MC8775V with Audio
PCI Express Mini Card

Product Specification

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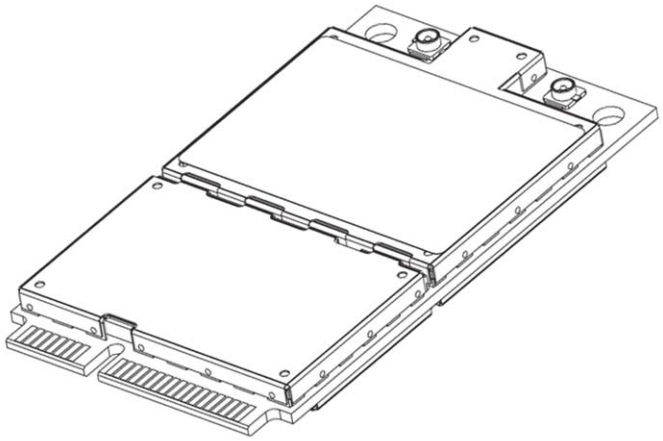

2130700
Rev 1.1
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HEART OF THE WIRELESS MACHINE™

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.

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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.

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6,339,405	6,359,591	6,400,336	6,516,204	6,561,851
6,643,501	6,653,979	6,697,030	6,785,830	6,845,249
6,847,830	6,876,697	6,879,585	6,886,049	6,968,171
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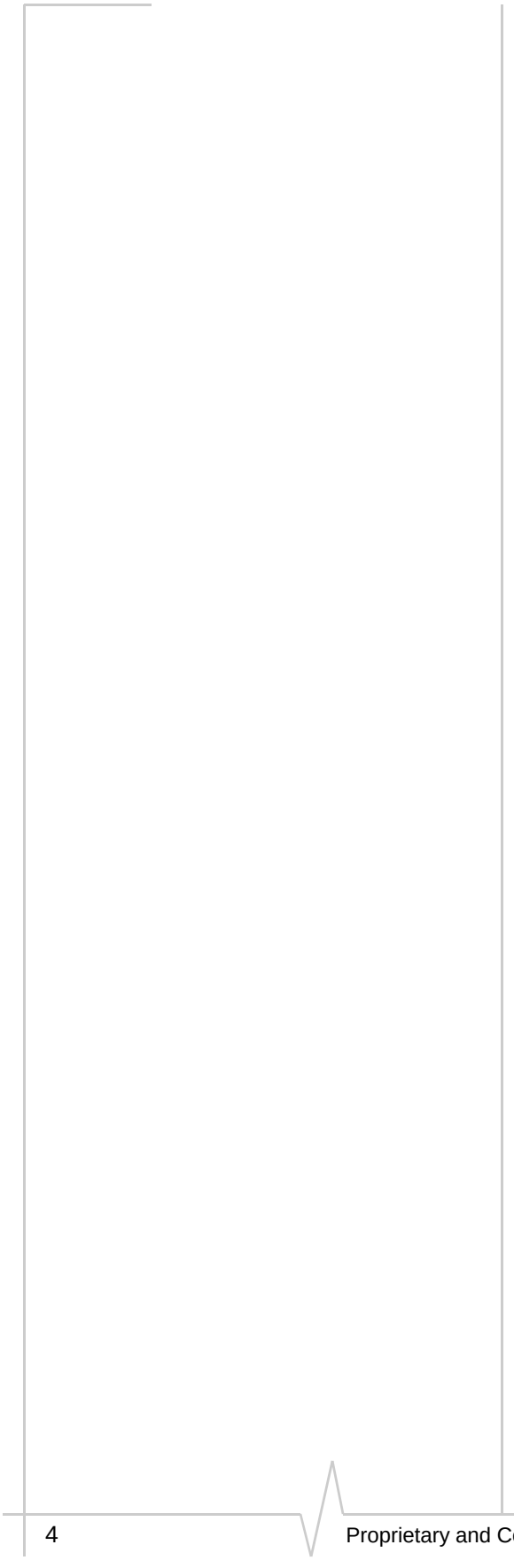


Table of Contents

1: Introduction

The Sierra Wireless MC8775V PCI Express Mini Card is a compact, lightweight, wireless UMTS-based modem. It provides GPS, EDGE, GPRS, GSM, and WCDMA (R99 and R5 HSDPA) 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**
  2100 MHz
- **UMTS WCDMA / HSDPA**
  850 MHz, 1900 MHz
- **GPS**
  1575.42 MHz

The modem is based on Qualcomm's MSM6280 baseband processor.

Specifications at a glance

This document describes high-level application and hardware interface requirements for integrating the MC8775V into a host product. For more detailed information, see Supporting documents on page 12.

Table 1-1: MC8775V Modem features

Physical features
• Small form factor—conforms to **PCI Express Mini Card Electro-mechanical Specification Revision 1.1** [R-18] • Two U.FL RF connector jacks
Electrical features
• Single supply voltage (VCC)—3.0V–3.6V • Self-shielded—no additional shielding required

Table 1-1: MC8775V 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
• Return voice call
• Save contact details
• Mobile-originated SMS e-mail
• Mobile-originated / terminated SMS concatenation
• Mobile-originated SMS e-mail concatenation

Application interface features
• NDIS NIC interface support (Windows XP) • Multiple logical channel USB support using 27.010 multiplexing protocol • Multiple non-multiplexed USB channel support • 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 Windows API (Application Program Interface)
Phone book
Supports Release 99 phone book features
Packet mode features
• Quad-mode UMTS (WCDMA) / HSDPA / EDGE / GPRS operation • GPRS / EDGE class B, multislot class 12 operation—supports all coding schemes (CS1–CS4, MCS1–MCS9) • UMTS (WCDMA) / HSDPA category 6 data rates—3.6 Mbps downlink, 384 kbps uplink • Circuit-switched radio bearers—64 kbps (maximum) uplink and downlink

Table 1-1: MC8775V Modem features (Continued)

Voice mode features
Supports: • All GSM vocoders, Enhanced Full Rate (EFR), Full Rate (FR), Half Rate (HR), and WCDMA Adaptive Multirate (AMR) encoders • MO and MT calling • Echo cancellation • Emergency calls (112, 110, 911, etc.) • Incoming call notification
Connectivity / GSM features

• Multiple (up to 16) cellular packet data profiles
• Suspend / Resume
• Sleep mode for minimum idle power draw
• SIM application tool kit with proactive SIM commands
• User-configurable audio prompts
• Enhanced Operator Name String (EONS)
• Profile list. Typical carrier profiles are available in a drop-down list in Watcher; the user can select a profile rather than enter all the parameters.
• 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
• Static and Dynamic IP address
• 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 and voice calls) while:
  ◦ GPRS is attached, or
  ◦ In a GPRS data session (class B GPRS suspend / resume procedures)

Table 1-1: MC8775V Modem features (Continued)

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 2 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) • UMTS WCDMA FDD (2100 MHz) • UMTS WCDMA FDD (850 MHz, 1900 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 MC8775V offers the following support features:

- Standard 1-year warranty
- Extended warranties available (additional 1 or 2 years)
- Enabling software (drivers, SDK, etc.): Windows XP
- Host-assisted, over-the-air firmware upgrades
- USIM support

Supporting documents

The following documents describe various aspects of the Mini Card, including design, usage, and integration issues. For a detailed list of related Sierra Wireless documents and related industry standards, see References on page 65.

- MC5720, MC8755, MC8765 Mini Card Hardware Integration Guide
- UMTS Modems Supported AT Command Reference
- MC87xx Modem Extended AT Command Reference
- GSM Software Development Kit API Manual
- MC8755/MC8765 Modem CnS Reference
- EM5625, MC5720, MC8755, MC8765 Modems USB Driver Developer's Guide
- Enabling Software Users Guide (Watcher Modem Management)

Accessories

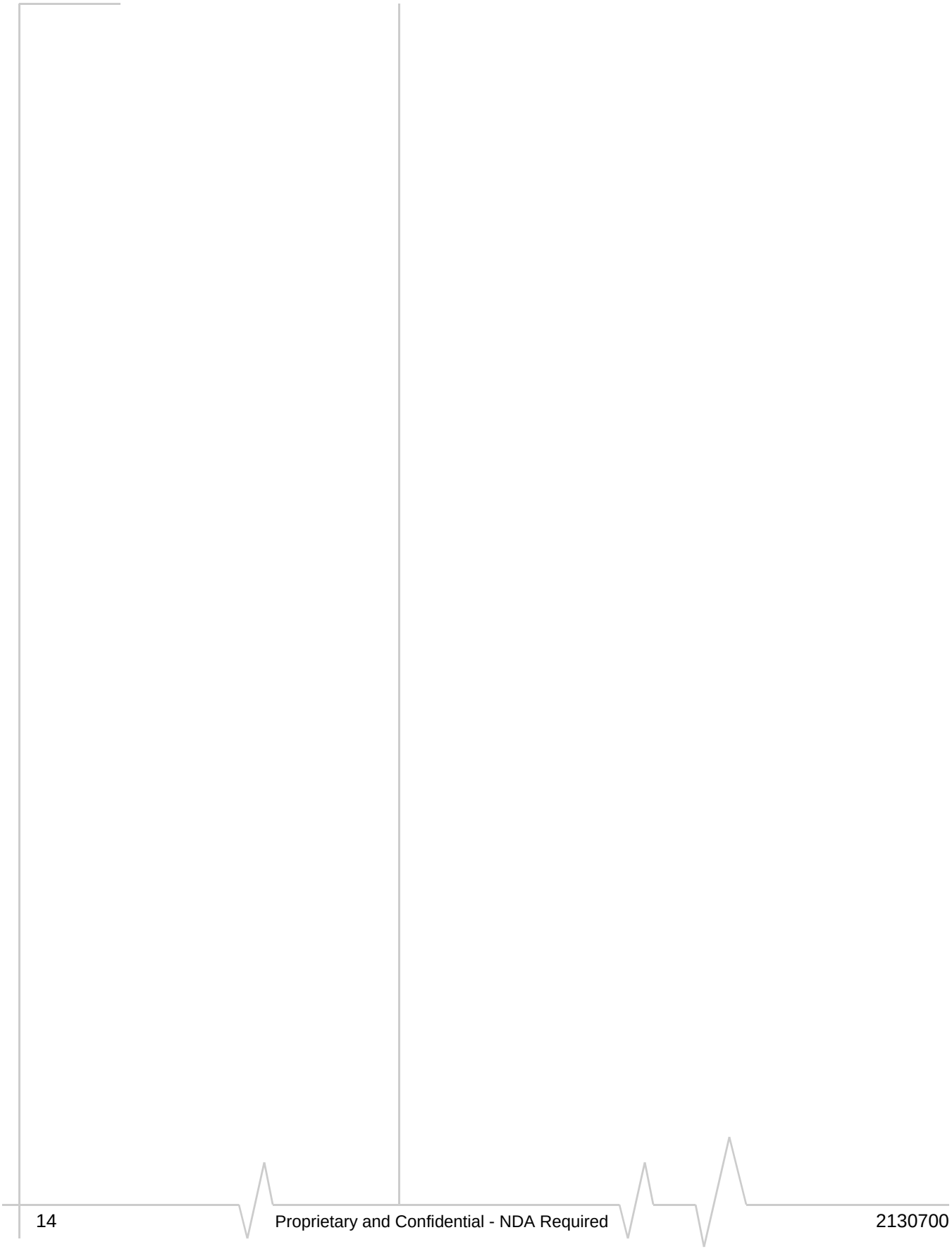
The MC8775V Development Kit includes:

- 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: UMTS overview

The Universal Mobile Telecommunications System (UMTS) specification is the third generation (3G) mobile systems standard developed by the 3rd Generation Partnership Project (3GPP), 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.

The MC8775V supports the **3GPP Release 5 UMTS Specification for Mobile Terminated Equipment** [R-9]. For additional information on this specification, visit the 3GPP web site at www.3gpp.org.

UMTS

3GPP UMTS Release 5 adds the WCDMA air interface, support for new UMTS services, and an IP-based infrastructure migration path, to the core GSM functionality, infrastructure and air interface.

At the radio access layer, the UMTS WCDMA air interface is the Direct Sequence WCDMA Frequency Division Duplex spread spectrum CDMA variant; the interface provides a three-layer radio channel organization supporting physical, transport and logical channel types. This allows abstraction of UMTS and GSM Radio Access Network base station control elements from MSC / VLR and SGSN Core Network elements and end-to-end services, enabling seamless network support for UMTS UE and GSM MS mobile devices.

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

- **Conversational** - Preserves the time relation between information entities of the data stream (conversational pattern - stringent and low-delay).
  Example: wireless telephone conversation
- **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 / EDGE is a 2.5G wireless technology providing end-to-end packet data services through the reuse of existing GSM infrastructure.

GPRS / EDGE packet data rates are determined by the number of timeslots available for downlink (Rx) and uplink (Tx), and the coding scheme that is used for any given transmission. The MC8775V supports multislot class 12 (4 Rx slots (maximum), 4 Tx slots (maximum), 5 active slots total), and all standardized coding schemes (CS 1 to CS 4 and MCS1 to MCS9).

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

Data rates for the MC8775V vary depending on timeslot availability. Table 2-1 summarizes typical and theoretical data rates (see Data Rates on page 61 for details):

Table 2-1: MC8775V data rates

Packet data service		Theoretical max data rate	Typical data rate
EDGE	Upload	236 kbps	100–130 kbps[1]
	Download	236 kbps	100–130 kbps (with bursts over 200 kbps)[1]
UMTS	Upload	384 kbps	100–300 kbps[1]
	Download	384 kbps	100–300 kbps[1]
HSDPA	Upload	384 kbps	100–300 kbps[1]
	Download	3.6 Mbps	Up to 2 Mbps[1]

[1] Depending on network implementation and network loading

3: Standards compliance

The MC8775V complies with the **3GPP Release 5 UMTS Specification for Mobile Terminated Equipment** [R-9] and several other 3GPP / ETSI standards ([R-10]–[R-17]).

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 supported
- Short Message Service
- UMTS Compliance Acceptance and Certification

UMTS WCDMA FDD specifications

The MC8775V supports the WCDMA FDD specifications listed in Table 3-1.

Table 3-1: Supported WCDMA FDD specifications

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

Table 3-1: Supported WCDMA FDD specifications

Item
Power control
PICH / DRX
Measurement for SFN / CFN timing, SFN / SFN timing
Cell selection
RLC 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 3 modes
RRC Specifications
Cell selection
RRC connection establishment
RRC connection release
System information processing
Idle mode paging
Dedicated mode paging
Initial direct transfer

Table 3-1: Supported WCDMA FDD specifications

Item
Uplink direct transfer
Downlink direct transfer
Signalling connection release
Signalling connection release request
Radio bearer establishment
Radio bearer release
Cell update
UE capability enquiry
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 MC8775V supports the GSM / GPRS / EDGE specifications listed in Table 3-2, 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. Possible 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 3GPP (3rd Generation Partnership Project) Release 99 (GPRS / EDGE), GERAN Feature Package #1, and Release 5 (WCMA).
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	Multi-slot class 12 with extended dynamic allocation of time slots
EGPRS multislot class 12	Class 12 allows up to 4 time slots in Rx and 4 for Tx with a maximum of 5 time slots active simultaneously. See Table A-1 on page 61.

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

Item	Comments
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.
One-phase packet access for EGPRS	
Two-phase packet access for GPRS	
Two-phase packet access for EGPRS	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.
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 1 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. Frequency Hopping enhances the frequency selection options for base cell selection / reselection, particularly in RF FH mode by varying the frequency of the EGPRS TRX every frame.

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

Item	Comments
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 can take 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.
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 Delayed TBF Release reduces the number of TBF establishments required during a packet data session, resulting in increased throughput for the mobile and reduced signaling on the network.
Extended Dynamic Allocation	Radio blocks can be transmitted on up to 4 different PDCHs.
Single Antenna Interference Cancellation (SAIC)	SAIC mitigates code-channel interference from neighboring cells resulting in improved voice quality, fewer dropped calls, increased voice capacity, and faster download rates for e-mail and websites.
Dual Transfer Mode (DTM)	Allows concurrent voice and data transfer while on GPRS / EDGE cell networks.
Vocoder—GSM	
Fixed rate speech codecs	Full rate and enhanced full rate are supported.

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

Item	Comments
AMR full rate / half rate	Adaptive Multi-Rate Codec AMR provides improvement in error robustness and voice capacity over the Enhanced Full Rate (EFR) codec in current GSM systems. The AMR codec contains a set of 8 fixed rate speech and channel codecs, fast in-band signaling and link adaptation. It can operate in either full rate (FR) or half rate (HR) GSM channel modes, and has the ability to adapt to radio conditions and traffic load to select the best channel mode. Contact Sierra Wireless for current level of support.
RATSCCh	During regular speech transmission (in the middle of a speech burst) RATSCCH (Robust AMR Traffic Synchronized Control Channel) steals a speech frame in order to signal the CHE (Channel Encoder)
AMR loopback mode	AMR loopback mode is used for testing.
Security	
Encryption support	GPRS / EGPRS support GEA1 and GEA2 data ciphering. GSM voice and CSD use A5/1 and A5/2 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.
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	

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

Item	Comments
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 5 or Release 99 support	
Circuit-switched data bearers	
Data bearers	Circuit-switched data bearers are supported, including: • Synchronous transparent mode = 64000 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
Vocoder - WCDMA	
AMR rates	Static multirate AMR and dynamic multirate AMR are supported, including these AMR rates: • 12.2 kbps • 10.2 kbps • 7.95 kbps • 7.4 kbps • 6.7 kbps • 5.9 kbps • 5.15 kbps • 4.75 kbps
HSDPA	
Support for: Category 12 (1.8 Mbps) and Category 6 (3.6 Mbps)	

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

Item	Comments
HSDPA logical channels	These HSDPA logical channels are supported: • HS-SCCH • HS-DPCCH • HS-PDSCH—Up to five 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.
Concurrent voice and HSDPA data	
HSDPA Indicator	Allows user interface to indicate when a data session is using HSDPA.
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)

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

Item	Comments
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.
Voice support	
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.
Supplementary services	Support for supplementary voice services such as Call Hold, Call Forward, Call Waiting, Multi-party Calls, Caller ID, Fixed Number Dialing, Service Dialing Numbers, etc.
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).

Supported voice features

The MC8775V supports the voice-related features listed in Table 3-3.

Table 3-3: Supported voice features

Item	Comments
USSD (Unstructured Supplementary Services Data)	This is a GSM-specific capability that supports transmitting information over GSM network signalling channels.
Voice encryption	Both A5/1 and A5/2 voice encryption are supported.

Table 3-3: Supported voice features (Continued)

Item	Comments
SIM Application Tool Kit with proactive SIM commands (compliant to R96)	3GPP TS 11.14 SIM Application Toolkit commands are stored on the SIM. These commands enable the SIM card to proactively drive the GSM host device and support interactions between the network and the end user.
User-configurable audio prompts	Several audio features, such as 'Incoming Call' and 'New SMS message', can be configured in Watcher.
Multi-party calling	Up to 5 remote parties are supported on a single call, plus an additional party on hold (on a separate call).

Table 3-4: Supported supplementary services

Service	Supported by		
	Watcher / CnS	GSM service code	AT command
Calling Line Identification Presentation (Caller ID)	Yes	Yes	Yes
Calling LIne Identification Restriction (hides your ID on outgoing calls)	Yes	Yes	Yes
Call Waiting	Yes	Yes	Yes
Call Hold	Yes	N/A	Yes
Multi-party service	Yes	N/A	Yes
Call Forwarding			
Unconditional	Yes	Yes	Yes
on Mobile Subscriber Busy	Yes	Yes	Yes
on No Reply	Yes	Yes	Yes
on Mobile Subscriber Not Reachable	Yes	Yes	Yes
Call Barring			
All outgoing calls	Yes	Yes	Yes
Outgoing international calls	Yes	Yes	Yes
Outgoing international calls (except those directed to the home PLMN country)	Yes	Yes	Yes
All incoming calls	Yes	Yes	Yes
Incoming calls when roaming outside the home PLMN country	Yes	Yes	Yes

Common UMTS WCDMA / GSM specifications

The MC8775V supports the common UMTS WCDMA / GSM specifications listed in Table 3-3.

Table 3-5: UMTS WCDMA / GSM specifications

Item	GSM	UMTS
Mobility management		
Automatic PLMN selection / reselection	Supported	Supported
Location updating procedure	Supported	Supported
IMSI attach procedure	Supported	Supported
IMSI detach procedure	Supported	Supported
Periodic location update	Supported	Supported
Authentication procedure	Supported	Supported
CM connection establishment from MS or network	Supported	Supported
CM connection release	Supported	Supported
Encryption key management	Supported	Supported
TMSI reallocation	Supported	Supported
Paging response	Supported	Supported
Abort procedure	Supported	Supported
Identification	Supported	Supported
CN system information	Supported	Supported
Call reestablishment	Supported	Supported
MM connection establishment emergency calls	Supported	Supported
Inter-RAT change procedure	Supported	Supported
CS follow-on procedure	Supported	Supported
Access class barring	Supported	Supported
Resumption procedure for Class B operation in GPRS	Supported	Supported
Handling of domain change CS to CS/PS and other combinations	Supported	Supported

Table 3-5: UMTS WCDMA / GSM specifications (Continued)

Item	GSM	UMTS
MM information	Supported	Supported
Network mode of operation I, II	Supported	Supported
GPRS mobility management		
GPRS attach	Supported	Supported
GPRS detach	Supported	Supported
Routing area update	Supported	Supported
GPRS authentication	Supported	Supported
GPRS identification	Supported	Supported
GMM status	Supported	Supported
Periodic routing area update	Supported	Supported
Ciphering	Supported	Supported
Access class barring	Supported	Supported
GMM status	Supported	Supported
Combined GPRS attach	Supported	Supported
Combined GPRS detach	Supported	Supported
Combined routing location / area update	Supported	Supported
PS SMS	Supported	Supported
Network initiated combined GPRS detach	Supported	Supported
Network mode of operation change	Supported	Supported
RAB management		
QoS-based activation, network offers lower / higher QoS	Supported	Supported
Primary PDP context activation	Supported	Supported
PDP context deactivation	Supported	Supported
Data services		
AT commands	Supported	Supported
MS PS data calls	Supported	Supported
Single PDP context	Supported	Supported
PDP type PPP	Not Supported	Not Supported

Table 3-5: UMTS WCDMA / GSM specifications (Continued)

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

UMTS RABS supported

Table 3-4 lists radio access bearers supported by the MC8775V as defined in **3GPP TS 34.108 (2001-01), sections 6.10.2.1 and 6.10.2.2** [R-11]:

Table 3-6: Radio access bearers

Feature
Combinations on Dedicated Physical Channel (DPCH)
• Stand-alone UL:3.4 DL:3.4 kbps SRBs for DCCH
• Stand-alone UL:13.6 DL:13.6 kbps SRBs for DCCH
• Streaming / unknown / UL:0 DL:64 kbps / CS or PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Streaming / unknown / UL:64 DL:0 kbps / CS or PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Streaming / unknown / UL:0 DL:128 kbps / CS or PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Streaming / unknown / UL:128 DL:0 kbps / CS or PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Streaming / unknown / UL:0 DL:384 kbps / CS or PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Interactive or background / UL:32 DL:8 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Interactive or background / UL:64 DL:8 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Interactive or background / UL:32 DL:64 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Interactive or background / UL:64 DL: 64 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Interactive or background / UL:64 DL:128 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Interactive or background / UL:128 DL:128 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Interactive or background / UL:64 DL:144 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Interactive or background / UL:144 DL:144 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Interactive or background / UL:64 DL:256 kbps / PS RAB + UL:3.4 DL: 3.4 kbps SRBs for DCCH
• Interactive or background / UL:64 DL:384 kbps / PS RAB + UL:3.4 DL: 3.4 kbps SRBs for DCCH
• Conversational / speech / UL:12.2 DL:12.2 kbps / CS RAB + Interactive or background / UL:32 DL:8 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH

Table 3-6: Radio access bearers (Continued)

Feature
• Conversational / speech / UL:12.2 DL:12.2 kbps / CS RAB + Interactive or background / UL:32 DL:64 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Conversational / speech / UL:12.2 DL:12.2 kbps / CS RAB + Interactive or background / UL:64 DL:64 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Conversational / speech / UL:12.2 DL:12.2 kbps / CS RAB + Interactive or background / UL:64 DL:128 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Conversational / speech / UL:12.2 DL:12.2 kbps / CS RAB + Interactive or background / UL:64 DL:256 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Conversational / speech / UL:12.2 DL:12.2 kbps / CS RAB + Streaming / unknown / UL:0 DL:64 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Conversational / speech / UL:12.2 DL:12.2 kbps / CS RAB + Streaming / unknown / UL:0 DL:128 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Conversational / unknown / UL:64 DL:64 kbps / CS RAB + Interactive or background / UL:64 DL:64 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Conversational / unknown / UL:64 DL:64 kbps / CS RAB + Interactive or background / UL:64 DL:128 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Conversational / unknown / UL:64 DL:64 kbps / CS RAB + Interactive or background / UL:128 DL:128 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Interactive or /background / UL:64 DL:128 kbps / PS RAB + Streaming / unknown / UL:0 DL:64 kbps / CS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Interactive or /background / UL:64 DL:128 kbps / PS RAB + Streaming / unknown / UL:0 DL:128 kbps / CS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
Combinations on DSCH and DPCH
• Interactive or background / UL:64 DL:256 kbps / PS RAB + UL:3.4 DL: 3.4 kbps SRBs for DCCH
• Interactive or background / UL:64 DL:384 kbps / PS RAB + UL:3.4 DL: 3.4 kbps SRBs for DCCH

Table 3-6: Radio access bearers (Continued)

Feature
• Conversational / speech / UL:12.2 DL:12.2 kbps / CS RAB + Interactive or background / UL:64 DL:256 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
• Conversational / speech / UL:12.2 DL:12.2 kbps / CS RAB + Interactive or background / UL:64 DL:384 kbps / PS RAB + UL:3.4 DL:3.4 kbps SRBs for DCCH
Combinations on SCCPCH
• Stand-alone 32 kbps SRB for PCCH
• Interactive or background / DL:32 kbps / PS RAB + SRB for CCCH + SRBs for DCCH + SRB for BCCH
• Interactive or background / DL:32 kbps / PS RAB + SRB for PCCH + SRB for CCCH + SRBs for DCCH + SRB for BCCH
Combinations on PRACH
• Interactive or background / UL:32 kbps / PS RAB + SRB for CCCH + SRBs for DCCH

Short Message Service (SMS)

Table 3-5 summarizes the MC8775V Mini Card's compliance with specific SMS features:

Table 3-7: 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 MC8775V is designed to be compliant with the **3GPP Release 5 UMTS Specification for Mobile Terminated Equipment** [R-9]. Final regulatory and operator certification requires regulatory agency testing and approval with the fully integrated UMTS UE host device incorporating the MC8775V 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 MC8775V (as defined by this document) are not supported.

For additional information on UMTS certification requirements, see Regulatory approvals on page 57.

EU certification requirements

Integrated mobile product European UMTS Certification requirements typically include:

- Full Type Approval (FTA) GCF regulatory 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 and Industry Canada type acceptance

The MC8775V complies with the agency certifications specified in Table 3-6.

Table 3-8: US and Industry Canada compliance requirements

Compliance Area	US Regulations	Industry Canada Regulations
Emissions	FCC part 15	ICES-003
Licensed transmission	FCC part 22, 24	RSS-133, RSS-129

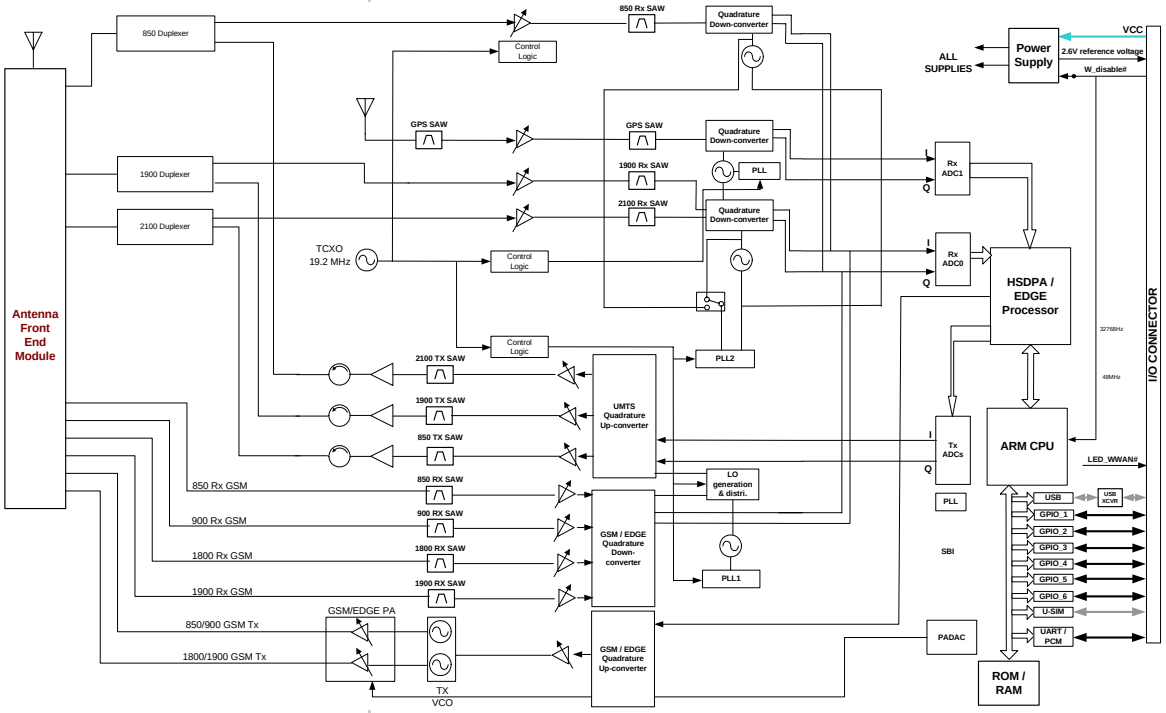
4: Electrical Specifications

The system block diagram in Figure 4-1 represents the MC8775V 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 53.
- **USIM**—Supported through the interface connector. The USIM cavity / connector needs to be placed on the host device for this feature.
- **USB**—Interface to the host for data, control, and status information.
- **UART**—Available for Control / stats and low data throughput applications
- **PCM audio**—Provides configurable A-Law / µ-Law / Linear PCM audio to external codec for wider application

The MC8775V 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: MC8775V system block diagram



Host interface pin assignments

The MC8775V host I/O connector provides pins for power, serial communications, audio, 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 39, Table 4-4 (“USB interface”) on page 40, Table 4-5 (“Serial port UART1 interface”) on page 40, Table 4-5 (“USIM interface signal”) on page 40, and Table 4-6 (“Module control signal”) on page 40).

*Note: The following table describes the **internal** structure of the module. For example, a Mini Card standard-compliant host platform will provide +3.3Vaux on pin 24, but this pin is not connected internally on the MC8775V. Thus, the pin is flagged internally as ‘No connect’.*

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, UART interface, and USIM interface.

Table 4-1: MC8775V connector pin assignments

Pin	Signal name	Description	Direction to module	Active state
1	MIC_P	Microphone positive	Input	
2	VCC	3.3 V supply	Input	Power
3	MIC_N	Microphone negative	Input	
4	GND	Ground	Input	Power
5	SPK_P	Speaker positive	Output	
6	GPIO_1	General purpose I/O *	Input	
7	SPK_N	Speaker negative	Output	
8	USIM_PWR	USIM VCC supply	Output	Power
9	GND	Ground	Input	Power
10	USIM_DATA	USIM IO pin	Input/Output	Low
11	VCC_MSM26_DIG	2.6 V voltage reference	Output	High (when module is on)
12	USIM_CLK	USIM clock	Output	High
13	NC	No connect		
14	USIM_RESET	USIM reset	Output	Low
15	GND	Ground	Input	Power
16	GPIO_2	General purpose I/O *	Input	
17	NC	No connect (UIM Pin 8)		
18	GND	Ground	Input	Power
19	NC	No connect (UIM Pin 4)		
20	W_DISABLE#	Wireless disable	Input	Low
21	GND	Ground	Input	Power
22	AUXV1	Auxiliary Voltage 1	Input (Analog Modem)	N/A
23	NC	No connect		
24	NC	No connect		
25	NC	No connect		
26	GND	Ground	Input	Power
27	GND	Ground	Input	Power

Table 4-1: MC8775V connector pin assignments (Continued)

Pin	Signal name	Description	Direction to module	Active state
28	GPIO_3	General purpose I/O *	Input	
29	GND	Ground	Input	Power
30	NC	No connect		
31	NC	No connect		
32	NC	No connect		
33	MDL_RESET_N	Reset	Input	Low
34	GND	Ground	Input	Power
35	GND	Ground	Input	Power
36	USB_D-	USB data negative	Input/Output	Differential
37	GND	Ground	Input	Power
38	USB_D+	USB data positive	Input/Output	Differential
39	VCC	3.3 V supply	Input	Power
40	GND	Ground	Input	Power
41	VCC	3.3 V supply	Input	Power
42	LED_WWAN#	LED driver	Output	Low
43	GND	Ground	Input	Power
44	GPIO_4	General purpose I/O *	Input	
45	CTS1 / PCM_CLK**	UART Clear to send *or* PCM Clock	Output	High/Low
46	GPIO_5	General purpose I/O *	Input	
47	RTS1 / PCM_DIN **	UART Request to send *or* PCM Data in	Input	High/Low
48	GPIO_6	General purpose I/O *	Input	
49	RXD1 / PCM_DOUT**	UART Receive data *or* PCM Data out	Output	High/Low
50	GND	Ground	Input	Power
51	TXD1 / PCM_SYNC **	UART Transmit data	Input	High/Low
		PCM Sync	Output	

Table 4-1: MC8775V connector pin assignments (Continued)

Pin	Signal name	Description	Direction to module	Active state
52	VCC	3.3 V supply	Input	Power

* No defined function - Reserved for future use

** PCM/UART functionality is switched via AT command or configuration during fulfillment. The maximum series impedance on PCM lines is 1 kΩ, and on UART lines is 1.5 kΩ.

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

All digital signals (pin types O, PU, and PD) conform to the specifications in Table 4-3.

Power supply

Power is provided to the MC8775V through multiple power and ground pins as outlined in Table 4-2.

Table 4-2: Power and ground specifications

Name	Pins	Type	Specification	Parameter	Min	Typ	Max	Units
VCC	2, 39, 41, 52	V	Voltage range	VCC	3.0	3.3	3.6	V
			Ripple voltage		-	-	100	mV_{pp}
VCC_MSM26_DIG	11	V	Maximum supply current = 10 mA		2.52	-	2.8	V
GND	4, 9, 15, 18, 21, 26, 27, 29, 34, 35, 37, 40, 43, 50	V			-	0	-	V

Digital interface

Table 4-3: Digital signal DC characteristics

Specification	Parameter	Conditions	Min (V)	Typ (V)	Max (V)
High-level input voltage	VIH		1.7	2.6	2.9
Low-level input voltage	VIL		-0.3	0	0.9

Table 4-3: Digital signal DC characteristics (Continued)

Specification	Parameter	Conditions	Min (V)	Typ (V)	Max (V)
High-level output voltage	VOH	Load < 3 mA	2.1	2.6	2.7
Low-level output voltage	VOL	Load < 3 mA	0	0	0.45
High-level input voltage (W_DISABLE#)	VIH_W	Internal pull-up to VCC	2.0	VCC	3.6
Low-level input voltage (W_DISABLE#)	VIL_W	Host sinking minimum 500 µA	-0.3	0	0.35

USB interface

The USB interface requires 3.3 V regulated voltage from the host device to provide power to the USB transceiver on the MC8775V. The USB interface is compliant with Version 2.0 of the USB standard for full speed operation.

Table 4-4: USB interface

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.

UART interface

The MC8775V has a simple four-line serial interface. Since the speed of the serial port is limited to 230.4 kbps, it should only be used for AT commands and control of the modem. The USB interface should be used for all high speed data transfers.

Table 4-5: Serial port UART1 interface

Name	Pin	Description	Type	Notes
CTS1_N	45	Clear to send	O	
RTS1_N	47	Request to send	PD	
RXD1	49	Receive data	O	UART1 serial data receive line (modem output)
TXD1	51	Transmit data	PD	UART1 serial data transmit line (modem input)

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 4-6: USIM interface signal

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

The MC8775V provides two signals for control and handshaking of the module from the host. These signals are summarized in Table 4-6.

Table 4-7: Module control signal

Name	Pin	Description	Type
W_DISABLE#	20	Wireless disable	PU
MDL_RESET_N	33	Reset modem	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 20k 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 1.1** [R-18]. If desired, LED behavior can be configured by adjusting software settings.

MDL_RESET_N is used by the host device to reset the module. Pulsing this signal (low) resets the modem. This signal must be an open drain / collector output on the host board.

Audio interface

The analog audio interface is summarized in Table 4-8, with detailed performance specifications in Table 4-9 and Table 4-10.

The MC8775V supports both a differential analog interface and PCM digital audio, and allows dynamic run-time selection of the appropriate interface.

Table 4-8: Analog audio interface connections

Name	Pin	Description	Type	Notes
MIC_P	1	Line Audio input	A	Differential audio input, line level
MIC_N	3	Line Audio input	A	Differential audio input, line level
SPK_P	5	Main speaker	A	Differential audio output, line level
SPK_N	7	Main speaker	A	Differential audio output, line level

Table 4-9: Microphone interface parameters

Parameter / Description		Test	Min	Typ	Max	Units
	Local impedance between SPK_P and SPK_N		25.6	32		Ω
Z_{In1}	Input impedance between MIC_P and MIC_N	Fully differential, A/D path	16	20	24	kΩ
THD_V	Total harmonic distortion +Noise (voice)	All inputs: • AV_{DD} = 2.5 V • 13-bit mode • analog input at 229 mV_{pp} • 498 Hz sine wave			1.78	%

Table 4-10: Speaker interface parameters

Parameter / Description		Test	Min	Typ	Max	Units
P_{O1}	SPK_AMP output power (rms)	• Differential • 32Ω load • PCMI = +3 dBm0 • 1.02 kHz sine wave		70		mW
	Output DC offset voltage between MIC_P and MIC_N, SPK_P and SPK_N	Fully differential	-20		20	mV
	Output common mode voltage, SPK_P and SPK_N	Measured at each output pin with respect to AVSS: V_{DD} = 2.5 V to 2.7 V	1.13	1.25	1.38	V
Z_{OUT1}	Differential output impedance	At 1.02 kHz, for outputs SPK_P and SPK_N			1	Ω

PCM interface

The MC8775V module's PCM audio interface features the following characteristics:

- runs in master mode
- supports Linear (13-bit), A-Law (8-bit), and μ-Law(8-bit) companding algorithms
- supports 2.048 MHz short frame sync (PCM) and 128 kHz long frame sync (AUX_PCM) operation

Note: The PCM interface is not AC97-compliant.

Note: The selected interface persists until it is explicitly changed using AT commands.

The PCM audio interface, described in the figures and tables below, is selected at run-time using AT commands—both the PCM audio and UART interfaces share the same physical pins. Once selected, the chosen interface becomes effective after the module resets.

Table 4-11: PCM digital audio interface connections

Name	Pin	Description	Type	Notes
PCM_CLK	45	PCM clock	O	
PCM_DIN	47	PCM data in	PD	
PCM_DOUT	49	PCM data out	O	
PCM_SYNC	51	PCM sync	PD	

PCM interface - short frame sync (2.048 MHz)

Figures 4-2, 4-3, 4-4, and Table 4-12 describe the short frame sync (2.048 MHz) PCM interface.

Figure 4-2: Timing diagram: short frame sync (PCM_SYNC)

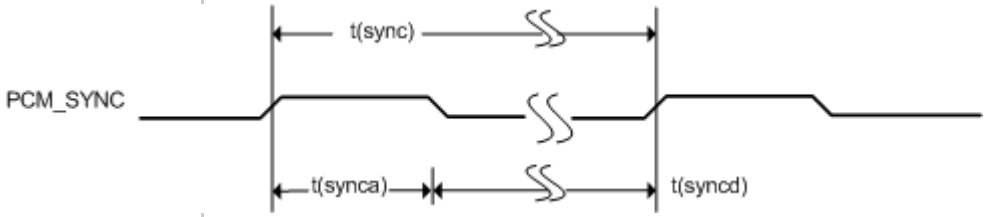


Figure 4-3: Timing diagram: PCM_CODEC to MC8775V

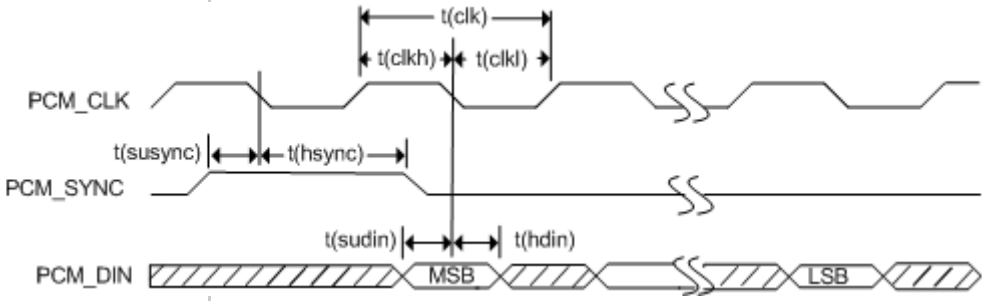


Figure 4-4: MC8775V to external PCM_CODEC

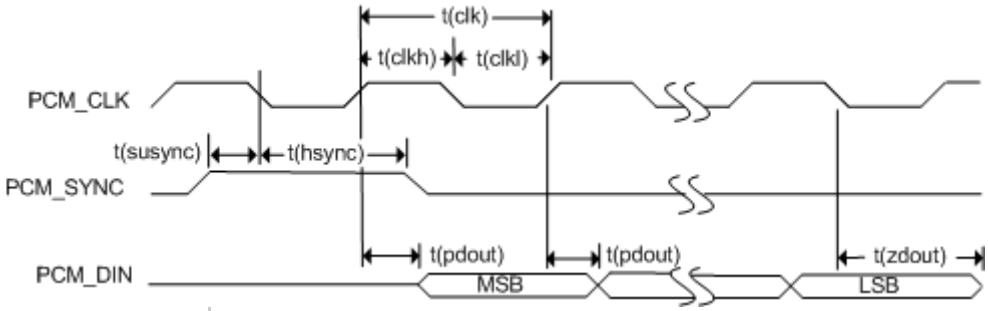


Table 4-12: PCM_CODEC short frame sync (2.048 MHz) timing parameters

Parameter	Description	Min	Typ	Max	Units	Notes
t(sync)	PCM_SYNC cycle time (PCM_SYNC_DIR=1)		125		µs	1
	PCM_SYNC cycle time (PCM_SYNC_DIR=0)		125		µs	
t(synca)	PCM_SYNC asserted time (PCM_SYNC_DIR=1)	400	500		ns	1
	PCM_SYNC asserted time (PCM_SYNC_DIR=0)				ns	
t(syncd)	PCM_SYNC de-asserted time (PCM_SYNC_DIR=1)		124.5		µs	1
	PCM_SYNC de-asserted time (PCM_SYNC_DIR=0)				µs	
t(clk)	PCM_CLK cycle time (PCM_CLK_DIR=1)	400	500		ns	1
	PCM_CLK cycle time (PCM_CLK_DIR=0)				ns	

Table 4-12: PCM_CODEC short frame sync (2.048 MHz) timing parameters (Continued)

Parameter	Description	Min	Typ	Max	Units	Notes
t(clkh)	PCM_CLK high time (PCM_CLK_DIR=1)	200	250		ns	1, 2
	PCM_CLK high time (PCM_CLK_DIR=0)				ns	
t(clkl)	PCM_CLK low time (PCM_CLK_DIR=1)	200	250		ns	1, 2
	PCM_CLK low time (PCM_CLK_DIR=0)				ns	
t(susync)	PCM_SYNC setup time to PCM_CLK falling		150		ns	
	(PCM_SYNC_DIR = 1, PCM_CLK_DIR = 1)					
	PCM_SYNC setup time to PCM_CLK falling				ns	
	(PCM_SYNC_DIR = 0, PCM_CLK_DIR = 0)					
t(hsync)	PCM_SYNC hold time after PCM_CLK falling		300		ns	
	(PCM_SYNC_DIR = 1, PCM_CLK_DIR = 1)					
	PCM_SYNC hold time after PCM_CLK falling				ns	
	(PCM_SYNC_DIR = 0, PCM_CLK_DIR = 0)					
t(sudin)	PCM_DIN setup time to PCM_CLK falling	50			ns	
t(hdin)	PCM_DIN hold time after PCM_CLK falling	10			ns	
t(pdout)	Delay from PCM_CLK rising to PCM_DOUT valid			350	ns	
t(zdout)	Delay from PCM_CLK falling to PCM_DOUT HIGH-Z		160		ns	

Notes:
1. This value assumes that CODEC_CTL is not being used to override the CDMA CODEC clock and sync operation.
2. t(clkh) and t(clkl) are independent of PCM_CLK_SENSE.

Auxiliary PCM (long frame sync, 128 kHz)

Figures 4-5, 4-6, 4-7, and Table 4-13 describe the long frame sync (128 kHz) PCM interface

Figure 4-5: Timing diagram: long frame sync (AUX_PCM_SYNC)

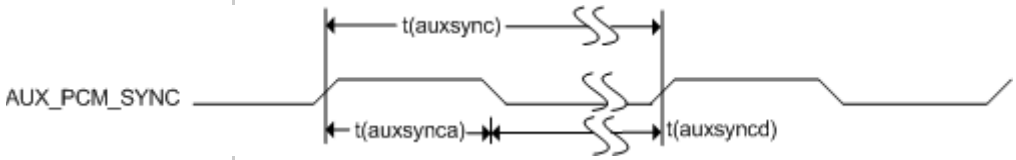


Figure 4-6: Timing diagram: AUX_PCM_CODEC to MC8775V

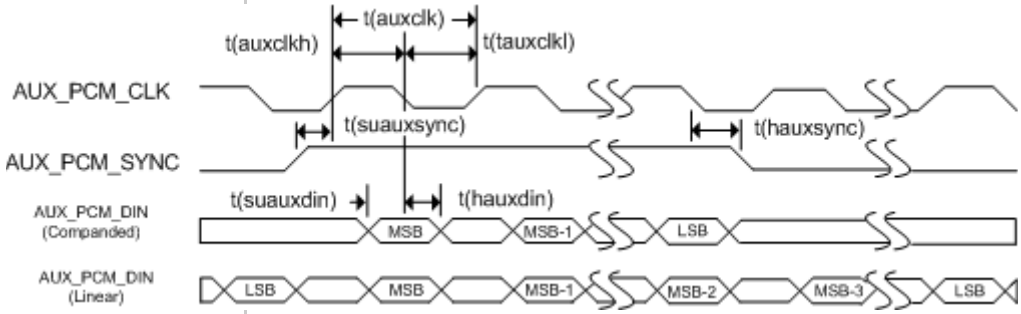


Figure 4-7: Timing diagram: MC8775V to AUX_PCM_CODEC

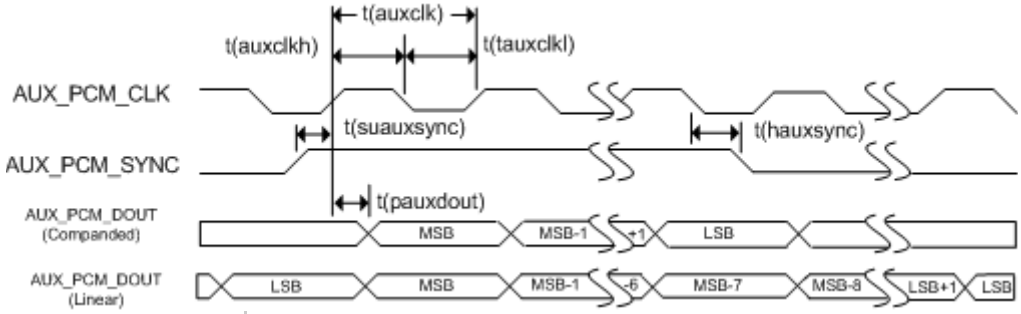


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Table 4-13: AUX_PCM_CODEC timing parameters

Parameter	Description	Min	Typ	Max	Units	Notes
t(auxsync)	AUX_PCM_SYNC cycle time		125		µs	1
t(auxsynca)	AUX_PCM_SYNC asserted time	62.4	62.5		µs	1
t(auxsyncd)	AUX_PCM_SYNC de-asserted time	62.4	62.5		µs	1
t(auxclk)	AUX_PCM_CLK cycle time		7.8		µs	1
t(auxclkh)	AUX_PCM_CLK high time	3.8	3.9		µs	1
t(auxclkl)	AUX_PCM_CLK low time	3.8	3.9		µs	1
t(suauxsync)	AUX_PCM_SYNC setup time to AUX_PCM_CLK rising	1.95			µs	
t(hauxsync)	AUX_PCM_SYNC hold time after AUX_PCM_CLK rising	1.95			µs	
t(suauxdin)	AUX_PCM_DIN setup time to AUX_PCM_CLK falling	70			ns	
t(hauxdin)	AUX_PCM_DIN hold time after AUX_PCM_CLK falling	20			ns	

Table 4-13: AUX_PCM_CODEC timing parameters (Continued)

Parameter	Description	Min	Typ	Max	Units	Notes
t(pauxdin)	Propagation delay from AUX_PCM_CLK AUX_PCM_DOUT valid			50	ns	

Notes:

1. This value assumes that CODEC_CTL is not being used to override the CDMA CODEC clock and sync operation.

VOICE path specifications

The following tables describe additional codec specifications for Transmit and Receive Voice path parameters (Table 4-14 to Table 4-21).

Table 4-14: Transmit VOICE path level translation and linearity, differential input[1,2,3]

Parameter	Test	Min	Typ	Max	Units
Level: Transmit reference signal (0 dBm0)	Differential analog input		57.3		mV_{rms}
Level: Overload signal (+3 dBm0)	Differential analog input		229		mV_{pp}
Absolute gain error[3]	• -10 dBm0 analog input level • 1.02 kHz sine wave	-1		1	dB
Gain error relative to gain at -10 dBm0	Analog input level: +3 dBm0 to -30 dBm0	-0.5		0.5	dB
	Analog input level: -31 dBm0 to -45 dBm0	-1		1	dB
	Analog input level: -46 dBm0 to -55 dBm0	-1.2		1.2	dB

[1] Total transmit channel gain = +24 dB in default configuration (MIC_GAIN = +24 dB)

[2] Sampling rate = 8 kHz

[3] Applies to all microphone amplifier gain settings

Table 4-15: Transmit Voice path frequency response and image rejection, digital transmit slope filter disabled (8K)[1,2,3]

Parameter	Test frequency (Hz)	Min	Typ	Max	Units
Gain relative to input signal gain at 1.02 kHz, digital Tx high pass filter disabled	< 100	-0.5		0.5	dB
	200	-0.5		0.5	dB
	300–3000	-0.5		0.5	dB
	3400	-1.5		0	dB
	3980			-14	dB
	4600			-35	dB
	7980			-47	dB
Gain relative to input signal gain at 1.02 kHz, digital Tx high pass filter enabled	< 100			-15	dB
	200			-5	dB

[1] Tx input path level = -10 dBm0

[2] To determine image rejection performance, use the 4600 Hz and 7980 Hz frequencies

[3] Sampling rate = 8 kHz

Table 4-16: Transmit Voice path anti-aliasing image rejection, differential input (8K)[1,2,3,4]

Parameter	Test	Min	Typ	Max	Units
Transmit image rejection at 2.048 MHz	• MIC_GAIN gain = +24 dB • Analog input level = 229 mV_{pp} at 2.047 MHz	30	60		dB

[1] Specifications must be met for left and right channels

[2] Select MIC1 differential input

[3] 13-bit mode

[4] Sampling rate = 8 kHz

Table 4-17: Transmit Voice path frequency response and image rejection, digital transmit slope filter enabled[1,2,3,4]

Parameter	Test frequency (Hz)	Min	Typ	Max	Units
Gain relative to input signal gain at 1.02 kHz, with slope filter selected, and digital Tx high pass filter enabled	100			-27	dB
	200			-8	dB
	250			-4	dB
	300		-1.80		dB
	400		-1.50		dB
	500		-1.30		dB
	600		-1.1		dB
	700		-0.8		dB
	800		-0.57		dB
	900		-0.25		dB
	1020		0		dB
	1500		1.8		dB
	1980		4.0		dB
	2500		6.5		dB
	3000		7.6		dB
	3100		7.7		dB
	3300		8.0		dB
	3500		6.48		dB
	3980			-13	dB
	4500			-35	dB
	5000			-45	dB
	7980			-50	dB

[1] Passband tolerance (300 Hz–3500 Hz) = ±0.25 dB

[2] Tx input path level = -10 dBm0

[3] To determine image rejection performance, use the 4500 Hz, 5000 Hz, and 7980 Hz frequencies

[4] Sampling rate = 8 kHz

Table 4-18: Transmit Voice path idle channel noise and distortion (8K) [1,2,3,4]

Parameter	Test	Min	Typ	Max	Units
Transmit noise (input refer noise)	• TXPGA gain = 0 dB • MIC_GAIN = +24 dB		10	15	μV_{rms}

Table 4-18: Transmit Voice path idle channel noise and distortion (8K) [1,2,3,4] (Continued)

Parameter	Test	Min	Typ	Max	Units
Transmit signal-to-THD+N ratio with 1020 Hz sine wave input across MIC_P and MIC_N	Analog input level at +3 dBm0	35			dB
	Analog input level at 0 dBm0	50			dB
	Analog input level at -5 dBm0	50			dB
	Analog input level at -10 dBm0	46			dB
	Analog input level at -20 dBm0	45			dB
	Analog input level at -30 dBm0	40			dB
	Analog input level at -40 dBm0	30			dB
	Analog input level at -45 dBm0	25			dB

[1] Specifications must be met with and without Tx slope filter enabled

[2] C-message weighted for 8k sampling rate

[3] Measurement bandwidth = 100 kHz to 20 kHz

[4] Sampling rate = 8 kHz

Table 4-19: Receive Voice path level translation and linearity, SPK_AMP selected [1,2,3,4,5,6]

Parameter	Test	Min	Typ	Max	Units
Level: Receive reference signal (0 dBm0)	• PCMI = 0 dBm0 • 1.02 kHz sine wave		1.06		V_{rms}
Level: Overload signal (+3 dBm0)	• PCMI = +3 dBm0 • 1.02 kHz sine wave		4.24		V_{pp}
Absolute gain error	• CPMI = 0 dBm0 • 1.02 kHz sine wave	-1		+1	dB
Gain error relative to gain at -10 dBm0	PCMI = +3 dBm0 to -40 dBm0	-0.5		+0.5	dB
	PCMI = -41 dBm0 to -50 dBm0	-1		+1	dB
	PCMI = -51 dBm0 to -55 dBm0	-1.2		+1.2	dB

[1] RXPGA = 0 dB

[2] Output measured differentially between SPK_N and SPK_P

[3] +3 dBm0 level corresponds to 0 dB full-scale sine wave

[4] Loaded condition (32 Ω)

[5] 13-bit mode

[6] Sampling rate = 8 kHz

Table 4-20: Receive Voice path frequency response and image rejection (8K) [1,2,3,4,5,6,7]

Parameter	Test frequency (Hz)	Min	Typ	Max	Units
Gain relative to input signal gain at 1.02 kHz, digital Rx high pass filter disabled	< 100	-0.5		0.5	dB
	200	-0.5		0.5	dB
	300–3000	-0.5		0.5	dB
	3400	-1.5		0	dB
	3980			-14	dB
	4600			-40	dB
	7980			-50	dB
Gain relative to input signal gain at 1.02 kHz, digital Rx high pass filter enabled	< 100			-15	dB
	200			-5	dB

[1] RXPGA = 0 dB

[2] Rx input path level = -10 dBm0

[3] Specification applies to SPK_AMP

[4] Loaded condition (32 Ω)

[5] Determine image rejection performance using the 3980 Hz, 4600 Hz, 7980 Hz frequencies

[6] 13-bit mode

[7] Sampling rate = 8 kHz

Table 4-21: Receive Voice path idle channel noise and distortion, SPK_AMP [1,2,3,4,5,6,7,8]

Parameter	Test	Min	Typ	Max	Units
Receive noise	PCMIN = “0000000000000”		124	150	μV_{rms}
Receive signal-to-THD+N ratio with 1.02 kHz sine wave input	PCMI = +3 dBm0	29			dB
	PCMI = 0 dBm0	50			dB
	PCMI = -5 dBm0	47			dB
	PCMI = -10 dBm0	46			dB
	PCMI = -20 dBm0	42			dB
	PCMI = -30 dBm0	40			dB
	PCMI = -40 dBm0	30			dB
	PCMI = -45 dBm0	25			dB

Table 4-21: Receive Voice path idle channel noise and distortion, SPK_AMP [1,2,3,4,5,6,7,8] (Continued)

Parameter	Test	Min	Typ	Max	Units
Intermodulation distortion (2-tone method)	PCMI = 498 Hz and 2.02 kHz equal amplitude tones, composite peak level equivalent to 0 dBm0 sine wave	50			dB

[1] RXPGA = 0 dB

[2] Output measured differentially between SPK_N and SPK_P

[3] +3 dBm0 level corresponds to 0 dB full-scale sine wave

[4] Loaded condition (32 Ω)

[5] 13-bit mode

[6] A-weighted

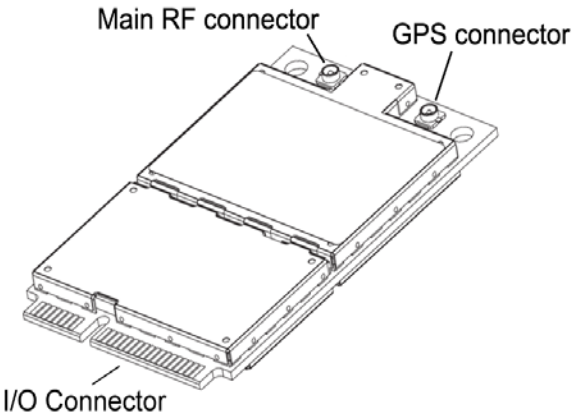
[7] Sampling rate = 8 kHz

[8] Measurement bandwidth = 100 Hz to 20 kHz

5: RF Specifications

The MC8775V 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 stand-alone GPS.

Figure 5-1: Module connectors



The RF Connectors (Hirose part number U.FL # CL331-0471-0-10) 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: In the event that the antenna connection is shorted or open, the modem will not sustain permanent damage.

Table 5-1: MC8775V RF port band options

UMTS bands	GSM / EDGE bands	GPS
IMT 2100 / 850 / 1900 MHz (Band Class I, II, V)	850 / 900 / 1800 / 1900 MHz	1575.42 MHz

Table 5-2: MC8775V Conducted Rx (Receive) Sensitivity

Band	Typical Conducted Rx Sensitivity (dBm)	Maximum Conducted Rx Sensitivity (dBm)
GSM 850 (2%[1]) CS[2]	-107.5	-106
EGSM 900 (2%[1]) CS[2]	-107.5	-106

Table 5-2: MC8775V Conducted Rx (Receive) Sensitivity (Continued)

Band	Typical Conducted Rx Sensitivity (dBm)	Maximum Conducted Rx Sensitivity (dBm)
DCS 1800 (2%[1]) CS[2]	-106.5	-105
PCS 1900 (2%[1]) CS[2]	-106.5	-105
Band I UMTS 2100 (0.1%[1]) 12.2 kbps	-110.5	-109
Band II UMTS 1900 (0.1%[1]) 12.2 kbps	-110.5	-109
Band V UMTS 850 (0.1%[1]) 12.2 kbps	-111.5	-110

[1] % = Bit Error Rate

[2] CS = Circuit switched

Table 5-3: MC8775V — 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 (1900 & 850 MHz) 12.2 kbps	+23 ± 1	Connectorized (Class 3)
Band I (IMT 2100 MHz band) 12.2 kbps	+23 ± 1	Connectorized (Class 3)

Table 5-4: Main antenna specifications*

Parameter	Min	Typ	Max	Units	Notes
Cable loss	-	-	0.5	dB	Maximum loss to antenna
Impedance	-	50	-	Ω	Antenna load impedance

Table 5-4: Main antenna specifications* (Continued)

Parameter	Min	Typ	Max	Units	Notes
VSWR	-	-	3:1		Maximum allowed VSWR of antenna
* Detailed antenna requirements are provided by Sierra Wireless in *MC5720, MC8755, MC8765, MC8775 MiniCard Hardware Integration Guide (Document #2130114)*					

Table 5-5: GPS antenna specifications*

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)
* Detailed antenna requirements are provided by Sierra Wireless in *MC5720, MC8755, MC8765, MC8775 MiniCard Hardware Integration Guide (Document #2130114)*	

Table 5-6: InterRAT and InterFrequency hopping

GSM 850 ↔ WCDMA 1900 handover - blind mode	GSM 1900 ↔ WCDMA 1900 handover - blind mode
GSM 850 ↔ WCDMA 850 handover - blind mode	GSM 1900 ↔ WCDMA 850 handover - blind mode
GSM 900 ↔ WCDMA 2100 handover - blind mode	GSM 850 ↔ WCDMA 850 handover - idle frame measurements
GSM 1800 ↔ WCDMA 2100 handover - blind mode	GSM 850 ↔ WCDMA 1900 handover - idle frame measurements
GSM 900 ↔ WCDMA 2100 handover - idle frame measurements	GSM 1900 → WCDMA 1900 handover - idle frame measurements
GSM 1800 ↔ WCDMA 2100 handover - idle frame measurements	GSM 1900 → WCDMA 850 handover - idle frame measurements
GSM 900 ↔ WCDMA 2100 cell reselection	GSM 850 ↔ WCDMA 850 cell reselection
GSM 1800 ↔ WCDMA 2100 cell reselection	GSM 850 ↔ WCDMA 1900 cell reselection
GSM 900 ↔ WCDMA 2100 CCO	GSM 1900 ↔ WCDMA 1900 cell reselection
GSM 900 (w/BCCH/PBCCH) → WCDMA 2100 reselection in packet transfer	GSM 1900 ↔ WCDMA 850 cell reselection
GSM 1800 (w/BCCH/PBCCH) → WCDMA 2100 reselection in packet transfer	GSM 850 ↔ WCDMA 850 CCO

Table 5-6: InterRAT and InterFrequency hopping (Continued)

PS data continuity during OOS and RAT change	GSM 850 ↔ WCDMA 1900 CCO
PS data continuity with MPDP (primary and secondary contexts) and RAT change	GSM 1900 ↔ WCDMA 1900 CCO
EDGE ↔ WCDMA cell reselection in packet transfer	GSM 1900 ↔ WCDMA 850 CCO
Inter-RAT NACC 2G ↔ 3G	GSM 850 (w/BCCH/PBCCH) → WCDMA 850 reselection in packet transfer
3G background PLMN search while in 2G	GSM 850 (w/BCCH/PBCCH) → WCDMA 1900 reselection in packet transfer
3G background PLMN search while in 3G	GSM 1900 (w/BCCH/PBCCH) → WCDMA1900 reselection in packet transfer
	GSM 1900 (w/BCCH/PBCCH) → WCDMA 850 reselection in packet transfer

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 MC8775V 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 39.

Table 6-1: Averaged standby DC power consumption

Signal	Description	Band	Typ	Max	Units	Notes / Configuration
VCC	**Standby current consumption with Sleep mode activated** (assumes USB bus is fully suspended during measurements)					
	HSDPA / WCDMA	Bands I, II, V	2.9	4	mA	DRX cycle = 8 (2.56 s)
	GSM / GPRS / EDGE	All	2.8	4	mA	MFRM = 5 (1.175 s)
	Standby current consumption with Sleep mode deactivated (assumes USB bus is fully suspended during measurements)					
	HSDPA / WCDMA	Bands I, II, V	73	80	mA	DRX cycle = 8 (2.56 s)
	GSM / GPRS / EDGE	All	46	55	mA	MFRM = 5 (1.175 s)
	Low Power Mode (LPM) / Offline Mode					
	RF disabled, but module is operational		2.5	4	mA	This state is entered when Watcher shuts down / turns off the radio.

Table 6-2: Averaged WCDMA / HSDPA talk / data DC power consumption

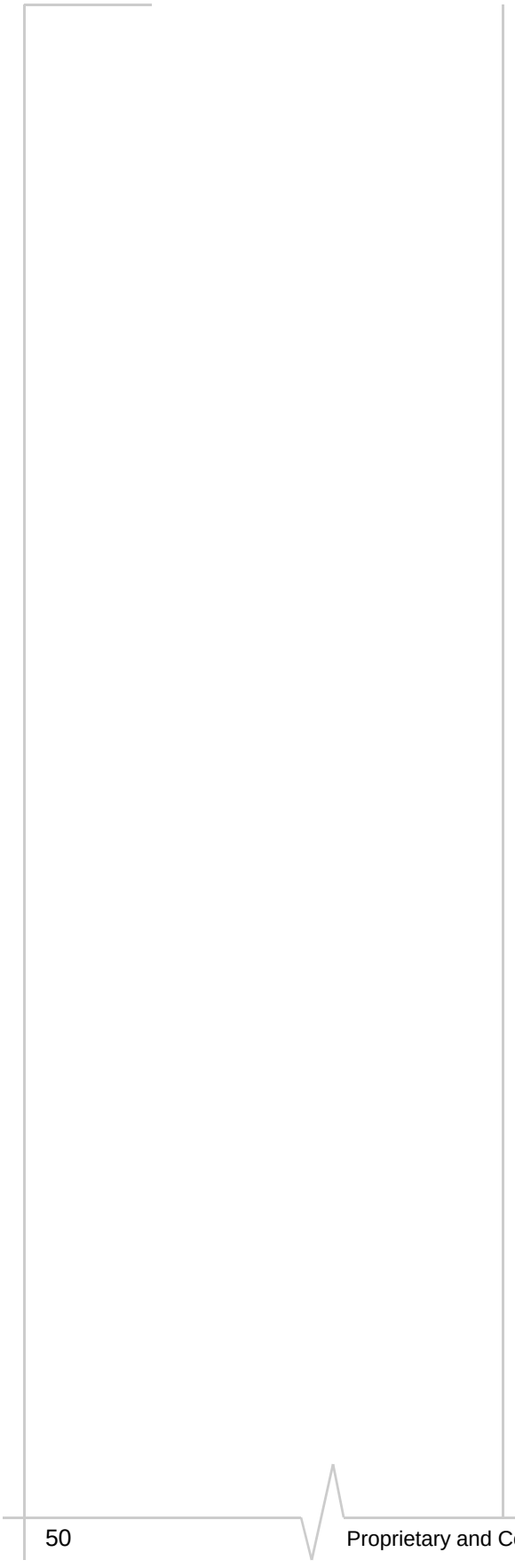
Signal	Description	Band	Typ	Max	Units	Notes / Configuration
VCC	**WCDMA talk / data current consumption** (includes USB bus current)					
	WCDMA talk current (AMR 12.2 kbps vocoder)	IMT2100 (Band I) PCS1900 (Band II) 850 (Band V)	300	-	mA	0 dBm Tx power
			480	-	mA	+15 dBm Tx power
			650	-	mA	+21 dBm Tx power
	WCDMA data current		330	-	mA	64 kbps UL / 384 kbps DL, +0 dBm Tx power
	WCDMA searching channels			180	mA	320 mA peak
	HSDPA current		340	-	mA	0 dBm Tx power
	Maximum peak talk current		-	1.2	A	Max RF output power, full rate, full operating temperature range

Table 6-3: Averaged GSM / EDGE talk / data DC power consumption

Signal	Description	Band	Typ	Max	Units	Notes / Configuration
VCC	**GSM / EDGE talk / data current consumption** (assumes USB bus current)					
	GSM Talk current (Full rate GSM vocoder, averaged over multiple Tx frames)	Quad GSM	300	-	mA	+5 dBm Tx power
			210	-	mA	+13 dBm Tx power
			300	-	mA	+29 dBm Tx power
		GSM850 & GSM900	360	-	mA	+33 dBm Tx power
	GPRS current (+13 dBm Tx power, GPRS CS2, averaged over multiple Tx frames)	Quad GSM	180	-	mA	1 Rx / 1 Tx slot
			180	-	mA	2 Rx / 1 Tx slot
			240	-	mA	4 Rx / 2 Tx slot
	GSM/GPRS searching channels	Quad GSM, GSM850, GSM900	-	163	mA	489 mA peak
	EDGE current (14 dBm Tx Power, averaged over multiple Tx frames)	Quad GSM	180	-	mA	1 Rx / 1 Tx slot
			180	-	mA	2 Rx / 1 Tx slot
			240	-	mA	4 Rx / 2 Tx slot
	Maximum Peak Talk current	Quad GSM	2.3	2.75	A	Max RF output power, Tx pulse current, full operating temperature range

Table 6-4: Miscellaneous DC power consumption

Signal	Description	Band	Typ	Max	Units	Notes/Configuration
VCC	Module OFF leakage current	All	310	600	µA	Full operating temperature range
	USB transmit current	All	-	10	mA	Full speed USB connection, C_L = 50 pF on D+ and D- signals



7: Software Interface

Physical interface options

The MC8775V module can communicate with the host via the USB (Universal Serial Bus) or UART physical interface.

Two different USB architectures are supported: non-MUX (non-composite USB) and MUX (27.010 multiplexing).

- The MUX architecture is supported through available Win32 drivers and the SDK.
- 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 **EM5625, MC5720, MC8755, MC8765 Modems USB Driver Developer's Guide** [R-8] for details.

Support tools

The MC8775V is compatible with the following support tools from Sierra Wireless and authorized third parties:

- Sierra Wireless Watcher
- CDMA Air Interface Tool (CAIT) from Qualcomm
- 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 7-1: Customizable features

Name	Description	Default
Voice functionality	When enabled, supports voice calls and displays the Watcher ‘voice’ tab.	Enabled
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	Watcher never shows the onscreen roaming indicator.	Indicator enabled
Service indicator disable*	Watcher never shows the onscreen “GPRS”, “EDGE”, or “3G” indicator.	Indicator enabled
Data counter disable*	Watcher never shows Rx and Tx data counters	Rx and Tx data counters enabled
Disable advanced profile menu (QoS)*	If disabled Watcher never shows advanced profile's QoS menus and user cannot change the minimum and requested QoS parameters.	Advance profile menu disabled
SIM PUK prompt enable	If enabled, Watcher shows the message "SIM blocked please enter PIN code".	Disabled, Watcher displays "Contact Service Provider" when SIM PIN is blocked
GPRS attach on start-up*	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. If blocked, the "Auto Connect" button on the profile edit menu is greyed out and cannot be selected.	The auto-connect feature menu item is enabled with the default state set to manual (not auto-connect).
Scan for profile	The modem scans through all its programmed profiles to find successful GPRS connection.	Not scanning. Only the selected profile is used for connection.

* Features only available if supported in the user interface

8: Mechanical and Environmental Specifications

The MC8775V module complies with the mechanical and environmental specifications in this section. Final product conformance to these specifications depends on the OEM device implementation.

Table 8-1: Mechanical and environmental specifications

Temperature (Temperature of immediate environment—for example, the interior of a laptop)	Operational	-25 ºC to +60 ºC - Full RF performance +60 ºC to +75 ºC - Reduced RF performance
	Non-operational	-40 ºC to +85 ºC, 96 hours (from MIL-STD 202 Method 108)
Relative humidity	Non-operational	85 ºC, 85% relative humidity for 48 hours (non-condensing)
Vibration	Non-operational	Random vibration, 10 to 1000 Hz, nominal 6 G rms in each of 3 mutually perpendicular axes. Test duration of 60 minutes for each axis, for a total test time of 3 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 6 faces, 2 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 **MC5720, MC8755, MC8765 Mini Card Hardware Integration Guide** [R-2]

Table 8-1: Mechanical and environmental specifications (Continued)

Form factor		The MC8775V is a PCI-Express Mini Card in a metal-shielded case.
Dimensions		Length: 51 mm Width: 30 mm* Thickness: 4.5 mm Weight: approximately 10 g * The actual width may exceed the 30 mm specification because the sides of the module are depanelized using a V-score process that can cause a rough surface.

Figure 8-1: Top and bottom views (MC8775V)

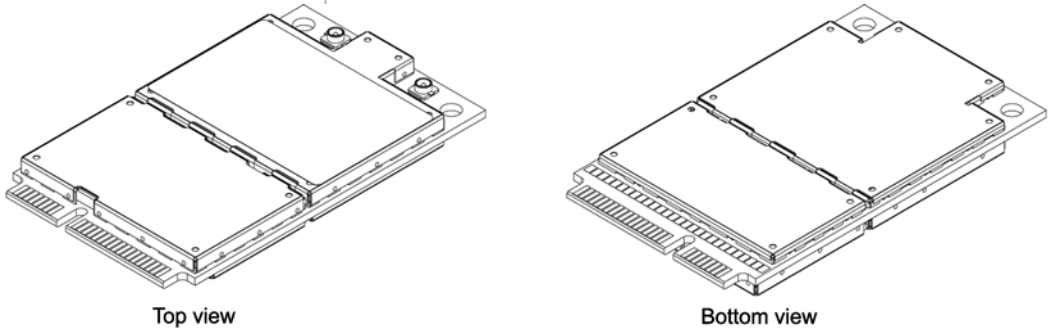
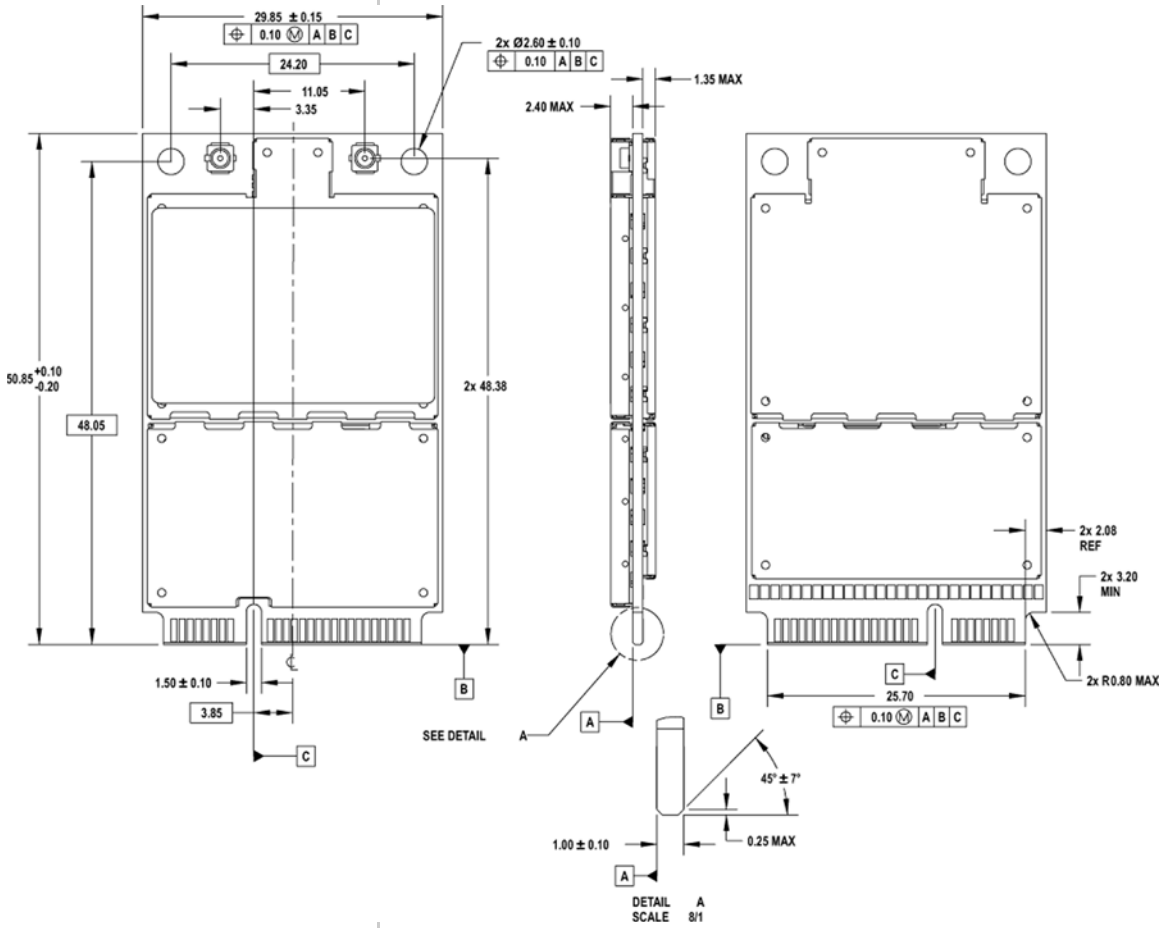


Figure 8-2: Dimensioned view (MC8775V)



Labeling

Figure 8-3: Unit label

The MC8775V label is non-removable and contains:

- Sierra Wireless logo and product name

- IMEI number in Barcode 128 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

Note: The MC8775V supports OEM partner specific label requirements.

9: Additional Requirements

Regulatory approvals

The MC8775V PCI-Express Mini Card meets applicable regulatory requirements; formal testing and approval will be based on the OEM's particular host platform. The OEM is also responsible for obtaining any other required regulatory approvals in target markets for the finished product.

FCC

For North American operation, the host product is required to meet appropriate regulatory approvals for stand-alone operation, including FCC parts 2, 15, 22, and 24 approvals.

The MC8775V PCI-Express Mini Card has an FCC ID for mobile applications. This will include approval by a test laboratory for FCC parts 22 and 24 conductive requirements.

Radiated tests (SAR, ERP, spurious harmonics) are dependent on the antenna configuration and must be done on the host platform with the implemented antenna design, and FCC Part 15 tests must be performed on the end-device. These tests are the OEM's responsibility.

The Sierra Wireless MC8775V PCI-Express Mini Card will be granted modular approval for mobile applications. OEMs may use the MC8775V PCI-Express Mini Card in host devices that can be categorized as Mobile Devices without additional FCC certification approvals if the following conditions are met (otherwise, additional FCC approvals must be obtained):

1. At least 20 cm (7.88") separation distance between the antenna and the user's body must be maintained at all times.
2. To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain, including cable loss, must not exceed 8 dBi in the cellular band and 4 dBi in the PCS band.
3. The MC8775V PCI-Express Mini Card and its antenna must not be collocated or operating in conjunction with any other transmitter or antenna within a host device.
4. A label must be affixed to the outside of the end product into which the MC8775V PCI-Express Mini Card is incorporated, with a statement similar to the following:
   This device contains TX FCC ID: N7NMC8775.

This equipment contains equipment certified under IC: 2417C-MC8775.

5. A user manual with the host device must clearly indicate operating requirements and conditions to ensure compliance with current FCC RF exposure guidelines.

The FCC defines a mobile device as being designed for use "in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating structures and the body of the user or nearby persons".

The FCC defines a portable device as being "designed to be used with any part of its radiating structure in direct contact with the user's body or within 20 centimeters of the body of the user or bystanders under normal operating conditions."

FTA Testing

GCF full type approval testing per **3GPP TS 34.121** [R-12] and **3GPP TS 34.123** [R-13][R-14][R-15] will be required for European regulatory certification of the finished UMTS UE mobile product to be deployed in EU/UK markets. Some of these tests (e.g. MMI) are dependent on the finished integrated system and are the responsibility of the OEM. Sierra Wireless offers professional services based assistance to OEMs with FTA testing and certification process, if required.

CE Mark

CE Mark testing per the EU will be required for European regulatory certification of finished UMTS UE mobile product to be deployed in EU/UK markets. RF Spurious Radiated and Safety (SAR) are required. These tests are dependent on the finished integrated system and are the responsibility of the OEM. Sierra Wireless offers professional services based assistance to OEMs with CE Mark testing and certification process, if required.

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.

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 **UMTS Modems Supported AT Command Reference** [R-4] and **MC87xx Modem Extended AT Command Reference** [R-5].

The **MC5720, MC8755, MC8765 Mini Card Hardware Integration Guide** [R-2] includes a list of test houses familiar with Sierra Wireless products.

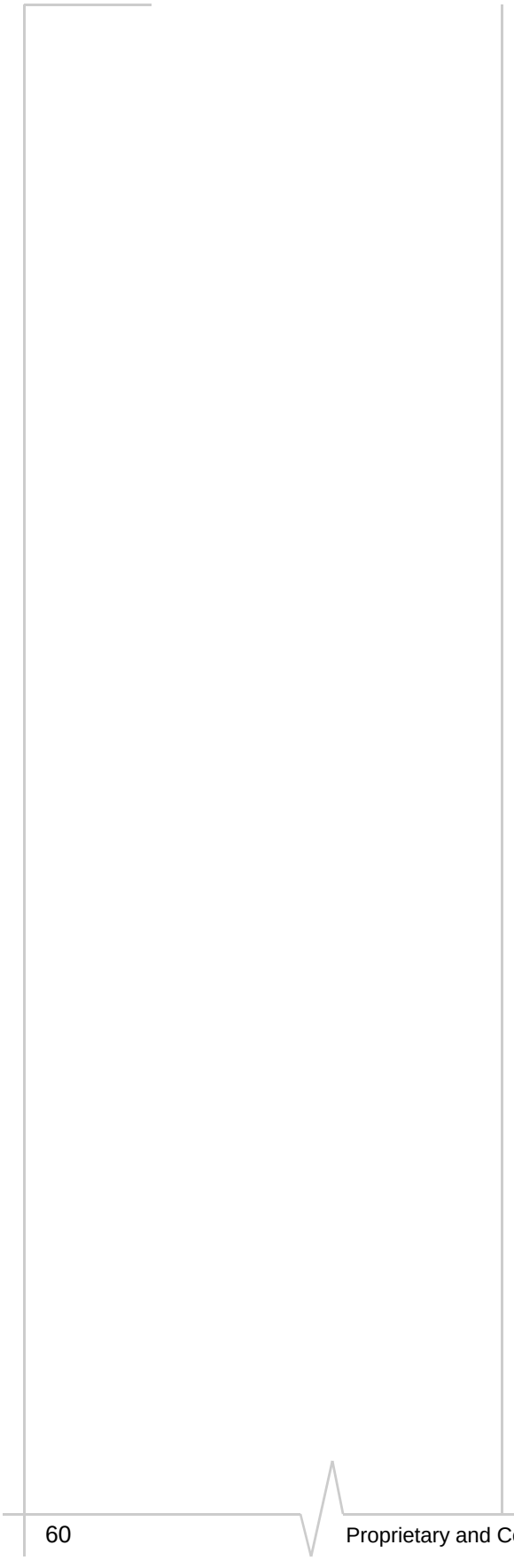
Sierra Wireless offers optional professional services based assistance to OEMs with regulatory approvals.

Integration requirements

When integrating the MC8775V 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 the Regulatory approvals on page 57.
- **Service provisioning**—Manufacturing process
- **Software**—As discussed in Software Interface on page 51.

Sierra Wireless provides guidelines for successful MC8775V PCI-Express Mini Card integration with the document suite and offers integration support services as necessary.



A: Data Rates

Multi-slot class definitions

Table A-1: Multislot 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

GPRS data throughput

Table A-2: GPRS data throughput

GPRS Coding Scheme Data Throughput	Max 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

EDGE data throughput

Table A-3: EDGE data throughput

EDGE Coding Scheme Data Throughput	Max 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
MCS 8 = 54.4 kbps / timeslot	217.6 kbps	8PSK
MCS 9 = 59.2 kbps / timeslot	236.8 kbps	8PSK

UMTS throughput

The MC8775V supports 64 kbps, 128 kbps, and 384 kbps for the uplink and downlink on UMTS networks.

HSDPA throughput

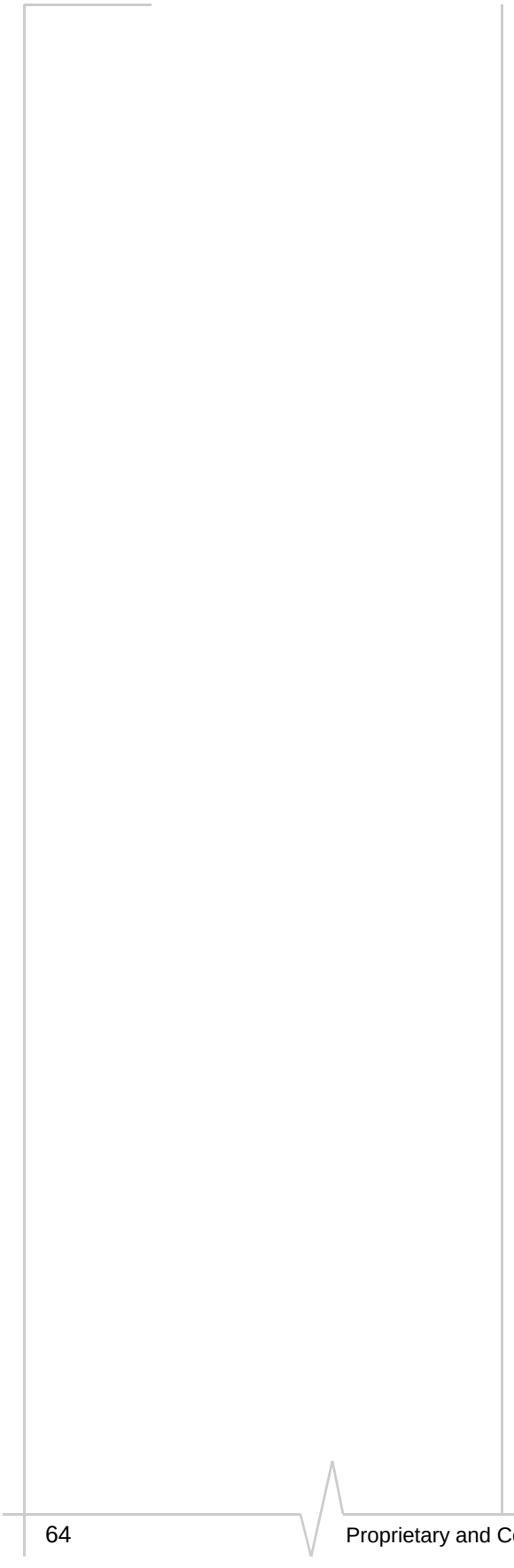
Table A-4: HS-DSCH-capable terminals

Category	Maximum number of supported HS-DSCH codes	Minimum inter-TTI interval	Number of soft values in terminal's hybrid ARQ buffer	Theoretical download maximum (L1peak rate [Mbps])	Modulation
Category 1	5	3	19,200	1.2	16QAM, QPSK
Category 2	5	3	28,800	1.2	16QAM, QPSK
Category 3	5	2	28,800	1.8	16QAM, QPSK
Category 4	5	2	38,400	1.8	16QAM, QPSK
Category 5	5	1	57,600	3.6	16QAM, QPSK
Category 6[1]	5	1	67,200	3.6	16QAM, QPSK
Category 7	10	1	115,200	7.3	16QAM, QPSK
Category 8	10	1	134,400	7.3	16QAM, QPSK
Category 9	15	1	172,800	10.0	16QAM, QPSK
Category 10	15	1	172,800	14.0	16QAM, QPSK

Table A-4: HS-DSCH-capable terminals (Continued)

Category	Maximum number of supported HS-DSCH codes	Minimum inter-TTI interval	Number of soft values in terminal's hybrid ARQ buffer	Theoretical download maximum (L1peak rate [Mbps])	Modulation
Category 11	5	2	14,400	0.9	QPSK
Category 12	5	1	28,800	1.8	QPSK

1 Supported on MC8775V



B: References

Sierra Wireless documents

These documents are (or will be) available in the Embedded Module Universal Development Kit:

Table B-1: Supporting documents

Reference	Doc Number	Title
[R-1]	2130391	Universal Development Kit User's Guide
[R-2]	2130114	MC5720, MC8755, MC8765 Mini Card Hardware Integration Guide
[R-3]	2130388	Enabling Software Users Guide (Watcher Modem Management)
[R-4]	2130617	UMTS Modems Supported AT Command Reference
[R-5]	2130616	MC87xx Modem Extended AT Command Reference
[R-6]	2130143	GSM Software Development Kit API Manual
[R-7]	2130602	MC8755/MC8765 Modem CnS Reference
[R-8]	2130634	EM5625, MC5720, MC8755, MC8765 Modems USB Driver Developer's Guide

3GPP / ETSI standards

Table B-2: 3GPP / ETSI standards

Reference	Doc Number	Title
[R-9]	3GPP Release 5	3GPP Release 5 UMTS Specification for Mobile Terminated Equipment
[R-10]	ETSI TS 100 916 V7.5.0 (1999-12)	AT Command Set for GSM Mobile Equipment
[R-11]	3GPP TS 34.108 (2001-01), sections 6.10.2.1 and 6.10.2.2	Common Test Environment User Equipment (UE) Conformance Testing

Table B-2: 3GPP / ETSI standards (Continued)

Reference	Doc Number	Title
[R-12]	3GPP TS 34.121 v5.6.0 (2003-09)	Technical Specification Group Terminals; Terminal conformance specification; Radio transmission and reception (FDD) (Release 5)
[R-13]	3GPP TS 34.123-1 v3.5.0 (2001-09)	Technical Specification Group Terminals; User Equipment (UE) conformance specification; Part 1: Protocol conformance specification (Release 1999)
[R-14]	3GPP TS 34.123-2 v3.5.0 (2001-09)	Technical Specification Group Terminal; User Equipment (UE) conformance specification; Part 2: Implementation Conformance Statement (ICS) proforma specification (Release 1999)
[R-15]	3GPP TS 34.123-3 v3.6.1 (2004-07)	Technical Specification Group Terminals; User Equipment (UE) conformance specification; Part 3: Abstract Test Suite (ATS) (Release 1999)
[R-16]	3GPP TS 27.010 v3.4.0 (2002-03)	Technical Specification Group Terminals; Terminal Equipment to User Equipment (TE-UE) multiplexer protocol (Release 1999)
[R-17]	3GPP TS 51.010 v5.10.0 (2004-09)	Technical Specification Group GSM/EDGE Radio Access Network Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) conformance specification; Part 1: Conformance specification (Release 5)

Other documents

Table B-3: Other documents

Reference	Doc Number	Title
[R-18]		PCI Express Mini Card Electromechanical Specification Revision 1.1

Agency standards

1. FCC 47 CFR - Part 15. Radio Frequency Devices. January 2001.
2. FCC 47 CFR - Part 22. Cellular Radiotelephone Services. October 1998.
3. FCC 47CFR - Part 24. Personal Communications Services. October 1998.
4. Industry Canada ICES-003. Interference-Causing Equipment Standard - Digital Apparatus. November 22, 1997.
5. Industry Canada RSS-129. 800MHz Dual-Mode CDMA Cellular Telephones. Issue 2. September 2, 1999.
6. Industry Canada RSS-133. 2 GHz Personal Communications Services. September 25, 1999.
7. IEC 61000-4-2. Electrostatic Discharge Immunity Test.
8. JESD22-A114-B. +/- 1 kV Human Body Model.
9. JESD22-C101. +/- 125 V Charged Device Model.

C: WWAN Frequency Bands

The MC8775V supports bands that appear in bold.

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

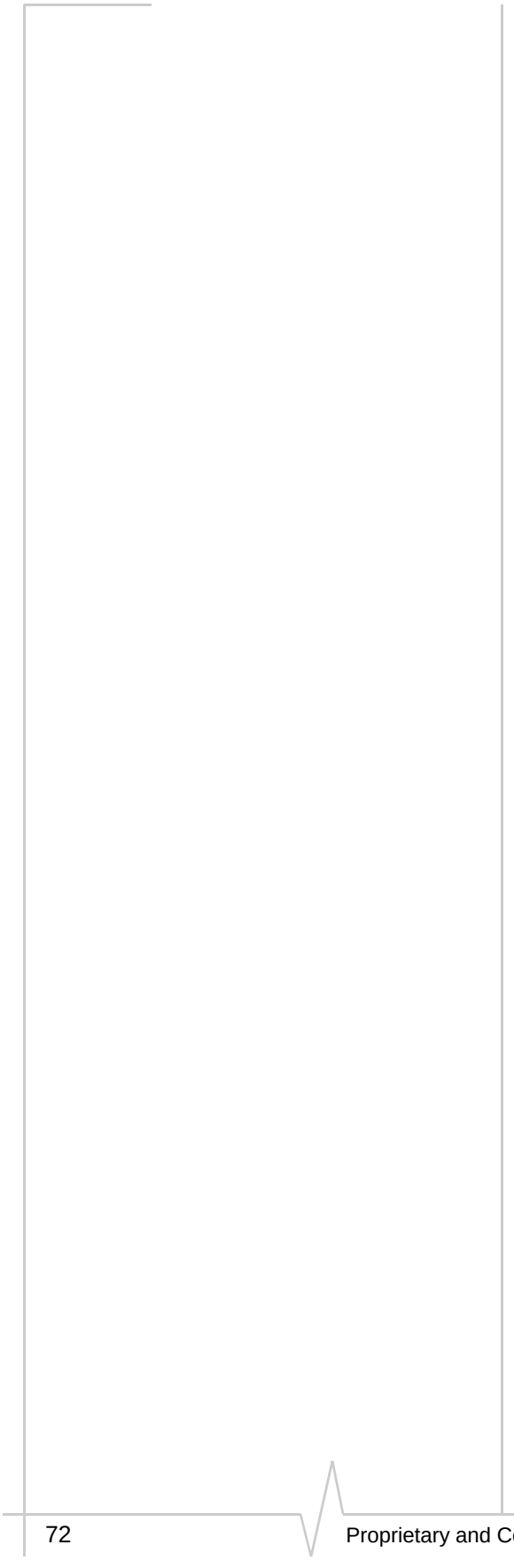
Network			Frequency bands (MHz)	FRX-FTX (MHz)
GSM	**GSM 850**	**Tx**	**824-849**	**45**
		Rx	**869 - 894**	
	GSM 900	**Tx**	**890 - 915**	**45**
		Rx	**935-960**	
	EGSM 900	**Tx**	**880-915**	**45**
		Rx	**925-960**	
	R-GSM	Tx	876-915	
		Rx	921-960	
	GSM 1800	**Tx**	**1710-1785**	**95**
		Rx	**1805-1880**	
	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 C-1: Worldwide Wide Area Network (WWAN) frequency bands (Continued)

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 C-1: Worldwide Wide Area Network (WWAN) frequency bands (Continued)

Network			Frequency bands (MHz)	FRX-FTX (MHz)
WCDMA 3GPP/FDD	**I**	**Tx**	**1920-1980**	**80**
		Rx	**2110-2170**	
	II	**Tx**	**1850-1910**	**190**
		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	
		Rx	875-885	
	WCDMA900	Tx	880-915	
		Rx	925-960	
	WCDMA2600	Tx	2500-2570	
		Rx	2620-2690	
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	



D: Acronyms

Table D-1: Acronyms and definitions

Acronym or term	Definition
3GPP	3rd Generation Partnership Project
AC97	Audio Code ‘97
API	Application Programming Interface
ERP	Effective Radiated Power
ESD	Electro-Static Discharge
FCC	Federal Communications Commission
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communications
IMEI	International Mobile Equipment Identity
IMSI	International Mobile Subscriber Identity
LED	Light Emitting Diode
MSM	Mobile Station Modem
OEM	Original Equipment Manufacturer
PDP	Packet Data Profile
PPP	Point to Point Protocol
PS	Packet Switched
PST	Product Support Tools
SAR	Specific Absorption Rate
SIM	Subscriber Identity Module (GSM)
SMS	Short Message Service
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus

Table D-1: Acronyms and definitions (Continued)

Acronym or term	Definition
USIM	Universal Subscriber Identity Module (UMTS)
WCDMA	Wideband Code Division Multiple Access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