

TOMMASO ROSATI
SOUND ART

THE
BOOK IS
NOW
AVAILABLE!

ELECTROACOUSTIC
SYSTEMS - ANALOG

CABLES, MIXER,
MICROPHONES,
SPEAKERS,
HEADPHONES

PLAY WITH SOUND

MANUAL FOR ELECTRONIC
MUSICIANS AND OTHER SOUND
EXPLORERS



TOMMASO ROSATI
TIMOTHY HSU

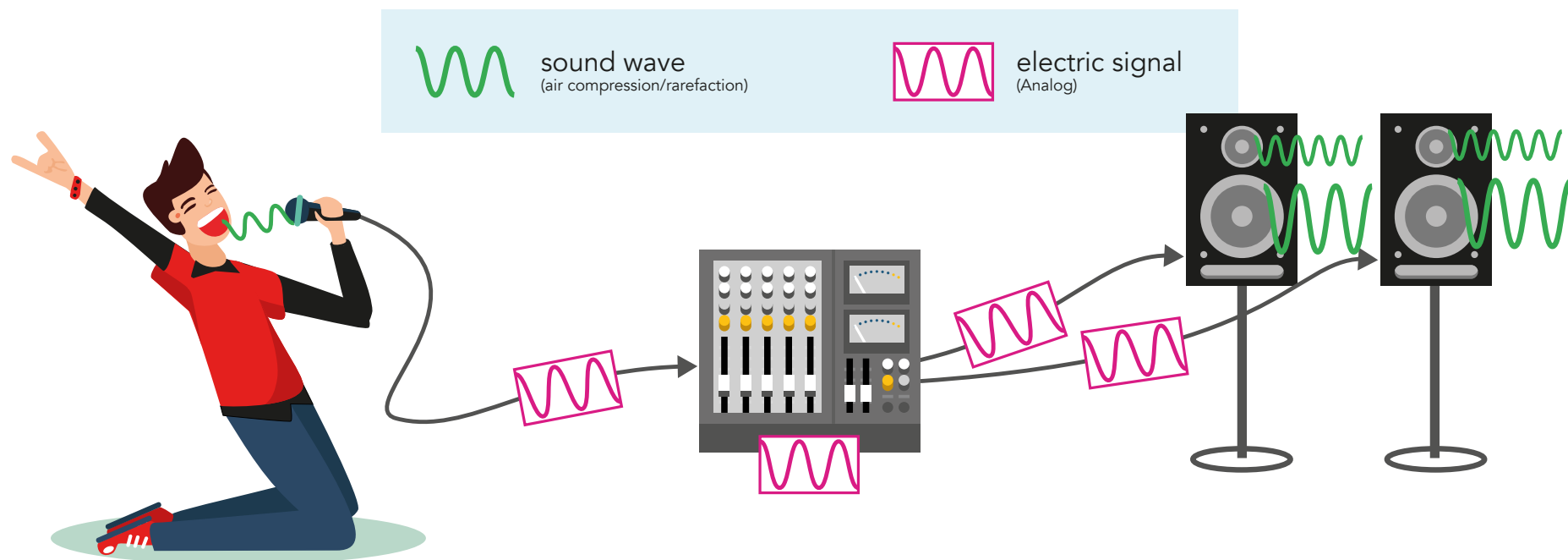
A Focal Press Book

Routledge

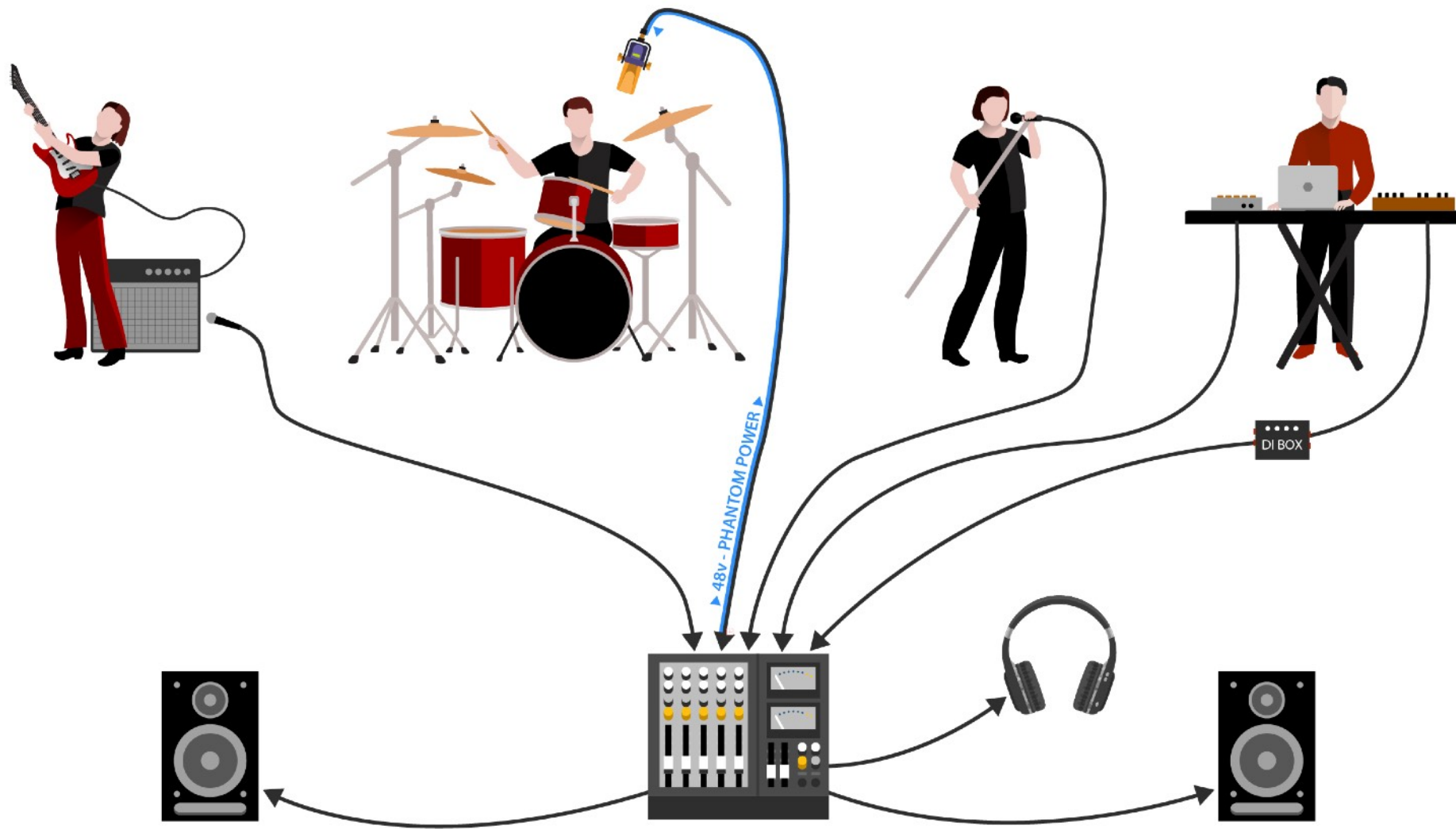
Electroacoustic systems - ANALOG

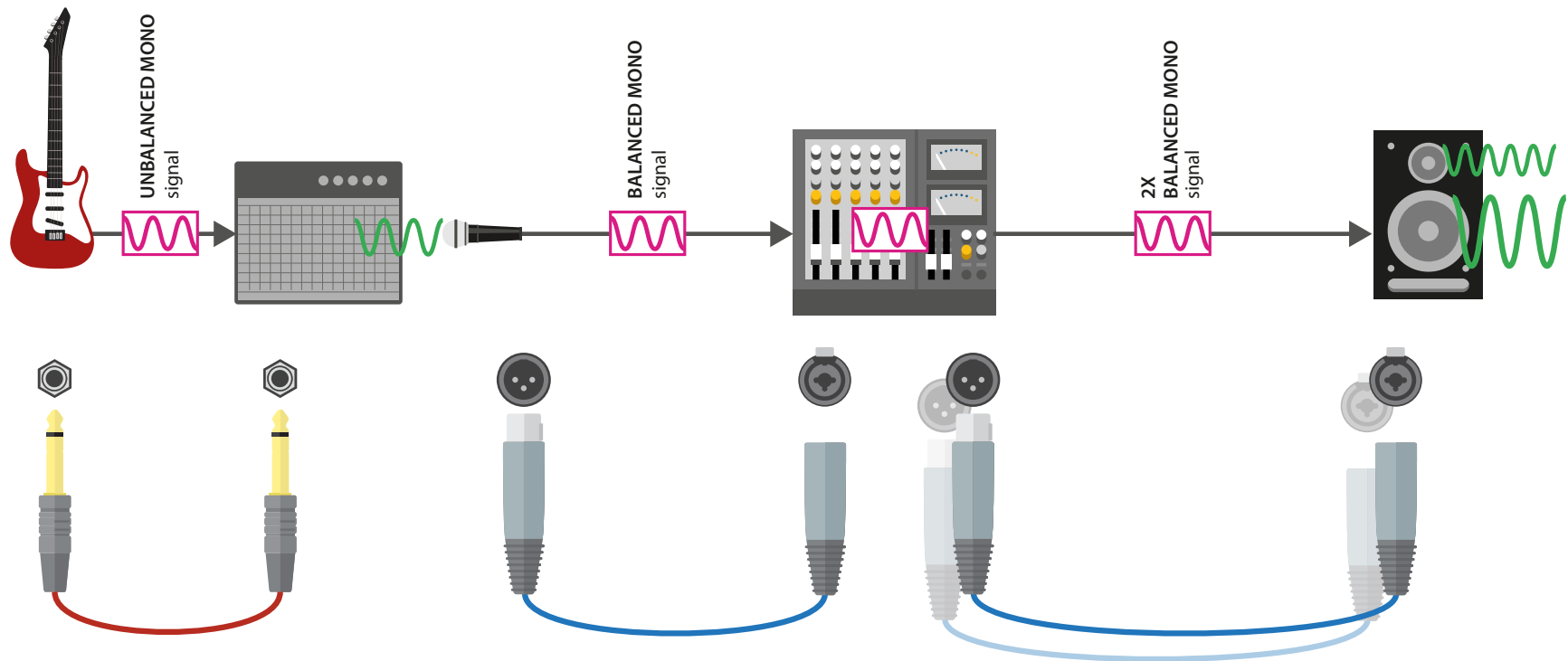
An electroacoustic system is a set of devices that, as a whole, receive, transmit, or store sound signals in analog or digital formats. Its purpose can be diverse, depending on the situation, device, cable, or configuration chosen.

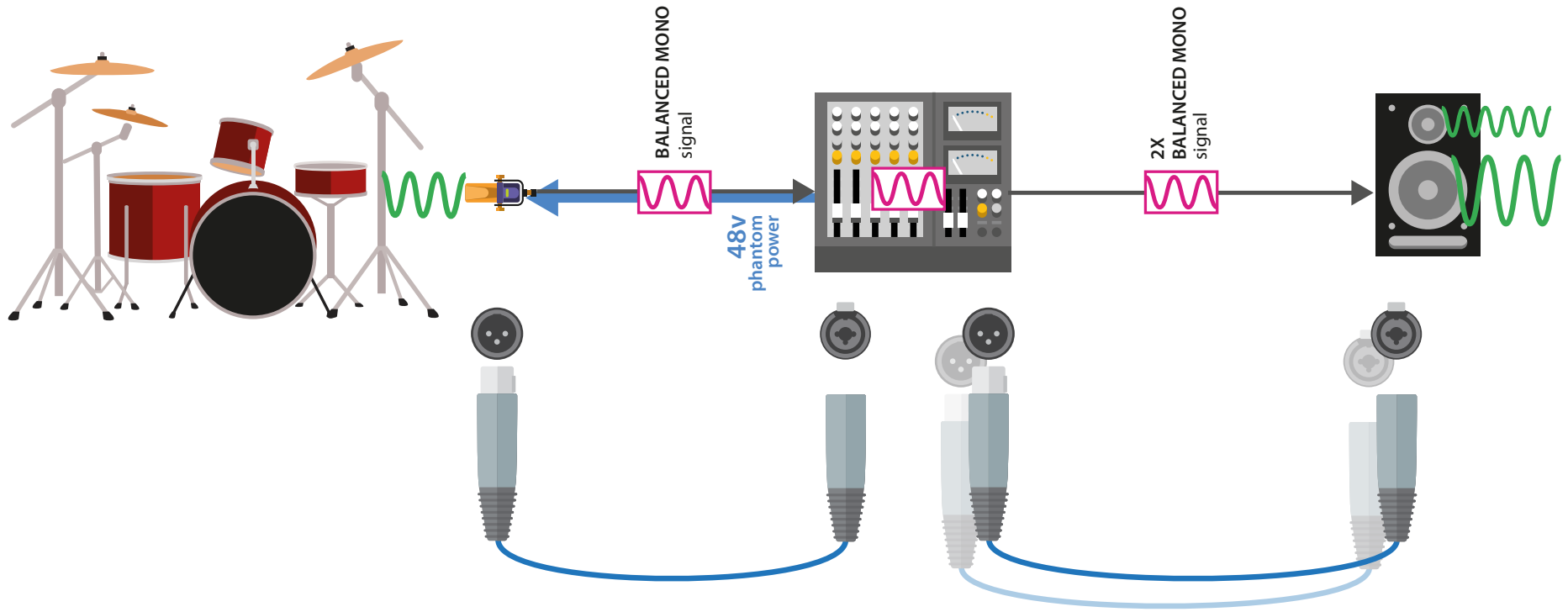
An analog signal is an electrical signal that is modulated to take on a waveform similar (analogous, in fact) to the waveform of the sound wave it represents.

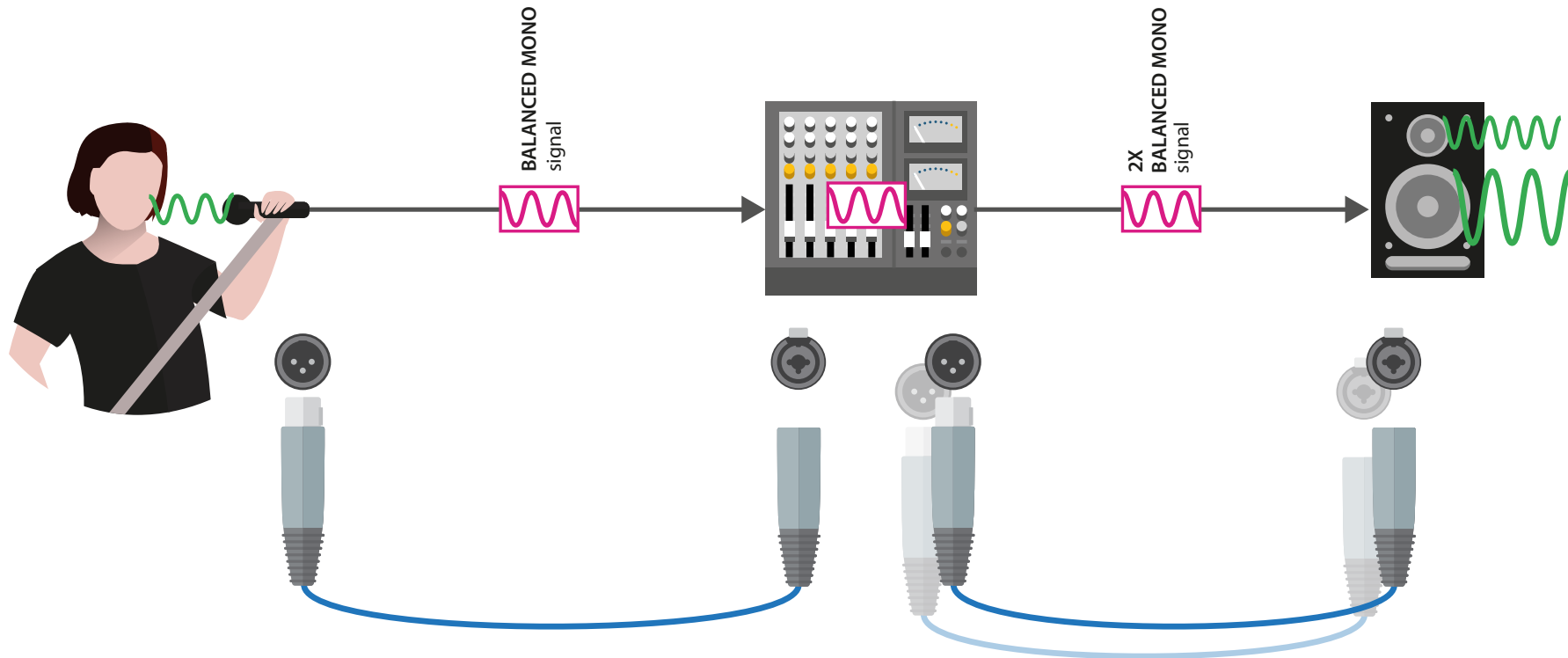


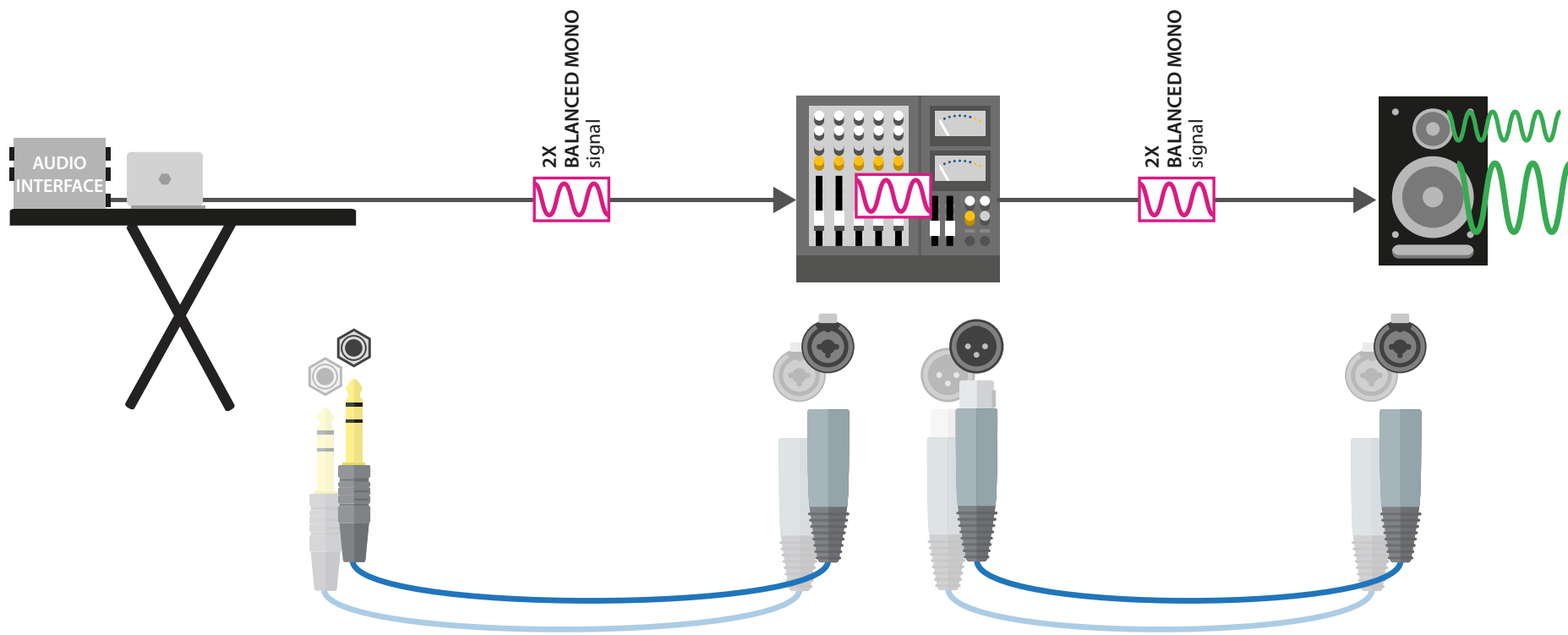
In this system, the microphone translates a sound wave (compressions and rarefactions in air) into an analog electrical signal. The signal passes through the cable and goes to the mixer. The mixer adds it to other inputs, potentially making small amplitude changes or timbral alterations by applying equalization. Finally, the signal is transmitted to the powered loudspeakers, which amplifies it and transforms the electrical signal back into sound waves (compressions and rarefactions in air).

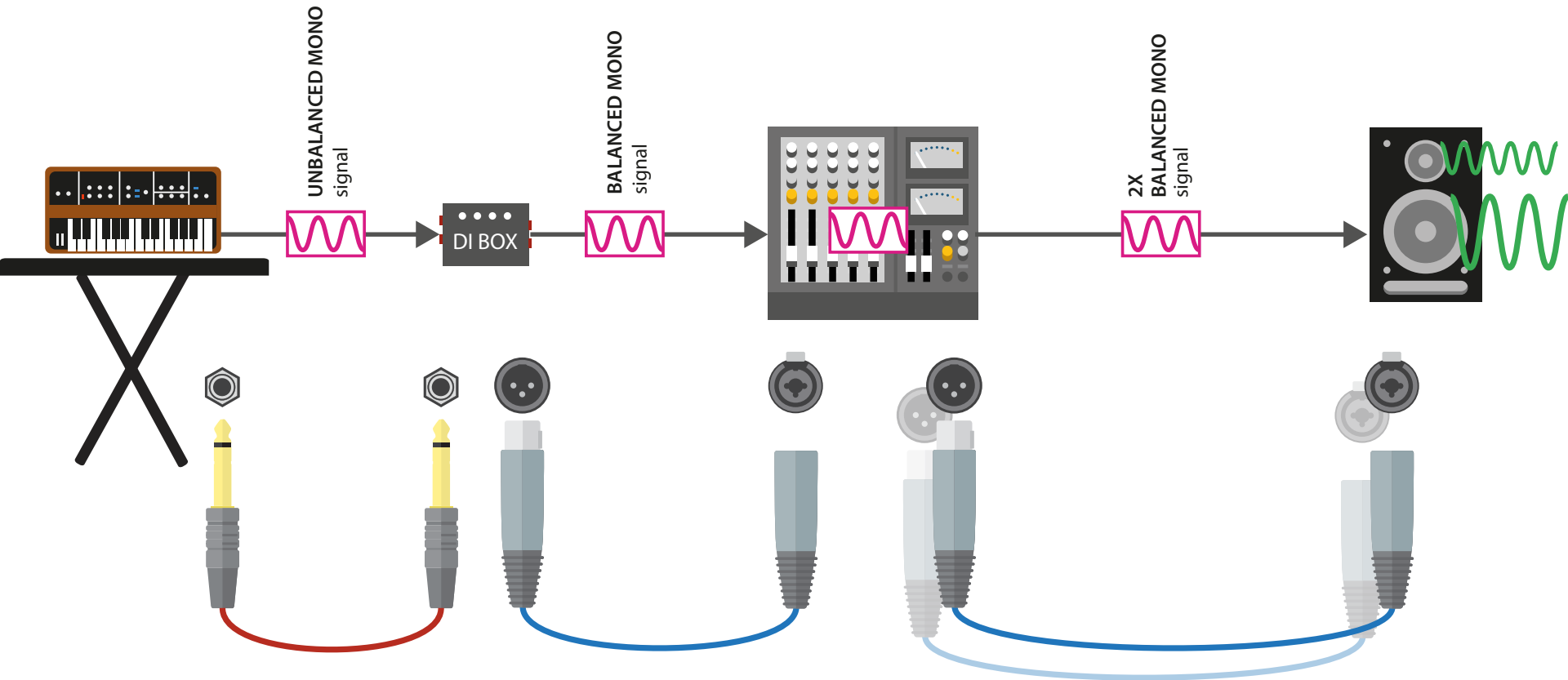








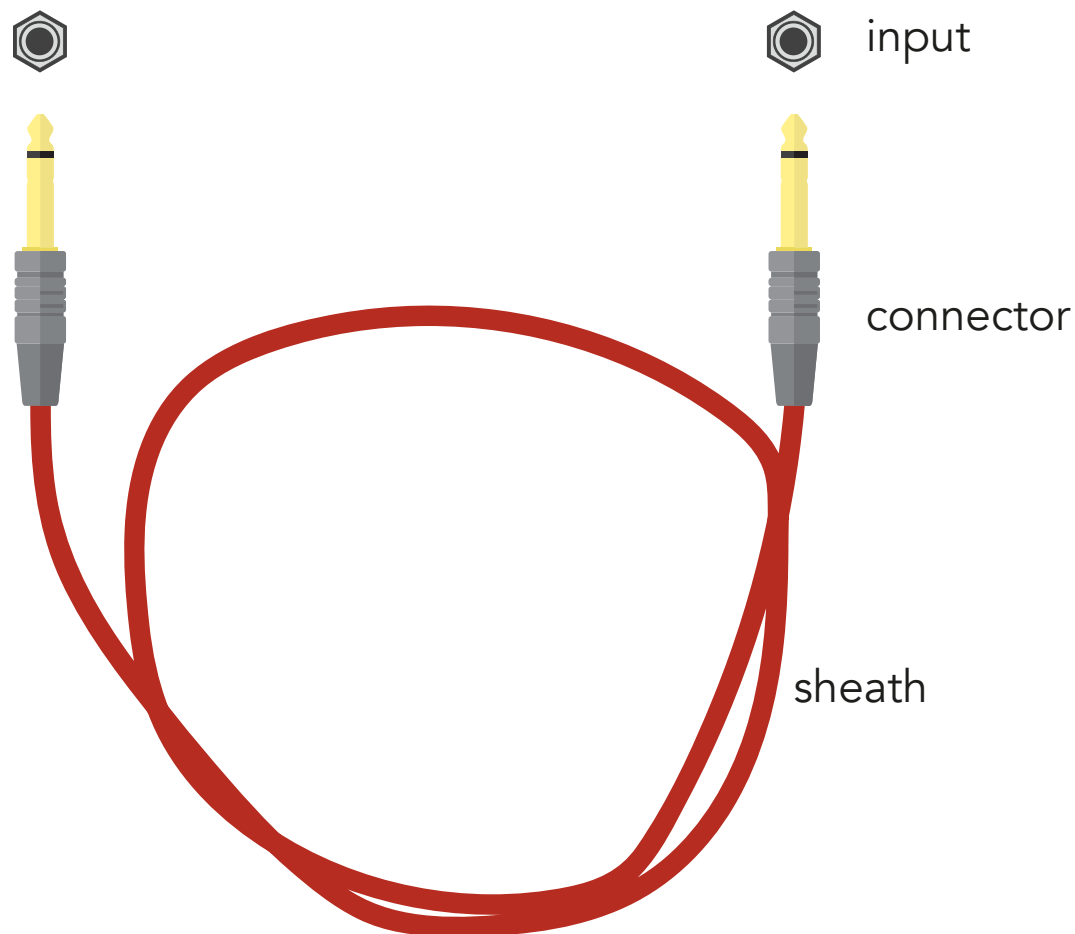




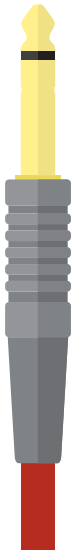
Cables, connectors, and inputs

Cables transmit signals from one point of the audio chain to another. A cable, generically, consists of a sheath or jacket containing several wires insulated from each other. The cable is terminated by two connectors, one at the beginning and one at the end of the cable.

Audio cables are divided into two main categories:
2-pin and 3-pin cables.



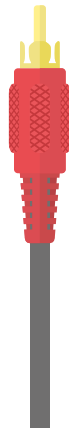
2-pin



TS
or 2-pin Jack
(1/4-inch 6.35mm)



mini TS
or 2-pin mini-Jack
(1/8-inch 3.5mm)



RCA

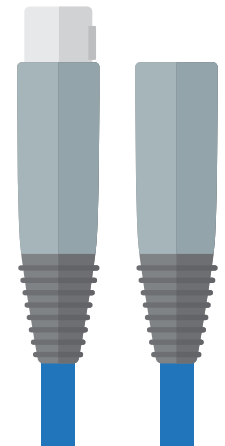
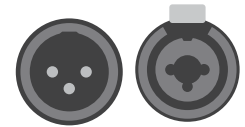
3-pin



TRS
or 3-pin Jack
(1/4-inch 6.35mm)

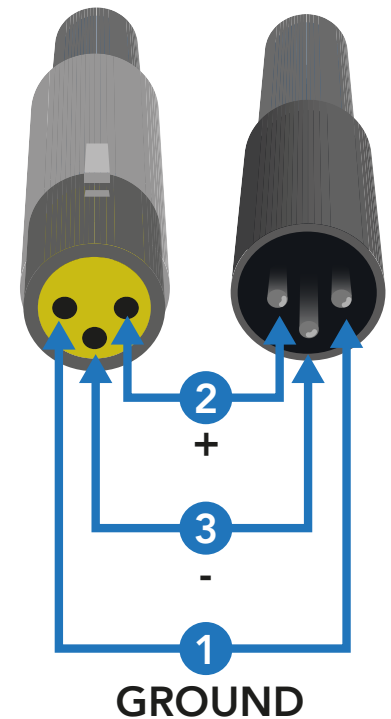
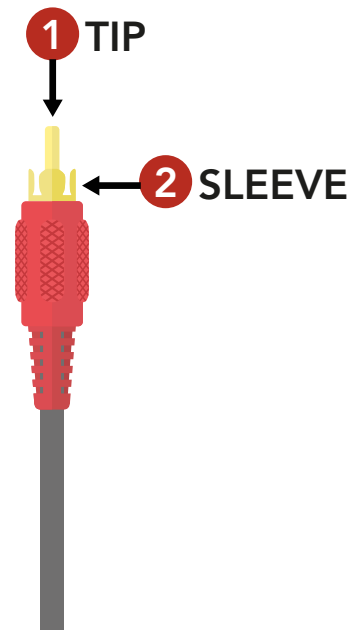
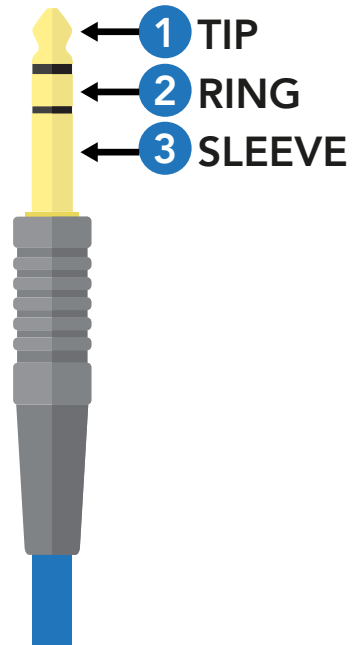
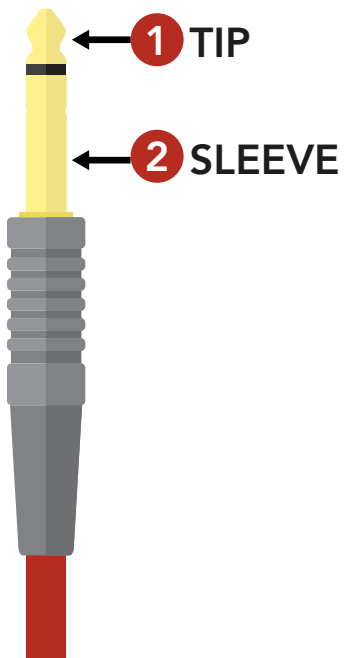


mini TRS
or 3-pin mini-Jack
(1/8-inch 3.5mm)



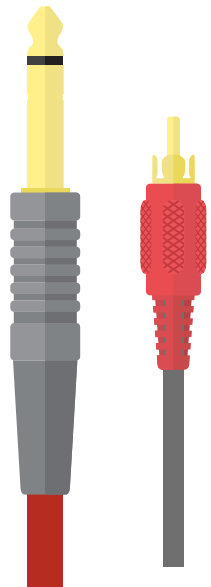
XLR
or Cannon

To find the number of cable pins, we need to check how many separate contacts the connector or plug has.



Cables - types of signals

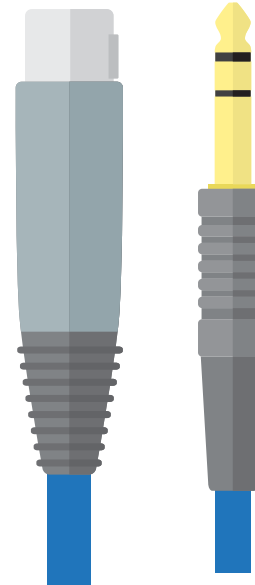
2-pin



unbalanced
MONO
signal



3-pin



balanced
MONO
signal



or

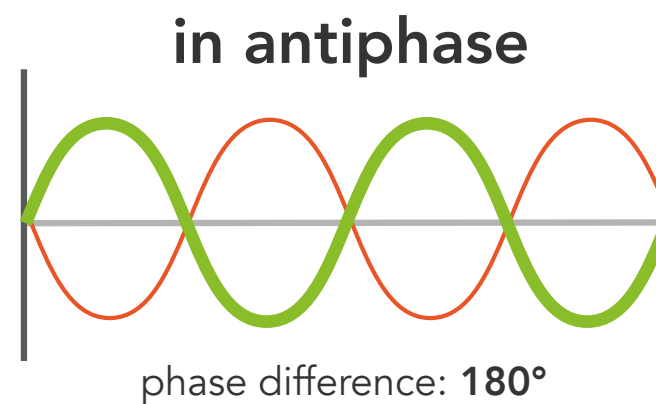
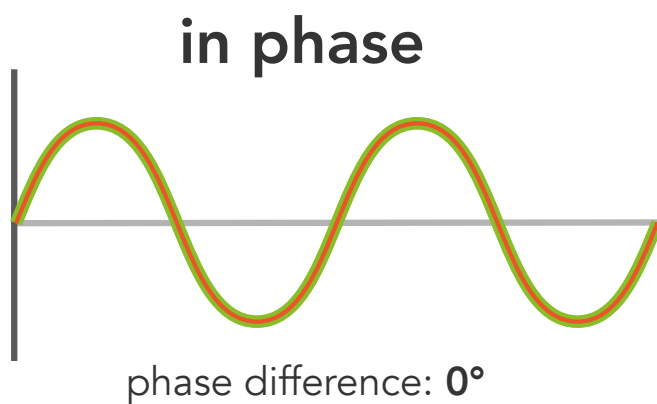
unbalanced
STEREO
signal




Balanced connection

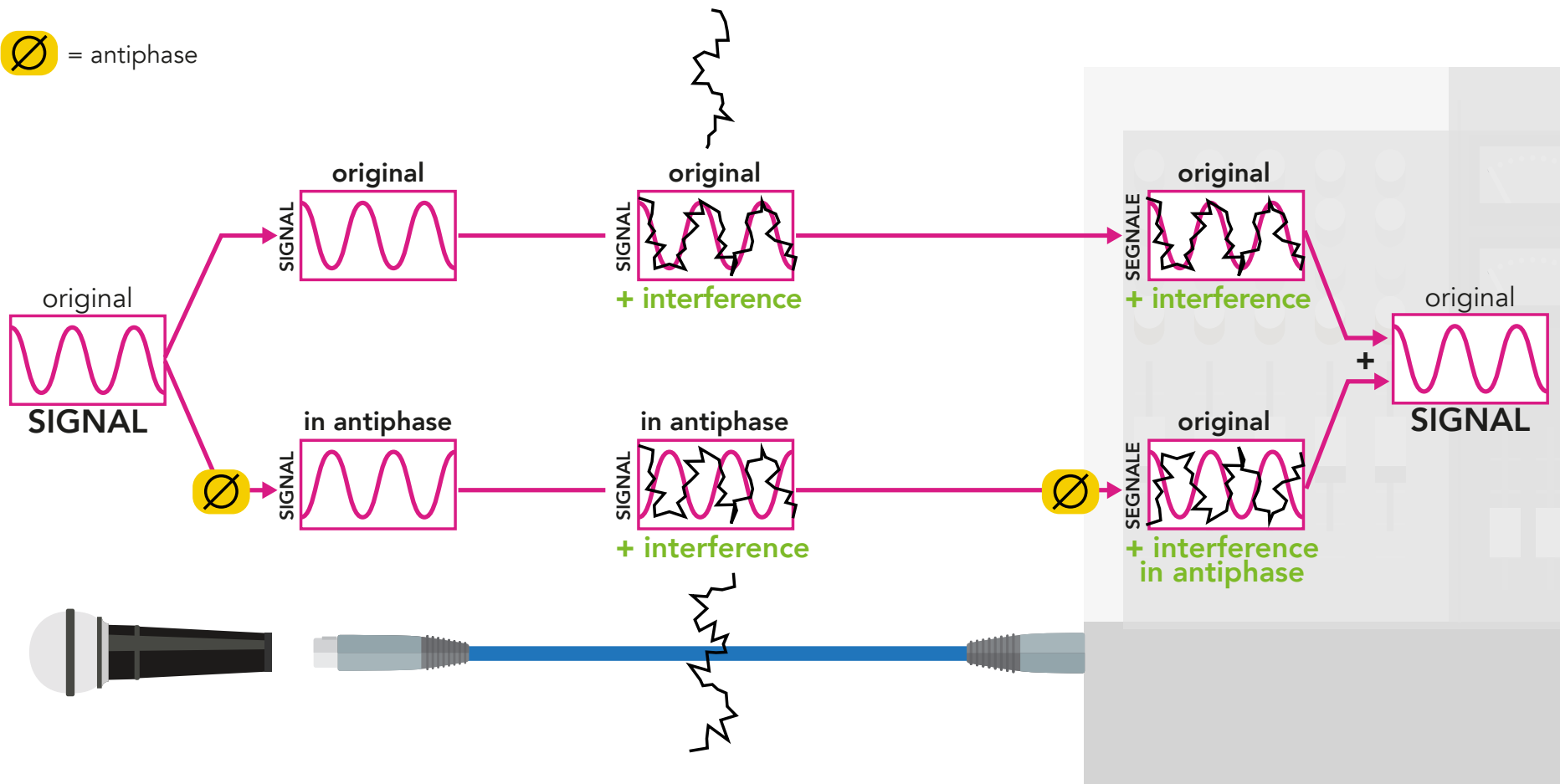
A **balanced connection** is a method of preserving the audio signal, even over long distances, by minimizing and canceling out external noise-inducing interference.

This is possible because balanced connections reverse the polarity of one of the wires within the cable

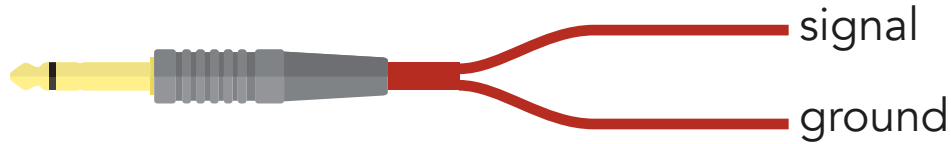


A microphone outputs two 'hot' signals: one through Pin 2 (+) and an inverted version through Pin 3 (-). Noise affects both signals identically. At the mixer, Pin 3's signal is inverted and added to Pin 2's, retaining the original signal while canceling the noise.

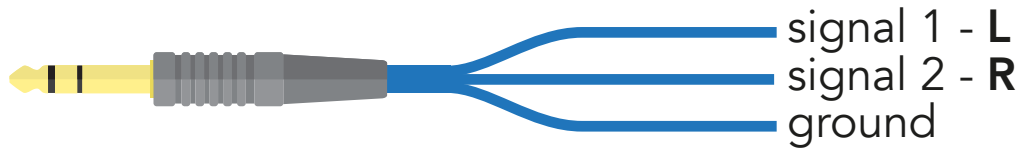
 = antiphase



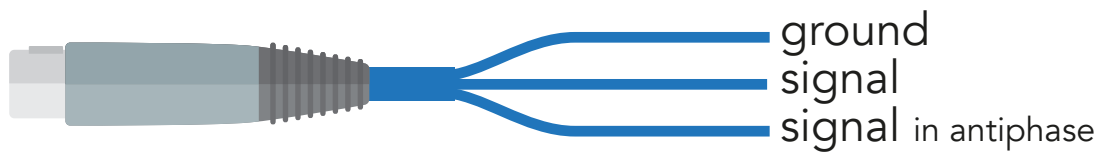
Cables - types of signals



▶ unbalanced
MONO
signal



▶ **STEREO**
signal



▶ balanced
MONO
signal



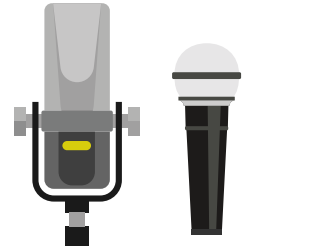
INPUT

Signal Levels

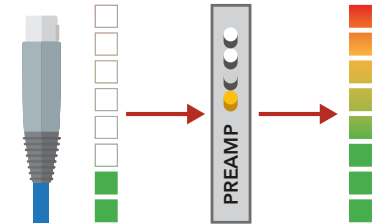
Each instrument or device produces a different level of voltage, which can be divided into three categories:

Mic level, Instrument level, and Line level

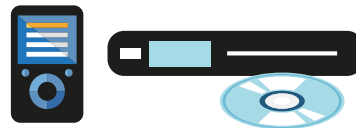
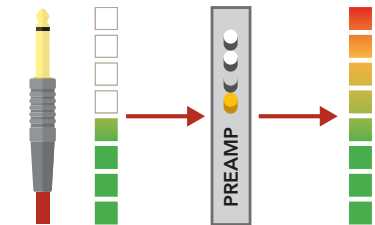
Mixers and other devices that receive multiple signals have different types of inputs, each intended to receive different kinds of signal levels.



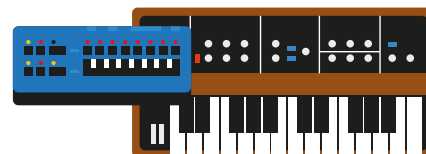
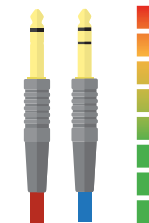
Mic level
from -60 to -40 dBV



Instrument level
-20 dBu



Line level
Consumer
-10 dBV



Line level
Professional
+4 dBu

both dBV and dBu measure the Volts of our signal but related to different values: 1V for dBV and 0.775V for dBu

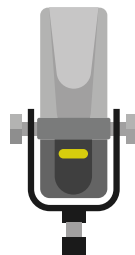
Impedance (Z)

is the opposition to alternating current caused by the resistance and reactance of elements in an electric circuit.

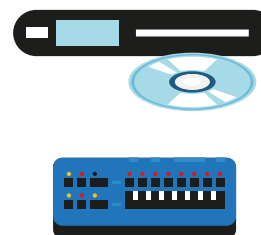
Every device has an **Output Impedance** and a **Load Impedance**. The output impedance refers to what resistance an external device experiences when plugged into the instrument. Load impedance refers to the impedance presented to an audio device from an external load, such as a speaker.

For example, Lo-Z is less prone to interference.

Mic



Line



Lo-Z
Low impedance
50 Ω - 600 Ω

Instrument



Hi-Z
High impedance
10 k Ω - 100 k Ω

DI-BOX

(Direct Inject Box)

DI-Box transforms an unbalanced high-impedance signal into a balanced low-impedance signal. This conversion allows our signal to make long runs without losing quality.

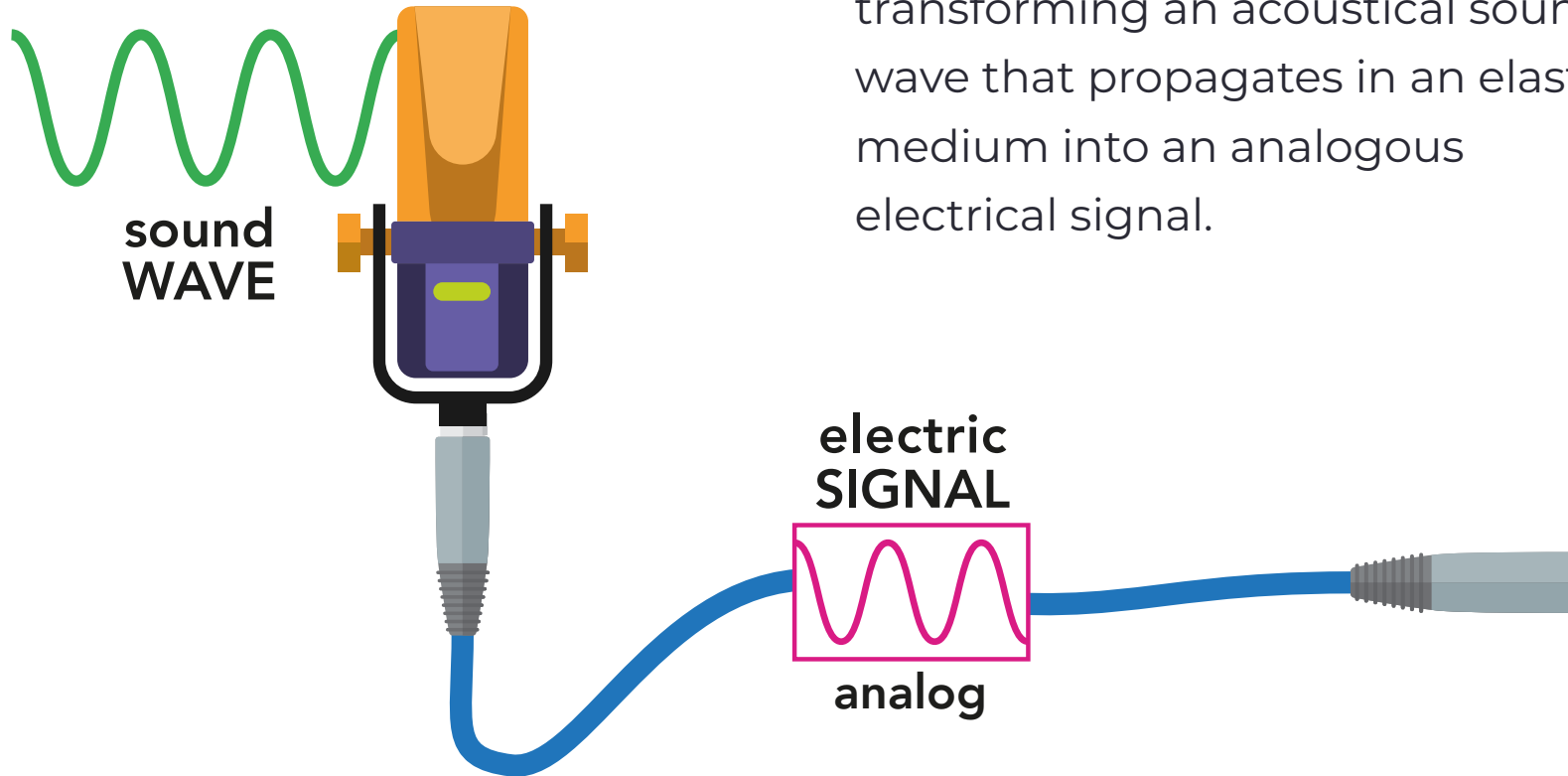


Microphones



CHECK OUT
"MICROPHONES AND PICKUP"

A microphone is a **transducer**, transforming an acoustical sound wave that propagates in an elastic medium into an analogous electrical signal.





CHECK OUT
"MICROPHONES AND PICKUP"



DYNAMIC

3-pin cable
XLR connector
mono balanced signal



Needs **+48V**
(phantom
power)

CONDENSER

3-pin cable
XLR connector
mono balanced signal



RIBBON

3-pin cable
XLR connector
mono balanced signal

SPECIAL MICROPHONES



CHECK OUT
"MICROPHONES AND PICKUP"

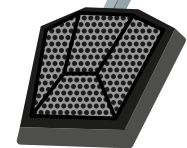
Contact piezo



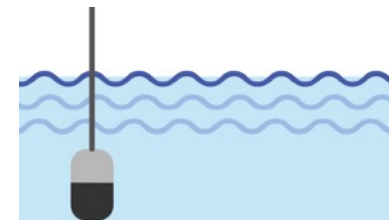
Electret



Boundary layer (PZM)

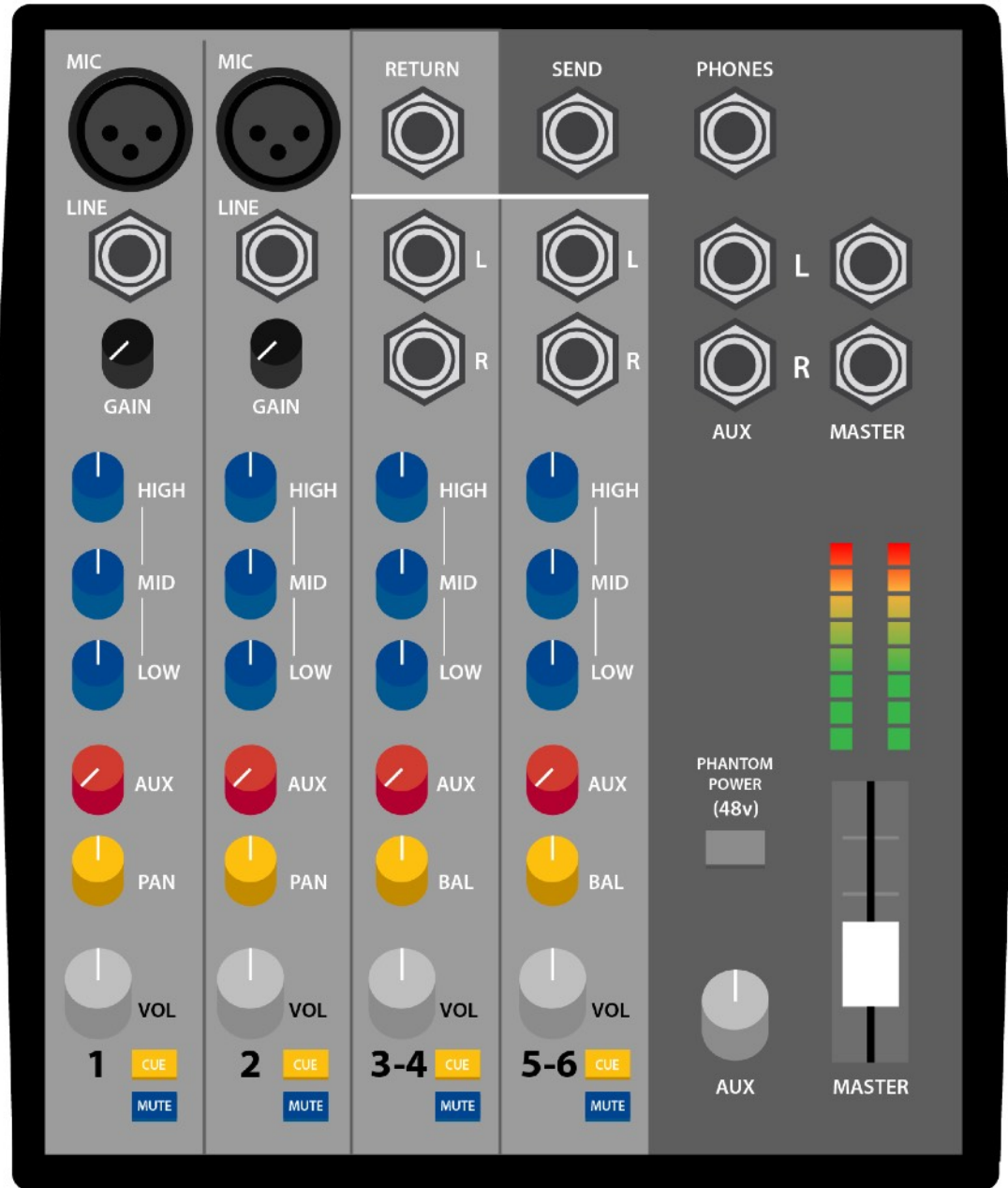


Hydrophone



PROCESSING

Analog Mixer



send/return

outputs to outboards and external effects and returns the processed signal

MIC input

XLR - mic level input

phones

headphone output

line/inst input

TS - Line or Instrument level input

gain

adjusts the preamplification of the input signal. Essential for mic level signals such as those from microphones

Equalizer (EQ)

emphasizes or attenuates certain bands of frequencies through filters (in this case highs, mids, and lows)

aux

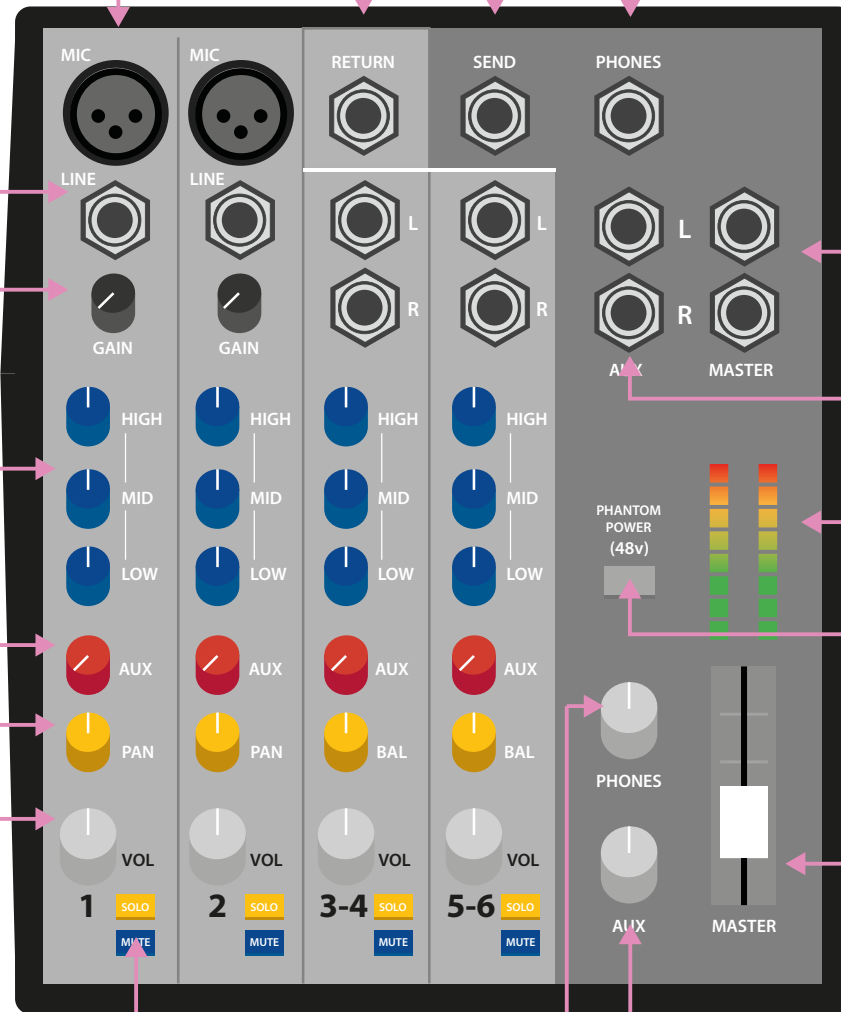
controls how much of each corresponding channel is sent to the auxiliary output

pan

determines the position of the sound in the stereo mix (L-R)

vol

controls the output volume of the corresponding channel



master

sends signal to the two main outputs (Left and Right), connected to the main speakers

aux

sends signal to the secondary outputs, usually connected to the stage monitors

meter

displays the amplitude of the left and right signals through the lighting of small LEDs

phantom power (+48V)

sends auxiliary power to the microphone inputs by pressing this button, essential for the operation of condenser microphones

master

controls the output volume of the main outputs

solo

plays only this channel, muting all others

mute

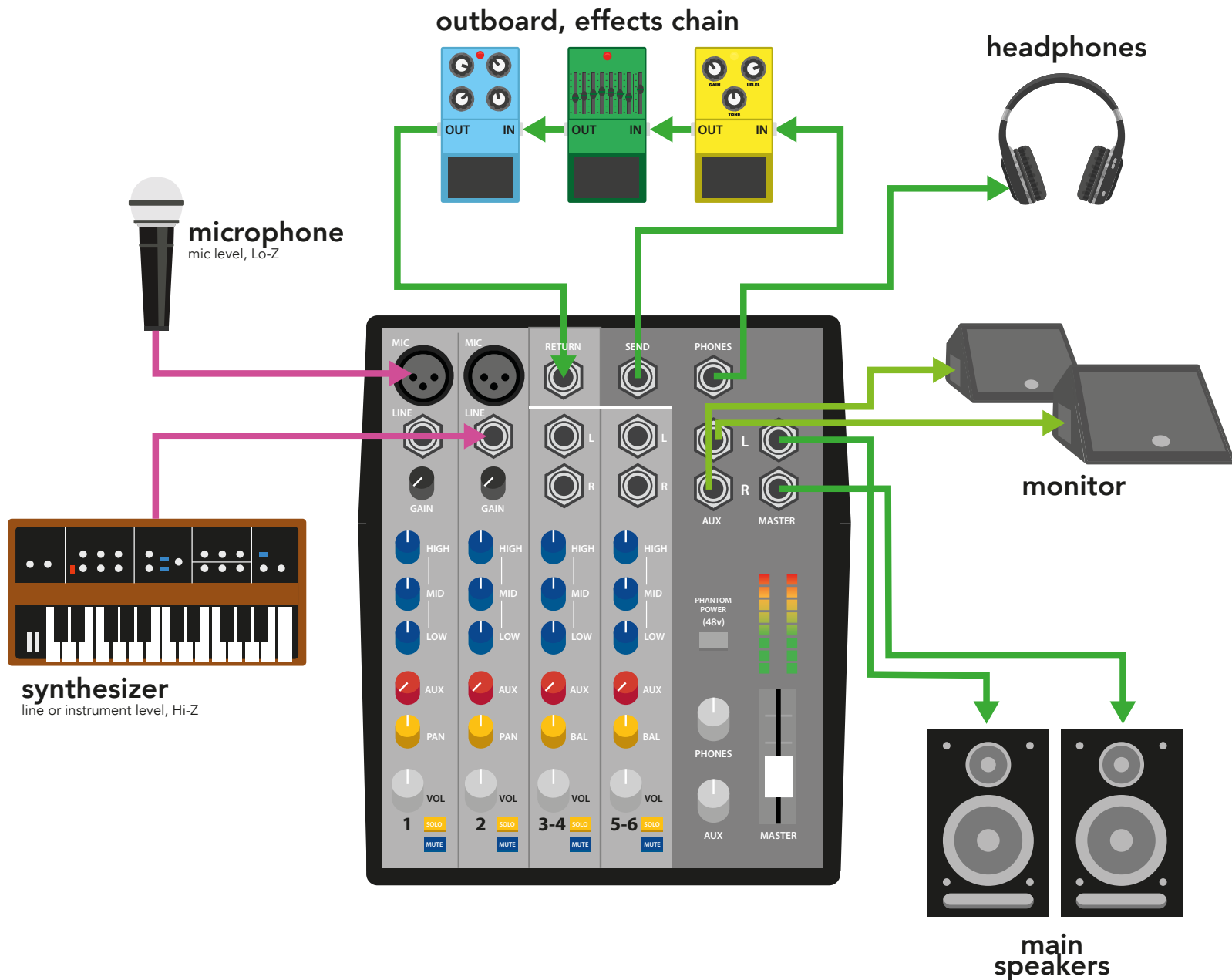
silences only this channel

aux

controls the output volume of the auxiliary outputs

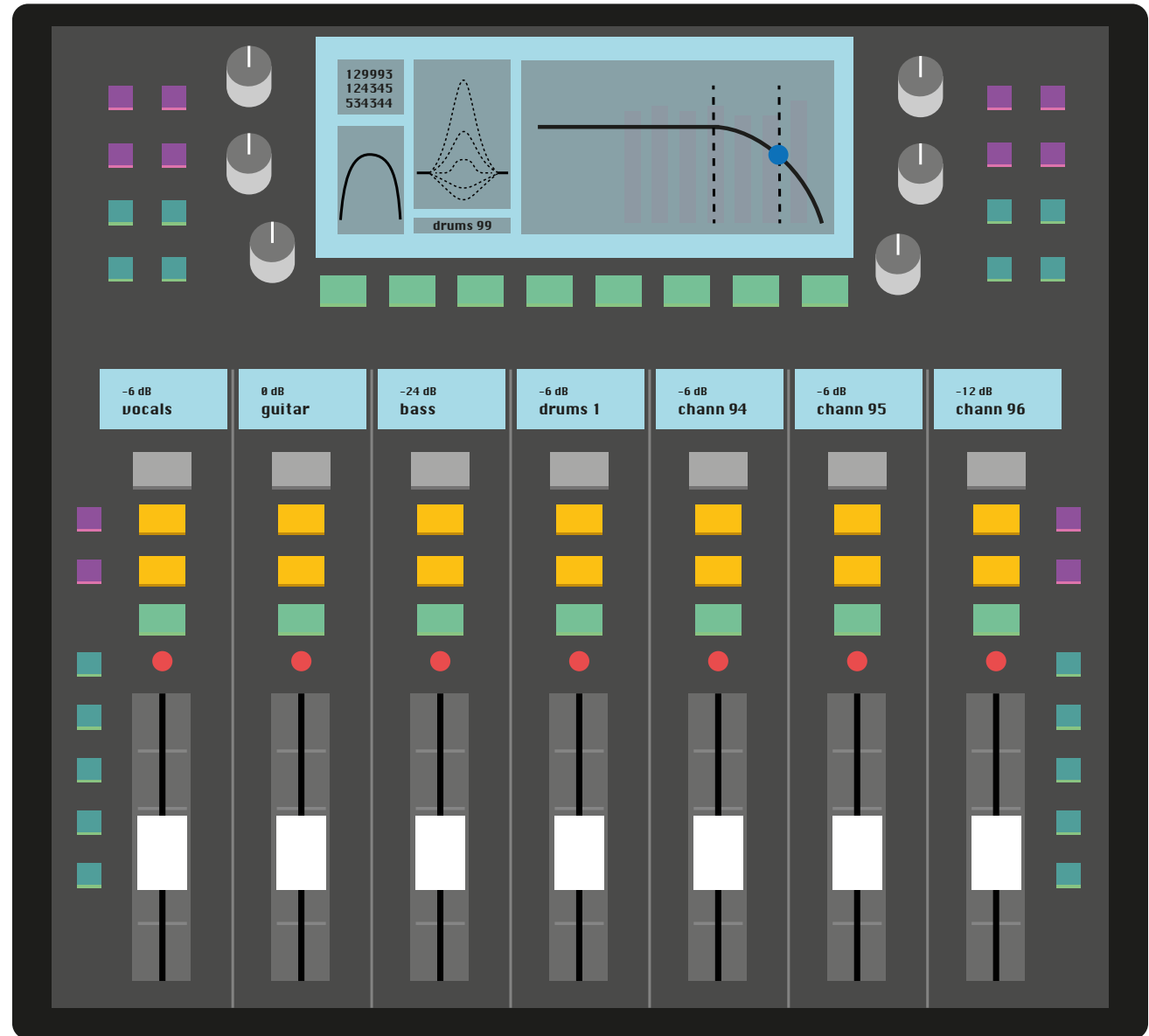
phones

controls the output volume of the headphones



Digital Mixer

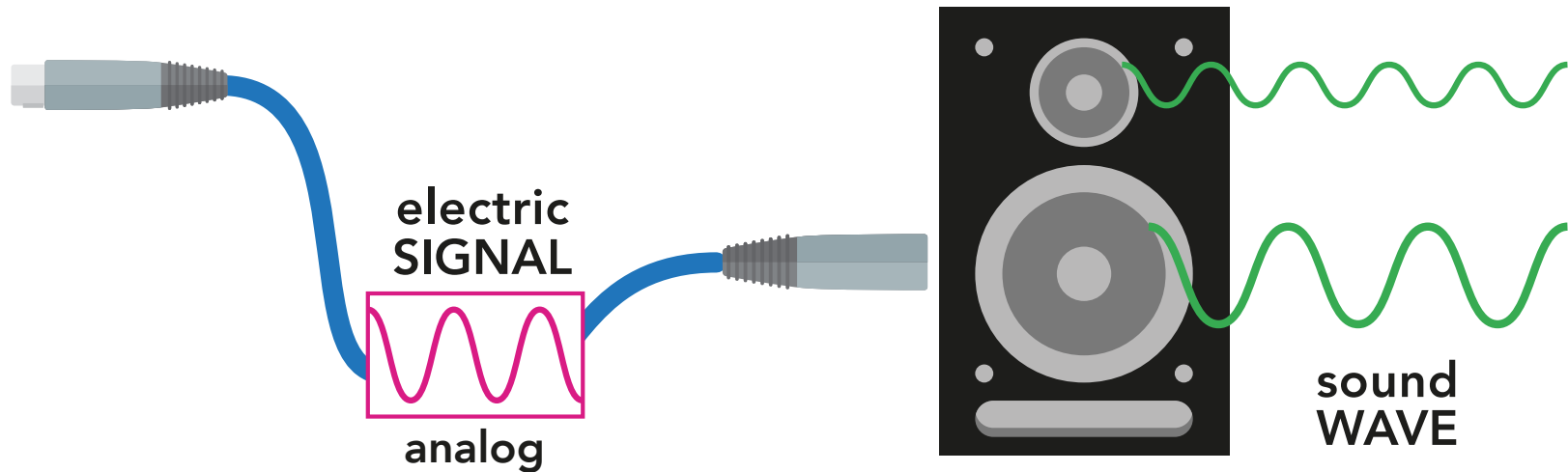
Digital mixers have a digital processor that manages their entire process. With digital mixers, users route and process sound in many versatile ways, save scenes or presets that can be recalled instantly, and rely on the advantages of digital signal processing.



OUTPUT

Monitors/Speakers

Dynamic loudspeakers work in reverse to the dynamic microphones. Here, the drivers receive an electrical signal that moves a cone, compressing and rarefying the air, effectively generating a sound wave that corresponds to the received signal.

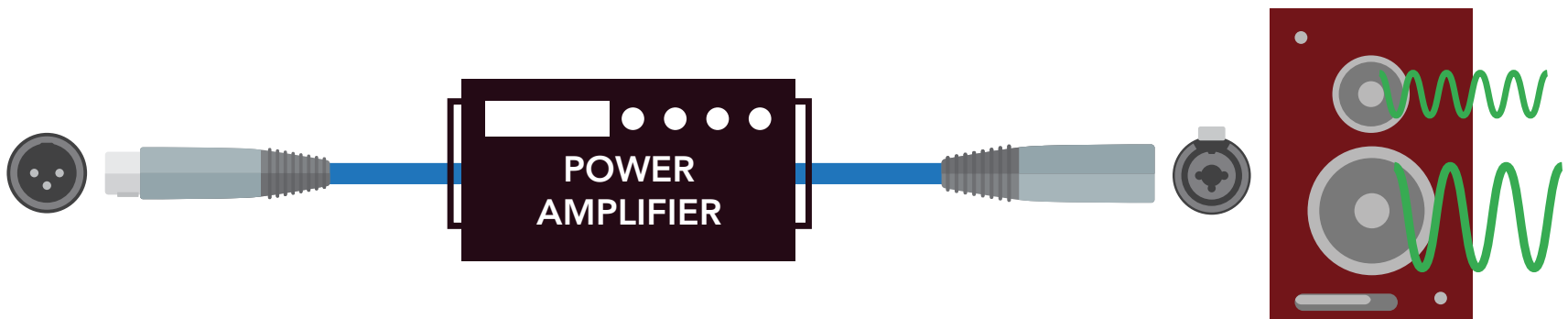


OUTPUT

If the loudspeaker box contains the speaker drivers and a **power amplifier**, all integrated in one enclosure, it is an **active speaker**.



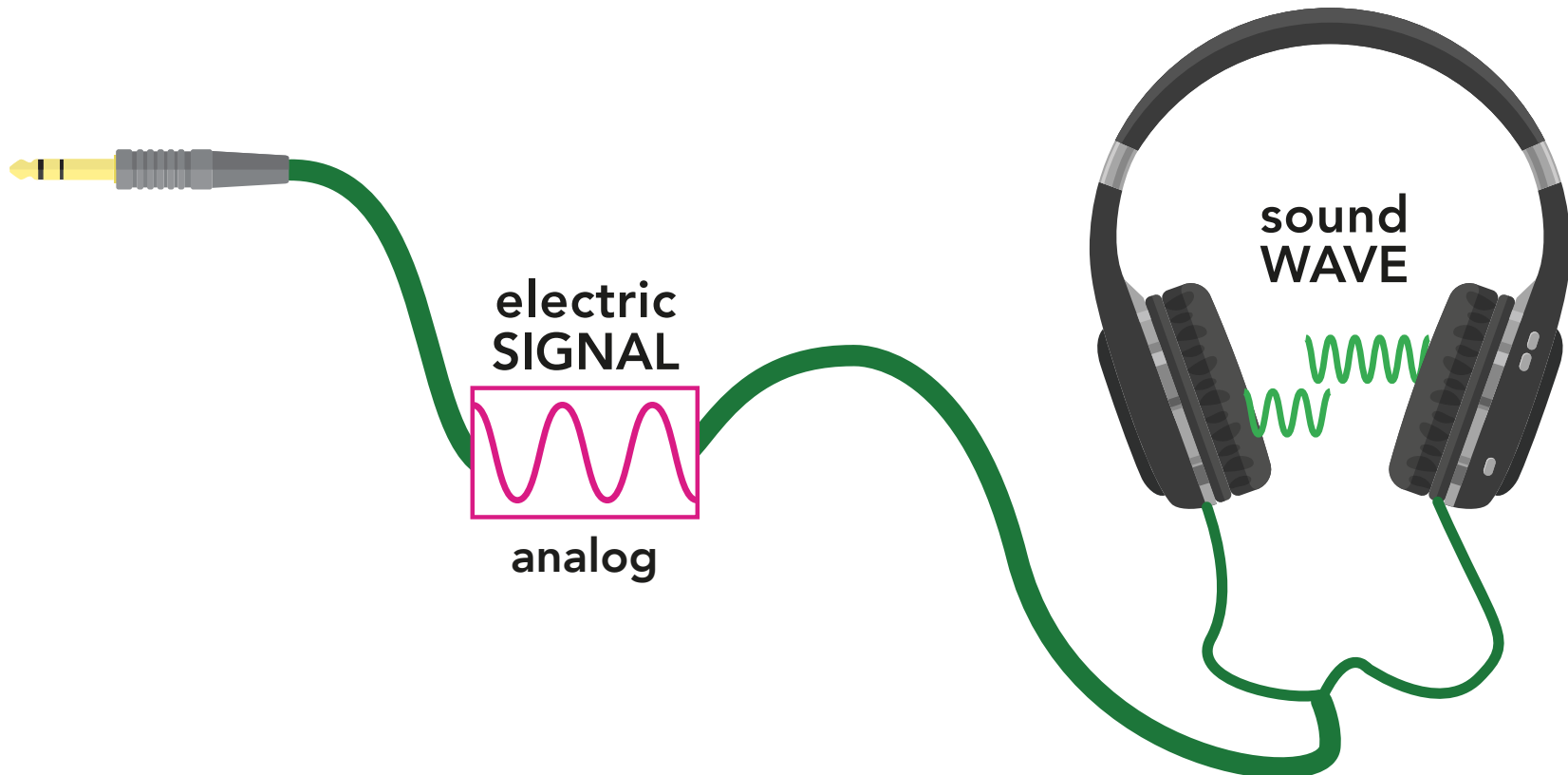
If the enclosure contains all the components except the power amplifier, then we have a **passive speaker**.



OUTPUT

Headphones

Headphones behave like small speakers. One major difference is that headphones generate sounds with much less sound pressure, they do not require power amplification.



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