

MSM6500™ CHIPSET SOLUTION

QUALCOMM CDMA TECHNOLOGIES

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MSM6500™ CHIPSET SOLUTION

Overview

QUALCOMM CDMA Technologies' (QCT) MSM6500™ chipset solution supports all major second generation (2G) and third generation (3G) technologies deployed worldwide. It brings the rich experience of 3G high-speed wireless data and worldwide roaming in a single-chip offering. The MSM6500 supports data rates of up to 2.4 Mbps on third generation (3G) CDMA networks that are ideal for high-end entertainment and multimedia applications while allowing roaming with second generation (2G) GSM/GPRS networks. The MSM6500 solution supports CDMA2000® 1X, CDMA2000 1xEV-DO and GSM/GPRS standards in a single-chip multimode implementation. The integration of GSM and GPRS into the MSM6500 family represents a natural evolution of QCT's product line, building on the company's extensive CDMA expertise to develop multimode solutions that address a single emerging worldwide market.

Like all the members of the MSM6xxx™ family, the MSM6500 solution features QCT's radioOne™ direct RF-to-baseband conversion technology, resulting in cost-effective multi-band, multimode handsets that can be produced in smaller form factors. The high-speed data access of the MSM6500 chipset will enable a new generation of handsets, smartphones, PDAs, video phones, data terminals, handheld computers and other wireless devices offering advanced video, gaming and multimedia services.

Seamlessly integrated into the MSM6500 solution is QCT's Launchpad™ applications suite, supported by our BREWapi™ (Binary Runtime Environment for Wireless™ Application Programming Interface), delivering superior multimedia, connectivity, position location, user interface and storage functionality. The Launchpad suite includes MPEG-4 video decoding/encoding, Qtunes™ MP3 audio decoding, Compact Media Extensions™ (CMX™) MIDI-based multimedia software, a digital camera interface, JPEG encoder/decoder, USB host, Bluetooth™ connectivity capabilities (which eliminates the need for wired connections between digital devices), and gpsOne™ technology for highly accurate positioning.

The MSM6500 chipset solution consists of the MSM6500 baseband processor, direct conversion RFL6000™ and RFR6000™ receiver devices, the integrated direct conversion RTR6300™ transmit device and GSM transceiver, the powerOne™ series PM6650™ power management device and a compatible power amplifier device. It is also compatible with the RFT6100™ if only CDMA2000 1X and 1xEV-DO systems operation is desired. These devices perform all of the signal processing and power management in the subscriber unit.

radioOne Technology

The radioOne solution offers a revolutionary technology for CDMA transceivers that uses Zero Intermediate Frequency (ZIF), or direct conversion, architecture for the wireless handset market. Direct conversion eliminates the need for large IF Surface Acoustic Wave (SAW) filters and additional IF circuitry, which reduces the handset Bill

of Materials (BOM), resulting in very cost-effective multi-band and multimode handsets that can be produced in smaller form factors.

Using advanced techniques developed by QCT to enable high-dynamic-range receivers, radioOne technology solves the problem of stringent interference specifications with which CDMA phones must comply. Our radioOne technology also incorporates the frequency synthesis and passive elements used in converting baseband signals to and from RF. A single external local oscillator is used for the CDMA receiver, which provides the capabilities needed to operate on systems around the world, and simplifies the procurement of parts while greatly reducing the cost of designing CDMA handsets.

MSM6500 Device Description



Based on the industry-leading MSM6100™ architecture, the MSM6500 solution incorporates a low-power, high-performance reduced instruction set computing (RISC) microprocessor core featuring the ARM926EJ-S™ central processing unit (CPU) and Jazelle™ accelerator circuit for advanced Java® applications from ARM® Limited.

In addition to the ARM core technology and radioOne architecture, the MSM6500 chipset integrates two new QDSP4000™ digital signal processor (DSP) cores, supports cost-effective high-performance memory architecture, and offers other sophisticated features, including an enhanced LCD interface, support for USB host controller through an embedded USB On-The-Go (OTG) core, and a graphics accelerator. The MSM6500 chipset utilizes a state-of-the-art 0.13u CMOS production process and advanced packaging technology.

The MSM6500 solution integrates functions that support CDMA operation and data rates of up to 2.4 Mbps on 1xEV-DO systems and up to 307 kbps on forward and reverse links simultaneously on CDMA2000 1X systems. These capabilities meet the Electronic Industries Alliance/Telecommunications Industry Association (EIA/TIA) IS-856 and Interim Standard 2000 (IS-2000) Revision A respectively. The MSM6500 chipset is also fully backward compatible with IS-95A/B cdmaOne™ networks. Receive diversity is supported on the CDMA2000 1X and 1xEV-DO modes—enhancing voice capacity on CDMA2000 1X systems and improving data throughputs on CDMA2000 1X and 1xEV-DO systems. The MSM6500 GSM/GPRS solution supports Phase 2+ of GSM and GPRS class B, multi-slot class 10 data services.

The MSM6500 chipset and system software supports QCT's gpsOne position location technology, which merges GPS satellite and network information to provide a high-availability solution with industry-leading accuracy and performance for a new class of mainstream CDMA2000 1xEV-DO handsets. This solution not only meets the FCC E911 mandate under the most challenging conditions, but also provides a ubiquitous platform for a rapidly increasing number of location-based applications and services.

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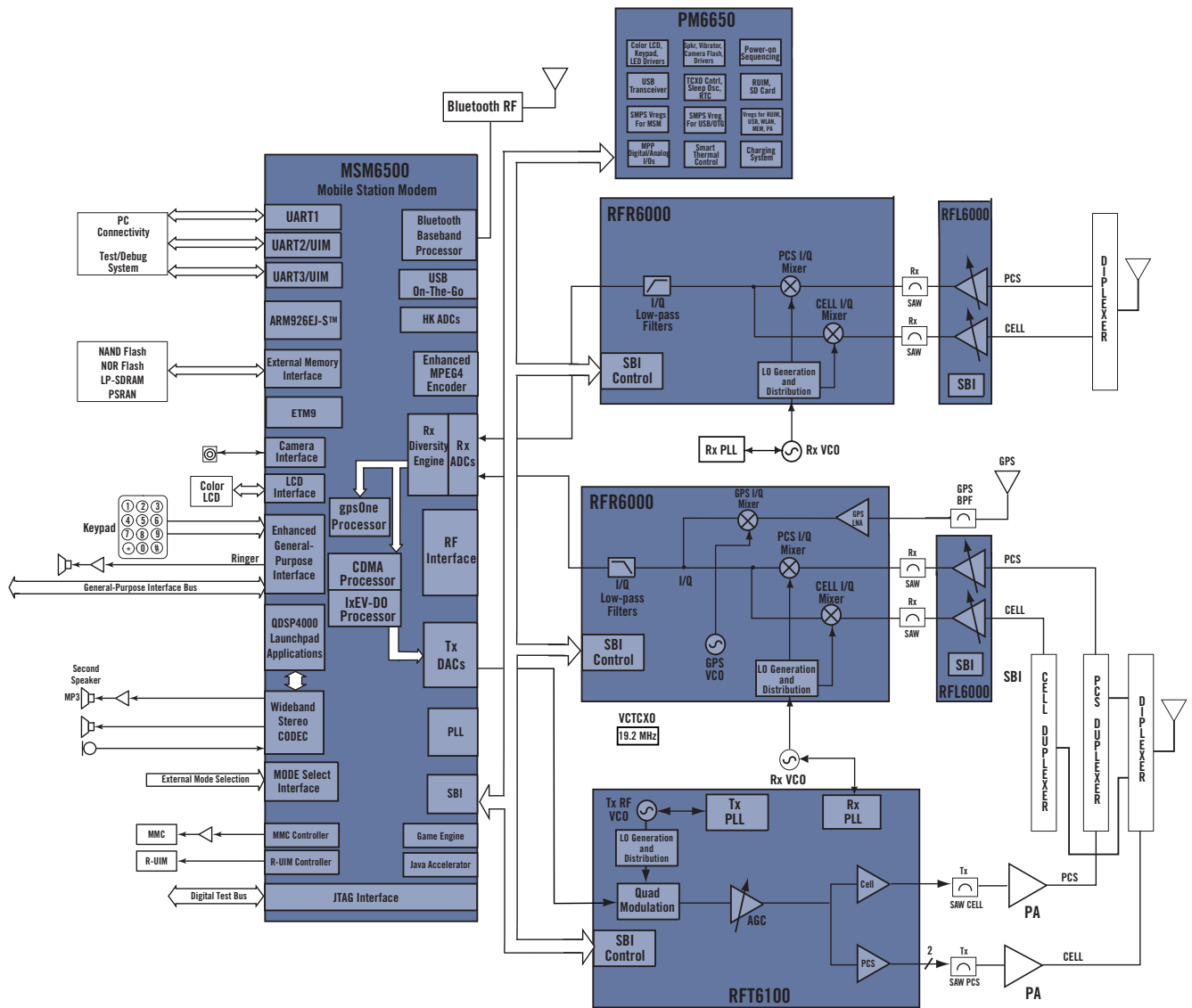
The Mobile Station (MS) collects measurements from the GPS constellation and the cellular/PCS network, and then sends the information to the Position Determination Entity (PDE), which optimizes the position location calculation based on existing information. gpsOne technology will enable consumer-priced, position-capable CDMA handsets. The chipset block diagram illustrates the baseline architecture for the MSM6500 and CDMA/GPS terminal devices.

The MSM6500 chipset and system software is also capable of operating in a standalone gpsOne mode, in which the handset acts as a GPS receiver.

MSM6500 Device Features

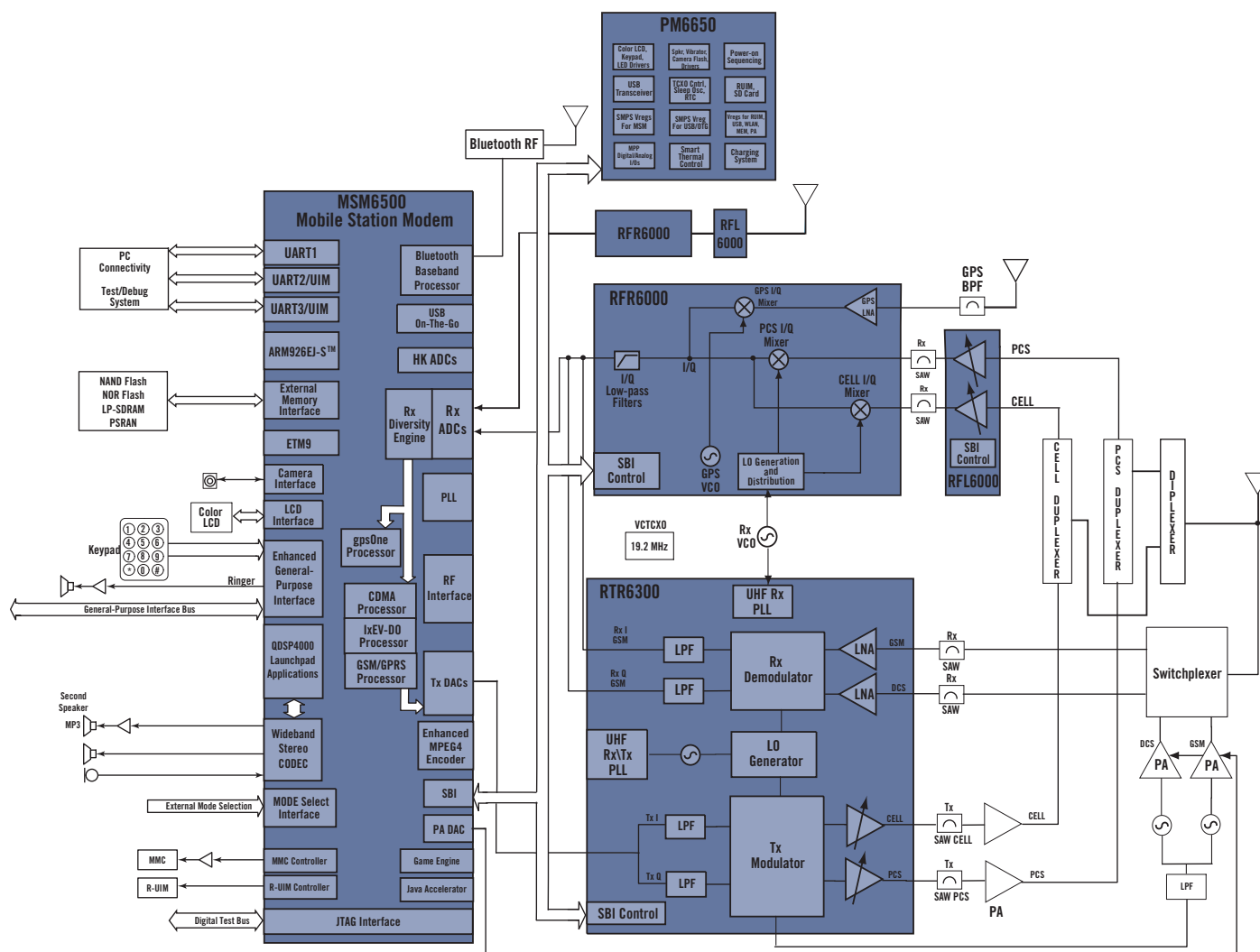
The MSM6500 system solution consists of the MSM6500, RFL6000, RFR6000, RFT6100 or RTR6300, PM6650, DMSS™ (Dual-Mode Subscriber Software™) and SURF6500™ platform, and features:

- CDMA2000 1xEV-DO (IS-856) support
- CDMA2000 1X (IS-2000)
- GSM/GPRS support, 3GPP compliant Revision 99 class B, multi-slot class 10 data services
- Receive diversity on CDMA2000 1X and 1xEV-DO systems
- High-performance ARM926EJ-S microprocessor core with memory management unit (MMU)



MSM6500 Chipset Architecture Configured for 1X/1xEV-DO with Receive Dual Diversity

- Java hardware acceleration through Jazelle core for faster Java-based games and other applets
- Advanced QDSP4000 DSP cores
- Integrated MPEG-4 decoder/encoder for streaming Video-On-Demand (VOD) and video-mail applications
- Integrated JPEG decoder/encoder for camera-based applications
- Integrated 2D/3D graphics accelerator engine for a more enhanced user experience
- Integrated Bluetooth baseband processor for wireless connectivity to peripherals
- Integrated gpsOne functionality that is capable of operating in standalone mode
- Integrated wideband stereo codec for digital audio applications
- Qtunes audio decoder
- Support for multiple vocoders; EVRC, and 13K QCELP®, Adaptive Multiple Rate (AMR), Full Rate (FR), Enhanced FR (EFR), and Half Rate (HR)
- Integrated USB OTG controller to enable direct connectivity to USB enabled accessories, such as printers, digital cameras, keyboards and CD-ROMs
- Direct interface support for cost-effective low-voltage, high-performance memory such as low-power SDRAM, page-mode NAND Flash, page and burst-mode NOR Flash among others
- Direct interface with advanced color LCD controllers and displays
- Direct interface to digital camera module
- Voice Recognition (PureVoice VR™), including speaker-independent digit dialing
- Multimedia Card (MMC) support
- Removable Universal Identity Module (R-UIM) card interface
- Multi-band operation; Cellular, PCS, EGSM, and DCS frequency bands along with GPS and Bluetooth technology
- Support for QCT's BREWapi platform
- Advanced 409-pin 0.5 mm pitch CSP packaging technology (14 mm x 14 mm)



MSM6500 Chipset Architecture Configured for Receive Dual Diversity 1X/1xEV-DO with Dual-Band GSM/GPRS

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RFT6100 Device Description



The RFT6100 device is a direct conversion chipset that integrates all the upconversion and modulation functionality necessary for CDMA and FM-mode phones operating in cellular and PCS bands. This transmit chip consists of two I/Q modulators, one for cellular and one for the PCS band. The baseband I/Q input from the MSM directly modulates the cellular or PCS carrier derived from the respective LO generation circuit.

Both the cellular and PCS output drive their own variable gain amplifier (VGA) with a gain control range of 85 dB. A final cellular driver amplifier provides a modulated RF output.

To accommodate split band and filtering, the PCS VGA drives two output amplifiers that can be selected independently or simultaneously via an input selectable switch. All RF outputs have fully integrated 50-ohm matching networks. Integrated on the RFT6100 is the receiver phase locked loop (PLL), the transmit PLL, and the entire transmit VCO including resonant components. The VCO drives the LO generation block, which in turn generates the required local-oscillator signal for all CDMA bands of operation.

RFT6100 Device Features

- Reduction in component count, space and cost via radioOne chipset that eliminates receiver and transmitter IF
- Single- or dual-band operation: cellular and PCS
- Single- or multimode operation:
 - Cellular FM
 - Cellular CDMA
 - PCS CDMA
- Full direct upconversion from analog baseband to RF
- Transmit signal path:
 - Baseband amplifier
 - Two-quadrature modulator/upconverter
 - RF AGC amplifier, switch network, driver amplifier
- Integration of LO generation circuit
- Requirement of only one external VCO for all CDMA bands of operation
- Entire transmit synthesizer on chip (transmitter PLL and VCO)
- Receiver PLL on chip
- Greater than 85 dB transmit power control range
- Power-reduction feature via MSM control extends handset talk time
 - Optimized for low DC power consumption versus RF output level
 - Transmit puncturing
 - Selective circuit power down
- Efficient three-line QCT Serial Bus Interface (SBI)
- Power supply voltage (2.7 to 3.0 V)
- Small thermally efficient package (40-pin BCC++)

RTR6300 Device Description



The RTR6300 device is a highly integrated RF device that incorporates a dual-band CDMA 1X transmitter with a dual-band GSM/GPRS transceiver. It derives its architecture from QCT's radioOne direct conversion devices for CDMA.

RTR6300 CDMA 1X Transmit Section

The RTR6300 device contains all the upconversion and modulation functionality necessary for CDMA and FM mode phones operating in cellular and PCS bands. This transmit chip consists of two I/Q modulators, one for cellular and one for the PCS band. The baseband I/Q input from the MSM directly modulates the cellular or PCS carrier derived from the respective LO generation circuit.

Both the cellular and PCS output drive their own VGA with a gain control range of 85 dB. A final cellular driver amplifier provides a modulated RF output. To accommodate split band and filtering, the PCS VGA drives two output amplifiers that can be selected independently or simultaneously via an input selectable switch. All RF outputs have fully integrated 50-ohm matching networks.

Integrated on the RTR6300 device is the receiver PLL, transmit PLL and the entire transmit VCO, including resonant components. The VCO drives the LO generation block, which in turn generates the required local oscillator signal for all CDMA bands of operation.

RTR6300 CDMA 1X Transmit Features

- Reduction in component count, space and cost via radioOne chipset that eliminates receiver and transmitter IF
- Single- or dual-band operation: cellular and PCS
- Single- or multimode operation:
 - Cellular CDMA
 - PCS CDMA
- Full direct upconversion from analog baseband to RF
- Transmit signal path:
 - Baseband amplifier
 - Two-quadrature modulator/upconverter
 - RF AGC amplifier, switch network, driver amplifier
- Integration of LO generation circuit
- Requirement of only one external VCO for all CDMA bands of operation
- Entire transmit synthesizer on chip (transmitter PLL and VCO)
- Receiver PLL on chip
- Greater than 85 dB transmit power control range
- Power reduction feature via MSM control extends handset talk time
 - Optimized for low DC power consumption versus RF output level
 - Transmit puncturing
 - Selective circuit power down

- Efficient three-line SBI
- Power supply voltage (2.7 to 3.0 V)
- Small thermally efficient package (48-pin BCC++)

RTR6300 GSM/GPRS Transceiver Section

The RTR6300 device also has an integrated transceiver for GSM bands for both GSM and GPRS modes. It contains a dual-band GSM/GPRS translational loop transmitter, which consists of lowpass filtering with DC offset correction circuitry, I/Q modulators and offset phase locked loop (OPLL). The transmit signals are derived from the baseband interface from the MSM6500 device. The signals are modulated to IF via the I/Q modulators, then applied to the OPLL where its output drives the GSM Power Amplifier (PA). The GSM receiver contains two LNAs, two direct conversion mixers and lowpass filtering. Also on chip are two UHF PLLs designed to support fast channel acquisition for GPRS and 3GPP compress mode operation.

The RTR6300 device voltage range is from 2.7 to 3.3 V, which provides operating compatibility for platforms utilizing a single-cell Li-Ion battery design. Operating modes for the RTR6300 device are controlled by the MSM6500 chip via the three-line SBI, and include selective power-down and gain control for optimal power savings and talk-time improvement. The RTR6300 device is fabricated on an advanced SiGe BiCMOS process, which accommodates both precision high-frequency analog circuits and low-power CMOS functions, and is provided in a 48BCC++ plastic package that includes an exposed center ground slug for improved RF grounding, mechanical strength and thermal continuity.

RTR6300 GSM/GPRS Features

- Simple single-pole RC baseband reconstruction filter between MSM6500 DAC and RTR6300 device
- Integrated synthesizer and LO generator system for GSM Tx/Rx and CDMA 1X Tx bands, eliminating external RF components
 - Two UHF PLLs designed to support Fast Channel Acquisition for GPRS
- GSM receiver with settable gain states
- Integrated differential LNAs, mixers and baseband filter for receive GSM operation
- Translational Loop Transmitter for GSM
 - Need for second local oscillator eliminated
 - Integrated low-pass filter and precision I/Q modulator
- Integrated DC auto-calibration system for GSM Tx/Rx operation
- MSM6500-controlled operation via newer, faster SBI
- Supply voltage from 2.7 to 3.3 V
- 48-pin BCC++ (7 x 7 mm²)

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RFL6000 Device Description



Integrated into the RFL6000 device are two low-noise amplifiers (LNAs): a cellular LNA and PCS LNA. Both LNAs utilize three gain settings that are programmable through the SBI.

Operating modes—sleep, Rx, and Rx/Tx—as well as LNA bias currents are all automatically adjusted via software to minimize DC power consumption. Depending on handset status, the LNA bias current adjusts to meet RF performance requirements with minimal power consumption.

The RFL6000 device is fabricated using SiGe BiCMOS process, which is suited for high performance RF circuits, and is packaged in a very small 16-pin bump chip carrier (16-pin BCC++).

RFL6000 Device Features

- Reduction in component count, space and cost via radioOne chipset that eliminates receiver and transmitter IF
- Two integrated LNAs with programmable gain steps
- Cellular LNA supports CDMA and FM modes
 - Cellular bands of operation in China, Japan, Korea, and the United States
 - Three CDMA gain settings
 - Two FM gain settings
- PCS LNA supports PCS CDMA operation
 - PCS bands of operation in China, Korea, and the United States
 - Three CDMA gain settings
- Programmable mode and bias control to reduce DC power consumption
- High reverse isolation
- Efficient three-line SBI
- Low power consumption
- Small package: 16-pin BCC++ (4 mm x 4 mm)
- SiGe BiCMOS process fabrication

RFR6000 Device Description



The RFR6000 device is the radioOne zero IF downconverter. The device has three mixers which, when combined with the RFL6000 device, provide full RF-to-baseband downconversion for the cellular, PCS and GPS bands. The LO generation block produces all LO signals, and only one external single-band VCO is required for all CDMA frequency bands of operation.

Included on the chip is the GPS LNA as well as the entire GPS VCO, including resonant components. The Rx PLL, which resides on the transmit companion chipset (the RFT6100 device), is switched between the GPS Voltage Control Oscillator (VCO) and the external Rx VCO.

Extension of standby time is achieved by selective circuit power down, gain control and bias current. These features, along with all radioOne chipset functions, are controlled by the MSM.

The RFR6000 device is designed to operate with 2.7 to 3.1 V power supplies and is compatible with single-cell Li-Ion batteries. Compatibility to the lower voltage (1.8 to 3.1 V) is assured when VDDM is connected to the MSM pad voltage.

The RFR6000 chip is fabricated using a SiGe BiCMOS process, which provides high-frequency, high-precision analog circuits as well as low-power CMOS functions. Package type is 40 BCCP, which includes a large ground slug for improved grounding, mechanical strength and thermal conductivity.

RFR6000 Device Features

- Compatibility with QCT's radioOne Zero IF chipset that eliminates the entire IF and reduces component count and space
- Single- or multi-band operation (cellular, PCS, GPS)
- Single- or multimode operation: cellular CDMA, PCS CDMA, cellular FM and GPS
- Full downconversion—RF to baseband
- Receive path circuitry
 - GPS LNA
 - Stepped gain control
 - Three-quadrature down converter
 - Band-specific low-pass filter
- Baseband amplifiers with DC offset adjustment
- Need for only one single-band external VCO (Rx VCO) for all CDMA bands of operation for entire radioOne chipset.
- Includes entire on-chip GPS VCO—including resonant circuit
- Individual circuit power on/off controls
- Power reduction feature control and extended handset standby time
 - Selective circuit power-down
 - Gain and bias controls
- Low power supply voltage (2.7 to 3.1 V), low power dissipation
 - Compatible with lower MSM voltage (1.8 to 3.0 Vdd)
- Small, thermally efficient package (40 BCC++)

powerOne Series PM6650 Device Description



The MSM6500 device also interfaces directly with the first in QCT's new powerOne series power management ICs, the PM6650 device. The PM6650 solution provides battery management and charging functions, including a USB charging option, and voltage regulation for the various MSM power

regimes, the radioOne chipset and all other MSM-supported peripheral features. Exceptional power savings are realized through the use of a switch-mode power supply (SMPS) from the PM6650 device to regulate the MSM's core voltage. All voltages generated for the MSM and radioOne RF chips are optimized for handset system control with the MSM6500 system software.

The PM6650 chip offers unparalleled integration of power management functions for CDMA terminals, affording a tremendous savings in size and BOM for handset design. Integrated features include a color LCD backlight driver, USB OTG transceiver, R-UIM and SD Card interface, PA bias control, speaker driver, real-time clock, TCXO control, and various general housekeeping and interface functions, making the PM6650 chip the ideal power management solution for feature-rich terminals.

PM6650 Features

- Complete battery management, voltage regulation, general housekeeping and user-interface functions for UMTS terminals
- Compatible with QUALCOMM's radioOne ZIF chipset and all MSM-supported peripheral features
- Trickle, fast, constant voltage and pulsed charging modes for the main battery, with current monitoring for over-current protection
- Available USB charging option with automatic charging source selection
- Complex power management, including MSM power-on sequencing and control, and dynamic voltage scaling for maximum power savings
- Switch-mode power supply (SMPS), which provides high-efficiency voltage regulation for the MSM core, and 1.8 V high-speed external bus interface and memory circuits

- SMPS voltage control for optimized PA Vdd and bias control for maximum talk-time performance
- SMPS voltage generation for white LEDs used for Color LCD backlighting
- USB OTG transceiver included
- Configurable Multi-Purpose Pins (MPPs) for digital or analog I/O utility functions such as general-purpose LED drivers, USIM or SD-Card-level translation, programmable resistors or digital switches
- High-current LED driver for Camera Flash application
- Speaker driver with programmable gain, turn-on time, and muting; single-ended or differential operation (drives external 8-ohm speakers with volume-controlled 500 mW)
- Real-time clock for tracking time, calendar functions, programmed durations and generating associated alarms
- TCXO Control provides warm-up, synchronization, and buffering of the TCXO signal for optimal QPH/catnap timing and maximum standby-time performance
- Automated power-on recovery from sudden momentary power loss
- Support for coin cell back-up battery (including charging)
- 84 BCCS dual-row bump chip carrier package (7 mm x 7 mm)

QUALCOMM's Complete Solution — Our Commitment to our Partners

QUALCOMM CDMA Technologies is enabling the future of communications. We work closely with our manufacturer and operator partners to develop solutions that meet market needs today and provide the technology foundation for the wireless communications of tomorrow. Our world-class CDMA engineers create detailed reference designs to accelerate testing and deployment for our partners. And our chipsets and system software are fully integrated and able to bring advanced features and functionality to today's wireless devices. With QUALCOMM CDMA Technologies, manufacturers and operators can offer sophisticated wireless solutions that succeed in the global marketplace.



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