LMU-3640 Hardware & Installation Guide

LMU-3640™
Hardware and Installation Guide

Contents

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1 Introduction

Welcome to the LMU-3640™ Hardware and Installation Guide. This manual is intended to give you information on the basic setup and installation of the CalAmp LMU-3640™ product(s) including hardware descriptions, environmental specifications, wireless network overviews and device installation.

1.1 About This Manual

The LMU-3640™ 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-3640™ 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-3640™.
- **Hardware Overview** – Describes the physical characteristics and interfaces of the LMU-3640™.
- **Installation and Verification** – Provides guidance for the installation of the LMU-3640™ versions 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.

1. You are familiar with GPS concepts and terminology

2. You have some experience with installing equipment in vehicles
3. You are familiar with the use of AT Commands
4. 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 (http://www.calamp.com/) .

1.4 About the CalAmp Location Messaging Unit - LMU-3640™

The CalAmp Location and Messaging unit-LMU-3640™ is a mobile device that resides in private, commercial or government vehicles. The LMU-3640™ is a single box enclosure incorporating a processor, a GPS receiver, a wireless data modem, and a vehicle-rated power supply. The LMU-3640™ also supports inputs and outputs to monitor and react to the vehicular environment and/or driver actions..

The LMU-3640™ collects, stores and transmits vehicular and location data over a designated wireless network including LTE and HSPA. Vehicular and location data are transmitted to a customized software application that has been designed to receive, acknowledge, process, store, and respond to this data.

Unit location and vehicular information is sent at pre-determined intervals, on demand, or when pre-programmed vehicular conditions are met. Transmission of data are sent immediately when in wireless network coverage and stored for later transmission when out of the wireless coverage area. SMS messaging can be used as an alternative or redundant communication backup.

The LMU-3640™ is designed to support a variety of custom fleet applications starting with basic automatic vehicle location and including applications requiring more sophisticated features such as geo-fencing, speed and mileage monitoring, third party security monitoring, dynamic reporting routines, and an array of exception alerts.

LMU-3640™ are sold exclusively to authorized systems integrators, software firms, and service providers who have developed their offering around the capabilities of the LMU-3640™. Customers are trained by CalAmp to integrate the mobile device with their system and to assist in support and maintenance of the devices.

Installations of LMU-3640™ are performed by CalAmp customers or contracted installers. Typical installations include hook-up to power, ignition, and ground. LMU-3640™s and the corresponding wiring are almost always hidden from view and general access. Placement of the units is usually under dashboards, in trunks or in compartments.

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-3640™ 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-3640™
- 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™

Maintenance Path (CalAmp)
Inbound Path (Customer)
Debug Path (CalAmp/Customer)
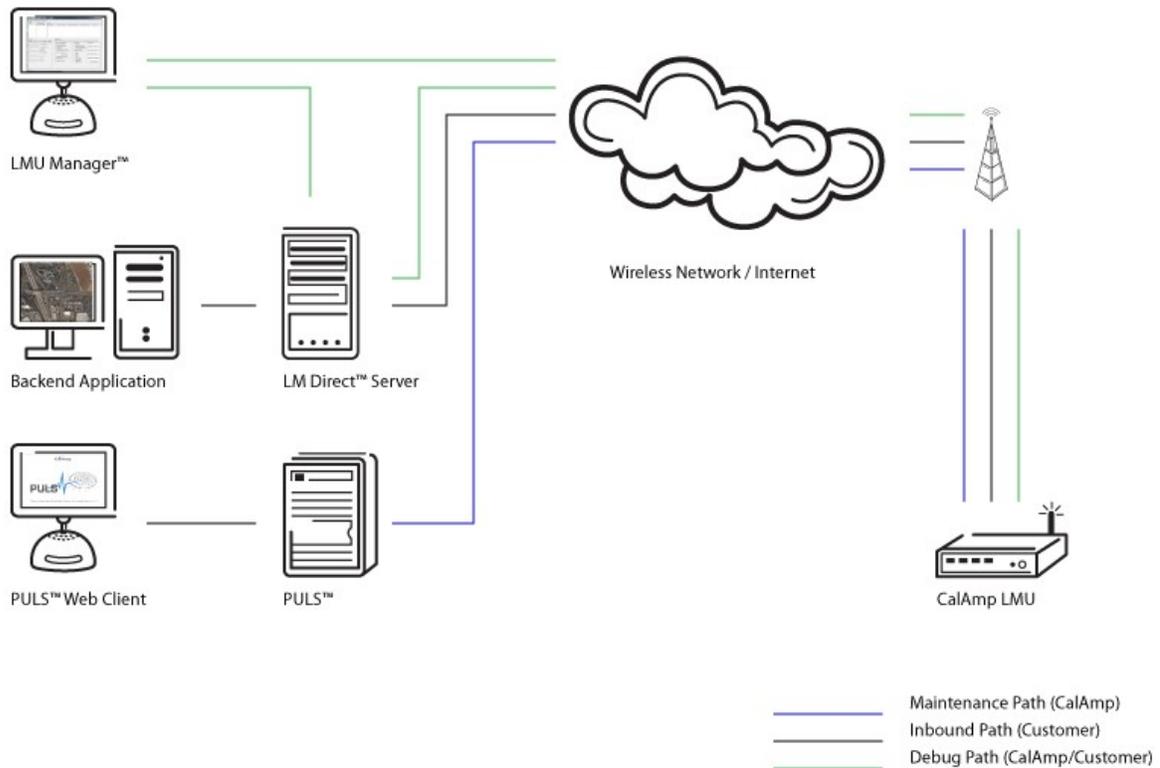
2.2 Component Descriptions

2.2.1 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 data base on reports received from the LMU-3640™ in a variety of formats.
- Present historic information received from the LMU-3640™ typically in a report/chart style format
- Request location updates from one or more LMU-3640™
- Update and change the configuration of one or more LMU-3640™

2.2.2 LMU Manager

LMU Manager is the primary support and configuration tool in the CalAmp system. It allows access to almost every feature available to the LMU-3640™. Unlike the backend software, it has the option of talking directly to an LMU-3640™ 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.

2.2.3 LM Direct Server

LM Direct is a message interface specification detailing the various messages and their contents the LMU-3640™ is capable of sending and receiving. This interface allows System Integrators to communicate directly with LMU-3640™s.

Sample code is available to system integrators upon request to aid in the development of an LM Direct Server.

2.2.4 Wireless Data Network

The Wireless Data Network provides the information bridge between the LM Direct server and the LMU-3640™s. Wireless data networks can take a variety of forms, such as cellular networks, satellite systems or local area networks. At this point in time, the networks available to the LMU-3640™ are:

- HSPA

- LTE

2.2.5 LMU-3640™

The LMU-3640™ is responsible for delivering the location and status information when and where it is needed. Data requests can come from any of the following sources:

- PEG™ script within the LMU-3640™
- A location or status request from the LM Direct server
- A location or status request from LMU Manager
- A request made from a host device such as a laptop, PDA or MDT

2.2.6 Host Device – Laptop/PDA or MDT

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-3640™ as a wireless modem as well as a vehicle-location device.

2.3 Wireless Data Primer

This section is meant to give an overview of the wireless data technologies employed by the CalAmp location products.

2.3.1 SMS (Short Message Service)

"The Short Message Service (SMS) is the ability to send and receive text messages to and from mobile telephones. The text can comprise of words or numbers or an alphanumeric combination. SMS was created as part of the GSM Phase 1 standard.(Excerpt taken from the GSM World website (http://www.gsmworld.com/technology/sms/intro.shtml#1))

SMS message are typically text based, though binary messages are possible and can range in size from 140 characters to 256 characters depending on the network being used.

3 Hardware Overview

3.1 LMU-3640™

3.1.1 Environmental Specifications

The LMU-3640™ 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, LMU-3640™s were 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-3640™ is designed to operate in and the relevant SAE tests that were performed. No formal altitude tests were conducted.

Temperature

Operating Temperature Range: -30° C to 75° C
Storage Temperature Range: -40° C to 80° C
SAE Test: SAE J1455

Humidity

95% relative humidity, 50° non-condensing
SAE Test: SAE J1455

Altitude

Operates at altitudes of up to 10,000 feet and can be stored safely up to 40,000 feet

Shock and Vibration

Ground vehicle environment with associated shock and vibration
SAE Test: SAE J1455
Mil Standard 202G and 810F

Bench-Handling (Non-Operating)

4 inch pivot drops on each of the faces on which it may be placed for servicing or installation.
SAE Test: SAE J1455, SAE J1113
Mil Standard 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 LMU-3640™ supports vehicles with 12 or 24 VDC systems including transients and electrical system noise.; this includes ranges from 9 to 30 VDC.
SAE Test: SAE J1455, SAE J1113

Backup Battery

The LMU-3640™ supports a Lithium-Ion 1000 mAh backup battery input to be used when primary power is lost; the supported voltage range is 9 to 16 VDC

Transient Protection

Input voltage transients typical of large trucks
SAE Test: SAE J1113 Part 11

Electrostatic Discharge (ESD)

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

Power Consumption

Average: 100mA at 13.8 VDC
Peak: 200mA for 50ms transmit burst (0.1% transmit duty cycle typical)
Stand By 20mA

3.1.2 Physical Specifications

Dimensions

5.7"(L) x 2.1"(W) x 1.3"(H)
145mm (L) x 53mm (W) x 33mm (H)

Weight

5oz (140g)

Operating Temperature

-30° C to +75° C (connected to primary power)
-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

Operating Voltage Range

The LMU-3640™ 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.

Power Consumption

Average: 70mA at 13.8 VDC
Deep Sleep: 7mA @ 12V
Sleep on Network (SMS): 10mA

3.2 LMU-3640™ Connectors

The LMU-3640™ offers 5 connectors to access power, I/O, serial communications and other expansion capabilities. These connectors are:

- **Primary Power Connector**
- **I/O Connector**
- **Serial Port Connector – Host/Aux1**
- **Serial Port Connector – Aux 2**

3.2.1 I/O Connector

The LMU-3640™'s features expanded power and I/O capabilities via its 24-Pin Molex 43045-2202 connector. Its pin-out is as follows:

*Refer to the Harness Diagrams page for more information on appropriate accessories for the LMU-3640™.

Pin	Signal Name	Description	Input or Output
1	Input 1	Input 1 – Digital Input	Input
2	Input 2	Input 2 – Digital Input	Input
3	Input 3	Input 3 – Digital Input	Input
4	Input 4	Input 4 – Digital Input	Input
5	ADC 1	Input 5 – Analog to Digital Input	Input
6	ADC 2	Input 6 – Analog Digital Input	Input
7	AUX1 TX	Input 7 – Digital Input	Input
8	AUX1 RX	1 Bit Bus Data (T)	Input
9	GND	1 Bit Bus Ground	Power
10	GND	1 Bit Bus Data (R)	Power
11	GND	1 Bit Bus Ground	Power
12	12V OUT SW	Output 0 - Starter Disable Relay Driver	Output
13	Input 0	Output 1 - Digital Output	Input
14	VCC 3V3 AUX1	Output 2 - Digital Output	
15	VCC 3V3 AUX2	Output 3 - Digital Output	
16	1BB T DATA	Output 4 - Digital Output	Input/Output
17	AUX2 RX	Output 5 - LED 1 Driver	Input
18	AUX2 TX	Output 6 - LED 2 Driver	Input
19	OUT 0	Analog to Digital Input 2	Output
20	OUT 1	Analog to Digital Input 3	Output
21	OUT 2	Analog to Digital Input 4	Output
22	GND	Analog to Digital Input 5	Power
23	VIN 1	Analog to Digital Input 4	
24	VIN 2	Analog to Digital Input 4	

3.2.2 VBUS Connector

The LMU-3640™'s features a 16-Pin Molex 43045-1600 connector to the vehicle bus. Its pin-out is as follows:

Pin	Signal Name	Color
1	J1708H	Brown
2	J1850-	White
3	CAN2L-11	Grey
4	K-Line_12/HD	Black/Red
5	J1708L	Red
6	CAN1L	Green
7	K/L-Line	Violet
8	Vcc In	Orange
9	SWCAN	Pink
10	J1850+	Black/White
11	CAN2H	Blue
12	GND	Black
13	GND	Black/Green
14	CAN1H	Yellow
15	ISO/K-Line	Blue/White
16	CAN2L-8	Green/White

3.2.3 Accessories

See the Harness Diagrams page for more information on LMU accessories, and supported products table.

3.3 GPS Receiver

50+ channel GPS receiver (with SBAS, DGPS)

Accuracy: 2 meter CEP (with SBAS)
Tracking Sensitivity: -162dBm
Acquisition Sensitivity: -148dBm

3.4 I/O Descriptions

The LMU-3640™ provides the following inputs and outputs (I/O):

Digital Inputs

Input 0: Ignition Sense (Always biased low)
Input 1: In-1 sel
Input 2: In-2 sel
Input 3: In-3 sel
Input 4: In-4 sel

Internal Inputs

Input 8: Motion Sensor
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 Wing Wake
Input 16: DB Wake
Input 17: Vbus Wake
Input 18: Pwr State 2
Input 19: Crank Detect

Analog to Digital Inputs

A/D 0: External Power Supply Monitor (VIN1)
A/D 1: Ext ADC1
A/D 2: EXT ADC2
A/D 3: HW Config
A/D 4: VIN2
A/D 5: VIN_VBUS
A/D 6: GPS Antenna Monitor
A/D 7: µP Temperature
A/D 8: Vref
A/D 9: Battery

Outputs:

Output 0: Out-0
Output 1: Out-1
Output 2: Out-2

Internal Outputs

Output 7: Pwr Switch
Output 8: Chrg Disable
Output 13: 12Vout Enable

3.4.1 3-Axis Accelerometer Input

The LMU-3640™ supports an internal 3 Axis Precision Accelerometer as one of its discreet inputs. When the LMU is moved in any direction, the associated input will be in the High state. If the LMU'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 Ignition and Inputs

The LMU-3640™ provides up to 7 inputs. These inputs are protected from typical vehicle transients and can be directly connected to most vehicle level logical inputs from 4 volts up to the vehicle power input level (typically 12 VDC). Their input impedance is approximately 10kO. One of these inputs is dedicated to sensing the vehicle's ignition status to provide for flexible power management. The other two inputs may be used to sense vehicle inputs such as cooling unit operation, a hidden driver "Panic" switch, taxi on-duty/off-duty meter status or many others.

The ignition input is pulled to ground through the 10k resistance, where the other inputs can be configured to be normally High (i.e. pulled to +12v through a 10k resistor) or Low (i.e. pulled to ground through a 10k resistor). The diagrams below show how to connect the inputs in both a high- and low-biased configuration:
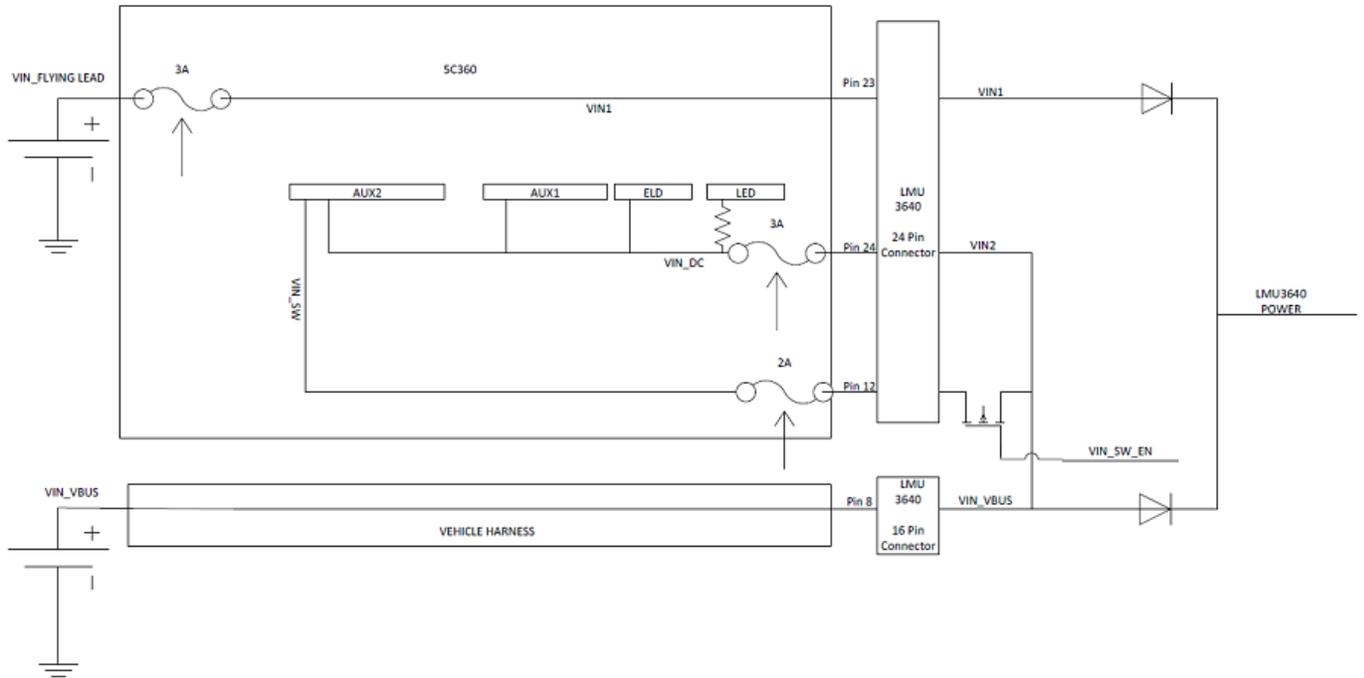
LMU-3640™ Input Wiring

3.4.3 Outputs

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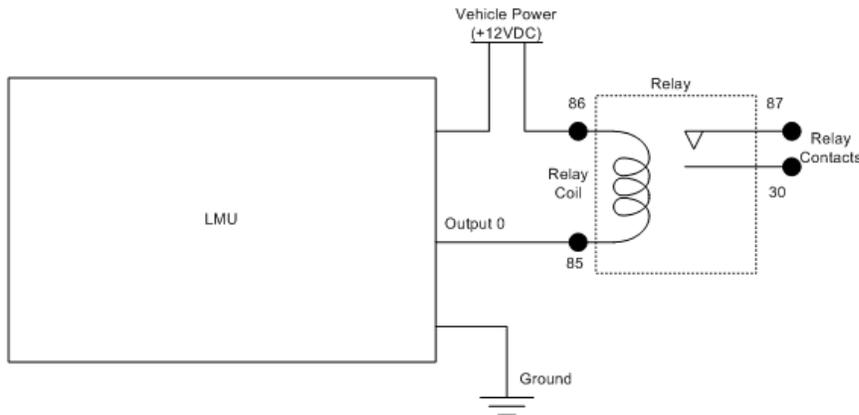
Sample Relay Wiring

3.4.4 Status LEDs

The LMU-3640™ is equipped with 3 Status LEDs; one for GPS, one for COMM (wireless network status), one for GPS, and one for WiFi. The LEDs use the following colors to indicate service:

Status LEDs

Status	Color
GPS	Green
Comm	Orange
WiFi/BT	Blue

4 Configuration and Activation

This section details how to quickly get an LMU-3640™ 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-3640™. (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-3640™.** 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 LMU-3640™s 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-3640™ and connect a serial cable from the LMU to your laptop
2. Open a terminal session to the LMU-3640™
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-3640™ and your handset
2. From the handset, send an SMS message to the LMU-3640™ phone number:

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: