

## Spectrum analyser Low pass filter

Written by Hans Summers  
Wednesday, 16 September 2009 22:18 -

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**Low-pass Filter**

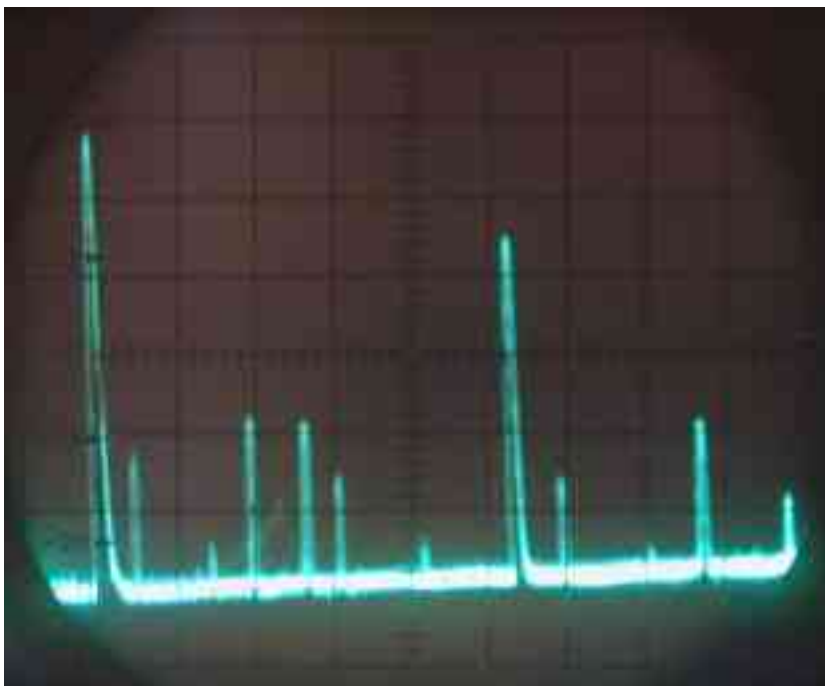
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## The simple man's Spectrum Analyser Low-pass filter

{gallery}salowpass/1{/gallery}



Up until now, the spectrum analyser display will look something like the picture here. Many small spurious peaks are visible as well as the "real" peaks. As the signal generator frequency

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is tuned, some of these peaks move across the screen extremely rapidly. Others move in the wrong direction, for example if tuning up in frequency, these contrary peaks move to the left of the screen.

The reason for these peaks is that all the analyser circuits are active until well over 300MHz. High harmonics of the desired waveform mix with the VCO frequency to the 145MHz IF and get through to the detector. Effectively we are viewing the spectrum from 145MHz to 290MHz, reflected in reverse around the 145MHz point. That's why a low pass filter is needed; in an ideal world it would pass everything below 145Mhz and stop completely everything above.

This filter is a 9-pole Chebyshev type designed for 1dB passband ripple. The 3dB cutoff frequency is calculated to be 120MHz, though in practice many signals above this get through as the frequency response is gradual not sudden.

Immediately following the filter is a wideband Silicon Bipolar MMIC (Monolithic Microwave Integrated Circuit) amplifier type MSA-0686. This provides approximately 20dB of gain, almost flat up to 500MHz. It continues to provide some gain all the way out to 6GHz! The 4-pin package looks similar to a transistor and is extremely tiny. Many different models of MMIC amplifiers are available and a similar gain type could be substituted here according to availability. The inclusion of this gain block greatly improves the sensitivity and dynamic range of the spectrum analyser.

{gallery}salowpass/circuit{/gallery}

The MMIC is best mounted on a small scrap of PCB stock approx 1cm square, with a cross cut in it using a sharp craft knife. I found out the hard way that layout of the MMIC circuit is extremely critical. Even 3 or 4 centimeters of wire at the input is too long and causes instability manifesting itself as wideband oscillations that fluctuate wildly when anything is in the immediate vicinity (e.g. the constructor's hand). For this reason, the 1cm square board holding the MMIC is mounted upside- down directly under the back of the SMA connector, see the right hand side of the photograph above. The ground connections (pins 2 and 4) at either end are soldered to the SMA socket and coax shield respectively. This arrangement proved successf though it does mean the MMIC is forever hidden from view.

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The coils can be air wound. 3 turns on a 5/16-inch bolt as former produces approximately 75nH inductance.

Each coil resides in its own compartment created by soldering PCB stock bulkheads between the sections.

{gallery}salowpass/2{/gallery}

Once the low pass filter is inserted in the signal path prior to the [1st Mixer](#) module, there is a massive though not complete reduction in the number of spurious responses visible.