

Homebrew Vektor Networkanalyzer for Amateur Radio Use up to 500 MHz

Prof. Dr. Thomas Baier
DG8SAQ

Cal Start = 10,685 MHz

Center = 10,7 MHz
Span = 30 kHz

Stop = 10,715 MHz

S21 dB

Mem2 Smith

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Juli 2006

Targets

- Minimum frequency range
100 KHz ... 30 MHz
- Sufficient accuracy to use
S-parameters for simulations
- Utilize standard PC as much as possible
- Cut down on hardware as much as
possible
- Easily obtainable standard components,
solderable by amateur with soldering iron

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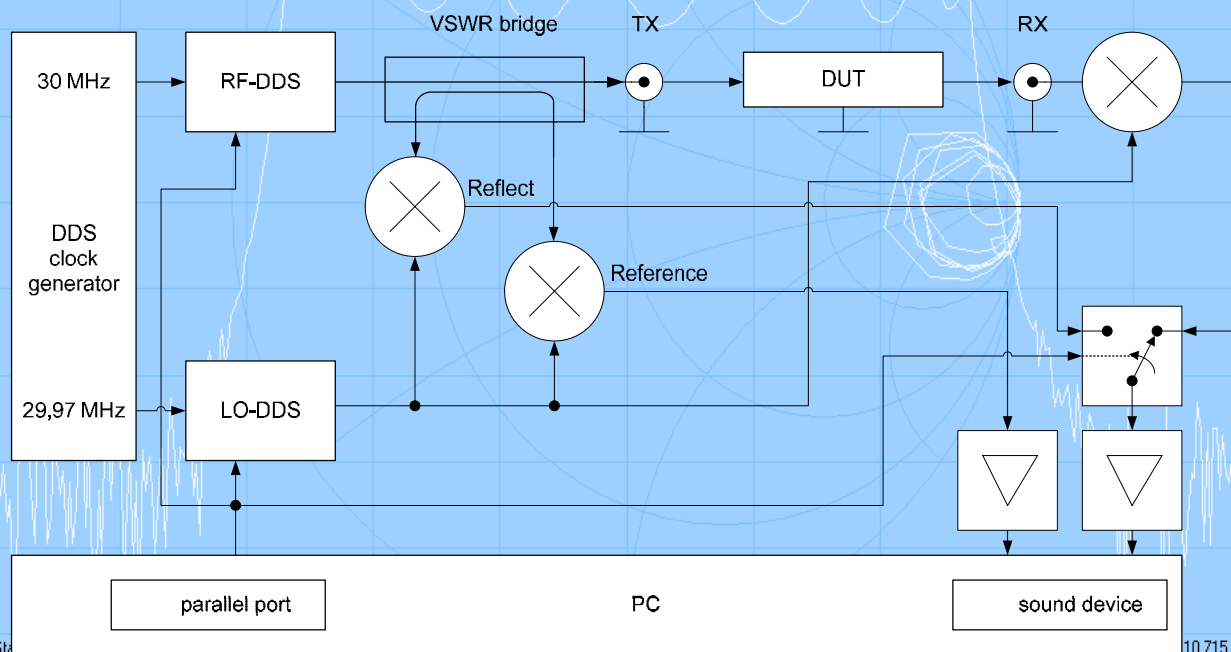
S21 dB

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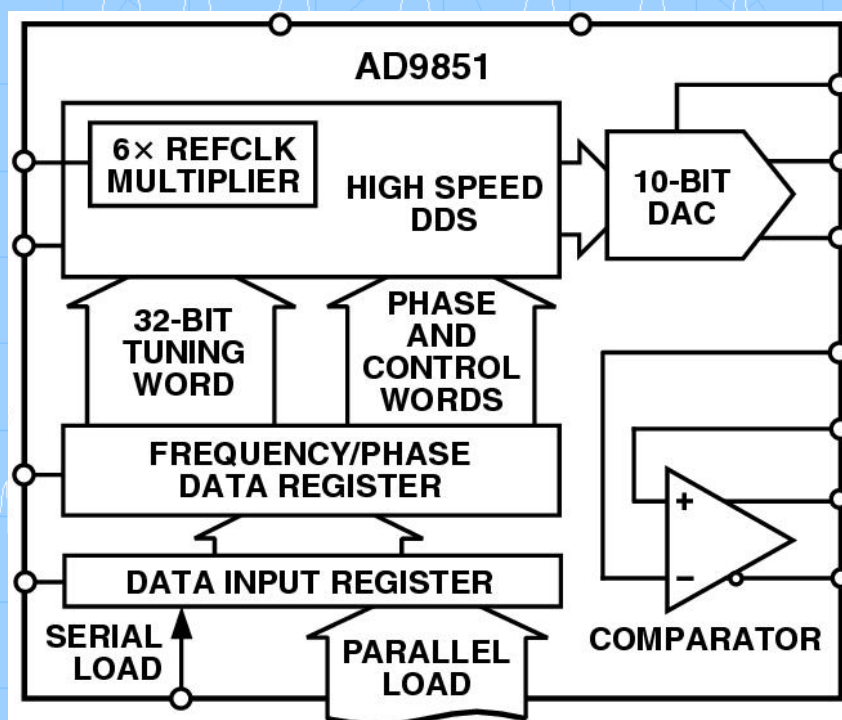
Principle of VNWA



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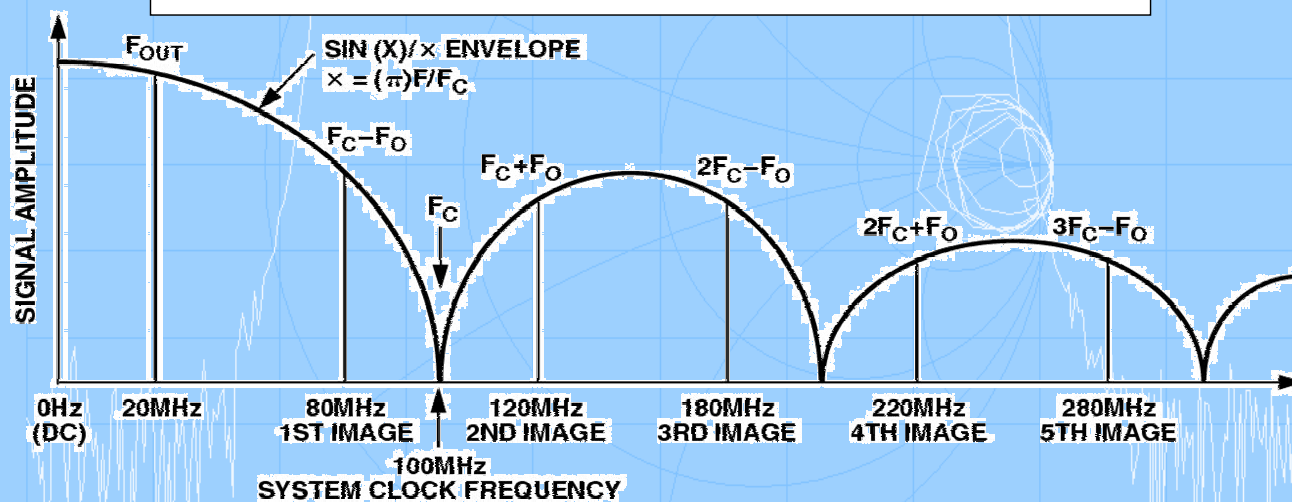
AD9851 DDS-Device



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Output Spectrum of a DDS Device



Cal Start = 10,685 MHz

Center = 10,7 MHz
Span = 30 kHz

Stop = 10,715 MHz

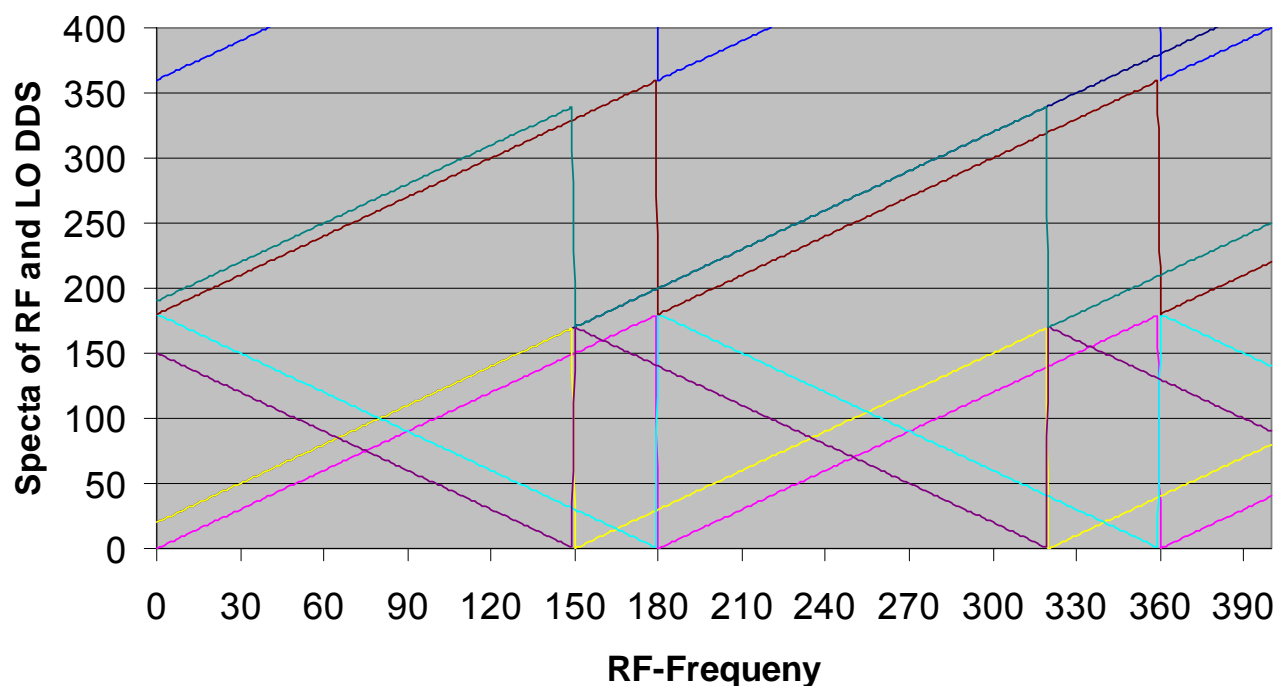
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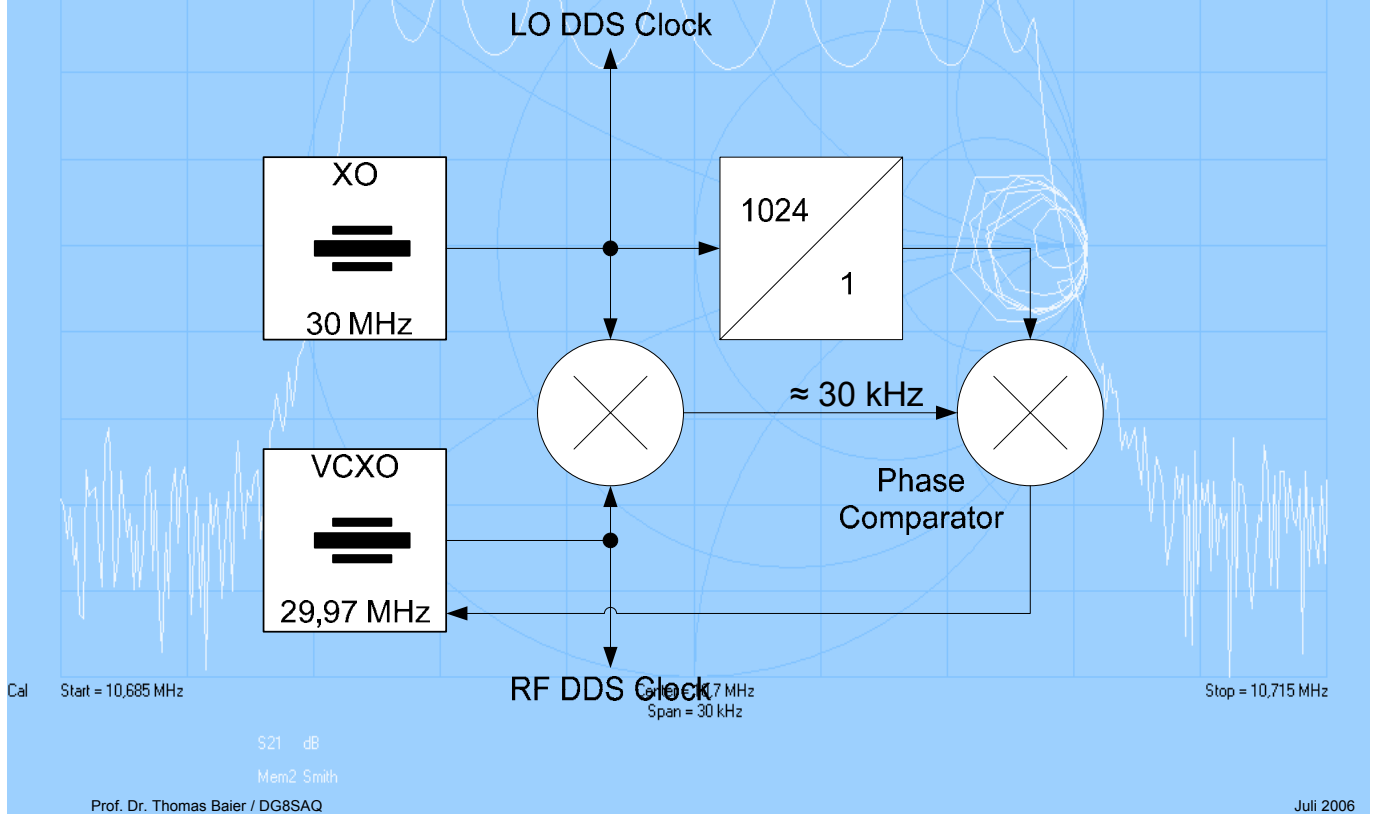
DDS Alias Frequencies



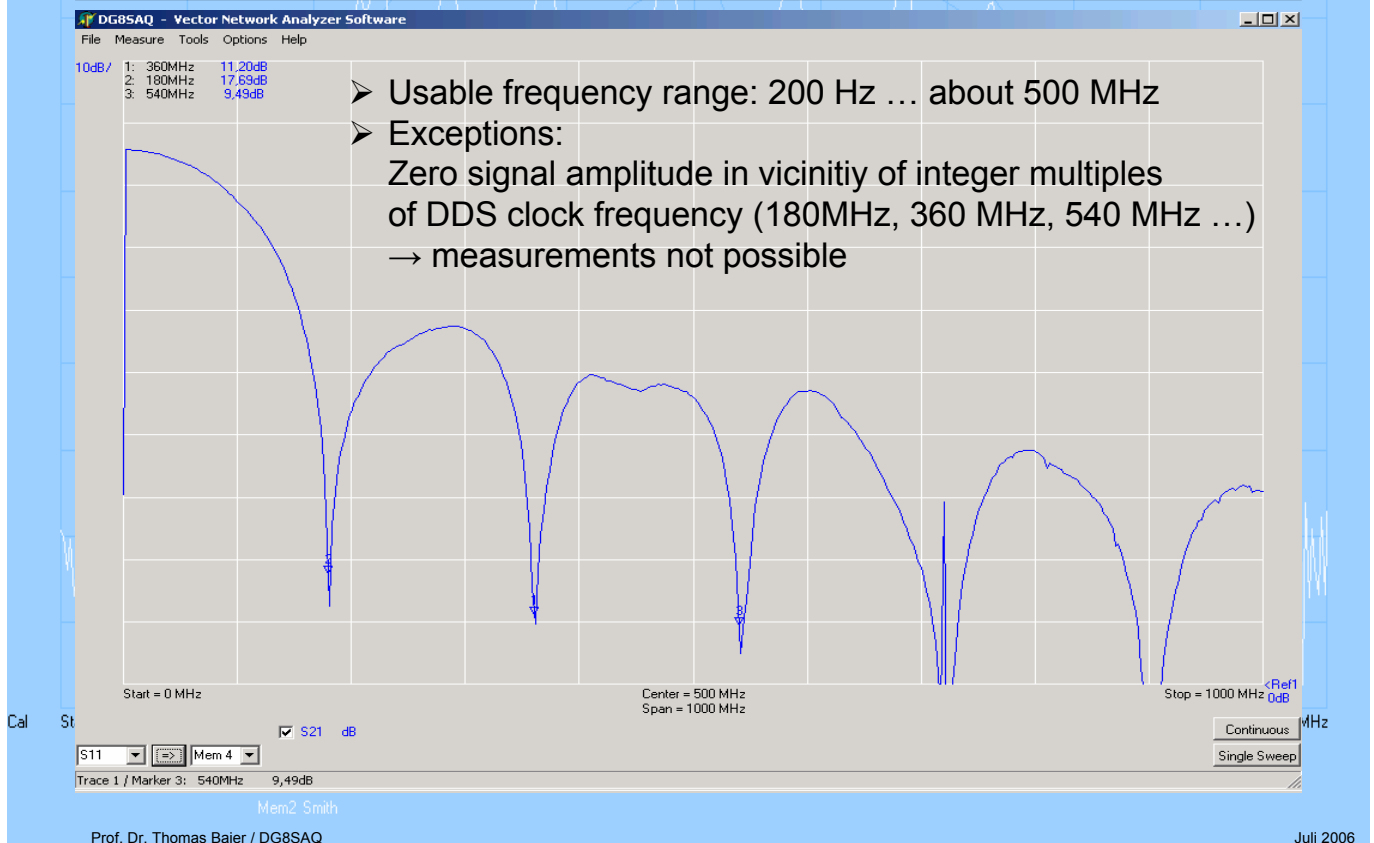
Computational Example: clock frequency RF-DDS: 180 MHz
clock frequency LO-DDS: 170 MHz

IF: 10 MHz

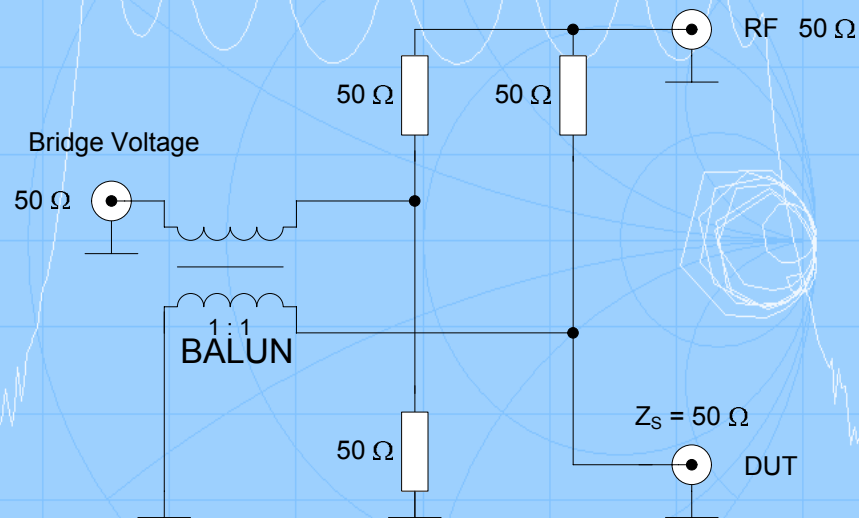
DDS Clock Generator



Measured Reference Signal



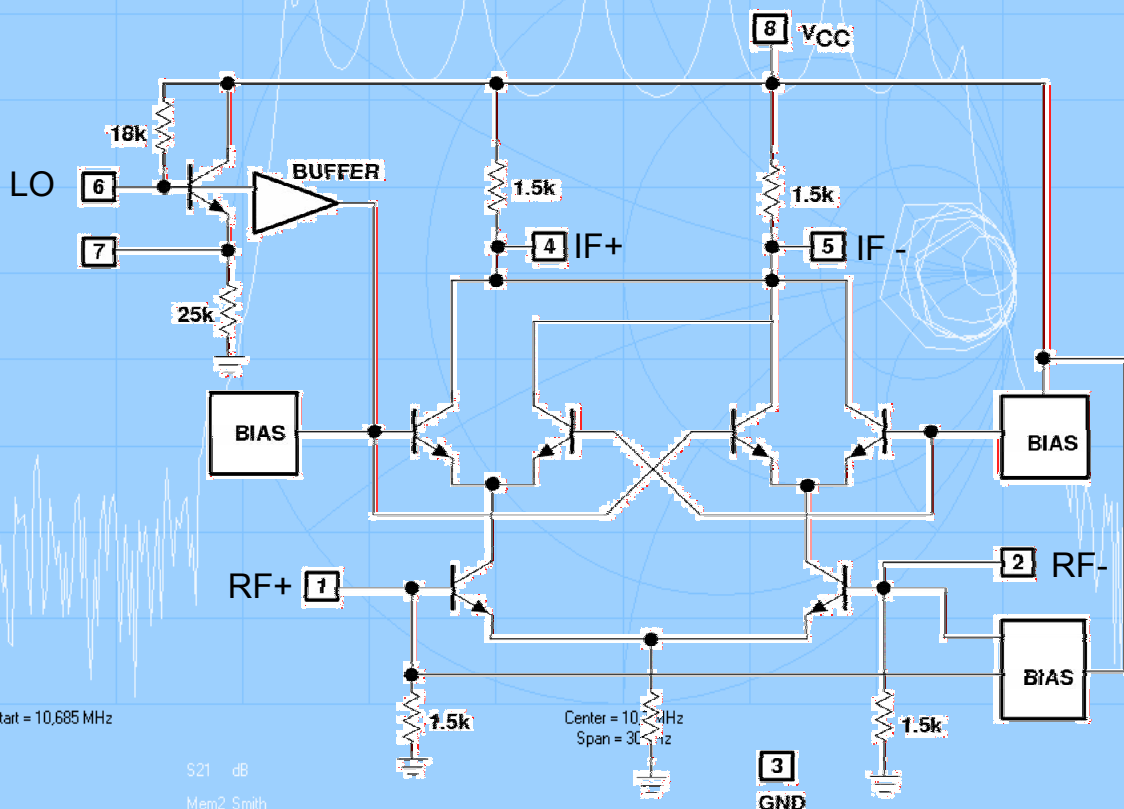
Standard VSWR Bridge



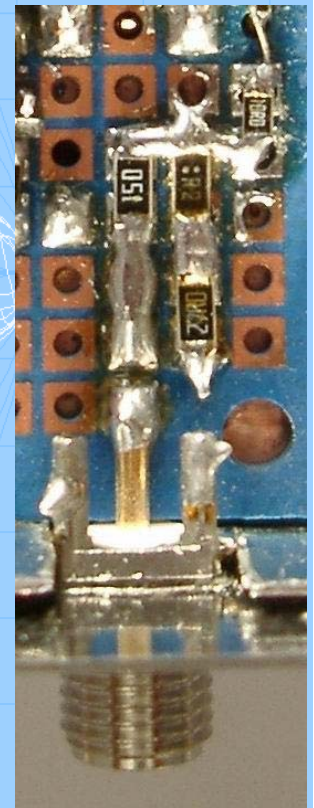
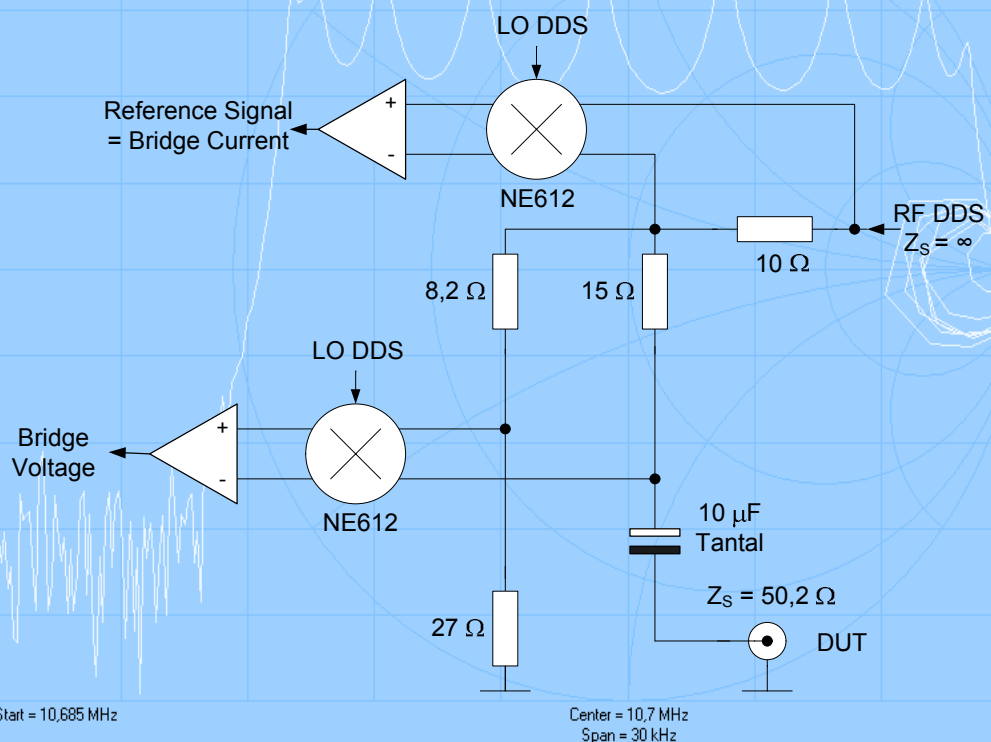
Problem: make wideband BALUN

Solution: use balanced *Gilbert Cell Mixer*

Gilbert Cell Mixer NE612



My VSWR Bridge



Problem: Frequenzgang des DC-Blocks im Hz - Bereich

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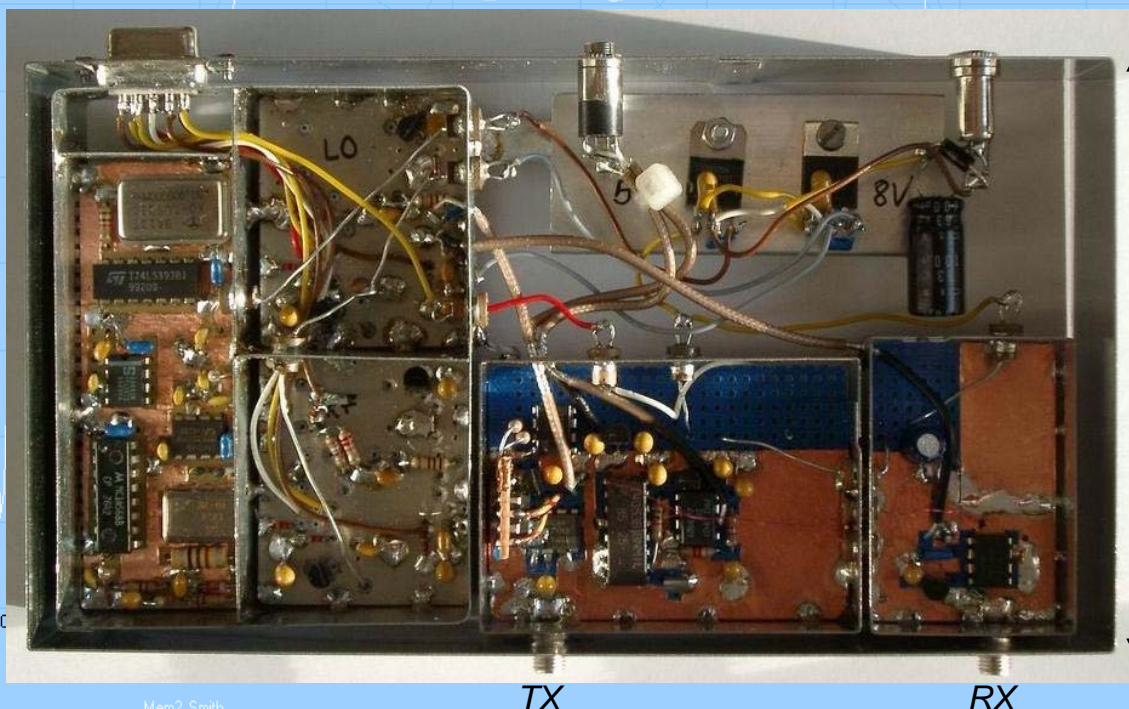
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Hardware (1)

to Parallel Interface

to Line In

+12V/250mA DC

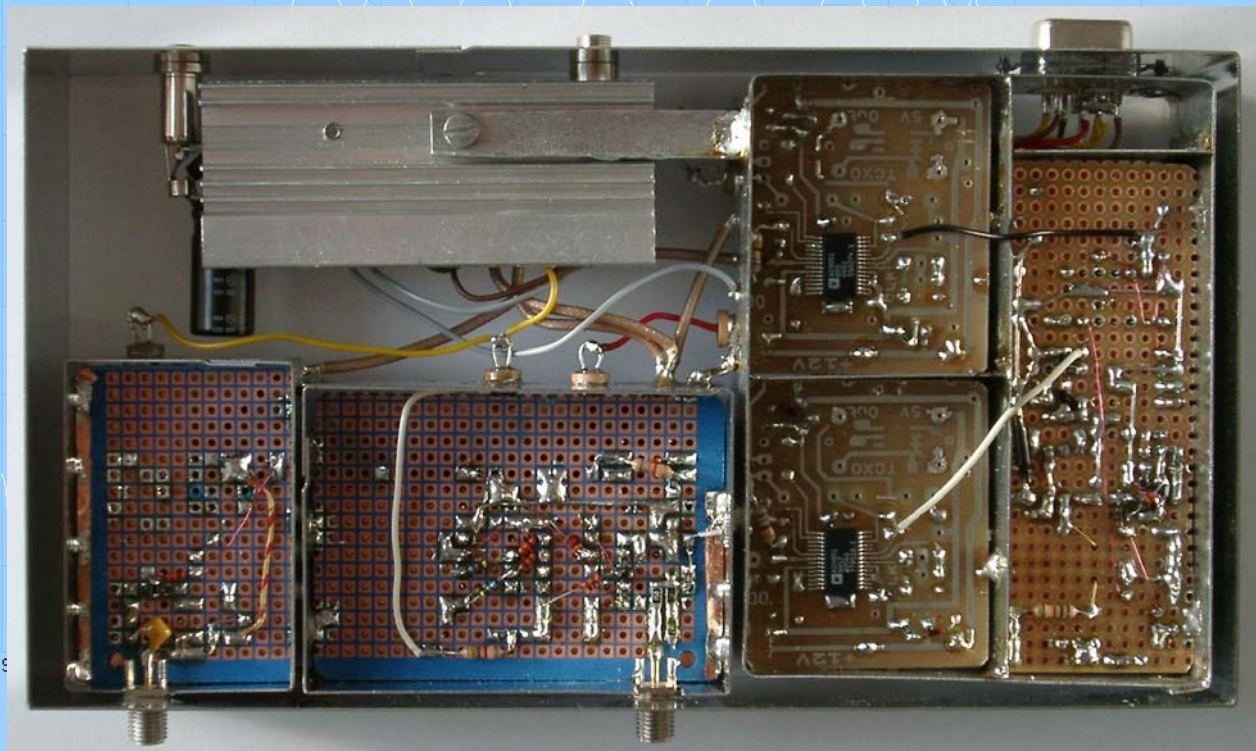


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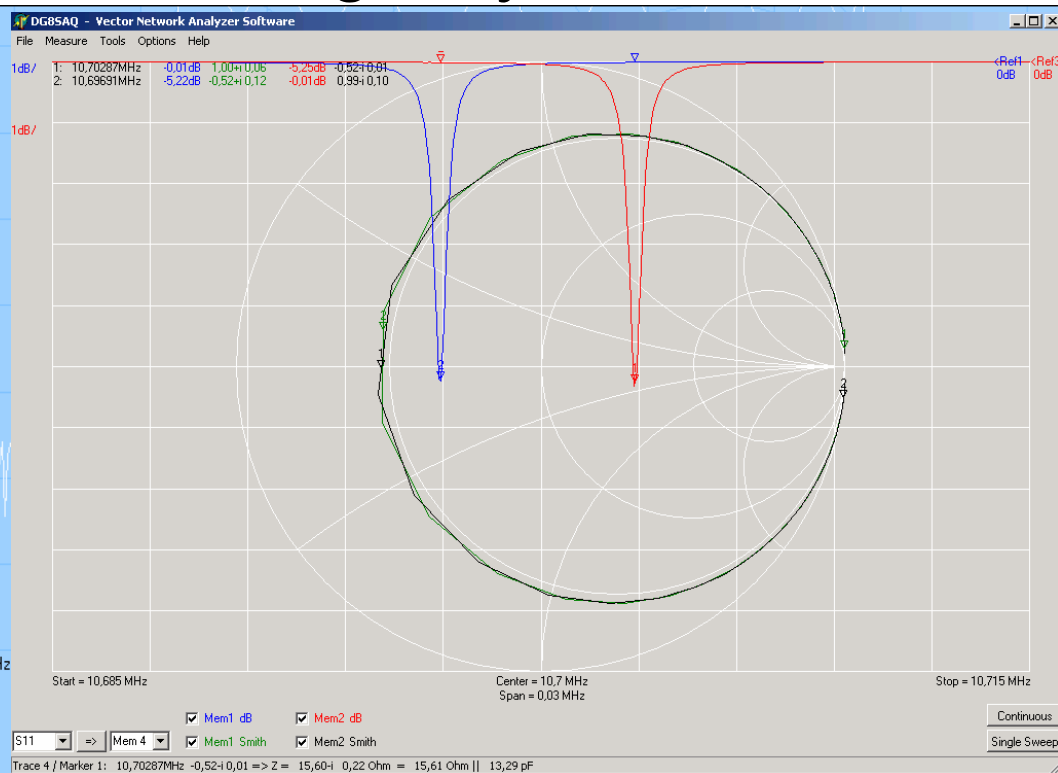
Hardware (2)



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Measurement of Oneport Devices, e.g. Crystals...

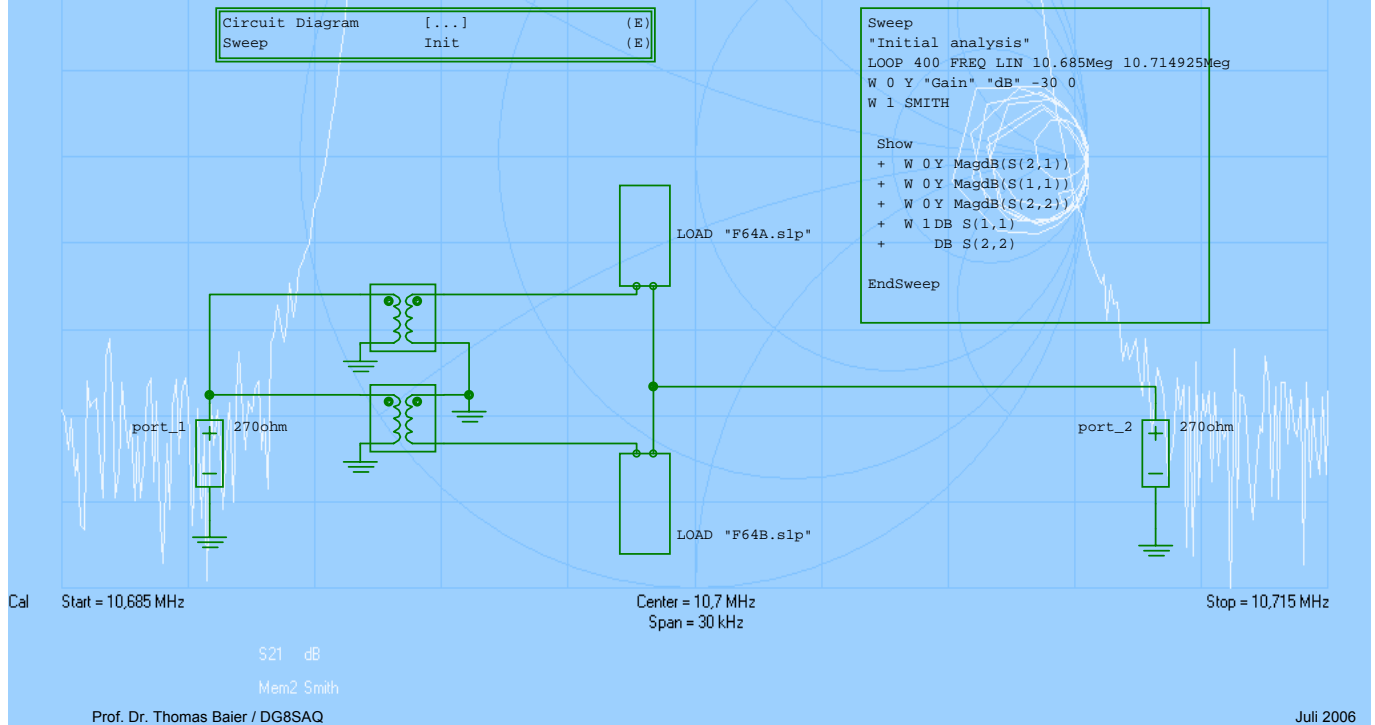


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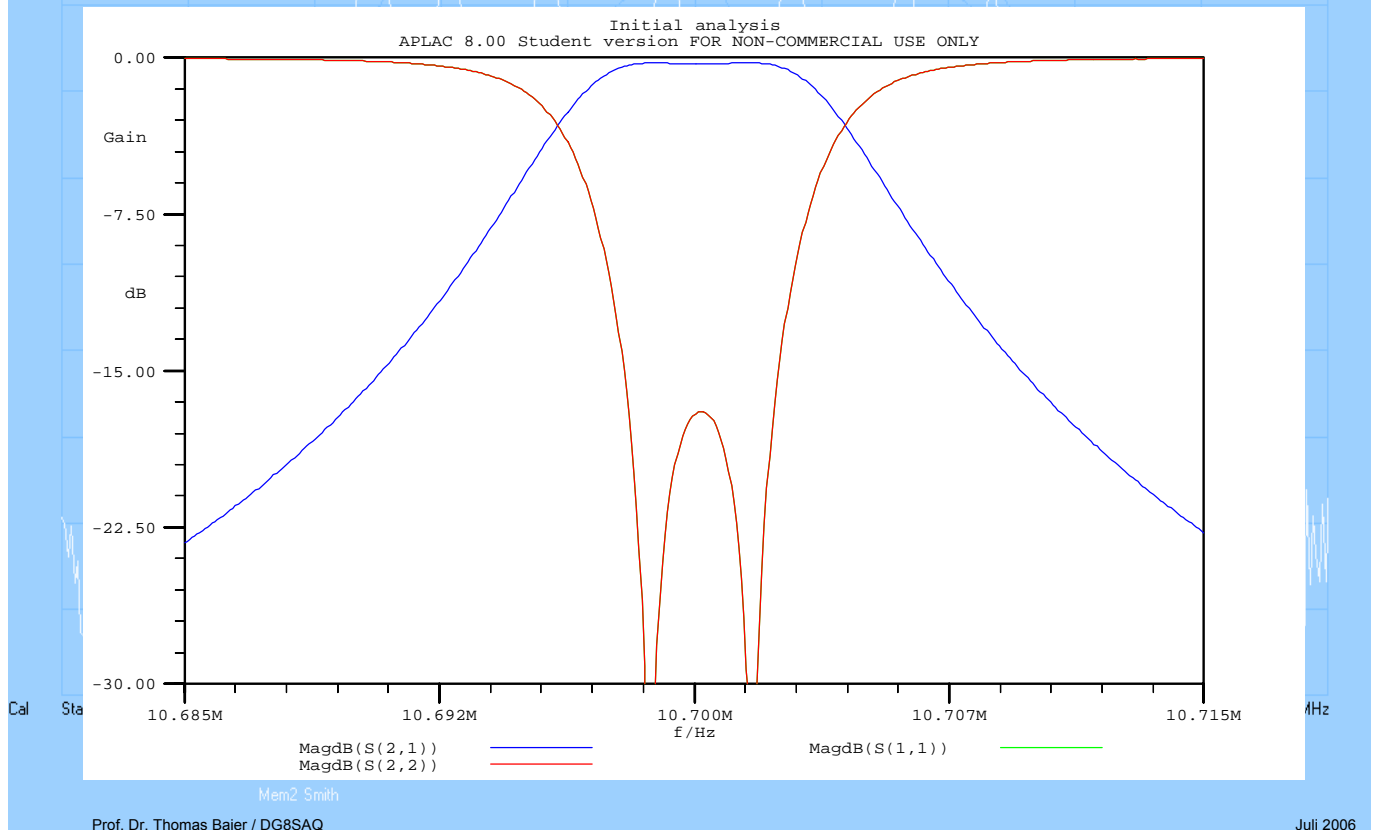
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... and Network Synthesis (1)

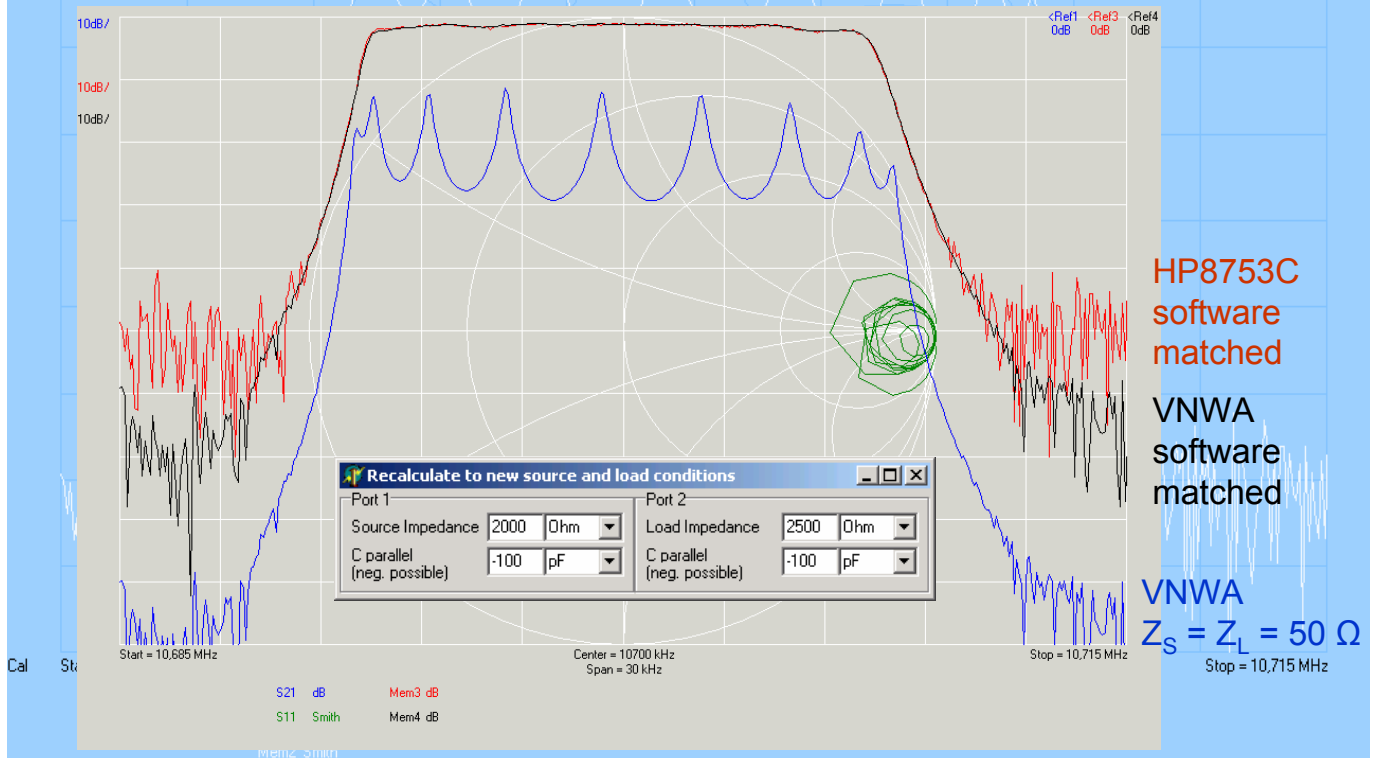
... e.g. with APLAC:



Network Synthesis (2)



Two Port Devices: XTal Filter

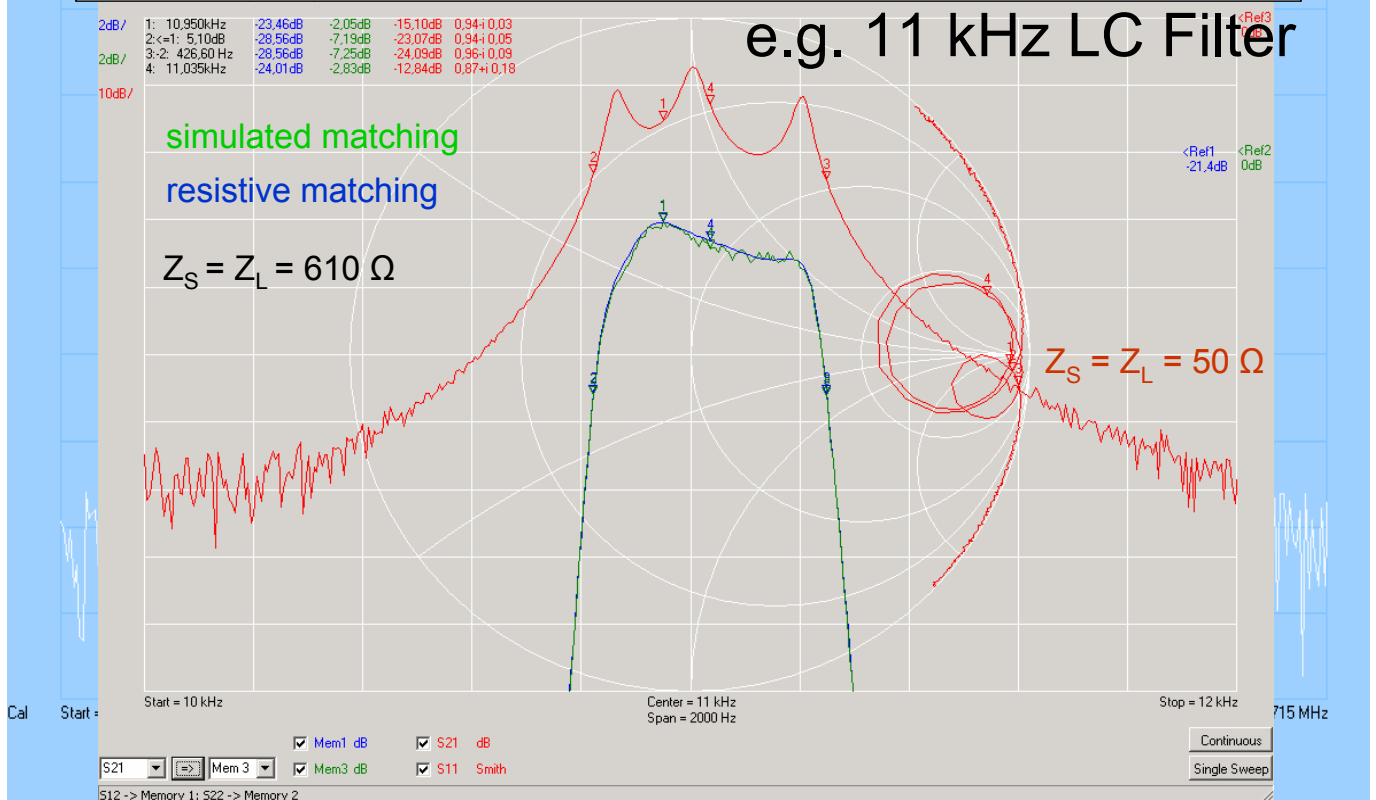


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Lower Frequency Limit

e.g. 11 kHz LC Filter

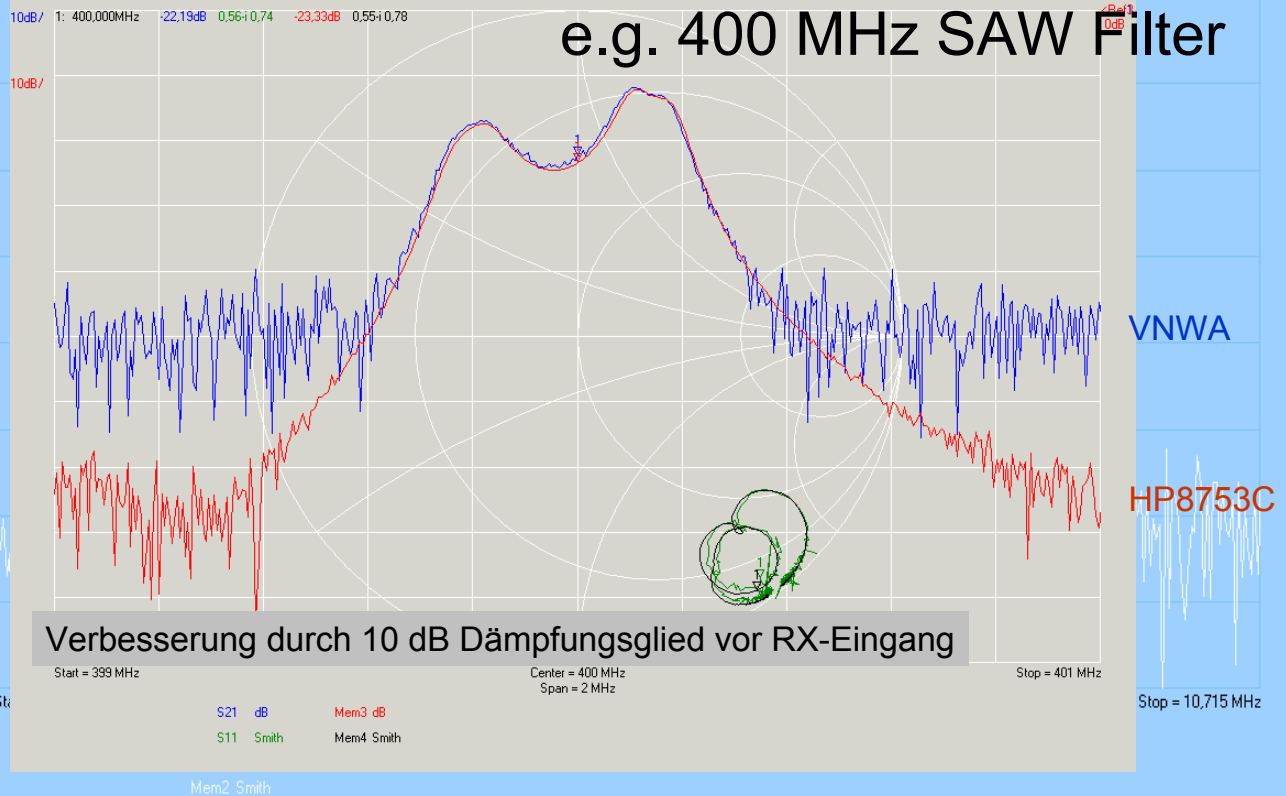


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Upper Frequency Limit

e.g. 400 MHz SAW Filter



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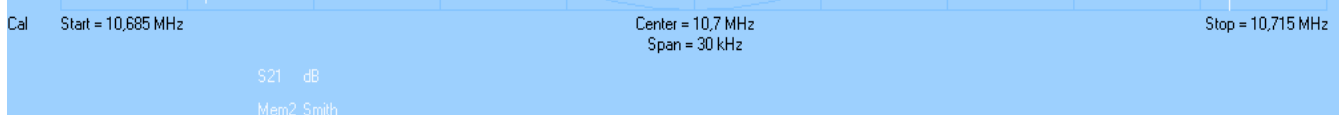
Summary

Achieved:

- 200 Hz – 500 MHz covered with exceptions, especially VLF-2m, 70cm covered!
- Accuracy sufficient for network synthesis.
- Minimum hardware, no tuning points.
- Universal software
- Principally achievable accuracy with PC sound device: 0,01dB and 0,1°, currently limited by Mixer nonlinearities

Possible Improvements:

- Higher level mixers
- DDS devices with higher clock rates (up to 1 GHz)



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