

# **CITY THEATRICAL**

**NEW YORK • LONDON**

## **RadioScan™ Spectrum Analyzer**

**P/N 5988**

### **User's Manual**

Rev 0.9

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# 1 Foreword

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## 1.1 Safety Notice

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This product is designed for use in dry locations only. Exposure to rain or moisture may cause damage.

# 2 Compliance Requirements

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The 5988 is compliant to the following standards:

- CE: EMC Directive of EU 2014/30/EU  
Low Voltage Directive if EU 2014/35/EU
- FCC: CFR 47 Part 15 Subpart B, Class B
- IC: ICES-003 (Issue 6), Class B

## 2.1 FCC Compliance Statement (United States)

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This device complies with Part 15 of the Federal Communications Commission (FCC) Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference; and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

## 2.2 IC Statement

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This device complies with Industry Canada's license-exempt RSSs. 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.

### 3 Introduction

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RadioScan is a 900MHz and 2.4GHz spectrum analyzer (includes a RadioScan hardware dongle and accompanying free RadioScan software) that enables you to easily visualize radio energy that is otherwise invisible to you. Using RadioScan helps you to create a broadcast plan that optimizes available spectrum in your area, and helps prevent interference with other mission critical radio devices near you.

RadioScan shows all radio activity near you in your chosen frequency, including frequency hopping gear like wireless DMX, as well as Wi-Fi networks, Bluetooth, wireless headsets, video transmitters, cordless phones, baby monitors, and microwave ovens. RadioScan can view spectrum data either in Spectrogram view or Waterfall view, notes can be added, and snapshots can be taken and saved. Scans of any length can be recorded, saved, and emailed, and can be played back and reviewed by others with just the free RadioScan software, without the need for the RadioScan hardware dongle.

By identifying SSIDs, broadcast channel, and the signal strength of wireless networks, RadioScan can help IT departments setup, maintain, and troubleshoot their wireless installations.

For users of City Theatrical Multiverse® wireless DMX/RDM products, RadioScan will guide you in creating the optimum broadcast plan for your production by helping choose the best SHoW ID based on the number of universes being broadcast and the best area of the spectrum on which to broadcast.



RadioScan is compatible with both PC and MAC computers. RadioScan software is available as a free download at: <http://www.citytheatrical.com/Products/radioscan> (Scroll down to the Downloads tab)

#### 3.1 Features

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- 900MHz and 2.4GHz spectrum analyzer with dual band antenna
- Finds all radio activity nearby in chosen spectrum
- Identifies SSID (network name) and RSSI (signal strength) of Wi-Fi networks
- Shows either Spectrogram or Waterfall view
- Can record and play back scans of unlimited length using free RadioScan software
- Takes and saves snapshots
- Records notes onto scans
- Guides users in choosing Multiverse SHoW IDs
- Compatible with PC and Mac computers (USB to USB-C cable provided)

## 5988 RadioScan Spectrum Analyzer

### 3.2 Part Number

*Table 1: Part Number*

Part #	Description
5988	RadioScan™ Spectrum Analyzer

# 5988 RadioScan Spectrum Analyzer

## 3.3 Product Detail

Top/bottom diagram shown to scale.



Figure 1: Product Top, Bottom and Side

## 4 Specifications

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Table 2: Physical Characteristics

Specifications	Description
Frequency	902-928MHz and 2.4-2.483GHz
Size (not including antenna)	Length: 2.0" (50mm) Width: 2.0" (50mm) Height: 0.5" (12.7mm)
Antenna	Detachable external omnidirectional broadband, 2dBi 900MHz, 4dBi 2.4GHz
Construction	NEMA 4 IP20 ABS Plastic
Power/Data Connector	USB-C with 1m (39.37") USB-A to USB-C cable

Computer Requirements	
Operating System	Windows 10 / Mac OS 10.15 or higher
Display resolution	800x600
Wi-Fi Radio	Internal or USB Wi-Fi adaptor
USB Port	1.1 or higher
RAM	4GB

Product Information	
Configuration	City Theatrical RadioScan software program
Use Environment	Indoor
Warranty	One year
Compliance	FCC / IC / CE / RoHS

## 5 Using RadioScan

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### 5.1 Download RadioScan Software

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Go to <http://www.citytheatrical.com/Products/radioscan> (Scroll down to the Downloads tab) to download the free RadioScan software program.

### 5.2 Plug In RadioScan Dongle

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Attach the 1m USB to USB-C cable from the RadioScan dongle to your computer.

### 5.3 Run RadioScan Software

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Find and open the RadioScan software program on your computer. It will recognize your RadioScan dongle and will begin a 2.4GHz scan.

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## 5.4 RadioScan Dongle Indicator Lights

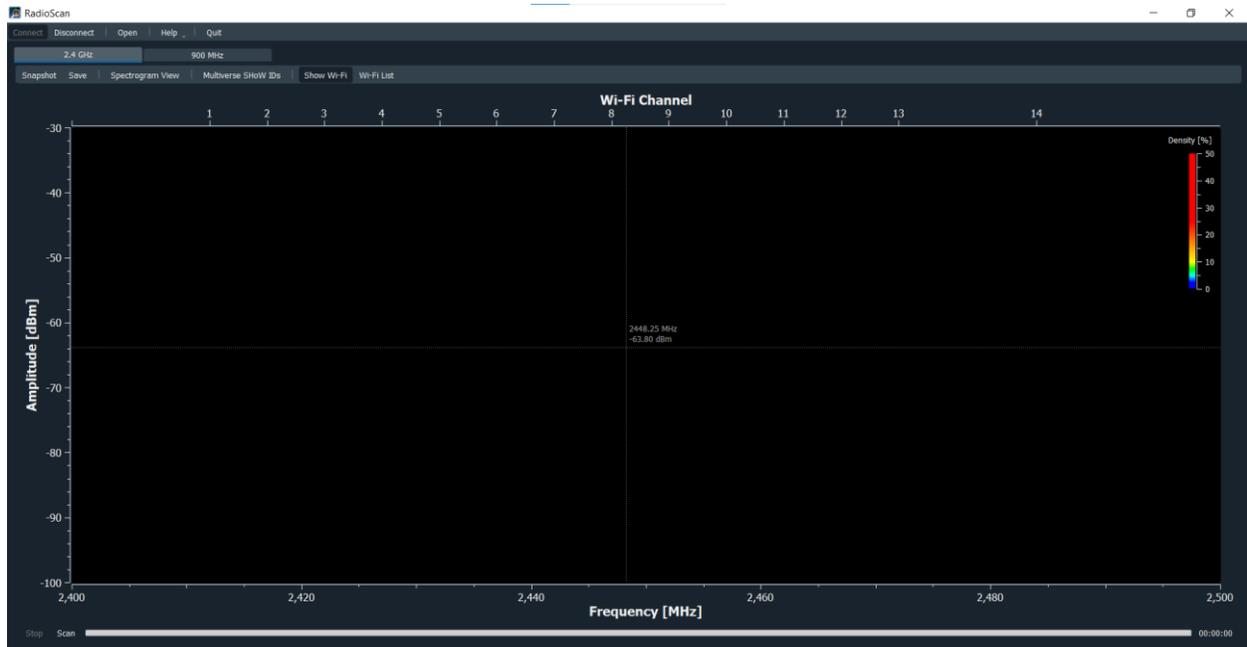
The RadioScan dongle has one multicolor LED indicator light that can inform you of various functions, as follows.

*Table 3: LED Indicator Light Colors*

<b>Red</b>	Powered, no connection to computer
<b>Green</b>	Powered and connected to computer
<b>Blue</b>	Powered, connected and application is connected
<b>Flashing Blue</b>	Powered, connected, application is connected and scanning
<b>Magenta</b>	Dongle is updating firmware

## 5.5 Screen View

By default, when you open the RadioScan software application, you will see this screen:



Frequency is shown on the X-axis on the bottom of the screen, and Wi-Fi channels are shown on the X-axis on the top of the screen. Amplitude is shown on the Y-axis on the left side of the screen.

A cross hair travels with the cursor showing frequency and amplitude at any point on the screen.

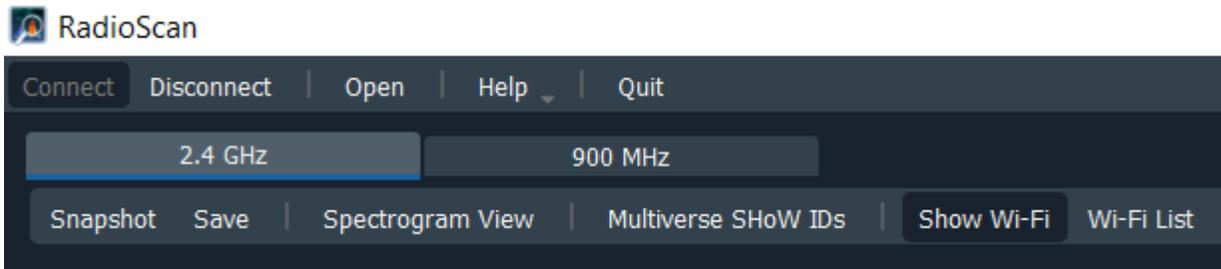
A 2.4GHz scan starts automatically when the program is opened and a RadioScan dongle is found, and Wi-Fi networks are shown by default.

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## 5.6 Other Controls

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Top of screen controls:



### Connect

Connects RadioScan dongle to RadioScan program.

### Disconnect

Disconnects RadioScan dongle from RadioScan program.

### Open

Opens a saved RadioScan recording.

### Help

**-User Manual** Provides a link to the 5988 RadioScan product manual

**-Update Firmware** Asks the location of the firmware that will be used for the update, and initiates a firmware update.

**-About** Provides License Information related to the RadioScan program

### Quit

Quits the RadioScan software program.

### 2.4GHz

Selects the 2.40-2.483GHz portion of the spectrum to scan.

### 900MHz

Selects the 902-928MHz portion of the spectrum to scan.

### Snapshot

Takes a snapshot of the current screen, and prompts for a location to save. Scan does not need to stop to take a snapshot.

### Save

Saves a recording of the current scan, and prompts for a location to save. Scan must stop before saving.

### Spectrogram View/Waterfall View

Toggles between Spectrogram view and Waterfall View of spectrum scan.

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### Multiverse SHoW IDs

Opens a table that shows the relationship of Multiverse SHoW IDs to the spectrum, and helps to choose the optimum area of the band to broadcast on. See pages 11-13 for complete information.

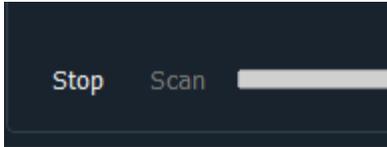
### Show Wi-Fi

Shows location of Wi-Fi networks nearby and identifies their Wi-Fi channel, SSID (name) and RSSI (signal strength).

### Wi-Fi List

Displays a table of Wi-Fi networks found, including their Wi-Fi channel, SSID (name) and RSSI (signal strength). List can be undocked, dragged to another location, and expanded.

### Bottom of Screen



### Scan

Starts a new scan.

### Stop

Stops a scan. After stopping, scans can't be restarted, so save the scan if a record is required.



### Scan Time

Scan time is shown in the lower right hand corner of the screen.



### Scan Bar

The Scan Bar tracks the course of the scan across the screen. The scan can be rewound to view previous events by pulling the Scan Bar to the left (the scan continues to record), and the scan resumed by pulling it back to the right.

## 5.7 Spectrogram View

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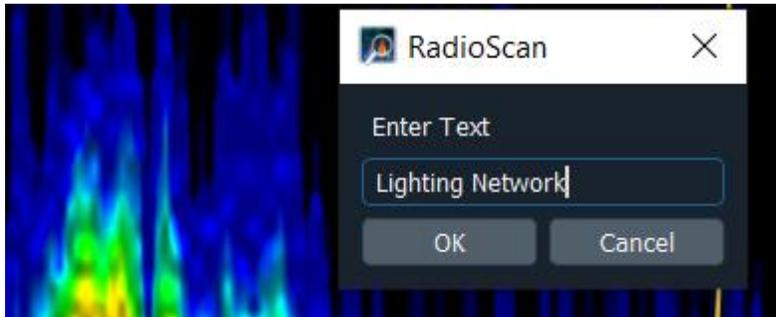
The default view of the RadioScan program is the Spectrogram View. The Y axis represents the amplitude of the radio energy on any frequency across the X axis.

Although the Spectrogram is two dimensional, color provides a third dimension of analysis. The

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color of the Spectrogram describes the accumulation of radio energy on a given frequency over the most recent two minute period. Blue designates a low amount of energy, often energy broadcast for only brief periods, and means the frequency is utilized less than 10% of the time. Green designates the frequency is being used 20-30% of the time, yellow means 30-50% of the time, and red shows the frequency is being used more than 50% of the time during the previous two minutes.

When analyzing the RadioScan data and looking for a suitable place to put your broadcast, look for areas of the Spectrogram View with more blue and less red.



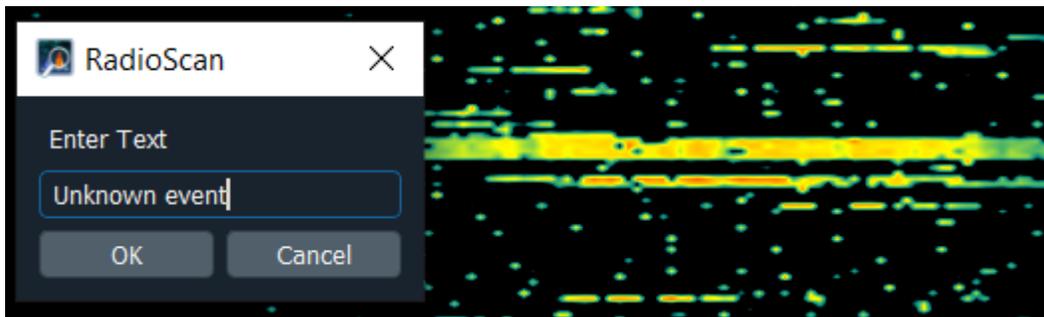
Notes can be added in Spectrogram View. Place your cursor at the spot you want to add a note (anywhere on the screen) and left click your mouse. Enter a note of unlimited length. Click OK and the note will be pinned to the screen starting at the point of your mouse click.

Multiple notes can be added this way at various locations on the screen. If a recording of the scan is saved, the note will appear in the entire recording. Left click on an existing note to edit. Right click on an existing note to delete.

### 5.8 Waterfall View

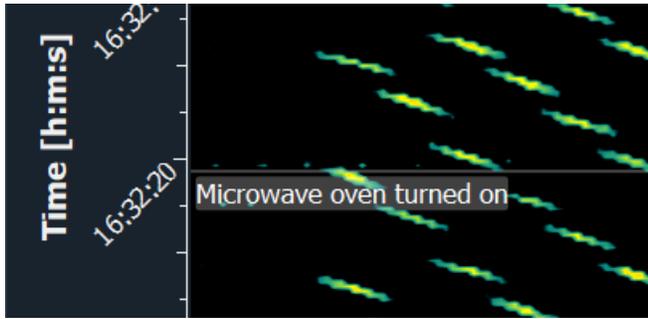
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Radio activity can vary over time. Devices can be turned on and off that can affect your own radio signal. Using Waterfall View allows you to roll back time to see the moment a device is turned on or off. This can help to track it down.



Notes can be added in Waterfall view. Place your cursor at the spot you want to add a note and left click your mouse. Enter a note of unlimited length. Click OK and the note will be pinned to the left margin of the screen at that point in time. Left click on an existing note to edit. Right click on an existing note to delete.

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### 5.9 Multiverse IDs

The Multiverse IDs feature is for users of City Theatrical Multiverse wireless DMX, and will describe the SHoW IDs that may be selected for various areas of the band (either 2.4GHz or 900MHz).

Multiverse SHoW IDs are a descriptive number that designates the portion of the spectrum on which to broadcast (900MHz or 2.4GHz), the data rate (this determines the number of universes of DMX that can be broadcast, the distance of the broadcast, and the degree of broadcast fidelity that can be expected), the portion of the broadcast band (full, adaptive, low, mid, high, and max), and the actual hopping pattern. See the SHoW ID chart on page 14 to see this explained graphically.

When the Multiverse IDs button is selected, a table appears showing the SHoW IDs available. These SHoW IDs are a function of the number of universes needed (the "X" axis of the table), and the relative position in the band (the "Y" axis of the table),.

Multiverse SHoW IDs			
	1	2	5
Adaptive	24150	24250	24350
Full	24100	24200	24300
Low	24110	24210	24310
Mid	24120		
High	24130	24230	24330
Max	24140	24240	24340

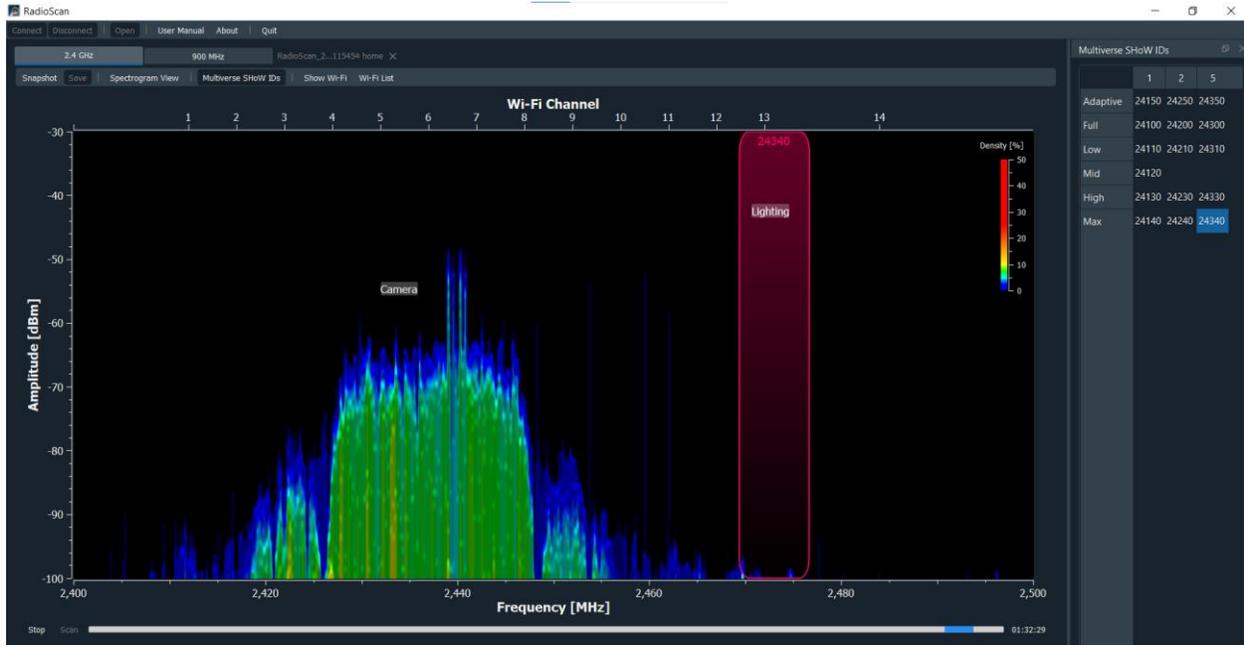
  

SHoW ID Details	
SHoW ID:	24340
Universes:	5
Frequency Range:	2469.39 - 2476.64 MHz
Type:	Max
Indoor Range:	100 ft
Outdoor Range:	1000 ft

Hovering over each individual SHoW ID reveals more information about it.

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Additionally, an overlay will appear that shows the portion of the band that the broadcast will reach while using the selected SHoW ID. Below, SHoW ID 24340 has been selected (a “Max” bandwidth selection that will broadcast in the area of Wi-Fi channels 13-14, outside of the normal Wi-Fi range in the U.S.)



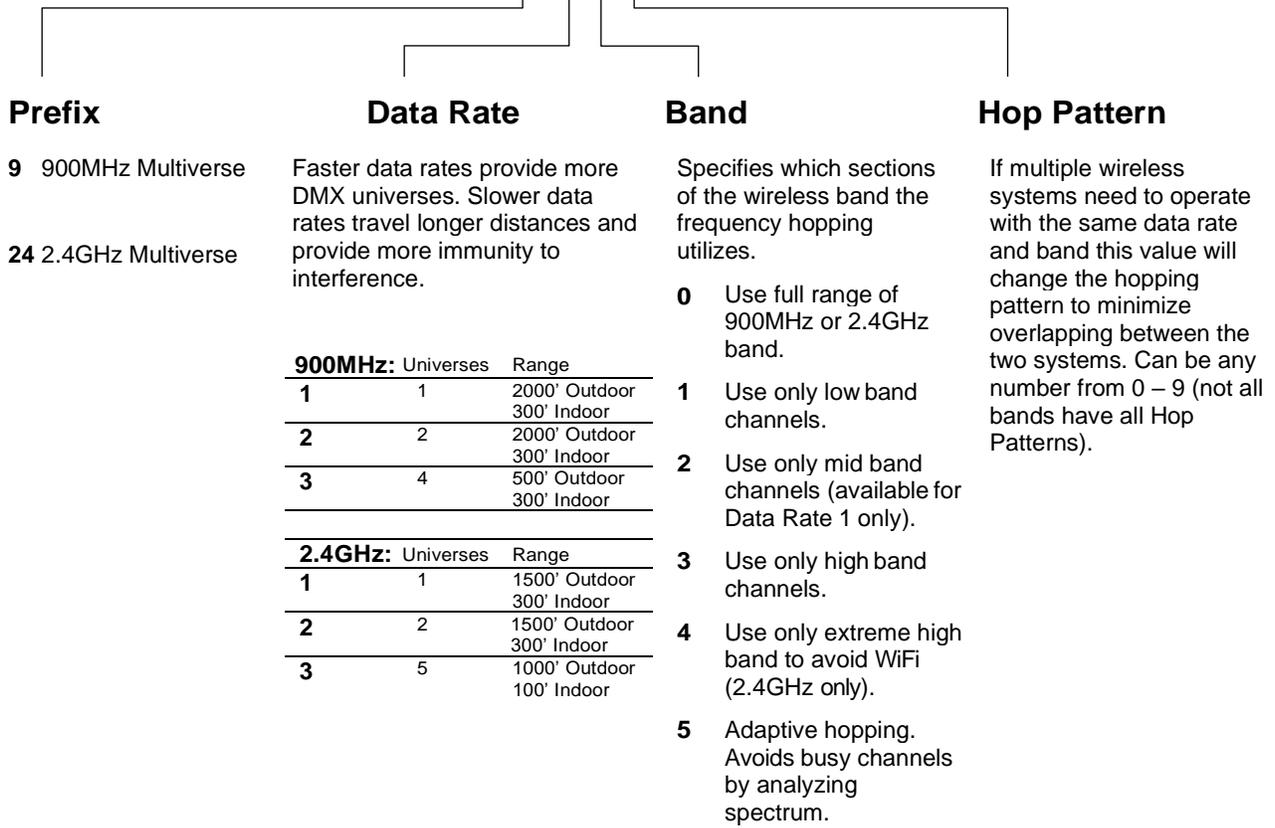
RadioScan allows the Multiverse user to find the optimum area of the chosen band on which to broadcast and directs him or her in how to best set up their Multiverse gear. This becomes an important part of the user’s broadcast plan and can be documented by using the Snapshot and Notes features (see image above), and submitted by email to a venue’s Spectrum Manager if required.

Begin your thought process of creating a broadcast plan by deciding how many universes need to be transmitted. SHoW IDs that carry fewer universes travel longer distances and often have more perfect fidelity than SHoW IDs that carry more universes. A good rule of thumb is to choose SHoW IDs with lower universe capacity whenever possible, and spread out your broadcast over more than one radio when possible, such as splitting your broadcast between the 2.4GHz and 900MHz radios on a 5910 Multiverse Transmitter.

We make the decision of how many universes to assign to each Multiverse Transmitter by characterizing our broadcast task as “more demanding” versus “less demanding”. “More demanding broadcasts” include direct view LED pixel chases, or longer distance broadcasts. “Less demanding broadcasts” are nearly any other combination of equipment including moving lights, LED fixtures, and conventional dimmers, and shorter distance broadcasts.

If longer distance broadcasts or direct view LED pixel chases of more universes are needed (such as nine or 10 universe broadcasts from one 5910 or 5911 Multiverse Transmitter), performance can often be improved by the use of specialized antenna such as panel or Yagi.

Multiverse SHoW ID Example: **24302**



Note: Not all combinations of digits are possible and unused numbers are reserved for future use.

Note: SHoW ID, SHoW Key (if used) and Universe must match between Transmitter and Receiver Cards.

**Figure 2: Multiverse SHoW ID**

### 5.10 Firmware Updates

City Theatrical issues firmware updates occasionally to add features or to fix bugs. The firmware version in use on your RadioScan dongle is found on the Help section of the RadioScan software program. Firmware updates are found on the CTI website on the 5988 Downloads tab. Update instructions and the firmware files themselves are found in that download.

## 6 Troubleshooting

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*Table 4: Troubleshooting Guide*

Symptom	Solution(s)
Unable to find any RadioScan device error.	Check for working USB data cable and not charging cable
	Verify that a USB Serial port was added to computer system.
LED is red	Device has not enumerated on the USB bus, check cable and computers USB port.

## 7 Customer Service

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