

XVI: THE TOWER

Vacuum-Tube Preamp And Modulator

OPERATOR AND
SERVICE MANUAL



REV A SEPT 2025



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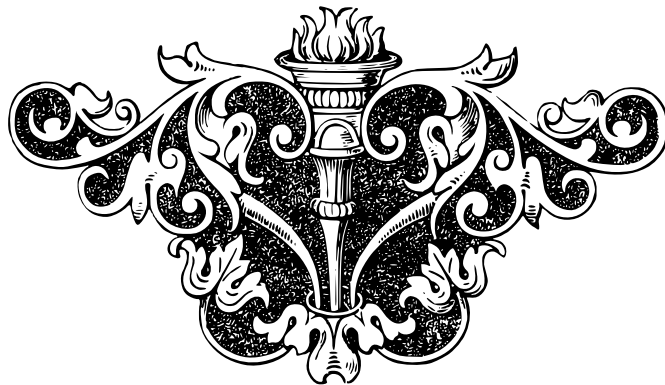
Special thanks to:

Eric Barbour

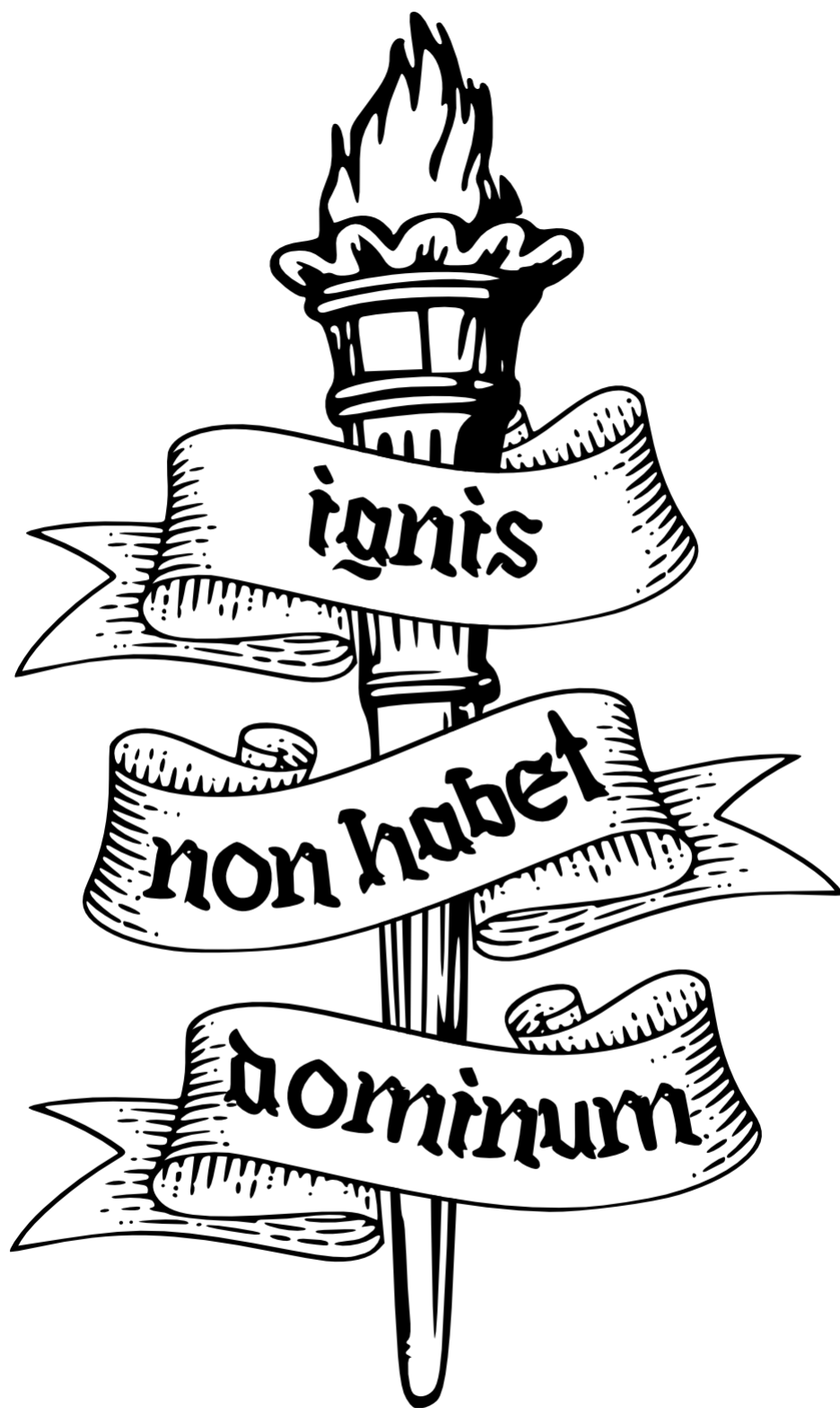
Unde Doug and Rusty on YouTube

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“Fire has no master”

Introduction

XVI: The Tower is an all-pentode effect that was designed to be weird. To make horrible, god-awful sounds that (more often than not) will have absolutely no musical value whatsoever.

It is the second original design of mine, the first being the Kosmo format 'XX: Judgment' module, which uses a ten volt filament version of the same 6LE8 that is the heart of this fucking crime against electronics

The 6LE8 (it also came as an 8LE8, 10LE8, and 15LE8) was originally designed to be used as a chroma demodulator, able to pull the chroma signal from the broadcast received by the television and push enough current to drive the red, green, and blue electron guns of a color television CRT directly. Hot shit back in the 60's

The tube is referred to as a 'twin pentode.' It is similar to other so-called 'dual control pentodes' such as the 6AS6. These pentodes are designed so that the suppressor grid can be used as an additional control grid (hence the name 'dual control'). The primary difference between pentodes such as the 6AS6 and the 6LE8 is the fact that, rather oddly, the 6LE8 has two separate suppressor grids and two separate plates

As is the case with the 6AS6, the suppressor grid is meant to be a secondary control grid - but here you have two of them, with a common number 1 control grid and common screen grid. One pair of elements (plate and suppressor) is meant to demodulate blue chroma information and drive the blue gun of a CRT, and the other pair is meant for red chroma information. To quote the datasheet - "The common screen grid provides internal matrixing of the red and blue information to provide sufficient drive to the green gun." To me, that sounds like a fancy way of saying 'mixer.'

The datasheet further states

"The characteristics of the 6LE8 are such that it may be used in either of two modes (1) the chroma information to grid number 1 and two phases of reference signal to the two number-3 grids or (2) reference signal to grid number 1 and two different phases of chroma information to the two number-3 grids"

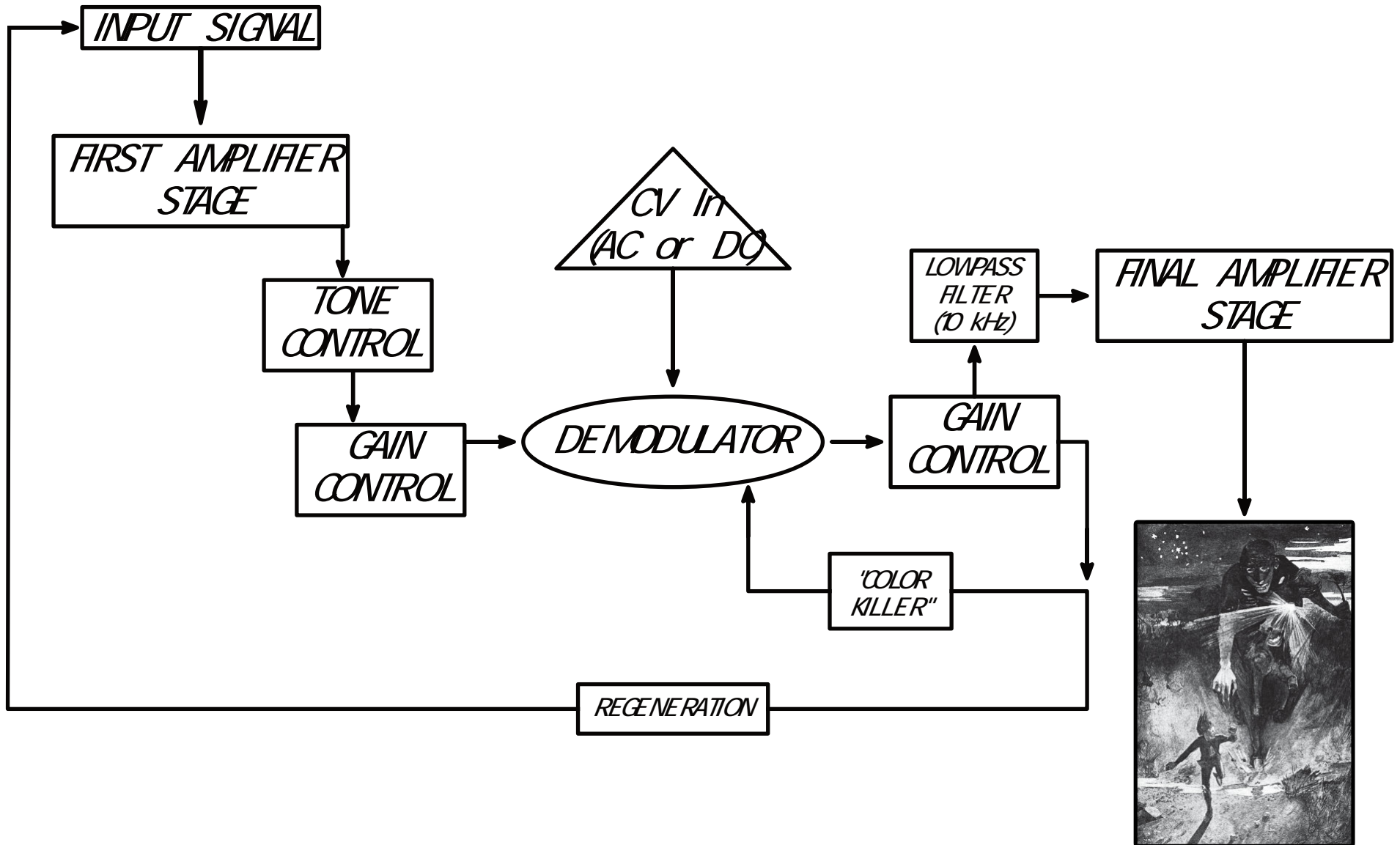
So, me, being the non-engineer, non-college-educated redneck that I am, immediately replaced the words 'chroma information' with 'audio signal' and the words 'reference signal' with 'control voltage or audio.' So that's what I did, and thus the Judgment module was pulled into existence, kicking and screaming.

I wanted to make a stand-alone version, though, in the same vein as Metasonix's TM series Boxes of pissed off, ancient electronics that howl and whine at the slightest provocation. So I took bit of inspiration (read: essentially copied) the first half of the Metasonix TM-7 Scrotum Smasher, using drawings posted by the owner of Metasonix (Eric Barbour) on the Modwiggler.com message board. I played with component values and got that bit working - my idea was to have two 6AK5 tubes feeding the 6LE8, with a high-passed positive feedback loop similar to the TM-7. I built the first version and it sounded gnarly but it wasn't exactly what I had hoped for.

Much like 'Judgment,' my idea was to have the input signal feed into the number 1 control grid. I thought that I could also send some of that signal to one of the two number-3 grids (I didn't entirely grasp the concept of phase cancellation at the time). I had both the plates tied together for a mono output. For the second number-3 grid I thought I would have a CV input. I had the idea that it would take the input signal, feed back into itself and take an external CV input and mix that in and just vomit out this contorted, unholy catastrophe of noise. That didn't happen, obviously. In fact, it sounded... fucking 'warm' A term I hate using, because it means nothing. But that's all it sounded like. It sounded like a boring, bog-standard 'tube preamp to warm up your audio' blahblahblah fucking barf.

I didn't touch the thing for a few months, maybe a year. After taking it upon myself to draw up all of the publicly available Metasonix TM and TX-series module diagrams I learned a few things. Studied some more. Then I went back to the Tower, tore it apart and rebuilt it. I completely changed the circuit and signal flow and now after several more iterations, I am proud to present my very own box of pissed off ancient electronics to the world. And you can build it, too! Probably.

Block Diagram



Regarding Power Supplies

I designed, tested, and intended for this circuit to work with a B+ voltage of 48VDC. This is low in comparison to most tube circuits, which often require a B+ voltage of at least 200VDC. You may get it to work at 12VDC or 120VDC but you will need to make adjustments that are beyond the scope of this document.

The power supply I used is a self-contained AC/DC supply from Meanwell. The part number is IRM-90-48ST. It takes 1.88A at 100-240VAC, 50 or 60 Hz directly and puts out +48VDC at 1.9A. It is fairly small and unobtrusive. As I built my Tower in an old test equipment enclosure, I had plenty of room to spare.

To get the roughly 1.4A of 6V required for the filaments I installed a 6.3V, 3A transformer in the enclosure. I used two 1N5401 diodes tied together as shown in figure 1 as a simple voltage dropping 'resistor' to bring the 7.5VAC I got out of the transformer down to around 6V.

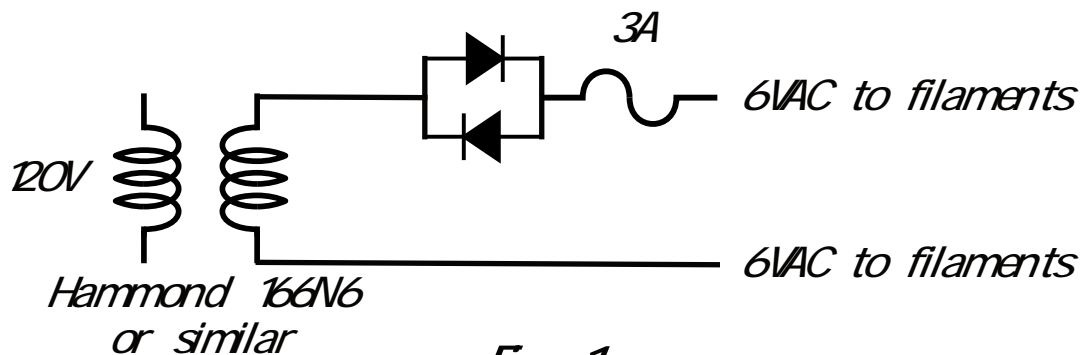


Fig. 1

As with most things, there are a thousand different ways you could get filament power and B+ voltage to the circuit. DC/DC buck or boost converters, switch mode supplies, linear regulators, etc. Most of the 'Nixie'-style SMPS boards available will work just fine without any added noise. I just used what I had in my parts bin.

Ultimately, I did what most designers seem to do - I left the power supply out. This serves multiple purposes. It is much simpler to draw, it leaves the question of power supply to the end builder to answer, and it tends to ward off anybody who wants to build this but doesn't really have the knowledge or ability to build it correctly and troubleshoot the circuit when it inevitably goes pear-shaped.

Is it gate-keeping? Yes, it is, but it isn't frivolous, nor is it born of any ill-intent. This isn't a hobby project in the same vein as, say, scrapbooking. Or whatever the hell normal people do.

Input and First Stage Amplifier.

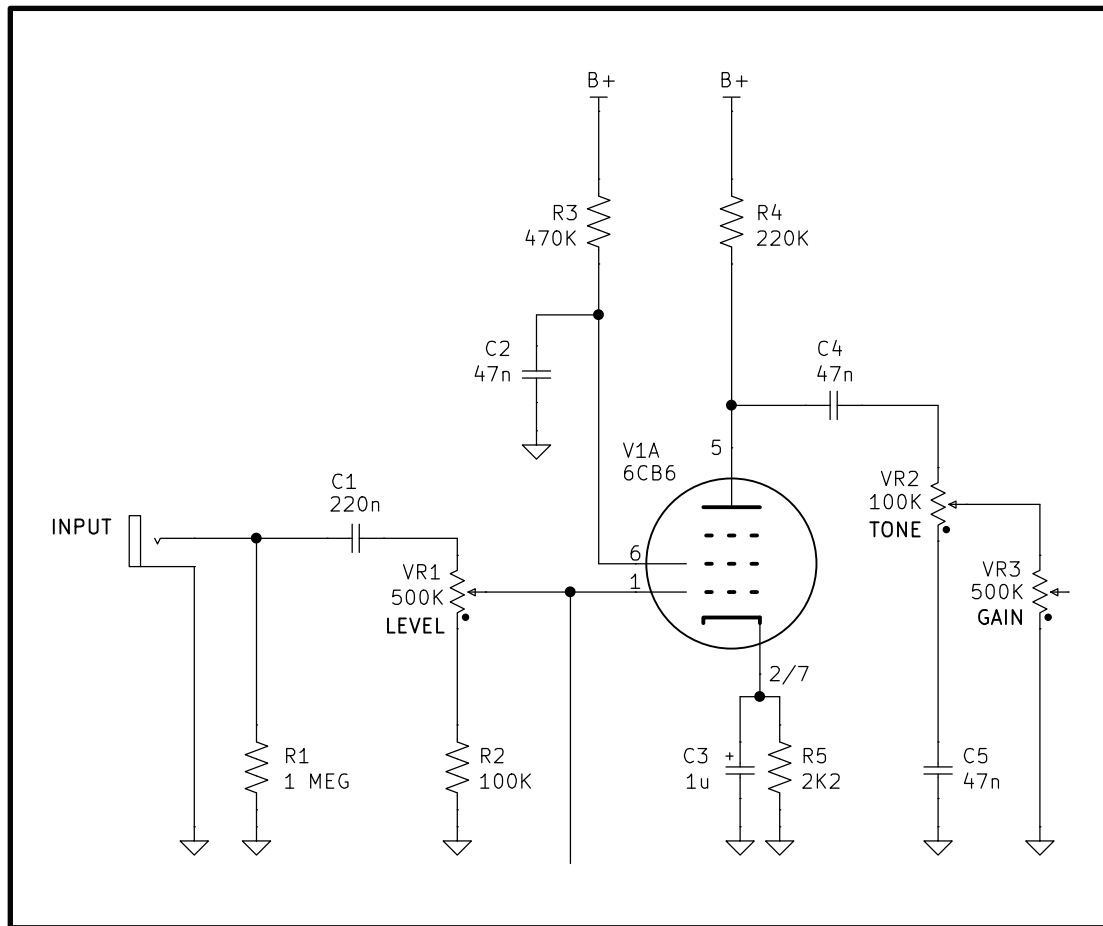


Fig. 2

I will not lie - the old adage 'good artists copy, great artists steal' has been taken almost literally in regards to this first part of the circuit. This input stage is entirely lifted from the Metasonix TM-7 Scrotum Smasher (and subsequently the TM-5 preamp). It is a shit resistance-coupled amplifier stage, and it is designed to be shit on purpose. Guitar nerds and hi- snobs would probably have an apoplexy if they saw this I mean, the plate current is only 222 fucking MICRO amps?! That can't POSSIBLY be anywhere NEAR the LINEAR REGION, RIGHT?!

Piss-taking aside - Component values have been changed based on my personal tastes and goals.. but also based on what parts I had on hand (it's a trans-dimensional chaos demodulator from hell, not the Space Shuttle).

For example, C1 in the TM-7 is 47nF, while I made mine quite a bit larger at 220nF. VR1 and R2 are sized differently as well. I chose 500K for the input level pot to give finer control, as the circuit can and will burst into self-oscillation and the character of destruction changes dramatically at seemingly random points. R2 simply shifts the adjustment band of VR1 by 100K, so the control range is limited to 100K when turned up all the way. This ensures a minimum grid leak resistance of 100K going into V1. On the TM-7, these are 100K for VR1 and 470K for R2.

The tone control serves two purposes in the *Tower* - it acts as a filter and, depending on how one sets the rest of the controls, it will change the frequency of self-oscillation and the frequency of any modulation added to the signal (but it's a *demodulator*, isn't it?).

Demodulator Stage.

In the interest of candor, I do not know exactly what is going on here, so I am going to make like an American prescription drug commercial and explain how I believe it to be functioning. At least the idea of what I want it to be doing.

Our now-amplified signal splits off to the CV jack and also to pin 9 (control grid 1) of the 6LE8. Going back to the datasheet, this is our 'reference signal.'

The CV input (at the top left) is a switched jack. Without anything inserted, the signal from the output of VR3 (Gain) is filtered, rectified via D1, and fed to pin 2 of the 6LE8. When CV (either audio or CV) is injected, that CV is filtered and rectified, and then fed to pin 2. The rectification keeps the negative swing of any CV signal from causing the tube to cut off and makes the whole thing work a lot better. This is one 'phase' of our 'chroma information.'

The two plates are tied together. Our 47K load resistor gives our tube a mighty 1.02 milliamps to play with. That's not much for a tube that has an average plate current of 17 mA specified in the datasheet. What this does is greatly impedes the tube's ability to 'demodulate' anything. It makes the demodulation effect erratic, at best. It's like asking someone with one arm to juggle. If you give the tube more juice, it is going to do its job better - which is exactly the opposite of what we want!

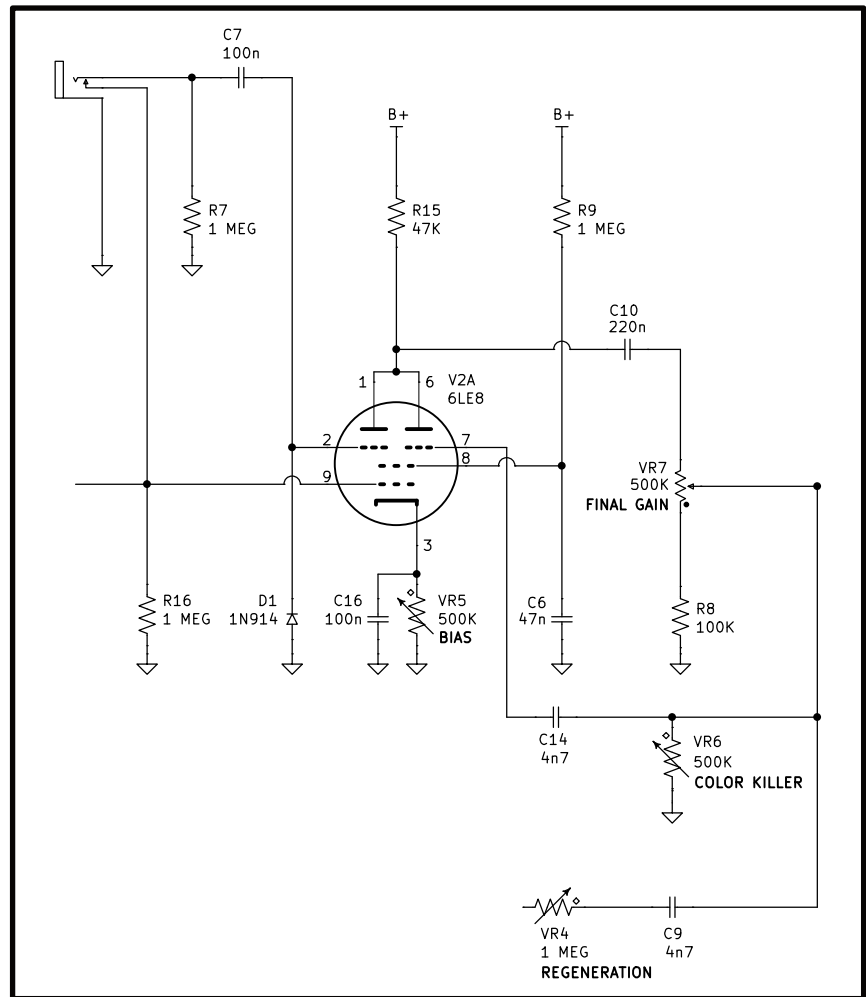


Fig 3

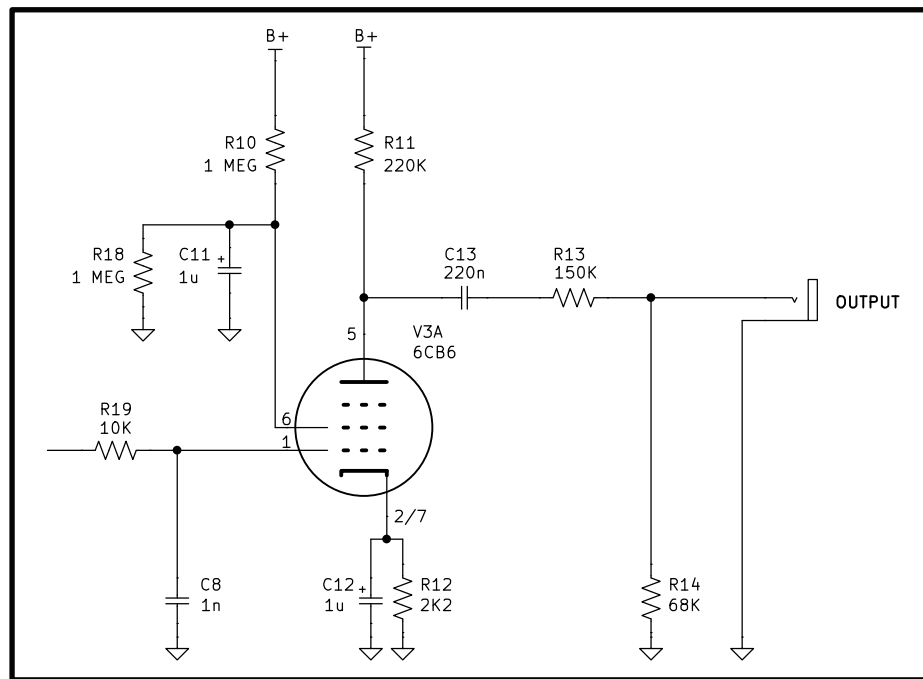
The output of pins 1 and 6 is fed through C10 and into another gain control (VR7) identical to the LEVEL control. After VR7, the signal is split. One leg goes into V3, and the other branches back as two feedback loops.

The 'Color Killer' control (VR6) is so named because it looks kind of similar to the color killer circuits used in old color televisions, and also because it sounds cool. In reality, it works with C14 as a high-pass filter. The sweep is absurd - 33862 kHz with VR6 turned all the way up and about 68 Hz with the pot turned down. The filter's primary purpose isn't to filter, though - it's to introduce phase shifts. This filtered signal is sent to pin 7 and is the second 'phase' of our reference signal.

VR4 is our positive feedback control. I used the term 'Regeneration' because it sounds cool. The signal, having had its phase inverted twice in the first two tubes, is back in phase with the input signal. This control, along with VR6 and VR5 (Bias) wildly alters the effect this entire thing has on whatever poor signal you passed through it.

VR5 does exactly what it says on the tin - it shifts the bias of the tube, which changes frequency response and the behavior of the entire circuit. C16 increases the overall gain of the tube, especially at lower frequencies. I experimented with this value a great deal, but any lower than 100nF tended to make a lot of AM radio noise and any higher had no notable overall effect on frequency response.

Final Gain Stage and Output



Since the previous two stages introduce a ludicrous amount of harmonics, oscillations and erratic noise to the signal that go into painfully high frequencies and beyond, I added a simple low pass filter with a cutoff of around 10 kHz at the input of the third and final tube, right after the gain pot.

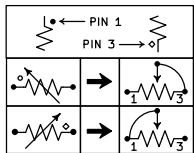
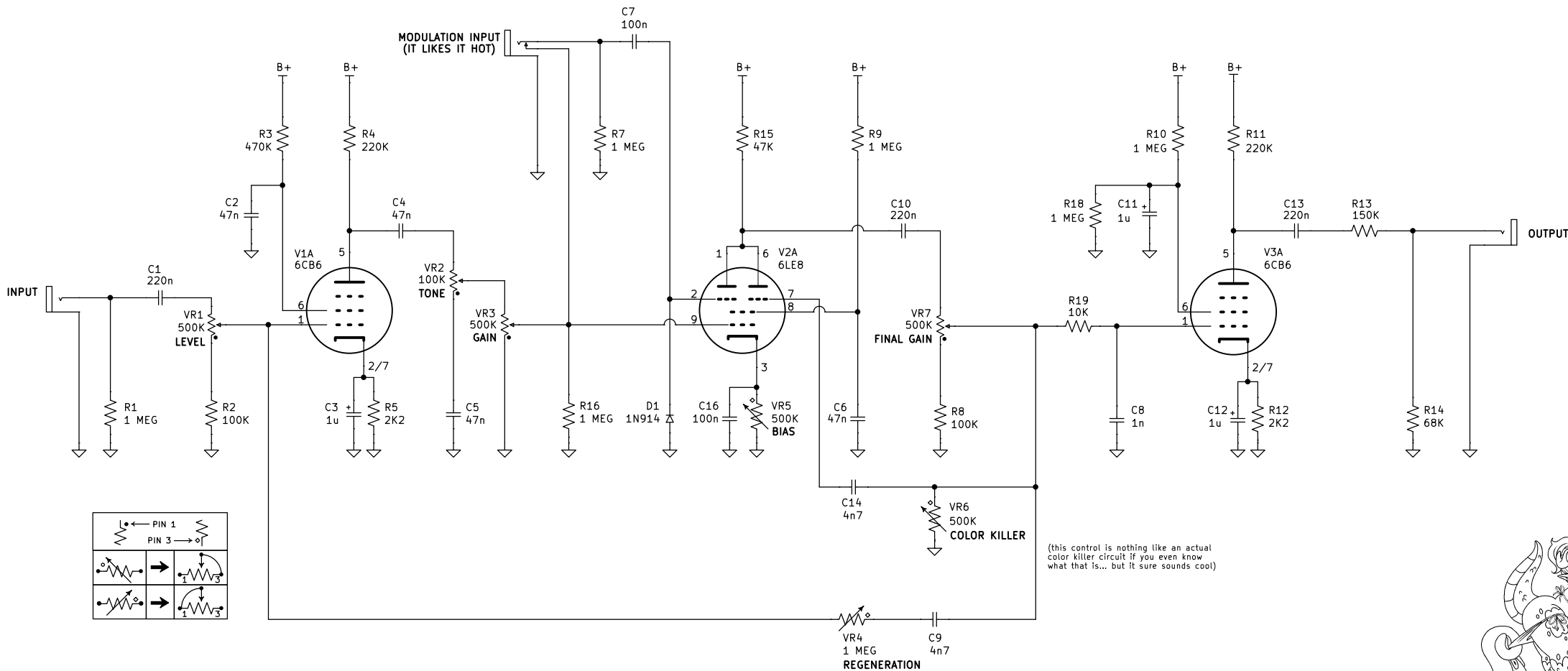
The rest of this portion is lifted directly from the TM-5/TM-7, with minor component value changes much like the first stage. The output is divided down via R13 and R14 to make one doesn't damage anything plugged into the output.

Tube Types

The tubes used for V1 and V3 are extremely negotiable. Several varieties of small remote-cutoff 7-pin pentodes, of the 7CM, 7BD, or 7BK base type, may be used to varying effect. Some suggestions would be EF95, 6AK5, 6AU6, 6X4 (6J1P), 6J1, 6BZ6, or 6AW6. Mind your filament draw.

V2 is non-negotiable. There are other 'twin pentode' types, such as the 6GS8 or 6HS8, but they are a different pinout and will not work. If you have those tubes and want to experiment, you'll have to rewire the socket (which isn't hard). Both the 6GS8 and 6HS8 are meant to be sync separator-dipper/AGC tubes and they use far less filament current than the 6LE8. There are also 'twin tetrodes' - such as the 8457, meant for use with battery-powered radio - which the enterprising experimenter may wish to employ, however they are rare and expensive.

EQUIPMENT BUILT FROM DIAGRAM AND OPERATIONALLY VERIFIED 26 AUGUST 2025



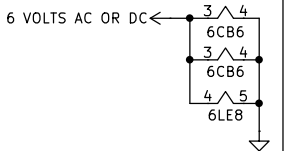
UNLESS OTHERWISE NOTED:
ALL RESISTORS SHALL HAVE A POWER RATING OF 1/2 WATT OR HIGHER.
ALL RESISTOR TOLERANCES SHALL BE 10% OR LESS.

ALL CAPACITORS SHALL HAVE A VOLTAGE RATING OF 63V OR MORE.
ALL CAPACITOR TOLERANCES SHALL BE 20% OR LESS.

6CB6 (most small-signal pentodes, but verify against datasheets)
filaments will pull about 300mA.

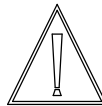
The 6LE8 filament is a HUNGRY motherfucker and will pull about 750mA.
Double that from a cold start for a few seconds before it warms up.

You are more than welcome to use the 10LE8 or 15LE8 instead for lower
filament current draw, but you will have to adjust your filament supply
accordingly.



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this equipment. Some experience with tube electronics is highly recommended.



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THE TOWER VACUUM-TUBE PREAMP AND MODULATOR.

Size: USLegal | Date: 2025-08-15

Rev: 3

KiCad E.D.A. 9.0.4

Id: 1/1

Unless otherwise noted:

All resistors shall have a power rating of 1/2 watt or higher and all resistor tolerances shall be 10% or less

All capacitors shall have a voltage rating of 63v or higher and all capacitor tolerances shall be 20% or less

CAPACITORS

REFERENCE	VALUE	QUANTITY
C1, C10, C13	220nF, FILM	3
C2, C4, C5, C6	47nF, FILM	4
C3, C11, C12	1uF, ELECTROLYTIC OR FILM	3
C7, C16	100nF, FILM	2
C8	1nF, FILM	1
C9, C14	4.7nF, FILM	2

RESISTORS

REFERENCE	VALUE	QUANTITY
R1-R7, R9, R10, R16, R18	1 MEGOHM	6
R2, R8	100K	2
R3	470K	1
R4, R11	220K	2
R5, R12	2.2K	2
R13	150K	1
R14	68K	1
R15	47K	1
R19	10K	1
VR1, VR3-VR6	B500K	5
VR2	B100K	1
VR7	B1M	1

ACTIVE COMPONENTS

REFERENCE	VALUE	QUANTITY
V1, V3	6CB6	2
V2	6LE8	1
D1	1N914	1



Tennessee, U.S.A.