User Manual

For the

PM-H

Vehicle Tracking Device

November28, 2017

R1.0

Author	Revision	Changes	Date
	1.0	Initial version	2017-11-28

Contents

1 Introduction

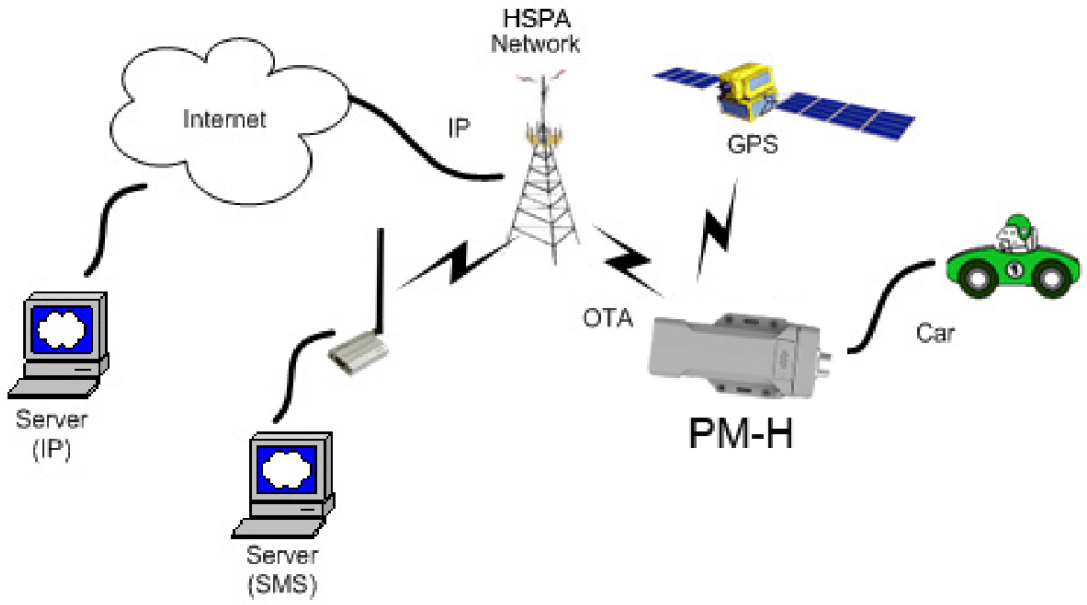
ThePM-His a self-Contained vehicle tracking device that combines GPS location with GSM/GPRS/WCDMA connectivity.

ThePM-H appears to a user or a server application as a single endpoint device. It can be queried, updated and configured either through a serial connection, or an over the air GPRS or WCDMA IP connection, or through SMS messaging. ThePM-Hpresents itself over these connections as an enhanced cellular modem with attached functional elements. These elements include:

- GPS location engine
- 1 General Purpose Bidirectional I/O (GPIO) pin
- 1 Relay drive pin output
- 1 1-Wire Bus Interface
- 3.3V Power out for Peripheral Sensors
- Serial UART port
- Input voltagesand Battery Voltage monitor
- Timers
- Watchdog lockup protection
- Motion detection

Access to these elements and general-purpose interfaces is done through an extended AT command set as defined herein.

Application scene:



- This product will be designed based on the 2G or WCDMAwirelessdata/MT6276 Baseband chipset, which includes GPS functionality, ARM CPU and GPRS protocol. This baseband internal connection 8M serial flash, GSM 900M/1800M/GPS RF Transceiver, and RF Front end circuit.

The device will use one dual band antenna (GSM900&PCS1800) and one dedicate GPS antenna.

2 Hardware Design

2.1 Basic Hardware

Items	Requirement
Baseband Chipset	MT6276A
RF 2G Transceiver	RF3235
RF 3G Transceiver	RF7411TR7
Memory	MCP_NAND 1Gb(x16) / mobile DDR 512Mb(x16)
Air Interface	Supportfor WCDMA Class 12 GPRS, GPS
Frequency	2G band support :GSM850 and PCS1900 Support for 12 class GPRS 3G band support : Band2 and Band5
Antenna	Internal Antenna[850M&1900M]
GPS Antenna	Dedicate high performance ceramic antenna
UIM requirement	No-UIM mode, GSM card connector optional
Interface	UART TX
	UART RX
	12V DC Input (1.2A max current) Main/Aux/Solar inputs
	Relay Drive (Open Drain ,500mA current)
	GPIO1
	1-Wire Bus Interface
	3.3V Power out
Voltage/Battery Monitor	internal analog input scaled
Build in battery manager	Supported
Dedicate Timers	No
Watchdog	Supported
Motion Detect	GPS/Accelerometer
LED	3 LED's (Red, Green, Orange)
Battery	Built in battery (4400mAh Lion)
Working Time	>40 hours (Continuously On) > 250 days Standby
Power switch	No
Power Cable color	12 colors
Power Cable connector type	12pin

Power Consumption	< 5Watts

The PM-Hprovides support for specialized hardware features through extended AT commands. The features supported include the following.

GPS

The major functionality of the GPS module is to compute the correlation results between the incoming signal and the selected PRN code based on certain Carrier Doppler Frequency, Code Doppler Frequency, code phase, carrier phase, and the particular satellite the module is tracking or acquiring.

GPIO

The GPIO pin, is presented to the external environment on the main connector. It is a general purpose bidirectional line capable of providing system interrupts to generate a report or drive logic levels to external devices. This line is 3.3V logic level input or output with transient voltage protection and internal pull-up resistor. GP1 is intended to use for a Door open sensor.

LED's

Three LED status indicators are provided to verify correct installation and operation. The status LEDs are color coded and directly convey the status of the cellular and GPS subsystems as described in the table below. Their valid operation also indicates operational status and power.

LED	Function	Status
Red	GPS	**On: GPS satellites acquired and Locked** **Flash Slow**: GPS satellite search is in progress **Off: No power or GPS subsystem fault**
Green	GSM/GPRS Connection	**On: Indicates GPRS connection is made** **Flash Slow**: GPRS subsystem initialized but no connection **Flash Fast**: GPRS initialization in process **Off: No power or GSM subsystem fault**
Orange	battery charging	**Orange LED is Flashing to indicate charging**

The PM-H provides user control allowing the LEDs to be extinguished once installation is verified. This feature reduces power and further conceals the PM-H Tracker from untrained parties wishing to defeat its operation.

UART

A UART port is provided for AT command and data interaction and optionally for connection to peripheral sensors

Relay Driver

A 500mA sink capable output pin is provided. This pin is meant to drive a relay coil indented to operate a door opening device.

1-Wire Bus Interface

The 1-Wire bus interface can be connected to sensors that support the 1-wire serial protocol such as Temperature sensors or driver identification.

3.3V Power Out

3.3V Power output is available to power peripheral sensors such a cargo sensor. The power is turned on only when the peripheral sensor is being read to save power.

Input Voltage and Battery Voltage Monitor

The Input Voltage monitorsand battery voltage monitor are internal analog inputs scaled such that the DC value of the voltage input pin to the PM-H system and internal battery voltage is measured. This value is scaled to span the most significant 8 bits of the A/D and consequently covers a scale from 0 to 32V for Input Voltage and 0 to 9V for internal battery voltage

Timers

Timers resident on the GSM baseband chip generate periodic interrupts for power down wakeup, watchdog support, report generation and other timer related functions. Report timers are supported by related AT command and cause generation of periodic reports.

Watchdog

MT6276 chipset provide internal software Watchdog, and a physically dedicate Watchdog circuit requirement is optional.

Motion Detect

Configurable through AT commands the unit can go to a low power mode when the main power is removed until motion is detected. Upon wakening, a report can then be generated, and the GPS enabled to detect drive events.

2.2 Basic RF Performance

Items	Requirements	Remark
TRP free space	>= 20 dBm	TRP free space
TIS free space	<= -104dBm	TIS free space
Antenna loss	<= -3dB	TRP-TX Power Conducted
Antenna Loss	<= -3dB	RX receive sensitivity conducted – TIS

2.3 Certification and Safety

Items	Requirement
Drop Design	1.2meter 6 direction standard drop test
Temperature Range	-20 to 65C Operation -40 to +85° C Storage
Humidity:	20% to 90% Operation 10% to 95% Storage

Altitude:	-500 to +18,000m
Vehicle ISO Test	ISO7637-2-2004; ISO7637-3-2007; ISO10605-2008; ISO16750-2-2010
FCC Certification	FCC 47 CFR Part 15 ,Part2,Part 22,Part 24
Others Operator Requirement	Industry Canada/ AT&T (optional)
ESD Requirement	10KV non-Conductive

3 Software Features

3.1 Basic Software

Items	Requirement
Air Interface	GSM850, PCS1900, WCDMA Band II, WCDMA Band V，GPS
GPRS Data	Supported
IP Stack	Ipv4/IPV6
Upgrade Method	Remote update/ PC tool
Remote Update	Supported
Power Modes	Supported
AT Command	Supported
Report	Supported；3000records
Driver	GPIO，LED，GPS，UART，3.3V out
GPIO	Interrupt for Door Open Detect
LEDs	GPS Status, WCDMA Status
Watch Dog	Supported
Reset	Soft reset
Startup Banner	Supported

3.2 Remote Update

The PM-Hsupports OTA field upgrades of the PM-Hresident application. An over the air TFTP (Trivial File Transfer Protocol) connection is made over a UDP/IP connection. A replacement file is then transferred from a server to the PM-Hand that file replaces the previous application image.

3.3 Auto Execute

The Auto Execute Utility copies the contents of file system.exf into system executable RAM and executes it from there. This file is the factory default application. Another file named custom.exf can be loaded into the file system.

Auto Execute will look first for a file named update.exf and load and execute that in place of custom.exf if it exists. If update.exf executes successfully, the previous copy of custom.exf is deleted from the file system and update.exf is renamed to custom.exf.

3.4 Power Modes

The PM-H device supports several power modes that are set by the power mode command. In full power mode the GPS is active and the cellular subsystem will maintain a persistent cellular connection whenever service is available. IP connection is maintained according to

the configuration of the device.

The device can be put into several levels of low power mode whenever it runs on the internal backup battery, or if the external input voltage is low or if it is not movingdepending on how the unit is configured through AT commands.

Power Mode	Cellular	GPS
Full Power (Track)	On	On
Listen	On	Off
Stealth	Off	Off

The device would return to full power whenever an event occurs that triggers a report. Those events include:

- Report timer
- GPIO change
- IP change
- Battery threshold
- Heartbeat
- Watchdog
- Power-up
- Motion Detected

Any hardware or software reset will return the device to full power mode.

3.5 Report

The PM-H captures data and forms a report record with that data. A report is a data structure containing all of the sensory and other typically useful data on the device. Reports are generated in response to specified events, such as periodic timeout, speed threshold, geo-fence crossing, etc., or in response to a Report Now command (AT+XRN).

Report Queuing

If a report trigger occurs while UDP connection is unavailable, it will be queued until connection becomes available and transmitted at such time. The only way report(s) can be lost is if too many reports are queued and the report-queue is overflowing. In such case the earliest report(s) will be discarded. The size of the queue can be configured via the Report Queue (AT+XRPQ) command.

Ack'ed Mode

UDP is not a 100% reliable connection and occasional reports or command/responses may be lost. Since all commands have responses, the server can repeat any command to which there is no response. In order to assure reliable reception of reports, Arsenal devices can be configured either in Normal or Ack'ed mode to send the reports. In the Normal mode the reports are simply sent "as is" with no acknowledgment from the server. In the Ack'ed mode every report sent is expected to be acknowledged by the server by sending back an ACK message back. If acknowledgement is not received within the specified timeout, the report is

re-sent. If the report is not acknowledged after the specified number of attempts, it is queued. If acknowledgement is received after the report is queued (i.e. past timeout of the last attempt), it is ignored.
Report is not considered “complete” until its acknowledgement is received. Thus, if report X is sent and report X+1 is triggered while waiting for acknowledgement of X, report X+1 will be queued until such acknowledgement is received and only then sent. The Arrow will attempt to re-send queued report(s) every time a new report is triggered. If there is more than one report queued, the reports will attempt to be sent in the order of triggering and only once the report is acknowledged, the next report is attempted. This assures that reports are sent and received in order.

Ack’ed mode assures that all reports are received, but adds overhead in time and data. Report that is not acknowledged is sent again and eventually will be queued and sent again. The number and frequency of re-tries is configurable via the Report Acknowledgement command (AT+XRPA).

Event Report Format

Reports can be generated in either an ASCII representation of hex or as actual binary encoded hex. The reporting format is selected via Report Format (AT+XRPF) command. Note that whilethe logical content of the report is the same in both representations, the size for an ASCII report is twice the size of actual numbers of bytes compared to binary representation.

3.6 Reset

There are a number of resets available on the device. Soft reset resets the baseband only by using an internal watchdog, while hard reset power cycles the whole device. There is also an option to reset the GPS sub-system only.

Context Preservation

When a reset is caused by the Network Watchdog or by the Reset command (modes 0,1), the context of the system is being preserved and is restored after the reset. The context includes all the periodic timers, the report queue, the odometer, etc. This allows to reset the unit as a troubleshooting measure either periodically or due to Network Watchdog without losing reports that are already in the queue or are pending on running timers. Note that the reset process may cause 1-2min of inaccuracy in the timers and should not be considered as very precise.

3.7 Startup Banner

After a reset a startup banner is printed through the UART only. The format and content of the banner shown below:

PROD: PUMA-H
IMEI: 353782066499613
IMSI: 310410964436268
ICCID: 89014103279644362684

MDL: 3005R04
BIN: 2.0.6
APP: 3.2.4
IO: 1.1.2
CFG: 0025 Puma/Jaguar-HSPA-KORE
IP: "34.224.196.58",15030
LPORT: 17006
APN: C2.KOREM2M.COM
SIM: Detected

Ready

4 Test Method

4.1 Hardware

Test Item	Description
Baseband Function Test	• Power Input Test • Power Consumption and Current Test • Heat Dissipation Test • UART Stability Test • GPIO Level Test • LED Stability Test • Drop Down Test • ESD Test • High/Low Temperature Test • Humidity Test
RF Test	• RF Performance Test • GPS Performance Test • Antenna Performance Test

4.2 Software Test

Test Environment Construct

➢ Message Test environment

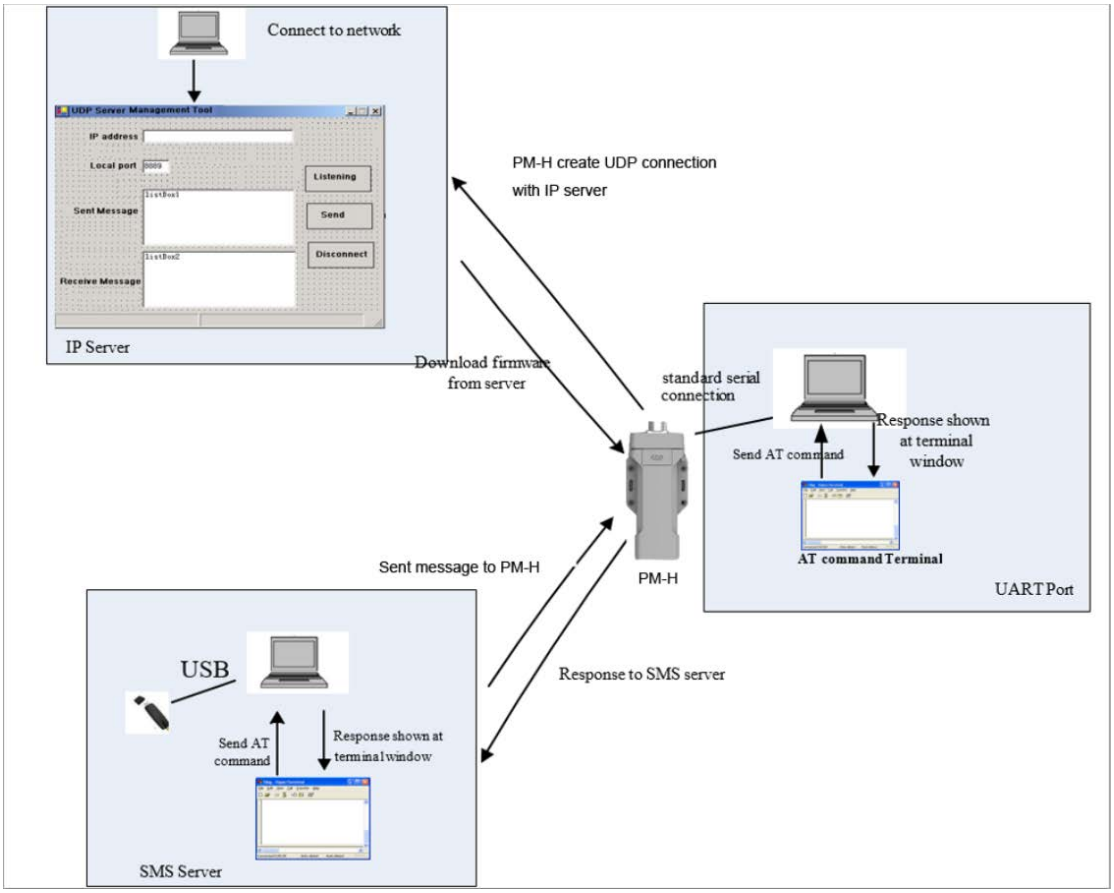
1. USB dongle and PC as message server
2. Send message to PM-H

➢ UDP Test environment

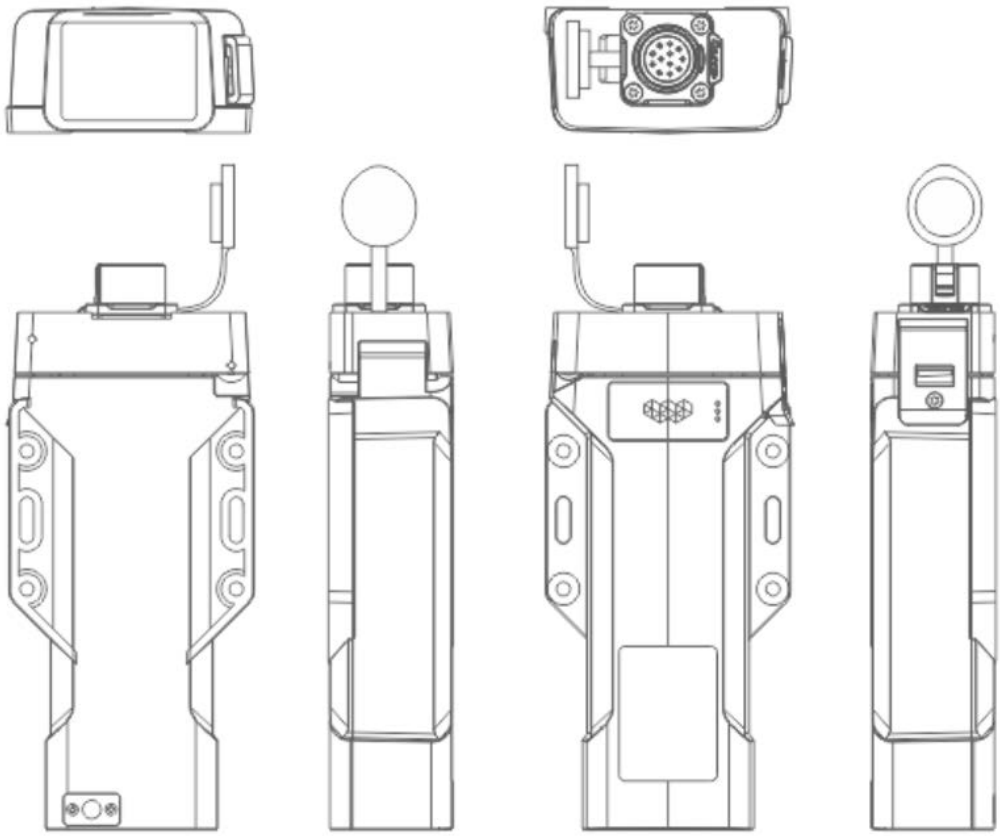
1. Connect dongle to PC and create dialup as ip server
2. PM-H create IP connection to server

➢ UART Test environment

1. Connect PM-H to pc with com serial cable
2. Open Terminal tool and send at command
3. Response can be shown at terminal window


Connect to network
UDP Server Management Tool
IP address
Local port
Sent Message
Receive Message
Listening
Send
Disconnect
IP Server
PM-H create UDP connection
with IP server
Download firmware
from server
standard serial
connection
Send AT command
Response shown
at terminal
window
AT command Terminal
UART Port
PM-H
Sent message to PM-H
Response to SMS server
USB
Send AT
command
Response shown at
terminal window
SMS Server

5 Mechanical Structure(mm) To be Updated



6 FCC Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

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

This device complies with part 15 of the FCC Rules. Operation is subject to the following two

conditions:
(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

RF Exposure Warning Statements:

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons during the normal operations.

7 IC STATEMENT

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
Le présentappareilestconforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitationestautorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareildoit accepter tout brouillageradioélectriquesubi, mêmesi le brouillageest susceptible d'encompromettre le fonctionnement.

In order to avoid the possibility of exceeding the IC radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

Afind'éviter la possibilité de dépasser les limitesd'exposition aux fréquences radio de la IC CNR102, la proximitéhumaine à l'antenne ne doit pas êtreinférieure à 20 cm (8 pouces) pendant le fonctionnement normal.