

WHAT IS CLAIMED IS:

1. An envelope tracking system comprising:
 - a power amplifier configured to amplify a radio frequency signal and to receive power from a power amplifier supply voltage; and
 - an envelope tracker configured to generate the power amplifier supply voltage based on an analog envelope signal corresponding to an envelope of the radio frequency signal, the envelope tracker including a DC-to-DC converter configured to output a plurality of regulated voltages, a modulator configured to generate a modulator output voltage at an output based on the plurality of regulated voltages and the analog envelope signal, and a modulator output filter coupled between the output of the modulator and the power amplifier supply voltage, the modulator configured to generate the modulator output voltage based on comparing the analog envelope signal to a plurality of signal thresholds.
2. The envelope tracking system of claim 1 wherein the modulator includes a plurality of switches selectively activated based on comparing the analog envelope signal to the plurality of signal thresholds.
3. The envelope tracking system of claim 1 wherein the envelope tracker further includes a plurality of modulators including the modulator and a plurality of modulator output filters including the modulator output filter, each of the plurality of modulators coupled to the power amplifier supply voltage by way of a corresponding one of the plurality of modulator output filters.
4. The envelope tracking system of claim 3 wherein an active number of the plurality of modulators is selected based on comparing the analog envelope signal to the plurality of signal thresholds.
5. The envelope tracking system of claim 1 wherein the modulator is configured to receive the analog envelope signal over a Mobile Industry Peripheral Interface Analog Reference Interface for Envelope Tracking.

6. The envelope tracking system of claim 1 wherein the analog envelope signal is a differential envelope signal.

7. The envelope tracking system of claim 6 wherein the modulator includes a differential envelope amplifier configured to amplify the differential envelope signal to generate a single-ended envelope signal, and a plurality of comparators each configured to compare the single-ended envelope signal to a corresponding one of the plurality of signal thresholds.

8. The envelope tracking system of claim 1 wherein each of the plurality of signal thresholds is controllable.

9. The envelope tracking system of claim 1 wherein the envelope tracker further includes a DC path filter coupled between a DC voltage and the power amplifier supply voltage.

10. The envelope tracking system of claim 9 wherein the DC-to-DC converter is further configured to generate the DC voltage.

11. The envelope tracking system of claim 9 wherein the DC path filter includes at least one series inductor and at least one shunt capacitor.

12. The envelope tracking system of claim 1 wherein the modulator output filter includes at least one series inductor and at least one shunt capacitor.

13. The envelope tracking system of claim 12 wherein the modulator output filter further includes a DC blocking capacitor in series between the modulator output voltage and the power amplifier supply voltage.

14. An envelope tracker comprising:

a power amplifier supply voltage terminal configured to output a power amplifier supply voltage for a power amplifier;

a DC-to-DC converter configured to output a plurality of regulated voltages based on regulating a battery voltage;

a modulator output filter; and

a modulator including an output coupled to the power amplifier supply voltage terminal through the modulator output filter, the modulator configured to generate a modulator output voltage at the output based on the plurality of regulated voltages and an analog envelope signal, the modulator configured to generate the modulator output voltage based on comparing the analog envelope signal to a plurality of signal thresholds.

15. The envelope tracker of claim 14 further comprising a plurality of modulators including the modulator and a plurality of modulator output filters including the modulator output filter, each of the plurality of modulators coupled to the power amplifier supply voltage terminal by way of a corresponding one of the plurality of modulator output filters.

16. The envelope tracker of claim 15 wherein an active number of the plurality of modulators is selected based on comparing the analog envelope signal to the plurality of signal thresholds.

17. The envelope tracker of claim 14 wherein the analog envelope signal is a differential envelope signal, the modulator including a differential envelope amplifier configured to amplify the differential envelope signal to generate a single-ended envelope signal, and a plurality of comparators each configured to compare the single-ended envelope signal to a corresponding one of the plurality of signal thresholds.

18. A mobile device comprising:

a transceiver configured to generate a radio frequency transmit signal;

a front end circuit including a power amplifier configured to amplify the radio frequency transmit signal and to receive power from a power amplifier supply voltage; and

a power management circuit including an envelope tracker configured to generate the power amplifier supply voltage based on an analog envelope signal corresponding to an envelope of the radio frequency transmit signal, the envelope tracker including a DC-to-DC converter configured to output a plurality of regulated voltages, a modulator configured to generate a modulator output voltage at an output based on the plurality of regulated voltages and the analog envelope signal, and a modulator output filter coupled between the output of the modulator and the power amplifier supply voltage, the modulator configured to generate the modulator output voltage based on comparing the analog envelope signal to a plurality of signal thresholds.

19. The mobile device of claim 18 wherein the envelope tracker further includes a plurality of modulators including the modulator and a plurality of modulator output filters including the modulator output filter, each of the plurality of modulators coupled to the power amplifier supply voltage by way of a corresponding one of the plurality of modulator output filters.

20. The mobile device of claim 19 wherein an active number of the plurality of modulators is selected based on comparing the analog envelope signal to the plurality of signal thresholds.