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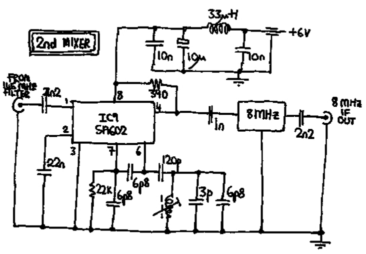
The simple man's Spectrum Analyser
2nd Mixer

{gallery}samixer2/1{/gallery}

The 2nd mixer is similar to the 1st mixer , in using the NE602 mixer IC with its internal oscillator. This time the

Again the controversial component is the coil. The oscillator frequency must be set reasonably precisely

{gallery}samixer2/2{/gallery}



The circuit of the 2nd mixer is shown to the left. 2nd IF filtering uses 3-terminal ceramic resonators. Mine are 8MHz types from the junkbox, having an unknown bandwidth. The 2nd mixer module includes one 8MHz filter, ahead of the main filtering which takes place in the [8MHz IF Filter module]. The filters could easily be replaced with similar types of different frequency. 10.7MHz filters are popular in consumer FM radios which always have a 10.7MHz IF frequency. Different frequency ceramic filters can be substituted without any circuit modifications other than retuning the oscillator to other than 153MHz. The difference to 145MHz should be the ceramic resonator frequency. Ceramic filters lower than 5MHz are probably not a good idea as the 2nd oscillator frequency will get close to the 1st IF and if it falls within the skirt of the 145MHz filter inadequate image rejection could become a problem.

How exactly is the frequency of the 2nd mixer local oscillator set to the required 153MHz? I said I wouldn't use a frequency counter, other spectrum analyser, or high bandwidth oscilloscope. Indeed I don't have any of those anyway. Once again, the signal generator and oscilloscope come to our aid. With the signal generator connected to the module input and oscilloscope at the module output, zero beat can be found.

In actual fact the presence of the 8MHz ceramic filter will cause amplitude peaks at 8MHz away from zero beat, however with only one filter in line the stop band isn't deep enough to render zero beat much reduced. On a 5MHz bandwidth oscilloscope, 8MHz signals are viewable, but the amplitude response is about half that at 5MHz, and even with the timebase on its fastest setting the sinewave is very squashed horizontally.

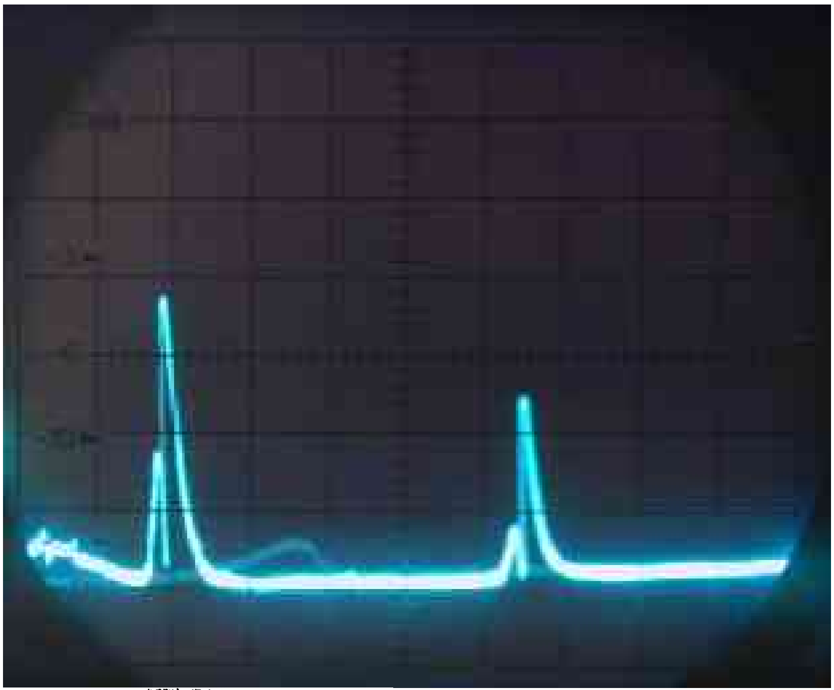
With this setup it should be possible to adjust the ferrite slug so that oscillation is near the 145MHz point. The signal generator can be tuned 8MHz either side of zero beat to see the peak in 8MHz signal amplitude at the ceramic filter's resonant frequency. Once the correct operation of the module has been verified it's advisable to box it and screw on the lid, since the proximity of the box can affect the oscillator resonance frequency.

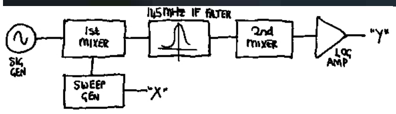
Alignment of the 2nd mixer local oscillator frequency to exactly 153MHz is the most difficult part of the spectrum analyser alignment procedure. The coil and/or capacitor values (I used 3pF in parallel with 6.8pF) might have to be changed depending on circuit layout i.e. parasitic capacitance. A variable trimmer capacitor could have been used instead of tunable coil, but it would be harder to adjust since the screwdriver would alter the capacitance, and also the adjustment would be highly sensitive because the whole range would be covered in just half a turn, whereas the ferrite slug is a multi-turn adjustment and relatively immune to screwdriver proximity affects.

After a certain amount of fiddling, the ferrite slug can be adjusted so that one 8MHz peak occurs with the signal analyser at 145MHz (which dial location is known), and the second 8MHz peak occurs 16Mhz higher in frequency at 161MHz. At this final stage the 145MHz filter module can be connected between the signal generator and the 2nd mixer module. Only the 145MHz amplitude peak at 8MHz should now be visible on the oscilloscope. Some very minor adjustment might be needed in case the signal generator wasn't exactly on 145Mhz when the ferrite slug was adjusted.

It's also a good idea to try to make a minor slight adjustment to get the oscillator frequency in the centre of the 145MHz filter passband. To do this, turn one way until the 8MHz signal abruptly decreases in amplitude, then turn it the other way until the signal drops out the other side of the 2MHz wide passband. Try to remember how much turning there was between these two sides, and set the ferrite slug in the middle of that range.

Now that's the hard part over with, and if the 5 modules constructed so far are connected together, a working spectrum analyser is the result and hopefully confirmation that all the hard work wasn't a waste of time! The module connection is shown below.





The result might be something like the image shown to the right. This shows the signal generator tuned to about 30MHz and the oscilloscope Y gain turned right up. The 90MHz 3rd harmonic is visible but sensitivity isn't good enough to show the 2nd and 4th harmonics. The resolution bandwidth is also quite wide and strangely notched, all things which will be tidied up when the 8MHz filter module is added, next.

Now with what amounts to a working spectrum analyser, the remaining modules are mere improvements, adding better resolution bandwidth, more amplification and filtering, step attenuator and crystal calibrator.