

## Envelope Tracking – Solution Note

### Background

**Envelope Tracking** is a power supply technique used for improving the energy efficiency of Radio Frequency (RF) power amplifiers. Using this technique, the fixed DC supply voltage to the RF power amplifier is replaced with a dynamic supply voltage that closely tracks the amplitude, or "envelope" of the transmitted RF signal. Envelope tracking ensures that the amplifier is operating at peak efficiency with respect to given output power requirements.

### Requirement

Conventional RF amplifiers have a fixed supply voltage and operate most efficiently when the amplifier is in compression (that is, the output no longer increases linearly in response to an increase in input).

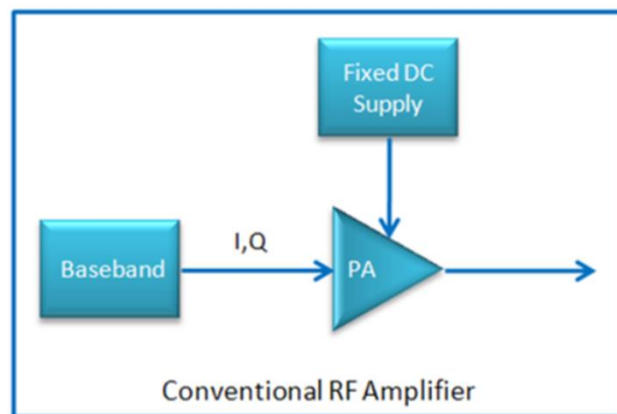


Figure 1: Conventional RF Amplifier

Systems such as GSM and GPRS that use a constant envelope achieve transmitter efficiencies of around 65%. However, as the demand for high-data throughput increases – despite the limited availability of radio frequencies – spectral efficiency must increase as well. This is achieved by using more complex modulation schemes in which the signal envelope is no longer constant but instead varies constantly during transmission.

As a result, however, the higher spectral efficiency leads to an increase in the peak-to-average power ratio (PAPR).

An amplifier operating with a fixed supply voltage becomes less efficient as PAPR increases because the amplifier spends more time operating below peak power and, therefore, spends more time operating below its maximum efficiency (with increased heat dissipation), as shown in Figure 2.

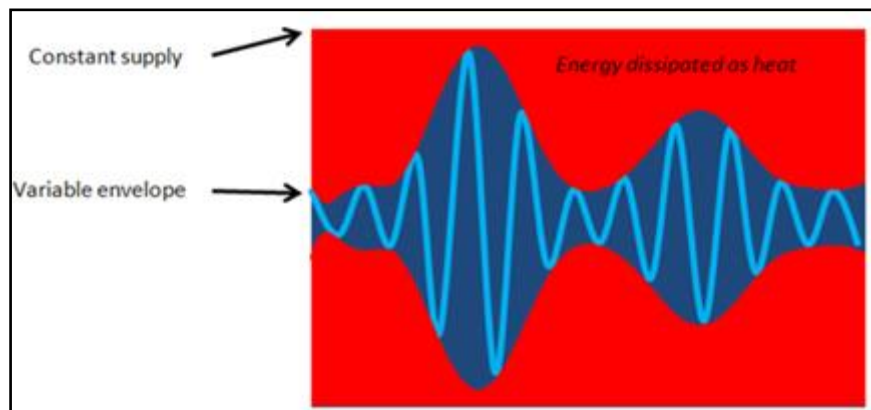


Figure 2: Reduced Efficiency in the Conventional RF Amplifier

In envelope tracking systems, the supply voltage is dynamically adjusted to track the RF envelope at high instantaneous power. Thus, the amplifier always operates in compression and therefore with high efficiency.

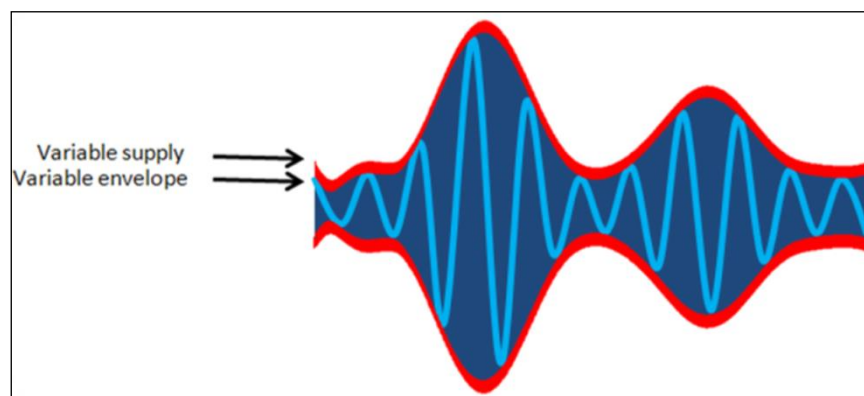


Figure 3: Improved Efficiency with Envelope Tracking

An envelope detector calculates the instantaneous amplitude of the transmitted signal and a supply modulator converts that amplitude signal into a supply voltage for the power amplifier. The supply voltage to the power amplifier continuously tracks the envelope of the transmitted signal and as a result, the amount of energy wasted through heat dissipation is minimized.

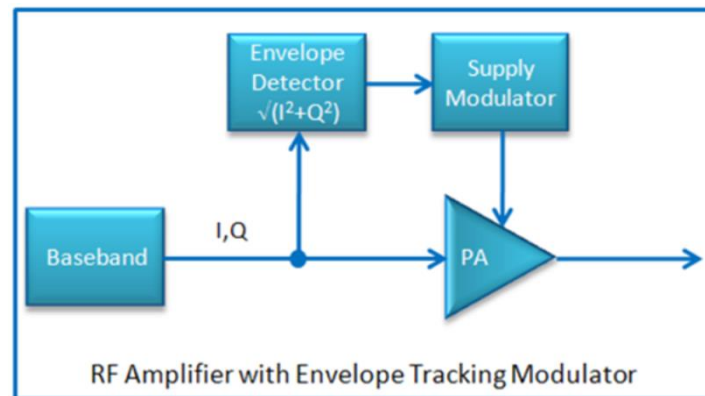


Figure 4: RF Amplifier with Envelope Tracking Modulator

## Solution

Tabor Electronics' **Wonder Wave** family of **Arbitrary Waveform Generators (AWGs)** provides excellent support for envelope tracking applications. Wonder Wave offers 4 synchronized output channels, supporting sampling rates of up to 200 MS/second. Its multi-channel solution allows for synchronization between the IQ baseband signals and the envelope signal (see Figure 5 below).

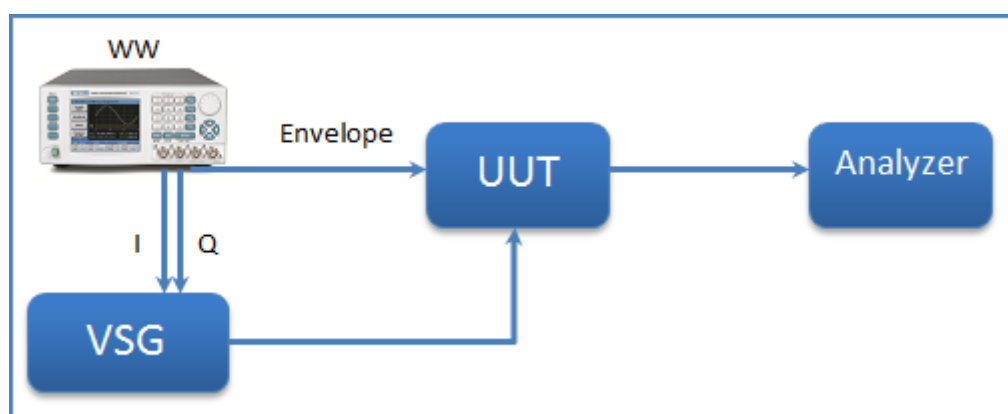


Figure 5: Wonder Wave Support for Envelope Tracking

Wonder Wave's powerful sequence generator lets you link and loop segments in user-defined fashion, and stores up to 10 different sequence tables.

Wonder Wave is supplied with ArbConnection – Tabor's comprehensive software tool that controls instrument operation, and provides unsurpassed programming and waveform creation capabilities.

## For More Information

To learn more about Tabor's solutions or to schedule a demo, please contact your local Tabor representative or email your request to [info@tabor.co.il](mailto:info@tabor.co.il). More information can be found at our website at [www.taborelec.com](http://www.taborelec.com)

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