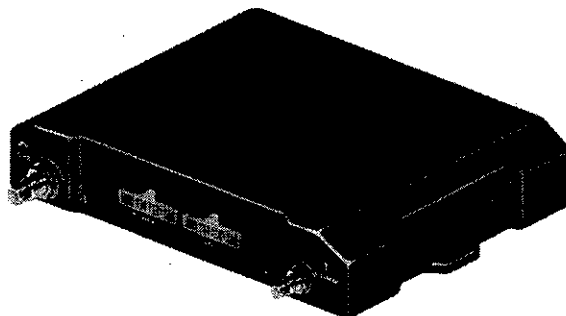




# LMU-4200™ Installation Guide



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## **Regulatory Information**

### ***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-4200™ 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-4200™ 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-4200™ is not designed for or intended to be used in portable applications (within 20 cm of the body of the user) and such uses are strictly prohibited.

To ensure that the LMU-4200™ 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 dBi.

## Table of Contents

Regulatory Information.....	ii
Human Exposure Compliance Statement.....	ii
1 Installing the LMU .....	1
1.1 Preparing for Installation.....	1
1.2 Plan The Installation .....	2
1.2.1 Size and Placement of LMU Unit .....	2
1.2.2 Placement of Antennas .....	3
1.2.3 Access to the SIM (Subscriber Identity Module) Card.....	5
1.2.4 Protection from Heat.....	5
1.2.5 Visibility of Diagnostic LEDs.....	5
1.2.6 Cable Length .....	5
1.2.7 Moisture and Weather Protection .....	5
1.2.8 Preventing Accidental or Unauthorized Modification .....	6
1.3 Installing the LMU in a Vehicle.....	7
1.3.1 Place the LMU unit in the vehicle.....	7
1.3.2 Connect power, ignition, and ground. ....	7
1.3.3 Place the GPS antenna.....	7
1.3.4 Mount the Comm. Antenna.....	8
1.3.5 Typical Connection Sequence.....	9
1.4 I/O Descriptions.....	11
1.4.1 Ignition and Inputs.....	12
1.4.2 Outputs .....	12
1.4.3 Status LEDs .....	13

# **1 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.

## **1.1 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
- Comm Antenna
- Optional Components:
  - Input and output cables
  - Relays
  - LMU peripherals (i.e. Serial adapter, ioPOD, BTA, TetheredLocator)
  - Host serial devices (e.g. PDAs, laptops, other serial devices)

## 1.2 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.

### 1.2.1 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-4200™.

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.

## 1.2.2 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...)

CalAmp offers three antennas for customers to purchase:

- IV1353-QB-02 (Combined Comm and GPS antenna – Adhesive Covert Mount)
- RM1353-QB-02 (Combined Comm and GPS antenna – Covert Heavy Duty Screw Mount)
- RM1353-TB-04 (Combined Comm and GPS antenna – Thru-hole roof or magnetic mount)

### 1.2.2.1 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.

### 1.2.2.2 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.

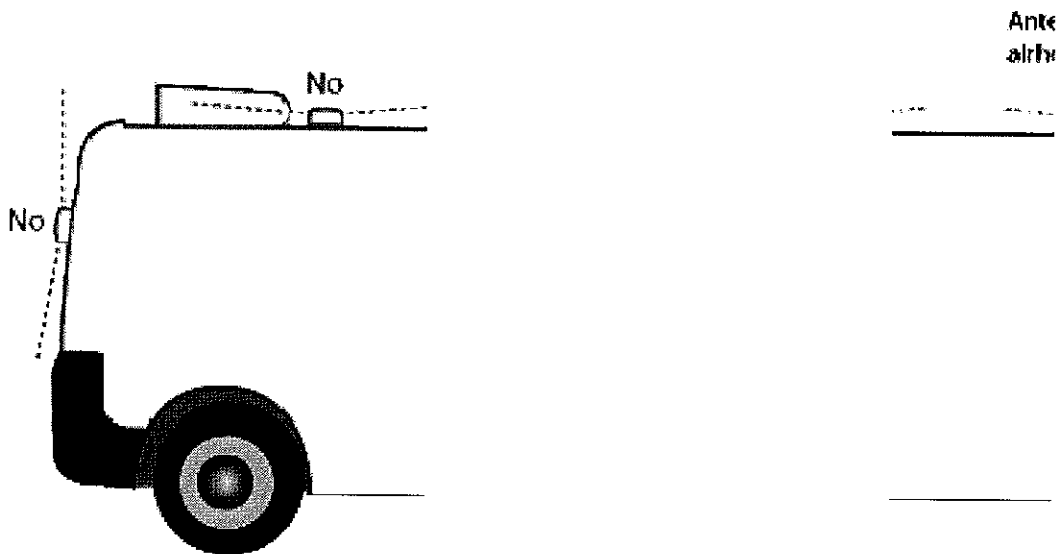


Figure 1 - Examples of good and poor GPS antenna placements

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.

### **1.2.3 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.

### **1.2.4 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.

### **1.2.5 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.

### **1.2.6 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.

### **1.2.7 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.

### **1.2.8 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.

### **1.3 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:

#### **1.3.1 *Place the LMU unit in the vehicle.***

Typically, the LMU should be placed under the passenger seat or dashboard of the vehicle. 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.

#### **1.3.2 *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.

#### **1.3.3 *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.

**LMU-4200™ Hardware and Installation Guide (Preliminary)**

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.

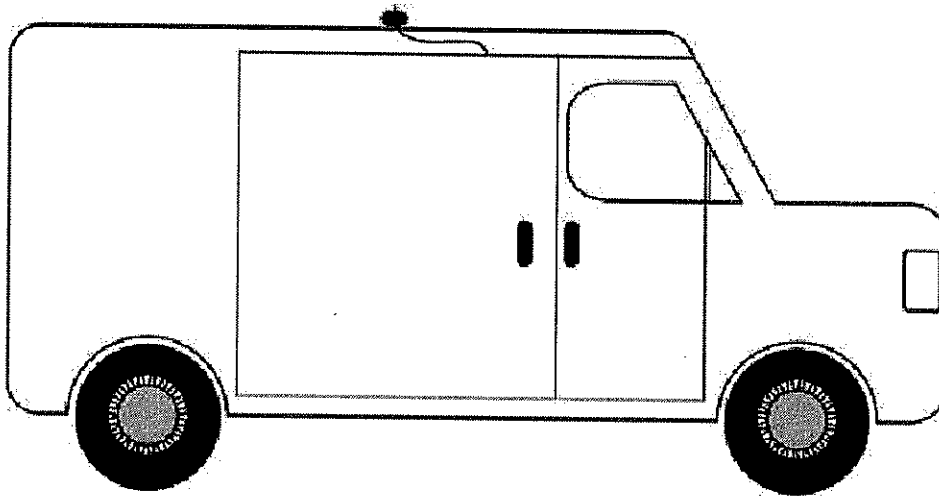
**GPS Antenna**

Figure 2 - GPS Antenna Location

**1.3.4 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.

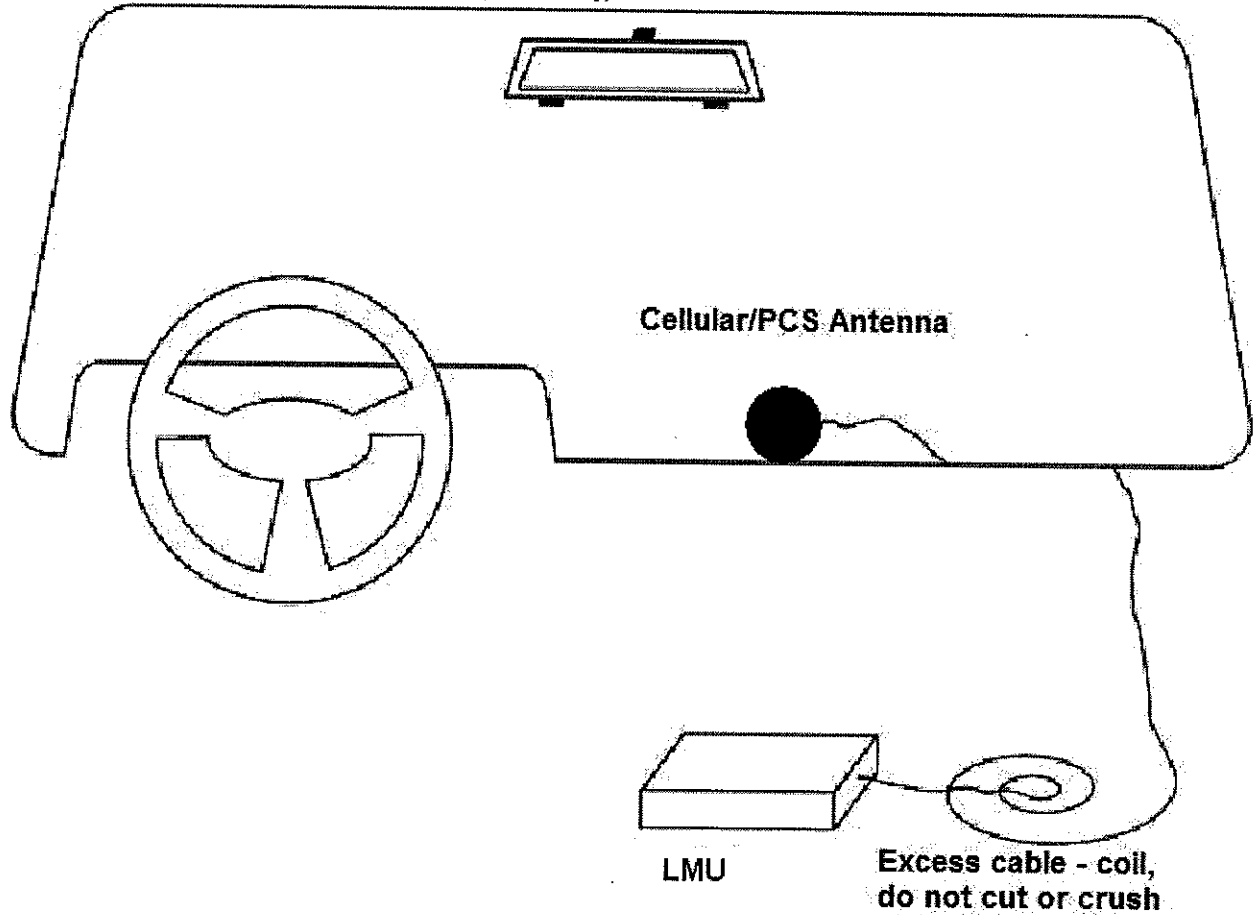


Figure 3 - Window Mount Antenna Location

### 1.3.5 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.

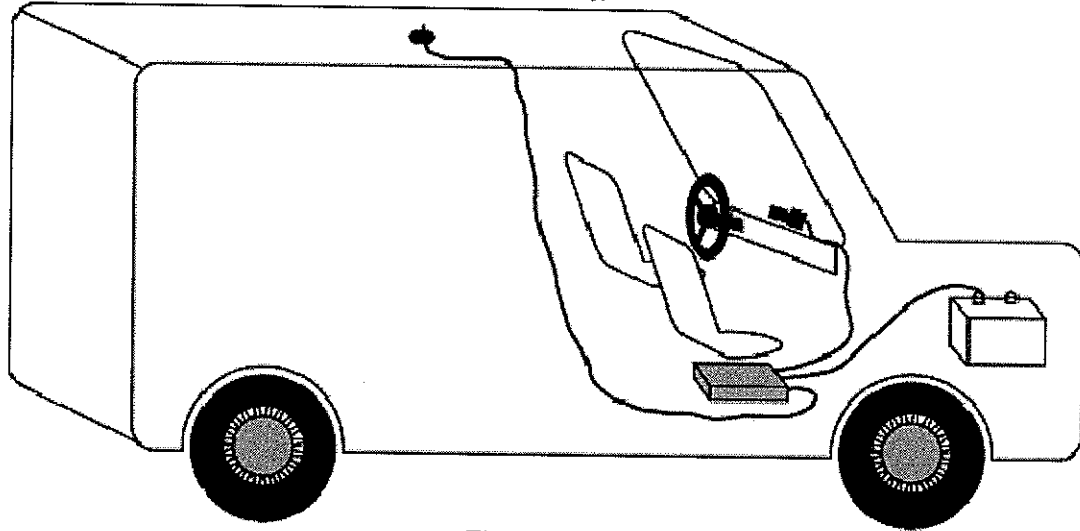


Figure 4 - Completed Install

## 1.4 I/O Descriptions

The LMU-4200™ 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 (Biased high)
- Input 7: Generic Digital Input (Biased high)

### Analog to Digital Inputs

- A/D 0: External Power Supply Monitor
- A/D 1: External Battery Power Supply Monitor (if installed)
- 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: GPS Antenna
- A/D 7: Internal Temperature
- A/D 8: Vref

### 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
- Output 5: LED Driver Output
- Output 6: LED Driver Output

### iButton / 1 Bit Bus

- Channel 1: External Temperature Sensor(s)
- Channel 2: iButton ID Support

### Motion

- MEMS accelerometer

### 1.4.1 Ignition and Inputs

The LMU-4200™ provides up to 8 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).

### 1.4.2 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.

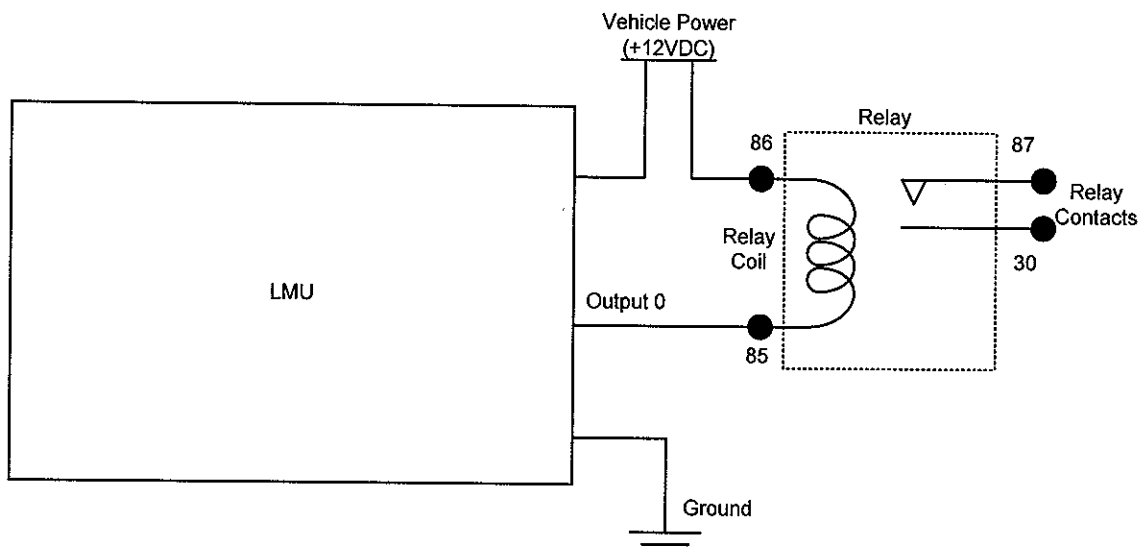


Figure 5 - Sample Relay Wiring

### 1.4.3 Status LEDs

The LMU-4200™ 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 1
GPS Off	Off
GPS On	Slow Blinking
GPS Time Sync	Fast Blinking
GPS Fix	Solid