Supply-Modulated Power Amplifiers for Amplitude Modulation Radar Transmitters

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Traditionally, radar transmitter power amplifiers are biased in Class-C to amplify rectangular envelope pulses. The reason for this is that Class-C is inherently self-modulating and is an efficient class of operation (Skolnik, *Radar Handbook Third Edition*). The problem with this mode of operation is that Class-C is nonlinear and creates a large amount of harmonic content. Additionally, rectangular pulses create high spectral side-lobes because of their sinc shaped spectrum. The combination of these two factors causes significant spectral pollution. With the current regulatory environment, there is a push towards significantly reducing this pollution. An additional factor that motivates spectral confinement is reduced radar detectability.

The challenge for new radar systems is to reduce this pollution while maintaining the efficiency of a Class-C amplifier. One approach to solving this problem is to use a Gaussian shaped pulse, which has much lower spectral side-lobes than a rectangular pulse. To address the efficiency, supply modulation can be used. Our approach is to use a resonant supply modulator to impart the Gaussian shape to the pulse, much like Envelope Elimination and Restoration (EER). The supply modulator is an LC circuit with FET switching for pulse shaping. With this configuration the drain voltage is zero between pulses thus eliminating the current draw, even for Class-A power amplifier operation. Our measurements show that we are able to achieve an average PAE of greater than 60% over the course of the pulse with a Class-AB power amplifier bias. Also, all harmonics are less than -38 dB relative to the fundamental. Our work covers both S-Band and X-Band with peak output powers of greater than 5 W.