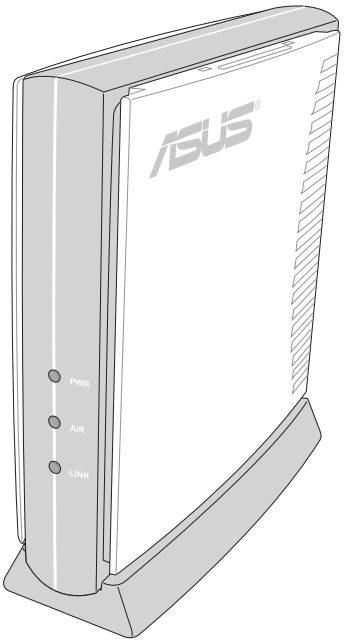
SpaceLink™ 802.11g Access Point

WL-300g

(For 802.11g and 802.11b Wireless Clients)



User's Manual

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1. Introduction

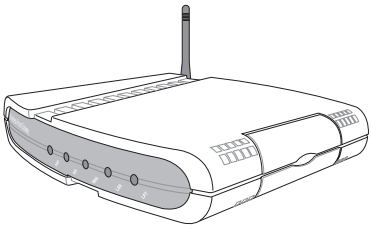
Overview

Thank you for purchasing the ASUS SpaceLink 802.11g Access Point. The ASUS SpaceLink 802.11g Access Point is designed to be fully compliant with IEEE 802.11g wireless local area networks (WLAN). 802.11g is an extension to 802.11b, used in majority of wireless LANs today. 802.11g will broaden 802.11b's data rates to 54 Mbps within the 2.4 GHz band using OFDM (orthogonal frequency division multiplexing) technology. 802.11g allows backward compatibility with 802.11b devices but only at 11 Mbps or lower depending on the range and presence of obstructions.

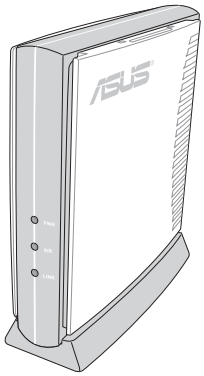
Wireless LANs are complementary extensions to existing wired LANs, offering complete mobility while maintaining continuous network connectivity to both corporate and home Intranets. They add a new level of convenience for LAN users. PC users stay connected to the network anywhere throughout a building without being bound by a LAN wires. This is accomplished through the use of SpaceLink Access Points. SpaceLink Access Points with built-in Internet gateway capability, allows your family to share a broadband Modem and one ISP account simultaneously from different rooms without wires! ASUS SpaceLink products can keep you connected anywhere, any time.

The SpaceLink™ Family

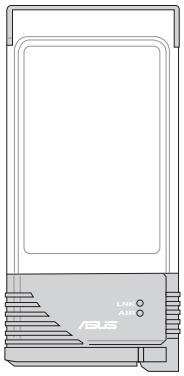
The SpaceLink™ Wireless PCI Card is a member of a product family that provides a complete wireless networking solution.



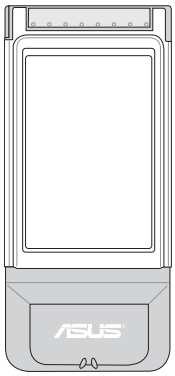
The **SpaceLink™ Home Gateway (WL-500)** creates a wireless network using the IEEE 802.11b wireless standard and allows sharing a single Internet connection.



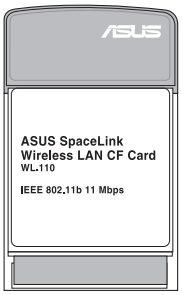
The **SpaceLink™ Access Point (WL-300)** creates a wireless network using the IEEE 802.11b wireless standard.



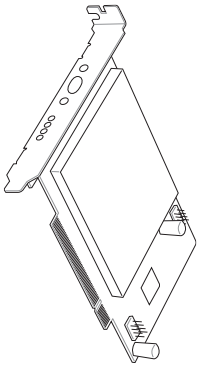
The **SpaceLink™ PC Card (WL-100)** is a IEEE 802.11b wireless LAN adapter that fits into a PCMCIA Type II slot in a Notebook PC.



The **SpaceLink™ Cardbus Card (WL-200)** is a dual band (IEEE 802.11a/b) wireless LAN adapter that fits into a Notebook PC's PCMCIA Type II slot with Cardbus support.

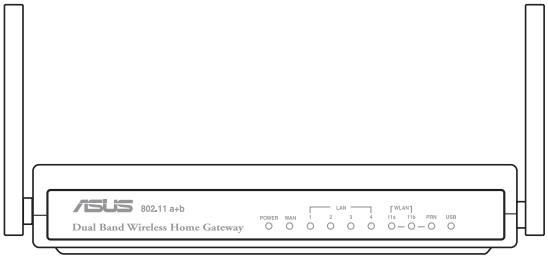


The **SpaceLink™ CF Card (WL-110)** is a IEEE 802.11b wireless LAN adapter that fits into a Compact Flash Type II slot in a Portable Digital Assistant (PDA).

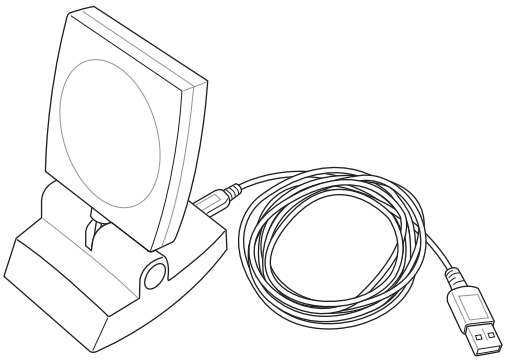


The **SpaceLink™ PCI Card (WL-230)** is a dual band (IEEE 802.11a/b) wireless PCI card that supports IEEE 802.11a, 802.11b, and Bluetooth.

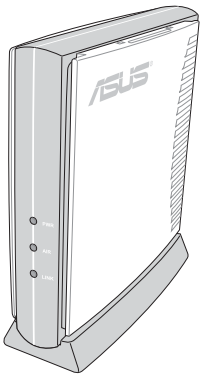
The above illustrations are not to scale.



The **SpaceLink™ Dual-Band Home Gateway (WL-600)** creates a wireless network using the IEEE 802.11b and 802.11a wireless standards and allows sharing a single Internet connection.



The **USB SpaceLink™ Client (WL-140)** is an IEEE 802.11b wireless USB LAN adapter that connects to any computer's USB port with the benefit of being able to place the antenna anywhere in order to maximize signal strength.



The **SpaceLink 802.11g Access Point (WL-300g)** creates a wireless network using the IEEE 802.11g and 802.11b wireless standards.

System Requirements

To begin using the SpaceLink Access Point, you must have the following minimum requirements:

- An Ethernet (10Base-T or 10/100Base-TX) adapter for wired client
- At least one 802.11g (54Mbps) or one 802.11b (11Mbps) wireless adapter for wireless mobile clients
- TCP/IP and an Internet browser installed

Note: The SpaceLink™ Access Point only supports 10Base-T, therefore it cannot be connected to pure 100Base-TX networks. The network must be either 10-Base or 10/100Base-TX.

The Product Package

Each SpaceLink™ Access Point comes with:

- One SpaceLink™ 802.11g Access Point
- One SpaceLink™ 802.11g Access Point Quick Start Guide
- One SpaceLink™ 802.11g Access Point User's Manual
- One power adapter (5 Volts DC, 1 Amp)
- One support CD (utilities and documentation)
- One RJ-45 Ethernet cable (straight-through)
- One Bracket for ceiling mounting
- One Bracket for office partition mounting
- One Sticker for wall mounting alignment

Wireless Operation

The SpaceLink 802.11g Access Point supports three modes of operation:

- **Access Point:** The SpaceLink 802.11g Access Point operates as a stand-alone device to provide network access to wireless mobile clients.
- **Access Point Client:** The SpaceLink 802.11g Access Point partners with another SpaceLink 802.11g Access Point to provide network access to wireless mobile clients.
- **Wireless Bridge:** The SpaceLink 802.11g Access Point communicates only with other SpaceLink Access Points that are set to Wireless Bridge Mode. (SpaceLink Access Points set to Wireless Bridge mode cannot support wireless mobile clients.)

By default, the SpaceLink 802.11g Access Point operates in Access Point mode.

Access Point Mode

In “Access Point” mode, the SpaceLink 802.11g Access Point will operate as a MAC layer learning bridge and forward packets between wireless mobile clients and the Ethernet network.

A wireless LAN that uses the SpaceLink 802.11g Access Point in “Access Point” mode generally consists of one or more 802.11b Access Points and one or more wireless mobile clients that have an 802.11b adapter installed.

The SpaceLink 802.11g Access Point maintains a table of MAC addresses, which it has learned are located either on the Ethernet network or on the radio network by monitoring the source address of packets it receives. For example, if the SpaceLink 802.11g Access Point receives a packet over its radio, it creates an entry in its table for the node that sent the packet and labels the entry as a member of the radio network. The SpaceLink 802.11g Access Point removes an entry from the table after five minutes of inactivity.

When the SpaceLink 802.11g Access Point receives a packet from the Ethernet network, it compares the packet’s destination address with the node addresses listed in its table. If the packet’s destination address is not in the table, the SpaceLink 802.11g Access Point will forward the packet to the wireless mobile clients. If the packet’s destination address is listed in the table as a member of the radio network, the SpaceLink 802.11g Access Point will forward the packet to the wireless mobile clients. If the packet’s destination address is listed in the table as a member of the Ethernet network, the SpaceLink

Access Point will not forward the packet to the wireless mobile clients. The SpaceLink 802.11g Access Point applies the same principles to determine if a packet received over its radio should be forwarded to the Ethernet network.

The SpaceLink 802.11g Access Point forwards all broadcast packets to wireless mobile clients. Given this, the SpaceLink 802.11g Access Point can only support a limited amount of network traffic. It is recommended that you only use the SpaceLink 802.11g Access Point on networks that contain less than 512 nodes.

The number of wireless mobile clients that can be supported by the SpaceLink 802.11g Access Point depends on the amount of information that each client exchanges with the network. Therefore, the number of clients that can be supported by one SpaceLink 802.11g Access Point will vary based on the applications in use and how frequently network information is accessed.

Roaming Between SpaceLink Access Points

If there are multiple SpaceLink Access Points on the network, then a wireless mobile client may seamlessly roam from one SpaceLink 802.11g Access Point to another.

Each SpaceLink 802.11g Access Point creates its own wireless cell or coverage area. This is also known as a Basic Service Set (BSS). Any wireless mobile client can communicate with a particular SpaceLink 802.11g Access Point if it is within the SpaceLink Access Point's coverage area.

If the cells of multiple SpaceLink Access Points overlap, then the wireless mobile client may switch from one SpaceLink 802.11g Access Point to another as it travels throughout the facility. During the hand-off from one SpaceLink 802.11g Access Point to another, the wireless mobile client maintains an uninterrupted connection to the network. This is known as "roaming."

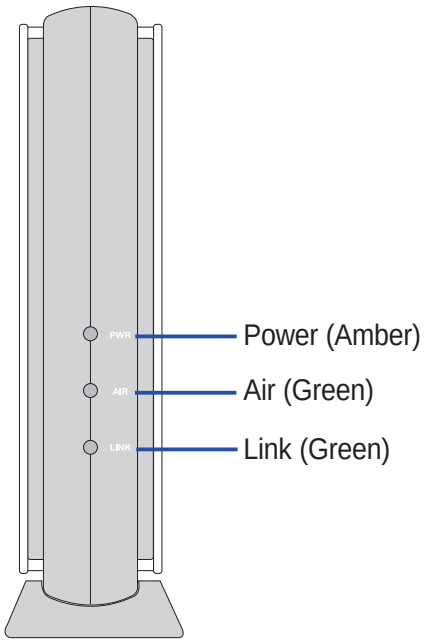
Multiple SpaceLink Access Points connected to a common Ethernet network form an Extended Service Set (ESS). All members of an Extended Service Set are configured with an ID, known as the SSID or ESSID. Wireless mobile clients must be configured with the same SSID as the SpaceLink Access Points on the network; a client can only roam between SpaceLink Access Points that share the same SSID.

Roaming Guidelines

- An 802.11b PC Card can only roam between 802.11b Access Points.
- All SpaceLink Access Points must have the same SSID.
- All computers with SpaceLinkPC card or CF card adapters must have the same SSID as the Access Points that they will roam between.
- If WEP encryption is enabled, then all SpaceLink Access Points and client adapters must use the same encryption level and WEP Key(s) to communicate.
- The SpaceLink Access Points' cells must overlap to ensure that there are no gaps in coverage and to ensure that the roaming client will always have a connection available.
- SpaceLink Access Points that use the same Channel should be installed as far away from each other as possible to reduce potential interference.
- It is strongly recommended that you perform a site survey using the utility provided with the SpaceLinkPC card or CF card to determine the best location for each SpaceLink 802.11g Access Point in the facility.

SpaceLink 802.11g Access Point LED Indicators

There are three LEDs on the front of the SpaceLink Access Point, as shown here.



Power LED

The Power LED is the top LED and turns amber when the power adapter is connected and the power switch is turned ON.

Air LED

The Air LED is the middle LED and turns green when the wireless function is working.

Link LED

The Link LED is the bottom LED and turns green when the Access Point has a physical connection to the Ethernet network.

Power Requirements

The SpaceLink 802.11g Access Point requires power from an external power supply. The SpaceLink 802.11g Access Point ships with a UL listed, Class 2 power supply (5V, 1A).

2. Installation

This chapter describes the installation procedure for the SpaceLink 802.11g Access Point and includes a description of the LEDs found on the unit.

Installation Procedure

Follow these steps to install the SpaceLink Access Point.

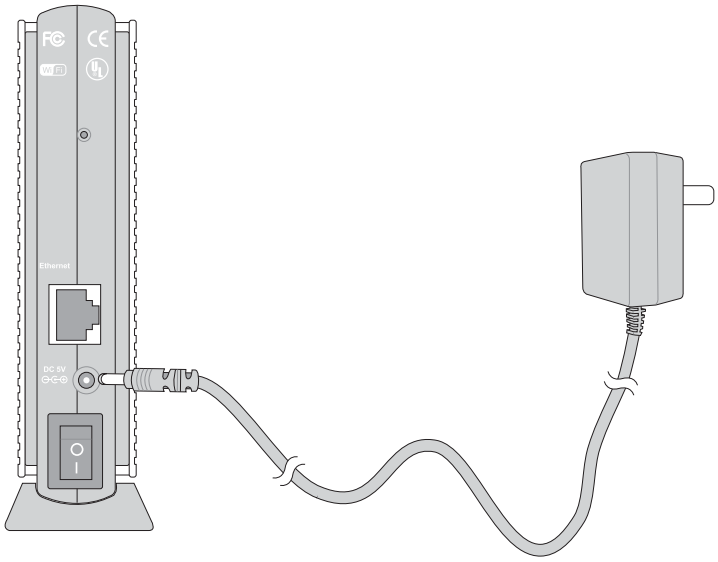
1. Determine the best location for the SpaceLink Access Point. Keep in mind the following considerations:
   - The length of the Ethernet cable that connects the Access Point to the network must not exceed 100 meters.
   - For standard placement, try to place the Access Point on a flat, sturdy surface as far from the ground as possible, such as on top of a desk or bookcase, keeping clear of metal obstructions and away from direct sunlight.
   - Try to centrally locate the Access Point or its antennas so that it will provide coverage to all of the wireless mobile devices in the area.
   - Use only the power supply that came with this unit. Other power supplies may fit but the voltage and power may not be compatible.

It is the responsibility of the installer and users of the SpaceLink 802.11g Access Point to guarantee that the antenna is operated at least 20 centimeters from any person. This is necessary to insure that the product is operated in accordance with the RF Guidelines for Human Exposure which have been adopted by the Federal Communications Commission.

2. Place the Access Point in the desired location. Wall mounting is also possible for the Access Point. Refer to the section entitled “Wall Mounting Option” on the next page for details.
3. Attach one end of an RJ-45 Ethernet cable to the Access Point and attach the other end to the RJ-45 10Base-T port of a network hub, switch, router, or patch panel (possibly on a wall).

The SpaceLink 802.11g Access Point does not support 100Base-TX; it only supports 10Base-T. Hubs or switches that supports both 10Base-T and 100Base-TX may be used.

4. Attach one end of the AC power adapter, included in the product package, to the back of the SpaceLink 802.11g Access Point and the other end to a power outlet.



Note: Use the Access Point only with the power adapter supplied in the product package. Using another power supply may damage the Access Point.

The Power LED on the front of the Access Point will light up when the unit is powered ON. In addition, the green Link LED will turn ON to indicate that the Access Point has a physical Ethernet network connection.

Wall Mounting Option

Out of the box, the SpaceLink 802.11g Access Point is designed to sit on a raised flat surface like a file cabinet or book shelf. The unit may also be converted for mounting to a wall or ceiling.

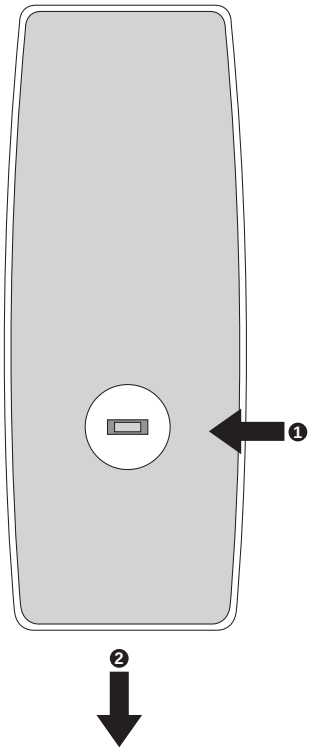
Follow these steps to mount the Access Point to a wall:

1. Remove the base by pressing the tab and sliding the base.
2. Remove the side cover to expose the mounting hooks.
3. Locate the screws provided with the Access Point.
4. Mark two holes in a flat surface using the provided hole template.
5. Tighten the two provided screws until only 1/4” is showing.
6. Latch the Access Point onto the two screws.

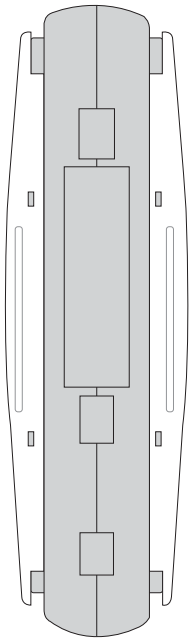
Note: Readjust the screws if you cannot latch the Access Point onto the screws or if it is too loose.

Step 1

Before:

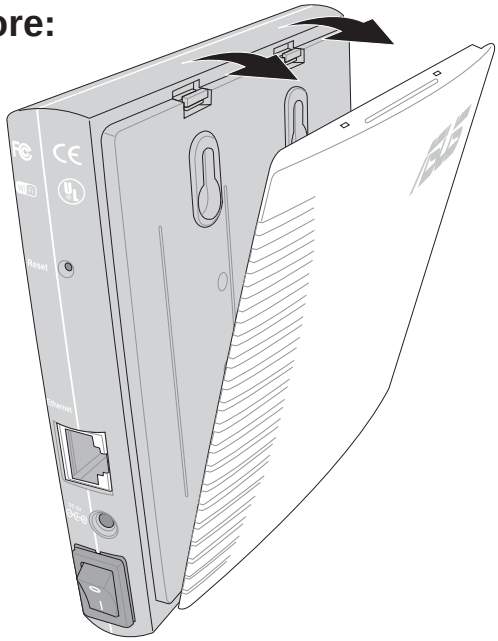


After:

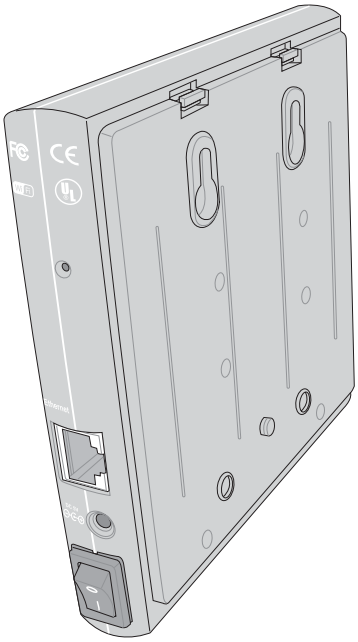


Step 2

Before:



After:



Note: Mounting brackets are provided for you to hang the SpaceLink 802.11g Access Point on an office partition or office ceiling.

Configuring the SpaceLink 802.11g AP

The home gateway can be configured to meet various usage scenarios. Some of the factory default settings may suit your usage; however, others may need changing. Prior to using the home gateway, you must check the basic settings to guarantee it will work in your environment.

Configuring the SpaceLink 802.11g Access Pointis done through a web browser. You need a Notebook PC or desktop PC connected to the SpaceLink 802.11g Access Pointand running a web browser as a configuration terminal. The connection can be wired or wireless. For the wireless connection, you need an IEEE 802.11b compatible device, e.g. ASUS SpaceLink PC Card, installed in your Notebook PC. You should also disable WEP and set the SSID to “default” for your wireless LAN device.

If you want to configure the SpaceLink 802.11g Access Pointor want to access the Internet through the SpaceLink Dual-Band Home Gateway, TCP/IP settings must be correct. Normally, the TCP/IP setting should be on the IP subnet of the SpaceLink Dual-Band Home Gateway. The SpaceLink 802.11g Access Pointincorporates a DHCP server so the easiest method is to set your PC to get its IP address automatically and reboot your computer. So the correct IP address, gateway, DNS (Domain Name System Server) can be obtained from the SpaceLink Dual-Band Home Gateway.

Note: Before rebooting your PC, the SpaceLink 802.11g Access Pointshould be switched ON and in ready state.

Advanced IP Settings

If you want to set your IP address manually, the following default settings of the SpaceLink 802.11g Access Pointshould be known:

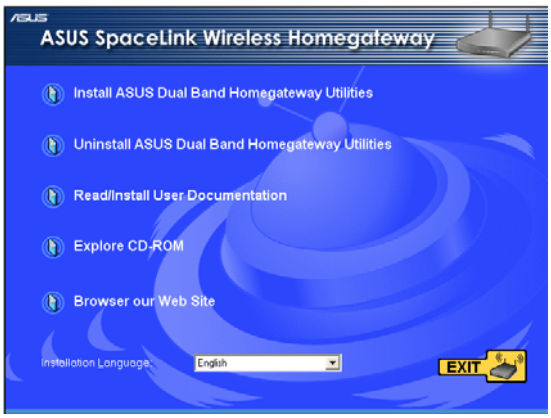
- IP address 192.168.123.1
- Subnet Mask 255.255.255.0.

If you set your computer's IP manually, it needs to be on the same segment. For example:

- IP address 192.168.123.xxx (xxx can be any number between 2 and 254 that is not used by another device)
- Subnet Mask 255.255.255.0 (same as the SpaceLink 802.11g Access Point)
- Gateway 192.168.123.1 (this is the SpaceLink 802.11g Access PointIP address)
- DNS 192.168.123.1 (SpaceLink 802.11g Access PointIP address or your own).

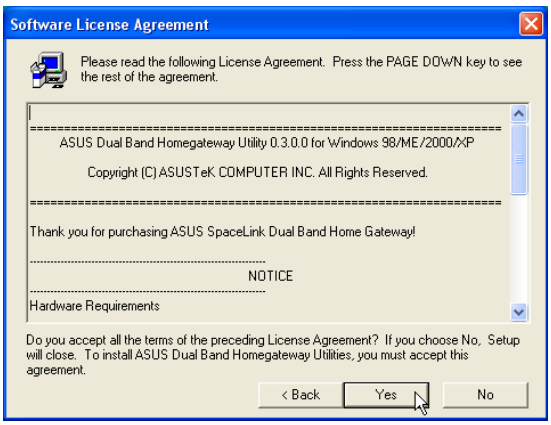
Installing the Homegateway Utilities

Follow these steps to install the SpaceLink Dual-Band Home Gateway Manager in Microsoft Windows:

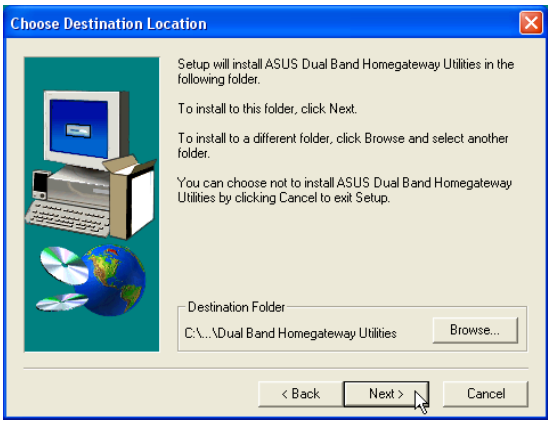


(1) Insert the support CD. Double-click **setup.exe** if your autorun has been disabled. Click **Install...Utilities.**

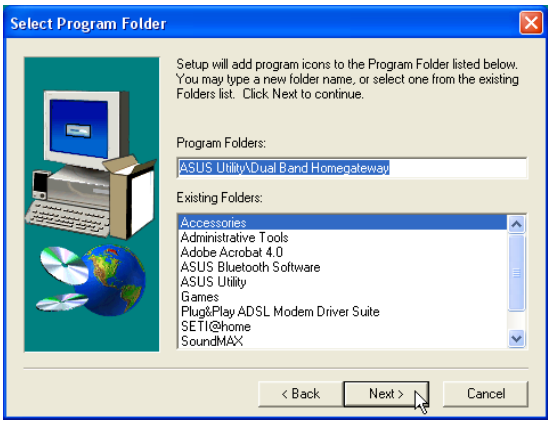
(2) Click **Next** after reading the welcome screen.



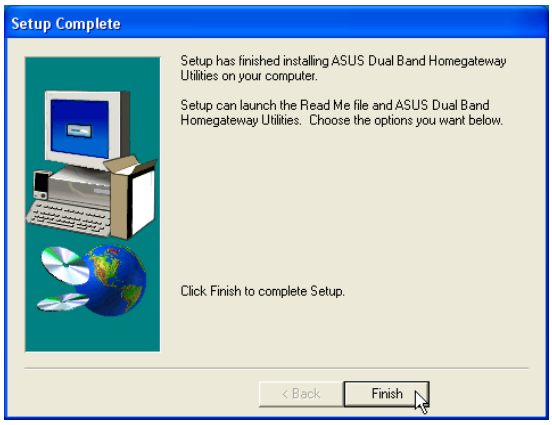
(3) Click **Yes** after reading the license agreement.



(4) Click **Next** to accept the default destination folder or click Browse to specify another path.



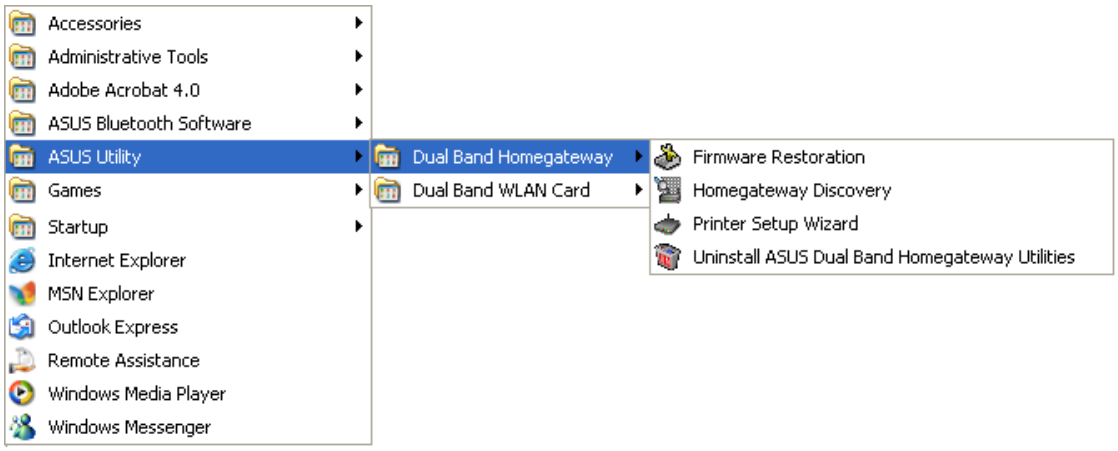
(5) Click **Next** to accept the default program folder or enter another name.



(6) Click **Finish** when setup is complete.

Homegateway Utilities

After installation, you can launch the utilities through the Start menu.



Connecting to the SpaceLink Web Manager

Wired Ethernet Connection

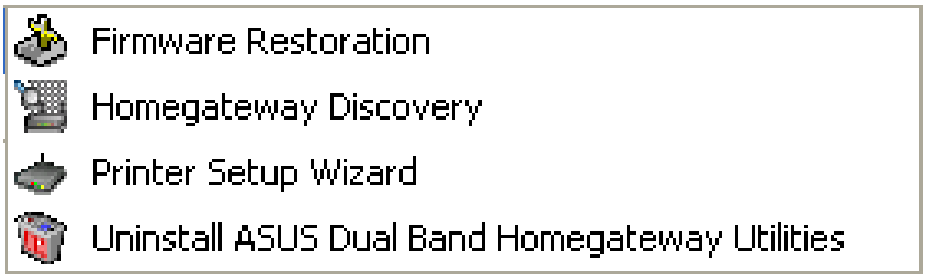
Besides using a network hub, you can also connect a LAN cable from your computer's network card to the Home Gateway using either a straight or crossover cable because the SpaceLink 802.11g Access PointLAN and WLAN RJ-45 ports have auto-crossover capability.

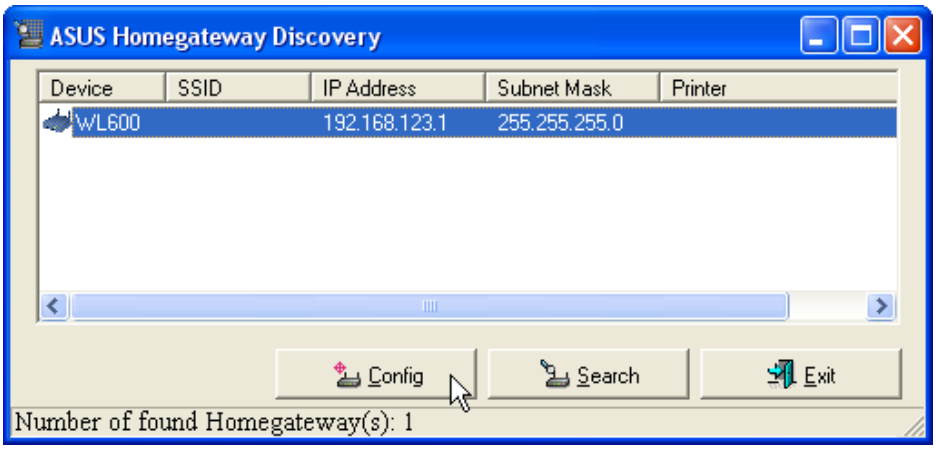
Wireless Connection

If you are using a Notebook PC with a wireless adapter, you can connect to the SpaceLink Homegateway Web Manager without a wired Ethernet connection.

Home Gateway Discovery

Run the ASUS **Homegateway Discovery** from the **Start** menu and click **Config** on the device.



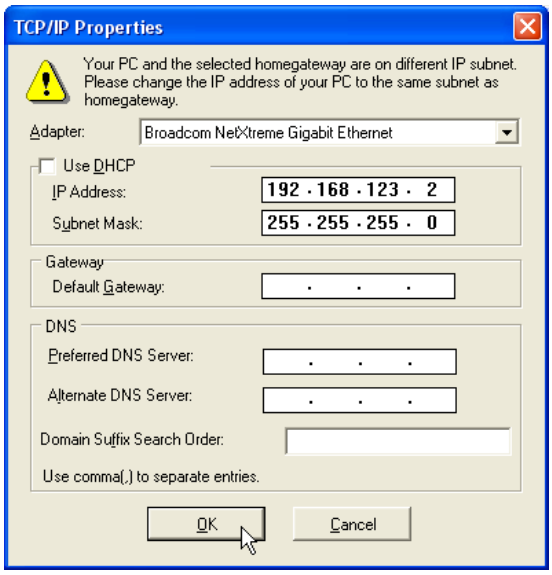


Manually Entering the Address

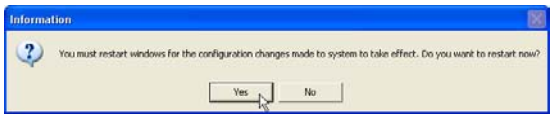
You can also open your PC's web browser and enter the IP address of the ASUS SpaceLink 802.11g AP: **http://192.168.1.1**

Home Gateway Discovery (Cont.)

Web access through the WLAN port (over the Internet) is disabled by default so that the above private IP can be used for configuration access. If Internet access through the WLAN port is enabled by the user, port 8080 must be used for configuration access. In this case, you would enter the following: **http://(WAN Port IP Address):8080** in your web browser.

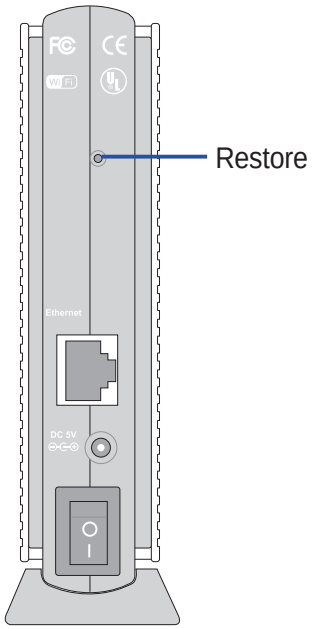


If your computer's IP is not on the same subnet as the SpaceLink Dual-Band Home Gateway, you will be asked to change it. The IP address can be any number from 2 to 254 that is not used by another device.



Restart your Windows if you are asked to.

If you cannot find any the SpaceLink 802.11g APs due to a problem in the IP settings, push and hold the "Restore" button on the SpaceLink 802.11g AP over five seconds to restore factory default settings.



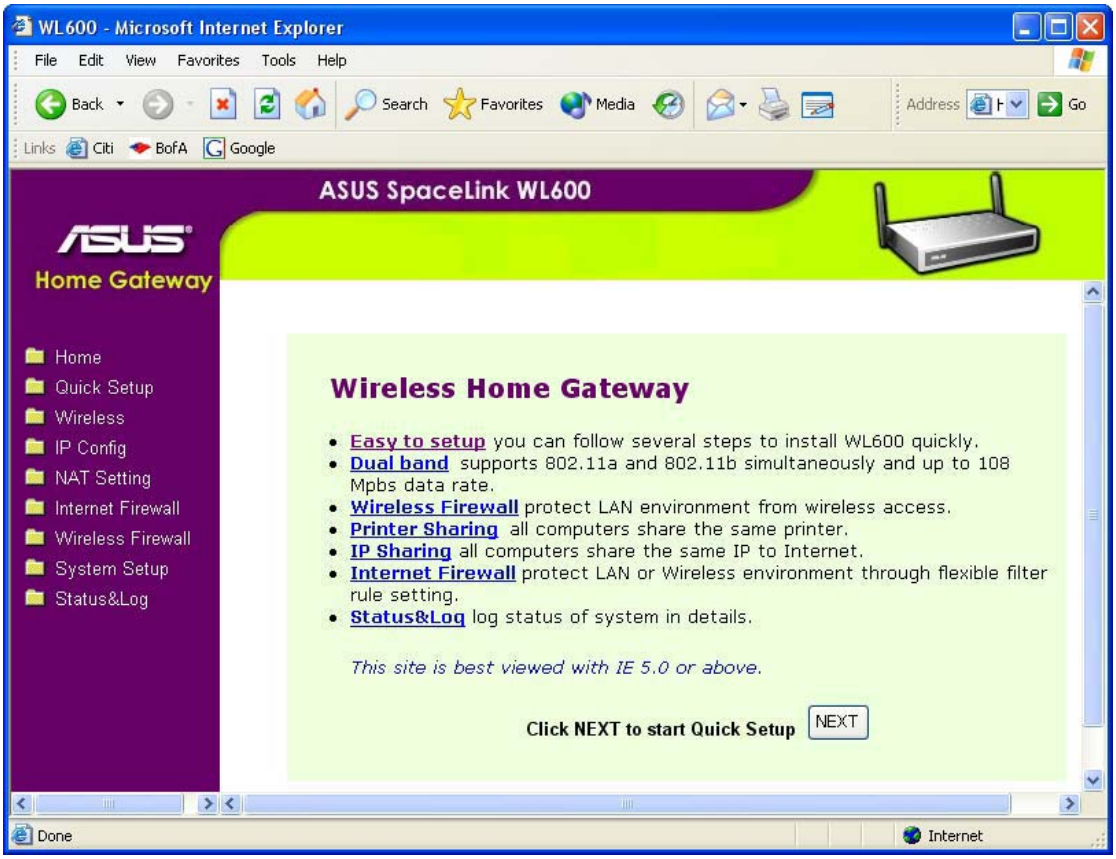
Home Gateway Discovery (Cont.)

User Name and Password

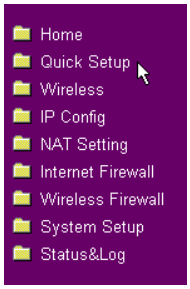
Once connected, a window will ask for the User name and Password in order to log in. The factory default values are "**admin**" and "**admin**".

Home Page

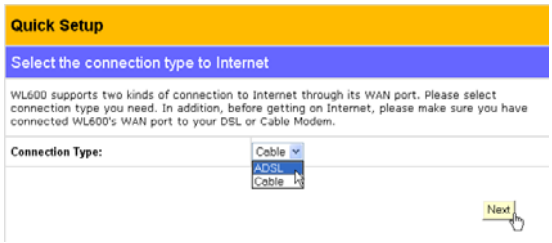
After logging in, you will see the ASUS 802.11g AP home page.

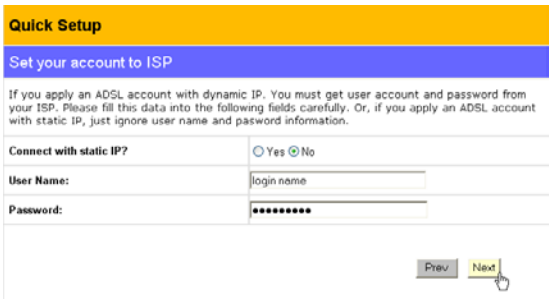


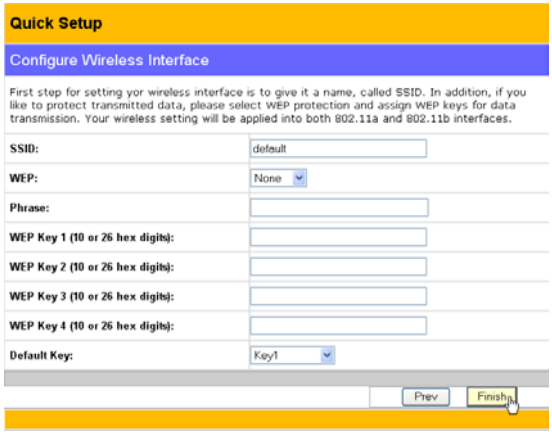
Quick Setup



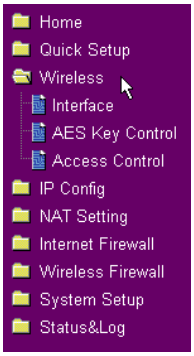
Click Next to enter the Quick Setup page. Follow the instructions to setup the ASUS SpaceLink Dual-Band Home Gateway.



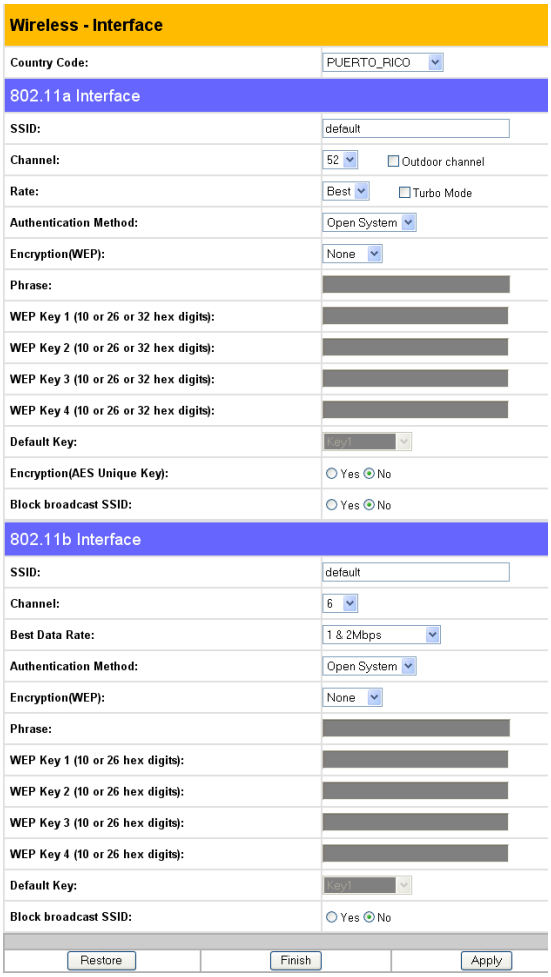


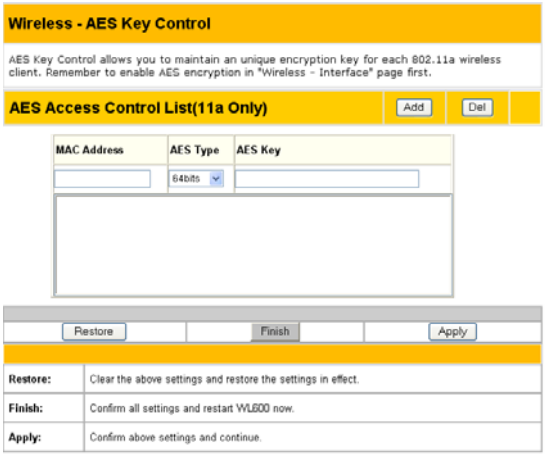


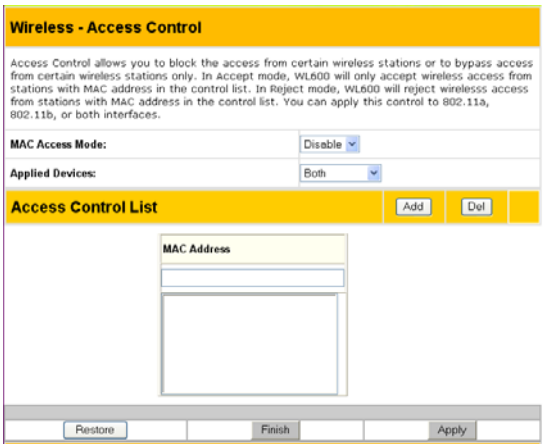
Wireless



Click this item on the menu to reveal a sub menu. Follow the instructions to setup the ASUS SpaceLink Dual-Band Home Gateway. Tips are given when you move your cursor over each item.







SSID & Channel

The SSID is an identification string of up to 32 ASCII characters that differentiate one SpaceLink Home Gateway or Access Point from another. The SSID is also referred to as the "ESSID" or "Extended Service Set ID." You can use the default SSID and radio channel unless more than one SpaceLink Home Gateway or Access Point is deployed in the same area. In that case, you should use a different SSID and radio channel for each SpaceLink Home Gateway or Access Point. All the SpaceLink Home Gateways and SpaceLink 802.11b client adapters must have the same SSID to allow a wireless mobile client to roam between the SpaceLink Home Gateways. By default, the SSID is set to "default".

Channel

IEEE 802.11b devices are direct sequence spread spectrum devices that spread a radio signal over a range of frequencies. The range of frequencies used by a direct sequence device is called a Channel.

The IEEE 802.11b specification supports up to 14 overlapping Channels for radio communication. But only 11 Channels are supported in the United States and therefore on the SpaceLink Home Gateway. To minimize interference, configure each the SpaceLink Home Gateway to use Non-overlapping channels. Non-overlapping channels have 25Mhz separation beginning at the first allowed channel for the country (for the US and most of Europe, channels 1, 6 & 11 are used).

Make sure that the SpaceLink Home Gateways sharing the same Channel (or Channels close in number) are as far away from each other as possible, based on the results of your site survey of the facility. You can find the site survey utility in the SpaceLink PC card or CF card setup CD.

Rate

Select "1, 2, 5.5 & 11Mbps" to maximize performance. Use "1 & 2 Mbps" only when backward compatibility is needed for some older wireless LAN cards with a maximum bit rate of 2Mbps.

The IEEE 802.11b specification supports four data rates: 11 Mbps, 5.5 Mbps, 2 Mbps, and 1 Mbps. As a wireless mobile client travels further and further away from the SpaceLink Home Gateway, the data rate automatically decreases in order to maintain a usable radio connection. Therefore, a client that is close to an the SpaceLink Home Gateway may operate at 11 Mbps, but a client that is far away from the SpaceLink Home Gateway may operate at 2 Mbps.

Authentication Method

It is suggested to select “Shared Key Only”. If “Open System Only” or “Shared Key and Open System” is used, the home gateway may accept connection requests from unauthorized wireless clients.

WEP

The IEEE 802.11b standard specifies an optional encryption feature, known as Wired Equivalent Privacy or WEP, that is designed to provide a wireless LAN with a security level equal to what is found on a wired Ethernet network.

WEP encrypts the data portion of each packet exchanged on the 802.11b network using either a 64-bit or 128-bit encryption algorithm. In addition, WEP is also used in conjunction with the optional Shared Key Authentication algorithm to prevent unauthorized devices from associating with an 802.11b network.

Enabling WEP can protect your data from eavesdroppers. If you do not need this feature, select “no” to skip the following setting. The SpaceLink Home Gateway supports both 64-bit and 128-bit encryption using the Wired Equivalent Privacy (WEP) algorithm. Select the type of encryption you want to use (64 or 128 bit) and configure one to four WEP Keys. The “128-bit” method is more secure than the “64-bit”.

64/128bits versus 40/104bits

You may be confused about configuring WEP encryption, especially when using multiple wireless LAN products from different vendors. There are two levels of WEP Encryption: 64 bits and 128 bits.

Firstly, 64 bit WEP and 40 bit WEP are the same encryption method and can interoperate in the wireless network. This lower level of WEP encryption uses a 40 bit (10 Hex character) as a “secret key” (set by user), and a 24 bit “Initialization Vector” (not under user control). This together makes 64 bits (40 + 24). Some vendors refer to this level of WEP as 40 bits and others refer to this as 64 bits. ASUS SpaceLink products use the term 64 bits when referring to this *lower* level of encryption.

Secondly, 104 bit WEP and 128 bit WEP are the same encryption method and can interoperate in the wireless network. This higher level of WEP encryption uses a 104 bit (26 Hex character) as a “secret key” (set by user), and a 24 bit “Initialization Vector” (not under user control). This together

makes 128 bits (104 + 24). Some vendors refer to this level of WEP as 104 bits and others refer to this as 128 bits. ASUS SpaceLink products use the term 128 bits when referring to this *higher* level of encryption.

Phrase

Automatically generate four WEP keys. A WEP key is either 10 or 26 hexadecimal digits (0~9, a~f, and A~F) based on whether you select 64 bit or 128 bit in the WEP pull-down menu. Type a combination of up to 64 letters, numbers, or symbols in the Magic Word column, then the SpaceLink Home Gateway Manager uses an algorithm to generate four WEP keys for encryption. If you want to type in the keys manually, leave this field blank.

The SpaceLink family of products all use the same algorithm to generate the keys so that they can all use the same WEP key.

Note: This function eases users from having to remember their passwords and is compatible to ASUS SpaceLink family of products. But this is not as secure as manual assignment.

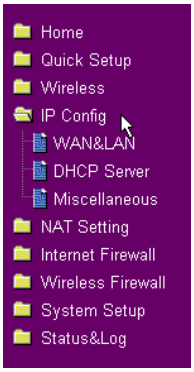
WEP Key

At most four keys can be set. A WEP key is either 10 or 26 hexadecimal digits (0~9, a~f, and A~F) based on whether you select 64 bit or 128 bit in the WEP pull-down menu. The home gateway and ALL of its wireless clients MUST have at least the same default key.

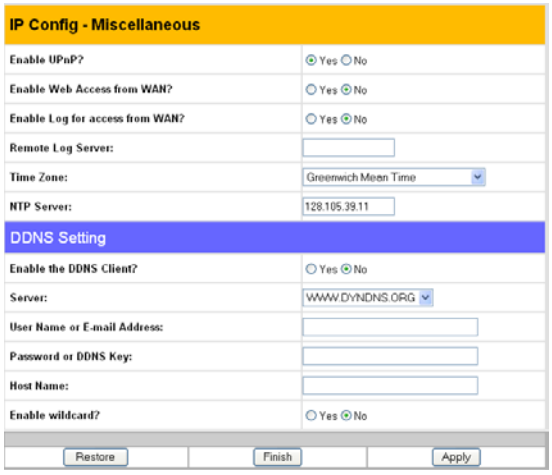
Default Key

The Default Key field lets you specify which of the four encryption keys you use to transmit data on your wireless LAN. As long as the SpaceLink Home Gateway or wireless mobile client with which you are communicating has the same key in the same position, you can use any of the keys as the default key. If the home gateway and ALL of its wireless clients use the same four WEP keys, select “key rotation” to maximize security. Otherwise, choose one key in common as the default key.

IP Config



Click this item on the menu to reveal a sub menu. Follow the instructions to setup the ASUS SpaceLink Dual-Band Home Gateway. Tips are given when you move your cursor over each item.



Static IP Address

IP Address - Normally, this is Dynamic (because fixed IP accounts cost more) and should be set to Automatic IP. Do not use “Static IP” if your ISP’s documentation does not mention an IP Address. If your ISP provided an IP Address with instructions to use it, select Static IP from “IP Addressing Method” and enter the address into the provided field.

WAN DNS Settings

DNS Server - Normally this is automatic and you would answer “NO” to the question about manually assigning DNS. If you are given instructions from your ISP to enter DNS addresses, select “YES” to manually assigning DNS and enter the IP addresses here. You can set the DNS server anytime using any connection type (Static IP, PPPoE, or Automatic IP).

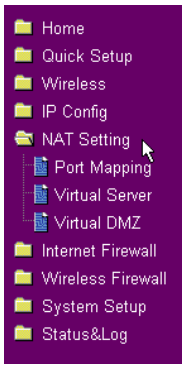
PPPoE Account

User Name - The name of your Internet account provided by your ISP. Some ISPs work with the entire account name along with the hosting domain (such as yourname@yourdomain.com) and others require that you enter only the account name (yourname). See the example above.

Password - Enter the password for your Internet account.

Click the "Finish" button to save your new settings and restart the SpaceLink Home Gateway or click "Save" and restart later.

NAT Setting



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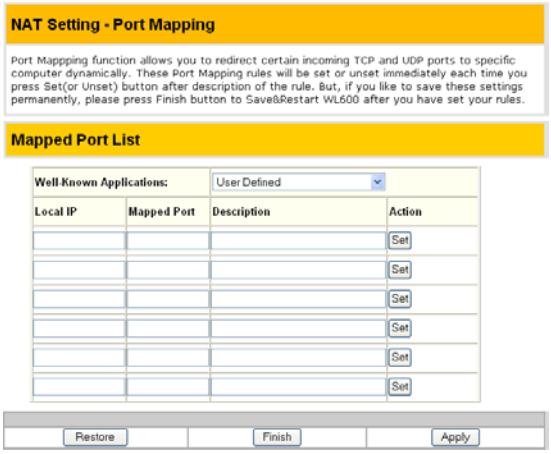
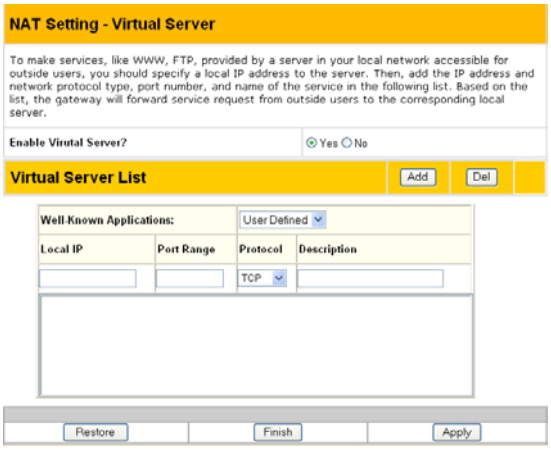
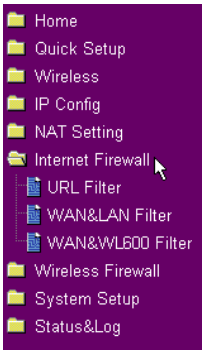




Internet Firewall



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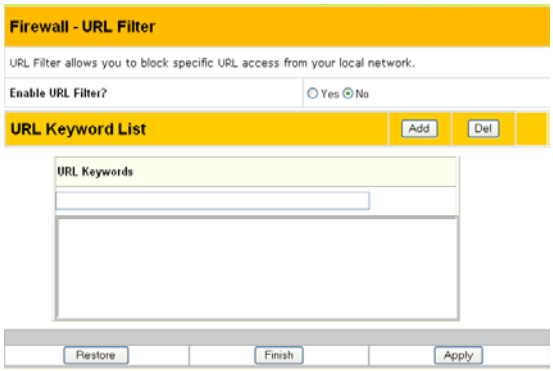
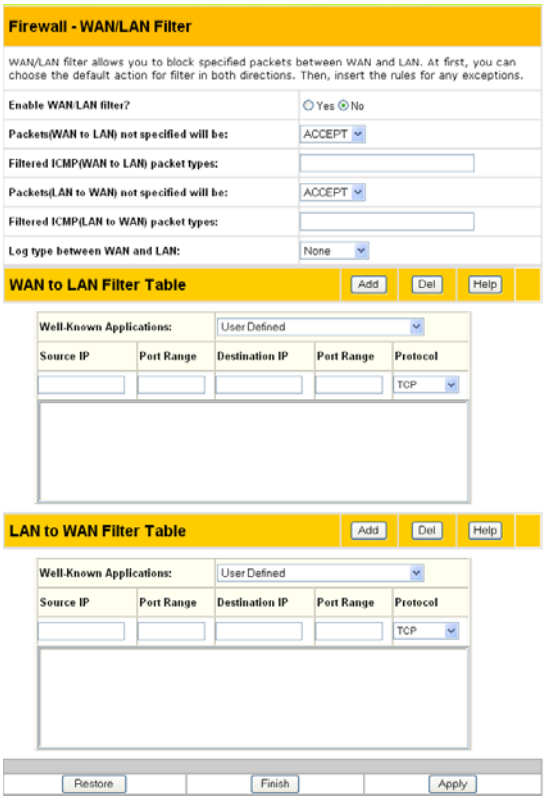
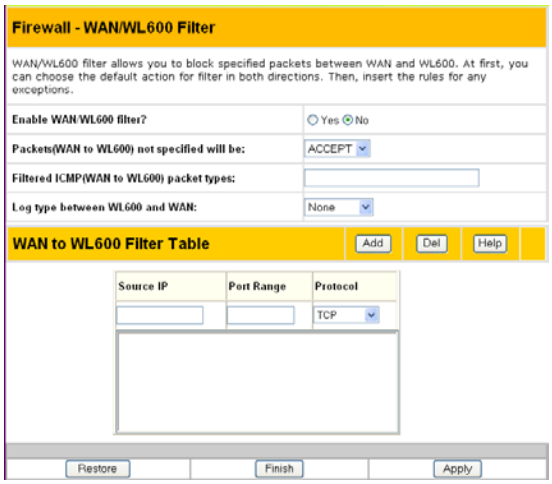
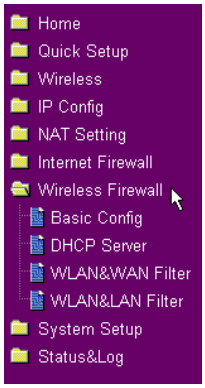






Wireless Firewall



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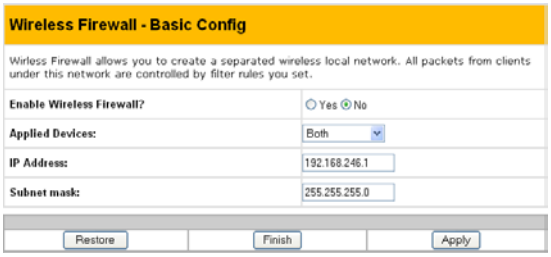
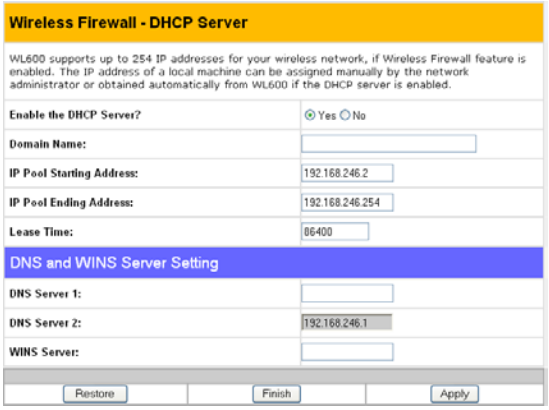
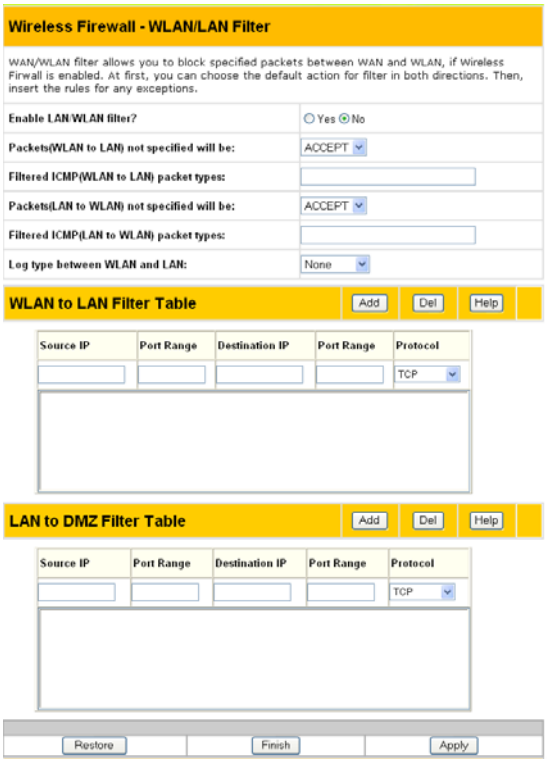
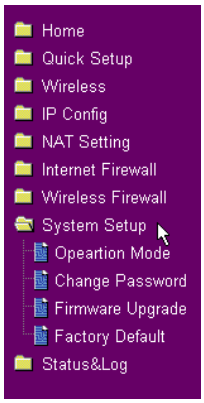


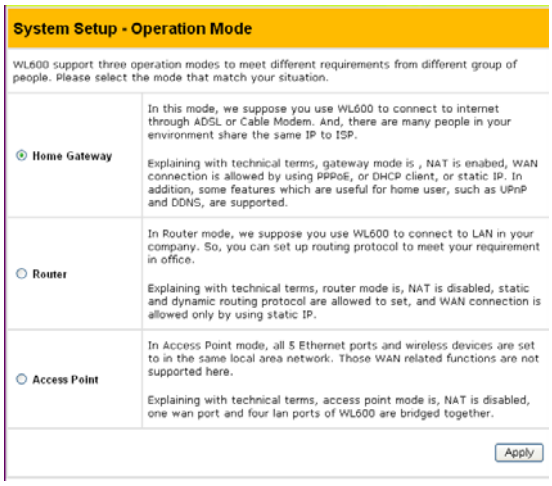


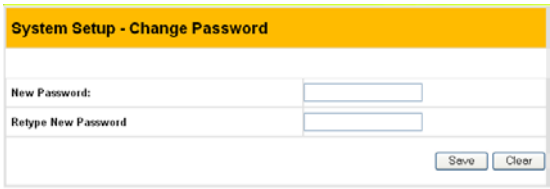


System Setup

Click this item on the menu to reveal a sub menu. Follow the instructions to setup the ASUS SpaceLink Dual-Band Home Gateway. Tips are given when you move your cursor over each item.



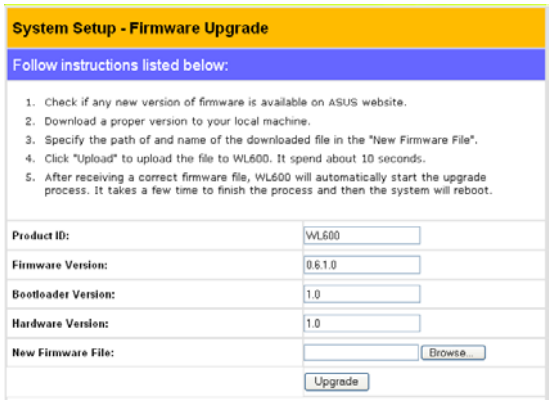


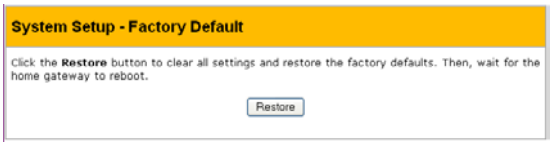


System Setup - Change Password

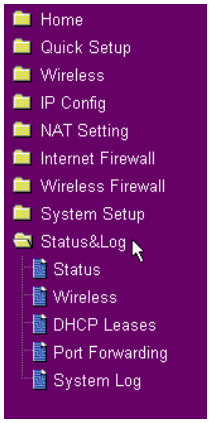
This page will allow you to change the default password “admin” (lower case) to any password of you choice. You can enter any usable characters between 1-16 characters long (cannot be left blank). Click **Save** button to save your new password. If you forget the SpaceLink Home Gateway’s password, you can reset the SpaceLink Home Gateway to its factory settings (see troubleshooting).

Note: The password is case sensitive.



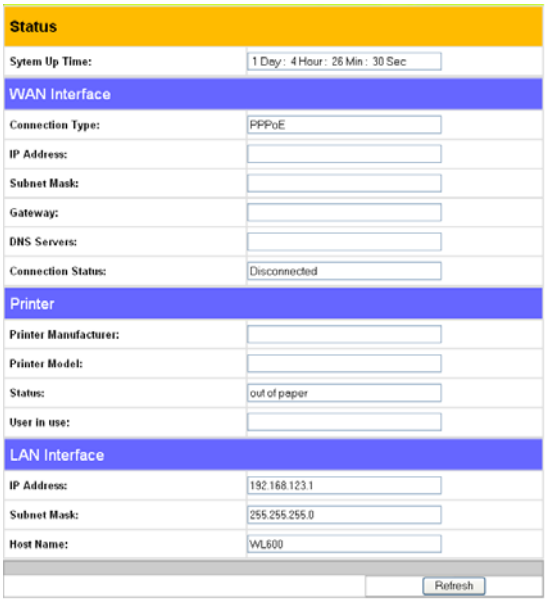


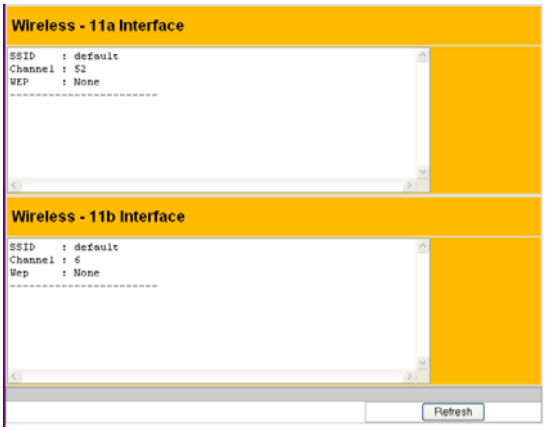
Status & Log

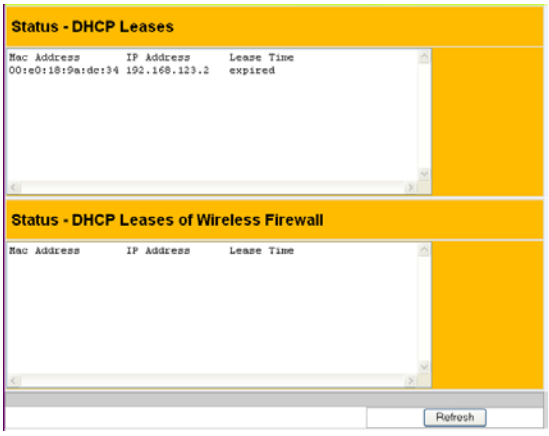


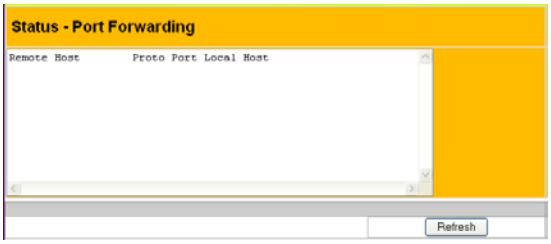
Click this item on the menu to reveal a sub menu. Follow the instructions to setup the ASUS SpaceLink Dual-Band Home Gateway. Tips are given when you move your cursor over each item.

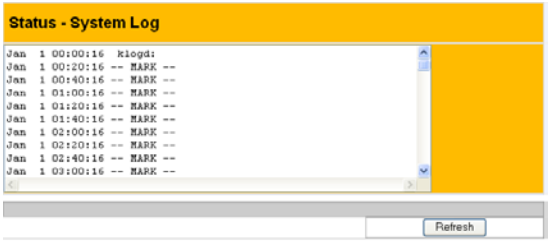
The Status page gives you all the necessary information for monitoring the SpaceLink Home Gateway's condition.







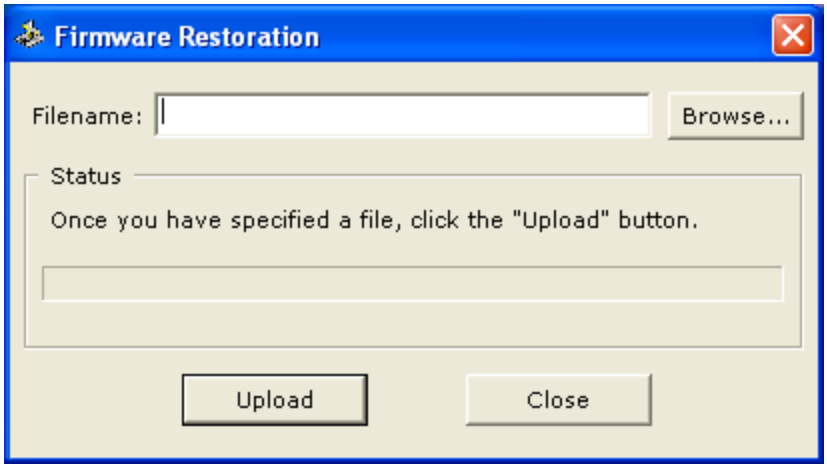




Firmware Restoration

This utility will automatically search out failed SpaceLink 802.11g APs and upload a firmware that you specify. The process takes about 3 to 4 minutes and during this process the PWR, AIR, and WLAN LEDs will remain lit while the LAN LED will flash slowly.

The Firmware Restoration utility is an emergency rescue tool to restore a SpaceLink 802.11g AP which has failed during a previous firmware upload. A failed firmware upgrade will cause the SpaceLink 802.11g AP to enter a failure mode, waiting for the user to use the Firmware Restoration utility to find and upload a new firmware. This is not a firmware upgrade utility and cannot be used on a working SpaceLink 802.11g AP. Normal firmware upgrades must be done through the web manager.



Using a Hub

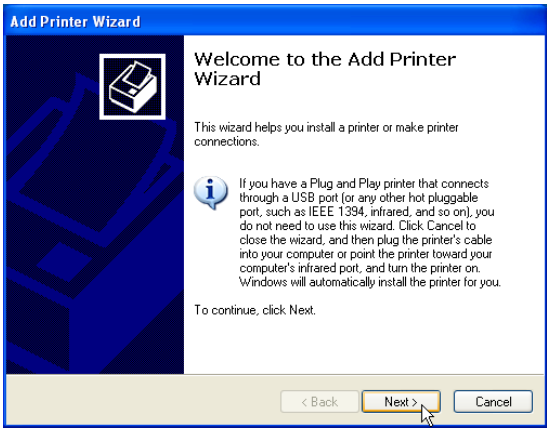
If you have problems upload a firmware while using a network hub, try connecting your computer directly to the LAN port. Either 10Base-T or 100Base-TX connections will work.

Printer Setup Wizard

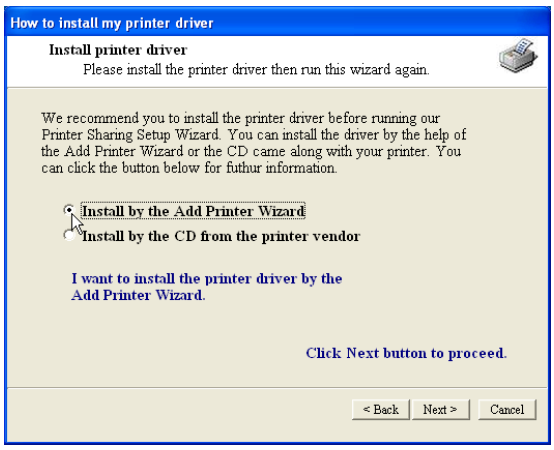
This utility helps you setup your computers to utilize the printer server function of the SpaceLink Dual-Band Home Gateway.

Add Printer Wizard

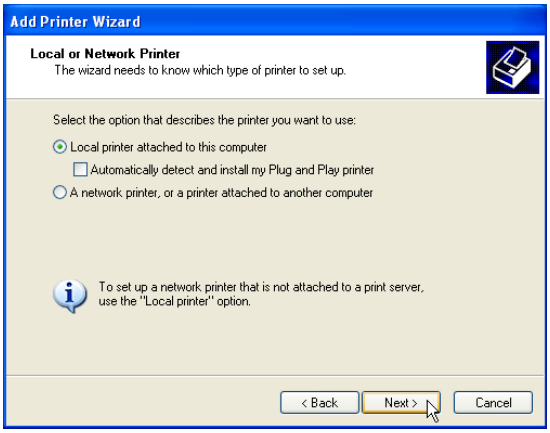
You should add your printer to your computer to simplify the SpaceLink 802.11g Access PointPrinter Setup Wizard. If you run the "Printer Setup Wizard" without your printer driver installed, it will direct you to the "Add Printer Wizard".



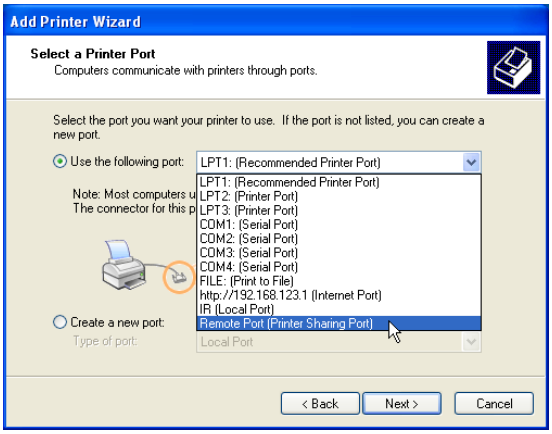
(1) Run the "Add Printer Wizard" from **Start | Printers and Faxes | Add Printer.**



(2) Choose "Install by the Add Printer Wizard".

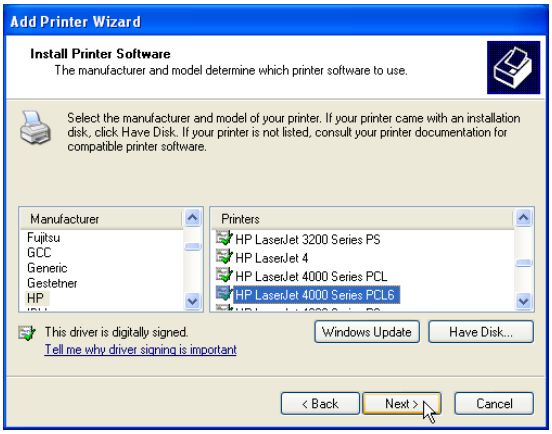


(3) Choose "Local printer attached to this computer".

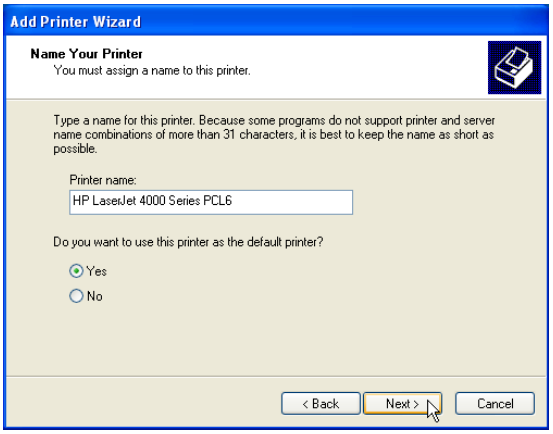


(4) Choose "Remote Port (Printer Sharing Port)". If this is not available, select LPT1.

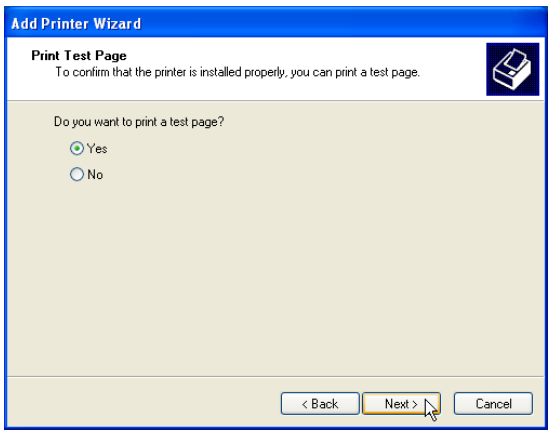
Printer Setup Wizard (Cont.)



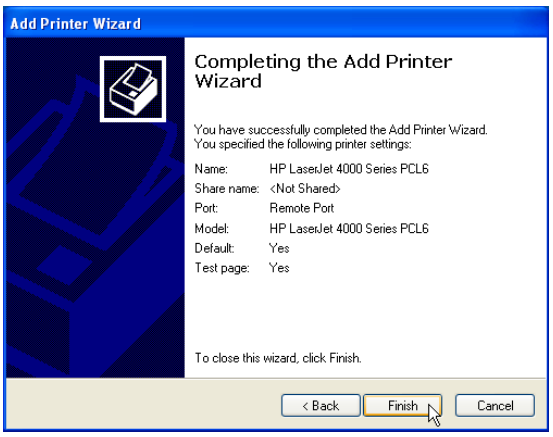
(5) Find your manufacturer and model. Click **Have Disk** if you cannot find it in the list and use the driver provided with your printer.



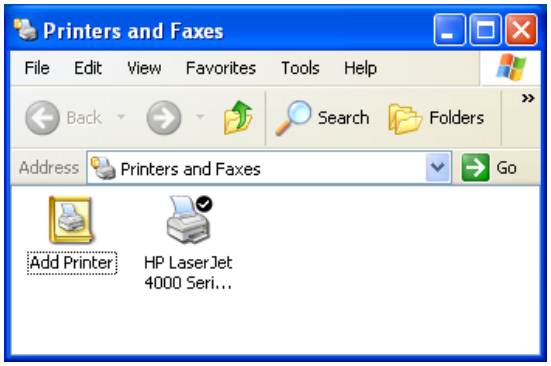
(6) Click **Next** to set this as your default printer.



(7) You can print a test page.



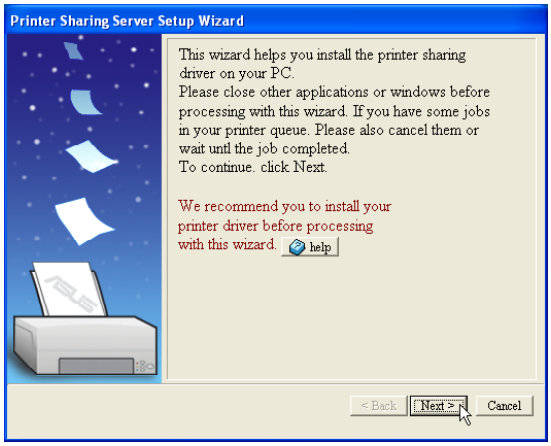
(8) Click **Finish** to close the wizard.



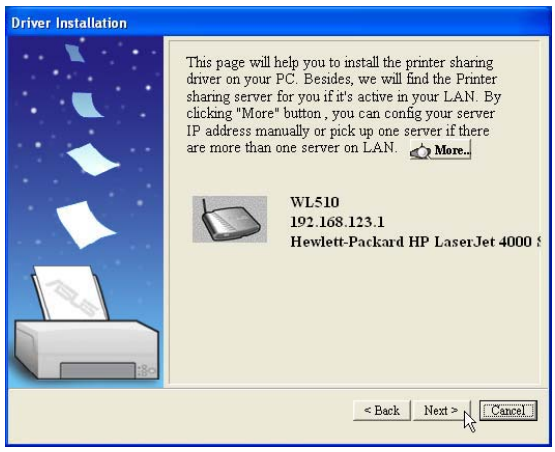
Your printer will show in the "Printers and Faxes" window and the check mark shows that it is set as your default printer.

Printer Setup Wizard

The wizard will explore all available SpaceLink Dual-Band Home Gateways and model information of the printers attached to them in your local network.

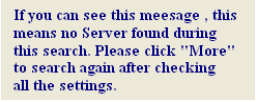


(1) If you already have your printer installed on your printer port (LPT1), it will make this setup process much easier. See next page for instructions. Run the Printer Setup Wizard from the Windows Start menu.

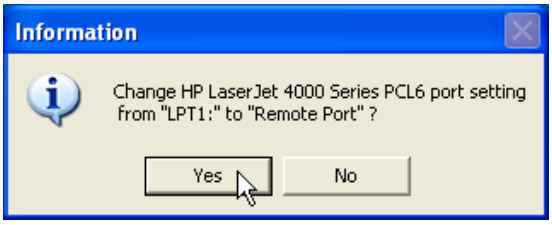


(2) If the printer is found, the name of the printer will be shown on this screen.

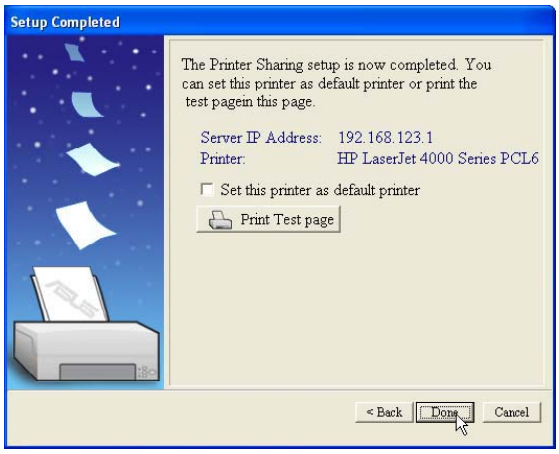
Note: If there is an error communicating with the printer, you will get this message.



Make sure that the printer is ON, ready, and connected. Click **Back** and **Next**.

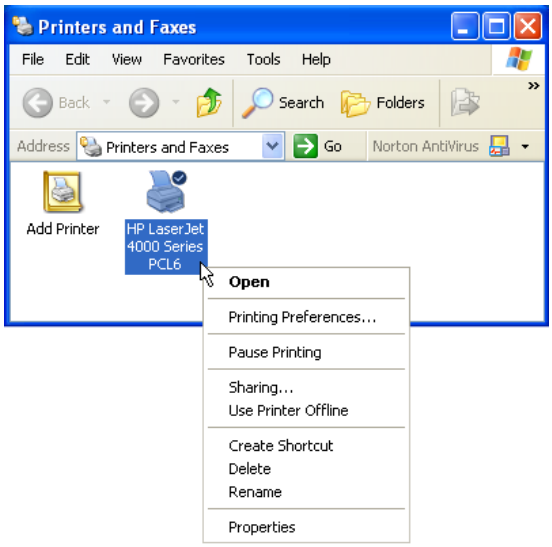


(3) This setup wizard will change your default printer to use “Remote Port” which is serviced by the SpaceLink Dual-Band Home Gateway.

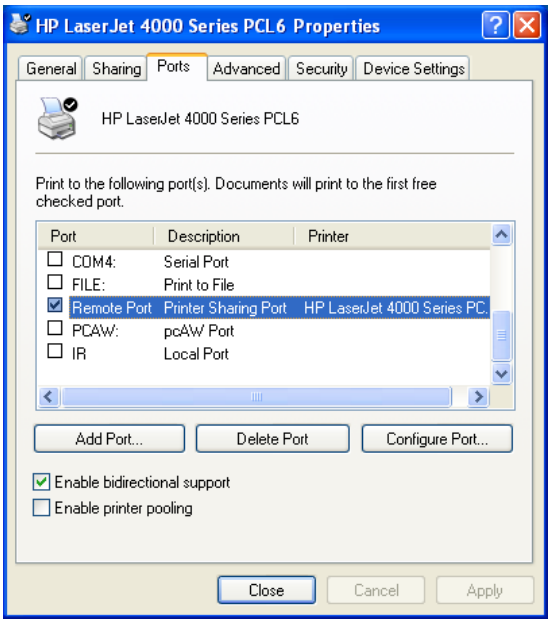


(4) Click **Done** when setup is complete.

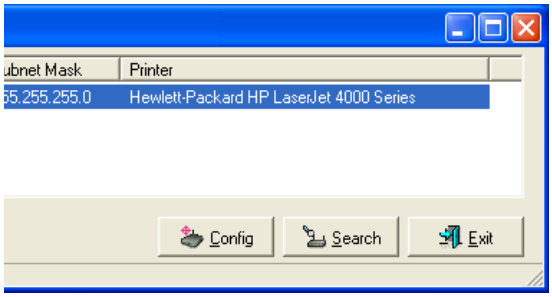
Verifying Your Printer



After setting up the printer, a printer icon will appear in Windows' "Printers and Faxes". Right click the printer icon and choose **Properties** to configure the printer.

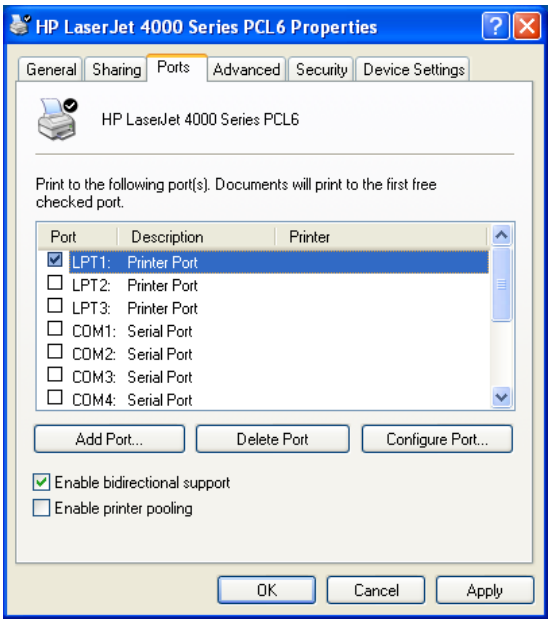


If your printer was previously setup, the SpaceLink 802.11g Access Pointprinter setup wizard will change your printing port from your local LPT1 (parallel) port to "Remote Port". If necessary, you can change this back at anytime or use Windows "Add Printer" to setup another printer on whatever port you require.



Printer Server	
Connected Printer Status:	on-line
User in service:	

When properly setup, the SpaceLink 802.11g Access Pointwill show the printer name in the "Homegateway Discovery" utility and show "on-line" under the "Printer Server" on the "Status" page of the web manager.



4. Wireless Performance

This section provides the user with ideas for how to improve the performance of a SpaceLink 802.11b network.

Site Topography

For optimal performance, locate wireless mobile clients and the SpaceLink 802.11g APs away from transformers, heavy-duty motors, fluorescent lights, microwave ovens, refrigerators, and other industrial equipment. Signal loss can occur when metal, concrete, walls or floors block transmission. Locate the SpaceLink 802.11g APs in open areas or add the SpaceLink 802.11g APs as needed to improve coverage.

Microwave ovens operate in the same frequency band as the SpaceLink 802.11g AP. Therefore, if you use a microwave within range of the SpaceLink 802.11g AP you may notice network performance degradation. However, both your microwave and your the SpaceLink 802.11g AP will continue to function.

Site Surveys

A site survey (utility provided with the SpaceLink PC card and CF card) analyzes the installation environment and provides users with recommendations for equipment and its placement. The optimum placement of 11 Mbps Home Gateways differs for 1 or 2 Mbps Home Gateways, because the locations and number of Home Gateways required are different.

Range

Every environment is unique with different obstacles, barriers, materials, etc. and, therefore, it is difficult to determine the exact range that will be achieved without testing. However, has developed some guidelines to estimate the range that users will see when the product is installed in their facility, but there are no hard and fast specifications.

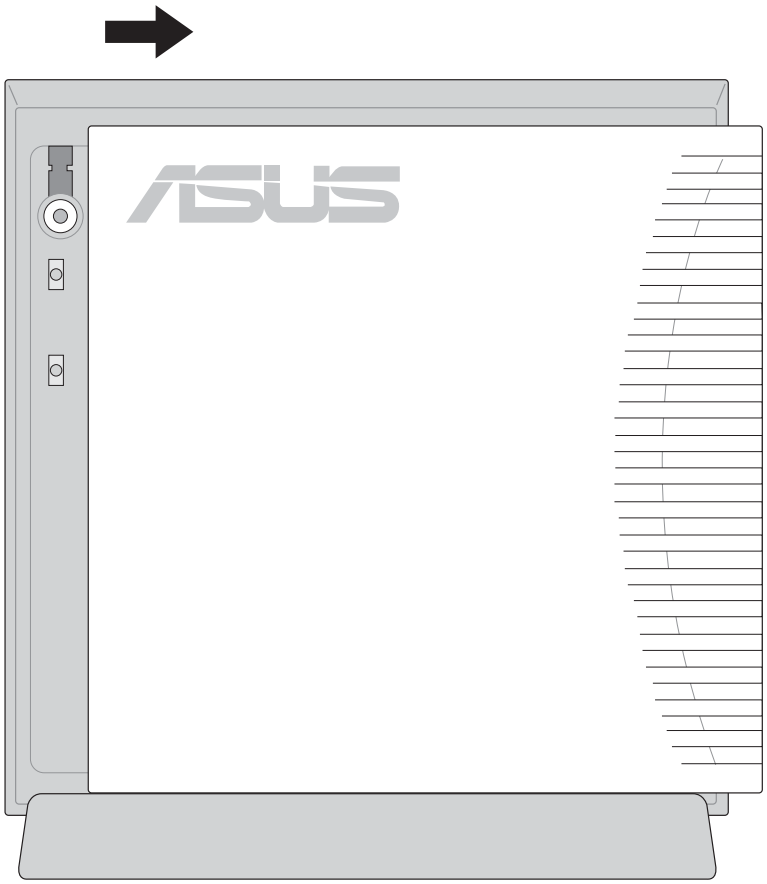
Radio signals may reflect off of some obstacles or be absorbed by others depending on their construction. For example, with two 802.11b radios, you may achieve up to 1000' in open space outdoors where two devices have a line of sight, meaning they see each other with no obstacles. However, the same two units may only achieve up to 300' of range when used indoors.

The IEEE 802.11b specification supports four data rates: 11 Mbps, 5.5 Mbps, 2 Mbps, and 1 Mbps. Operation at 1 Mbps provides greater range than operation at 11 Mbps. The SpaceLink 802.11g Access Pointwill automatically adjust the data rate to maintain a usable radio connection.

Therefore, a client that is close to the SpaceLink 802.11g Access Pointmay operate at 11 Mbps while a client that is on the fringe of coverage may operate at 1 Mbps. As mentioned earlier, you can configure the data rates that the SpaceLink 802.11g Access Pointwill use. Note that if you limit the range of data rates available to the SpaceLink Dual-Band Home Gateway, you may reduce the effective wireless range of the SpaceLink 802.11b products.

Location of antenna connector

Slide the right side cover back to reveal the antenna connector.



Note: Optional antenna kits are not currently available. Check with your local dealer for availability.

5. Troubleshooting

The SpaceLink Access Point is designed to be very easy to install and operate. However, if you experience difficulties, use the information in this chapter to help diagnose and solve problems. If you cannot resolve a problem, contact Technical Support, as listed on the front of this manual.

Common Problems and Solutions

Problem

AP does not power up:

Solution

- Check for faulty SpaceLink Access Point power supply by measuring the output voltage with an electrical test meter.
- Check failed AC supply (power outlet)

Problem

Cannot communicate with the SpaceLink Access Point through a wired network connection.

Solution

- Verify network configuration by ensuring that there are no duplicate IP addresses. Power down the device in question and ping the assigned IP address of the device. Ensure no other device responds to that address.
- Check that the cables used have proper pin outs and connectors or use another LAN cable.
- Check that the hub, switch, or computer that the SpaceLink Access Point is connected to supports 10Mbps speed.

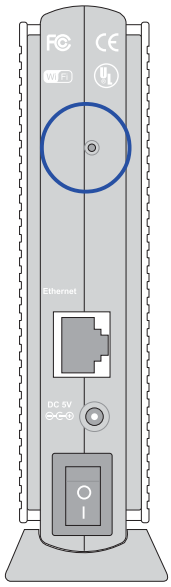
This is what you will see if you connect the SpaceLink Access Point to a:

	10/100 Mbps Hub	Pure 100 Mbps Hub
Hub LED	ON	OFF
Access Point (Link) LED	ON	ON

So you will not know if the connection is bad from the SpaceLink Access Point Link LED alone, you will have to look at the Hub LED if you are not sure what kind of hub the SpaceLink Access Point is attached to.

Problem

The SpaceLink Access Point Manager still cannot find or connect to the SpaceLink Access Point after verifying the IP address and LAN cable, changes cannot be made, or password is lost.



Solution

In case the SpaceLink Access Point is inaccessible, you can restore the SpaceLink Access Point's factory default settings. Use a straightened paper clip to press the button located in the hole labeled "Reset" on the back of the SpaceLink Access Point and keep it depressed over 5 seconds. The amber power LED will darken and then light up when reset is successful.

Reset to Defaults

The following are factory default values. These values will be present when you first receive your SpaceLink Access Point, if you push the reset button on the back of the SpaceLink Access Point over 5 seconds, or if you click the "Reset to Defaults" on the "General" page of the SpaceLink Access Point Manager.

Name	Default Value
Password	"asus"
IP address assignment	obtain an IP address automatically
Primary port	Ethernet
IP address	192.168.39.130
Subnet mask	255.255.255.0
Gateway	0.0.0.0
SSID	"default"
Channel	1
WEP type	WEP disable
AP name	"ASUS AP"
Operational mode	AP mode
Only allow IP packets	Disable
Authorization table	Disable
Host AP / Wireless Bridge MAC Add.	00-00-00-00-00-00
Fragmentation threshold	2346
RTS threshold	2346
Preamble mode	Long preamble
Authentication type	Both

Problem

My 802.11b PC Card will not associate with the SpaceLink Access Point.

Solution

Follow these steps:

1. Try to bring the devices closer together; the PC Card may be out of range of the SpaceLink Access Point.
2. Confirm that the SpaceLink Access Point and PC Card have the same SSID.
3. Confirm that the SpaceLink Access Point and PC Card have the same Encryption settings, if enabled.
4. Confirm that the SpaceLink Access Point's Air and Link LEDs are solid green.
5. Confirm that the authorization table includes the MAC address of the SpaceLink PC card if "Authorization Table" is enabled.
6. Confirm that the operational mode is "Access Point" mode.
7. Confirm that the SpaceLink Access Point and SpaceLink PC card have the same preamble mode.

Problem

The throughput seems slow.

Solution

To achieve maximum throughput, verify that your antennas are well-placed, not behind metal, and do not have too many obstacles between them. If you move the client closer to the SpaceLink Access Point and throughput increases, you may want to consider adding a second SpaceLink Access Point and implementing roaming.

- Check antenna, connectors and cabling.
- Verify network traffic does not exceed 37% of bandwidth.
- Check to see that the wired network does not exceed 10 broadcast messages per second.
- Verify wired network topology and configuration.

Problem

I cannot find SpaceLink Access Points using the SpaceLink Access Point Manager.

Solution

To configure the SpaceLink Access Point through a wireless LAN card, your computer must be in the same subnet of the SpaceLink Access Point. You cannot find SpaceLink Access Points with subnet different from your computer within the same gateway. You must change your computer to the same subnet as the SpaceLink Access Point. The factory default subnet of the SpaceLink Access Point is "192.168.39.0".

If you put the SpaceLink Access Point on different subnets, but physically connected inside the same gateway, the following symptoms will occur:

For example, if your computer's TCP/IP settings are:

IP address: 192.168.1.1, Subnet mask: 255.255.255.0

AP TCP/IP Settings	Ethernet Network		Wireless LAN
IP address	192.168.2.130	192.168.2.130	192.168.2.130
Subnet mask	255.255.255.0	255.255.255.0	255.255.255.0
Gateway	0.0.0.0	Not 0.0.0.0	Any value
Success of Search AP	Yes, then you can change the AP to match your subnet	No, you should "reset to defaults", then search again.	No, you should 1. "reset to defaults" 2. change your PC's IP address to 192.168.39.X then search again

In Windows NT/2000/XP, you must login with Administrator privileges so that all functions of the SpaceLink Access Point Manager can function correctly. If you do not login as a member of the Administrator group, you cannot run Access Point Manager.

Problem

How do I upgrade the firmware on the SpaceLink Access Point?

Solution

Periodically, a new Flash Code is available for SpaceLink Access Points on the Web site at **http://www.asus.com**. Ideally, you should update an Access Point's Flash Code using the "ASUS AP Live Update" utility installed along with the "ASUS AP Manager". See the next section for instructions on using "ASUS AP Live Update".

6. Appendix

Operating frequency range

The DSSS PHY shall operate in the frequency range of 2.4 GHz to 2.4835 GHz as allocated by regulatory bodies in the USA and Europe or in the 2.471 GHz to 2.497 GHz frequency band as allocated by regulatory authority in Japan.

Number of operating channels

The channel center frequencies and CH ID numbers shall be as shown below. The FCC (US), IC (Canada), and ETSI (Europe) specify operation from 2.4 GHz to 2.4835 GHz. For Japan, operation is specified as 2.471 GHz to 2.497 GHz. France allows operation from 2.4465 GHz to 2.4835 GHz, and Spain allows operation from 2.445 GHz to 2.475 GHz. For each supported regulatory domain, all channels marked with “Yes” shall be supported.

In a multiple cell network topology, overlapping and/or adjacent cells using different channels can operate simultaneously without interference if the distance between the center frequencies is at least 30 MHz. Channel 14 shall be designated specifically for operation in Japan.

DSSS PHY frequency channel plan

		(Regulatory Domains)					
CH ID	Frequency	X’10' FCC	X’20' IC	X’30' ETSI	X’31' Spain	X’32' France	X’40' MKK
1	2412 MHz	Yes	Yes	Yes	-	-	Yes
2	2417 MHz	Yes	Yes	Yes	-	-	Yes
3	2422 MHz	Yes	Yes	Yes	-	-	Yes
4	2427 MHz	Yes	Yes	Yes	-	-	Yes
5	2432 MHz	Yes	Yes	Yes	-	-	Yes
6	2437 MHz	Yes	Yes	Yes	-	-	Yes-
7	2442 MHz	Yes	Yes	Yes	-	-	Yes
8	2447 MHz	Yes	Yes	Yes	-	-	Yes
9	2452 MHz	Yes	Yes	Yes	-	-	Yes
10	2457 MHz	Yes	Yes	Yes	Yes	Yes	Yes
11	2462 MHz	Yes	Yes	Yes	Yes	Yes	Yes
12	2467 MHz	-	-	Yes	-	Yes	Yes
13	2472 MHz	-	-	Yes	-	Yes	Yes
14	2484 MHz	-	-	-	-	-	Yes

SpaceLink Access Point Specifications

The following technical specification is for reference purposes only. Actual product's performance and compliance with local telecommunications regulations may vary from country to country. ASUS will only ship products that are type approved in the destination country.

Ethernet Interface	RJ45 for 10BaseT with auto crossover MDI/MDI-X
Data Rate	11 Mbps with auto fallback to 5.5, 2 and 1 Mbps
Modulation	CCK (11Mbps, 5.5Mbps), DQPSK (2Mbps), DBPSK (1Mbps)
Technology	Direct Sequence Spread Spectrum
RF Output Power	14 ~ 17 dBm (at nominal temperature range)
Antenna	2 internal polarization diversity dipole antennas, One RF connector for optional external antenna
Range	Indoor 130 ft (40 m), semi-open 330 ft (100 m), outdoor (LOS, Light-Of-Sight) 1500 ft (457 m) at 11Mbps The range may vary by different environment
Receiver Sensitivity	Per< 8% @ length=1024 octets (at nominal temp. range) 11Mbps: -82 to -85 dBm; 5.5Mbps: -85 to -88 dBm; 2 Mbps: -88 to -91 dBm; 1 Mbps: -91 to -93 dBm
Operating Frequency	2.412 to 2.462 GHz (North America) 2.412 to 2.484 GHz (Japan) 2.412 to 2.472 GHz (Europe ETSI) 2.457 to 2.462 GHz (Spain) 2.457 to 2.472 GHz (France)
WEP	64/128-bit WEP; each includes 4 user-defined keys
Utilities	**AP Manager:** User-friendly utility for discovering and configuring SpaceLink Access Points with Access Control List features **AP Live Update:** Download the newest firmware from the Internet

Supported OS	Windows 98, 98SE, ME, NT4, 2000, XP
SNMP Support	MIB II, Proprietary Wireless MIBs
LED Indicators	Power, Wireless, Ethernet
DC Power Adapter	AC Input: 100V to 240V(50 to 60HZ) DC Output: 5V with max. 1 A current
Operating Temp.	0ºC to 55ºC
Storage Temp.	-20ºC to 70ºC
Humidity	5 to 95% (non-condensing)
Emissions	ETS 300 328 and ETS 300 826; CE Mark FCC Part 15C, Section 15.247
Size	40 mm (L) 138 mm (W) 150 mm (H) (± 0.2)
Weight	400 g excluding power supply
Warranty	One Year Limited Warranty

Operating Modes

Access Point	Standard 802.11b based access point, provides roaming capability between Wi-Fi compliant Access Points
Access Point Client	Act as a client station to associate with existing access points and bridge traffic from Ethernet port to a remote backbone network through the wireless interface
Wireless Bridge	Point-to-point or point-to-multi-points to bridge individual networks

DNS Server Address (Domain Name System)

DNS allows Internet host computers to have a domain name and one or more IP addresses. A DNS server keeps a database of host computers and their respective domain names and IP addresses, so that when a user enters a domain name into the Internet browser, the user is sent to the proper IP address. The DNS server address used by the computers on your home network is the location of the DNS server your ISP has assigned.

DSL Modem (Digital Subscriber Line) - A DSL modem uses your existing phone lines to transmit data at high speeds.

Direct-Sequence Spread Spectrum

See next few pages for detailed explanation.

Encryption

This provides wireless data transmissions with a level of security.

Extended Service Set (ESS)

A set of one or more interconnected basic service set (BSSs) and integrated local area networks (LANs) can be configured as an Extended Service Set.

ESSID (Extended Service Set Identifier)

You must have the same ESSID entered into the gateway and each of its wireless clients. The ESSID is a unique identifier for your wireless network.

Ethernet

The most widely used LAN access method, which is defined by the IEEE 802.3 standard. Ethernet is normally a shared media LAN meaning all devices on the network segment share total bandwidth. Ethernet networks operate at 10Mbps using CSMA/CD to run over 10-BaseT cables.

Firewall

A firewall determines which information passes in and out of a network. NAT can create a natural firewall by hiding a local network's IP addresses from the Internet. A Firewall prevents anyone outside of your network from accessing your computer and possibly damaging or viewing your files.

Gateway

A network point that manages all the data traffic of your network, as well as to the Internet and connects one network to another.

IEEE

The Institute of Electrical and Electronics Engineers. The IEEE sets standards for networking, including Ethernet LANs. IEEE standards ensure interoperability between systems of the same type.

IEEE 802.11

IEEE 802.xx is a set of specifications for LANs from the Institute of Electrical and Electronic Engineers (IEEE). Most wired networks conform to 802.3, the specification for CSMA/CD based Ethernet networks or 802.5, the specification for token ring networks. 802.11 defines the standard for wireless LANs encompassing three incompatible (non-interoperable) technologies: Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), and Infrared. 802.11 specifies a carrier sense media access control and physical layer specifications for 1 and 2 Mbps wireless LANs.

IEEE 802.11a / IEEE 802.11b

See next few pages for detailed explanations.

Infrastructure

A wireless network centered about an access point. In this environment, the access point not only provides communication with the wired network but also mediates wireless network traffic in the immediate neighborhood.

IP (Internet Protocol)

The TCP/IP standard protocol that defines the IP datagram as the unit of information passed across an Internet and provides the basis for connectionless packet delivery service. IP includes the ICMP control and error message protocol as an integral part. It provides the functional equivalent of ISO OSI Network Services.

IP Address

An IP address is a 32-bit number that identifies each sender or receiver of information that is sent across the Internet. An IP address has two parts: the identifier of a particular network on the Internet and an identifier of the particular device (which can be a server or a workstation) within that network.

ISM Bands (Industrial, Scientific, and Medicine Bands)

Radio frequency bands that the Federal Communications Commission (FCC) authorized for wireless LANs. The ISM bands are located at 902 MHz, 2.400 GHz, and 5.7 GHz.

ISP (Internet Service Provider)

An organization that provides access to the Internet. Small ISPs provide service via modem and ISDN while the larger ones also offer private line hookups (T1, fractional T1, etc.).

LAN (Local Area Network)

A communications network that serves users within a defined geographical area. The benefits include the sharing of Internet access, files and equipment like printers and storage devices. Special network cabling (10 Base-T) is often used to connect the PCs together.

MAC Address (Media Access Control) - A MAC address is the hardware address of a device connected to a network.

NAT (Network Address Translation) - NAT masks a local network's group of IP addresses from the external network, allowing a local network of computers to share a single ISP account. This process allows all of the computers on your home network to use one IP address. This will enable access to the Internet from any computer on your home network without having to purchase more IP addresses from your ISP.

NIC (Network Interface Card)

A network adapter inserted into a computer so that the computer can be connected to a network. It is responsible for converting data from stored in the computer to the form transmitted or received.

Packet

A basic message unit for communication across a network. A packet usually includes routing information, data, and sometimes error detection information.

PCMCIA (Personal Computer Memory Card International Association)

The Personal Computer Memory Card International Association (PCMCIA), develops standards for PC cards, formerly known as PCMCIA cards. These cards are available in three types, and are have about the same length and width as credit cards. However, the different width of the cards ranges in thickness from 3.3 mm (Type I) to 5.0 mm (Type II) to 10.5 mm (Type III). These cards can be used for various functions, including memory storage, landline modems and wireless modems.

PPP (Point-to-Point Protocol)

PPP is a protocol for communication between computers using a serial interface, typically a personal computer connected by phone line to a server.

PPPoE (Point-to-Point Protocol over Ethernet)

Point-to-Point Protocol is a method of secure data transmission. PPP using Ethernet to connect to an ISP.

Radio Frequency (RF) Terms: GHz, MHz, Hz

The international unit for measuring frequency is Hertz (Hz), equivalent to the older unit of cycles per second. One megahertz (MHz) is one million Hertz. One gigahertz (GHz) is one billion Hertz. The standard US electrical power frequency is 60 Hz, the AM broadcast radio frequency band is 0.55-1.6 MHz, the FM broadcast radio frequency band is 88-108 MHz, and wireless 802.11 LANs operate at 2.4 GHz.

SSID (Service Set ID)

SSID is a group name shared by every member of a wireless network. Only client PCs with the same SSID are allowed to establish a connection.

Station

Any device containing IEEE 802.11 wireless medium access conformity.

Subnet Mask

A subnet mask is a set of four numbers configured like an IP address. It is used to create IP address numbers used only within a particular network.

TCP (Transmission Control Protocol)

The standard transport level protocol that provides the full duplex, stream service on which many application protocols depend. TCP allows a process or one machine to send a stream of data to a process on another. Software implementing TCP usually resides in the operating system and uses the IP to transmit information across the network.

WAN (Wide Area Network)

A system of LANs, connected together. A network that connects computers located in separate areas, (i.e., different buildings, cities, countries). The Internet is a wide area network.

WECA (Wireless Ethernet Compatibility Alliance)

An industry group that certifies cross-vender interoperability and compatibility of IEEE 802.11b wireless networking products and to promote that standard for enterprise, small business, and home environments.

WLAN (Wireless Local Area Network)

This is a group of computers and other devices connected wirelessly in a small area. A wireless network is referred to as LAN or WLAN.

IEEE 802.11b (11Mbits/sec)

In 1997, the Institute of Electrical and Electronics Engineers (IEEE) adopted the 802.11 standard for wireless devices operating in the 2.4 GHz frequency band. This standard includes provisions for three radio technologies: direct sequence spread spectrum, frequency hopping spread spectrum, and infrared. Devices that comply with the 802.11 standard operate at a data rate of either 1 or 2 Mbps.

In 1999, the IEEE created the 802.11b standard. 802.11b is essentially identical to the 802.11 standard except 802.11b provides for data rates of up to 11 Mbps for direct sequence spread spectrum devices. Under 802.11b, direct sequence devices can operate at 11 Mbps, 5.5 Mbps, 2 Mbps, or 1 Mbps. This provides interoperability with existing 802.11 direct sequence devices that operate only at 2 Mbps.

Direct sequence spread spectrum devices spread a radio signal over a range of frequencies. The IEEE 802.11b specification allocates the 2.4 GHz frequency band into 14 overlapping operating Channels. Each Channel corresponds to a different set of frequencies. See the Appendix to determine the center frequency used by each Channel.

If operating multiple 802.11b Wireless PCI Cards in the same vicinity, the distance between the center frequencies must be at least 25 MHz to avoid interference. Note that the Channels available to an 802.11b Wireless PCI Card will vary from country to country. In the United States, the 802.11b standard allocates 11 operating Channels for direct sequence devices. Channels 1, 6, and 11 are independent and do not overlap with each other. To avoid interference between 802.11b Wireless PCI Cards, It is recommended that you configure the Wireless PCI Cards using only Channels 1, 6, and 11.

Direct-Sequence Spread Spectrum (for 802.11b)

Spread spectrum (broadband) uses a narrowband signal to spread the transmission over a segment of the radio frequency band or spectrum. Direct-sequence is a spread spectrum technique where the transmitted signal is spread over a particular frequency range. The Space Link Wireless PCI Card uses Direct-Sequence Spread Spectrum (DSSS) for radio communication.

Direct-sequence systems communicate by continuously transmitting a redundant pattern of bits called a chipping sequence. Each bit of transmitted data is mapped into chips by the Wireless PCI Card and rearranged into a pseudorandom spreading code to form the chipping sequence. The chipping sequence is combined with a transmitted data stream to produce the Wireless PCI Card output signal.

Wireless mobile clients receiving a direct-sequence transmission use the spreading code to map the chips within the chipping sequence back into bits to recreate the original data transmitted by the Wireless PCI Card. Intercepting and decoding a direct-sequence transmission requires a predefined algorithm to associate the spreading code used by the transmitting Wireless PCI Card to the receiving wireless mobile client.

This algorithm is established by IEEE 802.11b specifications. The bit redundancy within the chipping sequence enables the receiving wireless mobile client to recreate the original data pattern, even if bits in the chipping sequence are corrupted by interference. The ratio of chips per bit is called the spreading ratio. A high spreading ratio increases the resistance of the signal to interference. A low spreading ratio increases the bandwidth available to the user. The Wireless PCI Card uses a constant chip rate of 11Mchips/s for all data rates, but uses different modulation schemes to encode more bits per chip at the higher data rates. The Wireless PCI Card is capable of an 11 Mbps data transmission rate, but the coverage area is less than a 1 or 2 Mbps Wireless PCI Card since coverage area decreases as bandwidth increases.

IEEE 802.11a (54Mbits/sec)

The 802.11b standard was designed to operate in the 2.4-GHz ISM (Industrial, Scientific and Medical) band using direct-sequence spread-spectrum technology. The 802.11a standard, on the other hand, was designed to operate in the more recently allocated 5-GHz UNII (Unlicensed National Information Infrastructure) band. And unlike 802.11b, the 802.11a standard departs from the traditional spread-spectrum technology, instead using a frequency division multiplexing scheme that's intended to be friendlier to office environments.

The 802.11a standard, which supports data rates of up to 54 Mbps, is the Fast Ethernet analog to 802.11b, which supports data rates of up to 11 Mbps. Like Ethernet and Fast Ethernet, 802.11b and 802.11a use an identical MAC (Media Access Control). However, while Fast Ethernet uses the same physical-layer encoding scheme as Ethernet (only faster), 802.11a uses an entirely different encoding scheme, called OFDM (orthogonal frequency division multiplexing).

The 802.11b spectrum is plagued by saturation from wireless phones, microwave ovens and other emerging wireless technologies, such as Bluetooth. In contrast, 802.11a spectrum is relatively free of interference.

The 802.11a standard gains some of its performance from the higher frequencies at which it operates. The laws of information theory tie frequency, radiated power and distance together in an inverse relationship. Thus, moving up to the 5-GHz spectrum from 2.4 GHz will lead to shorter distances, given the same radiated power and encoding scheme.

COFDM (for 802.11a)

Power alone is not enough to maintain 802.11b-like distances in an 802.11a environment. To compensate, vendors specified and designed a new physical-layer encoding technology that departs from the traditional direct-sequence technology being deployed today. This technology is called COFDM (coded OFDM). COFDM was developed specifically for indoor wireless use and offers performance much superior to that of spread-spectrum solutions. COFDM works by breaking one high-speed data carrier into several lower-speed subcarriers, which are then transmitted in parallel. Each high-speed carrier is 20 MHz wide and is broken up into 52 subchannels, each approximately 300 KHz wide. COFDM uses 48 of these subchannels for data, while the remaining four are used for error correction. COFDM delivers higher data rates and a high degree of multipath reflection recovery, thanks to its encoding scheme and error correction.

Each subchannel in the COFDM implementation is about 300 KHz wide. At the low end of the speed gradient, BPSK (binary phase shift keying) is used to encode 125 Kbps of data per channel, resulting in a 6,000-Kbps, or 6 Mbps, data rate. Using quadrature phase shift keying, you can double the amount of data encoded to 250 Kbps per channel, yielding a 12-Mbps data rate. And by using 16-level quadrature amplitude modulation encoding 4 bits per hertz, you can achieve a data rate of 24 Mbps. The 802.11a standard specifies that all 802.11a-compliant products must support these basic data rates. The standard also lets the vendor extend the modulation scheme beyond 24 Mbps. Remember, the more bits per cycle (hertz) that are encoded, the more susceptible the signal will be to interference and fading, and ultimately, the shorter the range, unless power output is increased.

7. Safety Information

Federal Communications Commission Statement

This device complies with FCC Rules Part 15. Operation is subject to the following two conditions:

- This device may not cause harmful interference, and
- 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 Federal Communications Commission (FCC) rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

CAUTION!

You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

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Canadian Department of Communications

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

This Class B digital apparatus complies with Canadian ICES-003. Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

Regulatory Information / Disclaimers

Installation and use of this Wireless LAN device must be in strict accordance with the instructions included in the user documentation provided with the product. Any changes or modifications (including the antennas) made to this device that are not expressly approved by the manufacturer may void the user's authority to operate the equipment. The manufacturer is not responsible for any radio or television interference caused by unauthorized modification of this device, or the substitution of the connecting cables and equipment other than manufacturer specified. It is the responsibility of the user to correct any interference caused by such unauthorized modification, substitution or attachment. Manufacturer and its authorized resellers or distributors will assume no liability for any damage or violation of government regulations arising from failing to comply with these guidelines.

CAUTION: To maintain compliance with FCC's RF exposure guidelines, this equipment should be installed and operated with minimum distance [20cm] between the radiator and your body. Use on the supplied antenna. Unauthorized antenna, modification, or attachments could damage the transmitter and may violate FCC regulations.

Safety Information

In order to maintain compliance with the FCC RF exposure guidelines, this equipment should be installed and operated with minimum distance **[20cm]** between the radiator and your body. Use only with supplied antenna. Unauthorized antenna, modification, or attachments could damage the transmitter and may violate FCC regulations.

CAUTION: Any changes or modifications not expressly approved in this manual could void your authorization to use this device.

MPE Statement

Your device contains a low power transmitter. When device is transmitted it sends out Radio Frequency (RF) signal.

Caution Statement of the FCC Radio Frequency Exposure

This Wireless LAN radio device has been evaluated under FCC Bulletin OET 65C and found compliant to the requirements as set forth in CFR 47 Sections 2.1091, 2.1093, and 15.247(b)(4) addressing RF Exposure from radio frequency devices. The radiation output power of this Wireless LAN device is far below the FCC radio frequency exposure limits. Nevertheless, this device shall be used in such a manner that the potential for human contact during normal operation – as a mobile or portable device but use in a body-worn way is strictly prohibit. When using this device, a certain separation distance between antenna and nearby persons has to be kept to ensure RF exposure compliance. In order to comply with the RF exposure limits established in the ANSI C95.1 standards, the distance between the antennas and the user should not be less than **[20cm]**.

RF Exposure

The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.