YELLOWJACKET®-B/A/N/G

802.11 BANG Wi-Fi / Spectrum Analyzer

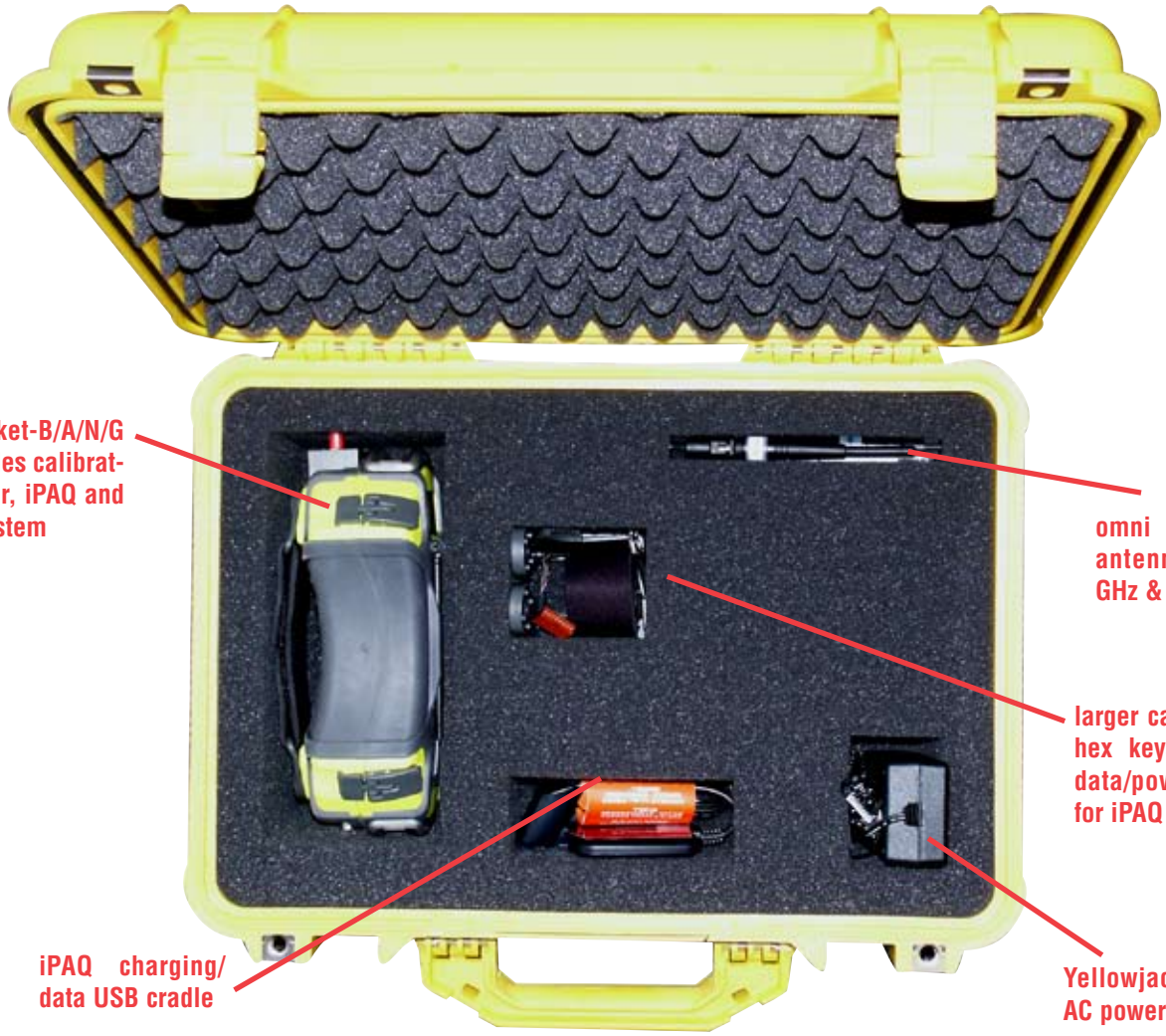
manual version 1.6

Contents

Unpacking Your Yellowjacket-B/A/N/G

Yellowjacket-B/A/N/G with accessories

Yellowjacket-B/A/N/G user's manual and software



Yellowjacket-B/A/N/G unit includes calibrated receiver, iPAQ and battery system

omni directional antennae (2.4 GHz & 5 GHz)

larger case handle, hex keys & spare data/power cable for iPAQ

iPAQ charging/ data USB cradle

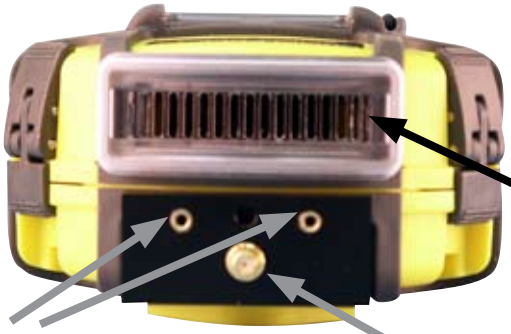
Yellowjacket-B/A/N/G AC power adapter

Yellowjacket-B/A/N/G BOTTOM VIEW

Air Vent
(Output)

Yellowjacket-B/A/G Receiver
Power/Charging Connector

Yellowjacket-B/A/N/G TOP VIEW



Air Vent
(Intake)

DF Antenna
screw mounts

SMA Male antenna input
Warning: Maximum input 0 dBm NO DC Input

SMA Male antenna input
Warning: Maximum input 0 dBm NO DC Input

Air Intake
Cooling Fan

iPAQ Power/Charg-
ing Connector

About Your Yellowjacket-B/A/N/G

Unpack and assemble your Yellowjacket-B/A/N/G unit as shown. Your Yellowjacket-B/A/N/G is a self-contained spectrum analyzer. The user interface (iPAQ), antenna and power connections are all accessible, but there is usually no need to open the protective, yellow hard case. If you should need to open the case to remove the iPAQ or address the internal connections, simply unhook all 4 latches on the case. Remove top cover to reveal iPAQ, cooling fan and power/data connector. The Yellowjacket-B/A/N/G receiver and battery system are below these components. The iPAQ may be disconnected and removed by users but the other components should only be accessed by Berkeley technicians. Removing such components will void your hardware warranty.

Power up the iPAQ by pushing the power button in the upper right corner of the iPAQ. Connect the appropriate frequency antenna to the SMA antenna input. iPAQs shipped by BVS are optimized for the Yellowjacket-B/A/N/G.

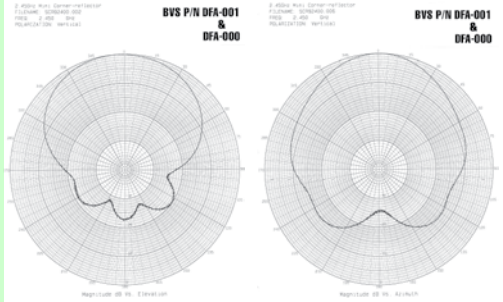
iPAQs supplied by BVS have the Yellowjacket-B/A/G software pre-installed. If you need to install the Yellowjacket-B/A/N/G software, see the software installation/re-installation section.

Tap the windows Start icon in the upper left corner and then choose Yellowjacket-B/A/N/G in the pulldown menu. If the Yellowjacket-B/A/N/G does not appear in the pulldown menu, tap on the “Programs” folder. Tap on the Yellowjacket-B/A/N/G icon.

Running the Yellowjacket-B/A/N/G software will power the Yellowjacket-B/A/N/G spectrum analyzer.

If the Yellowjacket-B/A/N/G software loses communication with the Yellowjacket-B/A/N/G, perform a soft reset by pressing the iPAQ’s reset button. If communications problems persist, perform a hard reset by holding down the two outer buttons on the front of the iPAQ while holding in the soft reset button. Remember, hard resets erase all data collected and software installed so backup all data and see software re-installation for details.

2.4 GHz Direction Finding Corner Reflector



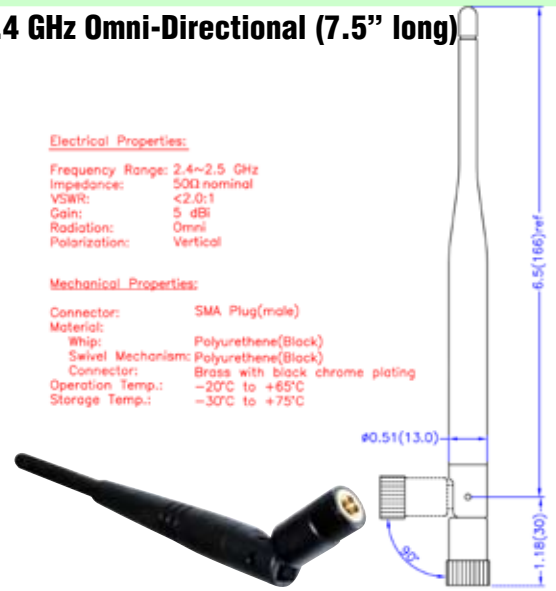
2.4 GHz Omni-Directional (7.5" long)

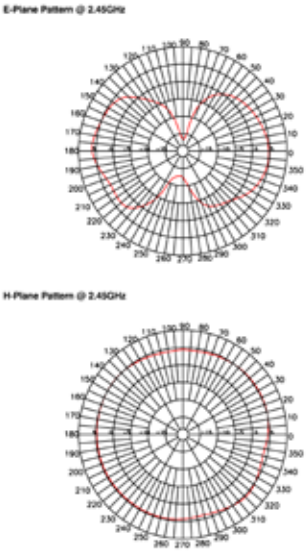
Electrical Properties:

Frequency Range:	2.4~2.5 GHz
Impedance:	50Ω nominal
VSWR:	<2.0:1
Gain:	5 dBi
Radiation:	Omni
Polarization:	Vertical

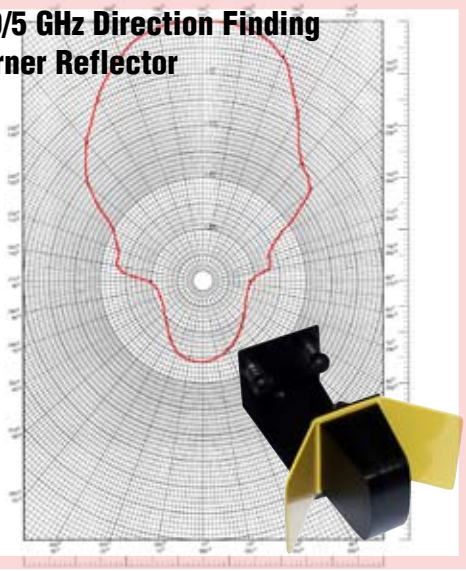
Mechanical Properties:

Connector:	SMA Plug(male)
Material:	
Whip:	Polyurethene(Black)
Swivel Mechanism:	Polyurethene(Black)
Connector:	Brass with black chrome plating
Operation Temp.:	-20°C to +65°C
Storage Temp.:	-30°C to +75°C





4.9/5 GHz Direction Finding Corner Reflector



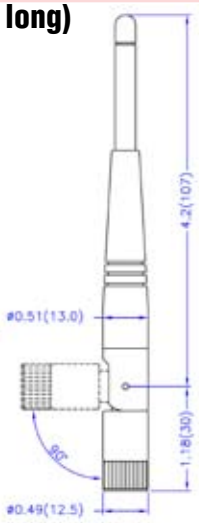
4.9/5 GHz Omni-Directional (5.5" long)

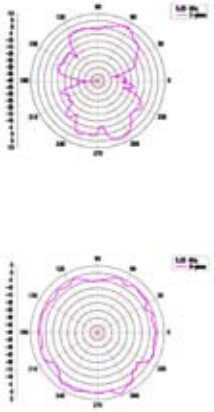
Electrical Properties:

Frequency Range:	5.15~5.35 GHz
Impedance:	50Ω nominal
VSWR:	<2.0:1
Gain:	5 dBi
Radiation:	Omni
Polarization:	Vertical

Mechanical Properties:

Connector:	SMA Plug(male)
Material:	
Whip:	Polyurethene(Black)
Swivel Mechanism:	Polycarbonate(Black)
Connector:	Brass with black chrome plating
Operation Temp.:	-20°C to +65°C
Storage Temp.:	-30°C to +75°C





Accessories

Your Yellowjacket-B/A/N/G includes the following accessories: 3 antennae, spare data/power cable (for iPAQ), larger case grip with hex key tools, an AC power/charging adapter, user's manual, SD software install card and CD-ROM software installer.

Yellowjacket-B/A/N/G Power System

Yellowjacket-B/A/N/G offers three choices of powering: internal Li-PO battery, external 12VDC (11-15 V) power supply or external auxiliary battery. The power smoothly transitions from one source to another providing uninterrupted functionality while plugging or unplugging the external supplies. The IPAQ runs from the built-in battery or from an internal regulated 5VDC supply when the external 12VDC is applied. Both batteries – the IPAQ built-in battery and the system Li-PO battery – are charged when the external 12VDC is applied. The charge time is 3 to 4 hours depending on the depth of discharge and the ambient temperature. The run time exceeds 3 hours when the batteries are completely charged.

The IPAQ battery is usually depleted at the same time as the system Li-PO battery. However, if the IPAQ battery is low while the system is still running, the equalizing mode of operation is provided. In this mode the IPAQ is powered from the system Li-PO battery. To enter this mode, set the IPAQ to "USB Charge" ON. This may prolong the total system run time. **Do not keep the "USB Charge" setting ON all the time since it will drain the system battery faster**, eventually reducing the system run time.

It is recommended to keep the IPAQ and/or the application software OFF while charging. The system supports a simultaneous charge and run though the charge time may substantially increase due to increased internal temperature.

When the internal temperature exceeds the maximum allowed for the Li-PO batteries the system automatically interrupts the charge. The red LED that can be seen through the bottom transparent hatch will be blinking. The same LED is solid ON when the charge is going and turns OFF completely when the charge is finished.

TROUBLESHOOTING

IPAQ AND Yellowjacket-B/A/N/G POWER ISSUES

Your Yellowjacket-B/A/N/G Spectrum Analyzer and your HP iPAQ are both charged and/or powered through the 4 pin power port at the bottom of the Yellowjacket-B/A/N/G. Both the receiver and iPAQ have their own internal batteries but both of these batteries are maintained and charged through the 4 pin power port. Here are some tips for prolonging the life of your hardware and data:

• The iPAQ's internal batteries are discharged when the iPAQ is "off" to maintain its memory. Keep the iPAQ charged! Charge it at least once a week!

• If the iPAQ's batteries are completely discharged, it will need several hours of charging before it can be powered on or even flash the charging (yellow) LED. Once the iPAQ is charged it may need to be soft or hard reset before powering on. The Yellowjacket-B/A/N/G software must be re-installed from an SD card or downloaded via ActiveSync. In order to install software using the SD card, the iPAQ must be removed.

1. Unhook all 4 latches and remove the top cover.

2. Remove the (optional) DF antenna by loosening the 2 thumb screws and unscrewing the antenna connection.

3. Be sure not to touch the air intake cooling fan while it is spinning. This fan spins to regulate the temperature of the receiver and batteries so be sure to keep all obstructions and objects from the fan's air path.

4. Remove the power/data connector at the bottom of the iPAQ. This connector provides communication and charging/battery power to the iPAQ.

You may now remove the iPAQ from its holder for other uses.

HARDWARE CONNECTION ISSUES

When the Yellowjacket-B/A/N/G software is started, the following screen will appear if the software was unable to detect the hardware. The following may cause this:

1. Loose connection to iPAQ serial cable. The serial cable may not be fully seated in the power/data slot on the bottom of the iPAQ. Check the connection. A soft boot of the iPAQ may be required. Soft booting is accomplished by pressing the recessed reset button on the iPAQ with the stylus.

2. Low batteries. Test this by running off of A/C power using the supplied 4 pin power connection to the Yellowjacket-B/A/N/G and the iPAQ. The charge (Yellow) LED on the iPAQ should be flashing if the cable is connected correctly and the Yellowjacket-B/A/N/G red power LED should be on.

3. COM port is held open. Soft boot the iPAQ to clear out the possibility that the serial port is being held open by a previously running copy of the Yellowjacket-B/A/N/G software.

SOFTWARE INSTALLATION/RE-INSTALLATION

The Yellowjacket-B/A/N/G software can be installed/re-installed in three ways.

CD installation
1. Connect the iPAQ to the PC by connecting through ActiveSync. Note that ActiveSync needs to be installed on the PC. It is preinstalled on the iPAQ.
2. Insert the CD. If the installation program does not appear after a few seconds, run autorun.exe from the root directory of the CD.
3. Choose the Yellowjacket-B/A/N/G software button.
4. Follow the installation instructions.
5. Software is now installed on the user's iPAQ.

SD (secure digital) card installation
(The iPAQ must be removed in order to access the SD card slot. Be careful not to touch the cooling fan while it is spinning)
1. The Yellowjacket-B/A/N/G shipped with an SD card that contains a copy of the Yellowjacket-B/A/N/G software.
2. Insert the SD card into the SD slot on the iPAQ.
3. Go to File Explorer on the iPAQ. Proceed to the SD Card folder off of the root directory ("My Device").
4. Run install.exe.
5. Choose the model of your iPAQ and press the install button.
6. Software should now be installed on your iPAQ.

OPERATIONAL TIPS

SURVEYING

While surveying, Yellowjacket-B/A/N/G achieves the most accuracy when antenna is at a vertical 90 degree angle and completely perpendicular to the ground or floor.

OPTIMIZATION

Remember that your iPAQ comes from the BVS factory optimized for powerful spectrum analysis right out of the box, but sometimes these optimized settings can be lost (back to HP's factory defaults) when the iPAQ's battery completely drains. The following are procedures for:

Disabling Bluetooth and 802.11 on an iPAQ
It is essential when running your Yellowjacket-B/A/N/G software that you do not have either 802.11b or Bluetooth running on the same iPAQ. This will interfere with Yellowjacket-B/A/N/G measurements in the 2.4 GHz band.

Turning Off Bluetooth
HP iPAQ 27xx series:
From the main screen on the iPAQ, select the antenna icon in the lower right-hand portion of the screen. Then choose the Bluetooth button to turn off Bluetooth.

The blue LED on the iPAQ should not be flashing when the radio is off.

Turning Off 802.11b
HP iPAQ 27xx series:
From the main screen on the iPAQ, select the antenna icon in the lower right-hand portion of the screen. Then choose the Wi-Fi button to turn off 802.11b.

Battery Settings
NOTE: In order to prevent the Ipaq from freezing when running Yellowjacket-B/A/N/G software, make sure to:

1. ALWAYS leave the checkboxes in the SETTINGS/SYSTEM/

POWER screen unchecked. Power-save mode will lock up the application due to the fact that the application is stopped while communicating with the hardware..

2. Make sure that the battery level on the Ipaq remains above 40%. The serial card interface may cease to operate when the battery level is under 40%.

To resolve the freeze, simply press the soft reset button on the iPAQ with the stylus.

Disabling Screen Saver on an iPAQ

DockWare (by default) runs a screen saver with a calendar on any new iPAQ (47xx series). This could interfere with the operation of Yellowjacket-B/A/N/G software. To disable:

1. Tap on the Windows icon in the upper-left corner of the iPAQ screen.

2. Tap “Programs” in the menu.

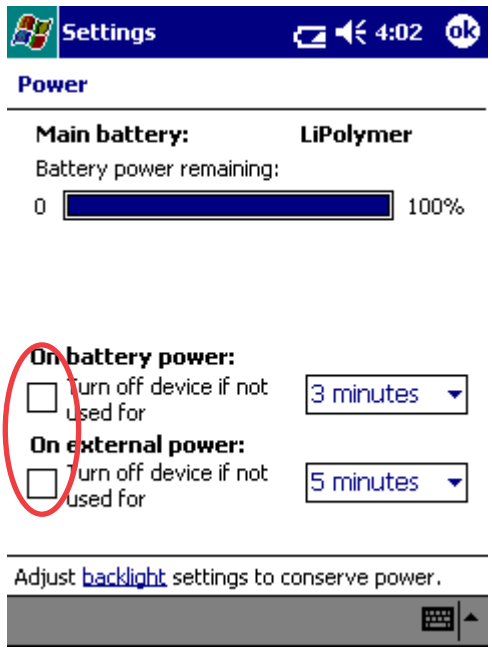
3. Tap on “DockWare”.

4. Once running, tap-and-hold on the screen.

5. Uncheck “Start Automatically”.

6. Now tap the upper right corner of the screen to terminate DockWare (where the ‘X’ would usually be).

7. DockWare is now disabled. It will need to be disabled again if the batteries completely discharge on the iPAQ.



Choose Settings and then choose System settings at the bottom. Select battery icon for Power Settings to access this screen. These power settings come unchecked from the BVS factory to ensure Yellowjacket-B/A/G software runs optimally.

Accessories for your YELLOWJACKET-B/A/N/G

12VDC to 110VAC car cigarette lighter power inverter
75 Watts output
P/N BB-12V
$ 35.00 OPTIONAL

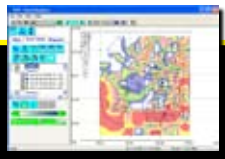
Rugged Carrying Case
ABS Plastic
P/N P-CASE
$ 100.00 STANDARD

External Li-Ion battery pack with belt clip (+4 hours runtime)
P/N BATT-PK
$ 375.00 OPTIONAL

4.9/5 GHz Direction Finding Antenna with mounting bracket, cable & SMA male
9 dBi gain
P/N 5NE
$ 250.00 OPTIONAL

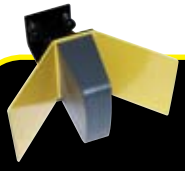
Remote Manager
802.11b/a/n/g monitoring software
Ask for a Quote OPTIONAL

30 dB attenuator pad for use with directional antennas (between DF antenna & BumbleBee) SMA male to female
P/N bbpad30
$ 30.00 OPTIONAL



Swarm
802.11b/a/n/g mapping software
Ask for a Quote OPTIONAL

2.4 GHz Omni Antenna
SMA male swivel
P/N S151AM-2450S
$ 25.00 STANDARD



2.4 GHz Direction Finding Antenna with mounting bracket, cable & SMA male
9 dBi gain
P/N 2ND
$ 250.00 OPTIONAL

4.9/5 GHz Omni Antenna
SMA male swivel
Co-Linear Dipole 5 dBi VSWR 1.8:1
P/N K181AM-5250S
$ 25.00 STANDARD

SWARM™

802.11b/a/n/g Wi-Fi Indoor/Outdoor Site Surveys

1 Create Survey Maps:
Swarm Projector (PC)

Import any bitmap for use in your Yellowjacket B/A/N/G

Create geo-coded site files for analysis

2 Constant Realtime Wi-Fi Surveys:
Swarm Collector (iPAQ)

Scan all 802.11 channels on BOTH 2.4 GHz and 5 GHz

JPEG snapshots of any survey screen

Collect survey data automatically via GPS

Collect data by manually tapping touch-screen

3 Coverage Reliability Analysis:
Swarm Analyzer (PC)

Plot surveys in multiple graphical and table views

Plot coverage by APs or AP channels

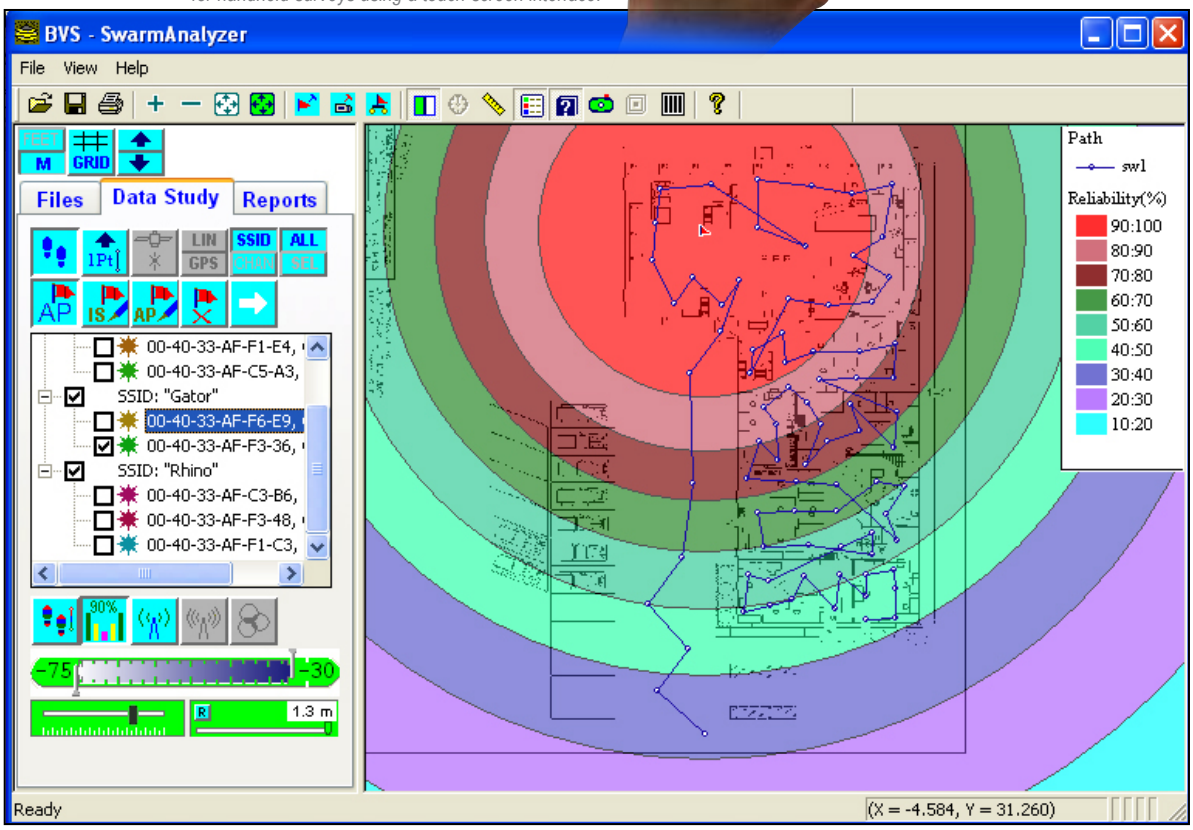
Locate unknown APs' positions

Print and export plots into bmp files for spreadsheets

Create KML file for plotting coverage over Google Earth™

Use Yellowjacket 802.11b/a/n/g Wi-Fi receiver hardware for handheld surveys using a touch-screen interface.

Swarm™ combines the power of realtime Yellowjacket® 802.11b/a/n/g Wi-Fi measurements with GPS geo-coding accuracy. First, create your survey bitmaps with both Linear and GPS **PROJECTOR** software. Next, simply walk or drive to any spot with GPS reception while ***Swarm™*** **COLLECTOR** scans all 802.11b/a/n/g channels and correlates them to your exact location automatically via GPS or manually by tapping on the touch-screen. GPS measurements provide both LAT and LON as well as time stamping for a complete Wi-Fi survey path anywhere in the world. ***Swarm™*** **COLLECTOR** allows JPEG screen snapshots to be taken at particular points of interest throughout the survey. Finally, survey data such as RSSI, MAC and SSID may be exported into ***Swarm's*** **ANALYZER** for further mapping coverage studies in multiple graphical and tabular layouts. In areas with little or no GPS reception, ***Swarm™*** **ANALYZER** only needs a few reference points to fill in the locations for the rest making it effective for quick outdoor studies. Surveys may be exported further into KML files for plotting in applications such as Google Earth™.



Features:

- *Create survey bitmaps with BVS' Linear or GPS Projector software*
- *Collect data by using GPS position for outdoor surveys*
- *Collect data by manually tapping locations for indoor studies*
- *Choose any 802.11b/a/n/g Wi-Fi channels to scan*
- *JPEG screen snapshots may be taken throughout the survey*
- *Survey data such as RSSI, MAC and SSID is exported into Swarm Analyzer for further mapping cov erage studies in multiple graphical and spreadsheet layouts*
- *Surveys may be exported further into KML files for plotting in applications such as GoogleEarth™*

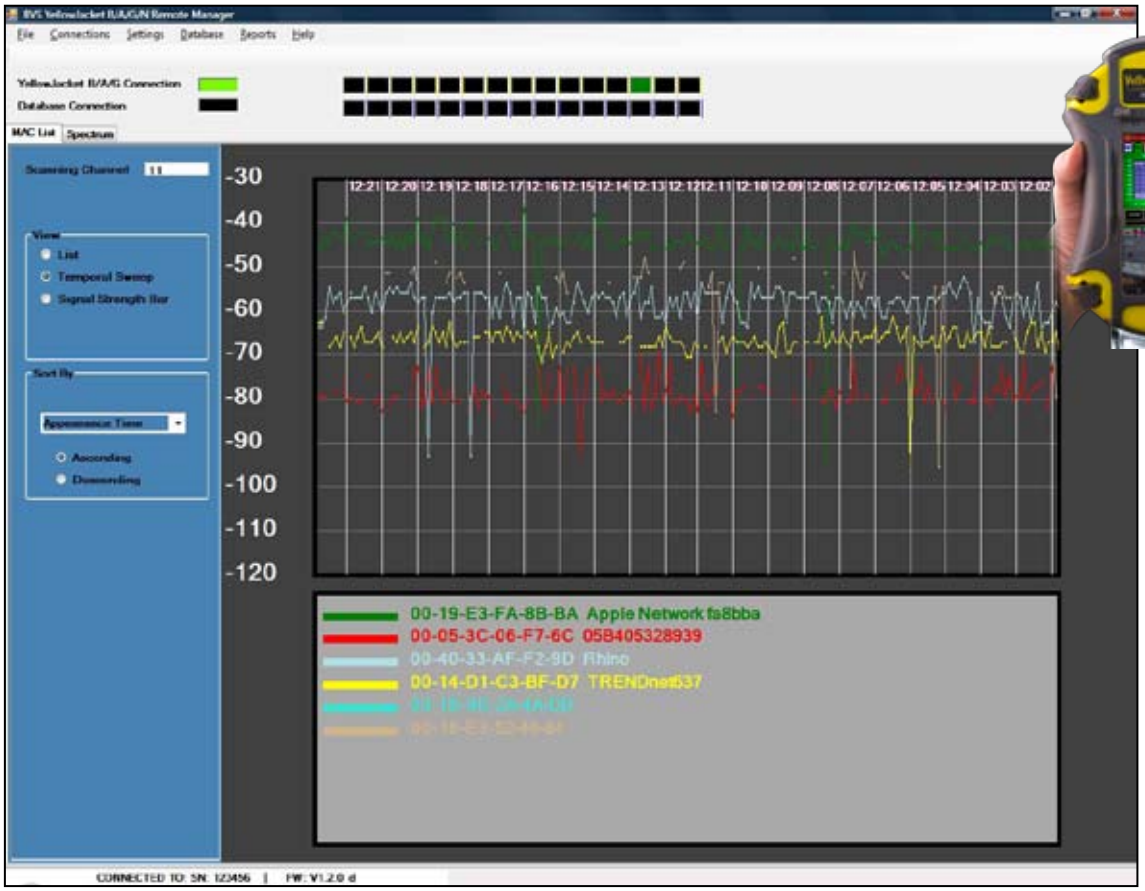
OPTIONAL SOFTWARE AVAILABLE FOR YOUR YELLOWJACKET-B/A/N/G

REMOTE MANAGER™ software

software for your

YELLOWJACKET®-B/A/N/G

802.11B/A/N/G REMOTE MONITORING SOFTWARE



now you can see everything your Yellowjacket® BANG sees...

- MAC
- SSID
- Multipath
- Power Triggers
- Waveform Traces
- Absolute Channel
- Spectrum Analysis
- Peak Hold/Search
- Signal-to-Noise Ratios

...from anywhere

FEATURES

- Controls Yellowjacket B/A/N/G remotely from any RJ-45 connection
- Monitor your network from anywhere - home and office.
- Data collected in real-time and stored in a relational database*
- Create comprehensive reports from your measured network data
- Export reports to PDF® and MS Excel® formats
- Collect spectrum data from the RF environment
- Collect packet data parameters on such as MAC, SSID, Channel
- Data reports over various time periods for temporal overview of your network
- Software includes ethernet receiver dongle and cable

Yellowjacket® B/A/N/G Remote Manager™ **software is a data monitoring & reporting application that connects to any *Yellowjacket® B/A/N/G* through a standard 10/100 ethernet connection. With *Remote Manager™*, users can control what wireless data is to be collected via the *Yellowjacket® B/A/N/G* receiver and store that data in a relational database* for future retreival and analysis. *Remote Manager™* allows users to scan the RF spectrum for packets and interference over time creating a network footprint of usage to find out who's in your network airspace with or without authorization. *Remote Manager™* even creates comprehensive PDF or MS Excel reports for an IT manager's overview. All of this can be accomplished from anywhere in the world; all you need is access to an ethernet connection to place your *Yellowjacket® B/A/N/G* receiver.**

OPTIONAL SOFTWARE AVAILABLE FOR YOUR YELLOWJACKET-B/A/N/G

Yellowjacket B/A/N/G Data Logger iPAQ Windows Mobile Software

Introduction

The YellowJacket 802.11 B/A/N/G Receiver (BANG) is a precision hand-held spectrum analyzer and packet demodulator. Data is displayed by YellowJacket software running on an iPAQ. This iPAQ is connected to the BANG via a serial cable. The BANG has several features to detect signals, interference, and packets. Many of these transmissions are bursty; they transmit and then turn-off. These types of transmissions can be difficult to detect with a spectrum analyzer. The BANG features Trace Peak Hold, Persistence Display and Channel Power Trigger to detect and measure bursty signals and bursty interference. See each feature's section in this manual.

802.11b, 802.11g, 802.11n and 802.11a are demodulated by the BANG receiver and displayed accordingly by the iPAQ software (BANG Controller).

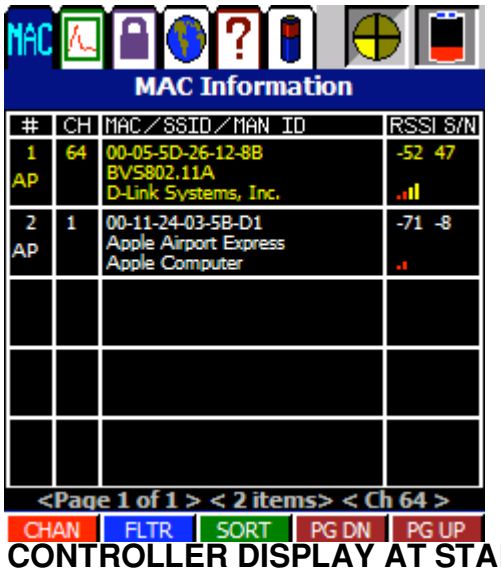
Installation of Software

The BANG software is pre-installed on iPAQ computers purchased from BVS. A completely depleted iPAQ battery will erase the software. See re-installation of software in the troubleshooting section of this manual.

For users who are using their own iPAQ, follow the CD or SD card installation instructions in the troubleshooting section of this manual to install the BANG software.

Getting Started

1. Power your BANG receiver and iPAQ as described in the "starting-up your BANG" section of the manual.
2. Tap the Start button on the iPAQ.
3. Tap on the "Programs" folder.
4. Tap on the "BANG" icon.
5. The MAC list display will appear initially and will scan the 2.4GHz channels by default.



BANG CONTROLLER DISPLAY AT STARTUP

Quick Tour
The BANG Controller has a tab control menu on the top of the display which separates the functionality into main sections. These are:

1. Packet Processing - This section contains data relating to processing 802.11 packets. Information such as MAC address, SSID, channel, RSSI and SNR (Signal To Noise ratio) information are displayed.
2. Spectrum Analysis - This section contains data relating to spectrum analysis including averaging, triggering, peak hold, marker and delta.
3. GPS-This is the area where global positioning information is displayed.
4. System Information - Information such as serial number, firmware version, and frequency bands are displayed here.
5. Power Profile - Information on battery life, voltage, and power source.

Next to the tabs are two indicators. The first is a yellow section which spins in a circle. This indicates that the software is functioning. Sometimes (for example in trigger mode) data will not update at a constant rate. This circle shows that the software has not frozen and is simply waiting for data.

The second indicator is for power. If a plug is shown, the BANG is on external power. If a battery is shown, the unit is operating on batteries and a percentage remaining will be displayed.

BANG Toolbar Options

From left to right, the toolbar buttons perform the following functions:

LOG FILE
When this icon is pressed, the log file control panel will be displayed. Use this control panel to choose a log file, start and stop recording. Press the icon again to remove the control panel. Log files can be used to post-process data with the PC Viewer utility.

SNAPSHOT
When the camera icon is pressed from the toolbar at the bottom of the screen, a snapshot of the
currently viewable display is taken. The snapshot is saved as a BMP format picture for viewing at a later time or for importing into documents and reports. As an example, the images of the BANG screens shown in this section of the manual were saved
using this option.


BANG CONTROLLER TOOLBAR ICONS

PACKET PROCESSING

The packet processing tab (MAC Information) puts the BANG in a mode to demodulate 802.11 B/A/N/G packets. The packets are separated by MAC address and put into a list. Each item in the list can be selected. This will lead to another series of screens for detailed analysis on the individual MAC address.

MAC LIST

The MAC list by default is populated as the different addresses arrive. The MAC addresses will only show in the list if it can be proven that the channel it is seen on is the channel it is transmitting from. This is so the correct RSSI value is shown. If the information was shown while it was off-channel, then the RSSI value would appear lower.

Each list item displays the following: Item number,whether it is an AP or not, channel number, MAC address, SSID, Manufacturer's ID, and RSSI value. The color of the information will vary depending on the strength of the signal. Green would be a stronger signal and red would be a weaker signal. There are also bars (as a phone would display) to show signal strength. These are located under the RSSI value.

There is a series of buttons under the list. These buttons are explained in the following paragraphs.

CHANNEL SELECTION

Pressing the 'CHAN' button at the bottom of the MAC list, a dialog appears with choices for channels to scan. Entire bands can be selected or deselected, as well as single channels.

LIST SORTING

The MAC list can be sorted by pressing the SORT button at the bottom of the list. The list can be sorted by:

1. Appearance Time – When a new MAC address shows up, it goes to the end of the list.
2. MAC Address – Alphabetically by MAC address.
3. RSSI – Strongest signals go to the top of the list.
4. SSID – Alphabetically by SSID.
5. Channel – By channel number

Just choose the appropriate radio button and press 'OK'.

PAGE DOWN

Loads the next (up to) 5 items in the list.

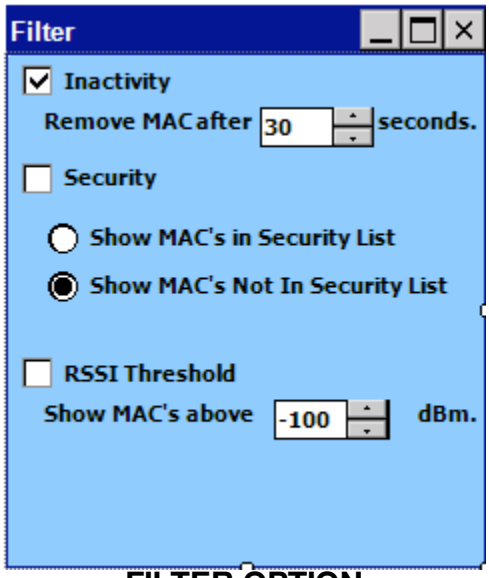
PAGE UP

Loads the previous 5 items in the list.

INDIVIDUAL MAC

When an individual MAC is chosen by tapping on its entry in the list, a set of screens become available. The first screen is the multipath screen. All of the screens are described below.

FILTER OPTION



FILTER OPTION

Filtering options for the MAC list can be chosen by pressing the blue 'FLTR' button on the bottom of the screen.

INACTIVITY

The inactivity selection is on by default. When selected, any MAC address for which a packet has not been received in the allotted time period will be removed from the list. When not selected, all MAC addresses will remain in the list unless dropped by one of the other filters.

SECURITY

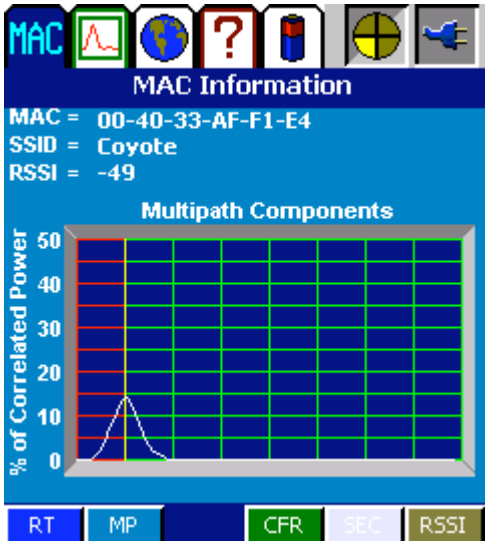
The security selection is used in conjunction with the security tab. When selected, either the MAC addresses in the authorized list or not in the authorized list will appear based on the radio button selection. When not selected, all MAC addresses will appear in the list unless filtered out by another filter.

RSSI THRESHOLD

The final filter is the RSSI Threshold filter. When selected, this filter will allow only those MAC addresses with an RSSI value greater than the threshold set to remain. When not selected, all MAC addresses will be allowed unless removed by a different filter.

MULTIPATH

The multipath screen is chosen by pressing the 'MP' button. It also comes up by default after choosing the MAC from the list. The screen shows a ratio of correlated power versuse time.



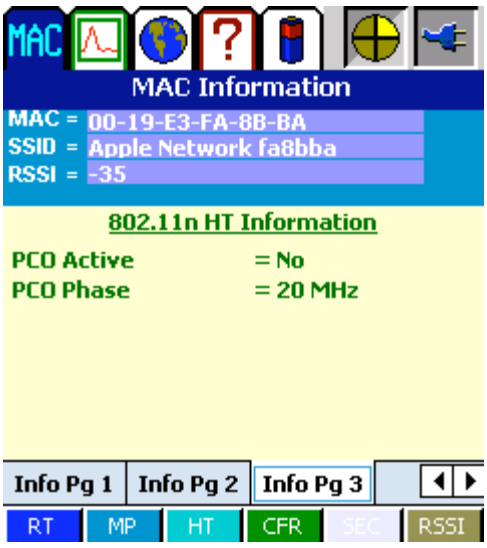
BANG CONTROLLER MULTIPATH

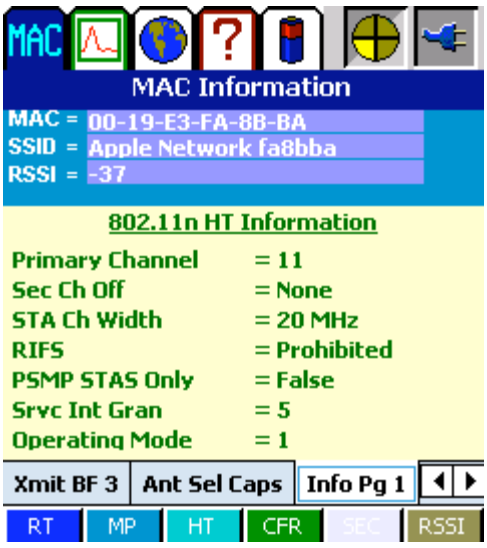
HIGH THROUGHPUT (802.11n)

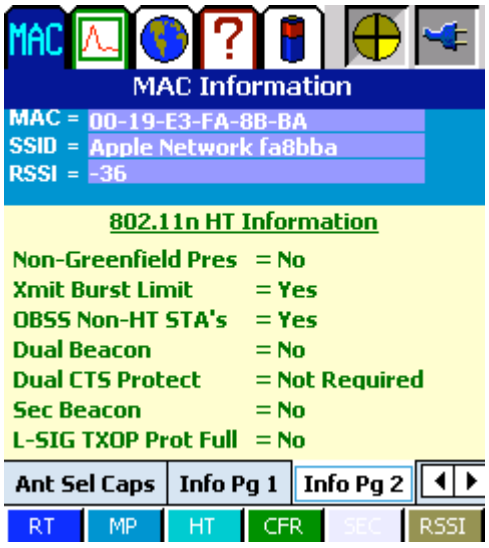
The HT (High Throughput) screen will display high throughput data if the access point/client is 802.11n capable and transmitting the high throughput information elements.

The data is a series of tabs. The first tabs are high throughput capabilities such as information about the 40 MHz mode. The next set are transmitter beamforming capabilities. This is followed by antenna selection capabilities and finally other data such as channel information.

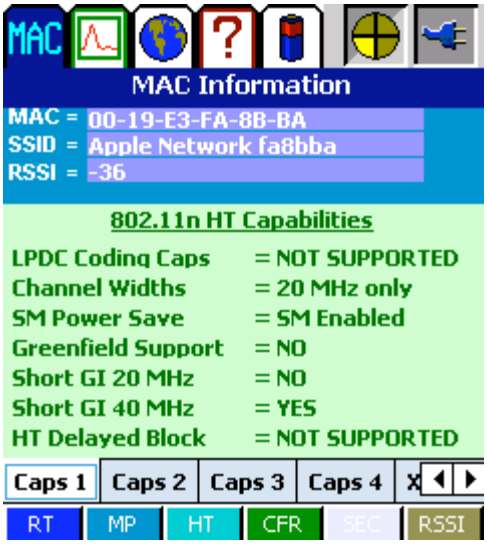
The data on this screen is not valid on a non-802.11n access point.

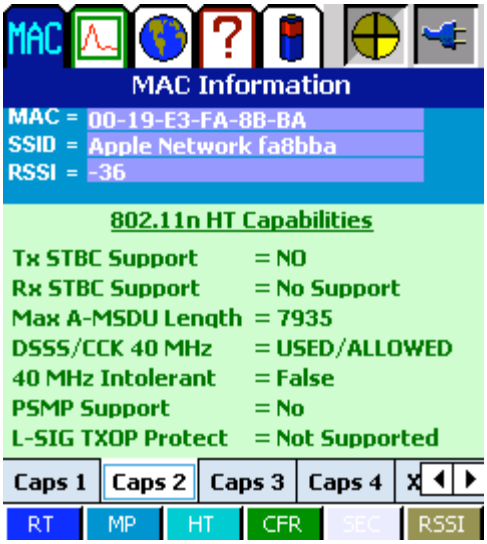


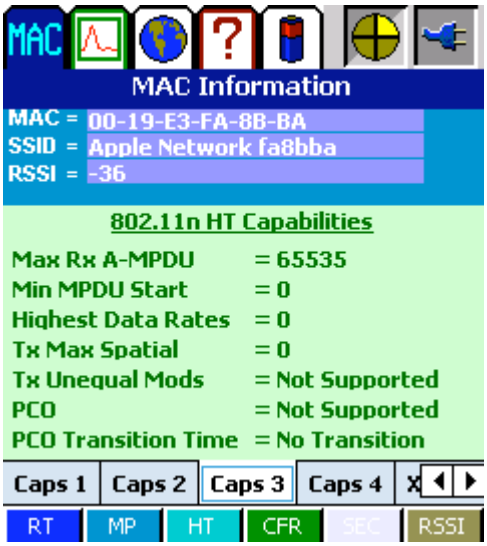


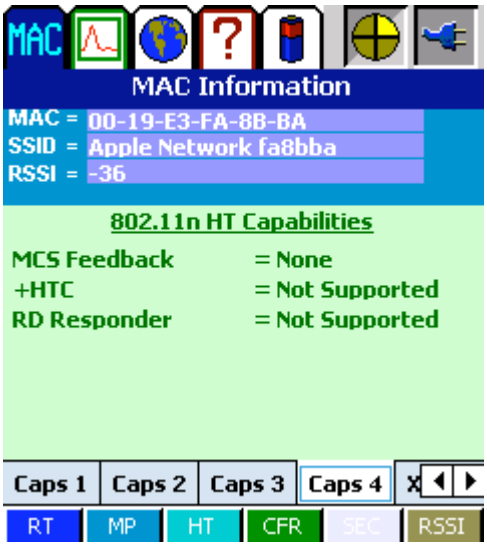


802.11 INFORMATION







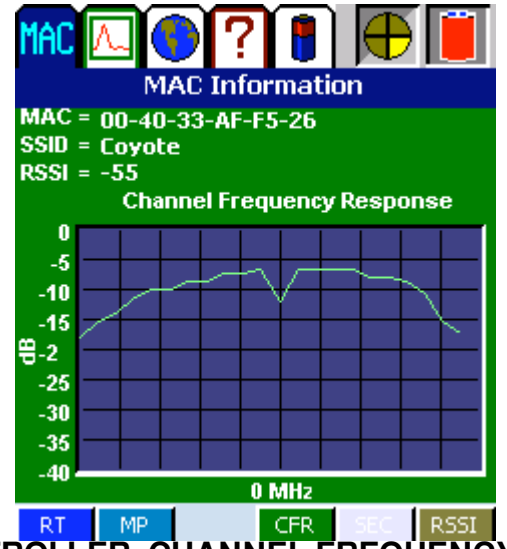


802.11N HIGH THROUGHPUT CAPABILITIES

802.11N BEAMFORMING CAPABILITIES

CHANNEL FREQUENCY RESPONSE

The channel frequency response screen shows the frequency response for the MAC in question. The plot is signal strength versus frequency.

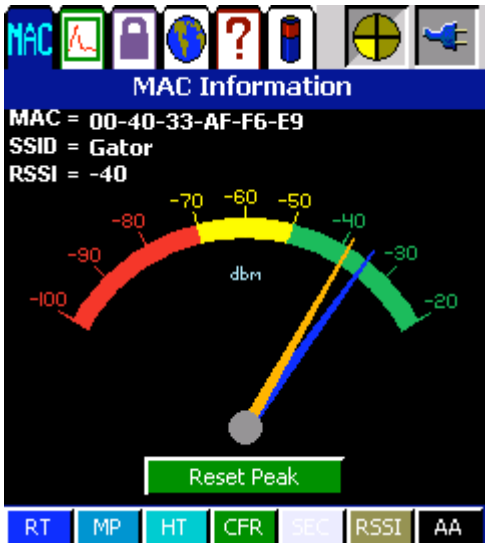


BANG CONTROLLER CHANNEL FREQUENCY RESPONSE

WISP ANTENNA ALIGNMENT

By clicking on the 'AA' button, a gauge will display. This gauge shows the current RSSI value (yellow) along with the peak value (blue) in dBm. The peak indicator can be reset by pressing the “Reset Peak” button.

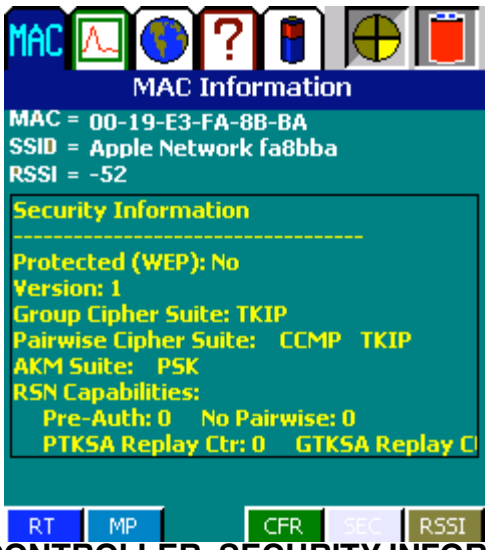
By connecting a direction-finding antenna to the YBAG, this gauge will assist in locating an access point. Simply change direction and watch the gauge. The peak indicator will mark the strongest signal received. By turning the unit until the current indicator approaches the peak indicator, the direction of the incoming signal can be located.



Antenna Alignment Screen

SECURITY

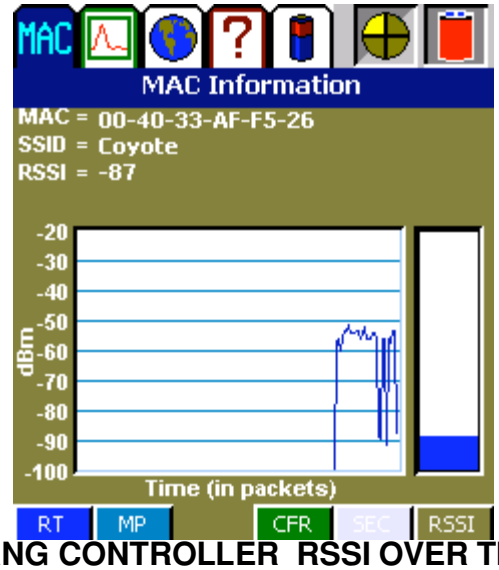
The security screen shows any security information that can be ascertained from the packets for this MAC address. Information on security types such as WEP,TKIP,CCMP, etc. may be shown.



BANG CONTROLLER SECURITY INFORMATION

RSSI OVER TIME

The RSSI over time screen simply shows the RSSI values of packets coming in for the selected MAC address. If the update stops, that means there are no packets currently arriving from that MAC address.

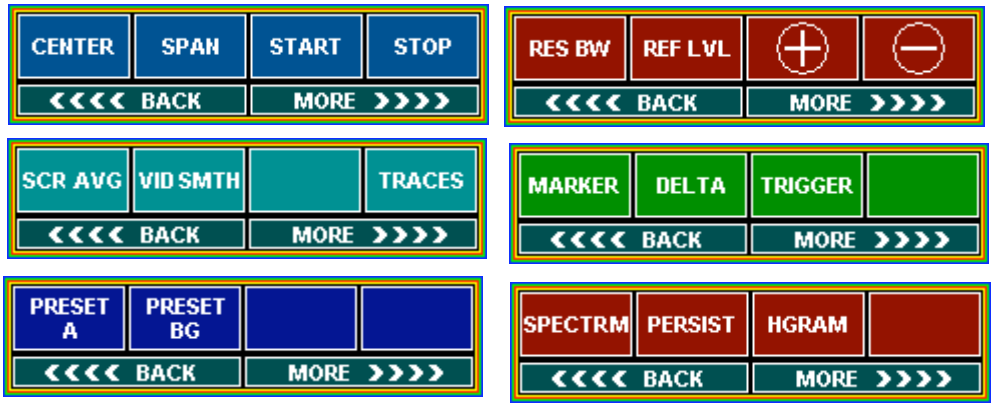


BANG CONTROLLER RSSI OVER TIME

SPECTRUM ANALYSIS

Navigating through the menus

Shown below are the different options for the spectrum analysis mode. To navigate through these options, simply press the “MORE” and “BACK” buttons. Pressing either button repeatedly will eventually scroll back to the first set of options.



BANG CONTROLLER SPECTRUM OPTIONS

Data Entry

BANG CONTROLLER DATA ENTRY (NUMERIC AND LEVEL)

Entering data for some options requires using the numeric data entry screen and/or the level entry screen (as shown above).

For the numeric entry screen, tap out the number and then press either the Ghz or Mhz button. To cancel the entry, press the 'X' button.

For the level entry screen, use the arrows to scroll up and down through data values. Press 'OK' when the correct value is selected. Press 'X' to cancel the selection.

Making a Measurement

This section describes the basic procedure to measure off-air signals in the 2.4 – 2.5 GHz band.

1. Start your BANG, if it is not already, as described in the Getting Started section.

2. Connect the 2.4 GHz omnidirectional antenna to the BANG.
3. Go to spectrum analysis mode: Tap the spectrum tab.
4. Set the frequency range to scan: Tap the “PRESET BG” option. Tap “ALL” on the data entry portion of the screen.
5. Set the Reference Level: Tap the “REF LVL” option. Verify that the reference level is set to –40 dBm.
6. Set the Trace options: Tap the “TRACES” option. Tap the “PEAK” button for trace 1.

7a. If the Trace is drawn off the top of the screen, tap the “TRACES” option. Tap the “Live” button for trace 1. Continue with step 5, but raise the Reference Level 10 dB. Continue with step 6.

7b. If the Trace is drawn does not display any signal after a minute or two, tap the “TRACES” button on the data entry portion of the screen. Tap the “Live” button for trace 1. Continue with step 5, but lower the Reference Level 10 dB. Continue with step 6.

Options

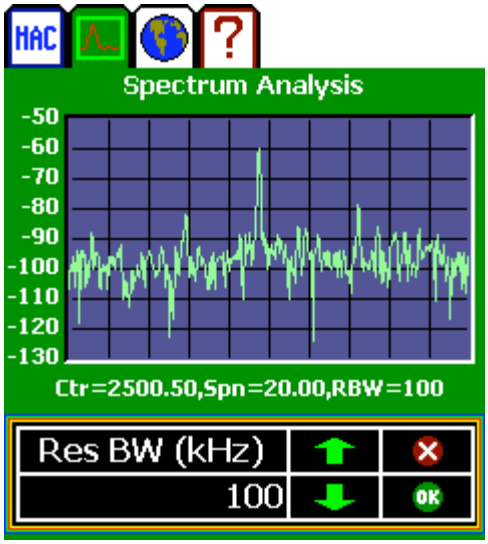
Center Frequency
This menu option allows the user to set the new center frequency to be displayed. The value, along with the current span, must not be outside the valid receiver bands.

Frequency Span
This menu option allows the user to set the span. The value, along with the center frequency, must not be outside the valid receiver bands. Use the numerical data entry instructions to set the value.

Start Frequency
This menu option allows the user to set the new start frequency. The value, along with the current span, must not be outside the valid receiver bands.

Stop Frequency
This menu option allows the user to set the new stop frequency. The value, along with the current span, must not be outside the valid receiver bands.

Resolution Bandwidth



Resolution Bandwidth

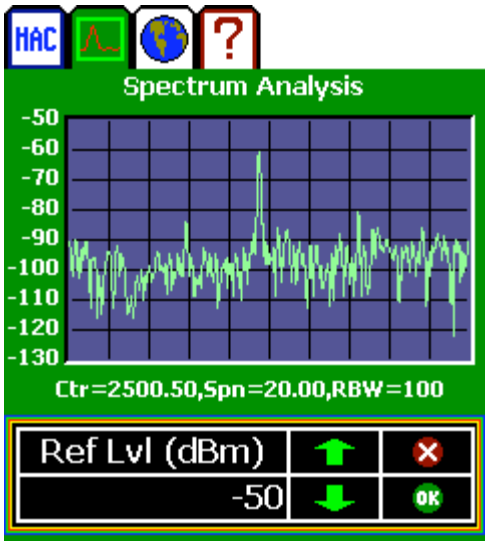
WHAT IS IT?
The BANG measures the energy present in different frequency bins, each bin's width equal to the resolution bandwidth.

HOW TO SET IT?
The resolution bandwidth is set by setting the level for the resolution bandwidth desired.

WHY TO USE IT?
Why use a small Resolution Bandwidth? A small Resolution Bandwidth is appropriate to measure frequency components and signal characteristics. Smaller Resolution Bandwidths increases the Sweep Time (number of traces displayed per second) for a given frequency Span.

Why use a large Resolution Bandwidth? A large Resolution Bandwidth is appropriate to measure large Spans of frequencies quickly. A Resolution Bandwidth larger than the signal's bandwidth can measure channel power. The BANG may be set to a large Resolution Bandwidth and a large Span to quickly sweep and identify frequencies of interest. The Span and Center can then be decreased to measure frequency components and the signal's characteristics.

Reference Level



REFERENCE LEVEL (SET TO –50 dBm)

WHAT IS IT?
This menu option allows the user to set the current reference level of the receiver. The valid choices are between -20 and -70 dBm, in 10 dBm increments.

HOW TO USE IT?
The level indicated by the BANG at the top of the measurement display is the reference level. The Reference Level should be adjusted to obtain the greatest dynamic range. The Reference Level should be set so that the strongest signal on the display is about 10 dB down from the top of the measurement display. If a signal is drawn off the top of the measurement display or the message “clipped” is displayed, lower the Reference Level. The highest Reference Level is –20dBm. The lowest Reference Level is –70dBm.

Zoom In

WHAT IS IT?
Zoom In will reduce the span shown on the display and re-center on the stylist tap.

HOW TO SET IT?
Simply tap on the frequency of interest. The span will be cut in half.

WHY TO USE IT?
Zooming in on a signal is used to get a clearer picture of a signal by reducing the span.

Zoom Out

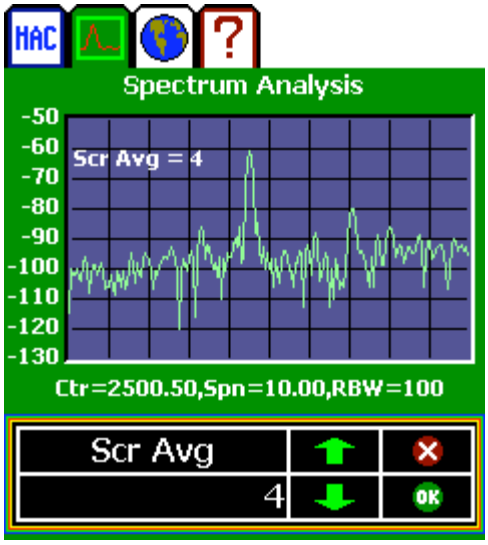
WHAT IS IT?

Zoom Out will double the span shown on the display.

HOW TO SET IT?
Simply tap on '-' . The span will be doubled.

WHY TO USE IT?
Zooming out from a signal is used to get a broader picture of a signal by increasing the span.

Screen Averaging



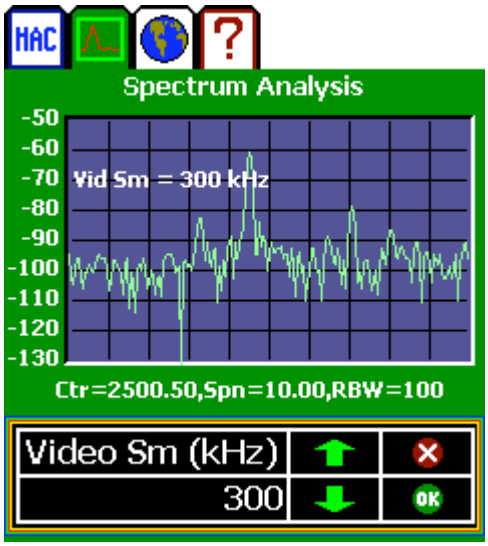
SCREEN AVERAGING

WHAT IS IT?
The screen averaging option provides an average of data points over the last N traces.

HOW TO SET IT?
Use the up and down arrows to set this value. 1 is no averaging. Any value over 1 will take the last N traces and display the average value for each frequency.

WHY TO USE IT?
Screen averaging is used as another method of smoothing the signal to average noise fluctuations.

Video Smoothing



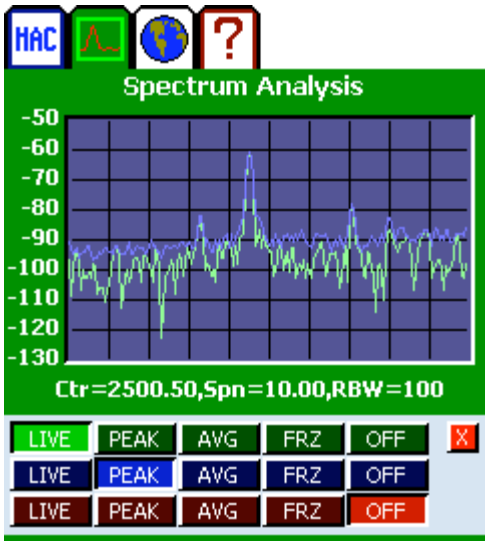
VIDEO SMOOTHING

WHAT IS IT?
Video Smoothing uses adjacent bin averaging to reduce the amount of fluctuation in the measured trace due to noise. This is different from Screen Averaging, which averages the same frequency bin from different traces.

HOW TO SET IT?
Use the arrows to increase or decrease the bandwidth which are averaged for the smoothing. When properly set, Video Smoothing can reduce the variation of the trace due to noise without distorting the trace. It is especially useful for smoothing signals that are not continuous or repetitive.

WHY TO USE IT?
The user must use good judgment when applying Video Smoothing. It is possible to smooth the trace too much so that the trace no longer represents the spectrum of the signal.

Traces



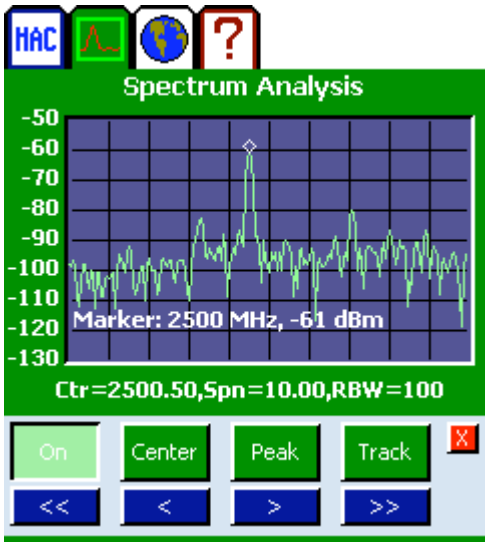
TRACES (1 is LIVE)(2 is on PEAK)(3 is OFF)

WHAT IS IT?
The Traces menu item allows the user to display three different traces in different ways. Each trace can be set to live, peak, average, freeze, or blank.

HOW TO SET IT?
Each trace has a different color. Assign the action for the trace based on the same color buttons. To make a trace report ‘live’ data, press the ‘LIVE’ button. To make a trace hold the peak value at each point, press the ‘PEAK’ button. The reported value will be the highest power at each frequency. To see averaged data (i.e. screen averaging or video smoothing), press the 'AVG' button. To freeze the current report of a trace, press the ‘FRZ’ button. This will display the last report for each frequency. To remove the trace from the screen, press the ‘OFF’ button.

TIP: Periodically clear “PEAK” hold data by setting the Trace to “LIVE” and then resetting it to “PEAK” hold.

Marker Functions

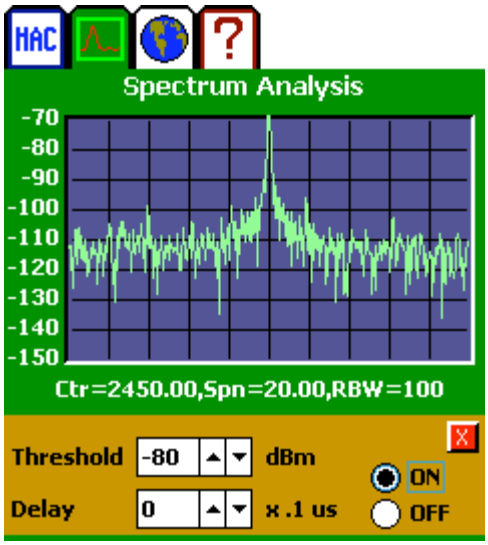


MARKER ENABLED

WHAT IS IT?
The marker menu option allows the user to place a marker at a certain frequency. The frequency and power values are shown at the marker position. It also allows a delta marker. This delta marker shows the difference in frequency and power from the marker.

HOW TO SET IT?
To turn on the marker value and/or the delta marker value, simply tap the ‘ON’ button for either value. Use the arrows to move the marker or delta value left or right across the screen. Use the double-arrows to move faster. To center the marker on the screen, press the ‘CENTER’ button. To place the marker on the highest power value, press the ‘PEAK’ button. To track the peak value, press the 'TRACK' button.

Trigger



SIGNAL TRIGGERING

WHAT IS IT?
Trigger Mode enables the BANG to quickly capture the spectrum from sources that are not continuously transmitting. The trigger threshold represents the amount of CHANNEL POWER that when exceeded will trigger the BANG to measure the spectrum. The trigger delay sets a delay between the trigger threshold being exceeded and the measurement of the spectrum.

HOW TO SET IT?
The trigger threshold is set by the user in dBm, and its range is from the current Reference Level to 20dB below the current Reference Level.

NOTE: Span MUST be set to 20 Mhz.

WHY TO USE IT?
Trigger Mode is very useful to capture the spectrum from any source that is not continually transmitting on the same frequency. This includes 802.11 a,b,g devices and Frequency Hoppers.

<u>Trigger Mode Example to Measure off-air signals.</u>

This section describes how to use the BANG's advanced Trigger Mode to measure off-air signals. This example will measure signals on 802.11 b/g channel 1, but the center frequency may be changed to any that your BANG can tune.

A Reference Level Setting of –40 dBm is appropriate for most off-air measurements, and is recommended to start off-air measurements. Changing the Reference Level to –30 dBm will decrease the BANG's sensitivity for stronger signals, and lowering the Reference Level to –50 will increase the BANG's sensitivity for weaker signals.

The Trigger Threshold represents the amount of channel power in a 20 MHz channel that must be exceeded to trigger the BANG to measure the spectrum. The Trigger mode requires the span to be set to 20 MHz.

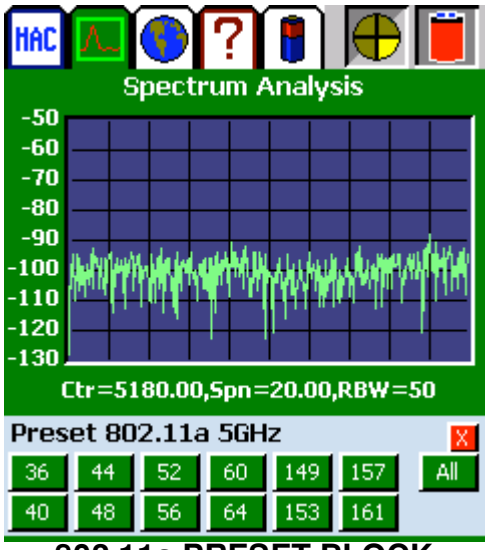
The Trigger Delay is not typically used for off-air testing and can be left at 0.

1. Start your BANG, if it is not already, as described in the Getting Started section.
2. Connect the 2.4 GHz omnidirectional antenna to the BANG.
3. Set the frequency range to scan: Tap the "Preset BG" option. Tap "1" on the data entry portion of the screen. This will set the center frequency.
4. Set the Span: Tap the "SPAN" button and set the Span to 20 Mhz.
5. Set the Reference Level: Tap the "REF LVL" option. Change the reference level to –30 dBm.
6. Set Trigger options: Tap the "TRIGGER" option. Change the Threshold to –45 dBm.
7. Start the Trigger: Tap the "ON" radio button
8. Check for relatively Strong Signals: The BANG will now trigger and display the spectrum of any signals that have a channel power greater than –45 dBm. If the BANG does not trigger and display a spectrum, no signals are present with a channel power above –45 dBm.
9. Stop the Trigger: Tap the "OFF" radio button.
10. Set the Reference Level: Tap the "REF LVL" option. Change the reference level to –40 dBm.
11. Set Trigger options: Tap the "TRIGGER" option. Lower the Threshold to –55 dBm.
12. Start the Trigger: Tap the "ON" radio button.
13. Check for Signals: The BANG will now trigger and display the spectrum of any signals that have a channel power greater than –55 dBm. If the BANG does not trigger and display a spectrum, no signals are present with a channel power above –55 dBm.
14. Stop the Trigger: Tap the "OFF" radio button.
15. Set the Reference Level: Tap the "REF LVL" option. Change the reference level to –50 dBm.
16. Set Trigger options: Tap the "TRIGGER" option. Lower the Threshold to –65 dBm.
17. Start the Trigger: Tap the "ON" radio button.
18. Check for Relatively Strong Signals: The BANG will now trigger and display the spectrum of any signals that have a channel power greater than –65 dBm. If the BANG does not trigger and display a spectrum, no signals are present with a channel power above –65 dBm.
19. Stop the Trigger: Tap the "OFF" radio button to exit the Trigger Mode.

The Reference Level and Trigger Level can be further lowered to check for weaker signals.

Stronger signals may "clip" the display when checking for weaker signals, but weaker signals will not "clip".

Band Presets



802.11a PRESET BLOCK

WHAT IS IT?
Presets automatically tune all of the BANG's settings to appropriate values for a variety of measurement tasks.

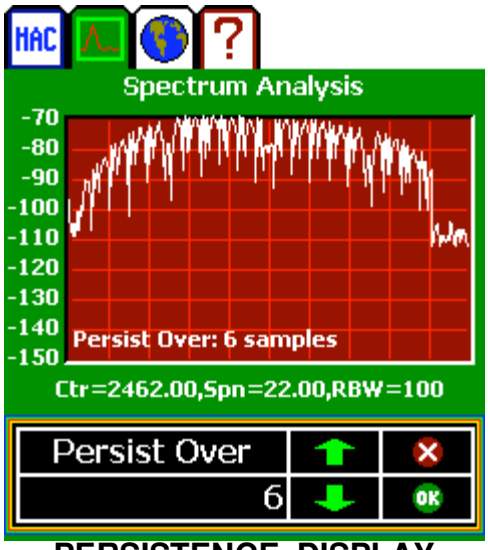
HOW TO SET IT?
Press on the appropriate band or channel to set the frequency, span and resolution bandwidth. For example, pressing the '2' button on the "Preset BG" display will set the receiver to channel 2 for 802.11bg networks. Pressing the "BAND" button will set the receiver to the entire 802.11bg band, including all channels (1-14).

WHY TO USE IT?
Presets can save time and don't require a detailed knowledge of the BANG's settings. However, the BANG is a general-purpose instrument and requires the user to set the instrument appropriately for their application. Presets that measure the entire 802.11 2.4 GHz band or the entire 802.11 5 GHz band use a large Resolution Bandwidth. This sweeps these large bandwidths quickly to detect which channels have activity. A sweep of each channel with activity can be set via the Presets to measure the signals with a small Resolution Bandwidth. See the Resolution Bandwidth section.

Persistence

The persistence display holds the peak value of each point in the spectrum sweep for N number of sweeps. The number of sweeps is determined by adjusting the value in the level entry block for persistence.

The X-axis is the current frequency range. The Y-axis displays the power values.



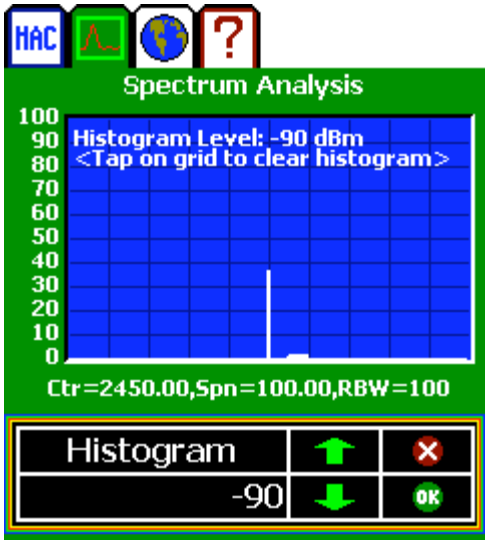
PERSISTENCE DISPLAY

Histogram

The histogram display shows the percentage, over the last 100 sweeps, of power values at each frequency that is above the user set level.

The level is selected by adjusting the value contained in the histogram level entry block. The X-axis is the current frequency range. The Y-axis is the percentage of time (from 0 to 100) when the power value at each frequency was above the set level.

The current percentage values displayed can be cleared by pressing the “clear” button on the histogram data entry block.



HISTOGRAM DISPLAY

SECURITY (AUTHORIZED/UNAUTHORIZED LISTS)

By pressing the tab with the lock, a security/authorization screen will appear.

The security screen allows for entering and maintaining of authorized and unauthorized access point lists. This is a feature that is used for determining if there are rogue/hostile access points within striking distance of the network. Checking the "Enable Security" checkbox enables the security feature.

Authorized List

The authorized list is a list that contains the MAC addresses of access points that are authorized to broadcast in the area to be concerned. This list can be created one of three ways. The first way is by entering MAC addresses in the topmost edit field on the security screen. Then the "ADD" button is pressed to add the address to the list. The next method is to retrieve a previously saved list or a list that has been created on a PC or laptop.

The final method is by pressing the "Generate Authorized List" button. This may be pressed after leaving the YBAG in the MAC list screen for a period where all access points have been seen. All of these MAC addresses will be moved into the authorized list. This list can be saved to RAM by pressing the "Save List" button. This list can be cleared by pressing the "Clear" button next to the list box.

The input file format for the authorized and unauthorized MAC list is as follows:

It is an ASCII file separated by CR/LF's. The first line is the number of authorized addresses in the list. Then each MAC is on a separate line.

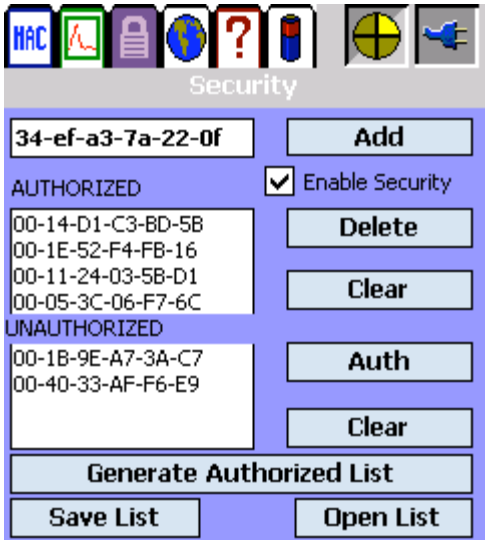
AUTH COUNT
AUTH MAC#1
AUTH MAC#2
.
.
.
AUTH MAC#N
UNAUTH COUNT
UNAUTH MAC#1
UNAUTH MAC#2
.
.
.
UNAUTH MAC#N

After creating this file, it may be imported by using the 'Retrieve List' option.

Unauthorized List

The unauthorized list is populated when the security feature is turned on. Any MAC addresses seen and demodulated by the receiver which are not in the current authorized list will be flagged and inserted into the unauthorized MAC address list.

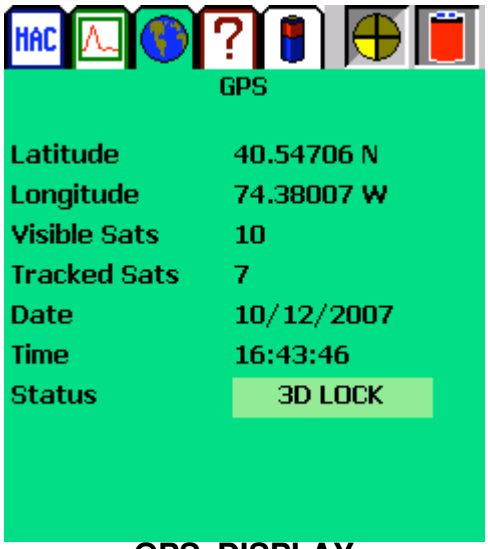
Items in this list can be saved or retrieved to/from RAM along with the authorized list by pressing the “Save List” or “Retrieve List” buttons. If the MAC addresses in the unauthorized list are wished to be authorized, simply select the entry in the list box and press the “Auth” button. This list can be cleared by pressing the “Clear” button next to the list box.



Authorization Screen

GPS Information

The GPS tab makes visible the GPS information screen. Information includes current latitude and longitude, number of visible and tracked satellites, data and time, and whether or not the receiver is locked. If the receiver is not locked, the status box will become red. It will appear yellow if there is a 2 dimensional lock, and green if it has a 3 dimensional fix.



GPS DISPLAY

NOTE: The internal GPS receiver is activated as soon as the iPAQ application starts. The first time the GPS receiver is used in a new location it may take up to 30 minutes to achieve a lock. After that it should only take a few minutes. Make sure that the GPS antenna is attached to the YellowJacket BANG GPS connector and threaded hand tight.

The GPS antenna should be in an area that can see a majority of the sky. GPS satellites are in orbit and change position. The antenna needs to be able to see a number of these satellites at any time. If you are using the YellowJacket BANG in a vehicle, it is best to mount the antenna on the roof. If you are walking outside, hold the antenna flat to the sky and keep at least 1 foot from the YellowJacket.

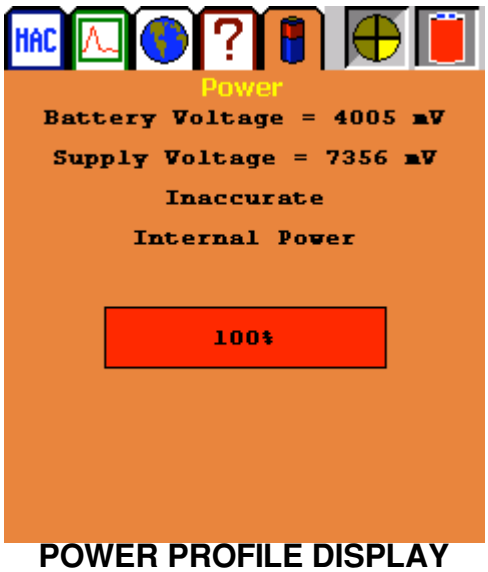
System Information

The system information tab shows the unit firmware version, serial number, and the frequency ranges which are tunable.

SYSTEM INFORMATION DISPLAY

Power Profile

The power profile tab shows battery and supply voltage, internal/external source, and percentage of battery life left. If this screen says “Inaccurate”, the battery has not been trained (needs a charge/discharge cycle.)



POWER PROFILE DISPLAY