

TTU-2820™

Hardware and Installation Guide



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[\[edit\]](#)[\[top\]](#) 1 Introduction

Welcome to the TTU-2820™ Hardware and Installation Guide. This manual is intended to give you information on the basic setup and installation of the CalAmp TTU-2820™ product(s) including hardware descriptions, environmental specifications, wireless network overviews and device installation.

[\[edit\]](#)[\[top\]](#) 1.1 About This Manual

The TTU-2820™ 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-2820™ 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-2820™.

- **Hardware Overview** – Describes the physical characteristics and interfaces of the TTU-2820™.
- **Installation and Verification** – Provides guidance for the installation of the TTU-2820™ in a vehicle and instructions on how to verify the installation is performing adequately.

[\[edit\]](#)[\[top\]](#) 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

[\[edit\]](#)[\[top\]](#) 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.

[\[edit\]](#)[\[top\]](#) 1.4 About the CalAmp Location Messaging Unit-TTU-2820™

The CalAmp Location and Messaging Unit-TTU-2820™ (TTU-2820™) is a mobile device that resides in private, commercial or government vehicles. The TTU-2820™ is a single box enclosure incorporating a processor, a GPS receiver, a wireless data modem, and a vehicle-rated power supply. The TTU-2820™ also supports inputs and outputs to monitor and react to the vehicular environment and/or driver actions.

Flexibility

The TTU-2820™ 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-2820™ 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.

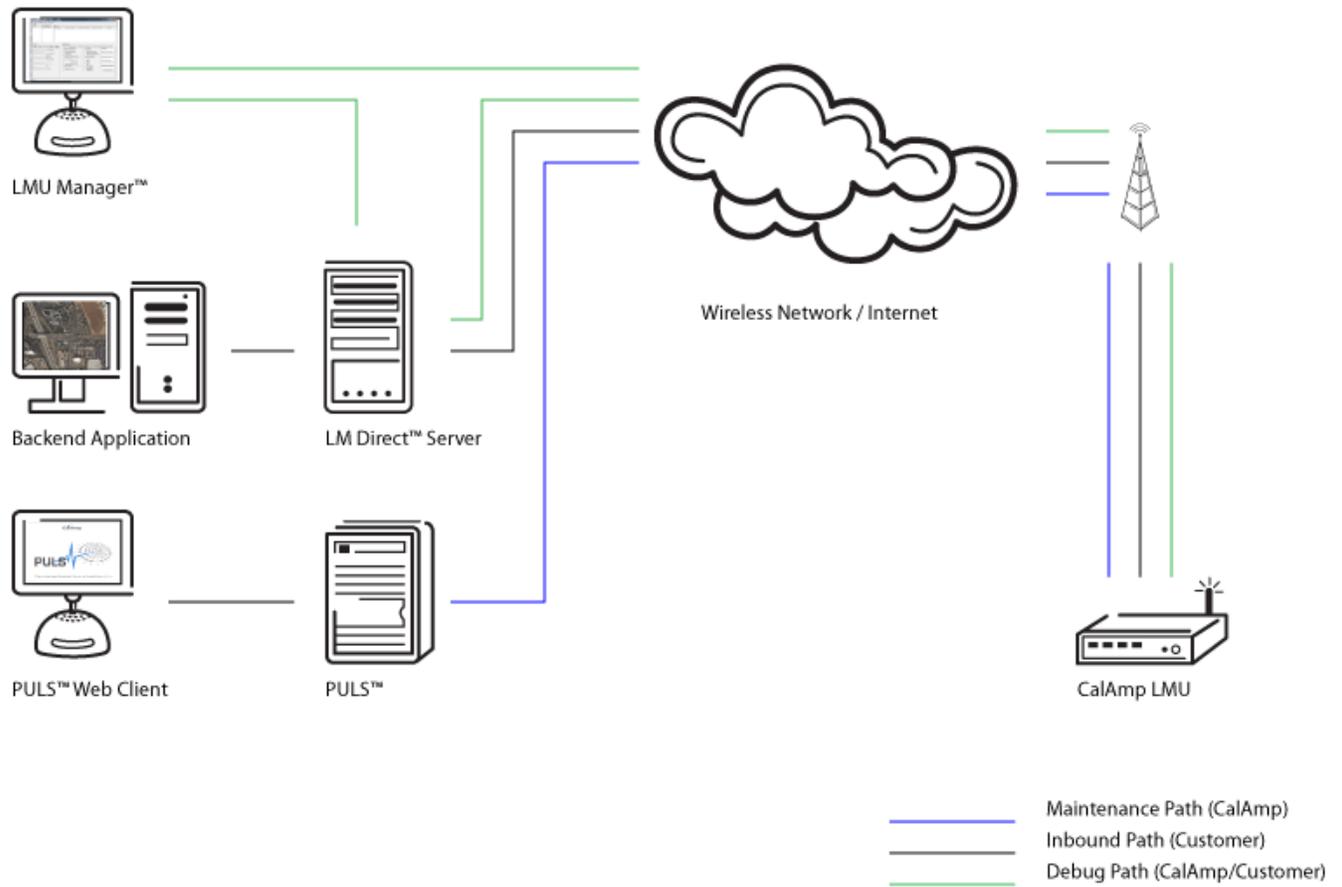
[\[edit\]](#)[\[top\]](#) **2 System Overview**

[\[edit\]](#)[\[top\]](#) **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-2820™ 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-2820™
- 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

[\[edit\]](#)[\[top\]](#) 2.2 Component Descriptions

[\[edit\]](#)[\[top\]](#) 2.2.1 Wireless Data Network

The Wireless Data Network provides the information bridge between the LM Direct™ server and the TTU-2820™. 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-2820™.

[\[edit\]](#)[\[top\]](#) 2.2.2 TTU-2820™

The TTU-2820™ 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-2820™
- 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 TTU-2820™ as a wireless modem as well as a vehicle-location device.

[\[edit\]](#)[\[top\]](#) 2.2.3 LM Direct™ Server

LM Direct™ is a CalAmp proprietary message interface specification detailing the various messages and their contents the TTU-2820™ is capable of sending and receiving. This interface allows System Integrators to communicate directly with TTU-2820's™. Please refer to the [LM Direct Reference Guide](#) for details.

[\[edit\]](#)[\[top\]](#) 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-2820™ in a variety of formats
- Present historic information received from the TTU-2820™, typically in a report/chart style format
- Request location updates from one or more TTU-2820s™
- Update and change the configuration of one or more TTU-2820s™

[\[edit\]](#)[\[top\]](#) 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.

[\[edit\]](#)[\[top\]](#) 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 TTU-2820™. Unlike the backend software, it has the option of talking directly to an TTU-2820™ 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](#).

[\[edit\]](#)[\[top\]](#) 3 Hardware Overview

[\[edit\]](#)[\[top\]](#) 3.1 Location Messaging Unit-TTU-2820™

[\[edit\]](#)[\[top\]](#) 3.1.1 TTU-2820™ 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 TTU-2820's™ main-board (i.e. sub assembly) by itself or in a partial housing proper ESD precautions should be taken. The handler should be in an ESD safe area and be properly grounded.

GPS Ceramic Patch Handling

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

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

Packaging

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

Electrical Over-Stress (EOS)

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

Storage and Shipping

One potential source of EOS is proximity of one TTU-2820™ GPS Antenna to another TTU-2820™ GSM Antenna. Should one of the units be in a transmit mode the potential exists for the other unit to become damaged. Therefore any TTU-2820™ GPS Antenna should be kept at least four inches apart from any active TTU-2820™ GSM Antenna or any other active high power RF transmitter with power greater than 1 Watt.

[\[edit\]](#)[\[top\]](#) 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.

[\[edit\]](#)[\[top\]](#) 3.1.3 Environmental Specifications

The TTU-2820™ 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-2820™ was subjected to standard tests defined by the Society of Automotive Engineers (SAE). The specific tests included temperature, shock, vibration, and EMI/EMC. These tests were performed by independent labs and documented in a detailed test report. In accordance with Appendix A of SAE J1113 Part 1, the Unit is considered a “Functional Status Class B, Performance Region II” system that requires Threat Level 3 Testing.

The following shows the environmental conditions the LMU is designed to operate in and the relevant SAE tests that were performed. No formal altitude tests were conducted.

Size

4.3" long x 3.2" wide x 1.6" high

110 mm long x 80mm wide x 40mm high

Weight

9.6 oz (272 g)

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

SAE Test: SAE J1455 Compliant

Mil Standard 202G and 810F Compliant

Ground vehicle environment with associated shock and vibration

Electromagnetic Compatibility (EMC/EMI)

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

FCC Part 15B Compliant

Industry Canada Compliant

EMC compliant for a ground vehicle environment

Operating Voltage Range

9 – 30VDC

Back-up Battery

3.8Ah mAh

4 Hour Charge Time

Power Consumption

Active Standby < 70mA at 12VDC

Radio Active Sleep <<TBD> at 12VDC

Deep Sleep < 2mA at 12VDC

GPS

50 channel WAAS capable GPS Receiver

2.5m CEP (with SA off)

-162 dBm tracking sensitivity

Communications (Comm)

Data Support

SMS, GPRS, CDMA 1xRTT or HSPA packet data

GSM/GPRS Quad-Band

850/900/1800/1900 MHz

GSM/GPRS Output Power

Class 4 (2 Watts) 850/900 bands

Class 1 (1 Watt) 1800/1900 bands

CDMA Dual-Band

800/1900 MHz

CDMA Output Power

800: +24dBm

1900: +24dBm

HSPA/UMTS Dual-Band

900/2100 MHz (bands VIII, I) or

850/1900 MHz (bands V, II)

3GPP release 6

5.6 Mbps upload, 7.2 Mbps download

GSM/GPRS Fallback

850/900/1800/1900 quad-band

GPRS class 12, EDGE MCS1-MCS9

RoHS Compliant

[\[edit\]](#)[\[top\]](#) **3.2 TTU-2820™ Connectors**

[\[edit\]](#)[\[top\]](#) **3.2.1 Primary Connector**

The TTU-2820™ uses 12 22AWG leads for its power and I/O connections. These leads are mapped as follows:

Wire	Signal Name	Description	Color	Input or Output
1	GND	Ground	Black	Ground
2	V _{CC}	Primary Power	Red	Input
3	IN-0	Input 0 – Ignition	White	Input
4	IN-1	Input 1 – Digital Input	Blue	Input
5	IN-2	Input 2 – Digital Input	Orange	Input

6	OUT-0	Ouput 0 – Starter Disable Relay Driver	Green	Ouput
7	OUT-1	Ouput 1 – Digital Output	Brown	Ouput
8	OUT-2	Ouput 2 – Digital Output	Yellow	Ouput
9	SER_OUT	Serial Output	Green\Black	Output
10	SER_IN	Serial Input	Blue\Black	Input
11	1BB	1-Bit Bus Data Line	White\Blue	Input
12	ADC	ADC Input	Pink	Input



TTU-2820™ Power and I/O leads

[\[edit\]](#)[\[top\]](#) 3.2.2 Serial Adapter

To add a host serial adapter to the TTU-2820™ there is 1 additional part:

- **Part Number [134074](#):** Serial Adapter.

To use this part, simply connect the following wires together on the screw block - red to red, black to black, orange to blue/black and yellow to green/black. Then connect the DB9 connector to your serial port.

[\[edit\]](#)[\[top\]](#) 3.2.3 Accessories

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

[\[edit\]](#)[\[top\]](#) 3.3 GPS Receiver

The TTU-2820™'s GPS receiver has the following specifications:

- 50 channel GPS receiver
- Accuracy: 2.5 meter CEP (with SA off)
- -162dBm Tracking Sensitivity

[\[edit\]](#)[\[top\]](#) 3.4 I/O Descriptions

The TTU-2820™ provides the following I/O:

Digital Inputs

- Input 0: Ignition Sense (Always biased low)
- Input 1: Generic Digital Input (high or low bias per S-158)
- Input 2: Generic Digital Input (high or low bias per S-158)
- Input 3: Not Available
- Input 4: Not Available
- Input 5: Motion Sensor (low = no motion, high = motion)
- Input 6: Power Switch State (low = external power, high = internal battery)
- Input 7: Battery Voltage Critical Sensor (low = VBatt ok, high = VBatt low. 3500mV threshold)
- Input 8: High Temperature Sensor (low = below Temp Threshold, high = above Temp threshold. Temp Threshold = 300)

Analog to Digital Inputs

- A/D 0: External Power Supply Monitor
- A/D 1: Generic External Analog to Digital Input
- A/D 2: GPS Antenna Monitor
- A/D 3: uP Temperature
- A/D 4: uP Voltage
- A/D 5: Battery Voltage
- A/D 6: Temperature Sensor
- A/D 7: Vcc Sys

Outputs:

- Output 0: Standard Open Collector Relay Output
- Output 1: Standard Open Collector Relay Output
- Output 2: Standard Open Collector Relay Output
- Output 3: Not Available
- Output 4: Power Supply Switch (cleared = switch to external power, set = switch to internal power)
- Output 5: Enable/Disable Battery charging (cleared = enable battery charging, set = disable battery charging)

[\[edit\]](#)[\[top\]](#) **3.4.1 Motion Sensor Input**

The TTU-2820™ supports an internal motion sensor as one of its discreet inputs. In this case, the TTU detects motion when the input is in the High state. If the TTU does not detect motion, then the input will be in the Low state. No external connections are required for this functionality to be operational.

[\[edit\]](#)[\[top\]](#) **3.4.2 Power State Input**

The TTU-2820™ can detect if it's using external power or if it's using its internal back-up battering. If the TTU-2820™ is using external power, this input will be in the Low state. If they have switched to the internal battery, then the input will register in the High state.

[\[edit\]](#)[\[top\]](#) **3.4.3 Battery Voltage Critical Input**

The TTU-2820™ has a built in low battery threshold of 3500mV, which is tied to a discreet input. If the battery level is above the threshold, then the input is in the Low state. If the battery level is below the threshold, the input will be in the High state.

[\[edit\]](#)[\[top\]](#) **3.4.4 High Temperature Input**

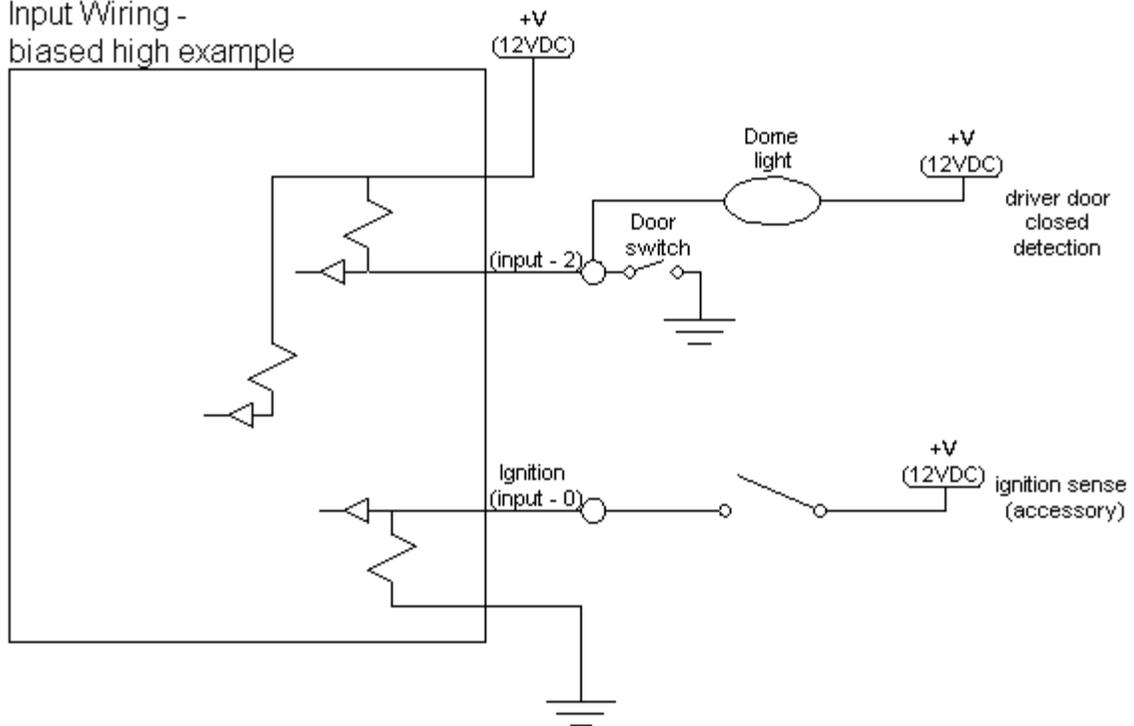
The TTU-2820™ has a built in high temperature threshold of 60° C. If the internal temperature of the TTU is above this value, then the input will be in the High state. If the TTU's temperature is below this value, then the input will be in the Low state.

[\[edit\]](#)[\[top\]](#) **3.4.5 Ignition and Inputs**

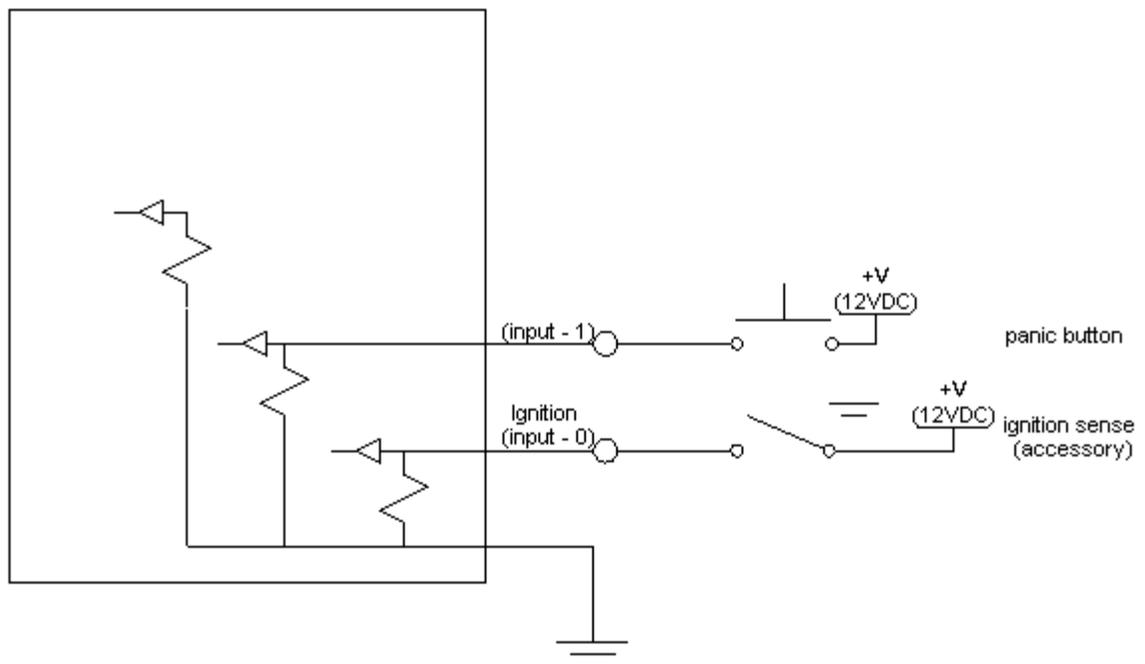
The TTU-2820™ provides up to 5 external inputs and one internal. The external inputs are protected from typical vehicle transients and can be directly connected to most vehicle level logical inputs from 4 volts up to the vehicle power input level (typically 12 VDC). Their input impedance is approximately 10kΩ. One of these inputs is dedicated to sensing the vehicle's ignition status to provide for flexible power management. The other two inputs may be used to sense vehicle inputs such as cooling unit operation, a hidden driver "Panic" switch, taxi on-duty/off-duty meter status or many others.

The ignition input is pulled to ground through the 10k resistance, where the other inputs can either be normally High (i.e. pulled to +12v through a 10k Ω resistor) or Low (i.e. pulled to ground through a 10k Ω resistor). Input 1 is always biased low, while inputs 2-4 are biased high. The diagrams below show how to connect the inputs in both a high and low-biased configuration:

Input Wiring -
biased high example



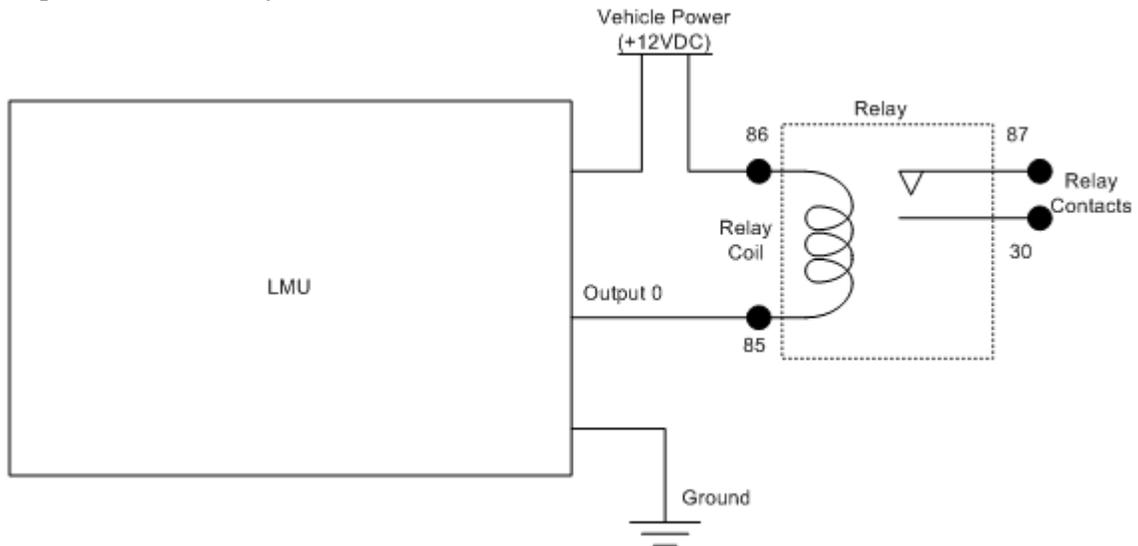
Input Wiring -
biased low example



Sample Input Wiring

[\[edit\]](#)[\[top\]](#) 3.4.6 Outputs

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



Sample Relay Wiring

External vs Internal Power Switch

This output allows the TTU to switch between power sources when certain conditions are met (e.g. low power on the currently selected supply). If this output is set then the TTU will use its internal battery as its power supply. If this output is cleared, the TTU will use the external power supply.

By default, this output is cleared so the TTU-2820™ will operate off external power.

Enable / Disable Battery Charging

This output allows the TTU to enable or disable the charging of its internal battery. If this output is set then the TTU will stop charging the internal battery. If this output is cleared, the TTU will charge the internal battery.

By default, this output is cleared (i.e. battery charging enabled)

[\[edit\]](#)[\[top\]](#) 3.4.7 Status LEDs

The TTU-2820™ is equipped with two Status LEDs, one for GPS and one for COMM (wireless network status). The LEDs use the following blink patterns to indicate service:

LED #1 (Comm LED - Orange) Definitions

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

LED #2 (GPS LED - Green) Definitions

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

