How to Solder

How to Solder

Basic soldering is a skill that's easy to learn and not hard to master.

It just takes practice!

How to Solder

There is a huge range of soldered situations out there, from tiny chip resistors on circuit boards to large UHF connectors.

There is also a large variety of irons, tips and solder to choose from, and it certainly does help to have the right tool for the job.

How to Solder

Although we will focus on the middle range of connector and cable size in this tutorial (using audio cable and connectors as examples), the theory can be applied to a solder joint of any size.

How to Solder

Good luck, and remember....

Good soldering takes practice!

How to Solder

Warning

You are working with HOT liquid metal, it is a matter of time before you will get burned.

Be careful!

Contents

Soldering Tools

The only tools that are essential to solder are a soldering iron and some solder.

There are, however, lots of soldering accessories available.

Soldering Tools

Different soldering jobs will need different tools, and different temperatures too.

For circuit board work you will need a finer tip, a lower temperature and finer grade solder. You may also want to use a magnifying glass.

Audio connectors such as XLR's will require a larger tip, higher temperature and thicker solder.

Clamps and holders are also handy when soldering audio cables.

Soldering Irons

There are several things to consider when choosing a soldering iron.

Soldering Irons

There are several things to consider when choosing a soldering iron.

- Wattage
- Adjustable or fixed temperature
- Power source (electric or gas)
- Portable or bench use

Soldering Irons

Soldering guns not recommend, as these have no temperature control and can get too hot. This can result in damage to circuit boards, melt cable insulation, and even damage connectors.

Wattage

It is important to realize that higher wattage does not necessarily mean hotter soldering iron. Higher wattage irons just have more power available to cope with bigger joints. A low wattage iron may not keep its temperature on a big joint, as it can loose heat faster than it can reheat itself.

Wattage

Smaller joints such as circuit boards require a lesser wattage iron - around 15-30 watts will be fine.

Audio connectors need something bigger – At least 40 watts is recommend.

Temperature

There are a lot of cheap, low watt irons with no temperature control available. Most of these are fine for basic soldering, but if you are going to be doing a lot you may want to consider a variable temperature soldering iron. Some of these have a thermostatic control so you can vary the heat of the tip.

Temperature

If you have a temperature controlled iron you should start at about 315-345°C (600-650°F).

You may want to increase this however - I prefer about 700-750°F.

Use a temperature that will allow you to complete a joint in 1 to 3 seconds.

Power

Most soldering irons are electrically powered, and are either 110/230v AC,

or benchtop soldering stations which transform down to low voltage DC.

Power

Battery and gas powered units are also available. These types are great for the toolbox, but for more then incidental work, you'll want a plug in one on your bench.

Power

Gas soldering irons can loose their heat in windy conditions more easily that a good high wattage mains powered iron.

Solder

The most commonly used solder type is rosin core. Rosin is flux, it cleans the wire and contact as you solder.

Solder

Rosin core solder comes in three main types - 50/50, 60/40 and 63/37. These numbers represent the amount of tin and lead are present in the solder, as shown below.

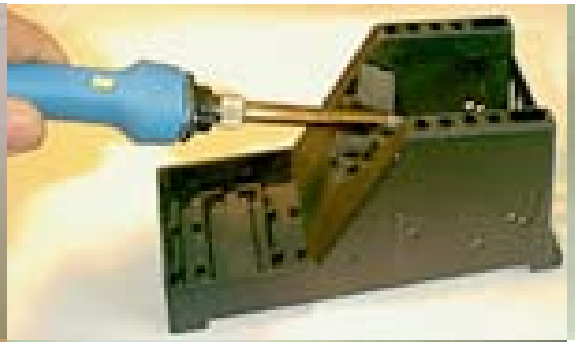
Solder Type	% Tin	% Lead	Melting Temp (ºF)
50/50	50	50	425
60/40	60	40	371
63/37	63	37	361

Solder

The other type of solder is acid core, Acid core can be detrimental to fittings and unless you are experienced at soldering, you should stick to rosin core solder.

Any general purpose rosin core solder will work fine.

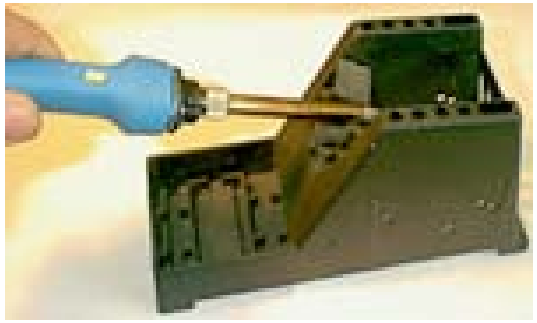
Soldering Accessories


Soldering Iron Tips

- **Try to use the correct size tip whenever you can.**
- **Smaller wires and circuit boards require smaller fine tips, mic cables with XLR connectors require larger tips.**
- **Types of tips: pointed, flat tips, (sometimes called 'spade tips').**

Soldering Iron Stands



These are handy to use if you are doing a lot of soldering.

- It is a heat resistant cradle for your iron to sit in, so you don't have to lie it down on the bench while it is hot.
- It can be essential if you are planning to do a lot of bench soldering as it is only a matter of time before you burn something (probably your elbow resting on the hot tip) if you don't use one.

Clamps

Clamps of some sort are strongly recommend. Trying to hold your soldering iron, the solder, and the wire is tricky enough, but when you have to hold the connector as well it is almost impossible. There are however, adjustable clamps that can be manipulated to hold both the connector and the wire in place so you still have two free hands to apply the heat and the solder.

Clamps

Here is what I use.

Magnifying Glass

If you are doing work on PCBs (printed circuit boards) you may need to get a magnifying glass. This will help you see the tracks on the PCB, and unless you have exceptional sight, small chip resistors are pretty difficult to solder on well without a magnifying glass.

Solder Wick

Solder wick is a mesh that you lie on a joint and when it heats up it also melts the solder which is drawn out of the joint. It is usually used for cleaning up solder from tracks on a circuit board, but you will need a solder sucker to clean out the holes in the circuit board.

Solder Wick

Place the wick on the solder you want to remove then put your soldering iron on top of the wick.

The wick will heat up, then the solder will melt and flow away from the joint and into wick.

Solder Suckers

If you work on PCB's, before too long you are going to need one of these.

These are a spring loaded vacuum device that sucks the melted solder out of the joint.

They are a bit tricky to use, as you have to melt the solder with your iron, then quickly position the solder sucker over the melted solder and release the spring to suck up the solder.

Step 1: Preparation

- If you are preparing the cable for a connector, put any connector parts first (the screw on part of an XLR, or casing of a 1/4" jack for example).
- Get into the habit of sliding these on before you start on the cable, or else you can bet it won't be long before you finish soldering your connector only to discover you forgot to put the connector casing on, and have to start all over again.

Step 1: Preparation

- Once you have all the connector parts on, you will need to strip the insulation from your cable. This means removing the insulation from the end of the wire and exposing the copper core. You can either use a wire stripper, side cutters, or a knife to do this.
- The obvious tool to choose to strip a wire would be.....a wire stripper.

Step 1: Preparation

There are many types of wire stripper, most of them work the same. You simply put the wire in, and squeeze it and pull the end bit off. It will cut to a preset depth, and if you have chosen the right depth it will cut the insulation off perfectly.

It is possible to choose the wrong depth and cut too deeply, or too shallow, but they are very easy to use.

Step 1: Preparation

- In some cases you may need to use a pocket knife or side cutters.
- Use side cutters for small cable and a pocket knife for bigger cables.

Step 1: Preparation

If you are using side cutters (as shown here), position them about 10mm (1/2 inch) from the end, and gently squeeze the cutters into the insulation to pierce it, but not far enough to cut the copper strands of the core. Open the cutters slightly so you can turn the wire and pierce the rest of the insulation. You may have to do this a few times to cut through all of the insulation, but it is better to cut too shallow and have to turn and cut again rather than cut the core and have to start again.

Step 1: Preparation

Now you should be able to slide the insulation off with your cutters, or pull it off with your fingers.

This may sound like a tedious method, but in no time at all you will be able to do it in two cuts and a flick of the cutters.

Step 1: Preparation

When removing the insulation from larger cable using a knife, great caution should be used. The chance of cutting yourself is very possible.

Step 1: Preparation

Step for stripping large cable using a knife:

- Determine the amount of the outer jacket that is to be removed.
- Hold the cable in one hand and the knife in the other hand.
- Place the sharp edge of the knife at the location on the cable where the jacket is to be removed.
- Pull the blade of the knife around the cable, applying enough pressure to score the jacket.

Step 1: Preparation

Return the knife to a safe location.

- Hold the cable with both hands on both sides of the location where you have scored the jacket.
- Begin bending the cable back and forward to stress the jacket. This will cause the jacket to split where you have scored the jacket.
- Now slide the outer jacket off of the cable.

Step 1: Preparation

If you are removing more than 4 feet of jacket from the cable you will need to do additional steps.

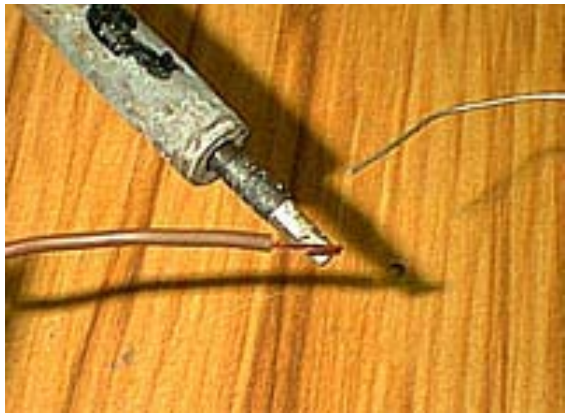
- **At 5 to 6 inches from the end of the cable, using your knife, carefully cut into the jacket to the end of the cable.**
- **Peal back the jacket to expose the inner wires.**
- **Grab hold of the jacket in one hand and the inner wires with the other hand, and pull them a part.**
- **The jacket will split as you pull until you get to the location on the cable that you have already cut through the jacket.**

Step 2: Tinning

Whatever it is you are soldering, you should ‘Tin' both sides before you attempt to solder them.

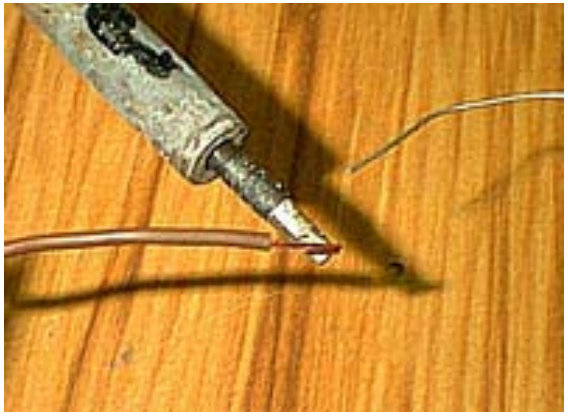
This coats or fills the wires or connector contacts with solder so you can easily melt them together.

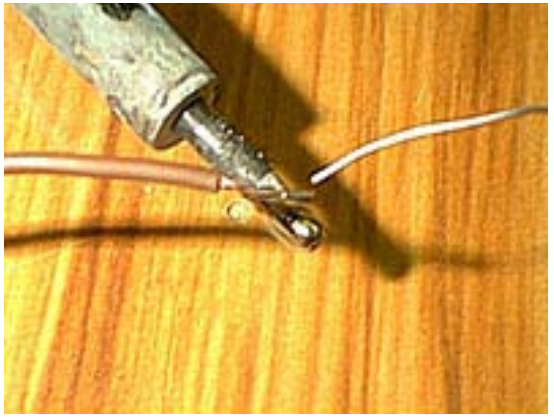
Step 2: Tinning



- To tin a wire, apply the tip of your iron to the wire for a second or two, then apply the solder to the wire. The solder should flow freely onto the wire and coat it (if it's stranded wire the solder should flow into it, and fill the wire).

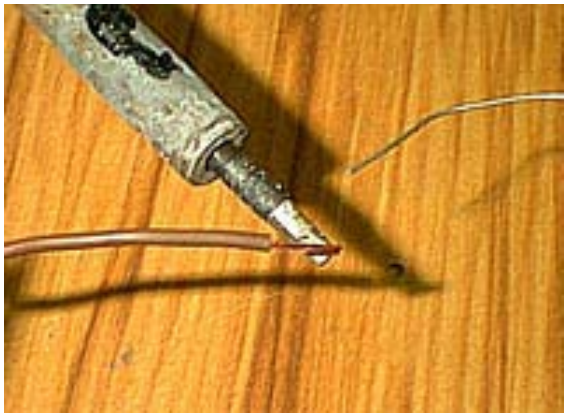
Step 2: Tinning

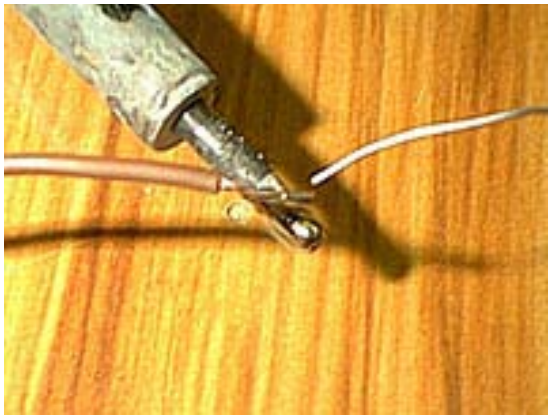




Be careful not to overheat the wire, as the insulation will start to melt. On some cable the insulation can 'shrink back' if heated too much, and expose more copper core that you intended. You can cut the wire back after you have tinned it, but it's best simply not to over heat it.

Step 2: Tinning





The larger the copper core, the longer it will take to heat up enough to draw the solder in, so use a higher temperature soldering iron for larger cables if you can.

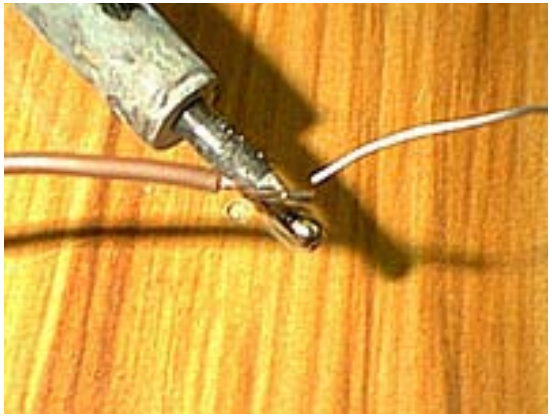
Step 2: Tinning

To tin a contact on an audio XLR connector, hold the iron on the outside of the contact for a second or two, then apply the solder into the cavity of the contact.

Once again, the solder should flow freely and fill the contact.

Connectors such as jacks have contacts that are just holes in a flat part of the connector. To tin these you put your iron on it, and apply the solder to where the iron is touching. The solder should flow and cover the hole.

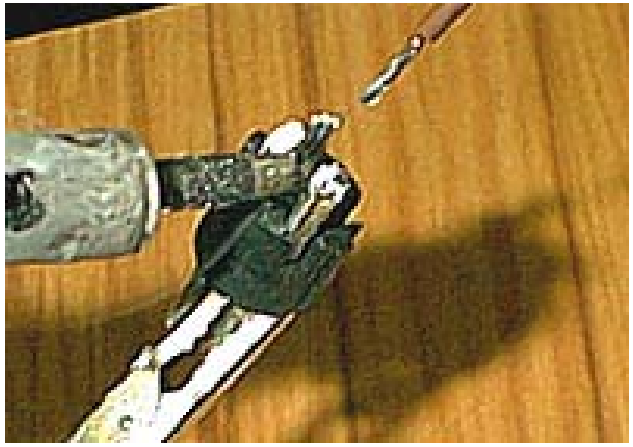
Step 2: Tinning

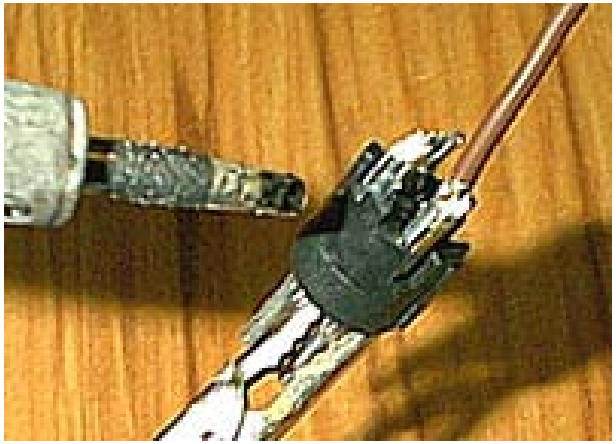


Once you have tinned both parts, you are ready to solder them together.

This step can often be the easiest when soldering audio cables.

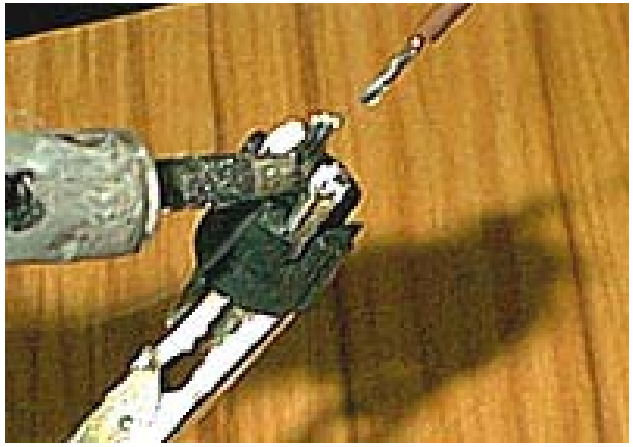
Step 3: Soldering

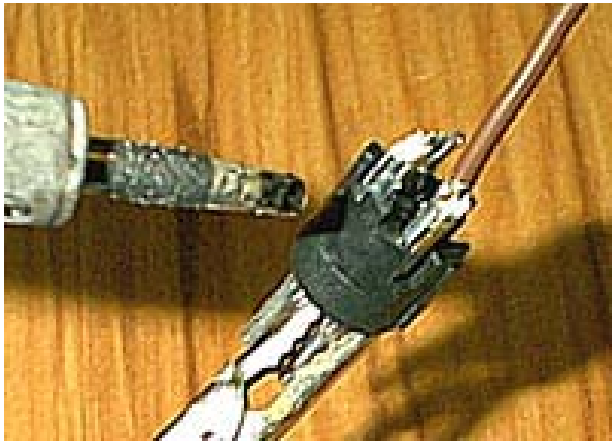




- You simply need to place your soldering iron onto the contact to melt the solder.
- When the solder in the contact melts, slide the wire into the contact.
- Remove the iron and hold the wire still while the solder solidifies again.
- You will see the solder 'set' as it goes hard.

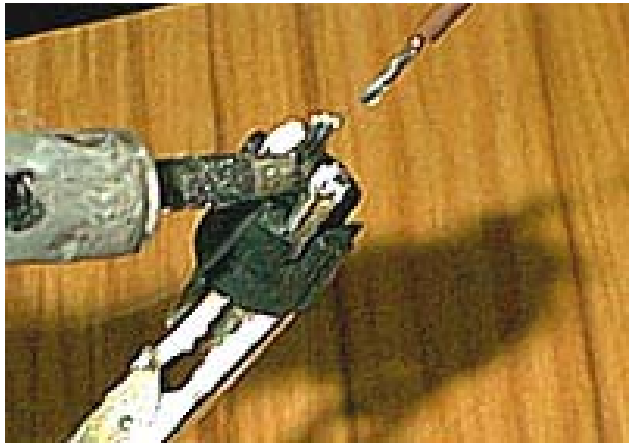
Step 3: Soldering

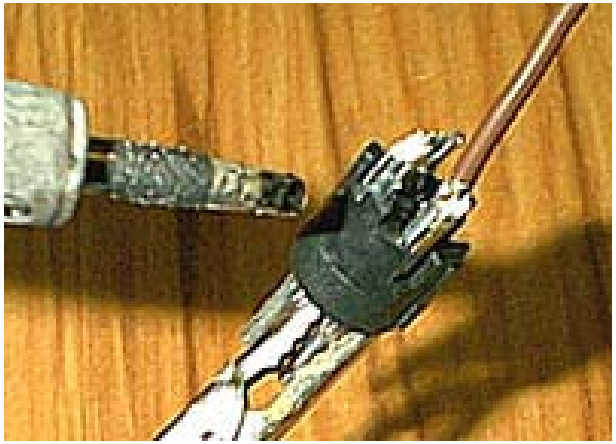




- This should all take around 1-3 seconds.
- A good solder joint will be smooth and shiny.
- If the joint is dull and crinkly, the wire probably moved during soldering.
- If you have taken too long it will have solder spikes.

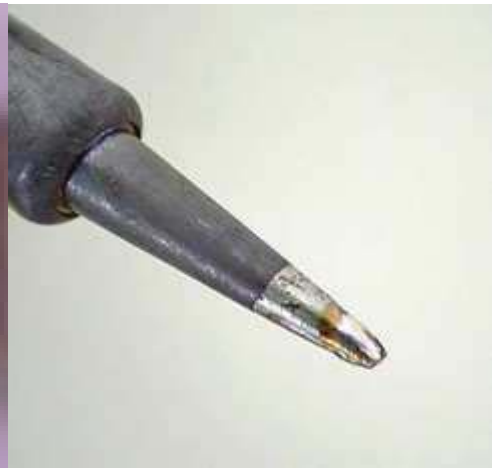
Step 3: Soldering





If it does not go so well, you may find the insulation has melted, or there is too much stripped wire showing. If this is the case, you should de-solder the joint and start again.

Cleaning Your Soldering Iron



You should clean your tip often during use. There are many cleaning solutions and the cheapest (and some say best) is a damp sponge.

Just rub the soldering iron tip on it after each solder connection.

Cleaning Your Soldering Iron

Some solder stations come with a little pad at the base of the holder. If you have one of these, you should get into the habit of wiping the tip on the pad each time you apply solder with it.

Cleaning Your Soldering Iron

If you need to clean solder off a circuit board, solder wick is what you need. You place the wick on the joint or track you want to clean up, and apply your soldering iron on top. The solder melts and is drawn into the wick. If there is a lot of solder the wick will fill up, so gently pull the wick through the joint and your iron, and the solder will flow into it as it passes.

Tips and Tricks

1. Melted solder flows *towards* heat.
2. Most beginning solderers tend to use too much solder and heat the joint for too long.
3. Don't move the joint until the solder has cooled.
4. Keep your iron tip clean.
5. Use the proper type of iron and tip size.

Tips and Tricks

Troubleshooting

- If either of the parts you are soldering is dirty or greasy, the solder won't take (or 'stick') to it. De-solder the joint and clean the parts before trying again.
- Another reason the solder won't take is that it may not be the right sort of metal. For example you cannot solder aluminum with lead/tin solder.

Tips and Tricks

Troubleshooting

- If the joint has been moved during soldering, it may look grainy or dull. It may also look like this if the joint was not heated properly while soldering.
- If the joint was overheated the solder will have formed a spike and there will be burnt flux residue.

Examples of Bad Soldering

- **Dry Joint**
- Needs more solder.

Examples of Bad Soldering

- **Cold Joint**
- Parts moved while solder cooled.

Examples of Bad Soldering

- **Cold Joint**
- Wire was not held in place.

Example of Perfect Soldering

- Note the lug's hole is full and the surface is shiny all around

Next we will get ready to do some hands on practice

Let’s try soldering

1. Plug in you soldering iron.
2. Let the iron heat up. This will take about 5 minutes.
3. Clean the tip of your iron.
4. Apply a small amount of solder to your iron.
5. Clean the tip of your iron, again.

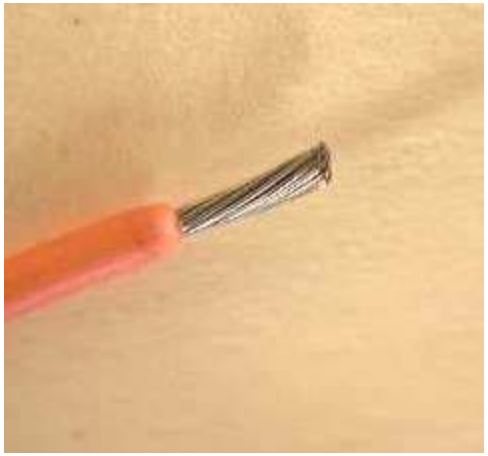
Let's try soldering

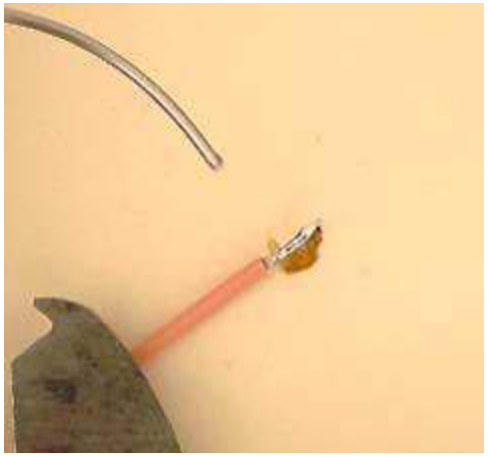
5. Strip off about ½ inch (12mm) of insulation from a piece of wire.
6. Secure the wire from moving.
7. Simultaneously place the tip of the iron and a small amount of the end of the solder to the wire.

   As the solder melts, the solder will cover and flow into the wire.

Let’s try soldering

8. Remove the solder and the iron from the wire.
9. All of this should have taken about 1 – 3 seconds.





Congratulations, you have just tinned your first wire.

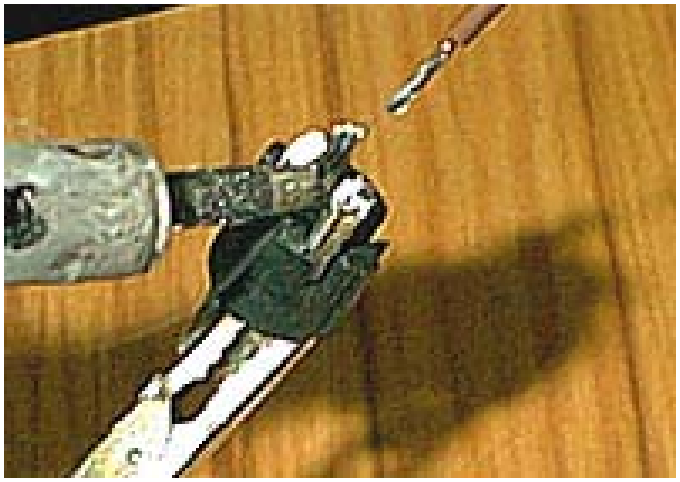
Soldering XLR Connectors

1. Secure the XLR connector from moving.
2. Simultaneously place the tip of the iron and a small amount of the end of the solder to one of the cups on the connector .

As the solder melts, the solder will flow and fill the cup.

Soldering XLR Connectors

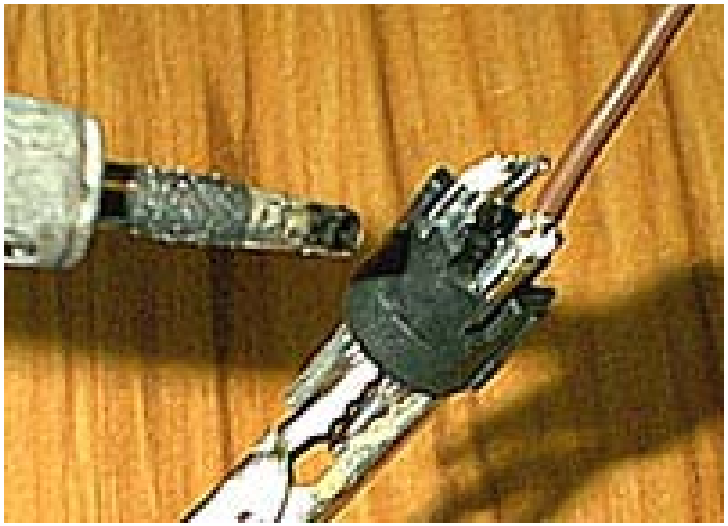
3. With the XLR connector held secure, hold the tinned wire with a pair of needle nose pliers.
4. Place your soldering iron onto the contact to melt the solder.



Soldering XLR Connectors

5. When the solder in the contact melts, slide the wire into the contact.
6. Remove the iron and hold the wire still while the solder solidifies again.

   You will see the solder 'set' as it goes hard.



Soldering XLR Connectors

- This should all take around 1-3 seconds.
- A good solder joint will be smooth and shiny.
- If the joint is dull and crinkly, the wire probably moved during soldering.
- If you have taken too long it will have solder spikes.

Soldering XLR Connectors

Congratulations, you have just soldered your first connection.

You are now on your way to soldering like a professional.

Keep practicing you will get better.

Time to Practice

Audio Cables

There are two main types of audio cable we will look at:

- *Single core / shielded* (unbalanced)

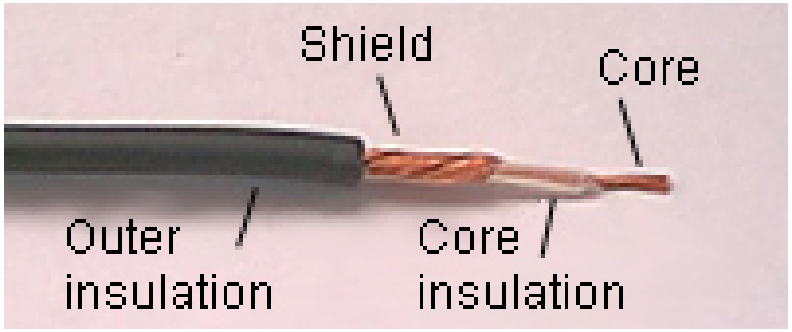
and

- *One pair / shielded* (balanced).

Audio Cables

Single Core / Shielded Cable

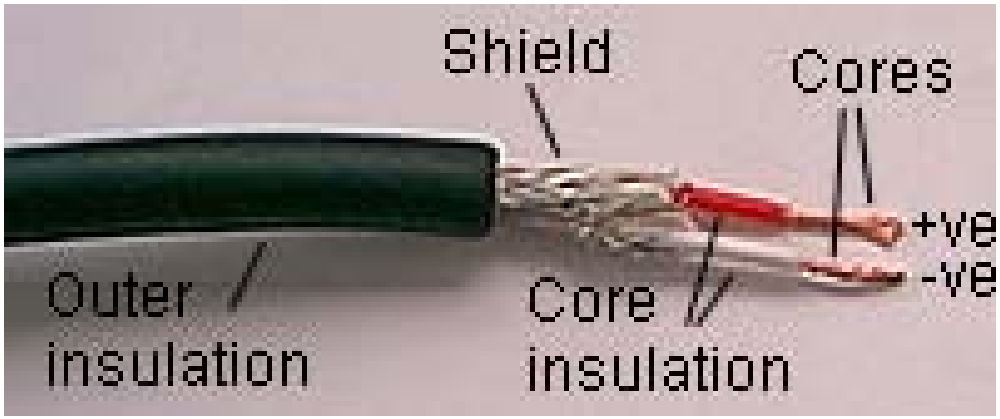
In a single core / shielded cable, the single core is used for the “+”, or 'hot', and the shield is used for the “-”, or 'cold'.
This type of cable is used for unbalanced audio signals.



Single core / shielded cable

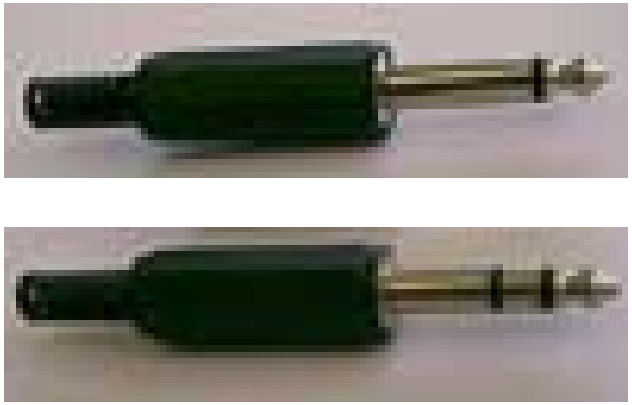
Audio Cables

A one pair / shielded cable has one core as the “+”, and the other core is “-”. The shield is earthed.
This type of cable is used for balanced audio signals.



One pair / shielded cable

Audio Connectors



- There are a variety of different audio connectors available. The most common types are *3-pin XLR*, *RCA*, and *6.5mm jacks* (also known as ¼" jacks).

Audio Connectors

3-pin XLR

- 3-pin XLR connectors are mainly used for balanced audio signals. Using a balanced signal reduces the risk of inference.
- Pin 1 is the earth (or shield)
- Pin 2 is the “+” (or 'hot')
- Pin 3 is the “-” (or 'cold).
- There are a number of different XLR's - 3-pin, 4-pin, 5-pin etc

3-pin XLR Male		
3-pin XLR Female		

Audio Connectors

¼" Jack (6.5mm Jack)

There are two types of 6.5mm Jacks: *Mono* and *stereo*. The mono jack has a tip and a sleeve, the stereo jack has ring, a tip and a sleeve.

- On the mono jack the tip is the “+”, and the sleeve is the “-” or shield.
- On a stereo jack being used for a balanced signal, the tip is the “+”, the ring is the “-”, and the sleeve is the shield.
- On a stereo jack being used for a stereo signal (left and right), the tip is the left, the ring is the right, and the sleeve is the shield.
- Jacks also come in various sizes - 6.5mm (¼"), 3.5mm, 2.5mm. The wiring for all of them is the same.

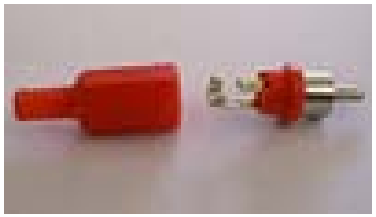
1/4" Mono Jack		
1/4" Stereo Jack		

Audio Connectors

RCA

RCAs are used a lot for home stereos, videos, DVDs etc.

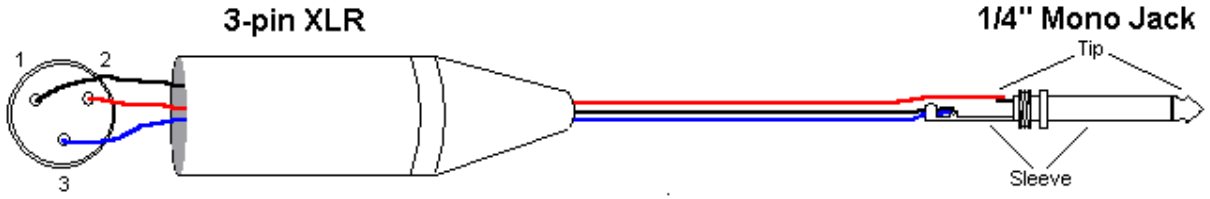
The RCA can carry either audio or video. It is wired the same way as a mono jack: The center pin is the “+”, and the outer ring is the “-” or shield.

RCA Male		

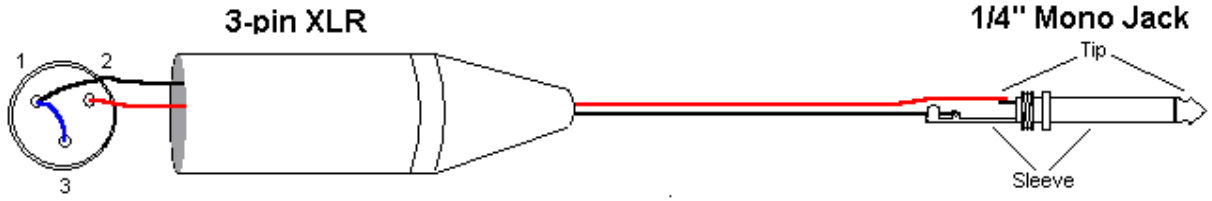
Audio Connections

XLR to 1/4" Mono Jack

- The most common way to wire a 3-pin XLR to a 1/4 inch mono jack (or 6.5mm jack), is to join the “-” and shield together.
- This can be done by either soldering the shield and “-” wires to the sleeve of the jack.....



- Or by soldering a jumper on the XLR.....

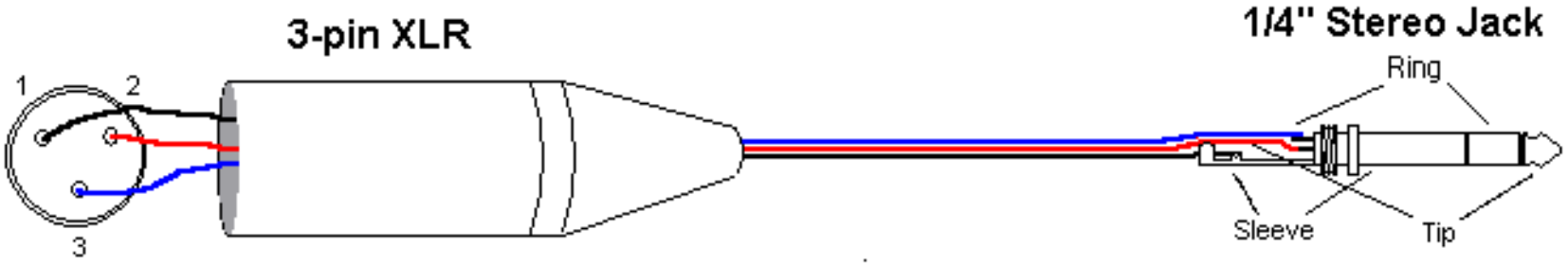


- Either way gives you the same result: An unbalanced audio cable.

Audio Connections

XLR to 1/4" Stereo Jack (wired for balanced mono)

- The usual way to connect a 3-pin XLR to a 1/4" stereo jack is to use the following pin allocation:
- XLR pin 1 to jack sleeve
- XLR pin 2 to jack tip
- XLR pin 3 to jack ring

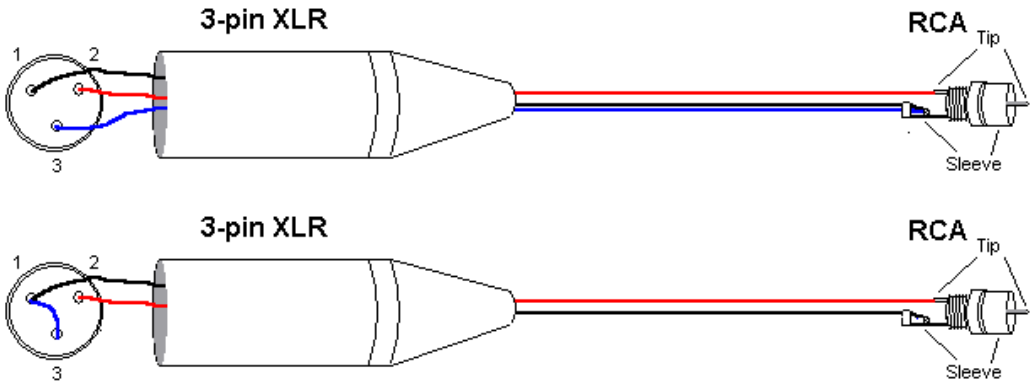


- This wiring configuration gives you a balanced mono audio cable.

Audio Connections

XLR to 1x RCA

- When connecting a 3-pin XLR to one RCA, you use the same wiring as if you were connecting an XLR to a 1/4" jack.
  The “-” and shield of the XLR are joined together, either at the XLR end or the RCA end. The easiest way is to solder a link between pins 1 and 3 (shield and “-”) of the XLR, rather than trying to solder the shield and “-” wire to the sleeve contact of the RCA.

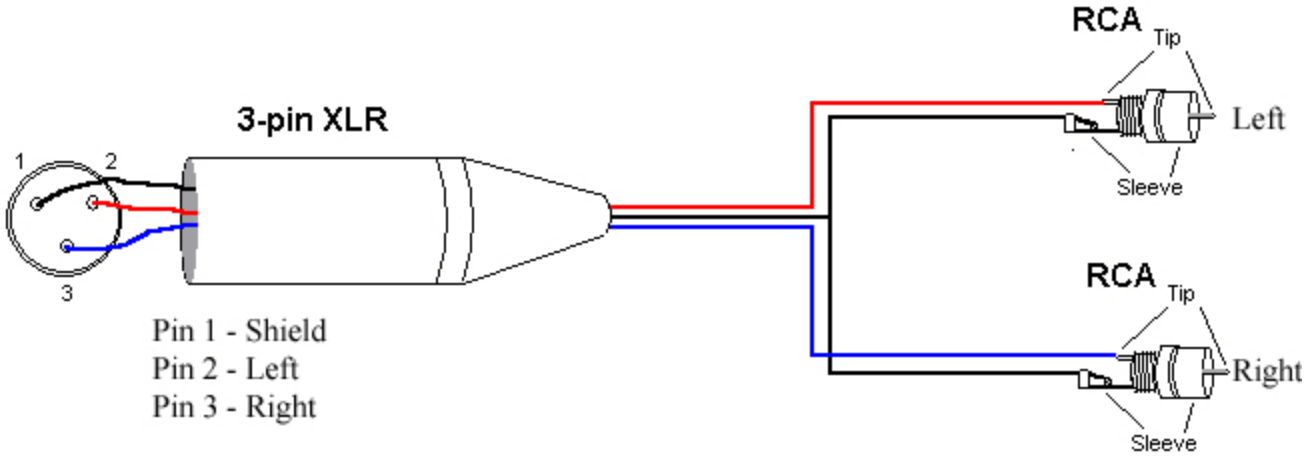


- This produces an unbalanced audio cable.

Audio Connections

XLR to 2x RCA

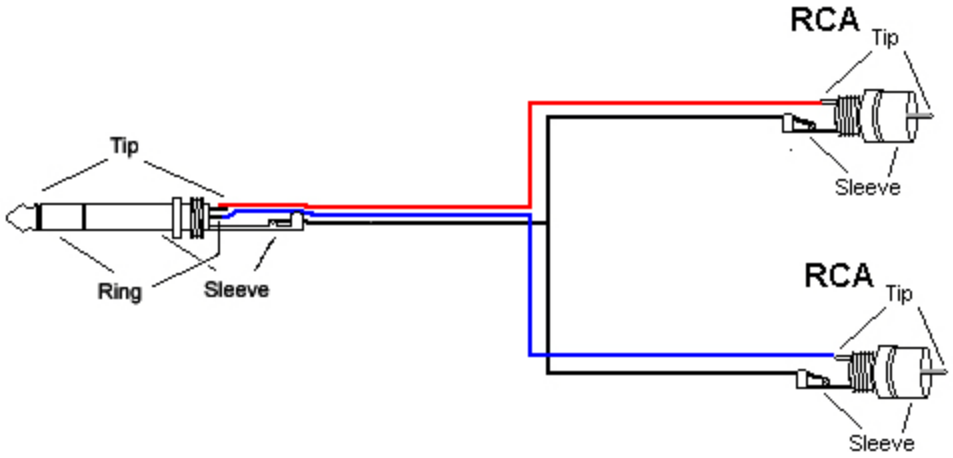
- A 3-pin XLR with a stereo signal can be split into left and right by wiring pin 2 of the XLR to the tip of one RCA plug, and pin 3 of the XLR to another RCA tip. Pin 1 of the XLR connects to the sleeve of both RCA plugs.



Audio Connections

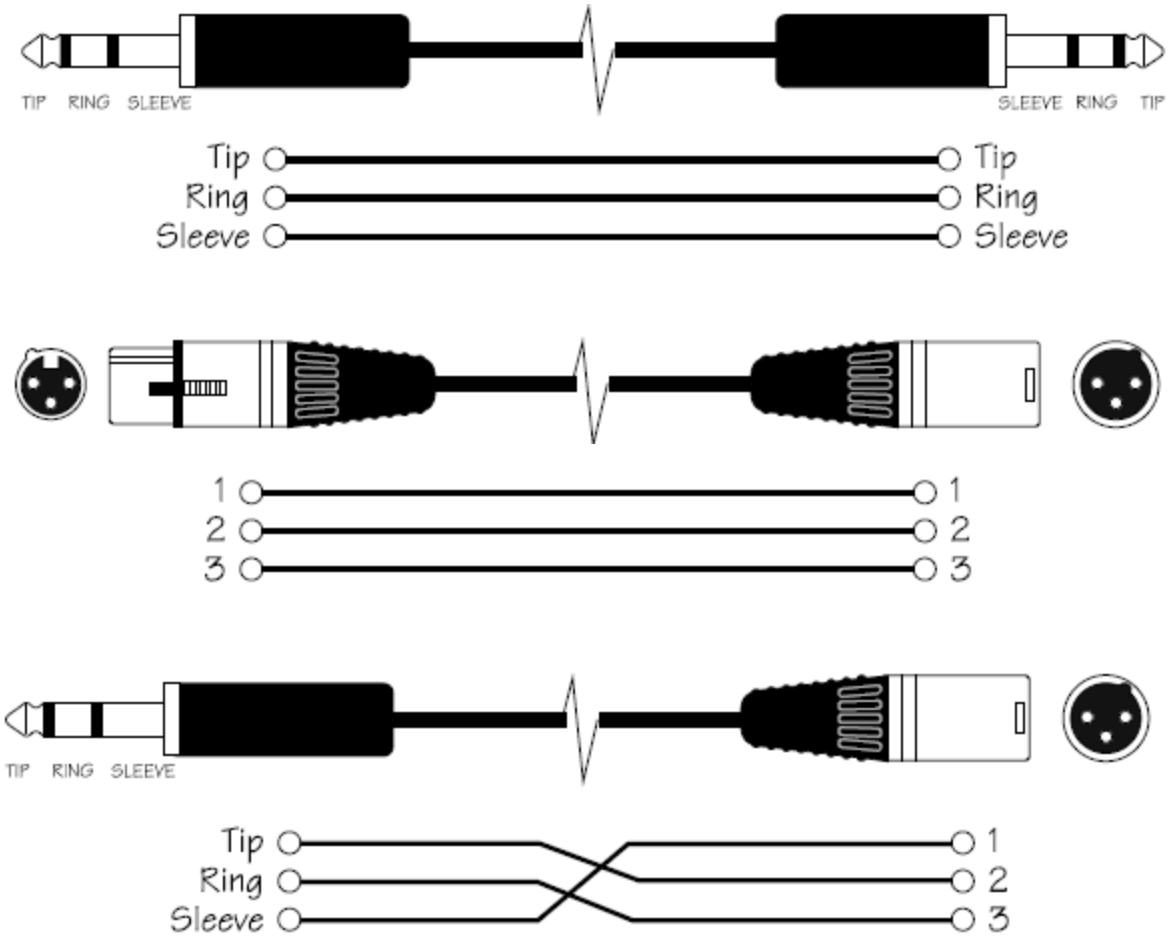
Stereo Jack to 2x RCA

- When a stereo 1/4" jack is being used for a stereo signal (as opposed to a balanced mono signal), the left and right parts of the stereo signal can be split off to two separate connectors. For example, a stereo headphone output can be split into left and right connectors, and one possible use for this would be to use these two independent connectors to feed left and right monitoring speakers.



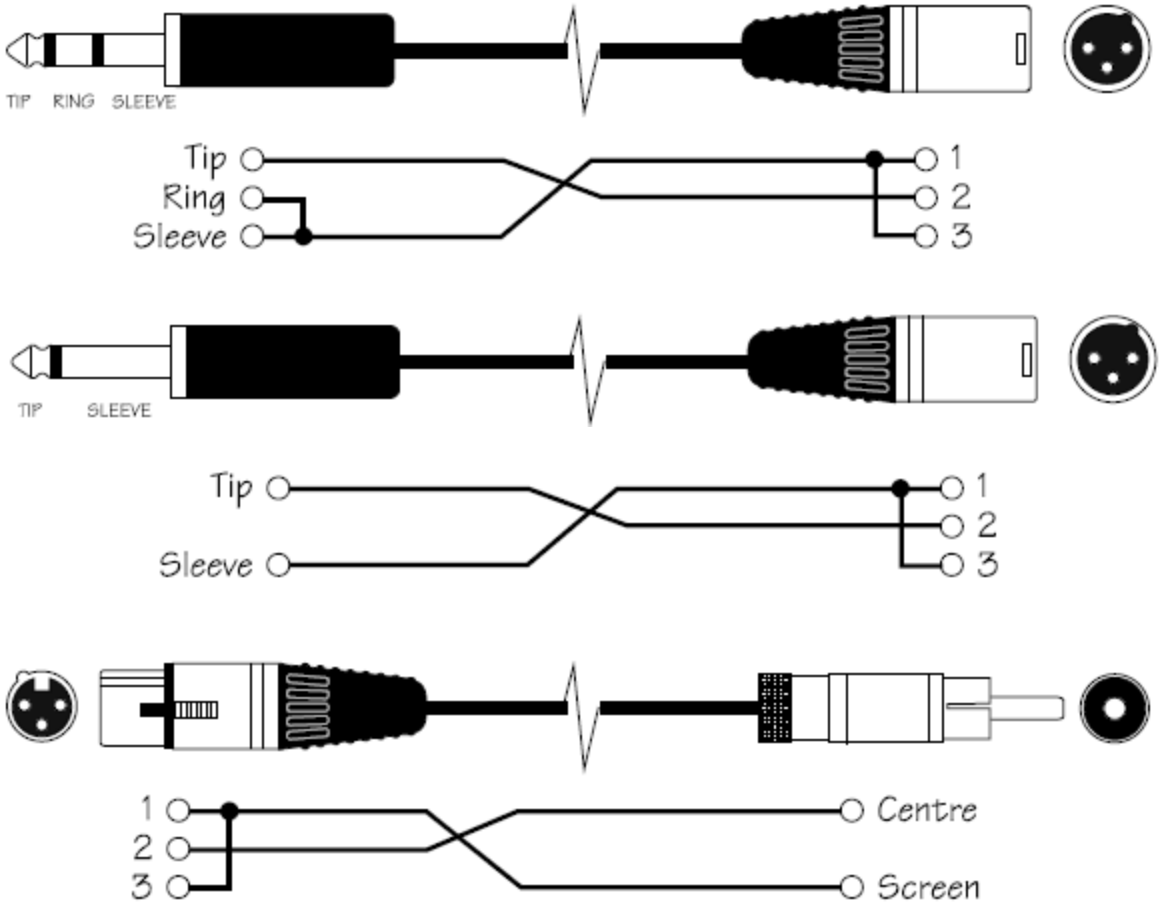
Audio Connections

Balanced



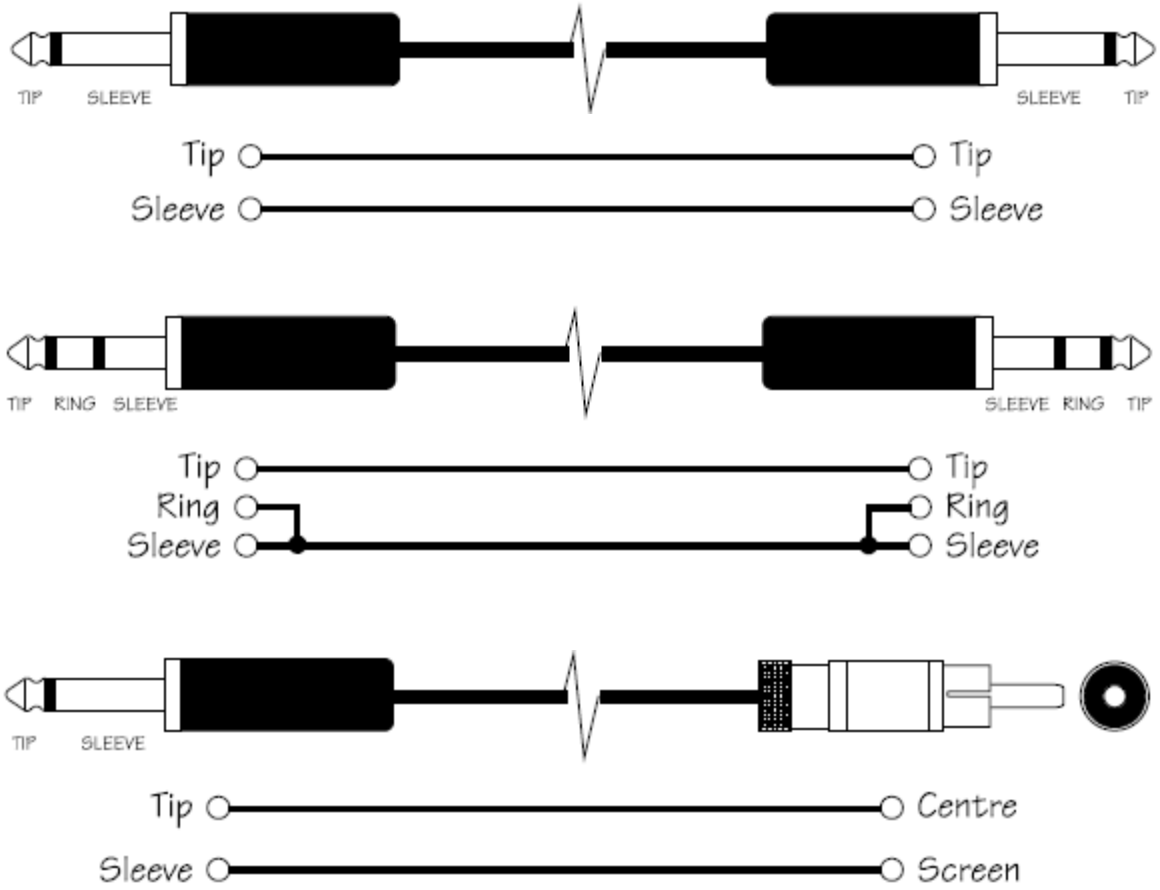
Audio Connections

Unbalanced



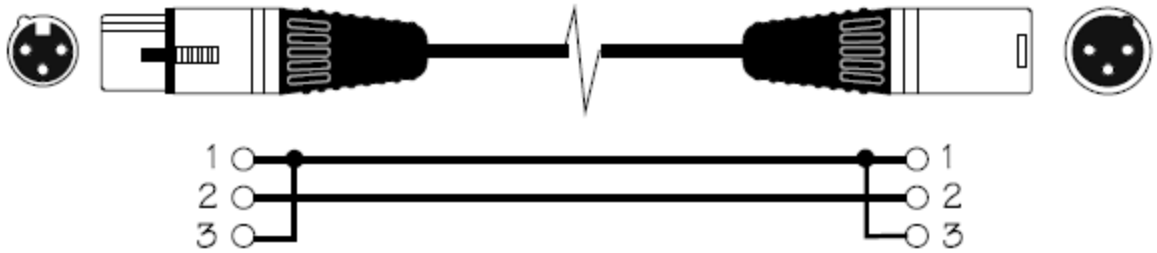
Audio Connections

Unbalanced



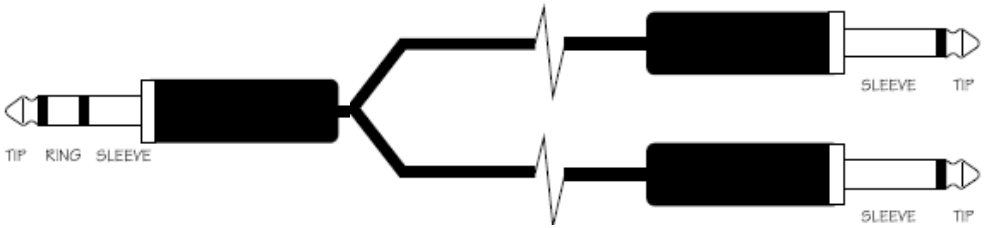
Audio Connections

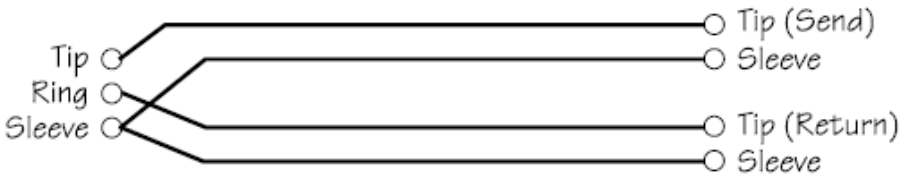
Unbalanced

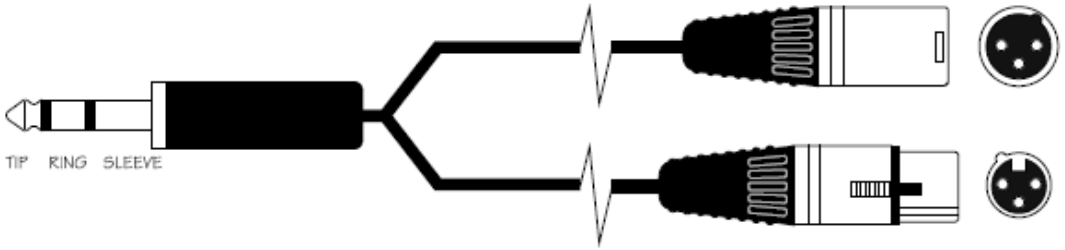


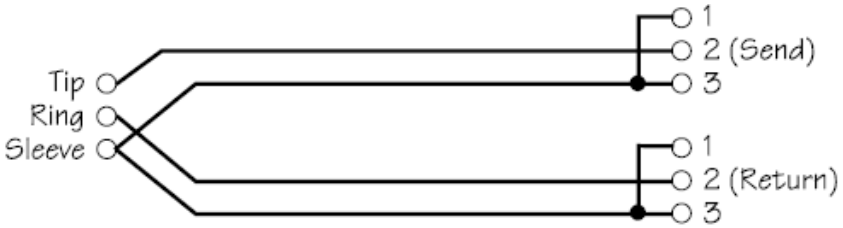
Audio Connections

Insert Leads



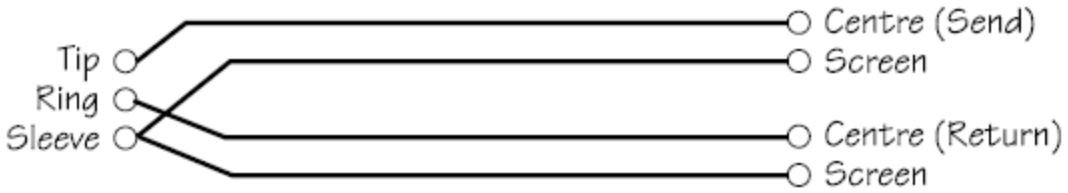






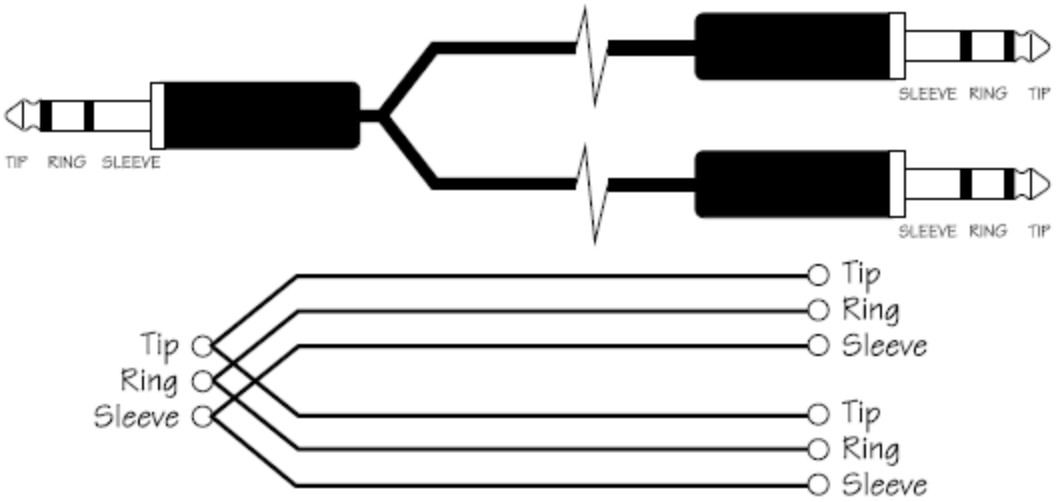
Audio Connections

Insert Leads



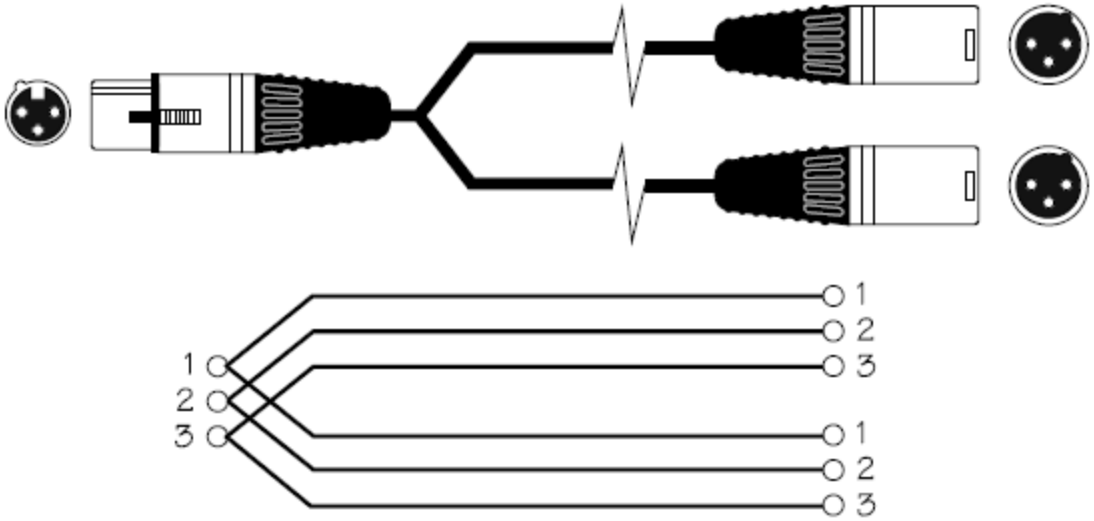
Audio Connections

“Y” Leads (Balanced)



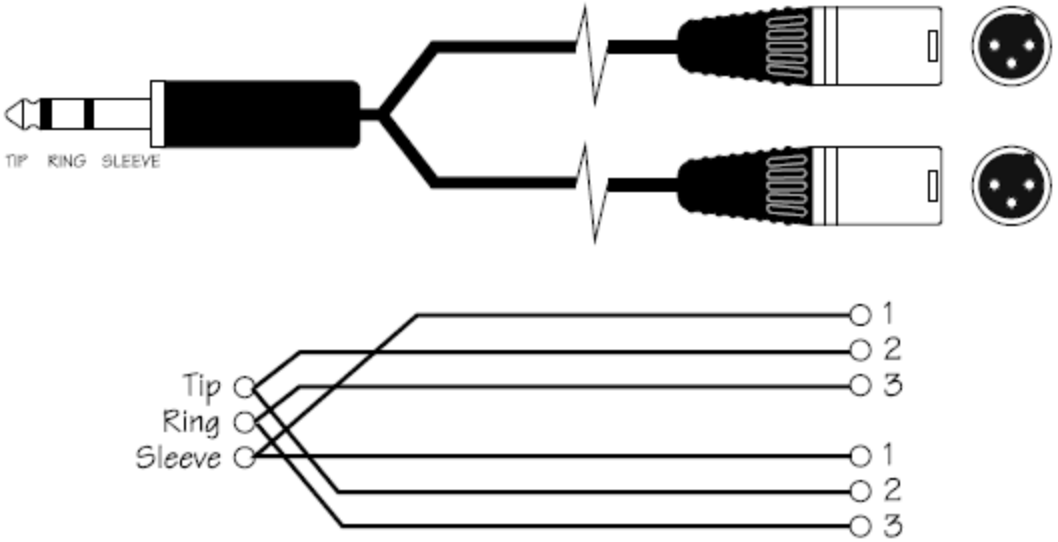
Audio Connections

“Y” Leads (Balanced)



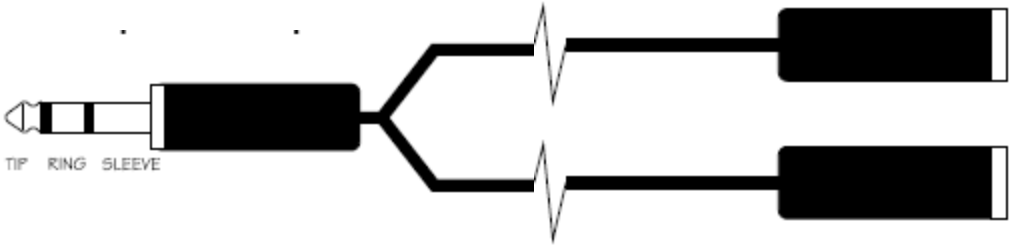
Audio Connections

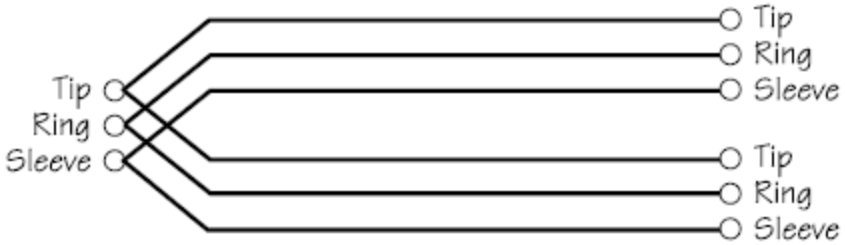
“Y” Leads (Balanced)



Audio Connections

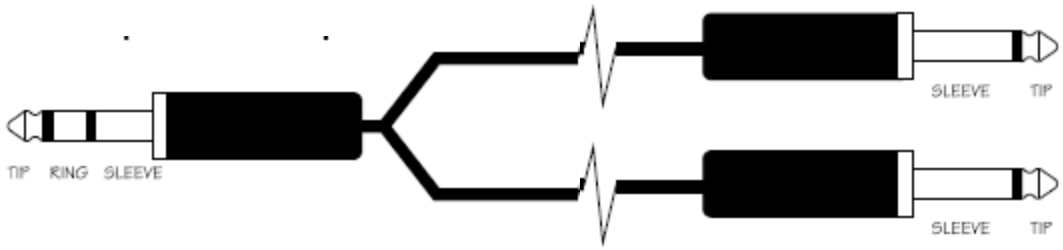
Headphone Splitter

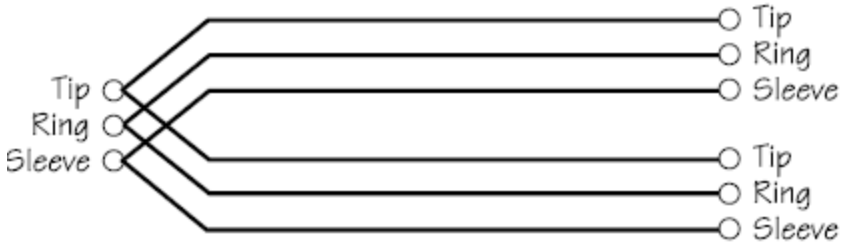




Audio Connections

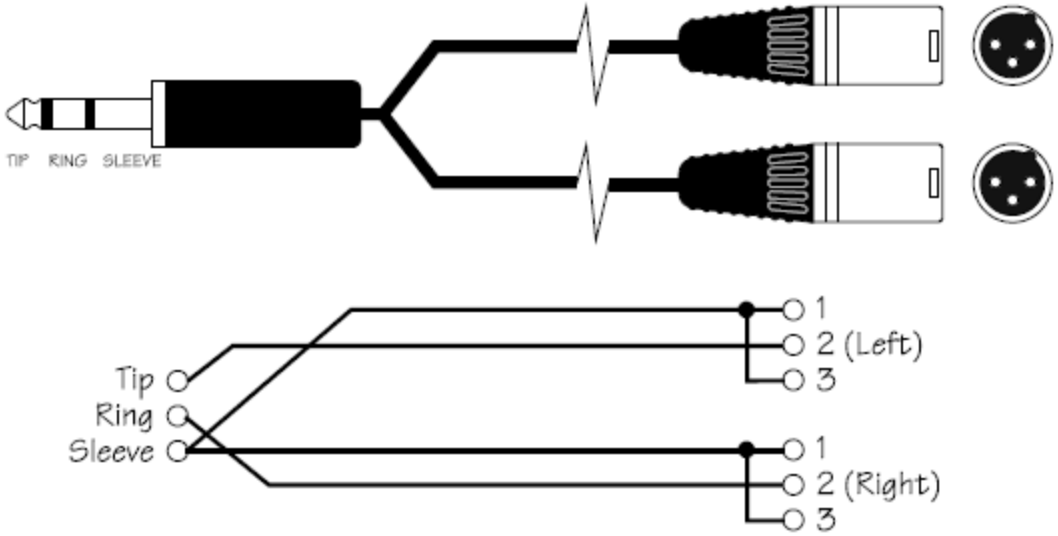
Headphone Separator





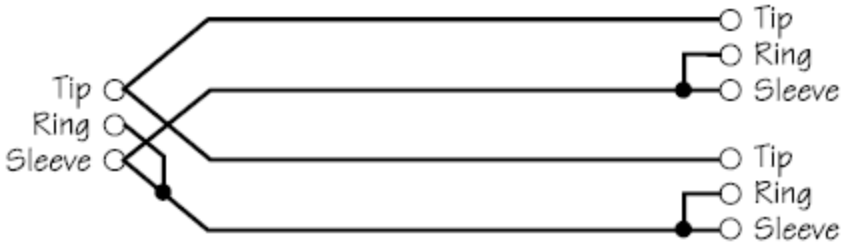
Audio Connections

Headphone Separator



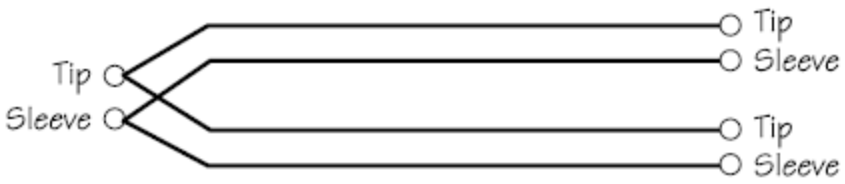
Audio Connections

“Y” Leads (Unbalanced)



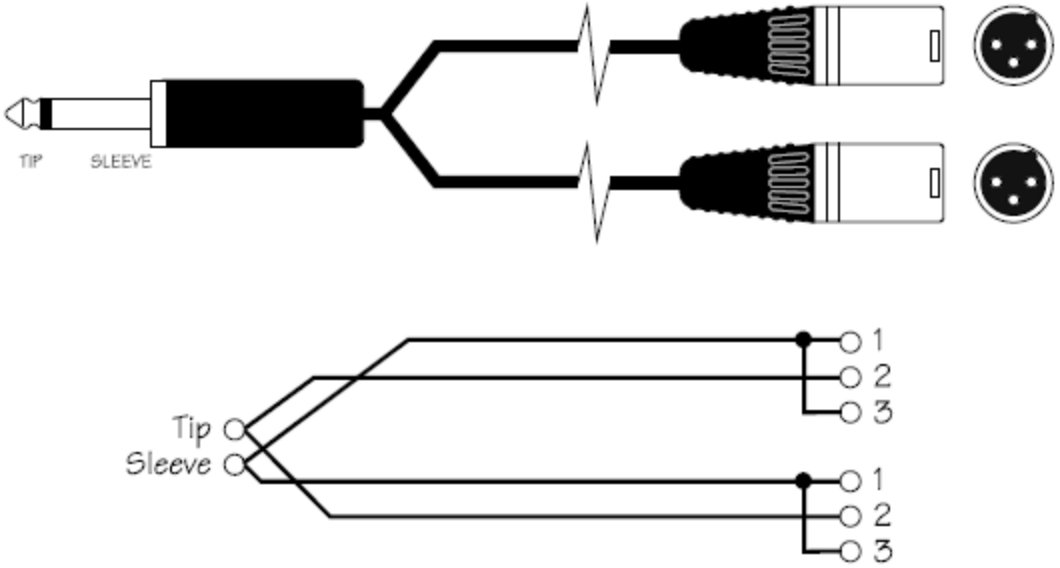
Audio Connections

“Y” Leads (Unbalanced)



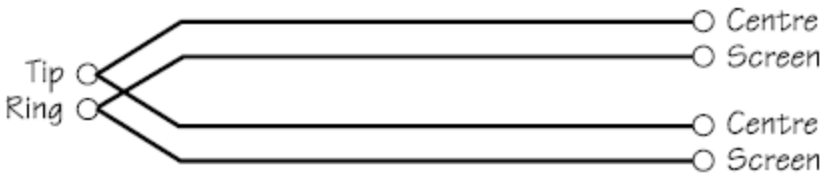
Audio Connections

“Y” Leads (Unbalanced)



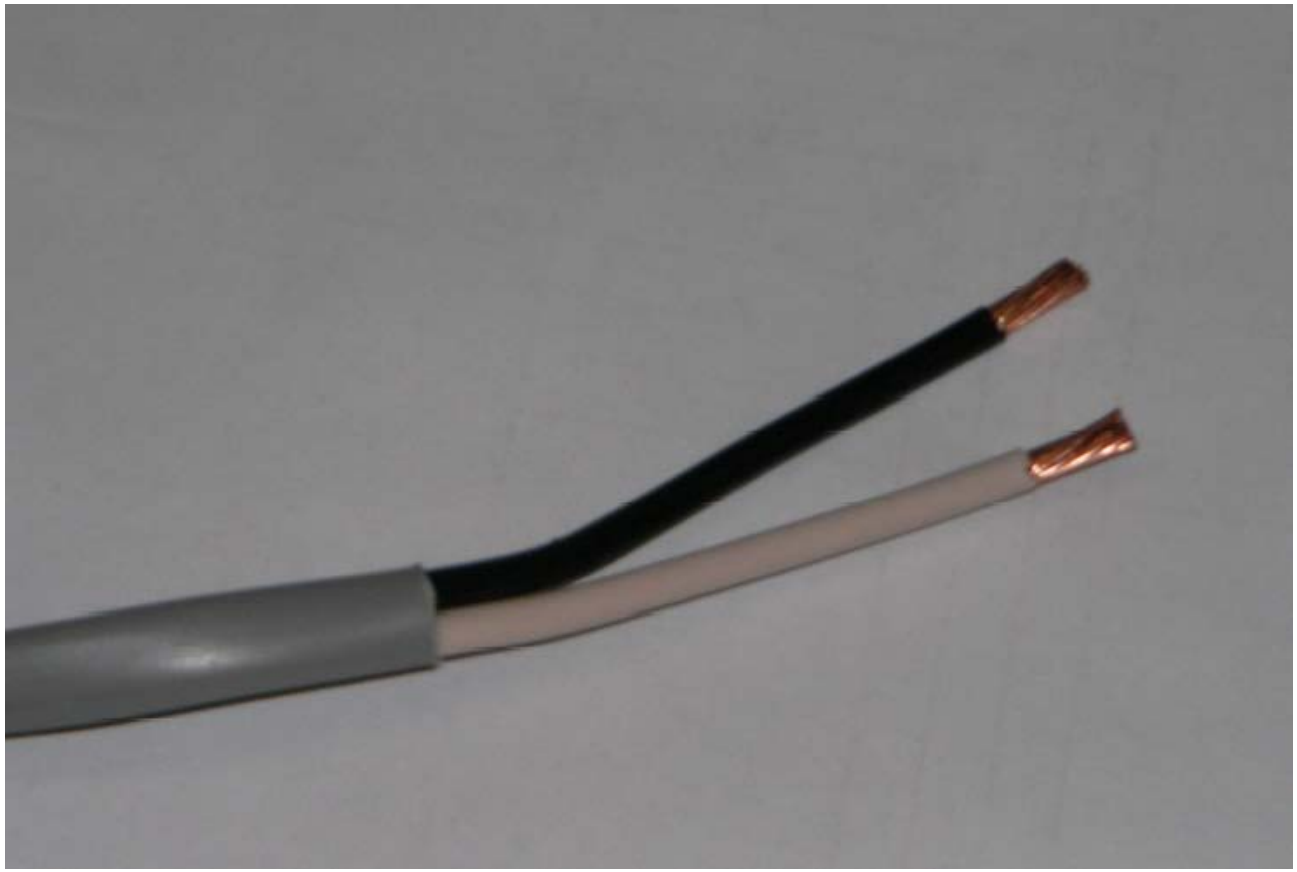
Audio Connections

“Y” Leads (Unbalanced)



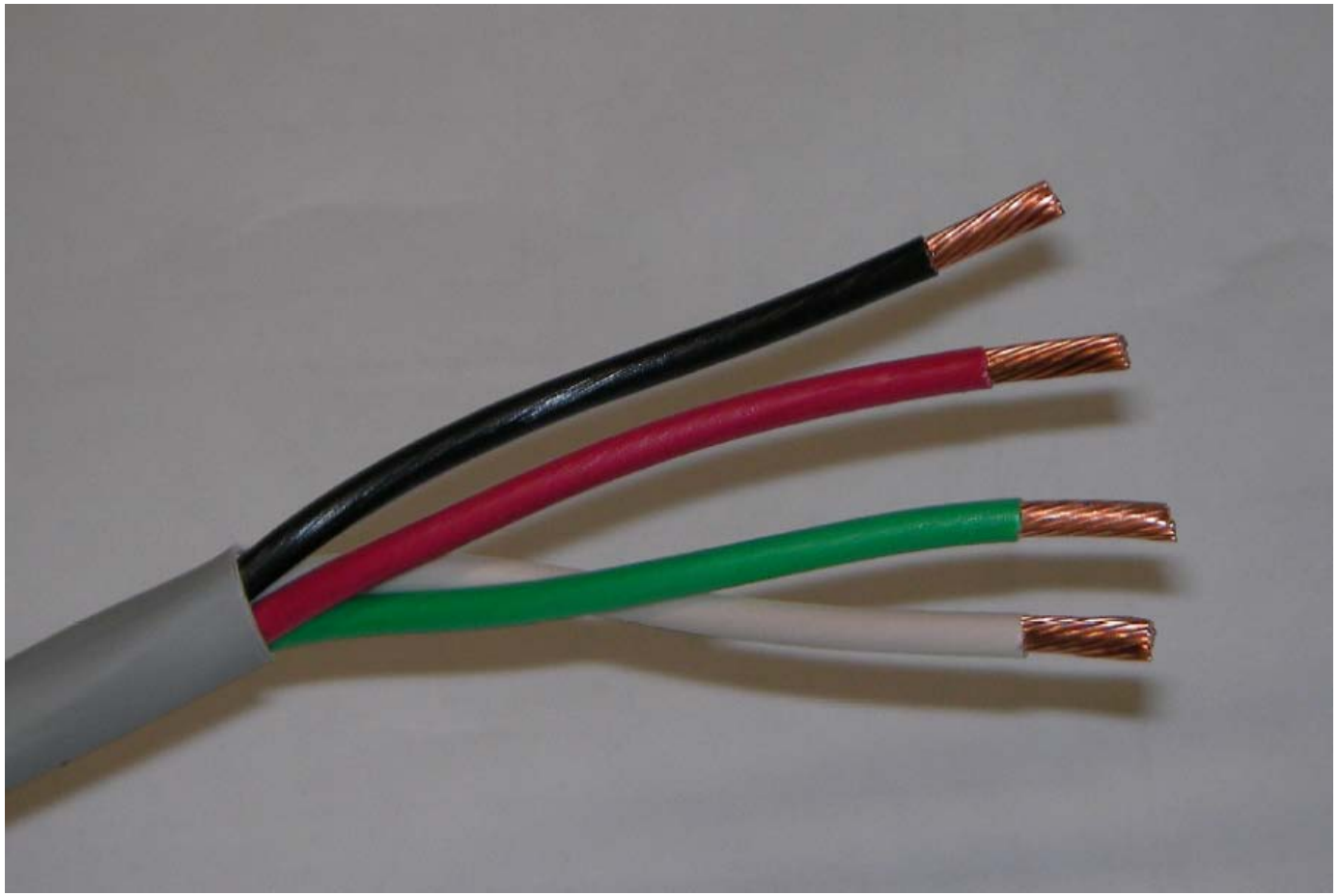
Audio Wire Types

2 Conductor / 12 Gage



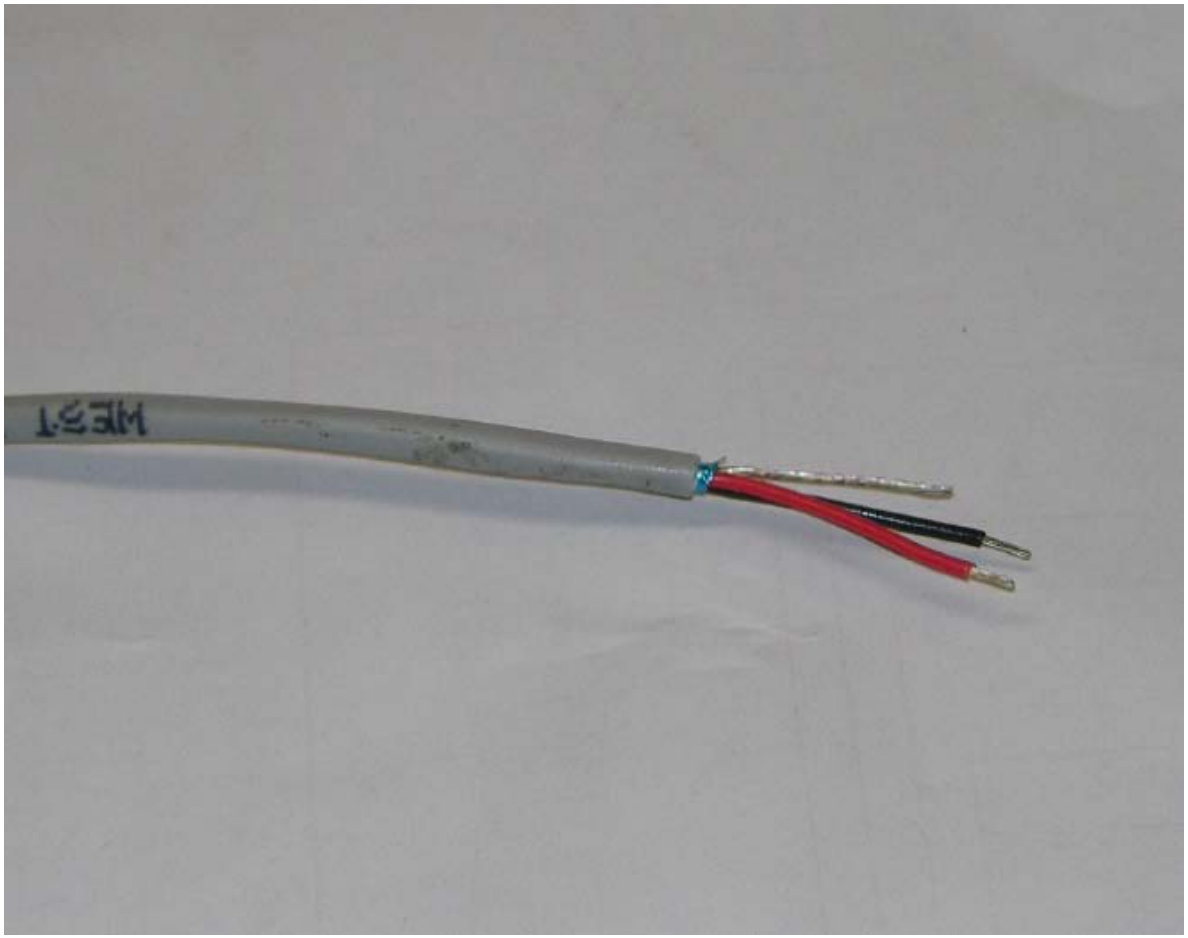
Audio Wire Types

4 Conductor / 12 Gage



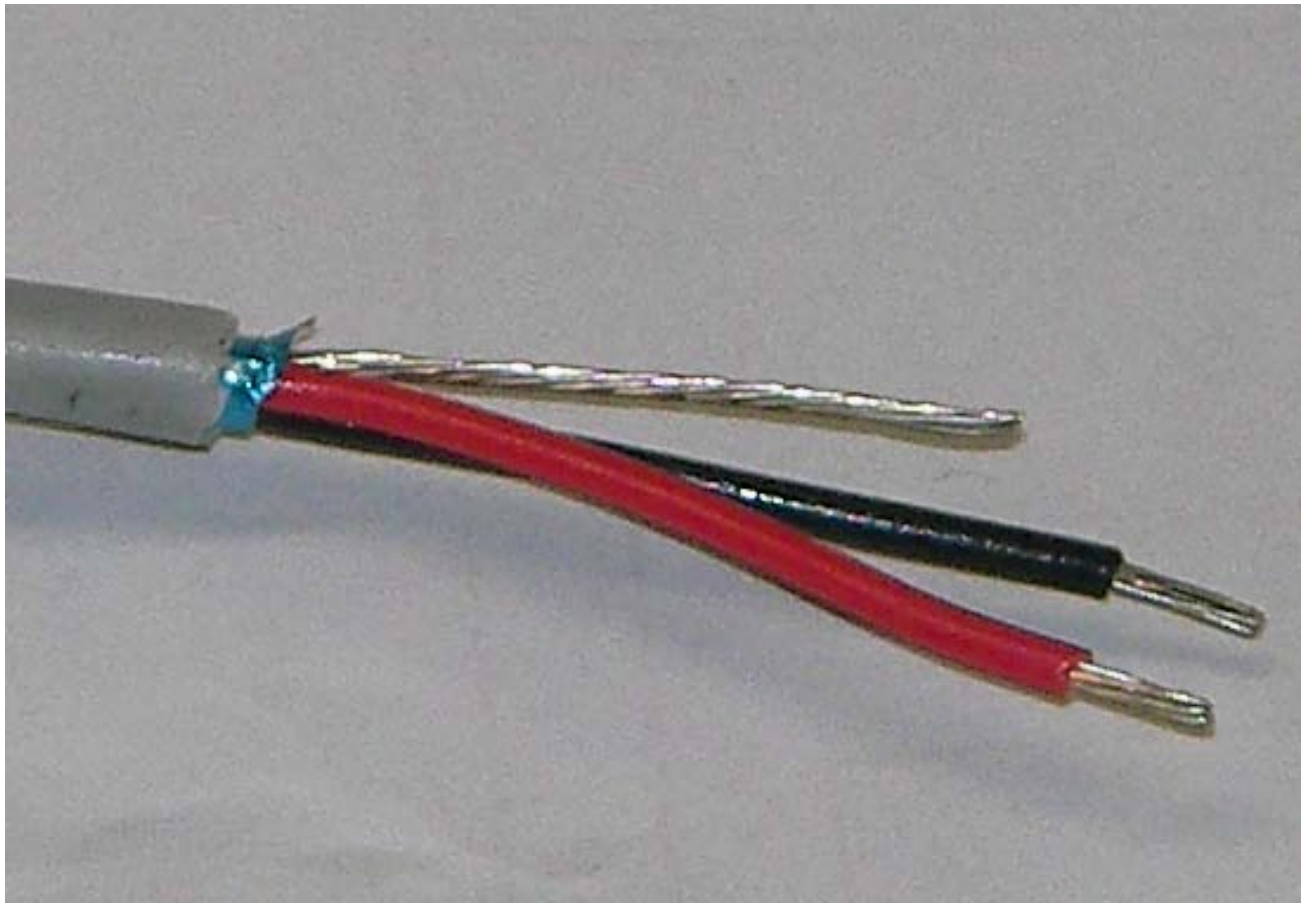
Audio Wire Types

Twisted Shielded Pair



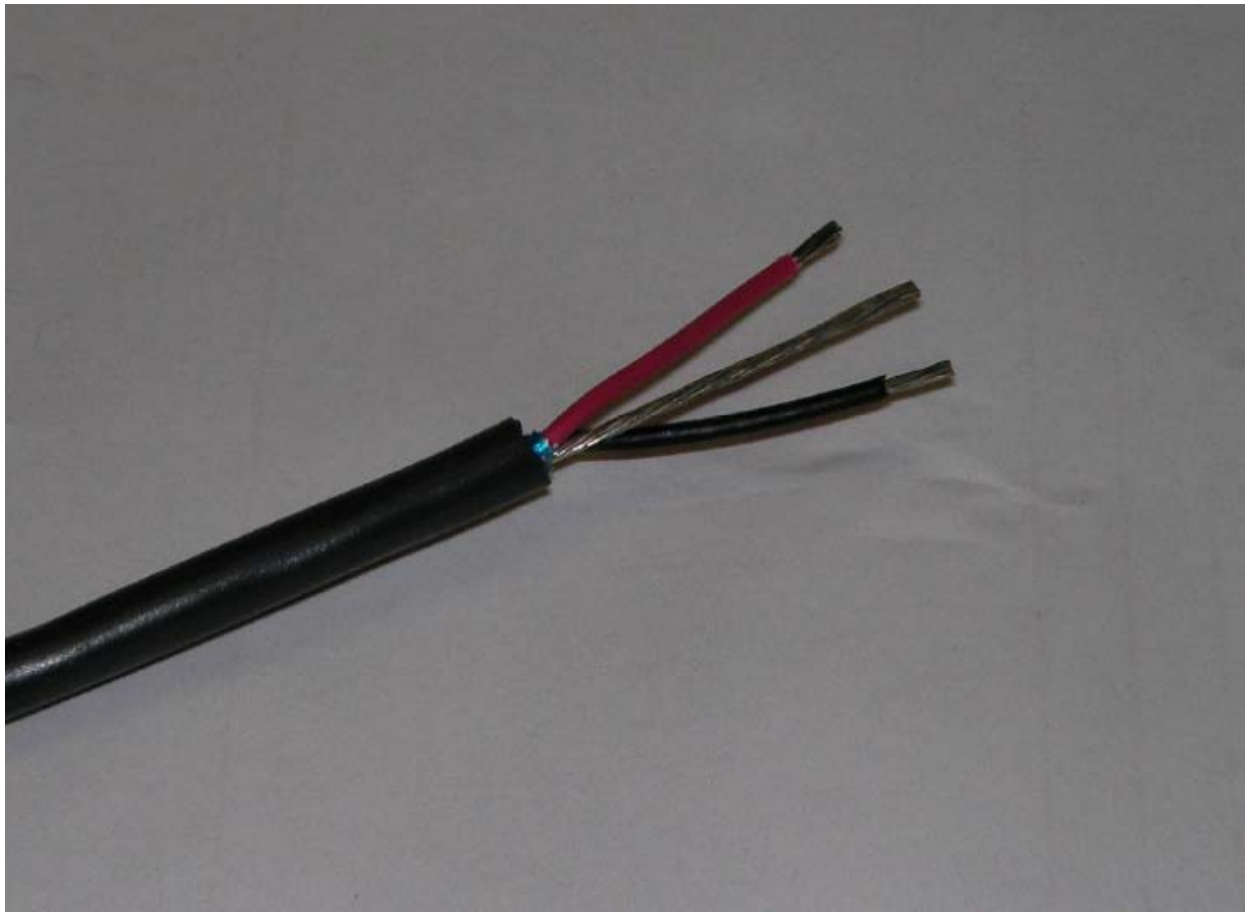
Audio Wire Types

Twisted Shielded Pair – close up



Audio Wire Types

Twisted Shielded Pair

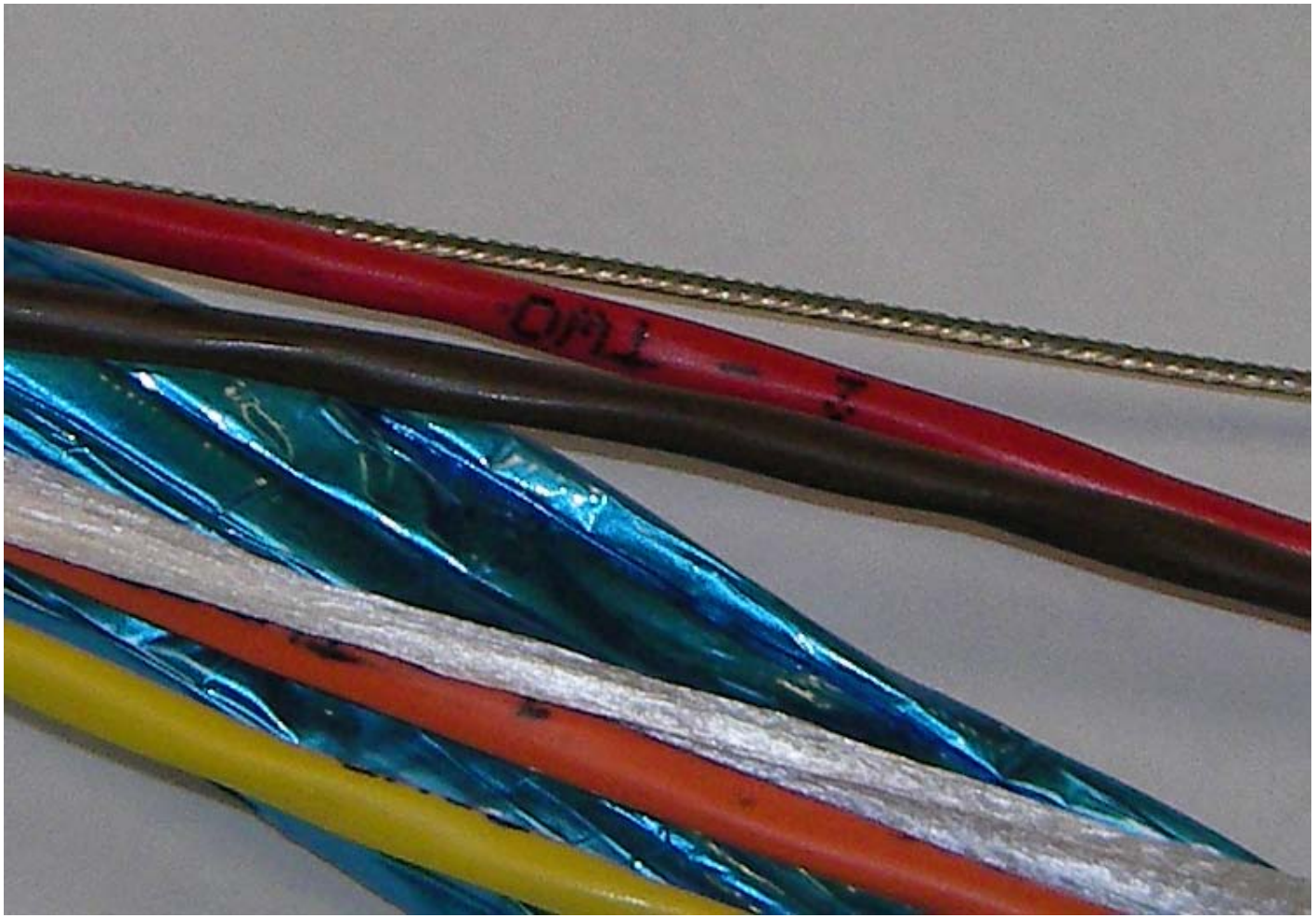


Audio Wire Types

4-Pair Snake Cable

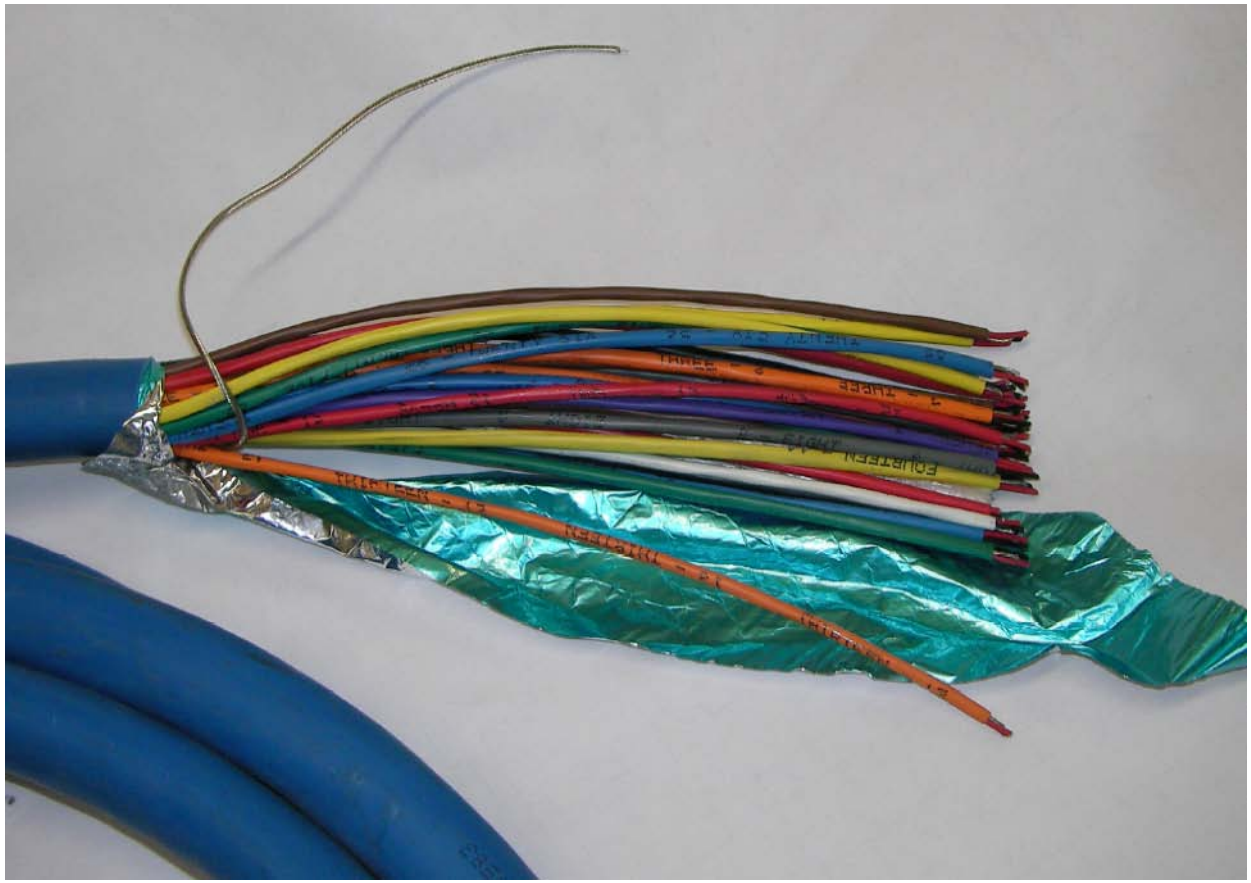
Audio Wire Types

Alpha Numeric



Audio Wire Types

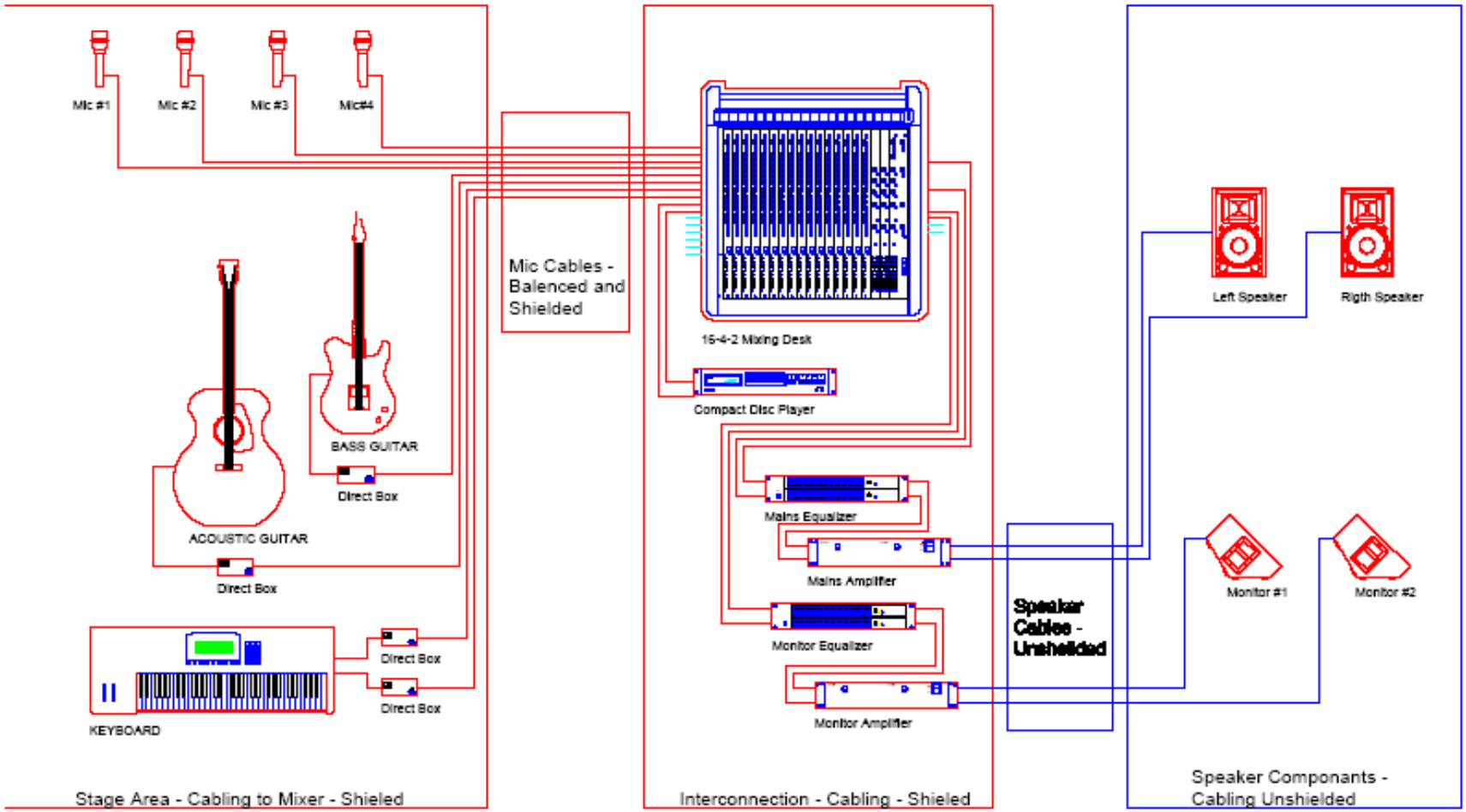
26-Pair Snake Cable



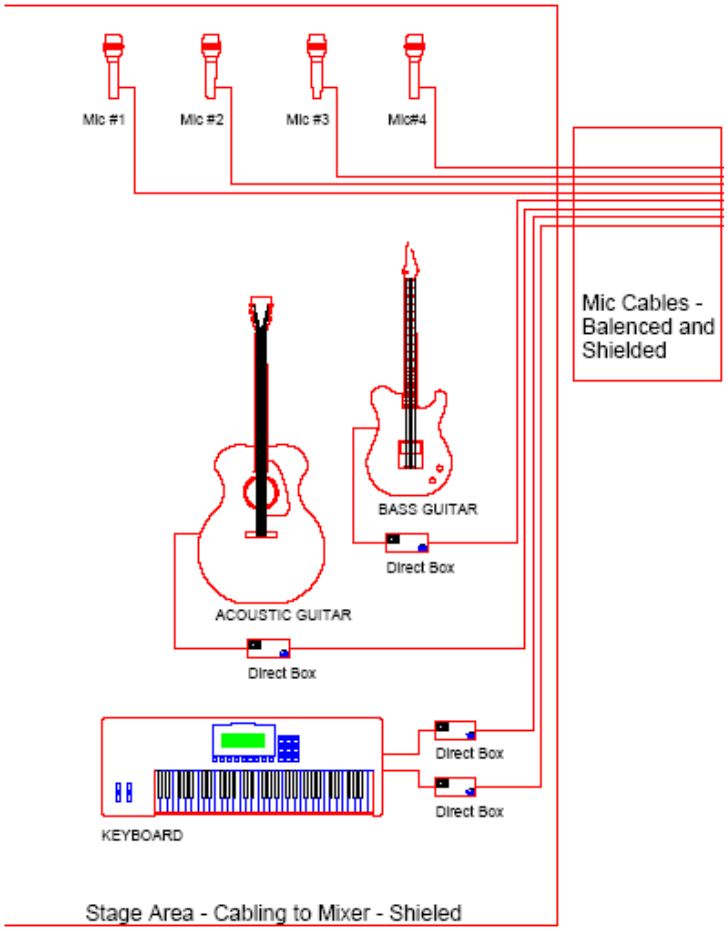
Audio Wire Types

26-Pair Snake Cable – close up

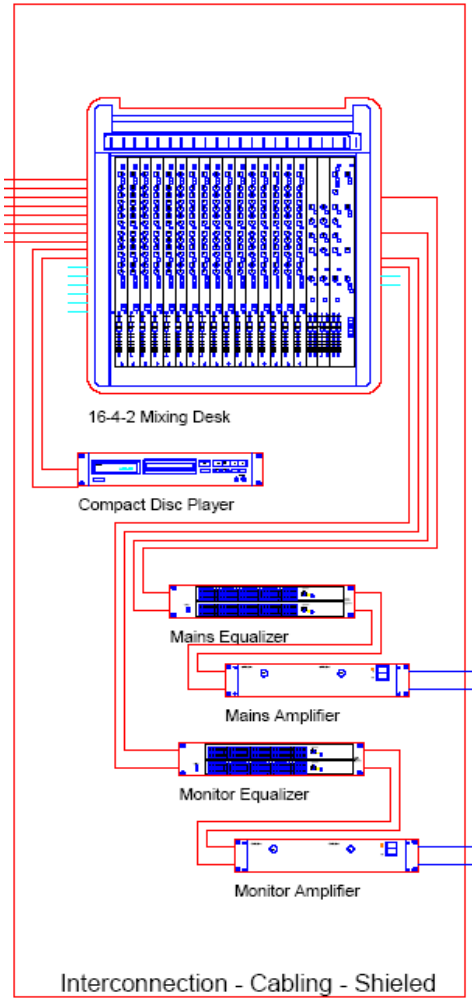
Basic Audio System Layout



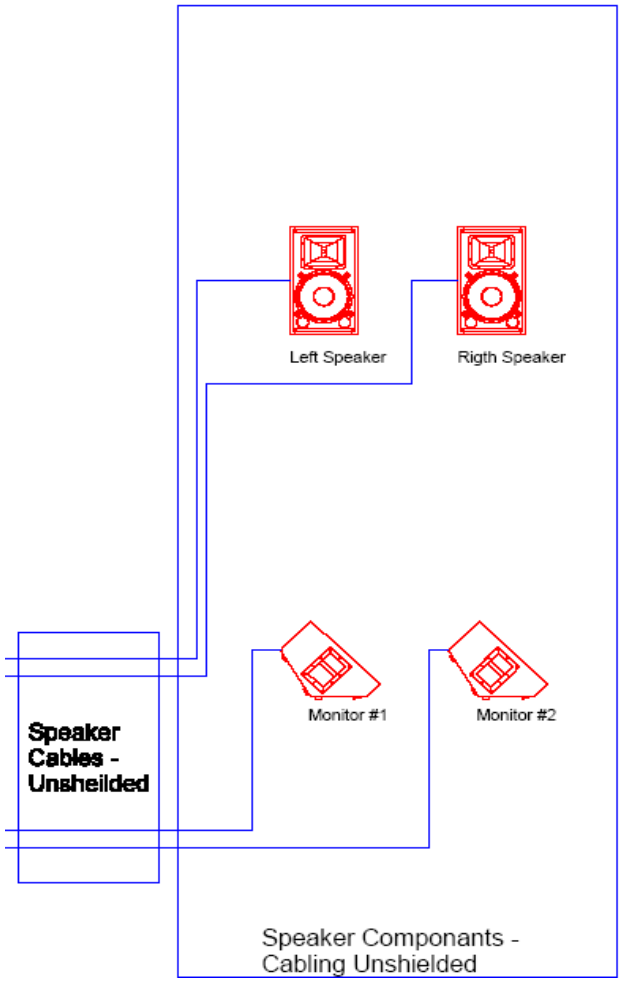
Basic Audio System Layout
Input section



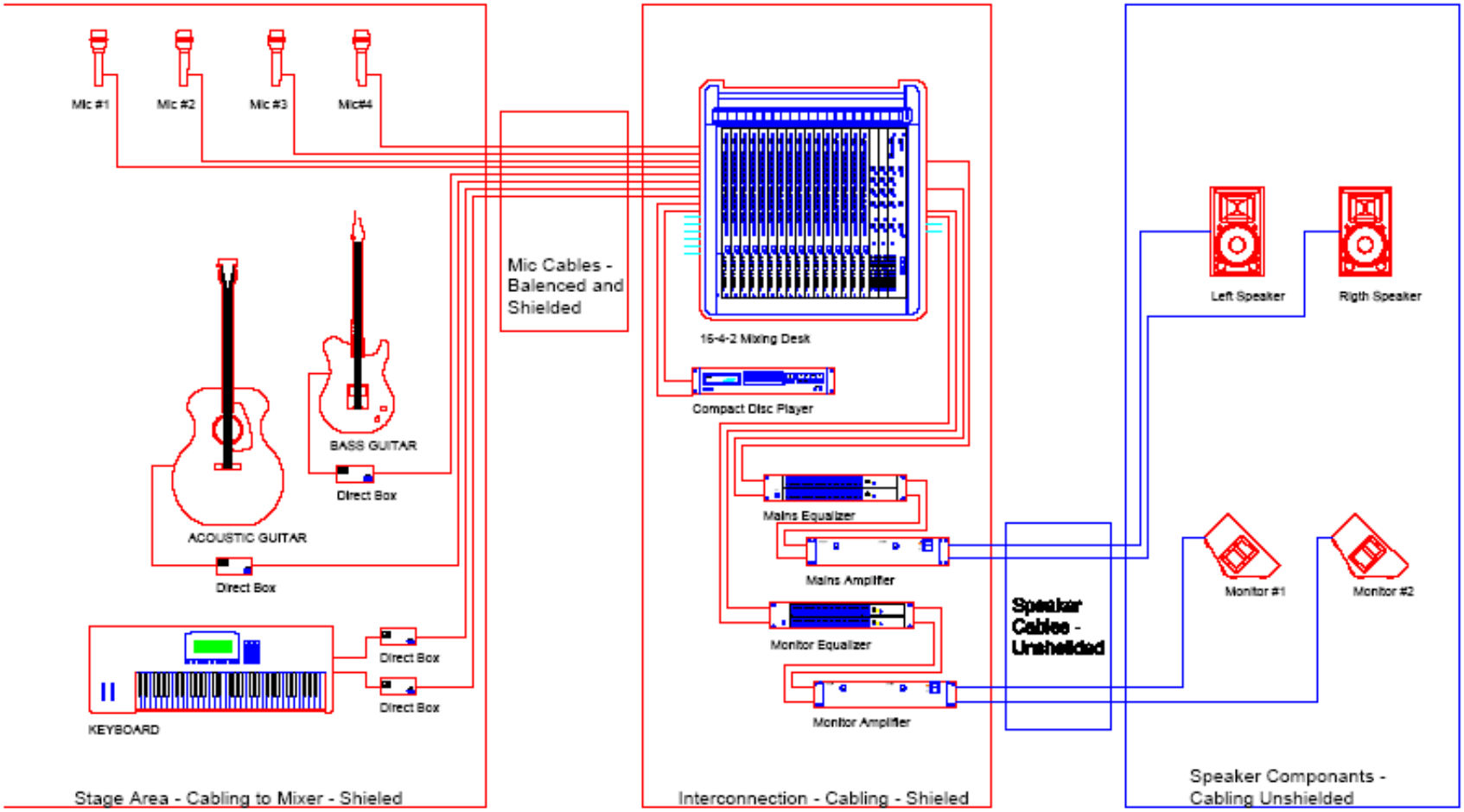
Basic Audio System Layout Interconnections



Basic Audio System Layout
Output Section



Basic Audio System Layout



For more Information

www.agiprofessional.com/india-2007

This is a growing web site that will have more and more resources available.