

Introduction

A Shure Educational Publication

Wireless Microphone Systems



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Wireless Microphone Systems

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Introduction

Get familiar with wireless microphone systems. Eliminate cables connecting you to the sound system, gaining freedom of mobility with no loss of sound.

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Learn more advanced wireless capabilities.

Introduction

Conventional wired microphones convert sound into an electrical audio signal that is sent to the sound system through a cable. Live music stages that are crowded with cables from microphones for vocals, guitars, drums and other instruments can become a snake pit of overlapping wires.

Wireless microphones convert audio signals created by microphones into radio signals, which are sent by a transmitter through the air to a receiver. The receiver converts the radio signals back into audio signals which are then sent through the sound system. They eliminate the need for cables, so you're no longer tethered to a sound system or tripping through messy performing environments.

With continuous technological advances and improvements in sound quality and reliability, wireless microphones are more affordable and popular than ever. Their potential uses go far beyond the stage. You can find wireless microphones in exercise studios, schools, houses of worship, presentation halls – anywhere a performer or presenter wants true freedom of movement.

No cables. No worries.

> **Simplicity**

Set up and go for it. Your stage is cleaner and your mics are less intrusive, so you can concentrate on your performance.

> **Mobility**

Be even more expressive. Wireless microphones cut you loose wherever you perform.

> **Versatility**

Multiple microphone choices, system configurations and features mean wireless systems can adapt to nearly anything you do and any place you go.

Product Glossary

Wireless Microphone Systems range from simple to sophisticated. But they all include various combinations of these key components:

- Transmitters – convert the audio signal from the microphone to a radio signal. There are two types:
Handheld Microphone Transmitter – combines handheld microphone element and transmitter in one unit.
Bodypack Transmitter – wearable unit with a connector that accepts microphones or guitar cables.
- Microphones (for Bodypack Transmitters) – Headworn, lavalier and instrument microphones ideal for a variety of vocal and instrument applications
- Receivers – modules that receive radio signals sent from transmitters and convert them back to audio.

[1] Transmitting

Two types of transmitters—handheld or bodypack – convert audio signals to radio signals so they can be sent, without a cable, to a wireless receiver at the mixing console.



Handheld Microphone Transmitter

This microphone/transmitter integrates the transmitter into the microphone handle, so both functions are contained in one unit.

Like conventional wired microphones, wireless handheld vocal microphones are tailored to meet diverse performance vocal requirements and musician preferences. Many different choices are available.



Bodypack Transmitter

Lavalier, Headworn and Instrument Microphones, as well as guitar cables, must plug into a Bodypack Transmitter to send their audio signals. Sleek, lightweight bodypacks can be easily clipped to clothing or a guitar strap.



Headworn Vocal Mic

Rugged, comfortable, easy-to-position headsets provide superior voice pickup in any active user setting.



Lavalier Vocal Mic

A range of sizes combine low visibility with high-quality professional audio. They provide full, clear sound for speech applications.



Clip-On Instrument Mic

A versatile solution for high volume wind, brass and percussion players. Gooseneck and clamp ensure secure fit and positioning.



Guitar/Bass Cable

Connects any guitar to a Bodypack for wireless performance.

[2] Receiving

Wireless receivers process signals sent from a Handheld Microphone Transmitter or a Bodypack Transmitter. They come in these two basic antenna configurations:



Single-Antenna Receivers

These receivers use one antenna. They are the most cost-effective choice, but momentary dropouts can occur as the user moves around. This happens when part of the radio signal is reflected by metal objects. This can cause loss of the signal at the receiver's antenna.



Diversity Receivers

These have two antennas along with a smart circuit that selects or combines them for the best signal quality. Since one antenna will almost certainly be receiving a clear signal, the risk of dropout is greatly reduced.

Concept Guide

These technical and operating concepts help define how a wireless microphone system functions and which is best suited to a specific application.

Frequency Ranges

Every wireless microphone system transmits and receives sound on a specific radio frequency, known as the operating frequency. These frequencies can typically be grouped into two large bands, or ranges: VHF (very high frequency) and UHF (ultra high frequency). They are part of the overall frequency spectrum shared by all kinds of other wireless devices, such as TV and radio broadcasts and cellular phones.

VHF vs. UHF

Each of these bands has their own benefits and potential liabilities for individual users. They can also vary greatly in price, depending on the system. However, the sound quality of a wireless microphone is determined by the microphone element and the audio circuitry in a particular system, not by the transmission frequency.

VHF (Very High Frequency) – VHF wireless microphone systems offer affordable options for beginning performers to pros. Most VHF wireless systems operate on the same frequencies used to broadcast television channels 7 to 13. But some VHF systems use non-TV frequencies (below 174 MHz), which are also used for business radio and drive-through restaurant headsets.

UHF (Ultra High Frequency) – There are up to eight times more frequencies available for wireless use in the UHF range than in VHF, as well as additional dynamic range in audio signals. UHF systems also have shorter, less visible antennas.

Frequency Selection

Fixed Frequency – Fixed-frequency systems are pre-set to their operating frequency and cannot be changed by the user. They are a more affordable choice particularly suitable for use in one particular area or installation.

Frequency Agile – Frequency-agile (tunable) systems allow users to quickly change frequencies to avoid interference from local TV channels, other wireless users or other external sources.

Using Multiple Wireless Microphones

Each microphone needs its own frequency to operate and transmit properly. So it is not possible to use two wireless systems on the same frequency in the same venue or to use two wireless microphones with just one receiver.

The individual frequency used by each microphone requires a certain amount of space within a particular frequency band. When two wireless systems are used together, the frequencies must be separated by some minimum amount that depends on the design of the system. If frequencies are set too close, microphones will compete with each other, and each system will experience noisy interference and/or sound dropouts.

As more transmitters and receivers are added to a particular setup, interaction between frequencies increases. This interaction produces more interfering frequencies that need to be avoided. More advanced wireless systems offer greater frequency selection, flexibility and the ability to combine more receivers and transmitters to serve more users. Many of these systems offer pre-configured groups of compatible frequencies to accommodate multiple users, as well as software that can scan for the most clear frequencies in any one particular location.

Microphone Basics

There's more to a microphone than its shape. While invisible from the outside of a microphone, these two fundamental operating principles can help fine tune the selection of the right microphone for your wireless system application.

Transducers

Transducers are the elements inside a microphone head unit. There are two types: dynamic and condenser. Both convert soundwaves produced by your voice or instrument into electrical signals that become amplified sound. But they differ slightly:



Dynamic

These are workhorse microphone elements with great sound that stand up to rugged regular use. They are also generally more affordable options.



Condenser

These produce a crisper, more defined sound and are better at capturing subtle details of delicate voices and instruments. They also require power to operate, which is supplied by the battery in a handheld wireless transmitter.

Polar Pattern

A polar pattern is the graphic representation of a microphone's directional sensitivity, which is how a microphone picks up sound from different directions. These are the three most common polar patterns:



Cardioid

These patterns pick up the most sound from in front of the microphone and some from the sides. They are less susceptible to feedback in loud environments.



Supercardioid

These are tighter patterns that help screen unwanted sound sources. They are perfect for individual instruments in a multi-instrument setting or single sources in noisy environments. They also provide the best rejection of feedback when used with floor wedge monitor speakers.



Omnidirectional

Omnidirectional polar patterns are equally sensitive to sound from all directions. These are most often found in lavalier microphones.

Needs Analysis

[Microphone Configurations]

Wireless system microphone and transmitter choices afford presenters and performers great flexibility in matching an application to a wireless configuration.

1

What type of microphone / transmitter configuration best fits your performance needs?

Application	Configuration
Vocalist	Handheld Microphone / Transmitter
Singing Dancer Singing Keyboardist Singing Drummer Fitness Instructor Dance Instructor	Headworn Mic + Bodypack Transmitter
Presenter Worship Leader Stage Actors	Lavalier Mic + Bodypack Transmitter Or Headworn Mic + Bodypack Transmitter
Horn Percussion	Clip-On Mic + Bodypack Transmitter
Guitar Bass	Instrument Cable + Bodypack Transmitter

2

Would your performance benefit from a particular microphone design profile?

Your usage application is only one key factor in choosing a wireless microphone. Also consider the microphone transducer design and polar pattern. These greatly impact how any wireless microphone reproduces your live sound.

For example, if you are a vocalist who performs onstage with loud monitors, you might want a handheld transmitter with a tight supercardioid polar pattern to minimize feedback.

If you tend to sing softly, a condenser microphone will more smoothly capture the subtleties and details of your voice.

[System Configurations]

The transmitter and receiver electronics in every wireless system are also designed to respond to the special needs of different user applications.

3

Where do you intend to use your wireless system? One location? Many locations?

One Location

If you intend to use the wireless system in one location, you simply need to make sure that you select a system that operates on frequencies compatible with your location's VHF or UHF broadcast TV channel frequencies.

Multiple Locations

If you intend to use the wireless system in different cities, you will probably encounter different active TV channels. A frequency-agile wireless system lets you change frequencies to adapt to changing situations as you travel.

International Locations

There is no single wireless frequency usable worldwide. Regulations and frequency allocation vary from country to country.

Tip: Visit www.shure.com/frequency to find out more about which frequency range is best for your requirements.

4

How many wireless systems will be in use at the time and location?

One System

If you are operating a single wireless system in a location where there are no other wireless systems in use, you will not have any special multisystem needs to manage.

Multiple Systems

If you operate more than one wireless system and move from venue to venue, it is usually more convenient to mount receivers in a small rack case. Some wireless systems allow two receivers to mount together in one rack space. These can be used with an antenna splitter that feeds one "master" pair of antennas to serve all receivers.

There is a limit to the number of wireless systems that can be used in one location. Each system must transmit on its own frequency. And those frequencies must be selected carefully to prevent interference.

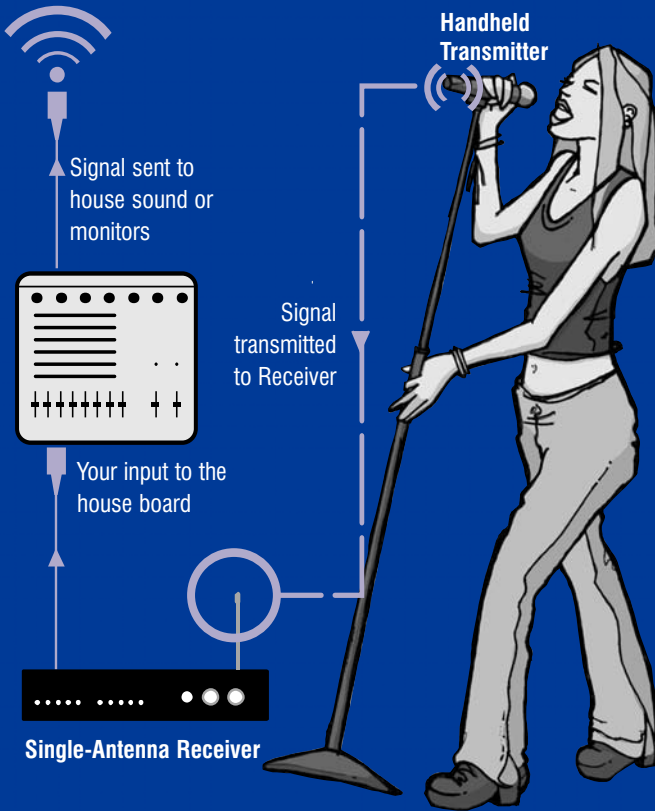
Better wireless systems allow for more units to be operated at the same time without interference. Some even include systems that help find an open frequency automatically and avoid sources of interference.

Tip: UHF and VHF systems can usually be combined without problems.

Setup Snapshots

These wireless system setup examples follow the wireless signal path for common vocal system configurations.

Singer



Application Profile | Handheld
A handheld wireless setup is great for performers who want a handheld vocal microphone that's not connected to a bodypack transmitter. Ideal for:

- Vocalists
- Speakers / Presenters
- Emcees

Considerations: RF signals

Signal path from transmitter to receiver

The signal path and signal strength between transmitter and receiver is affected not only by distance, but also by obstructions. Each installation location presents its own challenges.

Transmitter signals radiate in all directions, not just in a direct path. With single antenna receivers, direct and reflected signals can often cancel each other out, causing a sound dropout. Typically, single antenna receivers provide good performance outdoors or in areas where reflections are minimal. Diversity receivers, however, will provide superior performance in any environment.

Application

Profile | Lavalier

A lavalier microphone and bodypack transmitter setup can work for any presenter or performer. Ideal for:

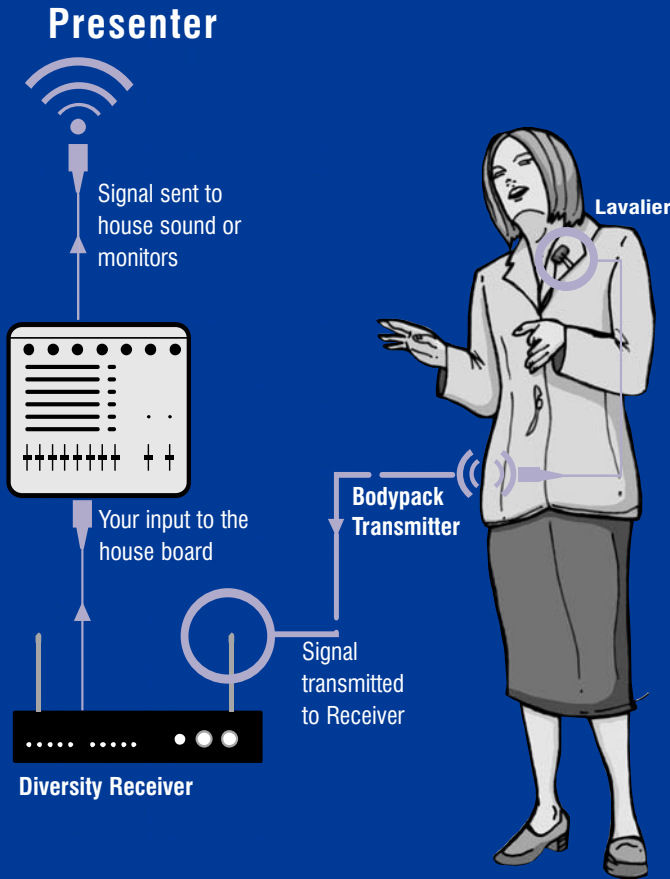
Speakers / Presenters
Worship Leaders
Theater Stage Actors

Application

Profile | Headworn

For situations where performers or presenters work with louder sound systems or use stage monitor speakers, a headworn microphone is a more effective choice. Ideal for:

Fitness / Dance
Instructors
Singing Dancers or
Instrumentalists (such
as drummers and
keyboardists)



Receiver and antenna placement

Place the receiver properly

Receivers are subject to interference from external sources that use radio frequencies. Where possible, keep receivers a few feet (or rack spaces) away from CD/DAT/MD players and special-effects units.

Position antennas properly

Ideally, antennas should be positioned above an audience or other obstructions so that the transmitter and receiver can "see" one another. When receivers are mounted in a rack, antennas must be located on the front panel or allowed to project through the top of the rack. Antennas should be oriented vertically or angled apart to maximize the distance between antenna tips.

Setup Snapshots

These wireless system setup examples follow the wireless signal path for common instrument system configurations.

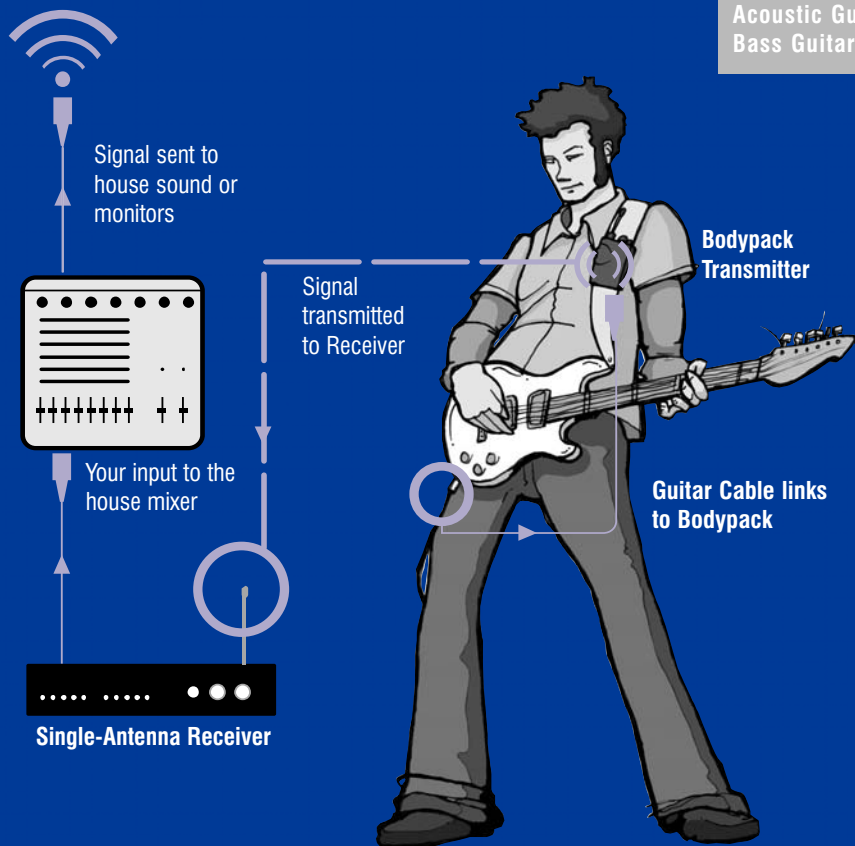
Application

Profile | Guitar

A wireless guitar setup helps guitarists move freely anywhere onstage. Ideal for:

- Electric Guitarists
- Acoustic Guitarists
- Bass Guitarists

Guitarist

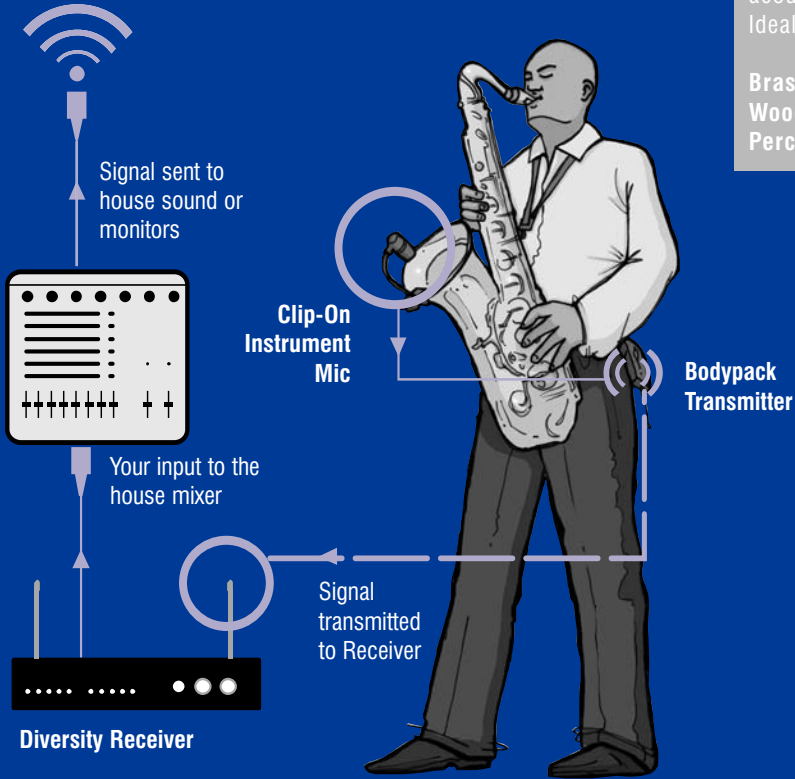


Considerations: Power

Batteries

Unlike most wired microphones, all wireless mic transmitters require batteries. Wireless performance suffers as batteries lose power. As a result, batteries are an important and constant replacement part. Alkaline batteries offer the longest life for wireless applications. Rechargeable nickel-cadmium batteries, though an economical choice, typically last less than three hours before recharging is necessary. This short lifespan makes them undesirable for most performers.

Saxophone



Application Profile | Clip-On

A small, clip-on instrument microphone and Bodypack Transmitter is a great wireless solution for many acoustic instruments. Ideal for:

- Brass
- Woodwind
- Percussion

Advanced Concepts

More technical aspects of wireless microphones:

Traveling with a wireless system

Selecting frequencies that avoid local TV channels in your home location is relatively easy. However, that can change if you are a touring performer who also goes to other cities or countries.

There is a portion of the VHF spectrum not used for television broadcasts that is available anywhere in the U.S. For this reason, these frequencies are called “traveling frequencies.” However, these frequencies are also shared by other types of users. In addition, only three traveling frequencies can be used together in one location without interference, which limits multi-user configurations.

Frequency-agile systems allow the user to change frequencies to avoid active TV channels or other interference sources encountered when traveling. Traveling overseas makes frequency selection even more difficult. A wireless system purchased in one country may be illegal or unusable in another country. There is no single wireless frequency that is legal worldwide, so it is usually better to rent a system from a reputable supplier in each country.

TV channel interference

Both VHF and UHF wireless microphones operate on frequencies that are primarily used to broadcast television signals. The introduction of digital television is increasing the number of occupied channels. It is sometimes possible for a wireless microphone to operate on an active television channel (for example, deep inside a large building with poor TV signal penetration). However, for reliable operation, it is important to choose wireless frequencies that are not used for TV broadcasts within a 50-mile radius of the user’s location.

Factors that make TV interference worse include:

- Being outdoors
- Using wireless mics in a location close to the TV transmitter antenna
- Using a wireless microphone transmitter more than 50 feet from the receiver
- Poor placement of receiver antennas

Notes



Learn more.

Wireless Microphone Systems: Selection & Operation Guide

This booklet provides greater technical detail about specific wireless microphone systems, components, frequency selection, usage applications, setup suggestions and system expansion. Request your copy by contacting Shure at one of the numbers listed below.

You can also download a PDF of this guide and data sheets for any Shure wireless microphone product at the Shure website:

- www.shure.com/wireless
- www.shure.com/datasheets

Additional Shure educational publications available:

- Audio Systems Guide for Houses of Worship
- Audio Systems Guide for Meeting Facilities
- Audio Systems Guide for Video Production
- Personal Monitor Systems | Selection & Operation Guide
- Personal Monitor Systems | Introduction Guide
- Mic Techniques for Music–Sound Reinforcement
- Mic Techniques for Music–Recording



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