Applications of Raspberry Pi and RTL-SDR

North Texas Microwave Society

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Outline

- Which Raspberry Pi and Purchase Options
- The Ubuntu Mate Operating System and Linux
- RTL-SDR dongles
- Spectrum and Logging Spectrum Programs
- Examples
- Links for other information

A+	B	B+	2, Model B
ARMv6 single core	ARMv6 single core	ARMv6 single core	ARMv7 quad core
700 MHz ARM	700 MHz ARM	700 MHz ARM	900 MHz ARM
600mA @ 5V	600mA @ 5V	600mA @ 5V	650mA @ 5V
←----------	Dual Core Video Core IV Multimedia Co-Processor ---------- →		
256 MB SDRAM @ 400 MHz	256 MB SDRAM @ 400 MHz	512 MB SDRAM @ 400 MHz	1 GB SDRAM @ 400 MHz

Different Versions of Pi

Raspberry Pi I used:

- Raspberry Pi 2 Model B V 1.1
- Ordered from Amazon and other sources
- RTL Dongle ordered from Amazon and others

CanaKit Raspberry Pi 2 with WiFi and 2.5A Power Supply (UL Listed)

by CanaKit

4.5 out of 5 stars ▾ 14 customer reviews

Note: This item is only available from third-party sellers (see all offers).

Available from these sellers.

- New Raspberry Pi 2 (RPi2) Quad-Core 900 MHz 1GB RAM
- CanaKit WiFi Adapter / Dongle (Ralink RT5370 chipset)
- CanaKit 2.5A Micro USB Power Supply (UL Listed) specially designed for the Raspberry Pi 2 (5-foot cable)
- CanaKit Raspberry Pi Quick-Start Guide

1 new from $69.99

Report incorrect product information.

Example of a Combination Package

Ubuntu Mate

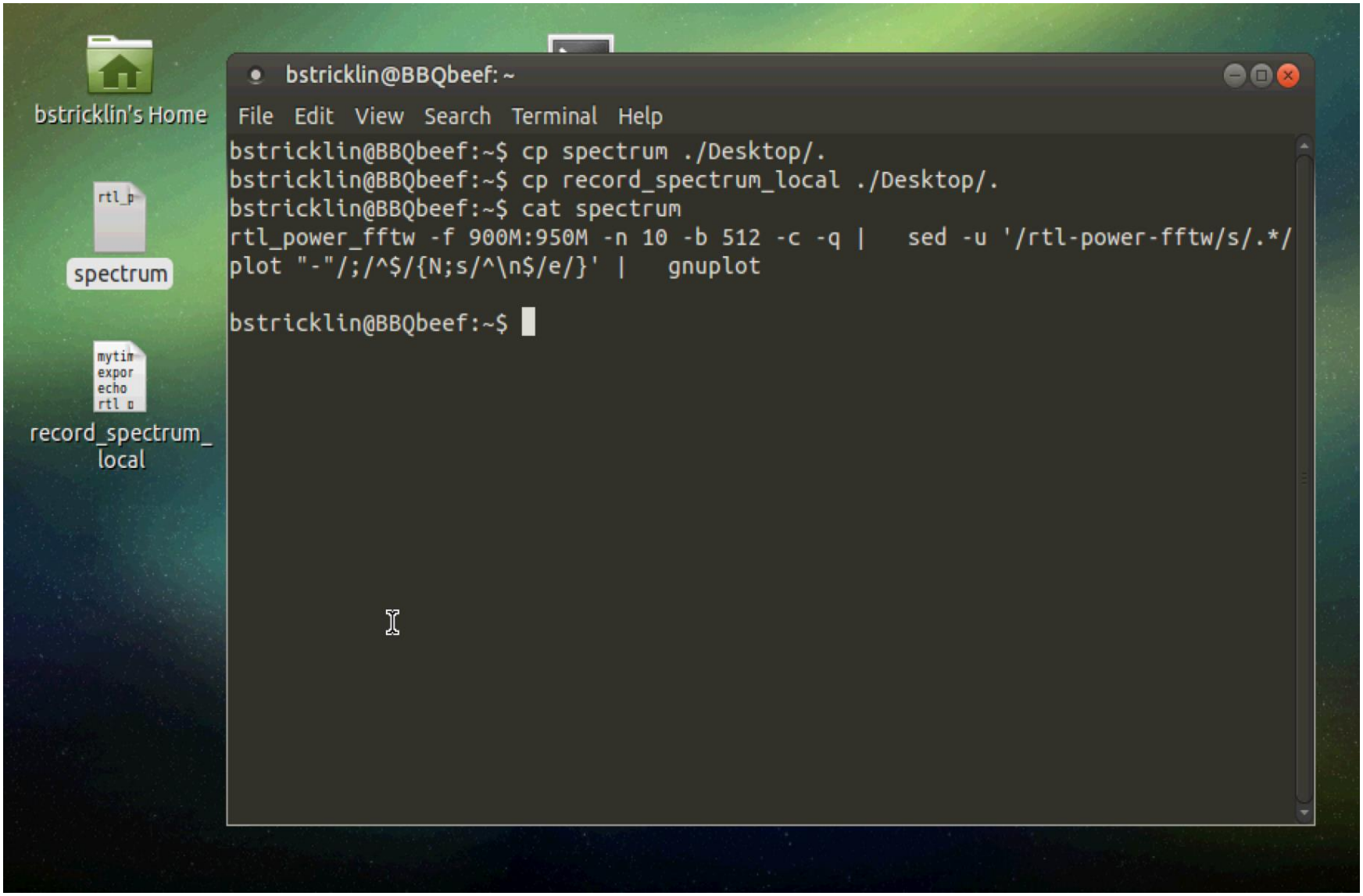
- Linux Operating System modified for the Raspberry Pi.
- Works just like Linux on other computers.
- Supports Remote Desk Top connections.
- Be careful with available memory.

Getting Started

- When you receive your Pi use an HDMI to connect it to a TV. If you have one connect a USB keyboard and mouse. Plug in the mini SD card. Connect the Wi-Fi interface or a network cable to your router.
- Make sure the TV is turned on and set to the proper Input. Then power up the Pi and watch the text and graphics as it boots.

Graphics Interface vs. Command Line

- You can accomplish a lot with the GUI. Mouse around and learn what is available.
- Learn to use the command line interface.
- Search for information on how to do things on the internet.
- Using the command line interface use “man command_name” to see instructions on how to use any command
- Buy a book on Ubuntu (Any book) at Half Price Books. Typically < $5. Use this for command reference.



Example of command line used to create a spectrum analyzer.

Important commands

- ls –l (Directory, -l gives detail)
- Df (disk Free)
- Whoami & who (Who is logged in)
- Chmod (Set file permisions)
- Cp (Copy files)
- Passwd (Change a password)
- History (History of commands)
- Ifconfig (Shows your IP address)
- Shutdown –r now (Restarts)
- Man (Read info on a command)
- Rm (Remove a file)
- Find (Find a file)
- Pwd (Your current dirrectory)
- Tar (archive files – ZIP)
- Mount & umount (add a disk drive)
- Date (date and time)
- Su (Switch Users)
- Exit (close session)

- Text Editors – vi, gedit, nano, nedit
- If you have trouble with editors cp files to a thumb drive and edit in Windows and then copy back. Just work with pure text files.

- Try not to use spaces in file names. Use _ for a space.

- Most Linux commands are in lower case.

Dongle Example

Note: SMA connector with a Bias Tee option for preamp power.

RTL-SDR Blog R820T2 RTL2832U 1PPM TCXO SMA Software Defined Radio with 2x Telescopic Antennas

by RTL-SDR Blog

$25.95 Prime

Get it by **Tomorrow, Oct 31**

4.5 ▾ 181

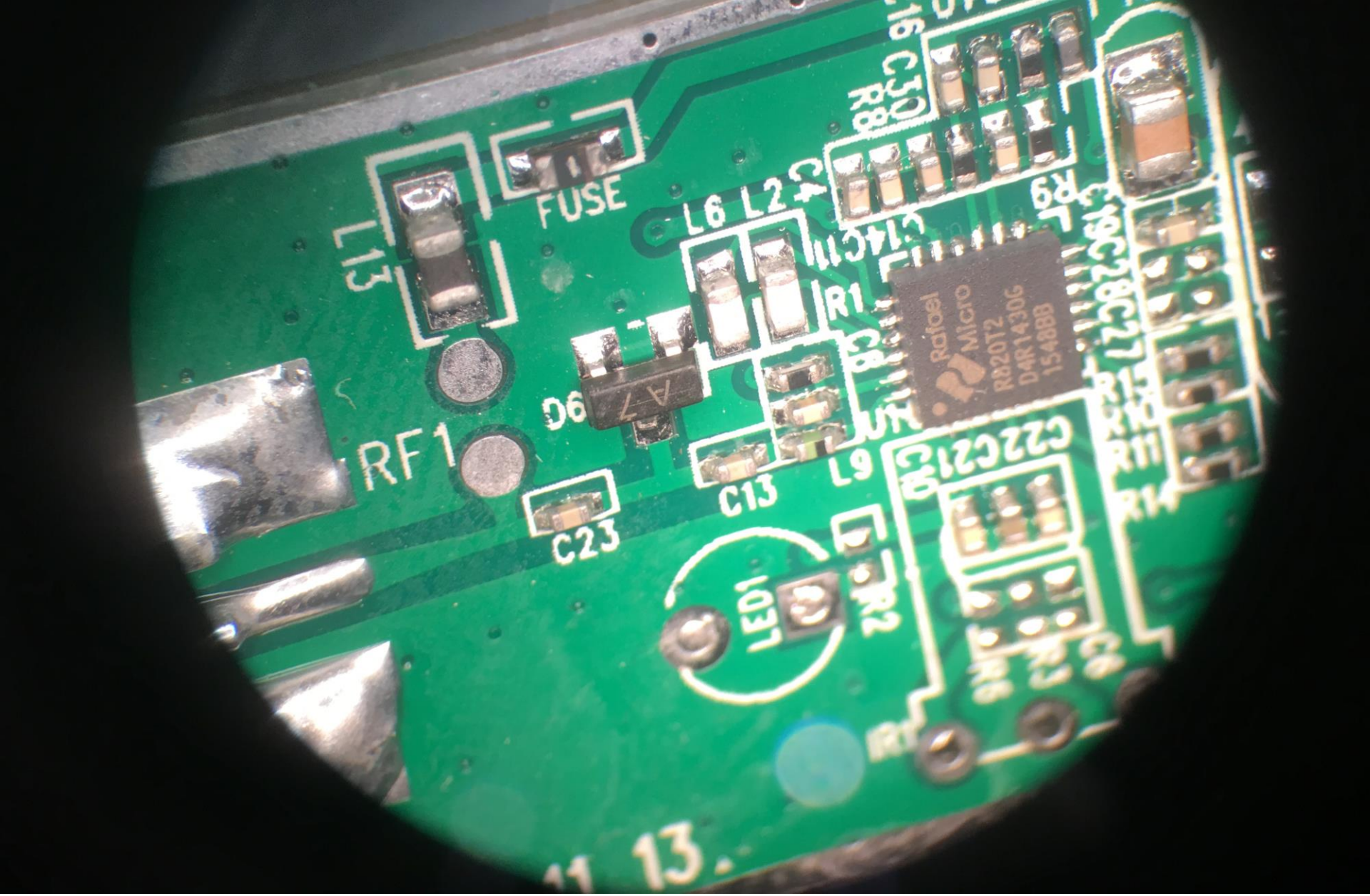
Product Features

... Includes 1x *RTL-SDR* Blog brand R820T2 RTL2832U 1PPM TCXO HF Bias Tee ...

Electronics: See all 137 items

RTL-SDR Dongle
Example of a package deal on Amazon


RF1
FUSE
2015 11 13.



R820T2 Note RF1 pads to bridge to have 5V Bias Tee operational.

Overview of the RTL-SDR

- A Two chip solution using a RF Analog chip
  - LNA front end with variable gain and external filter
  - Mixer
  - 2nd stage filter and variable gain amplifier driving output
  - A PLL based DDS Oscillator with I2C interface and a 28.8 MHz reference
- A digital processor or state machine to provide USB interface and control functions for RF chip.

See:http://superkuh.com/gnuradio/R820T_datasheet-Non_R-20111130_unlocked.pdf for a block diagram.

Viewing Spectrum activity

- If you install all the necessary support to run rtl_power_fftw the following command line will give you a spectrum view of the band selected:

```
rtl_power_fftw -f 900M:950M -n 10 -b 512 -c -q |   sed -u '/rtl-power-fftw/s/.*/
plot "-"/;/^$/{N;s/^\n$/e/}' |   gnuplot
```

- The frequency range here is 900 MHz to 950 MHz.
- The output of rtl_power_fftw is piped to sed and then piped to gnuplot for display.

Logging Spectrum Activity

- Rtl_power can be used to log PR power in a defined band of spectrum to a comma delimited file. The resulting file can be studied later of viewed as a JPG or PS file by processing the data with a program called heatmap.py. Use the Ubuntu Mate Graphics Application ‘Eye of MATE Image Viewer’.
- Be careful about filling up your system memory with large data files. Save data to an externally mounted thumb drive to be safe.

Examples of commands needed:

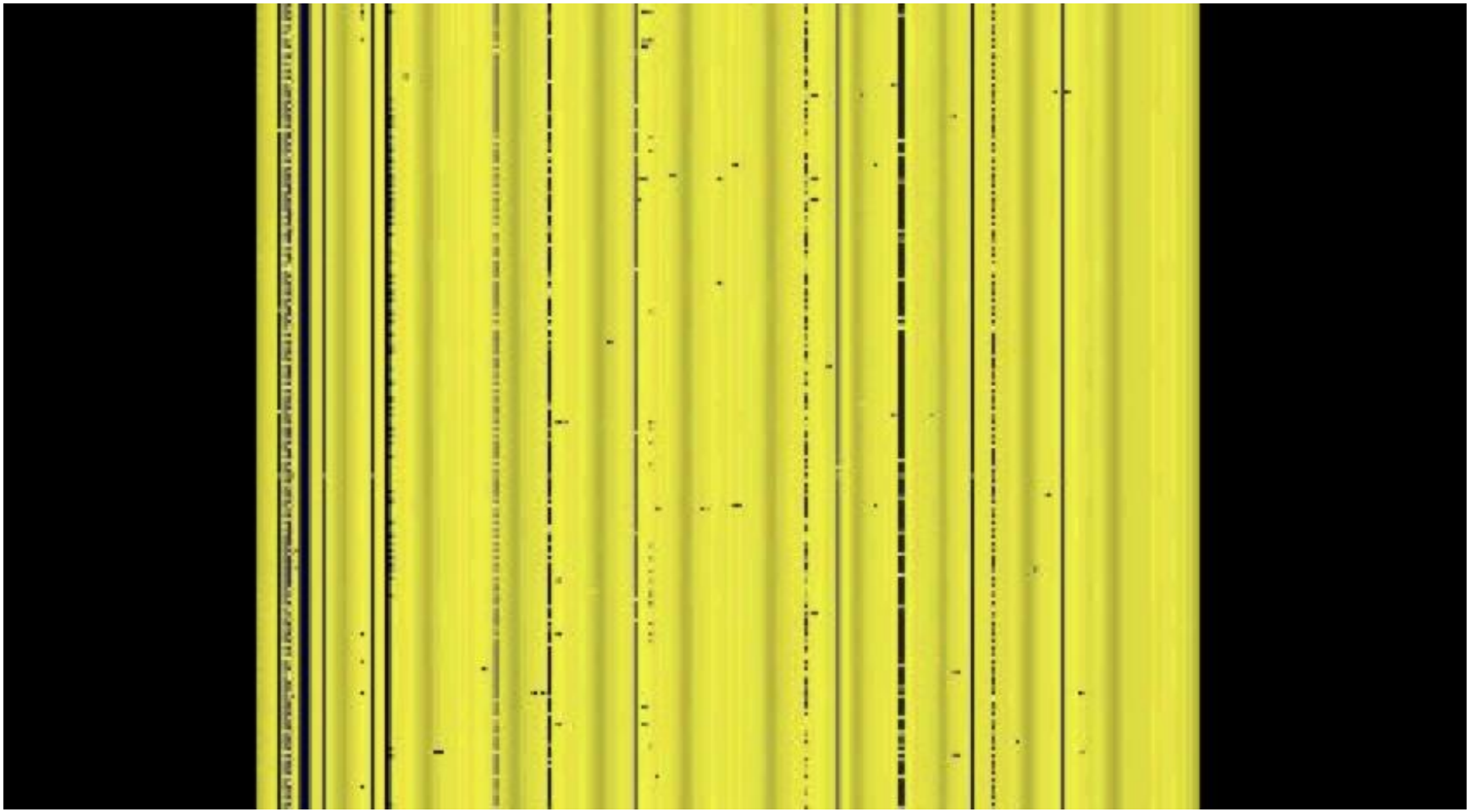
```
rtl_power -f 900M:930M:100k /media/users_name_here/UBUNTU_1/900mhz_$mytime.csv -i 1
```

Stop data collection with CTRL C then process file with:

heatmap.py 900mhz_time.csv 900mhz_time.jpg

Then use the Application ‘Eye of MATE…’ to view the waterfall type image.

Example of recorded waterfall:



Other Possibilities

- I have successfully installed gnuradio on this Ubuntu MATE using the command line:
- Apt-get install gnuradio

- After install completes you can launch with:
  - Gnuradio-companion

Good links for more info:

- http://kmkeen.com/rtl-power/
- http://www.rtl-sdr.com/tag/rtl_power/
- http://www.rtl-sdr.com/tag/r820t2/
- http://sdr.osmocom.org/trac/wiki/rtl-sdr