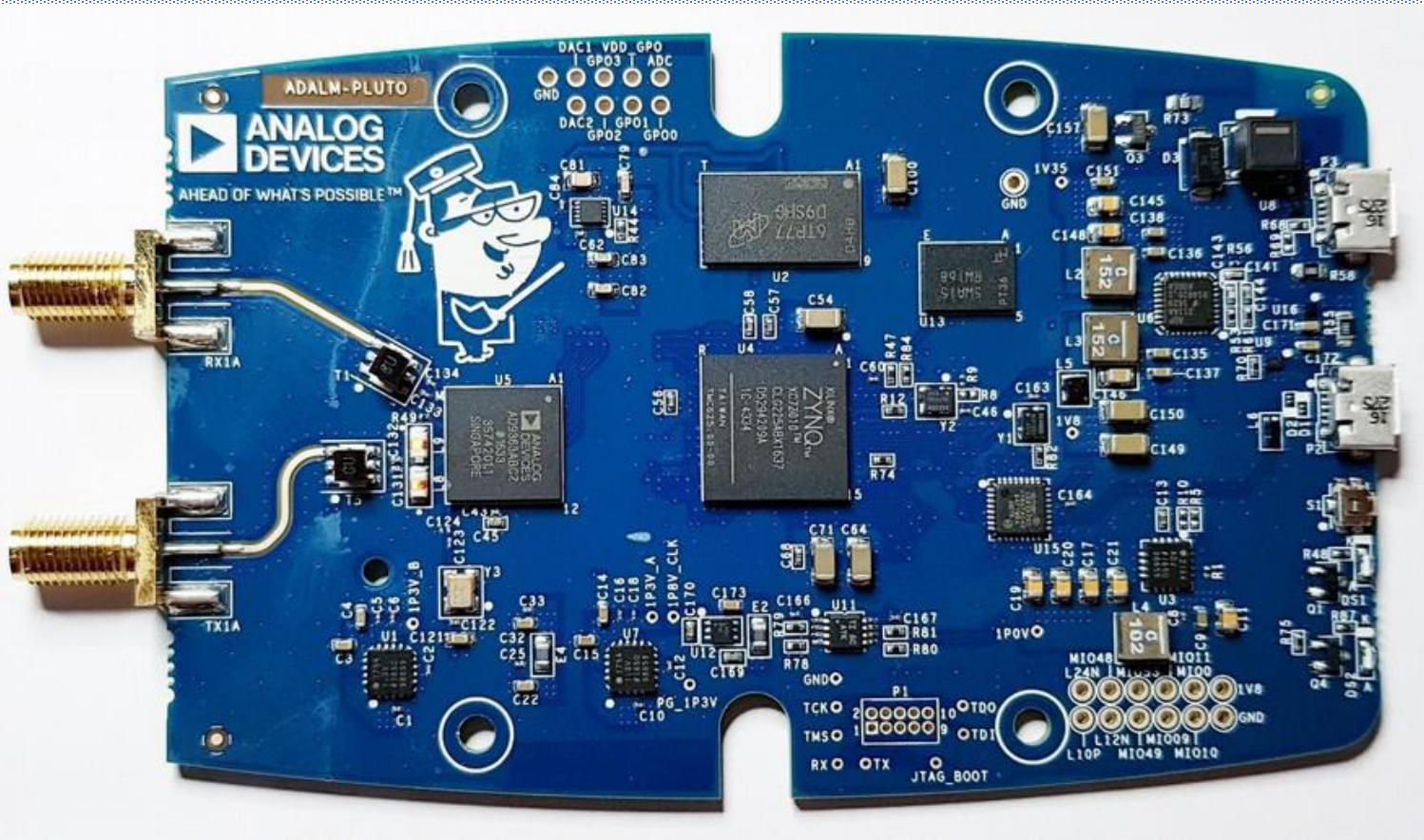


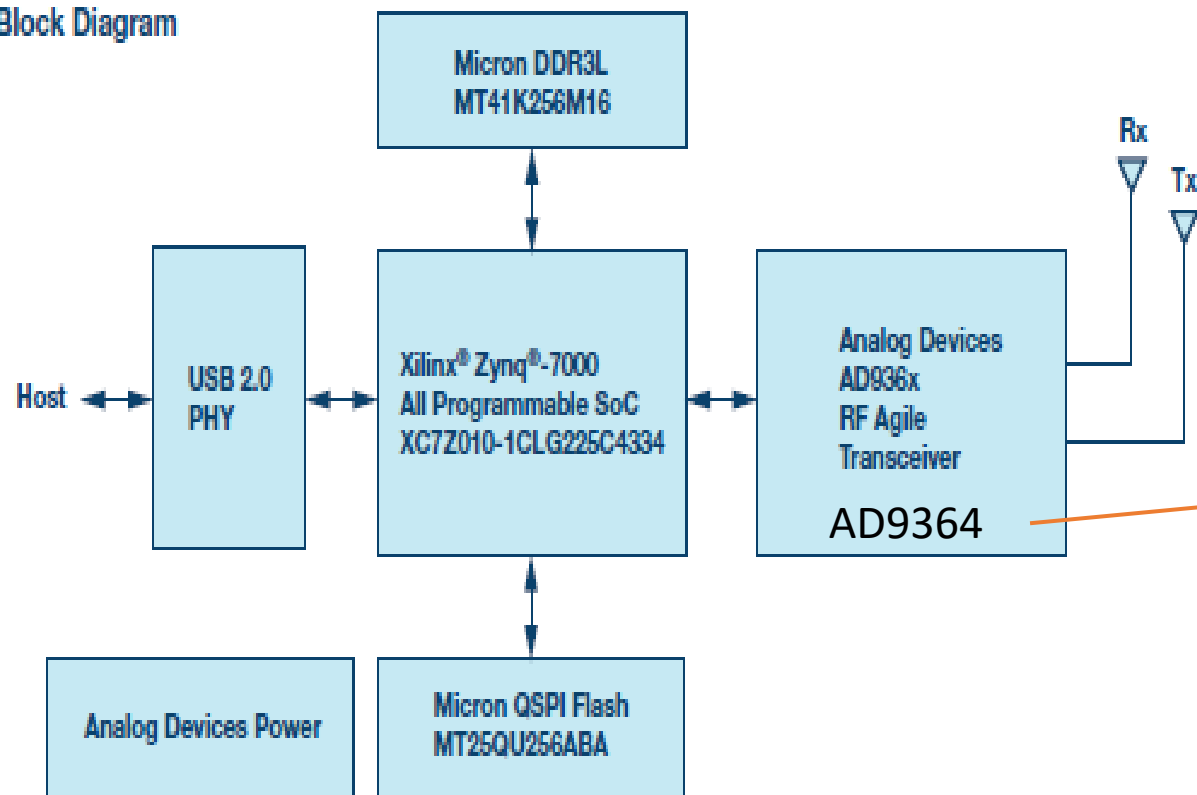
# EME and Adalm PLUTO



Mirek Kasal, OK2AQ



## Simplified Block Diagram



MOUSER : 4808.- Kč

Specifications	Typical
<i>Power</i>	
DC Input (USB)	4.5 V to 5.5 V
<i>Conversion Performance and Clocks</i>	
ADC and DAC Sample Rate	65.2 kSPS to 61.44 MSPS
ADC and DAC Resolution	12 bits
Frequency Accuracy	±25 ppm
<i>RF Performance</i>	
Tuning Range	70 MHz to 6 GHz
Tx Power Output	7 dBm
Rx Noise Figure	<3.5 dB
Rx and Tx Modulation Accuracy (EVM)	-34 dB (2%)
RF Shielding	None
<i>Digital</i>	
USB	2.0 On-the-Go
Core	Single ARM Cortex®-A9 @ 667 MHz
FPGA Logic Cells	28k
DSP Slices	80
DDR3L	4 Gb (512 MB)
QSPI Flash	256 Mb (32 MB)
<i>Physical</i>	
Dimensions	117 mm × 79 mm × 24 mm 4.62" × 3.11" × 0.95"
Weight	114 g
Temperature	10°C to 40°C

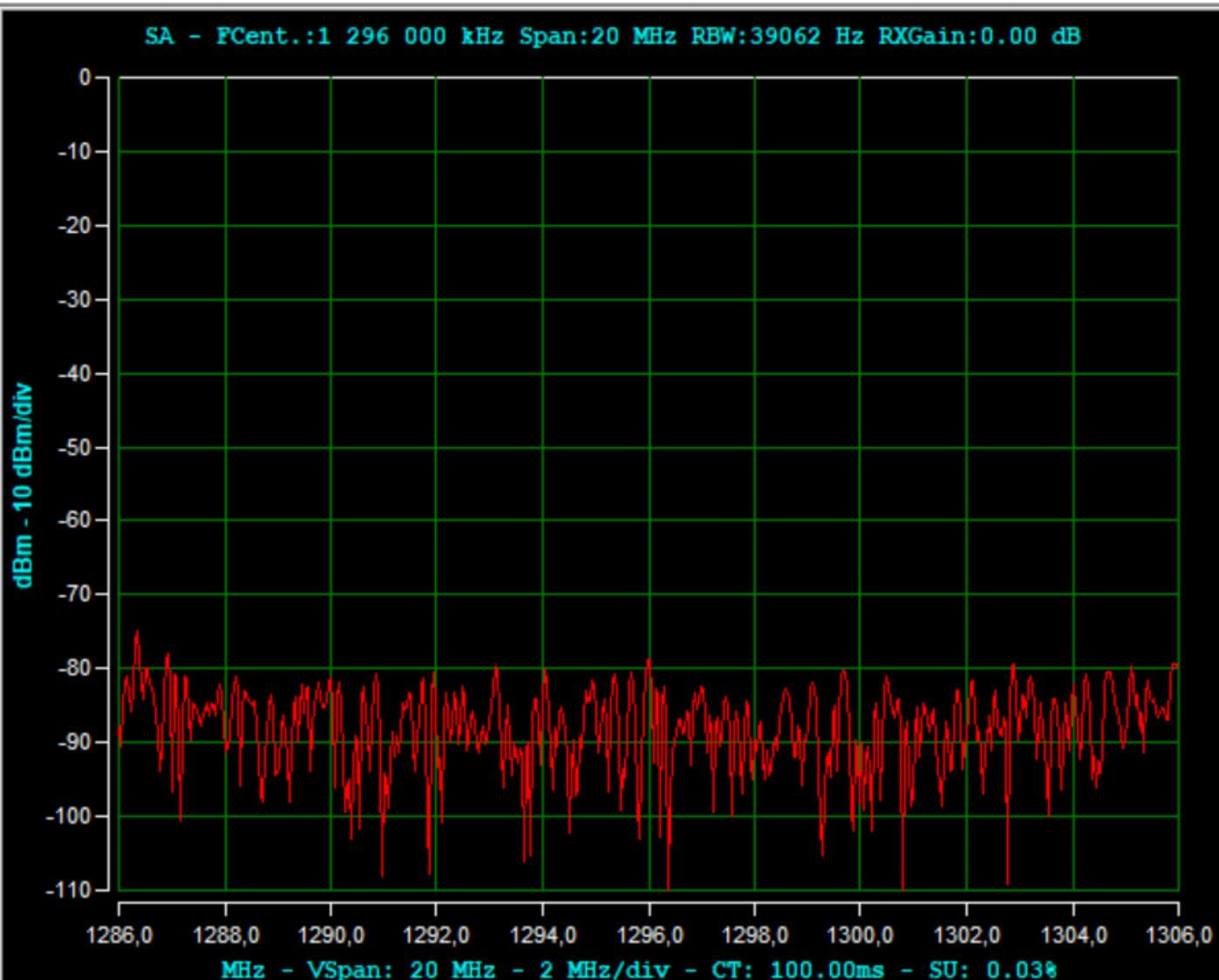
## **Advantages:**

- Low Price
- Freq. Range 70 MHz - 6 GHz
- High Sample Rate - Bandwidth
- Small Size
- Matlab Support
- Many Users – Many Applications
- Perfect Design - 10 layers PCB
- IIO Oscilloscope

ADC/DAC 12 bit

## **Disadvantages:**

- RF Shielding is missing
- Low Freq. Stability
- PTT Solution
- Latency



Power Temp Y Zoom Z Lock Z Reset Hold Copy L/C TSA Unit VF avg Legend Panels ToolBar

dBm

**Spectrum Analyzer**

Frequency kHz **1296000** MHz kHz RBW: 39062 Hz

Span MHz **20** RX Gain **0,0** RX Gain mode: manual

Trigger: Video, Line, Ext

FullBand MaxHold Remove LO img Fast-Cycle

**Spectrum Analyzer w/Tracking** **Gen/Sweeper**

Start Freq. MHz **90** Stop Freq. MHz **2500** RX offset kHz **0**

RX Gain **30,0** TX Pwr **-20,0** Resolution **512**

Manual Pause Calib. Req. 0dB Calib. Req. -40dB

Trigger Step Avg

**Generator**

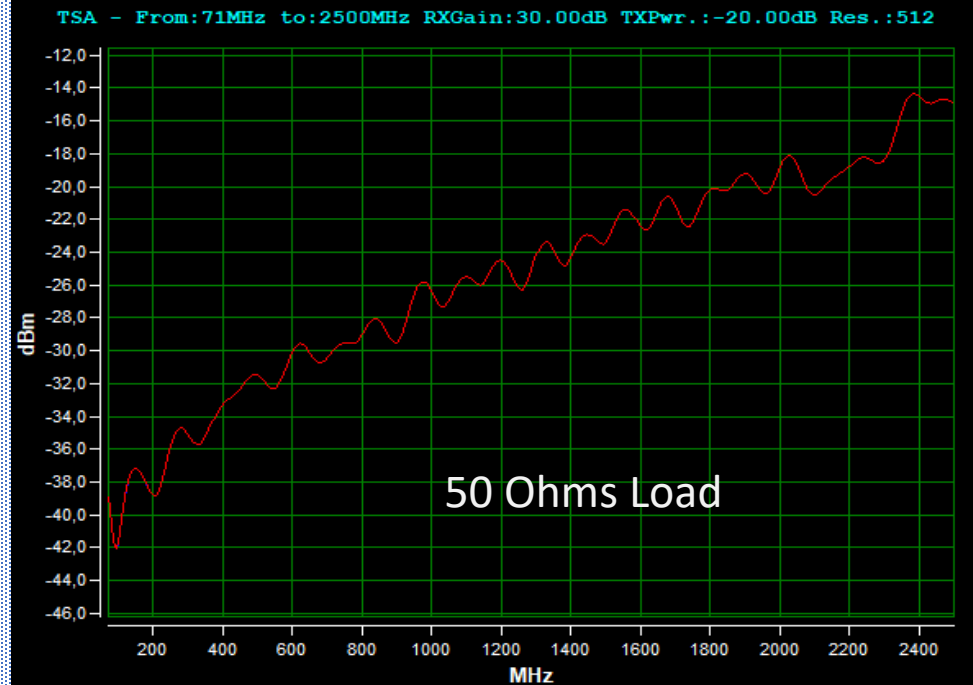
Frequency kHz **2304100** MHz kHz TX Pwr **0,3**

3rd 5th 7th 9th

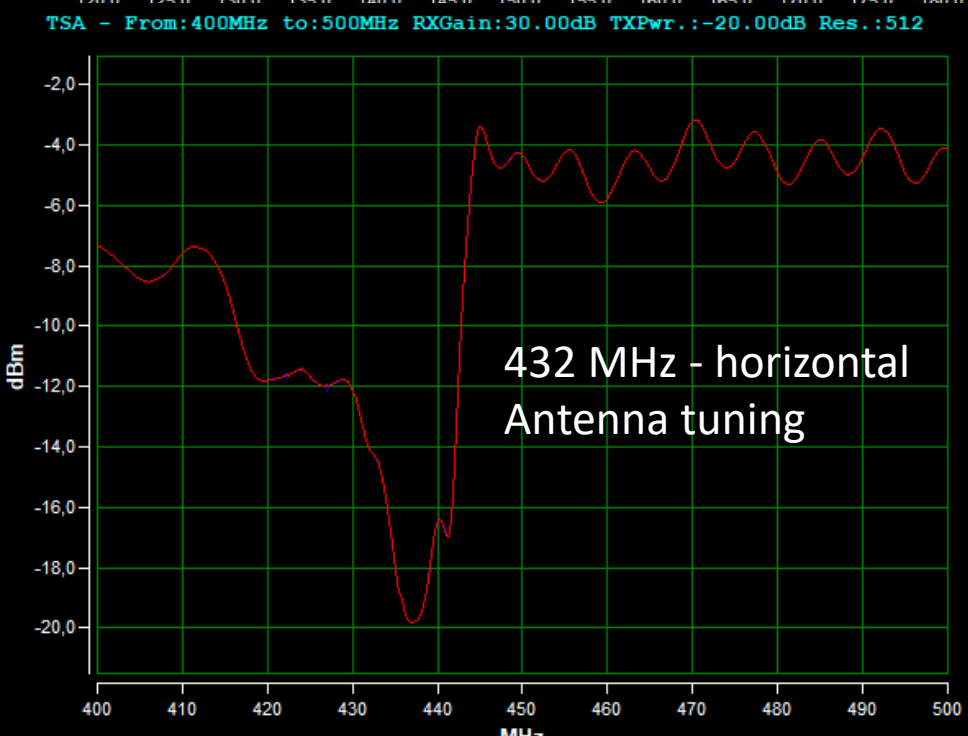
CW DC FMW FMN AM EXT



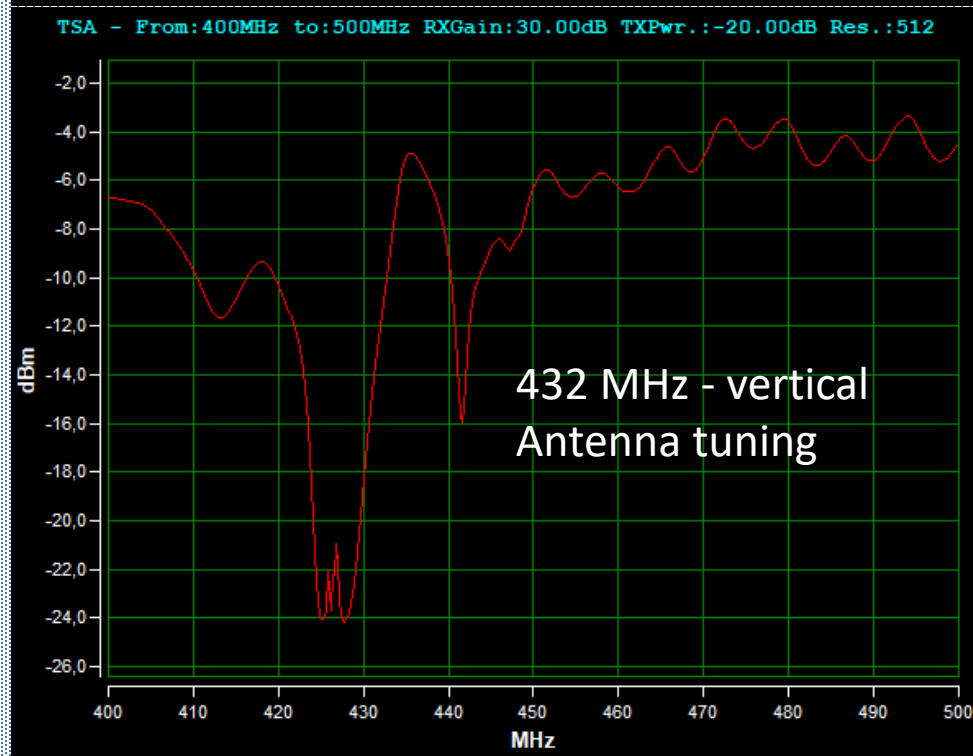
Spectrum analyzer + Tracking Oscillator



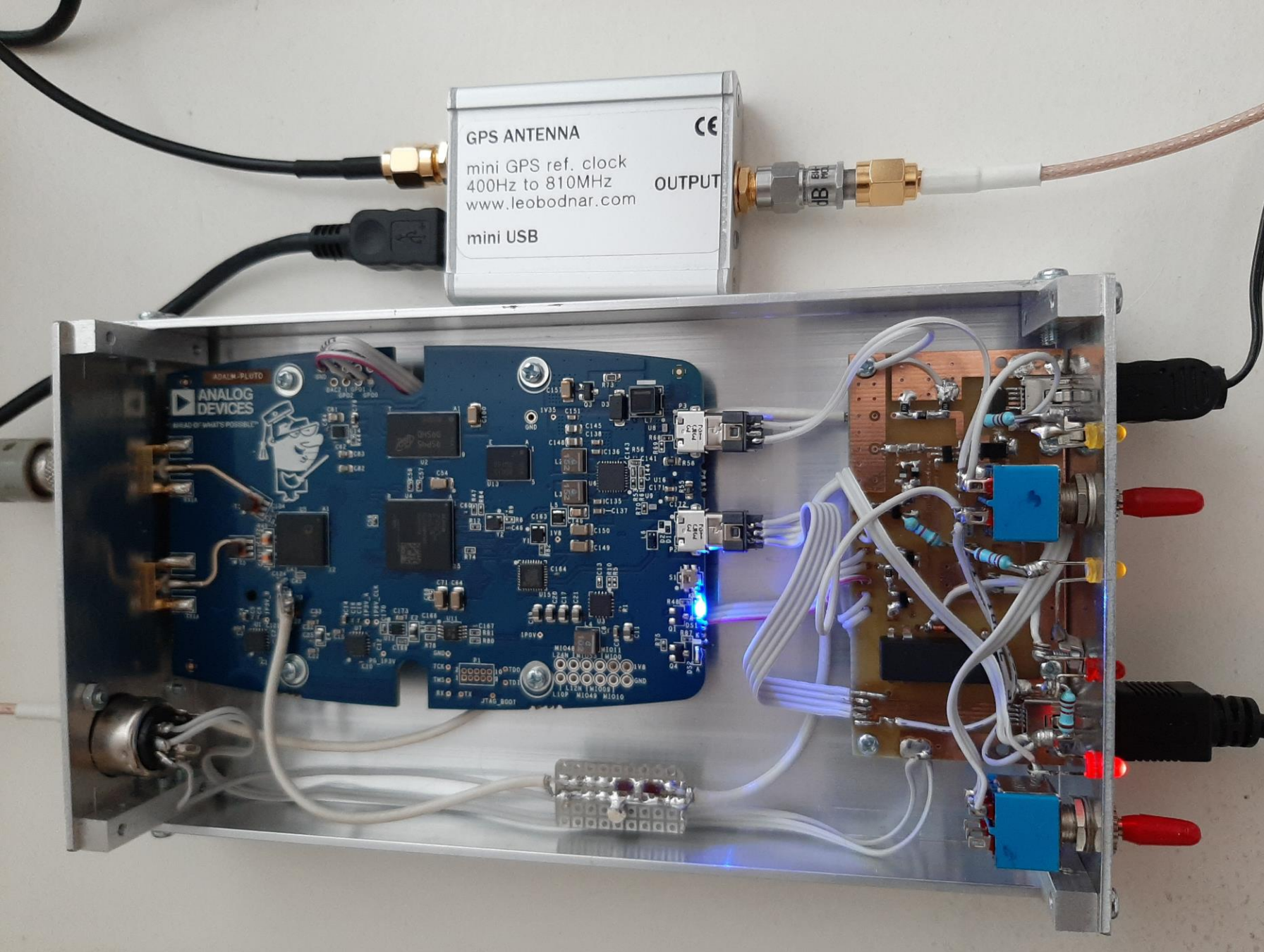
+



Directional Coupler

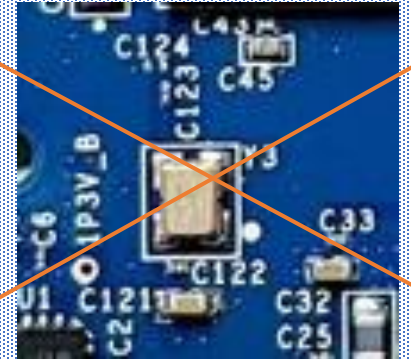






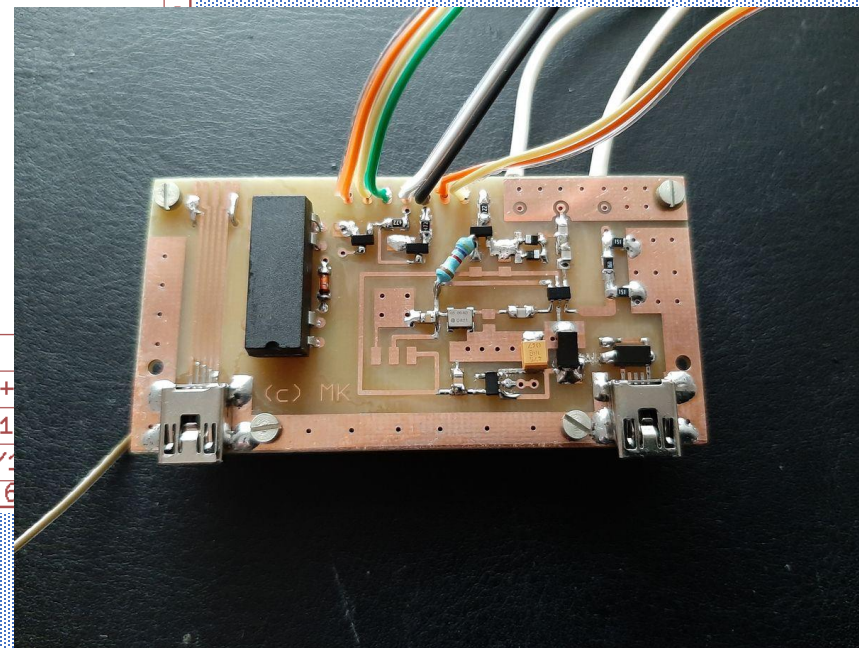
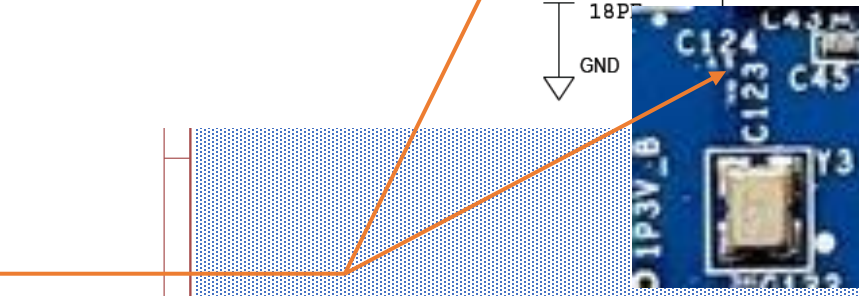
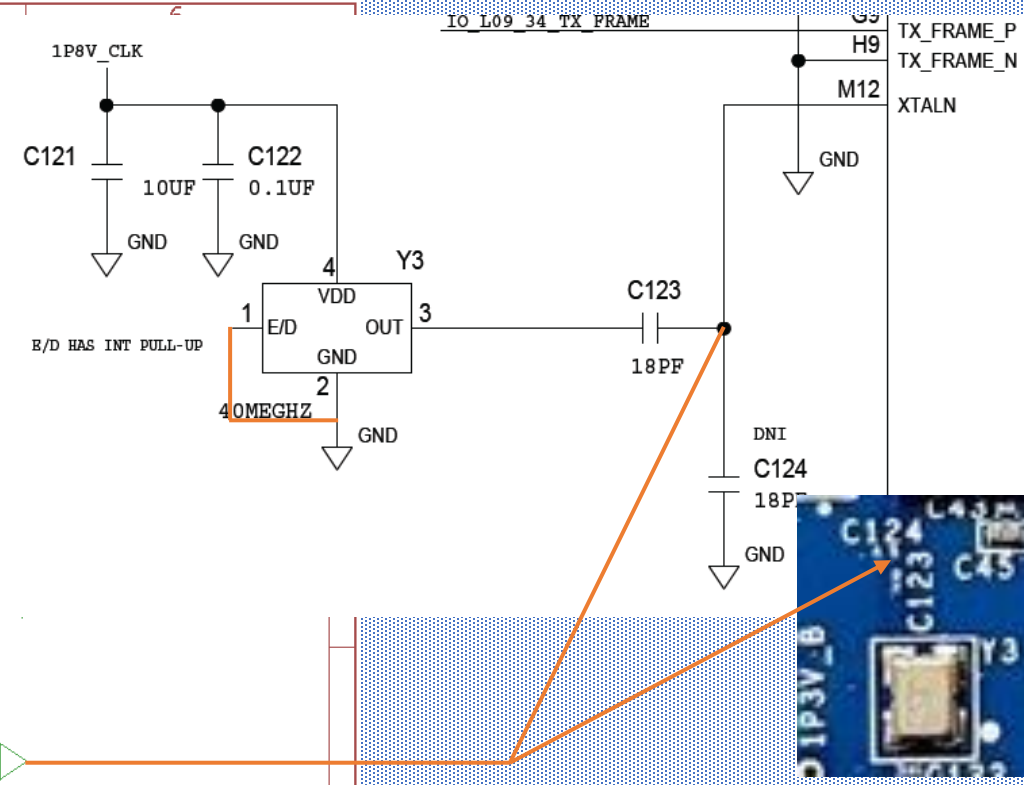
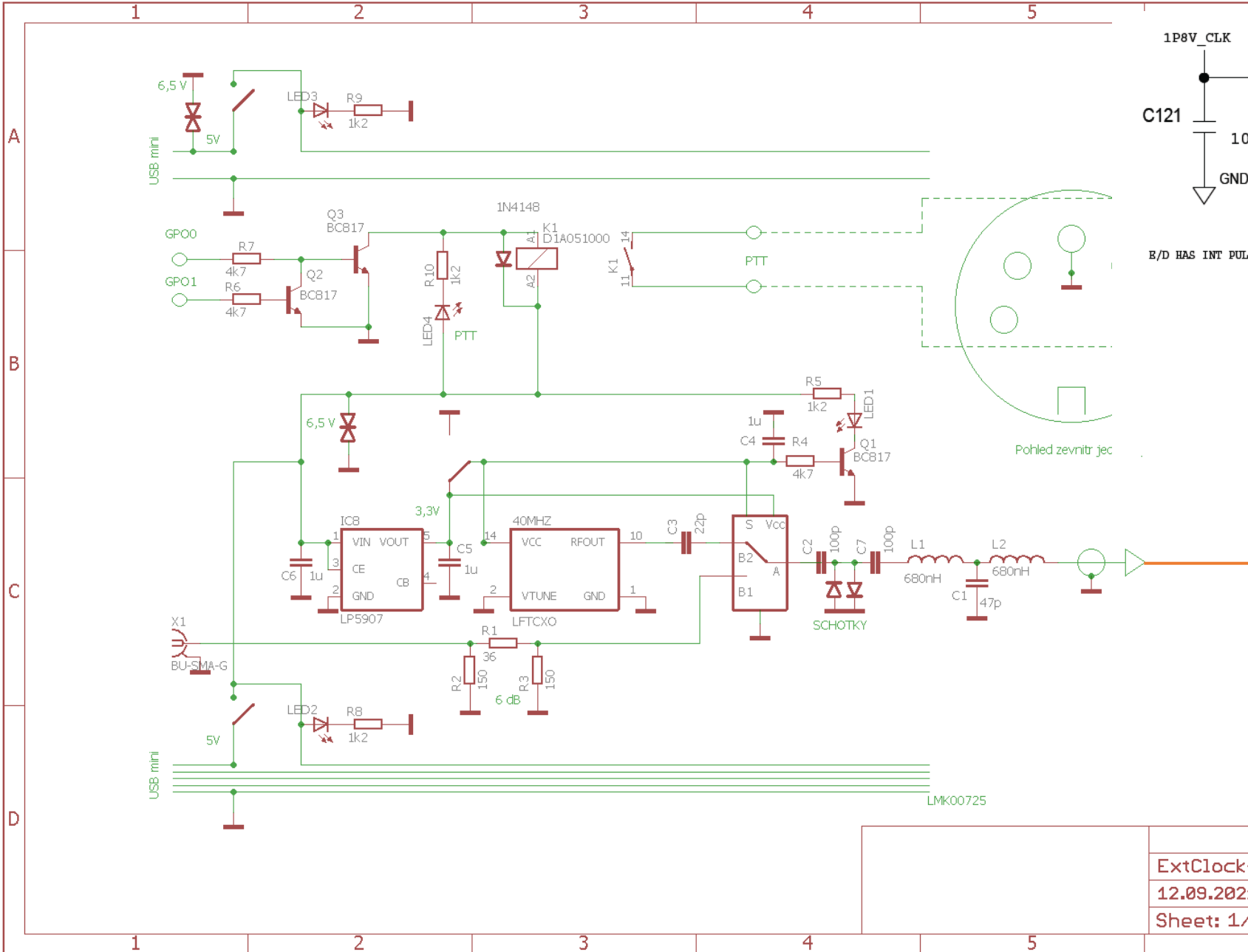
## Disadvantages:

- RF Shielding is missing
- **AI Box**
- Low Freq. Stability



Another TCXO 0,5 ppm  
External GPSDO

- PTT Solution
- Firmware F50EO
- GPO0 + GPO1



ExtClock+  
12.09.2021  
Sheet: 1/2



# Latency

WSJT-X v2.4.0 by K1JT, G4WJS, K9AN, and IV3NWV

File Configurations View Mode Decode Save Tools Help

Single-Period Decodes

UTC	dB	DT	Freq	Message
1843	-9	4.0	2340	: NOCTR SM6CKU -12 q0
1845	-9	4.0	2336	: NOCTR SM6CKU -12 q0
1847	-9	3.8	2330	: NOCTR SM6CKU RR73 q0
1848	-24	3.9	2373	: SM6CKU NOCTR 73 q0
1849	-21	3.5	2494	: NOCTR IK7EZN JN90 q0
1851	-21	3.5	2494	: NOCTR IK7EZN JN90 q0
1852	-24	4.0	2358	: IK7EZN NOCTR -23 q0
1853	-23	3.5	2493	: NOCTR IK7EZN R-23 q0
1855	-19	3.5	2494	: NOCTR IK7EZN R-23 q0
1857	-20	3.5	2494	: NOCTR IK7EZN RR73 q0
1858	-23	3.9	2335	: IK7EZN NOCTR 73 q0
1859	-20	3.5	2494	: TNX 73 SKIP q0

Average Decodes

UTC	dB	DT	Freq	Message
1843	-9	4.0	2340	: NOCTR SM6CKU -12 q0
1845	-9	4.0	2336	: NOCTR SM6CKU -12 q0
1847	-9	3.8	2330	: NOCTR SM6CKU RR73 q0
1848	-24	3.9	2373	: SM6CKU NOCTR 73 q0
1849	-21	3.5	2494	: NOCTR IK7EZN JN90 q0
1851	-21	3.5	2494	: NOCTR IK7EZN JN90 q0
1852	-24	4.0	2358	: IK7EZN NOCTR -23 q0
1853	-23	3.5	2493	: NOCTR IK7EZN R-23 q0
1855	-19	3.5	2494	: NOCTR IK7EZN R-23 q0
1857	-20	3.5	2494	: NOCTR IK7EZN RR73 q0
1858	-23	3.9	2335	: IK7EZN NOCTR 73 q0
1859	-20	3.5	2494	: TNX 73 SKIP q0

Log QSO Stop **Monitor** Erase Clear Avg Decode Enable Tx Halt Tx Tune  Menus

23cm ●

50 dB

**1 296,074 094**

**2021 čvn 14**  
**19:00:02**

Tx even/1st

Tx 1500 Hz

F Tol 50

Rx 2494 Hz

Report -15

T/R 60 s

Sh  Auto Seq  Call 1st  Tx6

Generate Std Msgs

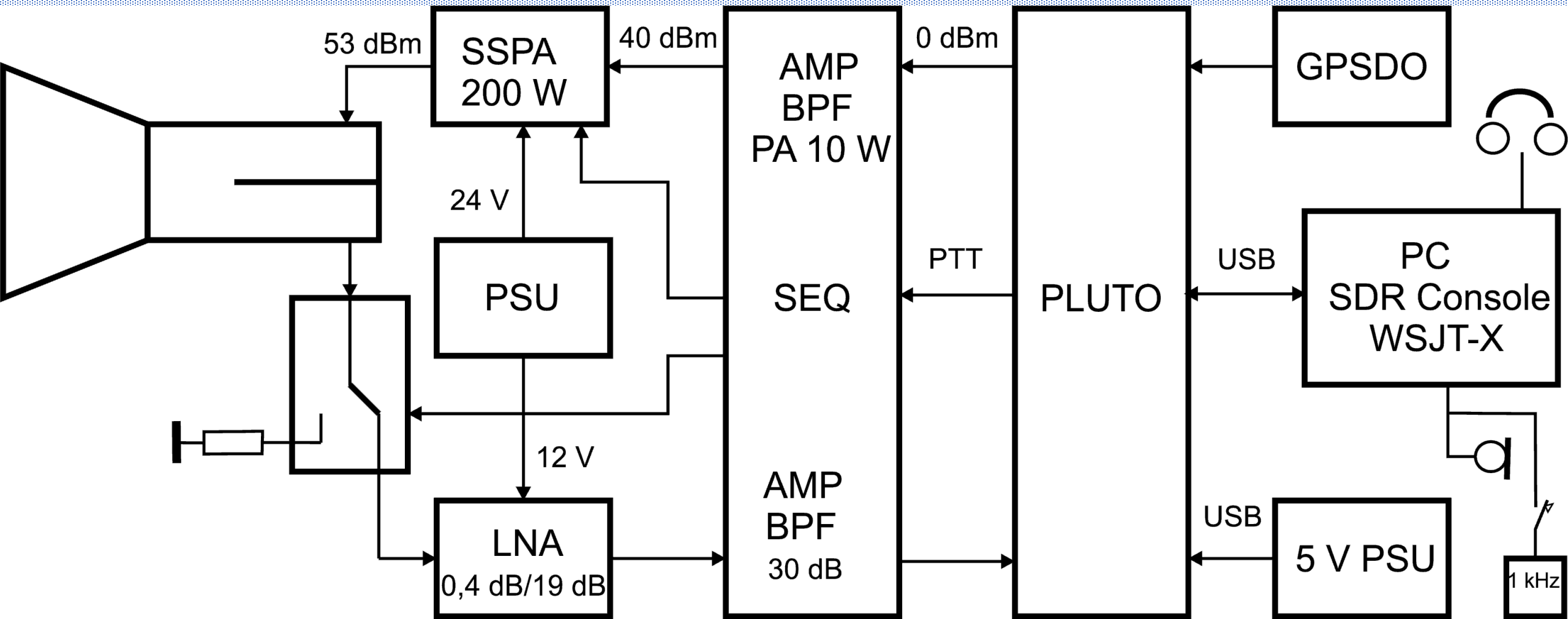
Next	Now
LA3EQ OK2AQ JN89	<input type="radio"/> Tx 1
LA3EQ OK2AQ -15	<input type="radio"/> Tx 2
LA3EQ OK2AQ R-15	<input type="radio"/> Tx 3
LA3EQ OK2AQ RR73	<input type="radio"/> Tx 4
LA3EQ OK2AQ 73	<input type="radio"/> Tx 5
CQ OK2AQ JN89	<input checked="" type="radio"/> Tx 6

Pwr

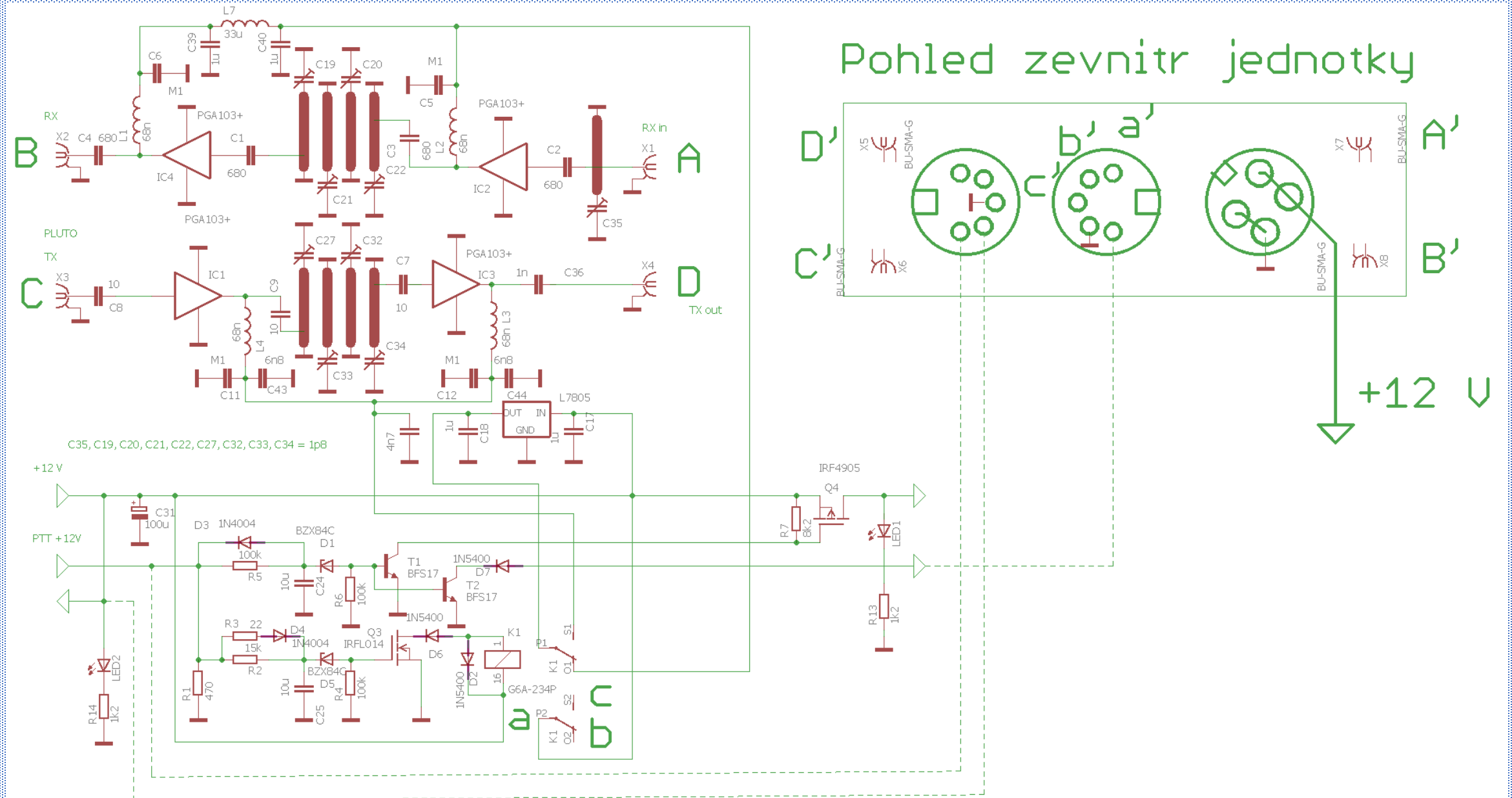
Receiving ● O65-60C 0 0 2/60 WD:10m



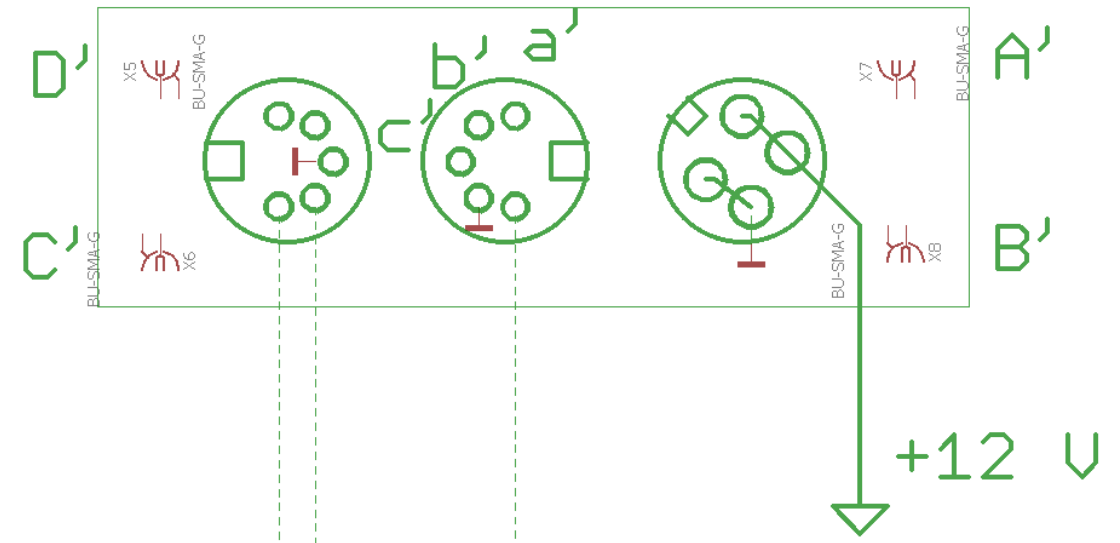
# EME SETUP



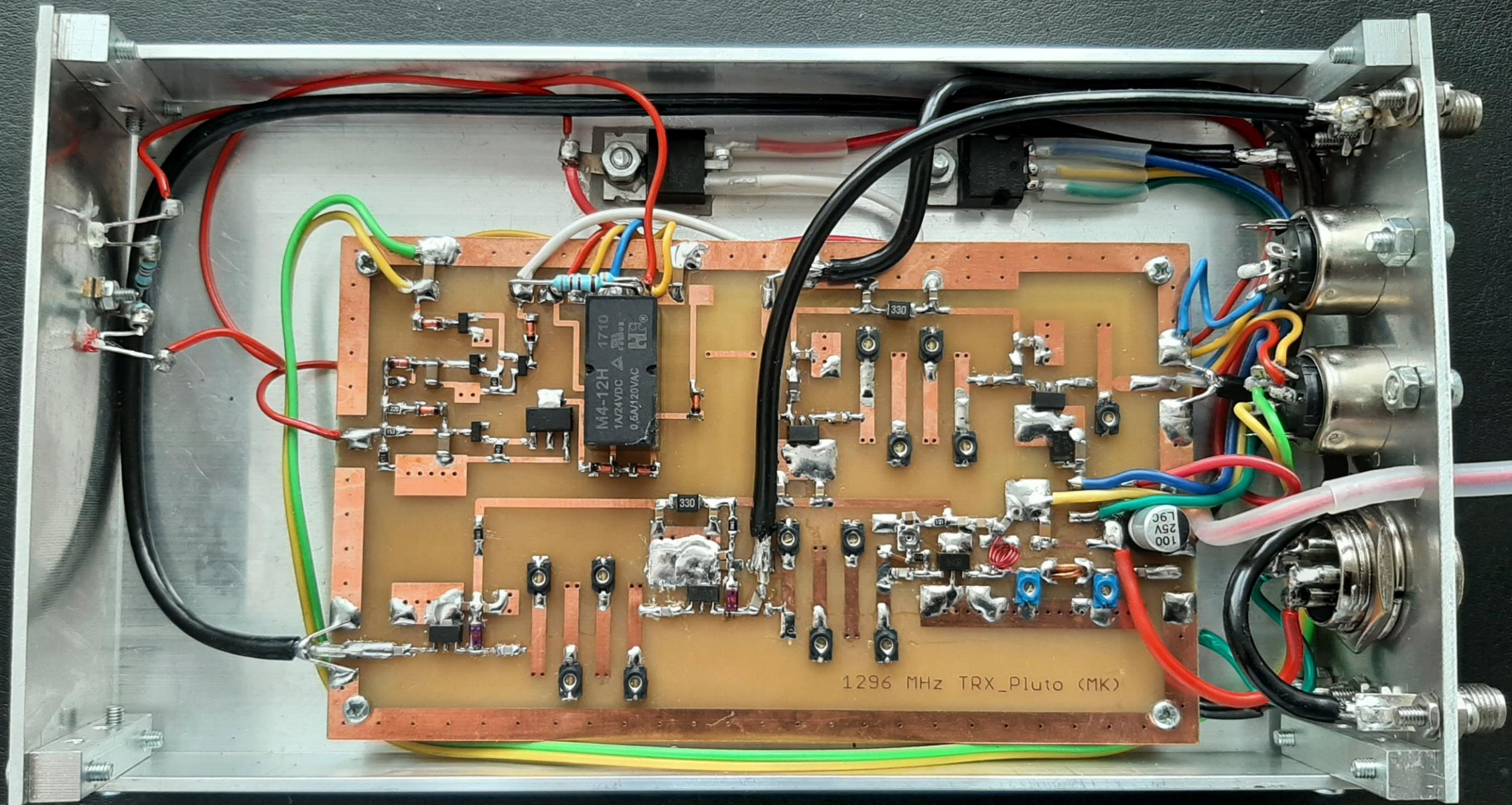
# 1296 MHz FRONT END



## Pohled zevnitř jednotky









Home View Receive Transmit Rec/Playback Favourites Memories Tools Help

Style

Receive

RX 1 100 - 2900 Hz

# 1.296.065.000

Line 1 (Virtual Audio Cable)

IF Display

Mode

Filter

UTC  
**14:50:12**

Transmit

TX 100 - 2900 Hz

# 1.296.065.000

Sync RX RX TX TX RX

Sync RX LSB USB AM FM CW

TX Tone Tune ...

23cm

Drive 84

Meter

PWR 0 1 2 W

SWR 1 1.1 1.5 2 3 4

DRV 0 25 50 75 100 mW

IPA 0 25 50 75 100 mA

VDD 12 13 14 15 V

ALC 0 25 50 75 100 125

Microphone: Gain 0

Normal DX Other

Line 2 (Virtual Audio Cable)

PlutoSDR, BW = 3.000 MHz

CPU: 1.9% GPU: 9.7% Audio: 115ms



Line 1

VAC

Line 2

VSPE

COM10

COM11



WSJT-X v2.5.1 by K1JT, G4WJS, K9AN, and IV3NWW

File Configurations View Mode Decode Save Tools Help

Single-Period Decodes				Average Decodes					
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message

Log QSO Stop Monitor Erase Clear Avg Decode Enable Tx Halt Tx Tune Menus

23cm 1 296,065 000 Tx even/1st Tx 1000 Hz F Tol 200 Submode C Rx 1444 Hz Max Drift 5 Report -15 T/R 60 s Sh Auto Seq Call 1st Tx6

DX Call DX Grid  
WSLUA EM13QC  
Az: 308 8703 km  
Lookup Add

2021 lis 07  
16:03:55

Generate Std Msgs Next Now Pwr

WSLUA OK2AQ JN89	<input type="radio"/>	Tx 1
WSLUA OK2AQ -15	<input type="radio"/>	Tx 2
WSLUA OK2AQ R-15	<input type="radio"/>	Tx 3
WSLUA OK2AQ RR73	<input type="radio"/>	Tx 4
WSLUA OK2AQ 73	<input type="radio"/>	Tx 5
CQ OK2AQ JN89	<input checked="" type="radio"/>	Tx 6

Receiving 065-60C 55/60 WD:6m

WSJT-X - Astronomical Data

2021 lis 07  
UTC: 16:11:08  
Az: 217.7  
El: 4.9  
SelfDop: -1821  
Width: 8  
Delay: 2.41  
DxAz: 121.5  
DxEI: -0.1  
DxDop: 311  
DxWid: 13  
Dec: -26.3  
SunAz: 254.2  
SunEl: -8.3  
Freq: 1296.1  
Tsky: 12  
Dpol: 78.7  
MNR: 0.7  
Dist: 360876  
Dgrd: -0.8

Doppler tracking

- Full Doppler to DX Grid
- Own Echo
- Constant frequency on Moon
- On DX Echo
- Call DX
- None

Sked frequency

Rx: 1 296,065 000  
Tx: 1 296,065 000

Press and hold the CTRL key to adjust the sked frequency manually with the rig's VFO dial or enter frequency directly into the band entry field on the main window.

Doppler tracking

Playback

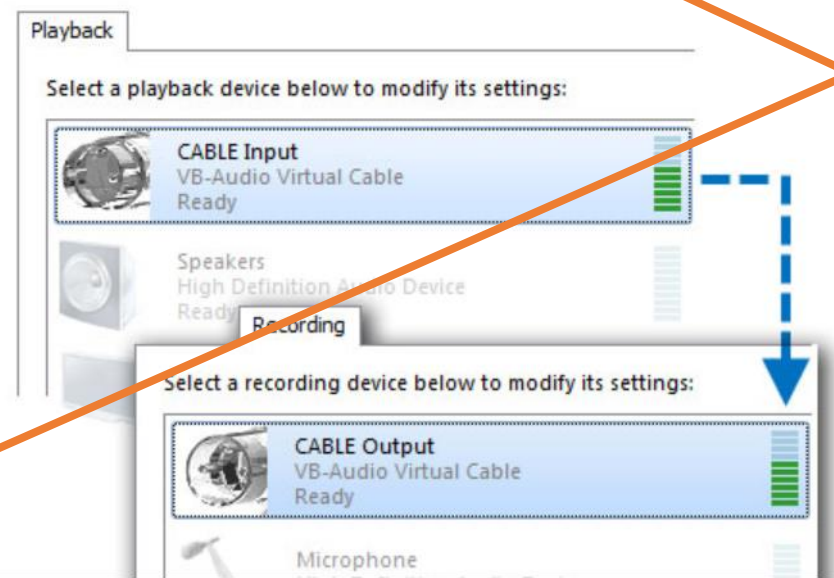
Select a playback device below to modify its settings:

- CABLE Input  
VB-Audio Virtual Cable  
Ready
- Speakers  
High Definition Audio Device  
Ready

Recording

Select a recording device below to modify its settings:


- CABLE Output  
VB-Audio Virtual Cable  
Ready
- Microphone



## VB-CABLE Virtual Audio Device.

VB-CABLE is a virtual audio device working as virtual audio cable. All audio coming in the CABLE input is simply forwarded to the CABLE output.

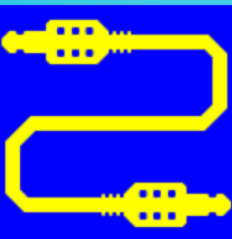
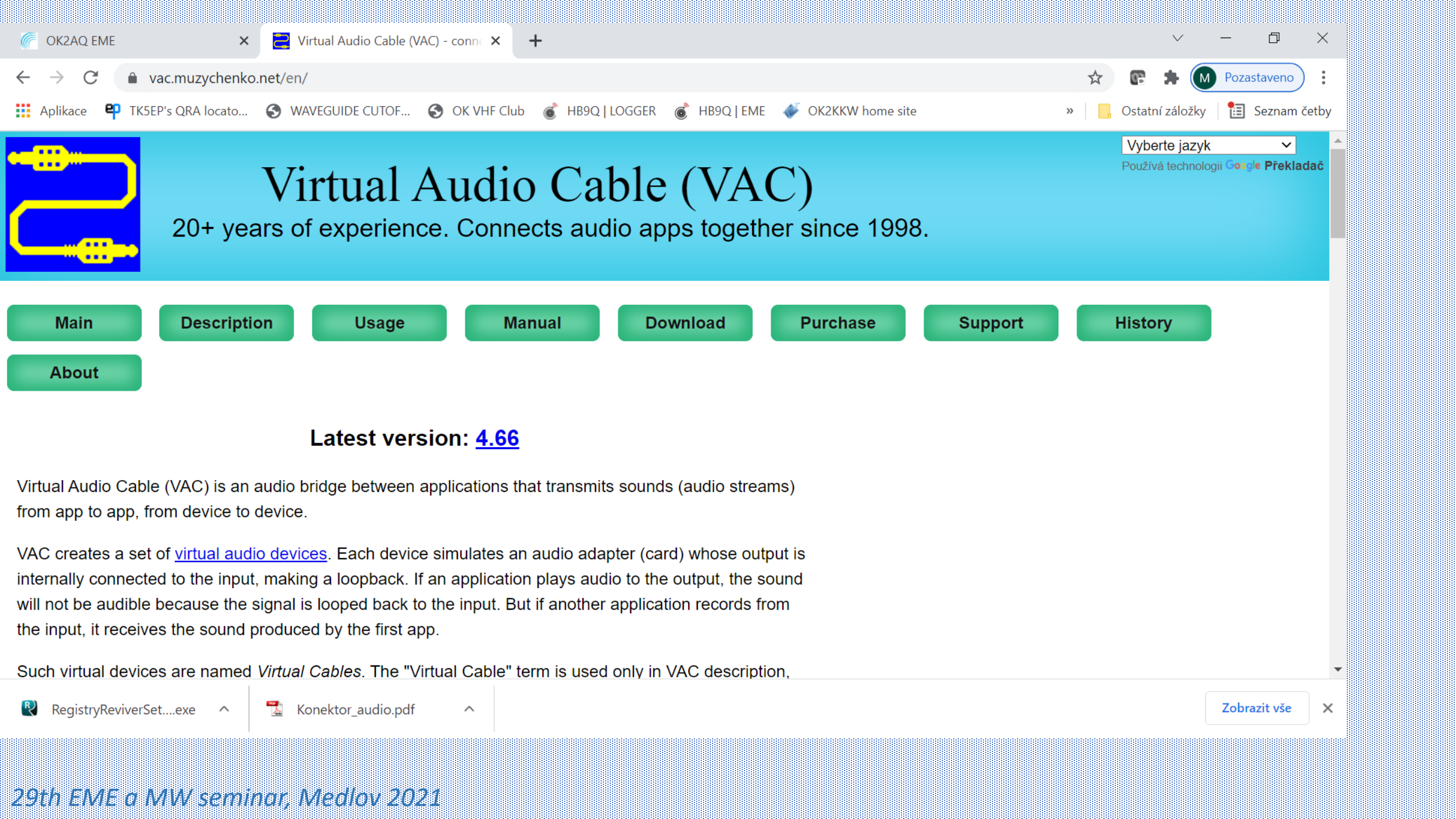
### Download and Install VB-CABLE Driver Now!

 VBCABLE\_Driver\_Pack43.zip  
(1.09 MB - OCT 2015 / XP to WIN10 32/64 bits)

INSTALLATION: Extract all files and Run Setup Program in administrator mode. Reboot after installation.

VBCable\_MACDriver\_Pack408.zip





# Virtual Audio Cable (VAC)

20+ years of experience. Connects audio apps together since 1998.

Vyberte jazyk  
Používá technologii Google Překladač

- Main
- Description
- Usage
- Manual
- Download
- Purchase
- Support
- History
- About

Latest version: [4.66](#)

Virtual Audio Cable (VAC) is an audio bridge between applications that transmits sounds (audio streams) from app to app, from device to device.

VAC creates a set of [virtual audio devices](#). Each device simulates an audio adapter (card) whose output is internally connected to the input, making a loopback. If an application plays audio to the output, the sound will not be audible because the signal is looped back to the input. But if another application records from the input, it receives the sound produced by the first app.

Such virtual devices are named *Virtual Cables*. The "Virtual Cable" term is used only in VAC description,

**Driver**

Cables   Clients  Streams

Worker threads  
 Up to  Prio

Timer res, mcs  Log level  Max NC

**Cable**

Format range  
 SR  ..  BPS  ..  NC  ..

Ms per int  Stream fmt  Capture port  WR

Max inst  Clock corr ratio  Render port  WR

Connected source lines  
 Mic  Line  S/PDIF

Volume control  Channel mixing  Enable spk pin  Use PortCls

Cable	MS	SR range	BPS range	NC range	Stm fmt limit	Vol ctl	Ch mix	PortCls	Current format	Rc stms	Pb stms	Signal levels	Oflows	UFlows
1	3	22050..48000	8..16	1..2	Cable range	Off	On	Off	ExtPCM/48000/16/2(3)	1	1			2
2	3	48000..192000	8..16	1..2	Cable range	Off	On	Off	ExtPCM/48000/16/2(3)	1	0			8

07.11 17:08:41.752 Cable 2: Format set to ExtPCM/48000/16/2(3)

QPC freq, MHz  System timer res, mcs

- Audio
- Controllers
  - CAT (Serial Port)
    - ▶ Port Selection
    - Mode Mapping
    - I/O Monitor
    - I/O Test
  - MIDI
  - Tmate
- Display
- Performance
- Receive
- Recording
- Tuning
- Auto-Mute
- Identities
- Start
- USB Relay

**Serial ports enabled for CAT control (logbooks, scanners, ...) using the TS-2000 protocol**

Speed: 57,600

Refresh

View

[Online help](#)

	Port	Speed	Location	Manufacturer	Description
<input type="checkbox"/>	COM4	57,600	USB Composite Device	Analog Devices, Inc.	PlutoSDR Serial Console
<input checked="" type="checkbox"/>	COM10	57,600	<unknown>	<unknown>	<unknown>
<input type="checkbox"/>	COM11	57,600	<unknown>	<unknown>	<unknown>

This program supports the use of serial ports for exchanging information with third-party programs such as logbooks. Normally you use virtual serial ports, for example those created using the VSP Manager by K5FR or VSPE from Eterlogic or com0com (Sourceforge).

**Protocol:** in your logbook program select the **Kenwood TS-2000** protocol.

**Note:** you cannot use a serial port for a third-party program and at the same time use it to connect to an external radio unless these programs use OmniRig or similar.

You connect the third-party program to one end of the serial cable and this program to the other. The third-party program sends commands to this program, for example to set the frequency and mode. The serial port cannot be used to monitor and synchronise another radio



OK

Cancel



Settings

General Radio Audio Tx Macros Reporting Frequencies Colours Advanced

Rig: Kenwood TS-2000 Poll Interval: 1 s

CAT Control

Serial Port: COM11

Serial Port Parameters

Baud Rate: 57600

Data Bits

Default  Seven  Eight

Stop Bits

Default  One  Two

Handshake

Default  None  
 XON/XOFF  Hardware

Force Control Lines

DTR:  RTS:

PTT Method

VOX  DTR  
 CAT  RTS

Port: COM1

Transmit Audio Source

Rear/Data  Front/Mic

Mode

None  USB  Data/Pkt

Split Operation

None  Rig  Fake It

Test CAT Test PTT

OK Cancel

Settings

General Radio Audio Tx Macros Reporting Frequencies Colors Advanced

Soundcard

Input: Line 1 (Virtual Audio Cable) Mono  
Output: Line 2 (Virtual Audio Cable) Mono

Save Directory

Location: C:/Users/Mirek/AppData/Local/WSJT-X/save Select

AzEl Directory

Location: C:/Users/Mirek/AppData/Local/WSJT-X Select

Remember power settings by band

Transmit  Tune

OK Cancel

**Hardware details**

Device name: mini GPS Reference Clock  
 Made by: Leo Bodnar Electronics  
 Firmware version: 1.14  
 Serial number: G63924 Blink

---

**Settings**

Output Hz: 40000000 Set frequency  
Factory defaults Advanced <<<

---

**Status**

GPS signal OK PLL lock OK

---

**Advanced**

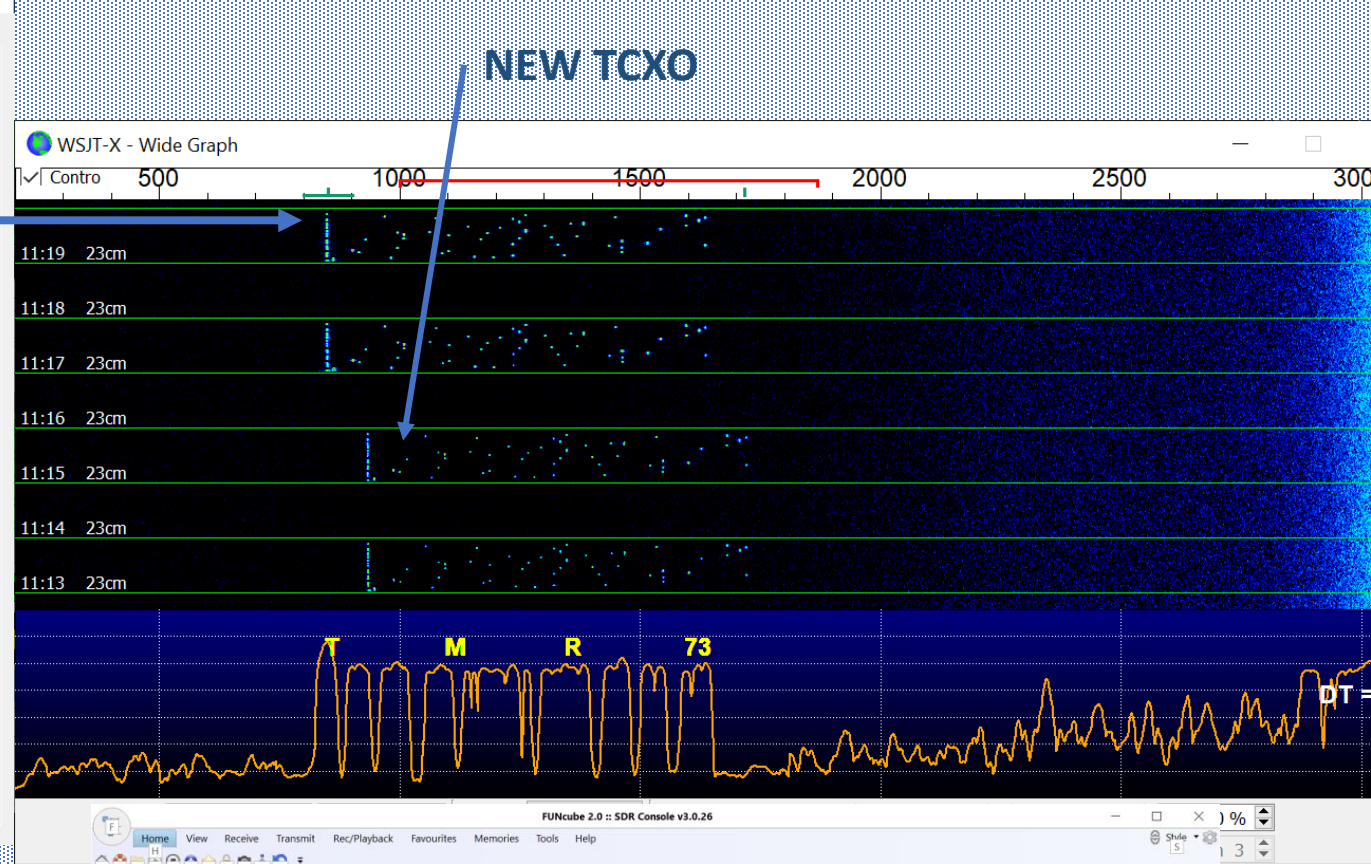
Output drive strength: 16mA Enable output

175000	GPS reference, Hz
1	N31
11	N2_HS
3200	N2_LS
11	N1_HS
14	NC1_LS
15	BW

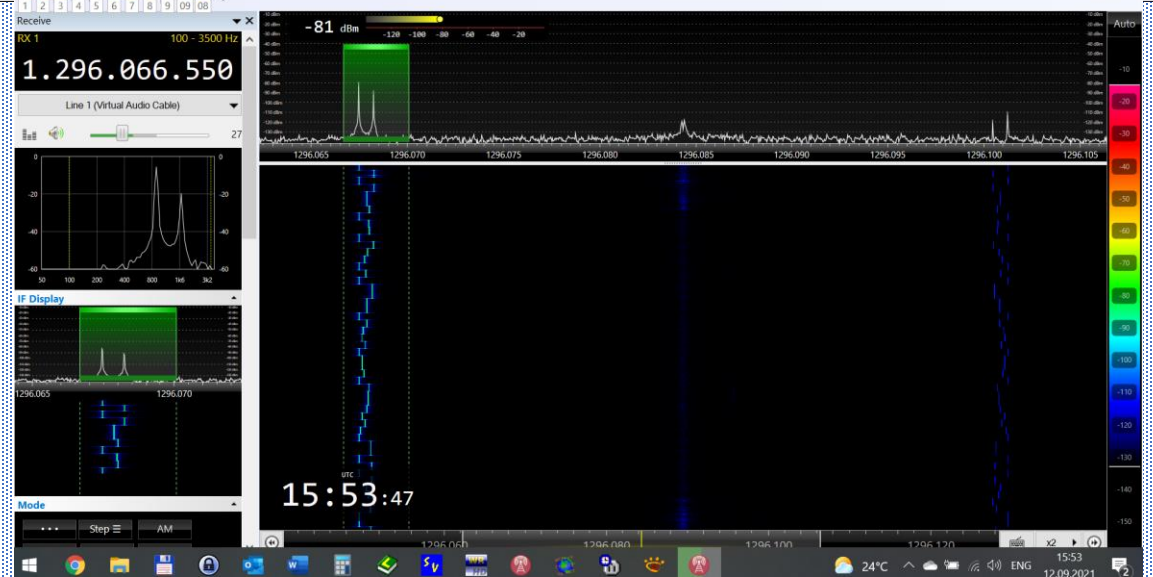
Update

---

Position: 49,2286534, 16,6326492, 357,300  
 UTC: 2021.09.12 15:52:46



## GPSDO Leo Bodnar Configuration

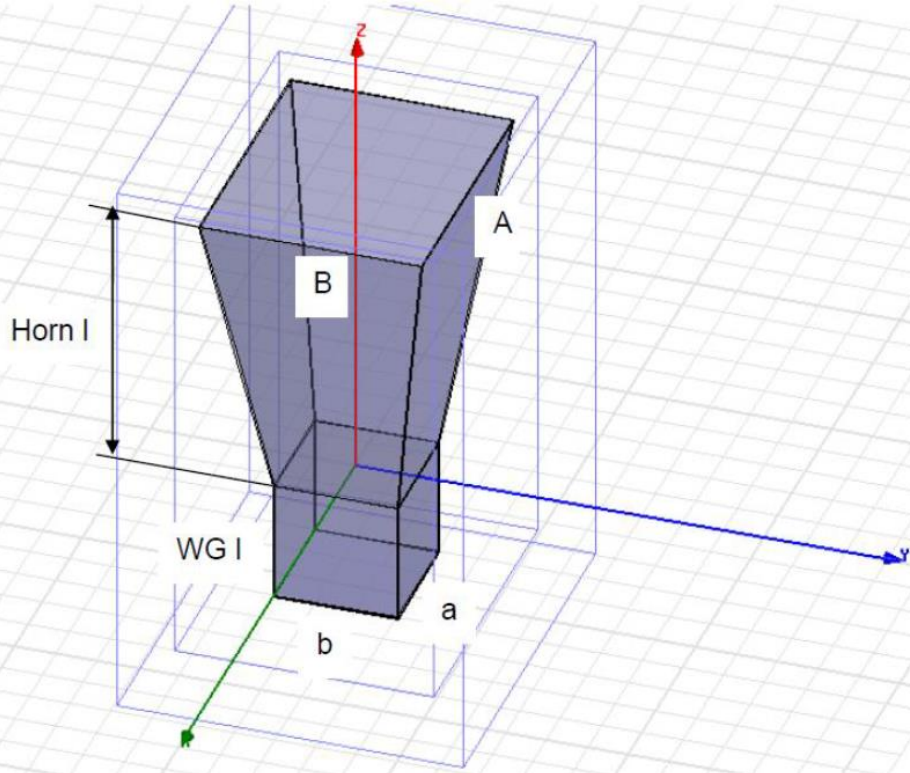




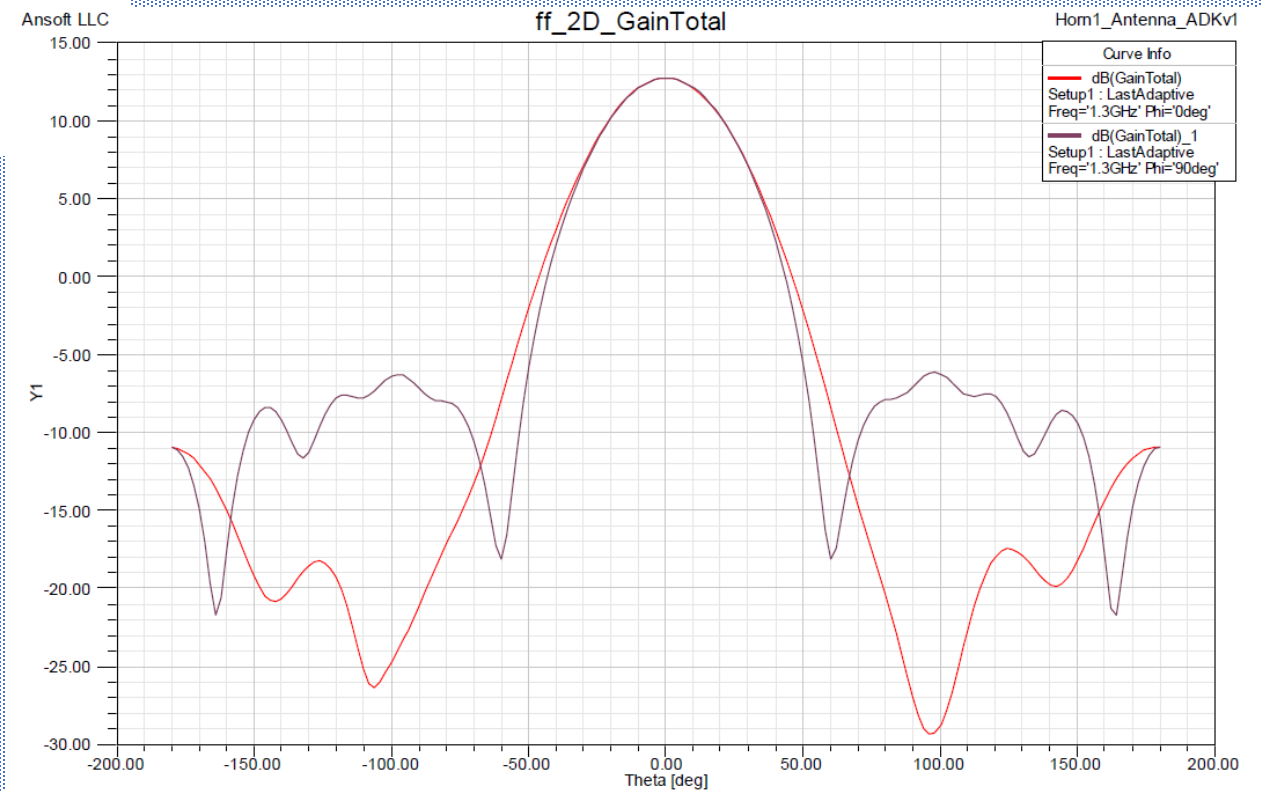
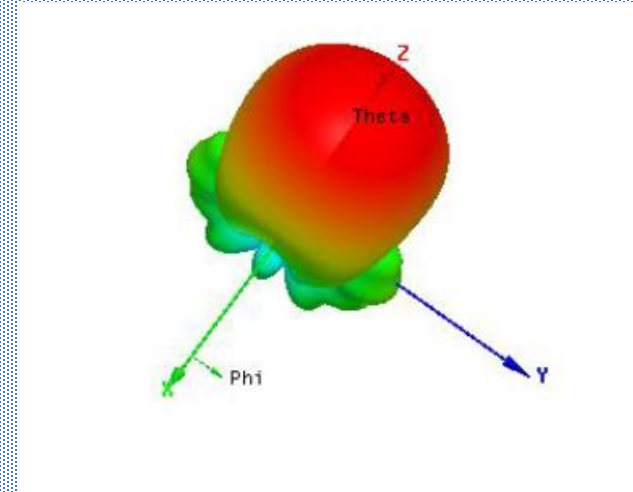


10 W

29th EME a MW seminar, Medlov 2021



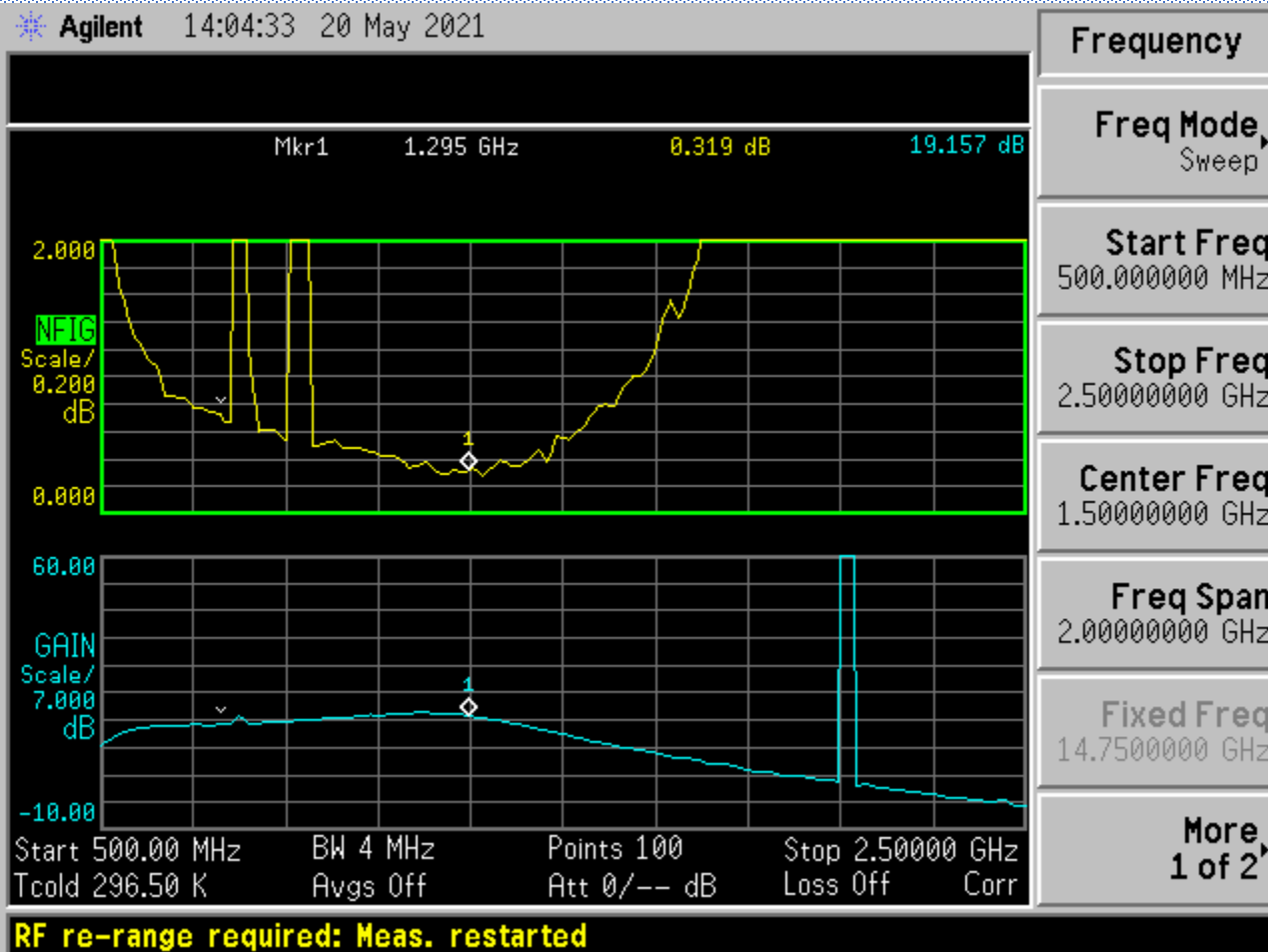
$a = b = 150 \text{ mm}$   
 $\text{WG I} = 150 \text{ mm}$   
 $A = 335 \text{ mm}$   
 $B = 270 \text{ mm}$   
 $\text{Horn I} = 400 \text{ mm}$



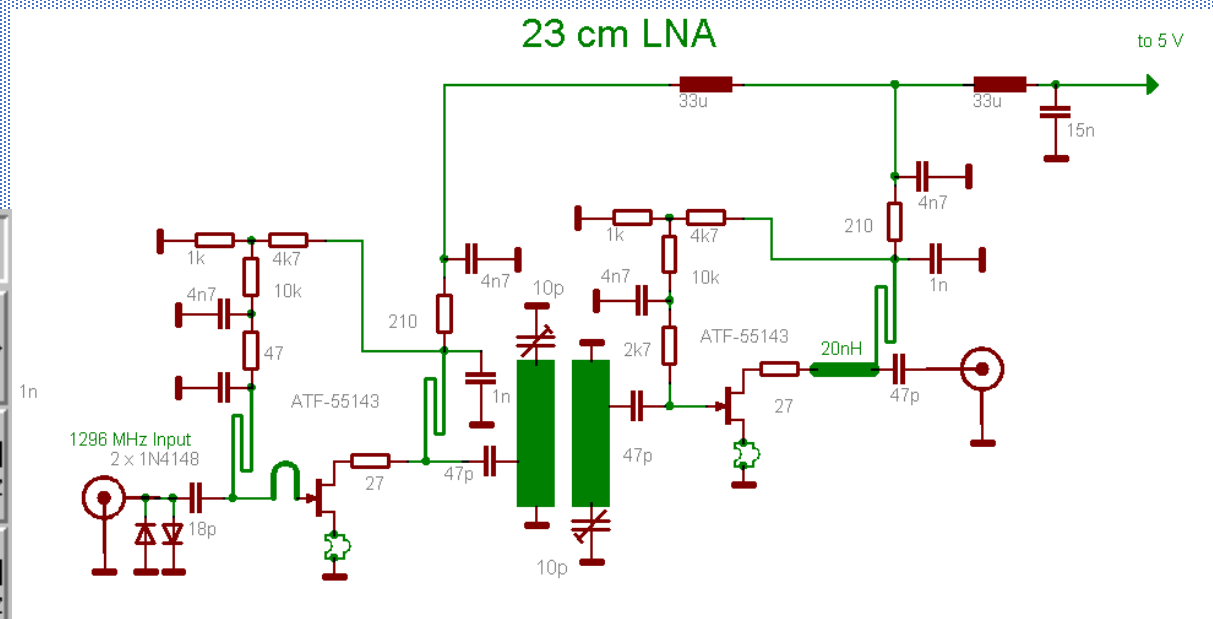


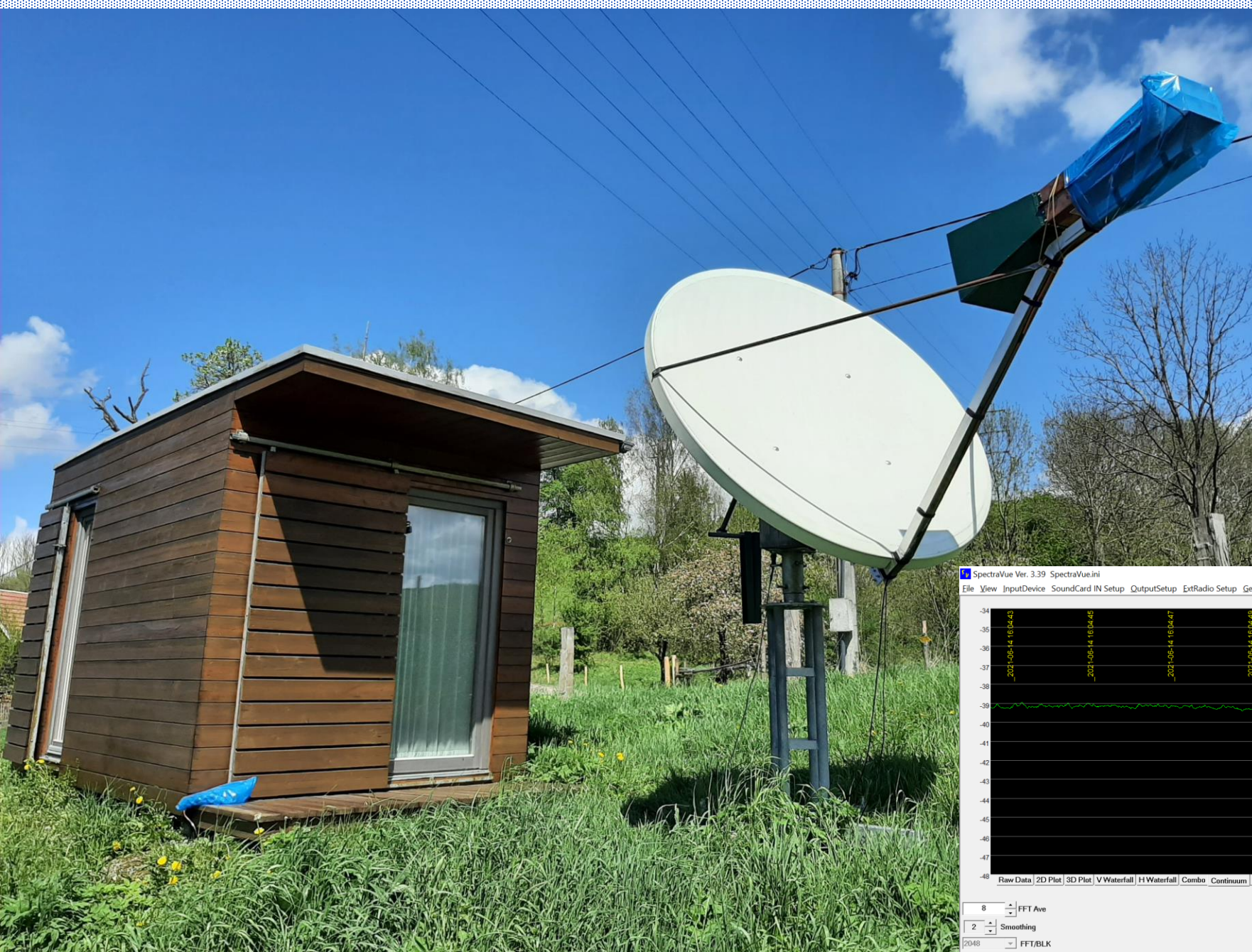
# LNA

## 1. Stage

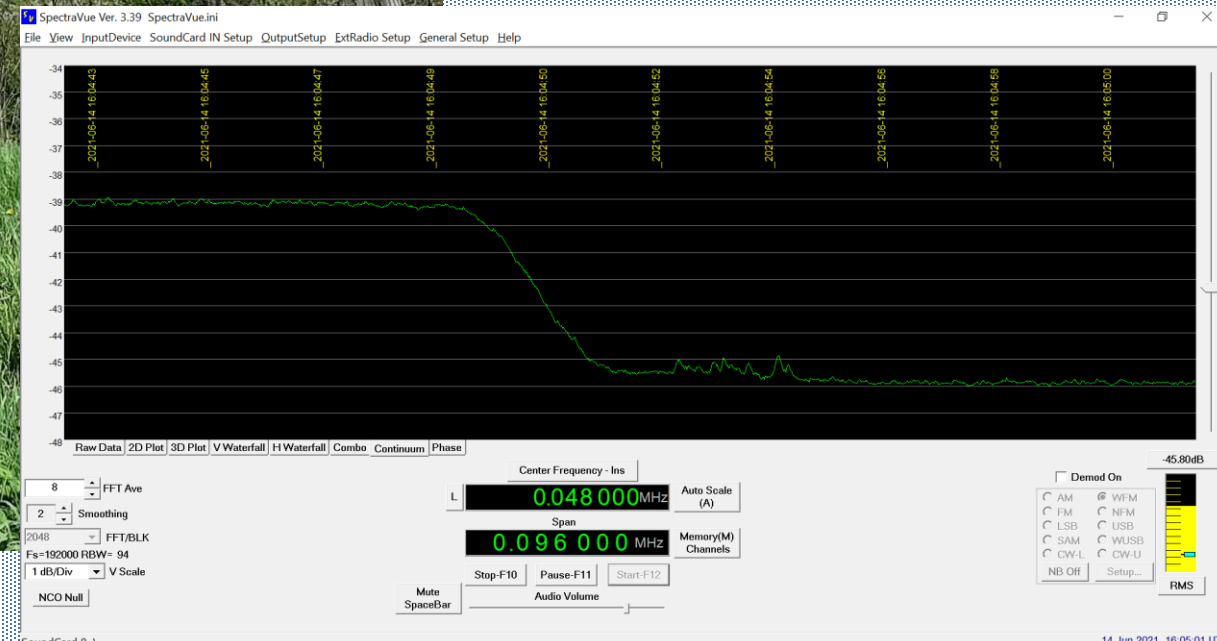


## 2. and 3. Stage





**SN/CS = 7 dB**  
**SFU = 71**





# Decoded JT65 & Q65

OK2DL	6 m	1 kW	-9
AA6I	3,6 m	350 W	-19
HB9Q	10 m	1 kW	-4
AA4MD	3,6 m	350 W	-18
DL7YC	4,9 m	250 W	-15
OK1KIR	6,1 m	1 kW	-9
W7EME			-27
UA3PTW	5,8 m	1 kW	-10
OK1DFC	2,6 m	1 kW	-17
OK1CA	10 m	500 W	-11
PA3FXB	2,9 m	350 W	-22
SM6CKU	8 m	200 W	-9
UA9FAD	3 m	100 W	-19
KB2SA	1,9 m	535 W	-16
KB2SA	1,9 m	50 W	-25
IK7EZN	2,4 m	150 W	-19
KA1GT	3,1 m	240 W	-15
FR5DN			-15
KN0WS	4,8 m	200 W	-6
LZ4OC	2,2 m	400 W	-9

DK3WG	3 m	500 W	-16
RA4HL	3 m	500 W	-15
DJ3JJ	2,5 m	320 W	-7
IK1FJI	3,2 m	1 kW	-10
KD5FZX	5 m	800 W	-11
N1AV	4,2 m	400 W	-16
IK2DDR	3,7 m	250 W	-18
N6NU	3 m	100 W	-22
GM0PJD	3,6 m	110 W	-20
DL6SH	8 m	400 W	-8
ES3RF	3 m	200 W	-21
N9JIM	1,5 m	500 W	-23
LA3EQ	1,9 m	250 W	-22
N0CTR	2,4 m	300 W	-23
I0NAA	5 m	250 W	-19
G7TZZ	3 m	100 W	-21
OM4XA	3 m	200 W	-19
DF3RU	6 m	750 W	-9
ZS5Y	3,8 m	150 W	-25

+ about 12 CW Stations

# 1296 MHz EME Experimental Setup





**THANK YOU FOR YOUR ATTENTION**