CDMA and GSM / UMTS Mini Card

Hardware Integration Guide

Proprietary and Confidential

Includes:

MC5725 / MC5725V

MC5727 / MC5727V

MC8775 / MC8775V

MC8780 / MC8781

MC8785V

MC8790 / MC8790V

MC8791V

MC8792V

2130114
Rev 1.8.2

SIERRA WIRELESS

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.

Safety and Hazards

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

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

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

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

Limitation of Liability

The information in this manual is subject to change without notice and does not represent a commitment on the part of Sierra Wireless. SIERRA WIRELESS AND ITS AFFILIATES SPECIFICALLY DISCLAIM LIABILITY FOR ANY AND ALL DIRECT, INDIRECT, SPECIAL, GENERAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

REVENUE OR ANTICIPATED PROFITS OR REVENUE ARISING OUT OF THE USE OR INABILITY TO USE ANY SIERRA WIRELESS PRODUCT, EVEN IF SIERRA WIRELESS AND/OR ITS AFFILIATES HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR THEY ARE FORESEEABLE OR FOR CLAIMS BY ANY THIRD PARTY.

Notwithstanding the foregoing, in no event shall Sierra Wireless and/or its affiliates aggregate liability arising under or in connection with the Sierra Wireless product, regardless of the number of events, occurrences, or claims giving rise to liability, be in excess of the price paid by the purchaser for the Sierra Wireless product.

Patents

Portions of this product may be covered by some or all of the following US patents:

5,515,013	5,629,960	5,845,216	5,847,553	5,878,234
5,890,057	5,929,815	6,169,884	6,191,741	6,199,168
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
6,985,757	7,023,878	7,053,843	7,106,569	7,145,267
7,200,512	7,295,171	7, 287,162	D442,170	D459,303
D599,256	D560,911			

and other patents pending.

This product includes technology licensed from   QUALCOMM® 3G

Licensed by QUALCOMM Incorporated under one or more of the following United States patents and/or their counterparts in other nations:

4,901,307	5,056,109	5,101,501	5,109,390	5,228,054
5,267,261	5,267,262	5,337,338	5,414,796	5,416,797
5,490,165	5,504,773	5,506,865	5,511,073	5,535,239
5,544,196	5,568,483	5,600,754	5,657,420	5,659,569
5,710,784	5,778,338			

Manufactured or sold by Sierra Wireless or its licensees under one or more patents licensed from InterDigital Group.

Copyright

Trademarks

AirCard® and "Heart of the Wireless Machine®" are registered trademarks of Sierra Wireless. Watcher® is a trademark of Sierra Wireless, registered in the European Community. Sierra Wireless, the Sierra Wireless logo, the red wave design, and the red-tipped antenna are trademarks of Sierra Wireless.

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Windows® is a registered trademark of Microsoft Corporation.
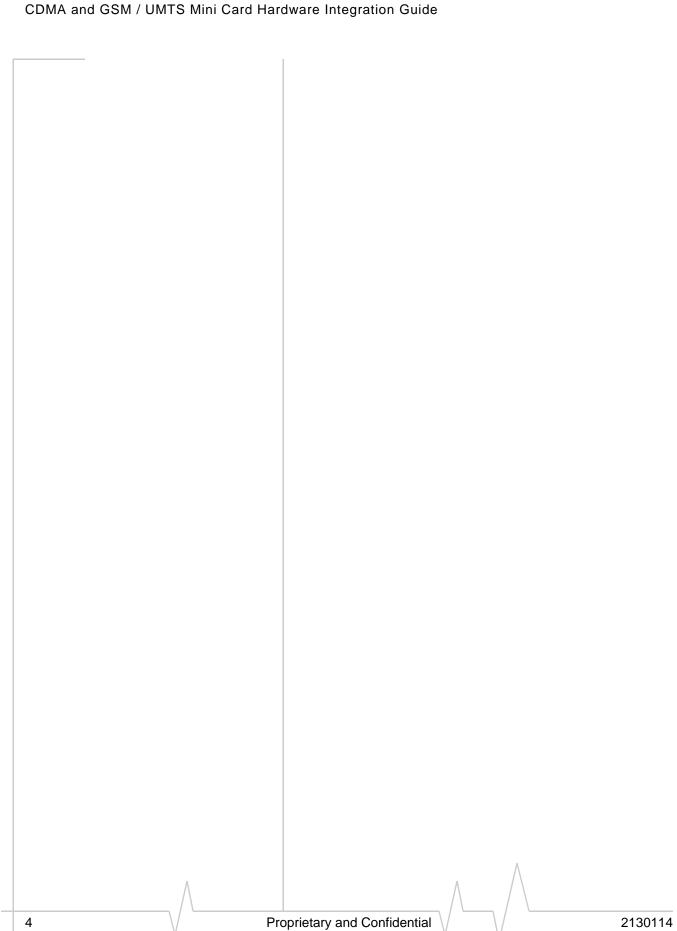
QUALCOMM® is a registered trademark of QUALCOMM Incorporated. Used under license.

Other trademarks are the property of the respective owners.

Contact Information

Sales Desk:	Phone:	1-604-232-1488
	Hours:	8:00 AM to 5:00 PM Pacific Time
	E-mail:	sales@sierrawireless.com
Post:		Sierra Wireless 13811 Wireless Way Richmond, BC Canada V6V 3A4
Fax:		1-604-231-1109
Web:		www.sierrawireless.com

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

www.sierrawireless.com

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Table of Contents

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

1: Introduction

Sierra Wireless' Mini Card modules form the radio component for the products in which they are embedded. Mini Cards are available for use on CDMA and GSM networks, including:

- **MC5725**/**MC5725V**/**MC5727**/**MC5727V**—Operate on CDMA networks using the CDMA IS-95A, 1X, and 1xEV-DO (IS-856) network standards, and support GPS.
- **MC8775 / MC8775V**—operate on GSM networks using the GSM / GPRS / EDGE / UMTS / HSDPA network standards, and support Standalone GPS functionality.
- **MC8780 / MC8781 / MC8785V / MC8790 / MC8790V / MC8791V / MC8792V**—operate on GSM networks using the GSM / GPRS / EDGE / UMTS / HSDPA / HSUPA network standards, and support Standalone GPS, gpsOneXTRA™, A-GPS, selected enhanced Navigation 2.0 features, and five NMEA sentences.

Purpose of this guide

This guide addresses issues that affect the integration of Sierra Wireless modules into host products, and includes design recommendations for the host products.

Note: An understanding of network technology and experience in integrating hardware components into electronic equipment is assumed.

The Universal Development Kit

Sierra Wireless manufactures a Universal Development Kit (UDK) that facilitates all phases of the integration process.

This kit is a hardware development platform that is designed to support multiple members of the wireless embedded module product family. It contains the hardware components that are typically necessary for evaluating and developing with the module, including:

- Development board
- Cables
- Antennas
- Other accessories

Required connectors

When integrating these modules into your host device, you need the following connector types:

- RF cables that mate with Hirose U.FL connectors (model U.FL #CL331-0471-0-10). Modules include one or two connector jacks depending on individual module support for diversity or GPS functionality.

- Industry-standard mating connector for 52-pin EDGE—some manufacturers include Tyco, Foxconn, and Molex. For example, the connector used on the Mini Card Dev Kit board is a Molex 67910-0001.

- Industry-standard USIM connector (MC87xx only)—the actual connector you use depends on how your device exposes the USIM socket. For example, the USIM connector used on the Mini Card Dev Kit board is an ITT CCM03-3518.

Note: Contact vendors before choosing your connectors — the numbers included here are for reference only. Choose connectors that are appropriate to your design.

Guide organization

This guide includes the following sections:

Note: The term "host" always refers to the host device.

Related documents

This guide deals specifically with hardware integration issues that are unique to the MC57xx and MC87xx modules.

Proprietary and Confidential 2130114
In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Table 1-1 lists other documents referenced in this guide.

Table 1-1: Related documentation

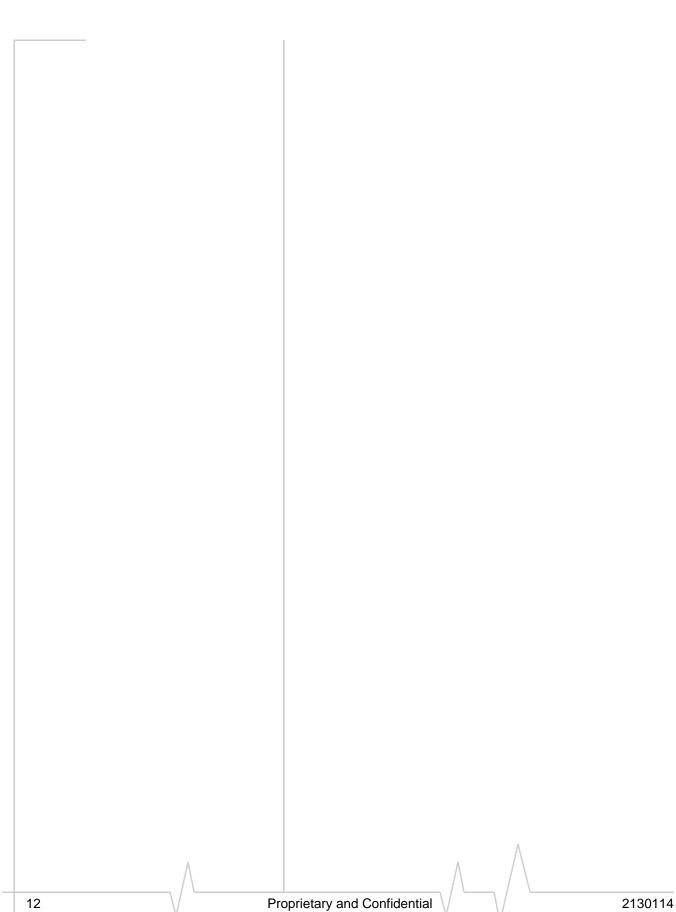| Document title	Description
AT Command Set for User Equipment (UE) (Release 6)	Standard AT commands for GSM / UMTS devices. Download this document (3GPP TS 27.007) from www.3gpp.org.
CDMA 1X Standard	Technical requirements for CDMA systems, including details on sleep cycle index (SCI) values. Order this document, CDMA 2000 Series Release A (2000) (document # TIA/EIA/IS-2000 Series, Release A) from www.tiaonline.org.
AirCard595U/595/MC5725/ MC5725V MiniCard CnS Reference (Document 2130754)	CnS (Control and Status) messages that are supported by the MC5725 / MC5725V
AirCard 595U/595, EM5625 Embedded Module, MC5720/ MC5725/MC5725V MiniCard AT Command Reference (Document 2130620)	Proprietary, basic AT commands for the MC5725 / MC5725V / MC5727 / MC5727V. For MC87xx-specific commands, see *UMTS Modems Supported AT Command Reference (Document 2130617).*
AirCard595U/595, EM5625 Embedded Module, MC5720/ MC5725/MC5725V MiniCard Extended AT Command Reference (Document 2130621)	Proprietary AT commands for the MC5725 / MC5725V / MC5727 / MC5727V. For MC87xx-specific commands, see *MC87xx Modem Extended AT Command Reference (Document 2130616).*
FCC Regulations - Part 15 - Radio Frequency Devices	This section of the FCC Code of Federal Regulations, Title 47 deals with radio frequency devices, including shielding requirements for embedded modules. Download this regulation from http://wireless.fcc.gov.
IEC-61000-4-2 level 3	Techniques for testing and measuring electrostatic discharge (ESD) immunity. Order this document from www.iec.ch.
MC5725 Mini Card Product Specification (Document 2130663)	Features, mechanical and electrical specifications, and standards compliance of the MC5725.
MC5725V Mini Card Product Specification (Document 2130671)	Features, mechanical and electrical specifications, and standards compliance of the MC5725V.
MC8775 PCI Express Mini Card Product Specification (Document 2130697)	Features, mechanical and electrical specifications, and standards compliance of the MC8775.

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Table 1-1: Related documentation (Continued)

Document title	Description
MC8775V with Audio PCI Express Mini Card Product Specification (Document 2130700)	Features, mechanical and electrical specifications, and standards compliance of the MC8775V.
MC8780 / MC8781 PCI Express Mini Card Product Specification (Document 2130782)	Features, mechanical and electrical specifications, and standards compliance of the MC8780 / MC8781.
MC8785V PCI Express Mini Card Product Specification (Document 2130932)	Features, mechanical and electrical specifications, and standards compliance of the MC8785V.
MC8790 PCI Express Mini Card Product Specification (Document 2111279)	Features, mechanical and electrical specifications, and standards compliance of the MC8790.
MC8790V PCI Express Mini Card Product Specification (Document 2111280)	Features, mechanical and electrical specifications, and standards compliance of the MC8790V.
MC8791V PCI Express Mini Card Product Specification (Document 2131032)	Features, mechanical and electrical specifications, and standards compliance of the MC8791V.
MC8792V PCI Express Mini Card Product Specification (Document 2131033)	Features, mechanical and electrical specifications, and standards compliance of the MC8792V.
MC87XX Modem CnS Reference (Document 2130602)	CnS (Control and Status) messages supported by the MC87xx series of modems.
MC87xx Modem CnS Reference (Voice) (Document 2130817)	Voice-related CnS (Control and Status) messages supported by the MC8775V, MC8785V, MC8790V,MC8791V, and MC8792V.
UMTS Modems Supported AT Command Reference (Document 2130617)	Proprietary, basic AT commands for the MC87xx. For MC57xx-specific commands, see the *AirCard 595U/595, EM5625 Embedded Module, MC5720/MC5725/MC5725V MiniCard AT Command Reference (Document 2130620).*
MC87xx Modem Extended AT Command Reference (Document 2130616)	Proprietary AT commands for the MC87xx. For MC57xx-specific commands, see the *AirCard595U/595, EM5625 Embedded Module, MC5720/MC5725/MC5725V MiniCard Extended AT Command Reference (Document 2130621).*
Mobile Station (MS) Conformance Specification; Part 4: Subscriber Interface Module	SIM testing methods. Download this document (3GPP TS 11.10-4) from www.3gpp.org.

Proprietary and Confidential 2130114
In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Table 1-1: Related documentation (Continued)

Document title	Description
PCI Express Mini Card Dev Kit Quick Start Guide (Document 2130705)	Setup and configuration of modules.
PCI Express Mini Card Electromechanical Specification Revision 1.1	Download this document from www.pcisig.com.
Universal Serial Bus Specification, Rev 2.0	Download this specification from www.usb.org.

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

≫|2: Power Interface

Overview of operation

Note: This chapter contains information for CDMA (MC57xx) and GSM (MC87xx) modules.

*Information that is **unique** to specific module types is clearly identified.*

The module is designed to use a 3.3V (nominal) power supply, provided by the host. It is the host's responsibility to provide safe and continuous power to the module at all times; the module does NOT have an independent power supply, or protection circuits to guard against electrical issues.

The module's power state is controlled by the host's assertion / de-assertion of the W_Disable# signal. The module also monitors its supply voltage and requests shutdown if the supply is insufficient.

Power signals

The module must be connected to a 3.3V power supply (as described in *PCI Express Mini Card Electromechanical Specification Revision 1.1*).

The MC87xx has more power pins than the MC57xx due to higher peak current requirements for GSM devices.

For detailed pinout and voltage / current requirements of these modules, see the Product Specification Document for your Mini Card.

Electrostatic discharge (ESD)

You are responsible for ensuring that the host has adequate ESD protection on digital circuits and antenna ports:
- (Operational) RF port (antenna launch and RF connector): *IEC-61000-4-2 — Level (Electrostatic Discharge Immunity Test)*
- (Non-operational) Host connector interface: *JESD22-A114-B +/- 1kV Human Body Model* and *JESD22-C101 +/- 125 V Charged Device Model*

Specific recommendations are provided where needed in this guide, however, the level of protection required depends on your application.

Note: ESD protection is highly recommended for the USIM connector at the point where the contacts are exposed, and for any other signals from the host interface that would be subjected to ESD by the user of the product.

Module power states

The module has four power states:

- **Disconnected**
  No power to the module.
- **Off**
  Power to the module, but the module is powered off.
- **Normal**
  The module is active. Several modes are possible (Receive, Transmit, Sleep, Shutdown).
- **Low power ("airplane mode")**
  The module is active, but RF is disabled.

Note: The module unit defaults to the Normal state when VCC3.3 is first applied in the absence of W_Disable# control.

State machines are implemented in the module to monitor the power supply and operating temperature.

Disconnected state

This state occurs when there is no power to the module — the host power source is disconnected from the module and all voltages associated with the module are at 0 V.

Note: The difference between the Disconnected and Off states is that, in the Off state, the module is still connected to the power source and draws minimal current.

Whether the host device is also powered off depends on the power rail design. If the connection between the power rail and the module is controlled by the host, the host can stay powered on and cut the power to put the modem into the disconnected state. If the power rail is shared between the host device and the module, the host is powered off when the module is powered off.

Off state

In this state, the host is powered up and the module is powered down (but still connected to the power source).

The host keeps the module powered off by driving the W_Disable# signal low. In this state, the module draws minimal current.

Normal state

This is the active state of the module. In this state:
- The module is fully powered.
- The module is capable of placing / receiving calls or establishing data connections on the wireless network.
- The USB interface is fully active.

Low power mode

In this state, RF (both Rx and Tx) is disabled in the module, but the USB interface is still active. This low power mode ("airplane mode") is controlled by software commands through the host interface.

For instructions on using the commands, refer to *AT Command Set for User Equipment (UE) (Release 6)* (+CFUN=0 command), *AirCard595U/595/MC5725/MC5725V MiniCard CnS Reference (Document 2130754)* (CNS_RADIO_POWER [0x1075] command), or *MC87XX Modem CnS Reference (Document 2130602)* (Disable Modem command).

Usage models

Usage models can be used to calculate expected current consumption. A sample usage model is provided in Table 2-1.

Table 2-1: Power consumption of a sample application

	Used by a field worker (data only)	Used for remote data logging
Upload (module Tx)	1000 kB/day	40 kB/h
Download (module Rx)	500 kB/day	100 kB/day
Coverage / data rate	1X / 80 kbps	IS-95 / 14.4 kbps
Hours of operation	8/day (off 16 hrs/day)	24/day
Total power consumed over 24 hours	60 mAh	200 mAh

This example model applies to a battery-operated device. In practice, because the module is isolated from the battery (the host device manages the power source), the mAh ratings depend on the device's supply efficiency.

The module automatically enters slotted sleep mode when there is no transmission or reception occurring (SCI = 2).

Transmit power is assumed to be +3 dBm.

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

3: RF Integration

The **MC87xx** operates on the frequencies detailed in Table 3-1.

Table 3-1: MC87xx— Supported frequencies

Product	Band	Frequencies (MHz)
MC8775 **MC8775V** **MC8780** **MC8781** **MC8785V** **MC8790** **MC8790V** **MC8791V** **MC8792V**	GSM 850	Tx: 824–849 Rx: 869-894
	EGSM 900	Tx: 880-915 Rx: 925-960
	DCS 1800	Tx: 1710-1785 Rx: 1805-1880
	PCS 1900	Tx: 1850-1910 Rx: 1930-1990
MC8775 **MC8775V** **MC8780** **MC8781** **MC8785V** **MC8790** **MC8790V** **MC8791V** **MC8792V**	Band I UMTS 2100	Tx: 1920–1980 Rx: 2110–2170
MC8775 **MC8775V** **MC8780** **MC8781** **MC8785V** **MC8790** **MC8790V** **MC8792V**	Band II UMTS 1900	Tx: 1850–1910 Rx: 1930–1990
MC8775 **MC8775V** **MC8780** **MC8781** **MC8785V** **MC8790** **MC8790V**	Band V UMTS 850 (Band VI is included as a subset of Band V)	Tx: 824–849 Rx: 869–894

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Table 3-1: MC87xx— Supported frequencies

Product	Band	Frequencies (MHz)
MC8792V	Band VIII UMTS 900	Tx: 880–915 Rx: 925–960
MC8775V **MC8780** **MC8781** **MC8785V** **MC8790** **MC8790V** **MC8791V** **MC8792V**	GPS	1575.42

RF connection

When attaching an antenna to the module:

- Use a Hirose U.FL connector (model U.FL #CL331-0471-0-10) to attach an antenna to a connection point on the module, as shown in Figure 3-1 (the main RF connector on the top side; the diversity RF or GPS connector on the bottom side).
- Match coaxial connections between the module and the antenna to 50 Ω.
- Minimize RF cable losses to the antenna; the recommended maximum cable loss for antenna cabling is 0.5 dB.

*Note: To **disconnect** the antenna, make sure you use the Hirose U.FL connector removal tool (P/N UFL-LP-N-2(01)) to prevent damage to the module or coaxial cable assembly.*

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Figure 3-1: Antenna connection points and mounting holes

Ground connection

When connecting the module to system ground:

- Prevent noise leakage by establishing a very good ground connection to the module through the host connector.
- Connect to system ground using the two mounting holes at the top of the module (as shown in Figure 3-1).
- Minimize ground noise leakage into the RF.
  Depending on the host board design, noise could *potentially* be coupled to the module from the host board. This is mainly an issue for host designs that have signals traveling along the length of the module, or circuitry operating at both ends of the module interconnects.

Shielding

The module is fully shielded to protect against EMI and to ensure compliance with FCC Part 15 - "Radio Frequency Devices" (or equivalent regulations in other jurisdictions).

Note: The module shields must NOT be removed.

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Antenna and cabling

*Note: Values in this guide are taken from the appropriate product specification documents (PSDs) (listed in **Related documents**, page 8) — in the case of a discrepancy between this document and the relevant PSD, use the value listed in the PSD.*

When selecting the antenna and cable, it is critical to RF performance to match antenna gain and cable loss.

Choosing the correct antenna and cabling

Consider the following points for proper matching of antennas and cabling:

- The antenna (and associated circuitry) should have a nominal impedance of 50 Ω with a return loss ≤ 10 dB across each frequency band of operation.
- The system gain value affects both radiated power *and* regulatory (FCC, IC, CE, etc.) test results.

Developing custom antennas

Consider the following points when developing custom-designed antennas:

- A skilled RF engineer should do the development to ensure that the RF performance is maintained.
- Identify the bands that need to be supported, particularly when both the MC57xx and MC87xx will be installed in the same platform. In this case, you may want to develop separate antennas for maximum performance.

Determining the antenna's location

Consider the following points when deciding where to put the antenna:

- Antenna location may affect RF performance. Although the module is shielded to prevent interference in most applications, the placement of the antenna is still very important — if the host device is insufficiently shielded, high levels of broadband or spurious noise can degrade the module's performance.
- Connecting cables between the module and the antenna must have 50 Ω impedance. If the impedance of the module is mismatched, RF performance is reduced significantly.
- Antenna cables should be routed, if possible, away from noise sources (switching power supplies, LCD assemblies, etc.). If the cables are near the noise sources, the noise may be coupled into the RF cable and into the antenna.

Disabling the diversity antenna

- MC57xx — If your host device is not designed to use the MC57xx module's diversity antenna, terminate the interface with a 50 Ω load.

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

- MC8780/MC8781/MC8785V/MC8790/MC8790V/ MC8791V/MC8792V—Use the AT command **!RXDEN=0** to disable receive diversity or **!RXDEN=1** to enable receive diversity.

Interference and sensitivity

Several sources of interference can affect the RF performance of the module (RF desense). Common sources include power supply noise and device-generated RF.

RF desense can be addressed through a combination of mitigation techniques and radiated sensitivity measurement.

Power supply noise

Noise in the power supply can lead to noise in the RF signal.

The power supply ripple limit for the module is no more than 200 mVp-p 1 Hz to 100 kHz. This limit includes voltage ripple due to transmitter burst activity.

Interference from other wireless devices

Wireless devices operating inside the host device can cause interference that affects the module.

To determine the most suitable locations for antennas on your host device, evaluate each wireless device's radio system, considering the following:

- Any harmonics, sub-harmonics, or cross-products of signals generated by wireless devices that fall in the module's Rx range may cause spurious response, resulting in decreased Rx performance.
- The Tx power and corresponding broadband noise of other wireless devices may overload or increase the noise floor of the module's receiver, resulting in Rx desense.

The severity of this interference depends on the closeness of the other antennas to the module's antenna. To determine suitable locations for each wireless device's antenna, thoroughly evaluate your host device's design.

Note: These modules are based on ZIF (Zero Intermediate Frequency) technologies; when performing EMC (Electromagnetic Compatibility) tests, there are no IF (Intermediate Frequency) components from the module to consider.

Note: Values in this guide are taken from the appropriate product specification documents (PSDs) (listed in Related documents, page 8) — in the case of a discrepancy between this document and the relevant PSD, use the value listed in the PSD.

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Device-generated RF

All electronic computing devices generate RF interference that can negatively affect the receive sensitivity of the module.

The proximity of host electronics to the antenna in wireless devices can contribute to decreased Rx performance. Components that are most likely to cause this include:

- Microprocessor and memory
- Display panel and display drivers
- Switching-mode power supplies

These and other high-speed devices (in particular, the processor) can decrease Rx performance because they run at frequencies of tens of MHz. The rapid rise and fall of these clock signals generates higher-order harmonics that often fall within the operating frequency band of the module, affecting the module's receive sensitivity.

Example

On a sub-system running at 40 MHz, the 22nd harmonic falls at 880 MHz, which is within the cellular receive frequency band.

Note: In practice, there are usually numerous interfering frequencies and harmonics. The net effect can be a series of desensitized receive channels.

Note: The module can cause interference with other devices such as hearing aids and on-board speakers.

Wireless devices such as the Mini Card transmit in bursts (pulse transients) for set durations (RF burst frequencies). Hearing aids and speakers convert these burst frequencies into audible frequencies, resulting in audible noise.

Note: It is important to investigate sources of localized interference early in the design cycle.

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

4: Host / Module Interfaces

LED output

The module drives the LED output according to the *PCI-Express Mini Card specification* (summarized in Table 4-1, below).

Table 4-1: LED states

State	Indicates	Characteristics
Off	Module is not powered.	Light is off.
On	Module is powered and connected, but not transmitting or receiving.	Light is on.
Slow blink	Module is powered and searching for a connection.	LED is flashing at a steady, slow rate. • 250 ms ± 25% ON period • 0.2 Hz ± 25% blink rate
Faster blink	Module is transmitting or receiving.	LED is flashing at a steady, faster rate. • Approximately 3 Hz blink rate *Note: MC572x modules support customer-defined LED controls.*

Figure 4-1: Example LED

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

B: Regulatory Information

Important notice

Because of the nature of wireless communications, trans-mission 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 and its affiliates accept no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

Safety and hazards

Do not operate your MC57xx / MC87xx modem:

- In areas where blasting is in progress
- Where explosive atmospheres may be present including refuelling points, fuel depots, and chemical plants
- Near medical equipment, life support equipment, or any equipment which may be susceptible to any form of radio interference. In such areas, the MC57xx / MC87xx modem **MUST BE POWERED OFF**. Otherwise, the MC57xx / MC87xx modem can transmit signals that could interfere with this equipment.

In an aircraft, the MC57xx / MC87xx modem **MUST BE POWERED OFF**. Otherwise, the MC57xx / MC87xx modem can transmit signals that could interfere with various onboard systems and may be dangerous to the operation of the aircraft or disrupt the cellular network. Use of a cellular phone in an aircraft is illegal in some jurisdictions. Failure to observe this instruction may lead to suspension or denial of cellular telephone services to the offender, or legal action or both.

Some airlines may permit the use of cellular phones while the aircraft is on the ground and the door is open. The MC57xx / MC87xx modem may be used normally at this time.

Important compliance information for North American users

The MC57xx / MC87xx modem has been granted modular approval for mobile applications. Integrators may use the MC57xx / MC87xx modem in their final products without additional FCC / IC (Industry Canada) certification if they meet the following conditions. Otherwise, additional FCC / IC approvals must be obtained.

1. At least 20 cm separation distance between the antenna and the user's body must be maintained at all times.

2. To comply with FCC / IC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain including cable loss in a mobile-only exposure condition must not exceed:
   - 5 dBi in the Cellular band and 4 dBi in the PCS band for the MC8775/MC8775V/MC8780/MC8781/MC8785V/ MC8790/MC8790V/MC8791V/MC8792V.
   - 5.1 dBi in the Cellular band and 4.15 dBi in the PCS band for the MC5725/MC5725V/MC5727/MC5727V.

3. The MC57xx / MC87xx modem and its antenna must not be co-located 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 MC57xx / MC87xx modem is incorporated, with a statement similar to the following:
   - For MC5725 / MC5725V / MC5727 / MC5727V:
     This device contains FCC ID: N7N-MC5725
     This equipment contains equipment certified under IC: 2417C-MC5725
   - For MC8775 / MC8775V:
     This device contains FCC ID: N7NMC8775
     This equipment contains equipment certified under IC: 2417C-MC8775
   - For MC8780:
     This device contains FCC ID: N7NMC8780
   - For MC8781:
     This device contains FCC ID: N7NMC8781
     This equipment contains equipment certified under IC: 2417C-MC8781
   - For MC8785V:
     This device contains FCC ID: N7NMC8785
     This equipment contains equipment certified under IC: 2417C-MC8785

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

- For MC8790 / MC8790V:
  This device contains FCC ID: N7NMC8790
  This equipment contains equipment certified under IC: 2417C-MC8790
- For MC8792V:
  This device contains FCC ID: N7NMC8792
  This equipment contains equipment certified under IC: 2417C-MC8792

5. A user manual with the end product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC / IC RF exposure guidelines.

The end product with an embedded MC57xx / MC87xx modem may also need to pass the FCC Part 15 unintentional emission testing requirements and be properly authorized per FCC Part 15.

Note: If this module is intended for use in a portable device, you are responsible for separate approval to satisfy the SAR requirements of FCC Part 2.1093 and IC RSS-102.

EU regulatory conformity

Sierra Wireless hereby declares that the MC8775, MC8775V, MC8780, MC8781, MC8785V, MC8790, MC8790V, MC8791V, and MC8792V modems conform with all essential requirements of Directive 1999/5/EC.

CE 0682

The Declaration of Conformity made under Directive 1999/5/EC is available for viewing at the following location in the EU community:

Sierra Wireless (UK), Limited
Lakeside House
1 Furzeground Way, Stockley Park East
Uxbridge, Middlesex
UB11 1BD
England

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Proprietary and Confidential

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

C: Acronyms and Definitions

Table C-2: Acronyms and definitions

Acronym or term	Definition
AGC	Automatic Gain Control
BER	Bit Error Rate - a measure of receive sensitivity
BLER	Block Error Rate
Call Box	Base Station Simulator - Agilent E8285A or 8960, Rohde & Schwarz CMU200
CDMA	Code Division Multiple Access
dB	Decibel = 10 x $\log_{10}$ (P1/P2) *P1 is calculated power; P2 is reference power* Decibel = 20 x $\log_{10}$ (V1/V2) *V1 is calculated voltage, V2 is reference voltage*
dBm	Decibels, relative to 1 mW - Decibel(mW) = 10 x $\log_{10}$ (Pwr (mW)/1mW)
DUT	Device Under Test
EDGE	Enhanced Data rates for GSM Evolution
EM	Embedded Module
ESD	ElectroStatic Discharge
FER	Frame Error Rate - a measure of receive sensitivity
GPRS	General Packet Radio Services
GPS	Global Positioning System
GSM	Global System for Mobile communications
Hz	Hertz = 1 cycle/second
inrush current	Peak current drawn when a device is connected or powered on
IS-2000	3G radio standards for voice and data (CDMA only)
IS-95	2G radio standards targeted for voice (cdmaONE)
LDO	Low Drop Out - refers to linear regulator
MC5725 / MC5725V / MC5727 / MC5727V	Sierra Wireless Mini Cards used on CDMA networks

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Table C-2: Acronyms and definitions

Acronym or term	Definition
MC57xx	Any of the following CDMA Mini Cards: MC5725 / MC5725V / MC5727 / MC5727V
MC8775 / MC8775V / MC8780 / MC8781 / MC8785V / MC8790 / MC8790V / MC8791V / MC8792V	Sierra Wireless Mini Cards used on GSM/UMTS networks
MC87xx	Any of the following GSM/UMTS Mini Cards: MC8775 / MC8775V / MC8780 / MC8781 / MC8785V / MC8790 / MC8790V / MC8791V / MC8792V
MHz	MegaHertz = 10E6 Hertz (Hertz = 1 cycle/second)
MIO	Module Input/Output
MPE	Maximum Permissible Exposure — the level of radiation to which a person may be exposed without hazardous effect or adverse biological changes
OTA	Over-The-Air or Radiated through the antenna
PCS	Personal Communication System - PCS spans the 1.9 GHz radio spectrum
RF	Radio Frequency
RMS	Root Mean Square
SA	Selective Availability
Sensitivity (Audio)	Measure of lowest power signal that the receiver can measure
Sensitivity (RF)	Measure of lowest power signal at the receiver input that can provide a prescribed BER / BLER / SNR value at the receiver output.
SIM	Subscriber Identity Module
SNR	Signal to Noise Ratio
SOF	Start of Frame - a USB function
UART	Universal Asynchronous Receiver Transmitter
UDK	Universal Development Kit (PCI Express Mini Card Dev Kit)
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module

 2130114

Table C-2: Acronyms and definitions

Acronym or term	Definition
VCC3.3	3.3 V supply voltage
WCDMA	Wideband Code Division Multiple Access — In this document, the term "UMTS" is used instead of "WCDMA".
XIM	In this document, XIM is used as part of the contact identifiers for the USIM interface (XIM_VCC, XIM_CLK, etc.).

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

Index

Numerics

1X
    CDMA Standard 9

A

acronyms and definitions 29–31
airplane mode 15
antenna
    connection and mounting points 19
    connection considerations 18
    custom, considerations 20
    diversity antenna, disabling 20
    limit, matching coaxial connections 18
    location, considerations 20
    matching, considerations 20
    maximum cable loss 18
AT commands
    3GPP specification, details 9
    low power mode, setting 15
    standard, MC57xx (reference document) 9
    standard, MC87xx (reference document) 10
AT commands, extended
    MC57xx, reference 9
    MC87xx, reference 10
AT commands, standard
    MC57xx, reference 9
    MC87xx, reference 10

C

cable loss
    antenna, maximum 18
CDMA
    1X Standard 9
CnS
    MC57xx reference 9
    MC87xx reference 10
connection
    grounding 19
connectors, required
    EDGE mating (52-pin) 8
    host-module 8
    RF, Hirose 8
    USIM 8
current
    consumption
        usage models 15

D

DCS 1800

RF parameters, MC87xx 17
desense. See RF
disconnected, module power state 14
diversity antenna
    disabling 20

E

EDGE connector, manufacturers 8
EGSM 900
    RF parameters, MC87xx 17
electrostatic discharge. See ESD
ESD
    protection requirements 13–14
    testing techniques document (IEC-61000-4-2) 9

F

FCC
    regulations, relevant section 9

G

GPS band
    RF parameters, MC87xx 18
grounding
    connection considerations 19
GSM 850
    RF parameters, MC87xx 17

H

Host/Module interface 23–24

I

impedance
    module-antenna 20
interference
    device generated 22
    power supply noise 21
    wireless devices 21

L

LED
    example 24
    states 23
low power mode
    setting, AT commands 15
low power, module power state 15

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.

In the event of a discrepancy in values between this guide and the Product Specification Document (PSD), the PSD takes precedence.