CRACKING THE CODE:

Conquering Wireless Dropouts

RF VENUE™

Summary

Achieving reliable wireless audio is possible in any setting, but even seasoned professionals can find themselves grappling with the complexities of radio frequency (RF) interference. Many argue that you don't need to be an RF expert—you simply need the right accessories (or "essentials" as professionals call them), along with our best practices, to ensure your wireless mics and IEMs perform flawlessly, regardless of the environment.

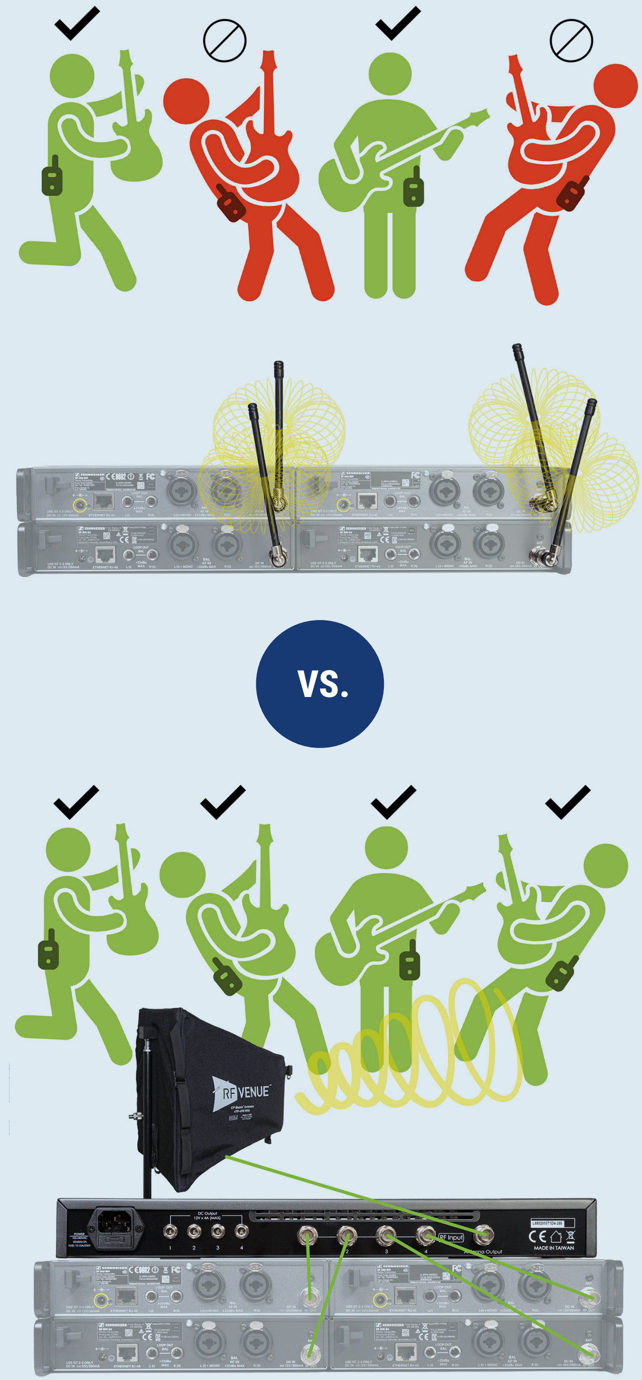
This guide unveils the reasons behind frustrating signal dropouts with wireless microphones and in-ear monitors (IEMs). Most importantly, this guide equips you with practical solutions for clear, confident wireless in your venue.

Understanding Wireless Dropouts

Wireless dropouts and RF signal fades are critical issues in audio environments, affecting everything from live theater performances to broadcast sports audio quality. A wireless dropout occurs when the RF signal is temporarily reduced, resulting in an interruption in sound, distortion, or inconsistent audio. Dropouts can severely impact the quality of your audio, leading to a frustrated audience and unprofessional results.

Wireless dropouts and signal fades are not just technical nuisances — they are significant barriers to maintaining a seamless audio experience. In wireless systems, especially those used for microphones and IEMs, dropouts can cause moments of silence or bursts of static, while signal fades can lead to fluctuating audio levels. Managing these issues requires a strategic approach that considers both the technical setup and the environment in which systems are used.

When managing wireless mics and IEMs as a system, it's essential to treat them as integrated components rather than separate entities. Both operate within the same RF environment, and their performance can be influenced by each other's signals. A cohesive approach to antenna placement and frequency coordination ensures that both mics and IEMs work harmoniously, reducing the chances of dropouts and signal fades.



Main Causes of Dropouts

Dropouts occur without sufficient signal above the noise floor. It is essential to maintain a minimum of 20dB of signal above the noise to lock the signal. The 5 listed items are factors that lead to diminished signal strength causing dropouts.

1 Radio Frequency Interference

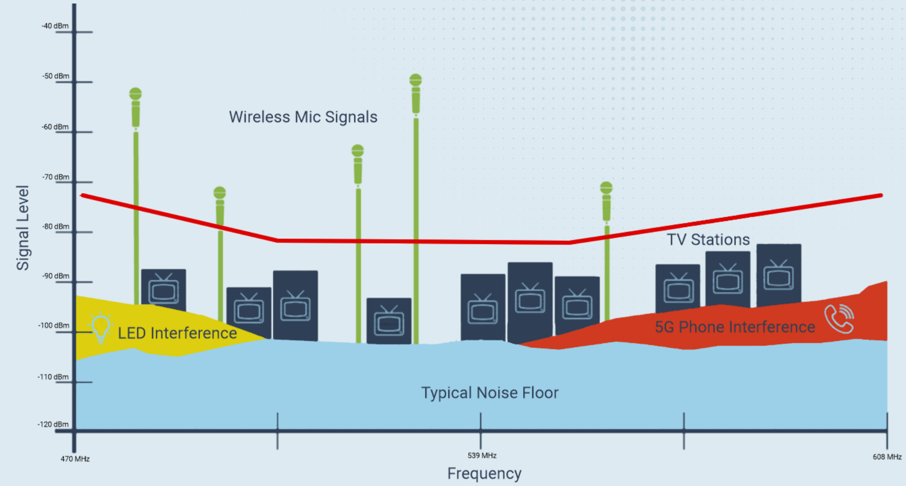
In today's crowded wireless landscape, interference from other devices like TV stations, 5G cell phones, LED lighting, and video walls/monitors can overwhelm the receivers or compete with your signal on the same frequency, causing dropouts.

2 Polarization Mismatches

Wireless signals have a polarization, which refers to the orientation of the signal wave. When the orientation of the transmitted signal doesn't align with the receiver's antenna, the signal strength can drop significantly, leading to RF loss.

3 Multipath Interference (Signal Echos)

This happens when the signal reflects off surfaces, creating multiple signal paths that reach the receiver at slightly different times. These overlapping signals can interfere with each other, causing loss of signal and dropouts.



4 Range Limitations

Range is not necessarily a fixed distance based on the transmit power of your radio, but rather the distance where the strength of direct signal falls to within 20 dB of the background interference. Background RF noise is the gating item here. A wireless system may have much greater range in a more rural setting as compared to a metro area.

5 Poor Frequency Coordination

Frequency coordination allows us to direct the mic and IEM channels away from interference, which can cause dropouts. Frequency Coordination will maximize the performance of your wireless equipment. With more devices competing for less available spectrum, you can no longer "fly blind."

IMPORTANT FOR EVERY SYSTEM

Preventing Dropouts

Choose the right essentials.

Essentials like proper remote antennas, antenna distribution, spectrum analysis tools, and interference filters can combat dropouts and fades.

Fewer antennas are preferred.

Contrary to popular belief, fewer, strategically placed antennas almost always yield better results than multiple antennas, placed closely together which can cause destructive interference. It’s critical to avoid “antenna farms” or large numbers of rear-mounted antennas on a wireless system. In these cases, an antenna distribution system or IEM combiner is needed along with remote antennas.

Use proper antennas to mitigate polarization loss.

While multiple antennas in a diversity setup significantly improve signal reception, they can’t completely guarantee proper polarization. This is because separated antennas do not necessarily share the same signal. Since both antennas cannot be in the same physical space, signals can arrive at different times.

Diversity series antennas always provide the most constant signal to receivers regardless of signal orientation. As it becomes weaker in one antenna, it becomes stronger in the other antenna at the same time. Diversity series antennas can guarantee the signal is never lost as long as line of sight is maintained.

Antenna distribution systems.

Distribution systems allow large numbers of receivers to be connected to a single diversity antenna pair. These systems manage multiple wireless channels efficiently, ensuring that both mics and IEMs receive the strongest possible signal with minimal risk of internal interference.

Use Circularly Polarized antennas with IEMs.

Most commonly associated with IEMs in wireless audio, circularly polarized transmission antennas radiate a signal with a polarity that rotates through 360 degrees, which greatly reduces the risk of dropouts from musicians bending and twisting while performing. No matter how people move around, CP antennas provide a constant signal to bodypack receivers regardless of orientation.

Wireless IEMs are overwhelmingly single ended receivers, they do not have diversity systems. Because of this, belt pack orientation in relation to linear antennas (paddles or whips that only transmit in a straight line) is a primary cause of dropouts and noises in your system.

The design of Circular Polarized antennas directs them to transmit in all 360° simultaneously, ensuring no matter how you bend or twist, you always receive optimum signal from your transmitters. The musicians will thank you. Deploying a CP antenna to maintain a consistent signal to the artist's bodypack IEM receiver is the right approach. Circularly polarized antenna elements can also be effective as receiving antennas with wireless microphones when the application demands a specialized approach.

TIPS & TRICKS

Preventing Dropouts

Position antennas for line of sight.

Mount antennas at an optimal height (8 to 10 feet above the stage deck) and aim them towards the transmitter area.

Prioritize directional antennas.

Choose antennas that cover only your desired pickup area, while ignoring non-relevant areas. Directional antennas help to minimize interference pickup from local sources, such as over-the-air TV broadcast channels or neighboring wireless audio systems.

Antenna spacing is important.

Ideally, you would minimize the number of antennas in a system: one for the IEM system, and a diversity pair for wireless mic reception. But if a situation requires multiple antenna systems, keep them at least 3 wavelengths (about 6 feet) apart to minimize negative interaction among them.

Locate antennas closer to transmitters.

Locate antennas ideally within 20 to 50 feet of your transmitters. This results in a stronger direct signal and less RF interference pickup.

Use bandpass interference filters.

Keep RF interference from ever entering your system. These filters block out-of-band interference caused by low-band 5G cell phones and video monitors. Simply choose one that allows you to tune your wireless mics between the upper and lower frequency values listed on the filter. Use one at the A and one at the B inputs of your distro. All receivers connected to the distro system will be protected.

Use high-quality coax cables.

Low-loss, double-shielded coax cables are recommended. Avoid damage to cables and also minimize sharp bends, especially around corners. Portable (as opposed to installed) cables will wear out; treat them with care.

Keep beltpacks out of pockets.

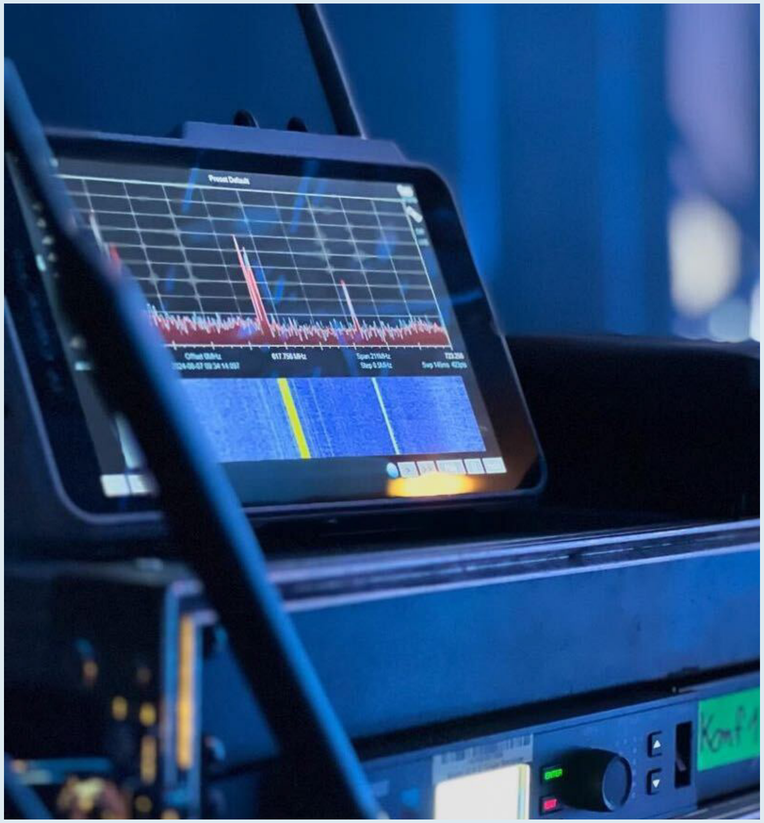
Avoid attaching artists' bodypacks under costumes, in pockets, or where the bodypack antennas could touch the body. This can decrease the signal and in certain situations cause dropouts in an otherwise good system.

Use fresh batteries.

Don’t get surprised by batteries that run out in the middle of a show. Battery meter accuracy can vary greatly depending of the chemistry of your batteries. Always know where your next batteries are if you need to replace them in a hurry.

Fine-Tune Your System

A well-tuned wireless system is the cornerstone of reliable audio performance. Fine-tuning involves more than just setting up your equipment — it's about actively monitoring, adjusting, and optimizing every aspect of your system to ensure peak performance.



Here's how to make sure your setup is operating at its full potential.

Use Spectrum Analyzers

A **spectrum analyzer** is an essential tool for monitoring and optimizing your wireless setup. By scanning the RF environment, it identifies all the active frequencies in your area, helping you to avoid interference from competing signals. Use a spectrum analyzer before every event to ensure that your system is operating on the clearest channels available. This proactive step can significantly reduce the likelihood of dropouts and ensure a smoother performance. Networked receivers often can be used to scan. But remember, they can only scan the frequency range they can tune to so they might not report the full RF picture to your frequency coordination software, as they cannot see out of band interference such as from 5G cell phones or from video monitors/walls.

Channel Selection

Channel selection is critical to maintaining a reliable wireless connection. The "find frequencies" feature on your radios may not be sufficient especially if multiple blocks or multiple manufacturers or models are used together.

Use frequency coordination software. RF Venue has an easy to use, free online tool called Wireless System Builder (www.wirelesssystembuilder.com) which provides a frequency coordination for your venue. You can improve your results when uploading the local RF scan data from your location.

Use Lower Power vs. Higher Power

All radio transmitters can potentially interfere with each other and the higher their power output, the greater the potential for interference. Select the lowest power necessary to cover your desired range. Walk-test your system to ensure your low power works sufficiently.

CONCLUSION

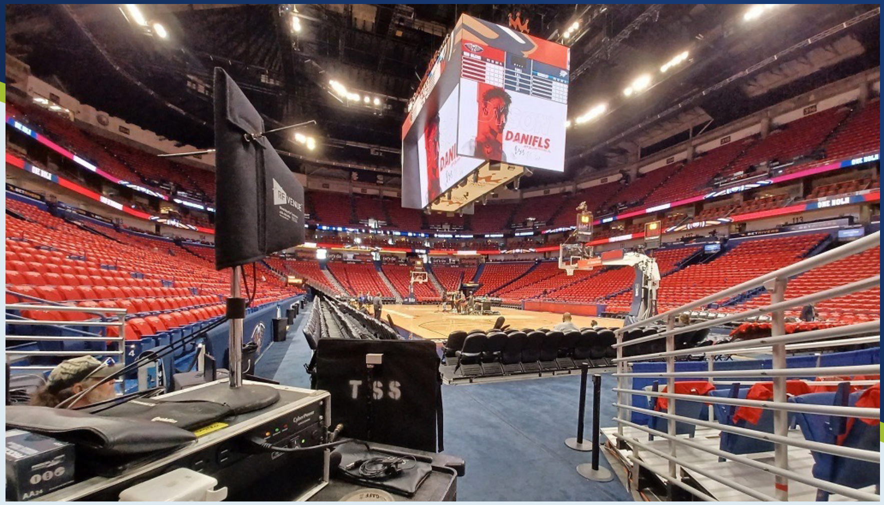
Ensuring Reliable Wireless Performance

Wireless dropouts can ruin even the most carefully planned events. Understanding the main causes — such as RF interference, poor frequency coordination, range limitations, polarization issues, and multipath interference — can help you take proactive steps to prevent them. By fine-tuning your system with tools like spectrum analyzers, selecting the best channels, and avoiding the most common issues, you can significantly enhance the reliability of your wireless setup.

Now is the perfect time to evaluate a new setup with the right configuration, or upgrade an existing one with improved performance. Consider adopting the strategies outlined in this guide to ensure that your audio performance remains consistent and dependable, no matter the environment.

RF Venue offers a range of essentials that are also packaged as easy-to-order packs that include everything you need: the distribution, antennas, and cabling for smaller or larger wireless microphone or IEM channel counts.

RF Venue's innovative products are designed to address the unique challenges of RF environments, ensuring your wireless audio system operates at its best.



Whether you're managing large events with lots of RF channels, touring and house of worship bands, or critical live broadcasts, RF Venue's microphone and IEM packs provide the robust, dependable wireless performance you need. We invite you to check out our website to see our range of packs and products.

Don't let signal dropouts or interference disrupt your next event. Choose RF Venue's industry-leading products to deliver an exceptional audio experience every time. Reach out to our team to learn more about how our solutions can elevate your audio setup to new heights.

Let's Talk

APPENDIX

RF Glossary

Term	Definition	System Application (Mics vs. IEMs) If Applicable
50 ohm Impedance	50 ohms is the characteristic impedance of transmission lines typically used in wireless audio to connect to transmitters, antennas, distros, receivers, etc. (Not to be confused with "resistance").	Mics and IEMs
Active Antenna	An antenna with a integrated RF amplifier. These antennas typically require DC power to operate.	Mics
Amplifier (ILAMP)	An RF amplifier that is either integrated into an antenna or patched in line (external).	Mics
Analog Wireless	Radios with conventional AM or FM modulation.	Mics and IEMs
Antenna Farm	A grouping of randomly placed antenna elements that mutually interfere with each other and degrade performance.	Mics and IEMs
Attenuator/PAD	A passive circuit that reduces signal strength to a lower, more acceptable level, which might be overloading a receiver.	Mics and IEMs
Band	A range of radio frequencies used for one or more specific purposes. For example, the UHF band used in North America for wireless microphones and TV broadcast comprises the range of 470 to 608 MHz.	Mics and IEMs
Bandpass Filter/ Interference Filter	A circuit that passes signals inside a certain frequency range, or band, with little or no attenuation, but attenuates or rejects signals outside the band. These can be used to reduce interference in an RF system.	Mics
BNC Connector	The BNC connector is a miniature quick connect/disconnect radio frequency connector very commonly used for coaxial cable.	Mics and IEMs
Capture Lock	When the receiver locks strongly enough onto the desired frequency carrier signal that it will track, and ignore interfering signals.	Mics and IEMs
Cascade	A serial method (as opposed to a parallel one) of sending RF signal out of a device to another. The number of possible cascade steps is dependent on the noise floor and signal to noise ratio.	Mics
Channel	Typically describes one center carrier frequency used for one wireless system. Some wireless systems do however use multiple catrriers.	Mics and IEMs
Circular Polarization	A circular-polarized antenna emits energy in a circular pattern. Energy travels in a corkscrew out from the antenna (when used for transmission). Used as a receiving antenna, it ignores the polarization of the transmitting antenna.	Mics and IEMs
DC Bias Over Coax	A DC voltage applied to a coaxial cable for remotely powering equipment such as inline amplifiers, active antennas, etc.	Mics
Decibel (dB)	The decibel (one tenth of a bel (B)) expresses the ratio of two values of a power When suffixed with letter codes that indicate the reference value (e.g. dBv, dBm) the numeric value expresses the ratio of a value to a fixed reference value.	Mics and IEMs
Digital Wireless	Digital wireless systems convert analog audio to a digital stream that modulates a radio carrier.	Mics and IEMs

RF Glossary

Term	Definition	System Application (Mics vs. IEMs) If Applicable
Dipole Antenna	An antenna made up of two active elements.	Mics and IEMs
Distribution Amplifier/Distro	Wireless microphone antenna distros receive multiple wireless microphone signals through a pair of antennas, and distributes those signals to multiple receivers via coaxial cable.	Mics
IEM Combiner	Active Antenna combiner system that expands a wireless IEM system by summing multiple transmitters to feed a single antenna.	IEMs
Diversity	A receiving technology that uses two redundant RF chains — from antennas to tuning, IF, and demodulation — to ensure reliable reception. This can be achieved in two main ways: see **spatial diversity** and **polarization diversity** for more information.	Mics
Dropout, Hit, Signal Fade	A random, intermittent loss of clear audio in the system occurs when the RF signal is temporarily reduced, resulting in an interruption in sound, distortion, inconsistent audio, or unwanted noises and static.	Mics and IEMs
Dynamic Range	The total linear amplitude range of a device, from the noise floor to the highest signal level (the threshold of distortion).	Mics and IEMs
Frequency	The specific channel (typically MHz for UHF) that a wireless signal uses to transmit and receive on.	Mics and IEMs
Frequency Coordination	The practice of calculating and selecting frequencies so you can configure your transmitters to be free from interference. Sources of interference can be external (tv stations and cell phones) and internal (when multiple transmitters are being used within your system).	Mics and IEMs
GHz	GHz stands for gigahertz, which is 1000 MHz.	Mics and IEMs
Ground Plane	Electrical approximation of a zero-potential reflective surface at the base of an antenna.	Mics and IEMs
Guard Band	The 600 MHz guard band (typically defined as the 614–616 MHz frequency range) has more restricted rules. It is intended to minimize isolation between portions of the spectrum not intended for wireless microphone use.	Mics and IEMs
Half-Wave Antenna	A half-wave antenna is the most commonly used type of dipole antenna. The length of its elements is approximately half of the maximum wavelength (λ/2).	Mics and IEMs
In-Ear Monitor/IEM	A wireless audio system used to transmit a signal to a performer's ear-buds or an IFB mix (interruptible fold back) to a host in a live broadcast.	Mics and IEMs
Intermodulation/IMD	The nonlinear distortion of mixing together multiple signals. This causes intermodulation distortion (commonly referred to as IMD), which produces artifact frequencies at the sums and differences of the mixed signals. IMD artifacts can fall within the range of the your wireless frequencies and possibly cause interference.	Mics and IEMs

RF Glossary

Term	Definition	System Application (Mics vs. IEMs) If Applicable
Linear Polarization	When the electric field of a radio is oscillating in only direction, (in a line) it is said to be linearly polarized.	Mics and IEMs
Megahertz/MHz	Hertz is the standard unit for measuring frequency and megahertz is one million hertz. UHF wireless audio gear will have a operating channel in MHz (a radio station's channel numbers - like 92.9 or 101.5 - are measured in MHz).	Mics and IEMs
Multipath Interference	In addition to the direct line-of-sight signal path between the transmitter and the receiving antenna, RF signals reflect (or "bounce" and "echo") off objects and surfaces before they arrive at the receiving antenna. The additional "echoing" signals arrive at different times in comparison to the direct signal. The difference may combine with the direct signal, reducing the level of the direct signal.	Mics and IEMs
N-Connector	N-Type connectors are designed to satisfy the need for a durable, weatherproof, higher power RF connector with consistent performance.	Mics and IEMs
Noise Floor	The sum of all non-intentional RF signals.	Mics and IEMs
Omnidirectional Antenna	An antenna that picks up in 360 degree "donut" polar pattern around the element. The null (or level of noise rejection) is at the top and bottom of the antenna.	Mics and IEMs
Out of Band	RF signal above or below your band of interest. Unfiltered out of band noise can still get into receiving circuitry and cause intermodulation at wireless mic/IEM frequencies.	Mics and IEMs
Paddle Antenna	Log Periodic Dipole array antenna. Tyically packaged as a "Sharkfin" or "Paddle", an LPDA antenna consists of three or more Dipoles lined in a row to create a directional antenna with added front end gain.	Mics and IEMs
Passive Antenna	Any antenna with no active amplifier circuitry. These antennas do not need power to operate.	Mics and IEMs
Passive Combiner	A passive RF device to easily combine two transmit signals into one antenna. Typically they offer lower isolation between channels.	IEMs
Passive Splitter	A passive RF device to easily split one recieve signal into multiple receive signals.	Mics and IEMs
PoE	Power over Ethernet, commonly found with wireless mic receivers or networking equipment.	Mics and Networking Equipment
Polar Pattern	A graphical representation of measurements of a transducer's (a microphone or an antenna) input or output sensitivity strength along degrees of rotation.	Mics and IEMs
Polarity	The direction or orientation of the waveform's voltage or current relative to a reference point or baseline.	Mics and IEMs
Polarization Cross Fade	The decrease in signal level/quality in the receiving antenna when its polarization does not match the polarization of the RF signal.	Mics and IEMs

RF Glossary

Term	Definition	System Application (Mics vs. IEMs) If Applicable
Polarization Diversity	Polarization diversity uses a co-located pair of antennas with polarization planes oriented 90 degrees apart, to receive RF signals effectively regardless of their polarization angle.	Mics and IEMs
Polarization Mismatch	When the polarization of the transmitted signal doesn't align with that of the receiver's antenna, the received signal strength can drop significantly.	Mics and IEMs
Power	Electric power is the rate of transfer of electrical energy within a circuit typically defined by Ohm's law. RF power is the amount of electromagnetic energy that is transmitted or received through radio waves.	Mics and IEMs
Power Supply	A source of power to an electrical circuit. Can be internal or external.	Mics and IEMs
Quarter-Wave Antenna	This antenna doesn't have a ground plane. These are the small antennas that will usually come with a transmitter or receiver and must be mounted directly to the chassis of a device.	Mics and IEMs
Rack/Rack Unit	Audio gear is usually stored in a "rack" in an out-of-the-way location at the venue. "Rack" can be referring to the actual cabinet used to store the equipment or it can refer to the slots in the special cabinets. A 1 rack unit (or 1RU) item will take up the entire width and height of one slot - which is approximately 1.75" high and 19" wide. Items can also be half-rack, 2RU, 4RU, etc.	Mics and IEMs
Range	Effective operating/ coverage of a transmitter to receiver.	Mics and IEMs
Receiver/RX	The section of a wireless system that converts an RF signal back into audio or its original signal format.	Mics and IEMs
Reception	The quality of signal vs. noise.	Mics and IEMs
Remote Antenna	An antenna that is located away from the wireless rack and closer to the area where wireless mics/IEMs are used.	Mics and IEMs
RF Interference/RFI	Any electromagnetic signal other than your intended signal.	Mics and IEMs
RF over Fiber/RFoF	A optical based system that converts a radio signal into light and then back in to a radio signal. Its purpose is to extend RF signals past the limitations of coax cables.	Mics and IEMs
RG8X Coaxial Cable	RF Venue RG8X is custom made with double-sheilding to improve noise and interfernece rejection while maintaining very low loss.	Mics and IEMs
Signal Strength	The intensity of a specific RF signal.	Mics and IEMs
Signal to Noise	The ratio of desired signal to unwanted noise in the RF spectrum. It is typically expressed logarithmically, in decibels or dBm.	Mics and IEMs
SMA Connector	Smaller rf connector used for many compact RF devices. (SubMiniature version A) connectors are semi-precision coaxial RF connectors developed in the 1960s.	Mics and IEMs

RF Glossary

Term	Definition	System Application (Mics vs. IEMs) If Applicable
Spatial Diversity	Spatial diversity is a wireless technique that uses multiple antennas seperated by some distance to improve signal quality and reliability.	Mics and IEMs
Spectrum	A range of particular frequencies.	Mics and IEMs
Spectrum Analyzer/SA	A measuring tool used to analyze RF energy. RF technicians, Audio Engineers, and AV Installers typically use SA's to troubleshoot with and visualize RF activity in the environment.	Mics and IEMs
Passive Splitter	A passive device (requires no power) like the RF Venue 2X1SPLIT, which can split or combine an RF signal.	Mics and IEMs
Squelch	Circuit in a receiver that mutes the audio output in the absence of the desired transmitter signal.	Mics and IEMs
Switch Mode Power Supply/SMPS	A compact, lightweight electronic power supply that incorporates a switching regulator to convert electrical power efficiently.	Mics and IEMs
Transmitter Combiner	Sums the outputs of IEMS/ IFB transmitters to a single antenna, resulting lower IMD (intermod) in less multipath and less clutter in the RF rig.	IEMs
Transmitter/TX	A device that the generator of the radio frequency current A transmitter/TX can be a wireless hand-held, or bodypack microphone. Or, transmitters can be rack modules that transmit IEM signals to a receiver (IEM-bodypack).	Mics and IEMs
Tuning	Assigning frequencies or channels.	Mics and IEMs
UHF	Ultra High Frequency band. 300 MHz to 3 GHz.	Mics and IEMs
VHF	Very High Frequency band 30 MHz to 300 MHz.	Mics and IEMs
Whip Antenna	Usually described as a 1/4 wave non dipole antenna that needs a ground plane to pick up reflections.	Mics and IEMs
Wireless Mic and IEM Accessories	These are things that are added to a wireless mic or in-ear monitor transmitter transmitters and receivers to increase reliability, especially as systems get larger. Examples include antenna distribution systems/distribution amplifiers, transmitter combiners, and remote antennas.	Mics and IEMs
Zone	A geographic area served by a distributed antenna system.	Mics and IEMs