LMU-5541 Hardware & Installation Guide

LMU-5541™
Hardware and Installation Guide

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Contents

1 Introduction

Welcome to the LMU-5541™ Hardware and Installation Guide. This manual is intended to give you information on the basic setup and installation of the CalAmp LMU-5541™ product(s) including hardware descriptions, environmental specifications, wireless network overviews and device installation.

1.1 About This Manual

The LMU-5541™ 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-5541™ 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-5541™.
- **Hardware Overview** – Describes the physical characteristics and interfaces of the LMU-5541™.
- **Installation and Verification** – Provides guidance for the installation of the LMU-5541™ 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. 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.

1.4 About the CalAmp Location Messaging Unit-LMU-5541™

The CalAmp Location and Messaging Unit-LMU-5541™ (LMU-5541™) is a mobile device that resides in private, commercial or government vehicles. The LMU-5541™ is a single box enclosure incorporating a processor, a GPS receiver, a wireless data modem, and a vehicle-rated power supply. The LMU-5541™ also supports inputs and outputs to monitor and react to the vehicular environment and/or driver actions.

Flexibility
The LMU-5541™ 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-5541™ 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

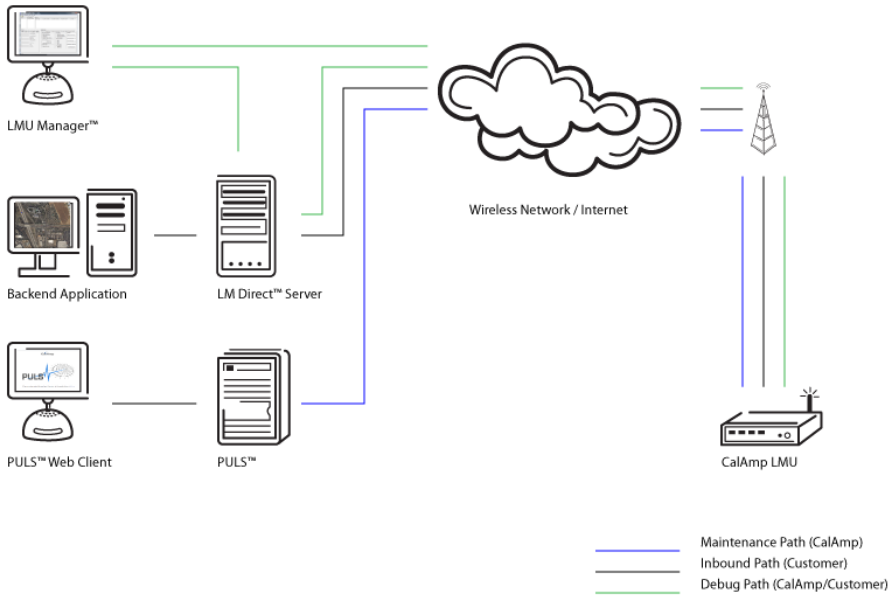
2.1 Overview

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-5541™ 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-5541™
- 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-5541™. 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-5541™.

2.2.2 LMU-5541™

The LMU-5541™ 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-5541™
- 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-5541™ 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-5541™ is capable of sending and receiving. This interface allows System Integrators to communicate directly with LMU-5541'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-5541™ in a variety of formats
- Present historic information received from the LMU-5541™, typically in a report/chart style format
- Request location updates from one or more LMU-5541s™
- Update and change the configuration of one or more LMU-5541s™

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-5541™. Unlike the backend software, it has the option of talking directly to an LMU-5541™ 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-5541™

3.1.1 LMU-5541™ 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-5541'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.

⚠ **WARNING:** This product can expose you to chemicals including carbon black, nickel, & bisphenol A, which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to **https://www.P65Warnings.ca.gov**.

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.

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-5541™ GPS Antenna to another LMU-5541™ 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-5541™ GPS Antenna should be kept at least four inches apart from any active LMU-5541™ 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-5541™ 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-5541™ 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.

Dimensions

5.75"(L) x 4.0"(W) x 1.2"(H)

146mm (L) x 102mm (W) x 40mm (H)

Weight

8oz (227g)

Temperature

-30° C to 60° C (connected to primary power)

-10° C to 60° C (operating on internal battery)

-20° C to 25° C ≤ 6 months (long term storage with battery)

Humidity

95% RH @ 50° C non-condensing

Shock and Vibration

U.S. Military Standard2 02G and 810G, SAE J1455

EMC/EMI

IEC 61000-4-2 (4KV test)

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-5541™ supports vehicles with 12 or 24 VDC systems including transients and electrical system noise; this includes ranges from 8 to 32 VDC.

Electrostatic Discharge (ESD)

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

Power Consumption

Operating Voltage

12/24 VDC Vehicle Systems

9-30 VDC (start-up, operating)

8-32 VDC (momentary)

Power consumption

Typical <2mA @ 12V (deep sleep)

Typical 20mA @12V (radio-active sleep)

Typical ~300mA @ 12V (active tracking w/GPS and cell enabled)

Satellite Location (GNSS)

Hybrid GPS, GLONASS, SBAS Engine (WAAS, EGNOS, MSAS)

55 Channels

Location Accuracy: ~2.0m CEP Open Sky (SBAS 24 hours static)

Tracking sensitivity -167 dBm

Acquisition sensitivity -156 dBm (hot start)

-148 dBm (cold start)

Location Update: up to 4 Hz

Communications (Comm)

Frequency		EG25-G
LTE	LTE-FDD	B1/ B2/ B3/ B4/ B5/ B7/ B8/ B12/ B13/ B18/ B19/ B20/ B25/ B26/ B28
	LTE-TDD	B38/ B39/ B40/ B41
WCDMA		B1/ B2/ B4/ B5/ B6/ B8/ B19
GSM		B2/ B3/ B5/ B8

RoHS Compliant

Data Support:

TCP/IP, UDP/IP, DHCP, HTTP, IP Router, PPP, HTTP web server, Telnet DHCP server, DDNS, DDNS Client, NAT, NMEA, TAIP, TSIP, TFTP, IP port forwarding, CalAmp Telematics Cloud API

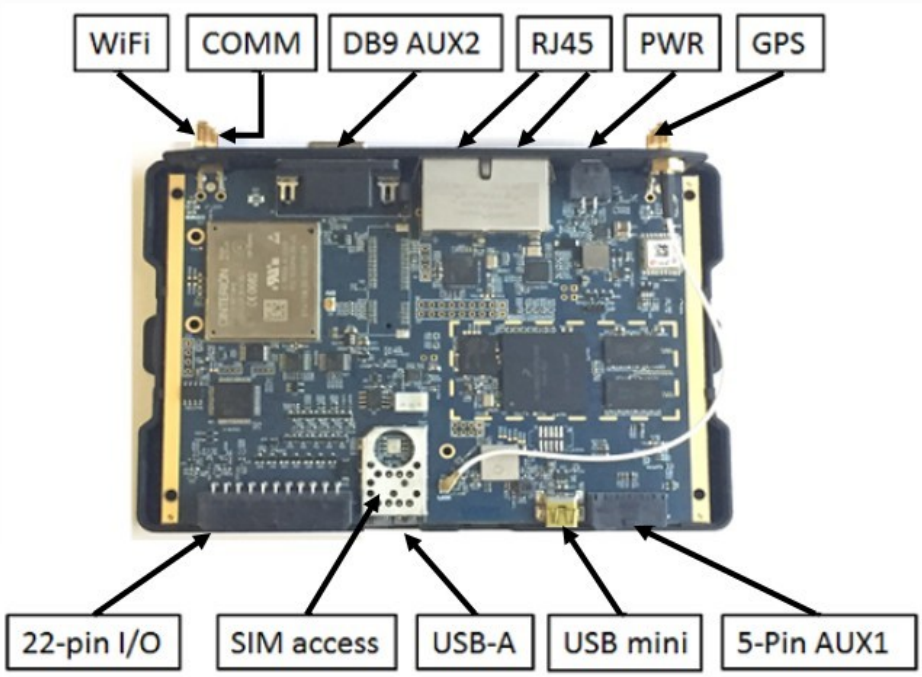
The following pertains to devices that have a JBUS connector and a 4-pin LMU power cable (part number 5C888) attached to the LMU.

Caution: Some JBUS vehicles operate on 24VDC. In situations where ignition and/or power is hard wired to the 4-pin LMU power cable, it is imperative to have matched voltage levels. Any mismatched voltages can create a problem. For example do not use 24VDC power from the JBUS simultaneoulsy with 12VDC from the LMU power cable, or vice versa, as this could damage the board.

4 LMU-5541™Connectors

The LMU-5541™ offers 22 connectors to access power, I/O, serial communications and other expansion capabilities. These connectors are:

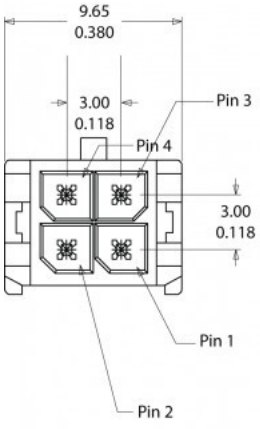
- SIM access
- SIM Access Slot
- Cellular main SMA
- External GPS SMA (with tamper monitoring, 3.0v)
- External WiFi SMA RP
- 2X Ethernet10/100 RJ45 USB Host Type A
- USB On-The-Go (mini) Serial (RS232/485) DB-9
- Serial 5 Pin Molex (switch power TTL Levels) Power, Ignition, I/O 4-Pin Molex
- I/O connector 22-Pin Molex



4.1 Power Connector

The LMU-5541™ 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

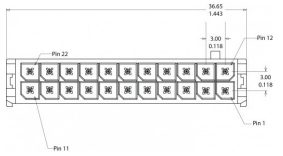


LMU-5541™ Header (looking into LMU)

4.2 I/O Connector

The LMU-5541™'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	Output
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 & 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

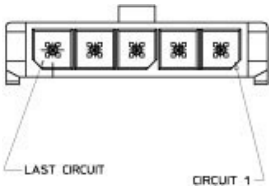


LMU-5541™ Header (looking into LMU)

4.3 Serial Interface Connectors

The LMU-5541™ offers 2 serial interface connections (Host/Aux1 and DB-9 SerialAux 2) on its front face. Host/AUX1 is provided via a Molex 43650-0501 connector using the following pin out:

Pin	Signal Name	Description	134364-SER 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



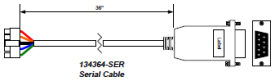
Serial Interface Connector

Users should only use CalAmp approved serial adapters for these connections.

4.4 Serial Interface Cables & Accessories

Serial Connectivity is a one cable solution. You can use either part numbers 134364-SER or 134364-MDT.

LMU Serial Cable (Part Number 134364-SER)

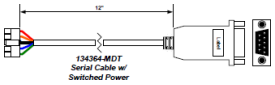


LMU™ Serial Adapter

or

LMU Serial Cable (Part Number 134364-MDT-SER)

The 134364-MDT Serial Cable has the same features as the 134364 product listed above except the MDT serial cable has an extra feature that allows power voltage adjustment.



LMU™ Serial Adapter

NOTE: CalAmp previously used the following serial cables. The following two cables are no longer in production. However, these legacy cables are still compatible with LMU-5541™. Part Number 134364-SER has effectively replaced Part Number 133337-5 while Part Number 134364-MDT has replaced Part Number 133564-1. The description for the legacy cables are listed below.

Serial Combo Adapter (Part Number 133337-5)

The Serial Combo Adapter is designed to allow laptops, and PDAs to communicate with the LMU-5541™ via a direct serial connection. While using this cable, the LMU-5541™ will accept AT Commands and act as a modem. No setup of the LMU-5541™ is necessary to use this cable.

Serial Combo Adapter (Part Number 133564-1)

The Serial Combo Adapter is designed to allow laptops, MDTs, barcode readers and other devices to communicate with the LMU-5541™ via a direct serial connection. While using this cable, the LMU-5541™ will accept AT Commands and act as a modem. No setup of the LMU-5541™ is necessary to use this cable. The 133564-1 also has switched power capabilities which allow for power to the serial device to be regulated. This cable will allow 'dumb' serial devices to use the LMU-5541™ to pass data to/from a remote application. In general, when in MDT mode, the LMU-5541™ will package any data received over the serial port into a 'User Message' and send it to its inbound address. Any User Messages received from the remote application that have an appropriate Message Type will be passed from the LMU-5541™ to the dumb serial device. The setup of this mode is controlled by S130 - 139 and is described in detail later in this document.

4.5 Accessories

See the Harness Diagrams page for more information on LMU accessories, and supported products table. Do NOT connect multiple power supplies or multiple grounds to the LMU-5541 and JPod2. Connecting multiple power supplies or multiple grounds may lead to excessive current draw through the LMU and JPod2.

4.6 RF Connector

LMU-5541™ uses an SMA connector with a 50 Ω impedance.

4.7 I/O Descriptions

The LMU-5541™ 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 or low/ S-158 Bit 6)
- Input 7: Generic Digital Input (Biased high or low/ S-158 Bit 7)
- Input 8: Motion Sensor (low = No motion, high = motion)
- Input 9: Reserved
- Input 10: Power State (low = external power, high = internal battery)
- Input 11: Vbatt Low

Analog to Digital Inputs

- A/D 0: External Power Supply Monitor
- A/D 1: External A/D Input (From Power Connector)
- A/D 2: External A/D Input (From 22 Pin I/O Conenctor)
- A/D 3: External A/D Input (From 22 Pin I/O Conenctor)
- A/D 4: External A/D Input (From 22 Pin I/O Conenctor)
- A/D 5: External A/D Input (From 22 Pin I/O Conenctor)
- A/D 6: Internal Battery Voltage
- A/D 7: GPS Antenna Voltage

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 1
- Output 6: LED Driver Output 2

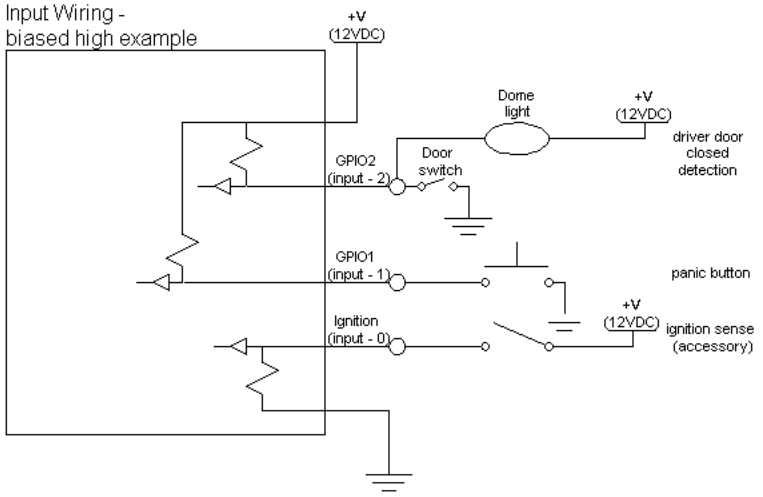
iButton / 1 Bit Bus

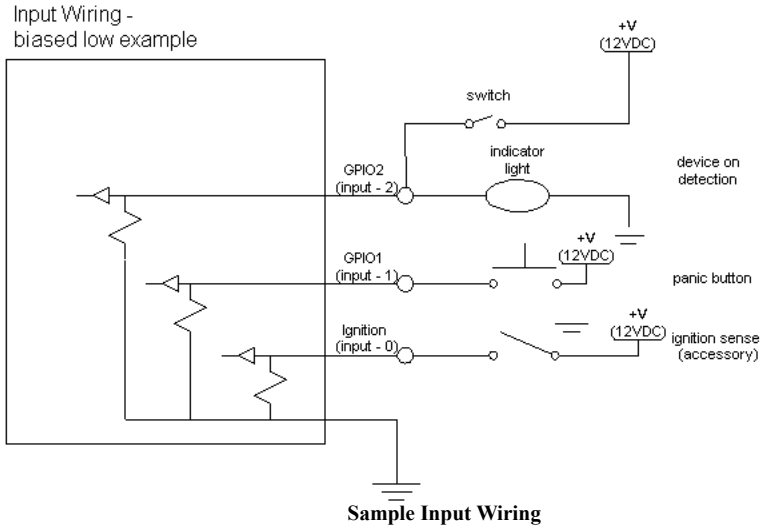
- iButton ID Support
- 1Wire bus with current boost for temperature sensors

4.7.1 Ignition and Inputs

The LMU-5541™ provides up to 7 High/low selectable inputs and one Ignition Sense input.. 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 10k□. One of these inputs is dedicated to sensing the vehicle's ignition status to provide for flexible power management. The other seven 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 200K10k resistor) or Low (i.e. pulled to ground through a 100K10k resistor). The diagrams below show how to connect the inputs in both a high- and low-biased configuration:

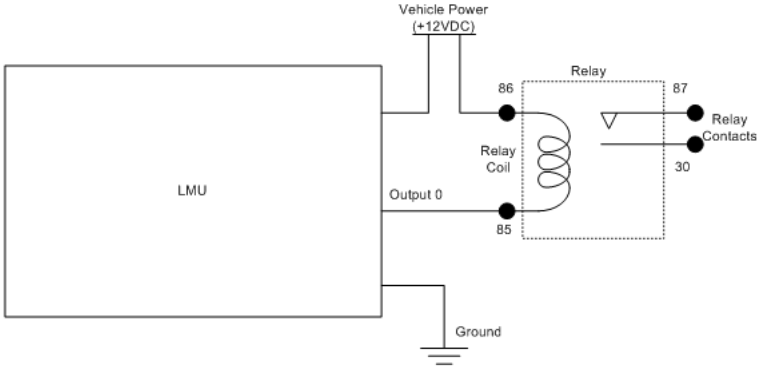




Sample Input Wiring

4.7.2 Open Collector Outputs

The LMU's outputs are designed to drive external relays. These outputs provide a high-current, open-collector driver that can sink up to 200 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

4.7.3 LED Outputs

The LMUs 2 LED outputs are designed specifically to control external LEDs. The LED outputs have two states. When on, they provide 3.3V to the external connector through a 100ohm series resistor. When off, these outputs are high impedance

4.7.4 Status LEDs

The LMU-5541™ is equipped with five Status LEDs; Power, BT, WiFi, GPS, COMM (wireless network). The LEDs use the following blink patterns to indicate service:

LED #1 (Power LED - Red/Green) Definitions

Condition	LED 1
LMU Off	Off
U-Boot	Red Solid
Kernel Start	Green Solid
LMU On	Red Solid

LED #2 (BT LED - Red/Green) Definitions

Condition	LED 2
U-Boot	Red Solid
Kernel Start	Green Solid
BT Off	No LED indication by default
BT On	No LED indication by default
BT Connected	No LED indication by default

Customer can define their own BT LED pattern by :

for Bluetooth LED Green :
echo 1 > /sys/class/gpio/gpio184/value

for Bluetooth LED Red:
echo 1 > /sys/class/gpio/gpio185/value

PEG action 133 is currently not supported on 5541 Platform

LED #3 (WiFi LED - Red/Green) Definitions

Condition	LED 3
U-Boot	Red Solid
Kernel Start	Green Solid
WiFi Off	Off
Client - Not Connected Searching	Green Slow Flashing
Client - Not Connected Authenticating	Green fast Flashing
Client - Connected	Green Solid
AP Mode	Red Solid

LED #4 (GPS LED - Red/Green) Definitions

Condition	LED 4
U-Boot	Red Solid
Kernel Start	Green Solid
GPS Off	Off
GPS On	Green Slow Blinking
GPS Time Sync	Green Fast Blinking
GPS Fix	Green Solid

LED #5 (Comm LED - Red/Green) Definitions

Condition	LED 5
U-Boot	Red Solid
Kernel Start	Green Solid
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

5 Configuration and Activation

This section details how to quickly get an LMU-5541™ 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-5541™. (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-5541™.** This device may not be supported for all the carriers or networks listed in this section (Verizon-LTE, Sprint-LTE, HSPA, GSM), for product availability consult the CalAmp sales team.

5.1 Quick Start - General Config

All LMU-5541s™ 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-5541™ and connect a serial cable from the LMU to your laptop
2. Open a terminal session to the LMU-5541™
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-5541™ and your handset

2. From the handset, send an SMS message to the LMU-5541™ phone number:

RP,2319,0,ddd.ddd.ddd.ddd

RP,768,0,ddd.ddd.ddd.ddd (32-bit products only)

RP,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

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

5.2 Auto provisioning of APNs in LMU

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
  - APN 1: PUBLIC

- AT&T – formerly Cingular Wireless (MCC 310, MNC 17, 18, 41)
  - APN 0 & 1: ISP.CINGULAR
  - mailto:ISP@CINGULARGPRS.COM">Username: ISP@CINGULARGPRS.COM
  - Password: CINGULAR1 Manxpronto (MCC 234, MCN 058)
  - APN web.manxpronto.net
  - Username: gprs
  - Password: gprs

- O2 UK (MCC 234, MNC 02, 10, 11)
  - APN 0 & 1: mobile.o2.co.uk
  - Username: mobileweb
  - Password: password

- O2 Ireland (MCC 272, MNC 02)
  - APN 0 & 1: open.internet
  - Username: gprs
  - Password: gprs

- Orange UK (MCC 234, MNC 33, 34)
  - APN 0 & 1: orangeinternet
  - Username: user
  - 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
  - APN 1: INTERNET3.VOICESTREAM.COM T-Mobile UK (MCC 234, MNC 30,31,32)
  - APN 0 & 1: general.t-mobile.uk
  - Username: user
  - Password: wap

- TelCel Mexico (MCC 334 MNC 02)
  - APN 0 & 1: INTERNET.ITELCEL.COM
  - Username: webgprs
  - Password: webgprs2002

- Telstra Australia (MCC 505, MNC 01, 11, 71, 72)
  - APN 0 & 1: telstra.internet

- Vodafone Ireland (MCC 272, MNC 01)
  - APN 0 & 1: isp.vodafone.ie
  - Username: vodafone
  - Password: vodafone

- Vodafone New Zealand (MCC 530, MNC 01) o APN 0 & 1: internet
  - Username: guest
  - Password: guest

- Vodafone UK (MCC 234, MNC 15)
  - APN 0 & 1: internet
  - Username: web
  - 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).

5.3 Activating LMU using AT Commands

Check with the CalAmp Sales team for availability of the LMU-5541™ with LTE, GSM or HSPA operators around the world.

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 LTE/GPRS/UMTS 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 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

6 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.

6.1 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)

6.2 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.

6.2.1 Size and Placement of the 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-5541™.

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.

6.2.2 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

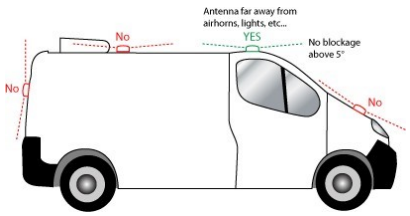
The Comm. Antenna must be located at least 20cm away from vehicle passengers, other personnel, or bystanders in order to comply with FCC radio frequency exposure limits.

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.

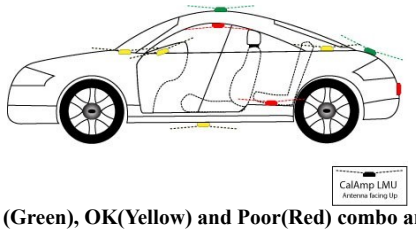


Examples of good and poor GPS antenna placements

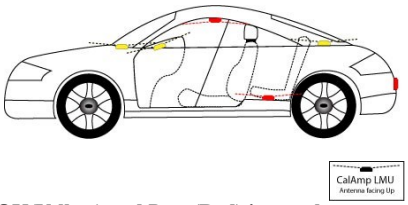
The received signal levels at the GPS antenna from the satellites are very low in power (approximately -136 dBm), so any blockage of the antenna can affect the quality of the location computed by the receiver. Kinks or tight knots in the antenna cable can also prevent the GPS receiver from operating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

6.2.3 Access to the SIM (Subscriber Identity Module) Card

When used in a GSM/GPRS/LTE 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.

6.2.4 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.

6.2.5 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.

6.2.6 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.

6.2.7 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.

6.2.8 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.

6.3 Installing the LMU in the 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:

6.3.1 Place the LMU 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.

6.3.2 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.

6.3.3 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.

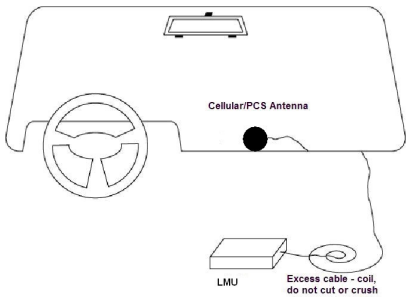
The ideal location is typically near the center of the vehicle's roof. However, it is also desirable to locate the cellular antenna as far from the GPS antenna as possible.

Examples of good and poor GPS antenna placements

6.3.4 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.



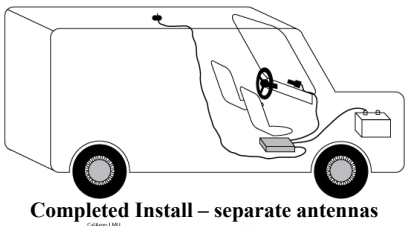
Window Mount Antenna Location

6.3.5 Typical Connection Sequence

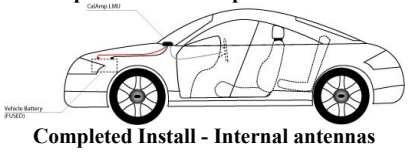
- Attach the cable from the GPS antenna.
- Connect the cable from the Comm.. antenna

- 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

6.4 Installation Verification

In many cases it is desirable to verify that an installed LMU-5541™ is working properly. That is, installers should verify that the GPS and communications functions of the LMU-5541™ 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-5541™. 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-5541™ to obtain its current status.

6.4.1 Comm Verification

Installers should first verify that the LMU-5541™ 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-5541™ to communicate with the modem and acquire the wireless network.

6.4.2 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)

6.4.3 Inbound Verification

The last item to verify is that the LMU-5541™ 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-5541™ 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 back-end 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-5541™ is sending data. The best way to do this is to force the LMU-5541™ to send in an unacknowledged Event Report (i.e., its current GPS location) with the following command:

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

The LMU-5541™ 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.

6.4.4 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:**

- **<App ID>:**

<p style="margin-left: 40px;">The Application ID value of the LMU indicating the host platform and the wireless networking technology of the LMU.

- <**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/LTE/GPRS 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.

- <i**nbound 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.

APP:081 8.3d

COM:0

GPS:No Time Sync INP:11100111 13.7V

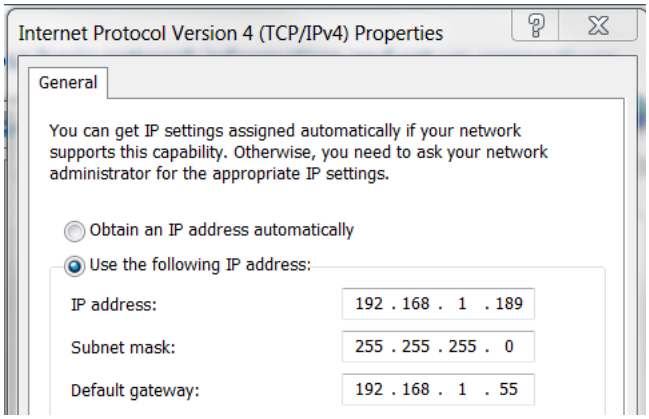
MID:4141000100 ESN

INB:207.7.101.227:20500 LMD

7 LMU-LMU5541 Router Configuration & Management

7.1 Configure Maintenance Computer

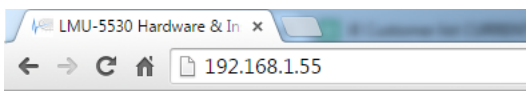
Change the IP settings on the maintenance computer to match the subnet of the LMU-LMU5541™
Go to Control Panel ? Network and Internet ? Network and Sharing Center ? Change adaptor settings ? Local Area Connection ? Properties ? Internet Protocol Version 4 (TCP/IPv4) ? Properties ?
Select “Use the following IP address:”
Enter the following IP settings:
Ethernet IP address = 192.168.1.189
Subnet mask = 255.255.255.0
Default gateway = 192.168.1.55



Select OK to apply changes.

7.2 Connect to the router

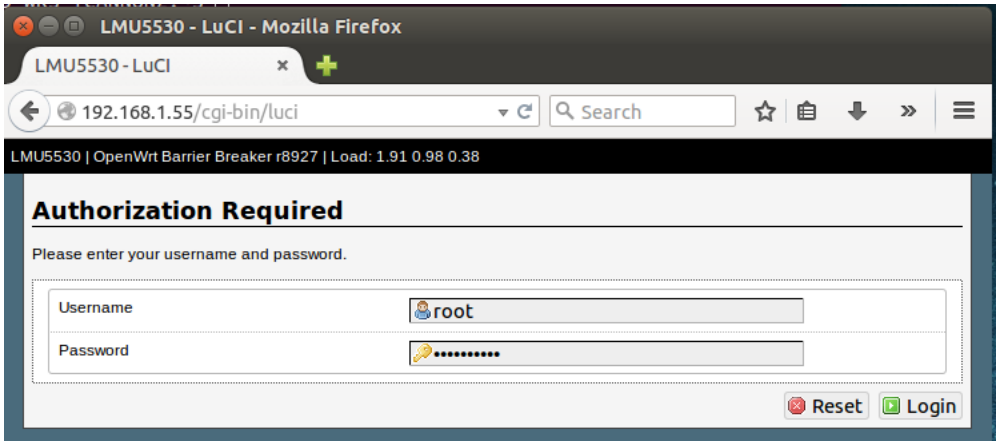
Use a web browser to log into the LuCI interface. Type 192.168.1.55 into the browser:



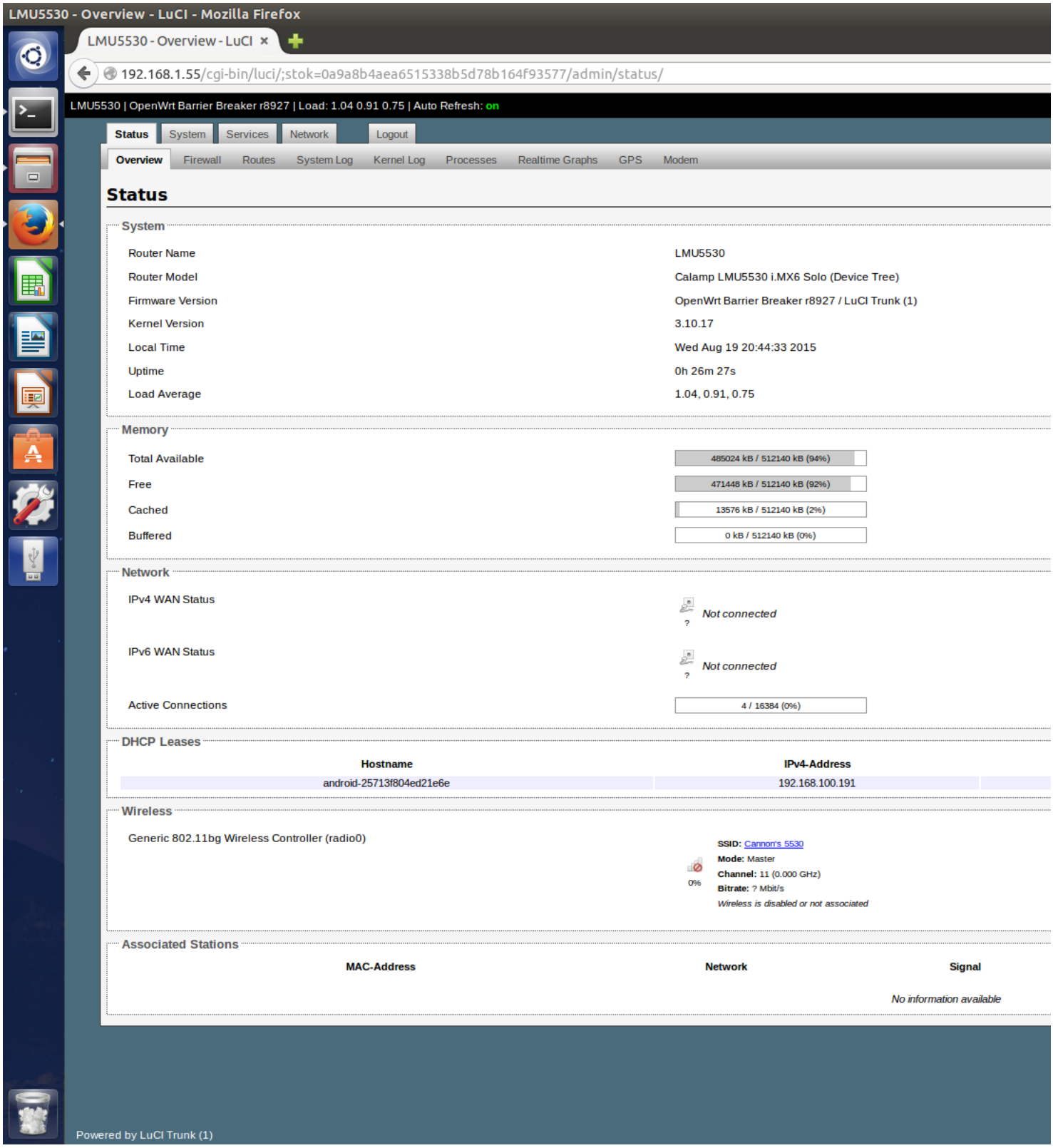
7.3 LuCI

Login screen:
Enter Username: **root**

Enter Password: SB327 compliant password. Please reachout to your FAE for details



Once you log in you will see the Overview screen:



7.4 How to turn on WIFI

To start the WIFI interface you can simply run the following PEG command:

Note: By default the WIFI interface is configured in Access Point mode with no security.
It is disabled after programming the image.

To start the WIFI interface you can simply run the following PEG command:

>>at$app peg action 190 1

To shut down WIFI run the following PEG command:

>>at$app peg action 190 0

To see WIFI status:

>>atiw

From Linux console you can also turn WIFI on/off using the following commands:

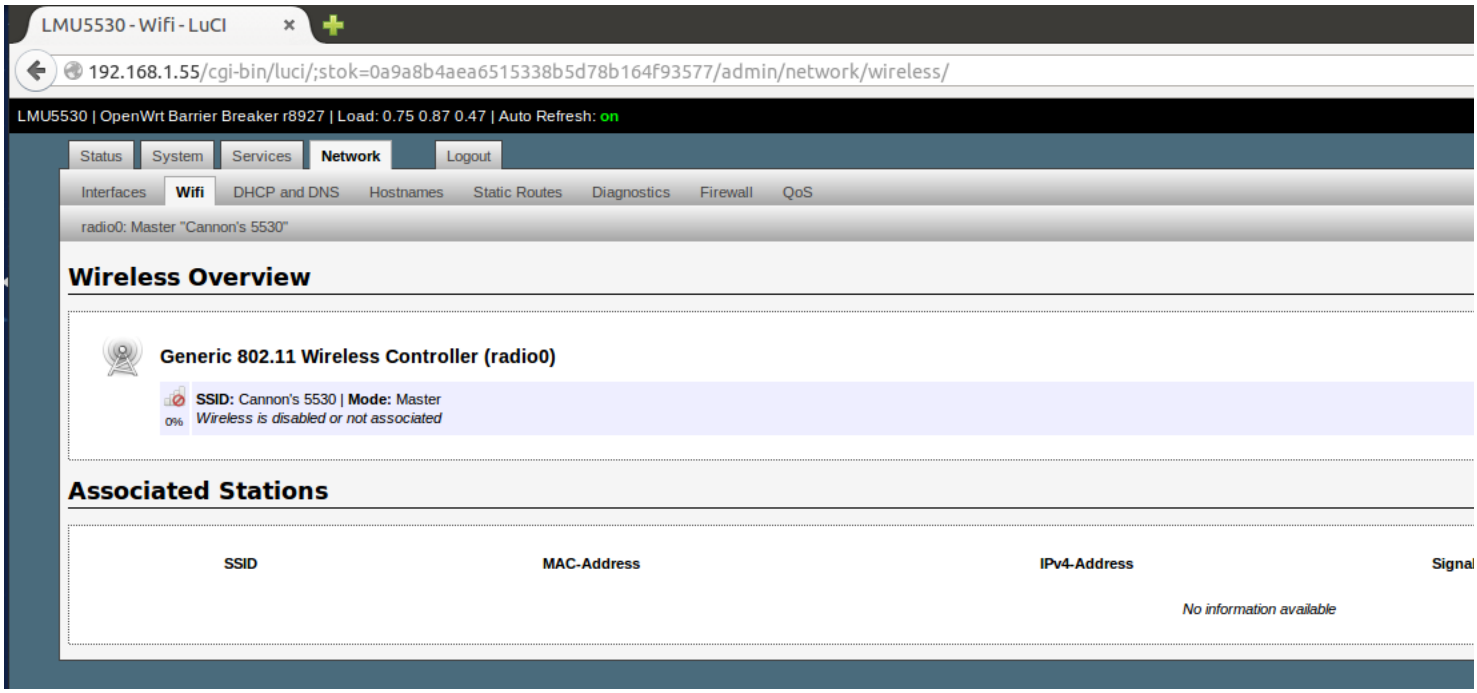
To turn on WIFI:

>> uci set wireless.radio0.disabled=0
>> uci commit wireless
>> /etc/init.d/network reload

To turn off WIFI:

>> uci set wireless.radio0.disabled=1
>> uci commit wireless
>> /etc/init.d/network reload

You can also turn WIFI on/off using the LuCI:



From the Overview page, click the Network tab and then the WIFI sub-tab.

7.5 How to test WIFI connectivity

As we mentioned, WIFI on the LMU5541 default is in access point mode so all clients can join it and get an IP address.
If you run WIFI on the LMU5541 from your Windows or Linux machine with WIFI enabled, you should see a new WIFI device with "calamp" as the SSID.
Try to join this network. It has no security and it should join “calamp” with no problem.
After joining you should check your WIFI interface in client side to see if it got a new IP address.
On Windows machines, go to console by running "cmd" and from there type

>>ipconfig

You should see new IP address with 192.168.100.xx subnet is assigned to wireless interface.
You can try to ping the LMU from the client side:

>>ping 192.168.100.55

Ping should work.

7.6 LED Behavior

Mode	Connected?	Client Connected?	LED State
OFF	NO		OFF
Client	NO		Green Flash (Slow)
Client	Authenticating		Green Flash (Fast)
Client	YES		Green Solid
AP		NO	Red Solid
AP		YES	Red Solid

7.7 Toggle between Access Point and Client Mode

You can switch between Access Point and Client Mode by changing Parameter 3901 (WIFI_MODE) and restarting the Wi-Fi interface.
Putting unit into Access Mode:

>>at$app param 3901,0,"ap"
>>at$app peg action 190 1

Putting unit into Client Mode:

>>at$app param 3901,0,"sta"
>>at$app peg action 190 1

7.8 Supported and Tested Wi-Fi Related Parameters

WIFI_AUTH = 3900 //16-char - AUTh mode
WIFI_MODE= 3901 //16-char - Mode of operation "ap" or "sta"
WIFI_SSIDL= 3902 //64-char - SSID of the network
WIFI_ENCRYPTIONL= 3904 //16-char - encryption method
WIFI_KEYL= 3905 //64-char - the pre-shared key (psk)
WIFI_EAP_TYPE= 3909 //16-char - EAP type for WPA/WPA2
WIFID_CHANNEL= 3950 //16-char - the channel number to operate on
WIFID_DISABLED= 3951 //unsigned 8 bits- to disable wireless network 1:enable, 0:disable
WIFID_TXPOWER= 3954 //32 bit - transmit power

8 Firmware & Co-Processor Update

Note: This section will program the u-boot, root file system, and kernel, on the IMX processor. The second section will program the Co-Processor. If you would like to simply upgrade the Firmware of adevice that already has the u-boot, root file system, etc., please go to the follow section of the Wiki: Firmware Update

The LMU-5541™ features two processors.

- IMX, the Linux processor
- STM8, the co-processor

The Firmware for the two processors in the LMU can be manually loaded.
Updating the firmware is performed in two sections, one section for each processor. The first section will program the u-boot, root file system, and kernel, on the IMX processor. The second section will program the Co-Processor.
Note: Note: During the u-boot update everything will be erased including the ESN, so please make a note of the ESN.
View ESN type: ***AT#ESN?*** <Enter>

8.1 Requirements

- Maintenance computer with serial connector or serial adaptor
- Download and install two programs: TFTP32 or TFTP64, and WinSCP. If your computer is a 64 bit version, then download tftpd64
  - tftpd download
  - winscp download
- All Firmware related files
- Co-processor image.bin file
- Terminal emulation program such as HyperTerminal, Putty, TeraTerminal, set to a Baud Rate of 115200
- Power supply +12VDC
- Ethernet cable
- USB to mini-USB cable
- CalAmp 4-pin Power cable p/n 5C888
- CalAmp programming pigtail, serial adaptor cable p/n 5C940
- CalAmp serial cable p/n 134364-SER
- 4-pin header at location J25.

8.2 Preparation

In the C: drive of the maintenance computer create a folder called tftpboot

- C:\tftpboot

Place all of the firmware and u-boot-lmu related files that were provided into the tftpboot folder

Connect the 5-pin connector of the CalAmp serial cable 134364-SER into the AUX1 connector of the LMU-5541™. Connect the DB-9 connector of 134364-SER to the serial connector or serial adaptor connected to the maintenance computer.

Connect the mini USB to the LMU-5541™ and connect the other end to a USB slot on your computer.

Connect 4-pin power harness SC5888 to the power connector on the LMU-5541™. Connect the wires of the power harness to +12VDC power supply; RED +12VDC, WHT +12VDC (ignition), BLK Ground

Take an Ethernet cable and connect one end to the LMU-5541™ RJ-45 connector and the other end to the maintenance computer.

Launch the terminal emulation program.

Power up the LMU-5541™.

Type: ***AT#ESN?*** <Enter>

Write down the ESN of the unit.

Remove power from the LMU-5541™.

8.3 Maintenance computer network setup

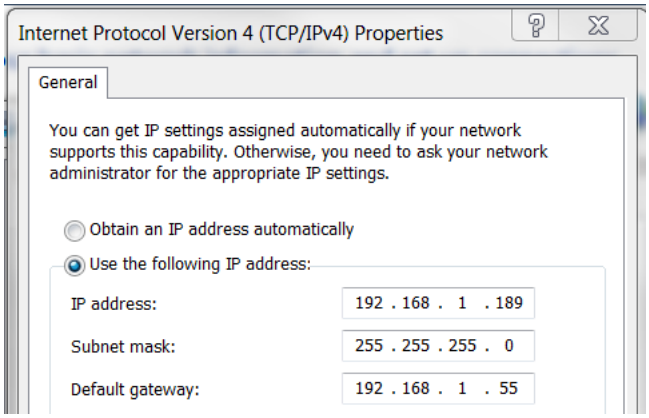
Change the IP settings on the maintenance computer to match the subnet of the LMU-5541™

Go to Control Panel → Network and Internet → Network and Sharing Center → Change adaptor settings → Local Area Connection → Properties → Internet Protocol Version 4 (TCP/IPv4) → Properties →

Select “Use the following IP address:”

Enter the following IP settings:

Ethernet IP address = 192.168.1.189
Subnet mask = 255.255.255.0
Default gateway = 192.168.1.55



Select OK

Ensure WiFi is disabled on the maintenance computer.

8.4 Programming the IMX processor

Apply power to the LMU-5541™, then view the terminal emulation screen.
Enter <B> to break the u-boot.

```
Net: FEC [PRIME]
Normal Boot
Hit 'B' to stop autoboot: 0
LMU5541-Boot >
```

The command prompt **“LMU-5541-Boot >”** will appear.
Type: ***nand erase.chip*** <enter>

```
LMU5541-Boot > nand erase.chip
```

When completed, **"LMU5541-Boot >"** will appear.

```
NAND erase.chip: device 0 whole chip
Erasing at 0x1ffe0000 -- 100% complete.
OK
LMU5541-Boot >
```

8.5 USB driver installation

If the USB driver has been previously installed, skip the USB driver installation.

Power cycle the unit.

If the USB driver has never been installed, a pop-up window will appear → Driver Software Installation. Proceed with the driver install.

Upon completion, it will indicate USB Input Device Installed.

8.6 Firmware update

Remove power from the LMU-5541™

Remove the top cover of the LMU-5541™

Connect the 4-pin connector of 5C940 into the 4-pin header located on the board at J25. The red stripe of 5C940 is placed facing towards the closest edge of the board.

Connect the 5-pin connector of the serial adaptor cable 5C940 to the 5-pin connector of the serial cable 134364-SER.

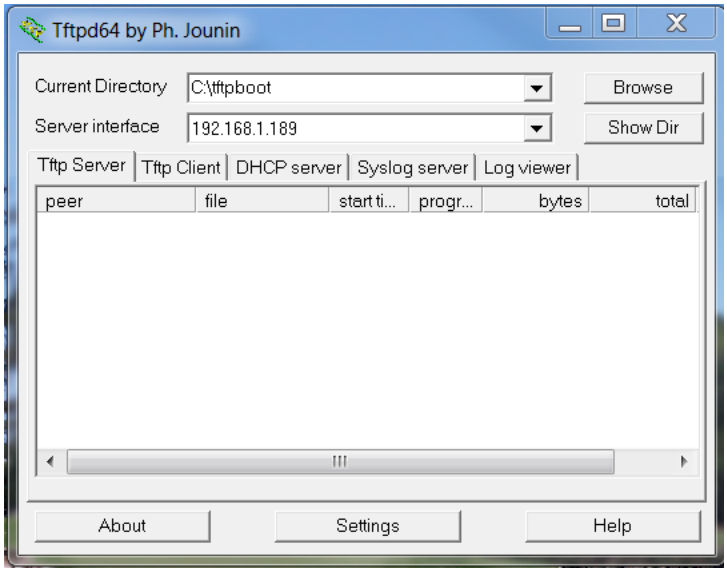
Connect the DB-9 connector of 134364-SER to the serial port or serial adaptor connected to the maintenance computer.

Power up the LMU-5541™

Launch the TFTP32 or TFTP64 server.

For the Current Directory window, Browse for Directory **C:\tftpboot**

For the Server interface window, select **192.168.1.189**



On the maintenance computer, open the command prompt by searching for **CMD.EXE** followed by <enter>

Type: ***cd c:\tftpboot***

```
C:\Users\amejia>cd c:\tftpboot
```

At the prompt c:\tftpboot, type: ***dir*** <enter> (to see and verify the files)

```
c:\tftpboot>dir
```

At the prompt c:\tftpboot, type: ***sb_loader.exe -f u-boot-lmu5541-btstrp.imx*** <enter>

```
C:\tftpboot>sb_loader.exe -f u-boot-lmu5530-btstrp.imx
```

In the command prompt screen, wait for an indication of a successful download.

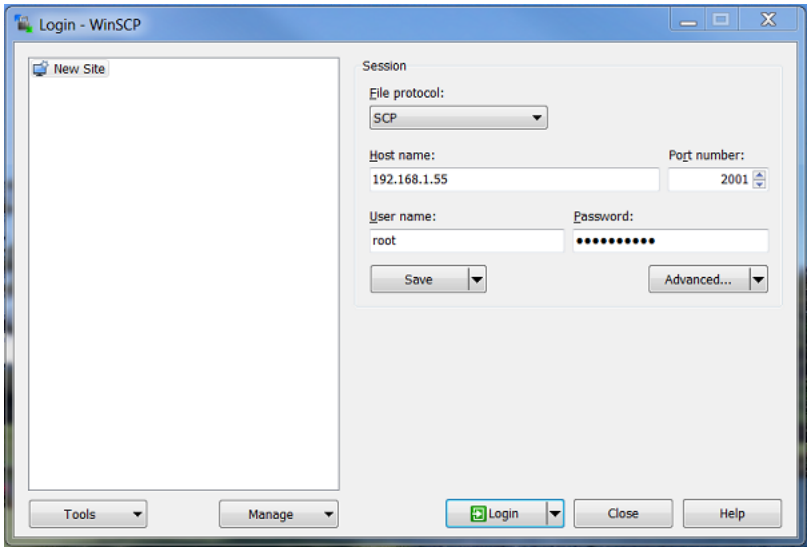
```
C:\tftpboot\22a_5530_164>sb_loader.exe -f u-boot-lmu5530-btstrp.imx
Found USB#VID_15A2&PID_0061#5&1B8E499F&0&4.
DCD Regs Written....
DCD Write Success!

Executed plugin successfully.

 Loading Firmware.
Succeed to download u-boot-lmu5530-btstrp.imx to the device.
Run into the image successfully.
```

Looking at the Terminal Emulation screen, you will see up to 9 files being serially loaded. Wait until all the files have been loaded as it takes several minutes. After all files are loaded “U-boot Upgrade complete” will appear on the terminal emulation screen.

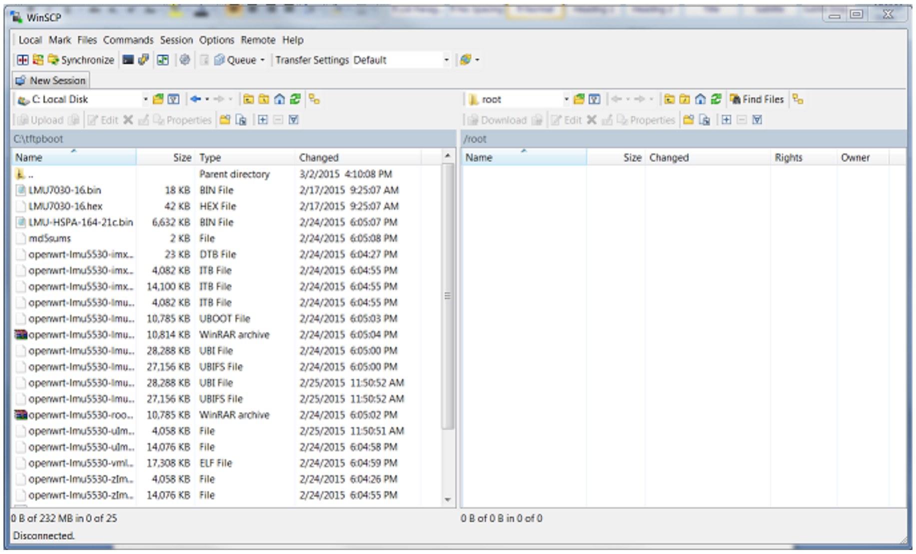
```
[   25.597914] uboot-env erased
[   25.749810] uboot-env-rdun erased
[   25.810871] <<<<<<<<<<<>>>>>>>>>>>
[   25.817475] CalAmp Uboot_Upgrade Completed
[   25.824322] U-boot Upgrade complete
[   25.840750] Rebooting...
[   25.846420] <<<<<<<<<<<>>>>>>>>>>>
[   25.862682] SysRq : Resetting
```

8.7 Programming the co-processor

WinSCP will be used to transfer the firmware for the co-processor into the Linux system after it is running.
Launch WinSCP
Select File Protocol: **SCP**
Enter Host Name: **192.168.1.55**
Enter Port Number: **2001**
Enter Username: **root**
Enter Password: SB327 Compliant Password. Please reachout to your FAE for details
Click on Login



A new WinSCP screen will appear. On the left side, browse for C:\tftpboot
The right half should be pointed to the /root directory in the LMU-5541.



Transfer the file called LMU7030-CoProc_vX.X.bin via SCP over to root. Drag the file LMU7030-vX.X.bin across the screen to the root side.
On the Terminal Emulation screen, press <Enter> to bring up the LMU5541 login:
Username: **root**
Password: SB327 Compliant Password. Please reachout to your FAE for details

```
LMU5530 login: root
Password:

BusyBox v1.19.4 (2015-02-24 17:48:02 PST) built-in shell (ash)
Enter 'help' for a list of built-in commands.

   ____      _    _
  / ___|__ _| |  / \   _ __ ___  _ __
 | |   / _` | | / _ \ | '_ ` _ \| '_ \
 | |__| (_| | |/ ___ \| | | | | | |_) |
  \____\__,_|_/_/   \_\_| |_| |_| .__/
                                |_|
```

Type: **ls** <Enter> (to view the name of the bin file)
Type: **lmu5541_program_stm8.sh /root/<file_name.bin>** <Enter>
Note: the bin file name is case sensitive and must be entered exactly as shown.
The co-processor, STM8, is being programmed.

```
Wrote and verified address 0x00008000 (100.00%)
Done.

Resetting device... done.
CalAmp STM-Manager started
Programming is done: success
root@LMU5530:~#
```

Programming is complete when "success" is returned and the **"root@LMU5541:~#"** prompt is displayed.
To view co-processor info type: **stm_cli --info**

8.8 Final Steps

Because of the command **nand erase.chip**, the ESN was wiped out and assigned the number zero. Change the ESN back to its assigned number with the following AT command.
AT#ESN <ESN_Number> OVERRIDE
Example: ***AT#ESN 5052000024 OVERRIDE***
After the Firmware update it is necessary to set the factory defaults on all the parameters.
Type: AT#FACTORY