

QucsStudio Simulator

APPLICATION AND PRACTICAL EXAMPLES

ADRIAN MOTAMEDI (K3ADM)

MARCH 27TH, 2020



K3ADM @ Foothills Amateur Radio Society

What is QucsStudio?

Qucs and QucsStudio

“Qucs stands for Quite Universal Circuit Simulator. So far Qucs is not yet finished, but it is already packed with features.

Qucs is an integrated circuit simulator which means you are able to setup a circuit with a graphical user interface (GUI) and simulate the large-signal, small-signal and noise behavior of the circuit. After that simulation has finished you can view the simulation results on a presentation page or window.”

Qucs stopped development 2017.

“QucsStudio is mainly a circuit simulator that has evolved out of the project Qucs, but isn't compatible with it. The simulation engine is even a complete new creation. It's meant to be a test project to create a complete development environment for electrical engineers. (graphical user interface, circuit simulator, PCB layouting, numerical data processing etc.) The application uses Qt4® by the Qt Company® as graphical user interface.” QucsStudio's last update was September 2019.

What are the features of QucsStudio?

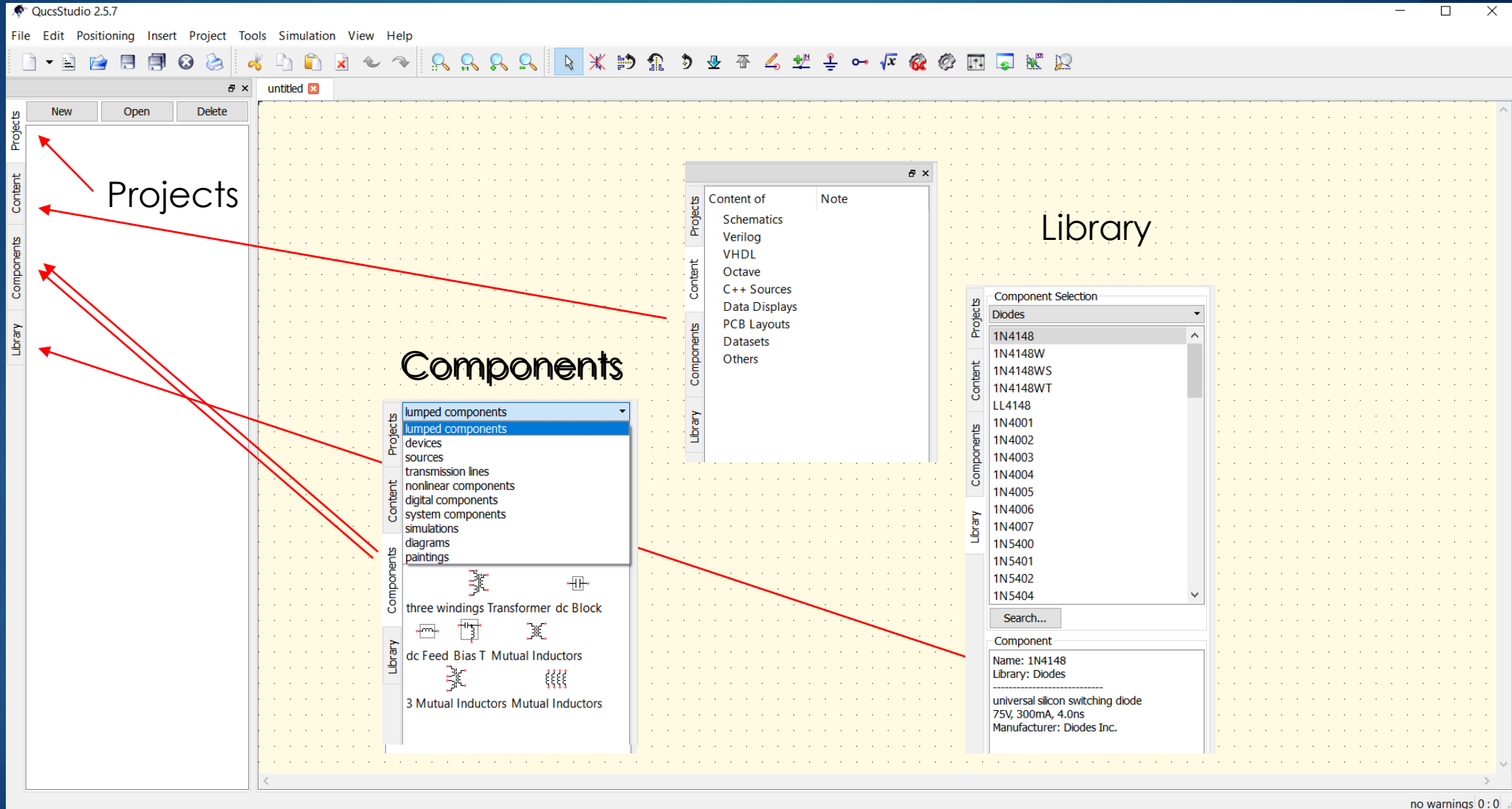
- More than 100 circuit components: all popular lumped, RF and digital components, microstrip, coplanar and stripline elements, SGP, Statz, TOM3, HICUM, JFET, MOSFET models, diode, photodiode, tunnel diode, SCR, triac, diac, OpAmp models, user-defined components (time, frequency and mixed domain) & many others ...
- DC analysis & AC analysis (including noise analysis)
- S-parameter analysis (including noise parameter calculation), Import of S-Parameters
- Transient analysis (including periodic steady-state simulation)
- Harmonic Balance analysis (including large-signal AC and noise analysis)
- Parameter sweeps, powerful optimization algorithms, tolerance and manual tuning with sliders

What are the features of QucsStudio?

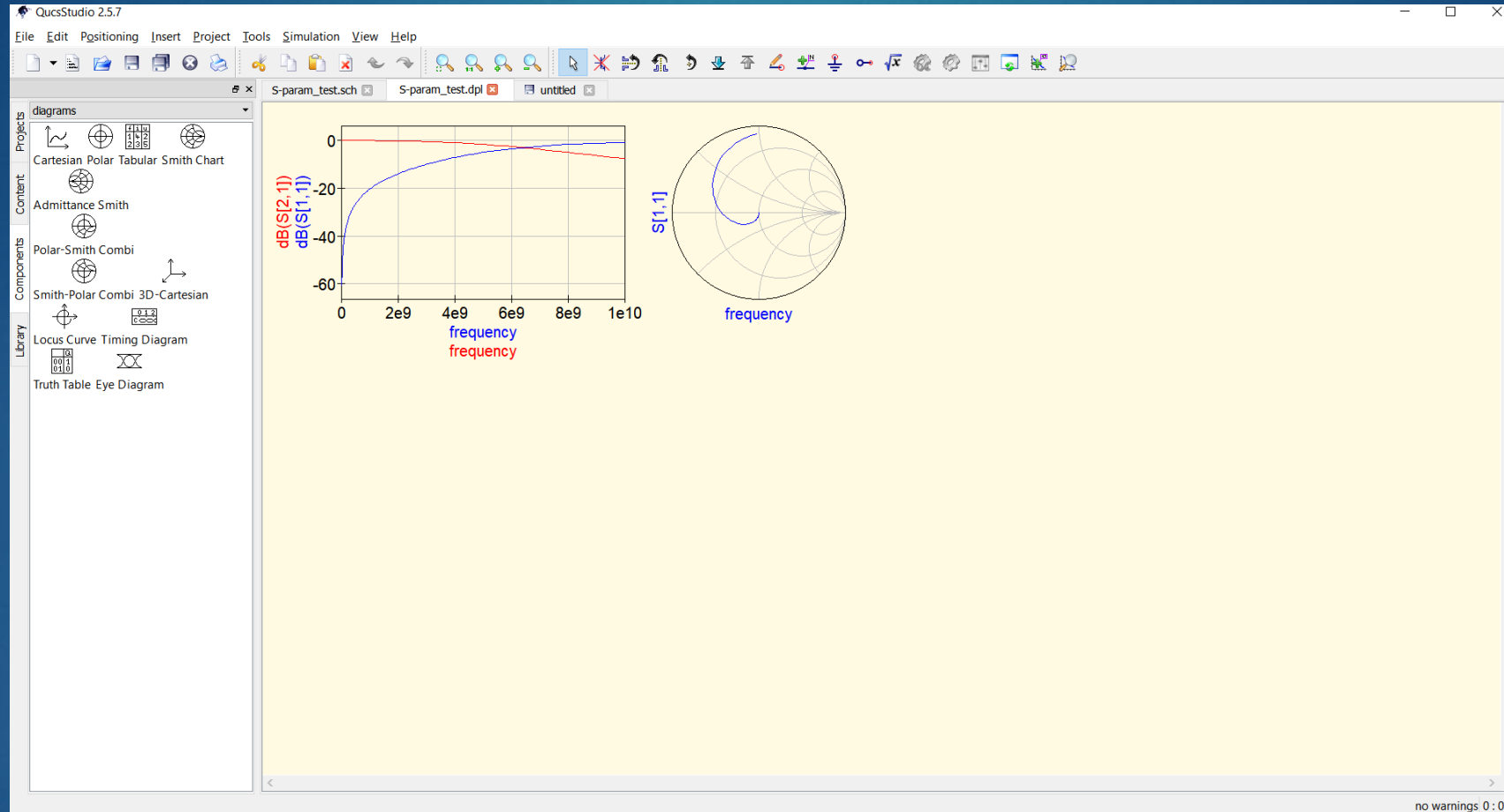
- Creation of user components with:
equation-defined components (voltage or frequency dependent)
- Digital simulations in VHDL using [GHDL](#) & by Verilog using [ICARUS](#)
- PCB layout and Gerber viewer using [KiCAD](#) by the [KiCAD team](#)
- RF transmission line calculator for: single & coupled microstrip line, single & coupled coplanar waveguide, single & coupled stripline, coaxial transmission line, rectangular waveguide
- Filter synthesis (LC ladder, stepped-Z, microstrip, active filters etc.)
- Attenuator synthesis (resistive pi, tee, bridged-tee and splitter topology)
- GPIB device control

Easier (careful!) than spice and multi-faceted, especially for High frequency, microwave and HAM radio. Similar to Keysight ADS

Graphic User Interface (1)



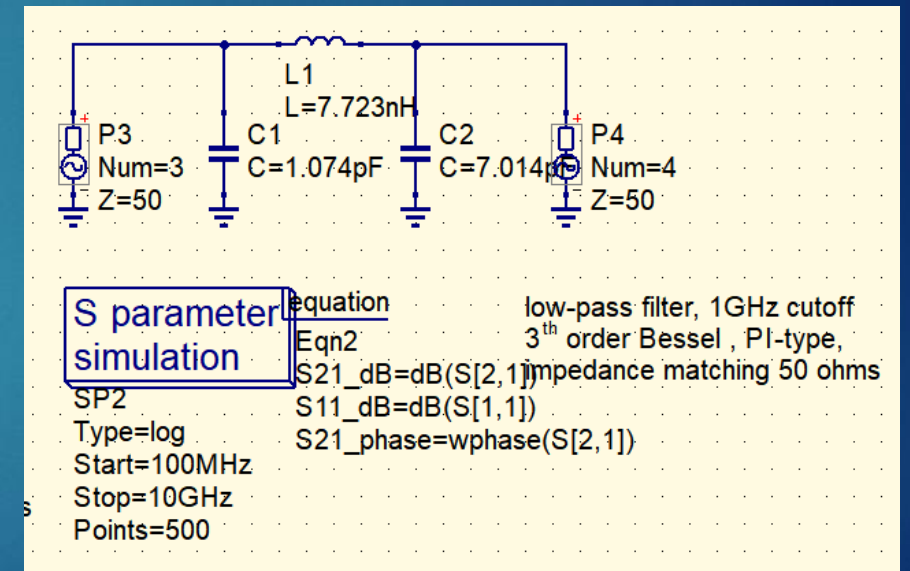
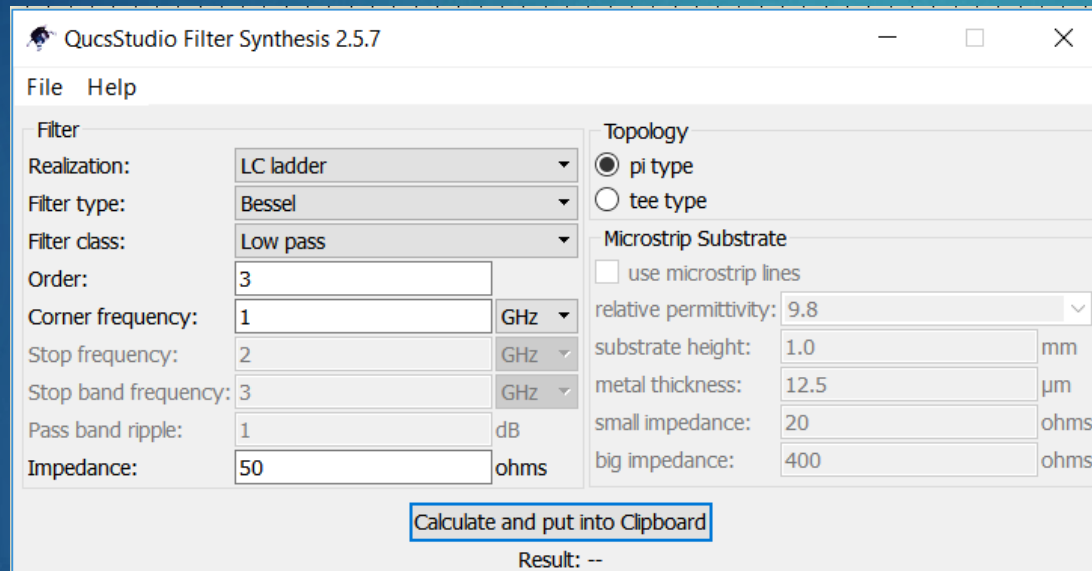
Graphic User Interface (2)



Additional tools (1/5):

Filter Synthesis:

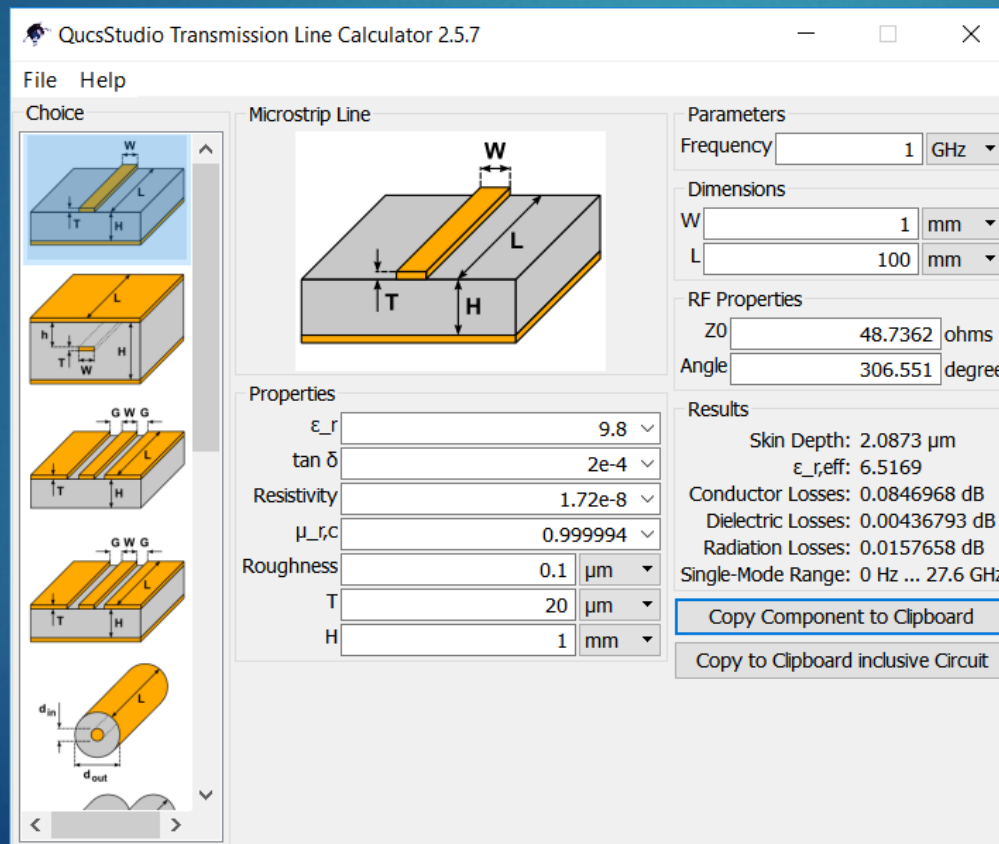
With lumped elements or with microstrip lines, etc.



Additional tools (2/5):

Line Impedance Calculator:

Microstrip, stripline, coax, co-planar feedlines, twisted pairs, also differential pairs,...



Additional tools (3/5):

Attenuator Synthesis:

PI, Tee, Bridged PI, Delta splitter, Star splitter

QucsStudio Attenuator Synthesis 2.5.7

File Help

Choice

PI Attenuator

Input

Attenuation: dB

Zin: ohms Input Power: W

Zout: ohms

Output

R1:	<input type="text" value="869.55"/> ohms	<input type="text" value="0.058"/> W
R2:	<input type="text" value="5.77"/> ohms	<input type="text" value="0.102"/> W
R3:	<input type="text" value="869.55"/> ohms	<input type="text" value="0.046"/> W

Result: **Success**

E6 E12 E24 E48

Put Circuit into Clipboard

Into Clipboard including Simulation

Additional tools (4/5):

Matching Circuit:

Based on impedance & device S-parameter.

Create Matching Circuit

calculate two-port matching

Reference Impedance

Port 1 ohms Port 2 ohms

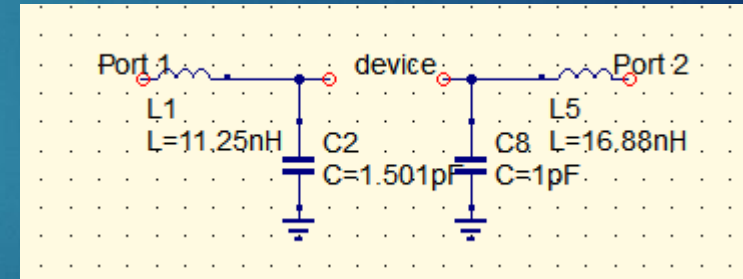
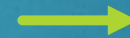
S Parameter

Input format use shortest path

S11 +j S12 +j

S21 +j S22 +j

Frequency: GHz



Additional tools (5/5):

Component Designer

QucsStudio Component Designer 2.5.7

File Help

Choice

round single-layer coil

Number of Turns	20	
Coil Diameter D	5	mm
Coil Length L	8	mm
Wire Diameter d	0.2	mm
Specific Resistance of Wire	1.72e-8	ohms*m
Operating Frequency	1	MHz
Inductance:	0.9573 μ H	
DC Resistance:	172.1 m Ω	
Wire Length:	0.3143 m	
Quality Factor:	30.9203	
Parasitic Capacitance:	176.1 fF	
Self-Resonance Frequency:	295.1 MHz (quarter wave)	
Gap between two Wires:	221.1 μ m	



QucsStudio Demo