DESCRIPTION OF MODULATION SYSTEM

SECTION 2.1033(c) (13)

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For equipment employing digital modulation techniques, a detailed description of the modulation system to be used, including response characteristics (frequency, phase and amplitude) of any filters provided, and a description of the modulating wavetrain, shall be submitted for the maximum rated conditions under which the equipment will be operated.

RESPONSE:

Transmit Path Description

The 700MHz LTE TRDU contains two identical Down-Link paths. Figure 1 provides the block diagram of the path starting at the CPRI input(either Primary or Secondary CPRI port) and ending at the duplexed Tx/Rx ports.

LTE carriers in the form of base-band I and Q data are streamed into the TRDU at the CPRI input as high speed serial data. Presently the rate is 1.2288Gbps, but higher speed options can be supported. The base-band carriers are centered at 0Hz consisting of a large number of sub-carriers which are modulated with QPSK, 16QAM, and 64QAM formats. The exact modulation is determined by the base-station base-band processing card that sources the serial I/Q data.

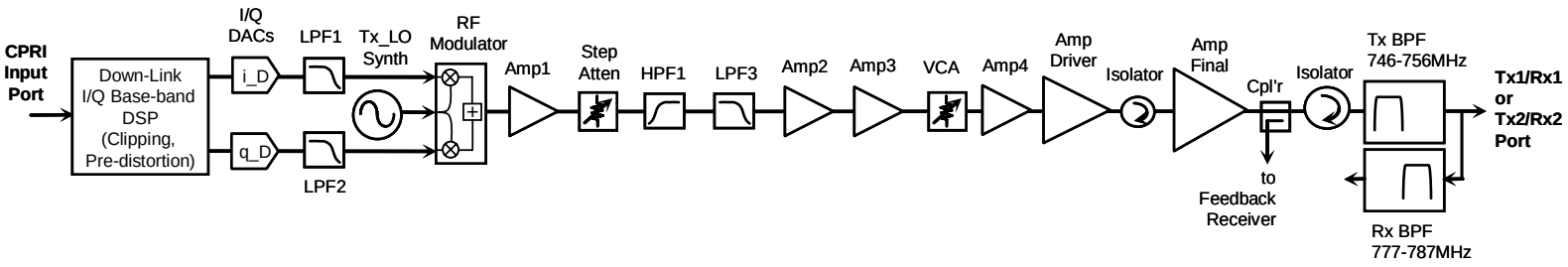

Figure 1: TRDU Transmit Path Block Diagram

Once the serial data is captured and converted to parallel format, the LTE carrier undergoes a number of digital processing steps that allow the TRDU to satisfy stringent efficiency requirements and emission limits. The majority of the processing involved the reduction of the signal's peak-to-average levels(Crest Factor Reduction or CFR) and addition of digital pre-distortion that overcomes the .
The modified carrier then passes from the digital domain to the analog domain through two DAC converters. Given that the carrier is in complex format each DAC puts out half of the bandwidth of the carrier, therefore the spectral energy of the carrier goes from 0Hz to 5MHz, while additional spectral energy exists at the frequencies that cover the 3rd, 5th, and 7th order inter-modulation.

Some band-limiting for noise and images from the DAC outputs is provided by two filters(LPF). These LPFs, identified as LPF1 and LPF2, are simple 5 pole LC filters with a 3dB corner at approximately 200MHz. The LTE carrier, still in complex I and Q form(though now in the analog domain), then drives the inputs of an RF quadrature modulator. The modulator combines the I and Q signals in quadrature and up-converts the 'real' carrier to the

desired frequency of transmission. The Tx_LO synthesizer is tuned close to the desired center frequency, which for this product is 752MHz while transmitting one 10MHz LTE carrier.

After the RF modulator there is a long cascade of small-signal and large-signal(driver, final) RF amplifiers to amplify the level of the transmitted signal to 45WRF(+46.5dBm). The cascade also has two RF attenuators. The RF step attenuator is used to set the net gain of the cascade close to a target gain of approximately 60dB. The voltage-controlled attenuator(VCA) is used to provide gain temperature compensation so that output power can be maintained despite variations in the transmit path gain over temperature. The coupler at the end of the path provides a sample of the transmitted carrier to a feedback receiver to form a closed loop system that maintains RF output power in addition to monitoring real time performance of digital-pre-distortion.

The transmit path also contains two additional sets of analog filters. A wide-band band-pass filter is made up from a cascade of a high-pass and low-pass filter in series. These are put in place to provide general noise and spurious rejection. Figure 2 and 3 show the responses of these two filters identified in Figure 1 as HPF1 and LPF3. The last filter element in the transmit path is a high power, cavity band-pass filter(Tx BPF) which is part of a duplexer filter. This filter rejects noise generated by the transmitter that falls into the receive band frequencies of 777-787MHz by over 100dB in order to avoid desensitizing the TRDU's receiver. This filter also provides rejection of RF energy in other frequencies to allow the TRDU to satisfy the 3GPP 36.104 specified emission limits. A profile of that filters rejections to the left and right hand sides of the pass-band is shown in Figures 4a and 4b.

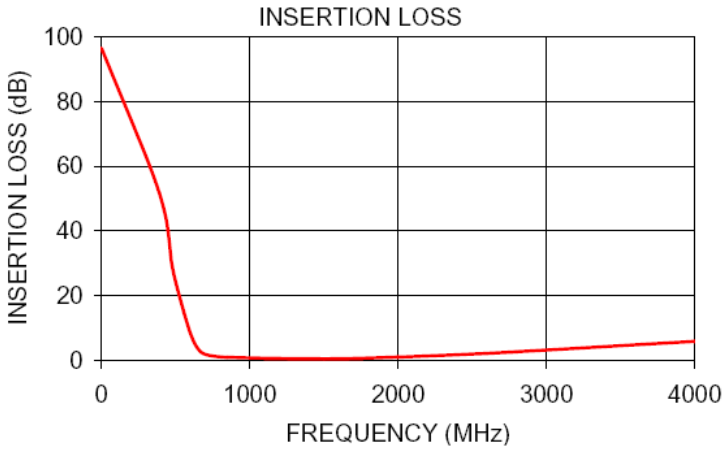

FIGURE 2: HPF1 Frequency Response

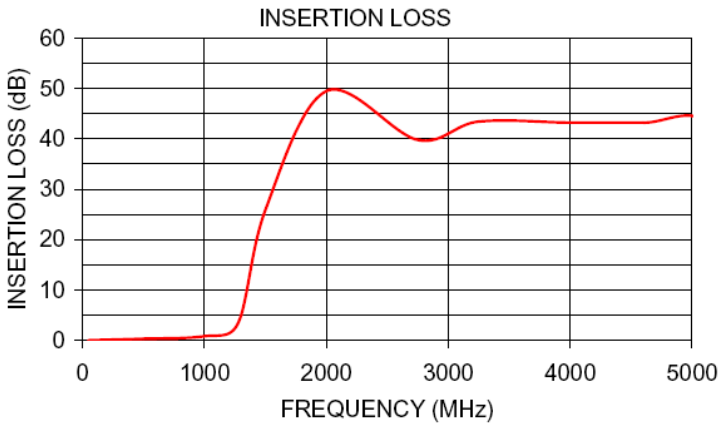

FIGURE 3: LPF3 Frequency Response

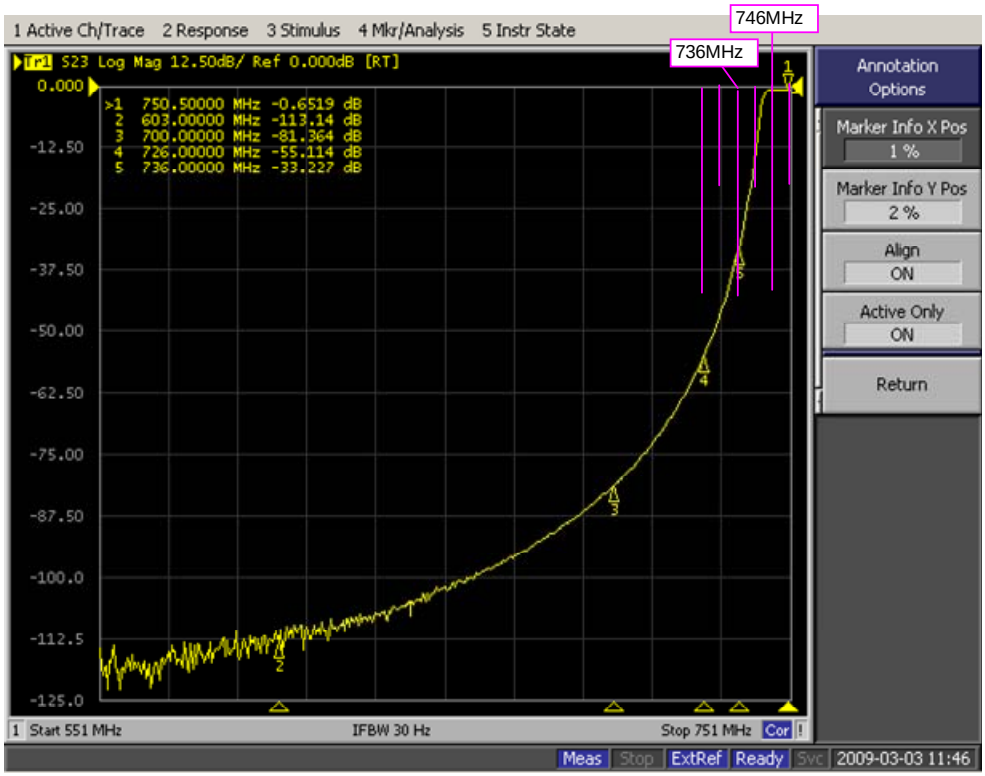

FIGURE 4a: Tx BPF Left side Frequency Response

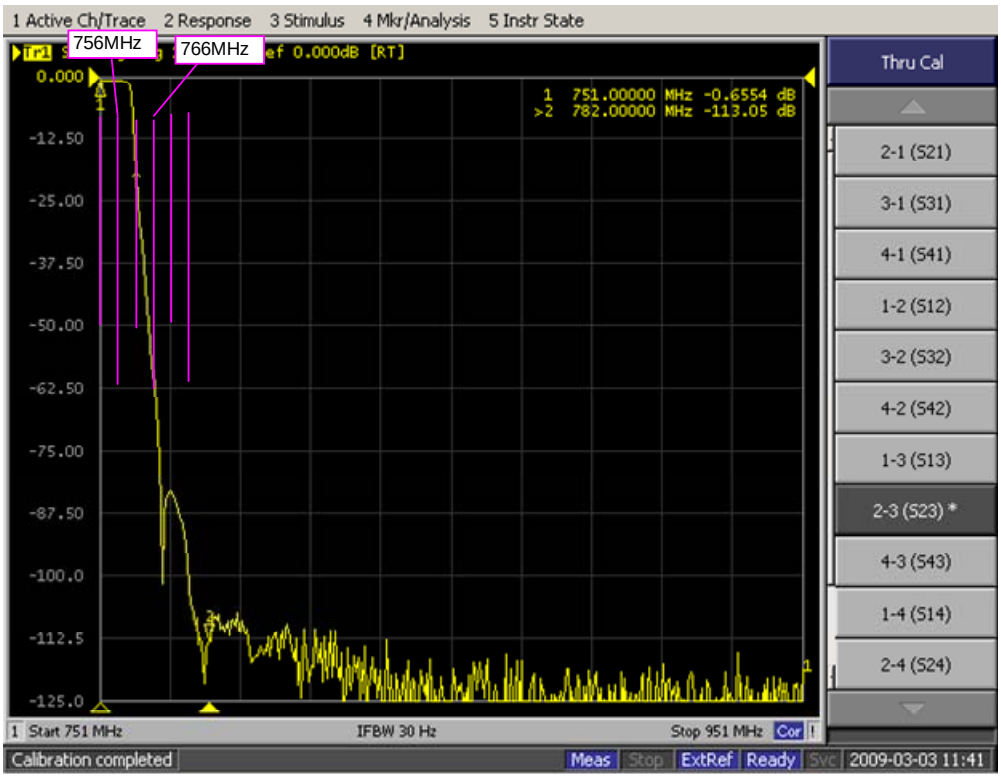

FIGURE 4b: Tx BPF Left side Frequency Response