

BANTAM INSTRUMENTS

WIRELESS LAN SPECTRUM ANALYZER
MODEL 424A



OPERATING MANUAL

WIRELESS LAN SPECTRUM ANALYZER

MODEL 424A

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 LAN Spectrum Analyzer

Model Number: 424A

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

April 12, 2004
Date

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Chapter 1

General Information

Introduction

This chapter provides basic information regarding the Model 424A Wireless LAN Spectrum Analyzer. Included are a basic description, battery and charging information, warranty, and performance specifications.

Description

The Model 424A is a handheld Spectrum Analyzer covering the frequency range of 1.8 – 2.9 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 Model 424A has an RS-232 serial interface which can be used to download measurement data to a computer. The PC Enhancement Software supplied with the Model 424A allows measurement data to be downloaded to a personal computer and to be printed to any Windows compatible printer or stored on the hard drive for later use. The computer must have a Windows¹ 95 or later operating system. The serial interface cable is included for connection between the Model 424A and a personal computer. Instructions for operating the PC Enhancement Software is contained in chapter 4.

Included with the Model 424A Wireless LAN Spectrum Analyzer is a 1.8 – 2.9 GHz antenna. Using this antenna, measurements can be made directly in signal strength, dB μ V/m, as antenna factors versus frequency for the antenna is stored within the memory of the Model 424A. Measurements can be made in dB μ V/m using the antenna, 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 Model 424A Wireless LAN Spectrum Analyzer

The following items are included as standard with every Model 424A Wireless LAN Spectrum Analyzer:

- 1.8 – 2.9 GHz Antenna (p/n 9014-0003)
- Battery Charger (p/n 9001-0001)
- PC Enhancement Software (p/n 9000-0007)
- Serial Interface Cable (p/n 9000-0003)
- Soft Carrying Case (p/n 9000-0004)
- Operating Manual (p/n 9900-0004)
- One Year Warranty

Options and Accessories

The following options and accessories may be ordered:

Option 001	Warranty Extension to 3 years
Option 002	Backlight, for use in low illumination
Option 005	Add 5.0 – 6.0 GHz Frequency Range
9010-0002	Cigarette Lighter 12 VDC Adapter
9010-0005	SMA Male to Reverse SMA Male Adapter
9011-0001	10 dB SMA Attenuator, DC – 6 GHz
9011-0002	20 dB SMA Attenuator, DC – 6 GHz
9011-0003	30 dB SMA Attenuator, DC – 6 GHz
9011-0004	40 dB SMA Attenuator, DC – 6 GHz
9050-0001	Transit Case for Model 424A and Accessories

Option 001 must be ordered at time of purchase. If Option 002 or Option 005 are ordered after time of purchase, the Model 424A must be returned to the factory for installation. Consult you local Bantam Instruments representative for information.

Battery and Charging Information

The Model 424A is typically 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. An internal sleep mode can be set for 5 minutes, 15 minutes, or never. When a front panel button has not been pressed for 5 or 15 minutes, the Model 424A enters a lower power sleep mode and is immediately awakened at the push of any front panel button.

The Model 424A 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 424A can also be powered or the batteries recharged from a 12V DC source such as a vehicle battery by using the optional 9010-0002 cigarette lighter adapter.

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 Model 424A. 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 Range:	1.8 GHz to 2.9 GHz
Span:	0 MHz to Entire Frequency Range
Frequency Markers:	3
Marker Resolution (Frequency):	1% of span or 100 kHz
Marker Resolution (Amplitude):	0.1 dB
Marker Readout Accuracy:	1% of span ± 2 ppm
Marker Functions:	Peak Search, left or right
Frequency Stability:	± 2 ppm
Resolution Bandwidth, 3 dB:	120 kHz, 1 MHz
Video Bandwidth:	30 kHz, 300 kHz
Preset WLAN Band:	2.4 – 2.5 GHz
Channels Identified:	1 through 14

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 Connector:	
in dBm, typical:	-30 dBm to -90 dBm
in dB μ V, typical:	77 dB μ V to 17 dB μ V
Sensitivity using supplied 1.8 to 2.9 GHz Antenna:	
entire 1.8 to 2.9 GHz range, typical:	65 dB μ V/m
across 2.4 to 2.5 GHz WLAN band, typical:	55 dB μ V/m
(antenna is optimized for 2.4 to 2.5 GHz band)	
Maximum Safe Input Level:	+23 dBm, 50 VDC
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
Detection Modes:	Normal, Quasi-Peak, Peak Hold
Input Connector:	SMA Female

OTHER FEATURES

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

Chapter 2

Operating Instructions

Introduction

This chapter covers the operating controls and interface connectors of the Model 424A Wireless LAN Spectrum Analyzer. The figure on the next page shows the Model 424A front panel and the section below identifies the function of each item.

The remaining sections of this chapter cover operation of the Model 424A such as the setting of frequencies, reference, limit lines, and scale. Markers and marker functions are also covered.

Basic Controls and Connectors:

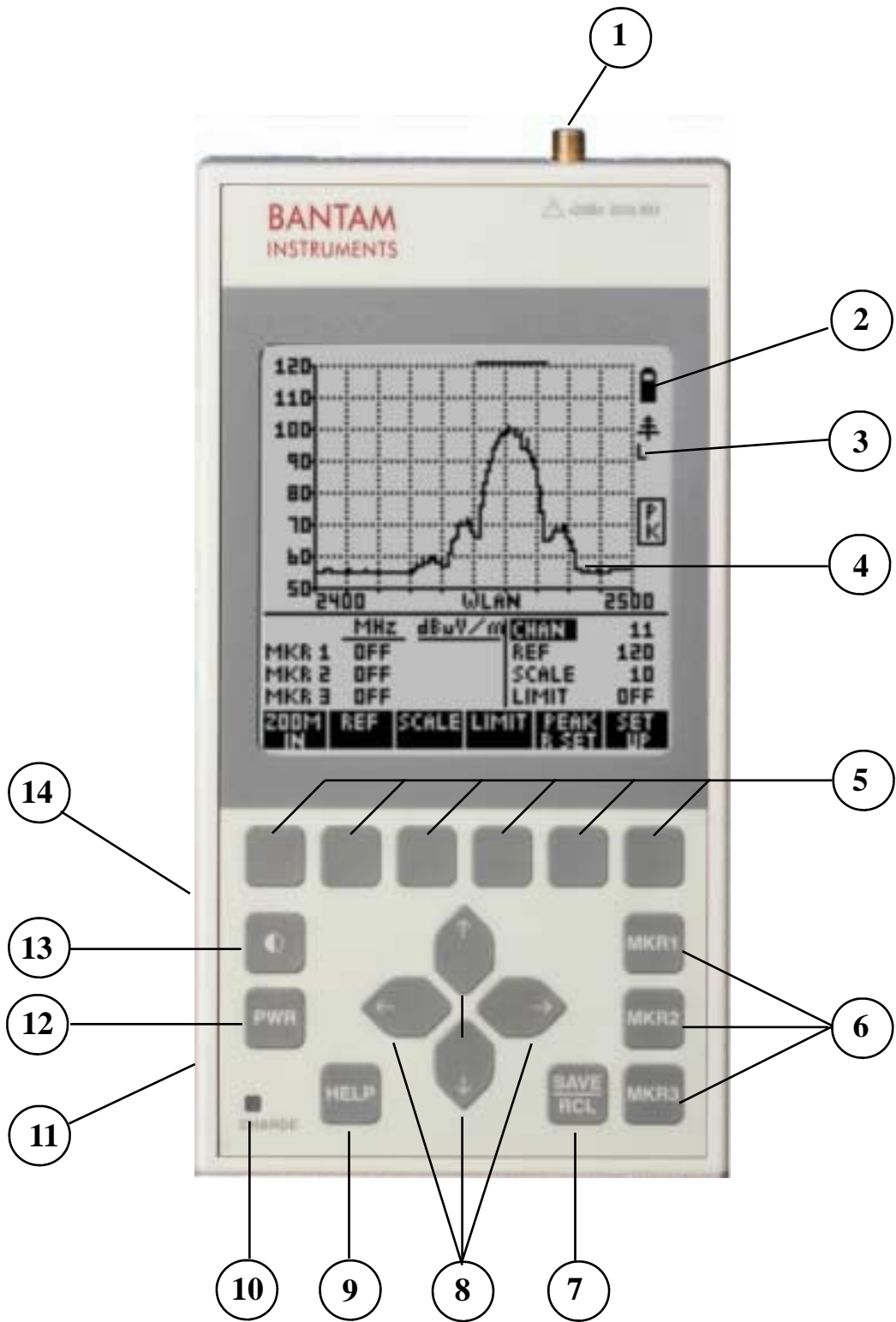
- ① **RF Input Connector.** SMA female connector. Signals to be measured enter through this connector.



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.** When measurements in dB μ V/m are selected, the antenna icon is displayed indicating that the antenna supplied with the Model 424A must be connected to the input of the spectrum analyzer.
- 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.
- ⑥ **Marker Keys.** These three keys activate and control the three markers.

Figure 1 – Model 424A Front Panel



Basic Controls and Connectors (Continued)

- 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 Model 424A is supplied with an external 100-240 VAC 50/60 Hz charger. An optional adapter for connection to an external 12 VDC power source is available.
- 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 optional LCD backlight.
- ⑭ **Serial Interface.** DB-9 female connector. For connection to the RS-232 serial interface of a Personal Computer.



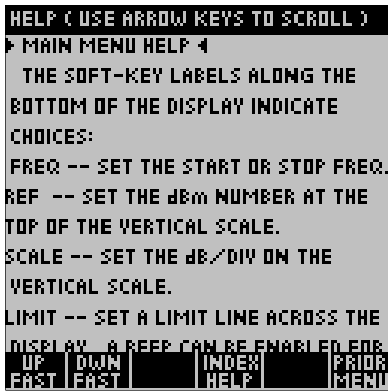
Contrast

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 (Optional)

If Option 002 Backlight is installed, additional information will appear on the contrast menu (as shown at left) to turn the backlight on or off. If “PUSH TO TURN ON BACKLIGHT” does not appear, the backlight option is not installed in your instrument. Your 424A may be returned to the factory for backlight installation. Consult your local sales representatives for details.



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.

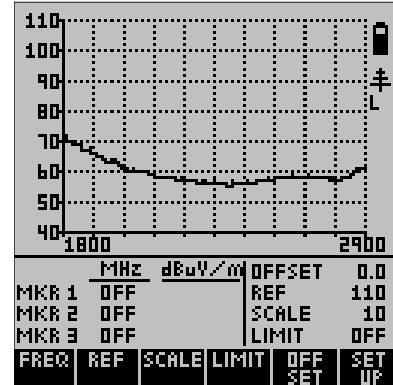


Help Index

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

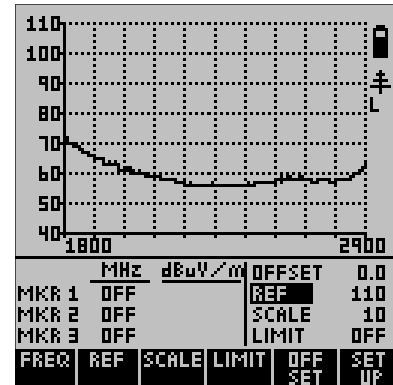
Main Menu

The Main Menu is the core menu in the operation of the Model 424A. 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.



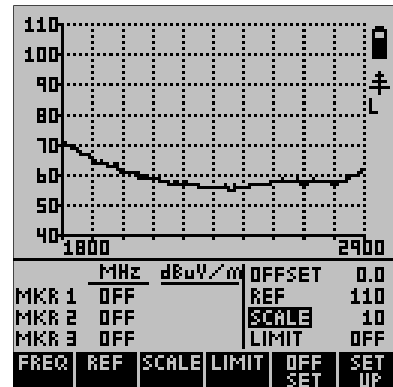
Reference Level

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 in 1 dB increments.



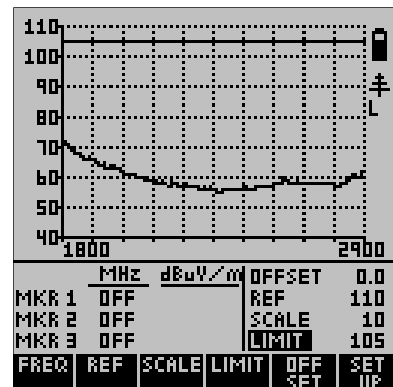
Scale

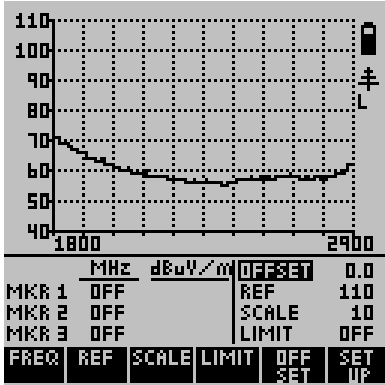
The scale is the dB per division associated with the vertical display. In the example at the right it is set to 10 dB which is the factory default value. To change the scale, press the soft key directly under “SCALE” at the bottom of the screen. Using the “Up” or “Down” cursor keys, the scale can be 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 -35 dB. To turn the Limit Line off, press the “LIMIT” soft key again.



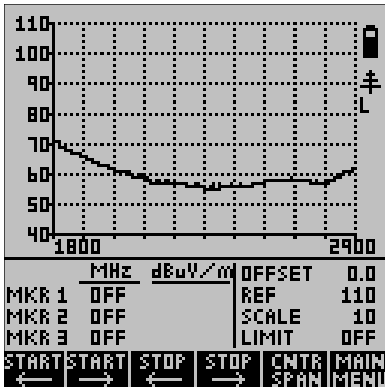


Offset

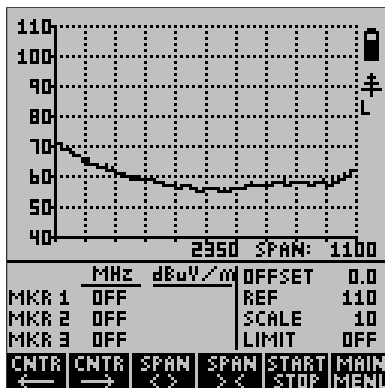
When an external amplifier or attenuator is used, it is often convenient to offset the measurement trace by the dB gain of the amplifier or dB attenuation of the attenuator. This is accomplished by pressing the OFFSET key. Positive values will move the trace upward and are used to reference the measurement 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 the 2.4 to 2.5 GHz 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. See Chapter 3 regarding WLAN measurements.



When 1.8 to 2.9 GHz full band measurements is 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 with the full frequency range of 1.8 to 2.9 GHz.

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.

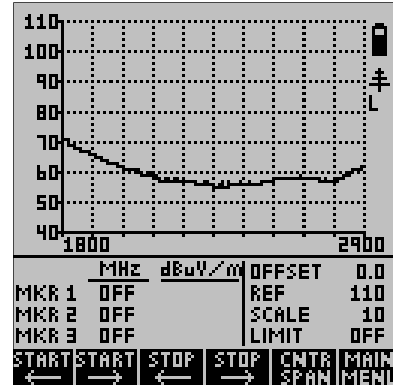
If a large frequency change needs to be made, the cursor keys can be used. When in the Start / Stop mode, the left and right cursors control the start frequency and the up and down cursors control the stop frequency. When in the Center / Span mode, the left and right cursor keys control the center frequency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

Frequency Zoom

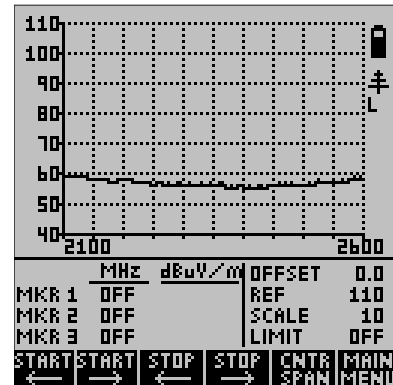
When in the Start / Stop mode, it is possible to zoom out to the full frequency range of the Model 424A and then quickly return to the original frequency range. This is very handy for making narrow band measurements and then quickly zooming out to check surrounding frequencies.

Pressing the START (left arrow) and STOP (right arrow) soft keys simultaneously quickly changes the start and stop frequencies to the full frequency range of 1.8 to 2.9 GHz.

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

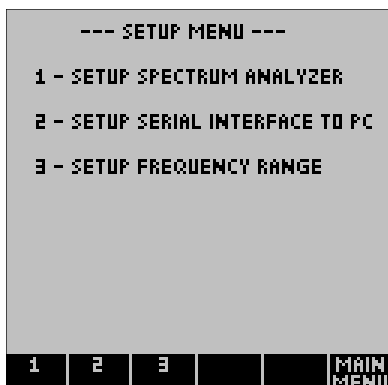


Press simultaneously to zoom out to maximum frequency range of the frequency band.



Press simultaneously to return to original frequency range.

Set Up Menu

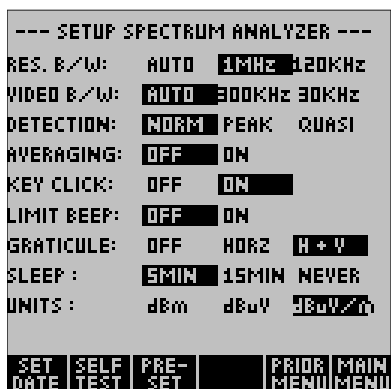


The Set Up menu, accessible from the Main menu, has three pages. The first page selects Spectrum Analyzer settings such as Resolution Bandwidth, Video Bandwidth, Detection Mode, Averaging, Key Click, Limit Beep, Graticule, Sleep Mode, Measurement Parameter (dBm or dB μ V, or dB μ V/m), Clock and Date 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 Model 424A Wireless LAN 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 Full Band or the 2.4 to 2.5 GHz WLAN sub-band.

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 PRIORITY 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.

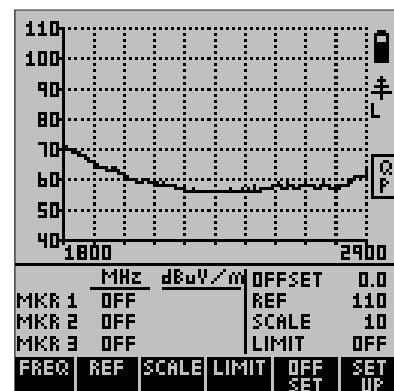
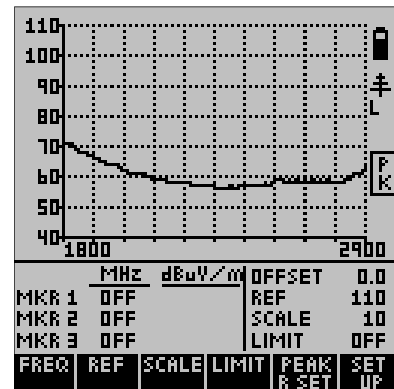
Normal Detection displays the amplitude of a signal as measured during each measurement scan.

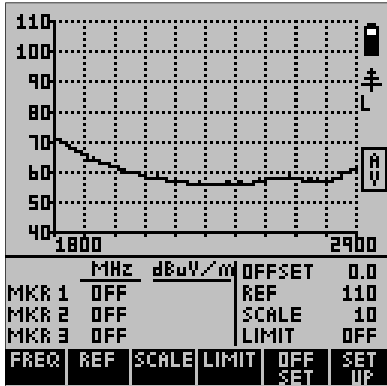
Peak Detection holds the highest amplitude of a signal from scan to scan. When peak detection is active, a small rectangle with the letters PK is displayed to the right of the graticule as shown to the right. To reset the peak detection memory, press the PEAK RESET soft key.

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 the furnished antenna must be connected 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.



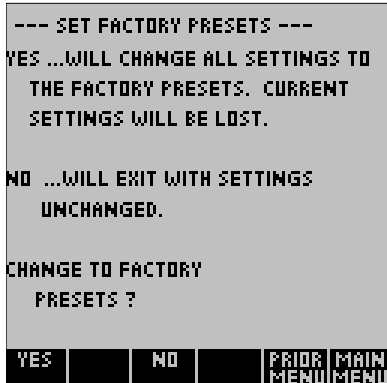
Self Test

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.



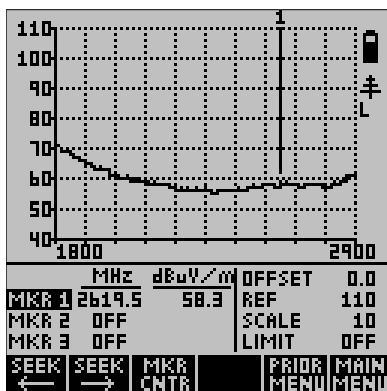
Resetting to Factory Pre-Sets



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 Model 424A 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 Model 424A. Pressing the soft key under “SEEK” will move the marker left or right to the highest amplitude signal in that direction.

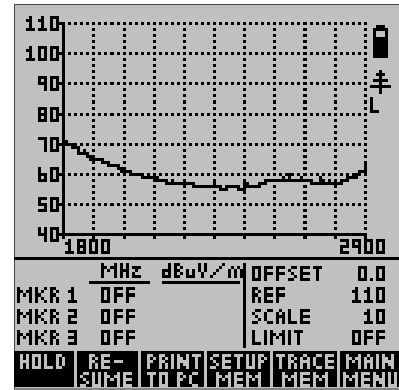
Pressing the soft key under “MKR CNTR” will change the frequency range so that the marker is at the center of the screen. If necessary, the frequency range will be narrowed to make this possible.

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”.

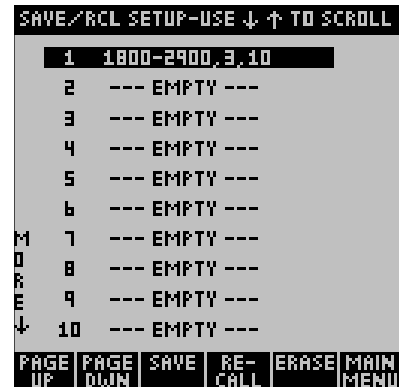


Print to PC

Using the PC Enhancement Software supplied with the Model 424A, it is possible to make a hard copy printout 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 424A can make the exact same measurement when setup is recalled. Setup Memory is accessed by pressing the soft key labeled “SETUP MEM”. The Model 424A 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.



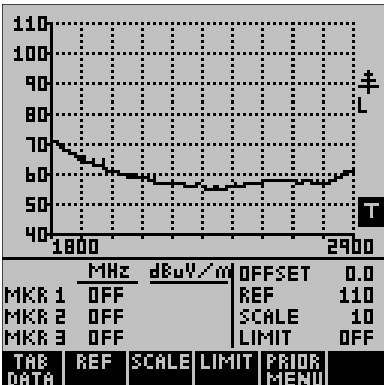
Once a setup memory location has been selected, pressing the “SAVE” soft key will store the current setup in this location. Pressing “RECALL” will load the setup from that location into the instrument, and pressing “ERASE” will erase the contents of the location.

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 424A, 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 indicate 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 Model 424A for WLAN Measurements

WLAN Measurement Mode

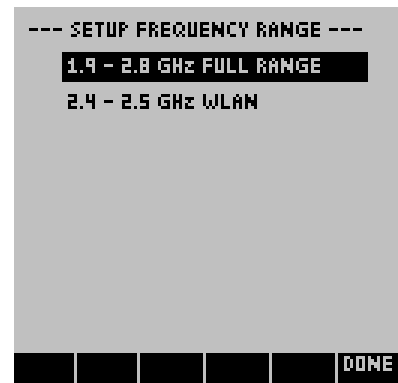
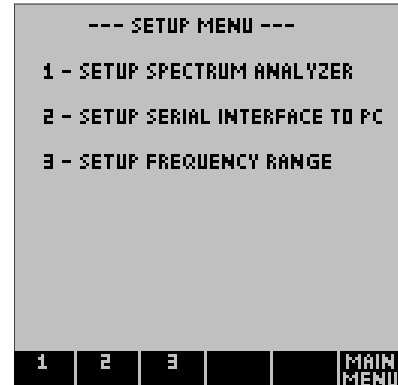
The Model 424A is designed for measurements of Wireless Local Area Networks (WLAN) in the 2.4 to 2.5 GHz frequency range. The 424A can be used for site surveys to determine the signal strength in an area around an Access Point. This site survey can identify the optimum location of Access Points to poor communications due to low signal level from signal absorption or cancellation due to multi-path reflections.

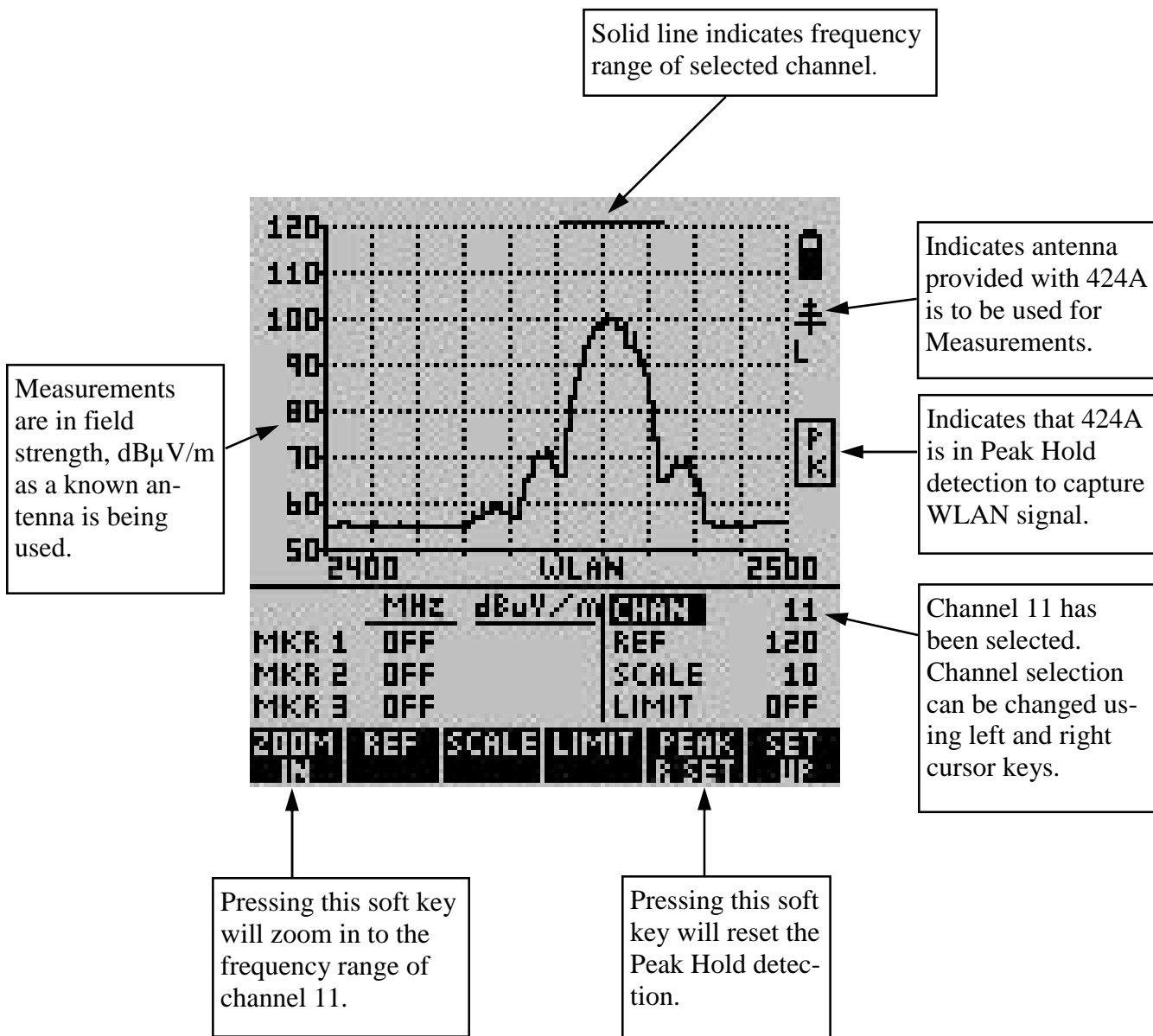
The Model 424A is also very effective at locating and identifying sources of interfering signals. Due to the fact that it is a true spectrum analyzer, it is sensitive to all signals, not just those matching 802.11 protocols.

To place the 424A in the WLAN measurement mode, press the SET UP soft key on the Main Menu. The above screen will appear.

Select “3 – SETUP FREQUENCY RANGE” and the screen to the right will appear. Using the down cursor key, select 2.4 – 2.5 GHz WLAN and then press the soft key labeled DONE.

The screen shown on the following page will appear. The 424A is now sweeping the 2.4 to 2.5 GHz WLAN 802.11b / 802.11g band. The antenna symbol at the right of the screen indicates that the provided 1.8 – 2.9 GHz antenna should be attached to the 424A input connector. With this antenna in place, calibrated measurements can now be made in Field Strength, dB μ V/m. If measurements in dBm or dB μ V referenced to the input connector are desired, go to the SETUP MENU, Page 1 and select one of these measurement parameters.





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.

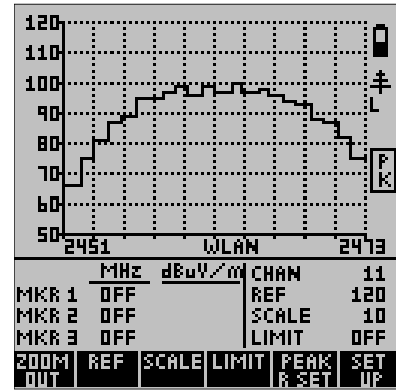
The solid bar at the top of the measurement screen represents the frequency range of WLAN channel 11. Using the right and left cursor keys, this indicator can be moved to any of the 14 WLAN channels. This indicator is a convenient indicator to identify the WLAN channel associated with a signal.

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 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 – 2.5 GHz span.

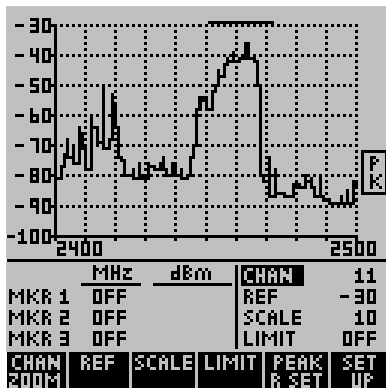


Channels associated with 802.11a and 802.11g are defined as follows:

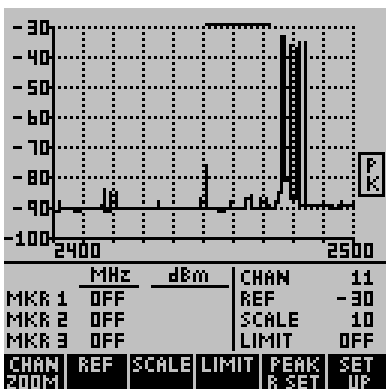
Channel 1	2401 – 2423 MHz
Channel 2	2406 – 2428 MHz
Channel 3	2411 – 2433 MHz
Channel 4	2416 – 2438 MHz
Channel 5	2421 – 2443 MHz
Channel 6	2426 – 2448 MHz
Channel 7	2431 – 2453 MHz
Channel 8	2436 – 2458 MHz
Channel 9	2441 – 2463 MHz
Channel 10	2446 – 2468 MHz
Channel 11	2451 – 2473 MHz
Channel 12	2456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

Measuring and Identifying Interference

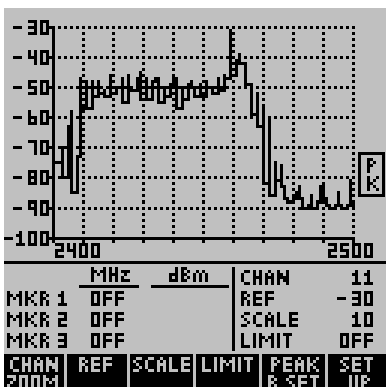
Signals which can interfere with WLAN communications can be measured and identified using the Model 424A. Since the Model 424A is a true spectrum analyzer, it detects all signals present in the WLAN band, not just those which contain 802.11b or 802.11g protocols. Several examples of interfering signals are shown at the left for reference.



The first signal at the left is a 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.

Chapter 4

Using the PC Enhancement Software

Introduction

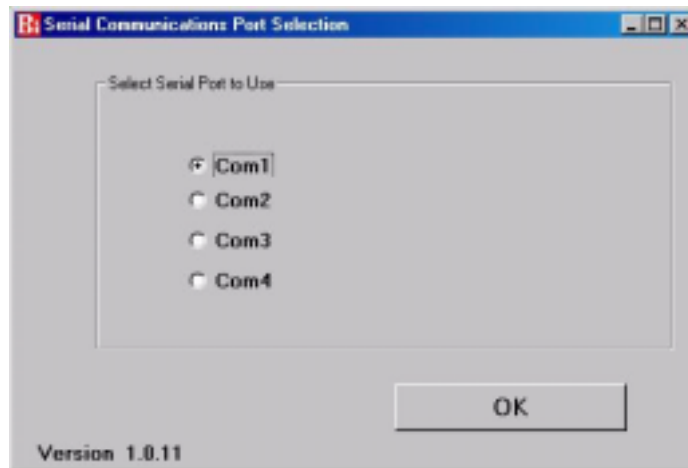
This chapter covers the installation and use of the PC Enhancement Software. This software, supplied with the Model 424A Spectrum Analyzer, allows measurement data to be downloaded to any PC operating under Windows 95 or later. Measurement data can be stored on disk within the PC or printed using any Windows compatible printer. A unique feature of this software allows data to be printed with the touch of a button on the 424A 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, press START located on the lower left hand corner of Windows. Select RUN from the pop up menu and then type X:SETUP.EXE, where “X” is the drive identifier for the CD ROM drive on your computer.

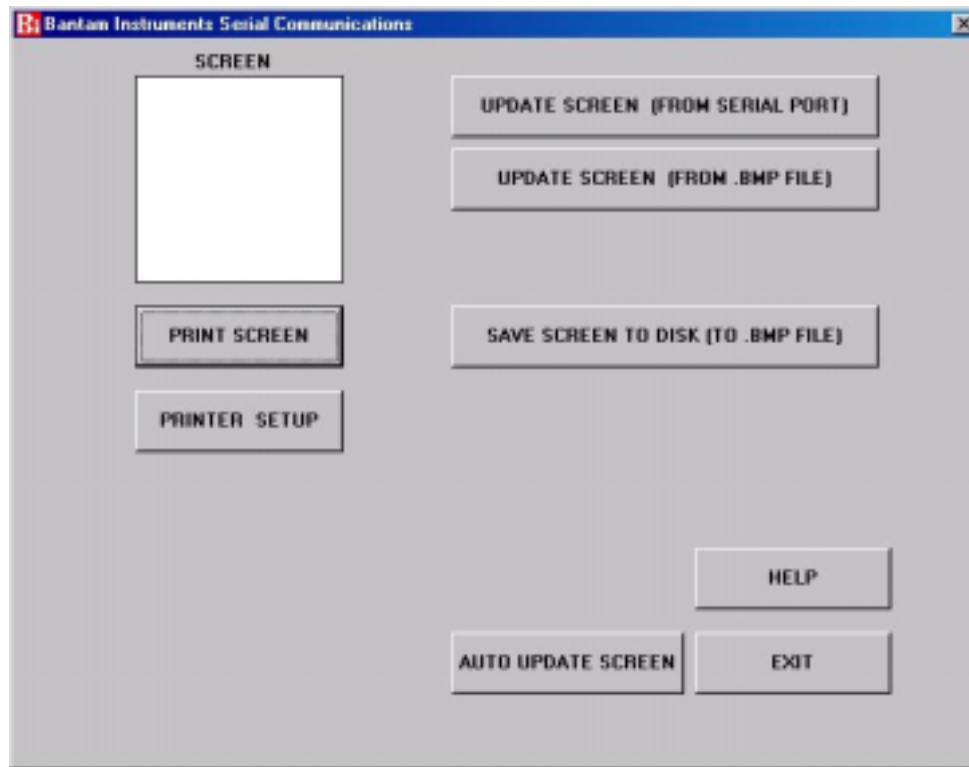
Starting the PC Enhancement Program

Connect the Model 424A Spectrum Analyzer to one of the RS-232 serial ports on the computer using the supplied serial interface cable. 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 424A

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 424A by clicking on the button labeled UPDATE SCREEN (FROM SERIAL PORT). Clicking this button will upload whatever is present on the 424A 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 424A screen fails to upload to the PC, check that the serial cable is connected to both the 424A and the PC. Also check that the correct COM port was selected when the program was started. Also go to the 424A SETUP menu from the 424A Main Menu. Select soft key labeled “2” and check that the baud rate is set for “57600” and that the serial address is set to “1”.

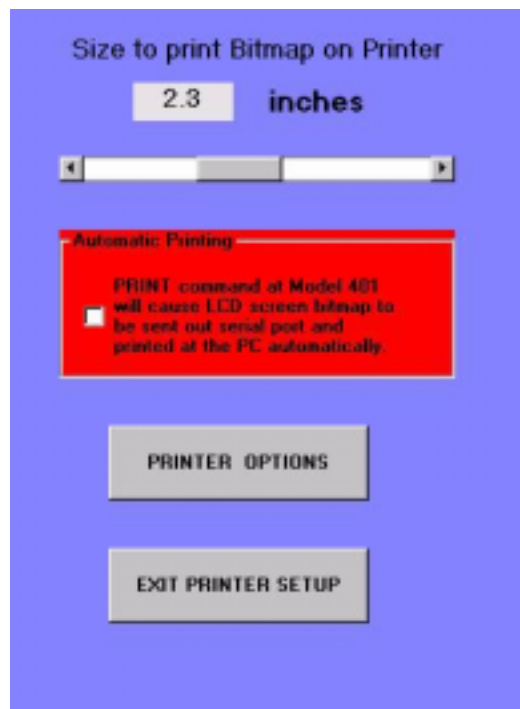
Saving the Downloaded Data to Disk

The downloaded data from the 424A can be saved to disk by clicking on the button labeled “SAVE SCREEN TO DISK (TO .BMP FILE)”. The format used is 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 to be viewed. The data will then be displayed on the program screen area.

Printing Downloaded Data

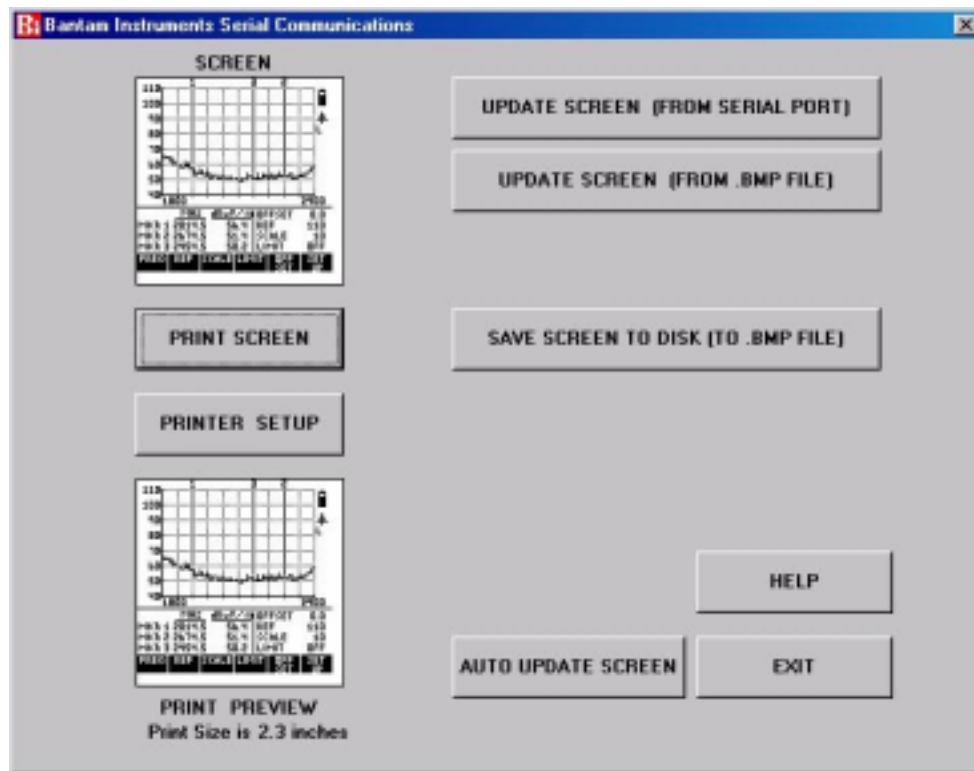
The screen can be printed at any time by clicking on PRINT SCREEN. Before doing so, click PRINTER SETUP and the window shown below will appear.



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 corresponds to a 1:1 copy of the 424A screen size.

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 display.

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.



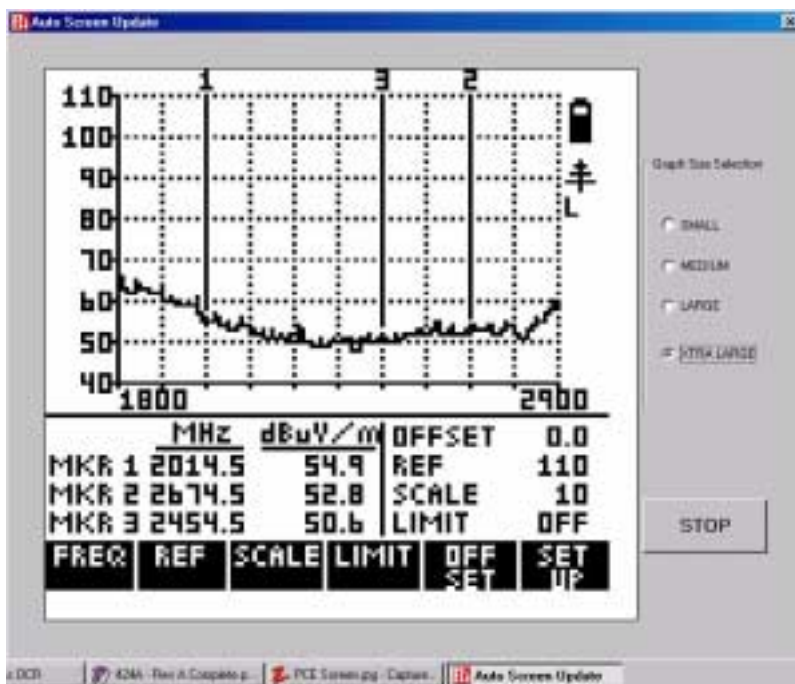
Automatic Printing from the 424A Keypad

Enabling the red area labeled “automatic printing” allows a printout to be made every time the PRINT TO PC soft key on the 424A is pressed. The PRINT TO PC soft key appears when the 424A front panel SAVE/RCL key is pressed. When “Automatic Printing” is selected, the main window will appear on the PC as following on the following illustration



Automatic Update of Screen Image

Often it is desired for the PC to continuously update the screen image from the 424A. This is especially useful when the PC is being used to monitor measurements being made on the 424A a distance away. To active this mode, press the AUTO UPDATE SCREEN button. The image will now be continuously updated.



On slower PC's 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 the 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.