RF Power Amplifier

Amplifier design: Danny de Gans

Speaker: Ruben Pellicer-Guridi

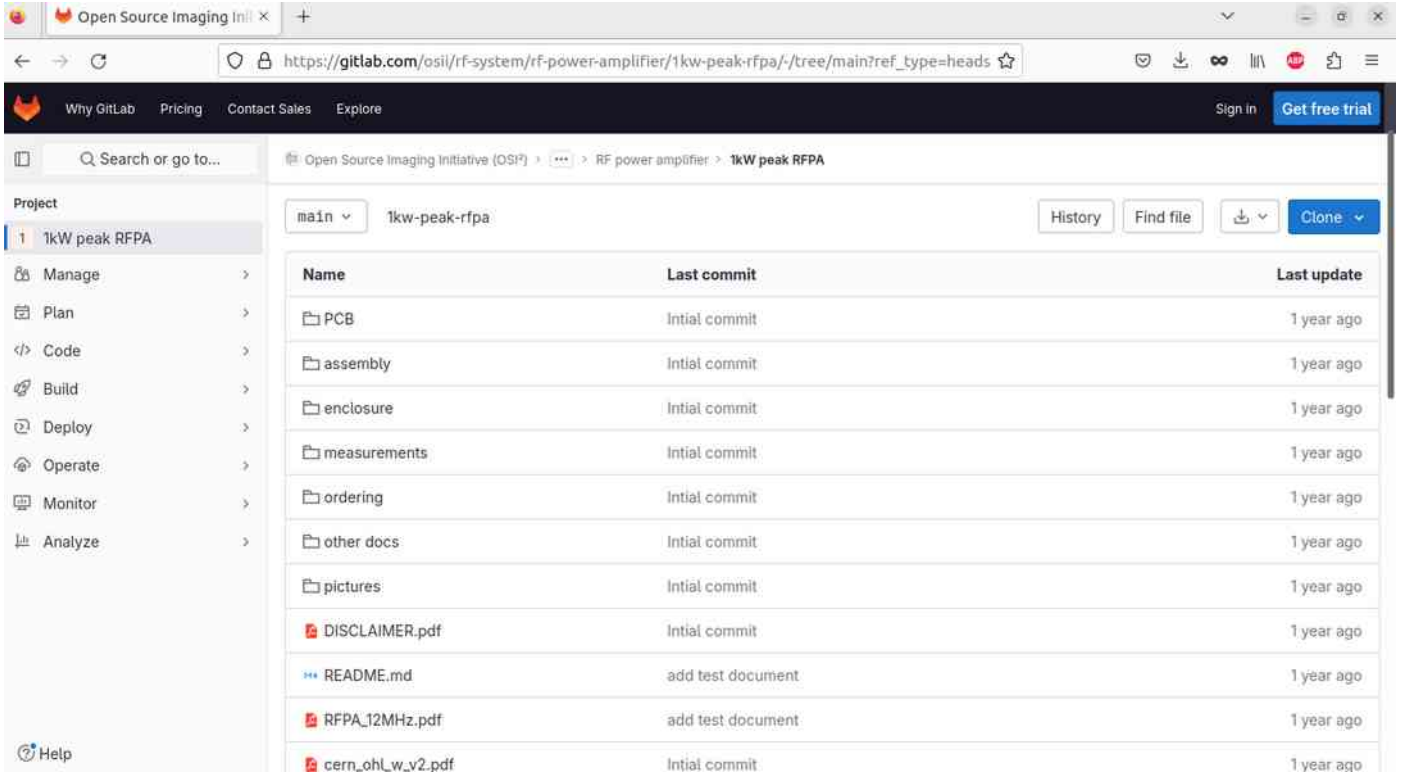
22nd of September, 2023

Berlin / Online

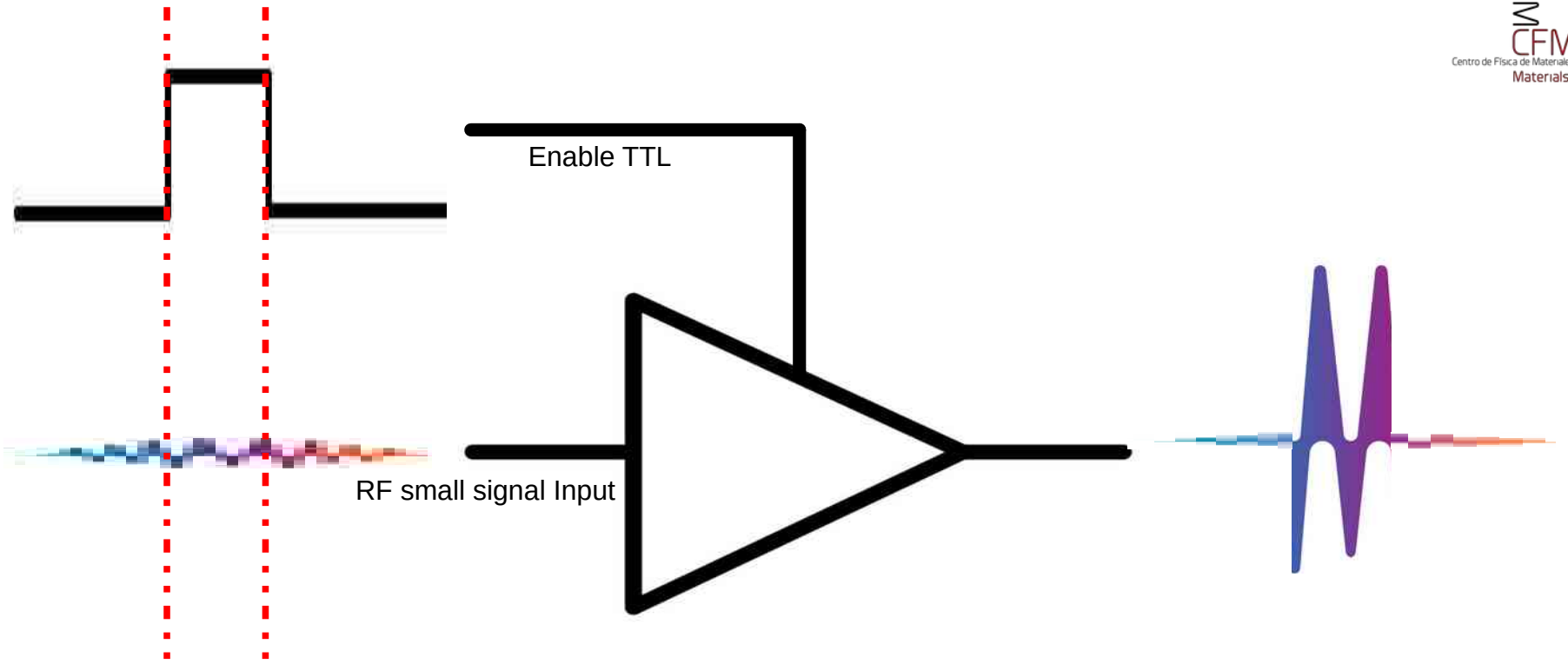
OSI² ONE
Build Workshop

Info sources

https://gitlab.com/osii/rf-system/rf-power-amplifier



Working principle



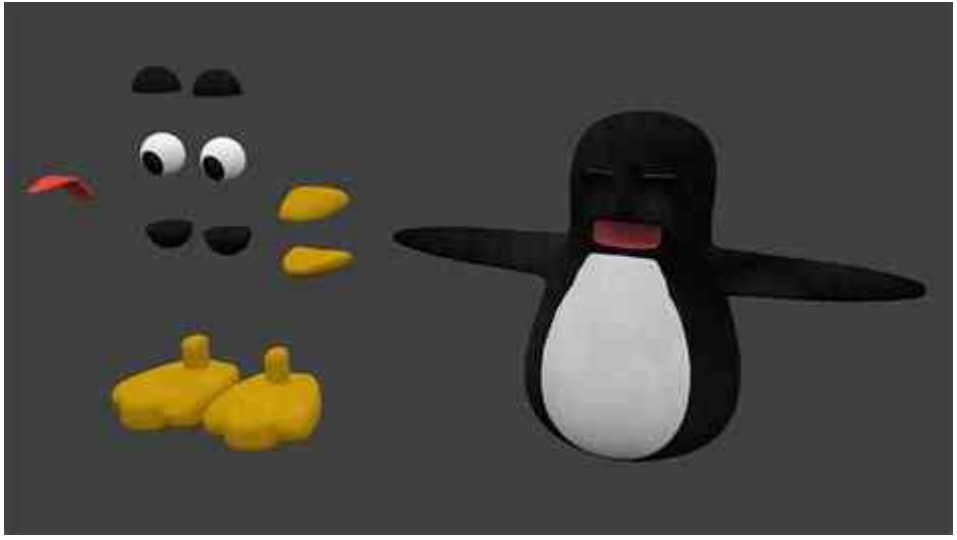
Construction

- PCBs
- Heatsink
- Transformer
- Capacitor bank
- Enclosure





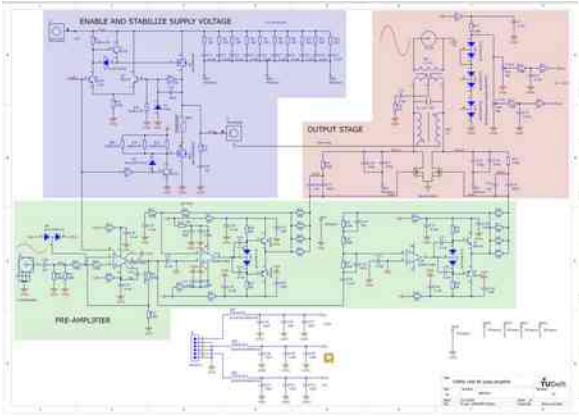

Shopping

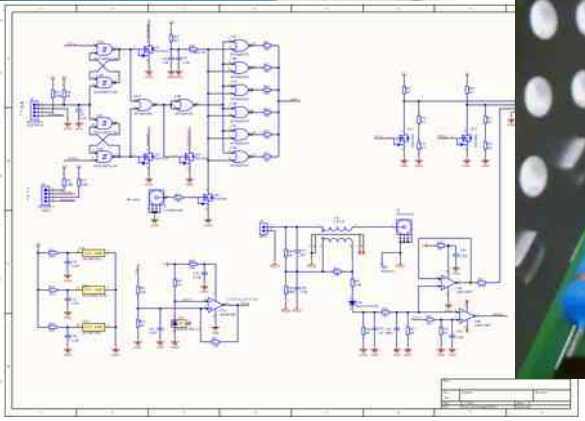


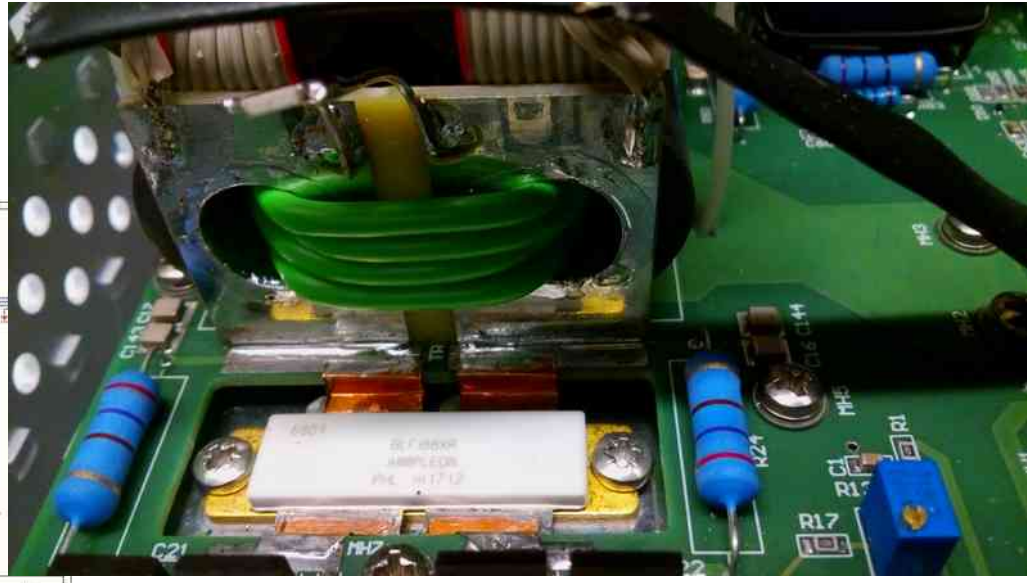
- BOM_MRIamp2.pdf
- BOM_enclosure.pdf
- PCBs
- 3D printed capacitor holders
- Copper plates for the capacitor holders
- Cables for transformer and enclosure peripherals

Budget ~1 k€

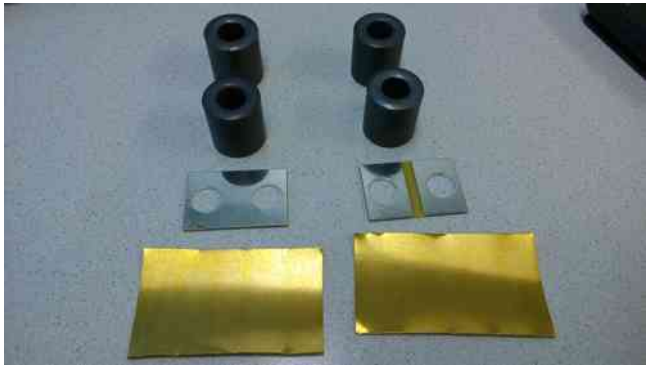
PCBs

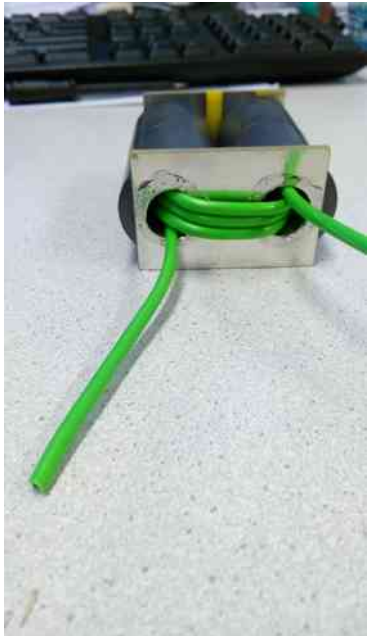

ENABLE AND STABILIZE SUPPLY VOLTAGE
OUTPUT STAGE
PRE-AMPLIFIER

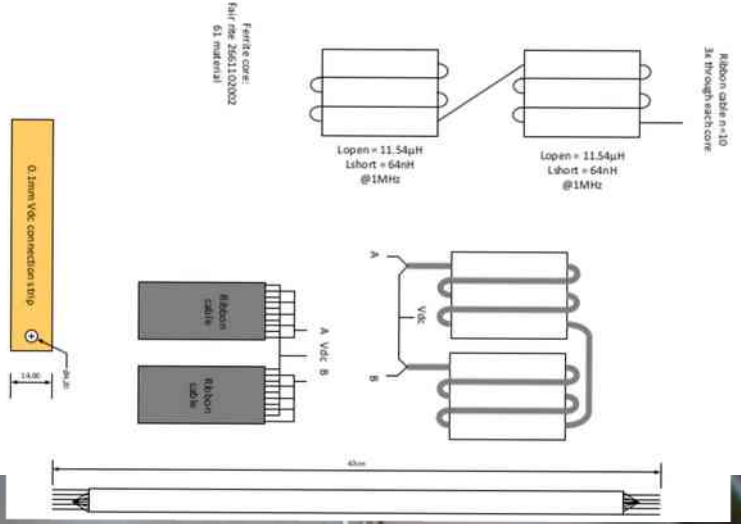


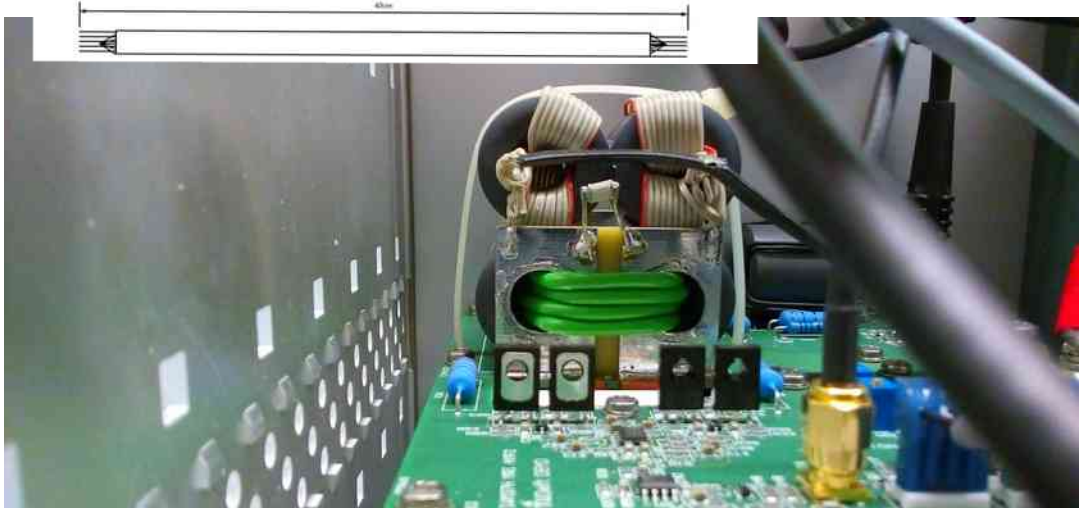

R17
C21

Transformer

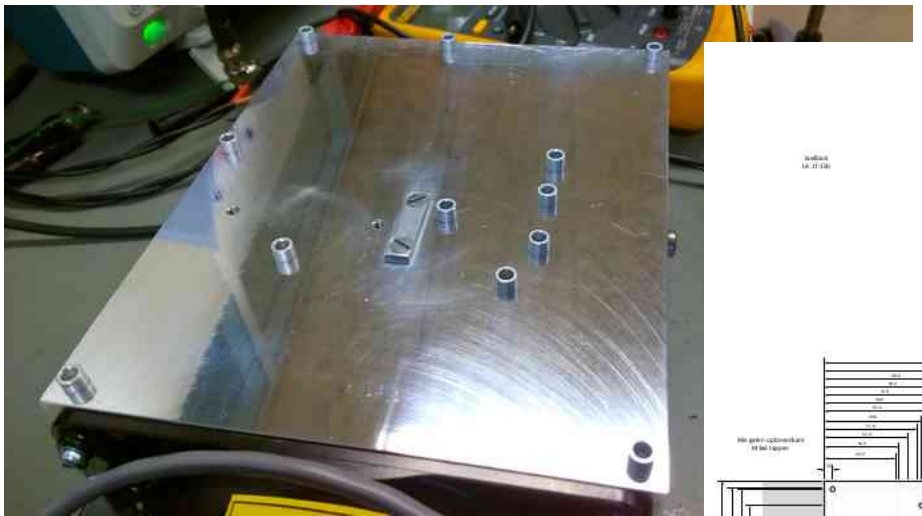


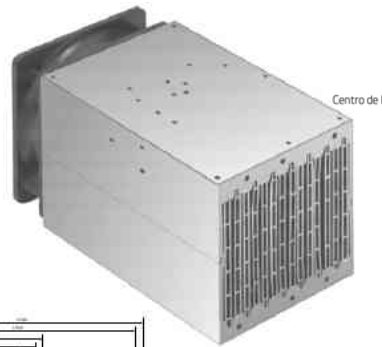


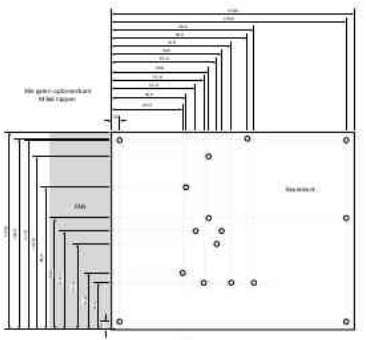


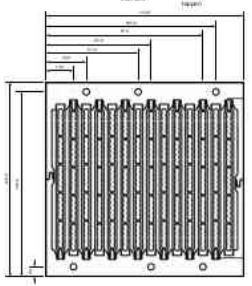


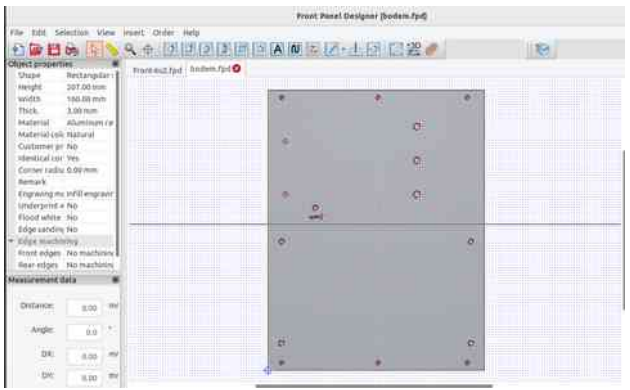
Heatsink










Front Panel Designer (bodem.fpd)
File Edit Selection View Insert Order Help
Object properties
Shape Rectangular
Height 207.00 mm
Width 160.00 mm
Thick. 3.00 mm
Material Aluminum ra
Material colo Natural
Customer pr No
Identical cor Yes
Corner radiu 0.00 mm
Remark
Engraving mo Infill engravi
Underprint e No
Flood white No
Edge sanding No
Edge machining
Front edges No machinin
Rear edges No machinin
Measurement data
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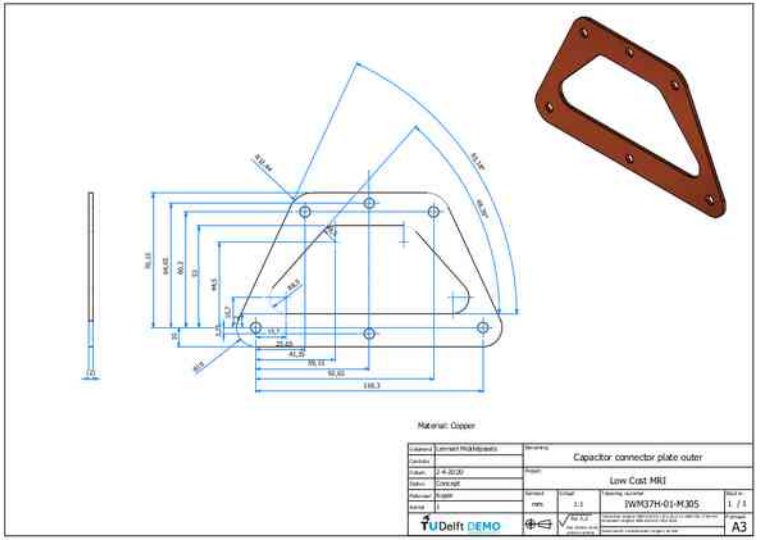
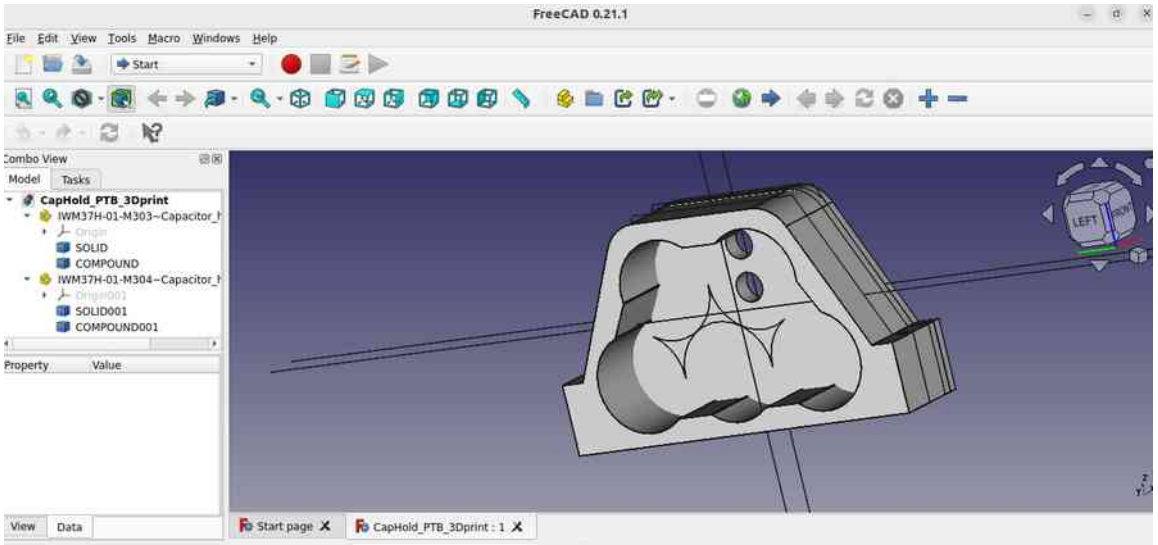
DY: 0.00 mm
front-out.fpd
bodem.fpd

Capacitors


Material: Copper
Capacitor connector plate outer
Low Cost MRI
IWM37H-01-M305
TUDelft DEMO
A3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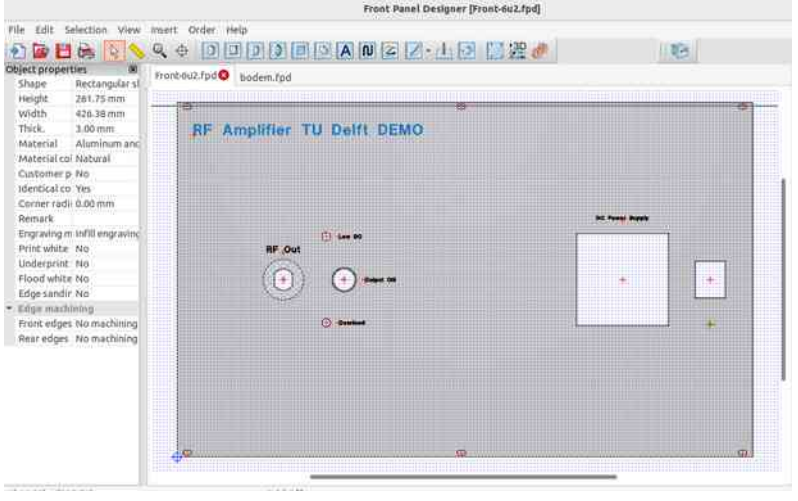
File Edit View Tools Macro Windows Help
Start
Combo View
Model Tasks
CapHold_PTB_3Dprint
IWM37H-01-M303~Capacitor_h
Origin
SOLID
COMPOUND
IWM37H-01-M304~Capacitor_h
Origin001
SOLID001
COMPOUND001
Property Value
View Data
Start page
CapHold_PTB_3Dprint : 1

Caution

High energy capacitors → Long time to discharge

Enclosure


RF Amplifier TU Delft DEMO
RF Out


Front Panel Designer [Front-6u2.fpd]
File Edit Selection View Insert Order Help
Front-6u2.fpd
bodem.fpd
RF Amplifier TU Delft DEMO
RF Out

Time to test the amplifier!

Kurzschluss- Reaktion

Biasing and testing (1)

- Before connecting the Lascar power supply adjust its voltages to 8V, -5V (-4V for AD8017) and +5V

Biasing and testing (2)

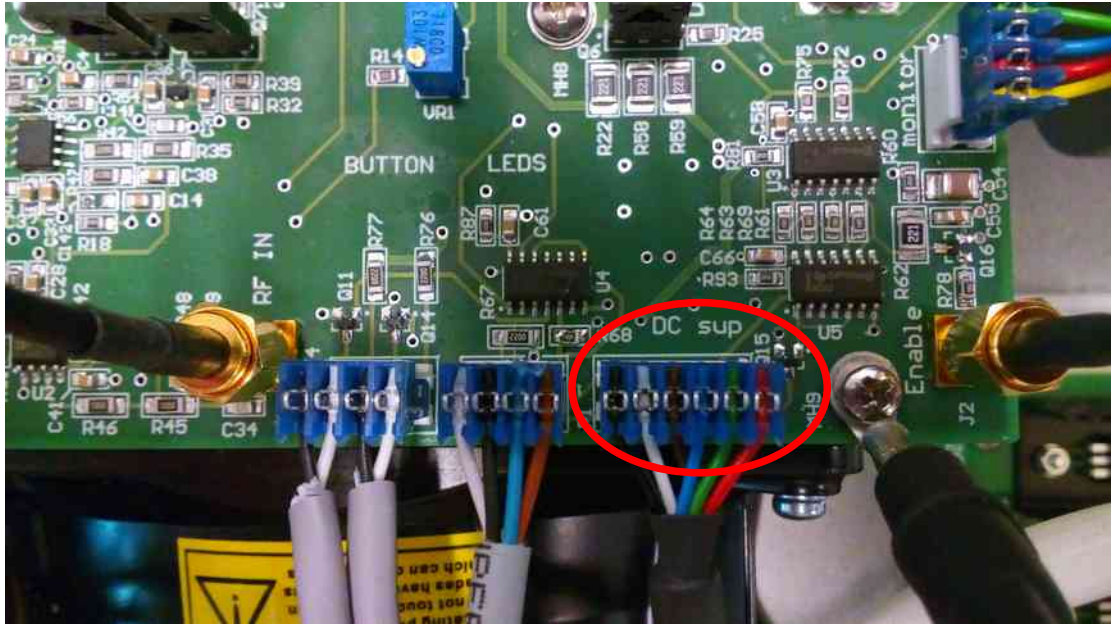
- Turn the Phoenix voltage adjustment potentiometer to its lowest setting

Biasing and testing (3)

- Connect a 50Ω/100W..1kW load to the output of the amplifier.

Biasing and testing (4)

- Connect P1 and switch on the power, the LOW voltage indicator LED will be on

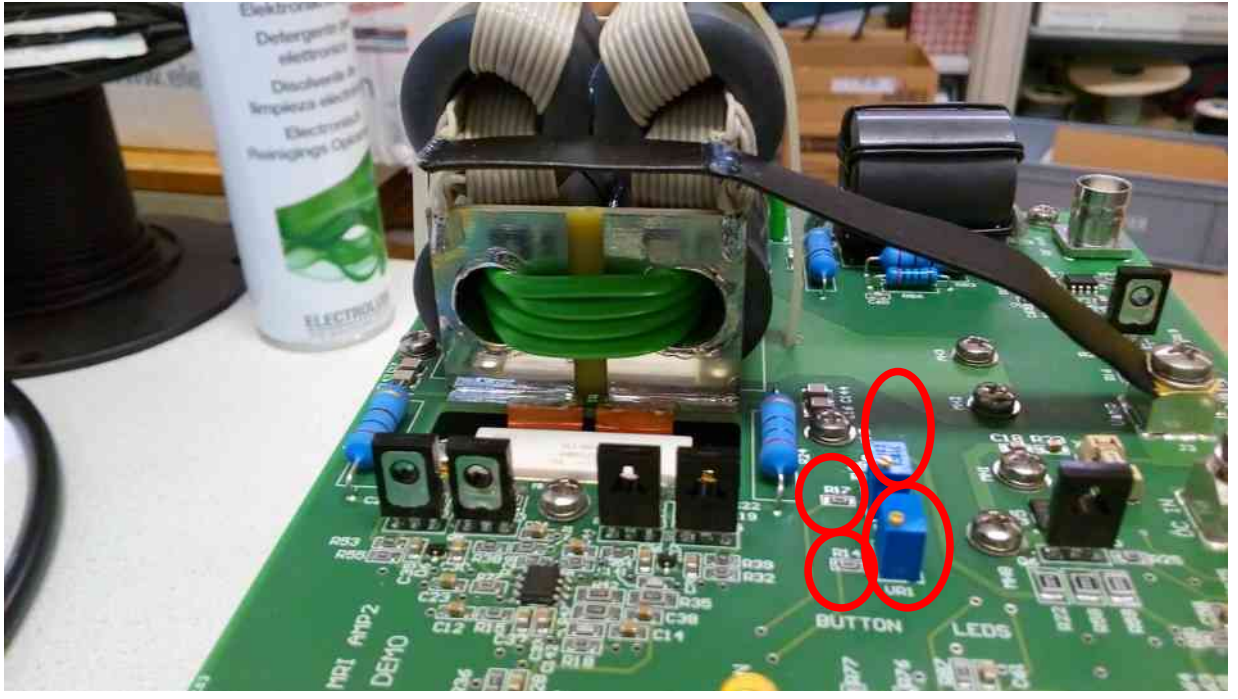


Biasing and testing (5)

- Increase the voltage of the Phoenix power supply to about 34V

Biasing and testing (6)

- Increase the voltage at VR1,2 to 2.0V. This can be measured at R14 and R17.

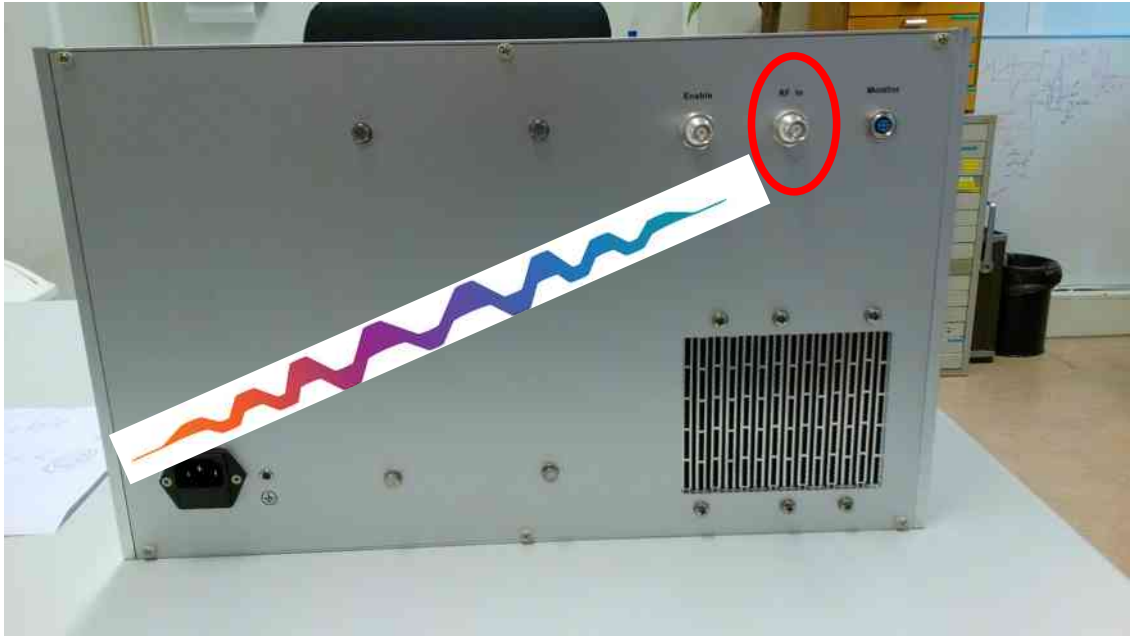


Biasing and testing (7)

- Press the Output ON button on the front of the amplifier to enable the amplifier.

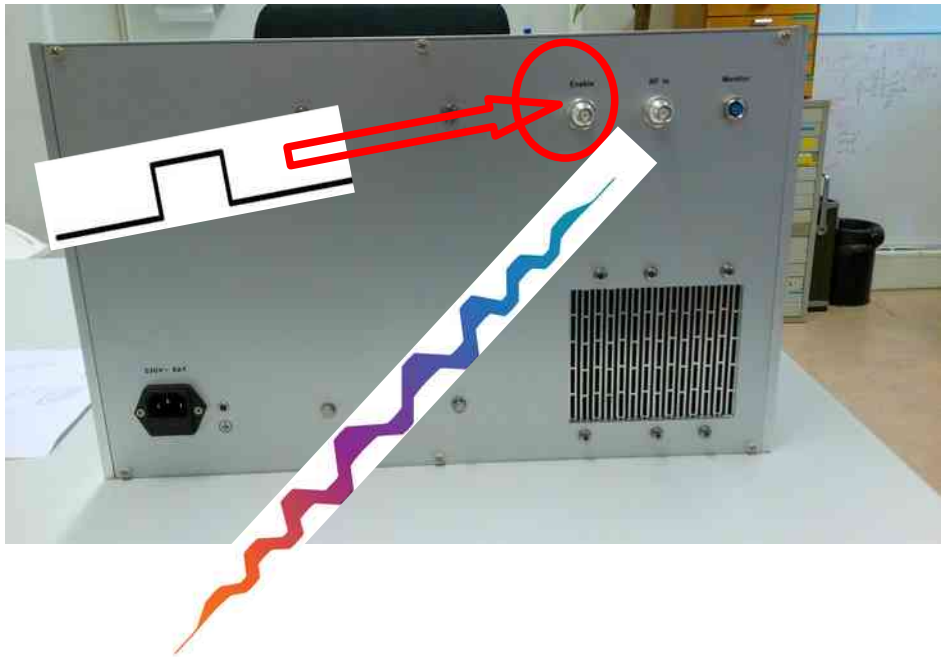
Biasing and testing (8)

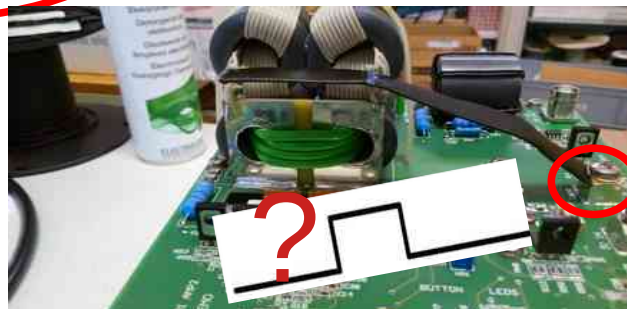
- Apply a 10mV signal of 1MHz at the RF In input.



Biasing and testing (9)

- Apply a single pulse with a **pulse time of 10µs** and a level of 1.5..5V at the Enable input and check if a signal is present at the load resistor and see if the voltage at J3 switches on and off.





Common mistake

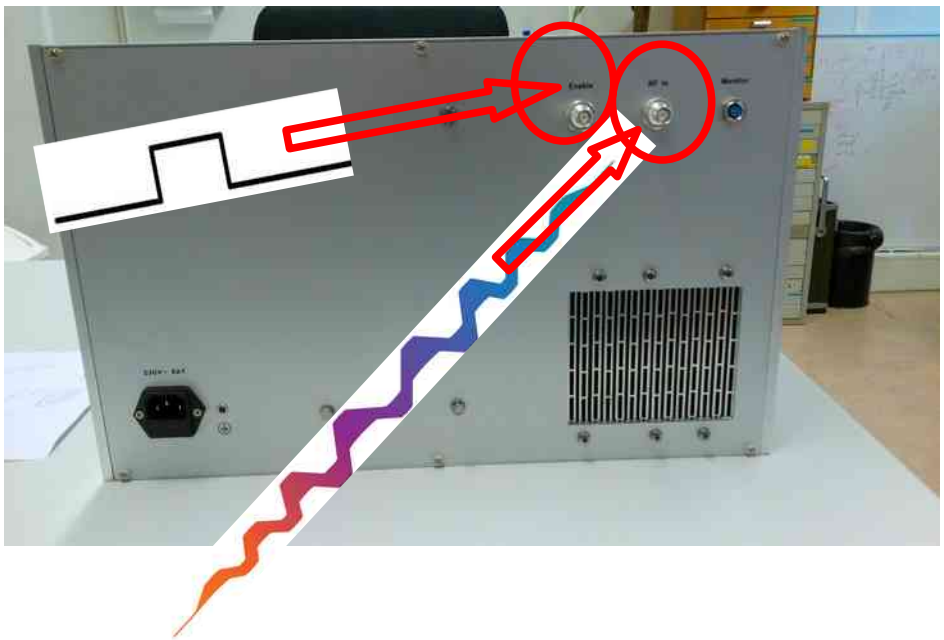
- ONLY short RF pulses! No Continuous wave.

Biasing and testing (10)

- Increase the voltage out of the phoenix power supply to 56V and the bias voltage potentiometers to 2.5V.

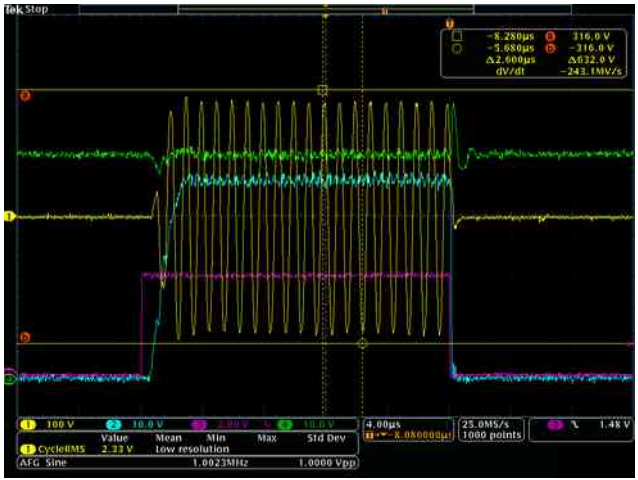
Biasing and testing (11)

- Test with 250mV amplitude input signal while checking the sine wave at the load with single enable pulses.



Biasing and testing (11)

Slowly increase the input signal amplitude and see if the peaks of the sine wave become distorted. The maximum output signal is 632Vpp at 1.1Vpp input signal. Increase the bias voltage to just the value at which the signal looks undistorted at full power (1kW). This takes a bias voltage of around 2.7V. Make sure that both potentiometers are set to the same voltage while tuning before applying an enable pulse.



Thank you!

Special thanks to **Danny de Gans** <D.H.deGans@tudelft.nl>

Speaker Ruben Pellicer-Guridi <ruben.pellicer@ehu.eus>