LMU-42x0™

Hardware and Installation Guide

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.

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.

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.
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.
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.
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.
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.

Placement of Antennas

There are effectively three options for placements of an antenna:

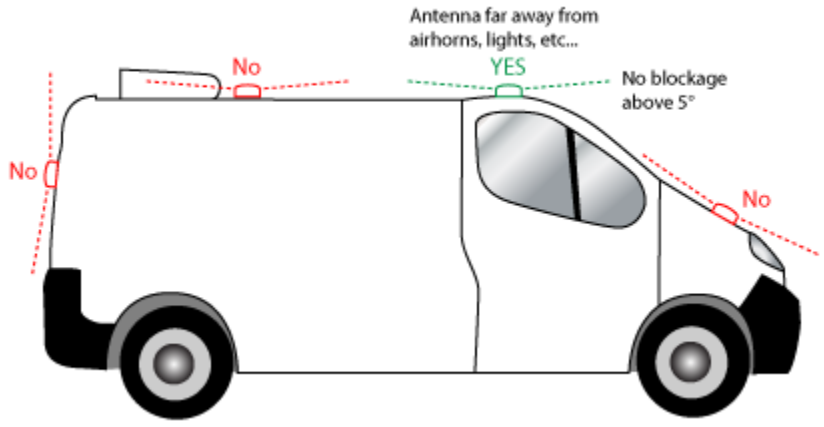
Roof-mount (magnetic or thru-hole)
Glass-mount
Covert (e.g. under the seat, dash, etc…)

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.

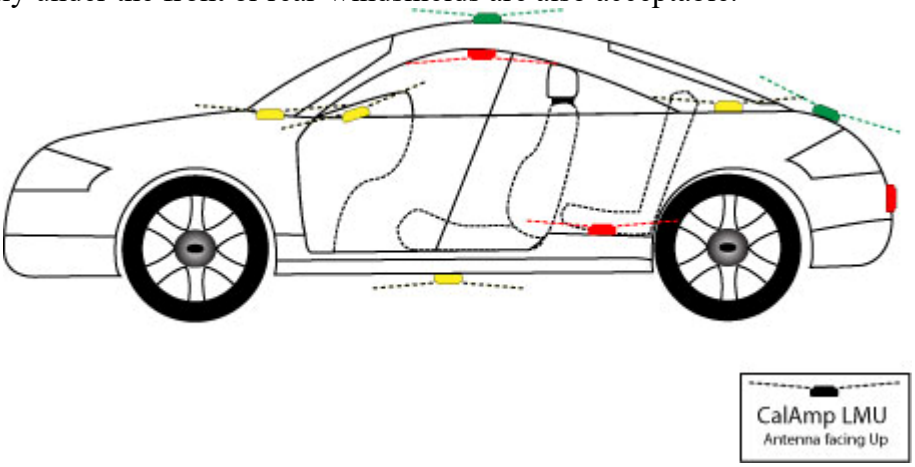


Examples of good and poor GPS antenna placements

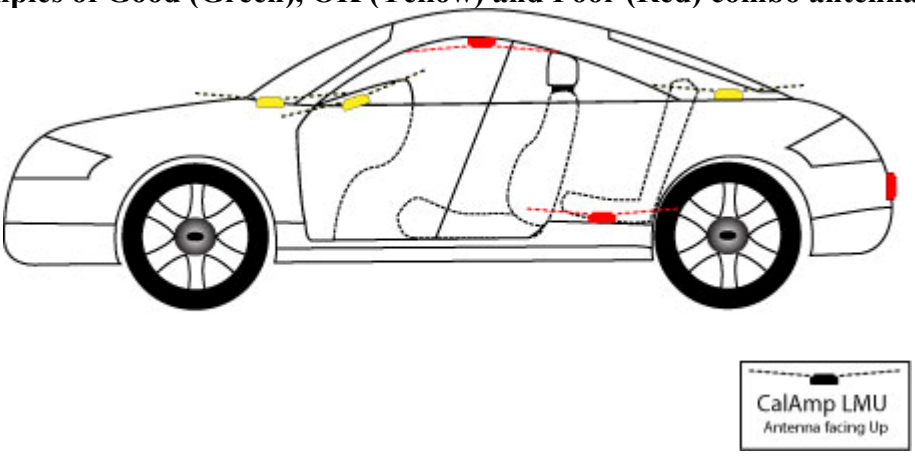
The received signal levels at the GPS antenna from the satellites are very low in power (approximately -136 dBm), so any blockage of the antenna can affect the quality of the location computed by the receiver. Kinks or tight knots in the antenna cable can also prevent the GPS receiver from operating 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



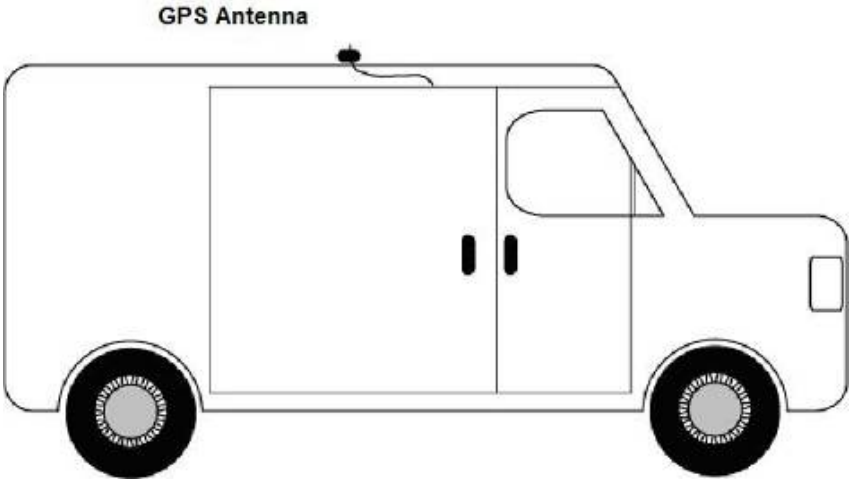
Examples OK (Yellow) and Poor (Red) internal antenna placements

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.

Place the GPS antenna.

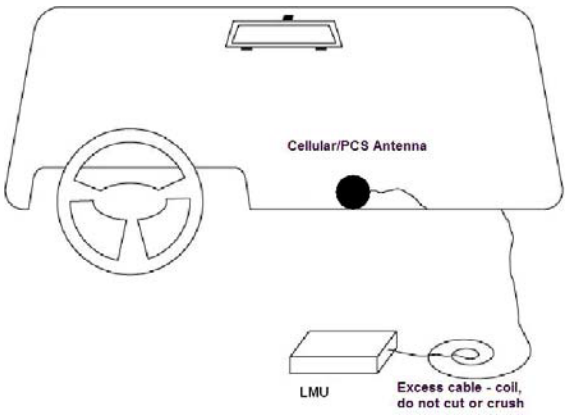
The GPS antenna must have a clear view of the sky. Mount the GPS antenna on the vehicle's highest point (for example, the roof of a car). Make sure that there are no obstructions close to the antenna that might block the view 360° to the horizon. Air horns lights, vents, etc... Should not block the antenna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

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.

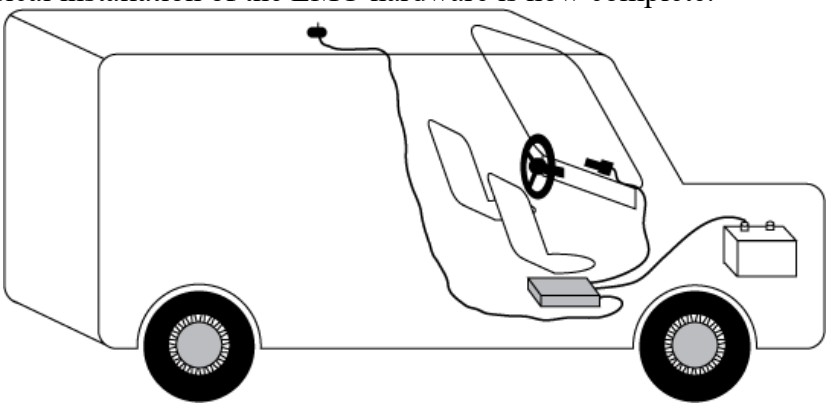


Window Mount Antenna Location

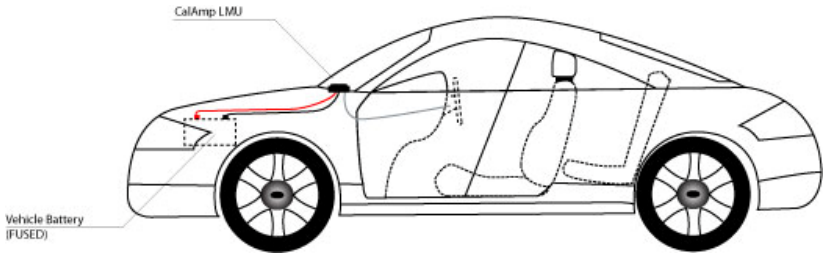
Typical Connection Sequence

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

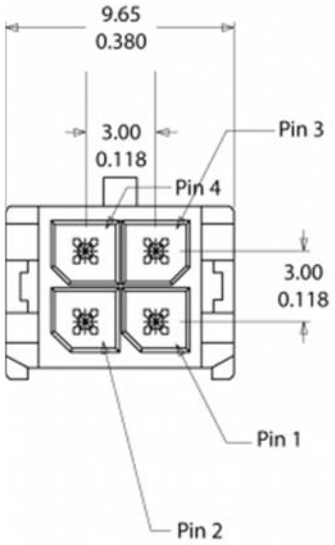


Completed Install - Internal antennas

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

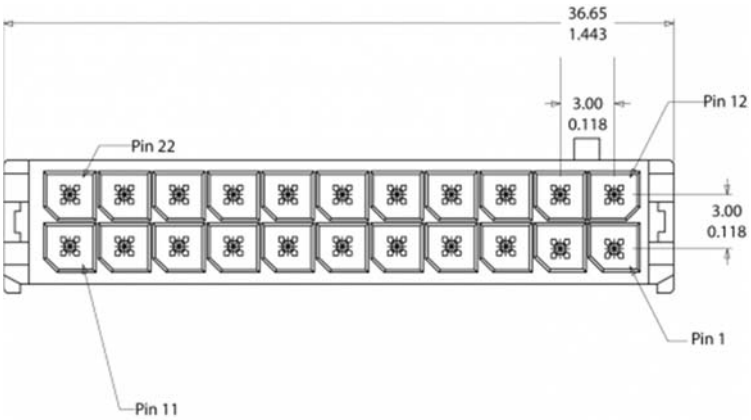


LMU-42x0™ Header (looking into LMU)

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

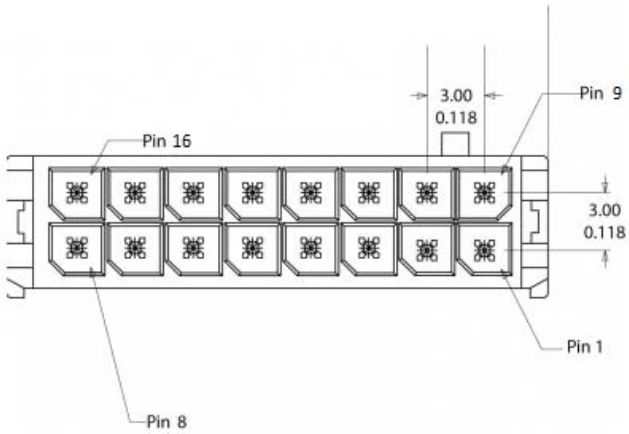


LMU-42x0™ Header (looking into LMU)

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

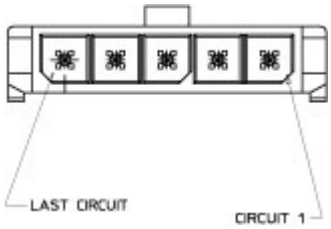


LMU-42x0™ Expansion Port (looking into LMU)

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

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	

jPOD™ Vehicle Bus Adaptor

Serial Adapter

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

Part Number 133337-5: Serial Adapter.

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)
NOTE: Shared with Output 1. Function selection controlled by S-159
Input 2: Generic Digital Input (Biased high or low/ S-158 Bit 2)
NOTE: Shared with Output 2. Function selection controlled by S-159
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

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

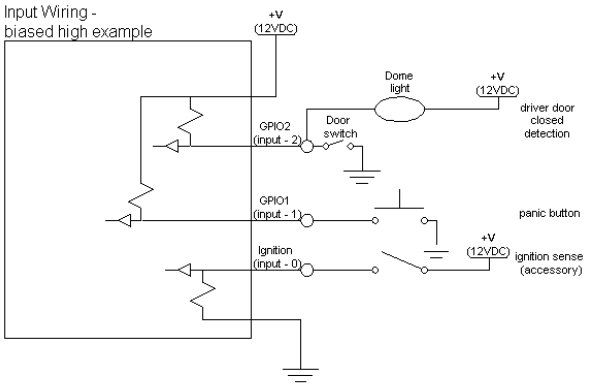
Output 5: Standard LED Driver
Output 6: Standard LED Driver

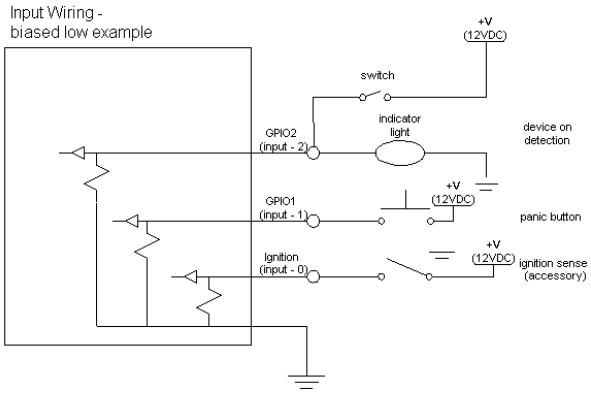
iButton / 1 Bit Bus

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

Ignition and Inputs

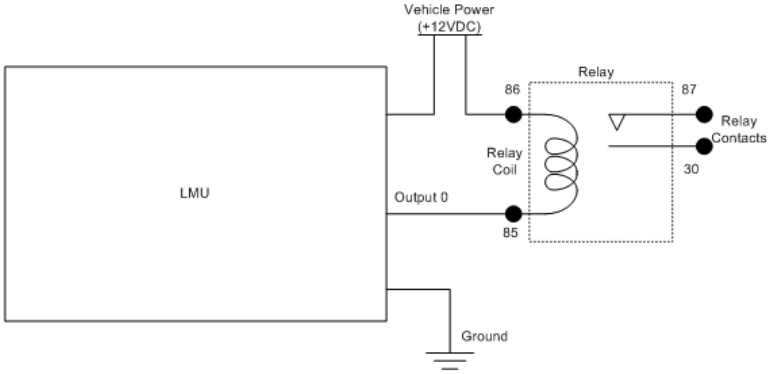
The LMU-42x0™ provides up to 7 inputs. These inputs are protected from typical vehicle transients and can be directly connected to most vehicle level logical inputs from 4 volts up to the vehicle power input level (typically 12 VDC). Their input impedance is approximately 10kΩ. One of these inputs is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





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

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