SDR - Charly 25

HamRadio 2017 in Friedrichshafen
SDR Academy

SDR Transceiver Project
OV-Erding C25

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Agenda

1. Introduction Project Team
2. Overview
3. Technical Details of the Hardware
4. Upcoming development
5. Frontend Software - PowerSDR

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Project Team

Edwin Richter
DC9OE

Markus Grundner
DG8MG

Markus Großer
DL8GM

Erwin Rauh
DL1FY

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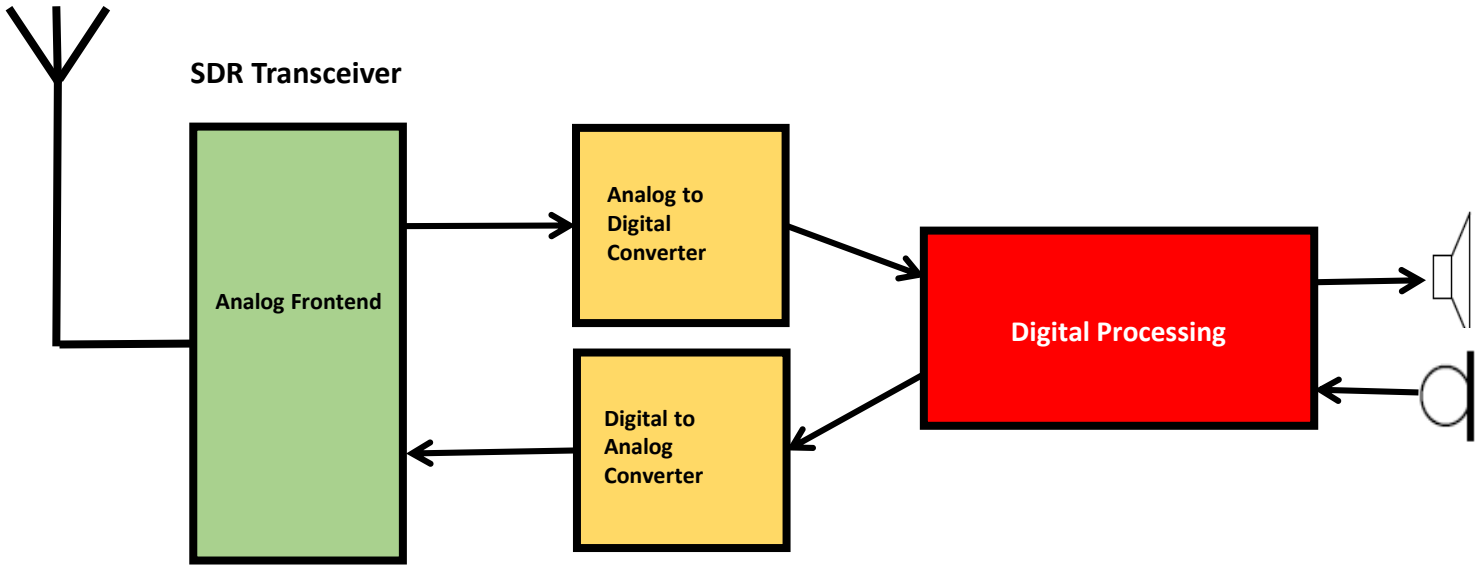
Overview



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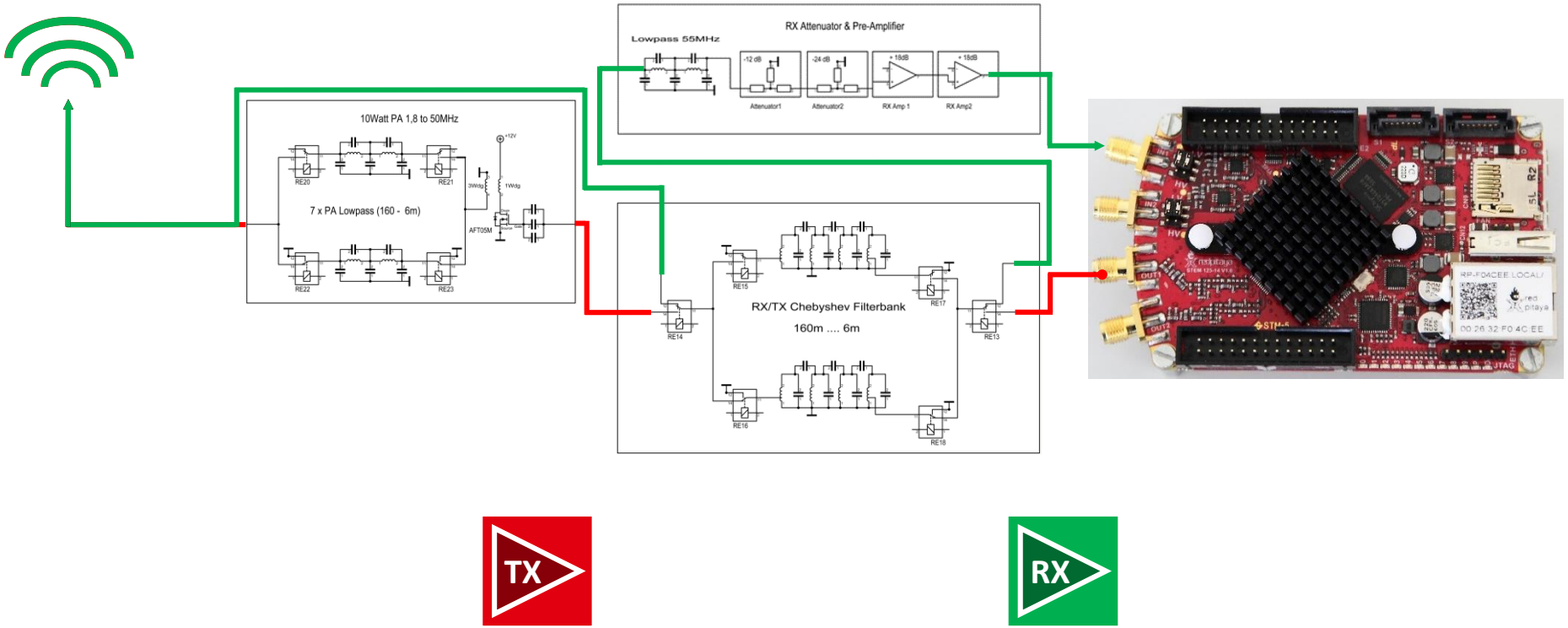
Overview



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Highlights

Technical Specification

- TX frequency: 160m – 6m Band
  RX frequency: 25KHz – 60MHZ
- 12 x Band pre-selector (Rx Filter for Ham Band)
- supports 2 fully independent receivers
- low noise preamp / attenuator -36dB - 0 - +36dB
- AM,FM,RTTY,CW,LSB,USB, DIGITAL modes available

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Technical Challenges using Stemlab 14 as a TRX

RX Sensitivity

is around -95dBm but there are two well known standard methods available for improvement

Implement Bridge 2-5 and add a 1:14 Transformer to overcome limitations of 1MOhm Input Impedance

Benefits

- Easy to implement
- Increased sensitivity (about -113dBm to -118dBm)

Disadvantages

- Limited Dynamic Range
- Limited large signal handling capability

- Basic Signal handling capability (w/o Transformer) is good at about +32dBm IP3, but will be ruined with sensitivity improvement methods proposed above.
- A better approach would be to connect to the A/D converter directly using a transformer

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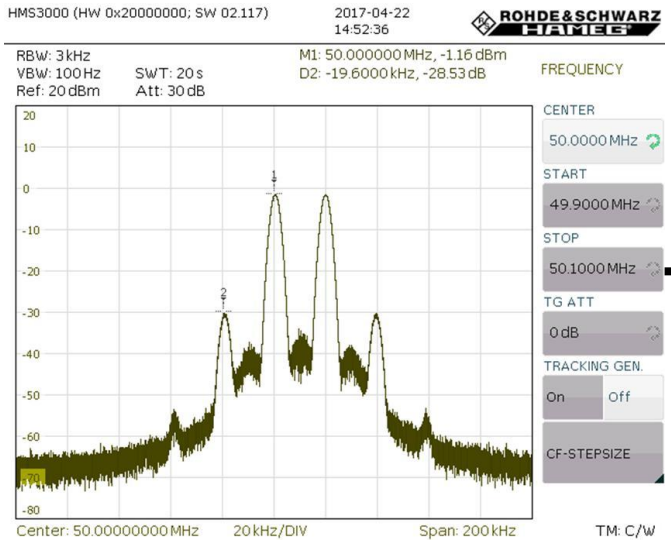
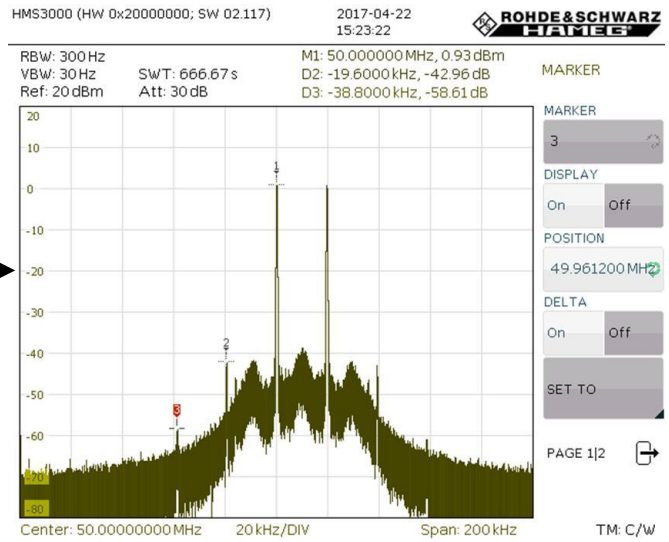
Improved IMD



New Output Amplifier



Signal Quality @ 50MHz
IMD of the Output Amplifier
Standard Red Pitaya
IMD -28dBc

Signal Quality @ 50MHz
IMD of the Output Amplifier
Red Pitaya with new Output Amplifier
IMD – 43dBc

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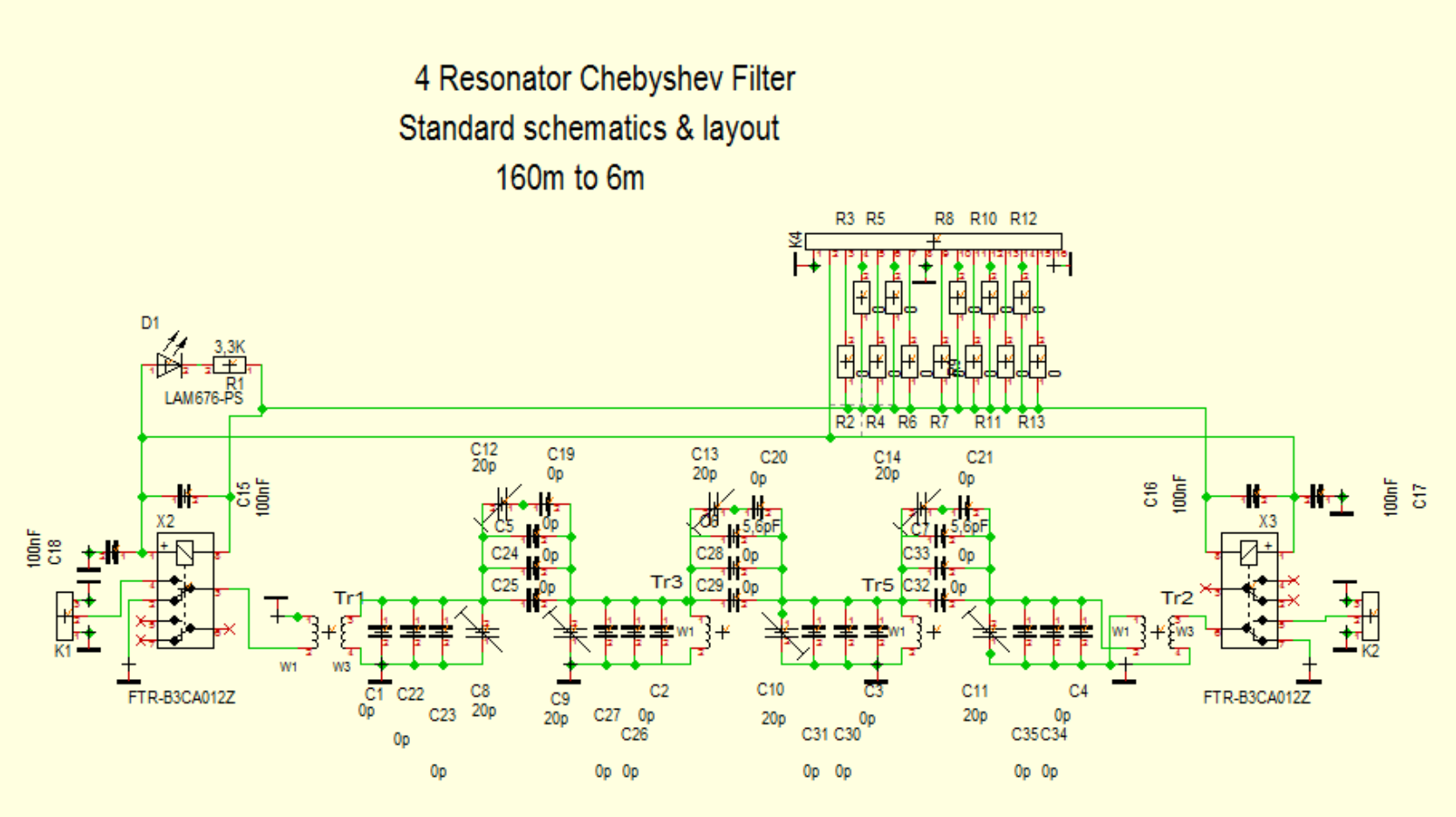
Receiving Filter



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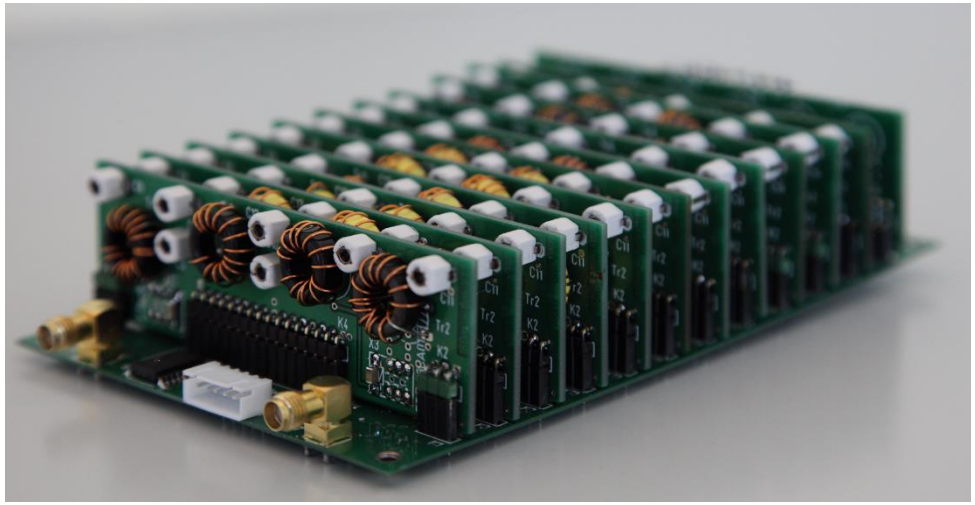
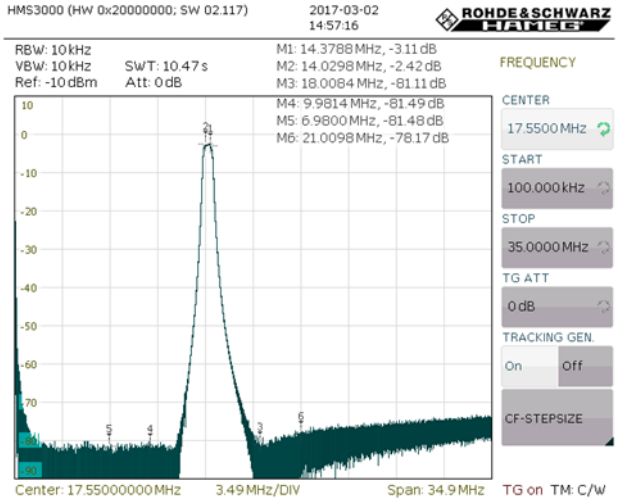
Receiving Filter





High-end 12 band Filter Board

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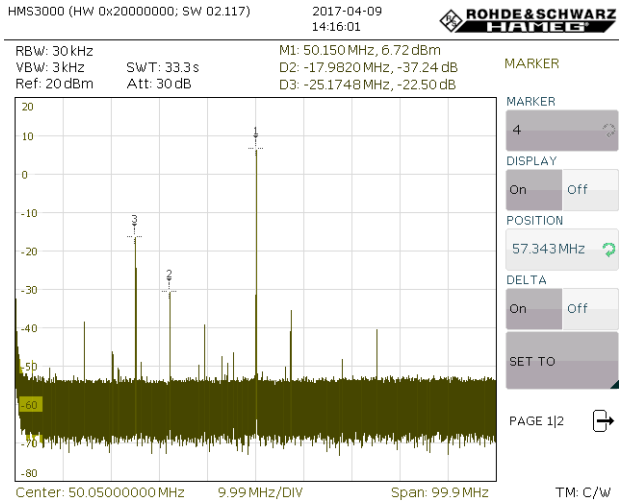
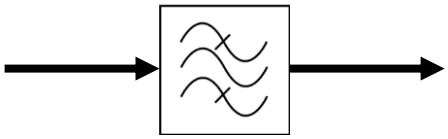
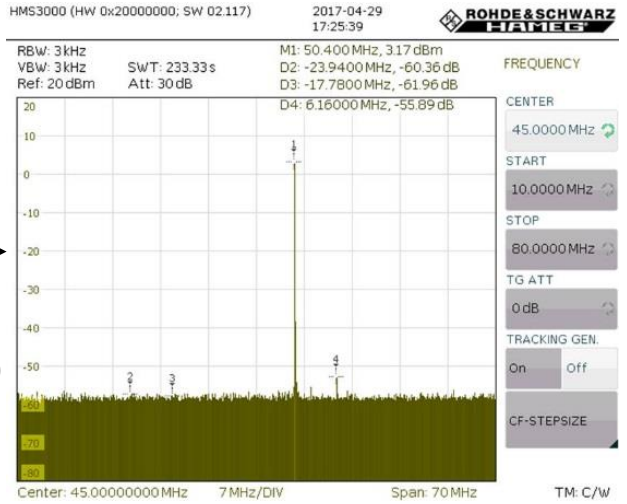
Optimized Transmit Signal



TX through RX Filter



protype RX Filterboard
(4 Resonator Chebychev Design)



Transmit Signal Quality @ 50MHz / Spurs
Standard Red Pitaya

Signal Quality @ 50MHz / Spurs
Standard Red Pitaya
Signal cleaned up with RX Filter

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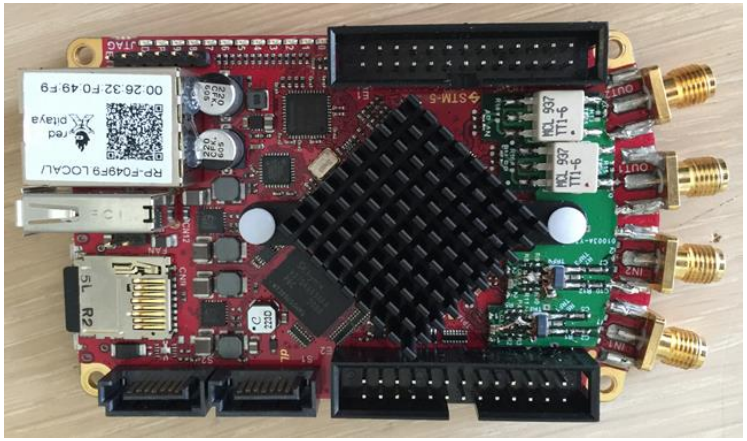
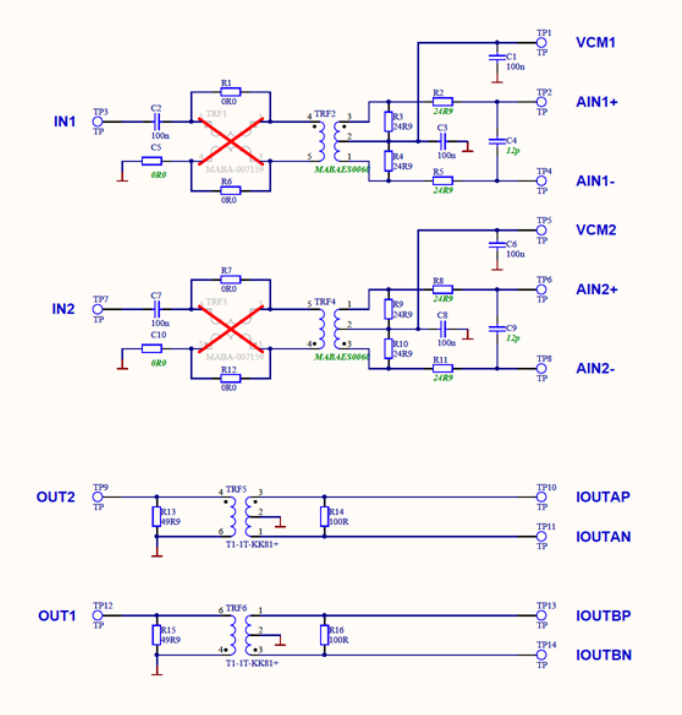
New RP for SDR TRx



Red Pitaya with modified front end



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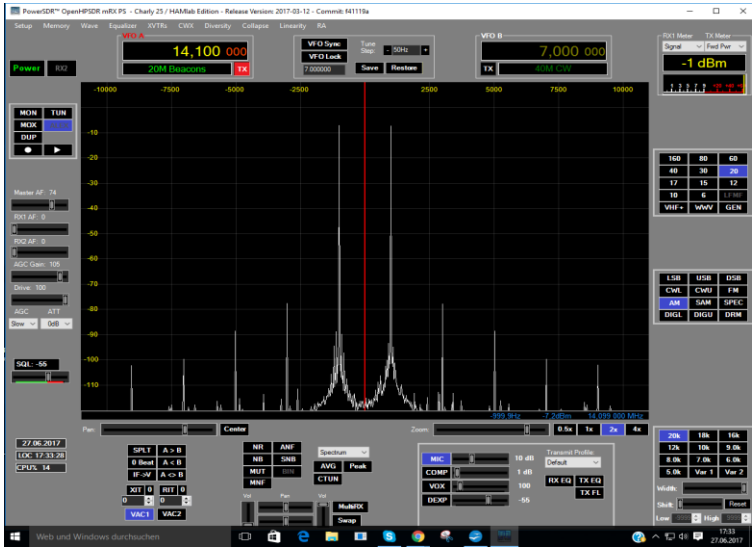
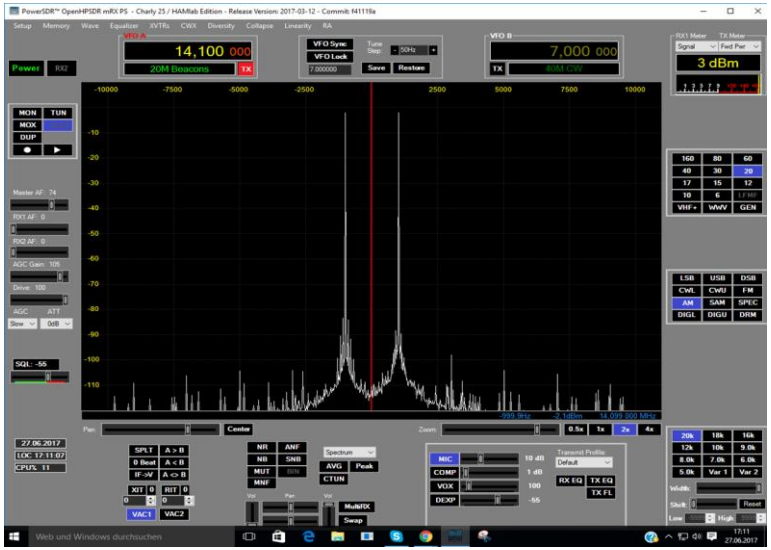
Technical Challenges using Stemlab 14 as a TRX



Non- Modified STEMlab14

@ 2x-3dBm Input with 50Ohm Termination – IP3= +32dBm!

Sensitivity around -95dBm



Modified STEMlab14

@ 2x-3dBm Input – IP3= +44,5dBm!

Sensitivity around -110 to -115dBm and x-talk improved from 40dB to 80dB!!!

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Technical Challenges using Stemlab 14 as a TRX

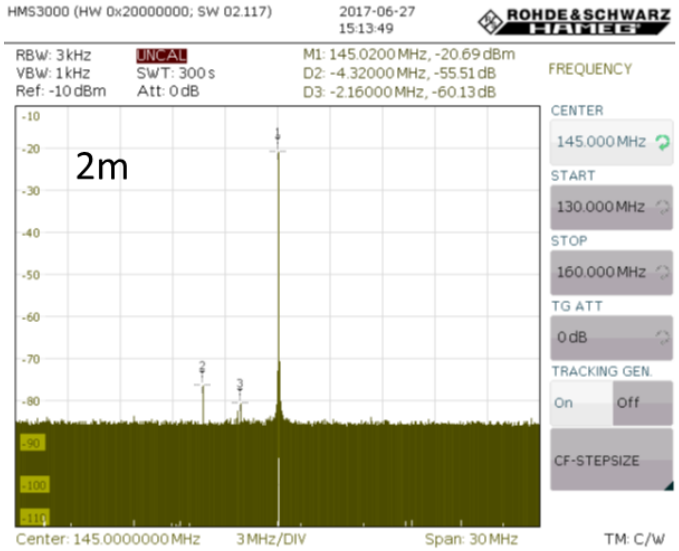
Next Steps – 4m,2m (70cm??) – using 2nd 3rd and eventually 5th Nyquist Zone

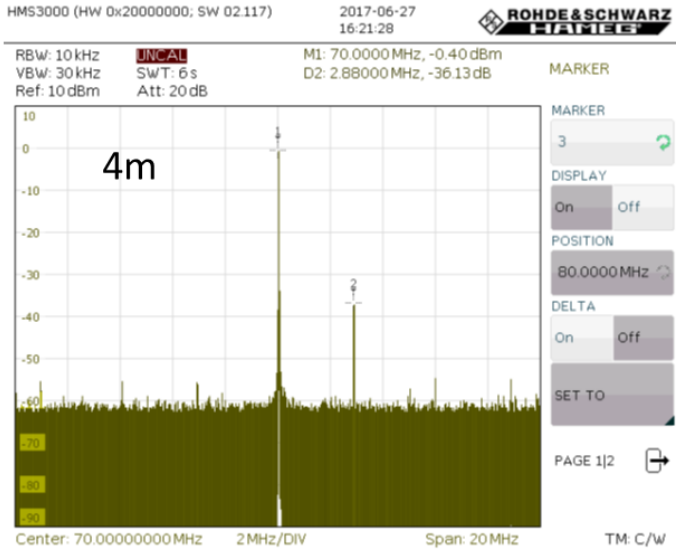
RX Sensitivity

70MHz – 113dBm
145MHz – 110dBm
435MHz – 100dBm

TX (with alternative Transformer)

- 0,5dBm output
- 10 dBm output
- 31 dBm output





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Upcoming

What did we need to improve ?

Work on…

- → Show actual output power and SWR on Power SDR software
- → Modified Red Pitaya frontend for the use of Alias frequencies for reception and transmission on 4m, 2m
- → Testing an external oscillator to reduce phase noise - additional GPS connection
- → Transverter connection
- → Power PA 250 Watt module (1,8 to 50 MHz)
- → And…

How can we take the next level of SDR?

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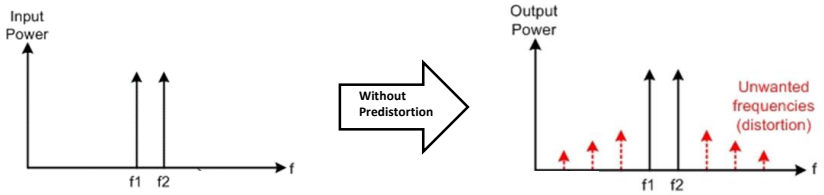
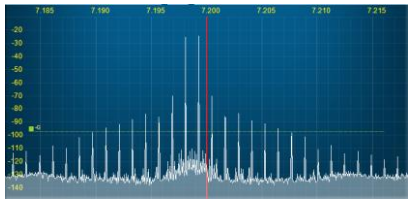
Upcoming - Predistortion





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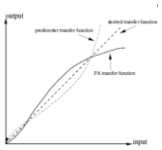

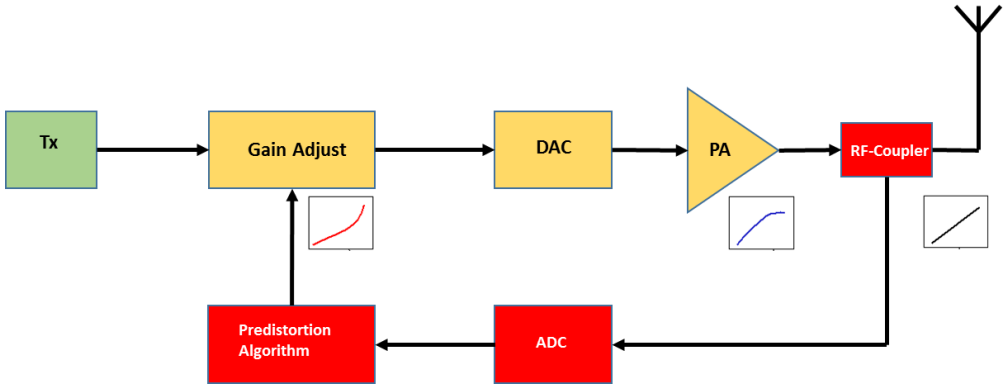

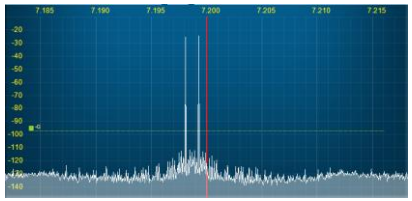

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Linearity of the TX Signal

Coupler will be integrated into the next generation C25 board design along with 20W Push Pull PA

1 : http://pavel-demin.github.io/red-pitaya-notes/sdr-transceiver-hpsdr/

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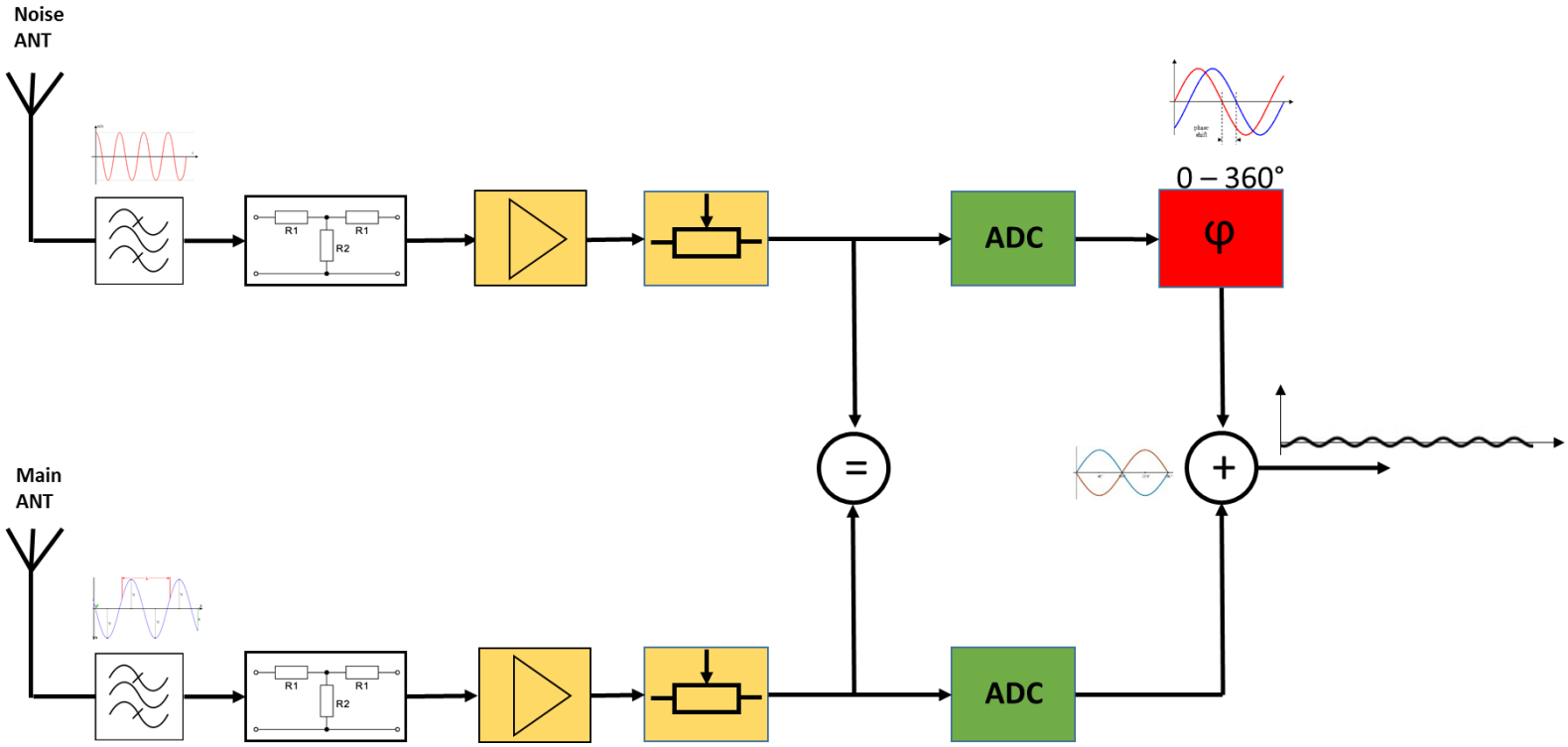
Upcoming - HF Noise Cancelling



Improvement of the x-talk between the two RX-Channels with -80db attenuation

Charly25 SDR - Hamlab

SDR Community

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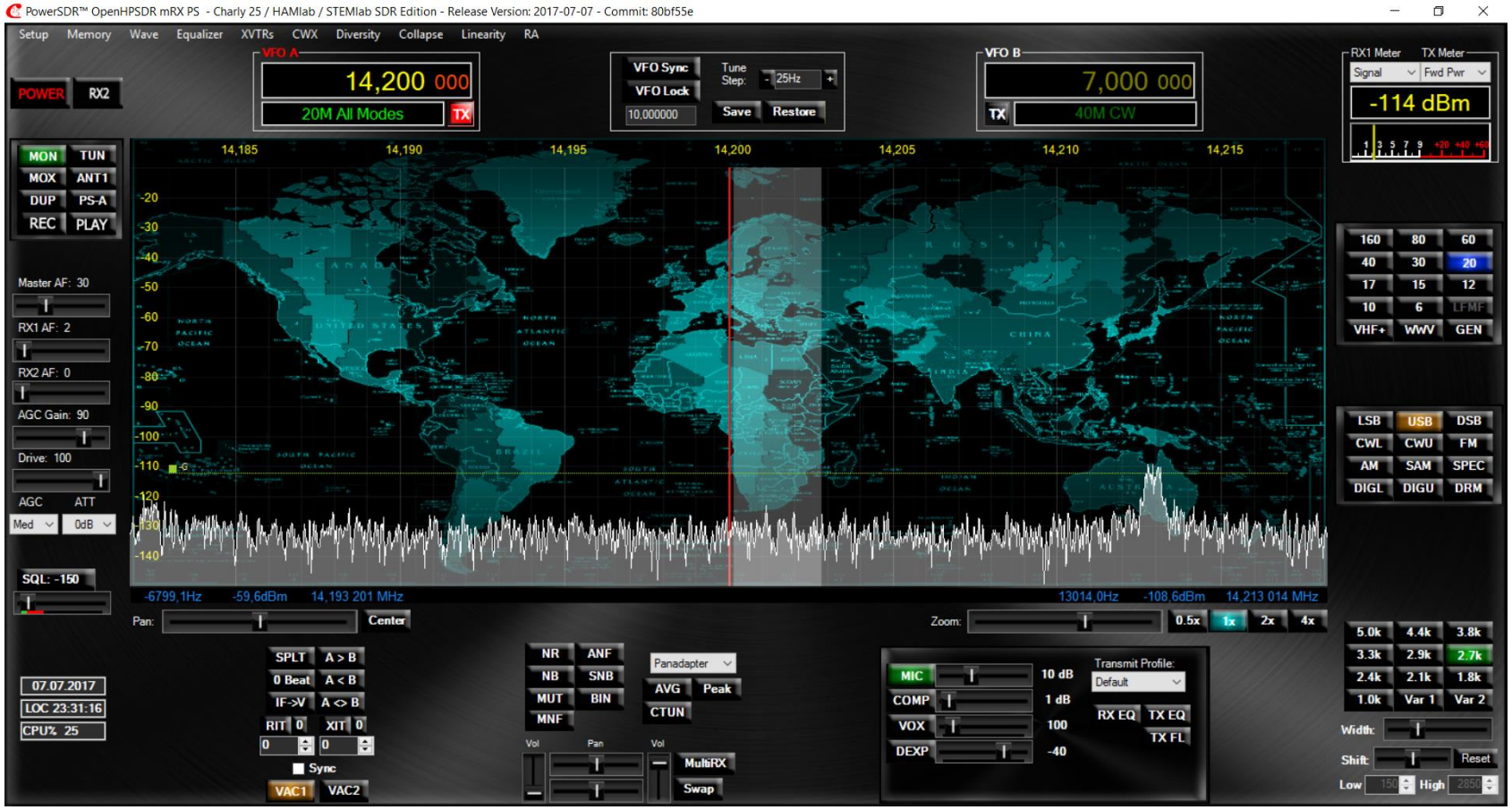
Frontend Software - PowerSDR



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PowerSDR Charly 25 / HAMlab / STEMlab Edition feature list – part 1

- ✓ The current version is based on the OpenHPSDR-PowerSDR version: 3.4.2
- ✓ Regular upgrades to the current OpenHPSDR-PowerSDR version will keep it up to date and compatible with it
- ✓ The title bar shows the commit hash and date from Git to simplify the support
- ✓ It has its own setup package and is compatible with 32bit and 64bit Windows systems from Windows XP until Windows 10
- ✓ There's an own path for its configuration data on the Windows operating system to avoid incompatibility with other PowerSDR installations on the same computer
- ✓ It has its own software update functionality via the Red Pitaya download server
- ✓ A remote start up routine for the SDR application on the Red Pitaya is implemented, so there’s no need to start up the SDR application via the web browser

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PowerSDR Charly 25 / HAMlab / STEMlab Edition feature list – part 2

- ✓ It can work with more then one Red Pitaya device on the network by selecting the device to start up
- ✓ It supports both antenna connectors of the TRX boards
- ✓ There‘s support for the sensing head which measures forward-power, backward-power and the SWR
- ✓ The attenuator and preamp settings are extended for the Charly 25, HAMlab and STEMlab hardware
- ✓ Two new device classes were added to make it compatible with the Charly 25, HAMlab and STEMlab hardware
- ✓ It automatically detects the available TRX, RX BPF and audio codec hardware and the running SDR application version

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PowerSDR Charly 25 / HAMlab / STEMlab Edition feature list – part 3

- ✓ It has its own PA settings table for the Charly 25, HAMlab and STEMlab hardware
- ✓ There's an own automatic calibration routine for the different attenuator and preamp settings to make sure that it always shows the real power level that arrives at the antenna connector, the calibration values are saved separately for each band
- ✓ It can handle the optional available 12 band RX BPF boards for both physical receivers
- ✓ Some extensions on the MIDI interface were implemented to support rotary encoders
- ✓ as VFO dial knobs
- ✓ It has additional test routines for the TX LPF, the RX attenuators and the RX preamps on the Charly 25, HAMlab and STEMlab hardware and a frequency sweeping routine for different tests
- ✓ Many further ideas we already have in our minds will be available soon…

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QUESTIONS ?

Thank you!

… is oiss klar ?

CW makes you happy