Ramped PSK

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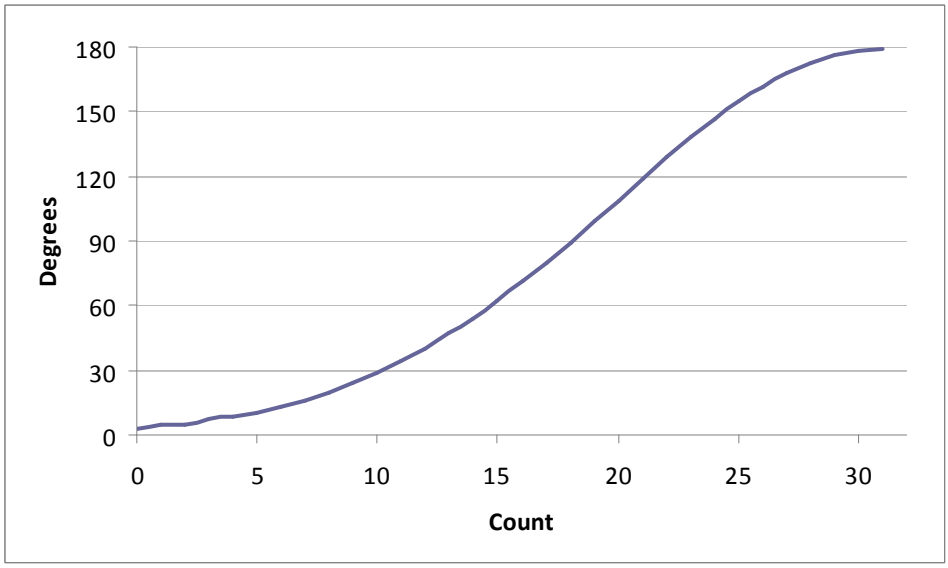
On the LF bands Binary Phase Shift keying is occasionally adopted for coherent low noise signalling – most recently in conjunction with the ***EbNaut*** software. The majority of LF transmitters require constant amplitude signalling, so for easy generation, the PSK has to be hard switched and the resulting switching sidebands just accepted.

One way round this is to ramp the phase from 0 to 180 degrees, or back over a period of a few milliseconds. This slower change in phase reduces the sideband energy, lowering the possibility for interference, and with less stressing of components in high power PA stages (hard switched PSK generates a very noticeable audio click in my PA and antenna loading coil)

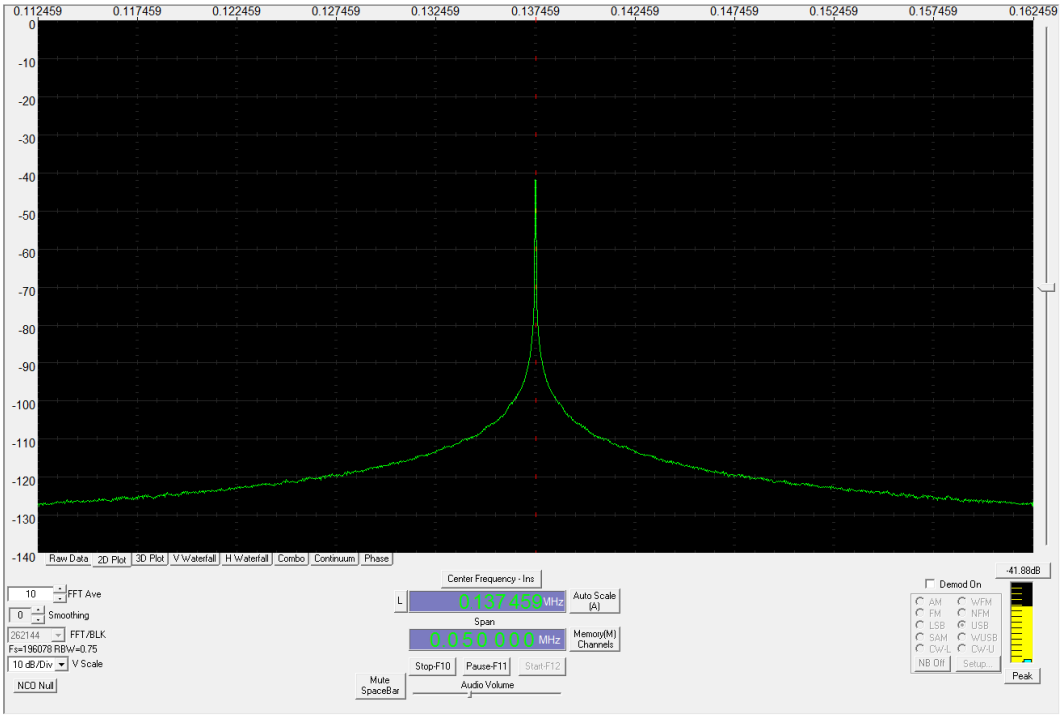
One ramp shape adopted for the purpose is the Gaussian curve shown below.



Comparison Spectra for Both PSK types

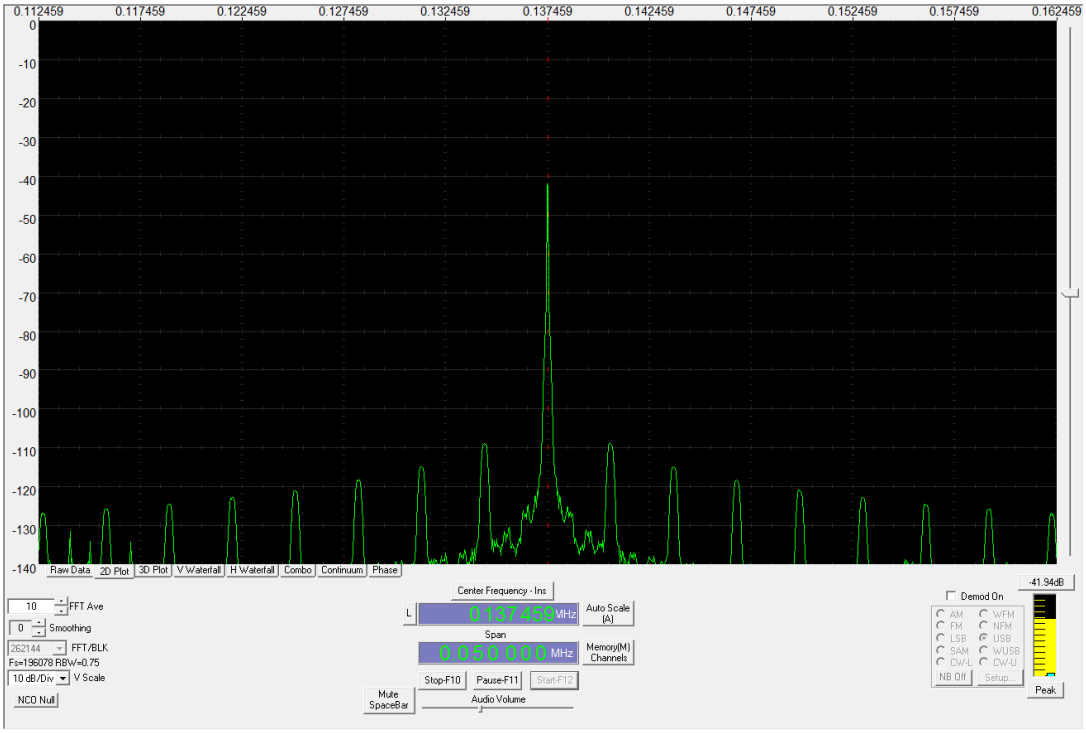
The two plots below are both generated using a random series of 0/1 transitions at 0.2 seconds per symbol (5B/s), generated using the ***EbNAut*** software. Amplitude of the carrier remains constant throughout

The first plot shows hard switched PSK, where the carrier phase is flipped 0/180° depending on the state of the control line.



Hard Switched PSK

For the second plot, the phase of the carrier is ramped from 0 to 180° (or back) using a Gaussian shaped curve, taking approximately 10ms duration for the ramp to complete. The ramp is generated by reprogramming the phase register in a DDS with 32 values taken from a lookup table. Each step is approximately 300us long and it is this step duration that is the reason for the discrete peaks at roughly 3kHz spacing.

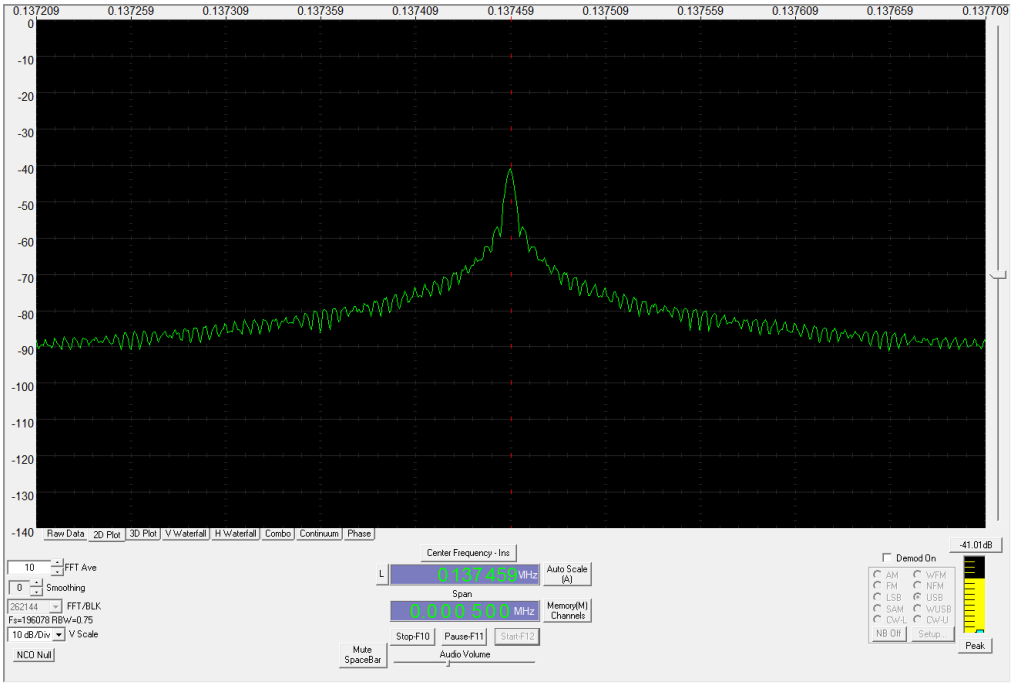


10ms long 32 step Gaussian Ramped PSK

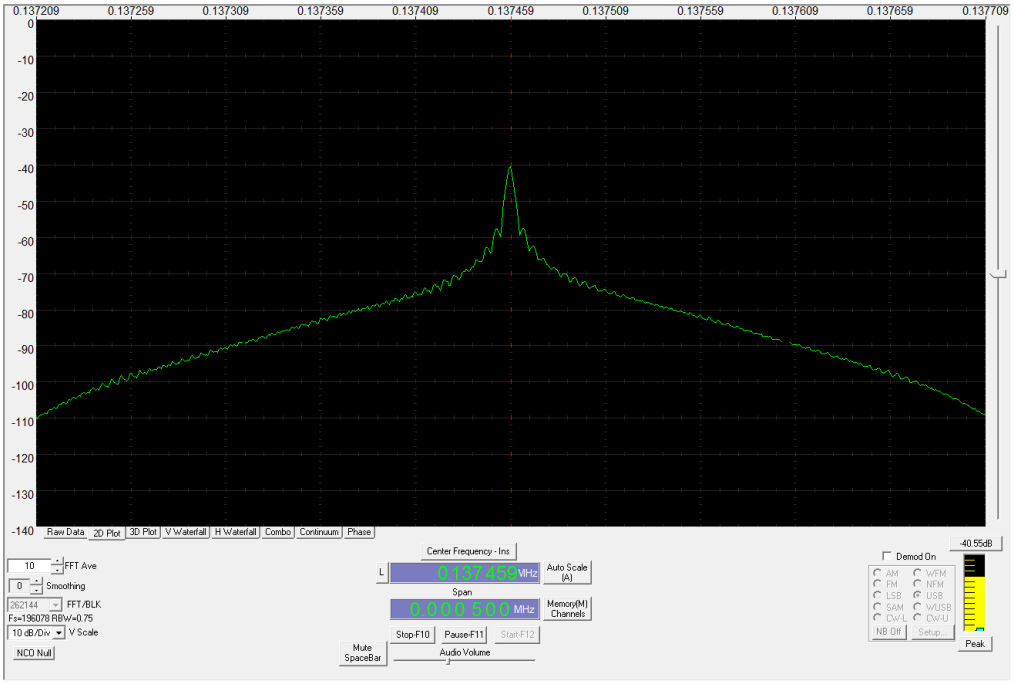
In both cases the peak value of any sidebands is roughly equal for both. The difference is that for hard switched PSK this maximum occurs at all spacings from the carrier, whereas for the ramped PSK waveform it occurs only around peaks every 3kHz. Thus the total amount of energy in the sidebands is considerably reduced, even though its worst case peak stays more-or-less the same at any given spacing from the carrier.

If a faster and higher resolution for the ramp could be adopted, the sidebands would move outwards with a corresponding reduction in total sideband energy.

Close In plots



Hard Switched BPSK, 0.2s symbols in 500Hz bandwidth



10ms 32 step Ramped BPSK