LITTLE BOXES for audio: How they differ, how to connect them, where to use them

Little audio devices can be confusing. What's the difference between a phantom power supply, a preamp, a direct box, and a stomp box? How do I connect a Bartlett Mic to them? Do I even need those devices?

In this month's issue I'll tell what those boxes are, how they work, and how to use our mics with them.

Some important specs for those devices are impedance and balanced/unbalanced. If you aren't familiar with those terms, please see the sidebar at the end of this article.

Phantom power supply
This device supplies power to condenser microphones to operate their internal circuitry. Phantom power is 12 to 48 volts DC on XLR pins 2 and 3 with respect to pin 1. Phantom power is supplied to a mic on the same mic cable that carries the mic signal to a mixer.

Behringer PS400, an example of a phantom power supply.

Nearly all mixers supply phantom power at their mic inputs. You simply plug a microphone into a mixer mic input and turn on phantom power.

All Bartlett Microphones are condenser mics, so all require phantom power. An exception is our battery-powered guitar microphone.

With this understanding, we're ready to take a look at each device mentioned above.

Guitar Preamp

Fishman Pro EQ Platinum, an example of a Guitar Preamp

A guitar preamp lets you match a pickup's signal to a mixer input and modify the pickup's sound. The preamp amplifies a high-Z, unbalanced signal from a pickup, and provides a low-Z, balanced signal that lets you run a long cable from the stage to the mixer without degrading the sound.

If your instrument has a pickup, that pickup needs to plug into a preamp or direct box, rather than directly to a mixer mic input. Why? A pickup is high impedance, but a mixer mic input is low impedance. If you connect a pickup directly to a mixer mic input, the mixer's low impedance input will "load down" the pickup, making it sound bad – thin or dull.

But a guitar preamp has a very high input impedance, which works great with a pickup's high-impedance signal. The guitar preamp converts that high-Z signal from the pickup into a low-Z, balanced signal that is ready to plug into a mixer's XLR mic input.

Some guitar preamps have EQ controls so you can adjust the bass, midrange and treble of your guitar's amplified sound. A few units have a sweepable notch filter to remove frequencies that feed back.

Some preamps are battery powered; some are phantom powered. Note: A phantom-powered preamp doesn't supply phantom power to a mic; instead, the preamp's internal circuitry is powered by phantom power from the mixer that it is plugged into.

Direct box
A direct box or DI (Direct Injection box) is a device that converts a high-impedance, unbalanced signal to a low-impedance balanced signal. That lets you run long cables to your mixer without picking up hum or losing high frequencies.

A guitar preamp has the same function, but it also has some built-in electronics for amplification and usually EQ.

A direct box has a 1/4òphone jack that you plug your pickup into. Coming out of the box is a male XLR connector. You use a mic cable to connect that XLR to your mixerôs mic input.

So the signal flow is:

Pickup > guitar cord > DI > mic cable > mixer mic input.

A passive direct box has an impedance-matching transformer inside, but has no electronics. An active direct box has an FET (field-effect transistor) inside. It requires a battery or phantom power to operate.

Whirlwind IMP 2, an example of a passive direct box.

Behringer Ultra-DI, an example of an active direct box

The input impedance of a passive direct box is about 12 kilohms. It will work with a guitar pickup but is not ideal. The input impedance of an active direct box is

about 1 megohms (1,000,000 ohms), which is an ideal load for a guitar pickup ï giving the best sound.

Mic preamp

ART Studio V3, an example of a tube mic preamp

A mic preamp amplifies the weak signal from a microphone up to a stronger signal called ñline levelò It has a female XLR connector which you plug a mic into, and a male XLR connector or phone jack output which you connect to a line input on a mixer or audio interface.

All sound mixers have mic preamps built in, so why would you need one? You probably donôt. But some mic preamps have a vacuum tube to lend a ñwarmò sound, and some have EQ controls so you can tailor the tone of your microphone from onstage.

Stomp box

Digitech Screamin' Blues, an example of a stomp box

A stomp box or pedal is an electronic device that lets you apply sound effects to an instrument, such as compression, EQ, distortion, chorus, flanging, and so on.

It has a high-Z ¼ò phone jack input and output, a footswitch to turn it on and off, and controls that affect the sound.

Suppose you want to connect a low-Z, balanced mic signal to a stomp box. You need to convert low-Z to high- Z, and convert balanced to unbalanced. A device for that purpose is a Radio Shack A3F XLR jack-to-1/4" plug adapter/transformer, part no. 274-016.

Note that the mic needs phantom power to operate. So you connect a phantom power supply between the mic and the adapter. Plug a mic cable into the output of the power supply, and connect that mic cable to the adapter/transformer. Finally, plug the adapter/transformer into the stomp box.

Hereôs the series of connections to make:

Mic > phantom power supply > mic cable > adapter/transformer > stomp box.

You donôt always need EQ. Bartlett Microphones are designed to sound good right out of the box. Just plug the mic into your bandôs sound mixer and turn on phantom power.

Our Fiddle Mic has "built-in EQ" in the form of mic placement. For a brighter sound (like turning up the high frequencies), place the mic behind the bridge. For a warmer sound (like turning up the low frequencies), place the mic near an f-hole. You should be able to find a sweet spot on your instrument that will deliver a consistent, natural timbre to the sound mixer.

SIDEBAR: Impedance
Impedance (abbreviated Z) is an electrical characteristic of any audio device. Itôs measured in ohms.

High impedance is about 25,000 ohms or more; low impedance is about 600 ohms or less.

These devices are high-Z:
*Guitar pickup
*Guitar amp input
*Stomp box input
*Guitar preamp input
*Direct box input

These devices are low Z:
*Professional microphone
*XLR mic input

Low impedance is an advantage whenever you need to run long cables. Suppose a signal from a high-impedance device is traveling on a cable. The signal picks up hum and loses high frequencies (treble) if the cable is more than about 15 feet long. A low-impedance signal can run on a cable hundreds of feet long without picking up hum or losing high frequencies.

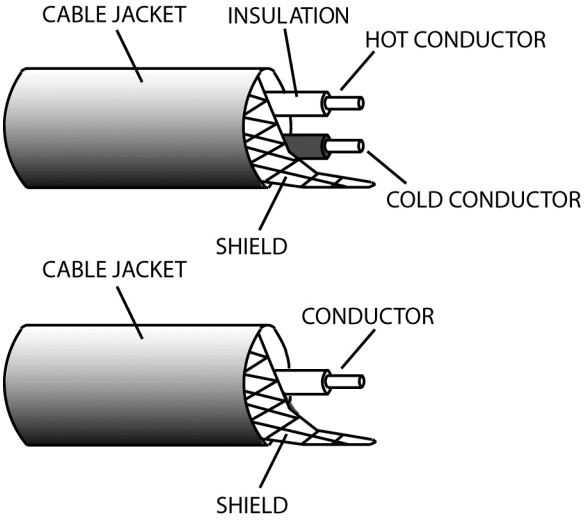
You can convert a high-impedance signal into low impedance in order to use long cables, such as a mic snake between the stage and mixer. That conversion is done by a direct box or guitar preamp, which we'll cover later.

Generally you should connect high-Z devices together and connect low-Z devices together. What happens if you plug a low-impedance signal (like from a mic) into a high-impedance input (like in a guitar stomp box or guitar amp)? The signal will be weak. You may need to turn it up so much that you hear noise. Fortunately, you can convert a low-Z signal into high-Z by using a step-up transformer. An example is the Radio Shack A3F XLR jack-to-1/4" plug adapter transformer, part no. 274-016, shown below.

SIDEBAR: Balanced vs. unbalanced

We also need to explain "balanced" and "unbalanced." This involves some tech-talk, but bear with me.

An audio cable has one or two wires (conductors) inside it. The conductor(s) are surrounded by a shield, which is a cylinder made of many thin wires. The shield covers the wires and reduces pickup of hum. A balanced signal is carried on two wires inside the shield. An unbalanced signal is carried on one wire and the shield.



In a balanced cable, the signal in one wire is in opposite polarity with the signal in the other wire. When the signal voltage goes positive in one wire, it goes negative in the other wire.

Suppose you plug this balanced cable into a mic input connector. The signal goes to a mic preamp. That preamp picks up the signal difference between the two wires, so it amplifies the signal. But a hum field is induced in both wires equally, and so it cancels out in the mic preamp input. That's because the difference between the signals in the two wires is zero for a hum signal. So a balanced cable rejects hum and noise more than an unbalanced cable.