



Linux® in Your Ham Shack



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KB1OIQ
Westford, MA USA

Presented to the
Billerica Amateur Radio Society
September 07, 2022

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

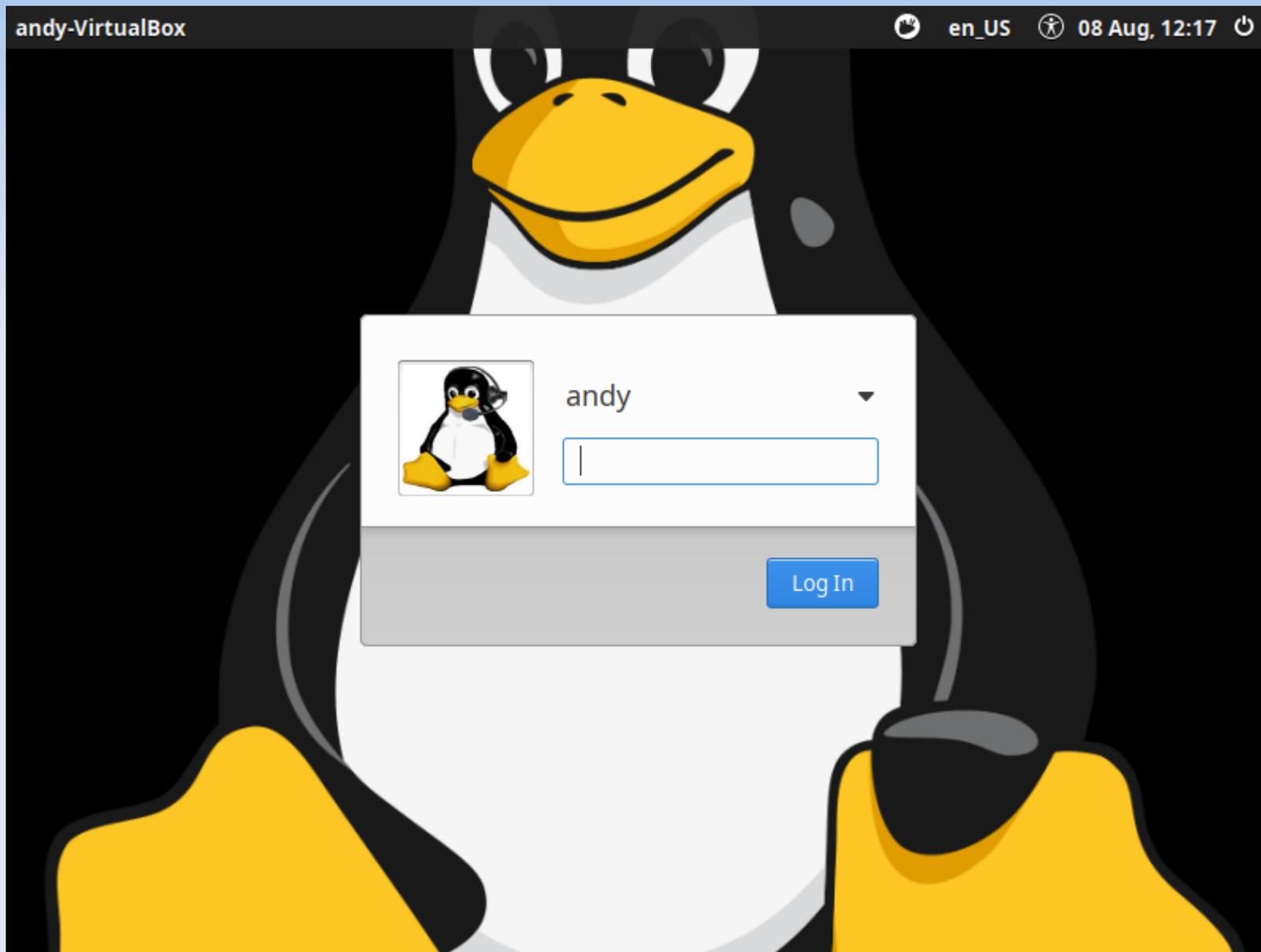
Initial Boot before Installation



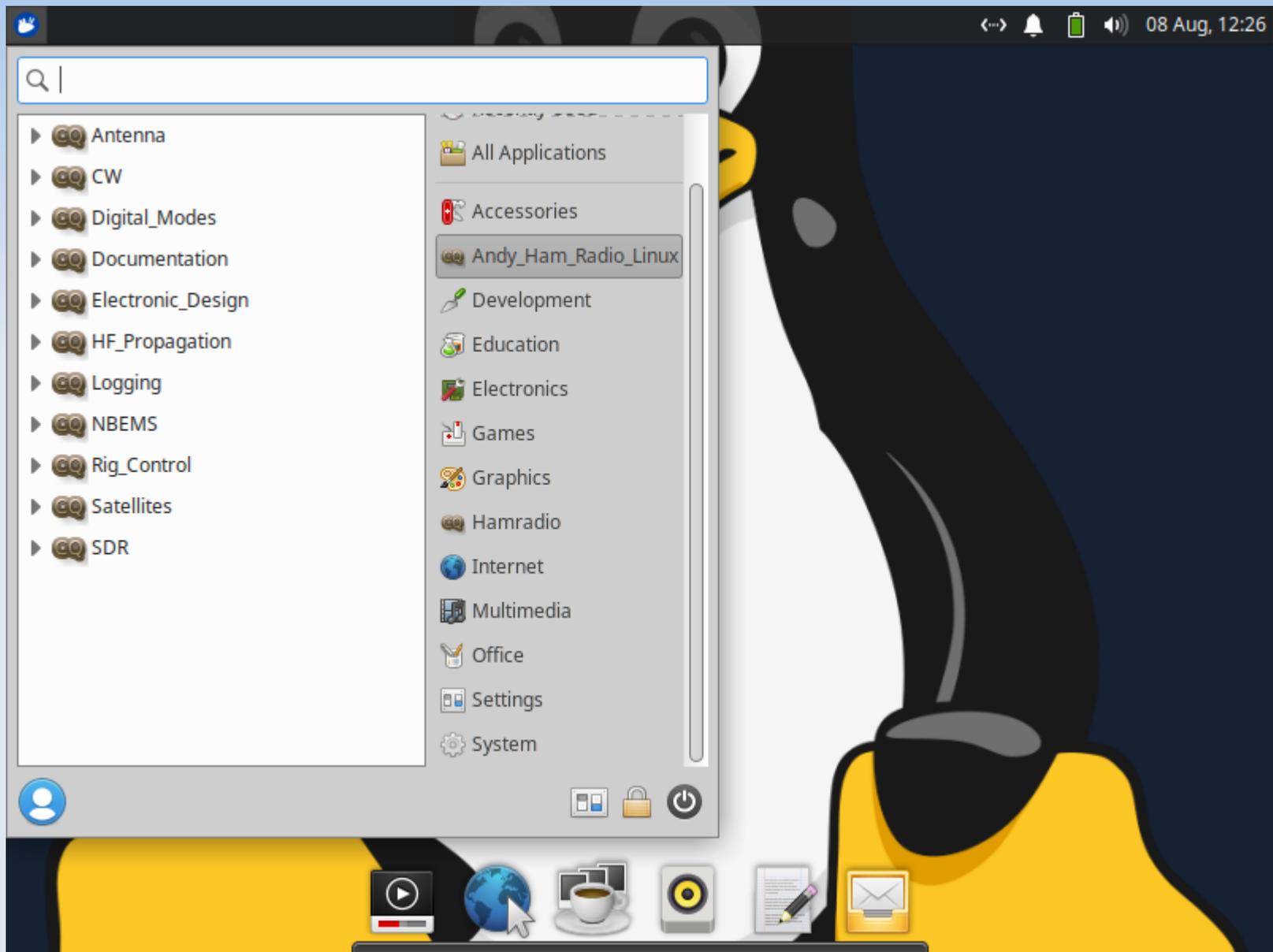
GETTING_STARTED

- 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.

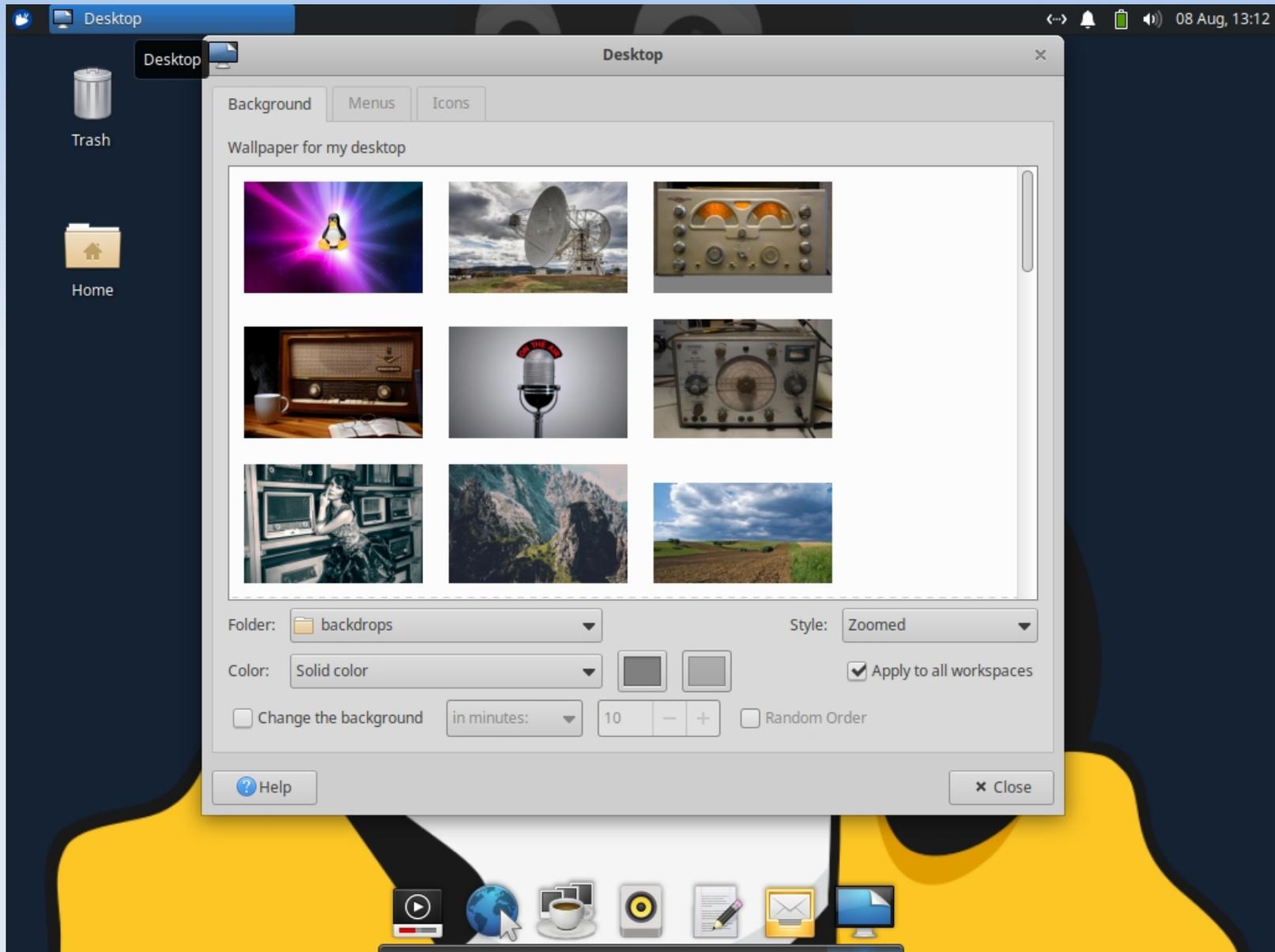
Initial Login Screen After Installation



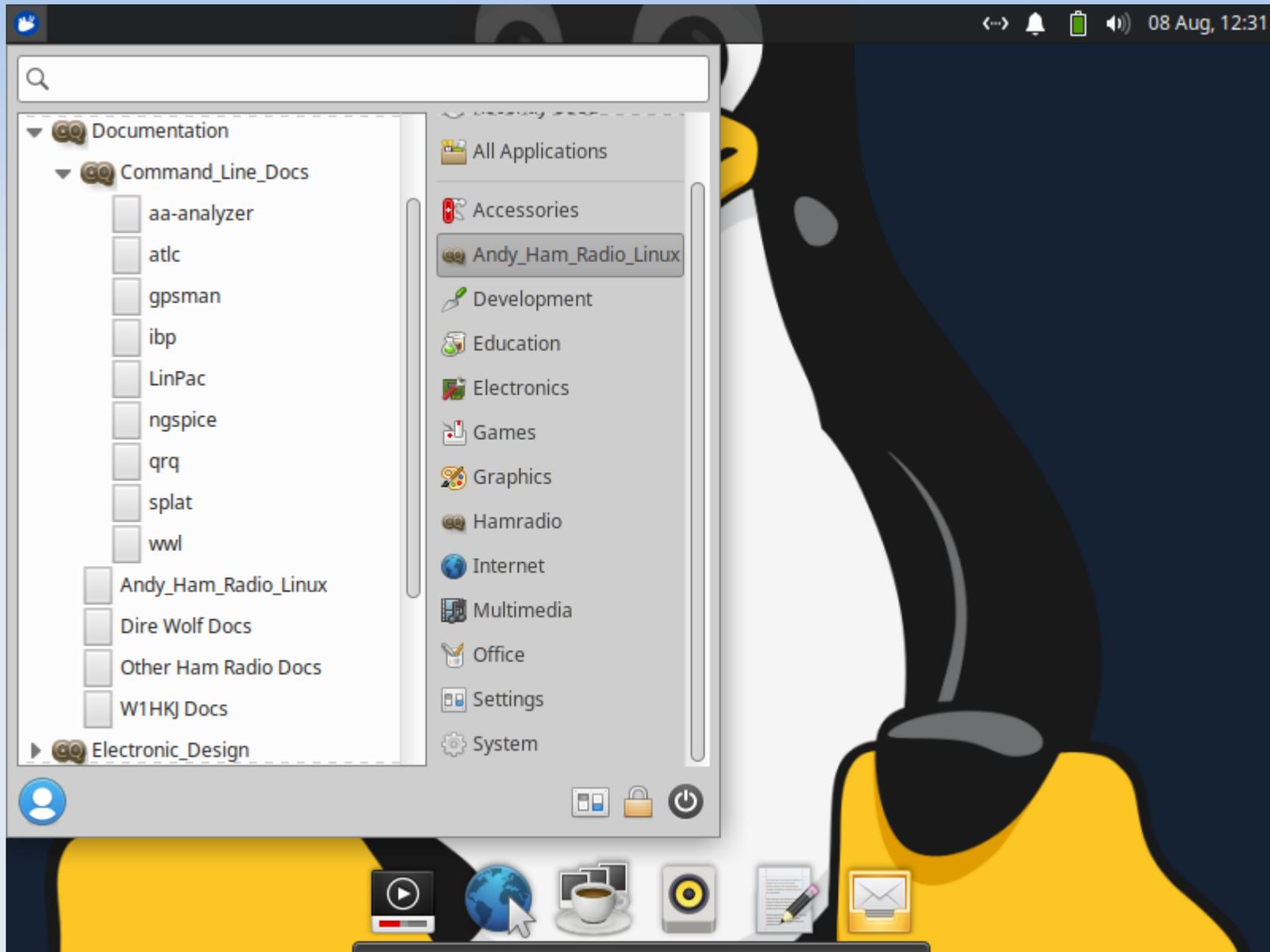
Initial Desktop



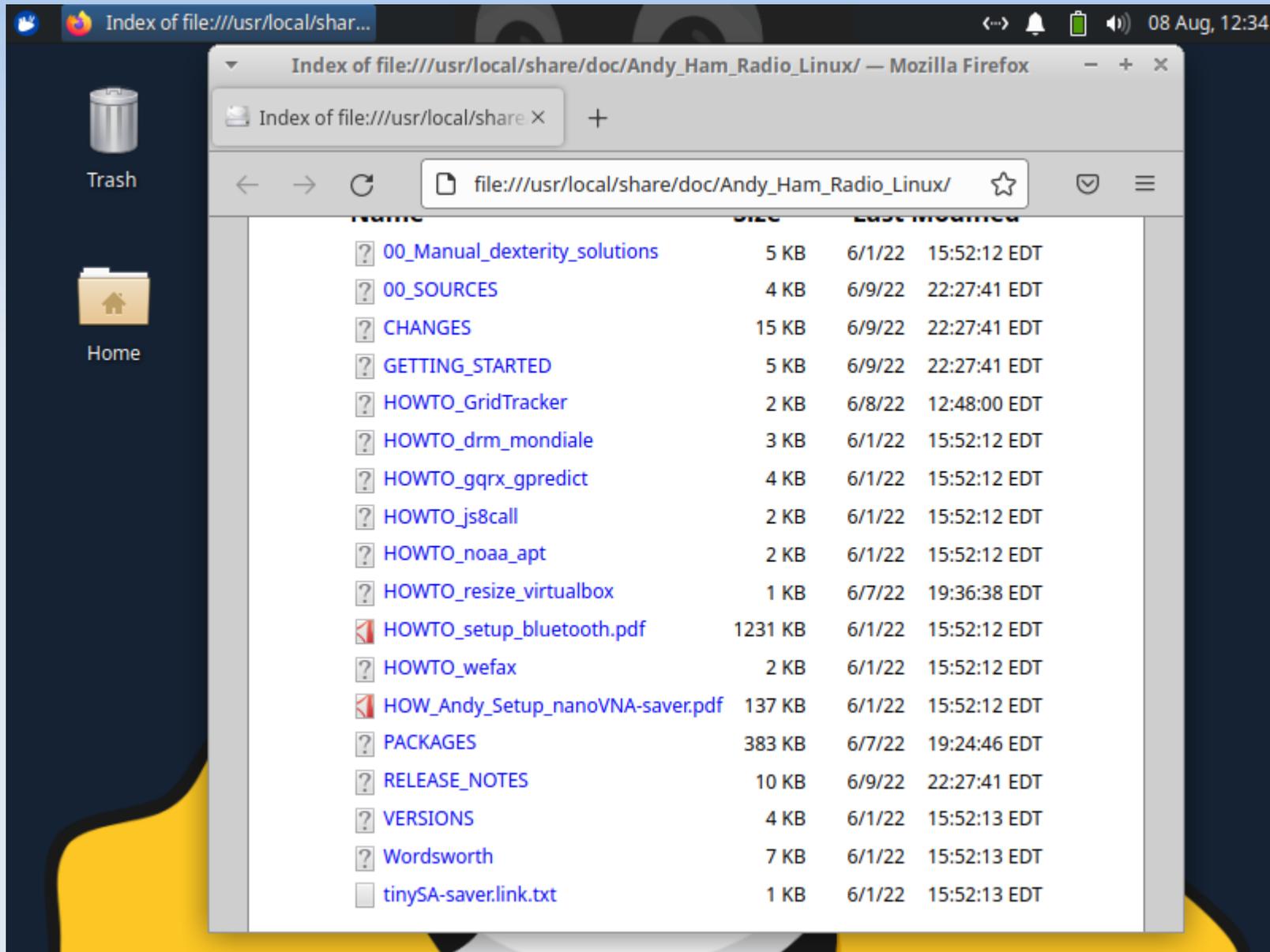
Desktop Backgrounds



Documentation



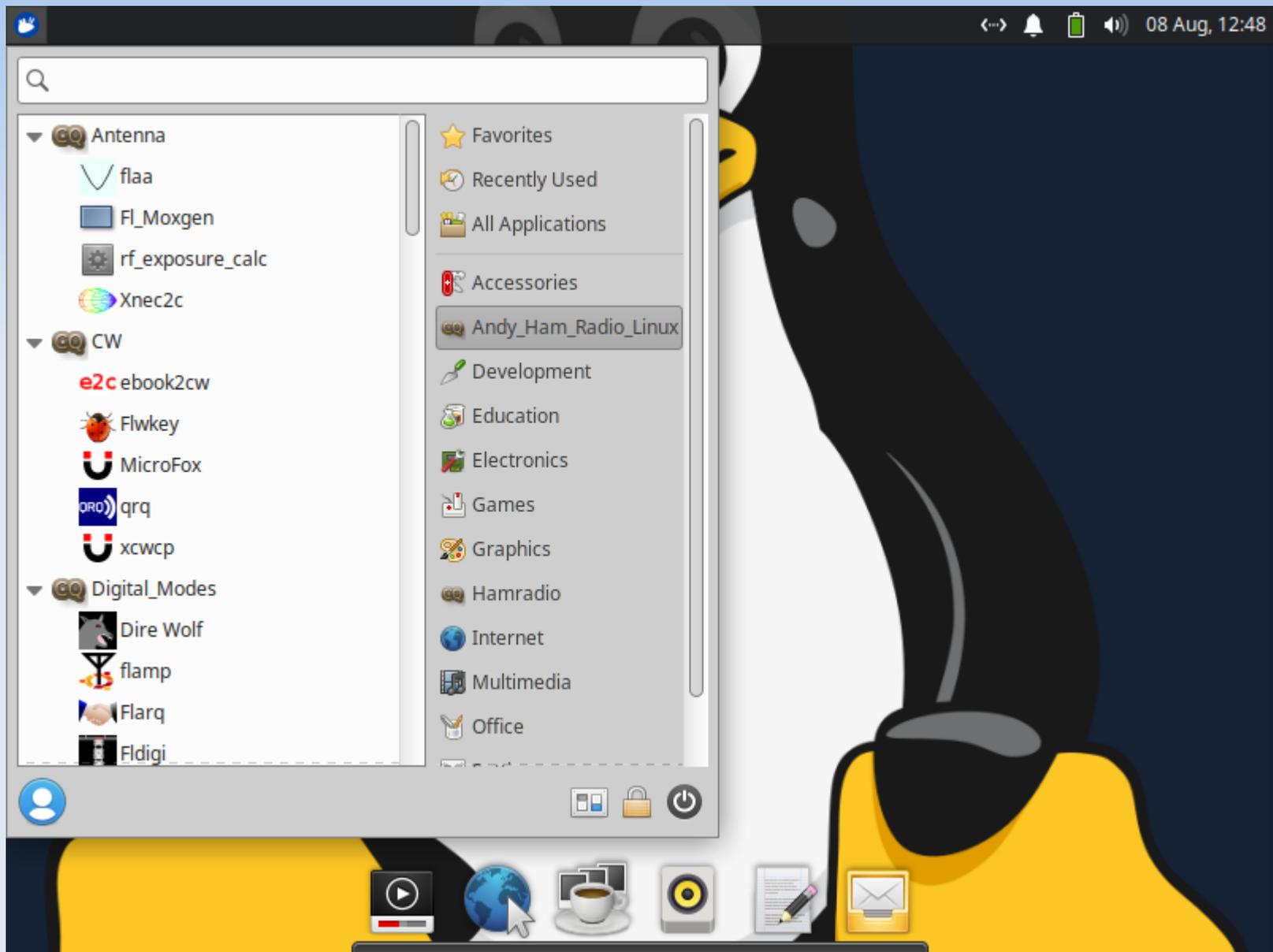
AHRL Documentation



The screenshot shows a Linux desktop environment with a file manager window open. The window title is "Index of file:///usr/local/share/doc/Andy_Ham_Radio_Linux/ — Mozilla Firefox". The address bar shows the file path: "file:///usr/local/share/doc/Andy_Ham_Radio_Linux/". The file manager displays a list of files and folders with columns for Name, Size, and Last Modified. The files listed are:

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_apt	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



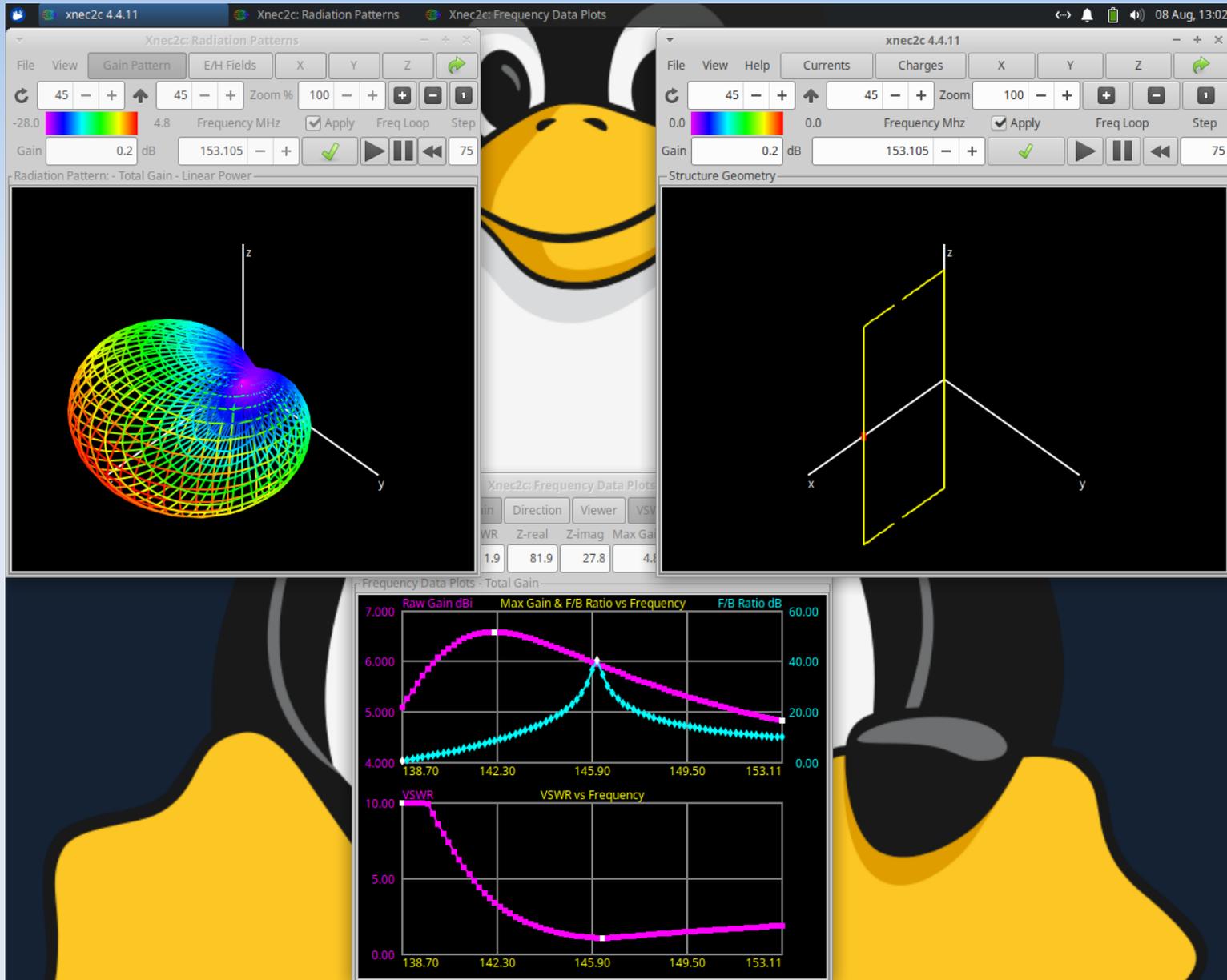
Moxon Rectangle - fl_moxgen

The screenshot displays the FL_MoxGen software interface. The main window shows a diagram of a Moxon Rectangle antenna with the following components and dimensions:

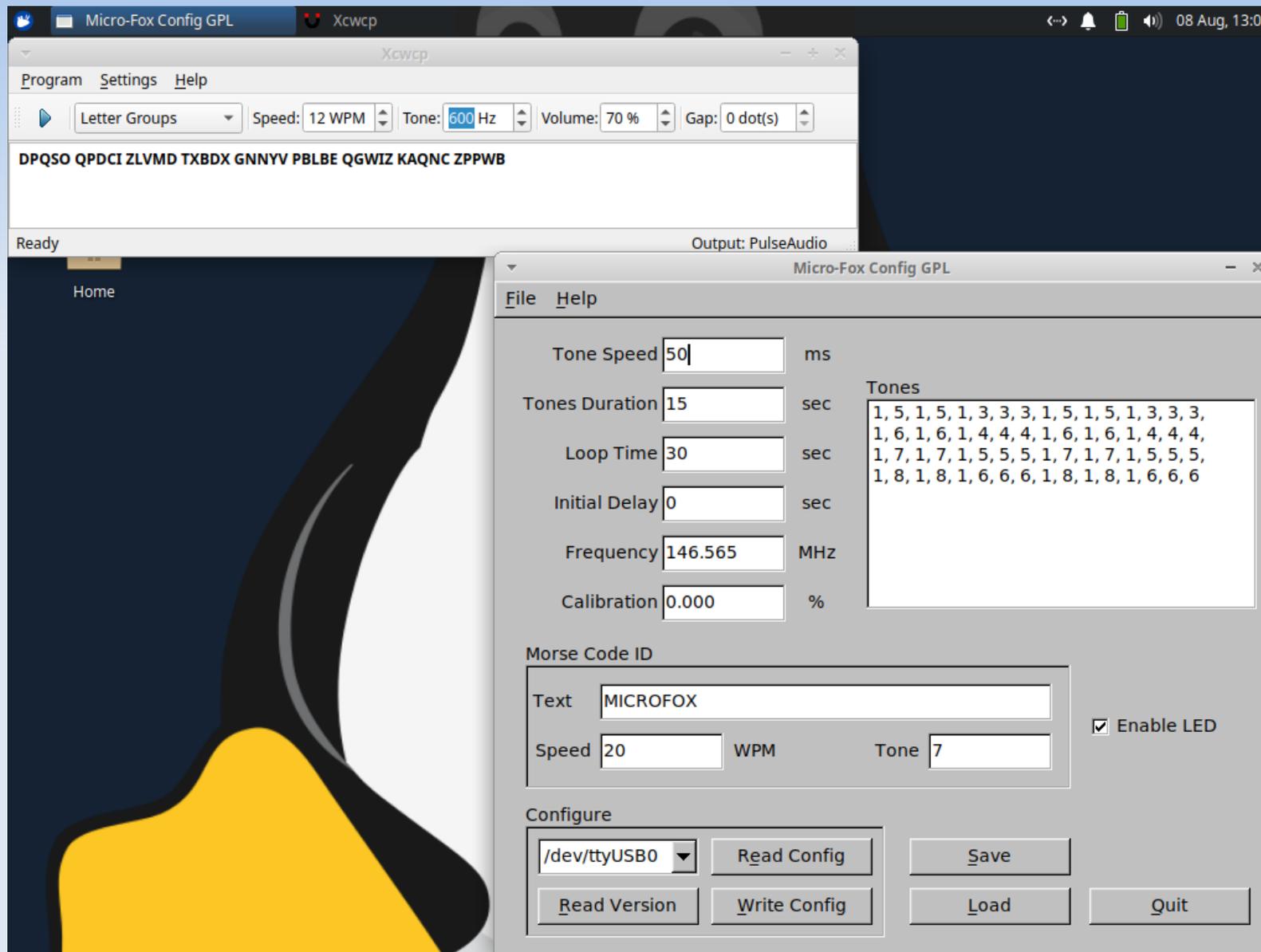
- Frequency (MHz):** 146
- Wire Size:** 14 AWG
- Dimensions:**
 - A: 29.207 in
 - B: 4.107 in
 - C: 1.117 in
 - D: 5.553 in
 - E: 10.777 in
- Result Units:** Inches (selected)

The diagram labels the **Feedpoint**, **Driven Element**, and **Reflector**. The dimensions A, B, C, D, and E are indicated by arrows on the diagram.

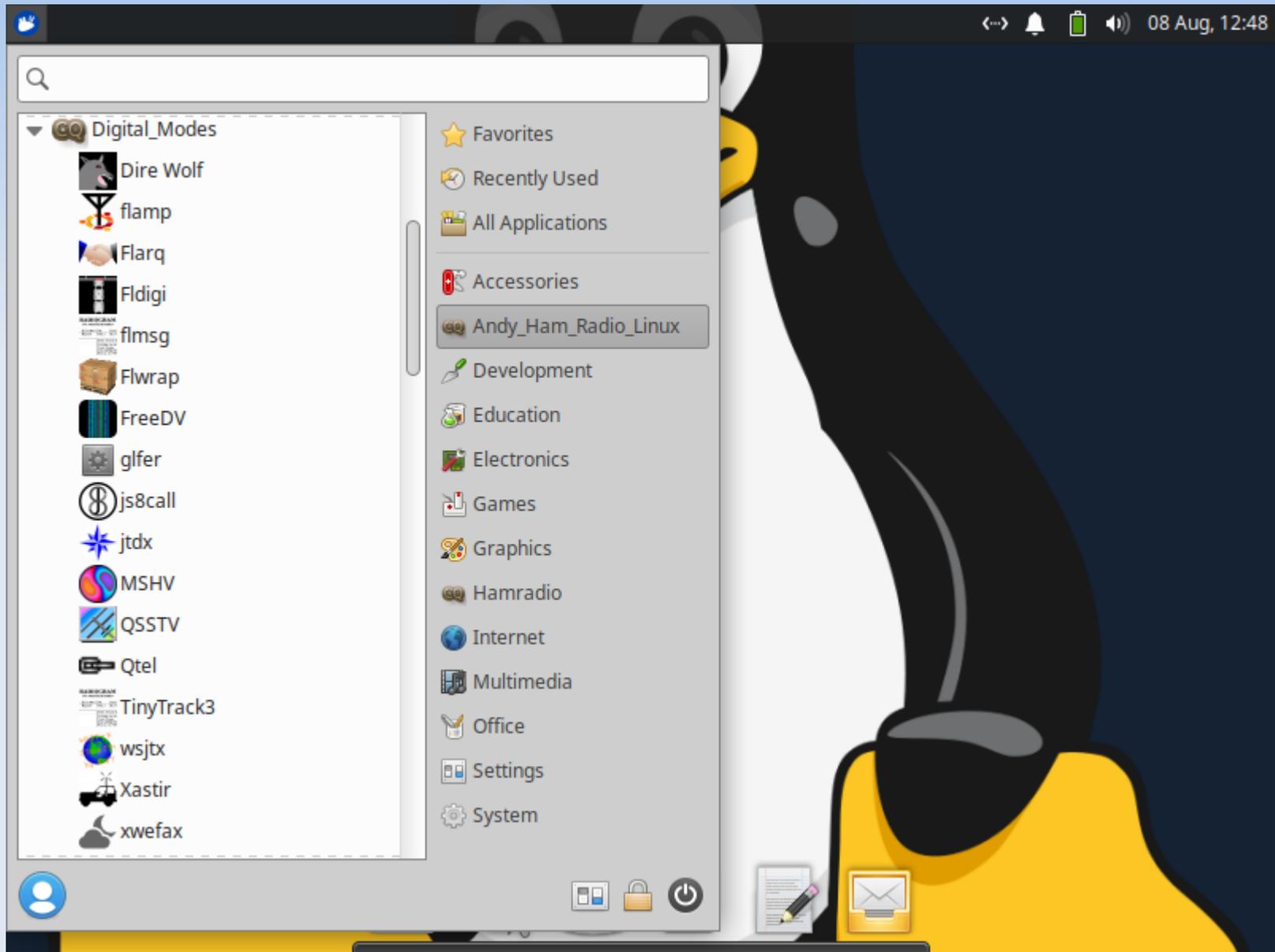
Antenna modeling - xnec2c



CW and Fox Hunting



Menu #2



Digital Modes - wsjtx

The screenshot displays the WSJT-X v2.5.4 software interface. The main window is titled "WSJT-X v2.5.4 by K1JT, G4WJS, K9AN, and IV3NWV". It features a menu bar with "File", "Configurations", "View", "Mode", "Decode", "Save", "Tools", and "Help".

The interface is divided into several sections:

- Band Activity:** A table showing received signals. The selected mode is 20m. The table columns are UTC, dB, DT, Freq, and Message. The selected entry is at 14.074 000 MHz.
- Rx Frequency:** A table showing received signals. The selected mode is 20m. The table columns are UTC, dB, DT, Freq, and Message. The selected entry is at 172515 UTC, -1.1 dB, 0.7 DT, 1415 Freq, with the message "CQ N8HCS EN63 U.S.A.".
- Controls:** Includes buttons for "Log QSO", "Stop", "Monitor", "Erase", "Decode", "Enable Tx", "Halt Tx", and "Tune". There are also checkboxes for "CQ only", "Tx even/1st", and "Hold Tx Freq".
- Frequency and Mode:** The current frequency is 14.074 000 MHz, and the mode is 20m. The transmit rate is 1423 Hz.
- DX Call and Grid:** The DX Call is EA8J and the DX Grid is IL18. The distance is 3161 mi and the azimuth is 89 degrees.
- Generate Std Msgs:** A list of standard messages for the EA8J call, including "EA8J KB1OIQ FN42", "EA8J KB1OIQ -15", "EA8J KB1OIQ R-15", "EA8J KB1OIQ RR73", "EA8J KB1OIQ 73", and "CQ KB1OIQ FN42".
- Wide Graph:** A waterfall plot showing frequency activity from 500 to 3000 kHz. The time axis shows the current time as 17:29:43 on 2022 Aug 08.

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

GridTracker 1.22.0503 [Band: 20m Mode: FT8 Layer: Grids - Worked 498 Confirmed 445]

GridTracker
 14.074.000 Hz (20m) FT8
 Mon 08 Aug 2022 17:33:37 UTC
 EA8J IL18 -15
 Canary Is. 3154mi 89°

RECEIVE

Rx Calls 47 QSO 22607
 Rx DXCC 4 QSL 7744
 Clear Live Clear Log

Map View Filters
 Band Auto
 Mode Auto
 Prop Unknown
 Data Logbook & Live

Legend
 QSO QSL
 QSX CQ CQDX
 QRZ QTH WSPR

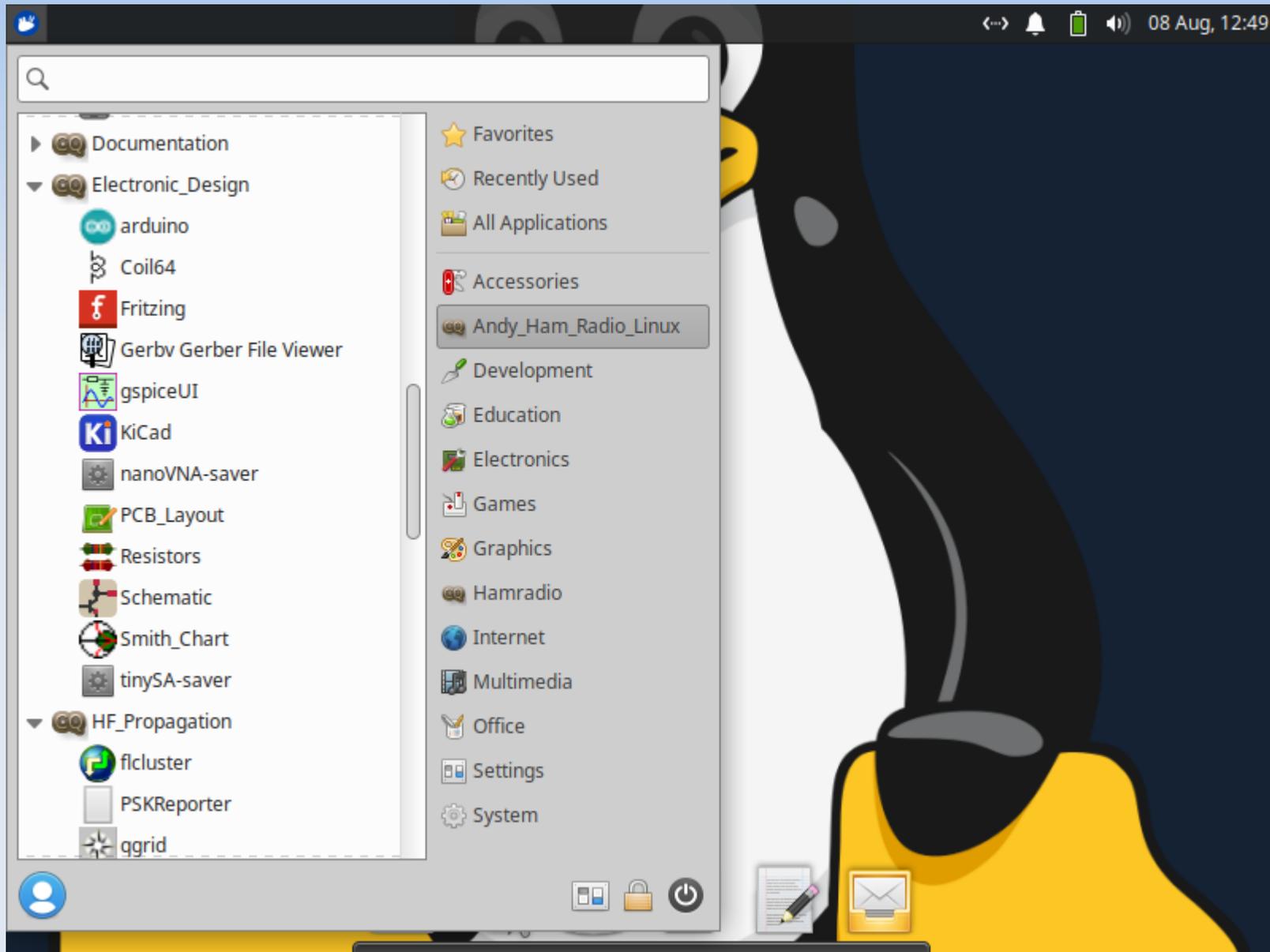
Call Roster: 47 heard • 11 in roster • 3 wanted

RECEIVE Halt Tx Logbook Live Band & Mode Callsigns All Traffic/Only Wanted Hunting New+Unconfirmed More Controls

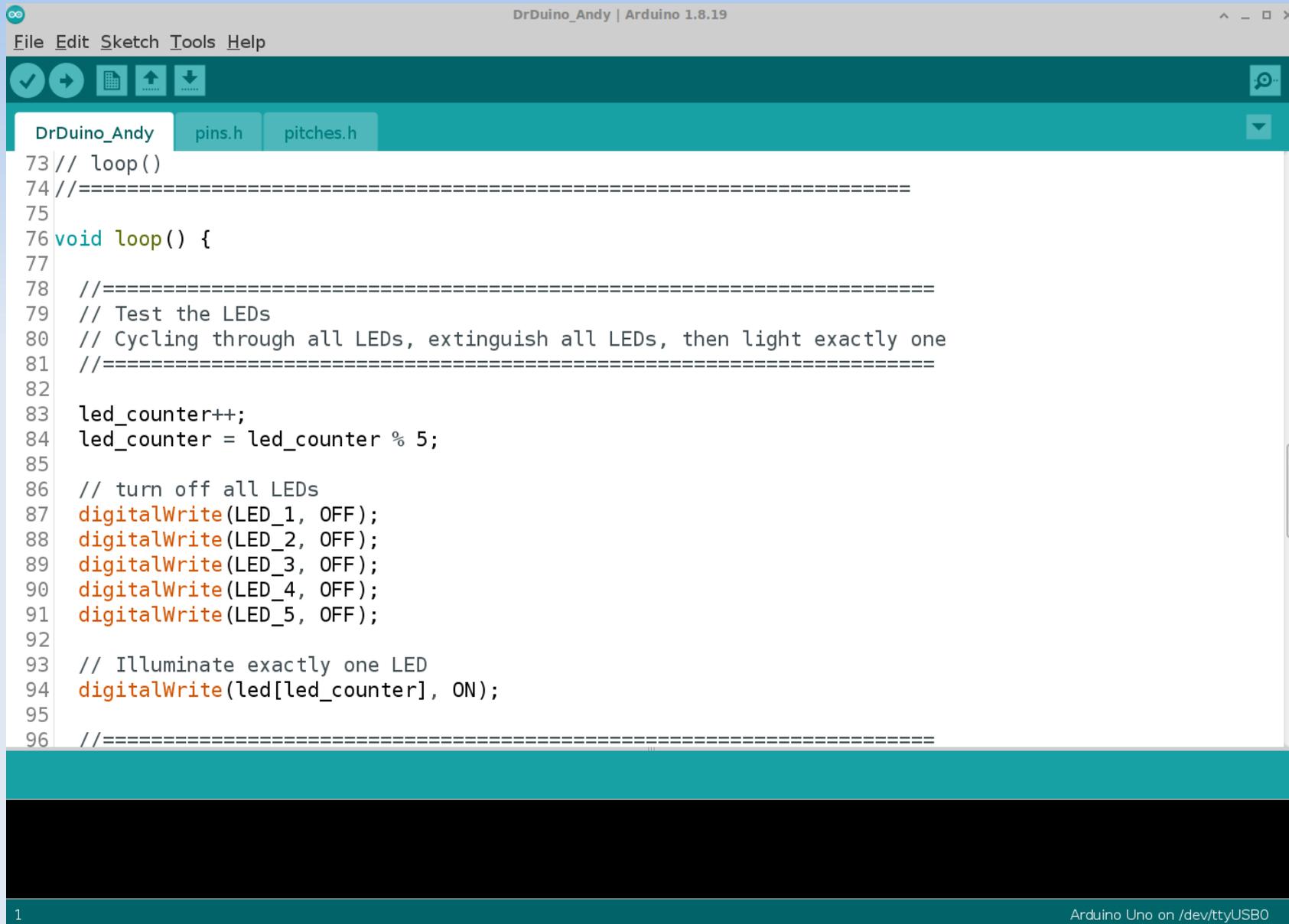
Callsign	Grid	Calling	DXCC	Flag	State	County	Cont	dB	Azim	PX	OAMS	Age
K9FE	EN51	CQ	United States		IL	Dupage	NA	-11	271	K9		0s
KF9UG	EN71	CQ	United States		IN	¿ Allen ?	NA	10	268	KF9		0s
LZ3CB	KN32	CQ	Bulgaria				EU	-12	52	LZ3		15s

20m / FT8
 GridTracker
 v1.22.0503

Menu #3



Electronic Design - arduino



The image shows a screenshot of the Arduino IDE interface. The window title is "DrDuino_Andy | Arduino 1.8.19". The menu bar includes "File", "Edit", "Sketch", "Tools", and "Help". The toolbar contains icons for saving, undo, redo, and other functions. The main editor area shows a sketch with the following code:

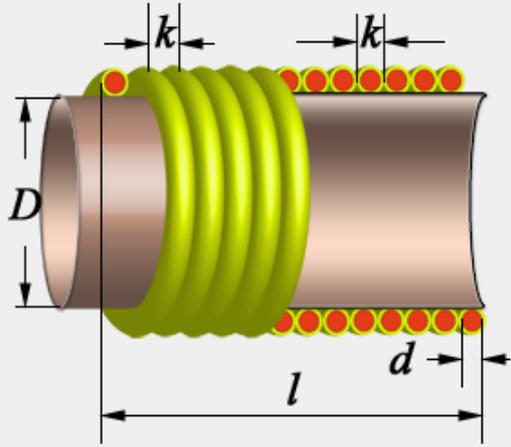
```
73 // loop()
74 //=====
75
76 void loop() {
77
78     //=====
79     // Test the LEDs
80     // Cycling through all LEDs, extinguish all LEDs, then light exactly one
81     //=====
82
83     led_counter++;
84     led_counter = led_counter % 5;
85
86     // turn off all LEDs
87     digitalWrite(LED_1, 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     //=====
```

At the bottom left of the IDE, the number "1" is displayed. At the bottom right, the text "Arduino Uno on /dev/ttyUSB0" is visible.

Electronic Design - coil64

Coil64 v2.1.23

File Actions Additional calculations Ferrite cores Branded cores Customize Help



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

Coil Inductance LC circuit

Inductance L: 50 microH

Frequency f: 0.6 MHz

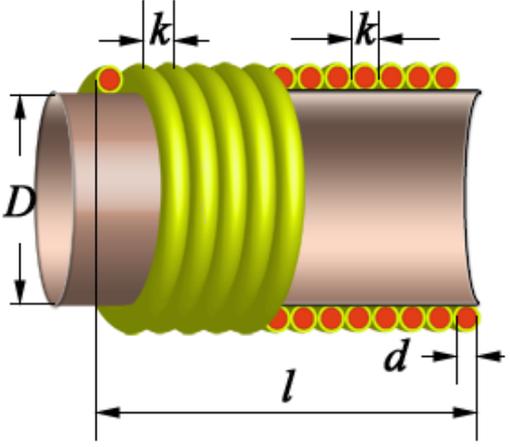
Former diameter D: 37 mm

Wire diameter d: 3 mm

Wire diameter with insulation k: 3.27 mm

Wire material:

- Copper
- Silver
- Aluminum
- Tin



Input:

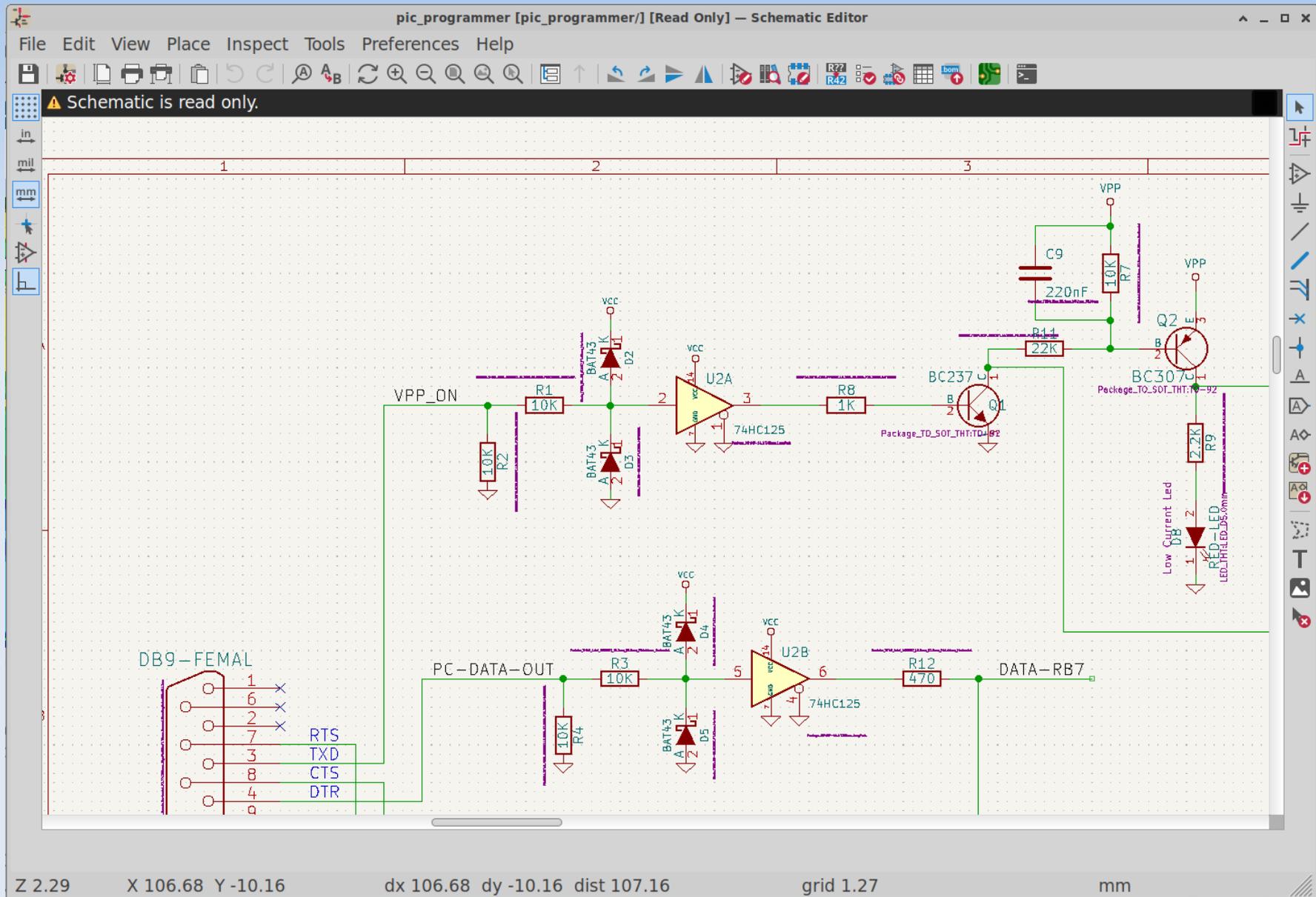
Inductance L: 50 microH
Frequency f: 0.6 MHz
Former diameter D: 37 mm
Wire diameter d: 3 mm
Wire diameter with insulation k: 3.27 mm

Result:

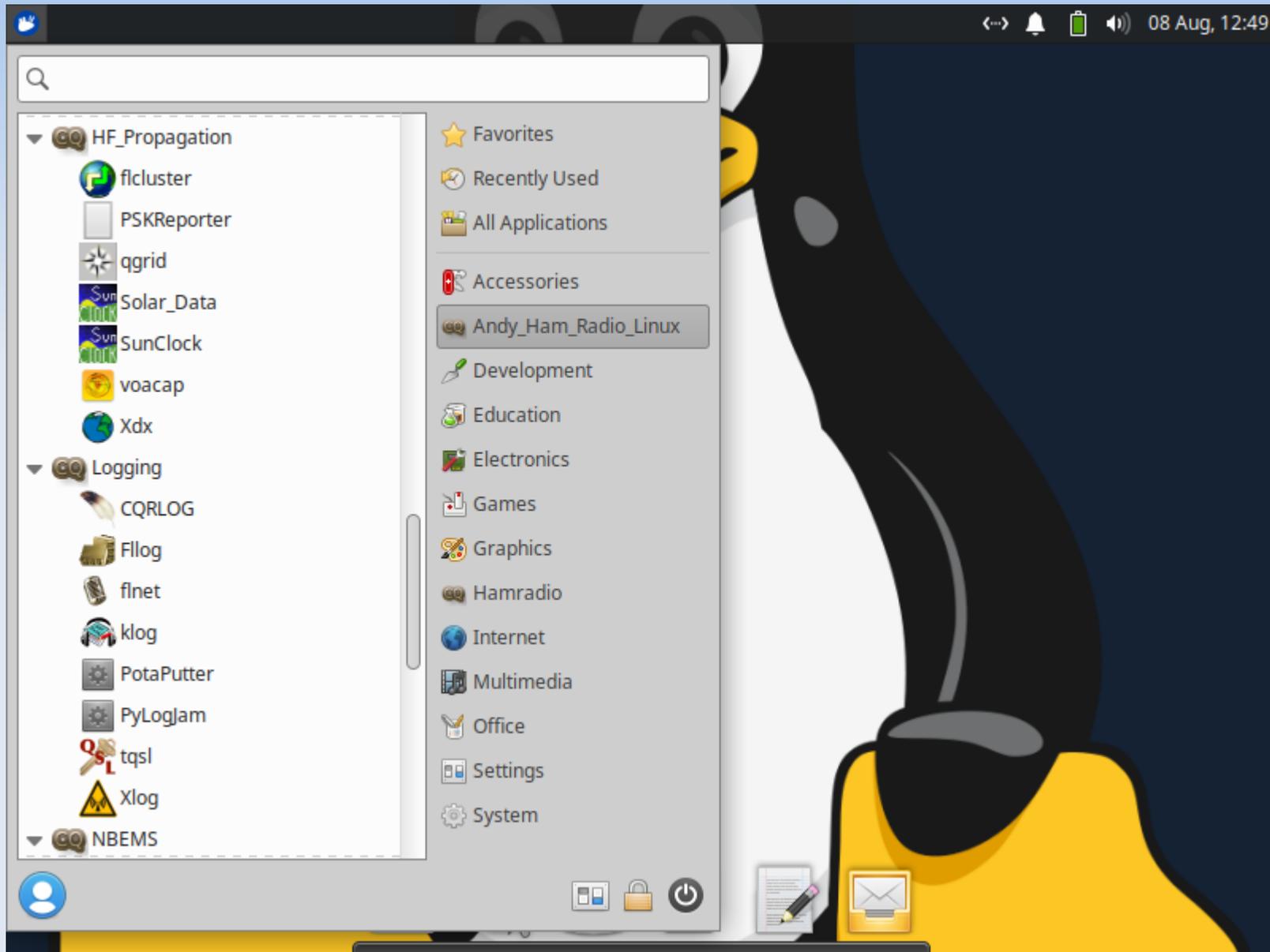
Number of turns of the coil N = 110.639
Length of wire without leads lw = 14.002 m
Length of winding l = 365.059 mm
Weight of wire m = 886.798 g
DC resistance of the coil Rdc = 0.034 Ohm
Reactance of the coil X = 188.496 Ohm

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

Electronic Design - kicad



Menu #4



HF Propagation #1

ImageMagick: solar.gif

Solar-Terrestrial Data - <http://www.n0nbh.com>

08 Aug 2022 1838 GMT

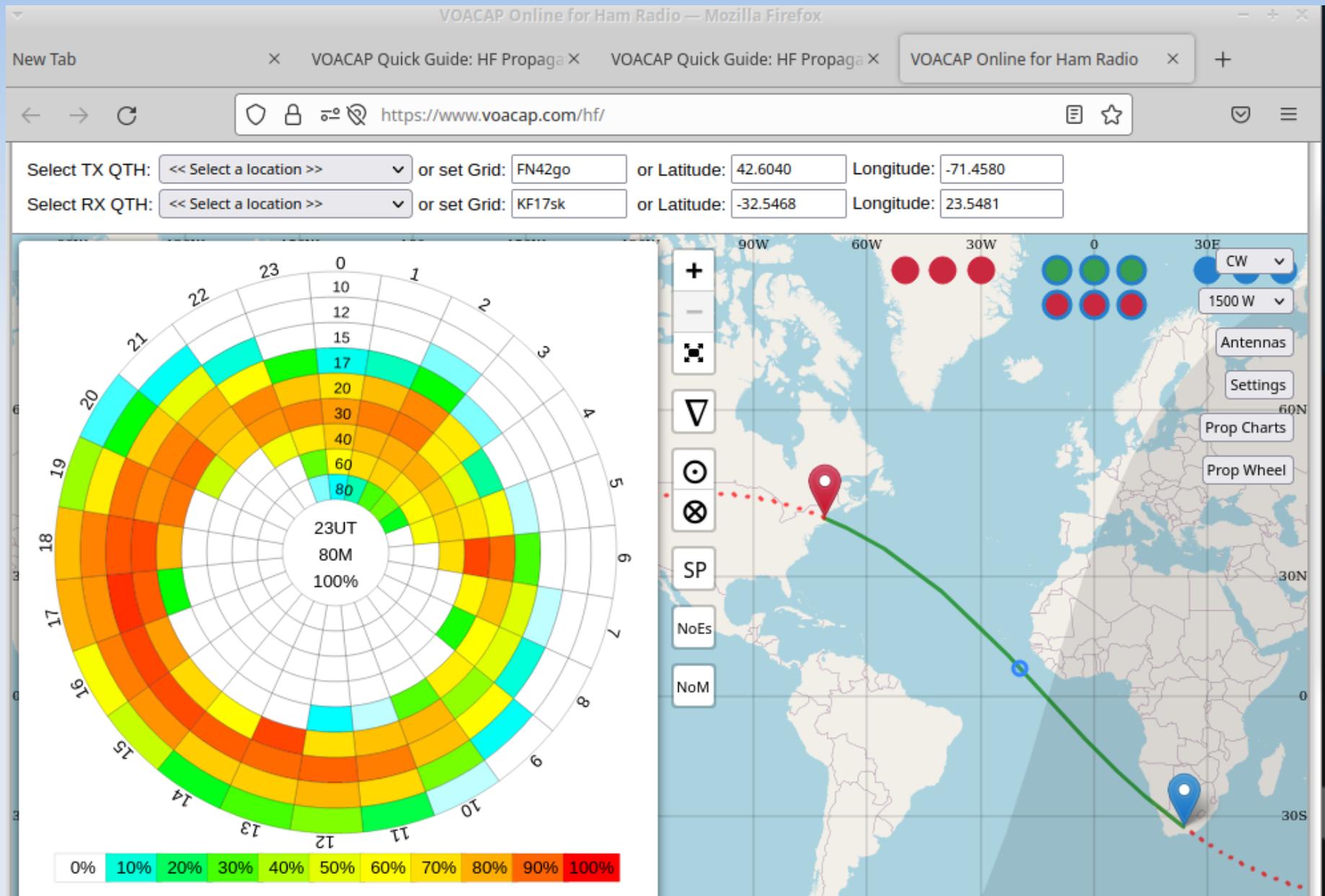
SFI 116	SN 74	VHF Conditions		HF Conditions		
A 24 K 3 / PIntry	X-Ray B4.5	Item	Status	Band	Day	Night
304A 129.8 @ SEM	Ptn Flx 16	Aurora	Band Closed	80n-40n	Poor	Fair
Elc Flx 976	Aurora 5/n=1.99	6n EsEU	50MHz ES	30n-20n	Good	Good
Aur Lat 62.5°	Aur Lat 62.5°	4n EsEU	Band Closed	17n-15n	Fair	Fair
Bz -3.3 SW 575.6	MUF	2n EsEU	High MUF	12n-10n	Poor	Poor
	MS	2n EsNA	Band Closed	Geomag Field	UNSETTLD	
		EME Deg	Poor	Sig Noise Lvl	S2-S3	
				MUF US Boulder	18.05	
				Solar Flare Prb	20%	
				(C) Paul L Herrman 2021		

QGrid 3.2

File Help

Locator	Home	Remote	Compass		
	FN42GO	FN32LL			
Latitude	42 36 15	42 28 45			
Longitude	-71 27 30	-73 2 30			
Bearing	264	Distance			
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

NR	DATE	UTC	CALL	BAND	MODE	RST	MYRST	QSLQ	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	W1ZX	7	CW	599	419			FN30
680	11 Jul 2010	1240	VA2NB	7	CW	359	579			FN25

Ready.    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

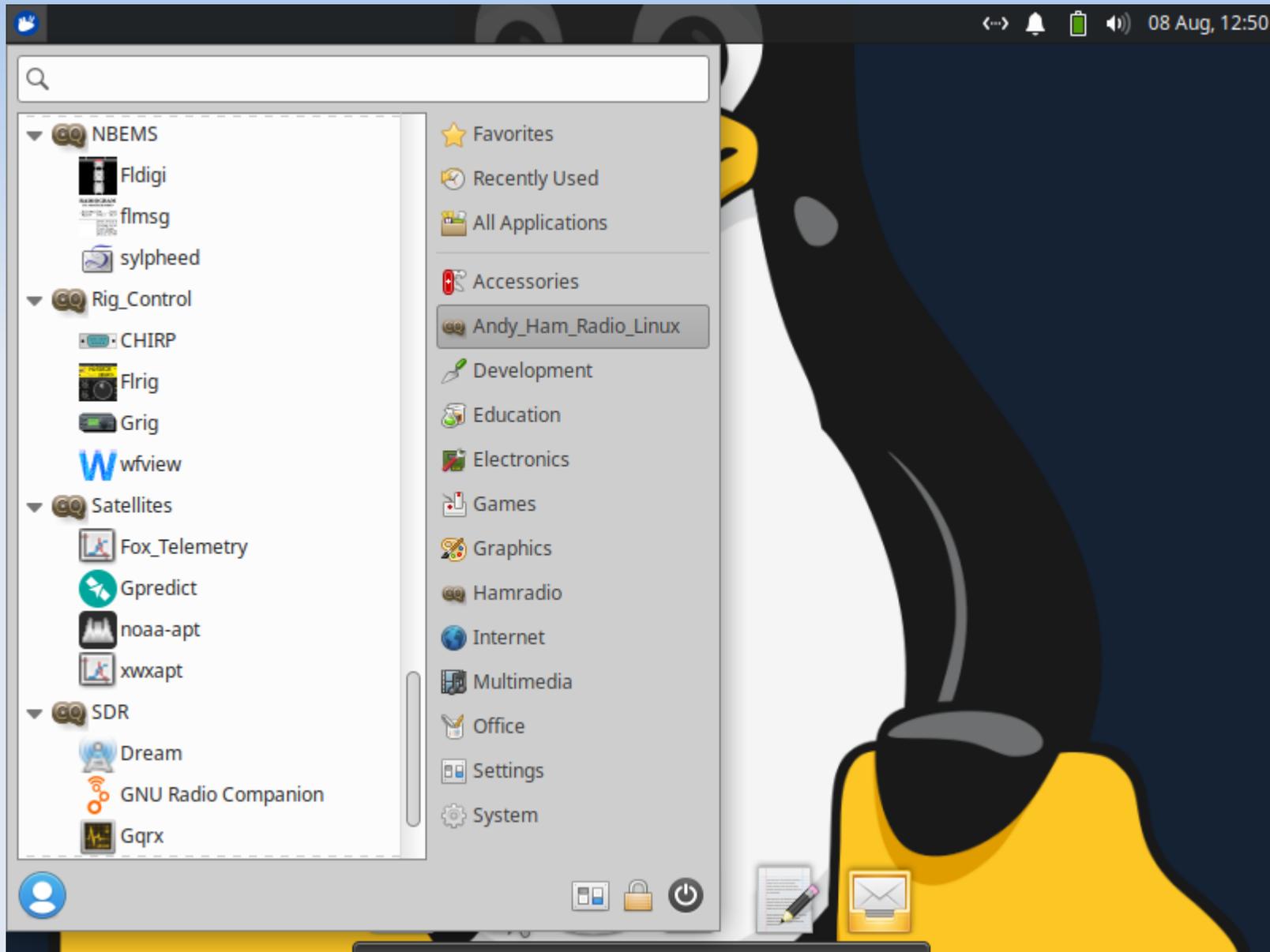
WAZ: 05 Cont: NA
 ITU: 08 DXCC: W
 LAT: 42.2373N LONG: 71.5314W
 DIST.: AZIM:
 10:17:51 23:14:24
 2019-09-05 22:08:41 GE
 Local:

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)

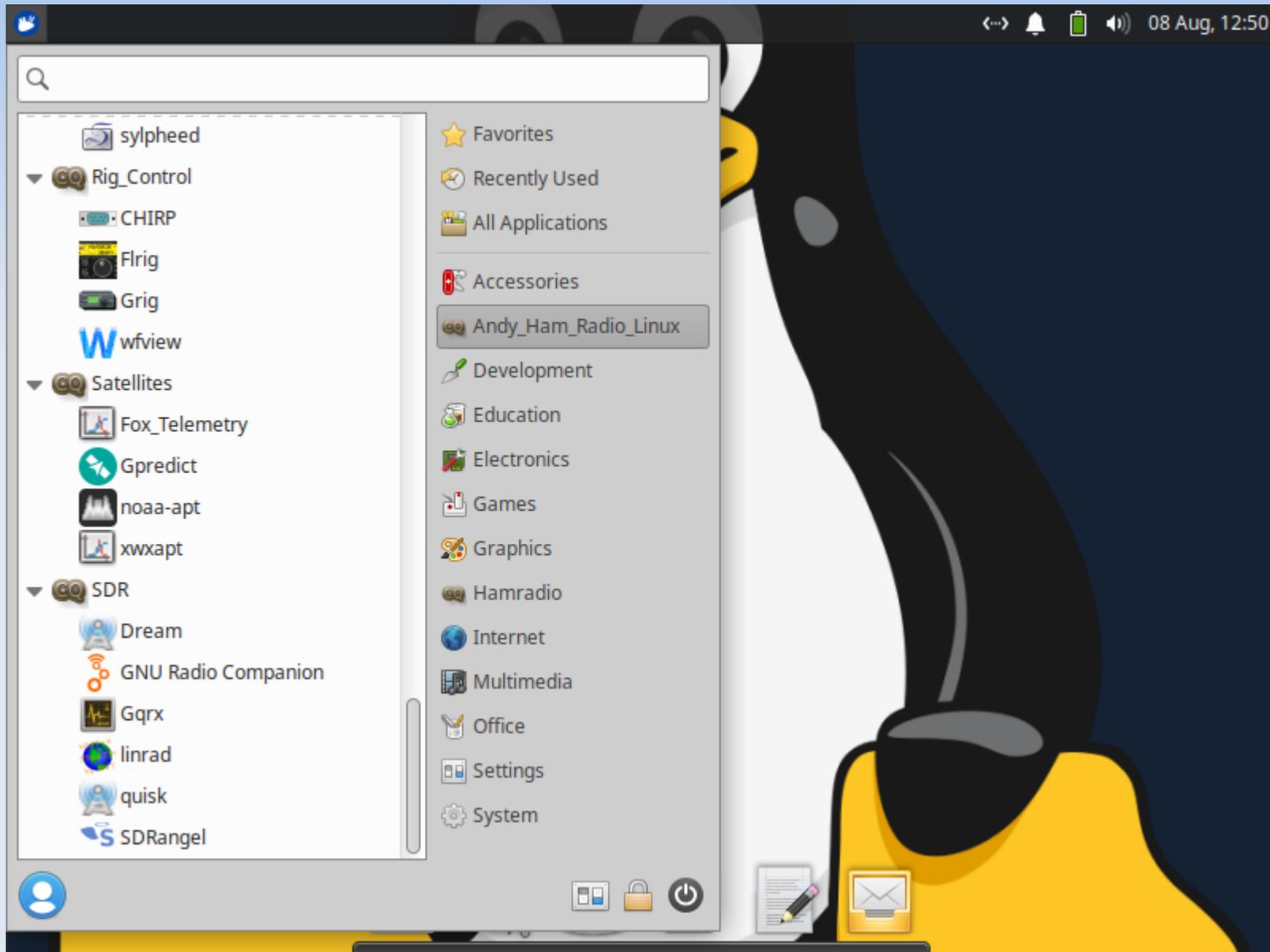
Menu #5



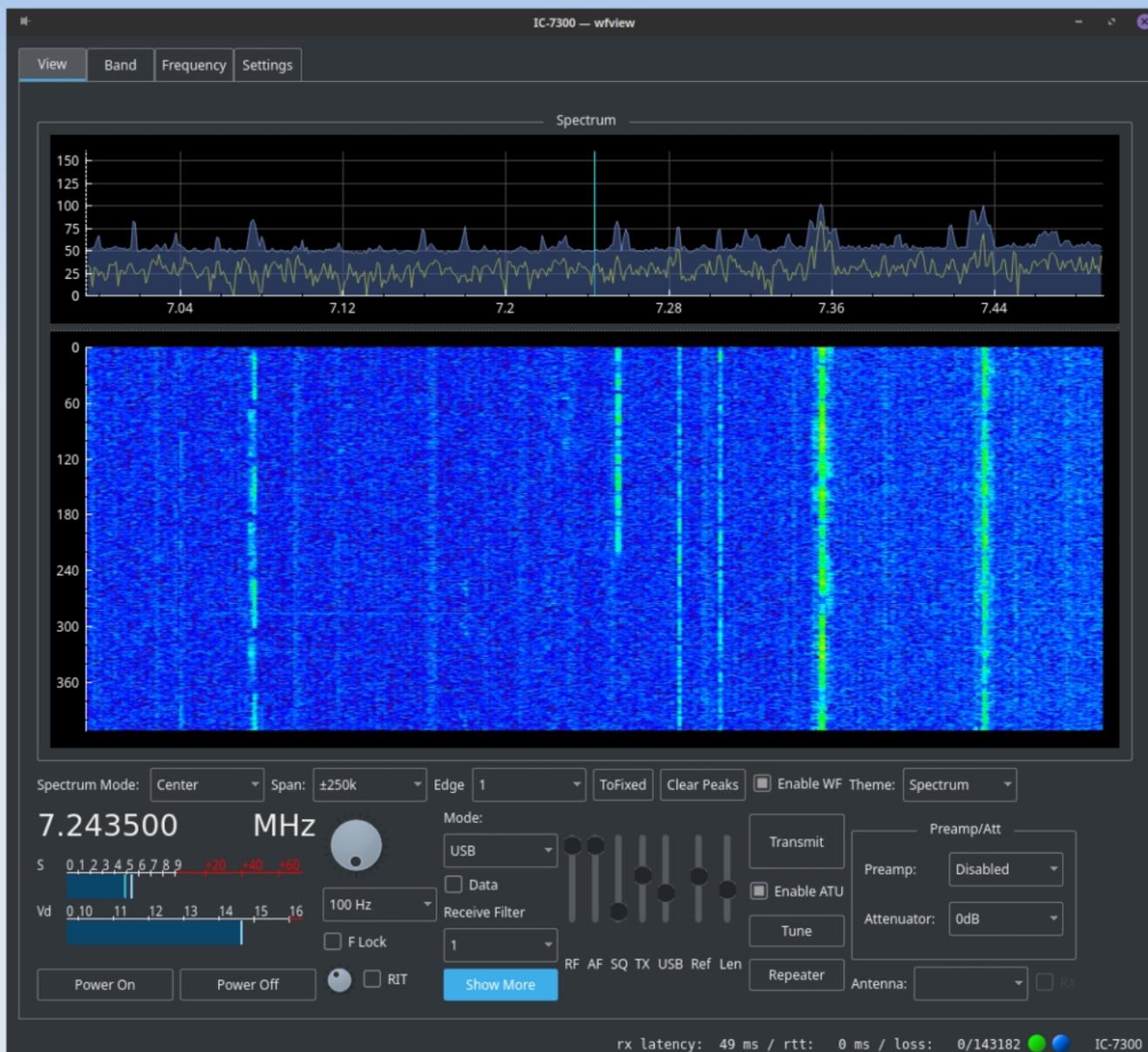
NBEMS

- 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				Computer Hardware			
	RT	MIN	MAX		RT	MIN	MAX
TX Temperature (C)	0000	0000	0000	Temperature (C)	0000	0000	0000
PA Current (mA)	0000	0000	0000	Battery I2C	0000		
RSSI (dBm)	0000	0000	0000	PSU1 I2C	0000		
Fwd Power (mW)	0000	0000	0000	PSU2 I2C	0000		
Ref Power (mW)	0000	0000	0000	RF I2C	0000		
VGA Control (V)	0000	0000	0000	Ground Resets	0000		
TX Antenna	0000			IHU Hard Error Data	0000		
RX Antenna	0000						

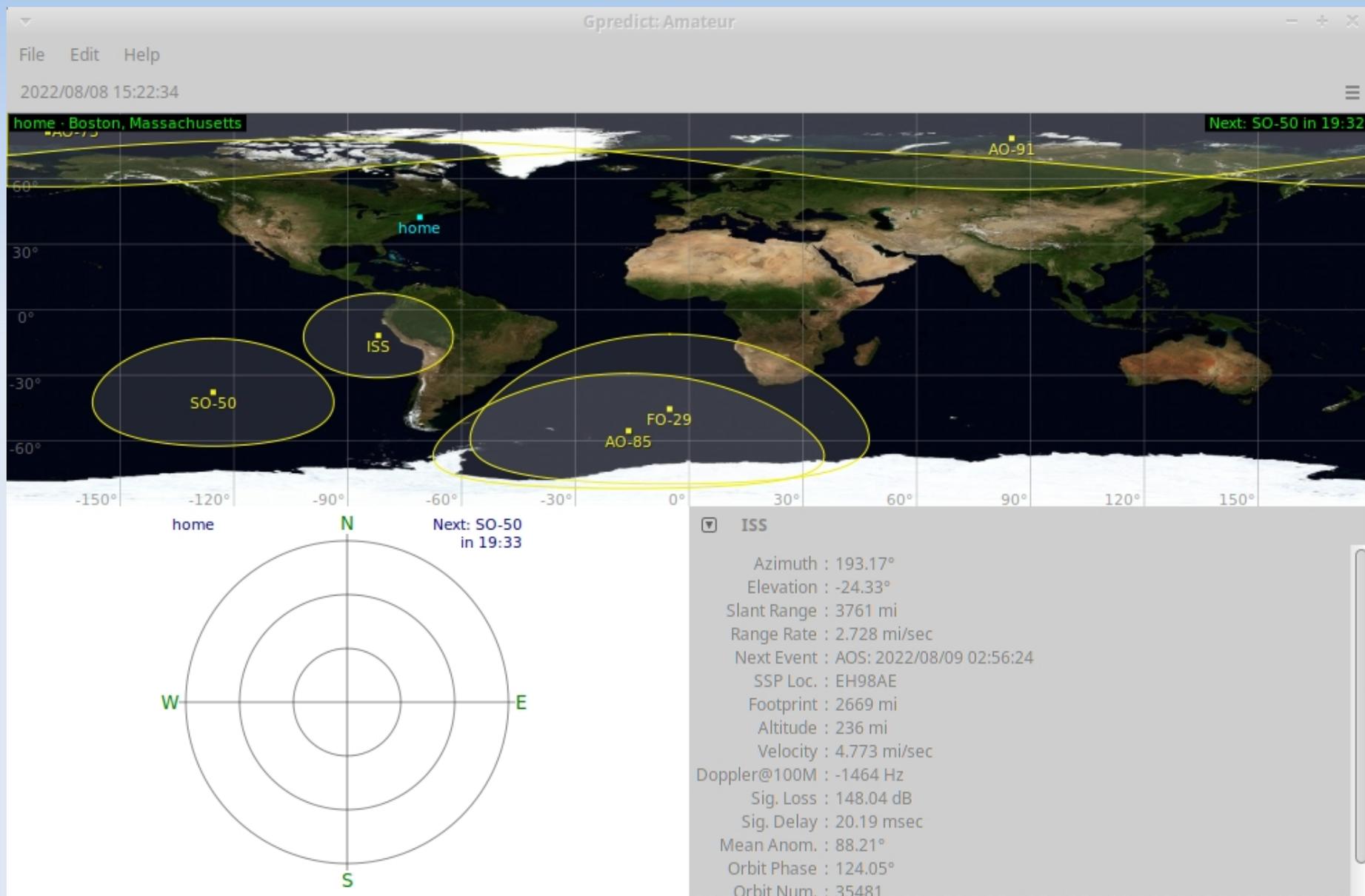
Computer Software				Battery			
	RT	MIN	MAX		RT	MIN	MAX
Spacecraft Spin (rpm)	0000	0000	0000	Cell A (V)	0000	0000	0000
Diagnostic Info	0000			Cell A + B (V)	0000	0000	0000
WOD Stored (000s)	0000			Cell A + B + C (V)	0000	0000	0000
Safe Mode	0000			Temperature A (C)	0000	0000	0000
Auto Safe Mode	0000			Temperature B (C)	0000	0000	0000
Auto Safe Allowed	0000			Temperature C (C)	0000	0000	0000
Science Mode	0000			Current (mA)	0000	0000	0000
Soft Error	0000			Board Temp (C)	0000	0000	0000

MPPT				Experiments			
	RT	MIN	MAX		RT	MIN	MAX
Current (mA)	0000	0000	0000	EXP4 Temp (C)	0000	0000	0000
				Vanderbilt Radiation	0000		

Current
 RT
 MAX
 MIN
 Display Raw Values
 Display UTC Time
 Last 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 signal flow graph with the following components and connections:

- RTL-SDR Source**: Configured with 1 channel, 2M sample rate, and 99.5M center frequency.
- Low Pass Filter**: Decimation of 10, cutoff frequency of 75k, and transition width of 25k.
- Rational Resampler**: Interpolation of 12, decimation of 5, and fractional bandwidth of 0.
- WBFM Receive**: Quadrature rate of 480k and audio decimation of 10.
- Multiply Const**: Constant of 250m.
- Audio Sink**: Sample rate of 48 kHz.

Three GUI sinks are connected to the RTL-SDR Source:

- QT GUI Frequency Sink**: FFT size of 2048, center frequency of 99.5M, and bandwidth of 2M.
- QT GUI Waterfall Sink**: FFT size of 1024, center frequency of 99.5M, and bandwidth of 2M.
- QT GUI Range** (ID: freq): Label: Freq, Default Value: 99.5, Start: 88, Stop: 108, Step: 100m.

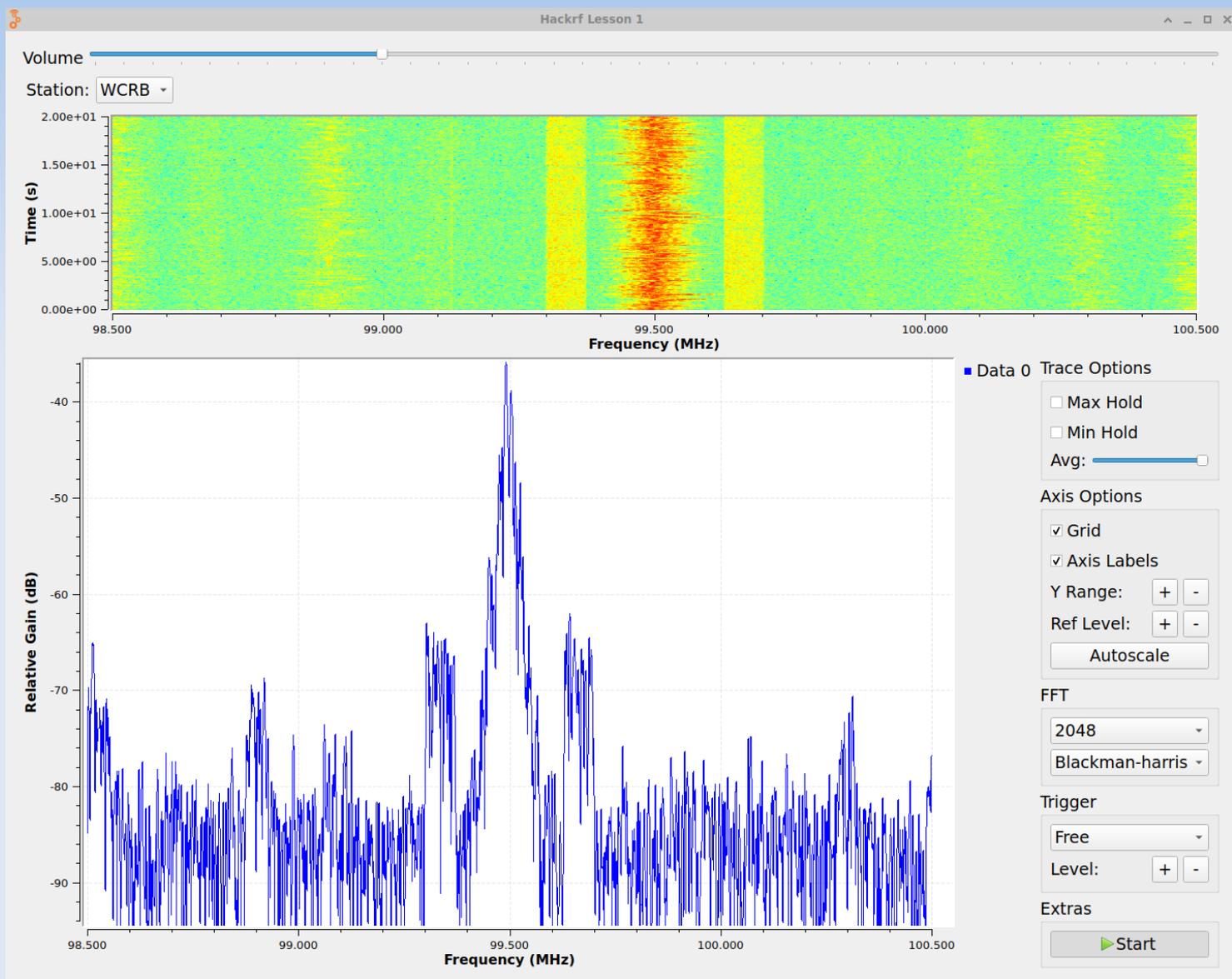
At the bottom left, a terminal window shows the following output:

```
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
```

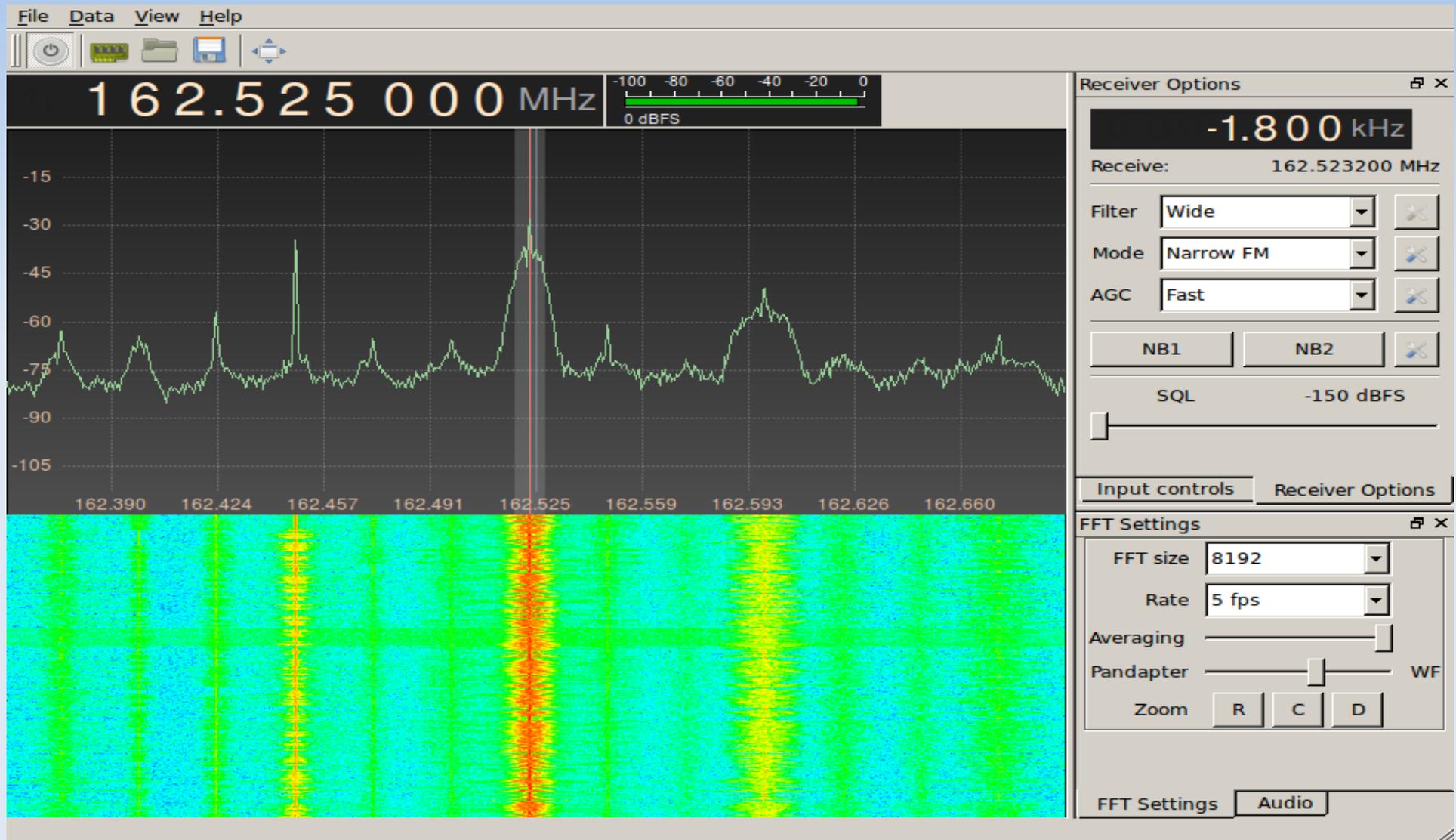
At the bottom right, a variables table is visible:

ID	Value
Imports	
Variables	
freq	99.5
freq	99.5
samp_ra	2000000.0

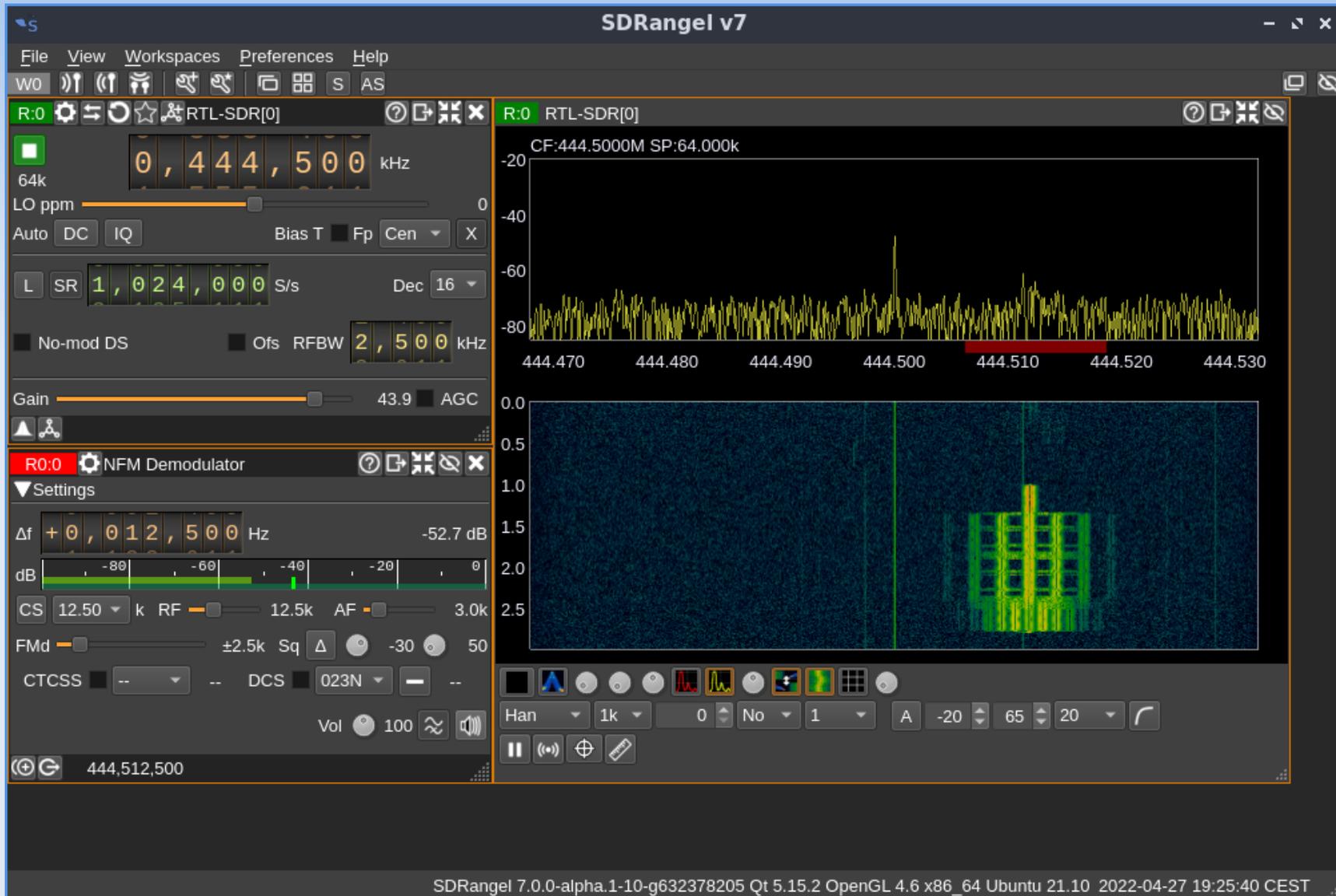
SDR GNU Radio Companion #2



SDR - gqrx



SDR - sdrangel



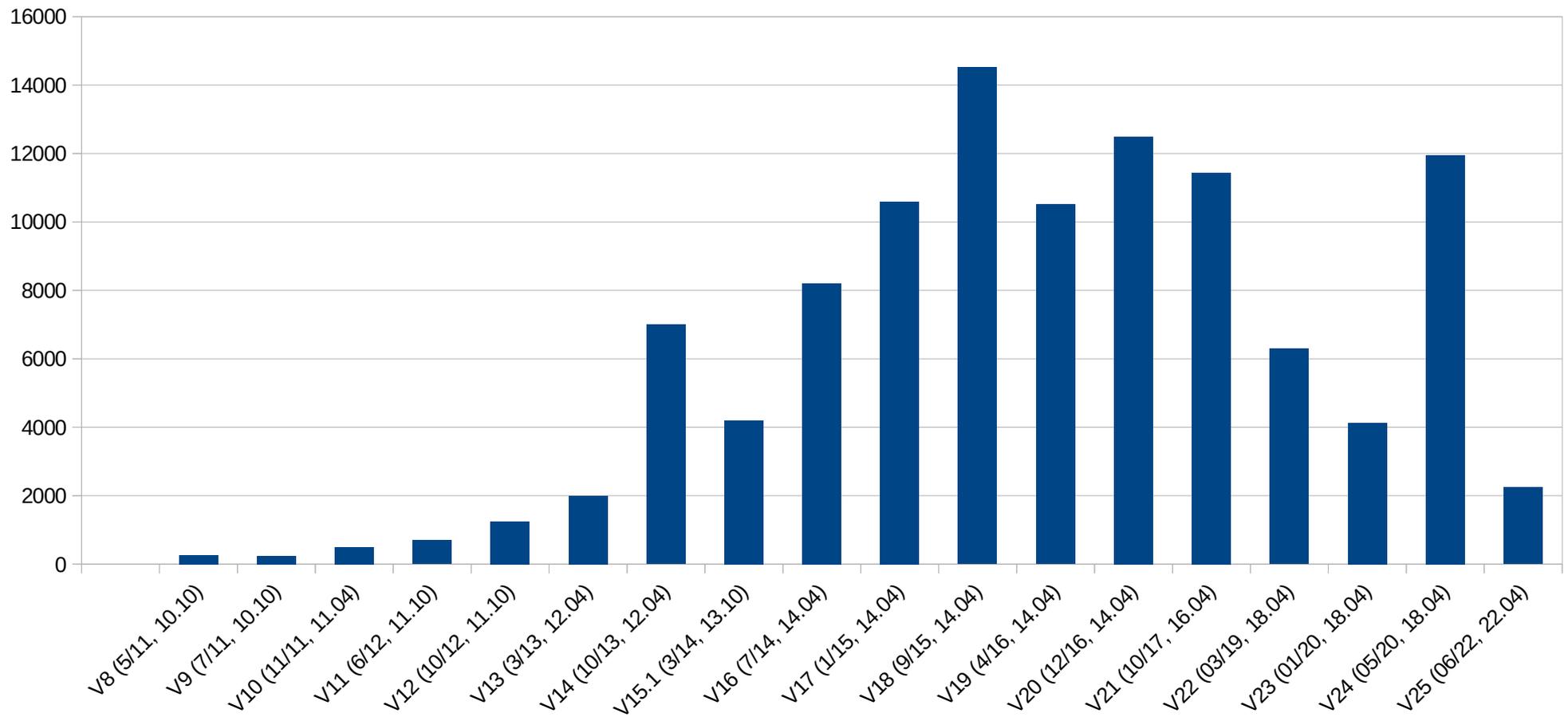
What's new and cool?

- 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.arri.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