



OCRA - Open Source Console for Realtime Acquisitions

OCRA Tabletop MRI System and its RF components

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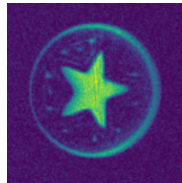
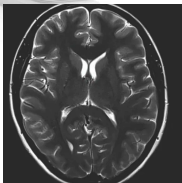
OCRA Tabletop MRI System



Magnet, console and gradient amplifier



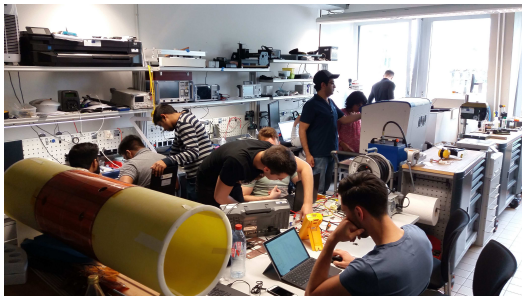
Human MRI vs. Tabletop MRI



www.siemens-healthineers.com



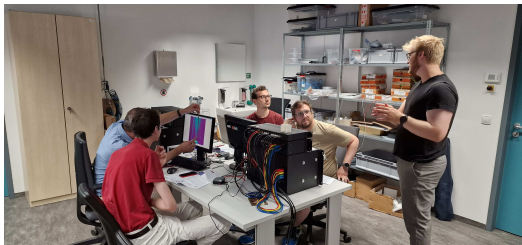
Teaching on real MR Hard- and Software



MR System Engineering 2019



Teaching on real MR Hard- and Software



MRSE (Siemens Healthineers) 2023



Open-Source Hard- and Software

github.com/OpenMRI/ocra

GitHub repository page for `OpenMRI/ocra`. The page shows the repository name, navigation tabs (Code, Issues, Pull requests, Actions, Projects, Security, Insights), a file tree with folders like Applications, HDL, HW, docs, utils, gignore, LICENSE, and README.md, and a commit history table. The README section is visible at the bottom, titled "OCRA: The Open Source Console for Realtime Acquisitions".

zeugmatographix.org/ocra/

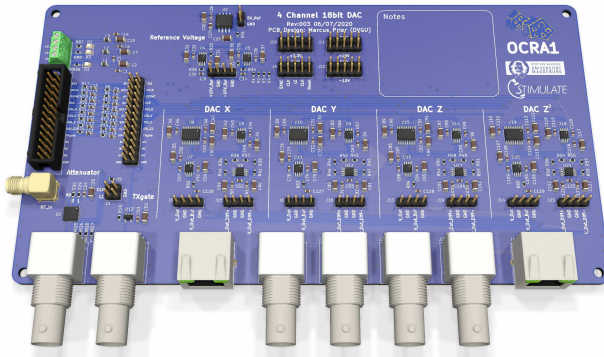
Website page for OCRA. The page features a dark theme with the OCRA logo, a "Download" button, and navigation links for "HOME" and "ABOUT". The main heading reads "OCRA1 - SPI CONTROLLED 4 CHANNEL 18BIT DAC AND RF ATTENUATOR". Below this, there is a search bar, a "POSTED ON" date (November 22, 2020), and a list of "RECENT POSTS" including "GRADIENT COILS FOR THE OCRA TABLETOP MRI SYSTEM".



OCRA Console Main Components



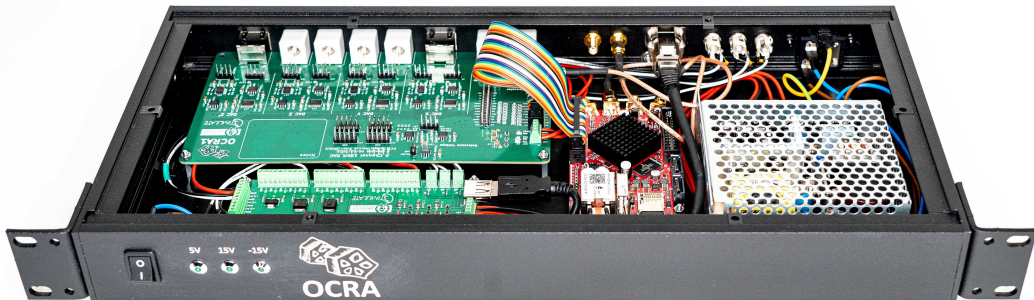
Red Pitaya



OCRA1



OCRA Console





GUI - Main Window and Global Parameters

The screenshot displays the Relax 2.0 software interface. On the left is the main window, and on the right is the 'Parameters' dialog box.

Main Window (Relax 2.0):

- Buttons: Spectroscopy, T1 Measurement, Projections, T2 Measurement, Imaging, Tools.
- Spin Echo dropdown menu.
- File path: Relax2_Rawdata/GOMRI_Spectrum_rawdata
- Parameters button.
- Acquire and Data Process buttons.

Parameters Dialog Box:

Generell

- RF Frequency [MHz]: 11.297279
- Center button
- Flipangle (Pulseamplitude) [°]: 90
- Flipangle (Hardpulselength) [°]: 90
- TE [ms]: 15.0
- T1 [ms]: 2.0
- TR [ms]: 6000
- Average: 10
- Sampling Time [ms]: 6

Projections

- X:
- Y:
- Z:

T1 Measurement

- T1 Start [ms]: 1.0
- T1 Stop [ms]: 2000.0
- Steps: 10

T2 Measurement

- TE Start [ms]: 4.0
- TE Stop [ms]: 20.0
- Steps: 10

Imaging

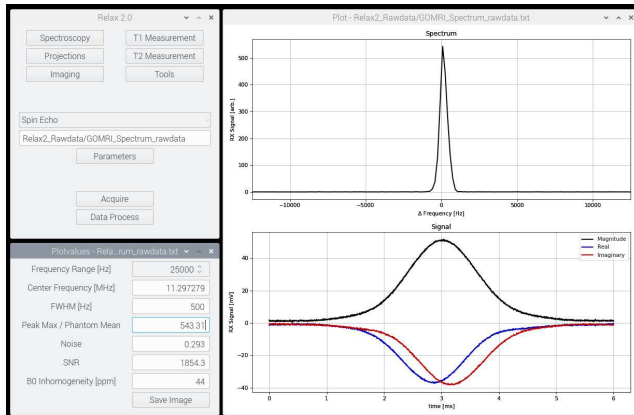
- Image Orientation: 0
- Image Resolution [pixel]: 256
- RF Frequency Offset [Hz]: 0
- RF Phase Offset [°]: 0
- 3D Slab Steps: 4
- Undersampling: Time (2), Phase (2)
- k-Space Cut: Center to 0 [1%] (1), Outside to 0 [1%] (1)

Config & Misc

- RF: 90° Ref. Pulselength [µs] (100), RF Attenuation [dB] (-13.00)
- Gradients: GRO Amplitude [mA] (2100), GPE Step [mA] (35), GS Amplitude [mA] (0), GDiff Amplitude [mA] (2000), 3D GS Slab Step [mA] (60), Crusher Amplitude [mA] (1500), Spoiler Amplitude [mA] (2000)
- Shim X [mA] (-50), Shim Y [mA] (0), Shim Z [mA] (30), Shim Z² [mA] (80)
- Imaging: Individual Plots (off), Readout BW Scaler (1)



GUI - MR Spectrum (Spin Echo)





GUI - MR Material Parameters (T1)

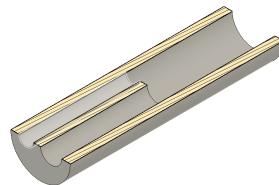
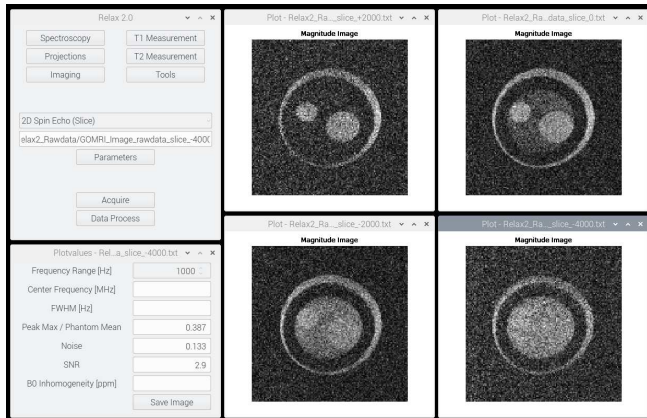
The screenshot displays the Relax 2.0 software interface for T1 measurement. On the left, the 'Relax 2.0' window contains a menu with 'Spectroscopy', 'Projections', 'Imaging', 'T1 Measurement', 'T2 Measurement', and 'Tools'. Below the menu, the 'Inversion Recovery (SE)' section is active, showing the file path 'Relax2_Rawdata/GOMRLT1_rawdata' and a 'Parameters' button. At the bottom of this window are 'Acquire' and 'Data Process' buttons.

Below the main window is the 'Plotvalues - Rela...T1_rawdata.txt' window, which includes input fields for 'Frequency Range [Hz]' (set to 20000), 'Center Frequency [MHz]', 'FWHM [Hz]', 'Peak Max / Phantom Mean', 'Noise', 'SNR', and 'B0 Inhomogeneity [ppm]', along with a 'Save Image' button.

On the right, two plots are shown. Both plots are titled 'Plot - Relax2_Ra...T1_rawdata.txt' and display 'Signal' on the y-axis and 'T1' on the x-axis. The top plot shows 'Measurement Data' as black dots and a 'Fit' as a green curve. The plot title indicates 'T1 = 1734.16ms, r = -0.98'. The bottom plot shows the same data with a linear fit, also indicating 'T1 = 1734.16ms, r = -0.98'.

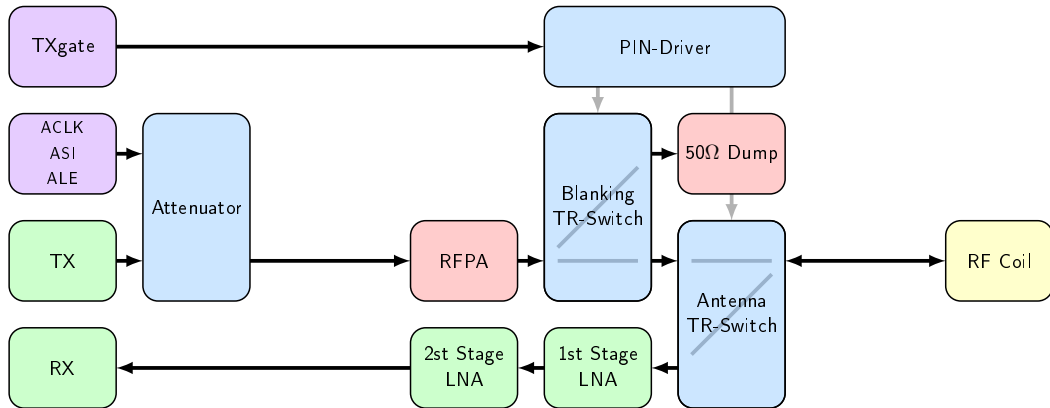


GUI - MR Imaging (Spin Echo Slice Select)



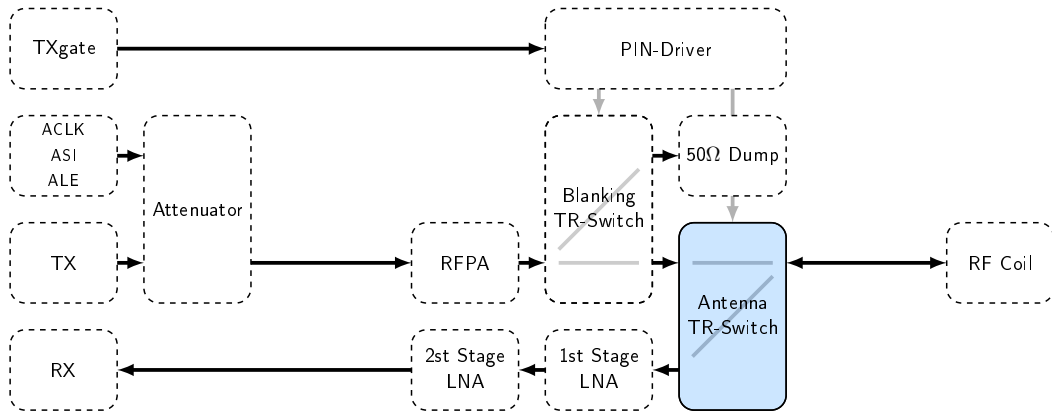


OCRA Tabletop RF System Overview



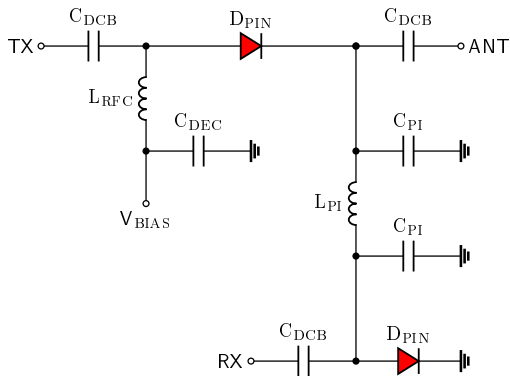


TR-Switch



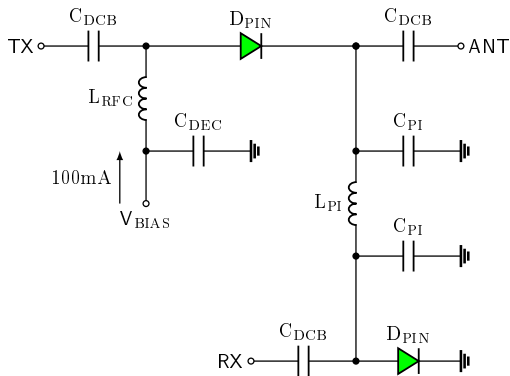


TR-Switch - Principle Schematic



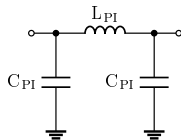


TR-Switch - Principle Schematic





Tabletop TR-Switch - Pi-Element



$$C_{PI} = \frac{1}{2\pi f_L Z_0} \quad L_{PI} = \frac{Z_0}{2\pi f_L}$$

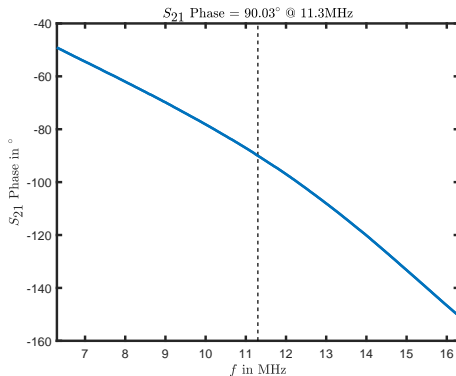
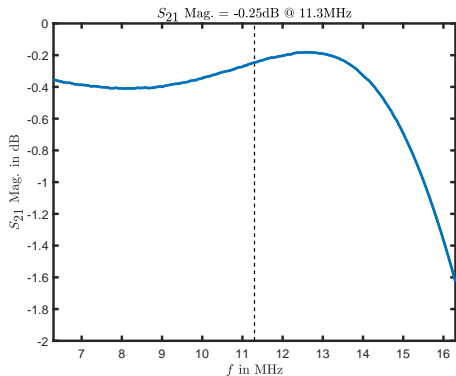
$$Z_0 = 50\Omega \quad f_L = 11.3\text{MHz}$$

$$\implies C_{PI} = 282\text{pF} \quad L_{PI} = 704\text{nH}$$

(Equivalent to 4.38m of RG-58 coaxial cable)

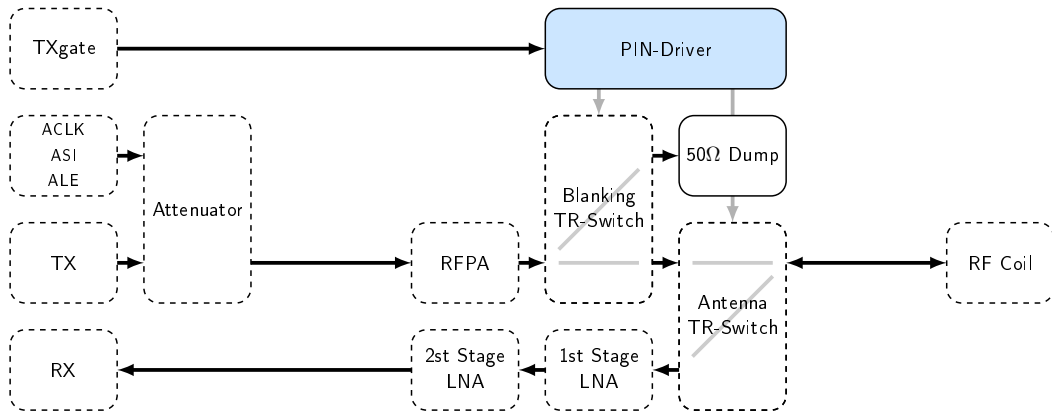


Tabletop TR-Switch - Pi-Element



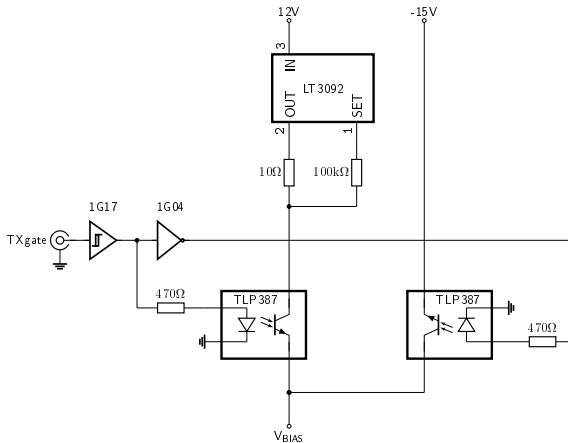


PIN-Driver



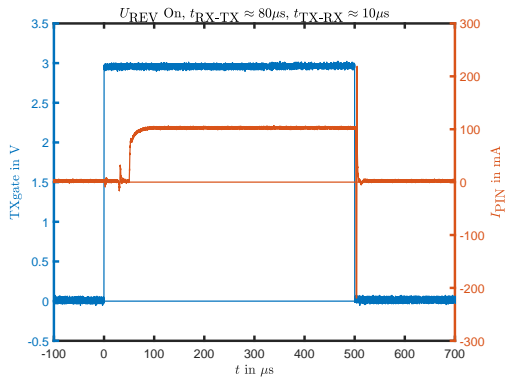
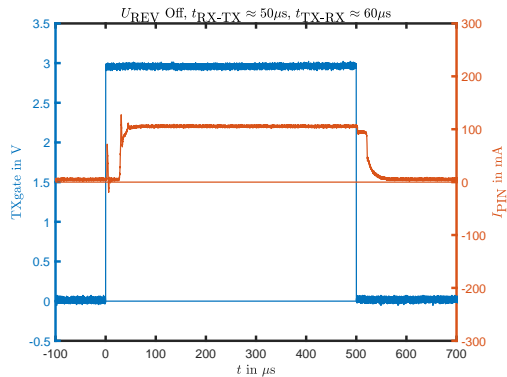


PIN-Driver - Schematic



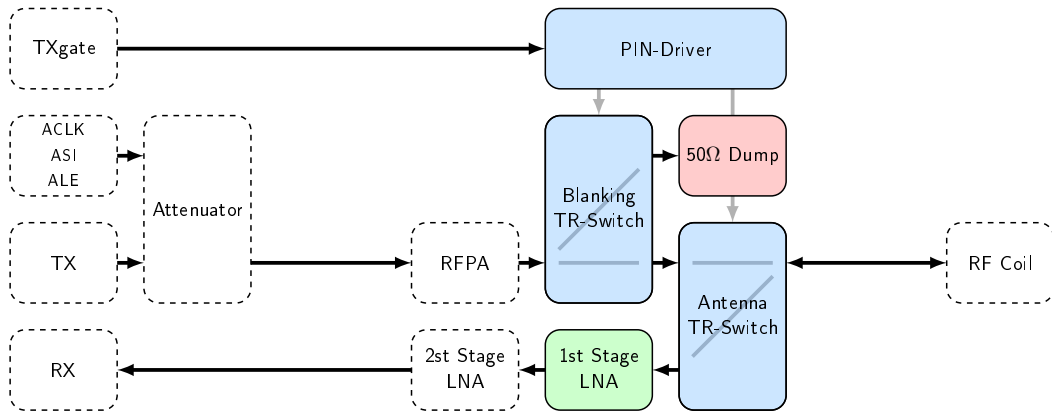


Tabletop TR-Switch - PIN-Driver



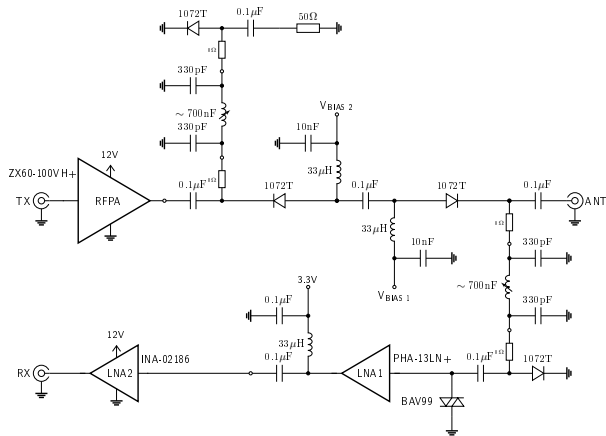


Tabletop TR-Switch



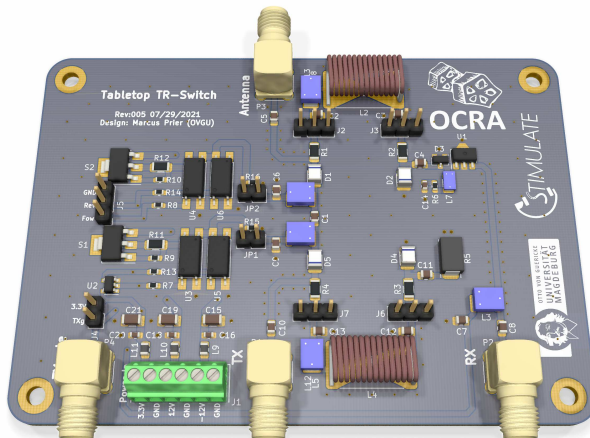


Tabletop TR-Switch* - Schematic



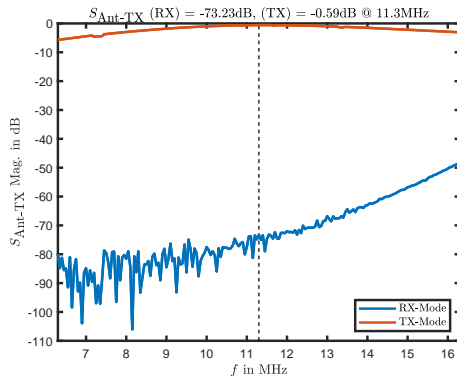
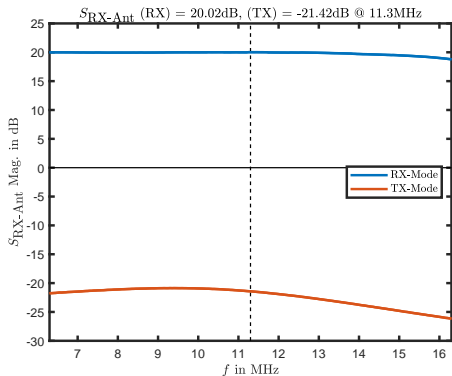


Tabletop TR-Switch - PCB



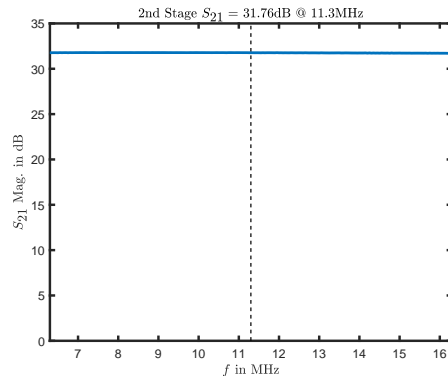
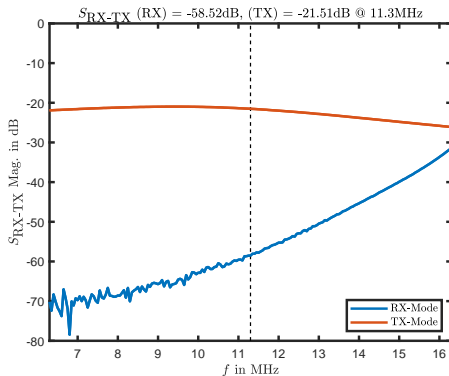


Tabletop TR-Switch - S-Parameter





Tabletop TR-Switch - S-Parameter





Summary

- ▶ ORCA Tabletop MRI System offers an open-source hard- and software platform
- ▶ Working RF components in the Tabletop System
- ▶ Easy to adapt for Halbach MRI System
- ▶ Additional components can be build (RF-Attenuator and SAR-Monitor)



Thank you for your attention!

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