

Originally appeared in Spectrum Monitor
May, 2016
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Revisiting Radio Jove with a Low Cost Computer

Jupiter has been known for many years to generate radio emissions generally in the 20 MHz range. They are caused by the interaction of Jupiter and its moons. They were discovered in the 1950s and are known to produce a variety of spectrum patterns called L (long) and S (short) waves. To successfully detect Jupiter requires a good antenna gain and a sensitive receiver without any AGC (automatic gain antenna.) The Radio Jove project has been around for several years and is an excellent way to explore the radio astronomy hobby on a budget. Since the Radio Jove receiver is a project designed for use in schools, the kit is relatively easy to assemble with good soldering skills. The kit and other resources are available at the Radio Jove site: <http://radiojove.gsfc.nasa.gov/>. A good source of details on the Radio Jove receiver and other projects is covered in a book by Steven Arnold titled 'Getting Started in Radio Astronomy', published by Springer.

I have written about the Radio Jove receiver in past columns and have monitored the 20.1 MHz frequency using the Radio Jove kit. I had detected several solar storms with it but I never knowingly recorded any Jovian storms using the twin-dipole kit. The antenna took up backyard space and I had discarded it after a year or so. Since then, I have installed a LWA designed antenna which operates between 20 to 80 MHz with 35 dB gain preamps. I decided to hook up the Radio Jove radio recently and try recording the Jupiter's signals using Skypipe II. The setup is straightforward.

The PC

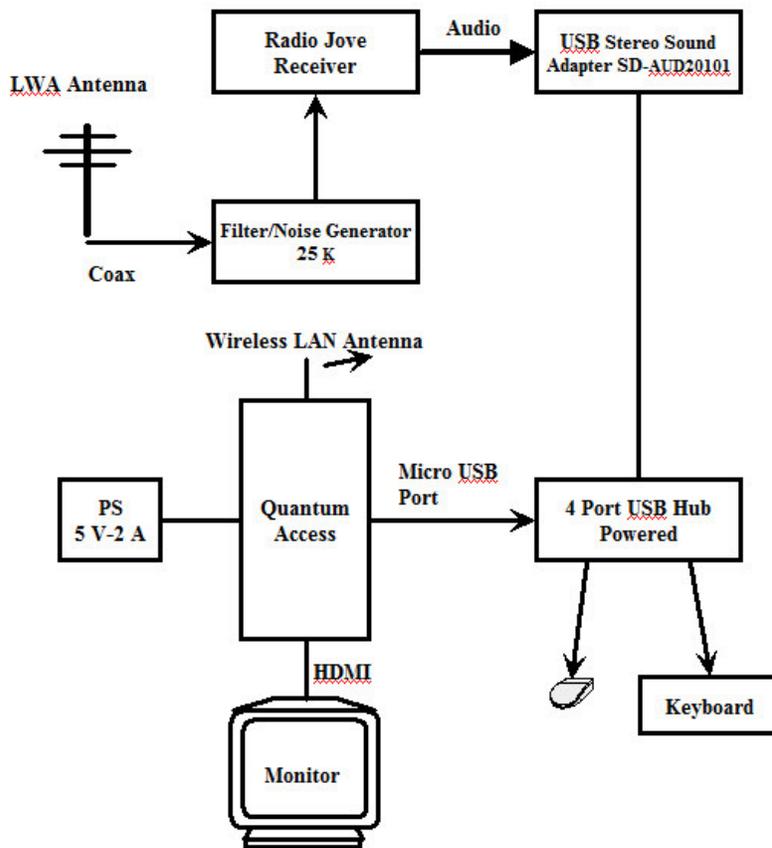
Since I monitor a number of frequencies with numerous PCs the electric bill tends to climb. I started looking for low cost PCs that would allow me to overcome using the old power hungry desktops. I recently saw an advertisement for the Azulle Quantum Access Mini PC Stick with Windows 8.1, Intel Atom Z3735F, and 2GB RAM+32GB storage. I ordered one since it offered a fairly small footprint and power requirements. The power supply is rated at 5 volts and 2 amps. Hooking up the Mini PC was easy but I found it somewhat inconvenient to plug it into a HDMI TV port. That may be a problem for some monitors. I used a DVI to HDMI adaptor and later added a short HDMI extension cable to allow the mini-PC to be moved around.. There is only one USB port so I used a powered USB hub to connect a keyboard and a mouse. The audio is set up to feed through the HDMI port to the TV. There is no microphone or line input to input to the software. I used an audio-microphone USB sound card by Syber SD-AUD20101 to feed the audio from the Radio Jove.



Above, the Quantum Access mini-PC looks like an overgrown USB stick. The video output is a HDMI video/audio connector that plugs directly into a TV/monitor HDMI port. In this picture I added a right-angle adaptor and then into a DVI/HDMI adaptor so it pointed up. The antenna is for the wireless LAN. You can see two ports on the side. One is for a micro-SD card. I stuck in a 32 GB card for storing the charts. The other is a micro-USB port. The mini-PC comes with Windows 8.1. I didn't have any problem loading the Radio-Sky programs. The sketch below shows how I connected it up. Nothing special here except the need for an audio input. The Syba USB Sound card that sells for about \$20 and is fairly easy to set up.

The Setup

Below is a sketch of the hook up.



The LWA antenna is a dual dipole with dual preamp that provides 35 dB of gain. The antenna is designed for 20 to 80 MHz operation. I have been using it for feeding a number of receivers for meteor, WWV, and other activities successfully using a couple of amplified splitters. However, to receive Jupiter with Radio-Jove, a dual half-wave dipole antenna is typically used and can be purchased with the Radio Jove kit.



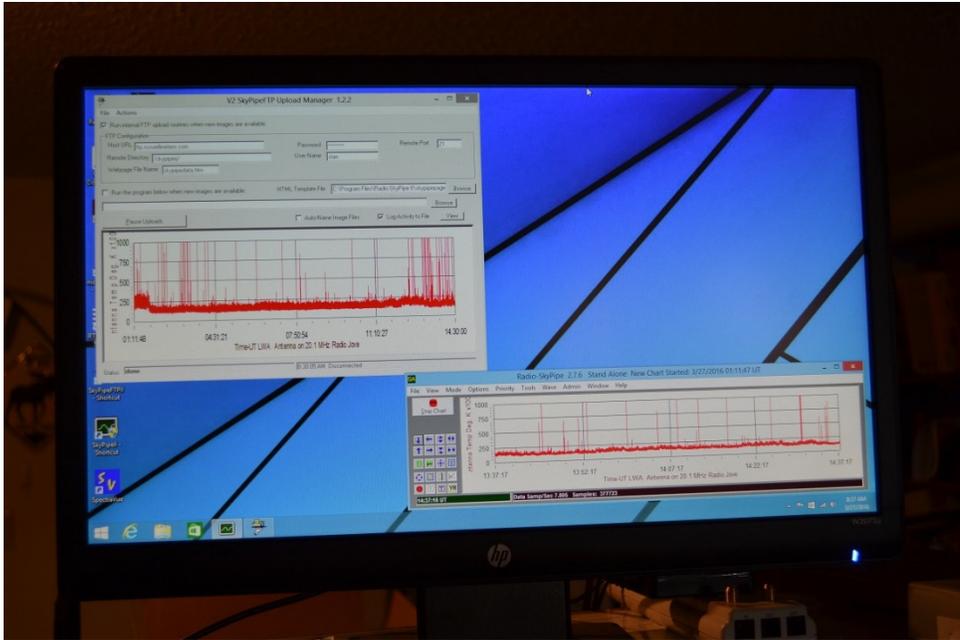
The Radio Jove is a fairly low powered box. The box on top is a 25 K (kelvin) noise source when turned on and becomes a band-pass filter to reduce SW broadcast interference. I used a HP signal generator to verify the settings and the weak signal response. I could see a signal as low as a 0.1 microvolt. To avoid power noise, I also use a well-regulated 12 volt DC wall-wart power supply to drive both units.

The Software

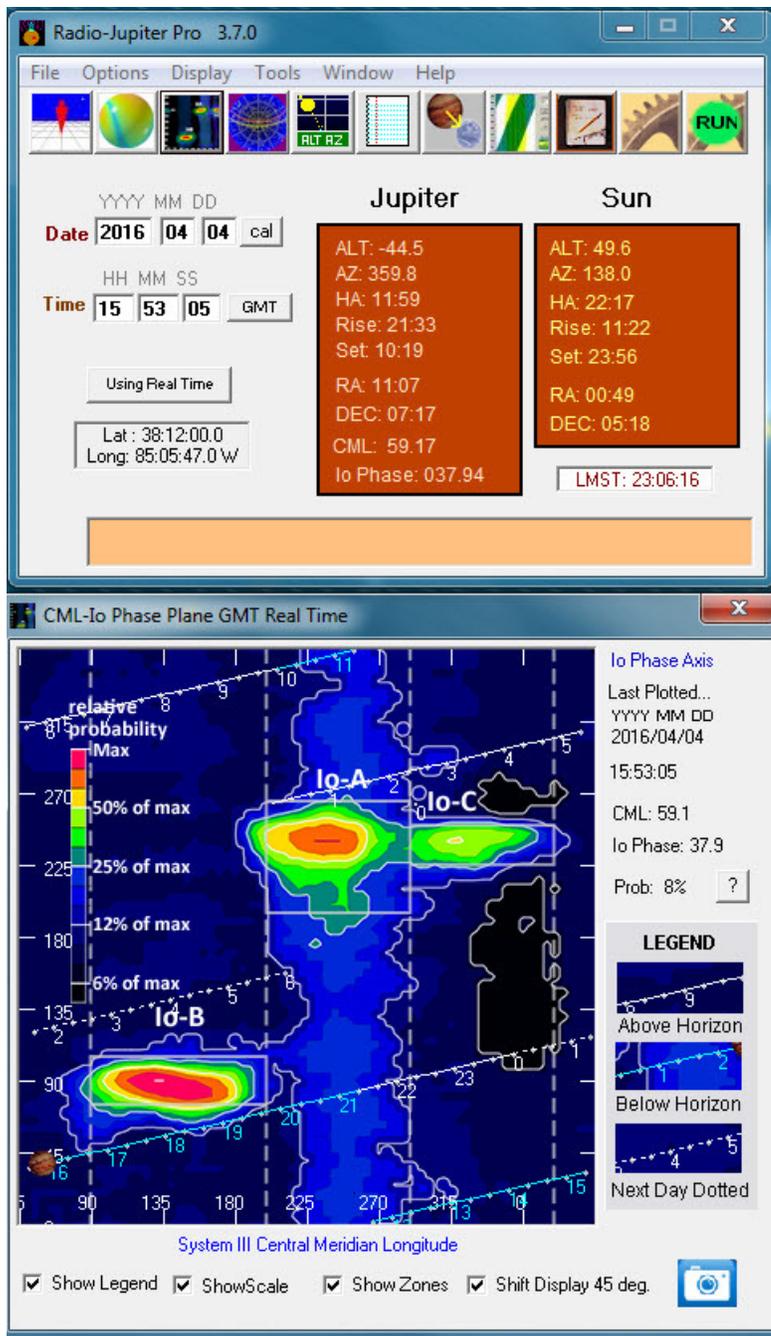
The Radio-Skypipe II software converts the audio signals into a digital reading and creates a digital strip chart. The software has been around for a number of years and is fairly easy to use. It can build daily charts and display shorter time spans as needed. It has a calibrator mode that was designed to accommodate the receiver. Its wizard takes you through the Radio Jove setup and even scales and labels the vertical 'Y' axis automatically. Figure 5 shows a screen picture of the Skypipe data being logged. The top chart is a 24 hour view and the lower chart I have set for an hour. This can be changed in the strip charts options to suit your needs.

(insert pix: screen shot.jpg)

Radio Skypipe II charts on mini-PC screen.

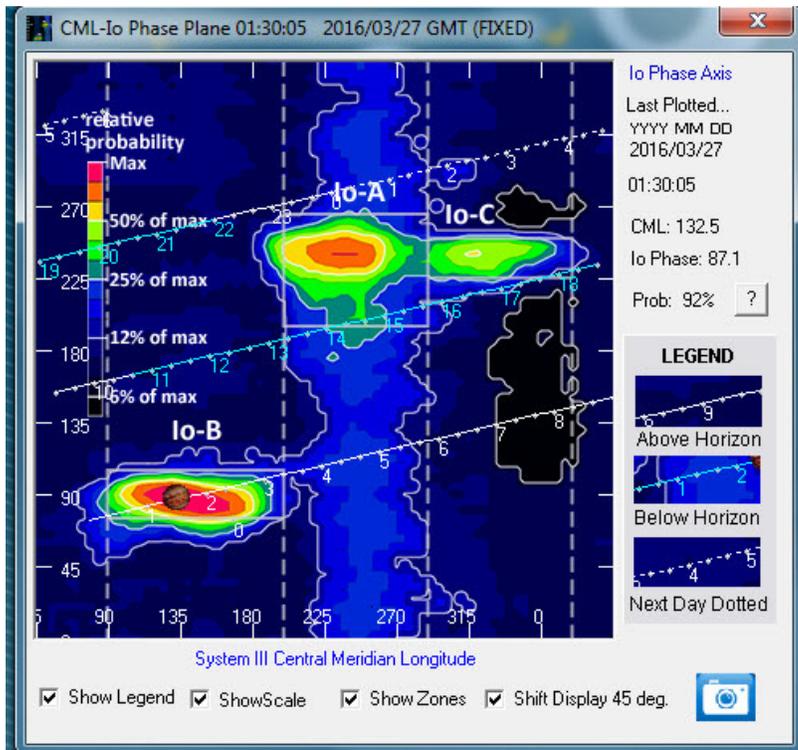


Radio Jupiter Pro 3 can be obtained from Radio-Sky Publishers for \$20. It allows you to keep track of Jupiter's travels and predicts the best time to monitor potential storms. You can input your antenna parameters to show the approximate antenna pattern of your antenna. Keep in mind the Radio Jove receiver is designed for 20.1 MHz and will detect solar storms during the day. The lower chart shows the path Jupiter is taking in relation to the moons and the potential hot spots. Note the chart indicates the above and below the horizon positions of Jupiter.

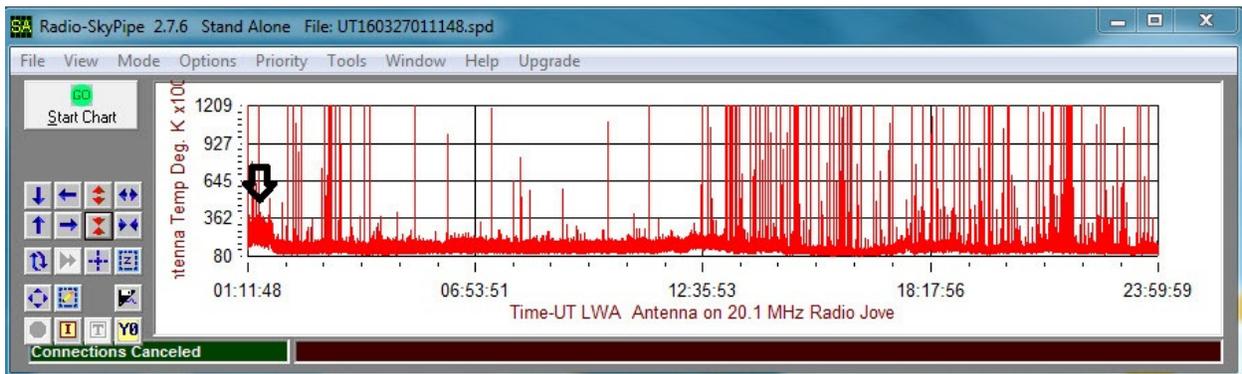


When I first hooked up the setup I started the Radio Jupiter Pro and saw that Jupiter was in the middle of an Io-B potential hot spot. Jupiter was above the horizon. I checked the SkyPipe

chart and saw a rise at the same time Radio Jupiter Pro indicated 92 % probability of a storm. See the Radio Jupiter Pro chart below.



Here's the chart that shows the increasing signal at about 01:11 UT.



I haven't confirmed the activity was indeed a Jupiter storm. Here's a link to some contributed data for March, 2016: radiojove.org/cgi-bin/calendar/calendar.cgi?month=3&year=2016. There are some observations for the previous day. One of the nice things about the Radio Jupiter Pro software is the ability to backtrack the time to a recorded event such as this. Like most transient events in Radio Astronomy it's a good idea to verify your observations. Another neat way to observe solar and Jupiter storms is with a spectrograph approach, In previous columns I have discussed the use of an SDR USB receiver with Radio-Sky's

Spectrograph. It also works well with RF-Space's SDR-14 but they have become somewhat obsolete.

After working with the Quantum Access PC I think it is a good option for low powered operation but when you add up all of the options, I believe a new low-end laptop is cheaper. You'll get a hard drive, monitor, keyboard, etc. And more than one USB port. The newer PCs are certainly getting more energy efficient except the Windows versions are mostly Windows 10. One bad feature of Windows 10 is it doesn't like some versions of the old reliable software used in the hobby. And another which is disastrous is that it wants to download software updates and REBOOT. The only way to overcome that is go wireless LAN and tell it that you're on a metered (pay-as-you go) network. I run all of my PCs with the manual update option. Once in a while an update appears to reset that and I have found a PC rebooted and no longer recording data.

Most of the software I have featured in past columns can be adapted for other interesting radio astronomy monitoring using a variety of receivers. Experimentation is where the fun is.

Radio Astronomy Hobby Book List

Here's a list of books of my shelves that may interest and assist your journey into the hobby. A search on ABE Books or other sellers often finds fairly inexpensive used copies. Though the books may be somewhat dated, they offer a good background in the concepts.

The New Astronomy by Paul and Lesley Murdin, pub. by Thomas Y. Crowell Co., 1978.

Radio Astronomy by Steinberg and Lequeux, pub. by McGraw-Hill Electronics Series, 1963.

Big Ear by John Kraus, pub. by Cygnus-Quasar Books, 1976.

The Big Dish: The Fascinating Story of Radio Telescopes by Roger Piper, pub. by Harcourt, Brace & World, Inc., 1963.

The Radio Sky and How to Observe It by Jeff Lashley, pub. by Springer,

The Amateur Radio Astronomer's Handbook by John Potter Shields, Crown Publishers, 1986

Clocks in the Sky: The Story of Pulsars by Geoff McNamara, pub. by Springer, 2008.

Introduction to Radio Astronomy by John Potter Shields, pub. by Howard Sams Pub., 1976.

Amateur Radio Astronomy by John Fielding, pub. by the RSGB, 2011.

The hobby can take you in many directions over time and having a good reference library is handy. The web certainly provides the latest and greatest details, but there's nothing like a good book when your computer is busy monitoring Jupiter.

If you are new to the hobby or just contemplating giving it a try, you will generally find we love to share what we know or help you find answers. I often mention the Society of Amateur Radio Astronomers. Drop by their web site at **radio-astronomy.org**. They are the premier amateur radio astronomy group and they meet at great locations and get tours of facilities led by professionals. Check them out.

Stan