Rapaudiology VUs

Design Concept

The idea for my Rapaudiology VUs started when I added a couple of vintage Bach Simpson VU meters to my monitoring setup. I realized that I wanted more than one calibration setting for measuring average loudness, as I had been working on different projects at the time with various loudness targets (different mastering projects as well as mixing projects) and I wanted something that would be helpful, and not just something cool to look at.

At first, I thought someone must be making a VU metering package that I could buy, but the ones I found available were not exactly what I needed. One featured a trim pot on the back of the box that allows you to calibrate 0VU to be whatever you want it to be, and it has an attenuating switch that reduces the calibration level down -14dB for consumer line level interfaces, but that wasn't what I wanted. I also found a boutique maker of mastering grade gear that makes a similar VU metering package, and in addition to having a trim pot behind each meter, there's a switch that attenuates the signal -15dB in five -3 decibel steps. This offers more flexibility but being able to only attenuate in -3dB steps still seemed limited.

What if I simply wanted to audition a mix and turn a calibrating knob until the needle peaked at 0VU so that I could reference other mixes with similar sonics, study their dynamic response and be able to set three independent positions this way? After a few prototype circuits, I came up with exactly what I had in mind, and after working with them for months, I realized other audio engineers might also find them useful for their versatility and so, here we are.

I believe the reason why analog VU meters in this configuration haven't been made available commercially is because the resistance (impedance) a VU meter needs to send back to the circuit has to be "fixed" in order to fall within a certain specification outlined for an analog VU meter, so a switch attenuating the signal using fixed resistors like what is found on the units available commercially would accomplish this. A potentiometer, which is what I'm using for each position is essentially a variable resistor. Having variable resistance means adding flexibility to what you can calibrate these meters to, but if you wanted to play it safe and calibrate them to a standard calibration (like 0.775 Vrms for 0dBu or 1.228 Vrms for +4dBu on a 600 Ohm load), all you need to do is feed a 1k tone to the meters and measure the voltage of the signal with a voltage meter capable of measuring true RMS and adjust the corresponding pots for each VU. Another consideration when using potentiometers or "pots" instead of fixed resistors is that pots have moving parts and they typically have a low cycle lifespan of 50 - 200 cycles. The high-quality Bourns Pro Audio pots I used are rated at 100,000 cycles.

While researching VUs, I learned that it's technically wrong if VUs don't fall within their spec, but I also learned that many audio pros have been using them unconventionally for years (I also learned that some classic analog gear used unbuffered VU meters, possibly adding noise back to the signal). Many seasoned audio engineers don't care if their VUs aren't up to spec and calibrate them to non-spec values. Keep in mind that mechanical VUs are not the most precise tools for measuring

loudness anyway and that RMS as a unit of measurement isn't truly accurate for measuring audio loudness, so they should be considered an approximation of what that really means (in other words, trust your ears more than your eyes when using *any* meters). However, I found that after working with them "out of spec" for a few months over several projects that they are actually quite useful when setting them up in a way that makes sense for the audio job at hand and not based on a standard (and I suspect that other audio engineers have discovered this and have worked with them in a similar way for years). For example, I often master Hip Hop albums that have average levels that go as high as -5.5dB (RMS) and so it's easy to calibrate to this non-fixed value by feeding a 1k tone at that level and turn a position's knob until the needle is at 0VU. If I'm also working on a mixing project where the average level is -12dB (RMS), I can just calibrate another position to that value and simply switch to that calibration. My third position is usually set at a lower RMS value, about -8.5dB (RMS) usually for masters destined to be cut to vinyl, where we can get away with less limited/compressed masters to have a bit more dynamics (you know, like the good old days).

Another concern of an impedance mismatch when it comes to placing a pair of analog VUs across the main outputs is noise. Without a proper buffer, noise coming back from the meters' internal rectifiers could affect the monitoring signal, and while the noise may be minor or even inaudible, in a mastering chain, any noise is undesirable. A buffer amplifier placed in the circuit takes care of this problem.

I found a couple of VU buffer amplifier schematics designed around the TL071 op amp and built them on protoboard, but this was very time consuming. Luckily JLM Audio, a maker of boutique quality DIY audio kits and gear makes a VU buffer amp that includes a high quality PCB with excellent components that isn't too expensive. The layout is very clean and easy to build if you have the necessary soldering skills, so I decided this would be the way to go when building more of these metering boxes.

To help keep the cost of parts and minimize build time, I decided to skip building an integrated power supply and used a DC 12 volt plug pack to power the buffer amp instead. These are inexpensive and easily replaceable should it be necessary to do so in the future. A sophisticated power supply for a build like this would be overkill.

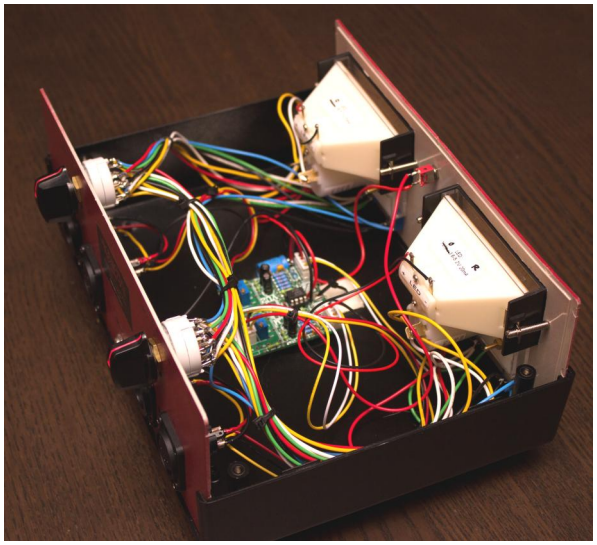
As much as I would love to build these metering boxes using vintage VUs, the truth is that they are hard to find and also expensive. VU meters are sensitive instruments and it can be a challenge to find a flawless working pair of vintage meters, but the good thing is that there are two alternatives: new "High End" VUs and new "Budget" VUs. Sifam makes the AL-29 at about $70 each (at the time of this writing) and for about half that, Nissei makes a very similar true AC VU that follows the same IEC spec requirements. To keep costs low on the units I will be building, I'll use the Nissei VUs but will offer the option to upgrade to Sifams should anyone want the absolute best new production analog VU meters available today.

One of the cool things about analog VUs is the amber glow of their lamps. New VUs come with yellow LEDs that resemble the amber glow of a vintage VU's 12V lamps. I thought maybe orange LEDs would look even better and had a few of them around. I optimized their current and really dug the way they came out. LEDs are a lot cheaper and have a longer life than the older lamps used in VUs, so this was a good improvement on the "cool" factor of analog VUs. After I got everything working the way I wanted, I got creative.

I put the position switches on the rear panel and it's pretty easy to access them from the front of the meters without having to look at them. The three calibration pots are placed under each meter (labled 1-3). The on/off switch powers the circuit as well as the LEDs. There is room to add an additional switch to power just the LEDs, but I figured most people would want them on while working with them (I know I do). For those who might want to work without them turned on at certain times, an additional switch to power/dim the LEDs can be a custom upgrade option.

I'm able to use a dedicated line source output from my mastering DAC to feed the meters so for my purposes, all I needed were XLR ins, but not everyone has this option. For those who can't spare an independent line source output for these meters, I added a "thru" connection so that the meters can be hung across the main outputs, before the monitor controller or monitor amp. The meters are completely bypassable and will pass signal through even when the meters are switched off. A cosmetic detail that took me some time to settle on was the choice of "gummies" under the meters. I know people monitor at levels that often shake console furniture, and wanted to minimize vibrations to the meters for those that will be placing these in close proximity to their monitors. I found a source of soft rubber conical feet meant to be used for speakers that worked really well. They look great but also help keep the box from sliding around your console and grip the surface they're mounted on quite a bit.

For knobs I found a source of NOS vintage knobs and have enough of them to build a few more meter boxes with them, so it's possible that the knobs will change from the pictures shown here if I run out. I wanted to give these a vintage look and was glad to have found these old school knobs. This inspired me to create decals that also have a vintage feel and used a 50's style font for them. I've been building and painting scale models since I was a kid and this was an opportunity to put those old skills to use.



Each unit will have a serial number assigned to them. Custom built units will have the option of including a "custom built for ____" personalized line on the serial number sticker, as well as a logo image placed on the front panel of the meters if desired. Painting, when done right, is a complex task. The paint needs to cure before applying the decals and after the decals have set, they are protected with a high quality Tamiya clear coat. Custom painting will also be an option for custom builds.

These Rapaudiology VUs are essentially a functional work of art for anyone out there that has a soft spot for analog VU meters, and are a great compliment to your ADC's peak meters. Analog VU meters have been used to measure stereo signals for decades. The ability to calibrate them to three independent levels that make sense to your style of work offers a versatile and unique way for measuring signals and analyzing average loudness during the mixing and mastering stages of audio.