Envelope Tracking and Pure Signal

Envelope tracking is an advanced method to increase efficiency of linear amplifiers. The PA supply voltage tracks the RF envelope. Depending on the amplifier devices efficiencies of more than 80% can be achieved.

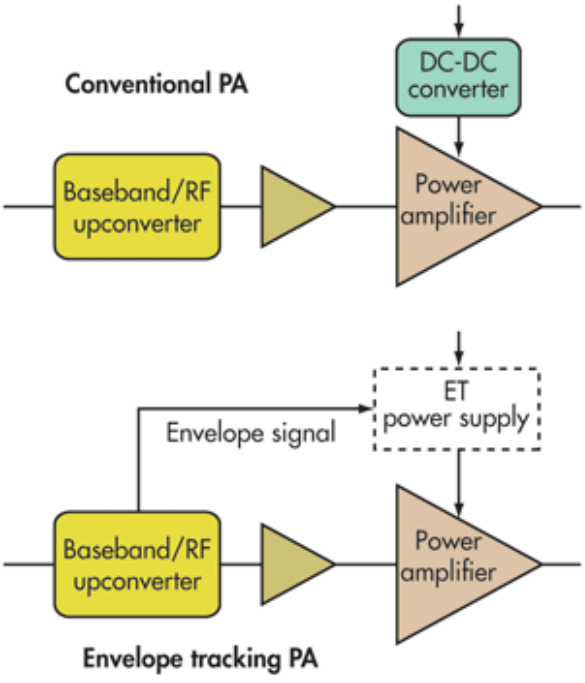
Advantages:

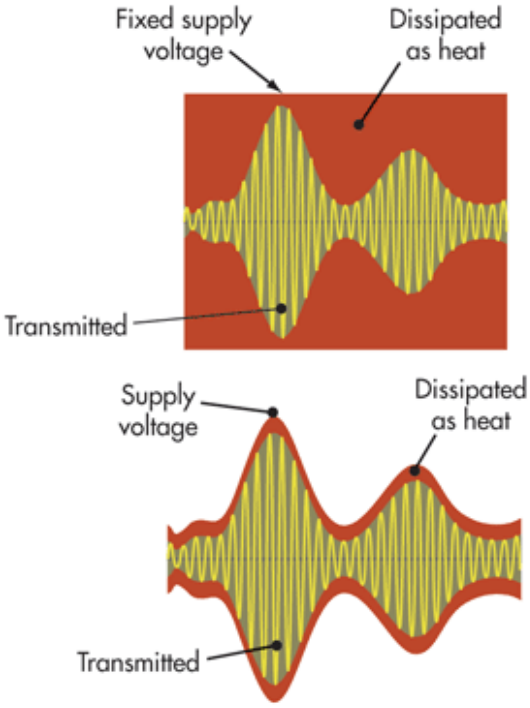
- Provides best performance at all power levels.
- Permits broadband operation.
- Provides additional advantages in terms of operation into mismatched loads, etc.

Disadvantages:

- Envelope tracking requires very fast - high bandwidth - power supply.
- Requires accurate envelope signal for power supply.

The RF supply or better the 'Envelope Power Amplifier' has to deliver the RF power + dissipation, i.e. the amp has to operate in a high-efficient switching class otherwise no efficiency gain will be generated. Class E provides efficiencies more than 90%. A well-designed low pass filter has to follow to integrate the square signal and form the continuous analogue supply voltage representing the RF envelope.



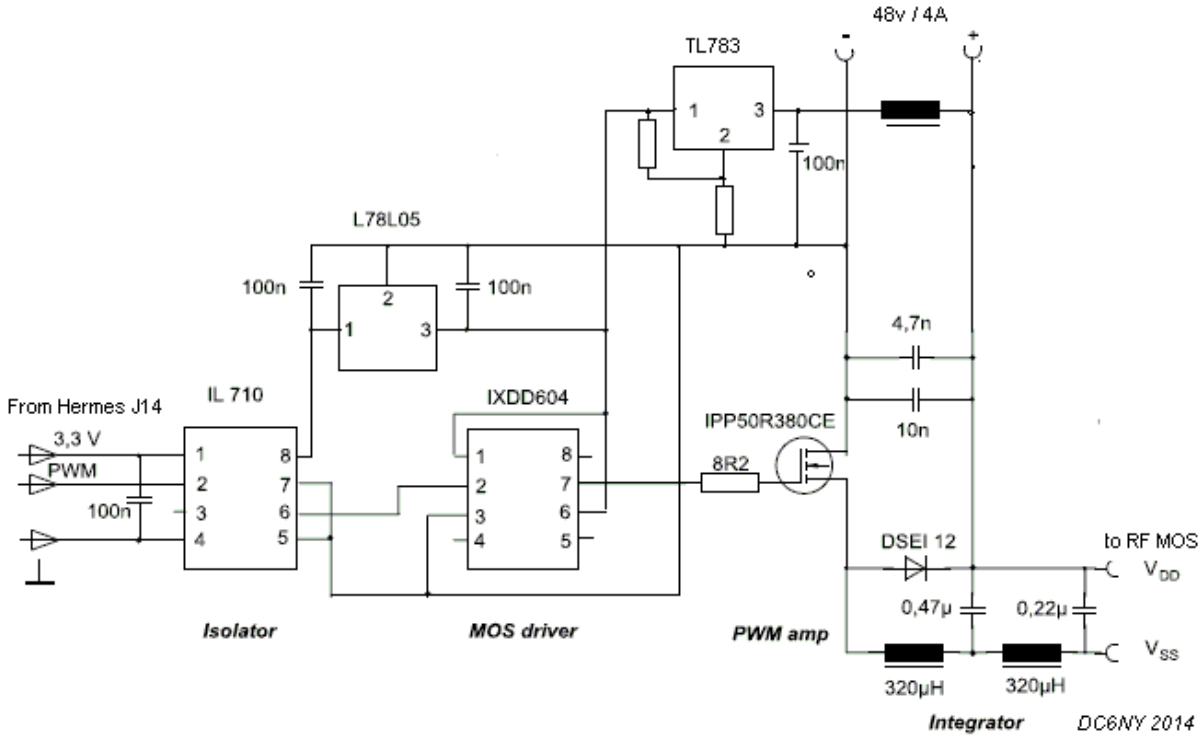


The envelope information is already part of our SDR and given by the well-known formula

Envelope = SQRT (I^2 + Q^2)

Phil, VK6PH, kindly implemented a pulse width modulator into the FPGA code of Hermes, which generates a 200 KHz-PWM signal out of the envelope shape with more than 50 dB dynamic range. The PWM signal is available at pin2 on J14 of Hermes. It's important to compensate group delay time of the integration LPF as well as other possible delays in the DUC process for good performance. Hence we are indebted also to Warren, NR0V, who provided the necessary delay adjustment of envelope amplitude, phase and gain in current PowerSDR mRX PS v.3.2.19. A monitoring 'channel' is also available.

I started some preliminary tests with a small 100W LDMOS amp and a 150W class E PWM amp being left over from a former EER project. Moreover I added a 5V SMPS in series to the PWM Power amp to provide some headroom of Vdd of the RF amp.



PWM Power Amplifier

Though the circuit is still not optimized, the results are very promising. PS does a fine job as usual and IMD performance is similar to constant voltage supply. Over a wide range of the envelope amplitude level the drain efficiency of the RF LDMOS amp was beyond 80 %.

In the next step I will design a 400 PWM amplifier to run a broadband 300W LDMOS amplifier with this technique. I would like to encourage folks to share in this exciting playground of these wonderful tools saving energy, reducing size and weight of power amplifiers and using the excellent features of pre-distortion.

Reporting will be continued depending on progress.

73, Helmut, DC6NY

References:

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