21m.380 · Music and Technology
Recording Techniques & Audio Production
Workshop: Cables, preamps, patchbays
Session 7 · Wednesday, September 28, 2016

1 Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
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<tbody>
<tr>
<td>12:25pm</td>
<td>Equipment pickup ([], [], [])</td>
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<tr>
<td>12:35pm</td>
<td>Small moss road case overview (all groups)</td>
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<td>12:45pm</td>
<td>How to patch a microphone (all groups)</td>
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<td>12:50pm</td>
<td>Review qz1</td>
<td>Patching exercise</td>
<td>Audio connections</td>
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<td>1:05pm</td>
<td>Patching exercise</td>
<td>Audio connections</td>
<td>Review qz1</td>
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<td>1:20pm</td>
<td>Audio connections</td>
<td>Review qz1</td>
<td>Patching exercise</td>
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<td>1:45pm</td>
<td>Packing up equipment (all groups)</td>
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<td>End of class &amp; return of equipment ([], [], [])</td>
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2 Small moss road case overview

2.1 How to open

- Identify front side first (labeled with white sticker)
- 2 locks: left, right
  - Open with same key (but other key than the one for large case)
  - Please remember to return keys to me!
- 4 latches (2 on each side): flip and twist

2.2 Standard studio gear dimensions

- Width: 19” (sometimes 8.5”)
- Height: Multiples of 1u = 1.75” (‘rack unit’; sometimes called ru)
2.3 Left 19" rack (from top to bottom)

- Marantz pmd580 solid state recorder (stereo only recordings)
- Art ProAudio HeadAmp6 Pro headphone amp (ctrl. room monitoring)
- RME Fireface 800 audio interface (audio i/o for laptop)
- RME adi-8 ds AD/DA converter (additional analog inputs to Fireface)
- True Systems Precision 8 8ch microphone preamp
- 2 Joemeek twinq 2ch mic preamps (discontinued)
- 1 Vintech 1272 2ch mic preamp
- 1 Jdk Audio r20 2ch mic preamp

2.4 Right 19" rack (from top to bottom)

- Rack drawer (1u): laptop
- Hear Technologies Hear Back headphone monitoring hub
- RJ45 feed thru patch panel (Hear Back hub to Hear Back mixers)
- 2 Redco r196-d25pg Bantam patchbays (internal patching)
- 2 Switchcraft PT16MX2DB25 XLR patchbays (main i/o)
- Rack drawer (4u): Bantam patch cables etc.
- Tripp Lite LCR2400 2400 W power conditioner (main power switch)

2.5 Signal flow

- Chs. 1–8: Mic → XLR patchbay → Bantam patchbay → RME Fireface 800
- Chs. 9–16: Mic → XLR patchbay → Bantam patchbay → RME ADI-8 DS → RME Fireface 800

1 The Moss schematics included in today’s handout (Ariza [2012b]) provide an overview of the small road case’s layout, as well as its patchbay allocation and internal rack connections. This document will be useful not only today, but also in the future, so please bring it along for all remaining workshops and recording sessions.
3 Microphone patching

3.1 Things to keep in mind

• Rule of 👍: Patch from output (top row) to input (bottom row)

• Exception: secondary moss Bantam patchbay (also inputs in top row!)

● Never patch under phantom power on a Bantam patchbay (temporary short circuit can destroy input stage!)

3.2 Procedure

1. Remove mic from case and attach to stand
2. Connect XLR cable from mic to XLR patchbay
3. Patch mic to preamp input on Bantam patchbay (48 V off?)
4. Patch preamp output to audio interface (or ADC) on Bantam patchbay
5. Turn on preamp, engage phantom power (if needed), adjust gain
6. When you’re done: clear levels, disengage phantom, turn off preamp
7. Unpatch (48 V off?)
8. Disconnect mic, return to case with clip or cradle, coil cable

4 Review qz1

4.1 Instructions

• Review your corrected quiz for later discussion with the instructor.

• Identify at least one question (points that remain unclear).

• Discuss your question(s) with your peers as a group.

4.2 Discussion points for later

• Question 1.1:
  – Complete calculations (values deliberately chosen for easy arithmetic)
  – Make it clear what your actual answer is.

• Question 2.1: Make sure you interpret logarithmic scales correctly.
  – Scale starts at 10 Hz, not 0 Hz
  – 8 kHz ≠ 800 Hz

• Question 3.1: Red dot indicates front direction (positive phase) of fig-8, not polar pattern

• Question 3.4: Sennheiser md421 is a dynamic mic (even though it looks similar to large-diaphragm condensers)
5 Patching exercise

5.1 General remarks

• No need to power up preamps now (we’ll do it together later)
• Use moss patchbay schematics handout (Ariza 2012b, p. 1) for help
• Leave mic & cables in place when it’s time to move on to next group

5.2 Task

1. Identify microphone and preamp and set up mic on a stand
2. Connect mic to correct channel on the XLR patchbay
3. Patch signal from XLR patchbay into correct preamp input
4. Patch preamp output into correct audio interface or ADC input

<table>
<thead>
<tr>
<th>Student</th>
<th>Microphone</th>
<th>XLR patch in</th>
<th>Preamp channel</th>
<th>Converter</th>
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<tbody>
<tr>
<td></td>
<td>Akg C414</td>
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<td>Vintech ch. 1</td>
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<td>Earthworks TC20</td>
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<td>Precision 8 ch. 5</td>
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<td>Precision 8 ch. 8</td>
<td>RME ADI-8 input 8</td>
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</tbody>
</table>

Table 2. Patching exercise
6 Audio connections

Consumer equipment typically uses unbalanced lines
- Standard operating (line) level: $-10\ \text{dBV}$
- Limited to short cable runs (ca. 25') due to interference
- High impedance

Professional equipment typically uses balanced lines
- Standard operating (line) level: $+4\ \text{dBu}$
- Longer cable runs possible
- Low impedance

6.1 Interference
- Electrostatic interference (prevented by cable shield)
- Electromagnetic interference (prevented by twisted pair, intelligent cable arrangement, balanced lines)

6.2 Balanced vs. unbalanced lines
- Balanced lines typically exploit the principle of common mode rejection to minimize interference
  - Requires extra wire with negative signal copy $-S$
  - Eliminate noise $N$ (same on both wires) through differential amplifier
- Requires additional circuitry for signal inversion and subtraction, so balancing is a property of inputs & outputs, not of cables!

Unbalanced:

\[
\begin{align*}
\text{Source} & \quad \text{Signal} \quad S \\
 & \quad \text{Noise} \quad N \\
& \quad S + N \\
& \quad S + N \odot
\end{align*}
\]

Balanced:

\[
\begin{align*}
\text{Source} & \quad S \\
& \quad N \\
& \quad (S + N) - (-S + N) = 2S \odot
\end{align*}
\]
6.3 **Di boxes**
- Di … direct injection; direct input
- Convert high-impedance unbalanced –10 dBV signal to low-impedance balanced +4 dBu signal
- Transformer isolation to remove hum from *ground loops*
- Active (48 V phantom power or battery) vs. passive; stereo vs. mono
- Available in moss: Radial jrc (active stereo) & Radial jdi (passive mono)
- Typical use: electric guitar, bass, keyboard (= unbalanced outs!)

6.4 **XLR connector**
- The ‘microphone cable’
- One male end (xlrm), one female end (xlrf)
- So every xlr cable can also function as an extension ☺
- But also requires paying attention before uncoiling a long xlr cable
- Signal ‘flows’ from female to male (easy to remember: 3 pins ‘point’ in direction of signal flow)
- Press button on socket to free plug

6.5 **Ts & trs connectors**
- Tip (ring) sleeve
  - Ts: 2 wires (unbalanced mono, e.g., guitar cable)
  - Trs: 3 wires (balanced mono or unbalanced stereo, e.g., headphones)
- Male on both ends (tr(s)m)
- Both ts and trs come in different shapes:
  - A-gauge (angular tip)
  - B-gauge (slightly smaller rounded tip)
- A-gauge connector sizes:
  - 2.5 mm (rare, but available on some smartphones)
  - \( \frac{3}{16} \)” = 3.5 mm (laptop headphone output)
  - \( \frac{1}{4} \)” = 6.35 mm (guitar cables)
- B-gauge connector sizes:
  - Bantam or tt: 0.173” = 4.4 mm (e.g., moss Redco patchbays)
  - Po316 phone plug: \( \frac{1}{4} \)” = 6.35 mm
- *Never plug \( \frac{1}{4} \)” A-gauge connector into \( \frac{1}{4} \)” B-gauge socket (bends contacts)!*

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6.6 **RCA connector**
- *Never* balanced (only 2 wires!)
- Often comes in stereo (red/white connector pair on home hi-fi systems)
- Common adapter: ¼”-TRS-to-RCA-stereo (laptop)

6.7 **Snakes**
- Multiple audio channels in a single cable
- Typically multiples of 8 channels (8, 16, 24)
- Channels are numbered and/or color coded
- Useful convention: follow resistor color code (cf., table[3])
- Larger snakes might have a *stagebox* connected on one end
- Larger XLR snakes are often bidirectional (sends & returns)
- Available in mOSS:
  - Hosa 8-channel TRSM-to-TRSM snake
  - Hosa 8-channel TRSM-to-XLRM snake
  - Pro Co Stagemaster XLR snake with stagebox (16 sends, 4 returns)

6.8 **Patchbay normalling**
- Patchbays are often *normalled*, i.e., vertically aligned outputs and inputs are connected by default *within* the patchbay.
- Such a default (or: normal) connection does not require a patch cable in the front.
- Idea: maintain default routing setup that requires no patch cables (but can easily be overridden)
- Different normalling standards define which socket(s) one needs to insert a plug into in order to break the normal connection:

**Half-normalled patchbay:** *Bottom* socket breaks normal connection
- Example: Top Redco patchbay in the mOSS
- Allows signal to be sent to two destinations simultaneously (passive split) ©
- Use case: Direct outputs (monitoring, multitrack recording)

**Fully (or single)) normalled patchbay:** *Either* socket breaks normal
- Less common
- Use case: Connecting a source that should not have more than a single load (e.g., dynamic mic, high-impedance output)

<table>
<thead>
<tr>
<th>Channel</th>
<th>Color</th>
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<tbody>
<tr>
<td>1</td>
<td>brown</td>
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<tr>
<td>2</td>
<td>red</td>
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<tr>
<td>3</td>
<td>orange</td>
</tr>
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<td>4</td>
<td>yellow</td>
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<td>5</td>
<td>green</td>
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<td>6</td>
<td>blue</td>
</tr>
<tr>
<td>7</td>
<td>violet</td>
</tr>
<tr>
<td>8</td>
<td>gray</td>
</tr>
</tbody>
</table>

**Table 3. Resistor color code for use with 8-channel audio snakes**

![Figure 2. Half-normalled patchbay](image)

![Figure 3. (Fully (or single)) normalled patchbay](image)
**Open (or denormalled) patchbay:** No normal connection exists

- Top row (outputs) and bottom row (inputs) entirely independent
- But outputs are still above inputs
- Use case: Connecting normally unused effect

**Parallel patchbay:** Permanent normal connection (cannot be overridden)

- Both top and bottom socket represent outputs (passive split)
- Use case: Direct outputs (monitoring, multitrack recording)

7 **Patching exercise results**

- Let’s power up the moss and its preamps
- Apply phantom power. Which mics require it (cf., table2)?
- Let’s randomly sample a few connections:
  - Visually monitor signal on preamp meter while setting levels
  - Visually monitor signal on audio interface or A/D converter

**References & further reading**


### Primary patchbay (points 1-48): all half-normalled

<table>
<thead>
<tr>
<th></th>
<th>RME Fireface 800</th>
<th>RME ADI-8 DS</th>
<th>Switchcraft PT16FX2DB25</th>
<th>Switchcraft PT16FX2DB25</th>
<th>True Systems Precision 8</th>
<th>twinQ, twinQ, Vintech, JDK, 1-8 OUT</th>
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<tbody>
<tr>
<td>1-8 OUT</td>
<td>1-8 OUT</td>
<td>9-16 OUT</td>
<td>1-8 OUT</td>
<td>9-16 OUT</td>
<td>1-8 OUT</td>
<td>1-8 OUT</td>
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### Secondary patchbay (points 49-56): all isolated

<table>
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<tr>
<th>ART 6 Pro</th>
<th>580</th>
<th>1-2 IN</th>
<th>1-2 OUT</th>
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<td>1-4 IN</td>
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### MOSS schematics (p.1 of 2)

#### 16-space double-wide rack (32 total spaces)

<table>
<thead>
<tr>
<th>Marantz PMD560</th>
<th>ART ProAudio HeadAmp6 Pro</th>
<th>RME Fireface 800</th>
<th>RME ADI-8 DS</th>
<th>Redco R196-D25PG</th>
<th>Redco R196-D25PG</th>
<th>True Systems Precision 8</th>
<th>Switchcraft PT16FX2DB25</th>
<th>Switchcraft PT16MX2DB25</th>
<th>Joemeek twinQ</th>
<th>Joemeek twinQ</th>
<th>Vintech</th>
<th>4 Space Rack Drawer</th>
<th>Tripp Lite LCR2400 2400W Power</th>
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<tr>
<td>Rack Drawer (Laptop)</td>
<td>hear Technologies Hear Back Hub</td>
<td>8 RJ45 Feed Thru Patch Panel</td>
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