



# **SDR-14 User's Guide** Version 1.2

Software Defined Receiver & Spectrum Analyzer

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Software Defined Receiver & Spectrum Analyzer



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## PACKAGE CONTENTS

- RFSPACE SDR-14 Software Defined Receiver and Spectrum Analyzer.
- USB Cable
- 12 Vdc Adapter
- USB Driver and SpectraVue Program CD
- User's Guide

## 1. GETTING STARTED WITH THE SDR-14

Here is a list of instructions to get started using the SDR-14 and SpectraVue software. Before connecting the SDR-14, please install the software.

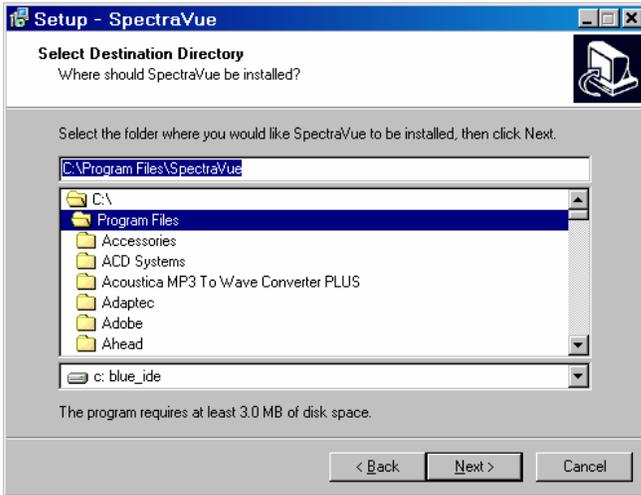
1. Run SETUP.EXE from the installation CD.



Continue by clicking NEXT.

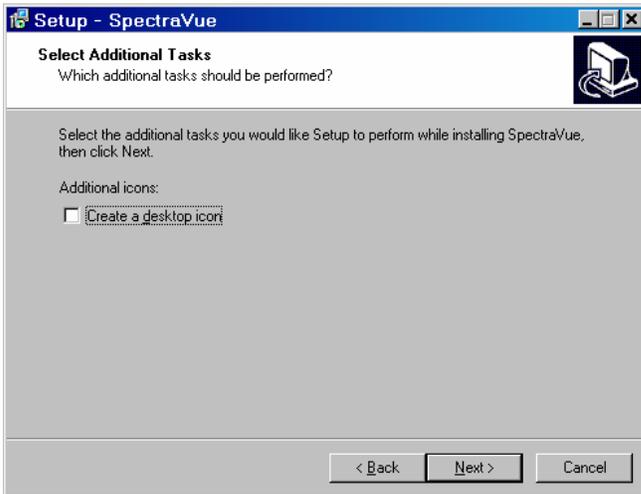


Continue by accepting the license agreement and clicking NEXT.



Select the installation directory and click NEXT.

Select the startup folder location and click NEXT.



If you would like a desktop icon, select "Create a desktop icon" and click NEXT.

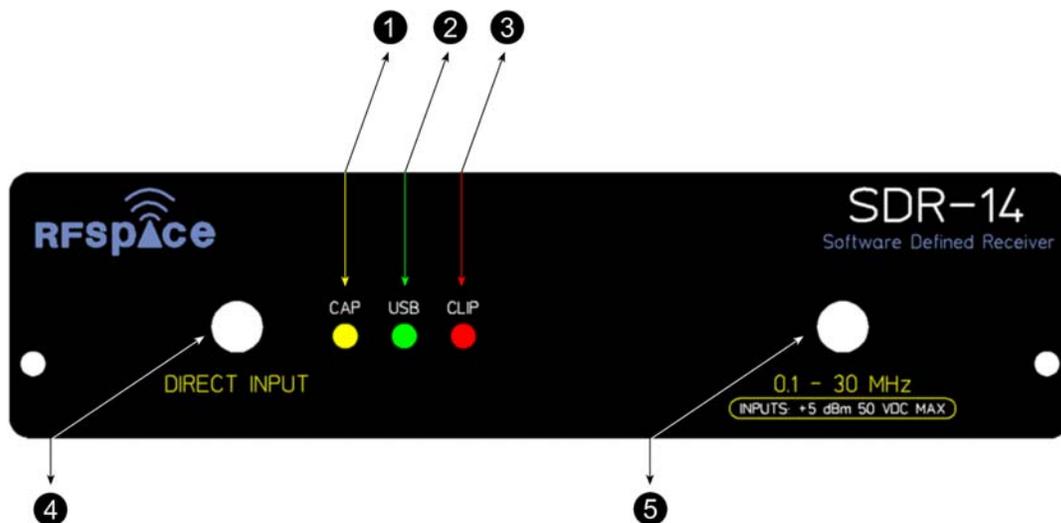
Click on Install and then on Finish.

At this point, SpectraVue should be installed on your directory of choice.

2. Connect the SDR-14 to the power supply and USB connector.
3. Windows will detect the SDR-14 unit and will request the driver. Please point the window to the location where the SDR-14 USB DRIVER is located (/Program Files/SpectraVue/USB Driver/). If Windows complains about now having passed "Windows Logo Testing" don't worry. We don't use the Windows logo.



4. RUN SpectraVue.exe.
5. If all the previous steps are ok, the program should now say "Idle" in the lower right hand window. This is an indication that the SDR-14 has been detected and is now in idle mode. Some computers require the SDR-14 to be disconnected and reconnected once after the initial installation of the driver. The GREEN USB light should now be lit.
6. The lower right hand window will always show the status of the SDR-14. It sometimes read "Loading 6620" This means that the filter settings have changed and the new settings are being sent to the receiver.
7. Hardware features:



**SDR-14 FRONT PANEL**

**(1) YELLOW CAPTURE LIGHT**

Lit when the SDR-14 is capturing RF data and converting it to digital. (blinks in non real-time capture modes other than 50,100 and 150 KHz)

**(2) GREEN USB LIGHT**

Lit when idle and blinks when data is flowing from the SDR-14 to the PC.

**(3) RED CLIP LIGHT**

Lit when the composite RF power into the ADC exceeds the full scale. (It is normal for this light to blink with extreme signal peaks and some atmospheric pulses. It is recommended to use the built-in attenuators to prevent this from happening to often. This is an indication of an overdrive condition.)

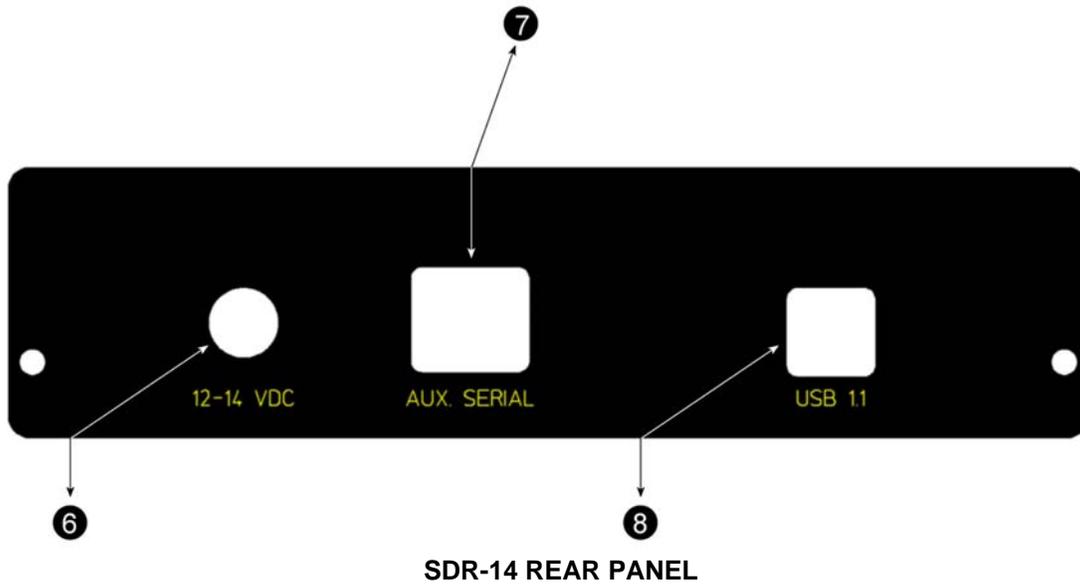
**(4) DIRECT INPUT SMA**

This input is called the Direct Input Port in the Software. It is a direct input into the ADC. In order to use this port, you need to filter and amplify the desired frequencies. The clock frequency (66.666 MHz) has been selected to allow sampling of the 50 MHz, 144 MHz, and 224 bands.

**(5) 0.1 - 30 MHz SMA**

This port is the HF input port. It contains a 10, 20, and 30 dB Attenuator (software controlled) and a built-in preamp.





**(6) 12-14 VDC CONNECTOR**

Use 15 Volts maximum into this port. The voltage can go down to 10 volts.

**(7) AUX. SERIAL**

This port is used for future frequency translators and other peripherals. This is not an RJ45 Ethernet port. There is 12 volts on this connector so don't connect a phone or PC to this port.

**(8) USB 1.1**

Used to connect the SDR-14 to the PC.

The SDR-14 draws over 500mA at 13.8 Volts. It is normal for the unit to get a little warm as it dissipates the heat. Please unplug when not in use.

**A GOOD STARTING POINT FOR THE SOFTWARE**

There are two versions of the Help files here:  
<http://www.moetronix.com/files/spectravue.chm>  
<http://www.moetronix.com/files/spectravue120.pdf>

**GOOD STARTING POINT:**

MAIN SCREEN-  
 FFT Ave = 2 to 4  
 Smoothing = 0  
 FFT Size = 4096 or 8192  
 V Scale = 5 or 10 dB  
 Center Frequency = 14.200

SDR-14 Setup-  
 DEMOD Ok 100KHz  
 30 MHz (6620 Off Real Mode) NOT SELECTED  
 RF Input Source = 0-30 MHz  
 RF Gain = 0 or -10 dB  
 6620 IF Gain = +12 dB  
 NCO DITHERS = CHECKED



SpectraVue is VERY graphics and CPU intensive. If the hardware is not fast enough, set the Slow CPU mode located in the FFT setup menu to N=2. For fastest update, N=0.

## 2. UNINSTALLING THE SOFTWARE

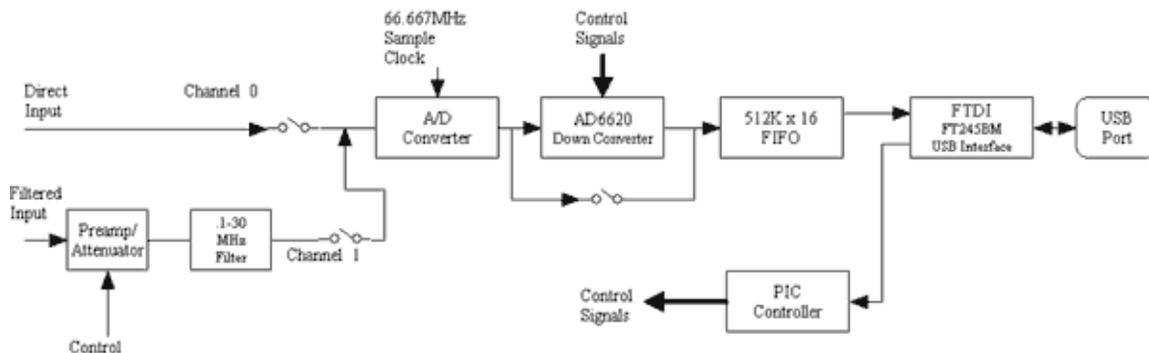
Should you need to uninstall the SDR-14 USB driver for any reason, you must:

- Run the FTDIUNIN.EXE file in the USB DRIVER Directory.
- You may also remove the software by using the Add/Remove Program in the Control Panel.

## 3. FAQ'S

### → What exactly is the SDR-14?

The SDR-14 hardware is primarily a signal capturing device. It samples the input data at a fixed 66.67MHz rate with a 14bit A/D converter. This sampled data can be sent directly to the PC or it can be converted to a complex baseband signal and downsampled to lower sample rates before being sent to the PC. The SDR-14 uses a USB 1.1 link back to the PC and can handle up to about 635Kbytes/sec continuous data rates. This means that the SDR-14 can support real time signal capture of up to about 160 KHz wide spectrum. The SDR-14 uses an NCO (Numerically Controlled Oscillator) that is user controlled from 1 to 33MHz in 1Hz steps to convert a frequency band to a complex baseband signal. For example, setting the NCO to 15.0MHz will shift the signals centered at 15MHz into zero complex frequency samples that are then sent back to the PC as I/Q data.



For sample rates faster than the USB can support, a memory buffer will store up to 262144 samples at up to 66Msamples/sec and then the SDR-14 will send the buffer at the slower USB rates back to the PC. This allows large FFT processing to be done on a block of contiguous sampled data at the full A/D sample rate. Demodulation is not possible since the blocks of data are not continuous.

The SDR-14 does not do any other signal processing except for the complex baseband conversion and downsampling. Any spectral analysis or demodulation must be done in software by the PC. In other words, there is no digital signal processor in the SDR-14 available for demodulation, FFT's, or other custom processing. It is merely a sampling and down conversion/down sampling device.

The SDR-14 has 2 inputs. One is a direct input to the A/D for custom applications. The other input has a preamp and 30MHz antialiasing filter so that the input can be used for measuring/receiving signals from 0 to 30MHz without external filtering.



## → What is unique about the SDR-14?

The SDR-14 is unique in that it can sample and buffer data at a high sample rates before sending it back to the PC. The digital down conversion provides a complex baseband signal that can be easily processed by the PC. The USB port provides a high speed connection back to the PC allowing demodulation or continuous processing of signals in up to about 160KHz of bandwidth. This all with relatively low cost hardware. The interface to the SDR-14 is also open so 3rd party developers can write their own custom application software.

Typical Panoramic adapters have fairly high bandwidth resolutions on the order of 2Khz or so. They cannot distinguish narrow signals while with the SDR-14 and a decent sized FFT, 1 Hz resolution is possible and just about any signal can be isolated.

## → What kinds of things can I do with an SDR-14?

The primary application of the SDR-14 is for spectral analysis of signals. Once the data is in digital samples, very accurate measurements/analysis can be performed on it.

- Wide band weak signal measurement such as in radio astronomy
- Antenna noise measurements
- Oscillator/transmitter hase noise measurements
- General monitoring of signals in up to 30MHz wide bandwidths
- Accurate frequency measurement (after calibrating the SDR-14)
- Amateur radio monitoring. The wide band view of signals is ideal for being able to see what is going on during a contest or for just looking for activity
- SWL monitoring. Again the wide band view of the spectrum "world" adds another dimension to listening

A secondary application of the SDR-14 is as a general coverage receiver. It can perform as a respectable receiver but since it has a "wide open" 30MHz wide front end, it can be overloaded by any strong signals within the 30MHz band. The SDR-14 has built in attenuators that can be controlled from the PC to help. Any demodulation functions must be done by the host PC since the SDR-14 does not have any DSP functionality to perform demodulation.

## → Can I write my own application software?

The SDR-14 USB interface is fully open and specified for use by 3rd party developers. Although the SpectraVue program is provided for general use, it is hoped that many custom applications will be written as the unit becomes available.

To make it easier for 3rd party developers to use the SDR-14, an [ActiveX](#) component is being developed that will make the interface to the SDR-14 a lot easier. It will wrap all the low level USB I/O into some easy to use interfaces as well as provide the data after being processed by an FFT.

This [ActiveX](#) control and an example C++ application using it will all be provided open source as a useable control or just as an example of how to interface to the SDR-14 USB port and do FFTs etc.

## → Will the SDR-14 be offered as a kit?

No. The SDR-14 has fine pitch surface mount components on both sides of the board. Although there are some who could probably assemble it by hand, the logistics of providing a parts kit, detailed instructions, and dealing with customers who bent or broke the pins on a



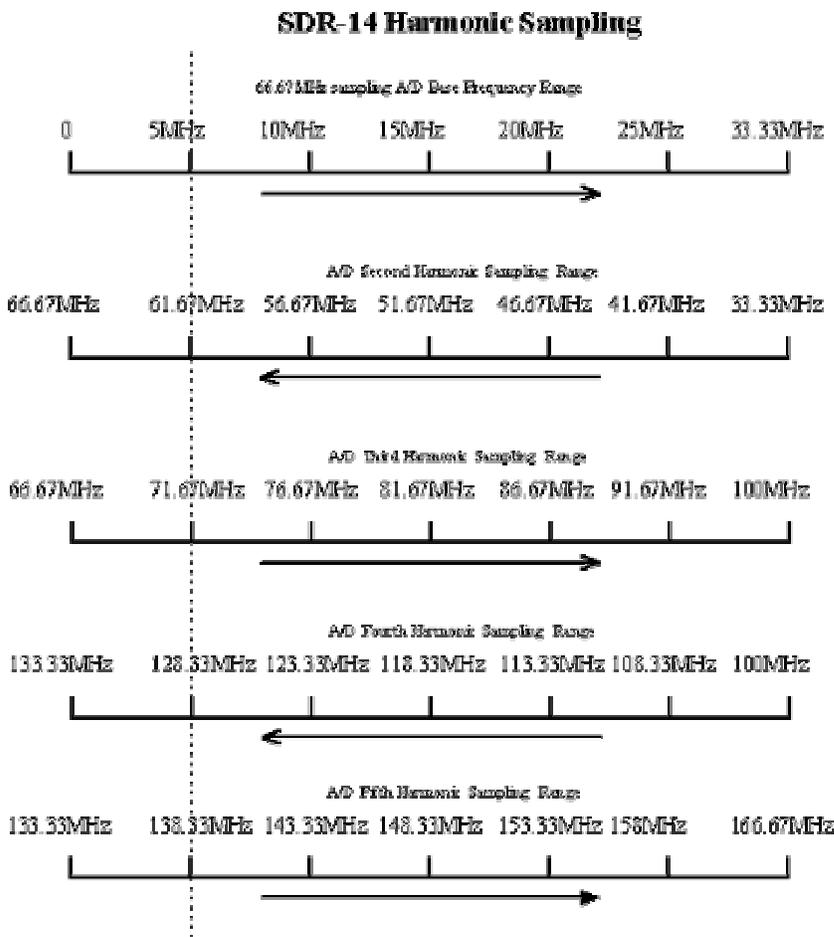
\$100 chip are just too much to deal with. We would end up having to charge more for a kit than an assembled unit.

→ **How does the SDR-14 analyze signals greater than its Nyquist rate??**

The Nyquist theorem says you cannot sample a signal whose *Bandwidth* is greater than  $F_s/2$  not the highest signal frequency. So as long as the bandwidth of the input signal is limited to one-half the sample rate you are ok. Thus the SDR-14 can sample signals beyond its 33.33MHz  $F_s/2$  sample rate using this technique called Harmonic Sampling.

There are physical limitations to the hardware that limit the practical highest frequency around 300MHz. Also as shown in the figure below, every other harmonic band folds back on itself causing the frequency spectrum to be inverted.

In order to use the SDR-14's Direct input, one MUST supply a suitable bandpass filter to limit the input bandwidth to the desired Harmonic sampling band. As can be seen, without a filter on the direct input, a 5MHz, a 61.67MHz, a 71.67MHz, a 128.33MHz, and a 138.33 Mhz signal would be received on top of one another without any filtering.



## 4. CONTACT US

For questions please email [INFO@RFSPACE.COM](mailto:INFO@RFSPACE.COM)

## 5. LIMITED WARRANTY

RFSPACE's warranty obligations are limited to the terms set forth below: RFSPACE, Inc. ("RFSPACE") warrants this hardware product against defects in materials and workmanship for a period of ONE (1) YEAR from the date of original retail purchase. If a defect exists, at its option RFSPACE will (1) repair the product at no charge, using new or refurbished replacement parts, (2) exchange the product with a product that is new or which has been manufactured from new or serviceable used parts and is at least functionally equivalent to the original product, or (3) refund the purchase price of the product. A replacement product/part assumes the remaining warranty of the original product or sixty (60) days from the date of replacement or repair, whichever provides longer coverage for you. When a product or part is exchanged, any replacement item becomes your property and the replaced item becomes RFSPACE's property. When a refund is given, your product becomes RFSPACE's property.

This Limited Warranty applies only to hardware products manufactured by or for RFSPACE that can be identified by the RFSPACE logo affixed to them. The Limited Warranty does not apply to any non-RFSPACE hardware products or any software, even if packaged or sold with RFSPACE hardware.

## 6. COMPLIANCE

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

**Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

**Warning:** Any modifications made to this device not expressly approved by RFSPACE, Inc. could void the user's authority to operate the equipment.

**Note:** Connections to the SDR-14 Aux Serial Port require the addition of a Steward 28A2025-0A0 Ferrite bead at the SDR-14 side of the cable.



**NOTES:**

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