

Using The Kludge 506 Equalizer

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1 Introduction

Thank you for purchasing the Kludge 506 equalizer. This three-band inductive equalizer 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 technician. It is not disposable equipment designed to be used and thrown away, but a traditional design intended for a lifetime of use.

2 History

The 506 is a negative feedback loop equalizer, a design that dates back originally to the 1950s. Tremaine's classic Audio Cyclopedia describes the design but mentions it is of little use because the "benefits of feedback" (which today we'd call linearization) change with equalization. Amplifier stages in that day were very limited.

In the 1970s, very high gain IC and discrete transistor circuits became available and that high gain made this design very popular and it was used in a wide variety of mixing consoles and standalone equalizers. We first encountered this design in an application note by Bel Losmandy of Opamp Labs in 1975, but he was certainly not the first one to use it. The basic topology could be found in mixing consoles from Fairchild to MCI and was almost the universal equalizing circuit for a while.

As monolithic op-amps improved, by the late seventies it became possible to simulate inductors with active gyrator circuits consisting of inexpensive components, and consequently this design evolved into the modern negative feedback gyrator equalizer that is almost universal today. However, the move to gyrators very much changes the sound characteristics of the circuit.

The Kludge 506 is designed to be as clean and transparent as possible within the restrictions of the design, and as such it has the character of the best of the early-seventies equalizers without the grunge that many of them picked up due to the limitations of active circuits of the day.

I would like to thank the late Bel Losmandy who first introduced me to this circuit many decades ago and whose delight in electronics and cogent explanations of them a generation of young engineers.

3 Some Specifications

The coaxial controls may be a bit peculiar to people who are not used to vintage equipment. The inner knob controls boost and cut with a detent to lock it in the center, while the outer knob controls the frequency of the filter. Turning the outer knob all the way to the right disables that filter completely. The bypass switch on the top disables all filters (but does not bypass input and output electronics unless the mastering version of the equalizer has been purchased).

All of the frequencies are indicated on the front panel and they were all picked because they made the sounds that I found most useful. Turning the f The filter Q varies with the amount of boost or cut but does not vary with level; it will not do the Pultec thing where the signal affects the filter frequency. There are plenty of equalizers on the market that do that, so we didn't need to make another one.

The top and bottom filters are shelving filters of fairly wide slope; because they are wide knowing the filter corner frequencies is not particularly useful since the setting will not translate to another arbitrary equalizer. We put them on the front panel because people want to see them, however.

Yes, there is considerable overlap between the filters. This is deliberate, because the peaking and shelving filters have different uses and you may need to use both in the same range.

4 Using It

The center knob of each band selects the amount of boost or cut, and the outer knob selects the frequency of the boost or cut. The far left position of the outer knob disables that filter completely.

So, if you want a 3 KHz boost around 3dB, set the outer ring of the midrange filter to 3 KHz and then turn the center knob to the right for boosting, until you get around 3 dB.

If you're trying to remove something and you don't know what frequency it's really at, you may find it's easier to find it by boosting it and exaggerating it. Turn the center knob to the far right, then adjust the outer knob until the effect you're trying to get rid of is as exaggerated as possible. Then turn the center knob to the left from boost to cut.

That's all there is. It's three resonant filters. There are very few tricks you might need to know about, but there are some.

4.1 TRICK 1: THE AIR BAND

If the treble shelf is set on the highest setting, it has a turnover frequency of 24 KHz, turning it into an "air band" filter. Why is this useful if we can only hear up to 20 KHz? It has nothing to do with ultrasonics, merely with the shape of the filter. If the filter is set to be 12dB at 24 KHz, it's also going to be up nearly 6dB at 12 KHz, so what this gives you is a rising top octave that accentuates the highest of the highs and can give a more open and airy feeling to some tracks.

This is a powerful tool and like all powerful tools it can be misused. Be very careful of using serious high end boost on recordings that are being recorded by high sample rate converters; it can severely increase any ultrasonics in the original track. You can't hear the effect on the ultrasonics, but you can see it on the meters and it can eat into your headroom nonetheless.

4.2 TRICK 2: BOOST AND CUT

The highest frequency of the bass shelf has the same turnover frequency as the lowest frequency of the midrange peaking filter. By setting them both to these frequencies, boosting one and cutting the other, you can make a "bass profiling" filter to help make low frequencies set right with one another in a cluttered mix.

Philosophically, you will almost always find it more useful to cut rather than to boost. If you find yourself boosting heavily in one range, think about whether there is some range where you could cut to achieve the same effect. Making things fit into a mix invariably centers around what can be removed to keep them from occupying the same space. Always be thinking about what you can remove.

4.3 Don't Overload It

This device can boost a tremendous amount, and it only has finite headroom. This is not a problem with the device but is common to all electronics. It is possible to drive it into overload, but because it is designed to saturate rather cleanly, you might not at first notice that you are overloading it slightly. The fact that it is so clean and will boost so dramatically without annoying artifacts means that you may need to pay more attention to your gain structure than with some other equalizers.

Of course, if you're one of those people that likes to overload things, by all means go ahead and do so. Just be aware of what you're doing and where your levels are. Use your ears.

5 Noise

Before looking for noise problems, be sure that the noise is not in your original signal and is being boosted by equalization to make it more audible. This product contains extensive RF filtering to prevent noise from radio sources on the input and output connections. However, because it employs real magnetics, it is sensitive to stray magnetic fields in your rack. If you are encountering noise pickup problems on the lower bands, try moving the unit to another position in the rack, preferably away from the power supply. Every possible attempt has been made in the design of the inductors to keep the magnetic circuit closed and avoid sensitivity to induced magnetic fields, and you will find this unit to be much less sensitive to such fields than the classic designs of the 1970s. However, only so much can be done for field rejection.

If at all possible, locate this and all other inductive equalizers away from the rack power supply.

6 Repair and Maintenance

The Kludge 506 equalizer is guaranteed against any failure resulting from defects in manufacture for a period of two years. We expect you will be using this equalizer for far longer than that, however, and we provide depot repair upon request.

If you someday wish your own technician to perform repair work, all component parts are available from the manufacturer. However, aside from the switch assemblies, inductors, and film capacitors, all components are standardized noncritical items that can be replaced without difficulty. Any changes to the inductors and film capacitors are apt to make undesirable alterations in the sound so we strongly recommend replacing them with the originals. Full schematics and all parts are available from the manufacturer upon request to qualified technicians, as is some amount of assistance.

7 Modifications

As we have spent more than a decade adjusting this design until it produced exactly the sound we precisely wanted, we have some interest in making sure that sound is retained. Consequently we do not advise or recommend any modifications, nor will we provide any assistance to people wanting to modify the devices.

The network was specifically designed around a particular monolithic op-amp IC, the red-painted chip in the circuit. However, during design testing we specifically made sure that there was enough phase margin so that the circuit will remain stable with the Burr-Brown OPA604, which has similar input characteristics. We tested out a large variety of op-amp chips and found the red IC to be the most appropriate one. However, as the IC is socketed, if you wish to try an OPA604 in that position, it will do no harm. Note that we do not consider this an upgrade or any sort of sonic improvement. We merely offer the advice that it is possible because people keep asking us about these things.

8 Mastering Version

The mastering option sacrifices noise rejection in order to have a cleaner and simpler signal path. The output is produced directly from the output of the monolithic op-amp.

If you have purchased the -M or -001 mastering option with this device, the input is unbalanced with pin 2 used, and the output is impedance balanced with pin 2 driven. Aside from omitting the balanced input and output stages, some amount of RF protection is also omitted from the mastering version on the grounds that it should not be necessary in a highly controlled environment.

Note that with the mastering option, it is not able to swing full output levels into a 600 ohm load. This should not be a problem in a modern mastering signal chain but should be taken into account if transformer-coupled equipment is being used directly after the equalizer.

9 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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