



Formerly Omnipoint Technologies, Inc.

Eagle™ II



GSM Radio Module

Wireless GSM Communication

Technical Manual

SAFETY PRECAUTIONS

Important Safety Information

The following information applies to the devices described in this manual. Always observe all standard and accepted safety precautions and guidelines when handling any electrical device.

- ❑ Save this manual: it contains important safety information and operating instructions.
- ❑ Do not expose the Eagle™ II product to open flames.
- ❑ Ensure that liquids do not spill into the devices.
- ❑ Do not attempt to disassemble the product: Doing so will void the warranty. With the exception of the Subscriber Identification Module (SIM), this product does not contain consumer-serviceable components.

Guidelines for Limiting RF Exposure

The Eagle 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 radiation.

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

- ❑ This device may only be used in fixed and mobile applications.
- ❑ Portable applications, as defined by the FCC, are prohibited.
- ❑ The use of this device for desktop and other applications where the antenna can easily be relocated are considered by the FCC to be mobile applications.
- ❑ A separation distance of at least 20 cm (7.87 inches) between the antenna and the 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 EIRP of 33 dBm / 2 W.
- ❑ End products must provide instructions to ensure compliance with radio frequency radiation exposure requirements.
- ❑ A warning label visible to all persons exposed to the antenna and identical to that described in this manual must be displayed on or next to the antenna.
- ❑ Separate FCC approval for RF exposure compliance is required for end products that do not meet these conditions.

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 Eagle 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.

Human Exposure Compliance Statement

Xircom, Inc. Wireless Technology Group certifies that the Eagle™ II 900/1900 MHz GSM Radio Module (FCC ID: J3OEAG2919) complies 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 certification is contingent upon installation, operation and use of the Eagle™ II and its host product in accordance with all instructions provided to both the OEM and end user. When installed and operated in a manner consistent with the instructions provided, the Eagle™ II meets the maximum permissible exposure (MPE) limits for general population / uncontrolled exposure as defined in Section 1.1310 of the FCC Rules and Regulations.

Disclaimer

The information and instructions contained within this publication comply with all FCC, NRTL, IMEI and other applicable codes that are in effect at the time of publication. Xircom, Inc. disclaims all responsibility for any act or omissions, or for 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.

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PRODUCT OVERVIEW

The Eagle II radio module is a compact, wireless OEM module that utilizes the Global System for Mobile Communications (GSM) international communications standard to provide two-way wireless capabilities via GSM services. The Eagle II module is a fully Type-approved GSM device, enabling application-specific, two-way communication and control.

The small size of the Eagle II module allows it to be integrated easily into the application and packaging.

Bringing the Features of GSM Communications to an Application

The Eagle II module takes full advantage of GSM capabilities, such as:

- ❑ Subscriber Identification Modules (SIMs) provide numerous advantages, such as number portability, remote wireless updates, memory updates, and remote provisioning.
- ❑ Wireless communication lets the Eagle II module accomplish tasks that previously required on-site visits. This capability offers innovative new services for an application.
- ❑ Terminal authentication and data encryption ensure confidential communication between the terminal user and the data recipient.

A variety of applications can use the Eagle II module for transmitting and receiving data and voice, such as:

- ❑ Automated meter reading
- ❑ Credit card verification
- ❑ E-mail and Internet access
- ❑ Fleet management systems
- ❑ Telematics
- ❑ Telemetry
- ❑ Wireless alarms

Providing Multi-Band Operation

The Eagle II module provides multi-band operation, with the operating frequency selectable by AT Command:

- ❑ The 900/1900 MHz Eagle II module is available for integration and deployment for use worldwide, with 1900 MHz support primarily in North America and regions where the 1900 MHz Personal Communication Services (PCS) band is allocated and 900 MHz support for networks in the rest of the world.
- ❑ The 900/1800 MHz Eagle II modules are available for deployment in Europe and the rest of the world, with the exception of North and South America.

Incorporating GSM Communications into the Design

As shown in the Figure 1, the Eagle II module is designed for easy integration with other components and packaging by leveraging the existing public GSM networks. Compare the Eagle II to systems that require the construction, operation, maintenance, and expense of a private wireless network.

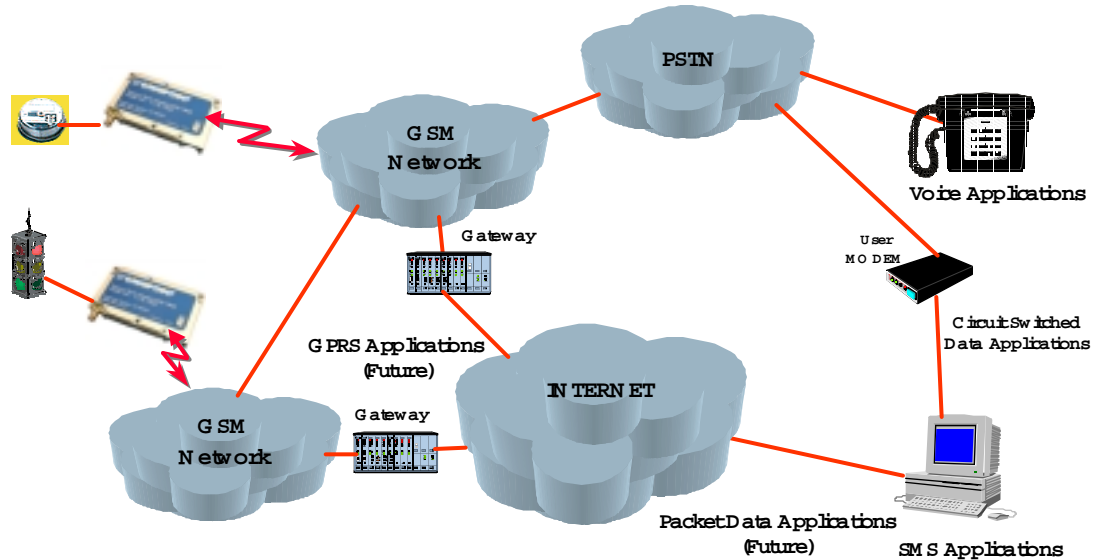


Figure 1: Applications Using the Eagle II module in a GSM Network

The Eagle II module supports the following GSM features:

- Short Message Service (SMS)
- Unstructured Supplementary Service Data (USSD)
- Circuit Switched Data (Transparent and Non-Transparent modes) for transmitting and receiving data
- Voice communications: Supports half-rate, full-rate and enhanced full-rate (EFR) vocoding schemes.

The Eagle II module communicates via a V.24 serial interface and uses the GSM AT command set. In addition, unique AT commands (see page 23) provide the opportunity to monitor and report network conditions that may be relevant to the network management of numerous deployed terminals.

Summary of the Features for the Eagle II Radio Module

Interface	Data input/output interface	60-pin, dual-row connector: 0.8 mm pitch, surface mount
	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 or female MCX versions available
	Command protocol	AT command set
	Subscriber Identification Module (SIM)	3 V mini-SIM carrier and interface on board
	Optional remote SIM	Accessible via the 60-pin connector
Power	Electrical power	Fixed DC voltage
	Peak currents and average power dissipation	Refer to the Operating Power table in the Technical Specifications 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	<ul style="list-style-type: none"> ▪ GSM Type Approval ▪ FCC Certification (Part 24) ▪ CE (European Community Certification) ▪ IC (Industry Canada) available
GSM Functionality	<ul style="list-style-type: none"> ▪ 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 programmable from 300 bps to 14.4 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. <p>Eagle II hardware is capable of supporting General Packet Radio Services (GPRS) if configured with optional memory. (GPRS Class B, Multislot Class 10 software will be available at a later date.)</p>	

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 Eagle II module. It reveals the manufacturer, the country of production, and the type approval facility. When the Eagle II module 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 Eagle II module is allowed to register with the network.
Developer's Kit	Eagle II Developer's Kit provides equipment for reducing the time required to develop an application that utilizes the Eagle II module. For more information, refer to: www.omnipoint-tech.com

TECHNICAL SPECIFICATIONS

Physical Dimensions and Weight

Size (L x W x H)	85.34 mm x 52.32 mm x 13.21 mm (3.36" x 2.06" x 0.52")
Weight	114 g (Less than 4 oz.)

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
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Operational vibration, random	0.1 m ² /s ³ , 2 to 200 Hz
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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
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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

Operating Power

The Eagle II module requires an input voltage of 4.2 VDC to 5.2 VDC. The input source voltage ripple should be less than 20% of the average supply voltage peak-to-peak under normal operating conditions.

Eagle II Module			Average Current (Amps)	Peak Current (Amps)
GSM 900	GSM	1 TX 1 RX	0.38 A	2.28 A
		1 RX	0.11 A	0.18 A
	GPRS Class 10	1 TX 4 RX	0.41 A	2.28 A
		2 TX 3 RX	0.66 A	2.28 A
	Sleep Mode		<20 mA	
DCS 1800 and PCS 1900	GSM	1 TX 1 RX	0.31 A	1.68 A
		1 RX	0.11 A	0.18 A
	GPRS Class 10	1 TX 4 RX	0.34 A	1.68 A
		2 TX 3 RX	0.51 A	1.68 A
	Sleep Mode		<20 mA	

Transmit Power

Eagle II module	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

Receiver Sensitivity

The receiver sensitivity measured at the antenna port is -106 dBm (minimum).

Physical Layout for the Eagle II Module

Refer to the Eagle II Interface Control Drawing (ICD), Document # 06700103, for information about the physical layout of the Eagle II module. The ICD provides the following information:

- Physical dimensions and location of interfaces
- 60-pin I/O connector
 - ◆ Connector location
 - ◆ Pin locations
 - ◆ Mating connector stack-up
- Antenna connector
 - ◆ Options
 - ◆ Location
 - ◆ Torque specification
- SIM card
 - ◆ Location
 - ◆ Clearances for installation and removal
 - ◆ Instructions for installation and removal
- Mounting features
 - ◆ Recommended fastener sizes
 - ◆ Fastener torque
 - ◆ Printed circuit board (PCB) layout
- Location of the status LED

PHYSICAL INTERFACES OF THE EAGLE II MODULE

The Eagle II module provides the following interfaces:

- Antenna connector, which allows the Eagle II module to communicate with other GSM devices.
- Signals on the 60-pin I/O connector allow the carrier board of the application to communicate with the Eagle II module. Two V.24 serial data interfaces allow simultaneously holding a circuit-switched call while sending and receiving SMS messages
- LED indicator provides a visual indicator for the operational status of the module

Refer to the Eagle II Interface Control Drawing (ICD), Document # 06700103, for the physical locations of these interfaces.

Note: For optimum performance and reliability, ensure that all mating connectors have a minimum of .76 microns (30 micro-inches) of gold plating on contact surfaces.

Antenna Interface

The Eagle II module is designed to support interchangeable antenna types, provided that each antenna has 50-ohm impedance and has been tuned to the frequency band intended.

The Eagle II module provides a connector for either a female SMA-type antenna (standard) or a female MCX antenna (optional). This allows a choice in the type of antenna configuration best suited for the application. The SMA-type connector is recommended for high-vibration or mobile environments.

Input/Output (I/O) Signal Connector

The Eagle II module communicates with the carrier board via a 60-pin, dual-row, surface-mount connector with a 0.8 mm pitch.

Mating Connector on the Carrier Board of the Application

The carrier board must provide a mating 60-pin connector. The following table describes the recommended connectors:

Description	Manufacturer	Vendor P/N	
		Tube Package	Tape Package
60 pin female	AMP (717) 564-0100	177983-2	177985-2
60 pin female	Berg (800) 237-2374	61082-061000	61082-061002

Note: The nominal PCB-to-PCB connector stack height (provided by the Eagle II module) is 8 mm (0.315 inches). If required, mating connectors with 12 mm and 16 mm stack heights are available from the listed manufacturers. When using higher stack height connectors, the mating carrier board must provide standoffs to accommodate the increased connector stack height.

I/O Signal Connector on the Eagle II Module

The Eagle II module communicates with the carrier board of the application via the 60-pin I/O signal connector. The following table describes the pin assignments for the connector, sorted by functionality.

I/O Connector Pin Assignments, Sorted by Functionality

Pin Number	Signal Name	Direction	Functionality	Voltage Level
Power				
1, 2, 3, 4, 5, 6	VIN	From CPE	Electrical power input to Eagle II module: 4.2 VDC to 5.2 VDC Refer to the table for Operating Power.	
21, 24, 25, 28, 29, 33, 44, 45, 48, 49, 52, 53, 57	GND	From CPE	Electrical power return for digital and analog grounds.	
Reset/Primary Serial I/O				
23	RESET_B	From CPE	Reset Input. Active Low. Internally pulled high and can be left disconnected if not used. If connected to external circuitry, maximum high level must not exceed 3.3 V. Pulse width must be at least 5 mS to guarantee a valid reset.	3 V *
8	RX0	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

Pin Number	Signal Name	Direction	Functionality	Voltage Level
16	TX0	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
18	CTS0	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
20	RTS0	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
22	DTR0	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
10	DSR0	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
12	DCD0	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
14	RI0	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
Microphone				
47	MIC1P	From CPE	Microphone 1 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.	
51	MIC1N	From CPE	Microphone 1 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.	
Speaker				
55	SPK1P	To CPE	Speaker 1 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.	
59	SPK1N	To CPE	Speaker 1 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.	

Pin Number	Signal Name	Direction	Functionality	Voltage Level
Clock				
27	CLKOUT	To CPE	Clock output. A 50% duty cycle 13 MHz square wave clock source. Used for synchronization of external circuitry to the base band processor. Leave signal disconnected if function is not used.	3 V
General Purpose I/O				
13, 15, 17, 19	GPIO0-GPIO3	To/From CPE	General purpose I/O bits 0 through 3. Used as general purpose input or output lines for monitoring or control of external devices. Requires customized stack software to implement. Leave signals disconnected if function is not used.	3 V
LED Status Signals				
40, 42	LED0-LED1	To CPE	Status LED signal 0 and 1. Outputs are active low. LED0 corresponds to the "red" element of a bi-color LED. LED1 corresponds to the "green" element of a bi-color LED. These signals indicate radio link status on a remote LED. Leave signals disconnected if function is not used.	3 V
Transmit and Receive Data Lines				
26	TX1	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
30	RX1	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
SIM Signals (Data Power Control)				
58	SIM-VCC	To CPE	SIM 3 volt power. A 3-volt power supply output signal to a remote SIM device. Power is controlled by the base band processor. Leave signal disconnected if function is not used.	3 V or 5 V
56	SIM-IN	From CPE	SIM IN signal. Active high. A remote SIM card detection signal input. Leave signal disconnected if function is not used.	5 V or 3 V
54	SIM-RST	To CPE	SIM reset. An output signal to reset a remote SIM device. Leave signal disconnected if function is not used.	3 V
50	SIM-IO	To/From CPE	SIM input output. Serial I/O line to a remote SIM device. Leave signal disconnected if function is not used.	5 V or 3 V
46	SIM-CLK	To CPE	SIM clock output signal to a remote SIM device. Clock frequency is 3.25 MHz. Leave signal disconnected if function is not used.	3 V or 5V

Pin Number	Signal Name	Direction	Functionality	Voltage Level
60	SIM-3 V	To CPE	SIM 3 V output used in conjunction with the SIM-IN signal to a remote SIM device. Leave signal disconnected if function is not used.	3 V
Status				
7	TX on	To CPE	Transmit ON. Digital output to indicate transmitter power status. A logic 1 indicates transmit power is on. A logic 0 indicates transmit power is off. Leave signal disconnected if function is not used.	2.2 V
9	RX on	To CPE	Receive ON. Digital output to indicate receiver power status. A logic 1 indicates receiver power is off. A logic 0 indicates receive power is off. Leave signal disconnected if function is not used.	2.2 V
Reserved: Do Not Use				
11, 31, 32, 34,35, 36, 37, 38, 39, 41, 43	Reserved		Leave open: do not use.	

Subscriber Identification Module (SIM) Carrier

The Eagle II module uses a push/pull SIM carrier (sometimes called SIM reader) and is installed as a slot on the side of the module. The Eagle II module uses a 3 V removable “mini-SIM” (or Plug-In) configuration.

The SIM, an integral part of any GSM terminal device, is a “smart card” that is programmed with subscriber information:

- ❑ The user information consists of an International Mobile Subscriber Identity (IMSI) number, which is registered with the GSM provider, and an encryption Ki (pronounced "key"). This information consists of a microprocessor and memory installed on a plastic card.

Note: The SIM is not provided with the Eagle II module. The SIM must be obtained from the GSM service provider and must be provisioned by the operator for data and/or voice. Always take care to protect the SIM: the GSM terminal will not operate without the SIM installed.

The SIM provides the IMSI for authentication. To gain access to the GSM network, the network must recognize the IMSI number, and the terminal must be able to properly decrypt the data sent by the network. The SIM also serves as a buffer for SMS messages, storing the message for transmission until a radio link is available and buffering received messages until retrieved.

Using a Remote SIM with the Eagle II Module

The Eagle II module also allows the use of a remote SIM—one not installed in the Eagle II module.

- ❑ To utilize a remote SIM, the integrator must provide a suitable SIM connector on the application

- ❑ The maximum distance from the Eagle II to the remote SIM connector must not exceed **TBD cm (TBD inches)**.

Status Indicator

The Eagle II module 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 Eagle II module.

LED Color	Link Status	Signal Quality
Green	Module 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	Module is in Start-up mode or is not attached to the network	

MODES OF OPERATION

GSM supports many optional services and modes. The Eagle II module supports the following GSM services:

- ❑ Voice communication
- ❑ Circuit-switched data
- ❑ Short-Message Services (SMS)
- ❑ Group 3 Fax
- ❑ General Packet Radio Service (GPRS)

Enabling the Transmission Modes for the GSM Services

Each of the GSM services has two modes that can be enabled separately:

- ❑ Mobile-originated (MO): allows the making of a service request (such as, making a telephone call or sending an SMS)
- ❑ Mobile-terminated (MT): allows receiving a service request (such as receiving a telephone call or an SMS)

Note: Contact your local GSM operator to ensure that the services and modes have been provisioned for the SIM.

Voice Communication

The Eagle II module 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 to enter and receive information from the Eagle II module. 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 Eagle II module supports three vocoder compression algorithms for voice communication: half-rate, full-rate, and enhanced full-rate (EFR)

Circuit-Switched Data

In this mode, the Eagle II module supports both of the connection modes of transmission that are provided by GSM:

- ❑ Transparent data mode delivers a service with a variable error rate, with a guaranteed throughput and delay.
- ❑ 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 Public Switched Telephone Network (PSTN) line.

Note: All GSM service providers may not support Transparent mode. In those cases, the Eagle II module switches automatically to Non-Transparent mode.

SMS: Short Message Services

Short Message Services (SMS) is a feature-rich GSM service. The Eagle II module can perform the following tasks:

- Sending and receiving text messages of up to 160 characters (7-bit characters)
- Sending and receiving binary messages of up to 140 bytes (8-bit data)
- Submitting a SMS Protocol Data Unit (PDU) to a SMSC (Short Message Service Center) and storing a copy of the PDU until either a report arrives from the network or a timer expires
- Receiving a SMS PDU from a SMSC
- Returning a delivery report to the network for a previously received message
- Receiving a report from the network
- Notifying the network when the module has sufficient memory capacity available to receive one or more SMS messages (after the module had previously rejected a message because its memory capacity was exceeded)

SMS Features Supported by the Eagle II Module

The following list details the key characteristics and assumptions regarding the form of SMS supported in the Eagle II module.

- Supports both mobile-originated (MO) and mobile-terminated (MT) SMS
- Delivers the message to a telephone
- Supports 8-bit data
- Supports Message Class 1
- Supports the concatenation of up to 255 messages
- Provides a status report indicator
- Supports the More Messages to Send (MMS) feature
- Allows the definition of a validity period
- Provides the Service Center Time Stamp
- Alerts the SMSC
- Supports Priority
- Supports Message Waiting
- GPRS (Future/Optional)

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 Eagle II module will support GPRS mode. Currently, the Eagle II module 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 Eagle II module that the SIM be configured for the optional services that are required for the application.

GSM Services Supported by the Eagle II Module

The Eagle II module 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 Eagle II module, 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)

SOFTWARE INTERFACE OF THE EAGLE II MODULE

The application sends commands to the Eagle II module via the 60-pin I/O signal connector. These commands use the AT (from "AT-tention") command set.

The Eagle II module operates in one of the following modes:

- ❑ Command mode: Used for configuring the Eagle II module, for interrogating the GSM network, and for placing and receiving calls. It uses the AT command set via the serial port for communication.
- ❑ On-line mode: Used after a circuit-switched data call has been established. Data is passed between the Eagle II module and the controlling application without command interpretation. The only AT command that is interpreted in On-line mode is the +++ command. (This command places the Eagle II module in Command mode but does not terminate the circuit-switched data call.)

The AT command driver of the Eagle II module never exits the Command state, that is, it never enters the On-line mode.

- ❑ In the Command state, characters that are received from the Customer Premise Equipment (CPE) are treated as AT commands by the Eagle II module.
- ❑ In response to the commands received from the CPE, the Eagle II module sends characters (AT commands) to the CPE.
- ❑ Various events can also trigger the Eagle II module to send characters (AT commands) to the CPE.

Format for the AT Commands

The general format of the command line is: **<prefix> <command> <CR>**

The prefix AT obtains synchronization, identifies the character parameters, and indicates that a command may be in the following characters.

AT commands are not case sensitive: use either capital letters or lower-case letters for the AT command.

AT Command Set

The following tables summarize the functional categories of AT commands that are supported by the Eagle II module. For a full description of the AT commands, refer to the *Eagle II Programmer's Manual*.

Note: A command description that includes an *asterisk denotes that the GSM service provider must enable supplementary services functionality before the command is available.

Call Control Commands

Command	Description
+++	Escape to Command mode
A/	Repeat last command
AT	Attention (prefix to all AT commands)
ATA	Answer a call
ATD	Dial a call
ATH	Hang up a call
ATO	Return to On-line mode
ATQ	Result Code suppression
ATV	Result Code format
ATX	Call Progress monitoring
AT+CBST	Bearer service selection
AT+CHUP	Hang up a call
AT+CR	Service report configuration
AT+CRC	Set the cellular result codes
AT+CRLP	Radio Link protocol
AT+FCLASS	Select the Call mode

GSM Network Commands

Command	Description
AT+CNUM	Subscriber services
AT+COPS	Operator selection
AT+CREG	Network registration information
AT+CSQ	Read the signal strength

GSM Terminal Commands

Command	Description
ATI	Read the equipment information
ATZ	Reload the manufacturer's default values

Command	Description
AT+CGMI	Read the manufacturer's name
AT+CGMM	Read the model code for the equipment
AT+CGMR	Read the revision for the equipment
AT+CGSN	Read the serial number
AT+CLCK	* Facility lock
AT+CMEE	Control Error reporting
AT+CPAS	Phone activity status
AT+CPIN	Enter the Personal Identity Number (PIN)
AT+CPWROFF	Power-off the GSM terminal
AT+CSCS	Select the GSM terminal character set
AT+GCAP	Read the GSM terminal capabilities
AT+GMI	Read the manufacturer's name
AT+GMM	Read the equipment model code
AT+GMR	Read the equipment revision number
AT+GSN	Read the serial number
AT+ICF	Read the control character framing
AT+IFC	Set the TE-TA Local Data Flow control
AT+IPR	Set the serial data rate
AT&C	Set to Data Carrier Detect (DCD) mode
AT&D	Set to Data Terminal Ready (DTR) mode
AT&F	Set to the Configuration Profile
AT&H	Request the Help screen
AT&V	View the current configuration
AT&W	Save the current configuration

AT Commands for SMS

Command	Description
AT+CMGD	Delete message from memory
AT+CMGF	Control Message mode
AT+CMGL	List messages
AT+CMGR	Read message
AT+CMGS	Send message
AT+CMGW	Write message to memory
AT+CMSS	Send message from storage
AT+CNMI	Set new SMS message indications
AT+CPMS	Configure the message storage
AT+CRES	Restore the SMS settings
AT+CSAS	Save the SMS settings
AT+CSCA	Set the address for the SMS service center
AT+CSDH	Show the Text mode parameters
AT+CSMP	Set the Text mode parameters
AT+CSMS	Select message service

S Registers

Command	Description
ATS0	Sets the number of rings before automatically answering the call
ATS3	Sets the Command Line Termination character
ATS4	Sets the Response Formatting character
ATS5	Sets the Command Line Editing character
ATS6	Sets the number of seconds to wait before dialing a call
ATS7	Sets the number of seconds to wait for completion of call answering or originating
ATS8	Sets the number of seconds to wait when a comma dial modifier is encountered in the dial string of an ATD command
ATS10	Sets the number of tenths of seconds to wait before disconnecting the call following the absence of received line signal

Result Codes

Command	Description
BUSY	Final Result Code: Busy signal detected
CONNECT	Intermediate Result Code: Connection has been established
CONNECT <text>	Intermediate Result Code: Connect with manufacturer-specific text
ERROR	Final Result Code: Command not accepted
NO ANSWER	Final Result Code: Connection completion timeout
NO CARRIER	Final Result Code: Connection terminated
NO DIAL TONE	Final Result Code: Connection terminated
OK	Final Result Code: Acknowledges execution of a command line
RING	Unsolicited Result Code: Incoming call signal from network

INITIALIZATION AND SETUP EXAMPLES

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 Eagle II module is designated as: **App > Eagle**
- ❑ The data exchange from the Eagle II module to the customer application is designated as: **Eagle > 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 Eagle II module, the module performs a power-up self-test. The self-test completes within **TBD** seconds. When queried with the AT command, the Eagle II module responds with one of the following result codes:

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

App > Eagle	AT	
Eagle > App	OK	Command valid: module is ready

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

Sending an Initialization String to the Eagle II Module

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

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

App > Eagle	AT&FE0Q0V1&C1&D2	Initialization string
Eagle > App	OK	Command is valid
App > Eagle	ATSO=1	Auto answer on 1st ring
Eagle > App	OK	Command is valid

Setting Up the Communication Mode for the Eagle II Module

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

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

Querying the Status of the Eagle II Module

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 *Eagle II Programmer's Manual*.

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

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

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

App > Eagle	AT+CSQ	Get the signal strength (for this command, do not enter "?")
Eagle > App	+CSQ: 10,99 OK	Receive signal strength = 10, -95 dBm RXQUAL =99, unknown

- The following command requests the current Public Land Mobile Network (PLMN).

App > Eagle	AT+COPS?	Request current PLMN
Eagle > App	+COPS: 0,2,31026 OK	Home PLMN is VoiceStream

Initialize the EAGLE II Module to Send SMS Text

To be able to send SMS text messages, the Eagle II module 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 Eagle II module by setting the text mode parameters.

App > Eagle	AT+CSMP=17,167,0,0	Set text mode parameters: <ul style="list-style-type: none"> ▪ 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
Eagle > App	OK	Command is correct

- After initializing the module 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.

App > Eagle	AT+CSCA="1917907004"	Service center initialization: VoiceStream SMSC – NJ
Eagle > App	OK	

- The following command selects TEXT mode for SMS messages.

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

- The following command sets the indicators for the message.

App > Eagle	AT+CNMI=0,1,0,0,0	Set the new message indicators AT+CNMI=<mode>,<mt>,<bm>,<ds>,<bfr> <ul style="list-style-type: none"> ▪ <mode>=0, Buffer 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
Eagle > 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 > Eagle	AT+CSAS	Save SMS settings
Eagle > App	OK	Successful transmission

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

App > Eagle	AT+CMGS="12017572673"	Send a message to the telephone number
Eagle > App	>	Ready to send message
App > Eagle	Hello, how are you?^Z	Enter the text message. End the message with Control Z.
Eagle > App	OK	Successful transmission

Requesting to Receive the SMS Text

The following example provides the AT command for requesting that the Eagle II module receive SMS messages. This string requests that the module send all of the messages that have been received.

App > Eagle	AT+CMGL="ALL"	Read ALL messages received, including status, originator, message number and message content
Eagle > App	+CMGL: 1, "REC UNREAD", "43322449"<CR> To be, or not to be! +CMGL: 3, "REC UNREAD", "46290800"<CR> Hello Test Message! OK	

Initiating a Data Call

The default traffic channel type for the Eagle II module is for data. The following example provides the AT command for requesting the Eagle II module to initiate a data call.

App > Eagle	AT + FCLASS = 0	Sets the traffic channel type to Data mode if the traffic channel was previously changed to Voice mode. (Data mode is the default traffic channel type.) Not required if in the default mode Note: This command is required only if the traffic channel type has been changed from data mode (default) to voice mode
Eagle > App	OK	
App > Eagle	AT + CBST = 7,0,1	Sets the Bearer type to: 9600 Baud, non-Transparent call
Eagle >App	OK	
App > Eagle	ATD "1234567890"	AT command to dial the phone number
Eagle > App	OK CONNECT 9600	The OK response is followed by the "Connect 9600" response when the connection is completed.
App > Eagle	ATH	Terminates the call
Eagle > App	OK	

Initiating a Voice Call

The Eagle II module supports the AT commands for requesting to initiate both mobile-originated (MO) and mobile-terminated (MT) voice calls.

Mobile-Originated Call

The following example provides the AT command for requesting the Eagle II module to initiate a mobile-originated (MO) voice call.

This command assumes that the Eagle II module is configured for the Data Call mode (default).

App > Eagle	AT + FCLASS = 8	Sets the traffic channel type to Voice mode
Eagle > App	OK	
App > Eagle	ATD "1234567890"	AT command to dial the telephone number
Eagle > App	OK	
App > Eagle	ATH	Terminates the call
Eagle > App	OK	

Mobile-Terminated Call

The following example provides the AT command for requesting the Eagle II module to initiate a mobile-terminated (MT) voice call.

This command assumes the Eagle II is configured for the Data Call mode (default).

App > Eagle	AT + FCLASS = 8	Sets the traffic channel type to voice.
Eagle > App	OK Ring	Displayed for incoming call notification
App > Eagle	ATA	Command to manually answer the MT call. If "Auto Answer" is required, the ATSO=x command, where x = "the number of rings" is used.
Eagle > App	OK	
App > Eagle	ATH	Terminates the call
Eagle > App	OK	

INTEGRATION AND TEST

The Eagle II module has been designed to minimize the amount of time required for integrating and testing the application. By being fully GSM Type Approved, the Eagle II module provides seamless integration into the GSM network.

The integration issues for the application can be narrowed to the utilization of the AT commands and the use of the GSM functionality. Coverage and signal quality may be evaluated by using the LED of the on-board status indicator. Additional network information can be determined by using AT commands.

Using the Eagle II Developer's Kit to Reduce Development Time and Effort

The Eagle II Developer's Kit can also speed the development and implementation of an application. This kit provides a platform for the development of an embedded application and can easily be tailored for custom applications. The kit also provides a significant amount of pre-developed software intended to speed the development of the application and to reduce the time required for bringing a new device to market.

For more information on the Eagle II Developer's Kit, refer to the Xircom, Inc. web site on the Internet: www.omnipoint-tech.com

Integrating the Eagle II Module

Note: Generally, all interfaces that are externally available to the end user need to be ESD-conditioned and terminated in some way. Many of these interfaces should not be connected with power applied.

At the highest level, this is done using some type of GSM test equipment (such as, Racal 6103E), a computer, and a serial interface tester. The GSM test equipment must be able to simulate a GSM call and measure the key parameters related to the module.

Additionally, the serial interfaces and some minimal SIM functionality can be verified by sending AT commands to the Eagle II module.

All of this needs to be verified at ambient as well as extreme conditions.

As part of integration, each of the following interfaces should be verified:

Interface	Recommendations
SIM	The maximum line length of the SIM interface is TBD cm (TBD inches). The Eagle II module takes care of the signal conditioning As a minimum, an external application with a remote SIM will require a standard SIM carrier. <ul style="list-style-type: none"> ▪ Tie the SW1 signal of this to the SIM 3 V line via a 20k resistor. ▪ Filter the SIM VCC signal with a 10 uf / 10 V capacitor to help with the line length.
Primary and secondary serial interfaces	The Eagle II module uses a 3 V digital interface that is 5 V tolerant. The RS-232 signals must be level-shifted to get standard levels. These signals must be ESD-protected.
Reset Interface	Resets the Eagle II module when tied low.
Audio/Microphone Interface	Preliminary balancing on Eagle II module. Maximum length TBD

Testing the following parameters verifies the RF parameters that may be affected by such things as RF path loss, power supply noise, and external interference.

Functionality	Parameters to be Tested
Transmitter	Frequency Error Phase Error PA Ramp Modulation Spectrum RF Power Steps Timing Advance
Receiver	BER Based RX Tests (RXQUAL RXLEV) BER Based Sensitivity

Testing the following GSM functionality verifies proper network communication.

Functionality	Parameters to be Tested
Network Function	Synchronization and registration Call set-up and call termination (both MT and MO calls) SMS and/or data calls

REPAIR AND RETURN POLICY

Note: The standard warranty for the Eagle II module 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 Eagle II Module

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. It is important to note the exact environment that the problem occurs and what is the integration platform. For example, does the problem occur only in the Eagle test fixture or in the target platform?

If the problem cannot be resolved over the telephone and the module 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 an Xircom test fixture. 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 responsibilities and actions required of manufacturers and integrators who incorporate OEM versions of the Eagle II module 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. Appropriate instructions, documentation and labels are required for all products. For more information concerning regulatory requirements, please contact Xircom, Inc.

GSM Full Type Approval (FTA)

The Eagle II module 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.

For applications that use an unmodified version of the Eagle II module, further testing in this area may not be required. Any OEM changes in the SIM interface, antenna port, software or the physical makeup of the unit may require an incremental FTA to ensure continued compliance with the above-mentioned standards. For more information concerning type approval, please contact Xircom, Inc.

Electromagnetic Compatibility (EMC) and Safety Requirements

The Eagle II module 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.

EMC/Safety Requirements for the USA

Compliance to the US rules and regulations falls under two categories:

- Radio approvals: Federal Communications Commission (FCC)
 - ◆ Transmitter: FCC Rules, Part 24
 - ◆ Unintentional emission: FCC Rules, Part 15
- Product safety approvals: NRTL by an OSHA-approved Nationally Recognized Testing Laboratory (NRTL)

Although the Eagle II module has been authorized by the FCC and listed as a component by an NRTL, products and applications that incorporate the Eagle II module will require final verification of EM emission and product safety approval.

Note: Particular attention should be made to the following statements regarding RF Exposure:

Human Exposure Compliance Statement

Xircom, Inc. Wireless Technology Group certifies that the Eagle™ II 900/1900 MHz GSM Radio Module (FCC ID: J3OEAG2919) complies 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 certification is contingent upon installation, operation and use of the Eagle™ II and its host product in accordance with all instructions provided to both the OEM and end user. When installed and operated in a manner consistent with the instructions provided, the Eagle™ II meets the maximum permissible exposure (MPE) limits for general population / uncontrolled exposure as defined in Section 1.1310 of the FCC Rules and Regulations.

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 siting and human exposure to radio frequency radiation. For further guidance, consult the FCC Rules, your service provider, or Xircom Inc.

Compliance with FCC Regulations

The Federal Communications Commission (FCC) is the agency of the Federal Government that oversees all non-governmental radio frequency transmitters that operate within the United States. 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. Intentional radiators operating as a PCS-1900 radio transmitter are regulated under Part 24, Subpart E—Broadband PCS of the FCC Rules and Regulations.

Unintentional Radiators, Part 15

Equipment designated as Class A is intended for use in a commercial, industrial or business environment. The Eagle II module has been tested and found to comply with the limits for a Class A digital device and can be integrated into equipment or applications intended for use in commercial, industrial or business environments.

The following statement must be included in the user manual for such products:

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 and used 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 in which case the user will be required to correct the interference at his own expense.

Equipment intended for use in a residential environment (notwithstanding use in commercial, industrial or business environments) is designated as Class B. The Eagle II module has been tested and found to comply with the limits for a Class B digital device and can be integrated into equipment or applications intended for use in residential environments.

The following statement must be included in the user manual for such products:

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.

Intentional Radiators, Part 24

Products incorporating the Eagle II transceiver operate as Personal Communications Services (PCS) devices under the authority of Part 24, Subpart E—Broadband PCS, of the FCC Rules and Regulations. All such transmitters must be authorized by the FCC through its Certification process, as detailed in Part 2, Subpart J - Equipment Authorization Procedures. Through the Certification process, the FCC verifies that the product complies with all applicable regulatory and technical requirements, including those that address human exposure to radio frequency radiation. In general, radio frequency transmitters cannot be sold or operated in the US prior to FCC approval.

Instructions to the Original Equipment Manufacturer (OEM)

To comply with the requirements of the National Environmental Policy Act (NEPA) of 1969, operation of an FCC-regulated transmitter may not result in human exposure to radio frequency radiation in excess of the applicable health and safety guidelines established by the FCC. Further information on RF exposure issues may be found in the FCC's Office of Engineering and Technology (OET) Bulletin Number 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields" and Supplement C, "Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radio Frequency Emissions." Both of these documents are available via the Internet at the OET web site: <http://www.fcc.gov/oet>

The Eagle 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 radiation.

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

- This device may only be used in fixed and mobile applications.
- Portable applications, as defined by the FCC, are prohibited.
- The use of this device for desktop and other applications where the antenna can easily be relocated are considered by the FCC to be mobile applications.
- A separation distance of at least 20 cm (7.87 inches) between the antenna and the 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 EIRP of 33 dBm / 2 W.
- End products must provide instructions to ensure compliance with radio frequency radiation exposure requirements.
- A warning label visible to all persons exposed to the antenna and identical to that described in this manual must be displayed on or next to the antenna.
- Separate FCC approval for RF exposure compliance is required for end products that do not meet these conditions.

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 Eagle 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.

Depending upon the application and type of product into which the Eagle II module has been incorporated, specific OEM actions and responsibilities required to meet these conditions vary. However, in all cases the primary concern is to ensure compliance with current FCC guidelines and regulations that limit human exposure to radio frequency radiation.

Definitions

For the purpose of determining compliance with current FCC rules addressing human exposure to radio frequency radiation, the FCC has established the following three categories of transmitting devices:

- ❑ Portable Devices – devices where the antenna is located within 20 cm (7.87 inches) of any person, including the user, if applicable. Portable devices operating under the authority of Part 24 (broadband PCS) are limited to a maximum of 2 W EIRP.
- ❑ Mobile Devices – devices designed to be used in other than fixed locations and generally such that the antenna is located at a minimum of 20 cm (7.87 inches) from any person, including the user, if applicable. Mobile devices operating under the authority of Part 24 (broadband PCS) are limited to a maximum of 2 W EIRP.
- ❑ Fixed devices – devices in which the antenna, either integral to the product or remotely located, is physically secured at one location and is not able to be easily moved to another location.

OEM Responsibilities for All Products Containing the RM1900-1

In addition to any other regulatory requirements, OEMs and integrators must include or provide the following information, instructions, warnings and labels with any device or product into which the Eagle II PCS-1900 GSM transceiver has been incorporated:

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. <ul style="list-style-type: none"> ▪ 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 7 dBi* in fixed products and applications. ▪ 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 <div style="border: 2px solid black; padding: 10px; margin-top: 10px;"> <p style="text-align: center;">WARNING</p> <p>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.</p> </div>

Human Exposure Compliance Statement	Include the following statement in the instruction / operation manual.	<p>Xircom, Inc. Wireless Technology Group certifies that the Eagle™II 900/1900 MHz GSM Radio Module (FCC ID: J3OEAG2919) complies 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 certification is contingent upon installation, operation and use of the Eagle™ II and its host product in accordance with all instructions provided to both the OEM and end user. When installed and operated in a manner consistent with the instructions provided, the Eagle™ II meets the maximum permissible exposure (MPE) limits for general population / uncontrolled exposure as defined in Section 1.1310 of the FCC Rules and Regulations.</p>
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Specific OEM Responsibilities for Portable Products and Applications

Each device or product, into which the Eagle II PCS-1900 GSM transceiver has been incorporated, and which is intended to be used in an application that meets the definition of "portable" MUST be separately authorized by the FCC for the purposes of determining compliance with current FCC guidelines limiting human exposure to radio frequency radiation.

Portable devices must be evaluated for RF exposure based on Specific Absorption Rate (SAR) limits; further information on such evaluations are available from the FCC via the Internet.

Specific OEM Responsibilities for Mobile Products and Applications

Separate or additional FCC approvals are NOT required for devices or products, into which the Eagle II PCS-1900 GSM transceiver has been incorporated, that are used in applications that meet the definition of "mobile."

For all end products, the OEM or integrator must provide instructions, warnings and labels to ensure that the product complies with current FCC guidelines limiting human exposure to radio frequency radiation.

Current FCC regulations limit the EIRP of mobile devices to 2 W. Because the nominal RF output power of the Eagle II PCS-1900 GSM transceiver is 1.0 W (30 dBm), antenna gain for mobile products and applications cannot exceed 3 dBi.

Specific OEM Responsibilities for Fixed Products and Applications

Separate or additional FCC approvals are not required for devices or products, into which the Eagle II GSM transceiver has been incorporated, that are used in applications which meet the definition of "fixed."

For all end products, the OEM or integrator must provide the instructions, warnings and labels to ensure that the product complies with current FCC guidelines limiting human exposure to radio frequency radiation.

Separate or additional FCC approvals are required for devices or end products used in fixed applications where antenna gain in excess of 7dBi is desired.

Nationally Recognized Testing Laboratory (NRTL) Approval

The Eagle II module has been tested by an NRTL and approved as a component for incorporation into OEM products. The final product and application that incorporates the Eagle II module will 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 be identified, and the appropriate steps should be taken to meet the requirements set forth in the intended market.

PIN ASSIGNMENTS OF THE I/O CONNECTOR

Signals of the I/O Connector, Sorted by Pin Number

Pin	Signal Name	Direction	Functionality	Voltage Level
1	VIN	From CPE	Electrical power input to Eagle II module: 4.2 VDC to 5.2 VDC Refer to the table for Operating Power.	
2				
3				
4				
5				
6				
7	TX on	To CPE	Transmit ON. Digital output to indicate transmitter power status. A logic 1 indicates transmit power is on. A logic 0 indicates transmit power is off. Leave signal disconnected if function is not used.	2.2 V
8	RX0	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
9	RX on	To CPE	Receive ON. Digital output to indicate receiver power status. A logic 1 indicates receiver power is off. A logic 0 indicates receive power is off. Leave signal disconnected if function is not used.	2.2 V
10	DSR0	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
11	Reserved		Do not use. Leave open	
12	DCD0	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
13	GPIO0	To/From CPE	General purpose I/O bit. Used as general purpose input or output lines for monitoring or control of external devices. Requires customized stack software to implement. Leave signals disconnected if function is not used.	3 V
14	RI0	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
15	GPIO1	To/From CPE	General purpose I/O bit. Used as general purpose input or output lines for monitoring or control of external devices. Requires customized stack software to implement. Leave signals disconnected if function is not used.	3 V

Pin	Signal Name	Direction	Functionality	Voltage Level
16	TX0	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
17	GPIO2	To/From CPE	General purpose I/O bit. Used as general purpose input or output lines for monitoring or control of external devices. Requires customized stack software to implement. Leave signals disconnected if function is not used.	3 V
18	CTS0	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
19	GPIO3	To/From CPE	General purpose I/O bit. Used as general purpose input or output lines for monitoring or control of external devices. Requires customized stack software to implement. Leave signals disconnected if function is not used.	3 V
20	RTS0	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
21	GND	From CPE	Electrical power return for digital and analog grounds.	
22	DTR0	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
23	RESET_B	From CPE	Reset Input. Active Low. Internally pulled high and can be left disconnected if not used. If connected to external circuitry, maximum high level must not exceed 3.3 V. Pulse width must be at least 5 mS to guarantee a valid reset.	3 V
24	GND	From CPE	Electrical power return for digital and analog grounds.	
25				
26	TX1	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
27	CLKOUT	To CPE	Clock output. A 50% duty cycle 13 MHz square wave clock source. Used for synchronization of external circuitry to the base band processor. Leave signal disconnected if function is not used.	3 V
28	GND	From CPE	Electrical power return for digital and analog grounds.	
29				
30	RX1	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
31	Reserved		Do not use. Leave open.	

Pin	Signal Name	Direction	Functionality	Voltage Level
32	ID0	To CPE	Identification 0. Bit 0 of four (0 to 3) output bits to identify hardware revision. Do not use: leave open.	3 V
33	GND	From CPE	Electrical power return for digital and analog grounds.	
34	ID1	To CPE	Identification 1. Bit 1 of four (0 to 3) output bits to identify hardware revision. Do not use: leave open.	3 V
35	Reserved		Do not use. Leave open.	
36	ID2	To CPE	Identification 2. Bit 2 of four (0 to 3) output bits to identify hardware revision. Do not use: leave open.	3 V
37	Reserved		Do not use. Leave open.	
38	ID3	To CPE	Identification 3. Bit 3 of four (0 to 3) output bits to identify hardware revision. Do not use: leave open.	3 V
39	Reserved		Do not use. Leave open.	
40	LED0	To CPE	Status LED signal 0. Outputs are active low. LED0 corresponds to the "red" element of a bi-color LED. LED0 and LED1 indicate radio link status on a remote LED. Leave signals disconnected if function is not used.	3 V
41	Reserved		Do not use. Leave open.	
42	LED1	To CPE	Status LED signal 1. Outputs are active low. LED1 corresponds to the "green" element of a bi-color LED. LED0 and LED1 indicate radio link status on a remote LED. Leave signals disconnected if function is not used.	3 V
43	Reserved		Do not use. Leave open.	
44	GND	From CPE	Electrical power return for digital and analog grounds.	
45				
46	SIM-CLK	To CPE	SIM clock output signal to a remote SIM device. Clock frequency is 3.25 MHz. Leave signal disconnected if function is not used.	3 V
47	MIC1P	From CPE	Microphone 1 Positive. Positive input pin from an electret-type microphone. Nominal microphone differential voltage should be 2.0 V. Impedance not less than 900 ohms. Leave signal disconnected if function is not used.	
48	GND	From CPE	Electrical power return for digital and analog grounds.	
49				
50	SIM-IO	To/From CPE	SIM input output. Serial I/O line to a remote SIM device. Leave signal disconnected if function is not used.	5 V or 3 V
51	MIC1N	From CPE	Microphone 1 Negative. Negative input pin from an electret-type microphone. Nominal microphone differential voltage should be 2.0 V. Impedance not less than 900 ohms. Leave signal disconnected if function is not used.	
52	GND	From CPE	Electrical power return for digital and analog grounds.	
53				

Pin	Signal Name	Direction	Functionality	Voltage Level
54	SIM-RST	To CPE	SIM reset. An output signal to reset a remote SIM device. Leave signal disconnected if function is not used.	3 V
55	SPK1P	To CPE	Speaker 1 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.	
56	SIM-IN	From CPE	SIM IN signal. Active high. A remote SIM card detection signal input. Leave signal disconnected if function is not used.	5 V or 3 V
57	GND	From CPE	Electrical power return for digital and analog grounds.	
58	SIM-VCC	To CPE	SIM 3 volt power. A 3-volt power supply output signal to a remote SIM device. Power is controlled by the base band processor. Leave signal disconnected if function is not used	3 V or 5 V
59	SPK1N	To CPE	Speaker 1 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.	
60	SIM-3 V	To CPE	SIM 3 V output used in conjunction with the SIM-IN signal to a remote SIM device. Leave signal disconnected if function is not used.	3 V

REFERENCES

Eagle II Product Documentation

- *Eagle II Programmer's Manual*
- Eagle II Interface Control Drawing (ICD), Document # 06700103

GSM and PCS Device Specifications

- GSM 11.10-1 version 4.19.1 (GSM 900- and 1800 MHz devices)
- PCS 11.10 (PCS 1900 MHz devices)

US Government

Federal Communications Commission (FCC)

Internet: <http://www.fcc.gov>

- FCC Rules, Part 24 and Part 25
 - ◆ 47 CFR Subpart E--Broadband PCS
 - ◆ 47 CFR § 24.52, sections 1.1307(b), 2.1091, and 2.1093
- FCC Rules, Part 15
- FCC Rules, Part 2
 - ◆ Subpart J--Equipment Authorization Procedures
 - ◆ Section 2.925

FCC Office of Engineering and Technology (OET)

Internet: <http://www.fcc.gov/oet>

- Bulletin Number 65 "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"
- Supplement C "Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Exposure to Radio Frequency Emissions"

Environmental Regulations

- National Environmental Policy Act (NEPA) of 1969 (Part 1, Subpart 1)

Mechanical Specifications

- ❑ ASTM D999
- ❑ ASTM D775
- ❑ IEC 68-2-27
- ❑ Bellcore Gr-63-CORE

RF and EMI Specifications

- ❑ ETSI Standards
 - ◆ ETS 300 019-1-1 Class 1.2
 - ◆ ETS 300 019-1-2 Class 2.1
 - ◆ ETS 300 019-1-3 Class 3.1
- ❑ EN 61000-4-6
- ❑ GSM 11.10, Section 12.2
- ❑ EN 55022 Class B

GLOSSARY AND ACRONYMS

App Application	Refers to the Application which sends or receives commands/responses from the Eagle II Module
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.
BER Bit Error Rate	Bit Error Rate
CSD Circuit Switched Data	Data link from a terminal through the network allowing real-time, duplex connectivity at 9600 bytes/second.
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.
EMC Electromagnetic Compatibility	The ability of a device to function satisfactorily in its electromagnetic environment without inducing intolerable disturbance to that environment (or to other devices)
ESD Electrostatic Discharge	Static electricity that can damage electronic equipment.
EU European Union	An organization of 15 European states whose purpose is to organize relations between the Member States and between their peoples.
FTA Full Type Approval	GSM Full Type Approval
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.
HLR Home Location Register	Home Location Register
ICD Interface Control Document	Document that defines the hardware interfaces.
IMEI International Mobile Equipment Identity	A unique number for each GSM Terminal tracked by the GSM operators in their Equipment Identity Register (EIR) database.
IMSI International Mobile Subscriber Identification	A unique number identifying the subscriber stored in the SIM card. Number is used in conjunction with the network for call routing.
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.
MSC Mobile Switching Center	The central switch of the GSM network. Performs call routing, collects call detail records for billing, and supervises system operations.
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
PA	Power Amplifier
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	Recieve
Short Message	An alphanumeric message of up to 160 characters that can be sent to or from a GSM terminal.
SIM Subscriber Identification Module	<p>“Smart Card” technology that contains user information and has four main functions:</p> <ul style="list-style-type: none"> ▪ 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.

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