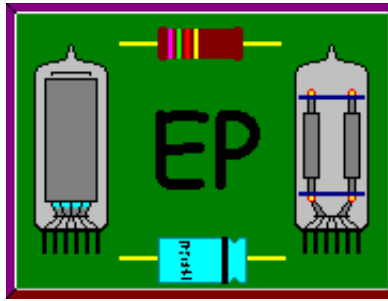


VFD Ring Modulator

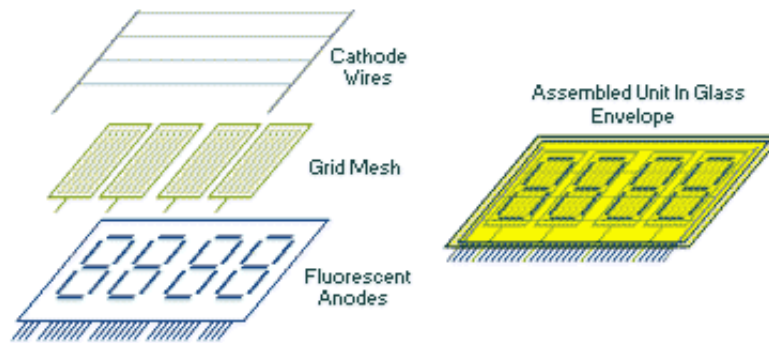


Here is a vacuum tube project that anyone can build, using easily available inexpensive parts, that involves no dangerous high voltages. Best of all, every part needed for this project can be obtained for free with a little ingenuity.



Vacuum Fluorescent Display (VFD) tubes

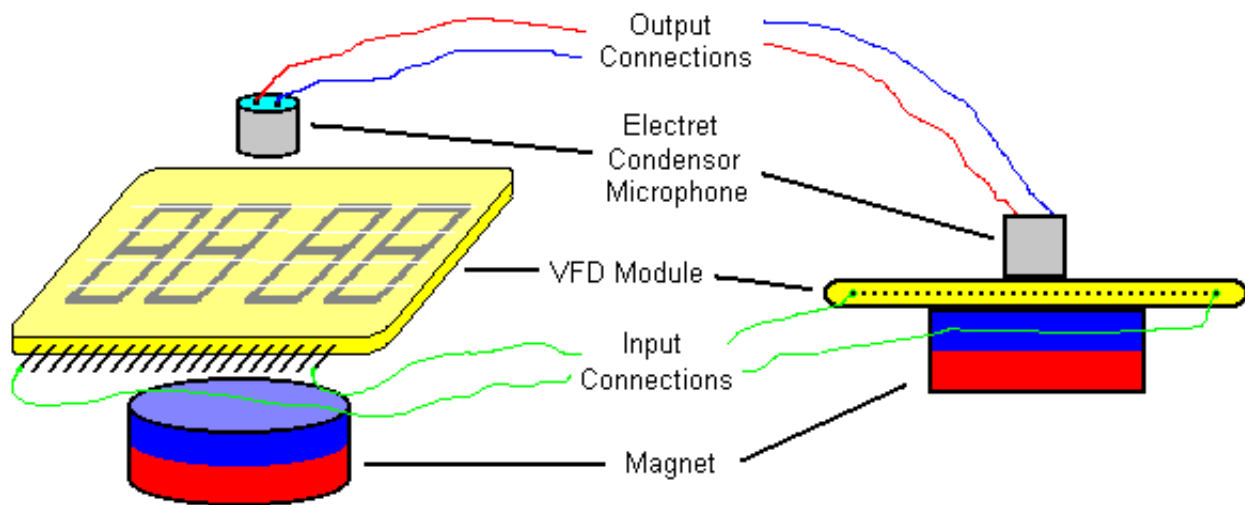
The heart of the ring modulator consists of what's called a vacuum fluorescent display tube. These glass tubes are used as displays in VCRs, tape decks, cd players, and microwave ovens, to name just a few.



Internal components of a typical VFD

These displays are actually a bunch of tiny triode tubes packaged together. In the front of the display is a self-heating cathode consisting of thin wires strung horizontally across the tube. Behind these are the grids, constructed of an extremely fine mesh that allows light to pass right through. In the back are the anodes, shaped in the desired display patterns and coated with a fluorescent paint, similar to the coating inside the face of a TV tube. In normal operation, electrons emitted from the cathode pass through the grids and strike the fluorescent anodes, causing them to glow.

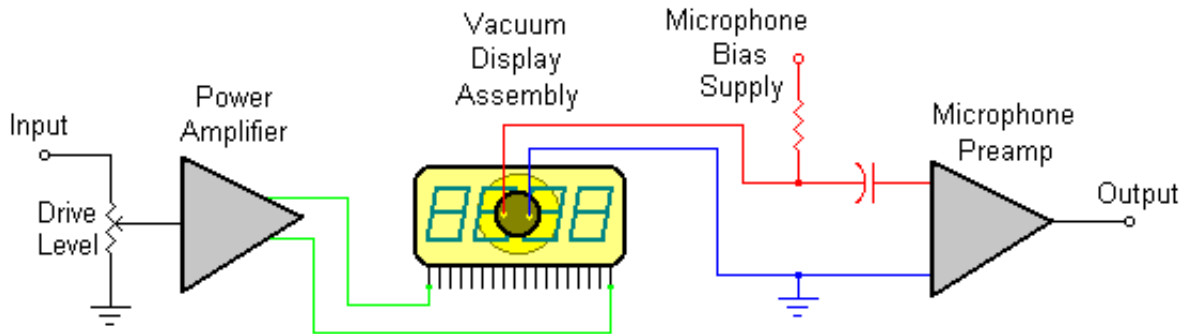
An interesting characteristic of VFDs is the mechanical resonance produced by the vibration of their cathode wires. If you hold one of these displays up to your ear and tap it, you will hear a ringing sound as the wires vibrate, much like the strings of a guitar. Different displays have different natural resonances, so each different type sounds unique. If we excite these wires with an audio signal, their ringing resonance will be "modulated" on to that signal, therefore we have a type of "ring modulator". ;-)



The basic VFD ring modulator

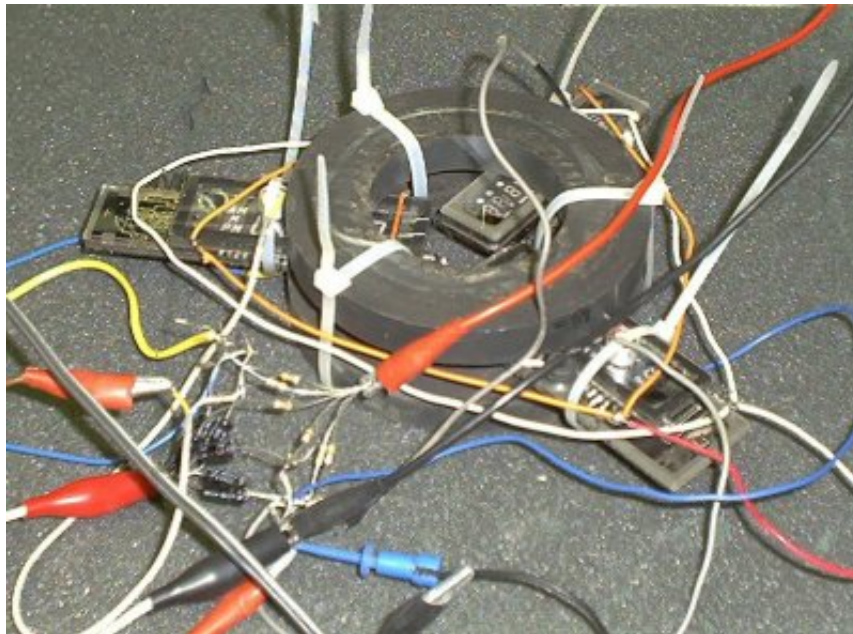
The cathode resistance of a typical VFD just happens to be in the range of about 4 - 20 ohms, a reasonable match for almost any amplifier. Connecting to the cathode is straightforward, as it is usually wired to the two outside pins of the display. This can be easily verified with an ohm meter. If an audio signal from an amplifier is connected across the cathode and a strong magnet positioned against the display, the cathode wires can be made to vibrate in a similar way to the wires vibrating the cone of a speaker. In fact, if you look closely, the vibration of the cathode wires is clearly visible! A small microphone element held against the display picks up the sound of these vibrations, and the whole assembly is then placed in a soundproof

box to minimise crosstalk.



Basic ring modulator wiring

A VFD ring modulator can be easily wired up using common audio components. More complex systems are only limited by one's imagination!



Multi-display modulator

This unit consists of six different VFD tubes wired together and sandwiched between some large woofer magnet rings. Using a variety of different displays and mixing their outputs together results in a wider, more interesting range of output sounds.

It's interesting to note that this entire assembly was built from 100% salvaged components. Magnets from old woofers, the bigger and stronger the better, displays from dead VCRs, CD players, etc, and electret condenser microphones from old portable tape units.

Here are some sound samples of the ring modulator in operation. Input is amplified square wave.

[rm1.wav](#) (129K)

[rm2.wav](#) (216K)

[rm3.wav](#) (129K)

An interesting effect can be obtained by increasing the signal level into the cathode until the wires begin to heat up significantly, causing them to stretch and the output frequency to drop!

[rm4.wav](#) (118K)

James Schidlowsky has composed some interesting drones using his own VFD modulator, an excerpt can be found [here](#).

For more information about salvaging and recycling electronic parts, see [here](#).

