



## **G.hn Access Multiplexer (GAM) Installation and Activation Guide**

**GAM-12-M / GAM-24-M  
GAM-12-C / GAM-24-C**

## **Publication Information**

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**GAM (G.hn Access Multiplexer)  
Installation and Activation Guide**

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# Chapter 1

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## About the GAM

## 1.1 Introduction

The GAM is a Fiber to the Distribution Point (FTTDp) solution typically installed inside a wiring closet. Each GAM comes with two (2) 10 Gigabit SFP+ interfaces to support any type of fiber or PON standards (using an SFP-based or external ONT as required that is compatible with the OLT). These SFP+ ports can further support additional GAM devices in medium to large MDUs and share the fiber backhaul link.

The ITU-T G.9960 G.hn Wave-2 standard leverages the existing telephone wiring (UTP, CAT-3 or CAT-5/5e) or RG-6/RG-59 coax cabling to deliver a Gigabit Internet service to each subscriber without the cost, complexity and delays associated with in-building fiber installation. G.hn is an Access technology for Operators looking to simplify their access network and backend infrastructure with an Ethernet-like technology that is highly scalable without some of the inherent complexity of DSL-related technologies. With G.hn, Operators deliver advanced services such as Gigabit High Speed Residential Internet and 4K IPTV without the high capital and operational expenses associated with a fiber retrofit. Each G.hn subscriber port supports up to 1.7 Gbps of dynamically allocated bandwidth for near symmetrical Gigabit services over the existing telephone wire or coaxial cable. The Positron GAM solution is MEF CE 2.0 compliant and is ideally suited to deliver Business Ethernet services in an MDU and/or MTU deployment.

**Note:** Read Chapter 5 Safety and Warnings before proceeding.

## 1.2 GAM Connections

All ports and connectors of GAM devices are located on the front of the device.

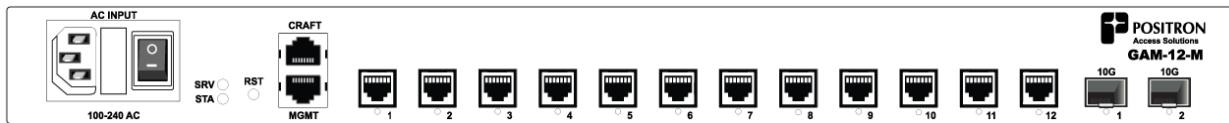


Figure 1: GAM-12-M Front Plate

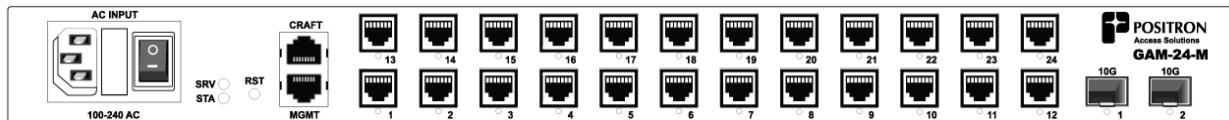


Figure 2: GAM-24-M Front Plate

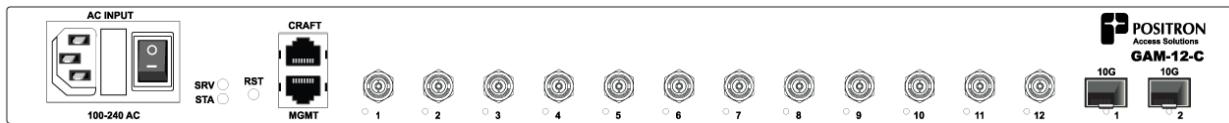


Figure 3: GAM-12-C Front Plate

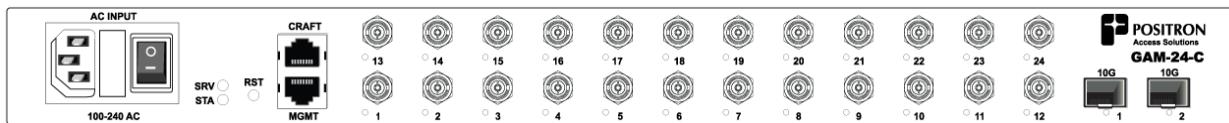


Figure 4: GAM-24-C Front Plate

### 1.2.1 Power Connection

The GAM devices require local 110-220Vac power and come with a country-specific power cord. The power connector incorporates an ON/OFF power switch. A field-replaceable fuse (250v / 5A 5mm x 20mm cartridge type time lag (slow blow) is part of the AC power connector housing as per the following illustration.

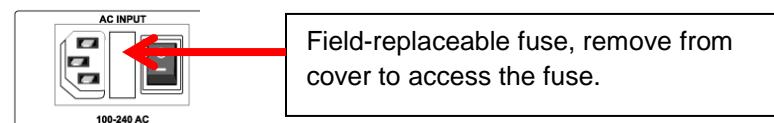


Figure 5: GAM Power Input Connector

### 1.2.2 Ethernet (SFP+) Ports



Figure 6: GAM SFP+ Connectors

The GAM has two (2) SFP+ ports that support any MSA-compliant SFP/SFP+ modules. (Fiber: 1G, 10G and Copper RJ-45: 100M, 1G)

Second uplink allows you to:

- Increase overall capacity
  - Either via Link aggregation, or
  - By splitting subscriber traffic between the two uplinks.
- Uplink protection
  - LACP
  - Ring G.8032
  - Point to point G.8031
- Daisy chain another GAM

**Important note:** When connecting the SFP+ port to a Passive Optical Network (PON) fiber connection, please make sure to use an Optical Network Unit (ONU) approved by the OLT vendor you are using.

### 1.2.3 G.hn Ports

The GAM-12-M has 12 G.hn RJ-45 ports and the GAM-24-M has 24 G.hn RJ-45 ports. When connecting a single telephone pair to an RJ-45 port (SISO mode), you need to use the “inner” pair. When connecting a second pair (MIMO mode), the second pair needs to be connected to the “outer” pair.

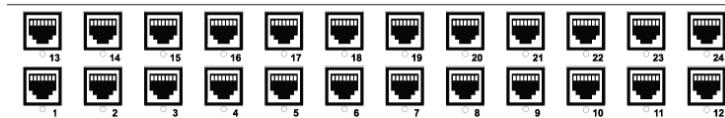
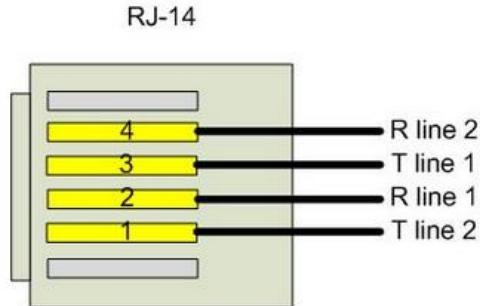


Figure 7: GAM G.hn RJ-45 Connectors

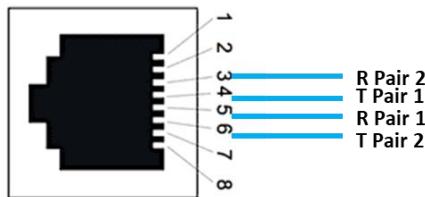
**NOTE:** RJ-45 or RJ-14 cables can both be used to connect to the GAM

Looking at the RJ-14 connector below, pair 1 (inner pair) is connected to pins 2 and 3. Pair 2 (outer pair) is connected to pins 1 and 4.



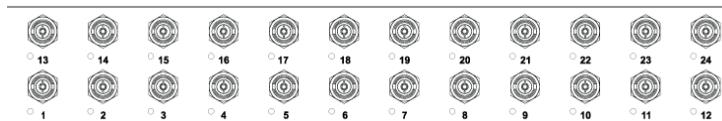
**Figure 8: Close-up of GAM G.hn RJ-14 Connector**

Looking at the RJ-45 connector below, pair 1 (inner pair) is connected to pins 4 and 5. Pair 2 (outer pair) is connected to pins 3 and 6.



**Figure 9: Close-up of GAM G.hn RJ-45 Connector**

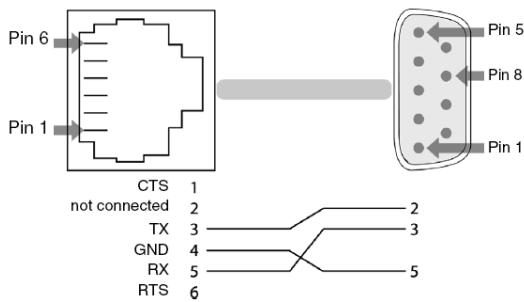
The GAM-12-C has 12 G.hn F-type Coax ports and the GAM-24-C has 24 G.hn F-type Coax ports. Each F-type G.hn port of the GAM can serve up to sixteen (16) remote G.hn end-point devices using standard coax splitters (5 MHz to 2400 MHz). **Note:** coax splitters are optional and not included with the GAM devices.



**Figure 10: GAM G.hn F-type Connectors**

#### 1.2.4 Local management ports

The GAM devices have two (2) local management ports. The CRAFT port is a standard serial (V.24, 115200, 8, N, 1) port that provides access to the command line interface of the GAM device. The pinout of the RJ-45 serial port is compatible with the popular Cisco pinout as per the following diagram:



**Figure 11: GAM Serial Management Port pinout**

The MGMT port is a 10/100/1000BaseTX Ethernet port that provides access to the WEB GUI interface using a standard WEB browser or an SSH interface to the command line interface of the GAM device.



**Figure 12: GAM Local Management Ports**

### 1.2.5 GAM LED Indicators

The GAM uses two (2) LED indicators to provide information about its global status and operating mode. The G.hn ports have status LEDs under each port. The two (2) SFP+ ports of the GAM each have a dedicated status LED located under each SFP+ connector.

LED	Condition	Function
SRV	Solid Green Solid Yellow Solid Red	System OK GAM is starting up No Internet Connection
STA	Solid Green Solid Yellow Blinking Yellow Solid Red	Normal Minor Alarm Active Firmware Update in Progress Critical or Major Alarm Active
G.hn ports	Off Blinking On	Disabled or Link Down Bad or low speed G.hn link Link is Up
1 or 2 (located under SFP+ connector)	Off Green Blinking green	Disabled or Link is Down Link is Up Link Activity

**Table 1: GAM LED indicators**

### 1.2.6 GAM Reset Button

Press the recessed RST button to reset the GAM. When depressed for two (2) to ten (10) seconds, it will perform a cold reboot of the GAM. When depressed for more than ten (10) seconds, it will return the GAM device to its original factory default settings and will perform a cold reboot of the GAM



Figure 13: GAM Reset (RST) button

## 1.3 G1000-M (MIMO/SISO) Copper Endpoint

The G1000-M (copper) G.hn bridge to Gigabit Ethernet comes with 2 Gigabit ports for customer connection, only one port should be used to connect the RG (residential Gateway). User traffic can be untagged, VLAN tagged or VLAN remapped to a different VLAN. A list of allowed VLANs per end-point device can be configured. This list is required for some application such as IPTV. The second Gigabit port of the G1000-M is available for connection to dedicated or specialized devices such as a TV set-top box.

The G1000-M comes with a built-in passive POTS splitter/combiner allowing analog phone service to multiplex the POTS service along with the G.hn signal. In this application, make sure to use a POTS splitter/combiner suitable for G.fast/G.hn at the GAM location. During power outage, the phone service will continue to operate.

LED position	Description
Top (yellow)	indicates unit booting or reset
Middle (green)	On/Off: indicates G.hn link up or down Blinking: bad or low speed G.hn link
Bottom (green)	indicates power on or off

Table 2: G1000-M LED summary

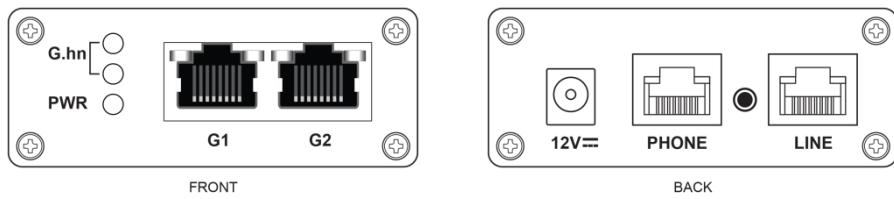


Figure 14: G1000-M port definition

## 1.4 G1001-M and G1001-MP (MIMO/SISO) Copper Endpoint

The G1001-M and G1001-MP (copper) G.hn Bridge to Gigabit Ethernet come with one (1) Gigabit port to connect the RG (residential Gateway). User traffic can be untagged, VLAN tagged or VLAN remapped to a different VLAN. A list of allowed VLANs per end-point device can be configured. This list is required for some application such as IPTV.

The G1001-MP comes with a built-in passive POTS splitter/combiner allowing analog phone service to multiplex the POTS service along with the G.hn signal. In this application, make sure to use a POTS splitter/combiner suitable for G.fast/G.hn at the GAM location. During power outage, the phone service will continue to operate.

LED position	Description
STA (yellow)	indicates unit booting or reset
G.hn (green)	On/Off: indicates G.hn link up or down Blinking: bad or low speed G.hn link
PWR (green)	indicates power on or off

Table 3: G1001-M / G1001-MP LED summary

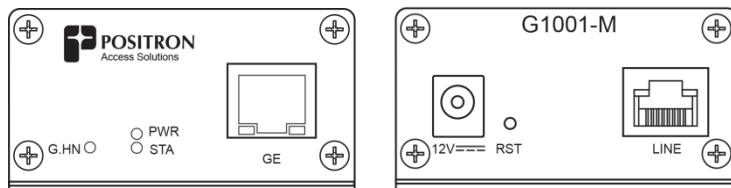


Figure 15: G1001-M port definition

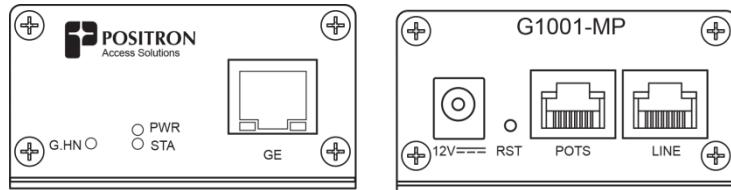


Figure 16: **G1001-MP port definition**

## 1.5 G1000-C (COAX) Endpoint

The G1000-C (coax) G.hn bridge to Gigabit Ethernet comes with 2 Gigabit ports for customer connection, only one port should be used to connect the RG (residential Gateway). User traffic can be untagged, VLAN tagged or VLAN remapped to a different VLAN. A list of allowed VLANs per end-point device can be configured. This list is required for some application such as IPTV. The second Gigabit port of the G1000-C is available for connection to dedicated or specialized devices such as a TV set-top box.

The G1000-C comes with a built-in passive COAX splitter/combiner; the second port is available to handle other Coax services such as Cable TV or Satellite (DIRECTV or others). Note: G.hn uses up to 200 MHz of spectrum in the range of 2-200 MHz, which leaves room for services using higher frequencies.

LED position	Description
Top (yellow)	indicates unit booting or reset
Middle (green)	On/Off: indicates G.hn link up or down blinking: bad or low speed G.hn link
Bottom (green)	indicates power on or off

Table 4: **G1000-C LED summary**

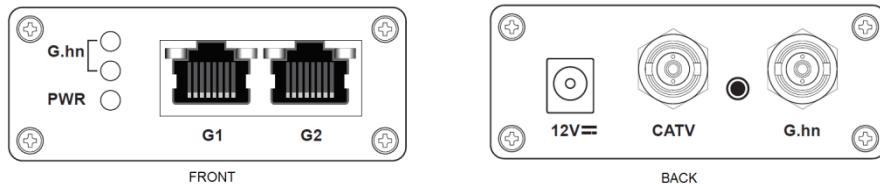


Figure 17: **G1000-C port definition**

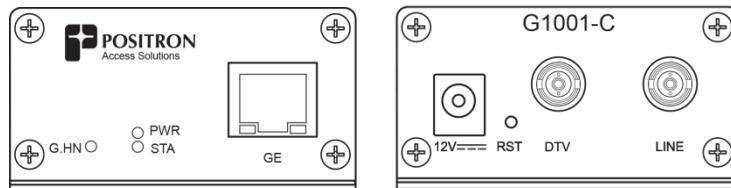
## 1.6 G1001-C (COAX) Endpoint

The G1001-C (coax) G.hn Bridge to Gigabit Ethernet comes with one (1) Gigabit port to connect the RG (residential Gateway). User traffic can be untagged, VLAN tagged or VLAN remapped to a different VLAN. A list of allowed VLANs per end-point device can be configured. This list is required for some application such as IPTV.

The G1001-C comes with a built-in passive COAX splitter/combiner; the second port is available to handle other Coax services such as Cable TV or Satellite (DIRECTV or others). Note: G.hn uses up to 200 MHz of spectrum in the range of 2-200 MHz, which leaves room for services using higher frequencies.

LED position	Description
STA (yellow)	indicates unit booting or reset
G.hn (green)	On/Off: indicates G.hn link up or down blinking: bad or low speed G.hn link
PWR (green)	indicates power on or off

**Table 5: G1001-C LED summary**



**Figure 18: G1001-C port definition**

# **Chapter 2**

---

## **WEB Management**

## 2.1 Introduction

A WEB GUI interface and a Command Line Interface (CLI) are available to manage GAM devices. Supported WEB browsers include Chrome, Edge or Firefox.

## 2.2 System Management

### 2.2.1 Logging into the WEB GUI

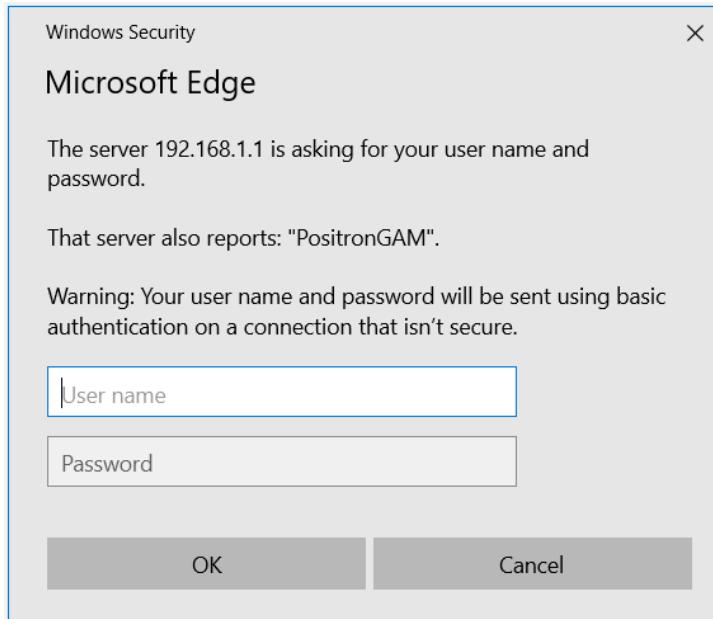
The default configuration values of the GAM devices are:

IP Address	192.168.10.1
Subnet Mask	255.255.255.0
Username	admin
Password	

**Table 6: GAM default credentials**

**Important** Note: older firmware versions prior of v1.1.x had default IP set to 192.168.1.1

Enter the system's IP Address into the Web browser and a login screen similar to the following will appear:



**Figure 19: GAM Login Page (Browser specific)**

Enter a Username and Password for the GAM device. The default Username is **admin** and the default password is null (not defined). Click **OK**.

**IMPORTANT SECURITY NOTE:** After a successful initial login, please change the password to avoid unauthorized access to the GAM device.

**About the X.509 Public Key Infrastructure (PKI) Certificate:** you may want to replace the default Positron-signed PKI Certificate used by the WEB GUI Administration Interface pre-installed by Positron with one from your preferred Certificate Authority.

**Note:** Secure HTTP is disabled by default. HTTPS can be enabled via menu: Configuration>Security>Switch>HTTPS

### 2.2.2 System

The System monitor page provides a front panel representation of the GAM device. The front panel is specific to the version of the GAM device. The sample screenshot below is for the GAM-12-M.

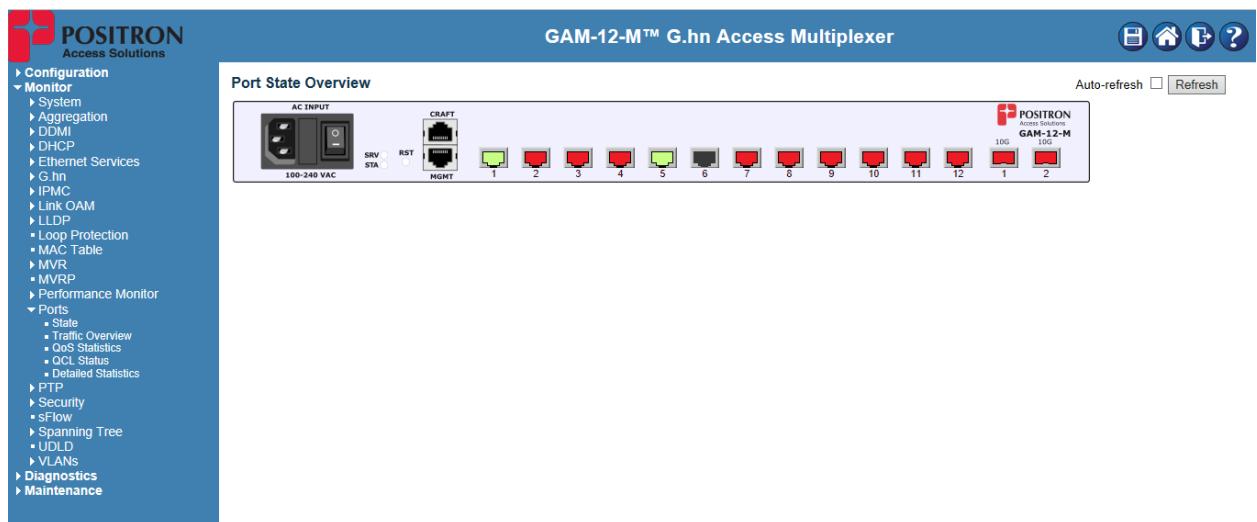


Figure 20: GAM Port Status page (default page after login)

### 2.2.3 General Information

Navigation Icons	Description
	Help for specific page
	Logout
	Return to the Home page (under monitoring / global port view).
	Save configuration to Flash. (same as using this CLI command: copy running-configuration start-config)
	Apply parameter to running-configuration. Any configuration change is not permanently saved to FLASH memory and will be lost after a restart of the GAM
	Reset configuration parameters to previous view
	Click to refresh
	Auto-refresh every 3 seconds
	Expand or collapse view

Table 7: *WEB GUI Navigation Buttons*

## 2.3 Configuring the Uplink (WAN)

### 2.3.1 SFP+ ports

The GAM supports (2) SFP+ 100Mbps/1Gbps/10Gbps ports and either one is available as uplink. The second SFP+ port is then usable as a second uplink for more capacity, for uplink protection or for daisy chaining two or more GAM devices together.

By default, both ports operate as 10Gbps SFPs. You can change the settings to 100Mbps/1Gbps fiber or copper SFPs. We recommend setting unused ports to the Disabled state to avoid unwanted alarms. Note: the alarm module of the GAM does not monitor the MGMT port. No alarm or error condition reported if the MGMT port is down.

Port Configuration																	<input type="button" value="Refresh"/>	
Port	Link	Speed		Adv Duplex		Adv speed					Flow Control			PFC		Maximum Frame Size	Excessive Collision Mode	Frame Length Check
		Current	Configured	Fdx	Hdx	10M	100M	1G	2.5G	5G	10G	Enable	Curr Rx	Curr Tx	Enable	Priority		
*		<>	v	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0-7	2048	<> v				
10G-1	<span style="color: green;">●</span> 10Gfdx	10Gbps FDX	v	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0-7	2048	<input type="checkbox"/>				
10G-2	<span style="color: red;">●</span> Down	10Gbps FDX	v	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0-7	2048	<input type="checkbox"/>				
MGMT	<span style="color: red;">●</span> Down	Auto	v	<input checked="" type="checkbox"/>	<input type="checkbox"/>	0-7	2048	<input style="background-color: #f0f0f0; color: black; border: 1px solid black; padding: 2px 5px; font-size: small;" type="button" value="Discard"/>										

Figure 21: Port Configuration page

### 2.3.2 Inband Management

While it is possible to manage the GAM via one of the local management port, it is more convenient to manage remote installations via the Inband management capabilities of the GAM. The in-band management used a VLAN inside the uplink interface.

You can add a VLAN to the Interface by using the “add interface” button under Configuration>System>IP

In the example below, VLAN 4093 is used for management, and IP address 192.168.101.22 accesses the management interface of the GAM.

**Important Note:** the GAM uses VLAN 2 to manage the G1000-x and G1001-x End-Point bridge devices. Do not change or delete.

IP Configuration											
Domain Name	No Domain Name										
Mode	Host										
DNS Server 0	No DNS server										
DNS Server 1	No DNS server										
DNS Server 2	No DNS server										
DNS Server 3	No DNS server										
DNS Proxy	<input type="checkbox"/>										
IP Interfaces											
Delete	VLAN	Enable	DHCPv4						IPv4		
			Type	IffMac	Client ID	ASCII	HEX	Hostname	Fallback	Current Lease	Address
<input type="checkbox"/>	1	<input type="checkbox"/>	Auto	Port G.hn-1				0	192.168.10.1	24	
<input type="checkbox"/>	2	<input type="checkbox"/>	Auto	Port G.hn-1				0	192.168.0.1	21	
<input type="checkbox"/>	4093	<input type="checkbox"/>	Auto	Port G.hn-1				0	192.168.101.22	21	
<input type="button" value="Add Interface"/>											
IP Routes											
Delete	Network	Mask Length	Gateway	Next Hop VLAN							
<input type="checkbox"/>	0.0.0.0	0	192.168.101.1	0							
<input type="button" value="Add Route"/>											
<input type="button" value="Save"/> <input type="button" value="Reset"/>											

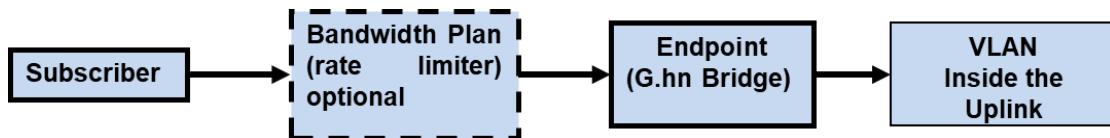
**Figure 22: In-band Management Settings**

To manage the GAM from a different subnet, you can add a default route using the “add route” button.

## 2.4 Configuring a G.hn Service

A G.hn service consists of an association of a subscriber, a bandwidth plan (optional), an endpoint and a Client VLAN (CVLAN). If an association is missing, user traffic will not work.

Upon detection of an Endpoint not associated with a Subscriber, the GAM will automatically assign VLAN 4094 used for the Self-Care Captive Portal of the GAM.



**Figure 23: Service Configuration**

### 2.4.1 G.hn Port

#### 2.4.1.1 Coax

#### G.hn Ports Configuration

Port	Name	Status	Enable
G.hn-1			<input checked="" type="checkbox"/>

**Figure 24: G.hn (coax) Port Configuration Settings**

**Enable/Disable:** Ports are either Enabled (default) or Disabled.

**Name:** A friendly name can be set (optional)

**Note:** The GAM does not monitor ports in Disabled state for any alarm conditions but traffic will still go through when a service is configured.

## 2.4.1.2 MIMO

### G.hn Ports Configuration

Port	Name	Status	Enable	Mode
G.hn-1		<input checked="" type="radio"/>	<input type="checkbox"/>	MIMO

Figure 25: G.hn (copper) Port Configuration Settings

**Enable/Disable:** Ports are either Enabled (default) or Disabled.

**Name:** A friendly name can be set (optional)

**MIMO/SISO:** Each port can be set to either MIMO (2-pair@100Mhz) or SISO (1-pair@ 200MHz) mode.

**Note:** The GAM does not monitor ports in Disabled state for any alarm conditions but traffic will still go through when a service is configured.

## 2.4.2 Bandwidth Profiles (Bandwidth Plans)

A bandwidth profile defines the maximum Downstream and Upstream bandwidth assigned to User Profiles. Rate Limiters enforce the bandwidth rules. Rate limiters operate at Layer-2 (Ethernet). For best Speed Test results, the rate limiter should be set 6% to 8% higher to take into account the typical IP/TCP overhead of about 6%.

The GAM creates and assigns a default bandwidth plan automatically to any Endpoint not yet attached to a subscriber profile. This default bandwidth plan provides enough bandwidth to support access to the Self-care Captive portal feature (VLAN 4094).

An administrator can create up to 14 additional bandwidth plans. (Note: this corresponds to ID 2 to 15 when using the CLI).

### G.hn Bandwidth Plans Configuration

Id	Name	Downstream Bandwidth	Upstream Bandwidth	Description
1	Default BW Profile	10 Mbit/s	10 Mbit/s	
2	25/10	25 Mbit/s	10 Mbit/s	
3	50/10	50 Mbit/s	10 Mbit/s	
4	100/50	100 Mbit/s	50 Mbit/s	
5	250/50	250 Mbit/s	50 Mbit/s	
6	500/100	500 Mbit/s	100 Mbit/s	
7	750/300	750 Mbit/s	300 Mbit/s	

[Add New Bandwidth Plan](#)

Figure 26: Configuring & Managing Bandwidth Plans

Click on a Bandwidth to manage it or click on the Add New Bandwidth Plan button to create a new one.

**Add Bandwidth Plan**

Name	Downstream Bandwidth	Upstream Bandwidth	Description
	1 Mbit/s	1 Mbit/s	

**Figure 27: Adding a Bandwidth Plan**

**Name:** This field is mandatory, and the name must be unique among all bandwidth plans. It must contain between 1 and 31 alphanumeric characters.

**Bandwidth:** Set the Downstream/Upstream bandwidth limits (in Mbps). Acceptable values are:

- **MIMO / SISO:** 10 to 1000 Mbps,
- **COAX:** 10 to 800 Mbps. A service over 800Mbps must be set to “unthrottled”.

**Description:** Use this optional free-form field to add a description of this bandwidth plan. There is no validation for the content of this field, which can hold up to 63 characters.

#### 2.4.3 Endpoint Devices (G.hn Bridge)

The GAM device authenticates and authorizes each managed Endpoint device to make sure the overall G.hn infrastructure is secure and delivers the required services to each Subscriber. You can pre-define Endpoints and assign them to a Subscriber profile or you can select from the list of Endpoint discovered by the GAM.

The following illustrates the list of Endpoint devices for a single Coax Port of the GAM where each port can handle up to 16 subscribers in a Point to Multipoint configuration using standard coax splitters. For copper ports (MIMO or SISO), each port only allows a single Endpoint device.

### G.hn Endpoints Configuration

<b>Id</b>	<b>MAC</b>	<b>Port</b>	<b>Name</b>	<b>Description</b>
1	00-0e-d8-13-00-d9	4	ep4	
2	00-0e-d8-13-00-de	5	ep5	
3	00-0e-d8-13-00-d8	6	ep6	
4	00-0e-d8-13-00-dd	7	ep7	
5	00-0e-d8-13-00-e1	8	ep8	
6	00-0e-d8-13-00-db	9	ep9	
7	00-0e-d8-13-00-e2	1	ep1	
8	00-0e-d8-13-00-e3	2	ep2	
9	00-0e-d8-13-00-da	3	ep3	
10	00-0e-d8-13-00-dc	10	ep10	
11	00-0e-d8-13-00-df	11	ep11	
12	00-0e-d8-13-00-e0	12	ep12	
13	00-0e-d8-13-08-18	13	ep13	
14	00-0e-d8-13-08-2e	24	ep24	
15	00-0e-d8-13-08-2c	23	ep23	
16	00-0e-d8-13-08-2a	22	ep22	
17	00-0e-d8-13-08-28	21	ep21	
18	00-0e-d8-13-08-26	20	ep20	
19	00-0e-d8-13-08-1a	14	ep14	
20	00-0e-d8-13-08-1c	15	ep15	
21	00-0e-d8-13-08-1e	16	ep16	
22	00-0e-d8-13-08-20	17	ep17	
23	00-0e-d8-13-1b-74	18	ep18	
24	00-0e-d8-13-08-24	19	ep19	

[Add New Endpoint](#)

**Figure 28: Managing Endpoint devices**

Clicking on the Add New Endpoint button takes you to the following screen:

### Add Endpoint

<b>MAC</b>	<b>Port</b>	<b>Name</b>	<b>Description</b>
	Unassigned		

Or select from those discovered endpoints...

<b>MAC</b>	<b>Port</b>
00-0e-d8-13-08-4a	12

[Save](#) [Reset](#) [Cancel](#)

**Figure 29: Adding an Endpoint device**

**MAC:** Set the endpoint MAC address. Enter the MAC address manually or select from the discovered endpoints list.

**Port:** Set the port that connects to the endpoint. You can set 'Unassigned' to pre-configure a device. However, traffic will not flow until you assign the Endpoint to its specific port. Note: In copper mode (MIMO/SISO), each G.hn port maps to a single Endpoint. In Coax mode, you can assign up to 16 Endpoint devices to a port.

**Name:** This field is mandatory, and the name must be unique among all endpoints. It must contain between 1 and 31 alphanumeric characters.

**Description:** Use this optional field to add a free-form description for this Endpoint. There is no validation for the content of this field; it can hold up to 63 characters.

#### 2.4.4 Subscribers

The GAM device relies on Subscriber profiles to control how it delivers High Speed Internet (HSI) services. Each Subscriber is associated to a specific Endpoint and a VLAN. Each subscriber can be assigned to different VLANs, or all subscribers can be assigned to the same VLAN (data VLAN).

The G.hn protocol will isolate traffic between endpoints when connected to the same port (coax). The GAM will isolate traffic between ports (port isolation). You can then assign an optional Bandwidth Plan to a Subscriber to control how much bandwidth is available at any time.

The following illustrates the list of Subscribers of the GAM along with the Endpoint assigned to each Subscriber.

G.hn Subscribers Configuration

ID	Subscriber Name	VLAN	Remapped VID	Endpoint Tagging	Allowed tagged VLANs	Endpoint	Bandwidth Plan	Description
1	s4	4093	-	untagged	00-0e-d8-13-00-d9 (ep4)	Unthrottled		
2	s5	4093	-	untagged	00-0e-d8-13-00-de (ep5)	Unthrottled		
3	s6	4093	-	untagged	00-0e-d8-13-00-d8 (ep6)	Unthrottled		
4	s7	4093	-	untagged	00-0e-d8-13-00-dd (ep7)	Unthrottled		
5	s8	4093	-	untagged	00-0e-d8-13-00-e1 (ep8)	Unthrottled		
6	s9	4093	-	untagged	00-0e-d8-13-00-db (ep9)	Unthrottled		
7	s1	4093	-	untagged	00-0e-d8-13-00-e2 (ep1)	Unthrottled		
8	s2	4093	-	untagged	00-0e-d8-13-00-e3 (ep2)	Unthrottled		
9	s3	4093	-	untagged	00-0e-d8-13-00-da (ep3)	Unthrottled		
10	s10	4093	-	untagged	00-0e-d8-13-00-dc (ep10)	Unthrottled		
11	s11	4093	-	untagged	00-0e-d8-13-00-df (ep11)	Unthrottled		
12	s12	4093	-	untagged	00-0e-d8-13-00-e0 (ep12)	Unthrottled		
13	s13	4000	201	TAGGED	00-0e-d8-13-08-18 (ep13)	Unthrottled		
14	s14	4000	-	untagged	00-0e-d8-13-08-1a (ep14)	Unthrottled		
15	s15	4000	-	TAGGED	00-0e-d8-13-08-1c (ep15)	Unthrottled		
16	s16	4093	-	untagged	00-0e-d8-13-08-1e (ep16)	Unthrottled		
17	s17	4093	-	untagged	00-0e-d8-13-08-20 (ep17)	Unthrottled		
18	s24	2401	-	untagged	00-0e-d8-13-08-2e (ep24)	Unthrottled		
19	s23	2301	201	TAGGED	00-0e-d8-13-08-2c (ep23)	Unthrottled		
20	s22	4093	-	untagged	00-0e-d8-13-08-2a (ep22)	Unthrottled		
21	s19	4093	-	untagged	00-0e-d8-13-08-24 (ep19)	Unthrottled		
22	s21	4093	-	untagged	00-0e-d8-13-08-28 (ep21)	Unthrottled		
23	s18	4000	-	untagged	00-0e-d8-13-1b-74 (ep18)	Unthrottled		
24	s20	4093	-	untagged	00-0e-d8-13-08-26 (ep20)	Unthrottled		

[Add New Subscriber](#)

Figure 30: Managing Subscribers

Click the Add New Subscriber button to get the following screen:

Add Subscriber							
Subscriber Name	VLAN	Remapped VID	Endpoint Tagging	Allowed tagged VLAN	Endpoint	Bandwidth Plan	Description
	0	0	<input type="checkbox"/>		<input type="button" value="None/Disabled"/>	<input type="button" value="Default BW Profile"/>	
<input type="button" value="Save"/> <input type="button" value="Reset"/> <input type="button" value="Cancel"/>							

**Figure 31: Adding Subscribers**

**Id:** The subscriber ID. This ID is available in the command-line interface (CLI) to specify an entity.

**Subscriber Name:** This field is mandatory, and the name must be unique among all subscribers. It must contain between 1 and 31 characters.

**VLAN:** Primary VLAN, this VLAN can be untagged, keep VLAN tag, or remapped to a different VLAN. A G.hn service can use any VLAN between 3 and 4093. The GAM reserves VLANs 1, 2 and 4095 for its internal use. The GAM automatically assigns VLAN 4094 to non-configured service to force the subscriber to use the Self-Care Captive Portal of the GAM (future capability).

**Remapped VID:** specify the VLAN ID used between the G.hn bridge and the GAM. In other words, the GAM remaps the Ingress user traffic (from the NNI port of the GAM) to this VLAN ID before forwarding to the End-Point. The reverse action takes place for traffic from the End-Point to the Internet. The GAM replaces the VLAN ID of the End-Point with the VLAN ID assigned to the Subscriber on the NNI port by the GAM.

**Endpoint Tagging:** Enable or disable primary VLAN tag at the subscriber endpoint. If disabled, the traffic will be untagged at the subscriber end. If enabled, the VLAN tag will be kept

**Allowed Tagged VLAN:** The Allowed tagged VLAN field is a list of VLAN (up to 14) that will be forwarded (untouched). This allows applications such as IPTV to preserve the VLAN and P-BIT information through to the Residential Gateway or set top box.

**Endpoint:** The endpoint assigned to this subscriber. We recommend creating the endpoint prior to creating the subscriber. A subscriber can be pre-configured (reserved) before creating an endpoint, but traffic will only flow upon its association to an endpoint.

**Bandwidth Plan:** Optional Rate limiter associated to the subscriber. The Bandwidth Plan should be created prior of creating the subscriber. If set to "unthrottled", this subscriber will have no bandwidth limit restriction.

**Description:** The field is optional, free-form description given to this subscriber. There is no validation for the content of this field, apart the number of characters, it can contain up to 63 characters.

## 2.5

### G.hn Power Mask Configuration

G.hn uses up to 200 MHz of spectrum on single copper pairs (SISO) and on COAX ports. When operating on two (2) copper pairs (MIMO), the 200 MHz of spectrum is split evenly on these two pairs with 100 MHz per pair.

In order to facilitate co-habitation with other services, you can adjust the Power Mask to avoid using specific spectrum frequency ranges. A Power Mask includes a **Start Frequency**, a **Stop Frequency** and a **Depth**. In a power mask (also called notch), all of the carriers (or signal) are removed and it is guaranteed that the transmitted Power Spectral Density (PSD) is at least as deep as the **Depth** setting for the interval specified by the **start** and **stop** frequency range.

**Important Note:** you can create up to 10 user notches and all User notches are applied system wide (to all ports)

A User Defined Notch entry includes the following:

**Delete:** click the **delete** button to remove an existing notch entry.

**Frequency Range (MHz):** specify the frequency range over which the power mask notch applies.

**Range:** allowed range for a notch is:

- **MIMO:** between 3.5 MHz and 100.0 MHz
- **SISO:** between 3.5 MHz and 200.0 MHz
- **Coax:** between 1.955 and 200.0MHz

**Depth:** specify the depth (in dB) of the attenuation applied to the G.hn signal. You should use this setting when you want to reduce the signal depth but not remove it completely. See **remove** below about how to completely remove a range of frequency. The allowed attenuation depth is from 0.5 dB to 40.0 dB

**Remove:** check this setting when you need to filter out the specified frequency range completely.

G.hn Power Mask Configuration

User-Defined Notches

Delete	Frequency Range (MHz)	Depth (dB)	Remove
Delete	0.000	- 0.000	0.0 <input type="checkbox"/>

Add Notch

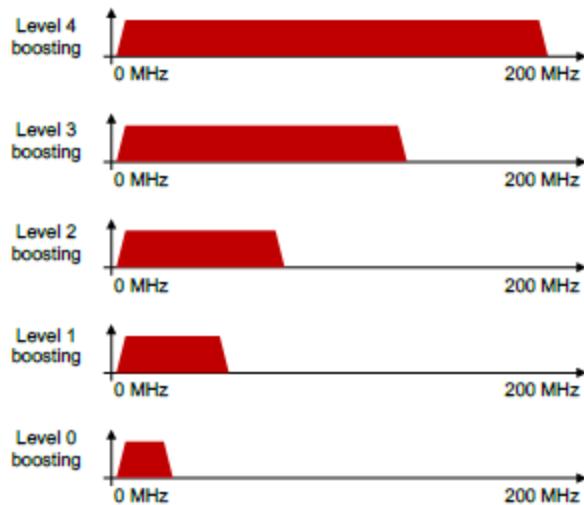
Save Reset

**Figure 32: Setting the G.hn Power Mask Notches**

## 2.6 VectorBoost configuration

VectorBoost is an innovative approach to dealing with crosstalk in broadband access networks based on G.hn operating over twisted-pair. Unlike “brute-force” approaches like precoding based vectoring used in standards like VDSL2 or G.fast, VectorBoost exploits the statistical properties of network traffic in broadband networks to achieve virtually the same user experience as if crosstalk did not exist.

Each G.hn line in a GAM can be configured to operate in five different levels of “boosting.” “Level 0” represents the lowest boosting, in which the line is only using spectrum from 2 to 30 MHz. “Level 4” represents the highest level of boosting, which uses up to 200 MHz. When a subscriber line is carrying a very small amount of traffic (for example, less than 100 Mbps), VectorBoost will tend to configure that G.hn pair in “level 0 boosting.” Because “level 0 boosting” uses only the lowest part of spectrum it will minimize the amount of crosstalk induced on neighboring pairs. VectorBoost will configure a higher boosting level, up to level 4 for G.hn links (or pairs) carrying a lot of traffic, for instance when users download or upload multiple large files.



**Figure 33: Understanding VectorBoost Levels**

In practice, VectorBoost needs to look at all G.hn links in a global way in order to compute the optimum level of boosting for each pair. The reason is that when VectorBoost decides the level of boosting for some of the pairs, it needs to know how much interference the other pairs are inducing on it. It is possible that a pair that only would need “level 1” boosting if it were isolated may actually need “level 2” boosting once the neighbor interference is taken into account.

### VDSL Coexistence

G.hn can co-habit with VDSL2 pairs in the same binder.

**Note:** Even if there are DSL services in the binder, we recommend you initially keep this option disabled. Only enable in the presence of high interference levels.

**Enabled:** All of the G.hn pairs in the binder must be under the control of this GAM. Other G.hn equipment using the same pair binder will cause interference that may prevent the VectorBoost™ engine from operating properly.

**Disabled:** The G.hn pairs can co-exist with other G.hn devices in the same binder, although with a reduced performance.

## **CDTA Configuration**

With VectorBoost™ enabled, you can allow the GAM to use the Collective Dynamic Transmit Allocation (CDTA) to adjust dynamically the allocation ratio of the available bandwidth between the downstream and upstream direction.

**Mode:** Enable or disable VectorBoost™ CDTA.

**Down:Up Weight:** Set G.hn VectorBoost™ engine CDTA “Down:Up weight”. For example, a value of 75 results in a 75:25 weight. This means that when there is full utilization of the bandwidth in both directions, you will end up with the total available bandwidth allocated 75% for downstream and 25% for upstream. Requires CDTA Mode set to: **enable**.

**Minimum Down:Up Rate:** Sets G.hn VectorBoost™ engine CDTA minimum Down:Up rate. Allowed values range from 30:70 to 80:20 (in percentage). Requires CDTA Mode set to: **enable**.

**Maximum Down:Up Rate:** Sets G.hn VectorBoost™ engine CDTA maximum Down:Up rate. Allowed values range from 30:70 to 80:20 (in percentage). Requires CDTA Mode set to: **enable**.

**Default Down:Up Rate:** Sets G.hn VectorBoost™ engine CDTA default Down:Up rate. The allowed range is from 30:70 to 80:20 (in percentage). This setting should be between is the rate at which the engine is initialized with.

**Important note:** with CDTA enabled, the actual downstream and upstream rates automatically adjust to match the actual bandwidth demand of each G.hn port. When CDTA is disabled, the selected Down:Up ratio will remain constant.

**Percentage Metric Change:** Sets the percentage metric change in the traffic demand that triggers the CDTA algorithm. CDTA will re-adjust the Down:Up bandwidth allocation as soon as the traffic ratio on the link differs from the currently allocated bandwidth ratio by the configured percentage. This configuration setting is effective only when CDTA is enabled.

**G.hn VectorBoost™ Configuration**

<b>General Configuration</b>	
VDSL Coexistence	Disabled <input type="button" value="▼"/>

<b>CDTA Configuration</b>	
Mode	Enabled <input type="button" value="▼"/>
Down:Up Weight	50 <input type="button" value="▼"/>
Minimum Down:Up Rate	30:70 <input type="button" value="▼"/>
Maximum Down:Up Rate	80:20 <input type="button" value="▼"/>
Default Down:Up Rate	50:50 <input type="button" value="▼"/>
Percentage Metric Change	5 % <input type="button" value="▼"/>

Figure 34: *VectorBoost configuration*

## 2.7 Managing VLANs on the uplink.

By default, the uplinks of the GAM are set in “trunk” mode and allow all VLANs from 3 to 4094 to go through. In the table below, only the configuration of the 2 uplinks (10G-1 and 10G-2) can be modified. The VLAN table for the G.hn 1 to 12 or 24) is managed by the G.hn subscriber configuration.

A user can decide not to use VLANs on a uplink, the mode must be changed to the following:

- Mode Access: all traffic will be untagged on the egress, and in the ingress all traffic will be tagged (inside de GAM) with the port VLAN.
- Mode Hybrid: in the egress, a specific VLAN (Port VLAN) can be untagged but all other VLAN will stay tagged. In the ingress, the untagged traffic will be tagged with the Port VLAN.

More information below about the different parameters.

## Configuration>VLAN>Configuration

Global VLAN Configuration											
Allowed Access VLANs		1,2,4093									
Ethertype for Custom S-ports		88A8									
Port VLAN Configuration											
Port	Mode	Port VLAN	Port Type	Q-in-Q Enable	Q-in-Q VID	Ingress Filtering	Ingress Acceptance	Egress Tagging	Allowed VLANs	Forbidden VLANs	
*	<>	4095	<>	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	<>	<>	2,4093,4094		
G.hn-1	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4093,4094		
G.hn-2	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4093,4094		
G.hn-3	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4093,4094		
G.hn-4	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4093,4094		
G.hn-5	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4093,4094		
G.hn-6	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4093,4094		
G.hn-7	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4094		
G.hn-8	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4094		
G.hn-9	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4094		
G.hn-10	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4094		
G.hn-11	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4094		
G.hn-12	Trunk	4095	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged Only	Tag All	2,4093,4094		
10G-1	Hybrid	4093	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged and Untagged	Untag Port VLAN	3-4094		
10G-2	Access	2	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged and Untagged	Untag All	2		
MGMT	Access	1	C-Port	<input type="checkbox"/>	0	<input checked="" type="checkbox"/>	Tagged and Untagged	Untag All	1		

[Save](#) [Reset](#)

**Figure 35: Global VLAN Configuration table**

Let us begin with the **Global VLAN Configuration** settings.

**Allowed Access VLANs:** This field shows the allowed Access VLANs, for the G.hn ports configured as Access ports. Ports in other modes are members of the VLANs specified in the Allowed VLANs field. By default, VLAN 1 is the only one enabled. More VLANs may be created using an enumeration list syntax where the individual elements are separated by commas. You can specify a range of VLANs with a dash separating the lower and upper bound. The following example sets VLANs 1, 10, 11, 12, 13, 200, and 300: 1, 10-13, 200, 300.

**Ethertype for Custom S-ports:** Specify the Ethertype/TPID (in hexadecimal) used for Custom S-ports. The setting applies to all of the ports with the **Port Type** set to **S-Custom-Port**.

### Port VLAN Configuration

The following settings apply on a Port-by-Port basis. Looking at the **Port VLAN Configuration** table, we see:

**Port.** This is the logical port number of this row.

**Mode:** The port mode (default is Trunk) controls the fundamental behavior of the port in question. A port can be in one of three modes as described below.

Whenever you select a particular mode, the configurable fields in that row entry may change (grayed out). Grayed out fields will show the value that the port will get when the mode is applied. The available **MODE** settings are:

**Access:** use Access ports to connect to end stations. Dynamic features like Voice VLAN may add the port to more VLANs behind the scenes. Access ports have the following characteristics:

- Member of exactly one VLAN, the Port VLAN (a.k.a. Access VLAN), which by default is 1
- Accept untagged and C-tagged frames
- Discard all frames not classified to the Access VLAN
- On egress all frames are transmitted untagged

**Trunk:** Trunk ports carry traffic on multiple VLANs simultaneously, and usually connect to other switches. Trunk ports have the following characteristics:

- By default, a trunk port is member of all VLANs (1-4095)
- The VLANs for a specific port may be limited by the use of Allowed VLANs for that port
- Frames classified to a VLAN outside of the list of allowed VLANs for that port are discarded
- By default, the GAM tags all frames not classified to the Port VLAN (a.k.a. Native VLAN) on Egress. Frames classified to the Port VLAN do not get C-tagged on Egress
- Egress tagging can be changed to tag all frames, in which case only tagged frames are accepted on Ingress

**Hybrid:** Hybrid ports add additional port configuration features beyond those available for **trunk** ports. These additional characteristics (beyond the ones for **trunk** ports above) include:

- VLAN Awareness: each port is configurable to be VLAN tag unaware, C-tag aware, S-tag aware, or S-custom-tag aware
- Ingress filtering is controllable
- Ingress acceptance of frames and configuration of egress tagging is configured independently

**Port VLAN:** Determines the port's VLAN ID (a.k.a. PVID). Allowed VLANs are in the range of 1 through 4095, with a default of 1. On **ingress**, frames are classified to the Port VLAN whenever the port is configured as: VLAN unaware,

the frame is untagged, or VLAN awareness is enabled on the port and the frame is priority tagged (VLAN ID = 0). On **egress**, frames classified to the Port VLAN are untagged when Egress Tagging configuration is set to untag Port VLAN. The Port VLAN is known as "Access VLAN" for ports in Access mode and as "Native VLAN" for ports in Trunk or Hybrid mode.

**Port Type:** Ports in hybrid mode allow for changing the port type, that is, whether a frame's VLAN tag is used to classify the frame on **ingress** to a particular VLAN, and if so, which TPID it reacts on. Likewise, on **egress**, the Port Type determines the TPID of the VLAN tag, if a VLAN tag is required. Available **Port Types** are:

- **Unaware:** On ingress, all frames (whether carrying a VLAN tag or not) get classified to the Port VLAN, and any VLAN tags present are not removed on egress.
- **C-Port:** On ingress, frames with a VLAN tag with TPID = 0x8100 are classified to the VLAN ID embedded in the tag. If a frame is untagged or priority tagged, the frame is classified to the Port VLAN. If frames are to be tagged on egress, they will be tagged with a C-tag.
- **S-Port:** On egress, whenever frames must be tagged, they will be tagged with an S-tag. On ingress, frames with a VLAN tag and a TPID = 0x88A8 get classified to the VLAN ID embedded in the tag. Priority-tagged frames are classified to the Port VLAN. If the port is configured to accept "Tagged Only" frames (see Ingress Acceptance below), frames without this TPID are dropped.
- **S-Custom-Port:** On egress, if frames must be tagged, they will be tagged with the custom S-tag. On ingress, frames with a VLAN tag and a TPID equal to the Ethertype configured for Custom-S ports are classified to the VLAN ID embedded in the tag. Priority-tagged frames are classified to the Port VLAN. If the port is configured to accept "Tagged Only" frames (see Ingress Acceptance below), frames without this TPID are dropped.

**Q-in-Q Enable:** This enables 802.1Q double-tag on hybrid ports that have the port type set to C-Port or S-Port. If set, it will set an inner tag of 0x8100, and an outer tag defined by the port type (0x8100 if port type is set to C-Port or 0x88A8 if the port type is set to S-Port).

**Q-in-Q VID:** defines the outer tag VLAN (VID) used when Q-in-Q is enabled. The valid range is 3 to 4093.

**Ingress Filtering:** Hybrid ports allow for flexible ingress filtering. Access and Trunk ports always have ingress filtering enabled. If ingress filtering is enabled (checkbox is checked), frames classified to a VLAN that the port is not a member of are discarded. If ingress filtering is disabled, frames classified to a VLAN that the port is not a member of are accepted and forwarded to the switch engine. However, the port will never transmit frames classified to VLANs that it is not a member of.

**Ingress Acceptance:** Hybrid ports allow for changing the type of frames accepted on ingress. The available settings are:

- **Tagged and Untagged:** Both tagged and untagged frames are accepted. See Port Type for a description of when a frame is considered tagged.
- **Tagged Only:** Only frames tagged with the corresponding Port Type tag are accepted on ingress.
- **Untagged Only:** Only untagged frames are accepted on ingress. See Port Type for a description of when a frame is considered untagged.

**Egress Tagging:** Ports in Trunk and Hybrid mode may control the tagging of frames on egress. The available settings are:

- **Untag Port VLAN:** Frames classified to the Port VLAN are untagged. Other frames are transmitted with the relevant tag.
- **Tag All:** All frames, whether classified to the Port VLAN or not, are transmitted with a tag.
- **Untag All:** All frames, whether classified to the Port VLAN or not, are transmitted without a tag. This option is only available for ports in Hybrid mode.

**Allowed VLANs:** Ports in Trunk and Hybrid mode control the VLANs they are allowed to become members of. Access ports can only be member of one VLAN, the Access VLAN. The field's syntax is identical to the syntax used in the Enabled VLANs field. By default, a Trunk or Hybrid port will become a member of all VLANs, and is therefore set to 3-4094. An empty field means that the port will not become a member of any VLAN.

**Forbidden VLANs:** A port may be configured to never become member of one or more VLANs. This is particularly useful to prevent dynamic VLAN protocols like MVRP and GVRP from dynamically adding ports to forbidden VLANs. The syntax is identical to the syntax used in the Enabled VLANs field. An empty field means that the port may become a member of all possible VLANs.

## 2.8 IPTV application

G.hn offers comprehensive support for IPTV and other multicast applications over copper and coax. This section discusses how to configure VLAN and other settings.

### 2.8.1 Configure allowed VLAN in subscriber

Make sure the VLAN used for video is properly configured in the subscriber configuration.

### 2.8.2 Create an IP interface VLAN for IGMP snooping.

In order for the IGMP snooping to work, an IP interface VLAN must be created on the VLAN of the snooping.

### 2.8.3 Enable IGMP snooping

**IGMP snooping** is the process of listening to Internet Group Management Protocol (IGMP) network traffic to control delivery of IP multicasts. The GAM listens in on the IGMP conversation between hosts and routers and creates and maintains a map of which links need which IP multicast transmission. These Multicasts feed are then be filtered from the end-point devices which do not need them, conserving bandwidth on those links.

The IGMP Snooping function requires the configuration of global settings for the GAM. Additional Port Settings further define how the IGMP Snooping operates for each port of the GAM.

#### Global Configuration Settings

The following settings are applied to the GAM device:

**Snooping Enabled:** Enables the Global IGMP Snooping function

**Unregistered IPMCv4 Flooding Enabled:** Enables support for unregistered IPMCv4 traffic flooding. The flooding control takes effect only when you enable IGMP Snooping. When IGMP Snooping is disabled, unregistered IPMCv4 traffic flooding is always active in spite of this setting.

**IGMP SSM Range:** SSM (Source-Specific Multicast) Range allows the SSM-aware hosts and routers to run the SSM service model for the groups in the

address range. You need to assign a valid IPv4 multicast address as prefix with a prefix length (from 4 to 32) for the range.

**Leave Proxy Enabled:** Enables the IGMP Leave Proxy capability. This feature avoids forwarding unnecessary IGMP Leave messages to the router side.

**Proxy Enabled:** Enables IGMP Proxy. This feature avoids forwarding unnecessary IGMP Join and Leave messages to the router side.

### **Port Related Configuration Settings**

The following settings operate on the ports (G.hn and SFP+) of the GAM device.

**Router Port:** for each port of the GAM, you can specify which ones act as router ports. A router port is a port on the GAM that leads towards the Layer-3 multicast source or IGMP Querier. These ports are typically the SFP+ ports labelled as 10G-1 and 10G-2.

**Important note:** When you select a port that is a member of an aggregation group as a router port, the whole aggregation group will act as a router port.

**Fast Leave:** Enable the fast leave support on the selected port(s). The GAM IGMP Snooping will remove group record and will stop forwarding data upon receiving the IGMP Leave message without sending a last member query messages. You should enable this feature only when there is a single IGMPv2 host connected to the specific port.

**Throttling:** enable this feature to limit the number of multicast groups to which a switch port can belong. By default, the throttling function is disabled for each port.

### IGMP Snooping Configuration

Global Configuration			
Snooping Enabled	<input checked="" type="checkbox"/>		
Unregistered IPMCv4 Flooding Enabled	<input type="checkbox"/>		
IGMP SSM Range	224.0.0.0	/ 8	
Leave Proxy Enabled	<input type="checkbox"/>		
Proxy Enabled	<input type="checkbox"/>		

### Port Related Configuration

Port	Router Port	Fast Leave	Throttling
*	<input type="checkbox"/>	<input type="checkbox"/>	<> ▼
G.hn-1	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
G.hn-2	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
G.hn-3	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
G.hn-4	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
G.hn-5	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
G.hn-6	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
G.hn-7	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
G.hn-8	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
G.hn-9	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
G.hn-10	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
G.hn-11	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
G.hn-12	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
10G-1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
10G-2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	unlimited ▼
MGMT	<input type="checkbox"/>	<input type="checkbox"/>	unlimited ▼

Figure 36: Configuration IGMP Snooping

## VLAN configuration for IGMP Snooping

Each page shows up to 99 entries from the VLAN table, the default being 20 pages, selected through the "entries per page" input field. When first visited, the web page will show the first 20 entries from the beginning of the VLAN Table. The first entry shows the lowest VLAN ID found in the VLAN Table.

**Start from VLAN:** allows you to select the starting point in the VLAN Table. Clicking the refresh button will update the displayed table starting from the specified VLAN or with the next closest VLAN Table match.

The **>>** button will use the last entry of the currently displayed entry as a basis for the next lookup. When reaching the last entry in the VLAN table, the WEB GUI displays "No more entries" in the displayed table. Use the **<<** button to start over.

## IGMP Snooping VLAN Table Columns

When creating an IGMP VLAN interface, make sure you setup the IP interface first. Please go to **System -> IP -> Add IP interface**.

**VLAN ID:** This is the VLAN ID of each entry in the VLAN table.

**Snooping Enabled:** Enables the per-VLAN IGMP Snooping. You can select up to 128 VLANs for IGMP Snooping.

**Querier Election:** Enable when participating in the IGMP Querier election of the VLAN. Otherwise, disable to act as an IGMP Non-Querier.

**Querier Address:** Defines the IPv4 address source address used in IP header for IGMP Querier election. When the Querier address is not set, the GAM uses the IPv4 management address of the IP interface associated with this VLAN. When the IPv4 management address is not set, the GAM uses the first available IPv4 management address. Otherwise, the GAM uses a pre-defined value. By default, this value is 192.0.2.1.

**Compatibility:** Compatibility is the result of hosts and routers taking appropriate actions depending on the versions of IGMP operating on hosts and routers within a network. The default compatibility setting is IGMP-Auto. The allowed selections are:

- IGMP-Auto
- Forced IGMPv1
- Forced IGMPv2
- Forced IGMPv3

**PRI:** this is the priority of the interface. It specifies the IGMP control frame priority level generated by the GAM. Use these settings to prioritize different classes of multicast traffic. The allowed range is 0 (best effort) to 7 (highest), with the default interface priority value set to 0.

**RV:** The Robustness Variable allows tuning for the expected packet loss on a network. The allowed range is 1 to 255, with the default robustness variable value set to 2.

**QI:** the Query Interval is the interval between General Queries sent by the Querier. The allowed range is 1 to 31744 seconds, with the default query interval set to 125 seconds.

**QRI:** The Query Response Interval is the Maximum Response Delay used to calculate the Maximum Response Code inserted into the periodic General Queries. The allowed range is 0 to 31744 in tenths of seconds. The default query response interval is set to 100 tenths of seconds (or 10 seconds).

**LLQI (LMQI for IGMP):** The Last Member Query Time is the time value represented by the Last Member Query Interval, multiplied by the Last Member Query Count. The allowed range is 0 to 31744 in tenths of seconds, with the default Last Member Query Interval set to 10 tenths of seconds (or 1 second).

**URI:** The Unsolicited Report Interval is the time between repetitions of a host's initial report of membership in a group. The allowed range is 0 to 31744 seconds, with the default unsolicited report interval set to 1 second.

#### IGMP Snooping VLAN Configuration

Start from VLAN  with  entries per page.

VLAN ID	Snooping Enabled	Querier Election	Querier Address	Compatibility	PRI	RV	QI (sec)	QRI (0.1 sec)	LLQI (0.1 sec)	URI (sec)
1	<input type="checkbox"/>	<input type="checkbox"/>	0.0.0.0	IGMP-Auto	0	2	125	100	10	1
2	<input type="checkbox"/>	<input type="checkbox"/>	0.0.0.0	IGMP-Auto	0	2	125	100	10	1
4000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0.0.0.0	Forced IGMPv2	0	2	125	10	10	1
4093	<input type="checkbox"/>	<input type="checkbox"/>	0.0.0.0	IGMP-Auto	0	2	125	100	10	1

Figure 37: Configuration IGMP Snooping VLAN settings

## IGMP Snooping Port Filtering Profile Configuration

**Port:** this column lists all of the available ports of the GAM and their associated IGMP Snooping profiles.

**Filtering Profile:** Select from the IPMC Profile defined for the GAM as the filtering condition for the specific port. You can view a summary of the assigned profile by clicking the view button.

**Profile Management:** You can inspect the rules of the assigned IP Multicast Profile (ICMP) by using the view button. Please refer to the next sub-section for more information about IPMC Profile creation and management:

IGMP Snooping Port Filtering Profile Configuration

Port	Filtering Profile
G.hn-1	3ch-video
G.hn-2	3ch-video
G.hn-3	3ch-video
G.hn-4	3ch-video
G.hn-5	3ch-video
G.hn-6	3ch-video
G.hn-7	3ch-video
G.hn-8	3ch-video
G.hn-9	3ch-video
G.hn-10	3ch-video
G.hn-11	3ch-video
G.hn-12	3ch-video
G.hn-13	3ch-video
G.hn-14	3ch-video
G.hn-15	3ch-video
G.hn-16	3ch-video
G.hn-17	3ch-video
G.hn-18	3ch-video
G.hn-19	3ch-video
G.hn-20	3ch-video
G.hn-21	3ch-video
G.hn-22	3ch-video
G.hn-23	3ch-video
G.hn-24	3ch-video
10G-1	block-all
10G-2	block-all
MGMT	3ch-video

Figure 38: Assigning an IGMP Profile to a GAM port

## 2.8.4 IP Multicast (IPMC) Profile Management

The IPMC profile is used for access control to IP multicast streams. You can create a maximum of 64 Profiles with at maximum 128 corresponding rules for each profile.

**Global Profile Mode:** Enable the Global IPMC Profile to indicate to the GAM to filter IP Multicast feeds based on the configured IPMC Profiles.

### IPMC Profile Table Setting

**Delete:** Check to delete the entry. The selected entry(ies) will be deleted during the next save.

#### IPMC Profile Configurations

Global Profile Mode	Enabled <input type="button" value=""/>
---------------------	---

#### IPMC Profile Table Setting

Delete	Profile Name	Profile Description	Rule
<input type="checkbox"/>	3ch-video		<input checked="" type="radio"/> <input type="radio"/>
<input type="checkbox"/>	block-all		<input checked="" type="radio"/> <input type="radio"/>

Figure 39: Managing an IP Multicast Profile

### Adding a New IPMC Profile

Click the **Add New IPMC Profile** button to create a new profile.

**Profile Name:** The unique name used associated to the IPMC profile in the profile table. Each name is composed of at maximum 16 alphabetic and numeric characters. At least one alphabet must be present.

**Profile Description:** You can insert a brief description of the IPMC profile. It is composed of at maximum 64 alphabetic and numeric characters. No blank or space characters are permitted as part of description. You can use "\_" or "-" instead of blank characters.

**Rule:** When creating a new IPMC profile, click the edit button to open the rule settings page. Open a summary view of the IPMC profile by clicking the view button.

IPMC Profile Table Setting

Delete	Profile Name	Profile Description	Rule
<input type="checkbox"/>	3ch-video		
<input type="checkbox"/>	block-all		
<a href="#">Delete</a>			

[Add New IPMC Profile](#)

[Save](#) [Reset](#)

Figure 40: Creating or Editing an IP Multicast Profile

Click the **Save** button when done.

Click the **edit** button to open the **IPMC Profile Address Configuration** page.

**Entry Name:** this is a unique name to identify the new IPMC Profile and index the entry in the IPMC address table. Each entry is composed of a maximum of 16 alphabetic and numeric characters. At least one alphabetic character shall be present.

**Start Address:** specify the starting IPv4 Multicast Group Address for the IP Multicast address range.

**End Address:** specify the ending IPv4 Multicast Group Address for the IP Multicast address range.

#### IPMC Profile Address Configuration

Navigate Address Entry Setting in IPMC Profile by  entries per page.

Delete	Entry Name	Start Address	End Address
<input type="checkbox"/>	all-mcast	224.0.0.1	239.255.255.255
<input type="checkbox"/>	video-channel1	239.253.1.240	239.253.1.240
<input type="checkbox"/>	video-channel2	239.254.1.240	239.254.1.240
<input type="checkbox"/>	video-channel3	239.255.1.240	239.255.1.240

[Add New Address \(Range\) Entry](#)

[Save](#) [Reset](#)

Figure 41: Managing IP Addresses for an IP Multicast Profile

Click the **Add New Address (Range) Entry** button to create another IPMC Profile Address Configuration entry.

**Entry Name:** this is a unique name to identify the new IPMC Profile and index the entry in the IPMC address table. Each entry is composed of a maximum of 16 alphabetic and numeric characters. At least one alphabetic character shall be present.

**Start Address:** specify the starting IPv4 Multicast Group Address for the IP Multicast address range.

**End Address:** specify the ending IPv4 Multicast Group Address for the IP Multicast address range.

#### IPMC Profile Address Configuration

Navigate Address Entry Setting in IPMC Profile by  entries per page.

Delete	Entry Name	Start Address	End Address
<input type="checkbox"/>	all-mcast	224.0.0.1	239.255.255.255
<input type="checkbox"/>	test	224.1.2.3	224.1.2.33
<input type="checkbox"/>	video-channel1	239.253.1.240	239.253.1.240
<input type="checkbox"/>	video-channel2	239.254.1.240	239.254.1.240
<a href="#">Delete</a>			

[Add New Address \(Range\) Entry](#)

[Save](#) [Reset](#)

Figure 42: Creating an IP Address range for an IP Multicast Profile

#### Creating or Managing Rules for an IPMC Profile

This page provides the filtering rule settings for a specific IPMC profile. It displays the configured rule entries in precedence order. First rule entry has highest priority in lookup, while the last rule entry has lowest priority in lookup.

**Profile Name and Index:** The name of the selected IPMC profile to manage. The Profile Name itself is not editable.

**Entry Name:** Select from the drop list of entries created for available address range you want to apply to this rule. You cannot select a blank entry ("--")

**Address Range:** This is the IP Multicast address range matching the selected entry name. This field is not editable. The GAM adjusts the range automatically as per the selected profile entry.

**Action:** Indicates the learning action performed upon receiving the Join/Report frame with a group address that corresponds to the address range of the rule. The available rules are:

- **Permit:** Group address matches the range specified in the rule will be learned.
- **Deny:** Group address matches the range specified in the rule will be dropped.

**Log:** Indicates the logging preference upon receiving Join/Report frames that match the address range of the rule. The available actions are:

- **Enable:** log information about the group address when it matches the range specified in the rule.
- **Disable:** Do not log information about the group address when it matches the range specified in the rule.

You can manage rules and the corresponding precedence order by using the following buttons:

- **Insert:** Insert a new rule before the current entry of rule.
- **Delete:** Delete the current entry of rule.
- **Up:** Moves the current entry of rule up in the list.
- **Down:** Moves the current entry of rule down in the list.

#### IPMC Profile [3ch-video] Rule Settings (In Precedence Order)

Profile Name & Index	Entry Name	Address Range	Action	Log	
3ch-video	1 video-channel1	239.253.1.240 ~ 239.253.1.240	Permit	Disable	
3ch-video	2 video-channel2	239.254.1.240 ~ 239.254.1.240	Permit	Disable	
3ch-video	3 video-channel3	239.255.1.240 ~ 239.255.1.240	Permit	Disable	

**Figure 43: Setting the priority rules for an IP Multicast Profile**

When creating IPMC Profiles, it may be a good idea to also create a **last** rule (inserted at the end of the rules tables) to block any other IP Multicast traffic and associated IGP Join / Leave not explicitly allowed. This is achieved with a rule such as this one.

### IPMC Profile [block-all] Rule Settings (In Precedence Order)

Profile Name & Index	Entry Name	Address Range	Action	Log
block-all	1 all-mcast	224.0.0.1 ~ 239.255.255.255	Deny	

Figure 44: Adding a Block All rule to protect the IP Multicast service

#### 2.8.5 Optional MVR proxy

The Multicast VLAN Registration (MVR) feature allows forwarding a multicast traffic to multiple recipient VLANs. (e.g. 1 VLAN unicast and 1 VLAN multicast) In an IP Multicast Television (IPTV) application, a Networked TV, PC or set-top box can receive the multicast stream. In order to eliminate the need for multiple (identical) IP Multicast feed to multiple set-top boxes or PCs, you can configure the GAM as a MVR receiver. When a subscriber selects an allowed channel (defined in an IPMC Profile), the IP Multicast recipient (IPTV, set-top box or PC) sends an IGMP/MLD report message to the GAM to join the appropriate multicast group address. MVR source ports are uplink ports that send and receive multicast data to and from the multicast VLAN. The Querier should connect to the source port. The GAM handles the MVR VLAN(s) and it is the only one that forwards the IGMP reports on behalf of the downstream (receiver ports) toward the upstream (source ports). The GAM always ignores Query packet from the downstream (receiver ports) and discards them silently.

Once the MVR VLAN members are configured, they shall associate with an IPMC profile with the specific MVR VLAN set as the allowed channel. The IPMC Profiles define the channel profiles (see previous section). **NOTE:** the GAM supports a maximum of four (4) MVR VLANs for each of the IPMC channel profile.

**IMPORTANT NOTES:** when using MVR it is important NOT to have a VLAN IP interface on the MVR VLAN (snoop VLAN). You shall also make sure to use an IPMC profile.

## **MVR Configuration**

The following page allows you to configure the MVR function.

**MVR Mode:** Enables or Disables the MVR function in the GAM. The control of Unregistered Flooding depends on the current configuration in IGMP/MLD Snooping. **NOTE:** we strongly recommend you enable Unregistered Flooding control when the MVR group table is full.

## **VLAN Interface Settings**

The following table lists the defined MVR entries and allows you to add or delete these entries.

**Delete:** Select the entry(ies) you wish to delete and then click the **save** button to remove them.

Click the **Add New MVR LAN button** to create a new MVR entry. Each entry requires the following:

**MVR VID:** Specify the Multicast VLAN ID. **NOTE:** make sure to avoid configuring MVR source ports that overlap with management VLAN ports.

**MVR Name:** this is an optional attribute to identify the specific MVR VLAN. The maximum length of the MVR VLAN unique Name is sixteen (16) alphanumeric characters. You can edit the MVR VLAN name for existing MVR VLAN entries if needed.

**Querier Election:** set to Enable to join IGMP Querier election in the VLAN. Set to Disable to act as an IGMP Non-Querier.

**IGMP Address:** use this parameter to define the IP address when the device acts as an IGMP Querier. The default IGMP address is not set (0.0.0.0). When the IGMP address is not set, the GAM uses the IPv4 management address of the IP interface associated with this VLAN. When the IPv4 management address is not set, the GAM then uses the first available IPv4 management address. Otherwise, the GAM uses a default value of 192.0.2.1.

**Mode:** in **Dynamic** mode, MVR allows dynamic MVR membership reports on source ports. In **Compatible mode**, the GAM will discard MVR membership reports from source ports. The default is Dynamic mode.

**Tagging:** specify whether the traversed IGMP/MLD control frames are sent as **Untagged** or **Tagged** with the MVR VID. The default is Tagged.

**Priority:** Specify the priority assigned to IGMP/MLD control frames. The default Priority is zero (0).

**LLQI:** The parameter defines the maximum time to wait for IGMP/MLD report memberships on a receiver port before removing the port from multicast group membership. The value is in units of tenths of a second. The valid range is 0 to 31744. The default LLQI is five (5) tenths or one-half second.

**Interface Channel Profile:** When creating an MVR VLAN, you shall select the required IPMC Profile to define THE channel filtering rules. Click the **view** button for a summary of the ICMP Profile. **NOTE:** the GAM does not allow overlapping permit group address. You can inspect the rules of the designated profile by using the  button:

**Port Role:** click on the  button to expand the view and configure the Port Role of each port of the GAM for this MVR entry. The available roles are:

- **Inactive (I):** The designated port does not take part in MVR operations. This is the default port role.
- **Source (S):** Configure uplink ports that receive and send multicast data as source ports. Subscribers cannot connect to source ports.
- **Receiver (R):** Configure a port as a receiver port if it is a subscriber port and should only receive multicast data. It does not receive data unless it becomes a member of the multicast group by issuing IGMP/MLD messages.

**Port Remap VID:** This applies to ports that configured as receivers. This is the VLAN ID (of the receiver) for the remapped multicast stream. A value of 0 removes any VLAN tag at the output interface. Otherwise, the GAM maps the multicast stream to the specified VLAN ID. In this case, the valid values range from 3 to 4093 (inclusively).

### Immediate Leave Settings

**Immediate Leave:** Enables the fast leave feature for the selected port(s). Upon receiving an IGMPv2/MLDv1 leave message from the port, the GAM will remove the port from the group record and will stop forwarding multicast data to that port. The GAM will not send a last member query messages. **NOTE:** we recommend you enable this feature only when there is a single IGMPv2/MLDv1 host connected to the selected port.

**MVR Configurations**

<b>MVR Mode</b>	Enabled
-----------------	---------

**VLAN Interface Setting**

Delete	MVR VID	MVR Name	Querier Election	IGMP Address	Mode	Tagging	Priority	LLQI	Interface Channel Profile	Port Role
<input type="button" value="Delete"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/> 0.0.0.0	Dynamic	Tagged	0	5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Port	Role	Remap VID	Port	Role	Remap VID					
G.hn-1	<input type="radio"/>	0	G.hn-7	<input type="radio"/>	0					
G.hn-2	<input type="radio"/>	0	G.hn-8	<input type="radio"/>	0					
G.hn-3	<input type="radio"/>	0	G.hn-9	<input type="radio"/>	0					
G.hn-4	<input type="radio"/>	0	G.hn-10	<input type="radio"/>	0					
G.hn-5	<input type="radio"/>	0	G.hn-11	<input type="radio"/>	0					
G.hn-6	<input type="radio"/>	0	G.hn-12	<input type="radio"/>	0					
(Role I:Inactive / S:Source / R:Receiver, Remap VID 0 = untag)										

**Immediate Leave Setting**

Port	Immediate Leave
*	<input type="radio"/>
G.hn-1	Disabled
G.hn-2	Disabled
G.hn-3	Disabled
G.hn-4	Disabled
G.hn-5	Disabled
G.hn-6	Disabled
G.hn-7	Disabled
G.hn-8	Disabled
G.hn-9	Disabled
G.hn-10	Disabled
G.hn-11	Disabled
G.hn-12	Disabled
10G-1	Disabled
10G-2	Disabled
MGMT	Disabled

Figure 45: Managing MVR VLAN assignments

## 2.9 DHCP Snooping / Option-82

The DHCP agent of the GAM supports DHCP Option 82. It forwards and transfers DHCP messages between DHCP clients and the DHCP server on same or different subnets (Relay mode). The GAM stores the incoming interface IP address in the GIADDR field of the DHCP packet. The DHCP server can use the value of GIADDR field to determine the assigned subnet. For such condition, please make sure the switch configuration of VLAN interface IP address and Port VLAN ID (PVID) correctly.

You can configure the **DHCP Snooping** function as follows:

**Snooping Mode:** Indicates the DHCP snooping mode. Possible modes are:

- **Enabled:** when you enable DHCP snooping, the GAM forwards the DHCP request messages a DHCP Server to trusted ports and only allow reply packets from trusted ports.
- **Disabled:** Disables the DHCP snooping function.

## Port Mode Configuration Table

For each port in the table, you can set the mode of a port as **trusted** or **untrusted**.

DHCP Snooping Configuration

Snooping Mode	Enabled
---------------	---------

Port Mode Configuration

Port	Mode
*	<>
G.hn-1	Untrusted
G.hn-2	Untrusted
G.hn-3	Untrusted
G.hn-4	Untrusted
G.hn-5	Untrusted
G.hn-6	Untrusted
G.hn-7	Untrusted
G.hn-8	Untrusted
G.hn-9	Untrusted
G.hn-10	Untrusted
G.hn-11	Untrusted
G.hn-12	Untrusted
10G-1	Trusted
10G-2	Trusted
MGMT	Untrusted

Save	Reset
------	-------

Figure 46: Managing DHCP Option 82

You then need to configure the **DHCP Relay** settings as follows:

**Relay Mode:** select the mode of operation for the DHCP relay function. Possible modes are:

- **Enabled:** DHCP unicast to a specific DHCP server enables the DHCP Relay function where the GAM forwards and transfers DHCP messages between the DHCP clients and the DHCP server on different subnets. DHCP broadcast messages are not flooded on all interfaces for security considerations.
- **Disabled:** Disable the DHCP relay function. DHCP packets will be sent as broadcast packets.

**Relay Server:** specify the IP address of the DHCP relay server.

**Relay Information Mode:** when you enable this function, the DHCP Snooping operates as per the Broadband Forum TR-101 specification that dictates how to

use Option 82. The Option 82 Circuit ID format is "[Agent Identifier][interface] [slot]/[port number]". For example, "000ED8-GAM12C-01012973" eth 0/6.0:3 indicates that the DHCP request was issued by Agent 000ED8-GAM12C-01012973 on an Ethernet interface by a GAM at slot 0. It further indicates that the DHCP packet originates from port #6 of the GAM, sent by endpoint #0 to this port, with a VLAN ID of 3. The Option 82 Remote ID value is set to the G.hn subscriber name associated to the G.hn end-point.

- **Enabled:** the DHCP agent of the GAM inserts the information for option 82 into DHCP messages toward the DHCP server and removes it on DHCP messages to the DHCP client.
- **Disabled:** Disable the DHCP relay function.

**Relay Information Policy:** the selected policy dictates the behavior of the DHCP Agent when it receives a DHCP message that already contains relay agent information. Available policies are:

- **Replace:** Replace the original relay information when a DHCP message that already contains it is received.
- **Keep:** Keep the original relay information when a DHCP message that already contains it is received.
- **Drop:** Drop the package when a DHCP message that already contains relay information is received.

**Relay Information Access Node ID:** specify the Agent Identifier to use when formatting the Circuit ID sub-option of Option 82. When empty, it will use the GAM SNMP System Name. When the SNMP System Name is empty, it will use the GAM serial number.

**Relay Information Index Base:** specify whether the GAM slot number and the G.hn end-point number in the Circuit ID are zero-based or one-based.

- **0-based:** GAM Slot / G.hn end-point numbers specified in the Circuit ID are zero-based
- **1-based:** GAM Slot / G.hn end-point numbers specified in the Circuit ID are one-based

DHCP Relay Configuration

Relay Mode	Enabled
Relay Server	192.168.101.92

DHCP Option 82 Configuration

Relay Information Mode	Enabled
Relay Information Policy	Replace
Relay Information Access Node ID	
Relay Information Index Base	1-based

Figure 47: Basic DHCP Relay Configuration Settings

### 2.9.1 DHCP relay (unicast request)

Configuring the GAM as a DHCP Relay ensures that the DHCP messages to and from the DHCP Server are always UNICAST.

### 2.9.2 DHCP forward (broadcast request)

Disabling the DHCP Relay function of the GAM is analogous to the GAM acting as a **DHCP Forwarder**. In this mode, Broadcast DHCP messages entering the GAM are forwarded as Broadcast DHCP messages to the DHCP Server.

## 2.10 PPPoE Intermediate Agent

The GAM supports the PPPoE Intermediate Agent. It operates as per the Broadband Forum TR-101 specification. The PPPoE Intermediate Agent intercepts all upstream PPPoE discovery stage packets, i.e. the PADI, PADR and upstream PADT packets, but does not modify the source or destination MAC address of these PPPoE discovery packets.

The PPPoE Intermediate Agent operates as per the Broadband Forum TR-101 specification. The Circuit ID format is "[Agent Identifier][interface] [slot]/[port number]". For example, "000ED8-GAM12C-01012973" eth 0/6.0:3 indicates that the PPPoE Discovery request was issued by Agent 000ED8-GAM12C-01012973 on an Ethernet interface by a GAM at slot 0. It further indicates that the PPPoE packet originates from port #6 of the GAM, sent by endpoint #0 to this port, with a VLAN ID of 3. The Remote ID value is set to the G.hn subscriber name associated to the G.hn end-point.

You can configure the following settings for the PPPoE Intermediate Agent:

**Information Mode:** select the mode of operation for the PPPoE Intermediate Agent function. Possible modes are:

- **Enabled:** enables the PPPoE Intermediate Agent where the GAM inserts specific information (Agent Information/TR-101) into a PPPoE Discovery message when forwarding to the PPPoE server and removes it from a PPPoE Discovery message when transferring to the PPPoE client.
- **Disabled:** Disable the PPPoE Intermediate Agent function.

**Information Policy:** the selected policy dictates the behavior of the PPPoE Intermediate Agent when it receives a PPPoE Discover message that already contains relay agent information. Available policies are:

- **Replace:** Replace the original relay information when a PPPoE Discover message that already contains it is received.
- **Keep:** Keep the original relay information when a PPPoE Discover message that already contains it is received.
- **Drop:** Drop the package when a PPPoE Discover message that already contains relay information is received.

**Information Access Node ID:** specify the Agent Identifier to use when formatting the Circuit ID sub-option. When empty, it will use the GAM SNMP System Name. When the SNMP System Name is empty, it will use the GAM serial number.

**Information Index Base:** specify whether the GAM slot number and the G.hn end-point number in the Circuit ID are zero-based or one-based.

- **0-based:** GAM Slot / G.hn end-point numbers specified in the Circuit ID are zero-based
- **1-based:** GAM Slot / G.hn end-point numbers specified in the Circuit ID are one-based

#### PPPoE Forward Configuration

Information Mode	Enabled
Information Policy	Replace
Information Access Node ID	
Information Index Base	0-based
<input type="button" value="Save"/> <input type="button" value="Reset"/>	

Figure 48: Basic PPPoE Intermediate Agent Configuration Settings

# Chapter 3

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## **Monitoring the GAM**

### 3.1 Monitoring the GAM

Select the **Monitor** sub-section on the left hand navigation panel of the WEB GUI to access the GAM monitoring pages.

Since the GAM is also a complete Carrier Ethernet switch, you will find detailed information beyond the G.hn features. This document is focused on the G.hn feature set, please refer to the online help section of each monitoring page for assistance or refer to the GAM User Guide more additional details.

### 3.2 System Information

The System Information page provides a global view of the GAM hardware platform. Of particular information, you will find the revision of the firmware and the uptime of the GAM.

You will also see the internal temperature of the unit and the speed of the cooling fans. The GAM design sustains ambient temperatures up to 45°C (113°F).

**System Information**

System	
Contact	
Name	
Location	
Hardware	
MAC Address	00-0e-d8-13-07-28
FPGA Version	8
Hardware Version	ASY-2100-20,R03
Serial Number	01012974
Temperatures	
CPU	34.6(C), 94.2(F)
Intake #1	30.1(C), 86.2(F)
Intake #2	30.6(C), 87.0(F)
Exhaust #1	30.9(C), 87.6(F)
Exhaust #2	25.7(C), 78.2(F)
Fans	
Fan #1	7198 rpm
Fan #2	7153 rpm
Fan #3	7332 rpm
Fan #4	6974 rpm
Time	
System Date	1970-01-02T18:15:22+00:00
System Uptime	1d 18:15:22
Software	
Booloader Version	1_4-18423M
Software Version	GAM-xx-C_v1.0.2
Software Date	2019-07-10T01:39:50-04:00
Code Revision	18933
Acknowledgments	<a href="#">Details</a>

**Figure 49: GAM System Overview**

### 3.3

## G.hn Ports, End-Points and Subscribers

The G.hn Overview provides a quick glance at the overall health of the GAM, its G.hn ports and information about the subscribers and their associated Endpoint devices. The figure below shows how the GAM supports multiple Endpoint devices per port when operating over a coax infrastructure in Point to Multipoint mode.

GAM Overview							Endpoint					Subscriber		
Port	Name	Status	MAC Address	Number of Endpoints	Status	MAC Address	Name	Model	VLAN	Bandwidth Plan	Name			
G.hn-1		●	00-0e-d8-13-07-40	1	●	00-0e-d8-13-08-48	APT 601	2001	Unthrottled	Appartment 601				
G.hn-2		●	00-0e-d8-13-07-41	0		00-0e-d8-13-08-46	APT 602	2002	Unthrottled	Appartment 602				
G.hn-3		●	00-0e-d8-13-07-42	0		00-0e-d8-13-08-42	APT 603	2003	Unthrottled	Appartment 603				
G.hn-4		●	00-0e-d8-13-07-43	0		00-0e-d8-13-08-4a	APT 604	2004	Unthrottled	Appartment 604				
G.hn-5	port feeding 5th floor	●	00-0e-d8-13-07-44	0		00-0e-d8-13-08-44	APT 605	2005	Unthrottled	Appartment 605				
G.hn-6	port feeding 6th floor	●	00-0e-d8-13-07-45	16	●	00-0e-d8-13-08-46	APT 606	2006	Unthrottled	Appartment 606				
						00-0e-d8-13-08-4e	APT 607	2007	Unthrottled	Appartment 607				
						00-0e-d8-13-08-50	APT 608	2008	Unthrottled	Appartment 608				
						00-0e-d8-13-08-52	APT 609	2009	Unthrottled	Appartment 609				
						00-0e-d8-13-08-3a	APT 610	2010	Unthrottled	Appartment 610				
						00-0e-d8-13-08-34	APT 611	2011	Unthrottled	Appartment 611				
						00-0e-d8-13-08-36	APT 612	2012	Unthrottled	Appartment 612				
						00-0e-d8-13-08-38	APT 613	2013	Unthrottled	Appartment 613				
						00-0e-d8-13-08-3e	APT 614	2014	Unthrottled	Appartment 614				
						00-0e-d8-13-08-54	APT 615	4094						
						00-0e-d8-13-08-3c								
G.hn-7		●	00-0e-d8-13-07-46	0										
G.hn-8		●	00-0e-d8-13-07-47	0										
G.hn-9		●	00-0e-d8-13-07-48	0										
G.hn-10		●	00-0e-d8-13-07-49	0										
G.hn-11		●	00-0e-d8-13-07-4a	0										
G.hn-12		●	00-0e-d8-13-07-4b	0										

Figure 50: GAM G.hn Overview (COAX – Point to Multipoint)

The G.hn overview when operating over copper (MIMO or SISO) mode shows a single Endpoint for each of the GAM G.hn ports.

#### G.hn Overview

GAM					Endpoint				Subscriber		
Port	Name	Status	MAC Address	Mode	MAC Address	Name	Model	VLAN	Bandwidth Plan	Name	
G.hn-1			00-e-d8-13-01-98	MIMO	00-e-d8-13-08-18	Bridge 1		2000	Unthrottled	appartment 1	
G.hn-2			00-e-d8-13-01-99	MIMO	00-e-d8-13-08-1a	Bridge 2		2000	Unthrottled	appartment 2	
G.hn-3			00-e-d8-13-01-9a	MIMO	00-e-d8-13-08-1c	Bridge 3		2000	Unthrottled	appartment 3	
G.hn-4			00-e-d8-13-01-9b	MIMO	00-e-d8-13-08-1e	Bridge 4		2000	Unthrottled	appartment 4	
G.hn-5			00-e-d8-13-01-9c	MIMO	00-e-d8-13-08-20	Bridge 5		2000	Unthrottled	appartment 5	
G.hn-6			00-e-d8-13-01-9d	MIMO	00-e-d8-13-08-22	Bridge 6		2000	Unthrottled	appartment 6	
G.hn-7			00-e-d8-13-01-9e	MIMO	00-e-d8-13-08-24	Bridge 7		2000	Unthrottled	appartment 7	
G.hn-8			00-e-d8-13-01-9f	MIMO	00-e-d8-13-08-26	Bridge 8		2000	Unthrottled	appartment 8	
G.hn-9			00-e-d8-13-01-a0	MIMO	00-e-d8-13-08-28	Bridge 9		2000	Unthrottled	appartment 9	
G.hn-10			00-e-d8-13-01-a1	MIMO	00-e-d8-13-08-2a	Bridge 10		2000	Unthrottled	appartment 10	
G.hn-11			00-e-d8-13-01-a2	MIMO	00-e-d8-13-08-2c	Bridge 11		2000	Unthrottled	appartment 11	
G.hn-12			00-e-d8-13-01-a3	MIMO	00-e-d8-13-08-2e	Bridge 12		2000	Unthrottled	appartment 12	

Figure 51: GAM G.hn Overview (Copper)

Please refer to the table below for more information about each column of the G.hn Overview page.

Column Heading	Associated Icon	Description
Port		ID of the G.hn Master Port
Name		Friendly name to identify the entity (Port, Endpoint or Subscriber)
Status		Port is disabled
		Service fully provisioned and Endpoint (bridge) is Up
		Service fully provisioned and Endpoint (bridge) is Down (outage is service-affecting)
		Endpoint is configured but unreachable. No subscriber associated to Endpoint. (Outage is non-service-affecting)
MAC address		MAC address of the G.hn Port on the GAM or Endpoint <ul style="list-style-type: none"> <li>- MAC address in black text means Endpoint is configured</li> <li>- MAC address in red text means</li> </ul>

		Endpoint has been discovered but is not yet configured
Number of Endpoints		Number of endpoints configured on the GAM G.hn port: Up to 16. Apply to Coax only.
Model		Model and Type of Endpoint discovered
VLAN		Endpoint VLAN used in the uplink trunk port. The range of allowed VLANs is from 3 to 4093. <b>Note:</b> the Gigabit Ethernet ports of the Endpoint always are set to Untag.

**Table 8: G.hn Overview Column**

Detailed information of endpoint is available by clicking on MAC address of the Endpoint.

System	
Detected on Port	13
Uptime	8 days, 8h 1m 36s
Hardware	
MAC	00-0e-d8-13-08-18
Model	G1000-M
Serial	01013599
FW Version	G1000M_FM-GNT-GNOW SPIRIT.v7_8_r590+7_positron_19589
Link	
Downstream Current Allocated Bandwidth (Mbps)	435
Upstream Current Allocated Bandwidth (Mbps)	433
Downstream Max Allocatable Bandwidth (Mbps)	1128
Upstream Max Allocatable Bandwidth (Mbps)	429
Downstream Current Usage (Mbps)	0
Upstream Current Usage (Mbps)	0
Downstream Number of Allocated Bands	1
Upstream Number of Allocated Bands	1
Estimated Wire Length (meters)	162

[Reboot G.hn Endpoint](#)

[Return](#)

**Figure 52: Detailed Endpoint Information (MIMO)**

**Notes:** When operating in MIMO or SISO mode, the GAM adjusts the bandwidth values over time to reflect the actual line utilization. The G.hn VectorBoost Engine manages the Dynamic Bandwidth Allocation process to allocate the bandwidth as per the demand of the Endpoint devices for the downstream and upstream directions. The reported estimated wire length information is in meters. You can use a ratio of 3.28 to convert to feet.

### 3.4 Monitor IP multicast group (IGMP snooping)

This page provides IGMP Snooping status of the GAM.

#### IGMP Snooping Status

The WEB page displays the **IGMP Snooping Statistics** as per the following table:

**VLAN ID:** this is the VLAN ID of the entry.

**Querier Version:** this is the IGMP Version of the current Querier.

**Host Version:** this is the IGMP Version of the current Working Host.

**Querier Status:** the Querier status is "ACTIVE" or "IDLE". "DISABLE" denotes the specific interface is administratively disabled.

**Queries Transmitted:** number of Transmitted Queries.

**Queries Received:** number of Received Queries.

**V1 Reports Received:** number of Received V1 Reports.

**V2 Reports Received:** number of Received V2 Reports.

**V3 Reports Received:** number of Received V3 Reports.

**V2 Leaves Received:** number of Received V2 Leaves.

#### Router Port

The WEB page also displays the GAM ports with an indication of port(s) acting as router ports. A router port is a port on the GAM that connects to the Layer-3 multicast device or IGMP Querier. **Static** denotes the specific port configuration as a router port. **Dynamic** denotes the specific port is learnt to be a router port. **Both** denote the specific port is both configured and learnt as a router port.

**Port:** GAM port number.

**Status:** Indicate whether specific port is a router port or not.

**IGMP Snooping Status****Statistics**

VLAN ID	Querier Version	Host Version	Querier Status	Queries Transmitted	Queries Received	V1 Reports Received	V2 Reports Received	V3 Reports Received	V2 Leaves Received
4000	v2	v2	IDLE	3	42	0	220	0	3

**Router Port**

Port	Status
G.hn-1	-
G.hn-2	-
G.hn-3	-
G.hn-4	-
G.hn-5	-
G.hn-6	-
G.hn-7	-
G.hn-8	-
G.hn-9	-
G.hn-10	-
G.hn-11	-
G.hn-12	-
10G-1	Both
10G-2	Static
MGMT	-

**Figure 53: IGMP Snooping Status and Statistics****IGMP Snooping Group Information**

This WEB page displays entries in the IGMP Snooping Group Table. The IGMP Group Table is sorted first by VLAN ID, and then by group.

**Start from VLAN:** select the starting entry to display in the IGMP Group Table.

**Group Address:** specify the starting Multicast group address to display.

**Entries per page:** specify the number of entries (up to 99) to display per WEB page. The default is 20 entries.

Click the **Refresh** button to update the displayed table starting from the exact or closest IGMP Group Table match. When displaying multiple pages, you can click the **refresh** button to use the first entry in the table as the to update the **Start from VLAN** and the **Group Address** input fields allowing for continuous refresh with the same start address.

When reaching the last entry in the table, the WEB page displays "No more entries". You can use the **>>** button to start over.

### IGMP Snooping Group Information

Start from VLAN  and group address  with  entries per page.

VLAN ID	Groups	Port Members														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4000	239.253.1.240													✓		
4000	239.254.1.240													✓		

**Figure 54: IGMP Snooping Group Information**

The entries in the IGMP Snooping Group include the following:

**VLAN ID:** this is the VLAN ID of the group.

**Groups:** this is the address of the group displayed.

**Port Members:** a check mark (✓) indicates the port(s) in the group.

### IGMP Source Filtered Multicast (SFM) Information

This WEB page displays the IGMP SFM Information. The IGMP SFM (Source-Filtered Multicast) Information table also contains the SSM (Source-Specific Multicast) information. This table is sorted first by VLAN IDs, then by group(s), and finally by Port Number(s). Different source addresses belonging to the same group appear as a single entry.

**Start from VLAN:** select the starting entry to display in the IGMP Group Table.

**Group Address:** specify the starting Multicast group address to display.

**Entries per page:** specify the number of entries (up to 99) to display per WEB page. The default is 20 entries.

The entries in the IGMP SFM Information Table include the following:

**VLAN ID:** this is the VLAN ID of the group.

**Group:** address of the group displayed.

**Port:** this is the port number of the GAM.

**Mode:** Indicates the filtering mode maintained per (VLAN ID, port number, Group Address) basis. Valid values are **Include** or **Exclude**.

**Source Address:** this is the IP Address of the Multicast source. The maximum number of IPv4 source address for filtering (per group) is eight (8). **None** indicates there is no source filtering address.

**Type:** the type of filtering is either Allow or Deny.

**Hardware Filter/Switch:** Indicates that the GAM is using hardware acceleration to handle the IGMP traffic.

#### IGMP SFM Information

Start from VLAN  and Group  with  entries per page.

VLAN ID	Group	Port	Mode	Source Address	Type	Hardware Filter/Switch
4000	239.253.1.240	10G-1	Exclude	None	Deny	Yes
4000	239.254.1.240	10G-1	Exclude	None	Deny	Yes

Figure 55: IGMP Source Filtering Multicast (SF) Information

### 3.5 MIMO Diagnostics: SNR, NOISE, PSD Rx Graphs

The GAM offers comprehensive Diagnostics Information in the form of graphs for the physical layer of each of the G.hn copper ports. The available diagnostics information represent real-time measurements reported from the End-Point device connected to the selected G.hn port of the GAM.

This WEB page allows you to select the port and the type of diagnostic as follows:

**Rx Port:** select the GAM G.hn port from which the measurements you require diagnostic information

**Tx Endpoint:** select the End Point available from the selected GAM port. There is always a single End-Point shown when operating over Copper (MIMO).

**Type:** select one of the following available diagnostic graphs:

- **SNR Probe:** the graph displays out-of-band probe data from the End-Point and the signal-to-noise ratio (SNR) measured at the GAM G.hn port.
- **SNR Data:** the graph displays the Signal-to-noise ratio (SNR) reported by the selected GAM G.hn port and from the in-band data (user traffic) currently transmitted by the End-Point.

- **PSD Rx:** the graph displays out-of-band probe data from the End-Point along with the power spectral density (PSD) measured at the GAM G.hn port.
- **Noise:** the graph displays the noise level over the whole frequency range potentially used by the G.hn port.

**Averaging:** when there is heavy user traffic on the selected G.hn port, you can select the number of measurement points taken over the whole frequency range to reduce the amount of monitoring traffic requested from the End-Point. Taking more measurements (plot more points) allow for a finer graph at the expense of using more resources. Reducing the number of measurements provides coarser but very adequate graphs. The default value of 4 provides adequate graphs while minimizing the monitoring resources required.

**Measurements:** click on start to open the graph and **stop** to stop collecting diagnostic information from the selected G.hn port and End-Point

#### G.hn SNR, PSD & Noise Diagnostic

Rx Port	Tx Endpoint	Type	Averaging	Measurements
Port 1	00-0b-6f-20-0d-fb	SNR Probe	4	Start

SNR Probe  
 SNR Data  
 PSD Rx  
 Noise

Figure 56: Selecting the type of G.hn Measurement graph (MIMO)

**Understanding the graphs:** **Channel 1** represents the 1<sup>st</sup> pair (inner pair) and **Channel 2** represents the 2<sup>nd</sup> pair (outer pair). When operating in SISO mode, the graph represents the measurements of the 1<sup>st</sup> pair.

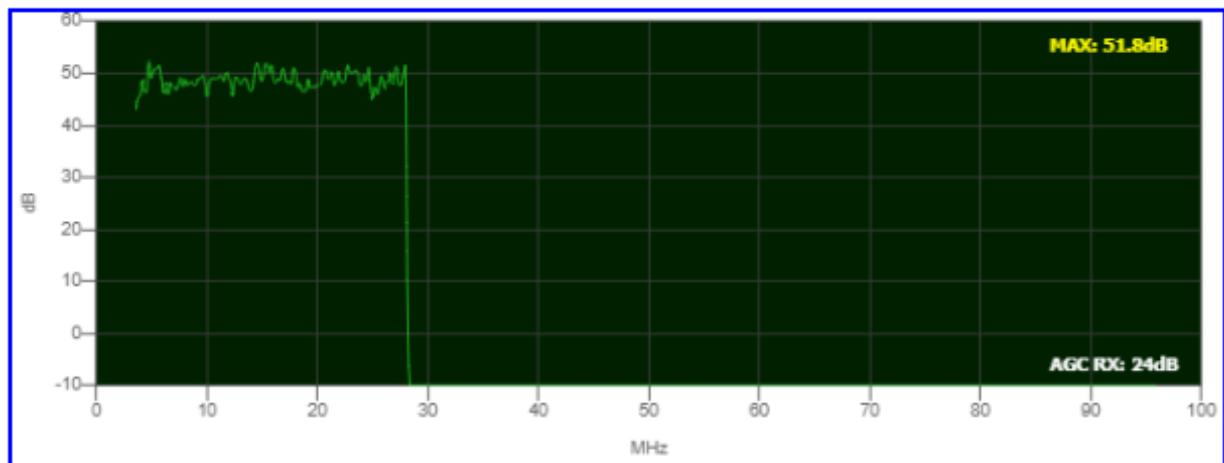
#### SNR PROBE

The following graph shows the SNR probe data from the End-Point device connected on the selected G.hn port of the GAM. **NOTE:** This screenshot represents a G.hn port in MIMO (2 active copper pairs) and operating at Boost Level 0.

G.hn SNR, PSD & Noise Diagnostic

Rx Port	Tx Endpoint	Type	Averaging	Measurements
Port 1	00-0e-d8-13-00-e2	SNR Probe	4	Start

Channel 1



Channel 2

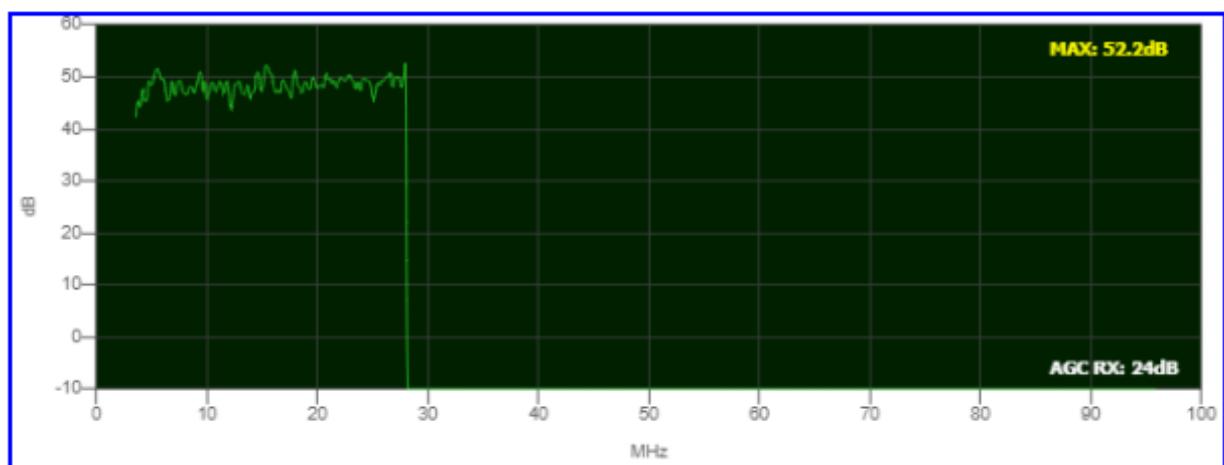


Figure 57: SNR Probe graph (MIMO)

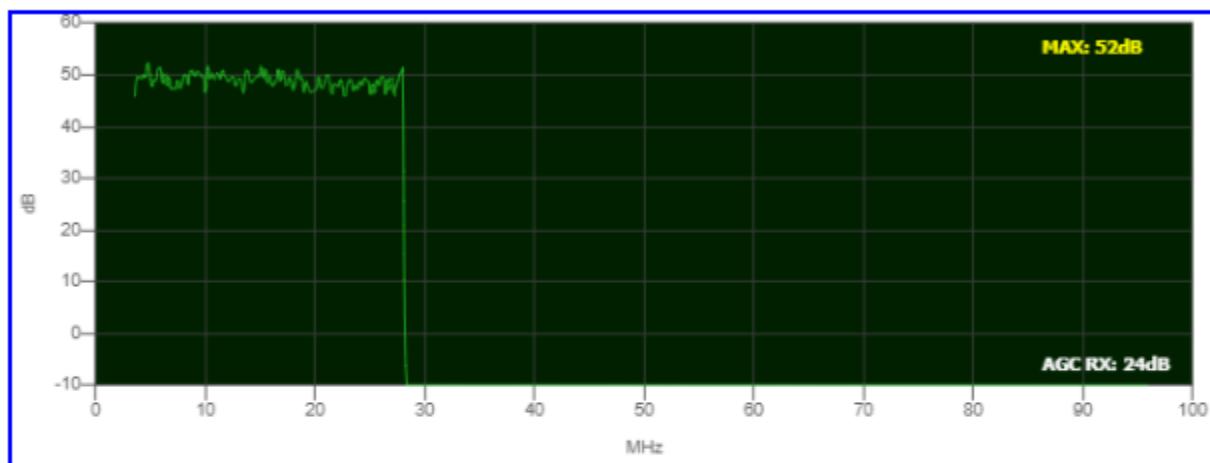
## SNR DATA

The following graph shows the SNR data from the End-Point device connected on the selected G.hn port of the GAM. **NOTE:** This screenshot was taken when the G.hn port was operating at Boost Level 0.

G.hn SNR, PSD & Noise Diagnostic

Rx Port	Tx Endpoint	Type	Averaging	Measurements
Port 1	00-0e-d8-13-00-e2	SNR Data	4	Start

Channel 1



Channel 2

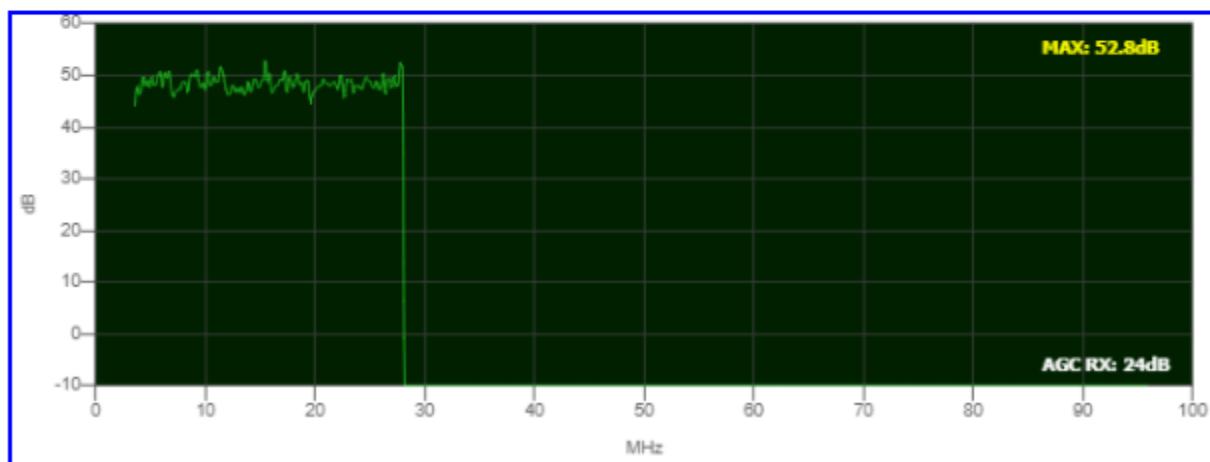


Figure 58: SNR Data graph (MIMO)

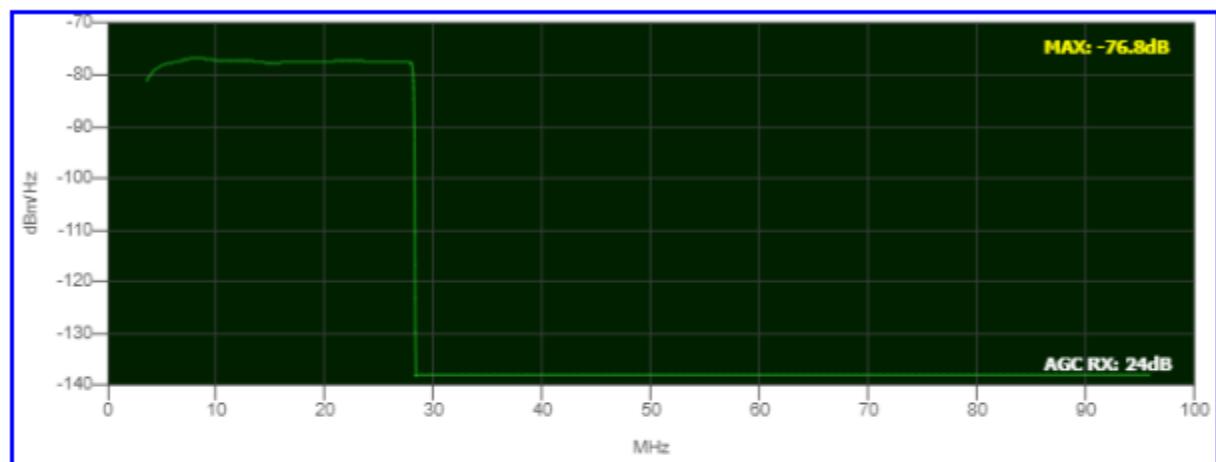
## PSD RX

The following graph shows the Power Spectral Density (PSD) from the End-Point device connected on the selected G.hn port of the GAM. **NOTE:** This screenshot was taken when the G.hn port was operating at Boost Level 0.

G.hn SNR, PSD & Noise Diagnostic

Rx Port	Tx Endpoint	Type	Averaging	Measurements
Port 1	00-0e-d8-13-00-e2	PSD Rx	4	Start

Channel 1



Channel 2

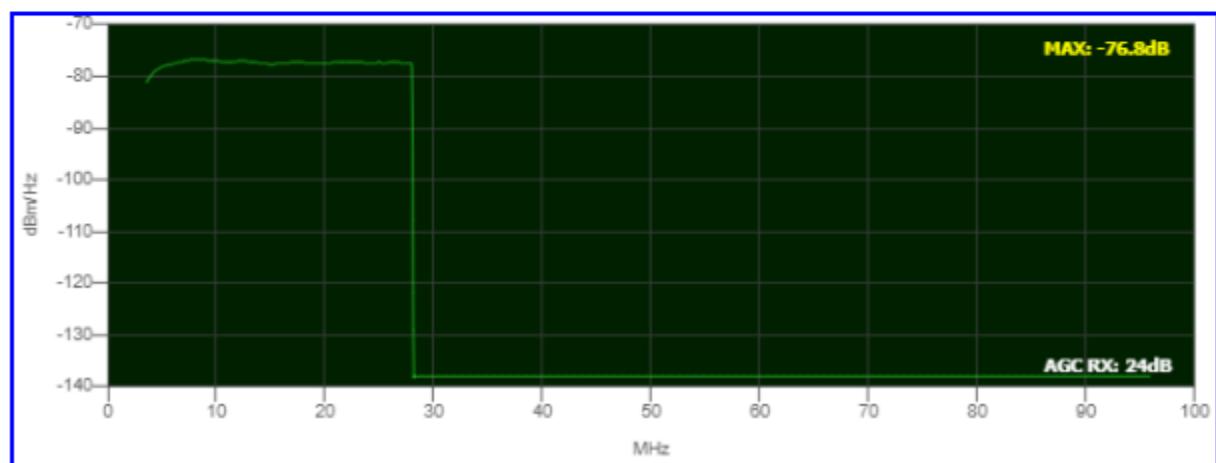


Figure 59: Receive PSD graph from remote End-Point (MIMO)

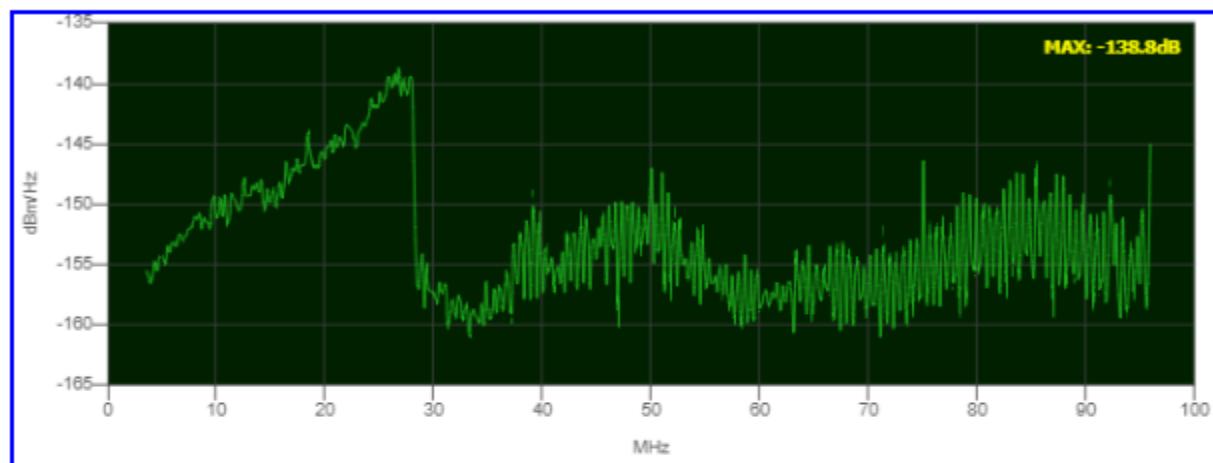
## NOISE

The following graph shows the noise reported by the End-Point device connected on the selected G.hn port of the GAM. **NOTE:** This screenshot was taken when the G.hn port was operating at Boost Level 0.

G.hn SNR, PSD & Noise Diagnostic

Rx Port	Tx Endpoint	Type	Averaging	Measurements
Port 1	00-0e-d8-13-00-e2	Noise	4	[Start]

Channel 1



Channel 2

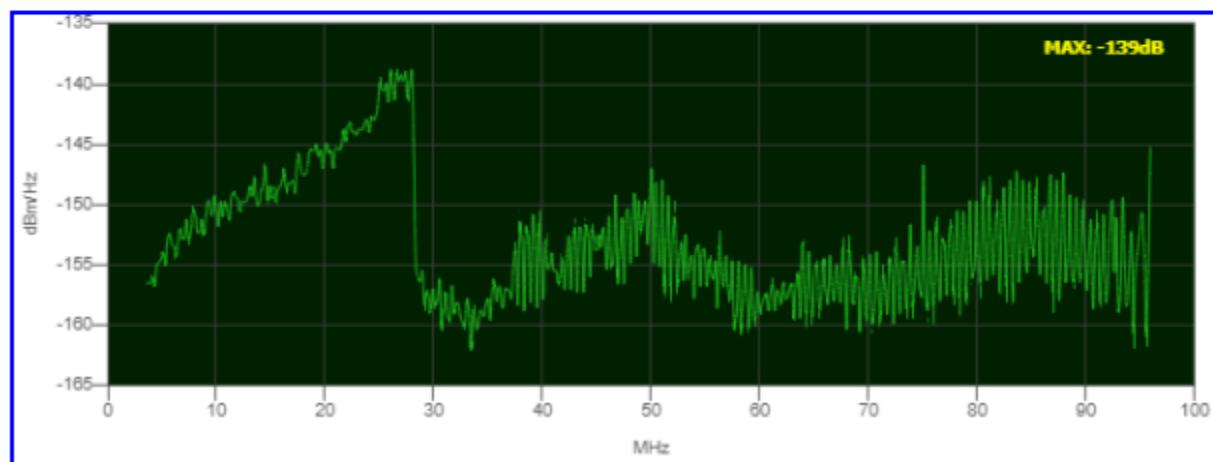


Figure 60: Noise graph (MIMO)

## 3.6

## COAX Diagnostics: SNR, NOISE, PSD Rx Graphs

The GAM offers comprehensive Diagnostics Information in the form of graphs for the physical layer of each of the G.hn COAX ports. The available diagnostics information represent real-time measurements reported from the End-Point device connected to the selected G.hn port of the GAM.

This WEB page allows you to select the port and the type of diagnostic as follows:

**Rx Port:** select the GAM G.hn port from which the measurements you require diagnostic information

**Tx Endpoint:** select from the End Point device(s) available from the selected GAM port. G.hn COAX ports can handle up to sixteen (16) End-Point devices).

### G.hn SNR, PSD & Noise Diagnostic

Rx Port	Tx Endpoint	Type	Averaging	Measurements
Port 1	00-0e-d8-13-08-34	SNR Probe	4	Start
<div style="border: 1px solid #ccc; padding: 5px;">         00-0e-d8-13-08-34          00-0e-d8-13-07-ec          00-0e-d8-13-07-e8          00-0e-d8-13-07-eb          00-0e-d8-13-07-f0          00-0e-d8-13-07-ef          00-0e-d8-13-08-36       </div>				

Figure 61: Selecting the End-point for the of G.hn Measurement graph (COAX)

**Type:** select one of the following available diagnostic graphs:

- **SNR Probe:** the graph displays out-of-band probe data from the End-Point and the signal-to-noise ratio (SNR) measured at the GAM G.hn port.
- **SNR Data:** the graph displays the Signal-to-noise ratio (SNR) reported by the selected GAM G.hn port and from the in-band data (user traffic) currently transmitted by the End-Point.
- **PSD Rx:** the graph displays out-of-band probe data from the End-Point along with the power spectral density (PSD) measured at the GAM G.hn port.
- **Noise:** the graph displays the noise level over the whole frequency range potentially used by the G.hn port.

**Averaging:** when there is heavy user traffic on the selected G.hn port, you can select the number of measurement points taken over the whole frequency range to reduce the amount of monitoring traffic requested from the End-Point. Taking more measurements (plot more points) allow for a finer graph at the expense of using more resources. Reducing the number of measurements provides coarser but very adequate graphs. The default value of 4 provides adequate graphs while minimizing the monitoring resources required.

**Measurements:** click on start to open the graph and **stop** to stop collecting diagnostic information from the selected G.hn port and End-Point.

#### G.hn SNR, PSD & Noise Diagnostic

Rx Port	Tx Endpoint	Type	Averaging	Measurements
Port 1	00-0b-6f-20-0d-fb	SNR Probe	4	Start

SNR Probe  
 SNR Data  
 PSD Rx  
 Noise

Figure 62: Selecting the type of Measurement graph (COAX)

#### SNR PROBE

The following graph shows the SNR probe data from the End-Point device connected on the selected G.hn port of the GAM.

#### G.hn SNR, PSD & Noise Diagnostic

Rx Port	Tx Endpoint	Type	Averaging	Measurements
Port 1	00-0e-d8-13-08-4c	SNR Probe	4	Stop

Channel 1

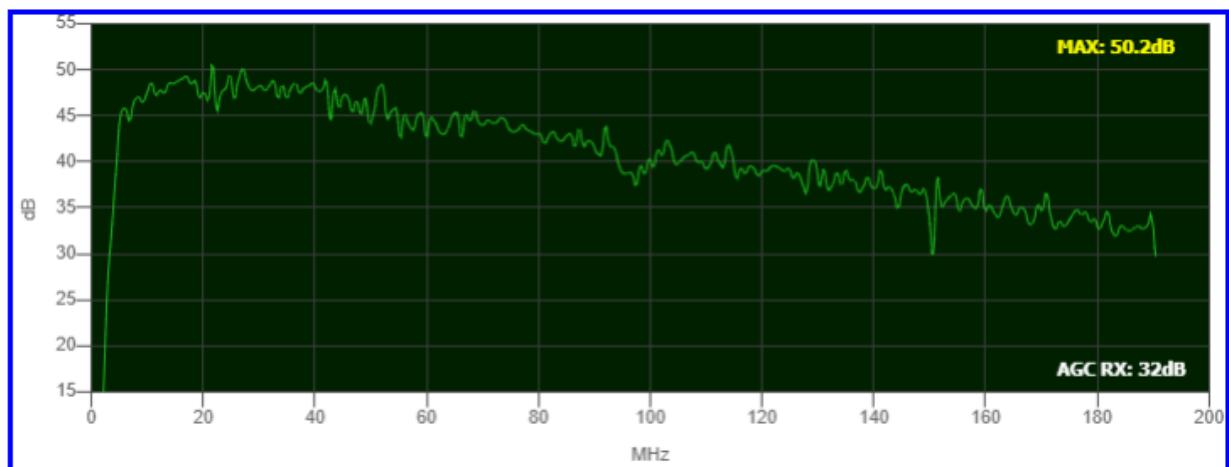


Figure 63: SNR Probe graph (COAX)

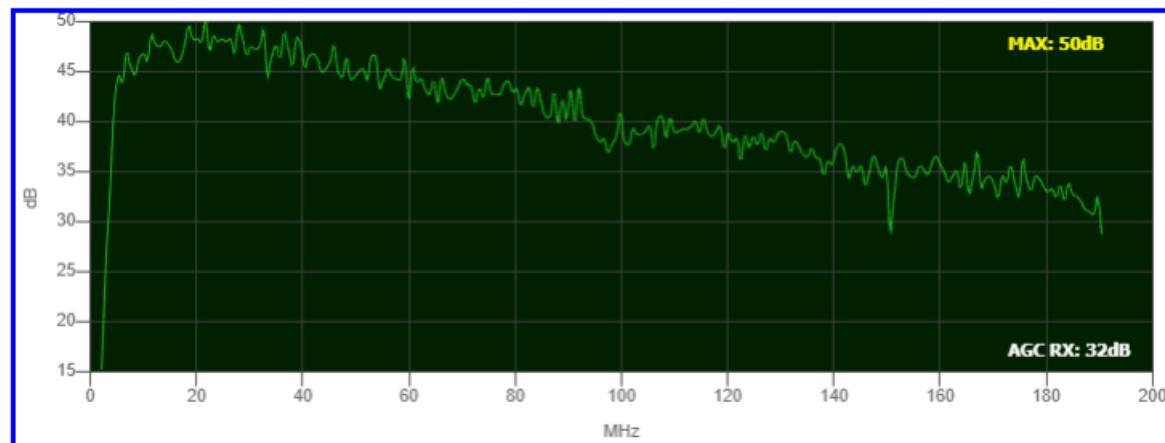
## **SNR DATA**

The following graph shows the SNR data from the End-Point device connected on the selected G.hn port of the GAM.

**G.hn SNR, PSD & Noise Diagnostic**

Rx Port	Tx Endpoint	Type	Averaging	Measurements
Port 1	00-0e-d8-13-08-4c	SNR Data	4	Stop

**Channel 1**



**Figure 64: SNR Data graph (COAX)**

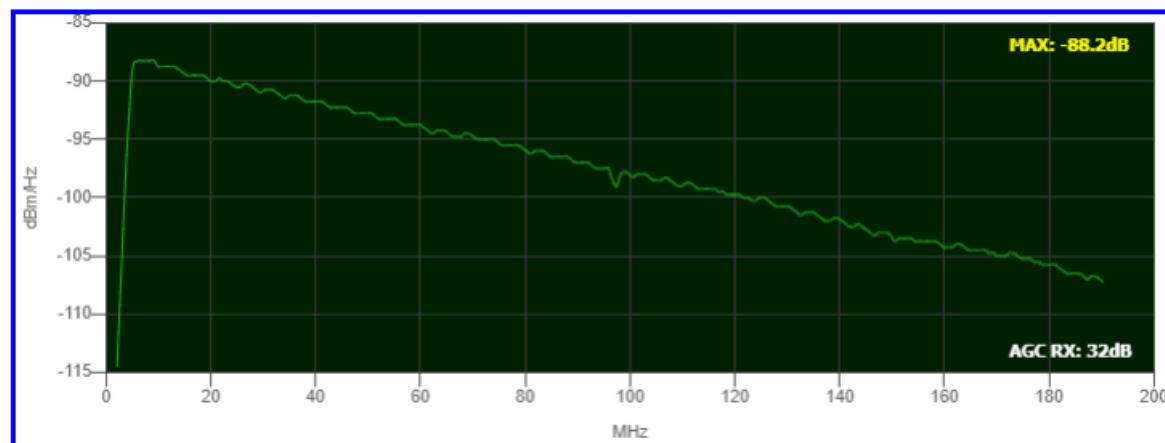
## **PSD RX**

The following graph shows the Power Spectral Density (PSD) from the End-Point device connected on the selected G.hn port of the GAM.

**G.hn SNR, PSD & Noise Diagnostic**

Rx Port	Tx Endpoint	Type	Averaging	Measurements
Port 1	00-0e-d8-13-08-4c	PSD Rx	4	Stop

**Channel 1**



**Figure 65: Receive PSD graph from remote End-Point (COAX)**

## NOISE

The following graph shows the noise reported by the End-Point device connected on the selected G.hn port of the GAM.

G.hn SNR, PSD & Noise Diagnostic

Rx Port	Tx Endpoint	Type	Averaging	Measurements
Port 1	00-0e-d8-13-08-4c	Noise	4	Stop

Channel 1

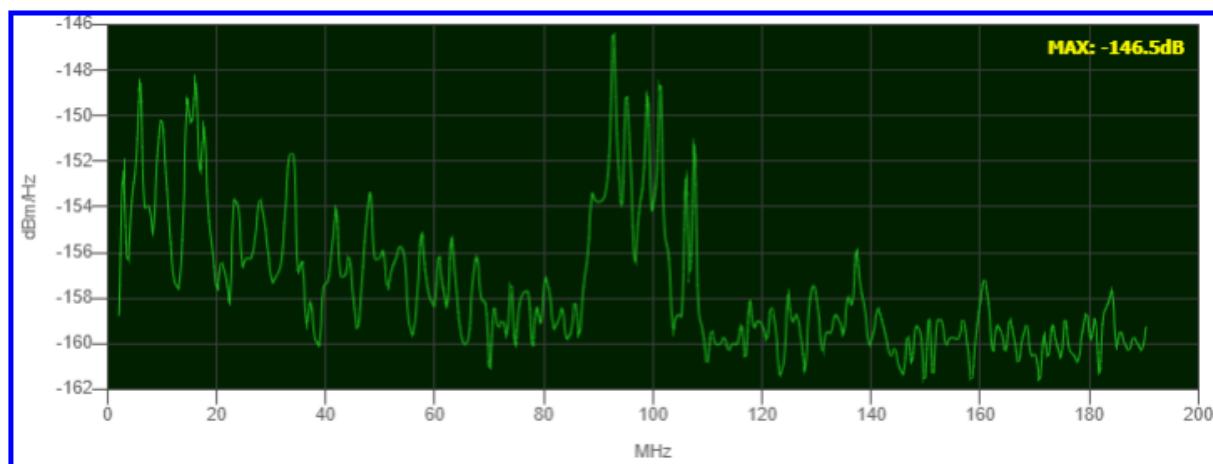


Figure 66: Noise graph (COAX)

## 3.7 Firmware upgrade

**Important note:** performing a software upgrade is service affecting. When uploading a new version, the GAM will automatically upgrade the backup bank and reboot to activate new software.

You can update the GAM firmware either via the web browser or from a URL. The GAM firmware also includes the G1000 / G1001 end-point firmware and the GAM will push a firmware update to G1000 / G1001 devices operating under out of date firmware.

### 3.7.1 Upgrade GAM Firmware from File on your PC

This WEB page facilitates an update of the firmware controlling the GAM.

Simply BROWSE to the location of a software image on your PC and click UPLOAD

Once the new firmware image is uploaded (HTTP post) to the GAM, the WEB page will indicate that the firmware update is in-progress. After about a minute, the firmware is updated and the GAM will automatically restart with the current configuration settings.

**Important Note:** WEB Access is temporarily suspended during the GAM firmware update process. Do not restart or power off the device at this time or the switch may fail to function afterwards. If you have physical access to the GAM, you will notice that the front LED flashes Green/Off with a frequency of 10 Hz while the firmware update is in progress.

The image shows a software upload interface. At the top, it says "Software Upload". Below that is a button labeled "Choose File" with the text "No file chosen" next to it. To the right is a blue "Upload" button.

Figure 67: Select File for Firmware Upload to the GAM

### 3.7.2 Upgrade GAM Firmware from URL

This WEB page lets you enter a file location where the GAM can go get a new firmware. The GAM acts as a “client” and must get the file from a server (FTP HTTP or HTTPS). All you need to do is provide the full URL of the firmware location and click Download to proceed.

**Note:** the upgrade of the GAM firmware automatically takes place once the download to the GAM completes.

#### Firmware Download

The image shows a firmware download interface. At the top, it says "Enter URL to download from (ftp, http or https)". Below that is a text input field containing the example URL "Example: ftp://jdoe:passwd@192.168.1.1/software/gam12m/gam12m\_positron-1.0.1.img". At the bottom is a blue "Download" button.

Figure 68: Entering the URL for Firmware Upload to the GAM

### 3.7.3 Activate Alternate Image

The GAM permanent storage (FLASH Memory) holds two (2) firmware banks (or images). You can use this WEB page to select which firmware the GAM should operate under: active or alternate (backup) firmware images. This WEB page also allows you to revert to the alternate image.

**Note:** when the active firmware image is the alternate image, this WEB page only displays the "Active Image" table. In this case, the **Activate Alternate Image** button is also disabled...When the alternate image is active (due to a corruption of the primary image or by manual intervention), uploading a new GAM firmware image will automatically use the alternate image slot and restart the GAM to make the alternate image the active one.

**Image:** file name of the firmware image, from when the image was last updated.

**Version:** this is the version of the firmware image.

**Date:** creation date of the firmware

**Software Image Selection**

Active Image	
Image	ce_jr2_mimo.mfi
Version	GAM-xx-M_v1.1.0
Date	2020-03-04T06:44:19-05:00

Alternate Image	
Image	linux.bk
Version	v1.1.0
Date	2020-03-03T06:44:03-05:00

[Activate Alternate Image](#) [Cancel](#)

**Figure 69: Selecting the Firmware Image for the GAM**

## 3.8 Configuration backup and restore

### 3.8.1 Backup the configuration

Once the system is configured, it is recommended to save a copy of the configuration.

Under Maintenance>Configuration>Download, select either the running or start config and click download. A copy of the configuration (text file in CLI format) will be downloaded to your PC

**Download Configuration**

Select configuration file to save.

Please note: running-config may take a while to prepare for download.

File Name
<input checked="" type="radio"/> running-config
<input type="radio"/> default-config
<input type="radio"/> startup-config-alternate
<input type="radio"/> startup-config

**Download Configuration**

**Figure 70: Selecting the Firmware Image for the GAM**

### 3.8.2 Restore the configuration

To restore a configuration, the user must have a web access to the unit, either using the local management port or remote IP access.

Under Maintenance>Configuration>Upload, Browse the file on your PC, select either the destination running or start config and click Upload.

## Upload Configuration

### File To Upload

No file chosen

### Destination File

File Name	Parameters
<input type="radio"/> running-config	<input checked="" type="radio"/> Replace <input type="radio"/> Merge
<input type="radio"/> startup-config-alternate	
<input type="radio"/> startup-config	
<input type="radio"/> Create new file	<input type="text"/>

**Figure 71: Selecting the Firmware Image for the GAM**

# Chapter 4

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## Technical and Regulatory Specifications

## 4.1 GAM Technical Specifications

Part Number	10GigE SFP+	G.hn Ports / Type	Out-of-band Management Ports
<b>GAM-12-M</b>	2	12 MIMO (RJ45)	1 x 10/100/1000BaseT 1 x serial
<b>GAM-24-M</b>	2	24 MIMO (RJ45)	1 x 10/100/1000BaseT 1 x serial
<b>GAM-12-C</b>	2	12 COAX (F-type)	1 x 10/100/1000BaseT 1 x serial
<b>GAM-24-C</b>	2	24 COAX (F-type)	1 x 10/100/1000BaseT 1 x serial
<b>Environmental</b>			
Dimensions	17.4" (442 mm) Width x 1.73" (44 mm) Height x 10.0" (254 mm) Depth		
Power Source	100-240 VAC / 50~60 Hz		
Operating Temperature	0°C to 45°C (32°F to 113°F)		
Storage Temperature	-40°C to 70°C (-40°F to 158°F)		
Relative Humidity	Up to 95%, non-condensing		
<b>10 Gbps Network-Network Interface (NNI)</b>			
2 x SFP+ ports	SFP+ offer versatile support for Active Ethernet and for GEON, 10GEON, NG-PON2 and XGS-PON via external ONU/ONT devices Also compatible with 3 <sup>rd</sup> party PON SFP ONT modules		
<b>G.hn Specification</b>			
G.hn Standards	<p>G.hn Wave-2 Domain Master on all GAM ports (MIMO or Coax)</p> <p>Based on GigaWire Alliance specification and fully compliant with the following ITU-T standards</p> <ul style="list-style-type: none"> <li>• G.9960 Amendment 2 - System Architecture and PHY Layer</li> <li>• G.9961 Data Link Layer</li> <li>• G.9962 Management</li> <li>• G.9964 PSD</li> </ul>		
Ease of Deployment	Support G.hn operation over telephone wiring (RJ45 with 1 or 2 pairs) and coax cabling (F-type connector)		
Point to Point and Point to Multipoint support	Point-to-point (twisted pair and coax) Point-to-multipoint operation (coax) for up to 16 Subscriber CPEs per G.hn port		
Ease of Operation	Supports firmware and configuration management of G.hn end-point devices		

Encryption	AES-128 encryption with individual keys for each End Point. The Positron GAM Master Node is also acting as the G.hn Security Controller
Modulation and Frequency Band	Supports OFDM 200 MHz. Telephone wiring supports 1 pair (Single Input Single Output - SISO) and 2 pairs (Multiple Input Multiple Output - MIMO) per RJ45 port Radio Band Notching function allows cohabitation with legacy analog cable TV channels on coax cabling and concurrent use with POTS and DSL on telephone pairs
Bandwidth Management	Up to 1.7 Gbps with Dynamic Bandwidth Allocation to optimize throughput based on nature of traffic flows with TDD Multiplexing for programmable upstream / downstream ratio
Vectoring (Telephone Wiring)	Support for VectorBoost™ for FEXT (Far-End Crosstalk) mitigation and improved performance over Telephone wiring
Mitigation of Near-end Crosstalk	Near End Crosstalk (NEXT) Mitigation and support for Neighbor Domain Interface Mitigation (NDIM)
PSD	Programmable PSD mask for coexistence with xDSL / radio and Far End Crosstalk (FEXT) mitigation
Reliability and Resiliency	State of the art LDPC Forward Error Correction (FEC)
<b>Layer 2 Switching</b>	
Spanning Tree Protocol (STP)	Standard Spanning Tree 802.1d Rapid Spanning Tree (RSTP) 802.1w Multiple Spanning Tree (MSTP) 802.1s
MAC Table	Up to 32K MAC addresses
Trunking	Link Aggregation Control Protocol (LACP) IEEE 802.3ad for any SFP+ or G.hn ports
VLAN	Supports up to 4K VLANs simultaneously (out of 4096 VLAN IDs) <ul style="list-style-type: none"> <li>• Port-based VLAN</li> <li>• IEEE 802.1Q tag-based VLAN</li> <li>• IEEE 802.1ad (Q-in-Q) double tag VLAN</li> <li>• MAC-based VLAN</li> <li>• Management VLAN</li> <li>• Private VLAN Edge (PVE)</li> </ul>
Generic VLAN Registration (GVRP)	Protocols for automatically propagating and configuring VLANs in a Multicast Domain for IPTV and other multicast services
IGMP v1/v2/v3 snooping	IGMP limits bandwidth-intensive multicast traffic to only the requesters Supports 1024 multicast groups
IGMP Proxy	IGMP snooping with proxy reporting or report suppression actively filters IGMP packets in order to reduce load on the multicast router
IGMP Query	IGMP query is used to support layer-2 multicast domain in the absence of a multicast router
MLD v1/v2 snooping	Deliver IPv6 multicast packets only to the required receivers
DHCP Server	Supports DHCP server to assign addresses to IPv4 client devices
DHCP Snooping	DHCP snooping provides security by filtering un-trusted DHCP messages and by building and maintaining a DHCP snooping binding table

DHCP Relay	By supporting DHCP option 82, it is possible to forward DHCP requests to another specific DHCP server via DHCP relay. The DHCP server may be on another network
<b>Layer-3 Support</b>	
IPv4 Static Routing	Static routing of IPv4 unicast traffic
IPv6 Static Routing	Static routing of IPv6 unicast traffic
<b>Security</b>	
Secure Shell (SSH) Protocol	SSH secures Telnet traffic in and out of the switch, SSH v1, v2 are supported
Secure Sockets Layer (SSL)	SSL encrypts the HTTP traffic, allowing advanced secure access to the browser-based management GUI in the switch
IEEE 802.1X	IEEE 802.1X: RADIUS authentication, authorization and accounting, MD5 hash, single / multiple host mode and single / multiple sessions Supports IGMP-RADIUS based 802.1X Dynamic VLAN assignment
RADIUS/ TACACS+	Supports RADIUS and TACACS+ authentication G.hn Aggregation Multiplexer acting as a RADIUS client
Layer 2 Isolation Private VLAN Edge (PVE)	PVE (also known as protected ports) provides L2 isolation between clients in the same VLAN, supports multiple uplinks
Port Security	Locks MAC Addresses to ports and limits the number of learned MAC addresses
IP Source Guard	Prevents datagram with spoofed addresses from being in the network
Storm Control	Prevents traffic on a LAN from being disrupted by a broadcast, multicast, or unicast storm on a port
ACLs	Supports up to 256 entries Drop or rate limitation based on source and destination MAC, VLAN ID or IP address, protocol, port, differentiated services code point (DSCP) / IP precedence, TCP / UDP source and destination ports, 802.1p priority, Ethernet type, Internet Control Message Protocol (ICMP) packets, IGMP packets, TCP flag
<b>Quality of Service</b>	
Hardware Priority Queue	Support 8 hardware queues
Scheduling	Strict priority and Weighted Round-Robin (WRR) Queue assignment based on DSCP and class of service (802.1p/ CoS)
Classification	Port based; 802.1p VLAN priority based; IPv4/IPv6 precedence/ type of service (ToS) / DSCP based; Differentiated Services (DiffServ); classification and re-marking ACLs, trusted QoS

Rate Limiting	Ingress policer; egress shaping and rate control; per VLAN, per port and flow based
IPv6 Support	Web/ SSL, Telnet/ SSH, ping, Simple Network Time Protocol (SNTP), Trivial File Transfer Protocol (TFTP), SNMP, RADIUS, Syslog, DNS Client, protocol based VLANs
<b>Carrier Ethernet Protocol and features</b>	
IEEE 802.3ah Ethernet OAM	Link Fault Management (LFM) for Ethernet links as defined in IEEE 802.3ah
IEEE 802.1ag Ethernet CFM	IEEE 802.1ag Ethernet CFM function that provides connectivity fault management
ITU-T Y.1731	ITU-T service OAM standard Y.1731 divides a network into maintenance domains in the form of hierarchy levels
ITU-T G.8031 AND G.8032v2	Provides the standards-based method of delivering high-performance Carrier Ethernet services over a multi-node ring protection switching to serve large MDUs or MTUs
<b>Management</b>	
Web GUI Interface	Built-in configuration utility for browser-based device configuration (HTTP/ HTTPS). Supports configuration, system dashboard, maintenance and monitoring
Firmware Upgrade	Web browser upgrade (HTTP/ HTTPS) and TFTP Secure upgrade through console port
Dual Firmware Image	Dual image and firmware partition provides independent primary and secondary OS files for backup while upgrading. Each firmware image has its corresponding firmware partition
SNMP	SNMP version1, 2c and 3 with support for traps and SNMP version 3 user-based security model (USM)
Remote Monitoring (RMON)	Embedded RMON software agent supports RMON groups 1,2,3,9 (history, statistics, alarms and events) for enhanced traffic management, monitoring and analysis
IPv4 and IPv6 Dual Stack	Coexistence of both protocol stacks to support a seamless migration
Port Mirroring	Traffic on a port can be mirrored to another port for Legal Interception (CALEA) or analysis with a network analyzer or RMON probe. Up to N-1 (N is Switch's Ports) ports can be mirrored to single destination port. A single session is supported
Network Time	Network Time Protocol (NTP) for clock synchronization over packet

Protocol	switched networks
Other Management	HTTP / HTTPPs; SSH; RADIUS; DHCP Client / DHCPv6 Client; SNTP; cable diagnostics; ping; syslog; Telnet client (SSH secure support), IPv6 Management
Discovery	Link Layer Discovery Protocol (LLDP) (IEEE 802.1ab) with LLDP-MED extensions

**Figure 72: GAM Product Specification**

## 4.2 G1000/1001 Technical Specifications

Part Number	Gigabit Ethernet ports	G.hn Port / Type	Built-in splitter/combiner
<b>G1000-M</b>	2	1 MIMO (RJ45)	Yes (POTS)
<b>G1000-C</b>	2	1 COAX (F-type)	Yes (Coax DTV)
<b>G1001-M</b>	1	1 MIMO (RJ45)	No
<b>G1001-MP</b>	1	1 MIMO (RJ45)	Yes (POTS)
<b>G1001-C</b>	1	1 COAX (F-type)	Yes (Coax DTV)
<b>Environmental</b>			
Dimensions	2.6" W x 1.25" H x 4" D / 66 mm W x 32 mm H x 102 mm D		
Power Source	100-240 VAC / 50~60 Hz		
Operating Temperature	0°C to 45°C (32°F to 113°F)		
Storage Temperature	-40°C to 70°C (-40°F to 158°F)		
Relative Humidity	Up to 95%, non-condensing		

**Figure 73: G1001 Product Specification**

## **4.3 Regulatory Compliance**

### **FCC Declaration of Conformance**

The GAM models comply with part 15 of the FCC Rules. Operation is subject to the following two conditions (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

### **Part 15 Class A Information**

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates; uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

### **Industry Canada**

The GAM models comply with ICES-003 of the Industry Canada Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Les modèles GAM sont conformes à la norme NMB-003 d'Industrie Canada. Leur fonctionnement est sujet aux deux conditions suivantes: (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

### **Europe - EU Declaration of Conformity**

The GAM models comply with the essential requirements of the EMC Directive 2014/30/EU and Low Voltage Directive 2014/35/EU. The following test methods have been applied in order to prove presumption of conformity with the essential

requirements of the EMC Directive 2014/30/EU and Low Voltage Directive 2014/35/EU:

CSA C22.2#60950-1: Issued: 2007/03/27 Ed: 2 (R2012) Information Technology Equipment Safety Part 1: General Requirements; Amd. 1: 2011, Amd. 2: 2014

UL 60950-1: Issued: 2007/03/27 Ed: 2 Rev: 2014/10/14 Information Technology Equipment Safety Part 1: General Requirements

IEC 60950-1: Issued: 2013/05/28 Ed: 2.2 Information Technology Equipment - Safety - Part 1: General Requirements; Consolidated Edition. Ed. 2: 2005

EN 55022: 2010: Information technology equipment - Radio disturbance characteristics Limits and methods of measurement

EN 55024: 2010: Information technology equipment - Immunity characteristics - Limits and methods of Measurement

EN 55032: 2012: Electromagnetic compatibility of multimedia equipment - Emission Requirements

English	Hereby, Positron Access solutions Corp., declares that the GAM models comply with the essential requirements and other relevant provisions of Directive 2014/30/EU and 2014/35/EU.
Français	Par la présente Positron Access solutions Corp., déclare que les modèles GAM sont conformes aux exigences essentielles et aux autres dispositions pertinentes selon les normes 2014/30/EU and 2014/35/EU.

## Safety

The GAM models conforms to IEC 60950-1/UL 60950-1/CSA C22.2 #60950-1 standards.

Les modèles GAM sont conformes aux normes IEC 60950-1/UL 60950-1/CAN C22.2 #60950-1.

# Chapter 5

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## Safety and Warnings

## Safety and Warnings

To ensure your safety when servicing and installing this equipment, please take the following precautions:

The GAM products accept 110-220Vac for powering (50-60Hz). A properly fused 3-contact (live-neutral-protective ground) power outlet wired in accordance to the National Electrical Code shall be used to provide the power to the GAM unit.

A power cord meeting IEC 60320 (C13 type) is supplied with the GAM device and shall be used to bring power to the GAM. The primary protective ground (earthing) is provided through this cord.

The power cord must always be disconnected before servicing the accessible front panel fuse to prevent from risk of electrical shock. Always use a replacement fuse of the proper current rating.

Only qualified personnel should service this system.

All wiring external to the product should follow the local wiring codes.

Use of this product in a manner other than defined in this installation guide may cause damage to equipment or injury to personnel.

If a problem has been isolated to this unit, do not attempt to repair. The unit's components are not user serviceable and therefore must not be replaced. Please return the unit to Positron Access Solutions for repair.

Observe local practice electrostatic discharge precautions when handling electronic equipment. Do not hold electronic plugs by their edge. Do not touch components or circuitry. Use a grounding wrist strap attached to a grounding connection point. Use only ESD-protective packaging materials when transporting equipment.



When installing in a closed or multi-unit rack environment, ensure that the maximum operating ambient temperature of 45°C (113°F) is not exceeded.

Installation of the equipment in a rack should be such that the amount of airflow required for safe operation of the equipment is available.

Connect the unit only to a properly rated supply circuit.

During installation and service, do not connect to a live power source. Ensure that fuses/breakers on the main power source are in the OFF/OPEN position or that power cords are unplugged from the unit.

Mounting of equipment in a rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.

**WARNING:** The intra-building ports (Electrical Ethernet – RJ-45, G.hn, V.24 console) of the equipment are suitable for connection to intra-building or unexposed wiring or cabling only. The intra-building ports of the equipment MUST NOT be metallically connected to interfaces which connect to the OSP or its wiring. These interfaces are designed for use as intra-building Interfaces only (Type 2 or Type 4 ports as described in GR-1089-CORE, Issue 4) and require isolation from the exposed OSP cabling. The addition of Primary Protectors is not sufficient protection in order to connect these interfaces metallically to OSP wiring.

THIS PRODUCT IS SUITABLE FOR MOUNTING ON OR ABOVE CONCRETE OR OTHER NON-CONDUCTIVE SURFACE ONLY.

# Chapter 6

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## **Warranty and Customer Service**

Positron Access Solutions will replace or repair this product within the warranty period if it does not meet its published specifications or fails while in service. Warranty information can be found in your Positron Access customer web portal:  
<http://www.positronaccess.com/Portal.php>

**Positron Access Solutions Sales Pricing/Availability and Technical Support**

US and Canada: 1-888-577-5254

International: +1-514-345-2220

[customerservice@positronaccess.com](mailto:customerservice@positronaccess.com)

**Repair and Return Address**

Contact Customer Service prior to returning equipment to Positron.

Telephone US and Canada: 1-888-577-5254 option 6

International: +1-514-345-2220 option 6