

**MSM6100 Chipset Architecture Using QCT's radioOne Zero Intermediate Frequency (ZIF)**

**Overview**

At QUALCOMM CDMA Technologies (QCT), we strive to constantly improve the indispensable communication tools we all use every day. QCT creates state-of-the-art chipsets, system software, development tools and products—such as the Launchpad™ suite of hardware cores and software—that enable the most advanced wireless multimedia applications available on a wireless device—while continually reducing complexity, cost and board-space requirements.

Third-generation (3G) mobile products are becoming personal information tools for work and entertainment, taking advantage of multimedia content delivered through high-speed data access. 3G form factors—smart phones, PDAs, handheld computers or other devices—will benefit from the MSM6100™ chipset's multimedia support for MP3 players, audio e-mail, still image e-mail, video e-mail, image capture, voice capture, karaoke, 2D/3G games, advanced gaming with position location and a whole host of applications using the core Launchpad features.

QCT's MSM6100 solution, part of QCT's MSM6xxx™ Mobile Station Modem™ (MSM™) family of chipsets and system software uses QCT's revolutionary radioOne™ Zero Intermediate Frequency (ZIF), or direct conversion, architecture and is optimized to support voice and multimedia data applications while enabling CDMA2000® 1X network benefits. The MSM6100 solution provides a seamless migration path from 2G to 3G services and applications, and increases voice capacity for CDMA2000 1X networks. The MSM6100 solution will enable CDMA developers to quickly develop 3G CDMA2000 1X handsets that exceed the specifications of mobile stations for worldwide cdmaOne™ and 3G 1xMC systems, including those based on IS-95A/B and IS-2000 standards.

The MSM6100 chipset solution consists of the MSM6100 baseband processor, direct conversion RFL6000™ and RFR6000™ receive devices, the direct conversion RFT6100™ transmit device, PM6050™ power management device and a compatible power amplifier device. These devices perform all of the signal processing and power management in the subscriber unit.

# MSM6100™ CHIPSET SOLUTION

## radioOne technology

The radioOne solution offers a revolutionary technology for CDMA transceivers that uses 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 BOM, facilitating 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. 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 will provide the capabilities needed to operate on systems around the world and will simplify the procurement of parts and greatly reduce the cost of designing CDMA handsets.

## MSM6100 Device Description



The 3G CDMA2000 1X MSM6100 chipset and system software features radioOne direct conversion architecture and 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.

Compliant with the Electronic Industries Alliance/Telecommunications Industry Association (EIA/TIA) Interim Standard 2000 (IS-2000)

Revision A, the MSM6100 chipset and system software incorporates the advanced feature set of QCT's Launchpad suite of technologies, integrated Moving Picture Experts Group (MPEG-4) video decoding/encoding, MPEG Layer-3 (MP3) audio decoding, a 2D/3D graphics accelerator for advanced gaming applications, a Compact Media Extension™ (CMX™)/Musical Instrument Digital Interface (MIDI) synthesizer, a digital camera interface, an enhanced liquid crystal display (LCD) interface, and Joint Photographic Experts Group (JPEG) encoding/decoding.

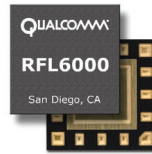
The MSM6100 solution also integrates two low-power, high-performance QDSP4000™ digital signal processor (DSP) cores and supports cost-effective memory architectures. Use of the ARM926EJ-S™ CPU and QDSP4000 DSP eliminates the need for the multimedia companion processor(s) normally required for video-based applications, playing MP3 music files and MIDI synthesizer/CMX functions.

The MSM6100 solution supports QUALCOMM's gpsOne™ position location technology, including standalone mode in which the handset can act as a GPS receiver. The gpsOne solution, featuring SnapTrack® technology, offers robust data availability under the most challenging conditions, whether in concrete-and-steel high-rises, convention centers, shopping malls, or urban canyons. Using a hybrid approach that utilizes signals from both the GPS satellite constellation and from CDMA cell sites, the gpsOne solution enhances location services availability, accelerates the location determination process and provides better accuracy for callers, whether during emergency situations or while using GPS-enabled commercial applications. The MSM6100 solution also supports the Launchpad's VectorOne™ compass capability.

### MSM6100 Device Features

- MSM6100 system solution consists of the MSM6100, RFL6000, RFR6000, RFT6100, PM6050, DMSS™ (Dual-Mode Subscriber Software™) system software and SURF6100™
- Supports CDMA2000 1XRTT Revision A
- Support for 307 kbps turbo and convolution coding
- High-performance ARM926EJ-S microprocessor core with memory management unit (MMU)
- Java hardware acceleration for faster Java-based games and other applets
- Advanced QDSP4000 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 more realistic game play
- Integrated Bluetooth™ baseband processor for wireless connectivity to peripherals
- Integrated wideband stereo codec for digital audio applications
- Direct interface support for cost-effective low-voltage, high-performance memory
- Direct interface with advanced color LCD controllers and displays
- Direct interface to digital camera module
- Advanced 341-pin 0.5mm pitch packaging technology (13 mm x 13 mm)
- Tri-Mode (CDMA cellular, CDMA PCS, AMPS cellular) operation
- Voice Recognition (PureVoice VR™), including speaker-independent digit dialing
- Multimedia Card (MMC) support
- Universal Serial Bus (USB)
- Removable Universal Identity Module (R-UIM) card interface

### RFL6000 Device Description



Integrated into the RFL6000 device are two Low Noise Amplifiers (LNA): a Cellular LNA and PCS LNA. Both LNAs utilize three gain settings that are programmable through the Serial Bus Interface (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 automatically to meet RF performance requirements with minimal power consumption.

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

### RFL6000 Device Features

- radioOne chipset eliminates receiver and transmitter IF, thereby reducing component count, space and cost
- Two integrated LNA with programmable gain steps
  - Cellular LNA supports CDMA and FM modes
    - Operates in cellular bands 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
- Fabricated in SiGe BiCMOS process
- Small package: 16-pin BCC++ (4mm x 4mm)

# MSM6100™ CHIPSET SOLUTION

## 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 band. The LO generation block produces all LO signals so that only one external single-band VCO is required for all CDMA frequency bands of operation.

Included on chip is the GPS LNA as well as the entire GPS VCO including resonant components. The Rx PLL, which resides on the transmit companion IC, the RFT6100 device, is switched between the GPS 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 of radioOne chipset functionalities are controlled by QUALCOMM's MSM.

The 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 the VDDM is connected to the MSM pad voltage.

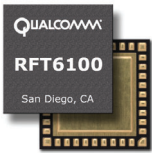
The RFR6000 device is fabricated using a SiGe BiCMOS process, which provide high-frequency, high-precision analog circuits as well as low-power CMOS functions. Package type is a 40-pin BCC++,

which includes a large ground slug for improved grounding, mechanical strength, and thermal conductivity.

## RFR6000 Device Features

- Compatibility with QUALCOMM's radioOne Zero IF chipset that eliminates the entire IF, thereby reducing 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-downconverter
  - Band-specific lowpass filter
  - Baseband amplifiers with DC offset adjustment
- Only one single-band external VCO (Rx VCO) is needed 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 extend handset standby time
  - Selective circuit powerdown
  - 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)
- Available in small, thermally efficient package (40-pin BCC++)

## RFT6100 Device Description



The RFT6100 is a direct conversion IC that integrates all the up-conversion and modulation functionality necessary for CDMA and FM mode phones operating in cellular and PCS bands. This transmit chip consists of I/Q modulators, one for cellular and the other 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 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

- radioOne chipset eliminates receiver and transmitter IF, thereby reducing component count, space and cost.

- 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
- Only one external VCO required 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 QUALCOMM SBI
- Power supply voltage (2.7 to 3.0 V)
- Available in small thermally efficient package (40-pin BCC++)

## MSM6100™ CHIPSET SOLUTION

### PM6050 Device Description



The MSM6100 device also interfaces directly with QCT's new power management chip, the PM6050 device, which provides battery management and charging functions, general housekeeping, and various functions supporting user interfaces. This device is optimized for handset system control

with the MSM6100 system software and include generating all the regulated voltages for the MSM and radioOne chipset.

The PM6050 offers unparalleled integration of power management functions for CDMA terminals, affording further savings in size and BOM for the handset design. The PM6050 chip supports many additional handset features, such as real-time clock and speakerphone applications, making it the ideal power management solution for feature-rich terminals.

### PM6050 Device Features

- Complete power management, housekeeping, and user interface functions for CDMA handsets, modems, PC cards, PDAs, etc.
- Fully compatible with QUALCOMM's radioOne Zero-IF chipset
- Valid external supply attachment and removal detection
- Supports unregulated and regulated charging systems
- Supports lithium-ion and nickel-based main batteries
- Trickle, constant current, constant voltage, and pulsed charging of the main battery
- Supports coin cell back-up battery (including charging)
- Current monitoring for overcurrent protection
- Voltage and current control loops to support unregulated external supplies
- Automated recovery from Sudden Momentary Power Loss (SMPL)
- Eight low-dropout regulator circuits with programmable output voltages
- Seven of eight regulators can be individually enabled/disabled for power savings
- 10-bit ADC for precise voltage and current measurements
- 10:1 analog multiplexer selects the ADC input signal (five wired internally, five accessible)
- Dual oscillators – 32.768 kHz off-chip crystal and on-chip RC assures MSM sleep clock
- Real-Time Clock for tracking time, calendar functions, and programmed durations and generating associated alarms
- On-chip adjustments minimize crystal oscillator frequency errors
- TCXO circuits control TCXO warm-up, and synchronize and buffer the TCXO signal
- Four programmable current sinks for driving backlights and LEDs
- Driver circuit compatible with 1.3 or 3.0 V vibrator motors
- Ringer/buzzer driver
- 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)
- MSM-compatible three-line serial bus interface for efficient initialization, status, and control
- 13 functions monitored and reported through real-time and interrupt status signals
- Dedicated circuits for controlled power-on sequencing, including the MSM's reset signal
- Supports and orchestrates soft resets

**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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