BumbleBee-TABLET

UMPC Spectrum Analyzer

manual version 1.5

BumbleBee-TABLET Interface Hardware user's manual

BumbleBee-TABLET Interface Software user's manual

IMPORTANT NOTE:

Please disable the Wireless LAN Radio and the Bluetooth Transmitter on the Tablet PC to minimize interference with the BumbleBee Receiver before you establish a connection.

Unpacking Your BumbleBee-TABLET

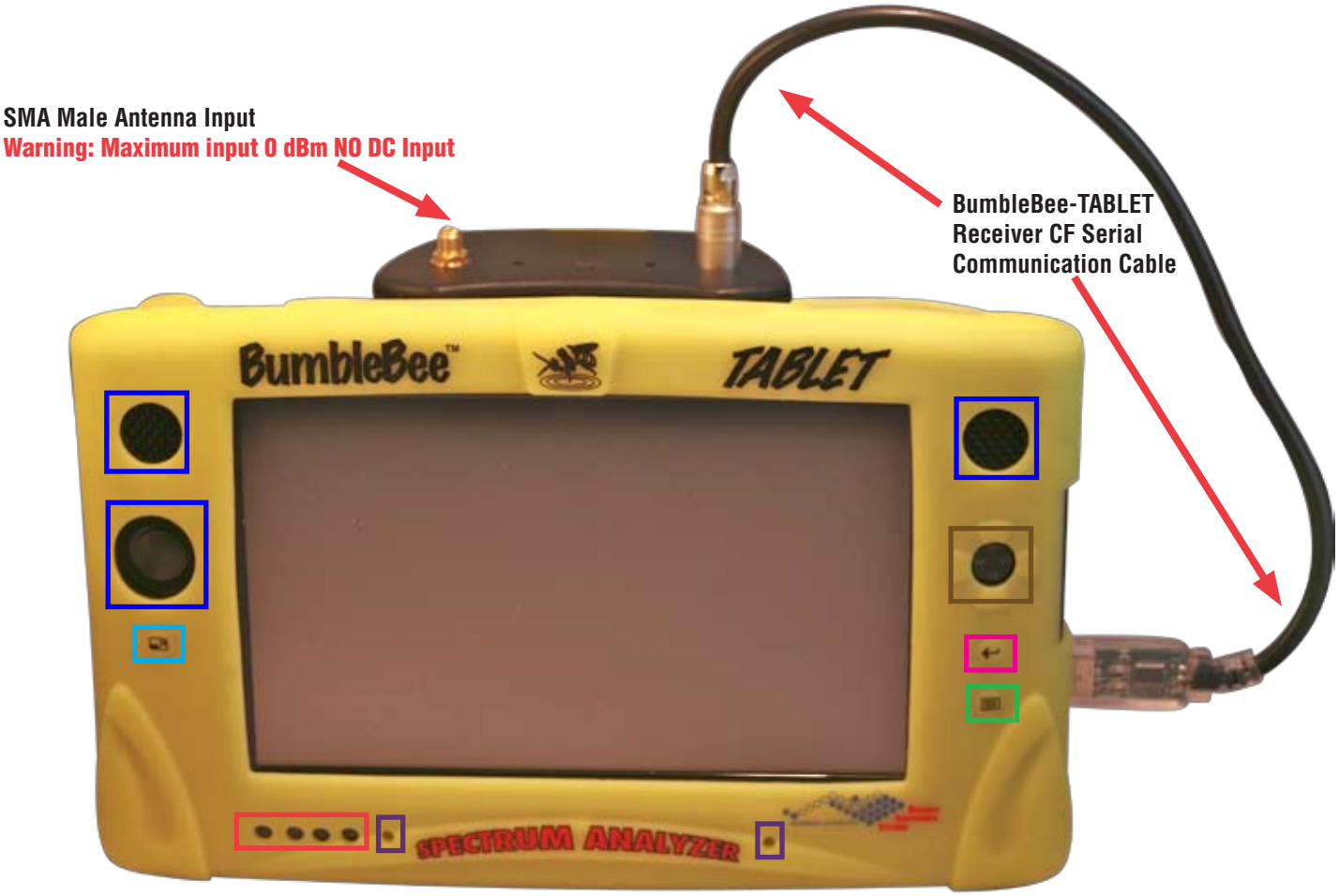
BumbleBee-TABLET protective case & Samsung Q1 UMPC Tablet

Samsung Q1 UMPC Tablet & BumbleBee-TABLET user's manual and software

Documentation includes software CD-ROM, user's manual and claibration certificate

Unpack and assemble your BumbleBee-TABLET unit as shown. Your BumbleBee-TABLET is a self-contained spectrum analyzer. The user interface (Samsung Q1 UMPC Tablet), antenna and power connections are all accessible, but there is usually no need to open the protective, yellow rubber casing. The tablet may be disconnected and removed and batteries changed by users but the other components should only be accessed by Berkeley technicians. Removing such components will void your hardware warranty. Please consult the included Samsung Q1 documentation for complete operating instructions, troubleshooting and tips of tablet PC. When you open your yellow, hard, protective case you will see the BumbleBee-TABLET unit with receiver hidden below it, included antenna (frequency depending upon model ordered), spare Ni-MH AA batteries, CF serial communication card, tablet power/charging adapter and BumbleBee receiver Ni-MH battery charger.

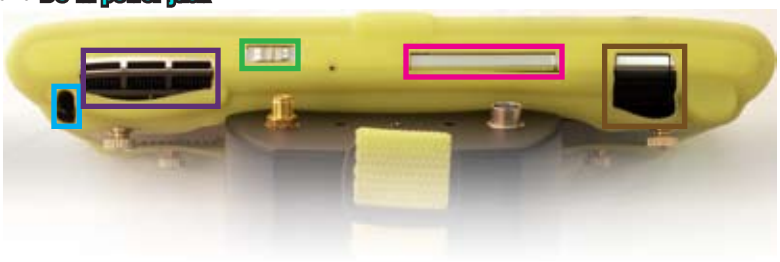
BumbleBee-TABLET shown with all available options below



About Your BumbleBee-TABLET

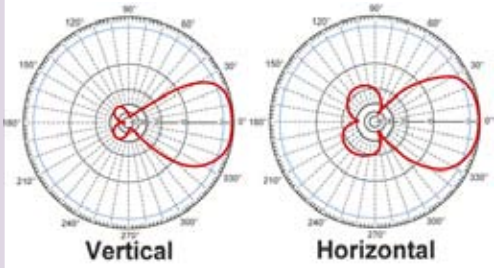
Some basic operations can be easily accessed on the tablet's face with the protective rubber sleeve still on the unit. The stereo speakers are located on either side of unit. The joystick plays the same role as the arrow keys on your keyboard and can also be toggled to move the cursor similarly to using a mouse. The auto-scaler button toggles between 3 different screen resolutions on the tablet's LCD. The status indicators display current tablet active features such as hard drive, Wi-Fi (be sure your tabet's 802.11 Wi-Fi radio is OFF when taking measurements), power/charging and screen backlight in iconic form. At the bottom are 2 array microphones. The menu button launches various OS menus. The enter button runs the currently selected item. The quick launch button allows the user to create "hot keys" for instant launching of the most popular applications. Other buttons and features including power, monitor out, USB, DC power jack, etc. are found on the top and **Tablet**

All ports and air ventilation should be easily accessed through the tablet's protective rubber sleeve still on the unit. Never block or modify the vents as it could overheat your tablet UMPC. Working down from the left view of the tablet, you will see the external ODD power port, the USB port, headphone jack, volume control button and hold switch. Working over from the left side at the top of the tablet, you will see the stylus holder, air vent, power/AV station switch, CF card slot and wired LAN port. Working down from the right view of the tablet, you will see the VGA monitor port, USB port and DC-in power jack.



Optional Direction Finding Antenna Specifications

900 MHz Direction Finding Yagi



Frequency	890-960 MHz
Gain	9 dBi
Polarization	Horizontal or Vertical
Horizontal Beam Width	54°
Vertical Beam Width	48°
Front to Back Ratio	14 dB
Impedance	50 Ohm
Max. Input Power	100 Watts
VSWR	< 1.5:1 avg.
Elements	5
Weight	1.5 lbs. (0.7 kg)
Length	19.6 in. (0.5 m)
Mounting	2 in. (50.8 mm) diameter mast max.
Operating Temperature	-40° C to 85° C (-40° F to 185° F)
Lightning Protection	DC Short
Connector	N-Female

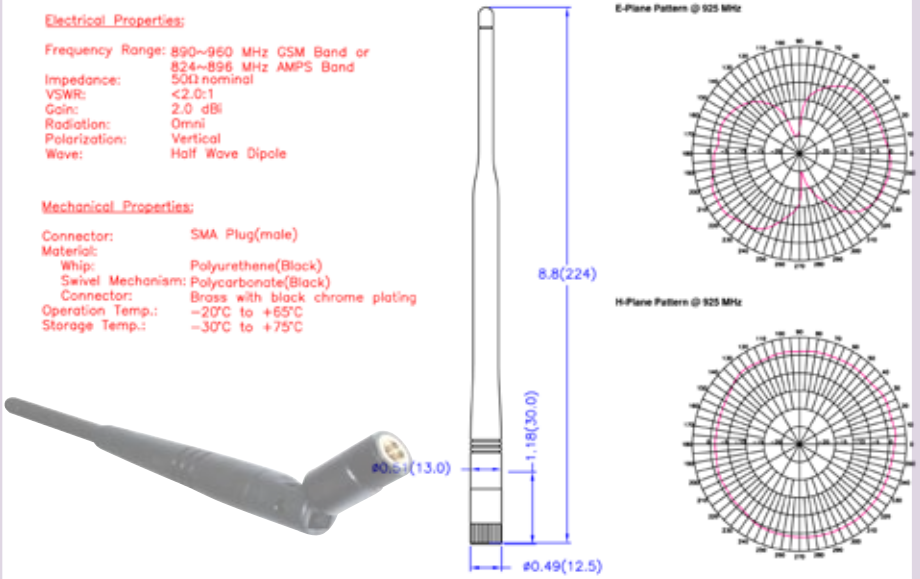
900 MHz Omni-Directional (9.5” long)

Electrical Properties:

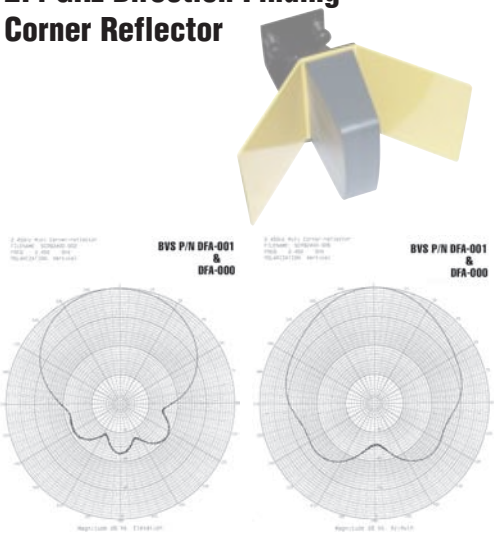
Frequency Range:	890~960 MHz GSM Band or 824~896 MHz AMPS Band
Impedance:	50Ω nominal
VSWR:	<2.0:1
Gain:	2.0 dBi
Radiation:	Omni
Polarization:	Vertical
Wave:	Half Wave Dipole

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



2.4 GHz Direction Finding Corner Reflector



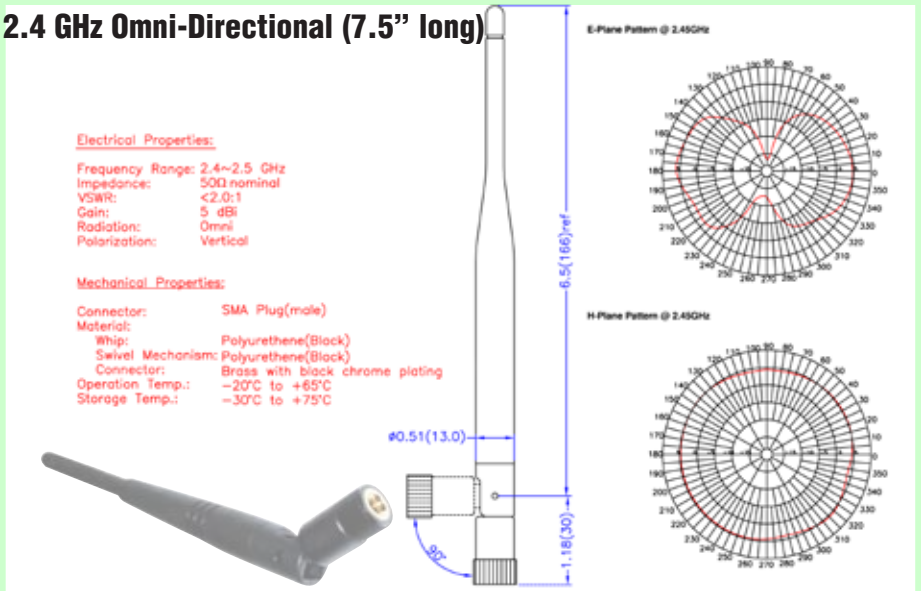
2.4 GHz Omni-Directional (7.5” long)

Electrical Properties:

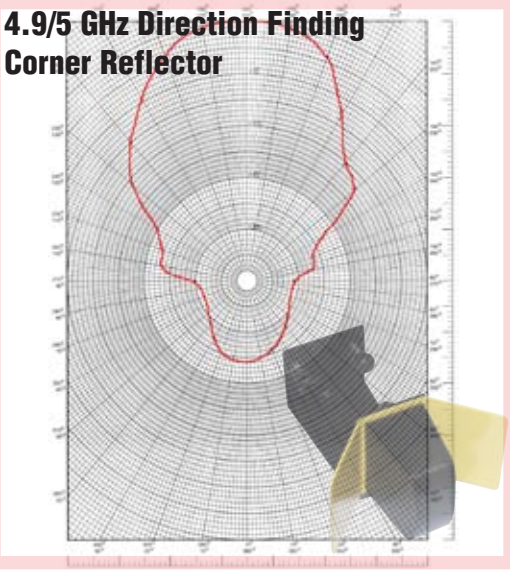
Frequency Range:	2.4~2.5 GHz
Impedance:	50Ω nominal
VSWR:	<2.0:1
Gain:	5 dBi
Radiation:	Omni
Polarization:	Vertical

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



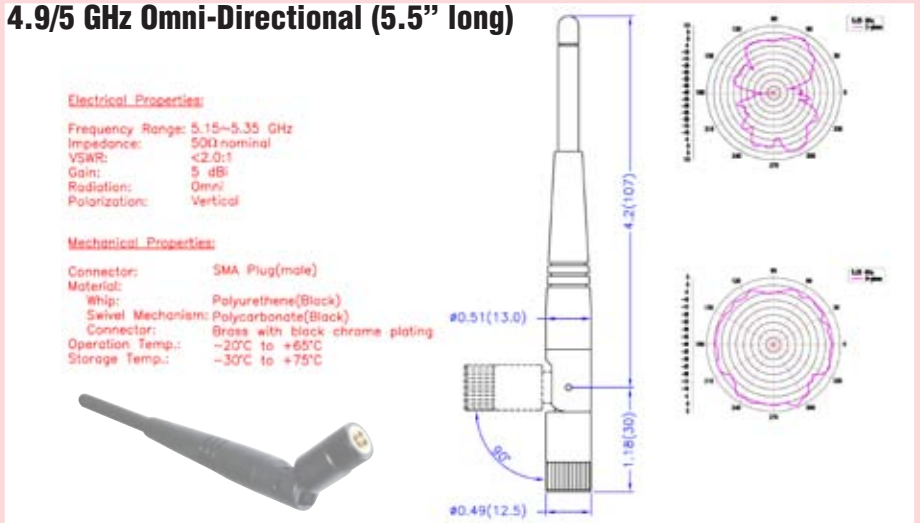
4.9/5 GHz Omni-Directional (5.5” long)

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 for your Bumble Bee-TABLET

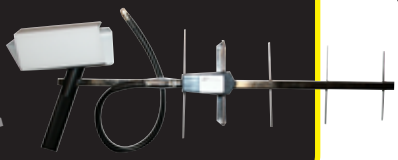
12VDC to 110VAC car cigarette lighter power inverter
75 Watts output
P/N BB-12V
$ 35.00 OPTIONAL

STANDARD

Ni-MH Fast-Charger
4 AA 6 V
P/N NIMH-001
$ 55.00

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

900 MHz DF Yagi Antenna with mounting bracket, cable & SMA male
9 dBi gain
P/N 900-Y
$ 125.00
OPTIONAL



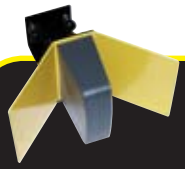
Data Playback Windows PC Software
$ 250.00
OPTIONAL

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

Honeycomb
Interference Mapping 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

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



900 MHz Omni Antenna
SMA male swivel
P/N C191AM-925
$ 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

HONEYCOMB™

RF Interference-Mapping Site Surveys

1 Create Survey Maps:
HoneyComb Projector (PC)

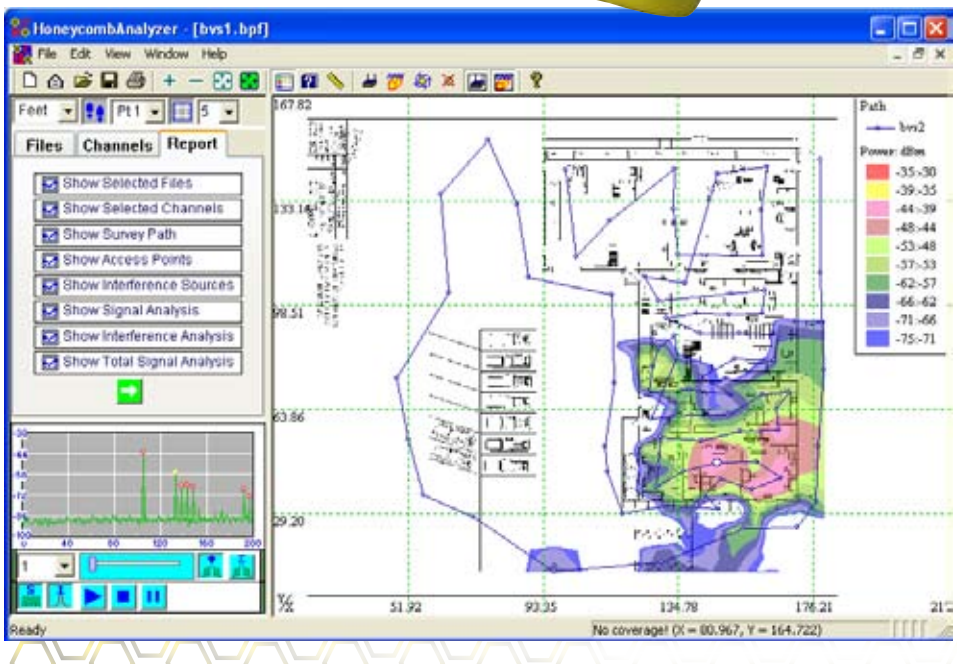
Import any image file of a floorplan or site
Create a distance projection
Add simple objects to image
Add custom objects to floorplan
Scale and crop image
Save for use in Collector and Analyzer

Honeycomb™ allows either BumbleBee-TABLET users or BumbleBee handheld (iPAQ) users to map interference using BVS receiver technology.

HoneyComb™ is Windows XP (Tablet/PC or iPAQ/PC) interference-mapping software designed for use with the BumbleBee™-TABLET spectrum analyzer system. It consists of three parts: Projector, Collector, and Analyzer. Sources of interference can be separated from 802.11 WLAN signals, allowing the user to graph severity of interference, percentage of channel capacity remaining and other significant interference related quantities. HoneyComb™ aids in locating jamming interference, unintentional interference and network intrusion as well as channel verification. HoneyComb™ will also map all likely signal sources and strengths for helping to clear "RF free zones." Floorplans or site maps can be used as a reference to collect data leaving the resulting interference maps to be overlayed onto floorplans for easy identification of interference prone areas.

2 Instant RF Surveys:
HoneyComb Collector (iPAQ)

Save multiple data files while using same projection file
Ability to choose up to 26 802.11b/a/g channels
Adjust duration of scan
Adjust period of scan for each channel
Automatically saves data to file
Take screen snapshots of any site
Saves data for further analysis in HoneyComb™ Analyzer
Shows walk/drive path
Access information on any point at any time



3 Plot Interference Analysis:
HoneyComb Analyzer (PC)

Imports data from other Honeycomb applications
Detect/Separate interference from Wi-Fi signals
Interference severity and channel
Plot and view interference-related problems
Wi-Fi channel capacity for intrusion detection
Plot and view "RF free zones"
Print and export plots into bmp files
Create a HTML report for any survey area

OPTIONAL SOFTWARE AVAILABLE FOR YOUR BUMBLEBEE

1. Establishing a Connection with the receiver:

Double click the BumbleBee Tablet icon on the desktop to start the software.

Ensure that the USB cable is properly connected to both, the Tablet PC and the BumbleBee Receiver.

Once this is done, click  on the toolbar to connect to the BumbleBee Receiver. The connection box pops up with the USB device listed in the list box.

Fig 1: USB Connection

Select the listing which indicates that the product is a BUMBLEBEE TABLET and click OK.
On clicking OK, the software will establish a connection with the BumbleBee Receiver. Once connection is successful, the receiver will be set in the default spectrum mode which is centered at 2425 MHz and spans 50 MHz with a Resolution Bandwidth of 50 KHz and a Receiver reference level of –20 dBm.

.

2 Description of Tool Bar Buttons:

2.1  Connection:

This button is establishes a connection with the hardware as discussed above.

2.2  Snapshot:

This button takes a snapshot of the application window. The snapshot can be saved either as a jpeg or a bmp at any location.

2.3  Selection Tool:

This button is used to select an area on the Display to measure spectral power within the selected area or to zoom into the selected area.

This button is first clicked, then the mouse is dragged while keeping the Left Button down, over the desired Spectral Region and that area is highlighted. Spectral Power within this selected region is calculated and displayed as shown:

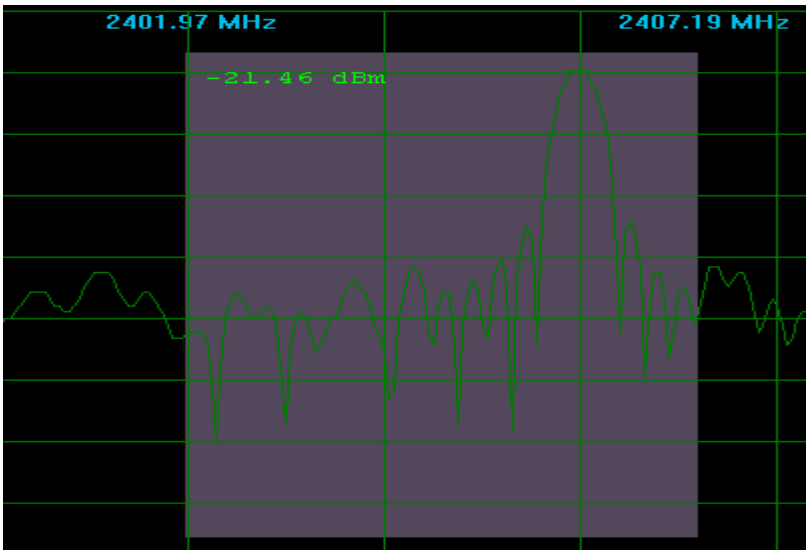


Fig 2: Spectrum Selection

2.4  Zoom In:

This button zooms into a selected area.

2.5  Zoom Out:

This button zooms out from a previously zoomed in region.

2.6  Record/ Log Spectrum:

Once in the Spectrum Mode or the Trigger Spectrum Mode, the Spectrum Data being viewed on the Screen may be logged by clicking this button. The Logged File is saved with the **spl** extension.

2.7  Replay the Logged Spectrum for post-processing/analysis:

This button selects BumbleBee Tablet Log Files (with extension **spl**) and replays them for post-processing and analysis. Once the playback begins, this button changes in appearance to  . Clicking this changed button freezes the playback and the button becomes  in appearance again. Click this button again to resume normal playback.

2.8  Stop Recording/Playback:

Stop the current recording or playback.

2.9  Fast Forward:

The replay speed is doubled. Click this button again to resume normal playback.

2.10  Rewind:

The play back is reversed at doubled speed. Click this button again to resume normal playback.

***NOTE:** For detailed explanation on Logging and re-playing a Spectrum Log File, see page29*

2.11  Print Preview & Print.

This prints out the current Spectrum Display. The Display can be printed out either in **True Color:** A true snapshot of the Display screen is printed as seen on the Display (with the Black Background); or in **Econo Color:** A snapshot of the Display is taken and printed against a white background or in **Black and White:** A Black and White print out is taken (i.e. Black foreground against a white background). The options can be changed in the File menu by Clicking on “Print Color Options”. Once clicked, the following Dialog Box pops up. Then select the option of choice and then click OK and click  see a preview of the screen.

Fig 3: Print Color Selection Options Dialog

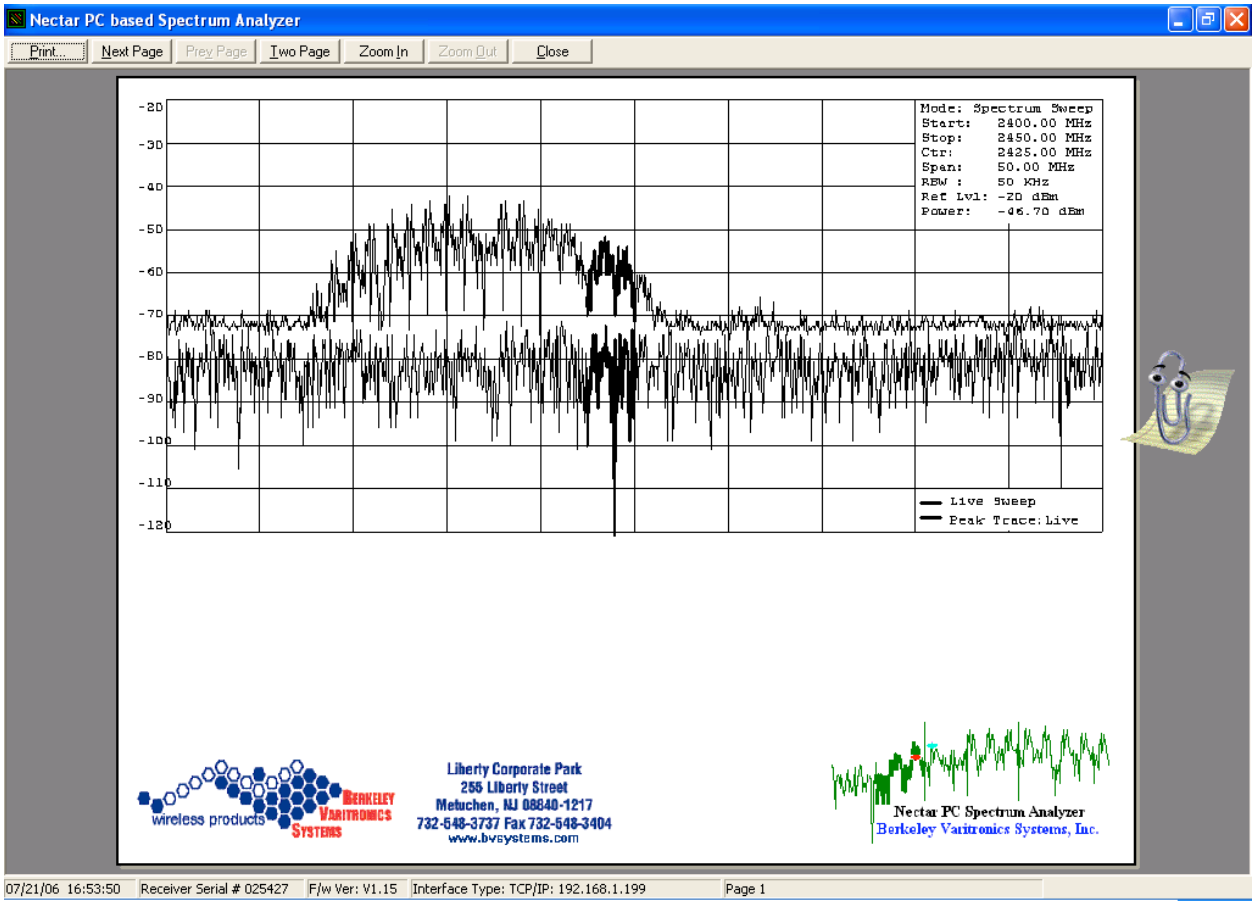


Fig 4: A Print Preview for a Black and White (Monochrome) print out.

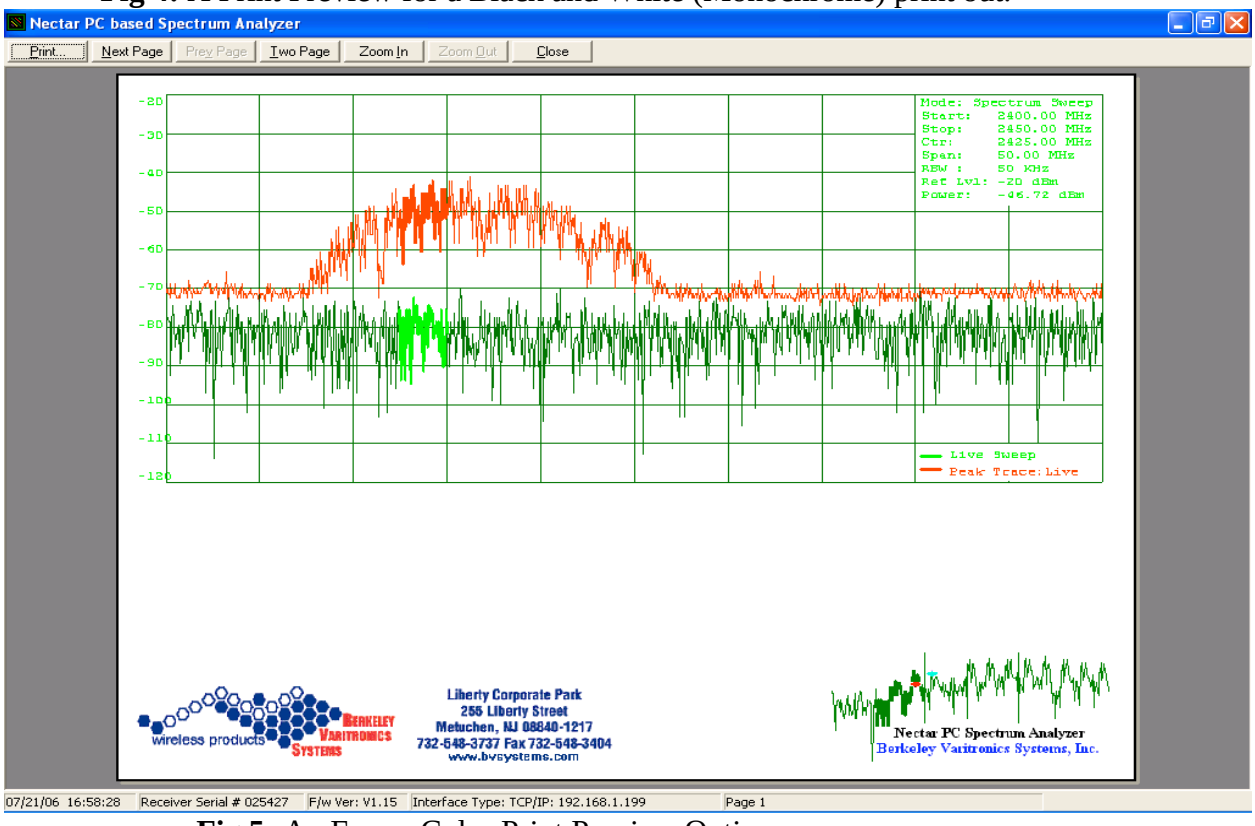


Fig 5: An Econo Color Print Preview Option

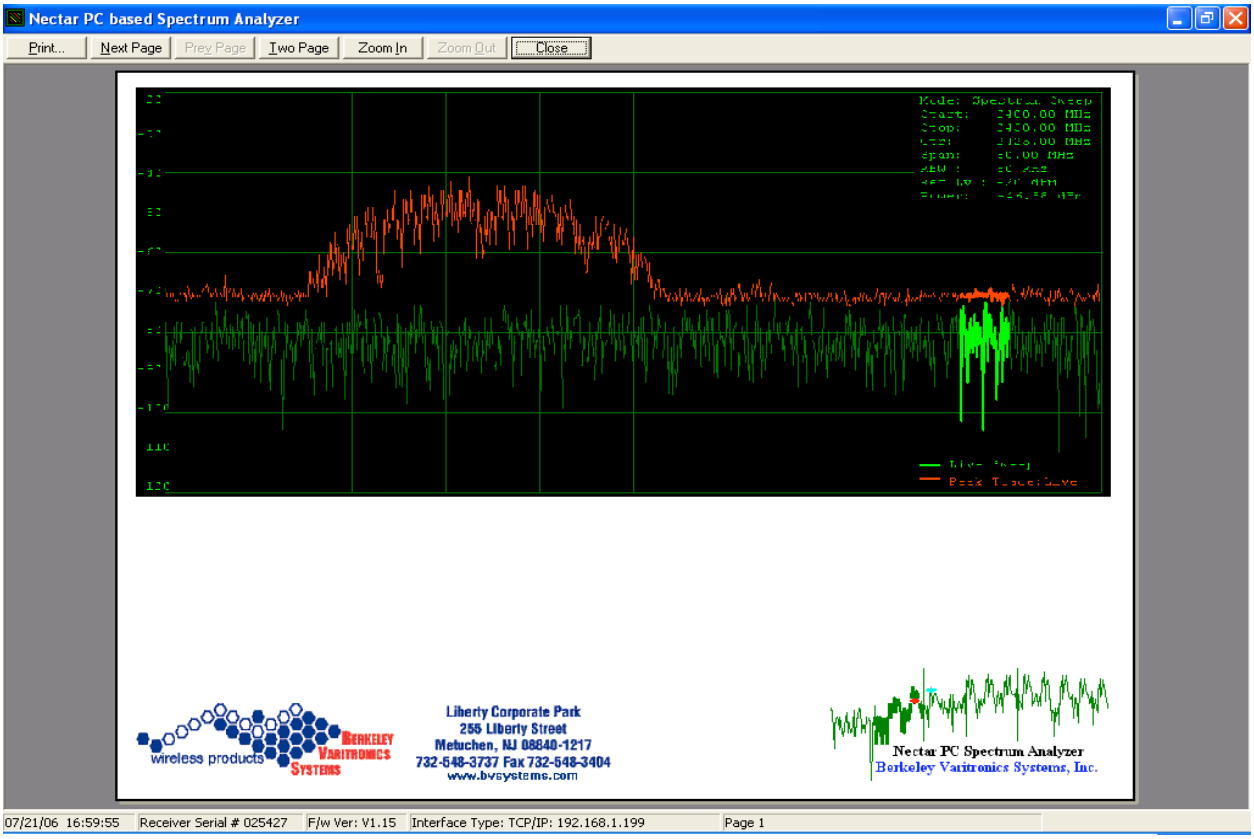


Fig 6: A true Color Print

2.12 Spectrogram Display:

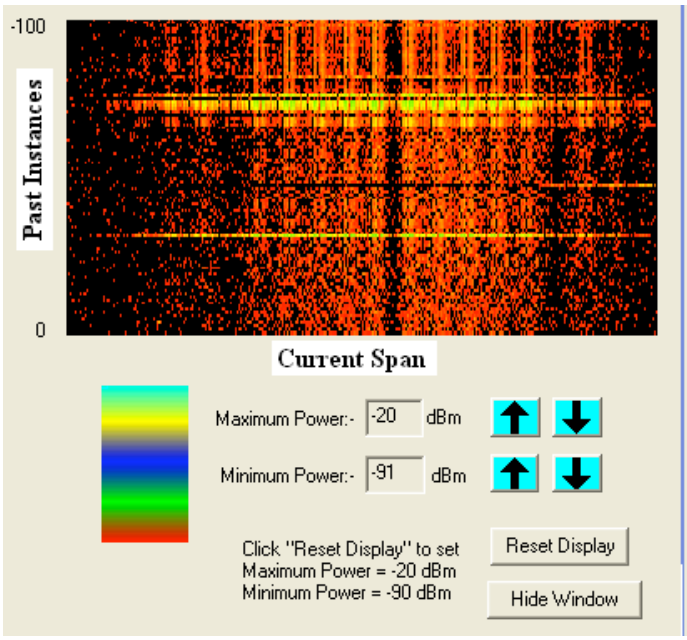


Fig 7.1: Burst of Microwave Energy from a Microwave oven.

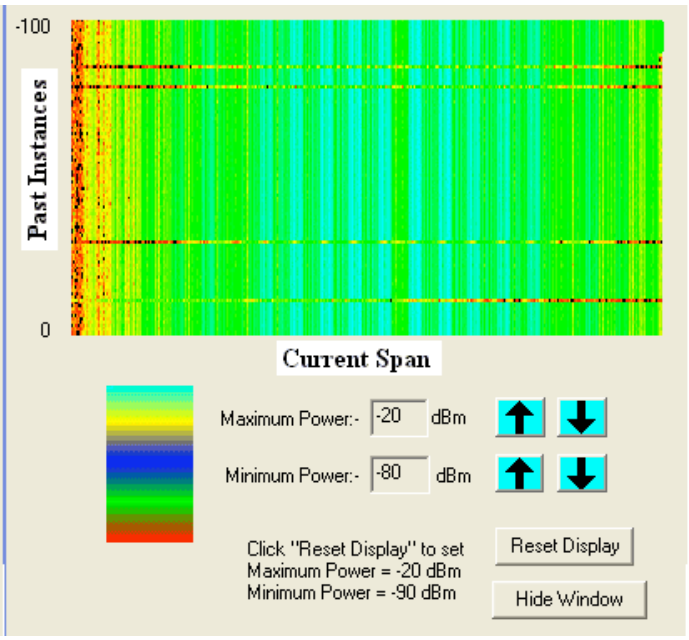


Fig 7.2: Persistence of a Direct Sequence Spread Spectrum Signal; from an 802.11b AP

The Spectrogram Display shows the power gradient of the last 100 spectral sweeps. The Power Gradient is plotted with Past Instances vs. the Current Span. The spectrogram is displayed using the colors given on the Color Bar. The Colors in the Color Bar represent the power values between the defined Maximum and Minimum power values. By selecting either Max Power or Min Power the corresponding values can be changed by clicking the buttons. Any power value greater than the Maximum Power value set is represented by **WHITE** color in the spectrogram while, any power value lesser than the set Minimum Power value is represented by **BLACK.** The Spectrogram can also be displayed for Spectrum being replayed from BumbleBee Tablet Log Files.

2.13 Histogram Display:

This displays the Histogram Display for the current waveform. The Histogram displays the percentage of time that the power in each frequency bin is above the threshold.

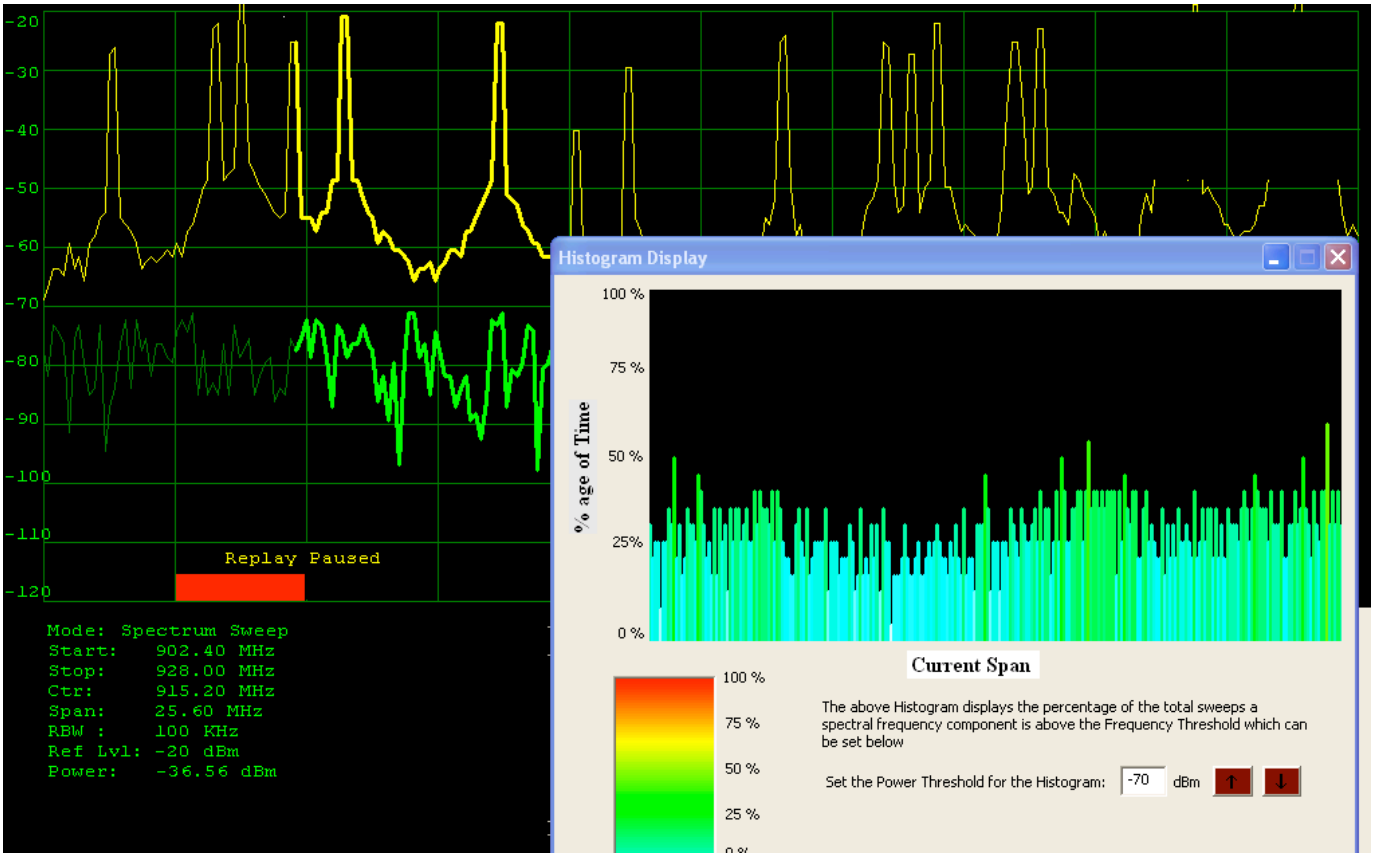


Fig 8: Histogram Display of an RFID waveform.

2.14 Interference Analyst:

The Interference Analyst is a collection of waveforms of most commonly used digital modulation and transmission techniques in the 900 MHz, 2.4 GHz and 5.8 GHz frequency bands. The Interference Analyst provides visual representation and description of waveforms of Direct Sequency Spread Spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS), Orthogonal Frequency Division Multiplexing (OFDM), Microwave oven Power Leakage. It also provides visual images of what the Spectrum looks like when one transmission scheme interferes with another. The Interference Analyst is very useful for users who do not have a good understanding of the above mentioned digital modulation and transmission schemes. It can be a handy feature for them to detect and identify the type of device transmitting on a particular channel.

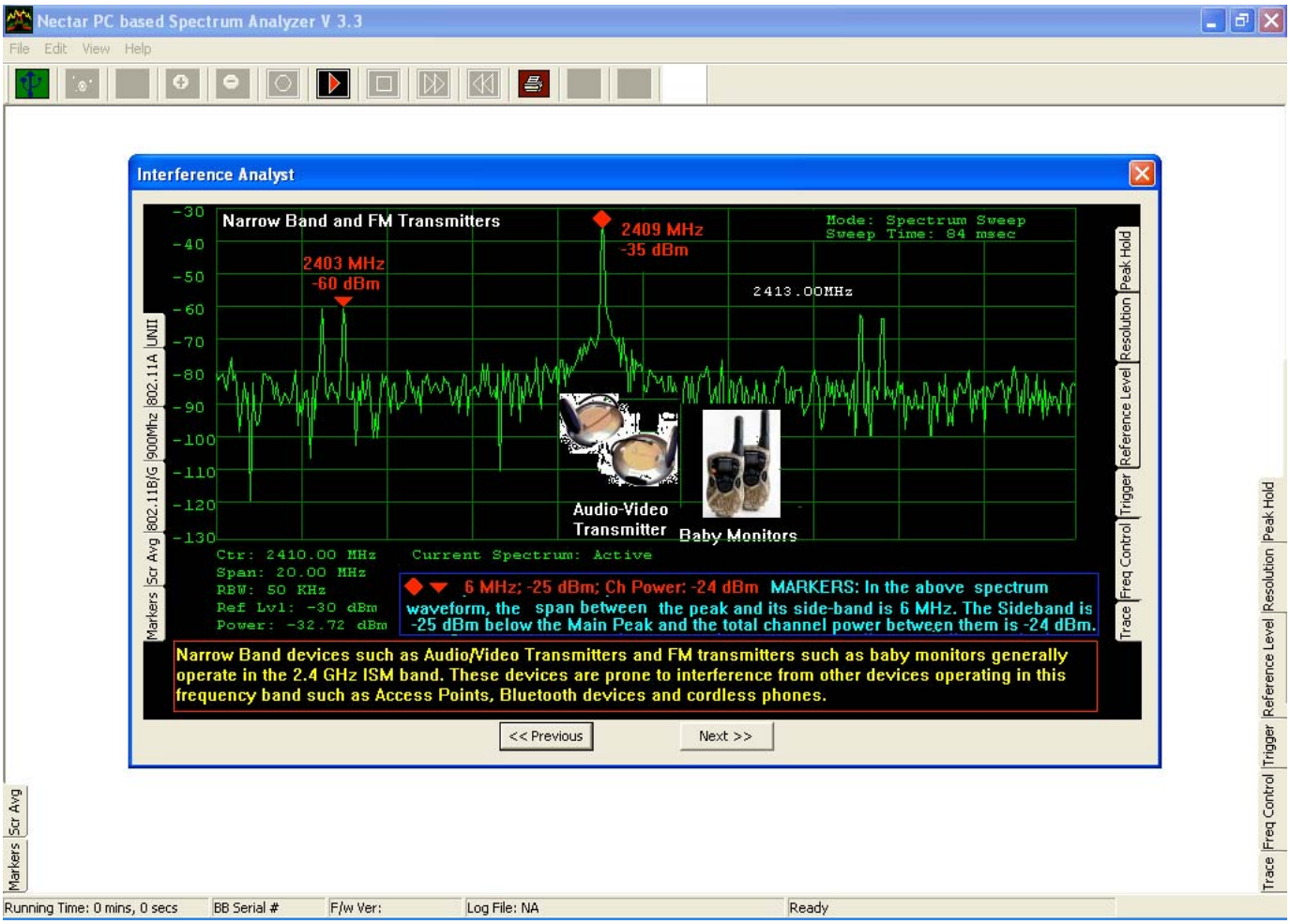


Fig 9: Interference Analyst Display of a Narrow Band waveform.

2.15 Create a User defined Spectrum Preset by saving a Spectrum Context File.

2.16 Re-Open a saved Spectrum Context File to trigger a User-defined Spectrum Preset.

3. Tab Options:

The Tabs on the Left and Right hand edge of the application window form the Control and Data Panel for the BumbleBee Tablet PC Software. Tapping on a Tab with the Stylus will make it pop out on the screen. Tapping outside the Tab will cause the popped up Tab to slide back and hide.

3.1 Frequency Control Panel:

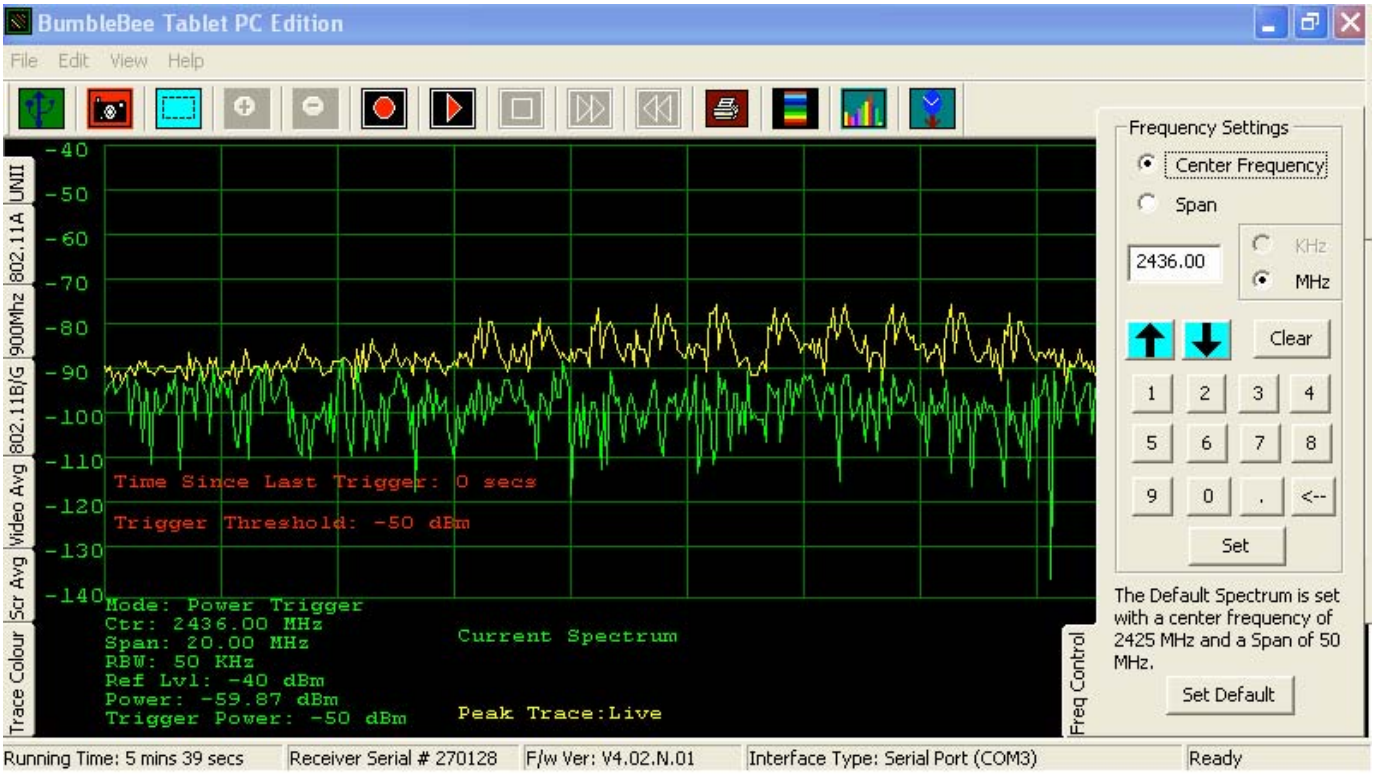


Fig 10: Frequency Control Panel

The Frequency Control Panel allows the user to set the Center Frequency and the Span of the Spectrum Analyzer.

To set the Center Frequency

1. Click the Radio Button for the Center Frequency.
2. Click “Clear” to delete the value shown.
3. Enter the Center Frequency value in the Text Box.
4. Select the units (KHz/MHz).
3. Click “Set”.

To set the Span, repeat the steps 2 through 5 after clicking selecting Span.

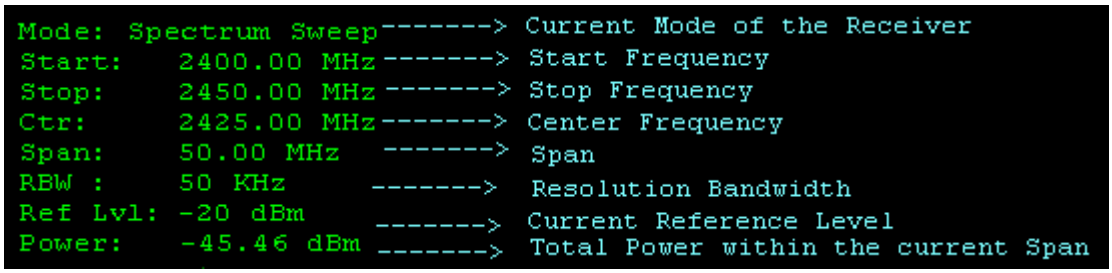
IMPORTANT NOTE:

1. *The Center Frequency has to be within the Frequency Band supported by the BumbleBee Receiver.*

2. *The Span is divided equally on both the sides of the Center Frequency.*

3. *The software performs "Span Checking" to make sure that the span does not exceed the bounds of the Frequency Band supported by the BumbleBee Receiver. For example: For a BumbleBee which supports the 2400 MHz – 2500 MHz frequency band, if the current center frequency is 2480 MH,. the maximum span which can be set would be 40 MHz.*

The Legend on the bottom of the window is explained as below:



3.2 Trigger Mode:

The Swept Spectrum Mode can be slow in detecting and measuring bursts of signal energy. This is because when the receiver scans a certain portion of the spectrum, it will miss a burst of signal energy such as a frequency hop of a Frequency Hopping device on a nearby frequency. In the Swept Spectrum Mode, the only time the receiver will detect and measure signal energy is when the burst of signal energy occurs at the frequencies the BumbleBee receiver is currently scanning. This problem can be particularly compounded if the Sweep Span is large and the resolution bandwidth is small. As a solution to this problem, the BumbleBee Receiver has a Power Trigger Mode. In this mode, the user can set a power threshold for the receiver to trigger on, every time the channel power exceeds this threshold. This way, the receiver captures bursts of signal energy occurring over a 20 MHz channel bandwidth whenever the Channel Power within this 20 MHz channel exceeds the Power Threshold. In addition to this, the user can set a delay so that the receiver will measure the channel power only after the amount of specified delay following a trigger. This setting ensures that the RF energy of the desired portion of the data packet is measured.

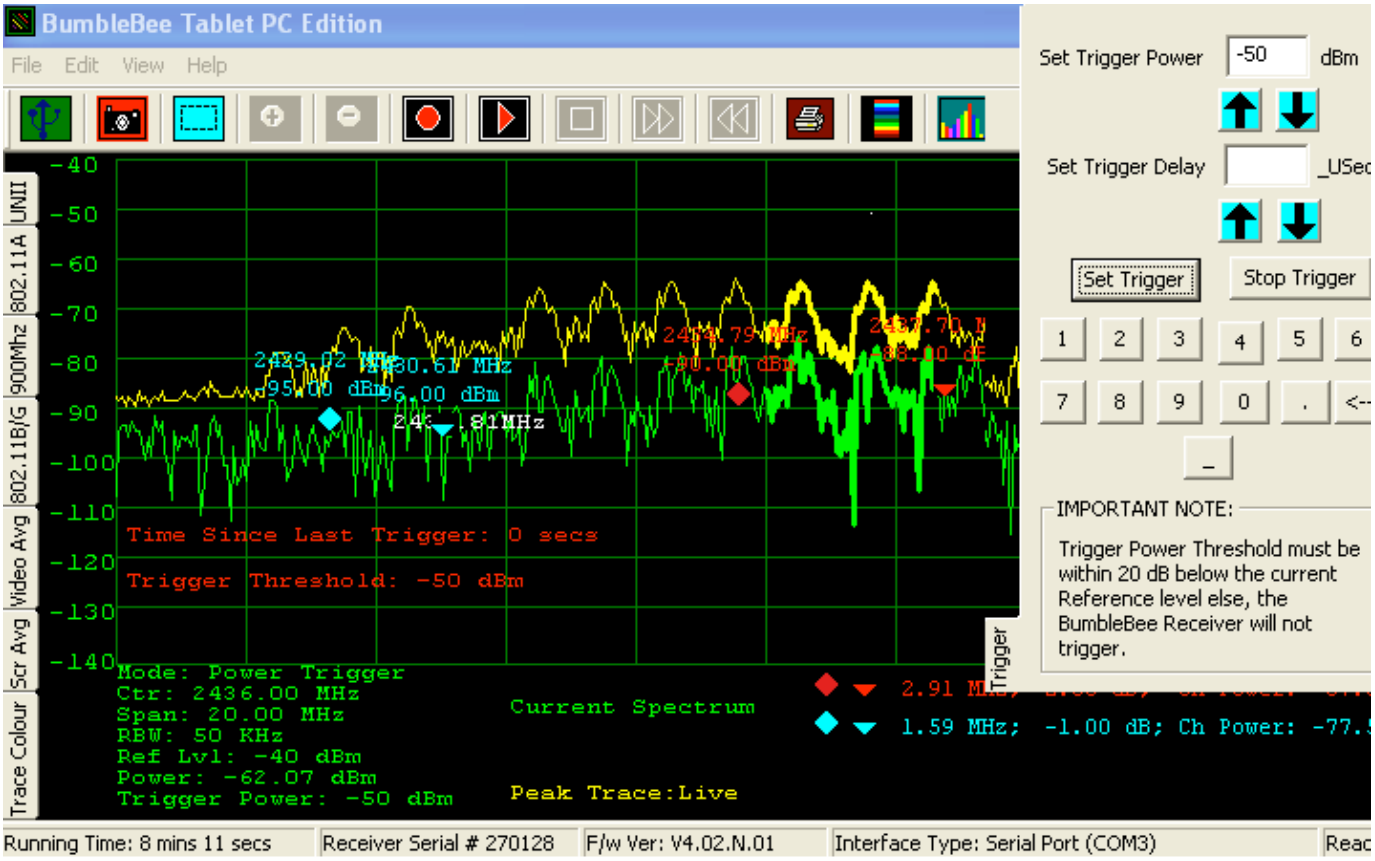


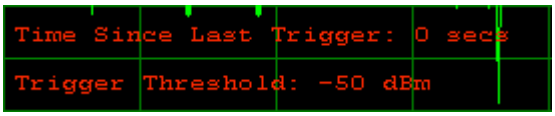
Fig 11: Trigger Mode Settings: The Direct Sequence Spread Spectrum Waveform above shows the presence of an 802.11 B Access Point.

To Set the Receiver to Trigger on a Channel Power greater than the Power Threshold:

1. Set the Receiver Reference Level.
2. Set the center frequency of the channel. This can be done either using the Frequency Control panel or the Preset Panels. **IMPORTANT**: **The Span must be set to 20 MHz**.
3. Tap the stylus on the Trigger Tab to pop up the Trigger Panel.
4. Set the Trigger Threshold power to within 20 dB of the current Reference Level[1].
5. Click “Set Trigger” to Set the BumbleBee Receiver to Trigger on a Channel Power greater than the Power Threshold.
6. To change any Spectrum parameter when the unit is in trigger mode, Stop the Trigger, make the desired setting and then click “Set Trigger” again.
7. A Trigger Delay in Micro Seconds can be entered to set the receiver to measures the spectrum after the delay following the channel power exceeding the power threshold.

IMPORTANT NOTES:

1. **The Trigger is only applied for a maximum Span of 20 MHz**. Set the Center Frequency to a suitable value and then set the Span to 20 MHz.
2. **The Trigger Threshold Power must be within 20 dB of the Reference Level.** If the Threshold value is below 20 dB of the Reference Level, the BumbleBee Receiver will not trigger. To adjust the threshold level greater than 20 dB below the reference level, lower the reference level and then adjust the trigger threshold.
3. **Stop the Trigger by clicking "Stop Trigger" to exit the Trigger Mode and resume the normal Spectrum Mode.**



IMPORTANT TIPS WHILE USING THE TRIGGER MODE:

The trigger mode will trigger when the power in a 20 MHz channel exceeds the set power threshold. The presets can be very helpful in conjunction with the trigger mode.

- **Select a channel using the Preset tabs.**
- **Set the Reference Level and the Resolution Bandwidth.**
- **Set a threshold value to be within AT MOST 20 dB below the reference level.**
- **Start the trigger. The receiver will now trigger on the preset channel.**
- **Click "Stop Trigger" to stop the trigger.**

3.3 Reference Level:

The Dynamic Range of Power measurement of the BumbleBee can be changed by varying the Reference Level of the Receiver. The Reference Level Settings for the BumbleBee Receiver can be changed from –20 dBm to –70 dBm in steps of 10 dB. For measuring very strong signals the reference level can be set to a high value like –20 dBm while low power signals can be measured by setting the reference level to –70 dBm. Hence when the Reference level has been set to –20 dBm, the receiver can measure signals with a maximum value of –20 dBm. If the reference level is a low value compared to the value of the received signal, the signals are subjected to clipping as seen in **Fig 13.**

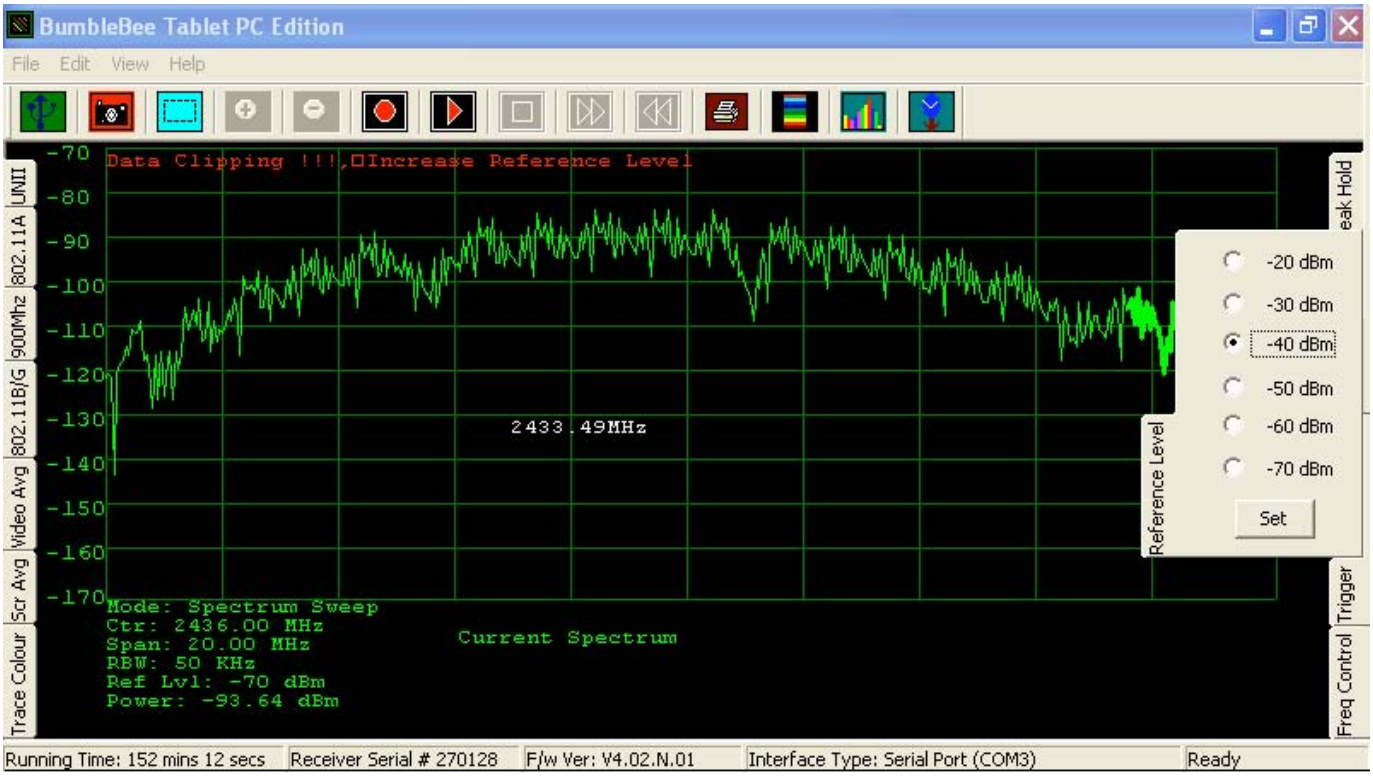


Fig 12: Reference Level Settings

IMPORTANT NOTE:

When using the Trigger Mode, the Reference Level setting must be at most 20 dB above the set Power Threshold value otherwise the BumbleBee Receiver will not trigger.

3.4 Resolution Bandwidth:

The BumbleBee measures the energy present within the frequency bins. The width of each bin is equal to the Resolution bandwidth.

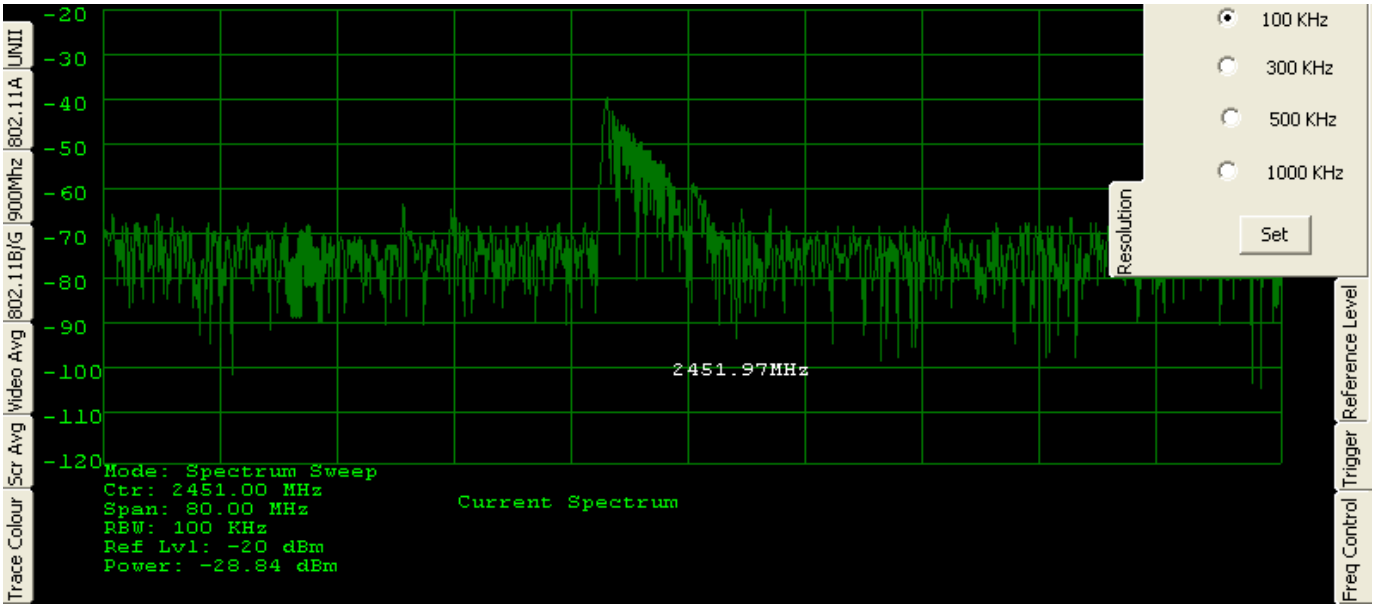


Fig 13.1 Burst of Signal Energy as observed using a 100 KHz resolution bandwidth.

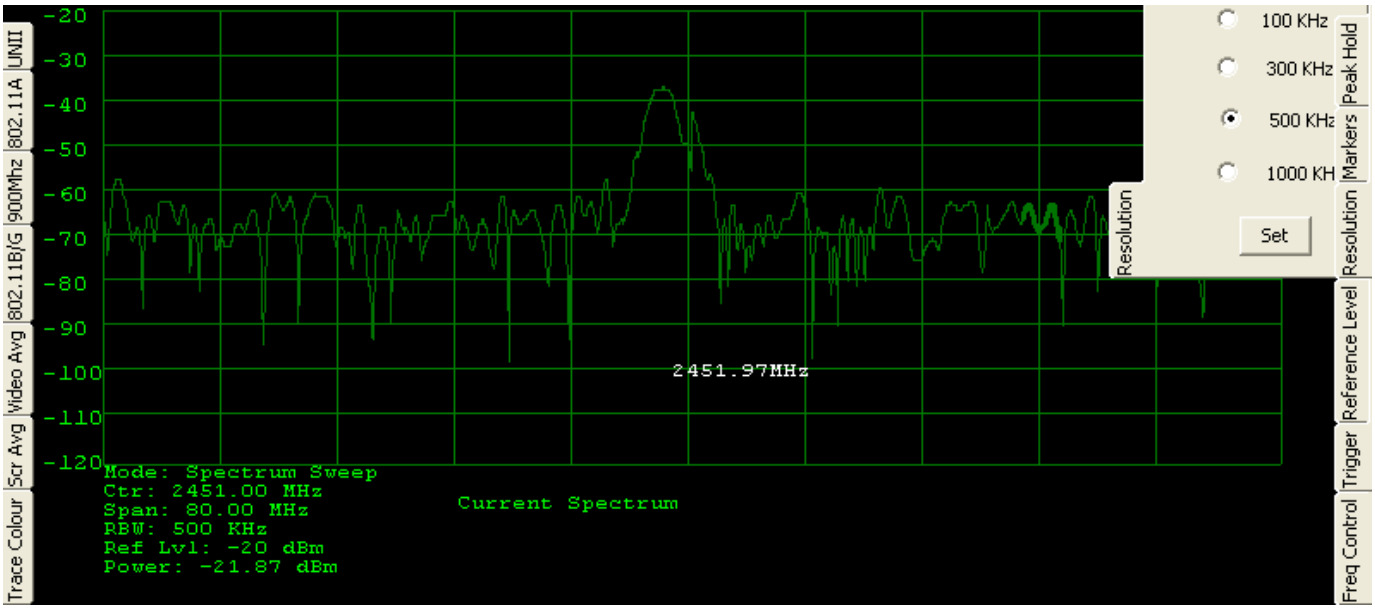


Fig 13.2 Burst of Signal Energy as observed using a 500 KHz resolution bandwidth.

The Resolution Bandwidth of the trace shown in **Fig 14.2** is 500 KHz. Each point in the spectrum above represents the total energy present in a frequency bin 500 KHz wide. A lower Resolution Bandwidth is very useful in accurately capturing and measuring individual frequency components within the spectrum. However, for a large span, a smaller Resolution Bandwidth would result in a longer sweep time. A higher Resolution Bandwidth can be used for a large span to reduce the sweep time. A Resolution Bandwidth greater than or equal to the bandwidth of the signal can be used to measure the Channel Power.

3.5 Markers/Delta Markers

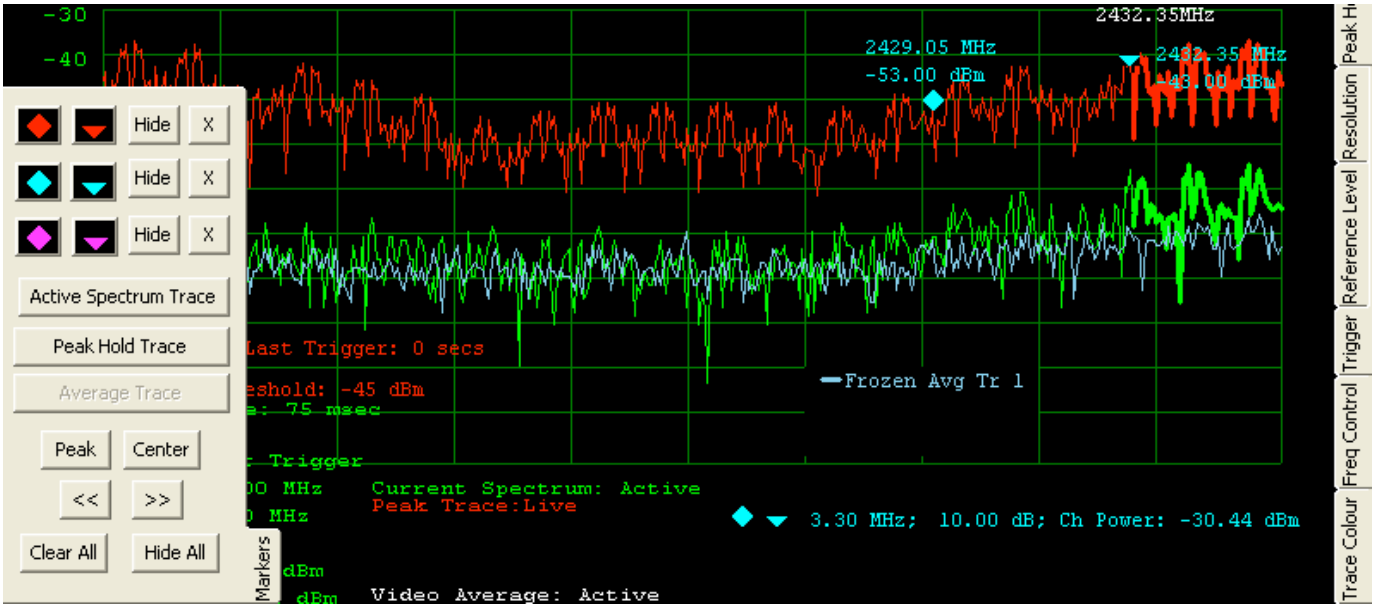


Fig 14: Markers/Delta Markers Settings

This Tab Panel can be used to set Markers/Delta Markers on the Spectral waveform at desired frequencies to measure power at that frequency. The Marker/Delta can be positioned either on the Active Trace, the Peak Hold Trace or the Average Trace provided those traces are active and not frozen

IMPORTANT: The Selection feature must be disabled. If the  button is  **,** then click the button again to restore it to  and disable the Selection feature.

In order to set the Marker and the Delta:

1. Click  on the Marker Tab Panel to set the Marker.
2. Then tap the stylus on the spectrum at the point of interest. This will set the Marker ( **)** at the desired point.
3. Click  **on** the Marker Panel to set the Delta.
4. Then again tap the stylus at some point away from the Marker  to place the Delta at that point.
5. The Frequency and the Power at the Marker and the Delta will be displayed just above them as shown below.
6. If the Markers need to be placed on the Peak Hold or the Average Trace, click the respective button on the Marker Settings Panel. This will cause the markers to shift from the Active SpectrumTrace to the selected Trace. To set the Markers back to the Active Spectrum Trace, click “Active Spectrum Trace” on the Marker Settings Panel.

7. If the Marker/Delta have been positioned on the Peak Hold Trace or the Average Trace, the markers will shift on the Active Spectrum Trace the moment the Peak Hold or the Average Trace is disabled.
8. Click Peak to position the markers on the Peak value of the trace on which they have been set.
9. Click Center to position the markers on the Center Frequency of the trace on which they have been set.
10. Click << to shift the Marker/Delta to the left and click >> to shift the Marker/Delta on the right of the trace on which they have been set.

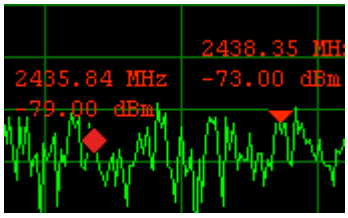


Fig 15.1: Marker/Delta Marker

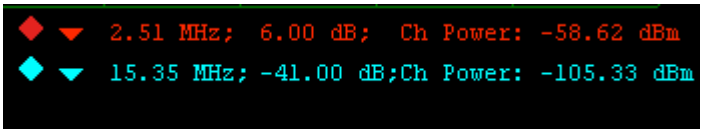


Fig 15.2. Marker/Delta Info

Fig 15.2 shows the measurements between the Maker and the Delta. The **Red** Marker/Delta pair is 2.51 MHz apart with the Delta being 6 dB above the Marker. The Channel Power between the Marker and the Delta marker is –58.62 dBm. Similarly the **Blue** Marker/Delta marker pair is 15.35 MHz apart, with the Delta being 41 dB below the Marker. The Channel Power between them is –105.33 dBm.

3.6 Peak Hold Traces:

Up to four traces, each, which traces the Peak Power in the Live Sweep waveform, can be set. However, only one of these four traces can be active at a given time. An active trace can be frozen by clicking the “Freeze” button for further analysis. If a peak trace is frozen, a new trace can be activated by clicking the corresponding check box, without disabling the frozen trace. Clicking “Hide” check box can hide the traces. **Fig 4** shows the Peak traces in detail.

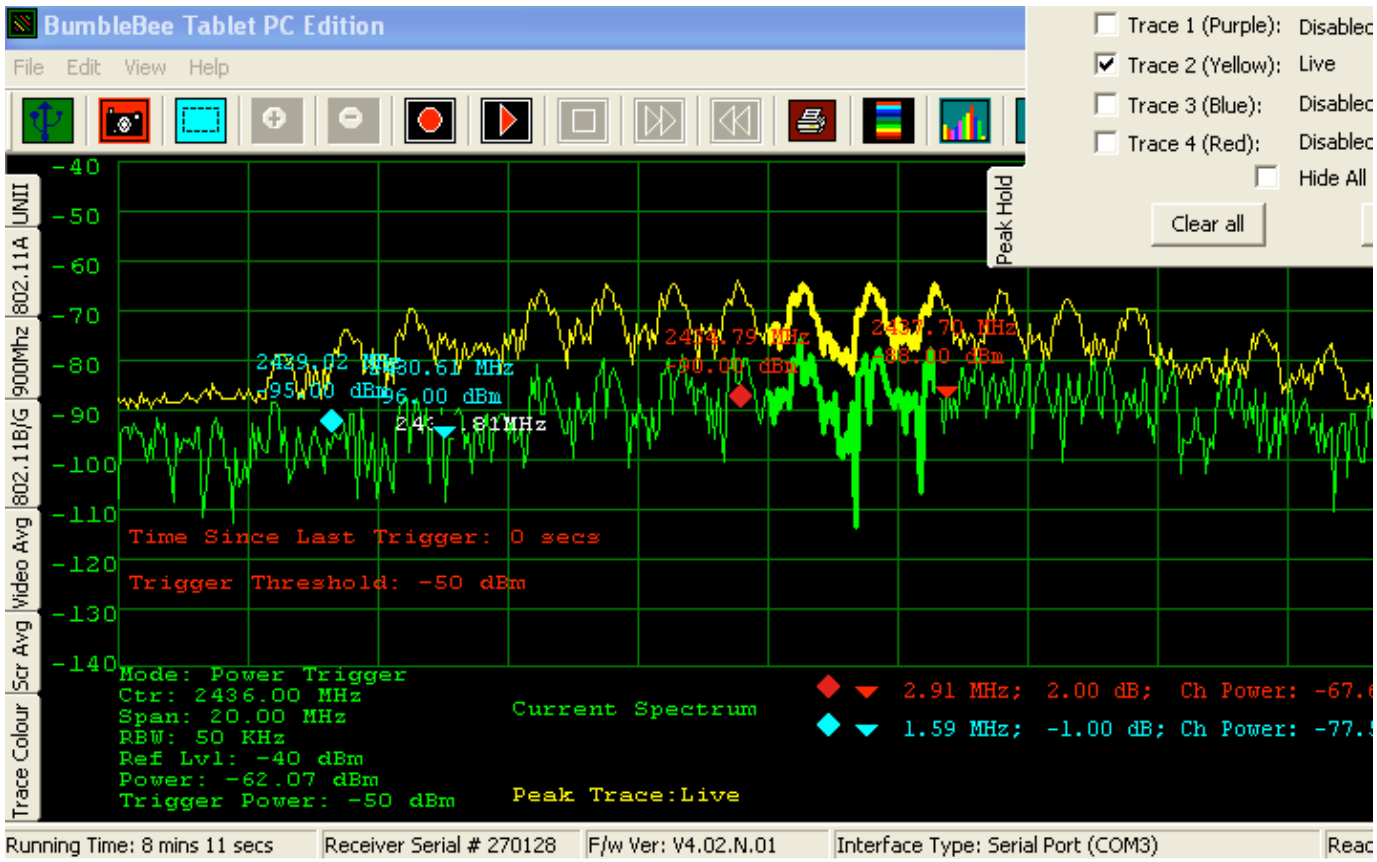


Fig 16 Peak Traces

3.7 Trace Averaging:

Trace Averaging is useful to obtain a trace, which is the average of the last N traces. This is helpful in reducing Noise in signals that are continuous to obtain a smooth trace with fewer variations. Non-continuous signals can be filtered with Adjacent Bin Averaging discussed later.

When 'Trace Averaging' is selected, a dialog box as shown on the left hand will pop-up. The desired number of traces to be averaged can be increased or decreased using the up/down arrow buttons. **Fig 5** shows the trace averaged over the last 7 sweeps

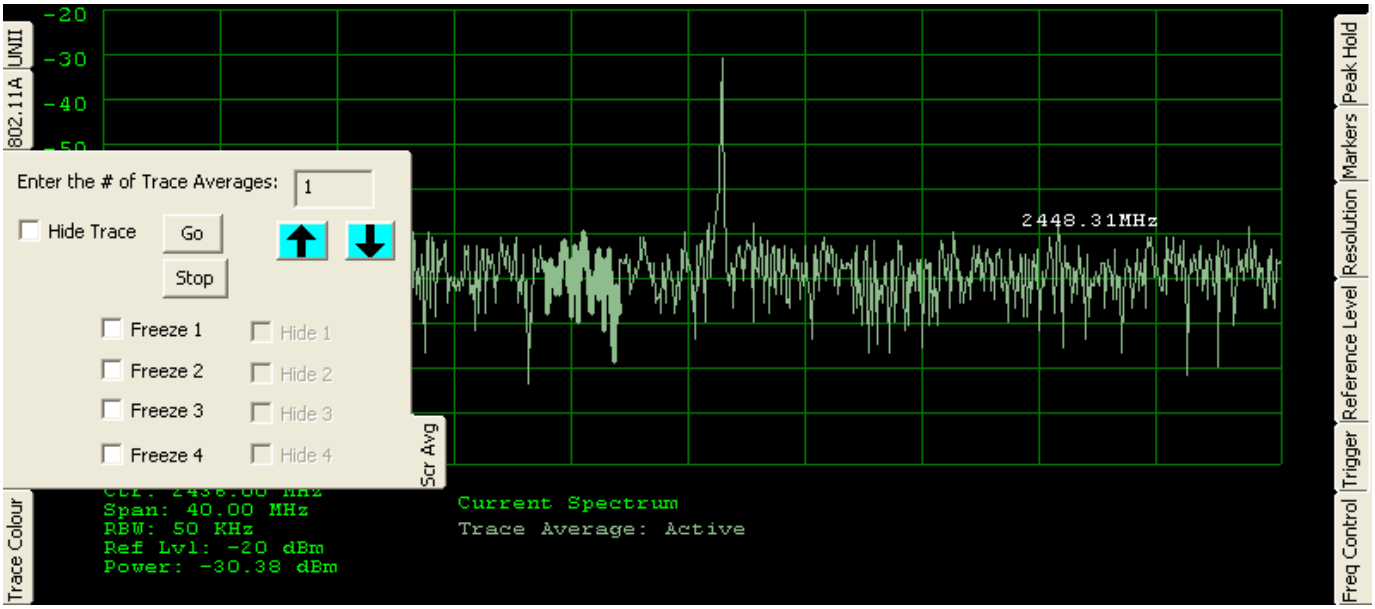


Fig 17.1: The trace in **OLIVE** color is the trace representing NO Averaging.

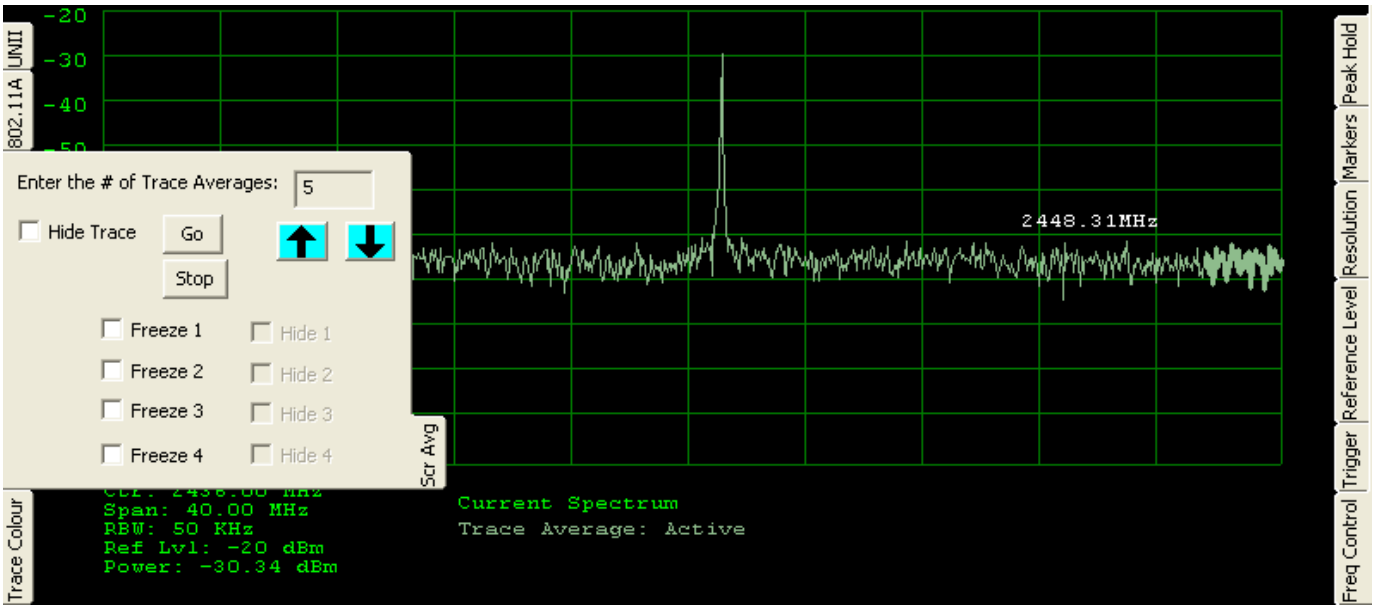


Fig 17.2: The above trace contains points which are an average of the last 5 trace points.

3.8 Adjacent Bin Averaging:

Adjacent Bin Averaging is also called Video Smoothing. This technique uses the adjacent-point averaging to reduce the amount of fluctuation in the measured trace due to the noise. N points of a trace are averaged together to produce each point. This reduces fluctuations in Noise and smoothes the trace. However, the user has to apply good judgment over the amount of smoothing to be applied as excessive smoothing could lead to loss of the desired information, with the waveform conveying nothing. **Fig 18.2** displays the live trace smoothed over 6 consecutive adjacent bins.

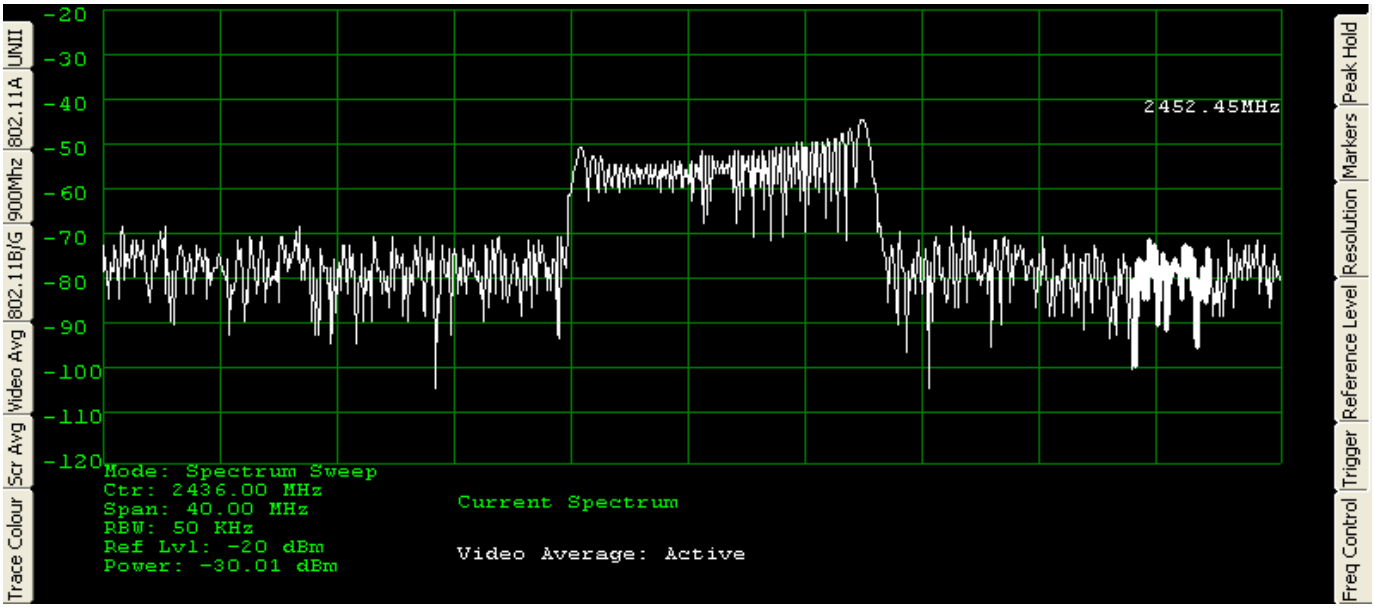


Fig 18.1: The White trace represents a waveform with no adjacent bin averaging

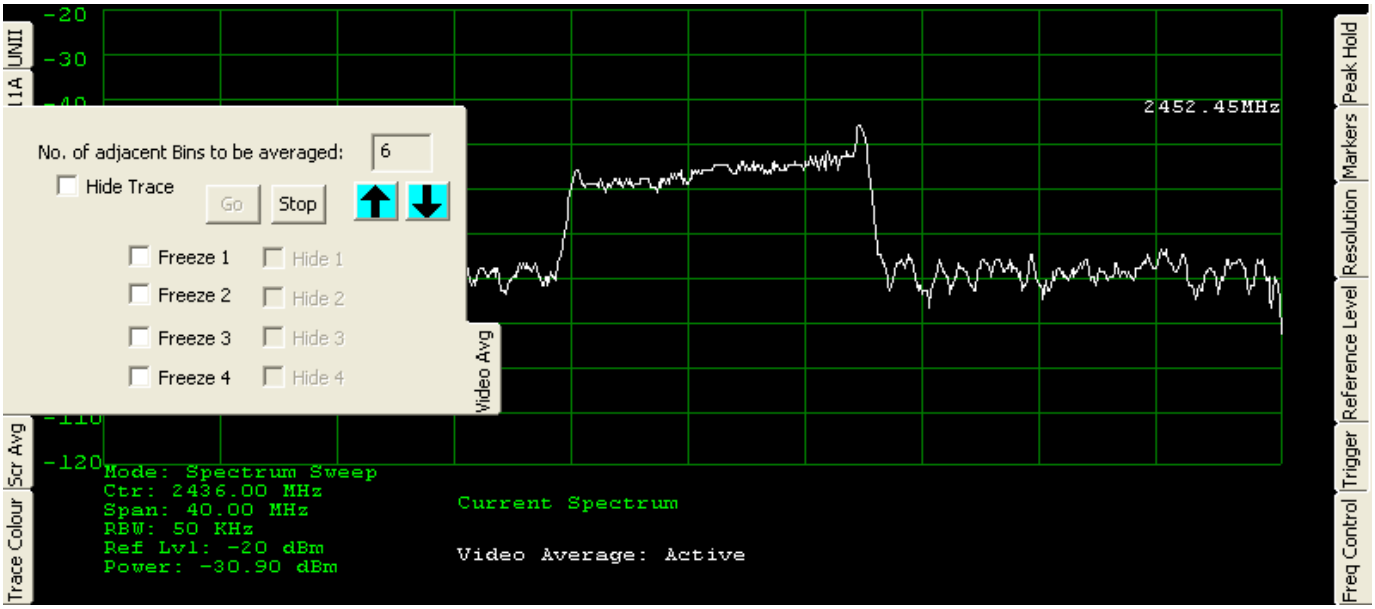
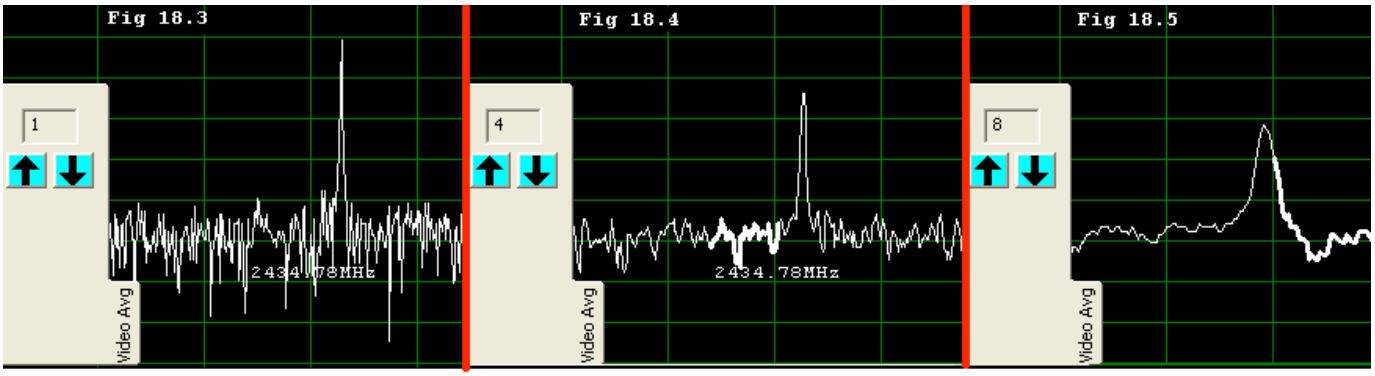


Fig 18.2: The White trace represents the average trace over 6 consecutive adjacent bins of the active trace.



The above figure demonstrates the use of Video Averaging. The **Fig 18.3** shows the waveform with no averaging; **Fig 18.4** shows a waveform with 4 adjacent bin averaged, while **Fig 18.5** shows a waveform with 8 adjacent bins averaged. It must be noted that lack of good judgment while using Video Averaging can cause a loss of information. This can be seen in **Fig 18.5** which seems to be "over-averaged". The **Fig 18.4** shows a good use of the video averaging feature with 4 adjacent bins being averaged. This not only eliminates the rapid noise fluctuations, but also retains the signal amplitude, which happens to be the information of interest.

3.9 Presets:

Presets allow the user to set the spectral parameters for channels of interest without manually setting all the parameters. Presets are a 'One Button Selection' for changing channels for various wireless standards. The figure below shows the Presets for the 802.11 B/BG standard. Check the desired channel.

IMPORTANT TIPS WHILE USING THE TRIGGER MODE:

The trigger mode will trigger when the power in a 20 MHz channel exceeds the set power threshold.

The presets can be very helpful in conjunction with the trigger mode.

- **Select a channel using the Preset tabs.**
- **Set the Reference Level and the Resolution Bandwidth.**
- **Set a threshold value to be within AT MOST 20 dB below the reference level.**
- **Start the trigger. The receiver will now trigger on the preset channel.**
- **Click "Stop Trigger" to stop the trigger.**

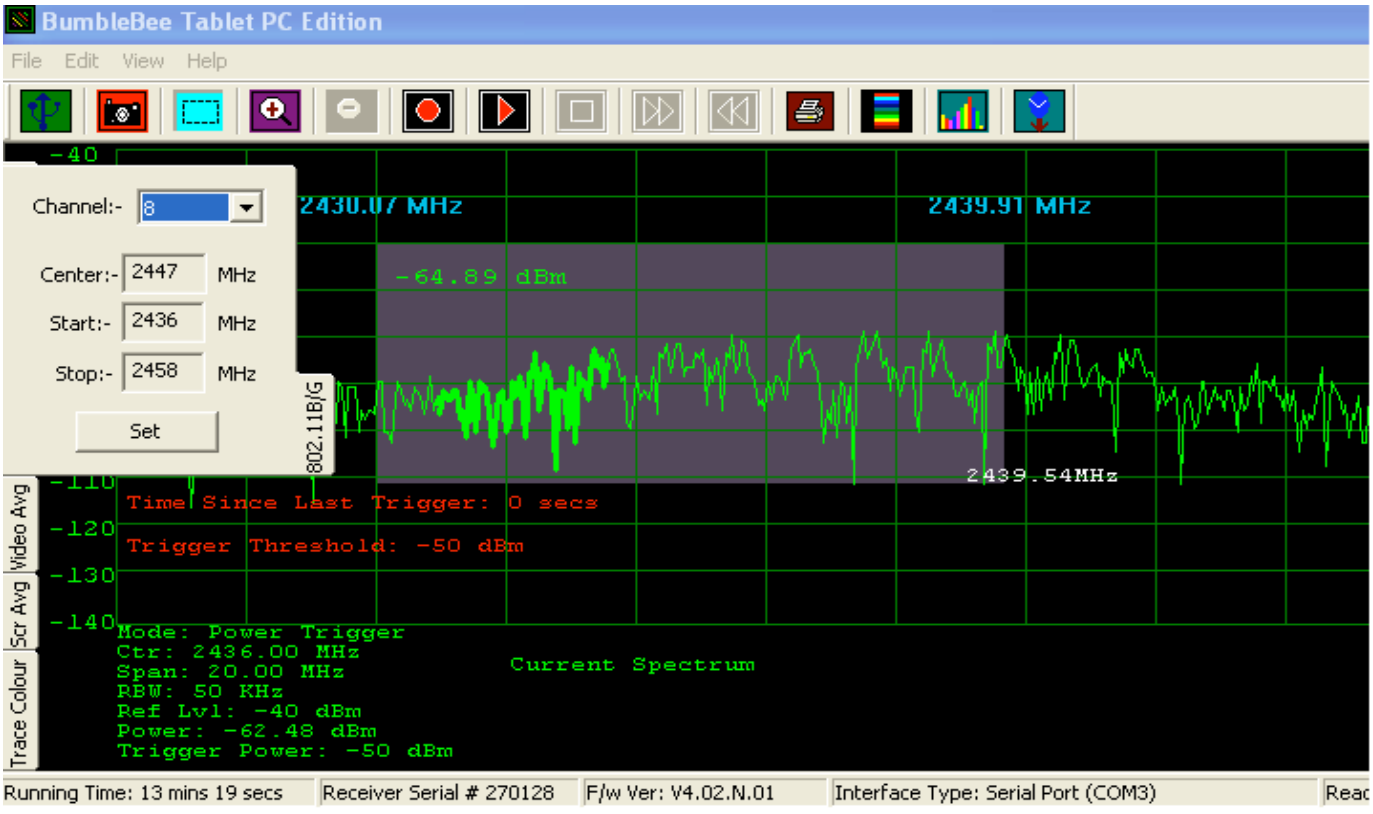


Fig 19: 802.11 B/G Channel Presets

4. Channel Power Measurements using the BumbleBee Tablet software

Measurement of channel power is an important application of the BumbleBee Tablet software and this can be done in **three** different ways.

4.1 Using Frequency Markers and Delta Markers:

By setting the Markers and Delta Markers as described in **4.4** on **page 11**, power will be calculated in the Spectrum between the marker and the delta marker.

4.2 Selecting a portion of the Spectrum Display:

By selecting a portion of the Display using the Selection tool as described on **page 10**,
The spectral power within the selected region is calculated and displayed within the selection in the color corresponding to the trace whose power it represents. The measurement is only made on the live trace **(GREEN)**. Power for the Peak and Average Traces is not measured. Measurement stops if the selected region is cleared.

Examples of Channel Power Measurement Capabilities:

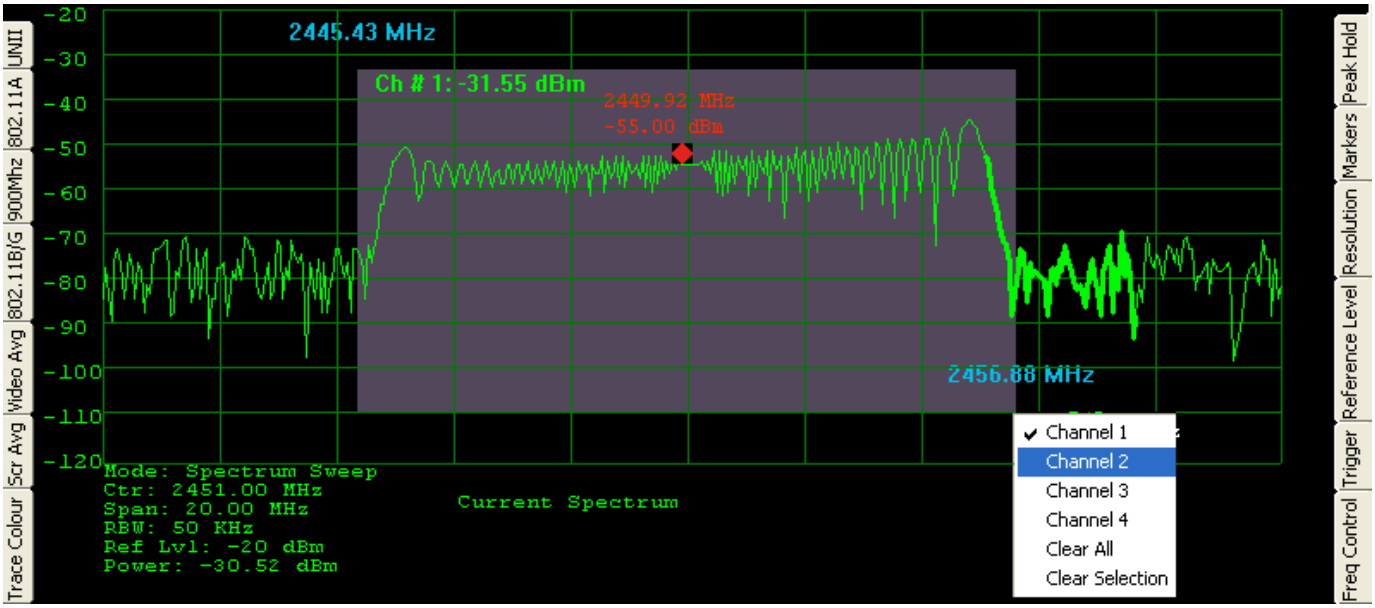


Fig 20.1: Wideband FM Signal centered at 2451 MHz with a power of –31.55 dBm

The Figure above shows a Wideband Frequency Modulated signal with a center frequency of 2451 MHz and a span of approximately 11 MHz. The Channel Power can be measured by clicking on  and then dragging the stylus across the spectrum. It should be noted that when you click  **,** the button will change to  **.** To assign a channel to the selected region, tap and hold the stylus on the screen for a couple of seconds. A pop-up menu will drop down and when you click “Channel 1”, for example, the selected region will be set to channel 1. This will ensure that if you tap the stylus on the display thereafter, the selected region for Channel 1 will not get disrupted until you again tap the stylus on the screen and check off “Channel 1” from the pop-up menu. To stop selections, click  which will then disable the selection tool and return the button to  **.**

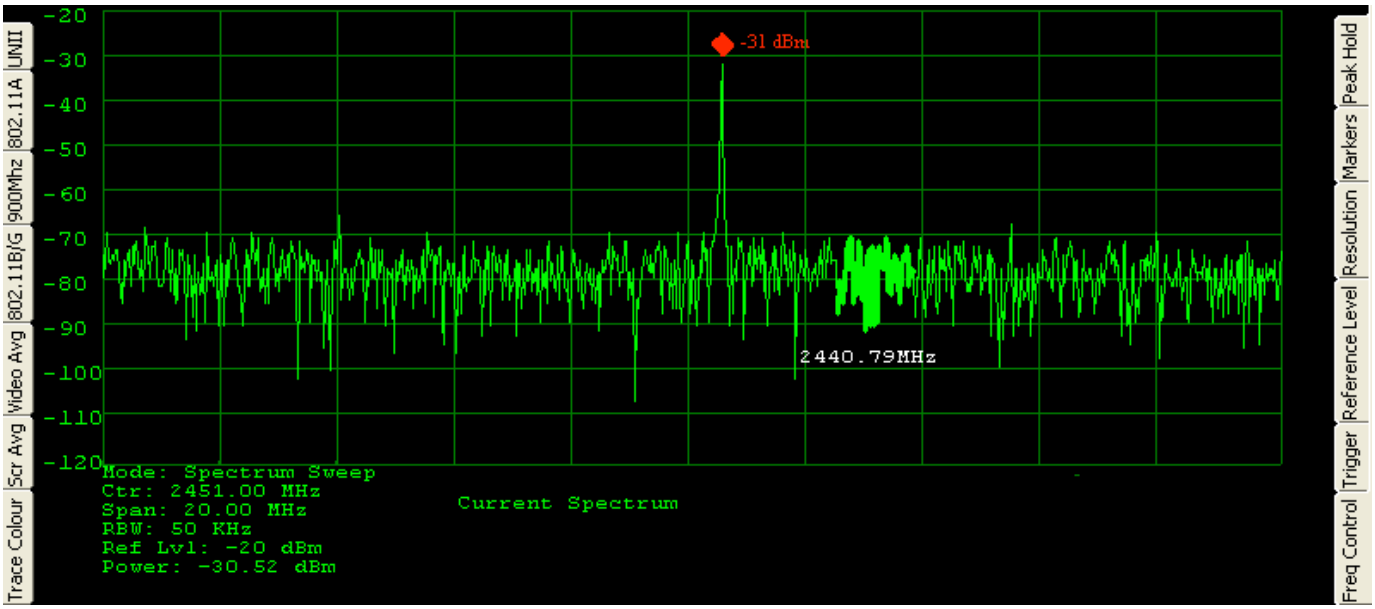


Fig 20.1: Narrowband unmodulated Signal with a peak power of –31 dBm.

Upon turning the Frequency Modulation off, it can be seen that the spectrum consists of a single peak at the center frequency of the previous Frequency Modulated signal. The Red Marker on the Peak indicates a Peak power of –31 dBm. This is in agreement to the principles of modulation that the power in the modulated signal is the same as the power in the unmodulated signal.

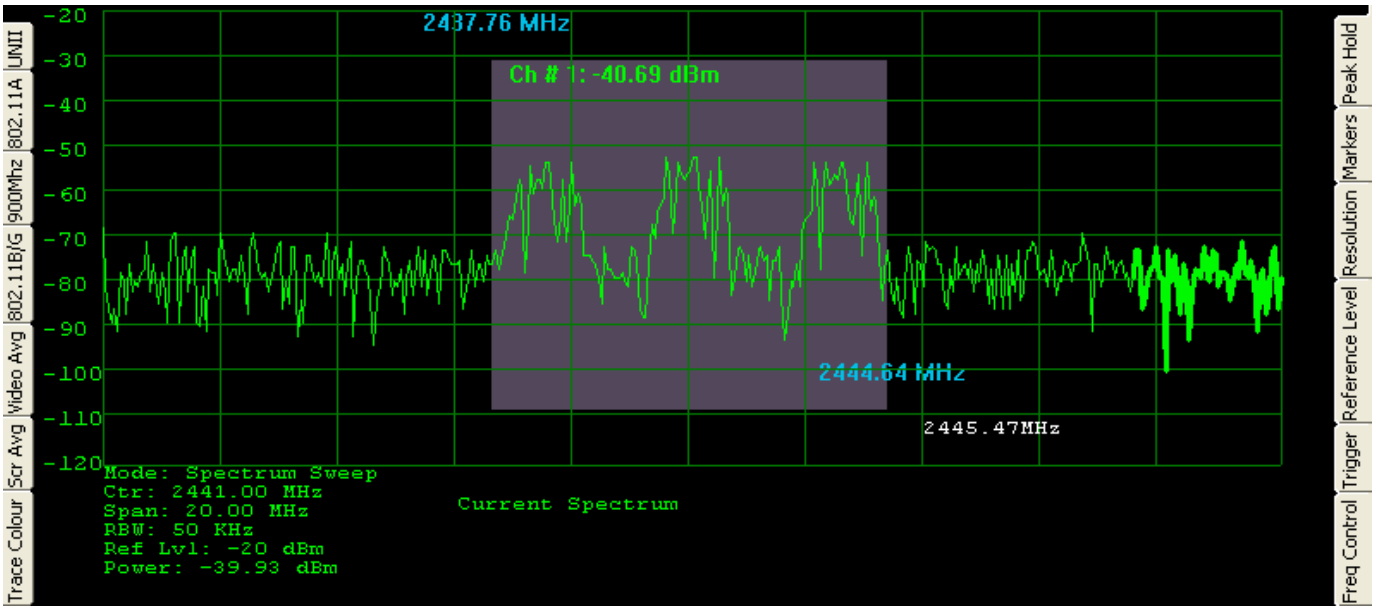


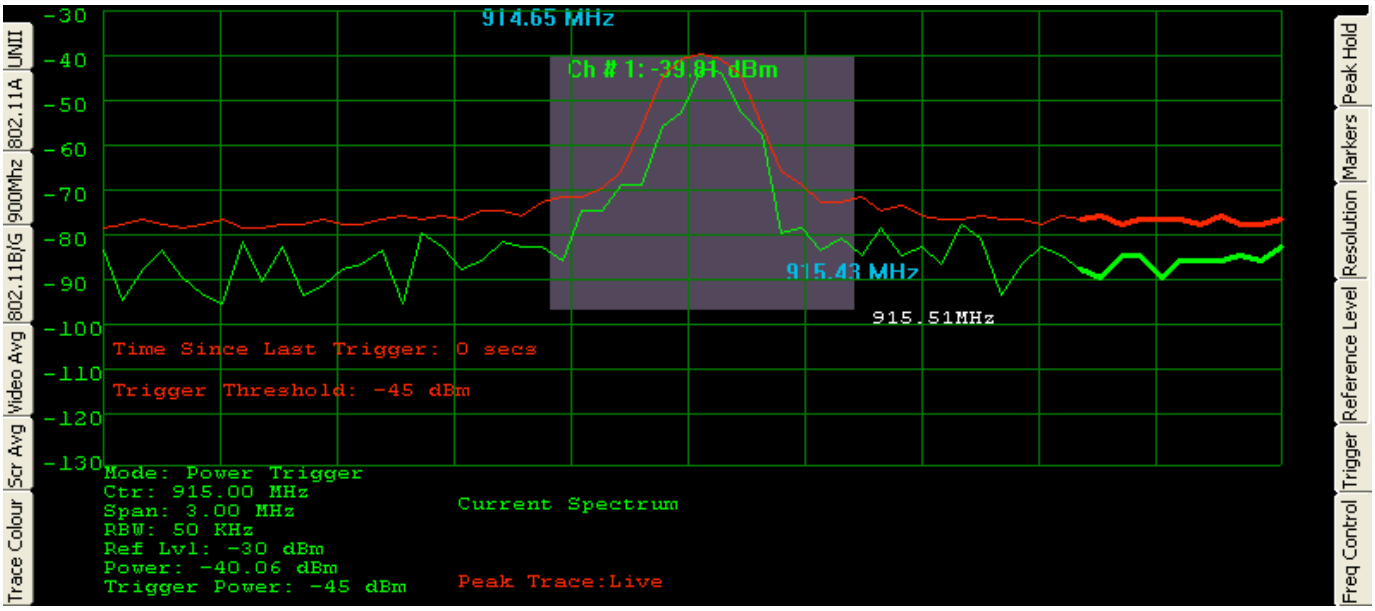
Fig 20.2: power measurement of a 3 channel multicarrier CDMA waveform.

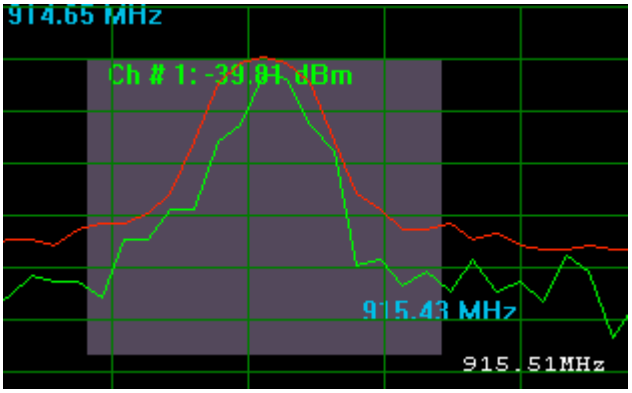
The Figure above shows the power measurement of a 3 channel, multicarrier CDMA waveform. For demonstration purposes, this is simulated using a CDMA signal source within the 2.4GHz frequency band. The signal generated has a total channel power of –40 dBm. The BumbleBee Tablet PC accurately captures and measures this signal power as can be seen below.

Measurement of Power from a GSM Signal in the 900 MHz frequency band.

The BumbleBee Tablet PC software can accurately capture and measure power from a GMSK modulated GSM Signal in the 900 MHz band. A GSM Signal is narrow band signal (~ 200 KHz), the following procedure should be followed to capture and measure GSM Signals:

1. Set the span to a low value: about 2 – 3 MHz.
2. Center the frequency to the frequency of the desired channel.
3. Set the Resolution bandwidth to either 50KHz or 100 KHz.
4. After setting the Reference Level to a desirably suitable value, set the receiver to trigger on a certain power threshold.
5. Turn the Peak trace on. You will then gradually be able to see the spectral envelope of the GSM signal, which alternates between several narrow band signals in the 200 KHz bandwidth.
6. By clicking  , drag the stylus across the Peak GSM Signal. Hold the stylus for a couple of seconds on the screen to be able to set the selected region to Channel 1.
7. The Signal power will then be displayed within the selected region.





4.3 Power Trigger Mode:

The Power Trigger Mode is a useful mode, in which, the receiver triggers only when the channel power exceeds a certain threshold, which is set by the user. If the user has set a value for the measurement delay, the receiver will take measurements only after that delay time. The device will trigger when the detected channel power exceeds the set power threshold. This mode is useful in detecting activity from non-continuous transmission sources such as Beacon packets from an AP or Frequency Hopping Spread Spectrum (FHSS) Packets from a Bluetooth device or any other Narrow band or CW signal.

Important Note: The trigger mode can be set only for a 20 MHz channel.

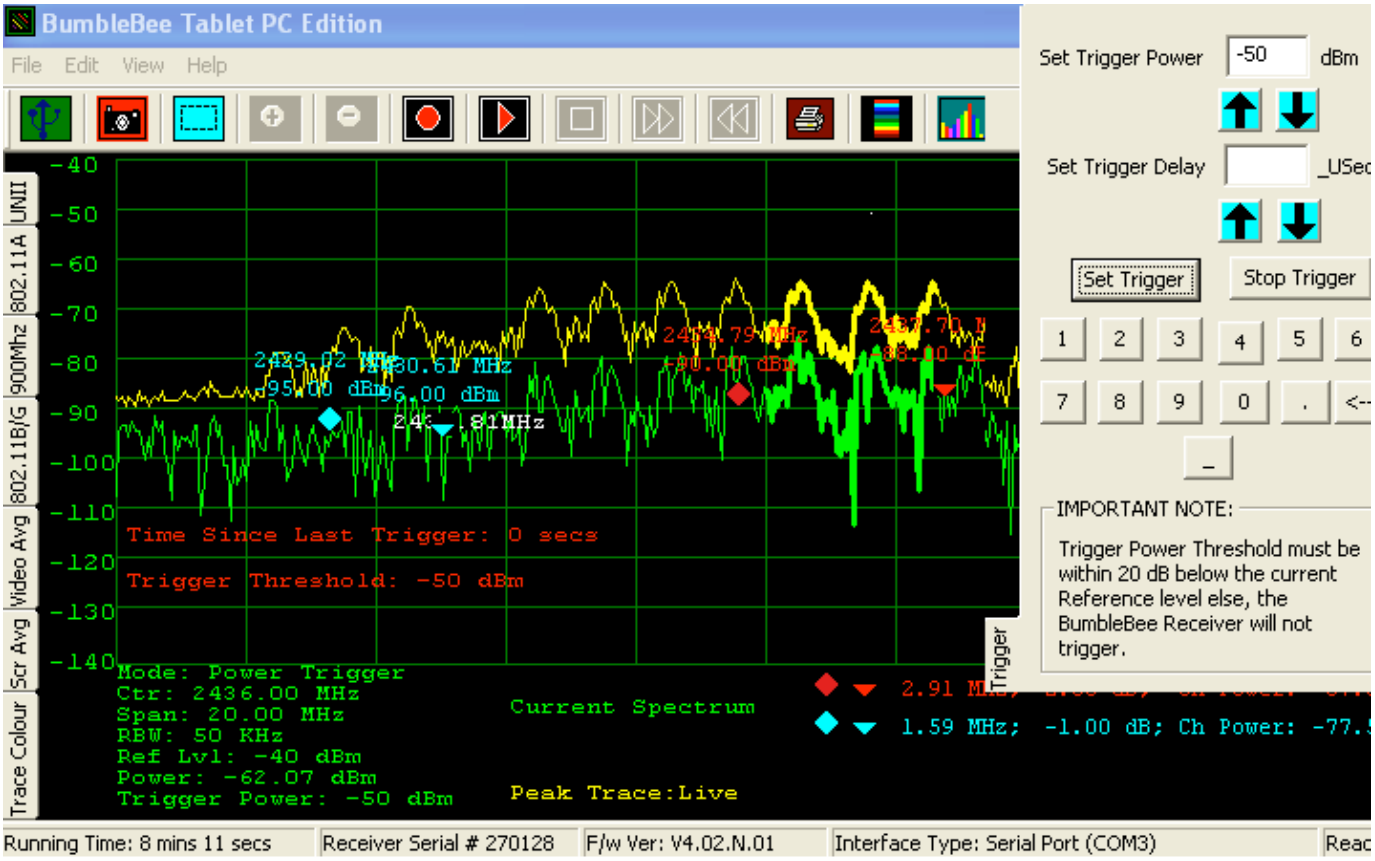


Fig 21: The Power Trigger Mode: A Direct Sequence Spread Spectrum Signal Possibly from an 802.11 B Access Point. The BumbleBee receiver has been set to trigger at –50 dBm with no delay in measurement.

5.1 Recording/Creating a Spectrum Log File for Future Playback:

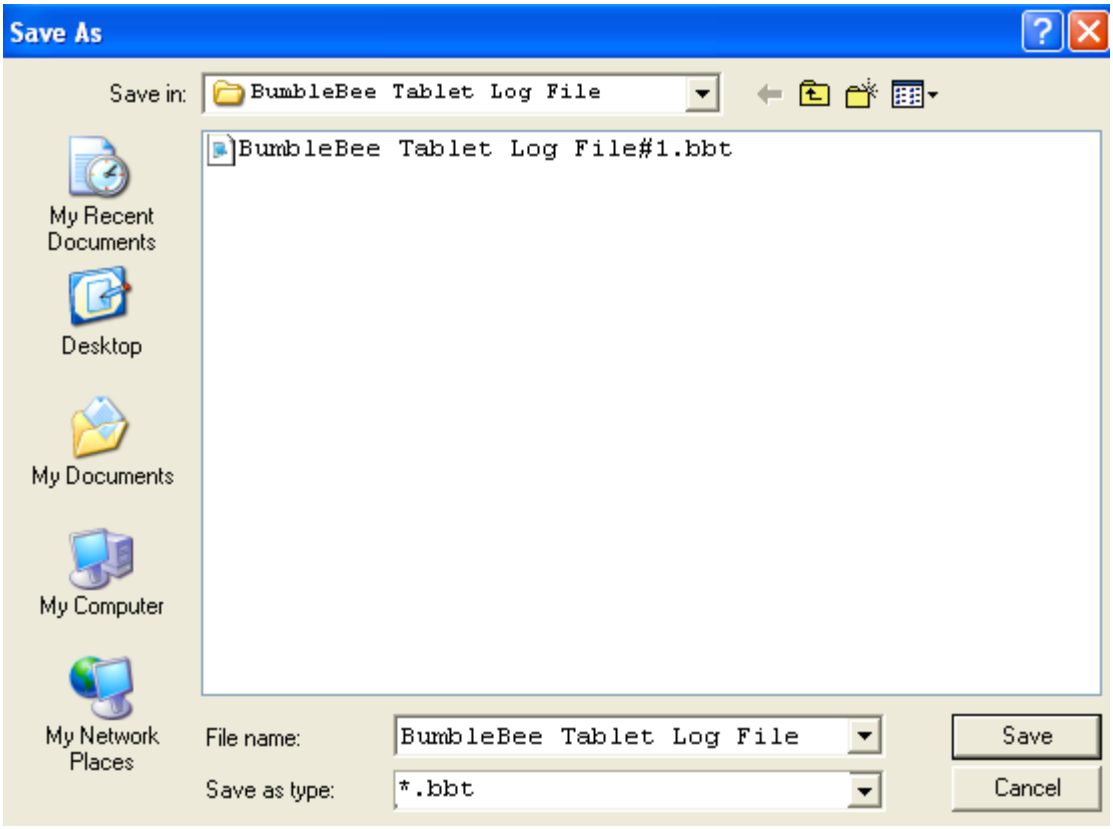
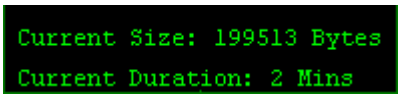


Fig 22: *Creating and Saving a Spectrum Log File.*

Once in the Spectrum Mode or the Trigger Spectrum Mode, the Spectrum being observed on the display can be logged in a Log File for future analysis. This is done by clicking the  **(Record)** button on the toolbar. Save the Log File at a desired location.

NOTE: *The log file will be created and stored with a* ***.spl*** *extension.*

Once logging begins, the Current Log File size (in Bytes) and the Current duration (in Minutes) of the file logged on the Display portion of the Spectrum are shown:



To stop the logging, simply click the  **(Stop)** Button. This does not stop the current spectrum display.

5.2 Replaying the Logged File:

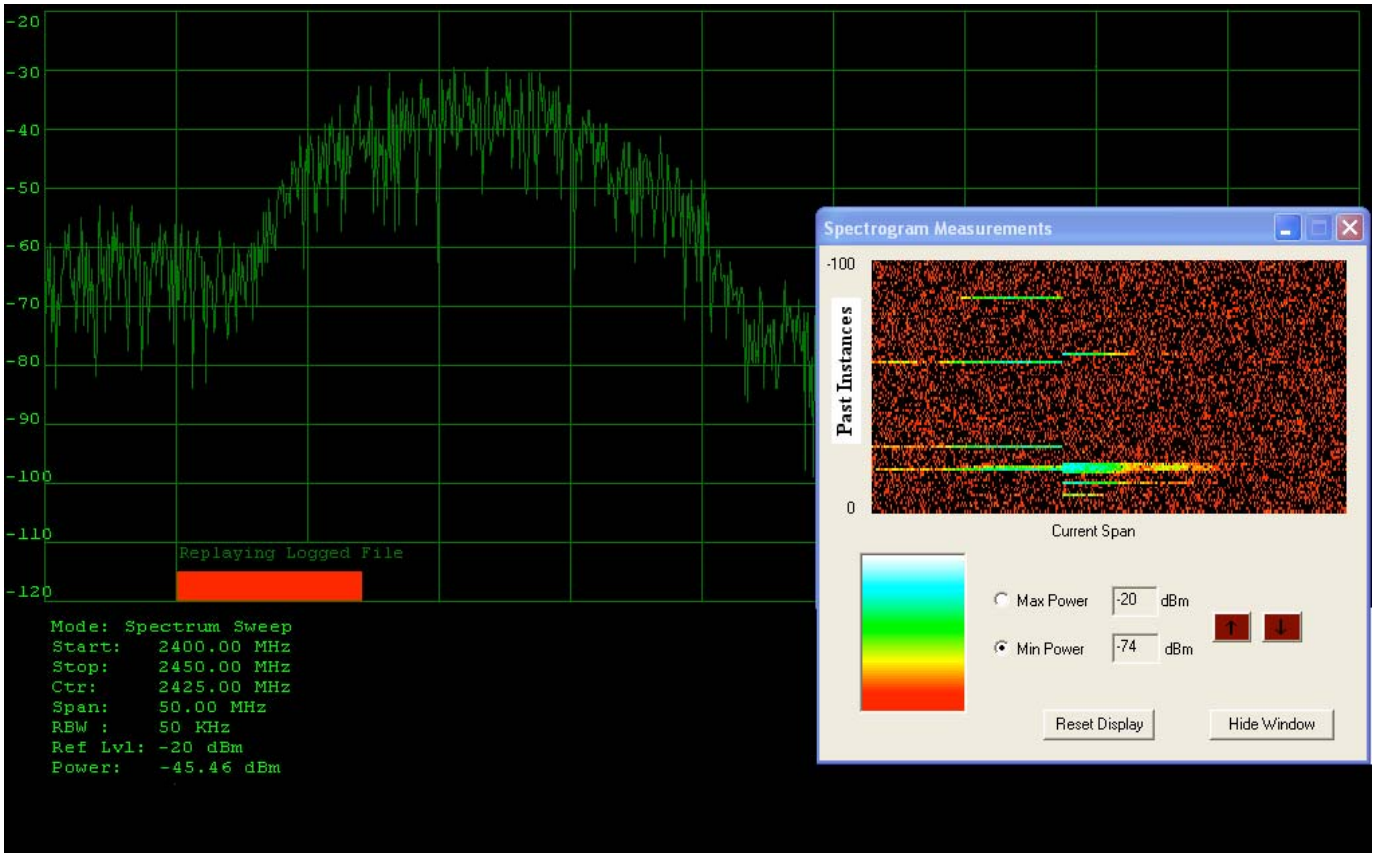
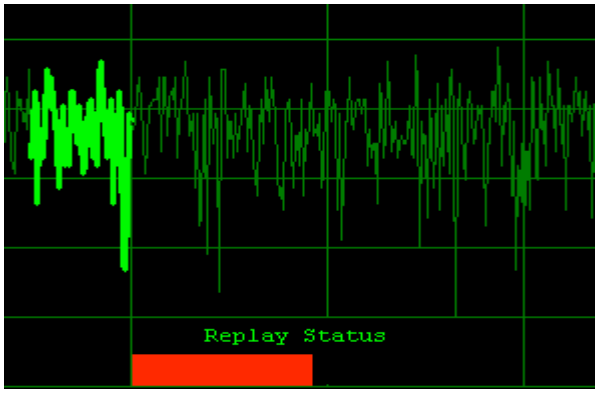


Fig 23: Replaying a previously Logged File.

A previously logged file (with extension **spl)** can be replayed by clicking the  **(playback)** button. The replay begins and the replay progress can be seen as a **red** progress bar on the bottom left of the display as shown in the Fig 3.2 above and the figure below:



Using the  and  buttons, the playback can be "forwarded" or "rewound" respectively at higher speeds, so as to jump to points of interest within the logged spectrum display quicker. To stop the playback, click the  **(Stop)** button.

5.3 User-defined Presets:

A particular spectral context of interest can be saved in a file at the click of the above tool-bar button for future access. This provides for user-defined presets for quck-access in situations when certain spectral settings need to be changed frequently. Upon clicking the Save Context button  the software displays the current spectrum analyzer settings which can be saved in a file:

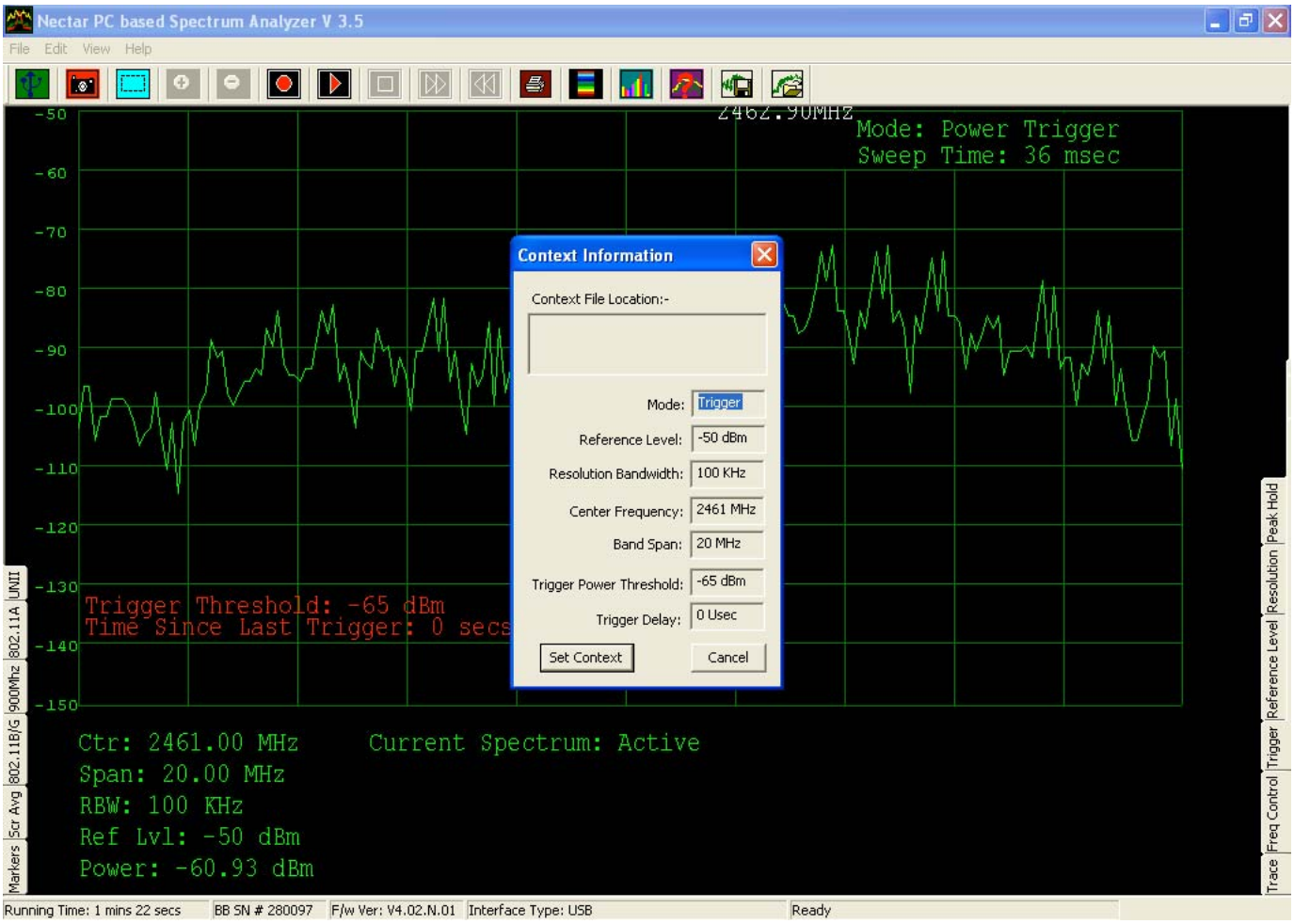


Fig 24: Create a user-defined preset by saving a Spectrum Context to a file.

Upon clicking the “Set Context” button on the settings display dialog, the settings can be saved to a file at a desired location. This saved context file can later be invoked by clicking the  button on the toolbar to set the BumbleBee spectrum analyzer to operate in that context. This way, the user can store frequently visited contexts and later revisit them conveniently without having to change the settings often.

IMPORTANT NOTES

- **In order to eliminate known sources of interference with the BumbleBee Tablet Receiver, please ensure that the Wireless LAN Radio and the Bluetooth transmitter are disabled before using the software.**
- **The Software, along with the Billionton CF Card Drivers are installed on the Tablet at the following location: C:\ProgramFiles\BVS\BumbleBee Tablet Edition.**
- **If there is ever any problem in getting the software to talk to the BumbleBee Receiver, please uninstall and re-install the Billionton CF Card Drivers.**
- **Before replaying of a Previously logged spectrum file begins, if the software is talking to the receiver, the software will terminate the connection to the Receiver through the CF Card. In order to begin active spectrum analysis again, the connection will have to be re-established as discussed in the manual.**
- **When the BumbleBee receiver is being used with Batteries, the software will monitor the battery charge and will terminate the application if the batteries drop low on charge. A notification message will be displayed before the software terminates. This is done to protect the batteries from draining completely.**
- **The CF Card must be securely connected to the cable and the cable must be securely connected to the BumbleBee Receiver through the round connector. Loose cable connection can be a major problem while using the BumbleBee Tablet Software.**
- **Please remove the CF card from the CF Card slot on the BumbleBee Tablet before replacing the batteries on the BumbleBee Receiver.**
- **Use Fully charged batteries in the BumbleBee Receiver and charge the BumbleBee Tablet before running the software for a longer duration of usage. When the batteries in the BumbleBee Receiver fall low on charge and need to be recharged, the BumbleBee Tablet software will shut down after a 30 second warning message.**
- **When using the BumbleBee with an external power supply, ensure that the Green power indicator LED turns on when the power supply is connected.**
- **The default power settings cause the Tablet PC to turn off and hibernate after 15 minutes.**

  For better performance, set the Tablet PC power options to optimize performance. This can be done by: Start Menu>>Control Panel>>Power Options.