WLAN a/b/g/n mini-PCI Module

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Version: 1.0

April 2009

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Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the 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 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.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For product available in the USA/Canada market, only channel 1~11 can be operated. Selection of other channels is not possible.

This device and its antenna(s) must not be co-located or operation in conjunction with any other antenna or transmitter.

This device is going to be operated in 5.15~5.25GHz frequency range, it is restricted in indoor environment only.

Devices will not permit operations on channels 120-132 for 11a and 11n/a which overlap the 5600 - 5650 MHz band.

IMPORTANT NOTE:

This module is intended for OEM integrator. The OEM integrator is still responsible for the FCC compliance requirement of the end product, which integrates this module.

20cm minimum distance has to be able to be maintained between the antenna and the users for the host this module is integrated into. Under such configuration, the FCC radiation exposure limits set forth for an population/uncontrolled environment can be satisfied.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains TX FCC ID: NKR-DNMA-92 ". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

Approved antenna for the End product.

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	
1	WNC	RPAA-A1-2.4G	PIFA Antenna	I-PEX	2.4GHz	2.98
2	WNC	RPAA-A1-2.4G	PIFA Antenna	I-PEX	2.4GHz	3.84
3	WNC	RPAA-A1-5G	PIFA Antenna	I-PEX	5GHz	5.85
4	WNC	RPAA-A1-5G	PIFA Antenna	I-PEX	5GHz	5.95

The above approved antenna is only allowed to use for the module. It will be necessary to keep 20cm away from human body. Other antenna type or same antenna type but higher antenna gain is not allowed to use.

IMPORTANT NOTE: In the event that these conditions can not be met (for example used within 20cm or higher antenna gain), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

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1. Introduction

Thank you for purchasing the WLAN a/b/g/n mini-PCI Module that provides the easiest way to wireless networking. This User Manual contains detailed instructions in the operation of this product. Please keep this manual for future reference.

System Requirements

- A laptop PC contains:
  - 32 MB memory or greater
  - 300 MHz processor or higher
- Microsoft® Win™2000/ME/98 Second Edition/XP

2. Driver/Utility Installation / Uninstallation

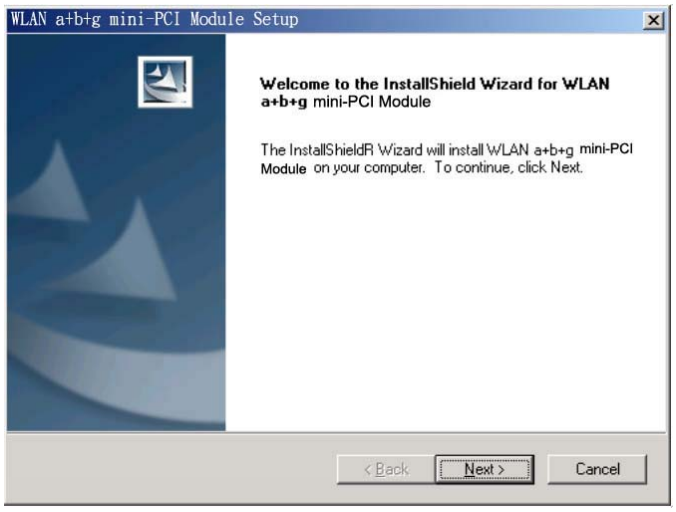
2.1 Installation

Note! The Installation Section in this User Manual describes the first-time installation for Windows. To re-install the driver, please first uninstall the previously installed driver. See Chapter 2.3 “Uninstallation” in this User Manual.

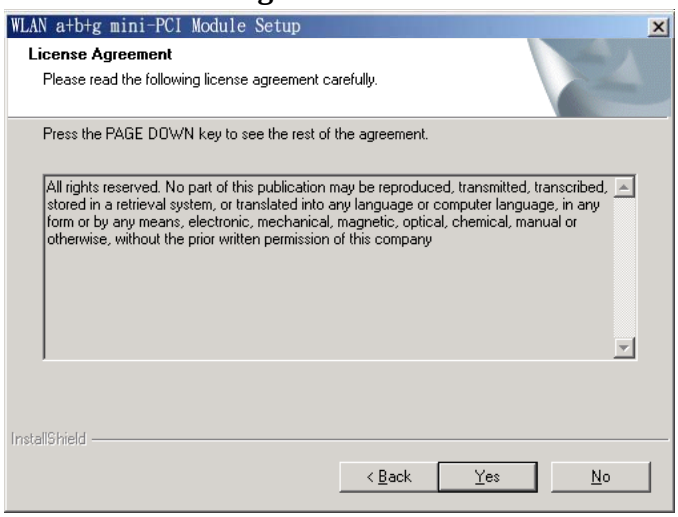
Follow the steps below to complete the driver/utility installation:

1. Insert the **Installation Software CD** into the CD-Rom Drive.

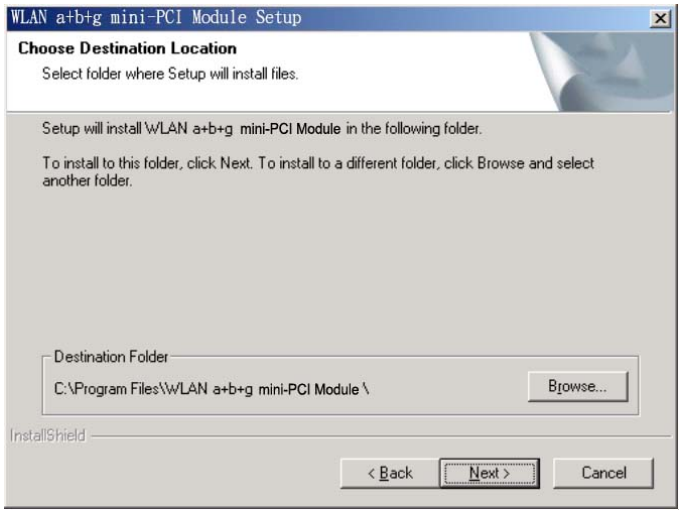
2. Click **“Next”**.



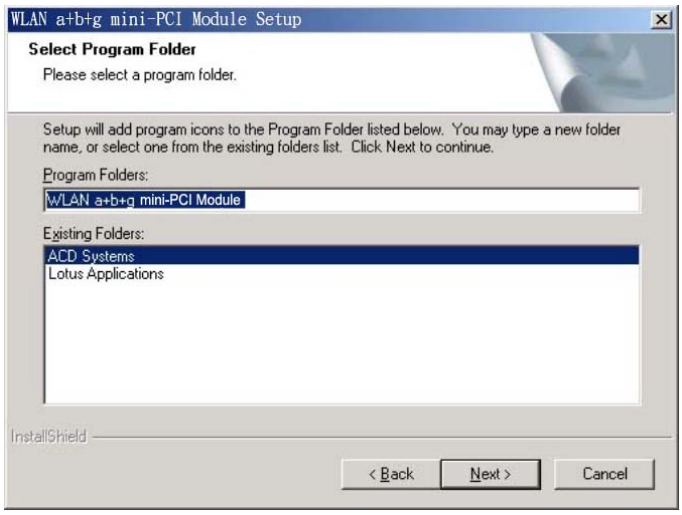
3. Read the **License Agreement** and click **“Yes”**.



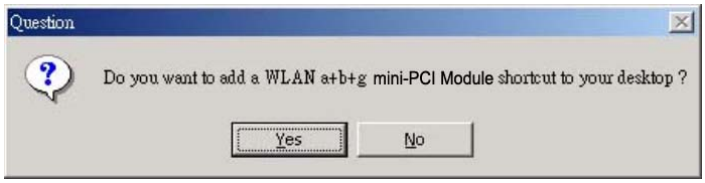
4. Click **“Next”** to continue or click **“Browse”** to choose a destination folder.



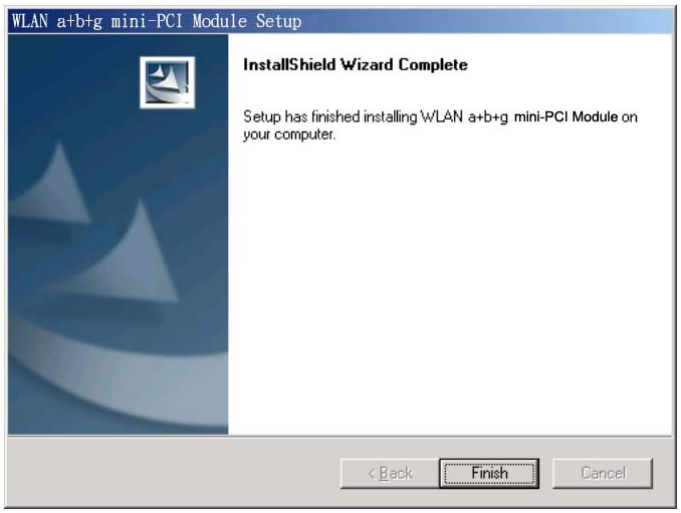
5. Click **“Next”**.



6. Click **“Yes”** to create a shortcut icon on your desktop.



7. Click **“Finish”**.



8. You should now see a shortcut icon on your desktop.

2.2 Additional Setup Processes

During software installation procedure, each operating system may prompt different specific options:

1. **Windows 98SE:** The system will request the original Windows CD during the installation process. When the installation is finished, you'll have to restart your computer.

2. **Windows Me:** Please restart your computer when the installation is finished.

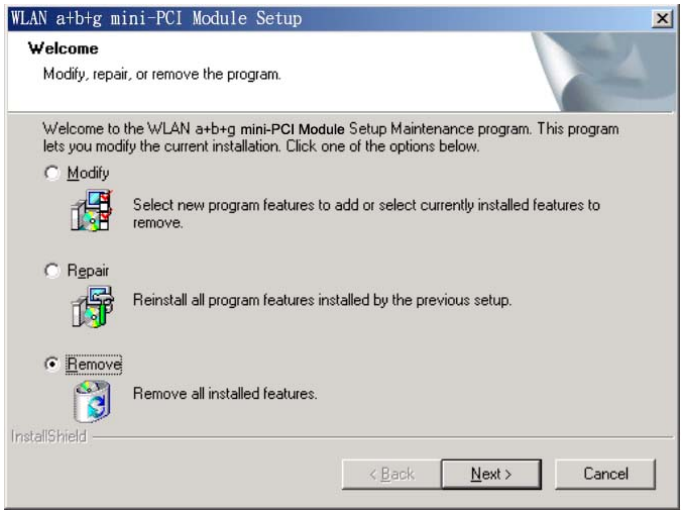
3. **Windows 2000/XP:** Select "Install the software automatically" when the window with this option appears, and then click "Next" to continue installation.

2.3 Uninstallation

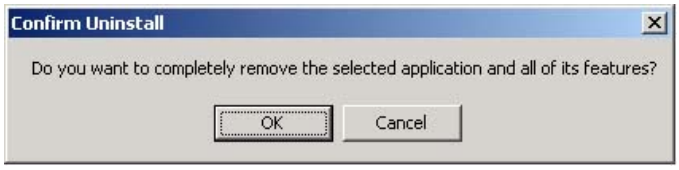
Note! Before uninstallation, please close all running programs.

1. Click Start>Programs>WLAN a+b+g mini-PCI Module >UnInstall WLAN a+b+g mini-PCI Module.

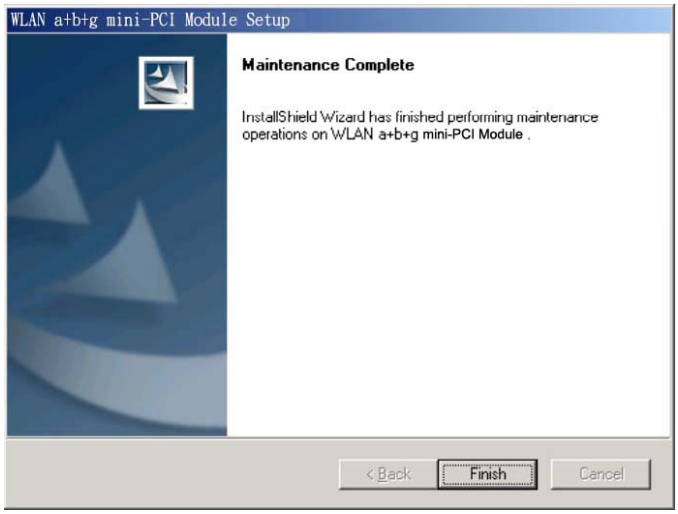
2. Choose **"Remove"**. Click **"Next"**.



3. Click **"OK"** to start **Uninstall**.

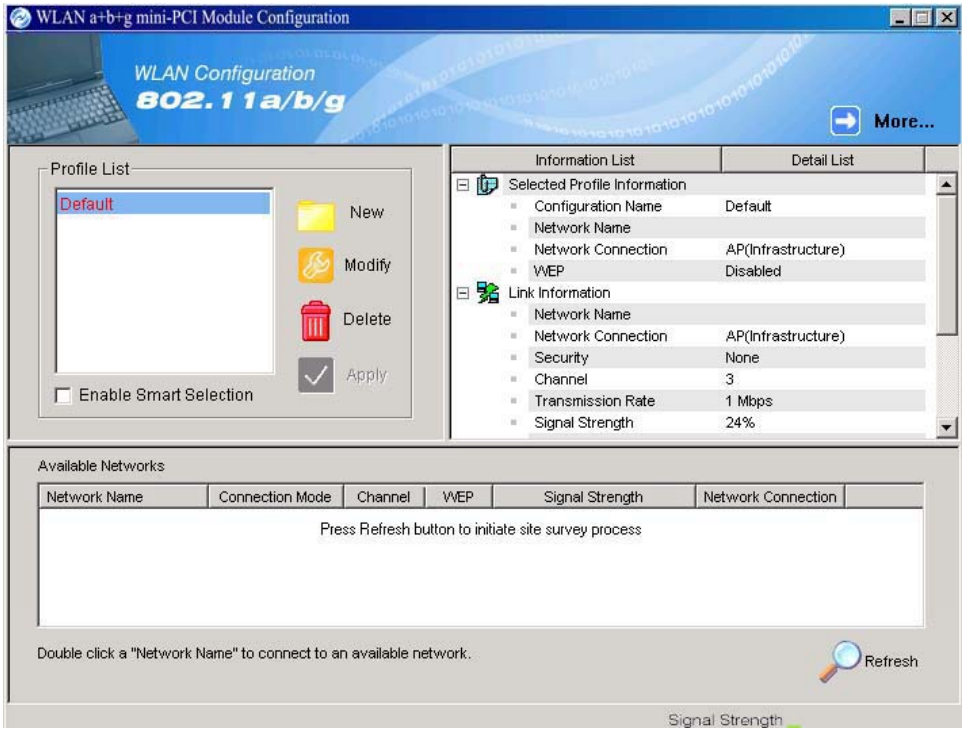


4. Click **"Finish"**. **Uninstall** is now completed.



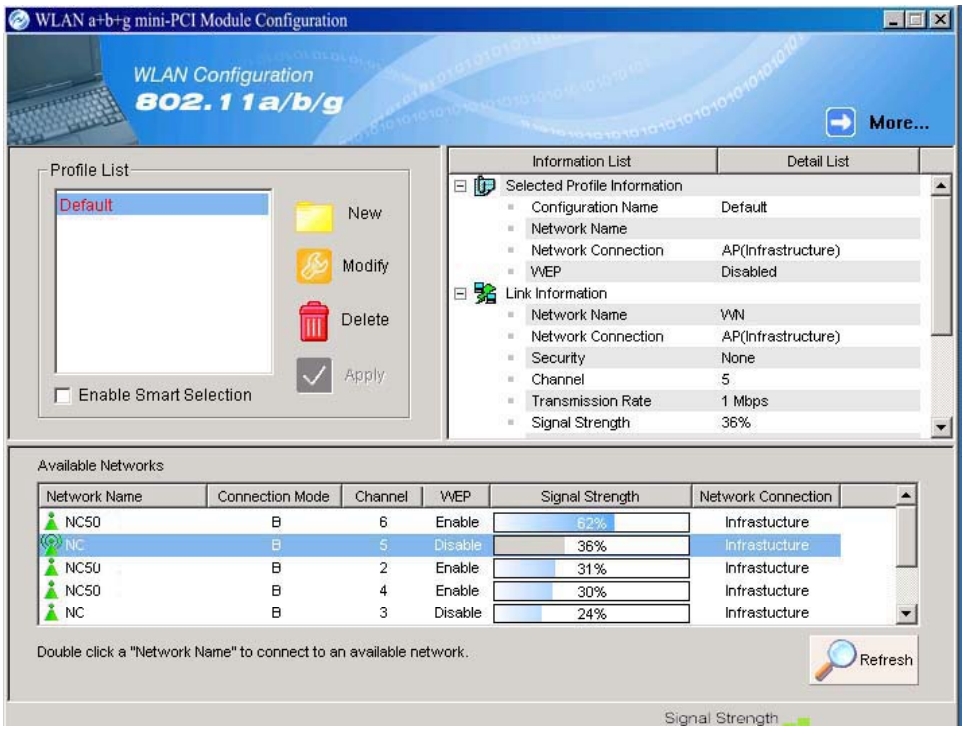
3. Connecting to an Existing Network

1. Double click the shortcut icon of WLAN a+b+g mini-PCI Module on the desktop, and the Configuration window appears.



2. Click on the **Refresh** button

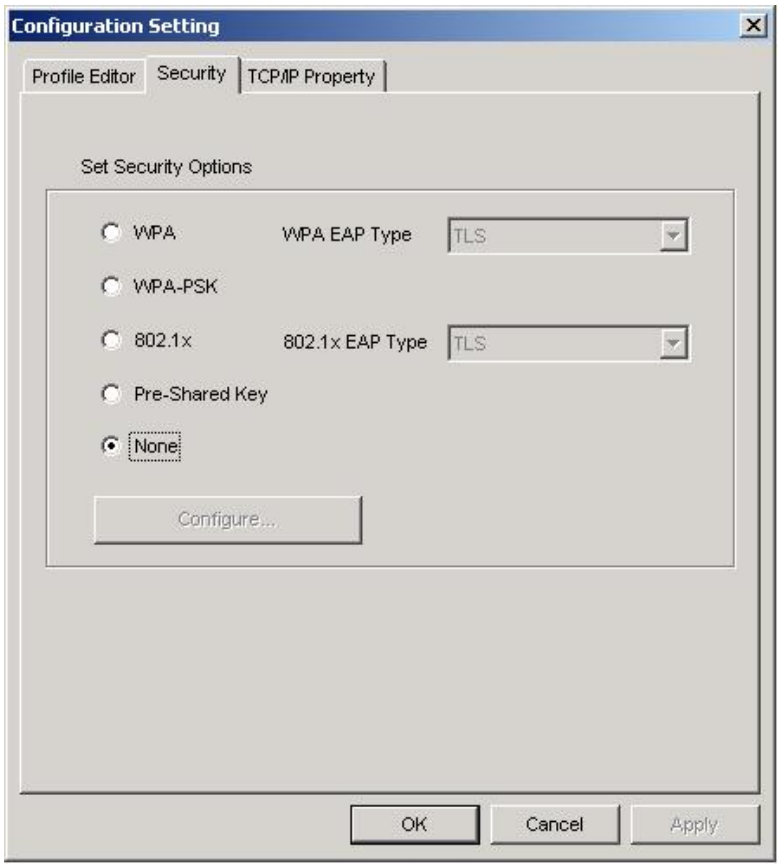
to list all available networks.



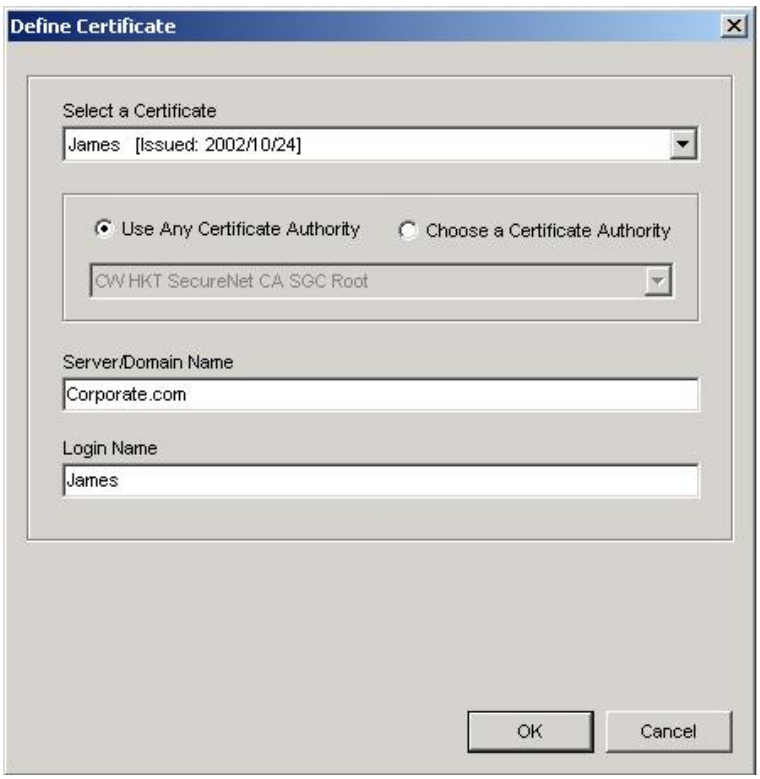
Note! To automatically connect to the network with the strongest signal, select **Enable Smart Selection**. **Any** displays in Profile List.

3. From the list of "Available Networks", choose one network by double clicking the **Network Name**. One of the following dialog boxes appears. Click **"Yes"** to continue.

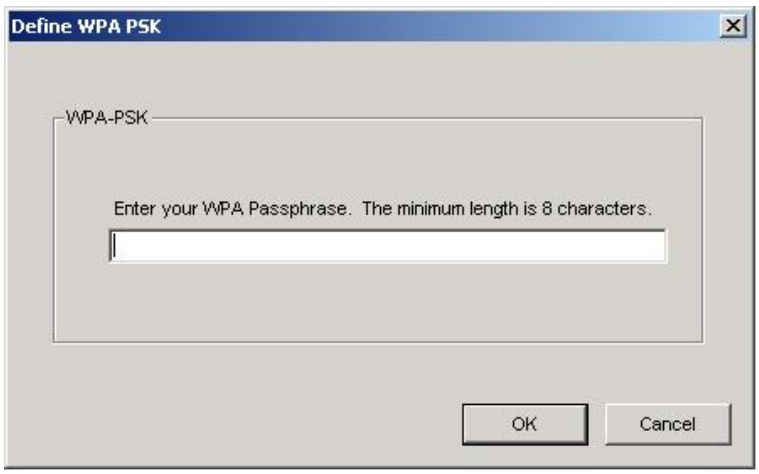
4. If the chosen network has security enabled, the **Security** tab displays. Select the security option used by the network. Contact the network administrator for the correct settings.



5. If selecting **WPA** or **802.1X**, select the EAP type, then click on the **Configure** button to select the certificate.



6. If selecting **WPA-PSK**, click on the **Configure** button to enter the PassPhrase.



7. If selecting **Pre-Shared Key**, click on the **Configure** button to enter the correct Encryption Keys**.**

   Key entry method:

   a.10hex digits: User must enter 10 hexadecimal digits.

   The hexadecimal define is "0-9" and "A-F".

   ex: 123456abc

   b.5 chars: User must enter 5 characters. ex: ab3#@

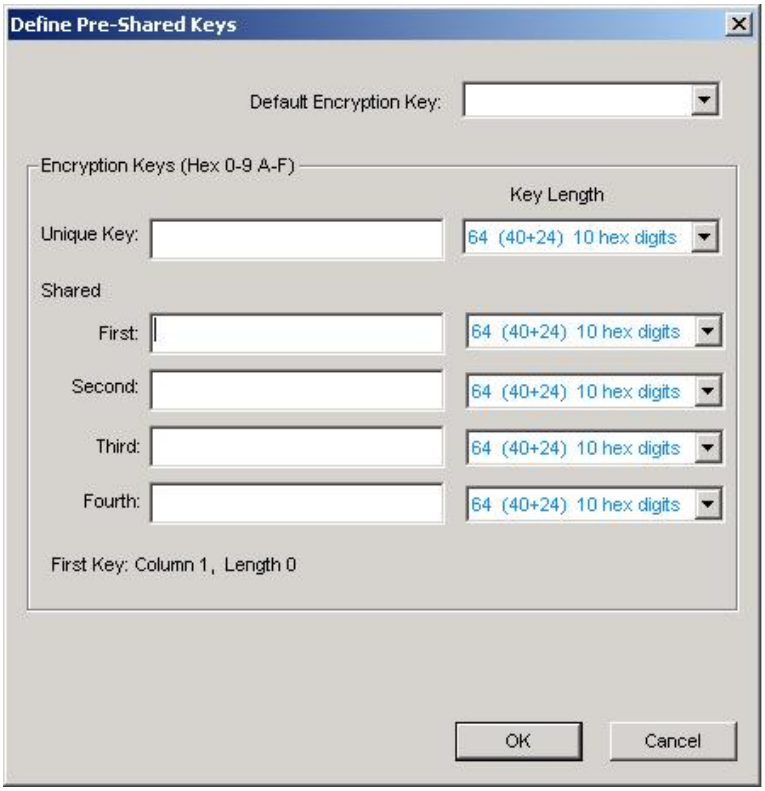
   c.13 chars: User must enter 13 characters.

   ex: ab3#@kf08&kdk

   d.16 chars: User must enter 16 characters.

   ex: ab3#@kf08&kdk456

   For WEP key, please contact with MIS administrator.



8. Click on **OK** (or **Apply** if using the other tabs) when done to save the settings.

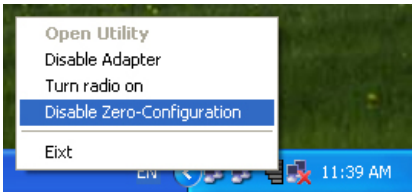
9. Once connected (the icon or in front of the name of the Connected Network), you can check the signal strength from the icon in the Windows System Tray.

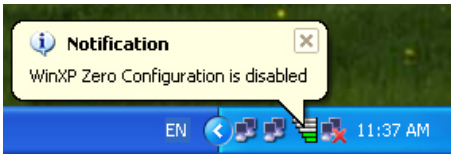
Additional Note for Windows XP

In Windows XP, it is recommended that you use the WLAN a+b+g mini-PCI Module Configuration Utility. Before using the Utility, please follow the steps below to disable the Windows XP Zero Configuration:

Option 1:

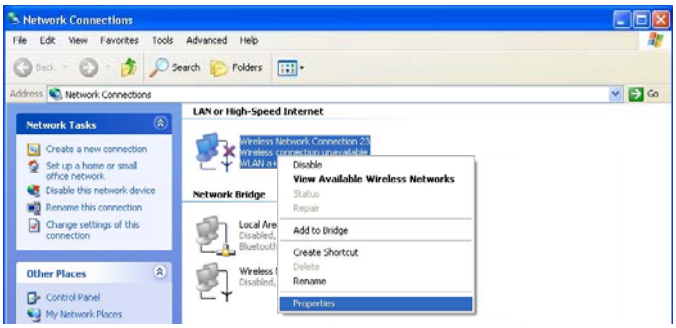
1. Double click the shortcut icon to open the Utility.
2. From the Windows System Tray, you should see the signal icon. Right-click it and select “Disable Zero-Configuration”.



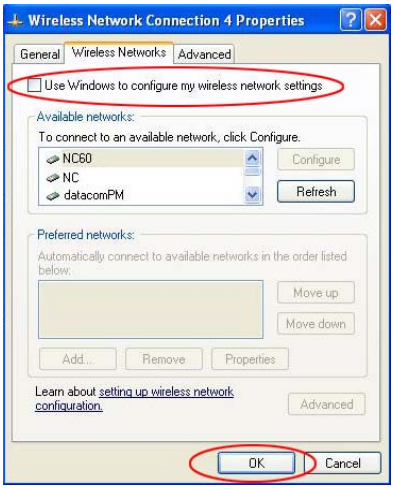


Option 2:

1. Go to “Control Panel” and double click “Network Connections”.
2. Right-click “Wireless Network Connection” of “WLAN a+b+g mini-PCI Module”, and select “Properties”.

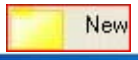


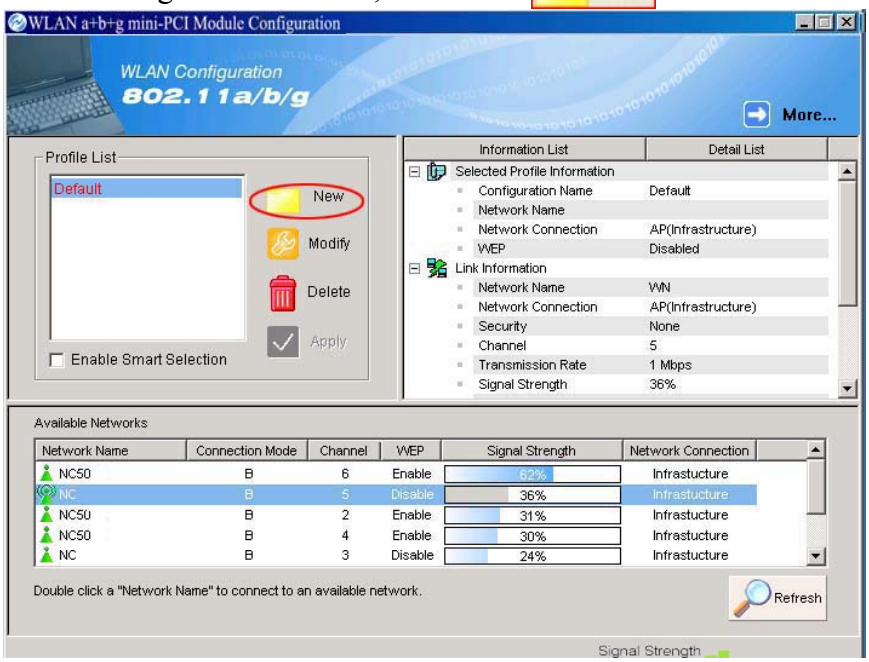
3. Select “Wireless Networks” tab, and uncheck the check box of “Use Windows to configure my wireless network settings”, and then click “OK”.



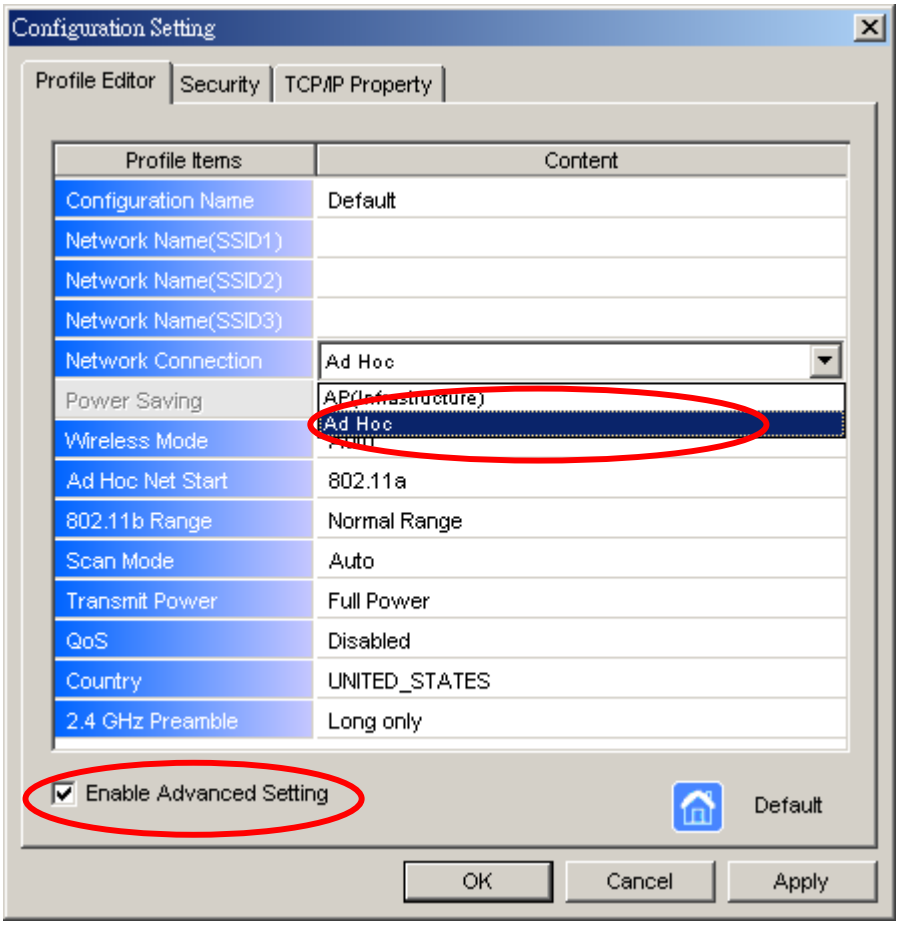
4. Creating an Ad Hoc New Network

NOTE! Ad-hoc mode is available only for 802.11b/g. It is not available for 802.11a. This is a client product and do not have radar detection function specified by FCC. The software will not let you to use ad-hoc under 802.11a.

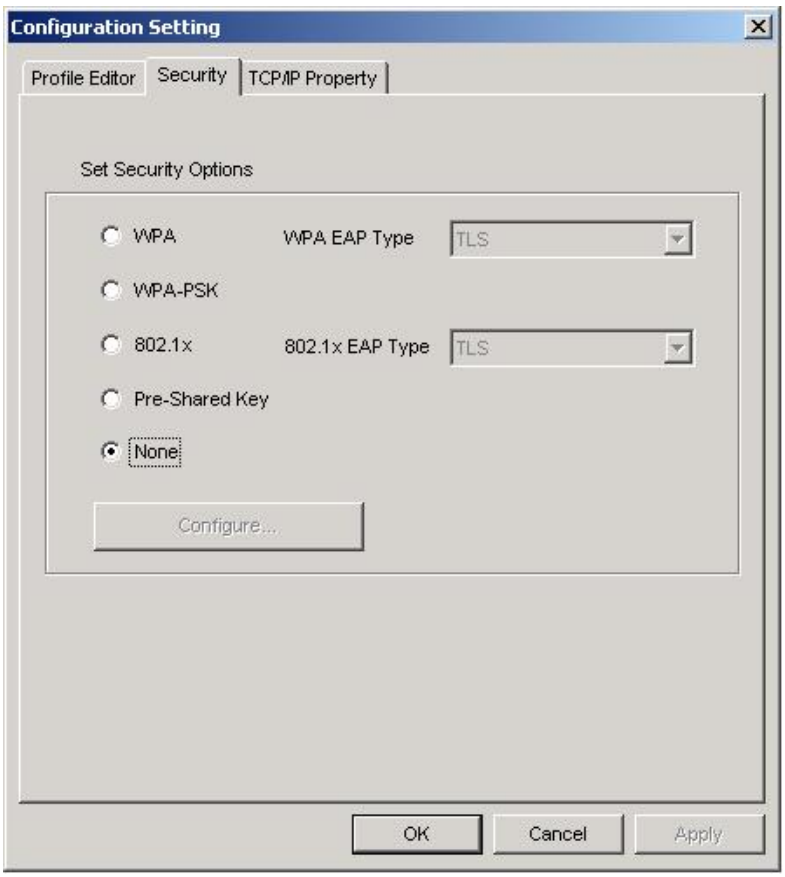
1. In the Configuration window, click **New** 



2. Select the “Profile Editor” tab.

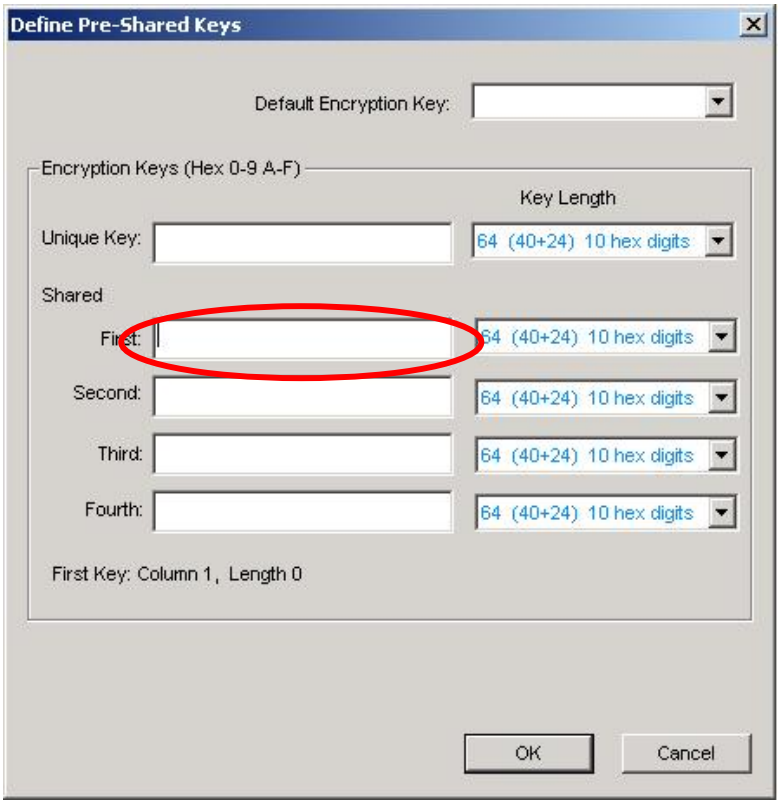


3. Choose the check box of **Enable Advanced Setting** to edit all settings.
4. If joining or creating an Ad-Hoc network, choose **Ad Hoc**.
5. Click **OK** (or **Apply** if using the other tabs) to save the settings.
   For details of each setting, refer to **Modifying a Wireless Network on page 20**.
6. Click the **Security** tab. If not using security, select **None**.



7. If security is used, select **Pre-Shared Key** and click on the **Configure** button.

8. Enter an encryption key in the **Shared: First** field.



9. Click **OK** (or **Apply** if using the other tabs) to save the settings. The new **Network Name** is listed in the **Profile List**.
   The driver does not allow channel selection in Ad-Hoc mode. Instead, the driver starts with an initial channel then checks channel status. If the channel is busy, the driver automatically uses a different channel.

For details of each setting, please see chapter 5.

5. Modifying a Wireless Network

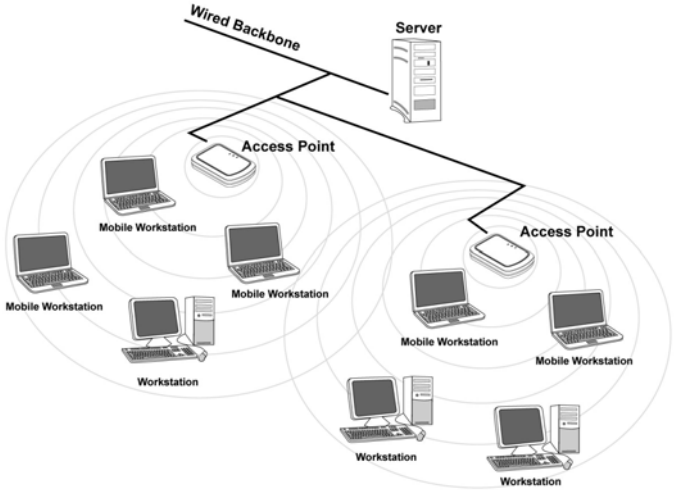
5.1 Infrastructure Mode and Ad Hoc Mode

You can set the Wireless Network Adapter to work in either **Infrastructure mode** or **Ad Hoc mode**.

NOTE! Ad-hoc mode is available only for 802.11b/g. It is not available for 802.11a. This is a client product and do not have radar detection function specified by FCC. The software will not let you to use ad-hoc under 802.11a.

Infrastructure Mode

In infrastructure mode, devices communicate with each other by first going through an Access Point (AP). Wireless devices can communicate with each other or can communicate with a wired network. When one AP is connected to wired network and a set of wireless stations, it is referred to as a BSS (Basic Service Set).



Ad Hoc Mode

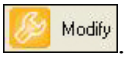
Ad-hoc mode is also called “peer-to-peer mode” or “Independent Basic Service Set (IBSS)”. In ad hoc mode, devices communicate directly with each other without using an Access Point (AP).

NOTE! Ad-hoc mode is available only for 802.11b/g. It is not available for 802.11a. This is a client product and do not have radar detection function specified by FCC. The software will not let you to use ad-hoc under 802.11a.

5.2 Modifying a Wireless Network

1. Open “WLAN a+b+g mini-PCI Module Configuration” by double clicking the shortcut icon on the desktop.

   Note! If there’s no network name listed in the “Profile List”, click **Refresh** button and double click a Network Name from **Available Networks**. The chosen Network Name is listed in the Profile List.

2. From the Profile List, select one Profile and click **Modify** button 

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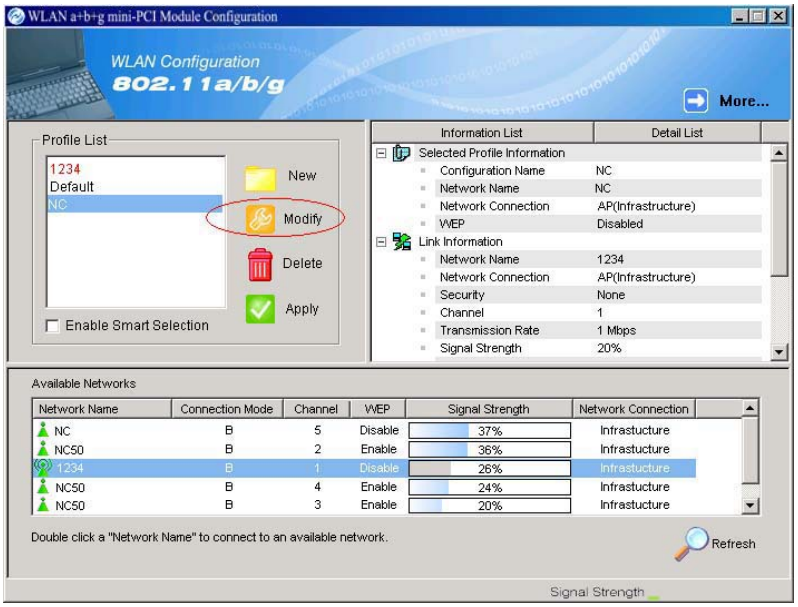
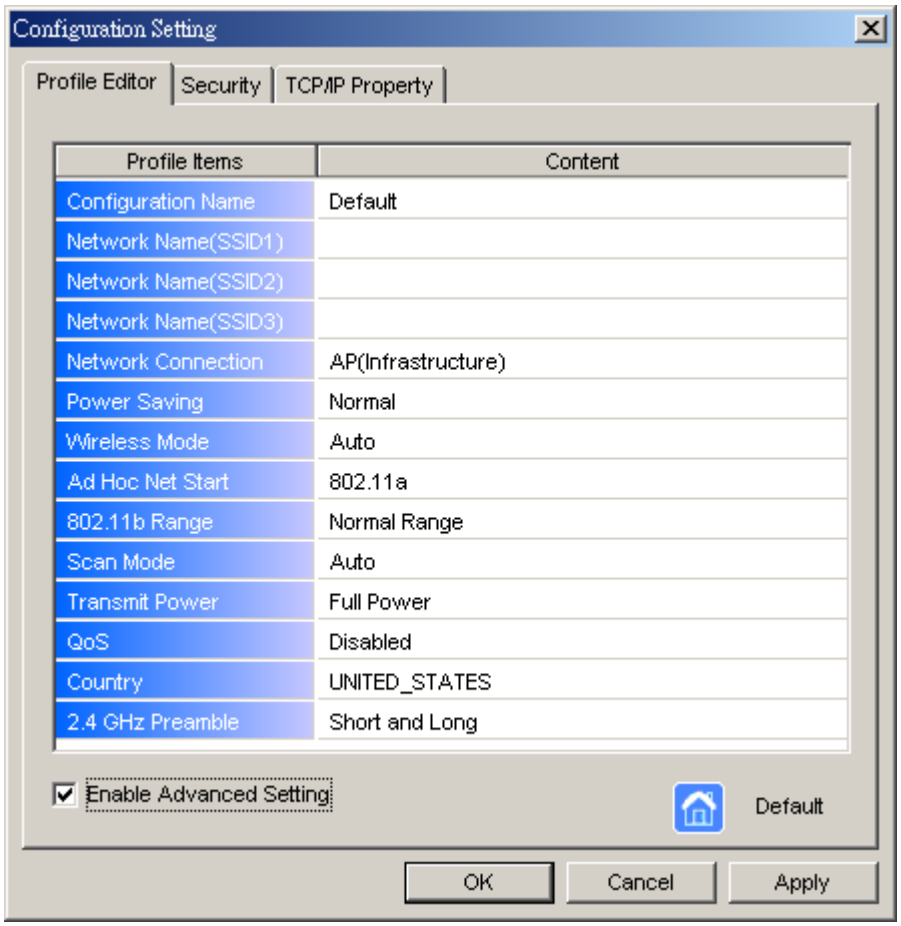


3. Select **Profile Editor** tab and edit the settings. Click **OK** to save the modifications.



- **Configuration Name:** This name identifies the configuration. This name should be unique.
- **Network Name (SSID1) (SSID2) (SSID3):** The name of the wireless network. This name cannot be longer than 32 characters. If the field is set to be "ANY" or is left blank, your computer will connect to an AP with the best signal strength.
- **Network Connection:** Specifies the mode of the network. Two options are "Infrastructure" and "Ad Hoc".
- **Power Saving:** Minimizes power consumption while maintaining network connectivity and high data transfer performance. In **Ad Hoc** mode, **Power Savings** function cannot be enabled. The power management options are:
  • **Off**: PC Card is powered up at all times.
  • **Normal**: PC Card sleeps less often and stays asleep for a shorter period.
  • **Maximum**: PC Card sleeps more frequently and stays asleep as much as possible.
- **Wireless Mode:** Three options are "802.11b", "802.11a", "802.11g",

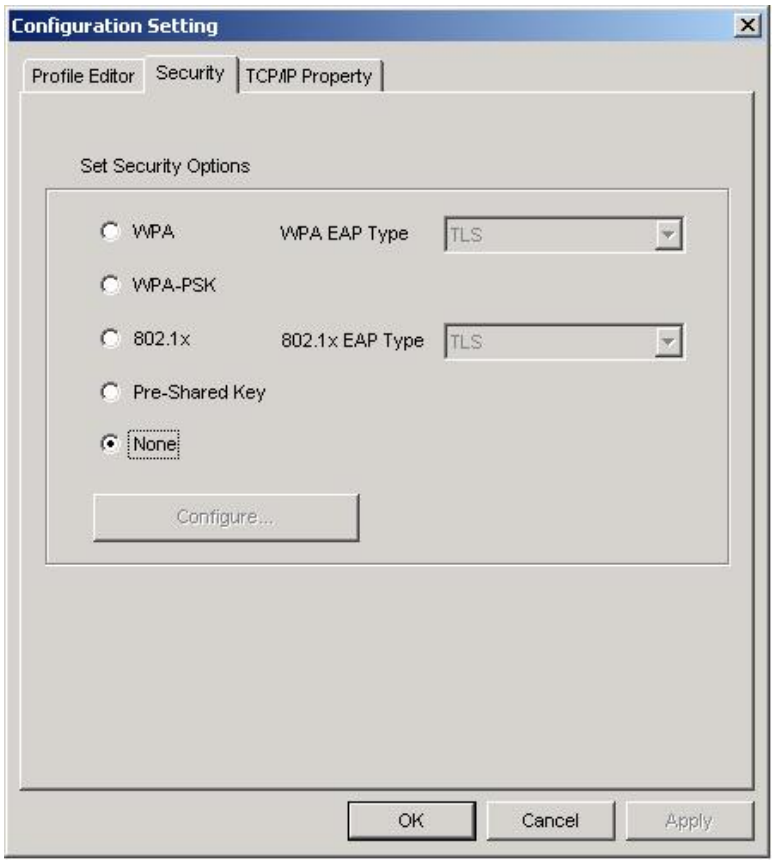
"Super A", "Super G" or "Auto". "Auto" allows the use of either 802.11a, 802.11g or 802.11b mode.

NOTE! Ad-hoc mode is available only for 802.11b/g. It is not available for 802.11a. This is a client product and do not have rador detection function specified by FCC. The software will not let you to use ad-hoc under 802.11a.

- **Ad Hoc Net Start:** Specifies a band to establish an Ad Hoc network if no matching SSID is found. Options available are the following: 802.11b and 802.11g.

  NOTE! Ad-hoc mode is available only for 802.11b/g. It is not available for 802.11a. This is a client product and do not have radar detection function specified by FCC. The software will not let you to use ad-hoc under 802.11a.
- **802.11b Range:** Options are **Normal Range** and **Extended Range**. This function can let user to determine the transfer range in 802.11b mode. Extended Range can prolong the transfer range with a lower data transmitting rate.
- **Scan Mode:** Options are **Active Scan**, **Passive Scan** and **Auto**. In Active Scan, the driver sends out the probe request frames from each channel and collects the response frames from the responding. In Passive Scan, the driver scan each requested channel, listening the beacons on each channel.
- **Transmit Power:** This setting allows you to change the output power of the PC Card to increase or decrease the coverage area.
- **QoS:** Disables or enables the PC Card to cooperate in a network using QoS (Quality of Service).
- **2.4 GHz Preamble:** Allows Ad-Hoc compatibility with other 2.4 GHz devices. Two options are **Short and Long** and **Long only**. Use **Long Only** when configuring the client for an 802.11b RoamAbout AP wireless network.

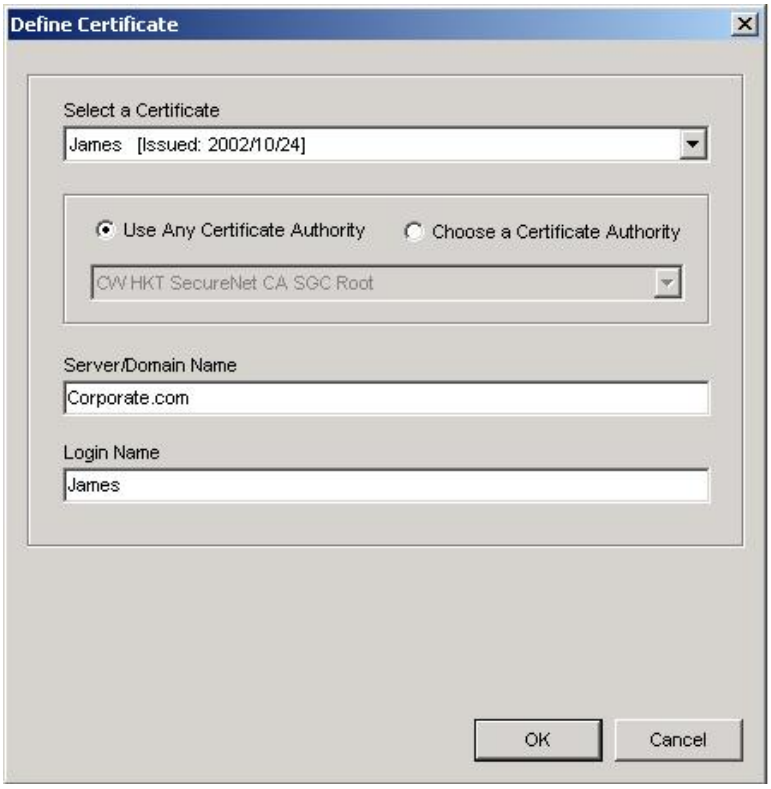
4. Select **Security** tab and choose the security mode.
   Note! *Check with your Network Administrator for the security features supported by your AP.*



- **WPA:** Enables the use of WiFi protected Access (WPA). This option requires IT administration.
  a) Select **WPA** to open the WPA EAP drop-down menu. The options includes TLS and PEAP.
  b) Click on the **Configure** button and complete the configuration information in the Define Certificate dialog.
- **WPA-PSK:** Enables the WPA-Pre Shared Key (PSK). Click on the **Configure** button and complete the configuration information in the WPA Passphrase dialog.
- **802.1x:** Enables 802.1x security. This option requires IT administration.
  a) Select **802.1x** to open the 802.1x EAP drop-down menu. The options include TLS and PEAP.
  b) Click on the **Configure** button and complete the configuration information in the Define Certificate dialog.

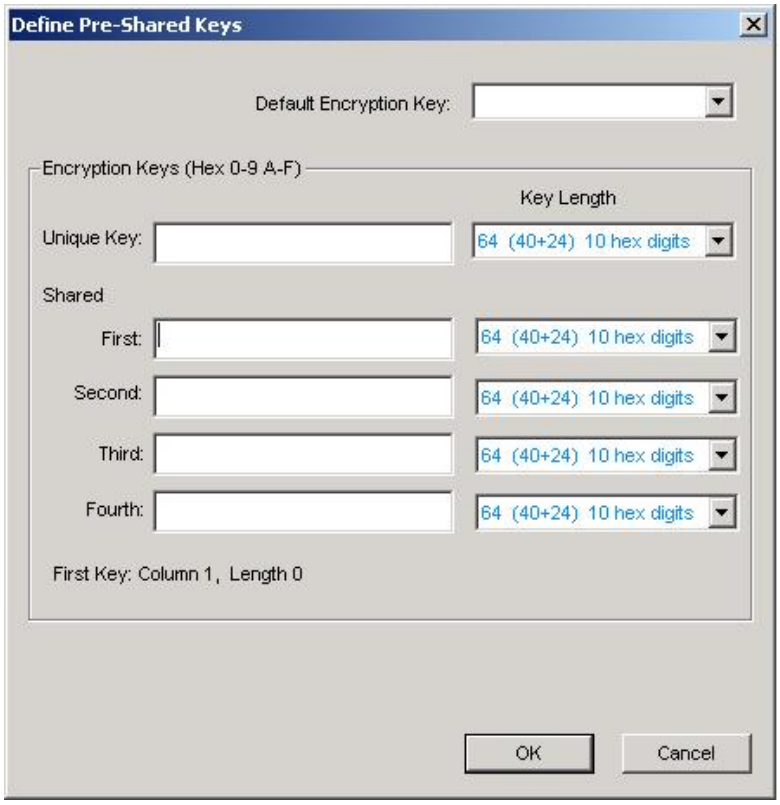
- **Pre-Shared Key:** Enables the use of pre-shared keys that are defined on the AP and the station.
  a) Select the **Pre-Shared Key** radio button.
  b) Click on the **Configure** button and complete the configuration information in the Define Certificate dialog.
- **None:** No security.

5. Define the Certificate.



- **Select a Certificate:** Select the Certificate to Authenticate to the RADIUS server from the drop-down menu.
- **Use any Certificate Authority:** The Default Setting. Select this radio button to use any Certificate Authority (CA) for authentication.
- **Choose a Certificate Authority:** Select this radio button to choose the desired Certificate Authority for authentication from the drop-down menu.
- **Server/Domain Name:** The the RADIUS server name or the domain name used for the network access.
- **Login Name:** The username used to log into the server or domain.
- **Define User Information (PEAP)**: Click on the **Define User Information** button and complete the configuration information in the Define User Information dialog.

6. If selecting **WPA-PSK**, click on the **Configure** button to enter the PassPhrase. The PassPhrase must be a minimum of 8 printable ASCII characters. The PassPhrase should be at least 20 characters to make it more difficult for an attacker to decipher the key.
7. If selecting **Pre-Shared Key**, click on the **Configure** button to enter the Encryption Keys.When finished, click **OK**. For WEP key, please contact with MIS administrator.

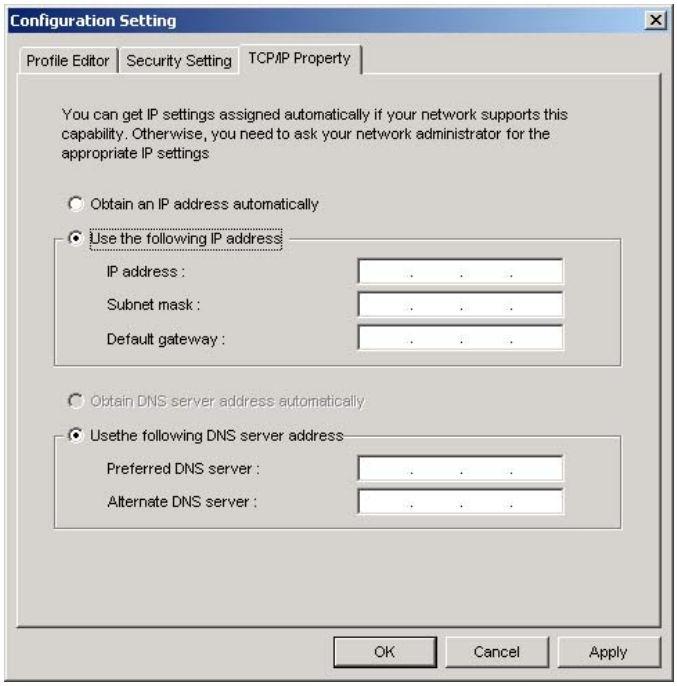


- **Key Entry Method:** Determines the entry method for the key. Hexadecimal (0-9, A-F) or ASCII text (all keyboard characters).
- **Default Encryption Key:** Allows you to choose one encryption key (First, Second, Third, or Fourth) as the transmit key, which encrypts transmissions from the PC Card.
- **Unique Key:** Defines the per-session encryption key for the current network configuration. Not used in Ad-Hoc mode.
- **Shared Keys:** Use these fields to enter the wireless network's encryption keys. The keys must be in the correct position (First, Second, Third, or Fourth).
- **Key Length:** Defines the length of each encryption key.
  - o For 40/64 bit (enter 10 digits for hexadecimal or 5 characters for ASCII)
  - o For 104/128 bit (Enter 26 digits for hexadecimal or 13 characters for ASCII)

When the length is changed, the number of available characters in the field automatically changes. If a previously entered key is too long, the key is automatically truncated to fit. If the key length is increased again, the key does not update to the previous value.

8. Click **OK** to save the settings.

9. Select “TCP/IP Property” tab. Enter the settings and click “OK” to save the settings.



- If the network uses DHCP server, choose **Obtain an IP address automatically**.
- If the network does not use DHCP server, choose **Use the following IP address** to set the relative settings. For the IP configuration information, please contact the network administrator.

5.3 Default Settings Windows XP Zero-Configuration

You may also choose the default parameters and directly proceed to Windows XP zero-configuration through the steps below:

1. Go to “Control Panel” and open “Network Connections”.
2. Right-click the Wireless Network Connection of “WLAN a+b+g mini-PCI Module”, and make sure this connection is **Enabled**.
3. Right-click the Wireless Network Connection of “WLAN a+b+g mini-PCI Module”, and then click “Properties”.
4. Select “Wireless Networks” tab and select “Use Windows to configure my wireless network settings” check box.

Note! Clear the check box of “Use Windows to configure my wireless network settings” will disable automatic wireless network configuration.

Appendix A: FAQ about WLAN

1. Can I run an application from a remote computer over the wireless network?

This will depend on whether or not the application is designed to be used over a network. Consult the application's user guide to determine whether it supports operation over a network.

2. Can I play computer games with other members of the wireless network?

Yes, as long as the game supports multiple players over a LAN (local area network). Refer to the game's user guide for more information.

3. What is Spread Spectrum?

Spread Spectrum technology is a wideband radio frequency technique developed by the military for use in reliable, secure, mission-critical communications systems. It is designed to trade off bandwidth efficiency for reliability, integrity, and security. In other words, more bandwidth is consumed than in the case of narrowband transmission, but the trade-off produces a signal that is, in effect, louder and thus easier to detect, provided that the receiver knows the parameters of the spread-spectrum signal being broadcast. If a receiver is not tuned to the right frequency, a spread-spectrum signal looks like background noise. There are two main alternatives, Direct Sequence Spread Spectrum (DSSS) and Frequency Hopping Spread Spectrum (FHSS).

4. What is DSSS? What is FHSS? And what are their differences?

Frequency-Hopping Spread-Spectrum (FHSS) uses a narrowband carrier that changes frequency in a pattern that is known to both transmitter and receiver. Properly synchronized, the net effect is to maintain a single logical channel. To an unintended receiver, FHSS appears to be short-duration impulse noise. Direct-Sequence Spread-Spectrum (DSSS) generates a redundant bit pattern for each bit to be transmitted. This bit pattern is called a chip (or chipping code). The longer the chip, the greater the probability that the original data can be recovered. Even if one or more bits in the chip are damaged during transmission, statistical techniques embedded in the radio can recover the original data without the need for retransmission. To an unintended receiver, DSSS appears as low power wideband noise and is rejected (ignored) by most narrowband receivers.

5. Would the information be intercepted while transmitting on air?

WLAN features two-fold protection in security. On the hardware side, as with Direct Sequence Spread Spectrum technology, it has the inherent security feature of scrambling. On the software side, WLAN offers the encryption function (WEP) to enhance security and access control.

6. What is WEP?

WEP is Wired Equivalent Privacy, a data privacy mechanism based on a 64-bit or 128-bit shared key algorithm, as described in the IEEE 802.11 standard.

7. What is infrastructure mode?

When a wireless network is set to infrastructure mode, the wireless network is configured to communicate with a wired network through a wireless access point.

8. What is roaming?

Roaming is the ability of a portable computer user to communicate continuously while moving freely throughout an area greater than that covered by a single access point. Before using the roaming function, the workstation must make sure that it is the same channel number with the access point of dedicated coverage area.

To achieve true seamless connectivity, the wireless LAN must incorporate a number of different functions. Each node and access point, for example, must always acknowledge receipt of each message. Each node must maintain contact with the wireless network even when not actually transmitting data. Achieving these functions simultaneously requires a dynamic RF networking technology that links access points and nodes. In such a system, the user's end node undertakes a search for the best possible access to the system. First, it evaluates such factors as signal strength and quality, as well as the message load currently being carried by each access point and the distance of each access point to the wired backbone. Based on that information, the node next selects the right access point and registers its address. Communications between end node and host computer can then be transmitted up and down the backbone. As the user moves on, the end node's RF transmitter regularly checks the system to determine whether it is in touch with the original access point or whether it should seek a new one. When a node no longer receives acknowledgment from its original access point, it undertakes a new search. Upon finding a new access point, it then re-registers, and the communication process continues.

Appendix B: Specification

Electric Characteristics:

Category	▪ Key Specifications
Main Chipset	▪ Atheros® Communication AR9220 dual band configurable radio
Frequency Range	▪ USA: 2.400 ~ 2.483 GHz, 5.15 ~ 5.35 GHz, 5.5 ~ 5.7 GHz, 5.725 ~ 5.825 GHz ▪ Europe: 2.400 ~ 2.483 GHz, 5.15 ~ 5.35 GHz, 5.47 ~ 5.725 GHz ▪ Japan: 2.400 ~ 2.497 GHz, 5.15 ~ 5.35 GHz, 5.47 ~ 5.725 GHz ▪ China: 2.400 ~ 2.483 GHz, 5.725 ~5.85 GHz *(Note: A DNMA-92 radio is capable to be operated within FCC DFS2 band or ETSI/EC DFS band, or other countries which is regulating or is planning to regulate mid-5 GHz band. The usage of mid-5 GHz band is subject to the regulatory approval alone with the resided devices like Access Point or Router.)*
Host Interface	▪ Mini-PCI form factor; Mini-PCI Version 1.0 type 3A
Channels support	▪ 802.11 b/g/n o US/Canada: 11 (1 ~ 11) o Major European country: 13 (1 ~ 13) o France: 4 (10 ~ 13) o Japan: 11b: 14 (1~13 or 14th), 11g/n: 13 (1 ~ 13) o China: 13 (1 ~ 13) ▪ 802.11 a/n o US/Canada: 23 non-overlapping channels; 36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 149, 153, 157, 161 o Europe: 19 non-overlapping channel; 36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140 o Japan: 19 non-overlapping channels; 36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140 o China: 5 non-overlapping channels; 149, 153, 157, 161, 165
Operation Voltage	▪ 3.3V +/-5%

Typical Current Consumption		802.11a	802.11b	802.11g	802.11n(2.4GHz)	802
		Avg/Max (mA)	Avg/Max (mA)	Avg/Max (mA)	Avg/Max (mA)	Av
	Continue Tx	617/744	566/691	706/859	579/712	591
	FTP Tx	356/667	363/700	271/743	358/741	379
	FTP Rx	224/590	156/685	165/721	184/726	287
	Standby mode	180/312	142/254	143/259	142/256	205
	The maximum current consumption would be impacted by radiation environment an					
	Condition: 2T2R @25 ° C (with +15 /-15% tolerance)					

RF Output Power (dB)

(Typical composite power)

Tolerance: +2/-2 dB @ 25 °C

+3/-3 dB @ 0 & 60 °C

802.11a

Frequency	6-24_Target	36_Target	48_Target	54_Target
5180	21	20	19	17
5320	21	20	19	17
5700	21	20	19	16
5825	21	20	19	16

802.11b

Frequency	1_Target	2_Target	5.5_Target	11_Target
2412	20	21	21	21
2484	19	20	21	21

802.11g

Frequency	6-24_Target	36_Target	48_Target	54_Target
2412	23	22	21	19
2442	23	22	21	19
2472	23	22	21	19

802.11a/n

Freq. Range: 5GHz/HT20:

Frequency	MCS 0/8	MCS 1/9	MCS 2/10	MCS 3/11	MCS 4/12	MCS 5/13	MCS 6
5180	21	21	21	20	20	20	19
5240	21	21	21	20	20	20	19
5320	21	21	21	20	20	20	19
5500	20	20	20	20	20	20	19
5700	19	19	19	19	19	19	18
5745	19	19	19	19	19	19	18
5825	19	19	19	19	19	19	18

Freq. Range: 5GHz/HT40:

Frequency	MCS 0/8	MCS 1/9	MCS 2/10	MCS 3/11	MCS 4/12	MCS 5/13	MCS 6
5190	19	19	19	19	19	19	18
5230	19	19	19	19	19	19	18
5270	19	19	19	19	19	19	18
5510	18	18	18	18	18	18	18
5670	18	18	18	18	18	18	17
5755	18	18	18	18	18	18	17
5795	18	18	18	18	18	18	17

802.11gn

Freq. Range: 2GHz/HT20:

Frequency	MCS 0/8	MCS 1/9	MCS 2/10	MCS 3/11	MCS 4/12	MCS 5/13	MCS 6
2412	21	21	21	21	21	21	19
2442	21	21	21	21	21	21	19
2472	21	21	21	21	21	21	19

Freq. Range: 2GHz/HT40:

Frequency	MCS 0/8	MCS 1/9	MCS 2/10	MCS 3/11	MCS 4/12	MCS 5/13	MCS 6
2422	21	21	21	21	20	20	18
2442	20	20	20	20	20	20	18
2462	20	20	20	20	19	19	18

EVM

802.11a

Data Rate	Relative constellation error (dB) IEEE Spec (1Tx)	Relative constellation Typical/Maximum
6M	-5	-25/-16
9M	-8	-25/-16
12M	-10	-25/-16
18M	-13	-26/-16
24M	-16	-24/-19
36M	-19	-27/-22
48M	-22	-28/-23
54M	-25	-28/-25

802.11b

Data Rate	Relative constellation error (dB) IEEE Spec (1Tx)	Relative constellation Typical/Maximum
1M	-10	-18/-15
5.5M	-10	-18/-15
11M	-10	-18/-15

802.11g

Data Rate	Relative constellation error (dB) IEEE Spec (1Tx)	Relative constellation Typical/Maximum
6M	-5	-24/-16
9M	-8	-25/-16
12M	-10	-25/-16
18M	-13	-26/-16
24M	-16	-23/-19
36M	-19	-29/-22
48M	-22	-31/-23
54M	-25	-31/-25

802.11ng

Data Rate	Relative constellation error (dB) IEEE Spec (1Tx)	Relative constellation Typical/Maximum
HT20		
MCS0	-5	-30/-16
MCS1	-10	-30/-16
MCS2	-13	-30/-16
MCS3	-16	-30/-19
MCS4	-19	-30/-22
MCS5	-22	-31/-23
MCS6	-25	-31/-25
MCS7	-28	-31/-27
MCS8	-5	-30/-16
MCS9	-10	-30/-16
MCS10	-13	-30/-16
MCS11	-16	-30/-19
MCS12	-19	-30/-22
MCS13	-22	-30/-23
MCS14	-25	-30/-25
MCS15	-28	-30/-27
HT40		
MCS0	-5	-30/-16
MCS1	-10	-30/-16
MCS2	-13	-30/-16
MCS3	-16	-30/-19
MCS4	-19	-30/-22
MCS5	-22	-30/-23
MCS6	-25	-30/-25
MCS7	-28	-30/-27
MCS8	-5	-30/-16
MCS9	-10	-30/-16
MCS10	-13	-30/-16
MCS11	-16	-30/-19
MCS12	-19	-30/-22
MCS13	-22	-30/-23
MCS14	-25	-30/-25
MCS15	-28	-30/-27

802.11na

Data Rate	Relative constellation error (dB)	Relative constellation

Sensitivity

802.11a

Data Rate	IEEE Spec (1 Rx dBm)	Typical/Maximum (
6M	-82	-95/-91
9M	-81	-95/-91
12M	-79	-94/-90
18M	-77	-92/-88
24M	-74	-88/-84
36M	-70	-85/-81
48M	-66	-81/-77
54M	-65	-79/-75

802.11b

Data Rate	IEEE Spec (1 Rx dBm)	Typical/Maximum (
1M	-82	-95/-91
5.5M	-80	-95/-91
11M	-76	-91/-87

802.11g

Data Rate	IEEE Spec (1 Rx dBm)	Typical/Maximum (
6M	-82	-95/-91
9M	-81	-95/-91
12M	-79	-94/-90
18M	-77	-93/-89
24M	-74	-90/-86
36M	-70	-86/-82
48M	-66	-82/-78
54M	-65	-80/-76

802.11ng

Data Rate	IEEE Spec (1 Rx dBm)	Typical/Maximum (
HT20		
MCS0	-82	-95/-91
MCS1	-79	-94/-90
MCS2	-77	-92/-88
MCS3	-74	-88/-84
MCS4	-70	-85/-81
MCS5	-66	-80/-76
MCS6	-65	-79/-75
MCS7	-64	-77/-73
HT40		
MCS0	-79	-90/-86
MCS1	-76	-90/-86
MCS2	-74	-89/-85
MCS3	-71	-85/-81
MCS4	-67	-82/-78
MCS5	-63	-78/-74
MCS6	-62	-77/-73
MCS7	-61	-74/-71

	802.11na **Data Rate** — **IEEE Spec (1 Rx dBm)** — **Typical/Maximum(2** **HT20** **MCS0** -82 -95/-91 **MCS1** -79 -93/-89 **MCS2** -77 -90/-86 **MCS3** -74 -87/-83 **MCS4** -70 -84/-80 **MCS5** -66 -80/-76 **MCS6** -65 -79/-75 **MCS7** -64 -77/-73 **HT40** **MCS0** -79 -91/-87 **MCS1** -76 -90/-86 **MCS2** -74 -87/-83 **MCS3** -71 -84/-80 **MCS4** -67 -82/-78 **MCS5** -63 -78/-74 **MCS6** -62 -76/-72 **MCS7** -61 -74/-70
Operation Distance	▪ 802.11a o Outdoor: 50 m @54Mbps, 300 m @6Mbps o Indoor: 30 m @54Mbps, 100 m @6Mbps ▪ 802.11b o Outdoor: 150 m @11Mbps, 300 m @1Mbps o Indoor: 30 m @11Mbps, 100 m @1Mbps ▪ 802.11g o Outdoor: 50 m @54Mbps, 300 m @6Mbps o Indoor: 30 m @54Mbps, 100 m @6Mbps ▪ 802.11n o Outdoor: 250 m @6.5Mbps (MCS0: 1 Nss/20MHz BW) o 30m @130Mbps (MCS15: 2 Nss/20MHz BW) o 30m @300Mbps (MCS15: 2 Nss/40MHz BW) o Indoor: 100 m @6.5Mbps (MCS0: 1 Nss/20MHz BW) o 20m @130Mbps (MCS15: 2 Nss/20MHz BW) o 20m @300Mbps (MCS15: 2 Nss/40MHz BW) *(Notes :Estimated range are based on 2dB dipole antenna. The real operational distance is depending on (Access Point) system efficiency and antenna performance.)*

PCB Dimension	▪ 50.8mm (L/H) x 59.6mm (W) x 1.0mm (T)
Data Rate	▪ 802.11b: 1, 2, 5.5, 11Mbps ▪ 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps ▪ 802.11n: @800GI(400GI) o 20MHz BW ▪ 1 Nss: 65(72.2)Mbps maximal ▪ 2 Nss: 130(144.4)Mbps maximal o 40MHz BW ▪ 1 Nss: 135(150)Mbps maximal ▪ 2 Nss: 270(300)Mbps maximal
Operation Temperature	▪ 0^{o} ~ 60^{o} C
Storage Temperature	▪ -20^{o} ~ 80^{o} C
Wi-Fi® Alliance®	▪ WECA Compliant
Radio & EMC Certificate	▪ US: 47 CFR 15, FCC Part 15 401~ Part 15. 407 (5150 ~ 5350 MHz & 5725~5825 MHz), Part 15.247 (5725~5850 MHz); FCC Part 15.247 (2400~2483.5 MHz), 47CFR 15, FCC-Class B, FCC Part 15.107 & Part 15.109; ▪ Limited Module Level Approval, ▪ Industry Canada: IC RSS210, RSS139-1, ICES-003; Limited Module Level Approval ▪ ETSI, EN301893, EN60950 (Europe); EN 301.893, EN 300.328, & EN 301489-1/17 EN 55022 & EN 55024;
Antenna connector	▪ 2 x SMT ultra-miniature coaxial connectors (Hirose® U.FL connector)