GLOW MOTION
TECHNOLOGIES

Ghostband

User Guide

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Ghostband

Contact

http://www.glowmotiontechnologies.com

Safety Information

The symbols below are used throughout this manual to identify important safety information. Heed all warnings and safety information.

Symbol	Meaning
	**Warning, Danger, or Caution** Risk of injury to yourself or the product.
	**Risk of Electrical Shock** Risk of severe electrical shock.

Warranty Information

Glow Motion Technologies, LLC warrants the Ghostband and the Transmitter, hardware products, against defects in materials and workmanship under normal use for a period of one (1) year from the date of retail purchase by the original end-user purchaser.

Glow Motion Technologies, LLC does not warrant that the operation of the product will be uninterrupted or error free. Glow Motion Technologies, LLC is not responsible for damage arising from failure to follow product use instructions.

FCC Statement

This device complies 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.

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. If the equipment is not installed and used as directed in the instruction manual, it may cause harmful interference to radio communications. It is the responsibility of the user to correct any interference.

Changes

Glow Motion Technologies, LLC provides this manual 'as is' without warranty of any kind, either expressed or implied, including but not limited to the implied warranties or merchantability and fitness for a particular purpose. Glow Motion Technologies, LLC may make improvements and/or changes to the product(s) and/or the program(s) described in this publication at any time without notice.

This publication could contain technical inaccuracies or typographical errors. Changes are periodically made to the information in this publication; these changes are incorporated in new editions of this publication.

Certifications

Conforms to ANSI/UL Std. 60950-1

Certified to CAN/CSA Std. C22.2 No. 60950-1

1

System Overview

The Ghostband system is a wireless, wearable, LED lighting system controlled via a DMX lighting console. The lighting console is connected through a Pathfinder processor to the GMT Transmitter which wirelessly communicates to the Ghostbands. System connections are covered in Chapter 2, the configuration of each components is covered in Chapter 3. Finally, best practices for getting the most out of the Ghostband system is covered in Chapter 4.

The major components of a Ghostband system are:

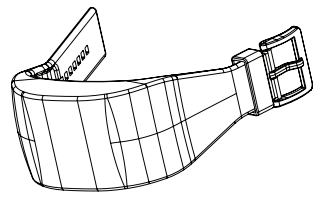

Figure 1. Ghostband wristbands.

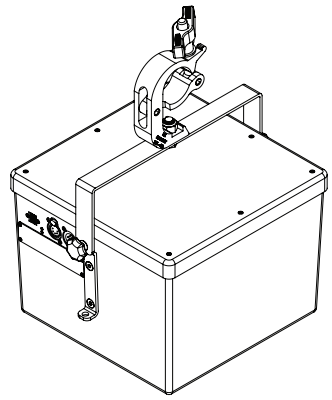

Figure 2. GMT Transmitter.

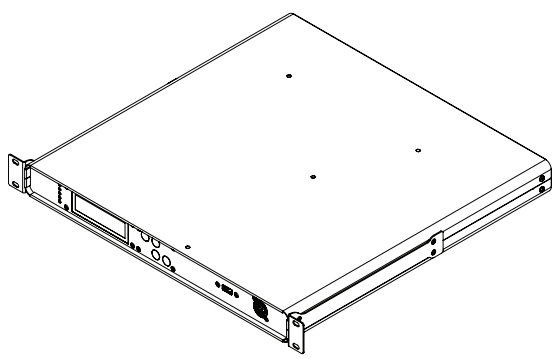

Figure 3. Pathfinder processor.

Cables:

- The Pathfinder power input cable is a standard C14 (IEC) connector (female) , terminated in any suitable male connector on the opposite end.
- GMT Transmitter receives power and data on XLR 5 pin cables. These cables must have all 5 conductors. The maximum length of this cable is 200m (660').

Ghostband

The Ghostband is a silicone wristband. It houses an LED module and diffusion material in a central cavity. The LED module is a small rectangular battery powered device with 2 SMD LEDs. All Ghostbands have a unique serial number.

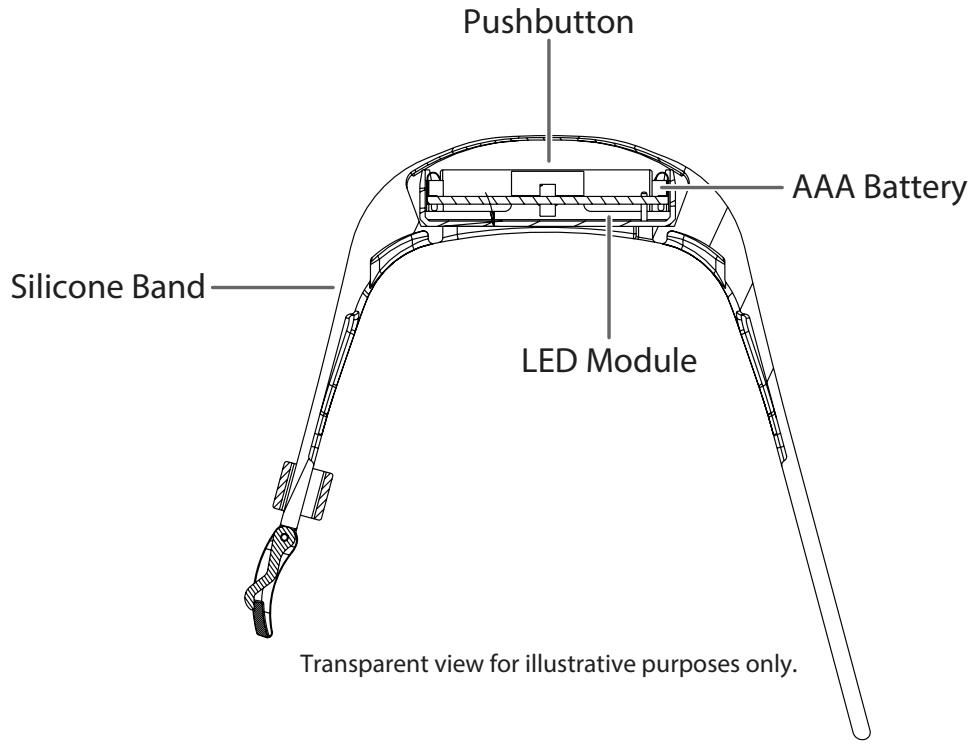

Figure 4. Ghostband components.

GMT Transmitter

The Transmitter is a lightweight plastic enclosure for the transmission circuitry of the Ghostband system. A bracket at the top holds a trigger clamp for mounting the device. A small push button addressing switch, power and data indicators and the input and output connectors all live above the label plate. The GMT Transmitter broadcasts in a 60 degree beam width from the base of the enclosure. See Appendix B for details regarding emissions.

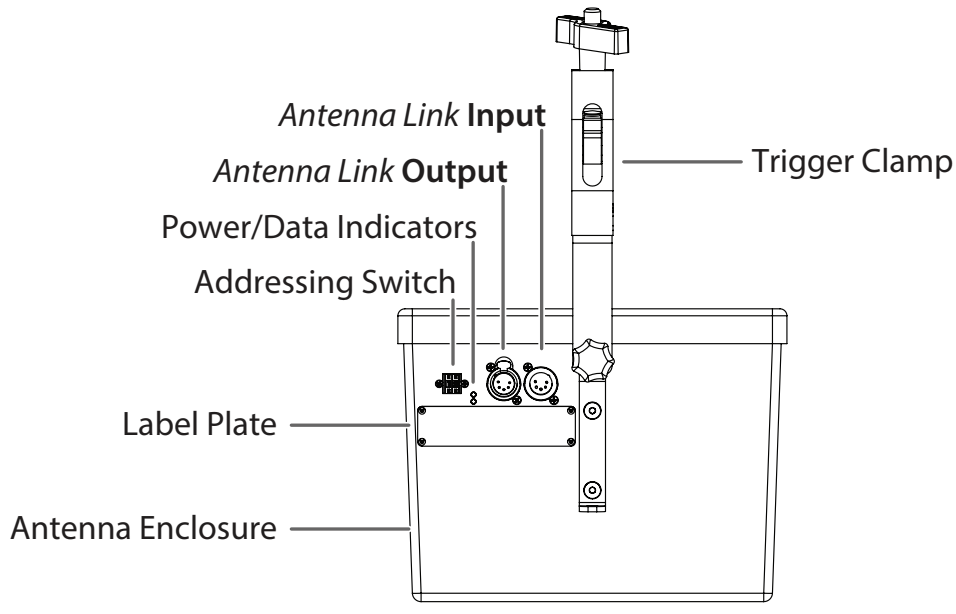

Figure 5. GMT Transmitter components.

Pathfinder

The Pathfinder is the data interface for DMX lighting consoles. It is also the power supply for the Transmitters.

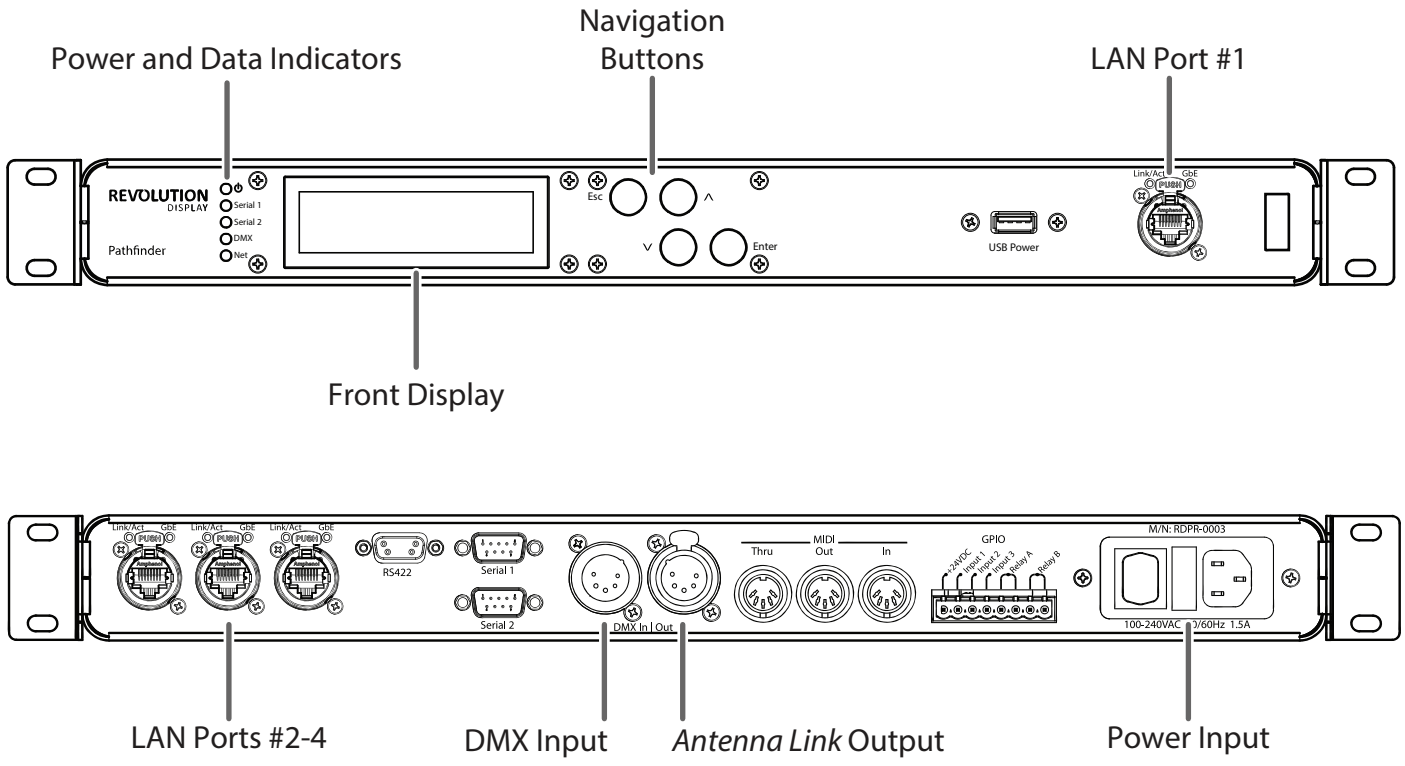

Figure 6. Pathfinder components.

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Electrical Specifications

Ghostband power requirement	1 x AAA battery
Ghostband memory (for address and settings)	Non-volatile
Battery life in standby	2 days
Battery life active use	5 hours (50/50 duty on full white)
Transmitter power requirement	24 VDC via XLR 5 pin from the Pathfinder
Wireless control	770MHz-934 MHz
Wireless range	600m (line of sight)
Pathfinder power requirement	100-240 VAC 50/60Hz 1.5A

Image Specifications

Ghostband pixel quantity	2 (controlled as a pair)
LED Type	3 in 1 SMD
Brightness	5 nits
Colors	16 Million
Lifetime (Hrs)	50.000

Mechanical Specifications

Item	*Length*	*Width*	*Height*	*Weight*	*IP Rating*	*Operating Temperature*
Ghostband	80 mm (3.14“)	45 mm (1.77”)	20 mm (.78“)	65 g (2.3 oz)*	IP50	0º - 40º C (32º - 104º F)
Transmitter	283 mm (11.2“)	310 mm (12.2”)	213 mm (8.4”)	2 kg (4.4 lbs)	IP50	0º - 40º C (32º - 104º F)
Pathfinder	431 mm (17“)	432 mm (17”)	44 mm (1.7”)	2.8 kg (6.2 lbs)	IP50	0º - 40º C (32º - 104º F)

* Weight of Ghostband is with AAA battery.

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Connections

The following paragraphs describe the connections of the Ghostband system.

Pathfinder Power - AC power is supplied to the Pathfinder on a C14 style connector. Adjacent to the power input connector is a toggle switch. At the point that power is turned ON, the blue power indicator on the front panel will be lit and the system will begin to boot. After about 5 seconds the unit will be fully booted and the front panel display will begin to cycle through various status reports.

Pathfinder LAN - Three Gigabit Ethernet ports exist on the rear of the Pathfinder and one on the front. All three access the Pathfinder LAN. Use the Pathfinder LAN to access the web UI or to send ArtNet to the Pathfinder. For newer consoles that support DMX control over Ethernet, the Pathfinder accepts Artnet II.

Pathfinder Inputs - In GMT mode, the Pathfinder accepts an ArtNet signal over the Pathfinder LAN or DMX 512 over the 5 pin XLR connector on the rear. See Appendix A for the full list of DMX channels and functions.

Pathfinder Output - Most of the time the DMX Output of Pathfinder is electrically a straight pass-thru. When the GMT Transmitter is set as the target device, the DMX Output connector is electrically disconnected from the DMX Input connector and the Pathfinder sends both power and data to the GMT Transmitter through the DMX Output port. All 5 pins of the XLR cable must be connected for the system to operate.

GMT Transmitter XLR Input - The GMT Transmitter receives the power that it needs to operate (24VDC) and a data signal from the Pathfinder on an XLR 5 pin connector.

GMT Transmitter XLR Output - The GMT Transmitter can be serial chained via the XLR output to up to three additional units (a system total of four GMT Transmitter(s). Always terminate the last Transmitter's XLR output connector with a standard 5 pin XLR terminator.

GMT Transmitter Wireless Output - The frequency that is used for communication to the Ghostbands is in the 770MHz-934 MHz range. The specific frequency to be used varies according to local conditions and ordinances and must be coordinated with the Ghostbands. See Chapter 3 for the specifics of adjusting this setting.

Ghostband Wireless Input - When powered on, the Ghostband units will respond to the commands received from the GMT Transmitter.

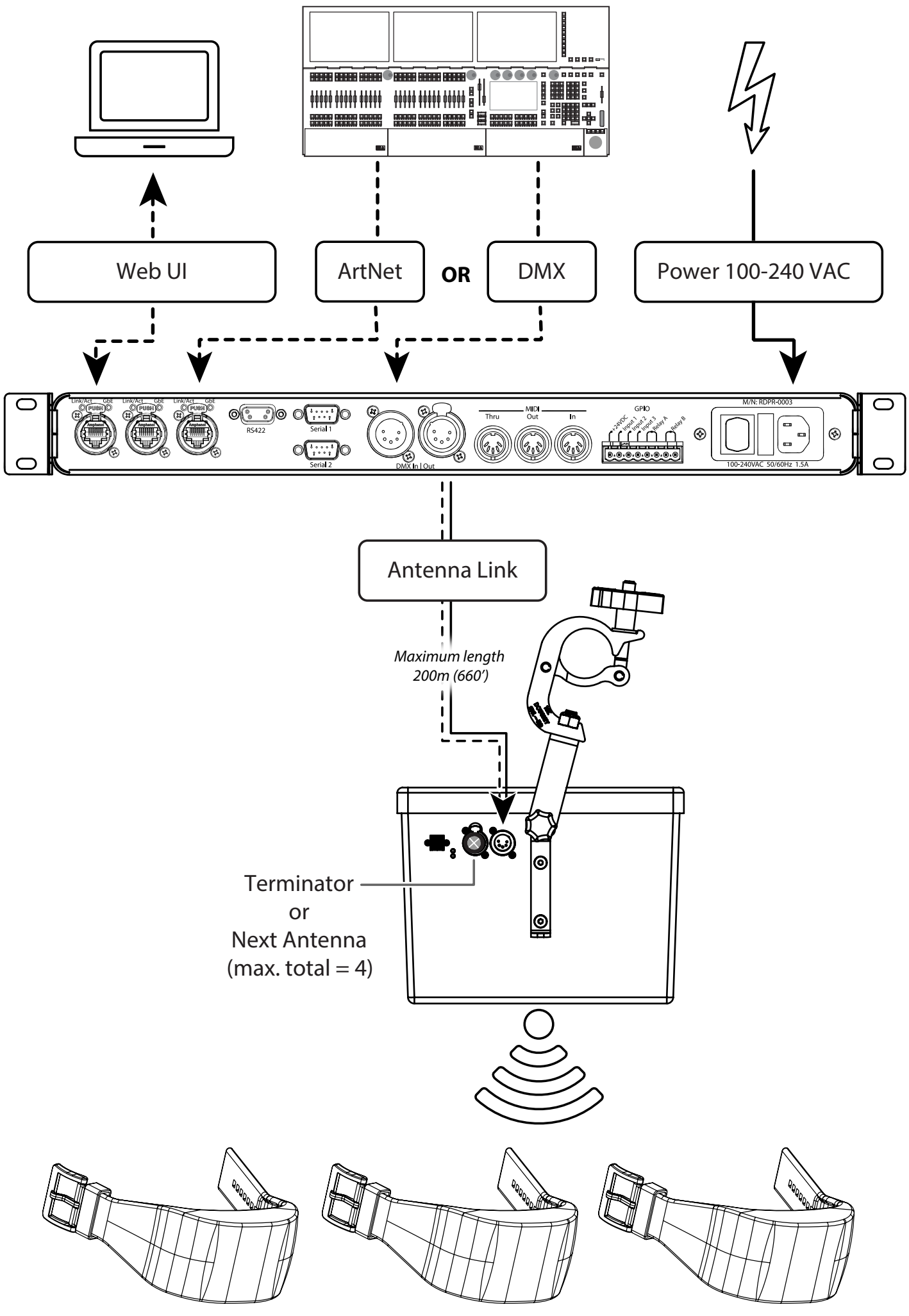

Figure 7. Ghostband system diagram.

Note: For convenience, a wireless router can be used with the Pathfinder LAN.

3

Configuration

Overview

Once all of the system components are physically connected, they must be configured. The three components to configure are: Transmitters, Ghostbands, and DMX/Artnet settings. Transmitters need to be discovered and set to match the frequency of the Ghostbands. Ghostbands need to be grouped to make large numbers of them easier to manage within the lighting console. Finally, DMX/Artnet settings need to be aligned with the lighting console so that the system integrates with the rest of the lighting being used in the production. All of this configuration is done via a web UI running on the Pathfinder.

Transmitter Setup

In order to make a Pathfinder aware of a connected Transmitter, the system must be told to scan for any available Transmitters. The system is being designed to have a maximum of four Transmitters, however at the time of this writing only one Transmitter is fully supported. Once the Pathfinder is aware of the connected Transmitter it will report back the settings it gets from the unit. In order for the Ghostbands to receive the Transmitter's signals the operational frequency needs to be the same as the one the Ghostbands are set to. To meet emissions regulations, the power setting must be set to an approved power level for the frequency in use. Later on in this chapter, the frequencies and power settings are listed as a table.

Ghostband Group Assignments

Assigning Ghostbands to groups allows large numbers of devices to be controlled by a single fixture on a lighting console. This is useful as there are usually thousands of Ghostbands in a show environment, compared to dozens or hundreds of lights. Putting all of the Ghostbands into a single group makes them easy to deal with, but limits the visual effect by having all of the bands running the same effect. So, Ghostbands are usually broken up into about 5 different groups.

Grouping Ghostbands is done from the Pathfinder’s web UI well in advance of the show time. Ghostbands can be grouped in two ways. Groups can be created by either Block Addresses or Short Addresses. The decision of whether to use a Block Address or Short Address for Ghostbands, stems from the way the DMX lighting console is configured. When a Simple Fixture (Dimmer + RGB) profile is used, Ghostbands are controlled only by Block Addresses.

Ghostbands can simultaneously have both a Block Address and a Short Address. This becomes important when a lighting console is configured so that the same group of Ghostbands are controlled by both a Simple and an Advanced Fixture. Appendix A has the full tables of DMX channels and function values for both fixture types.

The Short Address is an addressing mode with priority over Block addressing. For a Ghostband to receive a Short Address radio message, the message must contain either the specific short address of the Ghostband or have the message sent as a broadcast.

A group of Ghostbands can be assigned the same Short Address or the Short Address can be assigned to only a single device. For example, if a Ghostband that a performer is wearing is assigned an individual Short Address, this device can be controlled separately from the group of audience Ghostbands. The Ghostband system then allows the audience Ghostbands nearby to react to the performer's Ghostband, creating spatial visual effects around the performer. This is called the FOLLOW ME mode.

DMX|ArtNet

Pathfinder accepts an ArtNet signal over the Pathfinder LAN or DMX 512 over the 5 pin XLR connector on the rear. The settings in the Pathfinder must correspond to the settings of the lighting console. In other words, if the lighting console outputs DMX on 5 pin XLR, the Pathfinder must be set to receive the signal on 5 pin XLR. The same holds true for the starting address setting in Pathfinder and the ArtNet subnets and universes. If in doubt, check the settings of the lighting console and set the Pathfinder to correspond.

In order to assess the quantity of Simple Fixtures and/or Advanced Fixtures that need to be patched on the lighting console and configured in the web UI of Pathfinder, we need to discuss the fixture types in more detail.

Simple Fixture

Blocks are controlled from a lighting console by two Simple Fixtures. Two fixtures are used because the block is split by serial number, with all even-numbered bands on one Simple Fixture, and all odd-numbered bands on the other. The minimum number of Simple Fixtures on the lighting console will always be two.

As an example, when Ghostbands are used in a pre-arranged order in a stadium type application, each seating section can be assigned to a Block Address to enable chases around the stadium where each section lights up in turn. In order to light an entire block, both of the Simple Fixtures controlling the block would be used.

When the Ghostbands are used in a random audience situation like a festival, Blocks help create lighting effects limited to sections of the audience rather than having effects always light the whole audience.

Advanced Fixture

The Advanced Fixture is used to create complex effects such as ripples, waves, and the FOLLOW ME effect discussed earlier. The first Advanced Fixture that is patched in a lighting console is a broadcast fixture and the commands it sends will be received by all Ghostbands (as long as the short address is set to 65535). Effects can also be limited to just one block of Ghostbands if multiple Advanced Fixtures are patched into the lighting console. Only the first Advanced Fixture in the system can send broadcast messages to all Ghostbands. Additional Advanced Fixtures control specific blocks. For instance, the second Advanced Fixture controls Ghostbands assigned to Block 1. If three Advanced Fixtures are patched, then only Ghostbands assigned to Block 2 will respond to the messages from the third Advanced Fixture. This hold true for each additional Advanced Fixture.

NOTE: Short addressing and Block addressing can be combined to control groups within groups.

DMX Channel Assignment

Figure 8 on the facing page, shows how the DMX channels are assigned in a five block system with a starting address of one (1). Sixteen fixtures are required in this case because both Simple Fixture control and Advanced Fixture control are desired. Advanced Fixtures will always appear after the Simple Fixtures in the console patch. Blocks are divided into odds and evens when controlled by Simple Fixtures. Advanced Fixtures use Short addresses to control entire blocks.

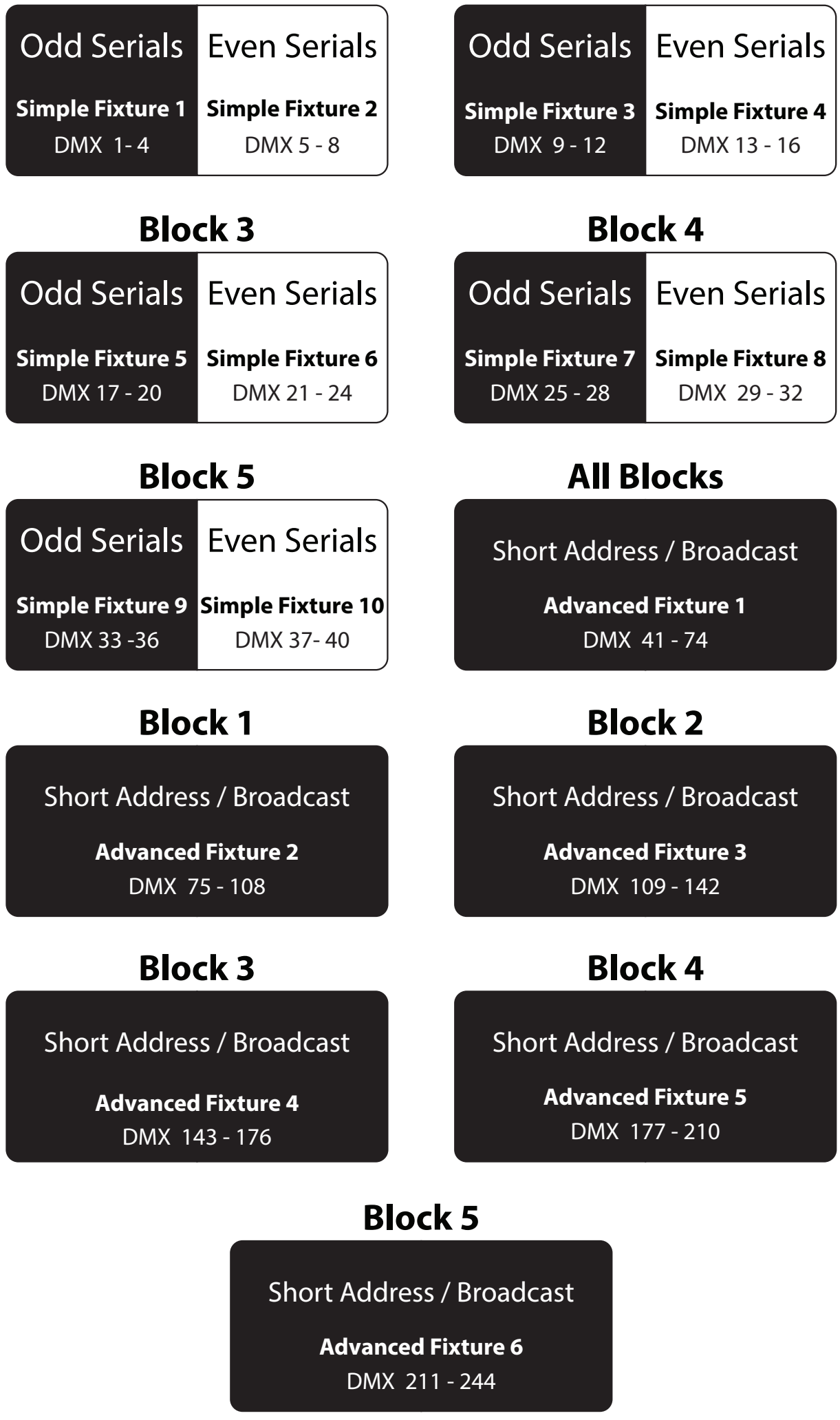

Figure 8. Five block Ghostband system DMX channel assignment.

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Pathfinder Front Panel Interface

The pushbutton interface on the front of the Pathfinder gives access to the main functions of the Pathfinder; ***IP Setup***, ***DMX Setup***, the ***Pathfinder Configuration Menu,*** and ***Target Device*** selection. The menu tree diagram in Figure 9 below, details the submenus and settings.

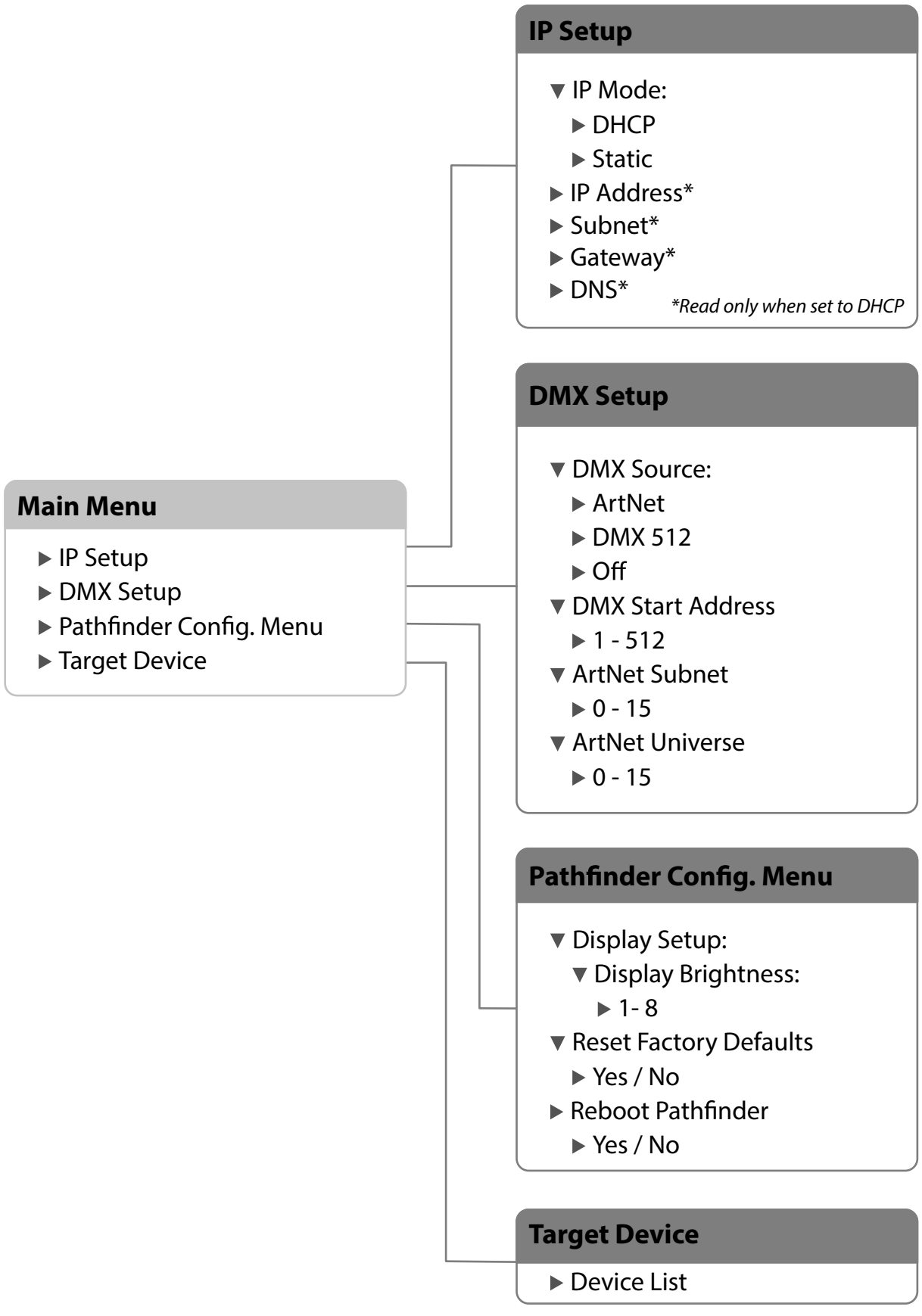

Figure 9. Pathfinder menu tree diagram.

Pathfinder Web UI

In addition to the front panel, a Pathfinder can also be configured using the web UI. The web UI contains Ghostband system specific settings that are not available on the front panel interface. The web interface can be accessed by any web browser connected to the Pathfinder LAN via either the front or the rear Ethernet ports. The IP address of the Pathfinder is reported by the front display of the Pathfinder as part of the status report banner that cycles on the front display. Use the front panel interface of the Pathfinder if the IP address needs to be changed.

A Pathfinder processor can be configured to target several different types of systems, one of which is the Ghostband system. The home page that is served by the Pathfinder will be the unique page for the target device that the Pathfinder is currently configured for. Setting the target device for the Pathfinder can be accomplished with the web UI of the Pathfinder or from the front panel interface. Figure 10 below, shows the GMT Transmitter home page.

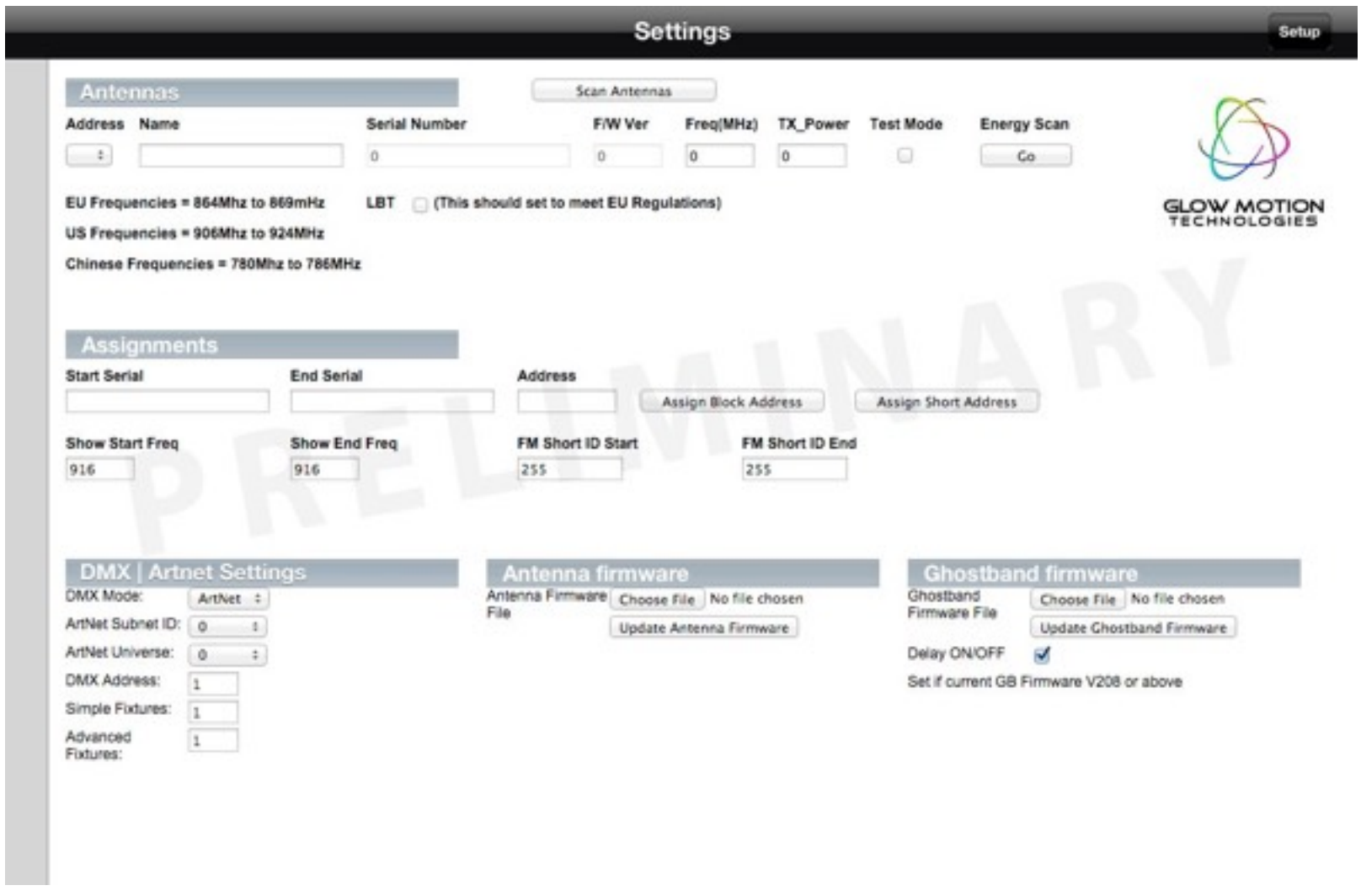

Figure 10. Pathfinder's home page for the GMT Transmitter.

If the page that is being displayed is not the home page of the Ghostband system shown above, it will be necessary to change the target device of the Pathfinder. This can be done on the Setup page. In order to reach the Setup page press the Setup button at the top right corner of the home page (outlined in red in Fig. 10 above).

The Setup page of the Pathfinder shown in Figure 11 below, allows for configuration of Pathfinder specific settings which also includes setting the target device. The baud rate setting is ignored in the case of the GMT Transmitter.

Numerical field values are sent to the Pathfinder each time the user exits a field. The web UI page will reload each time a value is sent.

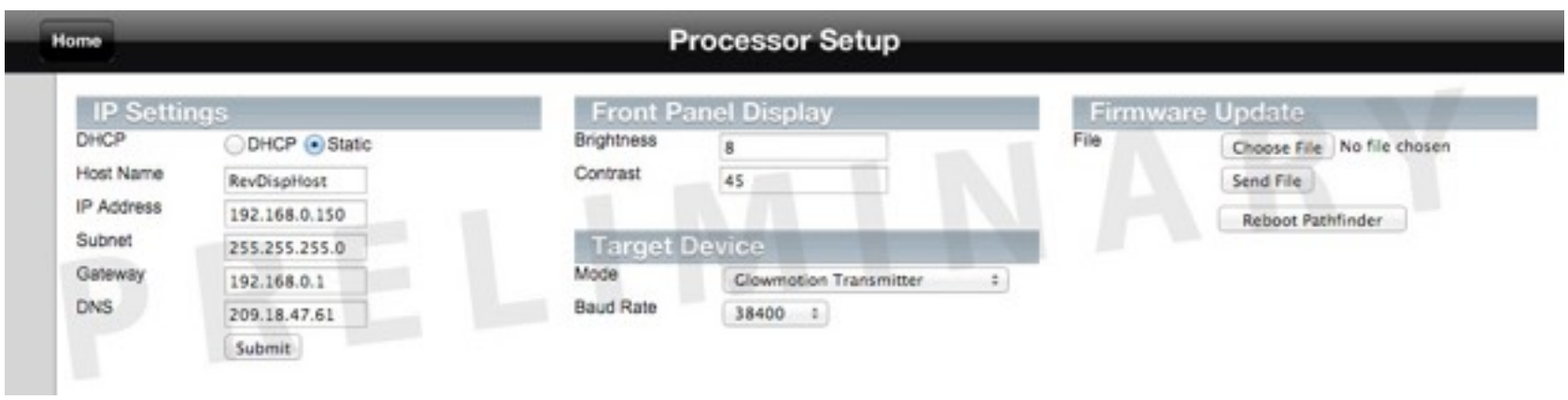

Figure 11. Processor setup page.

Ghostband Home Page

Scan Antennas - In order to begin the setup of a GMT Transmitter press the ***Scan Antennas*** button. The line below will be populated with the details of the Transmitter(s) that are found. At the time of this writing the system only fully supports a single Transmitter set to address one (1).

Name - The Transmitter can be named anything that makes sense for the system being setup.

Frequency - The frequency of the transmission should be set to match the frequency that the Ghostbands are set to*. At the time of the writing of this guide, all Ghostbands are set to 916 Mhz.

TX Power - Possible settings are 0-36. The Transmit power should be set as per the following table. The power will differ depending on the frequency in use and the region of operation.

Ghostband Regional Frequency Ranges

Frequency(MHz)	*Region*	*Band*	*Approved Power Setting*
780-786	China	Chinese WPAN	TBA
864-869	Europe	EU SRD	26
903-927	USA	North America ISM	TBA
916-929	Japan	Japanese Band	TBA
916-927	Australia	ISM	TBA

* The frequency that Ghostbands operate on is currently set in the firmware of the Ghostbands.

Test Mode - This is a range test that can help with the layout and design of the system. The Ghostbands will illuminate either GREEN, AMBER or RED depending on the received signal strength (red being the weakest).

Energy Scan - This button will display a new page where a BAND4 (769Mhz-832MHZ) or BAND5(833-935MHz) scan can be selected. A list of energy levels in dBm will be displayed for each frequency from -99dBm to -14dBm. A value of -99 means that the channels is clear.

LBT - *Listen Before Transmit,* this function ensures that any other transmissions on the same frequency as the Ghostband system, are not stepped on. This function is required to meet European radio regulations.

Assignments - Ghostbands can be identified by block address and by short address. Block addresses relate to the simple (dim+RGB) fixtures while short addresses relate to the Advanced Fixture. When creating assignments, if Ghostband serial numbers are all known, the start and end serial number of each block is entered into the respective numerical fields. The desired address is then entered into the address field. Select, ***Assign Block Address*** or ***Assign Short Address*** to choose how the value will be assigned. If Ghostbands serial numbers are not known, simply turn on the units one block at a time and use the maximum address range of 0 for the start address and 9999999999 for the end address to broadcast the address assignment.

Show Start Show End Frequencies - This is an experimental feature that must be used with Ghostbands in auto scan mode. It allows the operator to narrow down the number of frequencies that the Ghostband must scan. Contact a GMT field application engineer before using this mode.

DMX | Artnet Settings - DMX mode toggles between receiving DMX over Ethernet via Artnet or via 5 pin XLR. If Artnet is to be used, set the Subnet and Universe to the appropriate values.

DMX address is the starting address for the channel blocks.

The quantity of Simple Fixtures needed is determined by the number of blocks in the system.

Add Advanced Fixtures if the functionality is required.

Lighting Up Ghostbands for Testing

1. Ensure that the bands have fresh batteries installed in the correct polarity.
2. The Ghostbands have a pushbutton at the center of the LED module. Press and hold the pushbutton until the LEDs of the Ghostband light green and then turn off (about two seconds).
3. As soon as the LEDs go out, let go of the pushbutton. The band is now on and active.

If the center button is held down for a total of four seconds, the LEDs will flash red and the unit will be off.

Once the bands have been powered on they are available to receive the signals from the Transmitter(s). Transmitters can be placed in a test mode where they will broadcast a cycling test message to illuminate all Ghostbands. There are two ways to place a Transmitter in test mode; 1. Address a Transmitter to zero with the address switch. 2. Tick on the ***Test Mode*** checkbox on the GMT home page of the web UI.

When a Transmitter is set to an addresses 1-4 it is listening for commands coming from the Pathfinder. In order to have such a Transmitter send commands to Ghostbands, a DMX console must be connected, patched and sending commands to the Pathfinder.

4

Maintenance

Proper maintenance of the Ghostband system equipment involves periodically checking the hardware for any parts that may have come loose or become damaged. Connectors should be checked and replaced if housings have become damaged or pins are bent or deformed.

The Ghostbands can be reused. Encourage the attendees of your events to return the bands.

Cleaning of the Ghostbands involves removing the LED Module and the diffuser from the silicone band. Recycle the batteries and set the LED modules aside for functionality testing. The wristbands (with LED module and diffuser removed) can then be cleaned in a solution of water and mild soap, rinsed and air dried on racks.

Alternately, the silicone bands (with LED module and diffuser removed) can also be cleaned in an ultrasonic cleaning tank.

A

DMX Channels

The Ghostband units can be controlled via DMX channels either as Simple Fixtures, an Advanced Fixture or both. A Simple Fixture has four channels (Dimmer + RGB) the Advanced Fixture contains 33 channels. When controlled by Simple Fixtures, Ghostbands react directly to the color and intensity assignments coming from the lighting console. The Advanced Fixture channels have a much more complex relationship. Multiple channels must be set simultaneously in order to program complex effects. The Advanced Fixture for Ghostbands can co-exist simultaneously with Simple Fixtures. This is because the Ghostbands simply react to the last sent command. Tables 4 and 5 detail the channel assignments of both fixture types.

Simple Fixture

Channel	Description	Decimal	Default	Comments
1	Dimmer	0-255	0	Master level
2	Red	0-255	255	Red intensity
3	Green	0-255	255	Green intensity
4	Blue	0-255	255	Blue intensity

Advanced Fixture

Channel	Description	Coarse/Fine	Decimal	Default	Comments
1	Transmitter Address		0	1	Not Used
			1-98		Select individual Transmitters
			99 - 254		Not Used
			255		Broadcast from all Transmitters
2	Master Fader		0-255	0	Master LED level 0% to 100%
3	Commands		0	0	General LED profile
			1		RIPPLE effect profile
			2		WAVE effect profile
			3		FOLLOW ME profile function
			4		Not Used
			5		SPOT profile
			6		Not Used
			7		SEQUENTIAL RIPPLE
			8		BITMAP Play command
			9		Not Used
			10		Not Used
			11		RealTime RGB Only
			12-23		Not Used
			24		Erase after show area
			25-27		Not Used
			28		Block ripple
			29		Block wave
			30		Find Partner
			31		Not Used

Advanced Fixture (continued)

Channel	Description	Coarse/Fine	Decimal	Default	Comments
3 (Continued)	Commands		32	0	Increment_Ripple
			33		Normal _Revert internal message do not use
			34		Store After Show Profile
			35		Play After Show Profiles
			36		GROUPSET 0
			37		GROUPSET 1
			38		GROUPSET 2
			39		GROUPSET 3
			40		GROUPSET 4
			41		GROUPSET 5
			42		RX Follow Me (Only sent from a Band performing a FOLLOW ME command)
			43-254		Not Used
			255		Stop
4	Even Red		0-255	255	Even serial numbered nodes RED LED intensity
5	Even Green		0-255	255	Even serial numbered nodes GREEN LED intensity
6	Even Blue		0-255	255	Even serial numbered nodes BLUE LED intensity
7	Odd Red		0-255	255	Odd serial numbered nodes RED LED intensity
8	Odd Green		0-255	255	Odd serial numbered nodes GREEN LED intensity
9	Odd Blue		0-255	255	Odd serial numbered nodes BLUE LED intensity

Advanced Fixture (continued)

Channel	Description	Coarse/Fine	Decimal	Default	Comments
10	Red Fade In step increment		0-255	0	Step increment size
11	Green Fade In step increment		0-255	0	Step increment size
12	Blue Fade step In increment		0-255	0	Step increment size
13	Step Time		0-255	0	Time between step increments 0mS - 255mS
14	Duration		0-255	0	LED 'ON' duration 0ms-2550mS
15	Red Fade Out step increment		0-255	0	Step increment size
16	Green Fade Out step increment		0-255	0	Step increment size
17	Blue Fade step Out increment		0-255	0	Step increment size
18	Transmit Delay		0-255	0	Delay before re-transmit 0-2550mS
19	Transmit power		0-255	255	Transmit power level
20	Receive sensitivity		0-255	255	Receive sensitivity level (0=Min, 255=MAX)
21	Repeats		0-255	1	Number of times to repeat current LED profile
22	Flash delay		0-255	0	Time between repeats 0-2550mS
23	Priority		0-63	0	0 - Lowest Priority
			64-127		1-
			128-191		2-
			192-255		4 - Highest Priority
24	Start Frame High	C F	0-65535	0	Bitmap playback start Frame number, 16bit value
25	Start Frame Low				
26	End Frame High	C F	0-65535	65535	Bitmap playback end Frame number, 16bit value
27	End Frame Low				
28	Frame rate		0-255	4	Frame playback rate 0mS - 2550mS
29	Play back Mode		0-84	0	Last frame stays on - DISABLED
			85-170		Last frame stays on - ENABLED
			171-255		Loop Playback - ENABLED
30	Button Mode		0-63	0	Button disabled
			64-127		Voting mode
			128-255		After show mode
31	Short Address High	C F	0-65535	65535	16 bit node address
32	Short Address Low				
33	PLAY/STOP		0-25	255	STOP command is transmitted
			26-128		No action
			129-255		Transmit message

B

Transmitter Emissions

The GMT Transmitter has roughly a 60º radiation pattern. The figure below indicates the emission point is at the base of the enclosure. For ideal placement of the Transmitter, imagine a 60° cone projected from the base toward the audience. The Transmitter should be placed high enough that the entire audience is covered by this cone. To increase the coverage area, the Transmitter can be placed at the edge of a space and pointed diagonally down, but for optimal performance there should still be line of sight from the Transmitter to the position of each Ghostband. Placing the Transmitter at ground level and aiming it across the audience is not ideal, as closer patrons will block those in the distance.

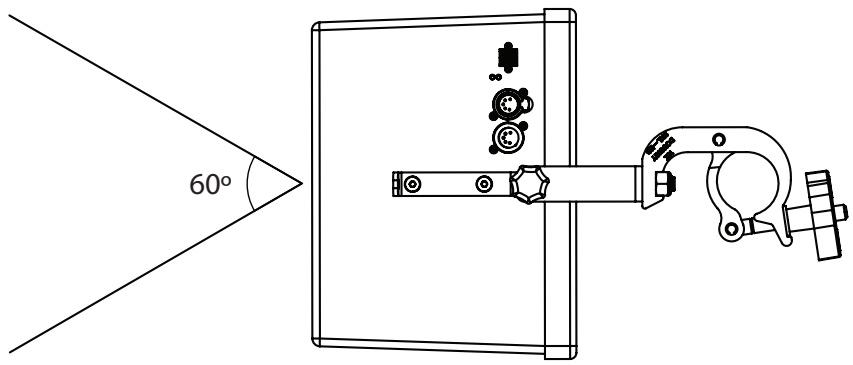

Figure 12. GMT Transmitter Emission Point

The following azimuth plots show the radiation patterns of the GMT Transmitter at two common frequencies.

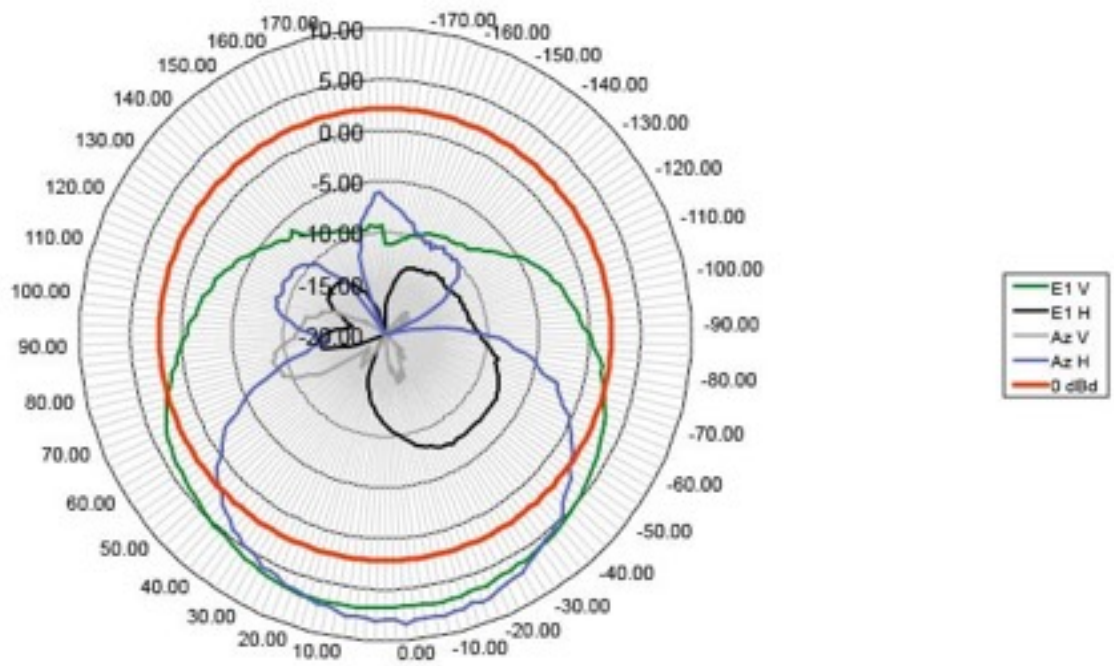

Figure 13. Antenna Gain dBi (868 MHz)

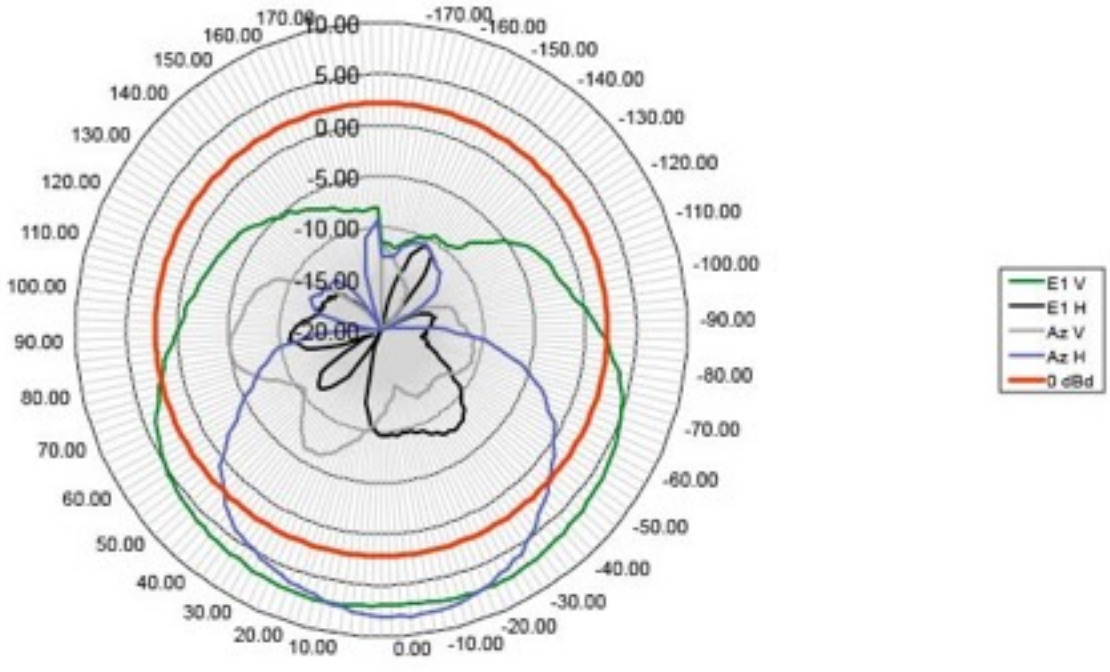

Figure 14. Antenna Gain dBi (915 MHz)