Amp Matching Tutorial

Or, how do I make my Axe-Fx sound exactly like my amp?
Fundamentals

- EQ
- Gain
- Feel
The Axe-Fx II is far more complex than other modelers:
Although the Axe-Fx is much more complicated than this, we can distill modeling into this simple diagram:

Most modelers use just this basic topology.
Input EQ

- Affects feel.
- Affects tone at low distortion (volume rolled off).
- Exact EQ is not important, only general shape.
- As a rule, less bass is desirable for high gain.
- Vintage amps have little input EQ, modern amps have aggressive treble boost and/or low-cut.
- Use Definition and Low Cut Freq parameters to adjust input EQ.
- Add a dedicated input EQ for unique voicings (popular studio technique).
Distortion

- Creates harmonic content.
- Filtered by Output EQ.
- Clarity of bass affected by Input EQ.
Output EQ

• Most important for overall tone.
• Provides most of “what you hear”.
• Can be a single lumped EQ or multiple Eqs.
• Multiple EQs provide greatest flexibility:
  - Separate Cabinet and Amp allows changing cab.
• Use IR Capture Utility to capture speaker/mic and use Tone Match to acquire matching data.
• Or use Tone Match to acquire all data as one lumped EQ.
• Fine-tune results with various EQ resources.
Why Does Model Sound Different?

- Component Tolerances:
  - Typical amps have 10% tolerance parts, or worse.

- Component Aging and Drift:
  - Component values can change over time/temperature.

- Potentiometer Taper:
  - Commercial log taper pots are crude.
  - Different tapers are substituted due to availability, revisions, etc.

- Parasitics:
  - Stray capacitance/inductance can alter frequency response.
  - Point-to-point amps are more susceptible.

- Speaker Impedance:
  - Degree of influence depends upon design.
  - Less negative feedback (damping) increases dependence on impedance.
  - More negative feedback lessens dependence.
Why Does Model Sound Different? (cont.)

- Speaker impedance affects frequency response since tube amps have low damping (high output impedance). \( E = I \times R \).
- Speakers are electromotive, voltage determines response.
- No modeler can measure speaker impedance since they lack the measuring equipment. The best we can do is predict based on published data.
- One can often eliminate the difference using SPKR parameters but this requires advanced knowledge of tube amp behavior.
- All these factors can cause variation in output frequency response.
- Fortunately there is an easy solution: Tone Matching…
Voltage output of a Suhr Badger vs. the Axe-Fx II model. While impressively accurate, the small deviations can be audible.
What is Tone Matching?

- Tone Matching is the basis for Amp Matching.
- The Tone Matching (TMA) block is a powerful, dual-channel FFT analyzer.
- The spectrum of each channel is captured and averaged over time.
- The difference between the two channels is computed and used to generate corrective matching data.
- The accuracy of the difference analyzer is enhanced multifold when the stimulus to both channel sources is identical.
- This corrective EQ compensates for the factors described earlier.
TMA Block Operation

- Reference FFT
- Local FFT
- Divide
- IFFT Match Data
The Best Way

Acquiring Speaker IR and Tone Matching Data Separately
IR Capture

• Hookup:
  o Axe-Fx II Output 2 Left to power amp
  o Power amp to speaker
  o Microphone to preamp
  o Preamp to Axe-Fx II Input 2 Left

• Test levels.

• Acquire Impulse Response and save to User Slot.
Hookup for Amp Matching

• Axe-Fx II Output 2 Left to amp.
• Amp to speaker.
• Microphone to preamp.
• Preamp to Axe-Fx II Input 2 Left.
• Important: Set Axe-Fx II Output 2 Level knob to full.

• Alternate configuration: A/B/Y box to Axe-Fx II and amp.

• Recommended: Footswitch for selecting between amp and Axe-Fx.
Matching

• Install Amp Matching Template preset.
• Select amp that is closest to amp being matched:
  o Amps fall into three basic classes: Fender, Vox, Marshall.
  o Fender amps have tone stack at input, fixed-bias power amp, negative feedback. Examples: Victoria, Tungsten, etc.
  o Vox amps have tone stack midway, cathode biased power amp, no negative feedback. Examples: Matchless, Bad Cat, etc.
  o Marshall amps have tone stack at end, fixed-bias power amp, negative feedback. Examples: Friedman, Aiken, various “Plexi” derivatives.
  o Many amps are also based on SLO100: Dual Rectifier, 5150, Framus Cobra
  o This will give you a good starting point for gain and EQ.
• Select Speaker IR previously acquired in cab block.
• Set MV appropriately. Adjust Level for same volume.
• Quickly set Drive and Tone for roughly the same distortion and sound.
Step 1: Rough Match

- Do a preliminary Tone Match.
- This will provide a starting point to fine-tune the gain and/or input EQ.
- Select Tone Matching block (TMA).
- Ensure that Ref Source is set to Input 2 Left.
- Press X and then Y to start capture of BOTH reference and local spectral data.
- Play a variety of chords up and down the neck to stimulate a wide spectrum.
- Press Enter to stop capture and generate matching data.
Step 2: Refine Gain

- Reduce guitar volume until amp starts to “clean up”.
- Adjust Axe-Fx Drive for same amount of distortion. Use Input Trim and/or Boost Switch as necessary.
Step 3: Refine Input EQ

- Input EQ affects bass “tightness” and clarity.
- Play low notes and adjust Low Cut Freq and/or Definition to increase/decrease bass clarity.
- If model is exactly same as amp being matched, this step is usually unnecessary.
- Speaker Low Freq Resonance frequency (Low Freq) can be adjusted if necessary.
Step 4: Refine Output EQ

• Now that the gain and input EQ are set the output EQ needs to be redone.
• Repeat Step 1 to obtain a new, improved Tone Match.
• Repeat Steps 2-4 as necessary.
The Easy Way

- Acquire Speaker IR and Tone Matching Data together.
- Delete or bypass Cab block.
- Follow Steps 1-4.
- Advantages:
  - Easy and quick.
  - No need to shoot cab IR.
- Disadvantages:
  - Cabinet and amp data not separated.
Improve

- Why stop at matching?
- The Axe-Fx II provides the tools to improve upon the shortcomings of amps.
- Use the Low Cut Freq and/or Definition parameters to alter the feel.
- Use the myriad of EQ resources.
- Increase or decrease Damping.
- Try different cabinets.