

TTU-4530™

TTU-4531™

Hardware and Installation Guide



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1 Introduction

Welcome to the TTU-4530™ Hardware and Installation Guide. This manual is intended to give you information on the basic setup and installation of the CalAmp TTU-4530™ product(s) including hardware descriptions, environmental specifications, wireless network overviews and device installation.

1.1 About This Manual

The TTU-4530™ 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 TTU-4530™ 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 TTU-4530™.
- **Hardware Overview** – Describes the physical characteristics and interfaces of the TTU-4530™.
- **Installation and Verification** – Provides guidance for the installation of the TTU-4530™ in a vehicle and instructions on how to verify the installation is performing adequately.

1.2 About The Reader

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

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

1.3 About CalAmp

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

infrastructure and process control applications. For additional information, please visit the Company's website at www.calamp.com.

1.4 About the CalAmp Trailer Tracking Unit-TTU-4530™

The CalAmp Trailer Tracking Unit-4530™ (TTU-4530™) is a mobile device that resides in private, commercial or government vehicles. The TTU-4530™ is a single box enclosure incorporating a processor, a GPS receiver, a wireless data modem, and a vehicle-rated power supply. The TTU-4530™ also supports inputs and outputs to monitor and react to the vehicular environment and/or driver actions.

Flexibility

The TTU-4530™ 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 TTU-4530™ 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

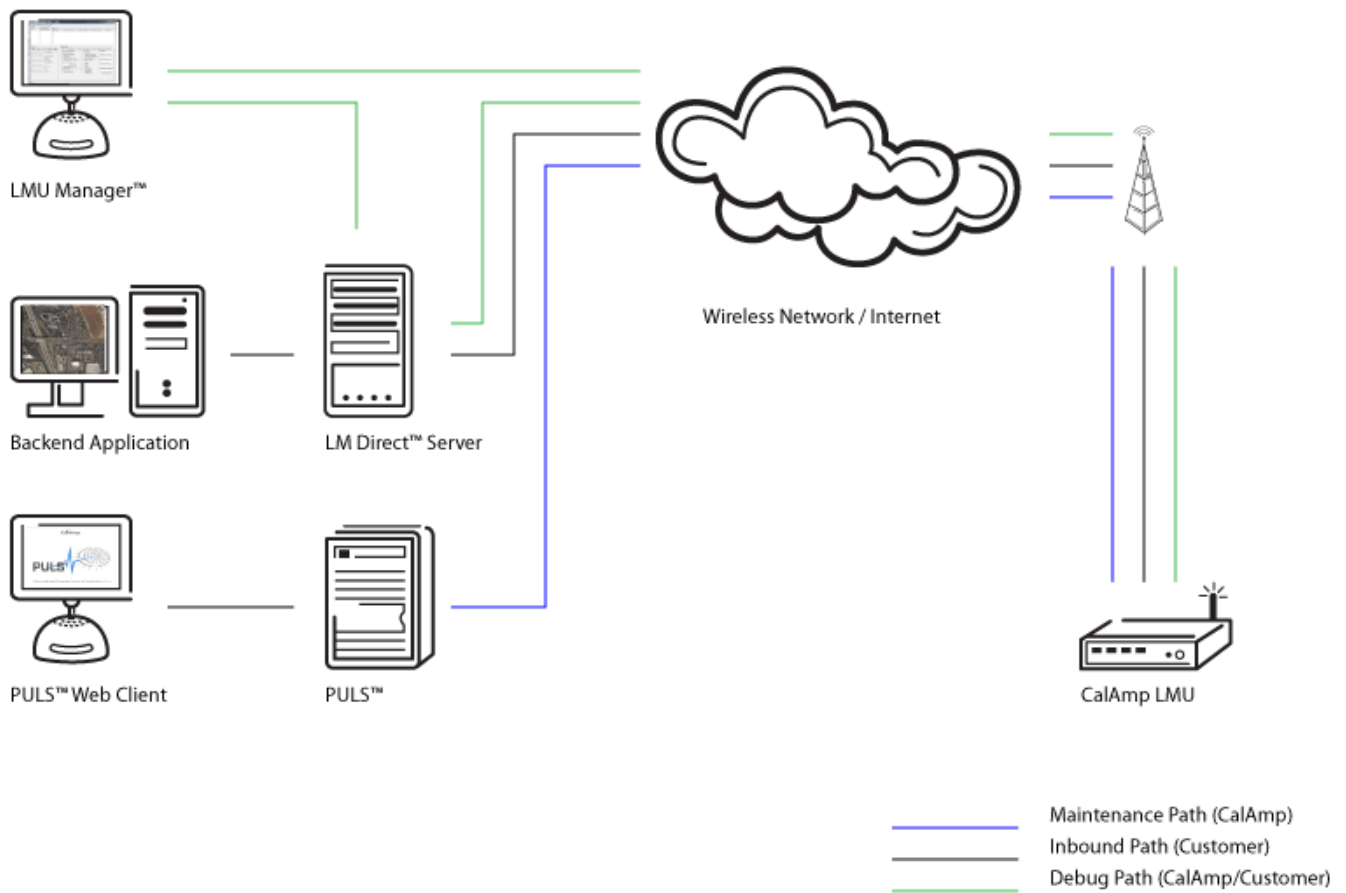
2.1 Overview

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 TTU-4530™ 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 TTU-4530™
- Host Device (GPS NMEA only)
- An LM Direct™ communications server
- Backend mapping and reporting software which typically includes mapping and fleet reporting functions
- PULS™
- TTU 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 TTU-4530™. 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 TTU-4530™.

2.2.2 TTU-4530™

The TTU-4530™ 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 TTU-4530™
- A location or status request from the LM Direct™ server
- A location or status request from TTU 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 TTU-4530™ 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 TTU-4530™ is capable of sending and receiving. This interface allows System Integrators to communicate directly with TTU-4530'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 TTU-4530™ in a variety of formats
- Present historic information received from the TTU-4530™, typically in a report/chart style format
- Request location updates from one or more TTU-4530s™
- Update and change the configuration of one or more TTU-4530s™

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 TTU Manager™

TTU Manager is the primary configuration tool in the CalAmp system. It allows access to almost every feature available to the TTU-4530™. Unlike the backend software, it has the option of talking directly to a TTU-4530™ or making a request forwarded by the LM Direct™ server.

For further details on using TTU Manager, please refer to the [TTU Manager Users Guide](#).

3 Hardware Overview

3.1 Trailer Tracking Unit-4530™

Handling Precautions

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 TTU-4530™ 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 TTU-4530™ 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 TTU is designed to operate in and the relevant SAE tests that were performed. No formal altitude tests were conducted.

Dimensions

6.356”(L) x 4.429”(W) x 1.725”(H)

158.902mm (L) x 112.496mm (W) x 43.815mm (H)

Weight

2.4oz (68.03g)

Operating Temperature

-30° C to +75° C

-10° C to +60° C (When using Internal Battery Power)

Storage Temperature

-40° C to +85° C

0° C to +30° C (Long Term w/Internal Battery)

Internal Battery Charging Temperature

+5° C to +45° C

Humidity

0% to 95% relative humidity, at 50° C non-condensing

Shock and Vibration

Ground vehicle environment with associated shock and vibration

SAE Test: SAE J1455

Mil Standard 202G and 810F

Electromagnetic Compatibility (EMC)

EMC compliant for a ground vehicle environment

SAE Test: SAE J1113 Parts 2, 12, 21 and 41

Operating Voltage Range

The TTU-4530™ supports vehicles with 12 or 24 VDC systems including transients and electrical system noise; this includes ranges from 7 to 32 VDC.

Electrostatic Discharge (ESD)

No damage or performance degradation after the ESD disturbance.

SAE Test: SAE J1113 Part 13

Power Consumption

Deep Sleep: 2mA

Sleep on Network (SMS): 10mA

Sleep on Network (GPRS): 20mA

3.3.1 Accessories

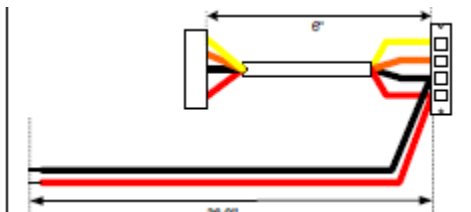
See the [Harness Diagrams](#) page for more information on TTU accessories, and supported products table.

3.3.2 Serial Interface Connectors

The TTU-4530 offers 2 serial interface connections (Host/Aux1 and Aux 2) via lead wires from the 34 pin Power Harness (part number **5C582**) .

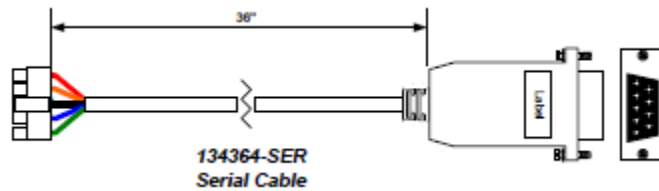
To connect serially requires the following cables:

- 34 pin Power Harness. Part number: **5C582**
- Terminal block. Part Number: **5C942**



TTU-4530 Terminal Block Part Number 5C942

- To serially connect to Aux1, simply connect the following wires together from the power harness to the screw terminal block - red to red, black to black, yellow to green/brown and orange to blue/brown. Make sure to do a continuity check to determine pin configurations(There are multiple black wires and thus this step is necessary to ensure that you are using the correct ground outlet)
- Serial Adapter part number: **134364-SER**



TTU™ Serial Adapter

- Note for Serial Adapter: The ON/OFF switch of the 134364-SER cable should be set to the default 'OFF' position.

3.4 I/O Descriptions

The TTU-4530™ provides the following inputs and outputs (I/O):

TTU-4530Z/TTU-4x30

App Id:

320-HSPA EHS5
 321-HSPA EHS6
 322-GSM BGS2
 323-LTE LE910
 324-CDMACE910
 325-LTE LHS5

Processor:

STM32F205-768

GPS:

UBLOX G7020

Input-0 Ignition
Input-1 In-1 sel
Input-2 In-2 sel

Input-3	In-3 sel
Input-4	In-4 sel
Input-5	In-5 sel
Input-6	In-6 sel
Input-7	In-7 sel
Input-8	Motion
Input-9	VBUS Active
Input-10	Pwr State
Input-11	Vbatt Low
Input-12	1BB Detect
Input-13	Batt Virt Ign
Input-14	Pure Virt Ign
Input-15	Radio Active Wakeup

Output-0	
Output-1	Out-1
Output-2	Out-2
Output-3	
Output-4	
Output-5	
Output-6	
Output-7	Pwr Switch
Output-8	Chrg Disable
Output-9	
Output-10	
Output-11	ADC1 0=Standard 1=4-20mA mode
Output-12	ADC2 0=Standard 1=4-20mA mode
Output-13	V_OUT switched

ADC-0	Vin
ADC-1	Standard / 4-20mA
ADC-2	Standard / 4-20mA
ADC-3	
ADC-4	
ADC-5	
ADC-6	GPS Ant.
ADC-7	uP Temp.
ADC-8	Vref
ADC-9	Battery

Host/Aux-1	Dnld/Select
Aux-2	
Aux-3	

1BB-Chan 1	
1BB-Chan 2	

Motion	MEMS
---------------	------

RTC YES
Sleep TTU
Processor STM32F205

App ID 321-HSPAg6

3.4.1 3-Axis Accelerometer Input

The TTU-4530™ supports an internal 3 Axis Precision Accelerometer as one of its discreet inputs. When the TTU is moved in any direction, the associated input will be in the High state. If the TTU's accelerometer does not detect motion, then the input will be in the Low state. No external connections are required for this functionality to be operational.

3.4.2 Status LEDs

The TTU-4530™ is equipped with three Status LEDs, one for GPS, one for COMM (wireless network status) and one TBD. The LEDs use the following blink patterns to indicate service:

LED #1 (Comm LED - Orange) Definitions

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

LED #2 (GPS LED - Yellow) Definitions

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

4 Configuration and Activation

This section details how to quickly get an TTU-4530™ 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 TTU 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 TTU-4530™. (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 TTU-4530™.** This device may not be supported for all the carriers or networks listed in this section (CDMA-Verizon, CDMA-Sprint, HSPA, GSM), for product availability consult the CalAmp sales team.

4.1 Quick Start - General Config

All TTU-4530s™ must go through a common step during the configuration and provisioning process. Specifically, this is pointing the TTU 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 TTU-4530™ and connect a serial cable from the TTU to your laptop
2. Open a terminal session to the TTU-4530™
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 TTU 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 TTU-4530™ and your handset
2. From the handset, send an SMS message to the TTU-4530™ 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 TTU 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

.2 Auto provisioning of GSM or HSPA TTUs

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

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

- o APN 0: PROXY
- o APN 1: PUBLIC

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

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

Manxpronto (MCC 234, MNC 058)

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

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

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

O2 Ireland (MCC 272, MNC 02)

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

Orange UK (MCC 234, MNC 33, 34)

- o APN 0 & 1: orangeinternet
- o Username: user

o Password: pass

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

o APN 0: INTERNET2.VOICESTREAM.COM

o APN 1: INTERNET3.VOICESTREAM.COM

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

o APN 0 & 1: general.t-mobile.uk

o Username: user

o Password: wap

TelCel Mexico (MCC 334 MNC 02)

o APN 0 & 1: INTERNET.ITELCEL.COM

o Username: webgprs

o Password: webgprs2002

Telstra Australia (MCC 505, MNC 01, 11, 71, 72)

o APN 0 & 1: telstra.internet

Vodafone Ireland (MCC 272, MNC 01)

o APN 0 & 1: isp.vodafone.ie

o Username: vodafone

o Password: Vodafone

Vodafone New Zealand (MCC 530, MNC 01)

o APN 0 & 1: internet

o Username: guest

o Password: guest

Vodafone UK (MCC 234, MNC 15)

o APN 0 & 1: internet

o Username: web

o Password: web

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

This feature can be disabled by setting Bit 0 of [S-Register 155](#).

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

To re-enable auto-provisioning, use:

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

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

4.3 Activating GSM or HSPA TTU using AT Commands

Check with the CalAmp Sales team for availability of the TTU-4530™ with GSM or HSPA

modems. For a GSM/GPRS operator you will get the TTU in one of two varieties, one with a SIM and one without.

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

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 TTU. 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 TTU.

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

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

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

The activation sequence for a GSM TTU 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?
```

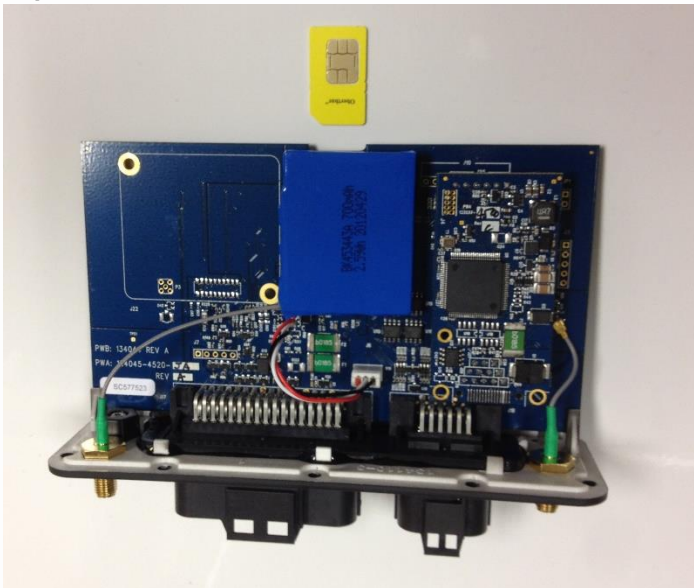
A good response should look similar to the following:

```
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:
```

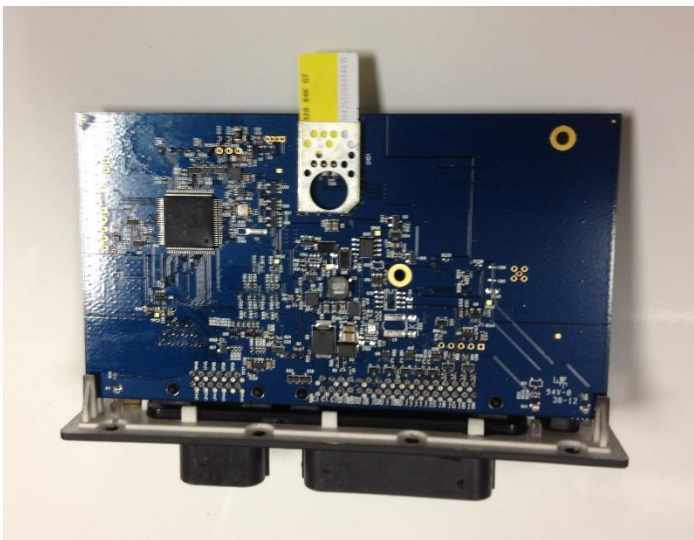
GPRS APN: IP:Public
Quality of Srvc: 1,0,0,3,0,0
GSM Class: B

The SIM carrier is located inside the TTU-4530™ housing on the back center of the device.

Top View:



Bottom View:



4.5 Activating a CDMA TTU-4530™

Check with the CalAmp Sales team for availability of the TTU-4530™ with CDMA modems. For CDMA devices, the activation sequence you will use varies from carrier to carrier. Each of the supported carriers is documented below.

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

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

4.5.1 Activating a CDMA TTU-4530™ – Verizon

Verizon supports a system that allows CDMA devices to be provisioned Over-The-Air. A CalAmp TTU-4530™ will automatically use this system to attempt to self provision. This procedure assumes that the TTU-4530™ has never been provisioned or activated before.

1. Power on the TTU-4530™, making sure you can observe the behavior of the Comm LED.
2. Wait until the Comm LED turns solid. This could take up to 5 minutes.
3. If after 5 minutes you observe that the Comm LED transitions from a slow blink to a fast blink several times (i.e. more than twice) you will need to contact Verizon Wireless for further support on account activation.

Once configured, you may verify that the TTU-4530™’s modem has registered to the CDMA network.

Enter:

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

The response should be similar to:

```
-----  
CDMA Service:      IS-2000  
Connection:       Yes  
RSSI:             -80 dBm  
-----
```

```
Channel:          0
Band:Side:       800:B
Base Station ID:          0
Network ID:        0
System ID:        4
ESN (Modem S/N:  2676319948 [9F8566CC]
Phone Number:    1234567890
IMSI:           310001234567890
CarrierConfig:   5
```

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

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

```
AT$APP MODEM UPDATE
```

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

Users may also force a reactivation with the command:

```
AT$APP MODEM ACTIVATE
```

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

4.5.2 Activating a CDMA TTU-4530™ – Sprint

Activating an TTU-4530™ on the Sprint CDMA network is identical to activating on the Verizon network.

1. Power on the TTU-4530™, making sure you can observe the behavior of the Comm LED.
2. Wait until the Comm LED turns solid. This could take up to 5 minutes.
3. If after 5 minutes you observe that the Comm LED transitions from a slow blink to a fast blink several times (i.e. more than twice) you will need to contact Sprint for further support on account activation..

Once configured, you may verify that the TTU-4530's™ modem has registered to the CDMA network.

Enter:

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

The response should be similar to:

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

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

5 Installing the TTU

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

5.1 Preparing for Installation

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

- The TTU to be installed
- A power harness
- GPS Antenna (for external devices)
- Cellular Antenna (for external devices)
- Optional Components:

- Input and output cables
- Relays
- TTU peripherals (i.e. Serial adapter, jPOD, TetheredLocator)
- Host serial devices (e.g. PDAs, laptops, other serial devices)

5.2 Plan The Installation

Verify Power, Ground and Ignition. Be sure to check each source (power, ground and ignition) to ensure that the proper signaling exists. This is typically accomplished with a multi-meter.

Before drilling any holes or running any wires, decide where each hardware component will be located (TTU, antennas, peripherals, etc.). Be sure that the cables to the TTU are not bent or constricted in any way. Also make sure that the TTU 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 TTU 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 TTU for the following purposes:

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

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

5.2.1 Size and Placement of TTU Unit

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

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

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

See the TTU [Environmental Specifications](#) for the exact measurements and specifications of the TTU-4530™.

Typical installations will place the TTU 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 TTU.

5.2.2 Placement of Antennas

There are effectively three options for placements of an antenna:

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

Comm Antenna Placement Guidelines

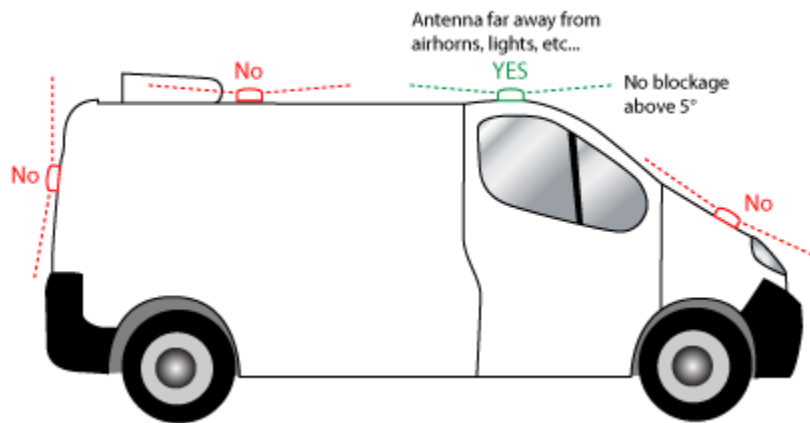
The Comm. Antenna must be located at least 20cm away from vehicle passengers, other personnel, or bystanders in order to comply with FCC radio frequency exposure limits.

Typically, the Comm antenna used by the TTU 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 TTU 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.



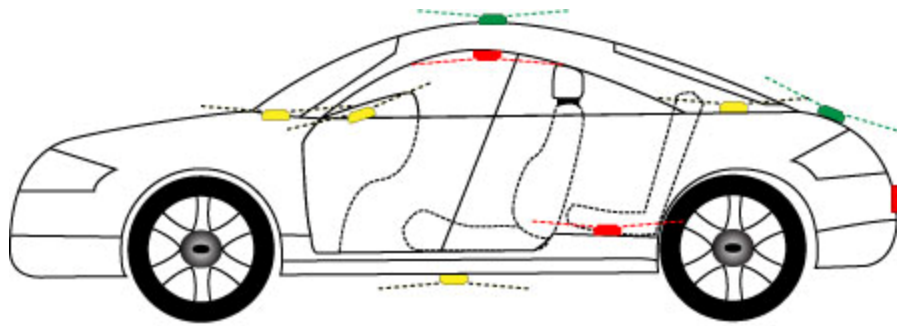
Examples of good and poor GPS antenna placements

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.

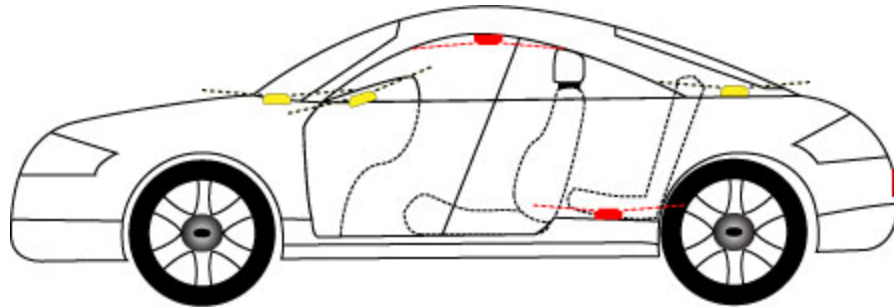
Placement of Combination and Internal Antennas

When dealing with combination antennas, it is more important to consider GPS performance over Comm performance. GPS signal strengths are much lower than those typically seen by cellular networks supported by the TTU. In order to maximize the performance the TTU 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 TTU that might block the view 360° to the horizon. As with stand-alone GPS antennas, nothing should not block the combination antenna beyond 5° above the

horizon with the best location being near the center of the roof. For more covert installs, directly under the front or rear-windshields are also acceptable.



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



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

5.2.3 Access to the SIM (Subscriber Identity Module) Card

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

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

5.2.4 Protection from Heat

It is best not to place the TTU 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 TTU is described in the TTU [Environmental Specifications](#) section.

5.2.5 Visibility of Diagnostic LEDs

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

For information about how to interpret the LEDs, see the [Status LED Behavior](#) section.

5.2.6 Cable Length

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

5.2.7 Moisture and Weather Protection

The TTU 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 TTU below a car's cup holders, or where rain might easily splash into the compartment when a door is opened.

5.2.8 Preventing Accidental or Unauthorized Modification

If you anticipate that fleet drivers or others might interfere with the TTUs once they are installed, take steps to be sure that it is not easy to disconnect the antenna wiring, remove the TTU from its power source, etc.

Two common methods are the use of Tamper Proof Sealant or creation of PEG Script to detect power loss or GPS antenna disconnections.

5.3 Installing the TTU in a Vehicle

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

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

5.3.1 Place the TTU unit in the vehicle.

Typically, the TTU should be placed under the passenger seat or dashboard of the vehicle. TTUs 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 TTU to the solid body of the vehicle, not to plastic panels. The TTU can be placed out of sight by removing interior trim and molding to expose available space, then replacing the trim once the TTU is in place

5.3.2 Connect power, ignition, and ground.

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

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

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

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

For best results, it is strongly recommended that the TTU 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.

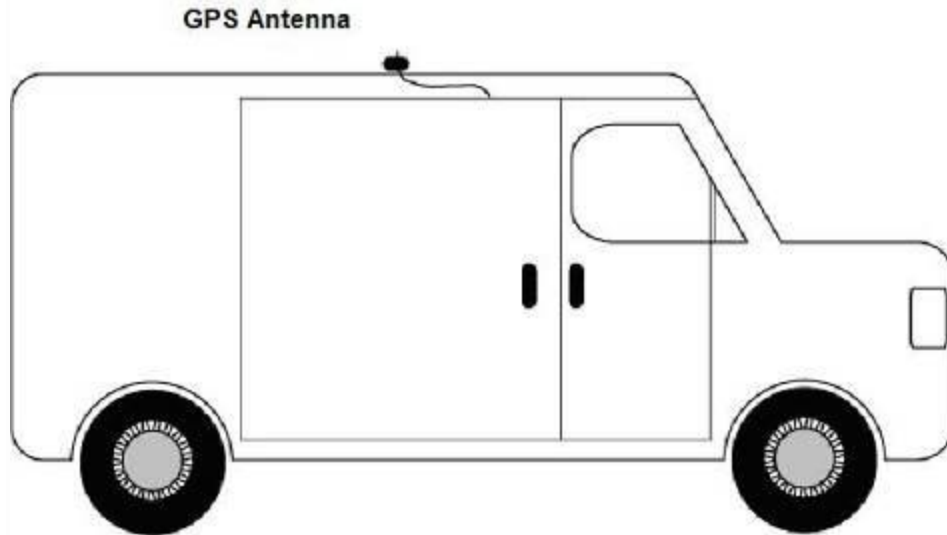
DO NOT connect the power cable to the TTU at this time.

5.3.3 Place the GPS antenna.

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

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

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

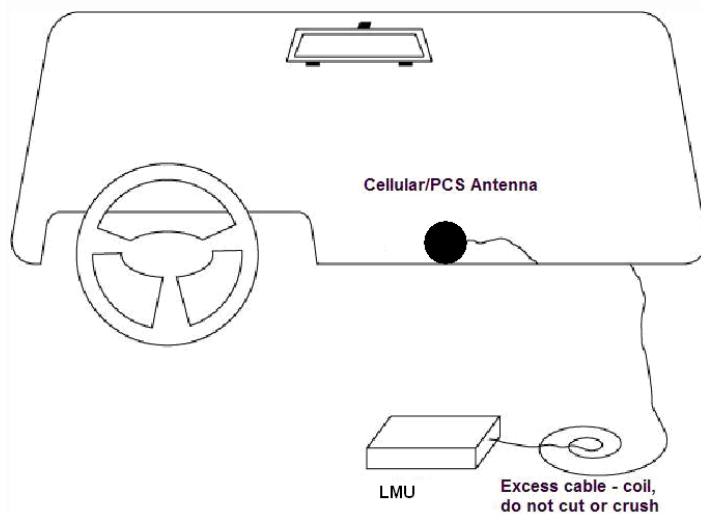


GPS Antenna Location

5.3.4 Mount the Comm. Antenna.

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

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



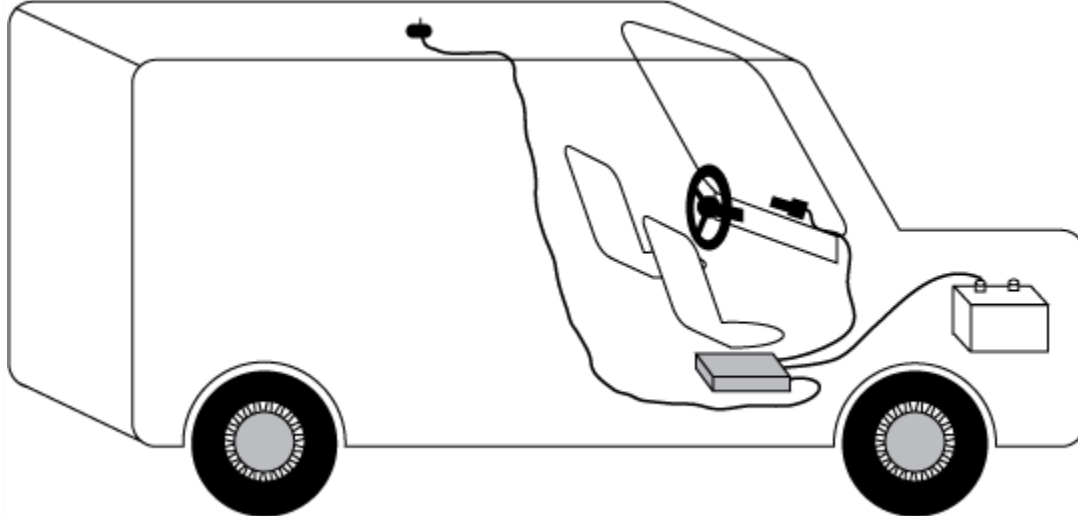
Window Mount Antenna Location

5.3.5 Typical Connection Sequence

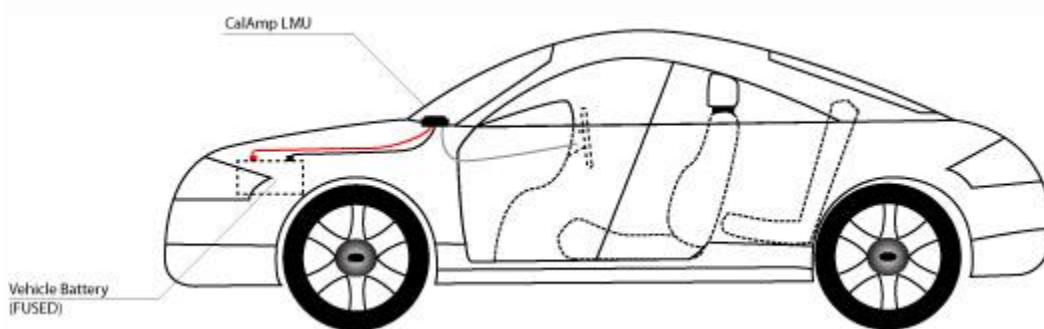
- Attach the cable from the GPS antenna.
- Connect the cable from the Comm.. antenna

- Connect any peripherals to the TTU
- Plug in the power harness.

The physical installation of the TTU hardware is now complete.



Completed Install – separate antennas



Completed Install - Internal antennas

5.4 Installation Verification

In many cases it is desirable to verify that an installed TTU-4530™ is working properly. That is, installers should verify that the GPS and communications functions of the TTU-4530™ 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 TTU-4530™. 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 a TTU-4530™ to obtain its current status.

5.4.1 Comm Verification

Installers should first verify that the TTU-4530™ 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 TTU 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 TTU-4530™ to communicate with the modem and acquire the wireless network.

5.4.2 GPS Verification

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

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

```
AT$APP GPS?
```

The response should be similar to:

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

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

5.4.3 Inbound Verification

The last item to verify is that the TTU-4530™ 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 TTU-4530™ is using the correct Inbound IP address by using:

```
AT$APP INBOUND?
```

The response should be similar to:

```
INBOUND LMD
```

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

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

The second step is to verify that the TTU-4530™ is sending data. The best way to do this is to force the TTU-4530™ to send in an unacknowledged Event Report (i.e., its current GPS location) with the following command:

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

The TTU-4530™ 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.

The current Comm, GPS and Inbound status of a GSM TTU 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 TTU:

```
!R0
```

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

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



```
INB:<inbound IP address>:<inbound port> <Inbound Protocol (LMD/LMX)>
```

APP:

o **<App ID>:**

The Application ID value of the TTU indicating the host platform and the wireless networking technology of the TTU.

o **<Firmware Version>:**

The current firmware version in use by the TTU

COM:

o **<RSSI>:**

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

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

If the character 'D' is present, it indicates the TTU 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.

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

This field indicates if the TTU has received an Acknowledgement from the Inbound server. This field will be empty if the TTU 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 TTU has received an ACK since the last warm boot. A '.' Indicates no acknowledgement has been received.

o **[./L]:**

This field indicates if the TTU'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.

o **[IP Address]:**

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

- o [**<APN>**]

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

GPS:

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

This field, if present, indicates a problem with the TTU'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 TTU' GPS receiver is off.

- o [**No Time Sync**]:

If this field is present, it indicates that the TTU'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 TTU GPS antenna is otherwise blocked.

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

If these fields are present it indicates that the TTU has, or had a valid GPS solution. The <Sat Count> field indicates how many GPS satellites are currently in use by the TTU. The <FixStatus> field indicates the type of fix. The Fix Status types are detailed in the [LM Direct Reference Guide](#).

INP:

- o **<input states>**:

This field details the current state of each of the TTU'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.

- o **<vehicle voltage>**:

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

MID:

- o **<mobile ID>**:

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

- o **<mobile ID type>**:

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

INB:

o <inbound IP address>:

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

o <inbound port>:

This is the current UDP port the TTU 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.

o <Inbound Protocol (LMD/LMX)>:

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

Example GSM Response

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

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Human Exposure Compliance Statement

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

CalAmp DataCom Inc. certifies that it has determined that the TTU-4530™ complies with the RF hazard requirements applicable to broadband PCS equipment operating under the authority of 47 CFR Part 24, Subpart E of the FCC Rules and Regulations. This determination is dependent upon installation, operation and use of the equipment in accordance with all instructions provided.

The TTU-4530™ complies with RF specifications when used near your ear or at a distance of 10 mm from your body. Ensure that the device accessories, such as a device case and device holster, are not composed of metal components. Keep the device away from your body to meet the distance requirement.

FCC Rules and Innovation, Science and Economic Development (ISED) Canada regulatory information

Compliance Statement (Part 15.19)

The equipment device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received including interference that may cause undesired operation.

Warning (Part 15.21)

Changes or modifications not expressly approved by Calamp Wireless Networks could void the user's authority to operate the equipment. Manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment.

Compliance Statement (Part 15.105(b))

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Innovation, Science and Economic Development (ISED) Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Class B digital device notice

"CAN ICES-3 (B)/NMB-3(B)"

This transmitter must not be co-located or operation in conjunction with any other antenna or transmitter. Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.