Appendix G – Operational Description

1. Circuit description

1.1 CDU-550 CDMA 1xEVDO Data Modem circuit description

The CDU-550 CDMA 1xEVDO Data Modem consists of the CDMA Engine, power generation part, digital part, RF part and connectors. The Fig 5-1 is block diagram of CDU-550 CDMA 1xEVDO Data Modem.

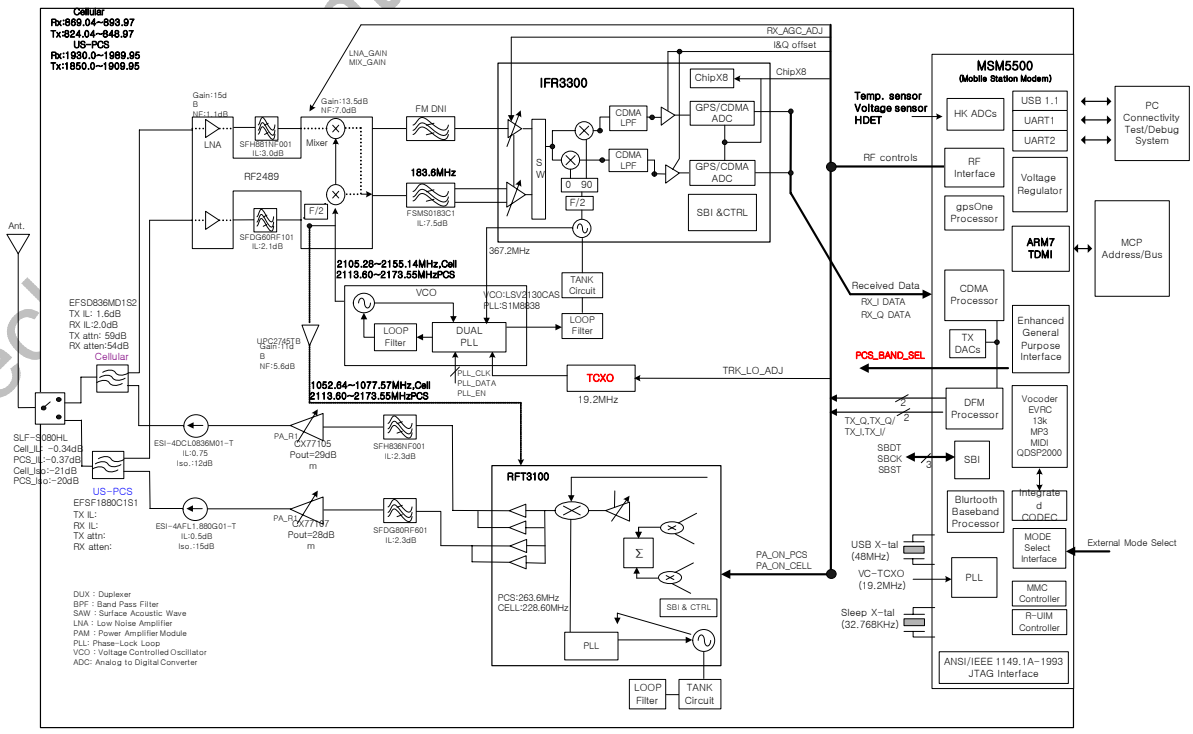


Figure 5.1 CDU-550 CDMA 1xEVDO Data Modem block diagram

1.2 Power interface part

DC Power is supplied from the HOST USB BUS power.

- LDO(U410): This component is DC/DC down converter. Output voltage is about 3.45V DC. This output voltage is inputted to CDMA Engine power interface.

Each block of CDMA Engine uses low-drop-output linear regulator.

- U403 : voltage regulator for digital circuit (2.8V DC & 2.6V DC)
- U404 : voltage regulator for VC-TCXO and S1M8662 (3.0V DC)
- U405 : voltage regulator for RF Rx part (3.0V DC)
- U406 : voltage regulator for RF Tx part (3.0V DC)
- And power AMP(U201) is directly supplied.

1.3 Digital part

- U400: MSM(Mobile Station Modem) ASIC is chip responsible for CDMA/FM mobile station's base-band digital signal processing. For this chip to function, TCXO(19.2MHz) is required as basic clocks.
  And sleep crystal (32.768KHz) is used as clock source of MSM ASIC.

MSM consists of CDMA core and DFM core. CDMA core is a part for processing CDMA signal consisting of modulator/demodulator, interleaver/deinterleaver and encoder/decoder in the CDMA mode.

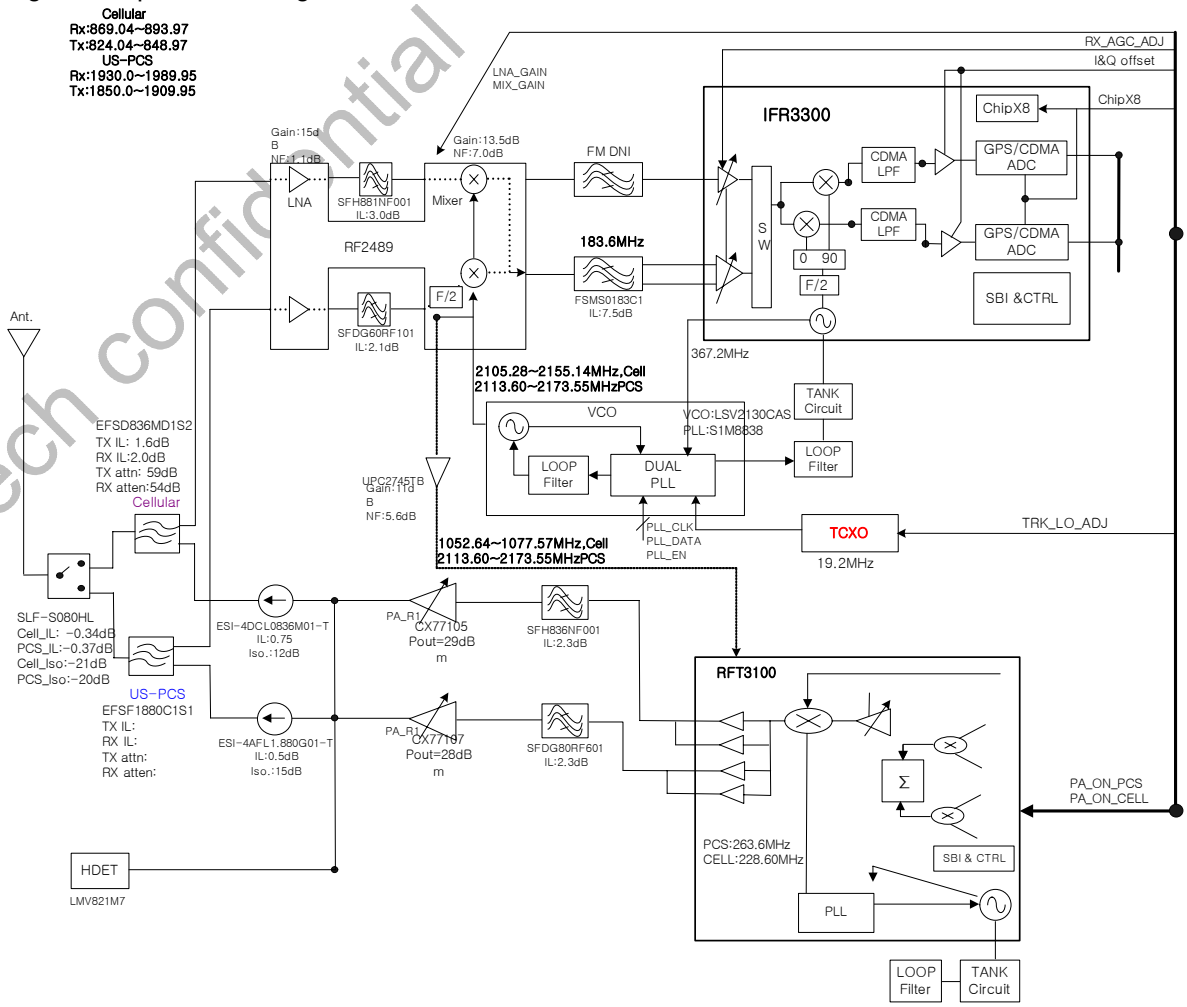
- U401: Memory part consists of Flash memory and SRAM.
  Flash memory: store to main program.
  SRAM: performs to read and write data

- U302: USB transceiver is fully compliant with the USB specification Rev1.1.
- XT301: USB transceiver 48MHz crystal.

1.4 RF part

RF part consists of synthesizing part, transmission and reception part.

Fig 5.2 RF part block diagram



1.4.1.1 Frequency synthesizing part

Frequency synthesizing part called PLL Synthesizer consists of three synthesizer circuit which is first local synthesizer, Tx IF synthesizer and Rx IF synthesizer. The first local synthesizer generates the primary local system oscillation frequency, operating over 1052.6 ~ 1097.6MHz for Cellular and 2113.6 ~ 2173.6MHz for US-PCS frequency range. Tx IF and Rx IF synthesizer generate the second local oscillation frequency, 457.2 MHz and 367.2 MHz for Cellular and 527.2 MHz and 367.2 MHz for Cellular respectively.

1.4.1.2 Receiving part

- Diplexer. The diplexer filters 800MHz Cellular and US-PCS signals.
- Duplexer. The duplexer filters the RF signal transmitted through Antenna and sends the signals to LNA.
- LNA. This part in front-end is used to amplify the received signal with low noise figure
- Down converter. It acts as a mixer using first local frequency to produce the desired signal in the mid-range frequency of 183.6 MHz.
- Rx AGC. This part is designed to control the gain of the dynamic range of midrange frequency produced in down converter according 80 dB dynamic range.

Currently, previous BBA is divided into IFR3300(or S1M8662;Rx IF-baseband converter) and RFT3100(Tx baseband-IF converter). IFR3300 acts as the baseband analog processor which processing the signals between the S1M8662 and digital processing circuit.

In the while, RFT3100 consists of Tx AGC and Tx part analog processor of previous BBA.

1.4.1.3 Transmission part

- TX AGC. It is designed to be gain-controlled from 84 dB dynamic range. The gain of this part is controlled by MSM using digital control signal.
- Up converter. This part mixes the IF frequency 228.6 MHz(for 800MHz), 263.6MHz(for 1900MHz) and the first local to generate transmission frequency of 824.64 ~ 848.37 MHz(for 800MHz) and 1851.25MHz ~ 1908.75MHz(for 1900MHz).
- Power AMP module. This part is designed to work in the CDMA mode and can generate the proper output power. The DC voltage into the power amp module is typical 3.6V.

2. Range of operating power levels and description of means for variation of operating power

Dynamic range of output power is from –56dBm to +24.5dBm with ±0.3dB variation in CDMA mode.

A temperature-compensated TX AGC (Automatic Gain Control) amplifier with 85dB gain range is included in the RFT3100. The transmit output power level is directly controlled by varying the gain of this TX AGC amplifier. A DC input voltage from the MSM5500 linearly controls the gain of the TX AGC amplifier.

The 84 dB dynamic range is 39 dB when the voltage 2.8V and -45 dB in 0.1V. The 81 dB dynamic range (0.3V ~ 2.4V) gain is used in this CDMA Data modem.

3. Description of frequency determining and stabilizing circuitry

Frequency synthesizing part is composed of the first local RX IF synthesizer which is single mode PLL synthesizer and the internal Tx IF and Rx IF synthesizer which are in RFT3100 and S1M8662 chip. These parts generate the first local oscillation frequency, Rx IF frequency and Tx IF frequency.

- First local frequency Synthesizer : 2105.3 ~ 2185.2MHz for 800MHz
  2113.6 ~ 2173.6MHz for 1900MHz
  PLL loop is composed of single PLL synthesizer, Loop filter, VCO and VC-TCXO
  It generates transmission and reception frequency.
- Rx IF synthesizer : 367.2 MHz
  Rx IF PLL loop is consisted of PLL synthesizer in the PLL module, VCO built in S1M8662, loop filter and VC-TCXO(Crystal oscillator 19.2 MHz). It oscillates twice the intermediate receiving frequency of 367.2 MHz and then generates 183.6 MHz, Rx IF frequency.
- Tx IF Synthesizer : 457.2 MHz for 800MHz
  527.2MHz for 1900MHz
  The configuration of PLL loop is composed of PLL Synthesizer, VCO which is internally installed, loop filter and VC-TCXO(19.2 MHz). It oscillates twice of the transmission intermediate frequency and then generates Tx IF frequency through the PLL loop.

The frequency of 19.2 MHz generated from the VC-TCXO is the main clock of each the frequency synthesizer part. PLL frequency stability is determined by the stability of oscillator of VC-TCXO. This prevents maximum frequency variation from exceeding ±2.0PPM.

4. Description of circuit employed for suppression of spurious radiation

In the CDMA transmit signal path, the frequency spectrum at the output of the CDMA DACs contains unwanted frequency components due to the DAC output transition edges and transients. The transmit clock frequency and harmonics are found in the spectrum.

Each CDMA DAC is followed by an anti-aliasing low-pass filter with a bandwidth of 630 KHz that reduces unwanted frequency components installed in MSM5500. And then Tx IF frequency from the RFT3100 is filtered by band-pass filter. The nominal specification of the filter is as following.

- Nominal center frequency : 228.6 MHz for 800MHz
  263.6MHz for 1900MHz
- 3 dB Bandwidth : ± 630 kHz
- Stop band attenuation : 40dB min.

The Tx RF output of the Tx Mixer and the AGC amp is filtered again by the SAW band pass filter. The nominal specification of the filter is as follows.

- Pass band : 824 MHz ~ 869 MHz for 800MHz
  1850MHz ~ 1910MHz for 1900MHz
- Attenuation : DC ~ 800MHz : 22 dB min.
  869 MHz ~ 1049 MHz : 25 dB min.
  1049 MHz ~ 2000 MHz : 19 dB min.

Finally, the spurious generated from Power AMP is filtered by the duplexer. The nominal specification of the duplexer is as follows

- TX Pass band : 824 MHz ~ 869 MHz for 800MHz
  1850MHz ~ 1910MHz for 1900MHz
- Attenuation : 869 MHz ~ 894 MHz : 40 dB min.

5. Description of modulation system used

The CDU-550 CDMA 1xEVDO Data Modem consists of MSM, baseband analog interface (RFT31000, S1M8662) as modulation system. The MSM integrates functions of a CDMA processing, a digital FM(DFM) processing, CDMA subsystem in the MSM performs CDMA signal processing about CDMA modulation / demodulation, viterbi coding/decoding, interleaving/de-interleaving, and etc.

The CDMA baseband processor performs forward-link demodulation, time tracking and reverse-link modulation for CDMA digital signals. The following figure shows a CDMA digital baseband processor block diagram.

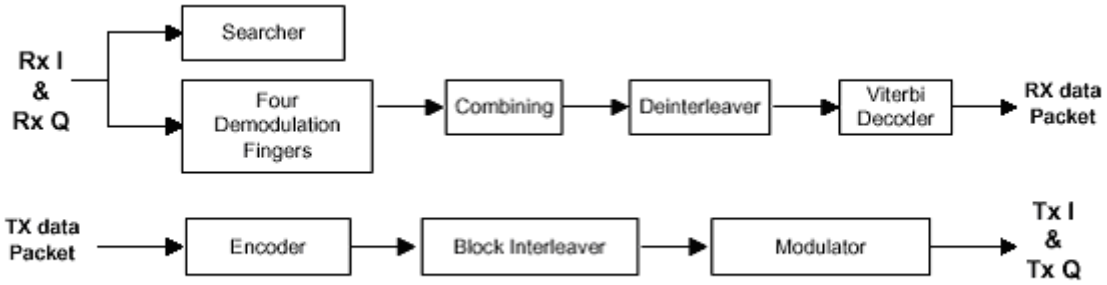


Figure 9.1 CDMA digital Baseband Block Diagram

The modulator performs the orthogonal modulation, long code PN spreading and quadrature spreading. The resulting data stream is then band limited with FIR filters and sent to the analog baseband processor.

The RFT3100 Transmit Signal Path (shown in figure 9.1) accepts analog I and Q data from the MSM and outputs modulated IF frequency the RF transmitter. The RFT3100 transmit path outputs a differential IF signal with spread spectrum modulation expending ±630KHz from the transmit IF center frequency.

The analog I and Q baseband components from the CDMA low-pass filters are mixed in quadrature with unmodulated I and Q signals. After mixing, the I and Q IF components are summed and output differentially. The IF frequency, I and Q IF VCO signals are generated on the RFT3100.

The transmitter IF VCO is set by an external varactor-tuned resonant tank circuit. An internal phase-lock loop and external loop filter network provides the feedback to the varactor that tune the VCO precisely to IF frequency.2 MHz. A master-slave divide-by-two circuit generates I and Q signals in precise quadrature for the mixers.