FASST

Field Associate Sound System Training

Microphones

Mics, not Mikes, turn acoustical signals into electrical signals. They very much perform the exact opposite function that speakers do.

Inside every microphone is an element or diaphragm that reacts to acoustic waves hitting it. The microphone or transducer changes that mechanical energy into electrical energy. The electrical voltage that is created is, as you could probably imagine, very small. A mic level signal is typically in the area of 0 to 77 millivolts or -20dBu. This electrical signal can then be input into a sound system for amplification. Note however, that since the signal is so weak, it must first be pre-amplified up to a line level voltage prior to being mixed with other line level signals.

There are basically two different types of microphones that are used in our industry: wired (or hard-wired) and wireless.

Wired Mics

Cable

As indicated by the naming convention, wired microphones transfer the audio signal to the mixer/preamp via a multi-conductor shielded cable. This cable typically uses two 20 or 22awg stranded copper conductors to carry a balanced audio signal. (Unbalanced microphones do exist, but thankfully, are rarely used in our industry) It also employs a non-jacketed, stranded conductor often referred to as the drain. The drain is basically the electrical reference for the audio signal and 'drains' inducted noise off the foil shield to ground. These cables are then wrapped in an aluminum foil that provides additional shielding. Microphones should always use this shielded cable to help minimize unwanted noise being inducted onto the cable. Additional pairs of conductors are often included in the same overall jacket to control external relays. However, these pairs are twisted together outside of the foil shield.

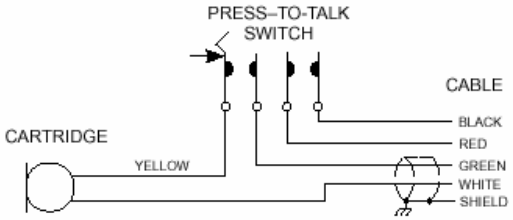
Push-to-talk switch

Very often, but not always, wired microphones have one or more 'press to talk' buttons. These buttons or switches must be depressed in order to activate the microphone for a specified zone. Internally, these buttons, when depressed, will either close the audio circuit path allowing the signal to pass, or create a contact closure that can be used on an external relay. As shown below in the Shure 514B schematic, the button can also perform both functions simultaneously. Be aware that while almost all microphones of this type use the button to create a contact closure, some do not break the audio path. In this design, the microphone is always passing audio down the cable. This design can be useful in certain applications. An example could be a microphone on a cook line where the cook wants to be heard throughout the kitchen without pushing a button. However, the button could be used to page an additional area such as the managers office that typically doesn't need to hear all the other pages.

Model 514B

CONNECTIONS

Refer to Figure 1 and Table 1 below. The GREEN wire is connected to the positive audio input, the WHITE wire is connected to the negative audio input, and the SHIELD is connected to chassis ground. The RED and BLACK leads control the external relay or switching circuit.



INTERNAL CONNECTIONS
FIGURE 1

Table 1. Typical Cable-to-Connector Wiring

INPUT TYPE	WIRE COLOR	FUNCTION	XLR CONNECTOR	1/4 IN. PHONE JACK
BALANCED	GREEN	AUDIO +	PIN 2	TIP
	WHITE	AUDIO –	PIN 3	RING
	SHIELD	CHASSIS GROUND	PIN 1	SLEEVE

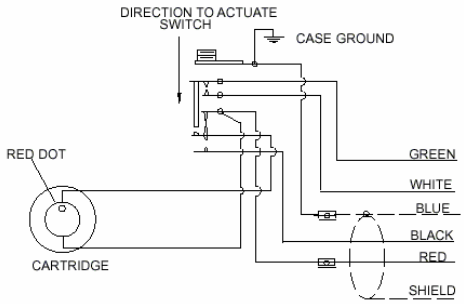
NOTE: The RED and BLACK leads are not part of the audio circuit. These wires provide a contact closure when the press-to-talk switch is depressed. This closure may be used to control an external relay or a transmit/receive circuit.

Model 515SBGX, 515SBG-18X, and 515SBG-18XF

MODEL 515SBGX: Does not include gooseneck or mounting flange
MODEL 515SBG-18X: Includes gooseneck and 76.2 mm (3 in.) diameter mounting flange
MODEL 515SBG-18XF: Includes gooseneck and 44.4 mm (1–3/4 in.) diameter mounting flange

The GREEN and WHITE cable leads are used to control an external relay or control circuit. Refer to the following table and to the wiring diagram in Figure 4.

INPUT TYPE	WIRE COLOR	FUNCTION	XLR CONNECTOR	1/4 IN. PHONE PLUG
UNBALANCED	RED	AUDIO	PIN 2	TIP
	BLACK	AUDIO GROUND	PIN 3	SLEEVE
	SHIELD	CHASSIS GROUND	PIN 1	SLEEVE
BALANCED	RED	AUDIO +	PIN 2	TIP
	BLACK	AUDIO –	PIN 3	RING
	SHIELD	CHASSIS GROUND	PIN 1	SLEEVE



INTERNAL CONNECTIONS

The 514B is an example of a hand held mic. It is often referred to as a CB or trucker style. The 515SBG-18X is an example of a gooseneck type. Operationally, both microphones are very similar. They only differ in their application.

Phantom Power

Microphones can also be categorized by the method in which it changes mechanical energy into electrical energy. Although there are several different ways, we will concentrate on just two of the basic types. *Dynamic* microphones are by far the most common in our industry. However, *condenser* microphones are widely used as well. The important difference between the two is that condenser microphones require DC voltage to operate. Most often the condenser mics use 48VDC, but some use 24VDC. This voltage is usually supplied by the mixer to the microphone using the same cable that the audio travels down. The term used to describe this voltage is *phantom power*. Since most installed systems will use dynamic microphones, the installer/technician needs to know how to turn off or disable this power. Systems with the phantom power engaged will often experience a pop when the push to talk button is engaged. In the worst circumstance the phantom power can completely destroy a dynamic microphone.

Splitting & combining multiple microphones

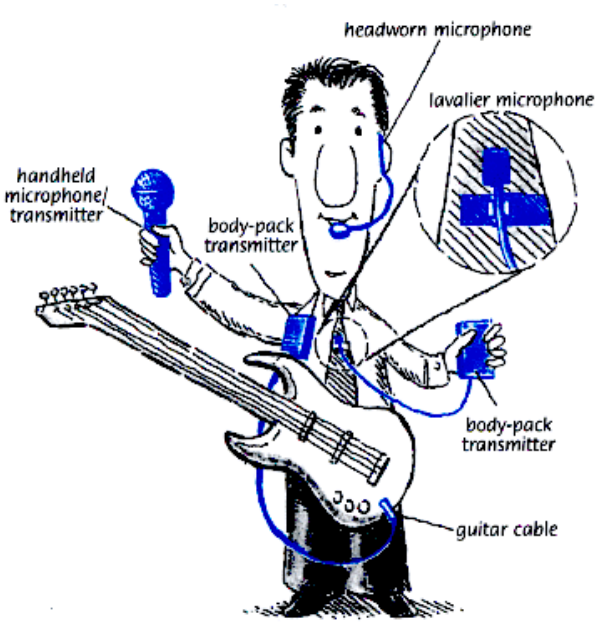
Be extremely careful when adding multiple microphones to a system. Some installations have been completed by connecting several microphones in parallel onto a single mic input. The customer could experience significant volume fluctuations depending upon the number of microphones open at any given time. The preferred method of combining mic signals is by using a microphone mixer where each mic has its own input.

Others installations have a single microphone that has its signal split to multiple mixers. Remember in both cases that the microphone signal is very weak to begin with and combining and splitting signals can have a severe impact on the quality and level of the signal. A mic level distribution amp should be used if attempting to send a mic signal to more than two mixers.

Testing & troubleshooting

A good way to test a microphone is to connect a tone generator to the audio leads of the mic. If the tone is heard, the microphone is probably OK. If no tone is heard when the switch is depressed, the diaphragm could be damaged or there could be a problem with a switch. This is also a good way to determine which leads are for the audio and which are for the contact closure if the documentation is unavailable.

Wireless Mic Systems



There are three basic components to a wireless system: A microphone, transmitter, and receiver. For hand held microphones the transmitter typically is incorporated in the same device as the microphone. For smaller lavalier and headset mics a belt pack usually contains the transmitter and batteries. In this instance, the mic is connected to the belt pack by a small wire that can be concealed in the users clothing.

As mentioned previously, wireless systems use RF (radio frequency) waves to send the audio signal from the microphone transmitter to the remotely located receiver. The receiver receives the RF signal and converts it to a mic level or a line level electrical signal. Some better quality systems have a switch on the receiver to select the desired output level.

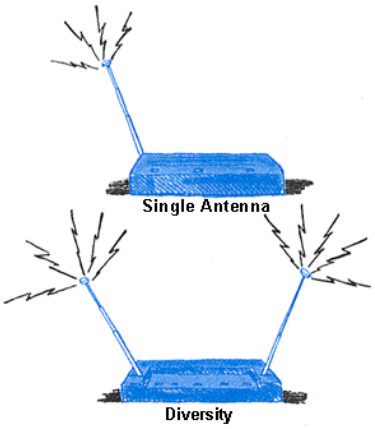
Base Frequency

All wireless mic systems are ordered with and operate on a specific base frequency. These frequencies are either in the VHF (30-300MHz) or UHF (300-1000MHz) range. The transmitter and receiver must both be set to the same frequency to function. Some systems are frequency tuneable (or agile) and allow the user to change channels if interference is a problem. Remember that both the transmitter and receiver need to be changed to the same channel.

VHF receivers are typically less expensive than their UHF counterpart and have a stronger signal, however, there are many more frequencies in the UHF range and therefore experience less interference. A side benefit is that the antennas for UHF systems are much smaller because of the smaller wavelengths in the UHF spectrum.

Often, the manufacturer will recommend appropriate frequencies based upon the city in which it will be used to avoid interference from local radio and television stations.

Antennas



When dealing with any kind of RF signal, there must be an antenna on the receiving end to capture the signal. Diversity systems incorporate the use of dual antennas. The receiver constantly measures the signals coming off both antennas and switches to the stronger of the two, thereby reducing signal drop. Most better systems now use the dual antenna system as it is significantly better than a single.

Wireless microphones often are labeled with ranges up to 1000'. Experience shows that these numbers are extremely optimistic and are probably established in ideal environments. Walls, curtains, and even people can significantly reduce the distance which these RF signals can travel. But one of the biggest inhibitors can be the metal audio cabinet that the receiver is mounted in. It is best to get these antennas outside of the rack, especially if there are front and rear doors on the cabinet.

If the location where the mic is to be used is a significant distance from the receiver, ½ wave antennas can be located closer to the user location and RF amplifiers used when necessary. In this instance the proper impedance coax must be used. Manufacturers design their systems differently so make sure you are using the correct cable. For example, Shure recommends the use of 50 Ohm RG-8 coax for some (if not all) of its receivers, where TOA has systems that recommend 75 Ohm RG-6 or RG-11. The moral of the story is: never assume.

Multiple Wireless Mics

Multiple microphones cannot be used with the same receiver. Each microphone must have its own receiver on separate frequencies. If multiple receivers are being used, it may be a good idea to look at using an antenna distributor as well.

Troubleshooting

No RF signal?

- Is the battery good? Better transmitters may have a battery indicator light to check.
- Is the transmitter turned on?
- Make sure both transmitter and receiver are set to the same frequency.

Good RF signal, but no audio.

- Make sure the all levels are turned up, including the gain on the transmitter.

Lots of feedback.

- Get out from under the loudspeaker!