

BANTAM INSTRUMENTS



WI RELESS WI ZARD



OPERATING MANUAL

WIRELESS WIZARD SPECTRUM ANALYZER SYSTEM

Operating Manual

BANTAM INSTRUMENTS
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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.

DECLARATION OF CONFORMITY



Manufacturer: BANTAM INSTRUMENTS, Inc.
197 South Murphy Avenue
Sunnyvale, CA 94086
USA

We hereby declare that the equipment herein conforms to the harmonized standards of the following European Commission Directives: 89/336/EEC and 72/23/EEC

Product Name: Wireless Wizard Spectrum Analyzer

Under 89/336/EEC as amended by 92/31/EEC, and 93/68/EEC

In accordance with EN 61326:1997, Emission:

EN 61326:1997 Class B radiated and conducted emissions

In accordance with EN 61326:1997, Immunity:

EN 61000-4-2:1998 Electrostatic Discharge: ± 4 kV contact, ± 8 kV air

EN 61000-4-3:1998 Radiated Immunity: 3 V/m

EN 61000-4-4:1995 Electrical Fast Transients / Burst: ± 1 kV AC, ± 0.5 kV I/O

EN 61000-4-5:1995 Surges: ± 1 kV differential mode, ± 2 kV common mode

EN 61000-4-6:1996 Conducted Immunity: 3V

EN 61000-4-11:1994 Supply Dips and Variations: 100%

Under 73/23/EEC as amended by 93/68/EEC

In accordance with 61010-1:1993 with amendments A1 and A2 1995, Product Safety

The product complies when used with Company supplied power supply.

A handwritten signature in cursive script, reading 'Robert Bathiany', is positioned above the printed name.

Robert Bathiany
Vice President

July 25, 2006
Date

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Chapter 1

General Information

Introduction

This chapter provides basic information regarding the Wireless Wizard Spectrum Analyzer. Included are a basic description, battery and charging information, warranty, and performance specifications.

Description

The Wireless Wizard is a handheld Spectrum Analyzer covering the frequency ranges of 1.8 to 2.9 GHz and 4.94 to 6.0 GHz. It is battery operated, making it fully portable and self-contained. Its small size and light weight makes it ideal for WLAN site surveys and searching for, and identifying potential interfering signals.

The Wireless Wizard has an RS-232 serial interface which can be used to download measurement data to a computer. The PC Enhancement Software supplied with the Wireless Wizard allows measurement data to be downloaded to a personal computer and to be printed to any WINDOWS¹ compatible printer or stored on the hard drive for later use. The computer must have a WINDOWS 95 or later operating system. The serial interface cable is included for connection between the Wireless Wizard and a personal computer. Instructions for operating the PC Enhancement Software is contained in chapter 4.

Included with the Wireless Wizard Spectrum Analyzer are three antennas. The two omni-directional antennas cover 1.8 to 2.9 GHz and 4.94 to 6.0 GHz. The log periodic directional antenna covers 2.4 to 6.0 GHz. Using these antennas, measurements can be made directly in signal strength, dB μ V/m, as antenna factors versus frequency for these antennas are stored within the memory of the Wireless Wizard. Measurements can be made in dB μ V/m using these antennas, or in units of dBm and dB μ V referenced to the input connector of the spectrum analyzer.

¹WINDOWS is a Trademark of Microsoft Corporation

Items included with your Wireless Wizard Spectrum Analyzer

The following items are included as standard with every Wireless Wizard Spectrum Analyzer Kit::

- Wireless Wizard Spectrum Analyzer
- LCD Backlight, for use in low illumination
- 1.8 to 2.9 GHz Omni-Directional Antenna (p/n 9014-0003)
- 4.94 to 6.0 GHz Omni-Directional Antenna (p/n 9014-0004)
- 2.4 to 6.0 GHz Log Periodic Directional Antenna (p/n 9014-0005)
- Battery Charger (p/n 9001-0001)
- 12 VDC Vehicle Power Adapter Cable (p/n 9010-0002)
- PC Enhancement Software (p/n 9000-0008)
- Serial Interface Cable (p/n 9000-0003)
- Transit Case (p/n 9050-0002)
- Operating Manual (p/n 9900-0005)
- One Year Warranty

Option

Option 001	Warranty Extension to 3 years (Must be ordered at time of purchase)
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Battery and Charging Information

The Model Wireless Wizard Spectrum Analyzer is capable of greater than 2 hours of continuous operation from the internal rechargeable NiMH (nickel-metal-hydride) batteries, but internal power management software generally allows operation across an entire work day.

The Wireless Wizard Spectrum Analyzer can be continuously powered from 100-240 VAC, 50/60 Hz line voltage using the supplied charger. While being powered, the internal batteries will also be charged, but at a lower rate. The Wireless Wizard can also be powered or the batteries recharged from a 12V DC source such as a vehicle battery by using the vehicle power adapter cable.

Use only factory supplied NiMH batteries. The use of other types of batteries may cause damage which will not be covered under the warranty. When replacing batteries, the entire set of four must be replaced at the same time. Never use batteries of varying ages.

Warranty

Bantam Instruments warrants its products to be free from defects in materials and workmanship for a period of 12 months. Under the provisions of this warranty, Bantam Instruments will repair or replace the product. This warranty, however, shall not apply to any damage caused by improper use or the application of voltages to the input connector which exceed the maximum specified limits. Please contact your local representative for information on service under this warranty.

There are no user-serviceable components inside of the Wireless Wizard Spectrum Analyzer. Refer service to qualified service personnel. Do not remove the back cover of the instrument. To do so will void the factory warranty.

Performance Specifications

FREQUENCY

Frequency Ranges:	1.8 to 2.9 GHz and 4.94 to 6.0 GHz
Span:	0 MHz to Entire Frequency Range
Frequency Markers:	3
Marker Resolution (Frequency):	1% of span \pm 2 ppm
Marker Resolution (Amplitude):	0.1 dB
Marker Readout Accuracy:	1% of span \pm 2 ppm
Marker Functions:	Peak Search, left or right
Frequency Stability:	\pm 2 ppm
Resolution Bandwidth, 3 dB:	120 kHz, 1 MHz
Video Bandwidth:	30 kHz, 300 kHz
Preset WLAN Bands:	Channels Identified:
2.40 to 2.50 GHz	1 through 14
4.94 to 4.99 GHz	1 through 18
5.15 to 5.25 GHz	34, 36, 38, 40, 42, 44, 46, 48
5.25 to 5.35 GHz	52, 56, 60, 64
5.49 to 5.71 GHz	100, 104, 108, 112, 116, 120, 124, 128, 132, 136
5.725 to 5.825 GHz	149, 153, 157, 161

GENERAL

Operating Temperature Range:	0°C to 40°C
Storage Temperature:	-10°C to 50°C
Line Power:	6VA
DC Power (12-14 VDC):	0.4A max.
Dimensions, mm:	193H x 102W x 33D
Dimensions, inches:	7.6H x 4.0W x 1.3D
Weight:	1.2 lbs (0.55 kg)
Safely and Electromagnetic Compatibility:	CE Mark Compliance

AMPLITUDE

Measurement Range at Input, typical;	-25 dBm to -85 dBm
Maximum Safe Input Level:	+23 dBm, 50 VDC
Sensitivity, 2.4 to 2.5 GHz:	
With Omni-Directional Antenna:	59 dB μ V/m, typical
With Log Periodic Antenna:	55 dB μ V/m, typical
Sensitivity, 4.94 to 6.0 GHz:	
With Omni-Directional Antenna:	70 dB μ V/m, typical
With Log Periodic Antenna:	66 dB μ V/m, typical
Scale:	1, 2, 5, 10, 20 dB/div
Scale Units:	dBm, dB μ v, dB μ V/m
Absolute Amplitude Accuracy, typical:	\pm 2.5 dB, -30 to -70 dBm
Input-related 2nd Order Response:	
1.8 to 2.9 GHz Range:	>70 dBc, typical
4.94 to 6.0 GHz Range:	>20 dBc, typical ¹
Detection Modes:	Normal, Quasi-Peak, Peak Hold
Input Connector:	SMA Female

OTHER FEATURES

Save/Recall, Setups:	20
Save/Recall, Traces:	16
RS-232 Interface Speed:	9600, 57600 Baud
RS-232 Interface Connector:	DB-9 (Female)

¹Built-in signal identification feature easily identifies the valid response. See page 25.

Chapter 2

Operating Instructions

Introduction

This chapter covers the operating controls and interface connectors of the Wireless Wizard Spectrum Analyzer. The figure on the next page shows the Wireless Wizard Spectrum Analyzer front panel and the section below identifies the function of each item.

The remaining sections of this chapter cover operation of the Wireless Wizard such as the setting of frequencies, reference, limit lines, and scale. Markers and marker functions are also covered.

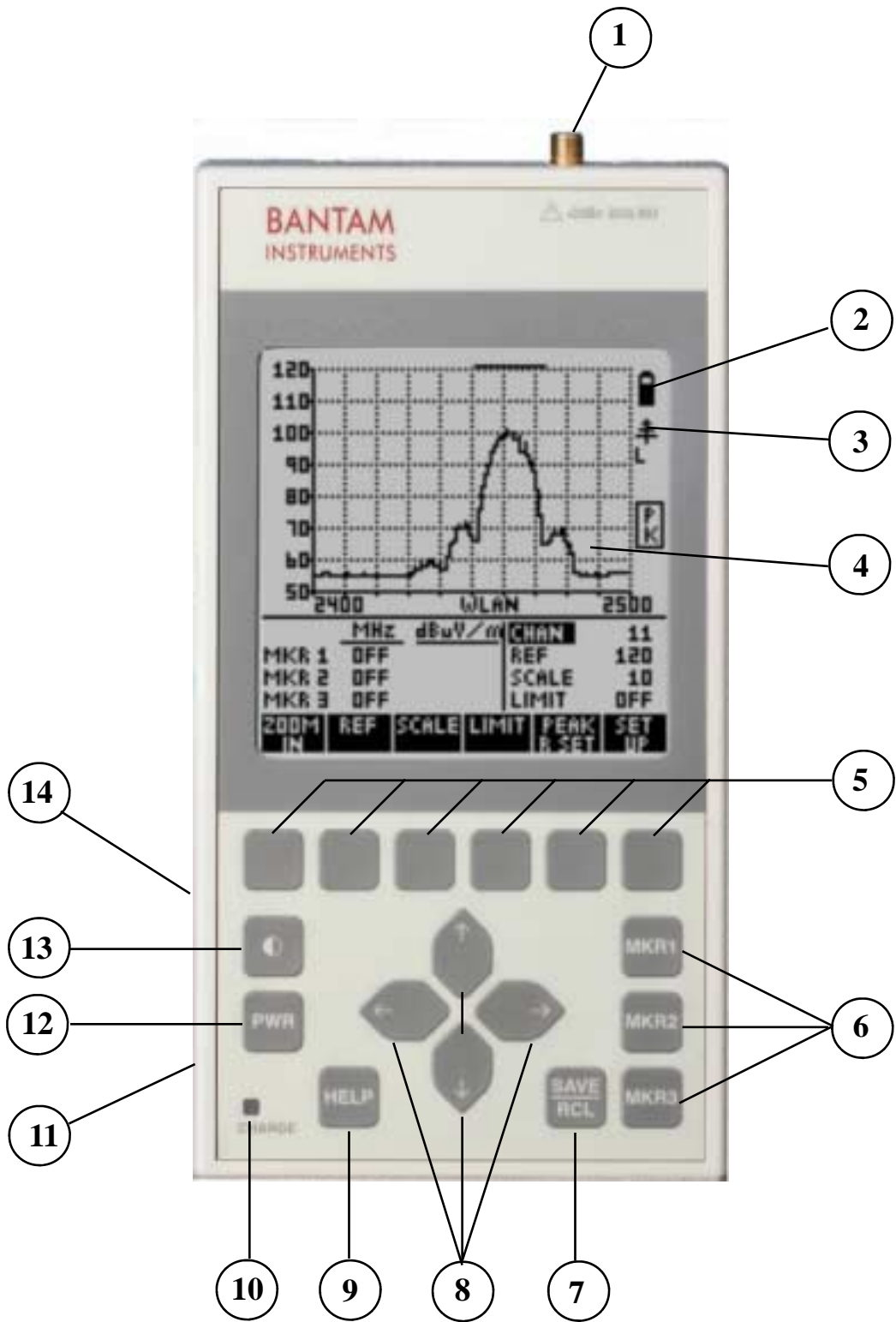
- ① **RF Input Connector.** SMA female connector. Signals to be measured enter through this connector.



CAUTION. RF signals greater than +23 dBm (200 mW) and/or DC voltages exceeding 50 volts can cause damage to the input circuitry of the spectrum analyzer. Such damage is not covered under the warranty.

- ② **Battery Icon.** Indicates battery charge in approximately 25% increments. When full discharge is indicated, approximately 4% of charge is remaining and instrument should be recharged immediately.
- ③ **Antenna Icon.** The antenna icon indicates which one of the antennas supplied with the Wireless Wizard has been selected and must be connected to the input of the spectrum analyzer. An “L” on the icon indicates that the low band 1.8 to 2.9 GHz antenna is to be connected. An “H” indicates to connect the 4.94 to 6.0 GHz high band antenna. A “D” indicates to connect the log periodic directional antenna.
- ④ **Liquid Crystal Display (LCD).** High resolution display for readout of measurement data and measurement parameters.
- ⑤ **Soft Keys.** The function of these six keys is indicated directly above on the Liquid Crystal Display.

Figure 1 – Wireless Wizard Front Panel



Basic Controls and Connectors (Continued)

- ⑥ **Marker Keys.** These three keys activate and control the three markers.
- ⑦ **Save / Recall Key.** This key enables the save and recall of measurement set-ups and traces. This key also enables hard copy printout when a Personal Computer is connected to the serial interface (Number 14).
- ⑧ **Cursor Keys.** These four keys up, down, left, and right, enable the selection of parameters and the increase or decrease of measurement settings.
- ⑨ **Help Key.** Pressing this key automatically displays a help screen relating to the operation being performed by the instrument. An index of help topics can also be accessed by pressing this key.
- ⑩ **Charge Indicator.** Indicates battery charging status when an external charger is connected. Glows yellow while the batteries are being charged and green when the batteries are fully charged. The green indication will only appear when charging with the instrument turned off. The indicator will flash and the charging will terminate if the batteries are above 55°C.
- ⑪ **External DC Power Connector.** For connection of external battery charger. The Wireless Wizard is supplied with an external 100-240 VAC 50/60 Hz charger as well as an adapter for connection to a vehicle accessory power outlet.
- ⑫ **Power On / Off Key.** Pressing this key turns the instrument on or off.
- ⑬ **Contrast Adjustment Key.** Pressing this key brings up a screen on the LCD for the adjustment of display contrast. If display is not visible due to severe misadjustment of the LCD contrast, then holding this key down for several seconds will rapidly cycle the contrast adjustment through its range and a display should be visible. The contrast can then be adjusted for an appropriate display. This key also accesses turning on or off the LCD back-light.
- ⑭ **Serial Interface.** DB-9 female connector. For connection to the RS-232 serial interface of a Personal Computer.

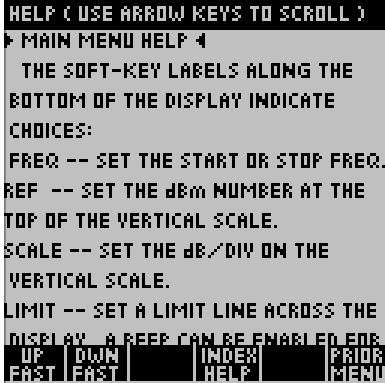


Contrast

Pressing the front panel contrast key will bring up the contrast menu shown at the left. Use the left or right front panel cursor keys to lighten or darken the display. If the display is not visible, holding down the front panel contrast key will rapidly cycle the contrast adjustment through its range. The contrast can then be adjusted for an appropriate display.

Backlight

The LCD Backlight can be activated when the Wireless Wizard is used in areas of low illumination. The LCD Backlight can be turned on or off by pressing the appropriate soft keys on the bottom left of the display.



Help

Help screens are accessed by pressing the HELP key on the front panel. The help screens are context-sensitive. The help information will relate to the current measurement process underway. Pressing the soft key labeled “PRIOR MENU” will return to the measurement in progress. The HELP screens may be scrolled rapidly using the soft keys or more slowly using the “Up” and “Down” cursor keys. A typical HELP menu is shown at the left.

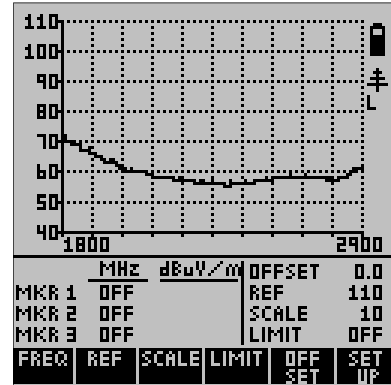


Help Index

Pressing the soft key labeled HELP INDEX, a list of topics is displayed. The appropriate help topic can then be easily selected.

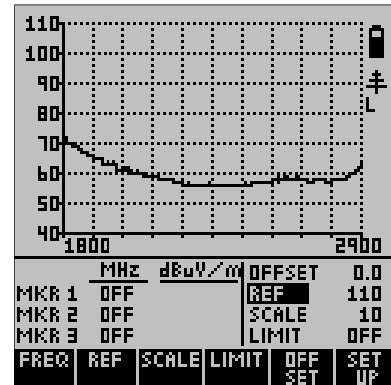
Main Menu

The Main Menu is the core menu in the operation of the Wireless Wizard. When the instrument power is turned on, or when a stored setup or stored trace is recalled, this is the menu which is first displayed. From this menu it is straightforward to adjust measurement parameters such as Scale, Reference, Limit Line, Frequency, and to access the instrument Set-Up menus.



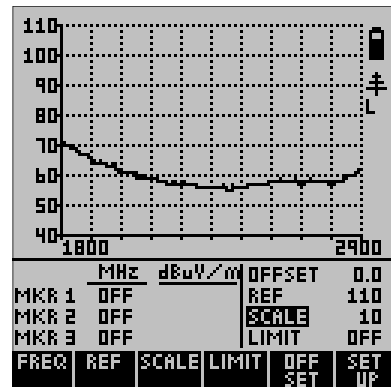
Reference Level

The Reference Level is the value associated with the top line of the graticule. In the example to the right, it is set to 110 dB μ V/m which is the factory default value. To change the Reference value, press the soft key directly under “REF” at the bottom of the screen. Using the “Up” and “Down” cursor keys, the reference value can be changed.



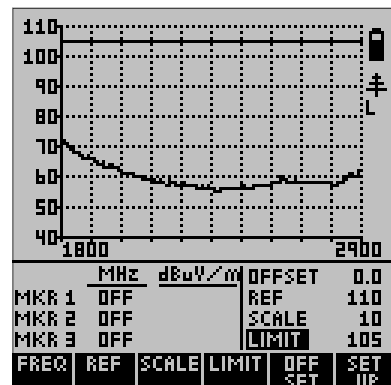
Scale

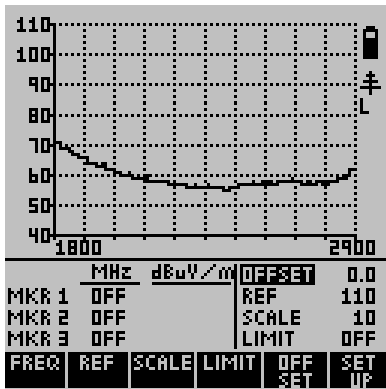
The scale is the dB per division associated with the vertical display. In the example at the right it is set to 10 dB which is the factory default value. To change the scale, press the soft key directly under “SCALE” at the bottom of the screen. Using the “Up” or “Down” cursor keys, the scale can be set to 1, 2, 5, 10, or 20 dB per division.



Limit Line

A Limit Line can be added as an amplitude guide for measurement data. The factory default for the Limit Line is “OFF”. To activate the Limit Line, press the soft key directly below “LIMIT” and then use the “Up” and “Down” cursor keys to set the value desired. The Limit Line can be set anywhere on the graticule in 1 dB increments. In the example at the right it is set at 105 dB μ V/m. To turn the Limit Line off, press the “LIMIT” soft key again.



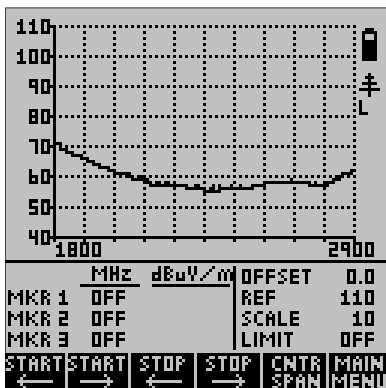


Offset

When an external amplifier or attenuator is used, it is often convenient to offset the measurement trace by the dB gain of the amplifier or dB attenuation of the attenuator. This is accomplished by pressing the OFFSET key. Positive values will move the trace upward and are used to reference the measurement to the input of the external attenuator. Negative values are used for external amplification, and move the trace downward. If no external amplifier or attenuator is used, the offset value should remain at 0. The factory preset value is 0.

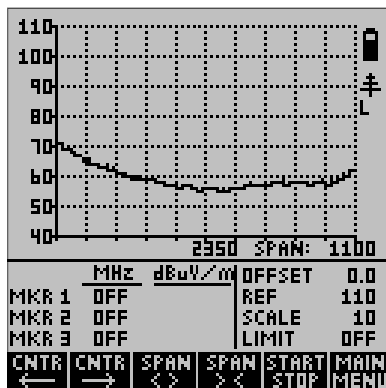
Frequencies

When a WLAN band is selected, the frequency range cannot be changed, but it is possible to zoom in to a single channel and then back out to the full WLAN band.



When full band (1.8 to 2.9 GHz or 4.94 to 6.0 GHz) measurements are selected The frequency range can be adjusted by going to the Main Menu and then pressing the soft key directly under “FREQ” at the bottom of the screen. The frequency menu will come up in one of two formats, either “START STOP” or “CENTER SPAN”.

In the example at left, frequency is displayed as Start and Stop Frequency. In the example just below it, frequency is displayed as Center Frequency and Span. When in the Start / Stop frequency mode, the display mode can be changed to Center / Span by pressing the soft key directly below “CNTR SPAN”. When in the Center / Span mode, the display mode can be changed to Start / Stop by pressing the soft key directly below “START STOP”. The factory default setting is the Start / Stop mode in the 1.8 to 2.9 GHz band.



The START STOP frequency mode is often easier to use for wide frequency scans. The CNTR SPAN frequency mode is very convenient for narrow scans, as the scanning window can easily be moved up or down in frequency by changing the center frequency.

The soft keys can be used to increase or decrease the Start / Stop or Center / Span frequencies. Pressing the soft key once will make a change of 1 MHz. Holding the key down will increase the rate of frequency change.

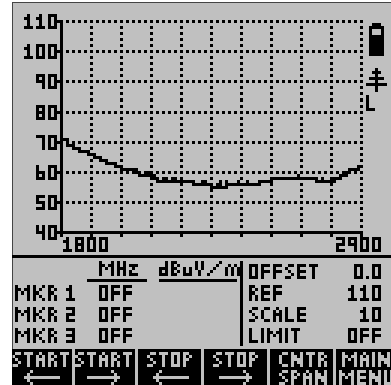
If a large frequency change needs to be made, the cursor keys may be used. When in the Start / Stop mode, the left and right cursors control the start frequency and the up and down cursors control the stop frequency. When in the Center / Span mode, the left and right cursor keys control the center frequency and the up and down cursor keys control the span.

Frequency Zoom

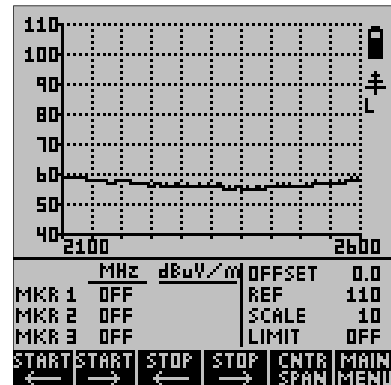
When in the Start / Stop mode, it is possible to zoom out to the full frequency range of the Wireless Wizard and then quickly return to the original frequency range. This is very handy for making narrow band measurements and then quickly zooming out to check surrounding frequencies.

Pressing the START (left arrow) and STOP (right arrow) soft keys simultaneously quickly changes the start and stop frequencies to the full frequency range.

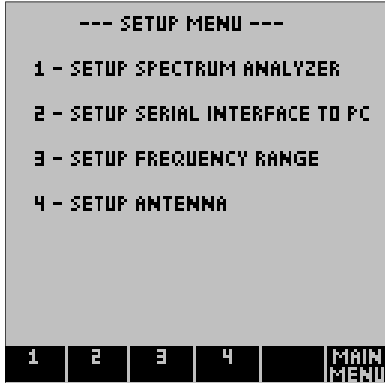
Pressing the START (right arrow) and STOP (left arrow) keys quickly returns to the original frequency setting.



Press simultaneously to zoom out to maximum frequency range of the frequency band.



Press simultaneously to return to original frequency range.

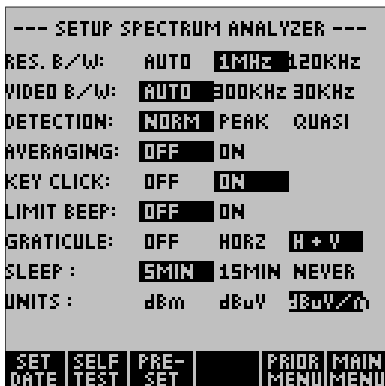


Set Up Menu

The Set Up menu, accessible from the Main menu, has three pages. The first page selects Spectrum Analyzer settings such as Resolution Bandwidth, Video Bandwidth, Detection Mode, Averaging, Key Click, Limit Beep, Graticule, Sleep Mode, Measurement Parameter (dBm or dB μ v), Clock and Date Setting, Self Test, and Return to Factory Defaults. This page will be discussed in this section.

The second page sets up the serial interface for communication with a personal computer (PC) using the Bantam Instruments software supplied with your Wireless Wizard Spectrum Analyzer. This is covered in Chapter 4 which discusses the operation of the Personal Computer interface software.

The third page selects the frequency band, either 1.8 to 2.9 GHz or 4.94 to 6.0 GHz. Also, several WLAN sub-bands may be selected, such as: 2.4 to 2.5 GHz, 5.15 to 5.25 GHz, 5.25 to 5.35 GHz, 5.49 to 5.71 GHz, and 5.725 to 5.825 GHz. In addition, the 4.94 to 4.99 GHz Public Safety Band can be selected.



Set Up Spectrum Analyzer (Set Up Menu Page 1)

In the Set Up Spectrum Analyzer menu, items shown in reverse video are the selected items. The flashing reverse video is the location of the cursor. The cursor can be moved up and down among line items by using the cursor up and down keys. The cursor can be moved left and right along the line item selections using the cursor left and right keys. When leaving this setup menu via the PRIOR MENU or MAIN MENU soft keys, the menu selections are activated.

Resolution Bandwidth

The resolution Bandwidth (RES. B/W) can be 120 kHz or 1 MHz. In the AUTO mode the instrument automatically selects the most appropriate bandwidth for the measurement.

Video Bandwidth

The Video Bandwidth (VIDEO B/W) can be 30 kHz or 300 kHz. In the AUTO mode the instrument automatically selects the most appropriate bandwidth for the measurement.

Detection Mode

Three types of detection may be selected; normal, peak, and quasi-peak.

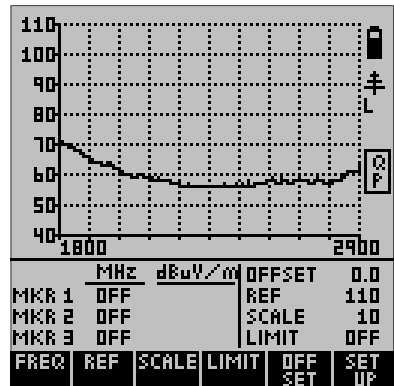
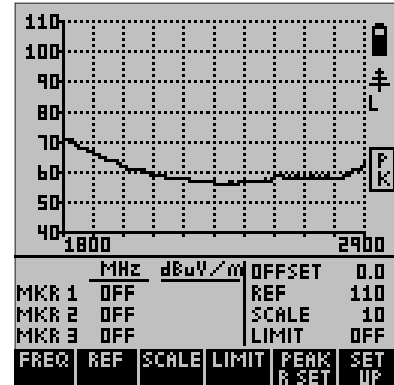
Normal Detection displays the amplitude of a signal as measured during each measurement scan.

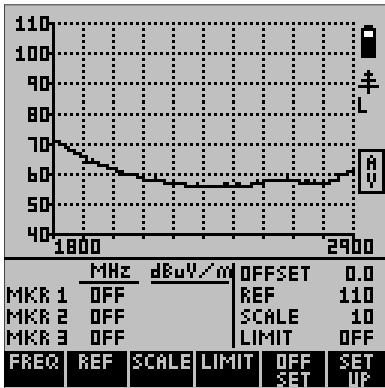
Peak Detection holds the highest amplitude of a signal from scan to scan. When peak detection is active, a small rectangle with the letters PK is displayed to the right of the graticule as shown to the right. To reset the peak detection memory, press the PEAK RESET soft key.

Quasi-peak is a detection mode which has a charge rate much faster than the discharge rate; therefore, the higher the repetition rate of the signal the higher the output of the quasi peak detector.

Quasi Peak detection is often used in EMC measurements as quasi-peak detectors weigh signals according to their repetition rate, which is a way of measuring their annoyance factor. Quasi-peak detection always gives a reading less than or equal to peak detection.

When in the Quasi Peak detection mode, a rectangle with QP in it is displayed to the right of the graticule.





Averaging

When averaging is on, the signal is averaged from trace to trace. This tends to bring signals up out of the noise so that they can be more easily measured. Averaging lowers the apparent noise as it is random. When averaging is on, a rectangle with AV will be displayed to the right of the graticule. Averaging can only be used when in the normal detection mode.

Key Click

When Key Click is on, an audible click is heard each time a front panel key is pressed.

Limit Beep

When limit beep is enabled, the instrument will beep after each sweep if the amplitude of the measurement data exceeds the limit line.

Graticule

The graticule may be turned off (OFF), display only horizontal lines (HORZ) or display both horizontal and vertical lines (H + V).

Sleep

To conserve battery power, the instrument can be set to go into a sleep mode if a button has not been pressed for a certain length of time. Time selections are 5 minutes (5 MIN), 15 minutes (15 MIN), or NEVER go into sleep mode. When in the sleep mode, pressing any key will return the instrument to the same measurement state it was previously in. When the charger is connected, the instrument does not go into the sleep mode.

Units

Measurement display mode can be set for dBm (dB referenced to a milliwatt) or dB μ v (dB referenced to a microvolt), or dB μ V/m (field strength). For field strength measurements one of the furnished antennas attached to the input connector.

Setting Date and Time

To access date and time setting, press the soft key directly below “SET DATE”. The screen at the right will appear. The date and time shown in the box at the center of the screen is that currently stored in the instrument. To change the date or time, use the cursor keys to change the settings. Exiting this menu will change the date to the new setting. Pressing the soft key under “SET CLK” will immediately reset the clock to the new time.

The clock is always in the 24 hour format. In other words, 3:00pm is displayed as 15:00. The data is always displayed in the month-day-year format.



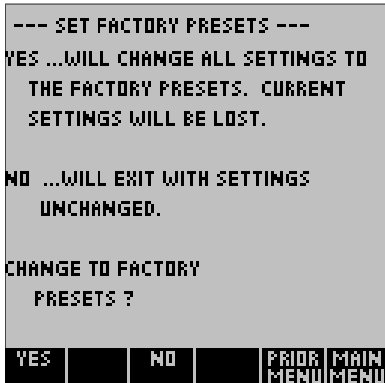
Self Test

Pressing SELF TEST will bring up the screen to the right. The instrument will conduct a self test and display the results (usually PASSED). The version of the instrument firmware is displayed along with the date, time, and internal instrument temperature. The power supply status is also indicated; either being charged from an external 12V source or powered by the internal batteries.

You will notice that this screen is also displayed for a few seconds at turn on. Each time power is activated, the instrument conducts a self test and a calibration sequence. The main menu is then displayed.



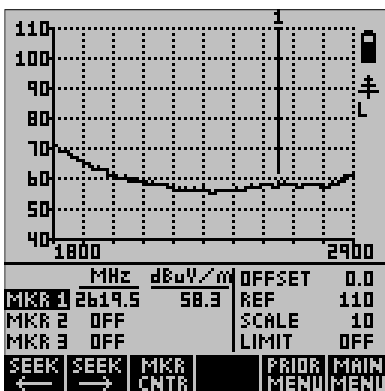
Resetting to Factory Pre-Sets



Pressing Pre-Set brings up the menu to the screen to the left. The factory default settings can be restored or the screen can be exited with settings unchanged. The factory defaults are as follows:

Frequency Range:	1.8 – 2.9 GHz
Frequency Mode:	Start / Stop
Units:	dB μ V/m
Scale:	10 dB per Division
Reference:	110 dB μ V/m
Offset:	0 dB
Limit Line:	OFF
Markers:	OFF
Resolution Bandwidth:	120 kHz
Video Bandwidth:	AUTO
Detection:	NORMAL
Averaging:	OFF
Key Click:	ON
Limit Beep:	OFF
Sleep:	5 MIN

Markers



The Wireless Wizard has three frequency markers. These markers can be accessed by pressing the front panel keys labeled MKR1, MKR2, or MKR3. A screen similar to the one at the left will be displayed. The active marker which was the last front panel key pressed is shown in reverse video (dark). It may be moved by pressing the left or right cursor keys. To turn a marker off, press the corresponding front panel marker key.

Two marker functions are built into the Wireless Wizard. Pressing the soft key under “SEEK” will move the marker left or right to the highest amplitude signal in that direction.

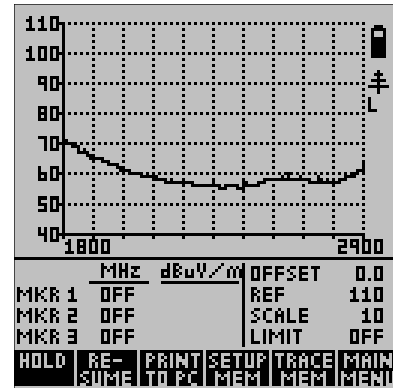
Pressing the soft key under “MKR CNTR” will change the frequency range so that the marker is at the center of the screen. If necessary, the frequency range will be narrowed to make this possible.

Save / Recall

Pressing the SAVE / RCL key on the front panel changes the soft key labels to those shown at the right.

Hold / Resume

Pressing the “HOLD” soft key stops the trace update on the screen. This is indicated by an “X” appearing under “HOLD”. To resume the trace update, press the soft key under “RESUME”.

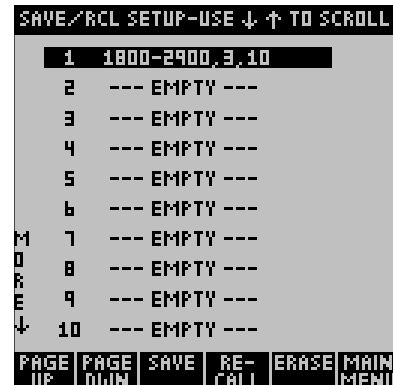


Print to PC

Using the PC Enhancement Software supplied with the Wireless Wizard, it is possible to make a hard copy print-out of measurement data each time this button is pressed. See Chapter 4 for information on setting up this feature.

Setup Memory

Setup Memory stores the basic measurement parameters such as frequency span, reference value, scale, etc., so that the Wireless Wizard can make the exact same measurement when setup is recalled. Setup Memory is accessed by pressing the soft key labeled “SETUP MEM”. The Model 425A has memory to store 20 measurement setups. Each setup in memory is identified by the measurement frequency range, reference dB value, and scale in dB per division. The soft keys labeled “PAGE UP” and “PAGE DOWN” switch between the first ten setups and the last ten. The cursor up / down keys can be used to select a specific setup.



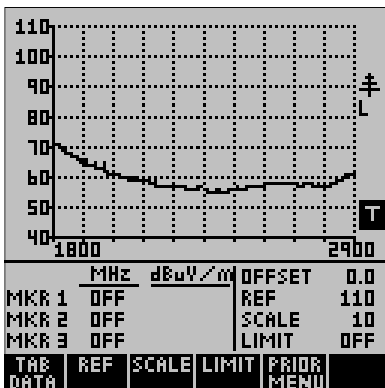
Once a setup memory location has been selected, pressing the “SAVE” soft key will store the current setup in this location. Pressing “RECALL” will load the setup from that location into the instrument, and pressing “ERASE” will erase the contents of the location.



Trace Memory

Trace Memory stores just the trace, or measurement data currently being measured. Trace Memory is accessed by pressing the soft key labeled “TRACE MEM”. There is memory sufficient to store 20 traces. Each trace memory is identified by the date and time it was stored. The soft keys labeled “PAGE UP” and “PAGE DOWN” switch between the first ten setups and the last ten. The cursor up / down keys can be used to select a specific setup.

Once a specific setup has been selected, pressing the “SAVE” soft key will store the current trace in this memory. Pressing “RECALL” will load the trace in memory into the Wireless Wizard, and pressing “ERASE” will erase the trace from the memory location.



When a trace is recalled, it is marked with a reverse video “T” as shown on the left. This is to show that the displayed trace is from memory; it is not current measurement data. The reference line value and scale of a stored trace can be changed; however the frequency span cannot.



Pressing TAB DATA will show tabular data about the saved measurement. Information such as Resolution Bandwidth, Video Bandwidth, whether Averaging was used, etc. can be determined.

To return to a live measurement press the soft key labeled PRIOR MENU.

Chapter 3

Using the Wireless Wizard for WLAN Measurements

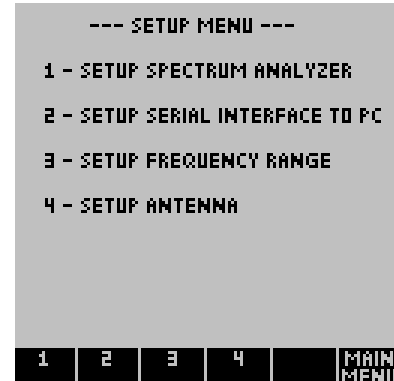
Introduction

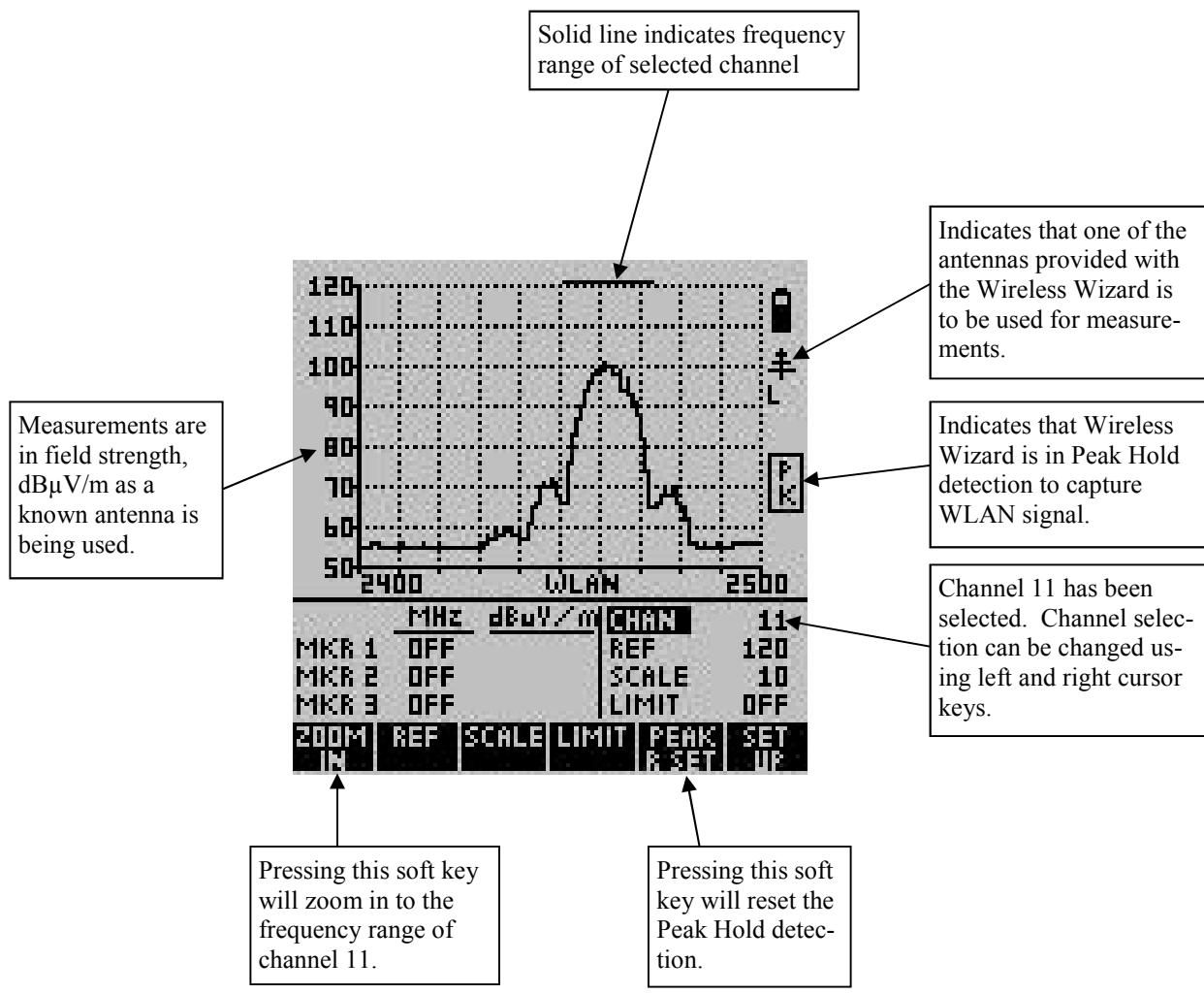
The Wireless Wizard is especially well suited for measurements of Wireless Local Area Networks (WLAN) in both the 2.4 and 5 GHz bands. The Wireless Wizard can be used for site surveys to determine the signal strength due to the location of an Access Point.

To Place the Wireless Wizard in the WLAN measurement mode, press the SET UP soft key, and then select “3—SET UP FREQUENCY RANGE”.

Using the down arrow cursor key, move the selection to select any of the preset WLAN bands: 2.4 to 2.5 GHz, 5.15 to 5.25 GHz, 5.25 to 5.35 GHz, 5.49 to 5.71 GHz, or 5.725 to 5.825 GHz. The 4.94 to 4.99 GHz Public Safety Band can also be selected. After selecting the appropriate band then press DONE.

The type of antenna to be used can be selected by pressing SET UP and then selecting page 4 - SETUP ANTENNA. The screen at the right will then appear. The user can then select to use either an omni-directional or directional antenna. Upon making a selection, the Wireless Wizard will use the antenna factors for the selected antenna. If no antenna is selected (NONE), then no antenna factors will be used and the Wireless Wizard will display measurements in dBm.





In the above example, the 2.4 to 2.5 GHz WLAN band was selected. To facilitate capture of the WLAN signal, the detection mode has been automatically set to PEAK HOLD. In this way the WLAN signal is captured by multiple sweeps of the spectrum analyzer. To reset the Peak Hold detection, simply press the soft key labeled PEAK R'SET.

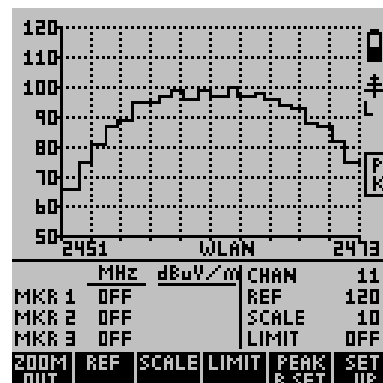
The solid bar at the top of the measurement screen represents the frequency range of WLAN channel 11. Using the right and left cursor keys, this indicator can be moved to any of the 14 WLAN channels within the 2.4 to 2.5 GHz band. This indicator is a convenient indicator to identify the WLAN channel associated with a signal.

Channel Zoom

By pressing the ZOOM IN soft key, the frequency range is changed to that of the selected WLAN channel. In this case it is channel 11 which has a frequency range of 2451 to 2473 MHz.

Note that the trace has a graininess or steps associated with it. In the channel zoom mode, only 25 frequency data points are measured. This allows measurements to be made very quickly, allowing rapid capture of WLAN signals within the channel.

Pressing the same soft key, which is now labeled ZOOM OUT will return to the full 2.4 to 2.5 GHz span.



802.11b/g Channels identified by the Wireless Wizard.

Channel 1	2401—2423 MHz
Channel 2	2406—2428 MHz
Channel 3	2411—2433 MHz
Channel 4	2416—2438 MHz
Channel 5	2421—2443 MHz
Channel 6	2426—2448 MHz
Channel 7	2431—2453 MHz
Channel 8	2436—2458 MHz
Channel 9	2441—2463 MHz
Channel 10	2446—2468 MHz
Channel 11	2451—2473 MHz
Channel 12	2456—2478 MHz
Channel 13	2461—2483 MHz
Channel 14	2473—2495 MHz

802.11a Channels identified by the Wireless Wizard.

5.15—5.25 GHz Band

Channel 34	5160—5180 MHz
Channel 36	5170—5190 MHz
Channel 38	5180—5200 MHz
Channel 40	5190—5210 MHz
Channel 42	5200—5220 MHz
Channel 44	5210—5230 MHz
Channel 46	5220—5240 MHz
Channel 48	5230—5250 MHz

5.25—5.35 GHz Band

Channel 52	5250—5270 MHz
Channel 56	5270—5290 MHz
Channel 60	5290—5310 MHz
Channel 64	5310—5330 MHz

5.49—5.71 GHz Band

Channel 100	5490—5510 MHz
Channel 104	5510—5530 MHz
Channel 108	5530—5550 MHz
Channel 112	5550—5570 MHz
Channel 116	5570—5590 MHz
Channel 120	5590—5610 MHz
Channel 124	5610—5630 MHz
Channel 128	5630—5650 MHz
Channel 132	5650—5670 MHz
Channel 136	5670—5690 MHz

5.725—5.825 MHz Band

Channel 149	5735—5755 MHz
Channel 153	5755—5775 MHz
Channel 157	5775—5795 MHz
Channel 161	5795—5815 MHz

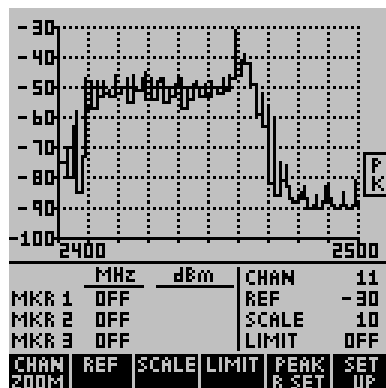
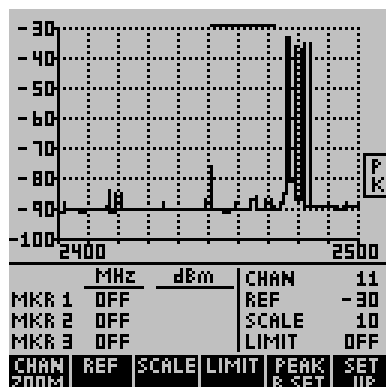
Measuring and Identifying Interference

Signals which can interfere with WLAN communications can be measured and identified using the Wireless Wizard. Since the Wireless Wizard is a true spectrum analyzer, it detects all signals present in the WLAN band, not just those which contain 802.11a, 802.11b, or 802.11g protocols. Several examples of interfering signals are shown at the right for reference.

The first signal at the right is microwave oven being operated approximately 10 meters from the point of measurement.

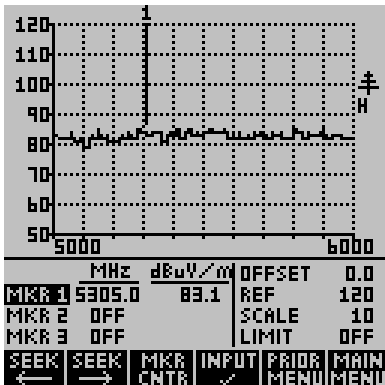
This second signal is a 2.4 GHz wireless telephone. The handset is approximately 5 meters from the measurement point and the base station is approximately 10 meters away.

This third signal is the 802.11 card in a laptop computer which has lost the Access Point with which it was communicating and is now searching for another Access Point. This measurement was made approximately 5 meters from the laptop computer.



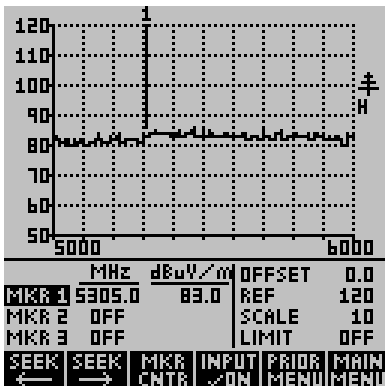
Special Considerations in the 5 GHz Band

In the 5 GHz band of the Model Wireless Wizard, it is possible to view responses from signals that are higher than the signal intended to be measured. Fortunately, at these microwave frequencies large signals are seldom encountered and the Wireless Wizard has a quick feature for verifying that a signal is real.



When in the 5 GHz band, press any of the front panel Marker keys (MKR1, MKR2, or MKR3) and the screen at the left will appear. Note the soft key labeled INPUT $\sqrt{}$ (Input Check). Pressing this soft key will check that the signal being viewed is real.

When pressing the INPUT $\sqrt{}$ key, if the signal disappears or changes frequency, it is not a real signal. Valid signals will remain constant. Invalid signals will disappear or appear to change frequency by 15 MHz when toggling between INPUT $\sqrt{}$ and INPUT $\sqrt{\text{ON}}$.



In the example at the left, the signal being viewed does not change frequency when toggling between INPUT $\sqrt{}$ and INPUT $\sqrt{\text{ON}}$, so it is a valid signal.

Chapter 4

Using the PC Enhancement Software

Introduction

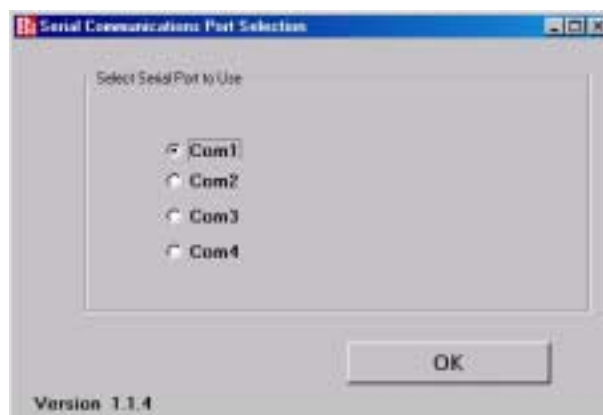
This chapter covers the installation and use of the PC Enhancement Software. This software, supplied with the Wireless Wizard, allows measurement data to be downloaded to any PC operating under WINDOWS 95 or later. Measurement data can be stored on disk within the PC or printed using any WINDOWS compatible printer. A unique feature of this software allows data to be printed with the touch of a button on the Wireless Wizard front panel without using the PC keyboard.

Installing the PC Enhancement Program

Insert the CD ROM into the computer. After several seconds the program should begin automatically installing. If this does not happen, click START located on the lower left hand corner of the WINDOWS desktop. Select RUN from the pop up menu and then type X:400Comm003a.EXE, where “X” is the drive identifier for the CD ROM drive on your computer.

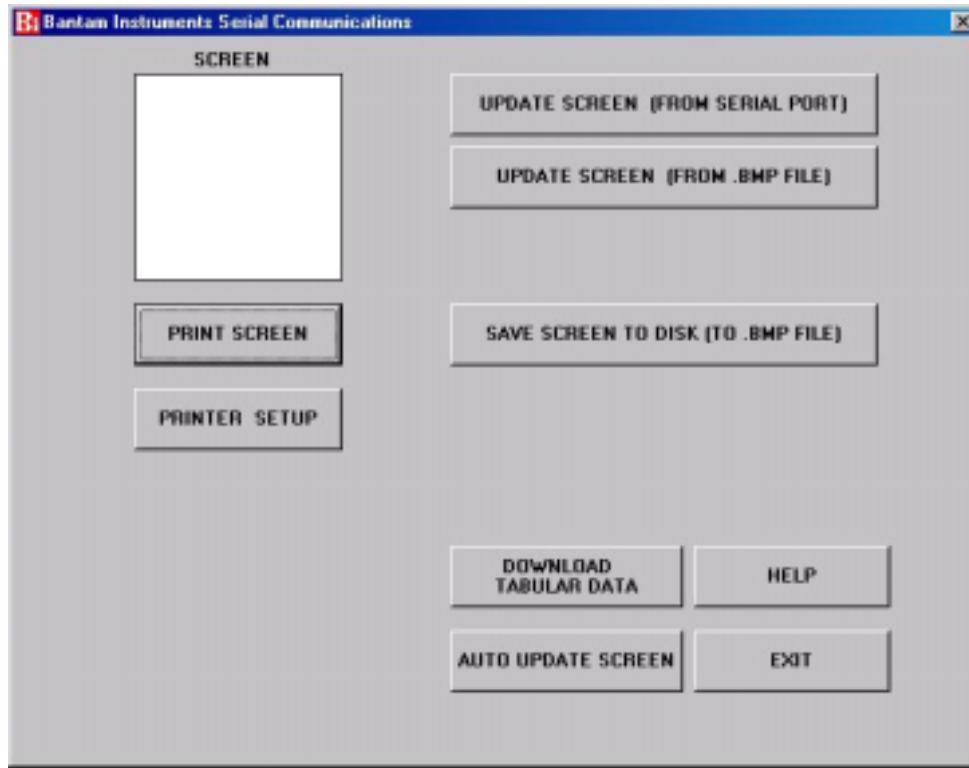
Starting the PC Enhancement Program

Connect the Wireless Wizard Spectrum Analyzer to one of the RS-232 serial ports on the computer using the supplied serial interface cable. If your computer does not have a serial port, use an inexpensive USB to Serial Port Adapter which can be obtained at most any computer store. Double click on the program icon to start the program. The first screen, shown below, will ask you to indicate the RS-232 COM port you are using. Select the appropriate COM port and then press OK.



Downloading Measurement Data from the Wireless Wizard

After selecting the COM port the following display will appear.



The white area in the upper left hand corner is called the “Screen”. Data can be uploaded from the Wireless Wizard by clicking on the button labeled UPDATE SCREEN (FROM SERIAL PORT). Clicking this button will upload whatever is present on the Wireless Wizard LCD display to the Screen. The upload can take as long as five seconds depending upon the speed of the PC being used, so click just once and wait a few seconds.

If the Wireless Wizard screen fails to upload to the PC, check that the serial cable is connected to both the Wireless Wizard and the PC. Also check that the correct COM port was selected when the program was started. Also go to the Wireless Wizard SETUP menu from the Wireless Wizard Main Menu. Select soft key labeled “2” and ensure that the baud rate is set for “57600” and that the serial address is set to “1”.

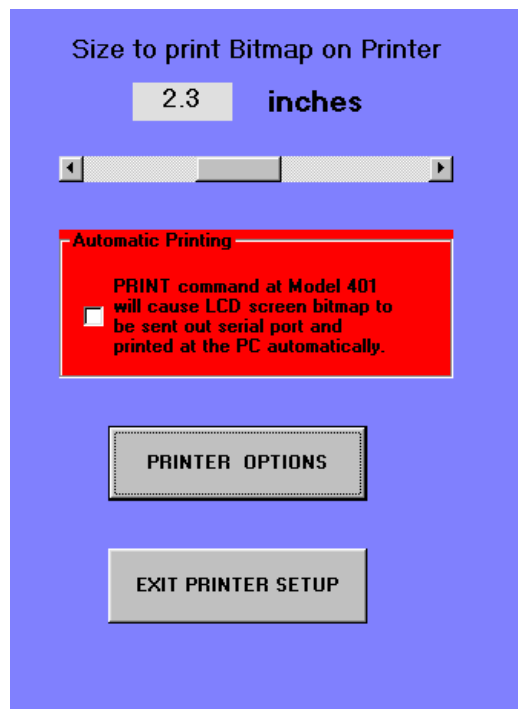
Saving the Downloaded Data to Disk

The downloaded data from the Wireless Wizard can be saved to disk by clicking on the button labeled “SAVE SCREEN TO DISK (TO .BMP FILE)”. The format used is .BMP bitmap which is compatible with most word processing, spreadsheet, presentation, and publishing software. Upon clicking on the button, you will have a choice of where to save the data and what name to place on it.

To view saved data, click on the UPDATE SCREEN (FROM .BMP FILE) and select the data file to be viewed. The data will then be displayed in the program screen area.

Printing Downloaded Data

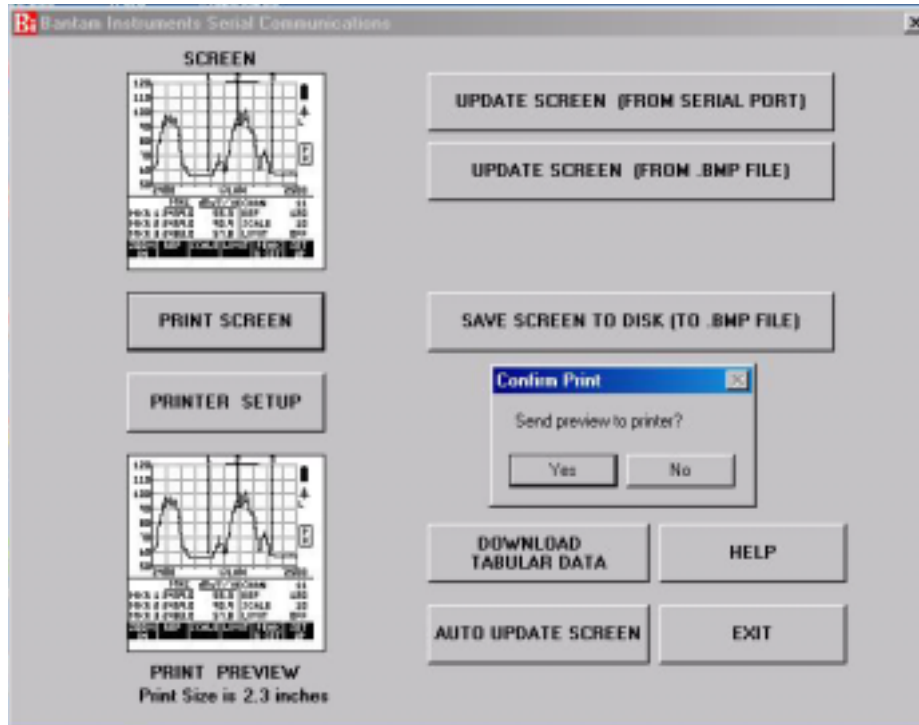
The screen can be printed at any time by clicking on PRINT SCREEN. Before doing so, click PRINTER SETUP and the window shown below will appear.



At the top of this window, the size of the printout can be set from a minimum of 2 inches square to a maximum of 4 inches square. The default is 2.3 inches which corresponds to a 1:1 copy of the Wireless Wizard screen.

The PRINTER OPTIONS key allows selection of the printer, printer resolution, and other standard Windows printer options. Clicking on EXIT PRINTER SETUP returns to the PC Enhancement Software main window.

If the Screen is to be printed, click on the PRINT SCREEN BUTTON. A duplicate Screen will appear at the bottom left of the main display and the print size will be shown. If this is correct, press OK and the Screen will be printed.



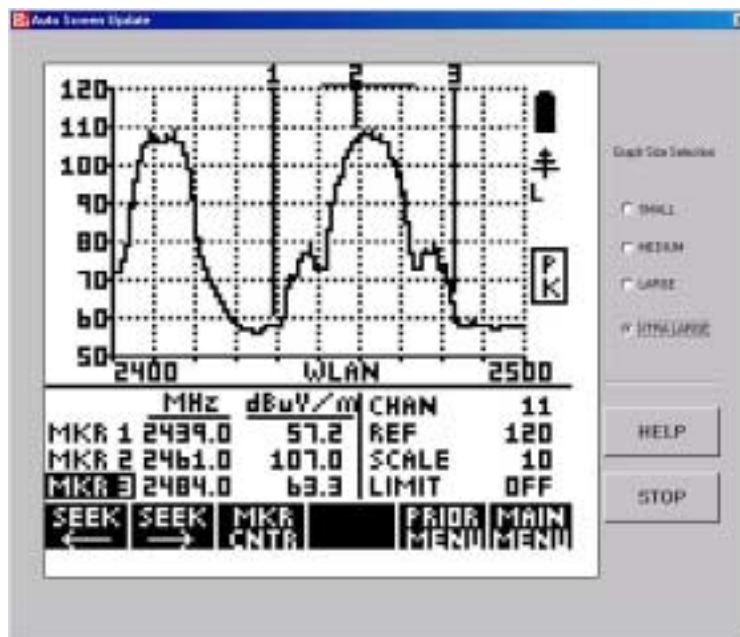
Automatic Printing from the Wireless Wizard Keypad

Enabling the red area labeled “automatic printing” allows a printout to be made every time the PRINT TO PC soft key on the Wireless Wizard is pressed. The PRINT TO PC soft key appears when the Wireless Wizard front panel SAVE/RCL key is pressed. When “Automatic Printing” is selected, the main window on the PC will appear as shown on the following illustration.



Automatic Update of the Screen Image

Often it is desired for the PC to continuously update the screen image from the Wireless Wizard. This is especially useful when the PC is being used to monitor measurements being made on the Wireless Wizard a distance away. To activate this mode, press the AUTO UPDATE SCREEN button. The image will now be continuously updated.

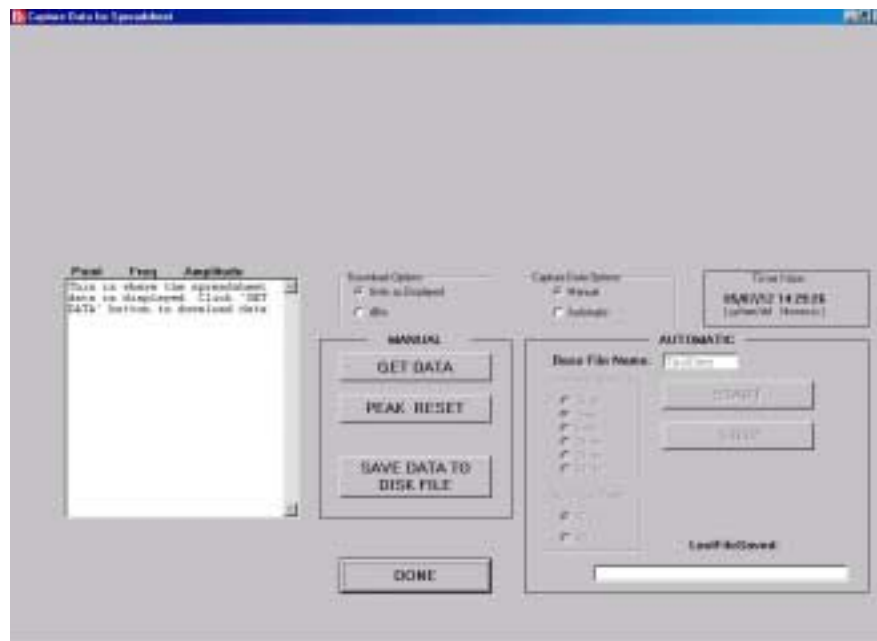


On slower PCs using older versions of WINDOWS, it is possible for the computer input buffers to occasionally overload. When this happens the update process will hesitate and the computer will emit an audible tone. As a first remedy, close any programs which are operating and not being currently used. If this does not cure the problem, simultaneously press CTR, ALT, and DEL keys. This will activate the WINDOWS Task Manager. Close programs here if they will not interfere with the operation of your PC.

In addition, some users may want to use a USB to RS-232 serial converter. These are inexpensive and usually have a memory to buffer bursts of incoming signal data which can overload a slow PC.

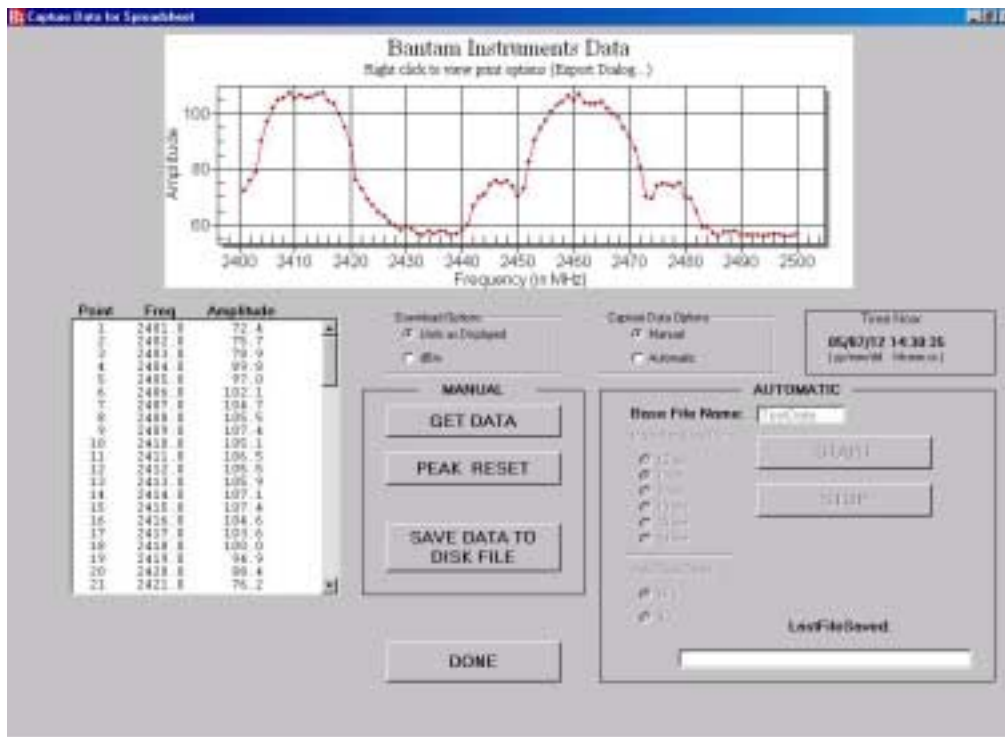
Downloading Tabular Data—Manual Mode

Tabular data can be downloaded from the spectrum analyzer. This data consists of 100 frequency, amplitude pairs separated by a comma. Each data pair is separated by a line feed. When 'DOWNLOAD TABULAR DATA' is pressed, the following window appears. The default under Capture Data Options is the Manual Mode.



When “GET DATA” is pressed, the frequency / amplitude pairs are downloaded and automatically graphed as shown below. The actual numbers can be viewed in the table below the graph and the tabular data can be stored to disk by pressing “SAVE DATA TO DISK FILE”.

The tabular data can be downloaded in two different formats, the format currently being displayed on the spectrum analyzer or in dBm measured at the input connector.



If the Wireless Wizard has been set to the Peak Hold detection mode, the peak detector can be reset by pressing the PEAK RESET button. The Wireless Wizard will reset the peak detector and begin accumulating data.

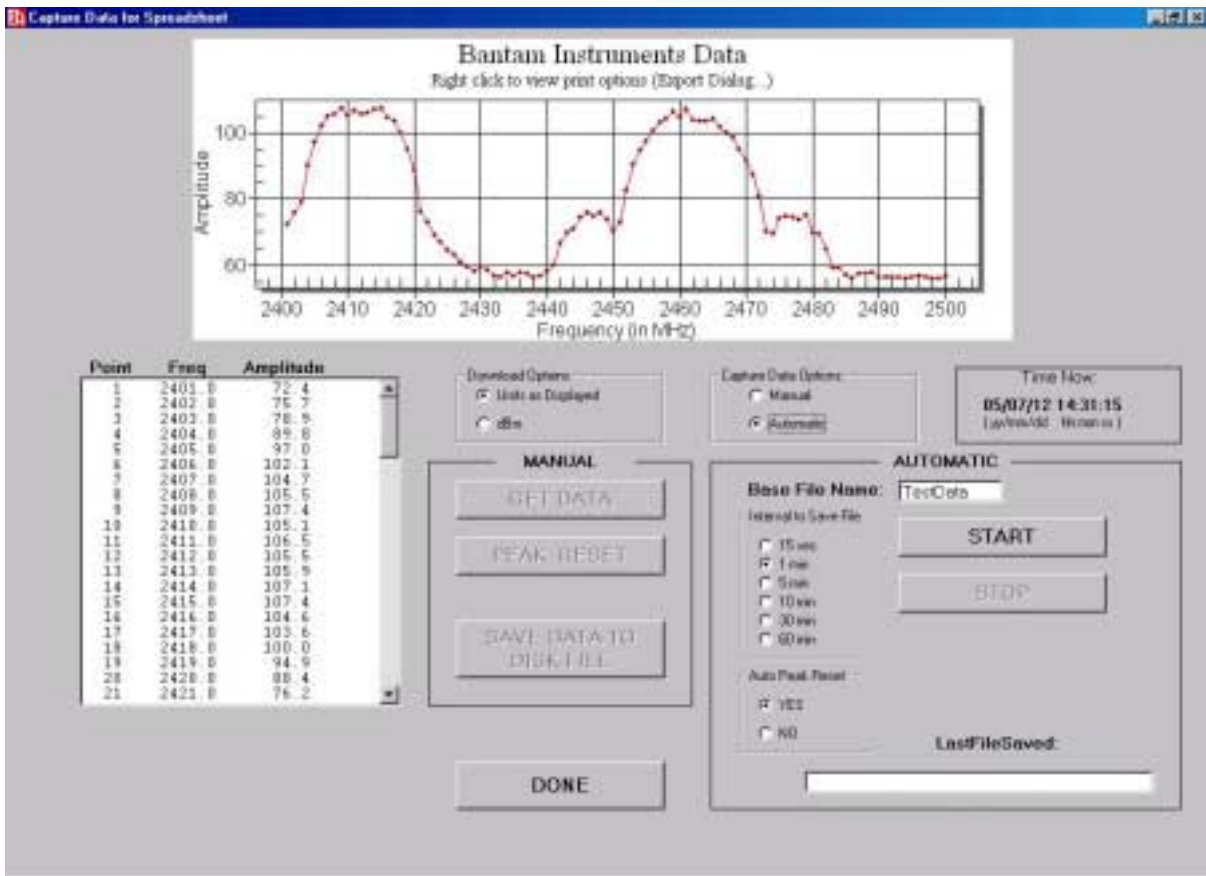
Downloading Tabular Data—Automatic Mode

The AUTOMATIC mode is used for automatic data logging. Data is taken at the selected time interval and automatically stored on the hard disk of the computer. The file name for the data identifies the date and time the data was taken. The directory in which the data is stored is set by entering the Base File Name.

Time intervals may be selected for 15 seconds, or 1, 5, 10, 30, or 60 minutes. The time and date is shown in a display on the right center of the screen. This time and date data is from the clock within the computer. If it is incorrect, it can be changed by using the WINDOWS Control Panel.

If Auto Peak Reset is selected, the Wireless Wizard peak hold detector, if peak hold detection has been selected, will be reset every time data is downloaded. If it is not selected, the peak hold data will continue to accumulate.

The AUTOMATIC mode screen is shown below.



Chapter 5

Remote Programming of the Wireless Wizard

Introduction

When a serial cable is connected between the Wireless Wizard Spectrum Analyzer and a computer, commands can be sent to setup the instrument and to receive measurement results. This capability can be used to automate testing or to monitor the RF environment from a remote location.

All commands listed here are in ASCII characters. The first character is always the serial channel number. The default serial channel number for the Wireless Wizard is "1". This number can be changed to "2" or "3" using the Wireless Wizard SET UP menu, page 2. This capability is useful if there are two or three instruments connected to the same computer. Next comes a three letter mnemonic which must be in CAPITAL ASCII characters. In some messages other ASCII characters will follow. Finally, every command must end with an ASCII ";" (semicolon) or a Carriage Return (ASCII 13 decimal or 0D hex).

The first commands that should be sent in every program are: REM and PRE. REM (REMOte) puts the Wireless Wizard Spectrum Analyzer into a mode where it can receive other remote commands over the serial interface. The Wireless Wizard front panel keys are then locked out from operation. Next, the "PRE" command returns the spectrum analyzer internal setup to a known state, the factory defaults or PREsets. Using the PRE command, it will not be necessary for your program to set up every measurement parameter in the Wireless Wizard. Just the parameters which are different from the factory defaults will have to be programmed. From this state you can proceed to send out other commands. If the program works when tested it should work in a repeatable way whenever executed in the future. So always send out "REM" and "PRE" as the first two commands of every program you write.

Messages returned from the Wireless Wizard Spectrum Analyzer will always begin with an ASCII "0" (ASCII zero). This is the serial address of the PC. Next comes a 3 ASCII character mnemonic followed by the data. The data will always be in ASCII characters. The message is always terminated by a Carriage Return (ASCII 13 decimal or 0D hex).

Before writing a program, the commands can be experimented with by connecting any terminal or terminal emulator (such as HyperTerminal in Windows) to the Wireless Wizard Spectrum Analyzer serial port. The default setup should be 57600 baud, 8 data bits, NO parity, 1 stop bit. Confirm that you have everything connected and configured correctly by turning off power to the Wireless Wizard and then turning power back on. You should see a sign on message on the terminal as follows:

```

Bantam Instruments WIRELESS WIZARD
RAM PASSED
SELF TEST PASSED
VERSION 3.00W
If message below is garbled, check baud rate setting...
Wizard Baud Rate is: 57600
Wizard Serial Addr is: 1

```

If the baud rate or serial address need to be changed, press SET UP from the Main Menu, and then select number 2. This screen then allows the serial communication port to the PC to be set up.

Control Commands for the Wireless Wizard

Command	Description	Example Command
REF±xx	Set Display Reference in dB	1REF-30;
SCLxx	Set vertical Scale dB per division	1SCL05;
LIM±xx	Set horizontal Limit Line position in dB	1LIM-40;
OKS±xx	Set Offset in dB	1OFS10;
F1Fxxxx	Set Start Frequency (in MHz)	1F1F2420;
F2Fxxxx	Set Stop Frequency (in MHz)	1F2F2450;
FCFxxxx	Set Center Frequency (in MHz)	1FCF2440;
FWFxxxx	Set Scan Frequency Width (in MHz)	1FWF20;
M1Fxxxx	Set Marker 1 Frequency (in MHz)	1M1F2405;
M2Fxxxx	Set Marker 2 Frequency (in MHz)	1M2F2482;
M3Fxxxx	Set Marker 3 Frequency (in MHz)	1M3F2491;
M11	Turn Marker 1 ON	1M11;
M10	Turn Marker 1 OFF	1M10;
M21	Turn Marker 2 ON	1M21;
M20	Turn Marker 2 OFF	1M20;
M31	Turn Marker 3 ON	1M31;
M30	Turn Marker 3 OFF	1M30;
MSLx	Marker Seek Left, where x=1, 2, or 3 (ignored if marker x if turned off)	1MSL3;

Command	Description	Example Command
MSRx	Marker Seek Right, where x=1, 2 or 3 (ignored if marker x is turned off)	1MSR2;
MTCx	Marker To Center, where x=1, 2 or 2 (ignored if marker x is turned off)	1MTC1;
RBA	Resolution Bandwidth AUTO	1RBA;
RBW	Resolution Bandwidth WIDE	1RBW;
RBN	Resolution Bandwidth NARROW	1RBN;
VBA	Video Bandwidth AUTO	1VBA;
VBW	Video Bandwidth WIDE	1VBW;
VBN	Video Bandwidth NARROW	1VBN;
DTN	Detection NORMAL	1DTN;
DTP	Detection PEAK	1DTP;
DTQ	Detection Quasi-Peak	1DTQ;
PRS	Peak Reset (when in Peak detection mode)	1PRS;
AV1	Averaging (of trace) ON	1AV1;
AV0	Averaging (of trace) OFF	1AV0;
SB1	Beep if Signal above limit line ON	1LB1;
SB0	Beep if Signal above limit line OFF	1LB0;
GOF	Graticule OFF	1GOF;
GHO	Graticule Horizontal lines only	1GHO;
GHV	Graticule Horizontal and Vertical lines	1GHV;
LL1	Limit Line ON	1LL1;
LL0	Limit Line OFF	1LL0;
PRE	PRESET to factory default values	1PRE;
REM	REMOTE mode (allow other serial commands) Keypad is locked out.	1REM;
RTL	Return to Local control (allow use of keypad)	1RTL;
DLS	Download Screen Image when signal exceeds the Limit Line. Use PC Enhancement program to receive. The data will be sent at end of sweep.	1DSL;

Command	Description	Example Command
DLE	Download Spreadsheet Data (ie EXCEL) when signal exceeds the Limit Line. (Data will be sent at end of sweep)	1DLE;
SSM	Set Display to Start-Stop Mode	1SSM;
CSM	Set Display to Center-Span Mode	1CSM;

Band Selection

LB0	Select 1.8 to 2.9 GHz Band	1LB0;
LB1	Select 2.4 to 2.5 GHz WLAN Band	1LB1;
HB0;	Select 4.94 to 6.0 GHz Band	1HB0;
HB1	Select 5.15 to 5.25 GHz WLAN Band	1HB1;
HB2	Select 5.25 to 5.35 GHz WLAN Band	1HB2;
HB3	Select 5.49 to 5.71 GHz WLAN Band	1HB3;
HB4	Select 5.725 to 5.825 GHz WLAN Band	1HB4;
HB5	Select 4.94 to 4.99 GHz Public Safety Band	1HB5;

When any of the WLAN bands are selected, the frequency range of the sweep cannot be changed. The F1F, F2F, FCF, and FWF commands are ignored by the Wireless Wizard. To set specialized bands, select either LB0 or HB0 and then use the F1F, F2F, FCF, and FWF commands to set up the frequency measurement range desired.

COMMANDS FOR READING BACK DATA FROM THE WIRELESS WIZARD

Command	Description	Example
?SFV	Show Firmware Version	1?SFV;
?F1F	Return Start Frequency (in MHz)	1?F1F;
?F2F	Return Stop Frequency (in MHz)	1?F2F;
?REF	Return Reference for Graph (in dBm)	1?REF;
?SCL	Return Scale for Graph (in dB per division)	1?SCL;
?LIM	Return setting of the Limit Line (in dBm)	1?LIM;
?M1F	Return Marker 1 frequency (in MHz)	1?M1F;
?M2F	Return Marker 2 frequency (in MHz)	1?M2F;
?M3F	Return Marker 3 frequency (in MHz)	1?M3F;
?DSC	Download data for 100 points displayed on the LCD in Spreadsheet format (freq, amplitude). Data is returned in the units selected on the Wireless Wizard	1?DSC;
?DSD	Same as ?DSC, above, except that data is always Returned in dBm as measured at the input connector.	1?DSD;
?AM1	Return Amplitude of Marker 1	1?AM1;
?AM2	Return Amplitude of Marker 2	1?AM2;
?AM3	Return Amplitude of Marker 3	1?AM3;
ABNxx	Return Amplitude of data point xx (where xx = 00 to 99 decimal) This is the amplitude of one of the selected 100 data points points displayed on the 40	1?ABN37
?OFS	Return Offset value	1?OFS;

DATA FORMATS SENT BACK FROM THE WIRELESS WIZARD

<u>Command (From PC)</u>	<u>Example Response Message</u>
?SFV;	VERSION01.03
?F1F;	0F1F234.0
?F2F;	0F2F890.0
?REF;	0REF-30
?SCL;	0SCL10
?LIM;	0LIM-35
?M1F;	0M1F316.0
?M2F;	0M2F617.7
?M3F;	0M3F808.0
?AM1;	0AM1-85.4
?AM2;	0AM2-22.4
?AM3;	0AM3-91.9
?ABN	0ABN-44.6
?INX	0IND
?OFS	0OFS-34.4
?DSC; and ?DSD;	0DSD*2437,-83.8*2438,-82.7*...*2439,-93.8

NOTE: This data consists of 100 frequency, amplitude pairs separated by a comma and terminated by a ASCII Line Feed character (10 decimal or 0A hex). The “*” indicates where the ASCII Line Feed character is sent since it is a non-printable character. At the end of the 100 pairs is a ASCII Carriage Return (13 decimal or 0D hex) terminating the transfer.