FCC Documentation

MM-5500SU CDMA 1X/EVDO Data Modem

Version : 0.1

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36a Gibson Avenue, Padstow
New South Wales, 2211. Australia
Phone: +61 2 9707 2000
URL: http//www.maxon.com.au

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 CDMA Engine (CCE-550) has been tested for FCC RF exposure hand and body SAR compliance with the MM-5500SU Wireless Modem organizer. In order to comply with FCC RF exposure requirements, the CDMA Engine must be operated with the MM-5500SU Wireless Modem organizer. The use of this device in any other type of host configuration may not comply with FCC RF exposure requirements and should be avoided. During operation, a 20 cm 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.**

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1. Contact Information

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

Maxon Electronics Australia Pty Ltd
36a Gibson Avenue
Padstow, New South Wales 2211
Australia

Phone: +61 2 9707 2000
Fax: +61 2 9707 3328

Mr. Ray Sanders – Managing Director
Mr. Ashween Prasad – Technical Manager
Email: engineering@maxon.com.au

2. Product Overview

2.1 Overview

The MM-5500SU Wireless Modem performs data communication functions between Host and IS-95A, B, CDMA2000-1X/EVDO CDMA Cellular station. The MM-5500SU Wireless Modem incorporates the wireless-modem functionality with the USB driver and power adaptor interface.

The MM-5500SU Wireless Modem connects directly to HOST computer utilizing an USB V1.1 interface. The MM-5500SU Wireless Modem functionality is specifically controlled from the Host via AT command sets. Range of supply voltage is from 5V to 7V on communication and 5V to 9V on idle. The power saving mode of the MM-5500SU Wireless Modem is controlled from the Host via USB port using AT command.

2.2 What is the MM-5500SU Wireless Modem

- IS-95A, B, and CDMA2000-1XEVDO CDMA Protocol Support
- USB1.1 Interface for data communication & Standard RS-232C for DM(Diagnostic Mode)
- Remote controlled by AT commands
- Comprehensive internal monitoring alerts
- 5 user profiles
- DATA Transmission up to 2.4[Mbps] (network limited)
- LED indicating of the modem status
- SMS 2-way support
- SMA antenna connector
- Secure 2-pin power jack
- Operating voltage of DC 5~9[V]
- Contemporary design
- Small size and light-weight

Figure 1. Appearance of MM-5500SU

3. Specifications

3.1 Mechanical Specifications

Table 1. Mechanical specifications

Dimensions	93mm x 79mm x 27mm, include projecting connect parts
Weight	Approx. 110g , except CDMA antenna and cable assemblies
Housing Material	CASE – SCM4 , SCM45C , Brackets – AL5052

3.2 Environment Specifications

Table 2. Environment specifications

Power supply voltage	DC +5V(minimum) ~ +9V(maximum) on idle state DC +5V(minimum) ~ +7V(maximum) on communication
Operating conditions	0°C ~ +60°C , 85%(at 50(C), relative humidity (non-condensing)
Storage Temperature	-40°C ~ +70°C

3.3 Electrical Specifications

Table 3. Current Consumption (Test condition: power supply=+5V, Temp.= 25°C)

Maximum current	Under 1.0A
Digital block operating voltage	+3.0V (typical)
On communication @ Maximum TX Power (24+/- 0.3dBm) with USB data communication	Under 800mA
Power down state - LED off, Modem sleep state	Under 30mA

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

3.4 USB specifications

The USB interface implemented in the MM-5500SU Wireless Modem complies with the Universal Serial Bus (USB) Specification Revision1.1.

3.5 CDMA RF Specifications

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

3.5.1 Transmitter specifications

Table 4. Transmitter performances

Type of Multiplexing	Frequency-Division Duplex
Frequency Range	824.64MHz ~ 849.37MHz
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	+3.75V DC @ Power Amp. +2.85V DC @ TX block

3.5.2 Receiver specifications

Table 5. Receiver performances

Type of Receiving		Super Heterodyne Method
Frequency Range		869.64MHz ~ 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 -108dBm @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

- ***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-5500SU CDMA 1X/EVDO Modem unit (1)
- CDMA Antenna (1)
- USB cable assembly (1)
- Power adapter assembly (1)

4.2 Getting start

First for mounting the MM-5500SU Wireless Modem, bind to the unit the holding bridles and connect accessory following procedure.

1. Connect **CDMA antenna** to the SMA connector – labeled "***SMA Ant***" at right bracket
2. Connect **USB data cable** assembly to the connector – labeled "***USB***" at left bracket
3. Connect **power adapter** assembly to the power connector – labeled "***PWR***" at left bracket

Note. Please pull out by grip the plug/connector, not the cable.

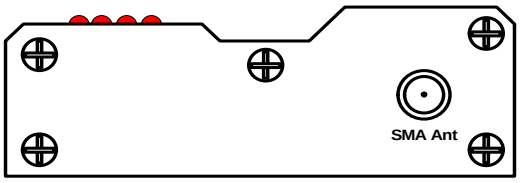

Figure 2. Right side bracket

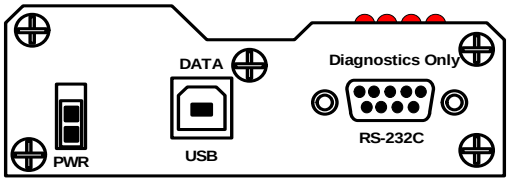

Figure 3. Left side bracket

4.3 Power Cable Guides

"PWR" port should be connected with the DC +5 power supply.

Table 6. Power connector Termination assignment

Connector type	Signal name	Description
2 pins	+	DC Power (DC +5V)
Micro-Fit 3.0	-	System reference(ground)

Note. To keep overall performance of the MM-5500SU Wireless Modem such as RF, the power supply should meet some electrical characteristics. For best performance, the good supply regulation is required because the most important characteristic of power supply follows the supplied voltage's stability.

4.4 Data Cable Guides

"**RS232C**" port should be connected with the TE2's COM port for DM communication.

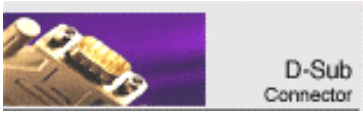

Figure 4. RS-232C cable of MM-5500SU

"**USB**" port should be connected with the TE2's USB port for data communication.

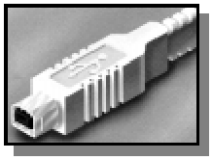

Figure 5. USB cable of MM-5500SU

Multiple service function (ex: SMS, Data and DM communication) of the MM-5500SU Wireless Modem will be serviced to out device through RS-232 and/or USB interface**.**

"USB" port is for data communication and the port can be connected with PC or external device directly. The Modem can communicate with only one port. The Modem is looking for active connection on power up time and communicates with the found connection. If both connections are active, USB will be selected. The USB will be Qualcomm solution which operates under MS-Windows-98SE and MS-Windows2000.

4.5 LED Display Guides

The MM-5500SU has four-LED Display that indicates status of the CDMA Engine. Below the Table 7 shows the status meaning.

Table 7. LED Display description

LED Display	Description
PWR	Indicate the CDMA power on
PKT	Indicate connection in Packet Switched mode
RSSI	Lights on in RSSI > -95dBm, Blinks in -95dBm > RSSI > -105dBm, Turn-off in RSSI < -105dBm
SMS	LED Blinking is unread SMS message exist

5. Circuit description

5.1 MM-5500SU interface board circuit description

The MM-5500SU interface board consists of the CDMA Engine(Model name: CCE-550), power generation part, RS-232 & USB transceiver part, LED driver part and connectors. The Fig 1-1 is block diagram of MM-5500SU interface board and CDMA Engine.

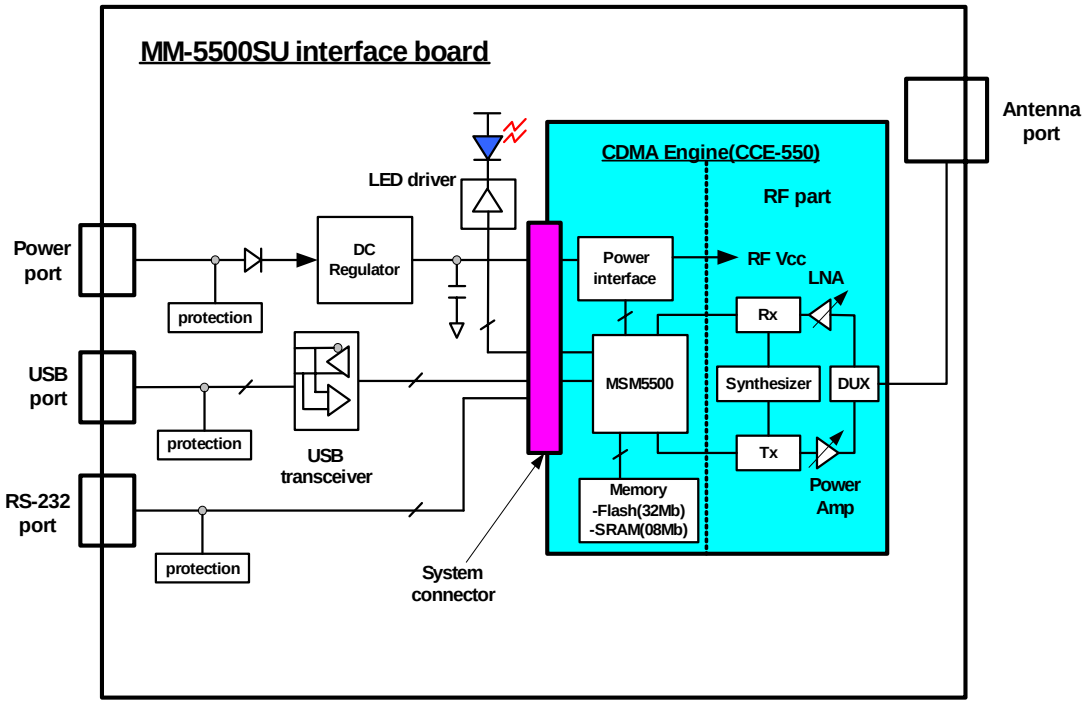

Figure 7. MM-5500SU interface board block diagram

5.2 Power generating part (MM-5500SU interface board)

DC Power is supplied by external source – battery or adaptor- operating over 5V to 7V range.

- DC Regulator: This component is regulator that accepts input voltage up to 6V DC. Output voltage is about 3.75V DC.

This DC regulator output voltage is inputted to CDMA Engine pin (pin signal name: VBATT).

5.3 RS-232 part (MM-5500SU interface board)

The MM-5500SU wireless modem communicates with PC for DM(Diagnostic Mode) port that indicates the CDMA modem's status. The CDMA Engine contains UART(Universal Asynchronous Receiver / Transmitter) for DM. The CDMA Engine provides 3.0V CMOS level signals and it is translated to RS-232C signal level at the MM-5500SU interface board.

5.4 USB interface part (MM-5500SU interface board)

The MM-5500SU wireless modem contains a USB (Universal Serial Bus) interface to provide an efficient interconnect between the Modem and a Host (PC). The MM-5500SU wireless modem's USB interface is designed to comply with the Universal Serial Bus specification, Revision 1.1.

The MM-5500SU wireless modem's USB interface supports full-speed (12Mbps) data rates.

5.5 LED driver part (MM-5500SU interface board)

Signals outputted from the CDMA Engine are used to control ON/OFF of LEDs.

Table 8. LED Display description

LED Display	Description
PWR	Indicate the CDMA power on
PKT	Indicate connection in Packet Switched mode
RSSI	Lights on in RSSI > -95dBm, Blinks in -95dBm > RSSI > -105dBm, Turn-off in RSSI < -105dBm
SMS	LED Blinking is unread SMS message exist

5.6 CDMA Engine circuit description

5.6.1 RF part (CDMA Engine)

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

Fig 4.2 CDMA Engine block diagram of RF part circuit

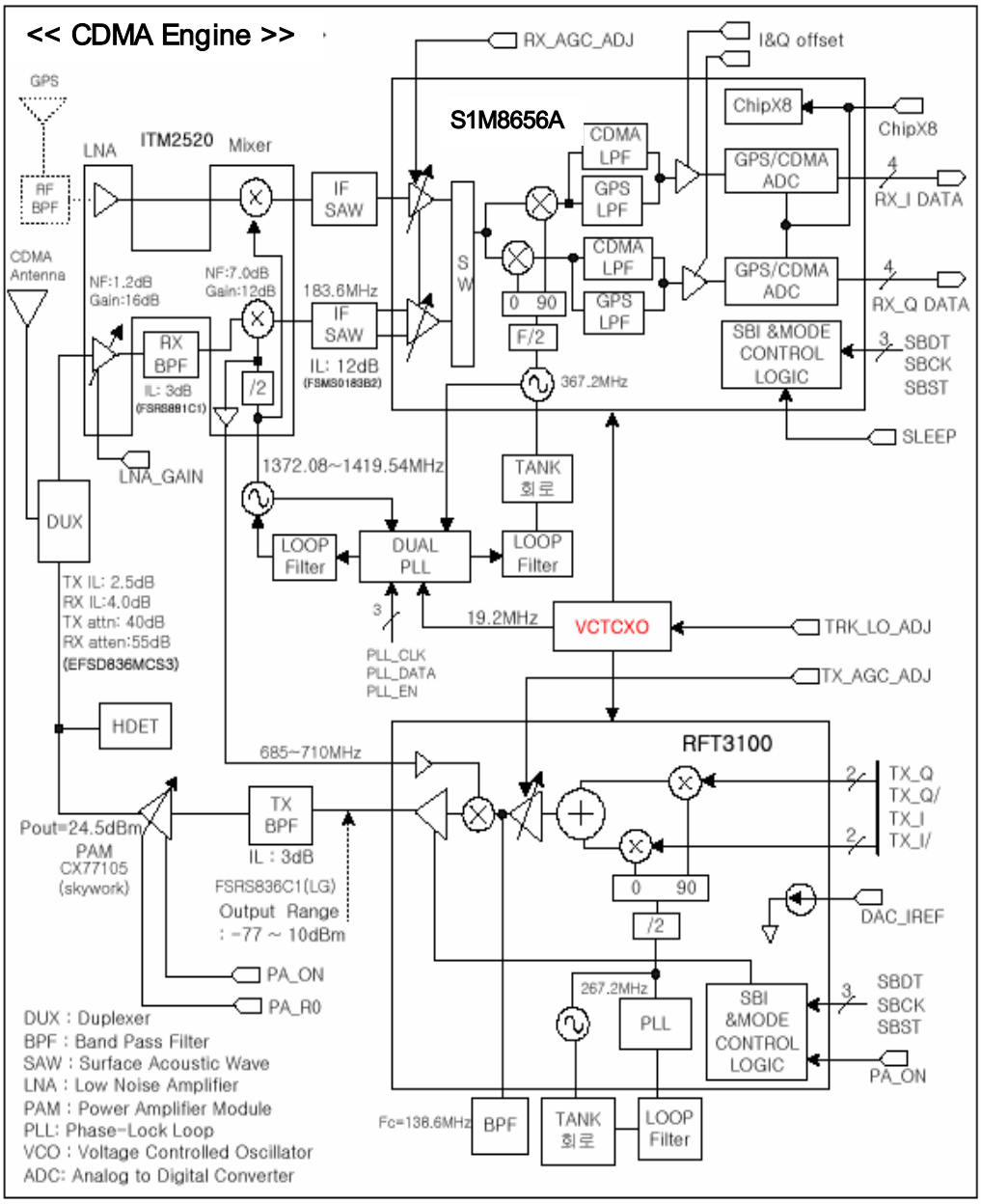

Figure 8. CDMA Engine(CCE-550) block diagram

5.6.1.1 Frequency synthesizing Part (for CDMA Engine)

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.

5.6.1.2 Receiving Part (for CDMA Engine)

- 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 S1M8656A(Rx IF-baseband converter) and RFT3100(Tx baseband-IF converter). S1M8656A acts as the baseband analog processor which processing the signals between the S1M8656A and digital processing circuit.

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

5.6.1.3 Transmission Part (for CDMA Engine)

- 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 and current supplied into the power amp module is typical 3.75V and 0.3A. In this CDMA Engine, power AMP is directly activated using internal DC/DC converter output voltage.

5.6.2 Logic Part (CDMA Engine)

5.6.2.1 DC Power supply Part(CDMA Engine)

The voltage regulator on interface board step-downs the supplied voltage to 3.75V for CDMA Engine.

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 S1M8656A(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 by battery.

5.6.2.2 Digital Part(CDMA Engine)

- 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.

5.6.2.3 Memory Part (CDMA Engine)

Memory part consists of Flash memory and SRAM.

Flash memory : store to main program.

SRAM : performs to read and write data

The system adapt CSP type memory, combination to Flash memory and SRAM

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 Engine.

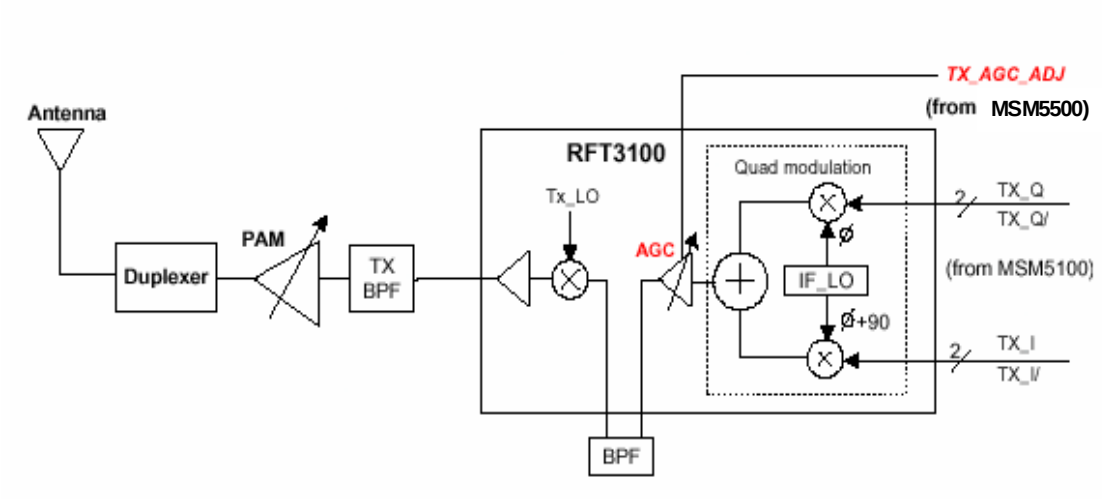

Figure 9. Output Circuit

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 S1M8656A 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 9551372.08 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 S1M8656A, 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.

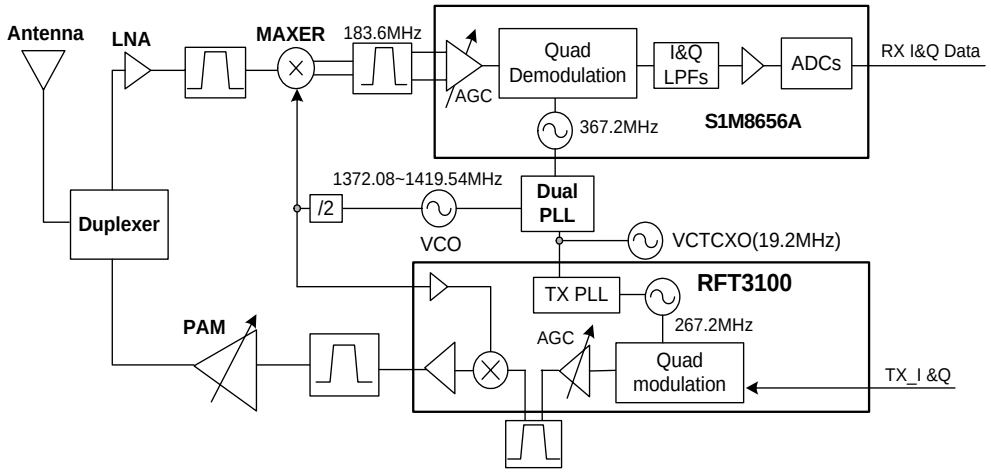

Figure 10. Frequency determining and stabilizing and circuitry

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 bandpass 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 CDMA Engine consists of MSM, baseband analog interface (RFT3100, S1M8656A) 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.

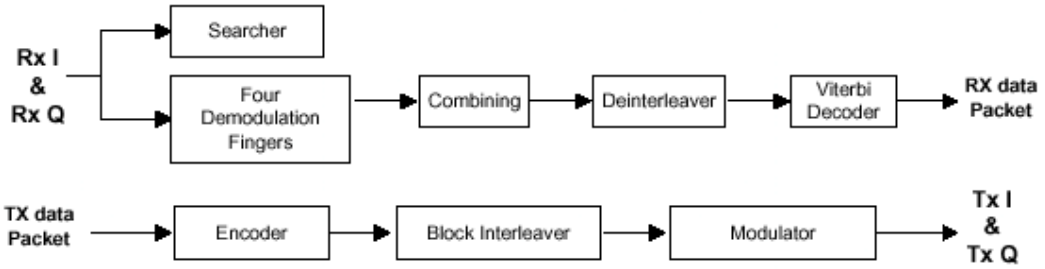

Figure 11. CDMA digital base-band block diagram

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 base-band 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 base-band components from the CDMA low-pass filters are mixed in quadrature with un-modulated 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.

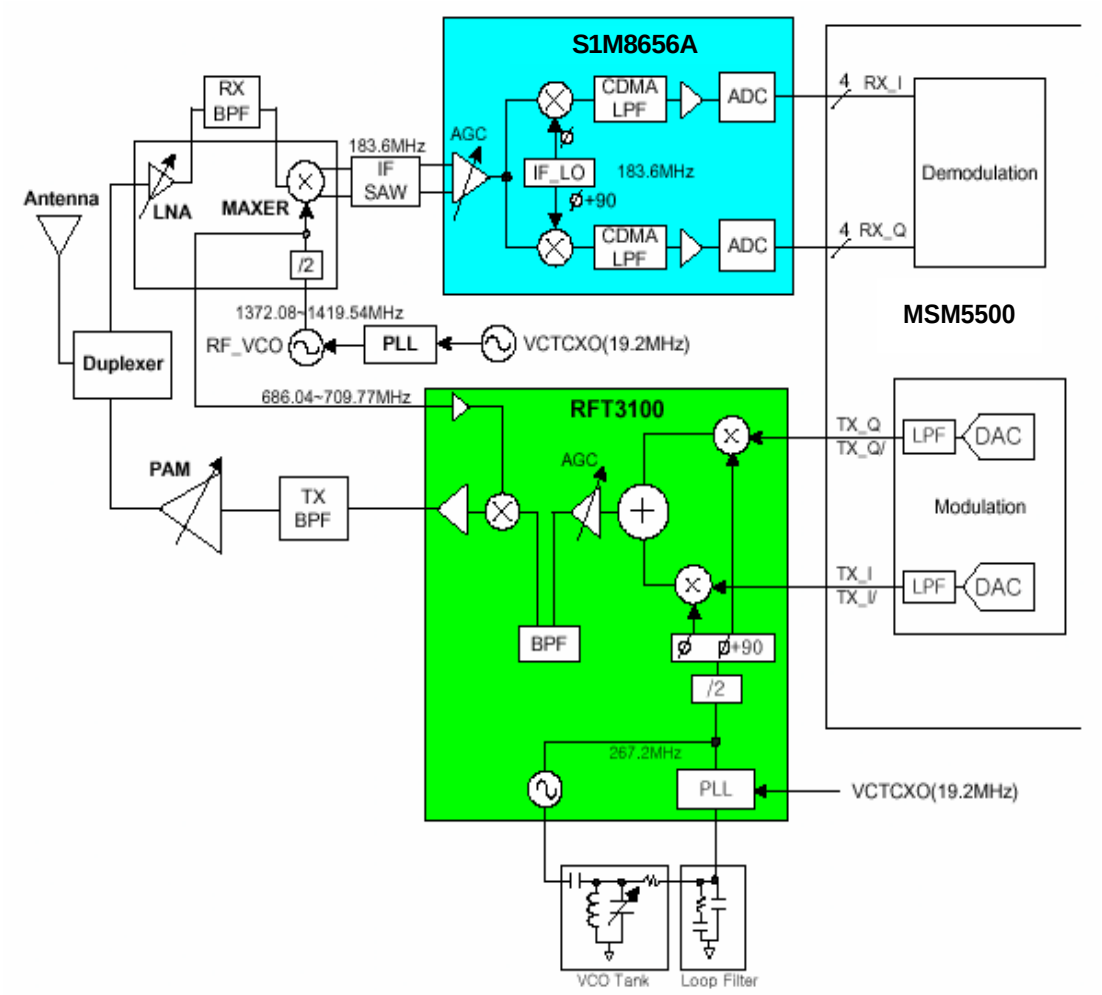

Figure 12. S1M8656A and RFT3100 functional block diagram