SAFARI

A Simulation of

Out of Band Resonances (OBR) of the SAFARI FDM - Frequency Dependent(R,L) Twisted Pairs

SRON

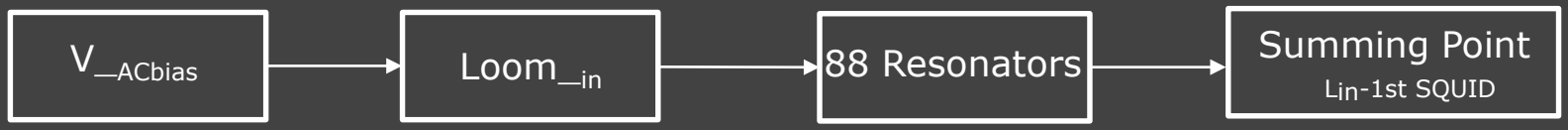
Amin Aminaei, 6 April 2020

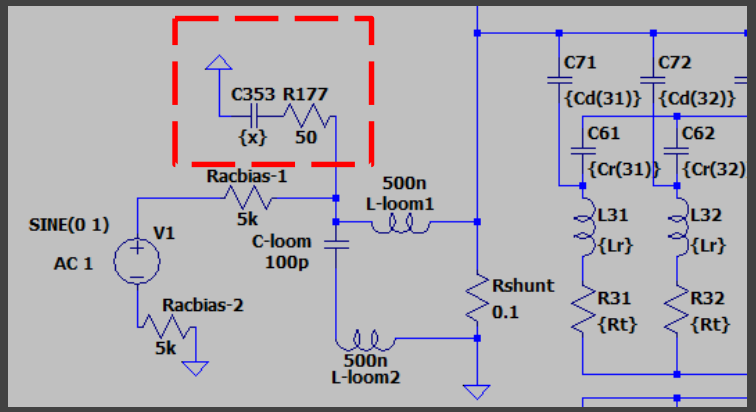
Netherlands Institute for Space Research

Netherlands Organisation for Scientific Research (NWO)

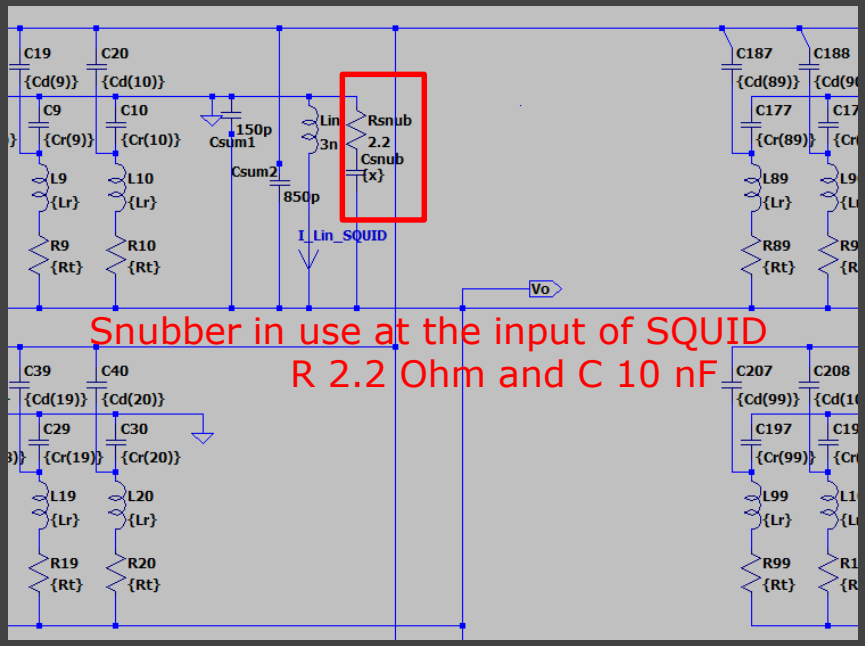
Simulation of SAFARI FDM blocks up to the input of the 1st SQUID

REMINDER





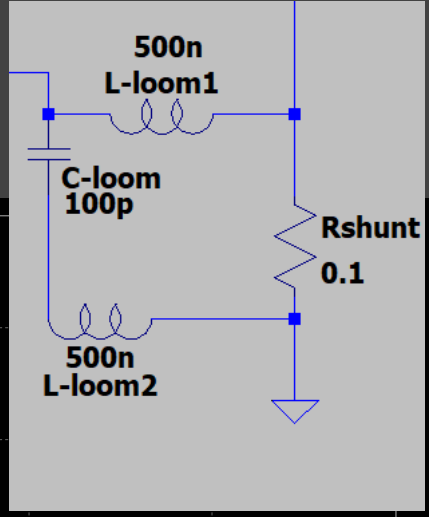
Snubber-1 (Theory) after Rac-bias
Optimal values,R 50 Ohm and C 10 nF



Snubber in use at the input of SQUID
R 2.2 Ohm and C 10 nF

SRON

Simulation of Input Loom with L,C



I(Lin)

ωr1=~1/[L-loom-in*(C-loom-in)]^0.5
@15.9 MHz

ωr2=~1/[Lin*(Csum1+Csum2)]^0.5
@98.7 MHz

R,C-snubber1 after Rac-bias

R,C-snubber2 used at Summing Point

FDM Resonances 1MHz-3.8MHz

A nearby OBR could occur which depends on the Loom-in characteristics

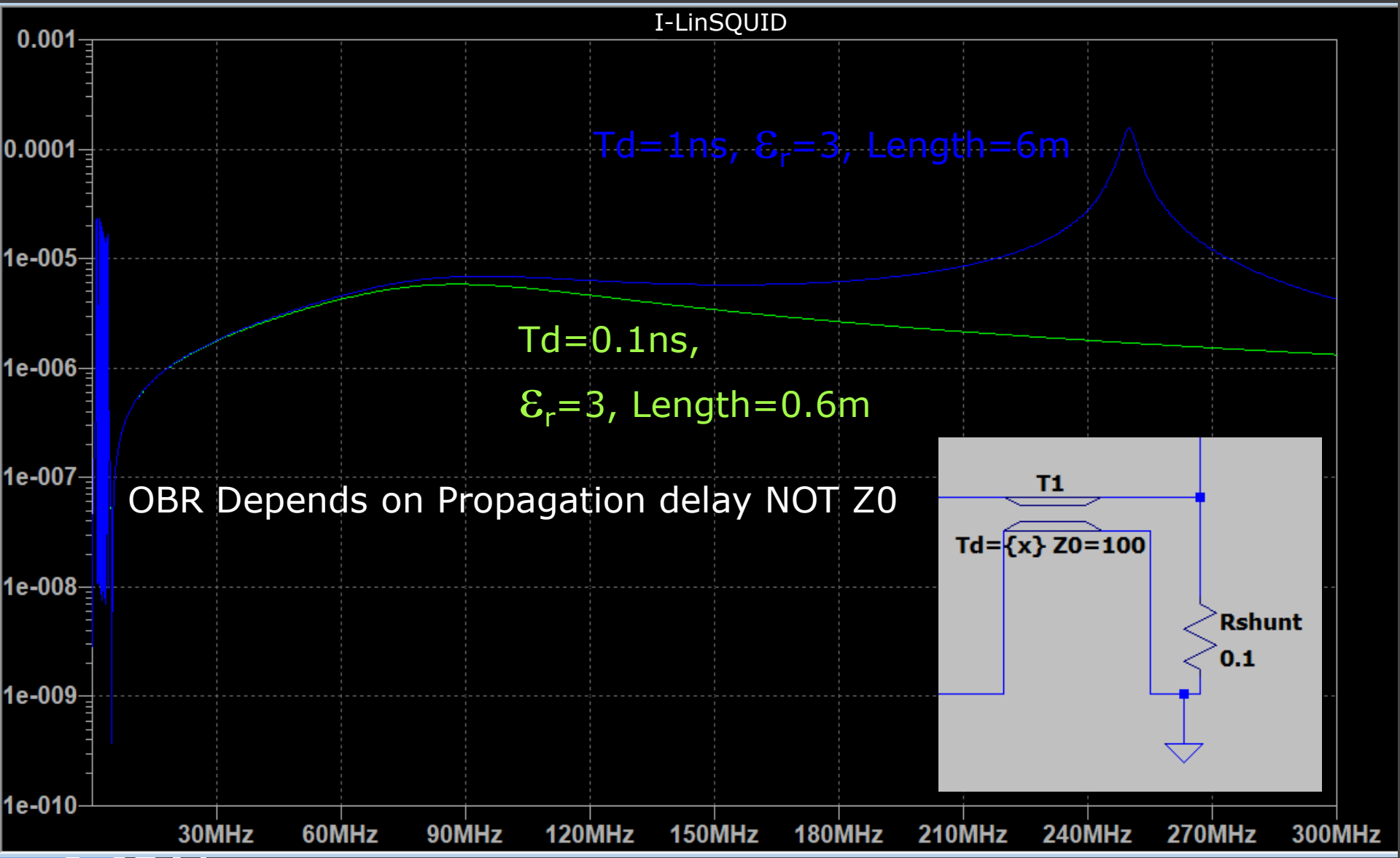
-60dB -80dB -100dB -120dB -140dB -160dB -180dB -200dB -220dB -240dB

30MHz 60MHz 90MHz 120MHz 150MHz 180MHz 210MHz 240MHz 270MHz 300MHz

f

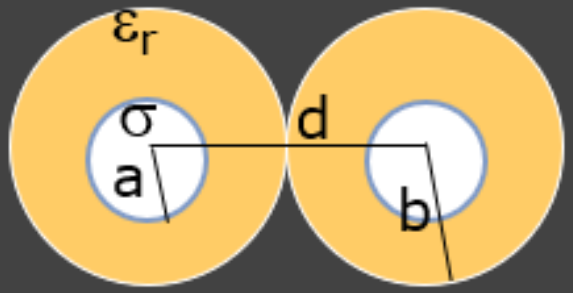
SRON

Simulation of Input Loom as a Lossless Transmission Line



Network model of twisted pairs, nominal values

SS Stainless Steel σ 1.45E6
diameter 2a=2x100µm (a=50um)
total wire =300 µm
insulation 100.0 µm, each side
distance between cable centres, d=300um
permittivity of inner dielectric and outer dielectric permitivity(3)

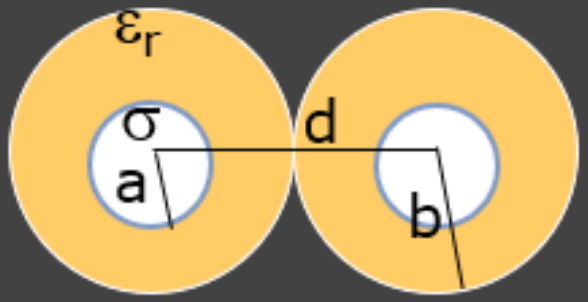


SAFARI2019_07_harness_EXCEL_v07-A.A..xlsx - Excel

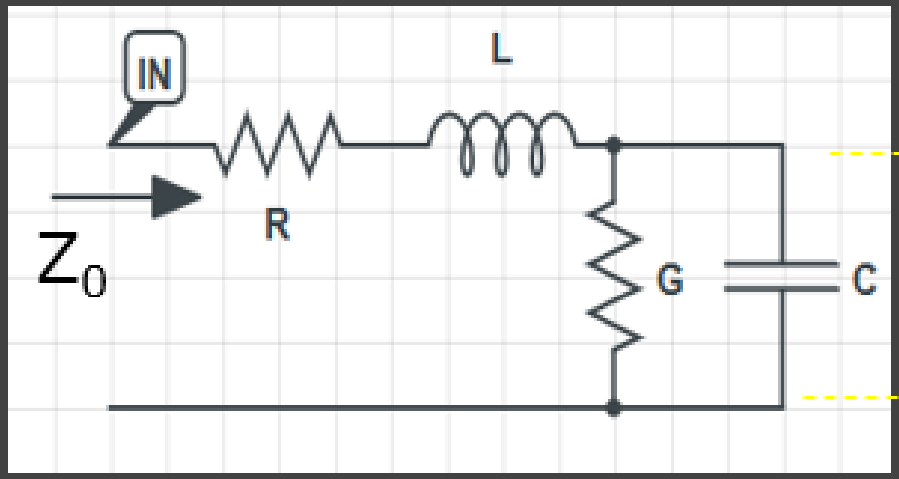
Name	Type	Shielded	Wires	Material	AWG	diameter
FE_SQUID_heater	Twisted pair	no	2	ss	38	100,70
AMP_SQUID_heater	Twisted pair	no	2	ss	38	100,70

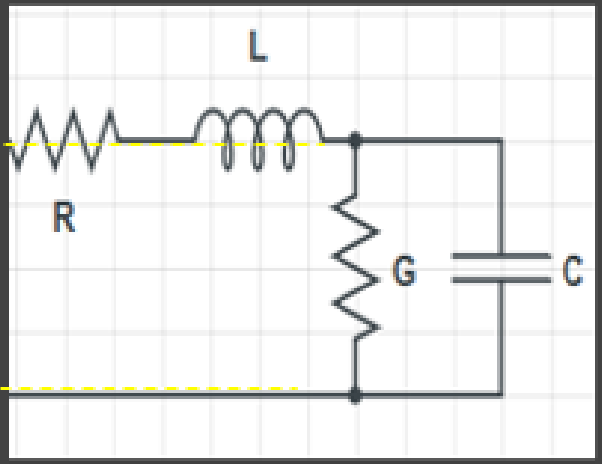
AreaCond ss	insulation	wiretot	AreaIns	signal ID
0,02	100,00	300,70	0,13	601,40
0,02	100,00	300,70	0,13	601,40

Model Schematics
--→ Calculated and Implemented in LT-Spice



$$Z_0 = \sqrt{\frac{Z}{Y}} = \sqrt{\frac{R(\omega)+j\omega.L(\omega)}{G(\omega)+j\omega.C(\omega)}}$$

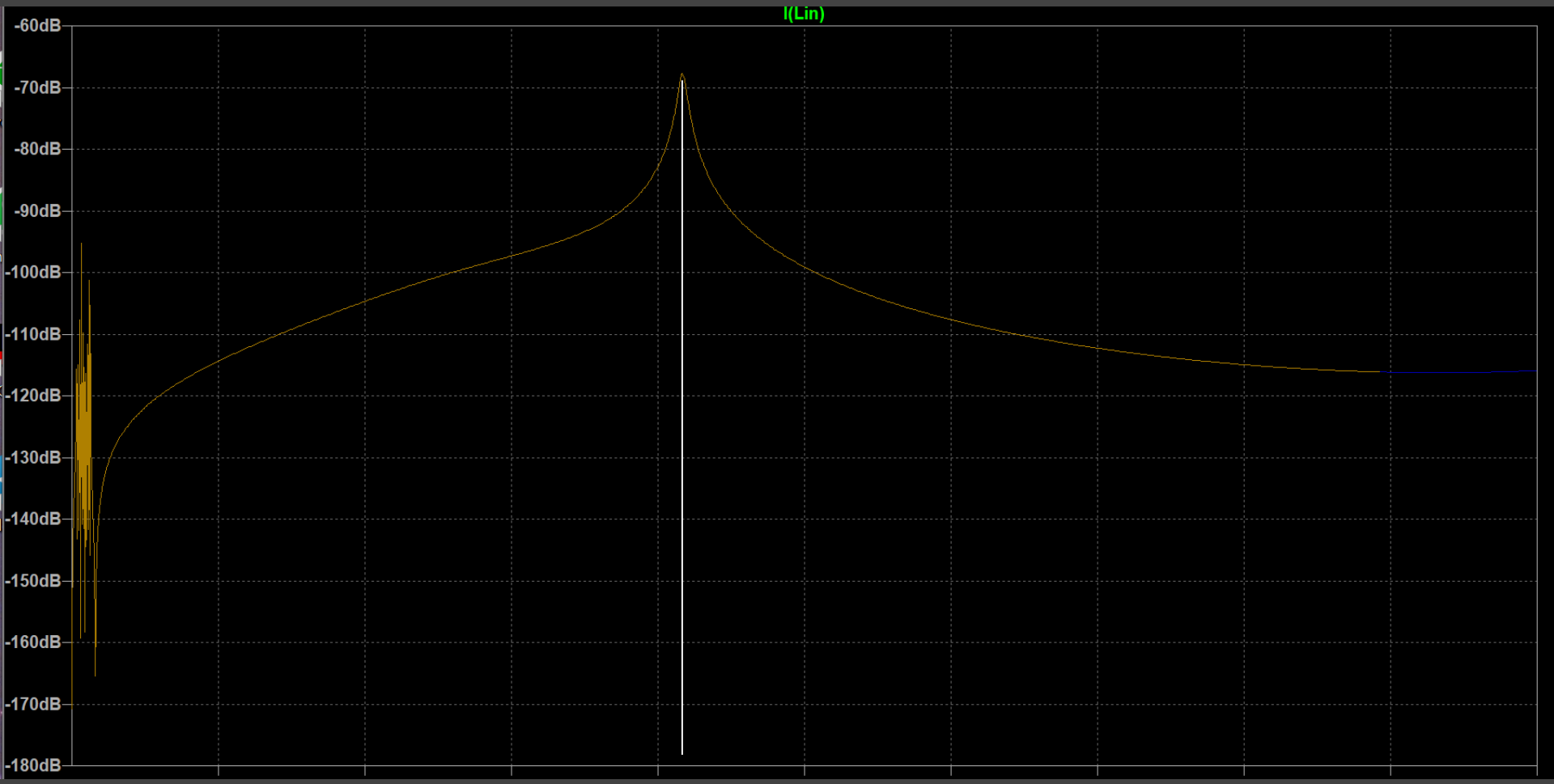




SRON

Typical frequency dependent micro-twisted pair, before R_{shunt}

Length=60cm, C=34pF, R=0.0065. f^0.5, L=3.24 e^{-7}+.001.(f)^-0.5

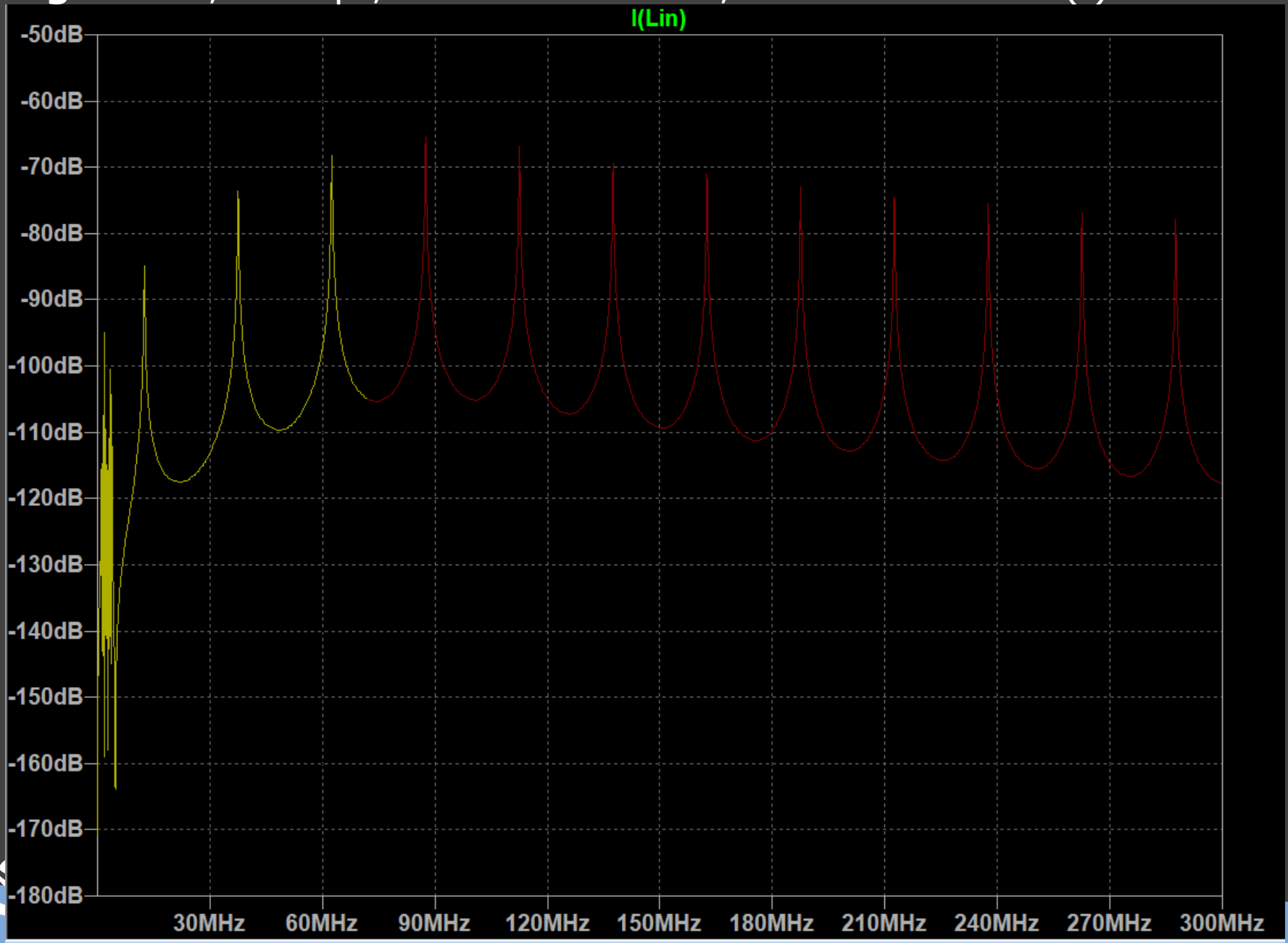


~125MHz

SRON

Typical frequency dependent micro-twisted pair, before R_{shunt}

Length=6m, C=34pF, R=0.0065. f^0.5, L=3.24E-7+.001.(f)^-0.5



Typical frequency dependent micro-twisted pair, before R_{shunt}

Length=10cm, C=34pF, R=0.0065. f^0.5, L=3.24E-7+.001.(f)^-0.5