



Linux® in Your Ham Shack



Andy Stewart
KB1OIQ
Westford, MA USA

Presented to the
Billerica Amateur Radio Society
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Biographical Info

Tech: 1/07, General 1/08, Extra 1/09

President: PART of Westford, MA (9/09 - 8/19)

ARRL EMA: Assistant Section Manager (2016), ACC (2017)

Founder: Worcester Linux Users' Group (1997)

Founder and Acting President:

Chelmsford Linux Meetup Group (2006-2020)

Linux Instructor:

Chelmsford Community Education (2004 - 2011)

Linux user since 1997

Computer Engineer – digital logic verification

Most Recent Interests

- Antique radios
 - Electrical restoration, especially late 1930s radios
- Homebrewing
 - Many kits
 - Built a 1920s style regenerative receiver with plugable coils for different frequency ranges
- FT-8 and GridTracker
- Fox hunting
- Of course: Andy's Ham Radio Linux

Goals

- Promote Linux
- Give back to ham radio and Linux communities
- Build on top of an existing Linux distribution
- Create a software collection containing as much ham radio software as possible – nothing proprietary
- Goal: Everything just works!
- Focus on the radio hobby!
- The idea of "Andy's Ham Radio Linux" began this way

Andy's Ham Radio Linux

- V25 is Xubuntu 22.04.* remastered
- Download the ISO file from SourceForge
 - Search for: Andy's Ham Radio Linux
 - Software is GPL or similarly free license
- Ways to get started:
 - Download the ISO first, then.....
 - Boot it in Virtualbox, or.....
 - Create a bootable USB thumb drive
- Install to the hard drive once you decide you like it
- Be sure to read the GETTING_STARTED guide(!!!)

Target Computer

- Any x86_64 computer 10 years old or less
- Minimum: 2-4 GB of memory
- Disk Space: 15 GB after installation
- Processor speed is not an issue for most ham radio programs, Exception: SDR
- Networking: wired or wireless
- USB or DVD required for installation

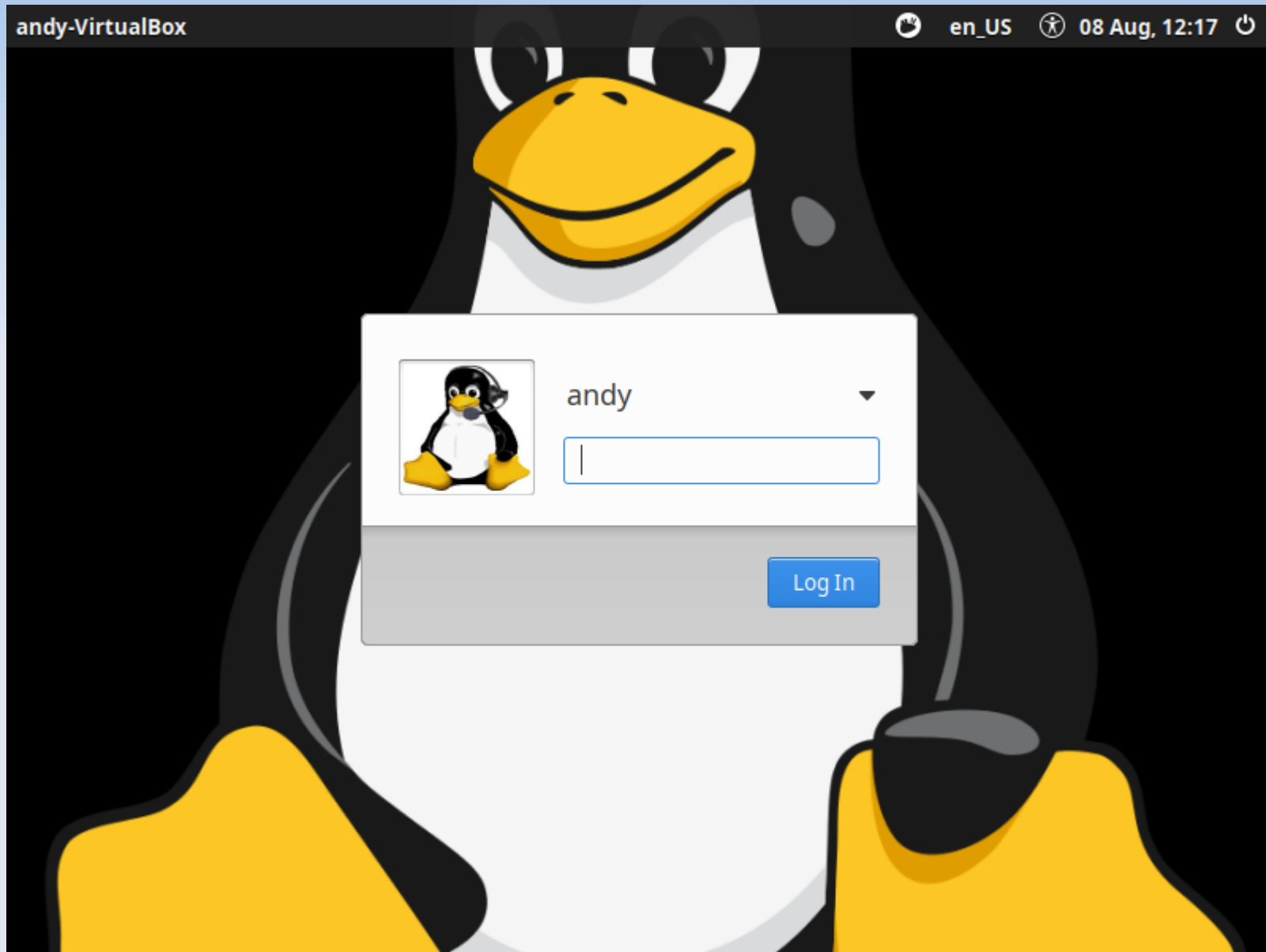
Initial Boot before Installation



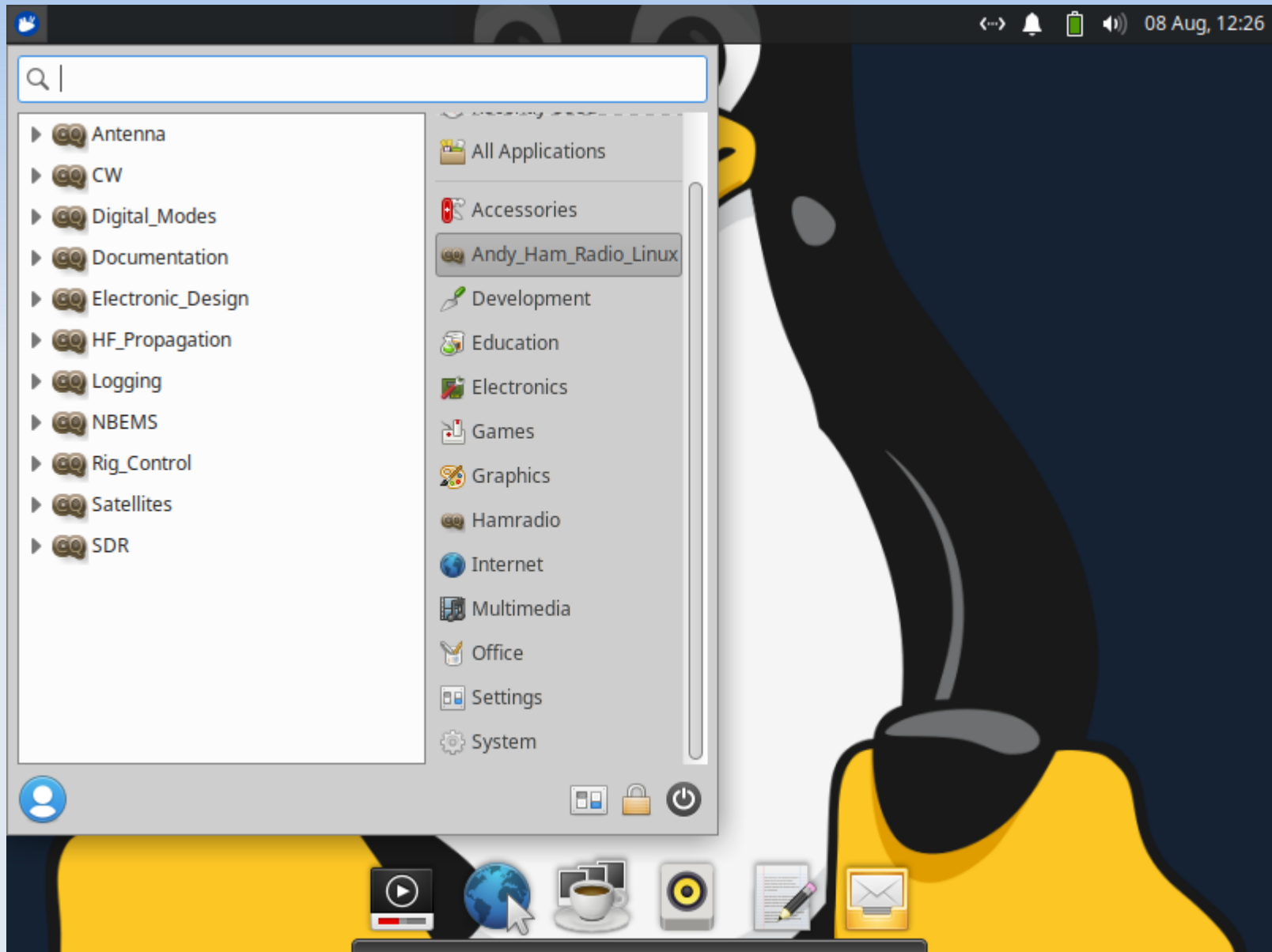
GETTING_STARTED

- PLEASE:
 - Be sure to download and read the GETTING_STARTED document BEFORE you begin the installation.
 - Follow the helpful hints!
- If you have problems logging in, you likely didn't read the document.

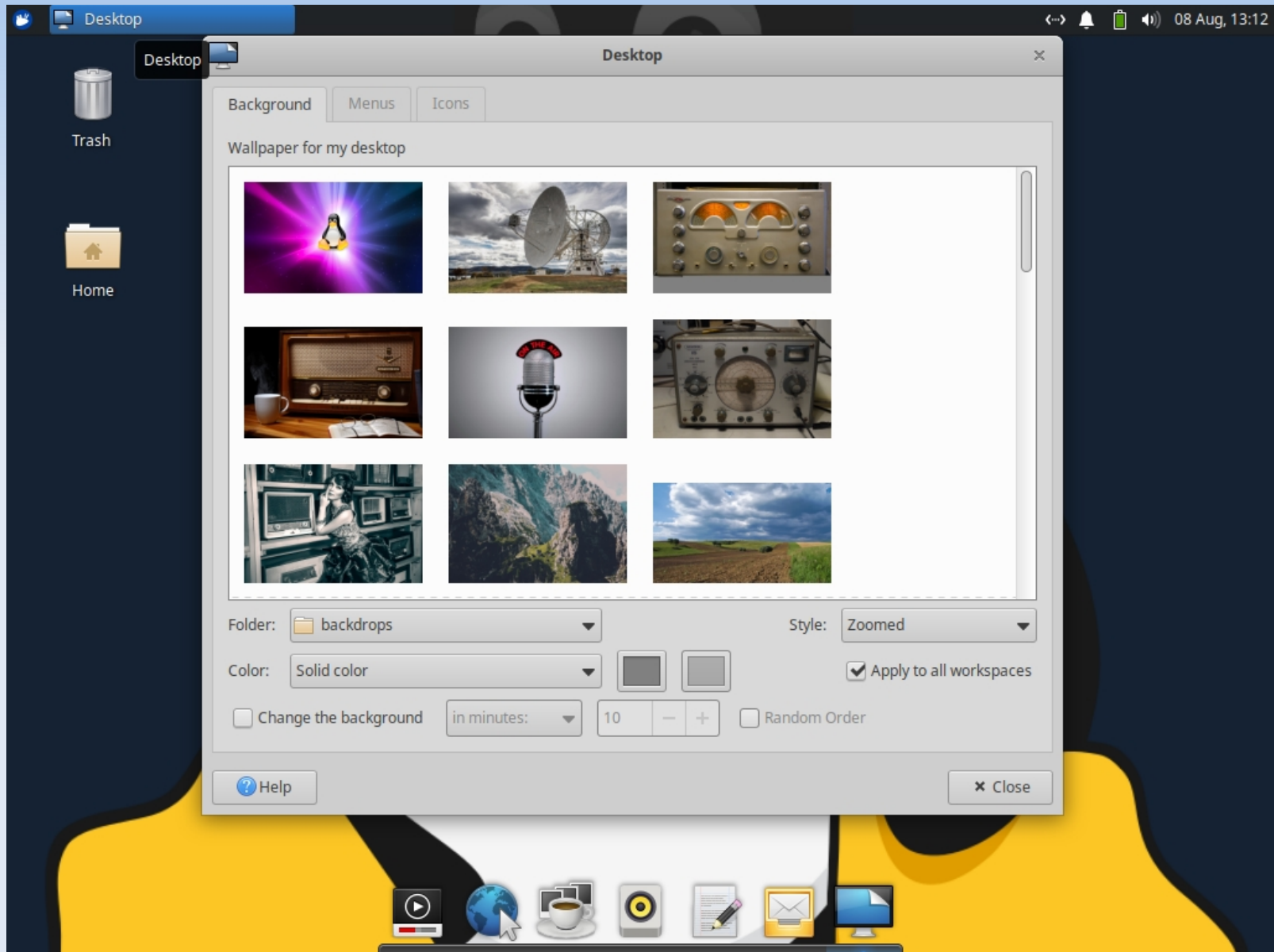
Initial Login Screen After Installation



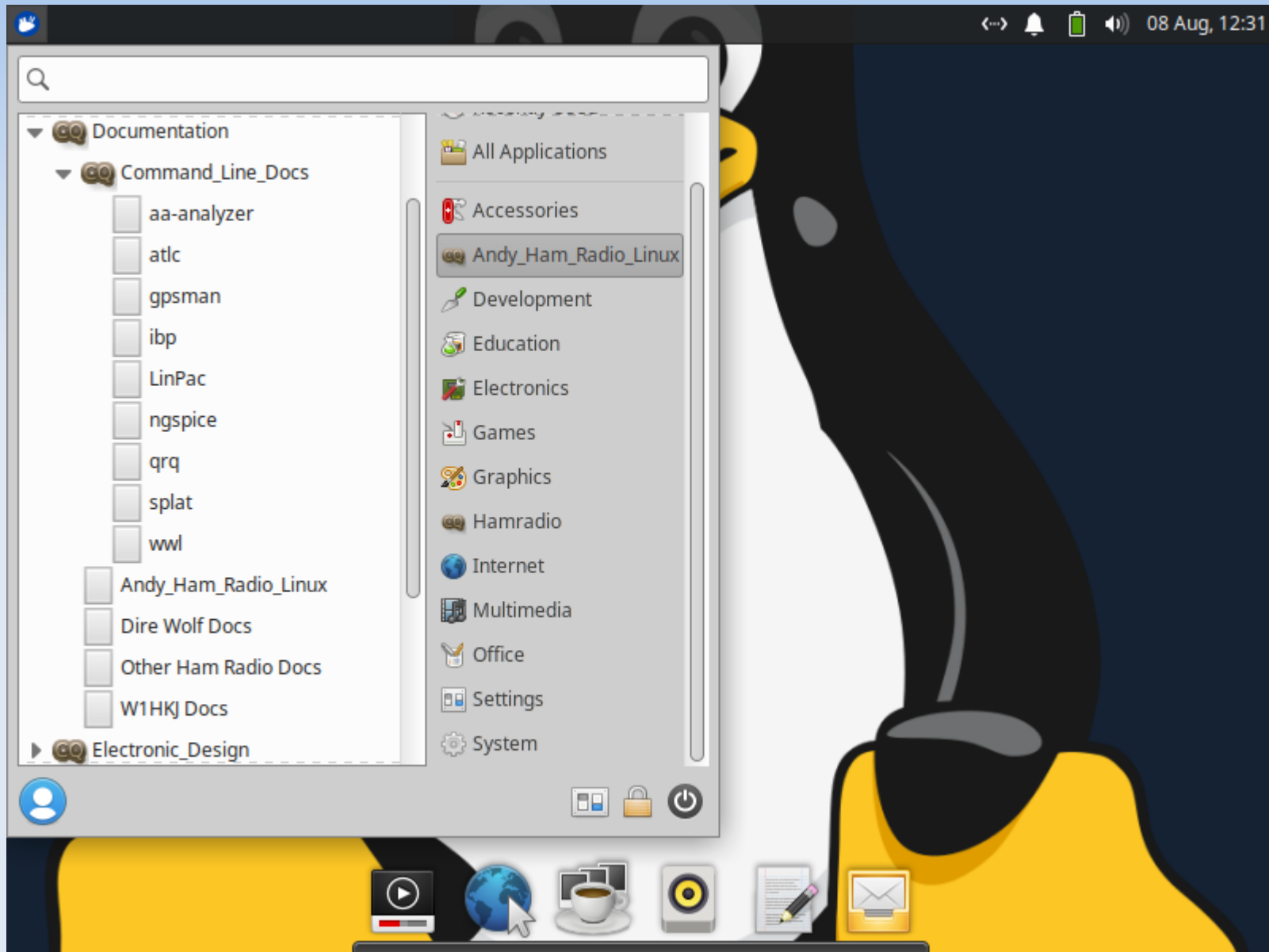
Initial Desktop



Desktop Backgrounds



Documentation

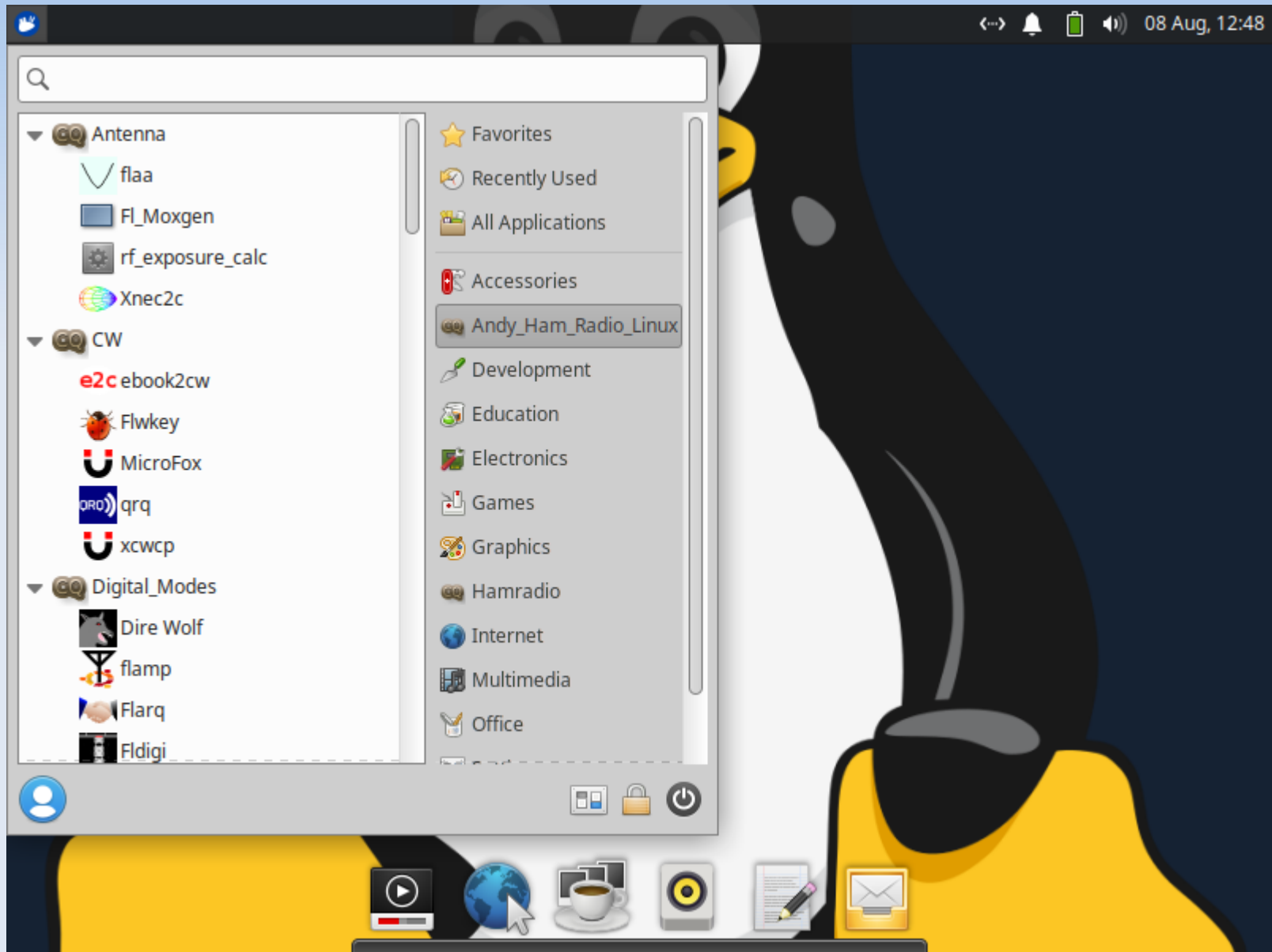


AHRL Documentation

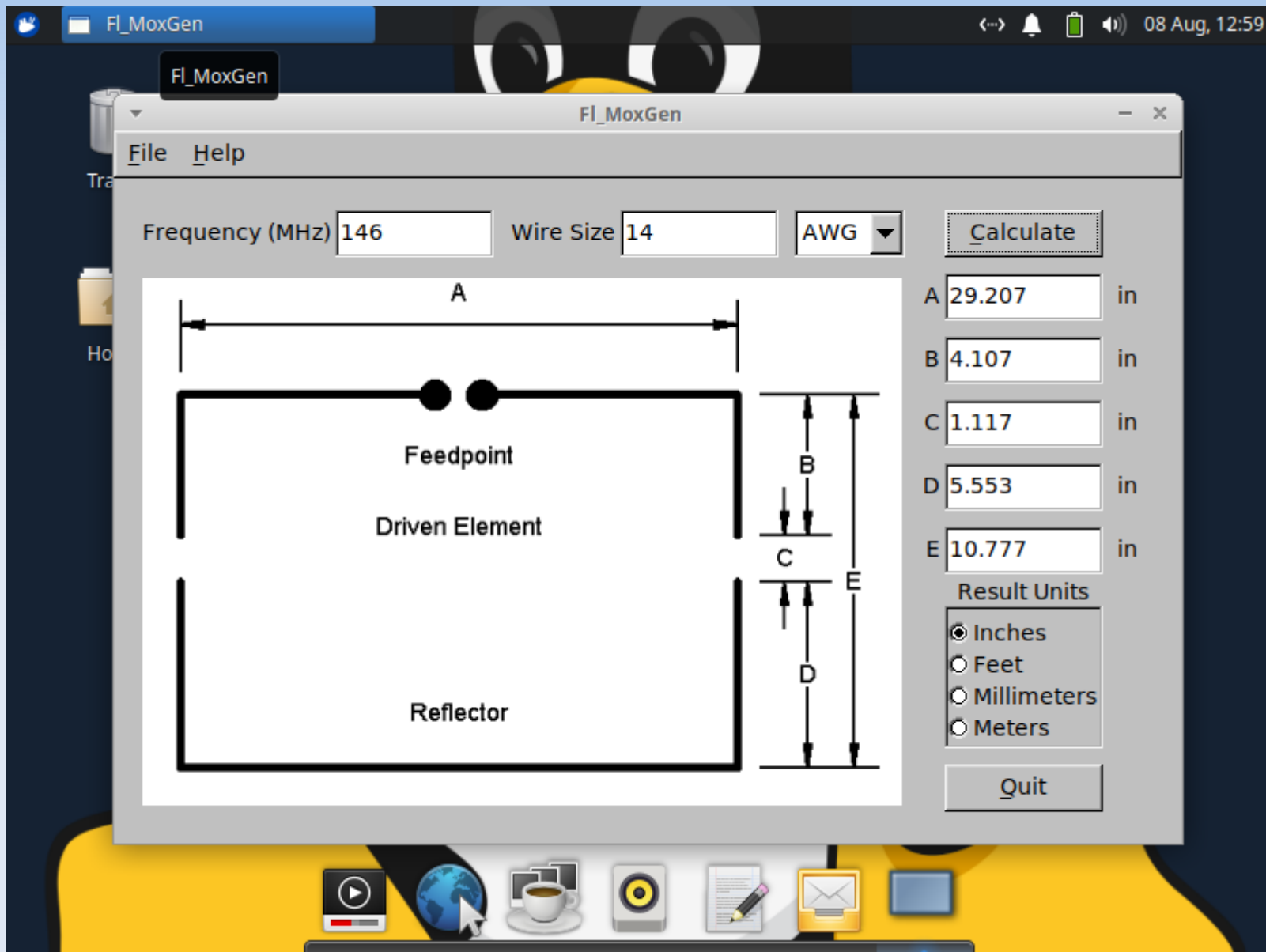
The screenshot shows a web browser window displaying the index of files for the AHRL documentation. The browser's address bar shows the URL `file:///usr/local/share/doc/Andy_Ham_Radio_Linux/`. The page title is "Index of file:///usr/local/share/doc/Andy_Ham_Radio_Linux/". The left sidebar of the browser shows the "Trash" and "Home" folders. The main content area displays a table of files with their names, sizes, and last modified dates.

Name	Size	Last Modified
00_Manual_dexterity_solutions	5 KB	6/1/22 15:52:12 EDT
00_SOURCES	4 KB	6/9/22 22:27:41 EDT
CHANGES	15 KB	6/9/22 22:27:41 EDT
GETTING_STARTED	5 KB	6/9/22 22:27:41 EDT
HOWTO_GridTracker	2 KB	6/8/22 12:48:00 EDT
HOWTO_drm_mondiale	3 KB	6/1/22 15:52:12 EDT
HOWTO_gqrx_gpredict	4 KB	6/1/22 15:52:12 EDT
HOWTO_js8call	2 KB	6/1/22 15:52:12 EDT
HOWTO_noaa_aprt	2 KB	6/1/22 15:52:12 EDT
HOWTO_resize_virtualbox	1 KB	6/7/22 19:36:38 EDT
HOWTO_setup_bluetooth.pdf	1231 KB	6/1/22 15:52:12 EDT
HOWTO_wefax	2 KB	6/1/22 15:52:12 EDT
HOW_Andy_Setup_nanoVNA-saver.pdf	137 KB	6/1/22 15:52:12 EDT
PACKAGES	383 KB	6/7/22 19:24:46 EDT
RELEASE_NOTES	10 KB	6/9/22 22:27:41 EDT
VERSIONS	4 KB	6/1/22 15:52:13 EDT
Wordsworth	7 KB	6/1/22 15:52:13 EDT
tinySA-saver.link.txt	1 KB	6/1/22 15:52:13 EDT

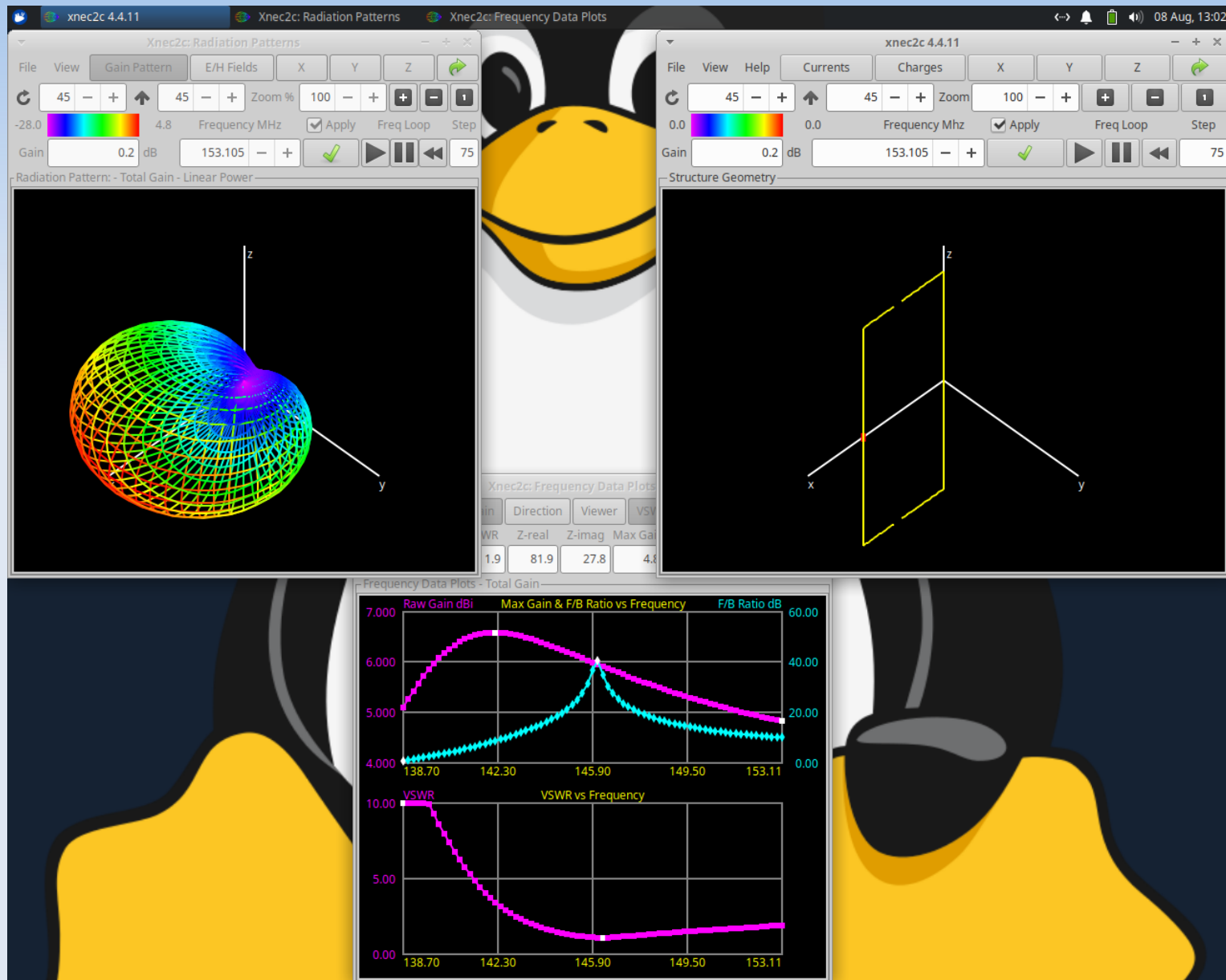
Menu #1



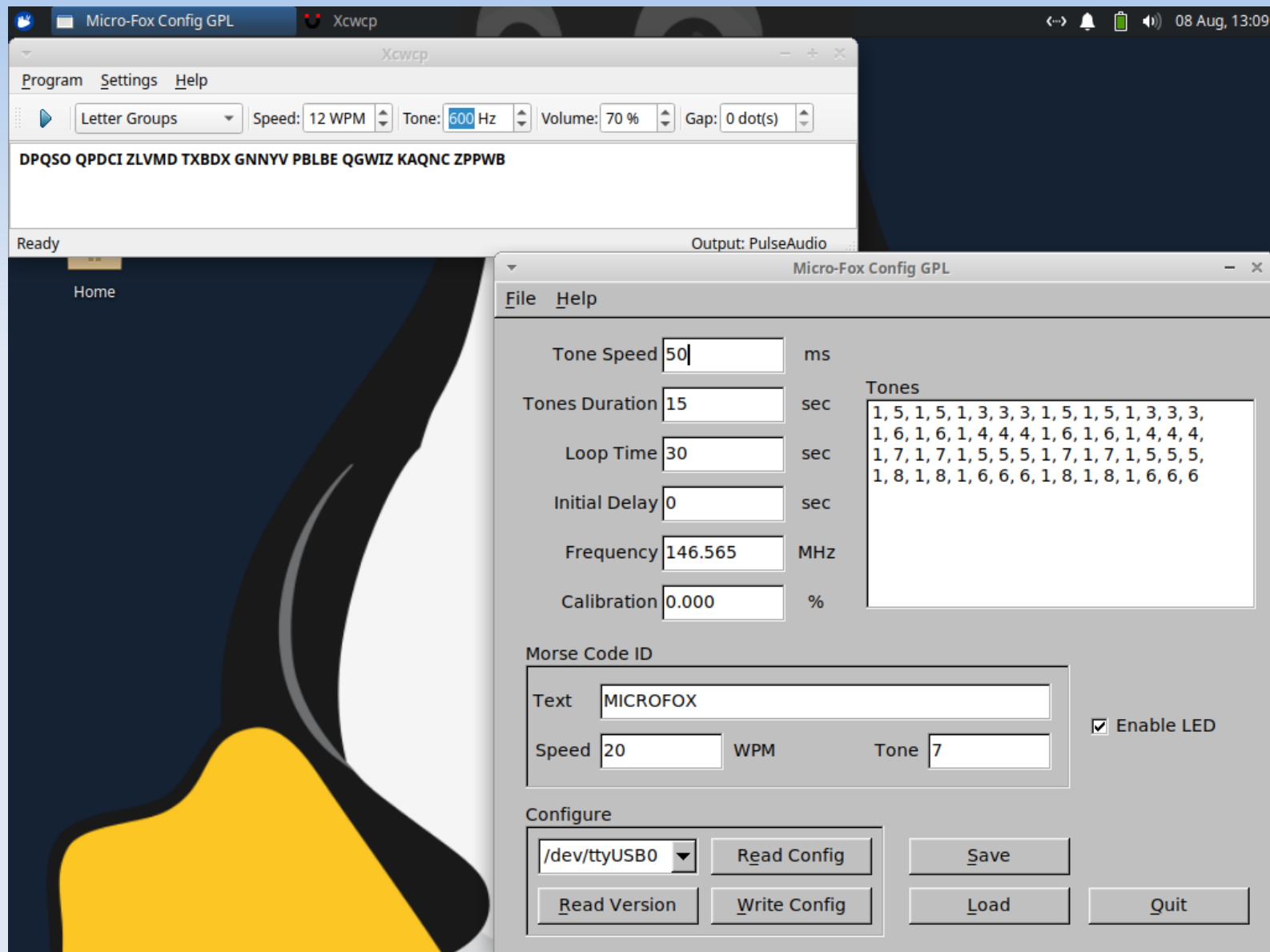
Moxon Rectangle - fl_moxgen



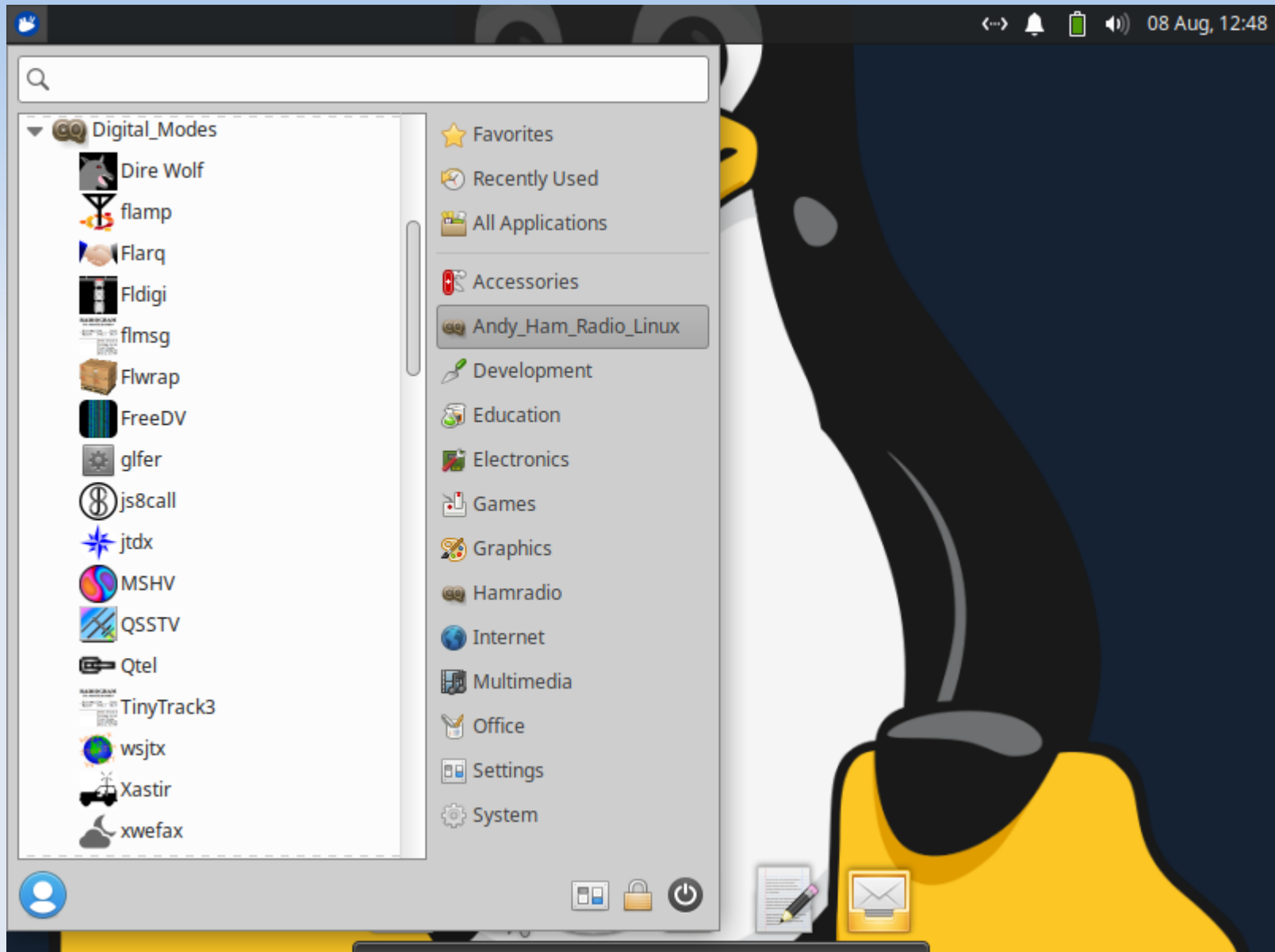
Antenna modeling - xnec2c



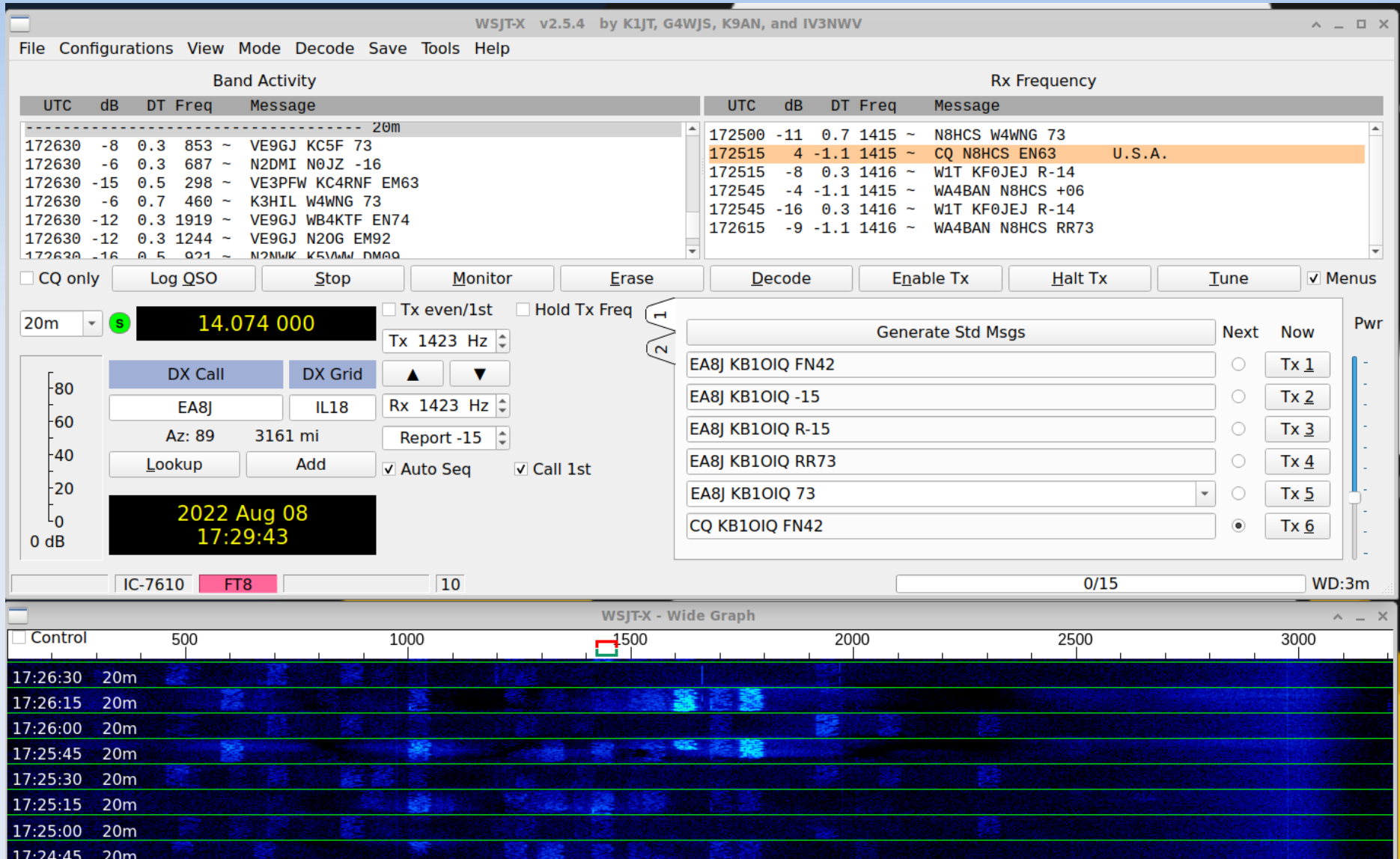
CW and Fox Hunting



Menu #2



Digital Modes - wsjtx



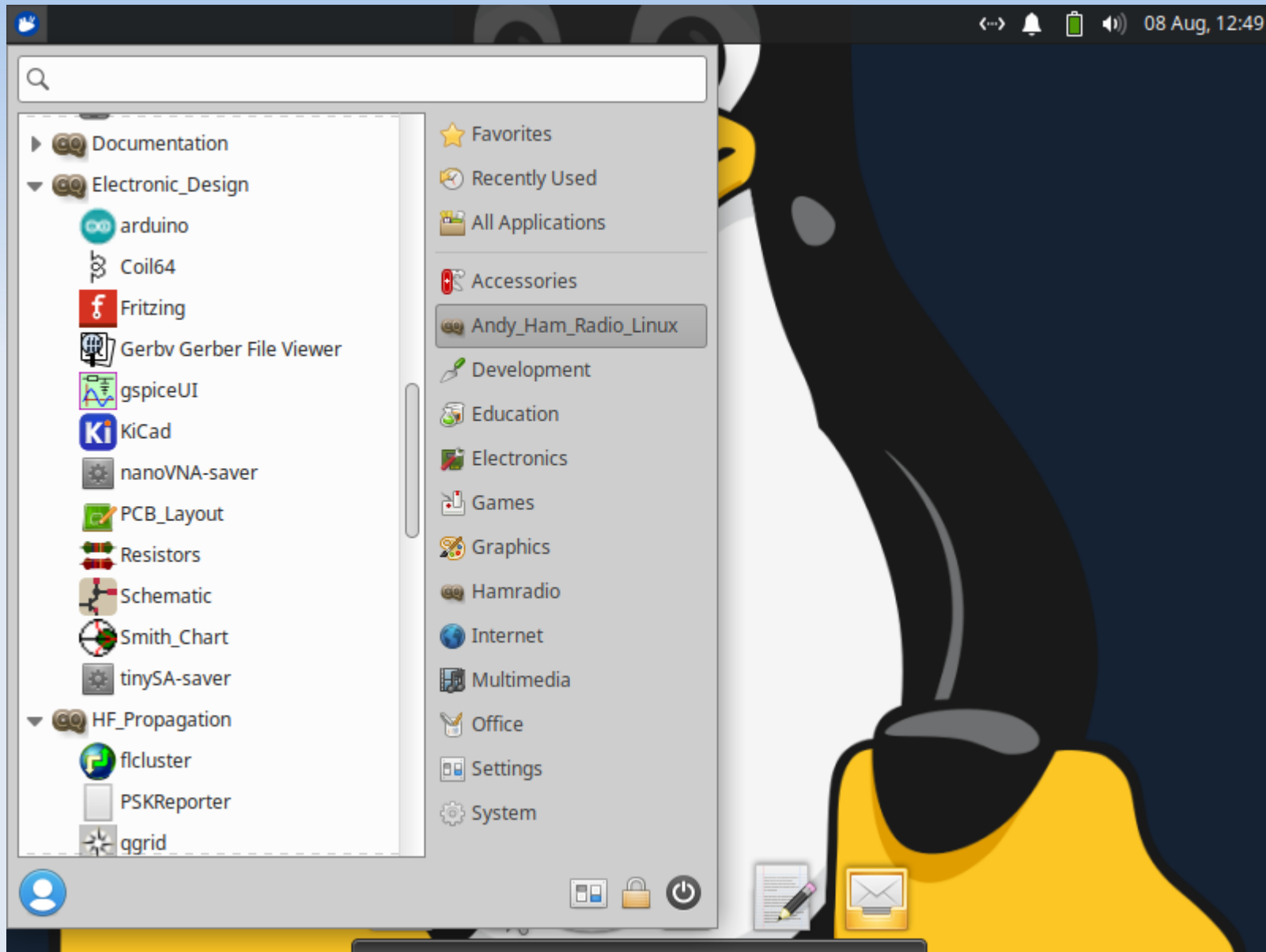
GridTracker

- GridTracker is not installed by default.
 - It will be included in the next AHRL release.
- I strongly encourage you to install it!
 - Read the local documentation for instructions.
- This is a MOST EXCELLENT program!
- Graphically manage grids:
 - Needed, Contacted but not confirmed, confirmed
- Talks to wsjtx
- Logs sent to LoTW and others

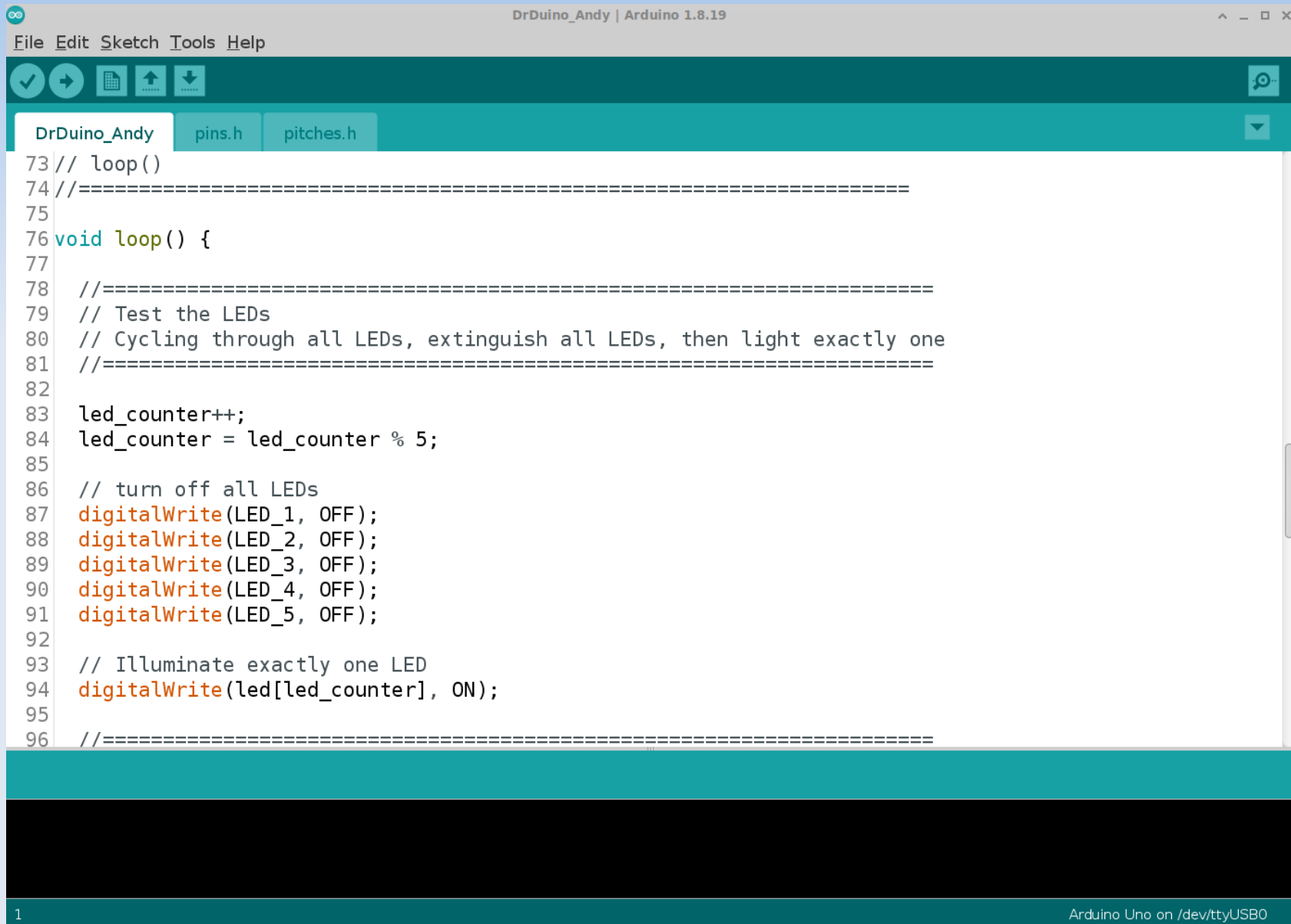
GridTracker



Menu #3



Electronic Design - arduino



The screenshot shows the Arduino IDE interface with the following components:

- Menu Bar:** File, Edit, Sketch, Tools, Help.
- Toolbar:** Check, Run, New, Open, Save, Find, and a search icon.
- Tab Bar:** DrDuino_Andy, pins.h, pitches.h.
- Code Editor:** Contains a C++ sketch for controlling 5 LEDs. The code is as follows:

```
73 // loop()
74 //=====
75
76 void loop() {
77
78     //=====
79     // Test the LEDs
80     // Cycling through all LEDs, extinguish all LEDs, then light exactly one
81     //=====
82
83     led_counter++;
84     led_counter = led_counter % 5;
85
86     // turn off all LEDs
87     digitalWrite(LED_1, OFF);
88     digitalWrite(LED_2, OFF);
89     digitalWrite(LED_3, OFF);
90     digitalWrite(LED_4, OFF);
91     digitalWrite(LED_5, OFF);
92
93     // Illuminate exactly one LED
94     digitalWrite(led[led_counter], ON);
95
96     //=====
```
- Status Bar:** Shows "1" on the left and "Arduino Uno on /dev/ttyUSB0" on the right.

Electronic Design - coil64

Coil64 v2.1.23

File Actions Additional calculations Ferrite cores Branded cores Customize Help

Coil Inductance LC circuit

Inductance L: 50 microH
Frequency f: 0.6 MHz

Former diameter D: 37 mm
Wire diameter d: 3 mm
Wire diameter with insulation k: 3.27 mm

Wire material:
☒ Copper
☐ Silver
☐ Aluminum
☐ Tin

Select the coil form

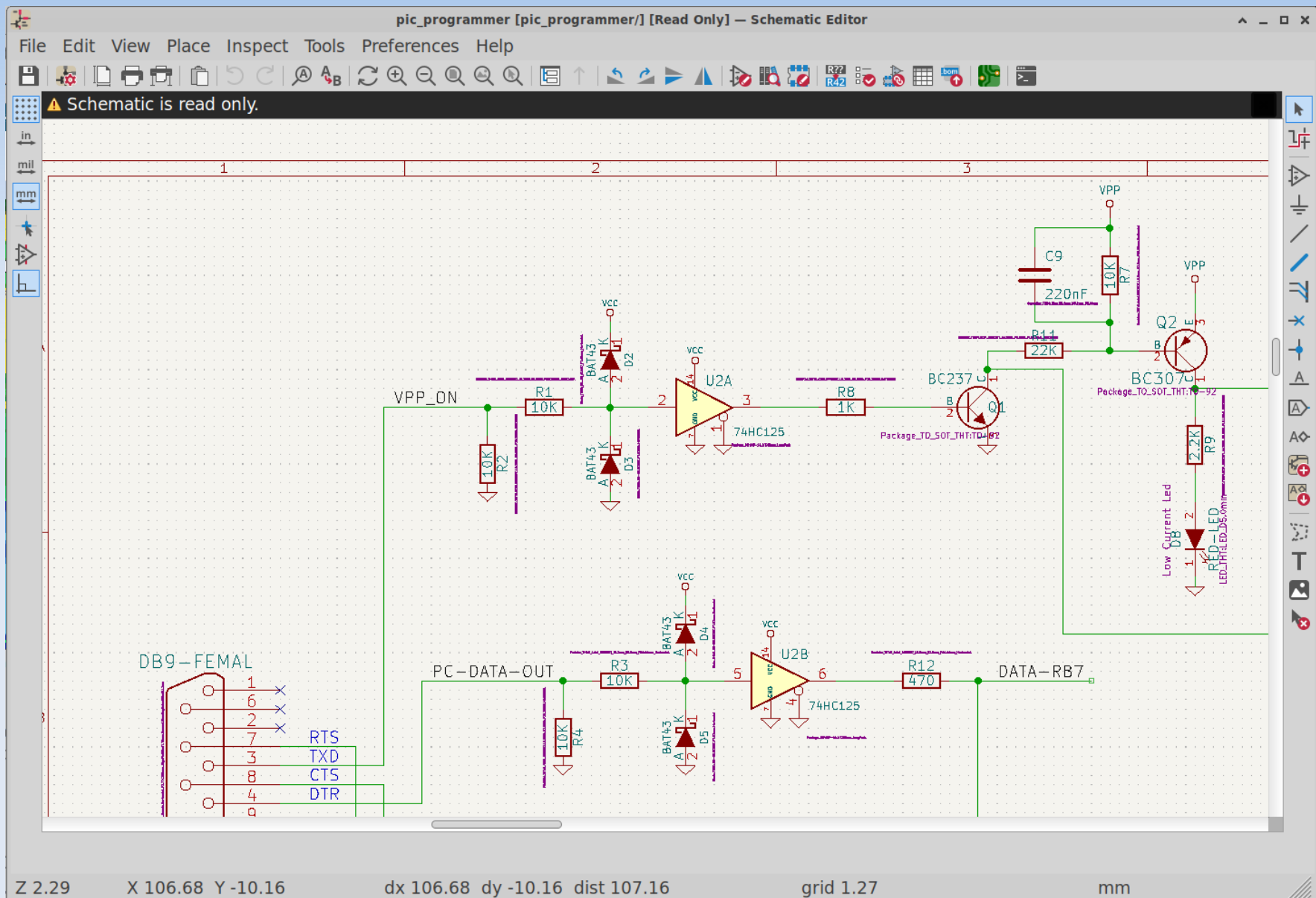
- One layer close-winding coil
- One layer coil with round wire
- One layer coil with rect wire
- One layer coil on a polygonal former
- Multilayer coil
- Multilayer coil with insulated pads
- Multilayer coil on a rectangular former
- Multilayer foil-wound coil
- Ferrite toroid coil
- PCB flat coil
- Tesla flat spiral coil

Input:
Inductance L: 50 microH
Frequency f: 0.6 MHz
Former diameter D: 37 mm
Wire diameter d: 3 mm
Wire diameter with insulation k: 3.27 mm

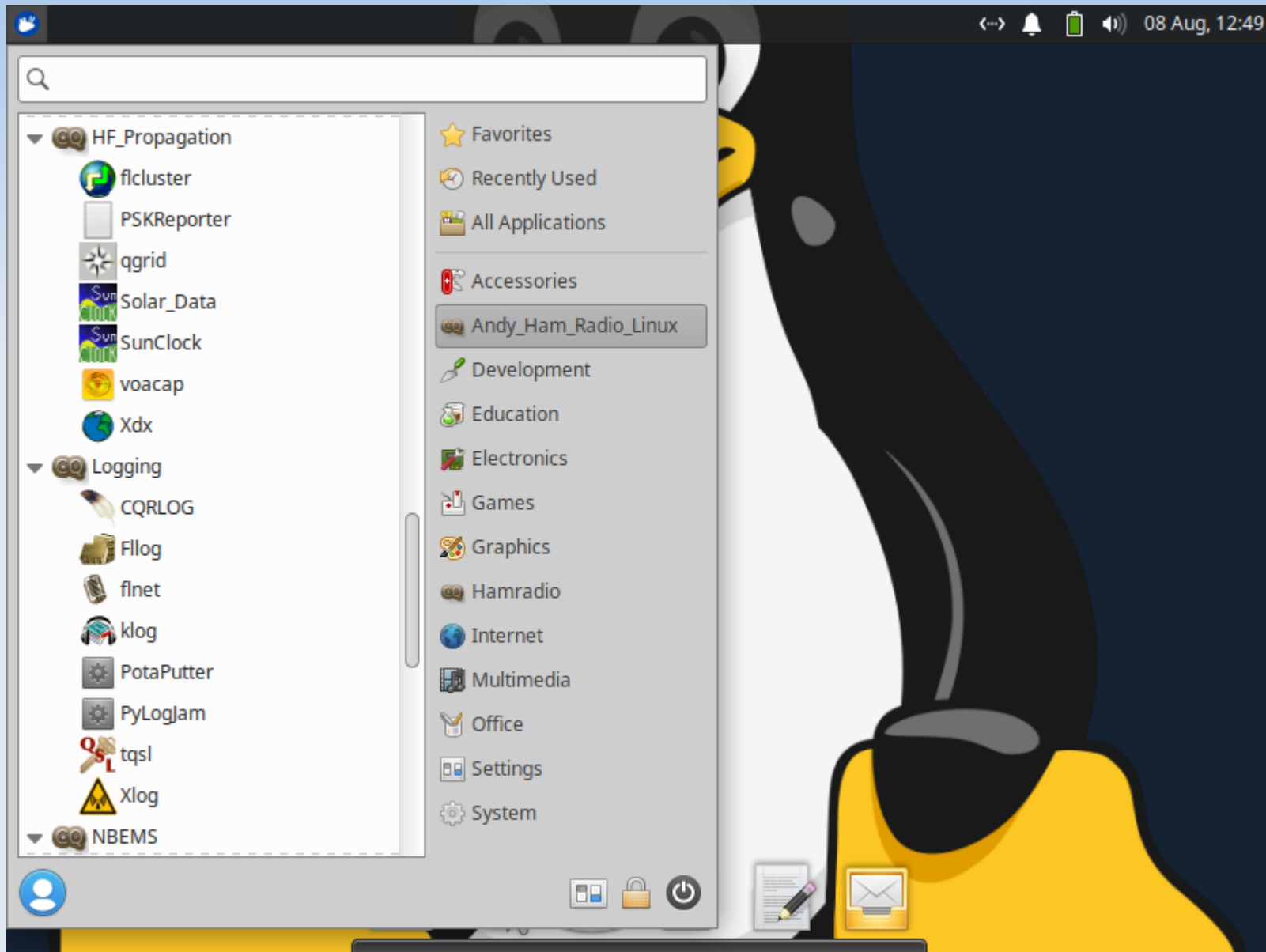
Result:
Number of turns of the coil N = 110.639
Length of wire without leads lw = 14.002 m
Length of winding l = 365.059 mm
Weight of wire m = 886.798 g
DC resistance of the coil Rdc = 0.034 Ohm
Reactance of the coil X = 188.496 Ohm

Self capacitance Cs = 4.554 pF
Coil self-resonance frequency Fsr = 17.551 MHz

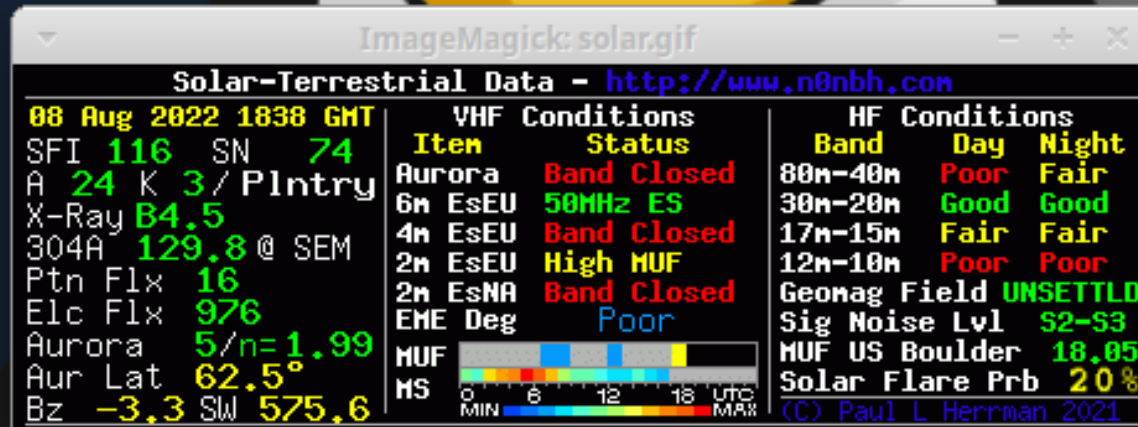
Electronic Design - kicad



Menu #4



HF Propagation #1

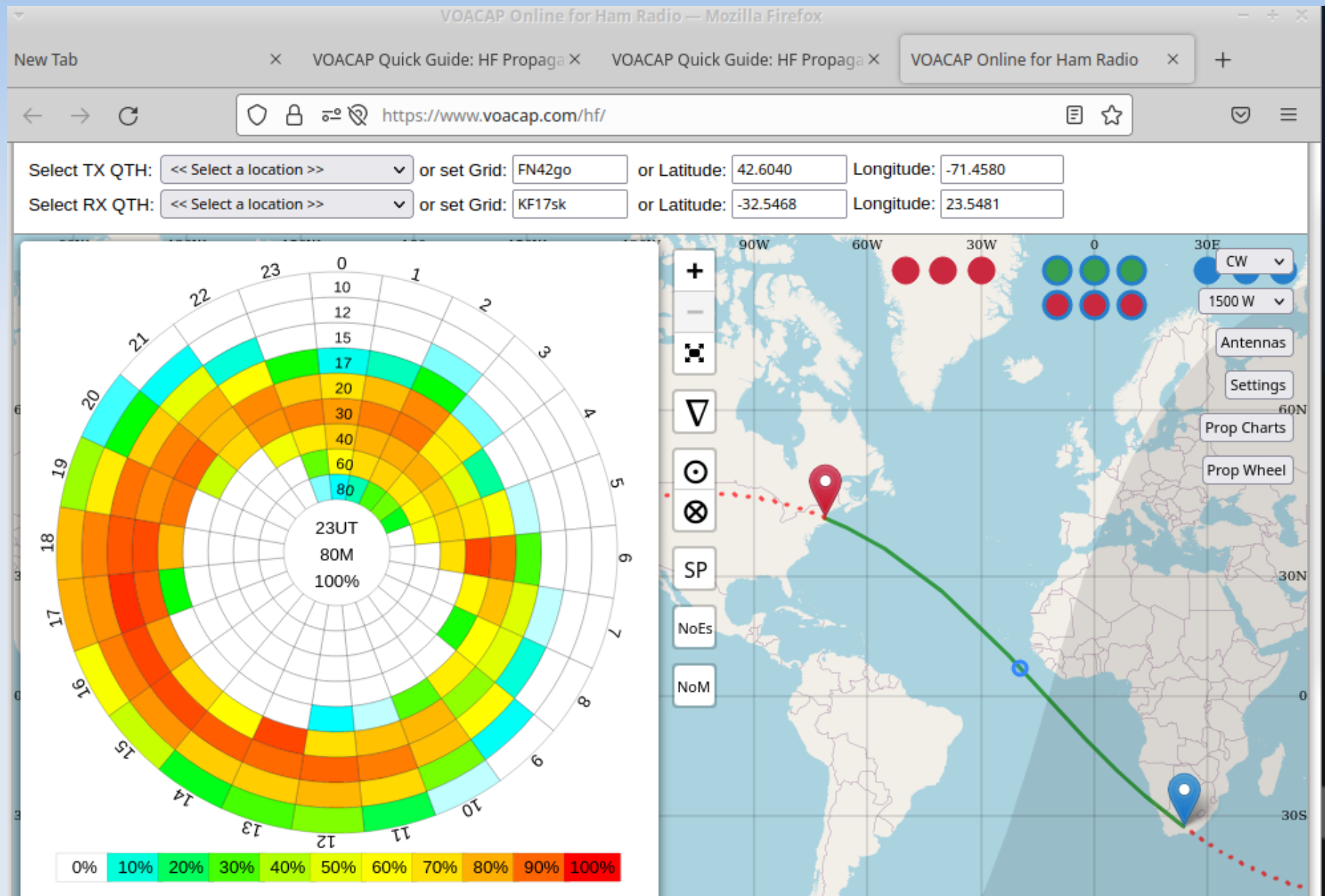


QGrid 3.2

File Help

	Home			Remote		
Locator	FN42GO			FN32LL		
Latitude	42	36	15	42	28	45
Longitude	-71	27	30	-73	2	30
Bearing	264			Distance 131		
To Lat/long			To Locator			Clear

HF Propagation #2



Logging SW: Xlog

Log Edit Options Tools Page Settings Help

+

↺

—

Write Update Delete

QSO 691

Date

16 Aug 2010

UTC

0023

Call

AB1HD

?

MHz

50

▼

Mode

SSB

▼

TX(RST)

59

RX(RST)

59

☐ QSL out

☐ QSL in

Locator

FN42ho

Remarks

Rich, Chelmsford, MA 01824 USA

HF

NR	DATE	UTC	CALL	BAND	MODE	RST	MYRST	QSLOL	QSLIN	LOCATOR
691	16 Aug 2010	0023	AB1HD	50	SSB	59	59			FN42ho
690	16 Aug 2010	0023	WA1KBE	50	SSB	59	59			FN42ho
689	08 Aug 2010	2035	VE3CWU	7	CW	579	229			FN03
688	08 Aug 2010	2000	N2JNZ	7	CW	459	559			FN24
687	08 Aug 2010	1910	KL7GLL	7	CW	459	449			FM18
686	31 Jul 2010	2145	I5ZSS	18	SSB	59	58			JN53ku
685	12 Jul 2010	0016	WA1KBE	50	SSB	59	59			FN42ho
684	11 Jul 2010	2151	WM4X	7	CW	579	579			FM18
683	11 Jul 2010	2140	W8JRA	7	CW	559	559			EN80
682	11 Jul 2010	1627	N8KZH	7	CW	359	559			EN90
681	11 Jul 2010	1305	WI2X	7	CW	599	419			FN30
680	11 Jul 2010	1240	VA2NB	7	CW	359	579			FN25

Ready.

S

✓

22 Aug 2010 1330 UTC

CQRLOG

New QSO ... (CQRLOG for Linux), database: Log 001

File View Window Statistics Online log Help

qsodate	time_on	time_off	callsign	freq	mode	rst_s

QSO nr. 1 QTH profile: New country!!

Call Frequency Mode ☒ AUTO RST sent RST rcvd

Name QTH GRID PWR QSL_S QSL_R

ITU WAZ IOTA State County Award

DXCC ref. Comment to QSO QSL VIA

☐ Offline

Date Start time End time

Comment to callsign

DXCC statistic

	1.8	3.5	7	10.1	14	18	21	24	28	50	144	430
SSB												
CW												
DIGI												

DXCC info

USA, Massachusetts

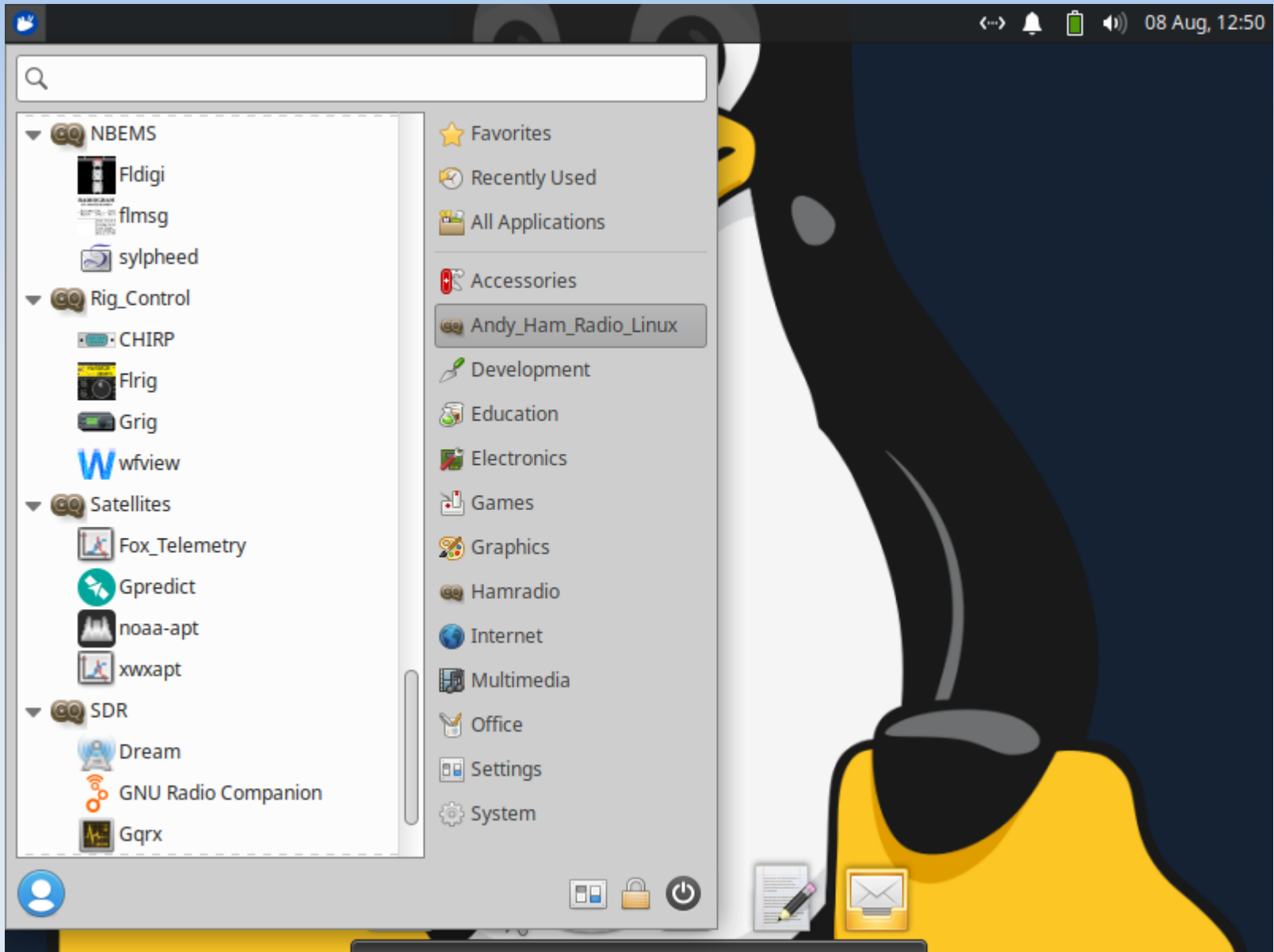
WAZ: 05 Cont: NA
ITU: 08 DXCC: W
LAT: 42.2373N LONG: 71.5314W
DIST.: AZIM:
10:17:51 23:14:24
2019-09-05 22:08:41 GE
Local:

Callbook (HamQTH.com)

Save QSO [enter] Quit program

My grid (to change press CTRL+L) Ref. call (to change press CTRL+R) KB1OIQ Ver. 2.3.0 (001)

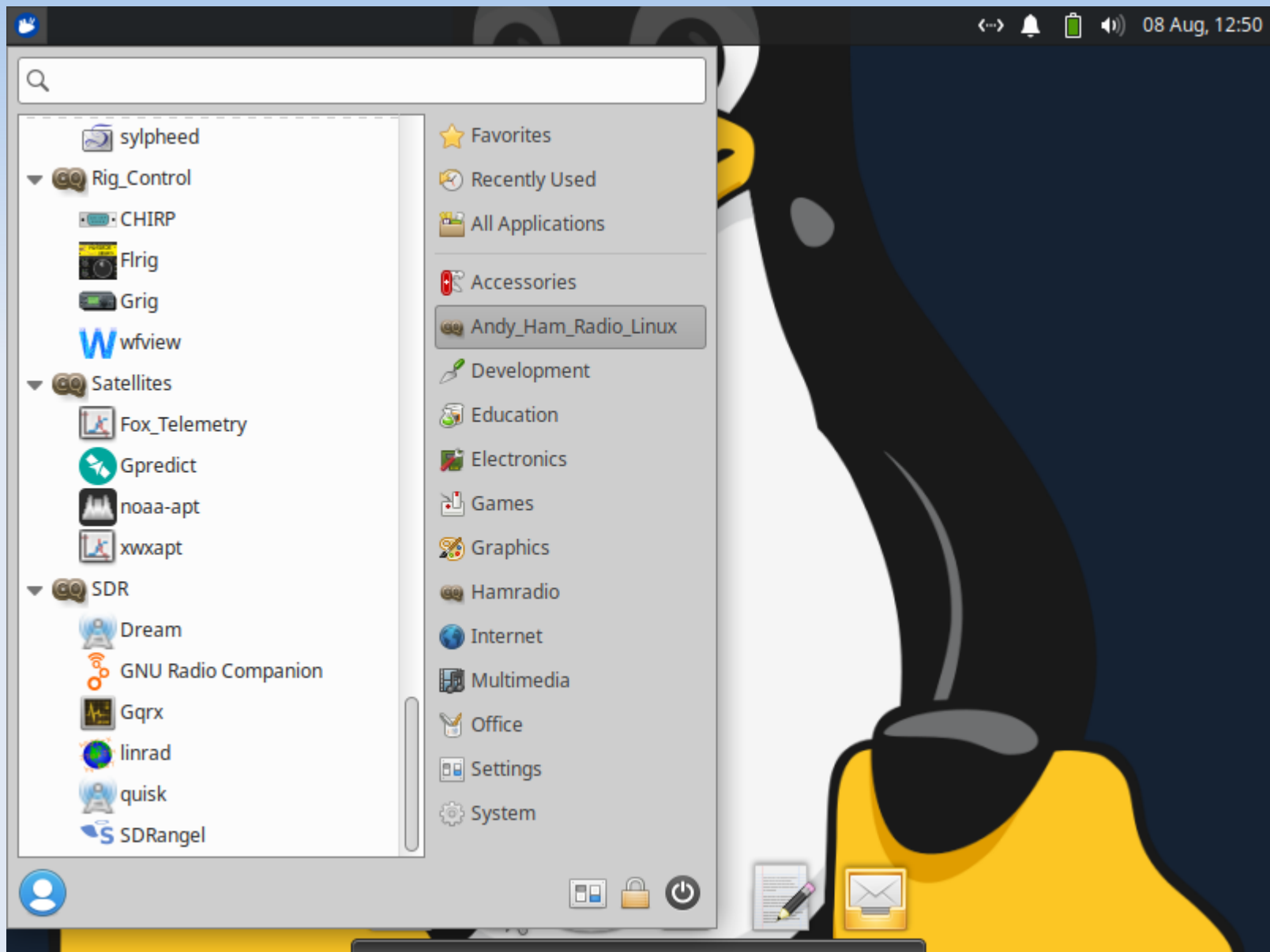
Menu #5



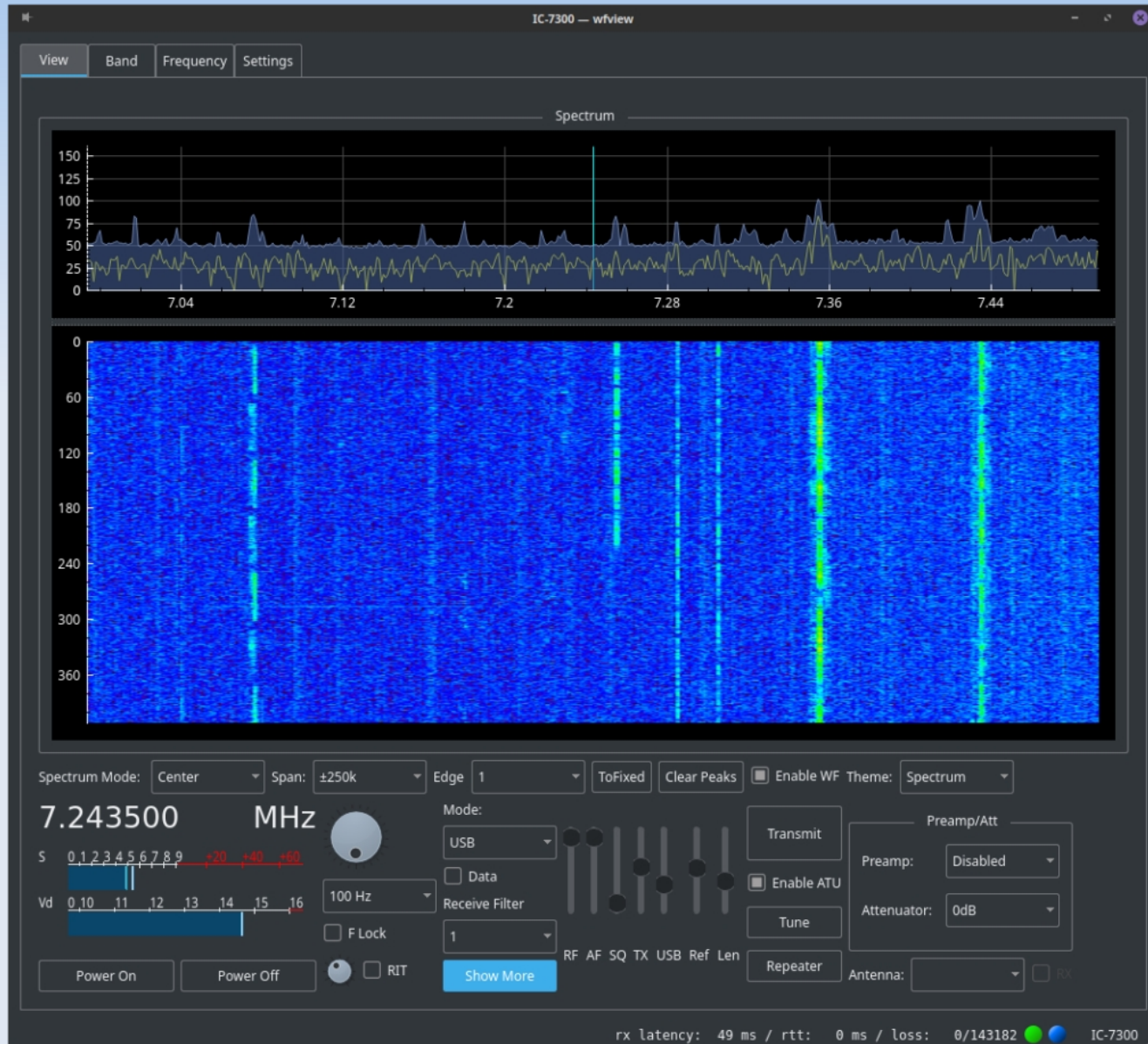
NBEMS

- Narrow Band Emergency Messaging System
- Open Source software suite
- Runs on the 3 major operating systems
- No infrastructure required
- Used by EMCOMM folks
- Ties in with sylpheed email program

Menu #6



Rig Control - wfview



Satellites - FoxTelem

AMSAT Telemetry Analysis Tool

File Decoder Spacecraft Help

Input AO-85 AO-91 AO-92 AO-95 CubeSatSim-BPSK CubeSatSim-FSK **Fox-1E** Golf-T Husky

Health WOD VU Rad (1E) VU Rad WOD Measurements

Satellite Mode: Telemetry Payloads Decoded:
Latest Realtime: Resets: Uptime: Max: Resets: Uptime: Min: Resets: Uptime:

Radio

	RT	MIN	MAX
TX Temperature (C)	0000	0000	0000
PA Current (mA)	0000	0000	0000
RSSI (dBm)	0000	0000	0000
Fwd Power (mW)	0000	0000	0000
Ref Power (mW)	0000	0000	0000
VGA Control (V)	0000	0000	0000
TX Antenna	0000		
RX Antenna	0000		

Computer Hardware

	RT	MIN	MAX
Temperature (C)	0000	0000	0000
Battery I2C	0000		
PSU1 I2C	0000		
PSU2 I2C	0000		
RF I2C	0000		
Ground Resets	0000		
IHU Hard Error Data	0000		

Computer Software

	RT	MIN	MAX
Spacecraft Spin (rpm)	0000	0000	0000
Diagnostic Info	0000		
WOD Stored (000s)	0000		
Safe Mode	0000		
Auto Safe Mode	0000		
Auto Safe Allowed	0000		
Science Mode	0000		
Soft Error	0000		

Battery

	RT	MIN	MAX
Cell A (V)	0000	0000	0000
Cell A + B (V)	0000	0000	0000
Cell A + B + C (V)	0000	0000	0000
Temperature A (C)	0000	0000	0000
Temperature B (C)	0000	0000	0000
Temperature C (C)	0000	0000	0000
Current (mA)	0000	0000	0000
Board Temp (C)	0000	0000	0000

MPPT

	RT	MIN	MAX
Current (mA)	0000	0000	0000

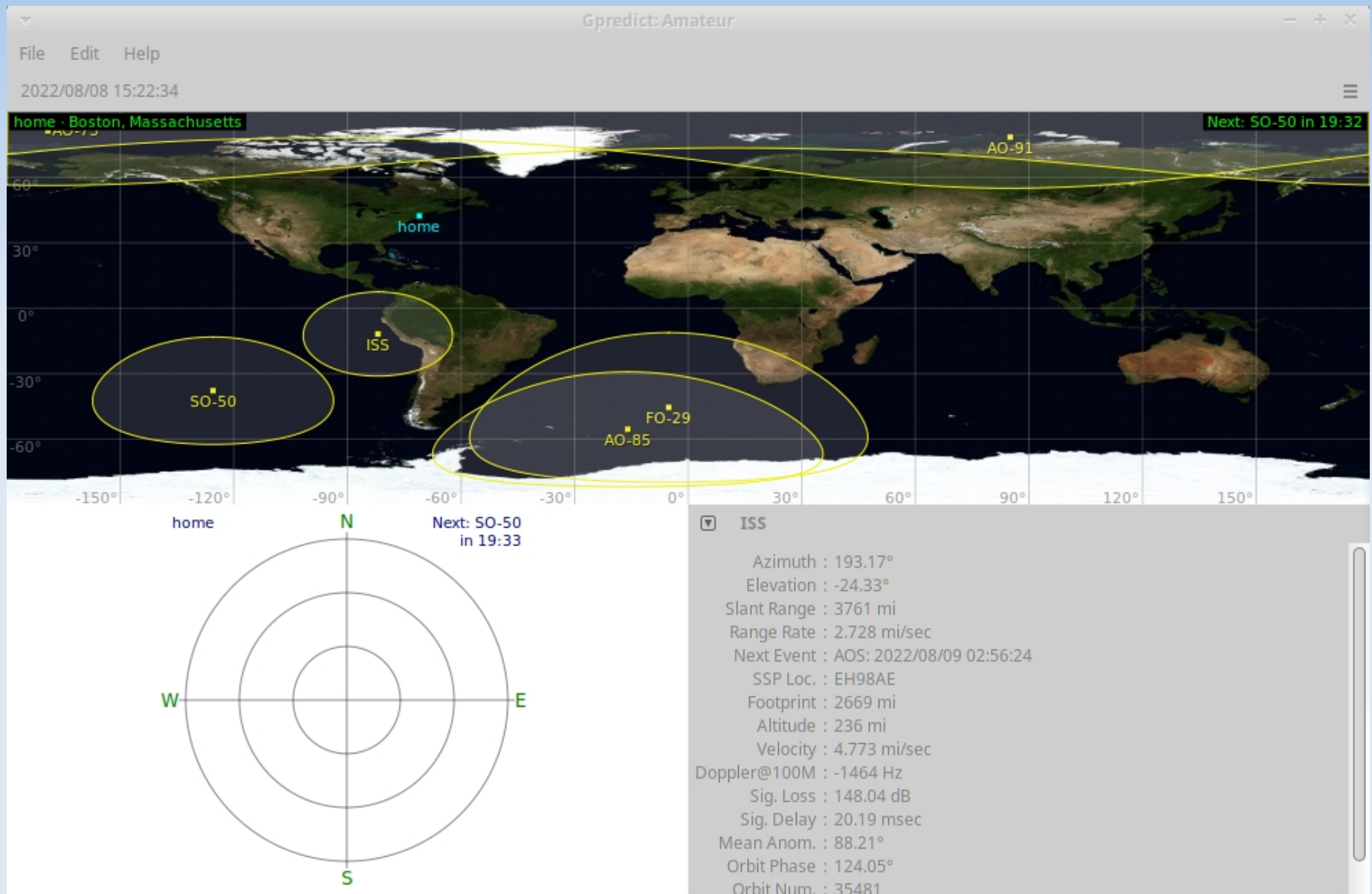
Experiments

	RT	MIN	MAX
EXP4 Temp (C)	0000	0000	0000
Vanderbilt Radiation	0000		

☒ Current ☐ RT ☐ MAX ☐ MIN ☐ Display Raw Values ☒ Display UTC Time Last 180 samples Captured:

Version 1.11g - 6 Jul 2021 Logs: /home/andy USB Errors: 0 / 0 Audio missed: 0.0% / 0 Frames: Payloads: Queue: 0

Satellites - gpredict



SDR – GNU Radio Companion

- SDR = Software Defined Radio
- Draw a block diagram of your signal processing
- GRC will write the python code and execute it
- Supports SDR devices such as:
 - RTL-SDR dongle
 - HackRF
- Many tutorials are available online

SDR – GNU Radio Companion #1

The screenshot displays the GNU Radio Companion (GRC) interface for a project named 'hackrf_lesson_1.grc'. The main workspace shows a flow graph with the following components and connections:

- RTL-SDR Source**: Configured with Sync: Unknown PPS, Number Channels: 1, Sample Rate (sps): 2M, Ch0: Frequency (Hz): 99.5M, Ch0: DC Offset Mode: 0, Ch0: IQ Balance Mode: 0, Ch0: Gain Mode: False, Ch0: RF Gain (dB): 10, Ch0: IF Gain (dB): 20, Ch0: BB Gain (dB): 20.
- Low Pass Filter**: Decimation: 10, Gain: 1, Sample Rate: 2M, Cutoff Freq: 75k, Transition Width: 25k, Window: Hamming, Beta: 6.76.
- Rational Resampler**: Interpolation: 12, Decimation: 5, Taps: Fractional BW: 0.
- WBFM Receive**: Quadrature Rate: 480k, Audio Decimation: 10.
- Multiply Const**: Constant: 250m.
- Audio Sink**: Sample Rate: 48 kHz.

Three GUI blocks are also present:

- QT GUI Range** (ID: freq, Label: Freq, Default Value: 99.5, Start: 88, Stop: 108, Step: 100m).
- QT GUI Chooser** (ID: freq, Label: Station, Num Options: 4, Default option: 99.5, Option 0: WCRB, Option 1: 100.7, Label 1: WZLX, Option 2: 104.5, Label 2: WXLO, Option 3: 105.7, Label 3: WROR).
- QT GUI Range** (ID: volume, Label: Volume, Default Value: 250m, Start: 0, Stop: 1, Step: 25m).

Two additional GUI blocks are connected to the RTL-SDR Source:

- QT GUI Frequency Sink**: FFT Size: 2048, Center Frequency (Hz): 99.5M, Bandwidth (Hz): 2M.
- QT GUI Waterfall Sink**: FFT Size: 1024, Center Frequency (Hz): 99.5M, Bandwidth (Hz): 2M.

The bottom left shows the terminal output:

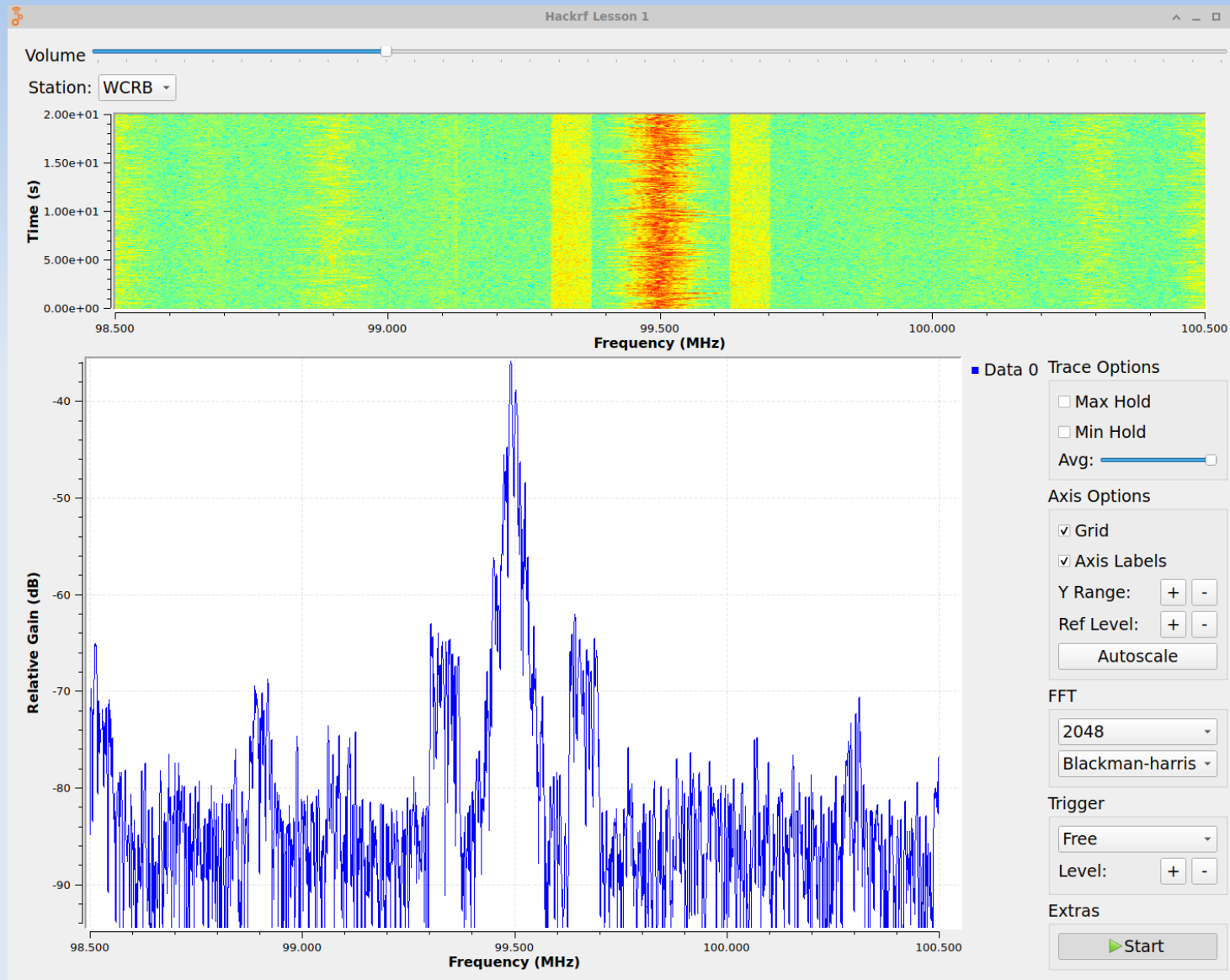
```
00000001
Detached kernel driver
Found Rafael Micro R820T tuner
[R82XX] PLL not locked!
Exact sample rate is: 2000000.052982 Hz
[R82XX] PLL not locked!
Allocating 15 zero-copy buffers
aU
```

The bottom right shows a table of variables:

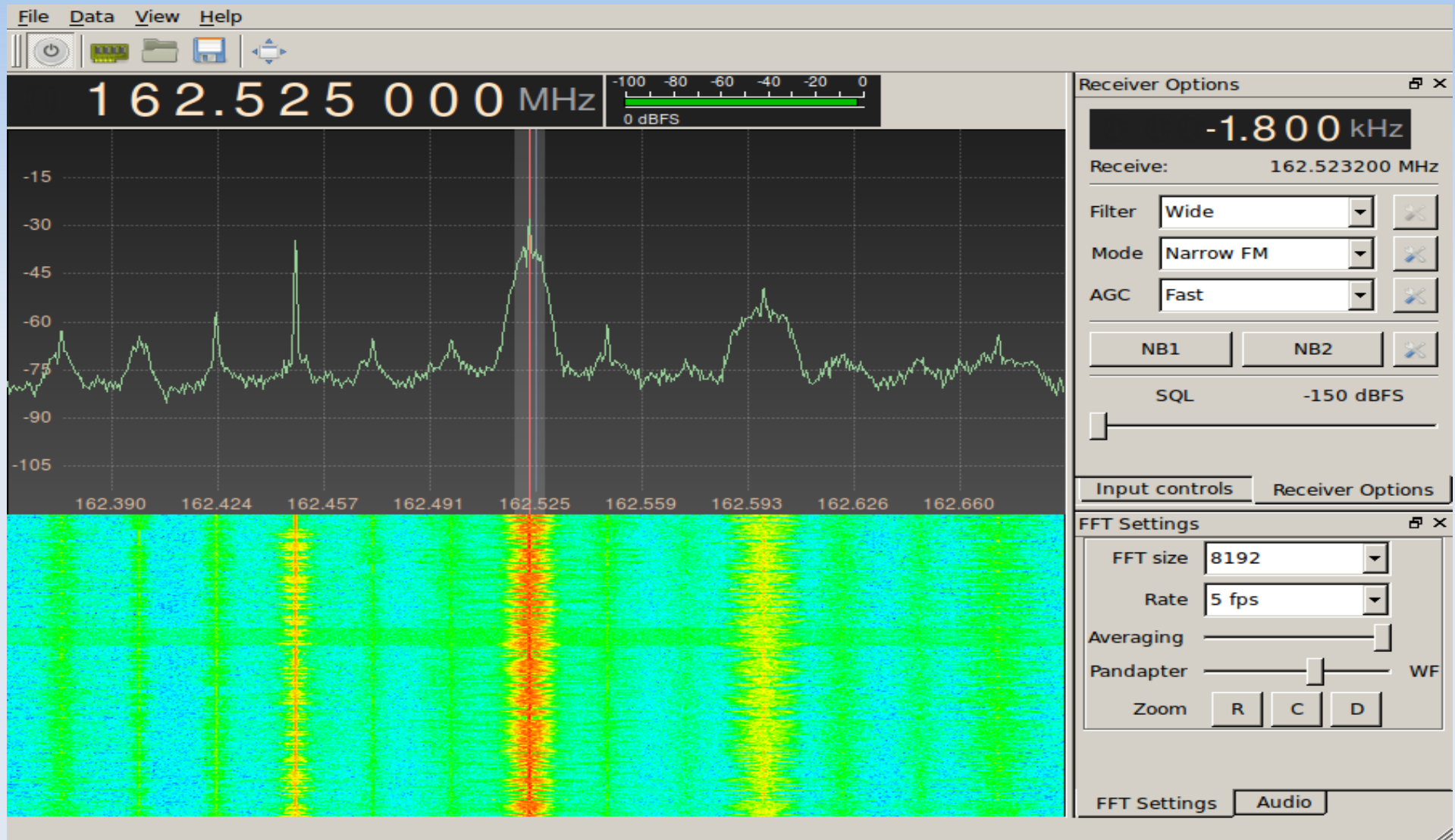
ID	Value
Imports	
Variables	
freq	99.5
freq	99.5
samp_ra	2000000.0

The right sidebar contains a search bar and a list of blocks categorized under 'Core' and 'Deprecated'.

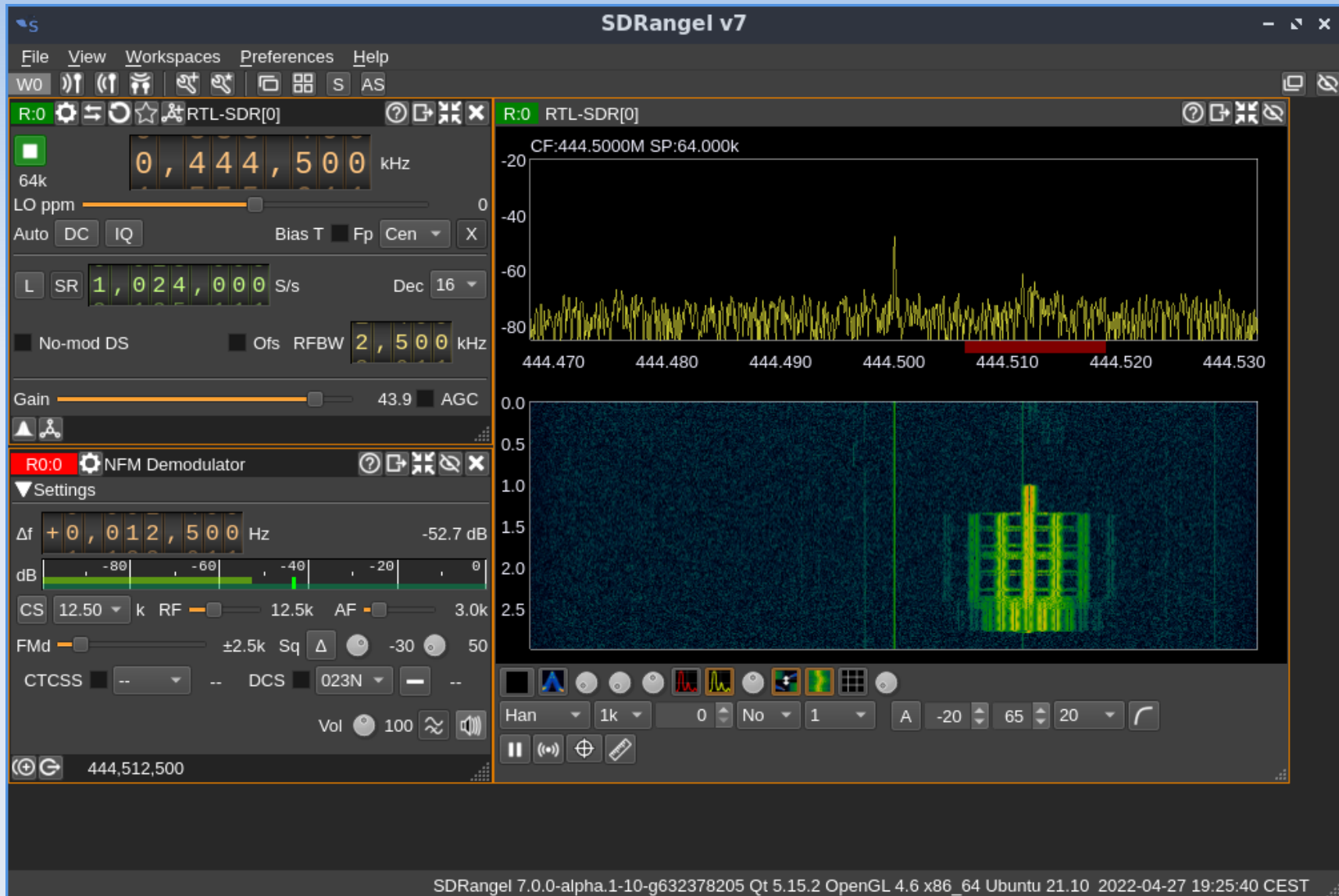
SDR GNU Radio Companion #2



SDR - gqrx



SDR - sdrangel



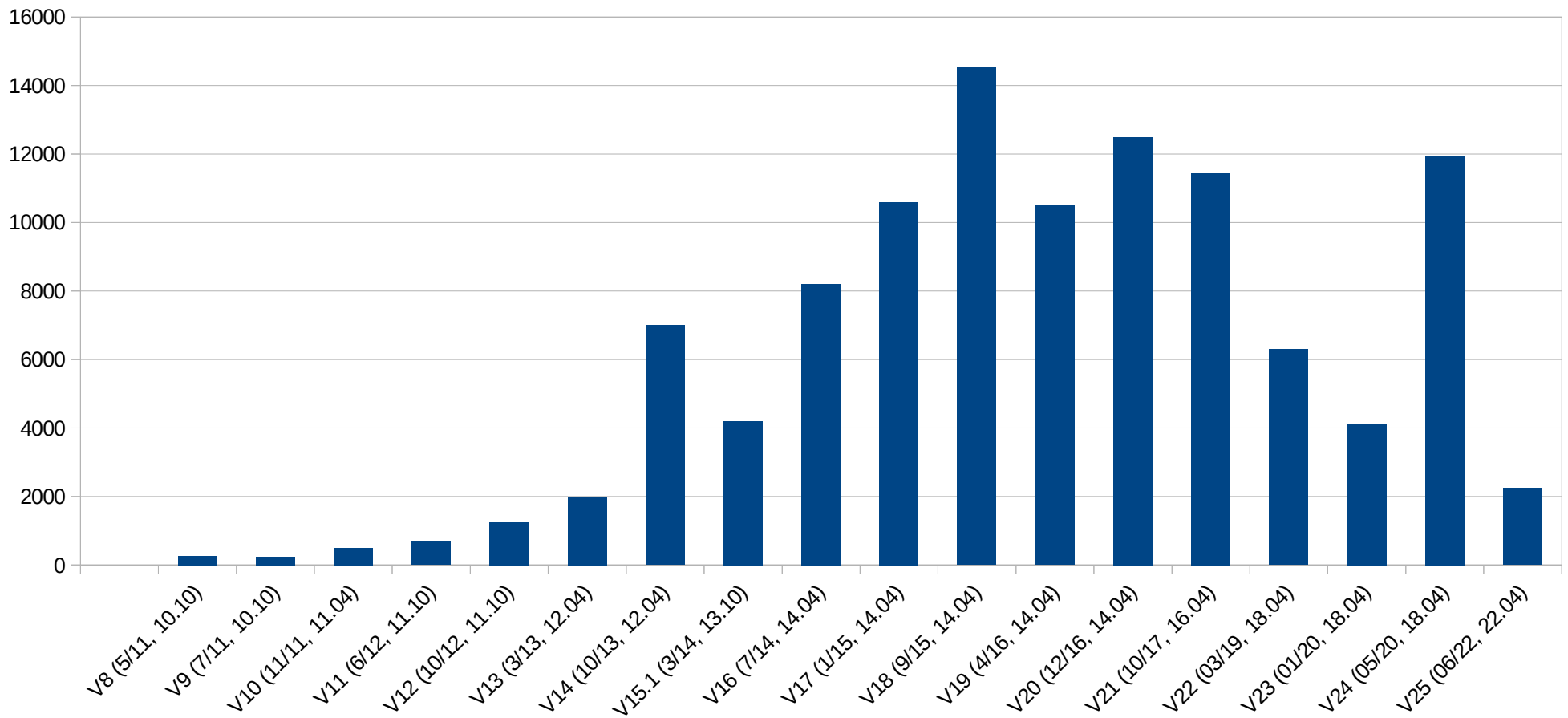
What's new and cool?

- Free Digital Voice (FreeDV)
 - Codec2: David (VK5DGR) Rowe
 - <https://freedv.org/>
- M17 Project
 - Low level protocols using Codec2
 - <https://m17project.org/>

Downloads

Number of Downloads

Andy's Ham Radio Linux



Awarded 03/2022

- 11 years and 100,000 downloads later.....
- <https://nediv.arrl.org/2022/03/02>



Sourceforge

- Go there: <http://www.sourceforge.net>
- Search for KB1OIQ
- Other ham radio programs are there
 - uBITX modified for blind amateur radio users
 - Bionics configuration programs
 - MicroFox, TinyTrack
 - Wordsworth – collaboration with K1IG
 - a way to learn CW
 - aa-analyzer for Rig Expert analyzers

Last Slide!

- Questions?
- Slides available:
 - Email: kb1oiq@arri.net
- Thanks for coming to this talk!
- Have a lot of fun, and 73 de Andy KB1OIQ