

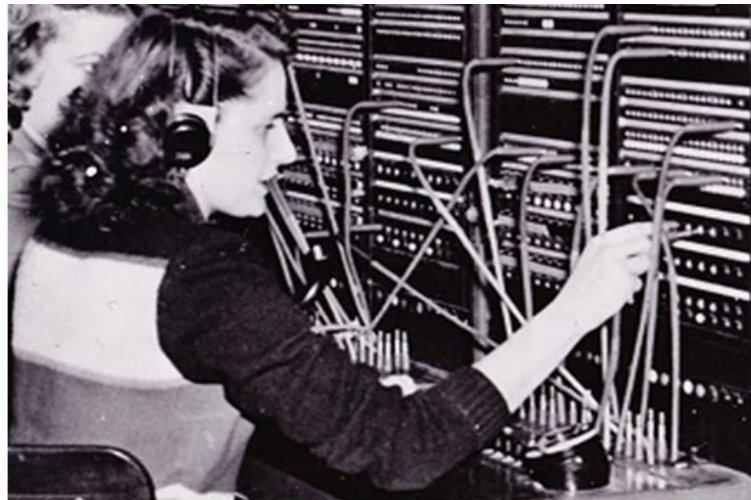


Sound System Connections

† Church Audio †



A very long time ago the Radio Corporation of America (R.C.A.) invented an audio connector. It became the standard for Phonographs in its time, and still today the connector is widely used. It is called an **RCA** or **Phono**. The connector has a particularly good contact area and is a secure fitting.



Also, a long time ago, an audio connector was developed for Telephone Switchboards. Today it is still widely used, especially with musical instruments. It is called a **Phone** Connector, or a **Phone Jack**.

6.5mm (1/4")
3.5mm
2.5mm

3 MONO



3 STEREO (TRS)



The original Phone connectors were **Mono**, consisting of a long Sleeve with a separated Tip (2 pin). **Three sizes** became available. 2.5mm 3.5mm 6.5mm (1/4"). As audio evolved into **Stereo** a second version of the Phone connector was developed, with the addition of a Ring near the Tip (3 pin). A classic application of this is on stereo Headphones. The stereo version of the Phone connector also serves in other audio applications not involving stereo. In these circumstances we prefer to call it a **TRS (Tip Ring Sleeve)** connector.



The American Audio Engineers Society (AES) and the European Broadcast Union (EBU) worked together to create a stereo connector. The connector was called an **XLR** (pin 1=**X** ground. pin 2=Left. pin 3=Right.). Some even call it an **AES/EBU**. *One of the earliest manufacturers was **Cannon** and the connector is sometimes still referred to (incorrectly) as a Cannon connector.*

Today the XLR is the standard connector for microphones. Great features include the locking mechanism which stops it being accidentally pulled out, and pins side by side so you don't hear a click in the audio when you plug it in or out (Phone Jacks click).

A larger size has since been developed for carrying large electrical currents to Loudspeakers.

New versions have also come out with additional pins for more specialised applications.



You shouldn't have any problem with modern connectors oxidising unless they are very old or worn, but any metal that comes into contact with the air will oxidise. Over time they will all get crusty, show spots of corrosion, and the metal plating will start to flake. The corrosion is the metal oxide that has formed. It starts as a fine invisible film. Unfortunately, as the oxide film increases, it begins to act like an insulator, and it starts filtering and attenuating the sound, even before it is visible.

Gold has a particular characteristic in that its oxide is a conductor, and so oxidisation is less of an issue. This is why gold-plated connectors are available.

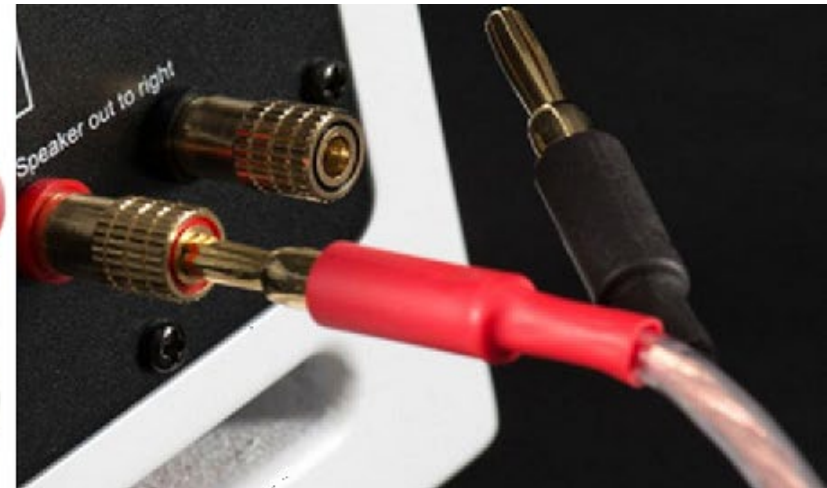
If a connector has started oxidising, you will hear a crackle or crunch sound when you move a jack around in a socket. By this stage it should be visible.

One solution to a crunchy connector sound is to spray it with an electrical contact cleaner. This works, but long-term have a notorious reputation for leaving a film of their own, which is corrosive, and eventually the latter condition is worse than the former.

If you are needing to spray it maybe time to replace... cut off the old connector and solder a new one in its place (it's only a few dollars).

Loudspeaker Connections

The electrical current that passes through a cable connected between a Power Amplifier and a Loudspeaker is quite powerful. Regular audio connectors are not made for high current and aren't suitable. Instead, we use specialised connectors that can handle higher volts and amps.





HARD-WIRED



Some Loudspeaker cabinets come with no connectors, and we simply attach the bare cable wires. This is termed **hard-wiring**, because it is physically attached.



A recent addition to the connector family is the **Speakon** connector. One of its features is its powerful locking system. Once you plug it in you can raise a loudspeaker cabinet up high on a crane etc with full confidence that the connector won't pull out.

Speakons can take a sizable electrical current. Should you need something even stronger, there is a power version of this, called Powercon.



Commercial Adaptors



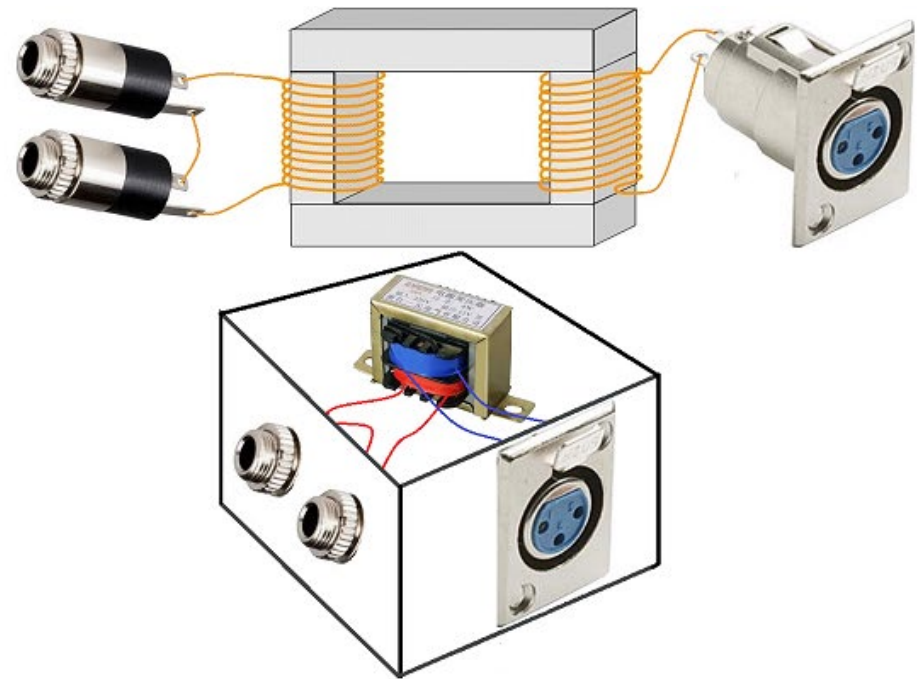
Home-made Adaptors



For Emergencies

There are a number of audio connectors in use, and unfortunately you never know which ones you will be dealing with. Fortunately, for the most part, they are interchangeable. You may purchase adaptors, or use a soldering iron and short lengths of cable and make your own to suit.

It is wise to have a box of Adaptors for those unexpected occasions when someone brings a device they want connected. Murphy's Law, their connectors won't suit any inputs you have got available. In a church service there are often one-off situations that need a special combination of connectors. From experience we all know to keep pairs of adaptors for those special moments (pairs in case you need two connections for stereo...Left, Right).



D.I. Boxes (Direct Input Boxes)

There are two kinds of audio connection. One is called **unbalanced (2 wire or 2 pin)**, and the other is called **balanced (2 wires covered by a screen or 3 pin)**. In the perfect audio environment, a Sound System should only contain 3-pin balanced connections. This eliminates parasite radio frequencies of various kinds from getting in to our System and creating annoying background buzzes and hums. Unfortunately, Musical Instruments, Computers, and Music Players are practically always unbalanced, and are always a potential threat to picking up background noise. Not all unbalanced items will give audible noise problems (but many inaudible noises added together will sum up). *Also: the longer the cable of an unbalanced connection, the more likely it will pick up parasite waves.* XLR (microphone) cables are balanced and the preferred connector for a Mixer. *XLR based cables can be incredibly long and still not pick up any external noise.* RCA and (Mono) Phone connectors are un-balanced and should be connected to a Mixer very cautiously.

A box has been invented called a **Direct Input Box (D.I. box)** which uses a Transformer to isolate the Input (and any background noises it has) from the Output, which will have your clean audio signal.

A D.I. Box has two Phone inputs. These are directly connected to each other. The idea is that a Musical instrument can connect to one of the Phone connectors and, if desired, the second Phone can be connected to a Musical Instrument Amplifier (if their instrument uses one). The output side of a D.I. box has an XLR which we connect the Mixer.

A D.I. box can be used as an **Adaptor** between Phone and XLR if you don't have one.



When we connect between balanced and unbalanced circuits there is a game we're playing with the earthing (grounding). As the outcome depends on a few variables we can never be sure of, we have a simple solution which we need to do manually. If you connect a D.I. Box and you hear a hum, then flick the Ground Lift switch to the 'other' position (regardless of what it is). If unsure, then try both positions.



Sometimes a Musical Instrument (eg. Keyboard or Guitar Effect Unit) may be particularly loud (very strong electrical signal) and can cause a distorted sound. Some D.I. Boxes offer an Attenuation (Pad) switch you can flick to lower the volume (dB), so it will be a clean sound. Failing that, the musician needs to turn the volume down.



A typical inexpensive D.I. Box has no battery inside; you simply connect to it and it goes. This kind is called a **Passive** D.I. Box. If you spend a little money you can buy a D.I. Box with electronics inside. This kind is called **Active**. It will need powering, which may be through a Battery, or it may use Phantom Power generated by the Mixer. With these Active D.I. Boxes you will get extra features (you may or may not ever use). Under normal circumstances a good Passive D.I. Box is all you ever require.



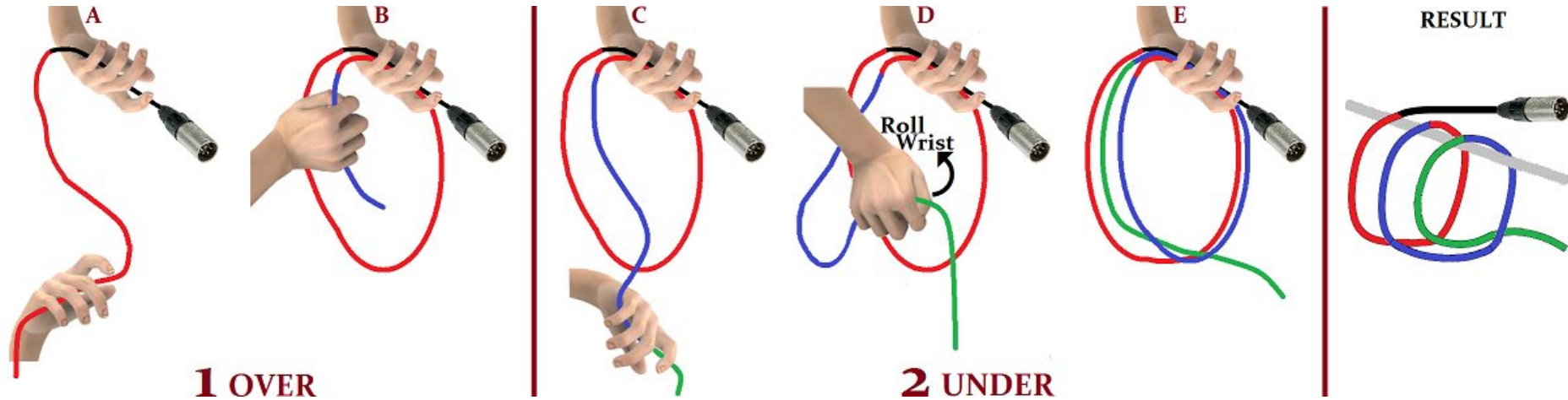
Some Guitar and Bass Amplifiers have a D.I. box built-in to their Cabinet. The D.I. (an XLR) will give a very clean output.



For people who find themselves using a lot of D.I. Boxes you can purchase a rack-mounted set. These will typically be Active and offer various features. The fact that all DI Boxes are in one physical place may not suit you, however.

If a hum or buzz doesn't go away, even passed through a DI Box, try and substitute the cables one by one to be sure it isn't a broken earth wire inside a cable.

Audio Cables



Coiling an Audio Cable

If you hold a cable at one end and simply pull arm-lengths towards you, coiling as you go, the result will be an untidy coil, full of twists. If you store a cable in this manner for long periods it causes permanent damage and shortens the life of the cable. When you later uncoil this cable it will easily tangle, and it will definitely not lie flat on the ground (becoming a tripping hazard) because of the tension and twists that bad coiling has produced.

The audio community have adopted a way of coiling a cable that doesn't put tension and twist on a cable. By using the Over-Under technique, the coil will have minimal tension, so the life of the cable will be prolonged, and it will unravel very easily (actually you can hold one end and throw it out and it won't tangle) and it always lies flat on the floor.

The method involves alternating between two ways of making the circle.

Hold the connector in one hand. Extend your other arm and grab the cable with your thumb facing you (as you normally would). Pull it to your connector hand letting it coil naturally, in the normal manner. Next time twist your hand down so your thumb is facing the ground before you extend your arm and grab the cable (with your hand twisted). When you bring your hand over to the connector hand this time you will make a coil from the inside. Continue alternating, one coil with thumb up, one coil with thumb down, so you create a coil of alternating loops.

PLASTIC
CABLE TIE



VELCRO
CABLE TIE



Cable Ties are readily available in stores, but be careful, the self-locking type are not usually suitable for holding a coil of Audio Cable as they don't easily undo. Velcro ones are a good choice. Musical Instrument Shops or the Internet can provide these.

Cable ties may be attached permanently to one end of a cable, always ready. Attach cable ties to the end that plugs in to the Mixer or Stage Box, and not the end where the Microphone is (that doesn't look very professional).



Audio Cable: For general purposes we use audio cable that has a wire mesh screen around the outside of the conducting wires. This screen captures radio waves and stops your cable acting like a radio antenna and picking up noise (and even radio transmissions).



Loud-Speaker Cable: This is special cable that doesn't need a screen. It connects a Power Amplifier to a Loudspeaker Cabinet. It has thick wire, which means low resistance, and can take a greater current. *Cable length should be the same to each Loudspeaker Cabinet (L-R) even if one Cabinet is closer to the Amplifier.*



Cables typically break just below the Connector. You can often see signs of a permanent bend (strained wires) before it finally breaks. Eventually you will need to cut the wire below the damaged section, reattach and solder the connector on fresh cable. Audio Connectors come with a cable strain-reliever built-in to help.



Manufacturers offer 90-degree (right-angled) connectors to alleviate situations where the cable will always be hanging downwards, straining the wires. They are also good for connections at the rear or down the side of some tight confined space that would otherwise put strain on a cable.

CREDITS

This material is offered freely to the Christian Churches; downloadable at Pietango.com

Text: *Original, by the Author, a Christian Recording Engineer.*

Images: *Designed by the Author. Some photographs were sourced from the Internet, then re-worked.*

Ever since the creation of the world, God's invisible attributes and divine nature have been evident. They are clearly understood through his workmanship, and all the wonderful things that he has made. Therefore, those who fail to believe and trust in him are without excuse, or defence. **Romans 1:20**

All of us have sinned and fallen short of God's glory, but God treats us much better than we deserve.

Because of Christ Jesus, he freely accepts us and sets us free from our sins. God sent Christ to be our sacrifice. Christ offered his life's blood, so that by faith in him we could come to God. **Romans 3:23**

If you declare with your mouth, "Jesus is lord," and believe in your heart that God raised him from the dead, you will be saved. For it is with your heart that you believe and are justified, and it is with your mouth that you profess your faith and are saved. **Romans 10:9**

For the Scripture (*Isaiah 28:16*) says, "Whoever believes in Him will not be disappointed." **Romans 10:11**

These things have been written so that you may believe that Jesus is the Christ, the son of God; and that by believing, and relying on him, you may have new life in his name. **John 20:31**