Reverb & Effects

Room Acoustics & Natural Reverb

Natural Reverb

- Before we talk about reverb in the context of a Pro Tools plugin, let's talk about natural reverb

- **Reverberation** is the series of reflections that occur when a sound is projected into an acoustic space, such as an auditorium or concert hall

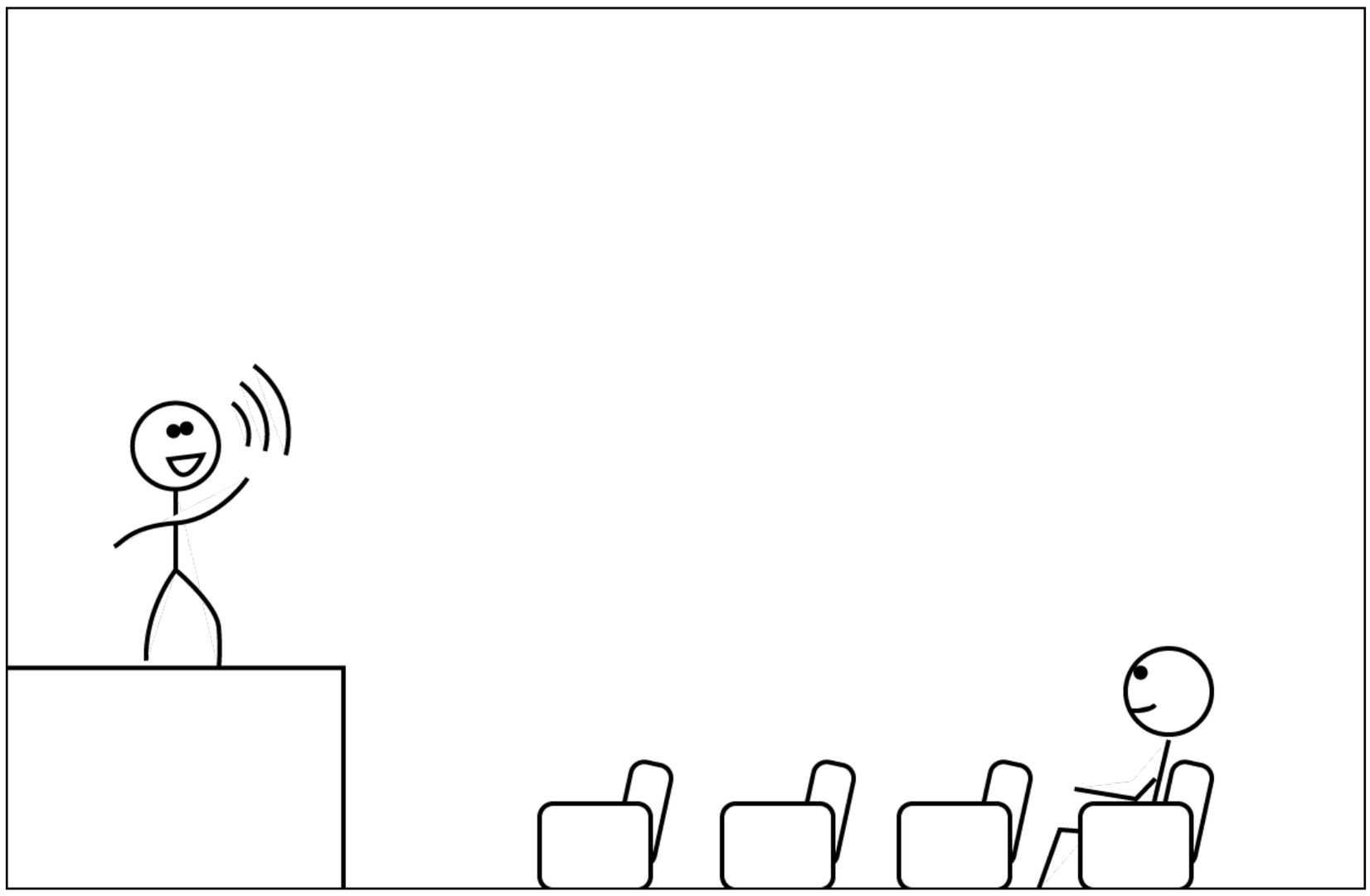
- These reflections arrive at the listeners ears later than the direct sound and appear to give the sound a longer decay than it would have on its own

Components of Reverb

- In the context of room acoustics and reverb, sound arriving at the listener is divided into 3 stages:
  - Direct Sound
  - Early Reflections
  - Reverberant Sound (sometimes referred to as the Reverb ‘Tail’)

Direct Sound

- Direct Sound takes the shortest path from the source to the listener and arrives before any reflections



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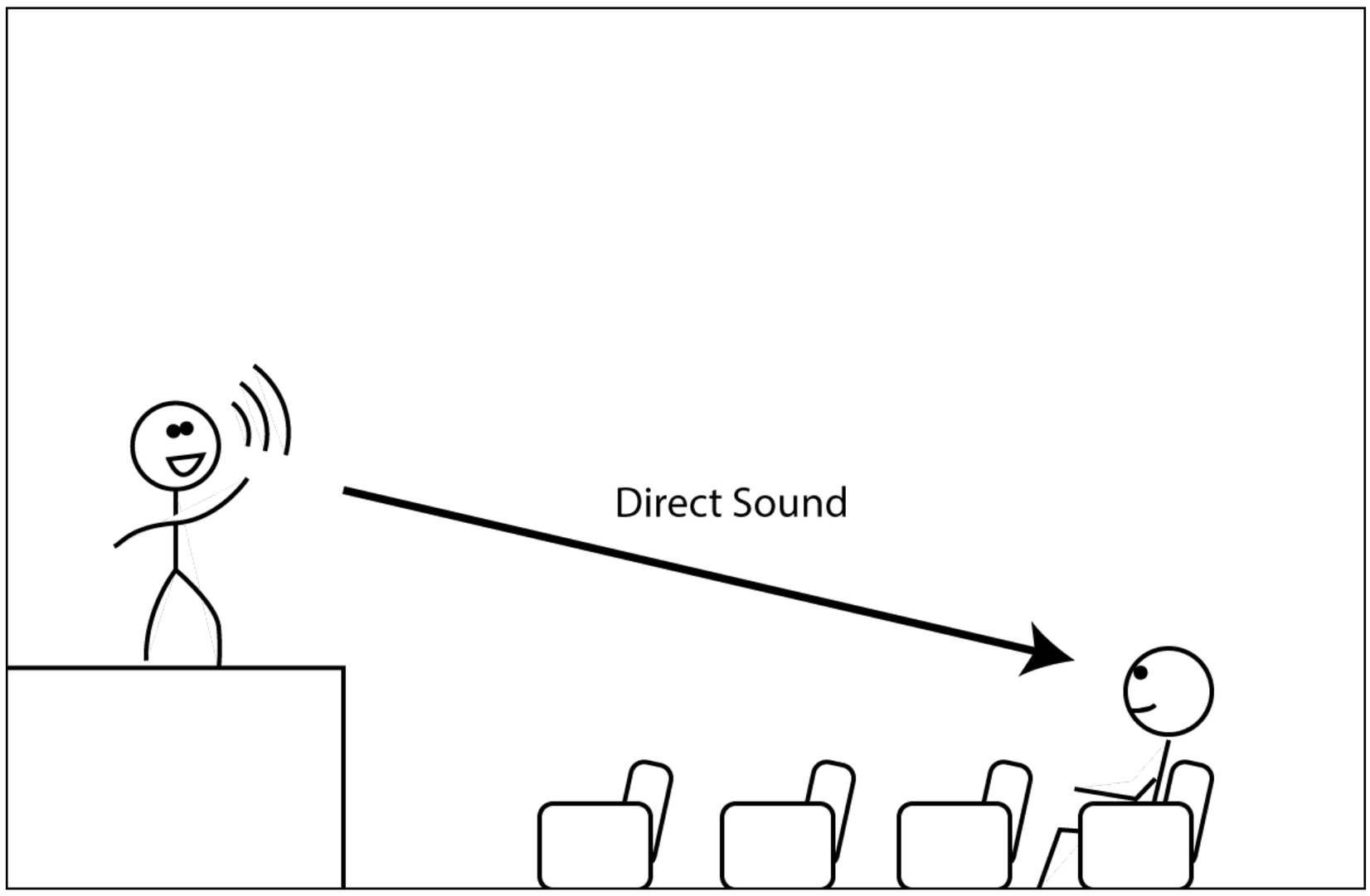
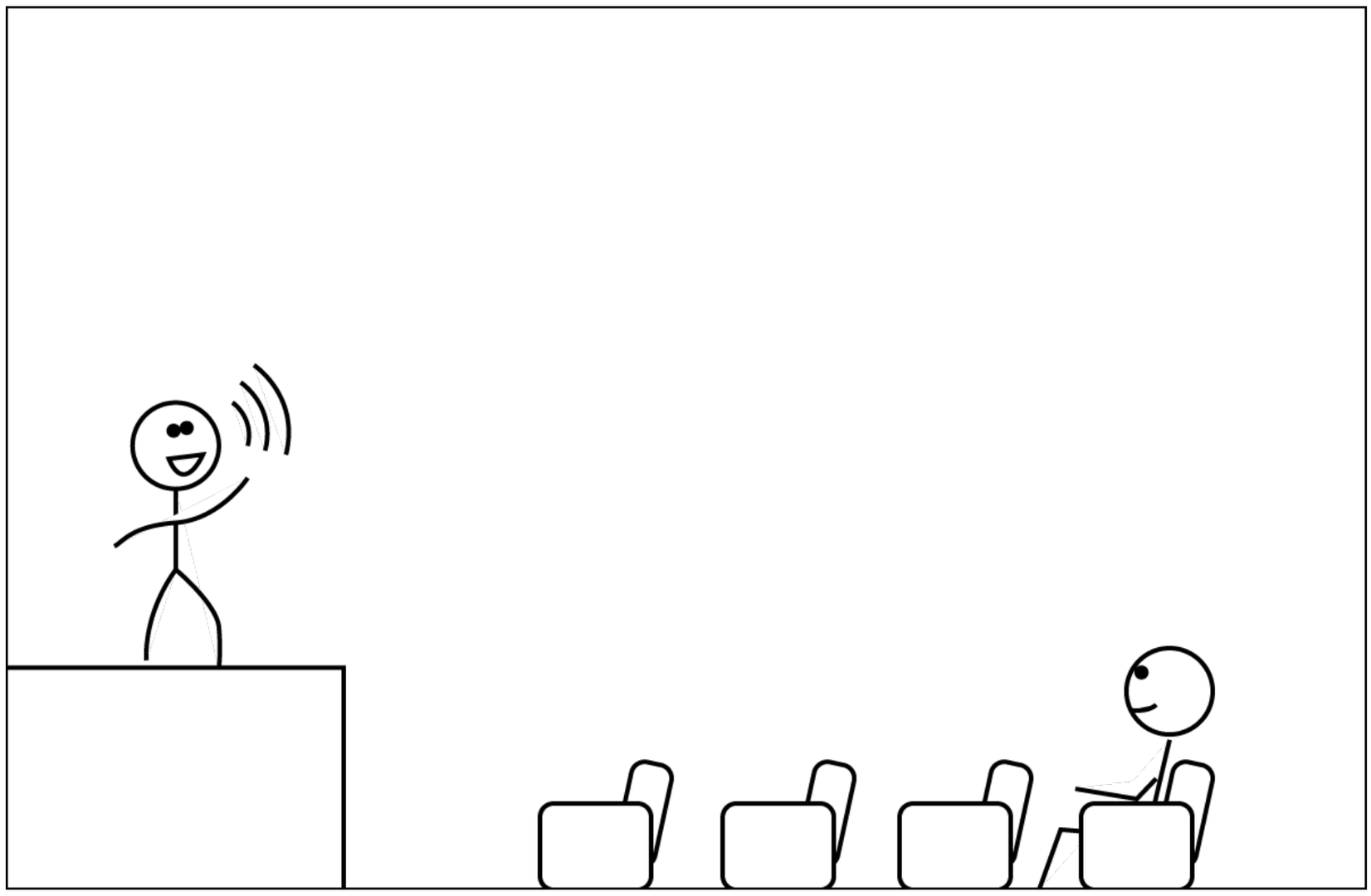


Early Reflections

- Early Reflections arrive within 50-80ms of the direct sound and reflect off of at least one surface on the way

- The time of arrival and frequency content of these reflections give us information about the size and type of space we are in



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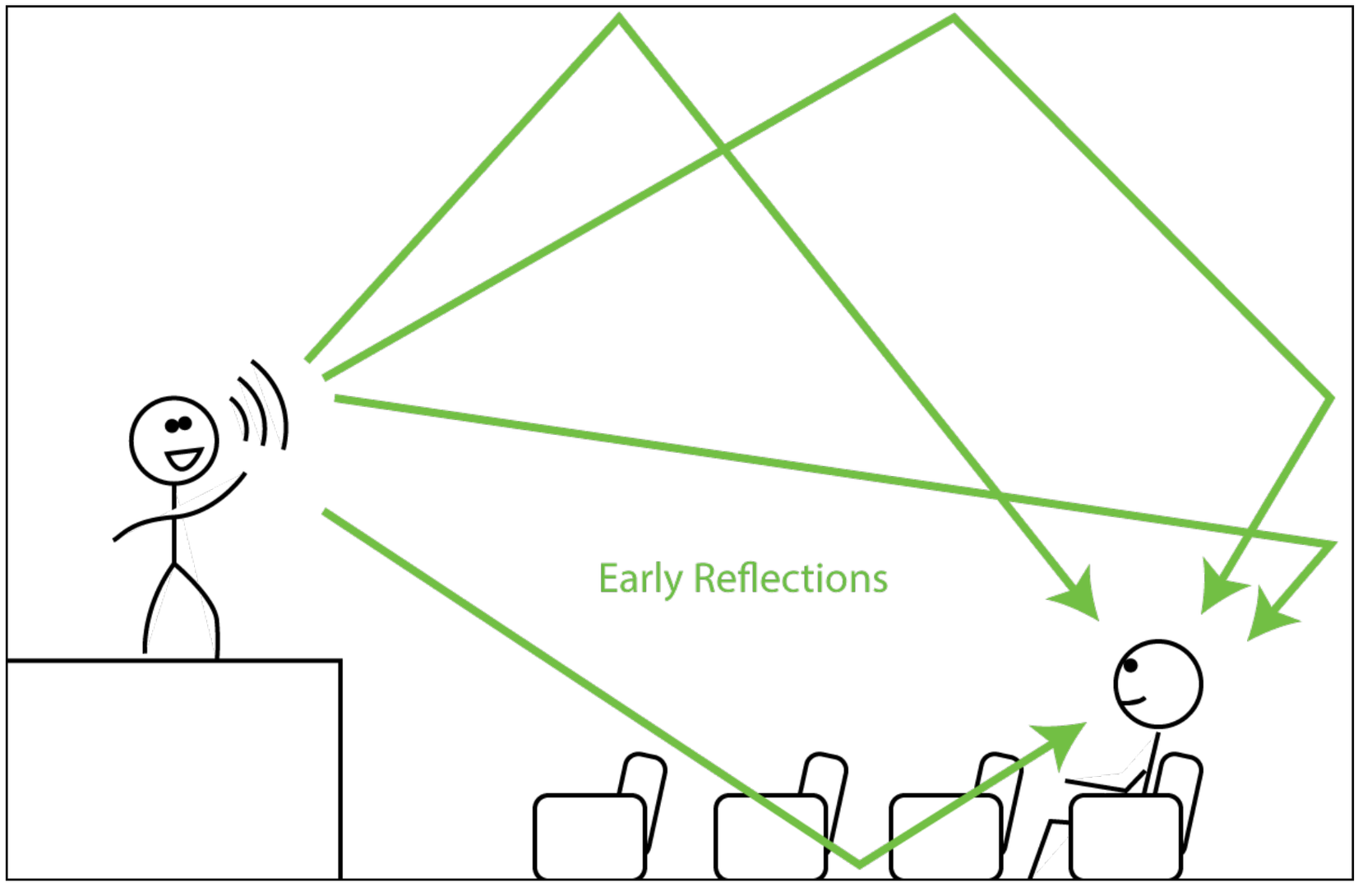
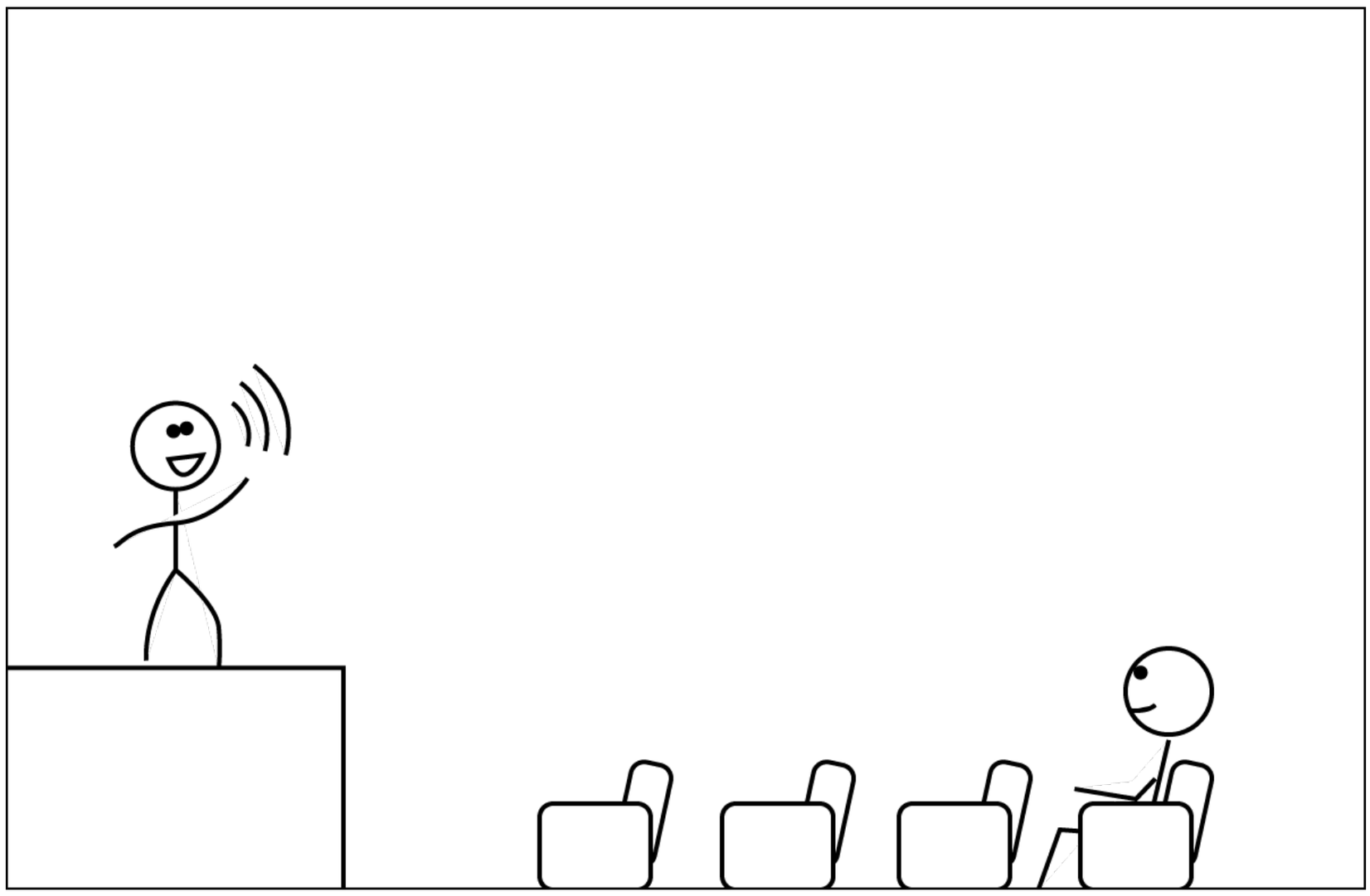


Reverberant Sound

- After the early reflections comes reverberant sound, a denser series of reflections often having reflected off of multiple surfaces before arriving at the listener



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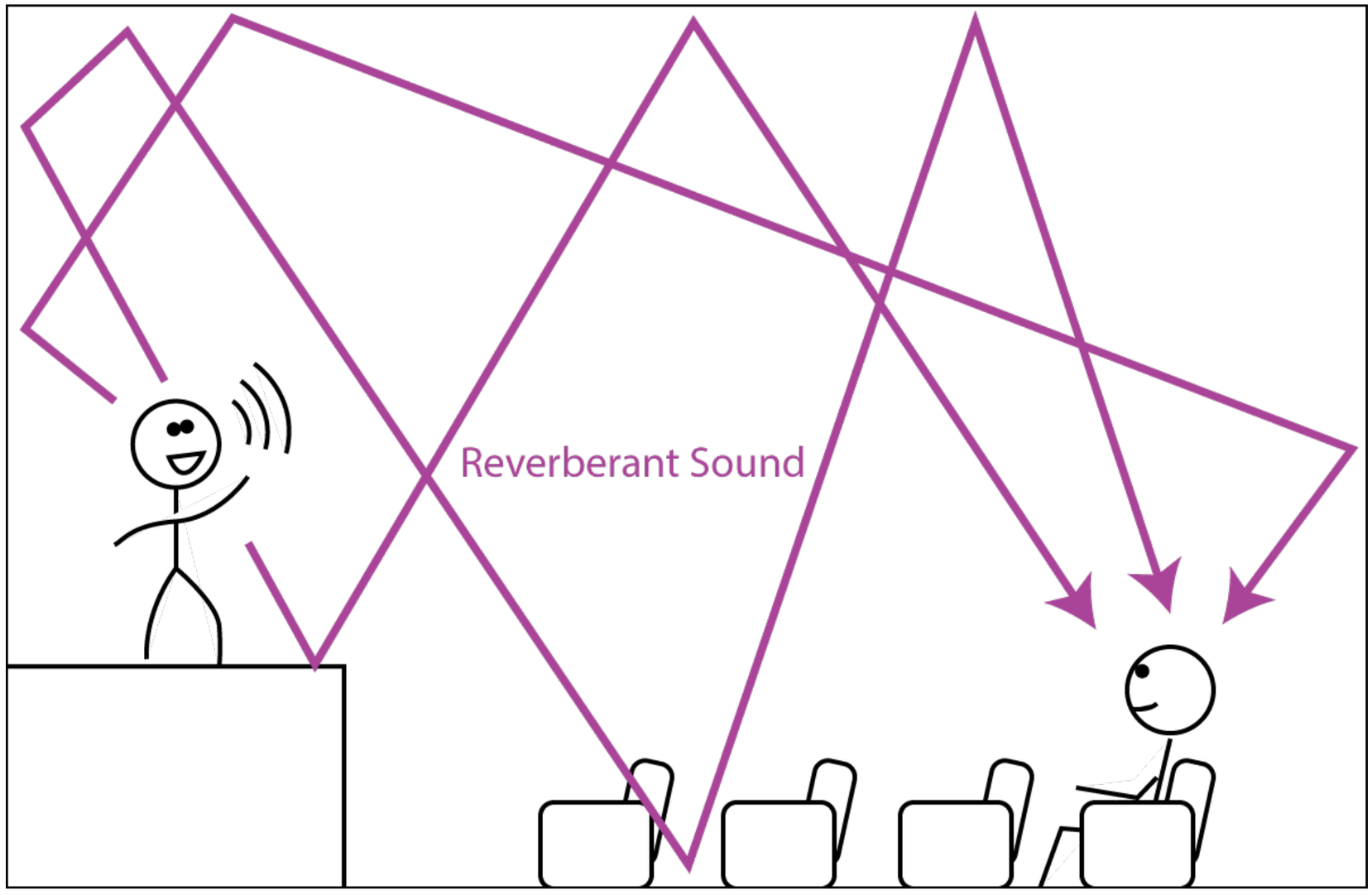
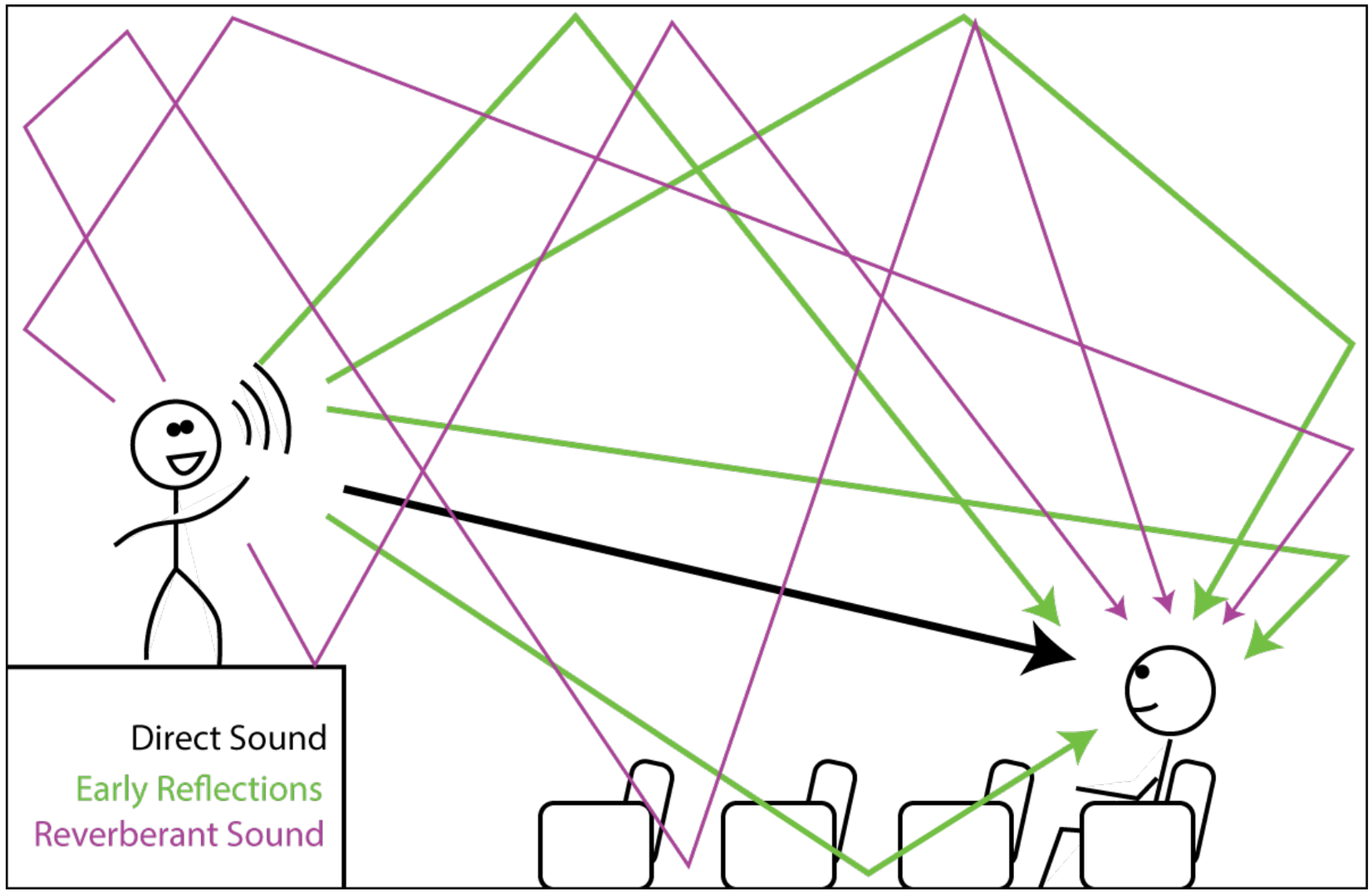


Reverberant Sound

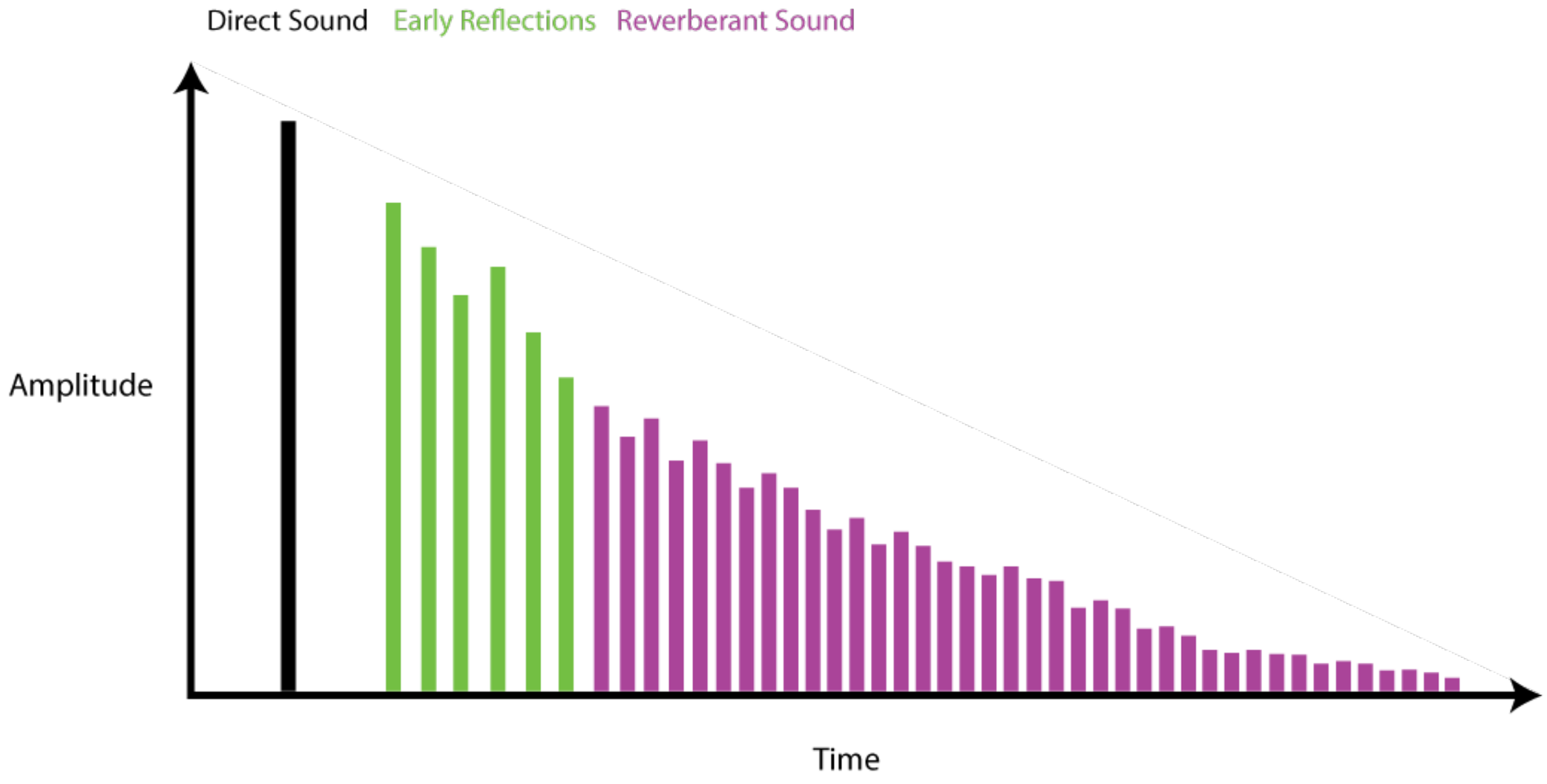
- The longer the path travelled by a reflection, the later it arrives and the weaker its amplitude is at the listener's position

- These reflections also tend to be lacking in high frequencies since they are the most easily absorbed (both by barriers/absorptive surfaces and air)



Reverb Time

- The time it takes the reverberant sound to drop 60dB from the level of the direct sound is what we call the ‘reverb time’ or RT60. This is the ‘length’ or ‘decay time’ of the reverb.



Reverb Time

- Reverb time varies greatly from room to room and is largely influenced by two factors:
    - The **size** of the room
        - Generally speaking, larger room = longer reverb
    - How **absorptive or reflective** the surfaces in the room are
        - Generally speaking, more reflective = longer reverb

Reverb Quality

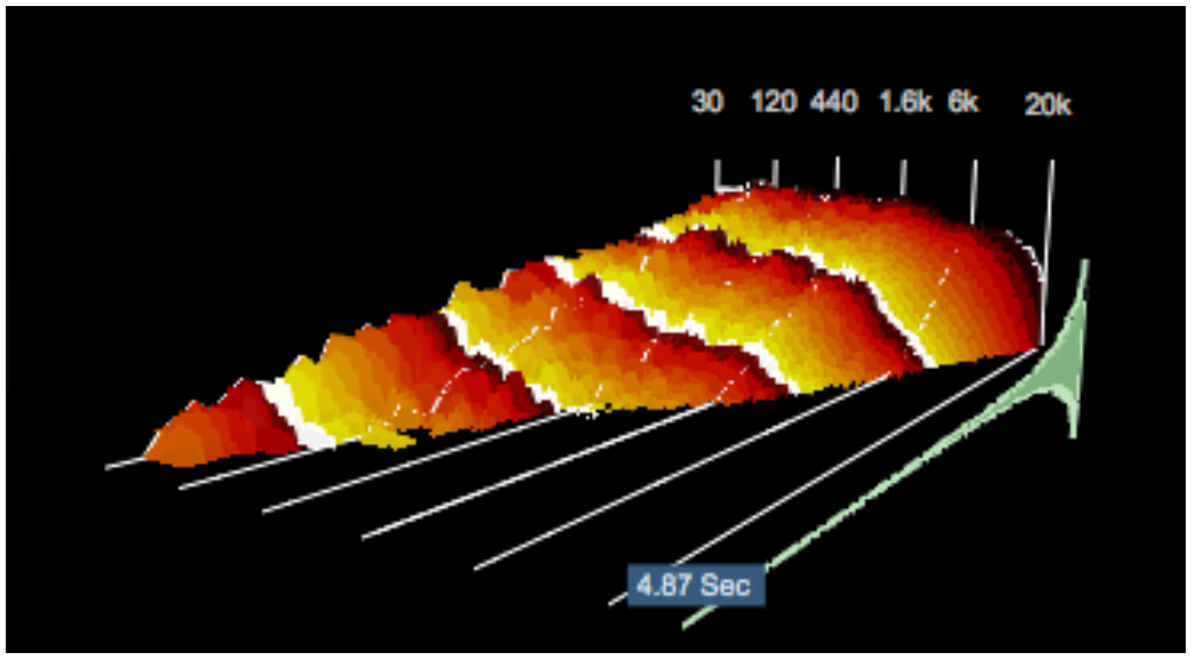
- The colour, quality or **Timbre** of the reverb is also influenced by the room

- Different sized rooms have certain frequencies at which they naturally resonate
    - At these frequencies, sound tends to build up and sustain longer

- Certain frequencies may also be absorbed/reflected more by the surfaces in the space
    - Remember: high frequencies are more easily absorbed than lows

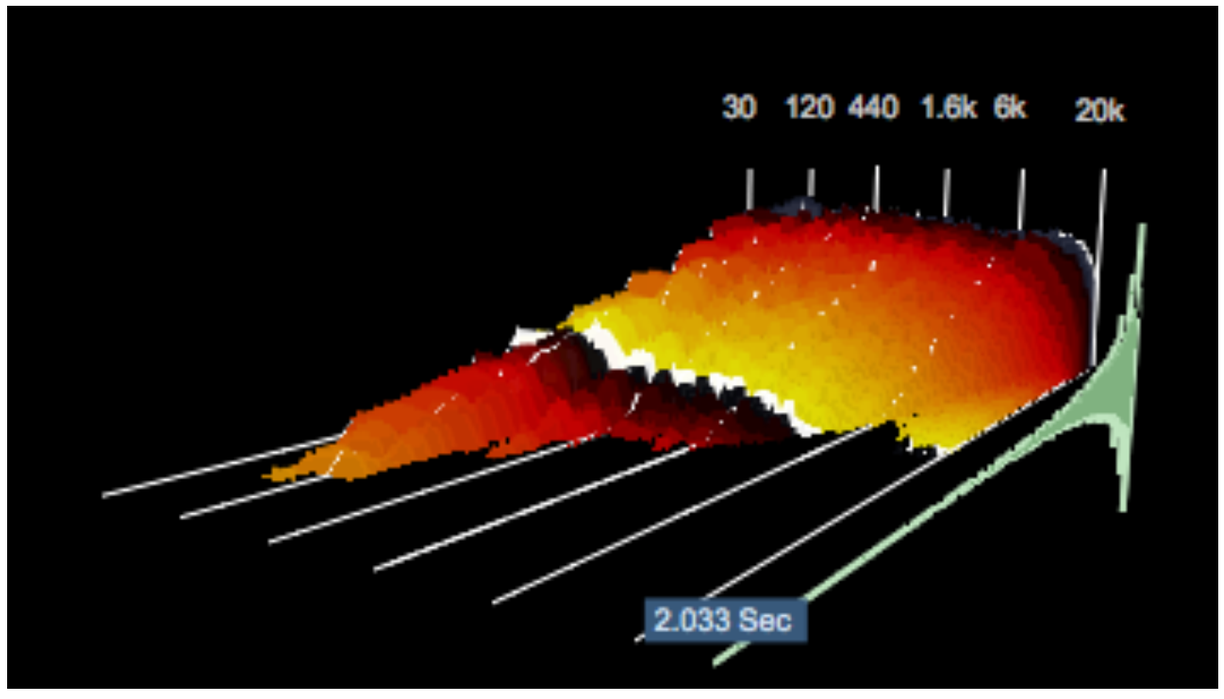
- We can observe both the Time and Frequency Response of a Reverb Signal using a **waterfall plot**

Waterfall Plots



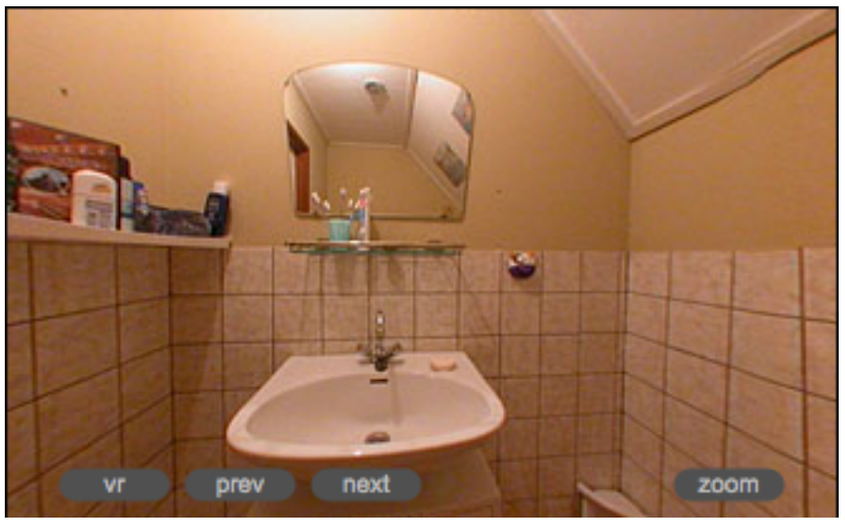
- Concertgebouw in Amsterdam

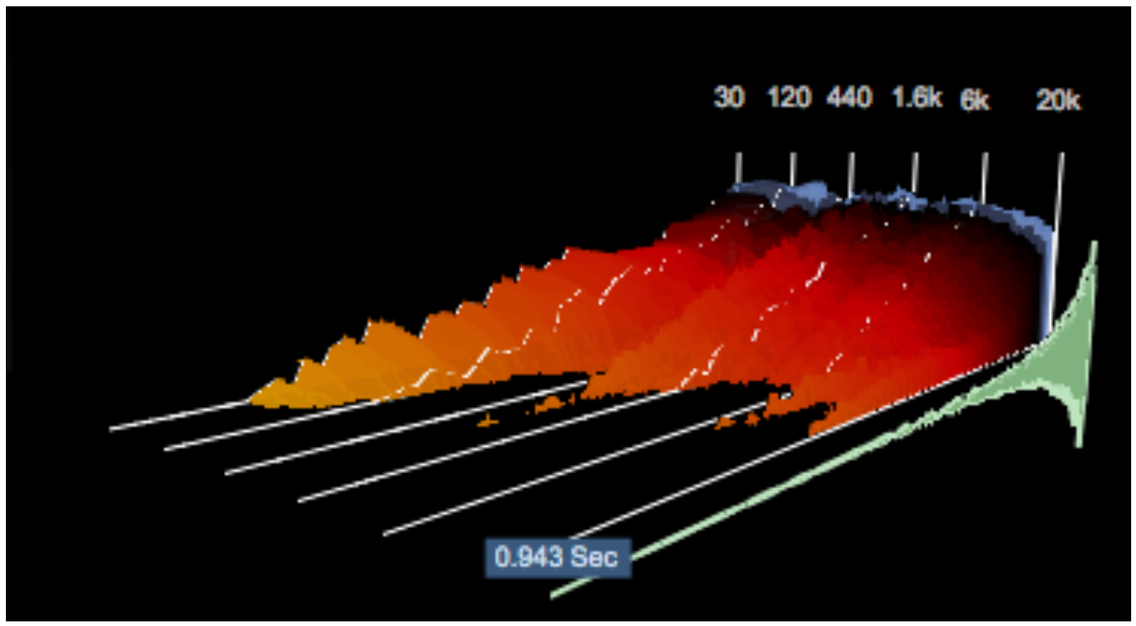
Waterfall Plots



- Allaire Recording Studio in upstate NY

Waterfall Plots





- A Bathroom *note the room resonances*

Artificial Reverb

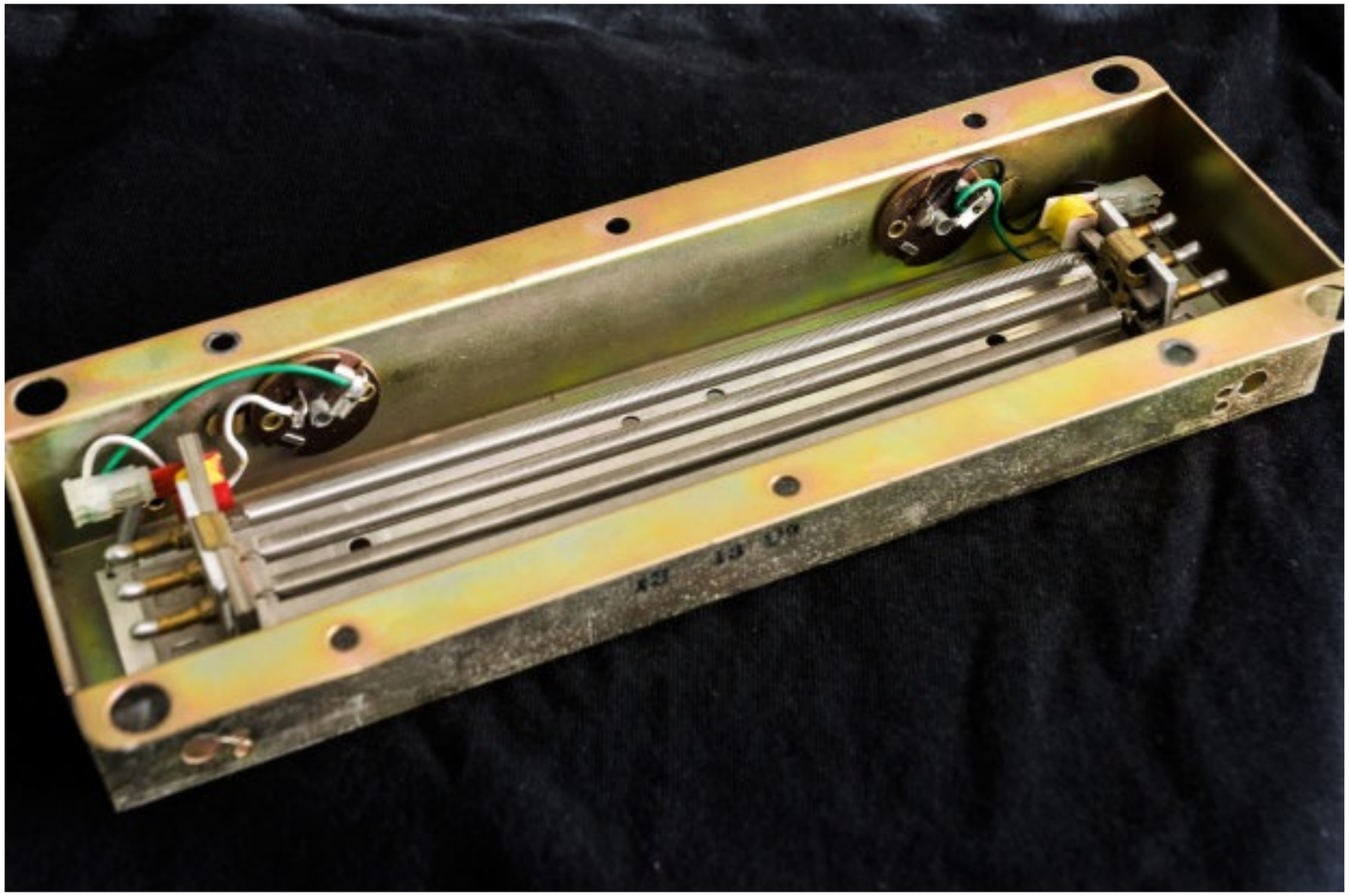
Artificial Reverb

- Many options:
  - Plate reverb
  - Echo chamber
  - Spring reverb
  - Digital hardware units (Lexicon 224, 480, PCM96, TC6000)
  - Plugins
- “Artificial” in the sense that the reverb isn’t natural reverb being captured during a performance in an acoustic space.

Plate Reverb

Echo Chamber

Spring Reverb



Digital Units

Reverb Plugins

- Digital emulation of natural reverb, or ‘classic’ artificial reverb units
- Used in a DAW (Pro Tools)
- Come in many flavours from many different plugin designers
    - In Pro Tools we get ‘D-Verb’ as our stock option

D-Verb!


Track
Preset
Auto
Aux 1
a
D-Verb
<factory default>
COMPARE
BYPASS
SAFE
Native
INPUT
REVERB
OUTPUT
GAIN
-4.0dB
HALL
CHURCH
PLATE
ROOM 1
ROOM 2
AMBIENT
NON-LIN
SMALL
MEDIUM
LARGE
DECAY
4.5 sec
PRE-DELAY
0 ms
HF CUT
15.10 kHz
DIFFUSION
87 %
LP FILTER
Off
MIX
DRY
100 %
WET
0
-1
-2
-3
-6
-12
-18
-24
-48
-96
- ∞
LR
DVERB

D-Verb Controls

- **Room Type:** Chooses the reverb algorithm (what kind of reverb is being modelled)
- **Room Size:** Alters the chosen algorithm, changing the perceived size and character of each reverb
- **Decay:** The reverb time (RT60)
- **Pre-Delay:** Adds time between the direct sound and the onset of early reflections
- **Diffusion:** Controls how quickly sound transitions from early reflections to reverberant sound (typically higher values sound better)
- **HF Cut:** Frequencies above this setting will decay more quickly than those below (mimicking real life)
- **LP Filter:** completely removes high frequencies above this setting
- **Wet/Dry:** Adjusts the ratio of direct sound to reverberant sound. If using as an aux send insert in Pro Tools, leave this at 100% wet

Pro Tools Demo!

Other Effects

Other Effects

- In Pro Tools (or any DAW), we have many choices for types of plugins we can insert on a channel

- Many of these ‘effects’ are emulations of hardware units, though not all

- Effects can be divided up into a few different categories, based on how they interact with sound

Effects Categories

- **Equalization (E.Q.):** effects the spectral (frequency) content of a sound

- **Dynamics:** (compression, expansion, limiting) effects the dynamic range of a sound

- **Delay:** effects the timing of a sound, potentially creating discreet copies of the sound which can be repeated in time

- **Modulation:** adds frequency or amplitude modulation to a sound

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Equalization

- E.Q. is a powerful tool that can be used to emphasize or de-emphasize certain frequency ranges within a sound

- EQ gestures can be very broad: Adding gain to all frequencies above 6kHz would ‘brighten’ the sound in a very general way

- Or they can be very specific: Attenuating only those frequencies *immediately* surrounding 255Hz by 10dB might control an unruly resonance at that frequency

Types of E.Q.

Filters

- HPF (High Pass Filter)
- LPF (Low Pass Filter)
- BPF (Band Pass Filter)

Shelves

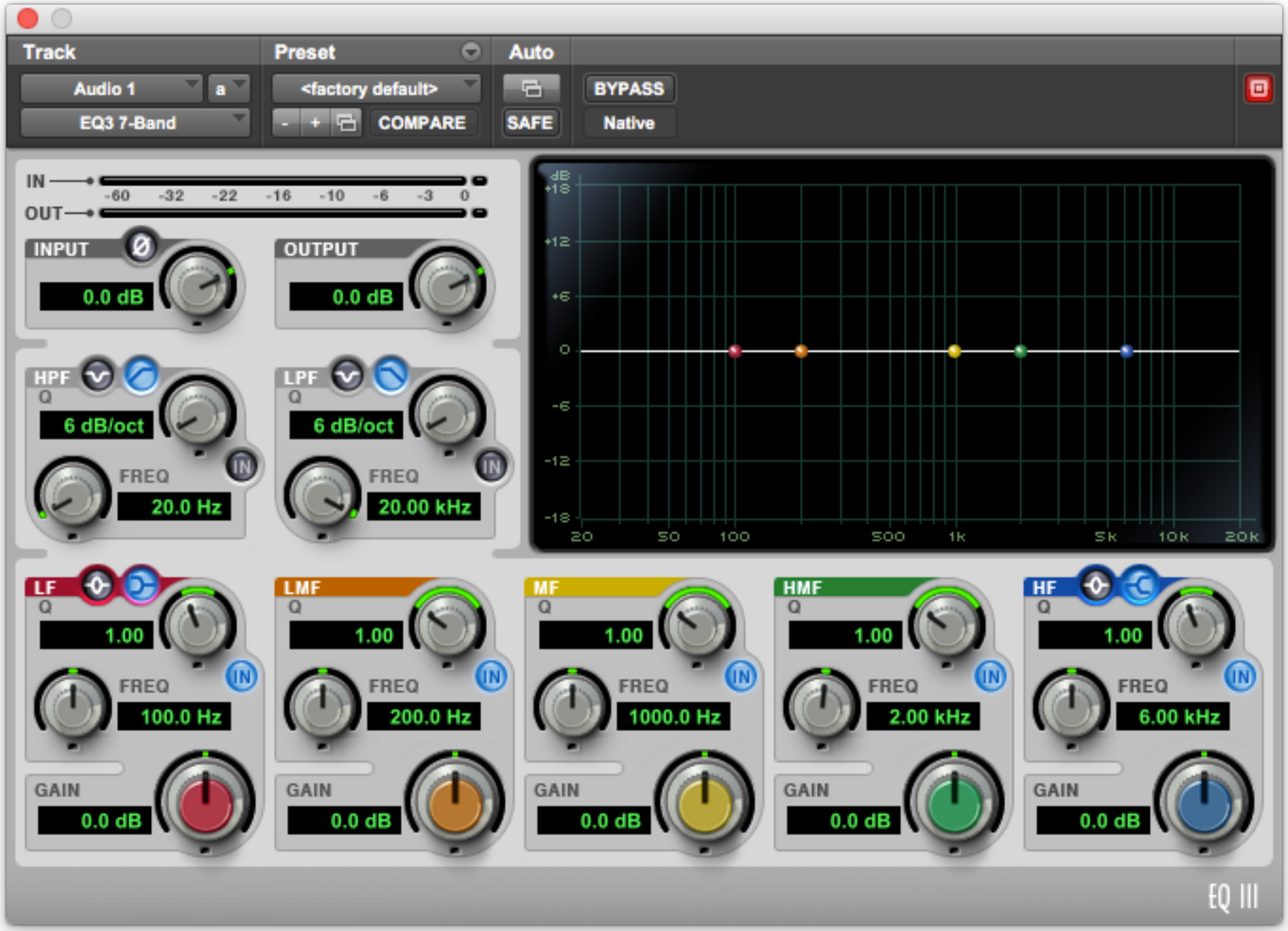
- High Shelf
- Low Shelf

Bells

- Peak/Bell
- Notch Filter

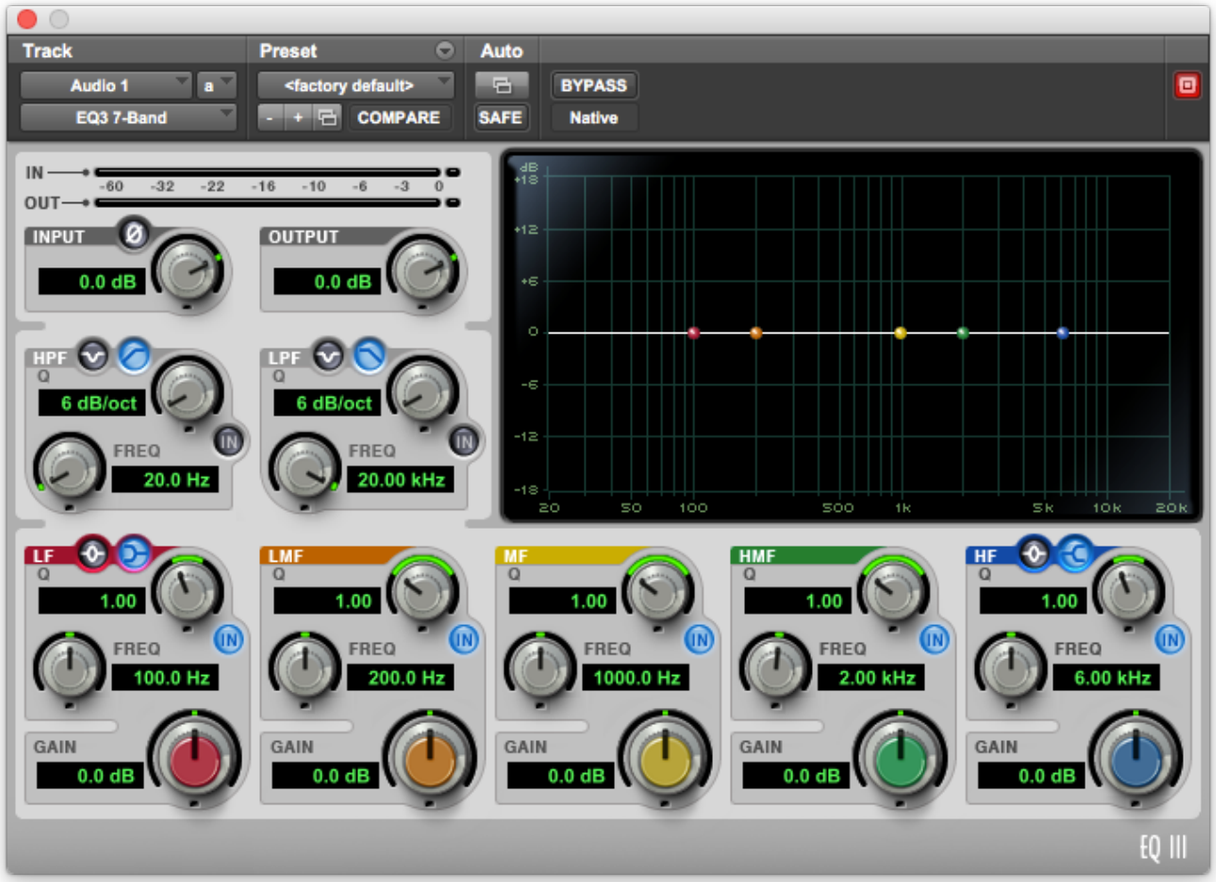
The default E.Q. plugin in Pro Tools gives us access to all of these

EQ3 - 7 Band


Track
Preset
Auto
Audio 1
a
<factory default>
BYPASS
EQ3 7-Band
COMPARE
SAFE
Native
IN
OUT
-60 -32 -22 -16 -10 -6 -3 0
INPUT
0.0 dB
OUTPUT
0.0 dB
HPF
Q
6 dB/oct
FREQ
20.0 Hz
LPF
Q
6 dB/oct
FREQ
20.00 kHz
dB
+18
+12
+6
0
-6
-12
-18
20 50 100 500 1k 5k 10k 20k
LF
Q
1.00
FREQ
100.0 Hz
GAIN
0.0 dB
LMF
Q
1.00
FREQ
200.0 Hz
GAIN
0.0 dB
MF
Q
1.00
FREQ
1000.0 Hz
GAIN
0.0 dB
HMF
Q
1.00
FREQ
2.00 kHz
GAIN
0.0 dB
HF
Q
1.00
FREQ
6.00 kHz
GAIN
0.0 dB
EQ III

EQ3 - 7 Band

- Has 7 ‘bands’ (HPF, LPF, LF, LMF, MF, HMF, HF)
- Each band has a control for Q
- Each band has a control for frequency
- All bands besides HPF/LPF have a control for gain
- HF and LF bands can be shelving E.Q.’s or Bell
- HPF and LPF can also be notch filters



*Handy Tip: Hold down *shift + control* (and click on any of a band’s parameters, i.e. Frequency) to isolate a band

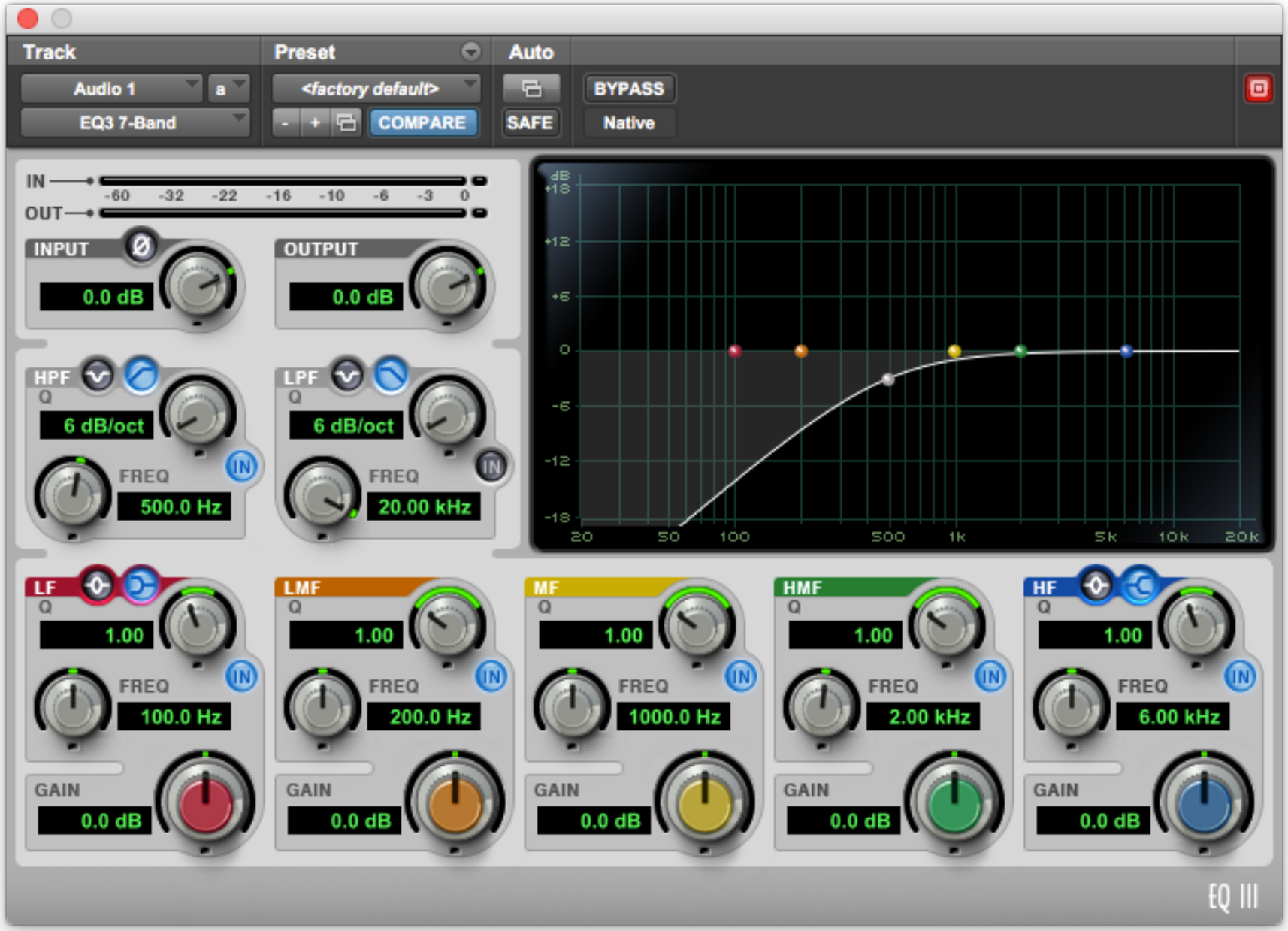
E.Q. - HPF & LPF

- **HPF (High-Pass Filter)**: Any frequencies above a chosen point will ‘pass’, unaffected. Any frequencies below will be filtered out completely.

- **LPF (Low-Pass Filter)**: Any frequencies below a chosen point will ‘pass’, unaffected. Any frequencies above will be filtered out completely.

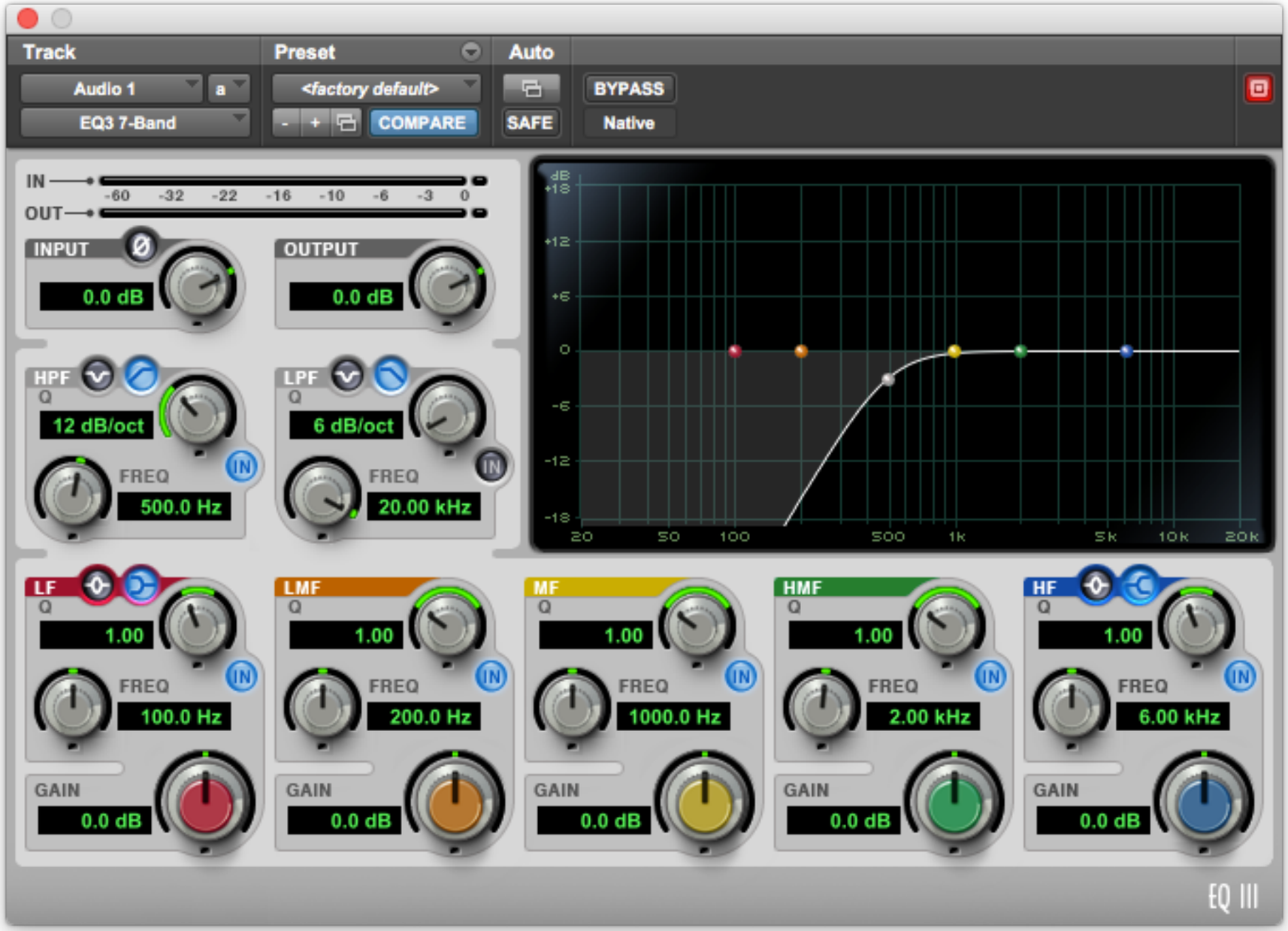
- A filter isn’t instantaneous. It takes place over a range of frequencies. We describe how ‘steep’ the cutoff is in **dB per octave**. Typically it changes in 6dB/octave steps.

E.Q. - HPF & LPF



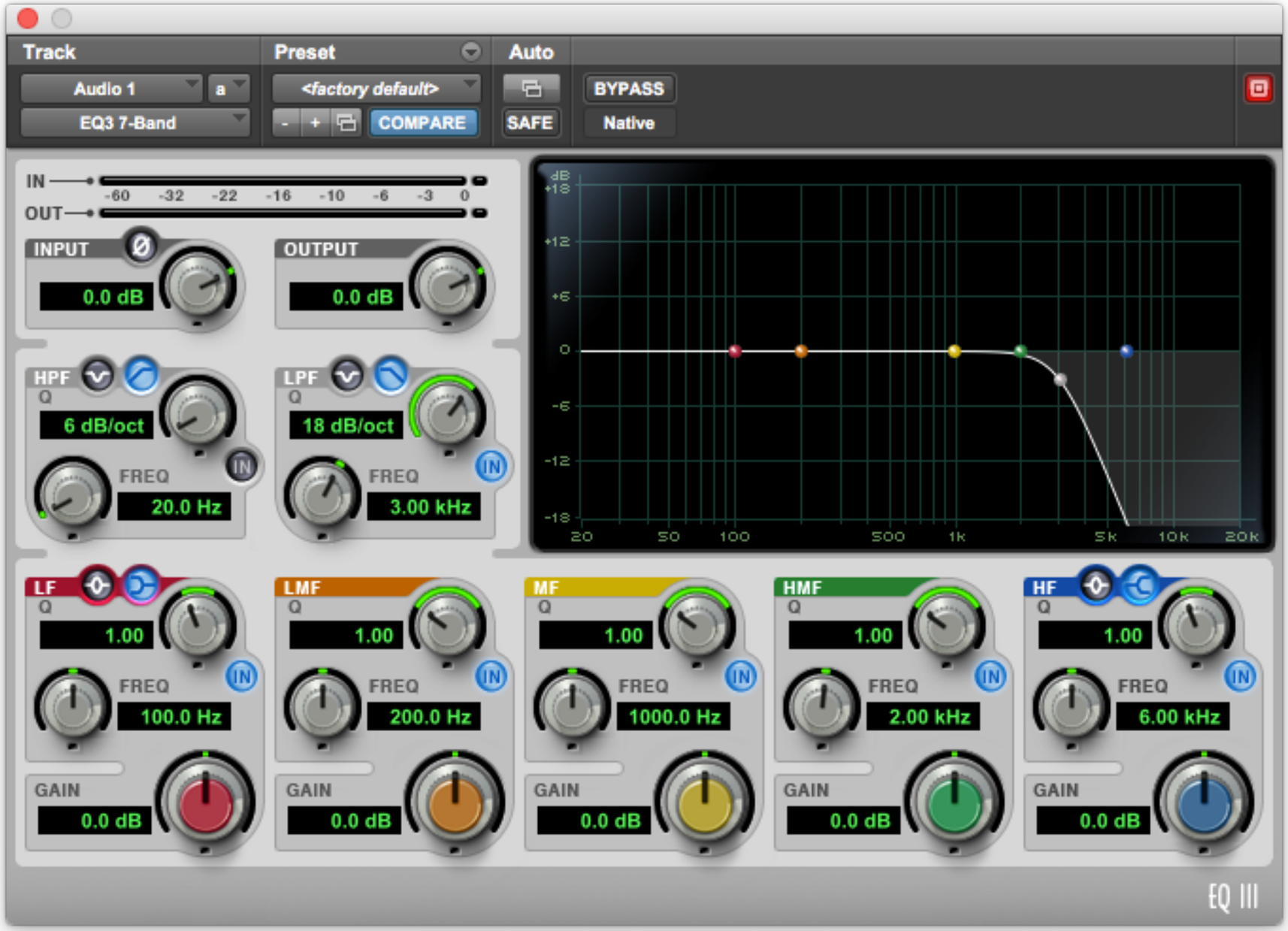
HPF at 500Hz, 6dB per octave

E.Q. - HPF & LPF



HPF at 500Hz, 12dB per octave

E.Q. - HPF & LPF

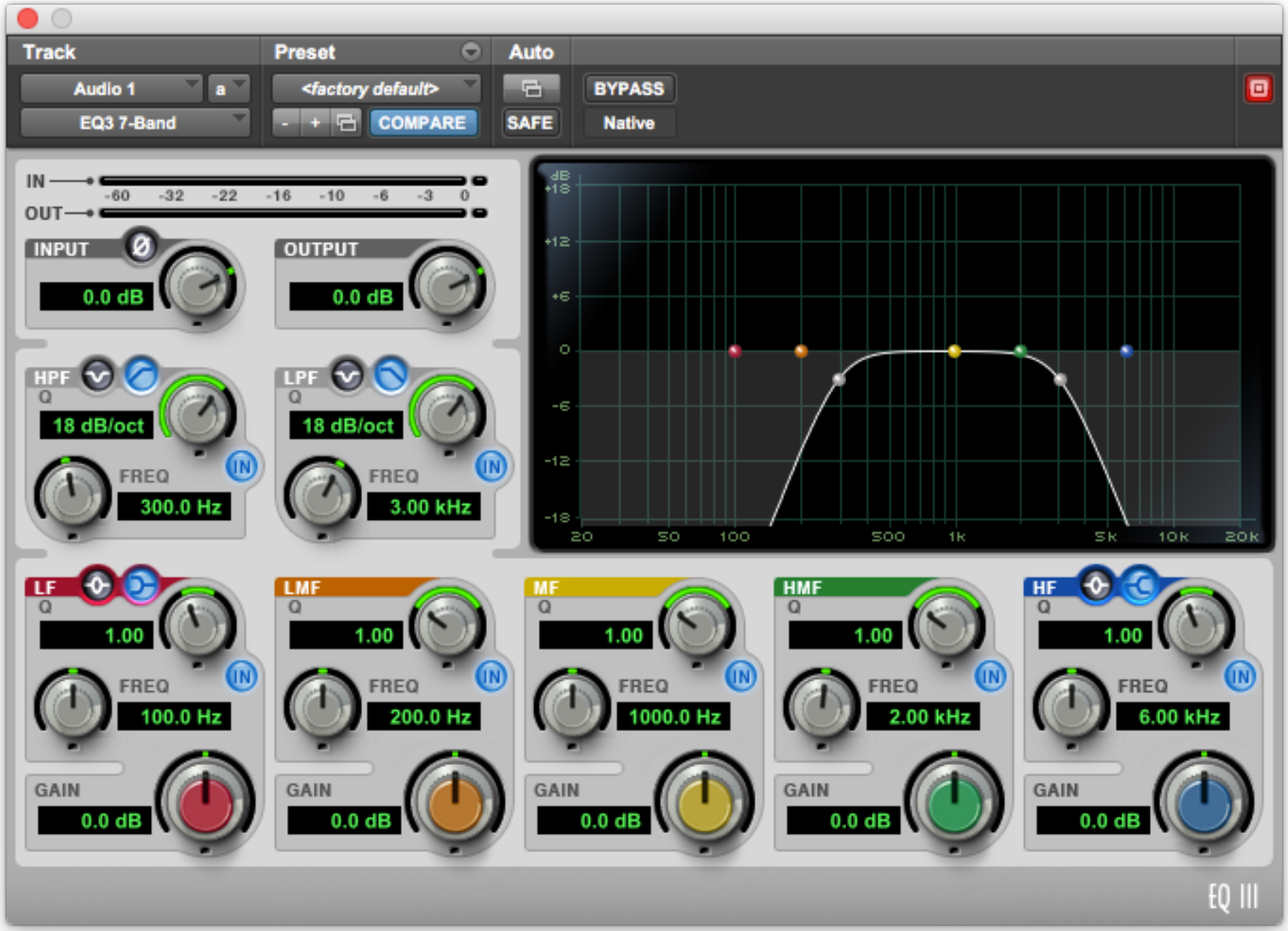


LPF at 3kHz, 18dB per octave

E.Q. - BPF

- When you combine a LPF and a HPF, only the frequencies between the two filters will pass
- This is called a **BPF (Band-Pass Filter)**
- Note: unlike bell or shelving E.Q.'s, HPF, LPF & BPF are only ever subtractive

E.Q. - BPF



HPF at 300Hz, LPF at 3kHz, both 18dB per octave

E.Q. - Shelving

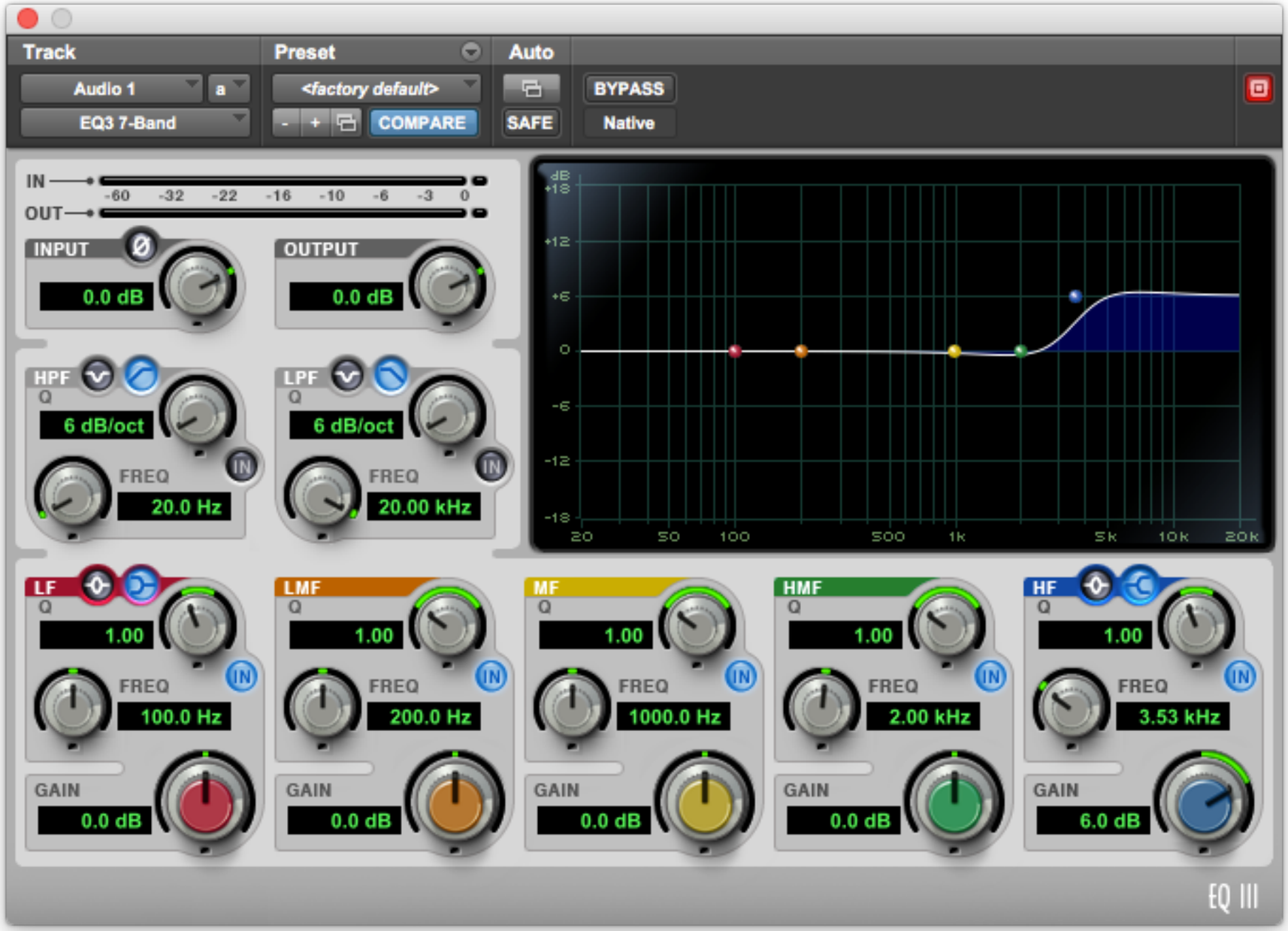
- A shelving E.Q. is something you've probably used before, perhaps on your home or car stereo (think 'Treble' & 'Bass' controls)

- With a **high-shelf**, amplitude is increased or decreased for all frequencies **above** a chosen point

- With a **low-shelf**, amplitude is increased or decreased for all frequencies **below** a chosen point

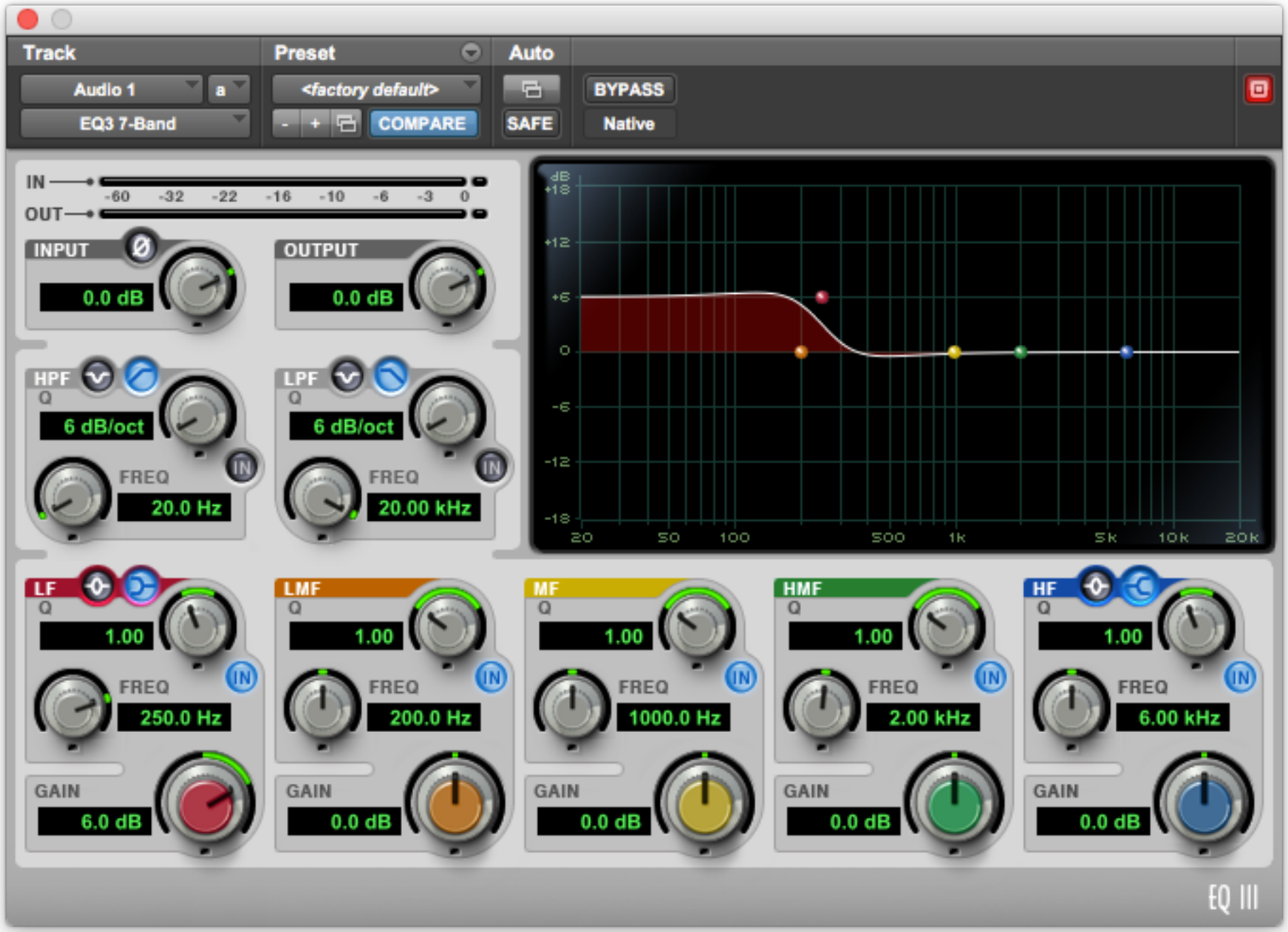
- In most consumer electronics, the frequency and Q are fixed, leaving the user only with a gain control

E.Q. - Shelving



High-Shelf: adding 6dB at 3.53kHz

E.Q. - Shelving



Low-Shelf: adding 6dB at 250Hz

E.Q. - Bell

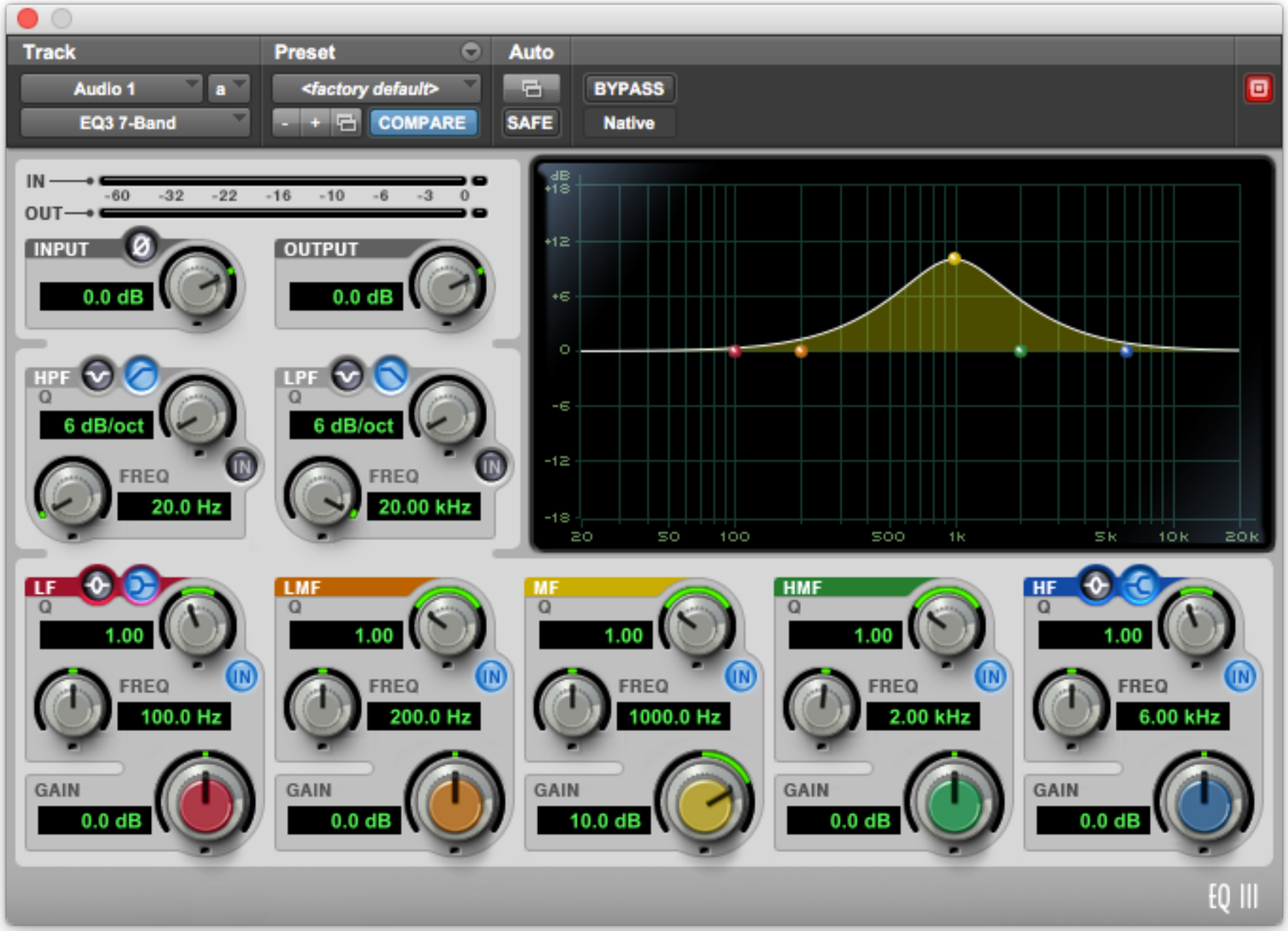
- Bell is the ‘shape’ you see as the default in most *midrange* bands of an EQ

- It boosts a range of frequencies around a centre point

- If the E.Q. is ‘**parametric**’, the user may also control the quality/sharpness of the bell curve (how broad or narrow it’s shape is). This control is called “**Q**”

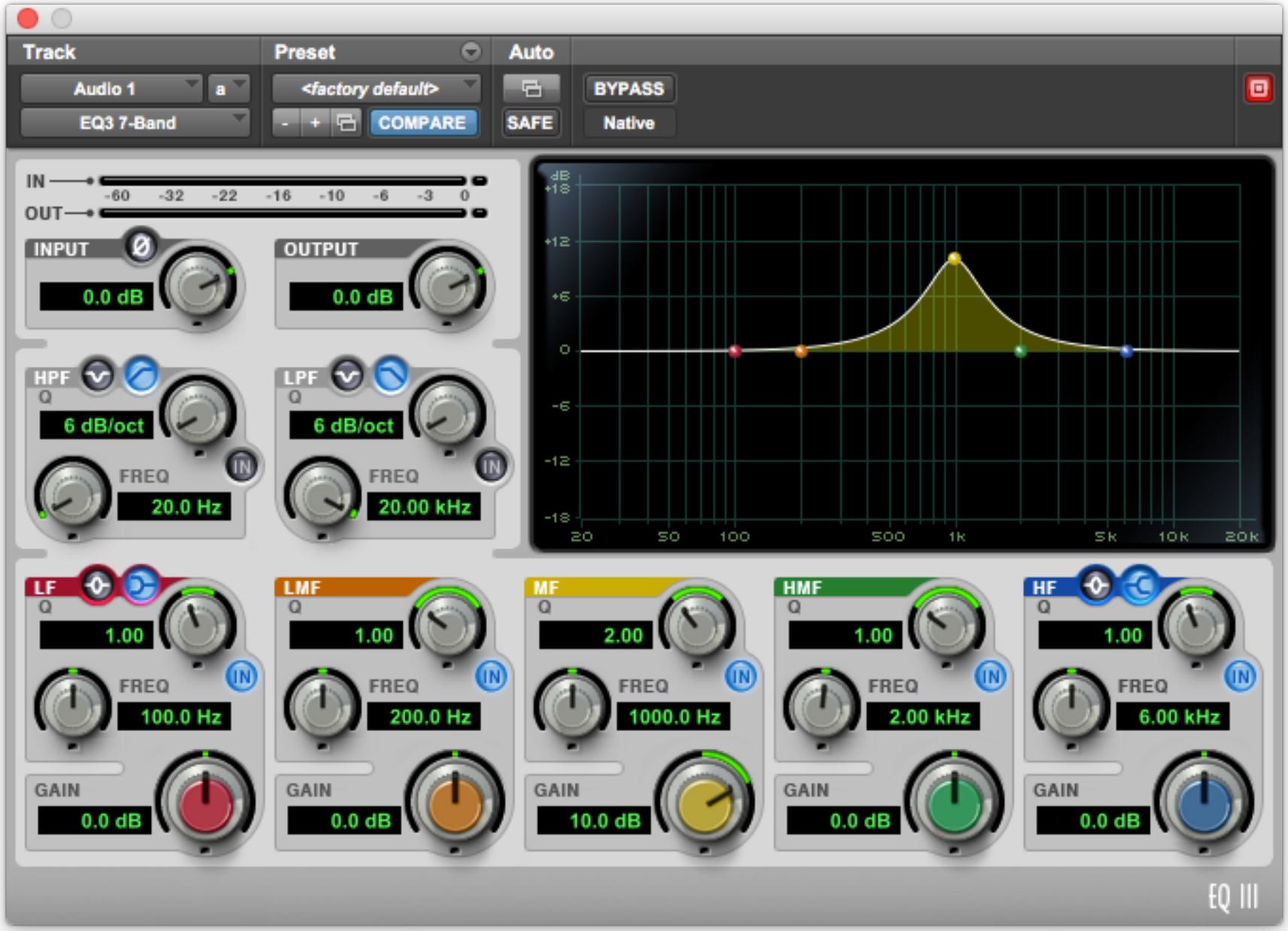
    - The default E.Q. plugin in Pro Tools is parametric and provides Q controls for both bell and shelf bands

E.Q. - Bell



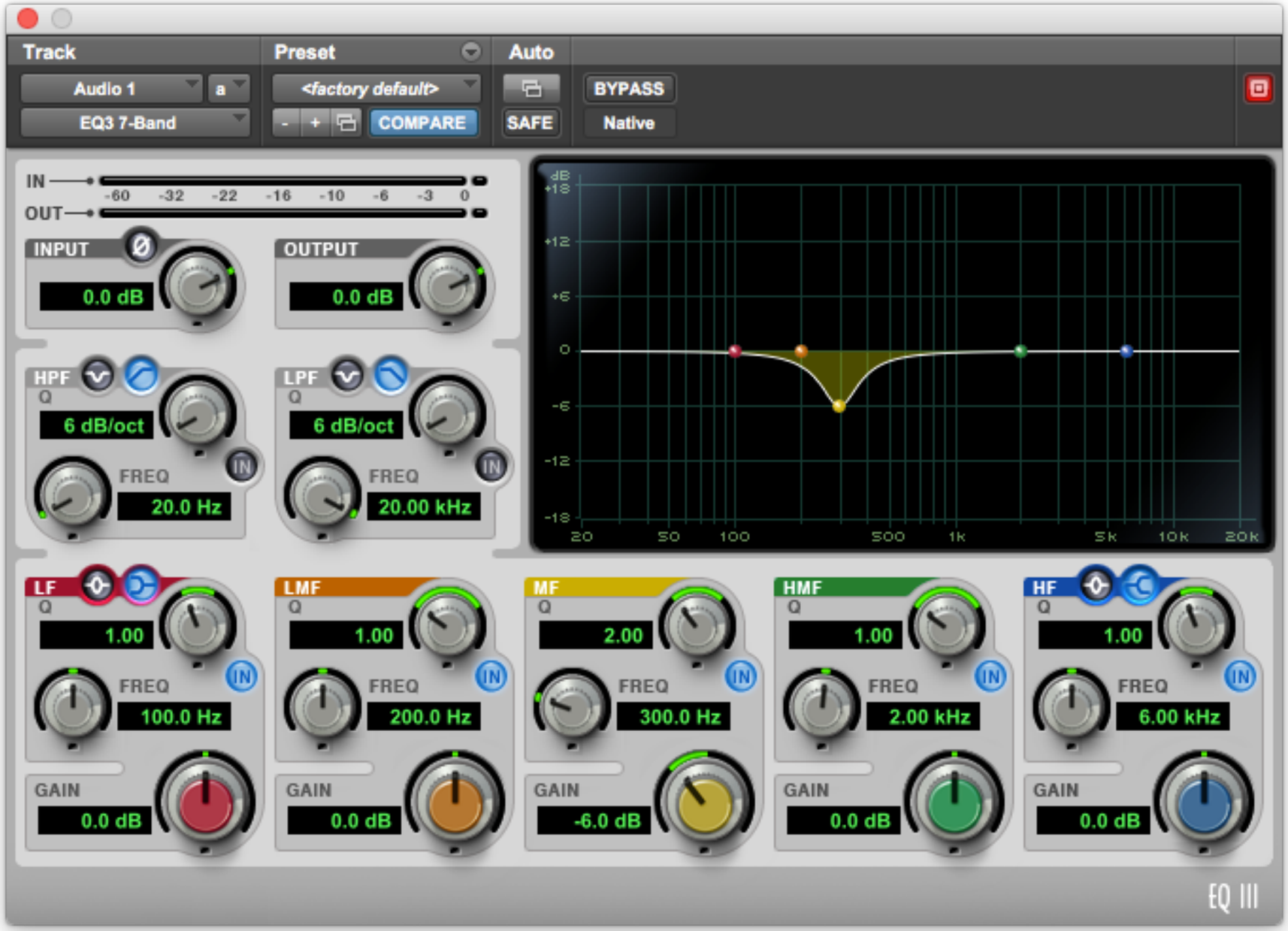
Boosting 1000Hz by 10dB, Q of 1

E.Q. - Bell



Boosting 1000Hz by 10dB, Q of 2

E.Q. - Bell



Cutting 350Hz by 6dB, Q of 2

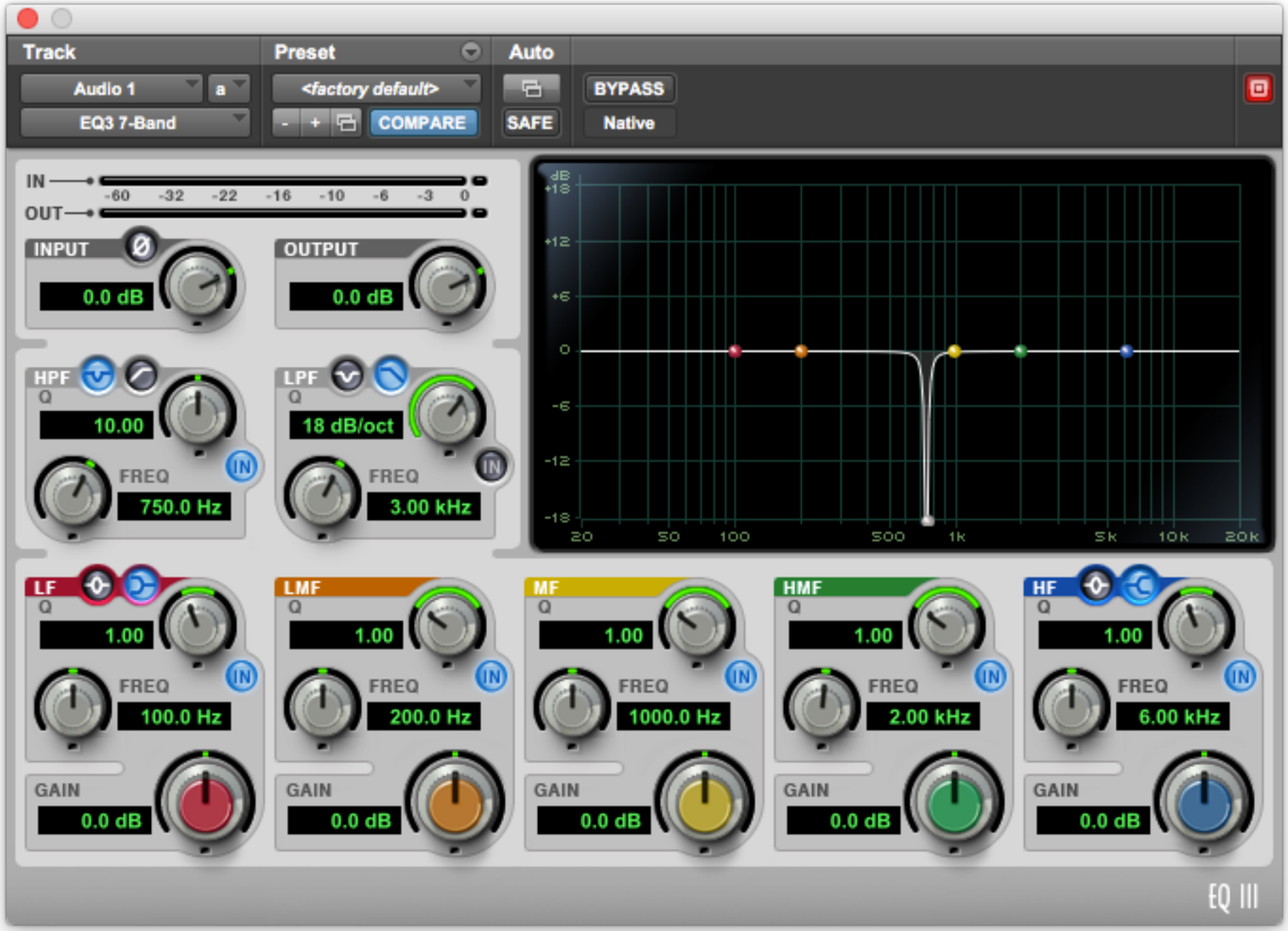
E.Q. - Notch Filter

- A **notch filter** is essentially a very steep bell curve with a specific purpose - to dramatically attenuate a very narrow band of frequencies

- This E.Q. curve is often used in live sound to reduce resonant frequencies in a room or PA system that might tend to feed back

- This can also be useful in recording if a particular frequency is causing problems, but should be used with care as it is not a subtle gesture

E.Q. - Notch Filter



Notch Filter at 750Hz, Q of 10

Pro Tools Demo!

(and then the end)