

CSI-Wireless Wireless-Link

LoCate-001 Users Manual

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Author: Russ Braathen
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1

Acronyms and Abbreviations

bps	Bits per Second
ADDR	Address (Data)
AMPS	American Mobile Phone System
Cellular Section	Cellular Data Modem for AMPS

DAC	Digital to Analog Converter
DGPS	Differential Global Positioning System
DSP	Digital Signal Processor
EEPROM	Electronic Erasable Programmable Read Only Memory
ESD	Electrostatic Discharge
ESN	Electronic Serial Number
FCP	Function Control Processor
GPS	Global Positioning System
ID	Identification (Numeric or alpha value)
I/O	Inputs and/or outputs
LJU	LoJack Unit
LNCC	LoJack Network Control Center
MIN	Mobile Identification Number
PPM	Parts per Million
RAM	Random Access Memory
RF	Radio Frequency
RSSI	Received Signal Strength Indicator
RTC	Real Time Clock
RX	Receiver or Receive
SAT	Supervisory Audio Tone
SID	System Identification Number (Cellular switch identifier)
ST	Signaling Tone
TX	Transmitter or Transmit
UTC	Universal Time Coordinated
VSWR	Voltage Standing Wave Ratio

Definitions

Action	A programmed response to an exception.
Aeris	Company that invented MicroBurst
Almanac	A subset of orbital parameters from the GPS satellite ephemeris used to calculate approximate satellite positions and velocities.
Baud	A unit of measurement specifying the signaling rate (Signals/Sec).
Concierge	Like a Concierge in a hotel, but offering help via cellular telephone
Control Channel	A specific cellular communications channel designated for use by the cellular system to set up a voice telephone call between the PSTN and a cellular user
Ephemeris	A set of GPS satellite parameters used to calculate precise satellite positions and velocities.
Exception	A predefined event or condition that causes a programmed response (Action).
Immobilizer	Type of vehicle security alarm that has the capability to immobilize the vehicle by interrupting the fuel line or ignition
MicroBurst	Data communications specification using telephone signaling protocol of the Analog Cellular Telephone system
Page	The event of receiving a cellular telephone call. Also known as an incoming call or cellular page.
PSTN	Public Switched Telephone Network (the copper wire telephone system)
Telematics	New technology description of Electronic Vehicle information and security services

1 Introduction

1.1 Operational Overview

The LoCate-001 vehicle unit provides a specific set of features for vehicle security and vehicle tracking through the integration of Cellular Control Channel data communications, Global Positioning System (GPS) technology, and an intelligent power management. This basic vehicle security, vehicle tracking, and event monitoring solution can be utilized in a stand-alone mode or in conjunction with a users personal communications system (cellular telephone, SMR network, or LMPR network).

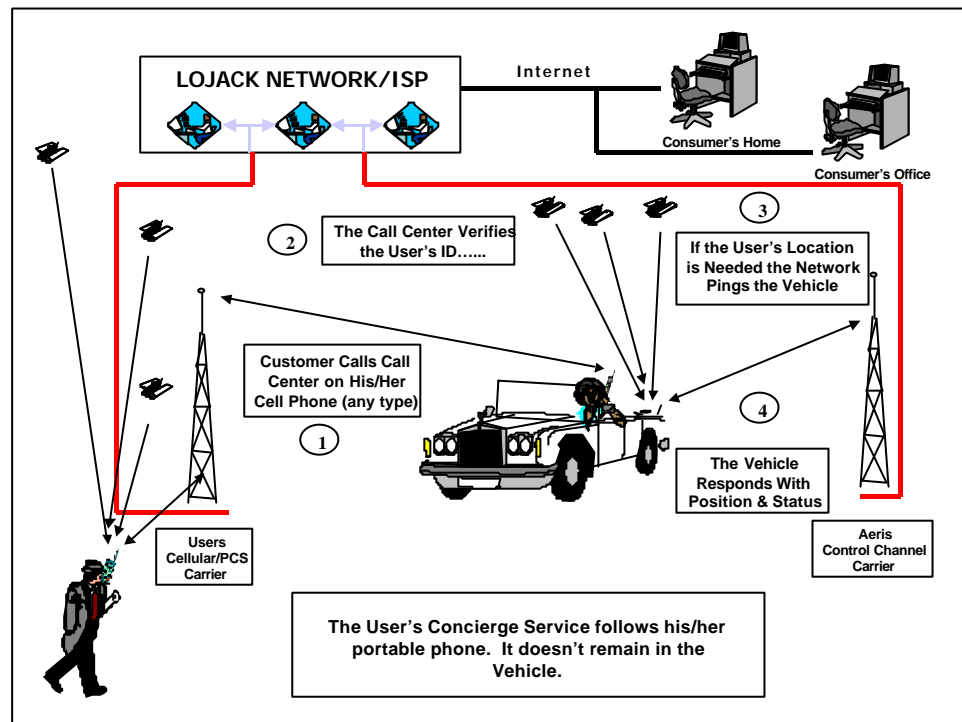


Figure 1 - Typical LoCate-001 Consumer Application

Figure 1 illustrates the typical consumer application. Standalone, the Consumer LoCate-001 operates as a vehicle security system, reporting exceptions and vehicle location through the Aeris Analog Control Channel Network. The addition of the users private Cellular or PCS phone (calling the LoJack Concierge Center) creates an end-to-end Telematics solution.

Figure 2 illustrates a commercial application of the LoCate-001. Standalone the Fleet LoCate-001 provides Security, Automatic Vehicle Location, and Asset Tracking. Combining the vehicle unit with the driver's handheld Digital PCS phone creates a complete Dispatching and Fleet Management Solution. The fleet manager can send and receive messages via the LoJack Gateway and can monitor the vehicle's location on demand.

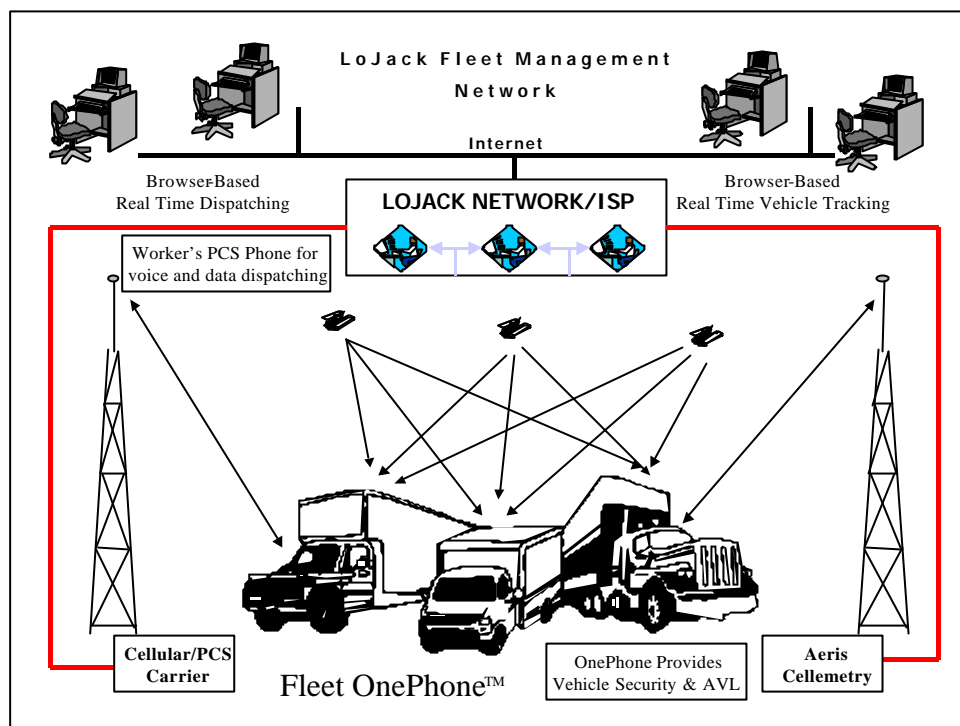


Figure 2 - Typical LoCate-001 Commercial Application

Both commercial and consumer products can offer a basic set of security features for a one time cost at the point of hardware sale only.

1.2 System Features

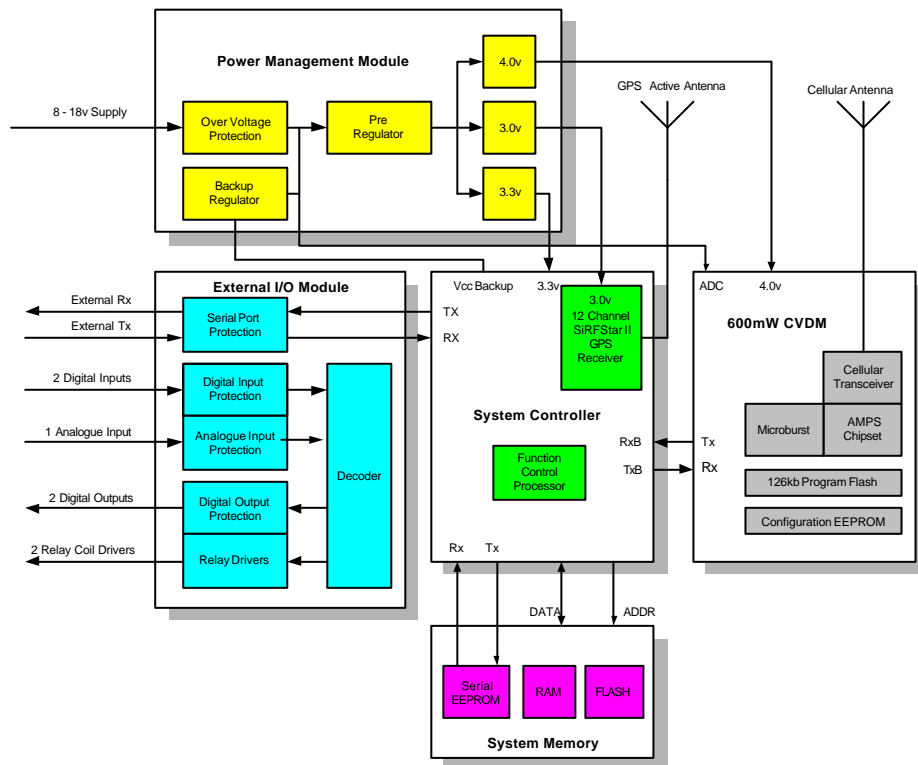
The LoCate-001 unit incorporates the following major features:

- Integrated Microburst radio, GPS receiver and power management modules.
- Real Time Clock for scheduling and power management.
- Low power mode.
- Event schedules & triggers
- Protected automotive power supply.

1.3 System Description

The LoCate-001 Product consists of the following major components:

- Twelve Channel GPS Receiver.
- 600 mW Cellular Control Channel Data Modem.
- Highly Integrated Function Control Processor/firmware.
- Power Management Unit.
- One analogue input and two digital input lines.
- Digital output and relay driver outputs for interface to a vehicle security system, immobilizer, and door control.
- GPS and cellular antennas (not supplied by Wireless Link)



1.4 Operating Modes

The LoCate-001 unit offers two major operating modes.

1.4.1 Armed Mode

When either of the LoCate-001 digital inputs becomes active, the LoCate-001 enters the Armed mode within 1 second.

The LoCate-001 will enter the Armed Mode based on activity on the analog input only during the wakeup period. The Armed Mode is a low power mode in which the only active functions are a wakeup timer and monitoring of the three input lines (the analog input is monitored only during the wakeup period). The vehicle battery level is sensed when the unit periodically wakes up to listen for messages from the LoJack Network Control Center (LNCC). The wakeup duration set by the configuration must be long enough, and its interval short enough, to account for Microburst network latencies.

1.4.2 Active Mode

In the Active Mode, the cellular radio is continuously on. Status will be transmitted at the interval define by the configuration (10 minutes).

2 System Component Description

The following sections provide description of the various system components.

2.1 Twelve Channel GPS Receiver.

The LoCate-001 unit incorporates an integrated twelve-channel GPS receiver.

2.1.1 GPS Position/Velocity Fix.

The GPS receiver establishes a position fix as shown in Table 1.

Time for Fix	Certainty	Conditions
< 1min.	90%	GPS receiver powered on 6 –24 hrs. without a current almanac, satellite ephemeris, initial position or time.
< 30 sec.	90%	“Warm Start”, GPS receiver powered on 1 – 6 hrs. with a current almanac, satellite ephemeris, initial position and time.
< 10 sec.	90%	“Hot Start”, GPS receiver powered off for less than 60 minutes with a valid almanac, satellite ephemeris, position and time.

Table 1 - Establishment of Position Fix

The GPS almanac is updated continuously as pages of the almanac are received during Active Mode state. During the Active Mode the GPS receiver is always powered on and attempting position fixes.

The GPS receiver can be configured during the Armed Mode to specify the “maximum time to fix” interval allowed for the GPS receiver to get a fix before powering off the GPS. This mode is necessary in situations where the GPS antenna is completely hidden from the sky and cannot get an updated position fix during its Armed Mode ‘wake-up/status check’ cycle.

During the Armed mode the GPS receiver is immediately powered off after getting a valid fix and determining that the vehicle has not moved. However, the cellular transceiver will remain on for the duration of the 'wake-up/status check' cycle to listen for messages from the LNCC.

2.1.2 Geo-fences

At the time of the installation the LoCate-001 may be factory programmed with 3 Geo-fences, and defaulted to the first 0-25 mile fence as follows:

1. ID # 1, 0 to 1 miles radius
2. ID # 2, 0 to 25 miles radius
3. ID # 3, 0 to 50 miles radius

Users can change these by contacting the LNCC where commands can be sent to the device to change the geo-fence. Alternatively they can execute these commands via the web page interface. A geo-fence defines a boundary or a geographic area calculated as a radius from a central point. Only one geo-fence can be enabled at a time. The LoCate-001 will send a Status message to the LNCC in the event that the vehicle crosses outside the fence selected.

Each Geo-fence is defined by the following parameters:

- ID (1-3) used to identify a particular constraint region. This value is created and stored by the host, not by the LoCate-001.
- Type (out of only)
- Boundary — circle with radius. Center of circle is Home Origin.
- Trigger - The LoCate-001 will generate an exception, when it has a valid GPS fix, based on:
 1. The vehicle crossing the geo-fence,
 2. When the unit powers up outside a geo-fence.

2.1.3 Distance and Home Origin

One Latitude-Longitude position, referred to as Home Origin, can be kept in the FCP EEPROM configuration memory. This data point is used to calculate the radii of the selected geo-fence, and subsequently the distance from the center of the circle. In the event that the vehicle exits this circle a trigger can be generated and sent to the LNCC.

2.1.4 Differential GPS

The LoCate-001 does not support DGPS computations.

2.2 System Timing

The LoCate-001 unit maintains accurate system time necessary to support the Armed Mode of operation. When the GPS receiver is active and can see at least one GPS satellite the LoCate-001 system time is synchronized to the GPS time.

2.3 External I/O

The seven I/O ports of the LoCate-001 device are configured as follows:

Port #	Designation	Type	Function	Signal Characteristics
1	Output	Relay Driver	Doors Unlock Relay	Pulse active low, 1 second maximum
2	Output	Relay Driver	Starter Enable/disable Relay	Level, stays high or low as determined by MIN3 / MIN4
3	Input	Digital	Crash Sensor, Low Impact	Active low, minimum 1 second. Rise time less than 150 microseconds
4	Input	Digital	Crash Sensor, High Impact	Active low, minimum 1 second. Rise time less than 150 microseconds
5	Output	Digital	Future Assignment	
6	Output	Digital	Future Assignment	
7	Input	Analogue	Future Assignment	

Table 3 – I/O Port Configuration

2.4 Event Monitor and Exception Handler

The LoCate-001 unit is programmed to recognize a number of events as exceptions and use these events to trigger action(s).

Some examples of events are:

- Excessive speed. Note this is not currently supported.
- Door lock open/close, as defined by monitoring of an LoCate-001 digital input. (This feature is not used with the I/O port assignments shown in Table 3.) Not currently supported
- Geo-fence violation
- The GPS antenna disconnected.
- Vehicle alarm violated, as defined by monitoring of an LoCate-001 digital input. Not currently supported. (This feature is not used with the I/O port assignments shown in Table 3.)

2.5 On Board Diagnostics

The LoCate-001 vehicle unit incorporates on board diagnostics and troubleshooting support that is accessible by connection to the asynchronous communications port. The following information is available:

2.6 Status

The following status criteria will be displayed in the Asset Vision Link test software, connected to the LoCate-001 via the RS232 serial port.

- GPS fix attained (Yes/No)
- Antenna Status (Connected/disconnected)
- Cellular RSSI
- Asset voltage
- Asset ID
- Internal phone number (MIN)
- System Identification (SID)
- ESN

2.7 Power Consumption Profile

The LoCate-001 unit has three major operating modes:

Power Off	This is the lowest consumption mode to maintain the RTC and monitor external digital inputs. The current draw from the supply lines in this mode is less than 100 microamperes at 12 volts.
Armed	In this mode the unit checks for scheduled events (not currently supported), external analog and digital inputs. Any unused modules are powered down. When processing is not required the unit runs in the power off state. The current draw from the supply lines in this mode is nominally 150 milliamperes at 12 volts.
Active	This is the full operating mode with both the GPS and the Cellular Section powered on continuously. The unit monitors exceptions, receives GPS position fixes and the Cellular Section is in the standby mode ready to receive any messages. The Cellular Section transmitter is turned on as required. The current draw from the supply lines in this mode is nominally 150 milliamperes with periods at 600 milliamperes at 12 volts when the cellular unit is in full power transmit.

3 Performance Specifications

3.1 Cellular Transceiver

Parameter	Specification	Units
Frequency Range (Tx)	824.010 – 848.970	MHz
Frequency Range (Rx)	869.010 – 893.970	MHz
Channel Spacing	30	KHz
Deviation	± 12	KHz Max.
Number of Channels	832	
Antenna Impedance	50	Ohms
Receiver Sensitivity	-116	dBm typical
Transmitter Power Output	0.6	Watts nominal
Peak Deviation	+/- 8	KHz
Frequency Stability	+/- 2.5	ppm maximum
Carrier Switching Time	2	ms
Channel Switching Time	40	ms maximum

Table 6– Cellular Transceiver Performance Characteristics

3.2 GPS Receiver

Parameter	Specification
Receiver	L1, C/A code
Channels	12
Max Solution Update rate	1/second
Satellite Reacquisition Time	100 ms
Snap Start	< 2 seconds
Hot Start	< 8 seconds
Warm Start	< 38 seconds
Cold Start	< 45 seconds
Minimum Signal Tracked	-175 dBW
Maximum Velocity	< 1,000 knots
Consumption	150 mA
Voltage	3.15 to 5.5 VDC
Protocols	NMEA v2.2, SiRF Binary
Position Accuracy	100 meter 2d RMS SA On 10 meter 2d RMS

Table 7 – GPS Receiver Specifications

3.3 LoCate-001 Antenna Specifications

The LoCate-001 unit requires two separate antennas, Cellular and GPS.

3.3.1 Warning on use of cellular antennas

The cellular antenna supplied with this unit must be used for installation and operation. Substitution of other antennas must be approved by the manufacturer for compliance to radiation safety limits.

The mounting of this unit and antenna must be done by professional installers to ensure that the user or nearby persons will maintain at least 20 cm from the cellular antenna in normal use.

3.3.2 Cellular Antenna Specifications

Parameter	Specification
Frequency	824 – 894 MHz
Gain	3 dBd maximum
VSWR	Max 2:1 over range
Max Power	2 watts
Nominal Impedance	50 Ohms
Connector	TNC
Cable	15 feet RG-174U

Table 8 – Cellular Antenna Specification

3.3.3 GPS Antenna Specifications

Parameter	Specification
Type	Low Noise with Active Amplifier
Frequency	1,575.42 MHz, ± 2 MHz
Gain	5 dBiC antenna, 24 dB active amp
Noise Figure	1.5 dB Max
Operating Temp	-30 to + 60 C
Nominal Impedance	50 ohms
Amplifier Bias Voltage	3.3 VDC, $\pm 10\%$
Connector	SMA
Cable	15 feet RG-174U
Antenna current supplied by LoCate-001	20 mA max

Table 9 – GPS Antenna Specification

3.4 Environmental Requirements

3.4.1 Temperature and Humidity

Parameter	Minimum	Maximum
Operating Temperature Range	-30 °C	+60 °C
Storage Temperature Range	-30 °C	+60 °C
Operating Humidity @ -30°C to +60 °C, %RH non condensing	0 %	95 %

Table 10 – Temperature & Humidity Specification

3.4.2 Vibration

The LoCate-001 is designed to be mounted in a non-frame area of a car or truck.

3.5 I/O PORTS

3.5.1 Serial Data Port

The LoCate-001 unit has 1 serial data port for general-purpose use, unit configuration and diagnostics. The port is a 9600-baud, full duplex, no parity, asynchronous serial RS232 interface. The electrical characteristics are as follows:

Parameter	Min	Max
Input Voltage High	3.5V	5.5V
Input Voltage Low	-0.6V	1.0V
Output Voltage High	4.0 V	5.5V
Output Voltage Low	-0.6V	0.6V
Input Impedance	40 KOhm	75 KOhm
Output Impedance	1.5 KOhm	4.0 KOhm

Table 12 – Serial Data Port Specifications

3.5.2 Analogue & Digital I/O Ports

The LoCate-001 has 7 I/O ports, 2 digital inputs, 2 digital outputs, 1 analogue input and 2 relay driver outputs. The electrical characteristics are as follows:

Parameter	Min	Max
GENERAL:		
Input Impedance	40 KOhm	75 KOhm
Output Impedance	1.5 KOhm	4.0 KOhm
DIGITAL:		
Input Logic High	3.5V	5.5V
Input Logic Low	-0.6V	0.6V
Output Logic High	4.0 V	5.5V
Output Logic Low	-0.6V	0.6V
ANALOGUE:		
Input Impedance	20 KOhm	40 KOhm

Input High Voltage	6.5V	7.5V
Input Low Voltage	-0.3V	-0.6V
RELAY DRIVER:		
Output Impedance	0 ohm	3 ohm
Input High Voltage for less than 1 mA draw	0V	32V
Reverse Voltage at 1 mA draw	0V	-2V

Table 13 – Analogue & Digital Ports Specifications

3.5.3 External Connector Pin Assignments

The external I/O connector pin assignments are as follows:

Connector: Molex 53259-1310 or equivalent

Mating connector, for customer-supplied cable harness: Molex 51067-1300 or equivalent

Pin	Description	Notes
1	Relay Driver 1	Connects relay coil to ground, other side of relay coil goes to supply positive.
2	Relay Driver 2	Connects relay coil to ground, other side of relay coil goes to supply positive.
3	Digital Output 1	0 and 5 volt logic signal with 2 KOhm series impedance driven from LoCate-001
4	Digital Output 2	0 and 5 volt logic signal with 2 KOhm series impedance driven from LoCate-001
5	Digital Input 1	0 and 5 volt logic signal with 300 KOhm to ground as input to LoCate-001
6	Digital Input 2	0 and 5 volt logic signal with 300 KOhm to ground as input to LoCate-001
7	Analog Input	Input for measurement, -0.3 volts to 7 volts
8	Ground	Connects to chassis of LoCate-001
9	Serial Output	Signal from LoCate-001 to Computer
10	Serial Input	Signal from Computer to LoCate-001
11	Reserved	Reserved for factory use
12	5 Volt Reference	5 volts with 2 KOhm series impedance, for reference use
13	Battery Voltage	For measurement only, 0 to 20 volts range.

Table 14 - External Signal Connector

Note:

Pin 1 is located next to larger connector (TNC)

Pin 13 is located next to smaller connector (SMA).

3.5.4 Power Lead Assignments

The LoCate-001 power lead assignments are as follows:

Black	Supply Battery Voltage Negative	Power input to Locate, battery negative with protection for current to chassis, connected to chassis with low impedance.
Red	Supply Battery Voltage Positive	Power input to Locate, 8 to 18 volts, 2 amp fused externally, internally protected.

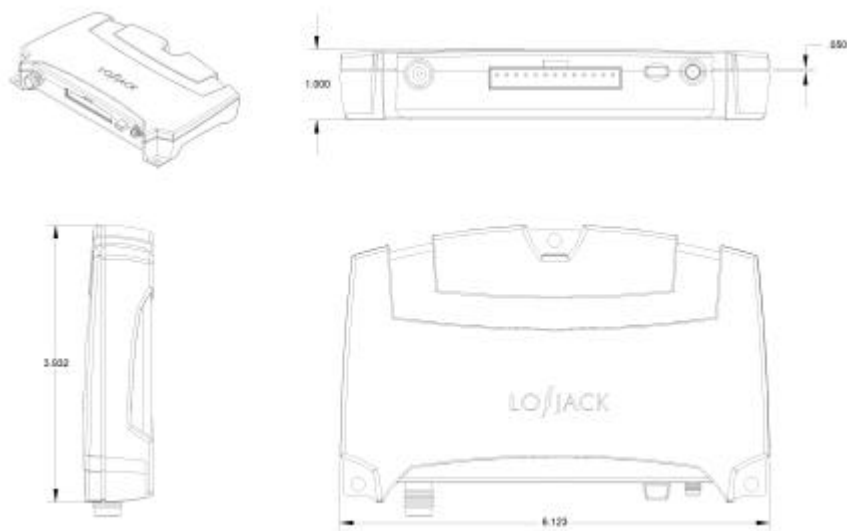
Table 15 - Power Supply Lead Use.

4 Mechanical and Physical

4.1 Housing

The LoCate-001 consists of a PCB contained inside a housing. The approximate size of the LoCate-001 is 156 mm (L) x 100 mm (W) x 25.4 mm (H).

1. The housing is aluminium cast.
2. Three mounting tabs will allow for use of a size 10 pan head screw.
3. The outside color of the housing is black.



LoCate-001 housing

4.2 Connection & Identification Requirements

The LoCate-001 unit shall be supplied with the following;

1. 18 AWG twisted power (red) wire end stripped and tinned, and the ground (black) wire terminated with a size TBD ring connector. Length from cable over mold is approximately 11.5 inches (292mm). This connection is to be brought out of the housing separately from the I/O and RF connectors.
2. The I/O lines will terminate using a multi-pin connector mounted on the housing.
3. Two labels with black lettering shall be fixed to the underside of the LoCate-001 housing. The top label shall include the Barcode information as detailed in paragraph 4.3 below. The label below shall contain the FCC and DOC information.
4. No over pack box will be provided.