RF Seminar

Radioberry

Software defined radio.

Hou je van stofzuigen of van puzzelen?

(wat een vraag?... we gaan het toch hebben over een SDR)

Presentatie

Johan Maas PA3GSB

Waar gaan we het over hebben....

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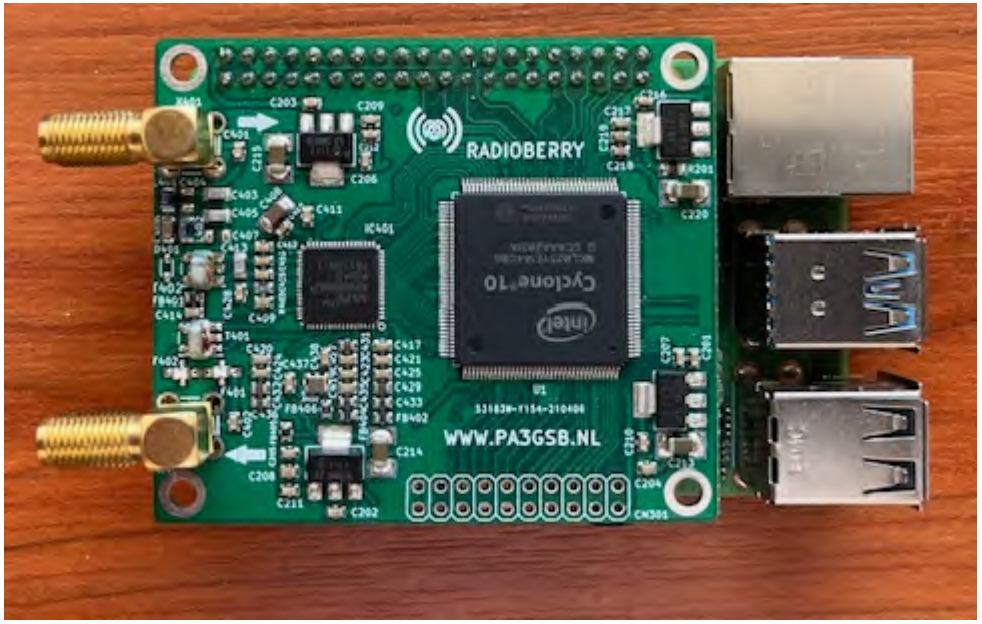
- Voortbrenging
- Gebruik



HamRadio

65x56mm

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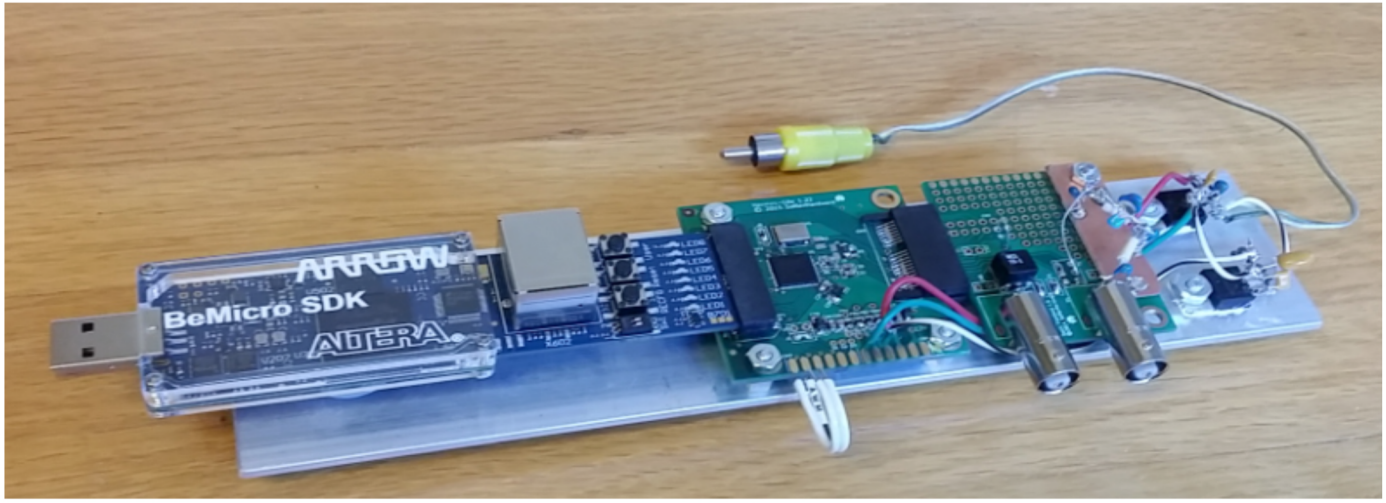
High Performance Software Defined Radio

An Open Source Design

https://openhpsdr.org/

Steve Haynal (KF7O) introduceerde Hermes Lite 1.0

gebasseerd op de SDR ontwikkelingen uit deze openHPSDR groep.



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Proposal

In augustus 2015 plaatste ik een bericht in het HL (Hermes Lite) forum:

Hermes Lite V2.0 proposal
(https://groups.google.com/g/hermes-lite/c/3xXRIskdkOw/m/wyfTD3RXIwAJ)

I was thinking about a version 2 of hermes lite.

My idea is to add the components of hermes lite to a pcb (including an FPGA eg cyclone II) which can be clicked to a rasperry pi.

-) no need for an ethernet component
(no ethernet code required; also easier to go to latest hpsdr proposal protoco; reduction of code in FPGA ; less complex?)
-) use of oscillator PI (can be set to 250Mhz; see wspr using a rpi)
-) loading fpga program controlled from pi no flash required?

The pi can react as an Hermes.

Maybe it is also possible to put the DSP code in the pi; together with a jetty local server the sdr can be reached from remote.

Reacties op proposal

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=> Steve wilde geen harde koppeling met een SBC (Single Board Computer) zoals een Raspberry PI.

=> Andere architectuur in gedachte; resulterend in de HL-2. Zoals bij velen bekend.

=> Hier liepen de ontwikkeling uit een; ondertussen nog wel contact gehouden met Steve; producten uitgewisseld.

I defined a name for the setup: Radioberry

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Main purpose of the project

=> Building a HAM Radio
=> Learning (from noob to guru)

noob = Een term die wordt gebruikt om aan te geven dat iemand een **beginneling** is.

guru = Een goeroe is een gids
ICT: persoon wiens mening een hoog aanzien genieten.

Idee gelanceerd nu aan de slag.

Vormgeven en Kennis

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=> Bij de start: Raspberry Pi 2 (RPI-2)

Kennis opdoen van => OS -> Linux

Voeding van Radioberry via voeding van RPI.

Powerplannetje gemaakt; voorzag geen problemen.

=> fuse / zekering

Vermogen in de componenten, warmte ontwikkeling
zou dit voor problemen zorgen?

Belangrijke bouwblokken

Radioberry bestaat uit 4 belangrijke componenten:

- Master clock
  Sampling rate

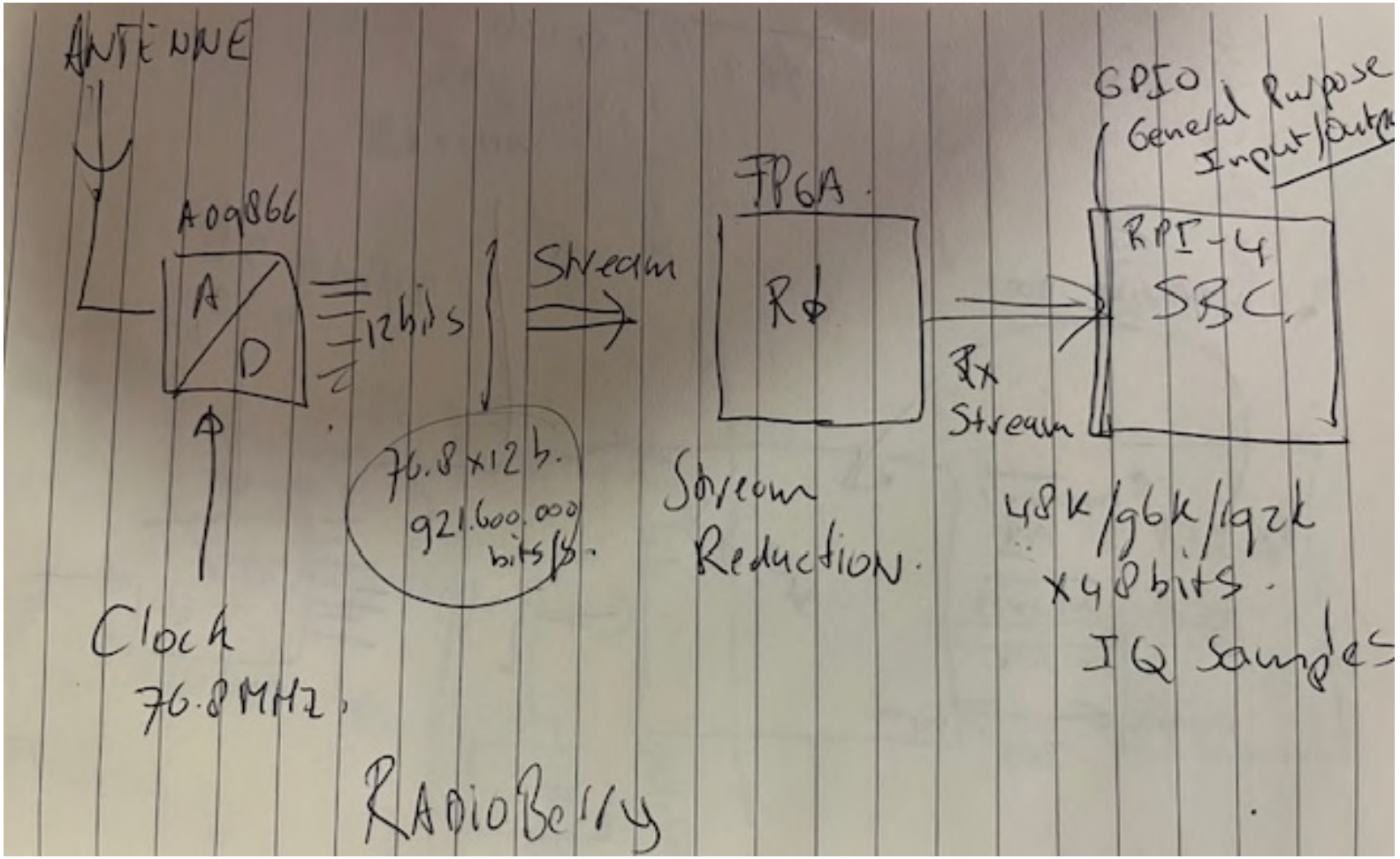
- ADC/DAC

- FPGA

  RX mode ; Sampling in ritme van clock via FPGA (DDC) verlagen datastroom.

  TX mode; Tx data via FPGA (DUC) aanbieden aan DAC.

- Koppeling radioberry - RPI


ANTENNE
AD9866
A
D
12bits
Stream
76.8 x 12 b.
921.600.000
bits/s.
Clock
76.8 MHz.
FPGA
Rx
Stream
Stream
Reduction.
GPIO
General Purpose
Input/Outp
RPI-4
SBC.
48K/96K/192K
x48bits.
IQ samples
RADIOBerry

RF Seminar

Master clock

RB = Radioberry

RB 1.0 => SI570 clock
i2c control via rpi

RB 2.0 => 38.4 OCX TCXO
gebruik van de multiplier in the AD9866. =>76.8 MHz.

Simpele opzet.

FPGA

Field Programmabel Gate Array

RB 1.0 => Cyclone III
- EP3C25E144C8

RB 2.0 => Cyclone 10
- 10CL025YE144C8G
- 10CL016YE144C8G

beschrijving van gedrag HW (HDL): gateware genoemd.

FPGA is vluchtig
radioberry.rbf is het gateware artifact wat geladen moet worden in de FPGA.

Laden van gateware via RPI.

Source: https://github.com/softerhardware/Hermes-Lite2/tree/master/gateware

ADC / DAC

AD9866

12 bit omzetter.

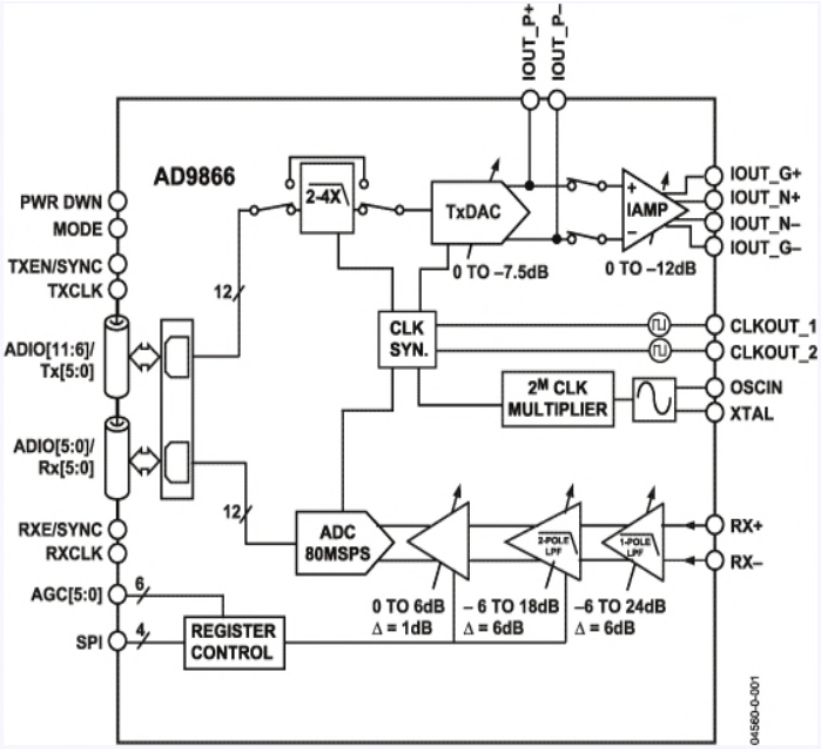
RX

-12db to 48 dB gain

TX

SPI FPGA – AD9866 for control.

Datasheet



Koppeling Radioberry - RPI

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=> MIPI interface; Te sterke koppeling met RPI.

=> GPIO General Purpose Input / Output

verschillende modes:

=> SMI Serial Management Interface;
protocol is niet goed beschreven / TE sterke koppeling met RPI
(RPI-5 SMI niet langer ondersteund)

=> SPI Serial Peripheral Interface

=> I2C /IIC

=> ethernet => experiment : LAN8720 ethernetboard

=> USB => radioberry juice board.

Uitgangspunt : Een zo onafhankelijk mogelijke SDR module

=> RPI-5 => IO via RP1 chip; gebruik makend PCI express (veelbelovend)

KICAD voor tekenen schema en pcb layout.

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RB 1.0 => 2 laags PCB

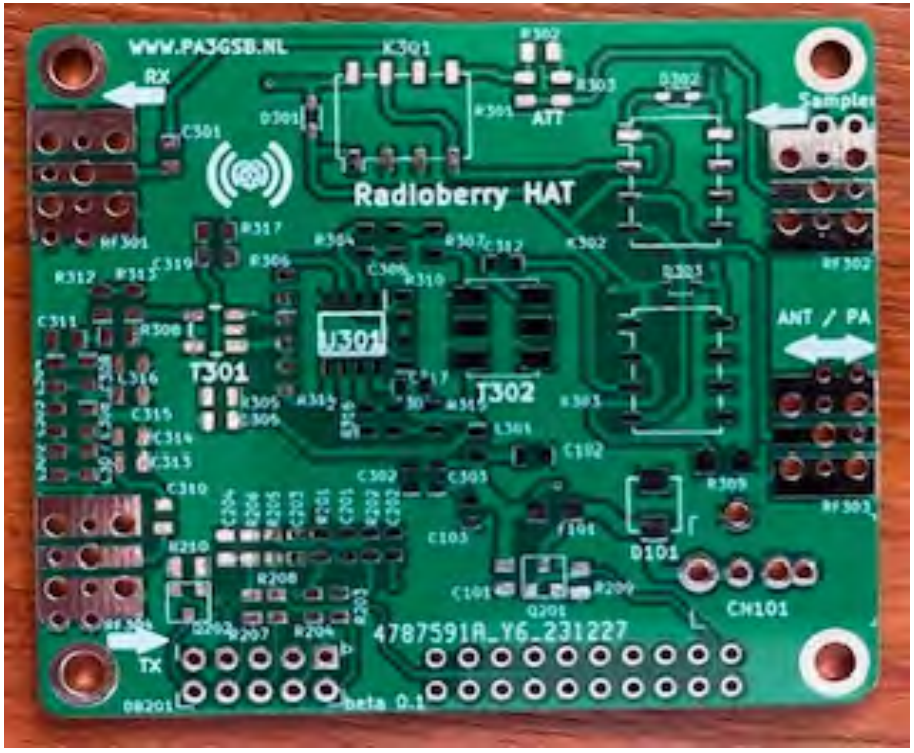
RB 2.0 => 4 laags PCB

Exports:

- BOM
- interactieve BOM
- Gerber Files

Makerfabs (PCBA)
Printen en assemblage.

Voor alleen printen: https://jlcpcb.com/



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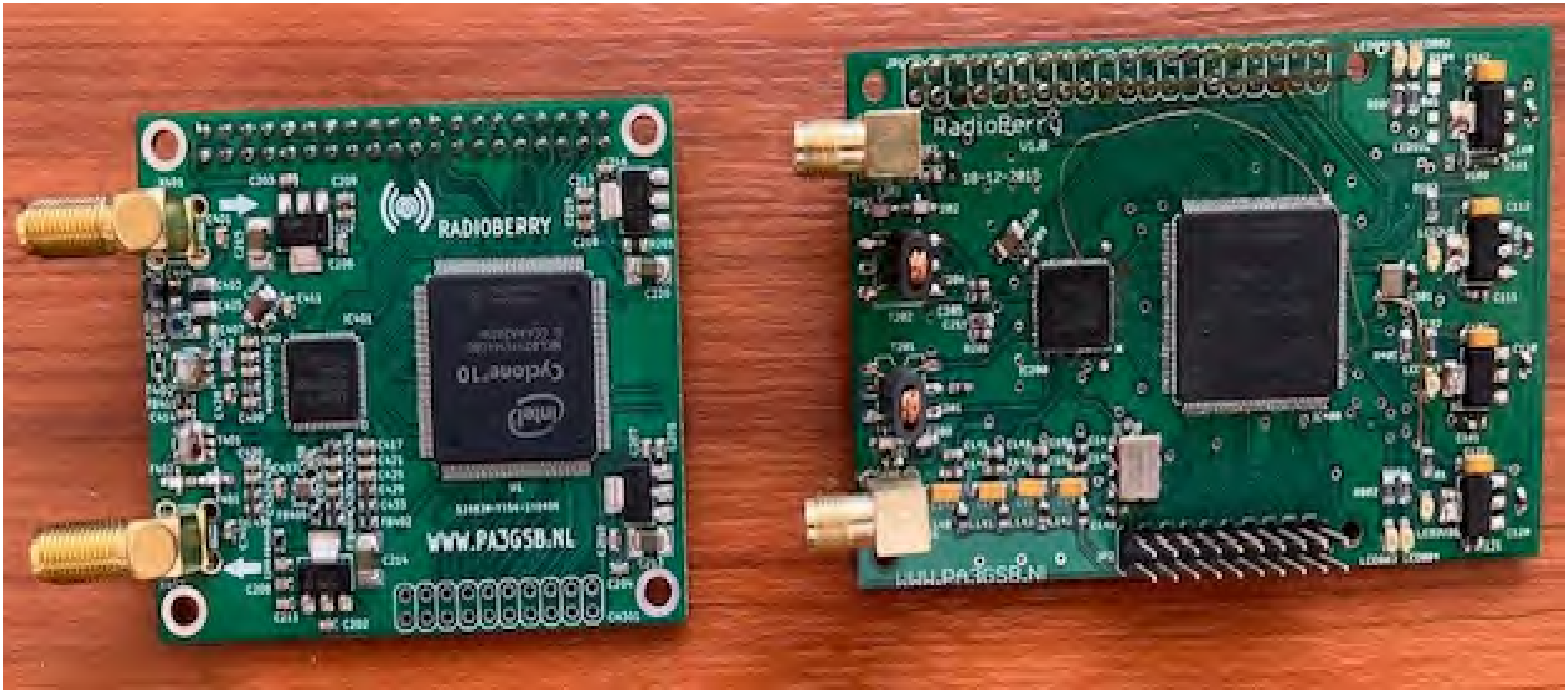
Resultaat



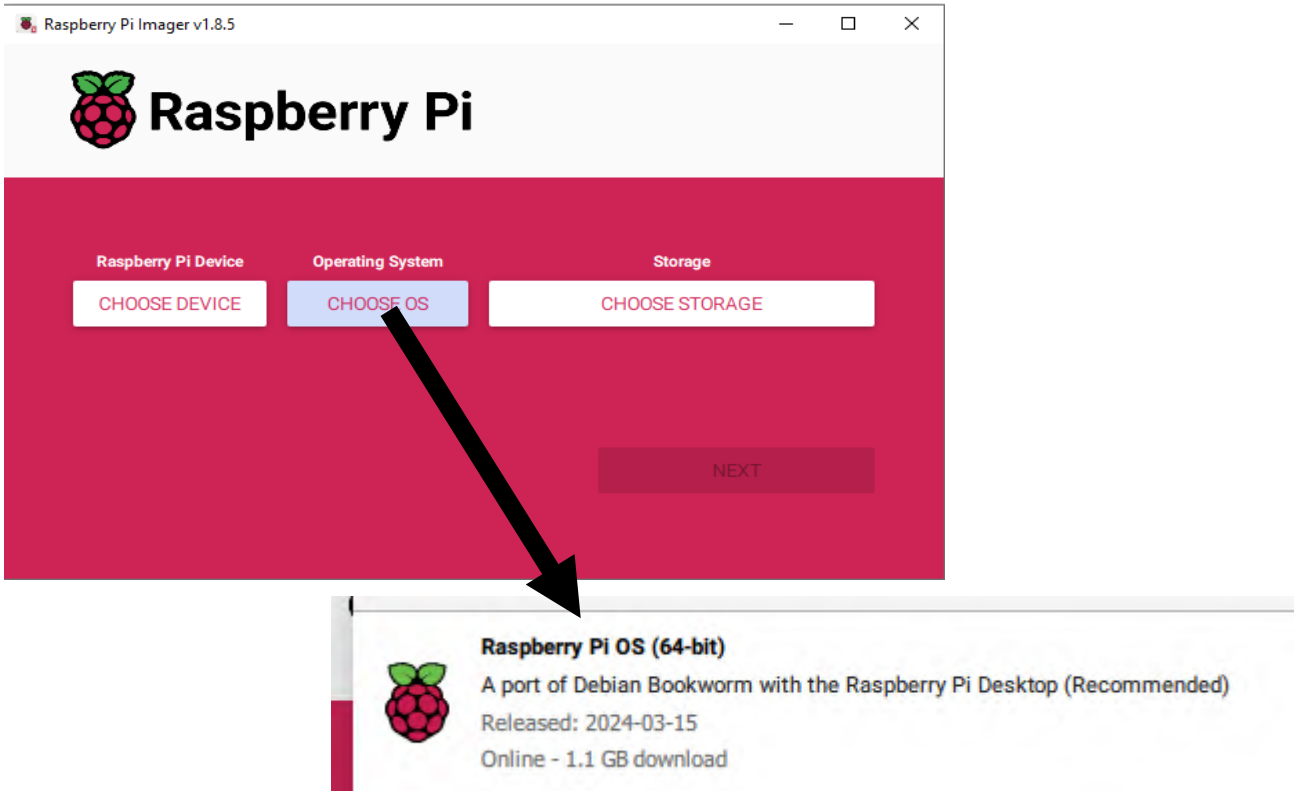
Open source / OHW

Worden te koop aangeboden; amazon / ali etc.

Hardware ready....

Voor het installeren van OS op RPI :

Utility: Install Raspberry Pi OS using Raspberry Pi Imager



https://www.raspberrypi.com/software/

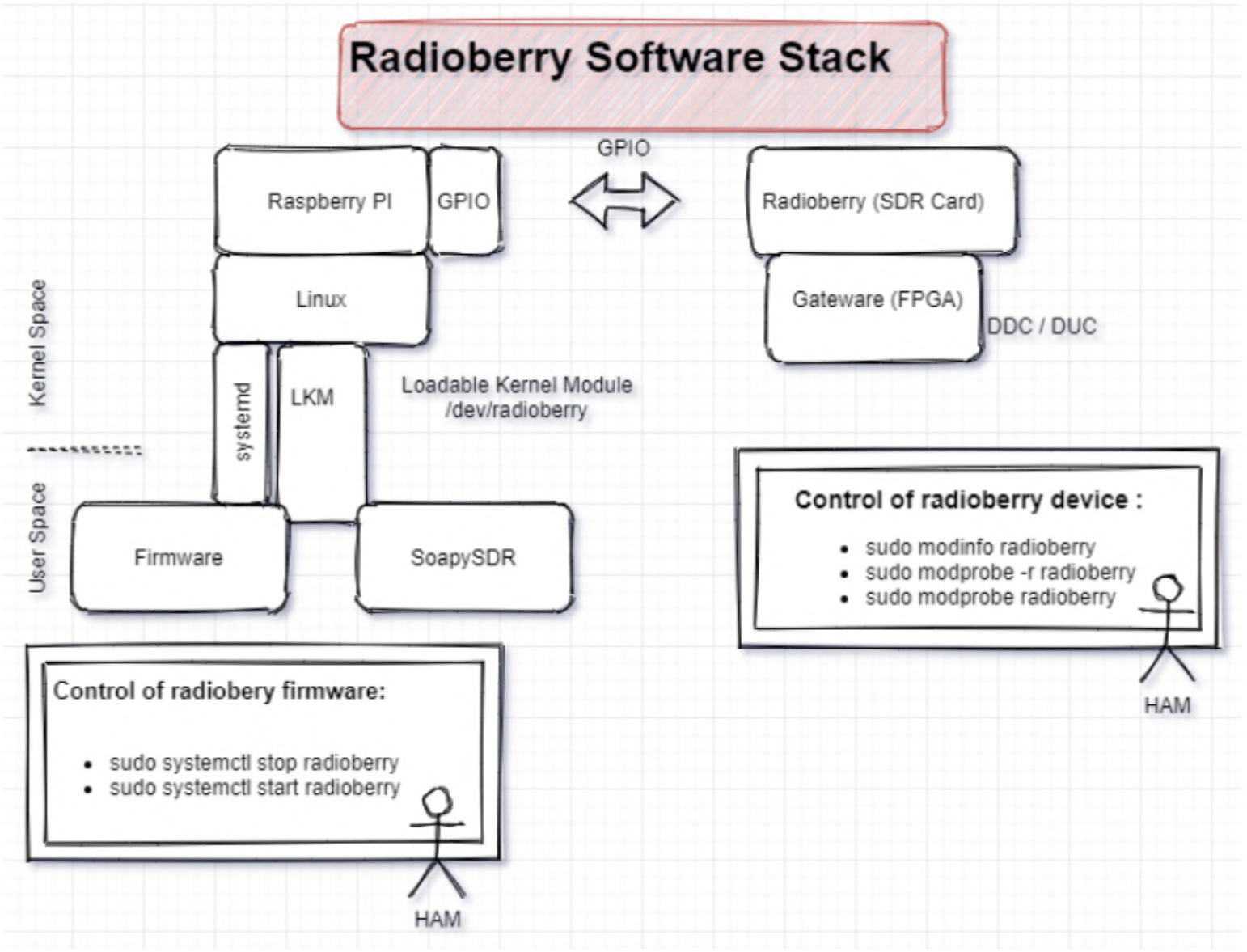
Gateware laden vanuit de RPI

Java als ontwikkeltaal was de target.

Echter lack of performance.
=> met name voor de IO afhandeling

C taal gekozen
- past goed in de linux wereld

Utility voor laden van radioberry.rbf (gateware artefact)


Radioberry Software Stack
GPIO
Raspberry PI
GPIO
Radioberry (SDR Card)
Linux
Gateware (FPGA)
DDC / DUC
Kernel Space
systemd
LKM
Loadable Kernel Module
/dev/radioberry
User Space
Firmware
SoapySDR
Control of radioberry device :
sudo modinfo radioberry
sudo modprobe -r radioberry
sudo modprobe radioberry
HAM
Control of radiobery firmware:
sudo systemctl stop radioberry
sudo systemctl start radioberry
HAM

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Device Driver (LKM)

Radioberry als een HAT

HAT identificatie via EEPROM (toekomst?)

RPI Hardware beschrijving middels een device tree en overlays.

dtoverlay=radioberry

Deze magische regel in de config.txt zorgt voor laden van radioberry kernel module

Verantwoordelijkheden van radioberry driver:

- Laden van gateware /lib/firmware/radioberry.rbf

- ioctl
  Radioberry settings

- read
- write

De software in de stack / of externe software kan gebruik maken van de radio zonder kennis van alle details.

Protocol

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SDR Programma's

- PowerSDR
- Thetis
- pihpsdr
- linhpsdr
- spark
- quisk
- ……..

Hoe kunnen al deze programma's nu 'praten' met de Hermes, HL, RB en andere radiohardware.

Openhpsdr protocollen:

- protocol 1
- protocol 2

Firmware

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Implementatie van protocol -1 voor Radioberry

Communicatie SDR program

- Discovery
- Control
- RX stream
- TX stream

Firmware communiceert met gateware via radioberry driver

=>Open driver: fd_rb = open("/dev/radioberry", O_RDWR)

=>Reading rx samples: read(fd_rb , rx_buffer , nr_samples)

=>Writing tx sample: write(fd_rb , tx_iqdata , sizeof(tx_iqdata))

=>Reading gateware info: ioctl(fd_rb, RADIOBERRY_IOC_COMMAND, &rb_info)

Firmware

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Implementatie van protocol -1 voor Radioberry

Communicatie SDR program

- Discovery
- Control
- RX stream
- TX stream

Firmware communiceert met gateware via radioberry driver

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=>Reading gateware info: ioctl(fd_rb, RADIOBERRY_IOC_COMMAND, &rb_info)

Firmware

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Ipv network stack in FPGA.

Ondersteuning:

- UDP

  UDP is a connectionless protocol, therefore much quicker.

  => sequence nummer in protocol

- TCP/IP

  TCP is a connection-oriented protocol.

  pihpsdr.

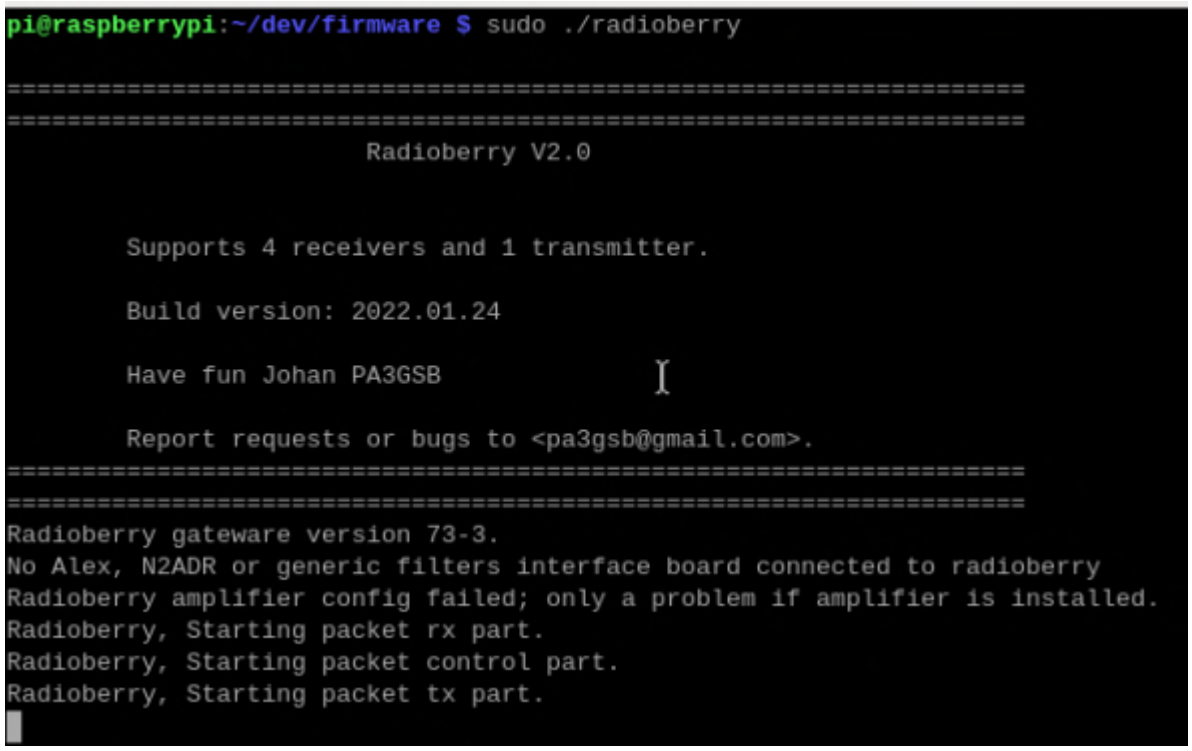
Extern Control

- Filters
- Temperature
- Radioberry PA (i2c)

Aardigheid registratie

Firmware

TCP/IP server connectie naar PA



Kortom de Firmware geeft heel veel mogelijkheden om allerlei koppelingen te maken.

SOAPY SDR protocol

- pihpsdr
- openwebrx
- GNU radio

Paul (PA0PHH) maakt gebruik van deze oplossing voor zijn eigen bouw radio.

Git: forks and pull requests.

https://github.com/paulh002/sdrberry

Installatie

Radioberry Software Installation @RPI-4 Latest

Installation of radioberry software.

The whole software stack will be installed.

https://github.com/pa3gsb/Radioberry-2.x/wiki/Radioberry-Software-stack

The install script will give details about the versions to be installed.

Open a command window and executing the following commands:

```
cd /tmp
wget https://raw.githubusercontent.com/pa3gsb/Radioberry-2.x/master/SBC/rpi-4/releases/dev/radioberry_install.sh
sudo chmod +x radioberry_install.sh
./radioberry_install.sh
```

Install script pihpsdr

This script does help in installing the development version of pihpsdr using the git repo of John Melton.

```
cd /tmp
wget https://raw.githubusercontent.com/pa3gsb/Radioberry-2.x/master/SBC/rpi-4/releases/dev/pihpsdr_install.sh
sudo chmod +x pihpsdr_install.sh
./pihpsdr_install.sh
```

https://github.com/pa3gsb/Radioberry-2.x/releases

BREAK

Radioberry-Juice

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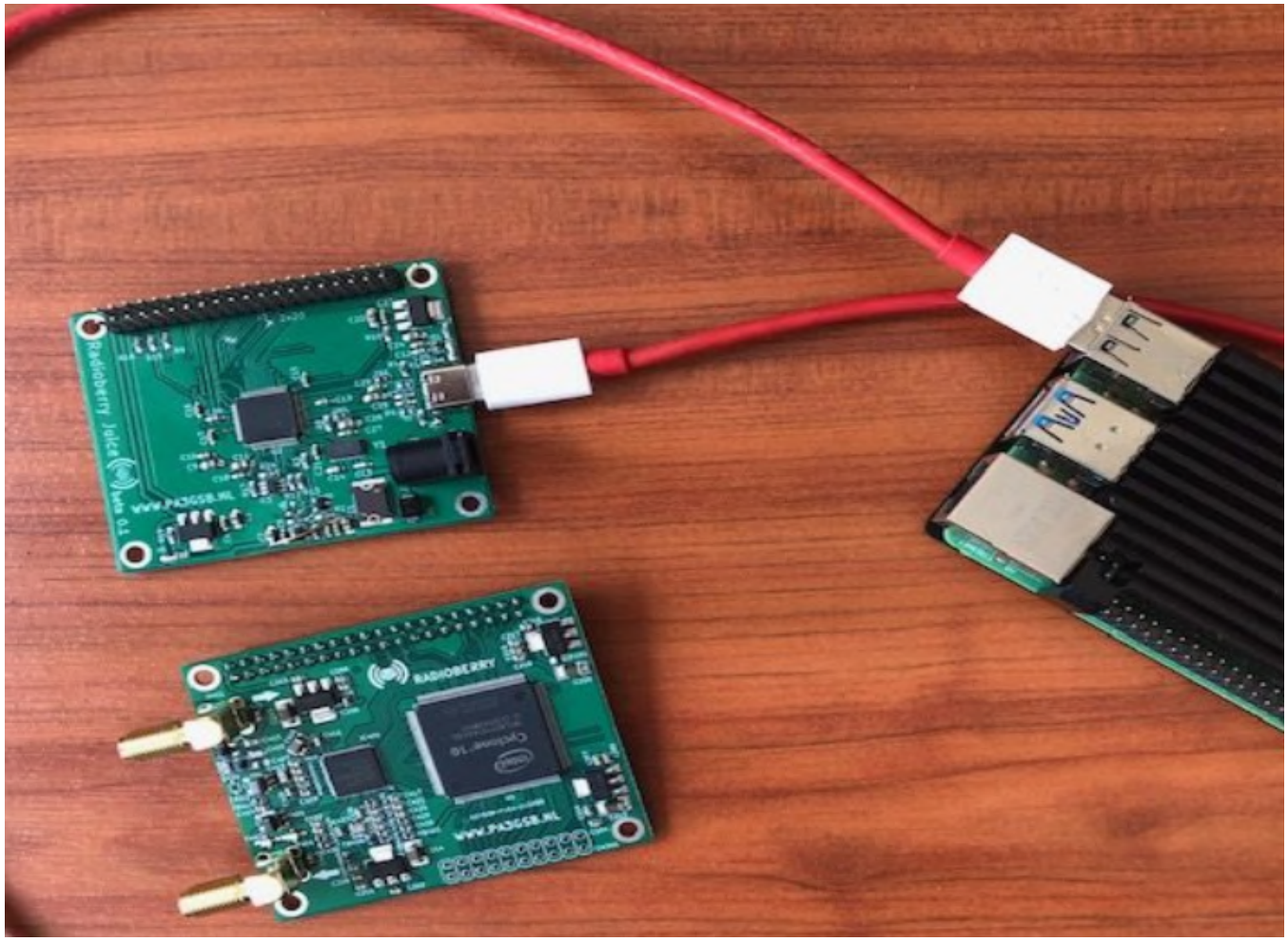
Wishes for the radioberry to improve:

IQ bandwith increase
CPU utilization reduction
Supporting multiple platforms
Different computer boards
Easy setup

But keeping :

The radioberry with the high coupling to the RPI must be kept; i want to keep the charm of this radio setup.

Radioberry-Juice



Radioberry-Juice

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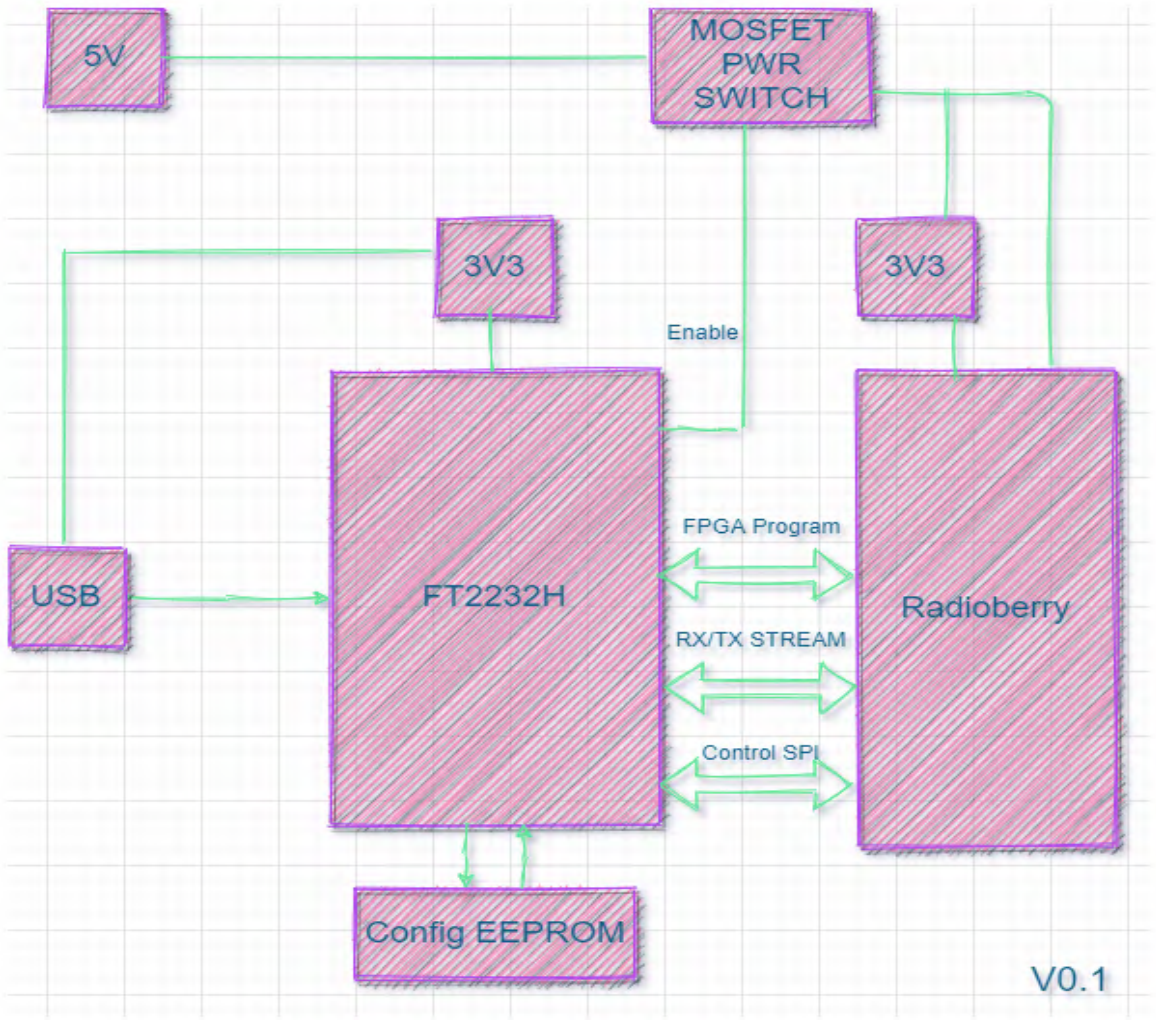
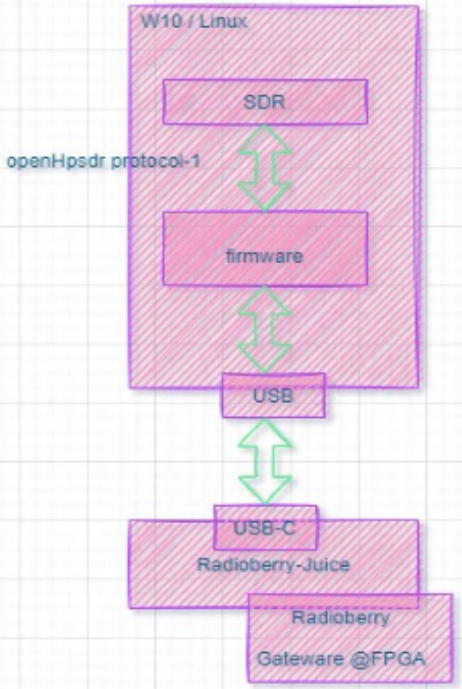
Vervangt RPI.



Radioberry Juice Configurations

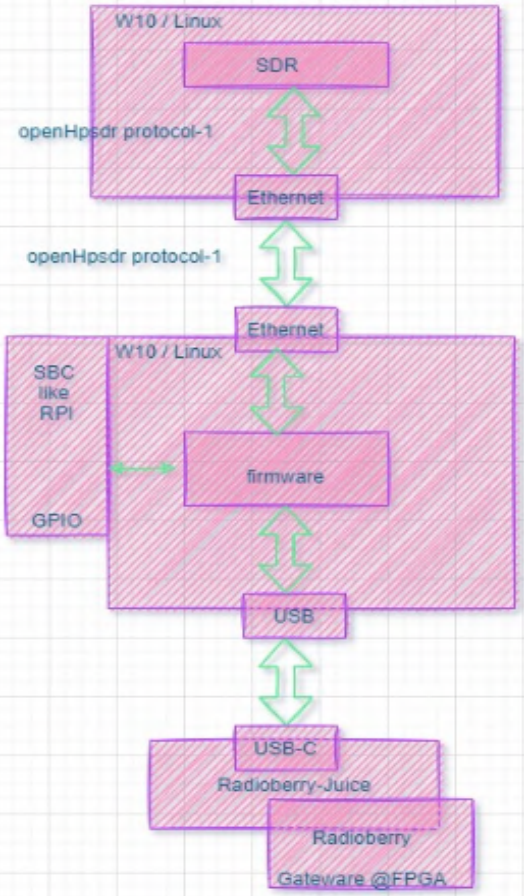


Local Setup

Radioberry Juice and SDR directly connected to same computer.

Running SDR program, radioberry firmware

Supported by Windows 10 and Ubuntu Linux.



Remote SDR Setup

Radioberry Juice and SDR not running on same computer.

Connected via ethernet using openHPSDR protocol-1

Supported by Windows 10 and Ubuntu Linux.

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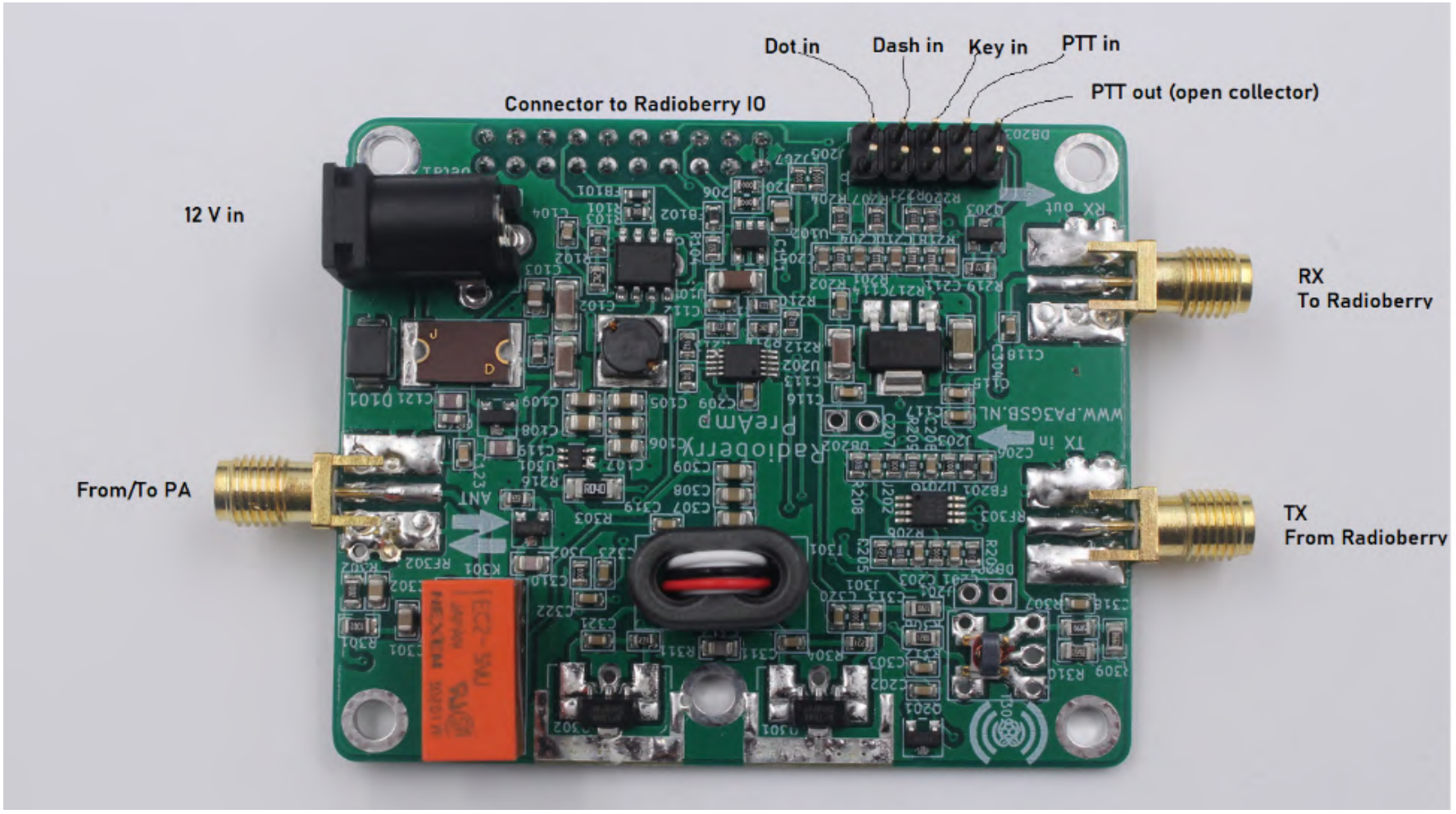
Radioberry PreAmp



5W Amplifier

Voedingsinkoppeling... Hint van Chris (PA3GZK)

https://www.ludens.cl/Electron/mosfetamps/amps.html

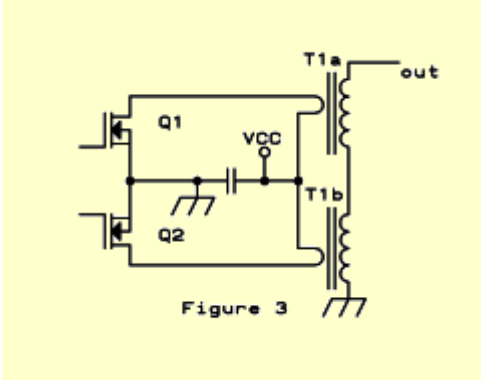


Figure 3

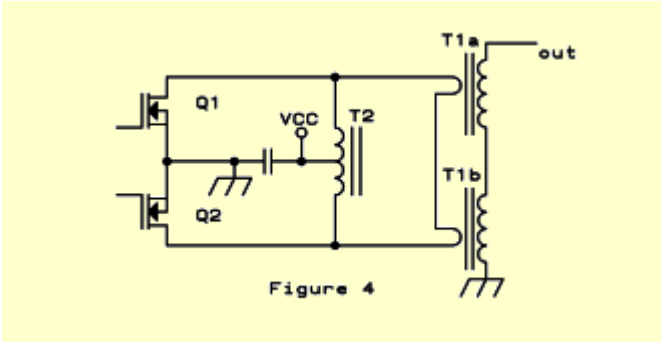
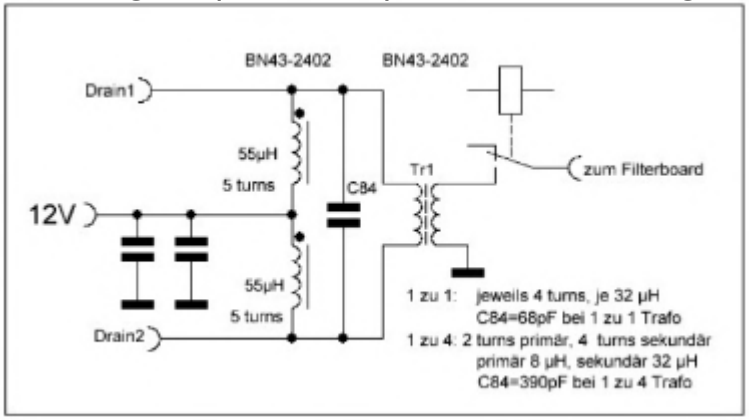


Figure 4

Ruediger (DJ1MR) heeft dit toegepast:



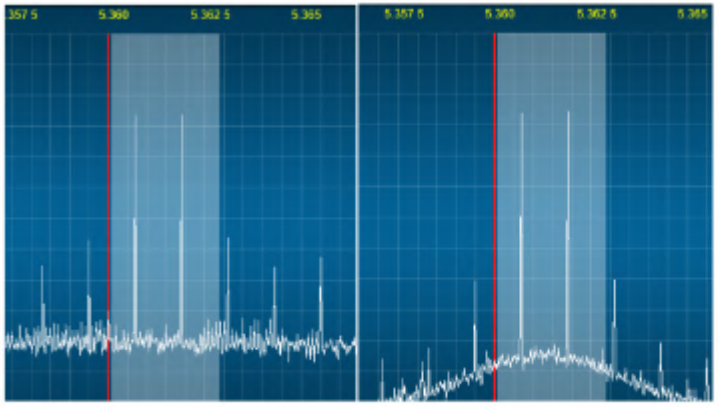
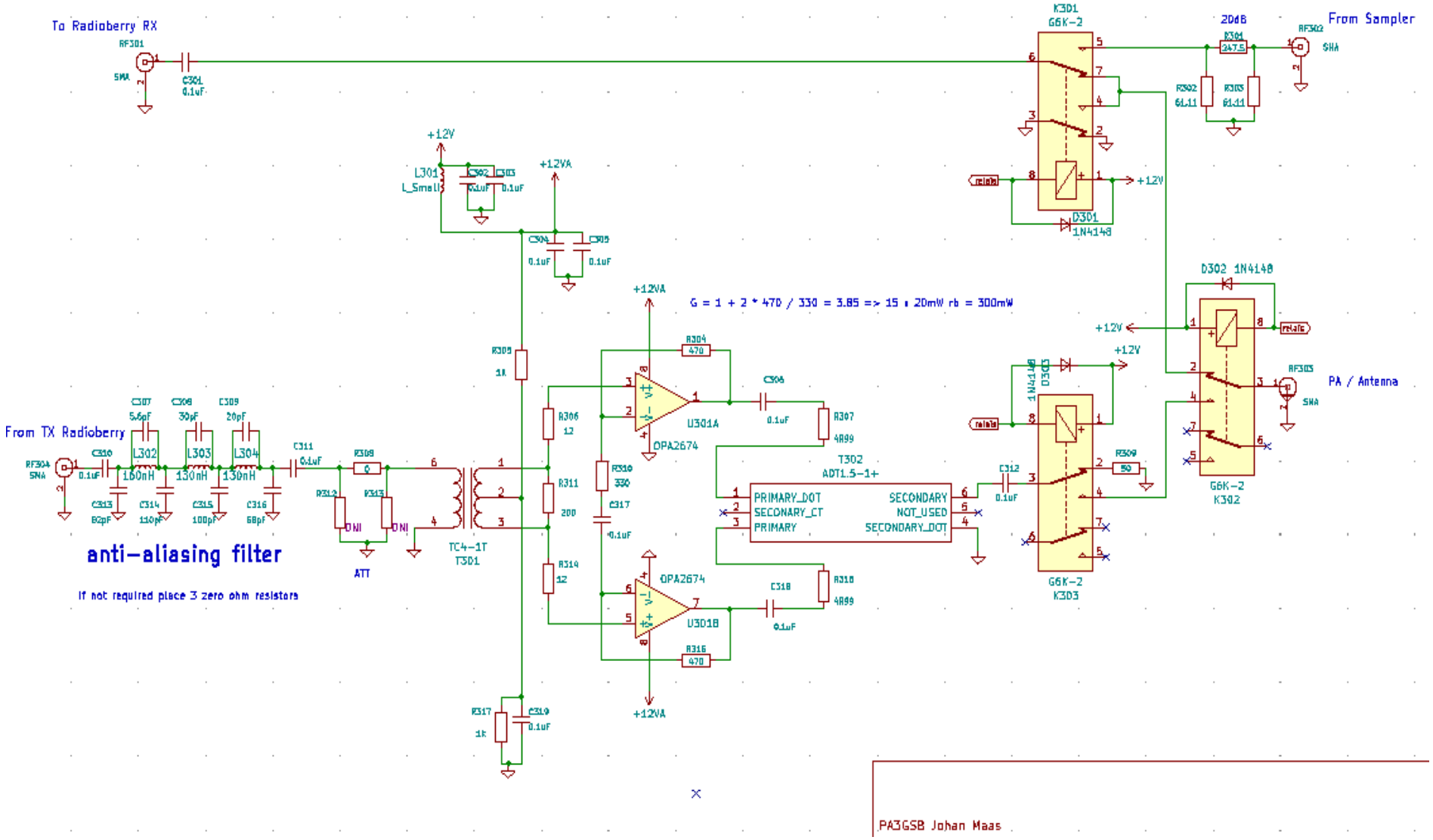


Abbildung 18: links IMD3 ohne PD ca. 42 dBc, rechts mit PD IMD3 ca. 55dBc

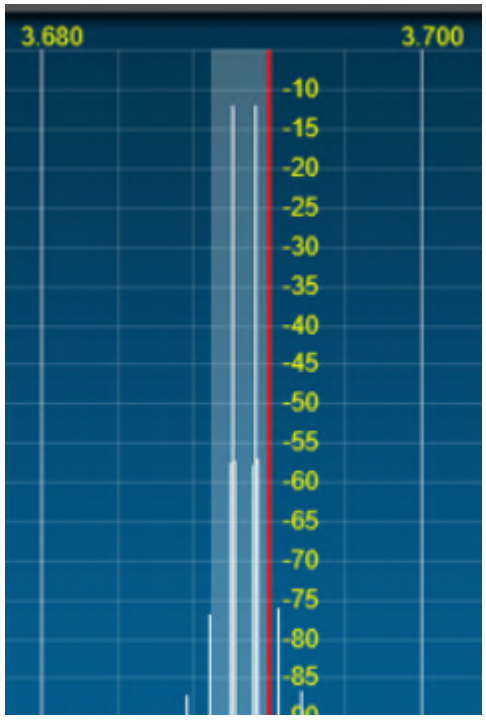
Radioberry HAT



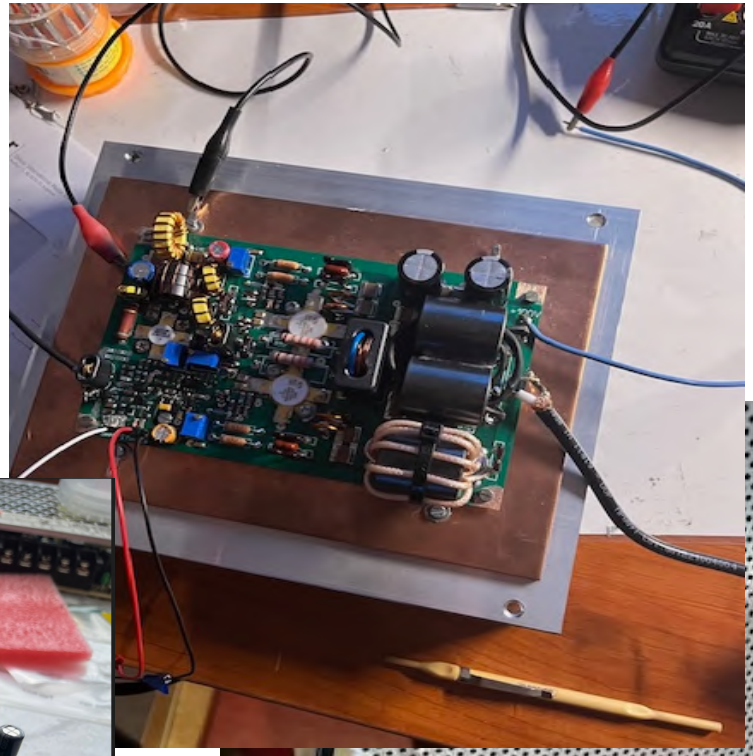
Radioberry HAT

Driver voor PA / sampler voor PureSignal

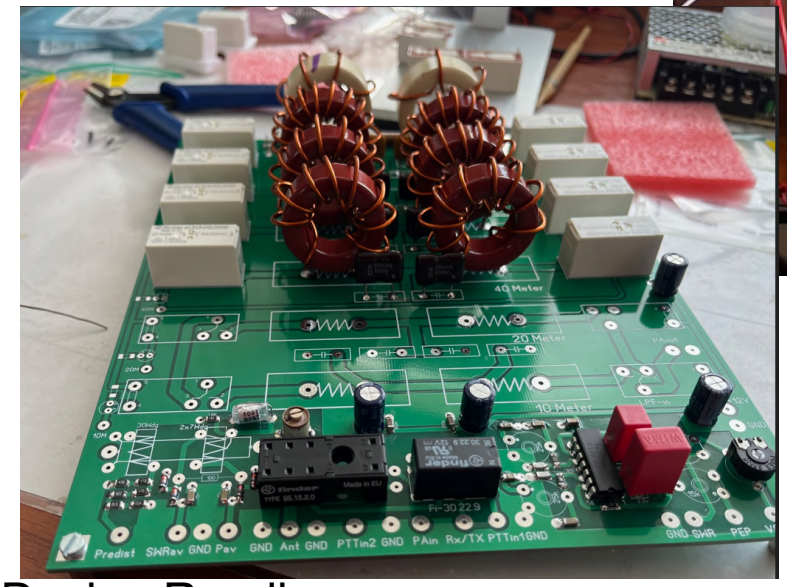
PA 600W

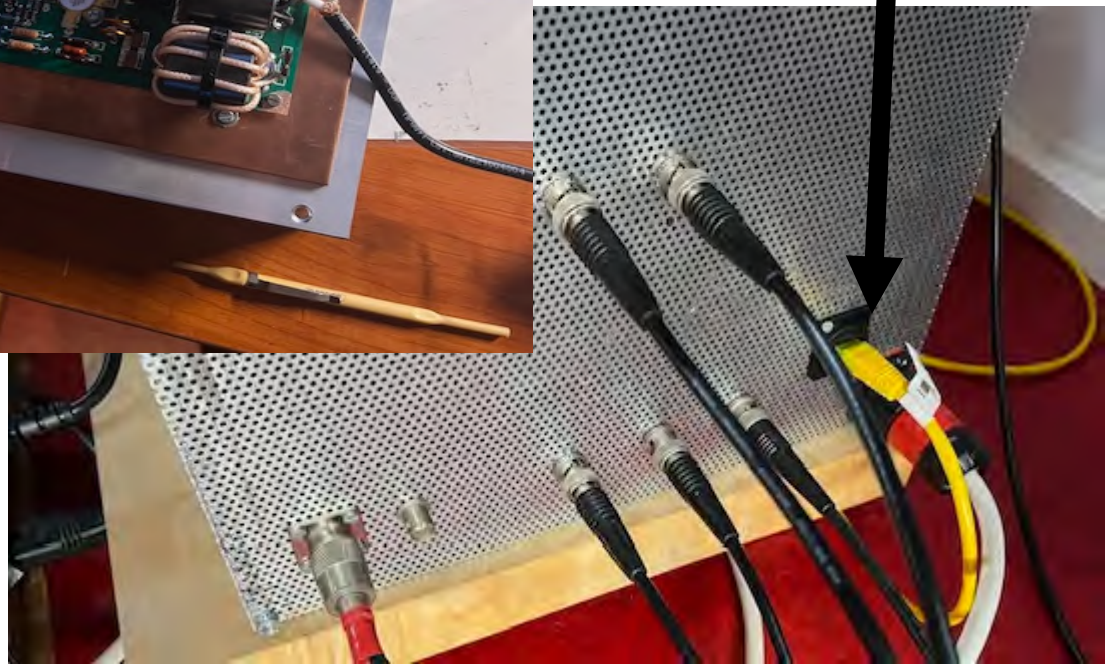


IMD-3 Pure signal.



Control via RP2040 en firmware.





Design Ruediger
DJ1MR

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Performance radioberry (ON-AIR)

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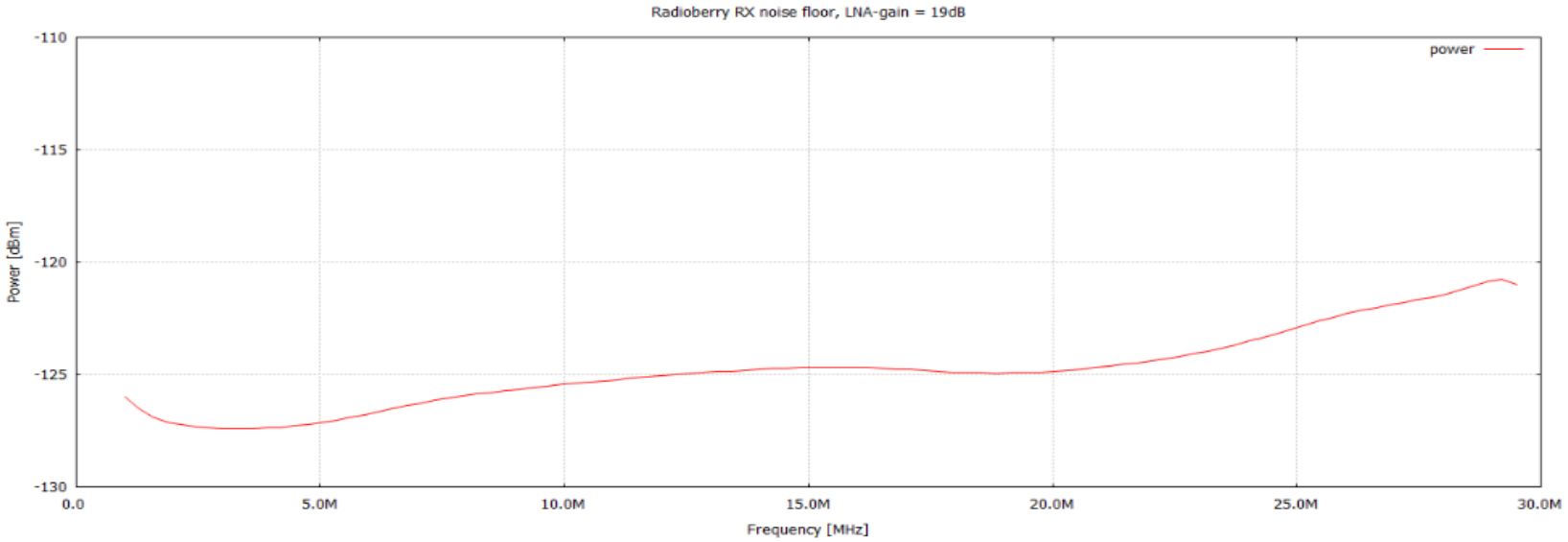
RX – Gevoeligheid



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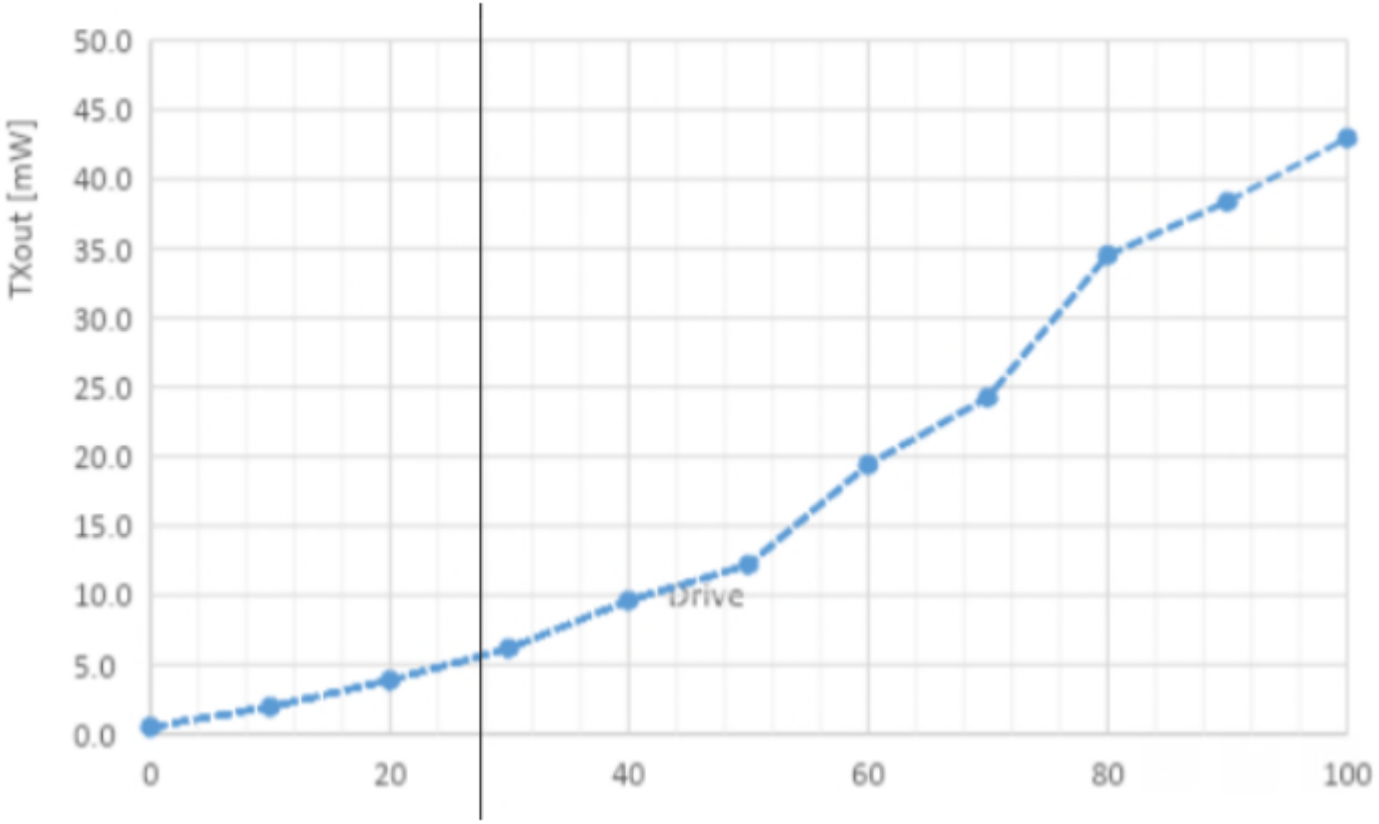
TX Output



THETIS

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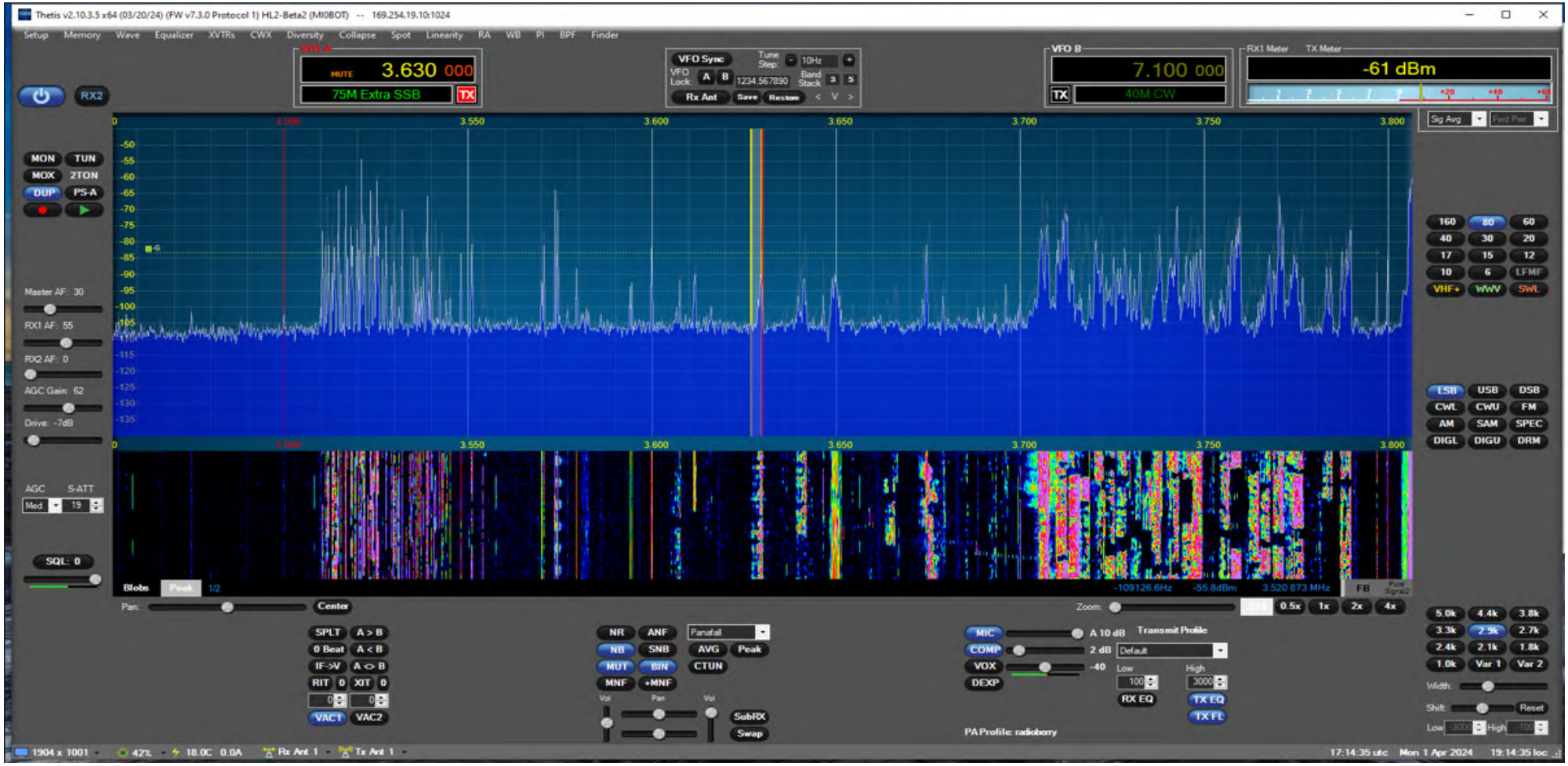
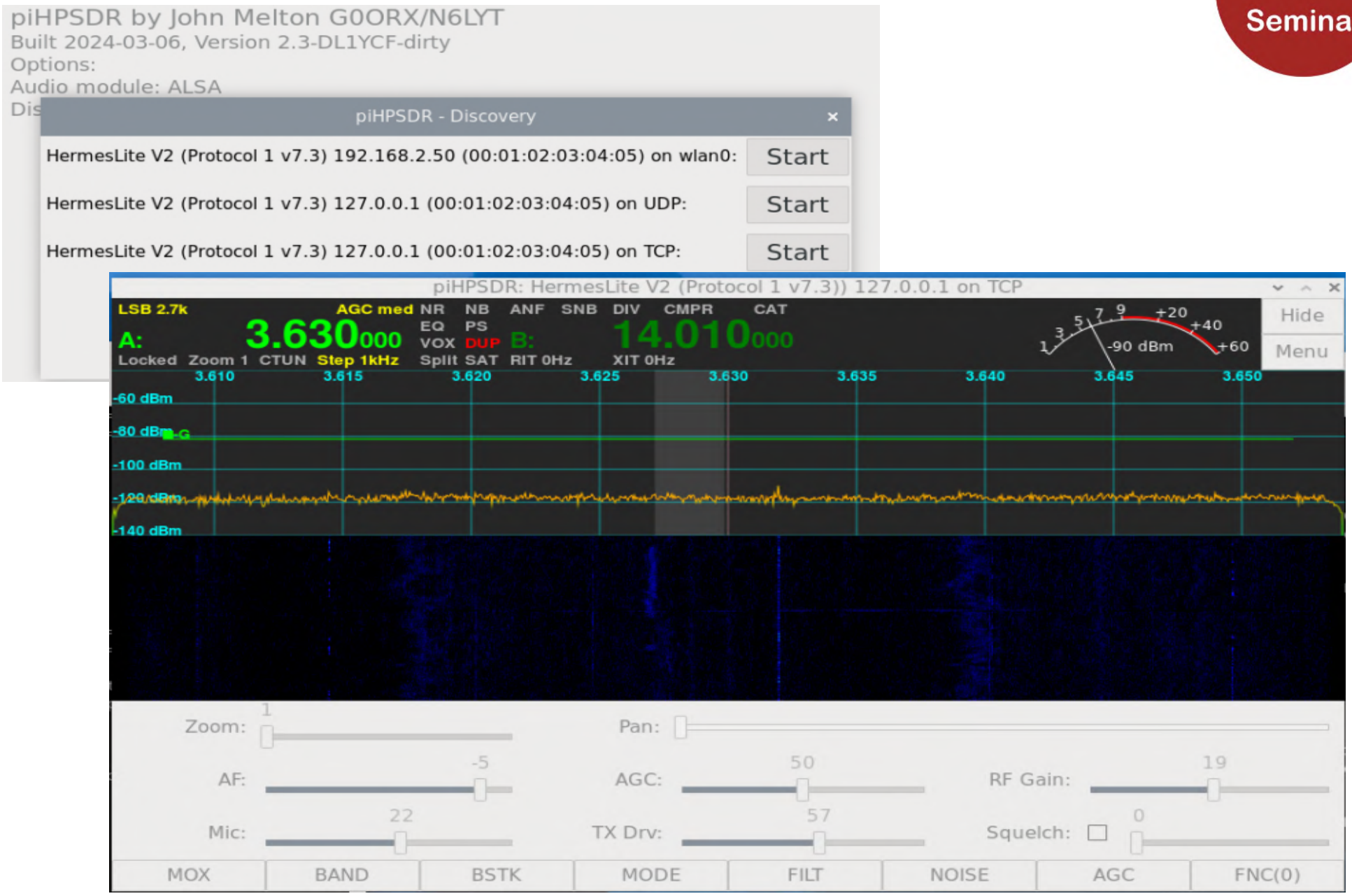


https://github.com/mi0bot/OpenHPSDR-Thetis/releases

PIHPSDR



https://github.com/dl1ycf/pihpsdr

WDSP

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The WDSP Guide

Using WDSP for Software Developers

WDSP is a full featured signal processing library for Software Defined Radio.

While assuming general SDR and programming knowledge, this guide provides the specifics of setting up and accessing WDSP.

https://github.com/TAPR/OpenHPSDR-wdsp

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Informatie links

http://www.pa3gsb.nl

https://github.com/pa3gsb/Radioberry-2.x
https://github.com/pa3gsb/Radioberry-2.x/wiki

https://www.pa3gsb.nl/radioberry/api/read.php

https://github.com/softerhardware/Hermes-Lite2

https://github.com/softerhardware/Hermes-Lite2/wiki

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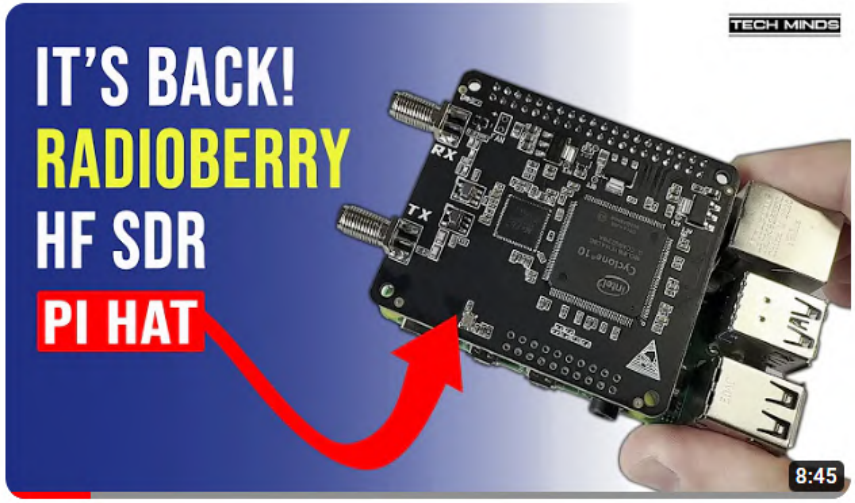
Veel aandacht o.a. youtube.



RADIOBERRY HF SDR TRANSCEIVER PI HAT - IT'S BACK!

138K weergaven • 8 maanden geleden

Tech Minds

Here we take another look at the **Radioberry** HF SDR Pi Hat which has just been re-released

4K

RADIOBERRY - HF SDR TRANSCEIVER PI HAT

98K weergaven • 2 jaar geleden

Tech Minds

Here we take a look at the **Radioberry**, a Radio PiHat for the Raspberry Pi design by Johan P

4K

What Exactly Is a Radio Berry | Software Installation | Software Packages | Sdr

RF Seminar

Conclusie:

Aan de slag met een Radioberry moet je dus van puzzelen houden!

Bedankt voor de aandacht.

Veel plezier met de hobby.

PA3GSB