

Microwave Journal



1.8 to 2.7 GHz, 2x2 MIMO Front-End and SDR Transceiver

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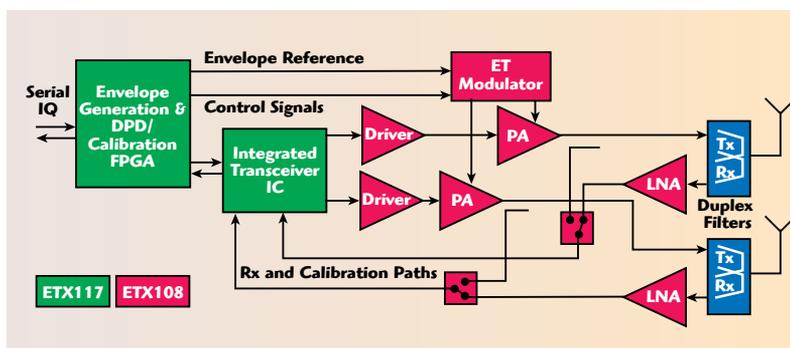
As the number of frequency bands and waveforms continue to expand in commercial and government wireless networks, the need for a high power, software defined radio (SDR) RF front-end has never been greater. NewEdge Signal Solutions is bringing the frequency and waveform agility that already exists in baseband and transceiver ICs to both the high power RF power amplifier (PA) and filter components of the system. NewEdge has developed two products to fulfill this emerging need (see **Figure 1**):

- ETX108, a $\times 2$ multiple-input-multiple-output (MIMO) RF front-end that transmits 7 W of average power per channel, using either 4G or a constant envelope (CE) waveform across 1.8 to 2.7 GHz

- ETX117, an SDR transceiver system developed in collaboration with Ettus Research.

The ETX108 front-end is broadband, covering 1.8 to 2.7 GHz in transmit and 1.7 to 2.7 GHz in receive. The PA provides 44 W peak or 7 W average output power per channel, assuming 8 dB peak-to-average power ratio (PAPR). The PA comprises all gain stages, power sequencing and supplies. With both channels at full output, it consumes less than 40 W. The receiver has a noise figure less than 1 dB and an input 1 dB compression point of 1.5 dBm. The compact front-end, measuring 5.25" \times 5.75", can be configured for envelope tracking (ET) or constant voltage operation. It supports either frequency division duplex (FDD) or time division duplex (TDD) LTE and, running NewEdge firmware on the ETX117 transceiver system, complies with 3GPP (LTE) ACLR1.

The ETX117 SDR transceiver system is comprised of the Ettus Research N230 SDR transceiver board with NewEdge firmware, which includes the envelope generation interface (EGI), crest factor reduction (CFR) and digital predistortion (DPD). This board is designed to work from 300 MHz to 6 GHz and can accept I/Q data via an Ethernet link, when the modem is remote, or directly from a number of baseband systems on a chip (SoC) via an adaptor cable. Most importantly, the board



▲ Fig. 1 RF front-end and SDR transceiver reference design. EGI, CFR and DPD code by NewEdge Signal Solutions.

ProductFeature

operates via Ettus Research's universal software radio protocol hardware driver (UHD). The UHD architecture is compatible with GNU Radio, C++/Python API, Amarisoft LTE 100, OpenBTS and other third-party software and frameworks.

MULTIPLE WAVEFORM SUPPORT

Supporting network provider and operators that want hardware easily upgraded in the field, the ETX108/ETX117 combination may be configured to operate in FDD LTE, TDD LTE and constant envelope modes. For best efficiency, the ET modulator on the ETX108 board should be used for high peak-to-average power ratio waveforms (e.g., FDD and TDD LTE). When running in TD-LTE mode, as defined by 3GPP TS 36.104, the PA in each channel can be disabled, meeting the 3GPP requirement that the transmit output must shut down to below -85 dBm/MHz within 17 μ s.

Onboard programmable resources within the ETX108 are available to control the TD-LTE T/R switch from a single TDD control line for each transmit channel. This guarantees accurate T/R switch timing, to minimize

transition time and avoid "hot switching," which can damage the switch. Onboard T/R switch control also ensures accurate enable/disable timing of the receive port.

For networks running legacy or lower peak-to-average ratio waveforms, such as FM or GSM, the ET modulator on the ETX108 board may be configured to act as a standard DC-DC converter and will operate the final stage RF power transistor at a fixed voltage.

ET EASY TO USE

In developing the ETX108/ETX117 combination, NewEdge has solved the challenges historically associated with ET:

- Access to the original modem data stream is required so that the envelope and RF signals may be separate, enabling envelope generation and RF delay management to be performed in the digital domain.
- RF PA implementation must take the ET modulator bias network into account, as traditional approaches to bias choke and matching network design are incompatible with ET modulator requirements. Wide

signal bandwidth waveforms dictate that the ET modulator and PA be highly integrated and developed as one functional block.

- For modern high peak-to-average waveforms, DPD and CFR firmware is really a "must-have" for average power levels greater than 1 to 2 W. NewEdge provides an ET compatible DPD/CFR solution that is part of the ETX117 SDR firmware.

The system allows users to bring their digital I/Q data over Ethernet (if the modem is based in the cloud, for example) or via a special adapter cable that brings the I/Q data from many popular baseband SoCs.

The ETX108/ETX117 combination quickly gets users up and running for evaluation, field trials and moderate volume applications. NewEdge Signal Solutions will be developing small form-factor and lower cost variations of this combination to meet additional customer requirements.

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