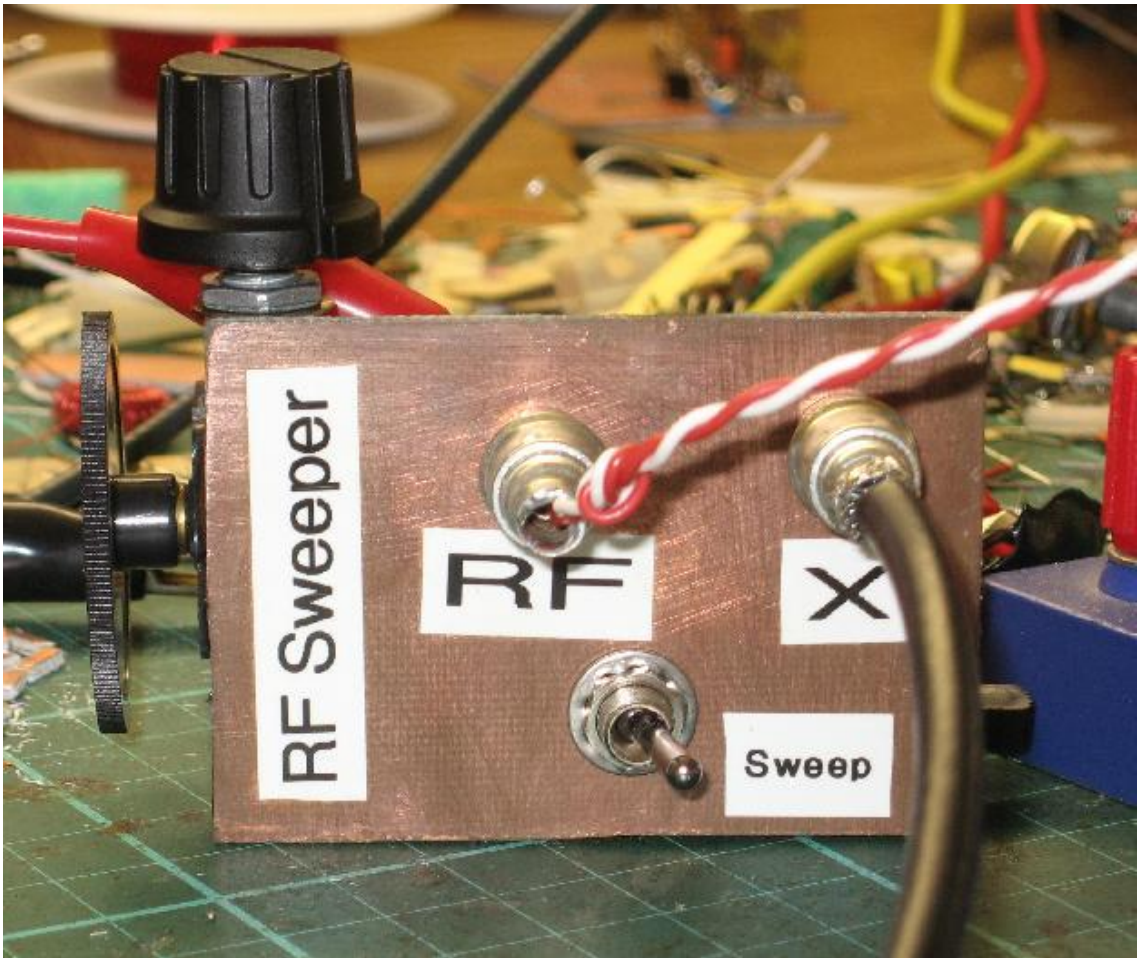
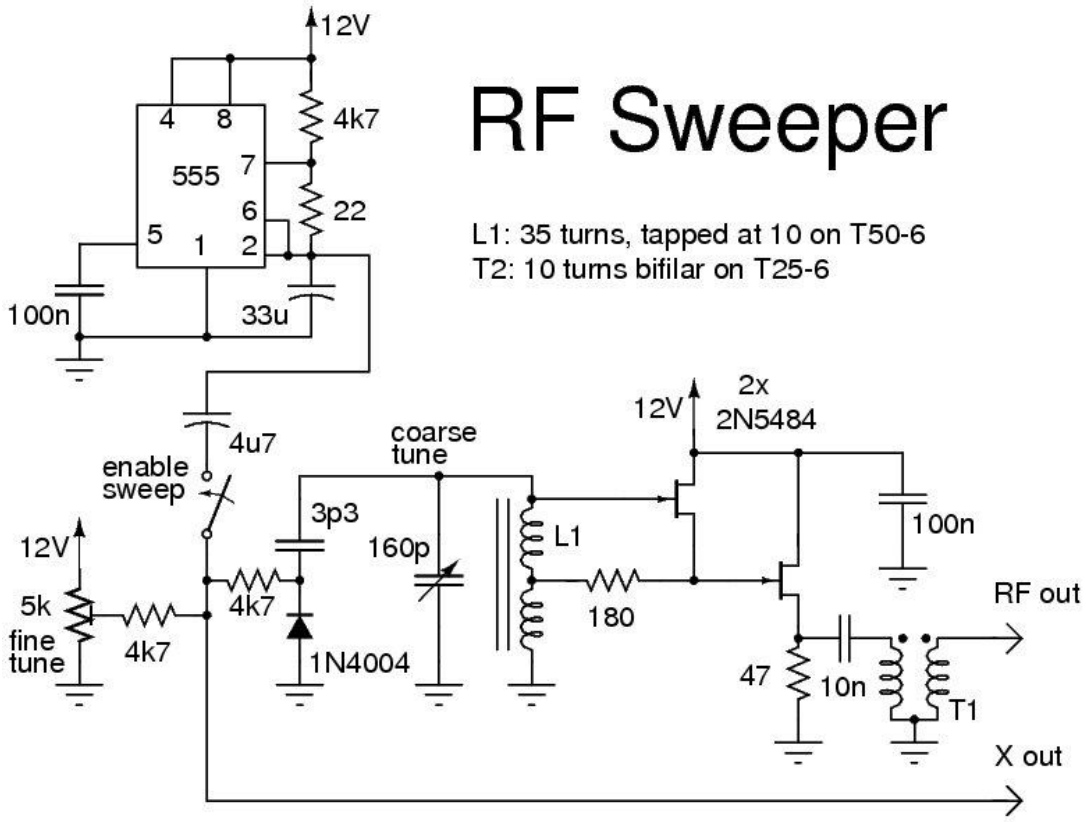
RF Sweep Generator

This simple tool has vastly expanded the kinds of projects I can undertake. My only recommendation is that you build it, or something similar. Without it making crystal ladder filters is next to impossible, and it finds other uses, like sweeping IF strips, filters, even antennas with the help of a simple resistive bridge.



For a long time I've been wanting to build an RF sweeper, the VK5BR one in particular still holds my interest. It is quite elegant with the calibrated width and external generator mixing. However, JF1OZL's unit is far simpler to build, it took me only 2 hours to hack together my copy. Despite a few drawbacks which I'll discuss shortly, it is one of my most useful pieces of test equipment.

The core of the circuit is a VCO based around your basic JFET Hartley oscillator. The oscillator is buffered once with another JFET and the signal coupled out via a bifilar transformer. The VCO functionality is implemented with a varicap diode, the timebase being a simple 555 timer IC.



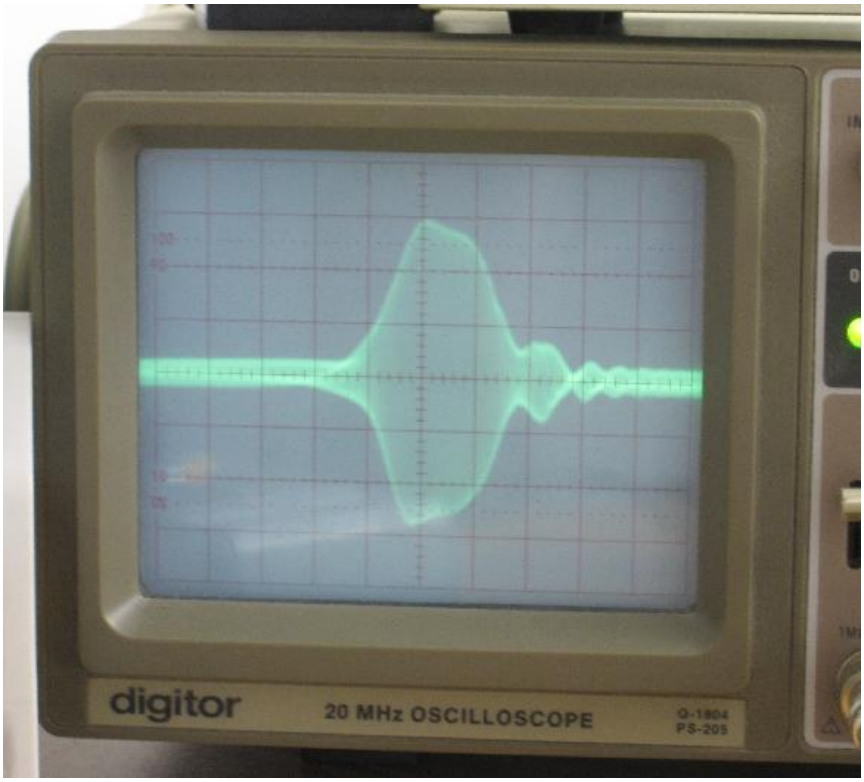
I used a 1N4004 as my "varicap" diode, and 2N5484 FETs. A plastic AM-radio tuning gang for the frequency adjustment. JF1OZL uses a pot for a fine frequency control, but only when the signal is unswept, I decided to arrange mine to bias the varicap at all times, and apply the timebase signal through a capacitor so the frequency swings either side of that set by the combination of the tuning cap and the bias on the varicap. Obviously this has linearity issues and width of sweep limitations, but the arrangement works quite well in practice.

My unit tunes 4.5 - 13.7 MHz with the values indicated.

If you need variable sweep width, or a wider sweep in general, you can replace the 3p3 coupling capacitor with a trimmer. If you require a more narrow sweep than can be provided by the minimum capacitance of your trimmer, pass the timebase signal through a 5k pot to reduce its amplitude before it is applied to the varicap (you may also wish to increase the 3p3 coupling cap and control the width purely by the amplitude of the timebase signal - you may also want to limit the range of the DC fine control signal to keep the varicap biased within a fairly linear region). Unfortunately this can not be directly calibrated in width, as the effectiveness of the capacitance varies with the main band-set capacitance setting. You could use a fixed frequency for the generator and add a mixer at the output to implement something quite similar to the VK5BR sweeper, which would then allow direct calibration of the sweep width.

I did not implement the additional output for a frequency counter. Instead I generally tap a 2-pole 12 dB pad at the 6 dB point and feed the counter from that. If I rebuild the unit, I will probably add an additional buffered output for the counter.

Here is the trace of a 11.98 MHz crystal filter I was tuning using the unit. The -20 dB width is about 4.5 kHz. You can determine this by turning off the sweep and using the fine tune control to rock the oscillator across the bandpass manually. Combined with a counter (and it is handy to be listening to the signal on a HF receiver) you can note the response and measure the circuit bandwidth.



Limitations

Retrace can be a problem, smudging the trace on the CRO. I think a blanking circuit would solve this, and could be easily implemented by taking the output from pin 3 of the 555 and using it to switch the RF output or the detected signal fed back into the Y-input of the CRO.

The oscillator buffering is insufficient. The load can pull the oscillator, at times quite badly. For example, crystal filters have been known to pull the oscillator so much it simply refuses to tune through the series resonance of the filter. The oscillator will jump more than 1 kHz over the "dead-short" region of the filter, going in either direction no matter how carefully you tune it. This is apparent even with a 12 dB pad between the generator and the filter. Fortunately this is fairly simple to fix, and it my silly choice of a Tx-6 core for the output transformer is largely responsible. This should be a FTx-43 ferrite core, not a powdered iron one. But the buffering should be improved, probably by adding another stage, BJT based I think, and an internal pad.

The trace isn't linear. The timebase wave-shape is 1st order exponential because the simple 555 timer circuit charges the capacitor via a constant voltage source. Implementing a better timebase with constant current charging (say an op-amp triangle generator or FET current source relaxation oscillator). This would improve the display by making a linear scan. However, this is only half the problem, the "varicap" isn't remotely linear, especially for wide scans. This can be improved by careful biasing after characterising the diode in question, and using relatively small voltage deviations to

approximate linear V/C characteristics. Obviously the rest of the circuit would need to be modified to support this. I just put up with the non-linearity, as shape is generally what I am looking at, not absolute width.

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