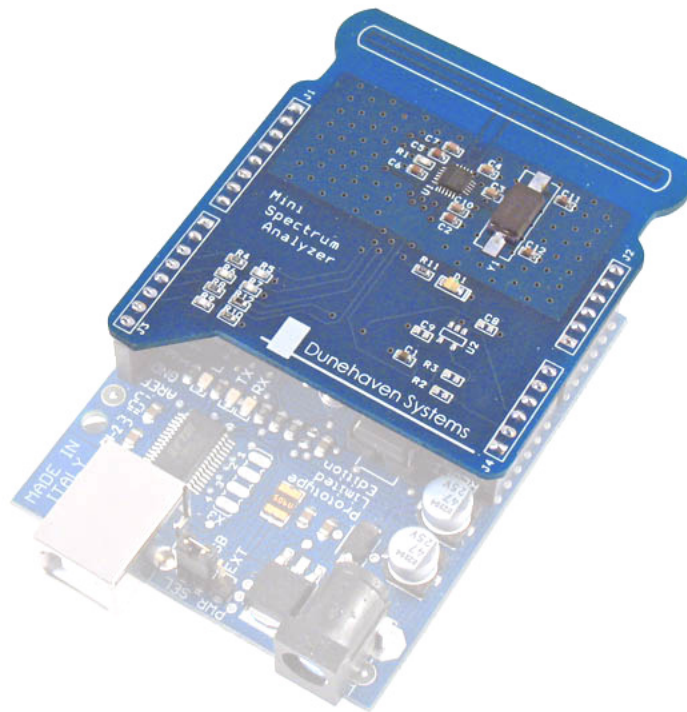


# Mini Spectrum Analyzer

Users Manual



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Thank you for purchasing the Mini Spectrum Analyzer. This device will let you observe radio signals in the 2.4 GHz band. This band is heavily used throughout the world for many types of low power, short distance communications. Examples of this are WiFi (802.11b), Bluetooth, ZigBee, Wireless USB and cordless phones. In addition, police radar and microwave ovens use this frequency band. Your spectrum analyzer will not allow you to “listen in” to any of these communications, but it will let you see the transmissions, understand what frequencies they are at, understand how strong the signals are and see how those signals relate to other signals. Although your spectrum analyzer is not a calibrated piece of test equipment (such units cost much, much more!), it can be extremely useful for many tasks that were previously done with much bigger and more expensive equipment.

The Mini Spectrum Analyzer comes in two parts. The RF (radio frequency) portion is a small circuit board with a special radio communications chip on it. This board plugs into another board, called Arduino. Arduino has a microprocessor chip that controls the radio. It also has a USB port for communicating with a PC running Windows. If you have not already bought an Arduino, one can be purchased from one of the sellers at <http://www.arduino.cc/en/Main/Buy>. Be sure to get the version called “Arduino Diecimila” or “Arduino Duemilanove”.

## Installing the Arduino Software

The Arduino board was designed for electronics hobbyists as an inexpensive platform for developing small projects requiring a microprocessor. To use it, you must download the software for running it. Don’t worry – you won’t need to know anything about developing software to use the spectrum analyzer. The software installation has three parts: the Arduino USB driver, the Arduino firmware and the Windows software.

## Installing the Arduino USB Drivers

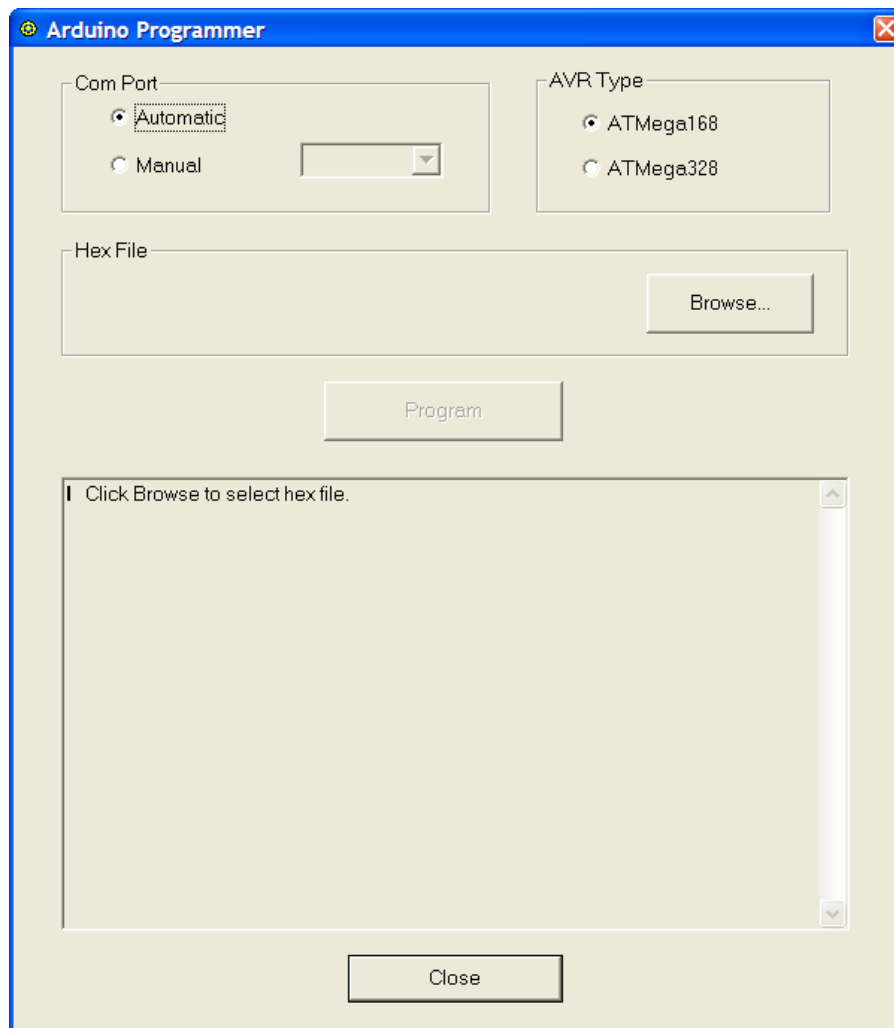
- To set up your Arduino board, follow the instructions at:  
<http://www.arduino.cc/en/Guide/Windows>

Follow steps 1 through 4, including installing the USB driver.

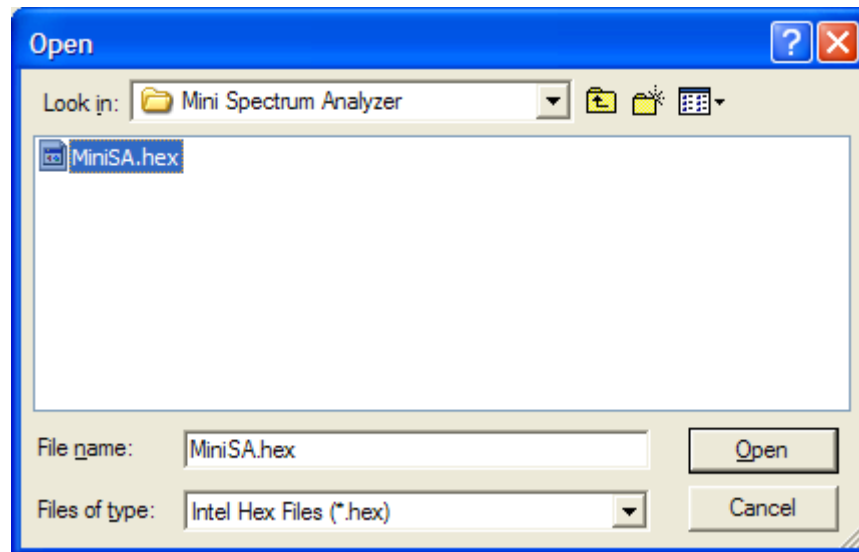
The Arduino package on that site is rather large, so you may follow the link to get just the FDTI driver if you prefer.

## Installing the Arduino Firmware and MiniSA Windows Software

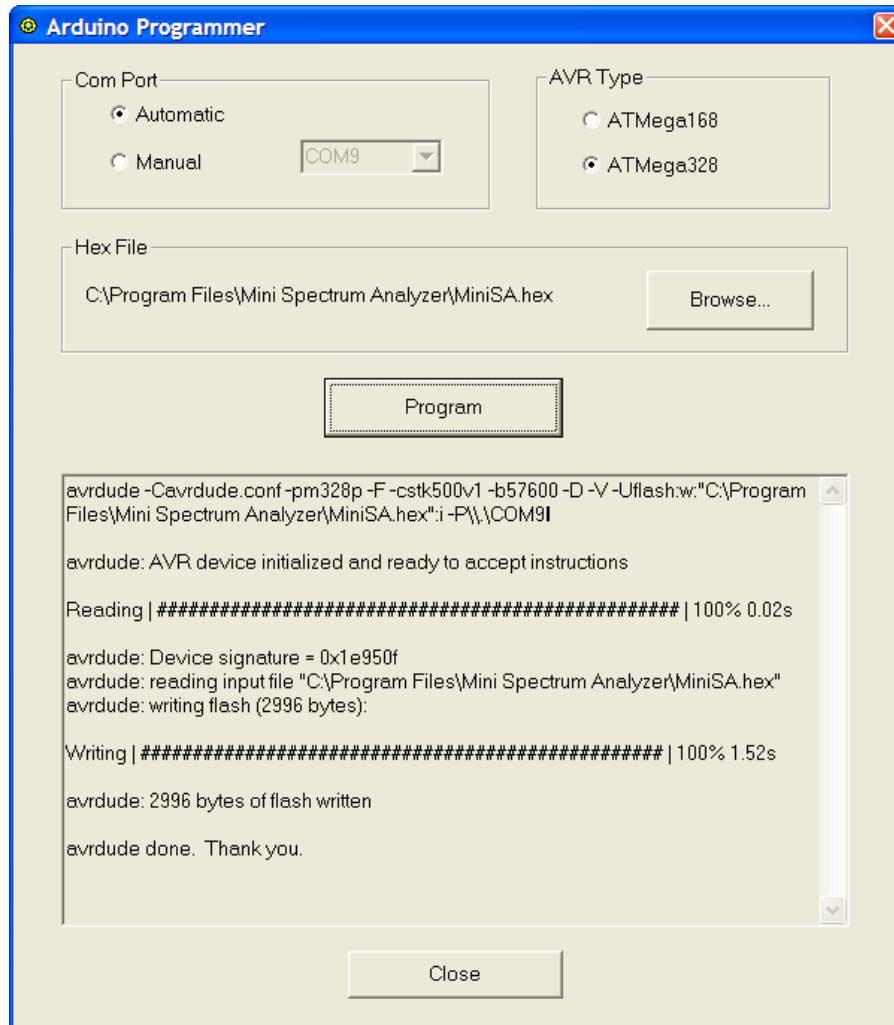
- Download the MiniSA software package from [http://www.dunehaven.com/minisa\\_DL.htm](http://www.dunehaven.com/minisa_DL.htm)
- Plug the Arduino board into your PC's USB port. Windows should recognize the board and tell you that your hardware has been installed and is ready for use. Run the "minisa setup.exe" file that you just downloaded. This will install the MiniSA software as well as software to program the Arduino with the spectrum analyzer firmware.
- Run the Arduino Programmer software. This will be run by default after running the setup file or you can run it by selecting "Arduino Programmer" from the "Mini Spectrum Analyzer" group added to your Start/Programs menu during installation.
- The Arduino Programmer window will appear. It looks like this:



- Normally, the program automatically locates the com port associated with the Arduino. In rare situations, that does not work and the com port can be selected manually. Leave the “Automatic” com port button selected unless you have problems.
- Before programming the Arduino, you must inform the software what kind of AVR part your Arduino has. For Arduino Diecimila, choose “ATMega168”. For Arduino Duemilanove, look at your Arduino board. The processor will be labeled either ATMega168 or ATMega328.
- Next, click “Browse...” and choose the MiniSA.hex file located in the installation directory. Click Open.



- Click Program on the Arduino Programmer window. The software will place the spectrum analyzer software into the Arduino’s flash memory. The programming process takes about 10 seconds. When complete, the window will look as shown below.

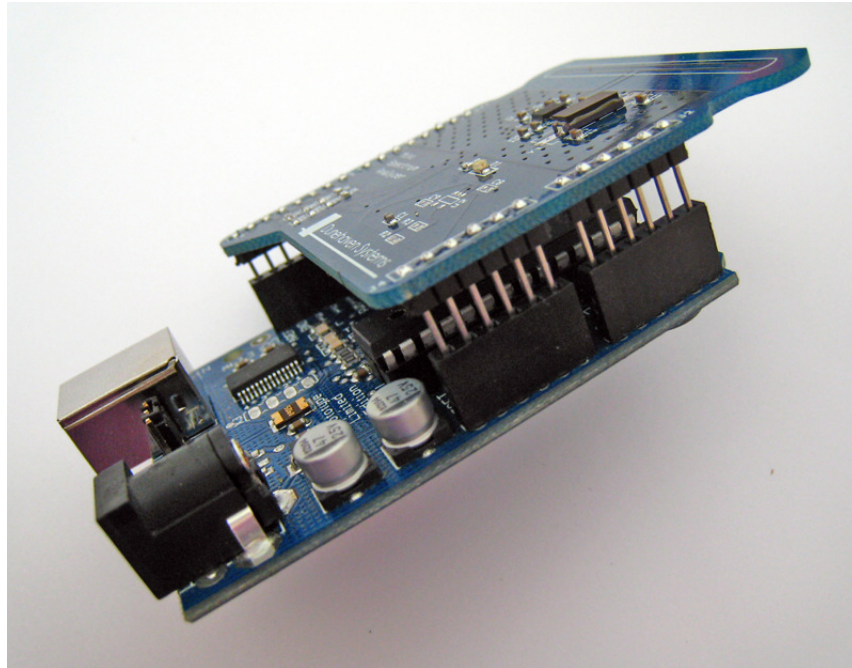


- The software installation is complete. Close the Arduino Programmer window.

## Installing the spectrum analyzer board

Unplug the Arduino from the USB cable.

Plug the spectrum analyzer board into the Arduino board by lining up the pins on the connectors as shown below and pressing the boards together. Note that there are more pins on one side than the other.

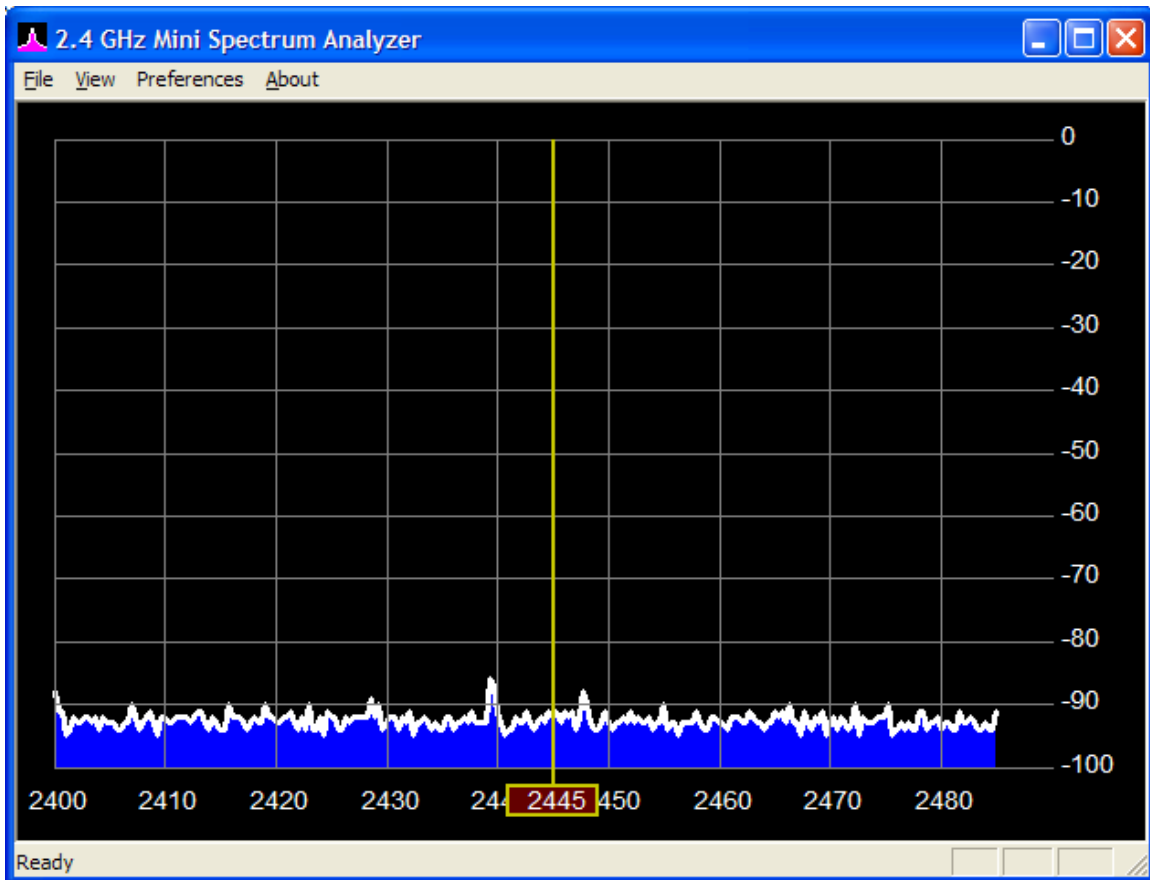


Plug the USB cable back into the Arduino. Your spectrum analyzer is now ready to use.

## Using the MiniSA software

You start the MiniSA Windows software by selecting “Mini Spectrum Analyzer” under the Start/Programs menu.

When you first run MiniSA, you should see a window like the one below.



What you are seeing is a live image of the 2.4 GHz environment around your spectrum analyzer. Along the bottom of the screen are the frequencies (in MHz). Along the right edge are amplitudes in dBm. The dBm numbers are negative, meaning the values higher up on the screen represent stronger signals. The window can be resized as needed.

Experiment by placing the spectrum analyzer near working 2.4 GHz systems, such as cordless phones or Wi-Fi routers. You will see either steady peaks in the spectrum or peaks that momentarily appear and disappear. The antenna is built into the circuit board inside the white rectangle at the end of the board. The antenna is somewhat directional so you can enhance desired signals and reject others by turning the board in different orientations.

## Peak Hold

Many transmissions in this band are pulsed communications, so from one sweep of the band to the next, the signal may appear or it might have stopped transmitting at the instant that a particular frequency is being monitored. It is often useful to have the spectrum analyzer remember where the peaks were from previous sweeps, so that a more complete picture of the spectrum can be seen. The MiniSA software has the ability to do this – just select Peak Hold from the View menu. This makes the white line for the spectrum take on the value of the highest peak that was seen at each frequency. Select the Peak Hold menu item again to turn it off.

A convenient keyboard shortcut for switching the Peak Hold function on and off is to press the Space key.

## Center Frequency and Span (Scroll and Zoom)

Rather than looking at the entire spectrum, you may be interested only in a portion of the entire 2.4 GHz band. To zoom into the spectrum, move the mouse pointer down below the bottom horizontal line (where the frequency numbers appear). The cursor will change to a left/right arrow. By clicking the left mouse button and dragging left and right, you can zoom in and zoom out on the waveform.

When you are zoomed in, you will not be able to see the entire spectrum. To move the graph up or down in frequency, move the mouse pointer up above the bottom of the graph. The cursor will change to a hand. By left-clicking and dragging the mouse, you can scroll the graph left and right.

## Zero-Span Mode

There is a special situation when zoomed in to the maximum level. The spectrum analyzer switches to a faster mode where it only acquires a single frequency and it plots this level as a straight horizontal line. This mode can be useful when observing signal strength changes of a signal that is known to be only at a single frequency.

## Freeze

To temporarily stop the spectrum analyzer, select the Freeze item from the View menu. Select it again to resume.

A convenient keyboard shortcut for switching the Freeze function on and off is to press the ‘.’ (Period) key.

## Export

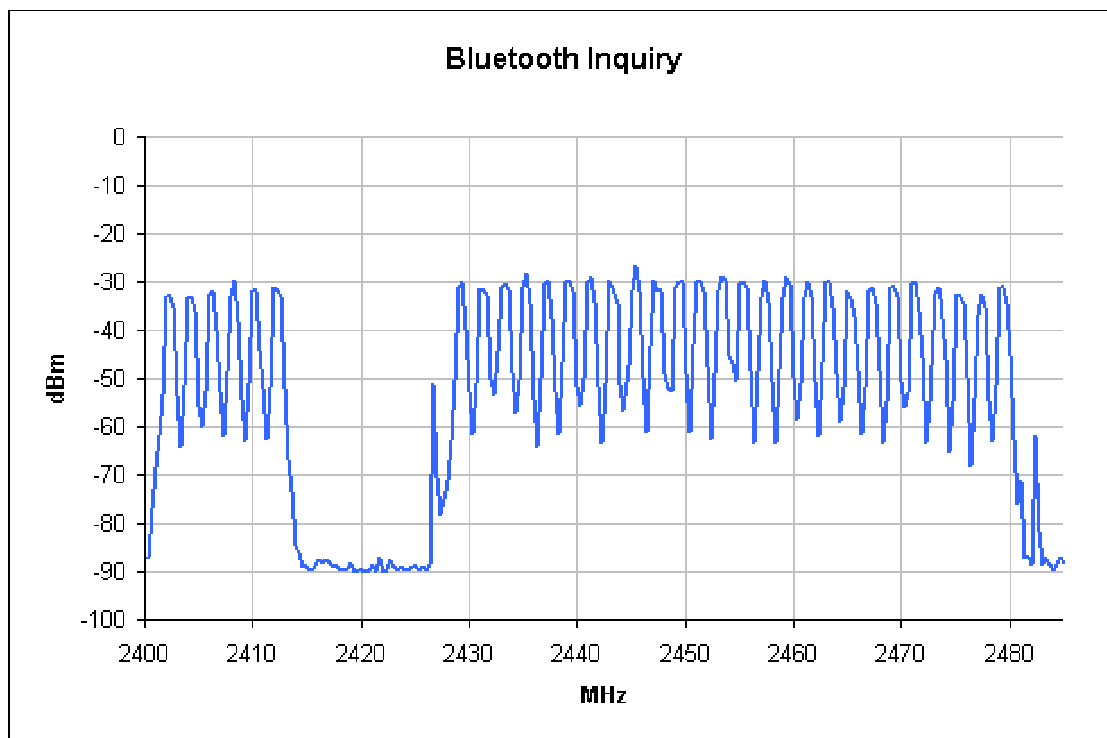
MiniSA has the ability to export the spectrum of a signal to a file for use with spreadsheet software. To do this, select Export from the File menu. Often, selecting Freeze first will give you more control over exactly what spectrum will be saved.

The file will be saved as a CSV (comma separated value) file, which programs like Excel can import. The beginning of the file looks like this as seen in a text editor:

```
2400,-92,-91
2400.33,-93,-90
2400.66,-93,-90
2400.99,-95,-91
2401.33,-91,-91
...
```

Each line is a series of three values: frequency, current spectrum and peak hold spectrum (if Peak Hold is turned on).

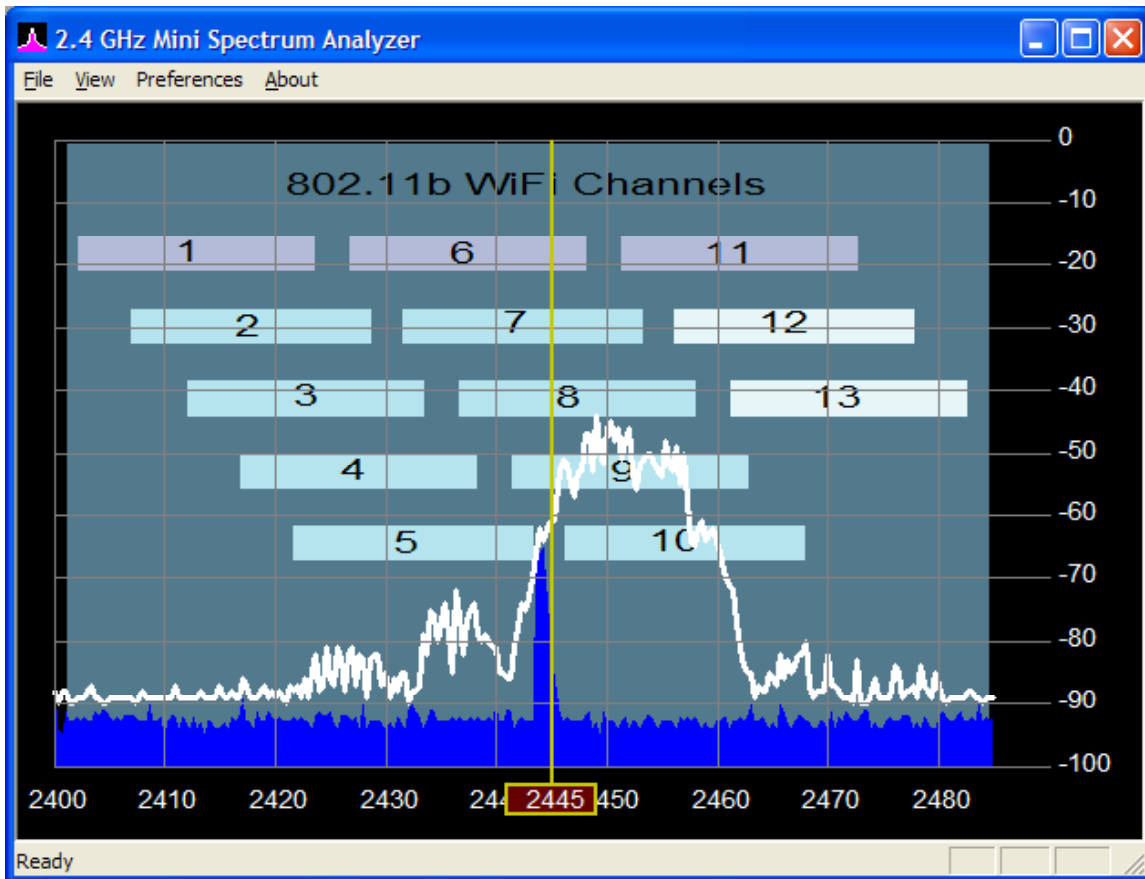
This type of file can be formatted to create charts or reports such as the one below (made in Excel):



## Templates

Spectrum analyzers are often used to examine signals of a particular type, such as WiFi signals. It can be helpful to annotate the signals with information about that type of signal, such as the frequency ranges of each of the WiFi channels. To assist with this, MiniSA has the ability to load in template files. These are graphic files that are drawn behind the spectrum waveform.

To use a template, select Open Template... from the File menu. Open the desired template file. The image of the file will be placed behind the spectrum graph. An example of an 802.11b access point on channel 9 using the included "WiFi Channels" template is shown below.



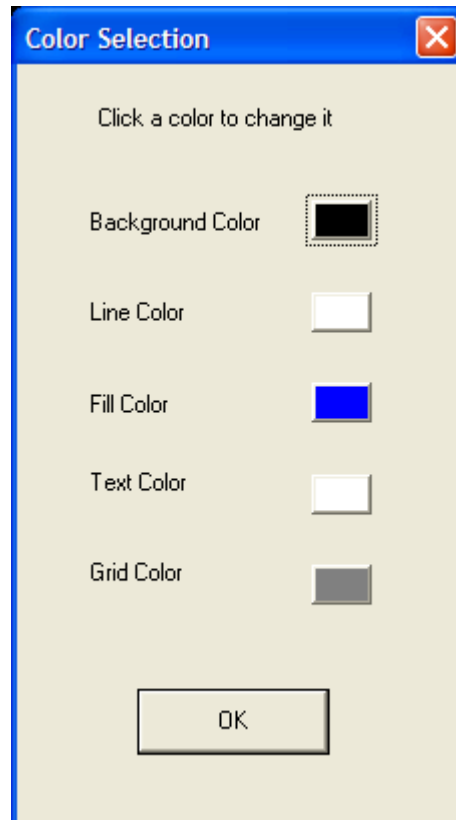
Templates will scroll and zoom with the waveform, so they always maintain the proper position with regard to the spectrum waveform.

Template files are .EMF (Enhanced MetaFile) format graphics files. These are vector-based files that can be stretched to any size with no loss of resolution. Template files can be made with any program capable of creating .EMF files, such as Adobe Illustrator. The left side of the image represents 2400 MHz and the right side corresponds to 2485 MHz.

The image will be stretched or shrunk to fit. For best results, avoid complex bitmap graphic images – they will slow down the screen update rate.

## Graph Colors

The default colors on the graph can be changed if desired. Select the “Colors...” item under the Preferences menu. A dialog box like the one below will appear.



For each element on the graph (background, text, etc.), a colored button shows the current color of that element. Click the colored button to bring up a color selection window. Select the desired new color and click OK. After choosing all the new colors, close the dialog box and the new choices will be seen on the graph. The color selections you make are saved for use next time you run the MiniSA software.

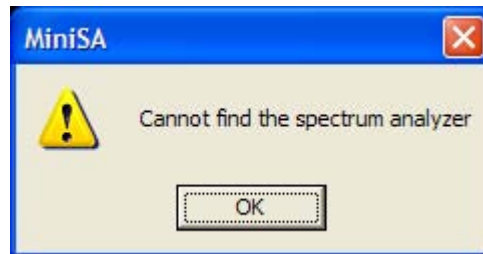
## Level Detector

The Mini Spectrum Analyzer board has a green indicator light that can be configured to turn on when the signal reaches a certain level. The level is set using the dialog box that opens when “Level Detector...” is selected from the Preferences menu. After entering

the desired level and clicking OK, the light will turn on whenever any part of the spectrum exceeds that level.

## Arduino Com Port

Arduino's USB port appears to be a serial port (Com Port) to Windows. The MiniSA software will try to figure out which com port Windows has assigned to it and will talk to the Arduino board on that com port automatically. In rare cases, this may not work on some PC's. If you get a message like this:



, select "Configure Com Port" from the Preferences menu and try a different com port from the list.

## Specifications

Frequency range	2.400 GHz to 2.485 GHz
Resolution	333 KHz
Sensitivity	Approximately -90 dBm
Tuning method	Swept tuned
Sweep speed	Approximately 6 sweeps/second
Antenna	Built-in folded dipole

## Limited Warranty

The Mini Spectrum Analyzer system is warranted to be free from defects in materials and workmanship for a period of one year from the date of purchase. This limited warranty covers normal use and does not cover abuse or use not in accordance with this manual.

Under no circumstance will the seller be responsible for any incidental or consequential damages, which may occur during the use of the product, or as a result of the product's failure to perform. In all cases, the customer's sole remedy for a product failure is limited to the repair or replacement of the product.