

Research Migration Project

<https://esim.fossee.in/research-migration-project>



The Research Migration Project is an initiative of FOSSEE, IIT Bombay that promotes the use of eSim for reproducing published research circuits originally implemented using proprietary simulation tools. The objective is to migrate these validated designs to eSim to build an open source resource database.

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Title of the circuit : Analysis and Modelling of Frequency-Domain Compensation Techniques for High-Bandwidth Current Shunt Resistors

Theory/Description : Current shunt resistors are used for current sensing, but at high frequencies, parasitic inductance causes resonance and gain peaking. To mitigate this, an RC compensation network (R_f - C_f) is used. The circuit includes a shunt resistor with parasitic elements and a compensation branch that controls the frequency response. The RC network suppresses high-frequency oscillations, improves stability, and ensures a smoother output by adjusting the damping through the compensation resistance (R_f).

Reason to reproduce with eSim : This circuit is suitable for eSim as it enables easy simulation of frequency response and parasitic effects using an open-source SPICE environment. It allows parameter variation, result verification, and better understanding of high-frequency compensation techniques.

Expected Outcome/outputs :

The simulation will produce magnitude vs frequency plots of the output voltage. The effect of varying compensation resistance (R_f) can be observed through changes in amplitude, resonance behavior, and damping characteristics. The circuit performance can be evaluated by analyzing bandwidth, peak response, and stability across the frequency range.

Circuit Diagram:

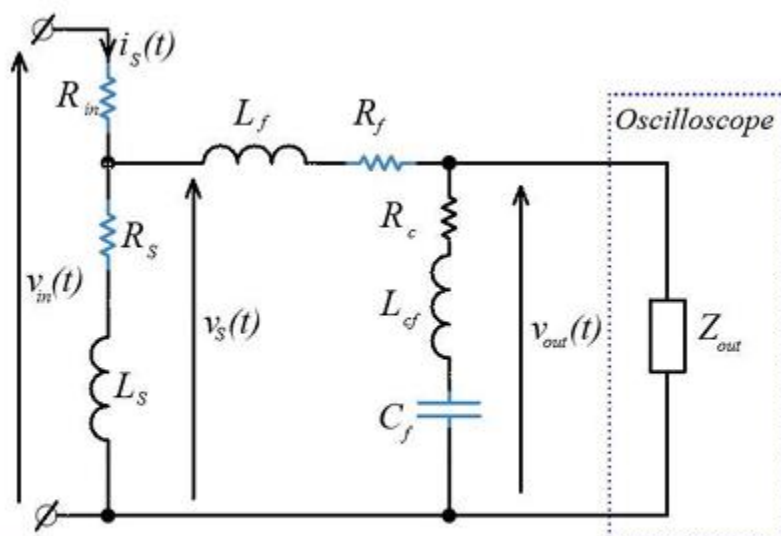


Fig. 4. The model of current shunt resistor with RC filter – model with load, oscilloscope 50 Ω termination and parasitic inductance (ESL).

TABLE II Parameters for simulation of transmittance frequency response for various filter capacitor value.

Symbol	VALUE	UNITS	COMMENT / RANGE
R_{in}	50	Ω	source resistance
R_s	0.3	Ω	Shunt resistor ($\pm 1\%$)
L_s	0.5	nH	shunt ESL
R_f	10	Ω	Filter resistance ($\pm 1\%$)
L_f	1.5	nH	Filter ESL — nominal 5 nH
Z_{out}	50	Ω	Scope impedance
L_{cf}	1.5	nH	capacitor ESL
R_c	750	mΩ	ESR + skin effect

Expected Results (Input, Output waveforms and/or Multimeter readings) :

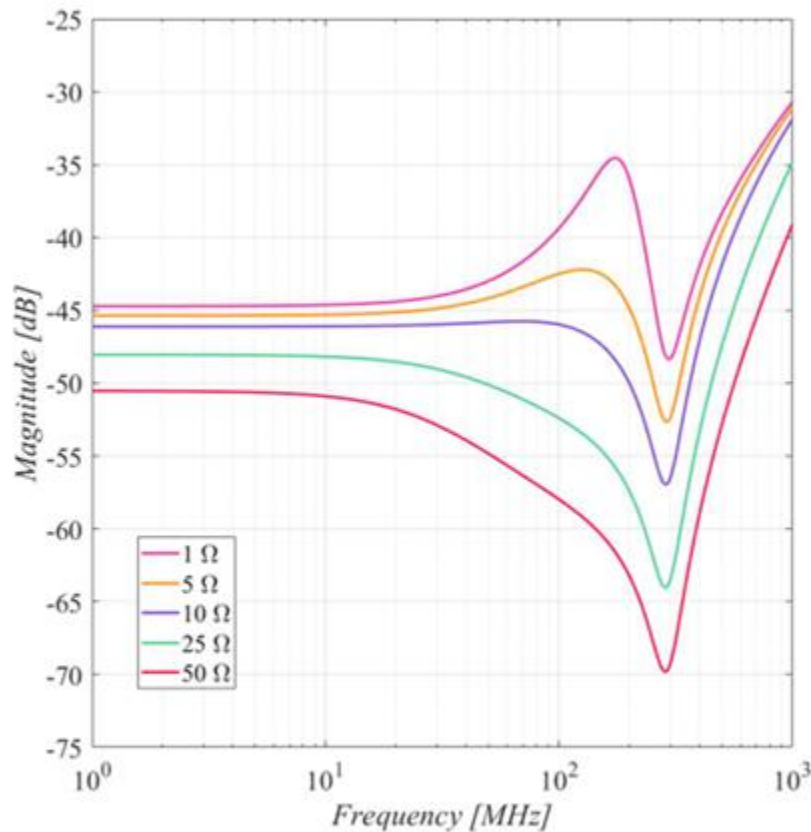


Fig. 6. Magnitude vs frequency - fixed parameter of capacitance 220 pF and variable value of R_l .

The input is an AC sinusoidal voltage source with constant amplitude over a wide frequency range. The output is the voltage across the load, whose magnitude varies with frequency. The waveform remains sinusoidal, but its amplitude changes due to resonance and damping effects. At low frequencies, the output remains stable, while at higher frequencies, variations such as gain peaking and attenuation are observed.

Research Paper/Journal/etc. :

Title:

Analysis and Modeling of Frequency-Domain Compensation Techniques for High Bandwidth Shunt Resistors

Author:

Maciej Chojowski, Robert Sosnowski, Marcin Baszyński, Szczepan Milewski

Page No.: 4,5

Link:

[Analysis and Modeling of Frequency-Domain Compensation Techniques for High Bandwidth Shunt Resistors | IEEE Journals & Magazine | IEEE Xplore](#)

