Formerly Omnipoint Technologies, Inc.

Redhawk™ II
GSM Wireless Terminal

Users Guide

SAFETY PRECAUTIONS

Important Safety Information

Some of the following information may not apply to all devices described in this manual. However, precautions should be observed when handling any electrical device.

- Save this manual, it contains important safety information and operating instructions.
- Do not expose the Redhawk II product to open flames.
- Care should be taken so that liquids do not spill into the devices.
- A qualified electrician should perform all primary connections to AC power.
- Do not attempt to disassemble the product. Doing so will void the warranty. With the exception of Subscriber Identification Modules (SIM), this product does not contain consumer serviceable components.

Guidelines for Limiting RF Exposure

The *Redhawk II* products are GSM radio transceivers, which operate under the authority of 47 CFR Part 24, Subpart E of the FCC Rules and Regulations. When installed and operated in accordance with the instructions provided in this manual, these devices comply with current FCC regulations regarding human exposure to radio frequency - electromagnetic fields.

The following installation and operation restrictions apply to all *Redhawk II* products:

- These devices may only be used in fixed and mobile applications
- Portable applications, as defined by the FCC, are prohibited
- A separation distance of at least 20 cm (7 7/8) inches between the antenna and body of the user and other persons must be maintained at all times
- In FIXED applications antenna gain* is limited to a maximum of 7 dBi, with a corresponding equivalent isotropic radiated power (EIRP) of 37 dBm / 5 W
- In MOBILE applications antenna gain* is limited to a maximum of 3 dBi, with a corresponding equivalent isotropic radiated power (EIRP) of 33 dBm / 3 W
- Desktop and other uses of these devices where the antenna can easily be relocated are considered by the FCC to be mobile applications.

* Antenna gain is defined as gain in dBi (dB referenced to an isotropic radiator) minus cabling loss.

> NOTE: Additional care must be taken by the installer and/or user of the Redhawk II™ products to ensure proper antenna selection and installation. Adherence to the above conditions is necessary to comply with FCC requirements for safe operation regarding exposure to RF radiation.

Disclaimer

The information and instructions contained within this publication comply with all FCC, NRLT, IMEI and other applicable codes in effect at the time of publication. Xircom, Inc. disclaims all responsibility for any act, or breach of law, code or regulation, including local or state codes, performed by a third party.

Xircom strongly recommends that all installations, hookups, transmissions, etc. be performed by persons who are experienced in the fields of radio frequency technologies. Xircom acknowledges that the installation, setup and transmission guidelines contained within this publication are guidelines, and that each installation may have variables outside of the guidelines contained herein. Said variables must be taken into consideration when installing or using the product, and Xircom, Inc. shall not be responsible for installations or transmissions that fall outside of the parameters set forth in this publication.

Xircom shall not be liable for consequential or incidental damages, injury to any person or property, anticipated or lost profits, loss of time, or other losses incurred by Customer or any third party in connection with the installation of the Products or Customer's failure to comply with the information and instructions contained herein.

Beta Release Notes

Data Services

The current software release does not support transparent circuit switched data or Group 3 Fax. These services will be added in subsequent versions.

AT Commands

The current software version does not support all AT commands listed in this document. Please reference the attached Errata sheet for a list of the non-functioning AT commands. These commands will be added in future software versions.

PUK Procedure

The PUK procedure outlined in this document will be changing.

DECLARATION OF CONFORMITY

Xircom, Inc. of 2300 Corporate Center Drive, Thousand Oaks, CA 91360 declares that the Xircom Redhawk™ II GSM Radio Module, model 2110-1300 (900/1800) is in conformance with all relevant essential requirements of the European Council Directives listed below:

1999/5/EC	Radio and Telecommunications Terminal Equipment Directive (Following Annex III of this Directive)
89/336/EEC	EMC Directive with Amendment 92/31/EEC and 93/68/EEC
72/23/EEC	Low Voltage Directive with Amendment 93/68/EEC

This declaration is made based upon compliance to the following standards:

EN 60950 (1992 w/ A1, 2, 3, 4)	Safety of Information Technology Equipment, Including Electrical Business Equipment
ETS 300 342-1 Edition 2 (June 1997)	Radio Equipment and Systems (RES); Electromagnetic Compatibility (EMC) for European digital cellular telecommunications system (GSM 900 MHz and DCS 1800 MHz). Part 1: Mobile and portable radio and ancillary equipment.
TBR 19 Edition 3 (October 1996)	European digital cellular telecommunications system (Phase 2); Attachment requirements for global system for mobile communications (GSM) mobile stations; Access
TBR 31 Edition 2 (March 1998)	Digital cellular telecommunications system (Phase 2); Attachment requirements for mobile stations in the DCS 1800 band and additional GSM 900 band; Access

Xircom further declares that all essential radio test suites have been carried out.

This declaration is made under our sole responsibility.

Authorized Signature: _____ Date: _____

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PRODUCT OVERVIEW

The Redhawk II Modem is built around the Eagle II™ Data Terminal, a compact, wireless modem that utilizes the international standard Global System for Mobile communications (GSM). The data terminal enables low-cost, application-specific, two-way communication and control. It takes full advantage of GSM capabilities such as Subscriber Identity Modules (SIM), which are "smart cards" that provides numerous advantages.

Over-the-air communication lets the Redhawk II terminal accomplish tasks that previously required on-site visits and offers innovative new service capabilities never before available. In addition, terminal authentication and data encryption ensures a more confidential communication link between the terminal user and the data recipient.

Figure 1: Redhawk II Modem

Model Variation

Redhawk II modems are available in two configurations:

- Redhawk II: This modem is GSM only and supports *Short message service* (SMS), *unstructured supplementary service data* (USSD), *voice*, and *circuit switched data* (transparent and non-transparent mode) up to 9.6 Kbps.
  - 900 MHz & 1800 MHz: Part # 2110-1300
  - 900 MHz & 1900 MHz: Part # 2110-1500

- Redhawk IIG: This modem has the same GSM functionality as the Redhawk II with the addition that it is GPRS hardware ready. It provides *GPRS packet data* up to and including Class 10, in addition to *Short message service* (SMS), *unstructured*

supplementary service data (USSD), *voice*, and *circuit switched data* (transparent and non-transparent mode) up to 9.6 Kbps.

- 900 MHz & 1800 MHz: Part # 2210-1300
- 900 MHz & 1900 MHz: Part # 2210-1500

General Description

The Redhawk II contains the Eagle II radio data module and a Carrier Board assembly in a aluminum housing. The Eagle II radio module provides the GSM over the air radio link and modem command functions. More detailed information on the Eagle II can be found in the Eagle II Technical Manual (part # 07100017). The Carrier Board provides DC to DC conversion and standard interface connections with drivers for two serial interfaces, a voice interface, and DC power.

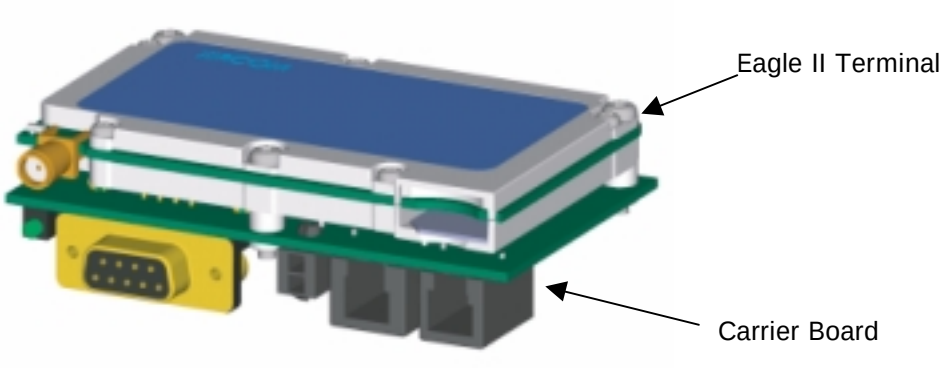

Figure 2: Redhawk II Modem Breakout

The modem operates under a wide range of DC input power. (+5V to +28V) Communication is through an RS-232 physical interface, using the GSM - AT command set. Other unique AT commands are also available, providing the opportunity to monitor and report network conditions that may be relevant to the management of multiple deployed terminals. See the *Programmers Manua*l for details on these unique commands.

Summary of the Features for the Redhawk II Modem

Interface	Primary serial port	V.24 protocol, 3 V (5 V tolerant) levels
	Secondary serial port	Secondary 3 V serial port (Any functions other than SMS messaging requires the development of custom applications)
	Voice	Supports three vocoder modes: half-rate, full-rate, and enhanced full-rate (EFR)
	Antenna	Female SMA
	Command protocol	AT command set
	Subscriber Identification Module (SIM)	3 V mini-SIM carrier and interface on board
Power	Electrical power	Fixed DC voltage
	Peak currents and average power dissipation	Refer to the Operating Power table in the Technical Specifications section for peak currents and average power dissipation for various modes of operation.
Radio Features	Frequency bands	GSM 900, DCS 1800, and PCS 1900 capability, depending on the product.
	GSM features supported	Provides for all GSM authentication, encryption, and frequency hopping algorithms.
Regulatory	Agency approvals	▪ GSM Type Approval ▪ FCC Certification (Part 24) ▪ CE (European Community Certification) ▪ IC (Industry Canada) available
GSM Functionality	▪ Mobile-originated and mobile-terminated SMS messages: up to 140 bytes or up to 160 GSM 7-bit ASCII characters. Up to 255 messages may be concatenated. ▪ Reception of Cell Broadcast Message ▪ SMS Receipt acknowledgement ▪ Circuit Switched Data (Transparent & Non-transparent fixed at 9.6 Kbps ▪ Voice ▪ Group 3 Fax ▪ Supports GSM Phase 2 + ▪ Supports Unstructured Supplementary Service Data (USSD) Not all GSM operators support USSD. For more information, contact Customer Support for the GSM operator. Redhawk IIG hardware is capable of supporting General Packet Radio Services (GPRS) when configured with optional memory. (GPRS Class B, Multislot Class 10 software will be available at a later date.)	
SIM	3 V Mini-Subscriber Identity Module (SIM) carrier and interface on board	
International Mobile Equipment Identity (IMEI)	The IMEI allows defective or stolen equipment to be barred from using the GSM network. The IMEI number is unique to each Redhawk II modem. It reveals the manufacturer, the country of production, and the type approval facility. When the Redhawk II modem is powered on and tries to register with the GSM network, the network provider checks the IMEI. If the IMEI is valid and has not been barred, the Redhawk II modem is allowed to register with the network.	

Table 1: Summary of Features

Front Panel

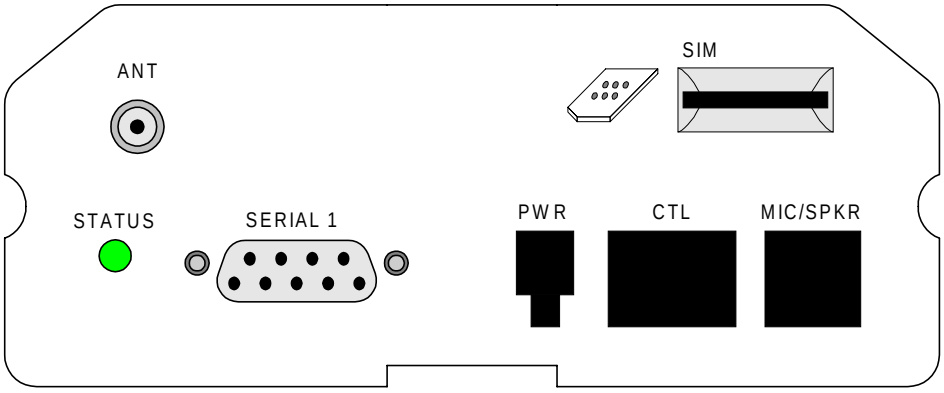

Figure 3: Redhawk II Front Panel

Antenna Connector (ANT)

The Redhawk II modem is designed to support interchangeable antenna types, provided that each antenna has 50-ohm impedance and has been tuned to the frequency band intended. It comes standard with a female SMA-type connector.

DC Power (PWR)

The Redhawk II modem requires an input voltage of 5.0 VDC to 28.0 VDC. The input source voltage ripple should be less than 20% of the average supply voltage peak-to-peak under normal operating conditions.

The power cable mating connector is a Molex part #43025-0200 (shell) and #43030-0009 (bag of pins) or #43030-0003 (reel of pins).

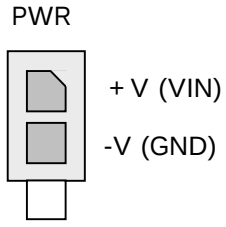

Figure 4: Input Power Connector

Pin Number	Signal Name	Direction	Functionality
1	VIN	From CPE	Electrical power input to Redhawk II modem: 5.0 VDC to 28.0 VDC
2	GND	From CPE	Electrical power return for digital and analog grounds.

Table 2: Power Connector Pin Out

Primary Serial Interface (SERIAL 1)

This serial I/O interface (RS-232) uses a DB-9 connector and supports auto baud capability from 300 bps to 19200 bps with hardware handshake flow control.

Pin Number	Signal Name	Direction	Functionality	Voltage Level
1	DCD0_DS	To CPE	Data Carrier Detect 0. DCE Output signal. Active low. Main serial interface data carrier detect signal. Connects to a DTE, CD, Carrier Detect pin.	3 V
2	RX0_DS	To CPE	Receive data 0. DCE Output signal. Main serial interface transmit data signal. During idle or reset, signal will be a logic 1. Connects to a DTE, RX, receive data pin.	3 V
3	TX0_DS	From CPE	Transmit data 0. DCE Input signal. Active low. Main serial interface receive data signal. During idle or reset, signal will be a logic 1. Connects to a DTE, TX, transmit data pin.	5 V or 3 V
4	DTR0_DS	From CPE	Data Terminal Ready 0. DCE Input signal. Active low. Main serial interface data terminal ready signal. Connects to a DTE, DTR, Data Terminal Ready pin.	5 V or 3 V
5	GND_IN	From CPE	Electrical power return for digital and analog grounds.	
6	DSR0_DS	To CPE	Data Set Ready 0. DCE Output signal. Active low. Main serial interface data set ready signal. Connects to a DTE, DSR, Data Set Ready pin.	3 V
7	RTS0_DS	From CPE	Request-To-Send 0. DCE Input signal. Active low. Main serial interface request to send signal. Connects to a DTE, RTS, Request-To-Send pin.	5 V or 3 V
8	CTS0_DS	To CPE	Clear-To-Send 0. DCE Output signal. Active low. Main serial interface clear to send signal. Connects to a DTE, CTS, Clear to send pin.	3 V
9	RI0_DS	To CPE	Ring Indicator 0. DCE Output signal. Active low. Main serial interface ring indicator signal. Connects to a DTE, RI, Ring Indicator pin.	3 V

Table 3: Primary Serial Connector Pin Out

NOTE: The maximum length for the Primary Serial cable is 50 feet.

Secondary Serial Control Interface (CTL)

This serial I/O interfaces (RS-232) that support auto baud capability from 300 bps to 19200 bps.

Connector: RJ-11

Pin Number	Signal Name	Direction	Functionality	Voltage Level
1	GPIO2_RJ	To/From CPE	General purpose I/O. Used as a general purpose input or output line for monitoring or control of external devices. Requires customized stack software to implement. Leave signals disconnected if function is not used.	3 V
2	GPIO1_RJ	To/From CPE	General purpose I/O. Used as general a purpose input or output line for monitoring or control of external devices. Requires customized stack software to implement. Leave signals disconnected if function is not used.	3 V
3	RX_D	From CPE	Receive Data 1. DTE Input signal. Secondary serial-interface receive data signal. Used as a debug interface for test purposes. Leave signal disconnected if function is not used.	5 V or 3 V
4	TX_D	To CPE	Transmit Data 1. DTE Output signal. Secondary serial-interface transmit data signal. Used as a debug interface for test purposes. Leave signal disconnected if function is not used.	3 V
5	GND _RJ	To CPE	Electrical power return for digital and analog grounds.	
6	GPIO0_RJ	To/From CPE	General purpose I/O. Used as general a purpose input or output line for monitoring or control of external devices. Requires customized stack software to implement. Leave signals disconnected if function is not used.	3 V

Table 4: Secondary Serial Connector Pin Out

NOTE: The maximum length for the Secondary Serial cable is 50 feet.

Voice interface (MIC/SPKR)

Uses an RJ-9 connector and provides differential microphone inputs and speaker outputs.

Pin Number	Signal Name	Direction	Functionality	Voltage Level
1	MIC0N	From CPE	Microphone Negative. Negative input pin from an electret-type microphone. Nominal microphone differential voltage should be 2.0 volts. Impedance not less than 900 ohms. Leave signal disconnected if function is not used.	
2	SPK0N	To CPE	Speaker Negative. Negative output pin. Low side of a push-pull amplifier. Speaker impedance 15 ohms, minimum. Speaker capacitance of 700 pF, maximum. Driver voltage is 4.5 V peak-to-peak. Leave signal disconnected if function is not used.	
3	SPK0P	To CPE	Speaker Positive. Positive output pin. High side of a push-pull amplifier. Speaker impedance 15 ohms, minimum. Speaker capacitance of 700 pF, maximum. Driver voltage is 4.5 V peak-to-peak. Leave signal disconnected if function is not used.	
4	MIC0P	From CPE	Microphone Positive. Positive input pin from an electret-type microphone. Nominal microphone differential voltage should be 2.0 volts. Impedance not less than 900 ohms. Leave signal disconnected if function is not used.	

Table 5: Voice Connector Pin Out

Subscriber Interface Module (SIM)

The SIM, an integral part of any GSM terminal device, is programmed with subscriber information. The SIM is not provided with the Redhawk II unit and must be provided by the GSM service subscriber. Care must be taken to protect the SIM. A GSM terminal will not operate without the SIM installed.

The user information consists of an identity (IMEI number) registered with the GSM provider, and an encryption Ki (pronounced key). The SIM consists of a microprocessor chip and memory, installed on a plastic card. Redhawk II uses the "mini-SIM" or plug in configuration. The SIM, which is removable, slips into a slot on the front of the modem.

The SIM card performs authentication. To gain access to the GSM network, the network must recognize the IMEI number and the terminal must be able to properly decrypt the data sent by the network. The SIM also serves as a buffer for Incoming and Stored SMS messages, or when a radio link is not available, store an outgoing message until a network link is established.

Power must be off when installing or removing a SIM card.

Status Indication (STATUS)

The Redhawk II modem provides a multi-color LED that indicates the current link status and signal quality.

Note: The LED illuminates any time power is applied to the Redhawk II modem.

LED Color	Link Status	Signal Quality
Green	Modem is attached to the network	Link signal is optimal
Orange		Link is less than optimal but is acceptable
Solid Red		Link is unacceptable
***Flashing* Red**	Modem is in Start-up mode or is not attached to the network	

GSM Overview

The GSM communications standard, already widely deployed in Europe, Asia, and North America, overcomes many of the drawbacks found in other wireless telemetry approaches. The GSM communications network was designed from the ground up, for reliable and inexpensive digital data transfers.

The GSM network (Figure 4) employs integrated data and data-friendly capabilities such as short message services, circuit switched data and, soon, GPRS, which brings the best of wireless and packet data into harmony and will make new services even more practical and affordable. In many countries around the world, especially in Western Europe, GSM-based networks are the only digital networks deployed.

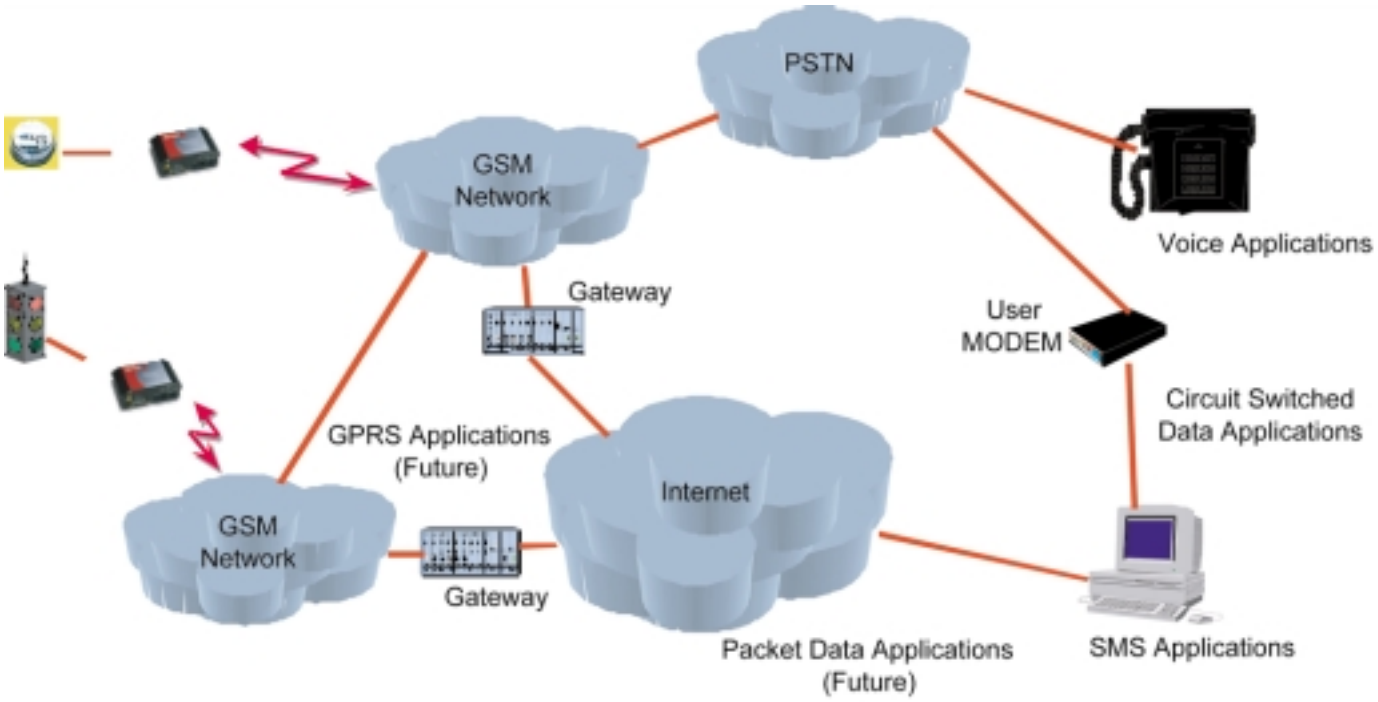

Figure 5: Redhawk II terminal deployment in a GSM network

The Redhawk II modem leverages *existing* public GSM networks, as opposed to other systems that require the utility to build, operate, and maintain expensive private wireless networks.

Redhawk II Programming Manual

For greater flexibility that enhances the usability of the Redhawk II Modems, Xircom has provided an AT Commands - Programmers Manual. Part #07100014-00A. This manual goes into greater detail, in an easy to read format, on the enhanced programming capabilities specific to the Redhawk II system.

Backward Compatibility

GSM functionality is forever evolving. Subsequently, in order to maintain the highest standards, the Redhawk II modems will be backward compatible with new GSM functionality such as General Packet Radio Service (GPRS). Applications supported with early current versions of the modem will continue to be supported, as GSM technology evolves to GPRS, and then on to third generation technologies, which are now in the process of standardization and development.

Modes of Operation

Redhawk II offers several modes of operation to address a variety of application requirements.

Circuit Switched Data

Circuit switched data is the most widespread and traditional means of data and voice transmission available today. A circuit switched connection occupies one network line for the entire length of data transmission and during this time, no other user may access this network line. A circuit switched connection is the optimal means for transmitting any continuous amount of data, such as video transmission or voice.

A common example of a circuit switched network is the public telephone system. When person A picks up the telephone and dials the number of person B, the network determines and assigns a path for that transmission. The signal travels through each assigned circuit switch to complete the connection.

Once the signal has reached person B, a continuous two-way transmission path has been established. On a long distance call, for example, many circuits would need to be connected together to make the call possible. These circuits are dedicated to the call for the duration of the transmission and cannot be shared by other users. This requires substantial network resources to be allocated per user.

Transparent and Non Transparent Transmissions

GSM provides two connection modes of transmission: transparent and non-transparent. All Redhawk II models support both modes. The *transparent data mode* delivers a service with a variable error rate, with a guaranteed throughput and delay, whereas the *non-transparent mode* delivers a constantly low forward error correction rate, but with a non-guaranteed throughput or delay.

The non-transparent service delivers the most reliable performance and is closest to using a modem over a fixed telephone line. Not all GSM service providers support transparent mode. In those cases, the unit switches automatically to non-transparent mode.

Short Message Service

To accommodate smaller messages, GSM uses short message service (SMS) for efficient and timely data transmission and data retrieval. SMS is a point-to-point, storage and forwarding, message service that is used in data transmissions such as paging, notification, news flashes, and information retrieval.

Short messages can carry up to 140 8-bit characters. (160, 7-bit characters available – See Programmers Manual for configuration)

Short Messages can be sent and received simultaneously with a voice or data call and are sent above the voice or data in the overhead-signaling path (Traffic & Bearer).

Although similar in concept to traditional paging, the primary difference is that SMS is not geographically restricted as paging systems are. Moreover, the GSM network stores and resends the message if the receiver's handset is turned off (In some cases, if a pager is turned off, the message is simply lost).

Listed below are the essential characteristics and assumptions regarding the form of SMS supported by the Redhawk II family of modems.

- Support of both mobile originated and mobile terminated SMS.
- Delivery of message to either designated telephone numbers.
- 8-bit data
- Message Class 1
- Message concatenation up to 255 messages (Verify with service provider that support for this capability is available)
- Up to 140 ASCII Character per message using 8-bit data mode. (160 characters if 7bit GSM ASCII used)
- Status report indicator not sent to SME
- More Messages to Send (MMS) configuration.
- Validity Period
- Service Center Time Stamp
- Alert SMS-SC
- Priority and Message Waiting
- Message Waiting

In addition to the above, the following important SMS functions are supported:

- Submit a SMS TPDU to an SMS-SC, and store a copy of it until either a report arrives from the network or from the network, or a timer expires
- Receive a SMS TPDU from an SMS-SC
- Return a delivery report to the network for a previously received message
- Receive a report from the network
- Notify the network when it has memory capacity available to receive one or more SMS messages after it has previously rejected a message because its memory capacity was exceeded

Support for Unstructured Supplementary Services Data

Unstructured Supplementary Services Data (USSD) is a supplementary service to allow for custom features by GSM service providers. The main distinction between USSD and SMS is that the originator is guaranteed a real-time response and acknowledgement in USSD, whereas SMS provides no such guarantee.

Put simply, USSD allows the transmission of strings of characters between the terminal and network in a transparent fashion. Both mobile-initiated and network-initiated USSD transactions have been standardized in the GSM specifications. Such transactions are normally in the form of a request character string followed by a response character string.

In the case of GSM handsets, a valid USSD string is keyed into the handset (e.g., *#1446#) and the SEND key is pressed.

- The characters of the request string are restricted to integers (0-9), hash (#) and star (*).
- The characters of the response string can be numeric or alphabet character.

USSD may be more appropriate for potential applications where a real-time response is required, such as point of sales. The Redhawk II modem supports all forms of USSD, both mobile and network initiated. Please note that (USSD is a GSM supplementary service requiring subscription.)

Voice

The Redhawk II modem has full voice capabilities, provided the necessary connections have been made for the speaker and microphone pins on the 60-pin I/O connector. The AT commands and their responses allow the user to enter and receive information from the Redhawk II modem. These functions include the ability for dialing, for providing on-hook or off-hook, and for controlling other aspects of the voice call interface.

The Redhawk II modem supports three vocoder compression algorithms for voice communication: half-rate, full-rate, and enhanced full-rate (EFR)

General Packet Radio Service (GPRS)

GPRS is the next step in GSM data services: a fully packet-based protocol service with direct access to the Internet. By bringing the best features of messaging, circuit-switched services, and packet data into harmony, GPRS promises to make new applications even more practical and affordable. Future releases of the Redhawk II modem will support GPRS mode. Currently, the Redhawk II modem is hardware-ready for GPRS, if the optional memory upgrade is installed.

PROVISIONING THE SIM

The GSM SIM can support optional features or services. Most GSM operators typically configure the SIM to send/receive voice calls and to receive SMS; however, some may require an additional tariff to enable the SIM to send SMS. The transmission of data and fax are also additional services that may require tariffs and additional provisioning. Each of these services has two separate modes that must be enabled to allow the service:

- Mobile-originated (MO): allows making a service request (such as, making a call or sending an SMS)
- Mobile-terminated (MT). allows receiving a service request (such as, receiving a phone call or an SMS)

It is imperative for the Redhawk II modem that the SIM be configured for the optional services that are required for the application.

GSM Services Supported by the Redhawk II Modem

The Redhawk II modem supports four GSM services (modes of operation) that must be enabled by the operator:

- Voice calls (MO and MT): requires a telephone number
- SMS (MO and MT): uses the telephone number for Voice
- Fax calls (MO and MT): requires a telephone number
- Circuit-switched data calls (MO and MT): requires a telephone number

The GSM SIM can have as many as three telephone numbers: one number for voice calls and SMS, one number for fax calls, and one number for data calls.

Selecting the Modes of Operation

When provisioning the SIM for the Redhawk II modem, enable the following modes of operation:

- Voice calls: configure the SIM for both MO and MT service (to send and receive)
- SMS: configure the SIM either for MT alone (to receive) or for both MO and MT (to send and receive)
- Data: configure the SIM either for MO alone (to send) or for both MO and MT (to send and receive)

Voice	SMS	Data	Fax	Function
MO/MT	MT	MO	X	Voice calls, receive SMS, make data calls
MO/MT	MT/MO	MO	X	Voice calls, receive/send SMS, make data calls
MO/MT	MT/MO	MO/MT	X	Voice calls, receive/send SMS, make/receive data calls (requires an additional data telephone number)

ANTENNA SELECTION

Connector

The modem antenna connector is a female SMA type. The modem is designed to support interchangeable antenna types provided they have impedance of 50 ohms.

Antenna Selection

If possible, a suitable *omni-directional* antenna should be mounted directly to the SMA connector on the modem. This type of direct-antenna mount is preferred when GSM Network signal strength is adequate and consistent. An example of this type of installation is where a modem is to be mounted on or near an office desktop and the antenna is located away from human contact, complying with the FCC requirements. (See FCC requirements for Human Exposure on page 41.)

Installations such as this greatly reduce the installation cost, since a separate coaxial cable and more expensive antenna are not required. If the antenna must be mounted remotely away from the modem, to assure an adequate and consistent signal, only a wide-beam directional antenna, or an omni-directional antennas are preferable.

Antenna Selection: Performance Guidelines

Antenna gain

FCC requirements limit the amount of antenna gain permissible. The combination of antenna and cable loss (if any) must be selected to maximize path gain within the FCC requirements (maximum of 3dBi for mobile and 7 dBi for fixed applications).

Beam width

For mobile applications, the installer should select an omni-directional antenna with good elevation beam width. With an omni-directional antenna, you trade some **gain** (azimuth) for an increased **elevation beam width** (elevation). Good omni-directional antennas with 2-3dBi gain, and a good elevation beam width are readily available.

Fixed applications could use any type of antenna because there is more flexibility in gain, but unless the installation site is on the outer fringes, or in a deep fade area, (major obstructions) gain is the most important thing. Again, you trade gain for beam width (azimuth and elevation).

The Installer should keep in mind that networks and site environments change. For example, new cell sites are added to expand existing coverage and/or capacity. With this growth, new obstructions are added as well, which could change the signal quality for fixed applications (e.g. a newly constructed building).

Therefore, it is recommended that the installer ***not*** install highly directional antennas attempting to pinpoint the link to a serving base station. Due to the FCC restrictions, the installer should be able to find a good performing antenna, which provides decent gain, and good beam width performance.

In order to accomplish “seeing” as much of the network as possible, the installer is advised to use as broad of a beam width as possible (and reasonable given any particular installation).

Installation using these guideline, avoid potential problems such as:

- New base station sites, that are installed closer to site, but cannot be "seen" by the network.
- Serving cell taken out of service temporarily, but the network lacks the ability to jump to other cell sites
- Newly constructed obstructions, resulting in an change to the RF environmental characteristics.

Polarization

All mobile antennas should be vertically polarized for optimal performance. Others will work, but may not provide the performance required. Base stations must be vertically polarized transmissions

Modem Antenna Location and Network Communication

The antenna location for modem installation is dependent on the individual site conditions. As a rule, the antenna should be positioned so that a reliable radio connection can be made with the GSM network. The following guidelines will assist the installer in making this determination.

- Where the reliability of the signal strength would be in question, one or more base stations would enhance quality of the signal.
- Where possible, the modem location should be selected so that the antenna has an unobstructed line of sight to the selected base-station(s)
- The antenna should be located to maximize the signal strength and quality received from the selected base-station(s).

- It is recommended that the installer obtain GSM Network coverage maps from the GSM operator indicating that the installation site is in a covered area. It is also recommended that coverage and signal quality be verified prior to installation, using a GSM handset.

- If possible, the modem and its associated antenna should be deployed inside an environmentally controlled protected structure (such as an office building).

> NOTE: (Xircom, Inc. offers diagnostic tools to aid installers with the selection of a optimal antenna location. Contact the Xircom Sales and Customer Support office at 1.888.684.5355 or 1.719.884.2444 for additional information. To report a problem, call the Xircom Customer Service department:

INSTALLATION & INITIALIZATION

Guidelines for Limiting RF Exposure

The Redhawk II products are GSM radio transceivers, which operate under the authority of 47 CFR Part 24, Subpart E of the FCC Rules and Regulations. When installed and operated in accordance with the instructions provided in this manual, these devices comply with current FCC regulations regarding human exposure to radio frequency - electromagnetic fields.

The following installation and operation restrictions apply to all Redhawk II products:

- These devices may only be used in fixed and mobile applications
- Portable applications, as defined by the FCC, are prohibited
- A separation distance of at least 20 cm (7 7/8) inches between the antenna and body of the user and other persons must be maintained at all times
- In FIXED applications antenna gain* is limited to a maximum of 7 dBi, with a corresponding equivalent isotropic radiated power (EIRP) of 37 dBm / 5 W
- In MOBILE applications antenna gain* is limited to a maximum of 3 dBi, with a corresponding equivalent isotropic radiated power (EIRP) of 33 dBm / 3 W
- Desktop and other uses of these devices where the antenna can easily be relocated are considered by the FCC to be mobile applications.
- Antenna gain is defined as gain in dBi (dB referenced to an isotropic radiator) minus cabling loss.

NOTE: Additional care must be taken by the installer and/or user of the Redhawk II™ products to ensure proper antenna selection and installation. Adherence to the above conditions is necessary to comply with FCC requirements for safe operation regarding exposure to RF radiation

Installation and Verification

NOTE: Only personnel who are trained and knowledgeable of all applicable requirements including those addressing exposure to RF radiation should perform installation and servicing of this equipment.

Before Installation:

Read the Installation and Verification section in its entirety prior to beginning any installation steps.

Identify a mounting and installation location. (Reference the *Mount Modem* paragraph on page 24.)

Verify GSM coverage. It is recommended that at the time of installation, the GSM operator provide coverage maps, verifying that the location selected is in a covered area. Further verification should be done using a GSM handset.

Installation

1. Unpack Modem

Remove the modem from the shipping box and verify contents with the shipping list.

2. Mount Modem

The Redhawk II contains the Eagle II radio modem interfaced with a carrier board, both contained within a protective housing. The applications that the modem is best suited for, would be those within an enclosed structure, office building or other facility, where the unit is protected against climatic changes. . The modem must be installed in a location that meets the environmental requirements for moisture, heat and cold, for this product.

For mobile, (unattached installations) the modem can be placed on any stable flat horizontal surface such as a desktop, bookshelf, or window ledge. The risk of damage to the modem unit, due to being knocked off the surface, or being pulled off by the cables should be avoided. Power interconnects, RS232 interconnect, and antenna interconnects should all be performed per detailed instructions found in this Installation Guide.

For fixed (permanently mounted) applications, the modem can be attached to any flat surface in any orientation. The installer is responsible to select a surface and fastener system which will adequately support the weight of the Redhawk II unit, the interconnect cabling and the antenna (if mounted directly to the Redhawk unit). When selecting the location and mounting configuration of the Redhawk II unit, the installer bears the responsibility to assure that all local and national safety codes are met and should select a location with adequate signal strength to assure consistent GSM network availability. The installer also shall assure that any security requirements are met.

Refer to Xircom Drawing Number 06700106, Mechanical Interface Control Drawing, for size and location of mechanical features including the following:

- Connector locations
- Location and size of Redhawk II mounting brackets
- Recommended mounting fastener sizes for Redhawk II
- Mounting Fastener Hole Pattern
- Clearance requirements for installation and removal of SIM card
- Instruction for installation and removal of SIM card

> **Note:** All cables which connect to the Redhawk II, should be supported with strain-relief within 8 inches (200 mm) of the connector interface. The Redhawk II connectors are not designed to support the weight of cabling beyond this length. Failure to adequately strain-relief cables may result in damage to the Redhawk II unit.

3. Install Antenna

Direct Antenna connection:

If an omni-directional antenna is to be attached directly on the modem, install the antenna by screwing it directly onto the SMA connector on the modem. If possible, torque the antenna to 8.0 +/- 1.0 inch-pounds. If it is not possible to torque the antenna connector using a torque wrench, tighten the antenna by hand as tightly as possible.

Remote Antenna connection:

Refer to the *Installing the Remote Antenna* section starting on page 48 for detailed requirements on antenna and coaxial cable for remote antenna installation. Connect the remote coaxial cable SMA connector onto the SMA connector on the modem. Torque the SMA connector pair to 8.0 +/- 1.0 inch-pounds.

Note: Failure to torque the SMA connectors properly may result in a poor antenna connection and degradation in performance. Overtorquing may result in damage to the Redhawk II modem.

4. *Install SIM card.*

Note: The SIM card is supplied by the service provider, and is not supplied by Xircom. The Redhawk II unit will not operate without a properly coded SIM card installed.

- ***Disconnect all power to the unit before installing the SIM card.***
- Install the SIM card in the SIM card slot on the front plate with the contacts facing up (Reference Figure 6). This is accomplished by pushing the SIM inward and down.

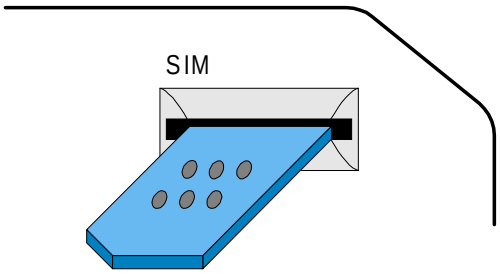

Figure 6: Modem SIM Access

NOTE: To prevent accidental removal, a needle nose pliers or tweezers is required to remove the SIM. To remove the SIM, lift the edge of the card while pulling it out.

5. *Diagnostic Terminal Connect & Setup*

Connect the Diagnostic Terminal to the Primary Serial Port (DB-9) connector using a standard (straight thru) modem cable. The diagnostic terminal can be a laptop PC, with a serial port connection, running a program such as ProComm™ or other communication application.

Set up the diagnostic serial communication to the Redhawk II default values:

Baud Rate	9,600 K bps	**Stop Bits**	1
Data	8 bits	**Parity**	No

Table 6: Redhawk II default serial interface values.

6. Connect Power Supply Cable

Install the power supply per manufacturer's recommended procedures. Plug the power supply cable plug into the modem power connector. The connector is keyed so it can only be installed one way. The connector also has an automatic locking feature that will engage when the connector pair is fully mated and is easily releasable with finger pressure.

7. Verify all Terminal Connections

Check that all Redhawk II connections have been installed per the instructions in this manual, and that the power cable (or cord) is secured with no exposed wires.

8. Apply Power

Verification

Using AT Commands

In the GSM vocabulary, a call from GSM mobile to the PSTN is called a "mobile-originated call" or "outgoing call." A call from the fixed network to a GSM mobile is called a "mobile-terminated call" or "incoming call."

In the following examples, "App" refers to the application. The following convention describes the direction of the data exchange:

- The data exchange from the customer application to the Redhawk II modem is designated as: **App > Modem**
- The data exchange from the Redhawk II modem to the customer application is designated as: **Modem > App**

> **Note:** With the exception of the + + + command (Online Escape Sequence), all commands must be preceded by the AT attention code (or command prefix) and terminated by pressing the <CR> character.
>
> In the following examples, the <CR> and <CR><LF> are intentionally omitted for clarity and space.

Initial Response to the AT Command

After power is applied to the Redhawk II, the modem performs a power-up self-test. The self-test completes within one (1) second. When queried with the AT command, the Redhawk II modem responds with one of the following result codes:

- OK signifies that the Redhawk II modem is ready, that it correctly interprets the AT command, and that it can execute the command.
- ERROR signifies that the Redhawk II modem does not understand the command or that the command is invalid.

App > Modem	AT	
Modem > App	OK	Command valid: modem is ready

The Redhawk II modem must be in Command mode when any command is entered (with the exception of the online escape sequence + + +). Commands entered when the modem is in Online mode are treated as data, and are transmitted as such to the receiving modem.

9. Modem Initialization

The following example provides the sample AT commands and responses for the following initialization tasks:

- Reset the modem to the factory defaults
- Enable character echo
- Set the modem to Verbose mode (to display result codes as words)
- Set the DCD to ON
- Monitor the DTR

App > Modem	AT& FE0Q0V1&C1&D0	Initialization string
Modem > App	OK	Command is valid
App > Modem	ATS0 = 1	Auto answer on 1st ring
Modem > App	OK	Command is valid

10.SIM PIN Status

The following example provides the AT command and response for querying the PIN status and entering the SIM PIN number if required.

App > Modem	AT + CPIN?	Query the SIM PIN status
Modem > App	+ CPIN: Ready OK	GSM terminal is not waiting for any password + CPIN: SIM PIN terminal is waiting for PIN + CPIN: SIM PUK terminal is waiting for PUK ERROR SIM is not installed

If the response is +CPIN:Ready, then skip the remainder of this paragraph and proceed to step 11. If the response is +CPIN:SIM PIN then proceed with the remainder of this paragraph to enable the terminal by entering the SIM PIN.

Caution: Use care when entering the SIM PIN. If it is entered incorrectly three times in a row, the GSM terminal will lock and a SIM PUK is required to unlock the SIM.

App > Modem	AT+CPIN="1234"	Enter the PIN number
Modem > App	OK	Command is valid
App > Modem	AT+CPIN?	Query the SIM PIN status
Modem > App	+CPIN: Ready OK	GSM terminal is not waiting for any password +CPIN: SIM PIN terminal is waiting PIN +CPIN: SIM PIN terminal is waiting PUK

If the response is +CPIN:Ready, then skip the remainder of this paragraph and proceed to step 11. If the response is +CPIN:SIM PIN then carfully verify that you have the correct SIM PIN and repeat the SIM PIN entry.

If the SIM locks up after 3 unsuccessful tries, user will need to contact the GSM service provider who supplied the SIM to obtain a SIM PUK number. The following example provides the AT command and response for entering the PUK and new PIN number.

App > Modem	AT+CPIN=5678,1234	Enter the PUK followed by the new PIN
Modem > App	OK	Command is valid
App > Modem	AT+CPIN?	Query the SIM PIN status
Modem > App	+CPIN: Ready OK	GSM terminal is not waiting for any password +CPIN: SIM PIN terminal is waiting PIN +CPIN: SIM PUK terminal is waiting PUK

If the response is +CPIN:Ready, then skip the remainder of this paragraph and proceed to step 11. If the response is +CPIN:SIM PIN then call Xircom Customer Support.

11. Data Call Setup (modem origination)

The following example provides the AT command and response for setting the Redhawk II modem for 9600 baud, non-transparent mode.

App > Modem	AT+CBST=7,0,1	9600 baud, non-transparent mode
Modem > App	OK	Command is valid

12. Modem Status Commands

The following examples provide the AT commands and responses for querying the status of the unit. For more information about the commands and response codes, see the *Redhawk II Programmer's Manual*.

- The following command checks to determine if the Redhawk II modem has successfully registered with the GSM network.

App > Modem	AT + CREG?	Get the registration status
Modem > App	+ CREG: 0,1* OK	Registered with home network + CREG = 0,2 registration in progress + CREG = 0,5 registered as roaming

*First character can be "0" or "1": "0" for manual response, "1" for auto response.

- The following command queries the strength of the RF coverage. This command provides information about the RF coverage for the Redhawk II modem.

App > Modem	AT + CSQ	Get the signal strength (for this command, do not enter "?")
Modem > App	+ CSQ: 20,99 OK	Receive signal strength = 20, -74 +/- 1 dBm RXQUAL = 99, unknown

Value	RSSI (dBm) +/- 1 dBm	Value	RSSI (dBm)
0	< -110	16	-82
1	-110	17	-80
2	-109	18	-78
3	-108	19	-76
4	-106	20	-74
5	-104	21	-72
6	-102	22	-70
7	-100	23	-68
8	-98	24	-66
9	-96	25	-64
10	-94	26	-62
11	-92	27	-60

12	-90	28	-58
13	-88	29	-56
14	-86	30	-54
15	-84	31	-52

Table 7: RSSI vs. Received Signal Power

Value	RSSI (dBm)
0	BER < 0.2%
1	0.2% < BER < 0.4%
2	0.4% < BER < 0.8%
3	0.8% < BER < 1.6%
4	1.6% < BER < 3.2%
5	3.2% < BER < 6.4%
6	6.4% < BER < 12.8%
7	12.8% < BER

Table 8: RXQUAL vs. Bit Error Rate

- The following command requests the current Public Land Mobile Network (PLMN). DeTeMobil is used as an example, the PLMN may be different.

App > Modem	AT + COPS?	Request current PLMN
Modem > App	+ COPS: 0,0,"DeTeMobil" OK	PLMN is DeTeMobil

SMS Message Verification

Modem Sent SMS (Text)

To be able to send SMS text messages, the Redhawk II modem must be initialized with the proper SMS mode. The following examples provide the AT commands and responses for initializing the SMS mode.

- The following command initializes the Redhawk II modem by setting the text mode parameters.

App > Modem	AT+CSMP=17,167,0,0	Set text mode parameters: ▪ 17: Sets reply pat, user data header, status report request, validity period format, reject duplicates and message type ▪ 167: Sets validity period ▪ 0: Higher layer protocol indicator ▪ 0: Information encode format
Modem > App	OK	Command is correct

- After initializing the modem with the proper SMS mode, select the proper service center. The service center is the Public Land Mobile Network (PLMN) to which the SME telephone number belongs. The following command selects the service center. Voicestream is used as an example, the users home PLMN may be different.

App > Modem	AT+CSCA="+491710760000"	Service center initialization: D1 – Germany
Modem > App	OK	

- The following command selects TEXT mode for SMS messages.

App > Modem	AT+CMGF=1	Set message format to TEXT mode
Modem > App	OK	Command is correct

- The following command sets the indicators for the message.

App > Modem	AT+CNMI=1,1,0,0,0	Set the new message indicators AT+CNMI=<mode>,<mt>,<bm>,<ds>,<bfr> ▪ <mode>=1, discard unsolicited result codes indication ▪ <mt>=1, SMS-DELIVERs are routed using unsolicited code ▪ <bm>=0, no CBM indications are routed to the TE ▪ <ds>=0, no SMS-STATUS-REPORTs ▪ are routed ▪ <bfr>=0, TA buffer of unsolicited result codes defined within this command is flushed to the TE
Modem > App	OK	Successful command

- The following command saves the SMS settings. Once the SMS commands have been saved, the initialization commands do not need to be sent again until they are changed.

App > Modem	AT+CSAS	Save SMS settings
Modem > App	OK	Successful transmission

- After the Redhawk II modem has been initialized, the following commands and sample responses provide the telephone number and the message to be transmitted.

App > Modem	AT+CMGS="12017572673"	Send a message to the telephone number (insert user modem phone number as the value in parenthesis)
Modem > App	>	Ready to send message
App > Modem	Hello, how are you?^Z	Enter the text message. End the message with Control Z.
Modem > App	+CMGS: 1 OK	Successful transmission

Modem RECEIVE SMS (Text)

The following example provides the AT command for requesting that the Redhawk II modem list received SMS messages. This string requests that the modem send (over the RS232 interface) all of the messages that have been received.

App > Modem	AT+CMGL="ALL"	Read ALL messages received, including status, originator, message number and message content (if messages are present)
Modem > App	+CMGL: 1, "REC UNREAD", "12017572673" Hello, how are you? OK	

SIM Data Provisioning Verification (Optional)

At this time the user has the option of verifying the data communications function from the users system application to the modem prior to connection to the CPE. To check this path, have the user's system application send a data stream to the modem and observe the data stream on the diagnostic terminal for verification of correct performance.

Match Modem Serial port to CPE

The modem is now ready to be interfaced with the CPE. The serial port settings, data type, and flow control between the modem and the CPE need to be matched. Reference Table 6 for the Redhawk II modem initialization defaults.

1. Match the bearer type selection (transparent deviation on different sheet or non-transparent data).

2. Match the flow control.

3. Match the serial interface parameters (baud rate, 8 data bits, 1 stop bit, no parity).

1. Set up diagnostic terminal serial interface parameters to match the modem (if modem has changed).
2. Save parameters to non-volatile memory. (AT&W command, AT+CSAS)

NOTE: It is recommended that the user CPE software have the same initialization string for the modem (reference section Modem Initialization on page 27) resident in its software to initialize the modem.

Verify Setup

1. Power down the unit
2. Wait 5 seconds and then re-apply power to verify commands were saved properly
3. Power down again.

Connect Primary Serial Port Cable

Plug the RS232 cable from the CPE into the Primary Serial Port connector (DB-9) on the modem. The connectors are keyed so it can only be installed one way. Tighten the jackscrews on the RS232 cable using the appropriate tools.

Final Verification

SMS Verification

Repeat the *SMS Message Verification* section starting on page 30.

DETAILED SPECIFICATIONS

Physical Dimensions and Weight

Size (L x W x H) including connectors	95.3 mm 55.2 mm x 38.1 mm (3.75” x 2.17” x 1.50”)
Weight	215 g (7.6 oz.)

Table 9: Size and Weight

Operating Power

The Redhawk II modem requires an input voltage of 5.0 VDC to 28.0 VDC. The input source voltage ripple should be less than 20% of the average supply voltage peak-to-peak under normal operating conditions.

Redhawk II Modem			Average Current (Amps)	Peak Current (Amps)
GSM 900	**GSM**	1 TX 1 RX	TBD	TBD
		1 RX	TBD	TBD
	GPRS Class 10	1 TX 4 RX	TBD	TBD
		2 TX 3 RX	TBD	TBD
	Sleep Mode		TBD	TBD
DCS 1800 and **PCS 1900**	**GSM**	1 TX 1 RX	TBD	TBD
		1 RX	TBD	TBD
	GPRS Class 10	1 TX 4 RX	TBD	TBD
		2 TX 3 RX	TBD	TBD
	Sleep Mode		TBD	

Table 10: Transmit Mode Versus Current Requirements

Transmit Power

Redhawk II modem	Power Class	Transmit Power
1900 MHz **1800 MHz**	GSM Power Class 1	1-W conducted power maximum (30 dBm +/- 2 dB), measured at the antenna port
900 MHz	GSM Power Class 4	2-W conducted power maximum (33 dBm +/- 2 dB), measured at the antenna port

Table 11: Transmitted Output Power

Receiver Sensitivity

The receiver sensitivity measured at the antenna port is -106 dB (typical) and -104 dB (minimum).

Care and Maintenance

The Xircom Redhawk II modem should be used in a protected indoor environment. The internal components of the modem must remain dry and free of moisture. Avoid installations in extremely cold or hot locations, and avoid extreme temperature changes during use.

There are no external or internal maintenance requirements.

ENVIRONMENTAL SPECIFICATIONS

Climatic, Operational

Internal circuitry provides automatic shutdown control to prevent the unit from operating above or below the specified operating temperature range.

Climatic: Operational

Operating temperature	-20°C to +55°C **Note:** Upper temperature range can be extended under certain operating conditions. Consult application note TBD.
Relative humidity	5 - 95%
Solar radiation	Not Applicable
Air pressure (altitude)	70 kPa to 106 kPa (-400 m to 3000 m)

Climatic: Storage and Transportation

Duration	24 months
Ambient temperature	-40°C to +85°C
Relative humidity	5% to 95%, non condensing (at 40°C)
Thermal shock	-50°C to +23°C, +70°C to +23°C; < 5 min
Altitude	-400 m to 15,000 m

Mechanical: Operational

Operational vibration, sinusoidal	3.0 mm disp, 2 to 9 Hz; 1 m/s^2, 9 to 350 Hz
Operational vibration, random	0.1 m^2/s^3, 2 to 200 Hz

Mechanical: Storage and Transportation

Transportation vibration, packaged	ASTM D999
Drop, packaged	ASTM D775 method A, 10 drops
Shock, un-packaged	150 m/s^2, 11 ms, half-sine per IEC 68-2-27
Drop, un-packaged	4-inch drop per Bellcore GR-63-CORE

Mechanical: Proposed Standards

Transportation	ETSI Standard ETS 300 019-1-2 Class 2.3 Transportation
Operational	ETSI Standard ETS 300 019-1-3 Class 3.1 Operational
Storage	ETSI Standard ETS 300 019-1-1 Class 1.2 Storage

Electromagnetic Emissions

Radiated spurious	FCC part 24 / Part 15 Class \ B GSM 11.10 Section 12.2 EN 55022 Class B

Electromagnetic Immunity (per ETSI ETS 300 342-1)

Radio Frequency (RF) Electromagnetic Field	3 V/m 800 – 1000 MHz; 1 KHz 80% EN 61000-4-3
Electrostatic discharge (ESD)	Contact discharge to coupling planes: ± 2 KV, ± 4 KV Air discharge to coupling planes: ± 2 KV, ± 4 KV, ± 8 KV
RF common mode	3 V rms (Level 2) 150 KHz – 80 MHz EN 61000-4-6

REPAIR AND RETURN POLICY

> **Note:** The standard warranty for the Redhawk II modem is 90 days.
>
> To report a problem, call the Xircom Customer Service department:
>
> - United States of America (toll-free): 1.888.684.5355
> - International: +1.719.884.2444

Reporting and Troubleshooting Problems with the Redhawk II modem

Problems can be reported by calling Customer Service. The Customer Service representative and/or service technician will attempt to resolve the problem over the telephone.

If the problem cannot be resolved over the telephone and the modem needs to be returned, the customer service representative provides an RMA number for shipping the module. The return address will be given at this time.

Upon receipt of the module, it will be thoroughly tested in a Xircom test lab. If the problem is found, a replacement module will be shipped back to the customer.

Note: The warranty period for replaced or repaired equipment is 30 days from time of shipment.

REGULATIONS AND COMPLIANCE

This section summarizes the compliance and type approval levels of the Redhawk II modem and the responsibilities and actions required of manufacturers who incorporate it into their products. In certain situations and applications these products will require additional FCC, CE, GSM FTA or other regulatory approvals prior to sale or operation. For more information concerning regulatory requirements, please contact Xircom, Inc.

GSM Full Type Approval (FTA)

The Redhawk II modem is type approved in accordance with the requirements of and through the procedures set forth by the GSM industry association. The relevant conformance specification is GSM 11.10-1 version 4.19.1 for GSM 900- and 1800 MHz devices. For PCS 1900 MHz devices, the relevant standard is PCS 11.10, a version of GSM 11.10-1 that has been modified as appropriate for the North American GSM market.

FCC notices

Unintentional emissions from digital devices are regulated by Part 15 of the FCC Rules and Regulations, which distinguishes between the environments in which these devices may operate. Equipment designated as Class A is intended for use in a commercial, industrial or business environment; equipment intended for use in a residential environment, not-withstanding use in commercial, industrial or business environments is designated as Class B.

The modem have been tested and found to comply with the limits for a Class B digital device and can be installed in a residential, as well as commercial, industrial or business, environment. The modem has been tested and found to comply with the limits for a Class A digital device and may only be installed in a commercial, industrial or business environment.

These devices comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

CLASS A

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses and can radiate radio frequency energy and, if not installed in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference. If this occurs, the user will be required to correct the interference at their own expense.

CLASS B

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

Human Exposure Compliance

Pursuant to 47 CFR Section (use the symbol) 24.52 of the FCC Rules and Regulations, personal communications services (PCS) equipment is subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 2.1091 and 2.1093, as appropriate.

Xircom, Inc. certifies that it has determined that these devices comply with the RF hazard requirements applicable to broadband PCS equipment operating under the authority of 47 CFR Part 24, Subpart E of the FCC Rules and Regulations. This determination is dependent upon installation, operation and use of the equipment in accordance with the instructions provided.

The modems are intended to be used in both fixed and mobile applications.

> "Fixed" means that the device is physically secured at one location and is not able to be easily moved to another location. "Mobile" means that the device is used in other than fixed locations and generally in such a way that a separation distance of at least 20 cm is maintained between the transmitter's antenna and the body of the user, or nearby persons.

These devices are not designed for in portable applications (within 20 cm of the body of the user or nearby persons) and such uses are strictly prohibited.

To ensure that these devices comply with current FCC regulations, limiting both the maximum RF output power and human exposure to radio frequency radiation, a separation distance of at least 20 cm (7.78 inches) must be maintained between the unit's antenna and the body of the user, and any nearby persons, at all times and in all applications and uses. In mobile applications, the maximum antenna system gain must not exceed 3 dBi; in fixed applications the maximum antenna system gain must not exceed 7 dBi.

> NOTE: Installation and operation of this equipment **must** comply with all applicable FCC Rules and Regulations, including those that implement the National Environmental Policy Act of 1969 (Part 1, Subpart I), with specific regard to antenna sitting and human exposure to radio frequency radiation. For further guidance, consult the FCC Rules, your service provider, or Xircom Inc..

NRTL / IMEI Approval

The Redhawk II modem has been tested by a NRTL agency and approved for the uses described in this manual.

This information technology equipment complies with the requirements given in UL 1950 and other applicable standards for use in an appropriate enclosure. The modem is listed by an approved NRTL agency, and meets all relevant requirements given in the National Electric Code.

> Note: If the Redhawk II is incorporated into an enclosure this require separate verification of product safety approval.

EMC/Safety Requirements for the Countries of the European Union (EU)

The European Union (EU) is comprised of fifteen countries that follow a harmonized set of standards, utilizing the CE mark as a uniform mark of acceptance. The member countries are:

- ❑ Austria
- ❑ Belgium
- ❑ Denmark
- ❑ Finland
- ❑ France
- ❑ Germany
- ❑ Greece
- ❑ Ireland
- ❑ Italy
- ❑ Luxembourg
- ❑ The Netherlands
- ❑ Portugal
- ❑ Spain
- ❑ Sweden
- ❑ United Kingdom

EMC/Safety Requirements for Other Countries

In most other countries that have not been listed above there are similar rules and regulations that must be met for importing the Eagle II module. Each may require a different mark of approval (for example, the CB Scheme) as an acceptance requirement. For each of these cases the country should identified, and the appropriate steps should be taken to meet the requirements set forth in the intended market.

Electromagnetic Compatibility (EMC) and Safety Requirements

The Redhawk II modem has been tested and approved for application in the United States of America (US) and the European Union (EU). The compliance details for each of these markets follow. For other markets, additional or alternative regulatory approvals may be required. Always ensure that all rules and regulations are complied with in every country that the OEM application is to be operated. Regardless of the country or market, the OEM must comply with all applicable regulatory requirements.

OEM Responsibilities for All Products Containing the Redhawk II Modem

In addition to any other regulatory requirements, OEMs must include or provide the following information and instructions with any device or product into which the Redhawk II modem has been incorporated. If the modem has been incorporated into an enclosure such that the label containing this information on the modem can no longer be seen then the following warning labels must be visible on the final product.

Information	Description
Detailed Operating Instructions for ensuring compliance with current FCC guidelines which limit human exposure to radio frequency radiation	The OEM must provide an operating/installation manual with the final product which clearly indicates that these operating conditions and restrictions must be observed at all times to ensure compliance with current FCC guidelines which limit human exposure to radio frequency radiation. ▪ 20 cm (7.87 inch) separation distance between the antenna and all persons must be maintained at all times for all fixed and mobile products and applications ▪ Portable devices and applications are prohibited unless such devices and products are specifically authorized by the FCC ▪ Maximum antenna gain is limited to 3 dBi* in mobile products and applications ▪ Maximum antenna gain is limited to 3 dBi* in fixed products and applications unless separate and specific FCC approval is obtained by the OEM ▪ Modifications and/or additions to the Eagle PCS-1900 GSM transceiver, including use of antennas with higher gain than those authorized by the FCC, are prohibited *dBi = antenna gain in dB relative to an isotropic radiator
Antenna Avoidance Label	Attach the following warning label directly to or displayed next to the antenna. Furthermore, this label must be visible to and easily readable by all persons in the immediate vicinity of the antenna **WARNING** To comply with FCC RF exposure requirements, a separation distance of 20 cm (7.87") or more must be maintained between this antenna and all persons.
Transmitter Identification Label	Affix the following label to the final product or device. Alternatively, the text of this label can be included within the body of any other labeling necessary to meet FCC regulatory requirements. Such labels must follow the general labeling guidance provided in Section 2.925 of the FCC Rules and Regulations. **CONTAINS TRANSMITTER** **FCC ID: XXX**

GLOSSARY AND ACRONYMS

App **Application**	Refers to the Application which sends or receives commands/responses from the Redhawk II Modem
AT Command Set	Commands issued by intelligent device to a modem to perform functions, such as to initiate call, to answer call, or to transmit data.
CSD **Circuit Switched Data**	Data link from a terminal through the network allowing real-time, duplex connectivity up to 9600 bytes/second.
CE **European Community Certification**	
CPE **Customer Premise Equipment**	A terminal in fixed location on the customer's premises.
Dbi	Decibels referenced to an isotropic radiator
DCE **Data Communications Equipment**	Data Communications Equipment
DCS **Digital Cellular System**	A collection of services and capabilities providing flexibility of access and mobility through a combination of wireless and wire-line networks, utilizing the 1800 MHz bandwidth.
DTE **Data Terminal Equipment**	Data Terminal Equipment
EFR **Enhanced Full Rate**	Voice (vocoder) compression algorithm which offers the highest quality voice communication.
EIR **Equipment Identity Register**	A database used to store International Mobile Equipment Identity (IMEI) of a locally issued terminal.
EIRP **Equivalent Isotropic Radiated Power**	In a given direction, the gain of a transmitting antenna multiplied by the net power accepted by the antenna from the connected transmitter.
ESD **Electrostatic Discharge**	Static electricity that can damage electronic equipment.
FTA **Full Type Approval**	GSM Full Type Approval
FCC **Federal Communications Commission**	US Government body that defines requirements for emission level of equipment in the United States.
GPRS **General Packet Radio Service**	Standard for packet communications utilizing Global Standard for Mobility (GSM) infrastructure.

GSM **Global System for Mobile Communications**	Standard for digital communications. Allows consistent communications in various parts of the world despite variations in RF spectrum allocations. Transferring the SIM (see below) permits users to roam by changing terminal equipment.
IMEI **International Mobile Equipment Identity**	A unique number for each GSM Terminal tracked by the GSM operators in their Equipment Identity Register (EIR) database.
Ki	A secret code used in authentication and encryption by the terminal.
LED **Light Emitting Diode**	Light Emitting Diode
MMS **More Messages to Send**	More Messages to Send
MO **Mobile Originated**	A voice or data call originated at the mobile terminal.
MT **Mobile Terminated**	A voice or data call originated from the network and sent to the mobile terminal.
Non-Transparent Mode	Delivers a constantly low error rate but with a non-guaranteed throughput or delay. The Non-Transparent service provides a performance that is closest to using a modem over a fixed PSTN line.
NRTL **Nationally Recognized Test Laboratory**	OSHA-approved Nationally Recognized Testing Laboratory
OEM	Original Equipment Manufacturer
Packet	A collection of data transmitted over a digital network in a burst.
PCS **Personal Communications Service**	A collection of services and capabilities providing flexibility of access and mobility through a combination of wireless and wireline networks.
PDU **Protocol Data Unit**	Data packet defined by protocol layer of SMS interface.
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
RF **Radio Frequency**	A frequency at which electromagnetic radiation may be detected and amplified as an electric current at the wave frequency.
Rx	Receive
Short Message	An alphanumeric message of up to 160 characters that can be sent to or from a GSM terminal.

SIM **Subscriber Identification Module**	"Smart Card" technology that contains user information and has four main functions: ▪ Authentication ▪ Storage of data ▪ Assist in encryption process ▪ Subscriber protection
SMS **Short Message Services**	Services provided by GSM network allowing the transmission and receipt of short messages.
SMSC **Short Message Service Center**	Location of SMS store and forward message server.
TBD	To Be Determined
Transparent Mode	Delivers a service with a variable error rate, with a guaranteed throughput and delay.
Tx	Transmit
Type Approval	Rigorous testing required by GSM operators to ensure terminals operating on network does not degrade performance, capacity, or functionality of GSM network.
UL **Underwriters Laboratory**	Testing agency chartered with ensuring safety of electrical devices.
USSD	Unstructured Supplementary Service Data
V.24 Serial Interface	The ITU-T standard defining interchange circuits between DTE and DCE. V.24 is the ITU-T equivalent of EIA standard RS-232, with the exception of voltage levels.

APPENDIX A

Installing the Remote Antenna

There are a number of antennas designed for use with the Redhawk II modem. If coverage is poor then the use of a remote antenna may be required. Ideally, the external antenna is mounted on a rooftop, or on the side of a building where optimal signal strength can be obtained.

Antenna Coaxial Cable and Connectors

In most cases RG223 50 ohms or similar small diameter cable can be used. For outdoor installations, the coaxial cable must be rated for outdoor exposure.

The antenna connector on the modem is a SMA female and mates with a SMA male on the coaxial cable. The SMA connector on the modem is gold plated. Use only a gold-plated SMA male connector when making the connection.

The connectors on the antenna end of the coaxial cable are dependent on the antenna manufacturer. Typically these are SMA, or Type N connectors. Termination styles of connectors vary depending upon manufacturer and connector type. Regardless of connector manufacturer, type and style, solder terminations are recommended to assure a reliable long-term RF connection.

SMA connectors should be tightened to 8.0 +/- 1.0 inch-pounds using a torque wrench, to assure proper grounding and connection.

> NOTE: SMA connectors are not rated for outdoor environments. Precautions must be taken to assure that SMA connectors are not exposed to water, liquids or corrosive environments or electrical failure may result.

For either fixed or mobile applications, if the antenna has less than a 3 dB gain and a separation distance of greater than 20 cm (7 7/8 inches) from the body of the antenna, and any nearby person(s), then the installation will comply with current FCC requirements addressing human exposure to radio frequency electromagnetic fields.

ⓘ Detailed Information regarding antenna gain, cable length and installation requirements, can be found in the Installation Manual. Assistance in Troubleshooting, problem solving, cable loss or antenna gain, can best be obtained by contacting Xircom, Technical Support Division.

> NOTE: The installer is responsible for assuring that the proper antenna is installed so that the above limits are not exceeded.

Outdoor Antenna Grounding

Any outdoor antenna used to transmit or receive RF signals and the antenna connecting cables must be properly grounded to comply with the National Electrical Code (NEC) - specifically, but not limited to, articles 250, 800, 810, 820.

Codes require proper grounding of the cables at the point where they enter a building. Local building codes may also be applicable. For clarification on either local or national grounding requirements, contact the state or county inspection officials in your location.

Coaxial Cable Routing

When surveying a site for external antenna installation, verify that there is a suitable path for the antenna cable from the antenna to the SMA connector on the modem. The coaxial cable must be supported along its path, and protected to assure that damage does not occur.

> All cables require routing to be free from any obstacles or any other type of interference that may cause the cable to be damaged or undergo later damage to the shielding or cable casing.

The modem location and its distance from the antenna determine cable lengths.

Installation of the cables should be in accordance with the manufacturer's instructions, the National Electrical Code, applicable building codes, and general industry standards and practices. Emphasis on freedom from obstacles, and the aesthetic guidelines required by site management should be taken into consideration during the install.

> NOTE: Coaxial cables must be professionally installed. Coaxial cables must be routed and installed in a manner that insures that the jacket, dielectric and outer shield are not crushed, kinked, cut, scraped or otherwise damaged.

Coaxial Cable Losses and Lengths

There are some important factors to consider concerning coaxial cable length. The FCC requires that for **mobile** applications, the maximum output power can be **no more than 2 W (+33 dBm) EIRP**, and for **fixed** applications, **no more** than **5W (+37dBm)**. When using a directional gain antenna and short coaxial cable connections, it is possible to exceed either FCC requirement. In such cases, additional attenuation must be added into the path gain. This can be achieved with either in line attenuators, or by adding more cable length.

To determine the amount of loss needed between the modem and the antenna, the following formula can be used.

Attenuation needed = g – p

where

g = antenna gain (in dB)

g = maximum path gain allowed by FCC based on the modem maximum output power of +30 dBm, and where **p** = 3 dB for mobile applications, or **p** = 7 dB for fixed applications

To determine the proper minimum cable length the following formula can be used.

L = (g – p) / a

where

L = required minimum cable length

g = antenna gain (in dB; per antenna manufacturers specifications).

p = maximum path gain allowed by FCC based on the modem maximum output power of +30 dBm, p = 3 dB for mobile applications, or p = 7 dB for fixed applications

a = attenuation per foot of cable (in dB; per cable manufacturers specifications).

As long as installation and operating restrictions previously provided are observed, and antenna gain is limited to 7 dBi for fixed, or 3 dBi for mobile applications, there is no need to introduce RF loss between the modem and antenna in order to comply with FCC MPE limits.

Note: Cable loss beyond that required to meet the FCC requirements, with the given antenna ,will decrease the signal strength reaching the modem. This will negatively impact the ability of the modem to communicate with the network.

For more details and guidelines, please see Table 12 and Table 13 and the following examples.

FIXED APPLICATIONS		MINIMUM CABLE LENGTH (feet)		
ANTENNA GAIN (dBi)	**REQUIRED PATH LOSS (dB)**	**RG 58 (0.33 db/ft)**	**RG 223 (0.29 db/ft)**	**RG 8 (0.15 db/ft)**
0	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	**1**	**3.0**	**3.4**	**6.7**
9	**2**	**6.0**	**6.9**	**13.3**
10	**3**	**9.0**	**10.3**	**20.0**

Table 12: Fixed Application

MOBILE APPLICATIONS		MINIMUM CABLE LENGTH (feet)		
ANTENNA GAIN (dBi)	**REQUIRED PATH LOSS (dB)**	**RG 58 (0.33 db/ft)**	**RG 223 (0.29 db/ft)**	**RG 8 (0.15 db/ft)**
0	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	**1**	**3.0**	**3.4**	**6.7**
5	**2**	**6.0**	**6.9**	**13.3**
6	**3**	**9.0**	**10.3**	**20.0**
7*		* = not recommended		
8*				
9*				
10*				

Table 13: Mobile Applications

Formula Examples

Example 1 :

The installer has a nominal 7dB gain antenna, is using RG-223 cable, and is using the modem in a fixed application.

G = 7 dB

p = 7 dB

a = 0.29 dB/ft

then Attenuation needed = 7 – 7 = 0 dB

and L = (7 – 7) / 0.29 = 0 ft

In this example, the length of cable the installer must use does not matter because he does not need any loss in the line to meet the FCC requirements.

Example 2 :

The installer has a nominal 7 dB gain antenna, is using RG-223 cable, and is using the modem in a mobile application.

G = 7 dB

p = 3 dB

a = 0.29 dB/ft

then Attenuation needed = 7 – 3 = 4 dB

and L = (7 – 3) / 0.29 = 13.8 ft

In this example, the installer must use at least 13.8 feet of cable or use a 4 dB “in line attenuator”, or a combination of the two.

Example 3 :

The installer has a 10 dB nominal gain antenna, using RG-223 cable, and the modem is in a fixed application.

G = 10 dB

P = 7 dB

a = 0.29 dB/ft

the Attenuation needed = 10 – 7 = 3 dB

and L = (10 – 7) / 0.29 = 10.3 ft

In this example, the installer must use at least 10.3 feet of cable, or use a 3 dB in line attenuator, or a combination of the two.

> NOTE: The installer is responsible for assuring that the proper antenna, cable length, and / or attenuation, is installed correctly, so that the limits of FCC §15.203 are not exceeded.

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