

Powerline MU

User Guide

PowerlineMU-UG-en
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*MOTOWI*⁴



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1 ABOUT THIS USER GUIDE

In future issues, this section will identify features, descriptions, and revisions that are new since the last previous issue of this document.

1.1 BECOMING FAMILIAR WITH THIS USER GUIDE

Quick Reference

The *Powerline MU User Guide* describes the following:

Table 1 Where to find information in this user guide

Planning and installing Powerline MU	Chapters 2 through 5
Configuring and maintaining Powerline MU	Chapters 6 and 7

Examples





Directions to commonly sought pieces of information are given as examples in [Table 2](#).

Table 2: Examples of where to find information in this user guide

If you want to know...	then see...
What Powerline MU devices are included in this manual	Section 2.2
How to plan your Powerline MU network	Chapter 3
How to install Powerline MU devices	Chapter 5

This document also employs a set of consistently used admonitions. Each type of admonition has a general purpose that underlies the specific information in the box. These purposes are indicated below.

Table 3: Admonition types

Admonition Label	General Message
	<p>NOTE: informative content that may</p> <ul style="list-style-type: none"> ◦ defy common or cursory logic. ◦ describe a peculiarity of the Canopy implementation. ◦ add a conditional caveat. ◦ provide a reference. ◦ explain the reason for a preceding statement or provide background for what immediately follows. <p>RECOMMENDATION: suggestion for an easier, quicker, or safer action or practice.</p>
	<p>IMPORTANT: informative content that may</p> <ul style="list-style-type: none"> ◦ identify an indication that you should watch for. ◦ advise that your action can disturb something that you may not want disturbed. ◦ reiterate something that you presumably know but should always keep in mind.
	<p>CAUTION! a notice that the risk of harm to equipment or service exists.</p>
	<p>WARNING! a notice that the risk of harm to person exists.</p>

1.2 GETTING ADDITIONAL HELP

To get information or assistance as soon as possible for problems that you encounter, use the following sequence of action:

1. Search this document, the user manuals that support the modules, and the software release notes of supported releases
 - a. in the Table of Contents for the topic.
 - b. in the Adobe Reader® search capability for keywords that apply.¹
2. Visit the Canopy systems website at <http://www.motorola.com/canopy>.
3. Ask your Canopy products supplier to help.

¹ Reader is a registered trademark of Adobe Systems, Incorporated.



4. Gather information such as
 - the IP addresses and MAC addresses of any affected Powerline devices.
 - the software releases that operate on these modules.
 - data from the Event Log page of the modules.
 - the configuration of software features on these modules.
5. Escalate the problem to Canopy systems Technical Support (or another Tier 3 technical support that has been designated for you) as follows. You may either
 - send e-mail to technical-support@canopywireless.com.
 - call 1 888 605 2552 (or +1 217 824 9742).

For warranty assistance, contact your reseller or distributor for the process.

1.3 SENDING FEEDBACK

We welcome your feedback on Canopy system documentation. This includes feedback on the structure, content, accuracy, or completeness of our documents, and any other comments you have. Please send your comments to technical-documentation@canopywireless.com.

2 OVERVIEW OF POWERLINE MU

Motorola Powerline MU Solution provides a broadband over low-voltage power line access solution that delivers reliable performance to multiple-dwelling units while mitigating interference by using low voltage wires. Motorola Powerline MU is designed for and works with the Canopy™ wireless broadband Internet platform. The standard Canopy system provides the broadband backbone for the system, creating a wireless transport system to the hotel, apartment building, or other multiple dwelling unit.

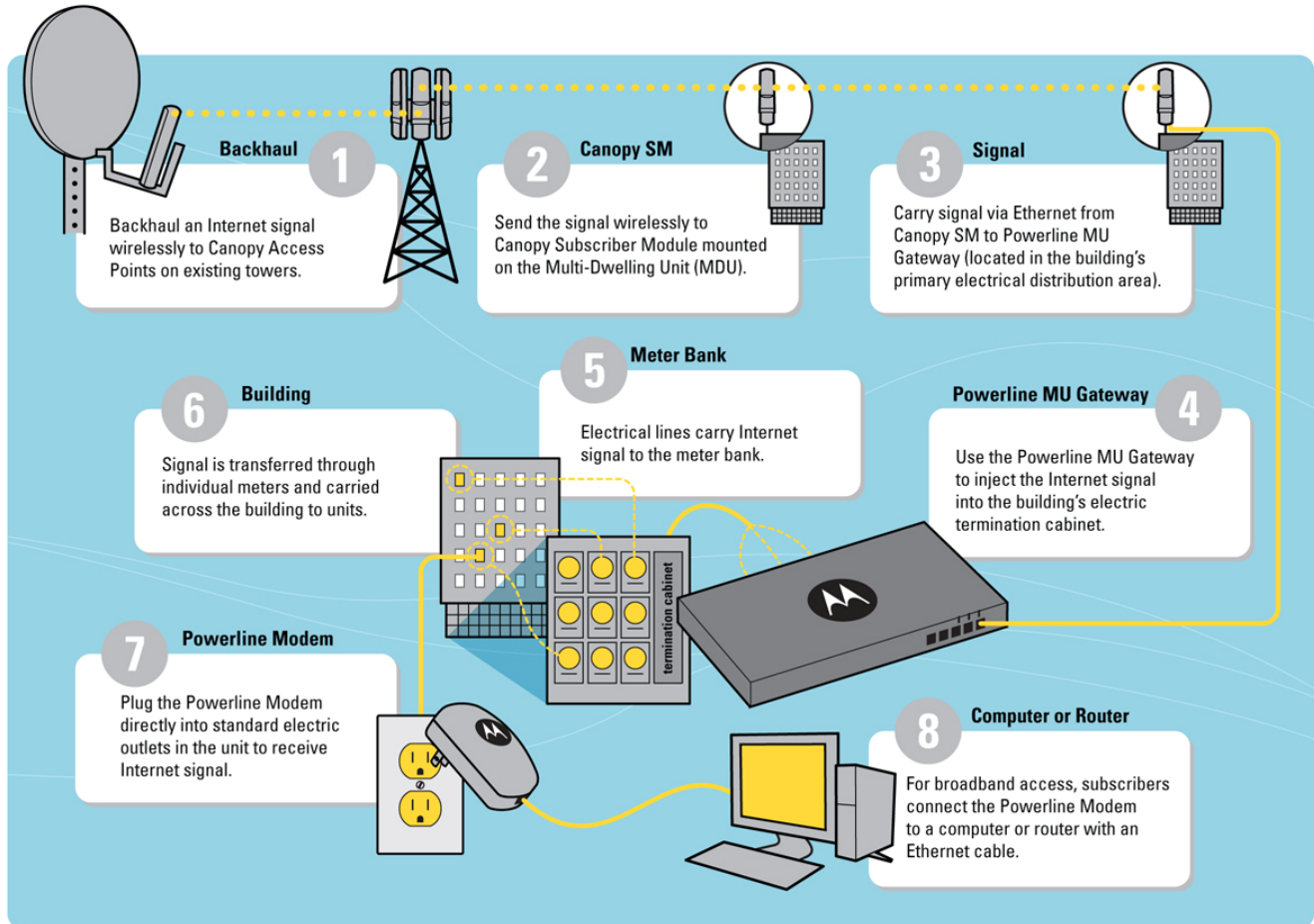


Figure 1 Powerline MU Network Overview

The Canopy Subscriber Module (SM) is the termination unit of the wireless part of the system and consists of a single transceiver that operates with a 60-degree antenna and communicates with one or more Access Points (AP). The synchronization and control of the SM is accomplished via the received AP signal. After the SM is turned on, it scans the channels and automatically registers with an AP.

The Category 5 Ethernet output cable from the SM plugs directly into the Powerline MU Gateway unit or via a Powerline MU Hybrid Adapter. Power to the SM is supplied by use of the SM "pigtail" electric cord. The integrated Subscriber Module (SM)-Powerline Gateway unit provides signal routing to the Modem devices within the home.

When the Gateway is connected to the low voltage side of the power transformer, digital data is transmitted over the power line. By using this technique and adding notch filtering



to Powerline MU carriers, the potential for radio frequency interference is significantly reduced, especially in the HF radio amateur bands.

Within the home or business, the Powerline Modem fits into any standard AC power outlet and performs the power line to Ethernet conversion, using the same circuitry as the Powerline MU Gateway. An Ethernet cable from the Modem to a computer or router completes the connection.

The Powerline Modem uses the HomePlug® protocol and can coexist without interference in the same home, but retail HomePlug units cannot take the place of the Powerline Modem

Careful planning of the Canopy wireless segment of your Powerline MU system is essential to a successful completion of the network. See “Designing Your Canopy Network” in the *Canopy System User Guide*. Follow that guide carefully to achieve a strong signal at the subscriber modules in the Powerline MU network.

2.1 POWERLINE MU FEATURES

2.1.1 Security

Powerline MU provides **the following security solutions:**

- **User ID and Password** - The default User ID is **admin**. The default Password is **Motorola** (case sensitive). We recommend these be changed when the system is deployed to help prevent unauthorized users from accessing the system. This can be done both locally and via Prizm. A factory reset will change them back to the defaults.
- **Authentication (Requires Prizm)** - The recommended Authentication method is via Motorola's Prizm EMS. In addition to monitoring and maintaining the Powerline equipment, it can also be used for MAC-based authentication for both the MU and end users. Much like Canopy today, Powerline MU devices can be managed via Prizm.
- **Encryption** - Data on the Powerline MU network is encrypted using 56-bit Data Encryption Standard (DES), the HomePlug standard. This prevents any HomePlug modem from establishing a connection on the network that does not have the correct Network Encryption Key (NEK). Not only will the modem not be able to connect to the network, the data packets will not transmit out of the Ethernet port of the modem to attempt to be decrypted.
- **Modem isolation** - There are two levels of Modem isolation:
 - A. The first is Virtual Local Area Network (VLAN) tagging. When a Modem is plugged in, it tries to communicate with a Gateway. If the NEK is correct, the Gateway and the Modem establish one to one Powerline VLAN communication. This is internal to the Gateway, so the VLAN ID can be viewed but cannot be changed without requiring a Gateway reconfiguration. This prevents modems on the network from having access to data on other modems.
 - B. The second is in the Modem itself. The modem by default acts as a router. It requests a DHCP address on the WAN side for management purposes. It also has a DHCP server for the LAN side so the PC or other device will obtain a private IP address. In addition, Network Address Translation (NAT) is on, so each modem (and PC or system under that modem) are on their own private IP network. The modem addressing can be set to static and NAT turned off if that is the way the network has been designed.



These multiple layers of security have been implemented to ensure the security of the Powerline MU system.

2.1.2 Bandwidth Management

Individual modems may be set for downlink and uplink sustained rates. The network operator can also select one of eight levels of Quality of Service (QoS) for all traffic to and from that modem or can use three Type of Service (ToS) bits (three higher order DSCP bits), which are part of the IP header, to determine QoS of individual packets.

In either case, eight indicated priorities map to 4 classes of service, using the scheme recommended in 802.1D. See QoS screen, Figure 44 Advanced Packet Priority.

If QoS is set manually using the Web page then it will be added as a part of the VLAN tag, not part of the IP header.

2.1.3 Network Operations

Powerline MU provides IP address configuration, NAT configuration, and DHCP configuration for manually or automatically obtaining IP addresses.

By default, NAT is enabled in the Modem.



2.2 POWERLINE MU PRODUCTS

The following products are available for Powerline MU networks.

Product Name	Part Number
Powerline Modem (US Plug)	0171486N01
Powerline Modem (Type C Plug)	0171486N03
Powerline MU Modem (Type G Plug)	0171486N14
Powerline MU Gateway (US Plug)	0171486N11
Powerline MU Gateway (Type C Plug)	0171486N04
Powerline MU Gateway power cord (Type G Plug)	0171486N19
Powerline MU Gateway 3 capacitive cords (Type G Plug)	0171486N20
Powerline MU Hybrid Adapter (US Plug)	0171486N02
Powerline MU Hybrid Adapter (Type C Plug)	0171486N08
Powerline MU Panel Extender	0171486N07
Powerline MU Inductive Coupler 500	0171486N21
Powerline MU Inductive Coupler 100	0171486N22
Powerline MU Inductive Coupler 250	0171486N23
Powerline MU Inductive Coupler 750 (available Q4, 2007)	TBD

2.3 ORDERING EQUIPMENT PLUG TYPES

For the Modem and Hybrid Adapters, a plug type must be specified, which will determine the appropriate part number. See Appendix A for plug types by country to validate your choice. US Plug and Type C plug Gateways ship with one 6-foot power cord and three 3-foot coupling cords of the respective plug type. For Gateways using G or I plugs, one matching power cord and one matching coupling cord kit must be specified by plug type and ordered in addition to the Type C plug Gateway.

If, however, you plan to install the Gateway using inductive couplers, you need only order the appropriate power cord.

Before ordering inductive couplers, please see the size chart in section 4.2.3.



3 Planning the Powerline MU Network

The Powerline MU network consists of three major design considerations:

- **Canopy** wireless devices
- **Powerline MU** devices
- **Electrical distribution** within the building

3.1 CANOPY WIRELESS

Careful planning of the Canopy segment of your network is essential to successful installation. Measure distances carefully and examine the physical constraints around the power line installations.

A site survey questionnaire is posted at <http://motorola.canopywireless.com/support/library/?region=1&cat=8>

Install Canopy devices, including Backhauls (BH) as needed, Access Points (APs), Cluster Management Modules (CMMs) as needed, and Subscriber Modules (SMs) according to installation information provided in the *Canopy System User Guide*.


3.2 POWERLINE MU

The Powerline MU section of the network consists of the following Motorola Powerline products:


- **Powerline Modem – CPE and Powerline-to-Ethernet adapter**

	<p>In Package:</p> <ul style="list-style-type: none"> 1 Powerline Modem 1 Ethernet Cable
-------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------


Powerline MU Gateway – Head-end and controller for Powerline network

	<p>In Package:</p>	
<p>1 Powerline MU Gateway</p>	<p>8 wood screws for mounting on board or wall</p>	
<p>1 6' (1.8 meters) power cord</p>	<p>8 anchors for mounting on dry wall or plaster</p>	
<p>3 3' (.9 meters) capacitive injection cords</p>	<p>6 small screws for attaching mounting brackets to Gateway</p>	
<p>2 mounting brackets</p>		


- **Powerline MU Hybrid Adapter -- Optional Twisted Pair adapter for utilizing unused phone lines for Gateway to Canopy Radio connectivity**

	<p>In Package:</p> <p>1 Powerline MU Hybrid Adapter</p> <p>1 CD for changing the name and NEK of the device</p>
-----------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------

- **Powerline MU Panel Extender – Accessory to provide coupling between four separate low-voltage distribution panels**

	<p>In Package:</p> <p>1 Powerline MU Panel Extender</p>
------------------------------------------------------------------------------------	----------------------------------------------------------------

Powerline MU Inductive Couplers – Accessory to provide inductive coupling between the Powerline MU Gateway and electrical termination cabinets.

	<p>In Package:</p> <p>1 Powerline MU Inductive Coupler</p> <p><i>Three sizes available August, 2007</i></p> <p><i>See size chart in section 4.2.3.</i></p>
-------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------

3.3 CONNECTING THE CANOPY NETWORK TO THE GATEWAY

Internet feed to the Gateway must be considered before the Gateway location is decided.

3.3.1 Ethernet from SM to Gateway

The simplest connection is from the Canopy Subscriber Module (SM) via shielded Ethernet cable directly to the Gateway. Use straight-through shielded outdoor Ethernet cables that adhere to Category 5 and 5e (TIA/EIA 568-B). *The SM must be plugged into an AC outlet, as it does not get power over the Ethernet cable.*



This connection may not be possible because of distances limitations (100 meters) or structural obstacles.

3.3.2 Ethernet from SM to Powerline MU Hybrid Adapter to Powerline MU Hybrid Adapter to Gateway

Connect the SM to a Powerline MU Hybrid Adapter plugged in to an AC outlet. Use a straight-through shielded Ethernet cable that adheres to Category 5 and 5e (TIA/EIA 568-B). Connect a telephone wire to the RJ11 jack on the Powerline MU Hybrid Adapter and run the telephone wire over existing twisted pair telephone wires to another Hybrid Adapter that is near the Gateway.

Connect the second Hybrid Adapter to the Gateway using the same kind of Ethernet cable defined above.

3.4 BUILDING ELECTRICAL CONSIDERATIONS

Most buildings have the same basic layout electrically. They all have a main feed that is then distributed to the customer premise.

3.4.1 Main Planning

You will need to involve the **building manager**, a **qualified electrician** and, perhaps, the local **utility** and a **local inspector**, depending on local regulations and where you connect the Gateway.

3.4.2 Owners of Electrical Equipment

The meter or the meter bank is usually the separation between the utility (line side) and the customer (load side). In multiple units buildings (MUs), the building typically owns all of the equipment all the way to the transformer outside the building, except the meters. The utility owns the meters and the outside transformer and must be included in plans that involve gaining access to these devices.

NOTE: Typical Powerline MU installations do not require gaining access to those devices.

3.4.3 Gateway Location

Choose the location for the MU Gateway(s) and discuss with the building management who needs to be involved.

The closer you connect to the customer premise, the better, but remember that you will want to connect to the point that serves the most customers with the least signal loss.

Determine the location of the broadband entrance point, which is the Internet access device, such as the Motorola Canopy SM.

Determine how to connect the Gateway to the Internet access device:

- Ethernet (from the Motorola Canopy SM)
- Ethernet via fiber
- Powerline MU Hybrid Adapter using telephone wiring
- Other Ethernet connection

4 Installing Powerline MU



WARNING!

A qualified electrician is required to connect the Powerline MU Gateway to the electrical panels in the building.



NOTE:

Every effort has been made to use diagrams, symbols, wiring colors and labels that are accepted universally across all countries. In cases where that is impossible, North American references are used in this documentation.

The following steps will guide you with your installation:

1. Gather information

You will need to gather information about the electrical system in the building in order to design your network.

- Locate all distribution points and electrical panels on the electrical diagram. These areas provide optimal locations for Gateway placement.
- Locate any electricity (power) meters or electricity (power) meter banks.
- Identify which areas of the building are powered by each panel.
- Identify all electrical closets and risers.
- Determine potential connectivity from the panel locations to the main Internet access point, including telephone cable and conduit access.

2. Find or create an electrical diagram of the building.

Electrical diagrams, which provide details of the building's electrical layout, are typically available from the property manager or electrician. Perform a site survey to know where all the power panels are located and determine how you will connect the gateways to the Internet access point. Be sure you know who has to be involved from an electrical connectivity standpoint; utility, building owner, etc.

It is a requirement of the standard for electrical installations in buildings that a diagram chart or schedule is provided, giving details of the installation. Thus such a diagram should be available, and if any modifications are made when installing the Powerline MU, they must be recorded.

If no electrical diagram is available, however, create one. The following symbols are often used to denote various electrical devices and connections. Symbols may differ according to the country of local code where the Powerline MU is being installed. For example, "Ground" is called "Earth" in some countries. The symbols used in various countries can be found on the International Electrotechnical Commission (IEC) website (www.iec.ch).

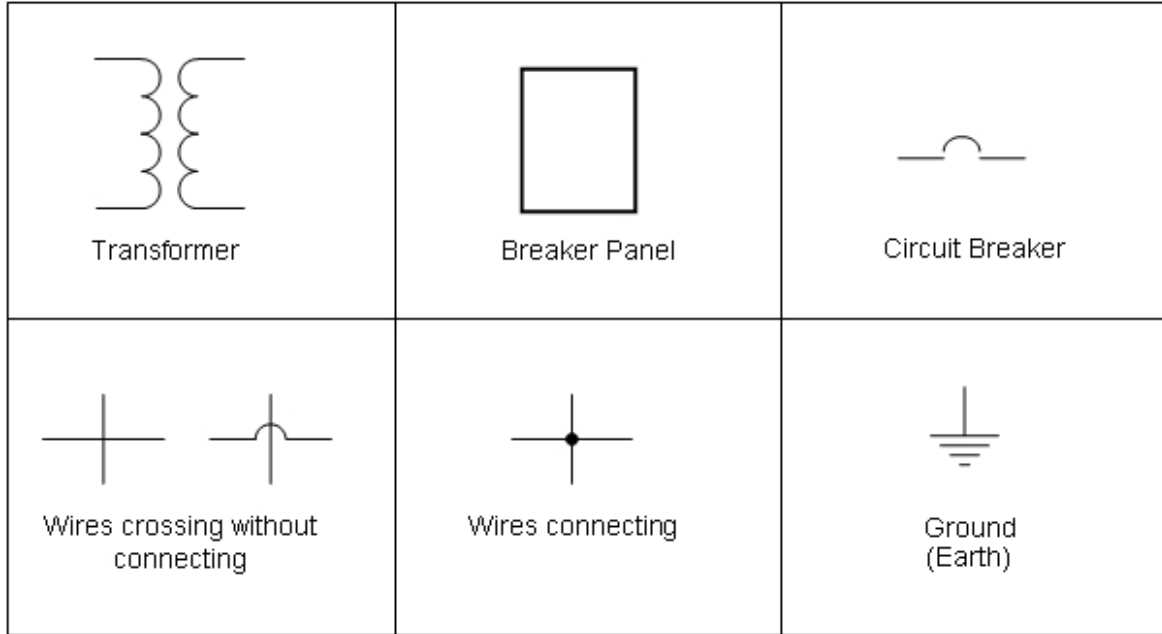


Figure 2 Electrical Symbols

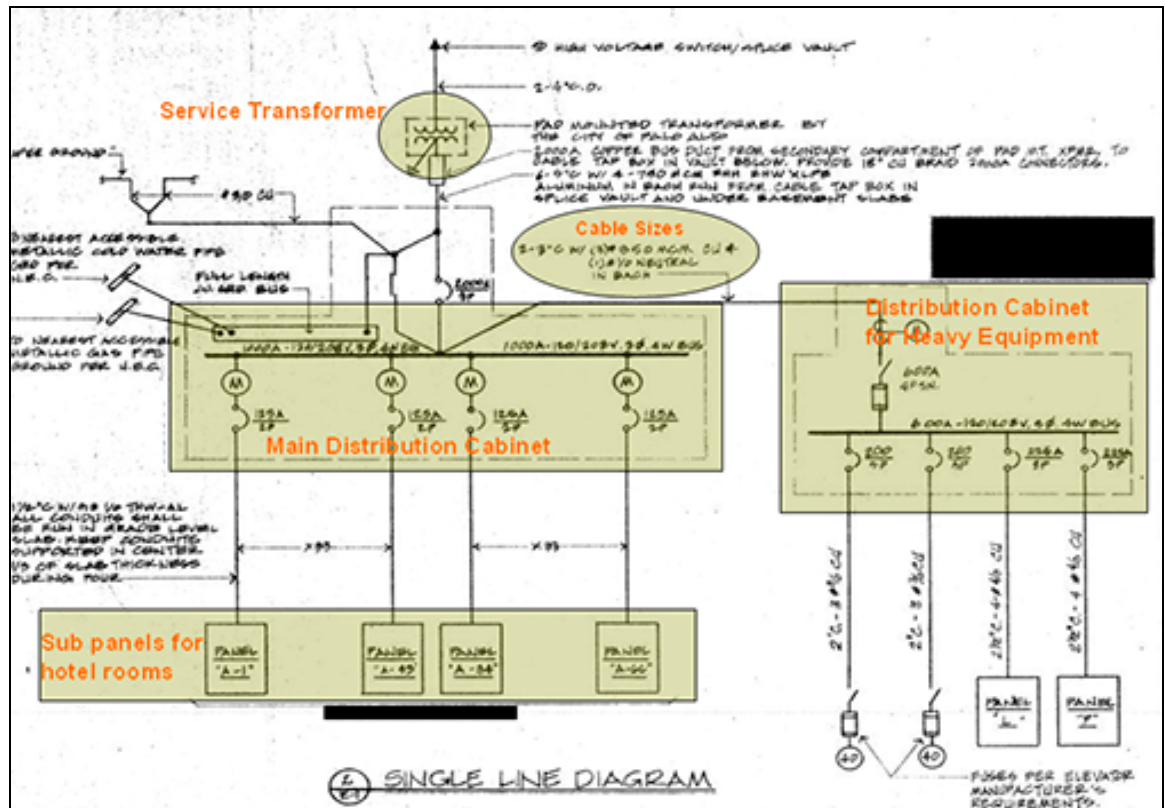


Figure 3 Sample Diagram A

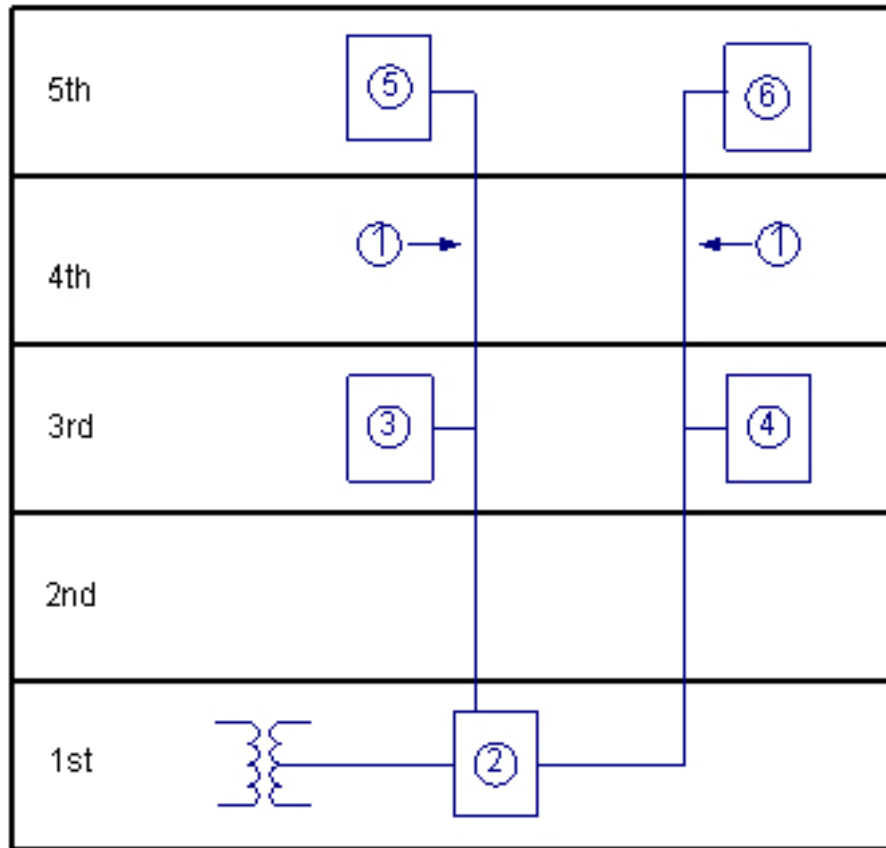


Figure 4 Sample Diagram B

Legend	
(1) 3 Phase, 4 Wire	(4) Sub-panel 2 (Sub-distribution Board goes to rooms 211-220 and to rooms 311-320)
(2) Main Panel (Main Distribution Board)	(5) Sub-panel 3 (Sub-distribution Board goes to rooms 401-410 and to rooms 501-510)
(3) Sub-panel 1 (Sub-distribution Board goes to rooms 201-210 and to rooms 301-310)	(6) Sub-panel 4 (Sub-distribution Board goes to rooms 411-420 and to rooms 511-520)

If you create an electrical diagram, include the following information:

- Determine the feeder routes for the electrical distribution.
- Note locations of all distribution points, electrical panels and meter banks.
- Diagram which rooms are connected to which location.
- Include dimensions of the building.
- Note the number of floors.
- Include the dimensions of each floor.
- Note the number of rooms per floor.



3. Choose the location(s) for the Gateway (s)

Choose the best location(s) for the MU Gateway or Gateways. Select locations that place the Gateways as close to the users as possible. The gateway also must be close to the power panel where the network signal will be coupled to the AC distribution.

As with all networking equipment, you should make sure that the area where you are mounting the equipment has proper ventilation and is not too hot.

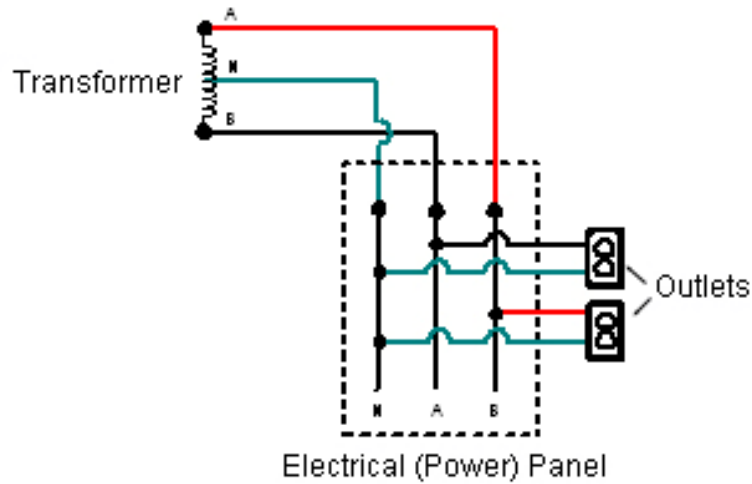
4. Determine the location of the broadband access router.

5. Determine how to connect the Gateway(s) to the Internet access device.

- Ethernet
- Hybrid Adapter using telephone wiring
- Wireless
- Powerline with different encryption key

4.1 TWO-PHASE (SINGLE-PHASE) INSTALLATION

Some apartment buildings may be wired for two-phases only, with a single phase to each apartment. For this type of building, follow instructions for mass-metered installation and connect only two outlets to the Gateway.

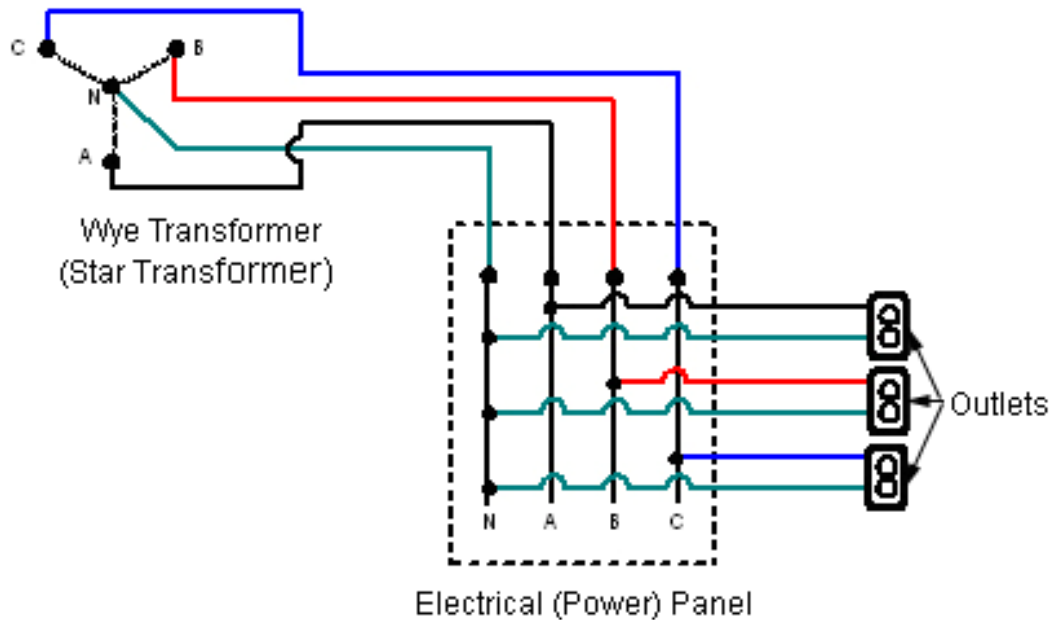


US colors are shown here. In other countries, the colors may be different. The electrical (power) panel is sometimes called a distribution panel.

Figure 5 Two-phase installation

4.2 THREE-PHASE INSTALLATION

Most large buildings are served by three-phase electrical service.



European colors are L1=Brown, L2=Black, L3=Grey, N=Blue. In some countries the electrical (power) panel is called a distribution board.

Figure 6 Three-phase installation

Commercial building installations will fit in one of the following categories:

- Mass Metered
- Individually Metered, single or three-phase
- Multiple Transformer

4.2.1 Mass Metered

Mass-metered electrical distribution is typically found in hotels, dormitories, and some older apartments. These have one meter where the power enters the building, followed by a large distribution panel that distributes electricity to other smaller sub or breaker panels, to the rooms or a combination of both.

You must have a qualified electrician install an AC outlet for each low-voltage phase in the electrical panel for the building. This can be up to three phases.

In the UK and Ireland, former codes required a two-meter distance between outlets on different phases. While this is no longer considered necessary, some electricians may prefer that installation. If so, to accommodate the length of the injection cords, install the outlets in a triangular design so that the Gateway is in the middle and post a caution sign that the outlets are for use with the Powerline MU Gateway only.

Place the Gateway on a secure table or shelf, or mount it in a rack or on a wall or board.

Plug a capacitive injection cord from each phase outlet to the phase jacks in the Gateway. (*The capacitive injection cords are power cords, but they do not draw power.*)

Plug a power cord from the AC Power jack in the Gateway to an AC outlet (see illustration).

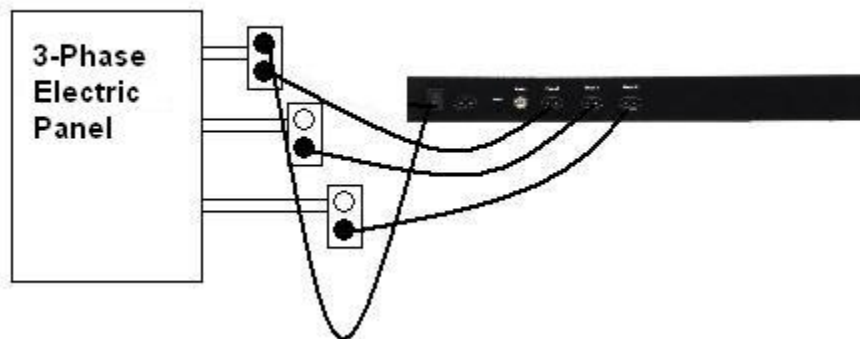


Figure 7 Mass-metered installation

4.2.2 Using a Panel Extender (multiple electrical panels)



Figure 8 Wiring the Panel Extender

To wire the Panel Extender, open the housing and connect 10- or 14-gauge wires as shown in Figure 8.

Figure 9 Wiring the Panel Extender

Pay careful attention to the "Signal Out" and Signal In" labels. The "Signal Out" ports are isolated so that the RF signal can pass from the "Signal In" port through the "Signal Out" ports, but the AC power cannot, so be sure to connect the newly created outlets to the "Signal In" port.

Figure 9 Wiring the Panel Extender



WARNING! You must have a qualified electrician install the Panel Extender(s). The installation should be carried out in accordance with local codes. This may include mounting the Panel Extender inside an enclosure with conduit affixed to the enclosure, or using 4-core cable and cable glands.

Once connected, if the product is opened up or in any way mishandled, a risk of electric shock exists. Installers should insure the Panel Extender is not easily accessible; for example, housing the device in a locked enclosure.

Create new electrical outlets by extending each phase (typically three) plus neutral from the first breaker panel. These outlets will be where the Gateway injects the signal onto the electrical grid. Use unused breakers if available.

Extend four wires (each phase plus neutral) from the newly created outlets to the "Signal In" port on the Panel Extender. Again, this can be done with the same type of wire used to create the outlets. Refer to local code for conduit and wire size requirements.

Extend four wires (each phase plus neutral) from the Panel Extender "Signal Out" ports to up to three additional breaker panels. Four wires will need to be installed and run for EACH additional breaker panel that is connected. At the subsequent breaker panel, directly connect the other end of the wire to a breaker on each phase, remembering to also connect the neutral. Again, use unused breakers if they are available.

The ideal place to connect the Powerline MU Gateway is at the primary breaker panel that feeds the outlets where signal is needed. Often, there will be additional breaker panels in the same room or on adjacent floors that service additional outlets where signal is needed. Signal can be injected into up to four breaker panels simultaneously with the use of one Panel Extender.

NOTE: The Panel Extender can only connect breaker panels off of the same transformer. Be sure that the SAME phases are connected to each other through the Panel Extender. This can be done with off the shelf electrical testing equipment and by your qualified electrician.

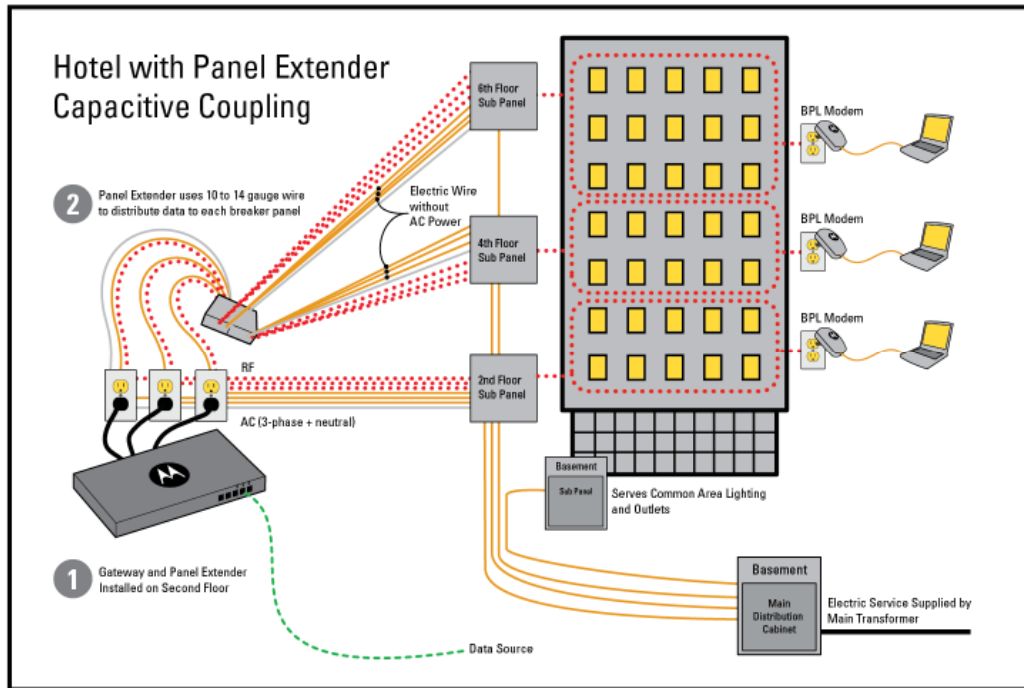


Figure 10 Mass Metered Building with Panel Extender Capacitive Coupling

4.2.3 Individually Metered

Typically found in apartments and condominiums, the individually metered building is sometimes referred to as "Garden Style." The electrical distribution will have a large distribution area, typically located in the basement of the building, followed by one or more areas that break off to meter banks. Meter banks are groups of meters that individually monitor power consumption per user premise.

Installation of Powerline MU in individually metered buildings may be accomplished using capacitive coupling or inductive coupling. The ideal way to install Powerline MU in an individually metered building is with inductive coupling, which typically requires less time because there is no need to create additional outlets and provides better signal penetration because there is less area for signal loss to occur.

Inductive Coupling



WARNING! You must have a qualified electrician install Inductive Couplers. Be sure to use proper safety gear, including properly rated electrical gloves and eyewear. Also be sure to follow the National Electric Code and any local codes that may apply.

Take care not to drop the open coupler onto bare wire.

Install Powerline MU Inductive Couplers in the termination cabinet. A typical termination cabinet will consist of cables coming from the transformer outside (line side), a large fuse breaker, then cables connecting to bus bars that feed the meter bank or banks (load side). Installing the couplers as close to the load side as possible will generate the best signal.

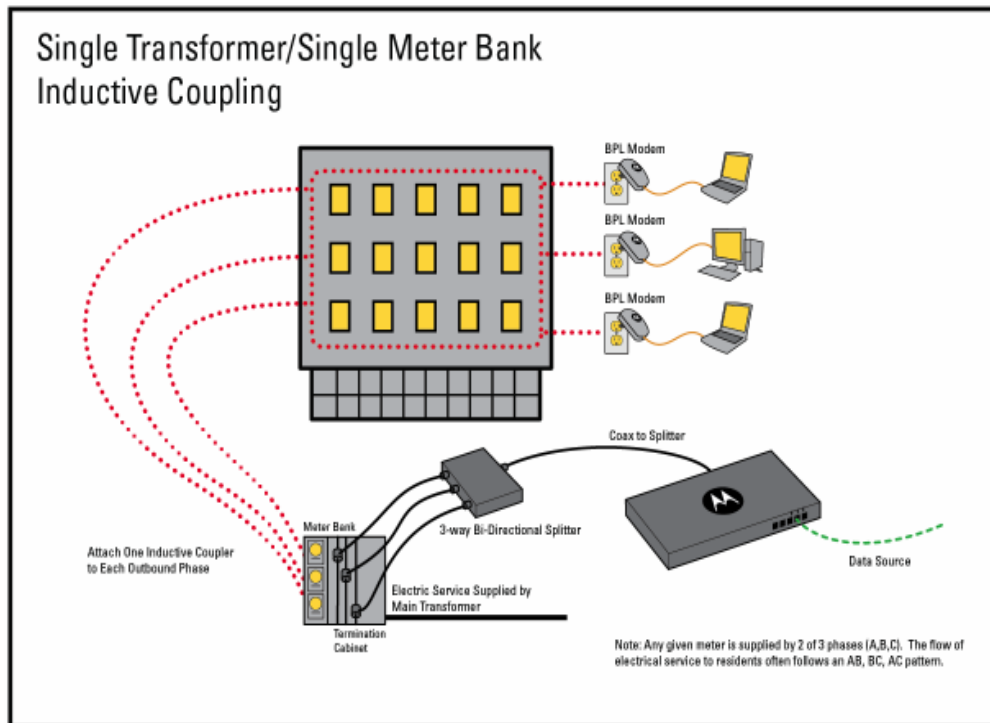


Figure 11 Inductive Coupling Installation Diagram

Inductive couplers are available in sizes to fit snugly on the cables in the cabinet. Couplers, or “donuts,” or “CT’s,” are metal rings that wrap around the cables so that the signal penetrates the outer shield of the cable and onto the lines without actually touching the bare wire. **The electrician should determine the size of the couplers.**

The ideal location to install inductive couplers is in the termination cabinet. In the termination cabinet there is a set of electrical cables which may differ in number and size. This cabinet also houses the bars that feed behind the meter bank. Within the meter bank, there are meters that measure consumption for each individual dwelling.

Sometimes there will be a larger distribution cabinet that services multiple termination cabinets and subsequent meter banks. This would also be a location to install the inductive couplers. In this distribution cabinet, there are multiple cables that feed the individual termination cabinets. These will also range in both number and size.

Both the termination and distribution cabinets will be located in one or more electrical closets in the building. Please consult the building engineer and a qualified electrician to locate them.

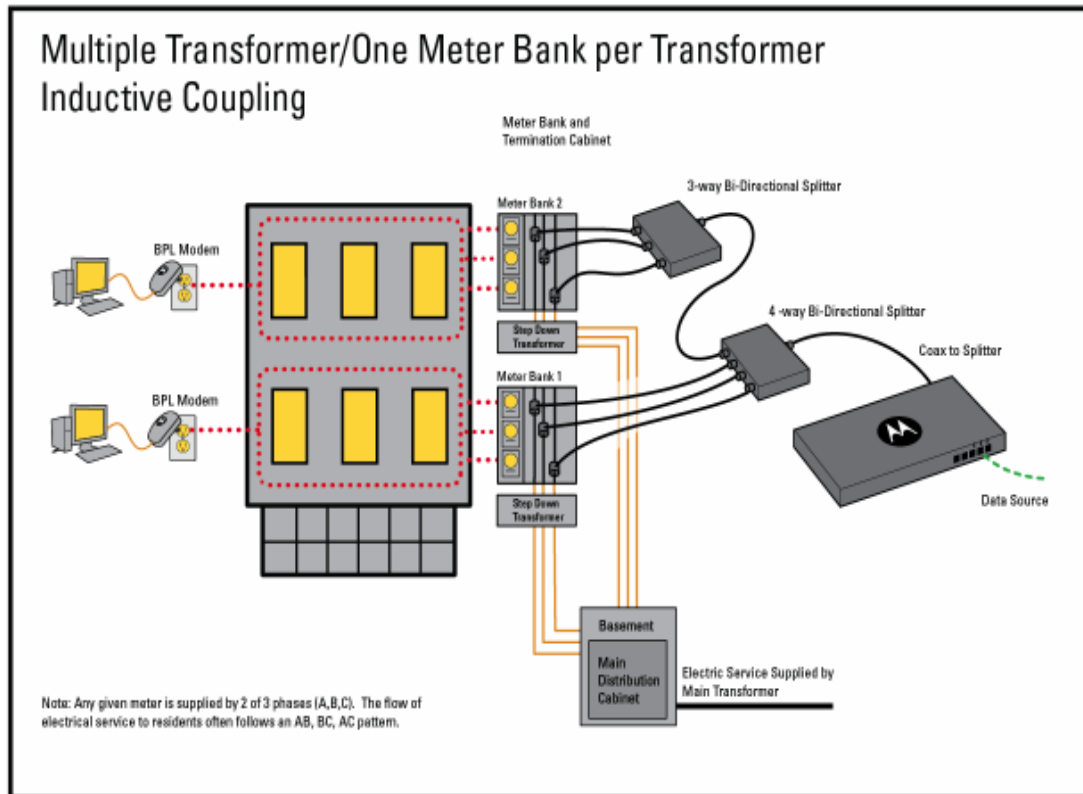


Figure 12 Inductive Coupler Connection, One Transformer

Items Needed

- Couplers: A typical multiple unit will have 4 wires (3 phase + neutral). Some will have 2 wires (1 phase + neutral) or 3 wires (2 phase + neutral). The sizes will typically range from 2/0 to 600 MCM.. The most common sizes are 250 MCM and 500 MCM. A qualified electrician can determine both the number of phases and size of cabling by inspecting the electrical system. **One coupler must be installed on each phase, but NOT the neutral.** In each case, be sure to choose the proper number and size of couplers.



Inductive Coupler Sizes

Column A lists the American Wire Gauge sizes, **Column B** lists Metric Wire Gauge sizes, and **Column C** measures the outer diameter of the electric wire installed in the building. Use that information to choose the recommended Powerline MU Inductive Coupler from **Column D**. **Column E** lists the inner diameter (the ferrite core) of the Powerline MU Inductive Coupler and **Column F** provides the part number for that coupler.

Conductor/Coupler Chart

Column A Conductor Size (American Wire Gauge)	Column B Conductor Size (Metric Wire Gauge, mm ²)	Column C Approx Conductor Outer Diameter With Insulation (mm)	Column D Recommended Powerline MU Inductive Coupler	Column E Powerline MU Coupler Inner Diameter (mm)	Column F Motorola Part Number
-	400	30.1	750*	31	TBD*
750 MCM	-	29.4	750*	31	
700 MCM	-	28.5	750*	31	
600 MCM	-	26.7	750*	31	
	300	26.5	750*	31	
500 MCM	-	24.9	500	25.4	0171486N21
-	240	24.2	500	25.4	
400 MCM	-	22	500	25.4	
-	185	21.1	500	25.4	
350 MCM	-	20.6	500	25.4	
300 MCM	150	18.5	500	19.4	
250 MCM	-	17.8	250	19.4	0171486N23
-	120	17.5	250	19.4	
4/0	-	16	250	19.4	
-	95	15.4	250	19.4	
3/0	-	14.7	250	19.4	
-	70	13.7	100	14	0171486N22
2/0	-	13.5	100	14	
1/0	-	12.2	100	14	
-	50	12	100	14	

*Powerline MU Inductive Coupler 750 available Q4, 2007.



- RG6 Coax cable
- Coax Splitters (must include 5-30 MHz in range). Number of splits and splitters is determined by the number of cables and locations of coupler installation. If possible, use bi-directional splitters. A possible source for bi-directional splitters is the Radio Shack® 2-way splitter (Model 15-2587) and the Radio Shack 4-way splitter (Model 15-2588).

Maximum dB Loss Chart

Number of Splits	Maximum dB loss per split
2-way	-3.5
3-way	-5.7
4-way	-7.5

- Conduit Fittings (compression connectors/setscrew couplings)
- Cable Ties as needed
- Rubber Grommets as needed

Procedure

1. Remove the panel of either the termination or distribution cabinets at the desired location.
2. Determine number of couplers needed.
3. Determine the number of bi-directional splitters needed (if feeding multiple cabinets).
4. Remove knock-out or create a small hole in the bottom or side of the cabinet.
5. Install conduit fitting in knock-out.
6. Mount the Gateway in the desired location. Be sure to note the distance between the Gateway location and the location where the couplers will be installed.
7. After determining the length needed, create RG6 coax cable with standard F-Connectors on each end.
8. Attach the F-Connector from one end of the cable to the back of the Gateway as shown in Figure 12.
9. Attach the other F-Connector lead (from coax going to Gateway) to the inbound port on the coax splitter. Attach terminators to any unused ports on the splitter.
10. Feed the coax end of the couplers through the conduit fitting and connect it to the splitter.
11. Open the coupler by gently lifting on the latch on the housing. The housing is hinged on the other side so it remains intact. The core itself will be in half, with one half containing the insulated cable that will induce the RF signal onto the electrical lines.
12. Connect one coupler to each phase in the cabinet, being sure the plastic case latches securely together. Be sure the cable stays inside the core when latching.



Also, be sure not to touch any bare wire or bus bars. (See Figure). Note: ***To reduce attenuation, attach the couplers to the LOAD side (to the meters) cables, not the LINE side (from the transformer) cables, if possible.***

13. Be sure couplers do not slide. If needed, use cable ties or rubber grommets to assure stability.
14. Tighten the conduit fitting to secure the coax cables.
15. Replace the panel of the cabinet.

4.2.4 Multiple Transformer

Multiple transformer installations are typically found in high-rises and larger commercial buildings. If this is a multiple-dwelling unit, it will probably be individually metered, but with more than one transformer. These buildings often have transformers on multiple floors and can even have different electrical feeds into the building. These situations require more planning than the preceding installations and will often require additional equipment, such as Panel Extenders and Hybrid Adapter units. They will sometimes even require multiple Gateways. Ideal installation here is similar to the Individually Metered scenario, but with more planning. The need here is to be sure you can get the internet connection to each of these Gateways. This can be done with telco cables if there is conduit.

All of these buildings have the same basic layout electrically. They all have a main feed that then distributes to the consumer's premise. The closer you get to the consumer, the better, but you also want to plan to connect to the point that serves the most customers with the least signal loss.

Here is one example of an effective coupling solution:

- Install Gateway in 2nd floor electrical closet.
- Couple floors 1-3 together with a Panel Extender.
- Either add a second Gateway on floor 5 for floors 4-6 or extend coupling from initial Gateway by adding additional splitters, based on signal strength. Try to use no more than two splits because of signal degradation.
- The signal will not travel back through the 2nd floor transformer and through the transformers on other floors, so extending the coupling with additional couplers and splitters will be necessary if one Gateway serves multiple meter banks.

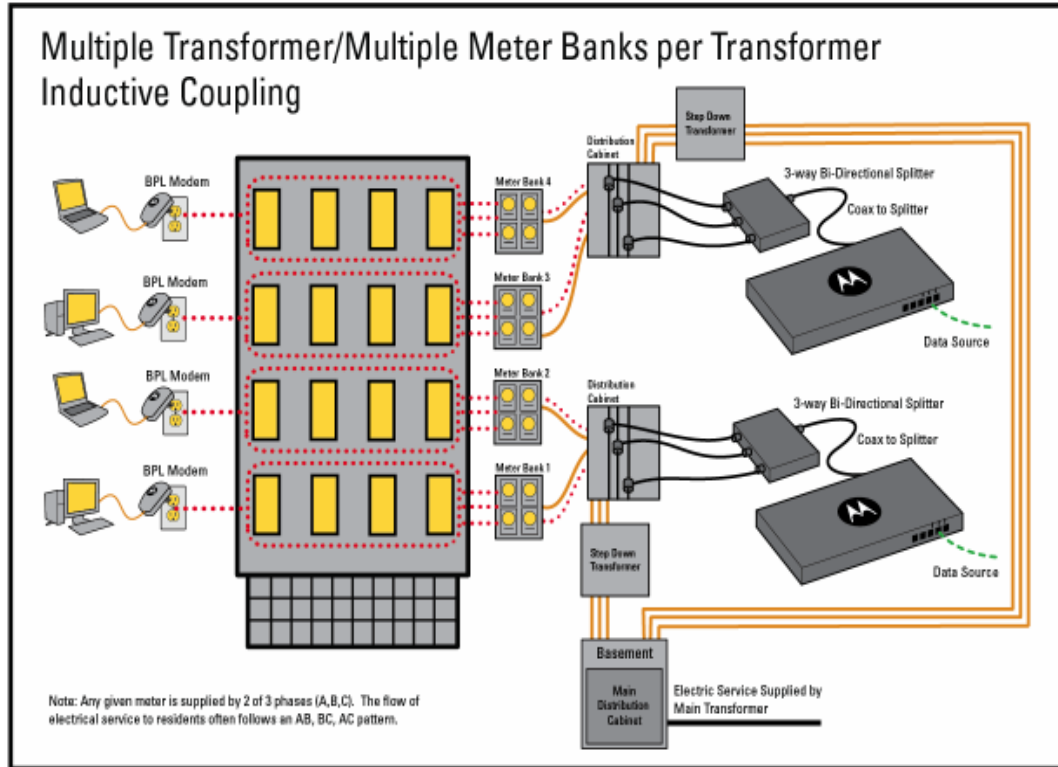


Figure 13 Inductive Coupler Connection, Multiple Transformers

Capacitive Coupling

An ideal place to use capacitive coupling in an individually metered building is directly after the meter bank. This reduces the attenuation that the meters cause to the signal, and, in most cases, the local utility will not need to be involved. In some areas, this is not possible due to the fact that you cannot access the area because of a conduit or other enclosure.

In most cases, capacitive coupling in an individually metered building will have to be done **AFTER** the meter bank. This is best done off of the house (or common or landlord) meter if it is located in the same room or on the same meter bank as the individual unit meters. In this case, the RF signal will have to penetrate through the house or common meter, then through a **SECOND** meter to get to the individual units. ***For this reason, inductive coupling is the better way to install Powerline MU in an individually metered building.***

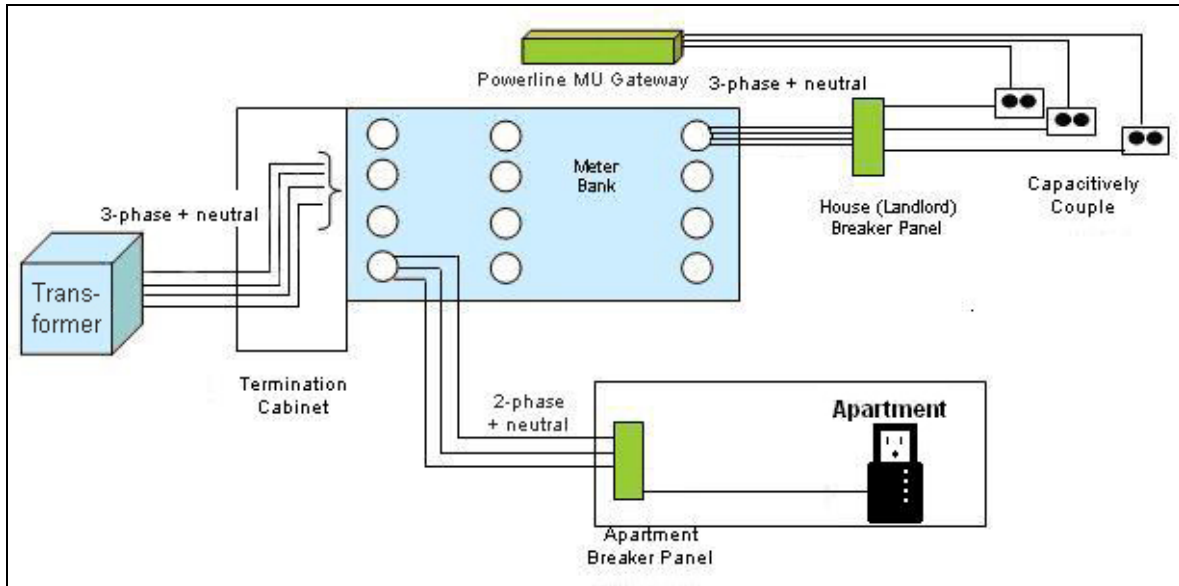


Figure 14 Individually-metered installation (capacitive coupling)



5 Hardware Installation

5.1 UPGRADING FIRMWARE

NOTE: When Upgrading to Firmware Version 2.0 over the Powerline, you must upgrade the Modems first, then upgrade the Gateway. Failure to do so in this order will result in loss of communication between the Gateway and Modem.

Upgrades to Powerline MU firmware for the Gateway and the Modem are made available along with the Canopy upgrade tool. You should become familiar with the tool. Firmware upgrades and the information about the CNUT upgrade tool are available on the Canopy website: www.canopywireless.com.

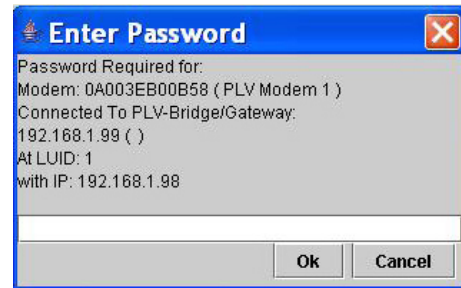
To upgrade the firmware via CNUT, use the following procedure:

Add the Modem to the network, using **Edit → Add Canopy Elements to Network Root**. Enter the IP Address of the Modem in the "Add Network Element" window.

Discover all the Modems in the network, using **View → Refresh/Discover Entire Network**. **During the discovery process, if the Enter Password pop-up dialog box appears, select Cancel.**

Add the appropriate Installation Packages to the Network Updater, using **Update → Manage Packages**.

Select the device to be upgraded by selecting the check boxes next to the device. Upgrade the device, using **Update → Update Selected Network Elements**.



5.2 EQUIPMENT STAGING

Check the Powerline MU devices before installing.

To connect to the Gateway's web based interface:

1. Connect your PC to the Gateway at one of the Ethernet LAN ports. Be sure the Gateway is plugged into an AC outlet and turned on.
2. Open your Internet browser and enter the LAN address of the Gateway connected to your computer.
3. Gateway Default Settings:
 - IP 192.168.1.99
 - Subnet 255.255.255.0
 - DHCP not enabled

Default Login information

- User id admin
- Password Motorola



To connect to the Modem web based interface:

1. Connect your PC to the Modem Ethernet port.
2. The Modem's default setting has a DHCP server enabled on the Ethernet interface. Therefore, if you connect a computer as a DHCP client, you will receive an IP address from the Modem. However, you may also static an IP address as follows:

Set your computer's IP address to

- IP 192.168.1.97
- Subnet 255.255.255.0

Open your Internet browser and enter the LAN address of the Modem connected to your computer: 192.168.1.98

3. Default Login information

- User id **admin**
- Password **Motorola**

The Powerline MU Gateway can be placed on a stable shelf or table, wall mounted, or installed in a standard 19" equipment rack.

Once installed, connect the power cord to an available receptacle.

5.3 INSTALLATION

Have a qualified electrician install power outlets for the Gateway and other devices in your design.

Using the 3-foot (.9 meter) capacitive injection cords (included), plug Phase I, Phase II, and Phase III into the corresponding outlets that were installed by the electrician. The cords are power cords, but they do not draw electricity.

5.3.1 Mount the Gateway

Connect the Gateway(s) in the proposed location(s) and connect to the network.

The Gateway can be set on a stable shelf or table. It is also designed to mount in a standard 19" rack. Simply attach the brackets and mount, using rack screws for your particular rack. The Gateway can also be flush mounted against a wall, either into a wood wall or on a plywood or solid wood backboard. If mounted in dry wall or plaster, use the wall anchors supplied with the Gateway.

Plug the Gateway into an available AC outlet. Turn the Power Switch on the back of the Gateway to ON.

Using a modem and your laptop computer, test connectivity and connection speed in a sampling of the offices or apartments where connection to the Internet is desired. Connect to the modem directly and use the Powerline scan feature.

If you have rooms that have a weak signal or no signal, verify that those rooms are connected to the same area as the Gateway. Repeat this process for each proposed Gateway location if the design has multiple Gateways. If there are areas with little or no coverage you will need to modify your Powerline MU design layout.



Testing can also be achieved using two modems if you have knowledge of the phase distribution within the building.

5.3.2 Install Modems

Plug Modems in desired locations in each room or unit. Test to be sure connectivity has been established by connecting a computer and making sure all four lights on the modem are lit.

If the AC Power light is not lit, you do not have AC power to your Modem. Choose another AC outlet.

If the Powerline light is not lit, you are not connected to the Powerline network. Try another outlet, preferably closer to the breaker box where your electrical power enters

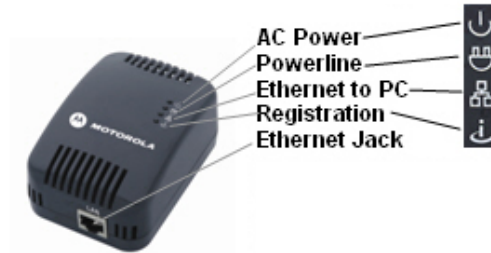
the residence or business. You can use a wireless router at the Motorola Powerline Modem location to re-establish a connection to the preferred computer location.

If the Ethernet to PC light is not lit, you do not have Ethernet connection to your computer or router. Check that the Ethernet cable is seated correctly in the Modem jack and in your PC or router. If that doesn't help, call your service provider.

If the Registration light is not lit and the other lights are lit, the modem is not registering on the network.

For more information, consult the Powerline MU Questionnaire and Troubleshooting Guide on the Powerline MU User Guide section of the Canopy website:

www.motorola.canopywireless.com/support/library/?region=1&cat=8



6 CONFIGURING THE POWERLINE MU GATEWAY

You must configure the Powerline MU Gateway and Modems for your system. For easiest setup, configure the components before they are installed.

Gateway Configuration Interface Map

System	System Info Date and Time Password Logs Reboot Backup Site Info
Advanced	BAM Configuration SNMP Configuration SNMP Access Control VLAN Configuration
IP Address	IP Configuration
Powerline	Modem List NEK Configuration PSD Settings Remote NEK

6.1 CONNECT TO THE GATEWAY

To connect to the gateway, use a PC or laptop with a web browser.

Set a static IP address on your Laptop to 192.168.1.97. ***You may have to temporarily disable anti-virus software or disable the proxy settings in your computer.***

Using a standard CAT-5 Ethernet cable, connect your PC or laptop to one of the numbered Ethernet ports on the front panel of the gateway. (see Figure 15).



Figure 15 Gateway connected to laptop



Open your web browser and enter the following Gateway default IP address:

http://192.168.1.99.

Enter your user ID and password.

Factory-installed defaults:

User ID: **admin**

Password: **Motorola**

When you first log in the System Info screen will display.

6.1.1 User Interface Navigation tips

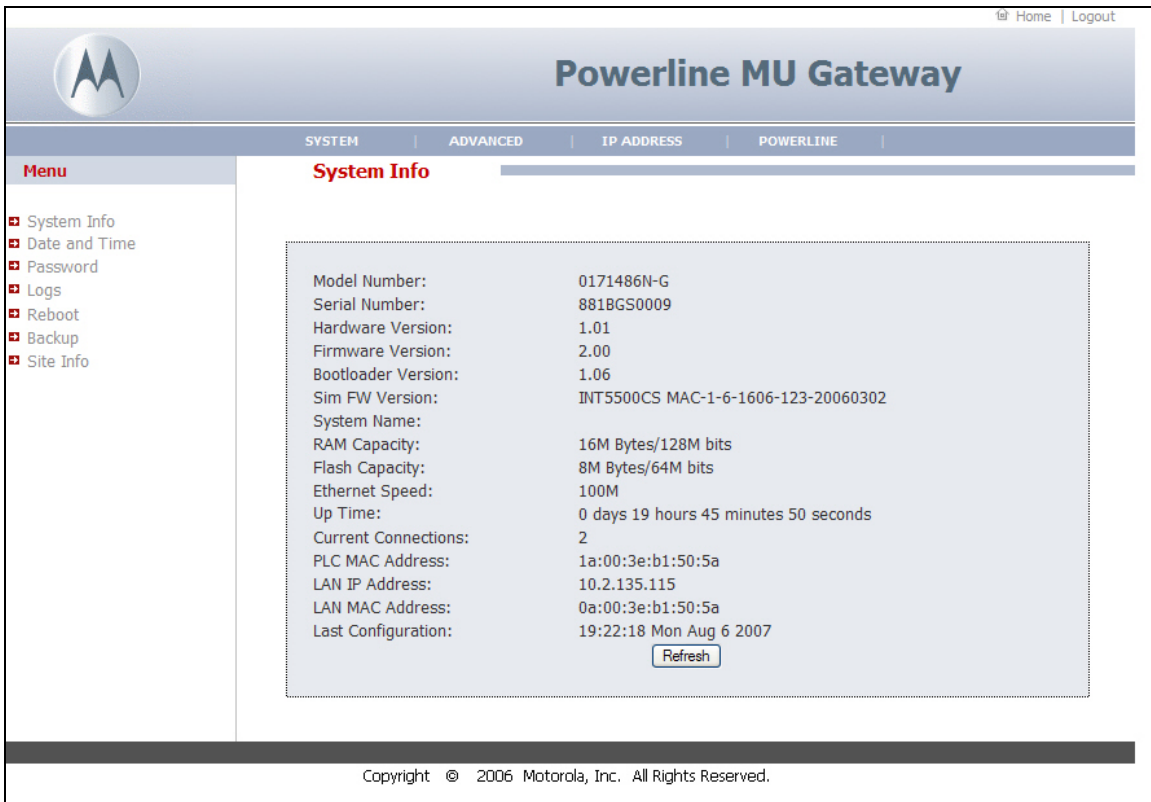
The user interface is divided into four main categories:

- **System:** View and make changes in the system. View the system information and logs. Set or change the time and date information, change the password, backup the settings, reboot the system, view site information, and upgrade the Gateway firmware.
- **Advanced:** The Advanced screen gives you links for setting up a BAM (management) server, setting up SNMP Configuration and SNMP Access Control.
- **IP Address:** Set the Gateway to obtain an IP address automatically or to use a specific IP address.
- **Powerline:** Set the bridge table timeout, view a list of modems, modem MAC addresses, VID's, Link Speed, set the Network Encryption Key, and change the PSD settings.

At the top of each screen is a **Home** link to go back to the System Information screen and a **Logout** link to log out of the Gateway.

6.2 CONFIGURATION AND MAINTENANCE

6.2.1 System Information



Home | Logout

Powerline MU Gateway

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- System Info
- Date and Time
- Password
- Logs
- Reboot
- Backup
- Site Info

System Info

Model Number:	0171486N-G
Serial Number:	881BGS0009
Hardware Version:	1.01
Firmware Version:	2.00
Bootloader Version:	1.06
Sim FW Version:	INT5500CS MAC-1-6-1606-123-20060302
System Name:	
RAM Capacity:	16M Bytes/128M bits
Flash Capacity:	8M Bytes/64M bits
Ethernet Speed:	100M
Up Time:	0 days 19 hours 45 minutes 50 seconds
Current Connections:	2
PLC MAC Address:	1a:00:3e:b1:50:5a
LAN IP Address:	10.2.135.115
LAN MAC Address:	0a:00:3e:b1:50:5a
Last Configuration:	19:22:18 Mon Aug 6 2007

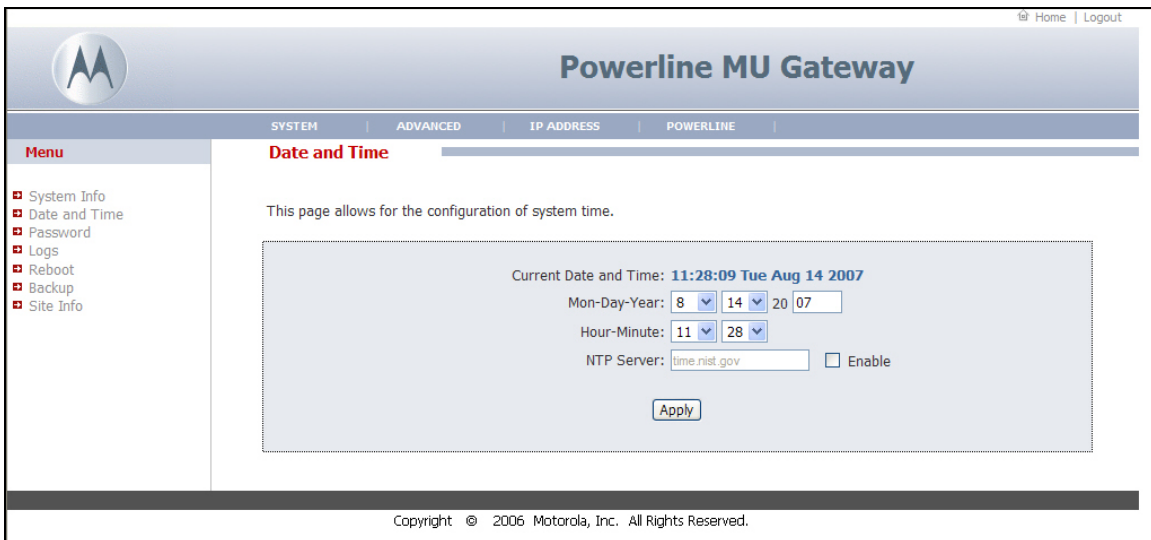
[Refresh](#)

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Figure 16 System Information Screen

The System Information screen displays hardware and configuration information about the Gateway. Select **Refresh** to view most current information.

6.2.2 Date and Time



Home | Logout

Powerline MU Gateway

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- System Info
- Date and Time
- Password
- Logs
- Reboot
- Backup
- Site Info

Date and Time

This page allows for the configuration of system time.

Current Date and Time: 11:28:09 Tue Aug 14 2007

Mon-Day-Year: 8 14 20 07

Hour-Minute: 11 28

NTP Server: Enable

[Apply](#)

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Figure 17 Date and Time Screen

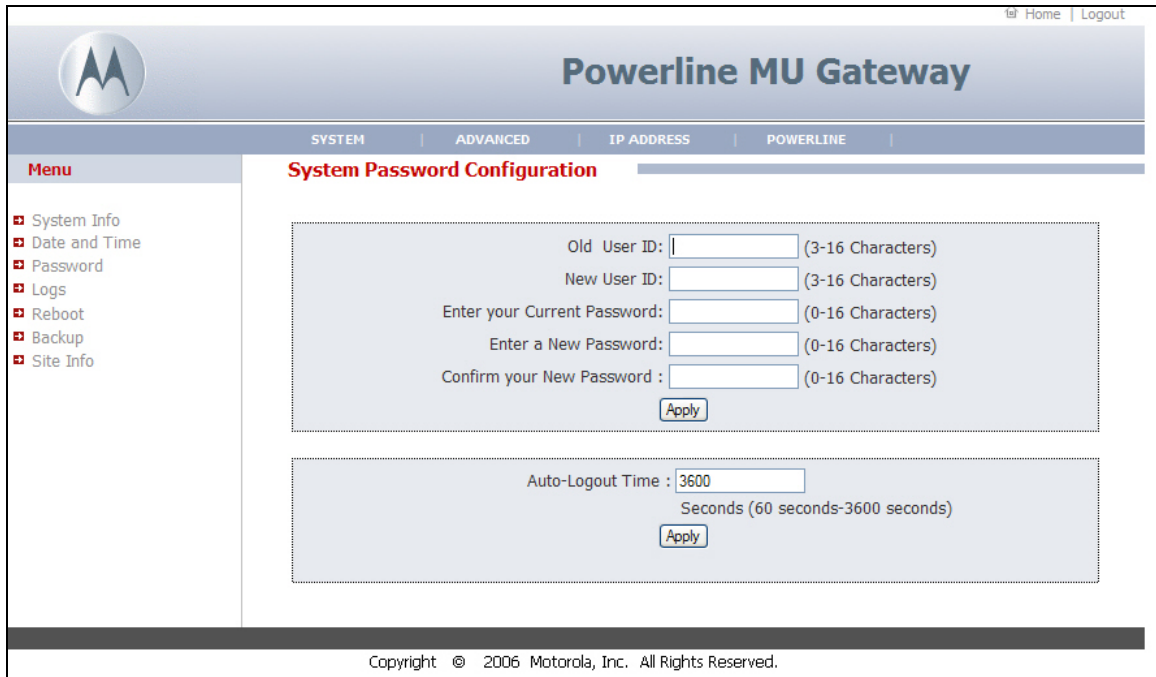
Use the Date and Time screen to set the current date and time on the Gateway (use 24-hour time format). You can also set the date and time by entering the Network Time Protocol (NTP) server and selecting **Enable**.

Select **Apply**.

6.2.3 System Password Configuration

The factory default user ID for the Gateway is **admin** and the factory default password is **Motorola**. You should change the user ID and password as soon as you log in the first time.

Use the System Password screen to change the user ID and password for this Gateway. The user ID and password are case sensitive.



Powerline MU Gateway

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- System Info
- Date and Time
- Password
- Logs
- Reboot
- Backup
- Site Info

System Password Configuration

Old User ID: (3-16 Characters)

New User ID: (3-16 Characters)

Enter your Current Password: (0-16 Characters)

Enter a New Password: (0-16 Characters)

Confirm your New Password : (0-16 Characters)

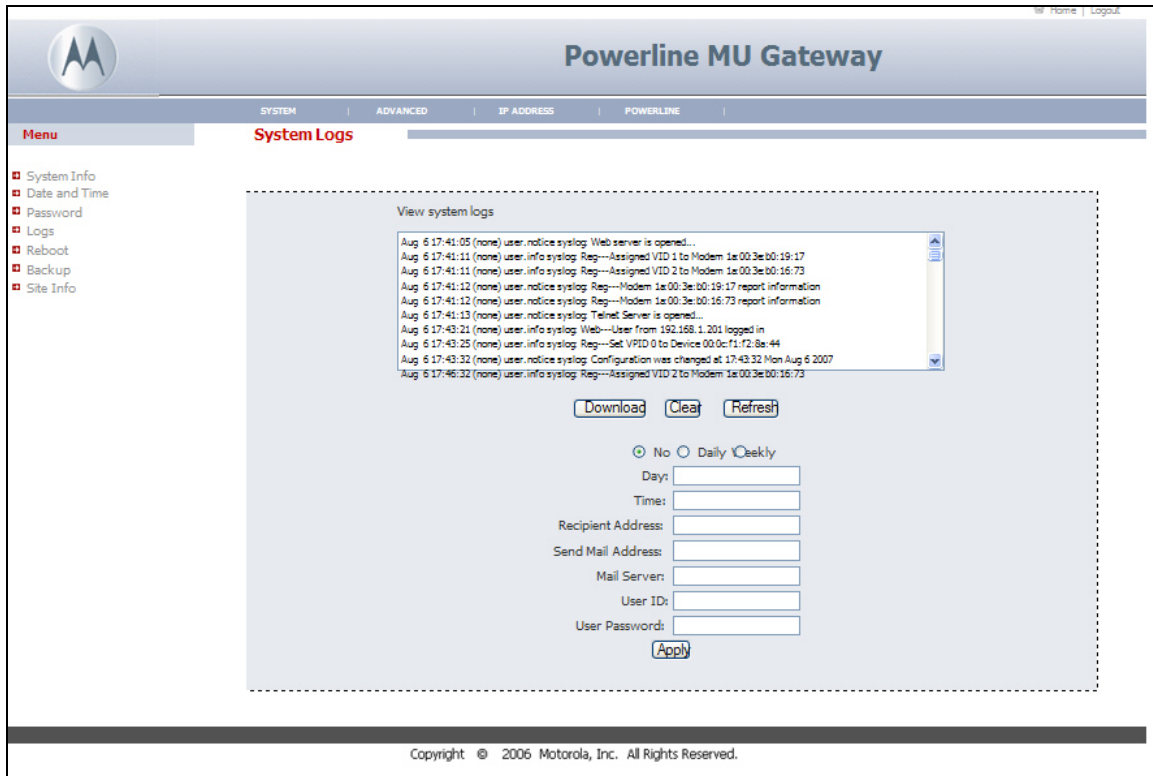
Auto-Logout Time : Seconds (60 seconds-3600 seconds)

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Figure 18 System Password Configuration Screen

Change the user ID and password to enhance security in the Gateway and select **Apply**. Determine the auto-logout time (in seconds) and select **Apply**.

6.2.4 Logs



Powerline MU Gateway

Menu **System Logs**

- System Info
- Date and Time
- Password
- Logs
- Reboot
- Backup
- Site Info

View system logs

```

Aug 6 17:41:05 (none)user.notice syslog: Web server is opened...
Aug 6 17:41:11 (none)user.info syslog: Reg---Assigned VID 1 to Modem 1a:00:3e:b0:16:73
Aug 6 17:41:11 (none)user.info syslog: Reg---Assigned VID 2 to Modem 1a:00:3e:b0:16:73
Aug 6 17:41:12 (none)user.notice syslog: Reg---Modem 1a:00:3e:b0:16:73 report information
Aug 6 17:41:12 (none)user.notice syslog: Reg---Modem 1a:00:3e:b0:16:73 report information
Aug 6 17:41:13 (none)user.info syslog: Telnet Server is opened...
Aug 6 17:43:21 (none)user.info syslog: Web---User from 192.168.1.201 logged in
Aug 6 17:43:25 (none)user.info syslog: Reg---Set VPID 0 to Device 00:0c:f1:f2:8a:44
Aug 6 17:43:32 (none)user.notice syslog: Configuration was changed at: 17:43:32 Mon Aug 6 2007
Aug 6 17:46:32 (none)user.info syslog: Reg---Assigned VID 2 to Modem 1a:00:3e:b0:16:73

```

Download Clear Refresh

No
 Daily
 Weekly

Days:

Time:

Recipient Address:

Send Mail Address:

Mail Server:

User ID:

User Password:

Apply

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Figure 19 Logs Screen

The System Logs screen provides valuable diagnostic tools. The box at the top displays the current logs.

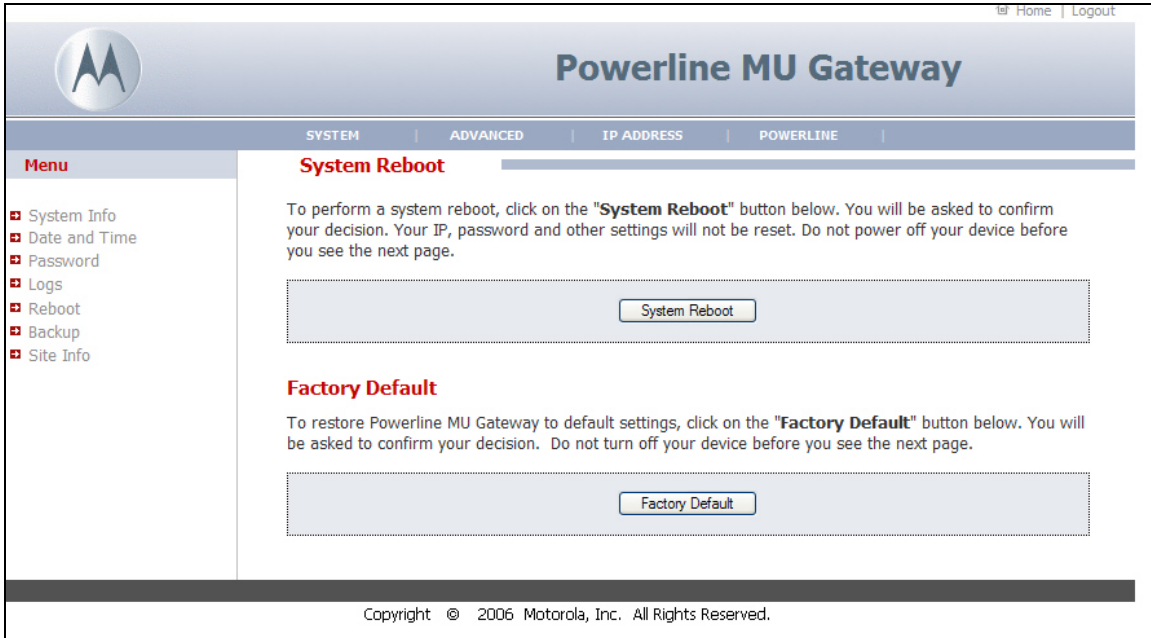
Select **Download** to download the log to a file.

Select **Clear** to clear the log file.

Select **Refresh** to refresh the screen with current information.

You can set the system log to deliver log files to an email account daily or weekly. Complete the text boxes on the page and select **Apply** to set up the system log. Enter the IP address of the mail server.

6.2.5 Reboot



The screenshot shows the Powerline MU Gateway web interface. At the top right, there are links for "Home" and "Logout". The main header features the Motorola logo and the title "Powerline MU Gateway". Below the header is a navigation menu with tabs for "SYSTEM", "ADVANCED", "IP ADDRESS", and "POWERLINE". The "SYSTEM" tab is selected, and the "Menu" on the left lists various options: System Info, Date and Time, Password, Logs, Reboot, Backup, and Site Info. The main content area is titled "System Reboot" and contains the following text: "To perform a system reboot, click on the 'System Reboot' button below. You will be asked to confirm your decision. Your IP, password and other settings will not be reset. Do not power off your device before you see the next page." Below this text is a button labeled "System Reboot". The section is followed by "Factory Default" with the text: "To restore Powerline MU Gateway to default settings, click on the 'Factory Default' button below. You will be asked to confirm your decision. Do not turn off your device before you see the next page." Below this text is a button labeled "Factory Default". At the bottom of the page, there is a copyright notice: "Copyright © 2006 Motorola, Inc. All Rights Reserved."

Figure 20 Reboot and Reset to Defaults Screen

It may become necessary to reboot the Gateway. Rebooting does not change your configuration settings.

Select **System Reboot** to reboot the Gateway.

Select **Factory Default** to change your Gateway back to the factory default settings for IP Address and the Password. Note: **The PSD values and NEK is not changed during a Factory Default.**

Do not power off the Gateway before you see the affirmation screen.

6.2.6 Backup and Restore Settings

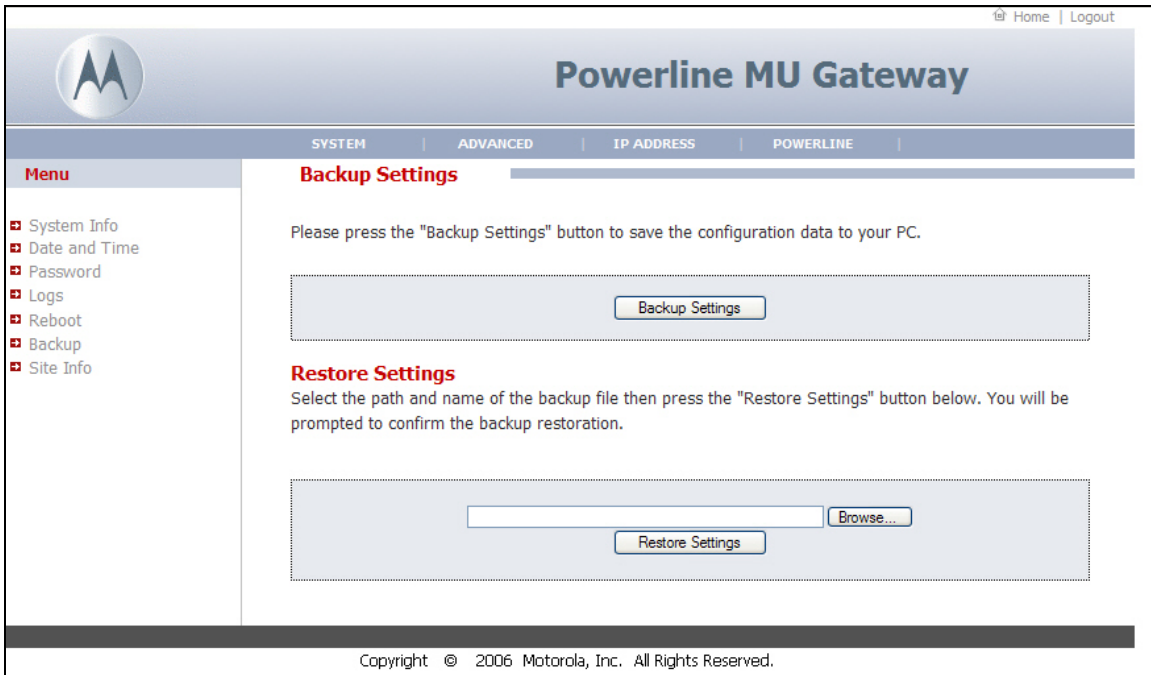


Figure 21 Backup and Restore Settings Screen

When you select **Backup Settings** you can save the Gateway settings to a local file. To restore settings, browse for the desired file and select **Restore Settings**.

6.2.7 Site Info

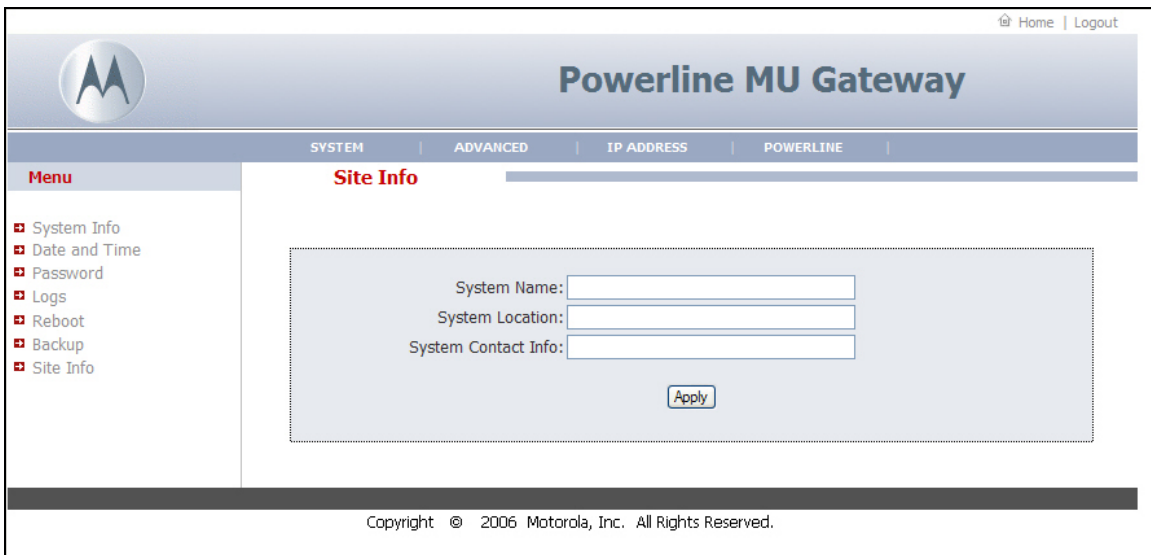
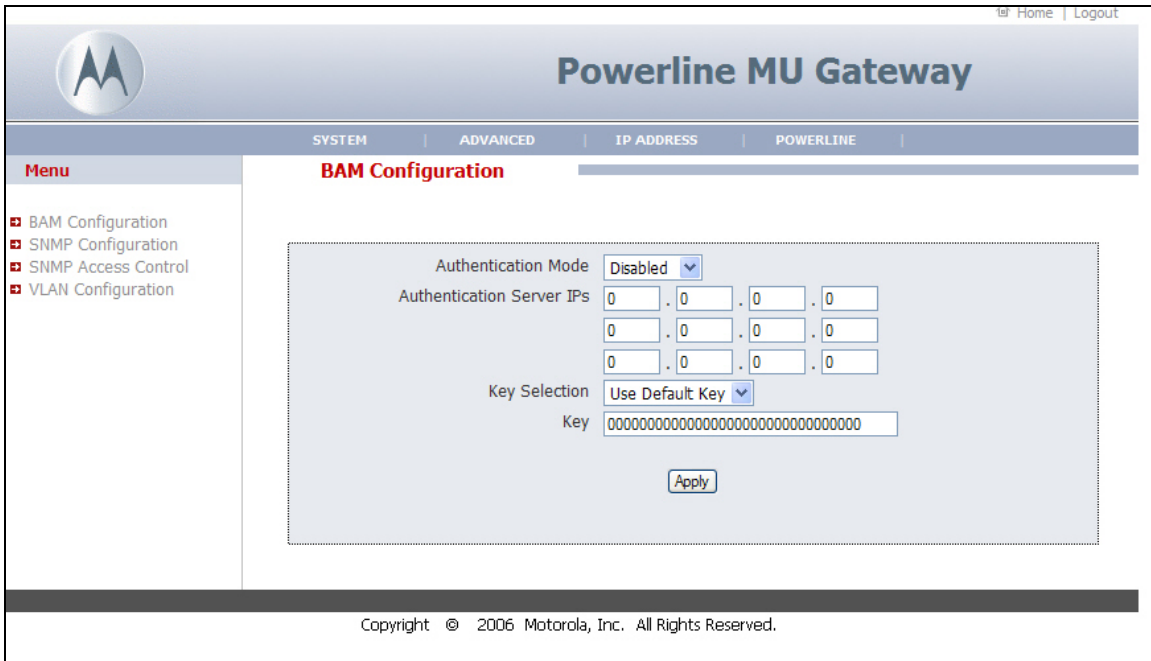


Figure 22 Site Info Screen

Enter site information and select **Apply**.

6.3 ADVANCED

6.3.1 BAM Configuration



Powerline MU Gateway

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- BAM Configuration
- SNMP Configuration
- SNMP Access Control
- VLAN Configuration

BAM Configuration

Authentication Mode:

Authentication Server IPs:

0 . 0 . 0 . 0

0 . 0 . 0 . 0

0 . 0 . 0 . 0

Key Selection:

Key:

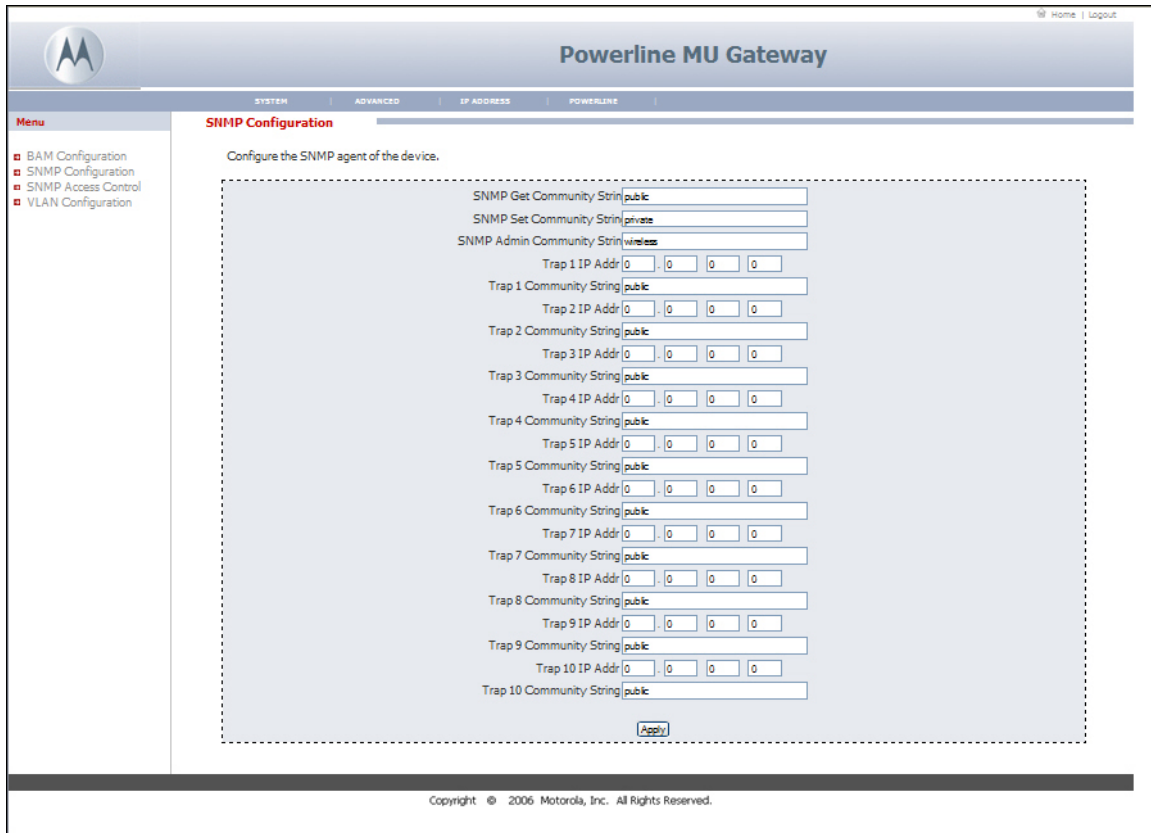
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Figure 23 BAM Configuration

Enable Authentication Mode and add one or more Authentication Server IPs to use a bandwidth manager. Select Use Default Key to use the all zeroes key, as shown in the screen above, or select “Use This Key” and enter a key. The Key must match the key entered in the bandwidth manager.

64 to 64Kbps	257 to 512 -- 512Kbps	2049 to 4096 -- 4Mbps
65 to 128 -- 128Kbps	513 to 1024 --1Mbps	4097 to 10240-- 10Mbps
129 to 256 -- 256Kbps	1025 to 2048 -- 2Mbps	>10241 -- 42.5Mbps (full speed)

6.3.2 SNMP Configuration



Powerline MU Gateway

Menu

- BAM Configuration
- SNMP Configuration
- SNMP Access Control
- VLAN Configuration

SNMP Configuration

Configure the SNMP agent of the device.

SNMP Get Community String

SNMP Set Community String

SNMP Admin Community String

Trap 1 IP Addr

Trap 1 Community String

Trap 2 IP Addr

Trap 2 Community String

Trap 3 IP Addr

Trap 3 Community String

Trap 4 IP Addr

Trap 4 Community String

Trap 5 IP Addr

Trap 5 Community String

Trap 6 IP Addr

Trap 6 Community String

Trap 7 IP Addr

Trap 7 Community String

Trap 8 IP Addr

Trap 8 Community String

Trap 9 IP Addr

Trap 9 Community String

Trap 10 IP Addr

Trap 10 Community String

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Figure 24 SNMP Configuration

What is SNMP?

The *Simple Network Management Protocol (SNMP)* is a TCP/IP application layer protocol that allows the exchange of management information between network devices. SNMP enables you to manage network performance and troubleshoot and solve network problems.

To manage a module, SNMP supports the `set` command, which instructs the agent to change the data that manages the module.

To monitor a network element, SNMP supports:

- the `get` command, which instructs the agent to send information about the module to the manager in the NMS.
- traversal operations, which the manager uses to identify supported objects and to format information about those objects into relational tables.

In a typical Canopy network, the manager issues these commands to the agents of more than one module.

When a specified event occurs in the module, the agent initiates a trap, for which the agent sends an unsolicited asynchronous message to the manager.

Select **Apply**.

NOTE:



SNMP Get community string can be used to do a "get" operation on the OID's belonging to the following groups:

whispPlvGatewayInfoGroup, whispPlvGatewayConfigGroup, whispPlvGatewayTrapConfigGroup and whispPlvGatewayPowerlineGroup of WHISP-PLV-GATEWAY-MIB.

Get community string does not support "set" operation on any of the OID's belonging to WHISP-PLV-GATEWAY-MIB.

SNMP Set community string can be used to do a "get" and "set" operation on the OID's belonging to the following groups:

whispPlvGatewayInfoGroup, whispPlvGatewayConfigGroup, whispPlvGatewayTrapConfigGroup and whispPlvGatewayPowerlineGroup of WHISP-PLV-GATEWAY-MIB.

SNMP Admin Community string can be used to do "get" and "set" operations on all the OID's of WHISP-PLV-GATEWAY-MIB.

Following table represents the WHISP-PLV-GATEWAY-MIB groups and the community strings that can be used to access them.

Groups in WHISP-PLV-GATEWAY-MIB	Access Rights using		
	Get Community String	Set Community String	Admin Community String
whispPlvGatewayInfoGroup	Get	Get	Get
whispPlvGatewayConfigGroup	Get	Get and Set	Get and Set
whispPlvGatewayTrapConfigGroup	Get	Get and Set	Get and Set
whispPlvGatewayPowerlineGroup	Get	Get and Set	Get and Set
whispPlvGatewayAdmConfigGroup	No Access	No Access	Get and Set
whispPlvGatewayAdmLanConfigGroup	No Access	No Access	Get and Set
whispPlvGatewayAdmSnmAccessConfigGroup	No Access	No Access	Get and Set
whispPlvGatewayAdmWanConfigGroup	No Access	No Access	Get and Set
whispPlvGatewayAdmModemGroup	No Access	No Access	Get and Set

SNMP Get community string can be used to do "get" operation only on all the OID's of RFC1213-MIB. SNMP Set and Admin community strings configured in this page can be used to do "get" and "set" operations on all the OID's of RFC1213-MIB.

Please note that SNMP Manager should load WHISP-GLOBAL-REG-MIB and WHISP-TC-MIB, to use WHISP-PLV-GATEWAY-MIB.

6.3.3 SNMP Access Control

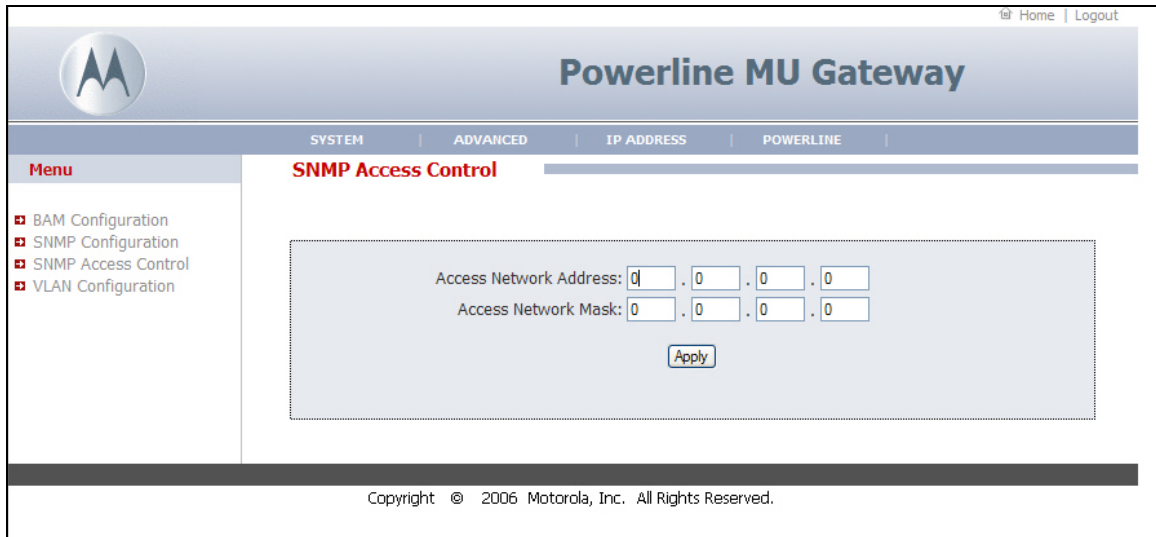


Figure 25 SNMP Access Control

Use this screen to control which IP addresses and networks are allowed to SNMP manage the Gateway. Enter the Access Network Address and Mask and select **Apply**.

6.3.4 VLAN Configuration

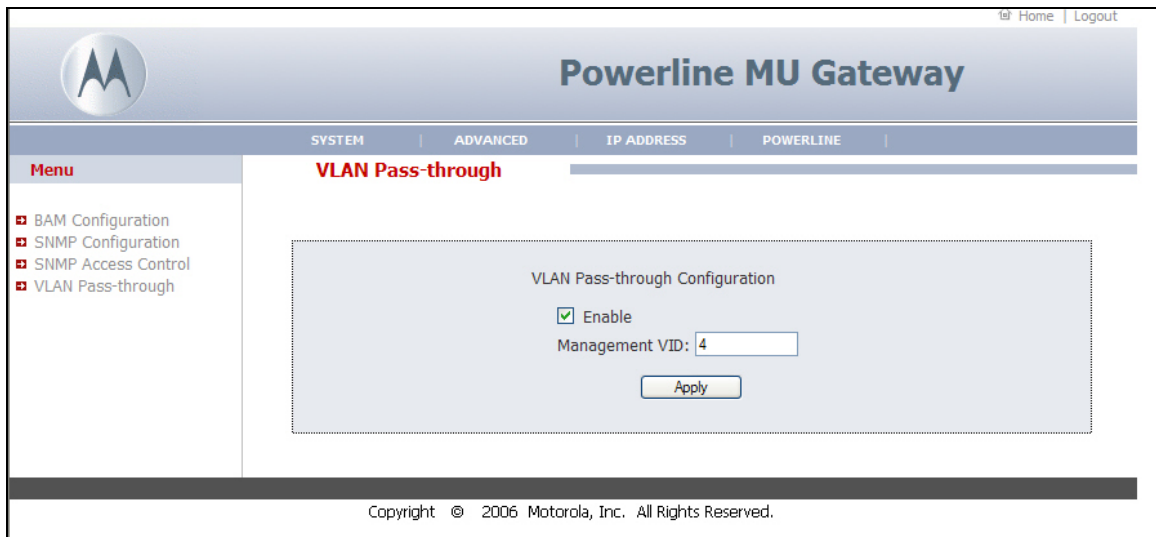


Figure 26 VLAN Configuration

VLAN Configuration Feature, new in Powerline Gateway 2.0

With the new 2.0 Firmware, you will be able to support VLANs in your Powerline MU network. This functionality enables maximum network performance by allowing for network isolation, network segmentation and tagging and un-tagging of packets.

A major difference between Motorola Canopy and Powerline MU VLAN functionality is that unlike Motorola Canopy, Powerline MU can only support *either* VLAN tagged or untagged packets, but not both at the same time. Once the mode of operation for the

Gateway and Modem has been selected, care must be taken to ensure that the entire network has been properly configured to support VLAN functionality.

There are two main ways that VLAN functionality can be implemented over Powerline. The first way assumes that the Modems are configured for NAT mode, and the second method assumes that the Modems are configured in Bridge mode. Figure 4 shows the test set up for both implementation examples.

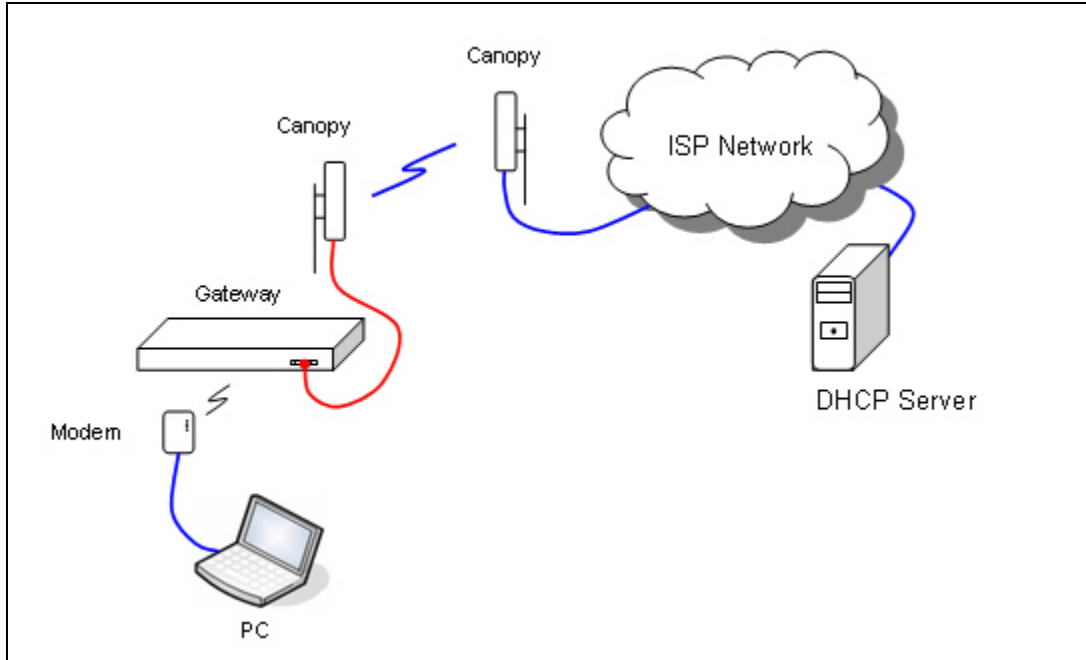


Figure 27 An Example Network Configuration for VLAN Implementation.

VLAN Implementation using Modems in NAT Mode

The following steps should be followed when operating Powerline MU in VLAN pass-through mode. The Powerline MU Gateway must be enabled for VLAN by checking the "VLAN Enable" box as shown in Figure 28. Figure 28 Example of VLAN Configuration Screen in the Gateway. Next, enter the Management VID (VLAN ID) for the Powerline network.

Note: Powerline Management VID must be different from Canopy Management VID.

After the Gateway has been configured for VLAN pass-through, the LAN and WAN ports will have different functionality. Where there was no differentiation between the LAN and WAN ports in standard operating mode, in VLAN mode, the LAN port will only accept VLAN tagged packets whereas the WAN port will only accept untagged packets.

The WAN port can be used for:

- Connecting a non-VLAN enabled Canopy network to the Gateway, thus allowing for a hybrid network where the Powerline network is VLAN enabled and the Canopy network is non-VLAN enabled.
- Connecting to a PC or other non-VLAN IP device to the Powerline network.

The LAN ports can be used for:

- Extending the network to other Powerline Gateways or other Ethernet based IP devices since these ports are Bridged.

Next, Powerline Modems can now be configured for VLAN pass-through by entering the VPID (VLAN Pass-Through ID) for the Modem. For example (as shown in Figure 6), Ethernet packets from devices connected to the Modem will be sent to the LAN port of the Gateway and tagged with the Modem's PLC (Powerline) MAC address (1a:00:3e:b0:19:17). Depending on whether the request packets were tagged with the Management VLAN ID or VPID, the response packets will be tagged with the respective VLAN ID. For example, if a PC connected to the LAN port of the Gateway sends packets tagged with VLAN ID = 4094, then the Modem will respond with VLAN ID 4094. If the PC pings with VLAN ID = 4 (Management VLAN ID), the Modem will respond with VLAN ID 4.

Note: Pass-through VPID can not be the same as the Powerline Management VID.

Powerline MU Modems have a powerful feature that will tag and un-tag packets, however there is about a 15% decrease in aggregate bandwidth availability because of the overhead in processing VLAN packets.

DHCP packets sent from the LAN port of the Gateway to the DHCP server will be tagged with the Management VLAN ID of the Powerline network. To ensure proper network operation, you will need to either un-tag and tag packets from your DHCP server or install a VLAN capable network card on the DHCP server.

DMZ can be configured when using the Modem in NAT mode; however, you will not be able to access the WAN IP address of the Modem until an Ethernet device is connected to the LAN port of the Modem. As in the prior example, the Modem will match ingress packet VLAN ID with egress VLAN ID.

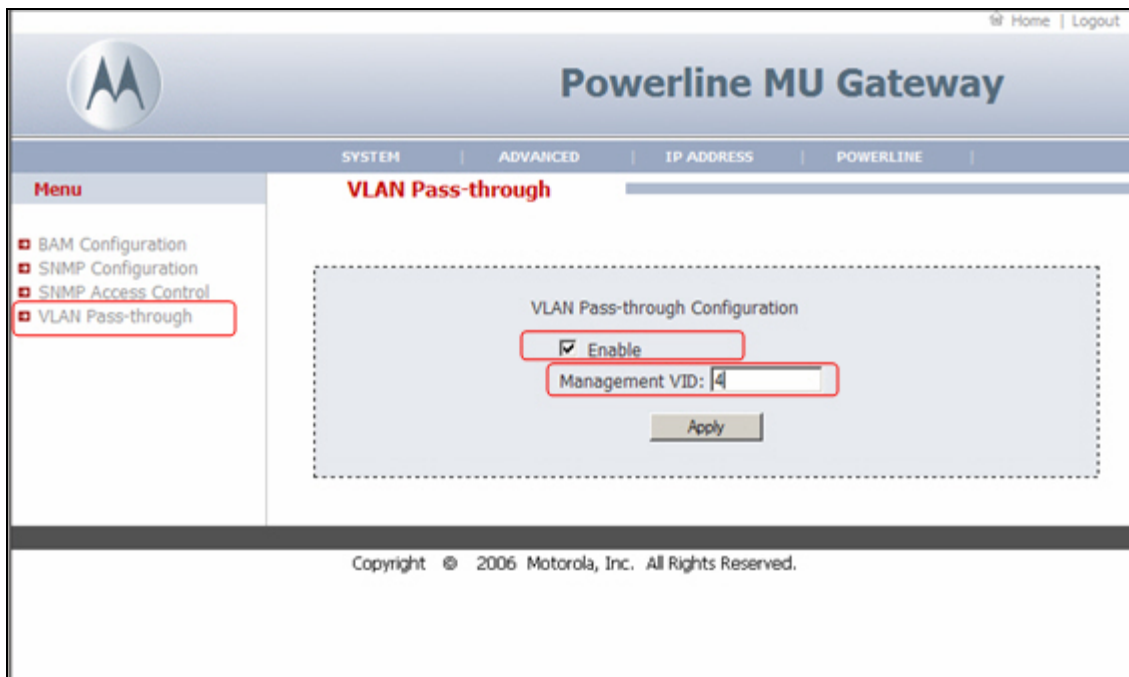


Figure 28 Example of VLAN Configuration Screen in the Gateway.

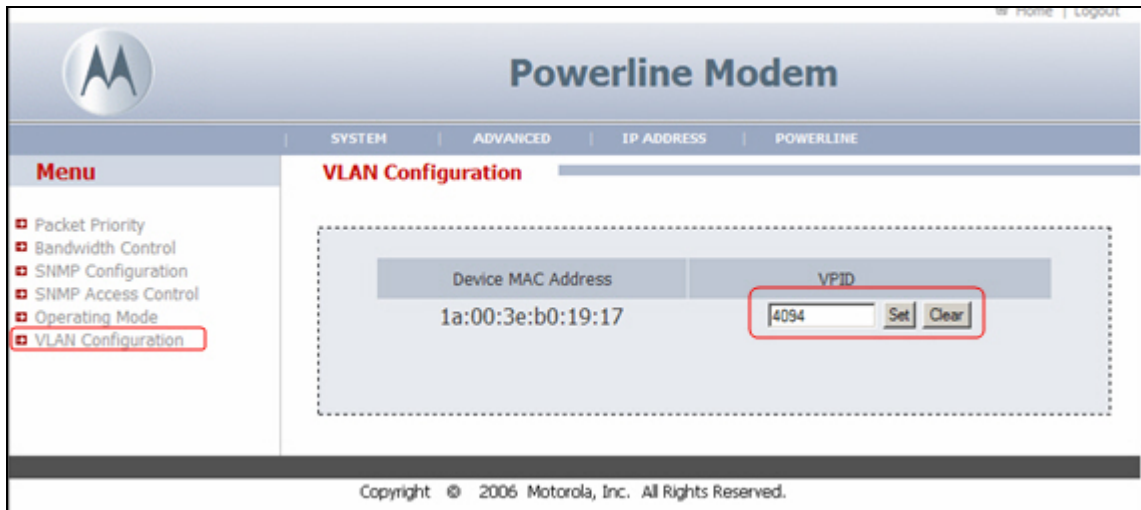


Figure 29. Example Configuration of a Modem in VLAN Pass-Through Mode.

VLAN Implementation using Modems in Bridge Mode:

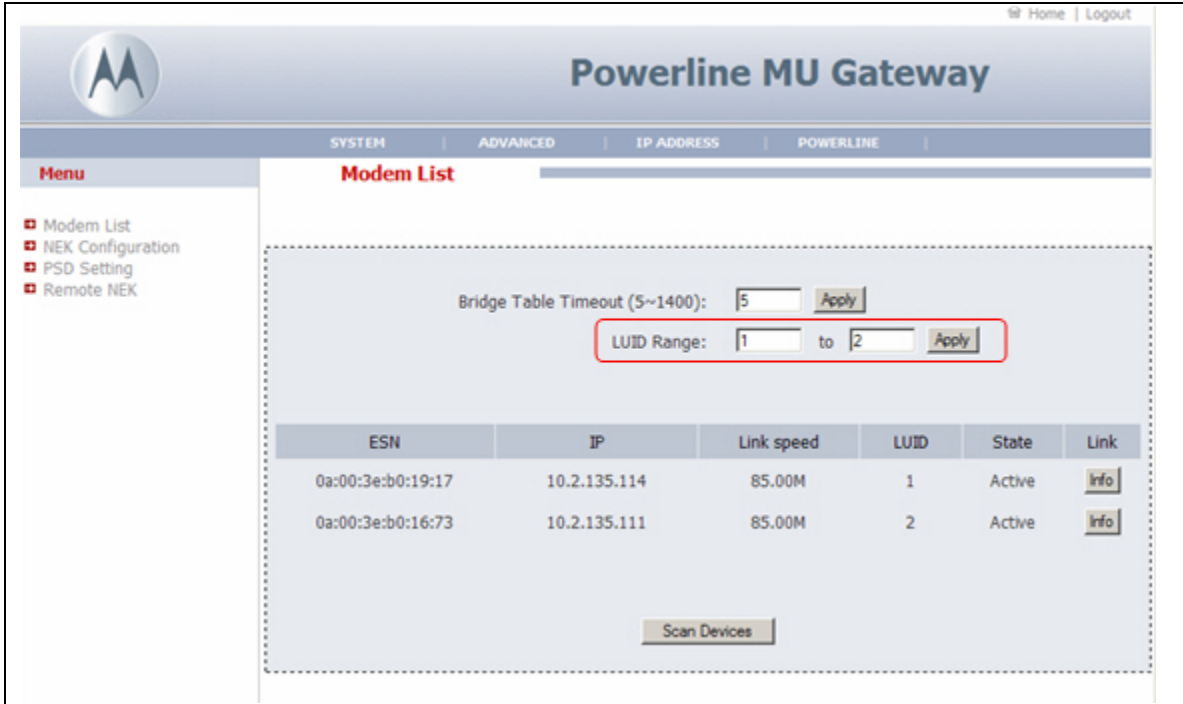
Configuration of the Gateway is the same when operating the Modems in Bridge mode. There are a few differences that you must keep in mind when the modem is in Bridge Mode.

- It is recommended that DHCP not be enabled for devices connected to the Modem since DHCP requests are tagged with the VPID.
- Ethernet devices connected to Powerline Modems can be configured for VLAN pass-through by entering the VPID (VLAN Pass-Through ID) next to the MAC address of the device. Note: The Modem can only support 128 VPID devices.
- Again, ensure that the Management VID is not used as VPID.
- You may mix Bridge mode and NAT mode Modems on the same Powerline network.

Gateway LUID Range Configuration

Firmware version 2.0 allows for the configuration of the LUID range assignment for Powerline MU modems (see Figure 30). This feature allows the ISP full control over their Powerline deployment by controlling the number of Modems which can register to a particular Gateway, which can be particularly useful in large-scale MDU deployments. It is highly recommended that this feature be used to prevent packet collision from Modems in the same Powerline network by ensuring that multiple Gateways do not assign overlapping Modem LUIDs.

Note: When deploying multiple Gateways over the same electric grid, it is important to isolate the Gateways either electrically or ensure that they are using different NEKs.



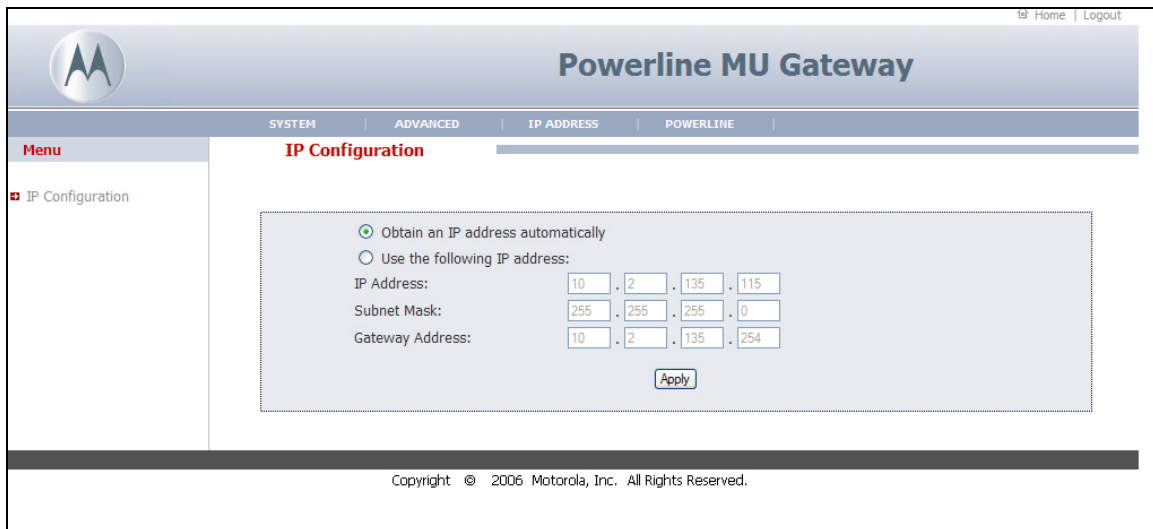
The screenshot shows the 'Modem List' configuration page in the Powerline MU Gateway. The page has a header with the Motorola logo and 'Powerline MU Gateway' title. Below the header is a navigation bar with tabs for SYSTEM, ADVANCED, IP ADDRESS, and POWERLINE. A left-hand menu lists options: Modem List, NEK Configuration, PSD Setting, and Remote NEK. The main content area is titled 'Modem List' and contains configuration fields for 'Bridge Table Timeout (5~1400):' set to 5 and 'LUID Range:' set to 1 to 2. Below these fields is a table of active modems with columns for ESN, IP, Link speed, LUID, State, and Link. A 'Scan Devices' button is located at the bottom of the configuration area.

ESN	IP	Link speed	LUID	State	Link
0a:00:3e:b0:19:17	10.2.135.114	85.00M	1	Active	Info
0a:00:3e:b0:16:73	10.2.135.111	85.00M	2	Active	Info

Figure 30. Modem LUID Range Configuration in the Powerline MU Gateway.

6.4 IP ADDRESS

6.4.1 IP Configuration



Powerline MU Gateway

Home | Logout

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

IP Configuration

IP Configuration

Obtain an IP address automatically
 Use the following IP address:

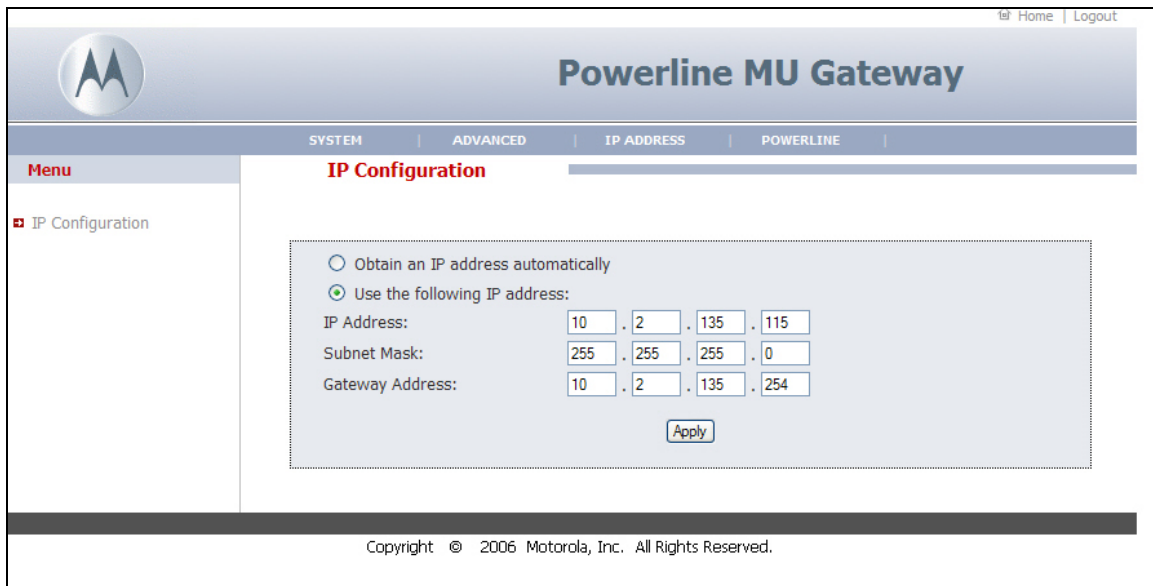
IP Address: 10 . 2 . 135 . 115

Subnet Mask: 255 . 255 . 255 . 0

Gateway Address: 10 . 2 . 135 . 254

Apply

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Powerline MU Gateway

Home | Logout

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

IP Configuration

IP Configuration

Obtain an IP address automatically
 Use the following IP address:

IP Address: 10 . 2 . 135 . 115

Subnet Mask: 255 . 255 . 255 . 0

Gateway Address: 10 . 2 . 135 . 254

Apply

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Figure 31 IP Configuration

On this page, you may configure the Gateway to obtain an IP address automatically, or enter a static IP address.

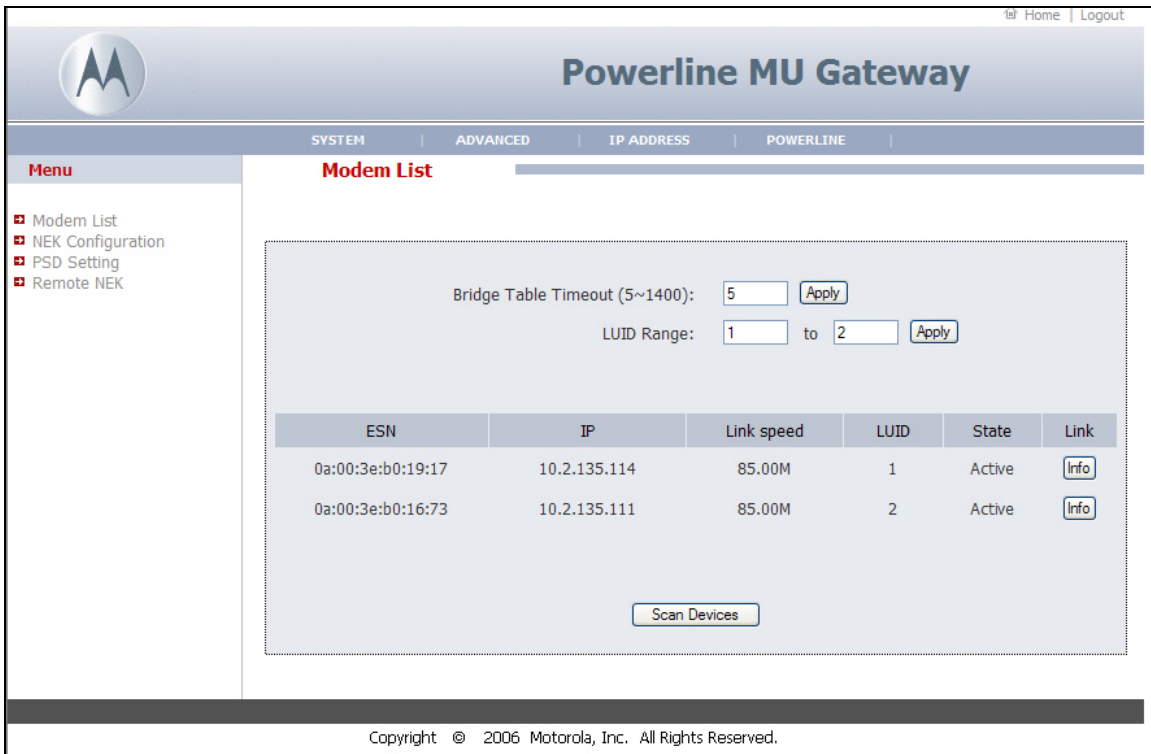
The default IP address is 192.168.1.99.

The subnet mask allows you to break down what appears to be a single large network into smaller ones, which reduces network overhead.

Select **Apply**.

6.5 POWERLINE

6.5.1 Modem List



Powerline MU Gateway

Home | Logout

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- ▣ Modem List
- ▣ NEK Configuration
- ▣ PSD Setting
- ▣ Remote NEK

Modem List

Bridge Table Timeout (5~1400):

LUID Range: to

ESN	IP	Link speed	LUID	State	Link
0a:00:3e:b0:19:17	10.2.135.114	85.00M	1	Active	<input type="button" value="Info"/>
0a:00:3e:b0:16:73	10.2.135.111	85.00M	2	Active	<input type="button" value="Info"/>

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Figure 32 Modem List

The Modem List displays a list of all the modems that appear on the Powerline MU Network. Select **Scan Devices** to update the list.

6.5.2 NEK Configuration

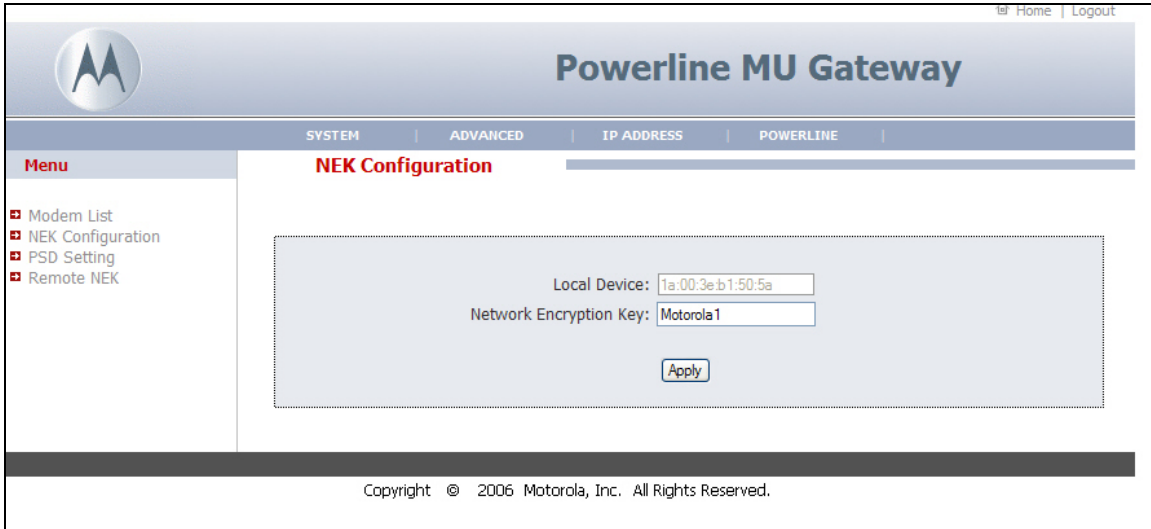


Figure 33 NEK Configuration

You may choose a Network Encryption Key (NEK). Remember to change all the Modems' NEKs to match the Gateway.

Use the Remote NEK screen to change the NEK on the Modems and any Hybrid Adapter Modems in the logical network. Hybrid Adapters must match the NEK of each other, but should not match the Gateway NEK.

The Hybrid Adapter must be physically connected to the Gateway using the Ethernet cable to change the NEK via this web page.

Select **Apply**.

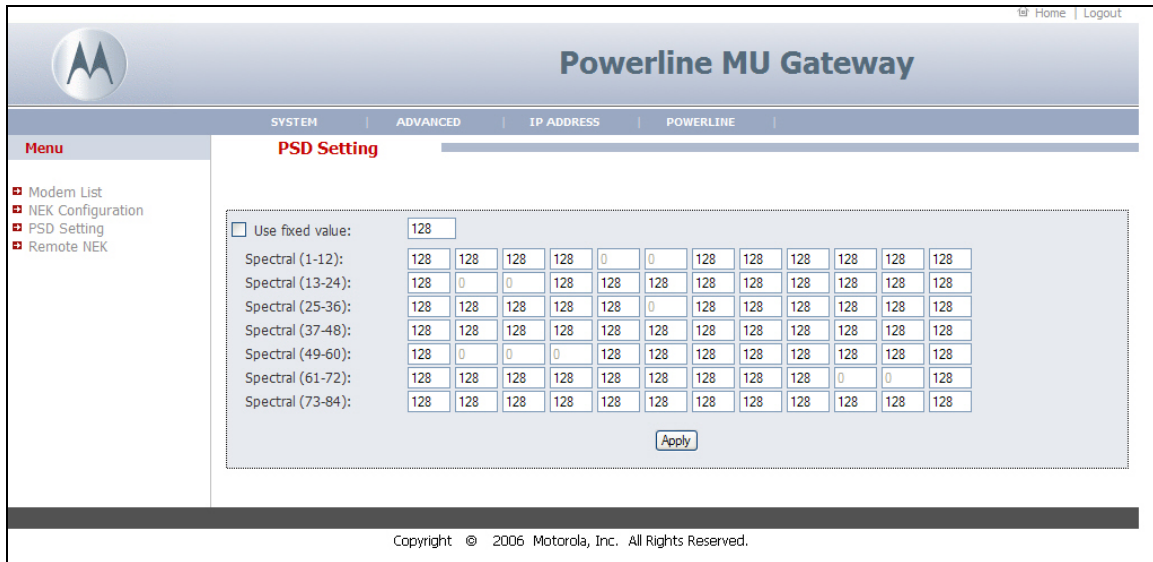
Another method for changing the NEK and name of the hybrid adapter is to use the Administration Utility provided on the CD that was packaged with each Hybrid Adapter. To install the administration utility, insert the CD in the CD drive of your computer. Installation should start automatically. If it does not, select RUN and browse for **setup.exe**. Select **OK**.

A manual for using the administration utility is included with the program.

You must have your computer physically connected to the Hybrid Adapter via an Ethernet cable to make changes using the administration utility.

Both Hybrid Adapters in a system must have the same NEK. Use an NEK that is not the same as the one for the rest of the network.

6.5.3 PSD Setting



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Figure 34 PSD Setting

The PSD (Power Spectral Density) setting screen provides a place for the end user to adjust power levels for each Powerline subcarrier. The factory default is 128. Each subcarrier can be raised or lowered in small steps from 255 down to a value of 0, which will turn it off.

At a PSD value of 128, the power output of the device is about 22dBm, or -50dBm/Hz.

Lowering the values of the PSD setting will lower the power output of the Gateway and/or Modem and correspondingly will decrease the distance at which the devices will be able to communicate. Raising the PSD value increases power output, but if it is raised above approximately 169, noise will start to degrade the signal. When using the Fixed Value check box to set all PSD values. The maximum practical value that can be configured is 169. However, setting the PSD value to 169 or higher can cause intermittent behavior and it is recommended that you use the default value and stay well below 169. If you wish to change each value, you must do so individually.

The PSD page is designed to allow the system operator to respond quickly to any radio frequency complaint and adjust Powerline carriers accordingly.

Grayed out values are reserved amateur operator radio frequencies and cannot be adjusted.

Select **Apply**.

Powerline MU Carriers Linked to Carrier Frequency.

The following chart links carrier frequency to a carrier channel. If you receive a complaint from an amateur radio operator that your Powerline MU system is causing interference, you must work with that person to find out on what frequency the interference exists. When you have determined the offending frequency, find it on the chart and turn down the related PSD setting until the interference no longer exists.

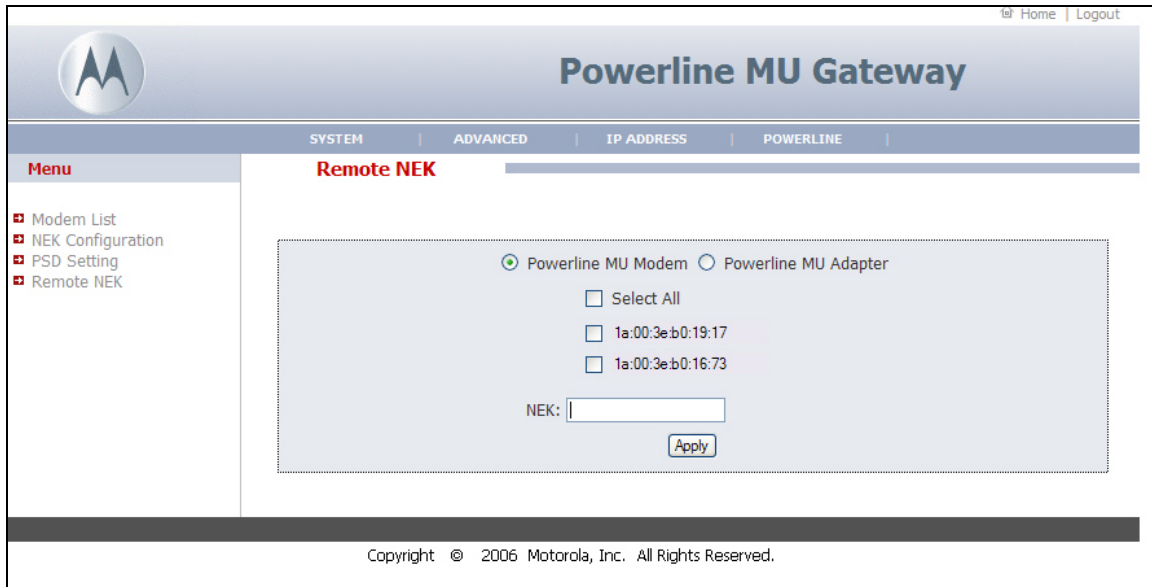
The device passes United States FCC testing at PSD settings 128 and lower. Do not exceed a PSD setting of 60 to be compliant with European regulations. In other regions, the recommended settings may be different.



Table 4 Powerline MU Carriers Linked to Carrier Frequency.

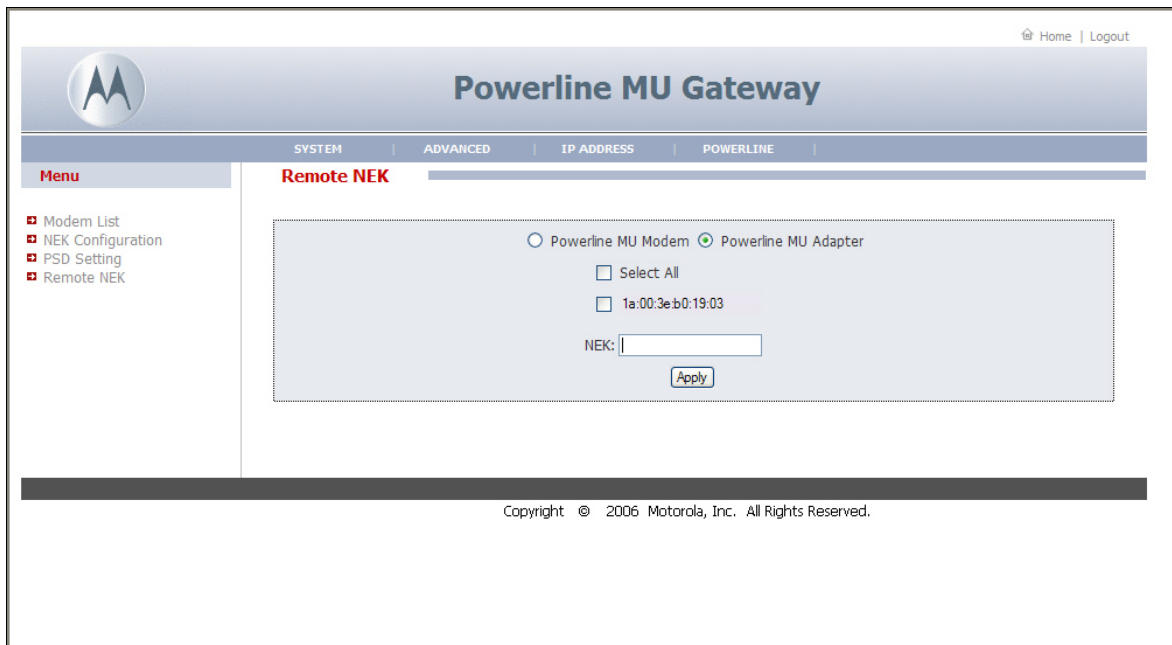
Carrier #	Center Freq (MHz)	Carrier #	Center Freq (MHz)	Carrier #	Center Freq (MHz)
1	4.4921875	29	10.1562500	57	15.6250000
2	4.8828125	30	10.3515625	58	15.8203125
3	5.0781250	31	10.5468750	59	16.0156250
4	5.2734375	32	10.7421875	60	16.2109375
5	5.4687500	33	10.9375000	61	16.4062500
6	5.6640625	34	11.1328125	62	16.6015625
7	5.8593750	35	11.3281250	63	16.7968750
8	6.0546875	36	11.5234375	64	16.9921875
9	6.2500000	37	11.7187500	65	17.1875000
10	6.4453125	38	11.9140625	66	17.3828125
11	6.6406250	39	12.1093750	67	17.5781250
12	6.8359375	40	12.3046875	68	17.7734375
13	7.0312500	41	12.5000000	69	17.9687500
14	7.2265625	42	12.6953125	70	18.1640625
15	7.4218750	43	12.8906250	71	18.3593750
16	7.6171875	44	13.0859375	72	18.5546875
17	7.8125000	45	13.2812500	73	18.7500000
18	8.0078125	46	13.4765625	74	18.9453125
19	8.2031250	47	13.6718750	75	19.1406250
20	8.3984375	48	13.8671875	76	19.3359375
21	8.5937500	49	14.0625000	77	19.5312500
22	8.7890625	50	14.2578125	78	19.7265625
23	8.9843750	51	14.4531250	79	19.9218750
24	9.1796875	52	14.6484375	80	20.1171875
25	9.3750000	53	14.8437500	81	20.3125000
26	9.5703125	54	15.0390625	82	20.5078125
27	9.7656250	55	15.2343750	83	20.7031250
28	9.9609375	56	15.4296875	84	20.8984375
	Notched				

6.5.4 Remote NEK



The screenshot shows the "Remote NEK" configuration page for a Powerline MU Gateway. The page title is "Powerline MU Gateway" and the sub-header is "Remote NEK". The navigation menu includes "SYSTEM", "ADVANCED", "IP ADDRESS", and "POWERLINE". The left sidebar menu has "Modem List", "NEK Configuration", "PSD Setting", and "Remote NEK". The main content area has two radio buttons: "Powerline MU Modem" (selected) and "Powerline MU Adapter". Below these are three checkboxes: "Select All", "1a:00:3e:b0:19:17", and "1a:00:3e:b0:16:73". There is an "NEK:" input field and an "Apply" button. The footer contains the copyright notice: "Copyright © 2006 Motorola, Inc. All Rights Reserved."

Figure 35 Modem NEK Screen (Powerline Modem)



The screenshot shows the "Remote NEK" configuration page for a Powerline MU Gateway. The page title is "Powerline MU Gateway" and the sub-header is "Remote NEK". The navigation menu includes "SYSTEM", "ADVANCED", "IP ADDRESS", and "POWERLINE". The left sidebar menu has "Modem List", "NEK Configuration", "PSD Setting", and "Remote NEK". The main content area has two radio buttons: "Powerline MU Modem" and "Powerline MU Adapter" (selected). Below these are two checkboxes: "Select All" and "1a:00:3e:b0:19:03". There is an "NEK:" input field and an "Apply" button. The footer contains the copyright notice: "Copyright © 2006 Motorola, Inc. All Rights Reserved."

Figure 36 Modem NEK Screen (Hybrid Adapter)

The NEK on the Modems must be the same as the NEK on the Gateway. Change the NEK on the Modems **BEFORE** you change the NEK on the Gateway. Then, change the NEK on the Gateway

Check "Select All" to make the change on all the Powerline Modems in the system.

Enter the NEK. Select **Apply**.

Select **Powerline MU Adapter** if there is a pair of Powerline MU Hybrid Adapters in the system. The two Hybrid Adapters must have matching NEKs, but they should not agree



with the NEK on the Gateway. Only the Hybrid Adapter that is connected to the Gateway can be changed.

To change the NEK of the Hybrid Adapter that connects to the Canopy SM or other broadband access device, physically carry that Hybrid Adapter to the Gateway and plug it in to the Ethernet jack. Enter the MAC address of the Hybrid Adapter and the desired NEK. Be sure both Hybrid Adapters in the system have matching NEKs. Select **Apply**.

Powerline MU Hybrid Adapter Administration Utility

If desired, you can connect the Hybrid Adapter to a computer and change the NEK for that device using the Hybrid Adapter Administration Utility. This utility is supplied on the CD that is in the box with the Powerline MU Hybrid Adapter.

7 Powerline Modem

Install the Powerline Modem according to the directions included in the package.

Remember that the Gateway NEK and Modems NEK must match.

7.1 CONNECT TO THE MODEM

To connect to the modem, use a PC or laptop with a working Ethernet port and a web browser.

Set a static IP address on your laptop to 192.168.1.97. ***You may have to temporarily disable anti-virus software on your computer.***

Using a standard CAT-5 Ethernet cable, connect your PC or laptop to the Ethernet port on the modem.



Figure 37 Modem Connected to Laptop

Open your web browser and enter the following address:

<http://192.168.1.98>.

Enter your user ID and password.

Factory-installed defaults:

User ID: **admin**

Password: **Motorola**

When you first log in to the Modem, the first page displayed will be the System Info screen.

7.1.1 User Interface Navigation tips

The user interface is divided into four main categories:



- **System:** View and make changes in the system. View the system information and logs. Set or change the time and date information, change the password, backup the settings, reboot the system, and upgrade the Modem firmware.
- **Advanced:** The Advanced screen gives you links for setting Packet Priority, Bandwidth Control, SNMP Configuration and SNMP Access Control.
- **IP Address:** Set the Modem to obtain an IP address automatically or to use a specific IP address. Set WAN and DMZ attributes, if desired.
- **Powerline:** Scan devices. Set the Network Encryption Key and view or change PSD settings..

At the top of each screen is a **Home** link to go back to the System Information screen and a **Logout** link to log out of the Modem.

7.2 POWERLINE MODEM SCREEN MAP

Use the following screen map to locate a screen.

System	System Info Password Logs Reset Backup Site Info
Advanced	Packet Priority Bandwidth Control SNMP Configuration SNMP Access Control Operating Mode (Modem Repeater) VLAN Configuration
IP Address	IP Configuration WAN DMZ
Powerline	Scan Devices NEK Configuration PSD Settings

7.3 CONFIGURING THE POWERLINE MODEM

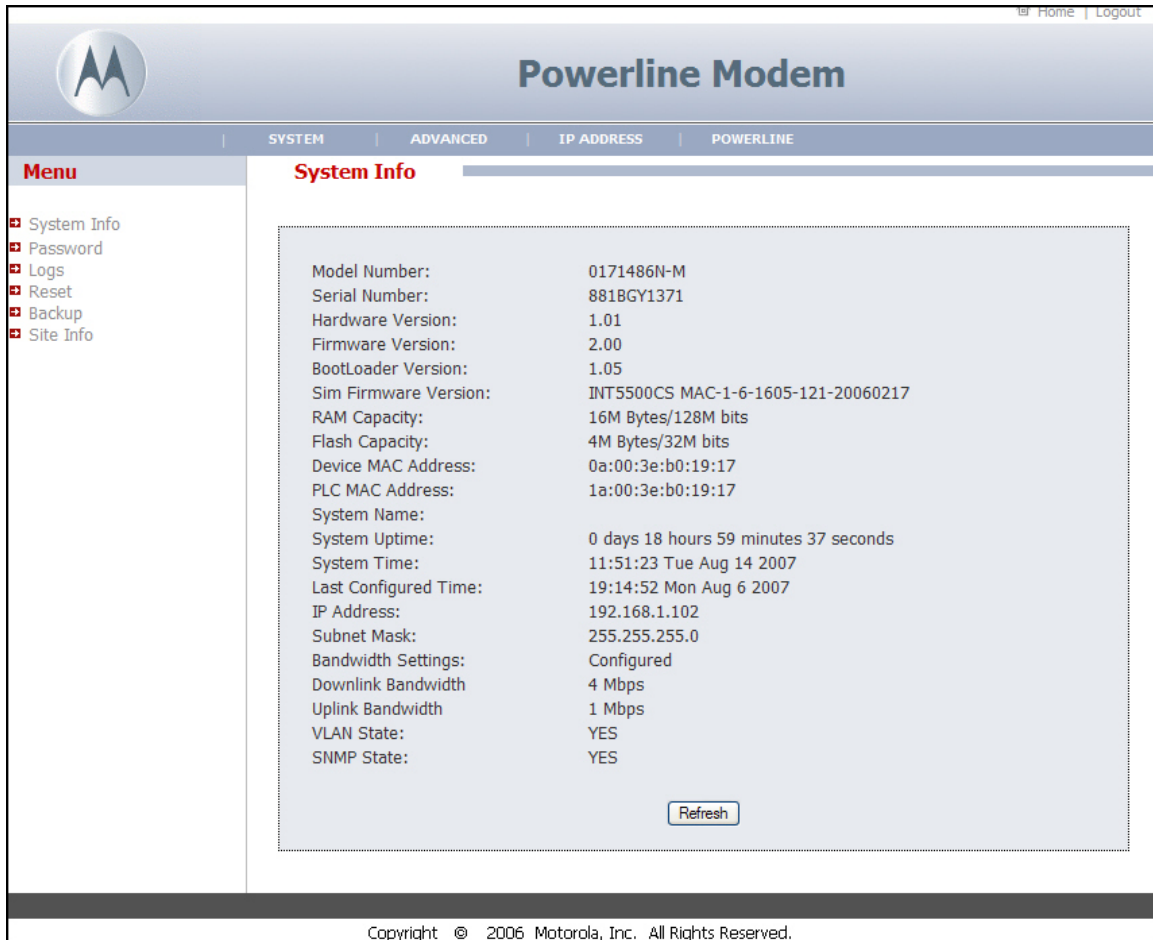
Open an Internet browser (for example, Internet Explorer, Mozilla, or Firefox).

In the address field, type 192.168.1.98 (modem default IP address).

In the welcome screen, enter your User ID and password. The factory default User ID is **admin**. The password is **Motorola**. The User ID and password are case sensitive.

Select **Login**.

7.3.1 System Info



Home | Logout

Powerline Modem

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- System Info
- Password
- Logs
- Reset
- Backup
- Site Info

System Info

Model Number:	0171486N-M
Serial Number:	881BGY1371
Hardware Version:	1.01
Firmware Version:	2.00
BootLoader Version:	1.05
Sim Firmware Version:	INT5500CS MAC-1-6-1605-121-20060217
RAM Capacity:	16M Bytes/128M bits
Flash Capacity:	4M Bytes/32M bits
Device MAC Address:	0a:00:3e:b0:19:17
PLC MAC Address:	1a:00:3e:b0:19:17
System Name:	
System Uptime:	0 days 18 hours 59 minutes 37 seconds
System Time:	11:51:23 Tue Aug 14 2007
Last Configured Time:	19:14:52 Mon Aug 6 2007
IP Address:	192.168.1.102
Subnet Mask:	255.255.255.0
Bandwidth Settings:	Configured
Downlink Bandwidth	4 Mbps
Uplink Bandwidth	1 Mbps
VLAN State:	YES
SNMP State:	YES

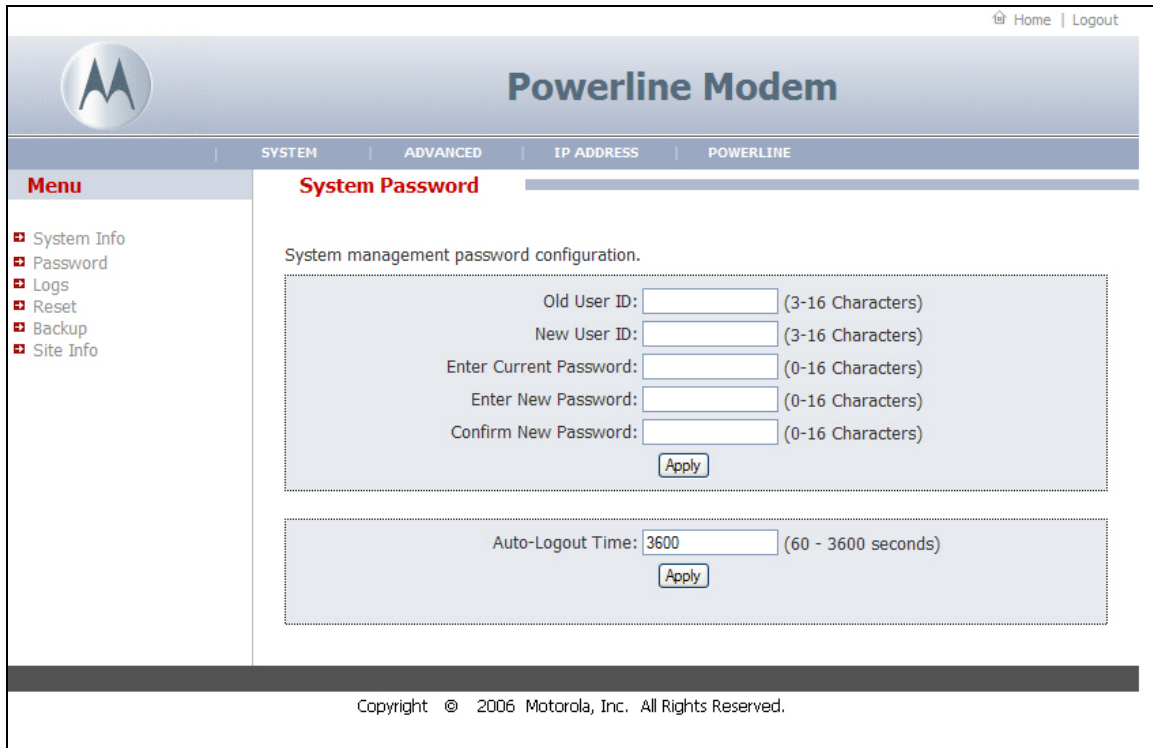
Refresh

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Figure 38 System Info Screen

The System Info page gives you a view of the Modem's status and settings. Select **Refresh** to update the information on the screen.

7.3.2 System Password



Home | Logout

Powerline Modem

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

System Password

System management password configuration.

Old User ID: (3-16 Characters)

New User ID: (3-16 Characters)

Enter Current Password: (0-16 Characters)

Enter New Password: (0-16 Characters)

Confirm New Password: (0-16 Characters)

Auto-Logout Time: (60 - 3600 seconds)

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Figure 39 System Password Screen

You can change the login information for a modem. The default user ID is **admin**. The default password is **Motorola**. For added security, change the user ID and password when you configure the modem.

To change the user ID and password:

Enter the old user ID.

Enter the new user ID.

Enter the current password.

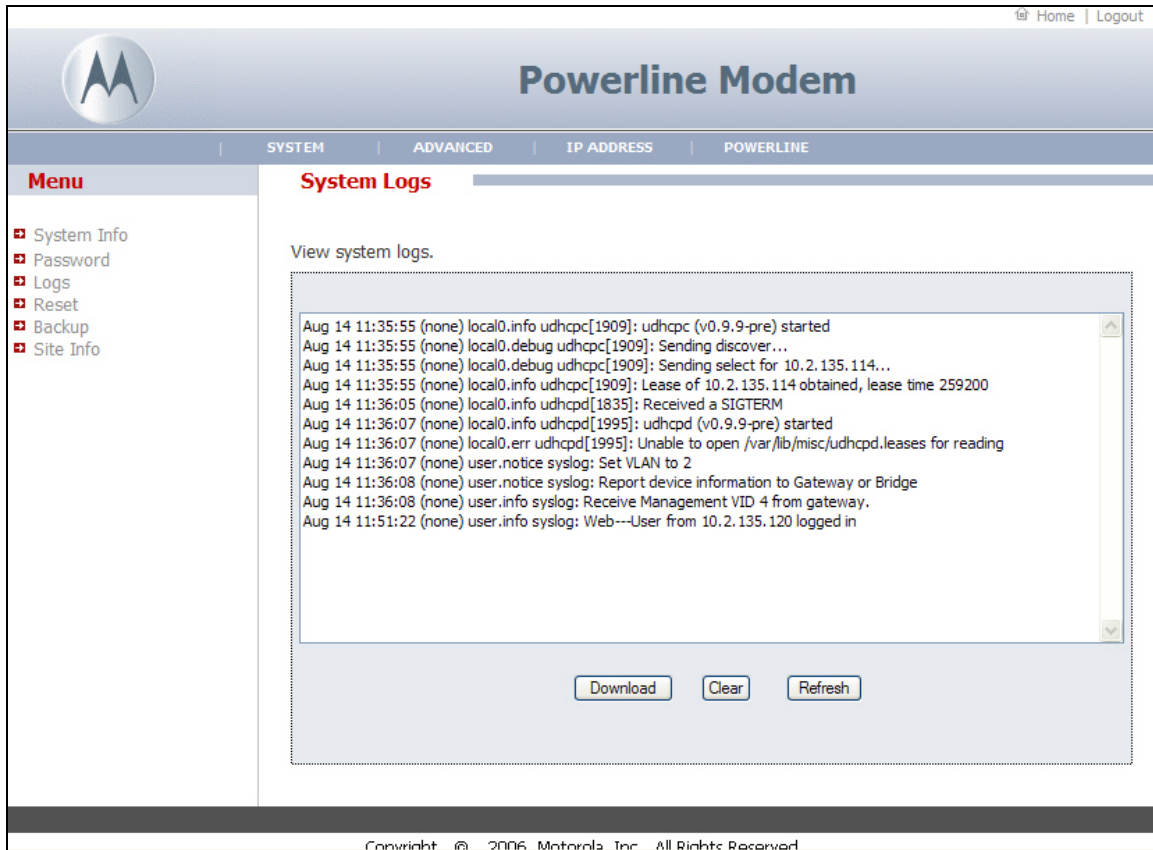
Enter the new password.

Enter the new password again.

Select **Apply**.

To change the time the system will logout automatically, enter a new time, in seconds, in the box and select **Apply**.

7.3.3 System Logs



Home | Logout

Powerline Modem

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- System Info
- Password
- Logs
- Reset
- Backup
- Site Info

System Logs

View system logs.

```

Aug 14 11:35:55 (none) local0.info udhcpd[1909]: udhcpd (v0.9.9-pre) started
Aug 14 11:35:55 (none) local0.debug udhcpd[1909]: Sending discover...
Aug 14 11:35:55 (none) local0.debug udhcpd[1909]: Sending select for 10.2.135.114...
Aug 14 11:35:55 (none) local0.info udhcpd[1909]: Lease of 10.2.135.114 obtained, lease time 259200
Aug 14 11:36:05 (none) local0.info udhcpd[1835]: Received a SIGTERM
Aug 14 11:36:07 (none) local0.info udhcpd[1995]: udhcpd (v0.9.9-pre) started
Aug 14 11:36:07 (none) local0.err udhcpd[1995]: Unable to open /var/lib/misc/udhcpd.leases for reading
Aug 14 11:36:07 (none) user.notice syslog: Set VLAN to 2
Aug 14 11:36:08 (none) user.notice syslog: Report device information to Gateway or Bridge
Aug 14 11:36:08 (none) user.info syslog: Receive Management VID 4 from gateway.
Aug 14 11:51:22 (none) user.info syslog: Web---User from 10.2.135.120 logged in

```

Download Clear Refresh

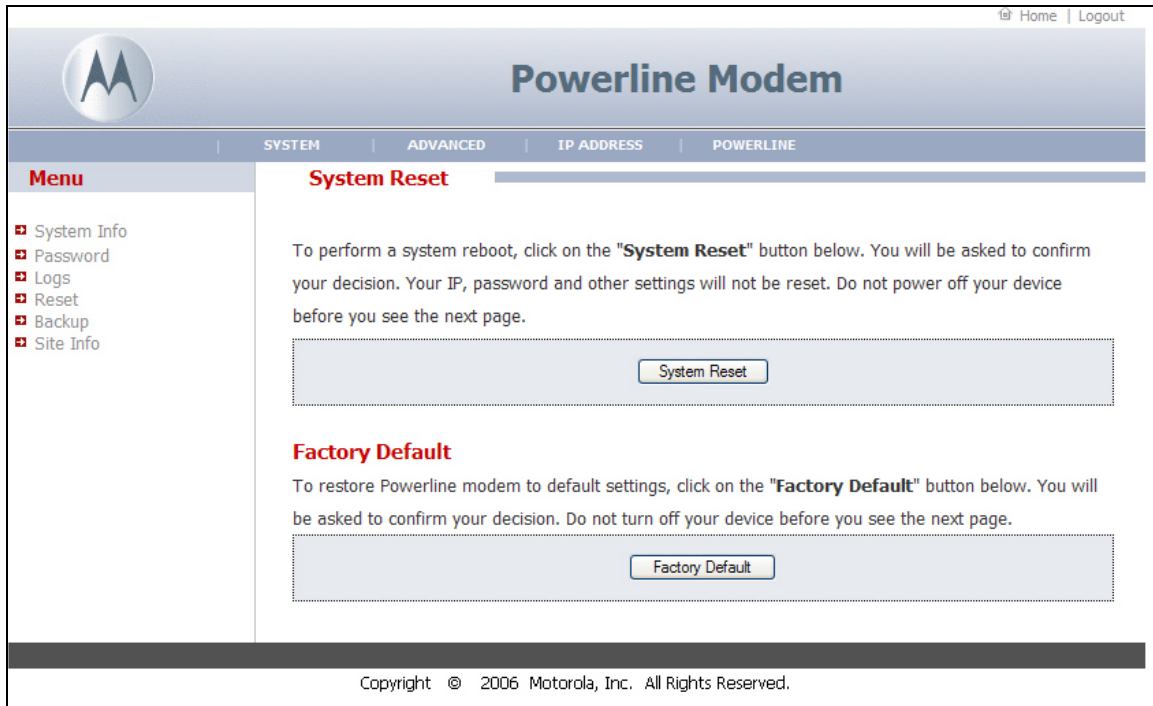
Copyright © 2006 Motorola, Inc. All Rights Reserved.

Figure 40 System Logs Screen

The Powerline Modem maintains a system log which displays potential security threats and system information.

Select **Download** to save the current information to a file. Select **Refresh** to update the information on the screen. Select **Clear** to clear the logs.

7.3.4 Reset



Home | Logout

Powerline Modem

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- ▣ System Info
- ▣ Password
- ▣ Logs
- ▣ Reset
- ▣ Backup
- ▣ Site Info

System Reset

To perform a system reboot, click on the "**System Reset**" button below. You will be asked to confirm your decision. Your IP, password and other settings will not be reset. Do not power off your device before you see the next page.

Factory Default

To restore Powerline modem to default settings, click on the "**Factory Default**" button below. You will be asked to confirm your decision. Do not turn off your device before you see the next page.

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Figure 41 Reset Screen

It may become necessary to reset the Modem if it begins working improperly. Resetting does not change your configuration settings.

Select **System Reset** to reboot the Modem.

Select **Factory Default** to change your Modem back to the factory default **The NEK & PSD settings are not changed**. Do not power off the Modem before you see the affirmation screen.

7.3.5 Backup

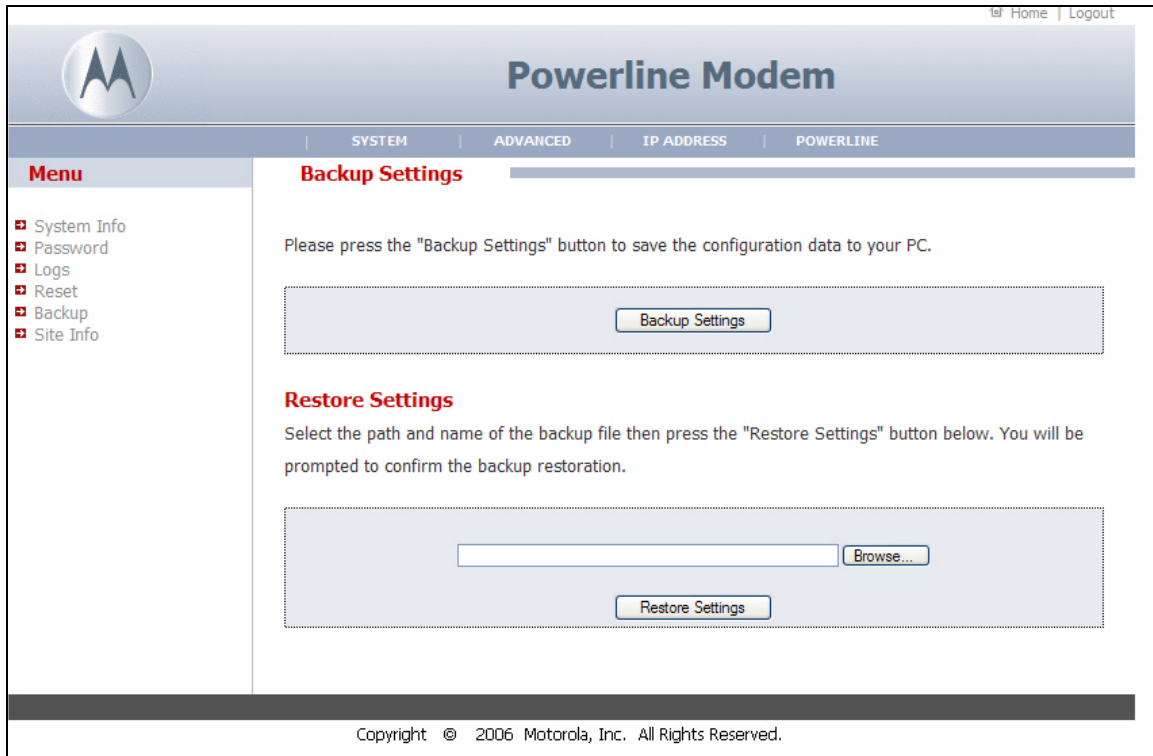
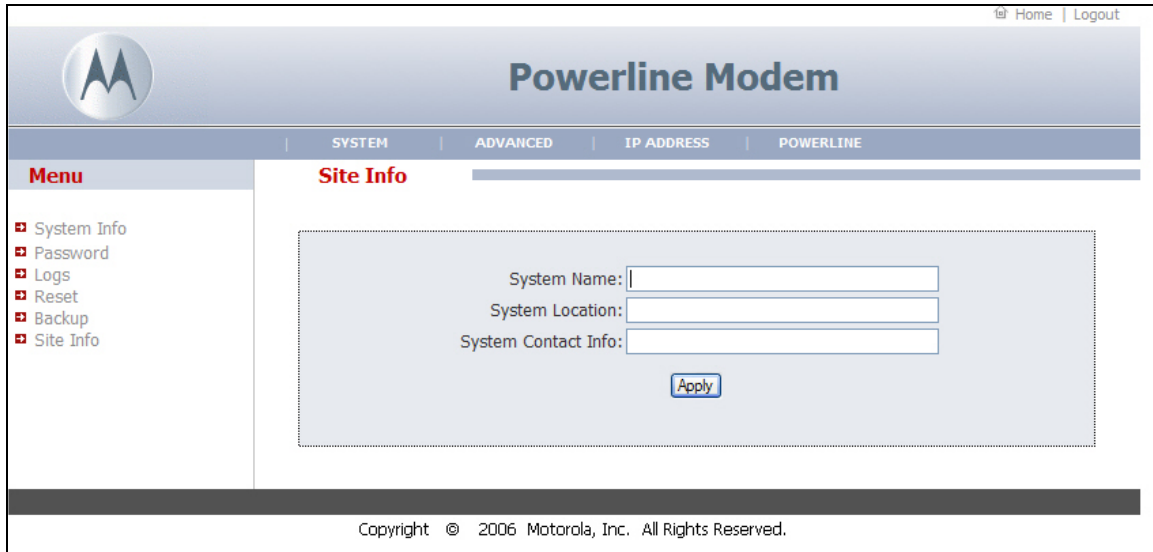


Figure 42 Backup Screen

Select **Backup Settings** to save the current settings to a file. Name the directory and filename.

Use the Browse button to find the file with the settings you want to restore. Then select **Restore Settings**.

7.3.6 Site Info

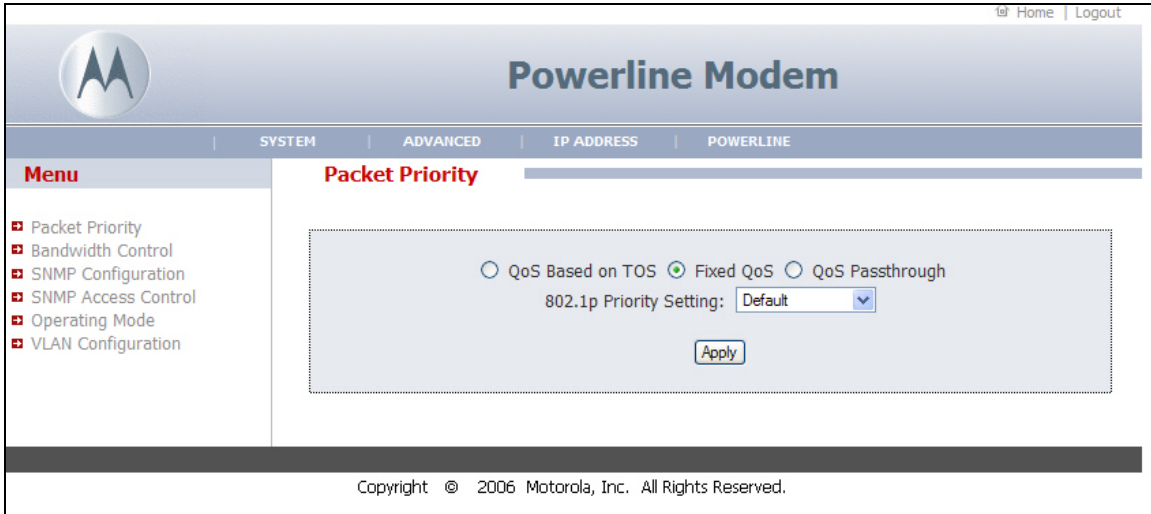


The screenshot shows the 'Powerline Modem' web interface. At the top right, there are links for 'Home' and 'Logout'. The main header features the Motorola logo and the title 'Powerline Modem'. Below the header is a navigation bar with tabs for 'SYSTEM', 'ADVANCED', 'IP ADDRESS', and 'POWERLINE'. A left-hand 'Menu' contains links for 'System Info', 'Password', 'Logs', 'Reset', 'Backup', and 'Site Info'. The 'Site Info' section is active, displaying a form with three input fields: 'System Name:', 'System Location:', and 'System Contact Info:'. An 'Apply' button is positioned below the fields. The footer contains the copyright notice: 'Copyright © 2006 Motorola, Inc. All Rights Reserved.'

Figure 43 Site Info Screen

Enter the name and location of the modem and the contact information for that modem. Select **Apply**.

7.3.7 Advanced Packet Priority



Home | Logout

Powerline Modem

SYSTEM | **ADVANCED** | IP ADDRESS | POWERLINE

Menu

- ❑ Packet Priority
- ❑ Bandwidth Control
- ❑ SNMP Configuration
- ❑ SNMP Access Control
- ❑ Operating Mode
- ❑ VLAN Configuration

Packet Priority

QoS Based on TOS
 Fixed QoS
 QoS Passthrough

802.1p Priority Setting:

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Figure 44 Advanced Packet Priority

Choose the desired Quality of Service (QoS) setting, either based on Type of Service (ToS), Fixed QoS, or QoS Passthrough. If you choose Fixed QoS, use the drop-down menu to select the desired priority setting.

Type Of Service (TOS) bits are a set of three-precedence bit flags in the IP header. When any one of these bit flags is set, routers may handle the datagram differently than those with no TOS bits set. Each of the three precedence bits has a different purpose and only one of the TOS bits may be set at any time, so combinations are not allowed. The bit flags are called Priority bits because they enable the application transmitting the data to tell the network the type of network service it requires.

The network operator can select one of eight levels of QoS for all traffic to and from that modem or can use three ToS bits (three higher order DSCP bits), which are part of the VLAN tag, to determine QoS of individual packets. Select **Apply**.

User Priorities or 3-bit ToS setting	Class of Service	Application class
7	3	Network Control—characterized by a “must get there” requirement to maintain and support the network infrastructure.
6	3	“Voice”—characterized by less than 10 ms delay, and hence maximum jitter (one way transmission through the LAN infrastructure of a single campus).
5	2	“Video” or “Audio” —characterized by less than 100 ms delay.
4	2	Controlled Load—important business applications subject to some form of “admission control,” be that pre-planning of the network requirement at one extreme to bandwidth reservation per flow at the time the flow is started at the other.
3	1	Excellent Effort—or “CEO’s best effort,” the best-effort type services that an information services organization would deliver to its most important customers.
2	0	Best Effort—LAN traffic as we know it today.
1	0	Background—bulk transfers and other activities that are permitted on the network but that should not impact the use of the network by other users and applications.
0	1	Default

7.3.8 Advanced Bandwidth Control

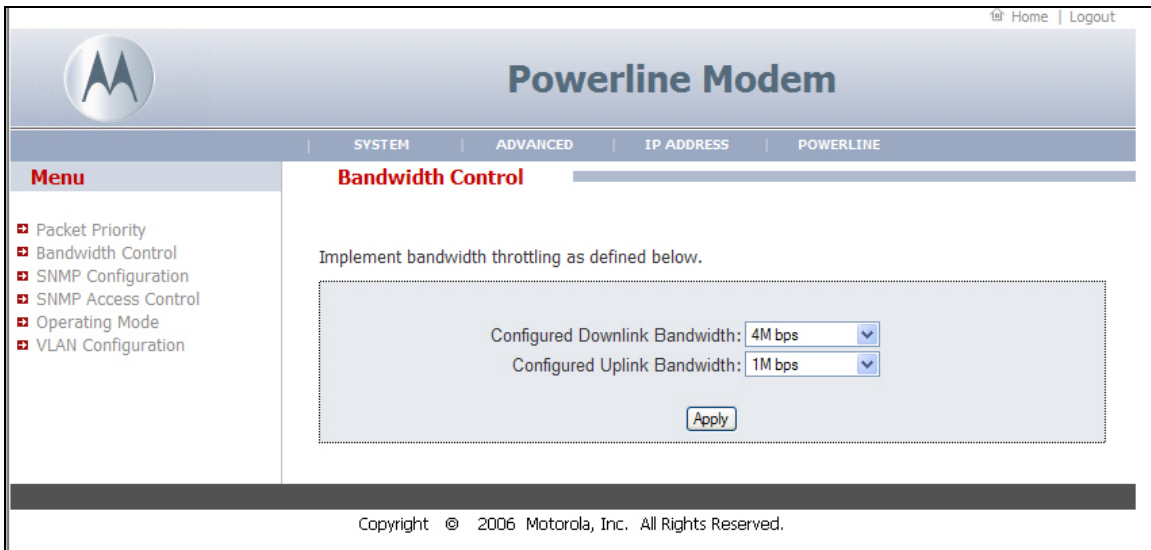


Figure 45 Advanced Bandwidth Control

Individual modems may be set for downlink and uplink sustained rates. The Advanced Bandwidth Control allows you to set a specific speed for the specific modem. Use this control to provide different service to different customers. Select **Apply**.

7.3.9 Advanced SNMP Configuration

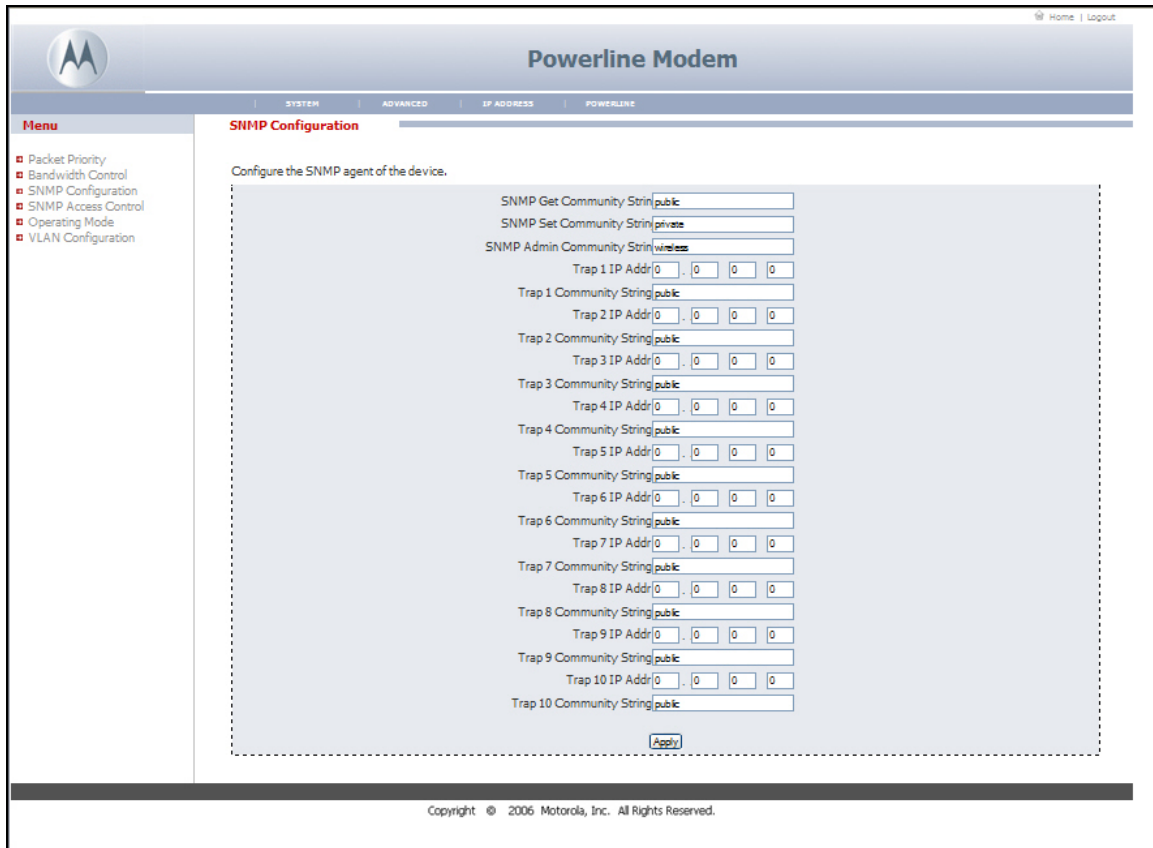


Figure 46 Advanced SNMP Configuration

What is SNMP?

The *Simple Network Management Protocol (SNMP)* is a TCP/IP application layer protocol that allows the exchange of management information between network devices. SNMP enables you to manage network performance and troubleshoot and solve network problems.

To manage a module, SNMP supports the `set` command, which instructs the agent to change the data that manages the module.

To monitor a network element, SNMP supports

- the `get` command, which instructs the agent to send information about the module to the manager in the NMS.
- traversal operations, which the manager uses to identify supported objects and to format information about those objects into relational tables.

In a typical Canopy network, the manager issues these commands to the agents of more than one module.

When a specified event occurs in the module, the agent initiates a trap, for which the agent sends an unsolicited asynchronous message to the manager.

Note: The Powerline Modem supports RFC1213-MIB and WHISP-PLV-MODEM-MIB.



SNMP Get community string can be used to do a "get" operation on the OID's belonging to the following groups:

whispPlvModemInfoGroup, whispPlvModemConfigGroup,
whispPlvModemTrapConfigGroup of WHISP-PLV-MODEM-MIB.

Get community string does not support "set" operation on any of the OID's belonging to WHISP-PLV-MODEM-MIB.

SNMP Set community string can be used to do a "get" and "set" operation on the OID's belonging to the following groups:

whispPlvModemInfoGroup, whispPlvModemConfigGroup,
whispPlvModemTrapConfigGroup of WHISP-PLV-MODEM-MIB.

SNMP Admin Community string can be used to do "get" and "set" operations on all the OID's of WHISP-PLV-MODEM-MIB.

Following table represents the WHISP-PLV-MODEM-MIB groups and the community strings that can be used to access them.

Groups in WHISP-PLV-MODEM-MIB	Access Rights using		
	Get Community String	Set Community String	Admin Community String
whispPlvModemInfoGroup	Get	Get	Get
whispPlvModemConfigGroup	Get	Get and Set	Get and Set
whispPlvModemTrapConfigGroup	Get	Get and Set	Get and Set
whispPlvModemAdmConfigGroup	No Access	No Access	Get and Set
whispPlvModemAdmWConfigGroup	No Access	No Access	Get and Set
whispPlvModemAdmSnmpAccessConfigGroup	No Access	No Access	Get and Set

SNMP Get community string can be used to do "get" operation only on all the OID's of RFC1213-MIB.

SNMP Set and Admin community strings configured in this page can be used to do "get" and "set" operations on all the OID's of RFC1213-MIB.

Please note that SNMP Manager should load WHISP-GLOBAL-REG-MIB and WHISP-TC-MIB, to use WHISP-PLV-MODEM-MIB.

7.3.10 Advanced SNMP Access Control

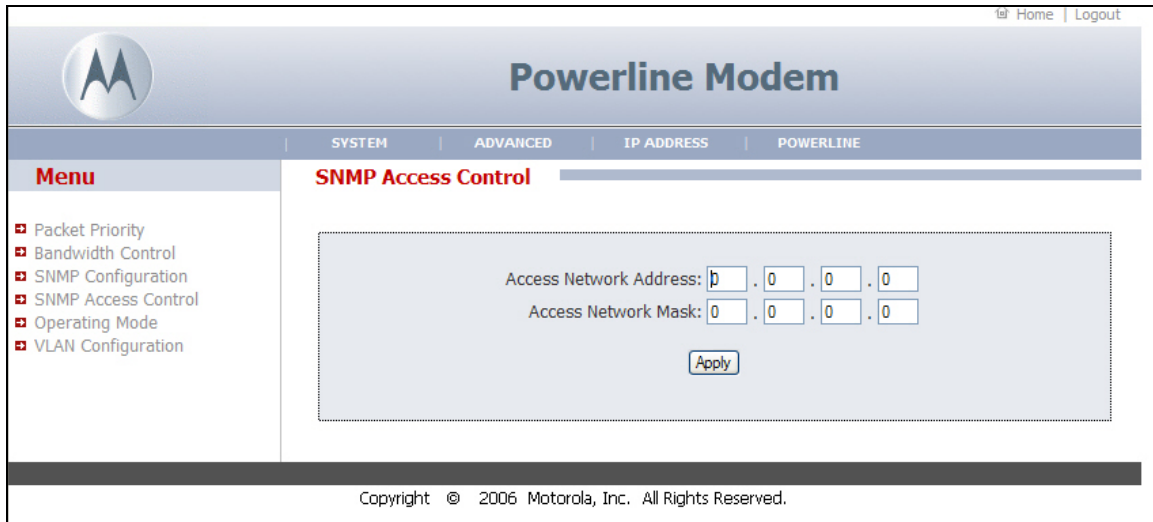


Figure 47 SNMP Access Control Screen

Use this screen to control which IP addresses and networks are allowed to SNMP manage the Modem. Enter the Access Network Address and Mask and select **Apply**.

7.3.11 Operating Mode (Modem Repeater Function)

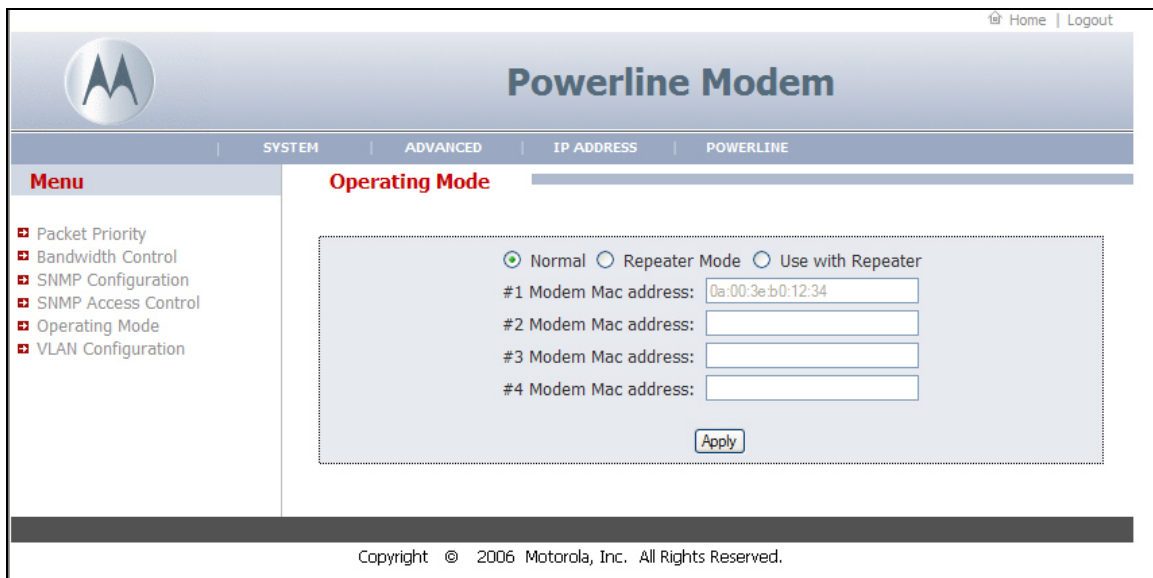


Figure 48 IP Operating Mode (Normal)

The “Operating Mode” option allows any Powerline MU Modem to behave as a Repeater for another Powerline Modem. By turning the first Modem into a Repeater, you can now connect up to four other Modems through the first Modem (see Figure 49). The Modem Repeater is for use in a single residence or office, not for the whole building.

Requirements:

- Modem 2 can not connect to the Gateway.
- In Modem 2, “Powerline→Scan Devices” shows the MAC address of Modem 1 with a good Link Speed (> 20 Mbps).

- Modem 1, Modem 2, and Gateway have the same NEK.

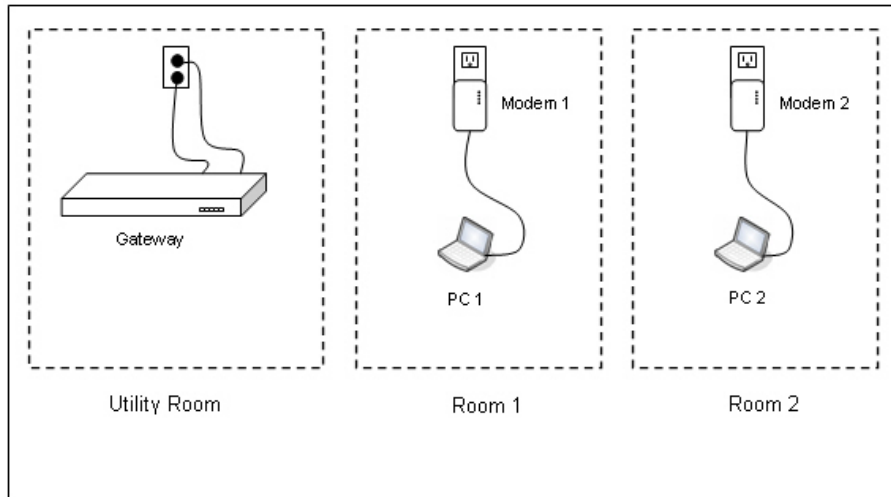
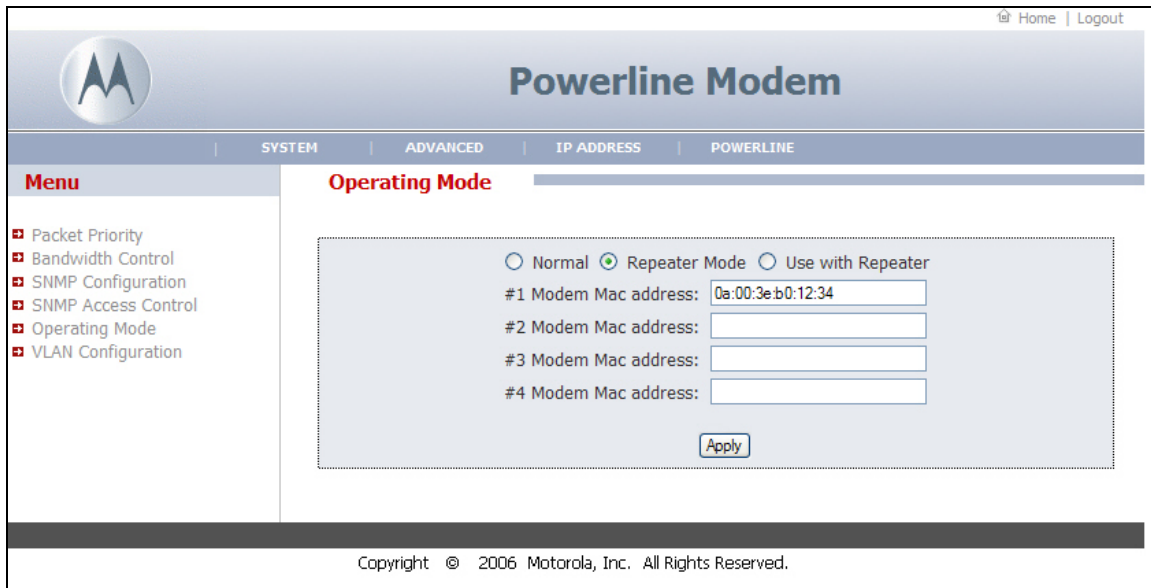


Figure 49 Typical Set Up for the Modem Repeater

Procedure:

To connect Modem 2 to the Gateway, first enable Modem 1 as a Repeater (see Figure 50).



The screenshot shows the Powerline Modem web interface. The top navigation bar includes the Motorola logo, the title "Powerline Modem", and links for "Home" and "Logout". Below the navigation bar are tabs for "SYSTEM", "ADVANCED", "IP ADDRESS", and "POWERLINE". The "Operating Mode" menu item is selected. The main content area displays the "Operating Mode" configuration page. It features three radio buttons: "Normal", "Repeater Mode" (which is selected), and "Use with Repeater". Below the radio buttons are four text input boxes for "Modem Mac address" labeled #1, #2, #3, and #4. The #1 box contains the MAC address "0a:00:3e:b0:12:34". An "Apply" button is located at the bottom of the configuration area. The footer of the page reads "Copyright © 2006 Motorola, Inc. All Rights Reserved."

Figure 50 Operating Mode (Repeater)

Procedure:

- Log into Modem 1 and open the "Operating Mode" menu on the left hand panel.
- Select the radio button for "Repeater Mode."
- Enter the MAC address of Modem 2 into the text input box. Select **Apply**.
- Log into Modem 2, and open the "Operating Mode" menu on the left hand panel.
- Select the "Use with Repeater" radio button and select **Apply**.

Note: Modems will reboot when changing the Operating Mode.

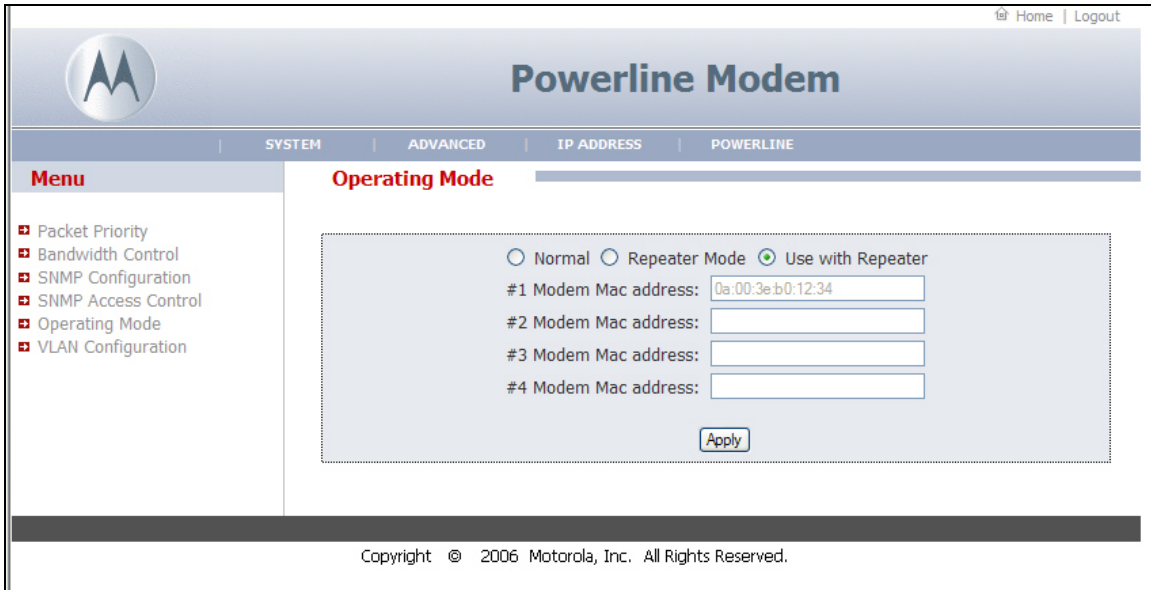


Figure 51 Operating Mode (Use with Re;eater)

General guidelines when using Modems as Repeaters:

- The maximum bandwidth available to Modem 2 is limited to the maximum bandwidth between the Gateway and Modem 1.
- The maximum bandwidth through Modem 2 will be about ½ of the maximum bandwidth over Powerline. Indeed you will be able to go about twice the distance from the Gateway to Modem 1. For example, if the max Layer 2 bandwidth between the Gateway and Modem 1 is 40 Mbps, then the max usable Layer 2 bandwidth between Gateway 1 and Modem 2 will be about 20 Mbps.

7.3.12 VLAN Configuration

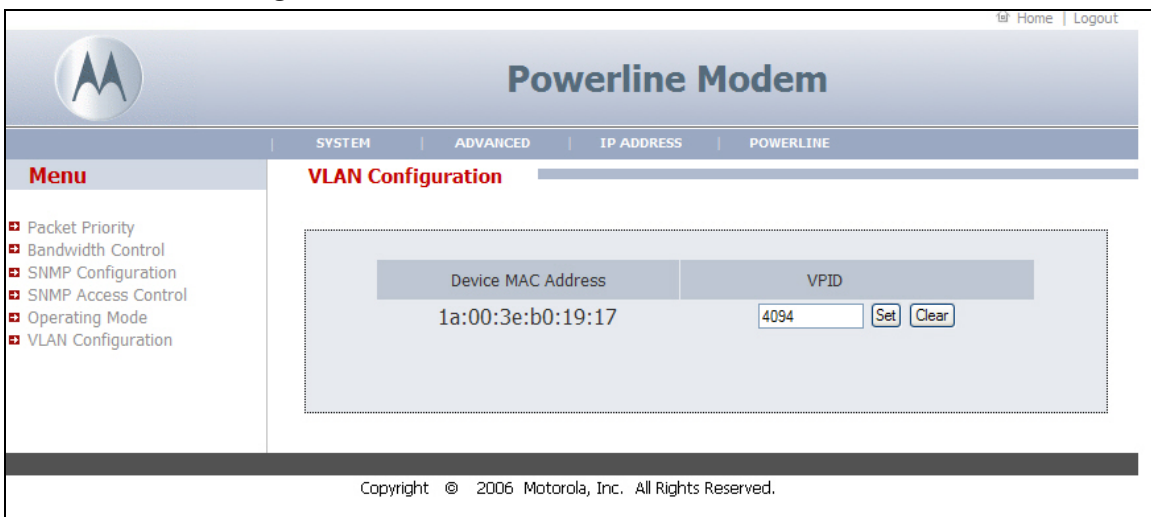
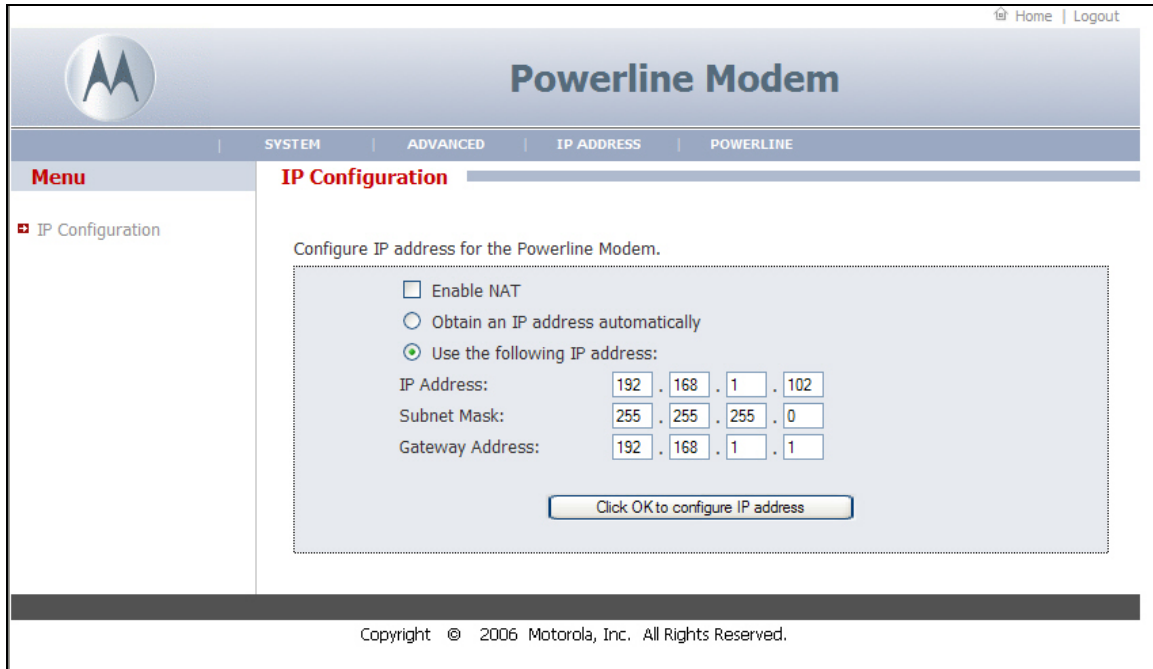


Figure 52 VLAN Configuration (Modem)

If the Gateway is set up for VLAN pass-through, Modems can now be configured for VLAN pass-through by entering the VPID (VLAN Pass-Through ID) for the Modem. Ethernet packets from devices connected to the Modem will be sent to the LAN port of the Gateway and tagged with the Modem’s PLC (Powerline) MAC address (1a:00:3e:b0:19:17). Depending on whether the

request packets were tagged with the Management VLAN ID or VPID, the response packets will be tagged with the respective VLAN ID. For example, if a PC connected to the LAN port of the Gateway sends packets tagged with VLAN ID = 4094, then the Modem will respond with VLAN ID 4094. If the PC pings with VLAN ID = 4 (Management VLAN ID), the Modem will respond with VLAN ID 4.

7.4 IP CONFIGURATION



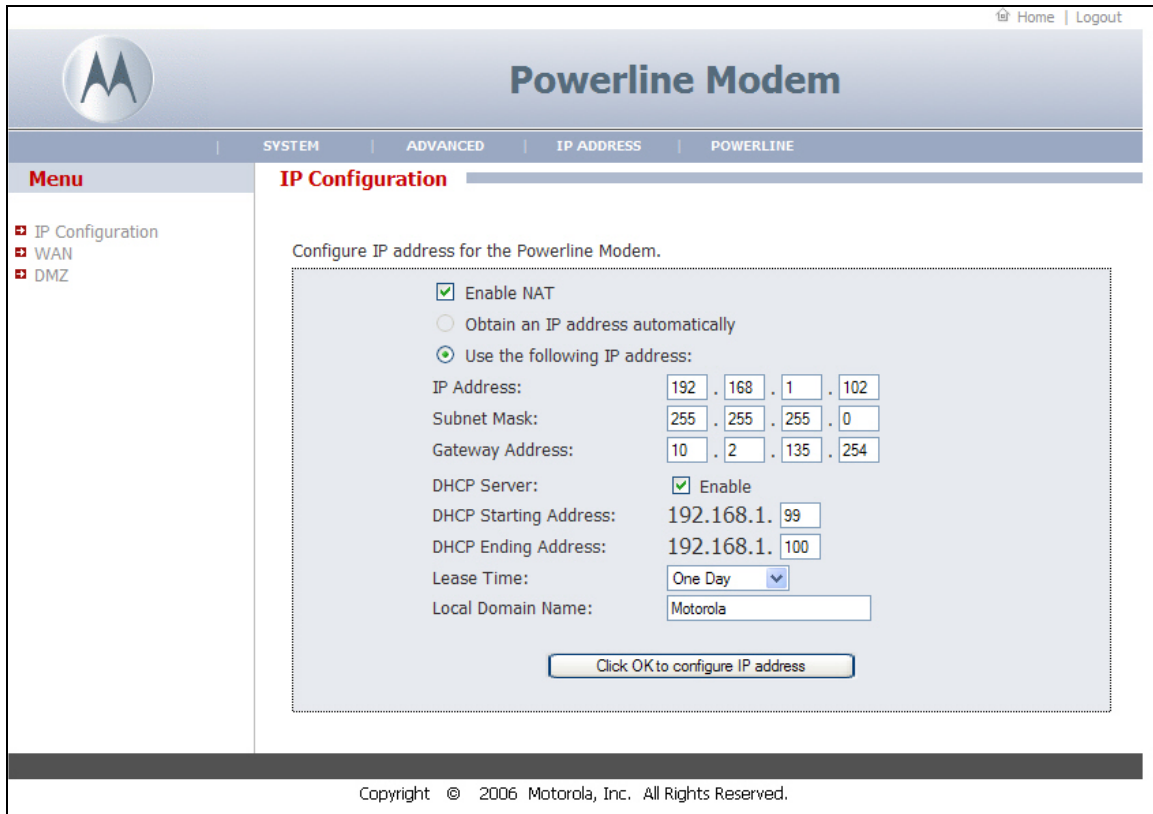
The screenshot shows the 'Powerline Modem' web interface. At the top right, there are links for 'Home' and 'Logout'. The main header features the Motorola logo and the title 'Powerline Modem'. Below the header is a navigation menu with tabs for 'SYSTEM', 'ADVANCED', 'IP ADDRESS', and 'POWERLINE'. The 'IP ADDRESS' tab is selected, and the page title is 'IP Configuration'. On the left, there is a 'Menu' section with a link to 'IP Configuration'. The main content area is titled 'IP Configuration' and contains the following text: 'Configure IP address for the Powerline Modem.' Below this text is a form with three radio button options: 'Enable NAT' (unchecked), 'Obtain an IP address automatically' (unchecked), and 'Use the following IP address:' (checked). Under the 'Use the following IP address:' option, there are three rows of input fields: 'IP Address' with values 192, 168, 1, and 102; 'Subnet Mask' with values 255, 255, 255, and 0; and 'Gateway Address' with values 192, 168, 1, and 1. A button labeled 'Click OK to configure IP address' is located below the input fields. At the bottom of the page, there is a copyright notice: 'Copyright © 2006 Motorola, Inc. All Rights Reserved.'

Set the Modem to obtain an IP address automatically, or enter a different IP address.

The default IP address is 192.168.1.98.

In the screen shown above, NAT is not enabled.

7.4.1 IP Configuration with NAT Enabled



Home | Logout

Powerline Modem

SYSTEM | ADVANCED | **IP ADDRESS** | POWERLINE

Menu

- ▣ IP Configuration
- ▣ WAN
- ▣ DMZ

IP Configuration

Configure IP address for the Powerline Modem.

Enable NAT
 Obtain an IP address automatically
 Use the following IP address:

IP Address: . . .
 Subnet Mask: . . .
 Gateway Address: . . .
 DHCP Server: Enable
 DHCP Starting Address:
 DHCP Ending Address:
 Lease Time: ▾
 Local Domain Name:

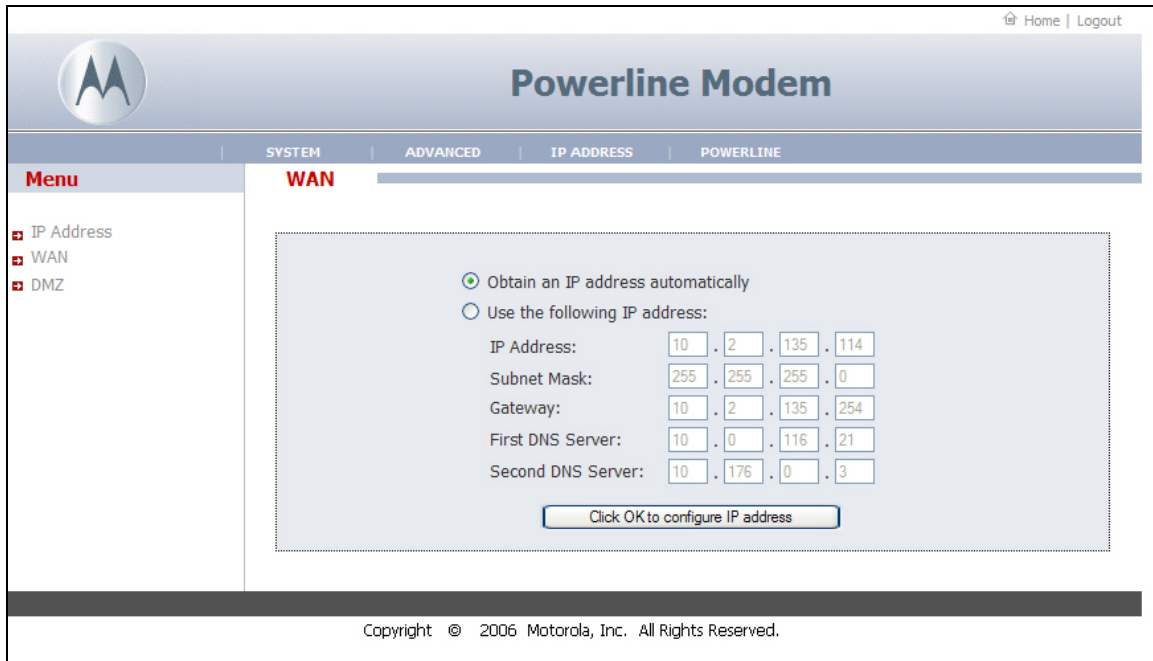
Click OK to configure IP address

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Figure 53 IP Address with NAT Enabled Screen

If enabled, NAT (Network Address Translation) allows the Modem to act as an agent between the Internet and the local network. This means that only a single, unique IP address is required to represent an entire group of computers.

7.4.2 WAN



Home | Logout

Powerline Modem

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- IP Address
- WAN
- DMZ

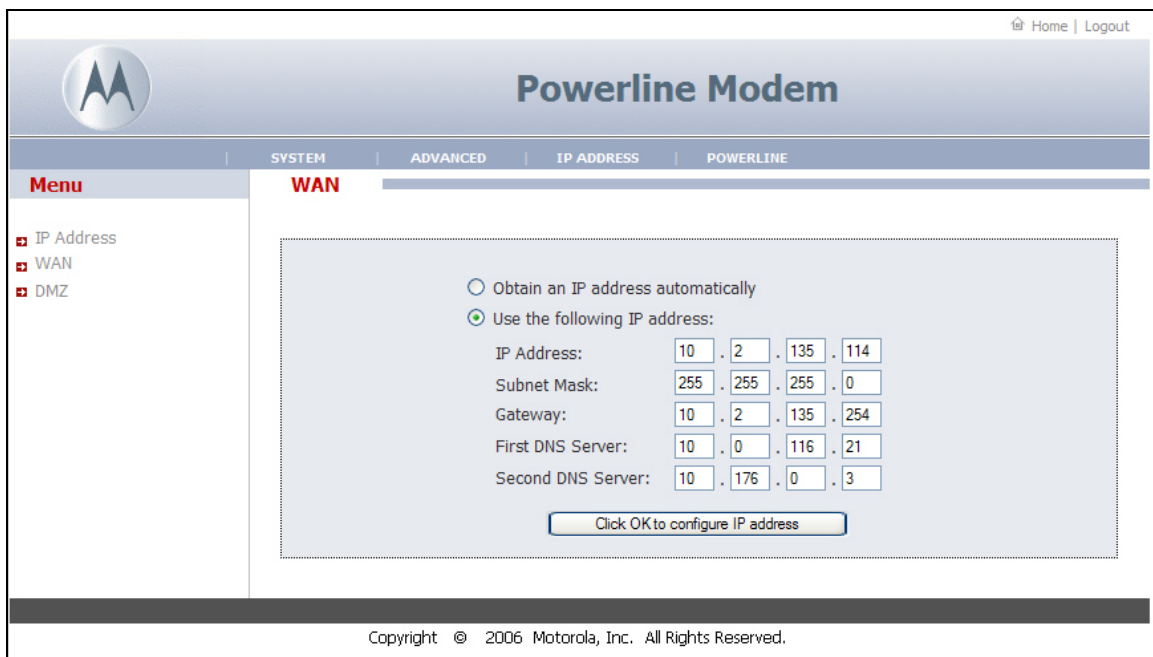
WAN

Obtain an IP address automatically
 Use the following IP address:

IP Address: . . .
 Subnet Mask: . . .
 Gateway: . . .
 First DNS Server: . . .
 Second DNS Server: . . .

Click OK to configure IP address

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Home | Logout

Powerline Modem

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- IP Address
- WAN
- DMZ

WAN

Obtain an IP address automatically
 Use the following IP address:

IP Address: . . .
 Subnet Mask: . . .
 Gateway: . . .
 First DNS Server: . . .
 Second DNS Server: . . .

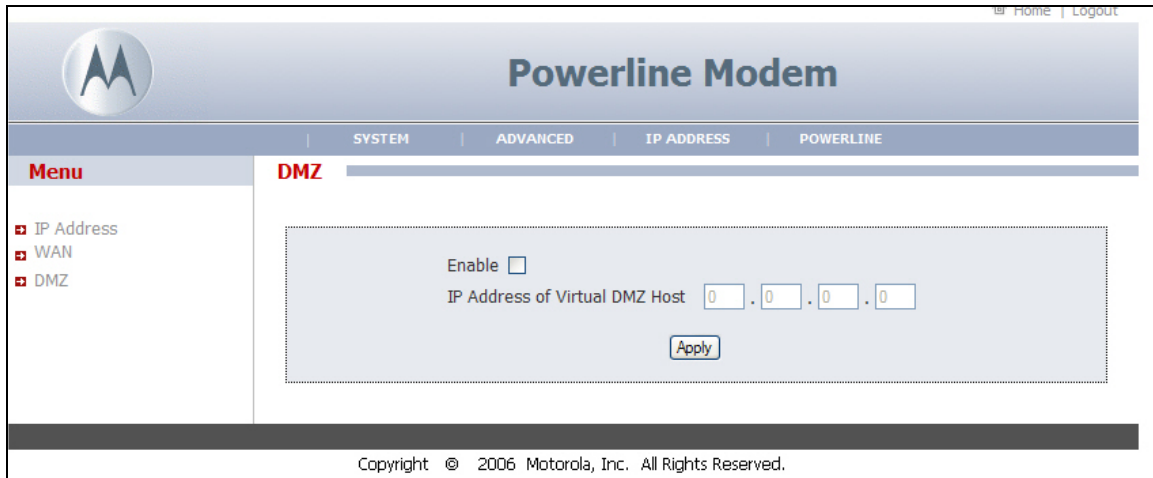
Click OK to configure IP address

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Figure 54 IP Address WAN

Choose whether you want the Modem to obtain an IP address automatically (default) or to use an IP address you enter.

7.4.3 DMZ



Powerline Modem

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- ▣ IP Address
- ▣ WAN
- ▣ DMZ

DMZ

Enable

IP Address of Virtual DMZ Host . . .

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Figure 55 IP Address DMZ

The DMZ (Demilitarized Zone) feature allows you to specify one computer on your network to be placed outside the firewall. DMZ can be used for connecting servers that need to be accessible from the outside world. This may be necessary if the firewall is causing problems with a particular application, such as a game or video conference application.

DMZ can be configured when using the Modem in NAT mode; however, you will not be able to access the WAN IP address of the Modem until an Ethernet device is connected to the LAN port of the Modem. As in the prior example, the Modem will match ingress packet VLAN ID with egress VLAN ID.

Use this feature on a temporary basis. The computer in the DMZ is not protected by the firewall.

View and enable or disable the DMZ setting.

IP Address of Virtual DMZ Host: Enter the IP address of the DMZ host.

Select **Apply** to save the setting.

7.4.4 Scan Devices

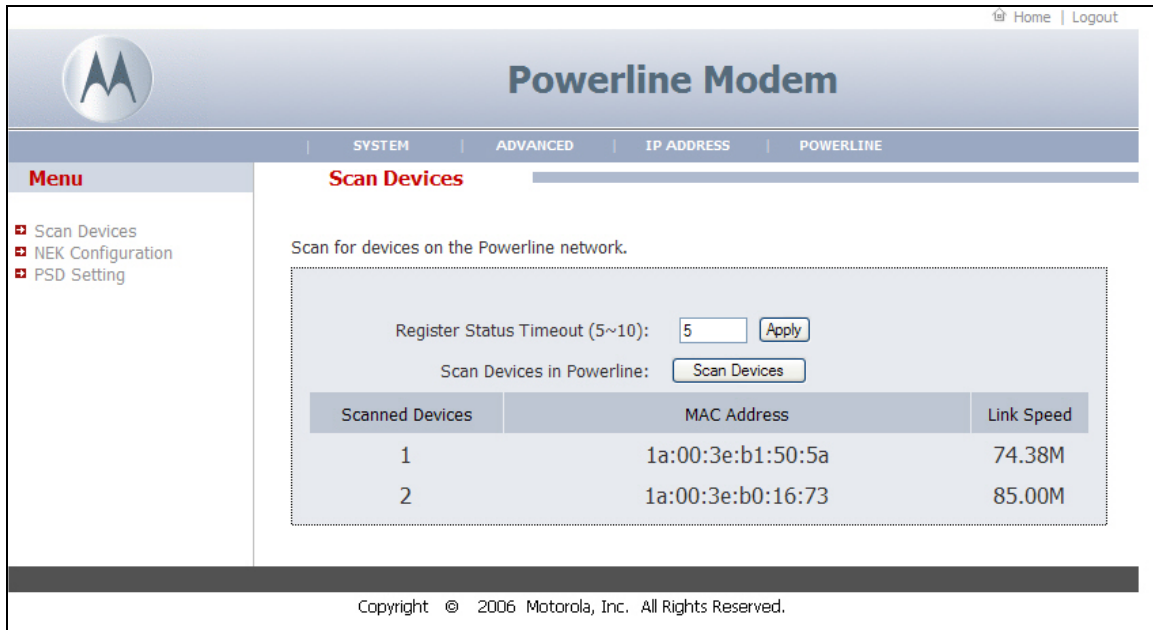


Figure 56 Scan Devices Screen

Select **Scan Devices**. A list of scanned devices on the Powerline Network and the associated MAC addresses and Link Speed will appear in the box.

7.4.5 Network Encryption Key

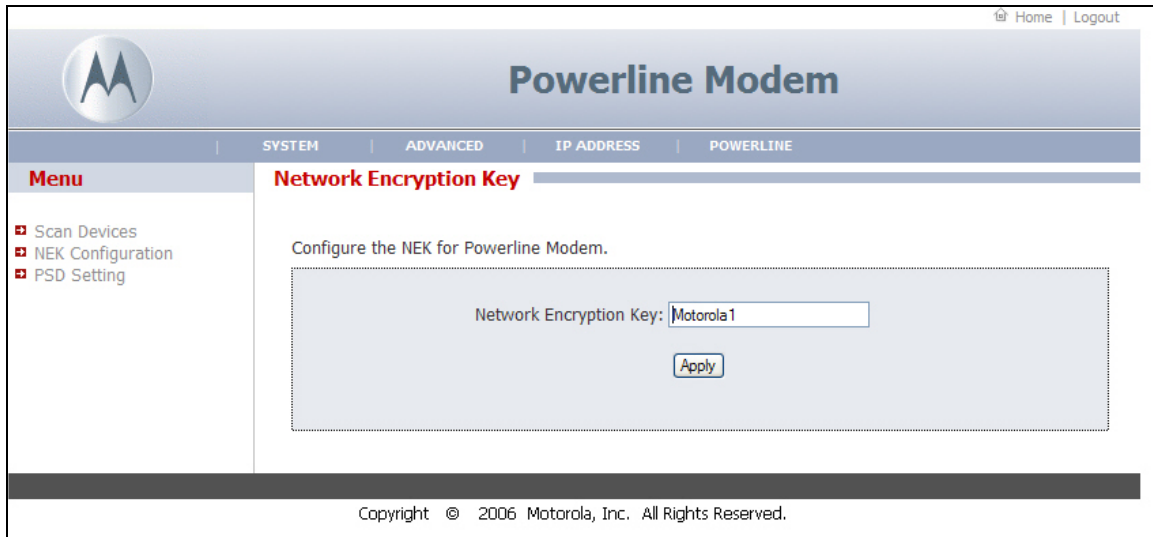
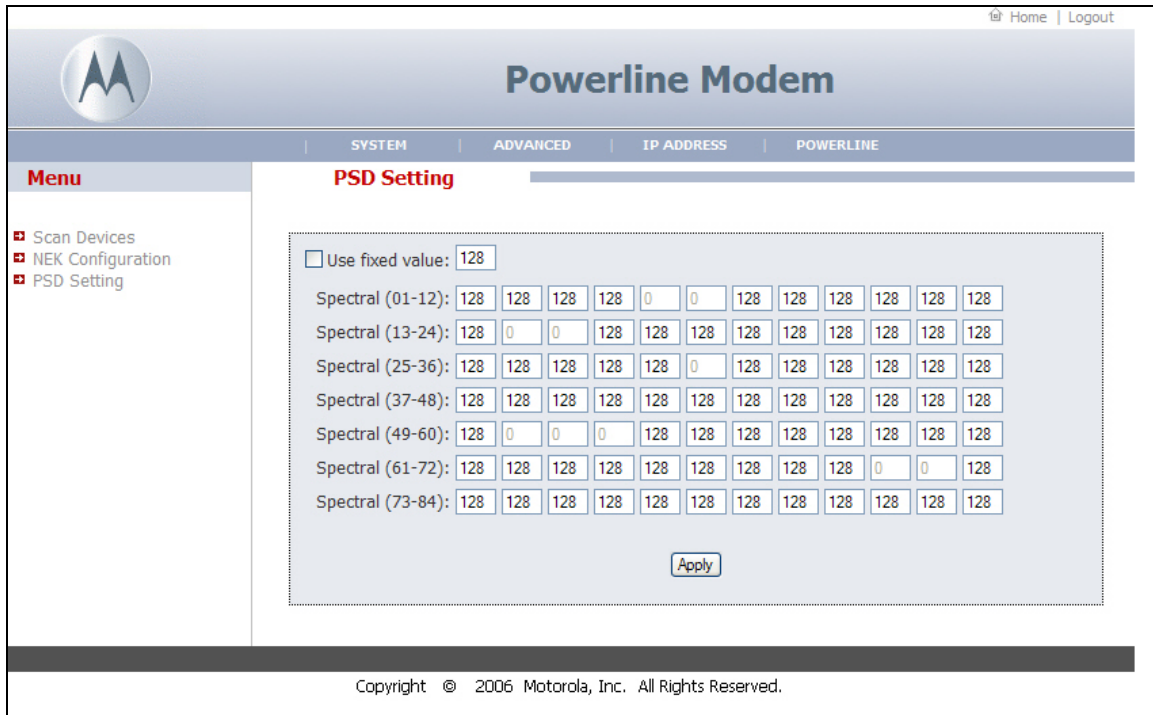


Figure 57 Network Encryption Key Screen

To change the Modem Network Encryption Key, enter the new network encryption key and select **Apply**. The NEK must be the same as entered in the Gateway.

7.4.6 PSD Setting



Home | Logout

Powerline Modem

SYSTEM | ADVANCED | IP ADDRESS | POWERLINE

Menu

- ▣ Scan Devices
- ▣ NEK Configuration
- ▣ PSD Setting

PSD Setting

Use fixed value: 128

Spectral (01-12):	128	128	128	128	0	0	128	128	128	128	128	128
Spectral (13-24):	128	0	0	128	128	128	128	128	128	128	128	128
Spectral (25-36):	128	128	128	128	128	0	128	128	128	128	128	128
Spectral (37-48):	128	128	128	128	128	128	128	128	128	128	128	128
Spectral (49-60):	128	0	0	0	128	128	128	128	128	128	128	128
Spectral (61-72):	128	128	128	128	128	128	128	128	0	0	128	128
Spectral (73-84):	128	128	128	128	128	128	128	128	128	128	128	128

Apply

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Figure 58 PSD Setting Screen

The PSD (Power Spectral Density) setting screen provides a place for the end user to adjust power levels for each Powerline subcarrier. The factory default is 128. Each subcarrier can be raised or lowered in small steps from 255 down to a value of 0, which will turn it off.

At a PSD value of 128, the power output of the device is about 22dBm, or -50dBm/Hz.

Lowering the values of the PSD setting will lower the power output of the gateway and/or modem and correspondingly will decrease the distance at which the devices will be able to communicate. Raising the PSD value increases power output, but if it is raised above approximately 169, noise will start to degrade the signal.

Refer to PSD information for the Gateway, in Section 6.5.3.

The PSD web page is designed to allow the system operator to respond quickly to any radio frequency complaint and adjust Powerline carriers accordingly.

Grayed out values are reserved HAM radio frequencies and cannot be adjusted.

Select **Apply**



8 Legal and Regulatory Notices

8.1 IMPORTANT NOTE ON MODIFICATIONS

Intentional or unintentional changes or modifications to the equipment must not be made unless under the express consent of the party responsible for compliance. Any such modifications could void the user's authority to operate the equipment and will void the manufacturer's warranty.

8.2 NATIONAL AND REGIONAL REGULATORY NOTICES

8.2.1 U.S. Federal Communication Commission (FCC) Notification

This device complies with part 15 of the US FCC Rules and Regulations. 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.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the US 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 these instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to correct the interference by one or more of the following measures:

- Increase the separation between the affected equipment and the unit;
- Connect the affected equipment to a power outlet on a different circuit from that which the receiver is connected to;
- Consult the dealer and/or experienced radio/TV technician for help.

8.2.2 Declarations of Conformity

A signed declaration of conformity to the requirements of the Council of the European Communities follows:

DECLARATION OF CONFORMITY (Gateway)

Česky [Czech]	Motorola tímto prohlašuje, že tento <i>Motorola Powerline MU 0171486Nyy series</i> , je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.
Dansk [Danish]	Undertegnede Motorola erklærer herved, at følgende udstyr <i>Motorola Powerline MU 0171486Nyy series</i> , overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF
Nederlands [Dutch]	Hierbij verklaart Motorola dat het toestel <i>Motorola Powerline MU 0171486Nyy series</i> , in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG
	Bij deze verklaart Motorola dat deze <i>Motorola Powerline MU 0171486Nyy series</i> , voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 1999/5/EC.
English	Hereby, Motorola, declares that this <i>Motorola Powerline MU 0171486Nyy series</i> , is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Eesti [Estonian]	Käesolevaga kinnitab Motorola seadme <i>Motorola Powerline MU 0171486Nyy series</i> , vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.
Suomi [Finnish]	Motorola vakuuttaa täten että <i>Motorola Powerline MU 0171486Nyy series</i> , tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Français [French]	Par la présente Motorola déclare que l'appareil <i>Motorola Powerline MU 0171486Nyy series</i> , est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE
	Par la présente, Motorola déclare que ce <i>Motorola Powerline MU 0171486Nyy series</i> , est conforme aux exigences essentielles et aux autres dispositions de la directive 1999/5/CE qui lui sont applicables
Deutsch [German]	Hiermit erklärt Motorola, dass sich diese <i>Motorola Powerline MU 0171486Nyy series</i> , in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 1999/5/EG befindet". (BMW)
	Hiermit erklärt Motorola die Übereinstimmung des Gerätes <i>Motorola Powerline MU 0171486Nyy series</i> , mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG. (Wien)
Ελληνική [Greek]	<i>ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ</i> Motorola <i>ΔΗΛΩΝΕΙ ΟΤΙ</i> <i>Motorola Powerline MU 0171486Nyy series</i> , <i>ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/EK</i>

Magyar [Hungarian]	Alulírott, Motorola nyilatkozom, hogy a <i>Motorola Powerline MU 0171486Nyy series</i> , megfelel a vonatkozó alapvető követelményeknek és az 1999/5/EC irányelv egyéb előírásainak.
Íslenska [Icelandic]	Hér með lýsir Motorola yfir því að <i>Motorola Powerline MU 0171486Nyy series</i> , er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 1999/5/EC.
Italiano [Italian]	Con la presente Motorola dichiara che questo <i>Motorola Powerline MU 0171486Nyy series</i> , è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Latviski [Latvian]	Ar šo Motorola deklarē, ka <i>Motorola Powerline MU 0171486Nyy series</i> , atbilst Direktīvas 1999/5/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.
Lietuvių [Lithuanian]	Šiuo Motorola deklaruoja, kad šis <i>Motorola Powerline MU 0171486Nyy series</i> , atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.
Malti [Maltese]	Hawnhekk, Motorola, jiddikjara li dan <i>Motorola Powerline MU 0171486Nyy series</i> , jikkonforma mal-ħtiġijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Dirrettiva 1999/5/EC
Norsk [Norwegian]	Motorola erklærer herved at utstyret <i>Motorola Powerline MU 0171486Nyy series</i> , er i samsvar med de grunnleggende krav og øvrige relevante krav i direktiv 1999/5/EF.
Slovensky [Slovak]	Motorola týmto vyhlasuje, že <i>Motorola Powerline MU 0171486Nyy series</i> , spĺňa základné požiadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.
Slovensko [Slovenian]	Motorola izjavlja, da je ta <i>Motorola Powerline MU 0171486Nyy series</i> , v skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 1999/5/ES.
Svenska Swedish	Härmed intygar Motorola att denna <i>Motorola Powerline MU 0171486Nyy series</i> , står i överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.
Español [Spanish]	Por medio de la presente Motorola declara que el <i>Motorola Powerline MU 0171486Nyy series</i> , cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE
Polski [Polish]	Niniejszym, firma Motorola oświadcza, że produkt serii <i>Motorola Powerline MU 0171486Nyy series</i> , spełnia zasadnicze wymagania i inne istotne postanowienia Dyrektywy 1999/5/EC.
Português [Portuguese]	Motorola declara que este <i>Motorola Powerline MU 0171486Nyy series</i> , está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.



DECLARATION OF CONFORMITY

Motorola declares under its sole responsibility that the products, to which this declaration relates, conform to the applicable essential requirements of the following Directive(s) of the Council of the European Communities:

- 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on the radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).
- 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).
- 72/23/EEC of 19 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).

Product: Model: Motorola Powerline MU Gateway **0171486Nyy**

Where “yy”=“04”

Model Number	Description
0171486N04	Powerline MU Gateway Type C Plug – 2 round pin European

Manufacturer: Motorola Inc.

Description: Power Line Communication Device (PLC Gateway)

Conformity: Harmonized standards used to demonstrate conformity:

The products have been shown to meet the following requirements:

- a) Safety – certified to EN 60950-1:2001+A11:2004 First Edition
- b) EMC – certified to meet EN55022:1998+A1:2000+A2:2003 (class B), EN55024:1998+A1:2001+A2:2003, CISPR/1/xyz/DPAS CISPR 22 A2 f9 Ed 4.0 with T-ISN, EN 61000-3-2:2000+A2:2005, EN 61000-3-3+A1:2001+A2:2005

Year of first application of CE mark: 2007

Notified Body number: 0682

Notified Body address: CETECOM ICT Services GmbH, Untertürkheimer Straße 6-10, D-66117 Saarbrücken, Germany

Signature:

Name: Philip Bolt

Aaron Ratner

Title: _____

Title: Canopy Quality Manager

Date: June 1, 2007

DECLARATION OF CONFORMITY (Modem)

Česky [Czech]	Motorola tímto prohlašuje, že tento <i>Motorola Powerline MU 0171486Nxx series</i> , je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.
Dansk [Danish]	Undertegnede Motorola erklærer herved, at følgende udstyr <i>Motorola Powerline MU 0171486Nxx series</i> , overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF
Nederlands [Dutch]	Hierbij verklaart Motorola dat het toestel <i>Motorola Powerline MU 0171486Nxx series</i> , in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG
	Bij deze verklaart Motorola dat deze <i>Motorola Powerline MU 0171486Nxx series</i> , voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 1999/5/EC.
English	Hereby, Motorola, declares that this <i>Motorola Powerline MU 0171486Nxx series</i> , is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Eesti [Estonian]	Käesolevaga kinnitab Motorola seadme <i>Motorola Powerline MU 0171486Nxx series</i> , vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.
Suomi [Finnish]	Motorola vakuuttaa täten että <i>Motorola Powerline MU 0171486Nxx series</i> , tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Français [French]	Par la présente Motorola déclare que l'appareil <i>Motorola Powerline MU 0171486Nxx series</i> , est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE
	Par la présente, Motorola déclare que ce <i>Motorola Powerline MU 0171486Nxx series</i> , est conforme aux exigences essentielles et aux autres dispositions de la directive 1999/5/CE qui lui sont applicables
Deutsch [German]	Hiermit erklärt Motorola, dass sich diese <i>Motorola Powerline MU 0171486Nxx series</i> , in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 1999/5/EG befindet". (BMW)
	Hiermit erklärt Motorola die Übereinstimmung des Gerätes <i>Motorola Powerline MU 0171486Nxx series</i> , mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG. (Wien)
Ελληνική [Greek]	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Motorola ΔΗΛΩΝΕΙ ΟΤΙ <i>Motorola Powerline MU 0171486Nxx series</i> , ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/EK

Magyar [Hungarian]	Alulírott, Motorola nyilatkozom, hogy a <i>Motorola Powerline MU 0171486Nxx series</i> , megfelel a vonatkozó alapvető követelményeknek és az 1999/5/EC irányelv egyéb előírásainak.
Íslenska [Icelandic]	Hér með lýsir Motorola yfir því að <i>Motorola Powerline MU 0171486Nxx series</i> , er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 1999/5/EC.
Italiano [Italian]	Con la presente Motorola dichiara che questo <i>Motorola Powerline MU 0171486Nxx series</i> , è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Latviski [Latvian]	Ar šo Motorola deklarē, ka <i>Motorola Powerline MU 0171486Nxx series</i> , atbilst Direktīvas 1999/5/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.
Lietuvių [Lithuanian]	Šiuo Motorola deklaruoja, kad šis <i>Motorola Powerline MU 0171486Nxx series</i> , atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.
Malti [Maltese]	Hawnhekk, Motorola, jiddikjara li dan <i>Motorola Powerline MU 0171486Nxx series</i> , jikkonforma mal-ħtiġijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Dirrettiva 1999/5/EC
Norsk [Norwegian]	Motorola erklærer herved at utstyret <i>Motorola Powerline MU 0171486Nxx series</i> , er i samsvar med de grunnleggende krav og øvrige relevante krav i direktiv 1999/5/EF.
Slovensky [Slovak]	Motorola týmto vyhlasuje, že <i>Motorola Powerline MU 0171486Nxx series</i> , spĺňa základné požiadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.
Slovensko [Slovenian]	Motorola izjavlja, da je ta <i>Motorola Powerline MU 0171486Nxx series</i> , v skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 1999/5/ES.
Svenska Swedish	Härmed intygar Motorola att denna <i>Motorola Powerline MU 0171486Nxx series</i> , står i överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.
Español [Spanish]	Por medio de la presente Motorola declara que el <i>Motorola Powerline MU 0171486Nxx series</i> , cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE
Polski [Polish]	Niniejszym, firma Motorola oświadcza, że produkt serii <i>Motorola Powerline MU 0171486Nxx series</i> , spełnia zasadnicze wymagania i inne istotne postanowienia Dyrektywy 1999/5/EC.
Português [Portuguese]	Motorola declara que este <i>Motorola Powerline MU 0171486Nxx series</i> , está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.



DECLARATION OF CONFORMITY

Motorola declares under its sole responsibility that the products, to which this declaration relates, conform to the applicable essential requirements of the following Directive(s) of the Council of the European Communities:

- 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on the radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).
- 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).
- 72/23/EEC of 19 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).

Product: Model: Motorola Powerline MU Modem **0171486Nxx**

Where "xx"="03", "14"

Model Number	Description
0171486N03	Powerline MU Modem Type C Plug – 2 round pin European
0171486N14	Powerline MU Modem Type G Plug – UK, Ireland

Manufacturer: Motorola Inc.

Description: Power Line Communication Device (PLC Modem)

Conformity: Harmonized standards used to demonstrate conformity:

The products have been shown to meet the following requirements:

- c) Safety – certified to EN 60950-1:2001+A11:2004 First Edition
 - d) EMC – certified to meet EN55022:1998+A1:2000+A2:2003 (class B), EN55024:1998+A1:2001+A2:2003, CISPR/1/xyz/DPAS CISPR 22 A2 f9 Ed 4.0 with T-ISN, EN 61000-3-2:2000+A2:2005, EN 61000-3-3+A1:2001+A2:2005
- Year of first application of CE mark: 2007

Notified Body number: 0682

Notified Body address: CETECOM ICT Services GmbH, Untertürkheimer Straße 6-10, D-66117 Saarbrücken, Germany

Signature:

Name: Philip Bolt

Title: _____

Aaron Ratner

Title: Canopy Quality Manager

Date: June 1, 2007

DECLARATION OF CONFORMITY (Hybrid Adapter)

Česky [Czech]	Motorola tímto prohlašuje, že tento <i>Motorola Powerline MU 0171486N08</i> , je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.
Dansk [Danish]	Undertegnede Motorola erklærer herved, at følgende udstyr <i>Motorola Powerline MU 0171486N08</i> , overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF
Nederlands [Dutch]	Hierbij verklaart Motorola dat het toestel <i>Motorola Powerline MU 0171486N08</i> , in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG
	Bij deze verklaart Motorola dat deze <i>Motorola Powerline MU 0171486N08</i> , voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijn 1999/5/EC.
English	Hereby, Motorola, declares that this <i>Motorola Powerline MU 0171486N08</i> , is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Eesti [Estonian]	Käesolevaga kinnitab Motorola seadme <i>Motorola Powerline MU 0171486N08</i> , vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.
Suomi [Finnish]	Motorola vakuuttaa täten että <i>Motorola Powerline MU 0171486N08</i> , tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Français [French]	Par la présente Motorola déclare que l'appareil <i>Motorola Powerline MU 0171486N08</i> , est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE
	Par la présente, Motorola déclare que ce <i>Motorola Powerline MU 0171486N08</i> , est conforme aux exigences essentielles et aux autres dispositions de la directive 1999/5/CE qui lui sont applicables
Deutsch [German]	Hiermit erklärt Motorola, dass sich diese <i>Motorola Powerline MU 0171486N08</i> , in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 1999/5/EG befindet". (BMWi)
	Hiermit erklärt Motorola die Übereinstimmung des Gerätes <i>Motorola Powerline MU 0171486N08</i> , mit den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtlinie 1999/5/EG. (Wien)
Ελληνική [Greek]	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Motorola ΔΗΛΩΝΕΙ ΟΤΙ <i>Motorola Powerline MU 0171486N08</i> , ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/ΕΚ

Magyar [Hungarian]	Alulírott, Motorola nyilatkozom, hogy a <i>Motorola Powerline MU 0171486N08</i> , megfelel a vonatkozó alapvető követelményeknek és az 1999/5/EC irányelv egyéb előírásainak.
Íslenska [Icelandic]	Hér með lýsir Motorola yfir því að <i>Motorola Powerline MU 0171486N08</i> , er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 1999/5/EC.
Italiano [Italian]	Con la presente Motorola dichiara che questo <i>Motorola Powerline MU 0171486N08</i> , è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Latviski [Latvian]	Ar šo Motorola deklarē, ka <i>Motorola Powerline MU 0171486N08</i> , atbilst Direktīvas 1999/5/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.
Lietuvių [Lithuanian]	Šiuo Motorola deklaruoja, kad šis <i>Motorola Powerline MU 0171486N08</i> , atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.
Malti [Maltese]	Hawnhekk, Motorola, jiddikjara li dan <i>Motorola Powerline MU 0171486N08</i> , jikkonforma mal-ftigijiet essenzjali u ma provvedimenti oħrajn rilevanti li hemm fid-Direttiva 1999/5/EC
Norsk [Norwegian]	Motorola erklærer herved at utstyret <i>Motorola Powerline MU 0171486N08</i> , er i samsvar med de grunnleggende krav og øvrige relevante krav i direktiv 1999/5/EF.
Slovensky [Slovak]	Motorola týmto vyhlasuje, že <i>Motorola Powerline MU 0171486N08</i> , spĺňa základné požiadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.
Slovensko [Slovenian]	Motorola izjavlja, da je ta <i>Motorola Powerline MU 0171486N08</i> , v skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 1999/5/ES.
Svenska Swedish	Härmed intygar Motorola att denna <i>Motorola Powerline MU 0171486N08</i> , står i överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.
Español [Spanish]	Por medio de la presente Motorola declara que el <i>Motorola Powerline MU 0171486N08</i> , cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE
Polski [Polish]	Niniejszym, firma Motorola oświadcza, że produkt serii <i>Motorola Powerline MU 0171486N08</i> , spełnia zasadnicze wymagania i inne istotne postanowienia Dyrektywy 1999/5/EC.
Português [Portuguese]	Motorola declara que este <i>Motorola Powerline MU 0171486N08</i> , está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.

DECLARATION OF CONFORMITY

Motorola declares under its sole responsibility that the products, to which this declaration relates, conform to the applicable essential requirements of the following Directive(s) of the Council of the European Communities:

- 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on the radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).
- 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).
- 72/23/EEC of 19 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).

Product: Model: Motorola Powerline MU Hybrid Adapter **0171486N08**

Manufacturer: Motorola Inc.

Description: Powerline MU PHO Adapter

Conformity: Harmonized standards used to demonstrate conformity:

The products have been shown to meet the following requirements:

- e) Safety – certified to EN 60950-1:2001+A11:2004
- f) EMC – certified to meet EN55022:1998+A1:2000+A2:2003 (class B), EN55024:1998+A1:2001+A2:2003, EN 61000-3-2:2000+A2:2005, EN 61000-3-3+A1:2001+A2:2005

Year of first application of CE mark: 2007

Testing facility name: Shenzhen Huatongwei International Inspection Co., Ltd

Testing facility address: Keji Nan No. 12 Road, Hi-tech Park, Shenzhen, China

Signature:

Name: Philip Bolt

Title: _____

Aaron Ratner

Title: Canopy Quality Manager

Date: June 1, 2007

8.3 LEGAL NOTICES

8.3.1 Software License Terms and Conditions

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9 Additional Resources

Canopy provides two additional resources where you can raise questions and find answers:

- Canopy User Community at <http://www.canopywireless.com/community>.
This resource facilitates communication with other users and with authorized Canopy experts. Available forums include General Discussion, Network Monitoring Tools, and Suggestions.
- Canopy Knowledge Base at <http://www.canopywireless.com/kbase>.
This resource facilitates exploration and searches, provides recommendations, and describes tools. Available categories include
 - General (Answers to general questions provide an overview of the Canopy system.)
 - Product Alerts
 - Helpful Hints
 - FAQs (frequently asked questions)
 - Hardware Support
 - Software Support
 - Tools

10 History of Changes in This Document

Version 2.0

The document is an updated version of the Version 1.2 document.

Additions include more PSD settings information, more QoS information, and more feature information. These changes occur throughout the document.

Version 3.0

This document is an updated version of the Version 2.0 document.

Additions include the installation instructions for the inductive coupler, technical specifications, and GUI screens for Gateway version 1.20 and for the Modem version 1.27.

Version 4.0

This document is an updated version of the Version 3.0 document.

Additions include the additional features in the Gateway and Modem firmware versions 2.0, including the new features, the modem repeater and VLAN pass-through.

Also added are the plug types table and drawings in Appendix A.

11 Technical Specifications

August 2007

Motorola Powerline MU is a new broadband solution that combines the Motorola Canopy[®] system with Broadband over Powerline (BPL) technology to deliver broadband services to homes, businesses and buildings that have been previously underserved or served only at high cost by other broadband access technologies.

Powerline MU solution allows service providers to deploy and manage a Broadband over Powerline network for Multi-Dwelling Unit or Multi-Tenant Unit buildings such as apartment buildings, hotels or retail outlets. Complementing and completing the MOTOwi4 portfolio, Powerline MU uses Canopy technology as the network backbone. Powerline MU provides a complete BPL solution from a leading manufacturer.

Please refer to Motorola's ordering instructions to select equipment best suited for the customer's electrical configuration. You can also visit <http://www.canopywireless.com> for more information.



Powerline MU Solution

Powerline Modem

Available Now!



- Plugs into a standard AC power outlet to receive Internet signal
- Performs Powerline to Ethernet conversion
- Ethernet output connects to a computer or supplies broadband input to a home network router or gateway
- Network Address Translation (NAT) for network isolation and protection
- QoS Support: Maps Ethernet QoS to Powerline QoS using VLAN priority
- Bandwidth management for service class differentiation
- Subscriber Authentication
- 6-foot Ethernet cable provided
- **Additional plug types available upon request**

Part Number	Type A (US) Plug: 0171486N01 Type C Plug: 0171486N03 Type G Plug: 0171486N14
Product Name	Motorola Powerline Modem
Description	Customer Premise Equipment in a Powerline MU solution
Modulation Type:	OFDM, QAM 256/64/16, DQPSK, DBPSK and ROBO mode (FSK)
Power Input:	100 – 240 VAC, 50/60 Hz
Power Consumption	7 Watts
Network Management:	SNMP v2c
Powerline Interface	HomePlug v 1.01 Turbo
Data Interface	Ethernet IEEE 802.3 10/100 Base T
Powerline Encryption	56 bit DES
Network Security	Firewall/NAT
Connectors	RJ45, Input power/PLC, plug Type A, C, or G plugs available (other plug types available on demand)
LED Status Lights	Power on, Powerline, Ethernet, Authentication
Dimensions	1.6 in. x 2.6 in. x 3.75 in. (4.1 cm x 6.6 cm x 9.5 cm)
Weight	.394 lbs (178.6 g)
Operating temperature:	0°C to 50°C (32°F to 122°F)
Safety	UL/cUL/CE/CB
Industry Canada	ICES-003 Class B
EN	EN55022 CE 0682 Class B
FCC	Part 15 Class B

Powerline MU Gateway

Available Now!



- Injects the Internet signal into the building’s electric distribution
 - Performs Ethernet to Powerline conversion
 - Ethernet input connects to Canopy Subscriber Module or other broadband source
 - Four port Ethernet Switch
 - Three Powerline outputs connect to three electrical phases via capacitive coupling cables (3 feet in length)
- QoS Support: Maps Ethernet QoS to Powerline QoS using VLAN priority
 - Bandwidth management for service class differentiation
 - Using BAM (Bandwidth Authentication Manager) provides authentication for associated Powerline Modems within its network
 - Plugs into a standard AC power outlet with 6 foot power cord
 - **Additional plug types available upon request**

Part Number	Type A (US) Plug: 0171486N11 Type C Plug: 0171486N04 Type G Plug: 0171486N19
Product Name	Motorola Powerline MU Gateway
Description	Head End Controller Equipment in a Powerline MU solution
Modulation Type:	OFDM, QAM 256/64/16, DQPSK, DBPSK and ROBO mode (FSK)
Power Input:	100 – 240 VAC, 50/60 Hz
Power Consumption:	7 Watts
Network Management:	SNMP v2c
Powerline Interface	HomePlug v 1.01 Turbo
Data Interface	Ethernet IEEE 802.3 10/100 Base T
Powerline Encryption	56 bit DES
Connectors	5 RJ45, 3 AC coupling connections, Input power (plug Types A, C, G available)
LED Status Lights	WAN, 4 LAN, Power on, PLC, Collision
Dimensions	1.75 in. x 17.3 in. x 7.98 in. (4.44 cm x 44.0 cm x 20.3 cm)
Weight	5.99 lbs (2715 g)
Operating temperature:	0°C to 50°C (32°F to 122°F)
Safety	UL/cUL/CE
Industry Canada	ICES-003 Class B
EN	EN55022 CE 0682 Class B
FCC	Part 15 Class B

Powerline MU Adapter

Available Now!



- Used in pairs
 - One Adapter converts data from an Ethernet source to Powerline and transports over telephone wiring to a second Adapter that converts data back to Ethernet to deliver to the Gateway
 - Provides greater flexibility for connecting Powerline MU Gateway(s) to the primary internet access point
 - Plugs into a standard AC power outlet (US plug pictured, Type C plug also available)
- **Additional plug types available upon request**

Part Number	US Plug: 0171486N02 C-Type Plug: 0171486N08 G-type Plug: 0171486N25
Product Name	Powerline MU Adapter
Description	Optional Powerline MU converter between telephone wiring and Ethernet
Modulation Type:	OFDM, QAM 256/64/16, DQPSK, DBPSK and ROBO mode (FSK)
Power Input:	100 – 240 VAC, 50/60 Hz
Data Interface	Ethernet IEEE 802.3 10/100 Base T
Flow Control	IEEE 802.3x
Twisted Pair	HomePlug v 1.01 Turbo
Connectors	1 RJ45, 1 RJ11, Input power (plug types A-US, C-European and G available)
LED Status Lights	Power on, Powerline, Ethernet
Dimensions	1.8 in. x 2.4 in. x 3.5 in. (4.57 cm x 6.1 cm x 8.89 cm)
Weight	.276 lbs (125 g)
Operating temperature:	0°C to 50°C (32°F to 122°F)
Safety	UL/cUL/CE
Industry Canada	ICES-003 Class B
EN	CE Class B
FCC	Part 15 Class B

Powerline MU Panel Extender

Available Now!



- Useful in mass-metered buildings such as hotels and corporate facilities which have a large distribution panel that distributes electricity to other smaller breaker panels
- Connect up to three phases from one breaker panel to the Powerline MU Panel Extender and transmit signal to up to three additional breaker panels
- Provides efficiency in signal distribution while mitigating signal loss

Part Number	0171486N07
Part Name	Powerline MU Panel Extender
Description	Optional Powerline MU extender to couple up to four breaker panels together
High Voltage Interface	Up to 277 VAC (phase-neutral), Up to 480 VAC (phase-phase), Accepts up to 14 AWG wires
Input current	1 mA @ 50/60 Hz
Connectors	4 blocks of 4-pin terminals, 1 block per electrical panel
Dimensions	1.8 in. x 7.9 in. x 3.8 in. (4.5 cm x 20 cm x 9.6 cm)
Weight	.85 lbs (385 g)
Operating temperature:	0°C to 50°C (32°F to 122°F)
Safety	CE/ UL authorization (In conjunction with Powerline MU Gateway)

Powerline MU Inductive Coupler



- Useful in individually-metered and multiple transformer buildings such as apartments and condominiums which have one or more meter banks with meters that monitor power consumption to individual residences
- Connect one coupler per phase just before the meter bank in the Termination Cabinet over the insulated portion of the electric cable
- Provides efficiency in signal distribution by injecting on the larger wires just before the meter bank and subsequent branching to individual residences with no contact to the actual metal conductor
- Three coupler sizes to accommodate various wiring gauges

500

Part Number	0171486N21
Part Name	Powerline MU Inductive Coupler 500
Description	Optional Powerline MU coupler to Induce Signal onto in-building cables before the Meter Bank.
High Voltage Interface	Fits up to 500 MCM cable rated 380A
Cable	75 Ohm Coaxial
Connectors	F-Connector (Coaxial)
Center Conductor	600v rated 22-gauge stranded copper THHN wire
Dimensions	2.8 in x 2.3 in x 2.2 in (70.14 mm x 58.3 mm x 55mm)
Inner Diameter of core	1 in (25.4 mm)
Outer Diameter of Core	2.02 in (51.31 mm)
Weight	.90 lbs
Operating temperature	-40°C to 55°C (-40°F to 131°F)
Safety	UL authorization (In conjunction with Powerline MU Gateway)

250

Part Number	0171486N23
Part Name	Powerline MU Inductive Coupler 250
Description	Optional Powerline MU coupler to Induce Signal onto in-building cables before the Meter Bank.
High Voltage Interface	Fits up to 250 MCM cable rated 255A
Cable	75 Ohm Coaxial
Connectors	F-Connector (Coaxial)
Center Conductor	600v rated 22-gauge stranded copper THHN wire
Dimensions	2.8 in x 2.3 in x 2.2 in (70.14 mm x 58.3 mm x 55mm)
Inner Diameter of core	.76 in (19.4 mm)
Outer Diameter of Core	2.02 in (51.31 mm)
Weight	.99 lbs
Operating temperature	-40°C to 55°C (-40°F to 131°F)
Safety	UL authorization (In conjunction with Powerline MU Gateway)

100

Part Number	0171486N22
Part Name	Powerline MU Inductive Coupler 100
Description	Optional Powerline MU coupler to Induce Signal onto in-building cables before the Meter Bank.
High Voltage Interface	Fits up to 2/0 AWG cable rated at 175A
Cable	75 Ohm Coaxial
Connectors	F-Connector (Coaxial)
Center Conductor	600v rated 22-gauge stranded copper THHN wire
Dimensions	2.8 in x 2.3 in x 2.2 in (70.14 mm x 58.3 mm x 55mm)
Inner Diameter of core	.55 in (14 mm)
Outer Diameter of Core	2.02 in (51.31 mm)
Weight	1.05 lbs
Operating temperature	-40°C to 55°C (-40°F to 131°F)
Safety	UL authorization (In conjunction with Powerline MU Gateway)

Inductive Coupler Sizes

Column A lists the American Wire Gauge sizes, Column B lists Metric Wire Gauge sizes, and Column C measures the outer diameter of the electric wire installed in the building. Use that information to choose the recommended Powerline MU Inductive Coupler from Column D. Column E lists the inner diameter (the ferrite core) of the Powerline MU Inductive Coupler.

A Conductor Size (American Wire Gauge)	B Conductor Size (Metric Wire Gauge, mm2)	C Approx Conductor Outer Diameter With Insulation (mm)	D Recommended Powerline MU Inductive Coupler	E Powerline MU Coupler Inner Diameter (mm)
-	400	30.1	750*	31
750 MCM	-	29.4	750*	31
700 MCM	-	28.5	750*	31
600 MCM	-	26.7	750*	31
-	300	26.5	750*	31
500 MCM	-	24.9	500	25.4
-	240	24.2	500	25.4
400 MCM	-	22	500	25.4
-	185	21.1	500	25.4
350 MCM	-	20.6	500	25.4
300 MCM	150	18.5	500	19.4
250 MCM	-	17.8	250	19.4
-	120	17.5	250	19.4
4/0	-	16	250	19.4
-	95	15.4	250	19.4
3/0	-	14.7	250	19.4
-	70	13.7	100	14
2/0	-	13.5	100	14
1/0	-	12.2	100	14
-	50	12	100	14

* Powerline MU Inductive Coupler 750 will be available Q4 2007.

Appendix A International Electric Grid Plug Types

International Electric Grid and Plug Types

COUNTRY	VOLTAGE	FREQUENCY	PLUG	COMMENTS
Afghanistan	20 V	50 Hz	C & F *	* A UN correspondent reports C and F common in Kabul, but its likely a variety of plugs may be used around the country. Some sources report Type D also in use. Other reports indicate voltage variances from 160V to 280V.
Albania	220 V*	50 Hz	C & F	*Voltage variations common
Algeria	230 V	50 Hz	C* & F	*A variation of Type C with a ground post offset about 1/2-inch from center may also be found.
American Samoa	120 V	60 Hz	A, B, F & I	
Andorra	230 V	50 Hz	C & F	
Angola	220 V	50 Hz	C	
Anguilla	110 V	60 Hz	A (maybe B)	
Antigua	230 V*	60 Hz	A & B	*Airport area is reportedly Antigua power is 110 V.
Argentina	220 V	50 Hz	C & I*	*Neutral and line wires are reversed from that used in Australia and elsewhere. Click here for more.
Armenia	220 V	50 Hz	C & F	
Aruba	127 V*	60 Hz	A, B & F	*Lago Colony 115V
Australia	240 V	50 Hz	I	*Outlets typically controlled by adjacent switch. Click here for more.
Austria	230 V	50 Hz	F	Type C may be found, but rare.
Azerbaijan	220 V	50 Hz	C, F	
Azores	220 V*	50 Hz	B, C, & F	*Ponta Delgada 110 V; to be converted to 220 V
Bahamas	120 V	60 Hz	A & B	
Bahrain	230 V*	50 Hz*	G	*Awali 110 V, 60 Hz
Balearic Islands	220 V	50 Hz	C & F	
Bangladesh	220 V	50 Hz	A, C, D, G & K	
Barbados	115V	50 Hz	A, B	
Belarus	220 V	50 Hz	C & F	
Belgium	230 V	50 Hz	E	Notes from correspondents: a 'C' style plug can be used with 'E' and 'F' receptacles. All double-insulated appliances are indeed fitted with a 'C' plug, and can be used in any compatible receptacle (C E F and narrow L). Type C receptacles are prohibited in Belgium.
Belize	110/220 V	60 Hz	B & G	
Benin	220 V	50 Hz	E	
Bermuda	120 V	60 Hz	A & B	

Bhutan	230 V	50 Hz	D, F, & G	Type M plugs also identified by some sources.
Bolivia	220/230 V*	50 Hz	A & C	*La Paz & Viacha 115V
Bosnia	220 V	50 Hz	C & F	
Botswana	231V	50 Hz	M	Type G may be found, but rare.
Brazil	110/220 V*	60 Hz	A & B, C	*127 V found in states of Bahia, Paraná (including Curitiba), Rio de Janeiro, São Paulo and Minas Gerais (though 220 V may be found in some hotels). Other areas are 220 V only, with the exception of Fortaleza (240 V). Outlets (click for more) are often a combination of type A and C and can accept either type plug.
Brunei	240 V	50 Hz	G	
Bulgaria	230 V	50 Hz	C* & F*	*Outlets are reported as type F, though both type C and F plugs may be encountered.
Burkina Faso	220 V	50 Hz	C & E	
Burundi	220 V	50 Hz	C & E	
Cambodia	230 V	50 Hz	A & C*	*Some outlets are a combination of type A and C and can accept either type plug. Plug G may be found in some hotels.
Cameroon	220 V	50 Hz	C, E	
Canada	120 V	60 Hz	A & B	
Canary Islands	220 V	50 Hz	C, E, & L	Type L plugs/outlets may have different pin spacing. The smaller and closer pins are for a rated current of 10 A, the bigger and wider pins are for a rated current of 16 A.
Cape Verde	220 V	50 Hz	C & F	
Cayman Islands	120 V	60 Hz	A & B	
Central African Republic	220 V	50 Hz	C & E	
Chad	220 V	50 Hz	D, E & F	
Channel Islands	230 V	50 Hz	G	
Chile	220 V	50 Hz	C & L	
China, People's Republic of	220 V	50 Hz	A, I, G	The "official" plug type is like type A but slightly shorter and without holes in blades. Type A and I outlets are common, and Type G might also be found. Click here for photos and more info.
Colombia	110 V	60 Hz	A & B	
Comoros	220 V	50 Hz	C & E	
Congo, People's Rep. of	230 V	50 Hz	C & E	
Congo, Dem. Rep. of (former Zaire)	220 V	50 Hz	C & D	
Cook Islands	240 V	50 Hz	I	
Costa Rica	120 V	60 Hz	A & B	
Côte d'Ivoire	220 V	50 Hz	C & E	

(Ivory Coast)				
Croatia	230 V	50 Hz	C & F	
Cuba	110/220 V	60 Hz	A & B, C, F & L	Most older hotels 110 V. Some newer hotels 220 V. Some outlets are a combination of type A and C and can accept either type plug.
Cyprus	240 V	50 Hz	<u>G</u>	
Czech Republic	230 V	50 Hz	<u>E</u>	
Denmark	230 V	50 Hz	C & K	Denmark's connectors have slight differences from those used elsewhere. While pin diameter and spacing is standard, outlets may have different housing depths which could interfere with standard adaptors -- one report says this is due to "childproofing." Also, Plug C fits into K-type outlets (but not vice versa).
Djibouti	220 V	50 Hz	C & E	
Dominica	230 V	50 Hz	D & G	
Dominican Republic	110 V	60 Hz	<u>A</u>	<u>Type J may exist in some hotels.</u>
East Timor	220 V	50 Hz	C, E, F, I,	A UN correspondent reports "power is poor in the country with frequent brownouts and blackouts. I suspect that surges are frequent as we go through a lot of surge-protecting power bars." Further he reports that Type I is common as much construction is done by Australians; type C is common in building built during Indonesian occupation; type E is less common; type F is common in offices but not hotels.
Ecuador	120-127 V	60 Hz	<u>A & B</u>	
Egypt	220 V	50 Hz	<u>C</u>	
El Salvador	115V	60 Hz	<u>A & B</u>	
England (See United Kingdom)				
Equatorial Guinea	220 V*	50 Hz	C & E	*Voltage varies between 150 & 175V with frequent outages
Eritrea	230 V	50 Hz	<u>C</u>	
Estonia	230 V	50 Hz	<u>E</u>	Type C may be found in older buildings. Type E plugs may work in either C or F type outlets.
Ethiopia	220 V	50 Hz	D, J, & L	
Faeroe Islands	220 V	50 Hz	C & K	
Falkland Islands	240 V	50 Hz	<u>G</u>	
Fiji	240 V	50 Hz	<u>I</u>	
Finland	230 V	50 Hz	C & F	
France	230 V	50 Hz	<u>E</u>	Type C plugs may be found on some appliances, and will fit the Type E outlet. Type C outlets may be found in older buildings. Type A may be found in older buildings but is illegal.
French Guiana	220 V	50 Hz	C & E	
Gaza	230 V	50 Hz	<u>H</u>	

Gabon	220 V	50 Hz	C	
Gambia	230 V	50 Hz	G	
Georgia	220 V	50 Hz	C	
Germany	230 V	50 Hz	C & F	
Ghana	230 V	50 Hz	D & G	
Gibraltar	240 V	50 Hz	C & G	
Great Britain (See United Kingdom)				
Greece	220 V	50 Hz	C, D, E & F	
Greenland	220 V	50 Hz	C & K	
Grenada (Windward Is.)	230 V	50 Hz	G	
Guadeloupe	230 V	50 Hz	C, D, & E	
Guam	110 V	60 Hz	A & B	
Guatemala	120 V	60 Hz	A, B, G, & I	
Guinea	220 V	50 Hz	C, F & K	
Guinea-Bissau	220 V	50 Hz	C	
Guyana	240 V*	60 Hz*	A, B, D & G	*Inside the capital city of Georgetown, both 120 V and 240 V at either 50 or 60 Hz are found, depending on the part of the city (50 Hz most common). Actual voltage may vary from area to area.
Haiti	110 V	60 Hz	A & B	
Honduras	110 V	60 Hz	A & B	
Hong Kong	220 V*	50 Hz	G, M	Type M replaced by Type G but still found.
Hungary	230 V	50 Hz	C & F	
Iceland	220 V	50 Hz	C & F	
India	230 V	50 Hz	C & D	Click here for photos and more info.
Indonesia	127/230 V*	50 Hz	C, F & G	*Conversion to 230 V in progress; complete in principal cities
Iran	230 V	50 Hz	C	
Iraq	230 V	50 Hz	C, D, & G	
Ireland (Eire)	230	50 Hz	G	Type D once common and may be occasionally found.
Isle of Man	240 V	50 Hz	C & G	
Israel	220 V	50 Hz	C	
Italy	230 V	50 Hz	C, F & L	Type L plugs/outlets may have different pin spacing. The smaller and closer pins are for a rated current of 10 A, the bigger and wider pins are for a rated current of 16 A. Both kinds are currently used and comply to the relevant Italian (CEI) regulations. Some outlets have overlapping holes to accept either older or newer types.
Ivory Coast (See Côte d'Ivoire)				

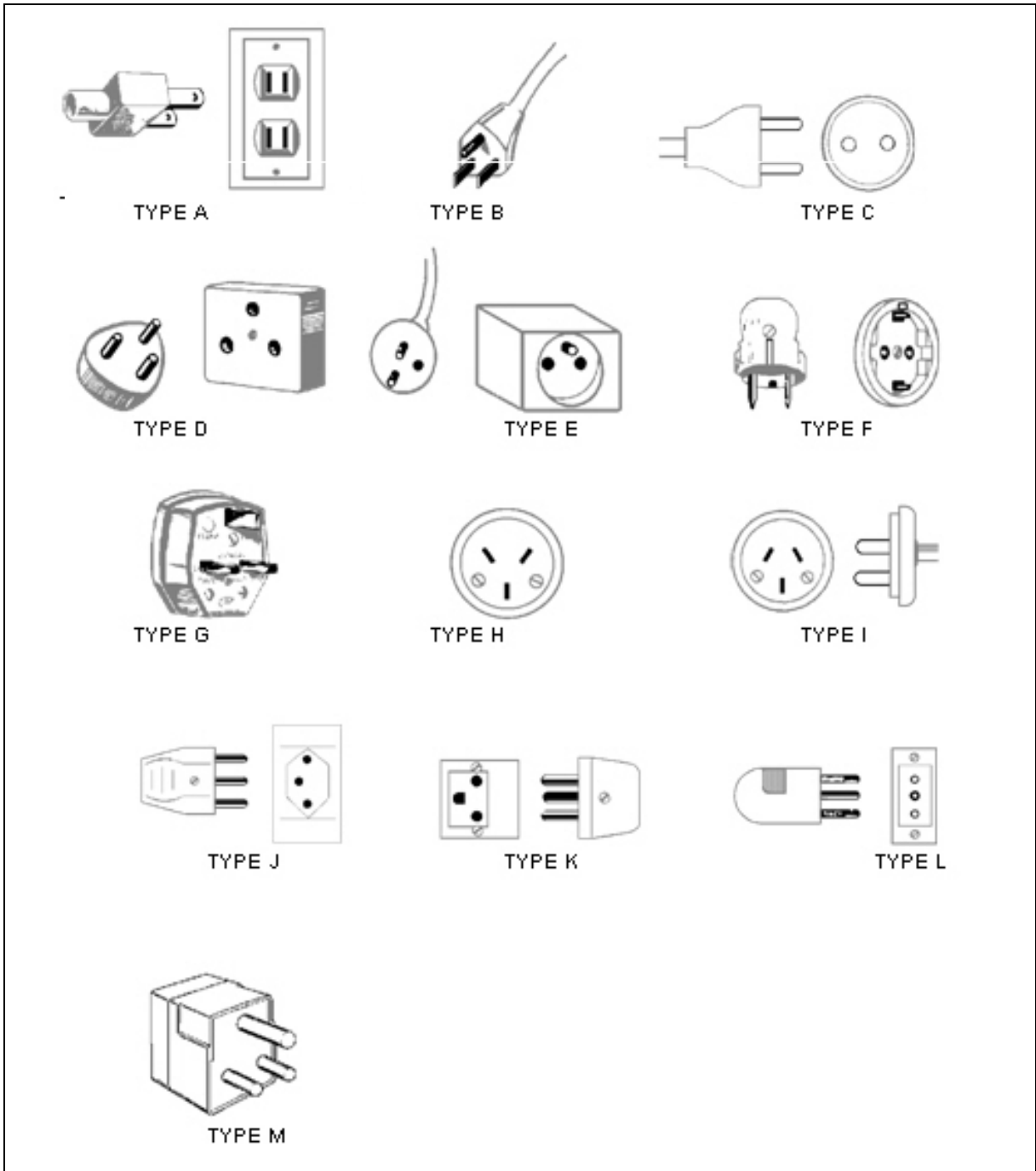
Jamaica	110 V	50 Hz	A & B	
Japan	100 V	50/60 Hz*	A, B	*Eastern Japan 50 Hz (Tokyo, Kawasaki, Sapporo, Yokohama, and Sendai); Western Japan 60 Hz (Osaka, Kyoto, Nagoya, Hiroshima)
Jordan	230 V	50 Hz	D, F, G & J*	*Type C may be found in some hotels.
Kenya	240 V	50 Hz	G	
Kazakhstan	220 V	50 Hz	C	
Kiribati	240 V	50 Hz	I	
Korea, South	220 V	60 Hz	C & F*	*Type F likely to be found in offices and hotels. 110 V power with plugs A & B was previously used but is being phased out. Older buildings may still have this, and some hotels offer both 110 V and 220 V service.
Kuwait	240 V	50 Hz	D* & G	*Type D primarily used for 15A service, Type G primarily for 13A service..
Laos	230 V	50 Hz	A, B, C, E & F	
Latvia	220 V	50 Hz	C & F	
Lebanon	110/220 V	50 Hz	A, B, C, D & G	
Lesotho	220 V	50 Hz	M	
Liberia	120 V	60 Hz	A & B	
Libya	127 V*	50 Hz	D	*Barce, Benghazi, Derna, Sebha & Tobruk 230 V
Lithuania	220 V	50 Hz	C & F	
Liechtenstein	230 V	50 Hz	J	
Luxembourg	220 V	50 Hz	C & F	
Macau	220 V	50 Hz	D & G	
Macedonia	220 V	50 Hz	C & F	
Madagascar	220 V	50 Hz	C & E	
Madeira	220 V	50 Hz	C & F	
Malawi	230 V	50 Hz	G	
Malaysia	240 V	50 Hz	G	
Maldives	230 V	50 Hz	A, D, G, J, K & L	
Mali	220 V	50 Hz	C & E	
Malta	240 V	50 Hz	G	
Martinique	220 V	50 Hz	C, D, & E	
Mauritania	220 V	50 Hz	C	
Mauritius	230 V	50 Hz	C & G	
Mexico	127 V	60 Hz	A & B	

Micronesia (Federal States of)	120 V	60 Hz	A & B	
Monaco	127/220 V	50 Hz	C, D, E F	
Mongolia	220 V	50 Hz	C & E	
Montenegro	220 V	50 Hz	C & F	
Montserrat (Leeward Is.)	230 V	60 Hz	A & B	
Morocco	127/220 V*	50 Hz	C & E	*Conversion to 220 V only underway
Mozambique	220 V	50 Hz	C, F & M*	*Type M found especially near the border with South Africa, including the capitol, Maputo.
Myanmar (formerly Burma)	230 V	50 Hz	C, D, F & G*	Type G* found primarily in better hotels. Also, many of major hotels chains are said to have multipurpose outlets, which will take Australian 3-pin plugs and perhaps other types.
Namibia	220 V	50 Hz	M	
Nauru	240 V	50 Hz	I	
Nepal	230 V	50 Hz	C & D	
Netherlands	230 V	50 Hz	C & F	
Netherlands Antilles	127/220 V*	50 Hz	A, B, & F	*St. Martin 120 V 60 Hz; Saba & (St. Eustatius 110 V 60 Hz A, maybe B
New Caledonia	220 V	50 Hz	F	
New Zealand	230 V	50 Hz	I	
Nicaragua	120 V	60 Hz	A	
Niger	220 V	50 Hz	A, B, C, D, E & F	
Nigeria	240 V	50 Hz	D & G	
Northern Ireland (see United Kingdom)				
Norway	230 V	50 Hz	C & F	
Okinawa	100 V*	60 Hz	A, B & I	*Military facilities 120 V
Oman	240 V*	50 Hz	G	*Voltage variations common
Pakistan	220 V	50 Hz	C & D	
Palmyra Atoll	120 V	60 Hz	A & B	
Panama	110 V*	60 Hz	A, B	*Panama City 120 V
Papua New Guinea	240 V	50 Hz	I	
Paraguay	220 V	50 Hz	C	
Peru	220 V*	60 Hz*	A, B & C	*Talara 110/220 V; Arequipa 50 Hz
Philippines	220 V	60 Hz	A, B, C	Type A most commonly found.
Poland	230 V	50 Hz	C & E	

Portugal	230 V	50 Hz	C & F	
Puerto Rico	120 V	60 Hz	A & B	
Qatar	240 V	50 Hz	D & G	
Réunion Island	220 V	50 Hz	E	
Romania	230 V	50 Hz	C & F	
Russia	220 V	50 Hz	F & C	Type F used in new construction. Type C common in older structures.
Rwanda	230 V	50 Hz	C & J	
St. Kitts and Nevis (Leeward Is.)	230 V	60 Hz	D & G	
St. Lucia (Windward Is.)	240 V	50 Hz	G	
St. Vincent (Windward Is.)	230 V	50 Hz	A, C, E, G, I & K	
Samoa	230 V	50 Hz	I	
Saudi Arabia	127/220 V	60 Hz	A, B, F & G	
Scotland (See United Kingdom)				
Senegal	230 V	50 Hz	C, D, E & K	
Serbia	220 V	50 Hz	C & F	
Seychelles	240 V	50 Hz	G	
Sierra Leone	230 V	50 Hz	D & G	
Singapore	230 V	50 Hz	G	Type A adaptors are widely available from shops as an extension set of 2 to 5 sets of sockets; most commonly used for audio and video equipment.
Slovak Republic	230 V	50 Hz	E	
Slovenia	220 V	50 Hz	C & F	
Somalia	220 V*	50 Hz	C	*Berbera 230 V; Merca 110/220 V
South Africa	220/230 V*	50 Hz	M**	*Grahamstad & Port Elizabeth 250V; also found in King Williams ** Types C & G can also be found in some areas.
Spain	230 V	50 Hz	C & F	A correspondent reports that in Barcelona's Barrio Gothic, voltage is 120 V 60 Hz using Types C & F plugs. Step up transformers are required to use typical European devices.
Sri Lanka	230 V	50 Hz	D	
Sudan	230 V	50 Hz	C & D	
Suriname	127 V	60 Hz	C & F	
Swaziland	230 V	50 Hz	M	
Sweden	230 V	50 Hz	C & F	

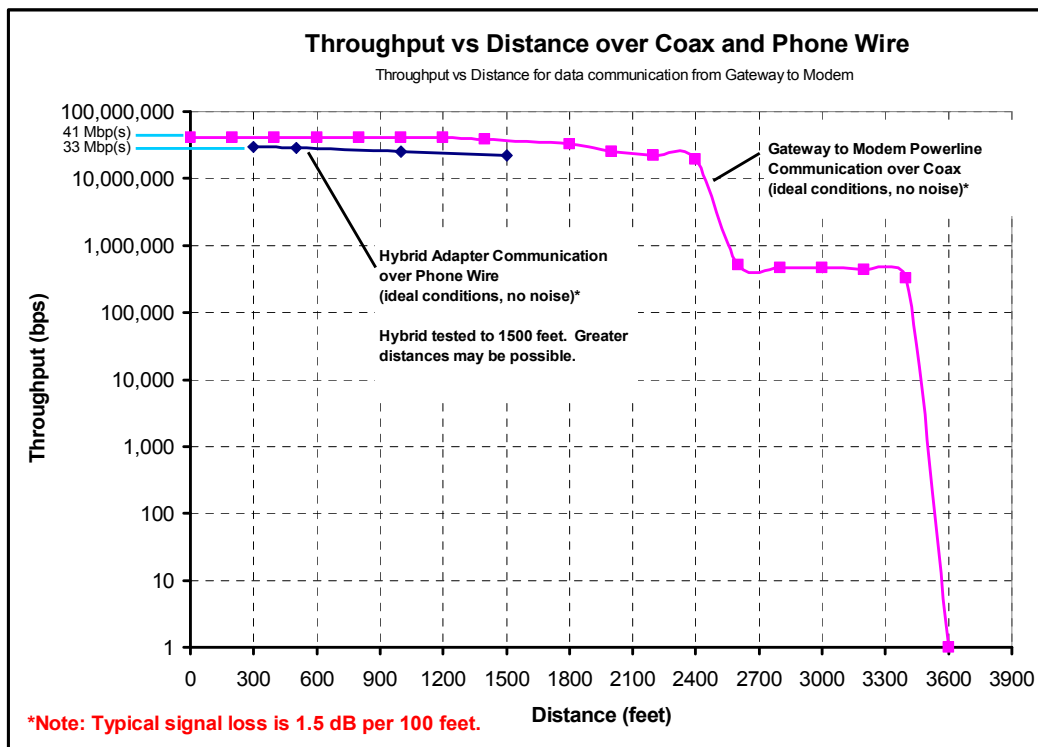
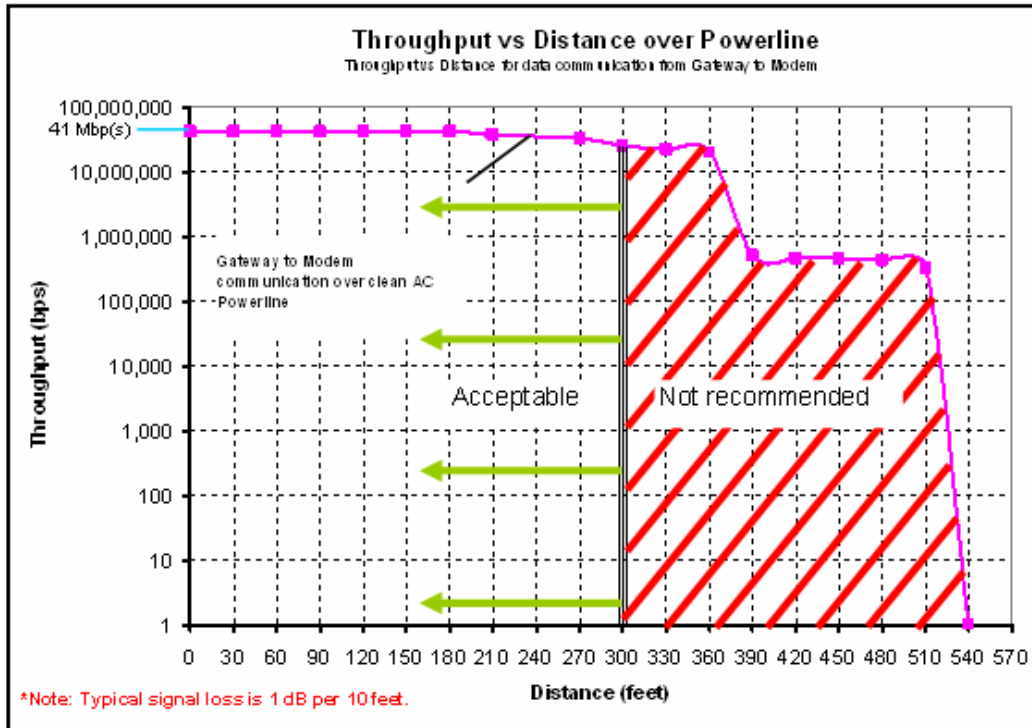
Switzerland	230 V	50 Hz	<u>J</u>	Type C plugs are common on appliances, and will fit the Type J outlet.
Syria	220 V	50 Hz	C, E, & L	
Tahiti	110/220 V	60 Hz	A, B, E	Information is based mainly on hotel experiences reported by travelers.
Tajikistan	220 V	50 Hz	C & I	
Taiwan	110 V	60 Hz	<u>A, B</u>	
Tanzania	230 V	50 Hz	D & G	
Thailand	220 V	50 Hz	A & C*	*Some outlets are a combination of type A and C and can accept either type plug.
Togo	220 V*	50 Hz	<u>C</u>	*Lome 127 V
Tonga	240 V	50 Hz	<u>I</u>	
Trinidad & Tobago	115V	60 Hz	<u>A & B</u>	
Tunisia	230 V	50 Hz	C & E	
Turkey	230 V	50 Hz	C & F	
Turkmenistan	220 V	50 Hz	B & F	
Uganda	240 V	50 Hz	<u>G</u>	
Ukraine	220 V	50 Hz	<u>C</u>	
United Arab Emirates	220 V*	50 Hz	<u>G</u>	
United Kingdom	230 V*	50 Hz	<u>G</u>	*Outlets typically controlled by adjacent switch. Though <i>nominal</i> voltage has been officially changed to 230 V, 240 V is within tolerances and commonly found.
United States of America	120 V	60 Hz	<u>A & B</u>	
Uruguay	220 V	50 Hz	C, F, I* & L	Type F becoming more common as a result of computer use. *Neutral and line wires are reversed from that used in Australia and elsewhere. Click here for more.
Uzbekistan	220 V	50 Hz	C & I	
Vanuatu	230 V	50 Hz	<u>I</u>	Some Type G may linger from British Colonial period, but are a rarity.
Venezuela	120 V	60 Hz	<u>A & B</u>	
Vietnam	127/220 V*	50 Hz	A, C & G	*To be standardized at 220 V. Type G found in newer hotels, primarily those built by Singaporean and Hong Kong developers.
Virgin Islands (British and U.S.)	115V	60 Hz	<u>A & B</u>	
Wales (See United Kingdom)				
Yemen, Rep. of	220/230 V	50 Hz	A, D & G	
Zambia	230 V	50 Hz	C, D & G	
Zimbabwe	220 V	50 Hz	D & G	

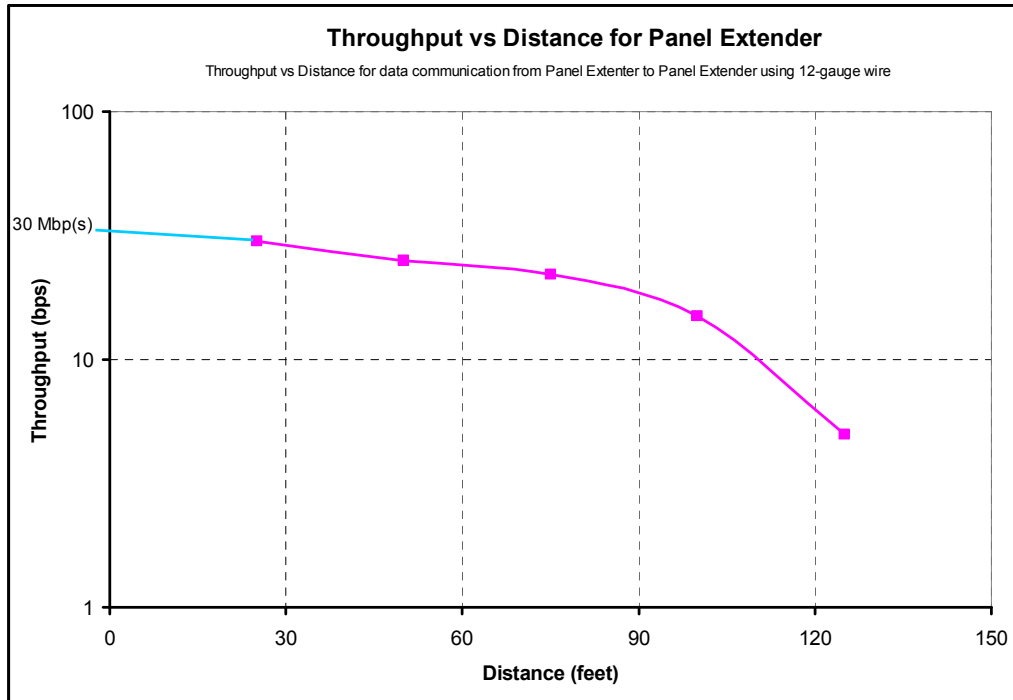
Plug Types



Appendix B Signal Distances

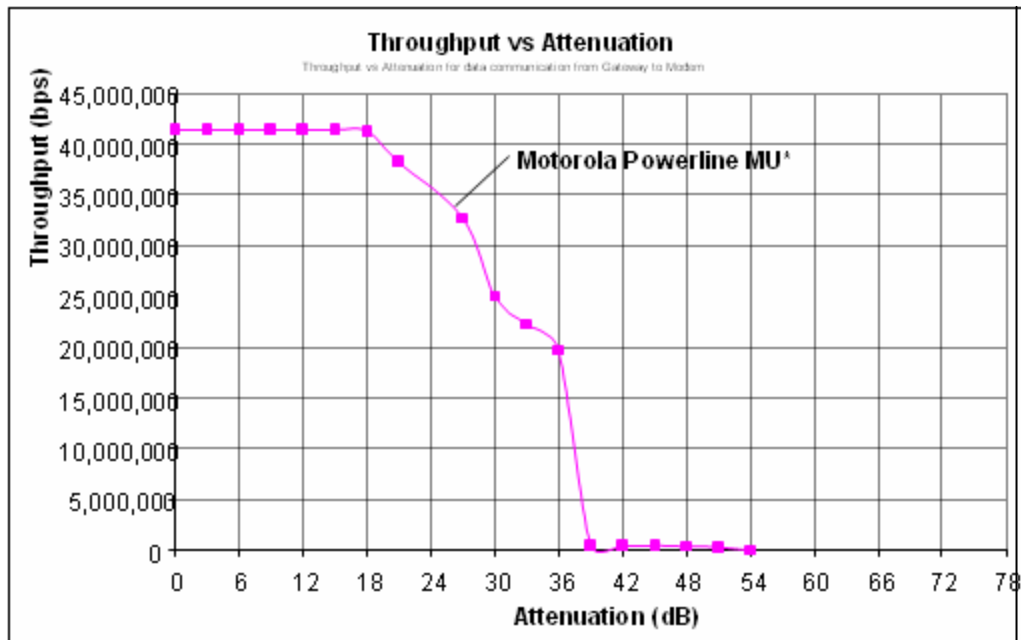
Signal distances will vary based on the age, condition and “noise” on the lines on which the is being transmitted. The following charts show distances based on ideal conditions with little or no outside interference. The Powerline MU system is designed to be used in an indoor environment.





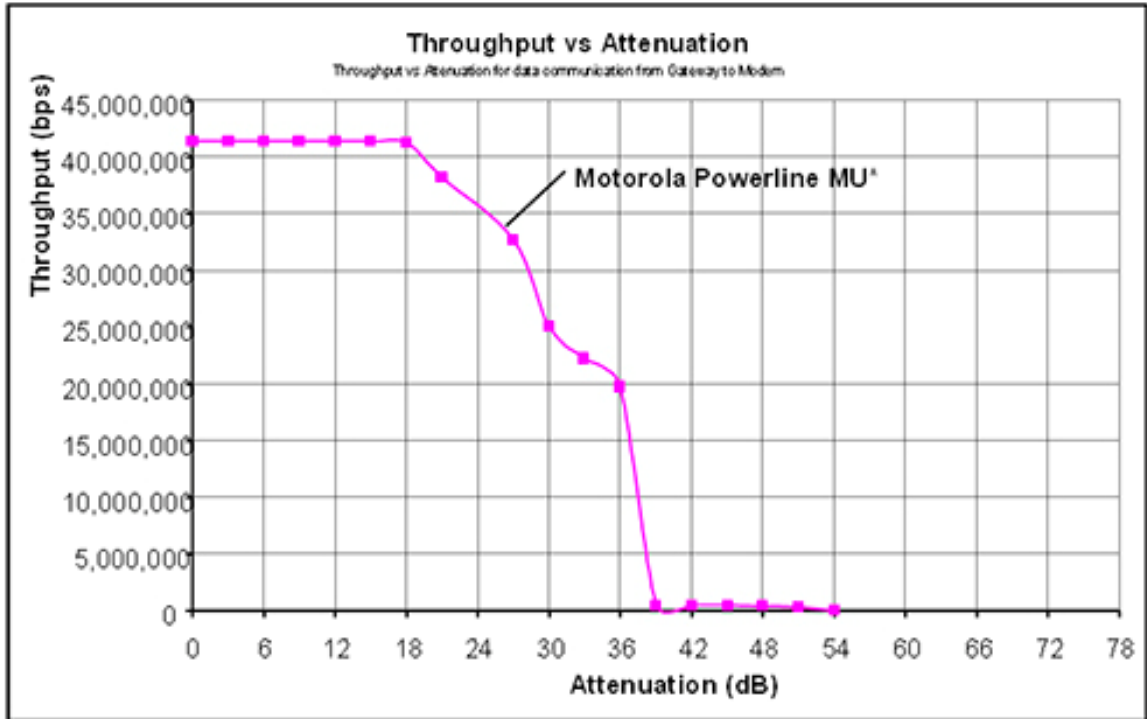
Greater distances may be achieved if the wires are in conduit, reducing the potential for outside interference.

Note: Typical signal loss is 3 dB per 10 feet minus 1-4 dB insertion loss (to account for wired connections from Panel Extender to Breaker Panel).



* Represents Maximum throughput with UDP Layer 3 traffic (untagged data packets)

- Signal begins to diminish at around 18dB of attenuation
- Signal drops quickly at 36dB
- Signal is not available after 40dB



* Represents maximum throughput with UDP Layer 3 traffic (untagged data packets)