The CDMA Wireless Data Modem is a complex consumer communications instrument that relies heavily on both digital signal and embedded processor technologies. The Wireless Data Modem manufactured by AnyDATA.net support Code-Division-Multiple-Access(CDMA). Operating both the cellular and PCS spectrum.

CHAPTER 3. Circuit Description

1. Overview

IRT3000 receives modulated digital signals from the MSM of the digital circuit and then, changes them into analog signals by the digital/analog converter (DAC, D/A Converter) in order to create baseband signals. Created baseband signals are changed into IF signals by IFT3000 and then, fed into the Mixer after going through AGC. IF signals that have been fed are mixed with the signals of VCO and changed into the RF signals and then, they are amplified at the Power AMP. Finally, they are sent out to the cell site via the antenna after going through the isolator and duplexer.

2. RF Transmit / Receive Part

2.1 CDMA Transmit End

8 bit I and Q transmit signals are inputted into 2 DACs (DIGITAL-TO-ANALOG CONVERTER) from the output terminal TX_IQDATA0 ~ TX_IQDATA7 of MSM through the input terminals TXD0~TXD7 of BBA. Transmit signal input speed is two times of TXCLK+, TXCLK- which are two transmit/receive reference frequency.
Among transmit signals being inputted, signals are inputted into I signal DAC when the transmit clock is in the rise edge, whereas signals are inputted into Q Signal DAC during the drop edge. I and Q transmit signals are compensated and outputted at MSM in order to compensate the 1/2 clock time difference generated between reference clocks. In the signals coming out from the output terminal of DAC, there are spurious frequency ingredients resulting from DAC output transition edge and parasite ingredients, transmit clock frequencies and harmonics which are unwanted signals. Accordingly, spurious ingredients are removed by passing the signals through LPF of passband 6.30KHz. Unlike the receive end, the transmit end LPF requires no OFFSET adjustment. Analog baseband signals that have passed the CDMA LPF are mixed with I and Q signals of frequency 130.38 MHz (260.76 MHz created in the BBA internal VCO are divided by half into frequency 130.38MHz having the phase difference of 90 degrees) in two mixers. The mixed signals are added again and converted into IF frequency 130.38 MHz ±630 KHz (CDMA Spread Power Density Modulated Signals) and then, outputted.

2.2. Tx IF/Baseband Processors, IFT3000 (U105)

The IFT3000 includes digital-to-analog converters(DAC) for converting digital baseband to analog baseband, low-pass filters, a mixer for up-converting to IF and an 85 dB dynamic range Tx AGC amplifier. The IFT3000 includes a fully programmable phase-locked loop(PLL) for generating Tx LO and IF frequencies. The IFT3000 also has an 8-bit general purpose ADC with three selectable inputs for monitoring battery level, RF signal strength and phone temperature.

2.3. Upconverter (U104)

Upconverters made up of a mixer part and Driver AMP part. The mixer part is used to receive double-balanced OUT+ and OUT- of transmit AGC from baseband and mix the output of VCO (U171) with UHF output signal, whereas the Amp part is used to buffer the output of this mixer. U105 has the operation range of RF500MHz~1500MHz and has the conversion gain of 0 dB. In addition, the suppression of spurious signals which are unwanted noise is about 30 dBc when being compared to RF output. The IF input signal range of the mixer is DC~200MHz. The isolation on RF output terminal and LO signal input terminal at the IF input terminal is 30dB. The range of LO signal that can be inputted is 300~1700MHz and power level is -6~0 dBm.

2.4. Transmit Bandpass Filter (F102, F103)

Transmit signals that have been converted from IF signals into RF signals after passing through the upconverter U105 are inputted into the Power Amp U102 after passing once again through RF BPF F102 in order to filter out noise signals amplified during the amplification of RF signals after going through upconverter(U105). This is carried out in order to create power level inputted to the Power AMP via RF BPF F102. IL of two RF BPFs is 4dB as a maximum, whereas the ripple in the passing band is 2dB(maximum). The degree of the suppression of transmit signals on receive band is at least 20dB or greater. The maximum power that can be inputted is about 25dBm.

2.5. Power Amplifier (U102)

The power amplifier U102 that can be used in the CDMA and FM mode has linear amplification capability, whereas in the FM mode, it has a high efficiency. For higher efficiency, it is made up of one MMIC (Monolithic Microwave Integrated Circuit) for which RF input terminal and internal interface circuit are integrated onto one IC after going through the AlGaAs/GaAs HBT (heterojunction bipolar transistor) process. The module of power amplifier is made up of an output end interface circuit including this MMIC. The maximum power that can be inputted through the input terminal is +17dBm and conversion gain is about 28dB. RF transmit signals that have been amplified through the power amplifier are sent to the duplexer and then, sent out to the cell site through the antenna in order to prevent any damages on circuits, that may be generated by output signals reflected from the duplexer and re-inputted to the power amplifier output end.

2.6. Description of Frequency Synthesizer Circuit

2.6.1 Voltage Control Temperature Compensation Crystal Oscillator(U174, VCTCXO)

The temperature range that can be compensated by U174 which is the reference frequency generator of mobile terminal is -30 ~ +80 degrees. U174 receives frequency tuning signals called TRK_LO_ADJ from MSM as 0.5V~2.5V DC via R and C filters in order to generate the

reference frequency of 19.68MHz and input it into the frequency synthesizer of UHF band. Frequency stability depending on temperature is ± 2.0 ppm.

2.6.2 UHF Band Frequency Synthesizer (U172)

Reference frequency that can be inputted to U172 is 3MHz~40MHz. It is the dual mode frequency synthesizer (PLL) that can synthesize the frequencies of UHF band 50MHz~1200MHz and IF band 20MHz~300MHz. U172 that receives the reference frequency of 19.68MHz from U174 creates 30kHz comparison frequency with the use of internal program and then, changes the frequency of 900MHz band inputted from X200 which is the voltage adjustment crystal oscillator into the comparison frequency of 30kHz at the prescaler in U172. Then, two signal differences are calculated from the internal phase comparator. The calculated difference is inputted to DC for adjusting the frequency of U174 through U172 No.2 PIN and external loop filter in order to generate UHF signals. In addition, outputs of other PIN17 are inputted into BBA after going through the VRACTOR diode and tank circuit so that the outputs of BBA internal receive end VCO are adjusted to 170.76MHz.

2.6.3 Voltage Control Crystal Oscillator (U171)

U171 that generates the LO frequency (900MHz) of mobile terminal receives the output voltage of PLL U172 and then, generates the frequency of 954MHz at 0.7V and the frequency of 980MHz at 2.7V. The sensitivity on control voltage is 23MHz/v and the output level is 1dBm(maximum). Since LO frequency signal is very important for the sensitivity of mobile terminal, they must have good spurious characteristics. U174 is -70dBc(maximum).

3. Digital/Voice Processing Part

3.1 Overview

The digital/voice processing part processes the user's commands and processes all the digital and voice signal processing in order to operate in the phone. The digital/voice processing part is made up of a receptacle part, voice processing part, mobile station modem part, memory part, and power supply part.

3.2 Configuration

3.2.2 Voice Processing Part

The voice processing part is made up of an audio codec into digital voice signals and digital voice signals into analog voice signals, amplifying part for amplifying the voice signals and sending them to the ear piece, amplifying part that amplifies ringer signals coming out from MSM3000, and amplifying part that amplifies signals coming out from MIC and transferring them to the audio processor.

3.2.3 MSM (Mobile Station Modem) Part

MSM is the core elements of CDMA terminal and carries out the functions of CPU, encoder, interleaver, deinterleaver, Viterbi decoder, Mod/Demod, and vocoder.

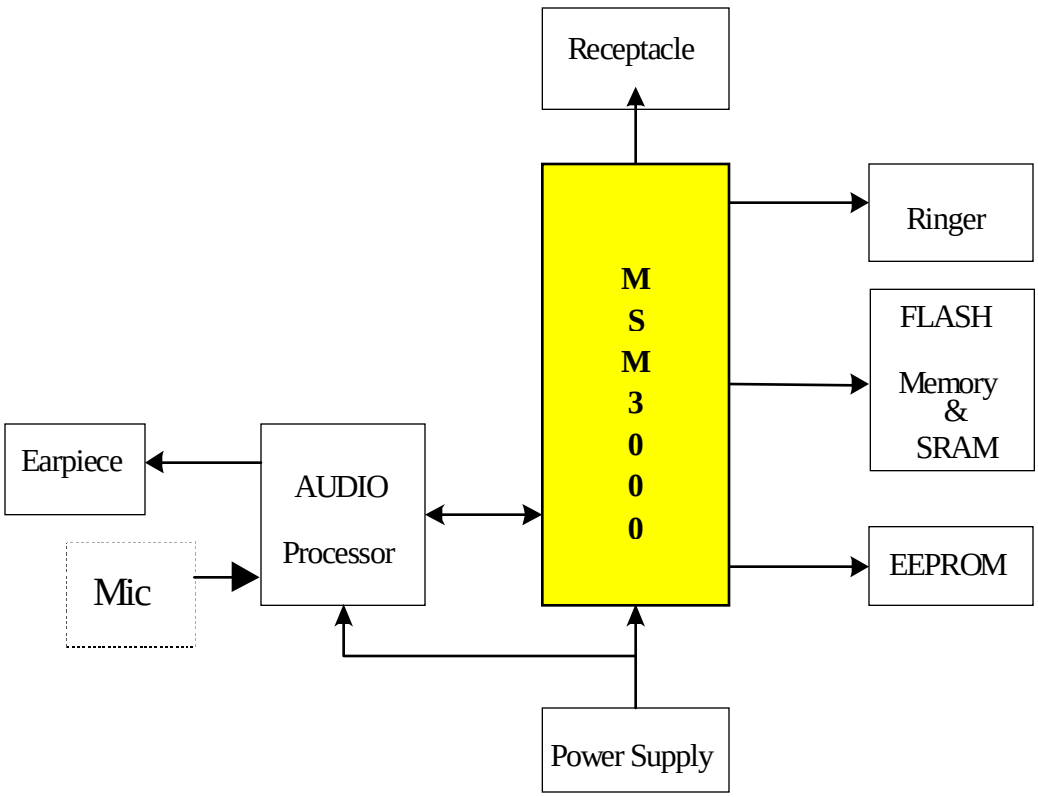
3.2.4 Memory Part

The memory part is made up of a flash memory, SRAM for storing data, and EEPROM.

3.2.5 Power Supply Part

The power supply part is made up of circuits for generating various types of power, used for the digital/voice processing part.
+4.2V from external DC (+6V) is fed into five regulators(U605,U603,U602,U604,U606).
The five regulators produces +3.0V for the IFR3000(U204) and for Tx Parts.

3.3 Circuit Description



[Figure 3-1] Block Diagram of Digital/Voice Processing Part

3.3.2 Audio Processing Part

MIC signals are amplified through the audio codec which is U401 (TWL1103), and converted into digital signals. Then, they are inputted into MSM3000. In addition, digital audio signals outputted from MSM3000 are converted into analog signals after going through the audio codec to be amplified. and then transferred to the ear piece.

3.3.3 MSM Part

MSM3000, which is U301, is the core element of CDMA system terminal that includes ARM7TDMI microprocessor core. It is made up of a CPU, encoder, interleaver, deinterleaver, Viterbi decoder, MOD/DEM, and vocoder. MSM3000, when operated in the CDMA mode, utilizes CHIPX8 (9.8304MHz) as the reference clock that is received from IFR3000, and uses TCXO (19.68MHz) that is received from U174. CPU controls the terminal operation. Digital voice data that have been inputted are voice-encoded and variable-rated. Then, they are convolutionally encoded so that error detection and correction are possible. Coded symbols are interleaved in order to cope with multi-path fading. Each data channel is scrambled by the long code PN sequence of the user in order to ensure the confidentiality of calls.
Moreover, binary quadrature codes are used based on Walsh functions in order to discern each channel.
Data created thus are 4-phase modulated by one pair of Pilot PN code and they are used to create I and Q data.
When received, I and Q data are demodulated into symbols by the demodulator and then, de-interleaved in reverse to the case of transmission. Then, the errors of data received from Viterbi decoder are detected and corrected. They are voice decoded at the vocoder in order to output digital voice data.
The MSM3000 has a improved feature not found on the MSM2300. The MSM3000 supports Enhanced Variable Rate Coder (EVRC) operation in addition to the standard 8k and 13k vocoding rating.

3.3.4 Memory Part

Memory part consisit of Flash Memory,SRAM and EEPROM.
In the Flash Memory part included SRAM of U308 (8M x 2M bits), there are programs used for terminal operation. The programs can be changed through down loading after the assembling of terminals. On the SRAM(2Mbits), data generated during the terminal operation are stored temporarily. On EEPROM (128Kbits) which is U307, non-volatile data such as unique numbers (ESN) of terminals are stored.

3.3.5 Power Supply Part

When the External DC (4.2V) is fed to the five regulators generated +3.0V. The generated voltages are used for MSM3000, IFT3000,IFR3000, audio codec, and other LOGIC parts. PWR ASIC is operated by the control signal SLEEP/ from MSM3000 and POWER_EN signal.
Q606(DTC114EE) is turned on by ON_SW_SEN
SE/ and then, 'L' is outputted on ON_SW_SENSE/. MSM receives this signal and then, recognizes that the POWER key has been pressed. During this time, MSM outputs PS_HOLD as

'H' and then, continues to activate D603 in order to maintain power even if the PWR key is separated.

3.3.6 Logic Part

The Logic part consists of internal CPU of MSM, RAM, ROM and EEPROM. The MSM3000 receives TCXO (=19.68Mz) from U7 and CHIPX8 clock signals from the IFR3000, and then controls the phone during the CDMA and the FM mode. The major components are as follows:

CPU : ARM7TDMI core

FLASH MEMORY + SRAM: U308 (LRS13061)

- FLASH ROM : 8Mbits
- STATIC RAM : 2Mbits

EEPROM : U307 (X84129S161-2.5)

- 128Kbits EEPROM

CPU

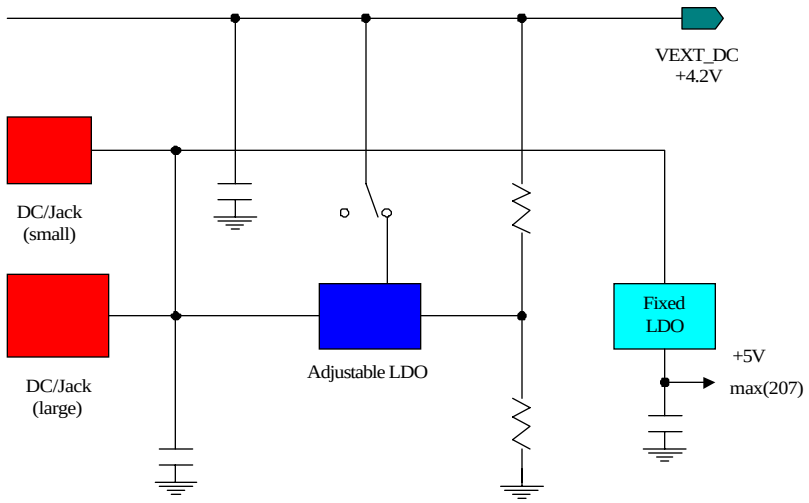
ARM7TDMI CMOS type 16-bit microprocessor is used and CPU controls all the circuitry. For the CPU clock, 27MHz is used.

FLASH ROM and SRAM

Flash ROM is used to store the terminal's program. Using the down-loading program, the program can be changed even after the terminal is fully assembled.
SRAM is used to store the internal flag information, call processing data, and timer data.

4. Level Translator Part

4.1 L/T supply power to Modem(4.2V).



[Fig 4-1] The Block Diagram of Source (in brief)

4.2 UART Interface

The Universal Asynchronous Receiver Transmitter (UART) communicates

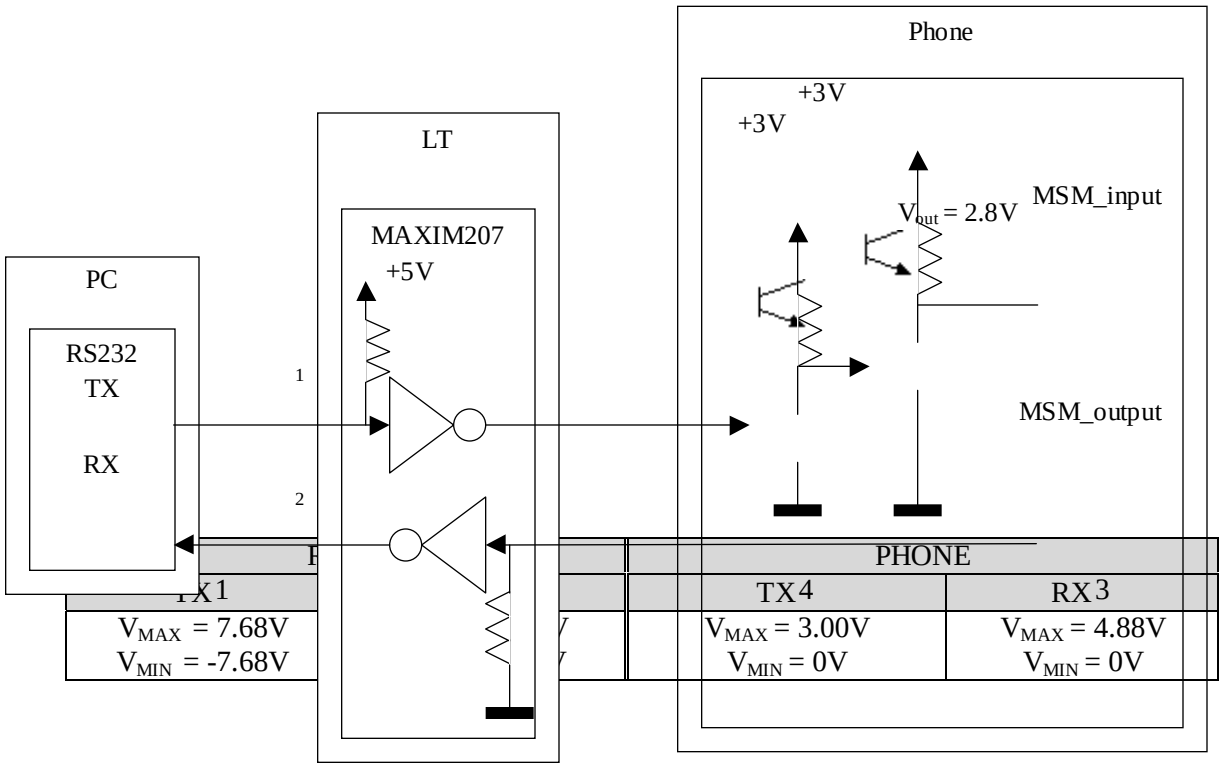
with serial data that conforms the RS-232 Interface protocol. The modem provides 3.0V CMOS level outputs and 3.0V CMOS switching input level. And all inputs have 5.0V tolerance but 3.0V or 3.3V CMOS logic compatible signals are highly recommended.
All the control signals of the RS-232 signals are active low, but data signals of RXD, and TXD are active high.

The UART has a 64byte transmit (TX) FIFO and a 64byte receive (RX) FIFO. The UART Features hardware handshaking, programmable data sizes, programmable stop bits, and odd, even, no parity. The UART operates at a 115.2kbps maximum bit rate.

4.2.1 UART Inter Pinouts

NAME	DESCRIPTION	CHARACTERISTIC
DP_DCD/	Data Carrier Detect	Network connected from the modem
DP_RI/	Ring Indicator	Output to host indicating coming call
DP_RTS/	Request to Send	Ready for receive from host
DP_TXD	Transmit Data	Output data from the modem
DP_DTR/	Data Terminal Ready	Host ready signal
DP_RXD	Receive Data	Input data to the modem
DP_CTS/	Clear to Send	Modem output signal
GND	Signal Ground	Signal ground

4.2.2 Signal level of RXD/TXD



[Figure 4-2] Signal Level of RXD, TXD

4.3 LED State Indication

	Name	Enable	Description
1	D17(SMS)	Low	Shot Message Service
2	D1(BUSY)	Low	State that Data transmit and receive between DTE and DCE
3	D2(IDLE)	Low	Stable State

4.4 The function of Real Audio Test(including Voice Test)

NAME	TYPE	DESCRIPSION
MIC+	I	Microphone audio input
MIC-	IS	Ear/microphone set detect
EAR	O	Ear audio output
GND_A		Audio ground