# Boss Buffers: Do They Suck?

The Pursuit of Toan

By xXx Goku Sephiroth 420 xXx

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**Abstract**

An analysis of twelve Boss pedals reveals significant variance in the performance of those pedals' buffers. The best buffers produce a frequency response that is effectively flat while the worst buffers dip by as much as 1.5 dB at 20 kHz. Waza pedals do not appear to have a flatter response than standard Boss pedals.

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# 1 Introduction

Many words have been spilled on the internet and countless lives have been lost on the subject of the buffers used in Boss pedals and how they can "suck tone", but it is very difficult to find any genuine measurements of these buffers. This paper intends to characterize how well different Boss pedals can pass an input signal through their buffers. In addition, I will answer the question that has haunted pedal enthusiasts for years: "Are Waza buffers better?"

Compilcating this is the fact that Boss has been selling some pedals under a particular model name for decades, and in that time the internal electronics have changed quite a bit. I don't have a list of exactly what these changes are, but it is exceedingly likely that a DS-1 made in 1978 has a buffer with different characteristics than one made in 2025. To this end, this paper will focus entirely on "modern" productions of all involved pedals.

# 2 The Pedals

I have a collection of twelve Boss pedals to test, six being Waza pedals and the other six being 'normal' pedals. The complete collection is:

**BD-2W** Blues Driver

**BP-1W** Booster/Preamp

**CE-2W** Chorus

**DC-2W** Dimension C

**DM-2W** Delay

**FZ-1W** Fuzz

**CP-1X** Compressor

**DS-1** Distortion

**DS-2** The Turbo Team

**GE-7** Equalizer

**IR-2** Amp & Cabinet

**LS-2** Line Selector

I made an effort to find production dates for these pedals but all the serial number decoders I could find gave me some dates in the future so I have no faith in their accuracy. All I can say with certainty is that I bought all of these pedals brand-new at retail between early 2024 and mid 2025 so I believe them all to be very modern productions by Boss standards.

Testing will also include a Wampler Tumnus Deluxe as a control pedal to measure what a true bypass looks like as a point of comparison.

## 3 Testing Methodology

Testing will be performed for one pedal at a time unless otherwise noted.

To begin, I have generated a five-minute 24-bit WAV file containing only white noise using Audacity. When plotted in the frequency domain this noise still varied from being completely flat by just over 0.15 dB in either direction from the average.

To correct this variance, I used a python script to do a FFT on the WAV file and flatten the magnitude across all frequencies. This produced a frequency plot where the greatest deviation is only about 0.10 dB.

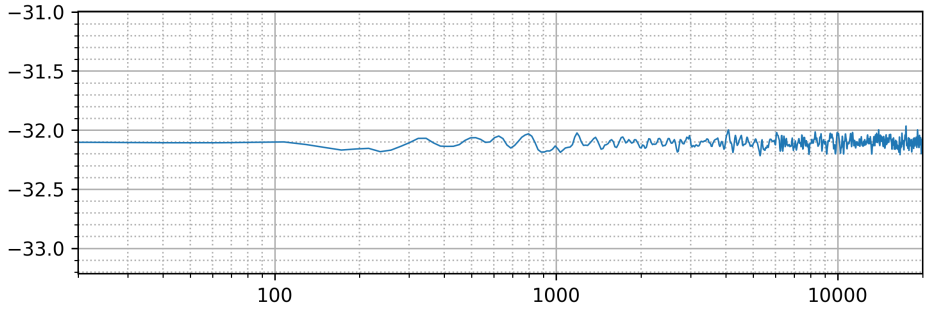


Figure 1: Test Signal

This signal will be played out of a DAC, sent through the pedal, received by a USB audio interface, recorded for five minutes, and graphed in the frequency domain. Because the input contains an even disrtibution of all frequencies we do not need to do any further processing, the raw frequency-domain plot of the output will be exactly the response curve we are looking for.

The output level of the DAC will be calibrated such that, with the interface's input preamp at 12 o'clock, the input level is -6 dB. This calibration will be done with a wire instead of a pedal at the start of testing and then the settings will not change throughout the test.

## 4 Signal Chain

The exact hardware used in this test run is:

**M1 MacBook Pro** Used to run the DAW and host the interface.

**Reaper 7.39** DAW used for playback and recording.

**Focusrite Scarlett Solo 3rd Gen** USB interface used for playback and recording.

**Voodoo Lab Pedal Power 3** Power supply for the pedal being tested.

**Brandless 3 foot TRS to double TS splitter** Connects the TRS output of the DAC to the TS input of the pedal.

**Ernie Ball Flat Ribbon Cable, 6 inch** Connects the pedal output to the interface's input.

**Ernie Ball Flat Ribbon Cable, 3 inch** Connects pedal to pedal in multi-pedal tests.

## 5 Measurements - No Buffer

First, we must establish a baseline for what the flattest possible signal that this setup can record looks like. This will be noisier than the ideal we set in Figure 1 because once the signal has to pass through a DAC and exist in a real wire in the real world it will get noisier.

For our own edification I will measure this in two different ways: once with just a cable directly from output to input to get the cleanest signal possible, and again through a true bypass pedal.

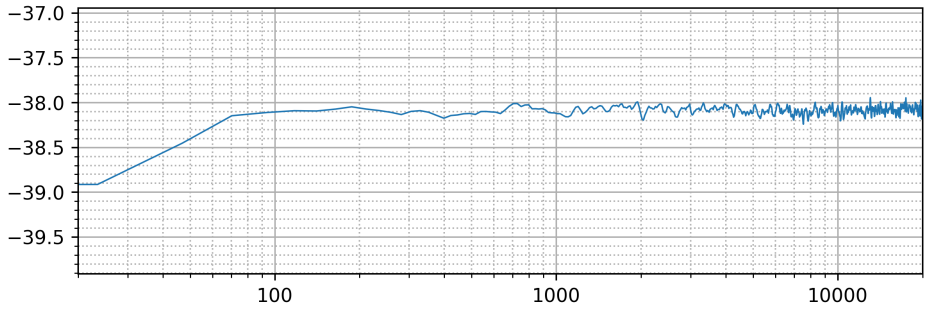


Figure 2: Just a Cable

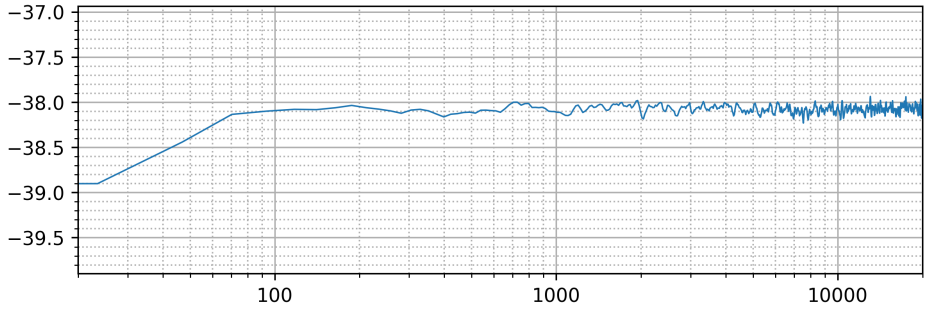


Figure 3: Wampler Tumnus Deluxe True Bypass

As expected, both of these configurations are very nearly exactly the same.

What is unexpected here is the bass rolloff of about 0.8 dB we see below 80 Hz. It is unclear if this is a result of parasitic capacitance of the cables, imperfections in the DAC or ADC, or even a wizard's curse. Fortunately, for the purposes of this analysis, we just have the accept this is the baseline and can leave the question of 'Why?' for another time.

# 6 Measurements - Standard Pedals

The below graphs show frequency response results for the buffers of non-Waza pedals.

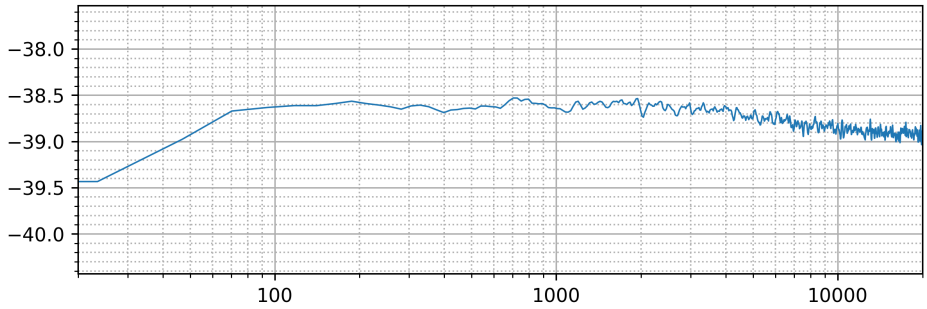


Figure 4: Boss CP-1X

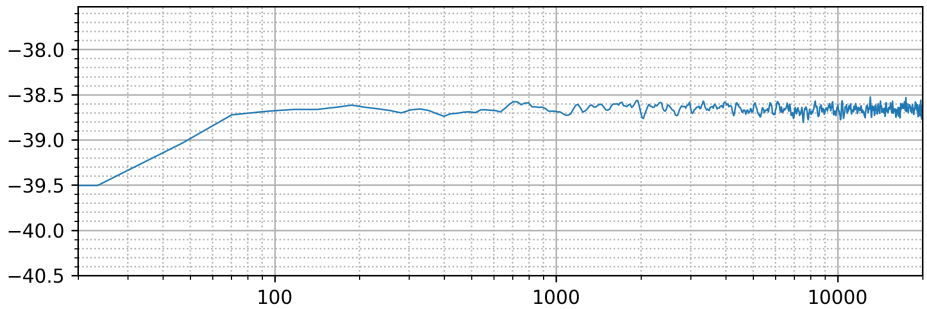


Figure 5: Boss DS-1

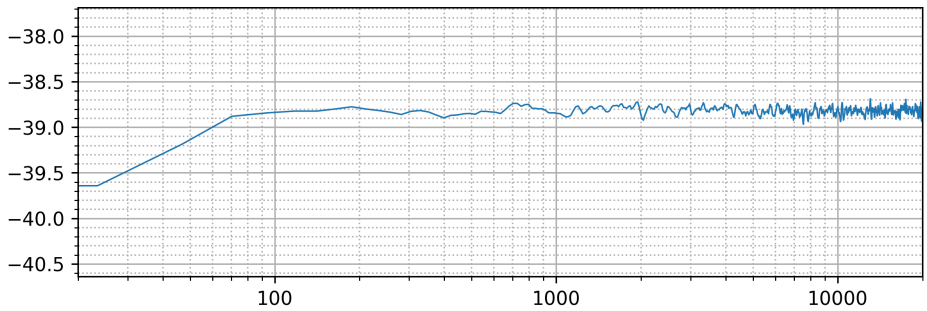


Figure 6: Boss DS-2

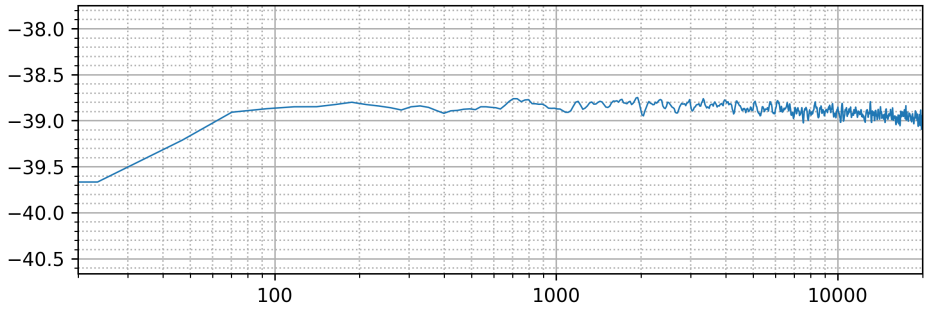


Figure 7: Boss GE-7

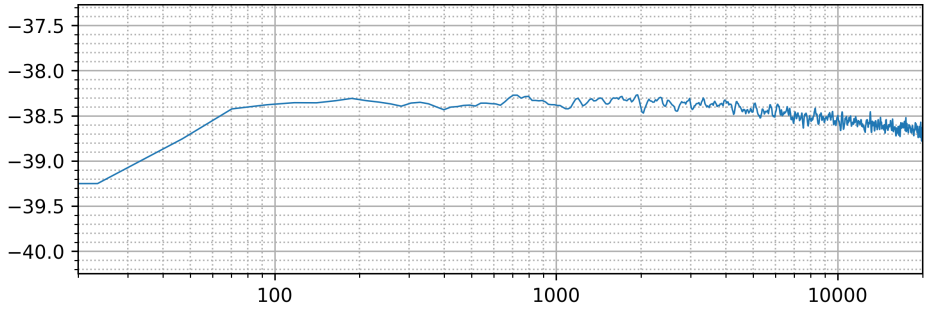


Figure 8: Boss IR-2

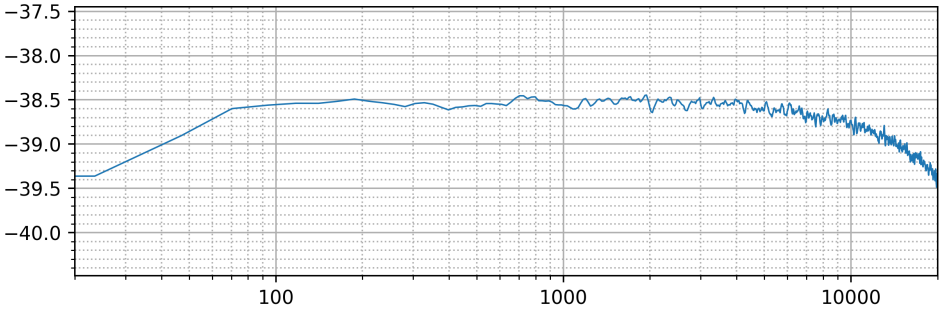


Figure 9: Boss LS-2

# 7 Measurements - Waza Pedals

The below graphs show frequency response results for the buffers of Waza pedals.

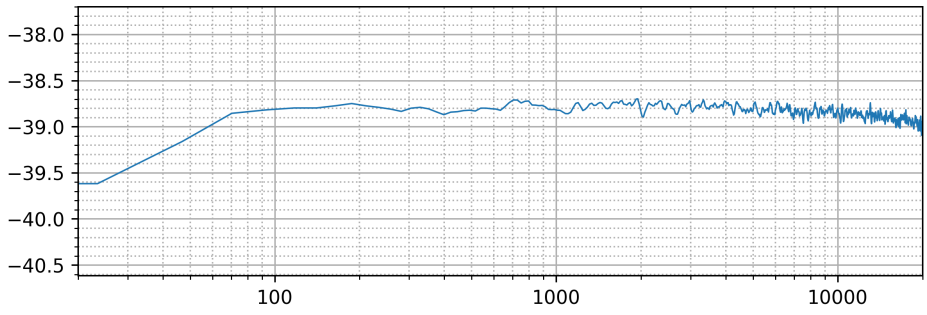


Figure 10: Boss BD-2W

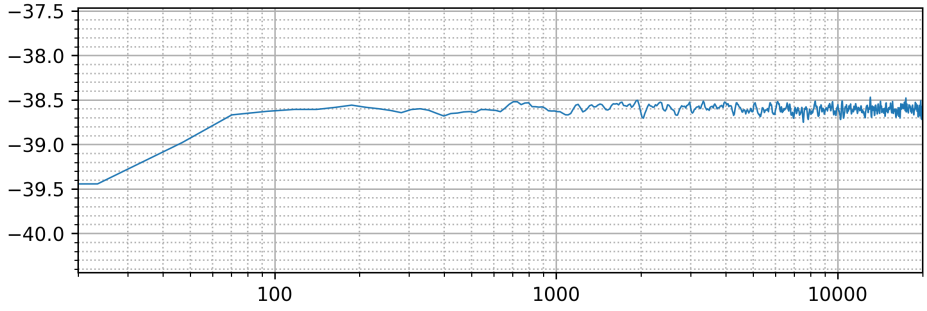


Figure 11: Boss BP-1W

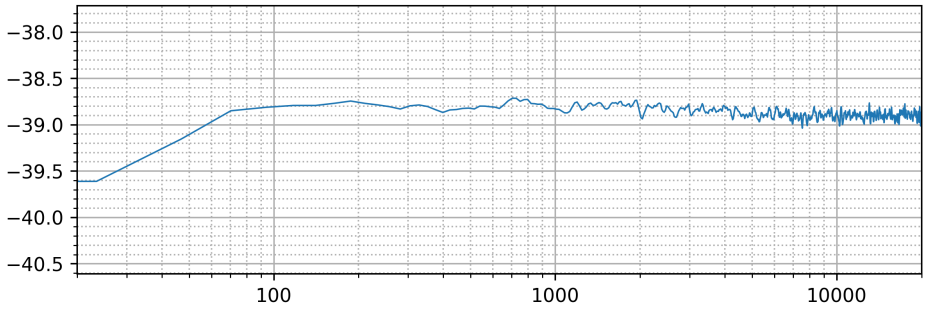


Figure 12: Boss CE-2W

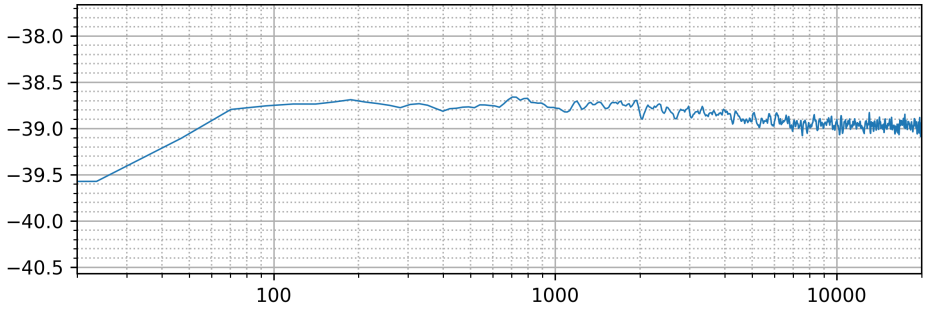


Figure 13: Boss DC-2W

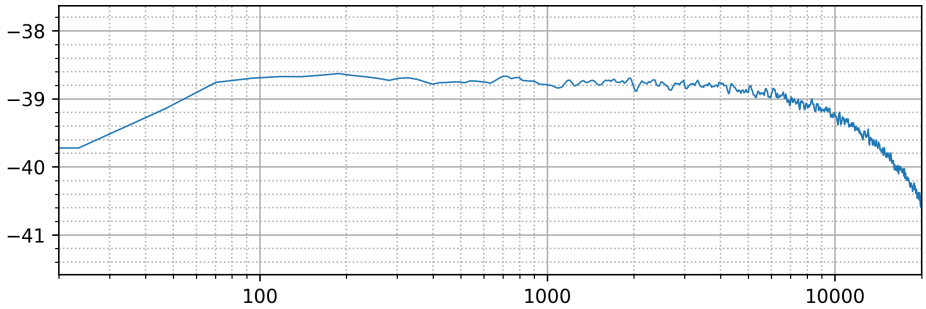


Figure 14: Boss DM-2W

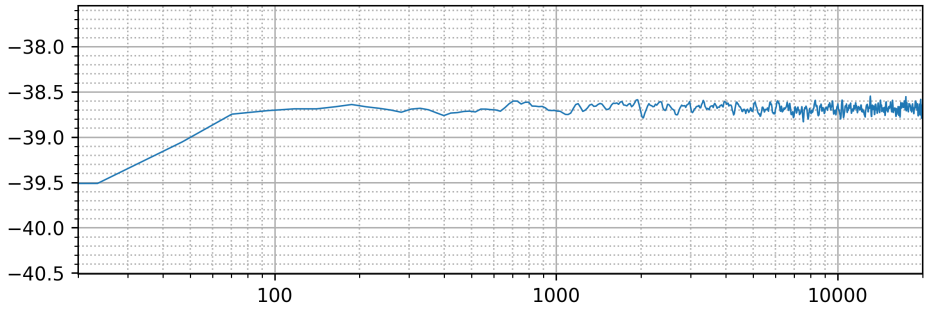


Figure 15: Boss FZ-1W

## 8 Measurements - Multi-pedal

From the above measurements we can see that buffer frequency response falls into three main categories: flat, minor falloff, and severe falloff. This section will measure the cumulative effect of stacking several of these buffers together.

First, a group of four pedals that all individually appear flat: DS-1, DS-2, BP-1W, FZ-1W

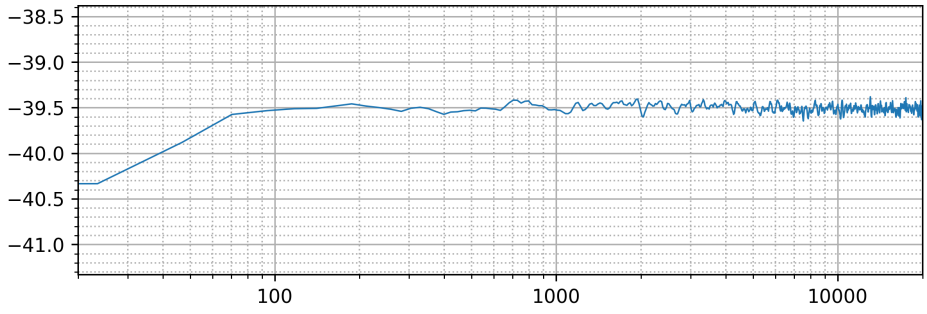


Figure 16: DS-1 → DS-2 → BP-1W → FZ-1W

Next, a group of four pedals that each have some minor attenuation in high frequencies: CP-1X, IR-2, BD-2W, DC-2W

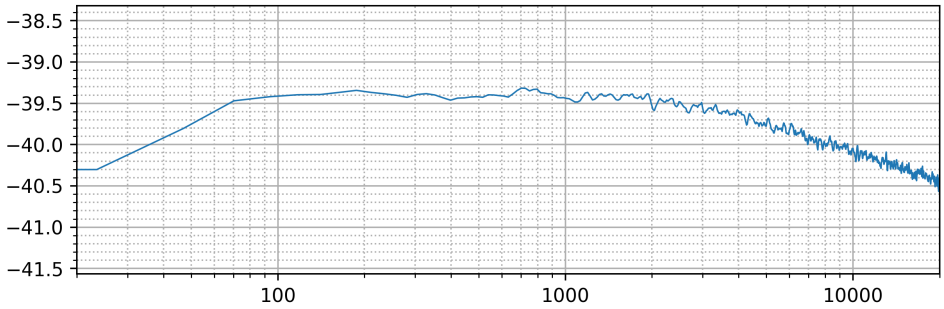


Figure 17: CP-1X → IR-2 → BD-2W → DC-2W

Finally, the four worst pedals. Unfortunately out of my twelve only two had the worst sort of behavior in the high frequencies, so to keep this chart 'fair' by measuring four pedals I'll also include the two worst pedals from the previous category: CP-1X, IR-2, LS-2, DM-2W

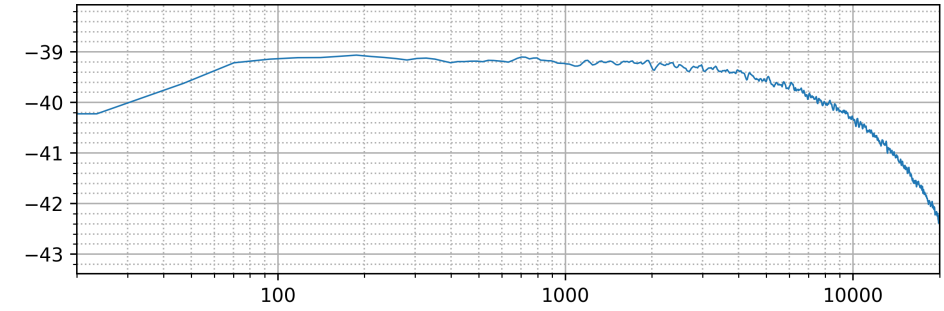


Figure 18: CP-1X → IR-2 → LS-2 → DM-2W

## 9 Bonus Measurements

Given the above information about Boss buffers, you may want to know if buffers from other manufacturers perform similarly. The only non-Boss buffered pedal I have immediate access to is the Tumnus Deluxe.

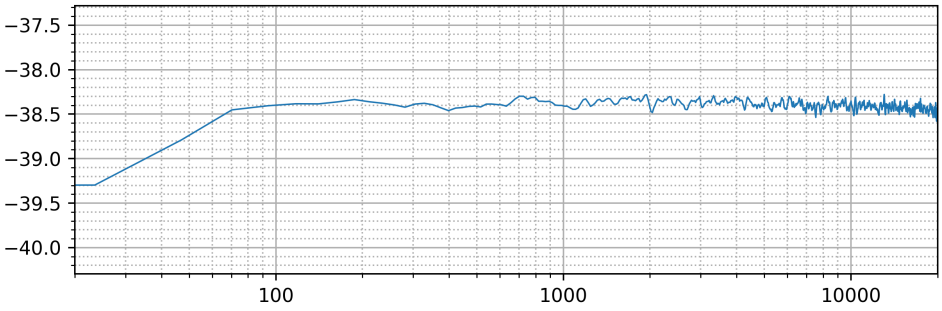


Figure 19: Wampler Tumnus Deluxe Buffer

I have also included measurements for a GE-7 with all switches completely neutral. Intuitively I would expect this to behave similarly to bypass so I think it is interesting to compare the two.

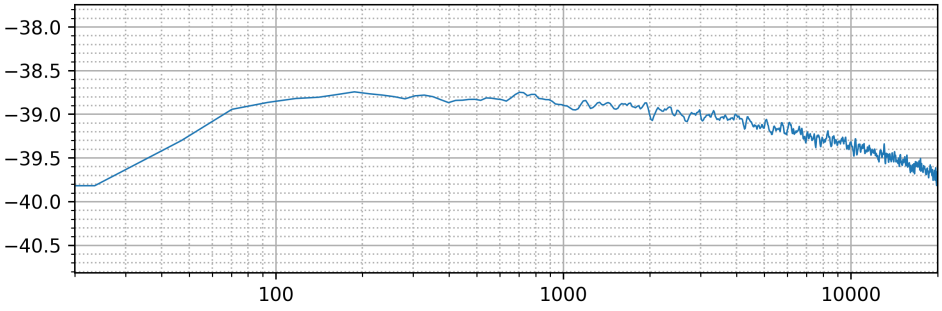


Figure 20: Boss GE-7 with neutral eq

## 10 Conclusion

The only behavior that is consistent across all of the buffers in the tested Boss pedals is that enabling a buffer results in a volume drop of about 0.5-1.0 dB. We can see the raw signal has a magnitude of approximately -38.0 dB and the buffered signal is generally between -38.5 dB and -39 dB.

Additionally, it appears that there is no measurable difference in quality between normal Boss pedals and Waza pedals, with the single worst performance going to the DM-2W and the humble DS-1 and DS-2 performing the best. Both Waza and non-Waza pedals contained a similar mix of good and bad buffers.

The frequency responses here can broadly be fit into three categories: completely flat, minor falloff, or severe falloff. You should take care when using pedals with a minor falloff to ensure you aren't stacking too many of them as the cumulative effect can become audible very quickly. Pedals with severe falloff should be routed around in your signal chain instead of set to bypass mode whenever possible.

This leads to something of a boring non-conclusion: Some buffers will suck a noticeable amount of decibels out of your high end and others won't. When in doubt, measure. Exceptional Waza Craftsmanship will not save you.