Using The Kludge 509 Rotating Limiter

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1 Introduction

Thank you for purchasing the Kludge 509 Rotating Limiter. This dynamic processing device is a versatile tool for dealing with a number of situations where conventional compressors are unable to control peaks without distortion. It is hand-assembled in the USA with the finest quality components available today. It was many years of design before we got to the point where we were happy with the design and we hope that you also will be happy with it. It is entirely through-hole construction and primarily built with standardized parts so that should it ever fail, repair should be a fairly simple matter for a trained audio electronics technician. It is not disposable equipment designed to be used and thrown away, but a intended for a lifetime of use.

2 What Is This Crazy Thing?

The Kludge Audio Model 509 Rotating Limiter is a phase rotating filter combined with a very high speed limiter. The phase rotator makes an asymmetric waveform more symmetric so that it can be limited more heavily without audible effects.

This device is intended for taking very asymmetric waveforms, like those from brass instruments and some types of vocals, and limiting their peak levels down considerably without audible effects. Used more aggressively it can help create a "radio sounding" voice or to reduce tonsil sounds on vocals. It can also be of benefit to control the attack on bass guitar. Any place where you use a fast limiter, the Model 509 is useful, and the phase rotator makes it more useful.

Signal going into the 509 is first routed through the phase rotator and then through a very high speed limiter with a threshold control. Both the phase rotator and the limiter are bypassable.

3 The Phase Rotator

The phase rotator is a device intended for use in front of a compressor or limiter when dealing with asymmetric signal sources like vocals, horns, or close-miked strings. It was initially invented by Leonard Kahn in the 1950s and became a standard tool in the broadcast industry. However, it remains rare in the audio production world in spite of being quite useful.

There is only one control on the phase rotator section. The switch on the front panel bypasses the rotator filter when it is switched to the right, and passes signal through it when it is switched to the left. The rotation is not always helpful on all signals. Try it; if it does not make a difference or if you don't find the difference beneficial, switch it into bypass and just use the limiter. There is no rule saying you have to use all the functions on everything. It's there when you need it, and when you don't need it keep the switch to the right.

If the limiter is bypassed or the threshold is very high, then you may not hear anything at all happening when the phase rotator is put into place. The phase rotator is intended to be inaudible by itself although it may create a slightly more "rounded" effect alone. This point of the phase rotator is *only* to allow you to reduce the limiting threshold lower than you otherwise could.

3.1 How it works

The rotator is an all-pass filter that alters the phase of each component the signal differently depending on its frequency.

If a 50 Hz signal is passed through, it will come out with identical polarity on the output. But, if an 800 Hz signal is passed through it will come out with the polarity completely reversed.

An early beta tester noted that when the device was taken out of bypass mode, it sounded like the signal was "out of phase" or more correctly "reversed in polarity." It was, at some frequencies. At other frequencies it wasn't.

To understand why this is useful, you have to think about the consequences of this action in the time domain instead of in the frequency domain. If you have an positive-going impulse, it's made up a lot of different frequency components all lined up together, and once it goes through the filter, those components will no longer be lined up and that positive-going impulse is just as likely to come out a negative-going impulse.

If you have a waveform that has far more positive-going peaks than negative ones, or vice versa, the action of the phase rotator is to make the waveform much more symmetric. It doesn't just shift the center of the waveform, it actually restructures the components of the waveform to make them symmetric.

This doesn't make the sound any louder. It hardly has any effect on the sound at all, other than a slight smearing effect that we have tried to minimize. However, if the phase rotation is done before a sharp limiter you will find that you can do more compression and limiting of the wave before you get audible distortion because you are limiting peaks symmetrically on both top and bottom.

3.2 What if I Limit Before the Phase Rotator?

If you put heavy limiting before the phase rotator, the flat-topped waveform will go into the phase rotator and the flattened tops will be shifted to the side of the waveform instead of the top. This will make the distortion from the limiter more audible, and it will also increase the peak values of the waveform. We are unable to find any case when this would be useful and we think this would be a circumstance you would want to avoid.

In short: don't put a clipped or heavily-limited signal into the phase rotator. Start with the cleanest possible signal.

In general, you probably want to put equalization before the phase rotator, and dynamics processing after it. The inbuilt limiter makes it convenient to do. If you have material with extremely varying levels, a soft knee gainriding compressor on the input might be a good ideal to keep the level going into the Model 509 uniform, but avoid anything that might cause even light clipping beforehand.

4 The Limiter

The limiter is a broadcast-style limiter with a very fast attack, and it is a very hard knee limiter as well, again in the broadcast limiter tradition. The release time is preset but there are multiple release time constants and the speed of the release depends on the degree of limiting. An earlier model allowed the user to vary the release time but it turned out that nobody really did.

This is an opto-based limiter, but it's got a faster attack and a sharper knee than was ever possible with conventional opto elements. It employs a light source and photoresistor which are very different than the el-op compressors and limiters of days gone by.

The only control on the limiter, aside from the bypass, is the threshold control. Turn the control to the left, and the threshold is brought down to lower and lower levels. A light comes on as the limiter is operating.

4.1 The Light

The light does not indicate the amplitude of limiting. The light indicates the *area of the waveform* that is being clipped. This means that if you have a very sharp and spiky waveform like a trumpet, the limiter may be limiting the peaks down a tremendous amount without the light illuminating much at all. On the other hand, if you are limiting a bass guitar without much heavy peaks, the light may be quite bright withough much limiting action.

Sometimes, unless you are in very deep darkness, limiting action may be taking place without the light being visible at all.

Does this make the light useless? Not at all, but it means that you cannot avoid using your ears. Limit until you can hear the effect, keep that point in mind, and then back off or increase limiting from that point. Always keep in reference the point on the dial where you can hear the limiting taking place. Use your eyes and your ears together.

When in doubt, use the bypass switch. If you can hear any difference going into bypass mode, it is due to limiting action.

5 Hints for Use

6 Repair and Maintenance

The Kludge 509 is guaranteed against any failure resulting from defects in manufacture for a period of two years. We expect you will be using this device for far longer than that, however, and we provide depot repair upon request.

7 End Note

We are sure that you will be as pleased with this product as we are, and we are delighted to hear any comments about it. Please address correspondence to:

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