Locator LD Installation and Operation Guide

onBoard™ Locator LD

SIERRA WIRELESS®

LOC-ED-140509
1.3
October 8, 2014

Copyright

Contact Information

Sales Desk:	Phone:	1-604-232-1488
	Hours:	8:00 AM to 5:00 PM Pacific Time
	Contact:	http://www.sierrawireless.com/sales
Post:	Sierra Wireless 13811 Wireless Way Richmond, BC Canada V6V 3A4	
Technical Support:	support@sierrawireless.com	
RMA Support:	repairs@sierrawireless.com	
Fax:	1-604-231-1109	
Web:	http://www.sierrawireless.com/	

Consult our website for up-to-date product descriptions, documentation, application notes, firmware upgrades, troubleshooting tips, and press releases: www.sierrawireless.com

Document History

Version	Date	Updates
1.3	October 8, 2014	Updates for SWI Template and related edits.

Contents

List of Figures

List of Tables

1. Introduction

This document provides instructions on preparing and installing the onBoard Locator LD.

1.1. Who Should Read This Guide

This document should be read by customers and vehicle installation specialists responsible for installing the onBoard Locator.

This Configuration and Installation Guide is specific to the onBoard Locator LD. Users of the self contained battery-powered onBoard Locator device must refer to the separate Installation and Operation Guide specific to that device.

1.2. What is the Locator LD

The onBoard Locator LD (shown in Figure 1) is a device used to track and manage a variety of fleet and mobile assets. When combined with InMotion Solutions' oMM, the onBoard Locator extends GPS tracking to a wider range of vehicle and non-powered assets within a single unified view. The Locator LD is a compact tracking device used primarily for tracking smaller "light duty" vehicles that do not require the vehicle area network (VAN) capabilities of the onBoard Mobile Gateway.

The Locator LD (shown in Figure 1) sends a vehicle's GPS location to a remote server over a cellular network. The unit is designed for installation underneath the dashboard of a light duty vehicle such as a car or truck. This unit is hard wired to the vehicle's battery and to an external antenna mounted on or within the vehicle.

Figure 1 - onBoard Locator LD

1.3. Requirements

The following items are required in order to install the unit:

- DC power supply (output from 6V to 32V is acceptable)
- Locator LD components:
    - Input and output cables
    - Relays
    - Locator LD peripherals

1.4. Handling Precautions

When handling the Locator LD, care must be taken to ensure the unit is not subjected to electrostatic discharge. Also be sure to adhere to the following requirements:

1. The GPS module of the Locator LD is very sensitive to electrostatic discharge so do not touch the circuit board during installation.
2. The GPS receiver can be damaged if exposed to an RF level that exceeds its maximum input rating. This can happen if a nearby source transmits an RF signal at a sufficiently high level (i.e. more than one watt). For example, avoid placing a GPS antenna from a Locator LD within four inches of another Locator LD's GSM antenna.

1.5. Provisioning

For information on provisioning a Locator LD including SIM card installation and setting up a device for a particular carrier, refer to the Locator Configuration and Troubleshooting guide.

1.6. Related Publications

Title	Description
onBoard Locator Installation and Operation Guide	Describes how to mount a Locator device on a chassis.
onBoard Locator Troubleshooting and Configuration Guide	Describes the procedures for removing and reinstalling the device's cover, accessing the internal motherboard, installing a SIM card, testing, and troubleshooting (including the device, signal quality issues, and server side).

2. Installation

The following subsections describe how to install the Locator LD into a vehicle.

2.1. Mounting and Wiring

2.1.1. Planning the Installation

Verify the power, ground and ignition to ensure that the proper signaling exists. This is typically accomplished with a multi-meter.

Before drilling any holes or running any wires, decide where each hardware component will be located (Locator LD, antennas, peripherals, etc.). Be sure that the cables to the Locator LD are not bent or constricted in any way. Also make sure that the Locator LD is kept free from direct exposure to the elements (sun, heat, rain, moisture etc.).

Be advised that an installation that violates the environmental specifications of the Locator LD will void the warranty. For more information on the unit's environmental specifications see Appendix D.

The following factors should be taken into account before starting installation.

2.1.1.1. Size and Placement of the Unit

Whether you intend to place the unit under a seat or into a cavity behind the vehicle's interior molded trim, be sure the Locator LD will fit before drilling any holes or running cables.

Be certain that the cables running to the unit will not be bent or constricted. Damage to the cables may impede the Locator LD's performance.

Be certain that the installation point will not violate any of the Locator LD's environmental specification (temperature, moisture, etc.) as improper installation of the Locator LD may void the warranty. For more information on the unit's environmental specifications see Appendix D.

In a typical installation the unit is placed under the vehicle dashboard or in the trunk. Make sure the unit will be accessible after installation as it may be necessary to add additional wiring or connections to the Locator LD.

2.1.1.2. Placement of Antennas

There are effectively three options for placements of an antenna:

- Roof-mount (magnetic or thru-hole)
- Glass-mount
- Covert (e.g. under the seat, dash, etc.)

Comm Antenna Placement Guidelines

The Comm antenna must be located at least 20 centimeters away from vehicle passengers, other personnel, or bystanders in order to comply with FCC radio frequency exposure limits.

Typically, the Comm antenna used by the unit for wireless service is a standard 3-dB gain whip. It is mounted with standard mounts (i.e. thru-hole, magnetic mount, or peel and stick) and requires a ground plane to work properly. If possible, it should be located at least 3 feet from the GPS antenna. Ensure that the cable does not get crushed during installation.

Please note that the antennas provided combine both the GPS and Comm portions.

GPS Antenna Placement Guidelines

In order to maximize the performance of the unit, the GPS antenna should have a clear view of the sky. When installing the GPS antenna on a vehicle, make sure that there are no obstructions close to the antenna that might block the view 360° to the horizon. Items like air horns, lights, vents, etc. should not block the antenna beyond 5° above the horizon. The best location is usually near the center of the roof; however it is also desirable to locate the cellular antenna as far from the GPS antenna as is practical.

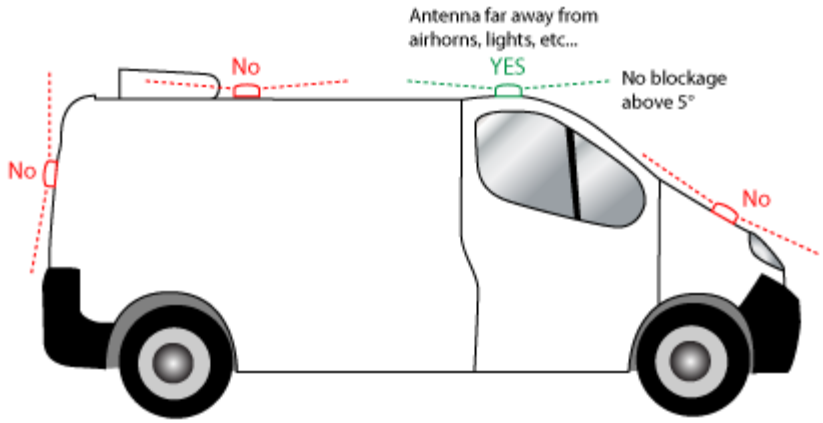

Figure 2 - Examples of good and poor GPS antenna placements

The signal levels received at the GPS antenna from the satellites are very low in power (approximately -136 dBm), so any blockage of the antenna can affect the quality of the location computed by the receiver. Kinks or tight knots in the antenna cable can also prevent the GPS receiver from operating properly. When laying out the antenna cable, care should be taken so that the cable is not subjected to crushing or strain.

Placement of Combination and Internal Antennas

When dealing with combination antennas, it is more important to consider GPS performance over Comm performance. GPS signal strengths are much lower than those typically seen by cellular networks supported by the Locator LD. In order to maximize the performance the Locator LD should have a clear view of the sky as possible. When installing the GPS antenna in a vehicle, make sure that there are as few obstructions as possible close to the Locator LD that might block the view 360° to the horizon. As with standalone GPS antennas, nothing should block the combination antenna beyond 5° above the horizon. The best location is near the center of the roof. For more covert installs, mounting directly under the front or rear windshields is also acceptable.

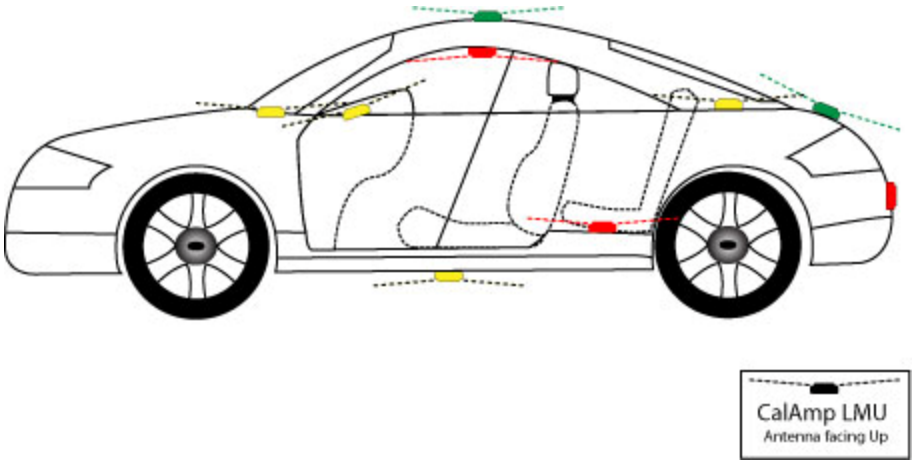

Figure 3 - Examples of good (green), OK (yellow) and poor (red) combo antenna placements

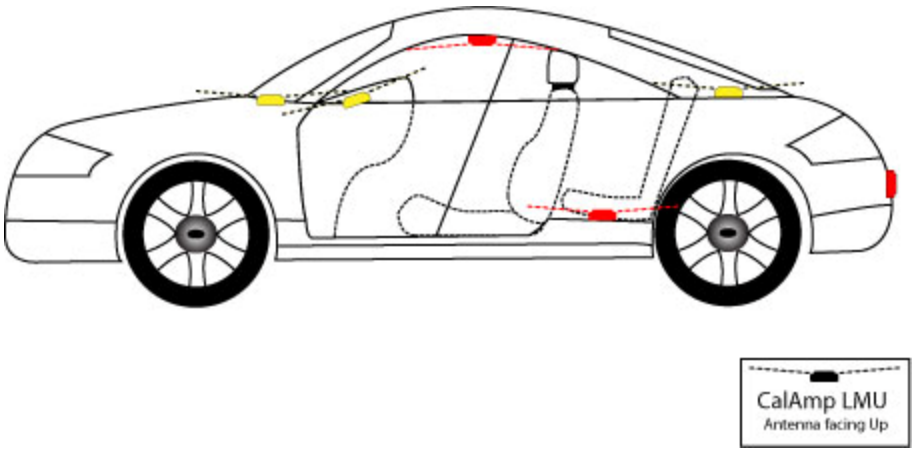

Figure 4 - Examples OK (yellow) and poor (red) internal antenna placements

2.1.1.3. Access to the SIM Card

When used in a GSM or iDEN network, each Locator LD uses a SIM card, which should be inserted before you install the unit for the first time. The SIM card is attached to the main-board inside the housing of the Locator LD unit.

At some future time, the SIM card may need to be replaced with a different one, so try to install the Locator LD in such a way that the cover can be removed to make the SIM card accessible.

2.1.1.4. Protection from Heat

It is best not to place the Locator LD unit in an unusually warm location such as directly near heater vents, near hot engine components, or in direct sunlight. The maximum temperature that can be tolerated by the Locator LD is described in Appendix D - Environmental Specifications.

2.1.1.5. Visibility of Diagnostic LEDs

Status LED lights on the front of the Locator LD unit can provide valuable information about the operation of the Locator LD. When feasible, attempt to install the Locator LD in such a way that these lights can be seen with reasonable ease.

You may find it useful to be able to view the LEDs periodically to make sure that the Locator LD is operating properly. If at any time you should encounter a problem with the Locator LD, you may need to read the LEDs in order to troubleshoot the problem. If you cannot fix the Locator LD yourself, you will need to provide the LED information to Sierra Wireless Support.

2.1.1.6. Cable Length

The RF cables which are provided for connecting to the Locator LD's antennas should be used at the length provided. Do not cut the cables. Instead, coil any excess cable length, making sure not to crimp or flatten the antenna cable.

2.1.1.7. Moisture and Weather Protection

The Locator LD unit must be located where it will not be exposed to moisture or water. In a typical installation inside a vehicle this is not commonly a concern; however, it might be best to avoid locating the unit below a car’s cup holders, or where rain might easily splash into the compartment when a door is opened.

2.1.1.8. Preventing Accidental or Unauthorized Modification

If you anticipate that fleet drivers or others might interfere with the units once they are installed, take steps to ensure that it will be difficult to disconnect the antenna wiring, remove the Locator LD from its power source, etc. Use of a tamper proof sealant is a common method to help prevent this.

2.2. Vehicle Installation

The following subsections provide instructions for installing a Locator LD into a vehicle.

2.2.1. Placing the Unit into the Vehicle

Typically, the Locator LD should be placed under the passenger seat or dashboard of the vehicle. Locator LD's with internal antennas should be placed to maximize their GPS performance. A typical location is under the dash close to the front windshield.

Attach the Locator LD to the solid body of the vehicle, not to plastic panels. The unit can be placed out of sight by removing interior trim and moulding to expose available space, then replacing the trim once the unit is in place.

2.2.2. Connecting the Power, Ignition, and Ground

The power input (red wire) must be connected to a constant (un-switched) +12 VDC or +24 VDC supply; preferably, connected directly to the vehicle battery terminal or as close to it as possible. This connection point should be fuse protected to not more than 5 amps.

The ignition input (white wire) must be connected to the vehicle ignition or another appropriate key operated line, such as *accessory*, ensuring that power to the ignition wire is available only when the vehicle ignition is on.

The ground line (black wire) must be connected to chassis ground.

Failure to connect these lines in the manner described may result in discharge of the vehicle battery.

For best results, it is strongly recommended that the Locator LD connection be on its own circuit. Connect the power input directly to the vehicle battery if possible and protect the circuit with an inline

fuse. If you must connect through the fuse box, use standard commercial wiring practices to create a permanent installation rather than using press-in fuse clips or other temporary measures.

DO NOT connect the power cable to the Locator LD at this time.

2.2.3. Placing the GPS Antenna

The GPS antenna must have a clear view of the sky. Mount the GPS antenna on the vehicle's highest point (e.g. the roof of a car). Make sure that there are no obstructions close to the antenna that might block the view 360° to the horizon. Air horns lights, vents, etc. should not block the antenna beyond 5° above the horizon.

Kinks or knots in the antenna cable can prevent the GPS receiver from operating properly. When laying out the antenna cable, take care that the cable is not subjected to crushing or strain.

The ideal location is typically near the center of the vehicle's roof. However, it is also desirable to locate the cellular antenna as far from the GPS antenna as possible.

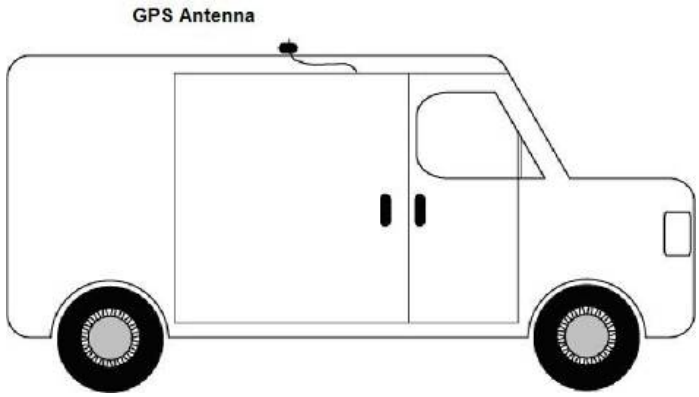

Figure 5 - GPS Antenna Location

2.2.4. Mounting the Comm Antenna

When using separate Comm and GPS antennas, it is best to locate the Comm antenna at least 3 feet from the GPS antenna. Ensure that the cable is not crushed during installation or normal vehicle operation.

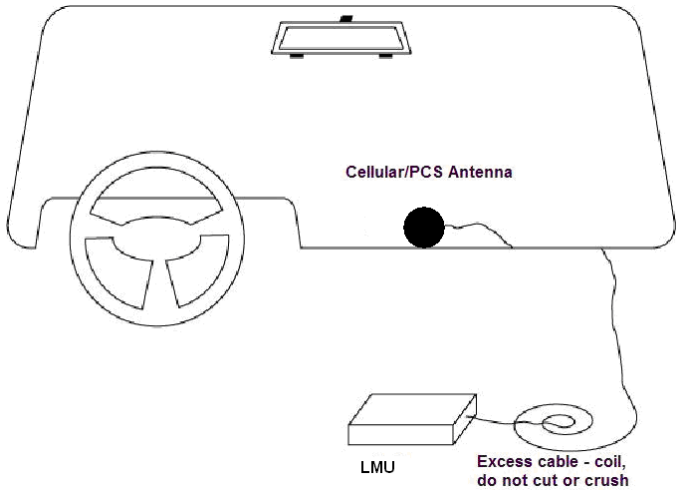

Figure 6 - Window Mount Antenna Location

2.2.5. Completing the Connections

The typical sequence of connections is as follows:

- Attach the cable from the GPS antenna.
- Connect the cable from the Comm antenna.
- Connect any peripherals to the Locator LD.
- Plug in the power harness.

The physical installation of the Locator LD hardware is now complete.

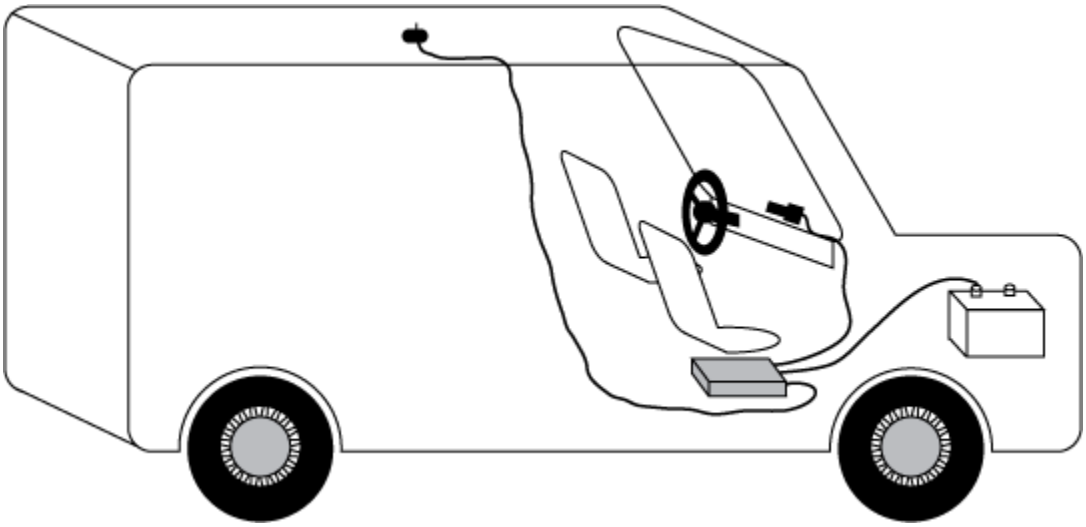

Figure 7 - Completed Install – Separate Antennas

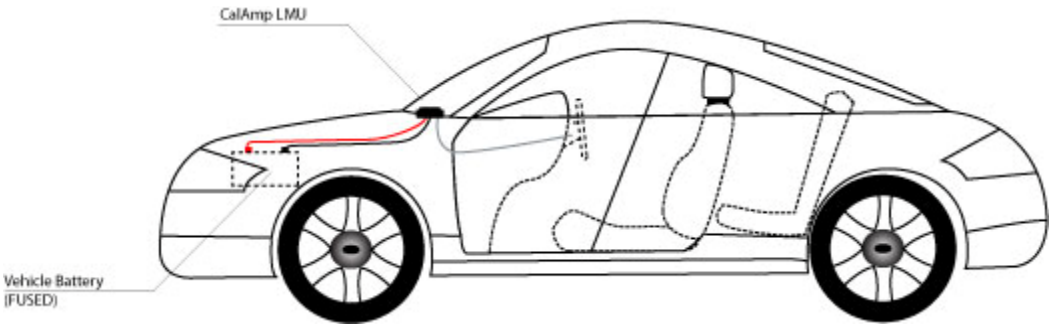

Figure 8 - Completed Install - Internal Antennas

Again, the Comm antenna must be located at least 20 cm away from vehicle passengers, other personnel, or bystanders in order to comply with FCC radio frequency exposure limits.

2.3. Power and Wiring Harness

The onBoard Locator supports general purpose inputs to connect to monitor events from external devices. The standard GPIO/Power harness includes power and general purpose lines.

This harness provides the complete set of I/O connectors including fused power and ignition lines.

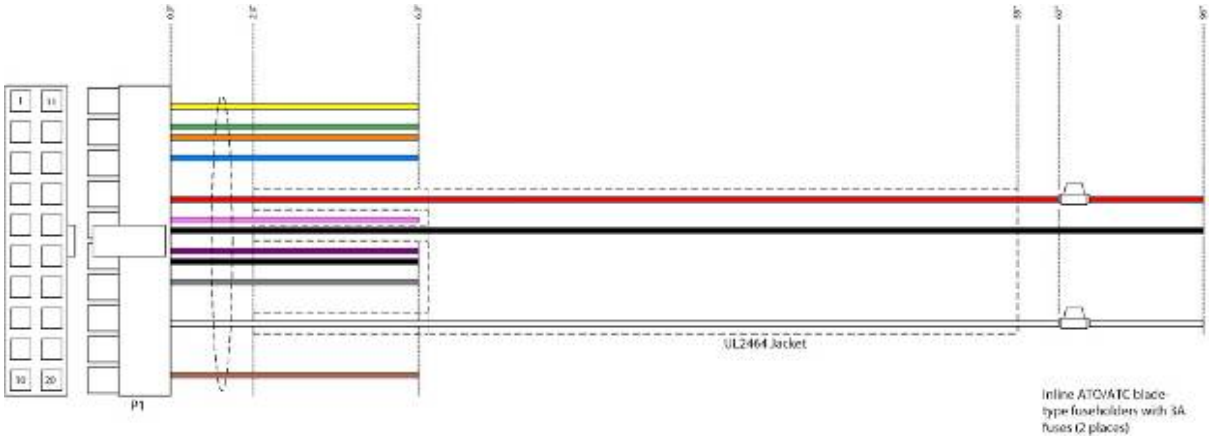

Figure 9 - Full I/O Wiring Harness

Contact Sierra Wireless if you have special wiring requirements.

1. Connect the 20-pin Molex plug to the 20-pin header of the Locator LD. Be sure to do this before installing the serial adapter pigtail.
2. Connect the crimp pins of the Locator LD's serial adapter pigtail; put the pins into the designated slots of the Molex connector as follows:
   a. Insert the black lead to Pin 1 (represented by the gray dot in the picture below).
   b. Insert the blue lead to Pin 4.
   c. Insert the green lead to Pin 13.
   d. Insert the orange lead to Pin 9.

   When installed properly, the metal crimp pins will be completely inside the Molex connector.

Note: for more information on the Locator LD's pinouts see Appendix A.

3. Connect the GPS and cellular antennas.
4. Connect the red (power) and white (ignition) wires to the positive terminal, and the black (ground) wire to the negative terminal of a 9V to 32V-rated DC power supply.

Appendix A. Header Pinouts

Table 1 - Pinouts on the Locator LD's Molex Connector

Pin	Signal	Description	Color	In/Out
1	GND	Ground	Black	Ground
2	OUT-0	Output 0 - Starter Disable Relay Driver	Green	Output
3	IN-1	Input 1 - Digital Input	Blue	Input
4	SER_IN	Serial Input	Blue	Input
5	ADC-1	Analog to Digital Input 1	Pink	Input
6	IN-3	Input 3 - Digital Input	Violet	Input
7	IN-4	Input 4 - Digital Input	Grey	Input
8	IN-0	Ignition	White	Input
9	VDD	VDD Reference Output (20 mA to 25 mA maximum)	Orange	Output
10	OUT-1/BOOT	Output 1 - Digital Output (Open Collector) BOOT Input	Brown	Input / Output
11	OUT-2	Output 2 - Digital Output (Open Collector)	Yellow	Output
12	IN-2	Input 2	Orange	Input
13	SER-OUT	Serial Output	Green	Output
14	VCC	Primary Power Input	Red	Power
15	GND	Primary Ground	Black	Ground
16	1BB-GND	1-Bit Bus Ground	Black	Ground
17	1BB-D	1-Bit Bus Data	White/Blue	Input / Output
18	Aux - TxD	Aux Port 2 - Transmit Data	White/Orange	Input
19	Aux - GND	Aux Port 2 - Ground	Black	Ground
20	Aux - RxD	Aux Port 2 - Receive Data	White/Yellow	Output

The following diagram identifies the pin numbers for the Locator LD's header:

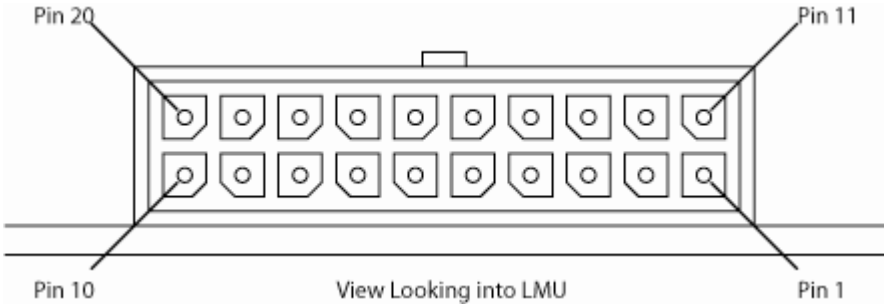

Figure 10 - Locator LD Pin Numbers

Appendix B. Ignition, Inputs, and Outputs

B.1. Input

The Locator LD can transmit the status of the following digital inputs to the oMM.

Note: *do not connect any other analog-digital input or outputs to the Locator LD device as the functionality is not yet supported in the current oMM release.*

Digital Inputs

- Input 0: Ignition Sense (Always biased low)
- Input 1: Generic Digital Input (bias select)
- Input 2: Generic Digital Input (bias select)
- Input 3: Generic Digital Input (bias select)
- Input 4: Generic Digital Input (bias select)

B.2. Ignition and Inputs

The Locator LD can monitor up to five digital input lines. The external inputs are protected from typical vehicle transients and can be directly connected to most vehicle level logical inputs from 4V up to the vehicle power input level (typically 12 VDC). Their input impedance is approximately 10k. One of these inputs is dedicated to sensing the vehicle's ignition status to provide for flexible power management. The other inputs may be used to sense vehicle inputs such as cooling unit operation, a hidden driver "panic" switch, taxi on-duty/off-duty meter status, and many other systems.

The ignition input is pulled to ground through the 10k resistance, where the other inputs can either be normally high (i.e. pulled to +12v through a 10k resistor) or low (i.e. pulled to ground through a 10k resistor). Input 1 is always biased low, inputs 2 to 4 are biased high. Figure 11 shows how to connect the inputs in both a high- and low-biased configuration:

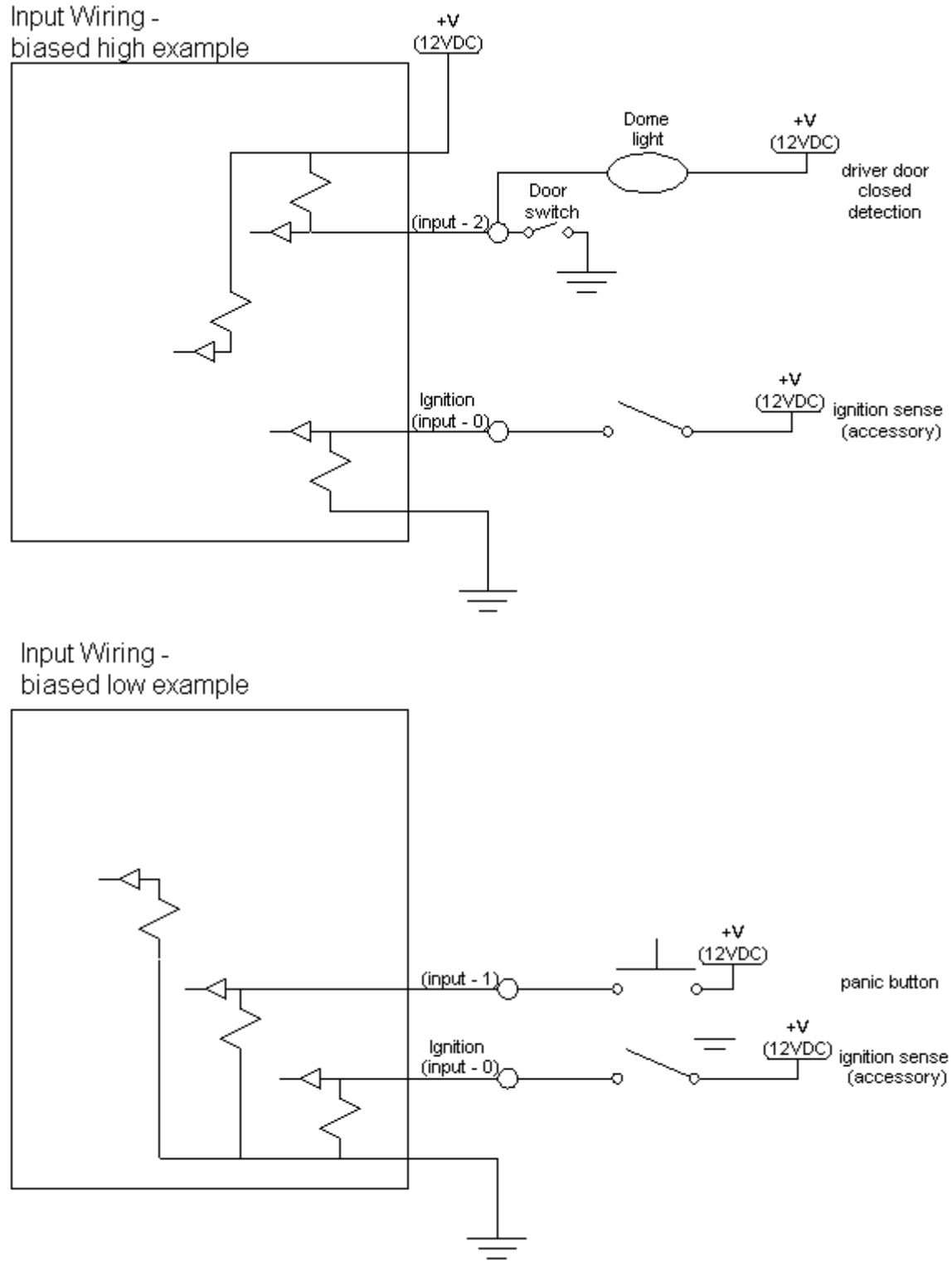

Figure 11 - Input Bias Configurations

Appendix C. Status LEDs

The Locator LD is equipped with two status LEDs, one for GPS and one for Comm (wireless network status). The LEDs use the following blink patterns to indicate service:

Table 2 - Orange Comm LED (LED # 1) Definitions

Condition	LED State
Modem Off	Off
Comm On - Searching	Slow Blinking
Network Available	Fast Blinking
Registered but no Inbound Acknowledgement	Alternates from Solid to Fast Blink every 1 second
Registered and Received Inbound Acknowledgement	Solid

Table 3 - Green GPS LED (LED # 2) Definitions

Condition	LED State
GPS Off	Off
GPS On	Slow Blinking
GPS Time Sync	Fast Blinking
GPS Fix	Solid

Appendix D. Environmental Specifications

The Locator LD is designed to operate in environments typically encountered by fleet vehicles, including wide temperature extremes, voltage transients, and potential interference from other vehicle equipment.

To ensure proper operation in such an environment, the Locator LD was subjected to standard tests defined by the Society of Automotive Engineers (SAE). The specific tests included temperature, shock, vibration, and EMI/EMC. These tests were performed by independent labs and documented in a detailed test report. In accordance with Appendix A of SAE J1113 Part 1, the Unit is considered a "Functional Status Class B, Performance Region II" system that requires Threat Level 3 Testing.

The following shows the environmental conditions that the Locator LD is designed to operate in and the relevant SAE tests that were performed. No formal altitude tests were conducted.

Table 4 - Locator LD Environment Specifications

Specification	Description
Size	• 4.0" long x 2.0" wide x 0.85" high • 10.2 cm long x 5.1 cm wide x 2.2 cm high
Weight	• 2.61 ounces / 75g (external antenna) • 3.0 ounces / 85g (internal antenna)
Operating Temperature	• -30° C to +75° C • -10° C to +60° C (When using Internal Battery Power)
Storage Temperature	• -40° C to +85° C • 0° C to +30° C (Long Term w/Internal Battery)
Internal Battery Charging Temperature	• +5° C to +45° C
Humidity	• 0% to 95% relative humidity, at 50° C non-condensing
Shock and Vibration	• SAE Test: SAE J1455 Compliant • Mil Standard 202G and 810F Compliant • Ground vehicle environment with associated shock and vibration
Electromagnetic Compatibility (EMC/EMI)	• SAE Test: SAE J1113 Parts 2, 12, 21 and 41 Compliant • FCC Part 15B Compliant • Industry Canada Compliant • EMC compliant for a ground vehicle environment
Operating Voltage Range	• 6VDC to 32VDC
Power Consumption	• Active Standby :70mA at 12VDC • Sleep on Network (SMS): 10mA • Sleep on Network (GPRS): 20mA • Deep Sleep: 3mA
GPS	• 50 channel (with SBAS, DGPS) GPS Receiver • 2m CEP (with SA off) • -160 dBm tracking sensitivity

Specification	Description
Communications (Comm)	• Quad Band Class 12 GPRS Modem • 850 MHz (Class 4) – 2W • 900 MHz (Class 4) – 2W • 1800 MHz (Class 1) – 1W • 1900 MHz (Class 1) –1 W • GPRS Packet Data (UDP) • SMS
RoHS Compliant	