ezWAVE

WAP-1100 Series

The innovation superhigh-speed wireless network,
Widelink takes the initiative.

Wireless LAN Access Point Users' Guide

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SAFETY INFORMATION

WARNING

* *Opening the unit, for whatever reason, could lead to damages that are not covered by the guarantee.*
* *To prevent fire or shock hazard, do not expose your ezWAVE wireless LAN PC cards to rain or moisture.*

NOTES:

* *The Widelink supplied software may show screens slightly different from those included in this manual.*
* *This manual is written based on the assumption that you are familiar with basic operations of Windows operating system.*

Chapter 1 Introduction To The Wireless LAN

A wireless LAN (WLAN) is a flexible data communication system implemented as an extension to, or as an alternative for, a wired LAN within a building or campus. Using electromagnetic waves, WLANs transmit and receive data over the air, minimizing the need for wired connections. Thus, WLANs combine data connectivity with user mobility, and, through simplified configuration, enable movable LANs. WLANs have gained strong popularity in a number of vertical markets, including the health-care, retail, manufacturing, warehousing, and academic arenas. These industries have profited from the productivity gains of using hand-held terminals and notebook computers to transmit real-time information to centralized hosts for processing. Today WLANs are becoming more widely recognized as a general-purpose connectivity alternative for a broad range of business customers.

1.1 What's Wireless LAN?

Wireless LANs use electromagnetic airwaves (radio and infrared) to communicate information from one point to another without relying on any physical connection. Radio waves are often referred to as radio carriers because they simply perform the function of delivering energy to a remote receiver. The data being transmitted is superimposed on the radio carrier so that it can be accurately extracted at the receiving end. This is generally referred to as modulation of the carrier by the information being transmitted. Once data is superimposed (modulated) onto the radio carrier, the radio signal occupies more than a single frequency, since the frequency or bit rate of the modulating information adds to the carrier.

Multiple radio carriers can exist in the same space at the same time without interfering with each other if the radio waves are transmitted on different radio frequencies. To extract data, a radio receiver tunes in (or selects) one radio frequency while rejecting all other radio signals on different frequencies.

In a typical WLAN configuration, a transmitter/receiver (transceiver) device, called an access point, connects to the wired network from a fixed location using standard Ethernet cable. At a minimum, the access point receives, buffers, and transmits data between the WLAN and the wired network infrastructure. A single access point can support a small group of users and can function within a range of less than one hundred

to several hundred feet. The access point (or the antenna attached to the access point) is usually mounted high but may be mounted essentially anywhere that is practical as long as the desired radio coverage is obtained.
End users access the WLAN through wireless LAN adapters, which are implemented as PC cards in notebook computers, or use PCI adapters in desktop computers. WLAN adapters provide an interface between the client network operating system (NOS) and the airwaves (via an antenna). The nature of the wireless connection is transparent to the NOS.

1.2 Wireless LAN Standard and Structure

○ Wireless LAN Standard – IEEE802.11b

The widespread acceptance of WLANs depends on industry standardization to ensure product compatibility and reliability among the various manufacturers. The Institute of Electrical and Electronics Engineers (IEEE) ratified the original 802.11 specifications in 1997 as the standard for wireless LANs. That version of 802.11 provides for 1 Mbps and 2 Mbps data rates and a set of fundamental signaling methods and other services. The most critical issue affecting WLAN demand has been limited throughput. The data rates supported by the original 802.11 standard are too slow to support most general business requirements and have slowed adoption of WLANs. Recognizing the critical need to support higher data-transmission rates, the IEEE recently ratified the 802.11b standard (also known as 802.11 High Rate) for transmissions of up to 11 Mbps.
With 802.11b, WLANs will be able to achieve wireless performance and throughput comparable to wired Ethernet. Outside of the standards bodies, wireless industry leaders have united to form the Wire-less Ethernet Compatibility Alliance (WECA).
WECA's mission is to certify cross-vendor interoperability and compatibility of IEEE 802.11b wireless networking products and to promote that standard for the enterprise, the small business, and the home. Members include WLAN semiconductor manufacturers, WLAN providers, computer system vendors, and software makers.

○ Wireless LAN Network Equipment

802.11 defines two pieces of equipment, a wireless *statio*n, which is usually a PC equipped with a wireless network interface card (NIC), and an *access point (AP*), which acts as a bridge between the wireless and wired networks. An access point usually

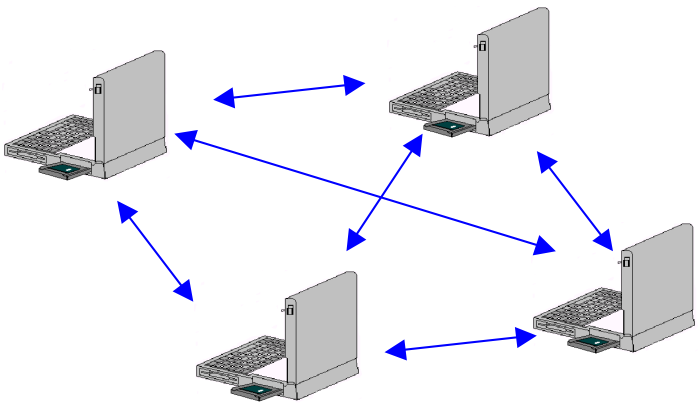
consists of a radio, a wired network interface (e.g., 802.3), and bridging software conforming to the 802.1d Bridging standard. The access point acts as the base station for the wireless network, aggregating access for multiple wireless stations onto the wired network. Wireless end stations can be 802.11 PC Card and PCI.

○ Wireless LAN Network Configuration

The 802.11 standard define two modes: *infrastructure* mode and *ad hoc* mode (or independent or peer-to-peer).

- Ad Hoc Mode

  Ad hoc mode (also called peer-to-peer mode or an Independent Basic Service Set, or IBSS) is simply a set of 802.11 wireless stations that communicate directly with one another without using an access point or any connection to a wired network. This mode is useful for quickly and easily setting up a wireless network anywhere that a wireless infrastructure does not exist or is not required for services, such as a hotel room, convention center, or airport, or where access to the wired network is barred (such as for consultants at a client site).



Independent Basic
Service Set (IBSS)

Figure 1. Ad Hoc Mode

- Infrastructure Mode

  In infrastructure mode, the wireless network consists of at least one access

point connected to the wired network infrastructure and a set of wireless end stations. This configuration is called a *Basic Service Set (BSS*). An *Extended Service Set (ESS)* is a set of two or more BSSs forming a single sub-network. Since most corporate WLANs require access to the wired LAN for services (file servers, printers, Inter-net links) they will operate in infrastructure mode.

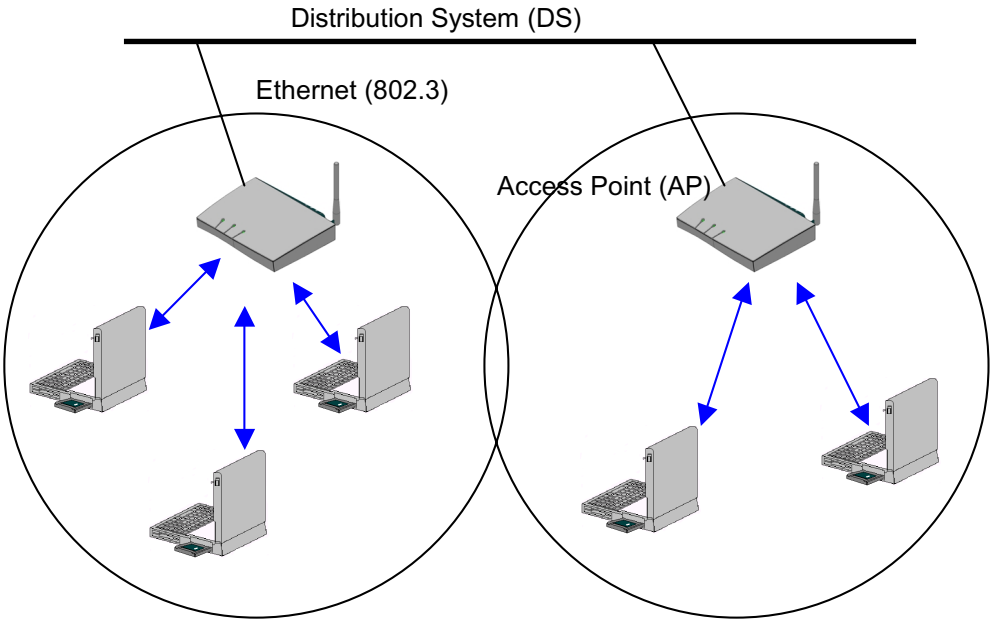


Figure 2. Infrastructure Mode

○ Roaming

Wireless communication is limited by how far signals carry for given power output. WLANs use cells, called microcells, similar to the cellular telephone system to extend the range of wireless connectivity. At any point in time, a mobile PC equipped with a WLAN adapter is associated with a single access point and its microcell, or area of coverage. Individual microcells overlap to allow continuous communication within wired network. They handle low power signals and "hand off" users as they roam through a given geographic area.

The 802.11 MAC layer is responsible for how a client associates with an access point.

When an 802.11 client enters the range of one or more APs, it chooses an access point to associate with (also called joining a Basic Service Set), based on signal strength and observed packet error rates. Once accepted by the access point, the client tunes to the radio channel to which the access point is set. Periodically it surveys all 802.11 channels in order to assess whether a different access point would provide it with better performance characteristics. If it determines that this is the case, it *re-associates* with the new access point, tuning to the radio channel to which that access point is set. Re-association usually occurs because the wireless station has physically moved away from the original access point, causing the signal to weaken. In other cases, Re-association occurs due to a change in radio characteristics in the building, or due simply to high network traffic on the original access point. In the latter case this function is known as "load balancing," since its primary function is to distribute the total WLAN load most efficiently across the available wireless infrastructure. This process of dynamically associating and re-associating with APs allows network managers to set up WLANs with very broad coverage by creating a series of overlapping 802.11b cells throughout a building or across a campus. To be successful, the IT manager ideally will employ "channel reuse," taking care to set up each access point on an 802.11 DSSS channel that does not overlap with a channel used by a neighboring access point.

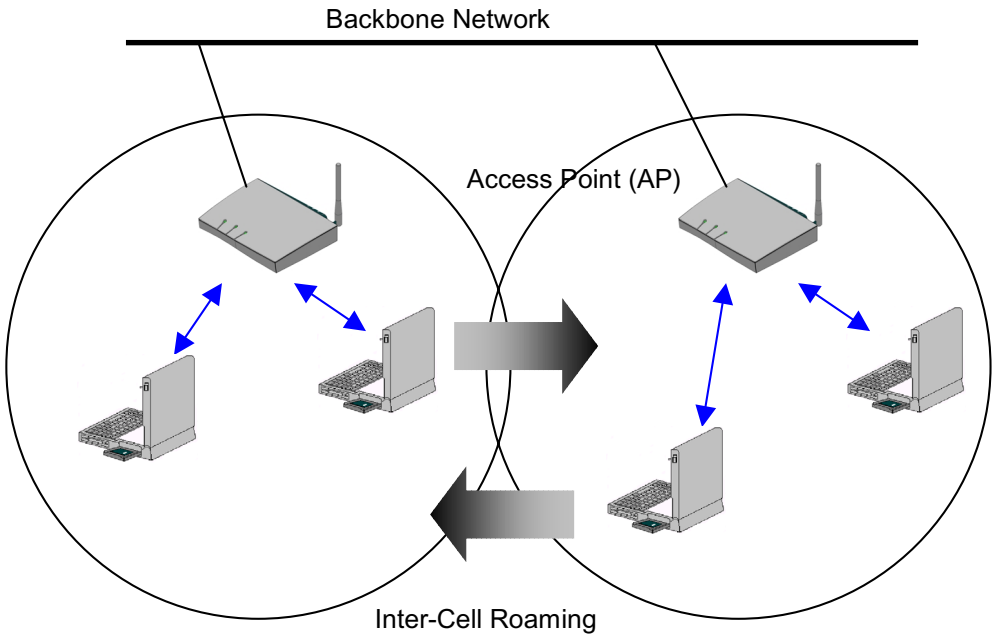


Figure 3. Roaming

○ BSS, ESS and SS ID

The basic service set (BSS) is the basic building block of WLAN network. Minimum WLAN BSS may be consist of only two stations. Using access point (AP) and network distribution systems (DS), WLAN service set can be extended arbitrary size – extended service set (ESS). Each service set has its network ID (SSID). All the service sets within an ESS network can have same service ID so that the ESS can support inter-cell ROAMING.

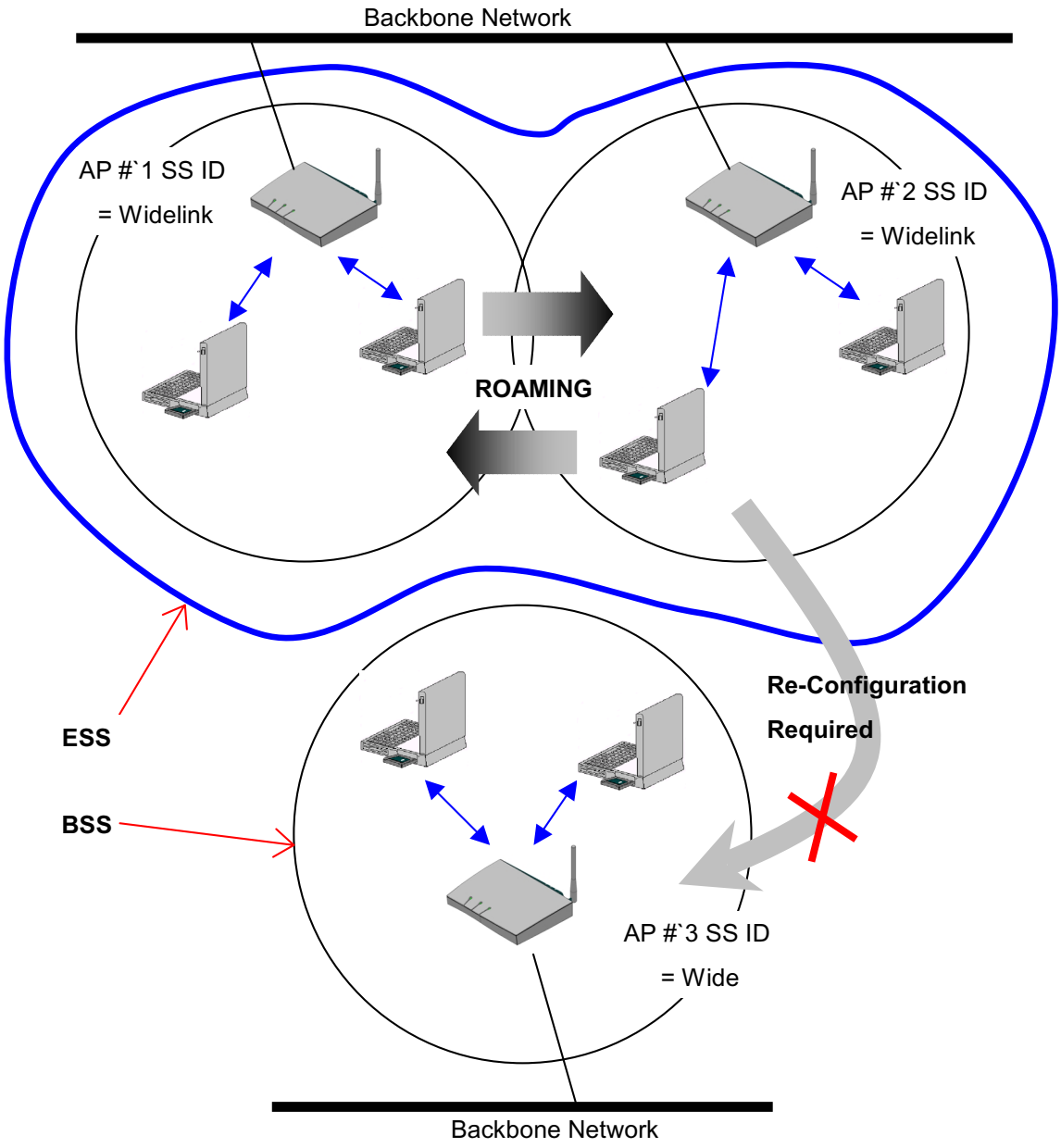


Figure 4. SSID and Roaming

Chapter 2 Setup ezWAVE Access Point

2.1 Before You Begin Installation

The ezWAVE WAP-1100 Series Access Point is a wireless LAN transceiver that can act as the center point of a stand-alone wireless LAN network or as the connection point between wireless and wired networks. In multiple installations, the roaming functionality provided by multiple Access Points allows wireless users to move freely throughout the facility while maintaining seamless, uninterrupted access to the network. The Access Point supports Access Point management software. The system settings are contained on the Access Point's firmware.

Before setting up your Access Point, ask your network system administrator for the following information:

- You need an IP (Internet Protocol) address for the Access Point. Each station or device on your network must have a unique IP address.

- If there are some Access Points already installed, you need to know their SSID and channel allocation strategy.

- WEP key allocation.

You should configure the Access Point before mounting it on a pole or a ceiling. Some configuration steps such as communicating with the Access Point should be done through a serial cable may be difficult if the Access Point is inaccessible.

Before you begin installation, make sure that you have the following items:

- The ezWAVE WAP-1100 Series Access Point
- The Access Point power supply

- The ezWAVE WAP-1100 Series Installation CD

If any of these items are missing from the package, contact your Access Point supplier. You will also need:

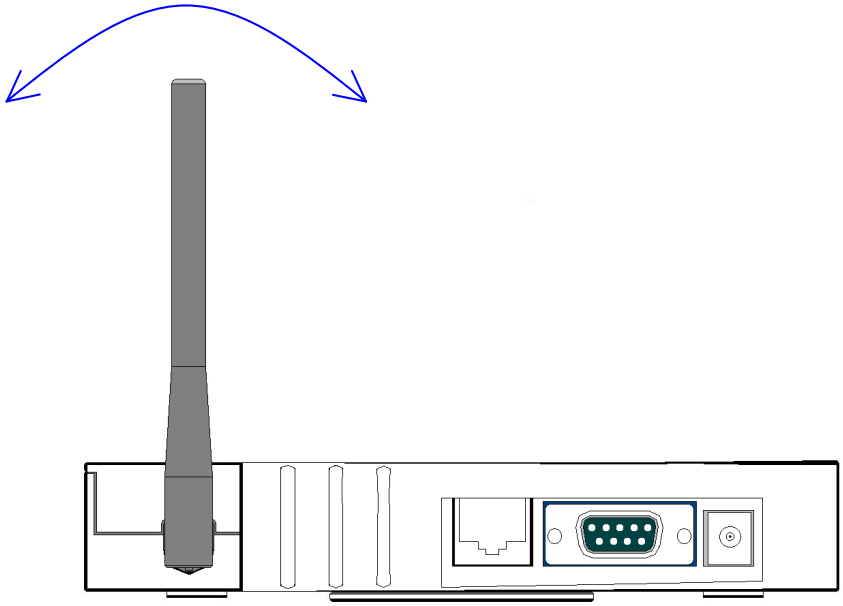
- A computer with serial port (com1, com2) or Ethernet port
- A 9-pin, straight-through, male-to-female serial cable

2.2 Installing The Widelink ezWAVE WAP-1100 Series Access Point

Follow the instructions below to install the Access Point.

STEP 1 Adjust the antennas

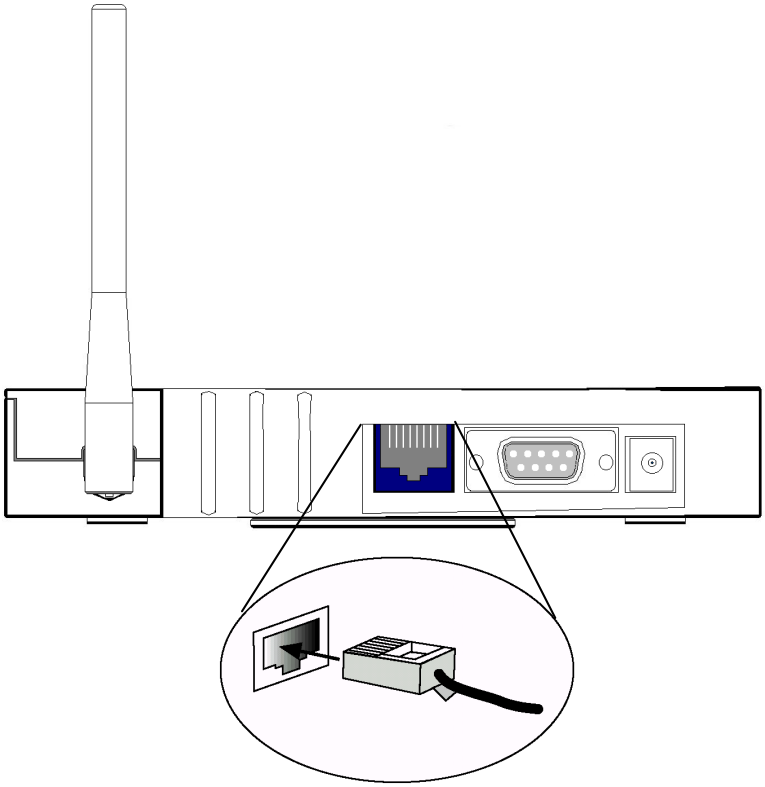
For maximum range, make sure the antennas on your Access Point straight up or straight down, no matter where your Access Point is mounted.
If you keep your Access Point on a table or a desk, turn the antennas so they point straight up. If you mount your Access Point on a wall or a pole, turn the antennas so they are vertical, even though the Access Point is on its side. If you mount your Access Point on the ceiling, turn the antennas so they point straight down.



Antenna configurations can be varied depending on the Access Point model, cell coverage or cell plan.

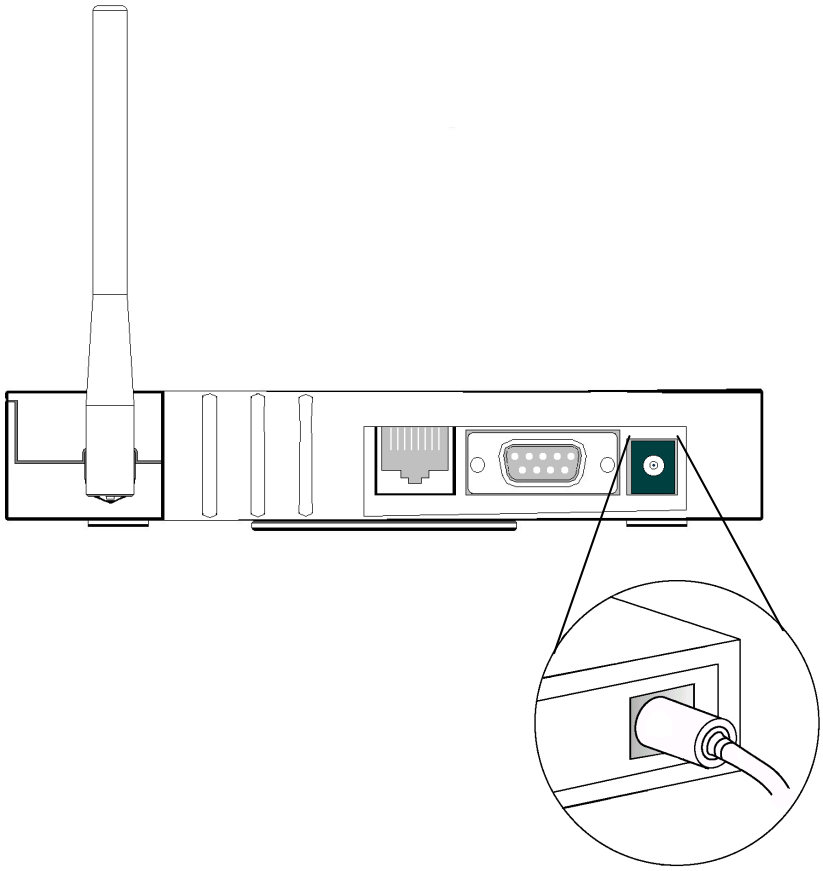
STEP 2 Ethernet Cable Connection

Connect the Ethernet cable from your wired LAN to your Access Point.
Make sure the unit is not powered up when you connect your network cable.



STEP 3 Connect The Power Pack

Plug the Power Pack into a wall outlet or a power strip, and plug the connector into the power receptacle on the back of the Access Point.



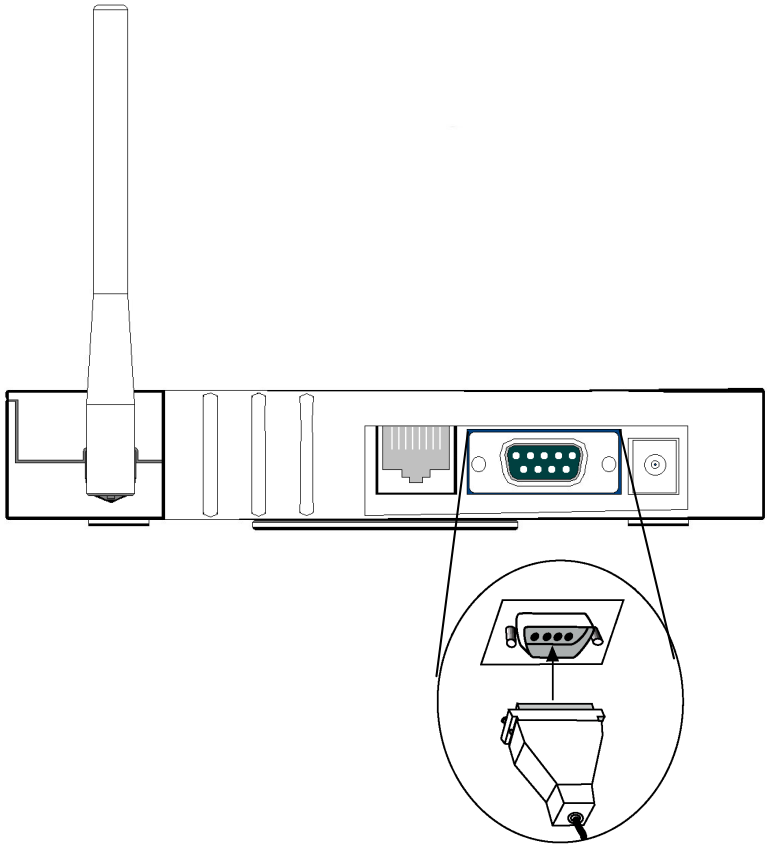
All three indicators on top of the access point will be bright green.
During normal operation, indicators will be bright green. If indicators do not either display a solid color or blink, see the "Top Panel Indicator Descriptions" in this manual.

Caution

If you have already installed Widelink ezWAVE WAP-1100 series client card, you can easily configure Access Point through air connection between your computer and Access Point. You may skip next step and go to Access Point Management section.

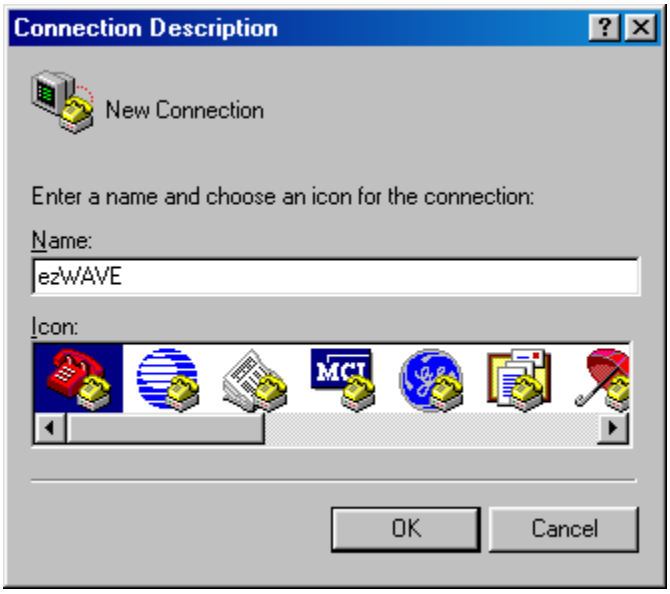
STEP 4 Connect Serial Cable

Use a 9-pin, straight-through, male-to-female serial cable to connect the COM 1 or 2 port on your computer to the RS-232 on the back of the access point. After you find the assigned IP address, you can remove this cable. You might need the cable again if you need to update the Access Point's configuration in the future.

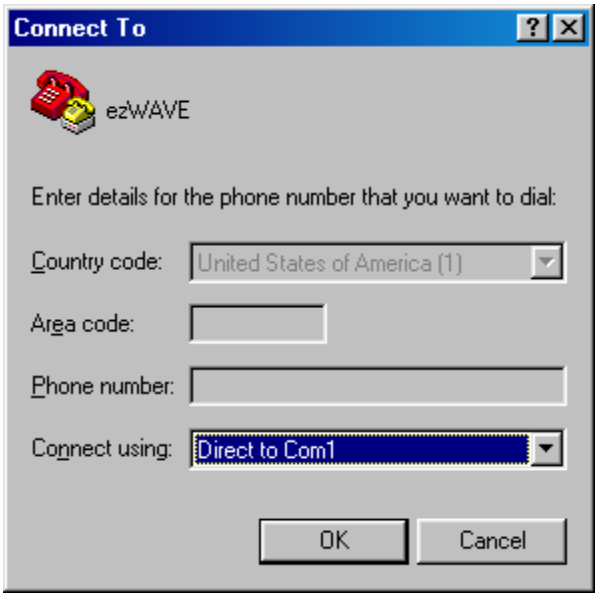


STEP 5 Open Terminal Program

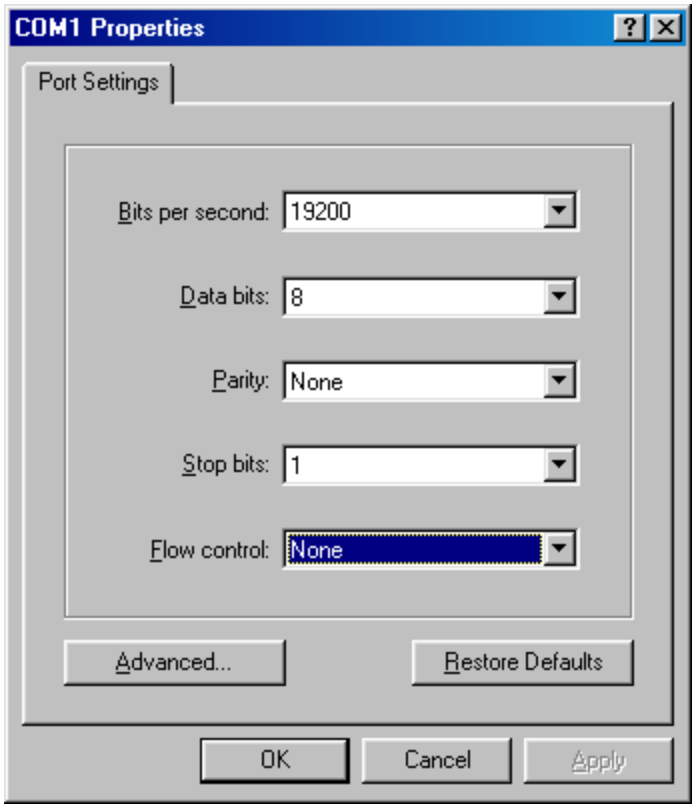
Open the HyperTerminal program on the workstation attached to the Access Point. These instructions describe HyperTerminal for example, but you can use any terminal-emulation program to communicate with the Access Point. The following window appears:



Type a name for the connection and click **O**K. The "Connect To" window appears:



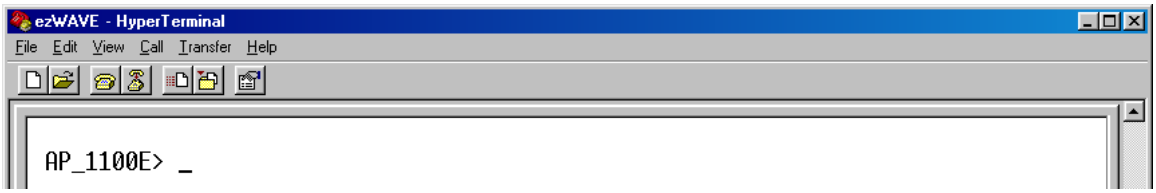
Choose the port on your computer to which the serial cable is connected. Click **O**K.
The "port settings" window appears:



Set Bits per second (baud rate) to 19200, Data bits to 8, Parity to None, Stop bits to 1, and Flow control to None. Click OK.

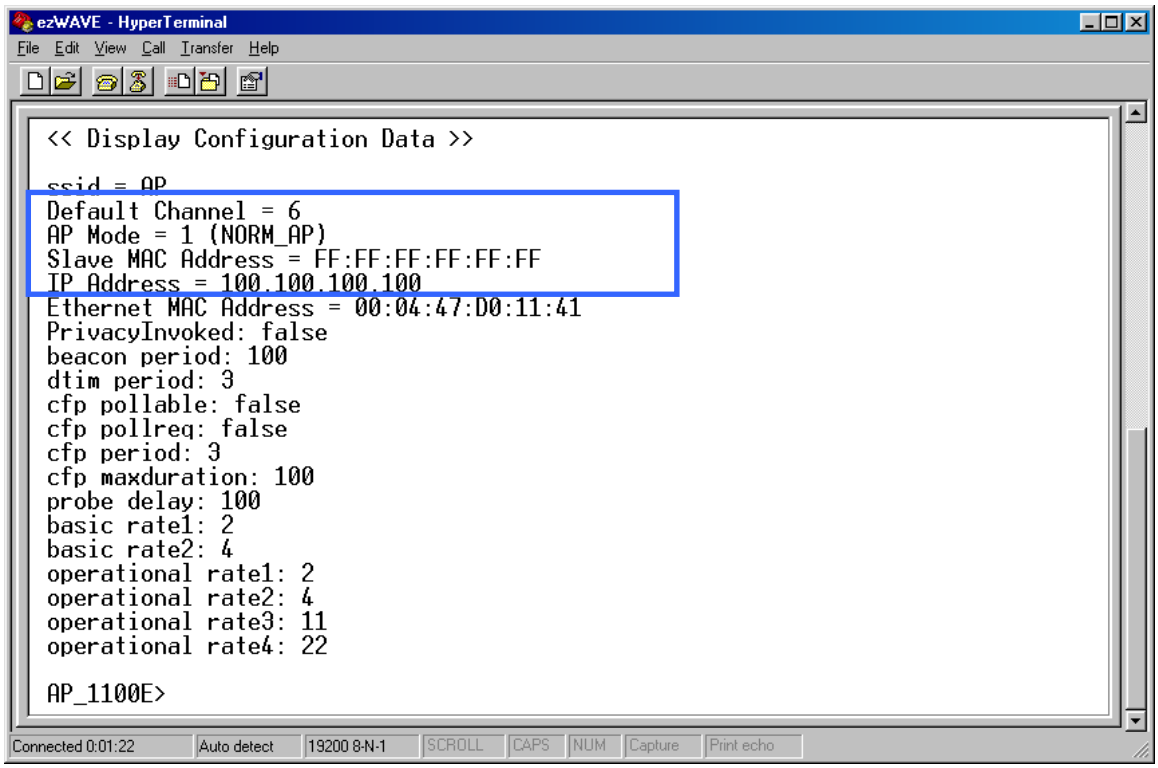
The Setup screen appears in the HyperTerminal window. If the text does not appear immediately, press **Enter**.

If it is successfully connected to Access Point, it will display "prompt" on the terminal program's display box:



Type **disconfig** and press **Enter** to see the current default settings of Access Point. Make a note of the SSID, Channel number and IP address. Widelink's Access Point has a default IP; **100.100.100.100**

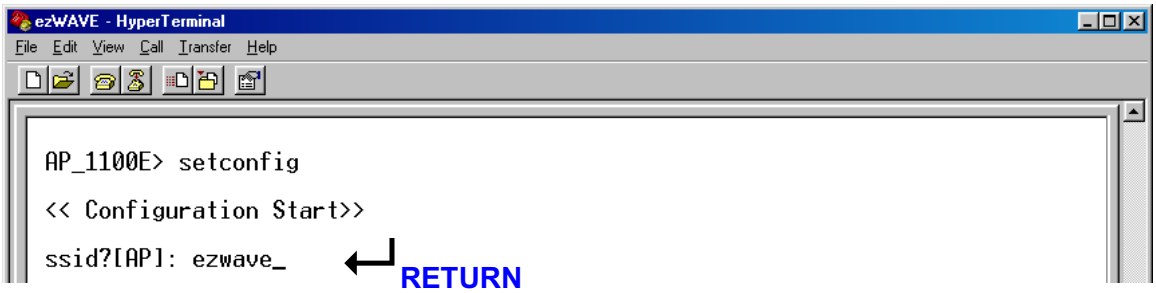
The other options that are displayed can be ignored in this chapter and there will be detailed explanation on next Access Point Management section



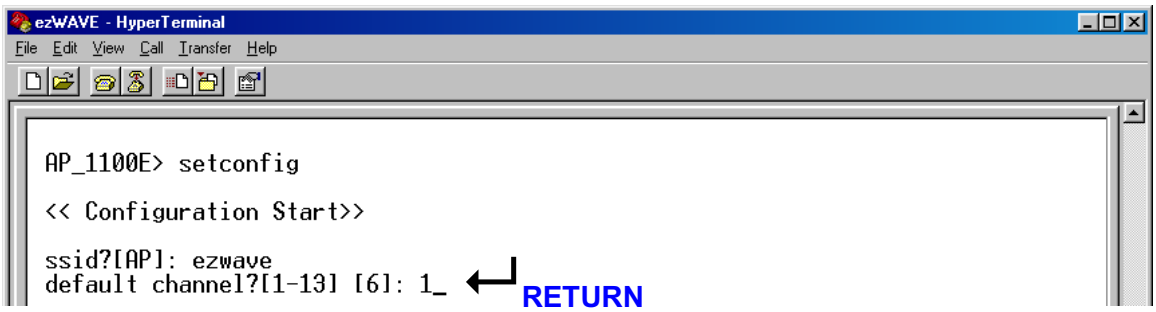
STEP 6 Configuration Change

Type **setconfig** and press **Enter** to change current default configuration settings. Using this command, you can change Access Point's SSID, Channel number, IP address, MAC address and WEP key enable/disable.

After typing **setconfig** command, whenever you press Enter key, there will occur changeable Access Point options and you can select or edit what you want. Refer to the next example.

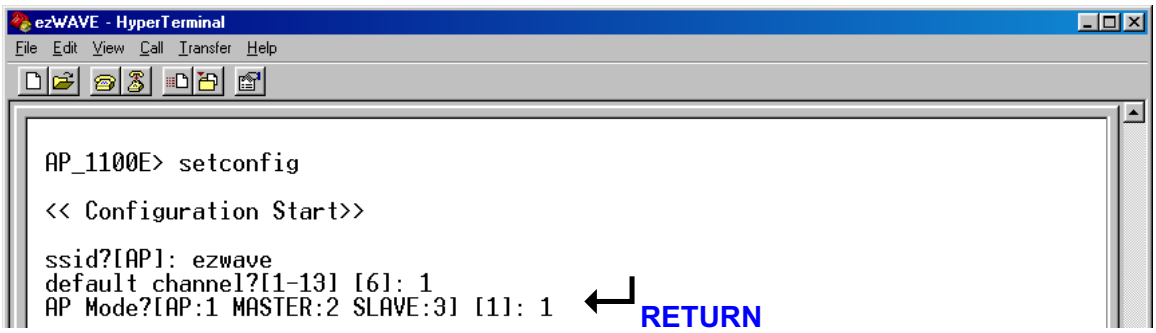


The SSID value is case sensitive and can enter up to 32 characters without banks.

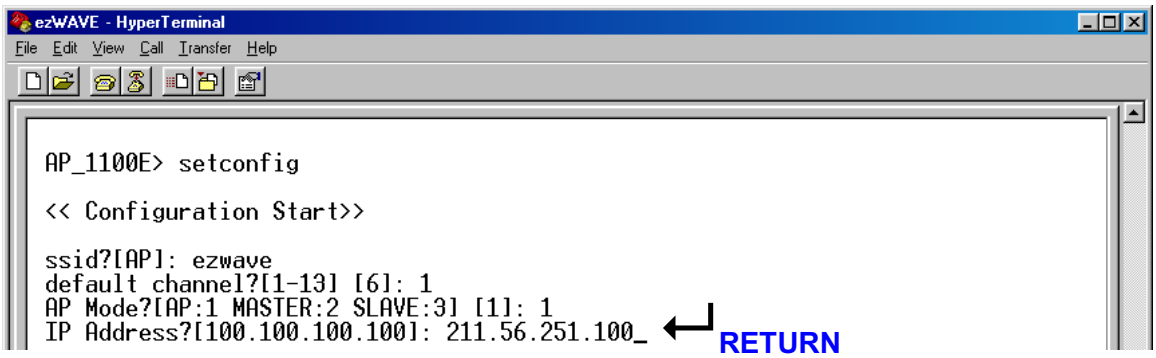


Available channel numbers varies from country to country. Please refer to the **Appendix Channel** chapter.

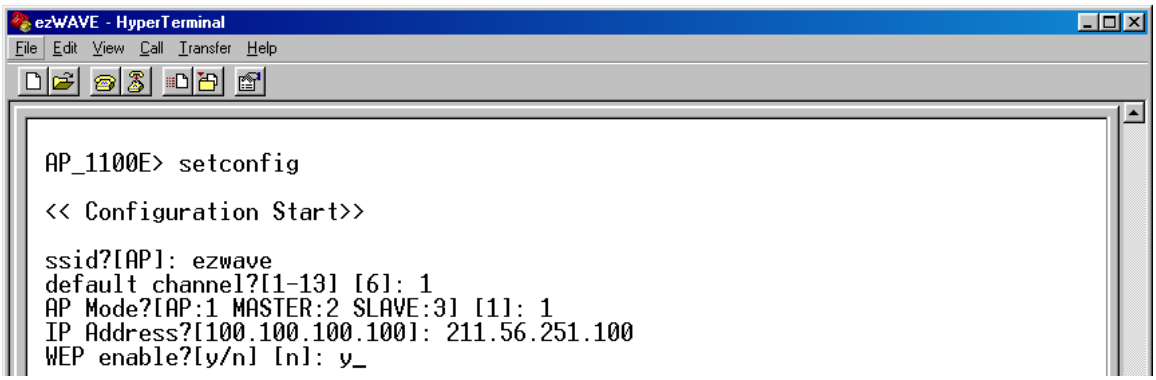
In addition to this, it there is Access Points that have already installed in the neighborhood of your Access Point, take a cautious attitude in selecting channel number. Otherwise, by selecting too close channel number with your neighbor Access Point, raise channel interference problems. This problem can degrade wireless LAN air link quality seriously. In order to avoid this problem, select a longest channel number with your neighbor Access Point.



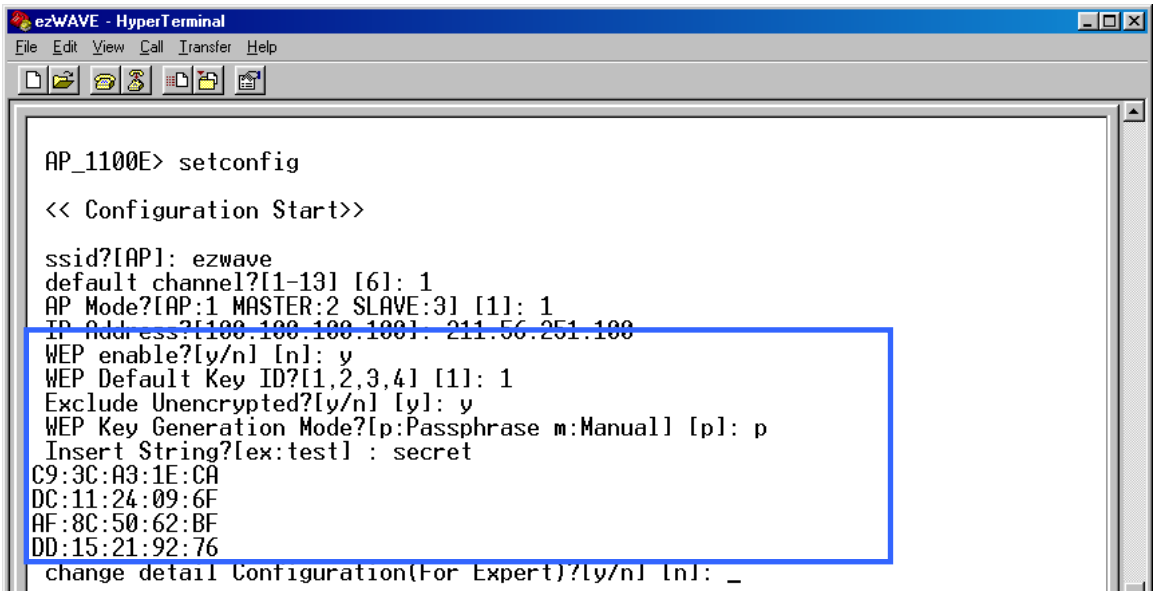
If you use Widelink ezWAVE WAP-1100E as a normal Access Point, select '**1**'. Otherwise, you use it as a point-to-point transmission device you should select '**2**' or '**3**'. This usage/process's detailed explanation will be followed on next chapter.



If you know which IP address should be set to your Access Point, then write it in this step. Otherwise if you do not know which IP to be used, ask your network administrator about available IP address. In this example, the IP address 100.100.100.100 is a default IP address that is assigned by Widelink.



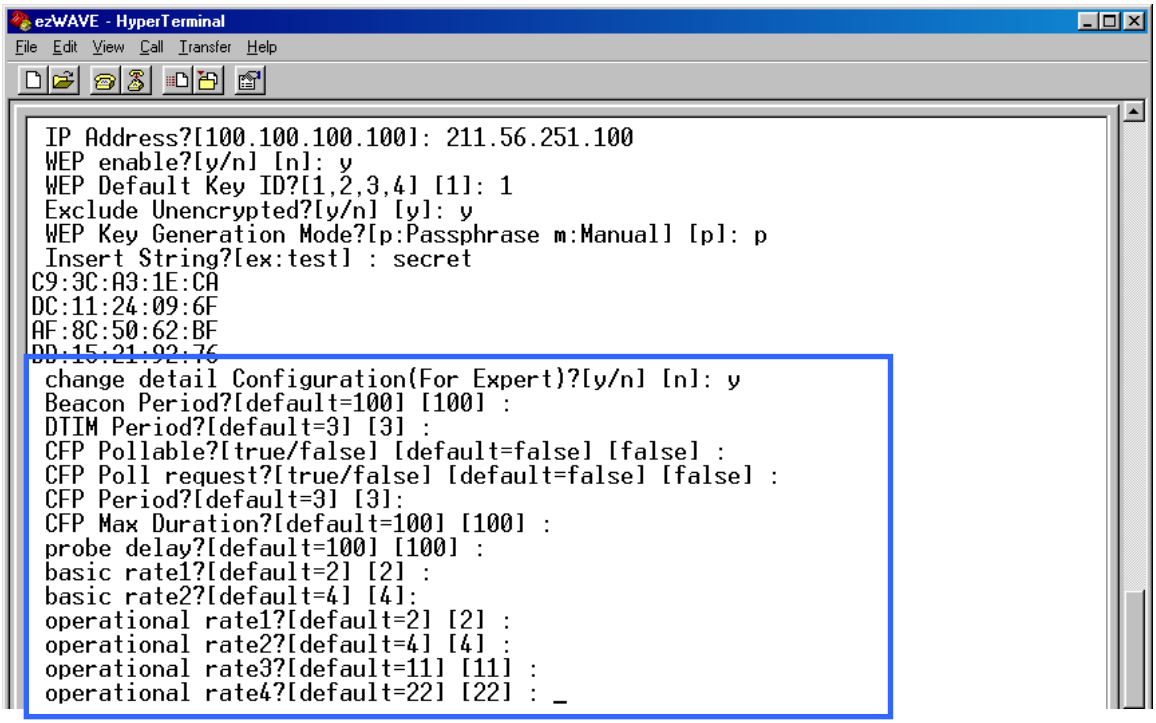
WEP stands for Wired Equivalent Privacy. WEP is an encryption scheme that provides secure wireless data communications to the users. WEP uses a 64bit-key or 128bit-key to control the network access. In order to do secure communication over the wireless LAN network, enable WEP function.



If you enable WEP function, select one of four WEP default key number. You can choose any number from 1 to 4 and then **Exclude Unencrypted** question is given. This question asks you whether you will allow a client that does not use WEP function to access communication with Access Point. Next question is **WEP Key Generation Mode**. There are two ways to generate the WEP key. One is by entering any text in the Passphrase. The other way is by entering Key value directly from the keyboard. In this case, you can

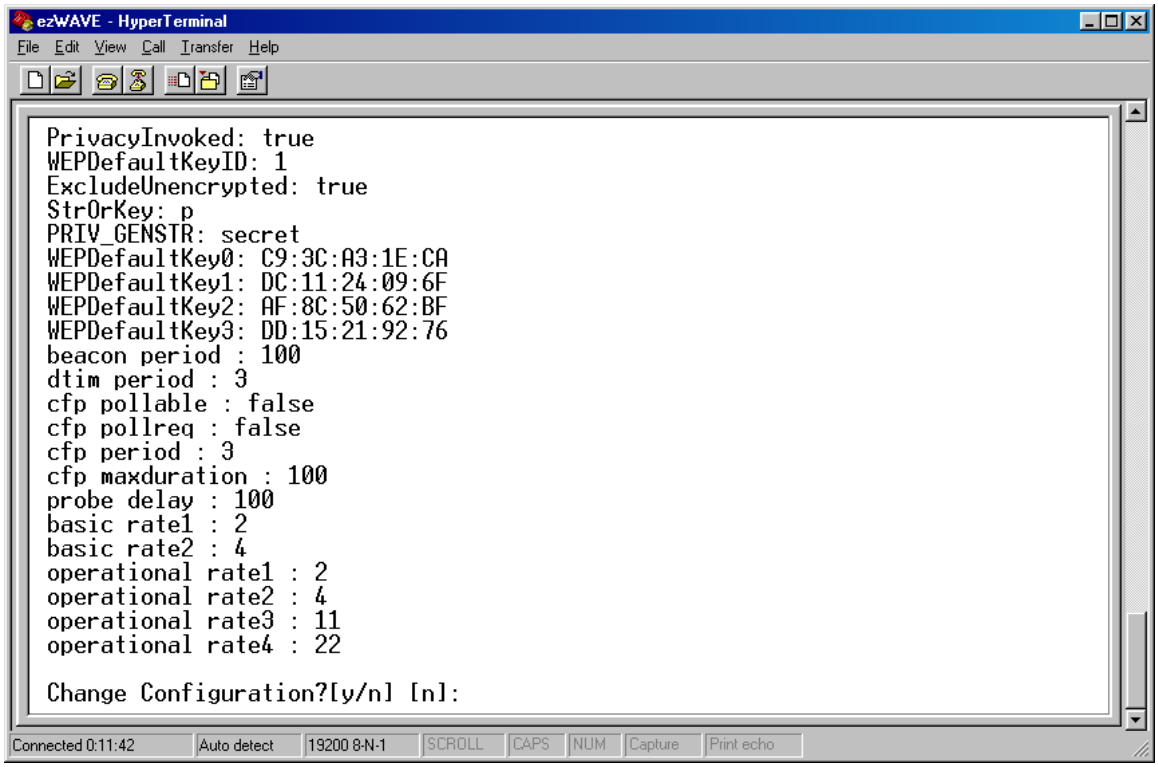
insert any character string.

As the wireless channel is more prone to the illegal access, WEP provides the users safe wireless LAN network access. But if you enable WEP function, it will degrade transmission throughput because it consume time to do encryption/decryption.



These options are provided for wireless LAN expert only, so if you does not have deep information about wireless LAN air interface specifications, do not change default options. More detail information about how to change detail configuration will be explained in Access Point Management section.

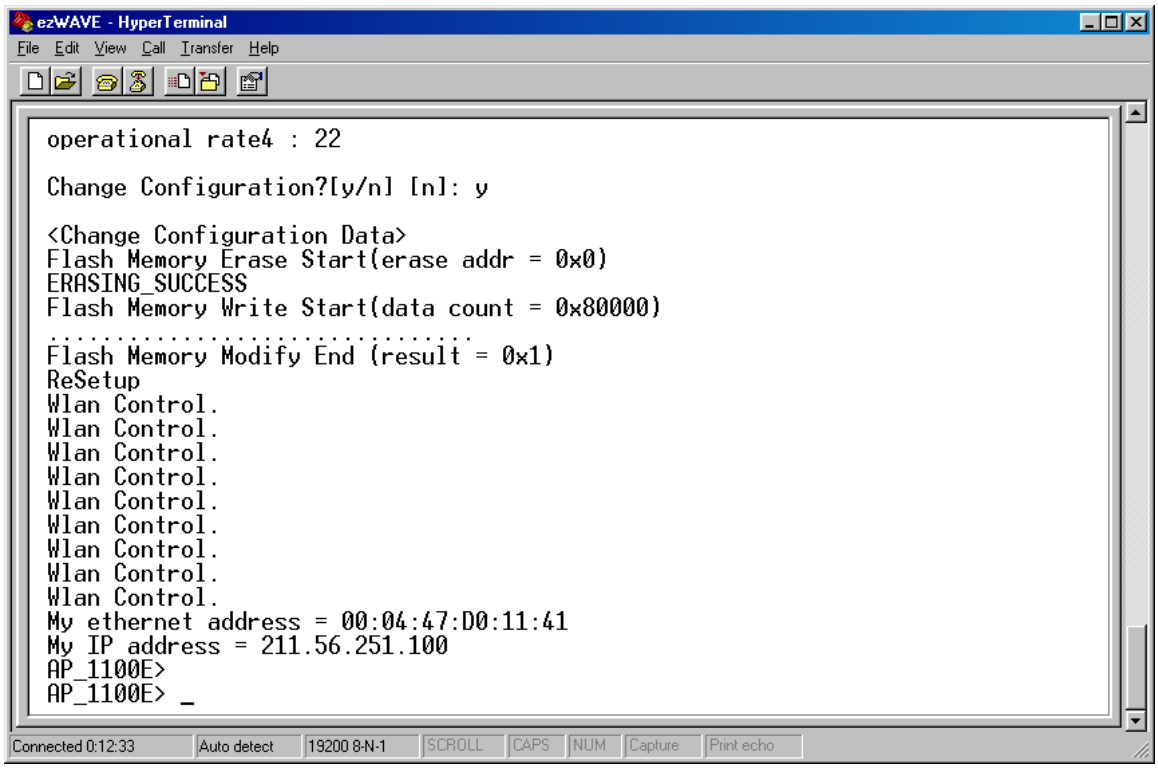
Now, you have completed all the setup options. Press Enter key. On the Hyper terminal screen, selected options lists will be displayed. After confirming all the changed options, press **y** (if you do not need any change) otherwise press **n**.



If you press **y** then Widelink's Access Point setup configuration will be completed and the setup program will update changed configuration in the memory.

Caution

During updating configuration data, it might display flash memory write error message. In this case, call for assistance from Widelink products' distributors.



2.3 Verifying the Operation of the Widelink Access Point

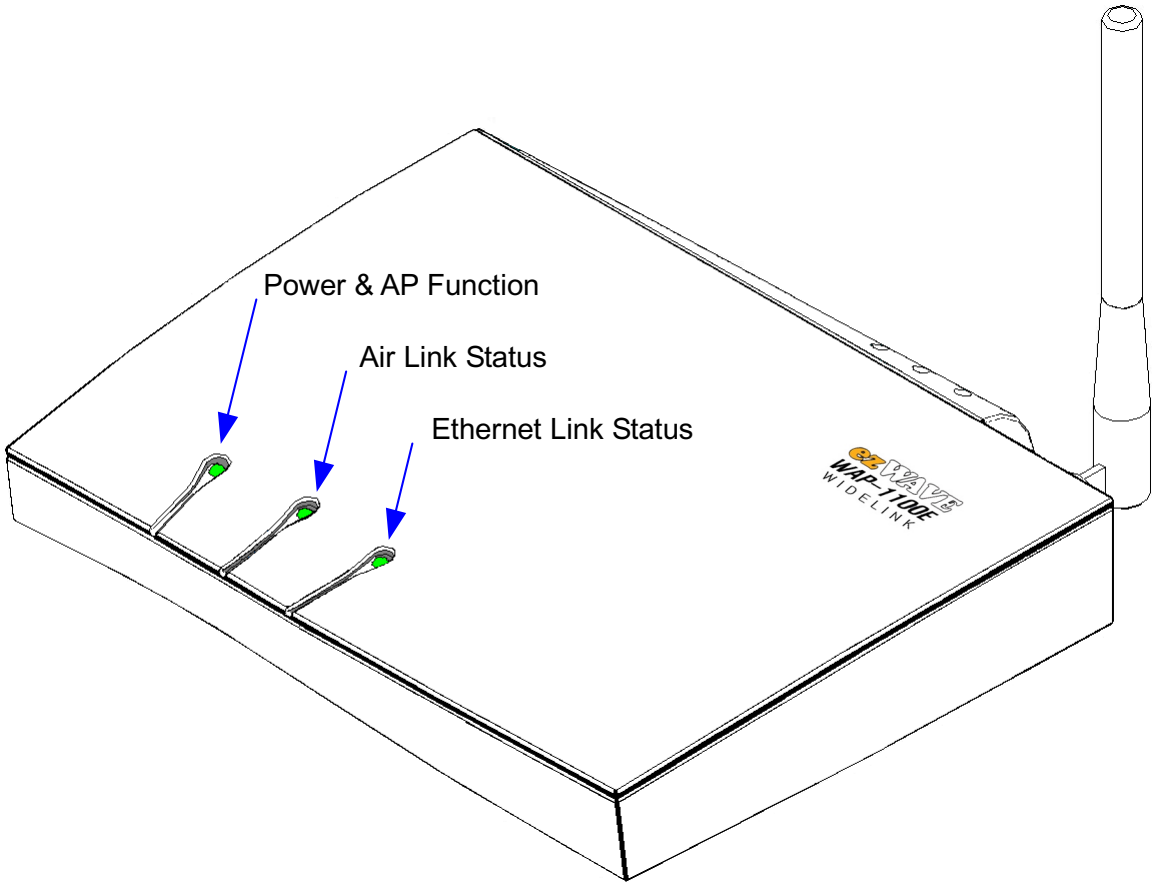
The AP runs a series of self-tests on power-up and reports status using its LEDs.
When power-up begins, the following occurs:

a. The firmware begins running diagnostics and initializes minimal hardware.

b. After the firmware completes its diagnostics and hardware initialization. The diagnostics then checks the RF module to see whether it is properly running the AP. And then, the firmware downloads RF module operating program.

c. Upon successful completion of the diagnostics and program download, the LED which shows the wireless LAN link status blinks for 2~3 seconds and then display bright green light steadily.

The diagnostics take approximately 30 seconds to complete after power-up. Upon successful completion of the diagnostics, the LED pattern shown in below figure is displayed.
If the AP fails to display the proper LED pattern, verify if you have correctly installed the AP. If the AP still fails to display the LED pattern, refer to troubleshooting section.



LED Name	Operational State
Power & AP Function	On (Green) = power is okay Orange = AP Functional Fail Occur
Air Link Status	ON (Green) = Air link status okay Blink = Air link or RF module has some problems.
Ethernet Link Status	Blink = Ethernet interface okay and AP is transfering data.

Chapter 3 Access Point Management

This chapter describes the pages in the Access Point's management system.
Before installing the Widelink Access Point Manager, first select a computer that meets these requirements:

- Operating system is Windows 98 and Windows 2000 or Windows ME.

- The computer is connected to the Access Point's wired or wireless LAN.

To install the Widelink Access Point Manager, insert the Widelink Access Point setup CD in the PC and run **SETUP** (this can be done from the Windows Explorer). Follow up the setup instructions. If you have a previous version of the Access Point Manager, install the Access Point Manager on the same computer folder. The setup process automatically upgrades the existing software and keeps your existing configuration files.

The Widelink Access Point Manager is included in the Widelink Access Point kit.
The AP Manager can be used as a setup/configuration tool for new Access Points and as a management tool to assist the ongoing management and support of Widelink wireless LANs.
The Widelink Access Point Manager has the following features:

- Ability to manage multiple APs remotely, including changing parameters in a wireless network with a single command

- Ability to view AP parameters, such as AP statistics, AP firmware version number, MAC addresses

- Integrity checking for many wireless parameter changes

- Integrated with a BooTP/TFTP application for simple AP firmware upgrades, also called flash upgrades.

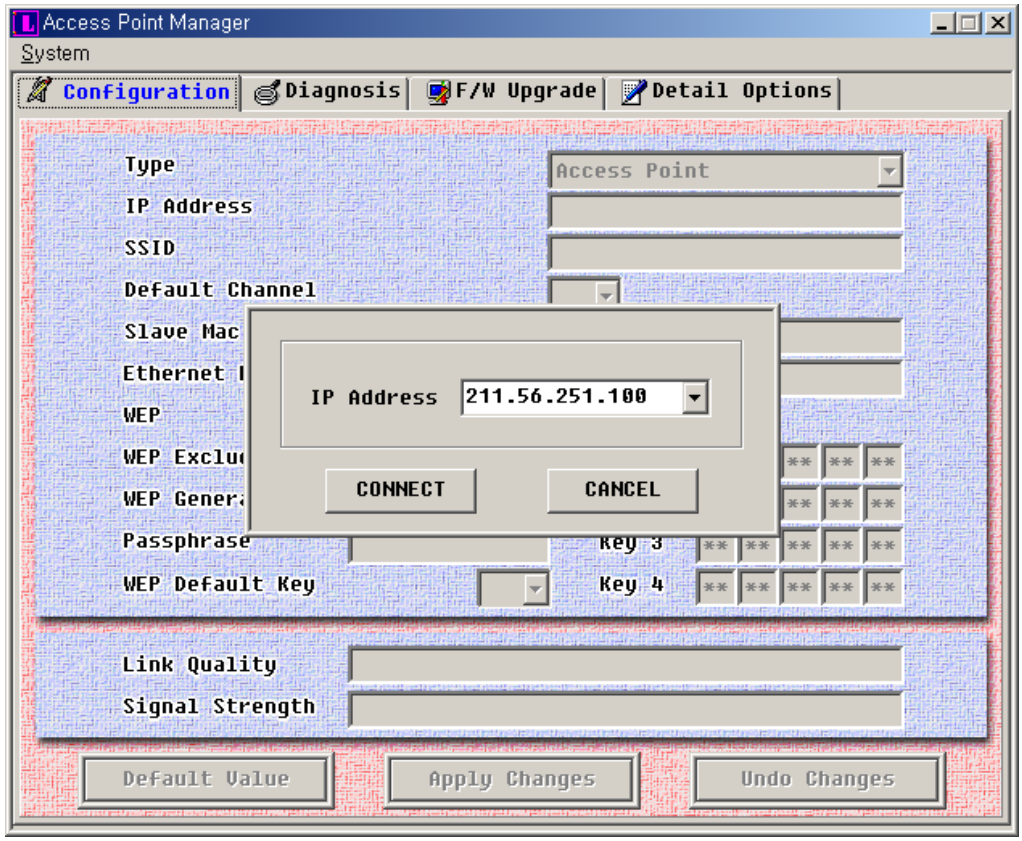
3.1 Starting a Configuration Tool

To modify Access Point parameters after installing the Access Point, you need to use a device connected to the console port or the Widelink Access Point Manager. The former was explained in the above chapter. The following sections describe how to configure the Access Point using Access Point Manager tool.

If you have installed the Widelink Access Point Manager on a computer, select:
Program Files ➔ Widelink ➔ ezWAVE Access Point Manager ➔ AccessPointManager.exe

Or you can simply click the AccessPointManager icon on the windows screen.

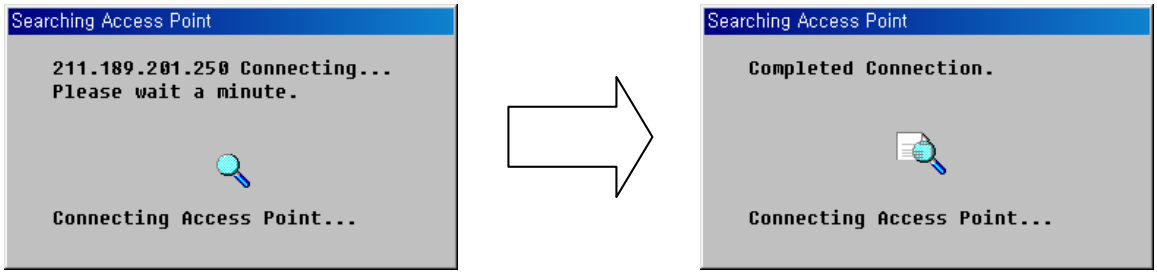
The program starts with the following screen.



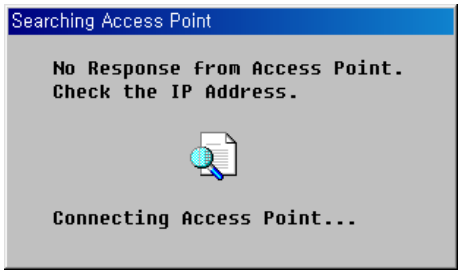
Access Point Connection

All the Access Points of Widelink have the same default IP address; 211.189.201.251. If you install the Access Point for the first time, you should type Widelink Access Point's default IP on the above IP address input dialog box and then press **CONNECT** button.

If the Access Point has no problem and wire/wireless link is connected without problem. Dialog box pop up to show that the Access Point Manager program is connected to the Access Point through its IP address.



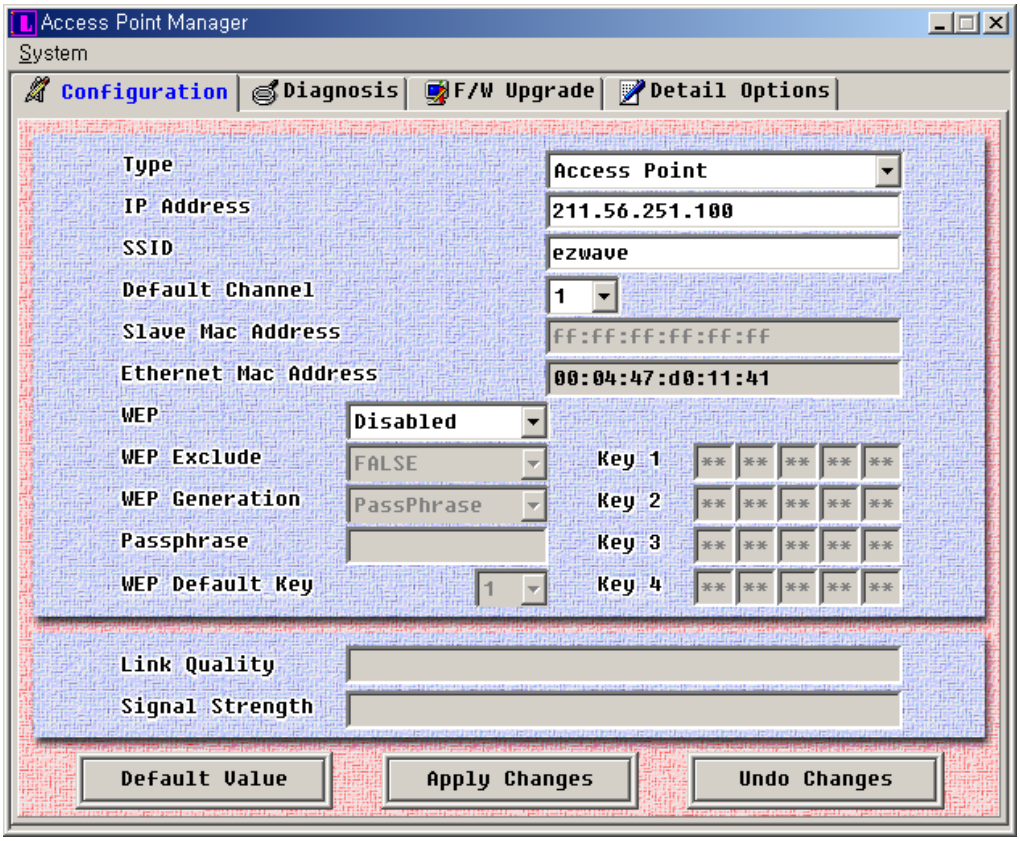
Otherwise if the Access Point Manager program is not able to find the Access Point, then following message is displayed and it will stop the search process.



If the Access Point connection fails, verify that you have correctly installed the AP. And if the AP still fails to connect, refer to troubleshooting chapter.

Access Point Configuration Window

Once the Access Point Manager program is successfully connected to an Access Point, all the configuration information are displayed through Access Point Manager program's configuration tab window.



- **Types:** Widelink's Access Point has multiple functions; Wireless LAN Access Point and Wireless LAN Bridge for point-to-point transmission. So, this dialog box displays current function mode. Default type value is Access Point mode.

- **IP Address:** This field allows the assignment or change of the Internet Protocol (IP) address of a station.

Widelink's ezWAVE Access Point has a default IP address of - **100.100.100.100**. It is

highly recommended that you change the IP address from the default only. You should not use the default IP address, except when you are installing the Access Point for the first time.

- **SSID:** The SSID is the network name for your Access Point. All Access Points on the same LAN must be set with the same SSID in order to support inter-cell roaming.
  If the Access Point is configured to communicate with wireless clients and the Secure Access parameter is enabled, each client must be configured with the same SSID. If Secure Access is not enabled, clients can be configured with the Access Point's wireless network name with word "**ANY**" (all uppercase/capital letter) or keep the Wireless Network Name field blank.

- **Default Channel:** The channel sets the center frequency of the Access Point. In a LAN-to-LAN configuration, the Access Points need to be set to the same channel. In a wireless client configuration with multiple Access Points, adjacent Access Points should be set to different channels (at least 5 channels apart recommended).
  For example, in a configuration with 3 Access Points, set the channels to 1, 6, and 11. Note that some countries only support a limited number of channels. Please refer to the Appendix Channel section. The Access Point does not allow you to set channels outside your country's band.
  Wireless clients with ezWAVE PC/PCI Cards automatically switch to the Access Point's channel when roaming between Access Points in a wireless network.

- **Slave Mac Address:** When the Access Point functions as a wireless LAN bridge master, it can define the slave bridge's MAC address.

- **Ethernet Mac Address:** The Media Access Control (MAC) address is a unique serial number assigned to a device by the Widelink.

- **WEP:** WEP stands for Wired Equivalent Privacy. WEP is an encryption scheme that provides the secure wireless data communications to the users. WEP uses a 64bit-key or 128bit-key to control the network access. In order to do secure communication over the wireless LAN network, enable WEP function. Use this setting to choose whether

clients must use data encryption when communicating with this Access Point.

- **WEP Exclude:** WEP Exclude option makes the Access Point service a client that does not use WEP function.

- **WEP Generation:** There are two ways to generate the WEP key. One is by entering any text in the Passphrase. The other way is by entering Key value directly from the keyboard. In this case, you can insert any character string.

- **Passphrase**: This field allows you to enter any character string to generate Key value.

- **Key 1, 2, 3 and 4**: These fields allow you to enter the WEP keys. Type ten hexadecimal digits (any combination of 0-9, a-f, or A-F) for 64-bit WEP keys. To protect WEP key security, existing WEP keys do not appear in the entry fields. You can write over existing keys, but you cannot edit or delete them.

The WEP keys for your network must be set exactly the same as your Access Points and your PC LAN cards. The same value must be assigned to Key 1 on both the Access Point and the PC LAN cards, the same value must be assigned to Key 2 on both the Access Point and the PC LAN cards, and so on, for all four WEP keys. For example, if you set WEP Key 3 on your Access Point to 0987654321 and select it as the active key, you must also set WEP Key 3 on the PC cards to the same value and select Key 3 as the active key.

- **WEP Default Key**: You can choose one of four WEP Keys that have been generated above step.

- **Link Quality**: When the Access Point functions as a wireless LAN bridge, it shows link

quality between Master Bridge and Slave Bridge

- **Signal Strength**: When the Access Point functions as a wireless LAN bridge, it shows signal strength between Master Bridge and Slave Bridge

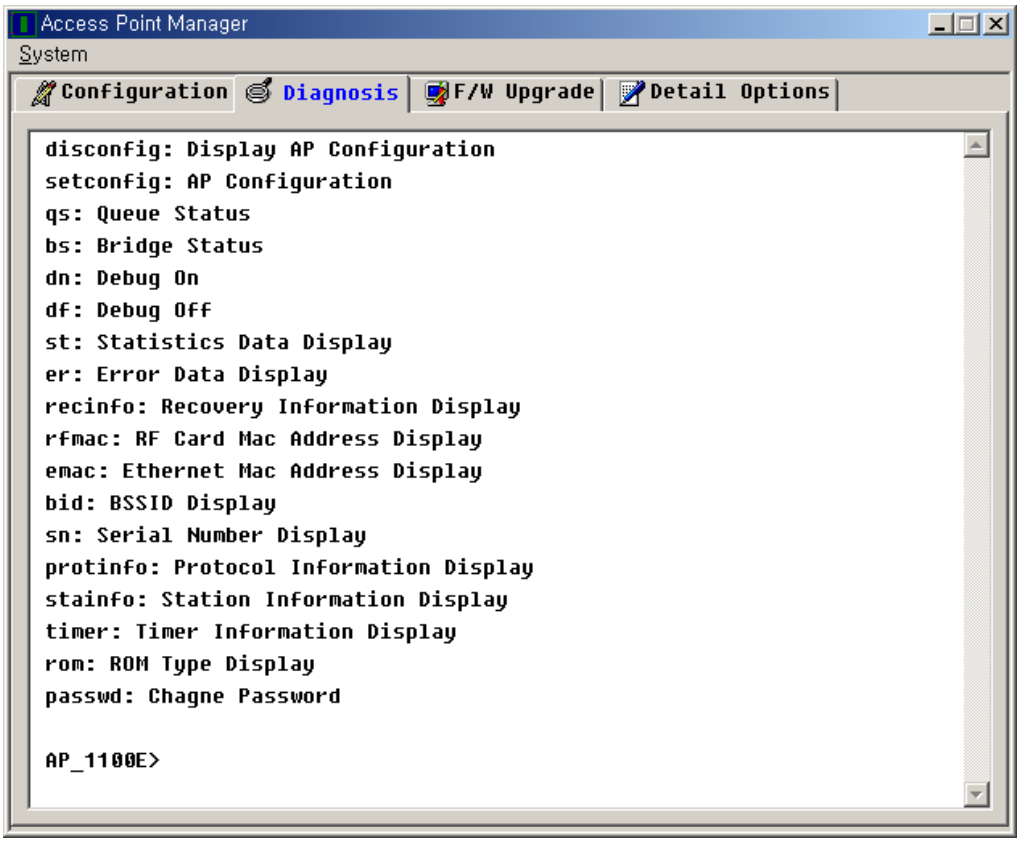
- **Apply Changes**: After entering new values for settings, click **Apply Changes** button to activate the new settings.

- **Undo Changes**: If you want to restore Access Point configuration, press this button.

Terminal Window for Diagnosis

The Diagnosis Tab provides the same function as terminal emulator programs, just like HyperTerminal program explained in above section.

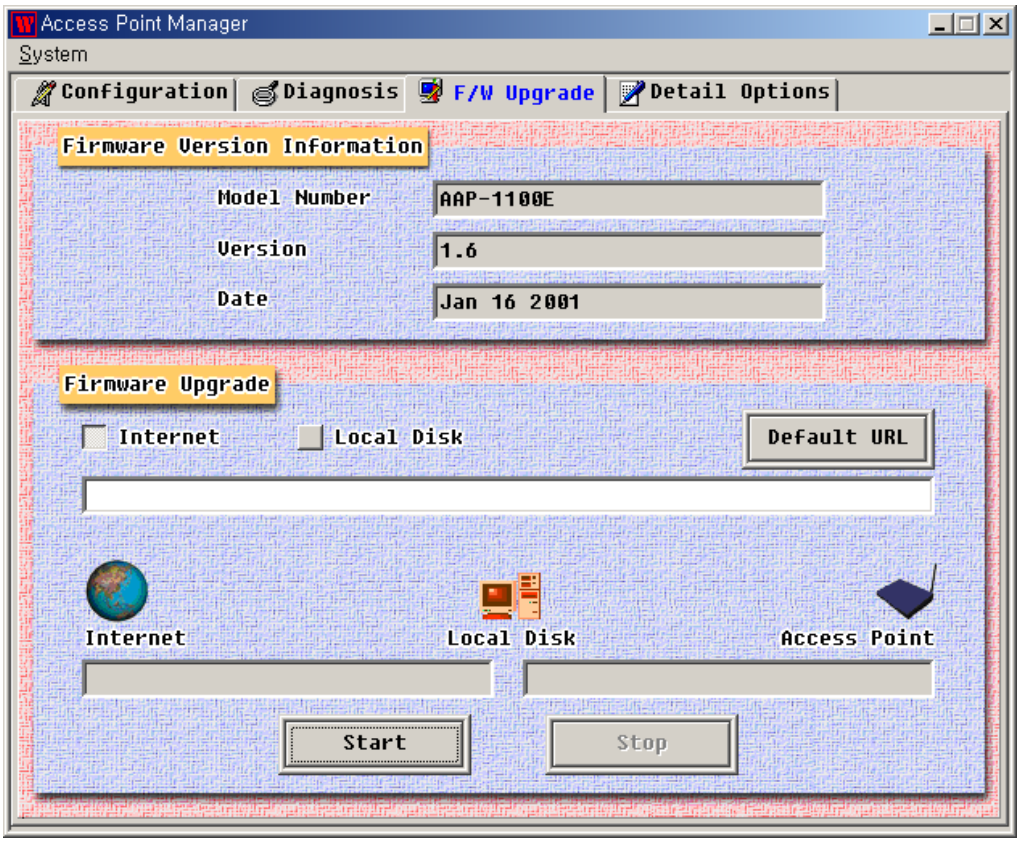
And you can do same things as you use terminal program. Please refer above **Open Terminal Program** section.



Firmware Upgrade Window

Use this page to simultaneously update the Access Point's system firmware via your local disk or Internet. After making firmware updates on this page, the Access Point will automatically be rebooted to activate the new firmware.

Before you update Access Point's firmware, you could check current Access Point's firmware version through the F/W Upgrade window.

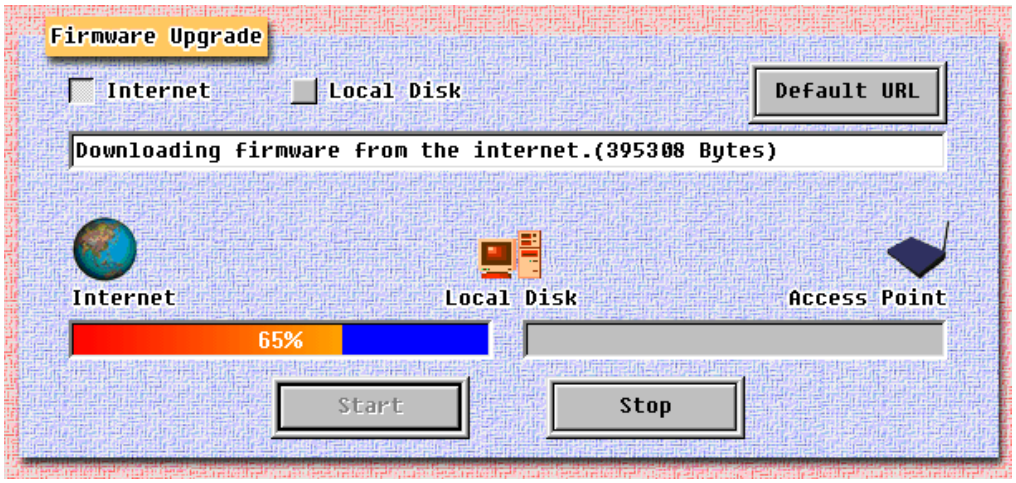


The firmware can be updated into two ways; one is via Internet and the other is via local disk or file server.

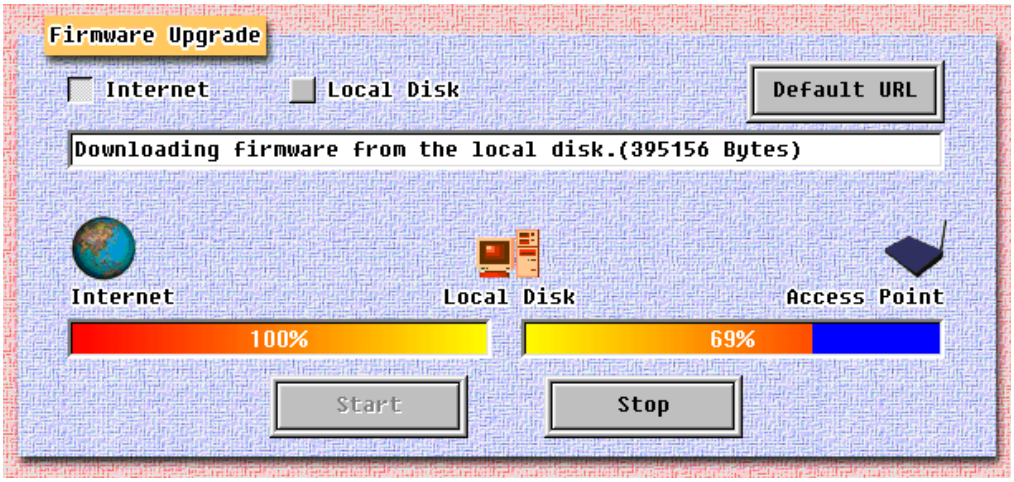
Firmware Upgrade Via Internet

In order to upgrade Access Point firmware via Internet, click the **Internet** selection button. If you know an URL address that supply Access Point's latest firmware version then enter the address in the dialog box. Otherwise click **Default URL** button.
The Default URL addresses Widelink's Internet homepage that supports the latest Access Point firmware version.

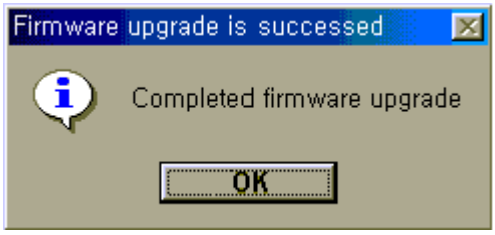
If you have defined URL address, press **Start** button so that the firmware can be transferred to your local disk (Program File → Widelink → ezWAVE Access Point Manager). During the firmware download, if there is an error or file transfer failure, then an error message will be displayed.

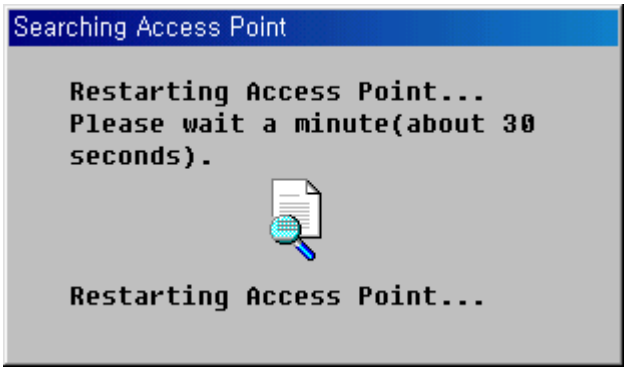


After completing the firmware download, the Manager performs Access Point firmware upgrade process. This process can be monitored just like as the firmware download process.



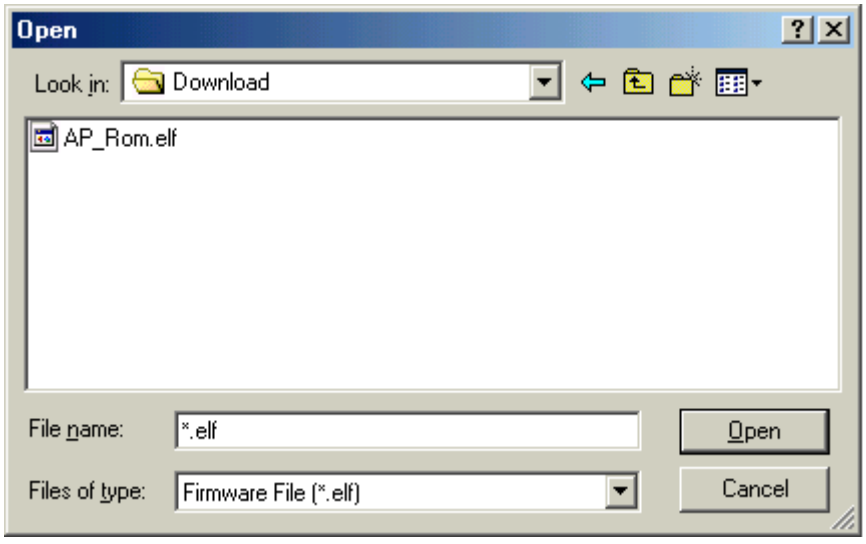
If the firmware download processes is completed successfully, download completed message is displayed and then Access Point Manager program tries to make a new connection with the Access Point. Meanwhile, the Access Point that have received the new firmware version go on self restarts process.





Firmware Upgrade Via Local Disk

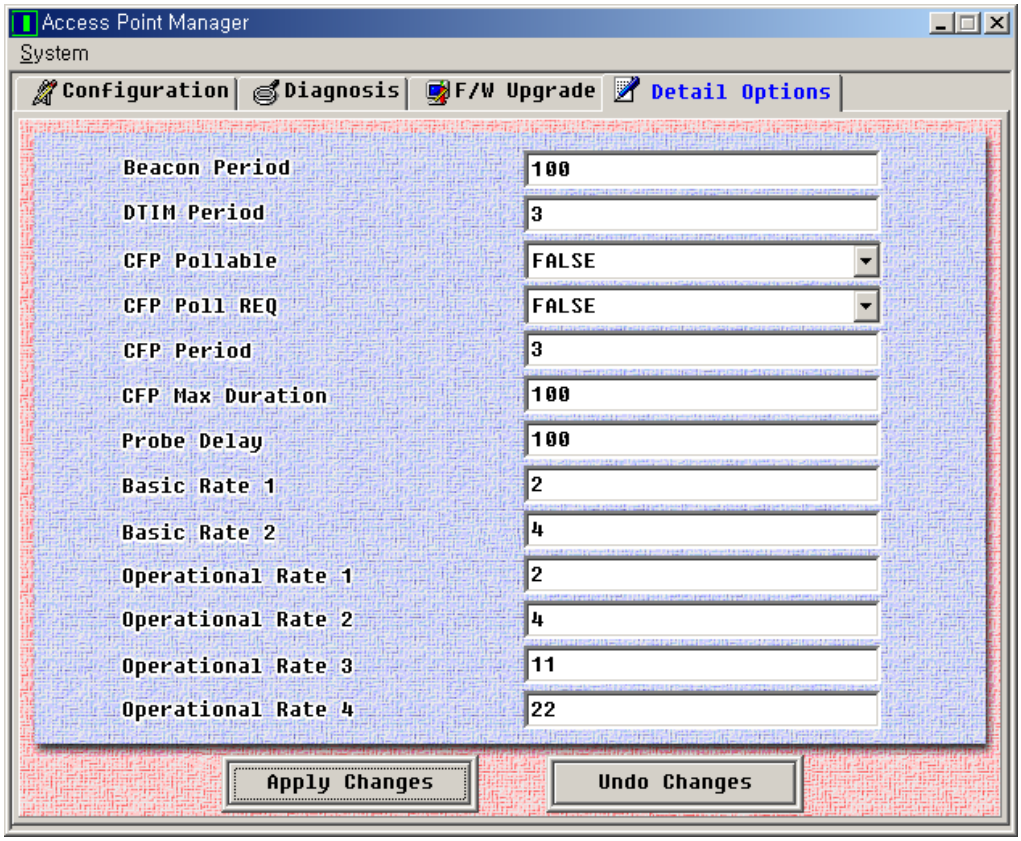
In order to upgrade Access Point firmware via local disk, click the **Local Disk** button. In order to use this option, you should have the latest firmware version in your local disk already. After you click **Browse** button, select the firmware that you want to update. At this point you should take a special attention in opening the file, to not open a wrong file or firmware version.



After confirming the file name, click the **Start** button. The other processes from this stage are same as those of the Internet.

Access Point Detail Control

This windows is provided for wireless LAN expert only. So if you do not have deep information about wireless LAN air interface specifications, do not change default options. More detailed information about how to change detail configuration will be explained in Access Point Management section.



- Beacon Period: The amount of time between beacons.

- DTIM Period: This setting, always a multiple of the beacon period, determines how often the beacon contains a delivery traffic indicator message (DTIM). The traffic indicator message tells power-save clients that a packet is waiting for them.

3.2 Setting Bridge Mode

You can connect two separate LANs over a wireless link by configuring two ezWAVE Access Points to communicate with each other. This is called a LAN-to-LAN connection. Two Access Points, using outdoor antennas, can connect two buildings or network segments that use the same communication protocol.

To configure two APs to communicate with each other in a LAN-to-LAN configuration, perform the following tasks:

1) Get the wireless MAC address of the remote AP. You can see the wireless address via the AP Manager or console device, as described in "Access Point Configuration Window" section. The wireless MAC address is NOT the same as the wired MAC address printed on the front of the AP.

2) Set the Bridge Mode to LAN-to-LAN, as described in above "Access Point Configuration Window section's Type item.

3) Make sure that the APs use the same channel. To change the AP channel, see "Access Point Configuration Window" section.

The AP provides the following bridging services:

- Store-and-forward capability
  The AP receives, checks, and transmits frames to other LANs, enabling the configuration of extended LANs.

- Frame filtering based on address
  Using the address database and the source and destination addresses from incoming frames, the AP isolates the traffic that *should not be allowed* on other LANs. This action reduces the total data traffic on an extended LAN by not forwarding the packets that have local destination addresses or packets that are not allowed to forward. This increases bandwidth efficiency.

- Data Link layer relay

  The AP operates at the Data Link layer of the Open System Interconnection (OSI) model. Operation at this layer makes the AP transparent to the protocols that use the LAN connectivity service. This protocol transparency is a key factor in the extended LAN service.

Chapter 4 Troubleshooting

T.B.D.

Appendix

Appendix A Cell Planning (Radio Range)

This section provides general guidelines on factors that influence network performance

Cell Site Survey

Because of differences in component configuration, placement and physical environment, every network application is a unique installation. Before installing the system, users should perform a site survey to determine the optimum utilization of networking components to maximize range, coverage and network performance.
Here are some operating and environmental conditions you should consider:

• **Data Rates**
Radio signal sensitivity and range are inversely proportional to data bit rates. The maximum radio range is achieved at the lowest workable data rate. There will be a decrease in receiver threshold sensitivity as the radio data rate increases.

• **Antenna Type and Placement (PCI card only)**
Proper antenna configuration is a critical factor in maximizing radio range. As a general guide, range increases in proportion to antenna height. For a detailed explanation of antenna types and configurations along with guidelines on selecting antennas for specific environments, see the documentation that comes with your antenna.

• **Physical Environments**
Clear or open areas provide better radio range than closed or filled areas. Also, the less cluttered the work environment, the greater the range.

• **Obstructions**
A physical obstruction such as metal shelving or a steel pillar can hinder the performance of the client adapter. Avoid locating the computing device in a location where there is a metal barrier between the sending and receiving antennas.

• **Building Materials**

Radio penetration is greatly influenced by the building material used in construction. For example, drywall construction allows greater range than concrete blocks. Metal or steel construction is a barrier to radio signals.

Enhancing Coverage

The system architecture options of the wireless station and ezWAVE Access Points provide for a variety of coverage alternatives and flexibility. The system can be designed to provide a wide coverage area with minimal overlap or coverage with heavy overlap. The latter improves system performance and protection against downtime in the event of a component failure. By arranging the ezWAVE Access Points to minimize overlap in coverage area, a large area can be covered with minimal system cost. The total bandwidth available to each mobile station will depend on the amount of data each mobile station desires to transfer and the number of stations located in each cell. Seamless roaming is supported, as a mobile station moves in and out of range of each ezWAVE Access Point, thereby maintaining a constant connection to the wired LAN. Each device in the radio network must be configured with the same Service Set Identifier (SSID) to provide the roaming capability. Multiple systems can operate in the same vicinity. The architecture provides multiple channels, which can coexist in the same area with virtually no interference to each other. In this mode, each system must be configured with different Service Set Identifiers (SSID) and different channels to prevent clients from roaming to ezWAVE Access Points from a different wireless system.

Appendix B Technical Specifications

Functional Specification

Item	Function
Configuration and setup	. Local monitor . Access Point Manager
Modes	. Access Point . Wireless LAN Bridge
Status Display	Power, Air Link Status, Wire Link status
Software Upgradeable	Via Access Point Manager or local monitor
Security	WEP 64 bit standard, upgradeable to 128 bit
Approval	WiFi, FCC (processing)
Max. No of Clients per AP	255

Electrical/Radio Specifications

Item	Specification	Description
Compliance	IEEE802.11b	
Radio Type	Direct Sequence Spread-Spectrum (DSSS)	2.4 GHz ISM Band
Operating Frequency	2400-2483.5 MHz	North American, ETSI, and Japan channel coverage, factory configurable
Range	Depending on data rate and environment.	Accurate values must be calculated for specific installation.
Data Rate	1, 2, 5,5 or 11Mbps	Dynamic rate selection based on radio medium quality.
FCC ID		FCC approval
Number of Channels	Max 14	Refer Appendix CHANNEL
Channeling	5 MHz increments	Programmable for IEEE 802.11b
Type of Modulation	BPSK 1 Mbit/s QPSK 2 Mbit/s CCK 5.5 and 11 Mbits/s	Nominal 10 MHz BW (-6 dB)
Receiver sensitivity	- 84 dBm	
Wired LAN Interface	10Base-T	RJ45 Connector
Serial Interface	RS-232 @ 19.2Kbps	DB-9 female
Power Consumption	4.5W @ 20°C	
Power Supply	1.5A DC Input	100-240VAC, 60Hz 5V VDC
Dimension	157w x 128d x 27h	MM
Weight	0.5Kg	Without antenna
Operating Temperature	-10°C ~ +50°C	
Storage Temperature	-20°C ~ +80°C	
Operating Humidity	10% ~ 90%	Non-condensing

Appendix C Channel Allocation

The channel identifiers and the channel center frequencies of each 22-MHz-wide channel are shown in the table below, as appropriate for the various areas or regulatory agencies.

Channel Identifier	Center Frequency	Regulatory Domains				
		North America	ETSI	Spain	France	Korea / Japan
1	2412MHz	√	√	–	–	√
2	2417MHz	√	√	–	–	√
3	2422MHz	√	√	–	–	√
4	2427MHz	√	√	–	–	√
5	2432MHz	√	√	–	–	√
6	2437MHz	√	√	–	–	√
7	2442MHz	√	√	–	–	√
8	2447MHz	√	√	–	–	√
9	2452MHz	√	√	–	–	√
10	2457MHz	√	√	√	√	√
11	2462MHz	√	√	√	√	√
12	2467MHz	–	√	–	√	√
13	2472MHz	–	√	–	√	√
14	2484MHz	–	–	–	–	Japan(√)