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Redhawk™ User's Guide and Technical Manual

GSM Wireless Terminal

This document is in DRAFT format and is subject to change at Omnipoint Technologies sole discretion at any time.

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 devices.
- Connection to AC power should only be performed by a qualified electrician.
- 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 Redhawk™ 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 Redhawk™ 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.

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Redhawk™ User's Guide and Technical Manual

GSM Wireless Modem

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INTRODUCTION

The Redhawk™ family of products is centered around the Redhawk™ Data Terminal, a compact, wireless modem 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 Redhawk™ 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 Redhawk™ terminals are available in several packaging variations. The OEM board is referred to as a Data Terminal Shielded Assembly (DTSA). When the DTSA is packaged in a plastic housing it is referred to as a Data Terminal Module (DTM). An environmental housing for the DTSA including AC power supply and internal antenna is called a Data Terminal Unit (DTU). Subsequent discussion of the terminal operation will refer to the DTM although the DTSA and DTU will operate in a similar manner unless noted otherwise.

The DTM may be used to transmit and receive data (voice will be available in 3Q99) in a variety of applications including Automated Meter Reading, Telemetry, Wireless Alarms, Credit Card Verification, Fleet Management Systems, e-mail, and internet access. The DTM 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. These data modes are described in greater detail later in this manual. The DTM operates under a wide range of DC input power (+7 to 32V), and communicates via an RS-232 physical interface using the GSM AT command set. Other unique AT commands are also available providing the opportunity to monitor and report network conditions that may be relevant to the network management of numerous deployed terminals.

The industrial version of the Redhawk™ has been designed to operate in an extended temperature range. It is fully functional over an industrial temperature range of -40°C to +65°C that is required by many of these applications. Additionally, the Redhawk™ DTM has condensation control to prevent water condensation on the board or its components during exposure to changing environmental conditions. Because of these features, the Redhawk™ DTM can function in both extreme outdoor environments as well as more benign indoor environments. The commercial version of Redhawk™ has been designed to work over a temperature range from -20°C to +65°C.

The Redhawk™ 2000 DTM leverages existing public GSM networks versus systems which require the utility to build, operate, and maintain expensive private wireless networks. See Figure 1. The device is environmentally hardened for use in outdoor and other rugged applications creating overall volumes and economies-of-scale for even smaller application deployments. The DTM is also a flexible design platform that can be quickly adapted to other applications.

This manual also describes the basic operation of the DTM and its deployment when integrated with a Redhawk™ DTU.

GSM functionality is currently evolving. The DTM will be backwards compatible with new GSM functionality such as GPRS. In other words, applications supported with early versions of the DTM 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.

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Figure 1, Redhawk™ 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.

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TECHNICAL SPECIFICATIONS

Physical

Dimensions (H x W x L)

DTSA	1.0” x 3.3” x 6.3”	25.4 mm x 83.8 mm x 160 mm
DTM	1.4” x 3.5” x 6.5”	35.6 mm x 88.9 mm x 165.1 mm
DTU	5.5” x 9” x 12”	139.7 mm x 228.6 mm x 304.8 mm

Figure 2, Redhawk™ DTSA

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Figure 3, Redhawk™ DTM

Figure 4, Redhawk™ DTU

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Environmental

The environmental specifications of the DTSA, DTM, or DTU are consistent.

Climatic, Operational

Redhawk™ 2000 - Commercial Version Operating Temperature	-20°C - +65°C
Redhawk™ 2000 - Industrial Version Operating Temperature	-40°C - +65°C
Relative humidity	5 - 95%
Solar radiation	NA
Air pressure (altitude)	70 kPa - 106 kPa (-400 m - 3000 m)

The extended operating range and condensation control of the Industrial version of the Redhawk™ DTM are maintained by active temperature control circuitry. The circuitry has automatic shutdown control to prevent the unit from operating above or below the specified operating temperature range. For operation in ambient temperatures below -20°C, the unit is equipped with internal heaters which maintain an acceptable operating temperature for all components on the board. The internal heaters also provide condensation control. For ambient temperatures of approximately -10°C to 45°C, the on board heaters maintain a 10°C rise over ambient. Maintaining a board temperature warmer than the surrounding air guarantees that condensation on the board will not occur, even while the Redhawk™ DTM is under extreme, changing environmental conditions.

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/s2, 9 - 350 Hz
Operational vibration, random	0.1 m2/s3, 2 - 200 Hz

Mechanical, Storage/Transportation

Transportation vibration, packaged	ASTM D999
Drop, packaged	ASTM D775 method A, 10 drops
Shock unpackaged (DTM only)	150 m/s2, 11ms, half-sine per IEC 68-2-27
Drop, unpackaged (DTM in housing)	4 inch drop per Bellcore GR-63-CORE

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Electromagnetic Immunity

ESD	IEC 1000-4-2 Level 4 - indirect
ESD (handling test)	to ±8 kV contact, ±15 kV air
Radiated immunity	±5 kV to all ports (direct) 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

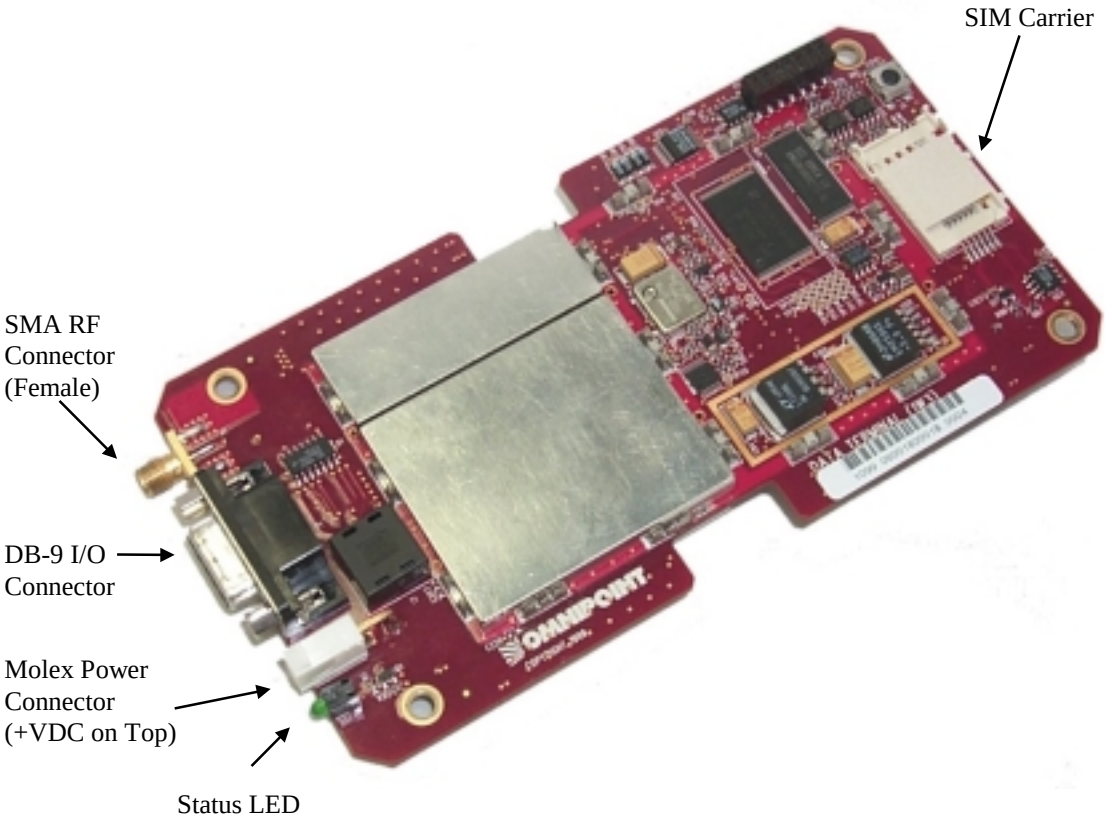

Figure 5, DTSA

Radio Frequency (Antenna) Interface

The antenna connector is a female SMA type. The DTM is designed to support interchangeable antenna types provided they have an impedance of 50 ohms. The DTM operates in the US licensed PCS frequency bands between 1850 MHz to 1990 MHz.

Input/Output (Customer Premise Equipment (CPE)/Local Interface)

The physical connector is a DB-9. This supports both the CPE/Local interface and diagnostic servicing. The electrical I/O interface is RS-232. The I/O interface supports autobaud capability from 300 bps to 9.6 Kbps.

Diagnostics are performed locally via the I/O interface and the local diagnostics terminal. Note: The local diagnostics terminal consists of a portable computing device running a communications application such as Procomm®.

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DB-9 Pinout

Pin	*RS-232 Signals*
1	DCD - Data Carrier Detect
2	RxD - Receive Data
3	TxD - Transmit Data
4	DTR - Data Terminal Ready
5	GND - Ground
6	DSR - Data Set Ready
7	RTS - Request to Send
8	CTS - Clear to Send
9	RI - Ring Indicator

RS-232 Flow Control

Flow control is accomplished via hardware handshake.

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. Redhawk™ uses the "mini-SIM" or Plug In configuration. The SIM (which is removable) is installed on a carrier on the Redhawk™ circuit card. Redhawk™ supports 3V SIMs only.

> *The SIM is not provided with the Redhawk™ 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.

Operating Power

Power to the DTM is provided via a Molex Mini-fit Jr. 2 pin power connector. Input voltage may vary from +7 VDC to + 32 VDC. Average current draw does not exceed 0.3 Amp @ 12 VDC. Peak current during transmit does not exceed 2 Amps. The input source voltage ripple should be less than 20% of the average supply voltage peak-to-peak under normal operating conditions.

> *Please note that some early prototype versions of Redhawk™ have an input voltage range limited to +7 to +14 VDC. If you are unsure which version you have, please contact the manufacturer.*

Power Dissipation:

Transmit mode	4.5 Watts (normal operating temp) 7.2 Watts max (at low temperature)
Idle mode (receiver operating, waiting to communicate)	2.5 Watts

Transmit Power

The Redhawk™ DTM operates as a GSM Power Class 1 device transmitting 1 Watt EIRP.

Status Indication

A single LED is provided that indicates three levels of DTM status.

Level 1 (LED off) indicates terminal not ready.

Level 2 (Green LED - blinking) indicates that the terminal has powered up but is not currently attached to the network.

Level 3 (Green LED) indicates that the terminal is ready and attached to the network.

> *Please note that some early prototype versions of Redhawk™ have LEDs that indicate power on only.*

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MODES OF OPERATION

Circuit Switched Data

GSM provides two connection modes of transmission: Transparent and Non-Transparent. The DTM 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.

> *Transparent mode is not supported by all GSM service providers. In those cases, the DTM 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 DTM.

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

- Support of both DTM originated and DTM terminated SMS.
- Delivery of message to either phone number or IP address (translated by SMSC)
- 8-bit data
- 7-bit GSM character set
- 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
- Priority
- Message Waiting

The DTM is equipped to:

- Submit a SMS 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

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- 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 verses 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 DTM 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.

VOICE

Not yet available.

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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 DTM, and the DTM sends characters to the CPE in response to those commands and as unsolicited indications of events. Both 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 Redhawk™ Terminal Reference Guide.

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

Call Control/Network Commands:

AT Command	*Description*	*Default*
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

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AT Commands for Data

AT Command	*Description*	*Default*
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&C	Set DCD signal	N/A
AT&D	Set DTR signal	N/A

AT Commands for SMS

AT Command	*Description*	*Default*
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

AT Command	*Description*	*Default*
AT+CBC	Battery charge	N/A
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)

Generic AT Commands

AT Command	*Description*	*Default*
+++	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+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

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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

DTM 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 DTM will be noted as “app -> DTM”, while the inverse data exchange will be noted “DTM -> 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 Redhawk™ completes its power on self test. When queried with the AT command, the Redhawk™ 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 -> DTM	AT	
DTM -> app	OK	command valid, Redhawk™ 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.

DTM Initialization

Upon first using the Redhawk™, 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

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

Data Call Setup (DTM origination)

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

DTM Status Commands

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

The first command checks if the DTM has successfully registered with the GSM network.

App -> DTM	AT+CREG?	get registration status
DTM -> 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 DTM, the following command can be used to query the strength of the RF coverage.

App -> DTM	AT+CSQ	get signal strength (NOTE: no "?")
DTM -> app	+CSQ: 10,99 OK	Receive signal strength = 10, -95dBm RXQUAL =99, unknown

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

DTM Sent SMS (Text)

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

App -> DTM	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.
DTM -> app	OK	command correct

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

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

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

App -> DTM	AT+CNMI=0,1,0,0,0	Set new message indicators AT+CNMI=<mode>,<mt>,<bm>,<ds>,<bfr> <mode> : controls the processing of unsolicited result codes 0 Buffer unsolicited result codes indications. <mt> : result code routing for SMS-DELIVERs 1 SMS-DELIVERs are routed using unsolicited code : +CMTI : « SM », <index> <bm> rules for storing received CBMs 0 no CBM indications are routed to the TE. <ds> for SMS-STATUS-REPORTs 0 no SMS-STATUS-REPORTs are routed. <bfr> 0 TA buffer of unsolicited result codes defined within this command is flushed to the TE
DTM -> app	OK	successful command

App -> DTM	AT+CSAS	Save SMS settings
DTM -> 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 Redhawk™ 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

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DTM Receive SMS (Text)

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

App -> DTM	AT+CMGL=”ALL”	read ALL messages received, including status, originator, message number and message content
DTM -> app	+CMGL: 1, "REC UNREAD", "43322449"<CR> To be or not to be! +CMGL: 3, "REC UNREAD", "46290800"<CR> Hello Test Message! OK	DTM returns text on one line.

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TROUBLESHOOTING

Troubleshooting the Redhawk™ terminal can be done in several ways. At the site, during installation or a service call the Field Management & Installation software is recommended. This software is intended to be installed on a PC to perform the functions such as Received Signal Strength, Network Registration, and other metrics relevant to the operation of the device.

Connection to the DTM is accomplished by serial cable between the PC serial port and the DB-9 connector on the DTM or DTSA.

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GLOSSARY/ACRONYMS

ANSI	American National Standards Institute
AT Command Set	Commands issued by intelligent device to modem (DTM) 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 Redhawk™ 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.
HLR	Home Location Register. Provides information on each subscriber registered in the corresponding network.
IMEI	International Mobile Equipment Identity. A unique number for each GSM Terminal tracked by the GSM operators in their Equipment Identity Register (EIR) database.

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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.
PSTN	Public Switching Telephone Network service. Provides connection to the fixed telephone network
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.
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
VLR	Visitor Location Register. Provides the necessary information to the MSC when call is made from a mobile.

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 DTSA and DTM are tested and meet the Class B environment limits while the DTU is tested and meets the Class A limits. The DTM/DTSA is tested in the more stringent environment due to the expectation that the device will be typically deployed where other electronic equipment is operating with less installation flexibility.

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

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

CLASS A (applies to DTU)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

CLASS B (applies to DTSA & DTM)

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 Redhawk™ DTU, 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 Redhawk™ 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

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determination is dependent upon installation and operation of the equipment in accordance with all instructions provided.

NRTL Approval

The equipment described in this manual have been tested by a NRTL agency and is 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 DTM and DTU are listed by an approved NRTL and meets all relevant requirements given in the National Electric Code.

GSM 1900 Type Approval / Type Certification

The DTM 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.

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APPENDIX B: DTM INSTALLATION AND SERVICE

> *NOTE: This section is intended for authorized personnel only. Installation and servicing of this equipment should be performed only by personnel who are trained and certified with the equipment, tools and processes required..*

Scope

This document applies to DTM Model numbers 2000-1000 and 2000-1990.

The focus of this document is to detail the installation and maintenance aspects of the DTM.

To detail these requirements it is necessary to understand the relationship of the GSM network and the DTM. Broken down these relationships include :

- The requirements of the service providers.
- The requirements of the customer.
- The venues for deployment.
- The requirements of site engineering.
- The requirements of the personnel who will actually be installing, commissioning and maintaining the DTMs.

DTM On-Site Installation, Connectivity and Provisioning Requirements

General Product Description

The DTM package consists of the following major components:

- DTM enclosure
- GSM Radio Module. (Redhawk^{TM})

Safety Precautions

CAUTION! PRODUCT SAFETY

The DTM is not designed to operate as a stand alone product in an external environment.

To avoid damaging the DTM in a stand alone configuration, it shall only be installed indoors and away from any humidity sources. The DTM may be installed outdoors only if it is enclosed in a NEMA 4 rated environmental enclosure or any similar enclosure with an equivalent rating.

DANGER! AVOID POSSIBLE SHOCK!

To avoid the possibility of shock, do not submerge or otherwise expose the DTM to water or any other liquids.

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DANGER! AVOID POWER LINES!

When following these instructions to install and connect the antenna, take extreme caution to avoid contact with overhead power lines, lights and power circuits. Such contact could be fatal.

PERSONAL SAFETY

Always wear safety goggles and other appropriate protective apparel when installing or working with tools.

Connections and Grounding

COMPLIANCE WITH THE NEC:

Installation of the DTM, antennas, and cables must be done in accordance with National Electrical Codes.

DTM Site Location

The DTM should be installed indoors in a location where it will be protected from humidity and extreme temperature variations. Its is possible to install the DTM outdoors as long as it is enclosed inside a suitable environmental enclosure, typically NEMA 4 or better. The installer will determine the best installation site, taking into account the different types of mounting methods, the type of antenna required and the power sources available to the DTM. The installer must verify that installation site is in an area of GSM coverage.

Antenna Location

Ideally the antenna location should be selected so that the antenna has an unobstructed line of sight to the basestation selected to serve with this installation site. In the case where a DTM is to be mounted on a desk top, a suitable mobile antenna should be used as long as GSM coverage is sufficient.

Cable Routing

When surveying an external site for antenna installation, verify that there is an adequate path for antenna cables to be routed from the antenna to the DTM.

General Installation Considerations

The DTM requires an external power supply to function. DTM model number 2000-1000 has an input voltage range from 7 - 32 VDC. DTM model number 2000-1990 has an input voltage range from 7 - 14 VDC.

Communication with the DTM is accomplished through the use of GSM-AT commands over an RS232 port. The DTM requires an RS232 cable terminated with a DB-9 female connector at the DTM end in order to communicate with Customer Premises Equipment. The connector on the opposite end of the RS232 cable is dependent upon the CPE interconnect requirements.

The external operating temperature range is from -20° C to + 65° C for the commercial version. The relative humidity is rated between 5 - 95% non condensing.

Permanent Installation, Surface Considerations

The DTM may be installed on any sturdy vertical or horizontal surface such as:

- Masonry
- Paneling
- Plaster board (Sheet rock, Gypsum, Drywall)
- Hardboard
- Wood
- Particle board
- Wafer board
- Sheet metal
- Concrete

Physical Dimensions for the DTM

Weight ½ pound.

Height 1.3 inches

Length 6.5 inches

Width 3.5 inches

Subscriber Identity Module (SIM)

The DTM will not function without a SIM card. It is the service providers responsibility to provide the customer with a SIM card. The location for the SIM card is inside of the DTM housing in a card carrier. Refer to figure 4.0 for SIM card location and installation.

Emissions

The DTM should not exceed the FCC RF emissions of 2W EIRP. Maximum output power has been specified at 30dBm ±2dB. In order to comply with the FCC requirement, the total path gain (antenna nominal gain - coax cable loss) cannot exceed 3dB. Therefore any combination of antenna gain and cable attenuation can be used as long as the (3dB path gain + 30dB DTU output power) is not exceeded.

> *NOTE: The total output power of this device is limited by FCC regulation to 2 Watts (+33 dBm) EIRP. In no case should combined antenna gain and cable loss exceed 3dB..*

Coax Cable

The DTM is designed to be installed as quickly and as economically as possible. In most cases RG223 or similar small diameter cable can be used. However in very short runs it is possible to exceed the FCC RF emissions limitation of 2 Watts (+33 dBm) EIRP. In such cases

additional attenuation must be introduced into the path gain. This can be achieved either with in line attenuators, or more economically, simply by adding more cable length.

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

$L = |g - 3|/a$

where L = required minimum cable length

g = antenna gain (per antenna manufacturers specifications).

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

If the antenna has less than 3dB gain, there is no risk of exceeding the FCC emission limit.

Antennas

The antenna location for DTM installation is dependent on individual site conditions. As a general rule the antenna should be positioned so that a reliable radio connection can be made with the GSM network; ideally with more than one basestation. The installation of directional antennas should generally be avoided due to the dynamics of basestation deployments.

> *NOTE: All antennas must be professionally installed. The installer is responsible for assuring that the proper antenna is installed so that the limits of FCC §15.203 are not exceeded.*

OUTDOOR ANTENNA GROUNDING:

Any outdoor antenna used to receive DTM signals and its connecting cables are required to be grounded by the National Electrical Code (NEC) - specifically articles 250, 800, 810, 820. Codes require proper grounding of the cables at the point where they enter a building. Local building codes may also be applicable. For clarification on either local or national grounding requirements, contact the state or county inspection officials.

Installation Requirements

This section consists of the physical installation requirements of the DTM. The DTM can be installed on any sound vertical or horizontal surface. The DTM is designed with the following external connectors, female D-Sub 9 connector, Molex® 2 pin female connector and a female SMA type connector. A green LED as also been provided for status indication. Refer to section xxx for an indication of the status levels. The D-Sub 9 connector is intended to be used as a communication port between the DTM and the customer premises equipment. Refer to Figure 6.

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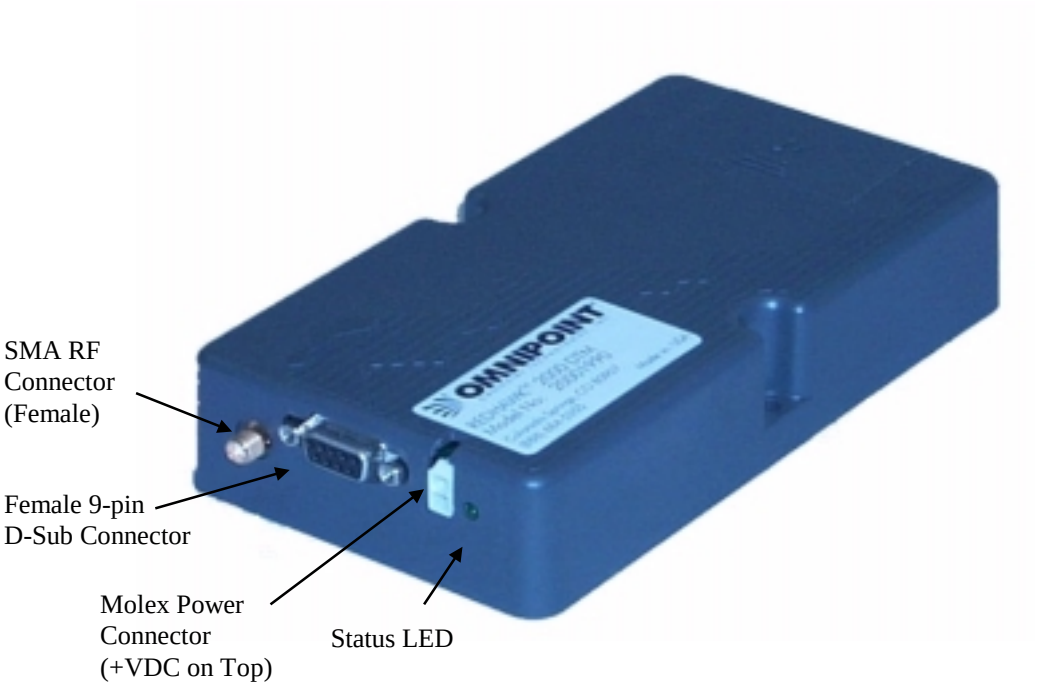

Figured 6

DTM Installation Options

The DTM may be installed on a desk top, a wall or a hidden location. If signal reception is quite good the DTM may be installed on a desk top or as near to the CPE as possible. If signal reception is poor the DTM may need to installed as near to a stand alone antenna as possible.

DTM Power Requirements

The DTM comes in two different models with different input power requirements. Model number 2000-1000 requires 7 - 32 VDC to function. Model number 20001990 requires 7 - 14 VDC to function. Any external power sources may be used as long as they meet UL class B standards for power supplies. The DTM provides a Molex® 2 pin female header connector for DC power into the DTM. The Molex® Mini-Fit, Jr™ header (P/N 39-30-1022) mates with Molex® Mini-Fit, Jr™ receptacle (P/N 3901-01-2025).

DTM Antenna Options

The DTM can be configured with a variety of different antennas. If the DTM is to be mounted on a desk top, a suitable mobile antenna can be used. If an outside antenna is required, a suitable omni-directional may be used. The DTM provides the installer with a female SMA connector for attaching an external antenna. The SMA connector may be connected directly to a mobile antenna or it may be connected to a coax cable which connects to a distant stand alone antenna.

Required Hardware

The following is a list of the hardware that is required to install the DTM on a flat surface.

If the DTM is to be mounted on a metal panel or other similar flat surface the requirements are as follows.

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Qty	Size	Type
2	#8 - 32 X 1 1/2"	Phillips Round Head (Zinc Plated or similar material).
2	#8	Hex Nut (Zinc Plated or similar material).
2	#8	Spring or Split Washer (Zinc Plated or similar material).
2	3/16" I.D., 7/16" O.D.	SAE Washer (Zinc Plated or similar material).

Refer to figure xxx for DTM mounting hole dimensions.

For wood or similar material type applications the following hardware is required.

QTY	Size	Type
2	#8 x 1"	Phillips Round Head (Particle Board screw).

There is no requirement to pre-drill when particle board screws are used.

For installation on concrete or brick type applications the following hardware is required.

QTY	Size	Type
2	#8 x 1 1/4"	Phillips Masonry Screw
2	3/16" dia x 15/16"	Metal Anchor

Use a 13/16" masonry bit to drill two holes for the metal anchors. Refer to figure xxx for proper hole placement.

Required Tools

1 #2 Phillips Screwdriver

1 Small Bubble level

1 5/16" Open End Wrench

1 13/16" Masonry Bit

1 Pencil or Marking Pen

Figure 7 displays the dimensions that should be used when the mounting surface must be pre drilled.

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Figure 7, DTM Mounting Holes (in inches)

Subscriber Identity Module (SIM) Location and Installation

To access the SIM card carrier slide the SIM access cover away from the DTM housing then lift up on the cover. The SIM access cover is designed to remain attached to the DTM housing. Install the SIM card in the SIM card carrier with the contacts facing down. Close connector and slide carrier away from the Omnipoint ® logo (located on the DTSA) until it latches. Close the SIM access cover and slide it back into the locking position until it snaps shut .

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Figure 8, DTM SIM Access

Installing the External Antenna

There are a number of antennas designed to be used with the DTM. If the DTU is to be mounted on a desk top then the bi-directional mobile antenna is to be used. If coverage is poor then the use of an external antenna may be required, such as the omni-directional antenna. This antenna has a gain of approximately 7dBi or 9dBi and a beamwidth of 180 degrees.

Figure 5.0 depicts a directional device. Ideally the external omni-directional antenna is to be mounted on a roof top or on the side of a building.

DANGER! AVOID POWER LINES!

When following these instructions to install and connect the antenna, take extreme caution to avoid contact with overhead power lines, lights and power circuits. Such contact could be fatal.

Figure 9, External Directional Antenna

> *NOTE: All antennas must be professionally installed. The installer is responsible for assuring that the proper antenna is installed so that the limits of FCC §15.203 are not exceeded.*

The installer should identify a suitable mounting location. At a minimum it is recommended that the GSM operator provide coverage maps indicating that the installation site is in a covered area. It is also recommended that coverage in the area be verified at the time of installation with a GSM handset. The antenna should be installed in a location where it will provide the best signal strength quality to the DTM.

> *NOTICE: In order to comply with FCC regulation, combined antenna gain and cable path loss cannot exceed +3dB. Refer back to section 2.1.10*

Installing the Cables

The service provider will determine the selection of the antennas and cable. Installation of these items should be in accordance with the manufacturer's instructions, the National Electrical Code, applicable building codes, and general industry standards and practices. All cables require routing in such a manner , so as to be free from any obstacles, injury to shielding , or to cable casing , or any other type of interference that may cause the cable to undergo later damage. Cable lengths are determined by the DTM location and its distance from the antenna. With emphasis on freedom from obstacles, and the aesthetic guide lines required by site management.

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Power Connection

DTM model number 2000-1990 is designed to be powered from an external 7 - 14 volt DC power supply. DTM model number 2000-1000 is designed to be powered from an external 7 - 32 volt DC power supply. Power may be supplied to the DTM through the use of the 2 pin Molex® connector. Refer to figure 6.

Antenna and Cable Grounding

Antennas and cabling should be grounded in accordance with section 810 of the National Electrical code, and any other applicable national or local codes, including industry standards.

RS232 Connection

Communication with external devices is made through the RS232 interface. This supports both the CPE/Local interface and diagnostic servicing. The physical connector is a D-Sub 9 . The I/O interface supports autobaud capability from 300 BPS to 9.6 KBPS. The D-Sub 9 is a female connector which is located on the PCB or Redhawk™ on the DTM.

Care and Maintenance

The Omnipoint DTM is intended to be used as an internal module.

- The internal components of the DTM must remain free and dry of moisture.
- Avoid extreme temperature changes during use. Extreme temperature variations may cause humidity to form within the enclosure which may cause the internal components to corrode.
- Avoid installing the DTM in extremely cold locations.

There is no external or internal maintenance required on the DTM.

Applicable Documents

NEMA standards publication number 250 - 1991 (Enclosures for electronic equipment)

Trouble-shooting Tips

In the event that the DTM fails to initialize, verify that the following conditions have been met.

- Verify that there is a SIM card and that it has been properly installed.
- Verify that the antenna type used has been properly connected.
- Verify that the RS232 cable is securely attached and that it has been properly wired on the CPE end. Refer to Technical Specifications, Interface in the main section for pin-out configuration out of the 9-pin, D-Sub connector on the Redhawk™ board.

Shipping

The DTM will be shipped in one box. The DTM will be fully assembled.

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APPENDIX C: DTU INSTALLATION AND SERVICE

> *NOTE: This section is intended for authorized personnel only. Installation and servicing of this equipment should be performed only by personnel who are trained and certified with the equipment, tools and processes required..*

Scope

These installation instructions apply to DTU Model numbers 2001-1990, 2001-1000,2001-1991, 2001-1001, 2001-1992 and 2001-1002.

The focus of this document is to detail the provisioning , installation, commission and maintenance aspects of the DTU.

To detail these requirements it is necessary to understand the relationship of the GSM network and the DTU. Broken down these relationships include :

- The requirements of the service providers.
- The venues for deployment.
- The requirements of the customer.
- The requirements of site engineering.
- The requirements of the personnel who will actually be installing, commissioning and maintaining the DTUs.

DTU Connectivity and Provisioning Requirements

General Product Description

The basic DTU package consists of the following major components:

- DTU enclosure
- GSM Radio Module(Redhawk^{TM}).
- Integral A/C interconnect box.
- Power Supply.
- Internal Patch Antenna with cable.
- Female D-Sub 9 connector for RS232 interface.
- (Optional) Female N-type Connector for external antenna interconnect.
- (Optional)External Antenna
- (Optional) Lightning protection for external antenna.

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DANGER! 100 - 240 VAC PRESENT IN ENCLOSURE.

The power supply and AC interconnect areas shall only be accessed by authorized personnel. All power into the Data Terminal Unit must be disconnected prior to accessing the power supply and AC interconnect areas. Failure to do so may result in serious injury or death.

DANGER! AVOID POSSIBLE SHOCK

To avoid possible shock, the power supply and the AC interconnect areas shall not be accessed during operation. To avoid possible shock, do not open the DTU in the presence of rain, snow, splashing water or anytime that water may potentially enter the enclosure. It is permissible for authorized personnel to open the enclosure door to verify that the DTSA is operating properly. Refer to the Status Indication in the main section of this manual.

DANGER! AVOID POWER LINES!

When following these instructions to install and connect the antenna, take extreme caution to avoid contact with overhead power lines, lights and power circuits. Such contact could be fatal.

PERSONAL SAFETY

Always wear safety goggles and other appropriate protective apparel when installing this equipment or working with tools. Always use appropriate tools and equipment when installing or servicing this equipment.

POWER SUPPLY FUSE

The DTU power supply comes with an internal fuse for over-current protection. Verify that the AC input power has been shut off before attempting to replace the fuse. In order to access the fuse the power supply cover must be removed. The fuse is located on the top side of the power supply board. If the fuse must be replaced use only 3.15A, 250VAC High-Break type fuses. Refer to figure 10 for fuse location.

Connections and Grounding

Installation of the DTU, antennas, and cables must be done in accordance with National Electrical Code.

DTU Location

Prior to the installation of the DTU a site survey must be performed in order to determine the best location for the DTU. The installer should refer to GSM coverage maps to assure that the installation site is in a covered area. The maximum cable length allowed for the RS232 cable is 50 feet. If an external antenna is required, locate the DTU within 50 feet of the customer interface. If the internal DTU antenna is be to used, the DTU should be installed in a manner and location that will allow the for the best possible reception.

External Antenna Installation

Ideally the antenna location should be selected so that the antenna has an unobstructed line of sight to the basestation selected to serve with this installation site.

> *NOTE: All antennas must be professionally installed. The installer is responsible for assuring that the proper antenna is installed so that the limits of FCC §15.203 are not exceeded.*

Cable Routing

When surveying the site for antenna installation, verify that there is an adequate path for antenna cables to be routed and securely attached from the antenna to the DTU.

General Installation Considerations

The DTU requires AC power to function. The internal power supply has an input range of 100 to 240 VAC and an input frequency range of 50 to 60 Hz. (Operation with line variations from 90 - 264 VAC is acceptable.) The output voltage of the internal power supply is rated at 12 VDC.

Communication with the DTU is accomplished through the use of GSM-AT commands over an RS232 port. The DTU requires an RS232 cable terminated with a DB-9 male connector at the DTU end in order to communicate with CPE. The connector on the opposite end of the RS232 cable is dependent upon the CPE interconnect requirements.

If an external antenna is to be used it must be connected to the N type female connector. The N-type female connector is an optional accessory.

The DTU is intended to be installed outdoors on a vertical plane with interconnect ports facing down. The DTU external operating temperature range is from -40°C to 65°C for the industrial version and -20°C to + 65°C for the commercial version. The DTU is rated between 5-95% relative humidity.

Installation Surface

The DTU may be installed on any sturdy vertical surface such as:

- Masonry
- Paneling
- Plaster board (Sheet rock, Gypsum, Drywall)
- Hardboard
- Wood
- Particle board
- Wafer board
- Heavy gauge sheet metal
- Concrete

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> *NOTE: The material used should be strong enough to support 10 pounds of vertical weight.*

Adequate space should be available so that cables and power lines can be properly placed during installation.

Subscriber Identity Module (SIM) Location

The DTU will not operate without a SIM card. Refer to Figure 10 for SIM card location and installation. Install SIM card in SIM card carrier with contacts facing down. Close connector and slide carrier toward the power supply until it latches.

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Figure 10, DTU SIM Access

Emissions

The DTU should not exceed the FCC RF emissions of 2W EIRP (+33dBm). Maximum output power has been specified at 30dBm ±2dB. In order to comply with the FCC requirement the total path gain (antenna nominal gain - coax cable loss) cannot exceed 33dB. Therefore any combination of antenna gain and cable attenuation can be used as long as the (3dB path gain + 30dB DTU output power) is not exceeded.

> *NOTE: The total output power of this device is limited by FCC regulation to 2 Watts (+33 dBm) EIRP. In no case should combined antenna gain and cable loss exceed 3dB.*

Coax Cable

The DTU is designed to be installed as quickly and as economically as possible. In most cases RG223 or similar small diameter cable can be used. However, in very short runs, it is possible to exceed the FCC RF emissions limitation of 2 Watts (+33 dBm) EIRP. In such cases additional attenuation must be introduced into the path gain. This can be achieved either with in-line attenuators, or more economically, simply by adding more cable length.

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

$L = |g - 3|/a$

where L = required minimum cable length

g = antenna gain (Per antenna manufacturers specifications).

a = attenuation per foot of cable. (Per cable manufacturers specifications).

If the antenna has less than 3dB gain, there is no risk of exceeding the FCC emission limit.

Antenna

The internal or external antenna location for DTU installation is dependent on individual site conditions. As a general rule the antenna should be positioned so that a reliable radio connection can be made with the GSM network; ideally with more than one basestation. The installation of narrow beamwidth directional antennas should generally be avoided due to the dynamics of basestation deployments.

> *NOTE: All antennas must be professionally installed. The installer is responsible for assuring that the proper antenna is installed so that the limits of FCC §15.203 are not exceeded.*

OUTDOOR ANTENNA GROUNDING:

Any outdoor antenna used to receive DTU signals and its connecting cables are required to be grounded by the National Electrical Code (NEC) - specifically articles 250, 800, 810, 820. If the DTU is to be mounted inside a building, the codes require proper grounding of the cables at the point where they enter a building. Local building codes may also be applicable. For clarification on either local or national grounding requirements, contact the state or county inspection officials.

DTU Installation

This section consists of the physical installation requirements of the DTU, coax cables, RS232 cable and power cable. The DTU can be installed on any sound vertical surface. The DTU is designed with two ½" NPT holes (7/8" diameter): one has been designated as AC power input while the other is intended for RS232 cable access. A third hole has also been provided for an external antenna Type-N connector(21/32" diameter). Refer to Figure 11.

> *NOTE: The surface must be able to support 10 Lbs. in a vertical position.*
>
> *Do Not Install DTU near heat sources to prevent overheating of the DTU components.*
>
> *DTU should be installed 24 inches minimum from the ground to permit operator access.*

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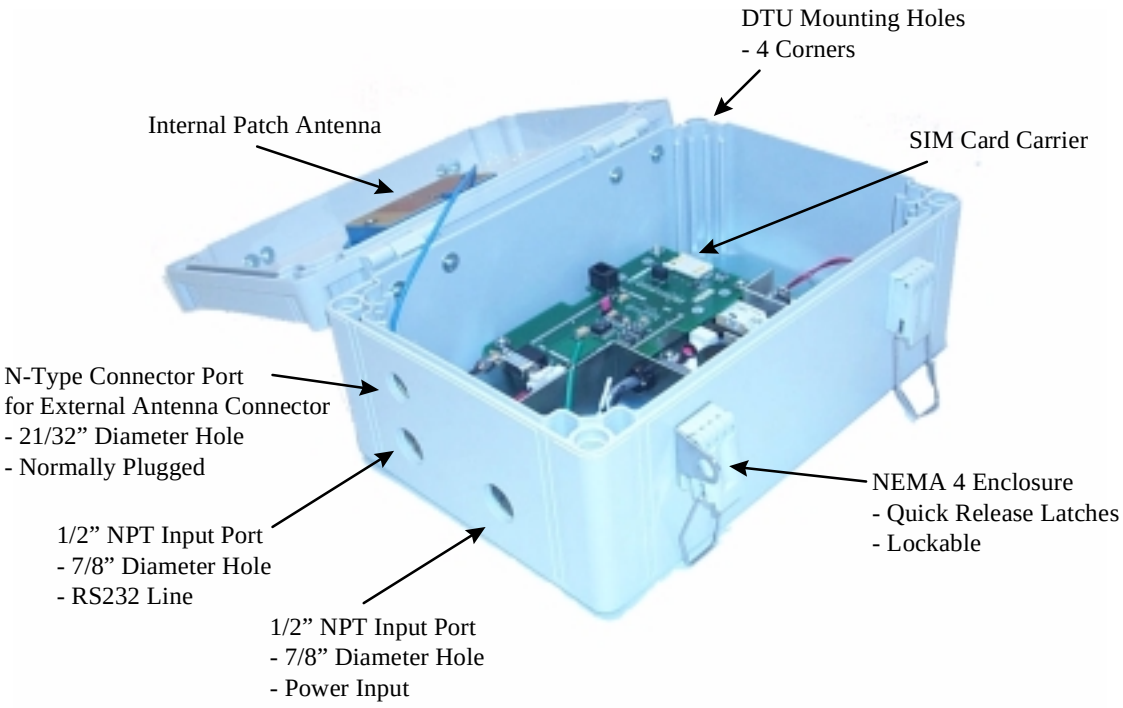

Figure 11, DTU

Required Hardware

The following is a list of the hardware that is suggested to install the DTU on a flat surface.

If the DTU is to be mounted on a heavy gauge metal plate or other similar flat surface the following hardware is suggested.

Qty	Size	Type
4	#10-32 X 1 1/2"	Phillips Round Head (Zinc Plated or similar material).
4	#10	Hex Nut (Zinc Plated or similar material).
4	#10	Spring or Split Washer (Zinc Plated or similar material).
4	13/64"I.D., 1" O.D.	Fender Washer (Zinc Plated or similar material).

Refer to Figure 12 for dimensions if drilling is required.

For wood or similar material type applications the following hardware is suggested.

QTY	Size	Type
4	#10 x 1 3/4"	Phillips Round Head (Particle Board screw).

Use a 1/8" wood bit to drill the holes for the four mounting screws. Refer to Figure 12 for proper hole placement.

For installation on concrete or brick type applications the following hardware is required.

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4	#10 x 1 ¾"	Phillips Masonry Screw
4	¼" dia x 1"	Metal Anchor

Use a ¼" masonry bit to drill four holes for the metal anchors. Refer to Figure 12 for proper hole placement.

Required Tools

- 3/8" Wrench or Socket
- #2 Phillips Screwdriver
- Small Bubble level
- 5/16" Open End Wrench
- ¼" Masonry Bit
- 1/8" Wood Bit
- Pencil or Marking Pen
- Power drill

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Figure 12, DTU Mounting Hole Dimensions

Installing the External Antenna

The standard antenna for deployment of a DTU is an internal patch antenna. This antenna is a directional antenna with a gain of approximately 4 dBi and a beamwidth of 180 degrees. If the deployment demands an external antenna, either due to poor signal strength or RF visibility to a GSM base station, several choices exist.

Antenna options include an omni-directional antenna and directional antennas with gains of 4 dBi or 7 dBi. Figure 13 depicts a directional antenna.

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Figure 13, External Directional Antenna

DANGER! AVOID POWER LINES!

When following these instructions to install and connect the antenna, take extreme caution to avoid contact with overhead power lines, lights and power circuits. Such contact could be fatal.

If an external antenna is required, then the DTU with optional N-type female cable assembly must be used. The installer should identify a suitable mounting location. At a minimum it is recommended that the GSM operator provide coverage maps indicating that the installation site is in a covered area. It is also recommended that coverage in the area be verified at the time of installation with a GSM handset. The antenna should be installed in a location where it will provide the best signal strength quality to the DTU.

> *NOTE: In order to comply with FCC regulation, combined antenna gain and cable path loss cannot exceed +3dB. Refer back to section 2.1.10*

Installing the Cables

The service provider will determine the selection of the antennas and cable. Installation of these items should be in accordance with the manufacturer's instructions, the National Electrical Code, applicable building codes, and general industry standards and practices. All cables require routing and installation in such a manner , so as to be free from any obstacles, so as to prevent injury to shielding or to cable casing , or any other type of interference that may cause the cable to undergo later damage. Cable lengths are determined by the DTU location and its distance from the antenna. Antenna location shall be selected with emphasis on freedom from obstacles, and the aesthetic guidelines required by site management.

Power Connection

> *CAUTION: VERIFY THAT THE POWER SOURCE IS OFF BEFORE ATTEMPTING TO MAKE ANY CONNECTIONS !!!*

NOTE: To maintain NEMA 4 environmental rating, use only fittings rated to NEMA 4 standards and installed according to manufacturer's recommended procedures. To maintain the DTU enclosure flammability rating (UL94-5V), install only NRTL (UL® or CSA®) approved conduit and fittings rated for UL94-V2, V1, V0 or 5V flammability such as Hubbell® Liquidtight® series fittings or Heyco Products Inc. Liquid Tight fittings

DANGER! 100 - 240 VAC PRESENT IN ENCLOSURE.

The power supply and AC interconnect areas shall only be accessed by authorized personnel. All power into the Data Terminal Unit must be disconnected prior to accessing the power supply and AC interconnect areas. Failure to do so may result in serious injury or death.

The DTU is designed to be powered from 100 VAC to 240 VAC, 50/60 HZ sources. Operation with line variations from 90 to 264 VAC are acceptable. Power may be supplied to the DTU through the use of ½' NPT conduit. Internally the DTU power supply cover must be removed in order to connect AC power to the DTU. Three wire nuts are provided within the power supply enclosure for quick installation. The DTU uses a standard wiring configuration for connection to the outside environment (black = HOT, white = NEUTRAL, green = GROUND). These wires have been pre-stripped for ease of installation. Refer to Figure 14.

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Figure 14, DTU Internal Layout

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NOTE: The AC Input Power to the DTU must be installed in a NEC approved conduit system which also meets NEMA 4 ratings. For this type of installation, a switch box must be provided which meets NEC requirements for "Permanent" installations. The switch box must be located "line-of-sight" with the DTU and must be located within 16 feet of the DTU.

Optionally, a power cord terminated with a grounding plug may be used provided:

1) The cord is adequately terminated using a strain relief fitting that is NRTL certified, that is rated for NEMA 4 environmental protection, and that meets UL94-V2, V1, V0, or 5V flammability requirements.

2) The maximum cord length is less than 1.5 meters..

Antenna and Cable Grounding

Antennas and cabling should be grounded in accordance with section 810 of the National Electrical code, and any other applicable national or local codes, including industry standards.

DTU Grounding

The DTU will be grounded through the AC input power line. The DTU has a single-point ground scheme whereby the AC-input ground and all internal component grounds are connected to the metal chassis.

RS232 Connection

Communication with external devices is made through the RS232 interface. This supports both the CPE/Local interface and diagnostic servicing. The I/O interface supports autobaud capability from 300 bps to 9.6 Kbps. The connector is a female D-SUB 9 connector which is located on the Redhawk™ DTSA radio module inside the DTU. The RS232 cable, which is to be supplied by the user, must have a male D-SUB 9 connector on one end and remain open on the other end to allow the cable to be fed out of the DTU. The cable should be installed on the DTU side first then fed through the ½" NPT fitting to the user's equipment. The use of Heyco® Liquid Tight fittings (P/N 3231 or equivalent) in conjunction with an adequate sealing washer (Heyco® P/N 3260 or equivalent) is recommended to provide adequate strain relief and NEMA 4 sealing for the RS232 cable. Optionally, a suitable NEMA 4 rated and UL94 rated conduit system may be used to route and protect the RS232 connection.

- Appropriate strain relief fittings should be used to maintain NEMA 4 rating.
- Use only UL 94 - V2, V1, V0 and 5V rated hardware to maintain UL flammability requirements.
- Sealing washers must be used on all external ports to form a water tight seal between the fittings and the enclosure.

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> *NOTE: The DTU has a environmental rating of NEMA 4 and a flammability rating of UL94-5V. To maintain the NEMA 4 environmental rating, use only fittings rated to NEMA 4 standards and installed according to manufacturer's recommended procedures. To maintain the DTU enclosure flammability rating, (UL94-5V), install only NRTL (UL® or CSA®) approved conduit and fittings rated for UL94-V2, V1, V0 or 5V flammability such as Hubbell® Liquidtight® series fittings or Heyco Products Inc. Liquid Tight fittings.*

Care and Maintenance

The Omnipoint DTU consists of a NEMA 4 rated enclosure. To preserve the life of the internal electronics, the enclosure door should remain closed with the latches secured during operation. The following recommendations have been provided to ensure the longevity and robustness of the DTU.

- The internal components of the DTU must remain free and dry of moisture. Installation and service should only be performed when there is no possibility of water intrusion into the DTU interior.
- Avoid extreme temperature changes during use. Extreme temperature variations may cause humidity to form within the enclosure which may cause the internal components to corrode.
- Avoid installing the DTU in extremely cold locations.

There is no internal or external cleaning required on the DTU.

Applicable Documents

NEMA standards publication number 250 - 1991 (Enclosures for electronic equipment)

Trouble-shooting Tips

In the event that the DTU fails to initialize, verify that the following conditions have been met.

- Verify that there is a SIM card and that it has been installed properly.
- Verify that the antenna has been properly connected.
- Verify that the RS232 cable is securely attached and that it has been properly wired on the CPE end. Refer to the Technical Specification, Interfaces in the main section for pin-out configuration out of the 9-pin, D-Sub connector on the Redhawk™ board.

Shipping

The DTU will be shipped in one box. It will be fully assembled and depending upon the customers request it may be shipped with or with out the following in no particular arrangement.

N-Type antenna connector, 2 liquid tight fittings.

No connectors, 1 environmental plug on the antenna port, 2 shipping plugs on the RS232 and AC Ports.

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Any combination of the above.

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