BEGINNER'S GUIDE TO AUDIO CONNECTIONS

An audio system has so many cables and connectors, it's easy to become confused. What plugs into what? This article will help you sort out the various types of audio cables and connectors.

Cables are assemblies of wires. They carry electric signals from one audio component to another. **Connectors** link together to form a temporary path for the signal to flow from one component to another.

CABLE CONSTRUCTION

Audio cables are usually made of one or two insulated conductors (wires) surrounded by a wire-mesh shield which reduces hum. Outside the shield is a soft plastic or rubber insulating jacket (Fig. 1).

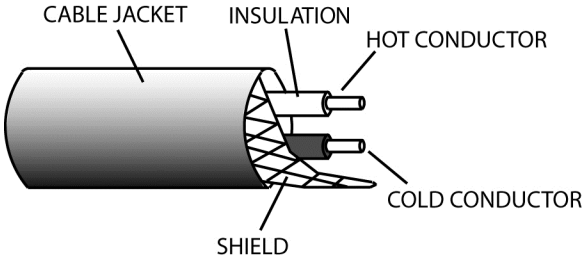

Fig. 1. Cutaway view showing the parts of a cable for balanced signals.

CABLES FOR BALANCED AND UNBALANCED SIGNALS

Cables are designed to carry signals that are either **balanced** or **unbalanced**. A cable for a balanced signal (Fig. 1) uses two conductors to carry the signal, surrounded by a shield. An cable for an unbalanced signal has a single conductor surrounded by a shield (Fig. 2). In this case, both the center conductor and shield carry the signal.

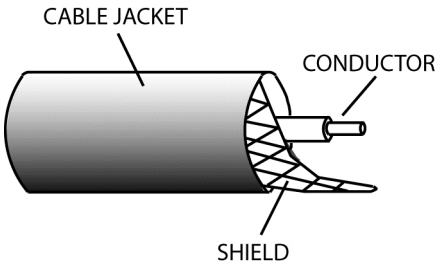

Fig. 2. Cutaway view showing the parts of a cable for unbalanced signals.

An example of a cable for balanced signals is a mic cable. An example of an cable for an unbalanced signal is a guitar cord.

A cable for a balanced signal (Fig. 1) is usually called a **balanced line**.
A balanced line rejects hum better than an unbalanced line, but an unbalanced line under 10 feet long usually provides adequate hum rejection and costs less.

SIGNAL LEVELS

A cable carries one of these four signal levels or voltages:

- **Mic level** is a weak signal. A microphone puts out a mic-level signal. It's typically about 2 millivolts or .002 volt.

- **Instrument level** is a fairly weak signal. An electric guitar or synth puts out an instrument-level signal. It's about 50 millivolts, or .050 volt.

- **Line level** is a moderately strong signal. An electronic device puts out a line-level signal. Some electronic devices are a mixer, recorder, effects device, and a mic preamp

  Geek speak: In unbalanced equipment, line level is 0.316 volt (also called -10 dBV). In balanced equipment, line level is 1.23 volts (also called +4 dBu).

- **Speaker level** is a strong signal. A power amplifier produces a speaker-level signal. It's about 1 to 1000 watts, or about 3 to 90 volts.

CABLE CONNECTORS AND CHASSIS CONNECTORS
Some connectors are part of cables; they are called **cable connectors**. Other connectors are built into equipment chassis; they are called **chassis connectors**. Cable connectors mate with (plug into) chassis connectors.

Several types of connectors are used in audio. We'll describe them below.

The **1/4-inch phone plug** (Fig. 3) is used to connect unbalanced line-level or instrument-level signals. This plug is part of a cable used with guitar amps, mixers, electric keyboards, electric guitars, and some power amplifiers. A guitar cord has a phone plug on each end. The tip of the plug is soldered to the cable's center conductor; the sleeve or long cylinder is soldered to the cable shield.

Fig. 3. A 1/4" phone plug.

You plug a phone plug into a **phone jack** (Fig. 4). The plug is on a cable; the jack is in the chassis of a piece of audio gear. Note that a jack is a receptacle; a plug goes into a jack to make a connection.

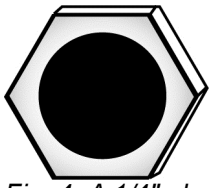

Fig. 4. A 1/4" phone jack.

The **RCA or phono plug** (Fig. 5) is also used to connect unbalanced line-level signals. It's commonly seen in stereo equipment. The center pin is soldered to the cable's center conductor; the cup is soldered to the cable shield.

Fig. 5. An RCA or phono plug.

An RCA plug connects to an RCA jack (Fig. 6). The plug is on a cable; the jack is in the chassis of a piece of audio gear.

Fig. 6. RCA jacks in a chassis.

The **3-pin professional audio connector (XLR)** is used with cables for balanced mics and balanced equipment. The female connector (with holes) plugs into equipment outputs. The male connector (with pins) plugs into equipment inputs.

Fig. 7. Female XLR cable connector

Fig. 8. Male XLR cable connector

A female XLR cable connector plugs into a male XLR chassis connector (Fig. 9).
A male XLR cable connector plugs into a female XLR chassis connector (Fig.10).

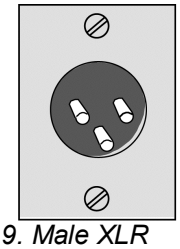

Fig. 9. Male XLR

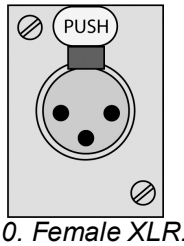

Fig. 10. Female XLR.

An XLR connector has 3 pins (male) or 3 holes (female). The pins or holes are numbered 1, 2, 3. In any XLR connector, pin 1 is soldered to the cable shield; pin 2 is soldered to the "hot" lead (usually red), and pin 3 is soldered to the remaining lead.

The **stereo phone plug** (Fig. 11) is used with stereo headphones and with balanced line-level cables. A stereo phone plug connects to a stereo phone jack (Fig. 12).

Fig. 11. Stereo phone plug (also called a TRS or tip-ring-sleeve connector)

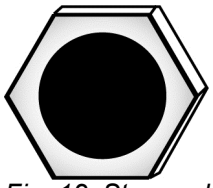

Fig. 12. Stereo phone jack.

How do you know if a 1/4" phone jack is balanced or unbalanced, mono or stereo? You need to look at the specifications in the equipment manual. For example, if the jack is labeled "AUX SEND", look up the specification for the AUX SEND connector in the manual. It will tell you if it's balanced or unbalanced.

For headphones, the tip is soldered to the left-channel lead (wire); the ring (just behind the tip) is soldered to the right-channel lead, and the sleeve is soldered to the common lead. For balanced line-level cables, the sleeve is soldered to the shield; the tip is soldered to the "hot" lead, and the ring is soldered to the remaining lead.

Some mixers have INSERT jacks that are stereo phone jacks; each jack accepts a stereo phone plug. Tip is the send signal to an audio device input; ring is the return signal from the device output, and sleeve is ground. These signals are unbalanced.

If your recorder or mixer has unbalanced mic inputs, but your mic and mic cable are balanced, you might be able to buy an adapter cable with a female XLR on one end and a 1/4" phone plug on the other end. It's called a female XLR to 1/4" adapter cable.

CABLE TYPES
Cables are classified according to their function. In any audio system you'll see several types of cables. Here are the most common:

Mic cable: This is usually a female XLR to a male XLR (Fig. 13). Between the connectors is a 2-conductor shielded cable. This type of cable is used to connect microphones to a mixer or mic preamp. It's also used to connect professional balanced equipment together to pass line-level signals.

Fig. 13. Mic cable for balanced signals. It has a female XLR on one end and a male XLR on the other end.

Snake: This is a metal box with multiple female XLRs, wired to a thick multiconductor cable, wired to several male XLRs (Fig. 14). A snake carries several mic signals from the stage to the mixer.

Fig. 14. An audio snake. It has three parts: a stage box full of XLR mic connectors, a long snake or multiconductor cable, and a "fan out" of several male XLR mic connectors.

Guitar cord: This is a phone plug to phone plug cable (Fig. 15). In between the plugs is a 1-conductor shielded cable. It's used with an electric guitar, acoustic guitar pickup, electric bass, or electronic keyboard.

Fig. 15. Guitar cord.

Fig. 16. Guitar cord with a straight phone plug and a right-angle phone plug.

Speaker cable: This cable connects a power amplifier to loudspeakers. A typical assembly is banana plug to banana plug with a 2-wire lamp cord between them (Fig. 17). Or, each end of the cable might have a Speakon connector, phone plug or bare wires.


Fig. 17. Speaker cables with banana plugs (left) or Speakon connectors (right).

Speaker cables are normally made of unshielded lamp cord (zip cord). To avoid wasting power, speaker cables should be as short as possible, and should be heavy gauge (between 12 and 16 gauge). Number 12 gauge is thicker than 14; 14 is thicker than 16.

Unbalanced patch cord (mono patch cord): This is a phone-to-phone cable with a 1-conductor shielded cable (Fig. 18).That's the same as a guitar cord. It's used to connect unbalanced equipment together. For example, patch cords can connect a mixer to external devices such as an effects unit, recorder, equalizer, power amplifier, etc.

Fig. 18. Unbalanced patch cord or patch cable. Same as a guitar cord.

Some patch cords are RCA to RCA. That's a typical cable used in a stereo system. Two connectors are used for the left- and right-channel signals.

Fig. 19. Stereo RCA to RCA cable.

Balanced patch cord (stereo patch cord): stereo phone to stereo phone (Fig. 20). Also called TRS to TRS. There's a 2-conductor shielded cable between the plugs. It can be used to connect balanced equipment together.

Fig. 20. Balanced patch cord or patch cable.

It's also used as an INSERT cable for effects. The tip is the effects send signal (unbalanced), the ring is the effects return signal (unbalanced), and the sleeve is the common ground for send and return.

EQUIPMENT CONNECTIONS
The instruction manuals for your equipment tell how to connect your components. Use cables as short as possible to reduce hum, but long enough to be able to make changes.

Basically, these connections are okay:

- Phone plug to phone jack.
- Stereo phone plug to stereo phone jack.
- RCA plug to RCA jack.
- XLR male to XLR female.
- XLR female to XLR male.
- Mic level to mic level.
- Line level to line level.

- Mic to mixer mic input. *Use an XLR mic cable.*
- Mic to mic preamp input. *Use an XLR mic cable*.
- Mixer aux send to effects input. *Use a balanced or unbalanced phone-to-phone.*
- Effects output to mixer aux return or FX return. *Use a balanced or unbalanced phone-to-phone.*
- Mixer main out to power amplifier line in. *Use a balanced or unbalanced phone-to-phone, or XLR mic cable.*
- Mixer main out to a powered speaker line in. *Use a balanced or unbalanced phone-to-phone, or XLR mic cable.*
- Mixer monitor send to monitor power amplifier line in. *Use a balanced or unbalanced phone-to-phone cable.*
- Power amplifier out to speaker. *Use a speaker cable.*
- Speaker to speaker (to play two speakers from one amplifier output). *Use a speaker cable.*

One last tip: Be sure to label all your cables on both ends according to what they plug into. For example, "Mixer ch. 2 monitor out" or "Reverb in." That way, if you temporarily change connections, or the cable becomes unplugged, you'll know where to plug it back in.

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