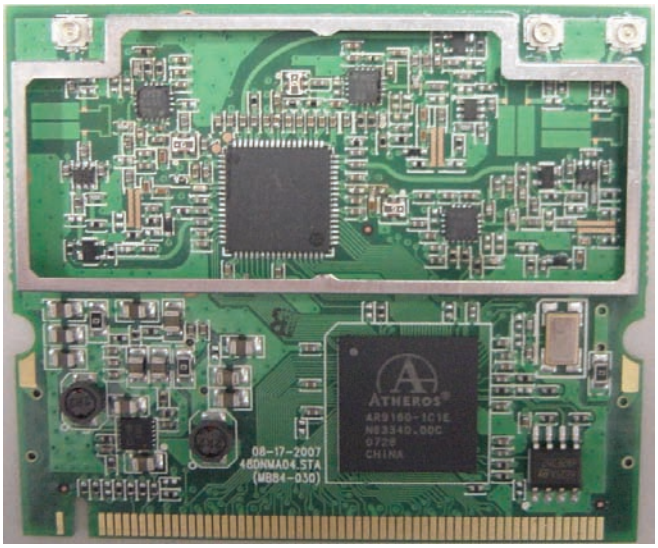
WLAN b/g/n mini-PCI Module



DNMA-84 User Manual

Version: 1.0

May 2008

Copyright Statement

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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: To assure continued compliance, (example - use only shielded interface cables when connecting to computer or peripheral devices) 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.

Country Code Statement

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

IMPORTANT NOTE:

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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-DNMA84 ". 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.

IMPORTANT NOTE:

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

"This device has been designed to operate with the antennas listed below, and having a maximum gain of 1.82 dB. Antennas not included in this list or having a gain greater than 1.82 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms."

"Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device."

The information is as follows:

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.

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1. Introduction

Thank you for purchasing the WLAN 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

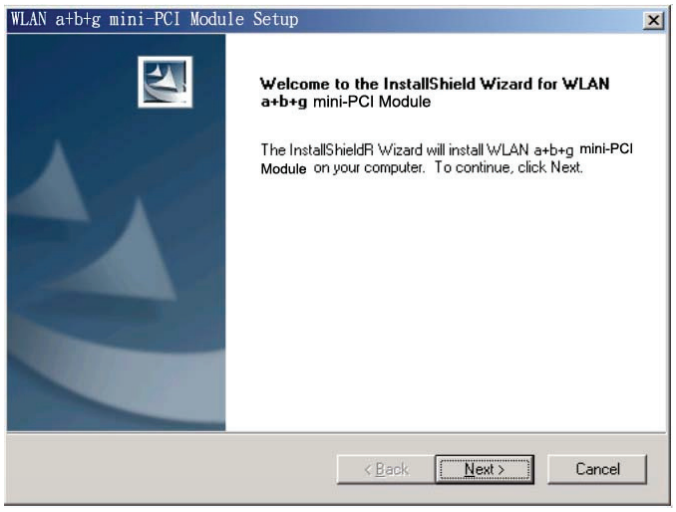
2.1 Installation

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.

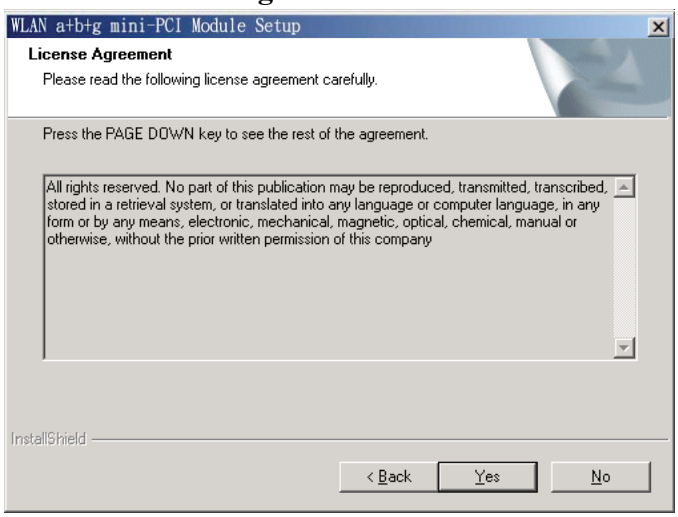
Follow the steps below to complete the driver/utility installation:

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

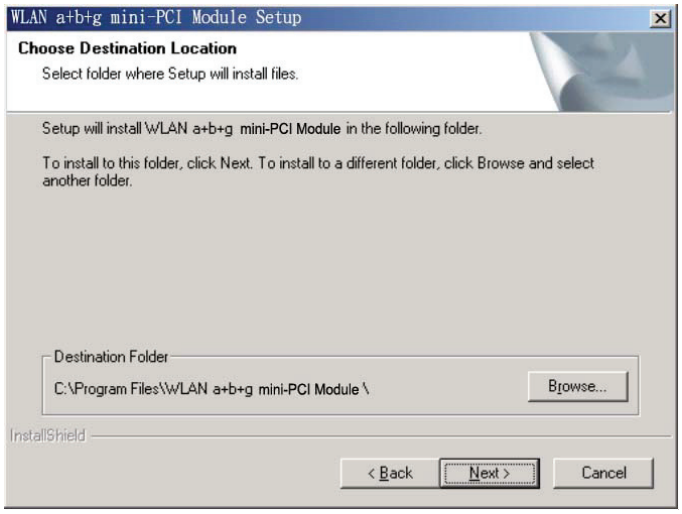
2. Click **“Next”**.



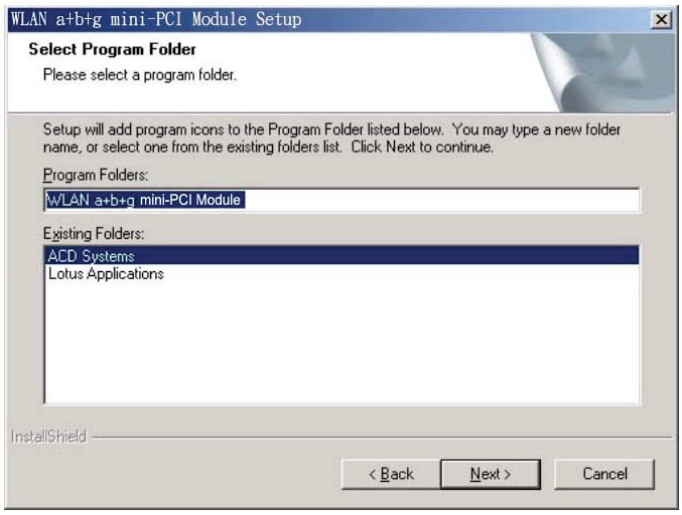
3. Read the **License Agreement** and click **“Yes”**.



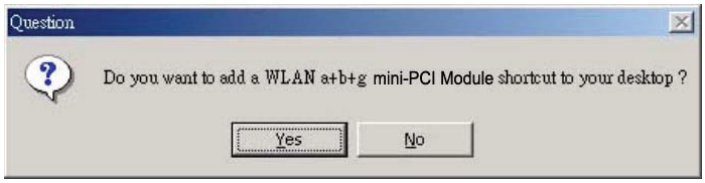
4. Click **"Next"** to continue or click **"Browse"** to choose a destination folder.



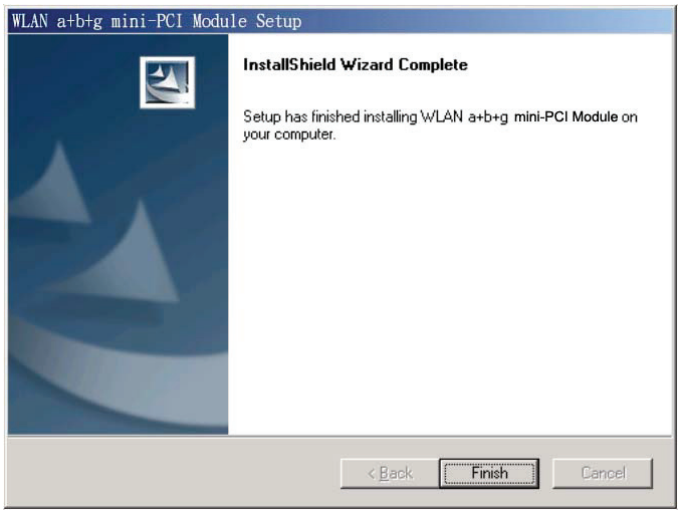
5. Click **"Next"**.



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.

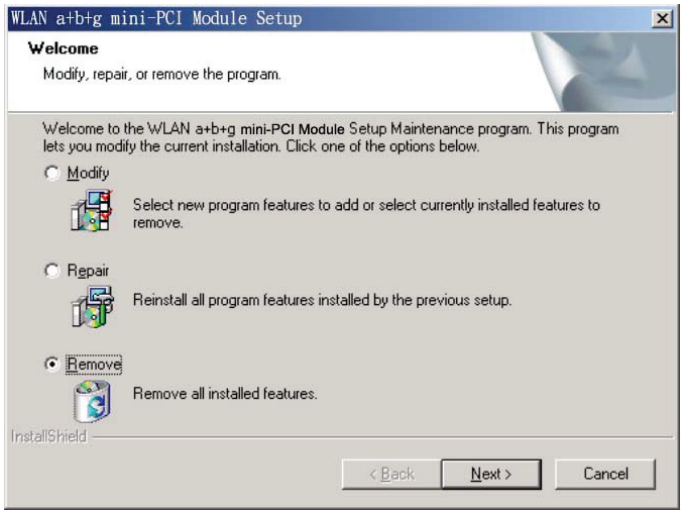
3. **Windows 2000/XP:** Select "Install the software automatically" when the window with this option appears, and then click "Next" to continue installation.

2.3 Uninstallation

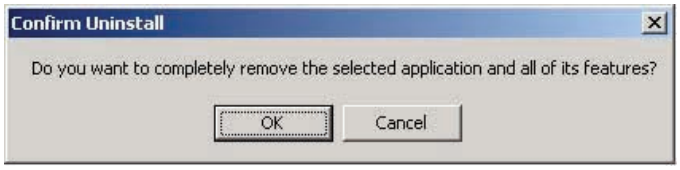
Note! Before uninstallation, please close all running programs.

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

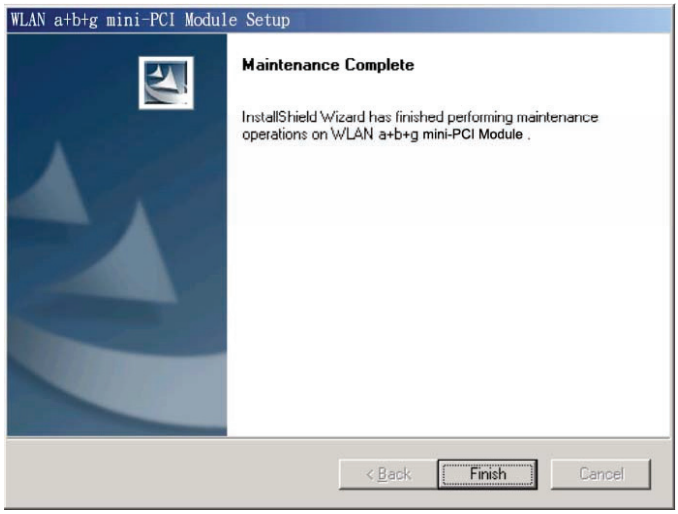
2. Choose **"Remove"**. Click **"Next"**.



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

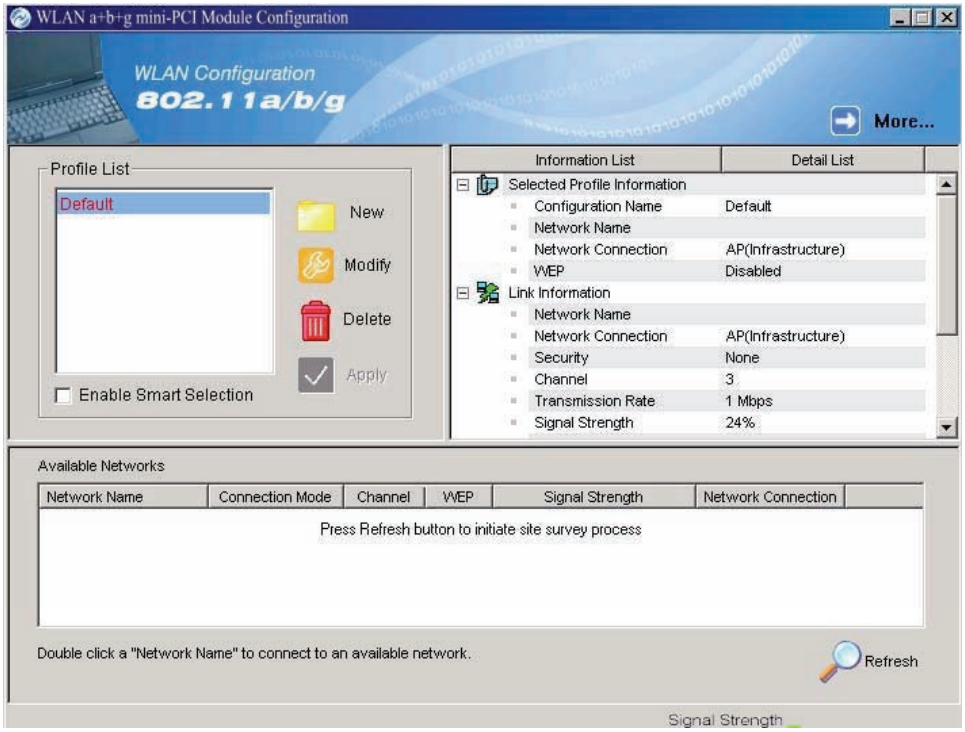


4. Click **"Finish"**. **Uninstall** is now completed.

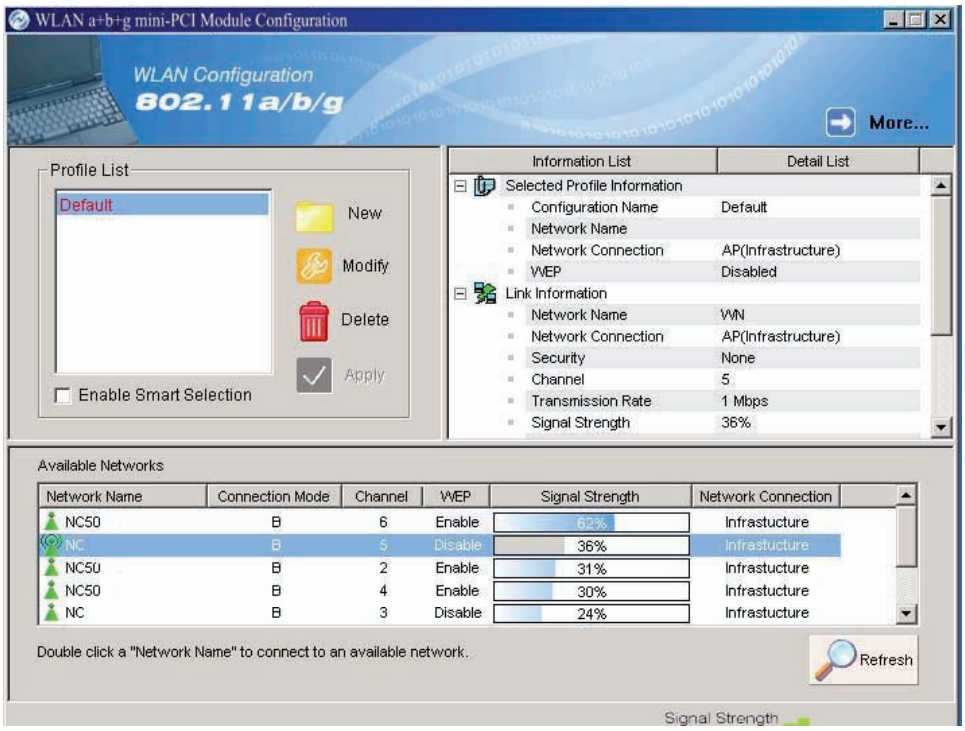


3. Connecting to an Existing Network

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



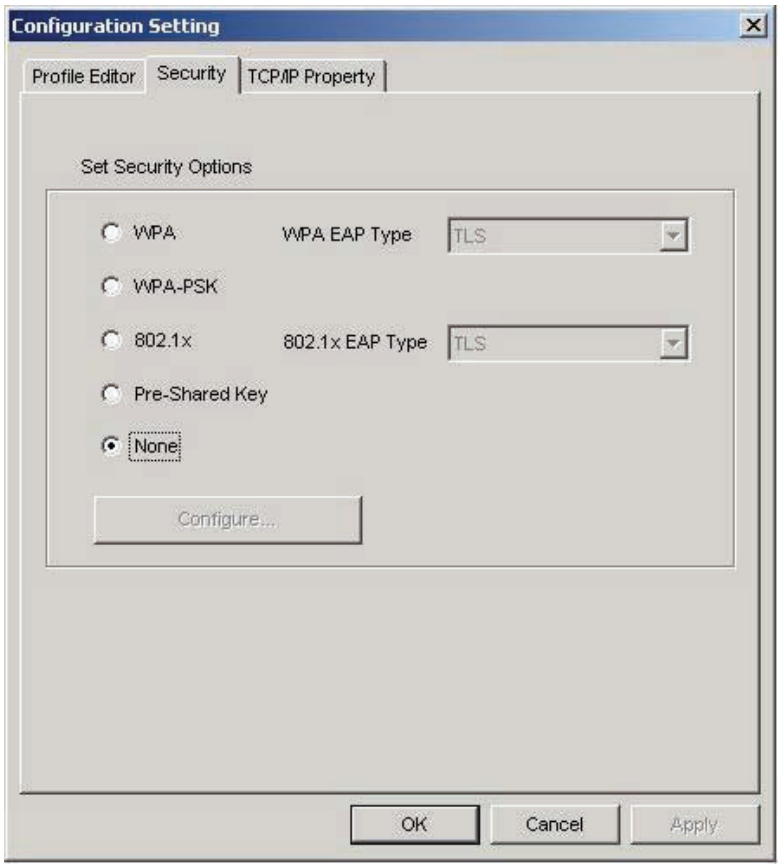
2. Click on the **Refresh** button to list all available networks.



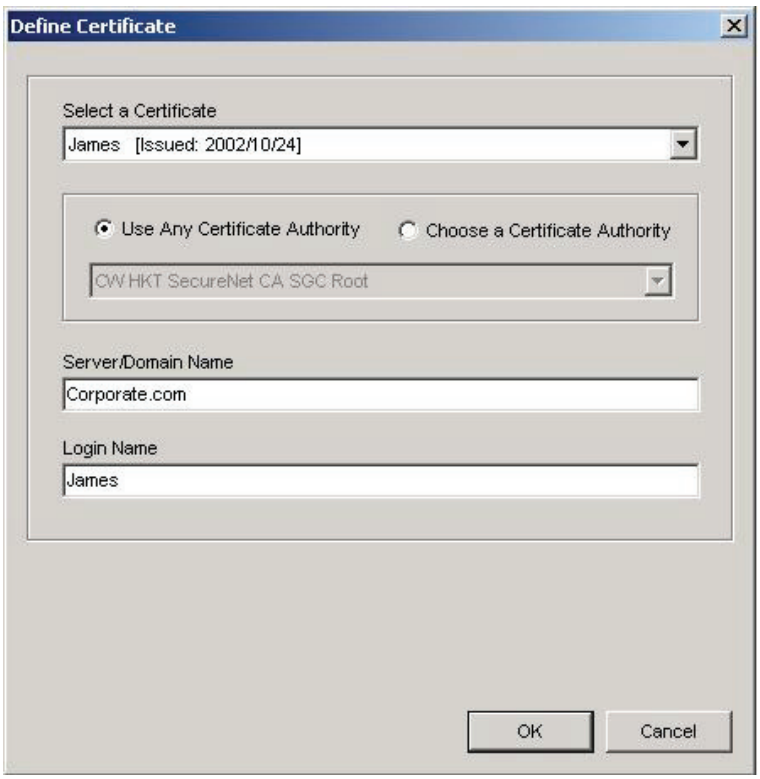
Note! To automatically connect to the network with the strongest signal, select **Enable Smart Selection**. **Any** displays in Profile List.

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.

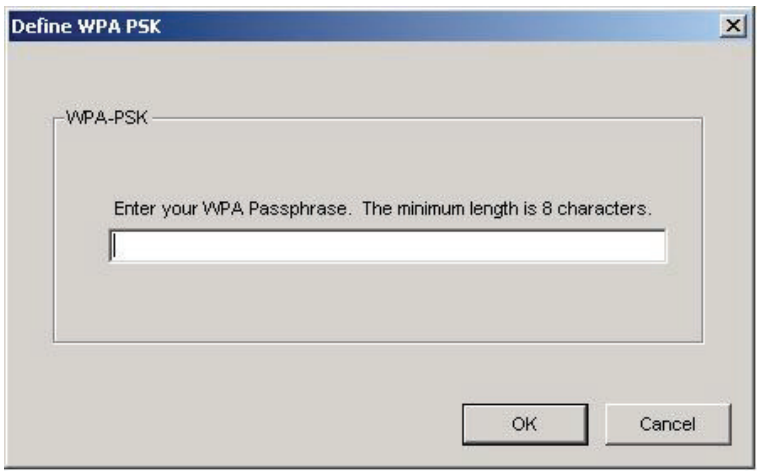
4. If the chosen network has security enabled, the **Security** tab displays. Select the security option used by the network. Contact the network administrator for the correct settings.



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#@

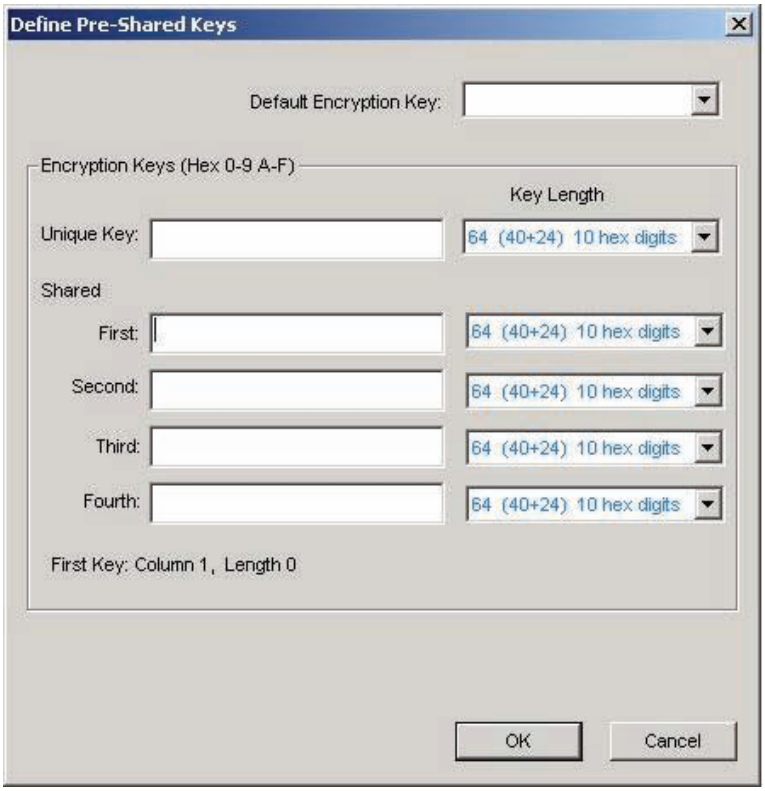
   c.13 chars: User must enter 13 characters.

   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.

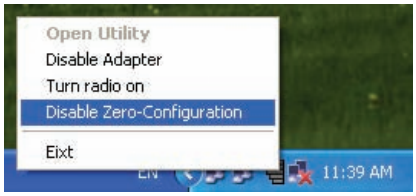
9. Once connected (the icon or in front of the name of the Connected Network), you can check the signal strength from the icon in the Windows System Tray.

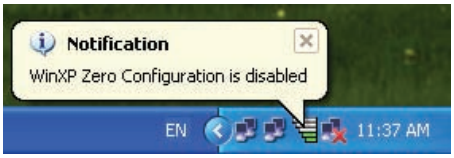
Additional Note for Windows XP

In Windows XP, it is recommended that you use the WLAN 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”.

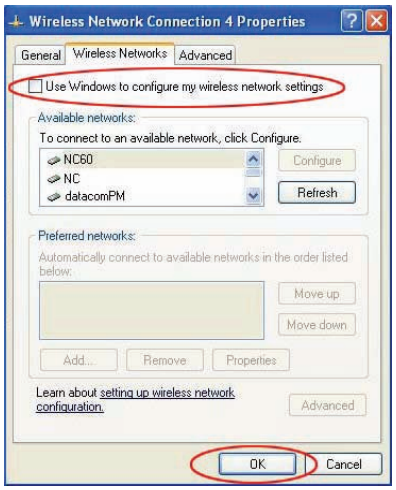




Option 2:

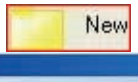
1. Go to “Control Panel” and double click “Network Connections”.
2. Right-click “Wireless Network Connection” of “WLAN b+g mini-PCI Module”, and select “Properties”.

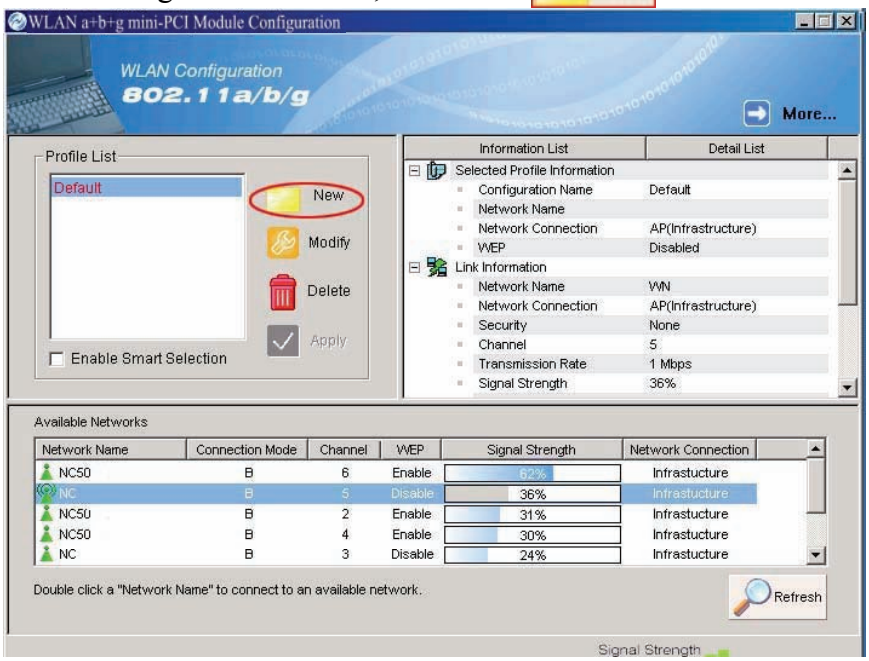
3. Select “Wireless Networks” tab, and uncheck the check box of “Use Windows to configure my wireless network settings”, and then click “OK”.



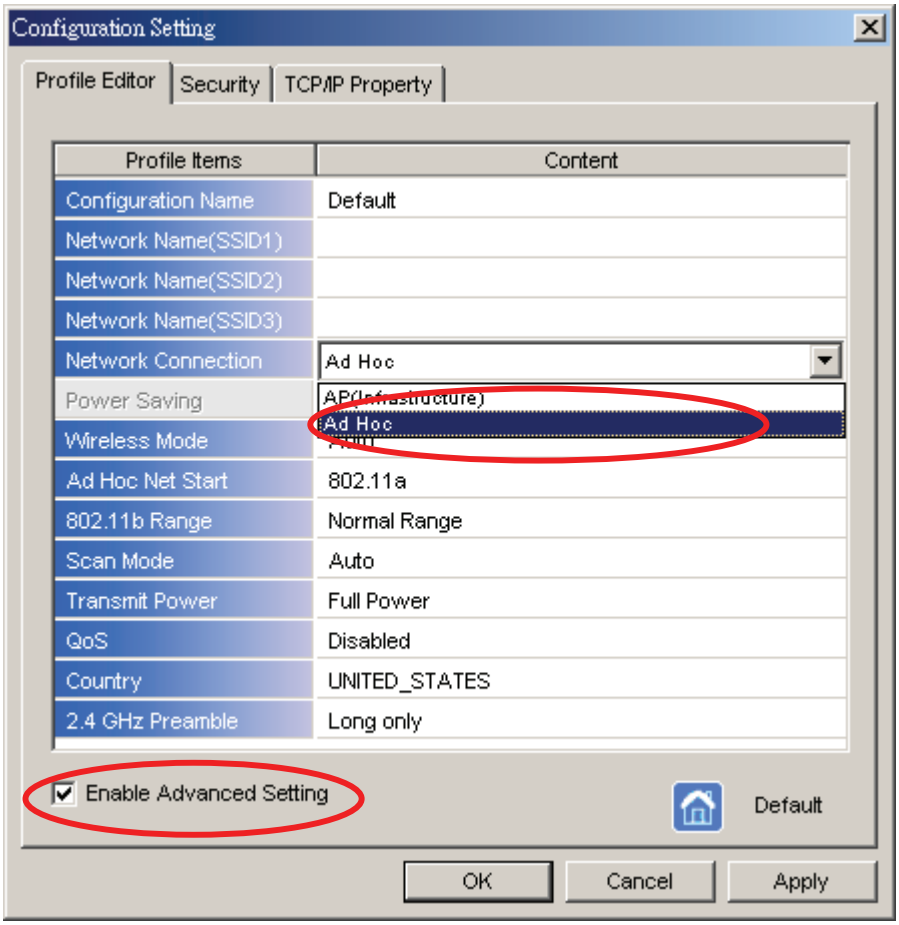
4. Creating an Ad Hoc New Network

NOTE! Ad-hoc mode is available only for 802.11b/g. This is a client product and do not have radar detection function specified by FCC.

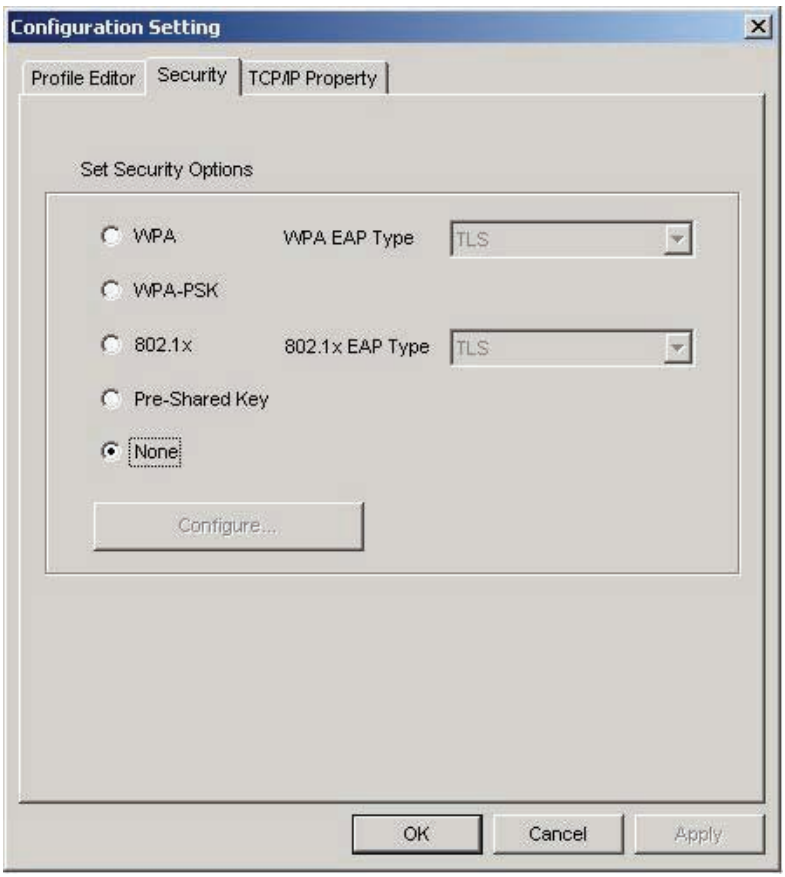
1. In the Configuration window, click **New** 



2. Select the “Profile Editor” tab.

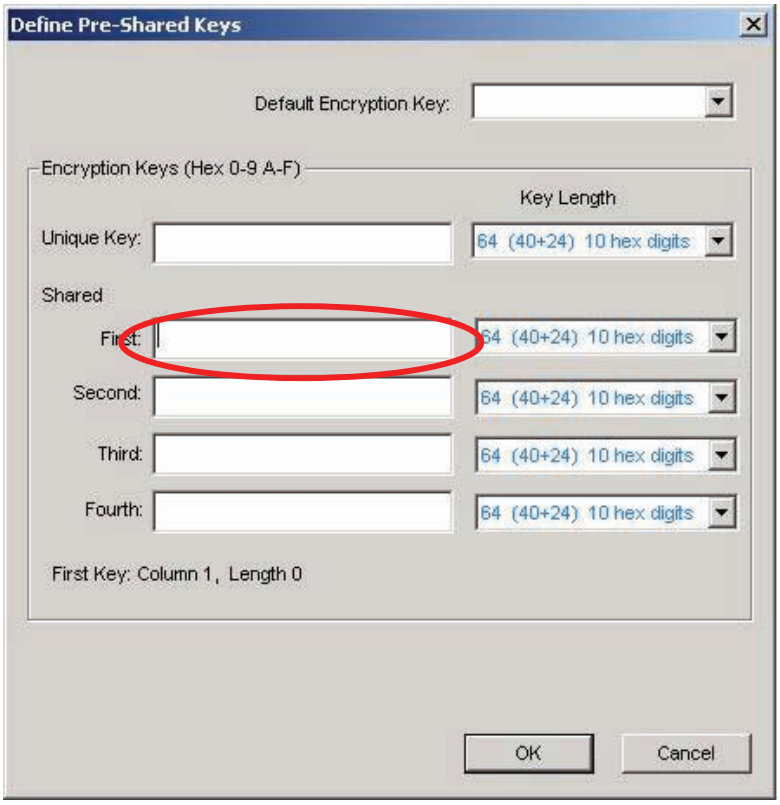


3. Choose the check box of **Enable Advanced Setting** to edit all settings.
4. If joining or creating an Ad-Hoc network, choose **Ad Hoc**.
5. Click **OK** (or **Apply** if using the other tabs) to save the settings.
   For details of each setting, refer to **Modifying a Wireless Network on page 20**.
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.

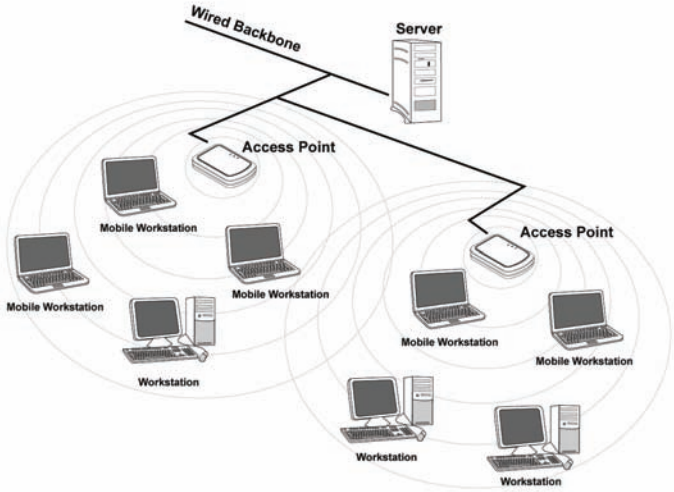
5. Modifying a Wireless Network

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**.

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).

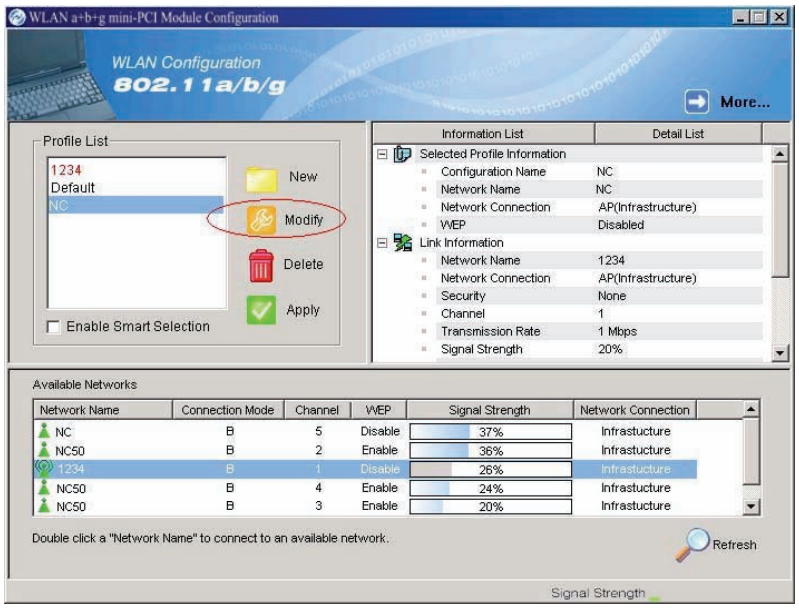
5.2 Modifying a Wireless Network

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

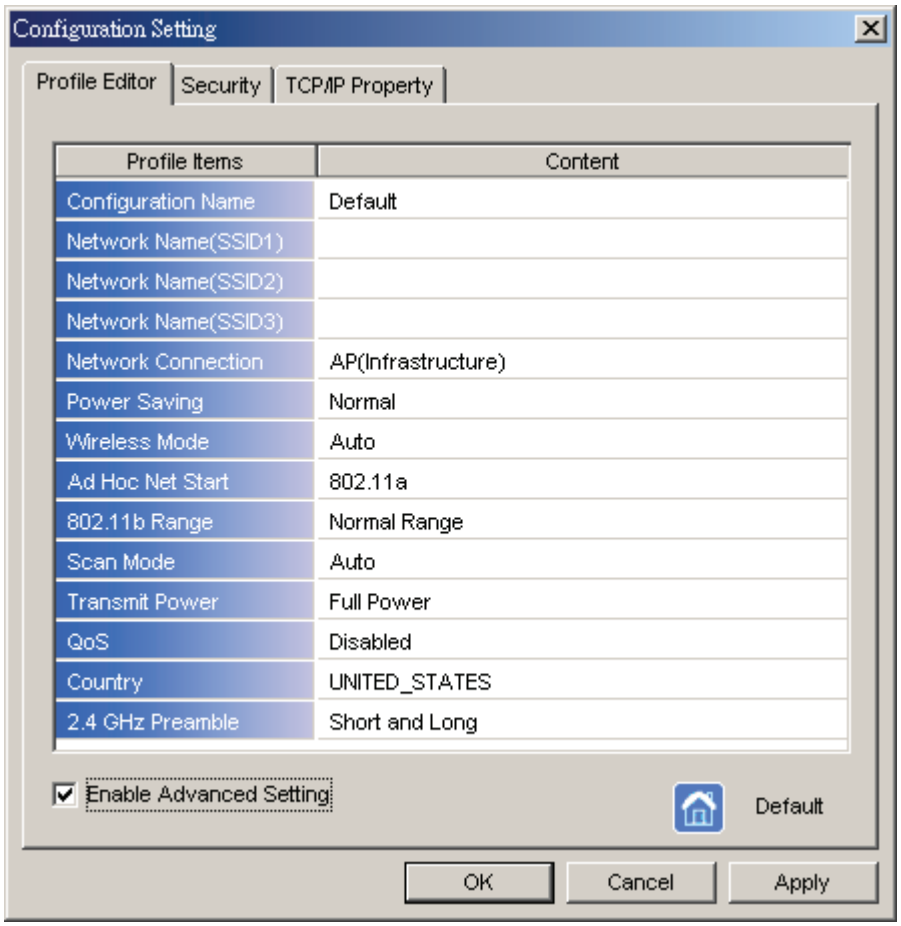
   Note! If there’s no network name listed in the “Profile List”, click **Refresh** button and double click a Network Name from **Available Networks**. The chosen Network Name is listed in the Profile List.

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

.



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

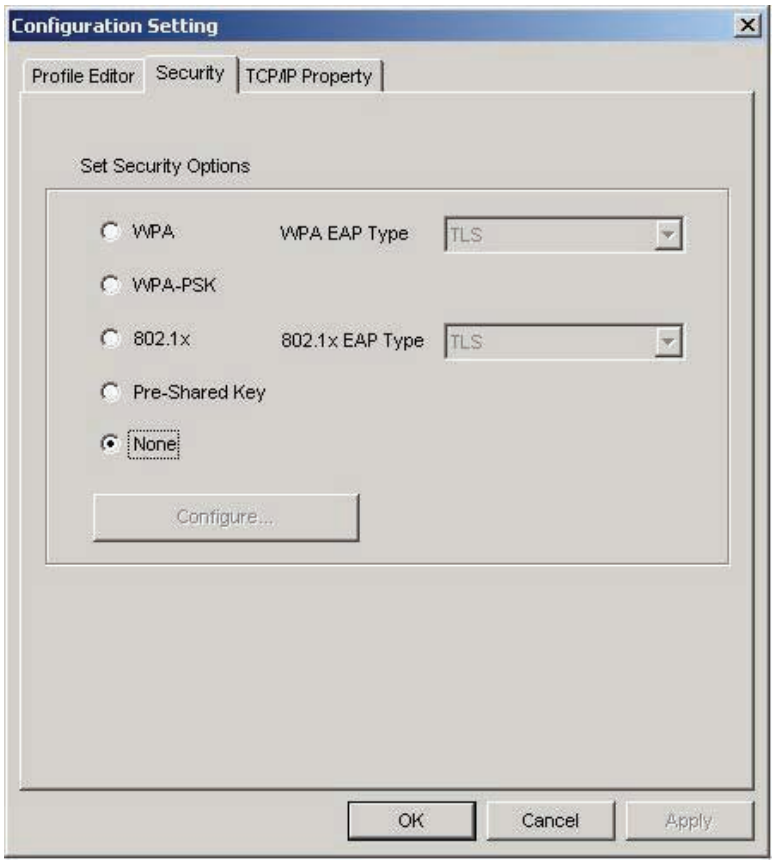


- **Configuration Name:** This name identifies the configuration. This name should be unique.
- **Network Name (SSID1) (SSID2) (SSID3):** The name of the wireless network. This name cannot be longer than 32 characters. If the field is set to be "ANY" or is left blank, your computer will connect to an 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", "802.11g", "Super G" or

"Auto". "Auto" allows the use of either 802.11g or 802.11b mode.

- **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.
- **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.

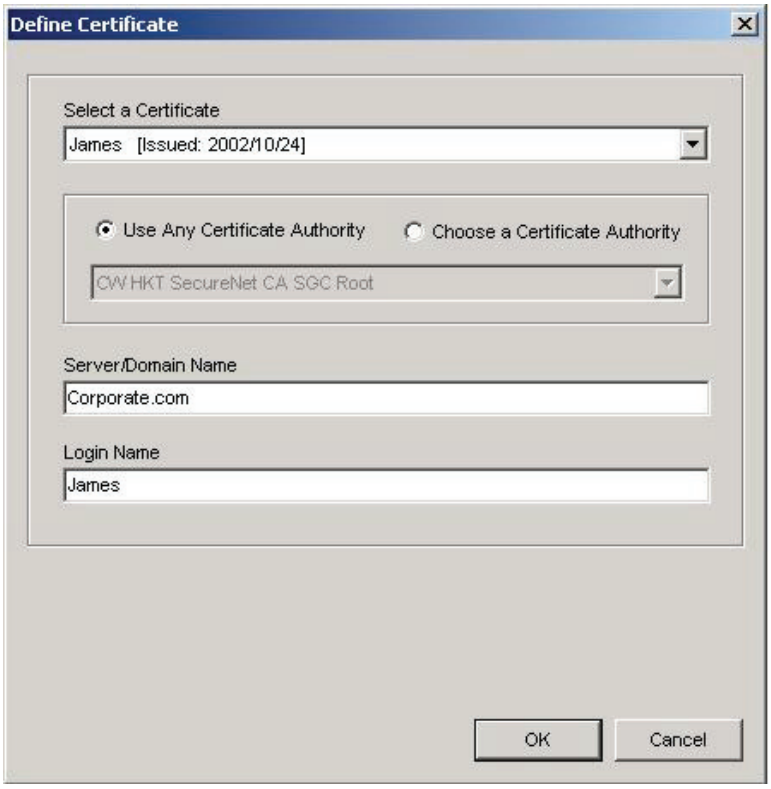
4. Select **Security** tab and choose the security mode.
   Note! *Check with your Network Administrator for the security features supported by your AP.*



- **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.

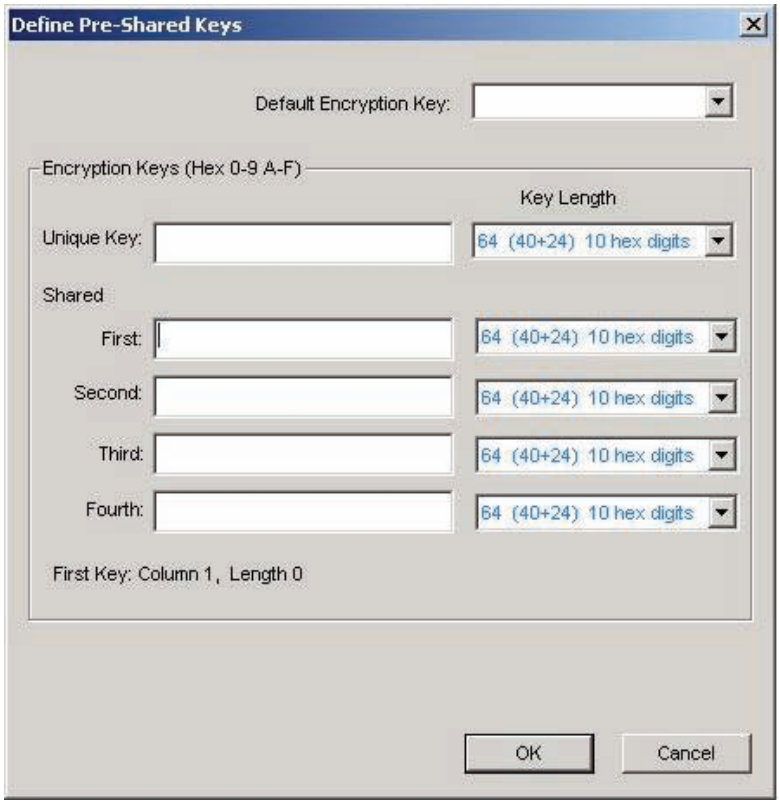
- **Pre-Shared Key:** Enables the use of pre-shared keys that are defined on the AP and the station.
  a) Select the **Pre-Shared Key** radio button.
  b) Click on the **Configure** button and complete the configuration information in the Define Certificate dialog.
- **None:** No security.

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.

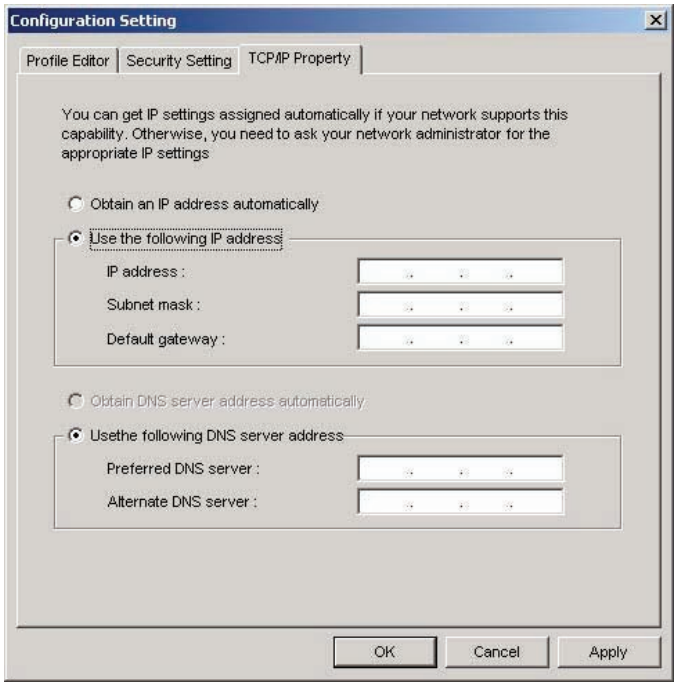


- **Key Entry Method:** Determines the entry method for the key. Hexadecimal (0-9, A-F) or ASCII text (all keyboard characters).
- **Default Encryption Key:** Allows you to choose one encryption key (First, Second, Third, or Fourth) as the transmit key, which encrypts transmissions from the PC Card.
- **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

DNMA-84, Product Specification, 802.11n draft 2.0 b/g mini-PCI card

Main chipset	➢ **Atheros® AR9160, AR9103**
TX/RX	➢ **3T3R**
Frequency range	➢ **USA: 2.400 – 2.4836GHz** ➢ **Europe: 2.400 – 2.4836GHz** ➢ **Japan: 2.400 – 2.497GHz** ➢ **China: 2.400 – 2.4836GHz**
Modulation technique	**DSSS (Direct Sequence Spread Spectrum) with** **DBPSK (Differential Binary Phase Shift Keying 1Mbps),** **DQPSK (Differential Quaternary Phase Shift Keying 2Mbps), and** **CCK (Complementary Code Keying 5.5&11Mbps), and** **OFDM (Orthogonal Frequency Division Multiplexing with BPSK for 6,9Mbps、 QPSK for 12,18Mbps、 16QAM for 24,36Mbps、 64QAM for 48,54Mbps)** ➢ **802.11n b/g** **DSSS (DBPSK, DQPSK, CCK)** **OFDM (BPSK, QPSK, 16-QAM, 64-QAM)**
Host interface	➢ **Mini-PCI form factor; Mini-PCI Version 1.0 type IIIA**
Channel spacing	➢ **5MHz**
Channels support	➢ **802.11n b/g** **US/Canada: 11 (1 ~ 11)** **Major European country: 13 (1 ~ 13)** **France: 4 (10 ~ 13)** **Japan: 11b: 14 (1~13 or 14th), 11g: 13 (1 ~ 13)** **China: 13 (1 ~ 13)**
Operation voltage	➢ **3.3V +/-5%**
Power consumption @25°C	**802.11b 802.11g 802.11n(Ng HT20) 802.11n(Ng HT40)** **Avg/Peak (mA) Avg/Peak (mA) Avg/Peak (mA) Avg/Peak (mA)** ➢ **Continue Tx 1207/1356 1184/1357 1284/1471**

	1373/1587 **➢ FTP Tx TBD TBD TBD TBD** **➢ FTP Rx TBD TBD TBD TBD** **➢ Standby mode TBD 349/418 TBD TBD** **➢ Power saving TBD TBD TBD TBD** *****The maximum current consumption would be impacted by radiation environment and the driver mechanism.** ***** Due to without NDIS driver supporting from Atheros for Windows OS, so the detail current consumption was hard to be gotten at this moment.**
Output power @25°C	**➢ 802.11b** **Test Frequencies 1/2_Target 5.5_Target 11_Target** **2412 19 19 19** **2437 19 19 19** **2462 19 19 19** **2472 19 19 19** **➢ 802.11g** **Test Frequencies 6-36_Target 48_Target 54_Target** **2412 19 17 16** **2437 19 17 16** **2462 19 17 16** **2472 19 17 16** **➢ 802.11n** **Freq. Range: 2.4GHz/HT20: @800GI(400GI)** **Test Freq MCS 0/8 MCS 1/9 MCS 2/10 MCS 3/11 MCS 4/12 MCS 5/13 MCS 6/14**

	MCS 7/15 **Mbps (800ns) 6.5/13 13/26 19.5/39 26/52 39/78** **52/104 58.5/117 65/130** **2412 19 19 19 19** **18 17 16 13** **2437 19 19 19 19** **18 17 16 13** **2462 19 19 19 19** **18 17 16 13** **2472 19 19 19 19** **18 17 16 13** **Freq. Range: 2.4GHz/HT40: @800GI(400GI)** **Test Freq MCS 0/8 MCS 1/9 MCS 2/10 MCS 3/11 MCS 4/12 MCS 5/13 MCS 6/14** **MCS 7/15** **Mbps (800ns) 13.5/27 27/54 40.5/81 54/108 81/162 108/216** **121.5/243 135/270** **2412 19 19 19 19** **18 16 15 12** **2437 19 19 19 19** **18 16 15 12** **2462 19 19 19 19** **18 16 15 12** **2472 19 19 19 19** **18 16 15 12**
EVM @25°C	**The transmit modulation accuracy is measured using error vector magnitude (EVM). EVM is the magnitude of the phase difference as a function of time between an ideal reference signal and the measured transmitted signal.** ➢ **802.11b** **Modulation Code Rate Relative constellation error (dB) Relative constellation error (dB)** **IEEE Spec (1Tx dB) Typical/Maximum (3Tx dB)** **DBPSK (1 Mbps) -10 -19/-16** **DQPSK (2 Mbps) -10**

	-19/-16 **CCK (5.5 &11 Mbps) -10** **-19/-16** ➢ **802.11g** **Modulation Code Rate Relative constellation error (dB) Relative constellation error (dB)** **IEEE Spec (1Tx dB) Typical/Maximum (3Tx dB)** **BPSK (6 Mbps) 1/2 -5 -27/-24** **BPSK (9 Mbps) 3/4 -8 -27/-24** **QPSK (12 Mbps) 1/2 -10 -27/-24** **QPSK (18 Mbps) 3/4 -13 -27/-24** **16-QAM (24 Mbps) 1/2 -16 -27/-24** **16-QAM (36 Mbps) 3/4 -19 -30/-27** **64-QAM (48 Mbps) 2/3 -22 -31/-28** **64-QAM (54 Mbps) 3/4 -25 -31/-28** ➢ **802.11ng** **Modulation Code Rate Relative constellation error (dB) Relative constellation error (dB)** **IEEE Spec (1Tx dB) Typical/Maximum (3Tx dB)** **HT20** **(MCS0) BPSK 1/2 -5 -29/-26** **(MCS1) QPSK 1/2 -10 -29/-26** **(MCS2) QPSK 3/4 -13 -30/-27**

	(MCS3) 16-QAM 1/2 -16 -30/-27 **(MCS4) 16-QAM 3/4 -19 -31/-28** **(MCS5) 64-QAM 2/3 -22 -32/-29** **(MCS6) 64-QAM 3/4 -25 -32/-29** **(MCS7) 64-QAM 5/6 -28 -33/-30** **(MCS8) BPSK 1/2 -5 -26/-23** **(MCS9) QPSK 1/2 -10 -26/-23** **(MCS10) QPSK 3/4 -13 -26/-23** **(MCS11) 16-QAM 1/2 -16 -26/-23** **(MCS12) 16-QAM 3/4 -19 -29/-26** **(MCS13) 64-QAM 2/3 -22 -30/-27** **(MCS14) 64-QAM 3/4 -25 -30/-27** **(MCS15) 64-QAM 5/6 -28 -32/-29** **HT40** **(MCS0) BPSK 1/2 -5 -29/-26** **(MCS1) QPSK 1/2 -10 -29/-26** **(MCS2) QPSK 3/4 -13 -29/-26** **(MCS3) 16-QAM 1/2 -16 -29/-26**

	(MCS4) 16-QAM 3/4 -19 -30/-27 **(MCS5) 64-QAM 2/3 -22 -31/-28** **(MCS6) 64-QAM 3/4 -25 -32/-29** **(MCS7) 64-QAM 5/6 -28 -33/-30** **(MCS8) BPSK 1/2 -5 -24/-21** **(MCS9) QPSK 1/2 -10 -24/-21** **(MCS10) QPSK 3/4 -13 -24/-21** **(MCS11) 16-QAM 1/2 -16 -24/-21** **(MCS12) 16-QAM 3/4 -19 -27/-24** **(MCS13) 64-QAM 2/3 -22 -28/-25** **(MCS14) 64-QAM 3/4 -25 -29/-26** **(MCS15) 64-QAM 5/6 -28 -30/-28**

Sensitivity @25°C	➢ **802.11b** **Modulation IEEE Spec (1Rx dBm) Typical/Maximum (3Rx dBm)** **DBPSK -82 -95/-92** **DQPSK -80 -93/-90** **CCK -76 -91/-88** ➢ **802.11g** **Modulation Code Rate IEEE Spec (1Rx dBm) Typical/Maximum (3Rx dBm)** **BPSK 1/2 -82 -95/-92** **BPSK 3/4 -81 -95/-92** **QPSK 1/2 -79 -95/-92** **QPSK 3/4 -77 -95/-92** **16-QAM 1/2 -74 -91/-88** **16-QAM 3/4 -70 -88/-85** **64-QAM 2/3 -66 -84/-81** **64-QAM 3/4 -65 -82/-79** ➢ **802.11ng** **Modulation Code Rate IEEE Spec (1Rx dBm) Typical/Maximum (3Rx dBm)** **HT20** **(MCS0) BPSK 1/2 -82 -95/-92** **(MCS1) QPSK 1/2 -79 -94/-91**

	(MCS2) QPSK 3/4 -77 -92/-89 **(MCS3) 16-QAM 1/2 -74 -89/-86** **(MCS4) 16-QAM 3/4 -70 -86/-83** **(MCS5) 64-QAM 2/3 -66 -82/-79** **(MCS6) 64-QAM 3/4 -65 -80/-77** **(MCS7) 64-QAM 5/6 -64 -78/-75** **(MCS8) BPSK 1/2 -82 -94/-90** **(MCS9) QPSK 1/2 -79 -92/-89** **(MCS10) QPSK 3/4 -77 -90/-87** **(MCS11) 16-QAM 1/2 -74 -87/-84** **(MCS12) 16-QAM 3/4 -70 -84/-81** **(MCS13) 64-QAM 2/3 -66 -79/-75** **(MCS14) 64-QAM 3/4 -65 -78/-75** **(MCS15) 64-QAM 5/6 -64 -76/-73** **HT40** **(MCS0) BPSK 1/2 -79 -89/-86** **(MCS1) QPSK 1/2 -76 -89/-86** **(MCS2) QPSK 3/4 -74 -89/-86** **(MCS3) 16-QAM 1/2 -71**

	-86/-83 **(MCS4) 16-QAM 3/4 -67** **-83/-80** **(MCS5) 64-QAM 2/3 -63** **-78/-75** **(MCS6) 64-QAM 3/4 -62** **-77/-74** **(MCS7) 64-QAM 5/6 -61** **-75/-72** **(MCS8) BPSK 1/2 -79** **-89/-86** **(MCS9) QPSK 1/2 -76** **-88/-84** **(MCS10) QPSK 3/4 -74** **-86/-83** **(MCS11) 16-QAM 1/2 -71** **-83/-80** **(MCS12) 16-QAM 3/4 -67** **-80/-77** **(MCS13) 64-QAM 2/3 -63** **-75/-71** **(MCS14) 64-QAM 3/4 -62** **-73/-69** **(MCS15) 64-QAM 5/6 -61** **-72/-68**

<table>
<tr><td>Operation distance</td><td>
➢ 802.11b
Outdoor: 150 m @11Mbps, 300 m @1Mbps
Indoor: 30 m @11Mbps, 100 m @1Mbps
➢ 802.11g
Outdoor: 50 m @54Mbps, 300 m @6Mbps
Indoor: 30 m @54Mbps, 100 m @6Mbps
➢ 802.11n
Outdoor: 250 m @6.5Mbps (MCS0: 1 Nss/20MHz BW)
30 m @130Mbps (MCS15: 2 Nss/20MHz BW)
30 m @300Mbps (MCS15: 2 Nss/40MHz BW)
Indoor: 100 m @6.5Mbps (MCS0: 1 Nss/20MHz BW)
20 m @130Mbps (MCS15: 2 Nss/20MHz BW)
20 m @300Mbps (MCS15: 2 Nss/40MHz BW)
</td></tr>
<tr><td>Transmit spectrum mask</td><td>
➢ For transmitted spectral mask for 11b shall be less than –50dBr for fc–22MHz<f<fc+22MHz.
➢ For transmitted spectral mask for 11g shall be less than –40dBr for fc–30MHz<f<fc+30MHz.
➢ For transmitted spectral mask for 11n 20MHz shall be less than –45dBr for fc–30MHz<f<fc+30MHz.
➢ For transmitted spectral mask for 11n 40MHz shall be less than –45dBr for fc–60MHz<f<fc+60MHz.
<table>
<tr><th>Mode of Operation
802.11g</th><th>IEEE Specifications</th></tr>
<tr><td>802.11g at ± 9 MHz Offset</td><td>0 dBr</td></tr>
<tr><td>802.11g at ± 11 MHz Offset</td><td>-20 dBr</td></tr>
<tr><td>802.11g at ± 20 MHz Offset</td><td>-28 dBr</td></tr>
<tr><td>802.11g at ± 30 MHz Offset</td><td>-40 dBr</td></tr>
<tr><th>Mode of Operation
802.11b</th><th>IEEE Specifications</th></tr>
<tr><td>802.11b at ± 11 MHz Offset</td><td>-30dBr</td></tr>
<tr><td>802.11b at ± 22 MHz Offset</td><td>-50dBr</td></tr>
<tr><th>Mode of Operation
802.11n</th><th>IEEE Specifications</th></tr>
<tr><td>802.11n at ±19 MHz offset</td><td>0 dBr</td></tr>
<tr><td>802.11n at ±21 MHz offset</td><td>-20 dBr</td></tr>
<tr><td>802.11n at ±40 MHz offset</td><td>-28 dBr</td></tr>
<tr><td>802.11n at ±60 MHz offset</td><td>-45 dBr</td></tr>
</table>
</td></tr>
<tr><td>Transmit spectrum flatness</td><td>For 802.11g the average energy of the constellations in each of spectral lines –16..-1 and +1..+16 will deviate no more than +/- 2dB from their average energy.
For 802.11n 40MHz mode, the average energy of the constellations in each of spectral</td></tr>
</table>

	lines –42..-2 and +2..+42 will deviate no more than +/- 2dB from their average energy. ➢ **The transmitted spectral flatness should be with in +2/- 4dB.**
Transmit center frequency tolerance	➢ **The transmitted center frequency tolerance shall be ±20 ppm maximum.**
Carrier suppression	**802.11b:** **The RF carrier suppression, measured at the channel center frequency, shall be at least 15 dB below the peak SIN(x)/x power spectrum.** **802.11g:** **The leakage of the center frequency component shall not exceed -15 dB relative to overall transmitted power or, equivalently, +2 dB relative to the average energy of the rest of the sub-carriers.** **802.11n:** **For all 20 MHz modes of transmission** **The leakage of the center frequency component shall not exceed -15 dB relative to overall transmitted power or, equivalently, +2 dB relative to the average energy of the rest of the sub-carriers.** **For all 40 MHz modes of transmission** **The center frequency leakage shall not exceed -18 dB relative to overall transmitted power, or, equivalently, +2 dB relative to the average energy of the rest of the sub-carriers.** ➢ **Delta > 15dB for b, g & 11n 20MHz** ➢ **Delta > 18dB for 11n 40MHz**
Transmit power on ramp and power down ramp time	➢ **The transmitting power-on ramp for 10% to 90% of maximum power m shall be no greater than 2 µs.** ➢ **The transmitting power-down ramp for 90% to 10% of maximum power shall be no greater than 2 µs.**
Receiver maximum input level	➢ **802.11b** **Modulation — IEEE Spec (1Rx dBm)** **DBPSK — >-4** **DQPSK — >-4** **CCK — >-10**

	➢ **802.11g** **Modulation Code Rate IEEE Spec (1Rx dBm)** **>-20** ➢ **802.11ng** **Modulation Code Rate IEEE Spec (1Rx dBm)** **>-20**
Operation system supported	➢ **Linux (TBD), without Windows OS supported**
PCB dimension	➢ ***50.8mm ±0.1 Max (L/H) x 59.6mm ±0.1 (W) x 1.0mm ±0.1 (T)***
Security	➢ **64-bit, 128-bit, 152-bit WEP Encryption** ➢ **802.1x Authentication** ➢ **AES-CCM & TKIP Encryption**
Operation mode	➢ **Infrastructure**
Transfer data rate	➢ **802.11b: 1, 2, 5.5, 11Mbps** ➢ **802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps** ➢ **802.11n: @800GI(400GI)** ● **20MHz BW** ▪ **1 Nss: 65(72.2) Mbps maximal** ▪ **2 Nss: 130(144.444) Mbps maximal** ● **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**
WHQL	➢ **No, due to without NDIS driver supported**
EMC certificate	➢ **FCC part 15 (USA)** ➢ **IC RSS210 (Canada)** ➢ **TELEC (Japan)** ➢ **ETSI, EN301893, EN60950 (Europe)** ➢ **VCCI CLASS B**

Media access protocol	➢ **CSMA/CA with ACK architecture 32-bit MAC**
Antenna	➢ **3 x SMT Ultra-miniature coaxial connectors**