

# **LAN-TO-GO<sup>®</sup>**

## **Wireless LAN PC Card**

### **User's Guide**

Federal Communications Commission (FCC) Stations

RADIO FREQUENCY 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 or more of the following measures:

- Reorient 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.

Any special accessories needed for compliance must be specified in the instruction manual.

Warning: A shielded-type power cord is required in order to meet FCC emission limits and also to prevent interference to the nearby radio and television reception. It is essential that only the supplied power cord be used.

Use only shielded cables to connect I/O devices to this equipment.

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



# **LAN-TO-GO PC Card**

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## **User's Guide**

**Computer & Communication Research Laboratories  
Industrial Technology Research Institute  
Chutung, Hsinchu, Taiwan 310, Republic of China**



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## FCC Registration

This device has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. However there is no guarantee that interference will not occur in a particular situation. Operation of this device is subject to the following two conditions:

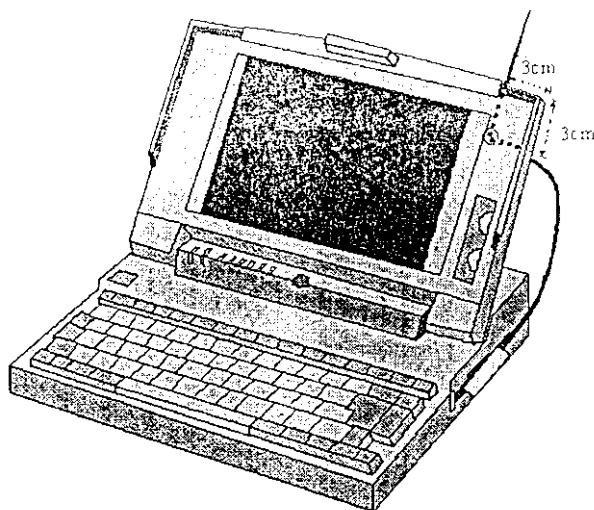
1. This device may not cause harmful interference.
2. This device must accept any interference received including interference that may cause undesired operations.

This device generates and uses radio frequency (RF) energy and, if not installed and used in strict accordance with the manufacturer's instructions, interference to radio and television reception may result. Interference can be determined by turning this device off and on while monitoring radio or television reception. The user may be able to eliminate any interference by one or more of the following measures:

- Reorient or relocate the affected device and/or its receiving antenna.
- Increase the distance between the affected device and this device.
- Plug the computer equipped with this device into an outlet on a different branch circuit from that used by the affected device.
- Consult the dealer or an experienced radio/TV technician for help.



The suggested usage of the antenna position is shown in the next figure, we are not able to guarantee the radiation characteristics if it is not followed.



**NOTE:** *Please be sure to use our antenna. If you want to use other antenna, the antenna should be approved by the FCC.*

The user may find the following booklet prepared by the Federal Communications Commission helpful:  
The Interference Handbook


This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402. Stock No. 004-000-00345-4. You can also access this booklet via World Wide Web at <http://www.fcc.gov/cib/Publications/tvibook.html>.



If you like, you can use the auxiliary mounting bracket to fix the antenna to your computer. First, slide the antenna module onto the mounting bracket. When you have determined the place to affix the bracket, remove the protective strip from the adhesive pad and press firmly in position. You can now remove the antenna module and remount it whenever you like.

If any of these items are missing or damaged, please immediately contact your authorized reseller or our Technical Support for replacement.

**NOTE:** *If you need to return the LAN-TO-GO PC Card to CCL/ITRI, you must pack it in the original (or equivalent ) packing material, or the warranty will be voided.*



# Introduction

Congratulations on your purchase of the LAN-TO-GO PC Card! The LAN-TO-GO PC Card is a wireless network interface card (NIC) for any computing device (hereinafter referred to as a *computer* in this Guide unless otherwise specified) equipped with a Personal Computer Memory Card International Association (PCMCIA) Type II or Type III slot. LAN-TO-GO PC Card conforms to the PCMCIA release 2.x standard and is designed to meet the IEEE 802.11 wireless LAN (WLAN) standard ratified in June 1997. As a result of the completion of the standard, customers can assure themselves that their investment in WLAN infrastructure will be secured and interoperability among multiple vendors will be guaranteed.

Wireless LANs are a complementary extension to existing wired LANs, offering complete mobility while maintaining continuous network connectivity to corporate Intranet. They add a new level of convenience for LAN users. This is accomplished through the use of a device known as an access points (AP), something refereed to as a wireless bridge.

LAN-TO-GO PC Card operates in the unlicensed 2.4 GHz Industrial, Scientific and Medical (ISM) band (FCC 15.247). To overcome the effects of interference and multi-path fading and allow co-existence with other wireless systems in the same geographical area, LAN-TO-GO PC Card incorporates state-of-the-art Direct Sequence Spread Spectrum (DSSS) radio technology. The term, spread spectrum, indicates a radio frequency modulation technique where the radio energy is spread over a much wider bandwidth than needed for the data rate. DSSS provides superior noise immunity to broadband interference which is overwhelming in civilian environments such as office and home.

## Package Contents

Your LAN-TO-GO package comes with the following items:

- A LAN-TO-GO PC Card (PCMCIA Type II).
- An antenna module with a mounting bracket and a connecting cable.
- Two 3 1/2" disks - one containing DOS driver and utilities, and the other containing Windows 95 driver and utilities.
- This LAN-TO-GO User's Guide.
- A registration card.





# Installing the LAN-TO-GO PC Card

The exact installation procedure for the LAN-TO-GO PC Card varies depending on the model of computer you are using. Refer to the manual that accompanied your computer for additional instructions. The LAN-TO-GO PC Card can be inserted into a computer whether the power is ON or OFF. Follow these steps:

1. Hold the LAN-TO-GO PC Card such that the 68-pin connector is next to the PCMCIA Type II or Type III slot of your computer and the printed label is facing up.
2. Insert the LAN-TO-GO PC Card into the slot in the computer and slide it in until it is firmly seated.
3. Plug the connector on the end of antenna's connecting cable into the LAN-TO-GO PC Card.
4. Slide the antenna module onto the mounting bracket.
5. Affix the mounting bracket with the antenna unit to the computer housing, using the adhesive tape on the bracket.

**CAUTION:** *Do not force the LAN-TO-GO PC Card into the slot, or severe damage to the computer may occur. It may be easier to attach the antenna cable to the LAN-TO-GO PC Card prior to inserting the LAN-TO-GO PC Card into the computer.*

# Installing Driver under MS-DOS

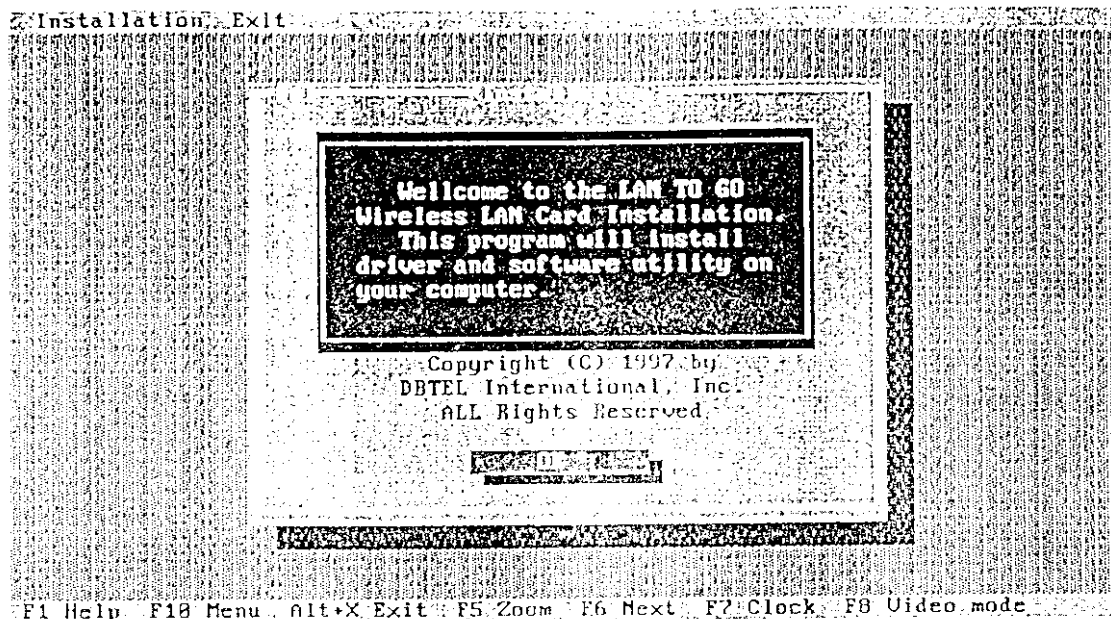
This chapter describes how to install the network driver and utility in a computer running the MS-DOS operating system with Card and Socket Services installed. If Card and Socket Services are installed on your computer, you can quickly and easily install LAN-TO-GO PC Card using the INSTALL program on the LAN-TO-GO MS-DOS Installation Disk. If your computer does not have Card and Socket Services installed, then you will need to manually configure the LAN-TO-GO PC Card by using the UTILITY program explained below.

INSTALL is quite user-friendly and intuitive. Follow the instructions that appear on the screen. INSTALL provides a familiar Windows-like interface that can be accessed with a mouse. It runs under MS-DOS version 3.1 or higher. If your system does not include a mouse, use the keys described in the following table to navigate through the program and select functions.

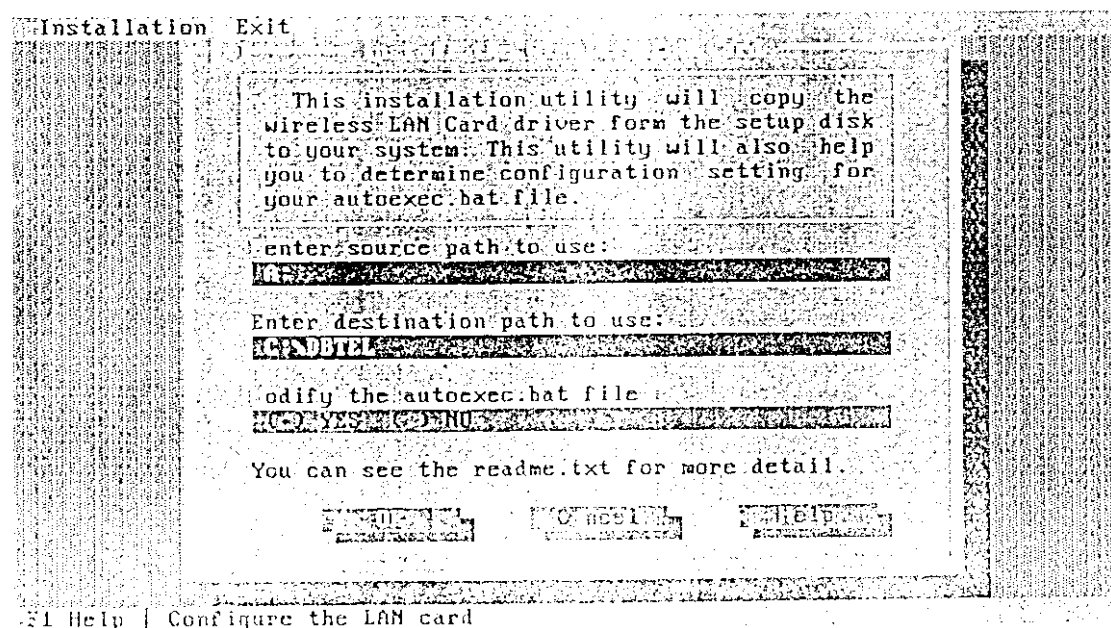
Function	Key
Help	<F1>
Next selection in a menu bar	<Down arrow>
Previous selection in a menu bar	<Up arrow>
Move to the next field or button	<Tab>
Move to the previous field or button	<Shift+Tab>
Select the highlighted function	<Enter>
Select a function that is not highlighted	<Alt> plus highlighted character For example, <Alt+X> for Quit

Follow these steps:

1. Make sure that the LAN-TO-GO PC Card has been properly installed in your computer.
2. Make sure that your computer is running DOS version 3.1 or higher.
3. If Card Services and Socket Services are available but not installed yet, install them first.
4. Place the LAN-TO-GO DOS Driver and Utility diskette in a floppy drive on your computer, switch to that drive.
5. At the DOS prompt, type INSTALL and then press <Enter>. Click on the "OK" button or press <O> when the first Welcome screen appears.



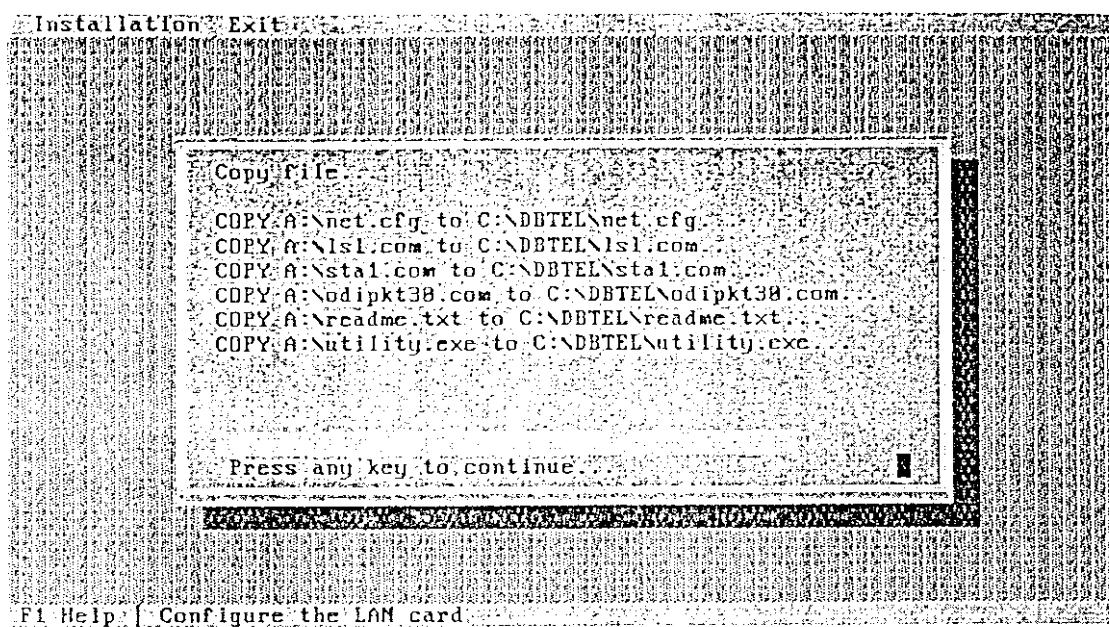
5. Enter the "Alt-U" command - you enter a key command by holding down the "Alt" key while you press the appropriate letter key, or use the mouse pointer to activate the pulldown menu bar and choose Install Utility item.



6. Enter the source path and the destination path, and decide whether you want INSTALL to automatically update your AUTOEXEC.BAT file. The default source path is A: and the default destination path is C:\DBTEL. Press the "OK" button when you are ready.
7. INSTALL will start copying files from the distribution diskette onto a



hard disk and will let you know when it finishes.



## Configuring the LAN-TO-GO PC Card using UTILITY

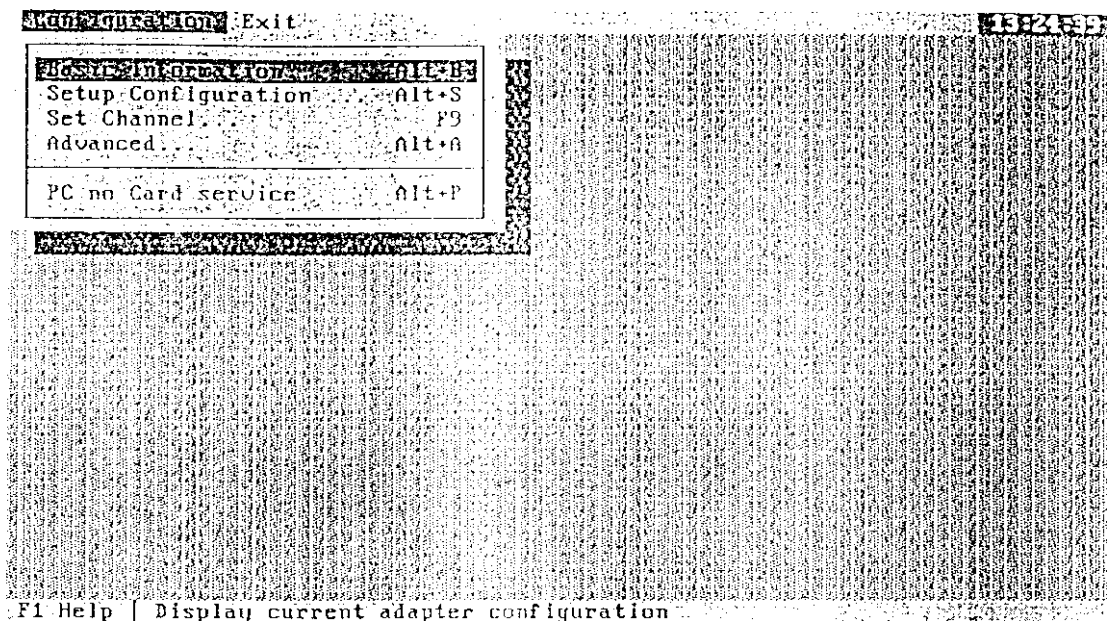
After completing the installation procedure, you can now configure the LAN-TO-GO PC Card by consulting the following paragraph. To configure the LAN-TO-GO PC Card, follow these steps:

1. At the DOS prompt, type CD \DBTEL (or the directory where you installed the programs) and then press <Enter>.
2. Type at the prompt UTILITY and press <Enter>.

You tell UTILITY what you want to do by entering commands. The table below summarizes the commands available in UTILITY. As an alternative, you can use your mouse to navigate through the menu and activate the function you want. For details about each of these commands, see their respective explanations.

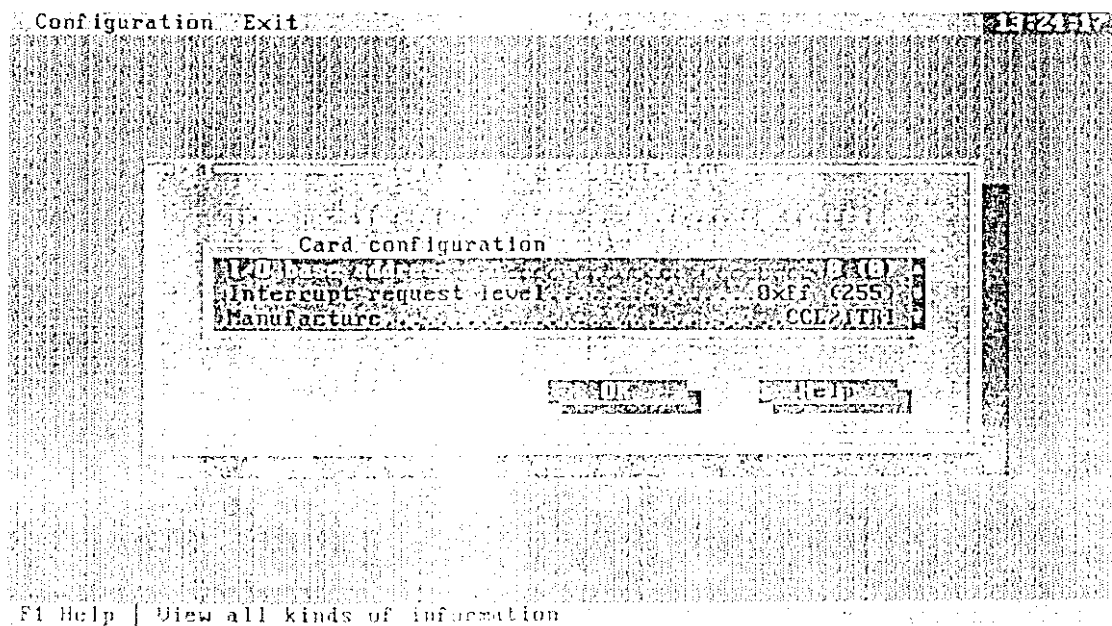
Function	Key
Basic Information	<Alt+B>
Setup Configuration	<Alt+S>
Set Channel	<F0>
Advanced	<Alt+A>
Activate Configuration pull-down menu	<Alt+C>
Activate Exit pull-down menu	<Alt+E>

Clock On/Off	F7
Help	F1



## Basic Information

This screen displays information about the LAN-TO-GO PC Card and its current configuration.



## 9 I/O base address

The I/O base address defines the beginning of address space available for communication between the computer and the LAN-



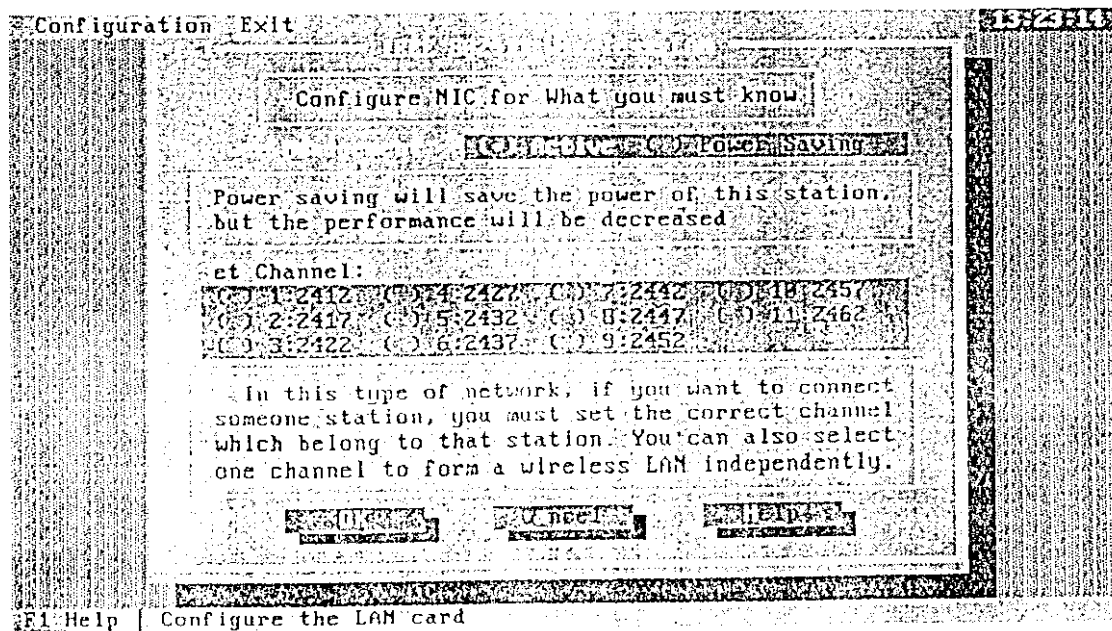
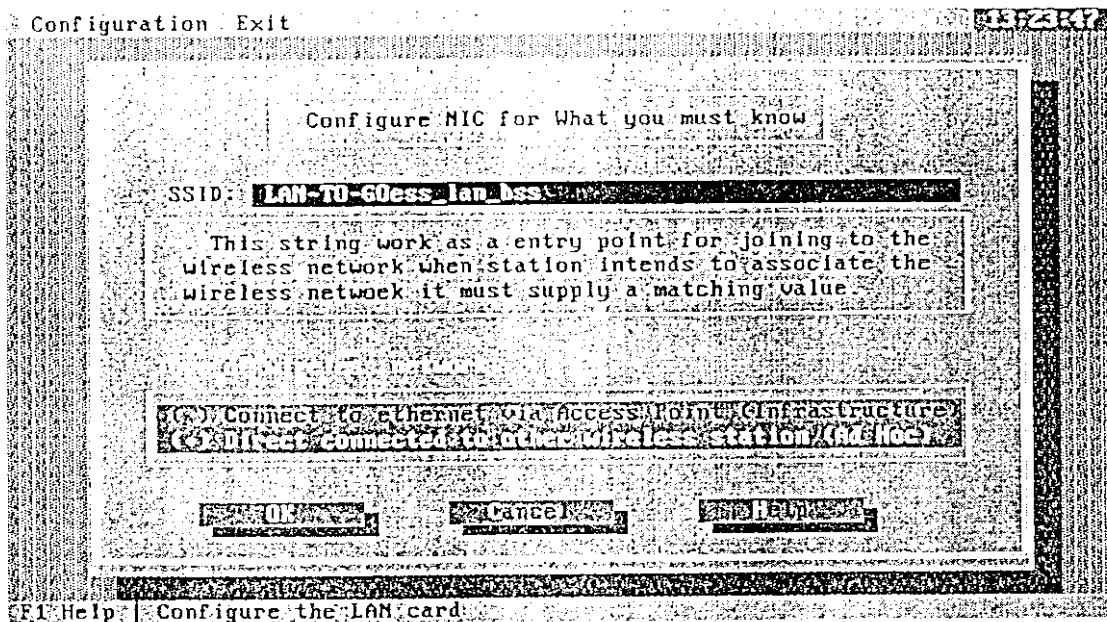
TO-GO PC Card. Each device must be assigned a unique address range.

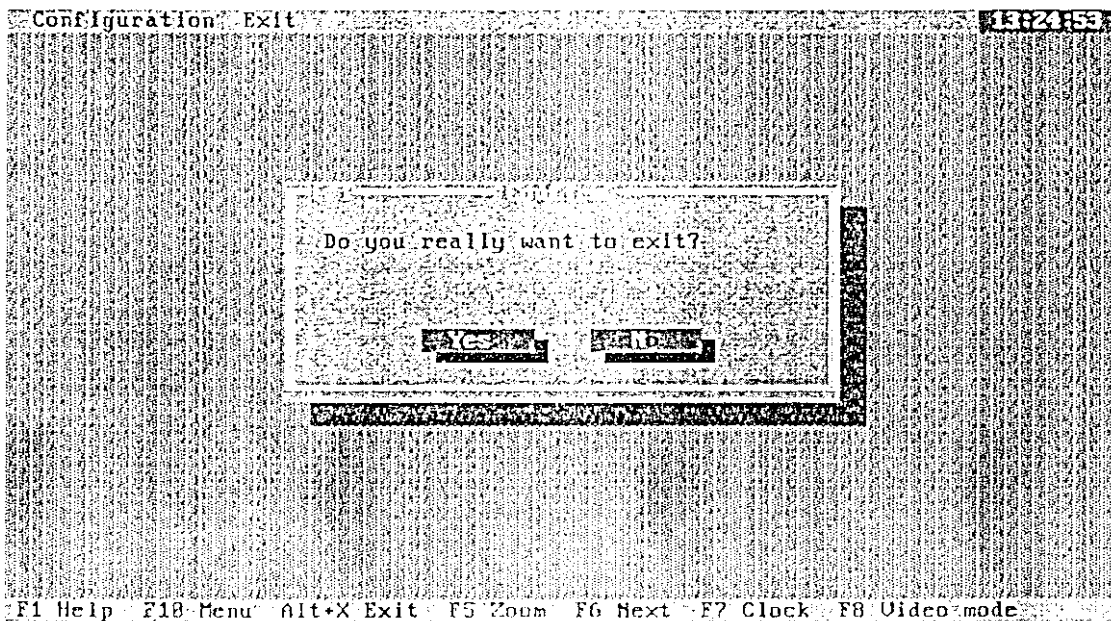
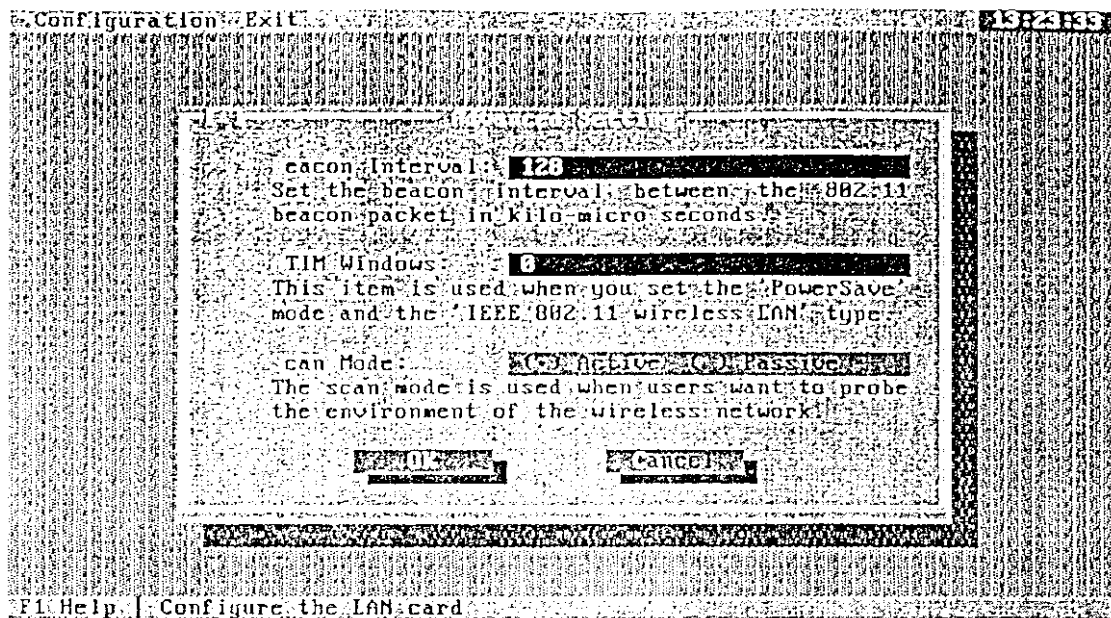
- Interrupt request level


An interrupt request (IRQ) signals the computer when a device needs attention. The LAN-TO-GO PC Card must have an IRQ assigned that is distinct from any other device installed in the computer.

- Manufacturer

Identify the maker of this LAN-TO-GO PC Card.







# Installing Driver under Windows 95

At the very beginning, please be sure your computer is running Windows 95 and the following items are available and at hand:

1. A computer equipped with a free PCMCIA Type II or Type III slot
2. A 3.5" floppy disk drive
3. LAN-TO-GO PC Card
4. LAN-TO-GO Windows 95 Driver Disk
5. Windows 95 CD-ROM or installation disks
6. LAN-TO-GO User's Guide

Installing the LAN-TO-GO PC Card under Windows 95 is straightforward: simply insert the LAN-TO-GO PC Card in any PCMCIA Type II compatible slot, power-up your computer (typically a notepad or notebook computer) if it was switched off. The New Hardware Found window with the "CCL/ITRI-WDAS-PCMCIA" identification will popup indicating that the system has detected a new hardware device. Then Windows 95 will automatically start an installation procedure. Please follow the on-screen instructions and proceed with care from now on.

**NOTE:** *If you are unfamiliar with how to install PC Card hardware properly, turn to Chapter 2 for instructions.*

If Windows 95 recognizes the hardware, it will try loading the driver on behalf of you. If it can not identify the appropriate driver, then Windows 95 will prompt you to select which driver you want to install for your new hardware. Select **"Driver from disk provided by hardware manufacturer"** and click **"OK"**. Next, Windows 95 will prompt you to specify the location containing the LAN-TO-GO driver. Insert the accompanying diskette titled **"LAN-TO-GO Windows 95 Driver Disk"** in drive A: (or B:). Click the **"OK"** button to continue. Then Windows 95 will start copying files (i.e., **Netlan2g.inf** and **Lan2go.sys**) from the LAN-TO-GO Windows 95 Driver Disk and the Windows 95 CD-ROM or installation disks. Again, the exact location containing the Windows 95 CD-ROM or installation disks may be varied such that you may need to identify correctly.

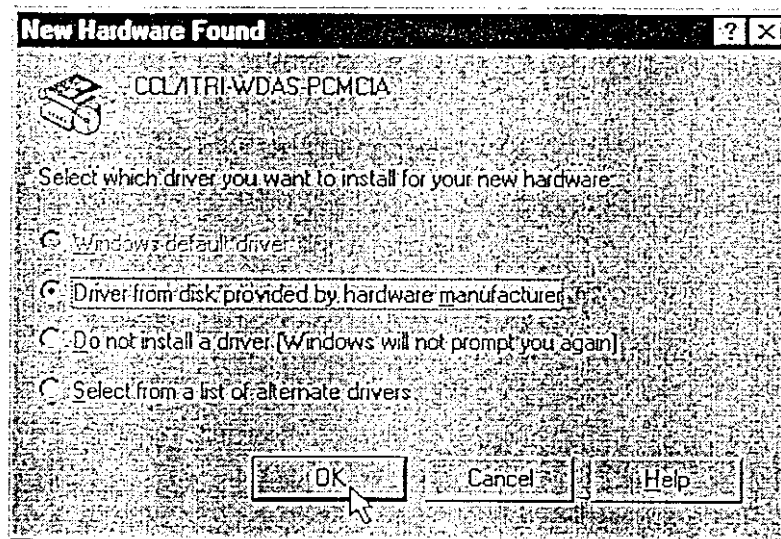
**NOTE:** *During driver installation, you may experience a conflict with the driver*



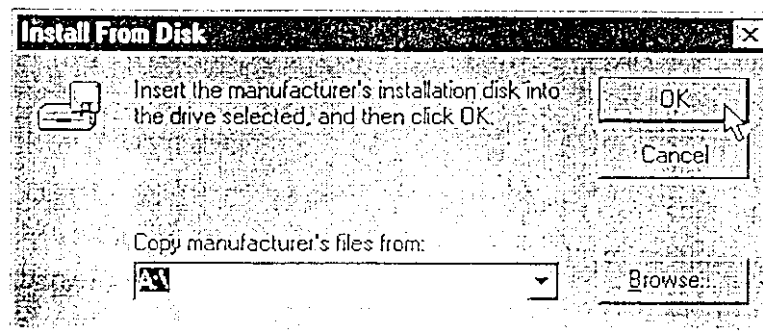
already loaded on your computer.

To put the matter in a nutshell, follow these steps:

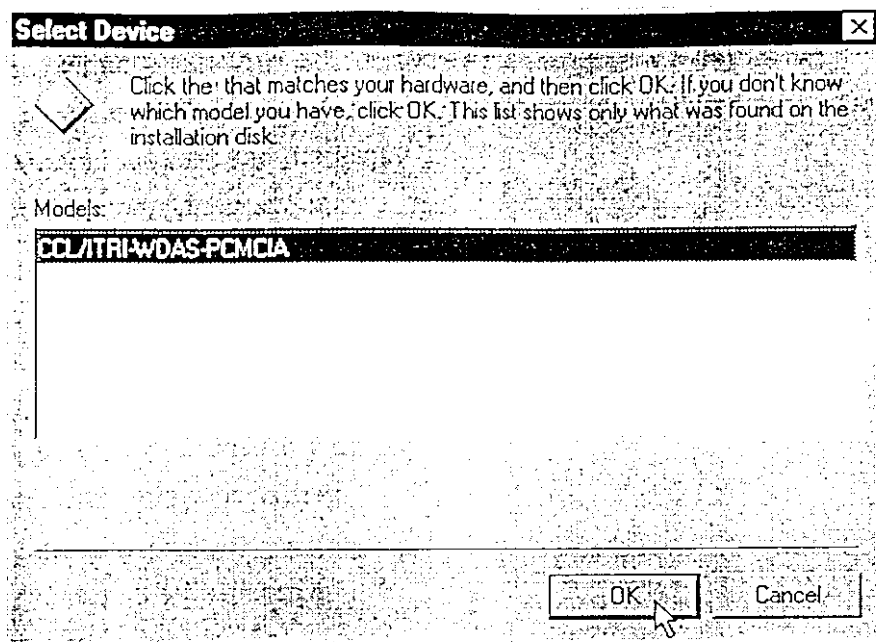
1. Insert the LAN-TO-GO PC Card in a PCMCIA Type II slot.
2. Power-up your computer if it was off and boot Windows 95.
3. A transient window will popup indicating that Windows 95 has found a new hardware and is installing the software for it. This window will last for only a few seconds and disappear by itself.
4. Then the New Hardware Found window will appear. Select "Driver from disk provided by hardware manufacturer" and click "OK" button.



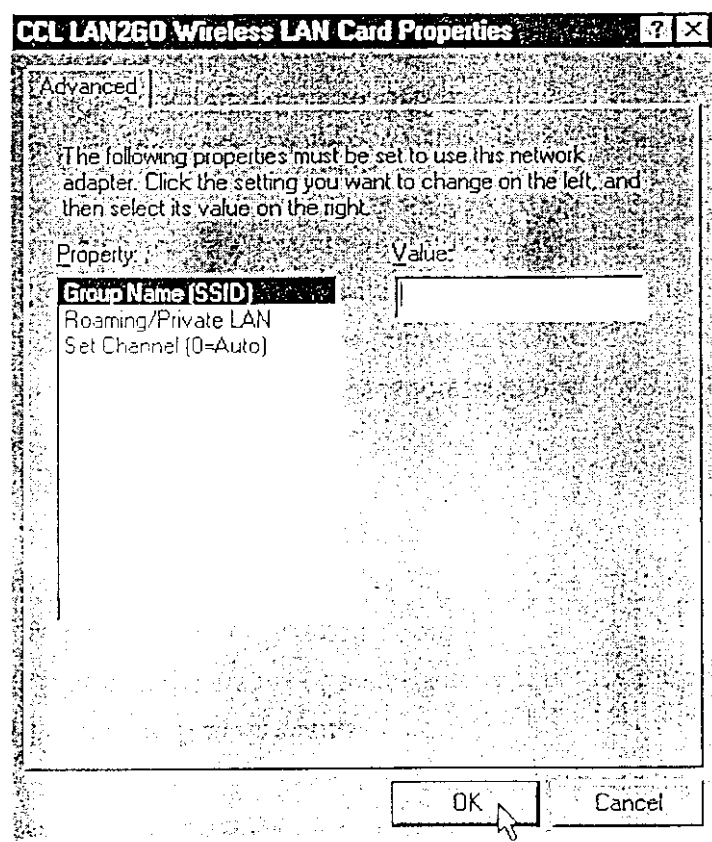
5. Insert LAN-TO-GO Windows 95 Driver Disk in drive A: (or B:) and click "OK". The Select Device window appears.



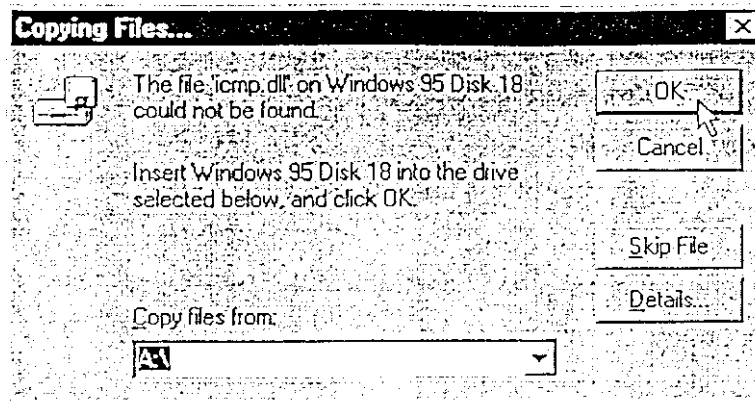
6. From the Select Device window, choose the "CCL/ITRI-WDAS-PCMCIA" from list and click the "OK" button.



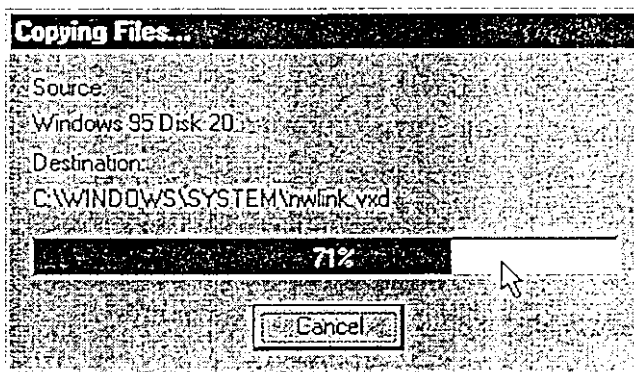
7. Then, the CCL/ITRI-WDAS-PCMCIA Properties holder will appear. If you are satisfied with all default settings, you can click the “OK” button to close this window. Otherwise, you can make any change as you would like now.



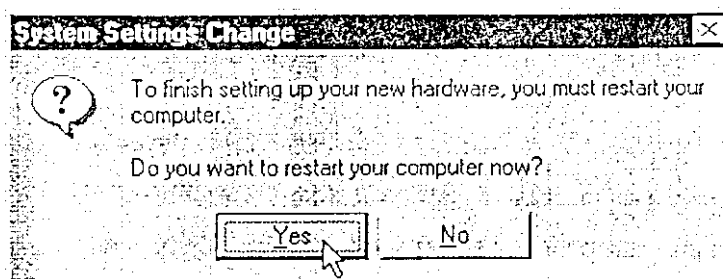
8. Insert Windows 95 CD-ROM or installation disks at request. Enter the correct drive and directory as needs when you are prompted.



9. Click the "OK" button to start copying files. Please be noted that your screen may look different from the one shown here.

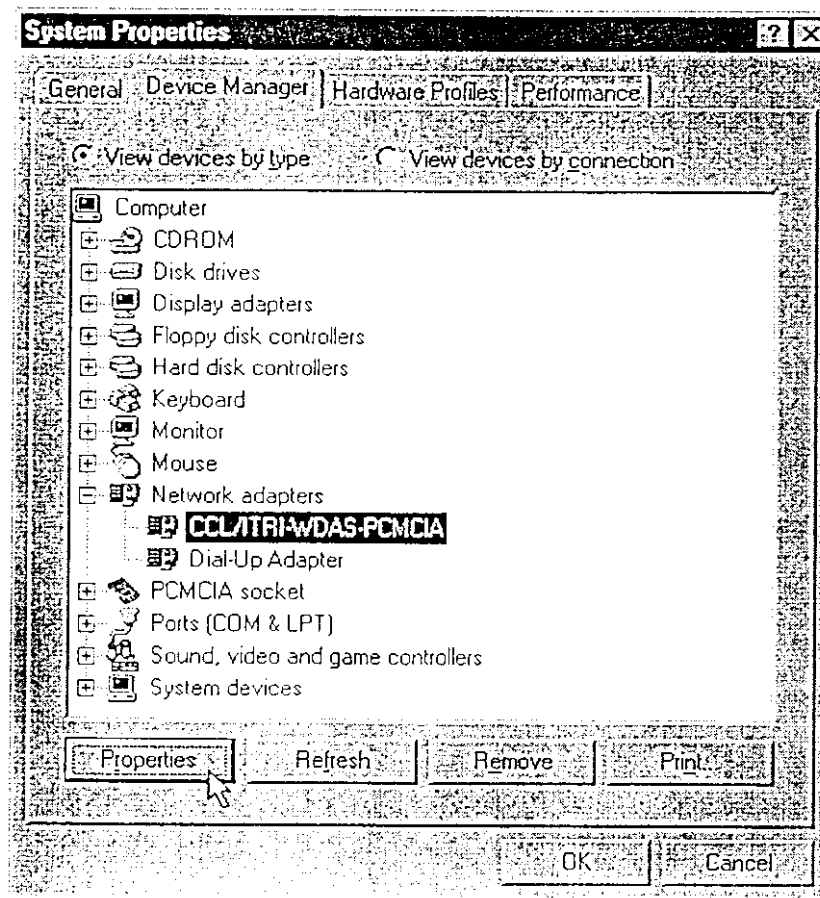


10. Upon finishing copying the files, you have the chance to shutdown and restart your system now by clicking the "Yes" button on the System Settings Change window. Otherwise, these changes will not take effect until next time you start your system.

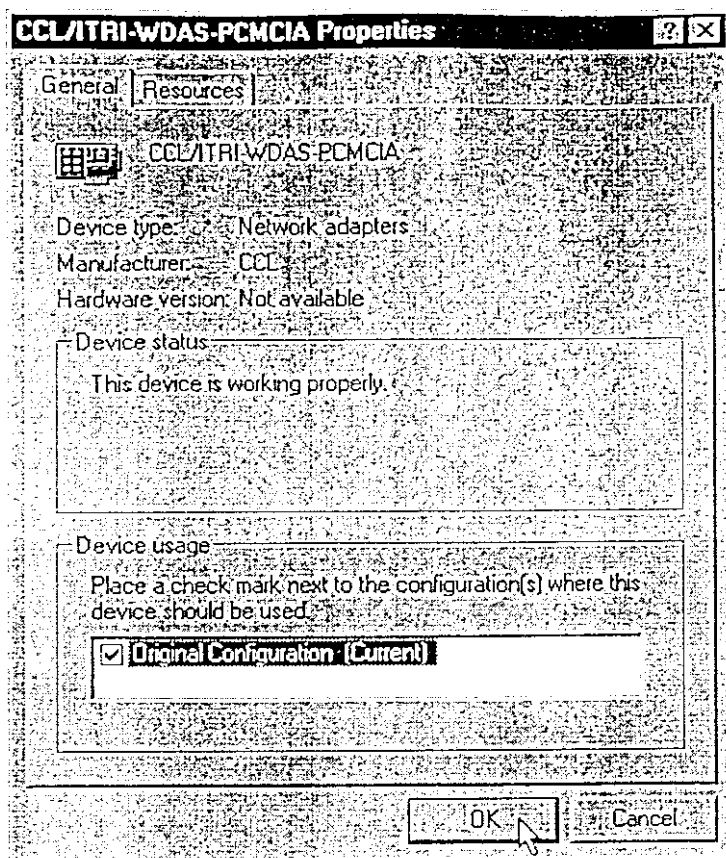


Check and change the current LAN-TO-GO PC Card's configuration

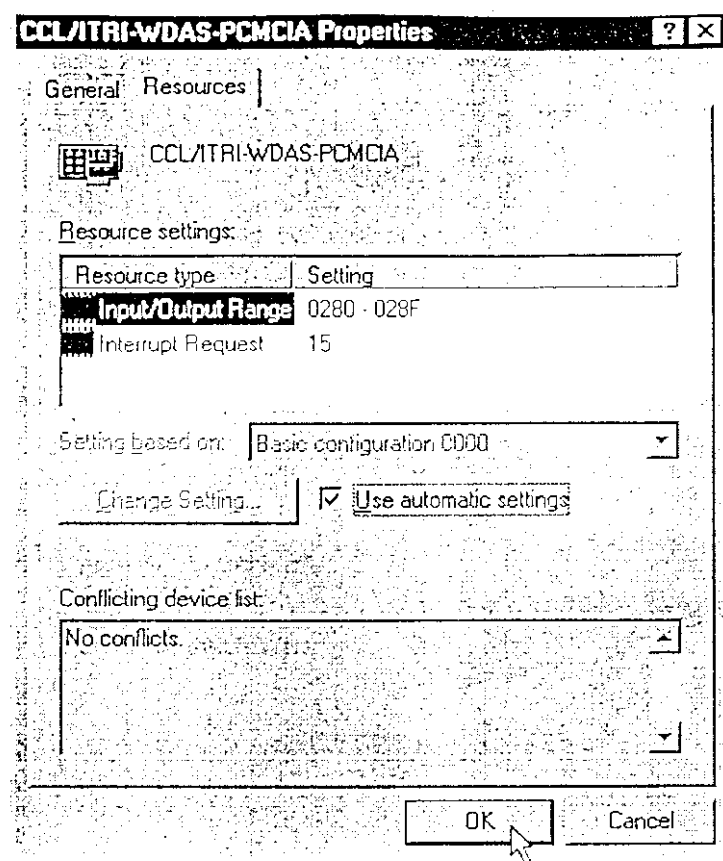
1. Double-click the "My Computer" icon on the Desktop. The My Computer window appears.
2. From the My Computer window, double-click the "Control Panel" icon. The Control Panel window appears.
3. From the Control Panel window, double-click the "System" icon. The "System Properties" folder appears.
4. Choose the "Device Manager" tab. Find and select the NIC with name "CCL/ITRI-WDAS-PCMCIA".
5. Click the "Properties" button. The CCL/ITRI-WDAS-PCMCIA Properties folder appears.



6. Choose the "General" tab. If the Device status area is shown "This device is working properly.", your LAN-TO-GO PC Card was installed successfully. Otherwise, you may get an error message.



7. Choose the "Resources" tab to display the current configuration. If no devices conflict, then a "No conflicts." Message should appear in the bottom Conflicting device list. If an error message appears, you need to find and solve the conflicts. To use different I/O port addresses and IRQ number, uncheck the "Use automatic settings" box, and click the scroll button "▼" to see what configurations are available.

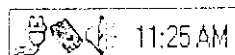


8. Click the "OK" button to close the folder.

### Remove the LAN-TO-GO PC Card from the computer

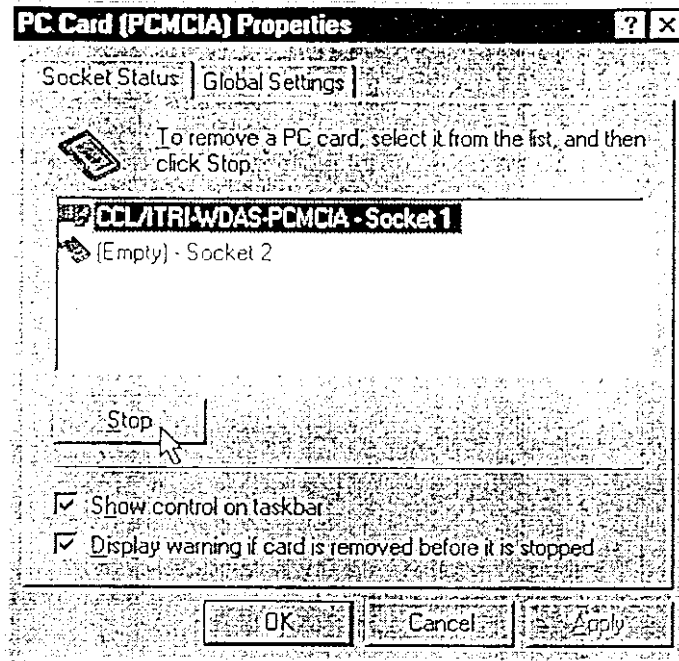
Although the PCMCIA software architecture supports automatic configuration and "hot insertion (referred to PC Cards to be inserted into a socket when power is on)" capability, it does not mean that you can definitely remove the PC Card without prior notice. The following procedure may save you a trouble whenever you want to remove the LAN-TO-GO PC Card from the computer whenever Windows 95 is still running. You are advised to take it for granted that thing should be done in that way. Ask Bill Gate to know how it is.

1. Double-click the small PC Card icon on the right-handed side of the Windows 95 Taskbar. Or double-click the "PC Card (PCMCIA)" icon from the Control Panel window.

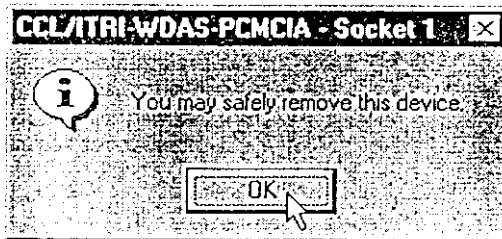


2. From the PC Card (PCMCIA) Properties holder, choose the "Socket Status" tab. A list of the PC Cards currently plugged into your system is

displayed.



3. To remove the LAN-TO-GO PC Card, select it from the list and then Click the "Stop" button.
4. You can be sure that the LAN-TO-GO PC Card can now be safely removed whenever you see the following popup window:



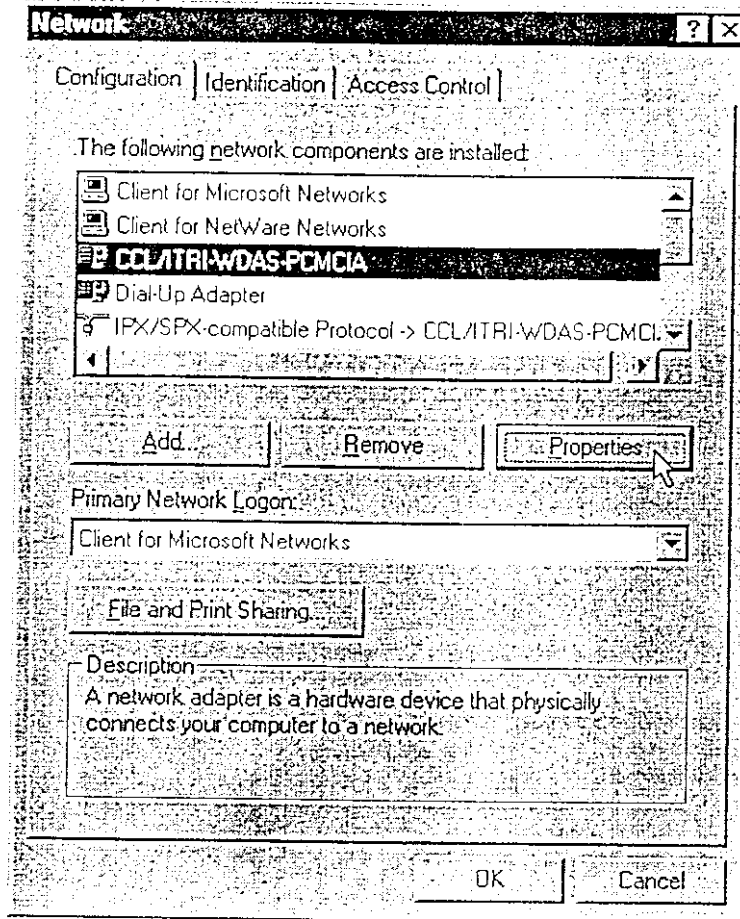
5. Click the "OK" button to close the window.

### View or change the LAN-TO-GO WLAN parameters

You can verify whether the LAN-TO-GO PC Card was installed properly or not, and view and change its parameters by proceeding as follows:

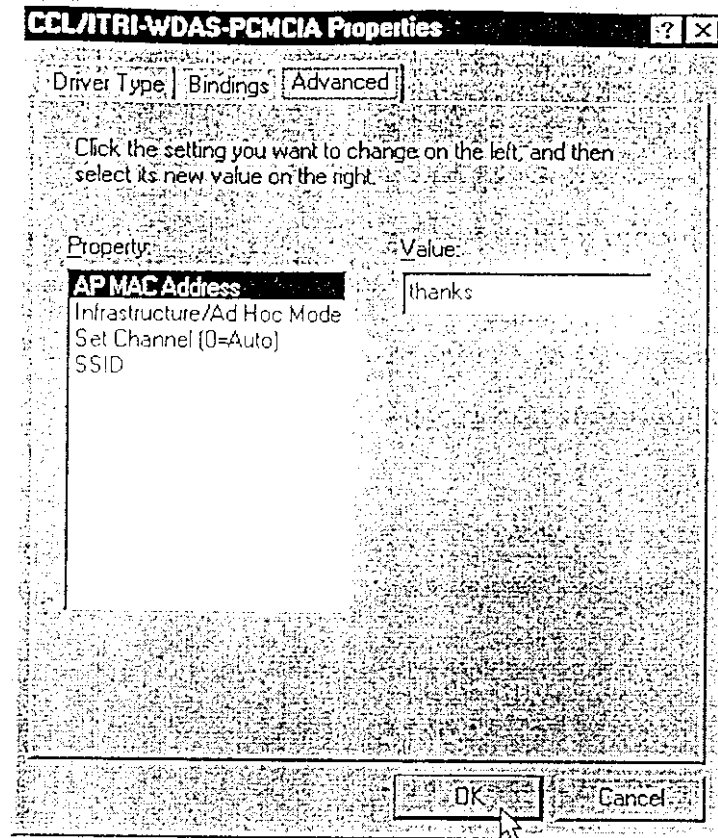
1. Click the "Start" button on the Windows 95 Taskbar. Move the pointer to Settings, and then click the Control Panel. The Control Panel window appears.
2. From the Control Panel window, double-click the "Network" icon. The Network folder will be displayed.

3. Choose the "Configuration" tab. All network components that have been added to your system will appear.
4. Find and select the NIC with name "CCL/ITRI-WDAS-PCMCIA". If it is not present, the prior installation was failed.
5. Click the "Properties" button. The CCL/ITRI-WDAS-PCMCIA Properties folder will appear.

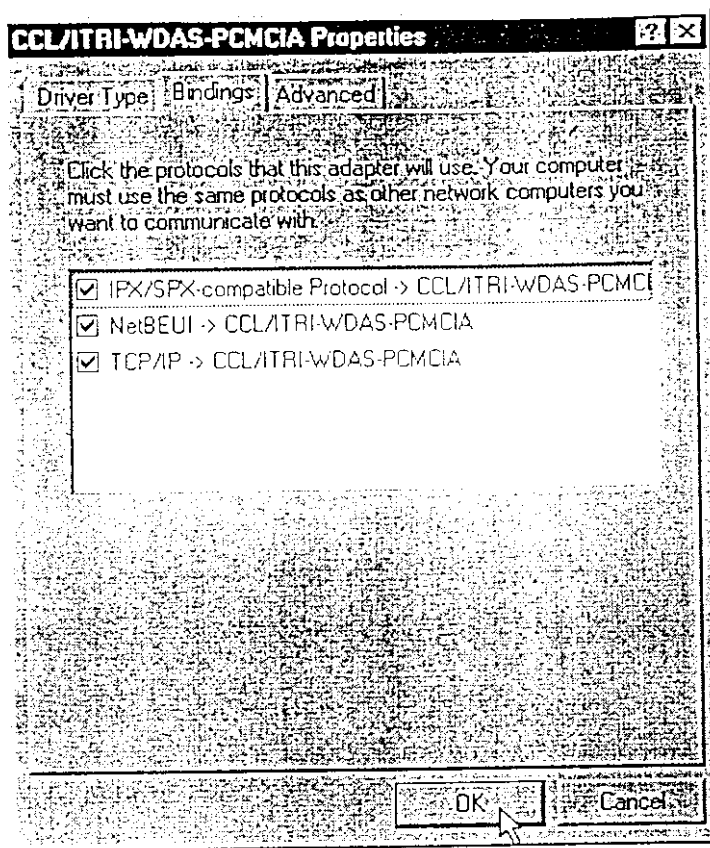


6. Choose the "Advanced" tab to display the LAN-TO-GO parameters. If you like, you can change the parameters as needs (see the following paragraph for a description of the parameters).





7. To view the network protocol settings, choose the "Bindings" tab in the CCL/ITRI-WDAS-PCMCIA Properties folder.



8. Click the "OK" button to quit the CCL/ITRI-WDAS-PCMCIA Properties folder.

If you changed parameters in the CCL/ITRI-WDAS-PCMCIA Properties window, Windows 95 may prompt you to reboot your system.

## LAN-TO-GO parameters

### AP MAC Address

Any device that contains an IEEE 802.11 conformant MAC and PHY interface to the wireless medium is called the Station (STA). The Access Point (AP), considered to be synonymous with "Portal" as defined in the 802.11 Specifications, provides logical integration between the 802.11 WLAN and an integrated wired 802.x LAN. The AP MAC Address specifies the address of the AP with which the STA will try to be associated initially. At any given instant, a STA may be associated with no more than one AP. A STA learn the presence of an AP and then requests to establish an association by invoking the function of scanning. The Access Points establishes coverage areas or *cells* similar in concept to those of a cellular phone network.

## Infrastructure/Ad Hoc Mode

An Ad Hoc network is often formed without pre-planning, for only as long as the LAN is needed. The principal characteristic of an Ad Hoc network is limited temporal and spatial extent. An Ad Hoc network is often supported by an Independent Basic Service Set (IBSS) network, where a STA communicates directly with one or more other STAs. In practice, an off-the-shell peer-to-peer network operating system (NOS) will provide the set of services required in an Ad Hoc network.

The 802.11 Specifications states that "the infrastructure includes the Distribution System Medium, Access Point and Portal entities, as well as being the logical location of Distribution and Integration service functions of an ESS". It is possible to create an Extended Service Area (ESA) that provides wireless coverage for an entire building or area by connecting multiple Access Points to existing wired LANs. In such an environment, a mobile user can maintain a seamless connection to the network as he moves about.

## Set Channel

If you experience severe interference or for any other reason, you may want to change the channel being used to a different one. If you want the LAN-TO-GO PC Card to pick a channel on its own, set the value to 0. As shown in the table below are the center frequencies for each selectable operating channel within the 2.4 to 2.4835 GHz frequency band. For North America (FCC), all channels 1-11 are supported; for Europe (ETSI), channels 3-11 are supported. For operation in Japan, channel 12, which uses the 2.471 to 2.497 GHz frequency band, should be chosen.

Channel	North America	Europe	Japan
1	2412 MHz	N/A	N/A
2	2417 MHz	N/A	N/A
3	2422 MHz	2422 MHz	N/A
4	2427 MHz	2427 MHz	N/A
5	2432 MHz	2432 MHz	N/A
6	2437 MHz	2437 MHz	N/A
7	2442 MHz	2442 MHz	N/A

8	2447 MHz	2447 MHz	N/A
9	2452 MHz	2452 MHz	N/A
10	2457 MHz	2457 MHz	N/A
11	2462 MHz	2462 MHz	N/A
12	N/A	N/A	2482 MHz

In a multiple cell network topology, overlapping and/or adjacent cells using different channels can operate simultaneously without interference if the distance between the center frequencies is at least 30 MHz.

## SSID

The Service Set Identity (SSID), or called Domain ID by some vendors, has relation to the seamless “roaming” feature of the system. Its purpose is to render a homogeneous WLAN environment regardless of the physical location the Station would be. The rule of thumb is to use the same value as that used by the Access Point with which the Station will be associated.

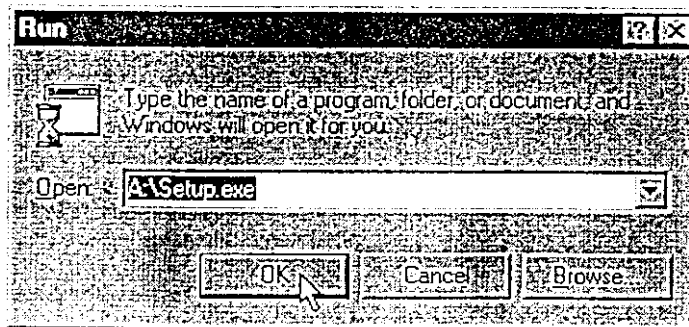
# LAN-TO-GO Utilities

There are two utilities to help you easily configure and test the LAN-TO-GO PC Card. The smalicon program will continuously monitor the link quality, and the WDASusa program is a site survey and configuration tool. Both programs run in Windows 95 and should be installed into the fixed disk before they can be used. The Setup program located in the LAN-TO-GO Windows 95 Utilities Setup Disk 1 will copy most of the files into the default directory, C:\Program Files\DBTEL, or into the directory specified during the installation. To run this program, you will need a computer that:

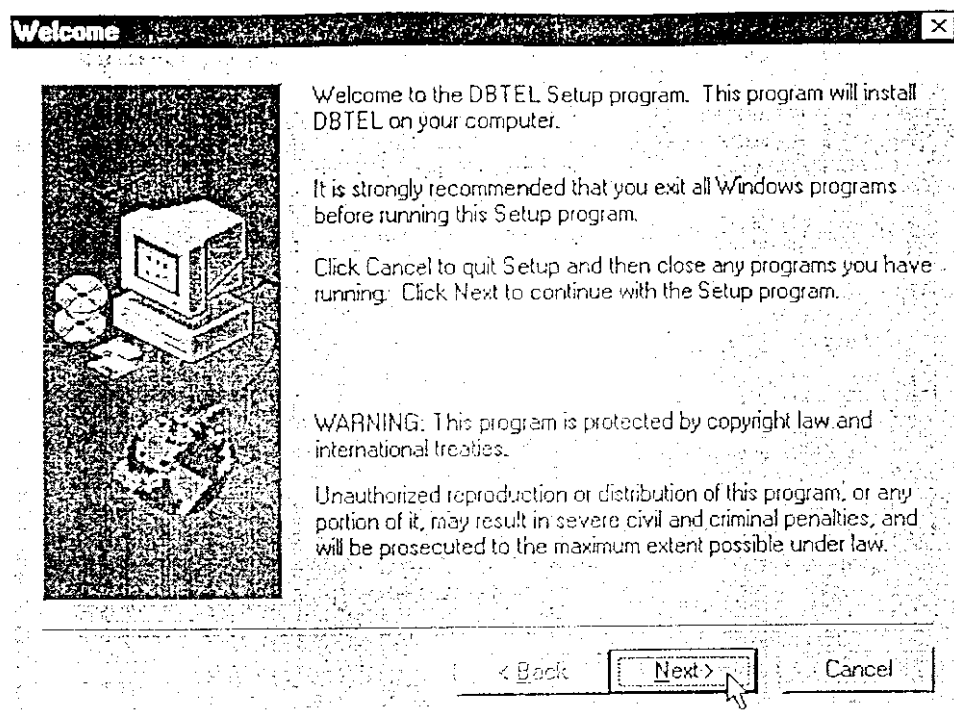
- Runs the Windows 95 operating system
- Has the LAN-TO-GO PC Card and its driver (miniport driver) properly installed.

Follow these steps:

1. Insert the LAN-TO-GO Windows 95 Utilities Setup Disk 1 in drive A:.
2. Click the "Start" button on the Windows 95 Taskbar. Move the pointer to Run... and then click on it. The Run window appears.

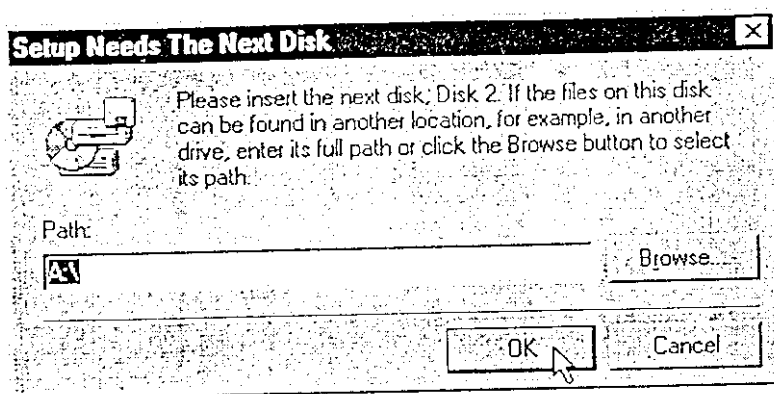


3. Type A:\Setup and click the "OK" button. The Setup program displays a Welcome message box with options to continue or exit. Click the "Next >" button to continue.



4. When the User Information window appears, simply fill in your name and the company you are working for (using the TAB key to change between fields). Click the "Next >" button when it is done. The Choose Destination Location window appears
5. Click the "Next >" button if you are satisfied with the default directory, C:\Program Files\DBTEL, or click the "Browse..." button to specify the directory you would like.

7. From Start Copying Files window, click the "Next >" button to start copying files, or click the "< Back" button to review or change any settings.
8. Insert the LAN-TO-GO Windows 95 Utilities Setup Disk 2 in drive A: at Setup request. Click the "Next >" button to continue.

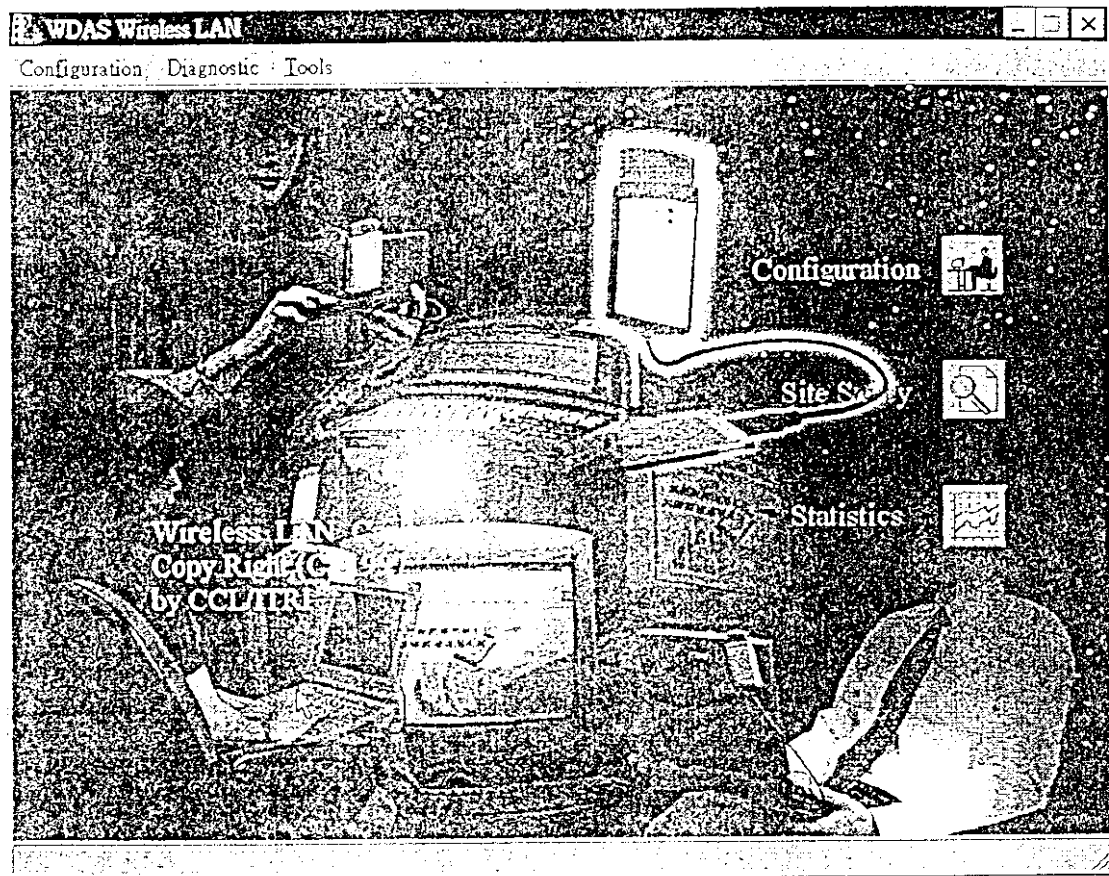


9. Click the "Finish" button when everything is done.
10. Review the README.TXT that opens automatically when the installation is complete.

When Setup is complete, the LAN-TO-GO Utilities Folder contains two icons: smalicon, and WDASusa.

# Configuration and Diagnosis

After the WDASusa program is loaded, the main menu similar to the following figure will appear



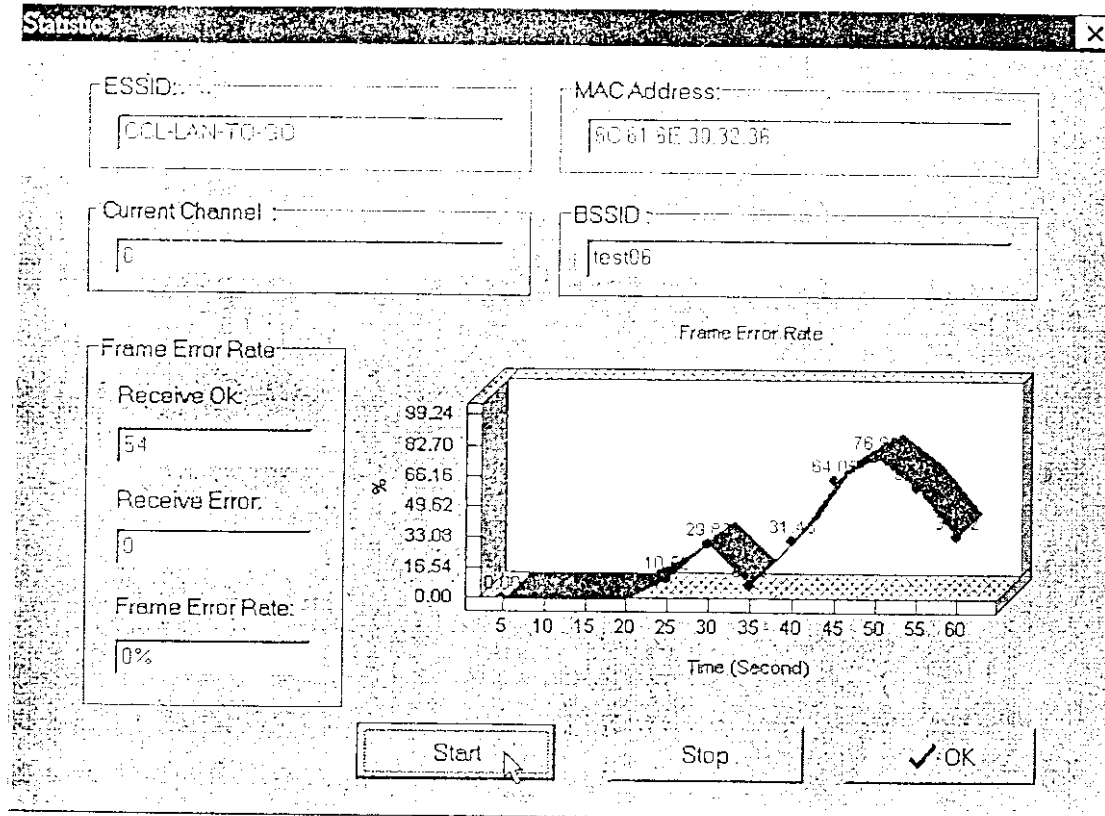
## Statistics

This tool displays the network statistics maintained by the LAN-TO-GO PC Card. The use of statistics is a convenient way to judge how your LAN-TO-GO PC Card is. The Statistics window displays all the settings essential to the proper operation of the LAN-TO-GO PC Card at a glance. If you see any contradiction or invalid value from this Statistics window, the LAN-TO-GO PC Card may be in trouble or the surrounding environment is too hostile to its operation. The *Beacons* transmitted periodically from the access point will be utilized to calculate the receiving frame Error Rate. The 32-bit *Cyclic Redundancy Check* (CRC) field of the Beacon frame is the criterion used to determine whether the frame is received successfully or not.



Follow these steps to use the statistics tool:

1. Click the Statistics option from the main menu of the WDASusa program. The Statistics window appears.
2. Click the "Start" button. The statistics of receiving Frame Error Rate will be calculated and depicted on the graph at an interval of five seconds.



3. Click the "OK" button when you are done.

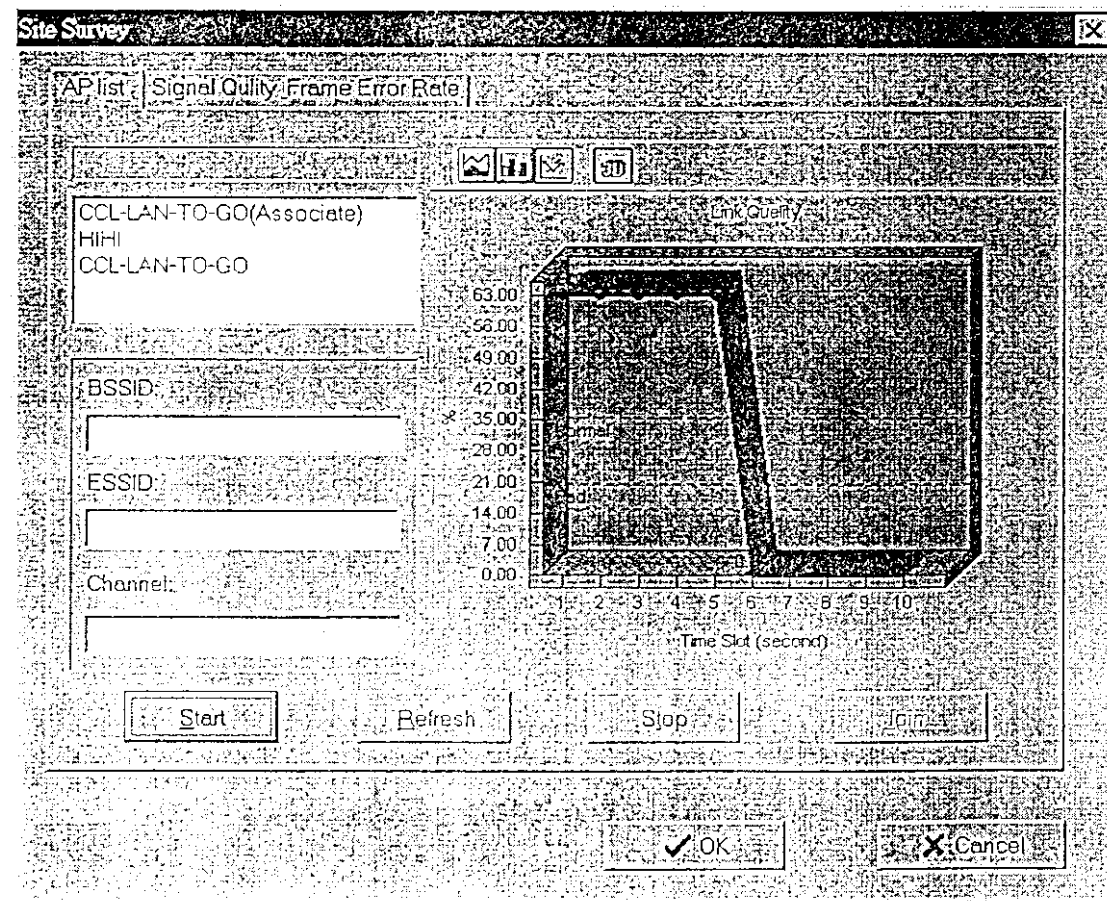
## Site Survey

The purpose of the site survey tool is to provide you with a directory of access points in the vicinity of your current location. You learn what access points are within the range of access by referring to AP List shown on the Site Survey folder. If your computer is being associated with any access point, it will be specifically indicated in the AP List also. You are required to first become associated with an access point before you are allowed to make use of the services provided by the access point. If multiple access points are present simultaneously, you have the freedom to make your choice among them. But, you need to be sure that you have the privilege to establish an association with

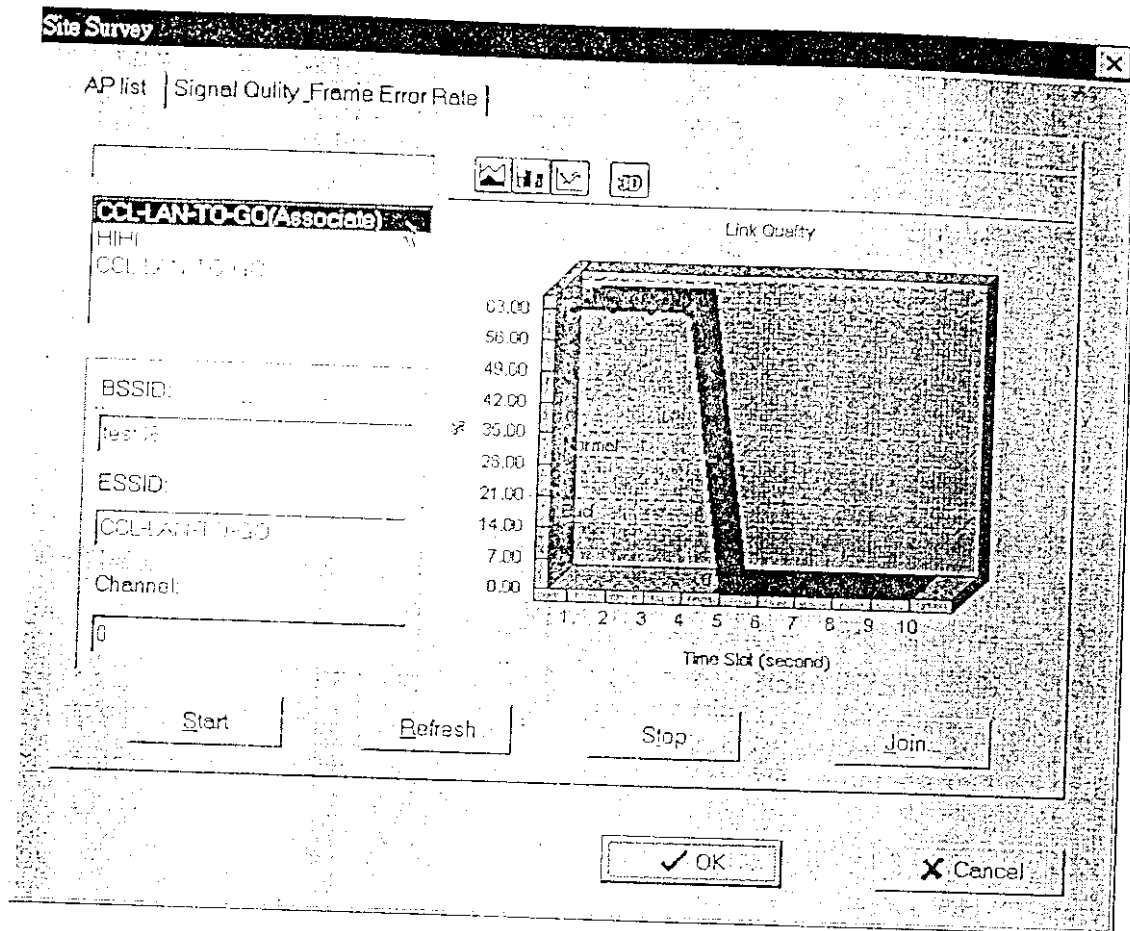
that access point. Ask your network administrator or MIS people to know exactly with which access points you are allowed to be associated. The presence of any particular access point does not automatically give you the right to be associated with. If you try to be associated with an access point which you are not authorized the privilege yet, then your request will be rejected. At any given instant, you can be associated with no more than one access point. This ensures that no chaos will occur in the network. On the contrary, an access point may be associated with many stations at one time.

Follow these steps to use the site survey tool:

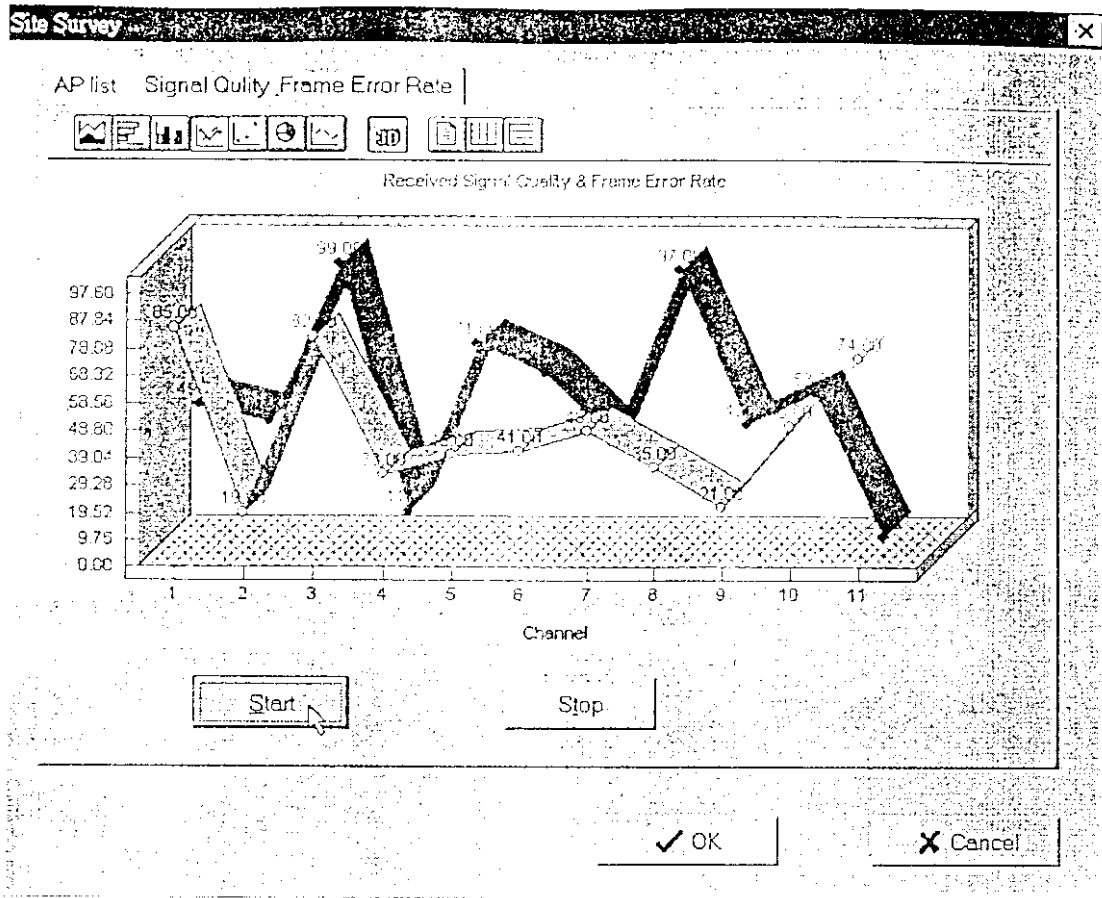
1. Click the Site Survey option from the main menu of the WDASusa program. The Site Survey folder appears.
2. Choose the "AP List" tab. The dialog box similar to the following one appears. All found access points, each identified with a unique host name (its ESSID), will be shown in the list.



3. Pick an access point from the list. The corresponding BSSID, ESSID, and Channel being used are shown immediately.



4. Click the "Start" button. The program will start monitoring the link quality between the station and the access point at a interval of time slot. The result will be logged and represented by the percentage diagram as shown in the figure.
5. Choose the "Signal Quality\_Frame Error Rate" tab if you want to see the receiving Frame Error Rate precisely.
6. Click the "Start" button. Because this is a stochastic process, the resulting curve will be fluctuating with time.
7. Click the "OK" button when you are done.



## Advanced Configuration

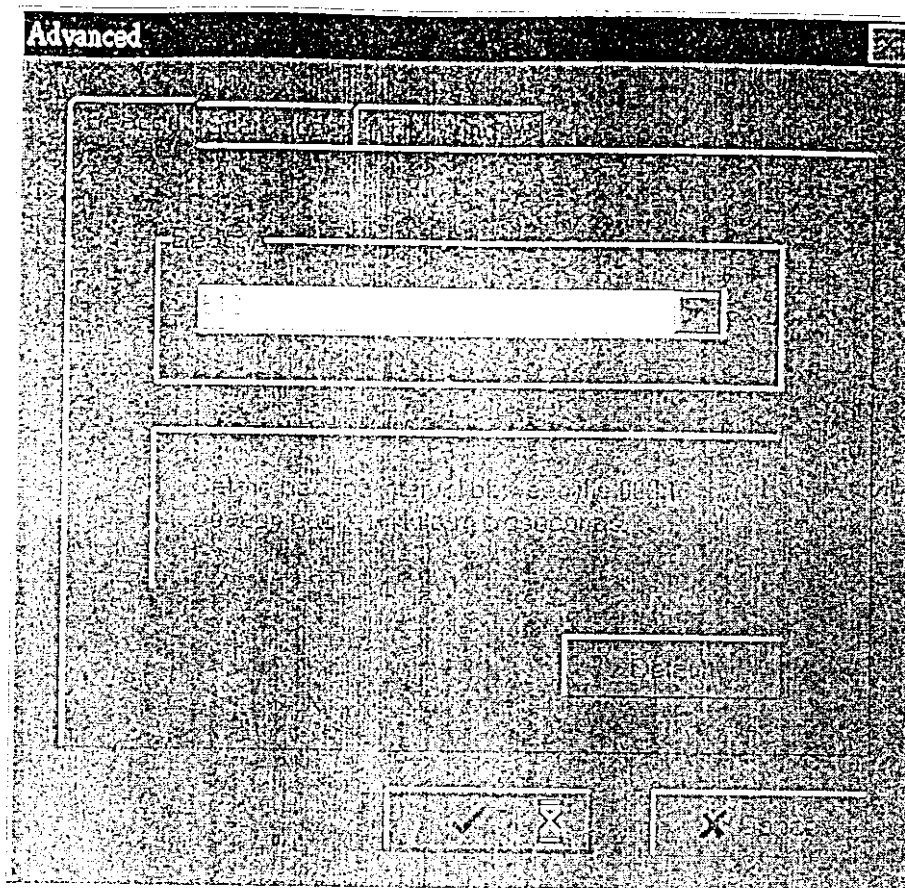
The following discussion deals with the subjects of synchronization, power management, roaming (scanning), etc., which are the essentials of wireless LAN. Generally speaking, you are not required to familiarize yourself with all the details explained below. As long as you follow the previous directions as to how to install the driver, you should be able to start using your wireless LAN without difficulty. Nevertheless, it will be to your advantage to become familiar with the topics covered below.

### Beacon Interval

In an 802.11 wireless LAN, all stations within a single BSS shall be synchronized to a common clock using the *Timing Synchronization Function* (TSF). All stations shall maintain a local TSF timer. The TSF keeps the timers for all stations in the same BSS synchronized. In an infrastructure network, the AP shall be the timing master and shall perform the Timing Synchronization Function. The Timing Synchronization Function in an Independent BSS (Ad Hoc) shall be performed by all of the members of the BSS via a distributed algorithm. The AP shall initialize the TSF timer independently of any simultaneously started APs and the APs shall make their efforts to ensure they are not synchronized with each other. To synchronize the other stations in a BSS, the AP shall periodically transmit special frames called *Beacons* that contain a copy of its TSF timer. Receiving stations shall always accept the timestamp value in Beacons sent from the AP servicing their BSS. Beacons shall be generated for transmission by the AP once every Beacon Interval time units. Occasionally, you may have need to change the Beacon Interval attribute as required.

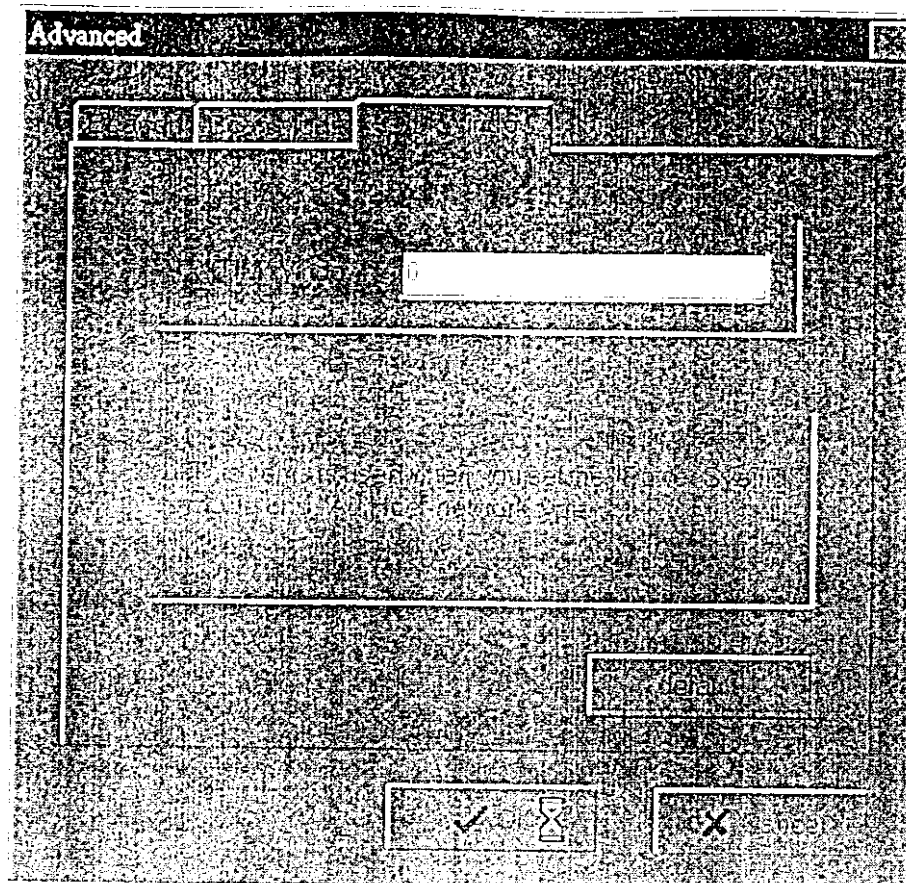
To change the Beacon Interval, follow these steps:

1. Click the Configuration option from the menu. The Advanced folder appears.
2. Choose the "Beacon" tab. Click the "▼" button, then a list of available values pops up.
3. Choose a value from the list and click the "OK" button.
4. Click the "Default" button if you want the default value to be used.



Scan Mode









# Specifications

Physical	
Interface	PCMCIA Type II
PC Card Dimensions	107 mm × 54 mm × 5 mm
Total Weight	110 g
Standard Compliance	IEEE 802.11
Media Access Protocol	Unicast: CSMA/CA + ACK, Broadcast: CSMA/CA
Frequency Band	2.4 - 2.4835 GHz ISM band
Number of Selectable Channels	
North America (FCC)	11
Europe (ETSI)	9
Japan	1
Modulation Technique	Direct Sequence Spread Spectrum (DSSS)
Data Rate	1 Mb/s (DBPSK), 2 Mb/s (DQPSK)
Frame Error Rate	Less than $8 \times 10^{-2}$
Output Power	12 dBm
Receiver Sensitivity	-82 dBm
Regulations	
USA	FCC Part 15
Europe	ETS 300-328
Environmental	
Operating Temperature	0° - 40° C
Humidity	
Range	
Open Office	200 m
Semi-Open Office	50 m
Closed Office	25 m
Operating Voltage	5 Vdc
Power Consumption	
Sleep Mode	30 mA
Receive Mode	320 mA
Transmit Mode	385 mA

## □ **Developer's Guide to Sutro Debug SUDBG.EXE**

Sudbg.exe is a DOS application program designed to provide an integrated test environment for the Wireless Local Area Network of CCL/ITRI. The target to verify is the operation of the Medium Access Control Protocol residing in the WLAN PC card. This program is interface-specific and dedicatedly written for the DSSS Wireless Data Access System(WDAS) of CCL/ITRI. No further distribution of Sudbg.exe and this document is allowed without permission from CCL/ITRI.

Sudbg.exe simulates the interface operation between the driver(DOS device driver) and the embedded(WLAN card). Commands are provided to issue some propriotorily defined operation demands to trigger the embedded to operate. It should be emphasized that the Sudbg.exe is not a device driver, it is not able to offer all the capabilities that the WDAS device driver possesses.

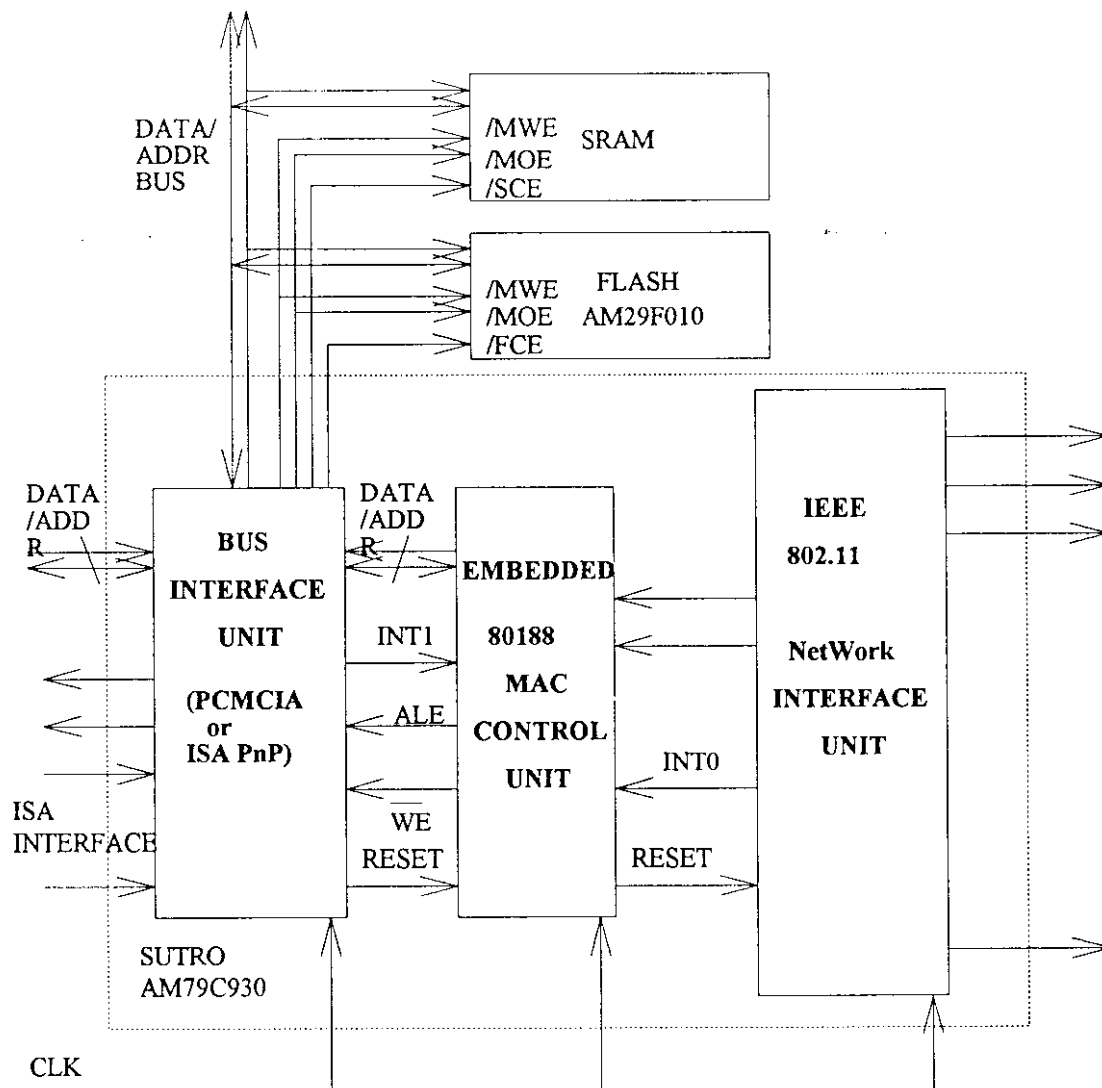
Sudbg.exe is suggested to be executed under single-tasking OS like DOS 6.22 or MS-Windows 3.1. Although it can also be executed under the MS-DOS command shell within the Microsoft Windows 95, some items are not guaranteed to work well due to the Operating System architecture, especially those relative to the IO and IRQ resources. The following section will briefly introduce how to use this tool under DOS environment.

### □ Preliminary

In this section, we will briefly outline the WLAN system architecture. As the following figure shows, there are three major devices that shall be briefly explained here for clarity.

AM79C930, also called SUTRO, contains Bus Interface Unit(BIU), 80188 Embedded CPU, and a Network Interface Unit(NIU). NIU is in charge of control of physical interface, which can be either DS or FH RF module; BIU is responsible for arbitration of access to data bus from both 80188 and host side. The CPU 80188, without further emphasis, controls the whole operation of the embedded system. Inside SUTRO BIU, four sets of registers: SIRs(System Interface Registers), MIRs(MAC Interface Registers), TIRs(Transceiver Interface Registers) and TCRs(TAI Configuration Registers) are provided. Only the MIRs are not visible by the driver. We may

access desired data either from SRAM and FLASH and control the TAI through the SIR, TIR and TCR register sets of the bus interface unit. Prior knowledge of the SIRs, TIRs and TCRs are necessary to skillfully manipulate the Sudbg.exe, which is beyond the scope of this manu and can be found in the AM79C930 data book.



## Start Executing the Sudbg.exe

Under DOS environment, type

the program will be loaded and start executing. Upon its execution, the sudbg first calls some PCMCIA Card Service functions to get the hardware resource information like IO Base Address(IOBA) and IRQ number. If no hardware is

present, or the PC-card is not CCL/WDAS card, then the sudbg will prompt a Message dialog Window, requesting an IOBA input:

*Invalid IRQ: 00/IOBA: 0000! Enter IOBA Value(ESC: 280): 300*

*Active Socket x, IOBA: 0300, IRQ: 0B! Press Any Key...*

Key in the IOBA you know(300 as example), or press ESC key to select the default value 0x0280. If a wrong IOBA is issued, then you will not be able to control the WLAN card at all.

If some proper PCMCIA drivers are present, the sudbg will show the following message:

*[SOCKET 0]: IOBA 0280, IRQ 0B.*

*Active Socket 0, IOBA: 0280, IRQ: 0B! Press Any Key...*

This says that a CCL/WDAS card has been found, and the hardware resource IOBA is assigned to 0x0280, IRQ to 0x0b. The socket 0 is currently active.

If two CCL/WDAS card are inserted to the PCMCIA slot, the given message will be:

*[SOCKET 0]: IOBA 0280, IRQ 0B. [Socket 1]: IOBA: 0300, IRQ: 05.*

*Active Socket 0, IOBA: 0280, IRQ: 0B! Press Any Key...*

, indicating that two cards are detected.

After press any key, some menu is shown on screen:

*Commands Packets 80188 Memory Register Inspect Tests More*

Above this main manu inside the frame, the currently active socket is shown: *Socket[x]*. If the “x” within the [] is not 0 nor 1, then it means that the sudbg has not detected a valid card’s presence after initialization process.

To have proper operation, user shall install some PCMCIA utility to provide the PCMCIA card service function calls. This is outside the scope of this document.

When manipulate the sudbg.exe, you may use the following key to move the cursor:

←: Move to the left

→: Move to the Right

↑: Move Up

↓: Move Down

↵: Enter to select

ESC: Cancel

PgUp: Go to the first item

PgDn: Go to the last item

Space: Change Active Socket

#### ☐ The Commands Submenu

Commands submenu contains some driver-embedded interface defined operation. When the *Commands* is selected, you will see the sub-command list:

- *Interrupt Mask*: Set some bits to 1 to unmask some specific interrupt events. Prior knowledge of the interrupt types is necessary to have a proper setting. It is interface-specific and is suggested to be used by Designer.
- *Interface Test*: Interface test command. Prior knowledge of the interrupt test is necessary to have a proper setting. Also Interface-specific.
- *Start Embed FSM*: To start the finite state machine of the embedded system through the interface-specific START\_EMBED\_FSM command. The card will not accept any transmission and reception demand if the embedded finite state machine is not started.
- *Stop Embed FSM*: To stop the finite state machine of the embedded system through the interface-specific STOP\_EMBED\_FSM command.
- *Set Channel*: Switch to the desired channel through the interface defined SET\_CHANNEL command. The channel number (1 to 11) and their associated frequencies are defined according to the IEEE 802.11 standard.
- *Set TSF Timer*: Not Implemented.
- *Set TBTT*: Not Implemented.
- *Sleep*: Not Implemented

□ The Packets Submenu

The *Packets* submenu collects all the frame generation setting bullets related to IEEE 802.11. As you chose *Packets*, you will see a submenu list as follows:

- *Set DA*: set your Destination Address.
- *Load Payload*: input any file as your payload. The file size shall not be larger than 1500 bytes.
- *Show Tx Packets*: Show the packet content and some information you are going to transmit.

- *Tx Packet*: transmit the current packet.
- *Reload Dummy Pkt*: load the default packet content as your current transmission packet. The result can be viewed by *Show Tx Packets*.
- *Set BSSID*: Set the Basic Service Set ID(Address3).
- *Set To/From DS: 00*: Change the TO\_DS and FROM\_DS subfields of the Frame Control Word. Once modified, the Address1(DA), Address2(SA) and Address3(BSSID) fields of a frame will be rearranged according to the IEEE 802.11 standard.
- *Set Original Src*: To set the Address4 field of a frame. This will be present only when the TO\_DS and FROM\_DS are both set to 1.
- *Set Rate: 1M*: Set the desired transmission rate. Both service rates (1M and 2Mbps) are provided. User can enter the asterisk "\*" to have a fixed transmission rate randomly selected by Sudbg.
- *Set Type: Data*: This sets the TYPE field of a frame. It can be either Data frame or Mgmt frame.

The above address settings all require 6-character input. If less than 6 characters, the setting will be rejected. Note that the Source address (Address2) is automatically read from the flash.

#### □ The 80188 Submenu

The 80188 submenu consists of some Code Execution and CPU related functions.

- *Set Sutro IRQ*: set the corresponding IRQ interrupt service routine entry point to the Interrupt vector table of the host PC. This is accomplished by calls to the DOS INT 21 services. Under Windows 95, it may cause troubles.
- *Enable Sutro IRQ*: Unmask IRQ Signalling of the embedded. Interrupt will not be generated by the AM79C930 if it is not enabled.
- *Resume Embed Core*: To continue the embedded 80188 core execution if the embedded core is in wait state.

- *80188 Core Reset*: Clear the SRAM contents to 0 and reset the embedded core.
- *Next Breakpoint*: Let the embedded free run to next predetermined "Break point".
- *Cease Embed Core*: Set the embedded 188 core into wait state.
  - *Disable SUTRO IRQ*: mask the IRQ of the embedded.
- *Reset SUTRO IRQ*: reset the original IRQ interrupt service routine entry back to the Interrupt vector table of the host PC. This is accomplished by calls to the DOS INT 21 services. Under Windows 95, it may cause troubles.

The above is useful for MAC developers to well control the embedded 80188 CPU inside the SUTRO. In order to let the embedded interrupt work properly, the following sequence shall be followed:

- 1). *Set SUTRO IRQ* and
- 2.) *Enable SUTRO IRQ*.

The first one sets the interrupt vector table the entry point of receive interrupt service routine contained in sudbg; It is not sufficient to have any interrupt triggered to 8259 unless the hardware mask of the wireless LAN card is enabled. Any embedded debug messages and packet received can be perceived by sudbg only if IRQ is both set and enabled.

When you quit sudbg, sudbg will check if *Set SUTRO IRQ* is executed. If yes, it will automatically reset it back to its original value before it quits. User, of course, can disable IRQ from the embedded by *Disable SUTRO IRQ* and *Reset SUTRO IRQ*.

If there is any necessity that users have to stop or resume the embedded operation, they can user *Disable Embed Core* and *Resume Embed Core* functions. The first holds the CS:IP to stop changing, keeping the CPU in the wait state.

One of the most frequently used function could be *Reset 80188 Core*, which will first stop the embedded's execution, clear SRAM and then reset 80188's program counter to its beginning value to restart.

As to *Next Breakpoint*, we have to make clear how it works a bit. In this environment, users are not able to set breakpoints anywhere they want after their codes are programmed into the flash. The breakpoints shall be set by modifying the source codes by adding the macro "Break()" or "Breakat(...)".

What these two macros do are to put the message into a defined buffer and to poll a “resume” command at a particular location. That is, these macros will first let users know where the embedded stays at this moment and embedded will not break the infinite polling loop until the *Next Breakpoint* command is ordered. If there is no breakpoint added to your source code, then *Next Breakpoint* affects nothing.

#### □ The Memory Submenu

The third one we are to introduce is *Memory*, which contains the basic operations to SRAM and Flash memory. This is especially important to provide the runtime inspection on the contents in the embedded for debugging.

- *Read SRAM*: Read contents of SRAM into the temporary allocated buffer. The SRAM is partitioned into two sectors: 0 and 1, with each 16 Kbytes in size. All displayed in Hex.
- *Display Buffer*: Display the contents in the temporary buffer for memory processing. The buffer size is 16 KBytes.
- *Fill Buffer With*: Fill some specific pattern to the entire temporary buffer.
- *Fill Part of Buffer*: Fill some specific pattern to the desired part of the temporary allocated buffer.
- *Write Buffer to SRAM*: write the current content of the temporary buffer to the desired sector in SRAM.
- *Write 1 Byte to SRAM*: write one specified byte to the absolute address you specify directly to the SRAM(not temporary buffer!).
- *Read Flash*: Read the contents of the desired flash sector. The flash is partitioned into 8 sectors: 0 to 7, each with size 16 Kbytes.

#### □ The Registers Submenu

The functions under the *Registers* submenu deal with registers display and modification within SUTRO and HSP3824. They are the previously mentioned SIRs, MIRs, TIRs and TCRs. In addition, the Control Registers(CRs) of the direct sequence spread spectrum baseband transceiver



HSP3824 can also be inspected and written for experiment purpose.

- *Show Registers*: Show the contents of all the visible registers within SUTRO and HSP3824. All displayed in Hex.
- *Modify SIR*: Modify the specified SIR register. Prior knowledge is necessary to have proper result. Please refer to the AM79C930 data sheet for more details.
- *Modify TIR*: Modify the specified TIR register. Prior knowledge is necessary to have proper result. Please refer to the AM79C930 data sheet for more details.
- *Modify TCR*: Modify the specified TCR register. Prior knowledge is necessary to have proper result. Please refer to the AM79C930 data sheet for more details.
- *Modify HSP3824*: Modify the specified CRx register. Prior knowledge is necessary to have proper result. Please refer to the Harris HSP3824 data sheet for more details.

#### □ The *Inspect* Submenu

The Inspect Submenu contains some message display, especially on the global variables used by the embedded. To do so, user shall first load the corresponding MP2(a map file generated after linking), and then the variable values will be displayed according to the alphabet order.

- *Load MP2 File*: Used to load an MP2 file.
- *Inspect...*: Inspect the contents of the variables listed in the MP2 file loaded.
- *Dbg Msg On*: Enable the real-time debug message display. This function will execute the following CPU dependent instructions:
  1. *Set SUTRO IRQ*
  2. *Enable Embed INT*
  3. *Pop up a dbg message box.*

Once if there is any debug message detected, the sudbg.exe will show the message on the debug box.

Note: The display of strings requires lots of CPU time, which may affects the host PC's operation. Also, interrupt will be

missing due to the display time spent.

- *Dbg Msg Off*: Turn off the debug message box. Also the followings will be executed:

1. *Disable Embed INT*
2. *Reset SUTRO IRQ*

#### □ The Tests Submenu

The *Tests* submenu contains some assistant Frame Error Rate Tests setups. The FER is used during product development to make sure if the FSM runs smoothly without being stucked. It can also used as a guide to how the RF performs, given that the MAC protocol performance is guaranteed to some degree.

- *Enable Tests*: To enable the test facility. This executes the following CPU-related steps:

1. *Start Embe FSM*.
2. *Set SUTRO IRQ*.
3. *Enable Embed INT*.

The Sudbg will not receive any frames if this is not executed.

- *FERTx Test End*: This will issues continuously the frame transmission requests whenever the sudbg can. Users may requests to send specified frame length, the delay inbetween frames and the number of frames to be transmitted. Before executing this, the *Enable Test* may be ignored due to some polling mechanism is implemented.
- *FERRx Test End*: This enables the sudbg to react upon the receive interrupt signalled by the embedded. The statistic counting will be refreshed after every 16 frames have been received. The *Enable Tests* must be executed before this, otherwise no embedded interrupts will be detected.
- *Disable Tests*: The reverse process of the *Enable Tests*, doing the following steps to restore to the original state:
  1. *Disable Embed INT*
  2. *Reset SUTRO IRQ*
  3. *Stop Embed FSM*

Note that this will be automatically executed when quitting the

sudbg, if the *Enable Tests* has been executed before.

- *Set RF Band*: Set the RF to the desired channel. In addition to the CCL, the Harris Evaluation board is supported as well. This will not be correctly program the frequency synthesizer if the IF/RF designed has been modified. It is suggested that *Set Channel* be used to select the desired channel.

#### □ The More... Submenu

The last one is the *More...* option. It contains:

- *Help*: display the basic idea what sudbg is for.
- *Quit*: quit the sudebug program. Under the top-menu, ESC can quit the whole program as well.

When it is about to quit, sudbg will try to restore all the settings back to the originals.

#### □ Quitting the Sufhss.exe

Under the top-menu, press ESC.

#### □ Summary

As emphasized, sudbg.exe is designed for the purpose of making sure the MAC layer protocol according to the operation mode defined between DOS driver and embedded. It is not a universal but a specially designed debug tool. Moreover, it just simply simulates the operation of this driver-embedded interface, users shall not expect it to simulate the jobs that a driver should do. The behaviors you see under the environment sudbg provides could be different from what you observe with a real driver.

## Testing procedure

Testing Equipment: Two notebooks are used for the testing.

1. HP OMNIBOOK: for EMI test. Please use the upper PCMCIA slot.
2. IBM ThinkPad: for function test ONLY.

EUT : There are models of LAN2GO cards.

Function Modes:

1. Receiver Mode: for setting cards in the receiver mode.
2. Transmitter Mode: for setting cards in the transmitter mode to sent the signal continually.
3. Function Test TX Mode: for function test, sent out the testing package, switching the card between receiver mode and transmitter mode automatically.

Function Test Procedure:

1. Set one card in the receiver mode.
2. Set the other card in Function Test TX mode in the same channel.

The testing program for the receiver card will show up the number of correct and the fail frames. Note that if these two testing cards are placed too close, the fail frames will increase because the signal saturates the RF front end. Several fail frames is acceptable because in the real implementation the system will re-sent the frames when it detected out the fail frames.

EMI Testing procedure

Set the testing card in either receiver mode or transmitter mode for EMI testing. (On the UPPER slot of **HP OMNIBOOK**) When testing the card number 3, please fix its antenna on the back of the panel by tape.

The Control Procedure:

## The Receiver Mode

### Star up

1. Power on the notebook. (Be sure that the card is **NOT** on the slot at this step.)
2. Place the card into the slot when the computer is in the DOS prompt (default).
3. Key in "card\_on.exe" for activating the card.
4. Key in "sudbg.exe" then the SUDBG main window will show up. Neglect any message, press **ESC** then press any key.
5. Under the main window select item "80188" **Enter**, under "80188" select item "80188 Core Reset" **Enter**.
6. Back to the main window select item "Commands" **Enter**, under "Commands" select item "Start Embed FSM" **Enter**.
7. Back to the main window select item "Commands" **Enter**, under "Commands" select item "Set Channel" **Enter**, key in channel number.
8. Back to the main window select item "Tests" **Enter**, under "tests" select item "Enable tests" **Enter**, and press any key.
9. Back to the main window select item "Test" **Enter**, under "Test" select item "FERTest RX End" **Enter**, the RECEPTION sub-window will pop out.

### Stop

Under the RECEPTION sub-window press "q", then press any key.

### Replay

Repeat the steps 5-9.

## The Transmitter Mode

### Star up

1. Power on the notebook. (Be sure that the card is **NOT** on the slot at this step.)
2. Place the card into the slot when the computer is in the DOS prompt (default).

3. Key in "card\_on.exe" for activating the card.
4. Key in "sudbg.exe" then the SUDBG main window will show up.  
Neglect any message, press **ESC** then press any key.
5. Under the main window select item "80188" **Enter**, under "80188" select item "80188 Core Reset" **Enter**.
6. Back to the main window select item "Commands" **Enter**, under "Commands" select item "Start Embed FSM" **Enter**.
7. Back to the main window select item "Commands" **Enter**, under "Commands" select item "Set Channel" **Enter**, key in channel number.
8. Back to the main window select item "Register" **Enter**, under "Register" select item "Modify TIR" **Enter**, key in "00" **Enter**, key in "04" **Enter**.
9. Back to the main window select item "Register" **Enter**, under "Register" select item "Modify TIR" **Enter**, key in "11" **Enter**, key in "8f" **Enter**.

### Stop

Under the main window select item "80188" **Enter**, under "80188" select item "80188 Core Reset" **Enter**.

### Replay

Repeat the steps 5-9.

## The Function test TX Mode

### Star up

1. Power on the notebook. (Be sure that the card is **NOT** on the slot at this step.)
2. Place the card into the slot when the computer is in the DOS prompt (default).
3. Key in "card\_on.exe" for activating the card.
4. Key in "sudbg.exe" then the SUDBG main window will show up.  
Neglect any message, press **ESC** then press any key.
5. Under the main window select item "80188" **Enter**, under "80188" select item "80188 Core Reset" **Enter**.

6. Back to the main window select item “Commands” , under “Commands” select item “Start Embed FSM” .
7. Back to the main window select item “Commands” , under “Commands” select item “Set Channel” , key in channel number.
8. Back to the main window select item “Tests” , under “Tests” select item “Enable tests” , and press any key.
9. Back to the main window select item “Tests” , under “Tests” select item “FERTest TX End” , the Test Frame Length sub-window will pop out just , the Max Random Delay sub-window will pop out, key in “10” , the Frame Counts sub-window will pop out press  again and there will be a sub-window show up the frames that have sent out.

## Stop

Under the Frame Counter sub-window press “q”, the press any key.

## Replay

Repeat the steps 5-9.

The relationship between channel number, fundamental frequency and Lo frequency is showed below.

Channel number	Fundamental frequency (MHz)	Lo Frequency (MHz)
1	2412	2132
2	2417	2137
3	2422	2142
4	2427	2147
5	2432	2152
6	2437	2157
7	2442	2162
8	2447	2167
9	2452	2172
10	2457	2177
11	2462	2182

## Testing Procedures

Testing Equipment: Two notebooks are used for the testing.

1. HP OMNIBOOK: for EMI test. Please use the upper PCMCIA slot.
2. IBM ThinkPad: for function test ONLY.

EUT: There are three LAN2GO cards, the model number, number and purpose are listed below.

Model	Number	Purpose
LAN2GOP1-A	3	EMI Testing
LAN2GOP1-A	5	Function Test
LAN2GOP1-B	9	EMI Testing

### Function Modes:

1. Receiver Mode: for setting cards in the receiver mode.
2. Transmitter Mode: for setting cards in the transmitter mode to sent the signal continually.
3. Function Test TX Mode: for function test, sent out the testing package, switching the card between receiver mode and transmitter mode automatically.

### Function Test Procedure:

1. Set one card in the receiver mode.
2. Set the other card in Function Test TX mode in the same channel.

The testing program for the receiver card will show up the number of correct and the fail frames. Note that if these two testing cards are placed too close, the fail frames will increase because the signal saturates the RF front end. Several fail frames is acceptable because in the real implementation the system will re-sent the frames when



it detected out the fail frames.

#### EMI Testing procedure

Set the testing card in either receiver mode or transmitter mode for EMI testing. (On the UPPER slot of HP OMNIBOOK) When testing the card number 3, please fix its antenna on the back of the panel by tape.

### *The Control Procedure:*

## The Receiver Mode

#### Star up

1. Power on the notebook. (Be sure that the card is **NOT** on the slot at this step.)
2. Place the card into the slot when the computer is in the DOS prompt (default).
3. Key in "card\_on.exe" for activating the card.
4. Key in "sudbg.exe" then the SUDBG main window will show up. Neglect any message, press [ESC] then press any key.
5. Under the main window select item "80188" [ENTER], under "80188" select item "80188 Code Reset" [ENTER].
6. Back to the main window select item "Commands" [ENTER], under "Commands" select item "Set Channel" [ENTER]. Key in channel number.
7. Back to the main window select item "Test" [ENTER], under "Test" select item "Enable tests" [ENTER], press any key.
8. Back to the main window select item "Test" [ENTER], under "Test" select item "FERtest RX End" [ENTER], the RECEPTION sub-window will pop out.

#### Stop

Under the RECEPTION sub-window press "q", then press any key.

#### Replay

Repeat the steps 5~8.

## The Transmitter Mode

### Star up

1. Power on the notebook. (Be sure that the card is **NOT** on the slot at this step.)
2. Place the card into the slot when the computer is in the DOS prompt (default).
3. Key in "card\_on.exe" for activating the card.
4. Key in "sudbg.exe" then the SUDBG main window will show up. Neglect any message, press [ESC] then press any key.
5. Under the main window select item "80188" [ENTER], under "80188" select item "80188 Code Reset" [ENTER].
6. Back to the main window select item "Commands" [ENTER], under "Commands" select item "Set Channel" [ENTER], Key in channel number.
7. Back to the main window select item "Register" [ENTER], under "Register" select item "Modify TIR" ENTER, key in "00" [ENTER], key in "04" [ENTER].
8. Back to the main window select item "Register" [ENTER], under "Register" select item "Modify TIR" [ENTER], key in "11" [ENTER], key in "8f" [ENTER].

### Stop

Under the main window select item "80188" [ENTER], under "80188" select item "80188 Code Reset" [ENTER].

### Replay

Repeat the steps 5~8.

## The Function test TX Mode

### Star up

1. Power on the notebook. (Be sure that the card is **NOT** on the slot at this step.)
9. Place the card into the slot when the computer is in the DOS prompt (default).
10. Key in "card\_on.exe" for activating the card.
11. Key in "sudbg.exe" then the SUDBG main window will show up. Neglect any message, press ESC then press any key.
12. Under the main window select item "80188" [ENTER], under "80188" select item "80188 Code Reset" [ENTER].
13. Back to the main window select item "Commands" [ENTER], under "Commands" select item "Set Channel" [ENTER], Key in channel number.
14. Back to the main window select item "Test" [ENTER], under "Test" select item

“Enable tests” [ENTER], press any key.

15. Back to the main window select item “Test” [ENTER], under “Test” select item “FERTest TX End” [ENTER], the Test Frame Length sub-window will pop out just [ENTER], the Max Random Delay sub-window will pop out key in “10” [ENTER], the Frame Counts sub-window will pop out press [ENTER] again and there will be a sub-window show up the frames that have sent out.

### Stop

Under the Frame Counter sub-window press “q”, then press any key.

### Replay

Repeat the steps 5~8 .

The relationship between channel number, fundamental frequency and Lo frequency is showed below.

Channel number	Fundamental Frequency	Lo Frequency
1	2412 Mhz	2132 Mhz
2	2417 Mhz	2137 Mhz
3	2422 Mhz	2142 Mhz
4	2427 Mhz	2147 Mhz
5	2432 Mhz	2152 Mhz
6	2437 Mhz	2157 Mhz
7	2442 Mhz	2162 Mhz
8	2447 Mhz	2167 Mhz
9	2452 Mhz	2172 Mhz
10	2457 Mhz	2177 Mhz
11	2462 Mhz	2182 Mhz

## The Transmitter Mode

### Star up

1. Power on the notebook. (Be sure that the card is **NOT** on the slot at this step.)
2. Place the card into the slot when the computer is in the DOS prompt (default).
3. Key in "card\_on.exe" for activating the card.
4. Key in "subbg.exe" then the SUBBG main window will show up. Neglect any message, press **F5** then press any key.

5. Under the main window select item "80188" **ENTER**, under "80188" select item "80188 Code Reset" **ENTER**.

6. Back to the main window select item "Commands" **ENTER**, under "Commands" select item "Set Channel" **ENTER**, Key in channel number.

7. Back to the main window select item "Register" **ENTER**, under "Register" select item "Modify TIR" **ENTER**, key in "00" **ENTER**, key in "04" **ENTER**.

8. Back to the main window select item "Register" **ENTER**, under "Register" select item "Modify TIR" **ENTER**, key in "11" **ENTER**, key in "8f" **ENTER**.

### Stop

- Under the main window select item "80188" **ENTER**, under "80188" select item "80188 Code Reset" **ENTER**.

### Replay

Repeat the steps 5~8.

## The Function test TX Mode

### Star up

1. Power on the notebook. (Be sure that the card is **NOT** on the slot at this step.)
9. Place the card into the slot when the computer is in the DOS prompt (default).
10. Key in "card\_on.exe" for activating the card.
11. Key in "subbg.exe" then the SUBBG main window will show up. Neglect any message, press **F5** then press any key.

12. Under the main window select item "80188" **ENTER**, under "80188" select item "80188 Code Reset" **ENTER**.

13. Back to the main window select item "Commands" **ENTER**, under "Commands" select item "Set Channel" **ENTER**, Key in channel number.

14. Back to the main window select item "Test" **ENTER**, under "Test" select item