AirPrime MC8705 PCI Express Mini Card

Product Specification

SIERRA WIRELESS

2400057
Rev. 5

Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

Safety and Hazards

Do not operate the Sierra Wireless modem in areas where blasting is in progress, where explosive atmospheres may be present, near medical equipment, near life support equipment, or any equipment which may be susceptible to any form of radio interference. In such areas, the Sierra Wireless modem **MUST BE POWERED OFF**. The Sierra Wireless modem can transmit signals that could interfere with this equipment.

Do not operate the Sierra Wireless modem in any aircraft, whether the aircraft is on the ground or in flight. In aircraft, the Sierra Wireless modem **MUST BE POWERED OFF**. When operating, the Sierra Wireless modem can transmit signals that could interfere with various onboard systems.

Note: Some airlines may permit the use of cellular phones while the aircraft is on the ground and the door is open. Sierra Wireless modems may be used at this time.

The driver or operator of any vehicle should not operate the Sierra Wireless modem while in control of a vehicle. Doing so will detract from the driver or operator's control and operation of that vehicle. In some states and provinces, operating such communications devices while in control of a vehicle is an offence.

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Consult our website for up-to-date product descriptions, documentation, application notes, firmware upgrades, troubleshooting tips, and press releases:

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Revision History

Revision number	Release date	Changes
1	August 2010	Created document
2	October 2010	Marked pins 22 and 33 as ‘No connect’
3	January 2011	Replaced ‘tbd’ markers with current measurements
4	February 2011	Updated minimum voltage for pin 2, and marked pin 11 as No Connect in Table 4-1. Updated average GSM current in Table 6-3.
5	March 2011	Updated W_DISABLE# description in Control signals (20k pull-up resistor). Changed pins 30/32 to ‘NC’ from ‘Reserved’.

Contents

1: Introduction

The Sierra Wireless AirPrime® MC8705 PCI Express Mini Card is a compact, lightweight, wireless UMTS-based modem. It provides GPS, EDGE, GPRS, GSM, WCDMA, HSDPA, HSUPA, and HSPA+ connectivity for portable and handheld computers, point-of-sale devices, telemetry products and other machine-to-machine and vertical applications over several radio frequency bands:

- **GSM, GPRS, EDGE**
  850 MHz, 900 MHz, 1800 MHz, 1900 MHz
- **UMTS WCDMA/HSDPA/HSUPA/HSPA+**
  800 MHz, 850 MHz, 900 MHz, 1900 MHz, 2100 MHz
- Receive diversity
  Optimized for diversity on 800, 850, 900, 1900 and 2100 MHz
- **GPS**
  1575.42 MHz

The modem, based on Qualcomm's MDM8200A baseband processor, supports data operation on HSPA+, HSDPA, HSUPA, WCDMA, EDGE, and GPRS networks.

Specifications at a glance

This document describes high-level application and hardware interface requirements for integrating the MC8705 into a host product.

For more detailed information, see Supporting documents on page 13.

Table 1-1: MC8705 Modem features

Physical features
• Small form factor—conforms to F1 as specified in **PCI Express Mini Card Electromechanical Specification Revision 1.2** • Two U.FL RF connector jacks
Electrical features
• Single supply voltage (VCC): 3.2V–3.6V • Self-shielded—no additional shielding required

Table 1-1: MC8705 Modem features (Continued)

Short Message Service (SMS) features

• Send and receive (mobile originate and mobile terminate)
  ◦ Mobile-originated / terminated over CS and PS channels
  ◦ Mobile-originated SMS over PS falls back to CS if PS service is not available, or there is a PS network failure.
• New message notification
• Message sorting
• Multiple recipients
• Save contact details
• Mobile-originated SMS e-mail
• Mobile-originated / terminated SMS concatenation
• Mobile-originated SMS e-mail concatenation
• Receipt notification

Application interface features
• NDIS NIC interface support • Multiple non-multiplexed USB channel support • Dial-up networking • USB selective suspend to maximize power savings • AT command interface (27.007 standard, plus proprietary extended AT commands) • CnS—Sierra Wireless' proprietary Control and Status host interface protocol • Software Development Kit (SDK) including a Linux API (Application Program Interface)
Phone book
Supports Release 99 phone book features
Packet mode features

• Quad-mode UMTS (WCDMA) / HSDPA / EDGE / GPRS operation
• GPRS multislot class 12—Supports all coding schemes (CS1–CS4)
• EDGE multislot class 12—Supports all coding schemes (MCS1–MCS9)
• UMTS R99 (WCDMA) data rates—384 kbps downlink, 384 kbps uplink
• HSDPA data rates:
  ◦ Category 6—3.6 Mbps
  ◦ Category 8—7.2 Mbps
  ◦ Category 10—14.4 Mbps
  ◦ Category 12—1.8 Mbps
  ◦ Category 14—21.1 Mbps

Table 1-1: MC8705 Modem features (Continued)

Packet mode features

• HSUPA data rates
  ◦ Category 3—1.45 Mbps uplink respectively
  ◦ Category 5—2.0 Mbps uplink respectively
  ◦ Category 6—5.76 Mbps
• Circuit-switched data bearers—64 kbps (maximum) uplink and downlink

Voice mode features
The MC8705 does not support voice.
GPS features
Provides: • Standalone GPS functionality • gpsOneXTRA™ • A-GPS features • Enhanced Navigation 2.0 feature • NMEA support *Note: GPS specifications are preliminary targets which are subject to change without notice. Actual GPS functionality is dependent on the firmware version, and on module configuration.*
Connectivity / GSM features

• Multiple (up to 16) cellular packet data profiles
• Traditional modem COM port support for DUN, CSD, and AT commands (concurrent with NDIS)
• Suspend / Resume
• Sleep mode for minimum idle power draw
• SIM application tool kit with proactive SIM commands
• Enhanced Operator Name String (EONS)
• Automatic GPRS attach at power-up
• GPRS detach
• GPRS detach only
• Combined GPRS / IMSI detach; MS-initiated and network-initiated detach
• Mobile-originated PDP context activation / deactivation
• Support QoS profile
  ◦ Release 99 QoS negotiation—Background, Interactive, and Streaming
  ◦ Release 97—Precedence Class, Reliability Class, Delay Class, Peak Throughput, Mean Throughput

Table 1-1: MC8705 Modem features (Continued)

• Static and Dynamic IP address. The network may assign a fixed IP address or dynamically assign one using DHCP (Dynamic Host Configuration Protocol).
• PAP and CHAP support
• PDP context type (IPv4). IP Packet Data Protocol context
• RFC1144 TCP/IP header compression
• Interaction with existing GSM services (MO / MT SMS) while:
  ◦ GPRS is attached, or
  ◦ In a GPRS data session (class B GPRS suspend/resume procedures)
• Support for EAP-SIM authentication and PC / SC. EAP-SIM is available through:
  ◦ The API
  ◦ AT commands
  ◦ The PC / SC interface

Network selection
• Network selection procedures described in 3G 22.011, R5 (June 2005) • Network selection procedures described in 3G 23.122, R5 (June 2005) • RRC connection reject message to redirect from a 3G system to a 2G system, according to 25.331, R5 (June 2004) • Network selection procedures described in 3G 43.022, R4 • A CPHS Customer Service Profile-like feature [PLMN Mode bit] on a USIM / SIM that hides network selection related menus • Initial HPLMN scan at two minutes after power on • An HPLMN rescan irrespective of the serving MCC • Disabling of non-North American 2G and 3G frequency bands when served by a North American 2G/3G system • Equivalent PLMN • Network selection generally within 30 seconds of power up • Enhanced network selection (ENS)
RF features
• Quad-band GSM/GPRS (850 MHz, 900 MHz, 1800 MHz, 1900 MHz) • Five-band UMTS WCDMA FDD (800 MHz, 850 MHz, 900 MHz, 1900 MHz, 2100 MHz) • GPS (1575.42)
Environmental features
Operating temperature ranges • Regular use: -25 °C to +60 °C • Reduced RF performance: +60 °C to +75 °C

Support features

The MC8705 offers the following support features:

- Standard 1-year warranty
- Enabling software (drivers, SDK, etc.) for Linux
- USIM support

Supporting documents

There are several additional documents describing various aspects of the Mini Card, including design, usage, and integration issues. These documents (AT command references, integration guides, etc.) are available at www.sierrawireless.com/minicard. Contact your Sierra Wireless account representative to obtain access permission.

Accessories

The MC8705 Development Kit includes:

- Embedded Modem Interface Kit
- Documentation suite
- Initial allotment of support hours
- USB cable

Sierra Wireless also offers antennas.

Ordering information

To order, contact the Sierra Wireless Sales Desk at +1 (604) 232-1488 between 8 AM and 5 PM Pacific Time.

2: Technology Overview

HSPA+

HSPA+ is an enhanced version of HSPA (High Speed Packet Access), as defined by the 3rd Generation Partnership Project (3GPP) Release 7 UMTS Specification for Mobile Terminated Equipment. Using improved modulation schemes and refined data communication protocols, HSPA+ permits increased uplink and downlink data rates.

HSPA

HSPA is a third generation (3G) evolution of WCDMA that combines two extensions to UMTS—HSDPA (High Speed Downlink Packet Access) and HSUPA (High Speed Uplink Packet Access).

UMTS

The Universal Mobile Telecommunications System (UMTS) specification is the 3G mobile systems standard based on an evolution of GSM core network components. High-speed 3G systems implementing the UMTS standard enable improved performance for wireless data applications, delivery of enhanced multimedia content, and improved network capacity to support additional subscribers.

UMTS supports Quality of Service (QoS) classes that describe differing use requirements. From most to least delay-sensitive, the QoS classes are:

- **Streaming**—Preserves the time relation between information entities of the data stream.
  Example: streaming multimedia
- **Interactive**—Preserves the data integrity of information entities (request / response pattern).
  Examples: web browsing, network games
- **Background**—Preserves the data integrity of information entities. The destination is not expecting the data within a certain time.
  Example: downloading email

These classes support everything from time-insensitive background data transfer to more time-critical applications.

GPRS/EDGE

GPRS and EDGE are 2G wireless technologies providing end-to-end packet data services through reuse of existing GSM infrastructure.

Note: The network controls slot assignments based on current network loads and the bandwidth required by the mobile device—users cannot change slot assignments.

GPRS/EDGE packet data rates are determined by the number of timeslots available for downlink (Rx) and uplink (Tx), and the coding scheme used for any given transmission. The MC8705 supports multislot class 12 (four Rx slots (maximum), four Tx slots (maximum), five active slots total), and all standardized coding schemes(CS 1 to CS 4).

Data rates

Data rates for the MC8705 vary depending on timeslot/packet service availability. Table 2-1 summarizes theoretical data rates (see Data Rates on page 59 for details):

Table 2-1: MC8705 data rates

Packet data service		Theoretical max physical layer throughput
EDGE	Uplink	236 kbps
	Downlink	236 kbps
UMTS	Uplink	384 kbps
	Downlink	384 kbps
HSUPA	Uplink	5.76 Mbps
HSDPA	Downlink	14.4 Mbps
HSPA+	Uplink	5.76 Mbps
	Downlink	21.1 Mbps

3: Standards Compliance

The MC8705 complies with the **3GPP Release 7 UMTS Specification for Mobile Terminated Equipment** and several other 3GPP/ETSI standards.

Note: Specifications requiring host device support for full compliance with standards are identified accordingly.

This section describes compliance details relating to:

- UMTS WCDMA FDD specifications
- GSM/GPRS / EDGE specifications
- Common UMTS WCDMA/GSM specifications
- UMTS radio access bearers supported
- Short Message Service
- UMTS compliance acceptance and certification

UMTS WCDMA FDD specifications

The MC8705 supports the WCDMA FDD specifications listed in Table 3-1.

Table 3-1: Supported WCDMA FDD specifications

Category	Item
Physical layer specifications	DL Channels: BCH, PCH, FACH, DCH, AICH, CPICH
	UL Channels: RACH, DCH
	Measurement for PCCPCH RSCP RSCP/SIR
	BTFD
	CCTrCH As defined by examples in 25.944
	Multifinger support
	Cell reselection
	Soft handover
	Power control
	PICH / DRX
	Measurement for SFN / CFN timing, SFN / SFN timing
	Cell selection

Table 3-1: Supported WCDMA FDD specifications (Continued)

Category	Item
RLS specifications	TM / UM / AM
	Max AM entities (4) • 3 for signalling • 1 for user data
	Only timer based polling for AM
	No timer based SDU discard for TM / UM / AM
	Poll PU polling for AM
	Poll prohibit
	Polling options: Last ReTX PU Poll, Poll Window, Poll SDU
	Status report transfer: Timer Status, Status Prohibit, Missing PU indicator
	Reset procedure: Indication to RRC
	Suspend / Resume
	Timer based SDU discard (UM / AM / TM)
	Status report transfer: Piggybacked Status PDUs, EPC based transfer
	SUFIs: Sending BITMAP and RLIST
	Start / stop for all three modes
RRC specifications	Cell selection
	RRC connection establishment
	RRC connection release
	System information processing
	Idle mode paging
	Dedicated mode paging
	Initial direct transfer
	Uplink direct transfer
	Downlink direct transfer
	Signalling connection release
	Signalling connection release request
	Radio bearer establishment
	Radio bearer release
	Cell update UE capability enquiry

Table 3-1: Supported WCDMA FDD specifications (Continued)

Category	Item
	Transmission of UE capability
	Cell reselection
	Measurement control
	Measurement reporting
	Soft HO/Active Set update
	DRX mode
	NV support for RRC channel scan
	Radio bearer reconfiguration
	Transport channel reconfiguration
	Physical channel reconfiguration
	UTRAN mobility information
	Integrity protection
	Security mode control
	Encryption: UEA1
	Integrity algorithm: U1A1

GSM/GPRS/EDGE specifications

The MC8705 supports the GSM/GPRS/EDGE specifications listed in Table 3-2 on page 20, as well as Enhanced Network Selection (ENS), and Enhanced Operator Name String (EONS).

EONS allows the operator to define the operator name displayed for any registered network based on the MCC/MNC/LAI on which the MS is currently registered. Strings that can be displayed when a MS is registered on a network are:

- Enhanced Operator Name String (EONS) from SIM
- Operator Name String (ONS) from SIM
- Service Provider Name (SPN) from SIM
- Network Identity and Time Zone (NITZ) as broadcast by network
- String from internal lookup table in UE

Table 3-2: Supported GSM/GPRS specifications

Item	Comments
8PSK modulation	Octagonal Phase Shift Keying Coding schemes MCS1–4 are GMSK and MCS5–9 are 8PSK.
GPRS header compression	Data packet header compression supported
3GPP compliance	Protocol stack supports the requirements of: • GPRS/EDGE—GPP Release 99 and GERAN Feature Package #1 • WCDMA—Release 5(HSDPA), Release 6(HSUPA) and Release 7(HSPA+)
GPRS operation mode class B	Class B terminals support either circuit-switched or packet-switched traffic (with simultaneous network attachment) but do not support both kinds of traffic simultaneously.
Link Adaptation (LA)	Together with IR (next table entry), LA adapts the EGPRS transmission to meet changing radio link conditions.
EGPRS Incremental Redundancy (IR)	IR adjusts the physical layer code rate to actual channel conditions by incrementally transmitting redundant information until decoding is successful. Automatic Repeat Request (ARQ) protocol takes care of requesting and retransmitting incorrectly received blocks. ARQ enables both dynamic RLC window management (to avoid window stalling) and dynamic RLC polling frequency (to minimize retransmission delay and save radio bandwidth).
GPRS multislot class 12	Multislot class 12 allows for dynamic allocation of time slots. See Table A-5 on page 61
EGPRS multislot class 12	
NC0	NC0 is the normal mode of control for a GPRS mobile in which the MS (Mobile Station) performs autonomous cell reselection.
DPC	Downlink Power Control Allows the network to adjust the downlink power of any dedicated channels on the BTS based on measurement reports sent by the mobile. This allows the network to reduce interference between multiple mobiles while still maintaining adequate signal quality for the individual mobiles.
One-phase packet access for GPRS	In establishing a TBF (Temporary Block Flow) connection, the MS (Mobile Station) requests either one-phase or two-phase packet access. In one-phase access, the network responds to a packet channel request by sending a packet uplink assignment message and reserving resources for uplink transfer of a number of radio blocks. In two-phase access, a packet resource request is sent on receipt of the packet uplink assignment.
One-phase packet access for EGPRS	
Two-phase packet access for GPRS	
Two-phase packet access for EGPRS	

Table 3-2: Supported GSM/GPRS specifications (Continued)

Item	Comments
RLC-acknowledged operation mode	The RLC-acknowledged and LLC-acknowledged modes are used to ensure the integrity of received data where QoS requires it. RLC (Radio Link Control) acknowledgment is typically the default (depending on the network and user profile). LLC-acknowledgment is optional and ensures that all LLC (Logical Link Control) frames are received without error. Since LLC-acknowledged mode requires acknowledgement of all LLC frames, the mode has an impact on throughput.
RLC-unacknowledged operation mode	
LLC-acknowledged transmission mode	
LLC-unacknowledged transmission mode	
GSM network operation mode I and II	The Network Operating Mode specifies the coordination of paging for circuit-switched and packet-switched services. Mode I - The mobile can receive circuit-switched pages while in a packet-switched call. Mode II - The mobile cannot receive a circuit-switched page while in a packet-switched call, as it would force the mobile to constantly monitor its CCCH channel.
PBCCH / PCCCHI	Packet Broadcast Control Channel PBCCH is a packet data signaling channel that can supplement the BCCH GSM control channel allowing decoupling of voice and packet control channels to set up data calls. PBCCH broadcasts GPRS/EGPRS specific cell re-selection parameters for serving and neighbor cells used in cell selection / re-selection for packet services.
GPRS test modes (ETSI test mode A and B)	The European Telecommunications Standards Institute (ETSI) defines standards and requirements for testing of GSM mobile equipment. In test mode A, the mobile requests an uplink TBF and transmits random data on a designated number of timeslots. This causes a device to transmit data without using upper layer protocols. Once the transmission has started, the downlink TBF halts. The device remains in this mode until the testing equipment terminates it. In test mode B, the mobile is prompted to receive data on a number of specified downlink timeslots and re-transmit the same data back on the corresponding uplink timeslots. Test mode B allows tests to be performed on both the transmitter and receiver within a single session.
NACC (R4 GERAN Feature Set 1)	Network Assisted Cell Change Enables the network to provide additional information about neighbor cells to the mobile while in a packet data session, which decreases the experienced service delays caused by cell re-selection.
MAIO	Mobile Allocation Index Offset MAIO and Hopping Sequence Number (HSN) are used in conjunction with Frequency Hopping to determine the hopping sequence used in each frame. The MAIO supports as many values as there are frequencies in the hopping list, and these are used to indicate the offset within the hopping list that identifies the frequency used.

Table 3-2: Supported GSM/GPRS specifications (Continued)

Item	Comments
Packet enhanced measurement report (PEMR)	Packet Enhanced Measurement Report (PEMR) is one of the RLC / MAC (Radio Link Control and Medium Access Control) control messages that include a carrier identifier. This message is a requirement of supporting multicarrier TBF.
Delayed TBF Release	Delayed Temporary Block Flow Release (also called Extended Uplink TBF) Delayed TBF Release reduces latency between uplink data transfers and reduced signaling on the network by maintaining a connection for brief periods when the network is temporarily inactive and the mobile station has no radio link control information to send. For this feature to work properly, the mobile station must support delayed TBF release.
Extended Dynamic Allocation	Radio blocks can be transmitted on up to four different PDCHs. Permits full class 12 operation.
Single Antenna Interference Cancellation (SAIC)	SAIC mitigates code-channel interference from neighboring cells resulting in fewer dropped calls, and faster download rates for e-mail and websites.
Circuit-switched data bearers	These circuit-switched data bearers are supported on 2G networks: • Asynchronous 9,600 bps • Asynchronous 14,400 bps
Repeated SACCH	Downlink and uplink SACCH (Slow Associated Control Channel) blocks can be repeated to improve SACCH signal quality.
Repeated FACCH	Downlink FACCH (Fast Associated Control Channel) blocks can be repeated to improve FACCH signal quality during handovers.
Security	
Encryption support	GPRS/EGPRS support GEA1, GEA2, and GEA3 data ciphering. GSM CSD and SMS use A5/1 and A5/3 encryption.
PAP for RADIUS authentication—GPRS / EGPRS	PAP (Password Authentication Protocol) is a method of authenticating usernames and passwords against a database on a RADIUS (Remote Authentication Dial-In User Service) server. In a standard login, the service provider prompts for a username and password. In PAP authentication, the username and password are entered in the client's dialing software and sent as one data package, rather than the server sending a login prompt and waiting for a response.
CHAP for RADIUS authentication—GPRS / EGPRS	CHAP (Challenge Handshake Authentication Protocol) is a more secure method for connecting to a system than PAP. After a link is established, the server sends a challenge message to the client. The client responds with a value calculated using a one-way hash function. The server compares its own calculation of the expected hash value to the client's response. If the values match, the authentication is acknowledged; otherwise the connection is terminated.
Support for encryption algorithm UEA1 (Kasumi)	UEA1 (UMTS Encryption Algorithm) generates the keystream as a function of a cipher key that is re-synchronized to every MAC/RLC frame. UEA is based on the Kasumi algorithm.

Table 3-2: Supported GSM/GPRS specifications (Continued)

Item	Comments
Support for integrity algorithm UIA1 (Kasumi)	UIA1 (UMTS Integrity Algorithm) is the algorithm used to compute the IK (Integrity Key) used in message authentication. UIA is based on the Kasumi algorithm.
UMTS	
WCDMA-to-GPRS reselection in CELL_FACH	CELL_FACH is an RRC (Radio Resource Control) service state in which cell reselection is performed. This feature prevents dropping of RRC connections.
Inter-frequency reselection in Cell_FACH	
Radio link failure	Radio link failure is a procedure that indicates an 'out-of-synch' state on one or more radio links. Node B of the RNC (Radio Network Controller) reports this event before attempting resynchronization. The radio link restoration procedure indicates restoration of the 'synchronized' state.
SIB scheduling	SIB (System Information Block) scheduling controls the broadcasting of information to user equipment in a cell. The user equipment retrieves the schedule, and is then able to change to sleep mode, receiving only those blocks that it needs.
SIB modification	
Re-establishment procedure	Following a radio link failure, the RNC maintains the RRC connection, waiting for re-establishment.
VT + PS call (subject to network availability)	Simultaneous VT (Video Terminal) and PS (Packet Switched) calls are supported.
Packet Cell Change Order from GSM→UTRAN	Call transfer between GSM-based and UTRAN-based cells is supported.
Background PLMN search	Improved algorithm for Higher Priority PLMN (HPPLMN) search while camped on a 3G cell.
Configurable Release 7, Release 6, Release 5 or Release 99 support	
Circuit-switched data bearers	
Data bearers	These circuit-switched data bearers are supported on 3G networks: • Synchronous transparent mode = 64000 bps • Synchronous transparent mode = 56000 bps • Asynchronous V110 UDI = 14400 bps • Asynchronous V110 UDI = 28800 bps • Asynchronous V110 UDI = 38400 bps • Asynchronous V120 = 14400 bps • Asynchronous V120 = 28800 bps • Asynchronous V120 = 56000 bps

Table 3-2: Supported GSM/GPRS specifications (Continued)

Item	Comments
HSDPA	
Data rates	The following data rates are supported: • Category 12 (1.8 Mbps) • Category 6 (3.6 Mbps) • Category 8 (7.2 Mbps) • Category 10 (14.4 Mbps) • Category 14 (21.1 Mbps)
HSDPA logical channels	These HSDPA logical channels are supported: • HS-SCCH • HS-DPCCH • HS-PDSCH—Up to fifteen HS-PDSCH channels are supported.
HSDPA transport channels	HS-DSCH is supported at these rates: • 120 kbps • 240 kbps • 360 kbps
Incremental redundancy	IR adjusts the physical layer code rate to actual channel conditions by incrementally transmitting redundant information until decoding is successful. Automatic Repeat Request (ARQ) protocol takes care of requesting and retransmitting incorrectly received blocks. ARQ enables both dynamic RLC window management (to avoid window stalling) and dynamic RLC polling frequency (to minimize retransmission delay and save radio bandwidth).
Chase combining retransmission scheme	The Chase combining retransmission scheme is the simplest HARQ (Hybrid Automatic Request) link adaptation technique. HARQ techniques are used to enhance system performance.
HSDPA Compressed Mode	Allows the user equipment to interrupt transmission and reception during a call for brief periods in order to measure the signal strength of neighboring cells that use different frequencies.
HSDPA Indicator	Allows user interface to display an indicator when HSDPA data transfer is in progress.
Simultaneous receive diversity support	Receive diversity bands: • Band I, UMTS 2100 • Band II, UMTS 1900 • Band V, UMTS 850 • Band VI, UMTS 800 • Band VIII, UMTS 900
Receiver equalizer support	

Table 3-2: Supported GSM/GPRS specifications (Continued)

Item	Comments
HSUPA	
Data rates	The following data rates are supported: • Category 3 (1.45 Mbps) • Category 5 (2.0 Mbps) • Category 6 (5.76 Mbps)
HSUPA indicator	Allows user interface to display an indicator when HSUPA data transfer is in progress.
HSUPA Compressed Mode	Allows the user equipment to interrupt transmission and reception during a call for brief periods in order to measure the signal strength of neighboring cells that use different frequencies.
Miscellaneous	
Fast link adaptation	The data rate is adapted to radio conditions.
Vary the effective code rate	The effective code rate is varied based on code space resources.
HARQ, MAC-HS disassembly	MAC-HS (High Speed MAC) is the base station MAC (Medium Access Control) protocol. MAC-HS enables fast radio resource allocation.
MAC-HS reordering queue distribution and processing support	
Cell change	These cell change methods are supported: • Synchronous and non-synchronous • Intra-Node B (softer repointing) • Inter-Node B (soft repointing)
Up-switching and down-switching of PS RAB between HS-PDSCH and DPCH	RAB (Radio Access Bearer) and channel mappings between the HS-PDSCH (High Speed Physical Downlink Shared Channel) and DPCH (Dedicated Physical Channel) are reallocated according to volume thresholds and inactivity timers.
Ciphering on the HS channel	Ciphering on high-speed channels protects radio-transmitted data against unauthorized third parties.
Support to not resume the HS channel if inter-RAT handover fails, but save the RB mapping information	RB (Radio Bearer) mapping information is preserved if a high-speed channel is dropped due to the failure of an inter-RAT (Radio Access Technology) transfer.
Support to not resume the HS channel if a radio link failure occurs, but save the RB mapping information	RB (Radio Bearer) mapping information is preserved if a high-speed channel is dropped due to a radio link failure.
WINS address support primary and secondary	Primary and secondary IP addresses can be assigned for WINS (Windows Internet Name Service) name servers.

Table 3-2: Supported GSM/GPRS specifications (Continued)

Item	Comments
Unstructured supplementary services data (USSD)	USSD provides support for transmitting information over the GSM network signalling channels. It provides fast session-based communication between the user and an application, enabling applications such as text messaging, prepaid roaming, and chat.
Security - IMEI Security	
SIM lock	The device can be 'MEP locked' to a particular PLMN.
SIM security	Both CHV1 and CHV2 are supported (unlock and unblock).

Common UMTS WCDMA/GSM specifications

The MC8705 supports the common UMTS WCDMA/GSM specifications listed in Table 3-3.

Table 3-3: UMTS WCDMA/GSM specifications

Item	GSM	UMTS
	✔—Supported ✘—Not supported	
Mobility management		
Automatic PLMN selection / reselection	✔	✔
Location updating procedure	✔	✔
IMSI attach procedure	✔	✔
IMSI detach procedure	✔	✔
Periodic location update	✔	✔
Authentication procedure	✔	✔
CM connection establishment from MS or network	✔	✔
CM connection release	✔	✔
Encryption key management	✔	✔
TMSI reallocation	✔	✔
Paging response	✔	✔
Abort procedure	✔	✔
Identification	✔	✔
CN system information	✔	✔
Call re-establishment	✔	✔

Table 3-3: UMTS WCDMA / GSM specifications (Continued)

Item	GSM	UMTS
	✔—Supported ✘—Not supported	
MM connection establishment emergency calls	✔	✔
Inter-RAT change procedure	✔	✔
CS follow-on procedure	✔	✔
Access class barring	✔	✔
Resumption procedure for Class B operation in GPRS	✔	✔
Handling of domain change CS to CS/PS and other combinations	✔	✔
MM information	✔	✔
Network mode of operation I, II	✔	✔
GPRS mobility management		
GPRS attach	✔	✔
GPRS detach	✔	✔
Routing area update	✔	✔
GPRS authentication	✔	✔
GPRS identification	✔	✔
GMM status	✔	✔
Periodic routing area update	✔	✔
Ciphering	✔	✔
Access class barring	✔	✔
GMM status	✔	✔
Combined GPRS attach	✔	✔
Combined GPRS detach	✔	✔
Combined routing location / area update	✔	✔
PS SMS	✔	✔
Network initiated combined GPRS detach	✔	✔
Network mode of operation change	✔	✔
RAB management		
QoS-based activation, network offers lower / higher QoS	✔	✔
Primary PDP context activation	✔	✔
PDP context deactivation	✔	✔

Table 3-3: UMTS WCDMA / GSM specifications (Continued)

Item	GSM	UMTS
	✔—Supported ✘—Not supported	
Data services		
AT commands	✔	✔
MS PS data calls	✔	✔
Single PDP context	✔	✔
PDP type PPP	✘	✘
PDP type IP	✔	✔
9.6 / 14.4 CS transparent data	✔	N/A
9.6 / 14.4 CS nontransparent data	✔	N/A
Fax	✘	✘
MT Sync CS data calls	✔	✔
MO Sync CS data calls	✔	✔
V.80	N/A	✔
V.42bis	✘	N/A
Multiple PDP context profiles (up to 16)	✔	✔
SMS specifications		
CS domain MT SMS point-to-point	✔	✔
CS domain MO SMS point-to-point	✔	✔
SMMA	✔	✔
Dedicated mode	✔	✔
Message classes 0, 1, 2, 3, none	✔	✔
SMS / SMSP / SMSS access from SIM / USIM	✔	✔
Reply path	✔	✔
Validity period	✔	✔
PS domain MT SMS point-to-point	✔	✔
PS domain MO SMS point-to-point	✔	✔
SMS status reports	✔	✔
SMS commands	✔	✔

UMTS RABs supported

The MC8705 supports the majority of the radio access bearers specified in 3GPP TS 34.108. If you require a detailed list, contact Sierra Wireless.

Short Message Service (SMS)

Table 3-4 summarizes the MC8705 Mini Card's compliance with specific SMS features:

Table 3-4: SMS features

Feature	Supported
Mobile-terminated SMS	Yes
Mobile-originated SMS	Yes
Point-to-Point messaging	Yes
Cell Broadcast messaging	No

UMTS compliance acceptance and certification

The MC8705 is designed to be compliant with the **3GPP Release 7 UMTS Specification for Mobile Terminated Equipment**. Final regulatory and operator certification requires regulatory agency testing and approval with the fully integrated UMTS UE host device incorporating the MC8705 modem.

The OEM host device and, in particular, the OEM antenna design and implementation will affect the final product functionality, RF performance, and certification test results.

Note: Tests that require features not supported by the MC8705 (as defined by this document) are not supported.

For additional information on UMTS certification requirements, see Approvals on page 55.

EU certification requirements

Integrated mobile product European UMTS Certification requirements typically include:

- Full Type Approval (FTA) GCF certification for EU UMTS markets
- CE Mark regulatory certification of compliance for EU UMTS markets
- Interoperability Testing (IOT) for EU UMTS Operators
- Operator acceptance testing and approvals as required based on UMTS operator business relationships

FCC certification

The MC8705 will, upon commercial release, comply with the agency certifications specified in Table 3-5.

Table 3-5: US compliance requirements

Compliance Area	US Regulations
Radio Spectrum	FCC Part 22, 24

4: Electrical Specifications

The system block diagram in Figure 4-1 represents the MC8705 module integrated into a host system. The module includes the following interfaces to the host:

- **Power**—Supplied to the module by the host.
- **Wireless Disable**—As described in the PCI-Express Mini Card specification
- **LED output**—As described in the PCI-Express Mini Card specification. If desired, LED behavior can be configured by adjusting software settings.
- **Antenna**—Two U.FL RF connectors for the Rx/Tx path, and for GPS. For more details, see RF Specifications on page 39.
- **USIM**—Supported through the interface connector. The USIM cavity/connector needs to be placed on the host device for this feature.
- **USB**—Sole interface to the host for data, control, and status information.

The MC8705 has two main interface areas, the host I/O connector and the RF ports. The details of these interfaces are described in the sections that follow.

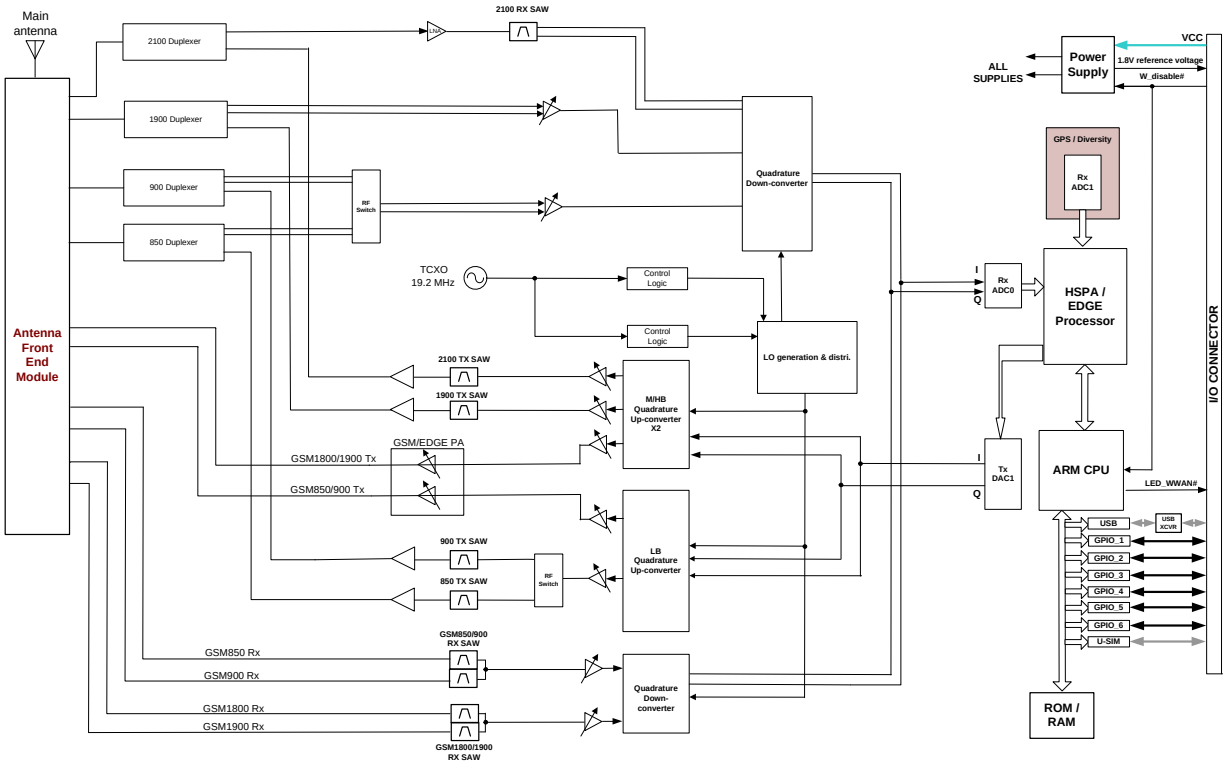

Figure 4-1: System block—Main antenna

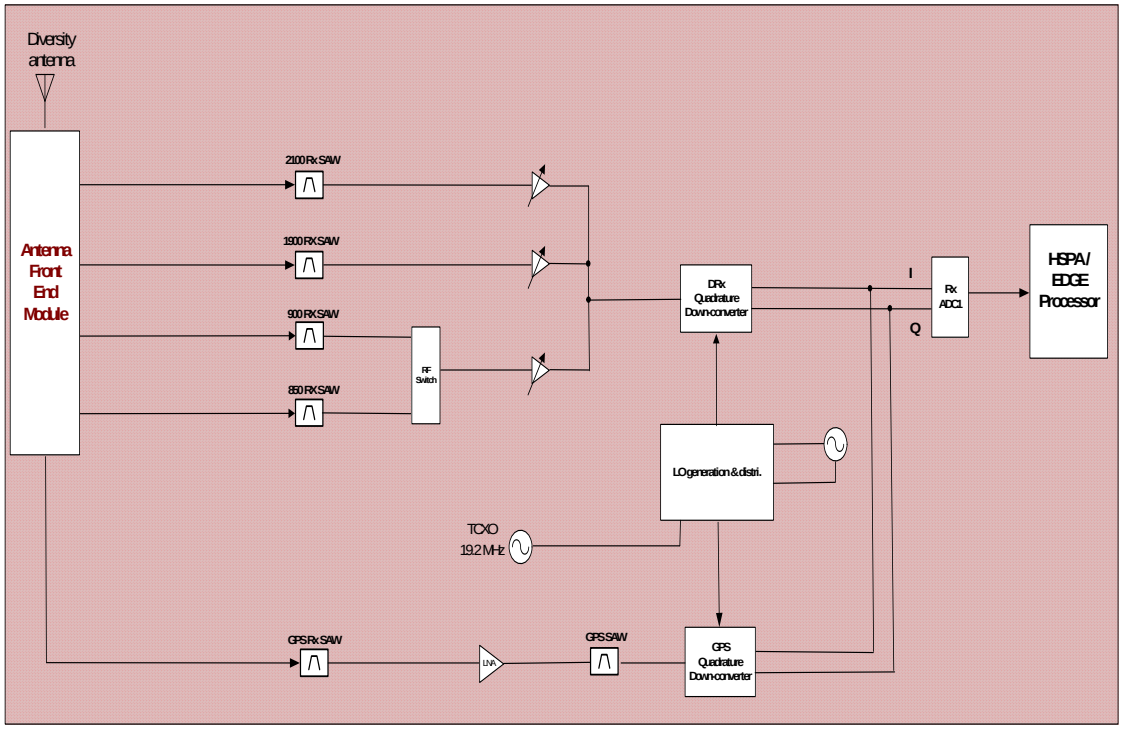

Figure 4-2: System block—GPS/diversity antenna

Host interface pin assignments

The MC8705 host I/O connector provides pins for power, serial communications, and control. Pin assignments are listed in Table 4-1. See the following tables for pin details based on interface types:

- Table 4-2, Power and ground specifications, on page 36
- Table 4-3, USB interface signals, on page 36
- Table 4-4, USIM interface signals, on page 37
- Table 4-5, Module control signals, on page 37

*Note: The following table describes the **internal** structure of the module.*

Table 4-1: MC8705 connector pin assignments

Pin	Signal name	Description	Input / Output (Direction to module)	Active state	Voltage levels (V)		
					Min	Typ	Max
1	NC	No connect					
2	VCC	3.3 V supply	Input	Power	3.20	3.30	3.60
3	NC	No connect					
4	GND	Ground	GND	GND	-	-	-

Table 4-1: MC8705 connector pin assignments (Continued)

Pin	Signal name	Description	Input / Output (Direction to module)	Active state	Voltage levels (V)		
					Min	Typ	Max
5	NC	No connect					
6	NC	No connect					
7	NC	No connect					
8	USIM_PWR	USIM VCC supply	Output (1.8 V)	Power	1.60	1.80	1.90
			Output (3.0 V)		2.70	3.00	3.30
9	GND	Ground	GND	GND	-	-	-
10	USIM_DATA	USIM I/O pin	Input High (1.8 V)	Low	1.20		2.10
			Input Low (1.8 V)		0.00		0.63
			Output High (1.8 V)		1.30	1.80	2.10
			Output Low (1.8 V)		0.00		0.30
			Input High (3.0 V)		1.95		3.30
			Input Low (3.0 V)		0.00		1.05
			Output High (3.0 V)		2.10	3.00	3.30
			Output Low (3.0 V)		0.00		0.40
11	NC	No connect					
12	USIM_CLK	USIM clock	Output High (1.8 V)	High	1.30	1.80	2.10
			Output Low (1.8 V)		0.00		0.47
			Output High (3.0 V)		1.90	3.00	3.30
			Output Low (3.0 V)		0.00		0.60
13	NC	No connect					
14	USIM_RESET	USIM reset	Output High (1.8 V)	Low	1.30	1.80	2.10
			Output Low (1.8 V)		0.00		0.47
			Output High (3.0 V)		2.20	3.00	3.30
			Output Low (3.0 V)		0.00		0.70
15	GND	Ground	GND	GND	-	-	-
16	NC	No connect					
17	NC	No connect					
18	GND	Ground	GND	GND	-	-	-
19	NC	No connect					

Table 4-1: MC8705 connector pin assignments (Continued)

Pin	Signal name	Description	Input / Output (Direction to module)	Active state	Voltage levels (V)		
					Min	Typ	Max
20	W_DISABLE#	Wireless disable	Input High	Low	2.30	3.30	3.60
			Input Low				0.90
21	GND	Ground	GND	GND	-	-	-
22	NC	No connect					
23	NC	No connect					
24	VCC	3.3 V supply	Input	Power	3.20	3.30	3.60
25	NC	No connect					
26	GND	Ground	GND	GND	-	-	-
27	GND	Ground	GND	GND	-	-	-
28	NC	No connect					
29	GND	Ground	GND	GND	-	-	-
30	NC	No connect					
31	NC	No connect					
32	NC	No connect					
33	NC	No connect					
34	GND	Ground	GND	GND	-	-	-
35	GND	Ground	GND	GND	-	-	-
36	USB_D-	USB data negative (Low/Full speed)	Input High		2.00	3.30	3.60
			Input Low		0.00		0.80
			Output High		2.80	3.30	3.60
			Output Low				0.30
		USB data negative (High speed)	Input High		0.30		0.44
			Input Low		0.00		0.01
			Output High		0.36	0.38	0.44
			Output Low		0.00		0.01
37	GND	Ground	GND	GND	-	-	-

Table 4-1: MC8705 connector pin assignments (Continued)

Pin	Signal name	Description	Input / Output (Direction to module)	Active state	Voltage levels (V)		
					Min	Typ	Max
38	USB_D+	USB data positive (Low/Full speed)	Input High		2.00	3.30	3.60
			Input Low		0.00		0.80
			Output High		2.80	3.30	3.60
			Output Low				0.30
		USB data positive (High speed)	Input High		0.30		0.44
			Input Low		0.00		0.01
			Output High		0.36	0.38	0.44
			Output Low		0.00		0.01
39	VCC	3.3 V supply	Input	Power	3.20	3.30	3.60
40	GND	Ground	GND	GND	-	-	-
41	VCC	3.3 V supply	Input	Power	3.20	3.30	3.60
42	LED_WWAN#	LED driver	Tri-state				
			Output Low		0.00		0.45
43	GND	Ground	GND	GND	-	-	-
44	NC	No connect					
45	NC	No connect					
46	NC	No connect					
47	NC	No connect					
48	NC	No connect					
49	NC	No connect					
50	GND	Ground	GND	GND	-	-	-
51	NC	No connect					
52	VCC	3.3 V supply	Input	Power	3.20	3.30	3.60

Host interface descriptions

This section and the sections that follow provide additional detail on each portion of the host I/O connector: power interface, USB interface, and USIM interface. Tables in these sections describe these portions of the interface and the pins used. Each pin includes a type code as part of its description:

- **A**-Analog pin
- **O**-Digital pin, Output
- **PU**-Digital pin input, internal Pull Up
- **PD**-Digital pin input, internal Pull Down
- **V**-Power or Ground pin

Power supply

Power is provided to the MC8705 through multiple power and ground pins as summarized in Table 4-2.

Table 4-2: Power and ground specifications

Name	Pins	Type	Specification	Parameter	Min	Typ	Max	Units
VCC	2, 24, 39, 41, 52	V	Voltage range	VCC	3.2	3.3	3.6	Va
			Ripple voltage		-	-	100	mV_{pp}
GND	4, 9, 15, 18, 21, 26, 27, 29, 34, 35, 37, 40, 43, 50	V			-	0	-	V

USB interface

The USB interface requires 3.3 V regulated voltage from the host device to provide power to the USB transceiver on the MC8705. The USB interface is compliant with Version 2.0 of the USB standard for high speed operation.

Table 4-3: USB interface signals

Name	Pin	Description	Type
USB_D-	36	USB data	A
USB_D+	38	USB data	A

The USB interface is powered directly from the VCC supply.

USIM interface

The USIM pins provide the connections necessary to interface to a USIM socket located on the host device. Voltage levels over this interface comply with 3GPP standards.

Table 4-4: USIM interface signals

Name	Pin	Description	Notes
USIM_PWR	8	USIM voltage	Power supply for USIM
USIM_DATA	10	Data I/O	
USIM_CLK	12	Serial clock	
USIM_RESET	14	Reset	
USIM_GND		Ground	Ground reference USIM_GND is common to module ground

Control signals

The MC8705 provides signals for control and handshaking of the module from the host. These signals are summarized in Table 4-5.

Table 4-5: Module control signals

Name	Pin	Description	Type
W_DISABLE#	20	Wireless disable	PU
LED_WWAN#	42	LED driver	O

W_DISABLE# is used to ask the module to shut down. Letting this signal float high allows the module to operate normally. This switch follows the behavior as described in the PCI-Express Mini Card specification. There is a 20 k pull-up resistor to VCC on this pin.

LED_WWAN# is driven, by default, by the module as described in Table 3-5 in **PCI Express Mini Card Electromechanical Specification Revision 1.2**. If desired, LED behavior can be configured by adjusting software settings.

5: RF Specifications

The MC8705 includes two RF connectors for use with host-supplied antennas. (It does not have integrated antennas.) One connector is used for the main Rx/Tx path, and the second connector is used for diversity and stand-alone GPS.

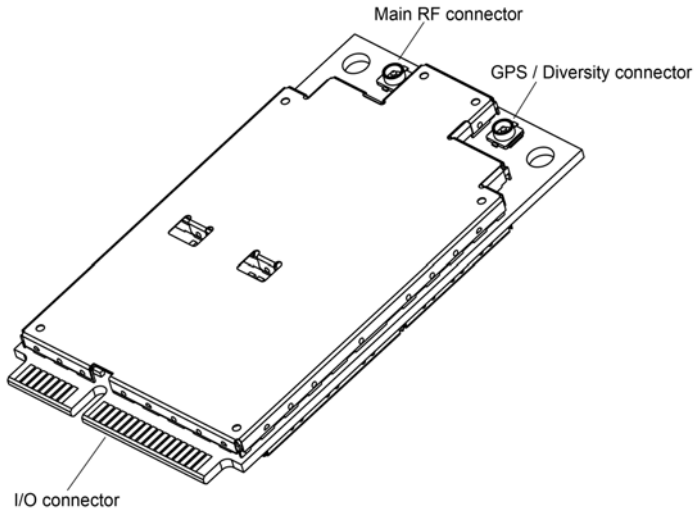

Figure 5-1: Module connectors

The RF connectors (Hirose part number U.FL # CL331-0471-0-10 or equivalent) are 3 mm x 3 mm low profile connectors that support coaxial cable connections to the module. The path is assumed to be 50 Ω. These connectors are installed on the top side of the module (see Figure 5-1).

Note: If the antenna connection is shorted or open, the modem will not sustain permanent damage.

The MC8705 supports:

- Quad-band 850/900/1800/1900 MHz GSM/GPRS/EGPRS
- Five-band 800/850/900/1900/2100 MHz WCDMA/HSDPA/HSUPA/HSPA+
- Five-band WCDMA receive diversity, and GPS.
- Radio transceiver requirements for 3GPP Release 7
- Inter-RAT and inter-frequency cell reselection and handover between supported frequency bands

Table 5-1: WCDMA frequency band support[a]

Band	Frequencies
Band I WCDMA 2100	Tx: 1920–1980 MHz Rx: 2110–2170 MHz
Band II WCDMA 1900	Tx: 1850–1910 MHz Rx: 1930–1990 MHz
Band V WCDMA 850	Tx: 824–849 MHz Rx: 869–894 MHz
Band VI WCDMA 800	Tx: 830–840 MHz Rx: 875–885 MHz
Band VIII WCDMA 900	Tx: 880–915 MHz Rx: 925–960 MHz

a. WCDMA channel spacing is 5 MHz, but this can be adjusted to optimize performance in a particular deployment scenario.

Table 5-2: GSM frequency band support

Band	Frequencies
GSM 850	Tx: 824–849 MHz Rx: 869–894 MHz
EGSM 900	Tx: 880–915 MHz Rx: 925–960 MHz
GSM 1800	Tx: 1710–1785 MHz Rx: 1805–1880 MHz
GSM 1900	Tx: 1850–1910 MHz Rx: 1930–1990 MHz

Table 5-3: GPS frequency band support

Band	Frequencies
GPS	1575.42 MHz

Table 5-4: Conducted Rx (Receive) Sensitivity

Band	Typical conducted Rx sensitivity (dBm)	Worst case conducted Rx sensitivity (dBm)
GSM 850 (2%[a]) CS[b]	-108	-107
EGSM 900 (2%[a]) CS[b]	-108	-107
DCS 1800 (2%[a]) CS[b]	-108	-107
PCS 1900 (2%[a]) CS[b4]	-108	-107

Table 5-4: Conducted Rx (Receive) Sensitivity (Continued)

Band	Typical conducted Rx sensitivity (dBm)	Worst case conducted Rx sensitivity (dBm)
Band I UMTS 2100 (0.1%[a]) 12.2 kbps	-110	-107
Band II UMTS 1900 (0.1%[a]) 12.2 kbps	-109	-107
Band V UMTS 850 (0.1%[a]) 12.2 kbps	-109	-107
Band VI UMTS 800 (0.1%[a]) 12.2 kbps	-109	-107
Band VIII UMTS 900 (0.1%[a]) 12.2 kbps	-109	-107

a. % = Bit Error Rate
b. CS = Circuit switched

Table 5-5: Conducted Tx (Transmit) Power Tolerances

Parameter	Conducted Transmit Power (dBm)	Notes
GSM / EDGE		
GSM850 & GSM900 bands CS	+32 ± 1	GMSK mode, connectorized (Class 4)
	+27 ± 1	8PSK mode, connectorized (Class E2)
DCS1800 & PCS1900 bands CS	+29 ± 1	GMSK mode, connectorized (Class 1)
	+26 ± 1	8PSK mode, connectorized (Class E2)
UMTS		
Band II, V, VI, & VIII (1900, 850, 800, and 900 MHz) 12.2 kbps	+23 ± 1	Connectorized (Class 3)
Band I (IMT 2100 MHz band) 12.2 kbps	+23 ± 1	Connectorized (Class 3)

Table 5-6: Main antenna specifications[a]

Parameter	Min	Typ	Max	Units	Notes
Cable loss	-	-	0.5	dB	Maximum loss to antenna
Impedance	-	50	-	Ω	Antenna load impedance
VSWR	-	-	3:1		Maximum allowed VSWR of antenna

a. Sierra Wireless provides detailed antenna requirements in the *AirPrime Intelligent Embedded Modules Hardware Integration Guide (Document #2130114).*

Table 5-7: GPS antenna specifications[a]

Parameter	
Gain	Maximum gain and uniform coverage in high-angle elevation and zenith. Gain in the azimuth plane is *not* desired.
Average 3D gain	> -5 dBi
VSWR	Typical value < 2:1
Isolation (GPS ↔ Main)	> 10 dB in all related bands
Polarization	Any, other than LHCP (left-hand circular polarized)

a. Sierra Wireless provides detailed antenna requirements in the *AirPrime Intelligent Embedded Modules Hardware Integration Guide (Document #2130114).*

6: Power Consumption

Note: All specifications in these tables are preliminary, based on chipset published expectations.

The power consumption numbers listed in this section are for the MC8705 Mini Card module connected to the host PC via USB. The module does not have its own power source and depends on the host device for power. Typical values are measured at room temperature, and minimum and maximum values are measured over the entire operating temperature range. For a description of input voltage requirements, see Power supply on page 36.

Table 6-1: Averaged standby DC power consumption

Signal	Description	Bands	Typ	Max	Units	Notes / Configuration
VCC	**Standby current consumption with Sleep mode activated** (assumes USB bus is fully suspended during measurements)					
	HSDPA / WCDMA	UMTS bands	4	5	mA	DRX cycle = 8 (2.56 s)
	GSM / GPRS / EDGE	GSM bands	4	5	mA	MFRM = 5 (1.175 s)
	Standby current consumption with Sleep mode deactivated (assumes USB bus is fully suspended during measurements)					
	HSDPA / WCDMA	UMTS bands	40	50	mA	DRX cycle = 8 (2.56 s)
	GSM / GPRS / EDGE	GSM bands	40	50	mA	MFRM = 5 (1.175 s)
	Low Power Mode (LPM) / Offline Mode					
	RF disabled, but module is operational		4	5	mA	This state is entered when Watcher shuts down / turns off the radio.

Table 6-2: Averaged Call Mode WCDMA/HSPA/HSPA+ data DC power consumption[a]

Signal	Description	Band	Average current	Units	Notes / Configuration
VCC	**WCDMA data current consumption** (includes USB bus current)				
	WCDMA	UMTS bands	700	mA	384 kbps at 20 dBm Tx power[b]
			360	mA	0 dBm Tx power
	HSUPA	UMTS bands	760	mA	2 Mbps at 20 dBm Tx power
			470	mA	0 dBm Tx power
	HSDPA (1.8 Mbps / 3.6 Mbps / 7.2 Mbps)	UMTS bands	820	mA	All speeds at 20 dBm Tx power[c]
			450	mA	0 dBm Tx power
	HSPA+ (21.1 Mbps)	UMTS bands	850	mA	20 dBm Tx power
			500	mA	0 dBm Tx power
	Peak current (averaged over 100 µs)	UMTS bands	1000	mA	

a. Measurements are for MDM8200A MDM2.0. Comsumption levels for MDM8200A MDM1.1 will be slightly higher.
b. Highest current is on Band II (PCS1900)
c. Approximate current difference between speeds = 30 mA

Table 6-3: Averaged Call Mode GSM/EDGE data DC power consumption (with 4 time slots)

Signal	Description	Band	Average current	Units	Notes / Configuration
VCC	**GSM/EDGE data current consumption** (assumes USB bus current)				
	GSM/GPRS	GSM bands	800	mA	Max PCL for each band[a]
			400	mA	10 dBm Tx
	EDGE	GSM bands	720	mA	Class 12
	Peak current (averaged over 100 µs)	GSM bands	2.70	A	Worst case on 850/900 band

a. Highest current is on 850/900 band Class 10 (Class 12 implements power backoff). Current on 1800/900 bands is typically 100–200 mA less.

Table 6-4: Miscellaneous DC power consumption

Signal	Description	Band	Typ	Max	Units	Notes/Configuration
VCC	Module OFF leakage current	All bands	200	700	µA	Full operating temperature range
	USB transmit current	All bands	10	10	mA	Full speed USB connection, C_L = 50 pF on D+ and D- signals

Table 6-5: Supported GPRS/EDGE power classes

Feature	Notes
EGSM 900/GSM 850 Power Class 4	2 W 33 dBm
GSM 1800/1900 Power Class 1	1 W 30 dBm
EDGE Power Class for 850/ 900MHz	Class E2[a] 27 dBm, 0.5 W
EDGE Power Class for 1800/ 1900MHz	Class E2[a] 26 dBm, 0.4 W

a. E2 power class applies to 8PSK modulation.

7: GPS

Note: The specifications in this section are subject to change without notice. Actual GPS functionality is dependent on the firmware version and module configuration.

The MC8705 Mini Card module includes a built-in GPS module that provides the following features:

- Standalone GPS
  - Leading standalone/autonomous GPS performance
  - -155 dBm sensitivity
  - -156 dBm tracking sensitivity
  - < 1 minute average cold start TTFF (Time To First Fix) in open sky
  - < 3 second average super hot TTFF in open sky
  - < 10 m accuracy in open sky

Note: For optimum performance, the modem should be registered on the GSM/UMTS network, but does not need to be on an active data call.

- gpsOneXTRA™
  - Enables enhanced standalone GPS operation by downloading < 40 kB file from a server on the Internet
  - Performance closer to UE-based operation than traditional standalone GPS operation
  - Best if downloaded once every 1–2 days, but valid for up to 7 days with some accuracy degradation
- A-GPS features
  - Leading A-GPS performance
  - Exceeds 3GPP RAN 4 AGPS performance specification
  - -155 dBm sensitivity
  - -156 dBm tracking sensitivity
  - < 5 second average cold start TTFF in open sky (UE-based)
  - < 3 second average super hot TTFF in open sky
  - < 10 m accuracy in open sky
  - UMTS Control Plane (CP)—UE-assisted and UE-based
  - GSM Control Plane (CP)—UE-assisted and UE-based
  - OMA SUPL 1.0 User Plane (UP)—UE-assisted and UE-based
- Enhanced Navigation 2.0 feature
  - Provides leading performance in car and walking navigation modes as well as accuracy while stationary
  - Airline/Game/Offline mode
  - GPS capability is available while phone is offline
- Application types
  - Supports NMEA (supported sentences: GGA, GSA, GSV, RMC, VTG)

8: Software Interface

Physical interface options

The MC8705 module communicates with the host via the USB (Universal Serial Bus) physical interface, using a non-MUX (non-composite) USB architecture.

The non-MUX architecture supports multiple pairs of endpoints, each with a unique supported service (Control, AT/PPP, HIP). Documentation outlining the design requirements for non_MUX is available; see the **Mini Card / AirCard / Compass USB Driver Developer's Guide** for details.

USB interface details

USB high/full speed throughput performance

This device has been designed to achieve optimal performance and maximum throughput using USB high speed mode. Although the device may operate with a full speed host, throughput performance will be on an "as is" basis and needs to be characterized by the OEM. Note that throughput will be reduced and may vary significantly based on packet size, host interface, and firmware revision. Sierra Wireless does not recommend using this device in USB full speed mode.

USB support for Direct IP

USB high speed mode must be used with the Direct IP interface (USB full speed mode is not supported).

Support tools

The MC8705 is compatible with the following support tools from Sierra Wireless and authorized third parties:

- Sierra Wireless Watcher
- QXDM from Qualcomm

Other features

Customization

Subject to commercial terms, Sierra Wireless can supply custom-configured modems to facilitate a carrier's network and performance requirements. Sierra Wireless also offers a standard configuration for each country.

Custom configurations are entered into a selector spreadsheet that Sierra supplies. A unique part number is assigned to each custom configuration to facilitate customer ordering.

Table 8-1: Customizable features

Name	Description	Default
MEP network locked	Mobile Equipment Personalization network locked to only allow use with specific preconfigured PLMNs (SIMs). MMI supports the entry of an unlock code subject to permanent locking feature below.	Off
MEP service provider locked		
Permanent MEP locked	Can block deactivation of MEP locked feature	Off
Roaming indicator disable[a]		Indicator enabled
Service indicator disable[a]		Indicator enabled
Data counter disable[a]		Rx and Tx data counters enabled
Disable advanced profile menu (QoS)[a]		Advance profile menu disabled
SIM PUK prompt enable		Disabled
GPRS attach on start-up[a]	If disabled, modem attaches when GPRS connection is required.	The modem GPRS attaches at start-up.
Disable Auto Connect	If disabled, the Auto Connect feature is blocked and cannot be enabled by the user.	The auto-connect feature menu item is enabled with the default state set to manual (not auto-connect).

a. Features only available if supported in the user interface

9: Mechanical and Environmental Specifications

9

The MC8705 module complies with the mechanical and environmental specifications in this section. Final product conformance to these specifications depends on the OEM device implementation.

Table 9-1: Mechanical and environmental specifications

	Mode	Details
Temperature (Temperature of immediate environment—for example, the interior of a laptop)	Operational	-25ºC to +60ºC—Full RF performance +60ºC to +75ºC—Reduced RF performance
	Non-operational	-40ºC to +85ºC, 96 hours (from MIL-STD 202 Method 108)
Relative humidity	Non-operational	85ºC, 85% relative humidity for 48 hours (non-condensing)
Vibration	Non-operational	Random vibration, 10 to 1000 Hz, nominal 6 G rms in each of three mutually perpendicular axes. Test duration of 60 minutes for each axis, for a total test time of three hours.
Shock	Non-operational	Half sine shock, 2 ms, 180 in/sec (375 g). Tested in each of three mutually perpendicular axes, positive and negative (5 x 6, 30 bumps total).
Drop	Non-operational	1 m on concrete on each of six faces, two times (module only).
Electrostatic discharge	Operational	The RF port (antenna launch and RF connector) complies with the following standard: • IEC 61000-4-2 Electrostatic Discharge Immunity: Test: Level3 Contact Discharge: ±6 kV Air Discharge: ±8 kV
	Non-operational	The host connector Interface complies with the following standards only: • ±1 kV Human Body Model (JESD22-A114-B) • ±125 V Charged Device Model (JESD22-C101)
Thermal considerations		See the **AirPrime Intelligent Embedded Modules Hardware Integration Guide**.
Form factor		The MC8705 is a PCI-Express Mini Card in a metal-shielded case.

Table 9-1: Mechanical and environmental specifications (Continued)

	Mode	Details
Dimensions		Length: 50.85 mm Width: 29.85 mm* Thickness: 4.38 mm Weight: approximately 11 g * Actual width may exceed the 29.85 mm specification because the module sides are depanelized using a V-score process that can cause a rough surface.

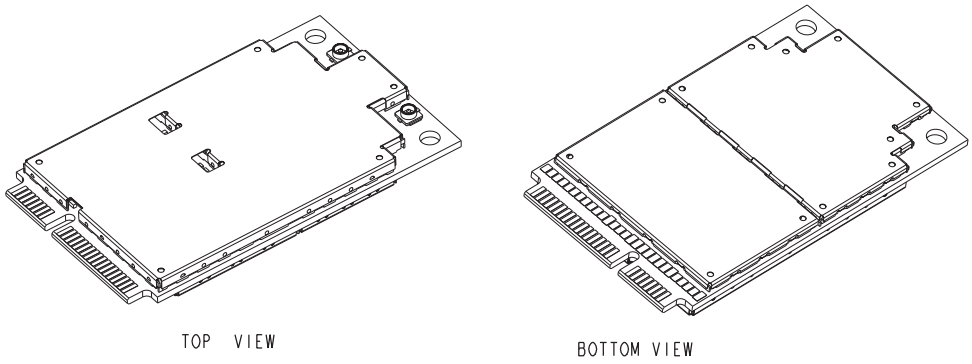

Figure 9-1: Top and bottom views

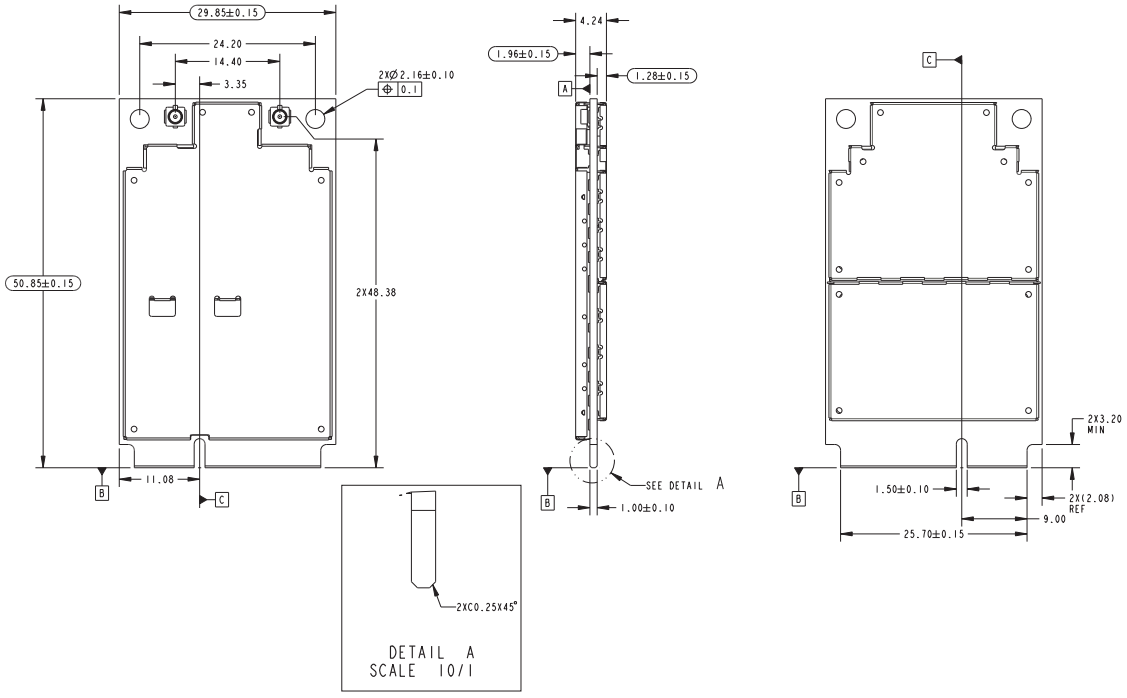

Figure 9-2: Dimensioned view

Labeling

Figure 9-3 shows the general label format for the MC8705. This is a sample label only.

Figure 9-3: Sample label format

The MC8705 label is non-removable and contains:

- Sierra Wireless logo and product name
- IMEI number in Code-128 barcode format
- SKU number (when required)
- Factory Serial Number (FSN) in alphanumeric format
- Batch revision number in hexadecimal format
- Manufacturing date code (incorporated into FSN)
- Licensed vendor logo
- Certification marks/details

Note: The displayed label is an example only. The production label will vary by SKU.

Note: The MC8705 supports OEM partner specific label requirements.

10: Approvals

Upon commercial release, the MC8705 will have approval from the following regulatory and type approval agencies:

- North America: Federal Communications Commission (FCC) and Industry Canada (IC)

Upon commercial release, the following industry type approvals may be obtained upon customer request:

- North and Latin America operators/carriers
  PTCRB approval per NAPRD03 requirement

Additional testing and certification may be required for the end product with an embedded MC8705 modem and are the responsibility of the OEM. Sierra Wireless offers professional services-based assistance to OEMs with the testing and certification process, if required.

11: Additional Requirements

Testing assistance provided by Sierra Wireless

Extended AT commands have been implemented to assist with performing FTA GCF tests and portions of CE Mark tests requiring radio module access. These are documented in the **AirCard/AirPrime UMTS Devices Supported AT Command Reference** and **AirPrime MC8xxx Embedded Modules Extended AT Command Reference**.

The **AirPrime Intelligent Embedded Modules Hardware Integration Guide** includes a list of test houses familiar with Sierra Wireless products.

Sierra Wireless offers optional professional services based assistance to OEMs with regulatory approvals.

Integration requirements

When integrating the MC8705 PCI-Express Mini Card, the following items need to be addressed:

- Mounting—Effect on temperature, shock, and vibration performance
- Power supply—Impact on battery drain and possible RF interference
- Antenna location and type—Impact on RF performance
- Regulatory approvals—As discussed in Approvals on page 55.
- Service provisioning—Manufacturing process
- Software—As discussed in Software Interface on page 49.

Sierra Wireless provides guidelines for successful MC8705 PCI-Express Mini Card integration with the document suite and offers integration support services as necessary.

IOT/Operator

Interoperability and Operator/Carrier testing of the finished system is the responsibility of the OEM. The test process will be determined with the chosen network operator(s) and will be dependent upon your business relationship with them, as well as the product's application and sales channel strategy.

Sierra Wireless offers assistance to OEMs with the testing process, if required.

A: Data Rates

Note: This device has been designed to achieve optimal performance and maximum throughput using USB high speed mode. Although the device may operate with a full speed host, throughput performance will be on an "as is" basis and needs to be characterized by the OEM. Note that throughput will be greatly reduced and may vary significantly based on packet size, host interface, and firmware revision. Sierra Wireless does not recommend using this device in USB full speed mode.

HSDPA throughput

Actual throughput rates depend on network configuration, network loading, and connection (signal) conditions.

Table A-1: HSDPA-capable terminals

Category	Supported	Maximum number of supported HS-DSCH codes	Minimum inter-TTI interval	Theoretical maximum peak rate (Mbps)	Modulation schemes
Category 1		5	3	1.2	16QAM, QPSK
Category 2		5	3	1.2	16QAM, QPSK
Category 3		5	2	1.8	16QAM, QPSK
Category 4		5	2	1.8	16QAM, QPSK
Category 5		5	1	3.6	16QAM, QPSK
Category 6	✔	5	1	3.6	16QAM, QPSK
Category 7		10	1	7.2	16QAM, QPSK
Category 8	✔	10	1	7.2	16QAM, QPSK
Category 9		15	1	10.0	16QAM, QPSK
Category 10	✔	15	1	14.4	16QAM, QPSK
Category 11		5	2	0.9	QPSK
Category 12	✔	5	1	1.8	QPSK
Category 14	✔	15	1	21.1	16QAM, 64QAM, QPSK

HSUPA throughput

Actual throughput rates depend on network configuration, network loading, and connection (signal) conditions.

Table A-2: HSUPA-capable terminals

E-DCH Category	Supported	Maximum number of E-DCH codes transmitted	Minimum spreading factor	Support for 10 ms; 2 ms TTI E-DCH	Maximum theoretical data rate with 10 ms TTI	Maximum theoretical data rate with 2 ms TTI
Category 1		1	SF4	10 ms only	0.72 Mbps	N/A
Category 2		2	SF4	10 ms and 2 ms	1.45 Mbps	1.45 Mbps
Category 3	✔	2	SF4	10 ms only	1.45 Mbps	N/A
Category 4		2	SF2	10 ms and 2 ms	2.0 Mbps	2.91 Mbps
Category 5	✔	2	SF2	10 ms only	2.0 Mbps	N/A
Category 6	✔	4	SF2	10 ms and 2 ms	2.0 Mbps	5.76 Mbps

UMTS throughput

The MC8705 supports 64 kbps, 128 kbps, and 384 kbps for the uplink and downlink on UMTS networks. Actual throughput rates depend on network configuration, network loading, and connection (signal) conditions.

EDGE data throughput

Actual throughput rates depend on network configuration, network loading, and connection (signal) conditions.

Table A-3: EDGE data throughput

EDGE coding scheme data throughput	Maximum theoretical throughput for 4 timeslots	Modulation
MCS 1 = 8.8 kbps/ timeslot	35.2 kbps	GMSK
MCS 2 = 11.2 kbps/ timeslot	44.8 kbps	GMSK
MCS 3 = 14.8 kbps/ timeslot	59.2 kbps	GMSK
MCS 4 = 17.6 kbps/ timeslot	70.4 kbps	GMSK
MCS 5 = 22.4 kbps/ timeslot	89.6 kbps	8PSK
MCS 6 = 29.6 kbps/ timeslot	118.4 kbps	8PSK
MCS 7 = 44.8 kbps/ timeslot	179.2 kbps	8PSK

Table A-3: EDGE data throughput

EDGE coding scheme data throughput	Maximum theoretical throughput for 4 timeslots	Modulation
MCS 8 = 54.4 kbps/ timeslot	217.6 kbps	8PSK
MCS 9 = 59.2 kbps/ timeslot	236.8 kbps	8PSK

GPRS data throughput

Actual throughput rates depend on network configuration, network loading, and connection (signal) conditions.

Table A-4: GPRS data throughput

GPRS Coding Scheme Data Throughput	Max theoretical throughput for 4 timeslots	Modulation
CS 1 = 8.0 kbps/ timeslot	32 kbps	GMSK
CS 2 = 12.0 kbps/ timeslot	48 kbps	GMSK
CS 3 = 14.4 kbps/ timeslot	57.6 kbps	GMSK
CS 4 = 20.0 kbps/ timeslot	80 kbps	GMSK

Multi-slot class definitions

Table A-5: Multi-slot class definitions

Class	Rx slots	Tx slots	Max Sum
1	1	1	2
2	2	1	3
3	2	2	3
4	3	1	4
5	2	2	4
6	3	2	4
7	3	3	4
8	4	1	5
9	3	2	5
10	4	2	5
11	4	3	5
12	4	4	5

B: WWAN Frequency Bands

B

The MC8705 supports bands that appear in bold.

Table B-1: Worldwide Wide Area Network (WWAN) frequency bands

Network			Frequency bands (MHz)	FRX–FTX (MHz)
GSM	**GSM 850**	**Tx**	**824–849**	**45**
		Rx	**869 – 894**	
	GSM 900	**Tx**	**890 – 915**	**45**
		Rx	**935–960**	
	EGSM 900	**Tx**	**880–915**	**45**
		Rx	**925–960**	
	R-GSM	Tx	876–915	
		Rx	921–960	
	GSM 1800	**Tx**	**1710–1785**	**95**
		Rx	**1805–1880**	
	GSM 1800 Korea	Tx	1750–1780	
		Rx	1840–1870	
	GSM 1900	**Tx**	**1850–1910**	**80**
		Rx	**1930–1990**	
PDC (Japan)		Tx	810–826	
		Rx	940–956	
		Tx	1429–1453	
		Rx	1477–1501	
IS-54 and IS-136 (D-AMPS and TDMA)	IS-54 and IS-136	Tx	824–849	
		Rx	869–894	
	IS-36	Tx	1850–1910	
		Rx	1930–1990	
CdmaOne		Tx	824–849	
		Rx	869–894	
		Tx	1850–1910	
		Rx	1930–1990	

Table B-1: Worldwide Wide Area Network (WWAN) frequency bands

Network			Frequency bands (MHz)	FRX–FTX (MHz)
CDMA2000 1x RTT	BC0: US Cellular	Tx	824–849	
		Rx	869–894	
	BC1: North American PCS	Tx	1850–1910	
		Rx	1930–1990	
	BC2: TACS Band	Tx	872–915	
		Rx	917–960	
	BC3: JTACS Band	Tx	887–925	
		Rx	832–870	
	BC4: Korean PCS	Tx	1750–1780	
		Rx	1840–1870	
	BC5: NMT 450	Tx	411–483	
		Rx	421–493	
	BC6: IMT 2000	Tx	1920–1980	
		Rx	2110–2170	
	BC7: North American 700 MHz Cellular	Tx	776–794	
		Rx	746–764	
	BC8: 1800 MHz Band	Tx	1710–1785	
		Rx	1805–1880	
	BC9: 900 MHz Band	Tx	880–914	
		Rx	925–959	
	BC10: Secondary 800 MHz Band	Tx	806–901	
		Rx	851–940	
	BC11: 400 MHz European PAMR Band	Tx	410–458	
		Rx	420–468	
	BC12: 800 MHz PAMR Band	Tx	870–876	
		Rx	915–921	

Table B-1: Worldwide Wide Area Network (WWAN) frequency bands

Network			Frequency bands (MHz)	FRX–FTX (MHz)
WCDMA 3GPP/FDD	**I**	**Tx**	**1920–1980**	**190**
		Rx	**2110–2170**	
	II	**Tx**	**1850–1910**	**80**
		Rx	**1930–1990**	
	III	Tx	1710–1785	
		Rx	1805–1880	
	IV	Tx	1710–1755	
		Rx	2155–2210	
	V	**Tx**	**824–849**	**45**
		Rx	**869–894**	
	VI	**Tx**	**830–840**	**45**
		Rx	**875–885**	
	VII	Tx	2500–2570	
		Rx	2620–2690	
	VIII	**Tx**	**880–915**	**45**
		Rx	**925–960**	
	IX	Tx	1749.9–1784.9	
		Rx	1844.9–1879.9	
WCDMA 3GPP/TDD (UTRA TDD HCR)			1900–1920	
			2010–2025	
			1850–1910	
			1930–1990	
			1910–1930	
TD-SCMA (UTRA TDD LCR)			1900–1920	
			2010–2025	
			1850–1910	
			1930–1990	
			1910–1930	

C: Acronyms

C

Table C-1: Acronyms and definitions

Acronym or term	Definition
3GPP	3rd Generation Partnership Project
8PSK	Octagonal Phase Shift Keying
A-GPS	Assisted GPS
AM	(RLC) Acknowledged Mode
AMR	Adaptive Multi-Rate Vocoder
API	Application Programming Interface
ARQ	Automatic Repeat Request
BER	Bit Error Rate
BTFD	Blind Transport Format Detection
CAIT	CDMA Air Interface Tool
CCTRCH	Coded Composite Transport Channel
CFN	Connection Frame Number
CHAP	Challenge Handshake Authentication Protocol
CNS	Control and Status (Sierra Wireless' propriety host interface protocol)
CP	Control Plane
CPHS	Common PCN Handset Specification
CS	Circuit-switched
CSD	Circuit-switched Data
DHCP	Dynamic Host Configuration Protocol
DL	Downlink (network to mobile)
DPCH	Dedicated Physical Channel
DSCH	Downlink Shared Channel
DUN	Dial-Up Networking
EAP-SIM	Extensible Authentication Protocol Method for GSM Subscriber Identity
EDGE	Enhanced Data rates for GSM Evolution

Table C-1: Acronyms and definitions (Continued)

Acronym or term	Definition
ENS	Enhanced Network Selection
EONS	Enhanced Operator Name String
EPC	Enhanced Power Control
ERP	Effective Radiated Power
ETSI	European Telecommunications Standards Institute
FACCH	Fast Associated Control Channel
FCC	Federal Communications Commission
FSN	Factory Serial Number
GMSK	Gaussian Minimum Shift Keying modulation
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HARQ	Hybrid Automatic Request
HPLMN	Home PLMN
HPPLMN	Higher Priority PLMN
HSDPA	High Speed Downlink Packet Access
HS-DPCCH	High Speed Dedicated Physical Control Channel
HS-PDSCH	High Speed Physical Downlink Shared Channel
HS-SCCH	High Speed Shared Control Channel
HSPA+	Enhanced HSPA, as defined in 3GPP Release 7 and beyond
HSUPA	High Speed Uplink Packet Access
IK	Integrity Key
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
inter-RAT	Radio Access Technology
IOT	Interoperability Testing
LED	Light Emitting Diode
LLC	Logical Link Control

Table C-1: Acronyms and definitions (Continued)

Acronym or term	Definition
LPM	Low Power Mode
MAC	Medium Access Control
MAC-HS	High Speed Medium Access Control
MAIO	Mobile Allocation Index Offset
MEP	Mobile Equipment Personalization
MSC	Mobile Switching Center
MSM	Mobile Station Modem
MUX	Multiplexing
NACC	Network Assisted Cell Change
NDIS	Network Driver Interface Specification
NIC	Network Interface Card
NITZ	Network Identity and Time Zone
OEM	Original Equipment Manufacturer
ONS	Operator Name String
PAP	Password Authentication Protocol
PC/SC	PC / Smart Card
PCCPCH	Primary Common Control Physical Channel
PCS	Personal Communication System
PDP	Packet Data Protocol
PICH/DRX	Paging Indicator Channel / Discontinuous Reception
PLMN	Public Land Mobile Network
PPP	Point to Point Protocol
PS	Packet-switched
PST	Product Support Tools
PU	Payload Unit
PUK	Personal Unblocking Key
QOS	Quality of Service
RAB	Radio Access Bearer
RADIUS	Remote Authentication Dial-In User Service

Table C-1: Acronyms and definitions (Continued)

Acronym or term	Definition
RATSCCH	Robust AMR Traffic Synchronized Control Channel
RLC	Radio Link Control
RNC	Radio Network Controller
RRC	Radio Resource Control
RSCP	Received Signal Code Power
SACCH	Slow Associated Control Channel
SAIC	Single Antenna Interference Cancellation
SAR	Specific Absorption Rate
SCCPCH	Secondary Common Control Physical Channel
SDK	Software Development Kit
SDU	Service Data Unit
SFN	Systm Frame Number
SGSN	Serving GPRS Support Node
SIB	System Information Block
SIM	Subscriber Identity Module
SIR	Signal-to-Interference Ratio
SKU	Stock Keeping Unit
SMS	Short Message Service
SPN	Service Provider Name
TBF	Temporary Block Flow
TM	Transparent Mode (RLC)
TMSI	Temporary Mobile Subscriber Identity
TTFF	Time To First Fix
UE	User Equipment
UEA	UMTS Encryption Algorithm
UIA	UMTS Integrity Algorithm
UL	Uplink (mobile to network)
UM	Unacknowledged Mode (RLC)

Table C-1: Acronyms and definitions (Continued)

Acronym or term	Definition
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module (UMTS)
USSD	Unstructured Supplementary Services Data
UTRAN	UMTS Terrestrial Radio Access Network
VLR	Visitor Location Register
VSWR	Voltage Standing Wave Ratio
VT	Video Terminal
WCDMA	Wideband Code Division Multiple Access
WINS	Windows Internet Name Service


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