LMU-42x0 Hardware & Installation Guide

Contents

LMU-42x0™
Hardware and Installation Guide

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1 Introduction

Welcome to the LMU-42x0™ Hardware and Installation Guide. This manual is intended to give you information on the basic setup and installation of the CalAmp LMU-42x0™ product(s) including hardware descriptions, environmental specifications, wireless network overviews and device installation.

1.1 About This Manual

The LMU-42x0™ is one of the most flexible economy mobile tracking hardware products available. In order to accurately describe the functionality of these units we have broken this manual into the following sections:

- **System Overview** – A basic description of a CalAmp LMU-42x0™ based tracking system. This includes a description of roles and responsibilities of each of the CalAmp components as well as a brief overview of the wireless data technologies used by the LMU-42x0™.
- **Hardware Overview** – Describes the physical characteristics and interfaces of the LMU-42x0™.
- **Installation and Verification** – Provides guidance for the installation of the LMU-42x0™ in a vehicle and instructions on how to verify the installation is performing adequately.

1.2 About The Reader

In order to limit the size and scope of this manual, the following assumptions have been made about the reader.

- You are familiar with GPS concepts and terminology
- You have some experience with installing equipment in vehicles
- You are familiar with the use of AT Commands
- You are familiar with the use of terminal programs such as HyperTerminal or PuTTY

1.3 About CalAmp

CalAmp is a leading provider of wireless communications products that enable anytime/anywhere access to critical information, data and entertainment content. With comprehensive capabilities ranging from product design and development through volume production, CalAmp delivers cost-effective high quality solutions to a broad array of customers and end markets. CalAmp is the leading supplier of Direct Broadcast Satellite (DBS) outdoor customer premise equipment to the U.S. satellite television market. The Company also provides wireless data communication solutions for the telemetry and asset tracking markets, private wireless networks, public safety communications and critical infrastructure and process control applications. For additional information, please visit the Company's website at www.calamp.com (http://www.calamp.com/) .

1.4 About the CalAmp Location Messaging Unit-LMU-42x0™

The CalAmp Location and Messaging Unit-LMU-42x0™ (LMU-42x0™) is a mobile device that resides in private, commercial or government vehicles. The LMU-42x0™ is a single box enclosure incorporating a processor, a GPS receiver, a wireless data modem, and a vehicle-rated power supply. The LMU-42x0™ also supports inputs and outputs to monitor and react to the vehicular environment and/or driver actions.

Flexibility

The LMU-42x0™ features CalAmp's industry leading advanced on-board alert engine that monitors vehicle conditions giving you the most flexible tracking device in its class. The PEG™ (Programmable Event Generator) application supports hundreds of customized exception-based rules to help meet customers' dynamic requirements. Customers can modify the behavior of the device to meet with a range of applications preprogrammed before shipment or in the field. Combining affordability and device intelligence with your unique application can give you distinct advantages over your competition.

Over-the-Air Serviceability
The LMU-42x0™ also incorporates CalAmp's industry leading over-the-air device management and maintenance system software, PULS™ (Programming, Updates, and Logistics System). Configuration parameters, PEG rules, and firmware can all be updated over the air. Our web-based maintenance server, PULS™ scripts, and firmware, can all be updated over-the-air. PULS™ offers out-of-the-box hands free configuration and automatic post-installation upgrades. You can also monitor unit health status across your customers' fleets to quickly identify issues before they become expensive problems.

2 System Overview

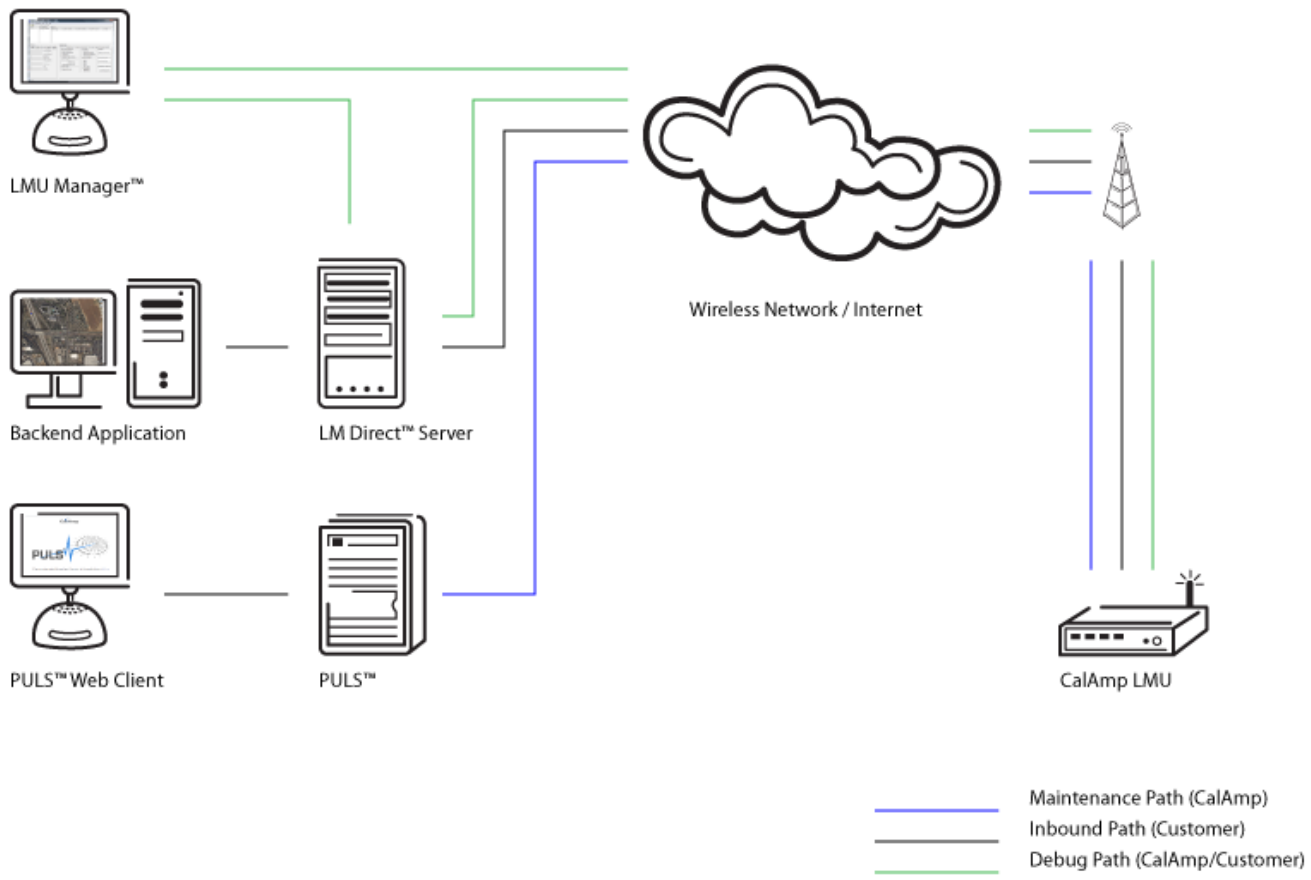
2.1 Overview

The entire purpose behind a fleet management system is to be able to remotely contact a vehicle, determine its location or status, and do something meaningful with that information. This could include displaying the vehicle location on a map, performing an address look-up, providing real-time driving directions, updating the vehicles ETA, monitoring vehicle and driver status or dispatching the vehicle to its next pick up.

These functions, of course, are completely dependent on the capabilities of the vehicle management application. The role of the CalAmp LMU-42x0™ is to deliver the location information when and where it is needed.

A typical fleet management system based on a CalAmp device includes the following components:

- A wireless data network
- An LMU-42x0™
- Host Device (GPS NMEA only)
- An LM Direct™ communications server
- Backend mapping and reporting software which typically includes mapping and fleet reporting functions
- PULS™
- LMU Manager™



Basic System Architecture

2.2 Component Descriptions

2.2.1 Wireless Data Network

The Wireless Data Network provides the information bridge between the LM Direct™ server and the LMU-42x0™. Wireless data networks can take a variety of forms, such as cellular networks, satellite systems or local area networks. Contact the CalAmp sales team for the networks available to the LMU-42x0™.

2.2.2 LMU-42x0™

The LMU-42x0™ is responsible for delivering the location and status information when and where it is needed. Data requests mainly come from the following sources:

- PEG™ script within the LMU-42x0™
- A location or status request from the LM Direct™ server
- A location or status request from LMU Manager
- An SMS request made from a mobile device such as a customer's cell-phone

In some cases, it is necessary to run an application in the vehicle while it is being tracked by the backend

software. Such examples could include instant messaging between vehicles or a central office, in-vehicle mapping or driving directions, email or database access. In most of these cases you will be using the LMU-42x0™ as a wireless modem as well as a vehicle-location device.

2.2.3 LM Direct™ Server

LM Direct™ is a CalAmp proprietary message interface specification detailing the various messages and their contents the LMU-42x0™ is capable of sending and receiving. This interface allows System Integrators to communicate directly with LMU-42x0's™. Please refer to the LM Direct Reference Guide for details.

2.2.4 Backend Software

Backend software is a customer provided software application. Regardless of its purpose, one of its primary functions is to parse and present data obtained from the LM Direct™ server. This allows the application to do any of the following:

- Display location database on reports received from the LMU-42x0™ in a variety of formats
- Present historic information received from the LMU-42x0™, typically in a report/chart style format
- Request location updates from one or more LMU-42x0s™
- Update and change the configuration of one or more LMU-42x0s™

2.2.5 PULS™

PULS™ (Programming, Update and Logistics System) is CalAmp's web-based maintenance server offering out-of-the-box hands free configuration and automatic post-installation upgrades. PULS™ provides a means for configuration parameters, PEG scripts, and firmware to be updated Over-The-Air (OTA) and allows CalAmp customers to monitor unit health status across your customers' fleets to quickly identify issues before they become expensive problems.

2.2.6 LMU Manager™

LMU Manager is the primary configuration tool in the CalAmp system. It allows access to almost every feature available to the LMU-42x0™. Unlike the backend software, it has the option of talking directly to an LMU-42x0™ or making a request forwarded by the LM Direct™ server.

For further details on using LMU Manager, please refer to the LMU Manager Users Guide.

3 Hardware Overview

3.1 Location Messaging Unit-LMU-42x0™

3.1.1 LMU-42x0™ Handling Precautions

Electrostatic Discharge (ESD)
Electrostatic discharge (ESD) is the sudden and momentary electric current that flows between two objects at different electrical potentials caused by direct contact or induced by an electrostatic field. The term is usually used in the electronics and other industries to describe momentary unwanted currents that may cause damage to electronic equipment.

ESD Handling Precautions
ESD prevention is based on establishing an Electrostatic Protective Area (EPA). The EPA can be a small working station or a large manufacturing area. The main principle of an EPA is that there are no highly charging materials in the vicinity of ESD sensitive electronics, all conductive materials are grounded, workers are grounded, and charge build-up on ESD sensitive electronics is prevented. International standards are used to define typical EPA and can be obtained for example from International Electro-technical Commission (IEC) or American National Standards Institute (ANSI).

This ESD classification of the sub assembly will be defined for the most sensitive component, therefore the following classifications apply:

- Class 1B – Human Model (< 1 kV)
- Class M1 – Machine Model (< 100V)

When handling the LMU-42x0's™ main-board (i.e. sub assembly) by itself or in a partial housing proper ESD precautions should be taken. The handler should be in an ESD safe area and be properly grounded.

GPS Ceramic Patch Handling
When handling the sub assembly it may be natural to pick it up by sides and make contact with the antenna boards. In an uncontrolled ESD environment contact with the center pin of ceramic patch antenna can create a path for electrostatic discharge directly to the GPS Module. The GPS Module is very sensitive to ESD and can be damaged and rendered non-functional at low levels of ESD.

One should avoid contact with the center pin of the patch during handling. The Factory will be placing a protective layer of Kapton® tape over the patch element to eliminate this ESD path.

Packaging
Anytime the sub assembly is shipped and it is not fully packaged in its final housing it must be sealed in an ESD safe bag.

Electrical Over-Stress (EOS)
The GPS receiver can be damaged if exposed to an RF level that exceeds its maximum input rating. Such exposure can happen if a nearby source transmits an RF signal at sufficiently high level to cause damage.

Storage and Shipping
One potential source of EOS is proximity of one LMU-42x0™ GPS Antenna to another LMU-42x0™ GSM Antenna. Should one of the units be in a transmit mode the potential exists for the other unit to become damaged. Therefore any LMU-42x0™ GPS Antenna should be kept at least four inches apart from any active LMU-42x0™ GSM Antenna or any other active high power RF transmitter with power greater than 1 Watt.

3.1.2 Battery Back-up devices

Please properly dispose of the battery in any of the CalAmp products that utilize one, do not just throw used batteries, replaced batteries, or units containing a back-up battery into the trash. Consult your local waste management facility for proper disposal instructions.

3.1.3 Environmental Specifications

The LMU-42x0™ 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 LMU-42x0™ 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 the LMU is designed to operate in and the relevant SAE tests that were performed. No formal altitude tests were conducted.

Size

4.8" long x 3.3" wide x 0.85" high

Weight

11 ounces.

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

Ground vehicle environment with associated shock and vibration
SAE Test: SAE J1455
Mil Standard 202G and 810F

Electromagnetic Compatibility (EMC)

EMC compliant for a ground vehicle environment
SAE Test: SAE J1113 Parts 2, 12, 21 and 41

Operating Voltage Range

The LMU-42x0™ supports vehicles with 12 or 24 VDC systems including transients and electrical system noise; this includes ranges from 7 to 32 VDC.

Electrostatic Discharge (ESD)

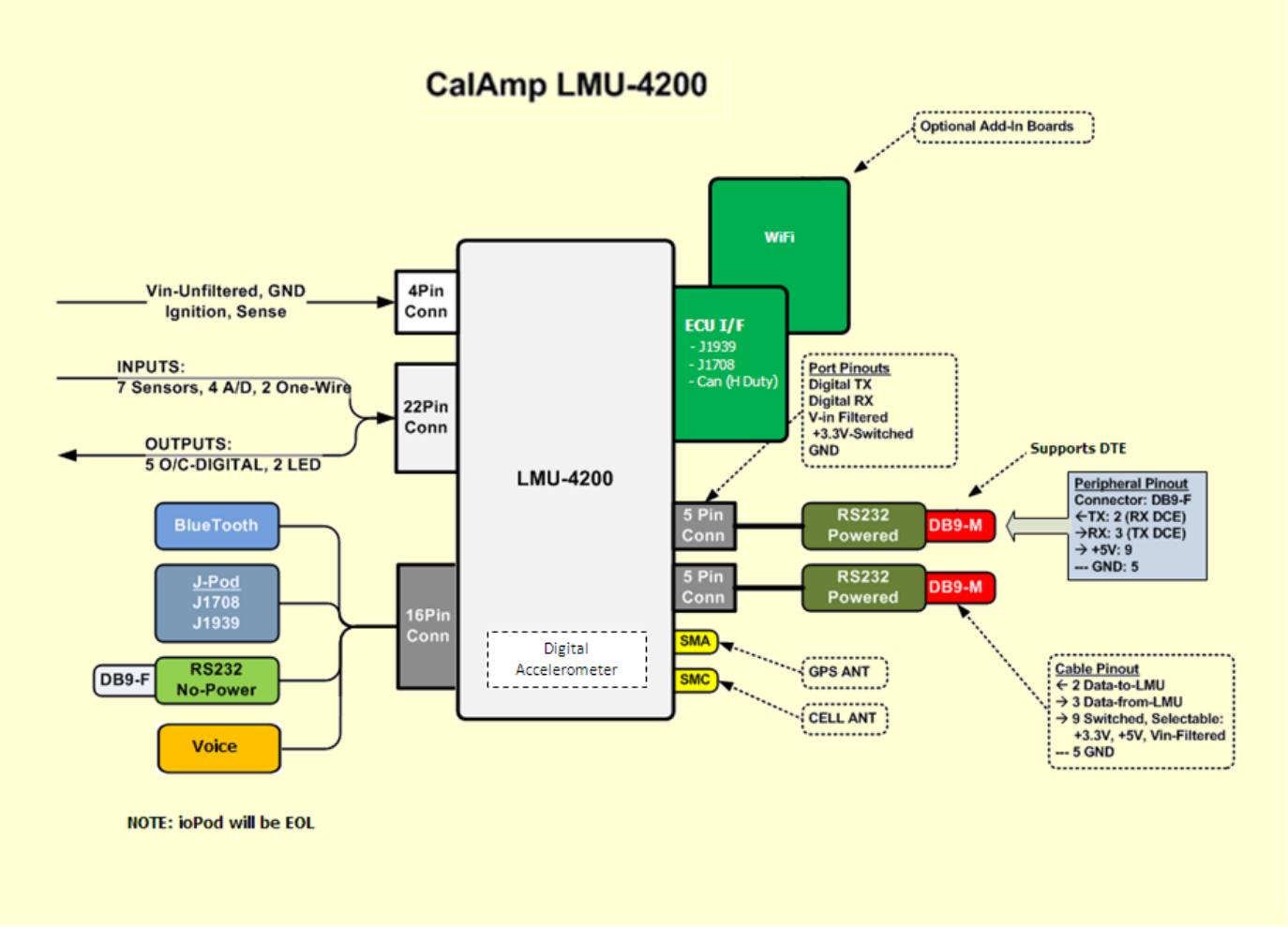
No damage or performance degradation after the ESD disturbance.
SAE Test: SAE J1113 Part 13

Power Consumption

Average: 70mA at 13.8 VDC
Deep Sleep: 4mA
Sleep on Network (SMS): 10mA
Sleep on Network (GPRS): 20mA

3.2 Location Messaging Unit- 4200™ & 4250™

The block diagram below correctly shows the 4200 board with the optional add-on board for Wifi or jPOD. The 4250 differs from the 4200 in that the Wifi or jPOD board are built in to the device, rather than existing as external add-ons.

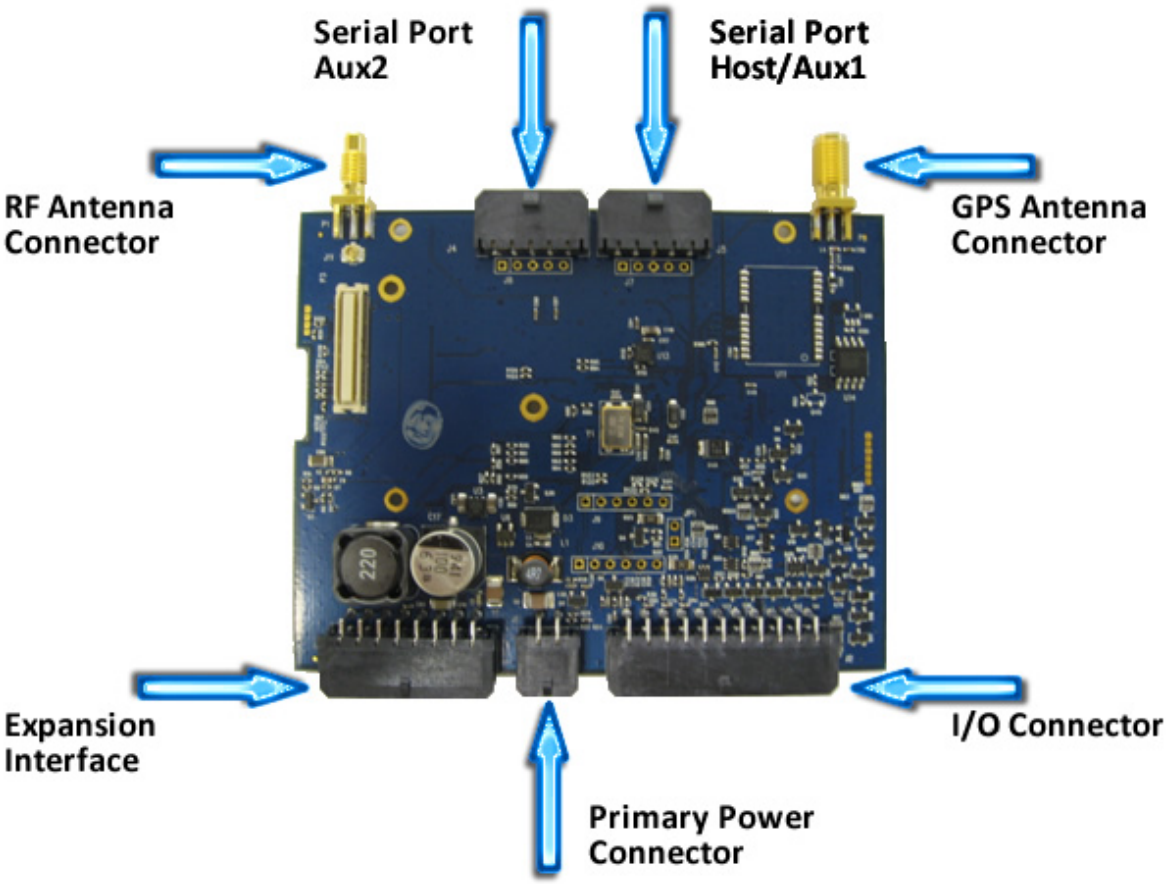


LMU-4200™ Block Diagram

3.3 LMU-42x0™Connectors

The LMU-42x0™ offers 5 connectors to access power, I/O, serial communications and other expansion capabilities. These connectors are:

- **Primary Power Connector**
- **I/O Connector**
- **Serial Port Connector – Host/Aux1**
- **Serial Port Connector – Aux 2**
- **Expansion Connector (only available on 4200/4250, not on 4x20 devices)**

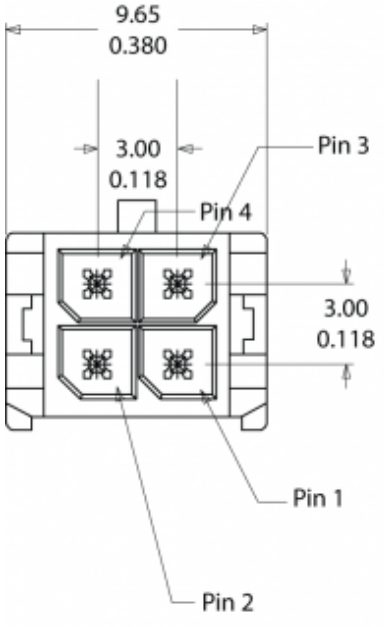


LMU-42x0™ Connectors

3.3.1 Power Connector

The LMU-42x0™ uses a 4 pin Molex 43045-0402 connector as its power connection. The pin out is as follows:

Pin	Signal Name	Description	5C888 Color	Input or Output
1	VIN	Power	Red	Power / Input
2	GND	Ground	Black	Ground
3	ADC1	Analog to Digital Input 1	Green	Input
4	INPUT 0	Input 0 / Ignition Sense – Digital Input	White	Input

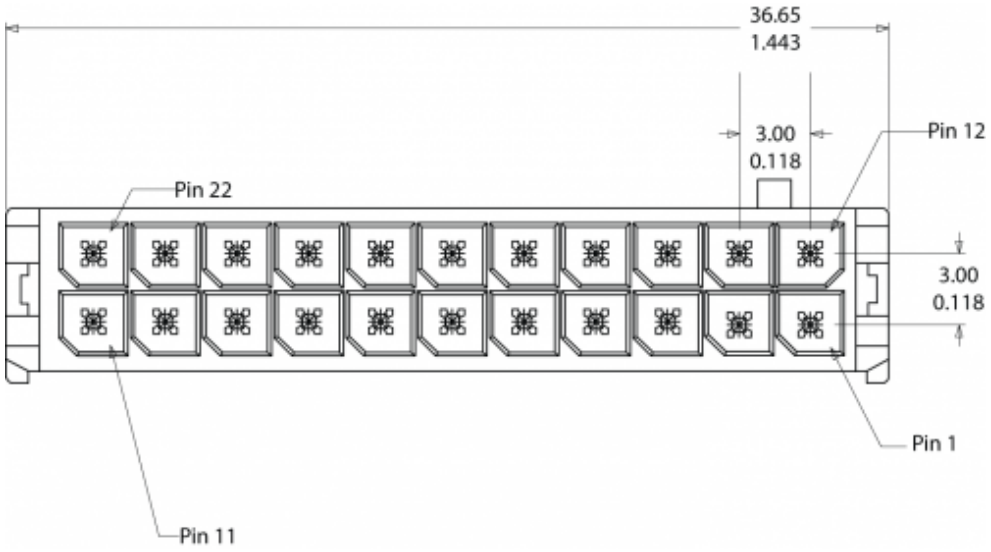


LMU-42x0™ Header (looking into LMU)

3.3.2 I/O Connector

The LMU-42x0™'s features expanded I/O capabilities via its 22-Pin Molex 43045-2202 connector. Its pin-out is as follows:

Pin	Signal Name	Description	5C889 Color	Input or Output
1	Input 1	Input 1 – Digital Input	Blue	Input
2	Input 2	Input 2 – Digital Input	Orange	Input
3	Input 3	Input 3 – Digital Input	Violet	Input
4	Input 4	Input 4 – Digital Input	Gray	Input
5	Input 5	Input 5 – Digital Input	Green & White	Input
6	Input 6	Input 6 – Digital Input	Blue & White	Input
7	Input 7	Input 7 – Digital Input	Black & White	Input
8	1BB T Data	1 Bit Bus Data (T)	Green & Black	Input/Output
9	1BB GND	1 Bit Bus Ground	Black	Ground
10	1 BB R Data	1 Bit Bus Data (R)	Orange & Black	Input/Output
11	1 BB Gnd	1 Bit Bus Ground	Black	Ground
12	Output 0	Output 0 - Starter Disable Relay Driver	Green	Output
13	Output 1	Output 1 - Digital Output	Brown	Output
14	Output 2	Output 2 - Digital Output	Yellow	Output
15	Output 3	Output 3 - Digital Output	Blue & White & Orange	Output
16	Output 4	Output 4 - Digital Output	Green & Black & Orange	Output
17	Output 5 - LED	Output 5 - LED 1 Driver	Red & Green	Output
18	Output 6 - LED	Output 6 - LED 2 Driver	Orange & Green	Output
19	ADC 2	Analog to Digital Input 2	Black & Red	Input
20	ADC 3	Analog to Digital Input 3	White & Red	Input
21	ADC 4	Analog to Digital Input 4	Orange & Red	Input
22	ADC 5	Analog to Digital Input 5	Blue & Red	Input

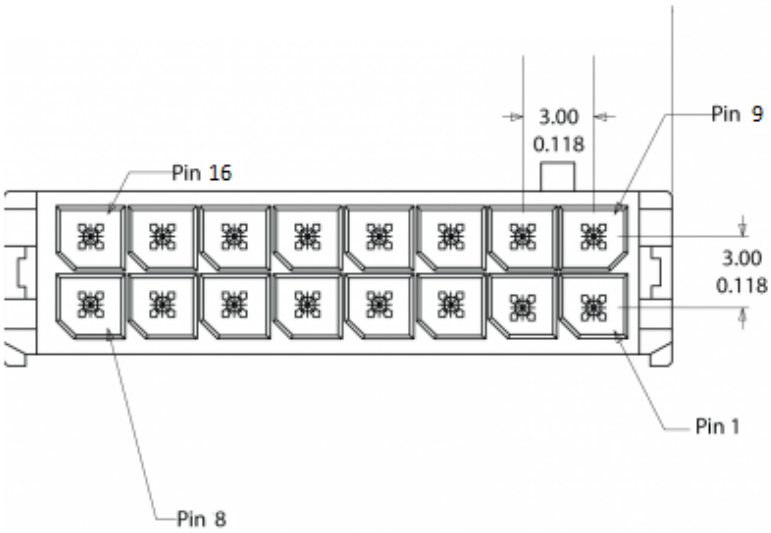


LMU-42x0™ Header (looking into LMU)

3.3.3 Expansion Port

The LMU-42x0™'s features expanded I/O capabilities via its 16-Pin Molex 43045-1600 connector. Its pin-out is as follows:

Pin	Signal Name	Description	Input or Output
1	SPKR _	Modem Speaker Output (-)	Audio Output
2	SPKR +	Modem Speaker Output (+)	Audio Output
3	V_BATT	Power Input (12 Volt nominal) for Battery Backup	Input
4	VIN_FILT	Filtered Vehicle Power (12V)	Output
5	I2C_SDI	I2C Bus Data In	Input
6	I2C_CLK	I2C Bus Clock	Output
7	MDM_RXD	Modem Serial Interface Rcv Data to MDT or other peripheral (TTL)	Output
8	HOST_RXD	Host Port Serial Interface Rcv Data to MDT or other peripheral (TTL)	Output
9	MIC -	Modem Microphone Input (-)	Audio Input
10	MIC +	Modem Microphone Input (+)	Audio Input
11	GND	Ground	Ground
12	EXT_INT	External Interrupt, active low	Input
13	3.3 VDC	For powering peripheral devices (500mA)	Output
14	I2C_SDO	I2C Bus Data Out	Output
15	MDM_TXD	Modem Serial Interface Tx Data from MDT or other peripheral (TTL)	Input
16	HOST_TXD	Host Port Serial Interface Tx Data from MDT or other peripheral (TTL)	Input

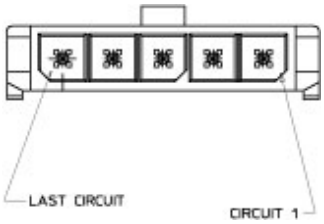


LMU-42x0™ Expansion Port (looking into LMU)

3.3.4 Serial Interface Connectors

The LMU-42x0™ offers 2 serial interface connections (Host/Aux1 and Aux 2) on its front face. These are provided via 2 Molex 43650-0501 connectors using the following pin outs.

Pin	Signal Name	Description	133337-5 Color	Input or Output
1	VIN_FILT	Filtered LMU Power	Red	Power Supply
2	VCC3V3	3.3V Power	Orange	Power Supply
3	Ground	Ground	Black	Ground
4	TX	Transmit Data	Blue	Input to LMU
5	RX	Receive Data	Green	Output From LMU



Serial Interface Connector

Users should only use CalAmp approved serial adapters with these connections. (Part Number 133337-5 and 133564-1)

LMU-42x0™ Serial Cable Plugged into Aux 1

3.3.5 Expansion Interface

The expansion interface located on the back of the LMU-42x0™ via the 16-in Molex connector is used to extend I/O functions and provide serial access to the LMU-42x0™. It should only be used with CalAmp expansion harnesses. The available accessories are:

jPOD™ Vehicle Bus Adaptor
The CalAmp jPOD Adapter is a J1939 compliant device that reads the parameters broadcast in the J1939 bus, processes them and provides filtered vehicle data to the LMU-42x0™.

A script is written using a special software tool and loaded into the jPOD. This script defines the specific parameters (PGNs/SPNs) to read, how to process them and how to send them to the host. The script does not send any requests onto the bus.

Selected J1939 Parameters	PGN	SPN
Battery Potential / Power Input 1	65271	168
Engine Coolant Temperature	65262	110
Engine Speed RPM	61444	190
Vehicle Speed	65265	84
Accelerator Pedal Position %	61443	91
Brake Pedal Switch - On/Off	65265	597
Total Vehicle Distance	65248	245
Engine Total Fuel Used	65257	250
Diesel Particulate Filter Status	64892	3701
DM1 (Diag Msg 1 - active DTC's)	65226	

Size

3.5" long x 1.7" wide x 0.9" high
Total length with cable: 12.7”

Weight

2.3 ounces

Power Consumption

Average: 70mA at 13.8 VDC

Diagnostic tools used by CalAmp:

J1939 Simulator from AU Group Electronics, - http://www.auelectronics.com
J1939 Scanner from Dearborn Group Technology, - http://www.dgtech.com/product/dpa5/dpa5.php

Pin outs for the J1939 signals on the DE15 pin connector:

Pin 1 - Power
Pin 2 - CAN Low
Pin 3 - CAN Hi
Pin 15 - GND

jPOD™ Vehicle Bus Adaptor

3.3.6 Serial Adapter

To add a host serial adapter to the LMU-2610™ there is 1 additional part:

- Part Number 133337-5: Serial Adapter.

3.3.7 Accessories

See the Harness Diagrams page for more information on LMU accessories, and supported products table.

3.4 GPS Receiver

50 channel GPS receiver (with SBAS, DGPS)
Accuracy: 2 meter CEP (with SBAS)
Antenna connector: SMA
Tracking Sensitivity: -160dBm
Acquisition Sensitivity: -144dBm
Note that the CalAmp LMU-42x0™ requires an antenna amplifier that operates at 3VDC; 5VDC amps will not work.

3.5 RF Connector

LMU-42x0's™ uses an SMC connector with a 50 Ω impedance.

3.6 I/O Descriptions

The LMU-42x0™ provides the following inputs and outputs (I/O):

Digital Inputs

Input 0: Ignition Sense (Always biased low)
Input 1: Generic Digital Input (Biased high or low/ S-158 Bit 1)
Input 2: Generic Digital Input (Biased high or low/ S-158 Bit 2)

Input 3: Generic Digital Input (Biased high or low/ S-158 Bit 3)
Input 4: Generic Digital Input (Biased high or low/ S-158 Bit 4)
Input 5: Generic Digital Input (Biased high or low/ S-158 Bit 5)
Input 6: Generic Digital Input (Fixed bias high)
Input 7: Generic Digital Input (Fixed bias high)
Input 8: Motion Sensor
Input 9: VBUS Active
Input 10: Pwr State
Input 11: Vbatt Low

Analog to Digital Inputs

A/D 0: External Power Supply Monitor
A/D 1: Generic External Analog to Digital Input
A/D 2: Generic External Analog to Digital Input
A/D 3: Generic External Analog to Digital Input
A/D 4: Generic External Analog to Digital Input
A/D 5: Generic External Analog to Digital Input
A/D 6: <TBD>
A/D 7: GPS Antenna Monitor

Outputs:

Output 0: Standard Open Collector Relay Output
Output 1: Standard Open Collector Relay Output
Output 2: Standard Open Collector Relay Output
Output 3: Standard Open Collector Relay Output
Output 4: Standard Open Collector Relay Output

LED Drivers

Output 5: Standard LED Driver
Output 6: Standard LED Driver

iButton / 1 Bit Bus

iButton ID Support
1Wire bus with current boost for temperature sensors

3.6.1 3-Axis Accelerometer Input

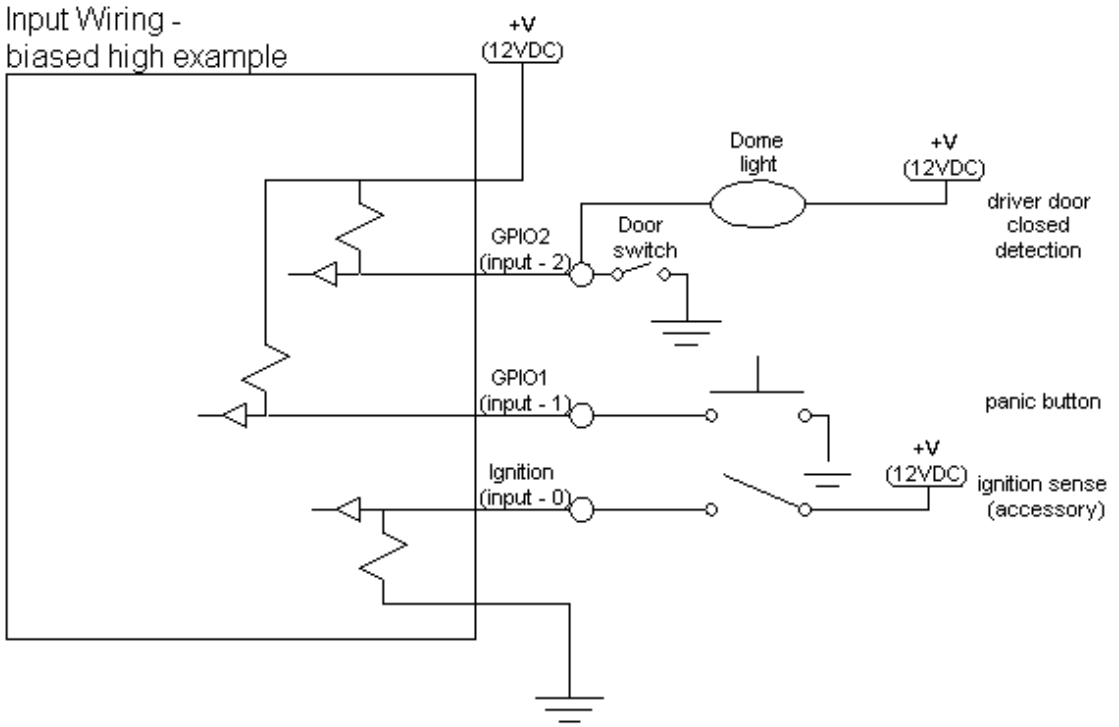
The LMU-42x0™ supports an internal 3 Axis Precision Accelerometer as one of its discreet inputs. When the LMU is moved in any direction, the associated input will be in the High state. If the LMU's accelerometer does not detect motion, then the input will be in the Low state. No external connections are required for this functionality to be operational.

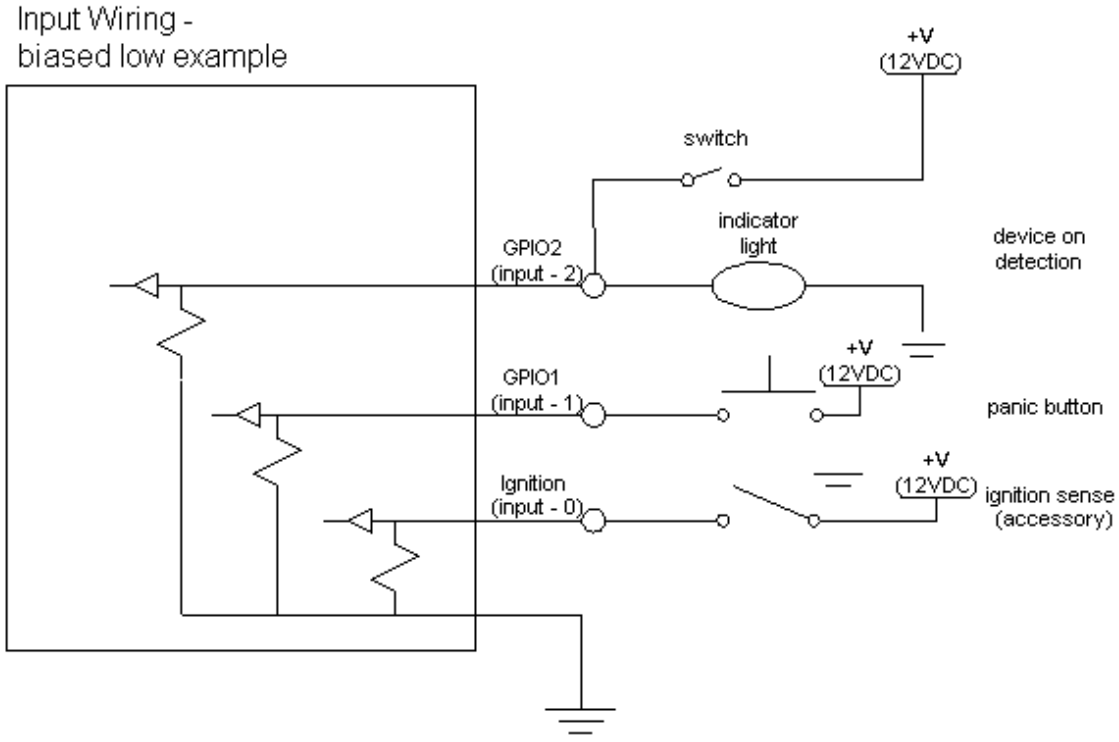
3.6.2 Ignition and Inputs

The LMU-42x0™ provides up to 7 inputs. These inputs are protected from typical vehicle transients and can be directly connected to most vehicle level logical inputs from 4 volts up to the vehicle power input level (typically 12 VDC). Their input impedance is approximately 10kΩ. One of these inputs is dedicated to sensing

the vehicle's ignition status to provide for flexible power management. The other two 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 or many others.

The ignition input is pulled to ground through the 10k resistance, where the other inputs can be configured to be normally High (i.e. pulled to +12v through a 10k resistor) or Low (i.e. pulled to ground through a 10k resistor). The diagrams below show how to connect the inputs in both a high- and low-biased configuration:

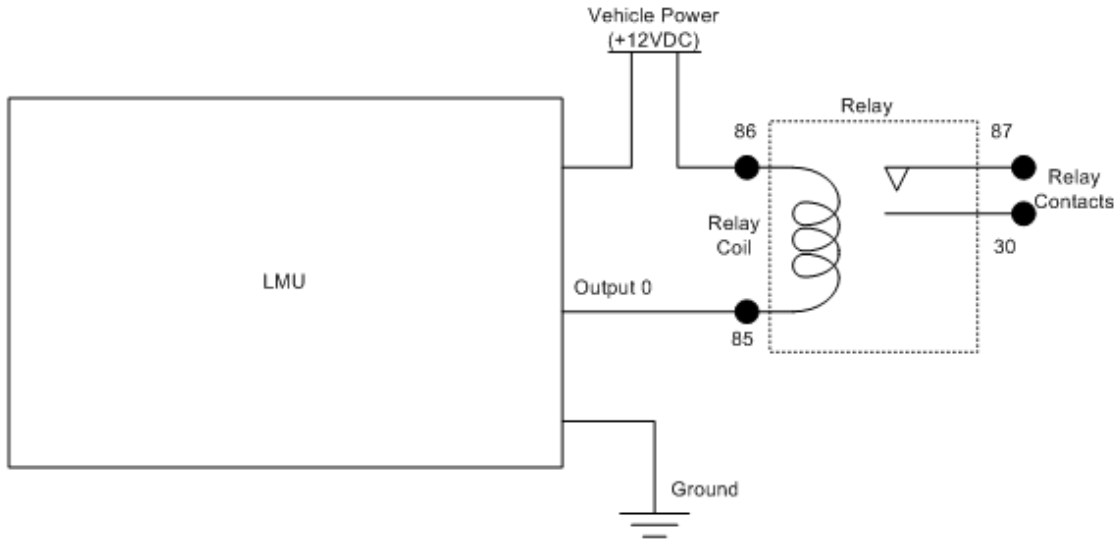




Sample Input Wiring

3.6.3 Outputs

The LMU's and ioPOD;s outputs are designed to drive external relays. These outputs provide a high-current, open-collector driver that can sink up to 150 mA each. These drivers may be used to drive external relays that can then control vehicle functions such as door locks, fuel shut-off valves, sirens and lights. If additional current is required to drive the relays, external circuitry can be added to source the current. This diagram is a typical use of an output to drive a relay.



Sample Relay Wiring

3.6.4 Status LEDs

The LMU-42x0™ 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:

LED #1 (Comm LED - Orange) Definitions

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

LED #2 (GPS LED - Yellow) Definitions

Condition	LED 2
GPS Off	Off
GPS On	Slow Blinking
GPS Time Sync	Fast Blinking
GPS Fix	Solid

4 Configuration and Activation

This section details how to quickly get an LMU-42x0™ provisioned and configured to point at a specific server. It is assumed that a PEG script has already been created and is being managed through LMU Manager or PULS™, the CalAmp Maintenance System.

We are making three assumptions to simplify the setup process:

- You have created, installed and configured an LM Direct™ Server to receive messages from the LMU-42x0™. (See LM Direct™ Reference Guide for details)
- You are using the standard wiring harness from CalAmp and the serial port expansion harness.
- You have created a HyperTerminal or Putty session.
- **You have contacted the CalAmp sales team regarding the network availability of the LMU-42x0™.** This device may not be supported for all the carriers or networks listed in this section (CDMA-Verizon, CDMA-Sprint, HSPA, GSM), for product availability consult the CalAmp sales team.

4.1 Quick Start - General Config

All LMU-42x0s™ must go through a common step during the configuration and provisioning process. Specifically, this is pointing the LMU to your LM Direct™ server, either via IP or a URL.

This configuration process is accomplished via a series of AT Commands:

1. Power up the LMU-42x0™ and connect a serial cable from the LMU to your laptop
2. Open a terminal session to the LMU-42x0™
3. Enter the address of the LM Direct™ server:

```
AT$APP PARAM 2319,0,ddd.ddd.ddd.ddd
AT$APP PARAM 768,0,ddd.ddd.ddd.ddd     (32-bit products only)
AT$APP PARAM 769,0,ppppp
```

Where ddd.ddd.ddd.ddd is the publicly addressable IPV4 address of your LM Direct™ server and ppppp is the UDP port number.

4. Alternatively if a URL has been set up for your LM Direct™ server, the LMU may be programmed with:

```
AT$APP PARAM 2319,0,myURL.MyCompany.Com
```

Where myURL.MyCompany.com is the URL assigned to the server.

5. Enter ATIC to verify the correct settings are displayed for your Inbound Server.

This configuration process is accomplished via a series of SMS Commands:

1. Power up the LMU-42x0™ and your handset
2. From the handset, send an SMS message to the LMU-42x0™ phone number:

```
!RP,2319,0,ddd.ddd.ddd.ddd
!RP,768,0,ddd.ddd.ddd.ddd     (32-bit products only)
!RP,769,ppppp
```

Where ddd.ddd.ddd.ddd is the publicly addressable IPV4 address of your LM Direct™ server and ppppp is the UDP port number

3. Alternatively if a URL has been set up for your LM Direct™ server, the LMU may be programmed with:

```
!RP,2319,0,myURL.MyCompany.Com
```

Where myURL.MyCompany.com is the URL assigned to the server

4. Verify your settings by sending the commands:

```
!RP?2319,0
!RP?769,0.
```

4.2 Auto provisioning of GSM or HSPA LMUs

For certain operators, the LMU can auto-populate the APN, username and password settings based on the Mobile Country Code (MCC) and the Mobile Network Code (MNC) of the SIM. Upon inserting a new SIM the APN, username and password will switch to the new SIM card's defaults if the MCC and MNC values change. The current list of supported MCC and MNC combinations are:

- AT&T – formerly AT&T Wireless or Cingular Blue (MCC 310, MNC 38)

  o APN 0: PROXY
  o APN 1: PUBLIC

- AT&T – formerly Cingular Wireless (MCC 310, MNC 17, 18, 41)

  o APN 0 & 1: ISP.CINGULAR
  o Username: ISP@CINGULARGPRS.COM
  o Password: CINGULAR1

- Manxpronto (MCC 234, MCN 058)

  o APN web.manxpronto.net
  o Username: gprs
  o Password: gprs

- O2 UK (MCC 234, MNC 02, 10, 11)

  o APN 0 & 1: mobile.o2.co.uk
  o Username: mobileweb
  o Password: password

- O2 Ireland (MCC 272, MNC 02)

  o APN 0 & 1: open.internet
  o Username: gprs
  o Password: gprs

- Orange UK (MCC 234, MNC 33, 34)

  o APN 0 & 1: orangeinternet
  o Username: user
  o Password: pass

- T-Mobile (MCC 310, MNC 16, 20, 21, 22, 23, 24, 25, 26, 27, 31, 58, 66, 80)

  o APN 0: INTERNET2.VOICESTREAM.COM
  o APN 1: INTERNET3.VOICESTREAM.COM

- T-Mobile UK (MCC 234, MNC 30,31,32)

  o APN 0 & 1: general.t-mobile.uk
  o Username: user
  o Password: wap

- TelCel Mexico (MCC 334 MNC 02)

  o APN 0 & 1: INTERNET.ITELCEL.COM
  o Username: webgprs
  o Password: webgprs2002

- Telstra Australia (MCC 505, MNC 01, 11, 71, 72)
  - o APN 0 & 1: telstra.internet
- Vodafone Ireland (MCC 272, MNC 01)
  - o APN 0 & 1: isp.vodafone.ie
  - o Username: vodafone
  - o Password: vodafone
- Vodafone New Zealand (MCC 530, MNC 01)
  - o APN 0 & 1: internet
  - o Username: guest
  - o Password: guest
- Vodafone UK (MCC 234, MNC 15)
  - o APN 0 & 1: internet
  - o Username: web
  - o Password: web

Unless otherwise stated, the username and password will be set to “dummy”.

This feature can be disabled by setting Bit 0 of S-Register 155.

```
AT$APP PARAM 1024,35,1,1
```

To re-enable auto-provisioning, use:

```
AT$APP PARAM 1024,35,1,0
```

Auto-provisioning occurs when the LMU detects a SIM with a new operator ID (i.e. the first 6 digits of the IMSI) or when Bit 0 of S155 is cleared and the GPRS context is blank (i.e. Parameter 2306,0).

4.3 Activating GSM or HSPA LMU using AT Commands

Check with the CalAmp Sales team for availability of the LMU-42x0™ with GSM or HSPA modems. For a GSM/GPRS operator you will get the LMU in one of two varieties, one with a SIM and one without.

If you get an LMU without a SIM (which is the typical case) the operator will simply ask for the IMEI of the LMU. The IMEI (International Mobile Equipment Identifier) is printed on the bottom of the LMU under the LMU’s ESN. Again, DO NOT give the operator the ESN of the LMU.

The operator will provide you with a SIM for each account activated. If they are especially nice (or you are especially persistent) they will also give you a list tying the IMSI (International Subscriber Identifier) of the SIM to the phone number assigned to it. Please note that the operator will likely tie the IMSI (i.e. the SIM) to a specific IMEI. Making sure the specific SIM matches to the right IMEI isn’t strictly necessary, but it will keep everyone’s book-keeping a little cleaner. You may also obtain this information by running a CSV report in

PULS (after the devices have connected to the network and sent in their first ID Report). See the PULS Users Guide for more information.

If you do happen to have a SIM, the operator will ask for the IMSI and ICC-ID (Integrated Circuit Card Identifier) along with the IMEI of the LMU. Again, in return you should get a list of IMSIs and Phone Numbers.

The IMEI, IMSI and ICC-ID are all available through the **ATI1** command. The IMEI should also be printed on the bottom of the LMU.

You should also get an APN (Access Point Name) value. The APN is the device on the network that allows a GPRS device (i.e. the LMU) to get to the internet. They tend to look like a URL, for example:

myAPN.myOperator.com

Operators can offer more than one type of APN and can even set up a custom APN just for your devices. The rates they charge will vary depending on the APN service you want. Operators may also request you use a blank APN. With the APN, you should also receive a username and password combination.

The last item an operator may provide is a SIM PIN. The PIN is effectively a password to the device. The main difference here is that the PIN will restrict all the capabilities of the GSM device, where the SPC is used just for configuration.

The activation sequence for a GSM LMU would therefore look as follows:

```
AT$APP PARAM 2306,0,“myAPN.myOperator.com”
AT$APP PARAM 2306,1,“myAPN.myOperator.com”
AT$APP PARAM 2314,0,“myUSername”
AT$APP PARAM 2315,0,“myPassword”
```

For a blank APN the following command can be used:

```
AT$APP PARAM 2306,0,“” (for a blank APN)
```

Only enter this next command if you have been given a non-zero PIN as any errors may lock you out of the modem.

```
AT$APP PIN <SIM pin>
```

You can confirm activation by watching the Comm LED to see if it goes solid. You may also confirm activation using

```
AT$APP COMM STATUS?
```

A good response should look similar to the following:

```
GSM Registered:         Yes
GPRS Registered:        Yes
Connection:             Yes
RSSI:                   -70 dBm
BER:                    0
Channel:                        0
Cell ID:                        0
Base Station ID:        0
Local Area Code:        0
Network Code:           38
Country Code:           310
IMEI (Modem S/N):       500167110060440
IMSI (SIM S/N):         310380100521849
Phone Number:
GPRS APN:               IP:Public
Quality of Srvc:        1,0,0,3,0,0
GSM Class:              B
```

4.4 Accessing the SIM

The SIM carrier is located on the right side of the LMU-42x0™ underneath the wireless modem (GSM or HSPA). The SIM's contacts should face upwards with the SIM notch oriented into the LMU-42x0™.

LMU-42x0™ SIM Insertion

4.5 Activating a CDMA LMU-42x0™

Check with the CalAmp Sales team for availability of the LMU-42x0™ with CDMA modems. For CDMA devices, the activation sequence you will use varies from carrier to carrier. Each of the supported carriers is documented below.

To obtain an account, a CDMA carrier will generally ask for three things, the Manufacturer, the Product Type and the ESN. Obviously the first two items are answered by "CalAmp LMU". The last one is a little misleading. The ESN on the LMU is the CalAmp serial number. The one the operator is interested in is the MSN-D (which they call the decimal ESN). DO NOT give them the CalAmp ESN (i.e. the top one on the label). It will only lead to the carrier telling you that the product doesn't exist and they can't activate it for you.

What you should get back will vary from operator to operator; however at very least it will be the MDN (Mobile Directory Number) and MIN (Mobile Information Number). You should also ask for the SPC (Service Programming Code) in case it is not 000000. The SPC is effectively a password to the modem which allows you to program some of the more sensitive items (ex: the MDN and MIN). Please note that the MIN and MSID can be the same value.

4.5.1 Activating a CDMA LMU-42x0™ – Verizon

Verizon supports a system that allows CDMA devices to be provisioned Over-The-Air. A CalAmp LMU-42x0™ will automatically use this system to attempt to self provision. This procedure assumes that the LMU-42x0™ has never been provisioned or activated before.

1. Power on the LMU-42x0™, making sure you can observe the behavior of the Comm LED.
2. Wait until the Comm LED turns solid. This could take up to 5 minutes.
3. If after 5 minutes you observe that the Comm LED transitions from a slow blink to a fast blink several times (i.e. more than twice) you will need to contact Verizon Wireless for further support on account activation.

Once configured, you may verify that the LMU-42x0™'s modem has registered to the CDMA network. Enter:

```
AT$APP COMM STATUS?
```

The response should be similar to:

```
   CDMA Service:       IS-2000
   Connection:         Yes
   RSSI:               -80 dBm
   Channel:            0
   Band:Side:          800:B
   Base Station ID:    0
   Network ID:         0
   System ID:          4
   ESN (Modem S/N:     2676319948 [9F8566CC]
   Phone Number:       1234567890
   IMSI:               310001234567890
   CarrierConfig:      5
```

Note that the Phone Number should match the MDN value the carrier gave you. The last 10 digits of the IMSI field should match the MIN/MSID value they gave you.

For devices that have had previous activations, an Over-The-Air activation process may be manually started using a single AT Command:

```
AT$APP MODEM UPDATE
```

This command is also used to initiate an Over-The-Air PRL Update for devices that are already provisioned.

Users may also force a reactivation with the command:

```
AT$APP MODEM ACTIVATE
```

Keep in mind, however, this may cause the modem to lose its credentials and become unable to register to the network.

4.5.2 Activating a CDMA LMU-42x0™ – Sprint

Activating an LMU-42x0™ on the Sprint CDMA network is identical to activating on the Verizon network.

1. Power on the LMU-42x0™, making sure you can observe the behavior of the Comm LED.
2. Wait until the Comm LED turns solid. This could take up to 5 minutes.
3. If after 5 minutes you observe that the Comm LED transitions from a slow blink to a fast blink several times (i.e. more than twice) you will need to contact Sprint for further support on account activation..

Once configured, you may verify that the LMU-42x0's™ modem has registered to the CDMA network. Enter:

```
AT$APP COMM STATUS?
```

The response should be similar to:

```
   CDMA Service:       IS-2000
   Connection:         Yes
   RSSI:               -80 dBm
   Channel:            0
   Band:Side:          800:B
   Base Station ID:    0
   Network ID:         0
   System ID:          4145
   ESN (Modem S/N:     2676319948 [9F8566CC]
   Phone Number:       1234567890
   IMSI:               310001234567890
   CarrierConfig:      1
```

The Phone Number field should match the <Phone Number> value you used in step 3 or 4. The last 10 digits of

the IMSI field should match the <MSID> value you used in step 3 or 4.

5 Installing the LMU

The installation of the LMU and its antennas can have a major impact on the LMU's performance. It is recommended that installers be familiar with the installation of GPS and cellular devices and are comfortable in a vehicle environment.

5.1 Preparing for Installation

Be sure you have received all the LMU components you need. This must include:

- The LMU to be installed
- A power harness
- GPS Antenna (for external devices)
- Comm Antenna (for external devices)
- Optional Components:
    - Input and output cables
    - Relays
    - LMU peripherals (i.e. Serial adapter, jPOD, TetheredLocator)
    - Host serial devices (e.g. PDAs, laptops, other serial devices)

5.2 Plan The Installation

Verify Power, Ground and Ignition. Be sure to check each source (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 (LMU, antennas, peripherals, etc.). Be sure that the cables to the LMU are not bent or constricted in any way. Also make sure that the LMU 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 LMU will void the warranty.

The best way to ensure a trouble-free installation is to consider your options and make some decisions before you start. Take a look at the vehicle and determine how to best install the LMU for the following purposes:

- Accurate data gathering and simulation of how customers actually use your solution
- Ongoing monitoring and maintenance of LMU equipment
- Accidental or intentional alteration of the equipment or cable connections

The following sections cover some of the issues to consider when planning your LMU installation.

5.2.1 Size and Placement of LMU Unit

The dimensions of the LMU should be taken into account, particularly when installing in a vehicle:

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

- Be certain that the cables running to the LMU will not be bent or constricted. Damage to the cables may impede the LMU's performance.
- Be certain that the installation point will not violate any of the LMU's environmental specification (temperature, moisture, etc…) as improper installation of the LMU may void the warranty.

See the LMU Environmental Specifications for the exact measurements and specifications of the LMU-42x0™.

Typical installations will place the LMU under the vehicle dash board, or in the trunk. Make sure you can get access to the unit afterwards as under some circumstances it may be necessary to add additional wiring or connections to the LMU.

5.2.2 Placement of Antennas

There are effectively three options for placements of an antenna:

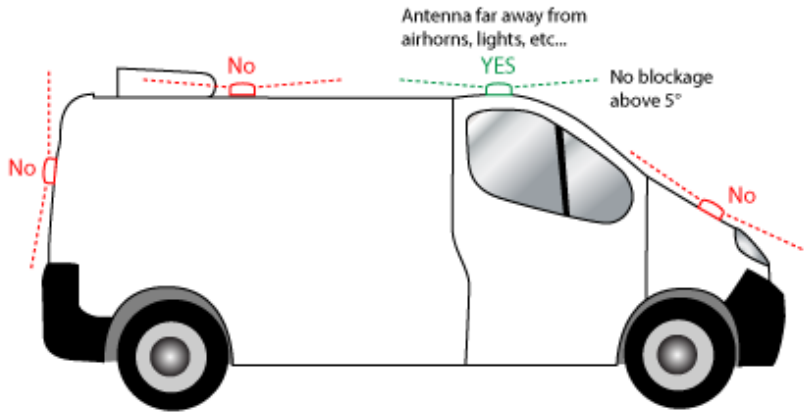
- Roof-mount (magnetic or thru-hole)
- Glass-mount
- Covert (e.g. under the seat, dash, etc…)

Comm Antenna Placement Guidelines
The Comm. Antenna must be located at least 20cm 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 LMU for wireless service is a standard 3-dB gain whip. It mounts 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 by CalAmp combine both the GPS and Comm portions.

GPS Antenna Placement Guidelines
In order to maximize the performance of the LMU 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. Things 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.

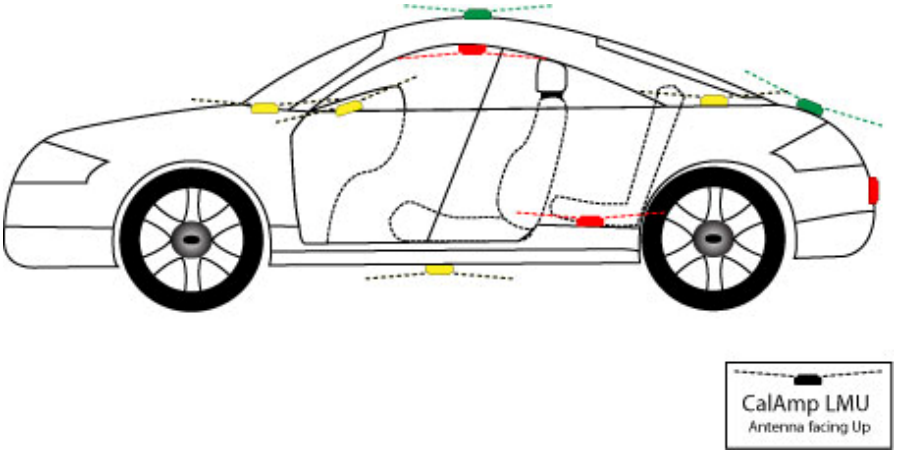


Examples of good and poor GPS antenna placements

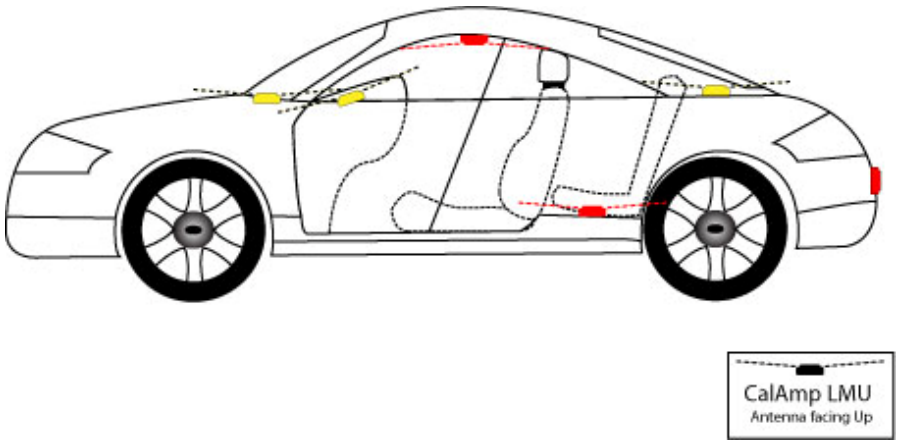
The received signal levels at the GPS antenna from the satellites are very low in power (approximately -136 dBm), so any blockage of the antenna can affect the quality of the location computed by the receiver. Kinks or tight knots in the antenna cable can also prevent the GPS receiver from operating 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 considered GPS performance over Comm performance. GPS signal strengths are much lower than those typically seen by cellular networks supported by the LMU. In order to maximize the performance the LMU 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 LMU that might block the view 360° to the horizon. As with stand-alone GPS antennas, nothing should not block the combination antenna beyond 5° above the horizon with the best location being near the center of the roof. For more covert installs, directly under the front or rear-windshields are also acceptable.



Examples of Good (Green), OK(Yellow) and Poor(Red) combo antenna placements



Examples OK(Yellow) and Poor(Red) internal antenna placements

5.2.3 Access to the SIM (Subscriber Identity Module) Card

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

At some future time, you might need or want to replace the SIM card with a different one, so try to install the LMU in such a way that the cover can be removed to make the SIM card accessible.

5.2.4 Protection from Heat

It is best not to place the LMU 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 LMU is described in the LMU Environmental Specifications section.

5.2.5 Visibility of Diagnostic LEDs

Status LED lights on the front of the LMU unit can provide valuable information about the operation of the LMU. When feasible, attempt to install the LMU 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 LMU is operating properly. If at any time you should encounter a problem with the LMU, you may need to read the LEDs in order to troubleshoot the problem. If you cannot fix the LMU yourself, you will need to provide the LED information to CalAmp customer support.

For information about how to interpret the LEDs, see the Status LED Behavior section.

5.2.6 Cable Length

The RF cables which are provided for connecting to the LMU antennas should be used at the length provided.

Do not cut cables. Instead, coil any excess cable length, making sure not to crimp or flatten the antenna cable.

5.2.7 Moisture and Weather Protection

The LMU 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 thought to be a concern; however, it might be best to avoid locating the LMU below a car's cup holders, or where rain might easily splash into the compartment when a door is opened.

5.2.8 Preventing Accidental or Unauthorized Modification

If you anticipate that fleet drivers or others might interfere with the LMUs once they are installed, take steps to be sure that it is not easy to disconnect the antenna wiring, remove the LMU from its power source, etc.
Two common methods are the use of Tamper Proof Sealant or creation of PEG Script to detect power loss or GPS antenna disconnections.

5.3 Installing the LMU in a Vehicle

This section provides instructions for installing an LMU in a vehicle.

Be sure to consider the design decisions described in the previous sections. When you are ready to begin installing the LMU, follow these steps:

5.3.1 Place the LMU unit in the vehicle.

Typically, the LMU should be placed under the passenger seat or dashboard of the vehicle. LMUs with internal antennas should be placed to maximize their GPS performance. A typical location include under the dash close to the front wind-shield.

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

5.3.2 Connect 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 LMU 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.

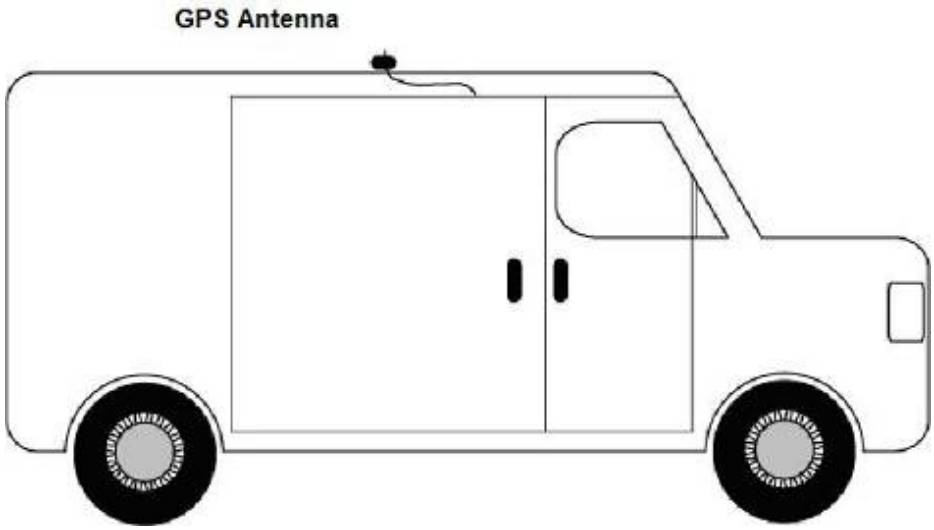
DO NOT connect the power cable to the LMU at this time.

5.3.3 Place the GPS antenna.

The GPS antenna must have a clear view of the sky. Mount the GPS antenna on the vehicle's highest point (for example, 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.

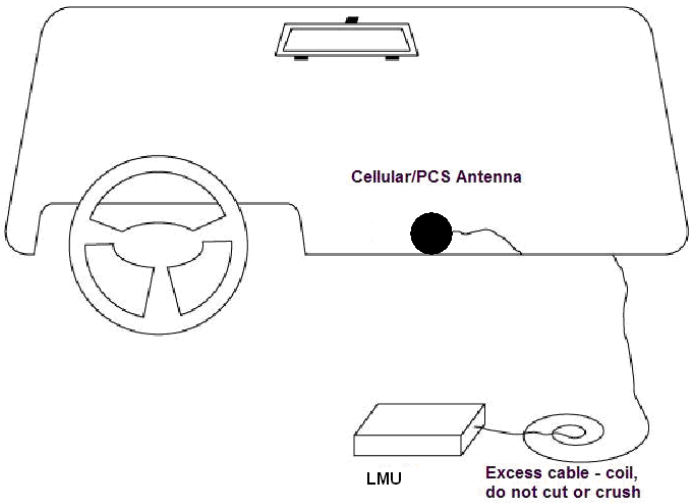


GPS Antenna Location

5.3.4 Mount 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.

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

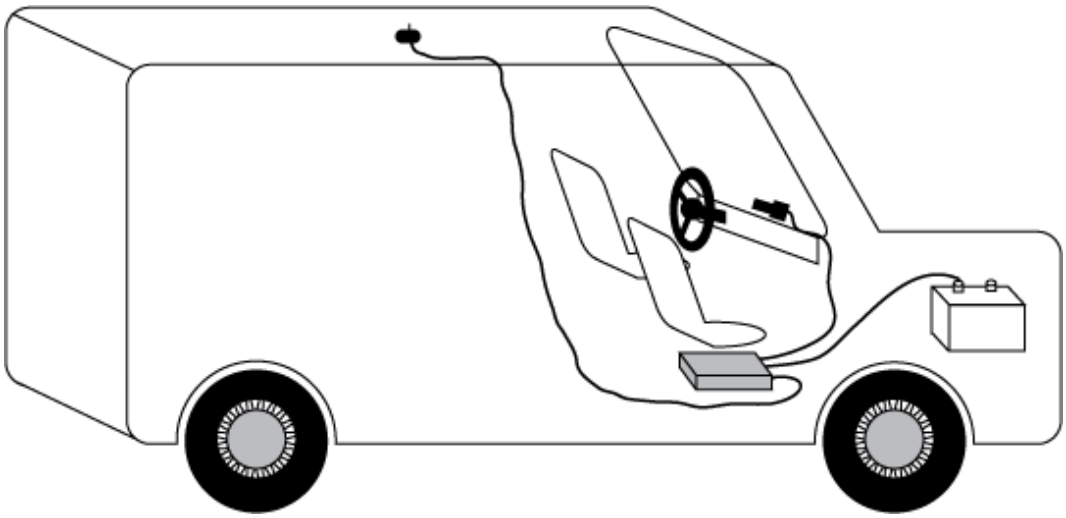


Window Mount Antenna Location

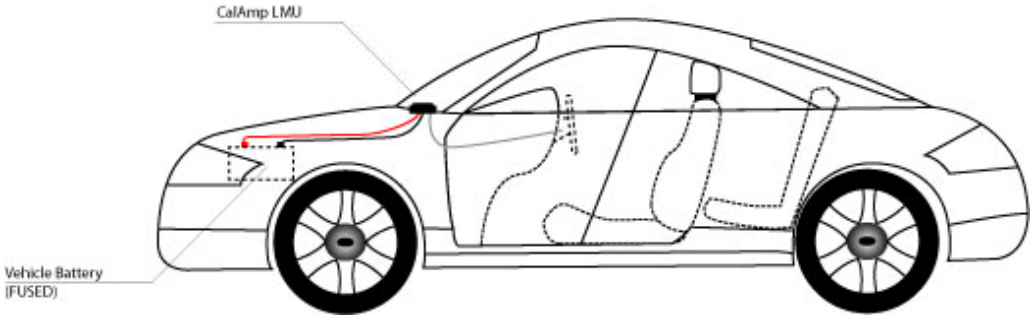
5.3.5 Typical Connection Sequence

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

The physical installation of the LMU hardware is now complete.



Completed Install – separate antennas



Completed Install - Internal antennas

5.4 Installation Verification

In many cases it is desirable to verify that an installed LMU-42x0™ is working properly. That is, installers should verify that the GPS and communications functions of the LMU-42x0™ are working properly before departing the installation site. In more robust cases, some key configuration settings such as the Inbound Address and URL should also be verified.

Note that these processes are all based on issuing AT Commands to the LMU-42x0™. It is expected that installers will have access to a serial port expansion cable and a laptop or PDA capable of a terminal connection. Alternatively, an SMS message can be sent to an LMU-42x0™ to obtain its current status.

5.4.1 Comm Verification

Installers should first verify that the LMU-42x0™ has been acquired and has registered to the wireless network. This may be verified in one of two ways. First, installers may look at the Comm LED (i.e., the one closest to the SMC antenna connector). If this LED is solid, then the LMU has registered to the network and established a data session.

If the LED is not visible, then Comm may be verified using an AT Command:

```
ATIC
```

Depending on the wireless network being used something similar to what is shown below will be displayed. It is important to verify that 'Yes' values are displayed at the top for Data and Network registration and the correct APN is displayed.

```
       Radio Access    : GSM
       Network Reg.    : Yes, Home
       Data Reg.       : Yes, Home
       Connection      : Yes
       RSSI            :      -97 dBm
       BER             :       99
       Channel         :      737
       Cell ID         :     3441
       Base Station ID :       40
       Local Area Code :    31003
       Network Code    :      410
       Country Code    :      310
       IMEI (Modem S/N): 351802055396182
       IMSI (SIM ID)   : 310410202524377
       ICC-ID (SIM S/N): 89014102212025243778
       Phone Number    :
       GPRS APN        : ISP.CINGULAR
       Maint. Server   : maint.vehicle-location.com(216.177.93.246):20500
       Inbound Server  : (0.0.0.0):20500
       Dual Comm       : routing id=0, log cid=0, modem type=21, inbnd index=0

OK
```

If any of the responses return Not-Acquired or Not-Registered (and the APN is correct), the wireless network operator should be contacted for further troubleshooting.

Please note that it may take several seconds (or longer) for the LMU-42x0™ to communicate with the modem and acquire the wireless network.

5.4.2 GPS Verification

The next step is to verify that the GPS receiver is seeing enough satellites to obtain a valid GPS position. Again, installers have two choices on how to perform this verification. First, like the Comm Verification, there is a GPS status LED (i.e., the one closest to the SMA connector). If this LED is solid, then the LMU has found GPS service.

If the LED is not visible then GPS service may be verified using an AT Command:

```
AT$APP GPS?
```

The response should be similar to:

```
Lat=3304713, Lon=-11727730, Alt=0
Hdg=113 Spd=0 3D-RTIME HDOP=130 nSats=7
```

Installers are looking for the 3D-RTIME setting along with a valid Lat, Long pair (i.e. something other than 0). If the GPS receiver does not have a valid lock within 2-3 minutes, installers should check antenna placement (see the Installation Notes section for placement suggestions), the antenna connector and that the antenna has a clear view of the sky. For further troubleshooting, installers should contact CalAmp Support (M2MSupport@CalAmp.com)

5.4.3 Inbound Verification

The last item to verify is that the LMU-42x0™ is sending data to the correct server. In general, this is a two-step process that will need the aid of an observer on the back end. That is, a technician will have to be logged in so they can monitor data coming into the backend mapping/vehicle management application.

First, verify that the LMU-42x0™ is using the correct Inbound IP address by using:

```
AT$APP INBOUND?
```

The response should be similar to:

```
INBOUND LMD
INBOUND 0 ADDR ddd.ddd.ddd.ddd:ppppp *
INBOUND 0 URL  myURL.myCompany.com
INBOUND 1 ADDR 0.0.0.0:20500
INBOUND 1 URL
INBOUND 2 ADDR 0.0.0.0:20500
INBOUND 3 ADDR 0.0.0.0:20500
```

The installer will need to verify with a backend technician that the, URL (myURL.myCompany.com), IP address (ddd.ddd.ddd.ddd) and port (<ppppp>) are correct.

The second step is to verify that the LMU-42x0™ is sending data. The best way to do this is to force the LMU-42x0™ to send in an unacknowledged Event Report (i.e., its current GPS location) with the following command:

```
AT$APP PEG SUNRPT 255
```

The LMU-42x0™ will respond with: OK

The backend monitor must then be contacted to confirm that they received an Event Report with Event Code 255.

Assuming that all three sections have passed, the installation can be considered to be complete.

5.4.4 Verification via SMS

The current Comm, GPS and Inbound status of a GSM LMU can be obtained via SMS provided you have access to an SMS capable phone or PDA.

Using your handset, send the following SMS Message to the LMU:

```
!R0
```

Within a few minutes, the LMU should return a response in the following format:

```
APP: <App ID> <Firmware Version>
COM:<RSSI> [./d/D][./a/A][./L][IP address] [<APN>]
GPS:[Antenna <Short/Open/Off>] | [No Time Sync] | [<FixStatus> <Sat Count>]
INP:<inputs states> <vehicle voltage>
MID:<mobile ID> <mobile ID type>
INB:<inbound IP address>:<inbound port> <Inbound Protocol (LMD/LMX)>
```

- **APP:**
  - o **<App ID>:**

    The Application ID value of the LMU indicating the host platform and the wireless networking technology of the LMU.
  - o **<Firmware Version>:**

    The current firmware version in use by the LMU
- **COM:**

- **<RSSI>:**

  This is the signal strength the wireless modem sees from the network. In general the LMU is at least scanning for the network if the RSSI is not -113.

- **[./d/D]:**

  If the character 'D' is present, it indicates the LMU had a data session established when it responded to the status request. For the 8-Bit product line an upper case 'D' indicates both the Inbound and Maintenance sockets are ready. The lower case 'd' indicates that only the Maintenance socket is ready. A '.' indicates no sockets are ready.

- **[./a/A]:**

  This field indicates if the LMU has received an Acknowledgement from the Inbound server. This field will be empty if the LMU has never received an ACK. The lower case 'a' will be present if it has received an ACK since the last cold boot (i.e. power cycle) but not the last warm boot (App Restart or Sleep). The upper case 'A' will be present if the LMU has received an ACK since the last warm boot. A '.' Indicates no acknowledgement has been received.

- **[./L]:**

  This field indicates if the LMU's log is currently active. An 'L' indicates that the log is currently in use (i.e. one or more records have been stored) where a '.' indicates the log is inactive.

- **[IP Address]:**

  This is an optional field if and is only present if the LMU has established a valid data session. This field will contain the current IP address of the LMU as assigned by the wireless network. Note that if you see a value of 192.168.0.0, this is an indication that the LMU has not been able to establish a data session.

- **[<APN>]**

  The current Access Point Name in use by a GSM LMU.

- **GPS:**

  - **[Antenna <Short/Open/Off>]:**

    This field, if present, indicates a problem with the LMU's GPS antenna. A value of Short indicates that the antenna cable has likely been crushed. A value of Open indicates that the antenna cable is either cut or disconnected. A value of Off indicates that the LMU' GPS receiver is off.

  - **[No Time Sync]:**

    If this field is present, it indicates that the LMU's GPS receiver has not been able to find even a single GPS satellite. This would likely been seen in conjunction with the above antenna error, or if the LMU GPS antenna is otherwise blocked.

  - **[<FixStatus> <Sat Count>]:**

    If these fields are present it indicates that the LMU has, or had a valid GPS solution. The <Sat Count> field indicates how many GPS satellites are currently in use by the LMU. The

<FixStatus> field indicates the type of fix. The Fix Status types are detailed in the LM Direct Reference Guide.

- **INP:**
  - **<input states>:**

    This field details the current state of each of the LMU's discreet inputs. This field is always 8 characters long. The left most character represents the state of input 7 where the right most represents the state of input 0 (i.e. the ignition). A value of 1 indicates the input is currently in the high state. A value of 0 indicates it is currently in the low state.

  - **<vehicle voltage>:**

    This field will contain the current reading of the LMU's internal A/D. This will be the supply voltage provided to the LMU in mV.

- **MID:**
  - **<mobile ID>:**

    This will be the current mobile ID in use by the LMU.

  - **<mobile ID type>:**

    This will be the type of Mobile ID in use by the LMU. The available types are, Off, ESN, IMEI, IMSI, USER, MIN and IP ADDRESS.

- **INB:**
  - **<inbound IP address>:**

    This is the current IP address in use by the LMU. This value should match the IP address of your LM Direct™ server.

  - **<inbound port>:**

    This is the current UDP port the LMU will use to deliver its LM Direct™ data. This value should match UDP port you are using on your LM Direct™ server. It is typically 20500.

  - **<Inbound Protocol (LMD/LMX)>:**

    This is the current UDP/IP messaging protocol in use by the LMU. In general it should be LMD.

Example GSM Response

```
APP:081 8.3d
COM:0
GPS:No Time Sync
INP:11100111 13.7V
MID:4141000100 ESN
INB:207.7.101.227:20500 LMD
```

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Human Exposure Compliance Statement
Pursuant to 47 CFR § 24.52 of the FCC Rules and Regulations, personal communications services (PCS) equipment is subject to the radio frequency radiation exposure requirements specified in § 1.1307(b), § 2.1091 and § 2.1093, as appropriate.

CalAmp DataCom Inc. certifies that it has determined that the LMU-42x0™ complies with the RF hazard requirements applicable to broadband PCS equipment operating under the authority of 47 CFR Part 24, Subpart E of the FCC Rules and Regulations. This determination is dependent upon installation, operation and use of the equipment in accordance with all instructions provided.

The LMU-42x0™ is designed for and intended to be used in fixed and mobile applications. “Fixed” means that the device is physically secured at one location and is not able to be easily moved to another location. “Mobile” means that the device is designed to be used in other than fixed locations and generally in such a way that a separation distance of at least 20 cm is normally maintained between the transmitter’s antenna and the body of the user or nearby persons. The LMU-42x0™ is not designed for or intended to be used in mobile applications (within 20 cm of the body of the user) and such uses are strictly prohibited.

To ensure that the LMU-42x0™ complies with current FCC regulations limiting both maximum RF output power and human exposure to radio frequency radiation, a separation distance of at least 20 cm must be maintained between the unit’s antenna and the body of the user and any nearby persons at all times and in all applications and uses. Additionally, in mobile applications, maximum antenna gain must not exceed 3.2 dBi.

FCC Rules and Industry Canada (IC) regulatory information
Compliance Statement (Part 15.19)
The equipment 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.

Warning (Part 15.21)
Changes or modifications not expressly approved by TransCore Amtech Systems could void the user’s authority to operate the equipment. Manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment.

Compliance Statement (Part 15.105(b))
Note: 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 Industry Canada license-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.

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Class B digital device notice
“CAN ICES-3 (B)/NMB-3(B)”

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