TechnoCom™
Wireless Location Leaders

Making Wireless Location Happen™

Over any network,
on any device,
for any application,
in any industry.

LMU-4000
Hardware Installation Guide

Version 1.0
July 2005

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Regulatory Information

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.

TechnoCom Corp. certifies that it has determined that the LMU-4000 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 LMU-4000 is designed for and intended to be used in fixed and mobile applications. "Fixed" means that the device is physically secured at one location and is not able to be easily moved to another location. "Mobile" means that the device is designed to be used in other than fixed locations and generally in such a way that a separation distance of at least 20 cm is normally maintained between the transmitter's antenna and the body of the user or nearby persons. The LMU-4000is not designed for or intended to be used in portable applications (within 20 cm of the body of the user) and such uses are strictly prohibited.

To ensure that the LMU-4000 complies with current FCC regulations limiting both maximum RF output power and human exposure to radio frequency radiation, a separation distance of at least 20 cm must be maintained between the unit's antenna and the body of the user and any nearby persons at all times and in all applications and uses. Additionally, in mobile applications, maximum antenna gain must not exceed 3 dBi.

Table of Contents

INTRODUCTION

Welcome to the LMU-4000 Hardware and Installation Guide. This manual is intended to give you information on the basic setup and installation of the TechnoCom LMU-4000 products including hardware descriptions, environmental specifications, wireless network overviews and device programming.

About This Manual

The LMU-4000 is one of the most flexible fleet management hardware products available. In order to accurately describe the functionality of these units we have broken this manual into the following sections:

- **Section 1 — System Overview** - A basic description of a TechnoCom LMU-4000 based fleet management system. This includes a description of roles and responsibilities of each of the TechnoCom components as well as a brief overview of each of the wireless data technologies used by the LMU-4000.
- **Section 2 — Hardware Overview** - Describes the physical characteristics and interfaces of the LMU-4000.
- **Section 3 — Installation** - Provides several quick start guides for each version of the LMU-4000 which describe how to get the LMU-4000 provisioned and reporting to a given server.

Revision History

Version	Date	Author	Description
1.0	05/24/2005	STP	Initial Release

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 IP networking concepts such as ports and IP addresses
- You are familiar with GPS concepts and terminology
- You have some experience with installing equipment in vehicles

About TechnoCom

TechnoCom is a privately held company, founded in 1995 and a leading-edge provider of solutions to enable wireless location services and assure their ongoing performance. We offer location support, mobile resource management and advanced telematics solutions combined with related professional services to wireless operators, service providers, system integrators and government agencies. These solutions enable customers to manage their wireless location infrastructures and services, reduce operating and capital costs, deliver superior levels of service, increase productivity and rapidly deploy new revenue-generating services. In both 2003 and 2004, TechnoCom was named by Deloitte & Touche as one of the "Technology Fast 50" in the Los Angeles area, giving recognition to the fact we are an able competitor in the high technology sector — despite the challenges of a rapidly evolving industry and marketplace.

About the TechnoCom Location Messaging Unit-4000™ (LMU-4000™)

The TechnoCom Location and Messaging Unit-4000™ (LMU-4000™) is a mobile device that resides primarily in commercial or government vehicles. The LMU-4000 is a single box enclosure incorporating a processor, a GPS receiver, a wireless data modem, and a vehicle-rated power supply. The LMU-4000 also supports inputs and outputs to monitor and react to the vehicular environment and/or driver actions.

The LMU-4000 collects, stores and transmits vehicular and location data over a designated wireless network including iDEN™, CDMA2000 1x, GPRS, 900 MHz wireless, and others via IP/UDP. 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-4000 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-4000s are sold exclusively to authorized systems integrators, software firms, and service providers who have developed their offering around the capabilities of the LMU-4000. Customers are trained by TechnoCom to integrate the mobile device with their system and to assist in support and maintenance of the devices.

Installations of LMU-4000s are performed by TechnoCom customers or contracted installers. Typical installations include hook-up to power, ignition, and ground. LMU-4000s 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.

Section 1 – System Overview

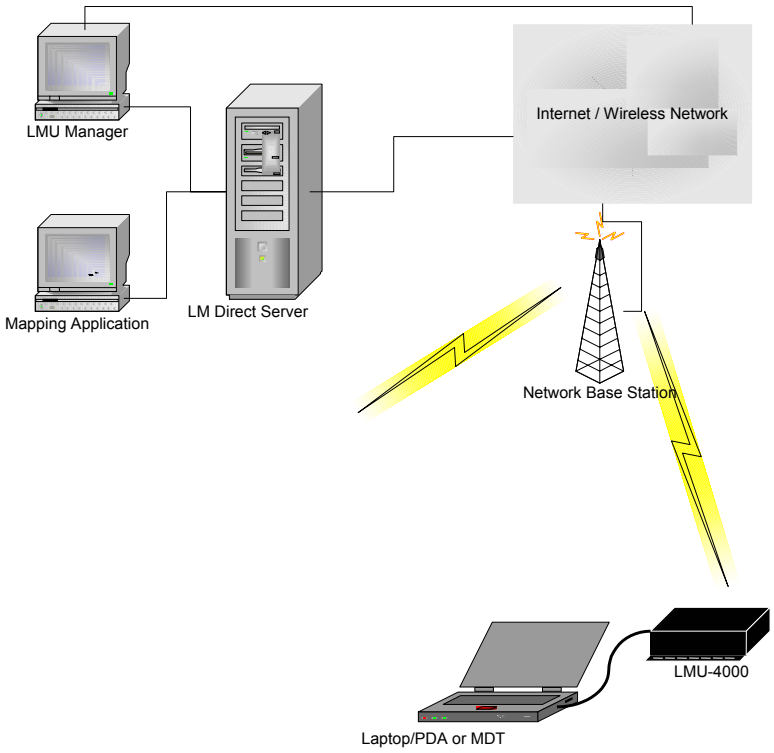
Overview

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 dependant on the capabilities of the vehicle management application. The role of the TechnoCom LMU-4000 is to deliver the location information when and where it is needed.

A typical fleet management system based on a TechnoCom device includes the following components:

- Backend mapping and reporting software which typically includes mapping and fleet reporting functions
- LMU Manager™
- An LM Direct™ communications server
- A wireless data network
- An LMU-4000
- Mobile Data Terminal (MDT)
- In-vehicle laptop (LMU Status™)



Component Descriptions

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-4000 in a variety of formats.
- Present historic information received from the LMU-4000 typically in a report/chart style format
- Request location updates from one or more LMU-4000s
- Update and change the configuration of one or more LMU-4000s

LMU Manager

LMU Manager is the primary support and configuration tool in the TechnoCom system. It allows access to almost every feature available to the LMU-4000. Unlike the backend software, it has the option of talking directly to an LMU-4000 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.

LM Direct Server

LM Direct is a message interface specification detailing the various messages and their contents the LMU-4000 is capable of sending and receiving. This interface allows System Integrators to communicate directly with LMU-4000's.

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

Wireless Data Network

The Wireless Data Network provides the information bridge between the LM Direct server and the LMU-4000s. 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-4000 are:

- iDEN™
- GPRS
- CDMA2000 1x

LMU-4000

The LMU-4000 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-4000
- 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

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-4000 as a wireless modem as well as a vehicle-location device.

Wireless Data Primer

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

iDEN

iDEN is a digital wireless communications technology developed by Motorola based on TDMA principles intended to increase capacity on existing analog SMR networks. The time slot spacing allows iDEN providers to offer such services as dispatch, interconnect phone, data, and text messaging. Data/Internet capable iDEN mobiles offer data rates of approximately 9600 bps.

Further information on iDEN can be found on the Motorola website:

http://www.motorola.com/LMPS/iDEN/

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."[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.

GPRS (General Packet Radio Service)

"The General Packet Radio Service (GPRS) is a new non-voice value-added service that allows information to be sent and received across a GSM mobile telephone network. It supplements today's Circuit Switched Data and Short Message Service. GPRS is NOT related to GPS (the Global Positioning System), a similar acronym that is often used in mobile contexts."[2]

GPRS is being deployed in its initial stages in approximately 52 countries around the world. Keep in mind that GSM frequencies change depending on where you are. In Europe, GSM sits in both the 900Mhz and 1.8GHz bands. In North America it sits in the 1.9GHz and 850 MHz bands. This means, that in order to roam with your GSM/GPRS mobile between countries, it needs to be able to operate on multiple frequencies.

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[1] Excerpt taken from the GSM World website (http://www.gsmworld.com/technology/sms/intro.shtml#1)
[2] Excerpt taken from the GSM World website (http://www.gsmworld.com/technology/gprs.html)

CMDA 1xRTT

"CDMA2000 1X technology supports both voice and data services over a standard (1X) CDMA channel, and provides many performance advantages over other technologies. First, it provides up to twice the capacity of earlier CDMA systems (with even bigger gains over TDMA and GSM), helping to accommodate the continuing growth of voice services as well as new wireless Internet services. Second, it provides peak data rates of up to 153 kbps (and up to 307 kbps in the future), without sacrificing voice capacity for data capabilities.

CDMA2000 1X phones also feature longer standby times. And because it's backwards-compatible with earlier CDMA technology, CDMA2000 1X provides an easy and affordable upgrade path for both carriers and consumers."[3]

[3] Excerpt taken from the Qualcomm website (http://www.qualcomm.com/cdma/3g.html)

Section 2 – Hardware Overview

Location Messaging Unit-4000 (LMU-4000)

Environmental Specifications

The LMU-4000 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-4000s 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 is designed to operate in and the relevant SAE tests that were performed. No formal altitude tests were conducted.

Temperature

CDMA2000 1x Operating Temperature Range: -20° C to 60° C
GSM Operating Temperature Range: -30° C to 60° C
iDEN Operating Temperature Range: -25° C to 60° C
Storage Temperature Range: -40° C to 80° C
SAE Test: SAE J1455

Humidity

5% to 95% relative humidity, 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
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-4000 supports vehicles with 12 or 24 VDC systems including transients and electrical system noise.; this includes ranges from 8.5 to 30 VDC.
SAE Test: SAE J1455

Backup Battery

The LMU-4000 supports a 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 10mA

Physical Specifications

Size

4.775" long x 3.5" wide x 1.5" high

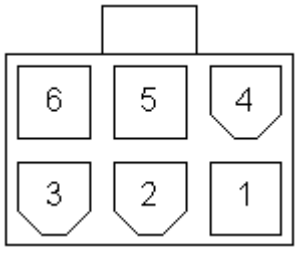
Weight

3/4 lbs.

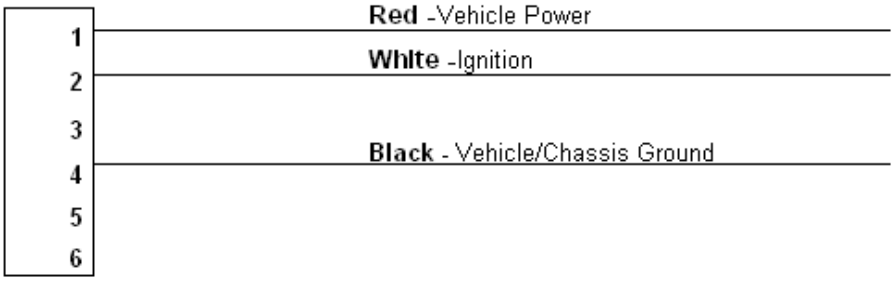
Primary Connector

The primary power and I/O functions are provided on the DF dual row 2 x 3 connector pin (male) located on the front side of the LMU-4000.

PIN	Signal Name	Description	Input/Output
1	Power	Primary power to the LMU 12V Nominal	Input
2	Ignition	Ignition/Input 0	Input
3	GPIO 1	Input 1 / Output 1 • 0, 12V level • Input/Output function software selectable • Active High/Low software selectable • 10K Ohm impedance	Input or Output
4	Ground	Vehicle or Chassis Ground	--
5	GPIO 2	Input 2 / Output 2 • 0, 12V level • Input/Output function software selectable • Active High/Low software selectable • 10K Ohm impedance	Input or Output
6	Output 0	Output 0: • 0, 12V level • Open Collector Active Low • 150mA Current limited	Output



Standard Wiring Harness



MOLEX
Mini-Fit JR. ™ Connector
Receptacle
5557d series dual row
Mouser Stock #:
538-39-01-2065

All wires are #18 AWG and
are stranded in one cable with
a sheath only.
10 Ft standard length

Expansion Interface

The expansion interface located on the back of the LMU-4000 is used to extend I/O functions and provide serial access to the LMU-4000. It should only be used with TechnoCom expansion harnesses.

GPS Receiver

- 16 channel GPS receiver
- Accuracy: 5 meter CEP (with SA off)
- Antenna connector: SMA
- Note that the TechnoCom LMU-4000 requires an antenna amplifier that operates at 3VDC; 5VDC amps will not work.

Available Radio Interfaces

- CDMA 1xRTT
- GPRS
- iDEN

RF Connector

- The LMU-4000's RF connector is TNC.
- The impedance is 50 Ohms nominal.

Section 3 – Configuration and Installation

Configuration Quick Start Guides

This section details how to quickly get an LMU-4000 provisioned and configured to point at a specific server. It is assumed that the default PEG script is sufficient for initial integration. This script sends an event report to the server every 60 seconds or every 1000 meters.

Please note that this section describes the manual provisioning process. In many cases a provisioning tool is available for the LMU-4000. Please refer to the provisioning tool's user manual for details.

We are making three assumptions to simplify the setup process:

1. You have installed and configured a server to receive messages from the LMU-4000.
2. You are using the standard wiring harness from TechnoCom and the serial port expansion harness.
3. You have created a hyperterminal session as described in Appendix A.

Quick Start — General Config

All LMU-4000s must go through a common set of steps during the configuration and provisioning process. These common steps are:

- Choosing a reporting format (LM Exchange or LM Direct)
- Pointing the LMU to the LM Exchange/LM Direct server, either via IP or a URL[4]

This configuration process is accomplished via a series of AT Commands.

1. Power up the LMU-4000
2. Plug the serial cable into your laptop
3. Open a terminal session to the LMU-4000
4. Choose the reporting format to be used

   LM Exchange users will enter the following command: `AT$APP INBOUND LMX`

   LM Direct users will enter: `AT$APP INBOUND LMD`

[4] This feature has been used and tested on CDMA 1xRTT, GPRS and iDEN networks throughout North and South America.

In both cases the LMU-4000 will respond with: `OK`

5. Next enter the location of the LM Exchange/LM Direct server. Again, this command will differ depending which messaging interface was selected.

   LM Exchange users will use: `AT$APP INBOUND ddd.ddd.ddd.ddd:20300`

   LM Direct users will enter: `AT$APP INBOUND ddd.ddd.ddd.ddd:20500` where `ddd.ddd.ddd.ddd` is the publicly addressable IP address of the server.

   The LMU-4000 will respond with: `OK`

6. If a URL has not be set up to point at the server address, the Inbound URL field must be cleared from the LMU-4000 with: `AT$APP PARAM 2319,0,""`

   The LMU-4000 will respond with: `OK`

7. Alternatively if a URL has been set up it may be programmed with:

   `AT$APP PARAM 2319,0,"myURL.MyCompany.Com"`

   Where "myURL.MyCompany.com" is the URL assigned to the server, the LMU-4000 will issue a response of: `OK`

The next step is to configure the LMU-4000 to allow it to register to the desired wireless network.

Quick Start — CDMA2000 1x LMU-4000

In order to use the CDMA2000 1x LMU-4000 you will need a CDMA2000 1x data account. When service is acquired, four pieces of information for each activation should be provided:

- A phone number (aka MIN)
- An SPC value (optional)
- A network username generally in the form of: <phonenumber>@MyCDMAProvider.com
- A network password

1. Connect the LMU-4000 as discussed above (i.e., power, GPS and RF antennas, serial cables, hyperterminal)
2. The first step is to program in the LMU-4000's phone number. This can be accomplished with: `AT$APP MODEM MIN <phoneNumber> <SPC>`

   The LMU will respond with: `OK`
   If the <SPC> value is omitted, the LMU-4000 will use 000000.

3. Next program the Username: `AT$APP PPP USER myUsername@MyCDMAProvider.com`

   Again the response should be: `OK`

   Lastly enter the network password: `AT$APP PPP PASSWORD "myPassword`

   The LMU-4000's response should again be: `OK`

4. Once configured, verify that the LMU-4000's modem has registered to the CDMA network. Enter: `AT$APP COMM STATUS?`

   The response should be similar to:

```
CDMA Registered:     Yes
Connection:          Yes
RSSI:                -80 dBm
Channel:             0
Band:Side:           Unsupported:A
Base Station ID:     0
Network ID:          0
System ID:           34463
```

```
ESN (Modem S/N:       2676319948 [9F8566CC]
Phone Number:         1234567890
```

If the CDMA registered value is No and/or the Connection value is No, it may be necessary to contact the CDMA provider to verify coverage, 1xRTT data service availability and account status.

Quick Start — GPRS LMU-4000

In order to use the GPRS LMU-4000 a GPRS service account is needed. When service is acquired the GSM/GPRS operator should provide a SIM card, possibly an SIM PIN number and an APN name. The SIM must be inserted into the LMU before the provisioning process can begin.

1. Connect the LMU-4000 as discussed above (i.e., power, GPS and GPRS antennas)
2. If one has been provided, the first step is to program the LMU with the SIM PIN:
   `AT$APP PIN 0000`

   Where 0000 is the PIN value as set by your GPRS operator, the LMU will respond with: `PIN: 0  OK`

3. Next program in our APN value. This is done with:
   `AT$APP GPRS CONTEXT 0 "IP:<apn name>"`

   Again the response should be: `OK`

   Note that a second APN can be programmed in with:
   `AT$APP GPRS CONTEXT 1 "IP:<apn name>"`

   Also note that the IP portion must be in upper case.

4. Lastly verify that the LMU-4000's modem has registered to the GPRS network. Enter:

   `AT$APP COMM STATUS?`

   The response should be similar to:

```
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:       0
Country Code:       310
IMEI (Modem S/N):   500167110060440
IMSI (SIM S/N):     310230100521849
Phone Number:
GPRS APN:           IP:INTERNET3.VOICESTREAM.COM
```

```
Quality of Srvc:    1,0,0,3,0,0
GSM Class:          B
```

If the `Registered` value is `No` and the GPRS APN value is correct it may be necessary to contact the GSM/GPRS operator to verify coverage and that the account is active.

Quick Start — iDEN LMU-4000

The iDEN LMU-4000 does not require any service specific provisioning parameters. Once service has been acquired, the only step needed is to verify activation.

1. Connect the LMU-4000 as discussed above (i.e., power and GPS antenna)
2. Verify that the modem has registered to the wireless network using:
   `AT$APP COMM STATUS?`

   The response should be similar to:

```
IDEN Service:       Yes
Packet Service:     Available, Registered, Idle
Connection:         Yes
RSSI:               -92 dBm
SQE:                26
Channel:            2468
Color:              2
Phone Number:       7604970444
CodePlug Ver:       0x0012
```

   If the `Connection` value is `No` it may be necessary to contact the iDEN service provider to verify coverage and that the account is active.

Installation Notes

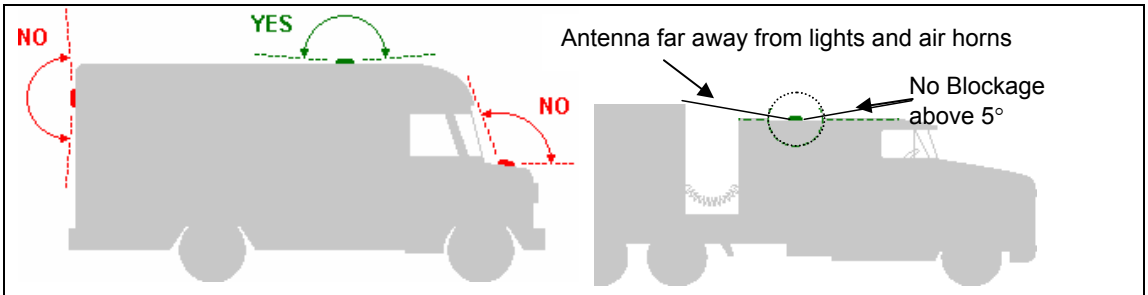
When installing the LMU-4000 into a vehicle, there are several factors to address. In general, installers will want access to the following pieces of equipment:

- The LMU-4000
- GPS Antenna - Through-hole or magnetic mount
- Cellular/PCS Antenna (LMU-4000 only) - 3dB gain whip, with either NMO or magnetic mount
- Standard wiring harness
- Optional I/O wire - 24 AWG, minimum (optional)
- Installation Tools – Tie wraps, wire nuts and electrical tape
- Serial port expansion cable
- Laptop or PC to configure the LMU-4000
- Vehicle wiring layout

First, verify that the power is configured correctly. It is essential that the power input (red wire) be connected to a constant (un-switched) +12 VDC or +24 VDC supply and that the ignition input (white wire) is connected to the vehicle ignition or another appropriate key operated line, such as ACCESSORY. Failure to do so may result in discharge of the vehicle battery.

Once power has been confirmed, install the GPS antenna. Placement of the GPS antenna is critical to proper operation of the LMU-4000. For the GPS receiver to accurately compute its location, its antenna must have a clear view of the sky. The best place to mount the GPS is usually on the vehicle's highest point (e.g., the roof of a car).

When installing the GPS antenna on a vehicle, make sure there are no obstructions close to the antenna that might block the view 360° to the horizon. Equipment such as an air horn or maker lights 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. The latter, of course, assumes that separate GPS and cellular antennas are used. Obviously that rule does not apply to combination antennas.



Examples of good and poor GPS antenna placement

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.

The cellular antenna used by the LMU for wireless service is a standard 3-dB gain whip. It mounts with standard mounts (i.e., through hole or magnetic mount) 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.

Typical installations will place the LMU-4000 under the vehicle dash board, in the trunk or in areas otherwise obscured from view. Keep in mind it is desirable to locate the LMU-4000 conveniently to allow future access after installation in case it is necessary to touch the unit. Installation positioning should also take into account the need for extra I/O, or if the LMU-4000 is to be connected to an MDT, PDA or laptop. To assist in mounting the LMU-4000, a simple template can be found in Appendix E.

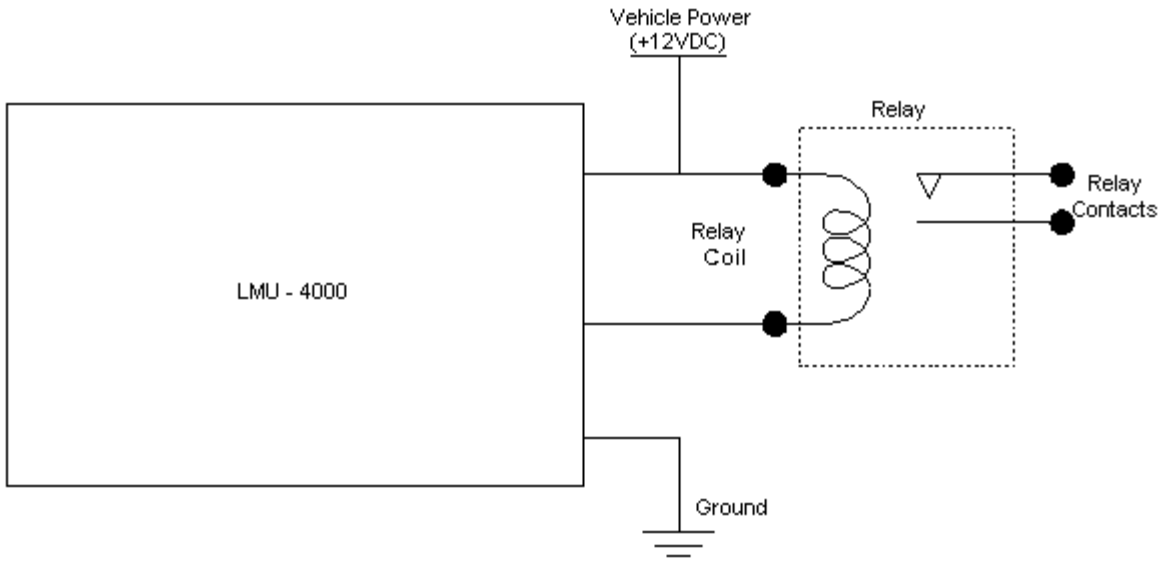
Once the unit is placed, connect the antennae and harness in the following order:

1. Attach the GPS antenna to the SMA connector
2. If you're using an LMU-4000, attach the cellular antenna to the TNC connector
3. Finally, plug in the 37 pin D-series connector

I/O Descriptions

Outputs

Pins 4, 5 and 6 provide outputs 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 a an output to drive a relay.

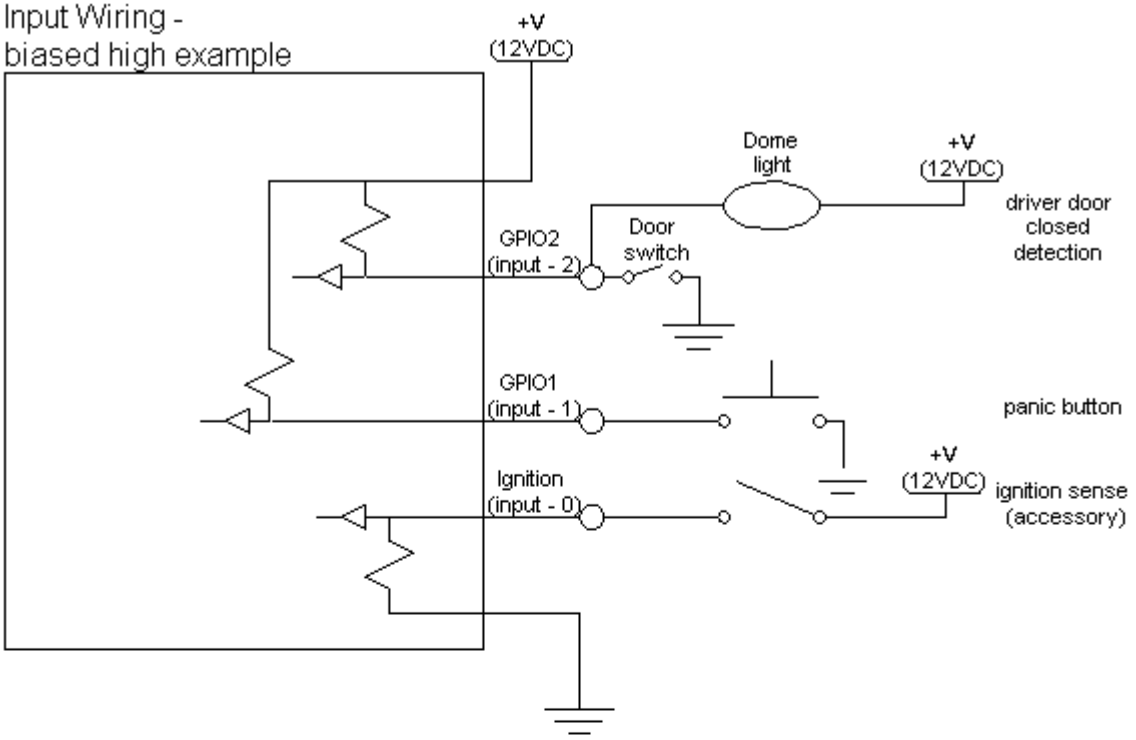


Ignition and Inputs

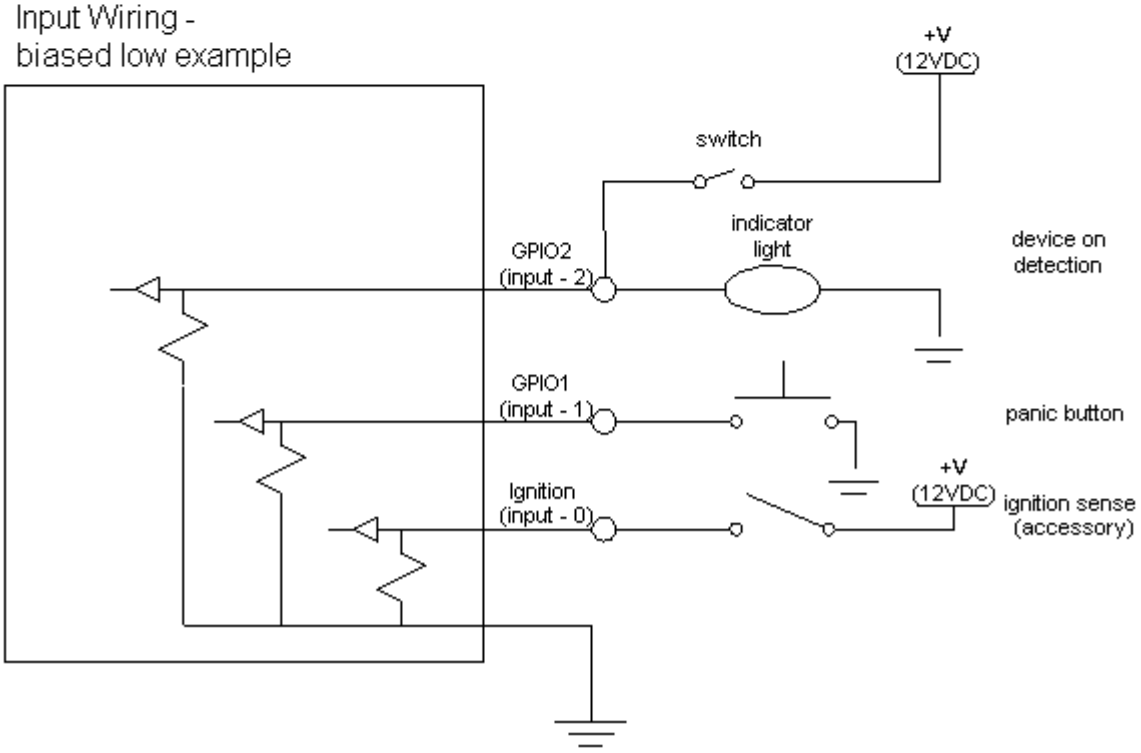
The LMU-4000 provides up to 3 inputs. These inputs are protected from typical vehicle transients and can be directly connected to most vehicle level logical inputs from 4 volts up to the vehicle power input level (typically 12 VDC). Their input impedance is approximately 10K Ω. One of these inputs is 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 or taxi on-duty/off-duty meter status.

The ignition input (pin 3) is pulled to ground through the 10k resistance, where the other two inputs (pins 5 and 6) can be configured to be normally High or Low. 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



Status LEDs

The LMU-4000 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) Definitions

Condition	LED 1
Modem Off	Off
Comm On - Searching	Slow Blinking
Network Available	Fast Blinking
Registered and Connected	Solid

LED #2 (GPS LED) Definitions

Condition	LED 1
GPS No-Fix	Off
GPS Fix	Blink followed by N short blinks, where N is the number of Satellites being tracked

Installation Verification

In many cases it is desirable to verify that an installed LMU-4000 is working properly. That is, installers should verify that the GPS and communications functions of the LMU-4000 are working properly before departing the installation site. In more robust cases, some key configuration settings such as the Inbound Address and URL should also be verified.

Note that these processes are all based on issuing AT Commands to the LMU-4000. It is expected that installers will have access to a serial port expansion cable and a laptop or PDA capable of a terminal connection.

Comm Verification

Installers should first verify that the LMU-4000 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 TNC antenna connector). If this LED is solid, then the LMU has registered to the network and established a data session.

If the LED is not visible, then Comm may be verified using an AT Command:

```
AT$APP COMM?
```

Depending on the wireless network being used, one of the following responses should appear:

```
iDEN RSSI:-91 Comm
```

```
GSM RSSI:-69 Comm
CDMA RSSI:-64 Comm
```

If any of the responses return `Not-Acquired` or `Not-Registered`, the wireless network operator should be contacted for further troubleshooting.

Please note that it may take several seconds for the LMU-4000 to communicate with the modem and acquire the wireless network.

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 blinking, then the LMU has found GPS service.

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

```
AT$APP GPS?
```

The response should be similar to:

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

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

Inbound Verification

The last item to verify is that the LMU-4000 is sending data to the correct server. In general, this is a two-step process that will need the aid of an observer on the back end. That is, a technician will have to be logged in so they can monitor data coming into the backend mapping/vehicle management application.

First, verify that the LMU-4000 is using the correct Inbound IP address by using:

```
AT$APP INBOUND?
```

The response should be similar to:

```
INBOUND LMD 63.200.203.51:20500
```

The installer will need to verify with the backend technician that the reporting type (LM Direct, vs. LM Exchange), IP address (<ddd.ddd.ddd.ddd>) and port (<ppppp>) are correct.

The second step is to verify that the LMU-4000 is sending data. The best way to do this is to force the LMU-4000 to send in an Event Report (i.e., its current GPS location) with the following command: `AT$APP PEG SUNRPT 255`

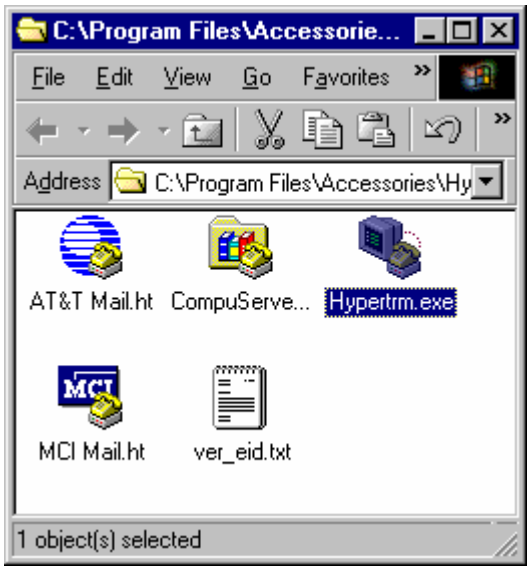
The LMU-4000 will respond with: `OK`

The backend monitor must then be contacted to confirm that they received an Event Report with Event Code 255.

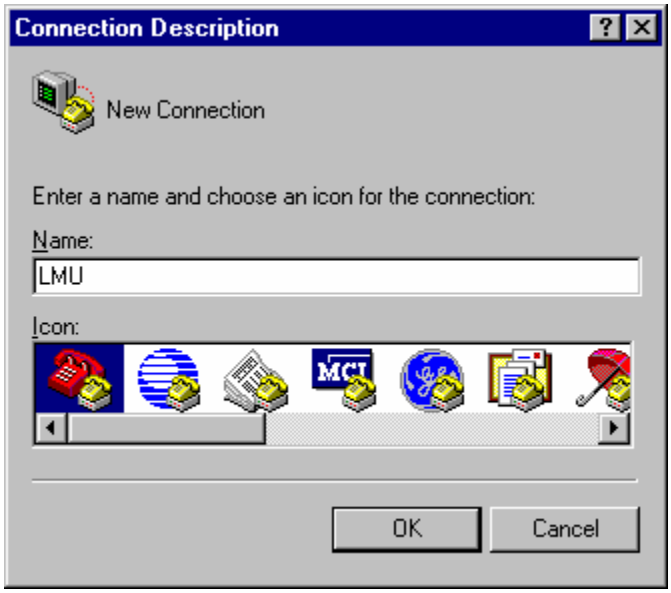
Assuming that all three sections have passed, the installation can be considered to be complete.

Appendix A – HyperTerminal Configuration

Click the **Start** button, go to **Programs, Accessories** and **Communications.**
Click the **Hyper Terminal** folder**.**

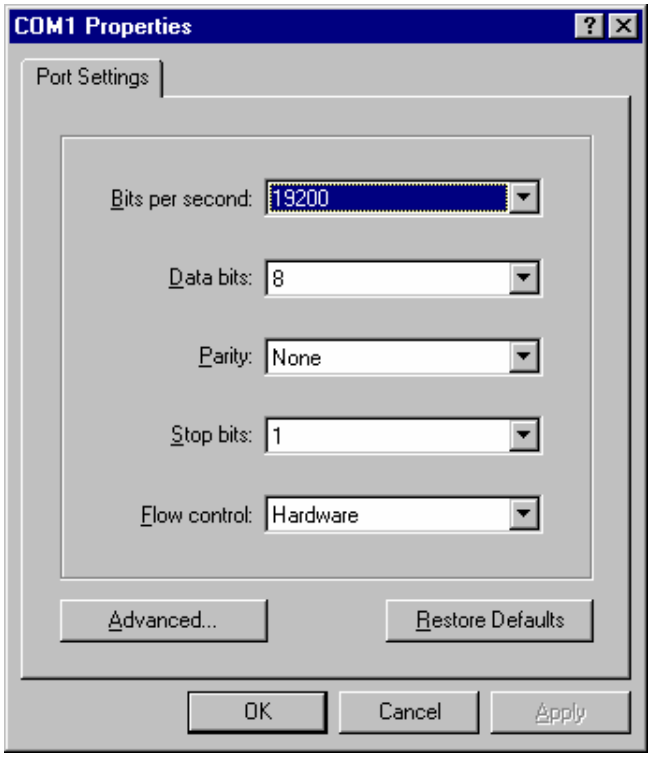


Double click the **Hypertrm.exe** icon



Name the connection **LMU**
Click **OK**.

Change *Connect using* to read **Direct to ComX**. Where X is the Com port that the LMU-4000 is attached to. This will probably be Com1.
Click **OK**.

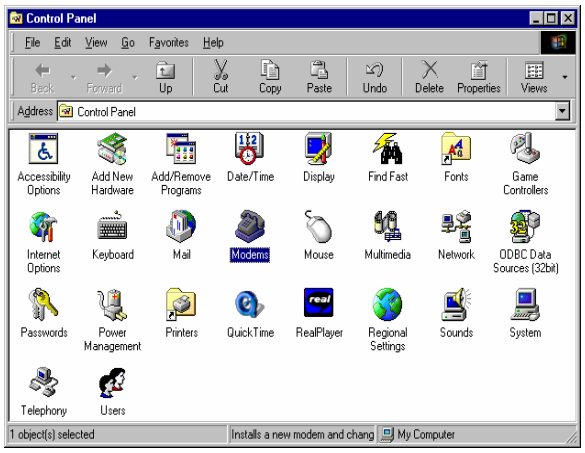


Change *Bits per second* to read **19200**.
Click **OK**.

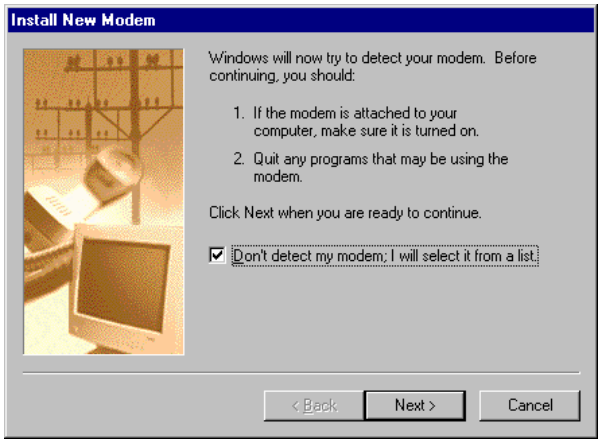
You should now be connected directly to the LMU-4000.

Appendix B – Install New Modem

Click the **Start** button, go to **Settings** and click **Control Panel.** Double click the **Modems** icon.

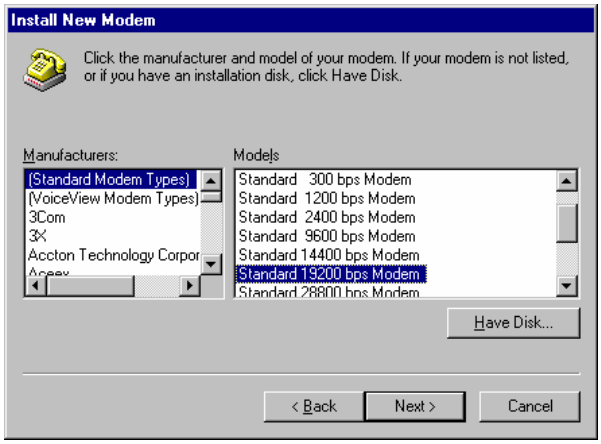


Click the **Add**… button
Check **Don't detect my modem; I will select it from a list.**



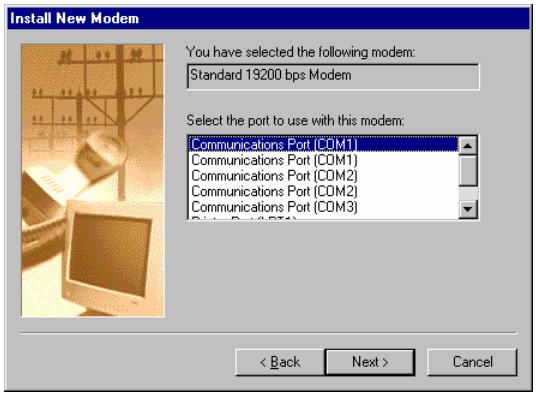
Click the **Next >** button.

Under *Manufacturers* choose: **(Standard Modem Types)**
From *Models* select: **Standard 19200 bps Modem**.

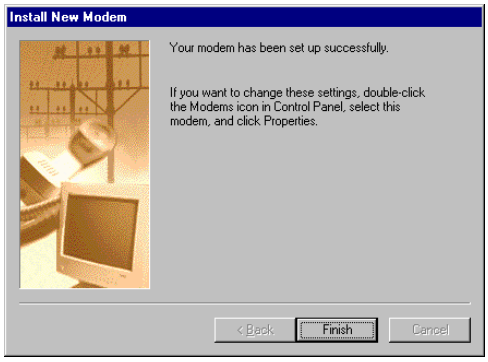


Click **Next >**

Select the Communications Port that will be used by the LMU-4000 (the most likely will be **COM 1**)



Click **Next >**.



When Windows has completed installing the modem, click **Finish**.

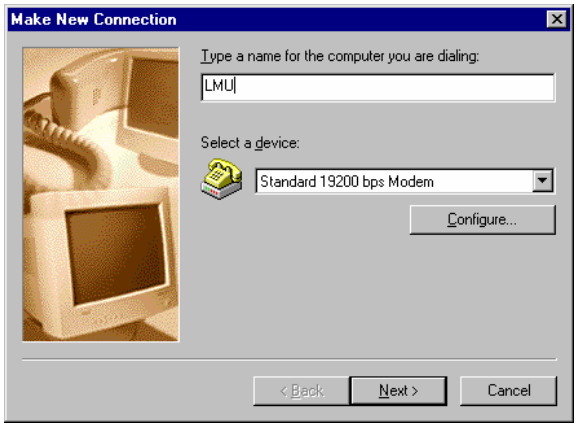
Appendix C – Configuring Dial-Up Networking

Create a New Connection

Go to **Start**, **Programs**, **Accessories**, **Communications,** and click **Dial-Up Networking**.

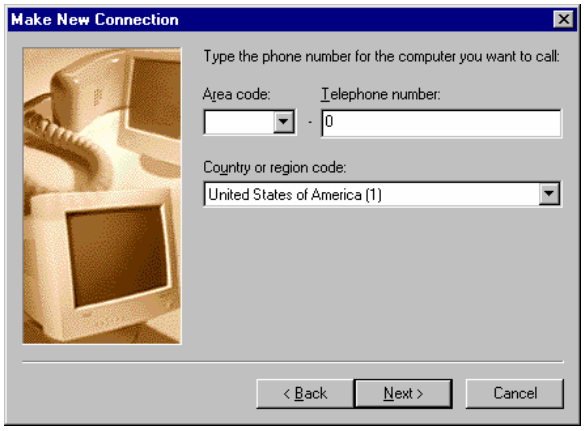
In the *Dial-Up Networking* window, double click the **Make New Connection** icon.

Name the connection **LMU** and select **Standard 19200 bps Modem** from the *Select a device* list.

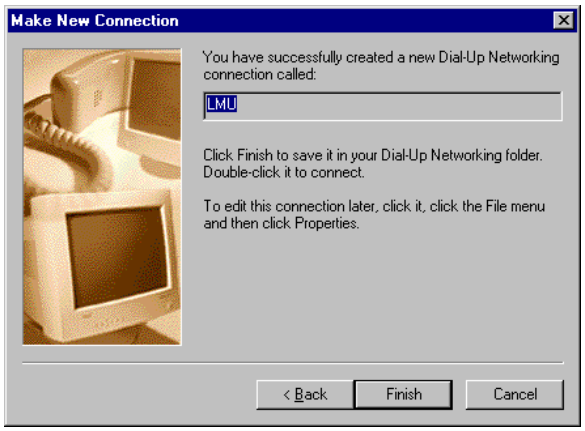


Click **Next >**.

Enter a telephone number of **0**. Ignore both the *Area code* and *Country or region code*.



Click **Next >**.

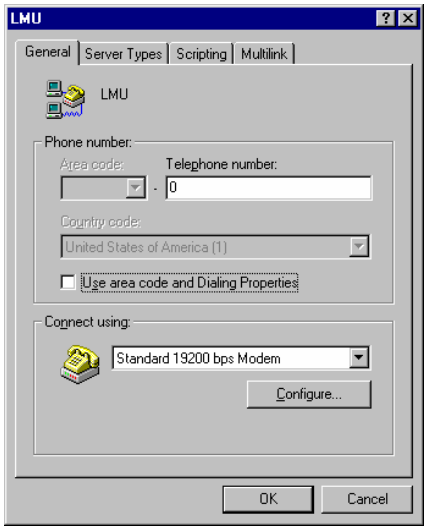


Click **Finish**.

Configure the Connection

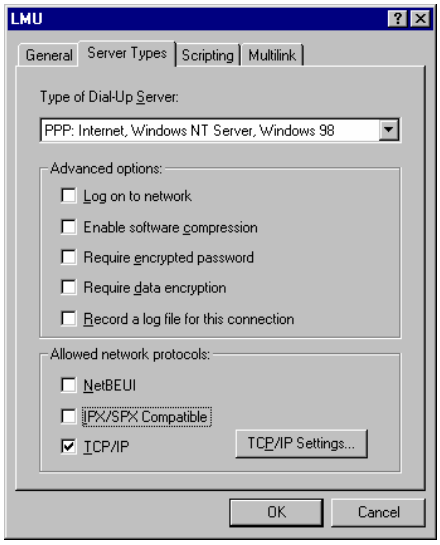
In the *Dial-Up Networking* window, right click *LMU* and choose **Properties**.

Uncheck **Use area code and Dialing Properties**



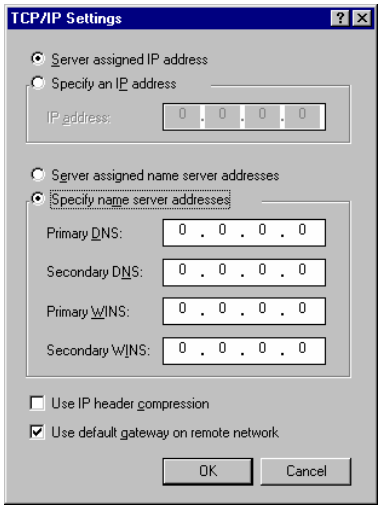
Click the *Server Types* tab.

Choose **PPP: Internet, Windows NT Server, Windows 98** as the *Type of Dial-Up Server*.
For *Advanced options and Allowed network protocols,* check only **TCP/IP**.



Click the **TCP/IP Settings…** button.

Click **Server Assigned IP Address**.
Click **Specify name server addresses**[5].
If available, enter the *Primary and Secondary DNS*.
Uncheck **Use IP header compression**.



Click **OK**.
Click **OK** to close the **LMU** window.

[5] The LMU-4000 was not intended to be an Internet access device, though it can be used as such. In order to accomplish this, at least a Primary DNS addresses is necessary. DNS addresses are generally supplied by the wireless service provider.

Connecting to the LMU-4000

In the *Dial-Up Networking* window, double click the *LMU* icon and click **Connect**. The *User name* and *Password* are not needed.

The connection should establish almost immediately.

To verify the connection is active, look for the Dial-Up Networking icon in the Task Tray.

Appendix D – Mounting Template