Product Specification

For the

Arrow Vehicle Tracking Device

By

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Authorized Recipients

Executive management as provided to and are bound by a Non Disclosure Agreement (NDA) in favor of Montage Asia or its agent and preventing disclosure or misuse of the confidential information herein.

Revision History

Revision	Date	Description

Scope

This document sets forth the basic technical requirements and feature set for the ion tracking device.

Description

The Arrow Tracker is a self contained, expandable, integrated commercial grade vehicle tracking device that uses GPS satellite location in combination with a quad band GSM/GPRS cellular radio connection to report that location. ion is optimized for reliability, cost and size. However, it remains highly flexible and capable of addressing diverse and specialized requirements through a novel expansion arrangement.

All antennas including the GPS patch and GSM helical antenna are internal to the device. Data reporting can be initiated by a command center or by the tracker itself via GSM/GPRS, SMS or UDP pathways.

The Arrow is unique in that it is intrinsically expandable. A screw fastened expansion door secures SIM card access as well an expansion connector and daughter board cavity. This port supports small integrated daughter boards with features such as motion detection, acceleration measurement or radio expansion through standards such Bluetooth, Zigbee or WiFi.

The Arrow also supports functional expansion by a side mount adapter. This adapter supports addition of physically large devices such as very large capacity batteries.

The Arrow is based on chip level design as opposed to using a module with an external processor. The application software executes on the base level Central Processing Unit (CPU) under direct Operating System (OS) control. This approach provides a much more reliable, lower power and faster response than module/processor architectures. Unlike in common module/processor based designs; the ion design allows direct operating system access by the application, thus mitigating the need for a redundant external processor.

For added redundancy against system lockup, a physically separate, dedicated watchdog chip oversees the ion system operation. If the system does not maintain the watchdog chip through programmed reporting, the system power is cycled and a new satellite and cellular connection is established.

The Arrow Tracker can be provisioned for UDP and SMS data services for both application command and data transactions within the 850, 900, 1800 and 1900 MHz GSM bands. Network provisioning is done with standard SIM cards. For added safeguard against network connection loss, a hardware ion endpoint reboot can be initiated by simply calling the provisioned phone number from a previously established Caller ID (CID).

Flexible I/O includes 2 bidirectional General Purpose Input Output (GPIO) ports that can also be assigned as a software Universal Asynchronous Receiver Transmitter (UART) port. A separate dedicated UART port is provided for general use as well as development and programming support. A high current relay drive is provided for starter motor relay control or general purpose drive (current sink only).

The power input, ground and GPIO signals that are present on the main 8 pin external vehicle connector are also available on the 8 pin internal expansion connector. On the internal connector, there is also a unique battery supply pin that supports connection of a rechargeable battery.

Over The Air (OTA) program updates are supported through Firmware Over The Air (FOTA) protocol. This server based update system is licensed from HP.

All inputs are electrically hardened against overvoltage and over current conditions present in automotive environments. This includes transient electrical noise and Electro Static Discharge (ESD). The power input is further protected against over current with an internal, self resetting fuse.

The Arrow enclosure and its features are secured using M2 sized metal fasteners for rugged mechanical performance. The daughter board expansion and vehicle interface are achieve through robust, commercial grade, pin to wire header connections (in contrast with leaf contacts commonly used in cell phones and other portable non-industrial systems).

The Arrow is physically disguised to appear to an untrained observer to be a nondescript part of the cabling system. It is a small black box with unremarkable features. Two LED status indicators are provided to verify correct installation and initial operation. A unique feature extinguishes those status indicators 24 hours after an initial power up sequence. This feature further conceals the ion Tracker from untrained parties wishing to defeat its operation. The status indicators resume normal operation after the primary power has been removed for any length of time. This allows for maintenance to be initiated by simply disconnecting and then reconnecting power. This feature may be disabled as a factory option.

The Arrow Tracker uses a simple cabling arrangement and supports splicing into an OBDII extension for power. Connection to the vehicle is made through a 3mm pitch rectangular header connection common to the automotive market.

As with all GPS location devices, the ion should be installed in a vehicle such that it has an unobstructed view of the sky during normal operation. Double sided foam tape can be used to secure the surface not facing the sky if needed.

Bullet Specifications

Cellular:	850/900/1800/1900 MHz Quad band
	GSM/GPRS Protocol CS-1, CS-2, CS-3 and CS-4
	Output power:
	Class 4 @ 850/900MHz
	> 24dB @ 850/900MHz (OTA TRP)
	Class 1 @ 1800/1900MHz
	> 26.5dB @ 1800/1900MHz (OTA TRP)
	Sensitivity:
	< -107dBm @ 850/900MHz (Chip)
	< -101dBm @ 850/900MHz (OTA TIS)
	< -106dBm @ 1800/1900MHz (Chip)
	< -103.5dBm @ 1800/1900MHz (OTA TIS)
	Antenna:
	Wire helix
	Meets minimum AT&T TRP/TIS requirements

Services:	GPRS Multi slot class 12
	SMS (Text):
	Point to point mobile originated and terminated
	Transport over GPRS
	UDP data
	DNS address resolution
	Dual APN access
	GSM circuit switched hard reboot (CID qualified)

GPS: L1-band (1.57542GHz)

Channels:

- 210 PRN
- 66 Search
- 22 Simultaneous tracking

Sensitivity (TIS):

- Tracking: -45dBm
- Reacquisition: -40dBm
- Acquisition: -40dBm

Sensitivity (UHIS):

- Tracking: -165dBm
- Reacquisition: -158dBm
- Acquisition: -149dBm

Acquisition time:

- Hot: <1.5s
- Warm: <34s
- Cold: <35s
- Reacquisition: <1.0s

WAAS:

- Position: <3m
- Velocity: >0.1m/s
- Acceleration: >0.1m/s^2
- Altitude: 18,000m (max)
- Velocity: 515m/s (max)
- Acceleration: 4G (max)

32 Geo fences

25x25x4mm patch antenna

I/O: One main port and one internal expansion port

All pins are 16V tolerant and ESD protected

Main Port:

- 8-Pin, 3mm pitch header
  - 3-Pins 2.8V GPIO
  - 2-Pin 2.8V serial UART
    - TX output
    - RX input
  - 1-Pin relay drive
    - -500mA drive
    - TVS overvoltage protection
  - 1-Pin power input:
    - 1.5A resetting fuse
    - TVS overvoltage protection
  - 1-Pin ground

Internal expansion:

- 8-Pin, 1.25mm pitch header
  - 3-Pins 2.8V I/O common with main GPIO port
  - 2-Pins 2.8V I/O GPS serial port (test only)
  - 1-Pin power input common with main port
  - 1-Pin ground common with main port
  - 1-Pin Li+ battery input to device

SIM: 6-Pin keyed insertion

LED:

- Red GSM status
- Green GPS status

Battery voltage measurement

Ambient temperature measurement

Power:	Vin:	
	9.0 – 16.0VDC (Main)	
	3.5 – 4.2VDC (Expansion)	
	Main:	
	Full Shutdown:	< 50µA
	Standby:	< 800µA (GSM Idle)
	GPS acquisition:	< 8.0mA (GSM Idle)
	GPS tracking:	< 6.0mA (GSM Idle)
	GSM dedicated:	< 92.0mA (GPS Off)
	GPRS max power:	< 183.0mA (GPS Off)
	Peak instantaneous	< 740mA
	Exp: 2.45 x Main	

Software:	Native ARM processor execution
	Montage proprietary application
	Extended AT command interface
	Easily configured reports to minimize data transport costs
	Based on proven GSM/GPRS modem stack
	Lockup protection:
	Independent watchdog with power cycle reset and reboot
	GSM circuit switched reset
	Flash memory:
	8MB for application and data storage
	2500 report log entries
	Serial port update
	Over the air update
	Development:
	Complete C language tool chain
	Serial to USB COM port support (custom supplied cable)

Physical:	Design:	Nondescript design
	Color:	Black
	Texture:	Light
	Material:	Acrylonitrate Ethylene Styrene + Polycarbonate
	Size:	91*39.4*12.8(mm)
	Weight:	TBDg
	Fasteners:	M2
	Expansion port:	
		Side mount
		Top hatch
	SIM:	Keyed retainer socket

Environment:	Temperature:
	-20 to 75° C Operation
	-50 to +100° C Storage
	Humidity:
	20% to 90% Operation
	10% to 95% Storage
	ESD: 10KV immune on all user accessible surfaces and ports
	Altitude: -500 to +18,000m
	Shock: 25G
	Vibration: TBD

Approvals: FCC 47 CFR Part 15 and Part 18
Industry Canada
UL Listing
PTCRB
AT&T

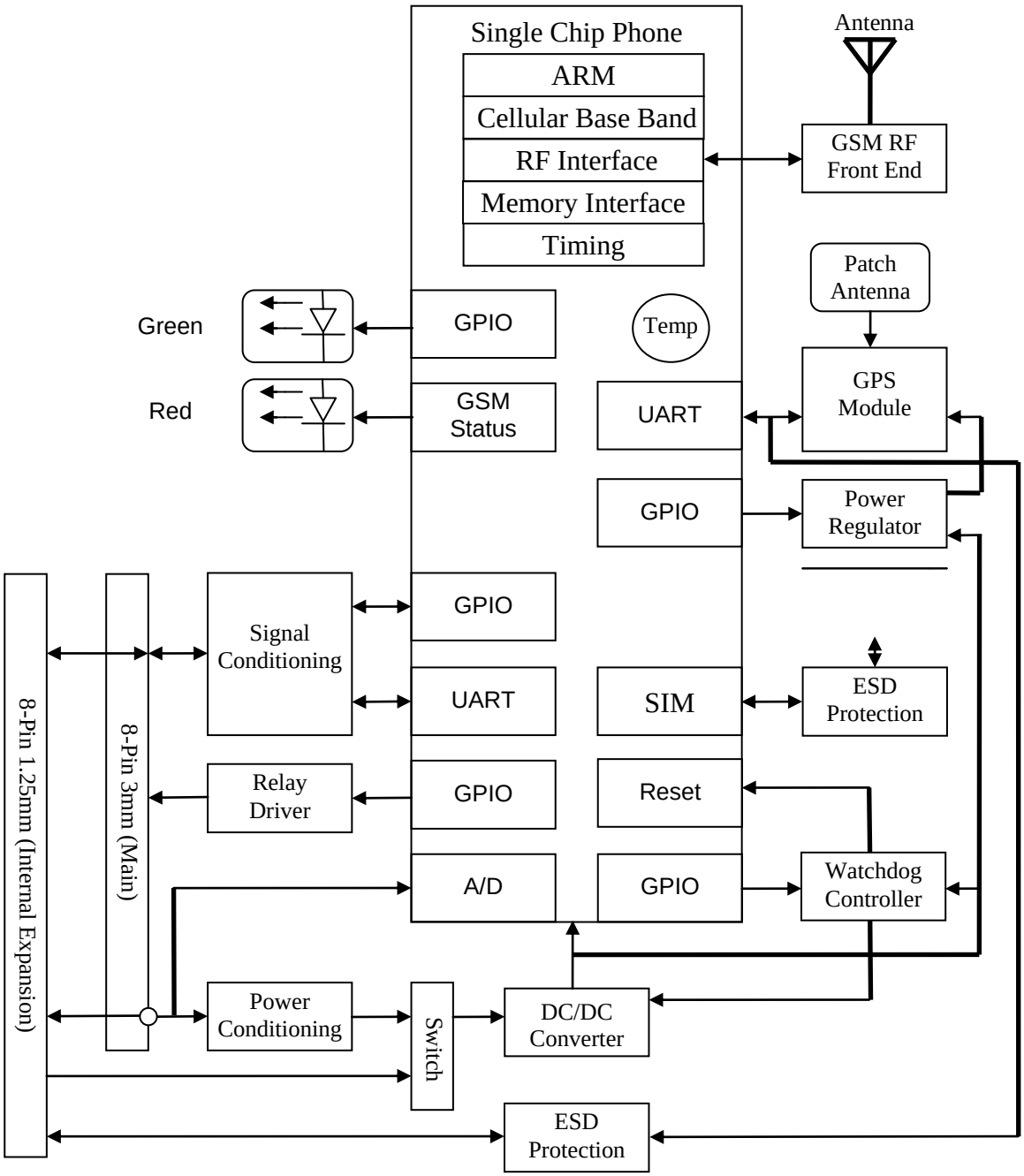
	Shock: 25G
	Vibration: TBD

Standards: ISO 10650
ISO 16750
ISO 7637

Hardware Architecture

Figure 1 shows a high level block diagram of the device system hardware. The core architecture is defined by the single chip cell phone and GPS module. The cell phone chip executes the software application and Operating System on the internal ARM CPU. The associated chips provide the complete functionality required with the exception of the peripheral resources shown.

Figure 1
Arrow Hardware Architecture Block Diagram

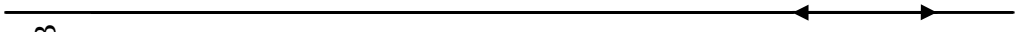


Software Architecture

The application software resides in system flash memory and operates directly under control of the native OS. Arrow does not use an external applications processor.

Structure

Figure 2 shows a high level block diagram of the basic architecture. The OS is closely knit with a debugger allowing for code development, maintenance and updates over the serial debug port. The boot loader provides control over all code and configuration memory. The watchdog is a dedicated hardware device that will issue a hardware reset to the unit in conjunction with a power cycle operation if it is not maintained by a periodic ping from the application program.



Features

Arrow acts like a GSM modem and responds to AT commands issued to it from either a physical serial port connection or to AT commands issued to it through SMS or a UDP connection.

With regard to text messages, ion "reads" all of its own text messages and tries to interpret each message as an AT command. SMS text may be sent to an endpoint through a CSD or GPRS connection interchangeably.

Key superset functions outside that of typical GSM/GPRS modems are required to support intrinsic ion Features. These include:

- Automatic field lockup recovery
    - Dedicated hardware watchdog with power and reset cycle
    - GSM Circuit Switched Data (CSD) commands
        - Hard reset
        - Restore factory defaults
        - Instantiate code download using FOTA
        - Set Caller ID (CID) qualifier
- Specialized GPS functions including
    - GPS data reporting
    - GPS module status reporting
    - GPS power control
    - Setup and monitor geographic fences
- Device initiated UDP reporting
    - Recurring schedule event
    - Low battery condition
    - Change in GPIO state
    - Report record queue
    - User defined IP addresses
    - Geographic fence violation
- Virtual AT command processor over SMS or a UDP connection
- Data logging to flash
    - OTA read of entries

  - Circular buffer
- OTA code update using FOTA
  - 100% buffered
  - Established 3rd party protocol
- Application specific I/O
  - Read/write digital
  - Read battery voltage
  - Read temperature
- Dual APN support

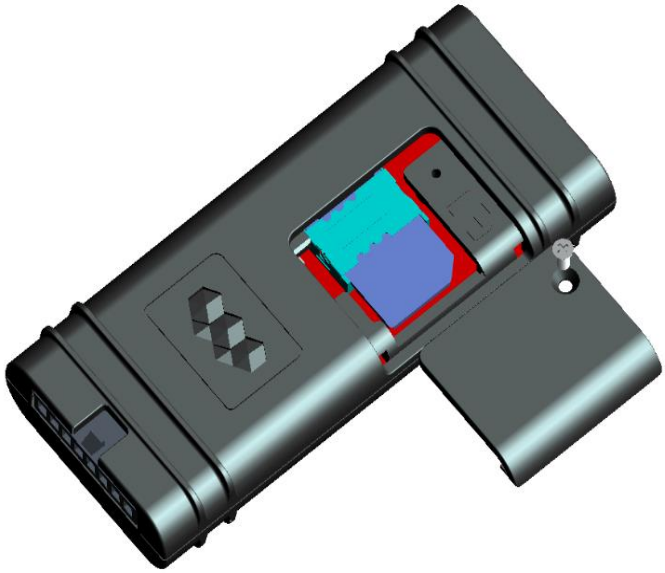
Further details on the Arrow software features are available in the document titled: "AT Command Specification for Arrow Tracker GPRS/GPS Tracking Device" and available from the author of this document.

Physical Attributes

Figure 3 shows various views of the Arrow Tracker and its critical physical features. For absolute locations of these features, the 3D CAD models should be referenced.

BOTTOM BACK

TOP FRONT



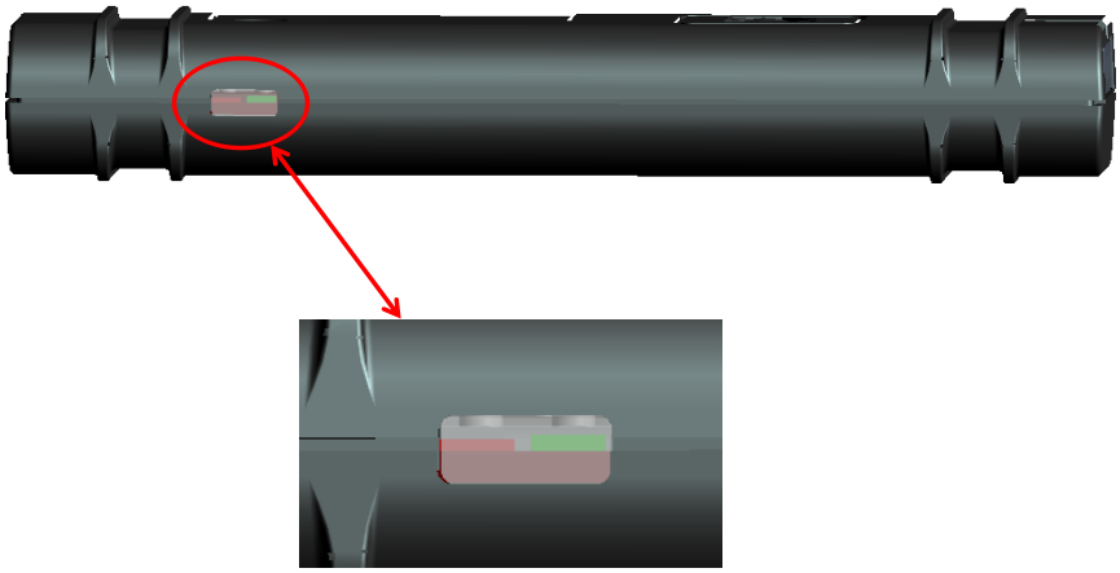
Signals

Interconnects are oriented as shown in Figure 5 looking into the front of the port. Electrical properties are in the subsequent table. The connector is keyed and latched.

Main Signals			
Pin Number	**Name**	**Description**	**Properties**
1	GPIO1	Configurable as general input or output	2.8V logic level, 15V tolerance, equivalent circuit in NOTE
2	GPIO2	Configurable as general input or output	2.8V logic level, 15V tolerance, equivalent circuit in NOTE
3	RLY	Relay drive, connect relay coil between pin 6 and this pin	500mA, 15V tolerance open drain MOSFEET, TVS overvoltage protected
4	GPIO3	Configurable as general input or output	2.8V logic level, 15V tolerance, equivalent circuit in NOTE
5	TX1	General UART TX output, also serves as debug serial out	2.8V logic level, 15V tolerance, equivalent circuit in NOTE
6	RX1	General UART RX input, also serves as debug serial in	2.8V logic level, 15V tolerance, equivalent circuit in NOTE
7	VIN	Power input, connect to positive side of battery power	3A PTC inline self resetting fuse, also clamped to GND through 15V hold
8	GND	System ground, connect to negative of battery power	Power and signal ground point

LEDs

The two status LEDs directly convey the status of the GSM and GPS subsystems as described in the table. Indirectly, through their absence of a valid indication, they also provide power and operational status. These LEDs are color coded and located as shown in Figure 7.



LED	Status
Green	**On**: GPS satellites acquired **Flash**: 250ms/250ms duty cycle indicates GPS satellite search is in progress **Off**: GPS subsystem fault
Red	**On**: Indicates GPRS connection is made **Flash**: 250ms/250ms duty cycle indicates GSM subsystem initialization **Off**: GSM subsystem fault

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.

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 présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre 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.

Afin d'éviter la possibilité de dépasser les limites d'exposition aux fréquences radio de la IC CNR-102, la proximité humaine à l'antenne ne doit pas être inférieure à 20 cm (8 pouces) pendant le fonctionnement normal.