6]
0.03 X 45° Chamfer
6X
3.025 [76.8]
2.633 [66.87]
1.455 [36.95]
1.419 [36.04]
0.595 [15.12]
0.462 [11.74]
0.098 [2.49]
0.000 [0.0]
(0.211 [5.4])
(2.0374 [51.75])
0.364 [9.250]
12.790 [324.9]
12.579 [319.5]
12.300 [312.4]
12.466 [316.6]
12.440 [316.0]
0.100 [2.5]
0.100 [2.5]
(0.787 [20.00])
MEC1
REAR MODULE CONNECTION SHOWN
3.025 [76.84] MUST BE MAINTAINED
TOLERANCE: +0.010" / -0.005"
COMPONENT KEEPOUT TOP & BOTTOM EDGE
ON BOTH PRIMARY & 2ND SIDES
MEC1 COMPATIBLE
FRONT CARD DESIGN
ALL EDGE FINGER CONTACTS MUST ADHERE TO PLATING SPECIFICATIONS OUTLINED BY SAMTEC
POWER LED
Ø0.109 [2.8]
EJECTOR MOUNTING
0.350 [8.9]
0.000 [0.0]
0.425 [10.8]
0.250 [6.4]
0.000 [0.0]
0.06 X 45° Chamfer
3X
2.850 [72.4]
0.425 [10.8]
0.000 [0.0]
4/10/2015


TYPICAL EDGE FINGER CHAMFERING
0.062 +0.006 -0.006 [1.6 +0.2 -0.2]
PAD TO PAD DIMENSION
0.018 [0.5]
30°
(0.031 [0.8])
BOARD THICKNESS & TOLERANCE
MIDPLANE CONNECTOR EDGE FINGER
0.06 [1.5]
SECONDARY SIDE
0.148 [3.8]
0.031 [0.8]
0.031 [0.8]
0.03 [0.8]
0.0217 [0.55]
0.06 [1.5]
PRIMARY SIDE
0.041 ± 0.005 [1.03 ± 0.13]
REAR MODULE CONNECTOR EDGE FINGER
0.142 [3.6]
(0.031 [0.8])
0.031 [0.8]
0.0217 [0.55]
0.041 ± 0.005 [1.03 ± 0.13]
0.06 X 45° Chamfer
3.025 [76.8]
2.850 [72.4]
0.000 [0.0]
0.350 [8.9]
POWER LED
3.025 [76.84] MUST BE MAINTAINED
TOLERANCE: +0.010" / -0.005"
0.100 [2.5]
12.300 [312.4]
12.466 [316.6]
12.497 [317.4]
0.03 X 45° Chamfer 6 PLACES
2.6710 [67.84]
1.7489 [44.42]
1.7017 [43.2]
1.6544 [42.02]
0.6060 [15.39]
0.4622 [11.74]
0.0980 [2.49]
0.0000 [0.0]
(2.065 [52.45])
(1.055 [26.8])
0.364 [9.25]
0.100 [2.5]
12.741 [323.6]
12.579 [319.5]
12.300 [312.4]
HSEC8
REAR MODULE CONNECTION SHOWN
0.425 [10.8]
0.000 [0.0]
Ø0.109 [2.8]
EJECTOR MOUNTING
0.000 [0.0]
0.250 [6.4]
0.425 [10.8]
COMPONENT KEEPOUT TOP & BOTTOM EDGE
ON BOTH PRIMARY & 2ND SIDES
HSEC8 COMPATIBLE
FRONT CARD DESIGN
ALL EDGE FINGER CONTACTS MUST ADHERE TO PLATING SPECIFICATIONS OUTLINED BY SAMTEC
4/10/2015

Component Height Restrictions Overview

The maximum component height on openGear cards is detailed in this section. Due to the differences between the 10 and the 20 slot frames, the max component height on each card will determine the number of cards that will fit into a frame.

Figure 5.4 provides an overview of the standard envelope in which an openGear card must meet.

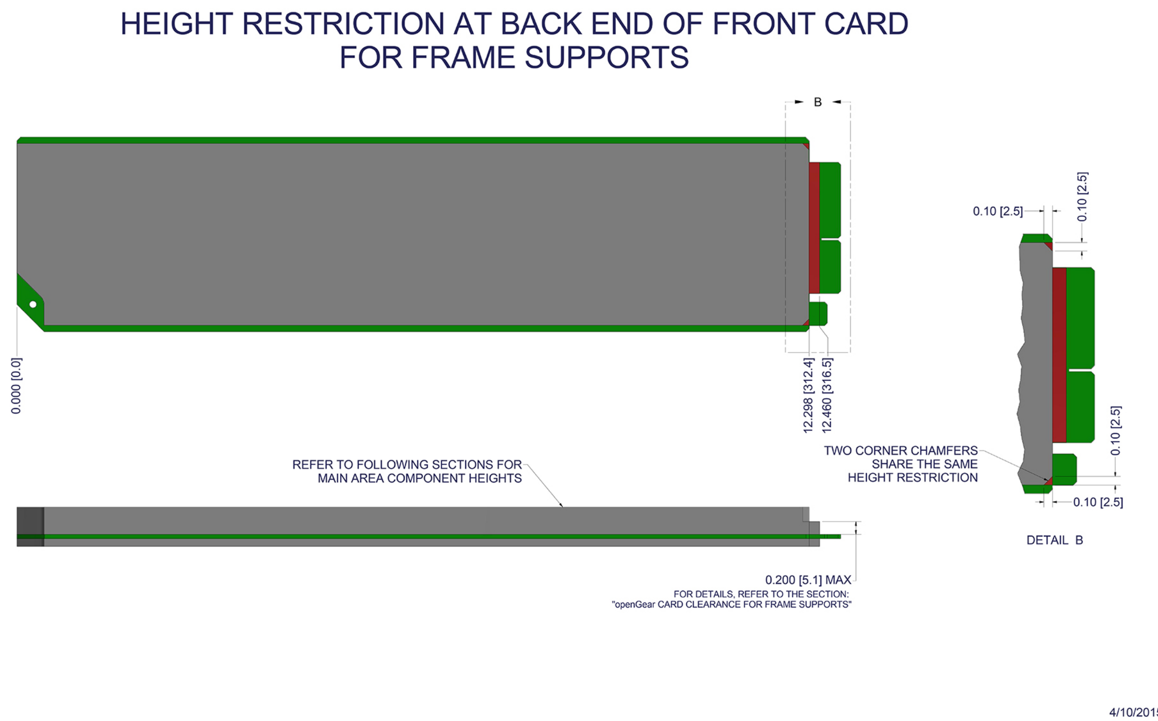


Figure 5.4 Component Height Overview

Designing Cards for the OGX-FR and OG3-FR Series Frames

This section provides information on designing cards for high density, standard density, and details the absolute maximum component height for cards for the OGX-FR and OG3-FR series frames. These drawings are also applicable for the DFR-8321 series frames, only that both power supplies are located on the right side of the chassis.

High Density

To support the highest density possible of 20 cards in an OGX-FR and OG3-FR frame, cards must be designed to take advantage of split rear modules in the frames (where two cards connect to each rear module). These have the tightest height restrictions as outlined in the diagram below. These cards also have a maximum power consumption limit of 15W. Refer to the chapter"**Rear Module Specifications**" on page 55 for more information on rear modules.

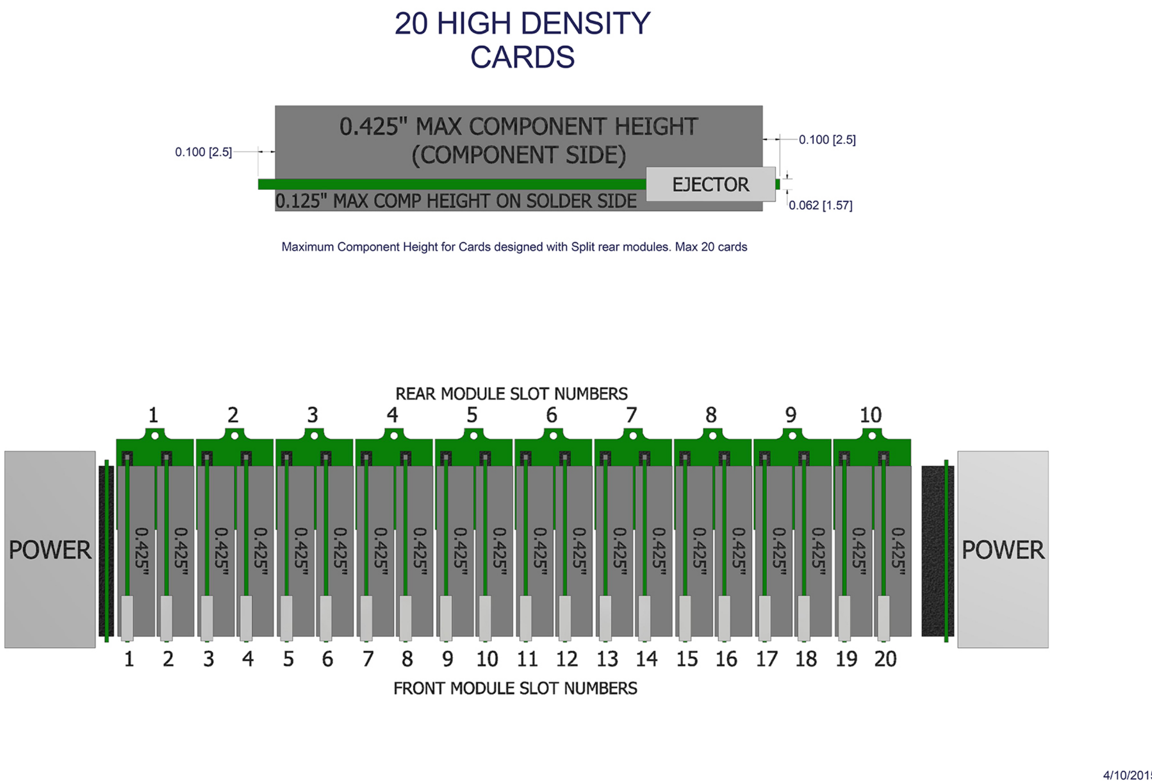


Figure 5.5 Maximum Component Height for Cards Designed with Split Rear Modules (Max. 20 Cards)

Standard Density

Cards that exceed the above power or height restriction can use full rear modules, taking up two slots in the frame. Ten cards can be installed into an OGX-FR and OG3-FR frame if it meets the component height restrictions as outlined in the diagram below. These cards also have a maximum power consumption limit of 30W.

✶ This assumes that the cards plug into the even slots.

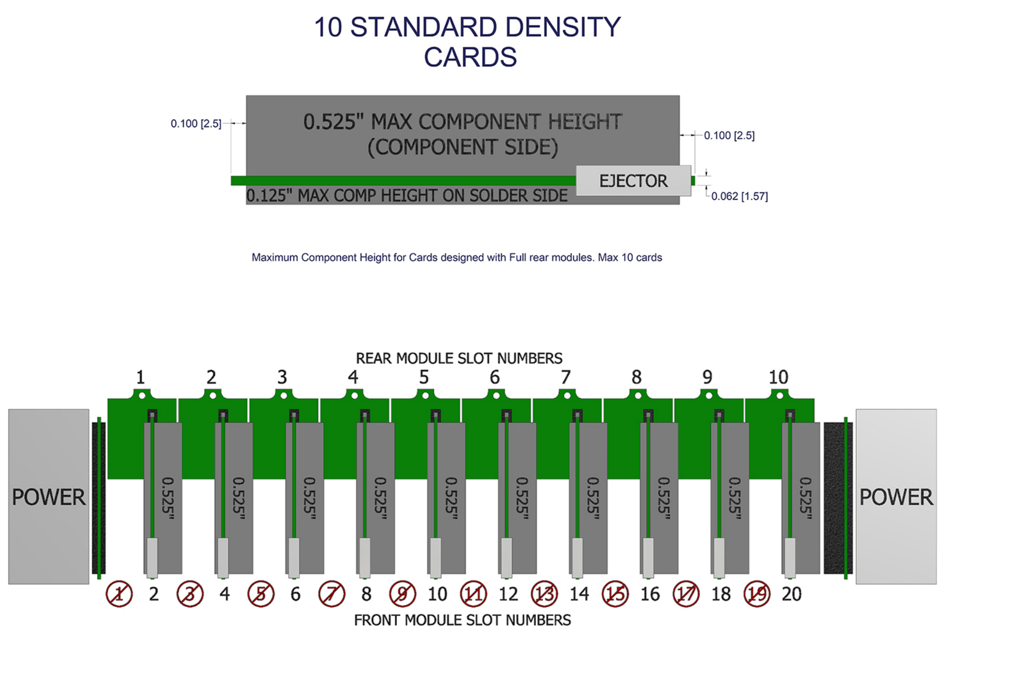


Figure 5.6 Maximum Component Height for Cards Designed with Full Rear Modules (Max. 10 Cards)

Absolute Maximum Component Height

The absolute maximum component height supported by the OGX-FR and OG3-FR is shown in **Figure 5.7**. Utilizing full rear modules in the even slots, the OGX-FR and OG3-FR frame can only support 9 cards with these dimensions, due to the height constraint on slot 20 and the frame controller card.

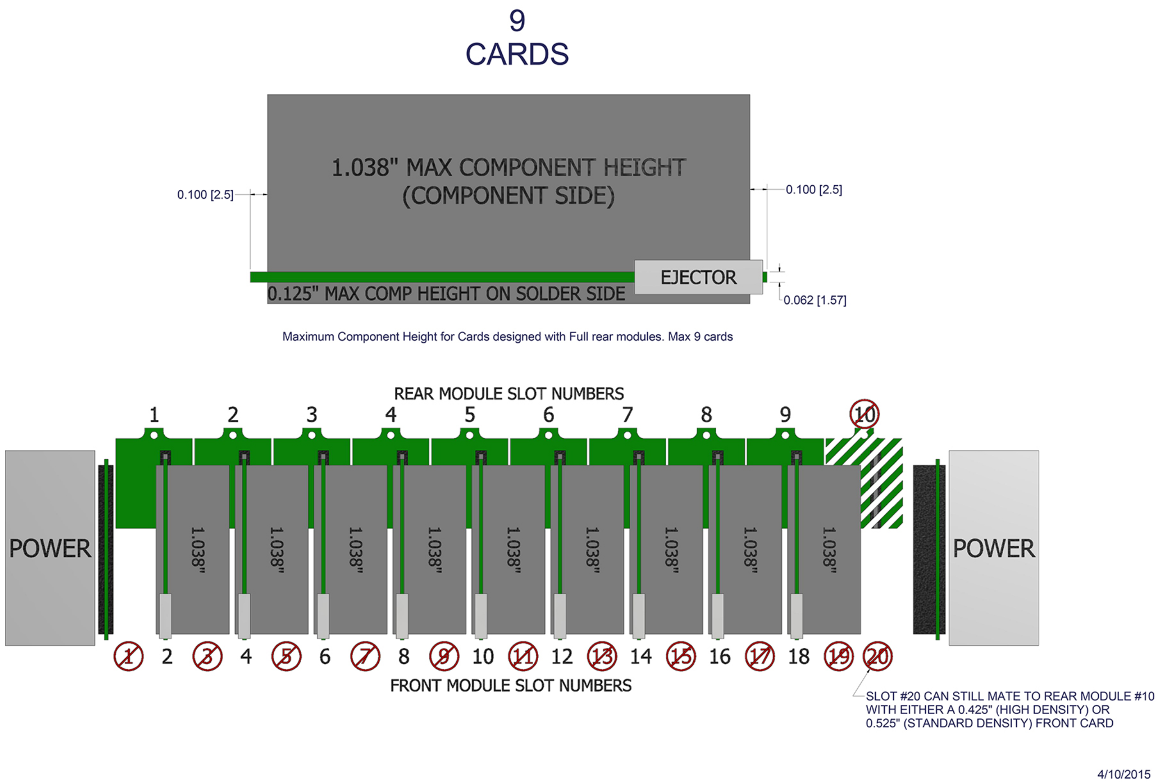


Figure 5.7 Maximum Component Height for Cards Designed with Full Rear Modules (9 Cards)

However, utilizing full rear modules in the odd slots, the OGX-FR and OG3-FR frame can support 10 cards with these dimensions.(**Figure 5.8**)

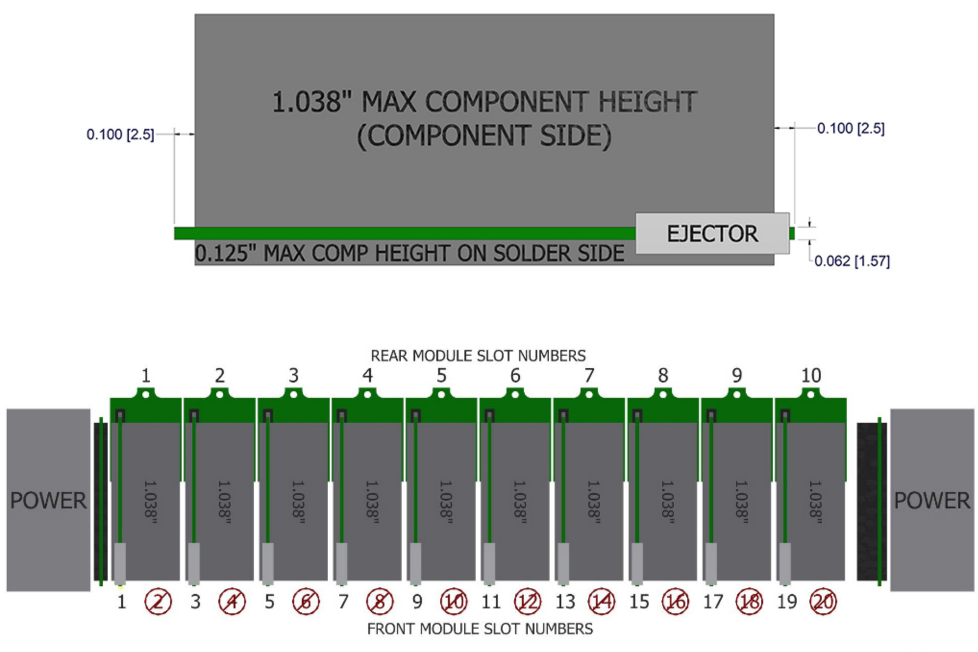


Figure 5.8 Maximum Component Height for Cards Designed with Full Rear Modules (10 Cards)

Slot Spacing

As **Figure 5.9** indicates and the table below confirms, if the component height is respected, frames will work with a combination of Full rear modules and Split rear modules. Since it is not always possible to design cards that meet this height specification or they plug into odd numbered slots we have provided a table that shows the spacing between every slot. If a card has to be above the 0.425 height, it will interfere with the adjacent slot. If a card is designed as such, special consideration should be planned to protect the components from being hit by other cards populating the adjacent slot.

✶ In the DFR-8321/8320, slot 1 clearance on the bottom side is to the sidewall of the chassis, not the GFC-8322.

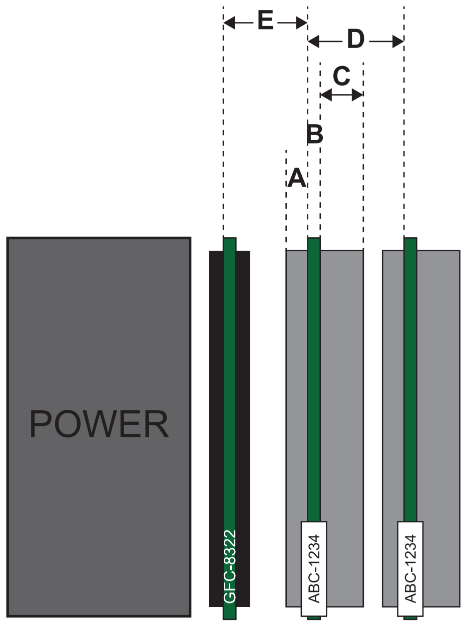


Figure 5.9 Slot Spacing in the OGX-FR and OG3-FR Frame

In **Figure 5.9** and the following table:

- **A** — Card Bottom (left side) spacing allowance
- **B** — Card Thickness
- **C** — Card Top (right side) spacing allowance
- **D** — Distance from bottom of card to bottom of the next card
- **E** — Distance from bottom of card to bottom of GFC-8322 Card

Table 5.1 OG3-FR — Slot Spacing

Slot	A	B	C	D	E	Tolerance (D-C-B-A)
GFC					0	
1	125	63	425	650	325	37
2	125	63	425	670	975	57
3	125	63	425	650	1645	37
4	125	63	425	670	2295	57
5	125	63	425	650	2965	37
6	125	63	425	670	3615	57
7	125	63	425	650	4285	37

Table 5.1 OG3-FR — Slot Spacing

Slot	A	B	C	D	E	Tolerance (D-C-B-A)
8	125	63	425	670	4935	57
9	125	63	425	650	5605	37
10	125	63	425	670	6255	57
11	125	63	425	650	6925	37
12	125	63	425	670	7575	57
13	125	63	425	650	8245	37
14	125	63	425	670	8895	57
15	125	63	425	650	9565	37
16	125	63	425	670	10215	57
17	125	63	425	650	10885	37
18	125	63	425	670	11535	57
19	125	63	425	650	12205	37
20	125	63	525	820	12855	32
MFC	375	63	100		13911	

Card-edge Control and Indicators

It is suggested that the front of all openGear card have a consistent user interface. As a minimum, each card should have a common POWER LED and the card's model number stamped on the ejector. The location of the POWER LED is shown in **Figure 5.10**.

Figure 5.10 Common Front Indicators

The POWER LED should include the following functions:

Table 5.2

LED Color	Function
Off	No power
Orange	Card is starting up
Green	Card is running with valid input and reference
Flashing Green	Boot loader is waiting for software upload
Green with Flashing Orange	There is a signal error (e.g. missing or invalid input or reference)
Red	Card is not operational

✶ Each card may have additional indicators, as required.

Midplane Connector

The midplane connector provides power, reference, and communications signals to every card in an openGear frame. Every module must have a connection to the midplane connector.

A Samtec HSEC8-110-01-S-DV-A connector is used on the midplane. Cards must be designed with gold plated edge fingers to mate with this connector. The pin spacing is 0.8mm, and a total of 20 pins (2 rows of 10) are provided.

The following pin assignment is defined, with pin number 1 located at the bottom component side of the PCB. Because many of these signals are shared across all cards in a frame, any unused pins on the midplane connector must be left unconnected.

Table 5.3 OGX-FR and OG3-FR Midplane — Pin Assignment

	Module Component Side	Module Solder Side	
19	RX P from MFC	TX P to MFC	20
17	RX N from MFC	TX N to MFC	18
15	GND	GND	16
13	CAN+	REF1	14
11	CAN-	GND	12
9	GND	REF2	10
7	PSB_BUS_IN2	GND	8
5	POS	AN_SlotID	6
3	POS	PSB_BUS_IN1	4
1	POS	NEG	2

Midplane Signal Descriptions

POS	Positive rail voltage from the power supply. Nominal +12V, 10%. 10.8V POS 13.2V. Maximum capacitive load = • 200 uF (this includes load on NEG rail) for single slot cards. (20 per frame) • 400 uF (this includes load on NEG rail) for double slot cards. (10 per frame) If the above capacitive load cannot be met, or the card current exceeds 1.5A, a hot swap controller must be used, with an inrush current limit of 2.5A (the OGX-FR and OG3-FR inrush current can be up to 5A). Maximum continuous current per slot: 2 Amps (5A in the OG3-FR)
NEG	Negative rail voltage from the power supply. Nominal -7.5V, 15%. -8.6V NEG -6.4V. Maximum capacitive load = • 200 uF (this includes load on POS rail) for single slot cards. (20 per frame) • 400 uF (this includes load on POS rail) for double slot cards. (10 per frame) Maximum current per slot: 1 Amp
GND	System electrical ground.
CAN±	CAN communications bus. Nominal 120 differential impedance. Design note: This bus is terminated on the midplane. Therefore, it must not be terminated on the cards.

RX_P_from_MFC **RX_N_from_MFC**	1000BASE-X SERDES receive interface - data direction is from the MFC-OG3-N to the slot
TX_P_to_MFC **TX_N_to_MFC**	1000BASE-X SERDES transmit interface - data direction is from the slot to the MFC-OG3-N Note: ALL these signals must be AC coupled with a .1uF capacitor at the transceiver on the card. Note: 1000BASE-X is polarity sensitive - do not swap _P and _N signals Note: controlled impedance traces at 100ohms differential
PSB_BUS_IN1 **PSB_BUS_IN2**	Low speed private serial bus. Leave unconnected if unused. See "**Private Serial Bus (PSB)**" on page 53. If not used, remove the gold fingers on the card's edge connector.
REF1, REF2	Analog reference signal. This signal is a point to point buffered copy of the reference input from the COMM I/O module (DFR-8321) or the Genlock Reference card (OG3-FR). Nominal impedance is 75ohm. Receiving cards should minimize stub length. Signals supported are: NTSC/PAL color black, HD tri-level sync, DARS reference. Design notes: • These REF signals are terminated on the midplane. Therefore, they must not be terminated on the cards. See "**Reference Distribution**" on page 33. • References must be buffered near card edge to minimize loading on this shared signal. • Keep stubs as short as possible. • Respect input impedance on cards: • Resistance — 22k1 or higher (100k or higher preferred) • Capacitance — 8pF or less (if your card has a higher input capacitance, please put a resistor in series near the card edge)
AN_SlotID	Analog slot identification. See "**AN_SlotID**" on page 51.

AN_SlotID

This single connection will be used to indicate the logical slot ID in the frame, and is analog encoded by using a single resistor to ground on the midplane. This scheme allows all modules to sense their slot ID using a simple A/D converter and a single pull-up resistor on the module.

✶ If the A/D Converter is not referenced to +3v3, the pull-up must be connected to the A/D reference voltage.

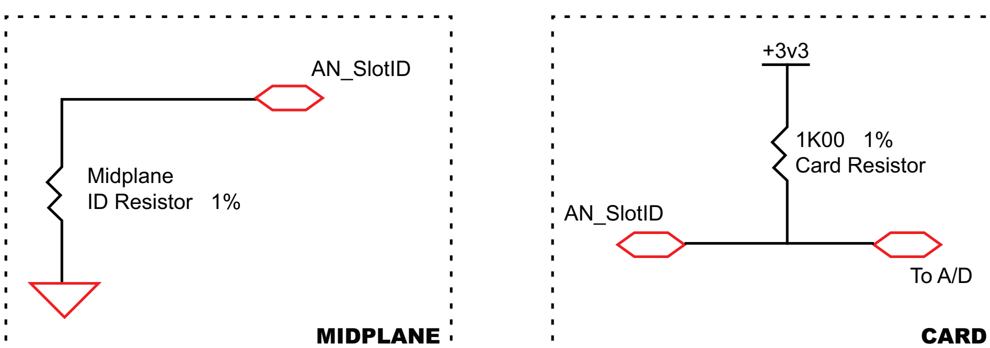


Figure 5.11 Slot ID Circuit

To cover for future frames, the AN_SlotID scheme supports up to 32 uniquely identifiable slots.

This feature has been designed to work with any A/D converter with a minimum of 6bit resolution. Additional A/D accuracy will enhance accuracy. One percent (1%) or better resistors must be used.

It is highly recommended that the A/D reading processor implement an averaging algorithm to further reduce the effects of noise on the analog voltage reading.

Table 5.4 outlines the standard EIA value resistors to be used and the min/typical/max readings with a 10-bit ADC (common on many micro-controllers):

Table 5.4 Analog ID Codes

ID Code	Pull Down Resistor Value	ADC 10-bit Conversion Code (Hexadecimal)			
		Min	Typ	Max	Margin
1	100K	3FF	3FF	3FF	
2	30K9	3DE	3DE	3DF	020
3	15K0	3BD	3BF	3C0	01E
4	9K76	39E	39F	3A1	01C
5	6K98	37C	37E	381	01D
6	5K36	35B	35E	360	01B
7	4K32	33B	33E	341	019
8	3K57	31B	31F	322	018
9	3K01	2FC	2FF	303	017
10	2K55	2DA	2DE	2E2	019
11	2K21	2BB	2C0	2C4	015
12	1K91	29A	29F	2A4	017
13	1K65	278	27C	281	019
14	1K47	25B	260	265	012
15	1K27	237	23C	241	01A
16	1K13	219	21E	223	013
17	1K00	1FA	1FF	204	015
18	887R	1DB	1E0	1E5	014
19	787R	1BD	1C2	1C7	014
20	681R	199	19E	1A3	01A
21	604R	17C	181	186	013
22	523R	15A	15F	163	018
23	453R	13A	13E	143	017
24	392R	11B	120	124	016
25	332R	0FB	0FE	102	019
26	280R	0DC	0DF	0E3	017
27	232R	0BD	0C0	0C3	018
28	187R	09E	0A1	0A3	019
29	143R	07D	07F	082	01C
30	102R	05C	05E	060	01D
31	66.5R	03E	03F	040	01B
32	32.4R	01F	020	021	01D

Table 5.4 Analog ID Codes

ID Code	Pull Down Resistor Value	ADC 10-bit Conversion Code (Hexadecimal)			
		Min	Typ	Max	Margin
N/A	0R0	0	0	0	01F

The following simple C formula can be used to find the ID Code value, ranging from 1 to 32:

ID Code = 0x21 - (ADC_VALUE + 0x10) >> 5   (single reading, 10 bit DAC)

To reduce the effects of system noise, we can for example read the ADC 16 times, adding the results together and using the modified equation:

ID Code = 0x21 - (ADC_VALUE + 0x100) >> 9   (sum of 16 readings, 10 bit DAC)

(The same method is used to determine the rear module IDs. It can also be used for on board info such as board type, PCB issue and revision/ECO level).

Private Serial Bus (PSB)

Two single ended signals (PSB_BUS_IN1 and PSB_BUS_IN2) are bussed across all slots -. These are reserved for a future slow speed control interface. The single ended signals are standard LVTTL signals.

✶ The format and protocol of this bus is currently undefined. If implemented, it will be enabled by a software upgrade on the MFC-OG3-N. The PSB will not be supported in the DFR-8310 or DFR-8321 frames, nor the MFC-8310-N, MFC-8320-S network or MFC-8320-N cards.

The single ended signals are unidirectional, from the network card, and will be used for control and arbitration.

If you wish to take advantage of this bus, the card interface is shown in the diagram below. The same circuit is used on BUS1 and BUS2. The parts are listed in the chapter "**Common openGear Parts**" on page 67.

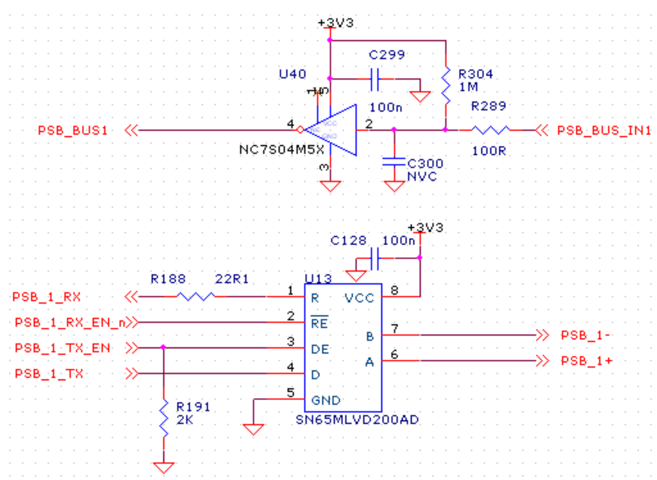


Figure 5.12 Card PSB Interface

GigE SERDES Interface

The OGX-FR and OG3-FR frame has implemented a GigE link from each slot to a central Ethernet switch on the MFC-OG3-N Network controller card. The Ethernet jack on the back of the frame as well as the processor on the MFC Network controller are also connected to the switch chip. The current implementation uses a Marvell 98DX240, 24 port 10/100/1000 switch.

The MFC-8322-S does not have a switch but does terminate all pairs into 100ohms so that the tracks are not floating.

Each GigE link consists of two differential pairs - one pair for each direction. Any card that wishes to use this interface must follow the following design guidelines:

- All traces from the edge connector to the PHY on the board must be made with 100 ohm differential pairs.
- Placement should be near the connector with the fewest vias possible on the traces (chip vendors such as Xilinx, Marvell and Broadcom have design guides for differential pairs and vias to maintain a constant impedance).
- The receive and transmit differential pairs are AC coupled on the MFC-OG3-N Network controller card. It is recommended to have AC coupling on the openGear card as well if the openGear card can be installed in a legacy DFR-8321 series frame.
- AC couple the transmit and receive signals with 10nf capacitors at the PHY for DC blocking so that cards could be used in the older generation frames w here the SERDES pins were bussed across all slots. (The receive and transmit differential pairs are also AC coupled on the MFC-OG3-N Network controller card).
- The signal pairs are polarity sensitive - always connect txpin_P to txsig_P, etc.
- The pairs are uni-directional - follow the signal convention defined in the midplane connector table.

Rear Module Specifications

This chapter describes the openGear rear I/O modules for the OGX-FR and OG3-FR series frames. All components described in this chapter are branded openGear and changes are controlled by Ross Video.

Overview

openGear has been designed with a set of "standard" rear I/O modules that can be used universally with many different processing cards. A standard rear module spans two slots in the openGear frame and may support either one card (full rear module) or two cards (split rear module). Vendors may optionally design multi-slot rear modules which span more than two slots (see the section "**Multi-slot Rear Modules**" on page 64), but must be in increments of two slots. Ross Video encourages openGear partners to use the standard rear modules whenever possible. Refer to the chapter "**Standard Rear I/O Modules**" on page 81 for the complete list of standard rear modules.

Custom rear I/O modules can also be designed. In which case, unique ID resistors MUST be requested from Ross Video. A complete list is posted on the openGear partner secure site. A template from our 10-BNC Full and Split rear modules is included in this chapter. Copy this template to guarantee adequate air flow on custom rear modules.

The system standard I/O module connector is one of the following:

- a Samtec MEC1-150-02 style, 100-pin card-edge connector. Cards may use an alternate I/O module connector, but will require the design of a mating rear I/O module as well; or
- HSEC8

OGX-FR Rear Module Design

The rear I/O modules sit in slots on the bottom of the frame with a 0.375" 4-40 screw at the top of the card to hold them in place against the rear of the frame. The screw is held in place during installation by an O-ring on the back side of the module. Refer to the chapter "**Common openGear Parts**" on page 67 for an O-ring part number.

Plating Requirements

Gold plated surfaces ground the rear module to the frame. These plated areas are crucial to passing EMI tests, they must not be overlooked. In addition, an EMI gasket has been added along the bottom edge of the midplane that contacts the midplane, the chassis, and the rear module. This has changed the gold plating area on the bottom edge to 0.170" (to match the new edge plating). This also moved the component keep-out, for any non-ground tracks or pins, to 0.240" to avoid any possible contact with the gasket.

Previous frame models included a keep-out of only 0.086" on the bottom edge. To provide forward compatibility, all rear modules designed for previous 20-slot frames need to adhere to the 0.240" keep-out as outlined above.

✶ If an existing rear module does not meet the 0.240" keep-out specification, then some means of insulating the components/signals from shorting out on the gasket is required.

Component Keep-outs

The rear modules cannot have any components on the top 0.304" of the solder side of the rear module, as this area of the module makes contact with the frame when installed. In addition, the area below the card edge connector and the sides of the rear module have component height restrictions, limited by the structural supports in the frame. Refer to the section "**OGX-FR Midplane**" on page 16 for additional details.

Ventilation Cut-outs

To support high power cards, the top edges of the rear module are notched to allow air flow out of the frame. In addition, ventilation holes are also necessary on the rear modules to ensure adequate airflow through the frame. The ventilation holes can be moved around on the rear module, keeping in mind that the top ones are the most effective. A total area of 0.177" +/- 25% allow for optimal ventilation without interfering with adjacent slots.

OGX-FR Specific Rear Module Design

✶ Any 2-slot cards exceeding 30W and 4-slot cards exceeding 60W may need additional ventilation holes to remove the excess heat.

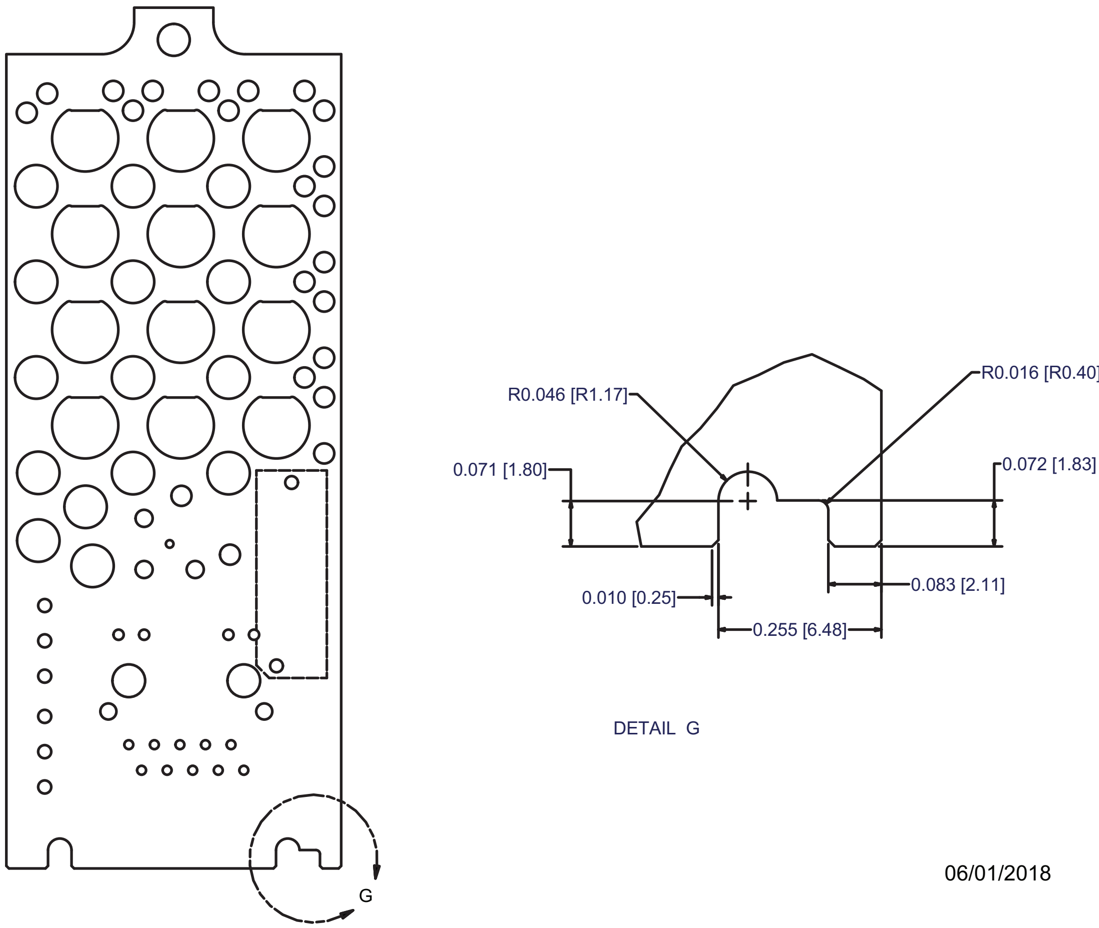


Figure 6.1 OGX-FR Rear Module Components

OG3-FR Rear Module Design

The rear I/O modules sit in slots on the bottom of the frame with a 0.375" 4-40 screw at the top of the card to hold them in place against the rear of the frame. The screw is held in place during installation by an O-ring on the back side of the module. Refer to the chapter "**Common openGear Parts**" on page 67 for an O-ring part number.

Plating Requirements

Gold plated surfaces ground the rear module to the frame. These plated areas are crucial to passing EMI tests, they must not be overlooked. In addition, an EMI gasket has been added along the bottom edge of the midplane that contacts the midplane, the chassis, and the rear module. This has changed the gold plating area on the bottom edge to 0.170" (to match the new edge plating). This also moved the component keep-out, for any non-ground tracks or pins, to 0.240" to avoid any possible contact with the gasket.

Previous frame models included a keep-out of only 0.086" on the bottom edge. To provide forward compatibility, all rear modules designed for previous 20-slot frames need to adhere to the 0.240" keep-out as outlined above.

✶ If an existing rear module does not meet the 0.240" keep-out specification, then some means of insulating the components/signals from shorting out on the gasket is required.

Component Keep-outs

The rear modules cannot have any components on the top 0.304" of the solder side of the rear module, as this area of the module makes contact with the frame when installed. In addition, the area below the card edge connector and the sides of the rear module have component height restrictions, limited by the structural supports in the frame. Refer to the section "**OG3-FR Midplane**" on page 29 for additional details.

Ventilation Cut-outs

To support high power cards, the top edges of the rear module are notched to allow air flow out of the frame. In addition, ventilation holes are also necessary on the rear modules to ensure adequate airflow through the frame. The ventilation holes can be moved around on the rear module, keeping in mind that the top ones are the most effective. A total area of 0.177" +/- 25% allow for optimal ventilation without interfering with adjacent slots.

OG3-FR Specific Rear Module Design

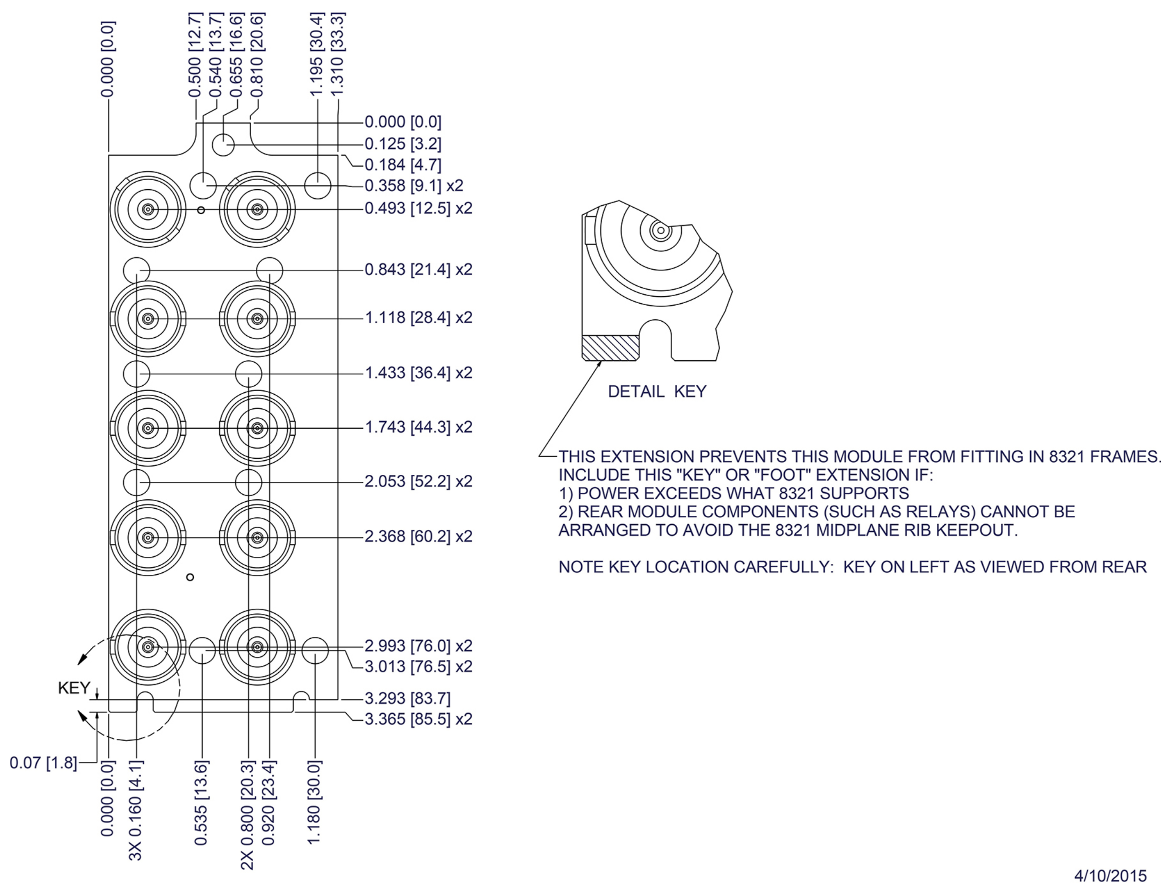
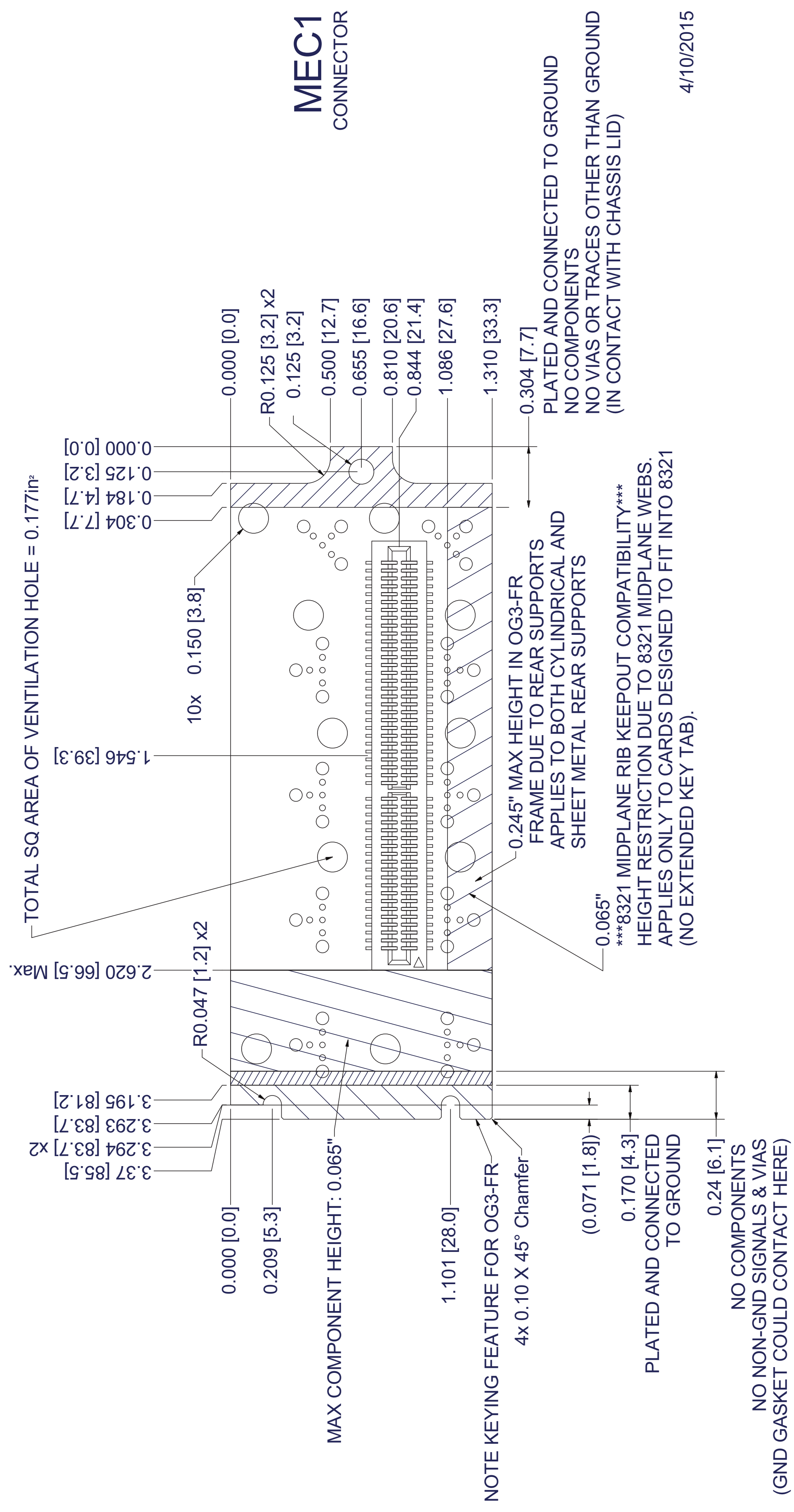


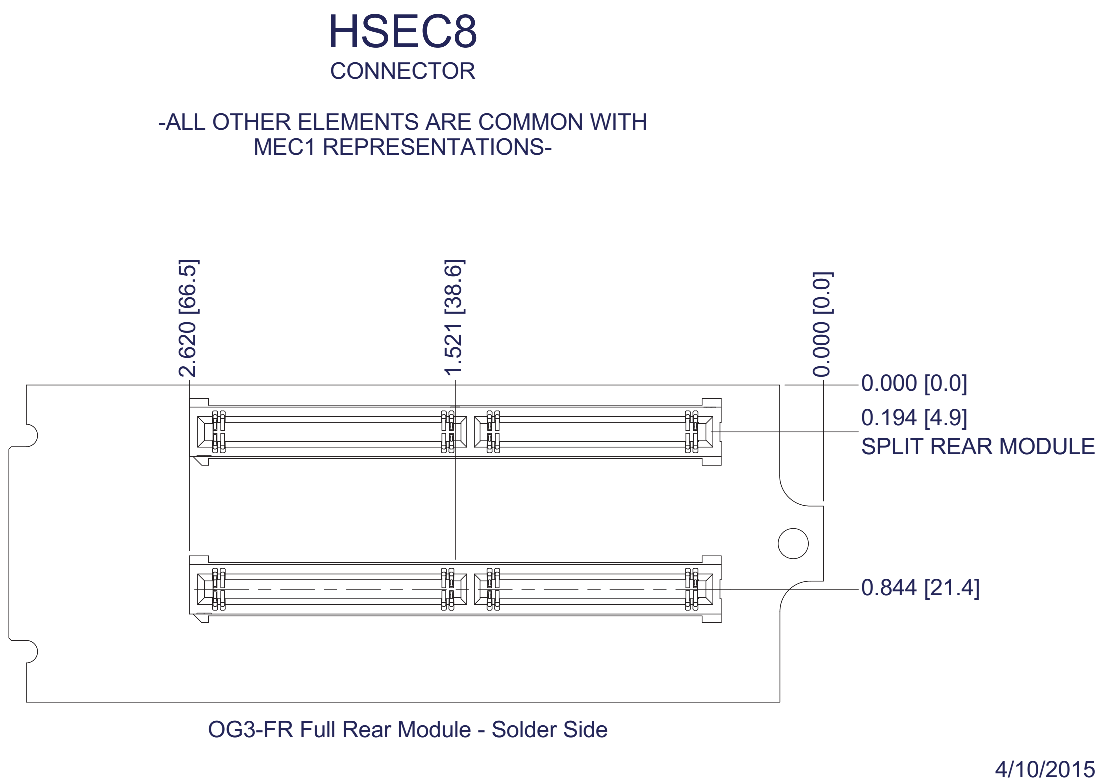
Figure 6.2 OG3-FR Rear Module Components

MEC1 and HSEC8 Connectors on the Rear Modules

This section provides information on the MEC1 and HSEC8 connectors.



MEC1
CONNECTOR
4/10/2015
TOTAL SQ AREA OF VENTILATION HOLE = 0.177in²
10x 0.150 [3.8]
0.000 [0.0]
0.125 [3.2]
0.184 [4.7]
0.304 [7.7]
1.546 [39.3]
2.620 [66.5] Max.
3.195 [81.2]
3.293 [83.7]
3.294 [83.7] x2
3.37 [85.5]
R0.047 [1.2] x2
R0.125 [3.2] x2
0.000 [0.0]
0.125 [3.2]
0.500 [12.7]
0.655 [16.6]
0.810 [20.6]
0.844 [21.4]
1.086 [27.6]
1.310 [33.3]
0.304 [7.7]
PLATED AND CONNECTED TO GROUND
NO COMPONENTS
NO VIAS OR TRACES OTHER THAN GROUND
(IN CONTACT WITH CHASSIS LID)
0.245" MAX HEIGHT IN OG3-FR
FRAME DUE TO REAR SUPPORTS
APPLIES TO BOTH CYLINDRICAL AND
SHEET METAL REAR SUPPORTS
0.065"
8321 MIDPLANE RIB KEEPOUT COMPATIBILITY
HEIGHT RESTRICTION DUE TO 8321 MIDPLANE WEBS.
APPLIES ONLY TO CARDS DESIGNED TO FIT INTO 8321
(NO EXTENDED KEY TAB).
0.000 [0.0]
0.209 [5.3]
MAX COMPONENT HEIGHT: 0.065"
1.101 [28.0]
NOTE KEYING FEATURE FOR OG3-FR
4x 0.10 X 45° Chamfer
(0.071 [1.8])
0.170 [4.3]
PLATED AND CONNECTED
TO GROUND
0.24 [6.1]
NO COMPONENTS
NO NON-GND SIGNALS & VIAS
(GND GASKET COULD CONTACT HERE)



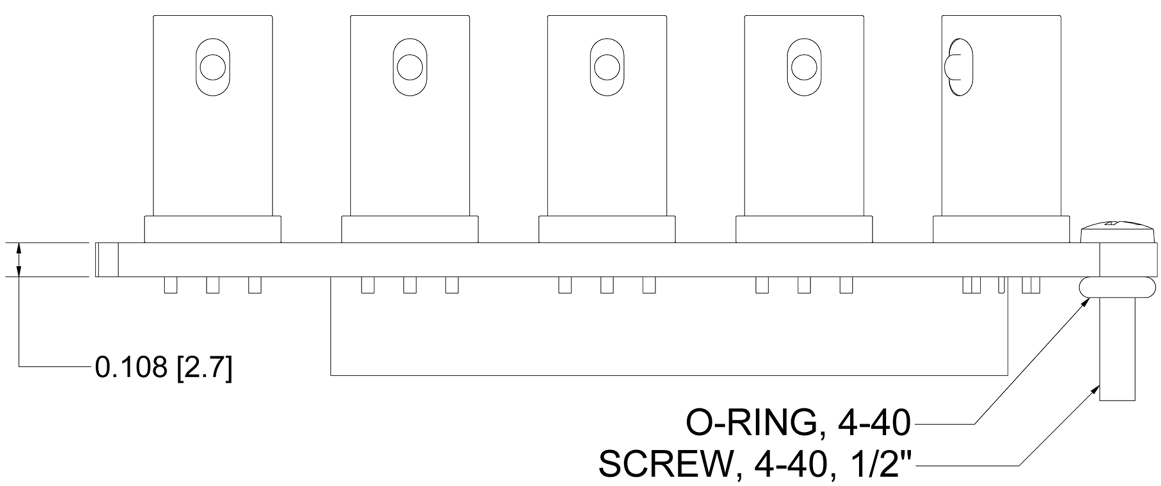


Figure 6.3 OGX-FR and OG3-FR Rear Module Thickness

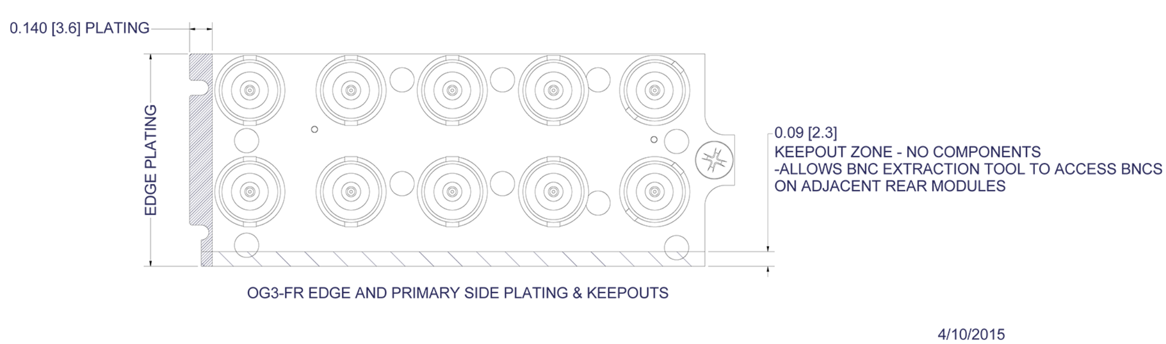


Figure 6.4 OGX-FR and OG3-FR Edge and Primary Side Plating and Keepouts

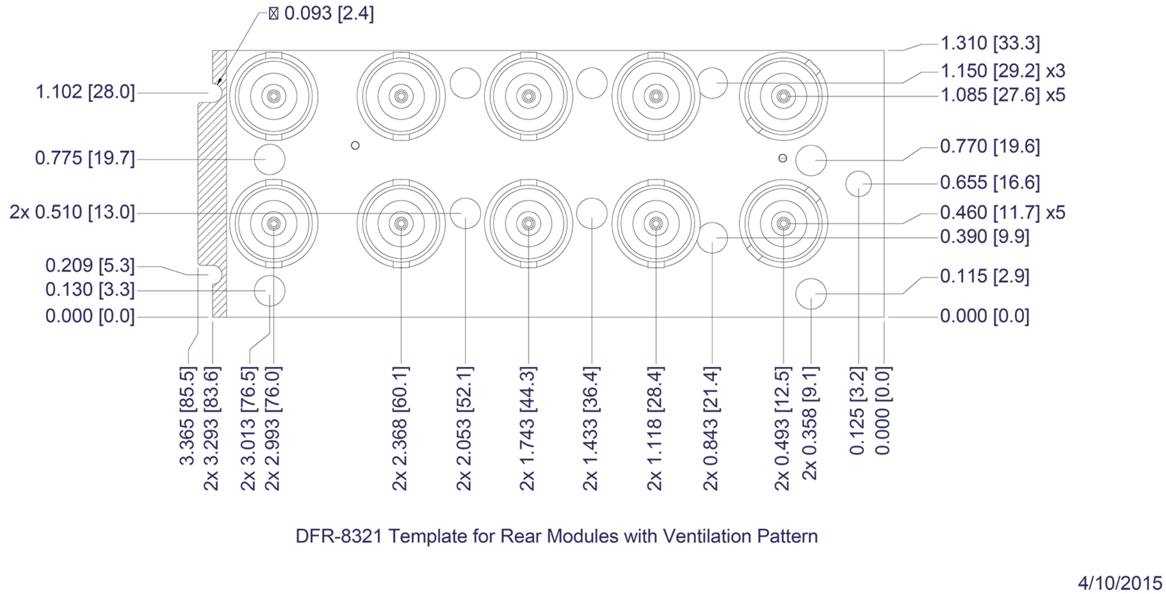


Figure 6.5 DFR-8321 Template for Rear Modules with Ventilation Pattern

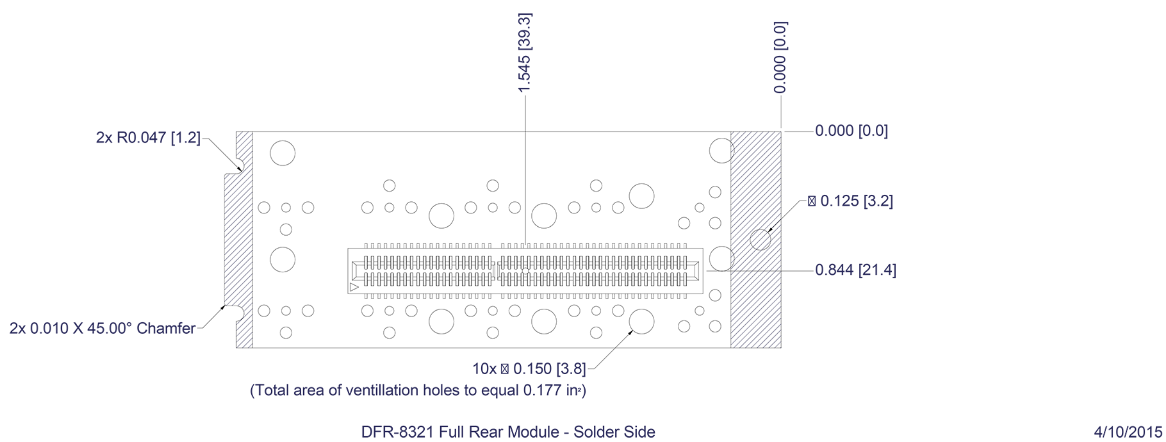


Figure 6.6 DFR-8321 Full Rear Module — Solder Side

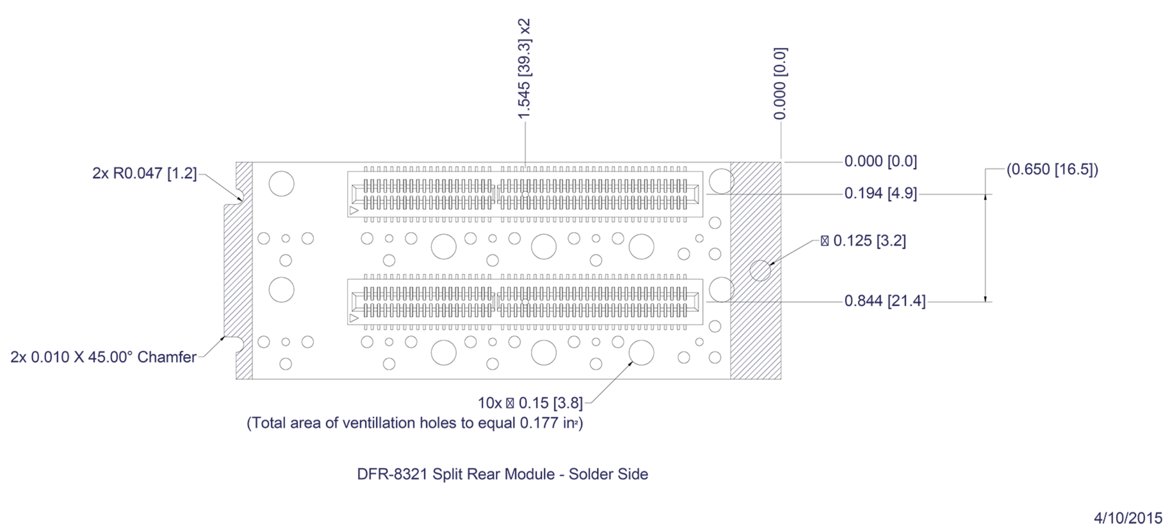


Figure 6.7 DFR-8321 Split Rear Module — Solder Side

Overlap of Rear Module BNCs on the OGX-FR and OG3-FR

Figure 6.8 illustrates the keep-out area on the rear module due to overlap from the rear module to the right (as viewed from the back of the OGX-Fr and OG3-FR frames).

✶ **Figure 6.8** is not to scale.

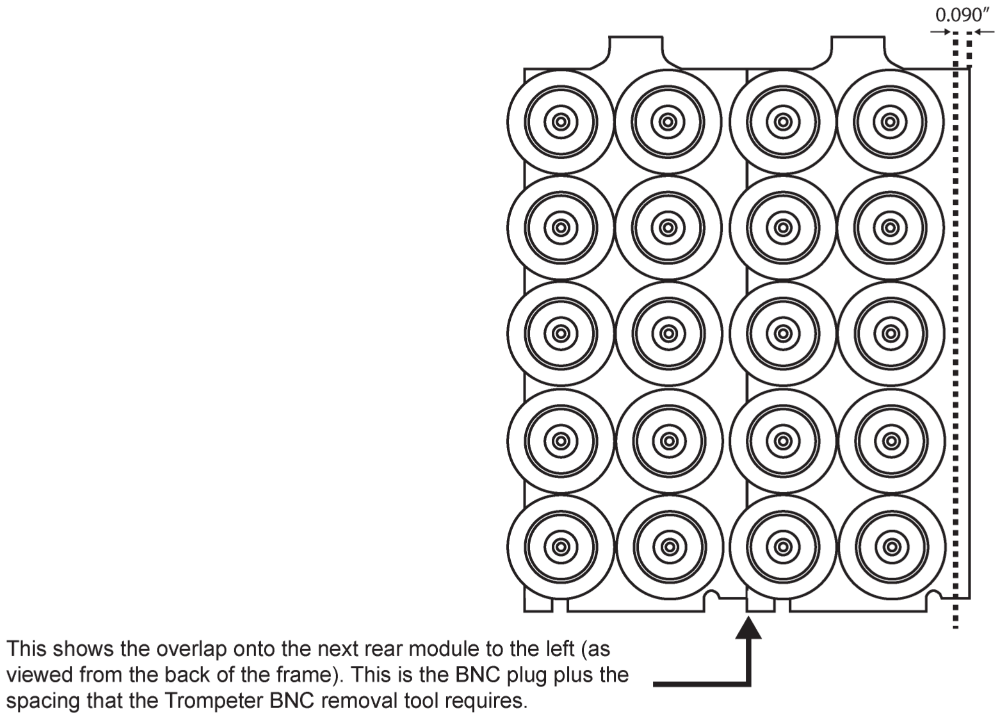


Figure 6.8 OGX-FR and OG3-FR Rear Module — BNC Overlap

Overlap with REF LOOP BNCs on the OGX-FR and OG3-FR

Figure 6.9 illustrates the BNC plugs installed and the overlap onto the next rear module. This also applies to the REF LOOP connectors on the OGX-FR and OG3-FR frames. The BNC removal tool adds additional overlap that must be accommodated for.

✶ **Figure 6.9** is not to scale.

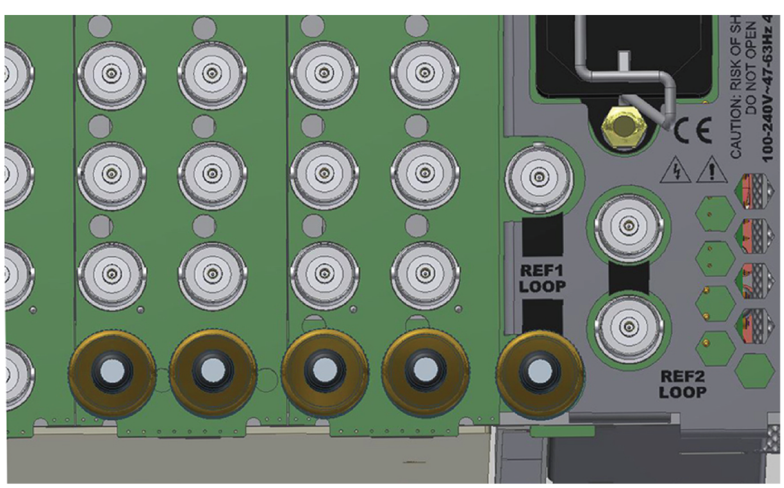


Figure 6.9 Rear Module — BNC Overlap on the REF LOOP Connectors

Rear Module Signal Descriptions

Rear modules using the standard 100 position, MEC1 card edge connector, have the potential for a card to be inserted into an incompatible rear module. In order to prevent damage to the card and/or rear module, cards should have the following capability.

- Short circuit protection – All I/O's should be able to survive a direct short to ground without damage
- Power enable – If the rear module requires power, the type of rear module should be verified before applying power. This can be achieved using the AN_BMID signals described below.

The standard pin assignment for the MEC1 rear module connector is defined in **Table 6.1**. This pin mapping supports up to 10 BNCs and 8 differential pairs and has been adopted by Ross Video and a variety of partners.

Table 6.1 Standard Pin Assignment for MEC1

Pin #	Card Component Side	Card Solder Side	Pin #
99	BNC1_GND	BNC1_GND	100
97	BNC1-SIG	BNC1_GND	98
95	BNC1_GND	BNC1_GND	96
93	BNC2_GND	BNC2_GND	94
91	BNC2_GND	BNC2_SIG	92
89	BNC2_GND	BNC2_GND	90
87	GND	GND	88
85	Reserved	Reserved	86
83	Reserved	Reserved	84
81	GND	GND	82
79	GND	BNC4_SIG	80
77	GND	GND	78
75	BNC3_SIG	GND	76
73	GND	GND	74
71	GND	GND	72
69	AES1P	AES5P	70
67	AES1N	AES5N	68
65	GND	GND	66
63	AES2P	AES6P	64
61	AES2N	AES6N	62
59	GND	GND	60
57	AES3P	AES7P	58
55	AES3N	AES7N	56
53	GND	GND	54
51	AES4P	AES8P	52
49	AES4N	AES8N	50
47	GND	GND	48
45	Reserved	Reserved	46
43	3.3V	3.3V	44
41	KEY	KEY	42
39	GND	GND	40

Table 6.1 Standard Pin Assignment for MEC1

Pin #	Card Component Side	Card Solder Side	Pin #
37	BNC5_SIG	GND	38
35	GND	GND	36
33	GND	BNC6_SIG	34
31	GND	GND	32
29	Reserved	Reserved	30
27	Reserved	Reserved	28
25	Reserved	Reserved	26
23	GND	GND	24
21	GND	BNC8_SIG	22
19	GND	GND	20
17	BNC7_SIG	GND	18
15	GND	GND	16
13	BNC10_GND	BNC10_GND	14
11	BNC10_GND	BNC10_SIG	12
9	BNC10_GND	BNC10_GND	10
7	BNC9_GND	BNC9_GND	8
5	BNC9-SIG	BNC9_GND	6
3	BNC9_GND	AN_BMID3 (formally GND)	4
1	AN_BMID2	AN_BMID	2

Table Notes:

BNCx_SIG	BNC signal output or input
BNCx_GND	BNC X isolated GND pins. For video inputs.
AESxP	Positive differential audio line
AESxN	Negative differential audio line
Reserved	Reserved pins, leave unconnected if not used
KEY	Connector key (no signal)
AN_BMID(+2)	Partner ID (formally rear module ID)
AN_BMID3	Unique rear module identification (formally GND)
GND	System electrical ground
3.3V	Reserved pins for active rear modules

Rear Module Identification

In earlier versions of the hardware specification[1], two pins on the rear module were used for identification of a unique rear module. Current practice is to use the dedicated 2 pins for vendor ID, and allow partners designing their own rear modules to develop their own rear module identification system.

Each rear module should include two signals, AN_BMID and AN_BMID2, which are used to identify the rear module vendor. Each signal is analog encoded by using a resistor to ground on the rear module. This scheme allows all cards to sense their rear module ID using a simple A/D converter and a 1K pull-up resistor on the front card.

1. 8200DR-005-07 Release Date: August 30, 2018 and earlier.

This feature has been designed to work with any A/D converter with a minimum of 6-bit resolution. Additional A/D resolution will enhance accuracy. One percent (1%) or better resistors must be used.

✶ It is highly recommended that the A/D reading processor implement an averaging algorithm to further reduce the effects of noise on the analog voltage reading.

These two partner identification resistors should be connected to pin 1 and 2 of the 100 pin connector as shown in **Figure 6.10** and **Table 6.1**, to ensure compatibility between cards. The combination of AN_BMID and AN_BMID2 IDs are designed to support 1024 uniquely identifiable rear modules. Going forward, to avoid running out of unique IDs, these resistors are used to identify partner ID.

To guarantee that all rear modules have uniquely identifiable codes, Ross Video will allocate the AN_BMID and AN_BMID2 pair on a per partner basis. Each partner is then free to uniquely identify their rear modules as they see fit. One suggested method is to use a pin 4 on the rear module and a resistor to ground to re-use the same methodology as the AN_BMID pins. Contact Ross for a vendor AN_BMID pair at www.openGear.tv/contact.

✶ openGear partners that do not use the HSEC8 or the MEC1 connectors, as described on page 57, are also welcome to use alternative methods of module identification of their own devising.

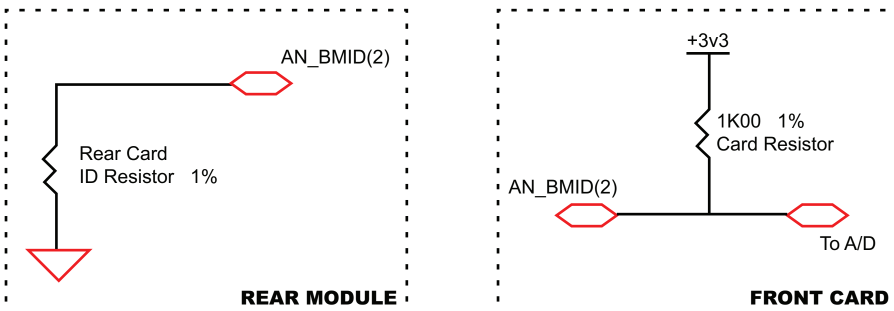


Figure 6.10 AN_BMID(2) Circuit

Multi-slot Rear Modules

All of the rear modules discussed in this chapter are considered “single width”. The frames can support up to 10 single width rear modules. For certain products, a single width rear module may not be large enough to accommodate all of the required IO connectors. It is possible to design rear modules that span multiple slots, as long as they conform to the mechanical specifications listed in this document. An example dual width rear module is shown in **Figure 6.11**.

✶ Multi-width modules can be created by step and repeat of the standard width (2-slot) module every 1.320”.

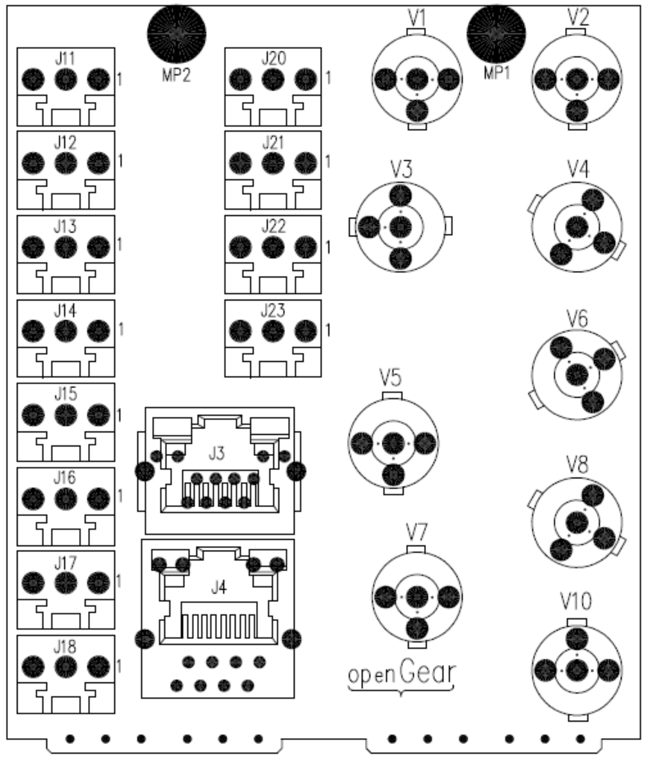


Figure 6.11 Example of a Dual Width Rear Module

Common openGear Parts

To simplify the design of openGear cards and rear modules, lists some common parts that are recommended for use.

Table 7.1 Recommended Parts

Part	Vendor	Vendor P/N	Notes
BNC	Q-Mate	QPC1094RV-004/.45MM	Custom 3-leg BNC
HD BNC	Amphenol	34-1032 (preferred)	STR JACK PCB, through hole, 3 legs receptacle
		34-1021 (alternate)	STR JACK PCB, through hole, 3 legs receptacle
Ejector	Bivar	CP86-WE	Blank white ejector
Card ID Label	Brady	THT-15-487-2.5	2” x 0.25” hi-temp label
GigE PHY	Broadcom	BCM54616SC0KFBG	PHY provides GigE SERDES interface to midplane (RMII or twisted pair interface if on card side)
	Marvell	88E1111-B2-BAB1-C000	
PSB Receiver	Fairchild	NC7S04M5X	CMOS Inverter
3-pin terminal block	Weco	931-HSL/03-NZ	
3-pin terminal plug	Weco	930-HFL-DS/03-GEN-NZ	
Rear Module Card Edge Connector	Samtec	MEC1-150-02-FM-D-A	
		HSEC8-160-01-S-DV-A	
DFR-8310 Rear Module PEM	Penn Engineering	SMTSO-440-2ET	
DFR-8310 Rear Module Screw	Accurate Screw	114052-PP-437-SS-1	Captive screw, 4-40, 0.437”
	OCE	0407CPPSS.2808	
DFR-8321 Rear Module Screw	OCE	0408MPP188VT	4-40, 0.5”
OG3-FR Rear Module O-Ring	Gould	FSPEOR-005N	
OG3-FR and OGX-FR Rear Module Screw	Gould	PMAS04400375PNP0100	Screw, PHMS, TL, 4-40 X 3/8L, PHIL, SS

Thermal Management

This chapter describes how we do thermal management on the OG3-FR frames. It defines how the MFC-OG3 card controls the front door fans speed in various conditions, taking into account the ambient temperature and the type of cards installed inside the 20-slot chassis. The goal is to operate the fans at the lowest possible speed for minimum acoustic noise and still meet the cooling requirement of all the openGear cards inside the frame.

✶ This chapter is also applicable to the OGX-FR frames.

Thermal Requirements

The OG3-FR is the successor of the DFR-8321 openGear frame and it is backward compatible with all existing openGear cards on the market. It is a requirement for the OGX-FR and OG3-FR to provide equivalent or better cooling when operating with legacy openGear cards and rear modules.

This section summarizes the thermal management protocols and requirements for the OGX-FR and OG3-FR.

Definition of a High Power Card

A high power card is an openGear card that requires the extra cooling capability provided by the OGX-FR and OG3-FR or require the extra power supplied only by these frames.

Any openGear card that has a power density of more than 6Watts per slot falls into the high power card category.

High Power Rear Module

The high power cards will be associated with rear modules that are specifically designed for the OGX-FR and OG3-FR frame. These rear modules will have an extra tab on the bottom left edge that will prevent them to be installed in a legacy DFR-8321 frame. Some high power rear modules will only fit in an OGX-FR frame and some rear modules will only fit in the OG3-FR frame.

For More Information on...

- rear modules specific to the OGX-FR frame, refer to the section “**OGX-FR Rear Module Design**” on page 55.
- rear modules specific to the OG3-FR frame, refer to the section “**OG3-FR Rear Module Design**” on page 56.

Thermal Management Protocol

A new communication protocol is created to communicate thermal management information from the openGear high power card to the MFC-8322-S/MFC-OG3-N frame controller card (MFC). It will be mandatory for the high power card to provide its airflow requirement in relation to the ambient inlet temperature as measured by the MFC with the fan door temperature sensors. The MFC frame controller card will collect the airflow requirement from all cards in the chassis and will control the front door fans speed based on the highest airflow requested value found from the collected data sets.

Legacy openGear cards may optionally support the new thermal management protocol. Legacy openGear cards that don’t support it will be assigned by the MFC with a default thermal curve that emulates the operation of the DFR-8321 airflow profile.

Overheat Failsafe

The new protocol allows an openGear card that is overheating to request to the MFC additional airflow, up to the maximum fan speed allowed. For example, the following situations could trigger the openGear card to request more airflow:

- The fan door was opened for a while and the card starts to overheat.
- The fan filter is clogged and the airflow is reduced from its nominal operational range.
- There is airflow obstruction external to the OGX-FR and OG3-FR frame.
- A local fan failure of an openGear card that uses a heat-sink/fan assembly.
- An unforeseen combination of cards and rear modules installation that creates a dead spot in the airflow profile inside the OGX-FR and OG3-FR frame.

Thermal Calibration Procedure

Since the high power openGear card must provide its airflow requirement based on the inlet temperature to the MFC, it is a requirement to have a simple procedure for openGear cards developers to calibrate their cards and create this data set.

Thermal Management

This section provides a test case for measuring the airflow, and observing the fan speeds under certain conditions.

Objectives

1. Describe the airflow in linear feet per minute (LFM) for each of the 15 fan speed steps.
2. Understand how the MFC-8322 frame controller cards controls the fan speed for different cases:
   a. When running with legacy openGear cards
   b. When running with high power openGear cards
   c. When running with mixed openGear cards

Airflow Measurements

An OG3-FR frame was fully populated with 20 openGear cards and 10 rear modules. The airflow in LFM was measured for all fifteen fan speed settings as follows:

Table 8.1 OG3-FR — Airflow LFM Measurements

OG3-FR Fan Speed Step	DFR-8321 Fan Speed Step	OG3-FR Airflow (LFM)	DFR-8321 Airflow (LFM)
0		0	-
1		30	-
2		42	-
3		54	-
4		66	-
5	1	78	79.4
6	2	90	86.8
7	3	102	92.9
8	4	114	97.8

Table 8.1 OG3-FR — Airflow LFM Measurements

OG3-FR Fan Speed Step	DFR-8321 Fan Speed Step	OG3-FR Airflow (LFM)	DFR-8321 Airflow (LFM)
9	5	126	101.3
10		138	
11		150	
12		162	
13		174	
14		186	

Fan Control Algorithm with Legacy openGear Cards

When an OGX-FR or OG3-FR frame is populated with only legacy openGear cards, or cards that do not support the new thermal management protocol, then the MFC assigns a default thermal curve that emulates the operation of the DFR-8321 airflow. The same algorithm that is described in the previous section will be used to evaluate the require fan speed. Since the OGX-FR and OG3-FR can be loaded with up to 300W and provides more than the legacy 5 fan speed steps, the DFR-8321 algorithm is extended.

OG3-FR Fan Control

On the OG3-FR, we will evaluate the total current of the openGear cards by summing the total current as reported by both power supplies and subtracting the current consumption as reported by the MFC-8322 frame controller card.

ITOT = IPSU1 + IPSU 2 - IMFC

Then we apply the same algorithm as before:

Total current = MAX [(PSU1 + PSU2 - MFC); SUM(Slot1..Slot20); (3 x MAX[Slot1..Slot20])]

With the 15 fan speed steps, we will implement the legacy algorithm this way:

Table 8.2 Fan Control — Legacy Algorithm

Fan Speed	Total Current (A) at 20°C or less	Total Power (W) at 20°C or less	Total Current (A) at 40°C (20% derating)	Total Power (W) at 40°C (20% derating)
0-3	n/a	n/a	n/a	n/a
4	0.0 to 2.0	0 to 24	0.0 to 1.6	0.0 to 19.2
5 (1)	1.0 to 3.0	12 to 36	0.8 to 2.4	9.6 to 28.8
6 (2)	2.0 to 4.0	24 to 48	1.6 to 3.2	19.2 to 38.4
7 (3)	3.0 to 5.0	36 to 60	2.4 to 4.0	28.8 to 48.0
8 (4)	4.0 to 6.0	48 to 72	3.2 to 4.8	38.4 to 57.6
9 (5)	5.0 to 10.0	60 to 120	4.0 to 8.0	48.0 to 96.0
10	9.0 to 14.0	108 to 168	7.2 to 11.2	86.4 to 134.4
11	13.0 to 18.0	156 to 216	10.4 to 14.4	124.8 to 172.8
12	17.0 to 22.0	204 to 264	13.6 to 17.6	163.2 to 211.2
13	21.0 to 26.0	252 to 312	16.8 to 20.8	201.6 to 249.6
14	>= 25.0	>= 300	>= 20.0	>= 240

✶ The fan speed step numbers (1) to (5) in parentheses represent the 5 legacy fan speeds of the DFR-8321 frame.

OG3-FR Fan Control Algorithm with High Power openGear Cards

Thermal Protocol

A simple software protocol extension will be created for the OG3-FR frame. In summary it works this way:

1. Every minute or so, the MFC broadcast on the CAN bus the measured inlet temperature in Celsius and the current fan speed setting (0 to 14).
2. Each openGear card supporting the thermal protocol responds with a message reporting its airflow requirement value (0 to 14) based on the inlet temperature or on other local temperature sensors.

It is important for the MFC to broadcast the message periodically at about a fixed rate.

The broadcast rate must be slow enough so that a fan speed step change has the time to create a measurable temperature change on the openGear cards inside the frame. This will be critical for the thermal overheat algorithm operation proposed later in this document.

The broadcast rate must be fast enough to adapt to an ambient temperature change. Typically this would be the air conditioning kicking in and out in a rack room.

Thermal Algorithm on the MFC Card

The software algorithm running on the MFC in this case is simple.

- The MFC measures the inlet temperature with the sensors available in the fan door.
- The MFC broadcasts on the CAN bus the temperature (°C) and the current fan speed (0 to 14).
- The MFC collects the airflow request values from each card supporting the protocol in the chassis.
- The MFC adjusts the fan speed to the highest value requested.

Since the inlet temperature will vary slowly in a typical installation, we probably need to measure the inlet temperature and adjust the fans speed every minute or so.

Thermal Algorithm on the openGear Card

The openGear will receive a message from the MFC that states the inlet temperature measured and the current fan speed setting. The openGear supporting the new protocol will have to respond with an acknowledge message reporting its own airflow requirement by returning the minimum fan speed setting that it needs to operate safely at this specific inlet temperature.

That implies that the openGear will have been previously thermally calibrated, that the relation between the inlet temperature and the minimum fan speed setting is known by the card.

For example, a typical high power card could have the following data set:

Table 8.3 Example of a Typical High Power Card

Inlet Measured Temperature (°C)	openGear Card - xxx Fan Speed Required
T <= 20	6
19 <= T <= 25	7
24 <= T <= 30	8
29 <= T <= 35	10
34 <= T <= 40	12
T >=39	14

In this table there is a 2°C overlap between each of the six inlet temperature zones, providing a two degrees Celsius hysteresis band. This is just an example, the number of temperature zones and the size of the hysteresis band will be specific to the card.

Thermal Algorithm on the openGear Card: Overheat Case

If the openGear card has a thermal sensor on board and noticed an overheat situation, the card can request more airflow to the MFC until its sensor temperature falls below an acceptable limit. The algorithm is simple:

- The openGear receives the inlet temperature and current fan speed message from the MFC.
- The openGear acknowledges and requests the next fan speed to be the current fan speed + 1 or higher if needed.

To avoid running the fan speed in a saw tooth waveform, where the fan speed would ramp-up linearly on an overheat case and then abruptly slow down when the overheated card has cool down, it is recommended to decrease the fan by steps of 1 to reach the lower target fan speed sets by the thermal algorithm. Ultimately, in the case where a card overheats, this will provide a smoother fan speed control slowly oscillating between no more than two fan speed settings.

Since the MFC will be adjusting the fan speed every minute, then it will be up the openGear card to decide what should be the incremental fan speed step. It is expected that a step of one would be enough for all typical cases.

Fan Control Algorithm with Mix of Legacy and High Power openGear Cards

Typical installations will likely have a mixed of legacy and high power openGear cards, so we must be able to satisfy the airflow requirements of all the cards populated in the chassis. To achieve this, we will proceed this way:

- We evaluate the fans speed requirements based on the legacy algorithm.
- We get the fans speed requirements received from the high power cards.
- We set the fans speed to the highest value found from both.

Software Extension for Legacy openGear Cards

The existing legacy cards can benefit from the flexibility of the thermal management protocol available with the OG3-FR high power frame. A legacy card will need to be calibrated thermally and its software will need to be updated to support the thermal management protocol.

Unoccupied Slots

Some of the openGear cards do not have a CPU and they are not visible on the CAN bus by the MFC. This implies that they are also not showing on Dashboard. This is the case for some simple low-cost DA cards or the RossGear 8000 Series cards with the openGear adapter.

Other cards may physically occupy more than one slot but are electrically connected to only one slot. Depending on the rear module options, some cards may occupy more or less slots. For example, this is the case for the MDK or the UDC that could use the standard 10-BNC rear module (R3-10B) occupying 2 slots or could use the MDK/UDC rear module (R2-MDK, R2-8625) occupying 4 slots.

There is no way for the MFC to know if a slot is either free or if it is populated with a card that does not provide a CAN bus interface. Although it looks simple, the unoccupied slots create a serious problem for the thermal management algorithm running on the MFC card. We have no choice than to assume that any empty slot may be occupied by a card that is not visible by the MFC. This implies to run the legacy thermal algorithm based only on the total frame power consumption to set the minimum fan speed requirement for these undefined slots.

When we have a frame populated with only high power openGear cards, then we need to address the case for the empty slots, otherwise the MFC will always default to the algorithm for the mix of legacy and high power openGear cards and never use the more efficient algorithm designed for the high power openGear cards.

The high power thermal algorithm can only be used when all the 20 slots have been identified by the MFC as either truly emptied or occupied by high power openGear cards.

OG3-FR Thermal Calibration Procedure

Since the high power openGear card must support the thermal protocol and acknowledge to the MFC its fan speed request based on the inlet temperature, it is a requirement to have a simple procedure for card developers to create this data. We will define the equipment needed and propose two calibration procedures. The first one requires a thermal chamber and the second one can be executed in a lab environment.

Thermal Calibration System Configuration

It is a requirement for the OG3-FR to run in an installation where several frames are stacked on top of each other. In a typical installation, a frame will be located between two other OG3-FR frames, and each one could be loaded with up to 300Watts of openGear cards.

So our thermal calibration system will be configured with three OG3-FR frames stacked and each one of the frame will be populated this way:

Top and Bottom Frames

- OG3-FR-C-P or OG3-FR-CN-P frame (2 PSU, Ref card, MFC-8322-S or MFC-OG3-N)
- 20 ZTC-8399 openGear Thermal Test cards, each one configured to dissipate 15Watts
- 10 R2-10B rear modules or equivalent

Middle Frame

- OG3-FR-C-P or OG3-FR-CN-P frame
- Filled with the high power openGear card to be calibrated
- Filled with its corresponding rear modules or the default R3-10B high power rear modules

Note that this configuration of three OG3-FR frames stacked may not be the absolute worst case installation that can be encountered. We have no control on how our equipment will be installed and conceivably, our OG3-FR frame could be stacked between higher than 300Watts of rack mounted equipment. Since we have to pick a configuration, we will use the three OG3-FR frames stacked as we have done in the past with other DFR-8300 series frames.

Procedure 1: With a Thermal Chamber

This is the best case scenario for calibrating thermally a high power openGear card. This procedure will be mandatory when the openGear card has an active cooling device such as a heat-sink and fan assembly installed on the card.

Install the three chassis described above in the thermal chamber and provide a means to monitor the temperature of the critical parts in the high power openGear cards installed in the middle frame. Typically, we would want to monitor the junction temperature of the FPGA, the CPU or other critical hot components.

The procedure simply consist of increasing the thermal chamber temperature from 20°C to 45°C in steps of 5°C or less and on each step, manually adjust the fans speed to the minimum value that provides enough cooling to run at a safe junction temperature. It is recommended to target a junction temperature lower by at least 5°C than the maximum value. This margin is needed to compensate for the imprecision of the various temperature sensors in used (fan door inlet sensors, IC junction sensors, others). If practical, higher than 5°C margin could be considered as well to maximize the life expectancy (MTBF) of the cards.

The fan speed can be manually controlled with the Dashboard Console command "**`fanspd`**".

On the MFC-8322-S, the DashBoard syntax is as followed:

`> fandebug 1`

`> fanspd [0 to 13]`[1]

1. The MFC-8322-S fan speed values 0 to 13 map to the fan speed values 1 to 14 of the MFC-OG3-N.

On the MFC-OG3-N, the Dashboard syntax is as followed:

> fanspd [1 to 14]

The result of this calibration will be the 6 fan speed settings that are needed to create the cooling requirement for this openGear card.

The following table can be used as a typical template to be filled while doing the calibration procedure.

Table 8.4 Template — Calibration

Temp. Operating Zone (°C)	Thermal Chamber Temp. Setting (°C)	OG3-FR Inlet Temp. (°C)	Worst Case Junction Temp. Slot 1 to 20 (°C)	Minimum Fans Speed Setting
T <= 20	18	20		
19 <= T <= 25	23	25		
24 <= T <= 30	28	30		
29 <= T <= 35	33	35		
34 <= T <= 40	38	40		
39 <= T <= 45	43	45		

Note that at the end, it will be the OG3-FR inlet temperature measured by the MFC-8322 Frame Controller card that will be used to control the fans speed when running the thermal management algorithm. The inlet sensor is located inside the fan door and may be biased by a few degrees from internal radiated heat. The table above assumes a 2°C bias for example. In this case, it is recommended to lower the thermal chamber temperature until the inlet sensor reading, visible on DashBoard, reaches the target temperature.

When changing the thermal chamber temperature, always let enough time for the system to stabilize before making the measurement. Depending of the temperature step, a period from 15-30 minutes should normally be enough for stabilization.

Procedure 2: Without a Thermal Chamber

If the openGear card does not have an active cooling device like a heat-sink and fan assembly, then its thermal response to the ambient temperature variations is approximately linear. In this case, we can do all the thermal calibration measurements at one fixed ambient temperature and extrapolate the results linearly from 20°C to 45°C.

Install the three openGear thermal chassis described earlier and provide a means to monitor the temperature of the critical parts in the high power openGear cards installed in the middle frame. Typically, we would want to monitor the junction temperature of the FPGA, the CPU or other critical hot components.

In this procedure we are only interested in evaluating the difference in temperature (delta T) from the measured inlet temperature and the junction temperature of the worst case device for each fan speed settings.

Using the Dashboard Console command "**fanspd**", try all fan speed possible and record the worst case junction temperature from all the cards installed in the frame. Evaluate the delta T in each case.

When changing the fan speed, always allow enough time for the system to stabilize before making the measurement. A period of 30 minutes should normally be enough.

The following table can be used as a template for the measurements:

Table 8.5 Template — Measurements

Fans Speed Setting	OG3-FR Inlet Temp. (°C)	Worst Case Junction Temp. Slot 1 to 20	Difference in Temperature ($\triangle T_{J-A}$)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

Then we need to determine what will be the minimum fan speed that we can safely run for each temperature zones from 20°C to 40°C. Assuming a maximum junction temperature 85°C with a 5°C margin, then we would have to fill this table:

Table 8.6 Template — Calibration

Temp. Operating Zone (°C)	Max. Difference in Temperature $\triangle T_{J-A}$(°C)	Min. Fans Speed Setting	Expected Max. Junction Temp. (°C)
T <= 20	$\triangle T_{J-A(max)}$ <= 85-5-20 = 60		20+ $\triangle T_{J-A}$ =
19 <= T <= 25	$\triangle T_{J-A(max)}$ <= 85-5-25 = 55		25+$\triangle T_{J-A}$ =
24 <= T <= 30	$\triangle T_{J-A(max)}$ <= 85-5-30 = 50		30+$\triangle T_{J-A}$ =
29 <= T <= 35	$\triangle T_{J-A(max)}$ <= 85-5-35 = 45		35+$\triangle T_{J-A}$ =
34 <= T <= 40	$\triangle T_{J-A(max)}$ <= 85-5-40 = 40		40+$\triangle T_{J-A}$ =
39 <= T <= 45	$\triangle T_{J-A(max)}$ <= 85-5-45 = 35		45+$\triangle T_{J-A}$ =

Case Study of a 15W openGear Card Design

In this case study, we want to show that it is possible to do a 15Watts card design that will occupy one slot in the OG3-FR openGear frame and meet the cooling requirements of the critical part. In this example we assume that the 85°C FPGA junction temperature will be the critical thermal constraint to meet.

In this study, we assume the following power distribution on the card:

- 15Watts total power
- 2.5Watts dissipated by switching power supplies, efficiency of about 12.5/15 = 83%.
- 9.0Watts dissipated by a large FPGA with a low profile 7mm heat-sink
- 1.5Watts dissipated by a CPU and its external memory.
- 2.0Watts dissipated by other distributed components (clock gen, IO drivers and IO receivers)

Components Selection

OG3-FR Frame	
Inlet temperature	40°C
Airflow	150 LFM minimum at maximum fan speed
Max. Comp.	0.525”, 13.3mm
FPGA	
Device	Xilinix Virtex-5, XC5VLXI55T-2FFG1136C
Package	Flip-Chip BGA, 35 x 35 x 3.1mm
Link	We can get thermal info of this device from this link: http://www.xilinx.com/cgi-bin/thermal/thermal.pl
JB	Junction to base 2.5 °C/Watt
JC	Junction to case 0.1 °C/Watt
Heat Sink	
Device	Alpha, UB35-7B, Low Pressure Drop, low thermal resistance
Size	35 x 35 x 7 mm
Link	http://www.micforg.co.jp/en/ref_datae.html
Term R.	6.1 °C/W @ 100 LFM 5.1 °C/W @ 150 LFM
Thermal Tape	
Material	Chomerics, THERMATTACH® T412
Size	35 x 35 x 0.23 mm
Therm R	7 °C-cm2/W / (3 cm x 3 cm) = 0.19 °C/W

Figure 8.1 shows thermal model of the FPGA and heat-sink assembly mounted on a PCB.

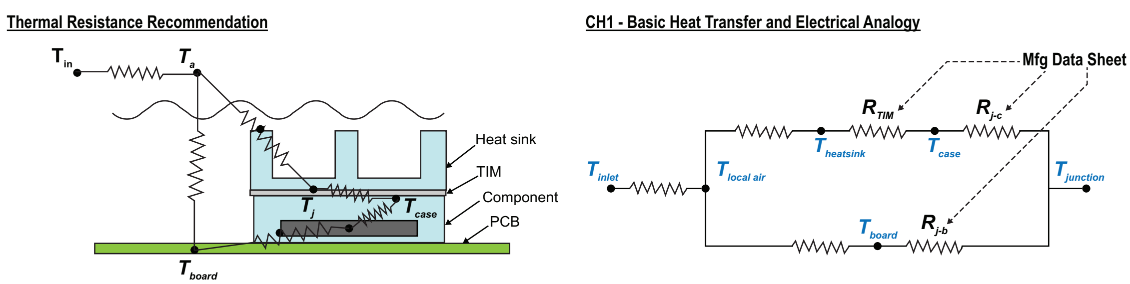


Figure 8.1 openGear Frame — 2RU, Airflow

At the design phase, we don't have all the data available and to start somewhere, we make the following assumptions:

- The air temperature rise from the inlet to the FPGA location is approximated to 2°C.
- The 9W FPGA power dissipation is distributed this way: 2W through the PCB and 7W through the heat-sink.
- The spec of the heat-sink assumes ducted air. It is not likely the case inside the OG3-FR. So we de-rate the 150 LFM airflow spec to 100 LFM flowing through the heat-sink.

The FPGA junction temperature can then be calculated this way:

$$T_j = (40 + 2)°C + 7W \times (0.1 + 6.1 + 0.19)\ °C/W = 86.7\ °C$$

This design example shows the limit of a high power component that you can practically use on a single slot 15Watts openGear card to be about 9Watts or less at 40°C ambient.

Case Study of a 30W openGear Card Design

In this case study, we want to show that it is possible to do a 30Watts card design that will occupy two slots in the OG3-FR frame and meet the cooling requirements of the critical part. In this example we assume that the 85°C FPGA junction temperature will be the critical thermal constraint to meet.

In this study, we assume the following power distribution on the card:

- 30Watts total power
- 5.0Watts dissipated by switching power supplies, efficiency of about 25/30 = 83%.
- 18.0Watts dissipated by a large FPGA with a high profile 20mm heat-sink
- 3.0Watts dissipated by a CPU and its external memory.
- 6.0Watts dissipated by other distributed components (clock gen, IO drivers and IO receivers)

Components Selection

OG3-FR Frame	
Inlet temperature	40°C
Airflow	150 LFM minimum at maximum fan speed
Max. Comp.	1.038", 26.3mm
FPGA	
Device	Xilinix Virtex-5, XC5VLXI55T-2FFG1136C
Package	Flip-Chip BGA, 35 x 35 x 3.1mm
Link	We can get thermal info of this device from this link: http://www.xilinx.com/cgi-bin/thermal/thermal.pl
JB	Junction to base 2.5 °C/Watt
JC	Junction to case 0.1 °C/Watt
Heat Sink	
Device	Alpha, UB35-20B, Low Pressure Drop, low thermal resistance
Size	35 x 35 x 20 mm
Link	http://www.micforg.co.jp/en/ref_datae.html
Term R.	2.7 °C/W @ 100 LFM 2.2 °C/W @ 150 LFM

Thermal Tape	
Material	Chomerics, THERMATTACH® T412
Size	35 x 35 x 0.23 mm
Therm R	1.7 °C-cm2/W / (3 cm x 3 cm) = 0.19 °C/W

We make the following assumptions:

- The air temperature rise from the inlet to the FPGA location is approximated to 5°C.
- The 18W FPGA power dissipation is distributed 4W through the PCB and 14W through the heat-sink.
- The spec of the heat-sink assumes ducted air. It is not likely the case inside the OG3-FR. So we de-rate the 150 LFM airflow spec to 100 LFM flowing through the heat-sink.

The FPGA junction temperature can then be calculated this way:

$$T_j = (40 + 5)\ °C + 14W \times (0.1 + 2.7 + 0.19)\ °C/W = 86.9\ °C$$

This design example shows the limit of a high power component that you can practically use on a dual slot 30Watts openGear card to be about 18Watts or less at 40°C ambient.

Standard Rear I/O Modules

This chapter contains a few examples of rear modules manufactured by Ross Video and Ward-Beck.

10 BNC Full Rear Module

This rear module is available from Ross Video. The part numbers are R1-10B and R2-10B for the 10-slot and 20-slot frames respectively. **Figure 9.1** displays the connection map for this rear module.

✶ This rear module displays an “**A**” in the top left corner.

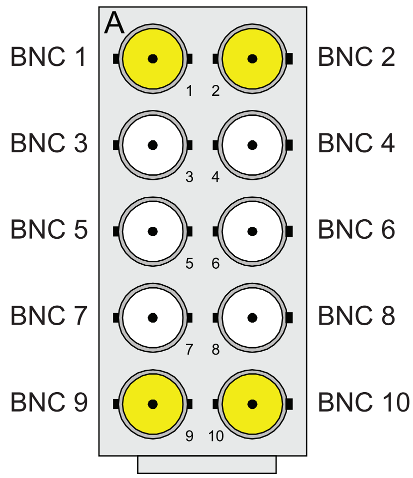


Figure 9.1 Full Rear Module — 10 BNC

Pin #	Card Component Side	Card Solder Side	Pin #
99	BNC1 GND	BNC1 GND	100
97	BNC1-SIG	BNC1 GND	98
95	BNC1_GND	BNC1_GND	96
93	BNC2 GND	BNC2 GND	94
91	BNC2 GND	BNC2 SIG	92
89	BNC2 GND	BNC2 GND	90
87	GND	GND	88
85	Reserved	Reserved	86
83	Reserved	Reserved	84
81	GND	GND	82
79	GND	BNC4 SIG	80
77	GND	GND	78
75	BNC3 SIG	GND	76
73	GND	GND	74
71	GND	GND	72
69			70
67			68
65	GND	GND	66

Pin #	Card Component Side	Card Solder Side	Pin #
63			64
61			62
59	GND	GND	60
57			58
55			56
53	GND	GND	54
51			52
49			50
47	GND	GND	48
45	Reserved	Reserved	46
43	Reserved	Reserved	44
41	KEY	KEY	42
39	GND	GND	40
37	BNC5 SIG	GND	38
35	GND	GND	36
33	GND	BNC6 SIG	34
31	GND	GND	32
29	Reserved	Reserved	30
27	Reserved	Reserved	28
25	Reserved	Reserved	26
23	GND	GND	24
21	GND	BNC8_SIG	22
19	GND	GND	20
17	BNC9 SIG	GND	18
15	GND	GND	16
13	BNC10_GND	BNC10_GND	14
11	BNC10 GND	BNC10 SIG	12
9	BNC10 GND	BNC10 GND	10
7	BNC9 GND	BNC9 GND	8
5	BNC9-SIG	BNC9_GND	6
3	BNC9 GND	BNC9 GND	4
1	AN BMID2 = OPEN	AN BMID = 30K9	2

8 BNC, 2 Audio Full Rear Module

This rear module is available from Ross Video. The part numbers are R1-8B-2A and R2-8B-2A for the 10-slot and 20-slot frames respectively. The Audio connections are supplied through WECO™ connectors. **Figure 9.2** displays the connection map for this rear module.

✶ This rear module displays an "**H**" in the top left corner.

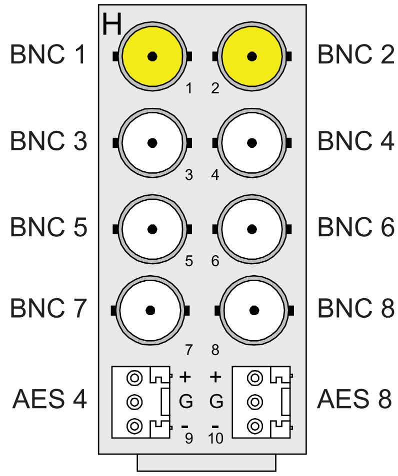


Figure 9.2 Full Rear Module — 8 BNC, 2 Audio

Pin #	Card Component Side	Card Solder Side	Pin #
99	BNC1 GND	BNC1 GND	100
97	BNC1-SIG	BNC1 GND	98
95	BNC1_GND	BNC1_GND	96
93	BNC2 GND	BNC2 GND	94
91	BNC2 GND	BNC2 SIG	92
89	BNC2 GND	BNC2 GND	90
87	GND	GND	88
85	Reserved	Reserved	86
83	Reserved	Reserved	84
81	GND	GND	82
79	GND	BNC4_SIG	80
77	GND	GND	78
75	BNC3 SIG	GND	76
73	GND	GND	74
71	GND	GND	72
69			70
67			68
65	GND	GND	66
63			64
61			62
59	GND	GND	60
57			58
55			56
53	GND	GND	54
51	AES4P (+)	AES8P (+)	52
49	AES4N (-)	AES8N (-)	50
47	GND	GND	48
45	Reserved	Reserved	46

Pin #	Card Component Side	Card Solder Side	Pin #
43	Reserved	Reserved	44
41	KEY	KEY	42
39	GND	GND	40
37	BNC5 SIG	GND	38
35	GND	GND	36
33	GND	BNC6 SIG	34
31	GND	GND	32
29	Reserved	Reserved	30
27	Reserved	Reserved	28
25	Reserved	Reserved	26
23	GND	GND	24
21	GND	BNC8_SIG	22
19	GND	GND	20
17	BNC9 SIG	GND	18
15	GND	GND	16
13			14
11			12
9			10
7			8
5			6
3			4
1	AN BMID2 = 3K01	AN BMID = 6K98	2

6 BNC, 4 Audio Full Rear Module

This rear module is available from Ross Video. The part numbers are R1B-6B-4A and R2A-6B-4A for the 10-slot and 20-slot frames respectively. The Audio connections are supplied through WECO™ connectors. **Figure 9.3** displays the connection map for this rear module.

✶ This rear module displays an "**F**" in the top left corner.

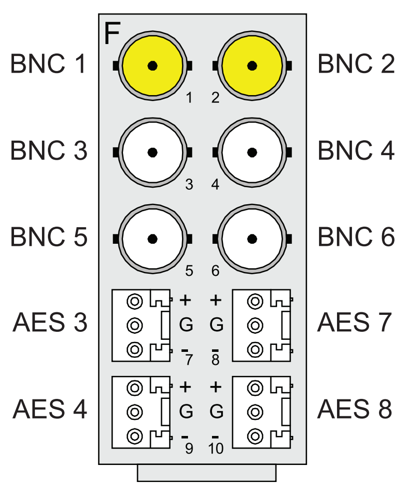


Figure 9.3 Full Rear Module — 6 BNC, 4 Audio

Pin #	Card Component Side	Card Solder Side	Pin #
99	BNC1 GND	BNC1 GND	100
97	BNC1-SIG	BNC1 GND	98
95	BNC1_GND	BNC1_GND	96
93	BNC2 GND	BNC2 GND	94
91	BNC2 GND	BNC2 SIG	92
89	BNC2 GND	BNC2 GND	90
87	GND	GND	88
85	Reserved	Reserved	86
83	Reserved	Reserved	84
81	GND	GND	82
79	GND	BNC4_SIG	80
77	GND	GND	78
75	BNC3 SIG	GND	76
73	GND	GND	74
71	GND	GND	72
69			70
67			68
65	GND	GND	66
63			64
61			62
59	GND	GND	60
57	AES3P (+)	AES7P (+)	58
55	AES3N (-)	AES7N (-)	56
53	GND	GND	54
51	AES4P (+)	AES8P (+)	52
49	AES4N (-)	AES8N (-)	50
47	GND	GND	48
45	Reserved	Reserved	46
43	Reserved	Reserved	44
41	KEY	KEY	42
39	GND	GND	40
37	BNC5 SIG	GND	38
35	GND	GND	36
33	GND	BNC6 SIG	34
31	GND	GND	32
29	Reserved	Reserved	30
27	Reserved	Reserved	28
25	Reserved	Reserved	26
23	GND	GND	24
21	GND		22
19	GND	GND	20

Pin #	Card Component Side	Card Solder Side	Pin #
17		GND	18
15	GND	GND	16
13			14
11			12
9			10
7			8
5			6
3			4
1	AN BMID2 = 4K321	AN BMID = 6K98	2

2BNC, 8 Audio Full Rear Module

This rear module is available from Ross Video. The part numbers are R1-2B-8A and R2-2B-8A for the 10-slot and 20-slot frames respectively. The Audio connections are supplied through WECO™ connectors. **Figure 9.4** displays the connection map for this rear module.

✶ This rear module displays an "**D**" in the top left corner.

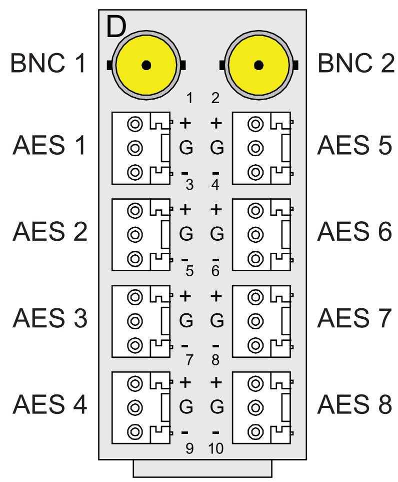


Figure 9.4 Full Rear Module — 2 BNC, 8 Audio

Pin #	Card Component Side	Card Solder Side	Pin #
99	BNC1 GND	BNC1 GND	100
97	BNC1-SIG	BNC1 GND	98
95	BNC1_GND	BNC1_GND	96
93	BNC2 GND	BNC2 GND	94
91	BNC2 GND	BNC2 SIG	92
89	BNC2 GND	BNC2 GND	90
87	GND	GND	88
85	Reserved	Reserved	86
83	Reserved	Reserved	84
81	GND	GND	82
79	GND		80

Pin #	Card Component Side	Card Solder Side	Pin #
77	GND	GND	78
75		GND	76
73	GND	GND	74
71	GND	GND	72
69	AES1P (+)	AES5P (+)	70
67	AES1N (-)	AES5N (-)	68
65	GND	GND	66
63	AES2P (+)	AES6P (+)	64
61	AES2N (-)	AES6N (-)	62
59	GND	GND	60
57	AES3P (+)	AES7P (+)	58
55	AES3N (-)	AES7N (-)	56
53	GND	GND	54
51	AES4P (+)	AES8P (+)	52
49	AES4N (-)	AES8N (-)	50
47	GND	GND	48
45	Reserved	Reserved	46
43	Reserved	Reserved	44
41	KEY	KEY	42
39	GND	GND	40
37		GND	38
35	GND	GND	36
33	GND		34
31	GND	GND	32
29	Reserved	Reserved	30
27	Reserved	Reserved	28
25	Reserved	Reserved	26
23	GND	GND	24
21	GND		22
19	GND	GND	20
17		GND	18
15	GND	GND	16
13			14
11			12
9			10
7			8
5			6
3			4
1	AN BMID2 = 9K76	AN BMID = 6K98	2

10 Audio Full Rear Module

This DFR-8321 rear module is not available from Ross Video. It was designed by Ward-Beck Systems Ltd. and uses Phoenix™ connectors. **Figure 9.5** displays the connection map for this rear module.

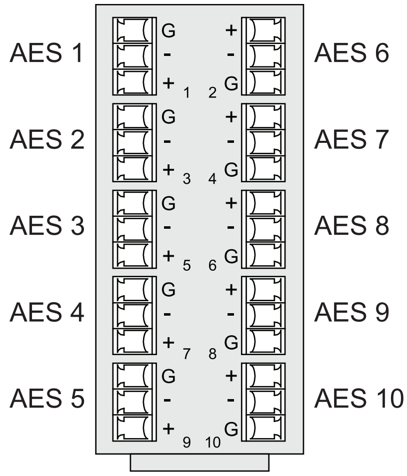


Figure 9.5 Full Rear Module — 10 Audio

Pin #	Card Component Side	Card Solder Side	Pin #
99	BNC1 GND(-)	BNC1 GND (-)	100
97	BNC1-SIG(+)	BNC1 GND (-)	98
95	BNC1_GND (-)	BNC1_GND (-)	96
93	BNC2 GND (-)	BNC2 GND(-)	94
91	BNC2 GND (-)	BNC2 SIG (+)	92
89	BNC2 GND (-)	BNC2 GND (-)	90
87	GND	GND	88
85	Reserved	Reserved	86
83	Reserved	Reserved	84
81	GND	GND	82
79	GND		80
77	GND	GND	78
75		GND	76
73	GND	GND	74
71	GND	GND	72
69	AES1P (+)	AES5P (+)	70
67	AES1N (-)	AES5N (-)	68
65	GND	GND	66
63	AES2P (+)	AES6P (+)	64
61	AES2N (-)	AES6N (-)	62
59	GND	GND	60
57	AES3P (+)	AES7P (+)	58
55	AES3N (-)	AES7N (-)	56
53	GND	GND	54
51	AES4P (+)	AES8P (+)	52

Pin #	Card Component Side	Card Solder Side	Pin #
49	AES4N (-)	AES8N (-)	50
47	GND	GND	48
45	Reserved	Reserved	46
43	Reserved	Reserved	44
41	KEY	KEY	42
39	GND	GND	40
37		GND	38
35	GND	GND	36
33	GND		34
31	GND	GND	32
29	Reserved	Reserved	30
27	Reserved	Reserved	28
25	Reserved	Reserved	26
23	GND	GND	24
21	GND		22
19	GND	GND	20
17		GND	18
15	GND	GND	16
13			14
11			12
9			10
7			8
5			6
3			4
1	AN BMID2 = 3K57	AN BMID = 3K57	2

10 BNC Split Rear Module

This DFR-8321 rear module is available from Ross Video (Part# R2S-10B). **Figure 9.6** displays the connection map for this rear module.

✶ This rear module displays an “**B**” in the top left corner.

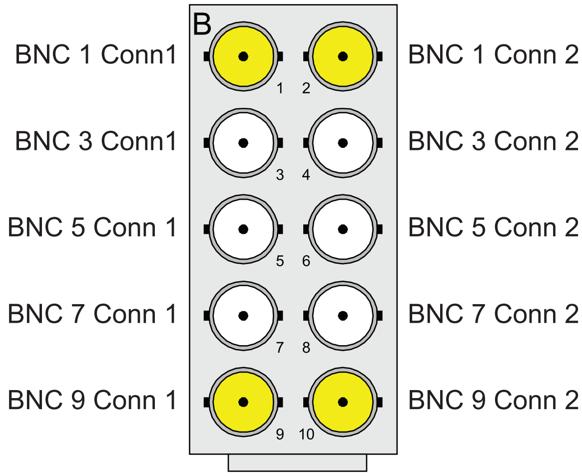


Figure 9.6 Split Rear Module — 10 BNC

CONNECTOR 1				CONNECTOR 2			
Pin #	**Card Component Side**	**Card Solder Side**	**Pin #**	**Pin #**	**Card Component Side**	**Card Solder Side**	**Pin #**
99	BNC1 GND	BNC1 GND	100	99	BNC1 GND	BNC1 GND	100
97	BNC1-SIG	BNC1_GND	98	97	BNC1-SIG	BNC1_GND	98
95	BNC1 GND	BNC1 GND	96	95	BNC1_GND	BNC1 GND	96
93			94	93			94
91			92	91			92
89			90	89			90
87	GND	GND	88	87	GND	GND	88
85	Reserved	Reserved	86	85	Reserved	Reserved	86
83	Reserved	Reserved	84	83	Reserved	Reserved	84
81	GND	GND	82	81	GND	GND	82
79	GND		80	79	GND		80
77	GND	GND	78	77	GND	GND	78
75	BNC3_SIG	GND	76	75	BNC3_SIG	GND	76
73	GND	GND	74	73	GND	GND	74
71	GND	GND	72	71	GND	GND	72
69			70	69			70
67			68	67			68
65	GND	GND	66	65	GND	GND	66
63			64	63			64
61			62	61			62
59	GND	GND	60	59	GND	GND	60
57			58	57			58
55			56	55			56
53	GND	GND	54	53	GND	GND	54
51			52	51			52
49			50	49			50
47	GND	GND	48	47	GND	GND	48

CONNECTOR 1				CONNECTOR 2			
Pin #	Card Component Side	Card Solder Side	Pin #	Pin #	Card Component Side	Card Solder Side	Pin #
45	Reserved	Reserved	46	45	Reserved	Reserved	46
43	Reserved	Reserved	44	43	Reserved	Reserved	44
41	KEY	KEY	42	41	KEY	KEY	42
39	GND	GND	40	39	GND	GND	40
37	BNC5_SIG	GND	38	37	BNC5_SIG	GND	38
35	GND	GND	36	35	GND	GND	36
33	GND		34	33	GND		34
31	GND	GND	32	31	GND	GND	32
29	Reserved	Reserved	30	29	Reserved	Reserved	30
27	Reserved	Reserved	28	27	Reserved	Reserved	28
25	Reserved	Reserved	26	25	Reserved	Reserved	26
23	GND	GND	24	23	GND	GND	24
21	GND		22	21	GND		22
19	GND	GND	20	19	GND	GND	20
17	BNC7 SIG	GND	18	17	BNC7 SIG	GND	18
15	GND	GND	16	15	GND	GND	16
13			14	13			14
11			12	11			12
9			10	9			10
7	BNC9_GND	BNC9_GND	8	7	BNC9_GND	BNC9_GND	8
5	BNC9-SIG	BNC9_GND	6	5	BNC9-SIG	BNC9_GND	6
3	BNC9_GND	BNC9_GND	4	3	BNC9_GND	BNC9_GND	4
1	AN BMID2 = 6K98	AN BMID = 6K98	2	1	AN BMID2 = 6K98	AN BMID = 6K98	2

6 BNC, 4 Audio Split Rear Module

This DFR-8321 rear module is available from Ross Video (Part# R2BS-6B-4A). This rear module uses WECO™ connectors to bring out the audio signals. **Figure 9.7** displays the connection map for this rear module.

✶ This rear module displays an "**G**" in the top left corner.

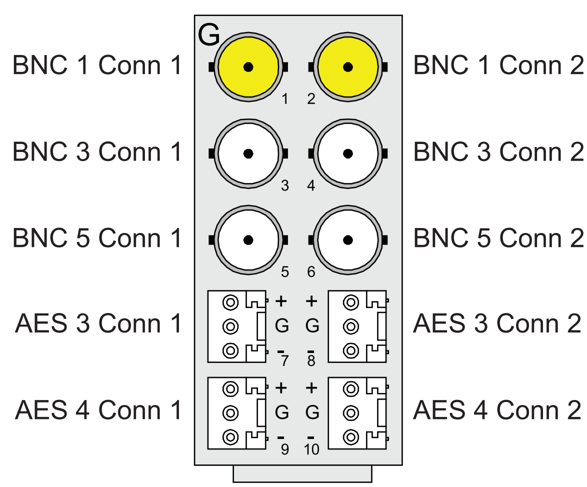


Figure 9.7 Split Rear Module — 6 BNC, 4 Audio

CONNECTOR 1			
Pin #	Card Component Side	Card Solder Side	Pin #
99	BNC1 GND	BNC1 GND	100
97	BNC1-SIG	BNC1_GND	98
95	BNC1 GND	BNC1 GND	96
93			94
91			92
89			90
87	GND	GND	88
85	Reserved	Reserved	86
83	Reserved	Reserved	84
81	GND	GND	82
79	GND		80
77	GND	GND	78
75	BNC3_SIG	GND	76
73	GND	GND	74
71	GND	GND	72
69			70
67			68
65	GND	GND	66
63			64
61			62
59	GND	GND	60
57	AES3P (+)		58
55	AES3N (-)		56
53	GND	GND	54
51	AES4P (+)		52
49	AES4N (-)		50
47	GND	GND	48
45	Reserved	Reserved	46
43	Reserved	Reserved	44
41	KEY	KEY	42
39	GND	GND	40
37	BNC5_SIG	GND	38
35	GND	GND	36
33	GND		34
31	GND	GND	32
29	Reserved	Reserved	30
27	Reserved	Reserved	28
25	Reserved	Reserved	26
23	GND	GND	24
21	GND		22

CONNECTOR 2			
Pin #	Card Component Side	Card Solder Side	Pin #
99	BNC1 GND	BNC1 GND	100
97	BNC1-SIG	BNC1_GND	98
95	BNC1 GND	BNC1 GND	96
93			94
91			92
89			90
87	GND	GND	88
85	Reserved	Reserved	86
83	Reserved	Reserved	84
81	GND	GND	82
79	GND		80
77	GND	GND	78
75	BNC3_SIG	GND	76
73	GND	GND	74
71	GND	GND	72
69			70
67			68
65	GND	GND	66
63			64
61			62
59	GND	GND	60
57	AES3P (+)		58
55	AES3N (-)		56
53	GND	GND	54
51	AES4P (+)		52
49	AES4N (-)		50
47	GND	GND	48
45	Reserved	Reserved	46
43	Reserved	Reserved	44
41	KEY	KEY	42
39	GND	GND	40
37	BNC5_SIG	GND	38
35	GND	GND	36
33	GND		34
31	GND	GND	32
29	Reserved	Reserved	30
27	Reserved	Reserved	28
25	Reserved	Reserved	26
23	GND	GND	24
21	GND		22

CONNECTOR 1				CONNECTOR 2			
Pin #	Card Component Side	Card Solder Side	Pin #	Pin #	Card Component Side	Card Solder Side	Pin #
19	GND	GND	20	19	GND	GND	20
17		GND	18	17		GND	18
15	GND	GND	16	15	GND	GND	16
13			14	13			14
11			12	11			12
9			10	9			10
7			8	7			8
5			6	5			6
3			4	3			4
1	AN BMID2 = 3K57	AN BMID = 6K98	2	1	AN BMID2 = 3K57	AN BMID = 6K98	2

10 Audio Split Rear Module

This DFR-8321 rear module is not available from Ross Video. It was designed by Ward-Beck Systems Limited and uses Phoenix™ connectors. **Figure 9.8** shows the physical details of the PCB for an openGear 10 Audio Split Rear Module.

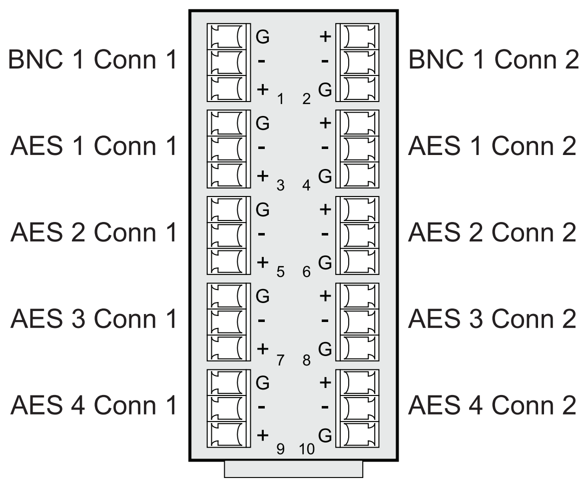


Figure 9.8 Split Rear Module — 10 Audio

CONNECTOR 1				CONNECTOR 2			
Pin #	Card Component Side	Card Solder Side	Pin #	Pin #	Card Component Side	Card Solder Side	Pin #
99	BNC1 GND (-)	BNC1 GND (-)	100	99	BNC1 GND	BNC1 GND	100
97	BNC1-SIG (+)	BNC1_GND (-)	98	97	BNC1-SIG	BNC1_GND	98
95	BNC1 GND (-)	BNC1 GND (-)	96	95	BNC1 GND	BNC1 GND	96
93			94	93			94
91			92	91			92
89			90	89			90
87	GND	GND	88	87	GND	GND	88
85	Reserved	Reserved	86	85	Reserved	Reserved	86
83	Reserved	Reserved	84	83	Reserved	Reserved	84
81	GND	GND	82	81	GND	GND	82

CONNECTOR 1				CONNECTOR 2			
Pin #	Card Component Side	Card Solder Side	Pin #	Pin #	Card Component Side	Card Solder Side	Pin #
79	GND		80	79	GND		80
77	GND	GND	78	77	GND	GND	78
75		GND	76	75	BNC3_SIG	GND	76
73	GND	GND	74	73	GND	GND	74
71	GND	GND	72	71	GND	GND	72
69	AES1P (+)		70	69			70
67	AES1N (-)		68	67			68
65	GND	GND	66	65	GND	GND	66
63	AES2P (+)		64	63			64
61	AES2N (-)		62	61			62
59	GND	GND	60	59	GND	GND	60
57	AES3P (+)		58	57	AES3P (+)		58
55	AES3N (-)		56	55	AES3N (-)		56
53	GND	GND	54	53	GND	GND	54
51	AES4P (+)		52	51	AES4P (+)		52
49	AES4N (-)		50	49	AES4N (-)		50
47	GND	GND	48	47	GND	GND	48
45	Reserved	Reserved	46	45	Reserved	Reserved	46
43	Reserved	Reserved	44	43	Reserved	Reserved	44
41	KEY	KEY	42	41	KEY	KEY	42
39	GND	GND	40	39	GND	GND	40
37		GND	38	37	BNC5_SIG	GND	38
35	GND	GND	36	35	GND	GND	36
33	GND		34	33	GND		34
31	GND	GND	32	31	GND	GND	32
29	Reserved	Reserved	30	29	Reserved	Reserved	30
27	Reserved	Reserved	28	27	Reserved	Reserved	28
25	Reserved	Reserved	26	25	Reserved	Reserved	26
23	GND	GND	24	23	GND	GND	24
21	GND		22	21	GND		22
19	GND	GND	20	19	GND	GND	20
17		GND	18	17		GND	18
15	GND	GND	16	15	GND	GND	16
13			14	13			14
11			12	11			12
9			10	9			10
7			8	7			8
5			6	5			6
3			4	3			4
1	AN BMID2 = 887R	AN BMID = 3K57	2	1	AN BMID2 = 887R	AN BMID = 3K57	2

DFR-8321 Frames

This chapter contains information about the DFR-8321 series frames. This frame is no longer produced but, as cards and many rear modules designed for the OG3-FR frame may also be installed in the DFR-8321 series frames, this section provides a reference for that frame.

Frame Overview

The DFR-8321 is an openGear 2RU Frame, that is capable of housing up to 20 plug-in card modules plus one frame controller card. This frame is composed of steel sides for added strength in stressful environments and an aluminum lid and bottom for light weight. The back of the frame allows for custom rear I/O interface modules that can be application specific.

The card guides will be included in the frame to support 20 openGear processing cards plus one Frame controller card. Whether all these card guides are used or not will depend on the configuration of the rear modules used in the frame.

The Frame is shown in the following figures below.

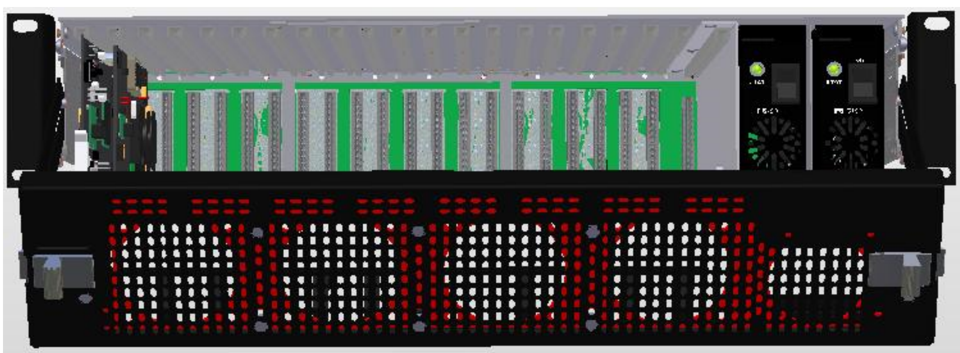


Figure 10.1 DFR-8321 Frame — Front View with Door Open

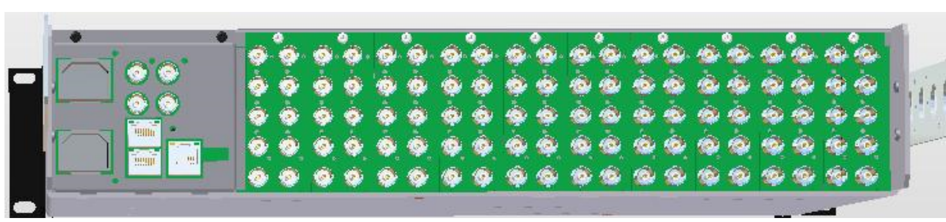


Figure 10.2 DFR-8321 Frame — Rear View with 10-BNC Rear Modules

Front Door

The front door of the frame is the main area that is seen by customers. The DFR-8321 door has small openings for the fan intake, which helps reduce emissions and increase noise immunity. The front door and the front of the ears on the DFR-8321 are powder painted with a black finish, but the rest of the frame is not painted. All silkscreen on the front door is white.

The front door of all the frames includes the following features:

- 1”x 1” emboss — To be used by openGear partners to brand their frames.
- FAULT LED — A red LED lights up to indicate a failure in the frame.
- FAN FAIL LED — This red LED lights if there is a problem with the fan board. Ex: fan stalled, fan defective.
- Mute button — To turn off audible alarm.

As an added feature, the DFR-8321 frame door can be separated from the frame without the use of any tools. This makes servicing the fan board or changing the filter much easier.

Figure 10.3 Front Door — Open to Display Hinges

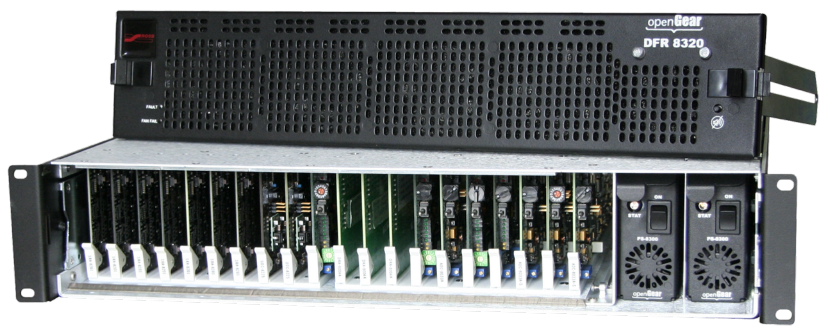


Figure 10.4 Front Door — Removed from Frame without Tools

Fan Card

The cooling of the frame is performed by the fan board mounted on the front door with air flow running from the front of the frame to the back of the frame. The fan card has four main 60mm fans plus a smaller 50mm fan for the power supplies. Power and variable speed control for the fan board is supplied by any variant of the Frame Controller card.

A filter is installed between the fan board and the front door to keep the inside of the frame free of dust. This filter may require to be cleaned periodically in dusty environments.

The fan board supports variable speed control. Depending on the power in the frame and on the heat rise in the frame, the fan speed will adjust accordingly. Once the frame is running with more than 60 watts, the fan speed reaches its maximum. This feature helps prolong the life of the fans, helps control the noise level and saves energy.

Frame Brackets

In high stress environments, frame support brackets (FSB-8320) are available to support the rear of the frame to the rear of the rack. The support brackets consists of two support bars, two support brackets and screws to attach the support bar to the frame.

The installation of the support brackets is shown in the figure below.

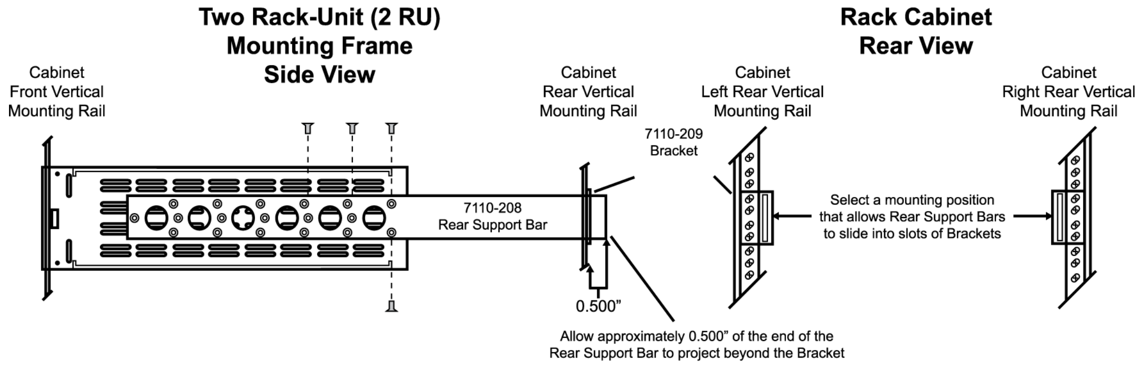


Figure 10.5 FSB-8321 — Frame Support Bracket Installation

Frame Midplanes

This section provides information on the midplanes for the DFR-8321 and DFR-8320 frames.

DFR-8321 Midplane

The midplane for the DFR-8321 frame has 20 HSEC8 card connectors to support up to 20 processing cards. Whether the frame is used with 20 cards or less will depend on the rear modules and not the midplane. Also, there is one MEC1 connector for the MFC-8320-x Frame Controller card. This allows the frame to be filled with 20 processing cards and 1 Frame Controller card. Finally, the power connectors to supply the +12 volts and –7.5 volts are also on the midplane.

On the back of the midplane, connections are provided for two looping frame references and an RJ45 connector for 10/100 Ethernet communications to the frame controller. The circuitry to buffer the frame reference to each slot also resides on the midplane.

The midplane has 10 cutouts for rear module connections. Slot 1 and Slot 2 share the first cutout, Slot 3 and Slot 4 share the second cutout and so on. The exact alignment and dimensions of these cutouts are displayed in the figure below. The ribs between cutouts restrict the height of components on all Rear Modules – this is more of an issue for double wide Rear Modules.

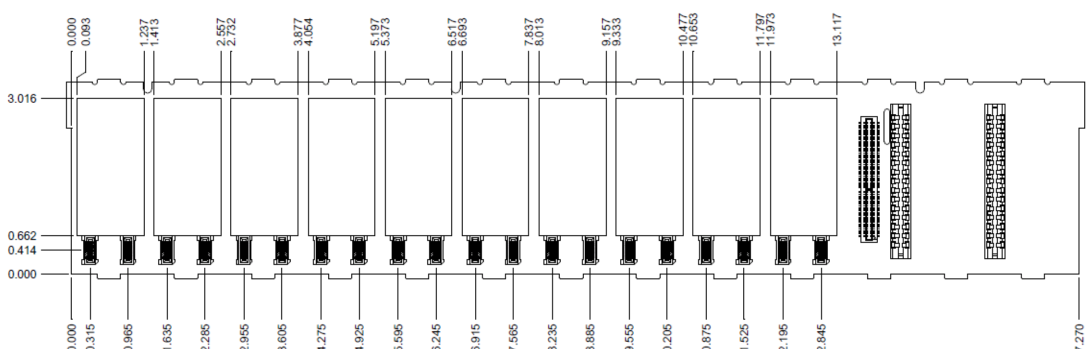


Figure 10.6 DFR-8321 Midplane — Physical Layout

It is important to note that the even slots become the primary slots in a 10 card configuration. This was required to allow optimal routing on the rear modules for high speed signals.

Private Serial Bus (PSB)

On the DFR-8321 midplane, provision was made to provide a secondary, higher speed communications bus. This functionality was never implemented.

DFR-8320 Midplane

The DFR-8320 midplane is very similar to the DFR-8321 midplane. The major differences are in the size of the cutouts and the reference circuitry and Ethernet jack was on a separate PCB attached to the midplane. These connectors and circuitry has been absorbed onto the DFR-8321 midplane.

The dimensions of the DFR-8320 midplane are shown in the figure below.

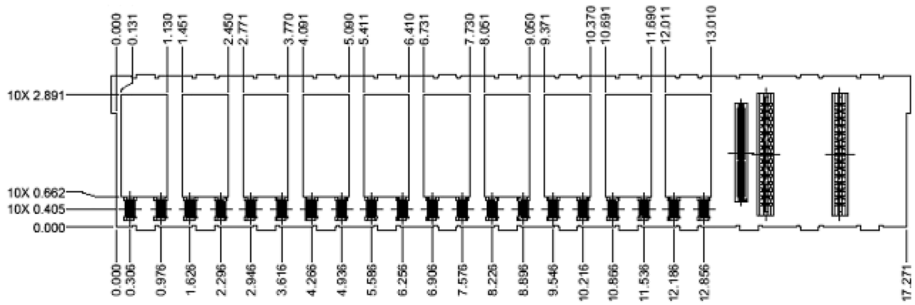


Figure 10.7 DFR-8320 Midplane — Physical Layout

Frame Connections

Each frame provides several connections on the rear panel that are required for frame operation.

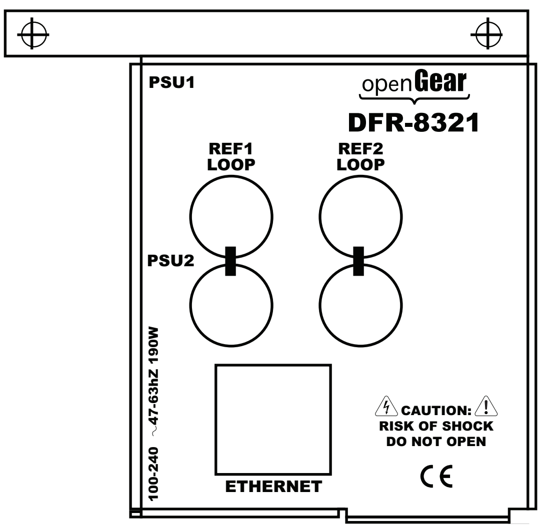


Figure 10.8 DFR-8321 — Rear Panel Connections

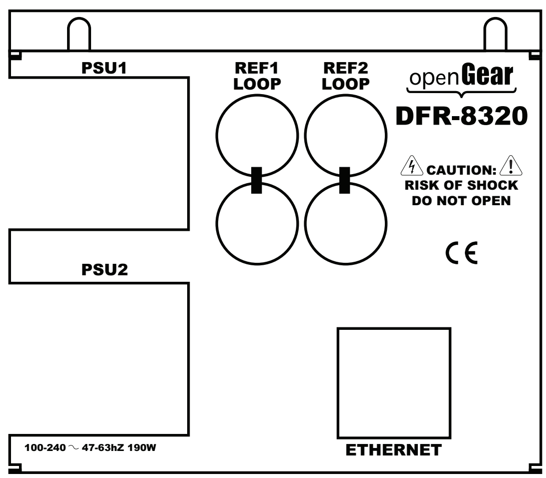


Figure 10.9 DFR-8320 — Rear Panel Connections

Table 10.1 provides the connections based on the openGear frame model.

Table 10.1 Connections — MFC Pinouts

MFC Pin #	MFC-8320-N or MFC-8320-S 10/100 with Auto MDIX PIN Description
1	TX+
2	TX-
3	RX+
4	Terminated to GND
5	Terminated to GND
6	RX-
7	Terminated to GND
8	Terminated to GND

Power Supply Overview

The PS-8300 power supply can be used in the DFR-8321 and DFR-8310 frames. These are hot swappable 150W power supplies. The specifications of this power supply are outlined in following sections.

A single power supply can power the entire frame. Two power supplies can be used to provide additional redundancy on power supply or AC input failure.

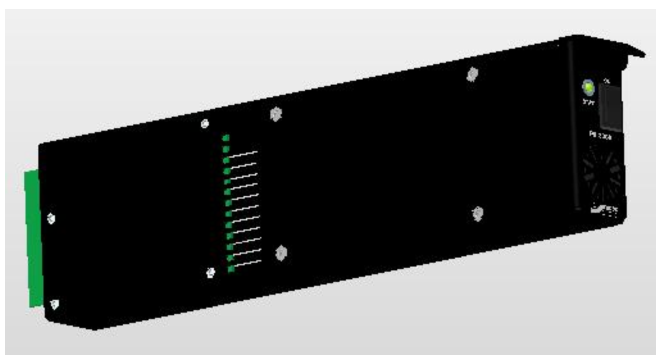


Figure 10.10 PS-8300 150W Power Supply for the DFR-8310 and DFR-8321

The rear of the power supply has a PCB with edge fingers that plug into card edge connectors on the midplane. The connector provides the following signals:

- AC input
- +12V and –7.5V DC outputs
- Power supply monitoring and alarms

On the front of the power supply are the following:

- On/off switch
- Cooling fan
- Bi-color LED that indicates one of the following status:
  - › Green — The power supply is operating normally.
  - › Red — When flashing there is either an over or under voltage condition, or there is no AC input when a redundant power supply is operating normally.

DFR-8321 Power Dissipation

openGear Cards are limited in power dissipation due to the cooling design employed by the frame. A maximum of 6watts per slot has been accommodated in the design. This maximum value is valid for a frame with the fan kit. Without moving air, this rating has to be de-rated to 2watts per slot.

Any openGear module which dissipates more than 6watts should be physically designed in such a way as to occupy more than one card slot, thereby restricting the addition of another module directly adjacent to it. This can be accomplished via the addition of a standoff (or equivalent).

- A module dissipating 6-12watts will occupy two card slots.
- A module dissipating 12-24watts will occupy 4 card slots.
- Under no circumstances can a module dissipate in excess of 24watts.

Power distribution is very important for the success of the openGear frame. The capability of being able to populate a frame with cards from various manufacturers is a very strong point of openGear. To achieve this successfully, we must obey the power limits to avoid frames from being overloaded.

Everyone will agree that one day, a technician somewhere will see an empty slot and want to populate it with a card. How will he know if the card can be plugged in or not? Maybe the frame is already filled with 19 cards that use up more than 6watts each and that one slot was kept empty intentionally when the frame was originally installed.

As providers of openGear products, we have a responsibility to protect our customers from such events. Ross Video has decided to create a blocker card that is mounted on the card to physically prevent customers from plugging in another card. We encourage our openGear partners to do the same. Ross Video will gladly share details on the blocker card with anyone interested.

Reference Distribution

Each frame has two frame wide, looping reference inputs. These can be used to distribute any reference signal to all the slots in the frame, up to a maximum bandwidth of 10MHz. This can include SD black burst, HD tri-level, or DARS.

In the DFR-8321 frames, each reference input is buffered using an opamp and distributed to each of the 20 slots in a star configuration as shown below.

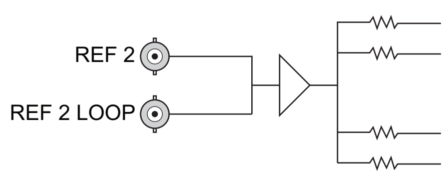


Figure 10.11 DFR-8321 — Simplified Reference Distribution

Because these reference signals are shared among all the slots in the frame, it is important that the cards do not terminate the frame reference inputs, but maintain a high impedance input. In addition, the stub length, resistance and capacitance values must be kept to a minimum to ensure that cards do not degrade the signal quality of the reference within the frame.

Environmental Specifications

This section provides information on the required environmental conditions, and frame airflow.

Internal Environmental

All openGear products are designed for studio use within the following environmental conditions:

- Frame Ambient Temperature — 5°C through 40°C
- Cooling — Forced air from front of the frame through the back of the rear I/Os.

With an external temperature of 40°C, there will be a temperature increase towards the exhaust end of modules. The allowable temperature rise is defined to be 25°C. Thus, modules within an openGear frame must operate within the following temperature range: 5°C through 65°C.

Frame Airflow

The frames with the cooling fan installed in the front door have a front to rear airflow as shown in the diagram below. Although the frame is specified to support up to 120W of processing cards, it is up to the individual cards to manage their thermal requirements across all valid slots in each frame.

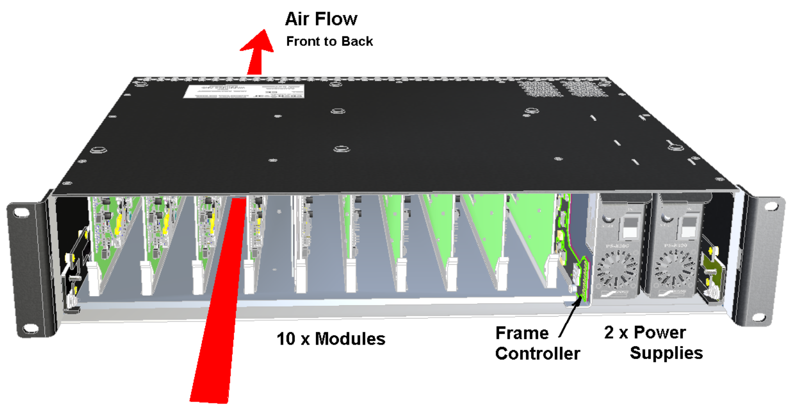


Figure 10.12 DFR-8321 — 2RU, Air Flow

Designing Cards for the DFR-8321

This section provides information on designing cards for high density, standard density, and details the absolute maximum component height for cards.

High Density

To support the highest density possible of 20 cards in an DFR-8321 frame, cards must be designed to take advantage of split rear modules in the frames. These have the tightest height restrictions as outlined in **Figure 10.13**.

These cards also have a maximum power consumption limit of 6W in the DFR-8321 frame.

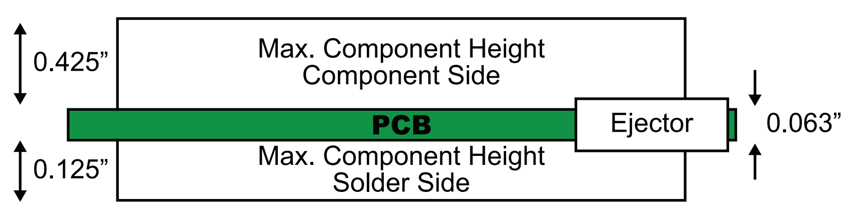


Figure 10.13 Max. Component Height for Cards Designed with Split Rear Modules (Max. 20 Cards)

Standard Density

Cards that exceed the above power or height restriction can use full rear modules, taking up two slots in the frame. Ten cards can be installed into an DFR-8321 frame if it meets the component height restrictions as outlined in **Figure 10.14**.

These cards also have a maximum power consumption limit of 12W in the DFR-8321 frame.

✶ This assumes that the cards plug into the even-numbered slots.

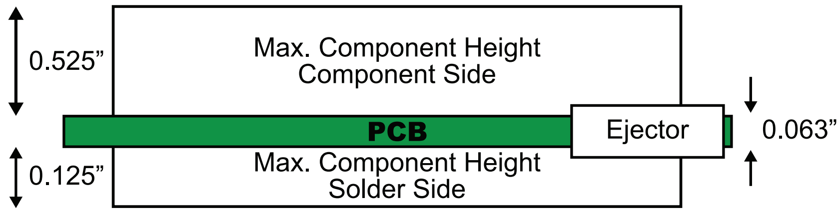


Figure 10.14 Max. Component Height for Cards Designed with Full Rear Modules (Max. 10 Cards)

Absolute Maximum Component Height

The absolute maximum component height supported by DFR-8321 is shown in **Figure 10.15**. Utilizing full rear modules, the DFR-8321 frame can only support 9 cards with these dimensions, due to the height constraint on slot 20 and the frame controller card.

✶ This assumes that the cards plug into the even-numbered slots.

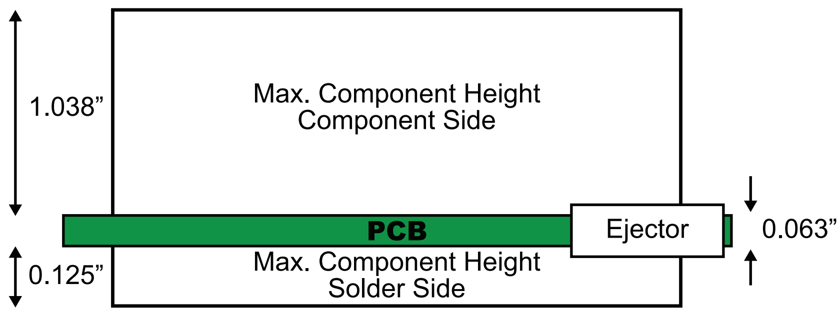


Figure 10.15 Max. Component Height for Cards Designed with Full Rear Modules (Max. 9 Cards)

The table below breaks down the spacing of the entire 20-slot frame. As the picture above indicates and the table below confirms, if the component height is respected, frames will work with a combination of Full rear modules and Split rear modules. Since it is not always possible to design cards that meet this height specification or they plug into odd numbered slots we have provided a table that shows the spacing between every slot. If a card has to be above the 0.425 height, it will interfere with the adjacent slot. If a card is designed as such, special consideration should be planned to protect the components from being hit by other cards populating the adjacent slot.

✶ Slot 20 in the DFR-8321 2RU frame has a fixed limit. The maximum component side height is limited to 0.525” due to the proximity to the frame controller PCB.

Slot #	PEM	bott	**1**	top	bott	**2**	top	bott	**3**	top	bott	**4**	top	bott	**5**	top
Cards for 10 slot frame:																
distance from inner left wall			325			975			1645			2295			2965	
Space between slots	325			650			670			650			670			650
Spacing Specifications	108	125	63	425	125	63	425	125	63	425	125	63	425	125	63	425
Tolerance	60			37			57			37			57			37
Slot #		bott	**6**	top	bott	**7**	top	bott	**8**	top	bott	**9**	top	bott	**10**	top
Cards for 10 slot frame:																
distance from inner left wall			3615			4285			4935			5605			6255	
Space between slots				670			650			670			650			670
Spacing Specifications		125	63	425	125	63	425	125	63	425	125	63	425	125	63	425
Tolerance				57			37			57			37			57
Slot #		bott	**11**	top	bott	**12**	top	bott	**13**	top	bott	**14**	top	bott	**15**	top
Cards for 10 slot frame:																
distance from inner left wall			6925			7575			8245			8895			9565	
Space between slots				650			670			650			670			650
Spacing Specifications		125	63	425	125	63	425	125	63	425	125	63	425	125	63	425
Tolerance				37			57			37			57			37

Slot #	bott	16	top	bott	17	top	bott	18	top	bott	19	top	bott	20	top
Cards for 10 slot frame:															
distance from inner left wall		10215			10885			11535			12205			12855	
Space between slots			670			650			670			650			820
Spacing Specifications	125	63	425	125	63	425	125	63	425	125	63	425	125	63	525
Tolerance			57			37			57			37			32

Slot #	top	MFC	bott	Power supply
Cards for 10 slot frame:				
distance from inner left wall		13675		
Space between slots				3265
Spacing Specifications	200	63	150	

Rear Module Design for the DFR-8321

The rear I/O modules sit in slots on the bottom of the frame with a ½” 4-40 screw at the top of the card to hold them in place against the rear of the frame. The screw is held in place during installation by an O-ring on the back side of the module. Refer to the chapter “**Common openGear Parts**” on page 67 for O-ring part number.

Gold plated surfaces ground the rear module to the frame. These plated areas are crucial to passing EMI tests, they must not be overlooked.

The rear modules cannot have any components on the top 0.304” of the solder side of the rear module, as this area of the module makes contact with the frame when installed. In addition, the area below the card edge connector and the sides of the rear module have component height restrictions, limited by the midplane in the frame. Refer to the section “**Frame Midplanes**” on page 97 for additional details.

Ventilation holes are necessary on the rear modules to ensure adequate airflow through the frame. The ventilation holes can be moved around on the rear module, keeping in mind that the top ones are the most effective. A total area of 0.177” +/- 25% allow for optimal ventilation without interfering with adjacent slots.

A template from our 10-BNC Full and Split rear module is shown in the following figures and can be copied to guarantee adequate air flow on custom rear modules.

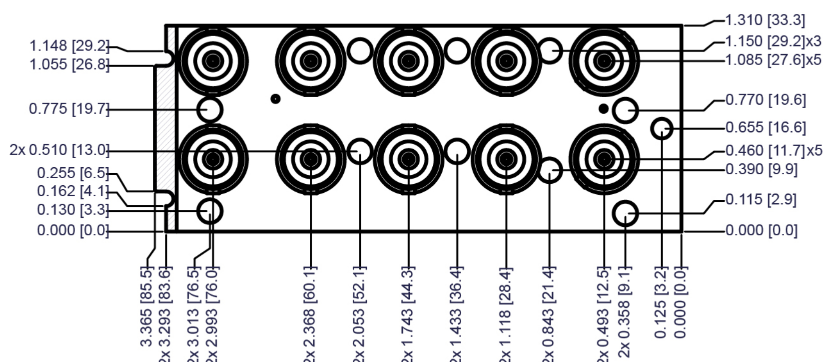


Figure 10.16 DFR-8321 Template for Rear Modules with Ventilation Pattern

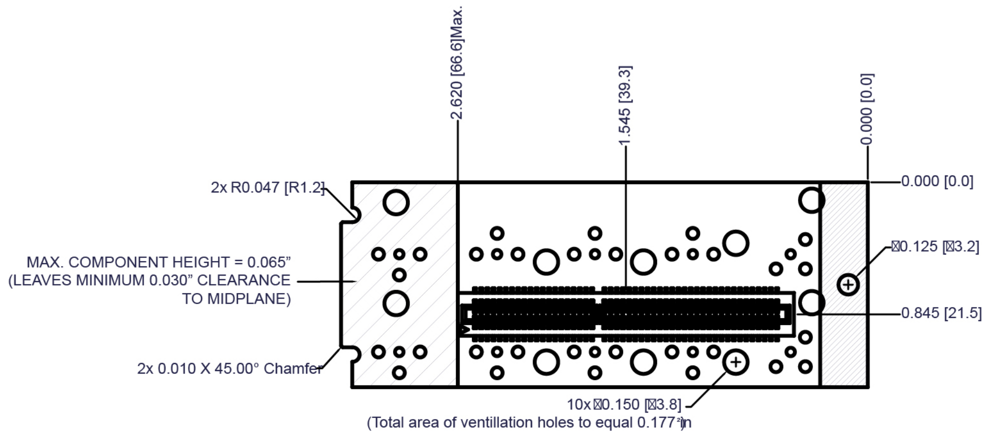


Figure 10.17 DFR-8321 Full Rear Module — Solder Side

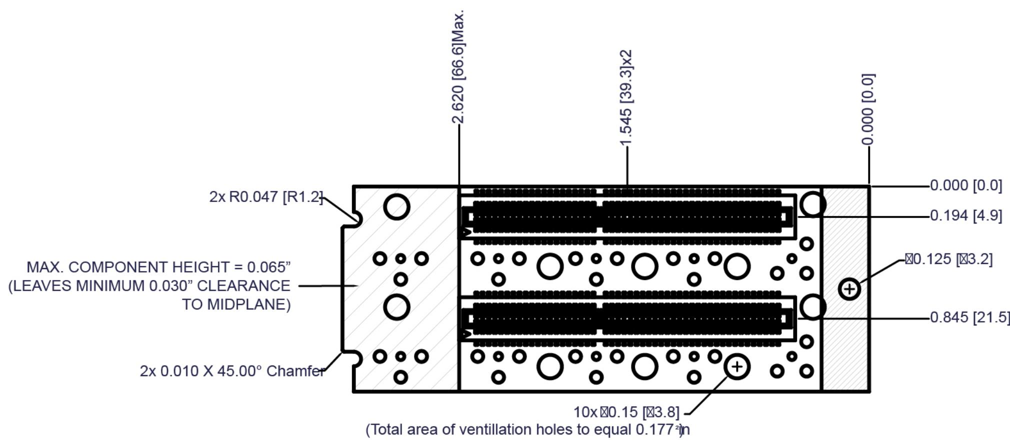


Figure 10.18 DFR-8321 Split Rear Module — Solder Side

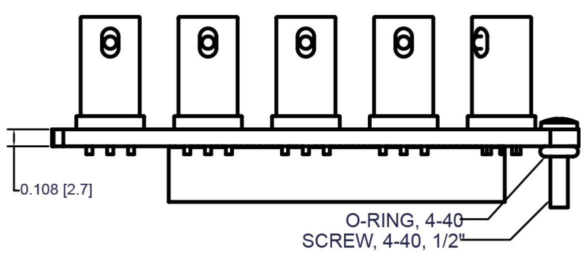


Figure 10.19 DFR-8321 Rear Module — Thickness

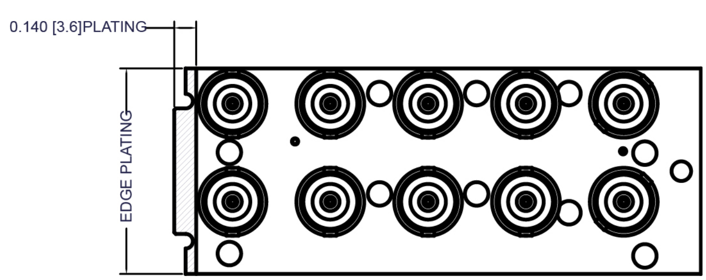


Figure 10.20 DFR-8321 Rear Module — Edge Plating on the Primary Side and Shoulders

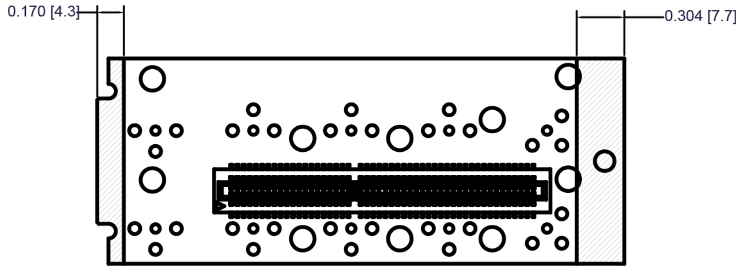


Figure 10.21 DFR-8321 Rear Module — Edge Plating on the Secondary Side

The majority of openGear BNC Rear I/O Modules for the DFR-8321 frame are designed in two flavors: Split I/O rear modules or Full I/O rear modules. The Split and Full rear module can be used together in the same frame. One Split rear module takes the same space as a Full rear module.

In the chapter “**Standard Rear I/O Modules**” on page 81 you will find the connection maps for a few standard openGear rear modules. Most are from Ross Video.

Split I/O Rear Modules

In order to take advantage of the high density capability in the DFR-8321 frame and utilize all 20 slots in a frame, split I/O rear modules will be required. These rear modules have two card connectors on the front and IO connectors on the back of the module. Because there are two card connectors on the rear module, the space available for IO connectors is limited. For example, if the split rear module uses BNCs, there is only enough room to place 5 BNCs for each card connector.

Full I/O Rear Modules

In a Full I/O rear module, there is one card connector and 10-BNCs. All 10 BNCs are connected to the card connector giving the processing card access to all 10-BNCs. This rear module is similar to the 10-slot frame rear modules.

DFR-8321 Thermal Management

This section provides a test case of measuring the DFR-8321 airflow, and observing the fan speeds under certain conditions. For more information on thermal management, refer to the chapter “**Thermal Management**” on page 69.

Objectives

1. Describe the airflow in LFM for each of the 5 fan speed steps
2. Understand how the MFC-8321 Frame Controller cards controls the fan speed

Airflow Measurements

A DFR-8321 frame was fully populated with 20 openGear cards and 10 rear modules. The airflow in linear feet per minute (LFM) was measured for all five fan speed settings as follows:

Table 10.2 Airflow Measurements

Fan Speed	Average Airflow (LFM)
1	79.4
2	86.8
3	92.9
4	97.8
5	101.3

Fan Control Algorithm

The thermal management algorithm implemented in the DFR-8321 frame is primarily based on the power consumption of the whole frame, with small temperature compensation. There are five fan speeds defined, with a large hysteresis band around each.

The DFR-8321 frame current is measures in milliamps on the +12V supply rail. The total current is evaluated by taking the maximum of one of these three cases:

- The sum of the power supply currents as reported by the PSU1 and the PSU2.
- The sum of the currents consumed in each slots, as reported by all the openGear cards
- Hot-spot case, evaluated as 3 times the highest reported card current.

Algebraically, the equation looks like this:

Total current = MAX [(PSU1 + PSU2); SUM(Slot1..Slot20); (3 x MAX[Slot1..Slot20])]

Each of the 5 fan speeds corresponds to a certain range of current. The ranges overlap significantly to provide hysteresis. The fan speed is incremented or decremented when it reaches the limit of a range.

The five current threshold values are reduced based on the ambient temperature measured at the fan door inlet. For every degree Celsius above 20°C, the current thresholds are decreased by 1% of its nominal value.

Table 10.3 Airflow Measurements

Fan Speed	Total Current (A) at 20°C or less	Total Current (A) at 40°C (20% de-rating)
1	0 to 3	0 to 2.4
2	2 to 4	1.6 to 3.2
3	3 to 5	2.4 to 4.0
4	4 to 6	3.2 to 4.8
5	>5	>4.0

Issues and Limitations

1. The measurement in milliamps is limited to a signed 16 bit integer quantity. This limits the current calculations to 32,767 mA. At 12V, this translates to 393Watts.
2. The reporting of current consumption by the openGear cards is unreliable. Cards may report current using the wrong units or wrong data type. They may use a nonstandard OID, or may use the expected OID for an entirely unrelated purpose. There is no process for openGear partners to verify compliance.
3. Current consumed on the -7.5V rail was not measured in the DFR-8321 power supplies, therefore was not considered in computing the total frame current.

4. The total current used for calculations includes the MFC card and the Fan card. This biases the current value by about 2Amp and precludes the usage of the lowest fan speed for all practical application.

DFR-8321, DFR-8320 Technical Specifications

This section provides the technical specifications for the DFR-8321, and DFR-8320 frames.

Rack Frame Mechanical

Table 10.4 DFR-832x Technical Specifications — Rack Frame Mechanical

Item	Specifications
Height	3.5” (90mm)
Width	17.45” (444mm) not including rack ears 19" (483mm) including rack ears
Depth	16.82” (427mm)

Frame Card Slots

Table 10.5 DFR-832x Technical Specifications — Frame Card Slots

Item	Specifications
Number of Slots	10 or 20
Absolute Max. Power: +12V Rail	1.0A (12W) per slot
Absolute Max. Power: -7.5 Rail	1A (7.5W) per slot
Total Frame Power	120W

Frame Controller and Fans

Table 10.6 DFR-832x Technical Specifications — Frame Controller and Fans

Item	Specifications
Max Power: +12V Rail	1.5A (18W)
Max Power: -7.5V Rail	0.2A (1.5W)
Total	19.5W maximum

Reference Inputs

Table 10.7 DFR-832x Technical Specifications — Reference Inputs

Item	Specifications
Number of Inputs	2 looping
Level	1Vpp nominal
Signal	Analog video sync (black burst or tri-level), or AES/EBU DARS
Impedance	75ohm terminating
Return Loss	>30dB to 30MHz
Max DC on Ref Input	±1V

PS-8300 Power Supply

✶ For safety reasons, Ross power supplies do not fit into rack frames of other manufacturers.

Table 10.8 DFR-832x Technical Specifications — PS-8300 Power Supply

Item	Specifications
Input	100 - 240VAC, 47-63Hz
Output 1	+12V, ± 10%, 0.5A - 12.5A
Output 2	-7.5V, ± 10%, 0A - 2.5A
Total	Sum of both outputs not to exceed 150Watt maximum

Environmental

Table 10.9 DFR-832x Technical Specifications — Environmental

Item	Specifications
Ambient temperature range	0ºC to 40ºC (32ºF to 104ºF)
Humidity, non-condensing	<95%

DFR-8310 Frames

This chapters provides a reference guide for the DFR-8310 series frames.

✶ The DFR-8310 series frame is no longer in production.

Frame Overview

The DFR-8310 is an openGear 2RU Frame capable of housing up to 10 plug-in card modules. The Frame is shown in the following figures below.

Unlike the DFR-8321 frame, the front door is attached to the frame. In order to remove the door, a screwdriver will be required.

Figure 11.1 DFR-8310 Frame — Front View

Figure 11.2 DFR-8310 Frame — Rear View

DFR-8310 Midplane

The midplane for the DFR-8310 frame has 10 HSEC8 card connectors to support up to 10 processing cards. Also, there is one MEC1 connector for the Frame Controller card. This allows the frame to be filled with 10 processing cards and 1 MFC-8310 Frame Controller card. Finally, the power connectors to supply the +12 volts and –7.5 volts are also on the midplane.

On the back of the midplane, connections are provided for two looping frame references via BNC connectors, an RJ45 connector for 10/100 Ethernet communications to the frame controller, a SMPTE Alarm connector, and an RJ45 connector labeled openBus.

The circuitry to buffer the frame reference to each slot and the SMPTE Alarm connector also resides on the midplane.

The openBus is an extension of the internal CAN communications bus. It is provided for debugging and should not be used by end customers.

Unlike the DFR-8321/20 midplanes, there are no vertical bars between slots, there are features next to slots 1 and 10 which will impact the space available for rear module connectors. In addition, there is a bracket between slots 4 and 5, which may impact the installation of cards that are more than a single slot wide.

The midplane in the DFR-8310 frame is shown in the figure below.

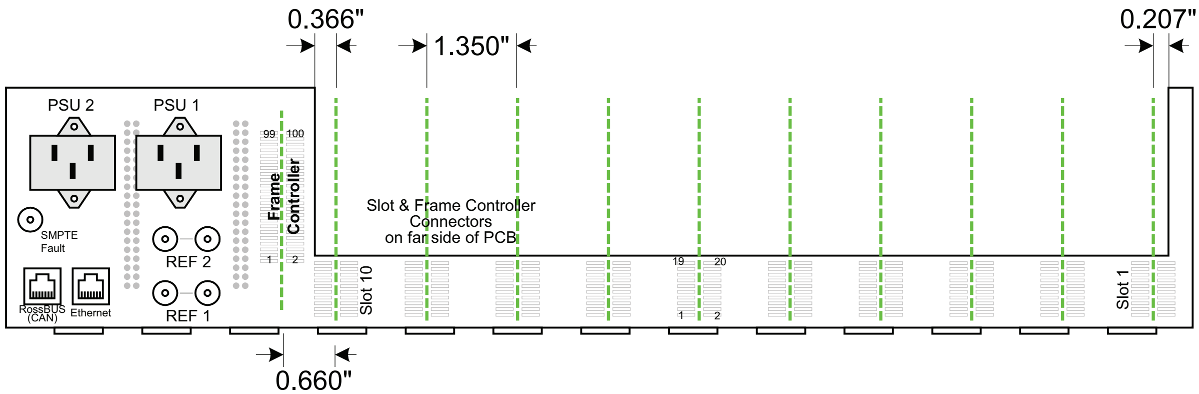


Figure 11.3 DFR-8310 Midplane — Physical Layout

DFR-8310 Frame Connections

Each frame provides several connections that are required for frame operation. These are located on the back of the frame.

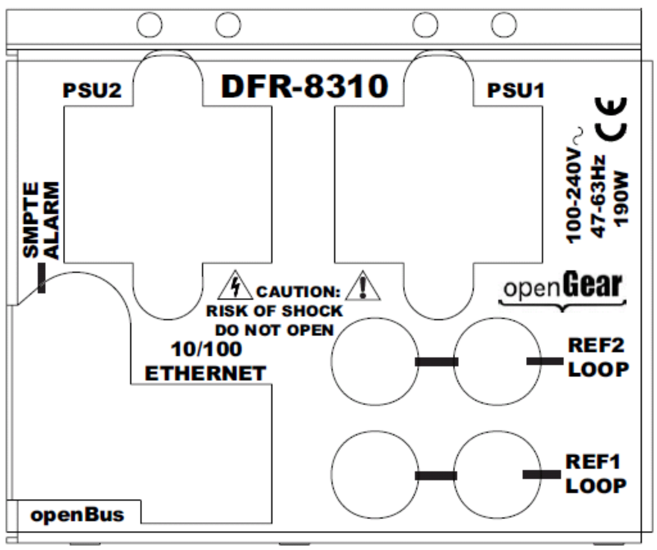


Figure 11.4 DFR-8310 — Rear Panel Connections

SMPTE Alarm

This BNC provides a SMPTE alarm when an error condition is detected in the frame, or a card reports an error. This connector is only available on the DFR-8310.

openBus Port

This RJ45 connector is an extension of the internal CAN bus. It should not be used by end customers. This connector is only available on the DFR-8310.

The connections based on the openGear frame model are given in **Table 11.1**.

Table 11.1 Connections — MFC Pinouts

MFC Pin #	MFC-8310-N 10/100, No Auto MDIX PIN Description
1	TX+
2	TX-
3	RX+
4	Terminated to GND
5	Terminated to GND
6	RX-
7	Terminated to GND
8	Terminated to GND

Frame Support Brackets

In high stress environments, frame support brackets (FSB-8310) are available to support the rear of the frame to the rear of the rack. The support brackets consist of two support bars, two support brackets and screws to attach the support bar to the frame.

The installation of the support brackets is shown in **Figure 11.5**.

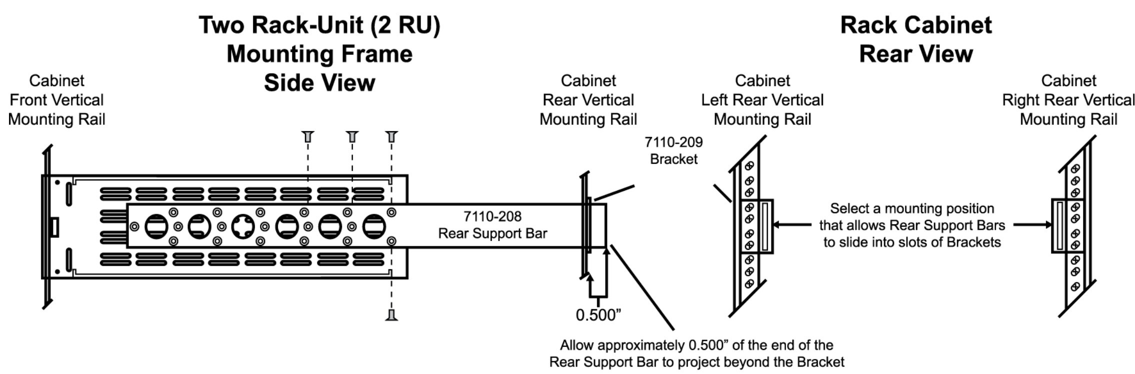


Figure 11.5 Frame Support Bracket Installation (FSB-8310)

Power Overview

The PS-8300 power supply can be used in the DFR-8321 and DFR-8310 frames. These are hot swappable 150W power supplies.

A single power supply can power the entire frame. Two power supplies can be used to provide additional redundancy on power supply or AC input failure.

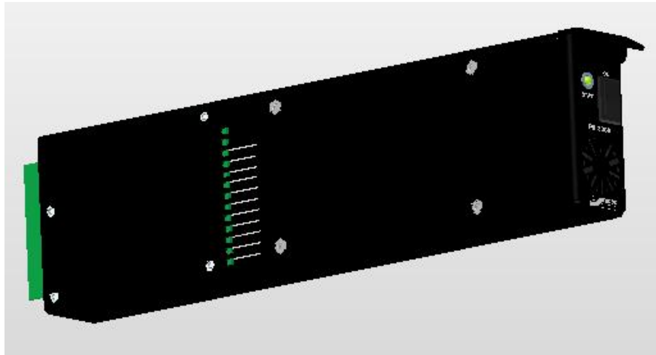


Figure 11.6 PS-8300 150W Power Supply for the DFR-8310 and DFR-8321

The rear of the power supply has a PCB with edge fingers that plug into card edge connectors on the midplane. The connector provides the following signals:

- AC input
- +12V and –7.5V DC outputs
- Power supply monitoring and alarms

On the front of the power supply are the following:

- On/off switch
- Cooling fan
- Bi-color LED that indicates one of the following status:
  - › Green – The power supply is operating normally.
  - › Red – When flashing there is either an over or under voltage condition, or there is no AC input when a redundant power supply is operating normally.

DFR-8310 Power Dissipation

openGear Cards are limited in power dissipation due to the cooling design employed by the frame. A maximum of 12 watts per slot has been accommodated in the design. This maximum value is valid for a frame with the optional fan kit. Without moving air, this rating as to be de-rated.

Any openGear module which dissipates more than 12 watts must be physically designed in such a way as to occupy more than one card slot, thereby restricting the addition of another module directly adjacent to it. This can be accomplished via the addition of a standoff (or equivalent) or more than 1/25” in height.

A module dissipating 12-24 watts will occupy two card slots. Under no circumstances can a module dissipate in excess of 24 watts.

Reference Distribution

Each frame has two frame wide, looping reference inputs. These can be used to distribute any reference signal to all the slots in the frame, up to a maximum bandwidth of 10MHz. This can include SD black burst, HD tri-level, or DARS.

In the DFR-8310 frame, each reference is buffered using a transistor and bussed to each of the 10 slots in the frame. Because of the emitter follower buffer, the reference signal received at each card slot will have a DC drop of 0.7 volts.

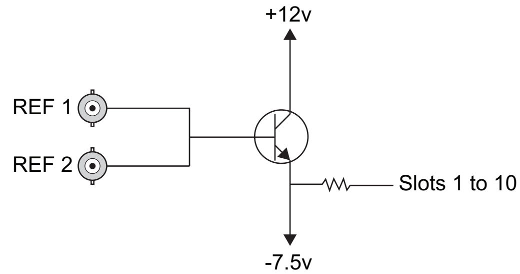


Figure 11.7 DFR-8310 Simplified Reference Distribution

Environmental Specifications

This section provides information on the required environmental conditions, and frame airflow.

Internal Environmental

All openGear products are designed for studio use within the following environmental conditions:

- Frame Ambient Temperature — 5°C through 40°C
- Cooling — Forced air from front of the frame through the back of the rear I/Os.

With an external temperature of 40°C, there will be a temperature increase towards the exhaust end of modules. The allowable temperature rise is defined to be 25°C. Thus, modules within an openGear frame must operate within the following temperature range: 5°C through 65°C.

Frame Airflow

The frames with the cooling fan installed in the front door have a front to rear airflow. Although the frame is specified to support up to 120W of processing cards, it is up to the individual cards to manage their thermal requirements across all valid slots in each frame.

Designing Cards for the DFR-8310

This section provides information on designing cards for high density, standard density, and details the absolute maximum component height for cards.

High Density

In order to support 10 cards in a DFR-8310 frame, the card height restrictions are outlined in **Figure 11.8**. This is due to the fact that slot 10 has a height restriction due to its proximity to the frame controller card.

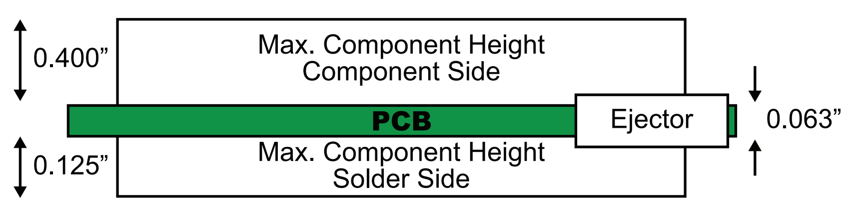


Figure 11.8 Maximum Component Height for Cards Designed with Split Rear Modules (Max. 10 cards)

Absolute Maximum Component Height

The absolute maximum component height allowed in the DFR-8310 frame is shown in **Figure 11.9**. The DFR-8310 frame can only support 9 cards with these dimensions, due to the height constraint on slot 10 and the frame controller card.

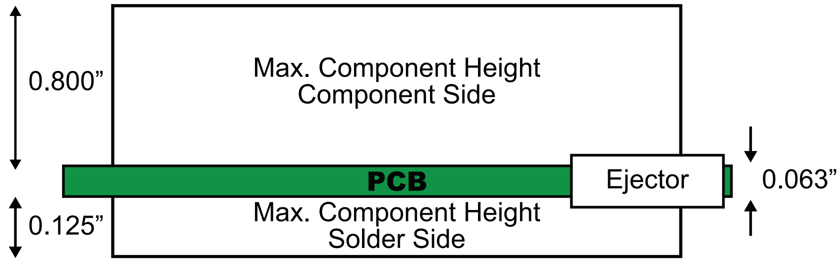


Figure 11.9 Maximum Component Height for Cards Designed with Full Rear Modules (Max.10 cards)

DFR-8310 Rear Module Design

The rear I/O modules sit in slots on the bottom of the frame with a ½” 4-40 captive screw at the top of the rear module to hold them in place against the rear of the frame. The screw is held in place during installation by an SMT PEM on the front side of the module. See the chapter “**Common openGear Parts**” on page 67 for PEM part number.

Gold plated surfaces ground the rear module to the frame. These plated areas are crucial to passing EMI tests, they must not be overlooked.

The rear modules cannot have any components on the top 0.215” of the solder side of the rear module, as this area of the module makes contact with the frame when installed. In addition, the area below the card edge connector and the sides of the rear module have component height restrictions, limited by the midplane in the frame. See the section “**DFR-8310 Midplane**” on page 109 for additional details.

Unlike the rear modules for the 20-slot frames, ventilation is part of the frame design, and holes are not necessary on the rear module.

A template from our 10-BNC rear module is shown in the following figures and should be used as a template for rear module designs.

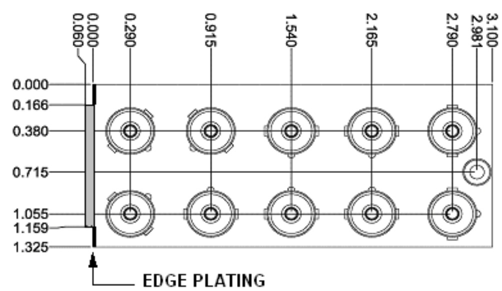


Figure 11.10 DFR-8310 Rear Module — Physical Dimensions

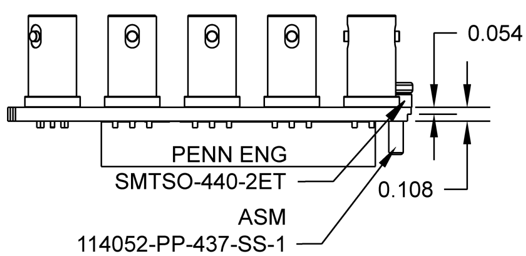


Figure 11.11 DFR-8310 Rear Module — Thickness

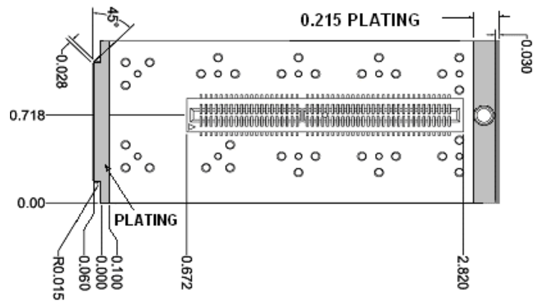


Figure 11.12 DFR-8310 Rear Module — Solder Side

DFR-8310 Technical Specifications

This section provides the technical specifications for the DFR-8310 frames.

Rack Frame Mechanical

Table 11.2 DFR-8310 Technical Specifications — Rack Frame Mechanical

Item	Specifications
Height	3.5” (90mm)
Width	17.45” (444mm) not including rack ears 19" (483mm) including rack ears
Depth	15.625” (390mm)

Frame Card Slots

Table 11.3 DFR-8310 Technical Specifications — Frame Card Slots

Item	Specifications
Number of Slots	10 or 20
Absolute Max. Power: +12V Rail	1.0A (12W) per slot
Absolute Max. Power: -7.5 Rail	1A (7.5W) per slot
Total Frame Power	120W

Frame Controller and Fans

Table 11.4 DFR-8310 Technical Specifications — Frame Controller and Fans

Item	Specifications
Max Power: +12V Rail	1.5A (18W)
Max Power: -7.5V Rail	0.2A (1.5W)
Total	19.5W maximum

openBUS Remote Power

Table 11.5 DFR-8310 Technical Specifications — openBus

Item	Specifications
Max Power: +12V	2.0A (24W), total frame power not to exceed 150W total

Reference Inputs

Table 11.6 DFR-8310 Technical Specifications — Reference Inputs

Item	Specifications
Number of Inputs	2 looping
Level	1Vpp nominal
Signal	Analog video sync (black burst or tri-level), or AES/EBU DARS
Impedance	75ohm terminating
Return Loss	>30dB to 30MHz
Max DC on Ref Input	±1V

SMPTE Fault Reporting

Table 11.7 DFR-8310 Technical Specifications — SMPTE Fault Reporting

Item	Specifications
Alarm Indicator	ANSI/SMPTE 269M-1999 contact closure
Connector Type	Female BNC
Max. Voltage	24V DC
Max. Current	20mA
Alarm Conditions	Loss of AC input power
	DC output voltage error
PS Monitored Parameters (-C version only)	DC output voltage
	DC output current
	Critical temperature
	PS-8300 fan failure
Frame Monitored Parameters (-C version only)	Backplane rail voltage
	Cooling fan failure
	Ambient temperature
Alarm Indicators	System fault LED
	Fan failure LED
	Frame controller audio alarm
	Frame door audio alarm

PS-8300 Power Supply

✶ For safety reasons, Ross power supplies do not fit into rack frames of other manufacturers.

Table 11.8 DFR-8310 Technical Specifications — PS-8300 Power Supply

Item	Specifications
Input	100 - 240VAC, 47-63Hz
Output 1	+12V, ± 10%, 0.5A - 12.5A
Output 2	-7.5V, ± 10%, 0A - 2.5A
Total	Sum of both outputs not to exceed 150Watt maximum

Environmental

Table 11.9 DFR-8310 Technical Specifications — Environmental

Item	Specifications
Ambient temperature range	0ºC to 40ºC (32ºF to 104ºF)
Humidity, non-condensing	<95%

Guide Updates

This chapter provides a brief summary of the content updates to this guide.

Guide Version	Description of Change(s)
5.1	• Updated **Table 7.1** to reference the correct Q-Mate part number • Updated the wording and look-up table in the section "**AN_SlotID**" on page 51
6.0	• Ported the guide to the new template • Added the chapter "**What's New in This Version**" on page 11 • Added the chapter "**OGX-FR Frame Specifications**" on page 13 • Added the section "**OGX-FR Rear Module Design**" on page 55 • Added the section "**Rear Module Signal Descriptions**" on page 62
7.0	• Updated the entries in the MFC row of **Table 5.1** • Updated the GFC-8222 (item E) call-out placement in **Figure 5.9**
8.0	• Updated the section "**Absolute Maximum Component Height**" on page 47 • Updated the description for Pin 4 in **Table 6.1** • Updated the section "**Rear Module Identification**" on page 63