Standard Audio Connectors

Common XLR Connector
*Balanced Connection
*Pins 1 & 2 flip position depending on Male/Female
*AES Standard (1982) 1=Always Ground, 2=Positive, 3=Negative
*Some equipment designed before 1982 might have pin3=Positive, with pin2= Negative
* Example KT 360 and KT410 EQs (Silver face)
*Most used for microphones and all proaudio equipment

Common TRS Connector (Tip/Ring/Sleeve)
*Comes in Multiple sizes, including 1/4", 1/8", and mini
*Can be single channel balanced connector, or dual channel unbalanced connector
*Has MANY uses, and so can be confusing - few standards
*Uses for 1/4" =
  *Headphones (T=Right, R=Left)
  *Mixer Balanced Outputs (T=+, R=-)
  *Mixer Inserts (T=Send, R=Return) - Sometimes reversed! Check Back of Mixer
*Uses for 1/8" (Usually Stereo 2 channel)=
  *Computer outputs (T=Right, R=Left)
  *Portable CD, iPod, Camcorder Outputs & Inputs (T=Right, R=Left)
*Uses for mini (Very Rare) = Camcorder Outputs & Inputs

Common TS Connector (Tip/Sleeve)
*Comes in Multiple sizes, including 1/4", 1/8", and mini
*Always an unbalanced, single channel connector
*Uses for 1/4"=
  *Mixer Unbalanced Outputs & Inputs
  *Guitar & Keyboard Outputs
  *Audio FX and Processing
  *With Large Gauge (#14/#18) Cable, Speakers
*Uses for 1/8" and Mini (Rare)=
  *Camcorder inputs, usually mic level

Common RCA Connector
*Metal ring (Ground) with inside Pin (Positive)
*Always an unbalanced, single channel connector
*Uses=
  *Most consumer (not pro) Audio Equipment
  *Cassette & CD Decks, Computer Audio Cards, etc...

<table>
<thead>
<tr>
<th>XLR Male</th>
<th>XLR Female</th>
<th>1/4” TRS Male</th>
<th>1/4” TS Male</th>
<th>RCA Male</th>
<th>1/8” TRS Male</th>
</tr>
</thead>
</table>

![XLR male](image1.png) ![XLR female](image2.png) ![1/4” TRS male](image3.png) ![1/4” TS male](image4.png) ![RCA male](image5.png) ![1/8” TRS male](image6.png)
Standard Audio Adaptors

XLR -> 1/4" TRS Balanced Adapter
* Used mostly for Mixers w/ Balanced 1/4" Outputs

BEWARE of XLR -> 1/8" Adapters. If they are wired like this, they WILL NOT work for Computer outputs. Instead, use 1/8" TRS -> (2) RCA adapters (below)

XLR -> TS Unbalanced Adapter - Pin2 HOT
* Used mostly for Inputs & Outputs, FX/Processing
* Can Also be used with gear that has Unbalanced 1/8" TS Outputs (Very Rare)
* Pin 3 is shorted to Ground, making the entire cable run Unbalanced
* Use with SHORT RUNS ONLY - Long Runs require a DI Instead

BEWARE of XLR -> TS Adapters that might be Pin3 Hot OR Gear that is wired Pin3 Hot. If the hot signal is shorted to ground, you will not get signal. These adapters are often NOT labeled. You have to use a meter is take apart connectors to verify wiring.

XLR -> RCA Unbalanced Adapter - Pin2 HOT
* Used mostly for Connecting Consumer Cassette & CD Decks to Mixers
* Use with SHORT RUNS ONLY - Long Runs require a DI Instead

BEWARE of XLR -> RCA that might be Pin3 Hot OR Gear that is wired Pin3 Hot. If the hot signal is shorted to ground, you will not get signal. These adapters are often NOT labeled. You have to use a meter is take apart connectors to verify wiring.

1/8" Stereo TRS -> (2) RCA
* Used most often for connecting Computers to Mixers/DIs
* Tip of TRS connector is the Right Output, and is wired to Red RCA Connector
* Sleeve of TRS connector is Ground, and is wired to the Ground of both RCA Connectors

BEWARE of TS -> (2) RCA adapters. These are mono "Y" Cables, and do not work for a stereo output. For short runs, you can use this adapter to plug strait into console, for long runs use this adapter with a DI (might require an RCA->1/4"TS adapter) or AV-1, and use XLR for rest of run.

1/4" Stereo TRS -> (2) 1/4" TS (Insert Cable)
* Inserting EQs or Compressors into a mixer channel
* Tip of TRS connector is often the Send or Output, and is wired to a TS Connector (Label Tip)
* Ring of TRS Connector is the Return or Input, and is wired to a TS Connector (Labeled Ring)
* Sleeve of TRS connector is Ground, and is wired to the Ground of both TS Connectors
* Specialized purpose

BEWARE of Mixers that are wired in reverse; Tip=Return, Ring=Send. Most consoles have a label on back by the connectors which tell you which is which.
BEWARE of Mono TS -> (2) TS connectors. These are TS "Y"s and should not be mixed up with insert cables.
Scary Audio Adaptors

XLR -> TRS 1/8" Adapters: Not Labeled
* How is it wired?
* Is it balanced mono?
* Are both hots wired to pin 2 (or pin 3)
* Is Tip Wired to Hot, and Ring Wired to Negative

You have to meter or take adapter apart to find out
DO NOT Use for computer connections

Sometimes 1/8" TRS to XLR is built to work with this adapter:
XLR to two 1/4" TS
This is wired with Ground on Pin1, Left to Pin2, Right to Pin3
Of course, Left and Right could be reversed
BUT, if you don't know that, how are you mis-wiring your system?
These kind of adapters are often made with good personal intentions,
but once they are recycled into regular gear, they are a lot more
trouble than they are worth, UNLESS they are well labeled.

XLR -> RCA: Not Labeled
* Pin 2 hot or pin 3 hot?
* Is Gear with XLR Connector Pin 2 or 3 hot?

XLR -> 1/4" or 1/8" TS: Not Labeled
* Is Gear with XLR Connector Pin 2 or 3 hot?

1/8" TRS -> RCA
* What is wired to what?
* Is Ring Wired to Hot or Ground?
* Do not use for computers.

1/8" TRS -> 1/4" TS
* What is wired to what?
* Is Ring Wired to Hot or Ground?
* Do not use to connect computers to DI.

XLR -> Edicon
* Don't get me started
Balanced and Unbalanced Audio

This page attempts to provide a very simple overview on balanced and unbalanced audio systems.

**What is an unbalanced line?**

Unbalanced lines consist of two wires - one which provides the signal and the other which provides a reference (i.e. ground). They're the type of connections you get on guitars, domestic audio equipment and some keyboards. Often, 1/4 jack connectors or phono/RCA connectors are used to connect unbalanced equipment.

**What are the disadvantages of unbalanced lines?**

The diagram illustrates what happens when a signal travels down an unbalanced line. The line itself is exposed to noise and interference along its length and this noise appears superimposed on the wanted signal at the receiving end. The cable's shielding (not shown on this diagram) helps the situation a little, but in general unbalanced lines are very prone to picking up noise.

**What is a balanced line?**

A balanced line usually consists of three conductors - two carrying signal and a shield/ground conductor. These lines are often used on professional equipment for carrying mic and line level signals. They usually use XLR connectors or 1/4" TRS jacks for connection. In balanced lines, the shield/ground conductor does not carry any signal/reference itself, so it can be left disconnected at one end to reduce "ground loops".
How does a balanced line work?

To remove noise from a signal we need some way of working out what is our wanted signal and what can be thrown away. Balanced lines achieve this by transmitting two versions of the signal down their length. The source equipment sends the normal signal down one conductor and a polarity-inverted signal down the other. This is usually done using either transformer-based or electronic output stages.

The cable itself is designed with the conductors having very similar impedances and twisted along their length so that any noise is picked up equally by both conductors, no matter where in the cable it occurs.

The receiving equipment has a transformer or electronic differential amplifier, and takes the inverted signal and returns it to its correct polarity. At this point, the wanted signals on each conductor are both the same polarity, whereas any noise is of opposite polarity. Summing the signals from the two conductors together reinforces the wanted signal and cancels anything unwanted, leaving a recovered signal which is very close to the original. (this is known as Common Mode Rejection - i.e. any signal which is the same on both conductors is removed.)

Even balanced lines aren't perfect, though - slight differences in impedance, twisting or input gain will allow some noise to slip through. This isn't generally a problem unless you're using very long runs or working in areas of high interference.

How can I create a balanced output from my unbalanced equipment?

The best way of doing this is to use a DI box. A DI box uses a transformer or electronic components to isolate the input from the output whilst still passing audio. They can take an unbalanced input (usually of instrument, line or speaker level, depending on the pads available) and give a balanced output, to feed your balanced line.
How can I connect an balanced signal to my unbalanced equipment?

It is possible to make adaptors to connect an balanced signal to unbalanced equipment. However, all of these adaptors will unbalance the signal negating the benefits of balanced wiring.

The best option is to use a 1:1 repeater coil, or transformer. However, in most situations you can use a passive DI box in reverse to similar effect (bearing in mind that there will be a level change). This method retains the balancing of the cable run to the rep coil/DI and only unbalances the short run between the coil/DI and the equipment.

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http://www.ians-net.co.uk/articles/balanced_lines.php
"Phantom powering" is a method of providing power to microphones and direct boxes by applying a voltage to the same wires that carry the audio signals. Phantom power can be generated from mixing consoles, mic preamplifiers, or in-line phantom power supplies. Most mixing consoles will have a phantom power switch which is labeled “ph”, “+48”, “48v”, “pwr”, or something similar. Small consoles may not carry phantom power at all, or will have a master phantom power switch which activates phantom power on every input channel. Larger consoles will have phantom power selectable in banks of channels, or individually on each channel.

Phantom power can only be transmitted on properly balanced lines and will not work in an unbalanced situation. Phantom power is transmitted by sending a DC voltage down the “+” and “-” signal conductors of a balanced line. Popular phantom voltages are 12V, 15V, 18V, 24V, and 48V. 48 volt phantom is the most common and many microphones require 48V for proper operation.

In general, phantom voltages are used to power electronics within condenser microphones and active direct boxes. These items require power for various parts of their operation, including impedance converters, preamplifier circuitry and, in some cases, to polarized microphone capsules. Microphones and DI boxes draw current from this voltage based on their needs.

**How does it work?**

Balanced microphone connections have two signal conductors relative to a ground conductor. With XLR-3 connectors, pin-2 and pin-3 are the signal conductors and pin-1 is the ground conductor. The definition of phantom power is an equal voltage applied to pin-2 and pin-3 with respect to pin-1.

For example: if you are using a microphone that requires 48V phantom power, this would be achieved by sending +48V down pin-2 of the XLR line, and +48V down pin-3 of the XLR line. These voltages are referenced to the ground pin, which is considered “0”.

Since the voltage is exactly the same on pin-2 and pin-3, and is being transferred on a balanced line, when the voltage on each pin gets to the balanced input, the negative (pin-3) is “phase flipped” and is canceled out of the signal. This works the same as how a balanced line cancels external noise from the audio signal.

Because phantom voltage is exactly the same on pin-2 and pin-3 with respect to pin-1, phantom power has no effect on balanced, dynamic microphones. A properly connected balanced, dynamic microphone will operate with or without phantom present.
Do you need phantom?

Items that normally require phantom power are: Condenser microphones, including: Lavaliere microphones, PZM/boundary microphones, podium microphones, small band microphones (Drum over-head mics, violin mics, etc...) and active direct boxes. If any of these devices are plugged into an input that does not have phantom enabled, they simply will not work.

Items that normally do NOT require phantom power are: Wireless microphones, Handheld wired microphones (normally SM58, 57, switched mics), passive and computer direct boxes. These item will work wether phantom is enabled or not. However, it is recommended to turn phantom power OFF when using ribbon microphones, because it is possible to damage the microphone.

Beware!

Do not use adaptors when connecting phantom power devices. Adaptors can connect pins together or involve transformers that will interrupt phantom power, and possibly cause a live voltage that could short out and cause sparks. This voltage is not strong enough to hurt someone directly, however a short could damage equipment and cause a fire in the wrong situation. Phantom power is almost always transmitted on an XLR connector and should always stay in an XLR format.

Some microphones and DIs that require power can also operate with battery power. These items have battery compartments inside of them at some point before the XLR output. Beware of these items. Sometimes, they will not use phantom power if a battery is installed inside of it (instead, running off of the the battery until the battery dies - at which point the microphone or DI stops working). Others will only work if a battery IS installed, using the battery to complete the circuit, though will not draw power from the battery as long as phantom power is being transmitted to the device. Sometimes it is hard to tell. Direct boxes are especially difficult to deal with because, often, seeing if there is a battery compartment requires physically taking the DI apart. Active direct boxes made by Countryman have different versions (Which are impossible to tell apart from the outside), which have different battery installation requirements. It is best to examine documentation when it is available.

Phantom allows us to use one cable to send power to a device while also receiving a balanced audio signal from it. Pretty cool, huh?

Includes excerpts from: “Phantom Basics” from Sound Devices @ http://www.sounddevices.com/
Audio Troubleshooting

General Troubleshooting guidelines:

• Always work in a logical signal-flow based pattern. Do not bounce around different places. Start at the end of the signal flow (usually the console) and work your way back to the beginning (usually the microphone). Try one “possible fix” at a time and check your signal flow each time.

• Use headphones when troubleshooting. That way, everybody else doesn’t have to listen to your mistakes.

• Invest in a Whirlwind “Q-Box”. This is a very handy tool that lets you check signal at any location, even directly out of a microphone.

No Sound

Before trying to find a “no sound” problem, **ALWAYS** turn down your input fader! You do not want to suddenly find the problem backstage, when the board is unattended, and have a microphone suddenly start screaming feedback because you found the missing connection. Always turn down your fader, try a possible fix, and then turn your fader back up to check.

• Check your connections. Yeah, yeah, I know - Check them anyway.

• Make sure everything is turned on. Some audio gear does not have lights to let you know that power is “ON”

• Use your headphones and check to see if you have a signal at the input (PFL Switch).

  • If you can hear the input with your headphone, then you know the problem is within the console routing

  • Follow the console routing from input to output, listening at each point (using the PFL and AFL buttons) to make sure the audio is getting to the output.

  • If you can not hear audio at the input, then check each point from the console to the microphone

• If you are using inserts, pull them out. If you then have sound, then the problem is in the inserted connection.
Feedback

• Check your speaker/microphone placement. Microphones MUST be behind speakers. Ceiling speaker systems are often significant causes of feedback.

• Try turning your speakers and microphones away from each other a little more.

• When possible, try to move speakers a little away from walls. Always point speakers away from walls.

• Make sure microphones are close to the source. Closer is always better. If a presenter is too far away from the microphone, then you will never get enough gain before feedback.

• Make sure your EQ is “Flat”. On the console input, all EQ knobs will be in the “12 o’clock” position. Absolutely nothing should ever be turned up (Past “12 o’clock”). If you have a graphic EQ (Either outboard or on the console), make sure nothing is turned up past the center point.

• Listen to your working volume. Is the microphone louder than it really needs to be? Loud volumes are tiring to the listener and are a significant cause of feedback. If it is too loud, slowly turn down the volume to a more reasonable listening experience.

• After you have confirmed that your EQ is “Flat”, then use EQ to turn down the problem frequencies.

  • For low frequency feedback, use the “low” EQ on the input fader and turn it down to prevent low frequency feedback and handling noise. Also, use the “HPF” (High Pass Filter)

  • For real high frequency “sibilance” and ringing, turn down the “high” EQ on the input fader.

  • Mid range frequencies need to be found. Often, there are mid range frequencies that are mistaken for Low Frequency feedback or High Frequency feedback. Finding mid-range frequencies takes practice. First you have to find the problem frequency and then turn it down.
Hums and Buzzes

Hums and buzzes are normally caused by one of three things: a bad cable, a ground problem, or an unbalanced connection. Bad cables and unbalanced lines are usually easy to find. Simply correcting the offending cable will correct the problem. Ground problems are often much harder to find, because it is not one thing that is causing the hum. It is the combination of multiple parts of the audio system and how they are connected that create the problem.

• Check to see if the hum is only coming from one place. If so, it is probably a cable problem. Jiggling cables will often help you find a problem connection. If jiggling cables does not help, then replace cables one at a time to try to find the problem.

  • When you find a bad cable - DO NOT just throw it in the pile with NFG on it. Label exactly where the problem is so that is can be found and fixed in the shop.

• Sometimes, it is a bad piece of equipment that is causing the problem. If replacing all of the cables does not give you a solution, then try replacing a piece of gear.

• IMPORTANT: Isolation Transformers (Shure IL-19) can not help in a bad cable situation.

• Ground hums are often the product of some type of grounding problem within all of the gear that is connected. Often, when there is a ground problem, many different parts of a sound system will create hum. (For example, all outputs on the audio console)

• Try disconnecting outboard pieces of gear, starting with equipment that is being use outside of the audio system (such as video decks and backstage monitors). If disconnection a single piece of gear stops the buzz, then you have probably found the problem connection. Try placing an AC Ground Lift on the piece of gear or by placing an Isolation Transformer (Shure IL-19) between the problem gear and the rest of the signal.

• Make sure ALL cabling that runs longer than 15 feet is balanced. A common problem is a long cable run that comes from a deck on stage to the FOH console. The entire run is XLR, but at the deck, the technician used an RCA to XLR cable adapter instead of a direct box. Because of this, they have made the entire line unbalanced. Look for TS to XLR type connections as well. Replace these type of connections with direct boxes.
• **Muddiness/Tinyness**

  • Check microphone placement. Microphones that are covered by anything can not produce quality sound. Microphones that are far away from the source will cause “Tinny” sound.

  • Check your EQ. If highs and mids are turned down too much, you will get a muddy and quiet sound. Make sure nothing on the EQ is boosted. Any kind of problem boosts will cause muddy and/or tinny sound.

  • Check speaker placement and make sure you are not creating feedback problems. Often muddiness is actually low-mid frequency feedback that just hasn’t taken off yet. Thin and sizzling sound can often be a result of high frequency feedback.

  • Most of the time, muddy and tinny sound can be corrected with good microphone placement and taking out any EQ boosts.

**Distortion**

Distortion is almost always a problem with gain structure. Whatever the cause, it must be fixed right away. Not only is it annoying to listen to, but distortion can damage speakers even at low volumes.

  • If you are using house system, make sure you always go in “Mic Level”, unless you know the input is “Line Level”. Use a -50dB Pad or an AV-1.

  • Always set your console mic pre-amp gains so that your input and output faders are at “0dB”. If a fader is turned down real low, it is likely that something before it is too loud - causing the distortion.

  • Sometimes, blown speakers can be the cause of distortion. Check the speakers and replace when possible.

  • Don’t boost EQ. By boosting, you are turning up the volume of a frequency range which could cause distortion.

  • Check your mic placement. Lav mics can be rubbing against a piece of clothing, making it sound like distortion.
**Inputs**
1) Pod
2) Lav
3) Head Table
4) Isle
5) RF 1
6) RF 2
7) Computer
8) Computer

ST1) CD
ST2) Cass
ST3) VHS

**Outputs**
STL) HL EON
STR) HR EON

GRP1) Record L
GRP2) Record R

MTX5) House System
MTX6)
MTX7)
MTX8)
Audio Basics - Outline
December 18 & 19, 2007

OPENING
Beginning Skills. Everything related to audio for A/V meeting rooms.
- Why and When you need audio systems
- The importance of interaction with the speakers/performers
- Audio is the one department that COMPLETELY relies on the performer.

Cables & Connections
- XLR
- RCA
- 1/4" TS, TRS
- 1/8" TS, TRS
- NL-4, 8
- EP 4, 6, 8 - Getting phased out in preference to NL4&8
- Pin Assignments of each

Theory
- Explanation of input & output
- Stereo, Mono, & More
- Balanced & Unbalanced
- Phantom Power
- Line Level, Mic Level, -50, -10, +4
- Passive & Active

SIMPLE SOUND SYSTEM

Draw a picture

<table>
<thead>
<tr>
<th>Source</th>
<th>Input Transducer</th>
<th>Mic Preamplifier</th>
<th>Amplifier</th>
<th>Output Transducer</th>
<th>Ear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microphone</td>
<td>Mixer</td>
<td></td>
<td>Amplifier</td>
<td>Speaker</td>
<td></td>
</tr>
</tbody>
</table>

Microphone ➔ Mic Pre-amp ➔ Amplifier ➔ Speaker
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The Source
- CD Players, computers, etc...
  - Line Outputs, headphone outputs
- The Voice
- Instruments

Input Transducers
- What is a transducer?
- Direct Box
  - Passive
  - Active
- Dynamic (Passive) microphones
  - Examples: sm58, sm57, D112, 421
- Condenser (Active) microphones
  - What is Phantom Power? - See Handout
  - Examples: Lavs, sm81, 414

The Mic-Pre
- Where is it found? (Usually the mixer)
- How do you use it?

The Amplifier
- What is it used for
  - Real simple explanation of ohms (btw - Resistance = Voltage/Current, R=V/I)
  - Understand that 2ohms is a greater load than 16ohms
  - Loading – General rule (only 2 speakers per channel, 3 max)

Output Transducers
- Speakers
  - What is a Cross-over
    - Passive Cross-over
    - Active Cross-over
  - What is an Active speaker - really?
    - Combination Systems (JBL EON as example)
- Headphones
  - Headphone outputs (Computers, etc...)

Variations on the Simple Sound System
- Powered Speakers (Eon)
- Powered Mixers
- Playback only (no Mics)

The Ear
- How does it work?
- Most common form of hearing damage - Noise damage!

SAFETY
Use Ear Plugs! – Where to find them.
  - Walkman style earphones / earbuds – NOT protection
Responsibility of the audio engineer in regards to volume
- Working Volumes
- Watch for people by speakers
- Watch for safety of others (Especially in shops)
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- LABEL, LABEL, LABEL!
- The importance of Speaker/Mic relationship
- The Podium
- Table/Panel Mics
- Q & A Mics

Setting up control
- Where to setup in the room
- Make sure you can get to everything, give yourself room
- Power
- Unbalance & Balanced Lines
  - Make sure all long runs are balanced
  - NOT just adapted to XLR

Snakes
- Why they are so important
- Smart Patching - 1 to 1
- Where should you always use them
  - Between Stage & FOH
  - From Main Snake to Stage
  - To/From Video
- Where should you try to use them
  - FOH gear
  - Wireless racks
  - Amp Racks
- Weird contact/ground hums

Stage
- Speakers
  - Mains
  - Monitors/foldback
  - Backstage Program
- Microphones
  - Pod
  - Table Mics
- Computers
- Other Playback from Stage

House Sound Systems
- Ceiling Speaker Systems
- Connecting at the wall
  - CC Mic Level Input (female)
  - CC Line Level Input (male)
  - Marriott Mic Level
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TROUBLESHOOTING

Power
- Most common form of hum
- Isolation Transformer (IL-19)
  - Easy “Patch”, not a fix

XLR Cables
- dropped ground
- one leg
- Loose connection

Speakers
- Lows only – no highs
  - re-explain crossover
  - Bi-amped systems
  - Speaker or cable?

No Sound At all
- Go over entire signal flow
- re-emphasize input & output
- Check signal routing at console
  - That one Button!
  - TURN DOWN THE VOLUME FIRST
- How to find where it works, and where it stops working

Tools
- Multi-meter
- Q-Box
- Speaker Test box/ connector
- CD/MP3 player
- Headphones