Chapter 8. Meeting 8, Interconnections, Signal Flow, Busses, and Patch Bays

8.1. Announcements

- Audio materials for first Processing Report (due 7 March):

  audioProcReport01.zip

- About Eargle readings
- Need schlep crew of three for Wednesday at 3:10 at my office
- Need volunteer solo musicians for Wednesday who can bring instruments

8.2. Quiz

- ?

8.3. Pro Audio and Consumer Audio

- Standard operating level and signal-to-noise ratio
- Cables
- Price

8.4. Cables

- Wires (conductors): carry voltages or grounds
- Shielding: meso level of protection
- Insulation: outer level of protection
- Connectors and Jacks: provide easy interface, can be male (M) or female (F)

8.5. Signals, Voltages, and Grounds

- Analog sound can be represented as a changing voltage
- Grounds are a point of zero voltage

- For safety: a path for faulty currents
- Ground loops: grounds with differing electrical potentials on the same connection (not exactly a ground)

  May result in a 60 Hz hum

8.6. Analog Cables: Types

- Unbalanced
  - Two conductors: one signal, one ground
  - SOL: -10 dBV
  - High impedance
  - Length Limit: 25 feet
- Balanced
  - Three conductors: two signals, one ground
  - SOL: +4 dBu
  - Low impedance
  - Length Limit: 1000 feet
  - Active and transformer balanced

8.7. Analog Cables: Connector Examples

- TS

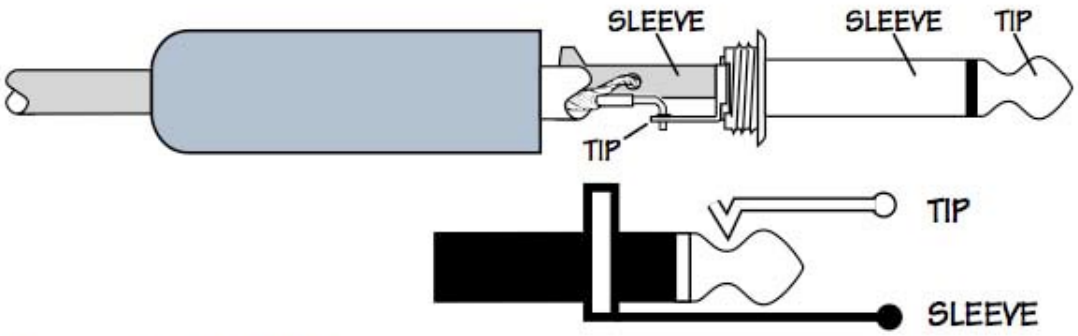


Figure C: TS Plug

- RCA (Phono)

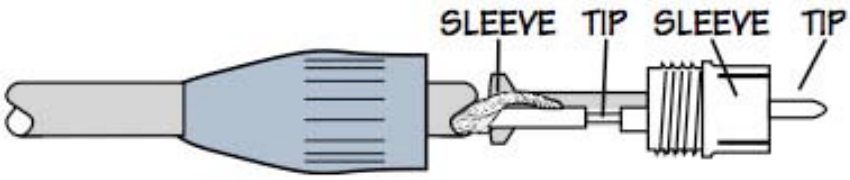
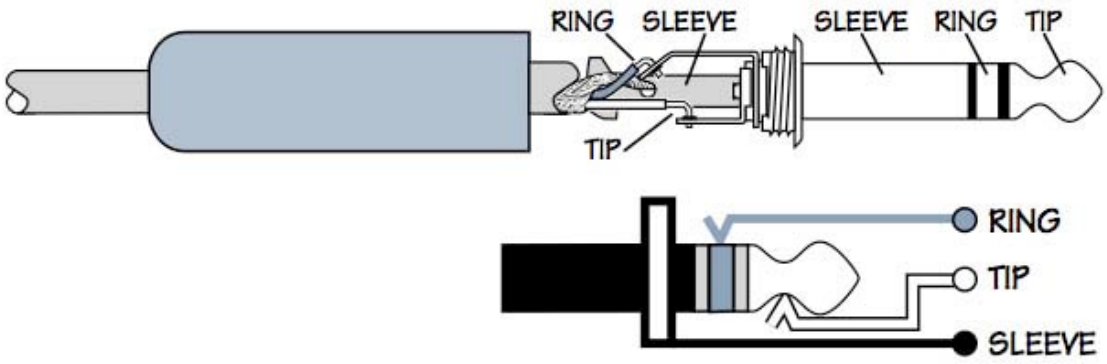


Figure D: RCA Plug

- TRS



- XLR

  Inputs are always XLRF, outputs are always XLRM

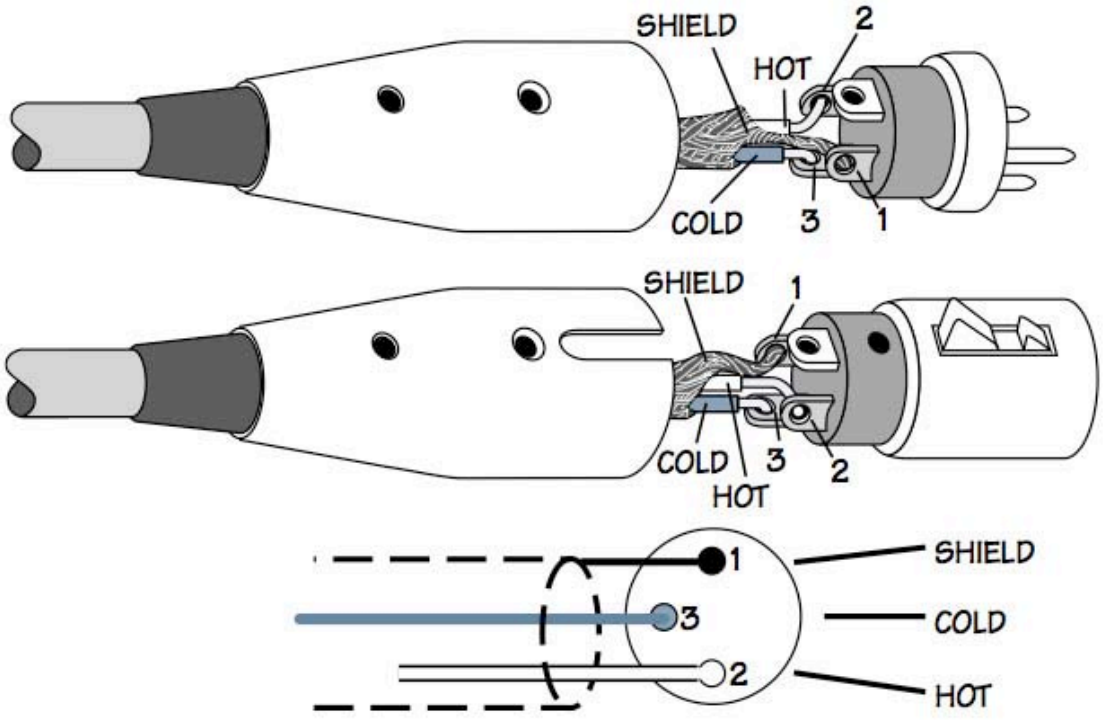


Figure A: XLR Connectors

- TT (Bantam)

8.8. Balancing a Signal

- Take a positive and negative (180 degree phase inversion) of a signal
- Transmit over a distance
- At the destination, make the negative positive again
- Sum the signals, than divide in half
- As a procedure: (1) signal (2) signal+ | signal- (3) signal+ noise+ | signal- noise+ (4) signal+ noise+ | signal+ noise- (5) signal++ (6) signal

8.9. Cable Internals: Conventional Two Conductor

- One braided wire, with shield used as second conductor (ground)

Courtesy of Canare Corporation of Amercia. Used with permission.

- Called guitar cable, instrument cable

8.10. Cable Internals: Conventional Three Conductor

- Two braided wires, with shield used as second conductor (ground)

Courtesy of Canare Corporation of Amercia. Used with permission.

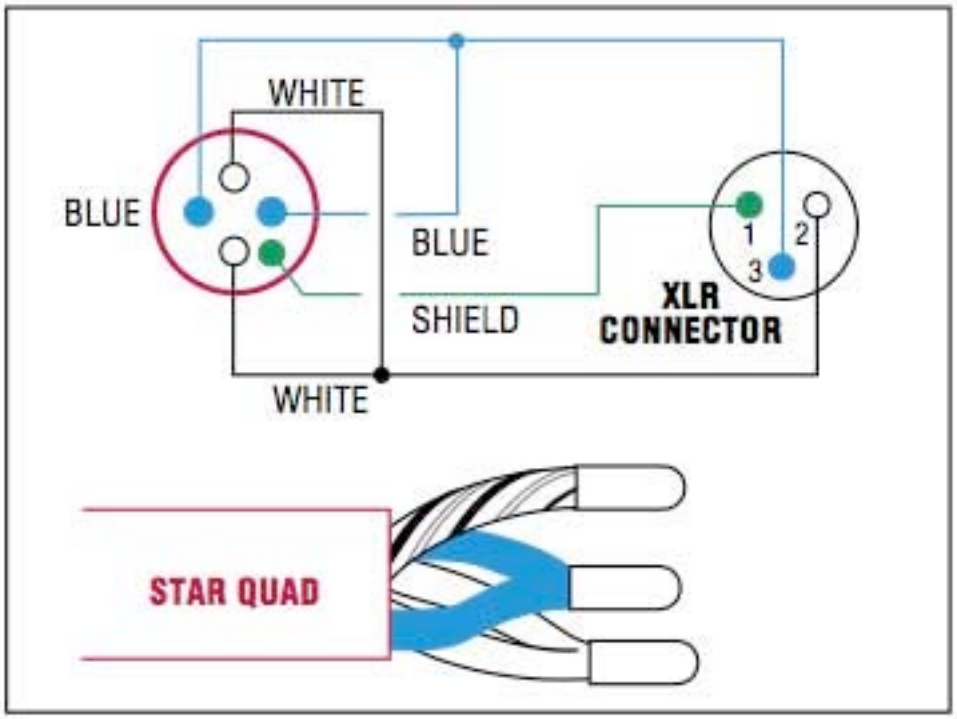
- Called Mic cable, twisted pair

8.11. Cable Internals: Star Quad

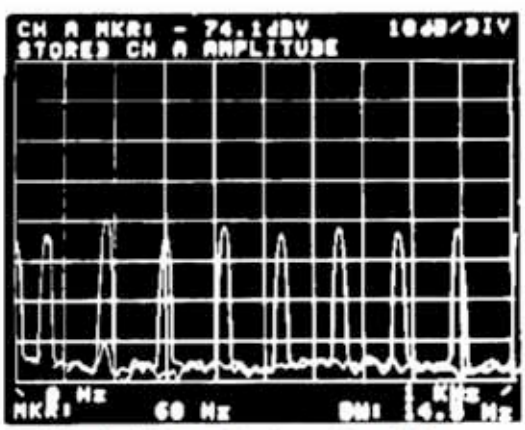
- 5 conductors: 1 ground, 2 positives, 2 negatives

- Four braided wires, with shield as fifth conductor

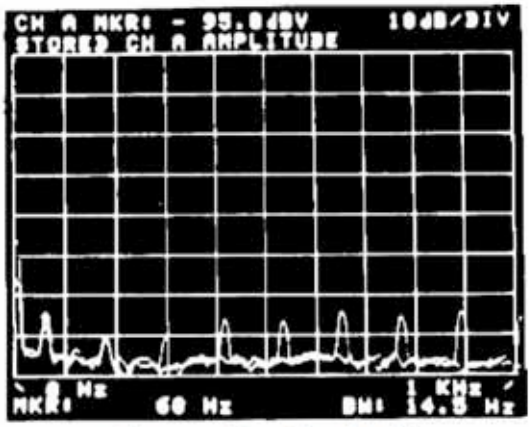
Courtesy of Canare Corporation of Amercia. Used with permission.



Courtesy of Canare Corporation of Amercia. Used with permission.



Typical 2 conductor mic cable.



Canare Star Quad cable.

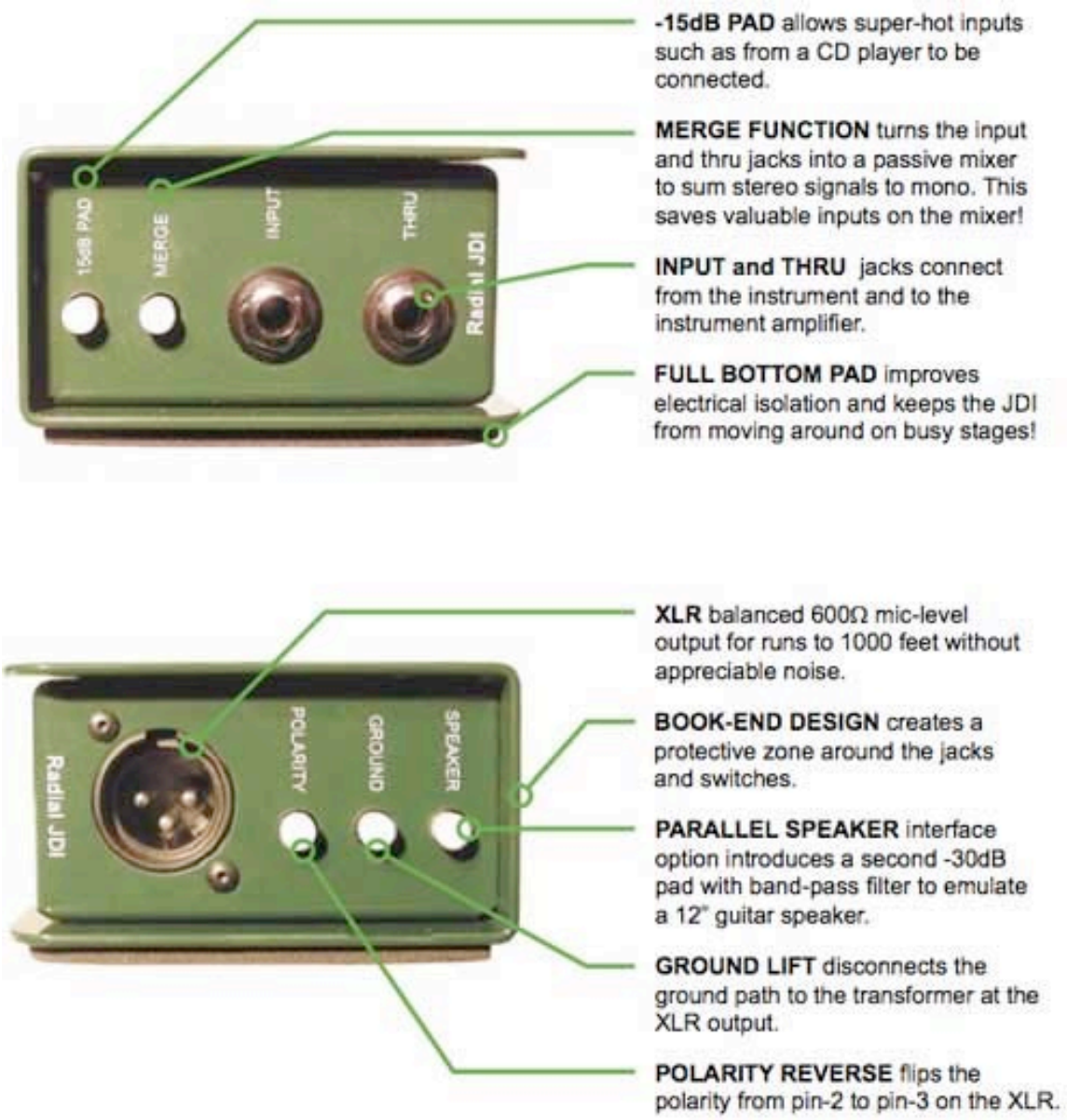
Courtesy of Canare Corporation of Amercia. Used with permission.

8.12. Converting from Balanced to Balanced

- Use a cable (best) or adapter (not recommended)

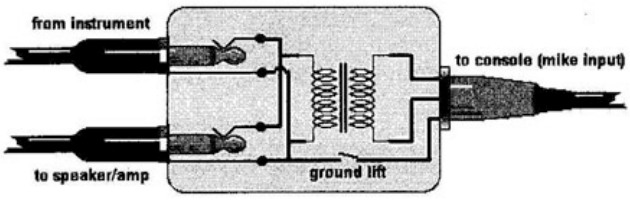
8.13. Converting from Unbalanced to Balanced: DI Box

- Never use an adapter or a cable
- Direct Injection Box: convert -10 dBu to +4 dBu and balance signal



- Transformer isolation removes ground-hum noise

Figure 16.4. *Schematic for a direct (DI) box.*



- Used to connect guitars, basses, keyboards, guitar/bass amp direct outs, turntables, drum machines, synths, et cetera into pro-audio inputs
- Can be used in forward and reverse to extend the run of an unbalanced signal

8.14. Analog Cables: More Examples

- Mini Stereo: 3 conductors used for 2 unbalanced channels

- Y or insert cable: 3 conductors used for 2 unbalanced signals

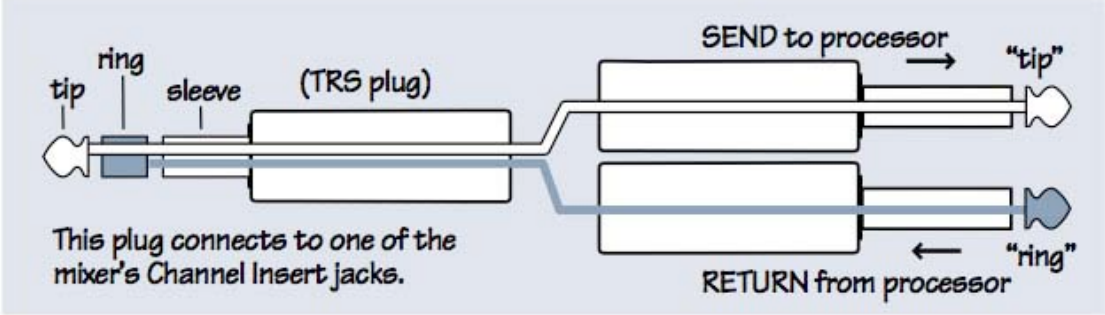
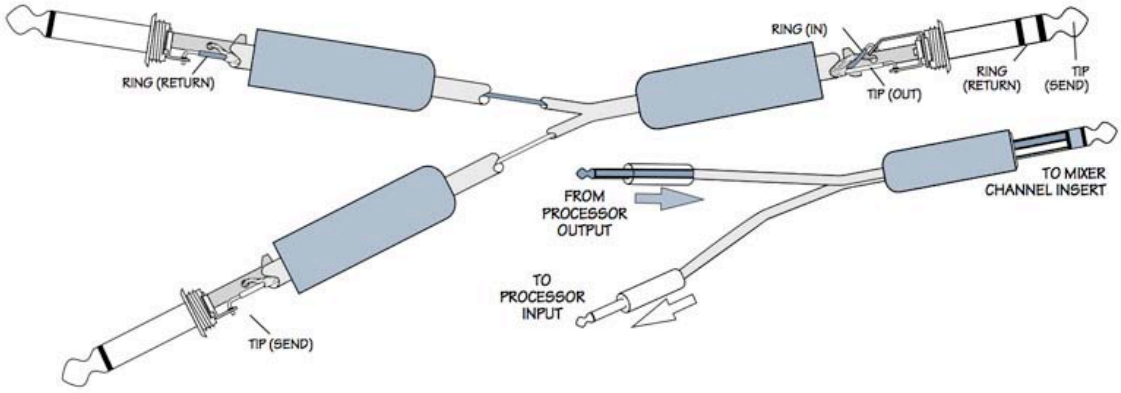


Figure E: Insert Plug



Y-cord insert cable

- Banana
  - Designed for amplified signals

- Speaker Wire

- Speakon
  - Designed for high-wattage, amplified signals

8.15. Digital Cables: Types

- Always handle two or more channels per cable
- Unbalanced
- Balanced
- Fiber Optic

8.16. Digital Cables: Examples

- SPDIF (Coaxial): looks like RCA

- AES/EBU: looks like XLR
- Toslink (2 channel optical)

- ADAT/Lightpipe (8 channel optical)
- MADI (optical or coaxial up to 64 channels)

8.17. Snakes

- Bundle cables in a single insulation

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8.18. Power: AC and DC, Phantom Power

- Alternating current (AC): 120 volts RMS in a 60 Hz sine wave
- Direct current (DC): not a sine wave
- Transformers: rectifies and smoothes AC into DC
- Phantom power: +48 Volt DC transmitted on +/- signal lines of a balanced cable

8.19. The Mixer and the Patchbay

- Mixer: signal control, processing, combination, and routing

- Combines fundamental tools used in almost every signal processing context
- Patchbay: signal routing
- Offers tools that have evolved into conceptual paradigms: may be hardware, may be software

8.20. The Mixer: Primary Components

- A mixer can be seen as having two primary components
- Channel strips
  - A number of commonly used routing and processing tools bundled together
  - Should be called a "track strip": may be applied to one or more channels
  - Physical mixers are made of numerous (4, 12, 16, 32, 64) channel strips
- Busses
  - A signal destination (a repository that signals lead in to, output may go to another channel or physical output)
  - May be called mains or main bus, groups or sub-groups, or auxiliaries, aux sends, aux

8.21. Channel Strip: Basics

- Amplifiers, processors, and distributors (bus assignment)
- Common vertical orientation is not the same as signal flow

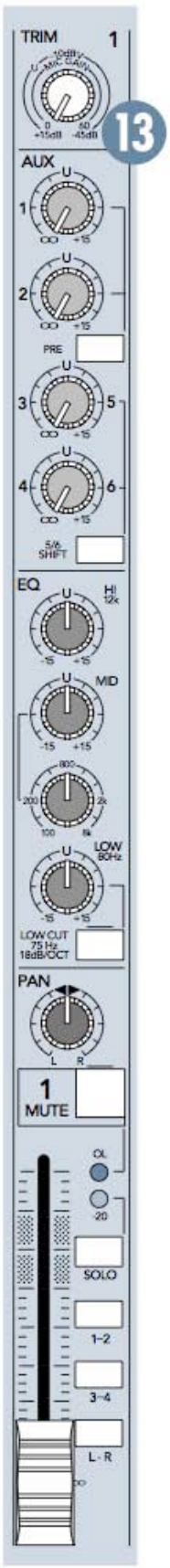
8.22. Channel Strip: Components

- Input or input selector
- Preamp, trim, line/mic level switch, pad, phase
- Insert: serial processing slot
- Low cut filter
- Auxiliary sends: for parallel processing or fader-controlled bus assignment
- Eq and dynamics (serial processors)
  - Shelves and parametric eq

    - Dynamic effects such as compressors, limiters, gates, and expanders
- Mute and solo control
- Fader
- Panning and bus assignment
    - Bus assignments may be stereo or multichannel
    - May use panning to assign to one channel of a stereo bus

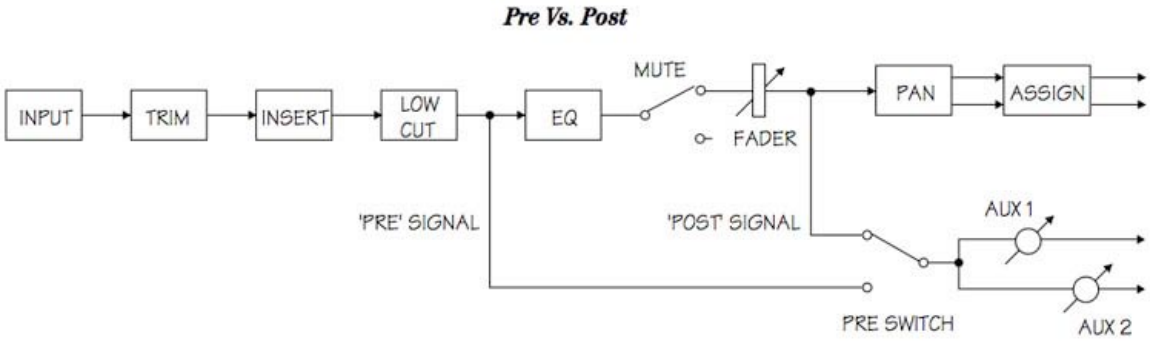
8.23. Channel Strip: Example: Mackie 1604

- Vertical orientation is not the same as signal flow
- Channel strip



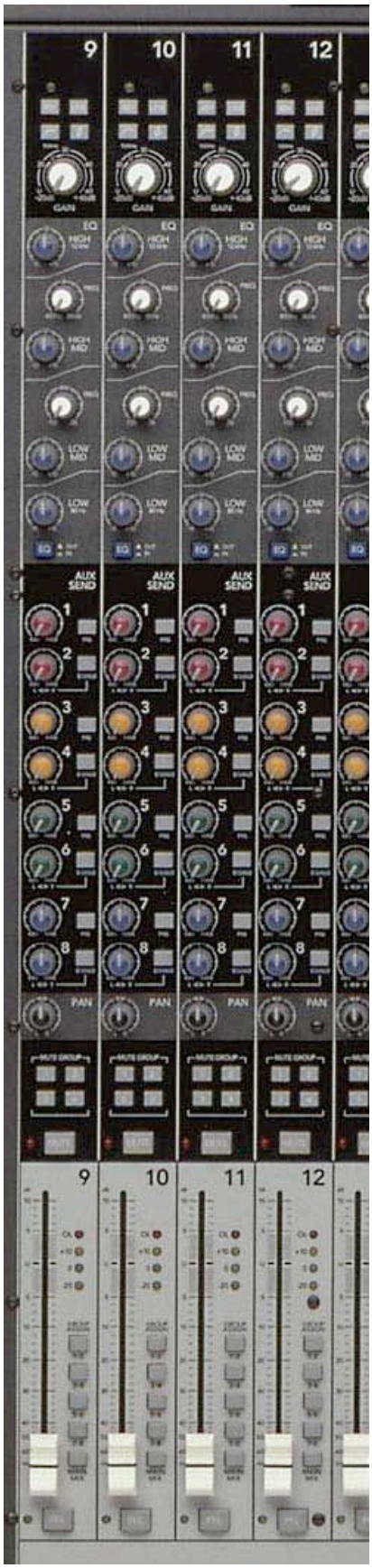
Source: Mackie 1604 mixer user manual.

- Signal flow



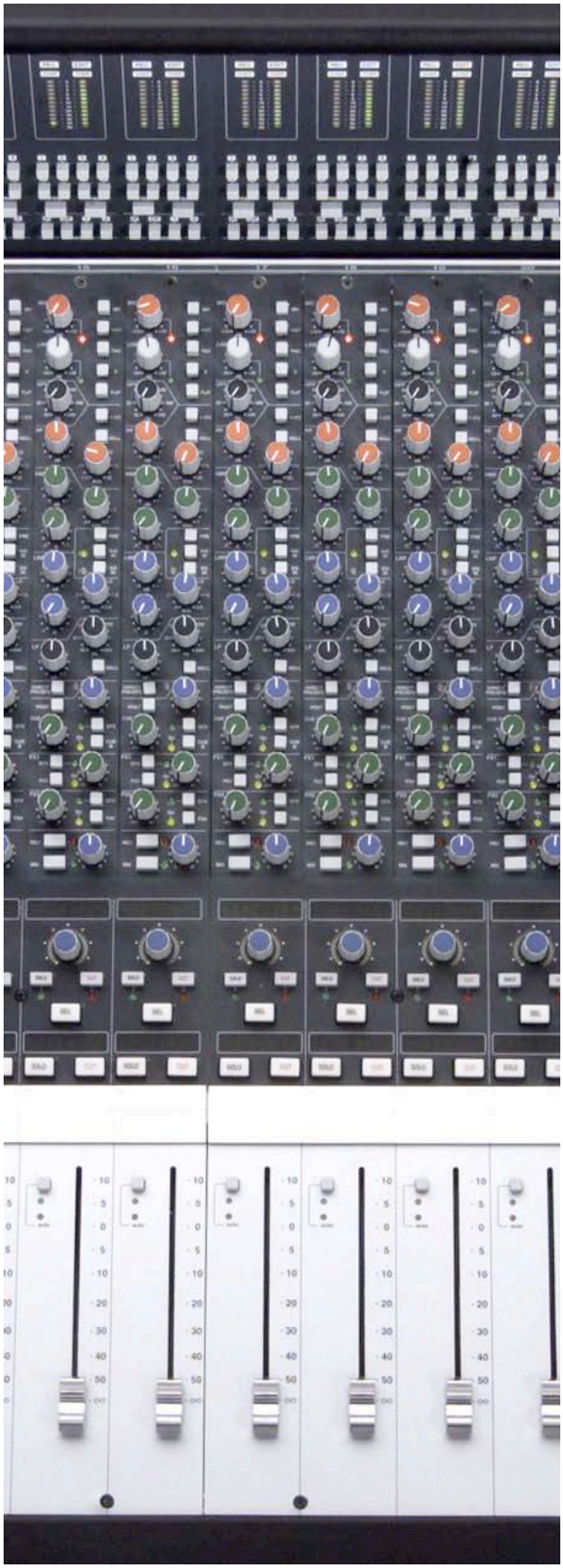
8.24. Channel Strip: Example: Mackie Onyx 2408

- Channel strip


9
10
11
12
GAIN
EQ
HIGH
HIGH MID
LOW MID
LOW
AUX SEND
1
2
3
4
5
6
7
8
PAN
MUTE GROUP
MUTE
9
10
11
12

8.25. Channel Strip: Example: SSL AWS 900

- Channel strip



8.26. Channel Strip: Example: SSL XLogic

- Channel strip

8.27. Busses

- Channels may output to one or more bus
- Other channels may take a bus as an input
- Used for grouping and processing related channels
- Used for distributing sub-mixes to other processors or outputs

8.28. Busses: Main-Outs, Sub-Outs, Control Room

- Main Outs: final output destination to a physical output; may be stereo or multiple channel
- Sub Outs: busses to alternative physical outputs
- Control Room: a bus designed to deliver audio to the engineer, not the main outs

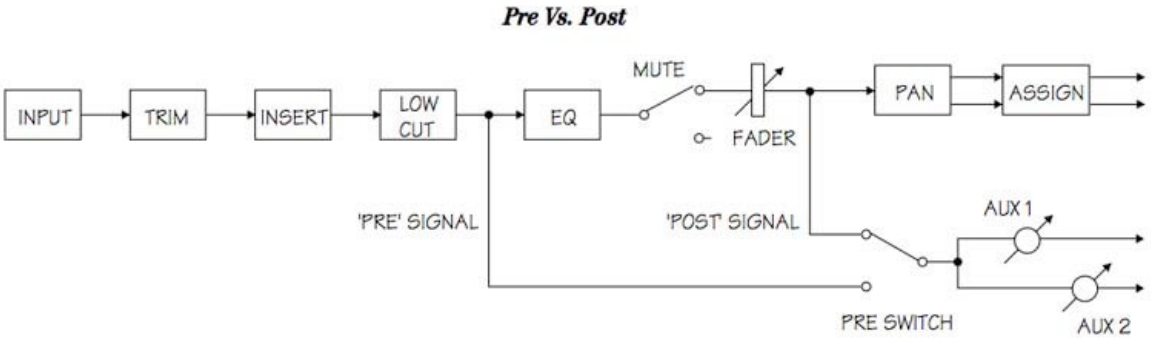
8.29. Busses: Grouping

- Assign a number of channels to a group channel
- Use the group channel for shared processing or fader control
- Then, assign the group to the main output

8.30. Busses: Auxiliaries

- Channel strip bus assignment with a rotary fader
- Used for creating a sub-mix different from the channel fader position
- On a physical mixer, physical output might be labeled auxiliary or auxiliary send
- On a a virtual mixer, auxiliaries are tracks that receive a bus as input

- Used to provide a different mix to monitors or outboard processors
- Can be pre- or post-fader



8.31. Patch Bay

- Expose all inputs and outputs in one place
- Can refer to a stand-alone device, or to the i/o section of a larger device
- Bring i/o from the rear of all devices to a front-panel interface
- Examples

8.32. Patch Bay: Concepts

- Vertical pairs matter
- Out over in: from front, outputs are represented on top, inputs are represented on bottom
- From rear: connect outputs from other devices on top; connect inputs to other devices on bottom
- Three common figurations: normal, half-normal, and de-normal

8.33. Patch Bay: Normal

- A normal connection is a default connection that does not require a patch
- A normal connection flows from the rear top to the rear bottom; no front-panel patch is necessary
- Can be half normal or full normal: difference is what happens when a cable is inserted into the front top
    - half normal: inserting a cable into front top does not break the normal connection; the signal is sent two places at once
    - full normal: inserting a cable into front breaks the normal connection; the signal is sent one place (out the front top)

8.34. Patch Bay: Denormal/Open

- What you see is what you get
- No internal normal connection; front simply connects to rear
- Outputs are still over inputs

8.35. Patch Bay: All formats

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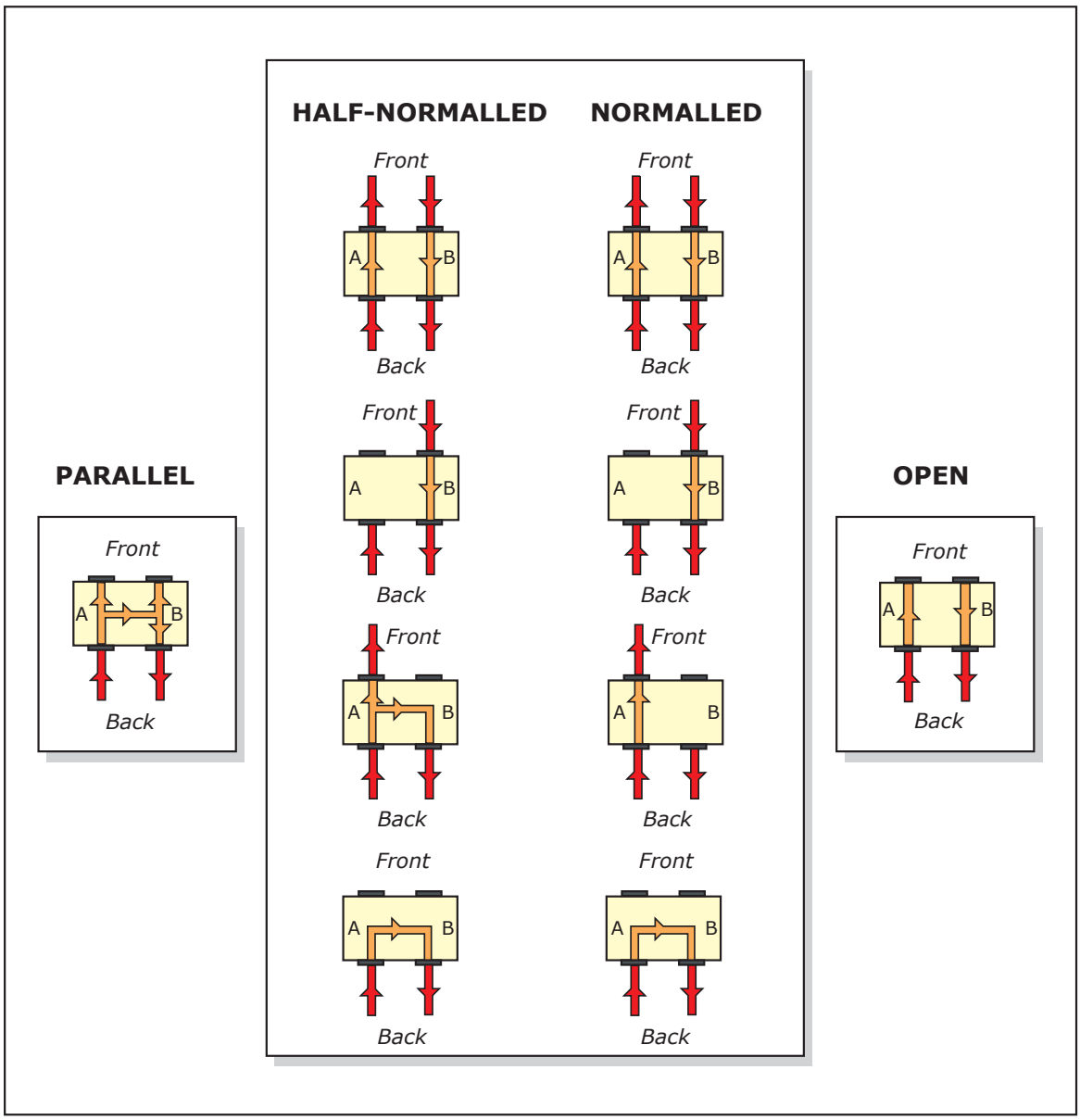

Image by MIT OpenCourseWare.

8.36. MOSS: Diagrams

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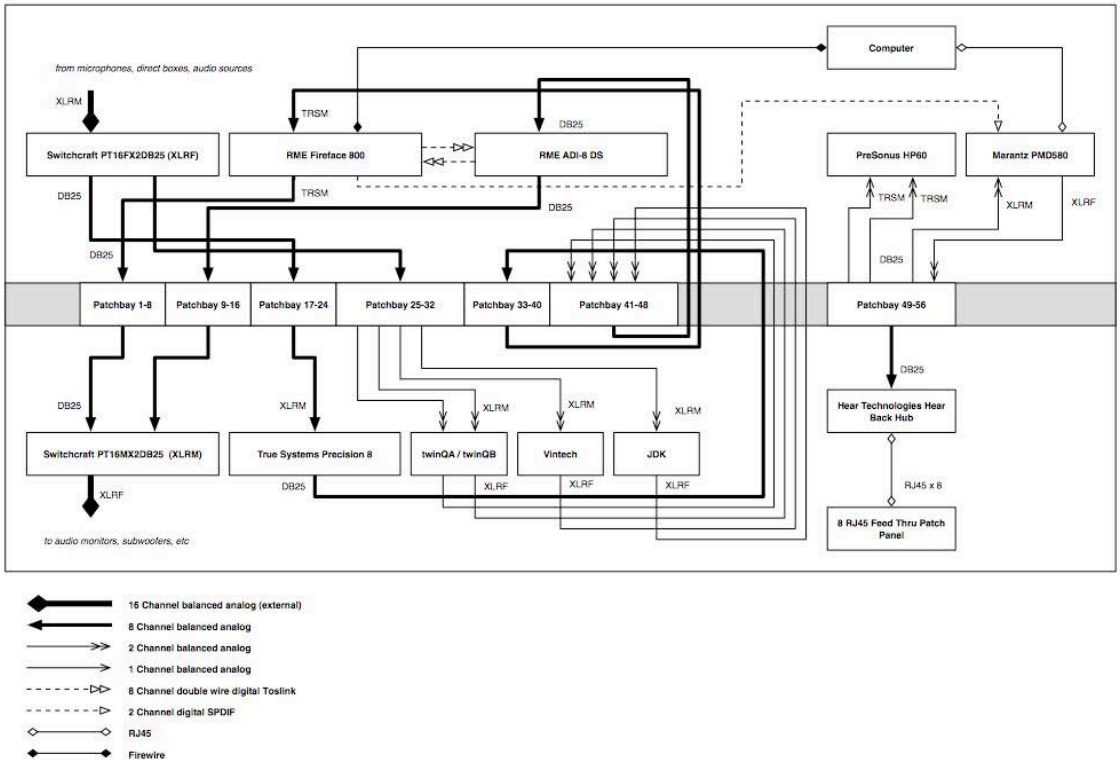
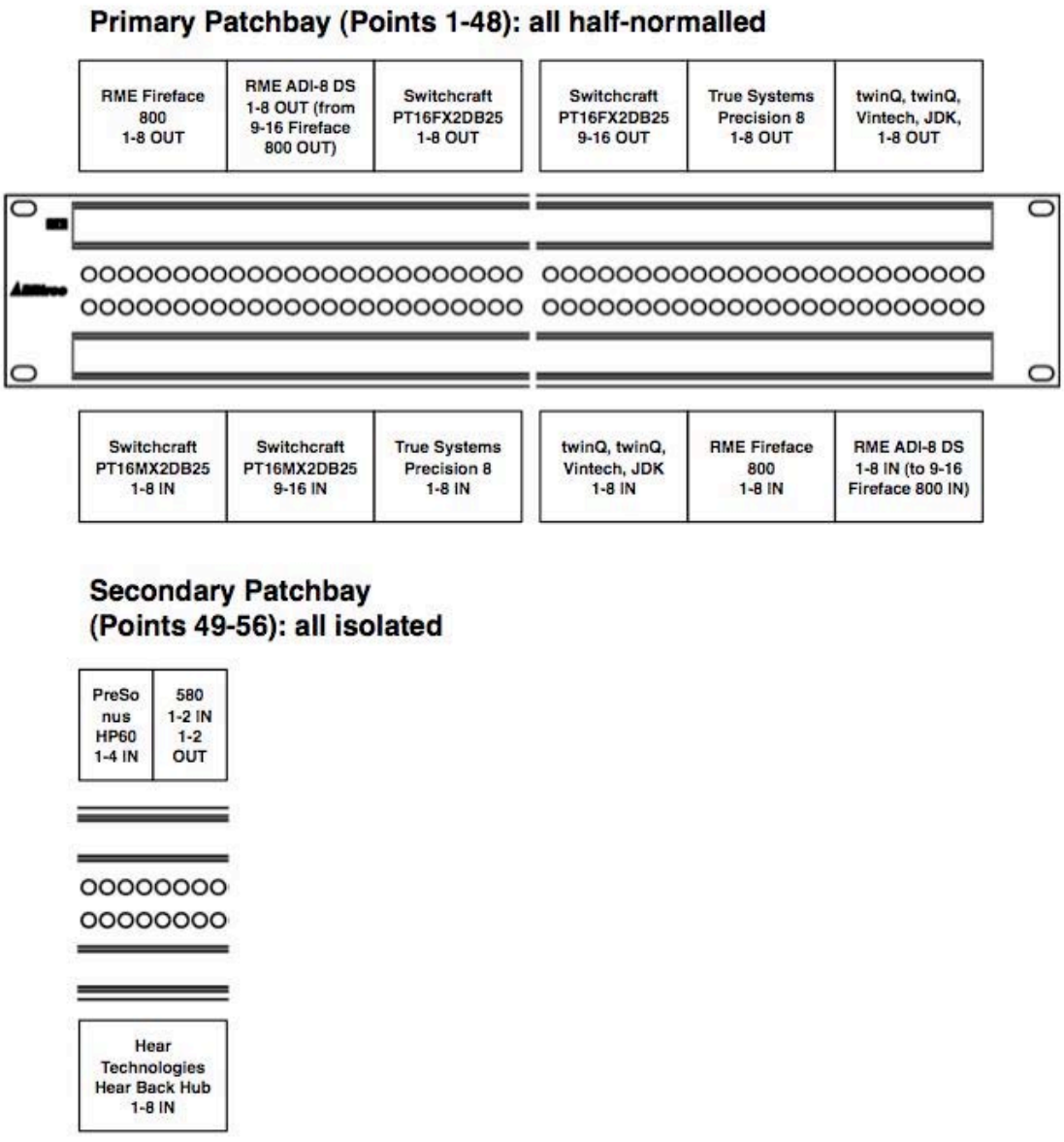
Internal Rack Connections





8.37. Reading: Eargle: Chapter 3, The Pressure Microphone

- How are capacitor pressure microphones affected by temperature?
- Is it possible that a microphone pad can change frequency response?
- What cable lengths does Eargle say are possible with a microphone and low capacitance cable?
- Which type of condenser might we expect to have a larger self-noise, a small or a large diaphragm?
- What are the advantages of using an electret material in the design of a capacitor microphone?

- How dies a piezoelectric microphone work? What are some applications?

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