

AiRocks Pro ARX-900 Digital Wireless Audio Repeater

User Guide

V3.2

February 17, 2016

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1 QUICK START GUIDE

1.1 RESET ARX-900 UNITS TO FACTORY DEFAULTS

- On the front panel keypad of the ARX-900 radios, select SYSTEM->FAC_RST (Factory Reset)->OK. This will ensure that the radios are in auto-channel-select mode so that they will automatically scan for the appropriate channels.

1.2 MASTER SETUP

- Mount Master unit on a pole or truss above the heads of people in the area for best performance (12-15 feet is best).
- Orient both antennas vertically.
- Run an Ethernet cable (customer provided) from the Master unit to the Breakout Box (BOB).
- Apply AC power to the BOB using the AC power cable supplied with the ARX-900 radio.
- Connect the main audio signal to the XLR input on the BOB and play an audio tone or music.
- Connect a computer running the Network Management System (NMS) software application to the BOB using a USB cable (customer provided).
- Select the "Master" tab on the NMS window. The Master unit is now broadcasting to Remote units within range.



1.3 RELAY SETUP

- Mount the Relay unit on a pole or truss above the heads of people in the area for best performance (12-15 feet is best).
- Orient both antennas vertically.
- Apply AC power to the ARX-900. Note that the front panel become illuminated.
- Connect an XLR audio cable to the audio output connector of the ARX-900.
- Connect the other end of the XLR cable to the powered speaker.
- Turn the audio volume control of the powered speaker to its lowest level, then apply power to the speaker.
- Slowly raise the audio level of the speaker until you can hear the tone or music from the Master.
- NOTE: Some powered speakers are susceptible to RF transmissions and may cause hum or buzz. If this happens, move the ARX-900 radio further away from the speaker. Re-align antennas if necessary.



2 AIROCKS PRO OVERVIEW

AiRocks Pro is a revolutionary new digital wireless audio system designed to provide significantly extended coverage area and ultra-reliable audio distribution for mobile pro-audio production, as well as installed sound applications. AiRocks Pro is typically used in large indoor or outdoor venues to distribute audio from a main audio source to multiple powered speakers distributed over a wide area. Based on a novel “repeater” or “transceiver” multi-hop radio technology, AiRocks Pro can be used to avoid obstacles, such as buildings, trees, or other obstructions, or to dramatically extend the coverage area compared to traditional wireless audio products.



Figure 1 AiRocks Pro ARX-900

2.1 TRADITIONAL WIRELESS AUDIO

Traditional wireless audio equipment consists of a “transmitter” and a “receiver” which send analog audio from point A to point B. This type of network is called a “point-to-point” network. Most wireless microphones, wireless in-ear devices, and wireless instrument equipment are point-to-point products.

Some newer wireless audio products provide the ability to send a signal from a single transmitter to multiple receivers. This type of network is called “point-to-multipoint” and can be effective if all receivers are within the transmission range of the transmitter. However, since the FCC limits the amount of power that each transmitter can radiate, the effective range of this type of system is somewhat limited.

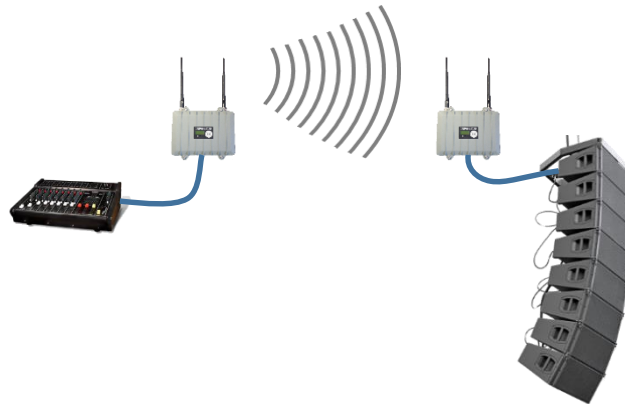
Also, some of these newer devices include what are called “transceivers”. These devices give a single unit the ability to be manually configured as EITHER a transmitter OR receiver, but not both simultaneously.

2.2 THE AIROCKS PRO REPEATER

AiRocks Pro is the world’s first digital wireless audio “**repeater**”. Each AiRocks Pro unit includes BOTH a transmitter AND a receiver operating **simultaneously** in the same unit. A signal that is received by an AiRocks Pro unit is immediately re-transmitted on a different frequency to other AiRocks Pro units within its transmission range. When AiRocks Pro units are positioned in a “line” (linear fashion) they form what is called a “multi-hop” wireless audio network. The range of this type of network is theoretically “unlimited”, however, practical considerations (such as path obstructions and interference) can limit the actual size of the achievable coverage area.

2.3 THE AIROCKS PRO NETWORK

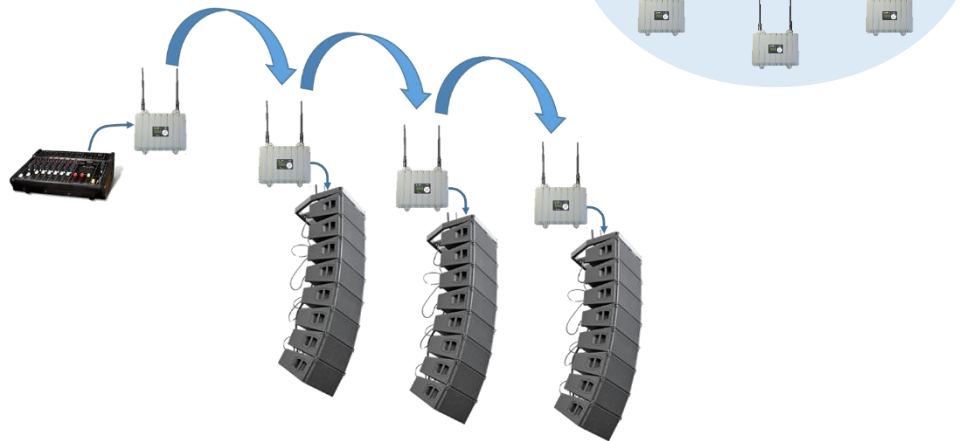
An AiRocks Pro **network** consists of a single Master and one or more Relay units. A network can be as simple as a single Master and one Relay:



Or the network can consist of one Master and up to 100 Relay units operating in a multi-hop configuration:

Each AiRocks Pro unit can be configured to operate either as the network “Master” unit or as a “Relay” unit (all AiRocks Pro units are identical and include the same hardware and software). The number of Relay units is limited by both the practical considerations mentioned above, as well as network “polling” when using the AiRocks Pro Network Management System (NMS) discussed below.

In an AiRocks Pro network, each AiRocks Pro Relay unit receives an audio transmission from a single “upstream” unit, and then re-transmits that same signal to one or more downstream units. Thus,



each AiRocks Pro unit creates its own point-to-multipoint sub-network. The input to each sub-network is the signal received by the single uplink AiRocks Pro unit. Therefore, *an AiRocks Pro network is a group of one or more sub networks all of which emanate from a single network Master*. Networks can be as simple as one Master unit and one Relay unit in a point-to-point configuration, or as complex as hundreds of units with multiple “branches” and “sub-networks”.

If there is a failure of one of the upstream AiRocks Pro units, the downstream units automatically begin scanning for any other AiRocks Pro transmission within range. If an acceptable signal is found, it then becomes the input signal for that sub-network, or any newly created sub-networks. Thus an automatic switchover is accomplished without the need for manual intervention.

An AiRocks Pro network creates an extensive “cloud” of ultra-reliable wireless audio for both small and large venue sound reinforcement applications. AiRocks Pro operates in the license-free 900 MHz frequency band and includes fully automatic channel scanning and selection with automatic link monitoring and optimization, so there is no need for complex frequency coordination or intermodulation calculations.

AiRocks Pro units are designed to be very simple to install. When initially powered up, an AiRocks Pro unit enters the Relay operating mode (unless it was previously configured as a Master unit or is set to “manual” channel selection) and begins scanning for an upstream signal. When a signal is found, the unit begins feeding the received analog audio out to the connected speaker via an XLR connector. It (optionally) also begins relaying the digital wireless signal, on a different frequency, to any downstream

units within range. Front panel controls allow the installer to manually configure operating parameters, as well as monitor several key functions such as received signal level, and audio level and activity.

2.4 NETWORK OVERVIEW

An AiRocks Pro network can operate in one of two modes: **Managed** or **Unmanaged**.

2.4.1 Unmanaged Network

An unmanaged network is simply an AiRocks Pro network that does not use the Network Management System. If the user wishes to merely deploy one or more Relay units in a small network, this can be done by simply plugging the units in and turning on the power. The AiRocks Pro units function fully automatically and autonomously. Front panel controls give the user full control of configuration parameters and monitor functions.

2.4.2 Managed Network

A managed network is one that employs the AiRocks Pro Network Management System (NMS) application. Use of the NMS is strictly optional, but highly recommended since it can give valuable information for configuring the network for optimum performance in the presence of interference, range, or obstruction limitations of the venue. The NMS gives a graphical view of everything that is happening in the network and can help quickly diagnose problems that arise during an event.

Note: The ARX-900 USB interface uses a standard HID driver which is built into the PC's operating system. Therefore, no custom USB drivers need to be installed. When the ARX-900 is first attached to a USB port, the operating system installs a HID driver for that port. This installation process can take up to 30 seconds. Be patient while this process takes place. It will only occur when the ARX-900 is first connected to a USB port, and will repeat if the ARX-900 is plugged into a different USB port.

Note: The ARX-900 Network Management System can run on a Windows XP or Windows 7 machine. It also requires Microsoft .NET Framework 4 or greater. The NMS will not run on a Mac.

2.5 EQUIPMENT OVERVIEW AND FEATURES

The AiRocks Pro system consists of the ARX-900 Wireless Audio Repeater and an optional ARX-900-BOB “breakout box”. The BOB is essentially an extender for the IO ports on the ARX-900 as well as a remote AC or DC power injector. Below is a diagram of the typical Master configuration using a Breakout Box.

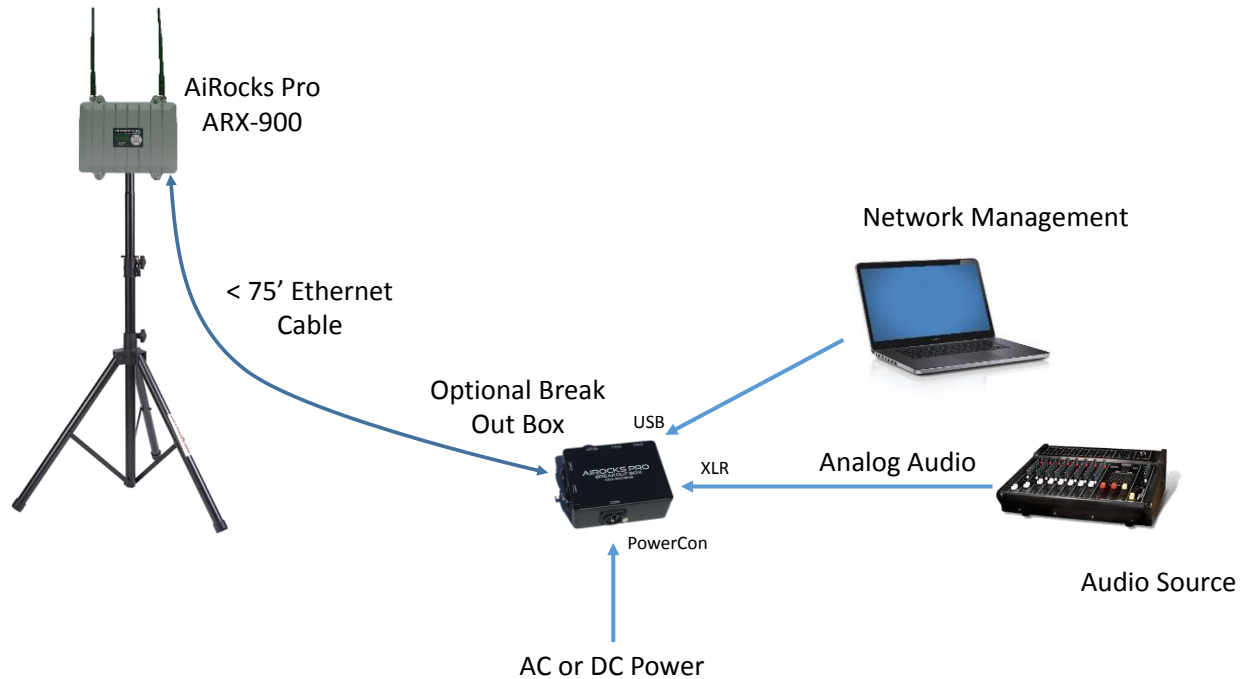


Figure 2 - Typical Master Location Setup

2.5.1 AiRocks Pro ARX-900 Wireless Audio Repeater

The ARX-900 is enclosed in a weather resistant outdoor enclosure and includes a sealed pushbutton front panel interface with an LCD display. The user can configure the unit from either the front panel, via the USB port of the BOB, or over the air by using the Network Management System.



Figure 3 - AiRocks Pro ARX-900 Wireless Audio Repeater



2.5.2 Key Features of the AiRocks Pro System

The AiRocks Pro system is the most feature-rich pro-audio wireless system on the market. These powerful features give the user a broad array of tools for managing the system in every the most challenging venues.

2.5.2.1 *Multi-Hop Transceiver Architecture*

The AiRocks system is the world's first "multi-hop transceiver" architecture targeting the pro-audio market. As mentioned earlier, traditional wireless audio systems include separate, inflexible transmitters and receivers with a transmit range limited by their FCC allowable transmit power. The AiRocks transceiver architecture gives vastly superior range and coverage of large outdoor venues by virtue of its "multi-hop" transmission technology.

2.5.2.2 *Transmit Diversity*

The AiRocks Pro includes "Transmit Diversity" mode to improve immunity to local interference (as of Version 3 firmware). This mode is used if the system experiences interference from frequency hopping spread spectrum RF devices such as wireless scoreboards, football coach wireless sideline communications intercom systems, or wireless theatrical intercom systems. Transmit Diversity mode attempts to avoid bursty packet interference from FHSS devices by using two transmit channels to transmit the audio signal. Transmit Diversity mode can be disabled to conserve the number of operating channels available for other AiRocks Pro radios if there is little or no interference in the area.

2.5.2.3 *Powerful Network Management System*

The AiRocks system includes a powerful Network Management System (NMS) which gives the user a broad array of tools for monitoring and controlling the network. NMS is built into every ARX-900 unit and provides a two-way control channel the gives the user a window into the detailed performance of any remote unit from one central location. Critical functions such as Receive Signal Strength Indicator (RSSI or receive signal level), Packet Error Rate (PER), Remote Spectrum Analysis (RSA), Audio Level, Audio Delay, can all be monitored AND controlled from the NMS GUI screen.

2.5.2.4 *Network Security*

The AiRocks Pro system implements network security through the use of Globally Unique IDs (GUID), which are similar to MAC addresses in Ethernet network equipment. If the GUID has not been registered in the NMS database, the unit will not be granted access to the network audio or control information.

2.5.2.5 *Automatic or Manual Channel Selection*

The AiRocks system is easily deployed by virtue of its automatic transmit and receive channel selection functions. In the Automatic Channel Selection mode the unit will automatically scan for an uplink AiRocks transmission. If found the unit will begin receiving the signal and immediately scan its local RF spectrum for the most desirable downstream channel. Once found, the Relay unit will begin sending the signal it has received from its uplink source to any downstream units within range. For venues with very closely spaced AiRocks units (due to speaker placement) a Manual Channel Selection mode is available which gives the user full control over selection of TX and RX channels.

2.5.2.6 *Remote Spectrum Analyzer (RSA)*

The AiRocks Pro system includes a Remote Spectrum Analyzer function that allows the user the scan the local RF environment **of any remote unit** and plot results of the scan on a Spectrum Analyzer graph in

the NMS Relay Monitor Window. Thus, the network operator can keep track of any potential interference at any remote Relay location.

2.5.2.7 Flash Memory Storage of Configuration Settings

All critical user configuration settings are store in flash memory so that when power is lost and restored, the last set configuration is re-established.

2.5.2.8 Weather Resistant Enclosure

The AiRocks Pro is housed in a sturdy aluminum weather resistant enclosure that is designed to withstand rain and dust encountered in the most hostile outdoor venues.

2.5.3 AiRocks Pro ARX-900-BOB Breakout Box

The ARX-900-BOB is an optional remote connector interface that duplicates audio interfaces and AC power connection, and provides a USB interface of the ARX-900 repeater. The BOB also includes a +12VDC (battery) power input connector to facilitate field deployment when AC power may not yet be available. The BOB allows the ARX-900 to be placed up to 75 feet* away (i.e. on a pole to raise it above any obstructions in a venue to provide better line-of-sight to other nodes). The interconnection between the ARX-900 and the BOB is a standard 8-conductor Ethernet cable. The main I/O connector is a Neutrik Ethercon (NE8FDV) which can accommodate standard RJ45 terminations or the Neutrik NE8MC Cable Connector Carrier, which provides a rugged termination for harsh environments.

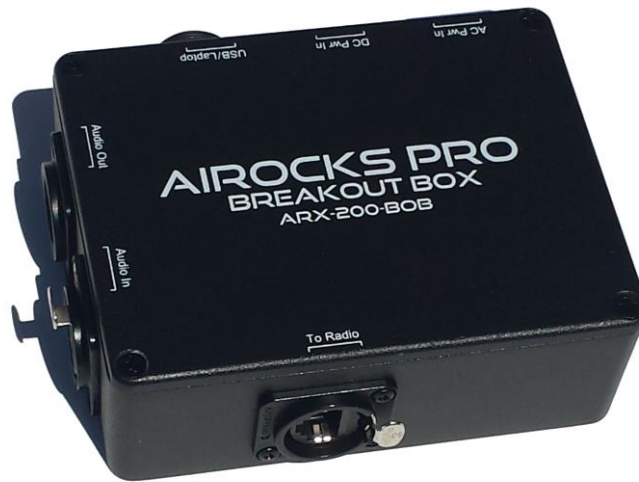


Figure 4 - ARX-900-BOB Breakout Box



*NOTE: The 75 foot limit is dictated by the USB drivers in the BOB and ARX-900. Longer cable runs can be used if only power and audio are run on the cable.

3 CONFIGURATION AND OPERATION

The AiRocks ARX-900 Wireless Audio Repeater includes numerous features and operating modes which are described in this section.

3.1 KEYPAD CONTROL SUMMARY

MASTER_SETUP		RELAY_SETUP		SYSTEM_SEL	
	MASTER_TX_CHAN1_SEL		RELAY_RX_CHAN1_SEL		SYSTEM_TX_DIVERSITY_SEL
	MASTER_TX_CHAN2_SEL		RELAY_RX_SIGNAL_MON		SYSTEM_RX_DIVERSITY_SEL
	MASTER_TX_POW_SEL		RELAY_RX_DIVERSITY		SYSTEM_CHAN_MODE_SEL
	MASTER_RX_CHAN_MON		RELAY_TX_ENABLE		SYSTEM_MSP_FW_VER_MON
	MASTER_AUDIO_LEVEL_MON		RELAY_TX_CHAN1_SEL		SYSTEM_DSP_FW_VER_MON
	MASTER_AUDIO_CONN_SEL		RELAY_TX_CHAN2_SEL		SYSTEM_PID
			RELAY_TX_POW_SEL		SYSTEM_STARTUP_SCREEN
			RELAY_AUDIO_LEVEL_MON		RX_SIGNAL_MON
			RELAY_AUDIO_GAIN_SEL		AUDIO_LEVEL_MON
			RELAY_AUDIO_DELAY_SEL		NET_ID_MON
			RELAY_AUDIO_CONN_SEL		PID_MON
			RELAY_NET_ID_MON		ARX900
					SYSTEM_FACTORY_RESET

3.2 FRONT PANEL CONFIGURATION AND DISPLAY

The ARX-900 can be configured from the front panel by using the 5-key navigation switch. The resulting modes and settings are displayed on the LCD. Below is a summary of the front panel menu functions.

3.2.1 Top Level Menu

Master	Select Master Mode
Relay	Select Relay Mode
System	Select System Configurations Functions

This top-level menu allows the operator to configure the unit to Master or Relay operating mode, or to select System Configuration Functions.

3.2.2 System Configuration Functions

SYSTEM_SEL
SYSTEM_TX_DIVERSITY_SEL
SYSTEM_RX_DIVERSITY_SEL
SYSTEM_CHAN_MODE_SEL
SYSTEM_MSP_FW_VER_MON
SYSTEM_DSP_FW_VER_MON
SYSTEM_PID
SYSTEM_STARTUP_SCREEN
RX_SIGNAL_MON
AUDIO_LEVEL_MON
NET_ID_MON
PID_MON
ARX900
SYSTEM_FACTORY_RESET

3.2.2.1 Transmit Diversity

Transmit Diversity utilizes two different RF channels for transmission to ensure reliable reception of the signal. Transmit Diversity is used when there is interference in the area that is causing (or may cause) dropouts (packet loss). It is recommended that Transmit Diversity be ENABLED (ON) for most applications unless there is a potential shortage of available channels.

3.2.2.2 Receive Diversity

Receive Diversity enables the use of both antenna ports for RF reception and allows the ARX-900 to automatically select the stronger of the two received signals. Receive Diversity is very helpful when there are “deep fades” of the received signal due to movement of people or vehicles in the venue that can cause multiple versions of the RF signal to appear at the antenna slightly out of phase, similar to audio reflections. These out-of-phase RF signals cause signal fading at the receiver of the ARX-900.

3.2.2.3 Channel Select Mode

Channel Select Mode allows the user to select either fully automatic transmit and receive channel selection, or manual channel selection. It is important to keep in mind **that several automatic functions will be disabled when Manual Channel Select mode is selected** (i.e. automatic channel scanning for an uplink transmission, and automatic selection of optimum downlink TX frequency). However, Manual channel selection may be helpful in certain RF environments.

NOTE: Use caution when using Manual channel selection since you will be able to select conflicting frequencies for TX and RX which may prevent the ARX-900 from performing properly. Always plan and document your channel plan when using Manual Channel Select mode.

3.2.2.4 MSP Firmware Version

Displays the currently installed version of the MSP (microprocessor) firmware.

3.2.2.5 DSP Firmware Version

Displays the currently installed version of the DSP (digital signal processor) firmware.

3.2.2.6 Physical ID

Allows the user to assign a “physical ID” (PID) to an ARX-900 unit. The PID will show up on a spectrum analyzer graph so that one can uniquely identify the transmission of the specific PID when the NMS is not used in the network. When the NMS is used, the Net ID of the unit appears on the spectrum analyzer graph.

3.2.2.7 Startup Screen

The display defaults to the selected startup screen after power up and after key pad timeout. The factory default screen is Receive Signal Level.

3.2.2.8 Factory Reset

Resets all internal operating parameters to their factory default values. It is helpful to reset all parameters after a firmware upgrade, or when initially installing a network in a new venue.

Factory default parameters include:

- Operating Mode – Relay
- Channel Select Mode – Auto
- TX Enable – Enabled
- TX Diversity - Enabled
- TX Power - +20dbm
- TX Channel1 – Automatically Selected
- TX Channel2 – Automatically Selected
- RX Diversity - Enabled
- Audio Gain - 0db
- Audio Delay – 0mSec
- Audio Output – Left & Right

3.2.3 Master Mode configuration functions

MASTER_SETUP
MASTER_TX_CHAN1_SEL
MASTER_TX_CHAN2_SEL
MASTER_TX_POW_SEL
MASTER_RX_CHAN_MON
MASTER_AUDIO_LEVEL_MON

3.2.3.1 Master Transmit Channel 1

Displays and controls the current *primary* downstream transmit channel (channel #1). In Auto Channel Select Mode the transmit channel is automatically selected when the unit scans for an available channel with the least local interference during power up. In Manual Channel Select Mode the transmit channel is selected by the user.

Note: If you are unable to change the Transmit Channel, the system is in Manual Channel Select Mode.

3.2.3.2 Master Transmit Channel 2

Displays and controls the current *secondary* downstream transmit channel (channel #2) when Transmit Diversity is enabled. In Auto Channel Select Mode the transmit channel is automatically selected when the unit scans for an available channel with the least local interference during power up. In Manual Channel Select Mode the transmit channel is selected by the user.

Note: Transmit Diversity is enabled or disabled in the System menu.

Note: If you are unable to change the Transmit Channel, the system is in Manual Channel Select Mode.

3.2.3.3 Master Transmit Power

Displays the current transmit power. Power can be adjusted from ~0dbm to ~+20dbm. It is recommended to keep the power at its maximum level (+20dbm).

3.2.3.4 Master Receive Channel

Displays the current receive uplink control channel (UCC). The receive channel is automatically selected when the unit scans for an available channel with the least local interference during power up. This channel is selected automatically and cannot be changed by the user. This channel is normally the same as TX Channel #1.

3.2.3.5 Master Audio Level

Monitors the incoming audio level from the XLR input in Master mode.

3.2.3.6 Master Audio Gain

Allows the user to modify the input gain of the audio input port in Master mode from 0db of gain to +47db of gain. For best noise performance, leave this setting at 0db.

3.2.4 Relay Mode configuration functions

RELAY_SETUP	
	RELAY_RX_CHAN1_SEL
	RELAY_RX_SIGNAL_MON
	RELAY_RX_DIVERSITY
	RELAY_TX_ENABLE
	RELAY_TX_CHAN1_SEL
	RELAY_TX_CHAN2_SEL
	RELAY_TX_POW_SEL
	RELAY_AUDIO_LEVEL_MON
	RELAY_AUDIO_GAIN_SEL
	RELAY_AUDIO_DELAY_SEL
	RELAY_AUDIO_CONN_SEL
	RELAY_NET_ID_MON

3.2.4.1 *Relay Receive Channel #1*

Displays and controls the current *primary* receive channel #1. In Auto Channel Select Mode the receive channel is automatically selected when the unit scans for and finds a transmission from an uplink unit. In Manual Channel Select Mode the receive channel #1 is selected by the user.

Note that only RX Channel #1 is controllable by the user. RX Channel #2 is automatically selected based on the signal received from the unit's uplink source and is only used when the uplink source is using Transmit Diversity.

Note: Transmit Diversity is enabled or disabled in the System menu.

3.2.4.2 *Relay Receive Signal Level (factory default screen)*

If the unit has found a signal, this function displays the current receive signal level. The receive signal display range is approximately -95dbm to 0dbm. It is desirable to keep this signal level greater than one bar (-70dbm). This is the factory default screen that appears after power up.

3.2.4.3 *Relay Receive Antenna Diversity*

Receive antenna diversity is helpful when using the standard dipole antennas. This allows the receiver to select the stronger of the two received signals automatically. When using a single, high-gain directional antenna, diversity should be disabled since the antenna will be connected only to Antenna Port #1 (right-hand side of unit).

3.2.4.4 *Relay Transmit Enable*

Displays and controls the current setting for the TX Enable function. This function can be used to disable the "transceiver" functionality of the ARX-900 so that the unit is "receive only". **Keep this function in mind when troubleshooting what appears to be a non-functioning unit. The unit will not "relay" a signal to downstream units if TX is disabled.**

3.2.4.5 *Relay Transmit Channel #1*

Displays and controls the current setting for the *primary* downstream transmit channel #1. In Auto Channel Select Mode the transmit channel #1 is automatically selected when the unit scans for an available transmit channel with the least local interference during power up. In Manual Channel Select Mode the transmit channel #1 is selected by the user.

3.2.4.6 *Relay Transmit Channel #2*

Displays and controls the current setting for the *secondary* downstream transmit diversity channel #2. In Auto Channel Select Mode the transmit channel #2 is automatically selected when the unit scans for an available transmit channel with the least local interference during power up. In Manual Channel Select Mode the transmit channel #2 is selected by the user.

Note that Relay TX Channel #2 is active only when Relay Transmit Diversity is enabled. The Relay Transmit Diversity function is enabled in the System menu.

3.2.4.7 *Relay Transmit Power*

Displays the current transmit power. Power can be adjusted from ~0dbm to ~+20dbm. It is recommended to keep the power at its maximum level (+20dbm) unless two units are placed very near each other.

3.2.4.8 Relay Audio Signal Monitor

Displays the average audio signal level received by the unit. It is desirable to keep the audio signal in the lower-middle of the display during normal operation since this will give the best dynamic range of the Digital-to-Analog Converter (DAC) in the receiver. The audio level can be manually controlled at the input of the Master unit and by the Relay Audio Gain function (below).

3.2.4.9 Relay Audio Gain

Displays the controls the audio gain in the receiver's audio path. The settings range from -10db to +20db. The factory default setting is 0db gain. The system gain from the Master input to the Relay output is -6db. This is to ensure that both the Master audio input and Relay audio output clip at the same level. If you prefer to have 0db of system gain, set the Relay Audio Gain to +6db. Keep in mind that, at this setting, the Relay output will clip 6db BEFORE the Master audio input.

3.2.4.10 Relay Audio Delay

The ARX-900 can add delay into the audio path to help compensate for speaker placement in a large venue. Up to 500mSec of delay per hop (Relay location) can be added. The delay can be applied either in a "cumulative" fashion (the delay of each hop is added to the relayed signal), or "non-cumulative" fashion (the delay is added only to the local node but not to the relayed signal). This gives the user a great deal of latitude in tuning the delay within the venue.

3.2.4.11 Relay Audio Output Channel Configuration

This function gives the user control of the audio output channel configuration (see the Audio Output Configuration section). The selectable configurations include Left+Right, Left Channel only, and Right Channel only and are used when transmitting a Stereo audio signal. They have no effect when transmitting Mono audio signals except for inverting the polarity of the audio signal.

The latter two configurations are useful for feeding balanced Left channel or Right channel stereo delay stacks. These signals are balanced and use XLR Pins 2 & 3 with Pin 1 as ground.

The Left+Right configuration will output the Left channel on XLR Pin2 (Tip/Hot) and the Right channel on XLR Pin3 (Ring/Cold). XLR Pin 1 is Ground.

3.2.4.12 Relay Network ID

When used in a Managed Network, this function displays the Network ID that has been assigned by the Network Managements System. In Unmanaged mode the Network ID is 0. Also, the Master network ID is always 0.

3.3 AUDIO INPUT AND OUTPUT CONFIGURATIONS

As a convenience to the user, the ARX-900 can accommodate several different audio input and output configurations. Each of the configurations can be selected electronically (no hardware jumpers) and can accommodate balanced mono and stereo audio input and output signals. This is accomplished internally by the use of switched audio connections as shown below. These audio configurations are selectable via the front panel or via the NMS. The NMS gives the user the ability to switch configurations remotely over the air.

Since the ARX-900 can only operate in one mode at a time (Master or Relay), the Audio Input connector and Audio Output connector share the same audio path (Audio+ and Audio-) and are therefore connected in parallel.

3.3.1 Stereo vs Mono

The ARX-900 transmit two independent audio channels over the air. The Master will always transmit XLR Pin 2 (Tip/Hot) on one channel, and XLR Pin 3 (Ring/Cold) on the other channel. This allows the user to apply (at the Master XLR) either balanced mono or unbalanced stereo to Pins 2 & 3 while Pin 1 is ground. The remote Relay can be configured by the user to output either balanced mono audio, unbalanced stereo (Left and Right), balanced Left channel only, or balanced Right channel only. The table below summarizes these configurations.

			Audio Out at Relay					
			Relay Output Audio Selector Button					
Source Audio at Master XLR			Left & Right		Left		Right	
XLR Pin	Balanced Mono		Balanced Mono		N/A		N/A	
Pin 1	Ground		Ground					
Pin 2	Audio +, Tip, Hot		Audio +, Tip, Hot					
Pin 3	Audio -, Ring, Cold		Audio -, Ring, Cold					
XLR Pin	Unbalanced Stereo		Unbalanced Stereo Left & Right		Balanced Left Channel Only		Balanced Right Channel Only	
Pin 1	Ground		Ground		Ground		Ground	
Pin 2	Left Channel, Tip, Hot		Left Channel, Tip, Hot		Left Channel +, Tip, Hot		Right Channel +, Tip, Hot	
Pin 3	Right Channel, Ring, Cold		Right Channel, Ring, Cold		Left Channel -, Ring, Cold		Right Channel -, Ring, Cold	

3.3.2 Audio Input Configurations (Master unit)

3.3.2.1 *Balanced Mono Audio Input Connector Configuration (factory default)*

The Balanced Mono audio input configuration is shown below. In this mode the audio input signal clips at +8.2dbu ($\sim 1.9\text{Vrms}$, 2.8Vpk).

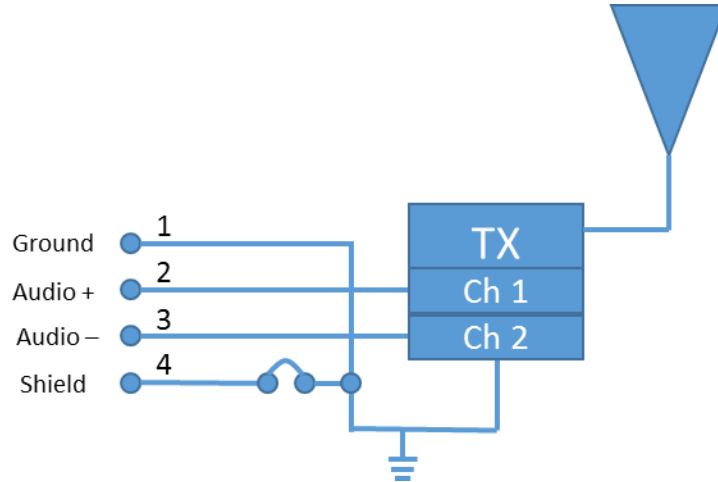


Figure 5 Balanced Mono Audio Configuration

3.3.2.2 *Unbalanced Stereo Audio Input Connector Configuration*

The ARX-900 transmits two independent audio channels over the air. This allow the Master to send unbalanced stereo channels on XLR Pins 2 & 3 (Pin 1 is a common ground for both channels). The Relay unit can select either the Left or Right channel and output this signal as a balanced audio output signal (Left or Right balanced output). Or the Relay can be configured send the Left channel out on Pin 1, and the Right channel out on Pin 2 with Pin 1 being a common ground for both channels. In this mode the audio input signal clips at +2.2dbu ($\sim .98\text{Vrms}$, 1.4Vpk).

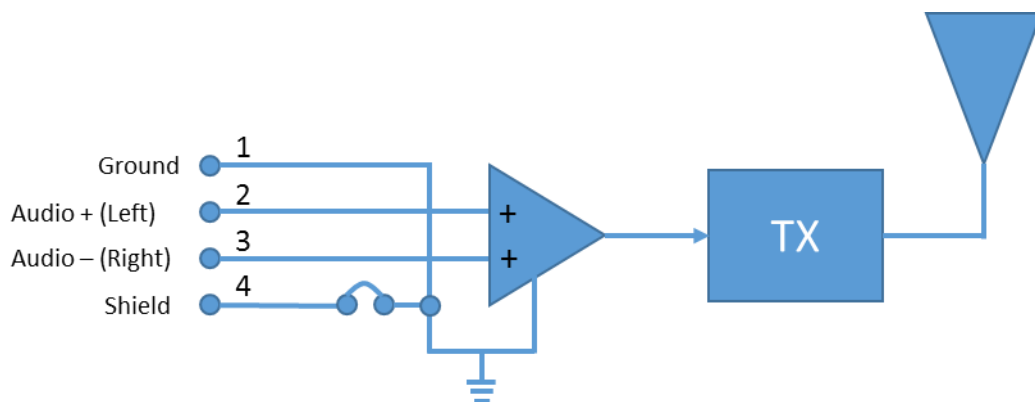


Figure 6 Unbalanced Stereo Audio Input Connector Configuration

3.3.3 Audio Output Connector Configurations (Relay units)

3.3.3.1 *Balanced Mono Audio Output Connector Configuration (factory default)*

When the Relay audio output configuration is set to L&R, the audio output on Pin 2 is the signal applied to the Master XLR Pin 2 (Audio +, Tip, Hot), and the output on Pin 3 is the signal applied to the Master XLR Pin 3 (Audio-, Ring, Cold). If balanced mono audio is applied to the Master XLR input connector, the Relay audio output selector button should be left in L&R so that both Tip and Ring signals are applied to the output XLR connector.

The Balanced Mono audio output connector configuration is shown below. In this mode the audio output signal clips at +8.2dbu (~2Vrms, 2.8Vpk).

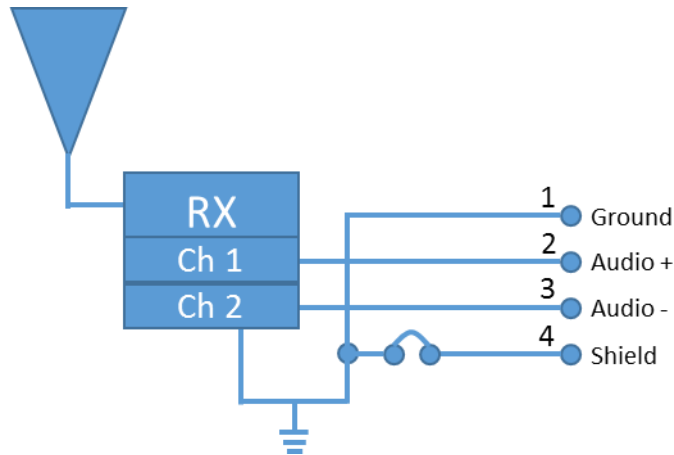


Figure 7 Balanced Mono Audio Output Connector Configuration

3.3.3.2 *Stereo Audio Output Connector Configuration*

3.3.3.2.1 Unbalanced Stereo Output (Left and Right Channels)

If unbalanced stereo is applied to the Master XLR input connector, and the Relay audio output is set to L&R, the audio output on Pin 2 is the signal applied to the Master XLR Pin 2 (Left channel audio), and the output on Pin 3 is the signal applied to the Master XLR Pin 3 (Right channel audio). Pin 1 is a common ground pin for both Left and Right channels.

In this mode the audio output signal of each channel clips at +2.2dbu (~1Vrms, 1.4Vpk). The Stereo Audio Output Connector configuration is shown below.

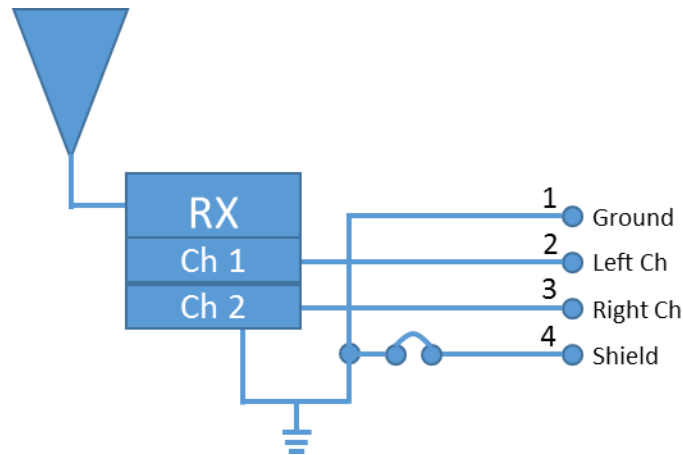


Figure 8 Unbalanced Stereo Audio Output Connector Configuration

3.3.3.2.2 Balanced Stereo Output (Left Channel Only)

When using AiRocks Pro for stereo delay stacks it is desirable to feed a balanced Left channel signal to one stack (from the Left Relay radio), and a balanced Right channel signal to the other stack (from the Right Relay radio). When the Relay audio output configuration is set to “Left”, the Left channel audio signal is output as a *balanced* single channel on Pins 2 & 3 of the Relay XLR output connector. This configuration is shown below.

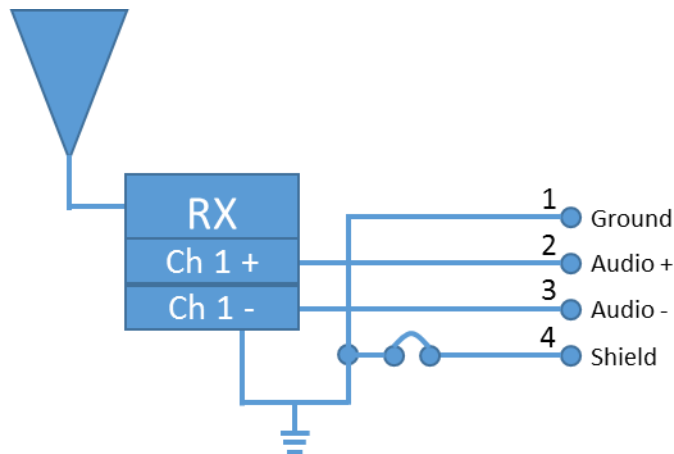


Figure 9 Balanced Stereo Output (Left)

3.3.3.2.3 Balanced Stereo Output (Right Channel Only)

When the Relay audio output configuration is set to “Right”, the Right channel audio signal is output as a balanced single channel on Pins 2 & 3 of the Relay XLR output connector. This configuration is shown below.

Note that two ARX-900 radios are required for Delay Stack applications since one will be feeding the Left stack, and the other will be feeding the Right stack.

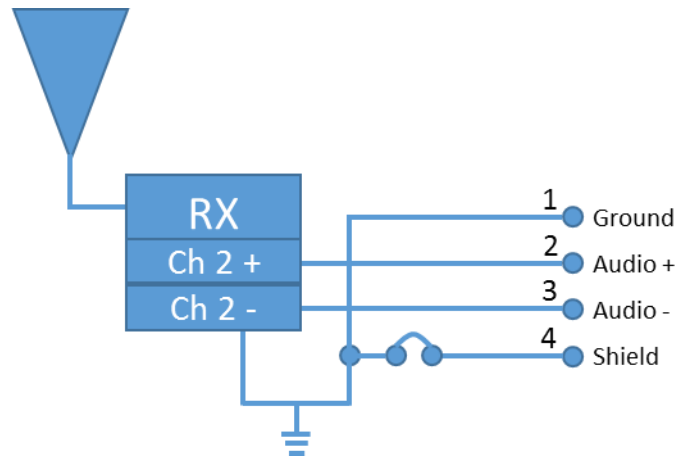


Figure 10 Balanced Stereo Output (Right)

4 EQUIPMENT INSTALLATION AND OPERATION

4.1 INSTALLING THE ARX-900 MASTER AND RELAY UNITS

To install and operate the ARX-900 you must be an experienced audio professional with a knowledge of applicable RF spectrum regulations. The FCC deems that it is the responsibility of the operator to know, understand, and abide by the rules.

The ARX-900 is designed to be installed by professional audio engineers, technicians, and network operators who have an in-depth understanding of wireless radio technology and who are knowledgeable in local regulations including building and wiring codes, safety, channel, power, outdoor/indoor restrictions, and license requirements. It is important to follow the installation and configuration instructions in this document in order to comply with the rules and restrictions imposed by the FCC and other government bodies who regulate the airwaves. The ARX-900 has passed certain FCC mandated testing using the equipment listed in this document, including the antennas. Use of other antennas or amplifying devices not listed in this document may violate these FCC regulations.

The ARX-900 is designed to be mounted in a vertical orientation for optimum results and to comply with FCC certification requirements.

The ARX-900 should be mounted as high as possible above any obstructions to achieve optimum performance. Direct line-of-sight to other ARX-900 units is important, but not necessary. Distances of more than 1000 feet can be achieved with a properly installed unit. The unit includes a pole mount which gives the user a variety of installation options.

The recommended mounting location of the ARX-900 is on a pole, such as a speaker stand or truss that allows it to be mounted 10 feet or more off the ground. Obstructions, such as people, trees, building, or other solid structures, can affect the quality of the radio transmission, and hence the achievable range of the unit for reliable, error-free operation. However, since the ARX-900 operates in the unlicensed 900 MHz band, direct line of sight is not required. The unit can be used in both indoor and outdoor environments and can pass through concrete walls with useable signal levels.

Interference in the 900 MHz band will also affect network performance. The range of each link is dependent upon, not only the transmit path, but also the level of interference in the area. The ARX-900 system is designed to avoid interference (TX and RX Diversity) and co-operate in the presence other 900 MHz systems. Additionally, the Network Management System provides the user with several tools to detect and avoid interfering signals.

4.1.1 Installing the Master Unit

Install the Master unit as high as possible, and with best possible line of sight to the first Relay unit. Typically, a Breakout Box (ARX-900-BOB or “BOB”) will be used to allow the Master to be mounted at a significant distance from the network operator position and main audio source. The BOB provides an input for the Master audio source, as well as AC or DC power inputs, and a USB interface for the Network Management System.

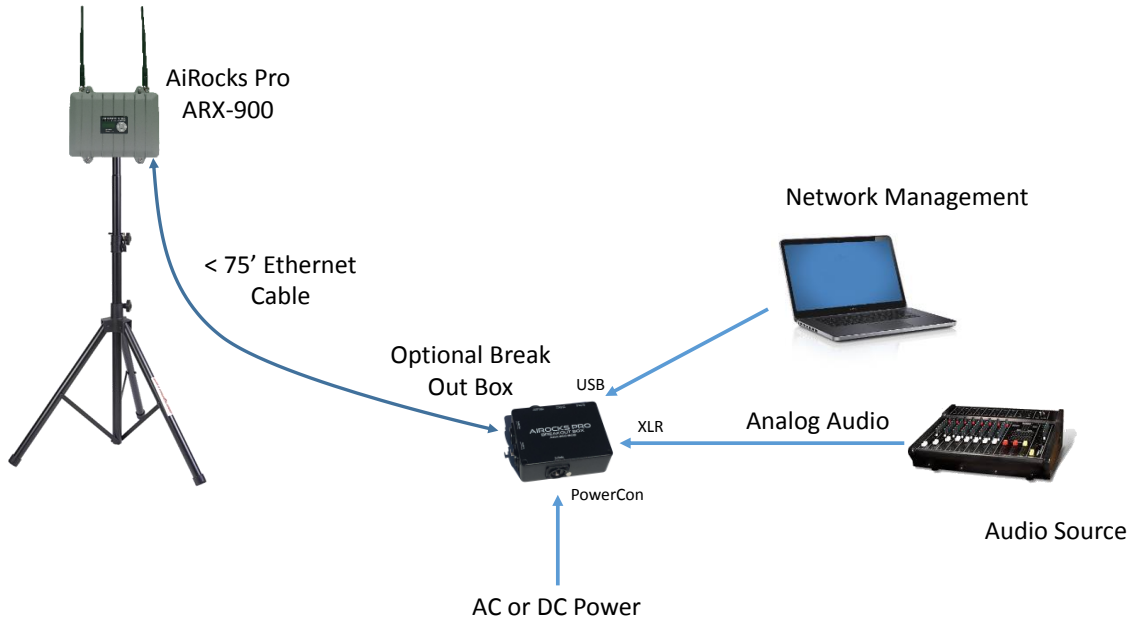


Figure 11 – Typical Master Unit Installation Configuration

- Once all cables are attached, apply AC or DC power to the BOB.
- Start the NMS application. The Master unit should appear in the Welcome Screen.
- Switch the NMS to Spectrum Analyzer mode to observe any potential interference in the area. Normally, when in Auto Channel Select mode, the ARX-900 will automatically avoid local interference. If you do experience interference switch to Manual Channel Select mode and manually assign TX and RX frequencies that avoid the local interference.
- Switch the NMS to the Master operating mode by selecting the Master tab on the NMS screen.
- The Master unit is now transmitting and any Relay units in the area will attempt to join the network. See the Network Management System section for further details on managing the network.
- Note that the audio connectors on the ARX-900 are still active even when the BOB is used. For example, an audio cable could be directly attached to the ARX-900 while power and USB cables are connected to the BOB.
- The USB port on the BOB is powered by the attached USB port on the PC. Therefore, it is not mandatory to apply AC or DC power to the BOB if AC power is applied directly to the ARX-900.

Note: The ARX-900 USB interface uses a standard HID driver which is built into the PC's operating system. Therefore, no custom USB drivers need to be installed. When the ARX-900 is first attached to a USB port, the operating system installs a HID driver for that port. This OS installation process can take up to 30 seconds. Be patient while this process takes place. It will only occur when the ARX-900 is first connected to the USB port.

Note: The ARX-900 Network Management System can run on a Windows XP or Windows 7 machine. It also requires Microsoft .NET Framework 4 or greater. The NMS will not run on a Mac.

4.1.2 Installing Relay Units

Install Relay units as high as possible, and with best effort line-of-sight to either the Master unit, or to the closest uplink Relay unit. The included mounting bracket provides several mounting options. Typically a BOB is NOT used with a Relay unit since Relay units are normally mounted close to the powered speaker to which it is providing audio. However, a BOB can be used if desired.



Figure 12 Typical Relay Installation

- Once the audio and power cables are attached to the Relay unit, apply AC power.
- The front panel display should show that the unit is in the Relay mode and will default to monitoring the received signal level. If not, press the navigation switches on the unit's front panel to select the Relay mode.
- If the Master unit is transmitting, and the Relay unit is set to Auto Channel Selection mode, the Relay unit will automatically tune to the uplink signal and the green RF Signal LED will illuminate. If audio is being sent by the Master, the Audio Signal LED will also illuminate.
- If the NMS is not being used (Unmanaged Network) the RF Signal LED will be constantly illuminated while the signal is being received.
- If the NMS is connected to the Master, the RF Signal LED on the Relay unit will blink until the NMS has assigned it a network ID. Once a network ID is assigned, the RF Signal LED will be constantly illuminated and the LCD display will show the network ID number.

4.1.3 Environmental Considerations

The AiRocks Pro is housed in a sturdy aluminum weather resistant enclosure that is designed to withstand rain, dust, and the rough handling encountered in the most hostile outdoor venues. ***However, the unit is “weather resistant”, NOT “weather proof” and is NOT designed for permanent outdoor installations.*** The AiRocks Pro system was designed for mobile production companies to be used in temporary installations in outdoor venues. It therefore uses commonly available XLR, PowerCon, and RJ-45 connectors which are not “sealed” to water intrusion, similar to the design of most powered speakers. However, when properly mounted in a vertical orientation, rain water will not penetrate these connector entry points (similar to the International Protection standard, IP63, which states “Water falling as a spray at any angle up to 60° from the vertical shall have no harmful effect”). If additional weather protection is desired, an ARX-900-BOB Breakout Box can be used with Relay units to route audio and power connections to a remote, weather-protected location. Ethernet cables with Neutrik Ethercon connectors installed are available from many pro-audio dealers and can provide additional protection from moisture and physical abuse.

5 NETWORK MANAGEMENT SYSTEM

5.1 NMS OVERVIEW

The AiRocks Network Management System (NMS) is a PC-based application that give the user a broad array of tools for configuring, operating, and diagnosing the AiRocks network. The NMS connects via USB to the Master unit and communicates over the air with all Relay units in the network. The communications with the Relay units is bi-directional so that the NMS is able to monitor AND control each unit from a central location.



Figure 13 NMS Welcome Screen

As mentioned earlier, AiRocks networks can either be “Managed” or “Unmanaged”. A Managed network is one which includes the use of the Network Management System. When a Relay unit “joins” a managed network it is assigned a unique Network ID. This allows the NMS to independently address each Relay unit to monitor its critical parameters (such as received signal strength, packet error rate, transmit power, audio level, etc.) and to control certain functions such as output volume or setting audio delay through the units. A network map gives the user a graphical representation of the network topology showing which Relay units are communicating with each other, and on which frequencies.

5.2 GUIDS AND REGISTRATION

Each AiRocks unit has a unique, fixed (in hardware) 16-digit hex number assigned to the unit during manufacturing (similar to a MAC address in a LAN network). This is called the Globally Unique ID, or GUID. The GUID is used by the NMS to create a database that allows the network operator to assign a

“friendly name” to each unit during deployment. Names such as “Stage Left” or “Middle Tower” can help keep track of where units are deployed in the venue.

During (or prior to) network deployment each AiRocks unit must be physically connected to the NMS USB port to become “registered” with the NMS. During the registration process the NMS captures the GUID and gives the user the opportunity to enter a friendly name. Once the unit is registered in the database this information can be used to (optionally) provide network security by allowing only registered units to participate in the network.

Note: The ARX-900 USB interface uses a standard HID driver which is built into the PC’s operating system. Therefore, no custom USB drivers need to be installed. The initial driver installation process can take up to 30 seconds. Be patient while this process takes place. It will only occur when the ARX-900 is first connected to a specific USB port. This same initial installation process will occur for each USB port to which the BOB is attached.

Note: The ARX-900 Network Management System can run on a Windows XP or Windows 7 machine. It also requires Microsoft .NET Framework 4 or greater. The NMS will not run on a Mac.

If AiRocks units are not registered prior to deployment they will appear as “unregistered” nodes in the NMS network map if the network security is “Open” (see Network Security section below). At this point the unit can be registered “over the air” by the network operator if desired (however, if network security is “Secure”, these nodes will not appear on the network map).

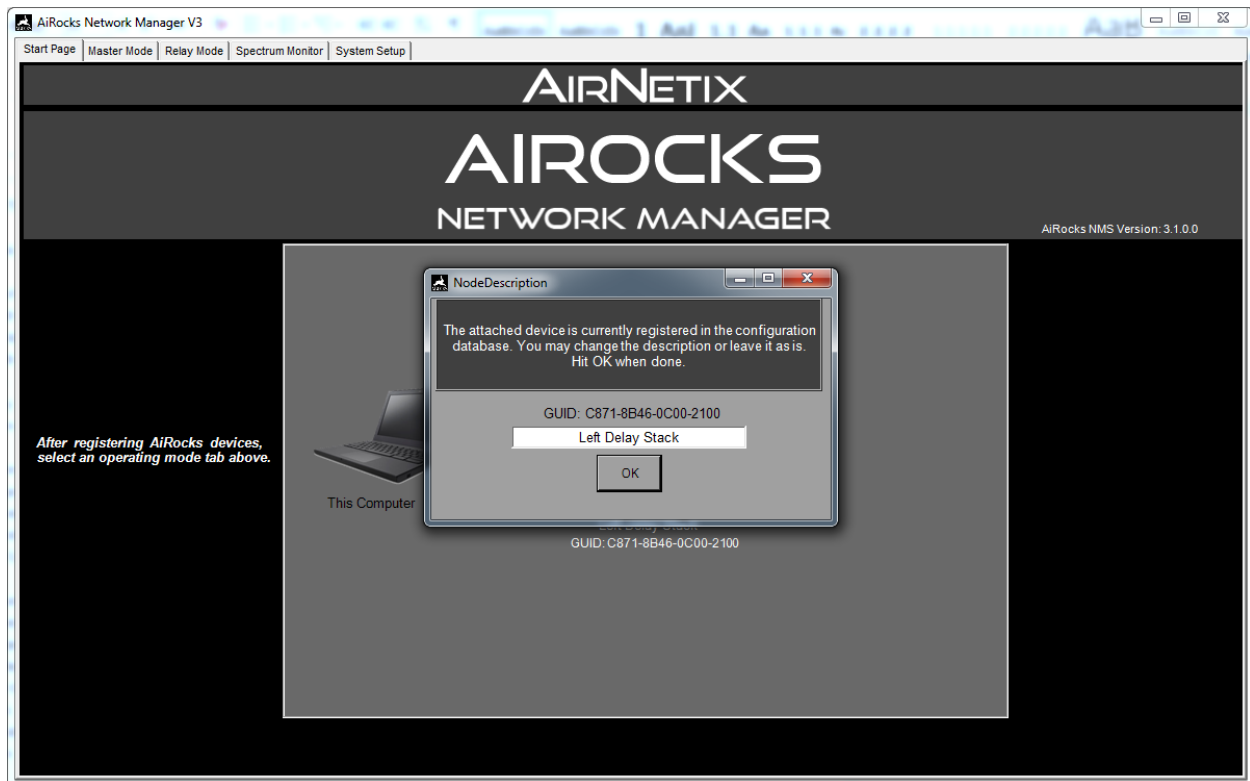
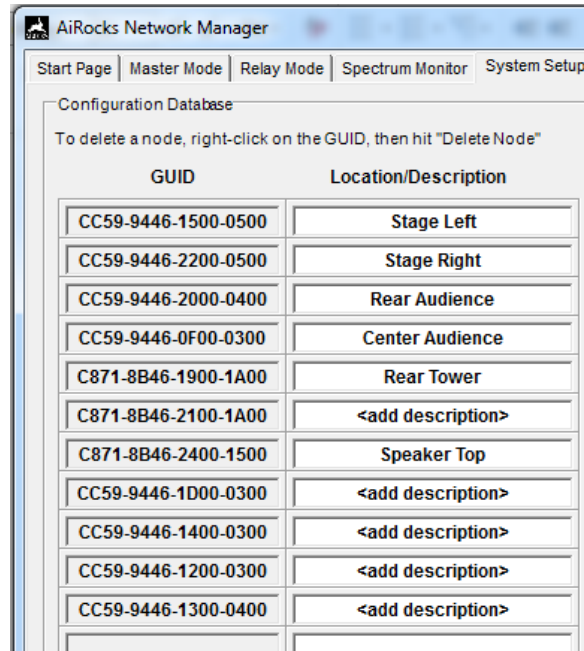


Figure 14 Registering a Node



GUID	Location/Description
CC59-9446-1500-0500	Stage Left
CC59-9446-2200-0500	Stage Right
CC59-9446-2000-0400	Rear Audience
CC59-9446-0F00-0300	Center Audience
C871-8B46-1900-1A00	Rear Tower
C871-8B46-2100-1A00	<add description>
C871-8B46-2400-1500	Speaker Top
CC59-9446-1D00-0300	<add description>
CC59-9446-1400-0300	<add description>
CC59-9446-1200-0300	<add description>
CC59-9446-1300-0400	<add description>

Figure 15 NMS Database

5.3 NETWORK SECURITY

AiRocks networks can operate as either **Open** networks or **Secure** networks.

5.3.1 Open Networks

Open networks are networks in which any AiRocks unit can “participate” in the network, regardless of whether or not it has been registered in the NMS database. During initial deployment, the network operator may wish to configure the network as Open to facilitate the deployment process, but then switch to “Secure” once the event begins.

5.3.2 Secure Networks

Secure networks are networks in which only “registered” AiRocks units can participate in the network. If a network is Secure, AiRocks units that are not registered in the NMS database will not be able to receive a signal and will provide no audio to the audio output port.

5.4 MASTER MODE OPERATION

An AiRocks network typically has only one Master unit*. The Master is located near the main audio source and transmits its signal to all Relay units within its transmission range. The NMS is connected to the Master via a USB connection from the PC or laptop on which the NMS resides.

5.4.1 Master Map Screen

After registering units using the Welcome screen (shown above), the network operator selects the “Master Map” tab at the top of the NMS screen. The NMS then switches to the Master Map window shown below, which is a map of the network nodes.



Figure 16 - Master Mode screen

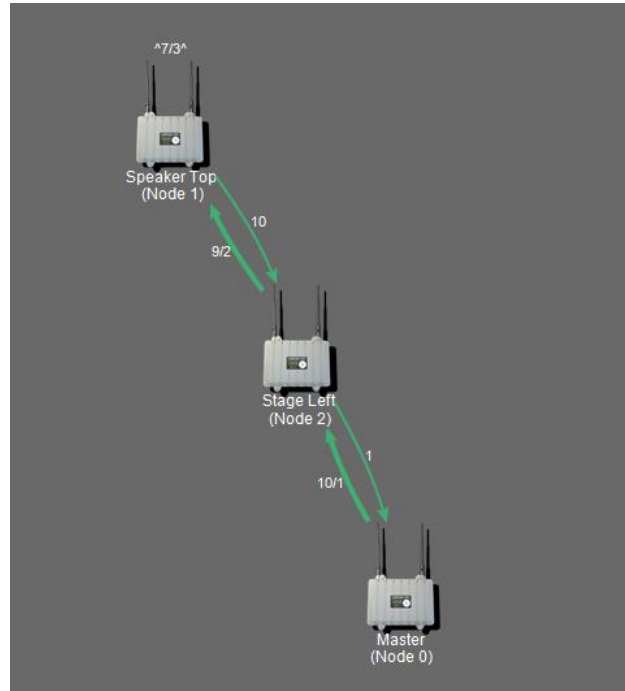
Any Relay unit that has been powered ON will attempt to connect to the Master. Once successfully connected, the Relay unit has “joined” the network and the NMS can be used to monitor and control its functions. In the example screen above, one Relay unit named “Stage Left” has joined the network and is receiving its signal from the Master unit. The outbound link from the Master is using channel 10 and channel 1 (large arrow from Master to Relay), and the inbound Uplink Control Channel (UCC) link is using channel 1 (small arrow from “Stage Left” to Master). A second relay unit named “Speaker Top” is receiving the relayed signal from “Stage Left” on channel 9 and channel 2 and is using channel 10 as the UCC.

The network operator can now get additional detail on any Relay by opening a Relay Monitor Window. This is done by highlighting the desired node in the network map and then hitting the “Open Monitor Window” button at the bottom of the screen, or by double-clicking on the desired node.

**Note: Multiple Master units can be used in Manual Channel Select mode. See “Multiple Masters” section for details.*

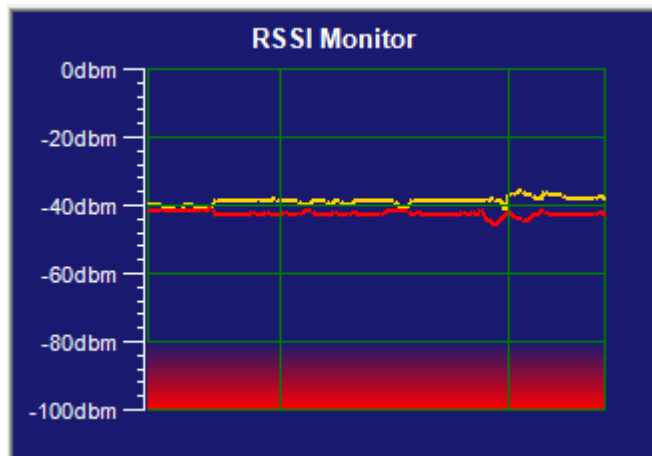
5.4.1.1 Network Map

The center of the Master Map screen shows a network map of all active nodes. The Master node will always appear at the bottom of the screen unless the user drags the node to a different location. If Auto Layout is ON, the nodes will automatically be realigned. If Auto Layout is OFF, the user can move the nodes to any location or configuration he chooses. This may be helpful for keeping track of physical node locations in the venue. For larger networks the user can (using the mouse wheel) scroll out so that the nodes appear smaller and more nodes fit within the network map. Clicking on a Relay node will “select” the node. Once a node has been selected the user can then click the “Open Monitor Window” at the bottom of the screen to bring up a detailed “Relay Monitor Window” of the selected node. The Master node is always assigned Node 0.



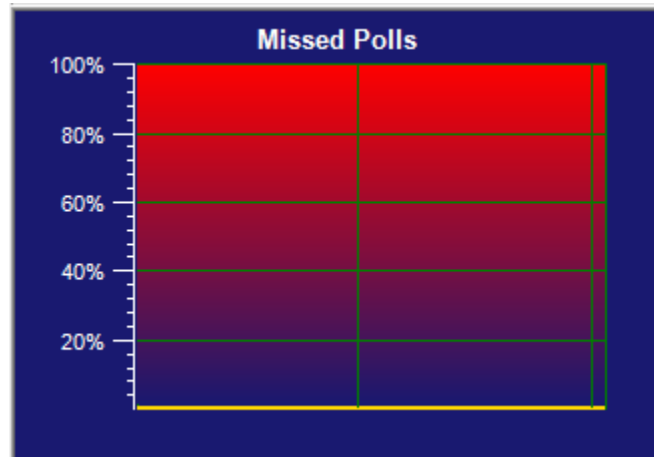
5.4.1.2 RSSI Plot

The RSSI (Receive Signal Strength Indicator) plot appears at the top right section of the Master screen. This plot shows the receive signal level of the selected node. The signal from Antenna 1 is shown in red, while the signal from Antenna 2 is shown in yellow. The ARX-900 automatically selects the strongest signal.



5.4.1.3 Missed Polls Plot

This plot will show the percentage of polls that have not been answered by the selected node. Poll responses are measured over a six second interval. After 100% missed polls over the six second interval, the NMS considers the node disconnected and removes the node from the active poll list. A few sporadically missed polls are acceptable for good network performance. However, a significant number of missed polls can be a result of poor link quality and the operator should consider changing the operating channel to one with less interference or moving nodes closer together.



5.4.1.4 Packet Error Rate (PER) Plot

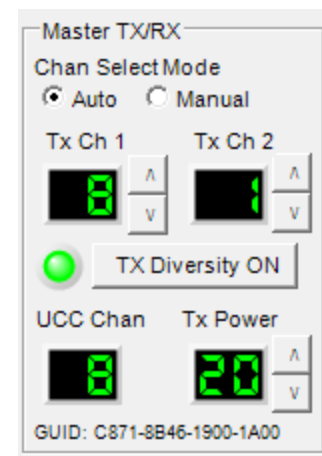
This plot shows the Packet Error Rate of the selected node. Since any dropped packets cause a dropout of the audio signal, the PER should be very low if not zero. The red line indicates the PER while the yellow line indicates the PER threshold. The PER threshold is the user-selected point at which the ALO function initiates a channel change request of its uplink source node.



5.4.1.5 Master TX/RX Functions

The function in this section of the Master screen include:

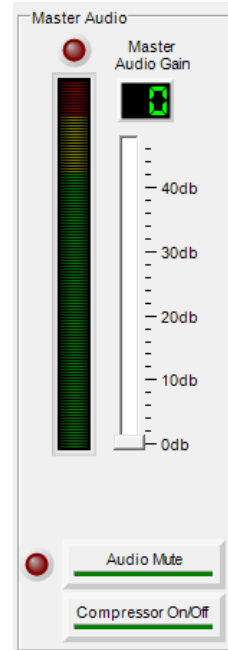
- Channel Select Mode – Select either fully Automatic channel selection, or Manual channel selection for the Master Node.
- Transmit Channel #1 – Channel #1 used by the Master's downstream transmission to Relay nodes.
- Transmit Channel #2 – Channel #2 used by the Master's downstream transmission to Relay nodes if TX Diversity is enabled.
- TX Diversity – Used to avoid local interference by transmitting on two channels simultaneously.
- UCC (Uplink Control Channel) – Channel used by the Master to receive uplink control information from Relay units.
- Transmit Power – The output power level of the transmit signal sent from the Master. It is recommended to leave this set to +20dbm.



5.4.1.6 Master Audio Functions

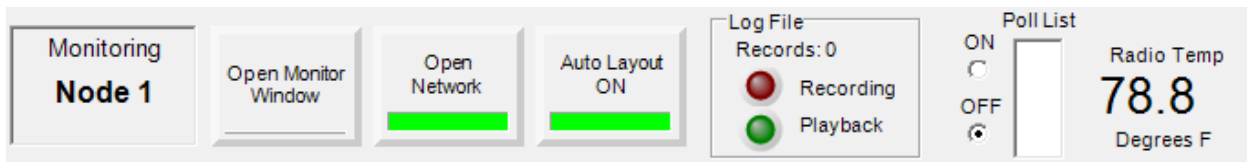
The function in this section of the Master screen include:

- Master Audio Gain – The audio input gain setting for the Master audio input signal. For best noise performance, leave this setting at 0db unless the incoming audio signal is too low. It is desirable for the audio level to show on the lower half of the LED display.
- Audio Mute – The Audio Mute function will mute the audio sent from the Master so that the entire network will be silent.
- Compressor On/Off – The Master audio input passes through an audio compressor which can be used if the input audio is highly variable (i.e. live announcer using microphone). This function can help avoid clipping, but also reduces the dynamic range of the audio signal.



5.4.1.7 Lower Screen Functions

The function in this section of the Master screen include:



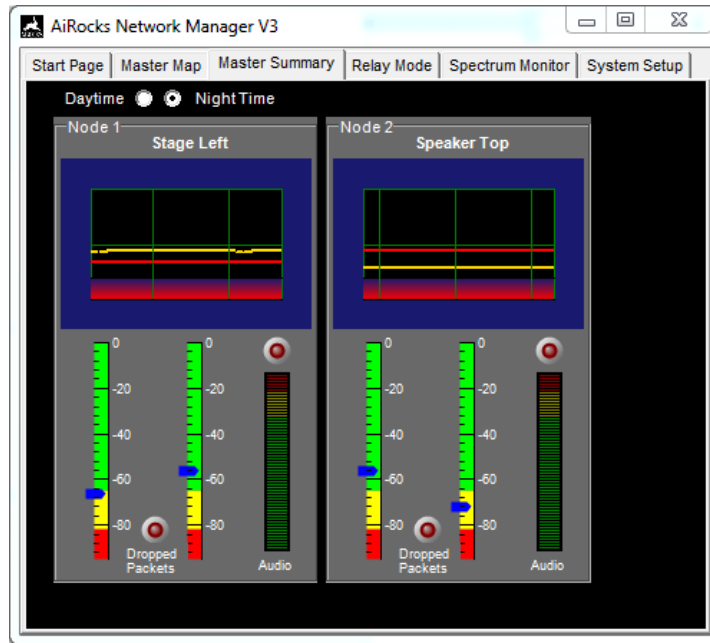
- Monitoring Node X – Indicates which node is selected and being monitored in the graphical plots on the right side of the screen.
- Open Monitor Window – When clicked, will open a Relay Monitor Window of the selected node. Select (click on) a node on the Network Map, then hit Open Monitor Window to display the Relay Monitor window of the selected node.
- Open/Secure Network – Open networks allow unregistered nodes to participate in the network. A Secure Network will only allow registered nodes to participate in the network. In an Open network, unregistered nodes text will appear in red. Registered nodes text appear in white.
- Auto Layout ON/OFF – When Auto Layout is on, nodes that appear in the network map are automatically placed in relation to the nodes with which they are communicating. The user can drag the master or any relay nodes to a more convenient location on the screen, but the physical proximity will be automatically maintained. When Auto Layout is OFF, the user can manually drag the nodes to a position that more closely emulates the actual physical location of the nodes in the venue. This may help the user keep track of the node locations more easily.
- Log File – Shows if Logging is enabled (Recording) or if a Playback log file is currently active (See Logging section for more details).
- Poll List – Shows the Network ID of which downstream nodes are being directly polled by the Master. Enabling the Poll List will cause the NMS to send and receive additional polling information to each Relay node so that the operator can view the nodes being polled by any

Relay node in the network. Caution should be used when enabling the Poll List since it will cause a doubling of polling traffic on the network control channel, which may slow the poll responses and cause the network updates to appear sluggish. The larger the network, the more impact the additional poll traffic will have.

- Radio Temperature – Displays the internal temperature of the ARX-900. The ARX-900 can withstand internal temperatures from 0 degrees Fahrenheit to 160 degrees Fahrenheit.

5.4.2 Master Summary Screen

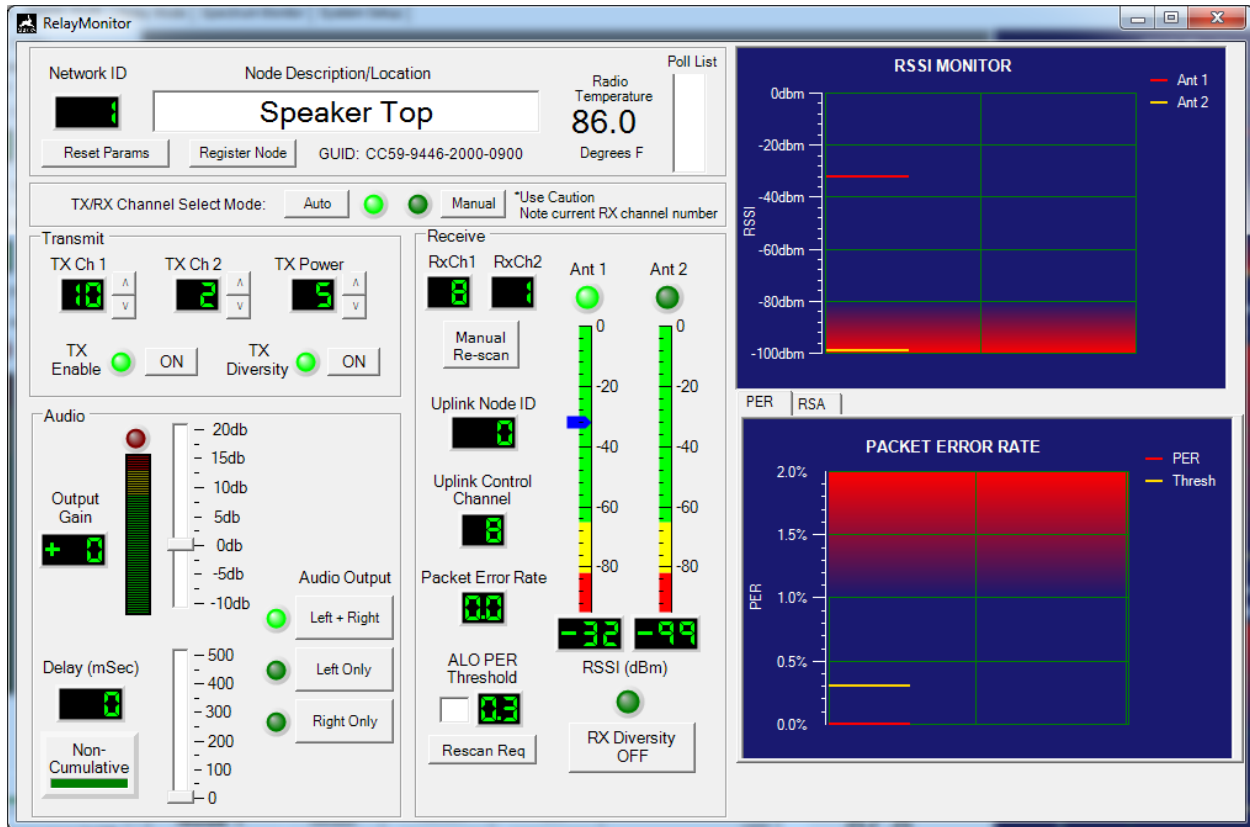
The Master Summary screen is a small view of all active nodes in a re-sizable window. Instead of leaving Relay Monitor windows open for every active node, you can use the Master Summary screen to keep an eye on active nodes in a much smaller footprint.



After selecting the Master Summary tab, resize the window to surround only the active node display. This section displays RSSI from antenna #1 and #2, as well as dropped packets (white line plotted if packet loss occurs) and an LED which blinks if the Packet Error Rate (PER) is greater than zero. An audio LED bar shows audio level and includes an audio clip LED at the top. The full size Relay Monitor window for any active node can be displayed by selecting the node name at the top of the display (i.e. “Stage Left”). Also a “Daytime” and “Night Time” button lets the operator choose between two different color schemes.

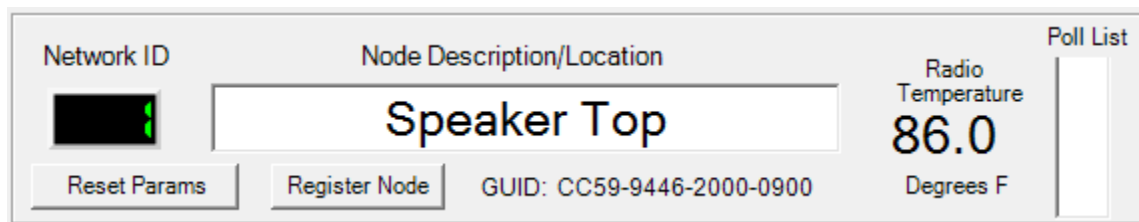
5.4.3 Relay Monitor Window

Once a Relay Monitor window has been opened, the network operator has full monitor and control capability over the remote Relay node.



5.4.3.1 Top Section

The top section of the Relay Monitor window includes the following functions:



- Network ID – This is the ID number assigned to the Relay node by the NMS.
- Node Description/Location – “Friendly name” assigned by the network operator and registered in the NMS database.
- Reset Params – Allows the operator the reset the remote units operating parameters to Factory Default values. Factory default parameters include:
 - Operating Mode – Relay
 - Channel Select Mode – Auto
 - TX Enable – Enabled
 - TX Diversity - Enabled

- TX Power - +20dbm
 - TX Channel1 – Automatically Selected
 - TX Channel2 – Automatically Selected
 - RX Diversity - Enabled
 - Audio Gain - 0db
 - Audio Delay – 0mSec
 - Audio Output – Left & Right
- Register Node – Allows the operator the register the node “over the air” after the node has been deployed.
 - GUID – Globally Unique ID embedded into the hardware of the ARX-900.
 - Radio Temperature – Internal temperature of the Relay unit.
 - Poll List – List of downstream nodes being polled by the Relay unit.

5.4.3.2 TX/RX Channel Select Mode

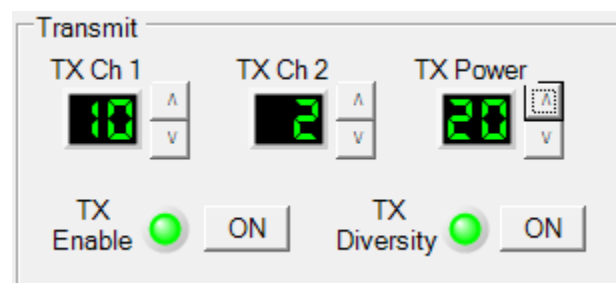


This control allows the operator to remotely select between Auto and Manual channel selection for the Relay node. ***Care must be taken when using Manual channel selection mode since the Relay unit will not automatically scan for a signal if its source signal channel is changed.*** When selecting Manual channel selection, the user should make a note of the channel currently selected for the Relay unit so that the unit can be “recovered” (i.e. manually changing the transmit channel of its uplink node to coincide with the manually selected receive channel of the “lost” downlink node).

5.4.3.3 Transmit Section

The Transmit section of the Relay Monitor Window includes the following functions:

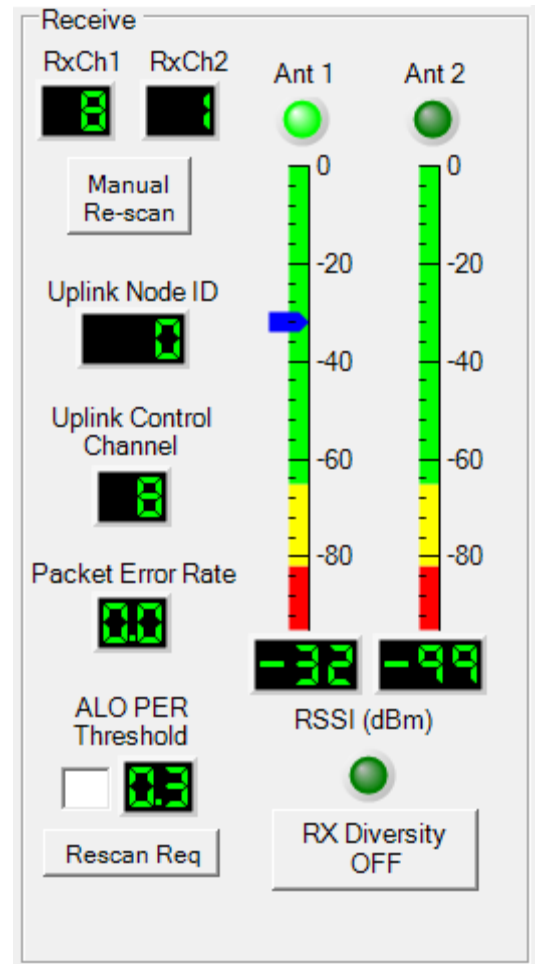
- TX Channel #1 - The channel currently used for the main downstream transmit signal of the Relay unit.
- TX Channel #2 - The channel currently used for the secondary downstream transmit signal of the Relay unit when TX Diversity is enabled.
- TX Power – Downstream and upstream transmit output power of the Relay unit. It is best to leave this setting at +20dbm.
- TX Enable – This controls allows the operator to turn off the downstream re-transmission of the unit’s received signal, thus making the unit a “receive-only” node. This may be desirable in densely packed venues when not all units are needed to provide adequate RF coverage.
- TX Diversity – Enables the ARX-900 to transmit on two channels simultaneously in order to avoid local interference. It is recommended to leave this enabled if there are enough operating channels available.



5.4.3.4 Receive Section

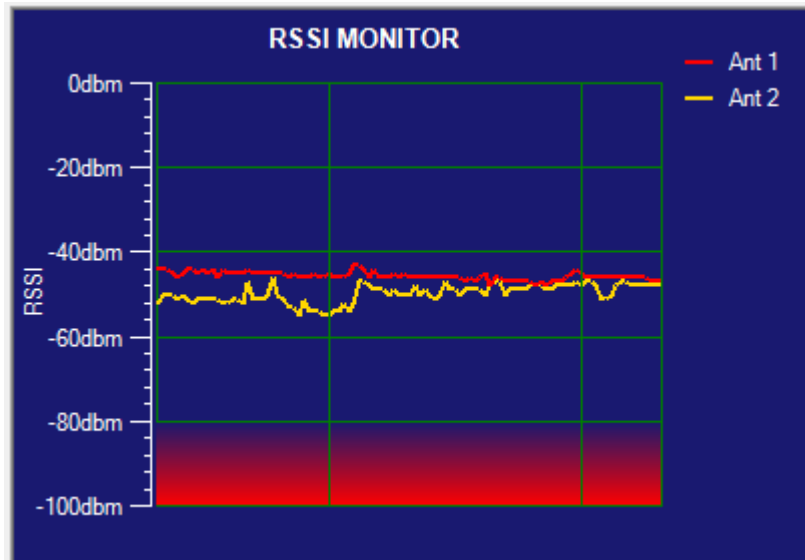
The receive section of the Relay Monitor Window includes the following functions:

- Receive Channel #1 – Indicates the primary receive channel of the Relay node.
- Receive Channel #2 – Indicates the secondary receive channel of the Relay node if Transmit Diversity is enabled in the upstream node.
- Manual Re-scan – Allows the operator to manually initiate a re-scan of the RF spectrum for a downstream signal from an uplink node. This may be desirable when a stronger downlink signal is available than the one currently being received by the Relay node.
- Uplink Node ID – Indicates the Network ID of the uplink node currently communicating with the selected Relay node.
- Uplink Control Channel – Indicates the uplink control channel being used for uplink control information.
- Packet Error Rate – Indicates the percentage of packets that were dropped over the past six second interval.
- ALO PER Threshold – ALO is not currently used in the ARX-900. It was initially used in the 2.4GHz version of the product and is not required in the 900 MHz version of the product.
- Rescan Req – Not used in the ARX-900.
- Ant1, Ant2 LEDs – If RX Diversity is enabled these LEDs indicate which antenna is currently being used by the receive section of the ARX-900. If RX Diversity is disabled, only Antenna #1 is used.
- RSSI – Receive Signal Strength Indicator – Shows the real-time receive signal level for each antenna. The ARX-900 automatically selects the stronger of the two signals when RX Antenna Diversity is enabled.



5.4.3.5 RSSI Plot

Displays a real-time plot of the current receive signal level on each antenna. Antenna 1 is plotted in red, and Antenna 2 is plotted in yellow. The ARX-900 automatically selects the stronger of the two signals when RX Diversity is enabled.



5.4.3.6 PER/RSA Plots

The PER plot (left-hand tab of this window) shows a real-time view of the Packet Error Rate of the selected Relay unit. The red line indicates the PER while the yellow line indicates the PER threshold used by the ALO function (ALO is not used in the ARX-900 product).

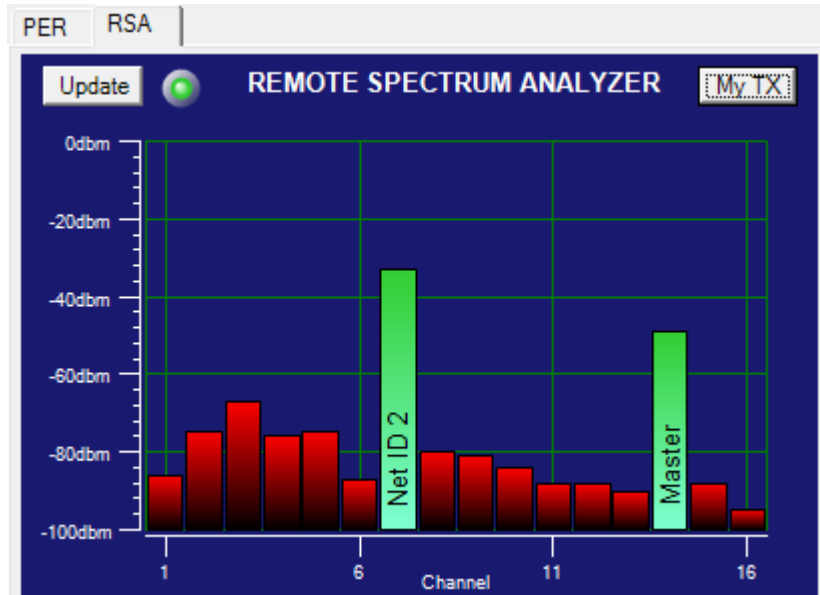


5.4.3.7 RSA (Remote Spectrum Analyzer) Plot

The RSA plot (right-hand tab of this window) shows the result of an RF scan of the local RF spectrum at the remote Relay location. When the RSA tab is selected the NMS will automatically initiate the RF scan, which takes about four seconds, and plot the results on this graph.

The user can also display the selected Relay's own uplink and downlink transmission channels by clicking the "My TX" button in the upper right. Clicking the "Update" button will initiate another RF spectrum scan.

The RSA function is very helpful during deployment to keep an eye on interference and AiRocks signal levels in the location of the remote Relay node.



NOTE: Performing the scan causes the Relay unit to temporarily stop receiving the RF signal from its uplink source, which in turn causes any downstream nodes to lose their uplink signal for the duration of the scan. RSA should NOT be performed during the event.

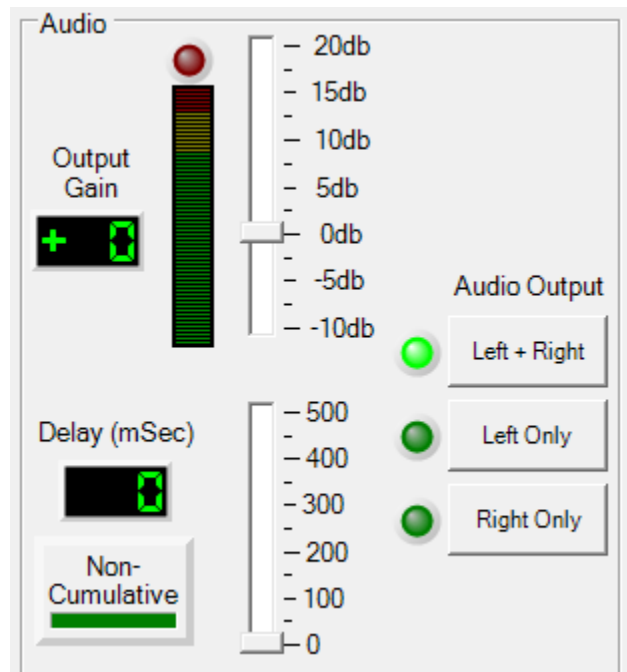
5.4.3.8 Audio Section

The Audio Section of the Relay Monitor window includes the following functions:

- Output Gain – Gain setting for the audio output of the XLR output connector of the selected Relay node.

Note that the audio system gain from Master input to Relay output is -6db. This allows the Master input and Relay output to clip at the same audio level. If you prefer 0db of system gain, set this Relay Output Gain to +6db and keep in mind that the Relay output will clip BEFORE the Master input.

- Delay – Audio delay added to the audio signal as it leaves the Relay unit (0 – 500 milliseconds).



Note that there is a base latency from Master audio input to Relay audio output of ~30mSec. This is in addition to the Delay added by this control.

- Cumulative/Non-cumulative – Selects whether the audio delay is added only to the audio signal sent out of the local XLR connector (non-cumulative), or whether the delay is also added to the RF signal relayed to a downstream node (cumulative).
- Audio Output Configuration – Selects the configuration of the XLR audio output connector (see Audio Configurations section for details).

5.5 SPECTRUM ANALYZER MODE SCREEN

Any AiRocks unit can be used as a Spectrum Analyzer when not being used as a Master or Relay unit. In fact, it may be desirable to dedicate a spare AiRocks unit as a Spectrum Analyzer for an event to give an added measure of security knowing where the interfering sources are, and to monitor the transmission of the Master and nearby Relay unit(s).

The screen below shows the Spectrum Analyzer mode. Transmissions from the Master and any Relay units are shown in green. Interference is shown in red. The spectrum is divided into 10 discrete channels which are used by the ARX-900. The blue horizontal indicator lines show peak signal levels in the channel, while the white indicators show a 10 second average of the signal power in the channel. These indicators can be reset by pressing the “Reset Peaks” button in the upper left.

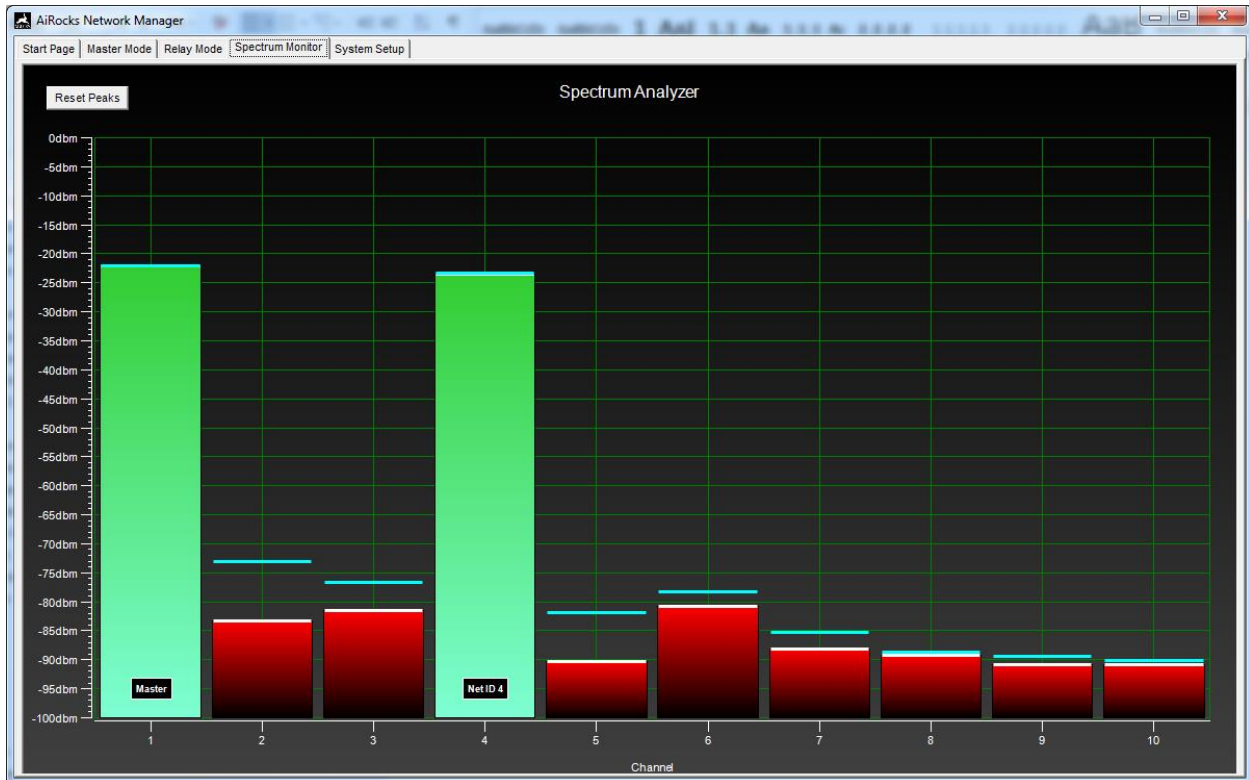


Figure 17 Spectrum Analyzer Mode

5.6 RELAY MODE SCREEN

This screen is used when the operator wishes to directly attach to a Relay unit within the network via the Breakout Box. The screen gives the same information and controls of the Relay Monitor window discussed above.

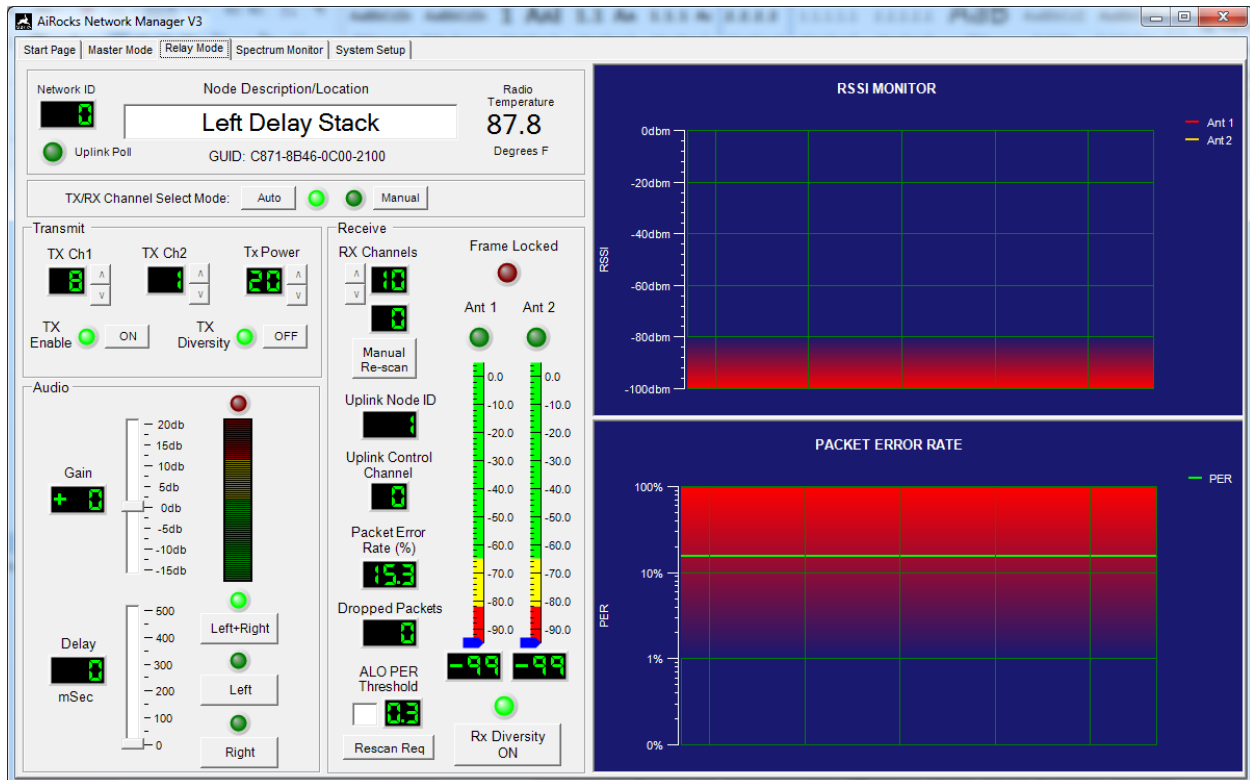


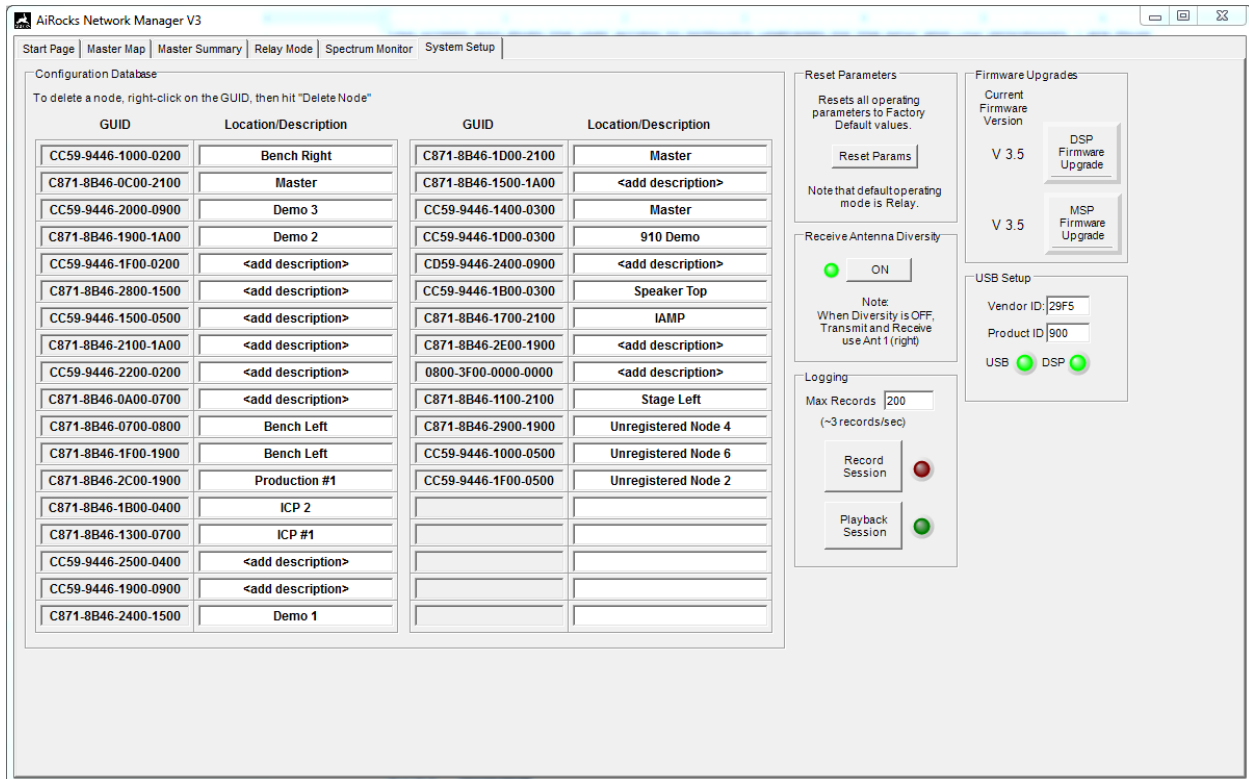
Figure 18 Relay Mode Window

5.7 SYSTEM SETUP SCREEN

The System Setup Screen displays the NMS Configuration Database entries of each of the registered nodes and their user-assigned friendly name. To delete node entries from the database, right-click on the node and hit delete.

This screen also gives the user access to firmware upgrades for the MSP and DSP processors. Care must be taken when performing firmware upgrades not to remove power or the USB cable during the process.

Factory Parameter Reset and Receive Antenna Diversity can also be controlled from this screen.



5.7.1 Logging and Playback

The Logging section of the System Setup screen allows the user to Log (Record) all of the polling information received by the NMS. This is useful for debugging or troubleshooting since a log file is created which can be sent to AirNetix for examination.

5.7.1.1 Recording

The process starts by setting the "Max Records" to a value between 10 and 10,000. Each record represents either a connection request or poll response from Relay units. Polls are sent out by the NMS at a rate of 300ms per poll. Therefore 200 records represent about 60 seconds of network polling.

Once the Max Records value is entered, hit the "Record Session" button. A screen will pop up asking you to name the log file. You can save this file anywhere on your computer. Once the file is given a name, close this window. This arms the NMS for recording and the red LED will flash.

Now switch to the Master screen to start the recording session. While in the Master screen, you will see the red “Recording” LED flashing, indicating that poll responses are being logged and the number of records in the log file. You can either stop the recording by leaving the Master screen, or let the recording continue until the Max Records have been logged. You can capture as many log files as you want by giving them different names.

5.7.1.2 Playback

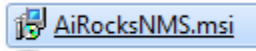
Once you have captured a log file it can be played back by hitting the Playback Session button in the System Setup screen. After you hit the button a window will pop up asking you to select the file for playback. Select the file and switch to the Master screen to view the file in progress. During playback the Relay Monitor window for each Relay node will be active for viewing (double-click a node to view its Relay Monitor window). You can see all of the collected parameters including RSSI, dropped packets, TX power level, etc.

You can allow the playback to continue until the end of the file or you can leave the Master screen to terminate playback.

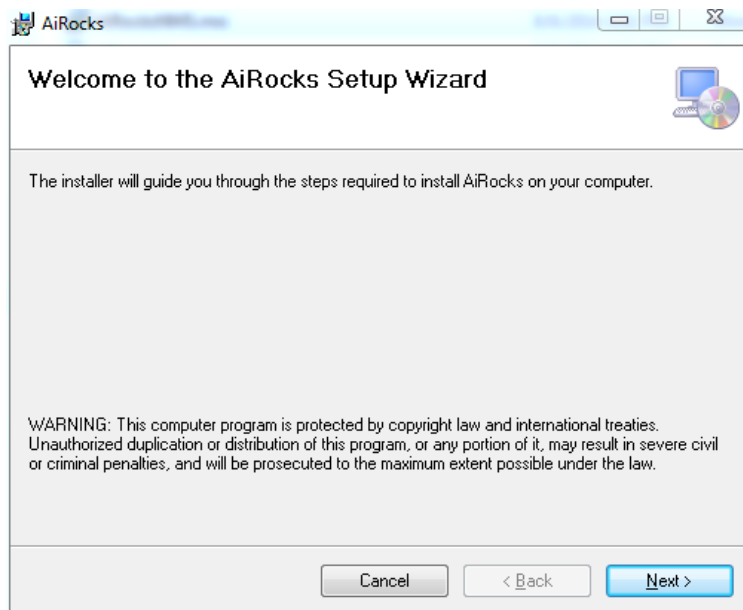
5.7.2 Installing the Network Management System software

The AiRocks Pro NMS runs on a PC (not a Mac) with either Windows XP or Windows 7 operating system. The PC must be configured with .NET 4 or greater. No other special drivers are required.

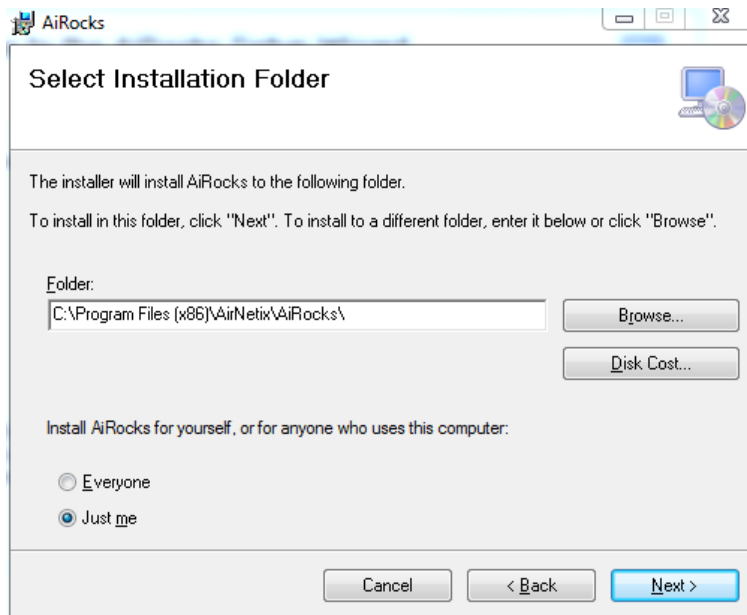
To install the AiRocks NMS click on the AiRocksNMS.msi icon.



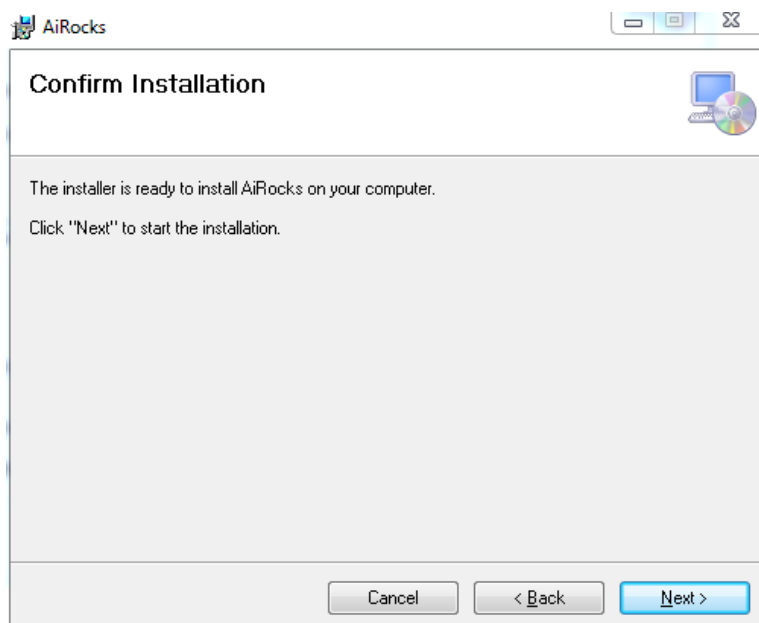
A welcome screen will appear. Click Next.



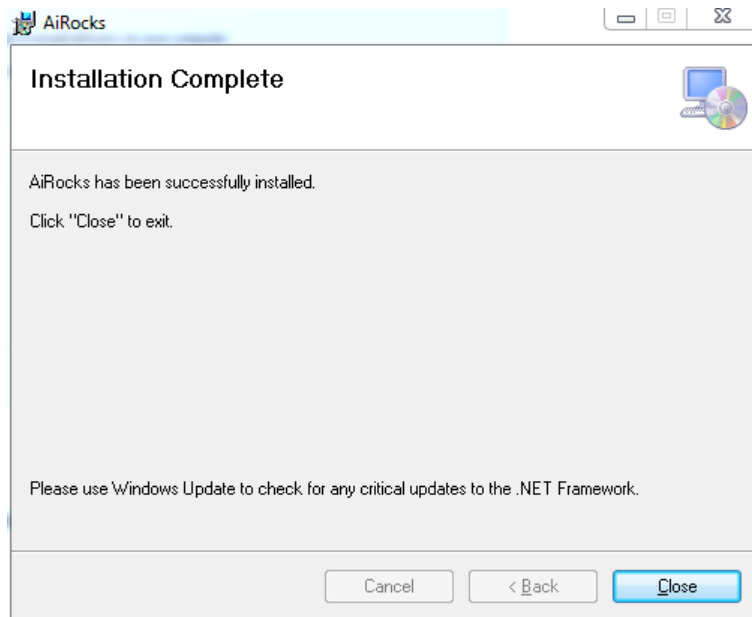
The following screen gives you the opportunity to change the installation location folder. Leave this at the default folder location.



Click Next to confirm installation.



After installation, click Close.



To begin using the NMS, click the AiRocks NMS icon on your desktop.



6 FIRMWARE UPGRADES

Version 3.x is a major upgrade for the AiRocks Pro system. It includes upgrades to the Network Management System software, as well as the DSP and MSP firmware. It includes many enhancements, bug fixes, and several major new features.

ALL THREE (Network Management System software, DSP firmware, and MSP firmware) MUST BE UPGRADED TO VERSION 3 FOR PROPER OPERATION OF THE AIROCKS PRO SYSTEM.

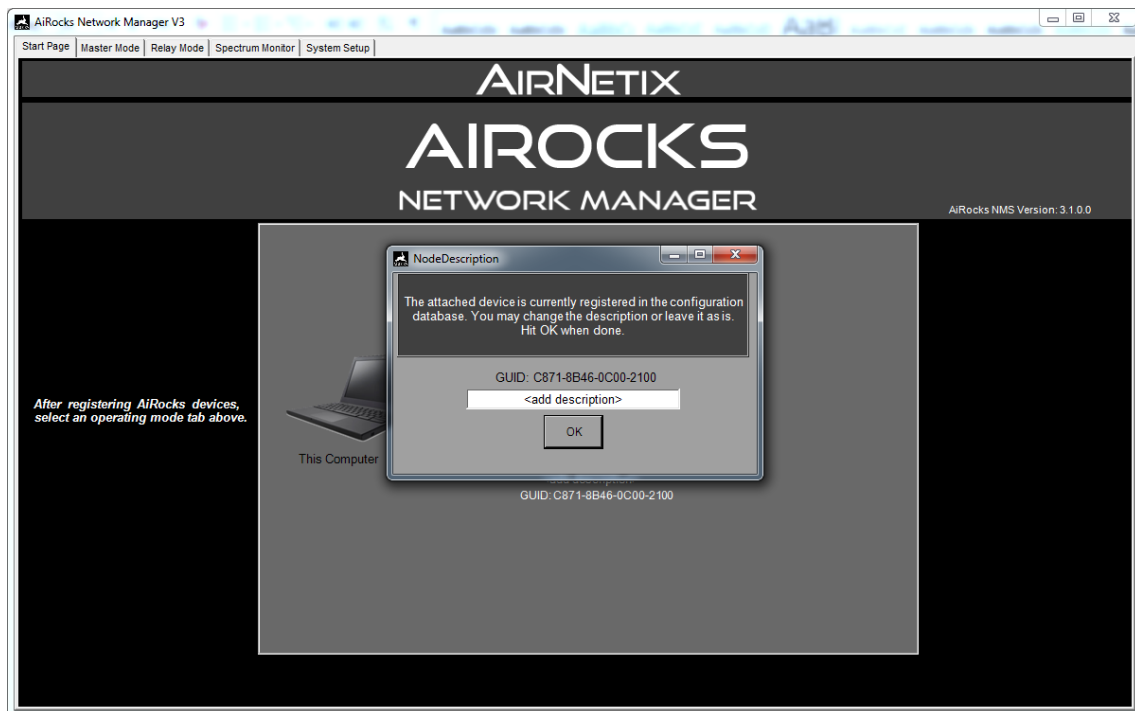
1. Start by removing any V1 or V2 Network Management System application software from your PC. Then install the AiRocks Pro NMS V3.x application software included with this upgrade file.
2. After installing the V3 NMS application, use the NMS application to:
 - a. Install the MSP V3 firmware first.
 - b. Then, install the DSP V3 firmware.

NOTE: ALL OF YOUR ARX-900 RADIOS MUST BE UPGRADED TO V3 FIRMWARE BEFORE DEPLOYING THE SYSTEM. RADIOS THAT RUN V2 FIRMWARE WILL NOT INTEROPERATE WITH RADIOS RUNNING V3 FIRMWARE.

6.1 ARX-900 MSP FIRMWARE V3.X UPGRADE PROCEDURE

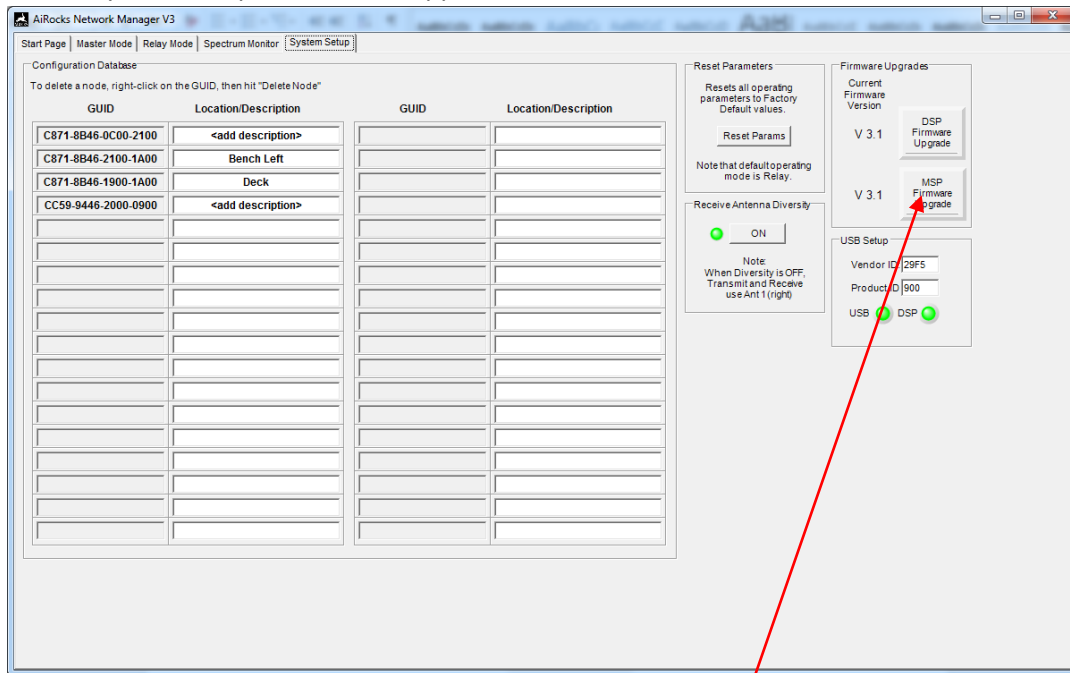
The AiRocks Pro includes two separate processors, the MSP (microprocessor) and the DSP (digital signal processor). This upgrade is for the MSP only.

1. Unzip the firmware upgrade file to your PC. The zip file contains one file:
 - a. ARX900_MSPFW_V3.x.TXT (MSP upgrade file).
2. Apply power to the Breakout Box (BOB).
3. Connect the PC to the BOB via USB cable.
4. Connect Cat5 from BOB to ARX-900. Verify that power has been applied to the radio (LCD screen illuminated).
5. Start NMS application on your PC. The NMS will initially show the Start Page. If the NMS has discovered the attached radio, the Node Description window will appear as shown below. If the Node Description window does not appear, re-check you power and Cat5 connections.

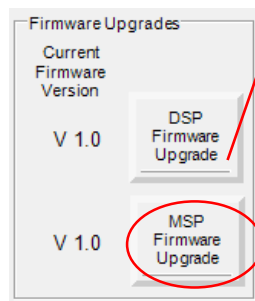


6. Click OK to dismiss the Node Description window.

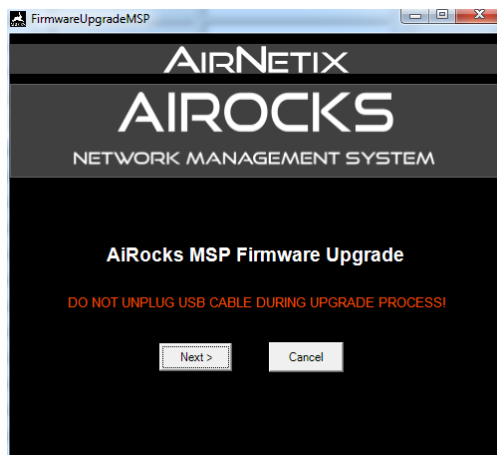
7. Go to “System Setup” tab in NMS application.



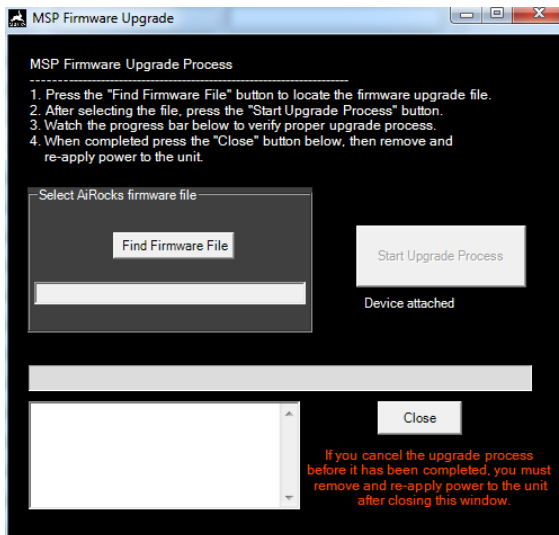
8. Click on the “MSP Firmware Upgrade” button.



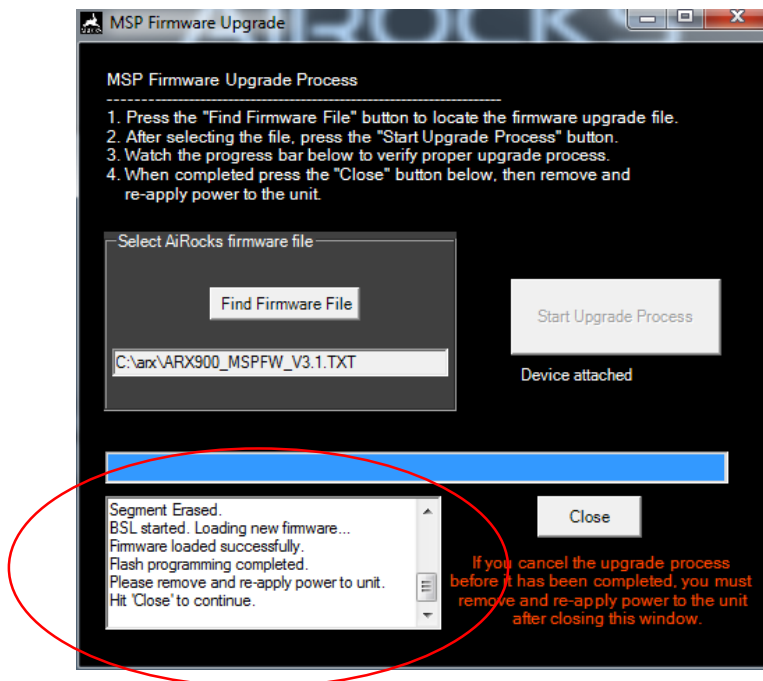
9. The following window will pop up.



10. Click on “Next”.
11. After a brief pause, the following window will pop up.

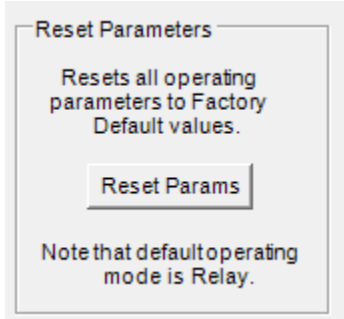


12. Click on “Find Firmware File” and navigate to the file named “ARX900_MSPFW_V3.x.TXT”
13. Click on “Start Upgrade Process”. You will then see the blue progress bar indicating the firmware is loading.
14. After a few seconds, you will see the following information indicating that the firmware has been successfully installed.



15. Click “Close” to dismiss this window.

16. You must now remove power from the ARX900 and then reapply power to complete the MSP firmware upgrade process.
17. After performing a firmware upgrade it is a good idea to reset all saved operating parameters to the Factory Default values. This can be done by navigating back to the System Setup screen and pressing the Reset Parameters button and hitting “Yes” when you are asked “Are you sure?”.

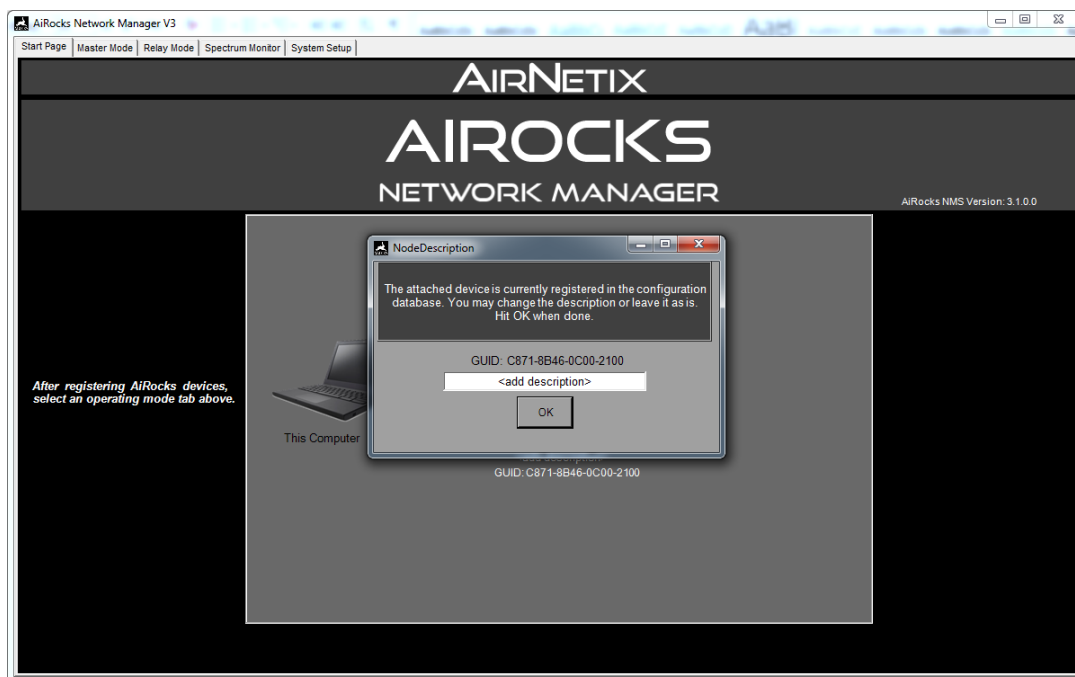


18. The firmware upgrade process is now complete

6.2 ARX-900 DSP V3.x FIRMWARE UPGRADE PROCEDURE

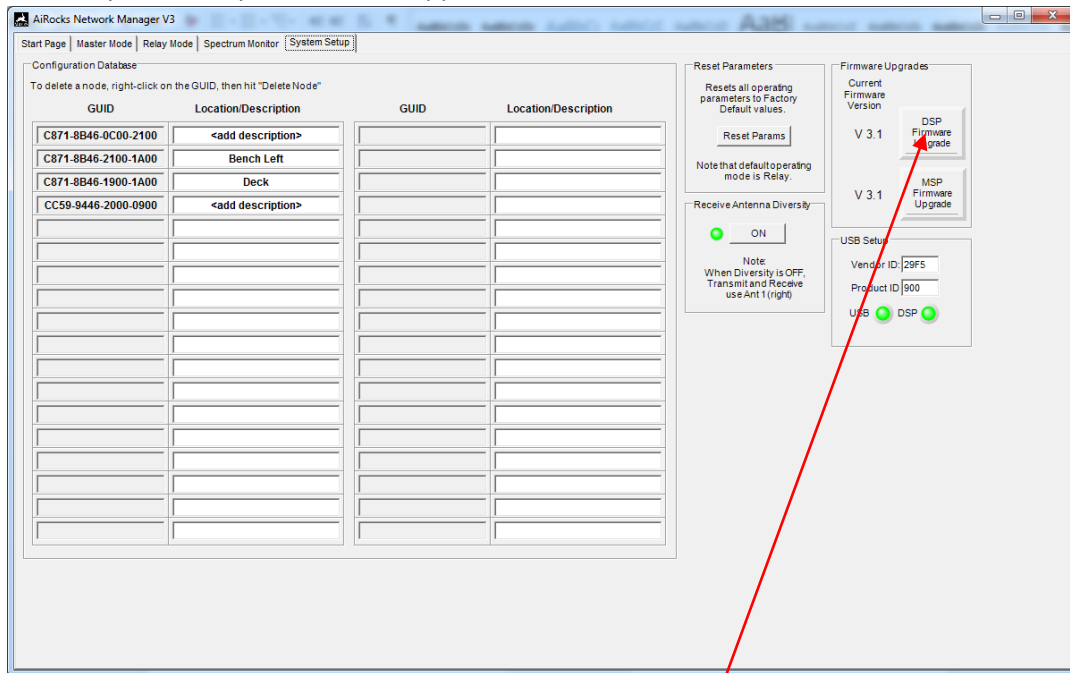
The AiRocks Pro includes two separate processors, the MSP (microprocessor) and the DSP (digital signal processor). This upgrade is for the DSP only.

1. Unzip the firmware upgrade file to your PC.
 - a. ARX900_DSPFW_V3.Xe.bin (DSP upgrade file).
2. Apply power to the Breakout Box (BOB).
3. Connect the PC to the BOB via USB cable.
4. Connect Cat5 from BOB to ARX-900. Verify that power has been applied to the radio (LCD screen illuminated).
5. Start NMS application on your PC. The NMS will initially show the Start Page. If the NMS has discovered the attached radio, the Node Description window will appear as shown below. If the Node Description window does not appear, re-check you power and Cat5 connections.

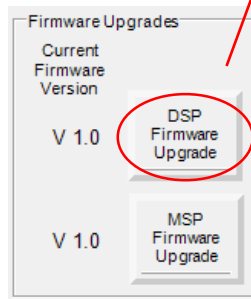


6. Click OK to dismiss the Node Description window.

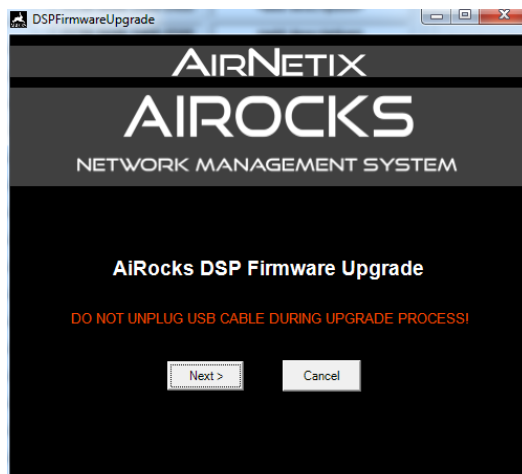
- Go to “System Setup” tab in NMS application.



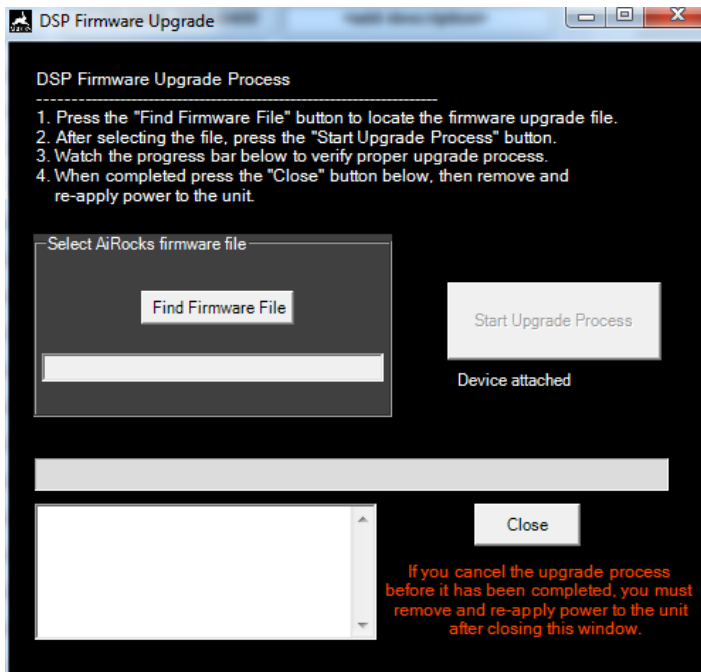
- Click on the “DSP Firmware Upgrade” button.



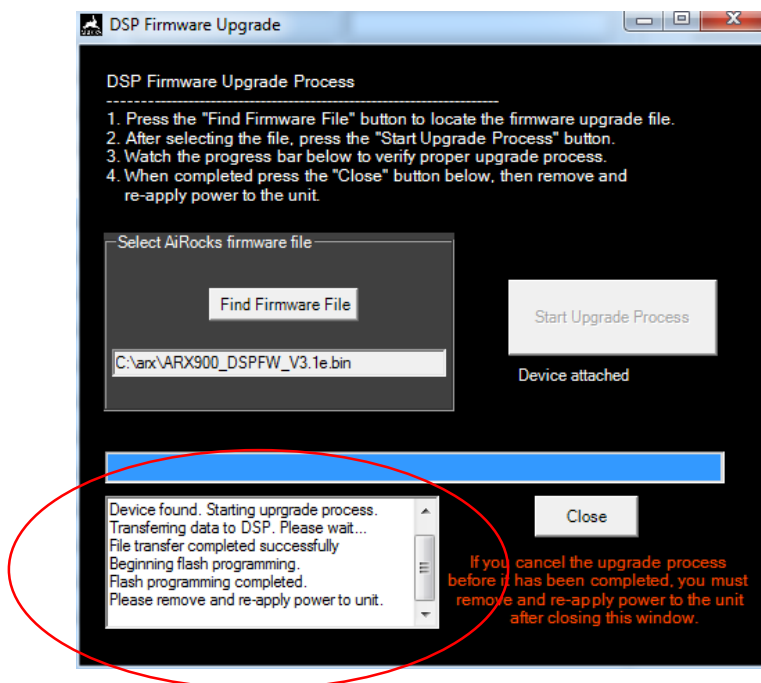
- The following window will pop up.



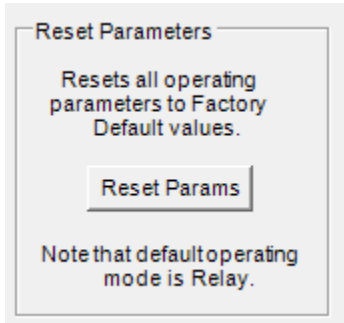
10. Click on “Next”.
11. After a brief pause, the following window will pop up.



12. Click on “Find Firmware File” and navigate to the file named “ARX900_DSPFW_V3.Xe.bin”
13. Click on “Start Upgrade Process”. You will then see the blue progress bar indicating the firmware is loading.
14. After approximately two minutes, you will see the following information indicating that the firmware has been successfully installed.



15. Click “Close” to dismiss this window.
16. You must now remove power from the ARX900 and then reapply power to complete the DSP firmware upgrade process.
17. After performing a firmware upgrade it is a good idea to reset all saved operating parameters to the Factory Default values. This can be done by navigating back to the System Setup screen and pressing the Reset Parameters button and hitting “Yes” when you are asked “Are you sure?”.



18. The firmware upgrade process is now complete

7 DEPLOYING AND MANAGING A NETWORK

Deploying an AiRocks network is similar to deploying any other RF network. It takes careful planning and close attention to interference sources, path distances, and link-of-sight positioning. The AiRocks Network Management System gives the operator a variety of tools to accomplish the planning and successful deployment of a well performing network. By using these tools the network operator can establish a strategy for deployment in even the most challenging venues.

7.1 NODE REGISTRATION

Register each AiRocks unit in the NMS database

It is recommended that you register each AiRocks unit in the NMS database before deployment. During this process, and with knowledge of the venue layout, “friendly names” can be assigned to each unit. This will help keep track of the location of each unit, especially if names like “Rear Tower” or “Stage Right” are used.

7.2 CHANNEL SELECTION MODE

Decide on whether Auto or Manual Channel Selection is to be used.

By far the simplest way to deploy an AiRocks network is to leave all Relay units in the “Auto” channel selection mode on all Relay units. This will allow Relay units to automatically select the best channels for both transmitting and receiving.

However, fully automatic channel selection may not always be the best choice. For example, if Relay units are close together in a “dense” deployment, it may be desirable to manually choose channels for each Relay unit based on the receive signal level of the nearest uplink. It may also be desirable to disable the Transmit function of some Relay units if there is no need for their transmit signal (i.e. no downstream nodes). This way there is no crowding into the channels showing the least local interference.

7.3 FREQUENCY SCAN

Perform a frequency scan of the local RF environment.

Use the Spectrum Analyzer screen to determine the level of RF interference in the local area. In most cases there will be some level of interference in some portion of the band. However, in most outdoor environments this interference will be limited to one or two sections of the band, and/or will be much lower in level than indoor environments. With 10 available channels, AiRocks typically has no problem finding suitable RF spectrum in most venues.

7.4 TRANSMIT DIVERSITY

Enable Transmit Diversity

Enable Transmit Diversity if there are enough available RF channels. This will help reduce the effects of any local interference.

7.5 MOUNTING POSITION

Mount the AiRocks units in an optimum position

As mentioned earlier, it is best to establish good line-of-sight between nodes. Mount the radios 12 – 15 feet above ground for best performance. People, trees, buildings, and any other solid object can affect useable range of the AiRocks units.

7.6 SIGNAL LEVELS AND FADING

You should target having a receive signal level of -65dbm or better before the event. This will allow for multi-path fading that happens when “people show up”. Fades of 10 – 15db or greater can occur due to moving bodies in an around the signal path between radios. Having the radios at 15 feet above ground can all but eliminate this multi-path fading.

7.7 DEPLOYMENT SEQUENCE

Deploy units in sequence

It is helpful to set up and turn on the Master unit before beginning the deployment of Relay units. This will allow you to check signal and interference levels as you deploy Relay points. It is also helpful to deploy Relay units starting closest to the Master and working your way “downstream”, while checking receive signal level and interference at each Relay location.

7.8 REMOTE SPECTRUM ANALYZER (RSA)

Check RSA functions.

It is a good idea to perform a few RSA scans during deployment to keep an eye on the local spectrum conditions at each Relay point. But, as mentioned previously, performing an RSA will take the unit off-line for ~4 seconds causing all downstream nodes to re-scan and re-acquire in uplink signal. RSA should NOT be performed during the event.

7.9 DC POWER

Use DC battery pack if AC is not available

AirNetix offers an optional DC battery pack which will allow you to position Relay units in the field before AC power is available (a common problems in large outdoor deployments). The DC battery pack will power the AiRocks unit for up to 12 hours and will allow the installer to fully test the unit transmit and receive functions.

8 SYSTEM SPECIFICATIONS

ARX-900 System Specifications (V3)			
Audio			
Number of Audio Channels	2	Stereo or Mono	
Frequency Response	20Hz to 15.6KHz +1db/-3db		
Max Input Level (Master mode)	+14.1dbu	Balanced Mono	
	+8.1dbu	Unbalanced Stereo	
	+8.1dbu	Unbalanced Mono	
Max Output Level (Relay mode)	+8.1dbu	Balanced Mono	
	+2.1dbu	Unbalanced Mono	
	+2.1dbu	Unbalanced Mono	
System Gain	-6db	Input and output clip at same audio level with 0db gain settings	
Noise Floor	-90dbu	Balanced Output	
Input and Output Connectors	XLR balanced or unbalanced	Input and Output	
Delay	17mSec	Master Input/Encode	
	13mSec	Relay Decode/Output	
	30	Master Audio Input to Relay Audio Output	
	2mSec	Relay Thru Hop Delay	
	0-500mSec	User added delay	
RF			
Frequency Band	902 – 928 MHz	License free ISM Band	
Operating Channels	10 channels @ 2 MHz intervals	Carrier center frequency from 906 to 924MHz	
Max output power	+20dbm	Into the antenna port	
Diversity	Transmit	Transmits on two channels simultaneously	
	Receive	Receives on two antennas and selects the strongest signal	

	Range	>1000 feet typical	Unobstructed Line of Sight with standard 2dbi TX and RX antennas and no interference
		>1800 feet typical	Unobstructed Line of Sight with optional 6dbi Yagi TX and RX antennas and no interference
	Antennas	2 ea. 2dbi dipole standard	Spatial diversity
		6-14dbi Yagi optional	
	Antenna Connectors	N-type	Male on antenna, Female on ARX-900
	Regulatory Approvals	FCC Part 15.247	FCC ID: 2AB8BARX900
		Industry Canada RSS-210	IC: 11944A-ARX900
	AC Power		
	Input Voltage Range	80-305VAC or 110-430VDC	
	Input Frequency	47-440Hz	
	Max Input Current	70mA / 45mA typ.	
	DC Power		
	Nominal Input Voltage	+12VDC	
	Maximum Input Voltage	+17VDC	
	Minimum Input Voltage	+7VDC	
	Power Consumption	~2 Watts	
	Environmental		
	Operating Temperature	0 to 65 degrees C	
		32 to 150 degrees F	
	Water and dust intrusion	Water falling as a spray at any angle up to 60° from the vertical shall have no harmful effect.	

*Specifications are subject to change without notice.

9 WARRANTY

9.1 LIMITED ONE YEAR WARRANTY

The equipment is warranted for one year from date of purchase against defects in materials or workmanship. This warranty does not cover equipment which has been abused or damaged by careless handling or shipping. This warranty does not apply to used or demonstrator equipment. Should any defect develop, AIRNETIX, LLC. will, at our option, repair or replace any defective parts without charge for either parts or labor. If AIRNETIX, LLC. cannot correct the defect in your equipment, it will be replaced at no charge with a similar new item. AIRNETIX, LLC. will pay for the cost of returning your equipment to you. This warranty applies only to items returned to AIRNETIX, LLC. or an authorized dealer, shipping costs prepaid, within one year from the date of purchase. This Limited Warranty is governed by the laws of the State of Georgia. It states the entire liability of AIRNETIX LLC. and the entire remedy of the purchaser for any breach of warranty as outlined above. NEITHER AIRNETIX, LLC. NOR ANYONE INVOLVED IN THE PRODUCTION OR DELIVERY OF THE EQUIPMENT SHALL BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, CONSEQUENTIAL, OR INCIDENTAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THIS EQUIPMENT EVEN IF AIRNETIX, LLC. HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL THE LIABILITY OF AIRNETIX, LLC. EXCEED THE PURCHASE PRICE OF ANY DEFECTIVE EQUIPMENT.

10 FCC STATEMENTS

Warning: Changes or modifications to this device not expressly approved AirNetix, LLC could void the user's authority to operate the equipment.

10.1 CLASS A DEVICES:

NOTE: 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.

10.2 RF EXPOSURE AND SAFETY INFORMATION

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance **30cm** between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

11 INDUSTRY CANADA SPECIFIC STATEMENTS:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

This radio transmitter **11944A-ARX900** has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio **11944A-ARX900** a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

- 2 dBi dipole - N-Male Connector
- 14 dbi Yagi – N-Male Connector

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

