FCC Documentation

MM-5500U CDMA 1x/EVDO Modem

Version : 0.1
Date :JUN 21, 2004

FCC RF EXPOSURE COMPLIANCE

In August 1996 the Federal Communications Commission (FCC) of the United States with its action in Report and Order FCC 96-326 adopted an updated safety standard for human exposure to radio frequency (RF) electromagnetic energy emitted by FCC regulated transmitters. Those guidelines are consistent with the safety standard previously set by both U.S. and international standards bodies. The design of this phone complies with the FCC guidelines and these international standards.

Use only the supplied or an approved antenna. Unauthorized antennas, modifications, or attachments could impair call quality, damage the phone, or result in violation of FCC regulations.

This MM-5500U CDMA card has been tested for FCC RF exposure hand and body SAR compliance. In order to comply with FCC RF exposure requirements, this product must be operated with the MM-5500U CDMA card. The use of this card in any other type of host configuration may not comply with FCC RF exposure requirements and should be avoided. During operation, a 1.5cm separation distance should be maintained between the antenna, whether extended or retracted, and the user's/bystander's body (excluding hands, wrists, feet, and ankles) to ensure FCC RF exposure compliance.

CAUTION

Change or modification without the express consent of Maxon Electronics Australia Pty Ltd voids the user's authority to use the equipment.   This equipment has been tested and found to comply with the limits pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in an appropriate installation. This equipment generates, uses, and can radiate radio frequency energy and, if not used in accordance with instructions, can cause harmful radiation to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If the equipment does cause harmful interference in radio and television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation distance between the equipment and the receiver
- Contact Maxon Electronics Australia Pty Ltd Technical Support for assistance.

Table of contents

1. Contact Information

If you have any technical queries about this manual, please contact:

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2. Product Overview

2.1   Overview

The MM-5500U CDMA 1x/EVDO Modem is designed to merge the capabilities of 3G 1x EV standard with the high value feature sets supported by 3G 1x MC IS-2000.

The MM-5500U is capable of 2.4Mbps peak data rate on the forward link and 153Kbps peak data rate on the reverse link. The MM-5500U solution enables up to a doubling of overall IS-95-A/B voice capacity and new, higher-data-rate services.

2.2   What is the MM-5500U CDMA 1x/EVDO Modem

- IS-95A/B, cdma2000-1X and EVDO CDMA Protocol Support

- Remote controlled by AT commands

- Data transmission up to 2.4Mbps [forward link], 153Kbps [reverse link]

- LED indicating of the modem status

2.3   Supplied accessories

- MM-5500U CDMA 1x/EVDO Modem (1)

- Ear-piece assembly (1)

- USB interface cable assembly (1)

- Deriver CD (1)

3. Specifications

3.1   Mechanical Specifications

Table 3.1 mechanical specifications

Dimensions	58mm x 38mm x 12mm, except antenna & USB connector parts
Weight	Approx. 35g , except ear-piece & USB cable assemblies
Housing Material	ABS

3.2   Environment Specifications

Table 3.2 environment specifications

Operating conditions	0°C ~ +60°C , 85%(at 50(C), relative humidity (non-condensing)
Storage Temperature	-40°C ~ +70°C
Humidity	95%, non-condensing

3.3   Electrical Specifications

Table 3.3 Current Consumption

- DC input voltage	+5VDC from USB port
- Maximum current	Under 850mA
- Typical current	Under 200mA
- Digital block operating voltage	+3.0V (typical)
On communication @ Maximum TX Power (24+/- 0.3dBm)	Under 700mA

(Note) The current consumption might vary of 5% over the whole operating temperature range.

3.4 CDMA RF Specifications

RF performances are compliant with IS-95A/B, cdma2000-1X RTT CDMA Protocol.

3.4.1 Transmitter specifications

Table 2.4 Transmitter performance

Type of Multiplexing	Frequency-Division Duplex
Frequency Range	824.64MHz ~ 848.37MHz
Channel Number	20CH
Bandwidth	1.23MHz
Occupied Bandwidth	Under 1.32MHz
Type of Oscillation	PLL Synthesizer & VCTCXO(19.2MHz)
VCO Output Frequency Range (divide-by-2 frequency range)	1372.08MHz ~ 1421.54MHz (686.04MHz ~ 710.77MHz)
Intermediate Center Frequency	138.6MHz
Modulation Method	OQPSK
RF Maximum Output Power	0.28W (24.5dBm/1.23MHz)
Frequency Stability(Accuracy)	Under defined freq. +/- 300Hz
Waveform Quality	Over 0.944
Conducted Spurious Emission	Over carrier +/-900KHz, -42dBc/30KHz Over carrier +/-1980KHz, -54dBc/30KHz
Common RF Impedance	50ohm
Supplied voltage	+3.8V DC @ Power Amp. +2.85V DC @ TX block

3.4.2   Receiver specifications

Table 2.5 Receiver performance

Type of Receiving		Super Heterodyne Method
Frequency Range		869.94MHz ~ 893.37MHz
Channel Number		20CH
Band width		1.23MHz
Type of Oscillation		PLL Synthesizer & VCTCXO(19.2MHz)
VCO Output Frequency Range (divide-by-2 frequency range)		1372.08MHz ~ 1419.54MHz (686.04MHz ~ 709.77MHz)
Intermediate Center Frequency		183.6MHz
Modulation Method		QPSK
Receiver Sensitivity		Under -104dBm @FER=0.5%
Single Tone Desensitization (-30dBm @F_C +/-900KHz)		Under -101dBm @FER=1%
Inter-modulation (Fc +/-900KHz&1.7MHz)	-43dBm	Under -101dBm @FER=1%
	-32dBm	Under -90dBm @FER=1%
	-21dBm	Under -79dBm @FER=1%
Common RF Impedance		50ohm
Supplied voltage		+3.0V DC

4. Instruction

Warning

- *To prevent fire or shock hazard, do not expose the unit to rain or moisture.*

- *Do not drop the unit or give a shock to the unit, or it may cause a malfunction.*

4.1 Supplied accessories

   - MM-5500U CDMA 1x/EVDO Modem with antenna (1)

   - USB cable assembly (1)

   - Earpiece assembly (1)

4.2 Getting start

Before you can begin using the MM-5500U CDMA 1x/EVDO Modem, you must:

4.2.1   Install Phone UI program and MM-5500U Modem

Insert installation CD (supplied with the Telstra CDMA Voice/Data Modem) into the CD-ROM drive.

This will automatically start the installation and install the required drivers plus Telstra CDMA

Voice/Data Modem Application software.

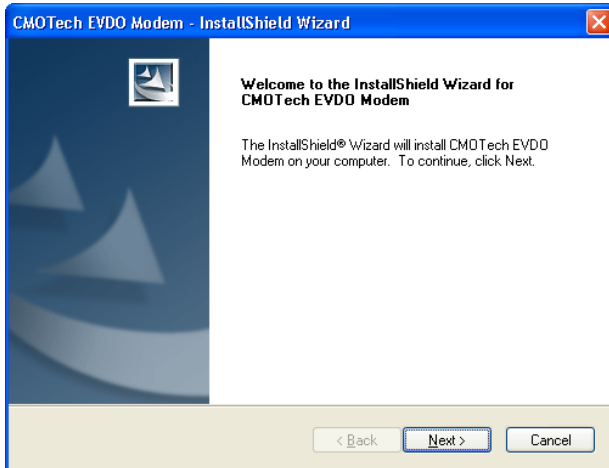**Do not connect Telstra CDMA Voice/Data Modem into your laptop/PC yet.**

The installation procedures are the same for Windows 98 Original Edition, Windows 98

Second Edition, Windows ME, Windows 2000 and Windows XP.

It's very important that you must install MM-5500U Modem by this procedure!

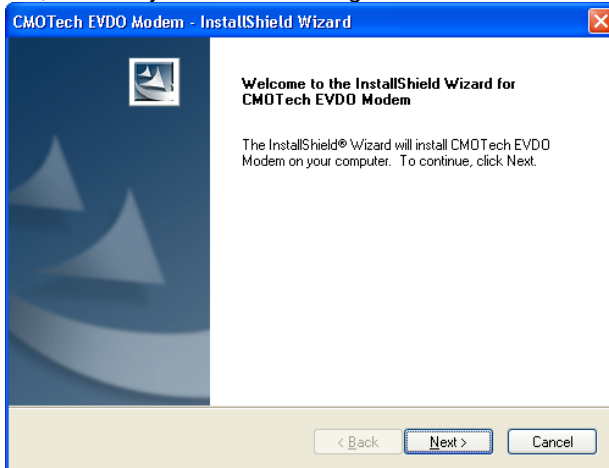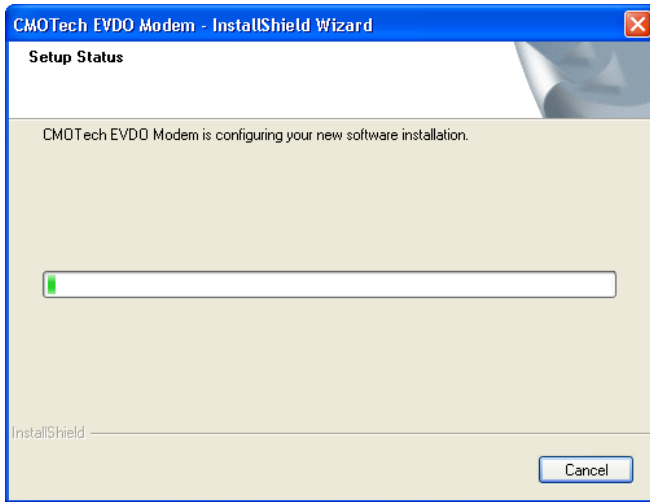4.2.1.1 Start Autorun
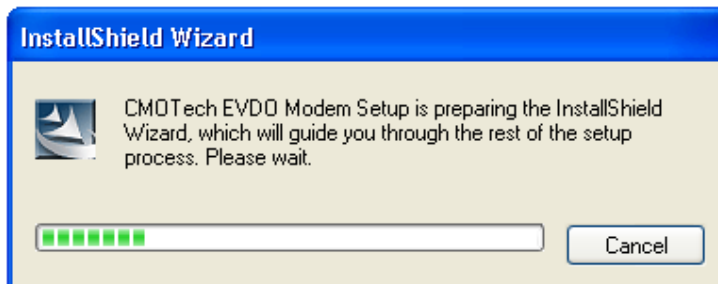
4.2.1.2 Install shield Wizard… click 'Next'
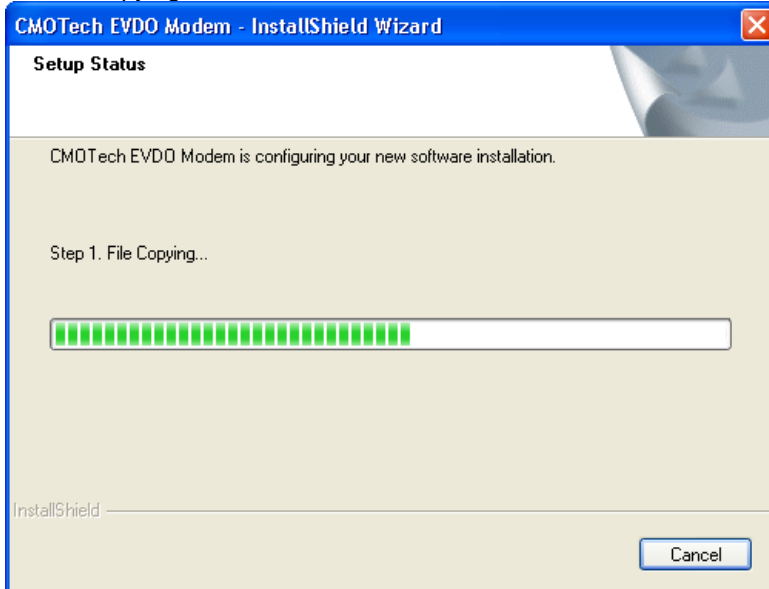

4.2,1.3 Ready to install the Program

4.2.1.4 Maxon Electronics Australia EVDO Modem is configuring your new software installation

4.2.1.5 Copying file

4.2.1.6 Maintenance Complete
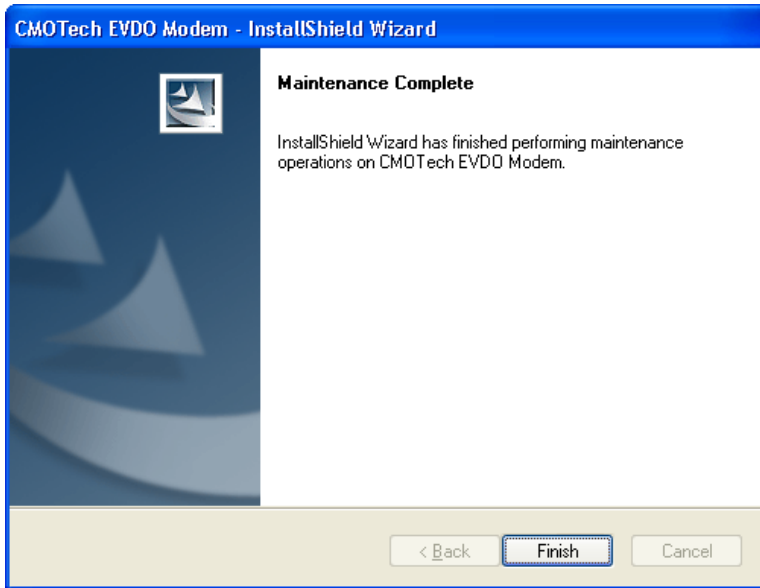
4.2.2   Connect **ear-piece** to the ear-jack connector if you want to use as a phone.

Microphone and earphone signals for Voice Call are provided to interface with headset directly.

1. Connect the ear-piece plug firmly the ear-jack port hole.

2. Ware the Ear-piece to the left or right ear and adjust the ear-piece to fit to your ear firmly.

- Press for more than a second during buzzer ringing for receiving voice call

- Press for more than a second when redial, this time you heard dialing sound

When adjusting the volume on the unit, please refer to the "MM-5500U Software manual" for detail information.

4.2.3   LED display

Table 4.2.1 LED function descriptions

Function	LED Color		
	RED	GREEN	YELLOW
POWER ON	ON	OFF	OFF
ACQUISITION- Fail	FLASH	OFF	OFF
ACQUISITION- OK (IDLE)	OFF	ON	OFF
VOICE CALL	ON	ON	OFF
DATA CALL	OFF	ON	FLASH
DORMANT	OFF	ON	ON

5. Circuit description

5.1 MM-5500U CMDA 1x/EVDO Modem circuit description

The MM-5500U CDMA 1x/EVDO modem consists of the CDMA Engine, power generation part, digital part, RF part and connectors. The Fig 5-1 is block diagram of MM-5500U CDMA 1x/EVDO modem.
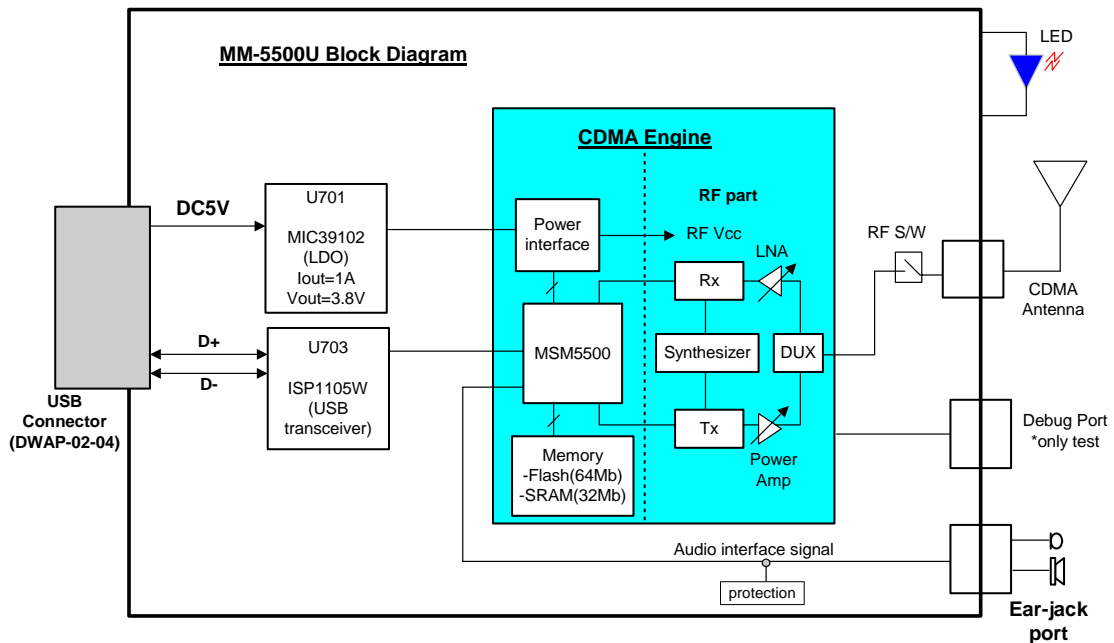

Figure 5.1 MM-5500U CDMA 1x/EVDO modem block diagram

5.2   Power interface part

DC Power is supplied from the USB connector.

- LDO(U701): This component is low dropout regulator. Output voltage is about 3.8V DC.

   This LDO output voltage is inputted to CDMA Engine power interface.

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

- U500 : voltage regulator for digital circuit (2.8 DC)

- U501 : voltage regulator for VC-TCXO and IFR3300 (3.0V DC)

- U502 : voltage regulator for RF Rx part (3.0V DC)

- U503 : voltage regulator for RF Tx part (2.85V DC)

- U505 : voltage regulator for digital part(2.7V DC)

- And power AMP is directly supplied.

5.3   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.

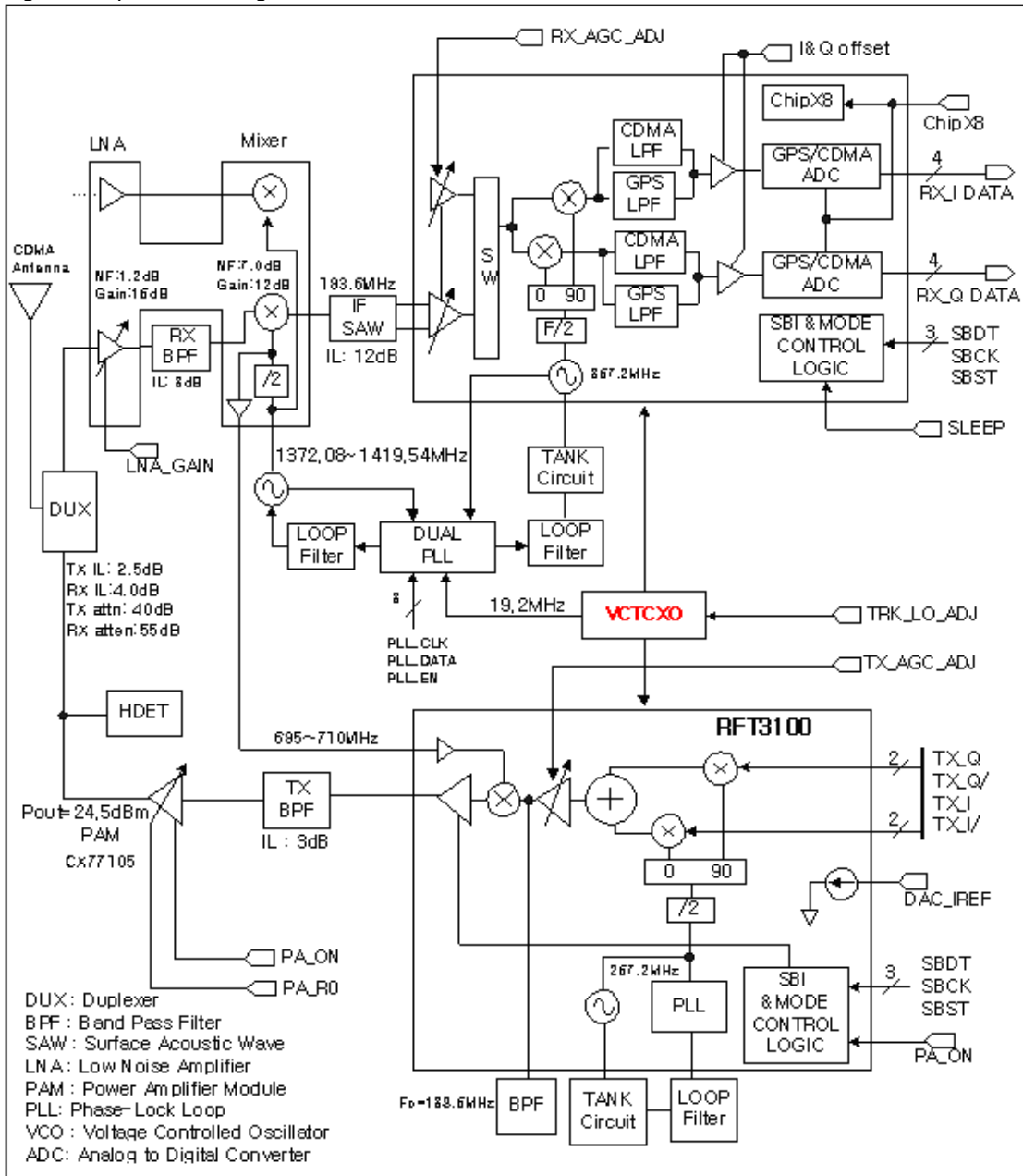   SRAM: performs to read and write data

- U703: USB transceiver is fully compliant with the USB specification Rev1.1.

5.4 RF part

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

Fig 5.2 RF part block diagram

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5.4.1.1   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 1372.08 ~ 1419.54 MHz frequency range. Tx IF and Rx IF synthesizer generate the second local oscillation frequency, 267.2 MHz and 367.2 MHz respectively.

5.4.1.2   Receiving part

- 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(Rx IF-baseband converter) and RFT3100(Tx baseband-IF converter). IFR3300 acts as the baseband analog processor which processing the signals between the IFR3300 and digital processing circuit.

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

5.4.1.3   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 transmission frequency 138.6 MHz and the first local 1372.08 ~ 1419.54 MHz to generate transmission frequency of 824.64 ~ 848.37 MHz.
- Power AMP module. This part is designed to work in 824 MHz ~ 849 MHz frequency range in the CDMA mode and can generate the proper output power. The DC voltage into the power amp module is typical 3.8V.

6. 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 card.
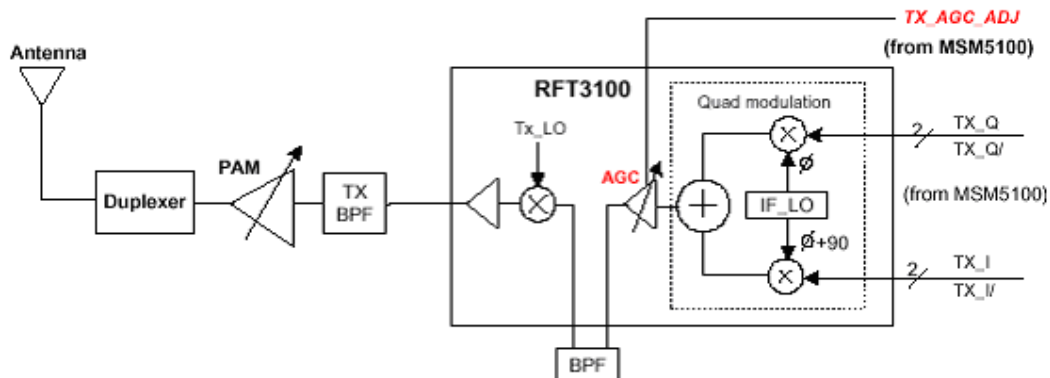
7. Description of frequency determining and stabilizing circuitry

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 IFR3300 chip. These parts generate the first local oscillation frequency, Rx IF frequency and Tx IF frequency.

- First local frequency Synthesizer : 1372.08 MHz ~ 1419.54 MHz

  PLL loop is composed of single PLL synthesizer, Loop filter, VCO and VC-TCXO

  It generates transmission and reception frequency of 1372.08 MHz ~ 1419.54 MH

- Rx IF synthesizer : 367.2 MHz

  Rx IF PLL loop is consisted of PLL synthesizer in the PLL module, VCO built in IFR3300, 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 : 267.2 MHz

  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 of 267.2 MHz and then generates Tx IF frequency of 138.6 MHz 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.
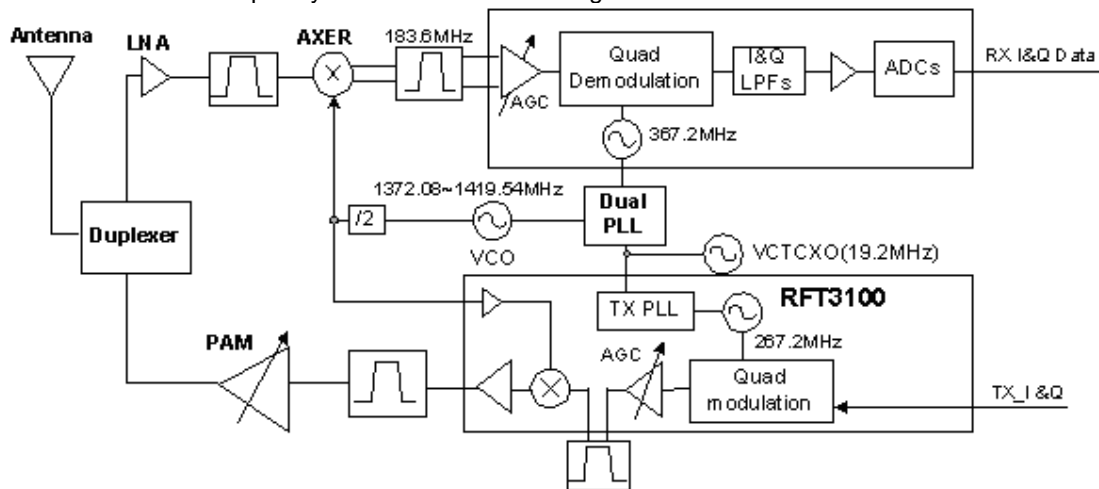
8. Description of circuit employed for suppression of spurious radiation

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 : 138.6 MHz

- 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

- 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

- Attenuation   : 869 MHz ~ 894 MHz : 40 dB min.

9. Description of modulation system used

The MM-5500U CDMA card consists of MSM, baseband analog interface (RFT31000, IFR3300) 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.
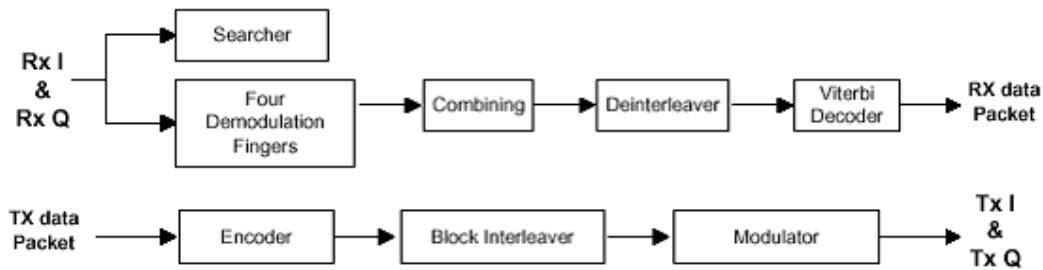

Figure 9.1 CDMA digital Baseband Block Diagram

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 8-2) accepts analog I and Q data from the MSM and outputs modulated IF centered at 138.6 MHz to the RF transmitter. The RFT3100 transmit path outputs a differential IF signal with spread spectrum modulation expending ±630KHz from the transmit IF center frequency of 138.6 MHz.

The analog I and Q baseband components from the CDMA low-pass filters are mixed in quadrature with unmodulated I and Q signals at 138.6 MHz. After mixing, the I and Q IF components are summed and output differentially. The 138.6 MHz I and Q IF VCO signals are generated on the RFT3100.

The transmitter IF VCO is set to 267.2 MHz 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 267.2 MHz. A master-slave divide-by-two circuit generates I and Q signals in precise quadrature for the mixers.