Choosing the Right Wired Headset for Intercom

All About Wired Intercom Headsets

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INTRODUCTION

This document offers a good working overview of what is involved in selecting an intercom headset, but along the way we will try to demystify several technical points that may sometimes challenge or frustrate any number of regular intercom users. Headsets are one of the most important, and frankly, intimate parts of an intercom system – yes intimate – they touch us on our head in operation and convey our words into the system and present other's words into our ears. Very important that we get this part right!

Headsets have become commonplace as more and more of us interact with different communication systems on our phones, laptops, and other personal devices. With so many choices, applications, plug-ins, adapters, and options…where do you begin? This array of options is even more dizzying for personal communication headsets (like those used on a Zoom call) than it is for professional intercom headsets. So, let's not get confused by consumer headsets or Bluetooth devices for gaming and online work and only look to professional intercom use.

When it comes to selecting an intercom headset, your environment and personal wearing style are two initial factors to consider. This would be true for either intercom headsets or personal communication headsets. A few other considerations cross over to both of these as well…

First, headsets are in no way audiophile headphones like one would use to listen to music, so let's be clear about that from the beginning.

This raises the distinction between headphones and headsets. Because an intercom is a communication system and the key characteristic of an intercom is the ability to talk and listen, intercom headsets include the headphone(s) and always includes an attached microphone on a moveable/bendable boom arm off one of the headphones. Another key difference is that intercom headsets are offered as a single driver or dual driver headphone while headphones used for listening only typically feature two drivers. Not to be overlooked…the earbud is a form of dual-driver headphone although a user is not required to insert both buds, and yes intercom headsets are offered with earbuds/earphones/in-the-ear as the headphones listening device.

The earpieces of headphones differ between open-back and closed-back styles. Open-back headphones allow sound to pass through the back of their ear cups, while closed-back headphones do not, which impacts how you hear the signal as well as the sounds around you. Almost all intercom headset earpieces are categorized as 'closed-back'. You should understand that within a production environment you would not want the intercom chatter to be heard outside the headset and also would not want the ambient noise of the environment to be audible to the user of an open-back headset.

Some questions to consider when buying new headsets are:

- Headphone type (in-ear, over-ear, on-the-ear, closed-back)
- Wearing style (left ear/right ear/both ears)
- Microphone Type (dynamic/electret)
- Microphone Polar Pattern (cardioid, supercardioid, hypercardioid, omnidirectional)
- Frequency Response
- Impedance
- Sensitivity
- Cable length

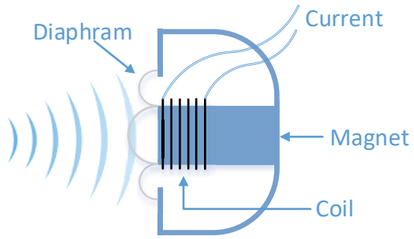
1. MICROPHONES

It is first worth considering how we speak when on intercom headsets. When we raise our voices, we add energy to the entire word. We are not able to add much level or energy to the consonants but we can easily add energy to the vowels. By raising our voices to become more intelligible, the level differences between the weaker consonants and the louder vowels increases and eventually ruins intelligibility. The consonants become masked or drowned out behind the vowels. When we whisper the opposite happens: the vowels drown.

So, to maximize intelligibility, keep your voice at a normal speaking level.

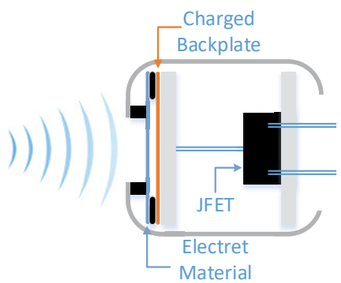
1.1 Headset Mics: Dynamic and Electret Types

Intercom headsets are available with many different types of microphone, but the most common are the Dynamic microphone and the Electret condenser microphone. Here's a basic description of each so you can consider the differences, but the specific system (usually by type, i.e., partyline, matrix, wireless) will indicate the recommended option for each application.



Dynamic Microphones

When wire is moved within a magnetic field a current is generated in the wire coil. Using this principle (technically referred to as induction), the dynamic microphone uses a wire coil, magnet, and a thin diaphragm to capture the audio signal. The diaphragm is attached to the coil. When the diaphragm vibrates in response to incoming sound waves, the coil moves backwards and forwards past the magnet. This creates an electrical current in the coil which is interpreted in the system as an audio signal. Dynamic microphones are the most common in intercom because they don't require external power.

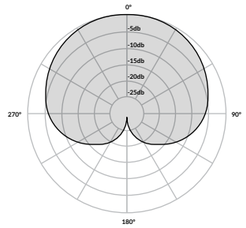


Electret Microphones

An electret microphone is one type of condenser microphone – these have a thin conductive diaphragm that sits close to a metal backplate. This configuration works like a capacitor wherein sound pressure vibrates the diaphragm which in turn changes the capacitance to produce the audio signal. Since they use capacitance instead of actual moving coils, fidelity and sound quality is improved. Recognize that this method of sound capture requires active power in the circuit, which is not available in all intercom devices. These are more commonly used in mixed broadcast/intercom type headsets because of their improved audio performance.

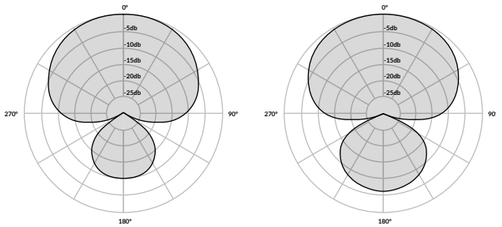
1.2 Microphones: Cardioid, Supercardioid, Hypercardioid, Omnidirectional

Polar patterns describe how microphones pick up sound. Directional microphones are seen in a number of variations, i.e., cardioid, supercardioid, hypercardioid. They differ not only in where they are sensitive to sound, but also in where they reject it, normally from the sides and behind.



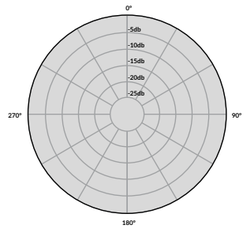
Cardioid

Cardioid mics capture pretty much everything in front and block everything else. This front-focused pattern will let you point the mic to a sound source and isolate it from unwanted ambient sounds.



Supercardioid Hypercardioid

Supercardioid / Hypercardioid microphones have the same front directionality but have a narrower area of sensitivity compared to cardioids. This results in improved isolation. Because of their enhanced ability to reject noise, you can use these within noisy stage environments and other louder settings.



Omnidirectional

Omnidirectional microphones will, in principle, pick up sound equally from all directions. However, in practice, the microphone will behave more and more directionally the higher the frequency of the signal going into it. The smaller the capsule, the more genuinely 'omni' the microphone is.

Overall, intercom headset microphones are most likely to have some directional characteristics, but when using them you will want to be aware of what the type is. A key implication of this is where you position the microphone in relation to your mouth.

1.3 Microphone Positioning

On nearly all intercom headsets, the mic capsule is positioned on a moveable 'boom' to allow you to adjust its position in relation to your mouth. Proper headset boom mic placement is important for clear communications.

Always position your microphone approximately half an inch away from the edge of your mouth for best results. With the headset on your head, make these adjustments:

- Grasp the boom with your fingers and move the microphone up or down so it is level with your mouth.
- Pull the microphone in toward your lips. Position the microphone with its talk side facing in.
- The microphone should be placed at the corner of the mouth 1/2 inch from your lips.
- Do not position the microphone directly in front of your mouth as it will pick up your breathing and explosive noises from your mouth. In addition, moisture can adversely affect the sound and performance of the microphone.
- Make sure the microphone windscreen is facing your lips. Do not purse your lips.

The image to the left is a good representation of how the headset microphone ought to be positioned to the side of your mouth. This mic placement would be the same for a single-ear headset as well.

Left Ear or Right Ear

Headsets are not ear specific and you can easily switch the headset to fit either ear. Dual-Earphone (both ears covered) headsets can be worn with the microphone on either ear. Choice of which ear for a Single-Earphone operation is likely to be driven by personal preference, but directional considerations from outside/background noise can also be relevant (i.e., putting the headset position towards the speakers in a theater or concert to help reduce the disruption of those sounds to your communications).

Comfort is also a consideration which will be very personal to each user which relates to which ear (or both) and what style of headset. The material used for the headband cushion, as well as the amount of cushioning used, can make a huge difference in how comfortable a headset is to wear and for what period of time.

Single or Dual-Ear Headsets

A Single-Earphone communication headset has only one earphone for one ear and is common for production communication in theater, broadcast, etc. where a user may need to hear the performance or what is going on nearby but at the same time need to be in constant communication. The source is always mono with a single driver headphone and is wired as such relative to the connected user station. See Section 2.3 Intercom Headset Connectors. It is a user preference for which side of the head the user is most comfortable listening and communicating on the intercom.

Dual-Earphone headsets offer circumaural for both ears. A Dual-Earphone or dual-ear headset doesn't necessarily deliver stereo audio. Most headsets that are double-ear are wired as mono, i.e., each ear gets the same audio source equally in each ear. Some Clear-Com dual-earphone headsets can be wired for separate intercom channels with one channel source per ear. Dual-earphone headsets are also a choice when a certain amount of noise isolation is required in applications where the ambient noise of either the show content or crowd noise interferes with communication. See below about types of headsets and noise isolation.

1.4 Headphone Impedance

Electrical impedance is essentially a measure of the opposition that a circuit presents to a current when a voltage is applied.

An intercom device's headphone amplifier is a relatively low-level amp that acts to boost the voltage of an audio signal to properly drive connected headphones. Headphone amps also act to better match the impedance at their outputs to provide optimal signal transfer and headphone performance. Most intercom devices like wired and wireless beltpacks have headphone amplifiers tailored to high impedance headphones (typically 200-400Ω).

Connecting a low-impedance pair of headphones (32 or 50 Ω) to intercom devices with a low-powered amplifier could cause trouble. Sending too much signal voltage to a low-impedance headphone driver could overload it and cause significant distortion.

Sensitivity refers to how effectively an earphone converts an electrical signal into an acoustical signal. Sensitivity indicates how loud the earphones will be for a given level from the source. Sometimes this is expressed as 'efficiency'. Typically, headphone sensitivity is expressed in dB SPL to 1 mW or to 1 V. The SPL (loudness) produced by the headphones at a given frequency with a set amount of power is known as its sensitivity, and for headphones, the generally accepted standard is to use one Kilohertz (kHz) as the sensitivity measurement frequency.

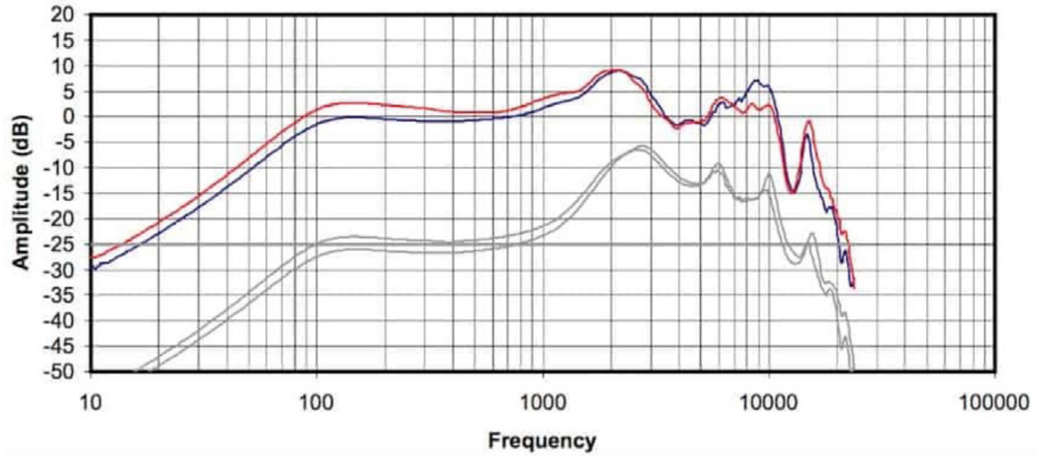
Headphone sensitivity ratings typically fall between **80 dB SPL/mW and 125 dB SPL/mW**. All else being equal, higher sensitivity headphones will be louder than lower sensitivity headphones (shown in this chart) and of course relative to the output of the headphone amp driving them.

Input power (mW)	Earphone #1 113.5 dB SPL/mW	Earphone #2 105 dB SPL/mW	Earphone #3 122 dB SPL/mW
0.1	103.5	95.0	112.0
0.5	110.5	102.0	119.0
1.0	113.5	105.0	122.0
1.5	115.3	106.8	123.8

1.5 Headphone Frequency Response

Headphone Frequency Response refers to the audio frequencies the headphones are capable of reproducing. It also involves the frequency-dependent sensitivity of the headphones. The frequency response measurement is the magnitude of the headphone output compared to its input as a function of frequency. It illustrates how accurately the headphones reproduce each frequency of an audio signal in terms of amplitude.

Here is an example of a frequency response of a pair of headphones. Notice that this device has a very stable response from 100Hz thru 1kHz, a bump at about 2kHz (most reasonably because it is most sensitive at this frequency or the headphone driver has a resonance at this frequency), followed by a roll off after 10kHz and by 20kHz you can see it is -25dB down. A reasonable specification for this device would state a frequency response of 100Hz-10kHz.



Another, though less-flattering, method of writing out the frequency response range would be to give a tolerance value. A tolerance value, written as ±X dB, suggests that the response range holds true within this frequency-dependent sensitivity variability. In the above example = 100-10kHz ±5dB.

2. TYPES OF HEADPHONES USED ON COMMUNICATION HEADSETS

2.1 What Headset, Where, and When?

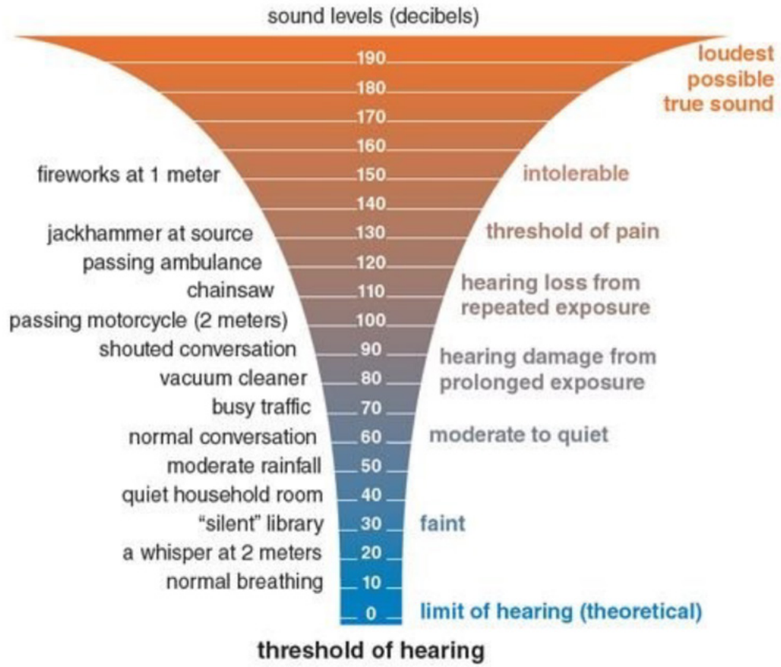
Having to wear a communication headset in a more controlled environment, such as a conference, is very different when compared to…

A monster truck rally in an arena

A pyrotechnic event in a concert environment

An important function for a headset is the amount of isolation it offers. For communication headsets for intercom we use the term acoustic isolation. There are headsets for other industries like aviation, construction, mining, and gaming that boast active noise filtering or cancellation. These are not common in standard intercom use, often require a power source like a battery pack, and are typically very expensive. For the majority of intercom applications, a degree of standard noise isolation is adequate and also allows for the headset designs to be more comfortable, not to mention more affordable.

Noise isolation ratings are measured in decibels (dB), or sound intensity. Most headsets provide from 10 dB to 30 dB of hearing protection. Minor differences in decibel ratings between headsets shouldn't affect sound quality since most people don't notice a change in volume of less than 6 dB, so what you should focus on here are bigger differences. As you can see in the next chart, a difference of 30 dB isolation from exposure would make a significant difference.



threshold of hearing

Unwanted background sounds, including music, can ruin speech intelligibility. If there are other sound sources in the room chances are that these sound sources take up space in the audible spectrum that was meant for the voice. Imagine the person you wish to hear is standing next to a roaring train passing by. The background sound is louder than the speech. These sounds can disturb the event reducing the ability to hear what you or others are saying.

Poor noise isolation can have a negative sound quality impact. This is especially true where audio cues are very important.

When choosing how you want the headset to fit, your personal preference is key, but your environment will also play a part in the decision. If you’re in a louder environment an Over-the-Ear headset will perform better because the full-sized ear cushion against your head (around your ear) helps block out noise around you from what you’re hearing in the headset. In extremely loud environments a dual-muff, over-the-ear headset is best.

Alternatively, there are some situations where you need to hear the sound of the event or ambient environment as much as you need to hear the intercom signal in your ear. Examples include quieter theatrical performances, ceremonies, public speaking situations, and some quieter sporting events. In these instances, a single-earphone, over-the-ear might be best as you will be able to hear the ambient sounds with one ear while isolating the communication sound with the over-the-ear earpiece of the headset. Alternatively, an earbud model may work well for you especially if you are primarily receiving cues and don’t have too much talking to do for your role.

As you can see, there is no ‘one size fits all’ answer.

2.2 Three Types of Communication Headsets

Over-the-Ear **On-the-Ear** **Earbud**

Clear-Com offers a versatile range of communication headsets in the following categories:

Over-the-Ear **On-the-Ear** **Earbud**

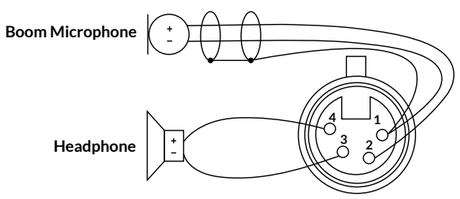
Model	CC-300	CC-400	CC-28-X4	CC-110	CC-220	CC-70
Type	Single-Earphone	Dual-Earphone	Single-Earphone	Single-Earphone	Dual-Earphone	Earbud
Headphone Type	Over-the-Ear, Closed Back	Over-the-Ear, Closed Back	On-the-Ear, Open Back	On-the-Ear, Open Back	On-the-Ear, Open Back	In-the-Ear
Headphone Freq Response	40Hz-20kHz	40Hz-20kHz	100Hz-14kHz	20Hz-20kHz	20Hz-20kHz	30Hz-14kHz
Headphone Impedance	400 Ohm	200 Ohm	320 Ohm	400 Ohm	400 Ohm	16 Ohm
Headphone Sensitivity @1kHz	102dB SPL@1VRMS	98dB SPL@1VRMS	114dB SPL@1VRMS	99dB SPL@1VRMS	99dB SPL@1VRMS	96dB SPL@1VRMS
Microphone Element	Dynamic	Dynamic	Dynamic	Dynamic	Dynamic	Dynamic

An alternative to an intercom headset is the intercom handset and should be considered here as well. Push-to-talk handsets and telephone-type handsets are useable in any intercom system but are more practical for users who cannot use a headset because of their workflow. An example might be an audio mixing position in a live performance venue. Handset units tend to have limited frequency response of 300–3300 Hz. The limited high frequency performance of these units, although being sufficient for voice communications, may not be suitable for users who maintain long periods of listening because it creates fatigue.

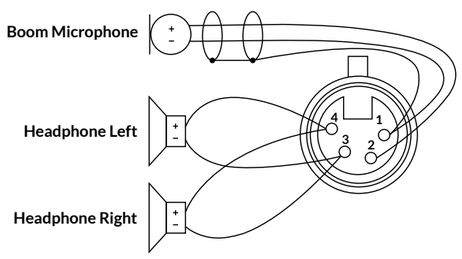
2.3 Intercom Headset Connectors

Headsets are the wearers' interface to the intercom system and how the headset is terminated is dependent on the intercom user station and function required. Communication headsets are offered in a variety of standardized connectors based on the XLR type.

The intercom listen function is normally configured as mono, i.e., a user listens to all intercom channels, and any program source if inserted, in both left and right earpieces equally. This is also called dual listen. See the example shown in the diagram below. The Clear-Com standard connector is the 4-pin female XLR. A headset wired as mono can also have other iterations, like having a 5-pin male XLR and can be either a single-ear or dual-ear headphone device.



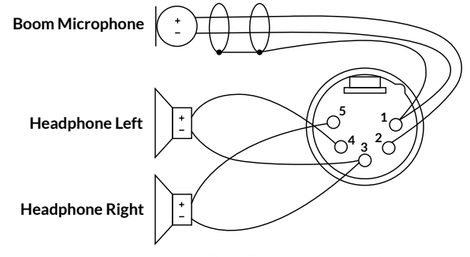
Single-Ear 4-pin Female XLR



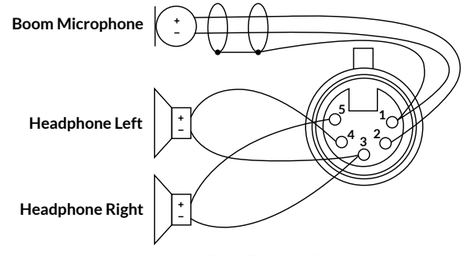
Dual-Ear 4-pin Female XLR

There are intercom workflows that require separate channel listens across the left ear and right ear. The reason behind this is typically intelligibility and to allow the user to focus more on important cues and direction. This is referred to as Split-Ear.

To be considered a Split-Ear operation, the system requires a stereo headphone or 'dual-earpiece' headset. Split-Ear operation places one intercom channel in one ear and another intercom channel in the other ear, resulting in listening to two sources separately and independently. One of these may be solely 'program audio' but both are delivered by the intercom. To fulfill this requirement, the dual-earpiece headset will be provided with a 5-pin or 6-pin XLR wired as split headphones (shown in the next two diagrams). The 5-pin male is typically standard.

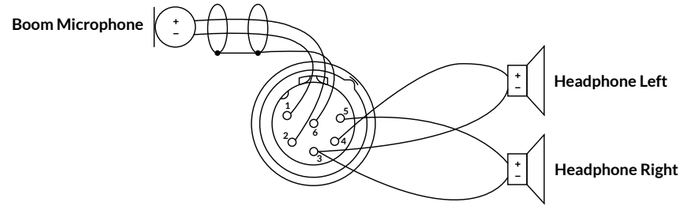


Dual-Ear 5-pin Male XLR



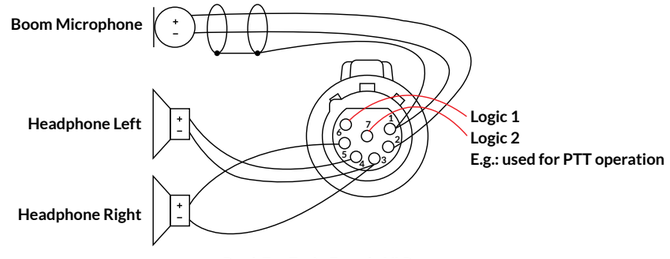
Dual-Ear 5-pin Female XLR

The 6-pin Male XLR connector offers connection for a balanced microphone and can also be used for this workflow.



Dual-Ear 6-pin Male XLR

The final headset connector option is the 7-pin XLR. This version is available for users who wish to include an inline PTT (Push-to-Talk) switch to turn the microphone on or off and/or to control other devices from this PTT switch, such as GPI's. This headset cable version works with the Clear-Com matrix keypanels logic control and offers two such controls.



Dual-Ear 7-pin Female XLR

3 Conclusion

We hope you've gained a slightly deeper understanding of what goes into the selection and use of an intercom headset. As you have learned there is a fair bit of detail to consider. We look forward to helping you bring your intercom vision into reality, headsets and all…

Visit the Clear-Com website for more information on headset products.

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About Clear-Com®

Clear-Com, an HME company, is a trusted global provider of professional real-time communications solutions and services since 1968. We innovate market proven technologies that link people together through wired and wireless systems.

Clear-Com was first to market portable wired and wireless intercom systems for live performances. Since then, our history of technological advancements and innovations has delivered significant improvements to the way people collaborate in professional settings where real-time communication matters. For the markets we serve – broadcast, live performance, live events, sports, military, aerospace and government – our communication products have consistently met the demands for high quality audio, reliability, scalability and low latency, while addressing communication requirements of varying size and complexity. Our reputation in the industry is not only based on our product achievements, but also on our consistent level of customer engagement and dedication to delivering the right solutions for specialized applications, with the expertise to make it work. Around the globe and across markets, Clear-Com's innovations and solutions have received numerous awards and recognitions for ingenuity and impact to customers.

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