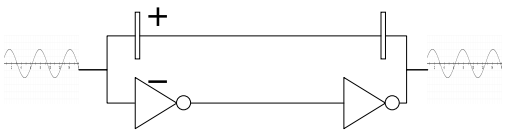
CABLE

Smallest cost per cable, but number of cables in a design can make the actual percentage for cable purchase considerable.

Balanced signal

- Very important to use whenever possible!
- Not considered professional unless balanced.

How Balancing works



Because every signal runs through cables, it is foolish to use poor quality cables:

- even one bad cable can destroy the integrity of a signal path.
- Inductance
- Shorts
- Open Circuits

Cable Properties

- Resistance
- Capacitance between conductors
- Inductance between conductors
- Shielding Density
- Durability
- Jacket Friction
- Gauge (AWG)

Cable Components

- Insulator
- Conductor
- # of Conductors
- Shield

Stranded conductors

- Should almost always be used
- Fail-safe
- More flexible

Shielded cable

Single conductor

- Used in unbalanced circuits
- Actually has two conductors (ground)

Dual conductor

- Used in balanced circuits
- If used in unbalanced circuits, capacitance is doubled, and therefore increases high frequency loss.

Shielding

- Stranded shielding
- Foil Shielding
- Braided shielding

Type of conductor material

Copper

- Excellent conductor
- Lacks tensile strength
- Used in installations where the cable will not be flexed often

Copper/Bronze

- higher strength, not as flexible.

Aluminum

- Strong
- Lightweight
- Too much resistance for long runs or small voltage.

Low level cables

- Susceptible to inductance noise
- Amplification of noise and hum occurs

Electrostatic Noise

- The higher the frequency of noise, the smaller the wavelength, and therefore the easier for the noise to enter the cable through small breaks in the shielding

Foil wrapping

- provides nearly 100% shielding effectiveness, but is not particularly strong or flexible, and can break easily.
- Foil is best used in permanent installations, or interior cabling which will not be subject to strain.

Wire Wrapping

- Wrapped wire shielding or braided wire shielding is more commonly used for standard connections to the sound system
- Wrapped wire can open with flexing, however.
- Braided wire is even more important when used with equipment requiring phantom power.

Electromagnetic Noise

- Caused when motors or ballast in fluorescent lighting, or SCR dimmers, inducts AC onto the interior cables
- Normal shielding does not exclude this type of inductive noise, unless the shield is iron or steel conduit.
- Only twisted pair balanced line and physical distance can eliminate or reduce this type of noise.

Ground Loops

- Caused by incorrect grounding procedures.
- No amount of shielding can correct this problem.

Jackets

- The exterior protection on a cable

Rubber

- Often a rubber outer jacket is preferred
- Flexible over a wide temperature range.

Vinyl

- Good quality vinyl used.
- Particularly when pulled through conduit - slipperier

Plenum cable.

- Tough slippery coating
- Withstand high temperatures.
- However, not flexible.
- Used for permanent runs where conduit is a problem.

Capacitance in shielding

- Because shielding completely surrounds a conductor, it can act as a capacitor.
- Functions as a low pass filter:
  - the greater the capacitance, the lower the cutoff frequency.
- Most problematic with
  - High capacitance per foot
  - Long cabling

Running cables over long distances

- > than 100 feet should be the best possible cable.
- The longer the distance, the greater the separation between cables
- Also, larger gauge of wire increases resistance.

Avoid coaxial RF cable (TV and Radio antennae wire)

- Higher capacitance
- Single small gauge inner connector
- Stiffer
- More susceptible to breaking

Strain Relief

- Most cables for sound have an inner non-conducting cord
- prevents the soft inner cables from distorting or breaking when stretched.
- should be carried through to the connectors as well, since that is where most of the pressure will occur.
- Sharp bends in the cable also promote premature breakage of the inner cables as well.

Mic Level Cables

- Very low level
- Will be amplified
- Any noise or hum inducted onto cable will be amplified as well
- Balanced signal

Line level Cables

- Low level
- Inducted noise amplified as well

Unshielded Cable

- Shielding adds capacitance, weight and cost to cable, so is not to be used when in a situation where it is not required.

Telephone cable

- twisted pair
- balanced
- high voltage.

Speaker cable

- sending higher powered signals.
- Any electrostatic or electromagnetic noise sources are much smaller relative to the powered signal, and are therefore way below the threshold level of perception.
- Larger Gauge wire is used, since much higher power is being sent.

Cable for speakers.

- Cables should therefore not be twisted
- Coiling should alternate instead of being coiled in a large pile.
- Inductance causes low frequency losses (high pass filter)
- requirements very similar to AC cable.
- Zip cord commonly used, but not recommended
- Also heavy duty AC cable used for industrial 240 V power extension cords.

Connectors

High quality connectors

- Able to open connector
- Gold coating on connections
- Strain relief
- Soldered connections to cable

Connectors

- Plug
- Jack
- Male
- Female

Chassis Mount vs. Cable Mount

- Chassis for boxes
- Exposed wire on the inside.

Terminal Blocks

Spade

Used when a system is not permanently installed.

- every connection increases the resistance.
- can increase with aging, corrosion, or dirt buildup.
- Important to clean.
- Regular connecting tends to scrape this residue off.
- Best to use connectors only in situations where there is frequent plugging and unplugging.
- Gold-plated pins aid in decreasing this problem.

Connecting and disconnecting.

- Make sure that you are holding onto the plug, not the wire.
- Pull out straight
- Never Force!
  - If you have to force, something is wrong
- Avoid handling the shaft
  - Oil and corrosion

Types of Connectors

Two-circuit connectors

Phone (1/4")

Phone plugs

- Also called TS, or 1/4”
- Standard diameter is 1/4”
- Inexpensive
- Can cause a pop when inserted into an active circuit
- Prefer metal shell plugs to plastic shells
  - More difficult to break or crack
  - Add shielding around the connection.
- No locking mechanism.
- High contact resistance.

RCA

RCA plugs

- Also called phono or pin connectors
- Common in consumer level equipment.
- Inexpensive
- Small footprint
- High problem with corrosion at the jack and plug connection.

Mini-phone plugs

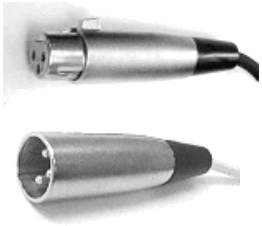
- 1/8” connectors
- Similar to 1/4” but smaller
- Less contact area
- More prone to break than phone
- Smallest footprint

Three-circuit connectors

Stereo Phone Plug

- Called TRS
- Can also be used to send two unbalanced signals in one connector
- Stereo headphones

XLR



XLR (XLR-3)

- Many other sized pins.
- Available in male and female versions.
- Professional connector of choice
- Lock together
- Connection first made by pin 1, so that grounding occurs, and no pop.
- Accommodates large diameter mic cables.
- Good strain relief
- Large contact areas.
- Fairly expensive.

Speaker Connectors

Speakon

Speakon

- Most popular current type
- Locking
- Many formats
- Multiple Pins (NL2-NL8)

Banana

- Used to be old standard
- Binding Posts on back of Amps
- Non-locking, easy to come out

Phone

- Some less professional Amps and Speakers use Phone
- Dangerous to confuse these with line level.

Bare Wire

- Used for permanent installations
- Good connectivity
- Hard to repatch

Power Connectors

IEC

- International Electric Connector
- Standard Plug in back or professional products

Edison

- The standard US Wall outlet.

“Wal Warts”

- External Power Supplies
- Isolate AC from inside of Chassis.
- Inexpensive.
- Prone to Failure
- Awkward

Digital Connectors

AES/EBU

- XLR

SP/DF

- RCA

MIDI

- Din 5

Ethernet

- RJ-45

EXTERNAL DATA BUSS

- SCSI
  - DB-25
  - Centronics 50
- USB
- Firewire (IEEE-1394)

Putting it all Together

- **Types of Cable Assemblies**

Single Cables

- Common

Dual Cables

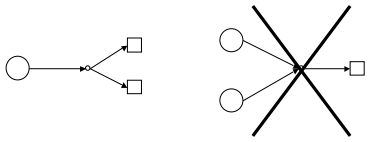
- Carries two channels of audio information
- These are also referred to as:

Snakes

- Multi-pair cables.
- Used when many separate connections need to be sent from to identical places.
- Using many separate mic cables can create a big mess.
- Easier to use a dedicated cable, which is clearly labeled on both ends.
- Best to separate sends and returns, since capacitive or inductive coupling can cause lower gain before feedback.

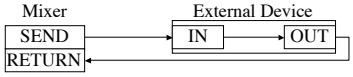
Y Cables

- Send same signal from one output to two separate outputs
- Use in this direction, not to combine two signals!

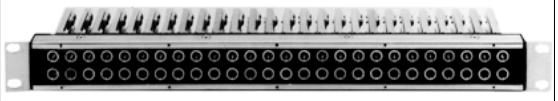


Insert cables

- TRS to dual TS
- Designed to send and return on same cable set
- Must be unbalanced.
- Saves space on the back of the device
- Because unbalanced, should be avoided when possible



Patch Bays



Adapters

- To convert from one type of connector to another
- Does not change level or other components

Some standard Types

- 1/4” - XLR
- 1/4” - RCA

Gender Adapters.

- Used to change gender of a cable end
- F-F
- M-M

Transformers, Pads, etc.

- Inline devices

IL-19

- Isolation
- Helps with Ground Loops

DI Boxes

- Used to convert line level to mic level
- May be active (Phantom Power)
- Often a way to send unbalanced signals a long distance

Pads

- Used to reduce level of signal if input device is overloaded
- Used when no output gain stage on source device

An Amazing Web site for Manufacturers

- http://www.auldworks.com/theater/proaud1.htm#INDEX

Some standard Sources of cable

- West Penn http://www.westpenn-cdt.com/
- Belden http://www.belden.com/
- Canare http://www.canare.com/
- http://www.whirlwindusa.com/
- http://www.wireworks.com/
- http://www.switchcraft.com/
- http://www.rapco.com/
- http://www.monstercable.com/
- http://www.hosatech.com/