

# NOTE ON THROUGH-ZERO FM

I have recently gotten credit for some work on through-zero frequency modulation which was not really mine. Fine! I did SOME of it, and most recently (Dec. 2010) Electronotes 206 did a thorough study (to MY satisfaction) using Matlab of some nagging issues.

<http://electronotes.netfirms.com/EN206.pdf>

So who gets most of the credit?

First of all (in time), Bob Moog. In his classic (I mean CLASSIC) 1965 AES paper, he spoke of using FM for “clangorous” sounds. About 1973, John Chowning presented a digital version of FM in an AES paper, and certainly talked about negative frequencies in a limited context. Later Bob returned with his frequency shifter design, and a full-fledged notion of modulating through zero.

In our own publication, we were looking for simpler implementations (see references in EN206 above link) and one was by Jan Hall, a multiplier-based design. But the most useful (cheapest!) idea was that from Doug Kraul who modified a traditional VCO design and used a flip-flop to “remember” which way the oscillator was modulating. A classic “I wish I had thought of that” moment for many of us.

My own contribution (in addition to dressing up the VCO)

<http://electronotes.netfirms.com/EN129.pdf>

was to press the view of a negative frequency as a time reversal (which may not have been mine originally) and to finally, in EN#206, point out that there is no problem with two simultaneous “reasons” for the VCO to reverse direction, which some had continued to see (but I guess not hear!) as pathological.

So, the most credit belongs to Bob and Doug.

Bernie            Feb. 2012