Why A PWM Compressor

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There are many different ways to make a gain control circuit for an analog compressor
You can use a; tube, FET transistor, diode bridge, VCA, optical (light dependent resistor) or PWM (pulse with modulator). All methods have good and bad points about them. The undesired part of this can range from parts that are no longer made, sonic artifacts, extreme complexity or difficulty to build, costly control requirements, or just very costly parts. In designing a compressor with as little artifacts as possible, the gain control choices are limited. PWM has been used in vintage compressors and also modern devices. If one takes that idea and uses the latest technology it is possible the build a compressor with very little negative sonic artifacts. It should be noted that all electronic devices will add some distortion to the audio path. The ear hates some of these distortions and likes others.

The basic idea is that audio is energy, in electrical form when you are inside a piece of gear. In a compressor the gain control method needs to reduce this energy. A VCA lets a percentage of the energy through, determined by a control voltage (it is a variable gain amplifier, or voltage controlled amplifier). The problem is when the control voltage is changed there are undesired things that happen. The control voltage can leak into the audio path and the distortions that the VCA generates when the control voltage changes. The result is a dynamically changing distortion, plus control leakage adding up to an ugly sonic artifact. The faster the VCA needs to work, the worse this can become.

If you could operate a switch at a high enough speed you would be able to control the average energy on the output of the switch. This energy could also be feed into a simple circuit that would help make the average more accurate. If the switch was on 50% of the time and off 50% of the time, there would be 50% of the energy at the output of the switch. If it was on 10% of the time and off 90% of the time you would have 10% of the energy at the output of the switch.

The modern PWM gain control circuit design has the advantage of being able to use current technology, very high speed parts. They were not available 20 years ago or were very costly and power hungry. Components that can switch between off an on in less than 1nS, that are suitable for build a switched gain control element are now available.

With the switching element selected, a circuit needs to be built that will turn the control voltage into a variable width on-off switching command. This circuit is known as a pulse width modulator. In a PWM the width of the pulse, or the on time to off time ratio changes with the applied control voltage. With very careful circuit design and printed circuit layout it is possible to build a very accurate system with very low artifacts. The artifacts and be in the range -118 db with respect to the maximum signal level.

There are other decisions in designing a compressor; how complex the side chain or detector circuit is and weather it is a forward feed or feedback design, complexity and circuit types can be interrelated.

In a feedback design the output of the compressor drives the side chain and then the gain control element. If the circuit is well designed the compressor will work very well an act like a self adapting or self correcting gain control device. The circuits must be very fast, for a fast acting compressor, this is not easy to do.

The forward feed design requires calculating the desired gain before gain is changed. It requires a high degree of accuracy in this calculation and in the control voltage / gain reduction relationship, or law of the gain control element.

If a compressor's control circuit does not perform well, it will limit the performance of the compressor. But with out a very good gain control circuit, it is not possible to build a very good compressor. Pushing technology to its limits is a good thing. Copying vintage designs does not advance the sonic world.