



**Qucs**

# **Quite Universal Circuit Simulator**

## **Overview, Status and Roadmap**

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EDA Developer room

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# Qucs /kju:ks/

- Overview
  - Project background
  - Package contents
  - What can you do with?
  - Demo
- Status
  - Development
  - Next release
- Roadmap
  - Our wishes for the future

# Project background

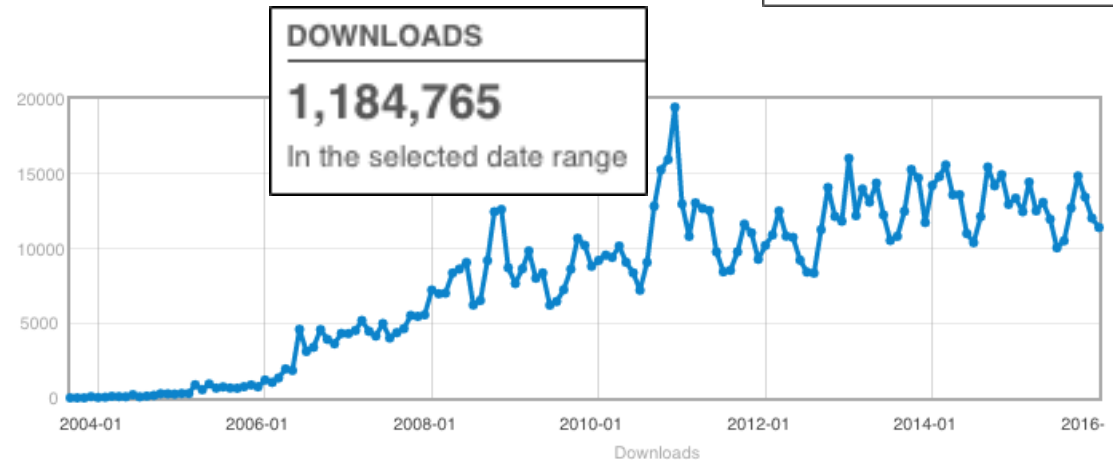


- Started in 2003
  - Michael Margraf
  - Stefan Jahn
- GPLv2+
- 20+ contributors
- 20 languages
- Cross-platform
- Users
  - Education
  - Research
  - Hobbyists
  - Industry

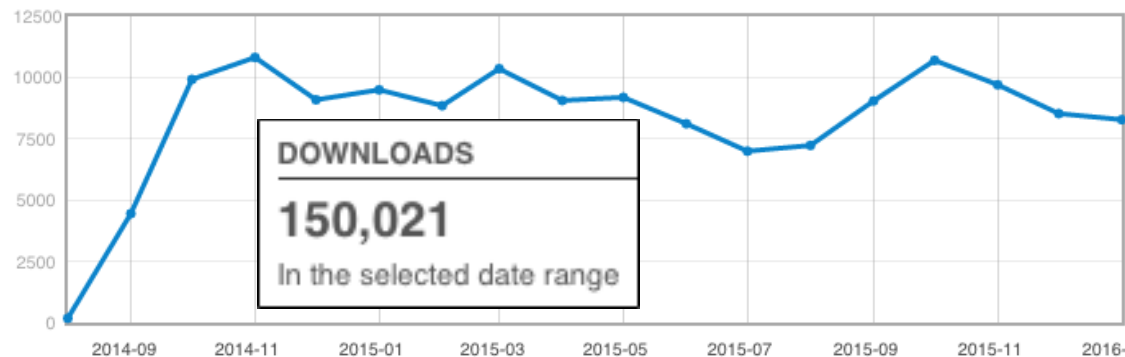
Web counter

**1300575**  
visitors since 2005/04/27

- 2003 ... 2016



- Qucs 0.0.18 - Windows





# Package contents

- (sort of an) IDE
- Schematic capture
- Simulation tools
  - Qucsator
  - Optimizer (ASCO)
  - Icarus-Verilog
  - FreeHDL
- Data visualization
- Equation system
- Component library
- Design / synthesis tools
- Extensible
  - Spice import
  - Verilog-A model builder
  - Octave/MATLAB
- Dependencies
  - C++ compiler
  - Qt4 (with Qt3Support)
  - Autotools / CMake
  - gperf / flex / bison
  - ADMS
  - LaTeX



# Support

- Website
  - <http://qucs.sourceforge.net>
- Current developers: ~ 6
- Documentation
  - Help
  - Tutorial Workbook
  - Report Workbook
  - Technical Manual
- SourceForge
  - Binaries
  - Git repository (mirror)
  - Issue tracker
  - Forum / mailing lists
- GitHub
  - Git repository (preferred)
  - Issue tracker
  - Wiki
  - Travis CI
  - AppVeyor
  - Coveralls



# Tools

- Graphical Interface
  - Qucs
  - ActiveFilter
  - Attenuator
  - Editor
  - Filter
  - Help
  - Matching
  - Library
  - Rescodes
  - Transcalc
- ~ 170 components
- Command Line
  - qucs
  - qucsator
  - qucsconv
- Third-party and scripts
  - asco
  - admsXml
  - iverilog
  - freehdl
  - ps2sp
  - octave
  - python



# Projects

Qucs 0.0.19 - Project: RLC\_step

RLC\_step\_tr.sch   RLC\_step\_tr.dpl

New   Open   Delete

- \_devel\_bsim6\_inverter\_transient\_p
- \_devel\_ngspice\_prj
- 555\_examples\_prj
- AC\_SW\_resonance\_prj
- asco\_optimize\_prj
- chaos\_prj
- DC\_AC\_active\_lp\_prj
- octave\_example\_prj
- RLC\_step\_prj**
- series\_rlc\_prj
- SP\_BFP405\_prj
- SP\_bpf\_10Ghz\_prj
- testset\_prj
- testset\_small\_prj
- total\_resistor\_prj
- TR\_boostconverter\_prj
- TR\_colpitts\_base\_prj
- TR\_diode\_hb\_prj
- TR\_gilbert\_prj
- TR\_multiplier\_prj
- va\_loader\_test\_prj
- verilog\_counter\_prj

S1 time=0.5 us

Pr1

R1 R=4 Ohm

L1 L=2 uH I=0

V1 U=13.5 V

C1 C=450 pF V=0

vt

transient simulation

TR1  
Type=lin  
Start=0  
Stop=3 us  
Points=1000

vt

time

no warnings 49 : 51



# Contents

Qucs 0.0.19 - Project: RLC\_step

Content of RLC\_step

- Others
- ▼ Datasets
  - RLC\_step\_tr.dat
- ▼ Data Displays
  - RLC\_step\_tr.dpl
- Octave
- Verilog
- Verilog-A
- VHDL
- ▼ Schematics
  - RLC\_step\_tr.sch

Projects

Content

Components

Libraries

RLC\_step\_tr.sch

RLC\_step\_tr.dpl

S1  
time=0.5 us

Pr1

R1  
R=4 Ohm

L1  
L=2 uH  
I=0

V1  
U=13.5 V

C1  
C=450 pF  
V=0

vt

transient simulation

TR1  
Type=lin  
Start=0  
Stop=3 us  
Points=1000

vt.Vt

time

no warnings 65 : 35



# Components



Qucs 0.0.19 - Project: RLC\_step

RLC\_step\_tr.sch RLC\_step\_tr.dpl

lumped components

- Resistor
- Resistor US
- Capacitor
- Inductor
- Ground
- Subcircuit Port
- Transformer
- symmetric Tran...

Search Components Clear

S1 time=0.5 us

Pr1

R1 R=4 Ohm

L1 L=2 uH I=0

V1 U=13.5 V

C1 C=450 pF V=0

vt

transient simulation

TR1  
Type=lin  
Start=0  
Stop=3 us  
Points=1000

vt.Vt

time

no warnings 66 : 145



# Libraries

Qucs 0.0.19 - Project: RLC\_step

Manage Libraries

Libraries

- System Libraries**
  - ▶ Bridges
  - ▶ Diodes
  - ▶ Ideal
  - ▶ JFETs
  - ▶ LEDs
  - ▶ MOSFETs
  - ▶ NMOSFETs
  - ▶ OpAmps
  - ▶ PMOSFETs
  - ▶ Regulators
  - ▶ Substrates
  - ▶ Transistors
  - ▶ Varistors
  - ▶ Z-Diodes
- User Libraries**
  - No User Libraries

RLC\_step\_tr.sch

vt

S1  
time=0.5 us

Pr1

R1  
R=4 Ohm

L1  
L=2 uH  
I=0

V1  
U=13.5 V

C1  
C=450 pF  
V=0

transient simulation

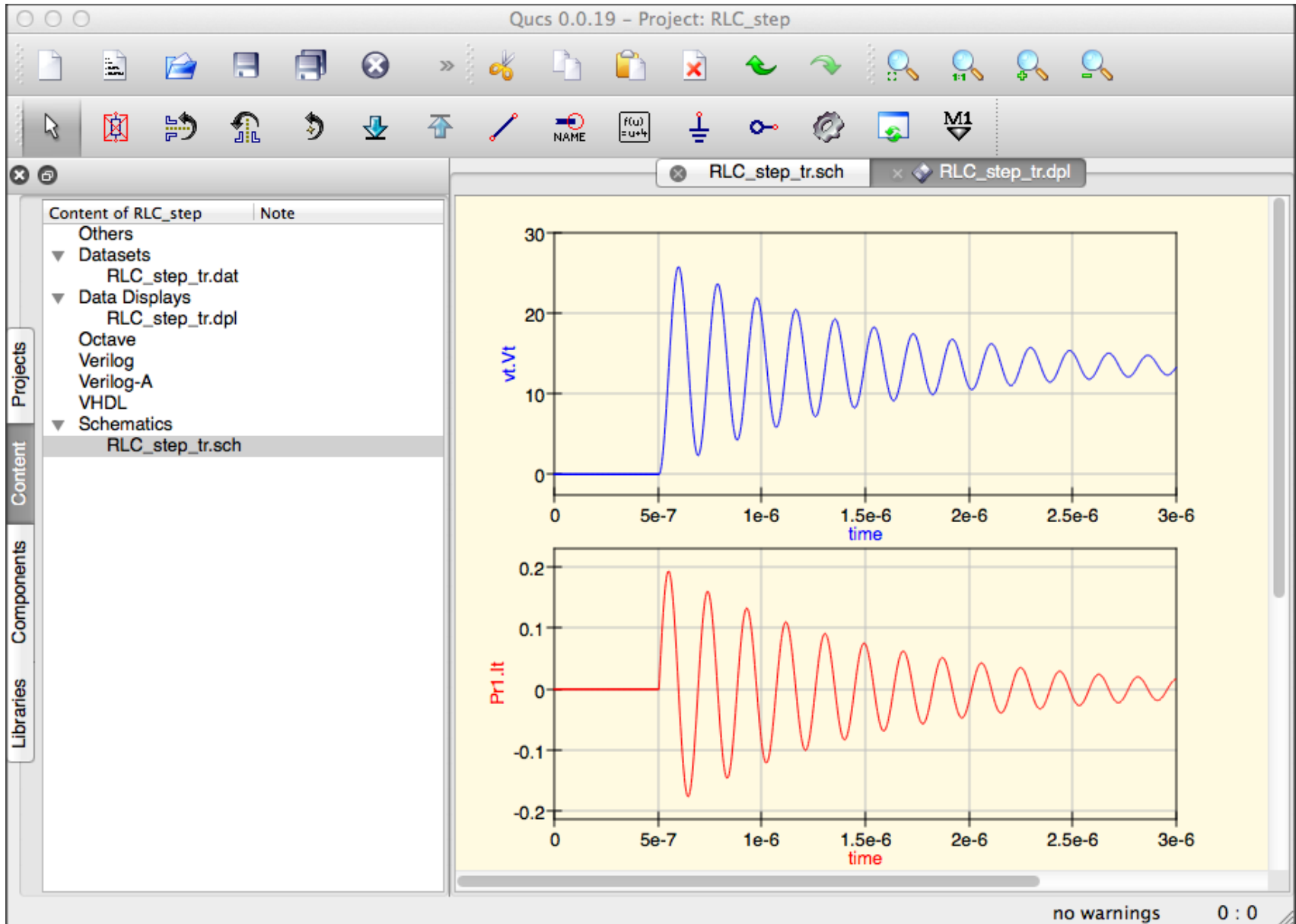
TR1  
Type=lin  
Start=0  
Stop=3 us  
Points=1000

vt.Vt

time

no warnings 52 : 78

# Visualization



# Qucs-ActiveFilter (1)



### Filter parameters

Passband attenuation, $A_p$ (dB)	3
Stopband attenuation, $A_s$ (dB)	20
Cutoff frequency, $F_c$ (Hz)	1000
Stopband frequency, $F_s$ (Hz)	1200
Passband ripple $R_p$ (dB)	3
Passband gain, $K_v$ (dB)	0
Filter order	5

### Transfer function and Topology

Approximation type:

Filter type:

Filter topology

### General filter amplitude-frequency response

The graph plots gain  $K$  (dB) against frequency  $F$  (Hz). It shows a passband with ripple  $R_p$  and a stopband with attenuation  $A_s$ . The cutoff frequency  $F_c$  and stopband frequency  $F_s$  are indicated on the x-axis.

### Filter topology preview

The circuit diagram shows a Sallen-Key active filter topology. It includes an input terminal, a voltage source  $V_1$ , capacitors  $C_1$  and  $C_2$ , resistors  $R_1$ ,  $R_2$ ,  $R_3$ , and  $R_4$ , and an operational amplifier  $OP_1$ . The output is labeled "output".

### Filter calculation console

Filter order = 14

Poles list  $P_k = Re + j*Im$

- 0.111964 + j\*0.993712
- 0.330279 + j\*0.943883
- 0.532032 + j\*0.846724
- 0.707107 + j\*0.707107
- 0.846724 + j\*0.532032
- 0.943883 + j\*0.330279
- 0.993712 + j\*0.111964
- 0.993712 + j\*-0.111964



# Qucs-ActiveFilter (2)

### Filter parameters

Passband attenuation, $A_p$ (dB)	3
Stopband attenuation, $A_s$ (dB)	20
Cutoff frequency, $F_c$ (Hz)	1000
Stopband frequency, $F_s$ (Hz)	1200
Passband ripple $R_p$ (dB)	3
Passband gain, $K_v$ (dB)	0
Filter order	5

### Transfer function and Topology

Approximation type:

Filter type:

Filter topology

### General filter amplitude-frequency response

The graph shows the magnitude response of the filter. The passband is flat with a ripple of  $R_p$  dB. The cutoff frequency  $F_c$  is where the magnitude is  $-A_p$  dB. The stopband frequency  $F_s$  is where the magnitude is  $-A_s$  dB. The gain  $K$  is 0 dB.

### Filter topology preview

### Filter calculation console

Filter order = 14

Poles list  $P_k = Re + j*Im$

- 0.111964 + j\*0.993712
- 0.330279 + j\*0.943883
- 0.532032 + j\*0.846724
- 0.707107 + j\*0.707107
- 0.846724 + j\*0.532032
- 0.943883 + j\*0.330279
- 0.993712 + j\*0.111964
- 0.993712 + j\*-0.111964

# Qucs-ActiveFilter (3)



### Filter parameters

Transient bandwidth, TW (Hz)	3
Stopband attenuation, As (dB)	20
Upper cutoff frequency, Fu (Hz)	1000
Lower cutoff frequency, Fl (Hz)	1200
Passband ripple Rp(dB)	3
Passband gain, Kv (dB)	0
Filter order	5

### Transfer function and Topology

Approximation type: **Butterworth**

Manually define transfer function

Filter type: **Band Stop**

Filter topology: **Cauer section**

Calculate and copy to clipboard

### General filter amplitude-frequency response

The graph shows a band-stop filter response. The y-axis is labeled 'K (dB)' and the x-axis is 'F (Hz)'. The response has a passband with ripple  $R_p$  and a stopband with attenuation  $A_s$ . The transient bandwidth is  $TW$ . The lower and upper cutoff frequencies are  $F_l$  and  $F_u$  respectively.

### Filter topology preview

The circuit diagram shows a 5th-order Cauer section active band-stop filter. It consists of three operational amplifiers (OP1, OP2, OP3), seven resistors (R1-R7), and two capacitors (C1, C2). The input is connected to OP1 through resistor R1. OP1 is configured as an inverting amplifier with feedback capacitor C1. The output of OP1 is connected to OP2 through resistor R2. OP2 is configured as an inverting amplifier with feedback resistor R4. The output of OP2 is connected to OP3 through resistor R3. OP3 is configured as an inverting amplifier with feedback resistor R7. The output of OP3 is connected to the final output through resistor R6. The input is also connected to OP2 through resistor R5.

### Filter calculation console

Filter order = 14

Poles list  $P_k = Re + j*Im$

- 0.111964 + j\*0.993712
- 0.330279 + j\*0.943883
- 0.532032 + j\*0.846724
- 0.707107 + j\*0.707107
- 0.846724 + j\*0.532032
- 0.943883 + j\*0.330279
- 0.993712 + j\*0.111964
- 0.993712 + j\*-0.111964

# Qucs-ActiveFilter (4)



### Filter parameters

Transient bandwidth, TW (Hz)	3
Stopband attenuation, As (dB)	20
Upper cutoff frequency, Fu (Hz)	1000
Lower cutoff frequency, Fl (Hz)	1200
Passband ripple Rp(dB)	3
Passband gain, Kv (dB)	0
Filter order	5

### Transfer function and Topology

Approximation type:

Filter type:

Filter topology:

### General filter amplitude-frequency response

The graph plots gain K (dB) against frequency F (Hz). It shows a passband with ripple Rp between lower cutoff frequency Fl and upper cutoff frequency Fu. The transient bandwidth TW is indicated between Fl and Fu. Stopband attenuation As is shown in the regions below Fl and above Fu.

### Filter topology preview

The circuit diagram shows an operational amplifier (OP1) configured as a Sallen-Key active filter. The input signal 'in' passes through resistor R1 to a network of capacitors C1 and C2, and resistors R2 and R3. Resistor R4 is connected to the non-inverting input of OP1. Resistor R5 is connected to the inverting input of OP1. Resistor R2 is connected between the output of OP1 and the node between C2 and R3. The output 'out' is taken from the output of OP1.

### Filter calculation console

Filter order = 14

Poles list  $P_k = Re + j*Im$

- 0.111964 + j\*0.993712
- 0.330279 + j\*0.943883
- 0.532032 + j\*0.846724
- 0.707107 + j\*0.707107
- 0.846724 + j\*0.532032
- 0.943883 + j\*0.330279
- 0.993712 + j\*0.111964
- 0.993712 + j\*-0.111964

# Qucs-Attenuator (1)



Qucs Attenuator 0.0.19

Topology

Tee

Input

Attenuation: 1 dB

Zin: 50 Ohm

Zout: 50 Ohm

Calculate and put into Clipboard

Output

R1: -- Ohm

R2: -- Ohm

R3: -- Ohm

Result:



# Qucs-Attenuator (2)



Qucs Attenuator 0.0.19

Topology

Pi

Input

Attenuation: 1 dB

Zin: 50 Ohm

Zout: 50 Ohm

Calculate and put into Clipboard

Output

R1: -- Ohm

R2: -- Ohm

R3: -- Ohm

Result:

# Qucs-Attenuator (3)



Qucs Attenuator 0.0.19

Topology

Bridged Tee

Input

Attenuation:  dB

Zin:  Ohm

Zout:  Ohm

Calculate and put into Clipboard

Output

R1:  Ohm

R4:  Ohm

Result:



# Qucs-Help

**Getting Started with Digital Simulations**

Qucs is also a graphical user interface for performing digital simulations. This document should give you a short description on how to use it.

For digital simulations Qucs uses the FreeHDL program (<http://www.freehdl.seul.org>). So the FreeHDL package as well as the GNU C++ compiler must be installed on the computer.

There is no big difference in running an analog or a digital simulation. So having read the [Getting Started for analog simulations](#), it is now easy to get a digital simulation work. Let us compute the truth table of a simple logical AND cell. Select the digital components in the combobox of the components tab on the left-hand side and build the circuit shown in figure 1. The digital simulation block can be found among the other simulation blocks. The digital sources S1 and S2 are the inputs, the node labeled as *Output* is the output. After performing the simulation, the data display page opens. Place the diagram *truth table* on it and insert the variable *Output*. Now the truth table of a two-port AND cell is shown. Congratulations, the first digital simulation is done!

**Qucs 0.0.8 - Project: Examples**

File Edit Insert Project Tools Simulation View Help

Content Components and.sch

digital components

digital source Inverter

n-port OR n-port NOR

digital simulation

Dig1  
.Type=TruthTable

S1  
Num=1

S2  
Num=2

Output

Y1



# Qucs-Matching

Create Matching Circuit

calculate two-port matching

Reference Impedance

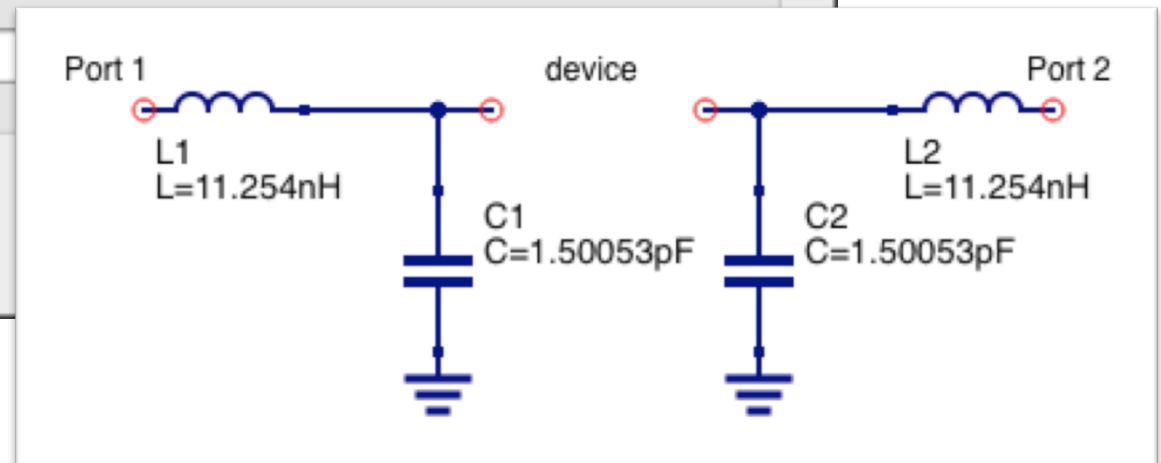
Port 1  ohms      Port 2  ohms

S Parameter

Input format

S11	<input type="text" value="0.5"/>	+j	<input type="text" value="0"/>	S12	<input type="text" value="0"/>	+j	<input type="text" value="0"/>
S21	<input type="text" value="0.5"/>	+j	<input type="text" value="0"/>	S22	<input type="text" value="0.5"/>	+j	<input type="text" value="0"/>

Frequency:



Paste into schematic→

# Qucs-Lib (1)



The screenshot shows the Qucs Library Tool 0.0.19 interface. It is divided into two main sections: "Component Selection" on the left and "Component" details on the right.

**Component Selection:** A dropdown menu is set to "Diodes". Below it is a list of diode models: 1N4148, 1N4148W, 1N4148WS, 1N4148WT, 1N4001, 1N4002, 1N4003, 1N4004, 1N4005, 1N4006, 1N4007, 1N5400, 1N5401, 1N5402, and 1N5404. A "Search..." button is located at the bottom of this section.

**Component Details:** The selected component is "1N4148" from the "Diodes" library. The description reads: "universal silicon switching diode 75V, 300mA, 4.0ns" with the manufacturer listed as "Diodes Inc.". Below the text is the diode symbol, which consists of a triangle pointing left towards a vertical line, with a horizontal line extending from the triangle's vertex. The symbol is flanked by two red circles representing connection points. Below the symbol is the text "! Drag n'Drop me !".

At the bottom of the "Component" section are two buttons: "Copy to clipboard" and "Show Model".

An orange callout box with the text "Paste into schematic →" is positioned over the right side of the component details section.

# Qucs-Lib (2)



Qucs Library Tool 0.0.19

**Component Selection**

OpAmps

- uA741
- op27(mod)
- op27(boyle)
- ua741(mod)
- ua741(boyle)
- ua741(TI)
- opa27(TI)
- tl081(TI)
- tl071(TI)
- OP07(TI)
- OP37(TI)
- mc1458(TI)
- AD825
- LM3886

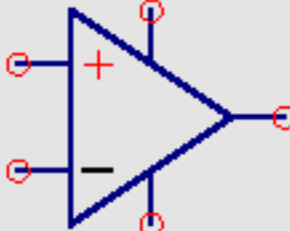
Search...

**Component**

Name: uA741  
Library: OpAmps

-----  
universal BJT operational amplifier  
Manufacturer: ???

Symbol:



! Drag n'Drop me !

Paste into schematic →

Copy to clipboard    Show Model

# Qucs-Lib (3)



Qucs Library Tool 0.0.19

**Component Selection**

Transistors

- 2DA1774R
- 2DC4617R
- 2N2219A
- 2N2222
- 2N2222A
- 2N2369A
- 2N2484
- 2N2905A
- 2N2907
- 2N2907A
- 2N2955
- 2N3019
- 2N3053
- 2N3055
- 2N3300

Search...

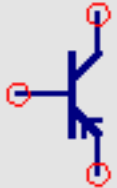
**Component**

Name: 2DA1774R  
Library: Transistors

---

universal silicon PNP BJT  
50V, 150mA, 150mW, 140MHz  
Manufacturer: Diodes Inc.  
NPN complement: 2DC4617R  
added by Leandro D'Archivio <morti667@hotmail.>

Symbol:

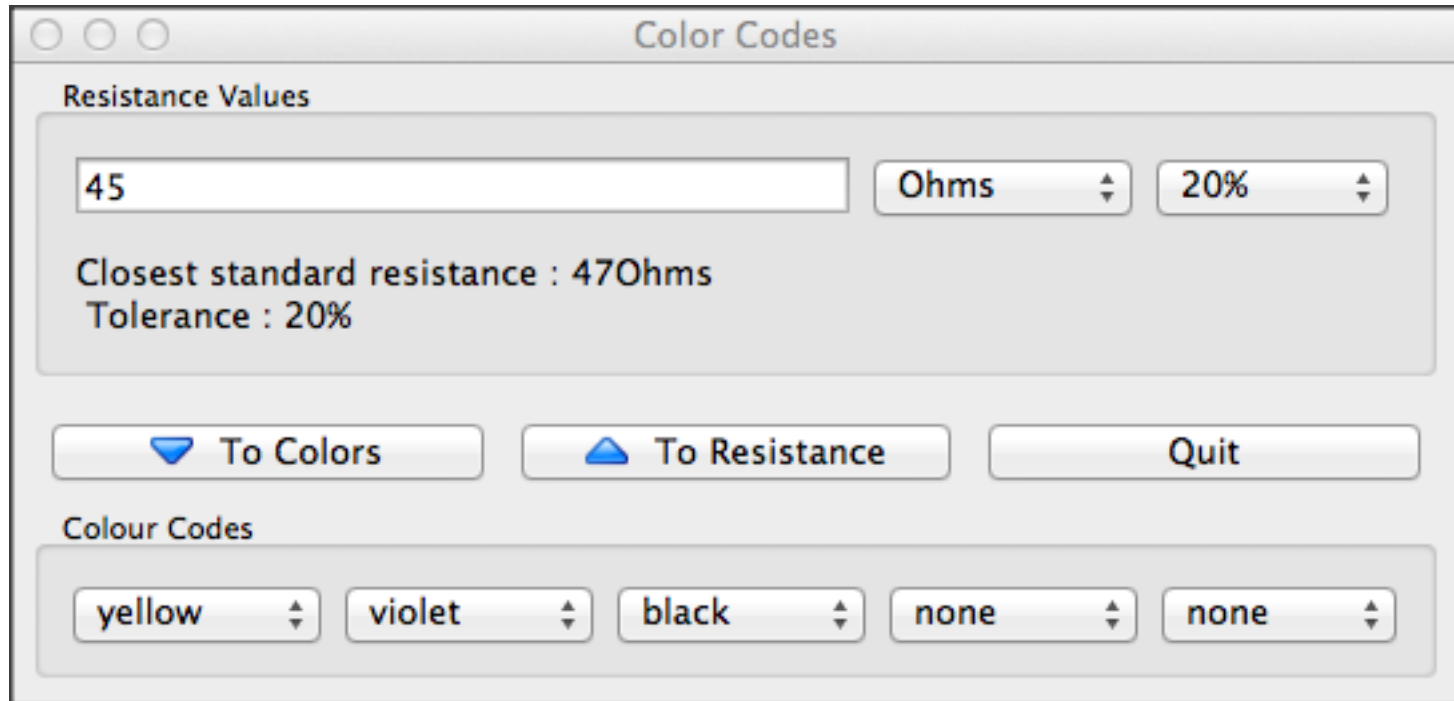


! Drag n'Drop me !

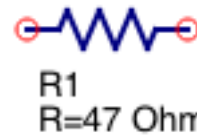
Paste into schematic →

Copy to clipboard    Show Model

# Qucs-Rescodes



Paste into schematic→



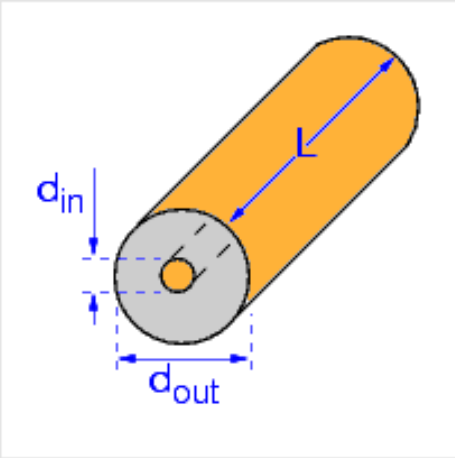


# Qucs-Transcalc (1)



Qucs Transcalc 0.0.19

**Transmission Line Type**  
Coaxial Line



**Substrate Parameters**

Er	2.1	NA
Mur	1	NA
Tand	0.002	NA
Sigma	4.1e+07	NA
	0	NA
	0	NA
	0	NA
	0	NA
	0	NA

**Physical Parameters**

din	40	mil
dout	134	mil
L	1000	mil
	0	NA

Analyze Synthesize

**Electrical Parameters**

Z0	50.0211	Ohm
Ang_l	442.003	Deg
	0	NA

**Component Parameters**

Freq 10 GHz

**Calculated Results**

Conductor Losses: 0.027839 dB  
Dielectric Losses: 0.0670065 dB  
TE-Modes: none  
TM-Modes: none

Ready.

# Qucs-Transcalc (2)



Qucs Transcalc 0.0.19

Transmission Line Type: Coaxial Line

Substrate Parameters:

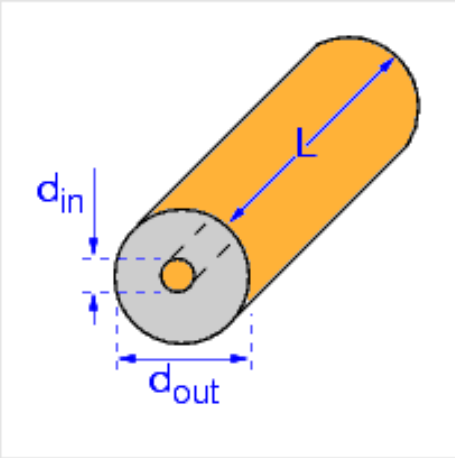
Er	2.1	NA
Mur	1	NA
Tand	0.002	NA
Sigma	4.1e+07	NA

Physical Parameters:

din	40	mil
dout	134	mil
L	1000	mil
	0	NA

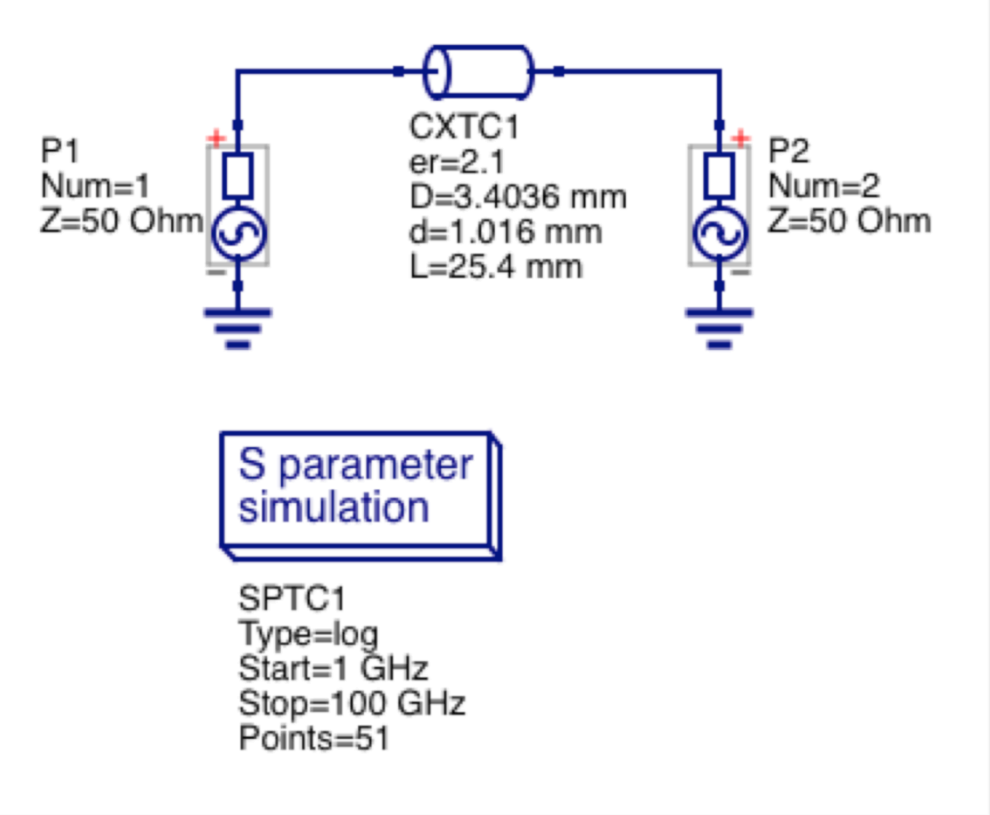
Ready.

Paste into schematic →



S parameter simulation

SPTC1  
Type=log  
Start=1 GHz  
Stop=100 GHz  
Points=51



# Qucs-Transcalc (3)

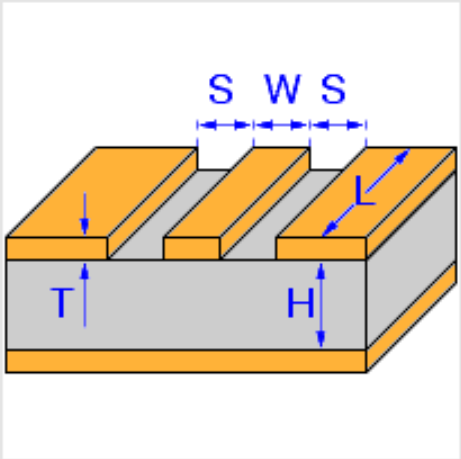


Qucs Transcalc 0.0.19

Transmission Line Type: Grounded Coplanar

Substrate Parameters:  
Er: 2.94 NA  
H: 10 mil  
T: 0.1 mil

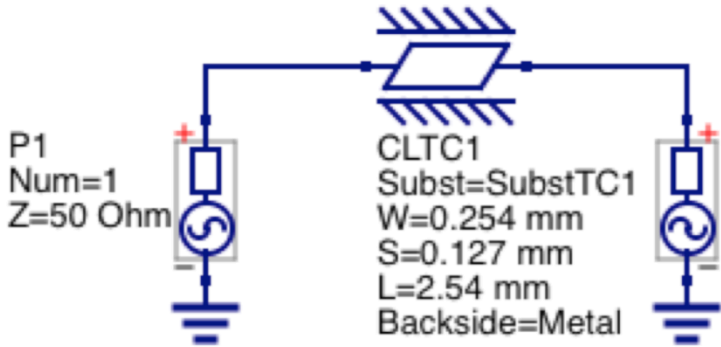
Physical Parameters:  
W: 10 mil  
S: 5 mil  
L: 100 mil



P1 Num=1 Z=50 Ohm

CLTC1  
Subst=SubstTC1  
W=0.254 mm  
S=0.127 mm  
L=2.54 mm  
Backside=Metal

P2 Num=2 Z=50 Ohm



SubstTC1  
er=2.94  
h=0.254 mm  
t=2.54 um  
tand=0  
rho=2.43902e-08  
D=0

S parameter simulation

Equation  
EqnTC1  
A=twoport(S,'S','A')  
ZL=real(sqrt(A[1,2]/A[2,1]))

SPTC1  
Type=log  
Start=0.1 GHz  
Stop=10 GHz  
Points=51

Paste into schematic →

Ready.

# Qucs-Transcalc (4)

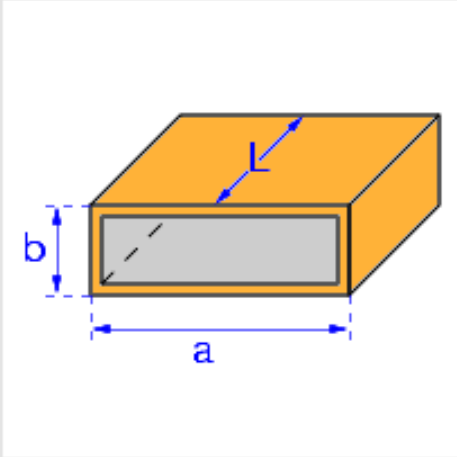


Qucs Transcalc 0.0.19

Transmission Line Type: Rectangular Waveguide

Substrate Parameters:  
Er: 1 NA  
Mur: 1 NA  
Cond: 4.1e+07 NA  
Tand: 0 NA

Physical Parameters:  
a: 1000 mil  
b: 500 mil  
L: 4000 mil



Paste into schematic →

Ready.

S parameter simulation

Equation

EqnTC2  
A=twoport(S,'S','A')  
ZL=real(sqrt(A[1,2]/A[2,1]))

SPTC2  
Type=log  
Start=1 GHz  
Stop=100 GHz  
Points=51

P3 Num=3 Z=50 Ohm

RLTC1 a=25.4 mm b=12.7 mm L=101.6 mm

P4 Num=4 Z=50 Ohm

# Qucs-Transcalc (5)



Qucs Transcalc 0.0.19

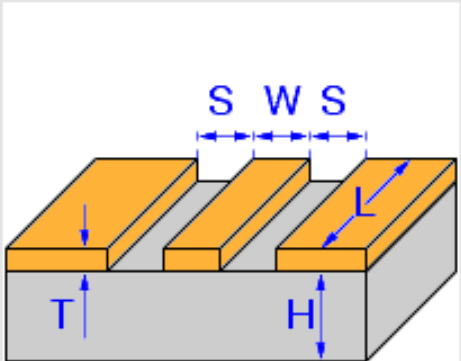
Transmission Line Type: Coplanar Waveguide

Substrate Parameters:

Er	2.94	NA
H	10	mil
T	0.1	mil

Physical Parameters:


W	10	mil
S	5	mil
L	100	mil



P1 Num=1 Z=50 Ohm

CLTC1  
Subst=SubstTC1  
W=0.254 mm  
S=0.127 mm  
L=2.54 mm  
Backside=Air

P2 Num=2 Z=50 Ohm



SubstTC1  
er=2.94  
h=0.254 mm  
t=2.54 um  
tand=0  
rho=2.43902e-08  
D=0

S parameter simulation

Equation

EqnTC1  
A=twoport(S, 'S', 'A')  
ZL=real(sqrt(A[1,2]/A[2,1]))

SPTC1  
Type=log  
Start=0.1 GHz  
Stop=10 GHz  
Points=51

Paste into schematic →

Ready.

# Qucs-Transcalc (6)



Qucs Transcalc 0.0.19

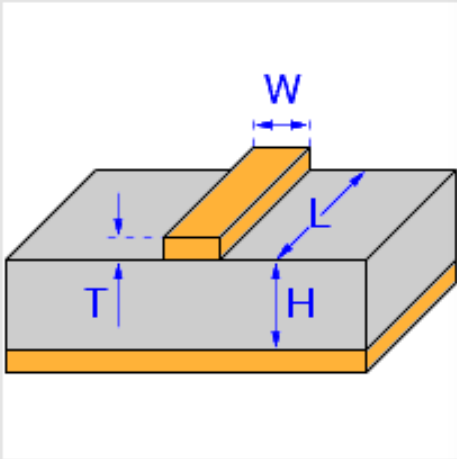
Transmission Line Type: Microstrip Line

Substrate Parameters:

Er	2.94	NA
Mur	1	NA
H	10	mil
H_t	1e+20	mil

Physical Parameters:

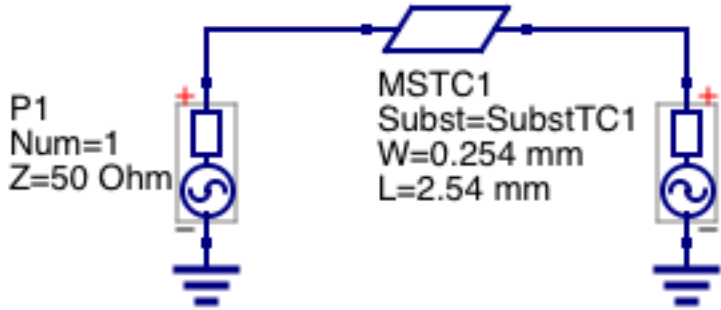
W	9.99999	mil
L	99.9999	mil
	0	NA
	0	NA



P1 Num=1 Z=50 Ohm

MSTC1 Subst=SubstTC1 W=0.254 mm L=2.54 mm

P2 Num=2 Z=50 Ohm



SubstTC1 er=2.94 h=0.254 mm t=2.54 um tand=0 rho=2.43902e-08 D=0

S parameter simulation

Equation

EqnTC1 A=twoport(S,'S','A') ZL=real(sqrt(A[1,2]/A[2,1]))

SPTC1 Type=log Start=0.1 GHz Stop=10 GHz Points=51

Paste into schematic →

Ready.

# Qucs-Transcalc

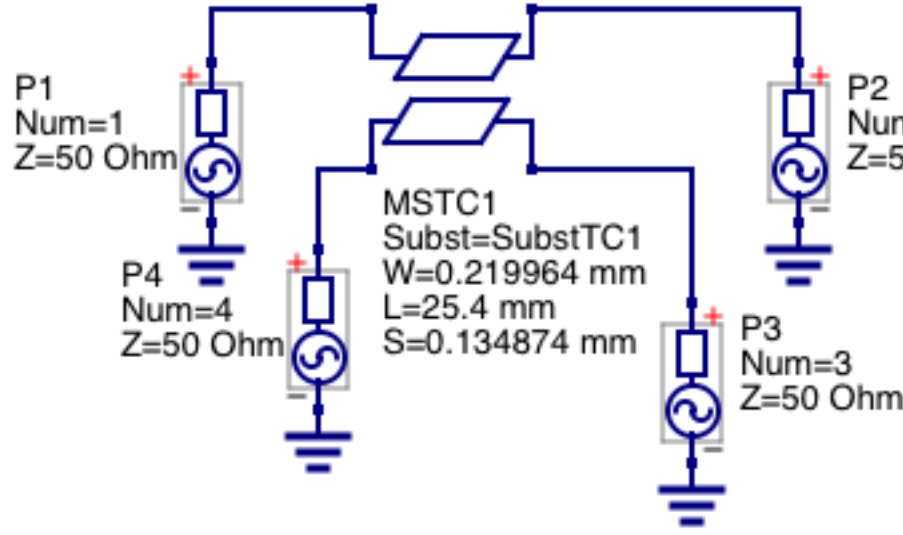
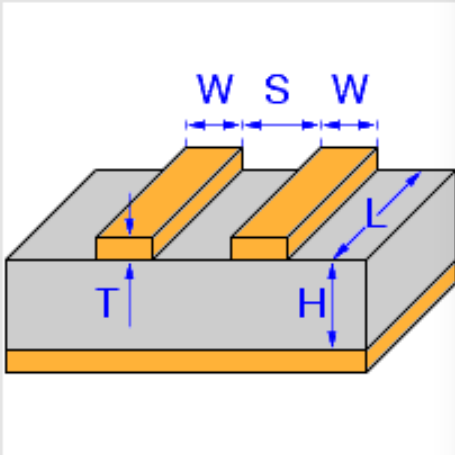


Qucs Transcalc 0.0.19

Transmission Line Type: Coupled Microstrip

Substrate Parameters:  $\epsilon_r=4.3$ ,  $h=0.210058$  mm,  $t=17.272$   $\mu$ m,  $\rho=2.43902e-08$ ,  $D=0$

Physical Parameters:  $W=0.219964$  mm,  $L=25.4$  mm,  $S=0.134874$  mm



**S parameter simulation**

SPTC1  
Type=log  
Start=1 GHz  
Stop=100 GHz  
Points=51

SubstTC1  
 $\epsilon_r=4.3$   
 $h=0.210058$  mm  
 $t=17.272$   $\mu$ m  
 $\rho=2.43902e-08$   
 $D=0$

P1 Num=1 Z=50 Ohm  
P2 Num=2 Z=50 Ohm  
P3 Num=3 Z=50 Ohm  
P4 Num=4 Z=50 Ohm

MSTC1  
Subst=SubstTC1  
W=0.219964 mm  
L=25.4 mm  
S=0.134874 mm

Paste into schematic →

Ready.

# Qucs-Filter



Qucs Filter 0.0.19

**Filter**

Realization:  LC ladder (pi type)  LC ladder (tee type)  C-coupled transmission lines  Microstrip end-coupled  Coupled transmission lines  Coupled microstrip  Stepped-impedance  Stepped-impedance microstrip  Equation-defined

Filter type:

Filter class:

Order:

Corner frequency:  GHz

Stop frequency:  GHz

Stop band frequency:  GHz

Pass band ripple:  1 dB

Stop band attenuation:  20 dB

Impedance:  50 Ohm

**Microstrip Substrate**

Relative permittivity:  9.8

Substrate height:  1.0 mm

metal thickness:  12.5 um

minimum width:  0.4 mm

maximum width:  5.0 mm

Calculate and put into Clipboard

Result: --

Paste into schematic →





# Command Line Tools

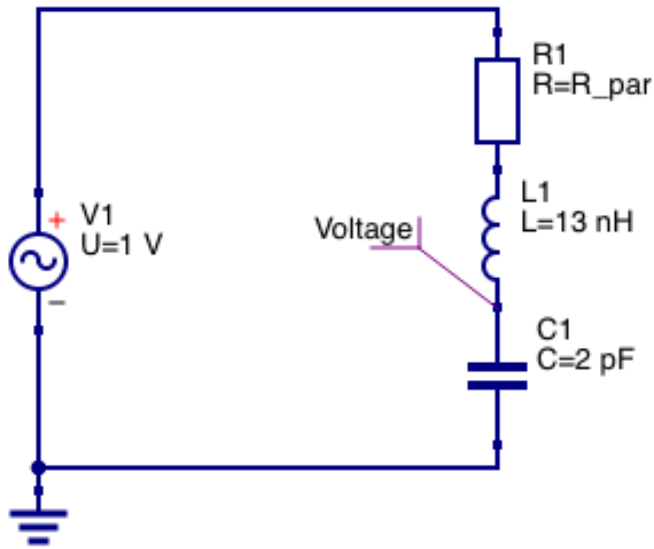
- Qucs – schematic
  - schematic to netlist
  - schematic to print
  - dump components data
- Qucsator – simulator
  - DC
  - Transient
  - AC
  - AC Noise
  - S-Parameter
  - S-Parameter Noise
  - (Harmonic Balance)
- Qucsconv - converter
  - spice - qucs
  - spice - qucslib
  - vcd - qucsdata
  - qucsdata - csv
  - qucsdata - touchstone
  - citi - qucsdata
  - touchstone - qucsdata
  - csv - qucsdata
  - zvr - qucsdata
  - mdl - qucsdata
  - qucsdata - matlab
- Custom file formats
  - schematic
  - library
  - netlist
  - data file



# Demo

- Examples
  - RLC circuit, parameter sweep
  - 555 timer: macro modeling
  - Optimization: Band-pass filter
  - 10 GHz microstrip band-pass filter
  - Verilog counter
- Development
  - Verilog-A support / model builder
  - Ngspice / Xyce front-end

# RLC, parameter sweep



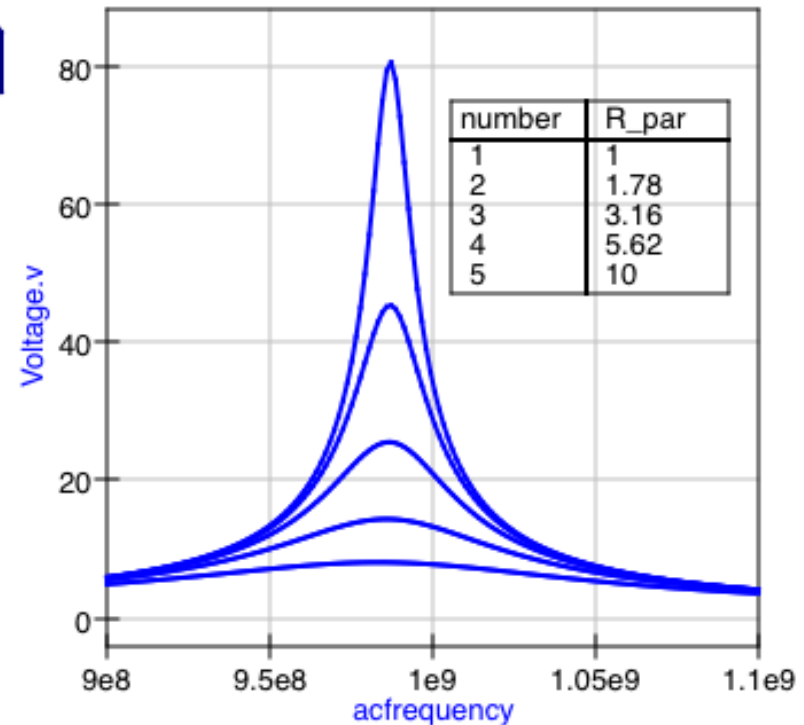
The voltage overshoot strongly depends on the quality of the resonance circuit.

## ac simulation

AC1  
Type=lin  
Start=0.9 GHz  
Stop=1.1 GHz  
Points=150

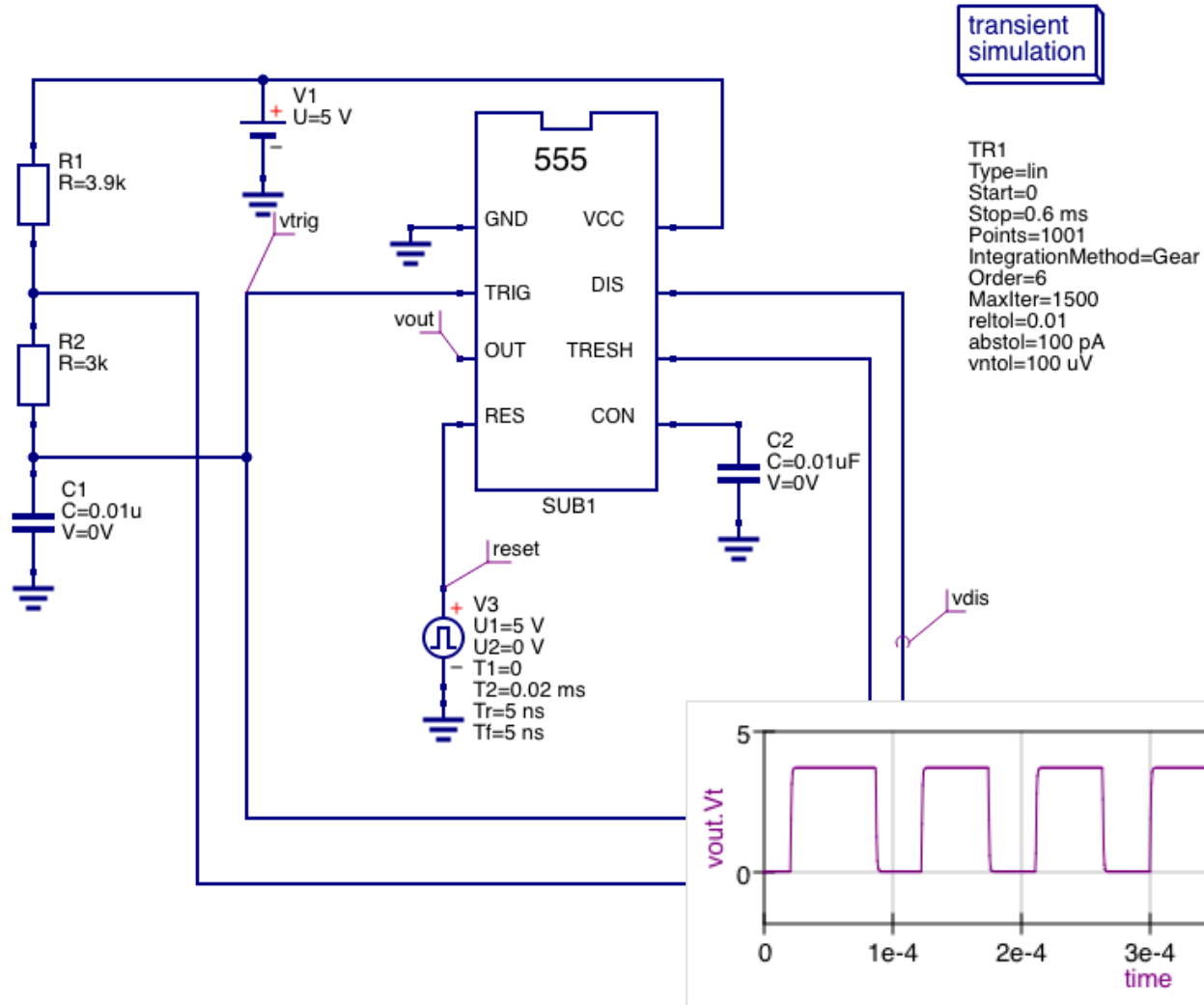
## Parameter sweep

SW1  
Sim=AC1  
Type=log  
Param=R\_par  
Start=1 Ohm  
Stop=10 Ohm  
Points=5

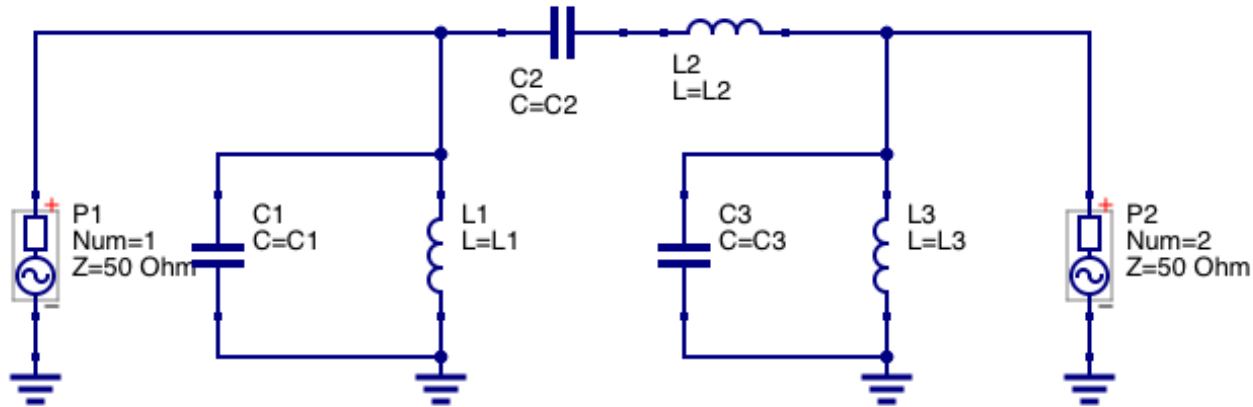




# 555 macro model



# Optimization (ASCO)

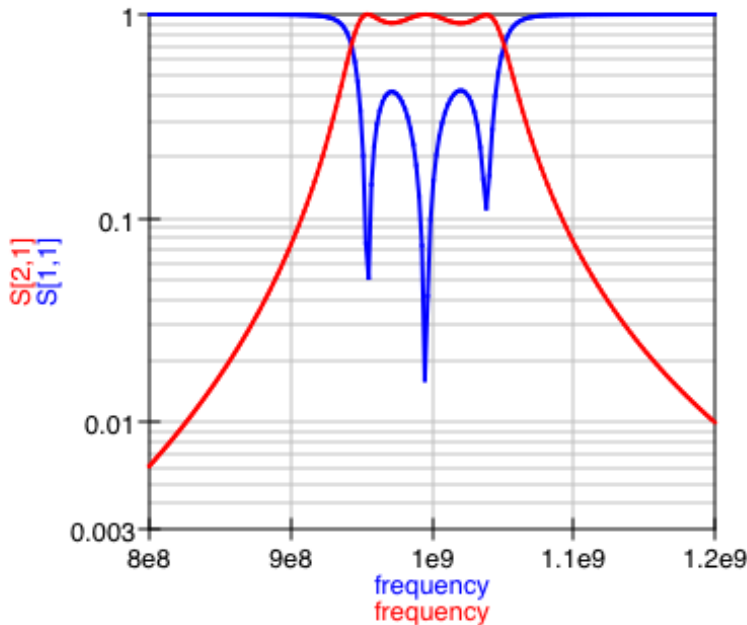


S parameter simulation

SP1  
Type=log  
Start=800 MHz  
Stop=1200 MHz  
Points=200

Optimization

Opt1



Equation

Eqn1  
Left\_Side\_Lobe=max(dB(S[2,1]),800e6:900e6)  
Pass\_Band\_Ripple=min(dB(S[2,1]),960e6:1040e6)  
Right\_Side\_Lobe=max(dB(S[2,1]),1100e6:1200e6)  
S11\_In\_Band=-max(dB(S[1,1]),960e6:1040e6)

number	Left_Side_Lobe	Pass_Band_Ripple	Right_Side_Lobe	S11_In_Band
1	-23.1	-0.856	-22.7	7.47

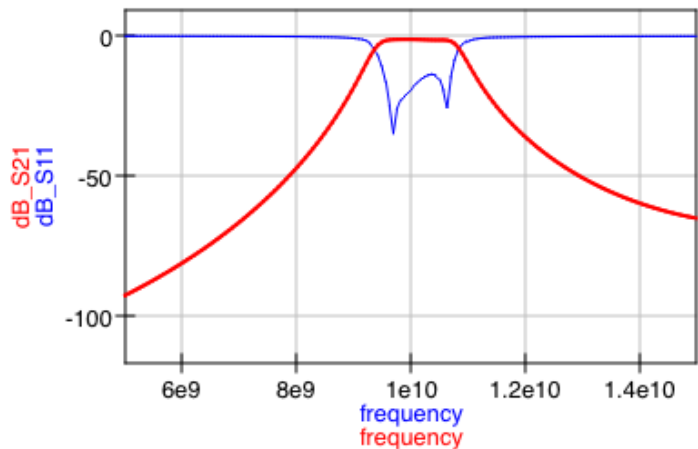
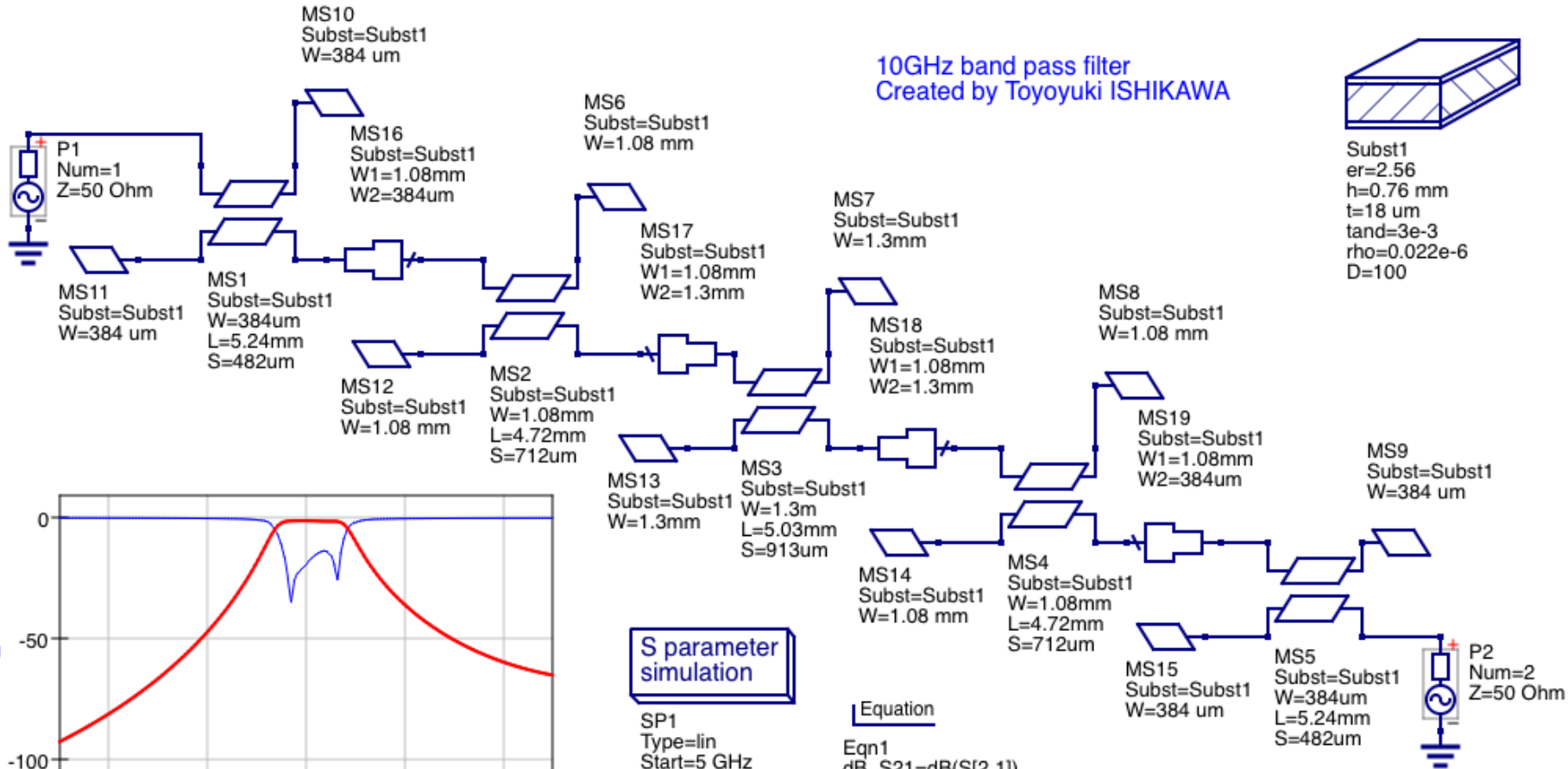


# Microstrip band-pass filter

10GHz band pass filter  
Created by Toyoyuki ISHIKAWA



Subst1  
er=2.56  
h=0.76 mm  
t=18 um  
tand=3e-3  
rho=0.022e-6  
D=100



S parameter simulation

SP1  
Type=lin  
Start=5 GHz  
Stop=15 GHz  
Points=150

Equation

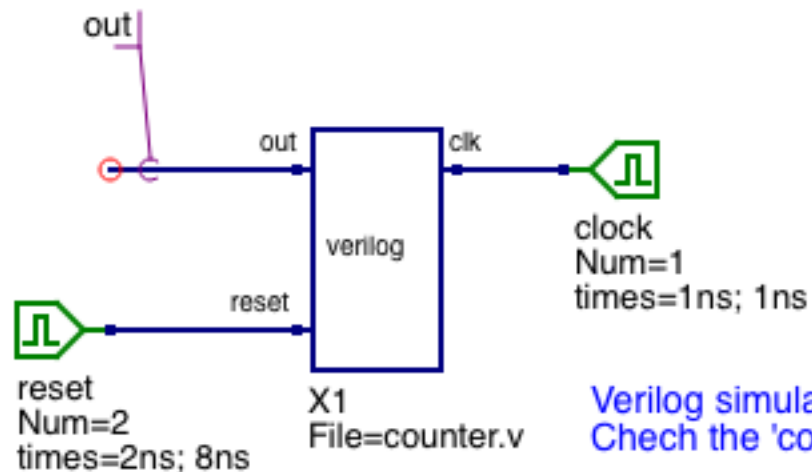
Eqn1  
dB\_S21=dB(S[2,1])  
dB\_S11=dB(S[1,1])



# Verilog Counter

digital simulation

Digi1  
Type=TimeList  
time=10 ns



```
module counter(out, clk, reset);  
  
    parameter WIDTH = 2;  
  
    output [WIDTH-1 : 0] out;  
    input                clk, reset;  
  
    reg [WIDTH-1 : 0]    out;  
    wire                clk, reset;  
  
    always @(posedge clk)  
        out <= out + 1;  
  
    always @reset  
        if (reset)  
            assign out = 0;  
        else  
            deassign out;  
  
endmodule // counter
```

Verilog simulation with Icarus Verilog  
Check the 'counter.v' for the HDL model.

dtime	0	1n	2n	3n	4n	5n	6n	7n	8n	9n	10n
X1.reset.X	0	1	0	0	0	0	0	0	0	0	1
X1.clk.X	0	1	0	1	0	1	0	1	0	1	0
X1.out.X	00	00	00	01	01	10	10	11	11	00	00



# Verilog-A

- Includes ~~53~~ 38 models written in Verilog-A
- Compact models
  - ~~BSIM 3, 4, 6 (Berkeley)~~
  - EKV (EPFL)
  - ~~HIGUM L0, L2 (TU-Dresden)~~
  - ~~FBH-HBT (TU-Berlin)~~
- ADMS (Automatic Device Model Synthesizer)
  - Verilog-A → XML transformations → “XYZ code”
- Limitations
  - Subset of Verilog-AMS
  - Not supported:  $V(n) < + \dots ;$

CMC  
license issues

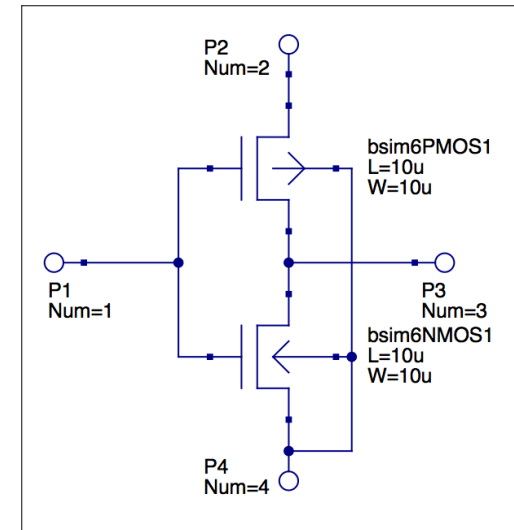
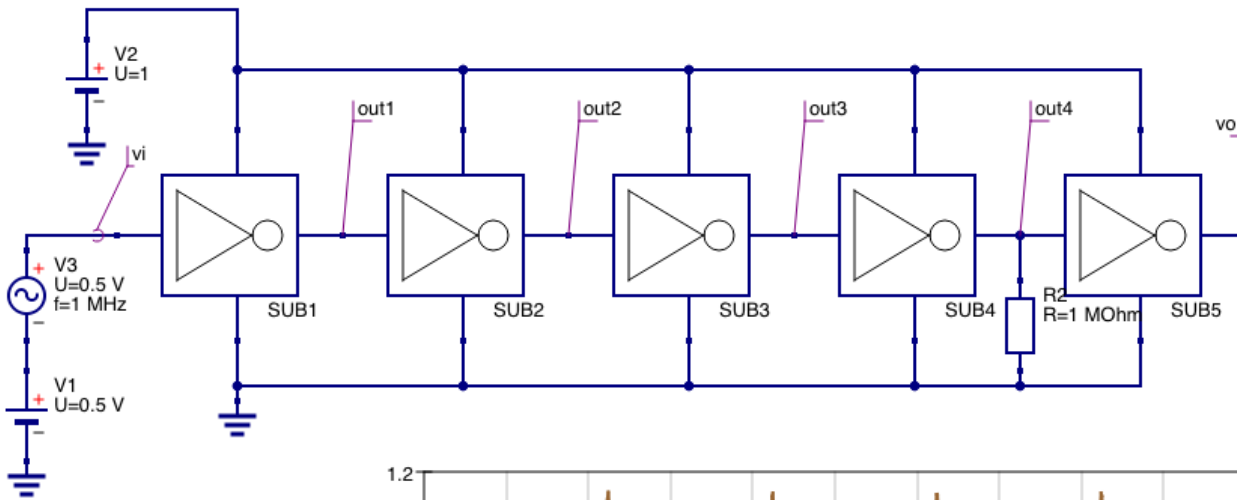
Accellera  
license issue





# Verilog-A model builder

- BSIM6: Qucsator x HSPICE

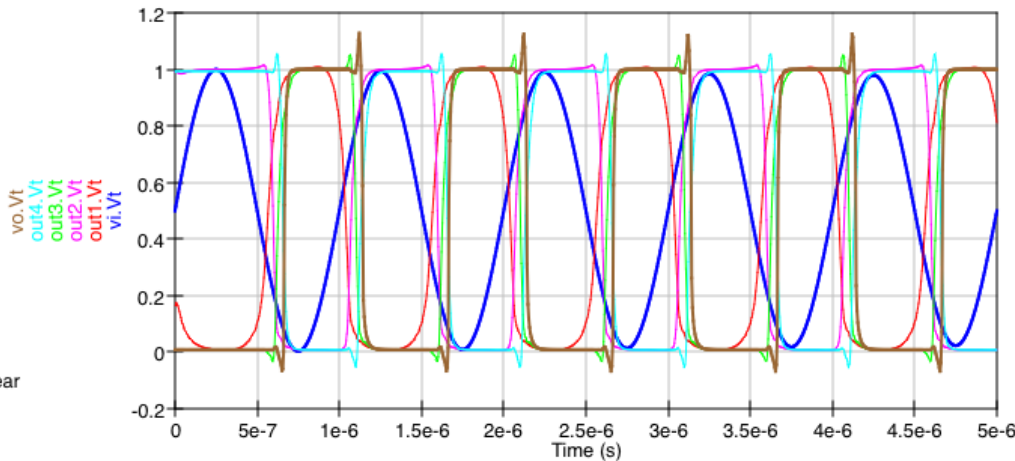


dc simulation

DC1

transient simulation

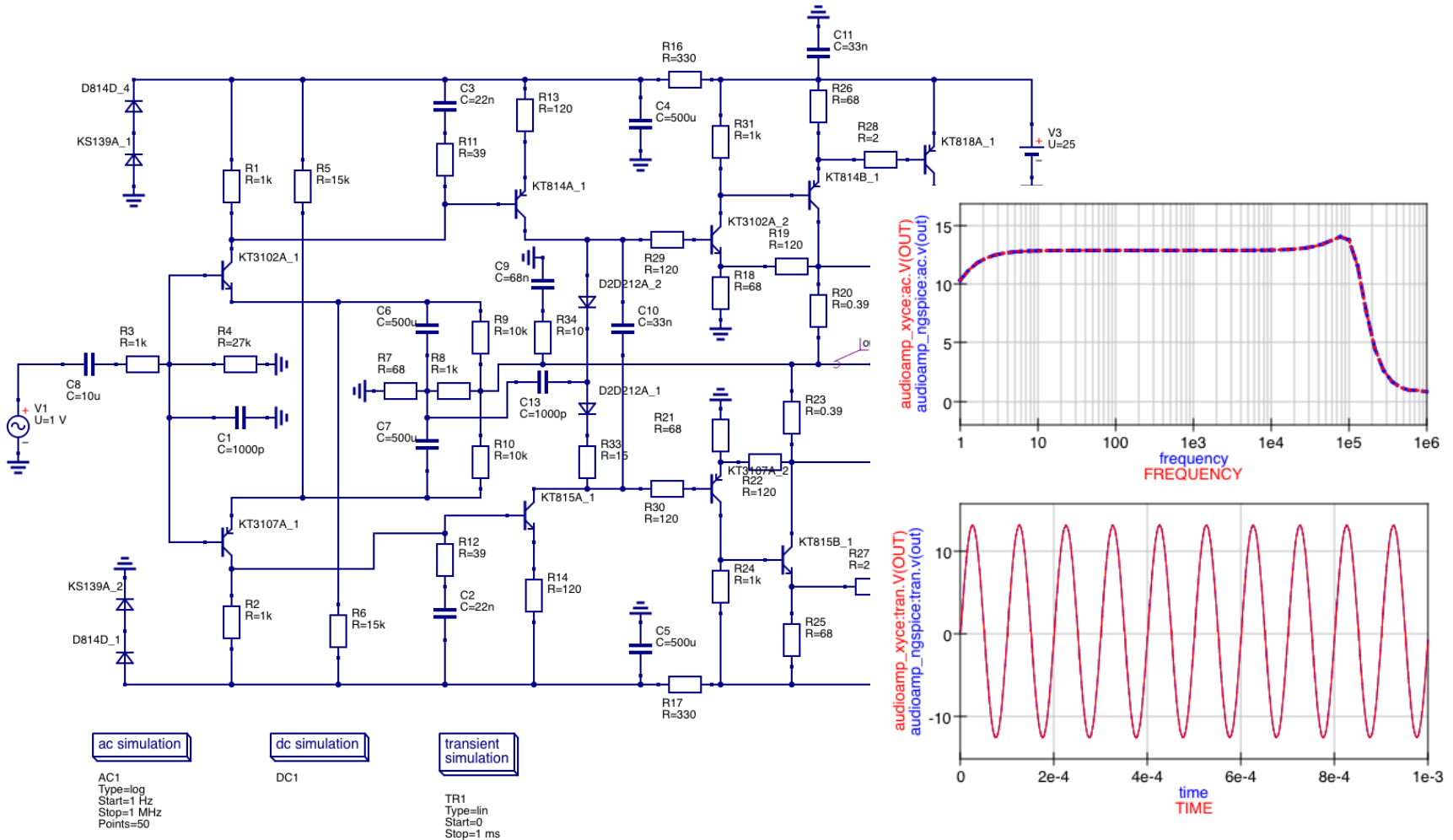
TR1  
Type=lin  
Start=0  
Stop=5 us  
Points=1000  
IntegrationMethod=Gear  
Order=6





# spice4qucs: Ngspice / Xyce

- Audio amplifier, troubles with Qucsator





# Status

- Release 0.0.19 (February 05, 2016)
  - Bug fixing, usability improvements, build system cleanup
  - Ongoing port Qt3Support to Qt4
  - New active-filter synthesis tool
  - Integration of regression tests, qucs-test repository
  - Removal of non-GPL models
  - ...
- Release 0.0.20 (no due date)
  - ~~BSIM-6~~
  - New RF models
  - spice4qucs: Ngspice (XSPIICE) and Xyce frontend
    - <https://github.com/Qucs/qucs/issues/77>
    - <https://github.com/ra3xdh/qucs/releases/tag/0.0.19S-rc3>
  - Tuner, Gnucap/Gnucsator, make ADMS optional, submit package to Debian, multiple simulators...



# Roadmap (whish list)

1. Simple GUI and simulator
  - Refactor/rewrite, (Qt4) Qt5, plug-ins, API...
  - Standard file formats, exchangeable
2. Powerful circuit analysis tools
  - Robust algorithms (Eigen, KLU)
  - API, high level interface (SWIG)
  - Harmonic-Balance
  - Large signal S-parameter simulation (LSSP)
  - EM field simulation / extraction (openEMS, NEC2++)
  - \*SPICE flavors compatibility/converter
  - Co-simulation (analog + Verilog/VHDL), interface (icarus, GHDL)
  - Monte-Carlo simulation
  - Solvers: Ngspice, Xyce, Gnucap, SpiceOpus
3. Design and synthesis tools
  - Data import / export
4. Industry standard device models
  - MEXTRAM, VBIC, HiSIM, IGBT, UTSOI, ...
5. Hardware implementation
  - Layout PCB, device (KiCad, Klayout)



# Resources

- Website: <http://qucs.sourceforge.net/>
- GitHub (preferred): <https://github.com/Qucs/qucs/>
- SourceForge: <http://sourceforge.net/p/qucs/git/>
- Mailing lists: <http://sourceforge.net/p/qucs/mailman/>
- IRC channel: #qucs
- Forum: <http://sourceforge.net/p/qucs/discussion/>
- Bug trackers:
  - <https://github.com/Qucs/qucs/issues>
  - [http://sourceforge.net/p/qucs/\\_list/tickets](http://sourceforge.net/p/qucs/_list/tickets)
- Source code documentation:
  - <http://qucs.github.io/qucs-doxygen/qucs/index.html>
  - <http://qucs.github.io/qucs-doxygen/qucs-core/index.html>
- Downloads: <http://sourceforge.net/projects/qucs/files/>
- (NEW) Qucs-Help: <http://qucs-help.readthedocs.org/>
- (NEW) Transifex translations:
  - <https://www.transifex.com/projects/p/qucs-desktop/>
  - <https://www.transifex.com/projects/p/qucs-help/>



# Final remarks

- Flexible and easy to use
- Advanced components and features
- Build and test infrastructure
- Right time for refactoring/redesign
- We are open for collaboration
- Roadmap: Your help is welcome!