

# WIRELESS EDUCATION



**beyerdynamic**

# WIRELESS BASICS

## WHY WIRELESS?

There are many interesting advantages of wireless microphone systems. One obvious advantage is that no time is required for laying cables. However, one of the greatest advantages is the newly gained freedom of movement, which is practically an essential requirement – and not just for rock concerts. Also for presentations, being able to make gestures gives more weight to the spoken word and instantly improves the interaction with the audience. Trip hazards due to countless cables are a thing of the past and the stage remains clear. This also creates a more professional impression of the entire event.

And not least, for beginners through to professional users (e.g. for fixed installations), the speed at which the system can be operational is one of the arguments in favour of a wireless system. It is, however, crucial to choose the correct system.

## AREAS OF APPLICATION

The extensive advantages are not just reserved for large live shows. Being able to move around freely in the space available can also be extremely valuable for smaller performances. Wireless systems are also used in theatre performances and church concerts of all sizes. Aside from music, wireless systems ensure a professional and clean appearance in the business world. Radio microphones are readily used in conference venues, lecture halls and community centres for applications such as speeches, presentations, meetings and interviews.

The use of a wireless system in conjunction with a headset or a lavalier microphone opens up further possibilities.

The singer, or speaker, now has both hands available to interact with his or her audience. A wireless system is therefore also becoming the tool of choice for sports events, among others.

## WHAT DO YOU NEED TO LOOK OUT FOR?

### ANTENNA POSITION AND RANGE

The positioning of the receiver antenna plays an important role. To guarantee optimal reception, there should be a line of sight between the transmitter and the receiver and the antenna should be as elevated as possible. The range that can be achieved depends on the components used. A minimum distance must also be maintained between the transmitter and the receiver.

### SHADOWING

The signal strength may be attenuated if there are obstacles in the direct line of sight between the transmitter and the receiver. This phenomenon, known as shadowing, leads to a smaller range. However, the obstacles don't just include walls or objects. People (the audience) can contribute enormously to the attenuation of the signal. It is therefore particularly important to choose a suitable antenna position to ensure uninterrupted reception.

### PERMISSIBILITY OF THE WIRELESS SYSTEM

It must be ensured that the wireless system being used is permitted in the respective country. In Germany, the responsible authority is the Federal Network Agency (BNetzA). Accordingly, all beyerdynamic radio systems have the required authorization from the Federal Network Agency. A distinction is also made between systems that have to be registered and those that do not.

### DISRUPTION/INTERFERENCE

If various different systems are being used, the frequencies must be carefully selected. If you are operating several transmitters simultaneously at one location, this can lead to disruption of transmission. Reasons for this disruption include interference or intermodulation.

# WIRELESS MICROPHONES

## RADIO TRANSMISSION

A wireless microphone system always comprises at least one receiver and one transmitter. The audio signal is transmitted between these two components. To be able to send an audio signal via the antenna, the signal must first be modulated to a high-frequency wave. When the radio signal from the transmitter is picked up by the antenna in the receiver, it is converted to an electrical signal in the receiver (demodulated). It then travels via cable to the mixer. For the radio transmission of an electric guitar, the signal goes to the associated amplifier. As the radio link itself only serves to transmit the signal, the sound should of course be reproduced in such a way that it is true to the original and unadulterated. You achieve the required sound by choosing the right microphone capsule or by choosing the right headset.

## RECEIVER

The principle of the receiver is best explained by comparing it to a conventional radio. The transmitter can be selected and modified but the receiver can only ever receive one signal at a time. Therefore, also for wireless microphone systems, a separate receiver channel must be available for each transmitter. This also applies for dual receivers. In the case of dual receivers, two receivers are encased in a single housing so that two channels can be received.

## TRANSMITTER

From the outside, there are only very slight differences between corded microphones and radio microphones. At the place where you find an XLR connector on corded microphones, wireless systems instead have a small antenna or a connected beltpack. This also functions as a transmitter.

Handheld transmitter: The microphone capsule as well as the transmitter itself are encased in one housing. The transmitter together with the electronics are located in

the lower part of the handheld transmitter. The microphone capsule is protected by what is known as the head grill and these remain together in the top part of the handheld transmitter. The user holds the microphone directly in his or her hand.

## HANDHELD TRANSMITTER

The microphone capsule as well as the transmitter itself are encased in one housing. The transmitter together with the electronics are located in the lower part of the handheld transmitter. The microphone capsule is protected by what is known as the head grill and these remain together in the top part of the handheld transmitter. The user holds the microphone directly in his or her hand.

## POCKET TRANSMITTER

Pocket transmitters are extremely handy and, due to their size, can easily be attached to an instrument or a piece of clothing. The respective microphone is connected to the pocket transmitter, which sends the signal directly to the receiver. Besides being used in connection with instrument microphones, they are also used in clip-on microphones (lavaliers) and headsets.

## TRANSMITTER: RADIO SIGNALS

Regardless of whether for handheld or pocket transmitters, omnidirectional antennas are generally used in microphone technology. Their radio signals are emitted in a constant circular pattern comparable to the waves that occur when you throw a stone into water. The radio signal is therefore not just sent to the receiver but is transmitted in all directions. As a result, radio waves can be reflected by walls or also by other objects. If signals are reflected unfavourably in such a way that they meet each other again and overlap, this can lead to drop outs. Two overlapping waves "cancel each other out". This is where the diversity receiver comes into play.

# WIRELESS WIKI

## WIRELESS WIKI AND DEFINITION OF TERMS

### ANTENNA CABLE

An antenna cable connects a remote antenna with the receiver. The cables are specially designed for high-frequency electrical signals. The attenuation factor specified always refers to 100 m of cable length.

### ANTENNA COMBINER

An antenna combiner is the counterpart to the antenna splitter. It converts multiple antenna input signals into one output signal.

### ANTENNA DIVERSITY

(See Diversity) Two antennas ensure the reception of just one signal. If the level for one antenna falls, the receiver switches to the other antenna. If this antenna provides a better signal, the receiver uses this one. Otherwise, it switches back to the initial position.

### ANTENNA SPLITTER

An antenna splitter converts one input signal into multiple antenna output signals. An antenna splitter is described as active or passive depending on whether or not it is equipped with an amplifier.

### CABLE ATTENUATION

Antenna cables weaken the signal from the antenna. The longer the cable, the greater the attenuation.

### CARRIER SIGNAL

The carrier signal (carrier for short) is a sinusoidal oscillation of a particular frequency. Other oscillations (information) are created (modulated) on the carrier. The compo-

site signal is demodulated in the receiver and the carrier as well as the information placed on it are separated from each other again.

### CROSSTALK

If signals from a particular channel incorrectly land on another channel, there is crosstalk between the channels.

### DIVERSITY

A diversity receiver has two antennas for receiving the one signal. If the signal from one antenna has interference, the receiver then uses the signal from the other antenna. A distinction is made between antenna diversity and true diversity. (See fig.). Receivers with no diversity are called non-diversity receivers.

### DOWN TIME

Down time describes the period of time for which there was an outage or a disruption.

### DROP OUT

If there is a disruption in the radio transmission and the automatic mute function is activated, this is called a drop out.

### DYNAMIC RANGE

The dynamic range is specified in decibels and provides information on the difference in volume between the quietest and the loudest signal that can be received and output by a device.

### FAR-NEAR DIFFERENCE

The difference between the longest and the shortest distance between the antenna and the stage.

# WIRELESS WIKI

## FEEDBACK

Feedback occurs when the output signal is picked up again by the microphone. The signal is amplified and is then picked up again from the microphone (a loop) and interference noise occurs.

Feedback mostly occurs due to incorrectly set up monitor boxes or due to reflections.

## FREQUENCY BAND

The term frequency band designates a certain frequency range that exhibits the same transmission characteristics.

## FREQUENCY MODULATION

Frequency modulation refers to changing a frequency to a carrier frequency used for transmission. For this, a low-frequency signal is created on a high-frequency sine oscillation.

## INTERFERENCE

If two carrier frequencies are too close to one another, this can cause the oscillations to overlap. The disturbance that this generates is called interference. (Example: Two radio transmitters are received simultaneously on one frequency.) -> See also: Diversity

## INTERMODULATION

When signals of different carrier frequencies are combined, this results in completely new signals with unwanted frequencies.

## LIMITER

To avoid distortions, a limiter ensures that the electrical signal is at an adequate level to ensure that overmodulation does not occur for the next circuits.

## MODULATION/DEMODULATION

The carrier frequency needed for transmission has a constant frequency and amplitude. As it only serves as

a carrier, it does not contain any information. A piece of information (or an 'event') is transmitted when the frequency or the amplitude is modified. This modification is called modulation. The deviation is detected again in the receiver. This process is called demodulation.

## MULTICHANNEL SYSTEM

A multichannel system is when multiple microphones are combined together in one system and operated simultaneously.

## PILOT TONE

The pilot tone is a signal, which is sent with the "regular" signal in analogue systems and is used for transmitting information. For example, the pilot tone provides the receiver with information on the battery charge or automatic muting. Identification between the transmitter and the receiver also takes place via the pilot tone.

## REFLECTION

Reflection occurs when a signal is reflected off an obstacle.

## REMOTE ANTENNAS

Remote antennas are external antennas that are not attached directly to the receiver but are instead connected to the receiver via an antenna cable. This allows rotational antennas, for example, to be positioned at an elevated point ideal for reception.

## ROTATIONAL ANTENNA

If it is not possible to position the receiver in the transmission range of the transmitter, a larger distance needs to be spanned. Antennas with a large directivity are used for this. These are highly sensitive in a particular direction and can therefore be targeted at a particular range, even from a large distance.

# WIRE LESS WIKI

## SHADOWING

Shadowing is when there is no direct line of sight between the transmitter and the receiver, as the line of sight is blocked by objects or similar obstacles. The radio signal is attenuated. (Approx. 10 dB)

## SIGNAL BANDWIDTH

A carrier signal doesn't only oscillate in the required frequency but also oscillates slightly in both directions. The entire range in which the carrier signal oscillates is called the bandwidth.

## SQUELCH

Muting in analogue wireless systems. If the receiver signal on the receiver becomes too weak, this is muted by the squelch. This avoids interference noise. You can generally configure the level at which the squelch is activated.

## TRUE DIVERSITY

(See Diversity) True diversity doesn't only work with two antennas but also with two receivers. The better signal is ultimately evaluated using the amplitude and the signal quality.

## UHF

UHF stands for Ultra High Frequency. These are microwaves in the decimetre range. This results in a frequency band of 300 MHz to 3 GHz.

## VHF

VHF stands for Very High Frequency. These are ultrashort waves. The VHF frequency band ranges from 30 MHz to 300 MHz.

# FREQUENCIES

**NOTE:** The following information on frequencies is valid in Germany and most of European Countries only.

## SEMI-PROFESSIONALS AND GASTRONOMY

- Private Veranstaltungen
- Semiprofessionelle Bands, DJs und Alleinunterhalter
- Eventgastronomie
- kleine Kirchen

### 170 - 230 MHz

This range is generally assigned in many countries and can be used for wireless microphones as well as in-ear monitoring and doesn't require a registration.

### 823 - 832 MHz (LTE - medium band)

This user group includes semi-professional users and smaller events. The latter also includes, for example, use in community centres. The LTE duplex band, also called the medium band, was assigned to this user group. This frequency range does not require registration and is therefore not subject to charges in many countries.

### 863 - 865 MHz (EU-wide harmonised frequency band)

A maximum of 2- 4 can be operated in parallel in the so-called harmonised frequency band, as this is a very narrow band. Like in the case of the medium band, this frequency range does not require registration and is free of charge.

### 1785 - 1805 MHz

This range is generally assigned until 31 December 2025 and can be used for wireless microphones as well as in-ear monitoring.

## PROFESSIONAL USERS

- Professional bands
- Professional hire companies
- Professional productions (bands/theatres/musicals on tour)

### 470 - 790 MHz (excl. 607-613 MHz)

This frequency range is intended for professional use. This range can also be used by users, who need more radio channels than can be simultaneously operated in the range that does not require a registration. Besides allowing users to operate more channels, the high level of operational security is an enormous advantage.

**Note:** The frequency range 694 - 790 MHz is only suitable until 2017.

# FREQUENCIES

## PLACE-RELATED INSTALLATION

- Educational establishments such as schools and universities
- Churches
- Exhibition centres
- Convention halls and conference venues and event venues
- Operas, musicals, concert halls or stadia

### 170 - 230 MHz

This range is generally assigned in many countries and can be used for smaller installation with less operational security.

### 470-790 MHz (excl. 607-613 MHz)

Many of the establishments mentioned above provide a fixed-installation microphone system. In these cases, the spoken word is usually an everyday tool, which makes it almost indispensable to have a wireless system that is easy to use and operational at all times.

Registration with the Federal Network Agency is also required for this frequency range.

**Note:** The frequency range 694 - 790 MHz is only suitable until 2017.

## RADIO BROADCASTING

- Public service broadcasting
- Private radio broadcasting programs
- Outside broadcast vans
- Film productions (private producers)

### 470-606 MHz und 614-710MHz

As radio broadcasts can also be transmitted wirelessly, the above two frequency ranges are allocated to both private and public service broadcasting corporations and programme providers.



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