



G.hn Access Multiplexer (GAM)

Quick Installation Guide

GAM-12-M / GAM-24-M

GAM-12-C / GAM-24-C

Publication Information

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**GAM (G.hn Access Multiplexer)
Quick Installation Guide**

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Chapter 1

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.

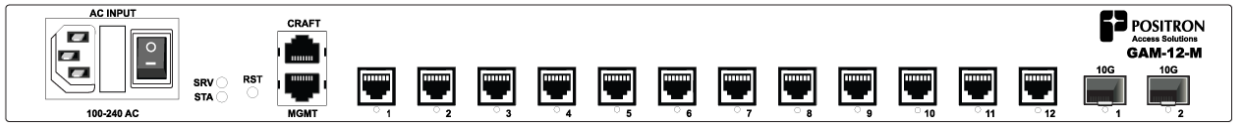


Figure 1: GAM-12-M Front Plate

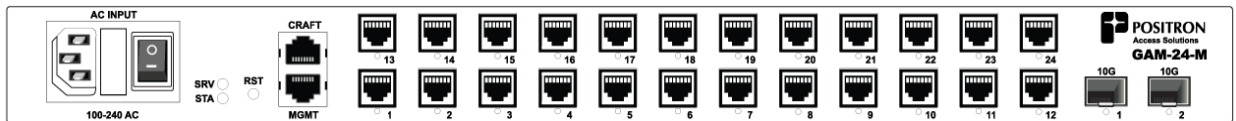


Figure 2: GAM-24-M Front Plate

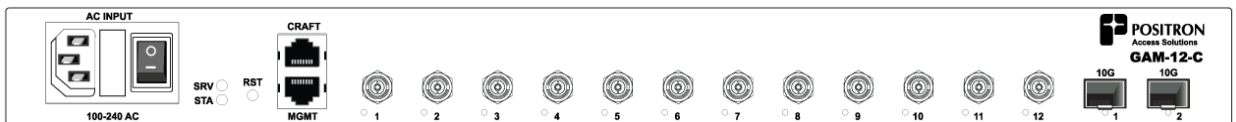


Figure 3: GAM-12-C Front Plate

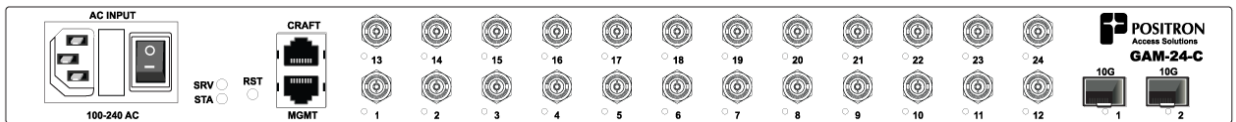


Figure 4: GAM-24-C Front Plate

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.

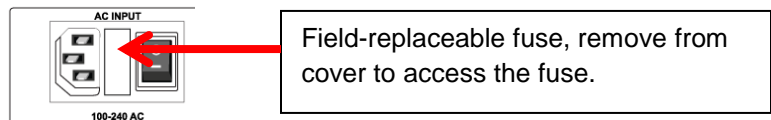


Figure 5: GAM Power Input Connector

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.

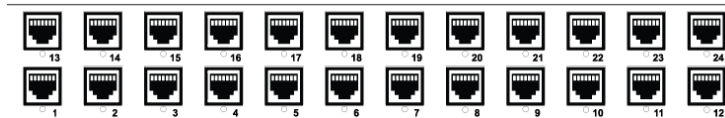


Figure 7: GAM G.hn RJ-45 Connectors

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.

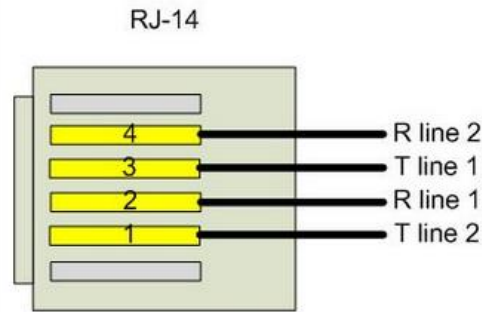


Figure 8: Close-up of GAM G.hn RJ-14 Connector

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.

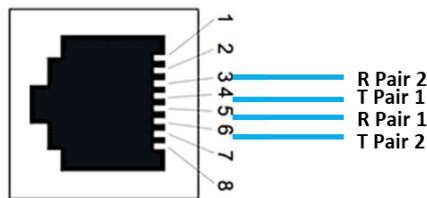


Figure 9: Close-up of GAM G.hn RJ-45 Connector

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.

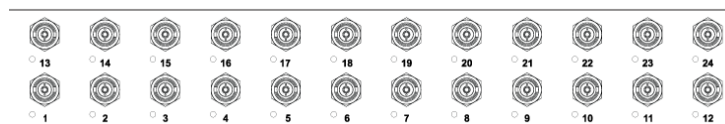


Figure 10: GAM G.hn F-type Connectors

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:

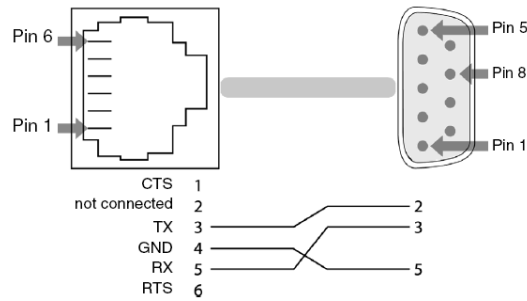


Figure 11: GAM Serial Management Port pinout

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.

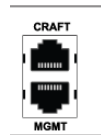


Figure 12: GAM Local Management Ports

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

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 2: 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:

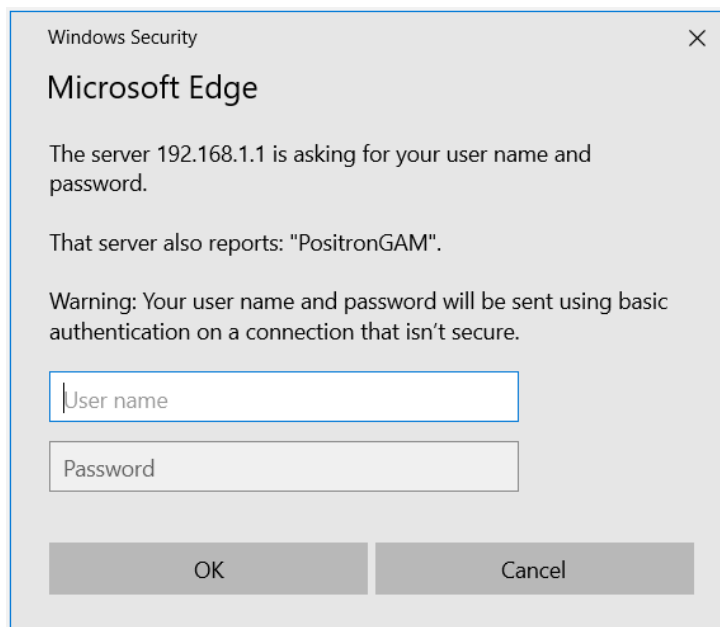


Figure 14: GAM Login Page (Browser specific)

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.

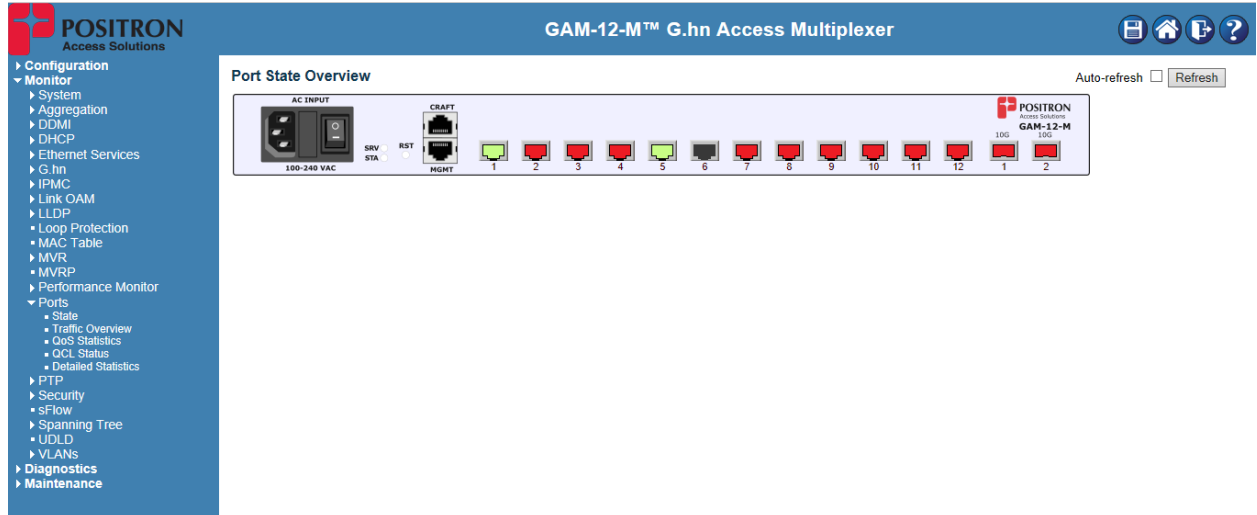


Figure 15: GAM Port Status page (default page after login)

2.2.3 General Information

For complete detail on web management, please refer to the GAM User's Guide.

Chapter 3

Technical Specifications

3.1 GAM Technical Specifications

Part Number	10GigE SFP+	G.hn Ports / Type	Out-of-band Management Ports
GAM-12-M	2	12 MIMO (RJ-45)	1 x 10/100/1000BaseT 1 x serial
GAM-24-M	2	24 MIMO (RJ-45)	1 x 10/100/1000BaseT 1 x serial
GAM-12-C	2	12 COAX (F-type)	1 x 10/100/1000BaseT 1 x serial
GAM-24-C	2	24 COAX (F-type)	1 x 10/100/1000BaseT 1 x serial
Environmental			
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		
Storage Temperature	0°C to 45°C		
Operating Humidity	10% to 90% relative, non-condensing		
10 Gbps Network-Network Interface (NNI)			
2 x SFP+ ports	SFP+ offer versatile support for Active Ethernet and for GEAPON, 10GEAPON, NG-PON2 and XGS-PON via external ONU/ONT devices Also compatible with 3 rd party PON SFP ONT modules		
G.hn Specification			
G.hn Standards	G.hn Wave-2 Domain Master on all GAM ports (MIMO or Coax) Based on GigaWire Alliance specification and fully compliant with the following ITU-T standards <ul style="list-style-type: none"> • G.9960 Amendment 2 - System Architecture and PHY Layer • G.9961 Data Link Layer • G.9962 Management • G.9964 PSD 		
Ease of Deployment	Support G.hn operation over telephone wiring (RJ-45 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 Domain Master 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 RJ-45 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™ vectoring 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 via VectorBoost™ vectoring
Reliability and Resiliency	State of the art LDPC Forward Error Correction (FEC)
Layer 2 Switching	
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"> • Port-based VLAN • IEEE 802.1Q tag-based VLAN • IEEE 802.1ad (Q-in-Q) double tag VLAN • MAC-based VLAN • Management VLAN • Private VLAN Edge (PVE)
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
Layer-3 Support	
IPv4 Static Routing	Static routing of IPv4 unicast traffic
IPv6 Static Routing	Static routing of IPv6 unicast traffic

Security	
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
Quality of Service	
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
Carrier Ethernet Protocol and features	
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

Management	
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 Protocol	Network Time Protocol (NTP) for clock synchronization over packet switched networks
Other Management	HTTP / HTTPS; 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

Table 3: GAM Summary Features

Chapter 4

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 metalically 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 metalically to OSP wiring.

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

Chapter 5

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

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