Model No.: XG-880M

WIRELESS

Marvell Solutions

Manufacturing Test Suite

Libertas™ 802.11g Client Card Evaluation Tool User Guide

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Section 1. Getting Started

1.1 Overview

This document explains how to use the software command line interface for the following Libertas™ Wireless LAN (WLAN) client cards:

- Marvell® CB-32 802.11g WLAN CardBus Card
- Marvell® MB-31 802.11g WLAN Mini PCI Card

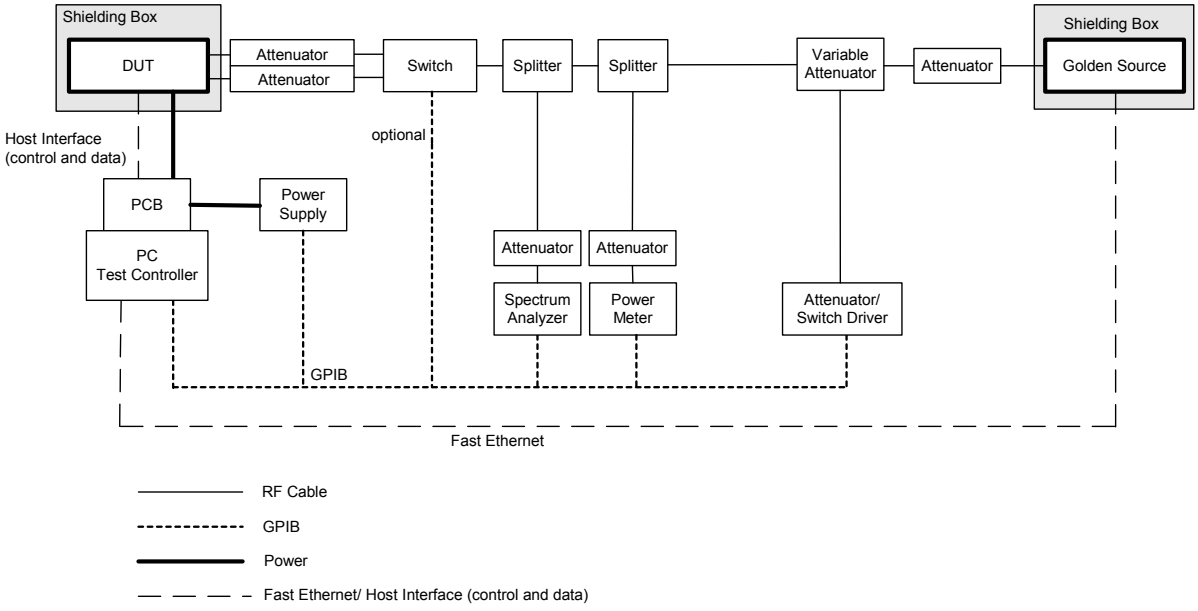
These cards include the highly integrated Libertas™ IEEE 802.11g two-chip solutions for client applications. The chipset consists of the 88W8000G Radio Frequency Transceiver and the 88W8310 WLAN Client device.

1.2 Equipment

The overall setup for testing the capabilities and performance of the Libertas™ family of WLAN chipset solutions is shown in Figure 1. The setup shows the equipment required to test the transmit/receive chains and throughput between a DUT and a golden source. Proper shielding is required for both the DUT and the golden source.

1.2.1 Test Setup

Figure 1: Test Setup



1.2.2 Calibration

It is critical to obtain accurate measurements of the path loss (due to cables, connectors, etc.) from the DUT to the Golden Unit and from the DUT to the power meter. For path loss measurements, sum the loss of each individual component along the path. Figure 2 shows the RF path loss for calibration. Figure 3 shows the switch settings for the programmable attenuator.

Figure 2: RF Path

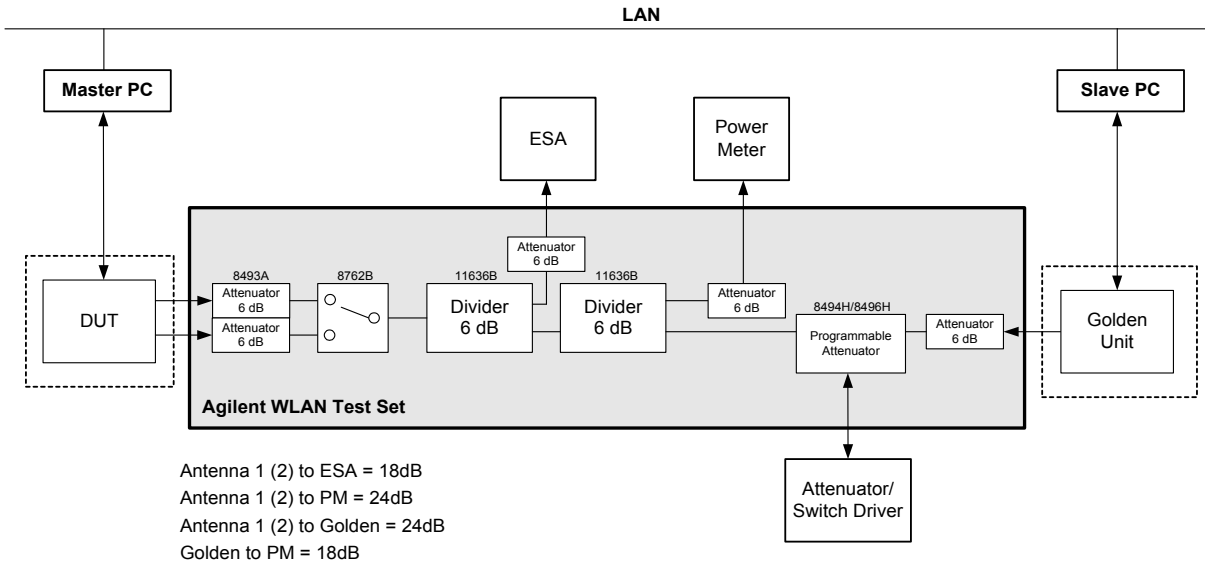
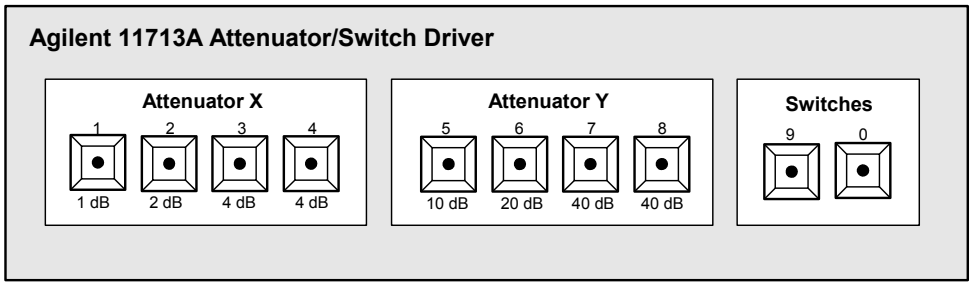


Figure 3: Switch Driver



1.3 System Requirements

- 300 MHz or faster CPU
- Windows® 2000 or 98SE (Second Edition)
- Marvell Libertas™ Client Card (CardBus or Mini PCI)

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Section 2. Software Requirements

2.1 Manufacturing Test Software Suite Contents

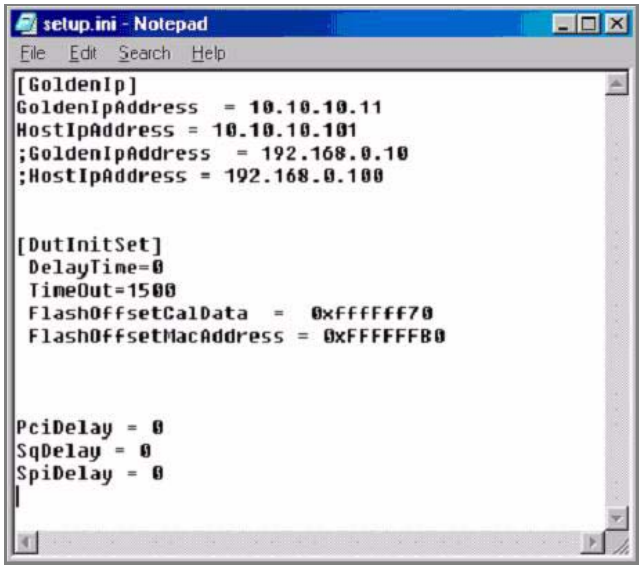
Table 1: Manufacturing Test Software

Filename	Description
SetUp.ini	Setup file. See Figure 4.
DutApi98Dll.dll	DLL file for DUT.
DutApiPci98_G.exe	Manual test module executable for client card.
GoldenAP.exe	Manual test module executable for AP golden unit.
CalDataFile.txt	Example manufacturing calibration data file. See Appendix A. "Sample CalDataFile.txt" .
Spi.hex	Hexadecimal file to program SPI (see command 35).

2.2 Software Installation

1. Copy the manufacturing test software files to a directory on the C: drive. DutApiPci98_G.exe, DutApi98Dll.dll, and SetUp.ini must be in the same directory.
2. Open the Setup.ini file with a text editor. When running both the DutApiPci98_G.exe and GoldenAP.exe test files, the Setup.ini should contain the Golden Unit IP addresses and DUT and Golden setup information:

Figure 4: Setup File



2.3 Windows Driver Installation

Installation of the driver will allow the user to access hardware memory space. The following files are required:

- MWLAN_G.inf
- windrvr.vxd
- DutApiPci98_G.exe
- wdreg.exe

2.3.1 Driver Installation Procedure

Windows explorer may not show *.Vxd file on the folder. At the MS-DOS command prompt, use the directory (DIR) command to check the entire contents of the installation disk.

Notes

- In some of the commands below you are asked to type a text string enclosed in double quotes. Do not type the quotes, they are just there for clarity.
- Commands that you type in are in **bold**.
- Pressing the **Enter** key after typing in a text string is assumed.

1. Copy windrvr.vxd from the installation disk to c:\windows\system\vmm32 directory.
2. Create an application directory (for example, “**mkdir** c:\mactest”).
3. Copy DutApiPci98_G.exe and wdreg.exe from the installation disk to the application directory.
4. Insert the Marvell card and Windows 98SE will run the device installation wizard.
   Use the INF file (a:\MWLAN_G.inf) on the installation disk to install the device.
5. Open the MS-DOS command prompt window and change the directory to the application directory (for example, “**cd** c:\mactest”).
6. Type “**WDREG.EXE** -VXD install” to run the registration program. This is CASE-SENSITIVE.
   The following messages should appear:

   ```
   Creating driver entry... OK
   Starting driver entry.… OK
   ```

7. Open the MS-DOS command prompt window:
   a) Change the directory to the application directory (for example, “**cd** c:\mactest”).
   b) Type “**DutApiPci98_G.exe**” to run the test program.

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2.3.2 Programming Configuration Information

The configuration information (MAC address, calibration data, CIS table, etc.) are saved in EEPROM and are accessed through the SPI interface. The image can be also programmed through the PCI interface. There are two ways to program the image (build-in SPI or with a hex file). Although the build-in image is more stable, loading the image from a hex file allows access to more recent information and allows more flexibility.

To program build-in image:

1. Type the command **37**.
2. Type **38** to verify the image against the build-in image. There should be no errors reported.
3. Type **48**.
   This command programs the sub-PID and sub-VID for the Marvell Mini PCI card (**47** for the CardBus).

To program the image from the file:

1. Type **39**.
   The current file name is displayed in brackets. The default is Spi.hex.
   When prompted for filename, either press **Enter** or type Spi.hex.
   If there is no change to the configuration, press **Enter**. If there is a change, the configuration information from the file name entered is retained for this execution (replaces the information in the default file).
2. Type **40**.
   This command will verify the image against the given file.
3. Type **48**.
   This command programs the sub-PID and sub-VID for the Marvell Mini PCI card (47 for the CardBus).

After downloading the image, or if the image already exists, the MAC address is programmed as follows:

1. Type “**46** xx.xx.xx.xx.xx.xx”.
   This command writes the MAC address (xx.xx.xx.xx.xx.xx). Use command 45 to view the MAC address currently programmed.
   a) Use hexadecimal values in the following format: xx.xx.xx.xx.xx.xx for the MAC address.
   b) Enter the values with a period (.) in between number pairs.
2. Type **99** to exit.

Notes

- To view the these commands, run the DutApiPci98_G.exe file as follows: “**DutApiPci98_G.exe** -m”. The space is required between DutApiPci98_G.exe and -m.
  See 3.1.3 "Additional Menu Interface" on page 13.
- Command **37** can be used to download the build-in Spi.hex file. However, when a new Spi.hex is available, use command **39**. When using command **37**, use command **48** to program PID/VID.

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Section 3. Command Line Interface

3.1 Using the Manual Test Module

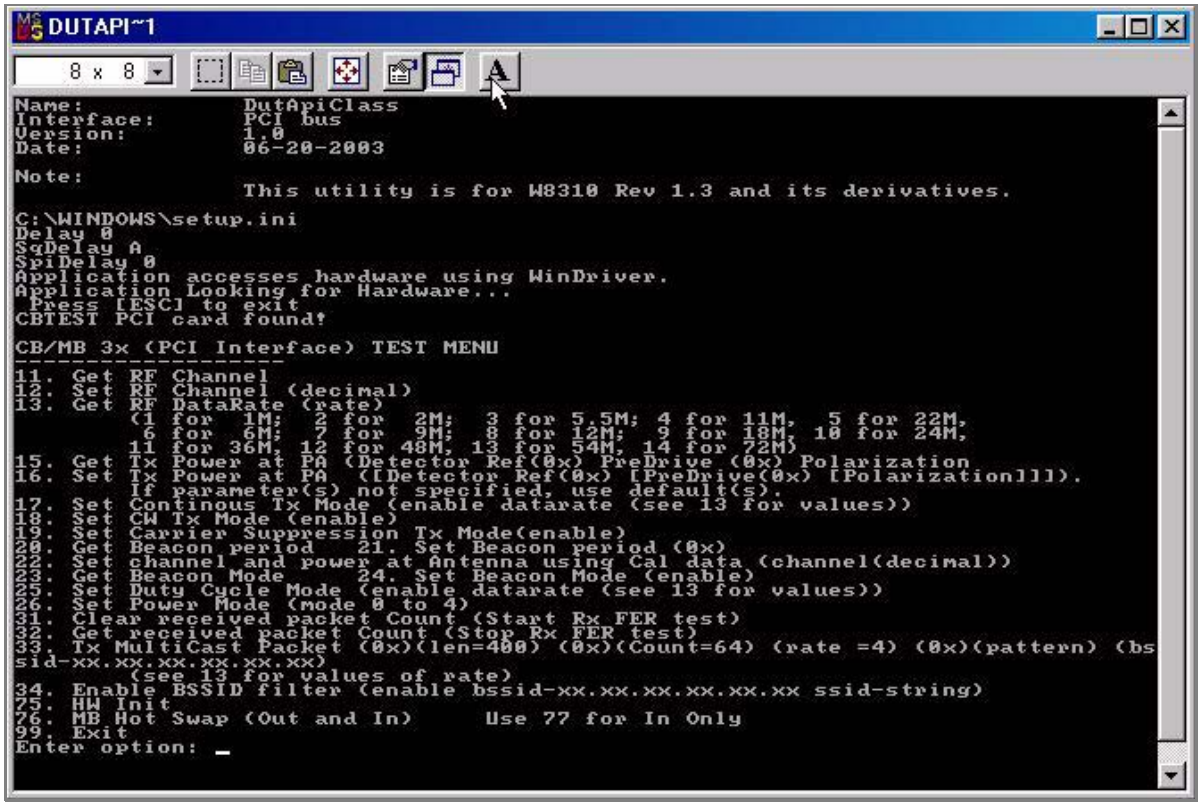
The manual test module runs through a simple menu-driven interface. Two executable files are needed for the test. The Setup.ini file must be located in the same directory as the executable files.

- DutApiPci98_G.exe. Controls the CardBus and Mini PCI cards.
- GoldenAP.exe. Controls the Golden unit. Needed for Rx Sensitivity tests (unless a signal generator is used).
- Setup.ini

Run both the DutApiPci98_G.exe and GoldenAP.exe files to launch the tool. Each command is numbered, and some commands accept input parameters. For example, to retrieve the current channel setting, type **11** and press **Enter**. This command returns the current channel. To set the channel to 6, type "**12** 6" and press **Enter**, where **12** is the command and 6 is the input parameter.

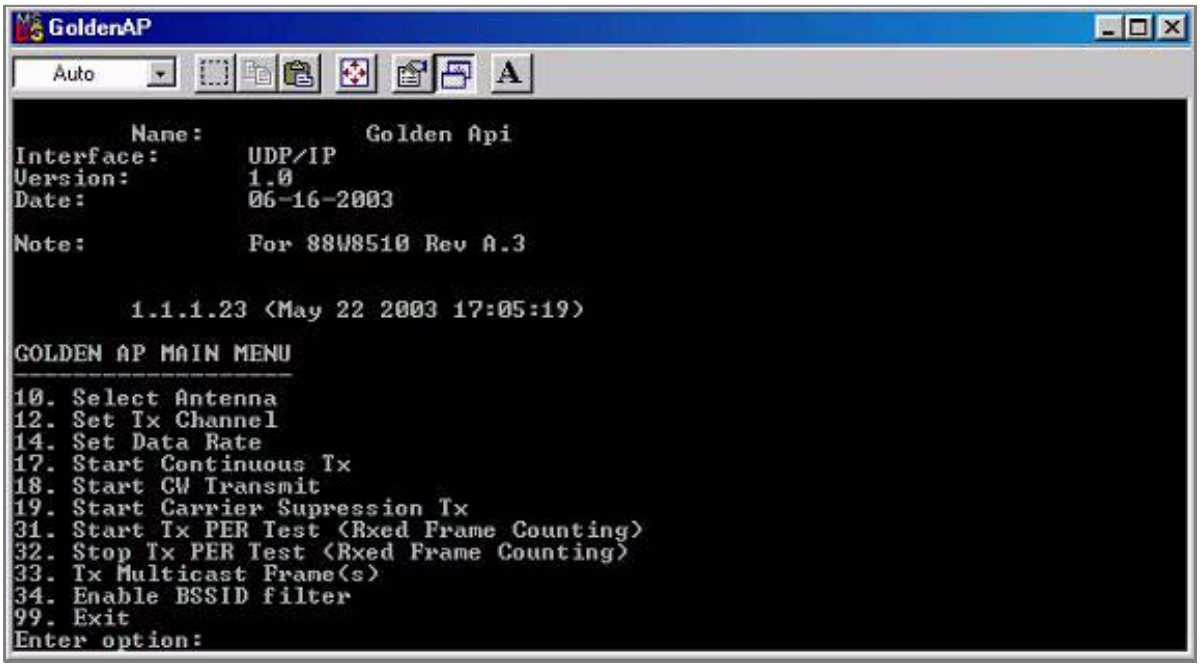
3.1.1 DUT Interface

Figure 5: PCI Interface Test Menu (DutApiPci98_G.exe)



3.1.2 Golden Unit Interface

Figure 6: Golden AP Main Menu (GoldenAP.exe)



3.1.3 Additional Menu Interface

There is also an additional menu of commands available. To open the menu, add a “-m” argument in the target line after typing the file name. Figure 7 shows how to create a shortcut for the additional menu interface.

Figure 7: Additional Menu Shortcut

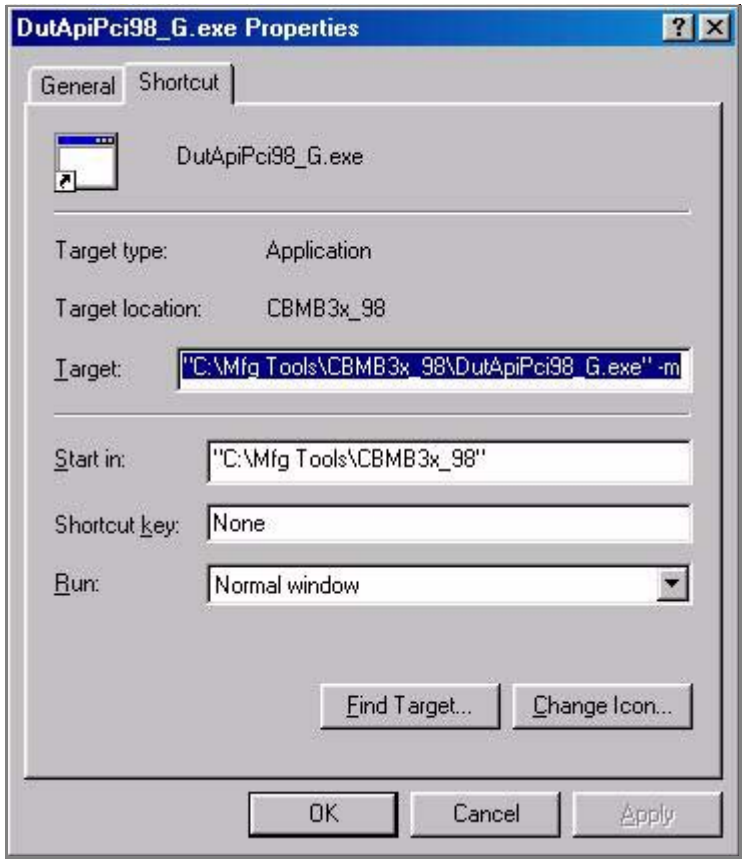
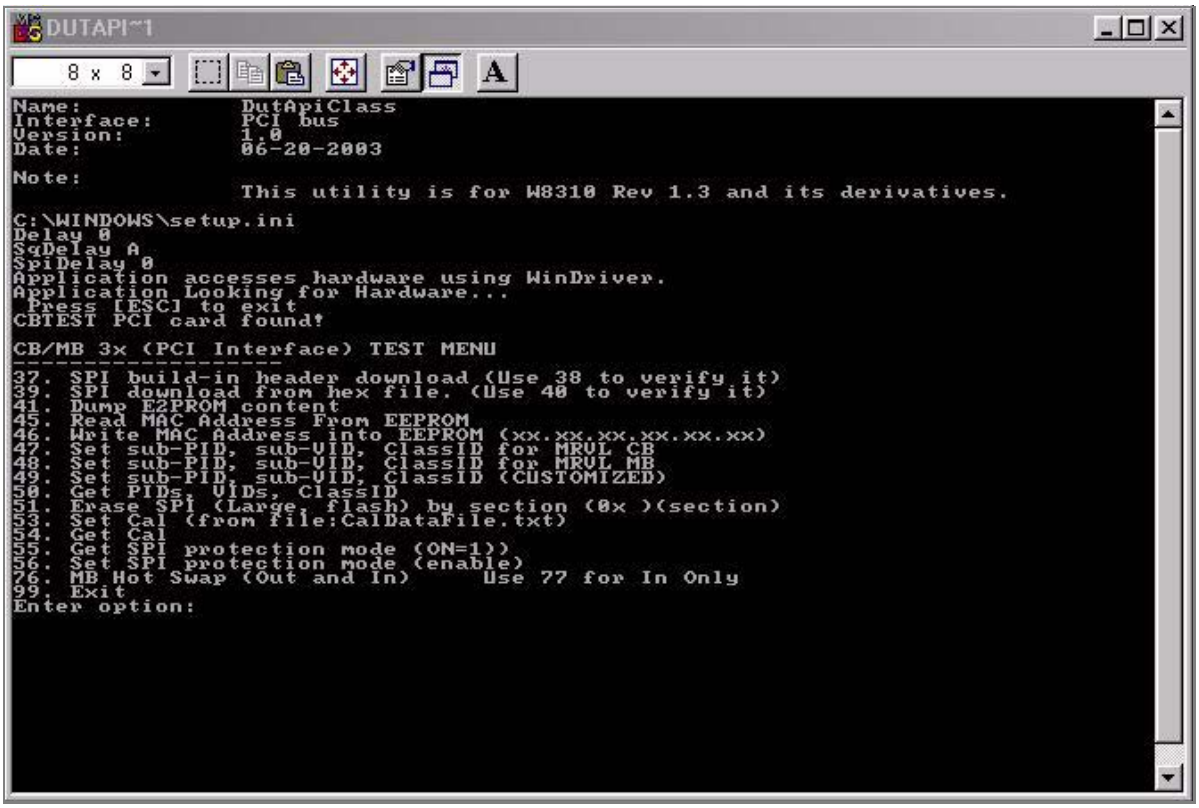


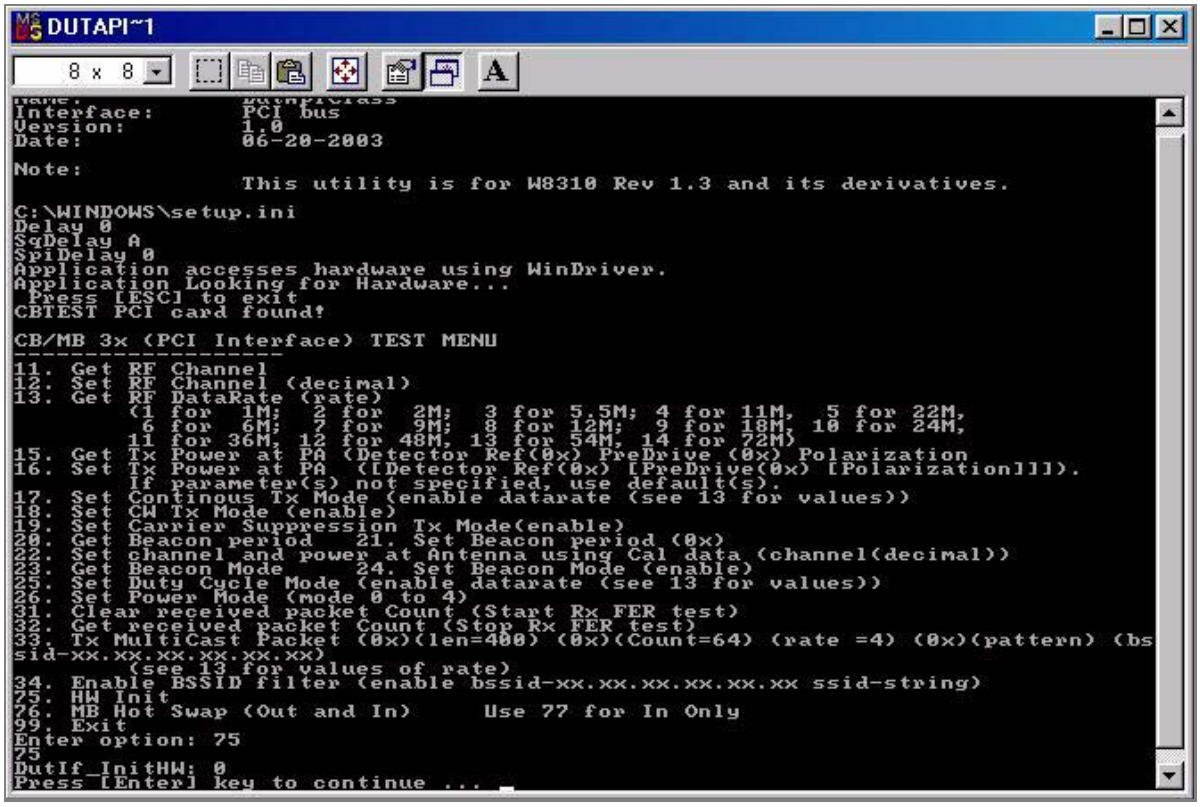
Figure 8: PCI Interface Test Menu (DutApiPci98_G.exe -m)



3.1.4 Before Getting Started

Initialize the device after launching the manual test module. Enter command **75** before running any RF tests.

Figure 9: Initialize Device (Command 75)



3.2 Receiver Sensitivity Test

3.2.1 Overview

The receiver sensitivity test is based on frame error rate (FER). The test will send a known number of frames, count the number of frames received on the DUT, and calculate the frame error rate. According to the IEEE specification, sensitivity is the lowest input power level needed to achieve a FER less than 8% for 802.11b data rates, and 10% for 802.11g data rates.

For the manufacturing test, the Golden Unit is used to transmit packets.

3.2.2 Test Procedure

1. Launch the GoldenAP.exe and DutApiPci98_G.exe files.
2. Type **75** to initialize the DUT (in the DutApiPci98_G.exe menu).
3. Type "**12** x" (where "x" is the channel number) to set the desired channel on the DUT.
4. Type **31** to clear the received packet counter.
5. OPTIONAL: Type "**34** 1 11.22.33.44.55.66" to filter on BSSID.
   In this example, only frames with BSSID = 11.22.33.44.55.66 will be counted.
6. Set the channel for the Golden Unit (in the GoldenAP.exe menu).
   Type **33**. The user is prompted to enter the length, count, data rate, pattern, and BSSID as parameters.
7. Type **32** to read the received packet counter. The DUT will report the number of frames received correctly (for example, no CRC error), the number of multicast frames received correctly, and the number of frames received with CRC errors. Calculate the FER based on the number of frames sent by the Golden Unit.
8. If necessary, adjust the settings on the programmable attenuators to achieve the desired FER.

Note

To verify the DUT is properly shielded, clear the received packet counter, wait a few seconds, and read the packet counter. The packet counter should read 0.

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3.3 Transmitter Tests

As an example, this section describes how to use the manual test module to set the DUT to Tx mode.

1. Connect antenna port 1 to the spectrum analyzer and power meter.
2. Start the manual test module.
3. Type **75** to initialize the DUT.
4. Type "**12** x" (where "x" is the channel number) to set the desired channel on the DUT.
5. Type "**17** 1 13" to enable continuous transmission at the 54 Mbps data rate. The device will output a continuous modulated signal.
6. Type "**17** 0" to disable continuous transmission.
7. Type "**18** 1" to enable carrier wave continuous transmission.
8. Type "**18** 0" to disable carrier wave continuous transmission.
9. Type "**33** 400 64 13 AAAAAAAA xx.xx.xx.xx.xx.xx" (where AA's are the frame pattern and xx's are the BSSID) to transmit 100 1 KB data packets at a 54 Mbps data rate.

Notes

- The default register values provided by Marvell are the settings used to achieve the highest output power while still meeting the IEEE specification requirements.
- If the measured EVM is higher than specified in the IEEE specification, please contact your Marvell Field Applications Engineer.

3.4 Command Descriptions

This section describes each command in detail.

3.4.1 RF Commands

3.4.1.1 Get RF Channel

Command Number	11
Name	Get RF Channel.
Parameters	none
Description	Returns current RF channel number.
Example	n/a

3.4.1.2 Set RF Channel

Command Number	12
Name	Set RF Channel
Parameters	Channel (1 through 14)
Description	Sets the RF channel.
Example	"**12** 11" sets the channel to 11.

3.4.1.3 Get RF Data Rate

Command Number	13
Name	Get RF data rate
Parameters	none
Description	Returns the current data rate: 1 = 1 Mbps 2 = 2 Mbps 3 = 5.5 Mbps 4 = 11 Mbps 5 = 22 Mbps (Marvell proprietary) 6 = 6 Mbps 7 = 9 Mbps 8 = 12 Mbps 9 = 18 Mbps 10 =24 Mbps 11 = 36 Mbps 12 = 48 Mbps 13 = 54 Mbps 14 = 72 Mbps (Marvell proprietary)
Example	n/a
Negative Number	Unable to be detected when MAC/BBP controls data rate through frame information. The data rate is unable to be detected.

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3.4.1.4 Get Tx Power at PA

Command Number	15
Name	Get Tx Power at PA
Parameters	None
Description	Returns the RF power settings. (RF power detector reference; predrive and polarization values).
Example	n/a

3.4.1.5 Set Tx Power at PA

Command Number	16
Name	Set Tx Power at PA 16 [RefDac [predriver [externalPApolarization]]
Parameters	Detector Reference Predrive Polarization
Description	Sets the RF power.
Example	"**16** [DetRef] [Predrive] [Polarization]"

3.4.1.6 Set Continuous Modulated Waveform Mode

Command Number	17 [enable_dataRate]
Name	Set Continuous Modulated Waveform Mode
Parameters	Enable (1 = enable, 0 = disable) data rate
Description	Sets the device for continuous transmission of a modulated waveform.
Example	"**17** 1 13" sets the device for continuous transmission at the 54 Mbps data rate. "**17** 0" disables continuous transmission.

3.4.1.7 Set Continuous Waveform Transmission Mode

Command Number	18
Name	Set Continuous Waveform Transmission Mode
Parameters	Enable (1 = enable, 0 = disable)
Description	Sets the device to continuously transmit a carrier waveform.
Example	"**18** 1" sets the device to continuously transmit a carrier waveform. "**18** 0" disables this mode.

3.4.1.8 Set Carrier Suppression Mode

Command Number	19
Name	Set Carrier Suppression Transmission Mode
Parameters	Enable (1 = enable, 0 = disable)
Description	Sets the device for Carrier Suppression Transmission Mode.
Example	"**19** 1" sets the device for Carrier Suppression Transmission Mode.

3.4.1.9 Set Channel and Power at Antenna with Calibration Data

Command Number	22
Name	Set channel and RF power at antenna with calibration data for the channel

Parameters	Channel 1 through 14: 1 = Channel 1 2 = Channel 2 3 = Channel 3 4 = Channel 4 5 = Channel 5 6 = Channel 6 7 = Channel 7 8 = Channel 8 9 = Channel 9 10 = Channel 10 11 = Channel 11 12 = Channel 12 13 = Channel 13 14 = Channel 14
Description	Sets the power using calibration data.
Example	"**22** 6" sets the channel to 6 and RF power using calibration data for channel 6.

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3.4.1.10 Set Duty Cycle Transmission Mode

Command Number	25
Name	Set duty cycle transmission mode
Parameters	Enable (1 = enable, 0 = disable) Data rate: 1 = 1 Mbps 2 = 2 Mbps 3 = 5.5 Mbps 4 = 11 Mbps 5 = 22 Mbps (Marvell proprietary) 6 = 6 Mbps 7 = 9 Mbps 8 = 12 Mbps 9 = 18 Mbps 10 =24 Mbps 11 = 36 Mbps 12 = 48 Mbps 13 = 54 Mbps 14 = 72 Mbps (Marvell proprietary)
Description	Sets the device to duty cycle transmit. The duty cycle is about 50% for lower date rates and decreases as the data rate increases.
Example	"**25** 1 13" sets device to duty cycle transmit at 54 Mbps.

3.4.1.11 Set Power Mode (Not Implemented)

Command Number	26
Name	Set power mode
Parameters	Power mode: 0 = active 1 = standby long 2 = power down 3 = deep sleep 4 = standby short
Description	Sets the power mode of the device. This command is not implemented yet.
Example	"**26** 0" sets device to active power mode.

3.4.2 FER Commands

3.4.2.1 Clear Received Packet Counter

Command Number	31
Name	Clear Received packet counter
Parameters	none
Description	Clears the received packet counter.
Example	n/a

3.4.2.2 Get Received Packet Counter

Command Number	32
Name	Get received packet counter
Parameters	none
Description	Returns the following values: GetRxPckt: Number of correctly received packets (no CRC error), including unicast and multicast. GetRxMultiCPkt: Number of correctly received multicast packets (a subset of the first number). GetRxErrPckt: Number of received packets with CRC errors. Frame error rate based on detected packets [GetRxErrPckt/(GetRxPckt + GetRxErrPckt)].
Example	n/a

Note

Because of the timing difference in Reading the counters, if you are in an environment that has continuous traffic, MultiCPckt count could be larger than RxPckt count.

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3.4.2.3 Transmit Multicast Frames

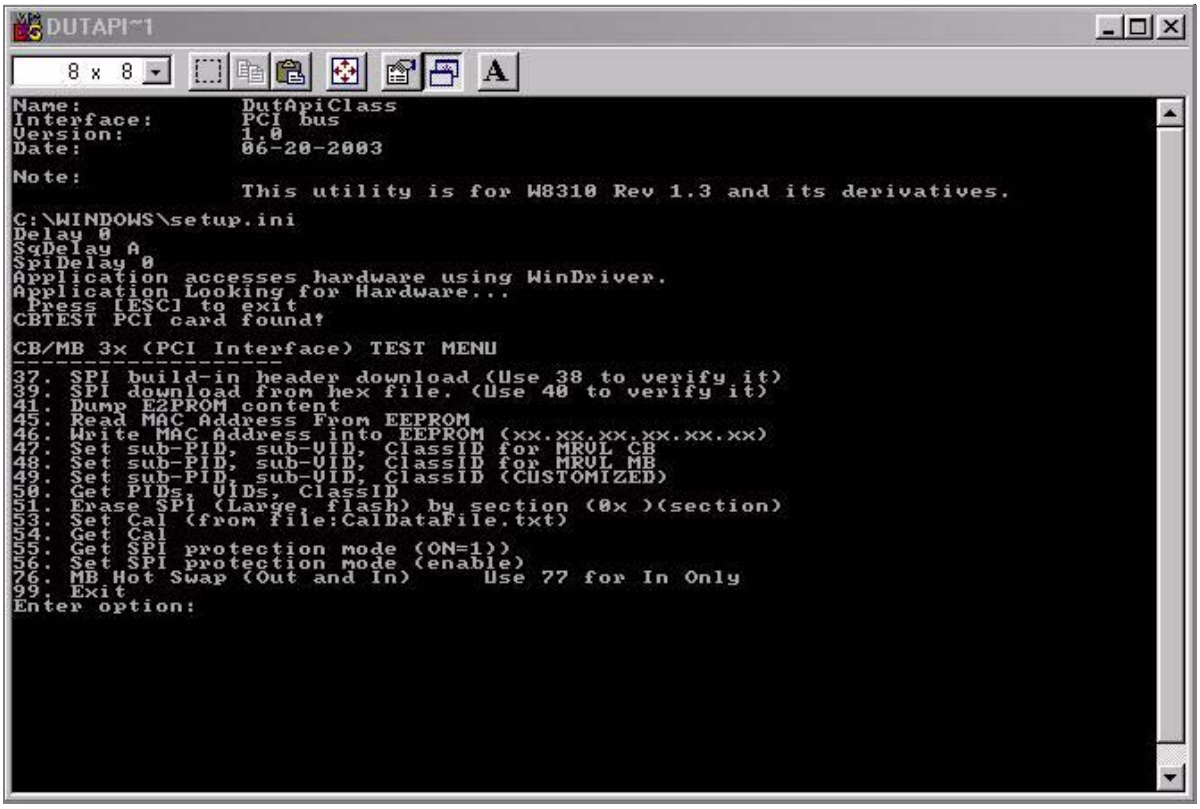
Command Number	33
Name	Transmit Multicast Frames
Parameters	Frame Length, in bytes (hex) Frame Count (hex) Data rate (hex): 1 = 1 Mbps 2 = 2 Mbps 3 = 5.5 Mbps 4 = 11 Mbps 5 = 22 (Marvell proprietary) 6 = 6 Mbps 7 = 9 Mbps 8 = 12 Mbps 9 = 18 Mbps A =24 Mbps B = 36 Mbps C = 48 Mbps D = 54 Mbps E = 72 Mbps (Marvell proprietary) BSSID (xx.xx.xx.xx.xx.xx) - BSSID field
Description	Transmits specified number of frames of specified length, at specified data rate, with BSSID set to specified value.
Example	"**33** 400 64 13 AAAAAAAA 00.11.22.33.44.55" sends 100 1 KB packets at the 54 Mbps data rate, with BSSID set to 00.11.22.33.44.55 (0x400 = 1024 decimal, 0x64 = 100 decimal).

3.4.2.4 Enable BSSID Filter

Command Number	34
Name	Enable BSSID filter
Parameters	Enable (1 = enable, 0 = disable) BSSID (xx.xx.xx.xx.xx.xx)
Description	Sets the received packets counter to include only frames that have the specified BSSID field.
Example	"**34** 1 00.11.22.33.44.55" sets the filter to be BSSID = 00.11.22.33.44.55. "**34** 0" disables the filter.

3.4.3 Configuration Information Access Commands

Figure 10: PCI Command Line Interface



3.4.3.1 SPI Build-In Header Download

Command Number	37
Name	SPI Build-In Header Download
Parameters	None
Description	Programs SPI header into EEPROM. Use command **39** with a hex file.
Example	**37**

3.4.3.2 SPI Header Verify

Command Number	38
Name	SPI Header Verify
Parameters	None
Description	Compares SPI built-in header with SPI header in EEPROM. Returns the error count and value of mismatched double words.
Example	**38**

3.4.3.3 SPI Download

Command Number	39
Name	SPI Download from Hexadecimal File
Parameters	None
Description	Programs the SPI header using a hex file. The command will prompt the user for the filename (Spi.hex is default).
Example	**39**

3.4.3.4 SPI Verify

Command Number	40
Name	SPI Verify from Hexadecimal File
Parameters	None
Description	Compares SPI built-in header with hex file. Returns the error count and value of mismatched double words.
Example	**40**

3.4.3.5 Display SPI EEPROM Content

Command Number	41
Name	Display SPI EEPROM Content
Parameters	(0x)(0x)(startAddress)(Length)
Description	Displays the SPI EEPROM.
Example	"**41** 0 20" will display 32 DWORDS starting from offset 0.

3.4.4 SPI/Flash Access Commands

3.4.4.1 Read MAC Address

Command Number	45
Name	Read MAC Address
Parameters	None
Description	Returns the MAC address programmed in the EEPROM.
Example	**45**

3.4.4.2 Write MAC Address

Command Number	46
Name	Write MAC Address into EEPROM/Flash
Parameters	xx.xx.xx.xx.xx.xx
Description	Writes the MAC address.
Example	"**46** 10.22.33.44.55.66"

3.4.4.3 Set sub-PID sub-VID Class ID for Marvell CardBus Card

Command Number	47
Name	Set sub-PID sub-VID Class ID for Marvell CardBus Card
Parameters	None
Description	Writes the Product ID and Vendor ID for CardBus.
Example	**47**

3.4.4.4 Set sub-PID sub-VID Class ID for Marvell Mini PCI Card

Command Number	48
Name	Set sub-PID sub-VID Class ID for Marvell Mini PCI Card
Parameters	None
Description	Writes the Product ID and Vendor ID for Mini PCI.
Example	**48**

3.4.4.5 Set sub-PID sub-VID Class ID (Customized)

Command Number	49
Name	Set sub-PID sub-VID Class ID (Customized)
Parameters	Will read back current IDs then prompt for new IDs.
Description	Programs a customized ID.
Example	**49**

3.4.4.6 Get PID VID Class ID

Command Number	50
Name	Get PID VID Class ID
Parameters	None
Description	Returns the PID and VID.
Example	**50**

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3.4.4.7 Erase Flash

Command Number	51
Name	Erase Flash
Parameters	(0x)(section)
Description	Erases Flash memory. This command is only supported for large EEP**RO**M sizes (1 Mbit) and will not erase small EEPROM.
Example	n/a

3.4.4.8 Write Calibration Table

Command Number	53
Name	Write Calibration Table
Parameters	none
Description	Writes calibration table data from the file CalDataFile.txt.
Example	**53** <<Given sample file here>>

3.4.4.9 Read Calibration Table

Command Number	54
Name	Read Calibration Table
Parameters	None
Description	Returns the calibration table data.
Example	54

3.4.4.10 Get SPI Protection

Command Number	55
Name	Get SPI Protection
Parameters	None
Description	Retrieves setting of SPI protection status bit.
Example	**55**

3.4.4.11 Set SPI Protection

Command Number	56
Name	Set SPI Protection
Parameters	1 = enables protection 0 = disables protection
Description	Sets SPI protection.
Example	“**56** 1” enables protection. “**56** 0” disables protection.

Note: Each write action from this program will set SPI protection mode to enable to prvent accidental crashing of the image.

3.4.5 Device Specific Commands

3.4.5.1 Client Hardware Initialization

Command Number	75
Name	HW Init

Parameters none
Description Hardware initialization. This command must be used before starting the RF tests.
Example n/a

3.4.5.2 Mini PCI Hot Swap (Out and In)

Command Number 76
Name Mini PCI Hot Swap (Out and In)
Parameters none
Description Prompts you to put in a new card. After the new card is replaced, press **Enter** twice. This command must be followed by command **75** (HW Init) to use the new card.
Example n/a

3.4.5.3 Mini PCI Hot Swap (In Only)

Command Number 77
Name Mini PCI Hot Swap (In Only)
Parameters none
Description Prompts you to put in a new card. After the new card is replaced, press **Enter** twice. This command must be followed by command **75** (HW Init) to use the new card.
Example n/a

3.4.6 Exit Test Command

3.4.6.1 Exit Test

Command Number 99
Name Exit
Parameters none
Description Exits the program.
Example n/a

Appendix A. Sample CalDataFile.txt

```
[Configuration]
Board = MB31-001
StructRev = 1
Pa_External = 3
AntHw =0x0a

[LED]
Led0 = 0xFF
Led1 = 0xFF
Led2 = 0xFF
Led3 = 0xFF

[CC]
CC_primary = 0x10
CC_secondary = 0xFF

[CCA1]
CCA_0 = 0xff
CCA_1 = 0xff
CCA_2 = 0xff
CCA_3 = 0xff


[CCA2]
CCA_0 = 0xff
CCA_1 = 0xff
CCA_2 = 0xff
CCA_3 = 0xff

[Cus]
Cus_0 = 0xff
Cus_1 = 0xff
```

```
[CalData]
CalTableOption =1
ant2NotCaled = 1
ExtPaPolar_neg = 0

ExterPA_PartId = 0x3
ExterPA_PreDriv = 0x4

Xosc =1635

;Channel1_Ant2Adjust =0
;Channel1_Loss = 4
;Channel1_Tune = 4

Channel1_PDref = 0x60
Channel2_PDref = 0x5e
Channel3_PDref = 0x5c
Channel4_PDref = 0x58
Channel5_PDref = 0x58
Channel6_PDref = 0x56
Channel7_PDref = 0x54
Channel8_PDref = 0x53
Channel9_PDref = 0x53
Channel10_PDref = 0x54
Channel11_PDref = 0x56
Channel12_PDref = 0x56
Channel13_PDref = 0x56
Channel14_PDref = 0x56

Channel1_Pa1 = 0xFF
Channel1_Pa2 = 0xFF

Channel2_Pa1 = 0xFF
Channel2_Pa2 = 0xFF

Channel3_Pa1 = 0xFF
```


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```
Channel3_Pa2 = 0xFF

Channel4_Pa1 = 0xFF
Channel4_Pa2 = 0xFF

Channel5_Pa1 = 0xFF
Channel5_Pa2 = 0xFF

Channel6_Pa1 = 0xFF
Channel6_Pa2 = 0xFF

Channel7_Pa1 = 0xFF
Channel7_Pa2 = 0xFF

Channel8_Pa1 = 0xFF
Channel8_Pa2 = 0xFF

Channel9_Pa1 = 0xFF
Channel9_Pa2 = 0xFF

Channel10_Pa1 = 0xFF
Channel10_Pa2 = 0xFF

Channel11_Pa1 = 0xFF
Channel11_Pa2 = 0xFF

Channel12_Pa1 = 0xFF
Channel12_Pa2 = 0xFF

Channel13_Pa1 = 0xFF
Channel13_Pa2 = 0xFF

Channel14_Pa1 = 0xFF
Channel14_Pa2 = 0xFF
```

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Section 5. Revision History

Table 2: Revision History

Document Revision	Document Change
Rev. -	First release.

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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.

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.

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

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

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

This device is intended only for OEM integrators under the following conditions:

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and

2) The transmitter module may not be co-located with any other transmitter or antenna.
As long as 2 conditions above are met, further transmitter test will not be required. However, theOEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following:"Contains TX FCC ID: M4Y-0XG880M".

Manual Information That Must be Included

The users manual for OEM integrators must include the following information in a prominent location " IMPORTANT NOTE: To comply with FCC RF exposure compliance requirements, theantenna used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.