# Software Defined Radio in Max/MSP

## *Tutorial 3 – FM and Audio Filters*

November 17th, 2011

For hardware setup information please refer the first tutorial in this series.

Open the patch: **basicSDR3.maxpat**



Note the steady progression of feature bloat. Click the speaker icon [ezdac~] to start the audio. Then click on the first example preset button to hear an FM weather radio broadcast at 162.5 MHz.  Try adjusting the frequency offset (tuning) slider. Then switch to FMW mode and try the same thing. Also try adjusting the noise filter slider. Toggle the noise filter r/s (type) button. Hear any difference? I don't.

Now click on preset 2. Toggle the notch/peak filter. A hidden carrier is revealed. Turn the notch/peak filter back on and adjust the frequency slider and width slider. Warning: before turning *on* the peak toggle, lower the AF gain a bit. Thanks.

Click on preset 3 to hear your favorite song again. Turn on the hum filter to make it sound small. Then adjust the slider to restore the fat.  I promise this is the last time we'll hear this vocal masterpiece.
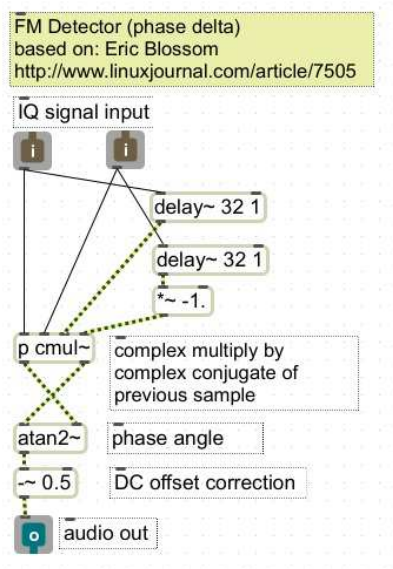
Click on preset 4 and move the noise filter slider all the way to the left (off) Then try moving it all the way to the right. Notice how the resolution diminishes along with the noise.

## FM Detector

Double-click the [detector] subpatch to look inside. The FM detector should look similar to this one:



The FM detector calculates the derivative of phase change from one sample to the next. This type of detector is called a differentiator. If it seems more complicated than AM, it's because it really is. It's also tough going for the Max signal processing engine; if you hear buzzing and crackling that gets progressively more annoying, toggle the master audio button.

The FM Wide mode uses the same detector with a much wider filter prior to detection. Did you notice that the mode selector button now automatically sets filter width and scale? Look in [filterSettings].

## Notch/Peak Filter

Double-click the [notch_filter] subpatcher, then Double-click the [notch_filter_engine] patcher to see a graph of the filter.
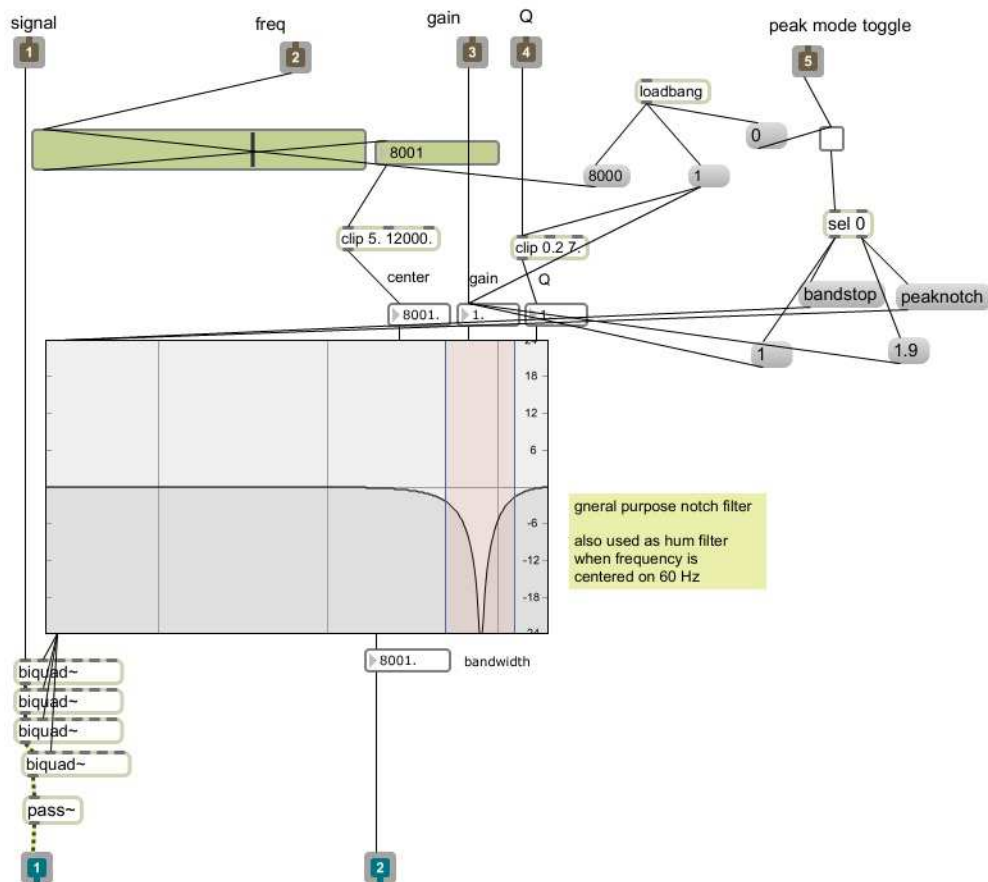
As you found out earlier, the notch filter is useful for removing carriers and other frequency specific interference.

## Hum Filter

Hmmmm… Isn't a hum filter just a notch filter set to 60 Hz?

## Noise Filter

The noise filter has two options: [rampsmooth~] and [slide~]. It smoothes out variations from one sample to the next. This can be effective on static. As you discovered earlier too much filtering decreases resolution.

## What's Next?

We've built a fully functioning receiver except for one small item. The next tutorial demonstrates device control for the Soft66LC2 and Funcube. Even if you don't have these particular devices it's worth a look. Please send comments and questions to radio@zerokidz.com