

Wireless Solutions Division Omnipoint Technologies, Inc.

Eagle™ Technical Specification

GSM Wireless Modules

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 this product to open flames.
- ◆ Care should be taken so that liquids do not spill into the device.
- ◆ Do not attempt to disassemble the product. Doing so will void warranty. This product does not contain consumer serviceable components. (This does not apply to Subscriber Identification Modules (SIMs)).

Guidelines for Safe Use

The Eagle[™] products are a radio transmitter and receiver intended for fixed and mobile uses only. They comply with the RF hazard requirements applicable to fixed PCS equipment operating under the authority of 47 CFR Part 24, Subpart E of the FCC Rules and Regulations when installed properly.

The Eagle[™] products comply with FCC requirements for Human Exposure by meeting these requirements:

1. The device's antenna must be installed no closer than 20 cm to any person.
2. Only fixed and mobile applications are permitted.
3. Portable applications (within 20 cm of any person) are strictly prohibited.
4. Antenna gain is limited to a maximum of 7 dBi for fixed applications.
5. Antenna gain is limited to a maximum of 3 dBi for mobile applications.

Eagle™ Technical Specification

GSM Wireless Modem

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INTRODUCTION

The Eagle™ family of products is centered around the fully type approved Eagle™ Data Module, a compact, wireless OEM module that utilizes the international standard Global System for Mobility (GSM) enabling low-cost, application-specific, two-way communication and control. It takes full advantage of GSM capabilities such as Subscriber Identity Modules (SIMs), which are “smart cards” that provide numerous advantages. Over-the-air communication lets the Eagle™ 2000 terminal accomplish tasks that previously required on-site visits and offers innovative new services. In addition, terminal authentication and data encryption ensure confidential communication between the terminal user and the data recipient.

The Eagle™ modules are available in several variations. 1900MHz modules are available for integration and deployment in North America and elsewhere the 1900 MHz PCS band is allocated. 900 and 1800 MHz modules are also available for rest of world deployments.

The Eagle™ module may be used to transmit and receive data and voice in a variety of applications including Automated Meter Reading, Telemetry, Wireless Alarms, Credit Card Verification, Fleet Management Systems, e-mail, and internet access. The Eagle™ module supports Short Message Service (SMS), Unstructured Supplementary Service Data (USSD) and Circuit Switched Data (Transparent and Non-Transparent Mode) up to 9.6 Kbps as the options for transmitting and receiving data. Half-rate, full-rate and enhanced full-rate vocoders are supported for voice. These modes are described in greater detail later in this manual. The Eagle™ module communicates via a V.24 serial 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 network management of numerous deployed terminals.

The Eagle™ module leverages existing public GSM networks versus systems that require the utility to build, operate, and maintain expensive private wireless networks. See Figure 1. The device is designed for easy integration with other components and packaging.

This manual also describes the basic operation of the Eagle™ module and makes recommendation for integration with other components.

GSM functionality is currently evolving. The Eagle™ module will be backward compatible with new GSM functionality such as GPRS. In other words, applications supported with early versions of the Eagle™ module will continue to be supported as GSM technology evolves to a GPRS capability and to so-called third generation technologies which are now in the process of standardization and development.

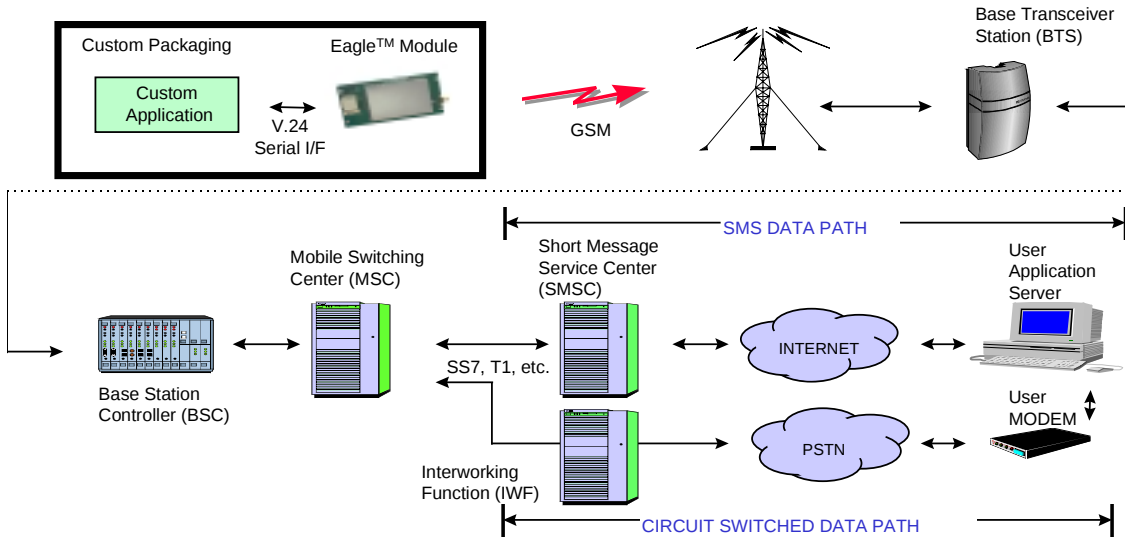


Figure 1, Eagle™ Terminal Deployment in GSM Network

GSM Overview

The GSM communications standard, already widely deployed in Europe, Asia, and North America, overcomes every significant drawback of other wireless telemetry approaches. GSM was designed from the ground up for reliable inexpensive digital data transfer.

Every GSM network enjoys several unique advantages over other analog and digital wireless technologies. Integrated data and data "friendly" capabilities such as Short Message Services (SMS), circuit switched data and, soon, General Packet Radio Services (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.

EAGLE™ ONE PRODUCT DESCRIPTION (SUMMARY)

The GSM type approved Eagle™ One module provides two-way wireless capabilities via GSM services. The Eagle™ One modules feature a small size, easily integrated into developer defined applications and packaging. As GSM functionality evolves, any new modules will be backward compatible (functionality, mechanical, and interfaces) into applications and products developed utilizing the Eagle™ One module. Features include:

- Authentication via GSM algorithms
- Encryption via GSM algorithms (A5.1 and A5.2)
- 3V Mini-Subscriber Identity Module (SIM) carrier and interface on board
- Terminal originated and terminated Short Message Service (SMS) messages (up to 140 8-bit ASCII characters or up to 160 GSM 7-bit ASCII characters) (up to 255 messages may be concatenated)
 - Cell broadcast
 - Receipt acknowledgement
- Unstructured Supplementary Service Data (USSD)
- Circuit Switched Data (Transparent & Non-transparent) programmable from 300 bps to 9.6 Kbps

Interface

- Data input/output interface: V.24 protocol, 3V (5V tolerant) TTL levels
- Second serial port (3V TTL) features ability to simultaneously hold a circuit switched call and simultaneously send and receive SMS messages
- 60 pin connector (dual row, 0.8 mm pitch, surface mount))
- Command protocol: AT command set
- Optional voice - 3 vocoders; half-rate, full-rate, and enhanced full-rate
- Optional remote SIM (accessible via 60 pin connector)
- Antenna: Female MMCX or Female SMA versions available

Power

- Electrical power: 5.0 +1.0 / - 0.2 VDC
- Typical power dissipation:
 - 0.75 Watts, standby power (registered on network and listening)
 - 1.75 Watts, average transmit power
- Typical current:
 - 1.5 Amps, peak transmit current
 - 0.35 Amps, average transmit current
 - 0.15 Amps, standby current

Radio

- PCS frequency bands; 1900 MHz, 900 MHz, and 1800 MHz
- Transmit Power:
 - 1900 MHz (Class 1) - 1 watt conducted power maximum (30 dBm +/- 2 dB)
 - 900 MHz (Class 4) - 2 watt conducted power maximum (33 dBm +/- 3 dB)
 - 1800 MHz (Class 1) - 1 watt conducted power maximum (30 dBm +/- 2 dB)
- Receive sensitivity, measured at the antenna port: -104dBm (typical)

Size

4.25" x 2.5" x 0.57" (L x W x H)
108 mm x 63.5 mm x 14.5 mm (L x W x H)

Weight

Less than 4 oz. (114 gm)

Environmental

Temperature Range: -20 to +65 degrees Centigrade (Operational), -40 to +70 degrees Centigrade (Storage)

Mechanical (Proposed Standards)

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

Regulatory

GSM Type Approved
FCC Part 15 (Class B) and Part 24

Warranty

1-year parts and labor limited factory warranty

TECHNICAL SPECIFICATIONS (DETAILED)

Physical

Dimensions (H x W x L)

0.57" x 2.5" x 4.25"

14.5 mm x 63.5 mm x 108 mm

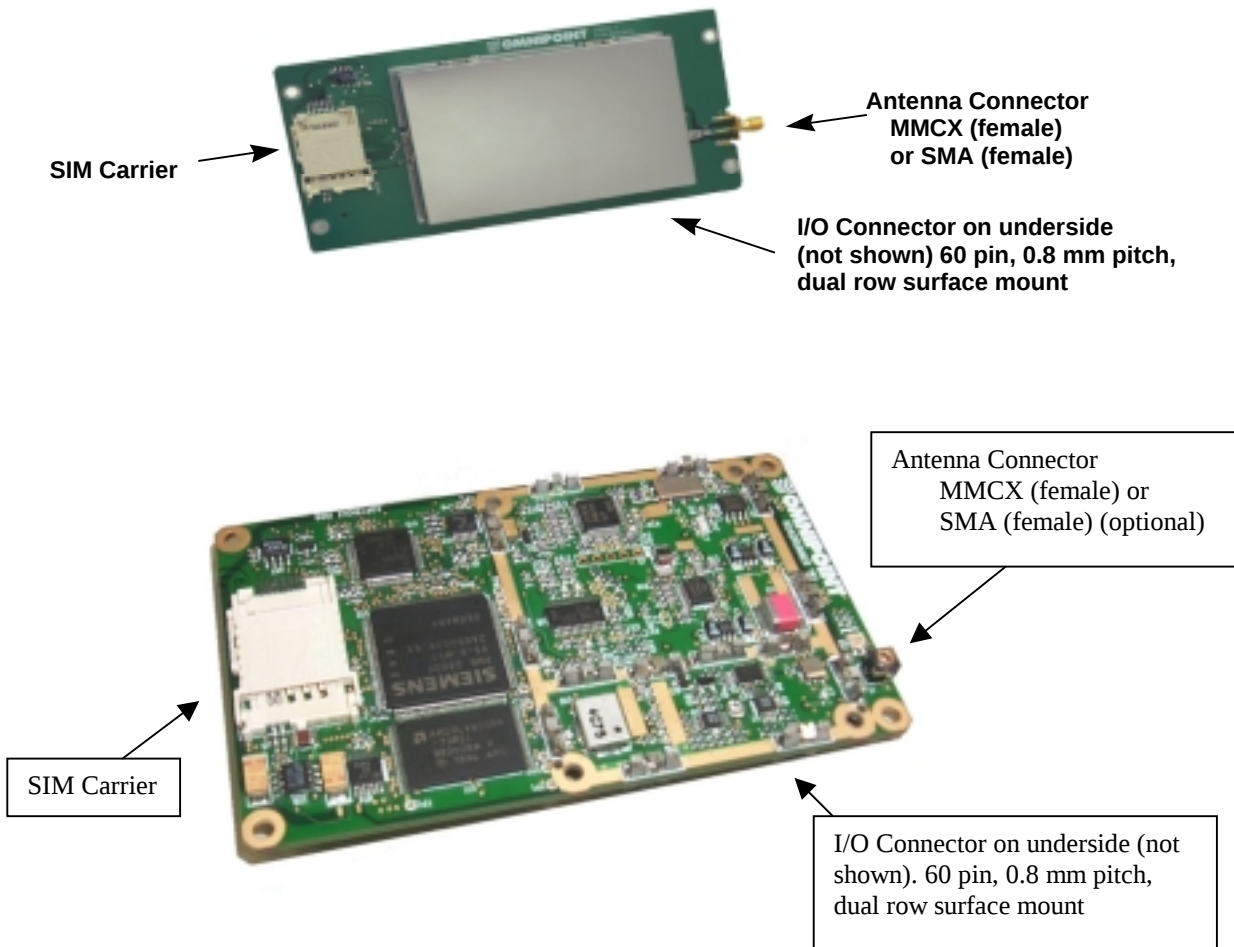


Figure 2, Eagle™ OEM Module (conceptual)

Place holder for dimensional picture

Figure 3, Eagle™ OEM Module Layout and Dimensions

Environmental**Climatic, Operational**

Eagle™ Operating Temperature	-20°C - +65°C
Relative humidity	5 - 95%
Solar radiation	NA
Air pressure (altitude)	70 kPa - 106 kPa (-400 m - 3000 m)

Climatic, Storage/Transportation

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

Mechanical, Operational

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

Mechanical, Storage/Transportation

Transportation vibration, packaged	ASTM D999
Drop, packaged	ASTM D775 method A, 10 drops
Shock unpackaged (Eagle™ module only)	150 m/s ² , 11ms, half-sine per IEC 68-2-27
Drop, unpackaged (Eagle™ module in housing)	4 inch drop per Bellcore GR-63-CORE

Electromagnetic Immunity

ESD	IEC 1000-4-2 Level 4 - indirect
ESD (handling test)	to ±8 kV contact, ±15 kV air, ±5 kV to all ports (direct)
Radiated immunity	method of IEC 1000-4-3 (15±5 V/m, 200 kHz - 1 GHz)
EFT	IEC 1000-4-4 Level 4 (4 kV power, 2kV signal & control)

Interfaces

Note: It is recommended that all mating connectors have a minimum of 30 micro-inches gold plating.

Input/Output

The physical connector is a 60 pin, dual row, surface mount connector with a 0.8 mm pitch.

Pin Number(s)	Signal Name	Direction	Functionality	Interface Characteristics
1, 2, 3, 4, 5, 6	5V	From CPE	5VDC power to Eagle	
21, 24, 25, 28, 29, 33, 44, 45, 48, 49, 52, 53, 57	GND	From CPE	Digital and analog ground reference	
23	RESET_B	From CPE	Active low reset to CPE circuitry **	3V TTL *
8	TX0	To CPE	Main serial interface transmit data	5V or 3V TTL
16	RX0	From CPE	Main serial interface receive data	5V or 3V TTL
18	RTS0	To CPE	Main serial interface request to send	5V or 3V TTL
20	CTS0	From CPE	Main serial interface clear to send	5V or 3V TTL
22	DTR0	From CPE	Main serial interface data terminal ready	5V or 3V TTL
10	DSR0	To CPE	Main serial interface data set ready	5V or 3V TTL
12	DCD0	To CPE	Main serial interface data carrier detect	5V or 3V TTL
14	RI0	To CPE	Main serial interface ring indicator	5V or 3V TTL
47	MIC1P	From CPE	Positive differential microphone input	3V TTL
51	MIC1N	From CPE	Negative differential microphone input	3V TTL
27	CLKOUT	To CPE	13 MHz square wave clock	3V TTL
55	SPK1P	To CPE	Positive differential speaker output	3V TTL
59	SPK1N	To CPE	Negative differential speaker output	3V TTL
32, 34, 36, 38	ID0-ID3	To CPE	Revision code	3V TTL
13, 15, 17, 19	GPIO0-3	To/From CPE	General purpose I/O	3V TTL
40, 42	LED0-1	To CPE	LED output signals	3V TTL
26	TX1	To CPE	Aux. serial interface transmit data	3V TTL
30	RX1	From CPE	Aux. serial interface receive data	3V TTL
35	DAI-CLIN		Reserved	
37	DAI-FIN2		Reserved	
39	DAI-DIN2		Reserved	
41	DAI-FOUT2		Reserved	
43	DAI-DOU2		Reserved	
58	SIM-VCC	To CPE	SIM Switched Power	3 Volt
56	SIM-IN	From CPE	SIM Card Presence Detect	3V TTL
54	SIM-RST	To CPE	SIM Reset	3V TTL

Pin Number(s)	Signal Name	Direction	Functionality	Interface Characteristics
50	SIM-IO	To/From CPE	SIM Serial I/O	3V TTL
46	SIM-CLK	To CPE	SIM Clock (3.25MHz)	3V TTL
60	SIM-3V	To CPE	SIM VCC	3 Volt
31	TEMP_OVER	From CPE	High temp shutdown override**	
7, 9, 11	SP0-SP2	NC	Spare interface pins	

Notes:

* 3V TTL absolute maximum input is 3.3V. 3V TTL Voh is 2.8V min. 3V TTL Vih is 2.0V min. 5V or 3V TTL Voh is 2.0V min.

** Can be left unconnected.

Operating Power

The Eagle™ module requires an input voltage of 5.0 +1.0 / - 0.2 VDC. The input source voltage ripple should be less than 20% of the average supply voltage peak-to-peak under normal operating conditions.

Power Dissipation:	
Transmit mode	1.75 Watts (average transmit power)
Idle mode (receiver operating, waiting to communicate)	0.75 Watts
Current Draw:	
Transmit mode	1.5 Amps (peak transmit) 0.35 Amps (average transmit)
Idle mode (receiver operating, waiting to communicate)	0.15 Amps

Radio Frequency (Antenna) Interface

The antenna connector may be either a female MMXC or female SMA type. This allows the developer a choice in the final product configuration. The Eagle™ module is designed to support interchangeable antenna types provided they have a 50 ohm impedance.

Serial Data Interface

Two V.24 serial data interfaces are provided. The primary is a 3V (5V tolerant) TTL interface. The second serial port (3V TTL) is provided which features the unique ability to simultaneously hold a circuit switched call while sending and receiving SMS messages.

V.24 flow control is accomplished via hardware handshake. The serial interfaces support programmable data rates from 300 bps to 9.6 Kbps.

Subscriber Interface Module (SIM)

The SIM, an integral part of any GSM terminal device, is a “smart card” programmed with subscriber information. The user information consists of an identity (IMEI number) registered with the GSM provider and an encryption Ki (pronounced key). It consists of a microprocessor chip and memory installed on a plastic card. Eagle™ uses the “mini-SIM” or Plug In configuration. The SIM (which is removable) is installed on a carrier on the Eagle™ circuit card.

A SIM remote from the module may be utilized. The SIM carrier must be of the type -TBD- and the interface cable must be no longer than TBD.

The SIM is not provided with the Eagle™ unit. The SIM is provided by the GSM service provider and must be provisioned by the operator for data and/or voice. Care must be taken to protect the SIM. A GSM terminal will not operate without the SIM installed.

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 SMS messages, storing the messages until a radio link is available.

Provisioning identifies the phone number that will be used to communicate with the terminal and identifies the data modes (transparent or non-transparent) that will be supported. Additionally the SIM must be provisioned to support mobile originated/mobile terminated SMS messages. Provisioning entails registering the unique SIM in the HLR (Home Location Register) with the options granted for use.

Transmit Power

The 1900 or 1800 MHz Eagle™ modules operate as a GSM Power Class 1 device transmitting 1 Watt EIRP.

The 900 Eagle™ module operates as a GSM Power Class 4 device transmitting 2 Watt EIRP.

Receiver Sensitivity

Receive sensitivity, measured at the antenna port is -104dBm (typical).

Status Indication

An LED indicates Eagle™ module link status and signal quality.

Link Status

The LED is flashing when the Eagle™ module is not attached to the network.

The LED is solid when the Eagle™ module is attached to the network.

Signal Quality

The LED shows green when the link signal is optimal.

The LED shows orange when the link is less than optimal but is acceptable.

The LED shows red when the link is unacceptable.

At start-up the LED flashes red.

Modes of Operation

Circuit Switched Data

GSM provides two connection modes of transmission: Transparent and Non-Transparent. The EagleTM module supports 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 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.

All GSM service providers may not support transparent mode. In those cases, the EagleTM module switches automatically to Non-Transparent mode.

SMS

SMS is a feature rich GSM service with a multitude of options defined. This section defines a subset of SMS that meets the requirements specified for Release 1.1 of the EagleTM module.

The following lists the key characteristics and assumptions regarding the form of SMS supported in the EagleTM module.

- Support of both mobile originated and mobile terminated SMS.
- Delivery of message to either phone number or IP address (translated by SMSC)
- 8-bit data
- Message Class 1
- Message concatenation up to 255 messages
- Status report indicator not sent to SME
- More Messages to Send (MMS)
- Validity Period
- Service Center Time Stamp
- Alert SMS-SC (SMS-Service Center)
- Priority
- Message Waiting

The EagleTM module is equipped to:

- Submit a SMS transport protocol data unit (TPDU) to a SMS-SC, and store a copy of it until either a report arrives from the network or a timer expires
- Receive a SMS TPDU from a 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

USSD

Unstructured Supplementary Services Data (USSD), is a supplementary service to allow for custom features by GSM service providers. The main distinction with USSD versus SMS is that the originator is guaranteed a real-time response/acknowledgement, whereas SMS provides no such guarantee. USSD may be more appropriate for potential applications where a real-time response is required, such as point of sales.

The Eagle™ module supports all forms of USSD, both mobile and network initiated.

USSD characteristics

USSD is a GSM service that, in a simplistic form, 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 is a GSM supplementary service requiring subscription.

Please note that all GSM operators support all of the aforementioned data services. Check with specific operator for compatibility.

VOICE

Keypad, microphone, and speaker interfaces are available on the 60-pin connector. Calls are initiated by AT command. Three vocoder compression algorithms are supported; half-rate, full-rate, and enhanced full-rate (EFR).

SOFTWARE INTERFACE

AT Command Set

The AT command driver never exits the command state (i.e., it never enters the data transfer state). In the command state, characters that are received from the CPE are treated as commands by the Eagle™ module, and the Eagle™ module sends characters to the CPE in response to those commands and as unsolicited indications of events. Either capital letters or lower-case letters can be used.

The general format of the command line is <prefix> <command> <CR>. The prefix 'AT' is used to obtain synchronization, identify character parameters and indicate a command may be in the following characters. For further details regarding the Command Set see the Eagle™ Terminal Reference Guide.

The DTM supports the following commands (* denotes command availability when voice functionality is added):

The Eagle™ module supports the following commands:

Call Control/Network Commands:

<i>AT Command</i>	<i>Description</i>	<i>Default</i>
ATA	Answer Call	N/A
ATD	Dial Call	N/A
ATL	Monitor Speaker Loudness	Command Ignored
ATP	Select Pulse Dialing	Command Ignored
ATT	Select Tone Dialing	Command Ignored
ATS0	Automatic answer =<n> on "n" ring	'0' (no automatic answer)
AT+CAOC	* Advice of charge	
AT+CCFC	* Call forwarding number and conditions	N/A
AT+CCUG	* Closed user group	N/A
AT+CCWA	* Call waiting	N/A
AT+CHLD	* Call related supplementary services	N/A
AT+CHUP	Hang-up call	N/A
AT+CLCK	* Facility lock	N/A
AT+CLIP	* Calling line ID presentation	'0' (disabled)
AT+CLIR	* Calling line ID restriction	'0' (disabled)
AT+CMOD	Call mode	
AT+COLP	* Connected line ID presentation	'0' (disabled)
AT+COPS	Operator selection	N/A
AT+CPWD	* Change password	N/A
AT+CR	Service reporting control - outgoing	'0' (disabled)
AT+CRC	Service reporting control - incoming	'0' (disabled)
AT+CREG	Network registration	'0' (disabled)
AT+CRLP	Radio link protocol	N/A
AT+CSQ	Signal Quality	N/A

AT Commands for Data

<i>AT Command</i>	<i>Description</i>	<i>Default</i>
ATO	Back to online mode	N/A
ATQ	Result code suppression	'0' (DCE transmits result code)
ATV	DCE response format	'1' (Verbose)
ATX	Result code selection	'4' (connect speed display)
AT+CBIN	Set AT data encoding	
AT+CBST	Bearer type selection	'9600' (non-transparent preferred)

AT Commands for SMS

<i>AT Command</i>	<i>Description</i>	<i>Default</i>
AT+CMGC	Send commands	N/A
AT+CMGD	Delete message	N/A
AT+CMGF	Message format	'1' (text mode)
AT+CMGL	List message	N/A
AT+CMGR	Read message	N/A
AT+CMGS	Send message	N/A
AT+CMGW	Write message to memory	N/A
AT+CMSS	Send message from storage	N/A
AT+CNMI	New message	'3' (buffer/flush results)
AT+CPMS	Preferred message storage	N/A
AT+CSCA	Service center address	N/A
AT+CSCB	Select cell broadcast message type	'0' (PDU mode)
AT+CSCS	Select TE character set	'IRA' (IA5)
AT+CSDH	Show text mode parameters	N/A
AT+CSMP	Set text mode parameters	N/A
AT+CSMS	Select message service	N/A
AT+CUSD	USSD	'0' (disabled)

AT Commands for Terminal Control

<i>AT Command</i>	<i>Description</i>	<i>Default</i>
AT+CMEE	Report terminal equipment error	N/A
AT+CPWROFF	Power down terminal equipment	N/A
AT+ICF	TE/TA character framing	'3.3' (eight data bits, no parity, 1 stop bit)
AT+IPR	Fixed TE data rate	'0' (automatic detection)
AT&C	Set DCD signal	N/A
AT&D	Set DTR signal	N/A

Generic AT Commands

<i>AT Command</i>	<i>Description</i>	<i>Default</i>
+++	Escape Sequence	N/A
AT	Request TA attention	N/A
ATE	Enables local echo	N/A
ATZ	TA sets all parameter to their defaults as specified by manufacturer and resets TA	N/A
AT+CBC	Battery charge	N/A
AT+CGMI	Request manufacturer identification	N/A
AT+CGMM	Request model identification	N/A
AT+CGMR	Request revision identification	N/A
AT+CGSN	Request product serial number	N/A
AT+CNUM	Subscriber number	N/A
AT+CPAS	Phone activity status	N/A
AT+CPIN	Enter PIN	N/A
AT+CRES	Restore settings	N/A
AT+CSAS	Save settings	N/A
AT+FCLASS	* Select Call Mode	
AT+GCAP	Request capabilities list	N/A
AT+GMI	Same as AT+CGMI	N/A
AT+GMM	Same as AT+CGMM	N/A
AT+GMR	Same as AT+CGMR	N/A
AT+GSN	Same as AT+CGSN	N/A
AT+VLS	* Line Select	
AT+VTS	* DTMF	
AT+VTD	* DTMF Tone Duration	
AT&F	TA sets all parameter to their defaults as specified by manufacturer	N/A
AT&H	Request help screen	N/A

Result Codes

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
OK	Final Result Code: Acknowledges execution of a command line
RING	Unsolicited Result Code: Incoming call signal from network
+CDS	Unsolicited Result Code: Incoming SMS report
+CMS ERROR	Unsolicited Result Code: Message service failure result code
+CMT	Unsolicited Result Code: Incoming SMS message
+CMTI	Unsolicited Result Code: Incoming SMS in storage indication
+CRC	Unsolicited Result Code: Cellular Result Code
+CRING	Unsolicited Result Code: Incoming call

S Registers

S0	Sets the number of rings before automatically answering the call
S3	Command Line Termination Character
S4	Response Formatting Character
S5	Command Line Editing Character
S6	Ignored (Pause Before Blind Dialing)
S7	Sets the Number of Seconds to Wait for Completion of Call Answering or Originating
S8	Sets the Number of Seconds to Wait when Comma Dial Modifier Encountered in Dial String of "D" Command
S10	Sets the Number of Tenths of Seconds to Wait Before Disconnecting After Absence of Received Line Signal

Eagle™ Module Initialization and Setup Examples**AT commands**

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

Data exchange from the customer application to the Eagle™ module will be noted as “app -> Eagle™ module”, while the inverse data exchange will be noted “Eagle™ module -> app”.

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..

Upon applying power to the unit, it will be a few seconds while the Eagle™ completes its power on self test. When queried with the AT command, the Eagle™ responds with the result code OK, which means it is ready and understands and can execute the command, or with ERROR, which means that the modem does not understand the command or that the command is invalid. In the following examples “App” refers to application.

App -> Eagle™ module	AT	
Eagle™ module -> app	OK	command valid, Eagle™ ready

The modem must be in command mode when any command other than the online escape sequence is entered. Commands entered when the modem is in online mode are treated as data and transmitted as such to the modem at the other end of the line.

In the following examples <CR> and <CR><LF> will be intentionally omitted.

Eagle™ module Initialization

Upon first using the Eagle™ module, the following is the recommended initialization string:

- Reset factory defaults
- Enable character echo
- Verbose mode on, display result codes as words

- DCD is on
- Monitor DTR

App -> Eagle™ module	AT& FE0Q0V1&C1&D2	Initialization string
Eagle™ module -> app	OK	command valid
App -> Eagle™ module	ATSO=1	Auto answer on 1st ring
Eagle™ module -> app	OK	command valid

Data Call Setup (Eagle™ module origination)

App -> Eagle™ module	AT+CBST=7,0,101	9600 baud, non-transparent mode
Eagle™ module -> app	OK	command valid

Eagle™ module Status Commands

After the Eagle™ module has been powered on successfully. The following commands can be used to query the status of the unit.

The first command checks if the Eagle™ module has successfully registered with the GSM network.

App -> Eagle™ module	AT+CREG?	get registration status
Eagle™ module -> app	+CREG: 0,1 OK	Registered with home network +CREG=0,2 registration in progress +CREG=0,5 registered as roaming

If there is any doubt to the RF coverage for the Eagle™ module, the following command can be used to query the strength of the RF coverage.

App -> Eagle™ module	AT+CSQ	get signal strength (NOTE: no “?”)
Eagle™ module -> app	+CSQ: 10,99 OK	Receive signal strength = 10, -95dBm RXQUAL =99, unknown

App -> Eagle™ module	AT+COPS?	ask for current PLMN
Eagle™ module -> app	+COPS: 0,2,31016 OK	Home PLMN is Omnipoint

Eagle™ module Sent SMS (Text)

To be able to send SMS text messages, the Eagle™ module must be initialized with the proper SMS mode:

App -> Eagle™	AT+CSMP=17,167,0,0	Set text mode parameter: (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™ module -> app	OK	command correct

Then the proper service center must be selected. The service center is the PLMN that the SME phone number belongs.

App -> Eagle™ module	AT+CSCA="1917907004"	Service center initialization Omnipoint SMSC - NJ
Eagle™ module -> app	OK	

App -> Eagle™ module	AT+CMGF=1	Set message format to TEXT mode
Eagle™ module -> app	OK	command correct

App -> Eagle™ module	AT+CNMI=0,1,0,0,0	Set new message indicators AT+CNMI=<mode>,<mt>,<bm>,<ds>,<bfr> <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™ module -> app	OK	successful command

App -> Eagle™ module	AT+CSAS	Save SMS settings
Eagle™ module -> app :	OK	Successful transmission

Once the aforementioned commands have been saved, the initialization commands do not need to be sent again until they are changed. The Eagle™ is now ready to send an SMS message. The phone number of the SME is entered. (NOTE: SME must belong to SMS service center.)

App -> DTM DTM -> App App -> DTM	AT+CMGS="12017572673" > Hello, how are you ?^Z	Send message... enter SME address (phone number) followed by the text message End with Control Z.
DTM -> App :	OK	Successful transmission

Eagle™ Module Receive SMS (Text)

To receive SMS messages from the Eagle™ 2000, the unit is asked to send all received messages via the following command.

App -> Eagle™ module	AT+CMGL="ALL"	read ALL messages received, including status, originator, message number and message content
Eagle™ module -> app	+CMGL: 1, "REC UNREAD",	

	"43322449"<CR> To be or not to be! +CMGL: 3, "REC UNREAD", "46290800"<CR> Hello Test Message! OK	
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INTEGRATION AND TEST CONSIDERATIONS

The Eagle™ modules have been designed to minimize the integration and test issues and time. Because the modules have been fully type approved integration into the GSM network should be seamless. Application issues will be narrowed to utilization of the AT commands and the applications use of the GSM functionality.

Coverage and signal quality may be evaluated using the on-board LED. Additional network information is available via AT commands.

The Eagle™ Developer's Program can also speed development. A development platform is available for embedded application development that can easily be tailored for custom applications. A significant amount of software has already been developed, again, to speed the application development and reduce the time it takes to bring a new device to market.

GLOSSARY/ACRONYMS

ANSI	American National Standards Institute
AT Command Set	Commands issued by intelligent device to modem (Eagle™ module) to perform functions, e.g., initiate call, answer call, transmit data, etc.
BSC	Base Station Controller. Controls the operation of the BTS and acts as an interface between the BTS and MSC.
BTS	Base Transceiver Station. The digital radios and antennas that send and receive information over the air to the terminal.
Circuit Switched Data	Data link from terminal through network allowing real-time, duplex connectivity at 9600 bytes/second with Eagle™ terminal.
CPE	Customer Premise Equipment. Refers to terminal in fixed location on customer's premises.
DTSA	Data Terminal Shielded Assembly. Raptor product intended for OEM sales where integrator packages terminal.
DTM	Data Terminal Module. Raptor product intended for OEM sales where deployment requires package to protect circuitry.
DTU	Data Terminal Unit. Raptor product permitting deployment of terminal in harsh environments.
Duplex	Two-way communication allowing transmission and receipt of data at the same time.
EIR	Equipment Identity Register. A database used to store IMEIs of locally issued terminals.
ESD	Electro-static discharge.
GPRS	General Packet Radio Service. Standard for packet communications utilizing GSM infrastructure.
GSM	Global Standard for Mobility. PCS standard for digital communications. Allows consistent communications in various parts of the world despite variations in RF spectrum allocations. Transferring 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.
IMSI	International Mobile Subscriber Identity. 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 provided by SIM card used in authentication and encryption by the 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.
NEMA	National Electrical Manufacturers Association. A standards body that establishes criteria for electrical equipment.
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.
Short Message	An alphanumeric message of up to 160 characters that can be sent to or from a GSM terminal.
SIM	Subscriber Interface Module. "Smart Card" technology containing user information. Has four main functions. 1) Authentication. 2) Storage of data. 3) Assist in encryption process. 4) Subscriber protection.
SMS	Short Message Services provided by GSM network allowing the transmission and receipt of short messages.
SMS-SC	SMS - Service Center. Location of SMS store and forward message server.
TPDU	Transport protocol data unit. Data packet defined by protocol layer of SMS interface.
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

APPENDIX A: REGULATORY INFORMATION

FCC Registration

Part 15 of the FCC rules distinguishes between different environments. Class A is intended for business or industrial environments. Class B is intended for residential environments. The Eagle™ module is tested and meets the Class B environment limits.

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.

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:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. Consult the dealer or an experienced radio/TV technician for help.

Human Exposure Compliance

Pursuant to 47 CFR § 24.52 of the FCC Rules and Regulations, personal communications services (PCS) licensees and manufacturers are subject to the radiofrequency radiation exposure requirements specified in § 1.1307(b), § 2.1091, and § 2.1093, as appropriate. For equipment operating at a fixed location, such as the Eagle™ module, radiofrequency exposure limits are given in § 1.1310, subject to the constraints given in § 1.1307(b) which specifies the conditions which would require preparation of an Environmental Assessment.

Omnipoint Technologies, Inc. certifies that it has determined that the Eagle™ complies with the RF hazard requirements applicable to fixed and mobile 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 and operation of the equipment in accordance with all instructions provided.

The Eagle™ module is designed for and intended to be used in 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 designed to be used in other than fixed locations and generally in such a way that a separation distance of at least 20 cm is normally maintained between the transmitter’s antenna and the body of the user or nearby persons. The Eagle™ module is not designed for or intended to be used in portable applications (within 20 cm of the body of the user) and such uses are strictly prohibited.

To ensure that the Eagle™ module complies with current FCC regulations limiting both maximum RF output power and human exposure to radiofrequency radiation, as separation distance of at least 20 cm 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. Additionally, in mobile applications, maximum antenna gain must not exceed 3 dBi.

The Eagle™ module complies with FCC requirements for Human Exposure by meeting these requirements:

1. The device's antenna must be installed no closer than 20 cm to any person.
2. Only fixed and mobile applications are permitted.
3. Portable applications (within 20 cm of any person) are strictly prohibited.
4. Antenna gain is limited to a maximum of 7 dBi for fixed applications.
5. Antenna gain is limited to a maximum of 3 dBi for mobile applications.

The Eagle™ module is intended for fixed and mobile applications. The maximum allowable antenna gain for fixed application is 7 dBi. The maximum allowable antenna gain for mobile applications is 3 dBi.

NRTL Approval

The Eagle™ module 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 Eagle™ module is listed by an approved NRTL and meets all relevant requirements given in the National Electric Code.

GSM 1900 Type Approval / Type Certification

The Eagle™ module is type approved in accordance with the requirements of and through the procedures set forth by the GSM North American industry association. The relevant conformance specification is PCS 11.10, a version of GSM 11.10-1 version 4.19.1 modified as appropriate for GSM application in North America.

The Eagle™ module needs no further GSM Type Approval for any data applications and for other applications provided that the interfaces to this device are implemented as described in this document and are equivalent to the approved configuration, e.g., remote SIM and man-machine interface.