

Seminar in delavnica

Načrtovanje elektronike za EMC

Načrtovanje filtra za flyback pretvornik

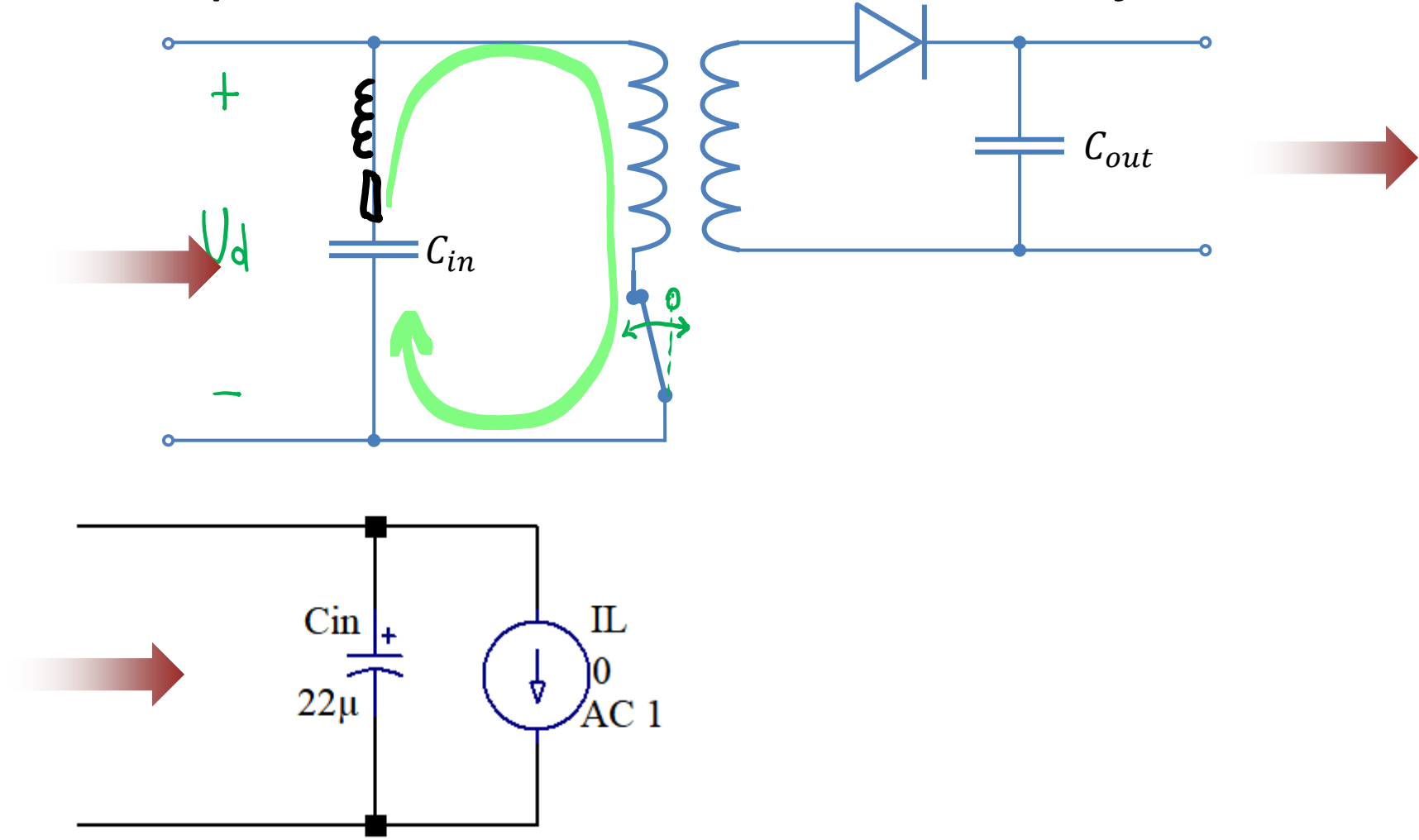
M. Jankovec

Univerza v Ljubljani

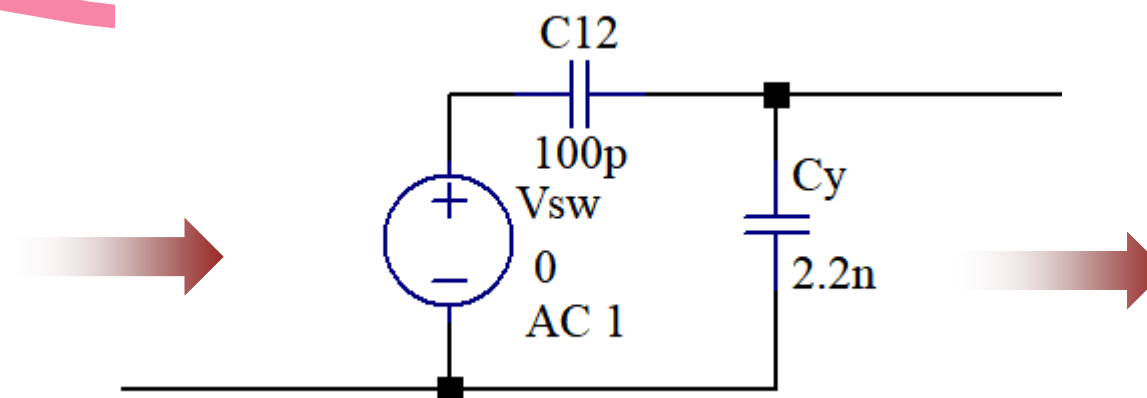
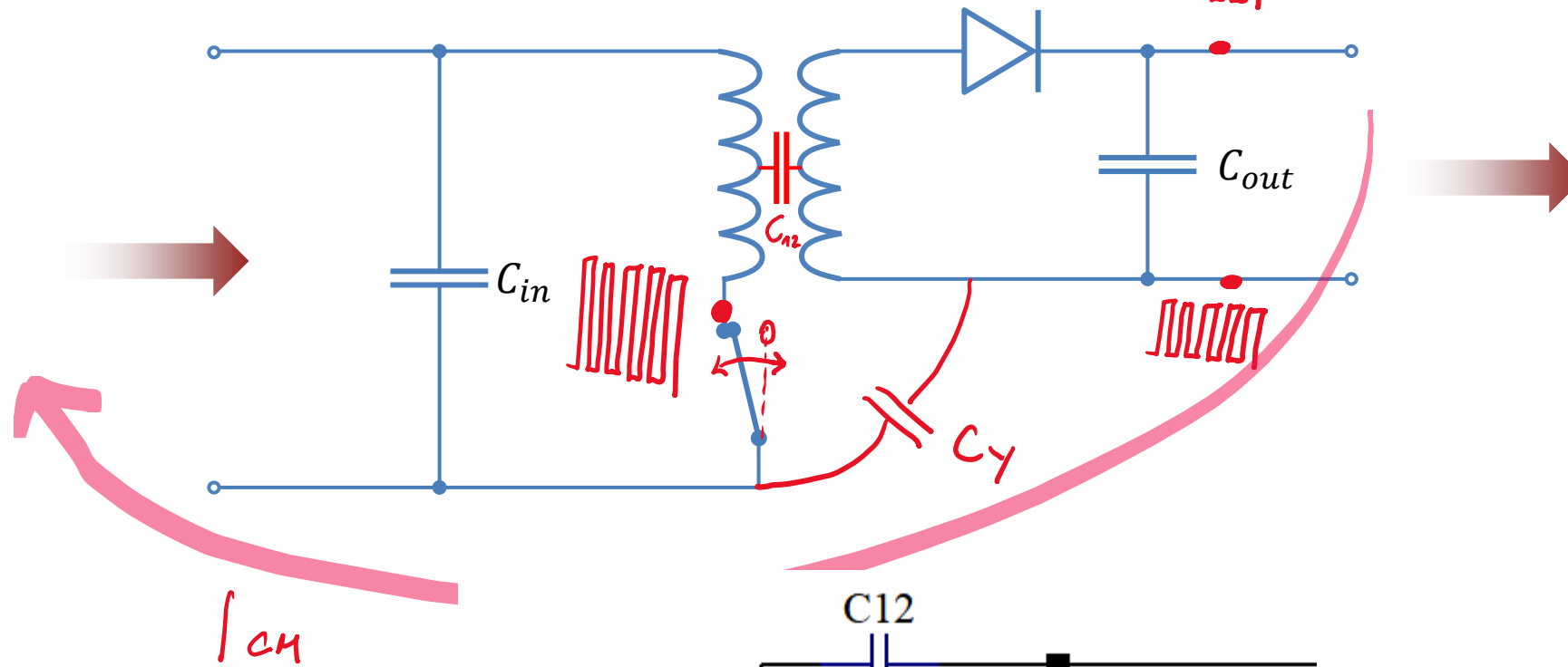
Fakulteta za elektrotehniko

Tržaška 25, SI-1000 Ljubljana, Slovenia

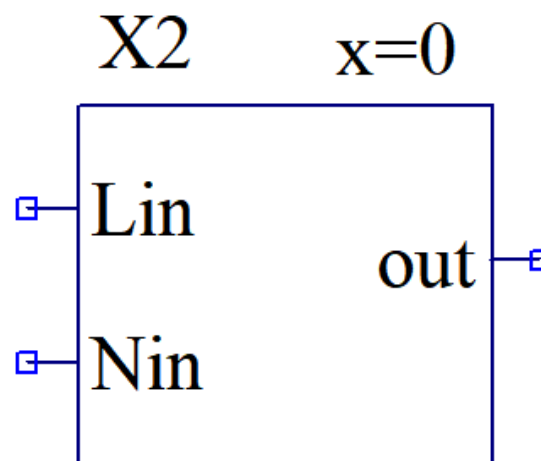
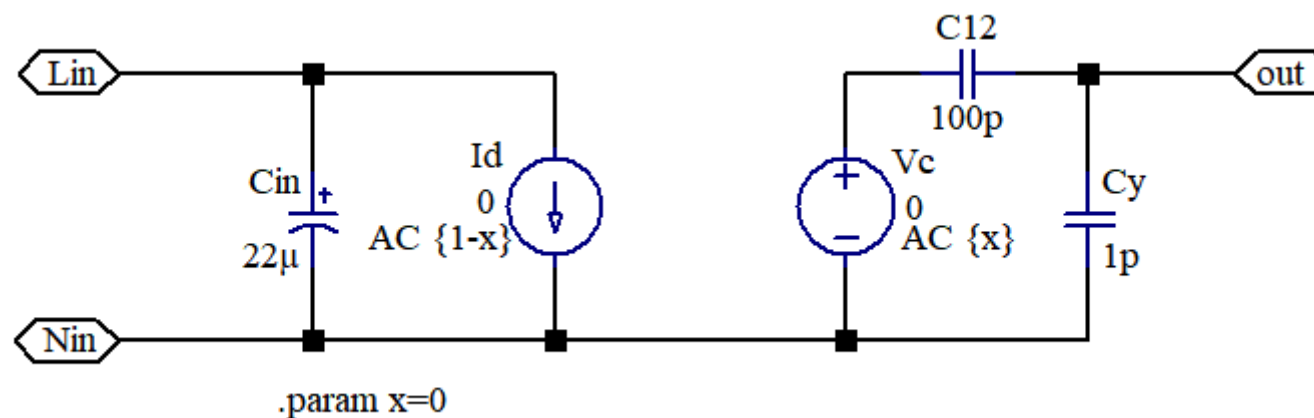
Flyback DC/DC pretvornik – diferencialne motnje



Flyback DC/DC pretvornik – sofazne motnje

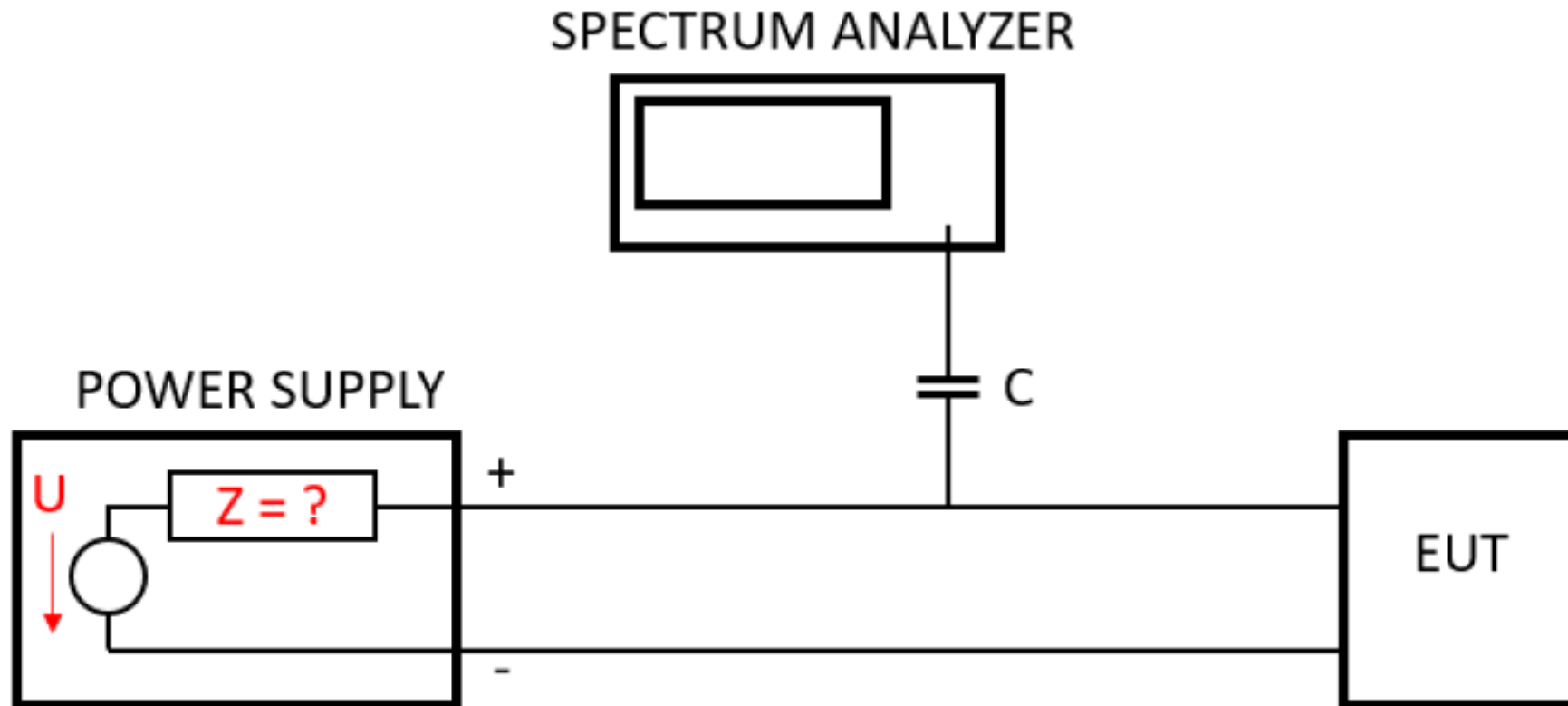


Flyback DC/DC pretvornik – model

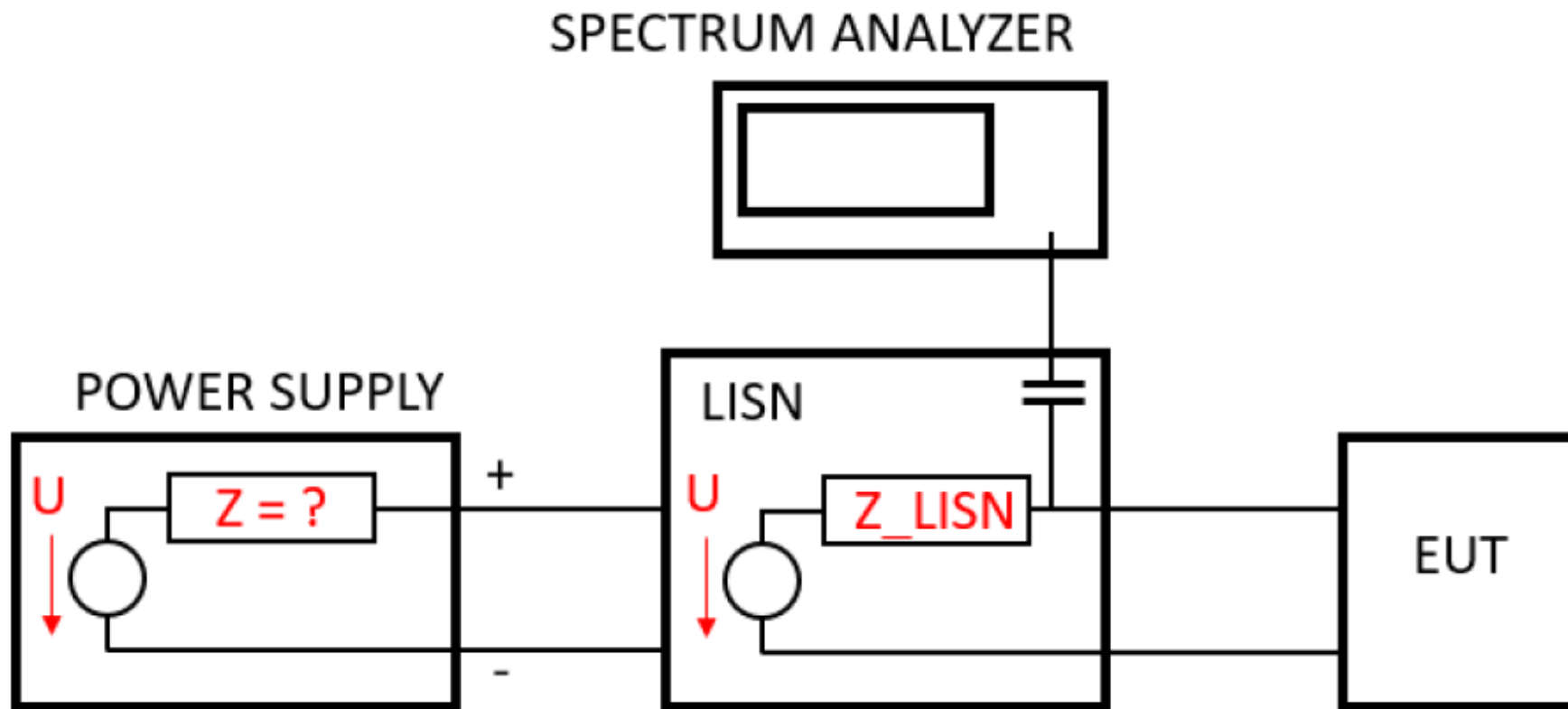


X=0 -> Diferencialne
X=1 -> Sofazne

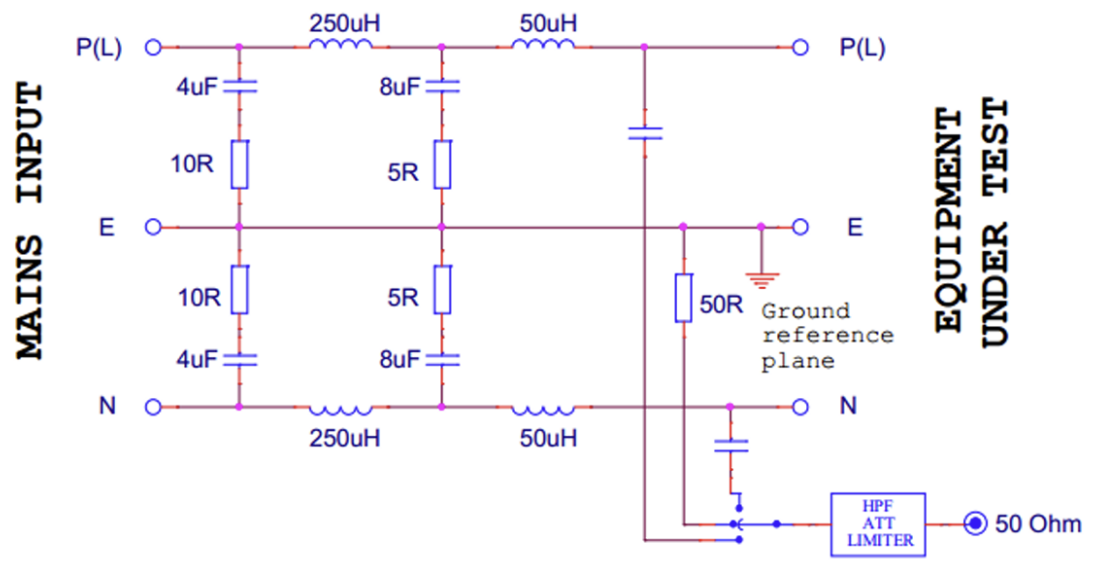
Merilna postavitve



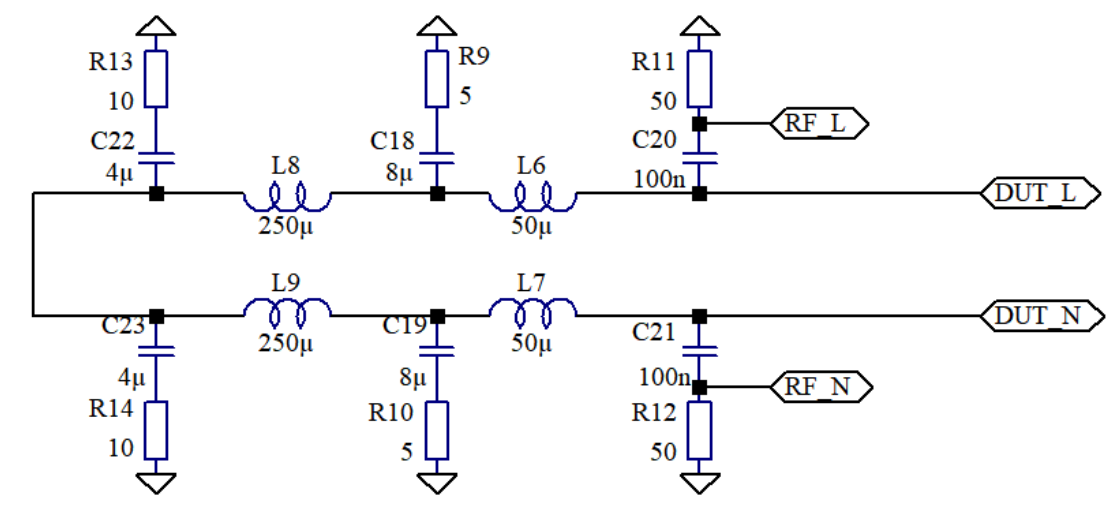
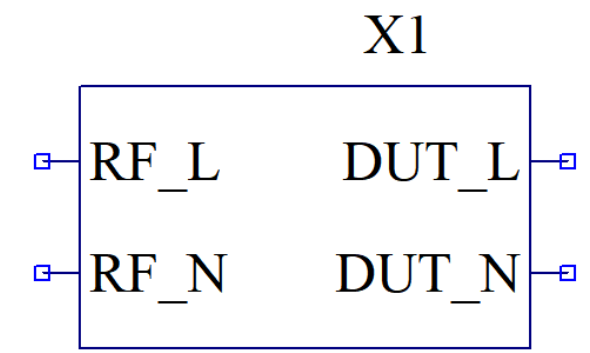
Merilna postavitve



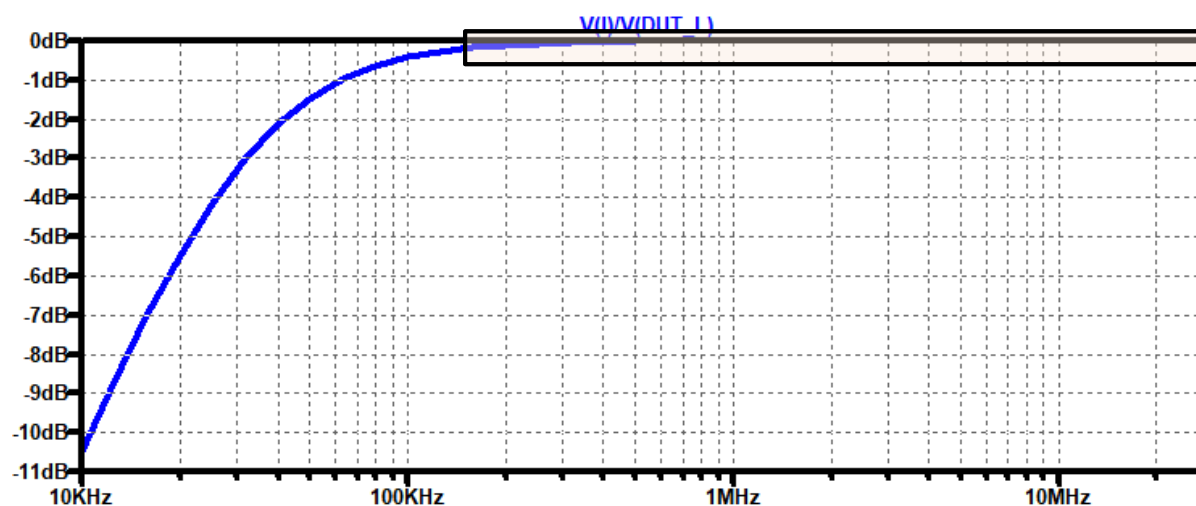
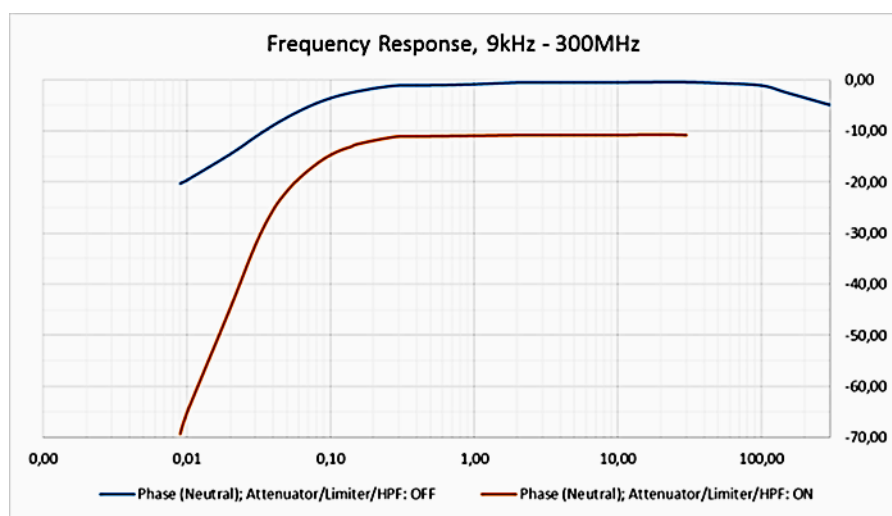
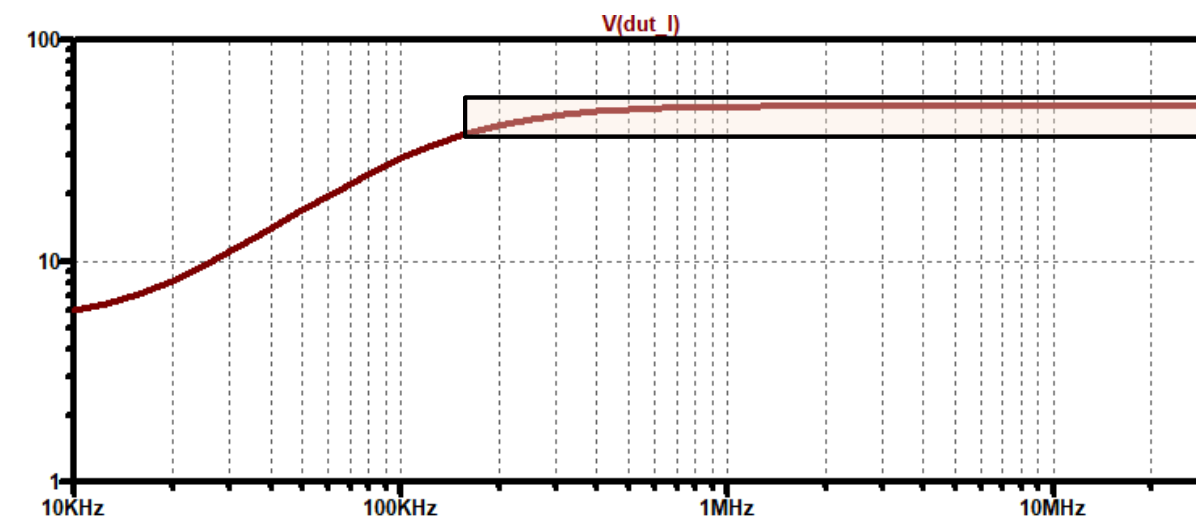
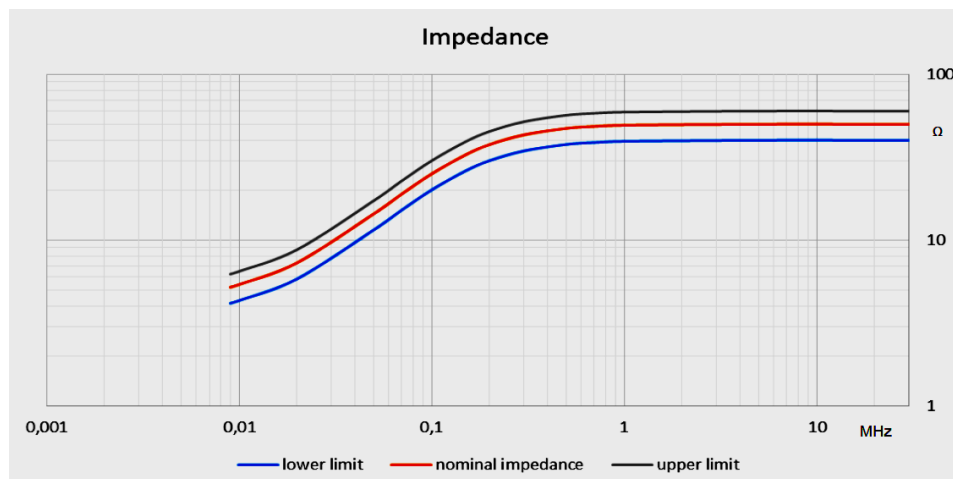
LISN



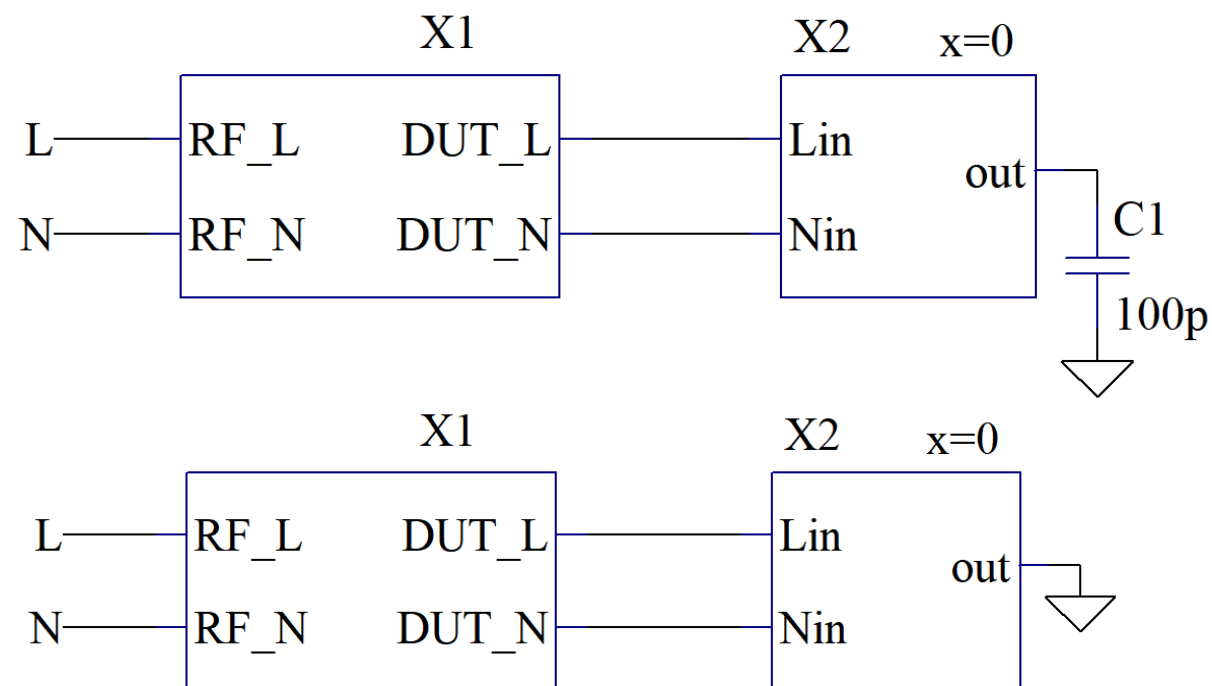
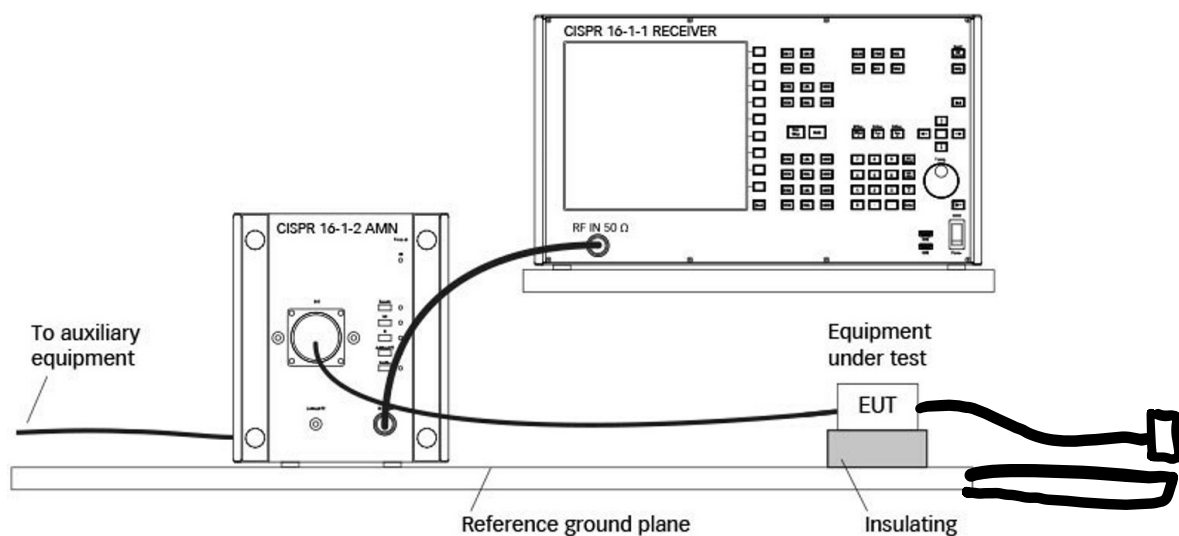
EQUIPMENT UNDER TEST



Impedanca LISN na izhodu DUT



Merilna postavitvev po CISRP-16



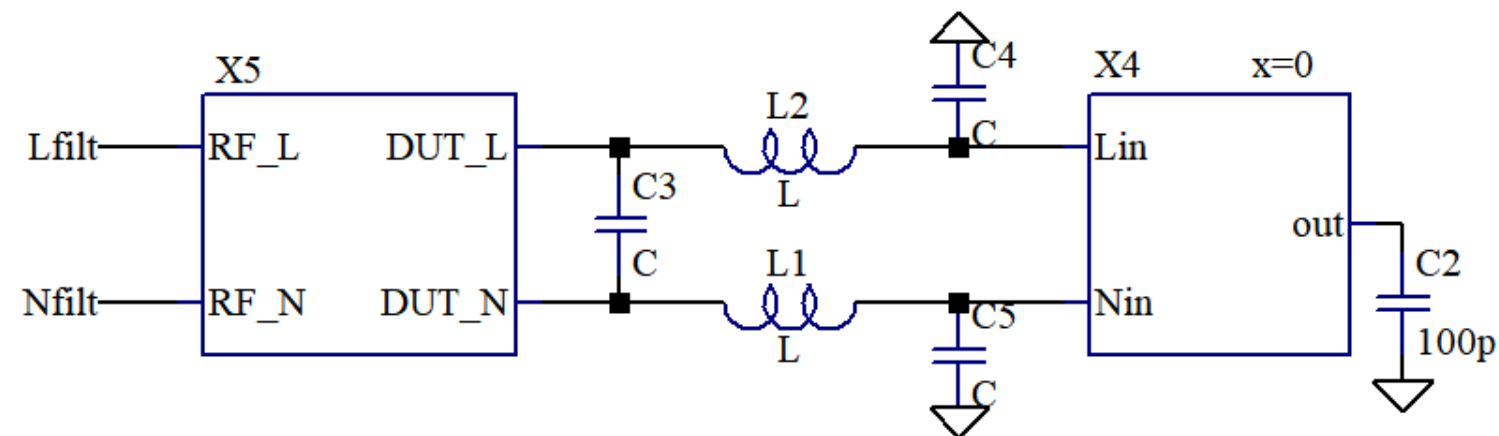
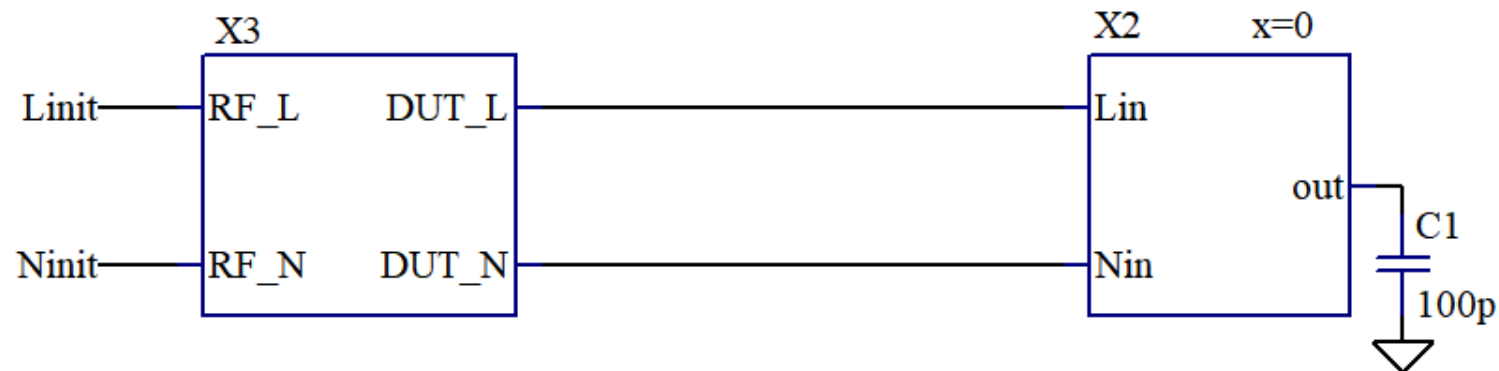
Končna simulacija s filtrom

$$IL_L = \frac{V(L_{init})}{V(L_{filt})}$$

$$IL_N = \frac{V(N_{init})}{V(N_{filt})}$$

$$IL_{CM} = \frac{V(L_{init}) + V(N_{init})}{V(L_{filt}) + V(N_{filt})}$$

$$IL_{DM} = \frac{V(L_{init}) - V(N_{init})}{V(L_{filt}) - V(N_{filt})}$$

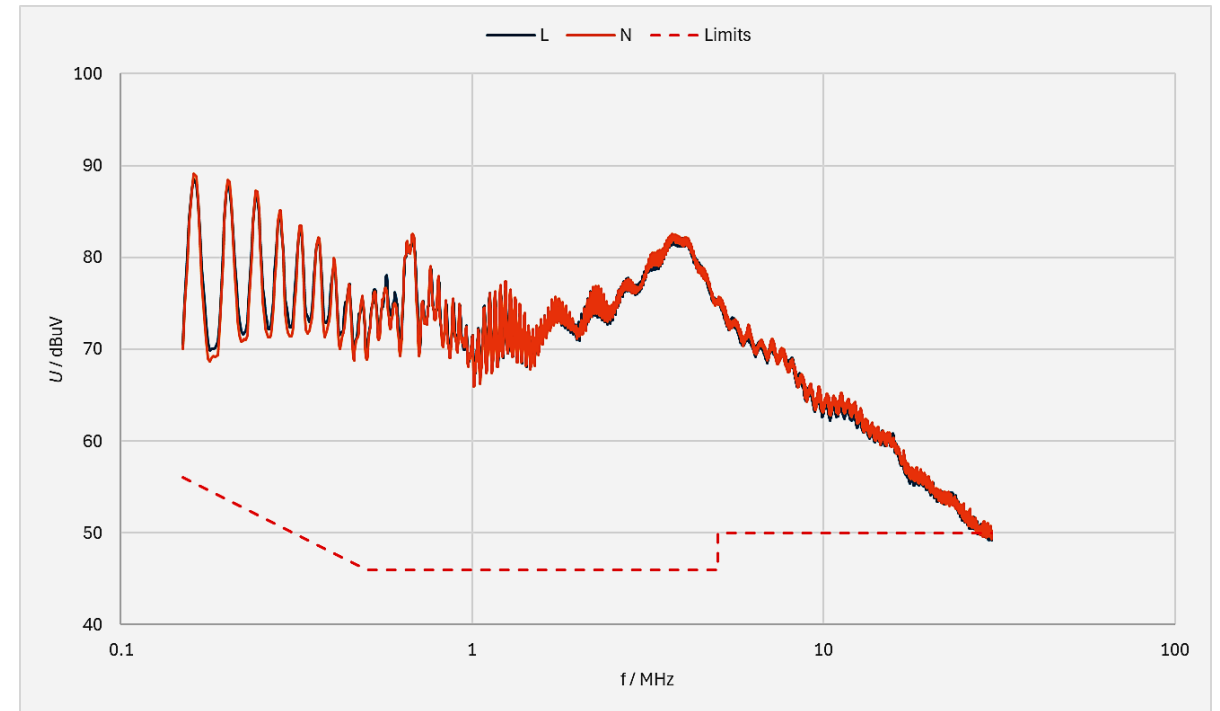
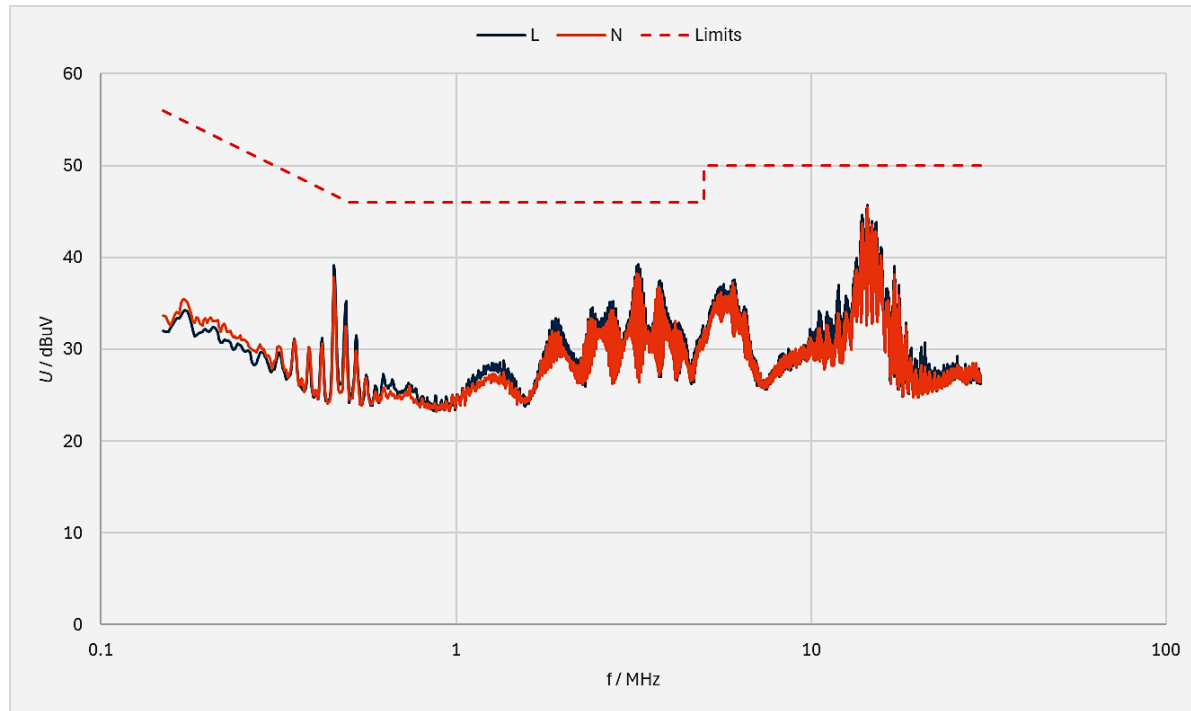


.ac dec 10 150k 30MEG

Primer



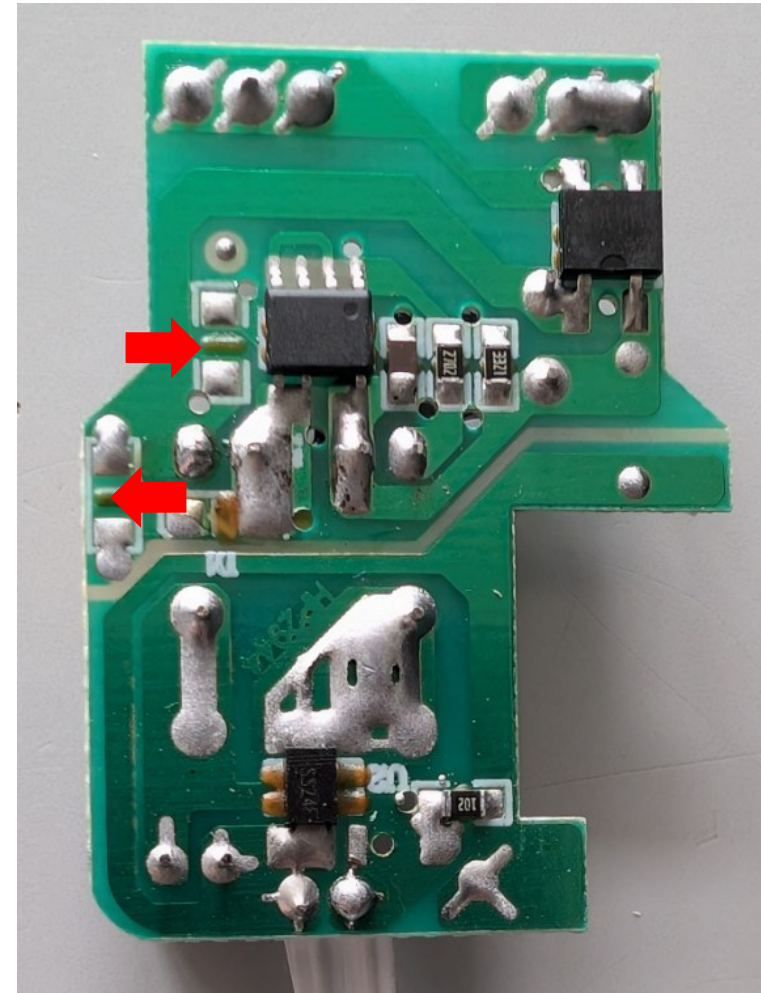
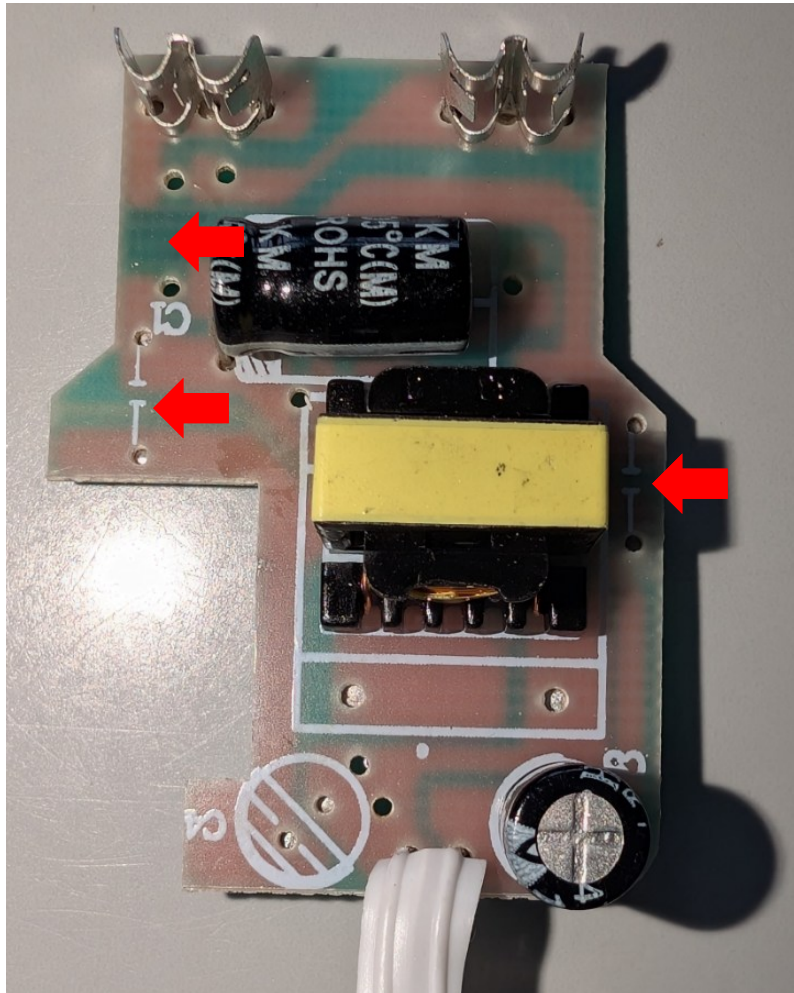
Preliminarne meritve



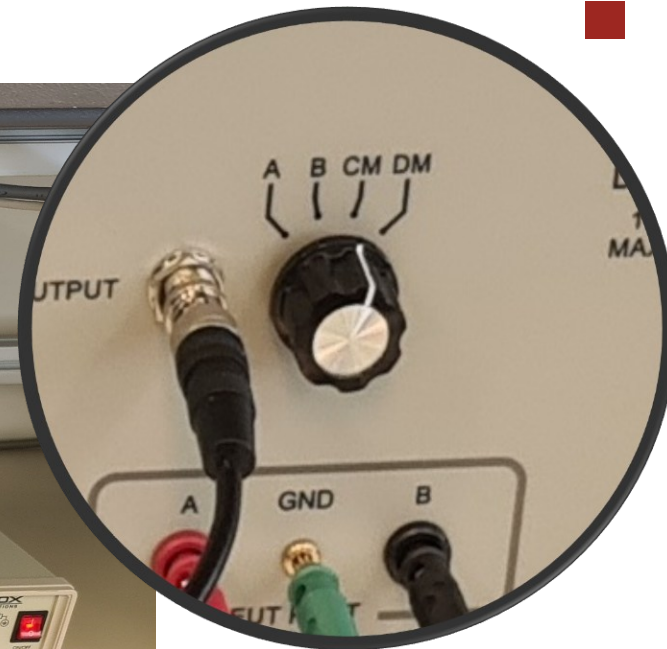
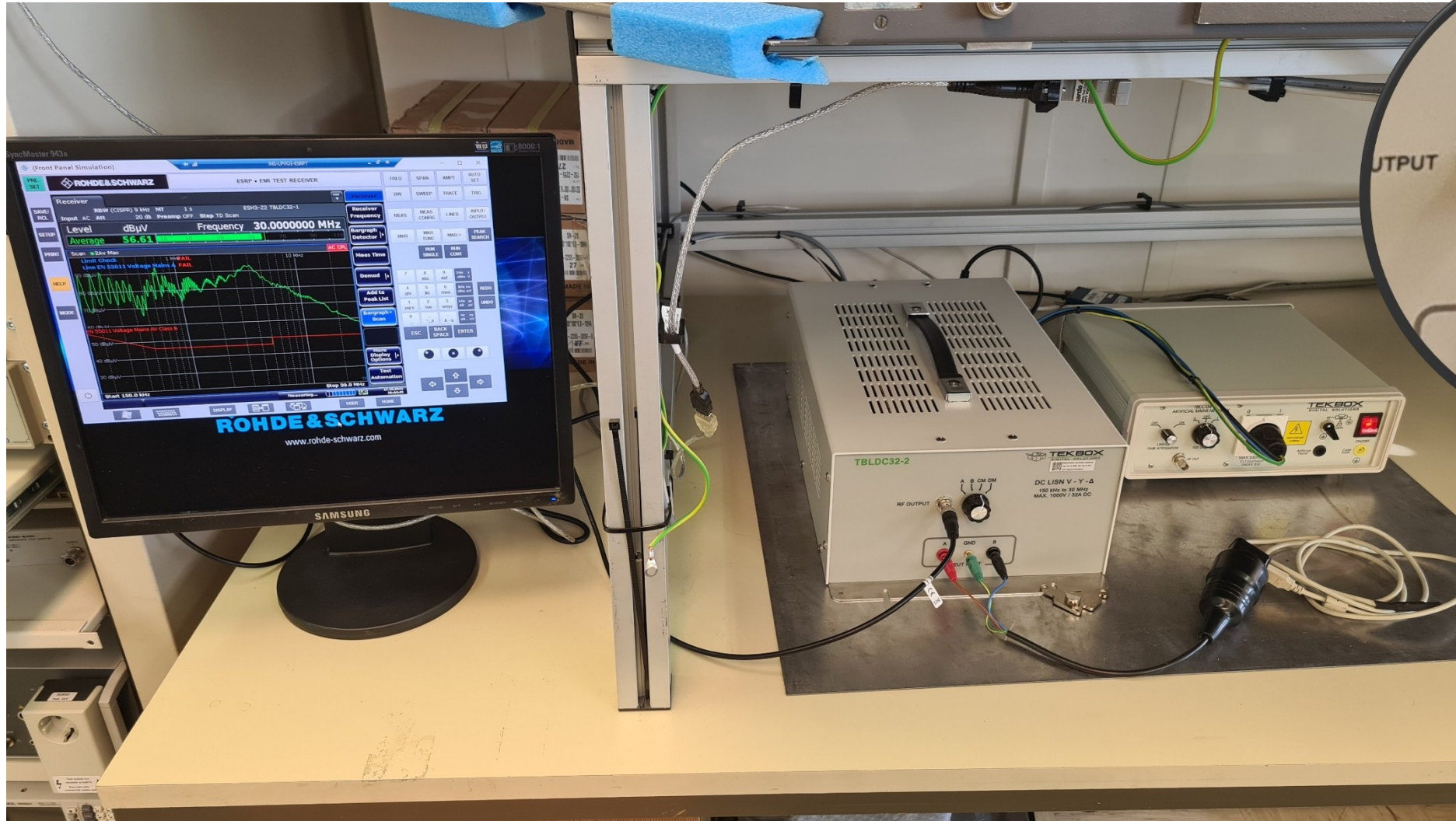
Eden od razlogov za razliko



Manjkajoče komponente filtra



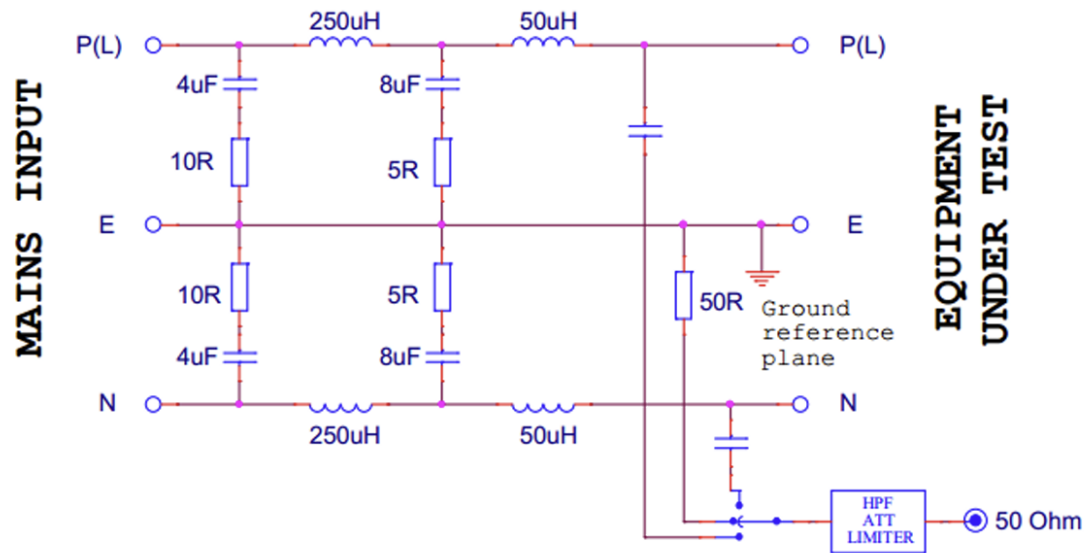
Meritve



Razlika

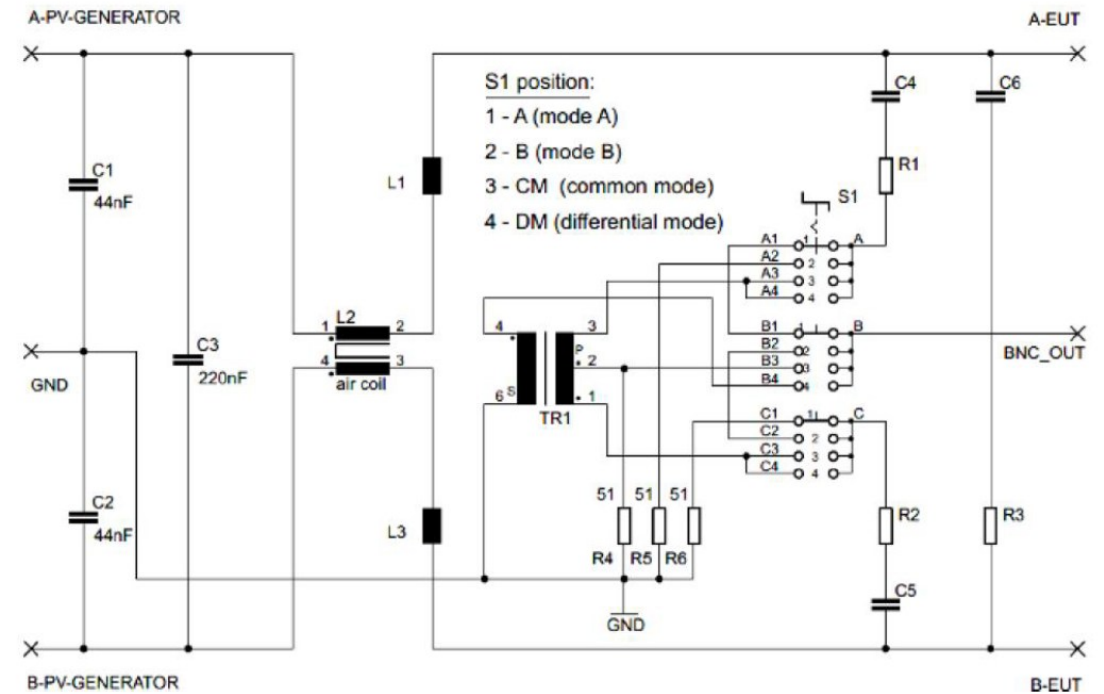
TBLC-08

50 Ω

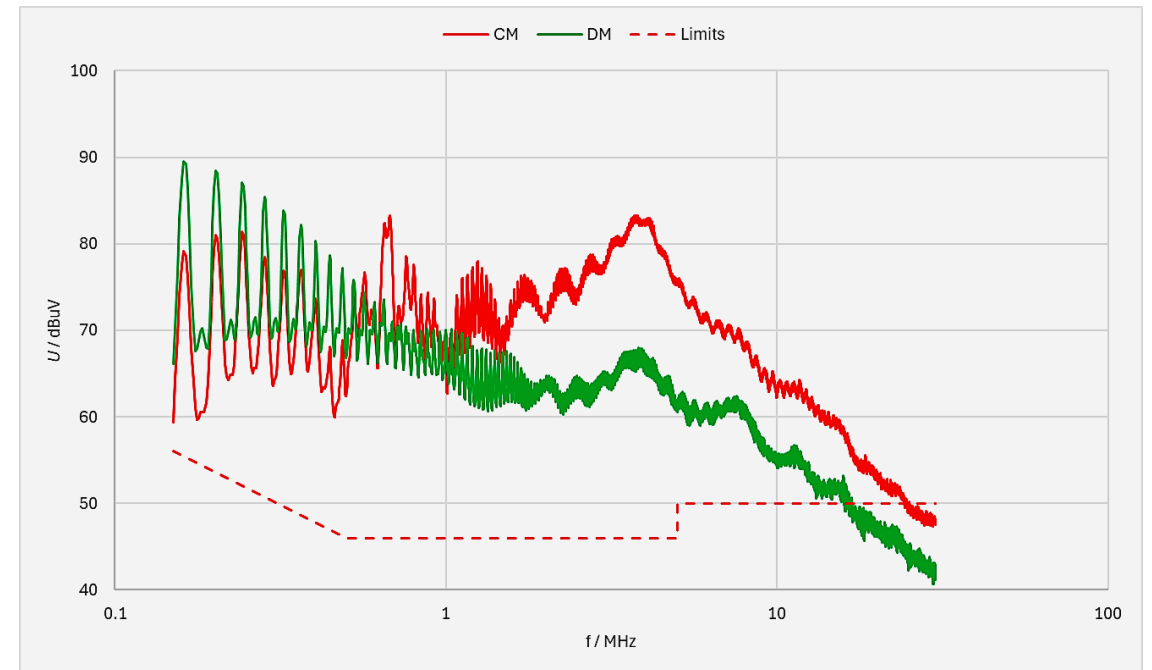
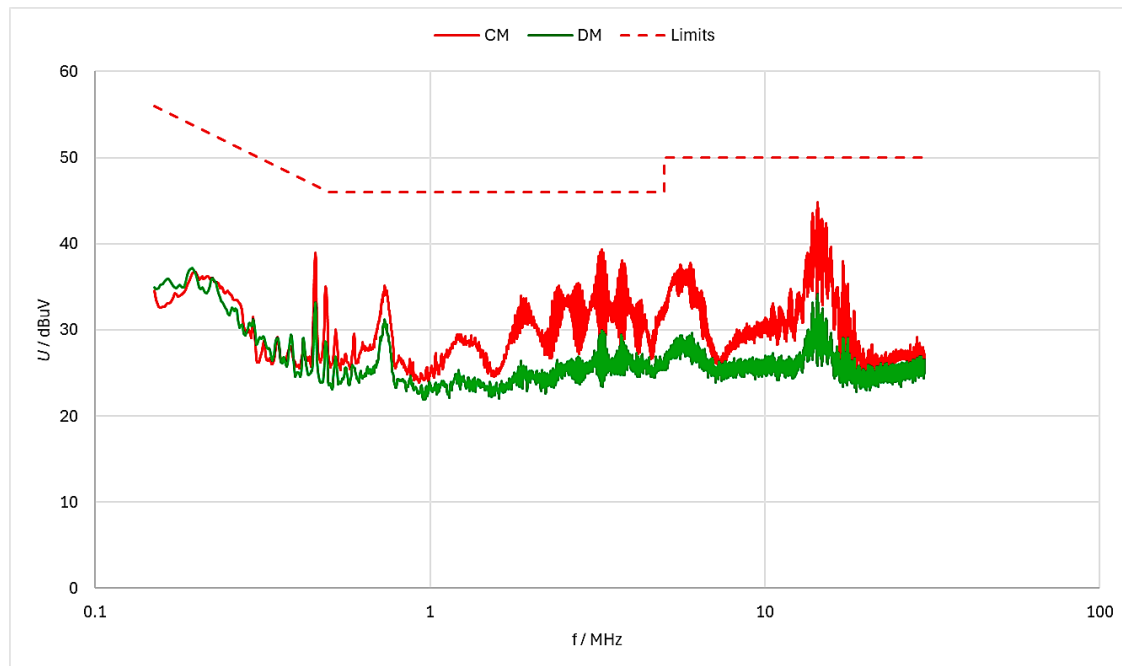


TBLDC32-2

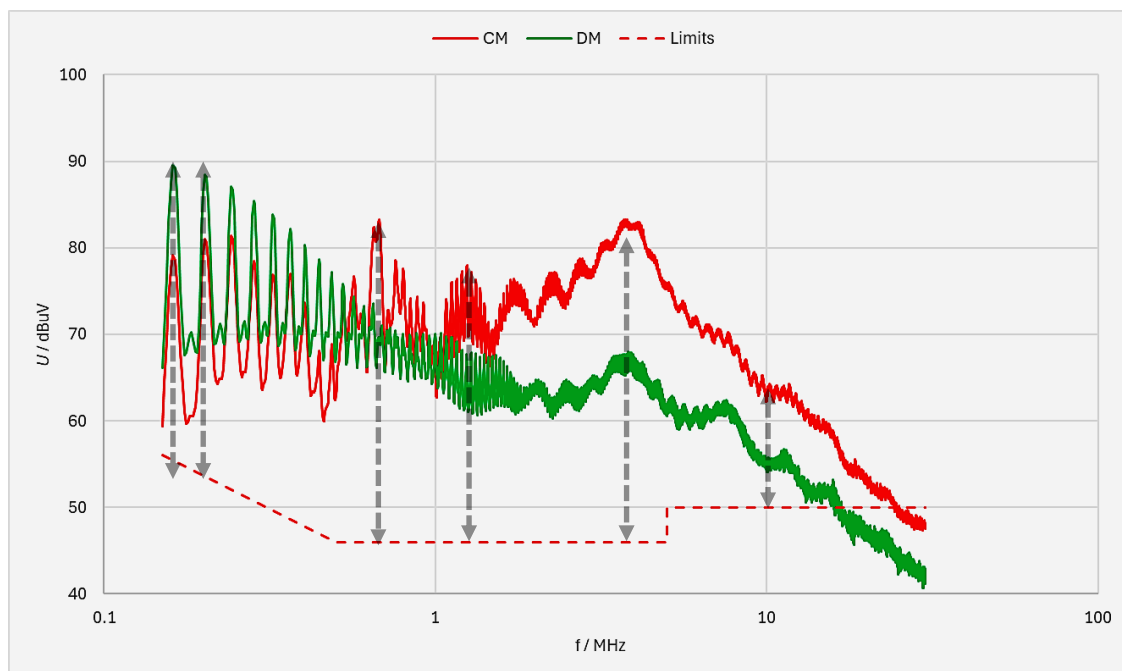
150 Ω



CM in DM



Potrebno vstavitevno dušenje filtra



f / MHz	U_{CM} / dBm	U_{DM} / dBm	Limita / dBm	S_{CM} / dB	S_{DM} / dB
0.164	78.6	89.2	56.0	32.6	43.2
0.204	88.1	80.6	53.6	44.5	37.0
0.681	68.8	82.1	46.0	32.8	46.1
1.25	76.8	68.0	46.0	40.8	32.0
3.86	83.0	67.6	46.0	47.0	31.6
10	63.9	55.0	50.0	23.9	15

Izbor CM dušilk

System

PARAMETERS

Applications Hints

- Long Datasignal Lines: 90 Ohm
- Clock- and Datasignal Lines: 50 Ohm
- Supply Voltage Lines (Vcc): 10 Ohm
- Ground Planes (GND): 1 Ohm
- User defined

Noise attenuation

Att: 50 dB f: 1 MHz

Z_{In}

Z: 50 Ohm

Z_{Out}

Z: 50 Ohm

DETAILS

Order Code	Series...	Size	Spec	V _R	L ₀	I _R	R _{DC}	Z _{CM, Min @1.00 MHz}	Att@1.00 MHz	Lines	T _{op}	V _T	Assembl...	L	W	H
74461240004	WE-LF	SV		250 V	400 µH	3.60 A	20.0 mΩ	1.34 kΩ	23.2 dB	2	125 °C	1.50 kV	THT	18.0 mm	13.0 mm	20.0 mm
7446122001	WE-LF	SV		250 V	1.00 mH	2.00 A	60.0 mΩ	3.31 kΩ	30.7 dB	2	125 °C	1.50 kV	THT	18.0 mm	13.0 mm	20.0 mm
7446122003	WE-LF	SV		250 V	3.30 mH	1.50 A	150 mΩ	10.8 kΩ	40.7 dB	2	125 °C	1.50 kV	THT	18.0 mm	13.0 mm	20.0 mm
7446121007	WE-LF	SV		250 V	6.80 mH	1.00 A	300 mΩ	12.1 kΩ	41.7 dB	2	125 °C	1.50 kV	THT	18.0 mm	13.0 mm	20.0 mm
7446121010	WE-LF	SV		250 V	10.0 mH	700 mA	550 mΩ	10.1 kΩ	40.2 dB	2	125 °C	1.50 kV	THT	18.0 mm	13.0 mm	20.0 mm
7446121018	WE-LF	SV		250 V	18.0 mH	500 mA	750 mΩ	6.65 kΩ	36.6 dB	2	125 °C	1.50 kV	THT	18.0 mm	13.0 mm	20.0 mm
7446120027	WE-LF	SV		250 V	27.0 mH	400 mA	1.20 Ω	4.86 kΩ	33.9 dB	2	125 °C	1.50 kV	THT	18.0 mm	13.0 mm	20.0 mm
7446120039	WE-LF	SV		250 V	39.0 mH	400 mA	1.70 Ω	4.58 kΩ	33.4 dB	2	125 °C	1.50 kV	THT	18.0 mm	13.0 mm	20.0 mm

7446121007 ×

WE-LF - SV
6.80 mH · 1.00 A

7448030509 ×

WE-CMNC - M
9.00 mH · 5.00 A

744821110 ×

WE-CMB - XS
10.0 mH · 700 mA

Click and type or drop
an Order Code here

Show Panel: CMA DMA Zoom Zdif DEC

Insertion Loss Common Mode @50Ω

7446121007 ×

WE-LF - SV
6.80 mH · 1.00 A

7448030509 ×

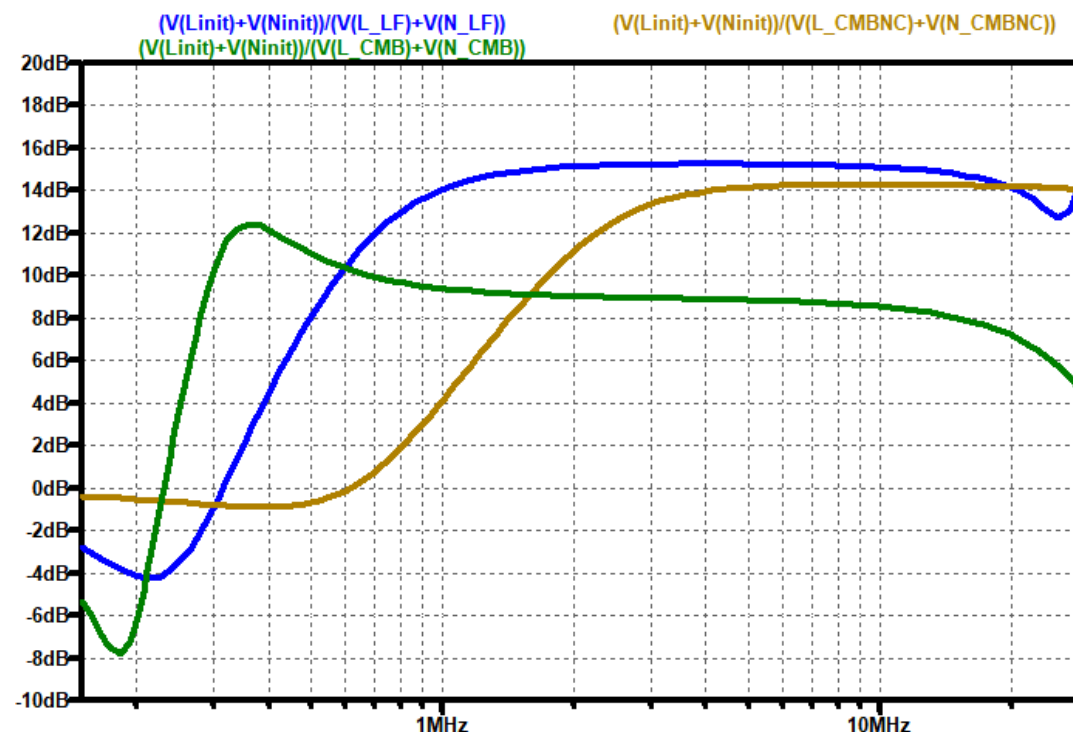
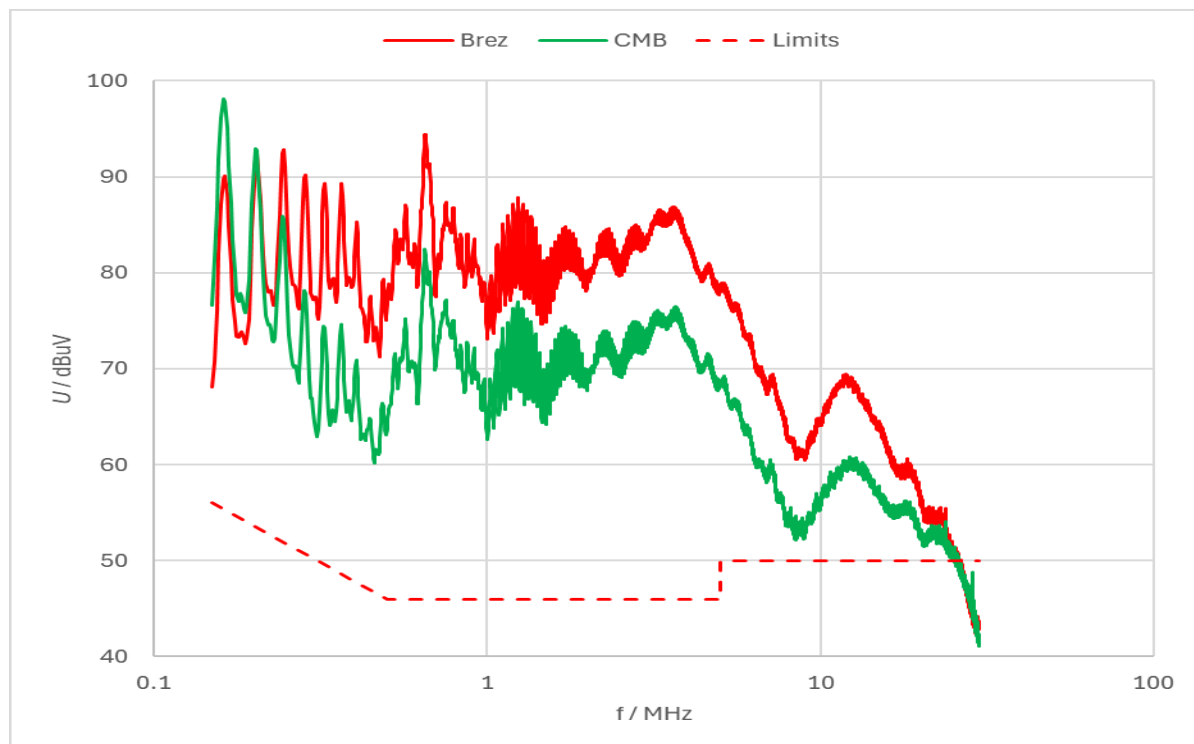
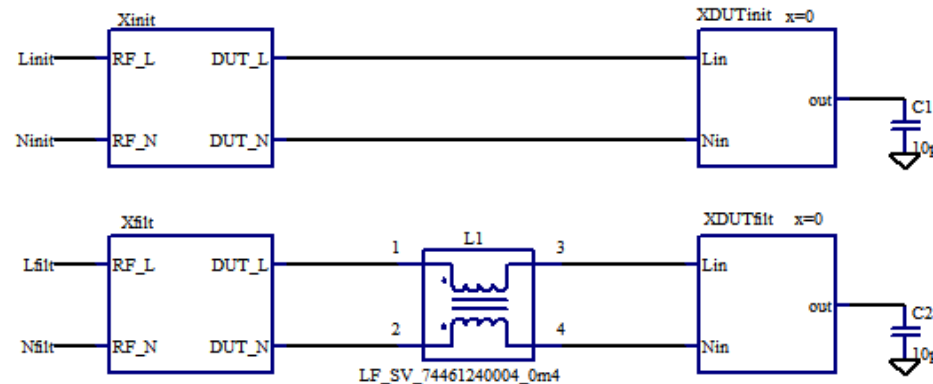
WE-CMNC - M
9.00 mH · 5.00 A

744821110 ×

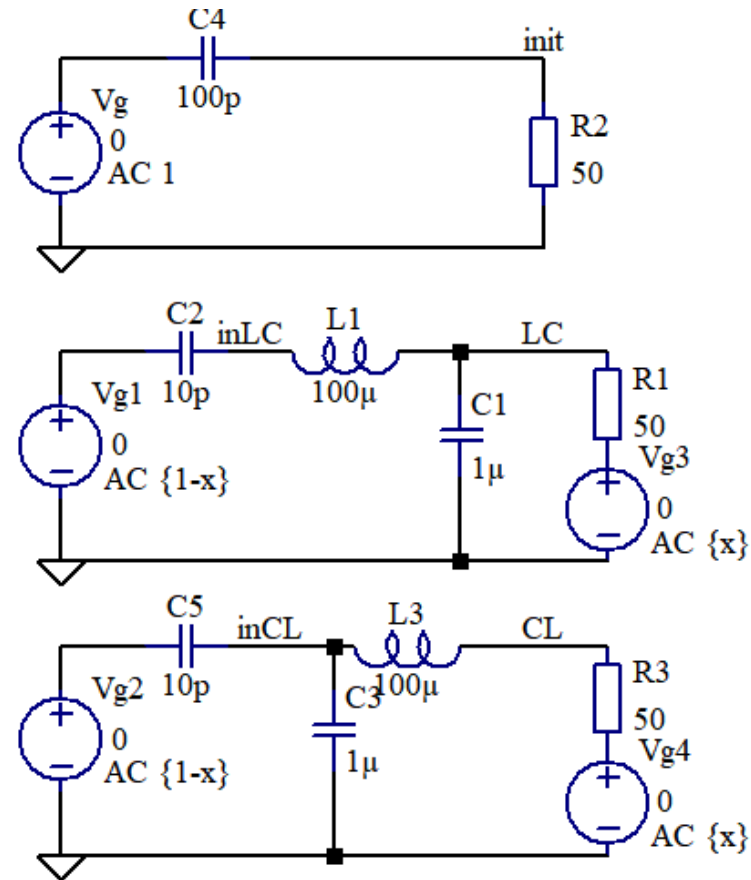
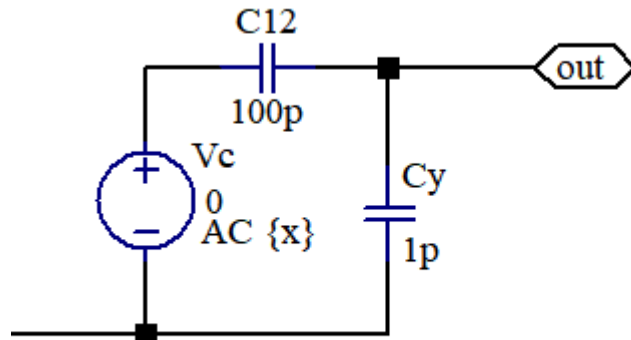
WE-CMB - XS
10.0 mH · 700 mA

Rezultati s CM dušilko

7446121007 × WE-LF - SV 6.80 mH · 1.00 A	7448030509 × WE-CMBCNC - M 9.00 mH · 5.00 A	744821110 × WE-CMB - XS 10.0 mH · 700 mA
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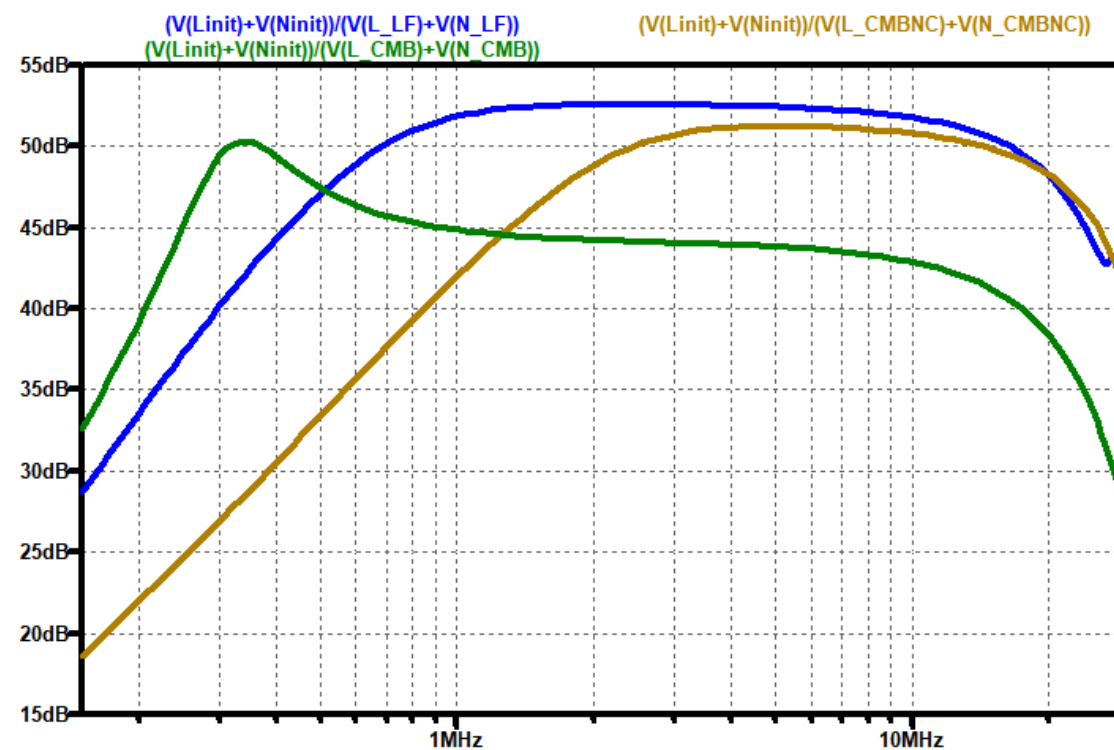
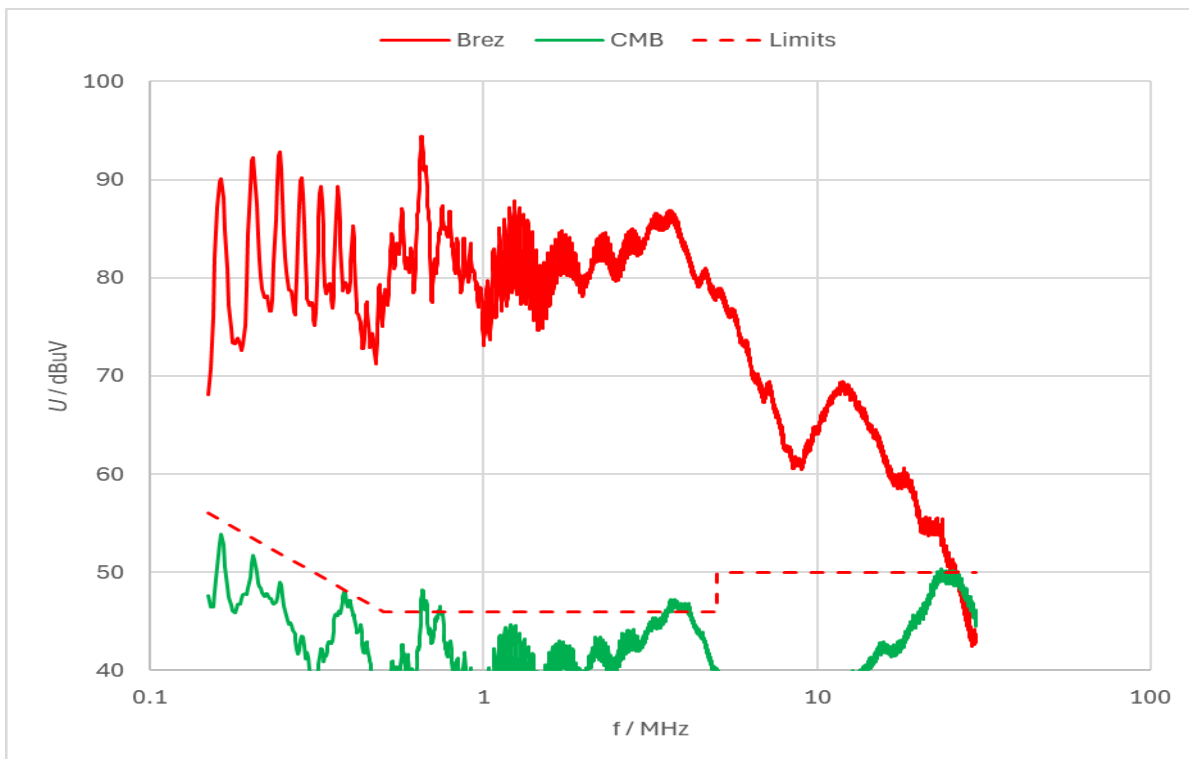
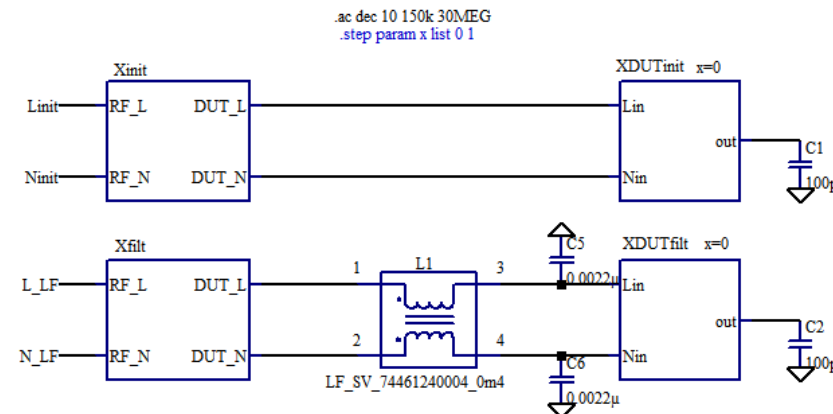
Kapacitivni vir motnje



```
.ac dec 1000 100 100MEG
.param x=0
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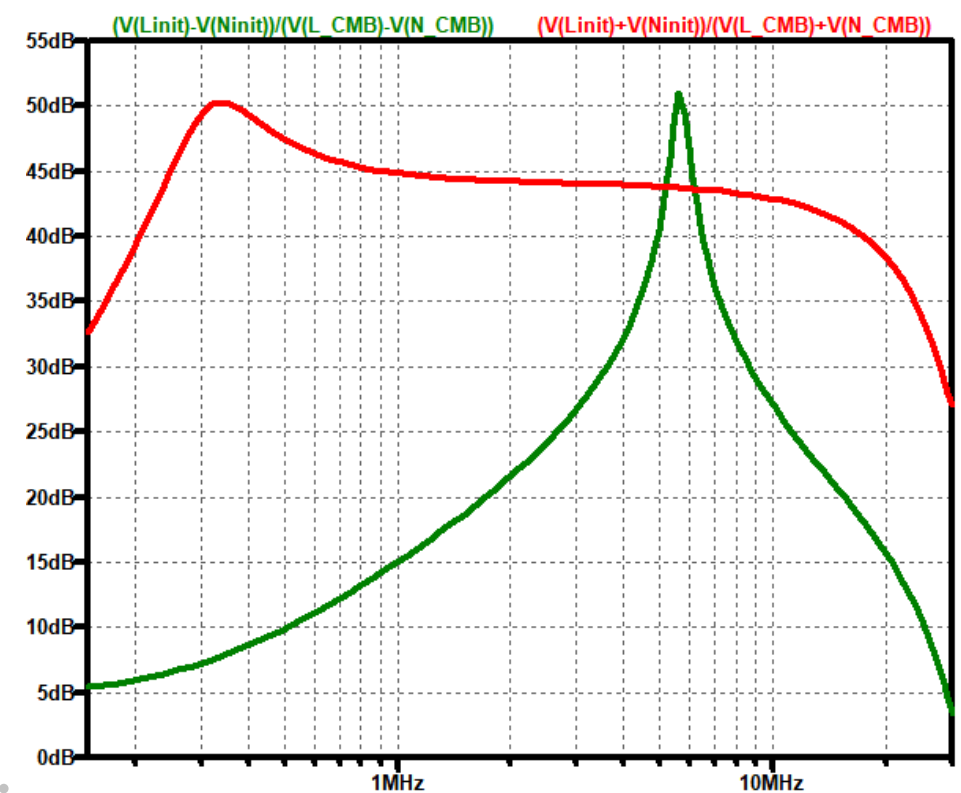
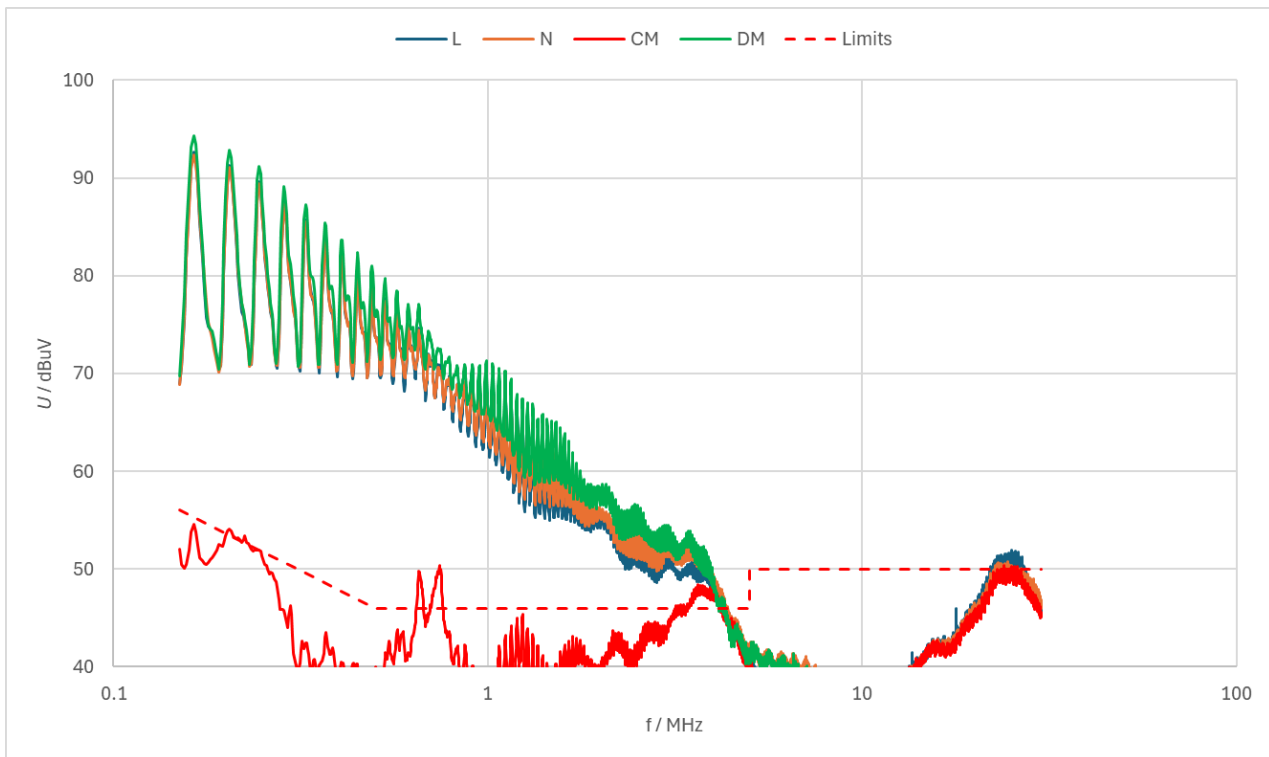
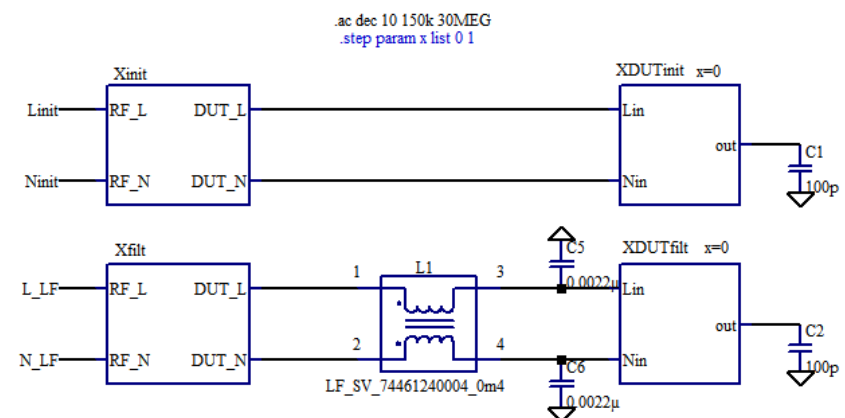
Rezultati s CM dušilko in $Cy=220n$

7446121007 ✕ WE-LF - SV 6.80 mH - 1.00 A	7448030509 ✕ WE-CMBNC - M 9.00 mH - 5.00 A	744821110 ✕ WE-CMB - XS 10.0 mH - 700 mA
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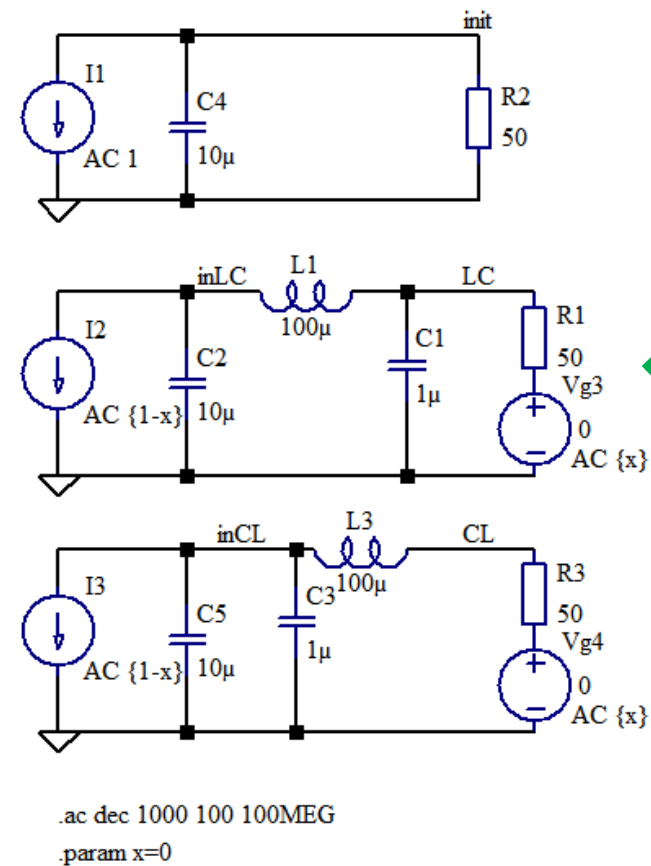
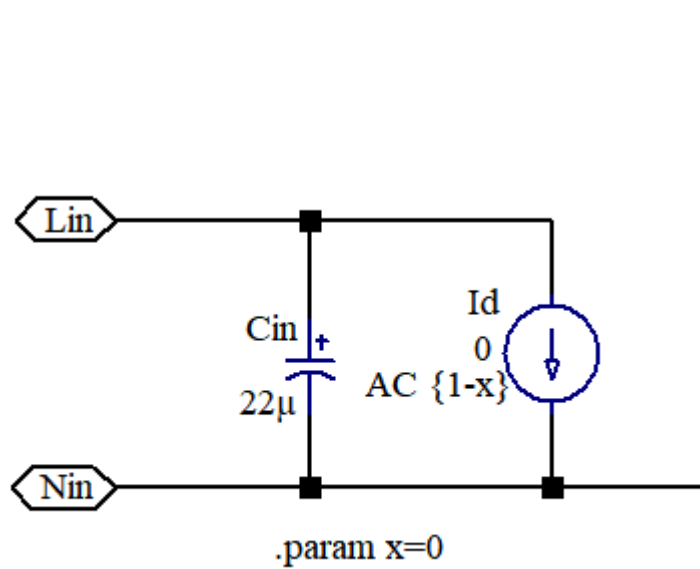


Rezultati s CMB dušilko in $C_y=220n$

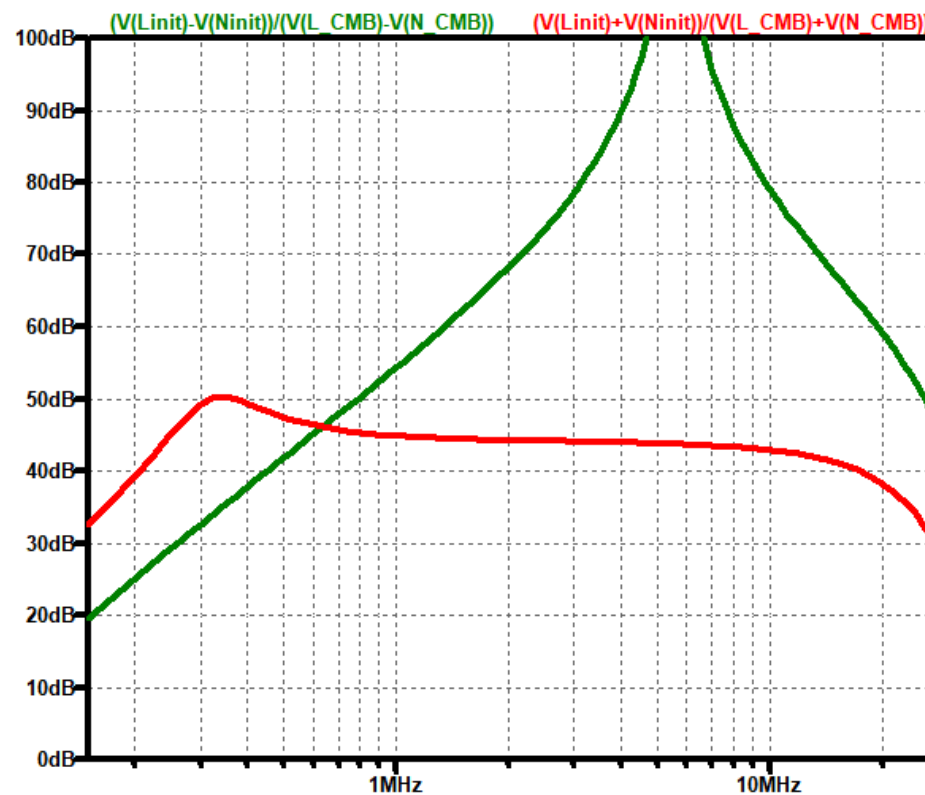
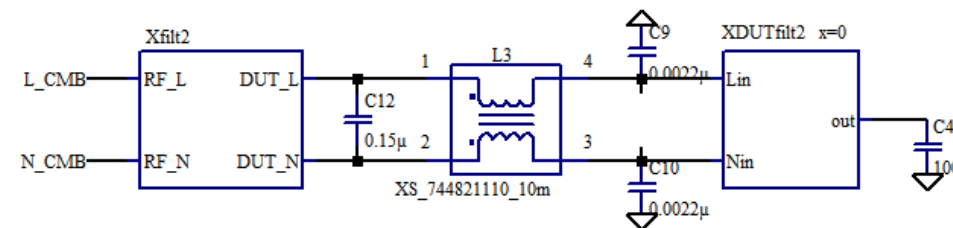
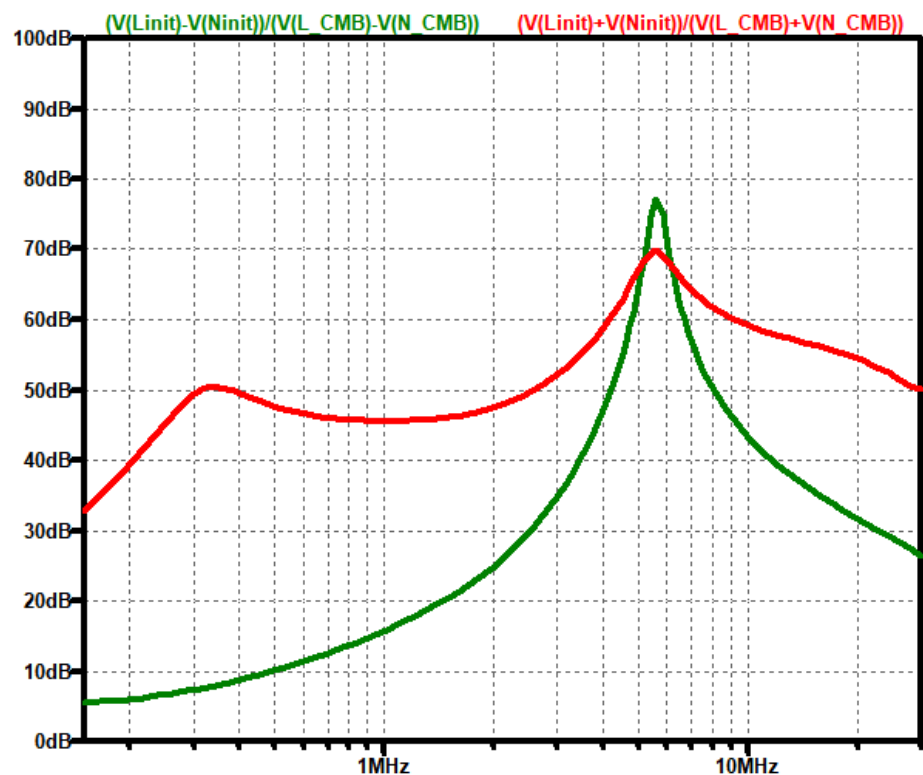
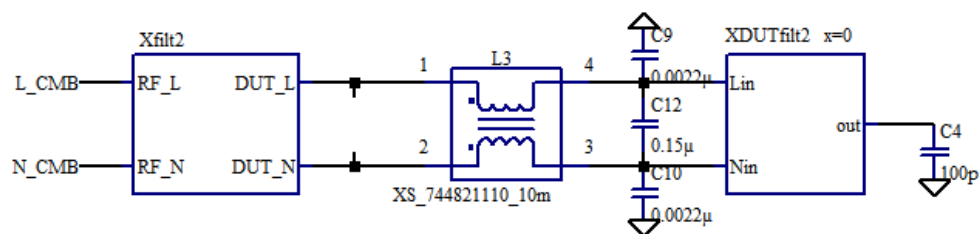
7446121007 × WE-LF · SV 6.80 mH · 1.00 A	7448030509 × WE-CMBNC · M 9.00 mH · 5.00 A	744821110 × WE-CMB · XS 10.0 mH · 700 mA
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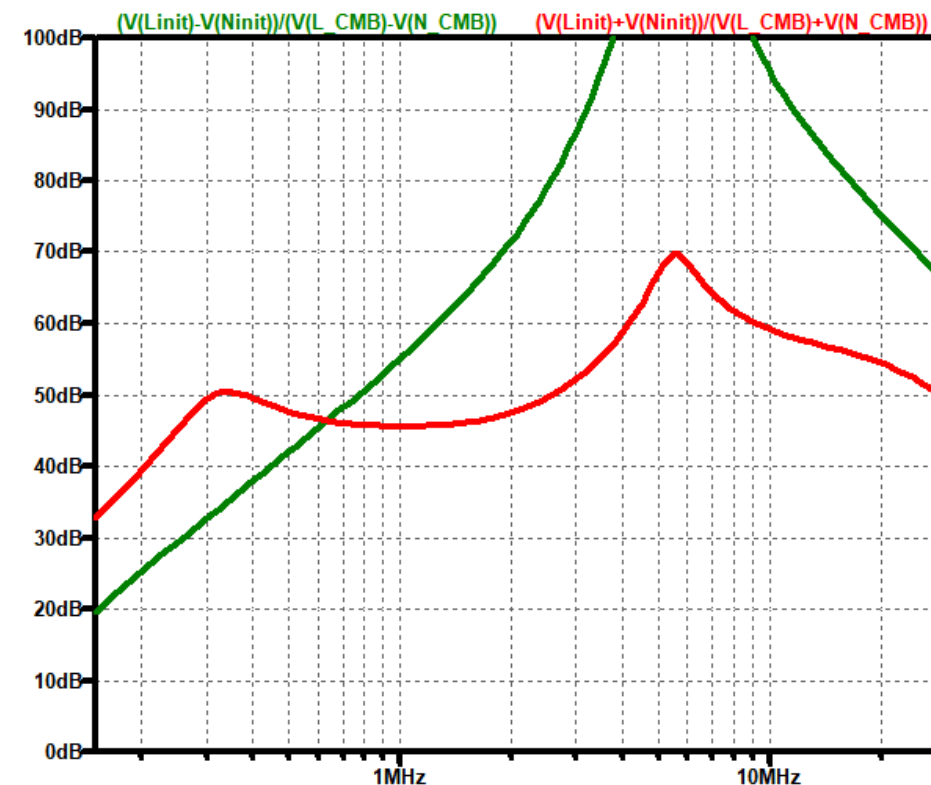
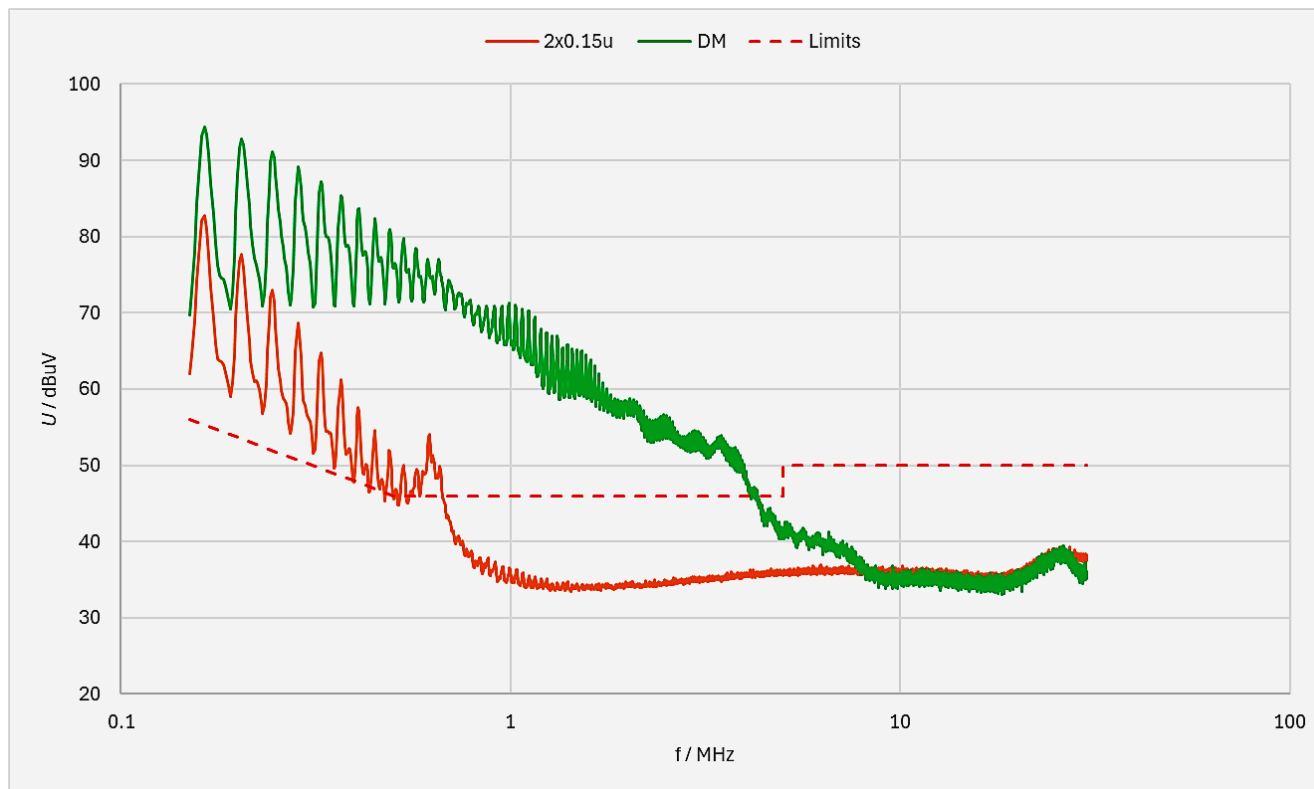
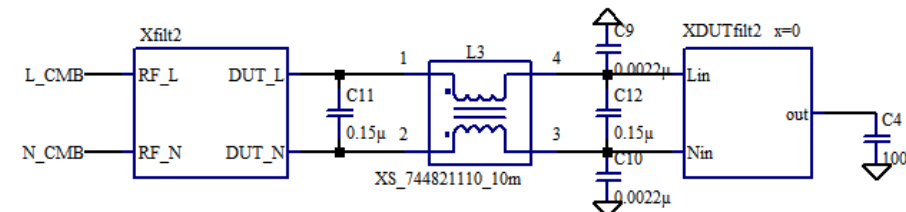
Kam postaviti x kondenzator?



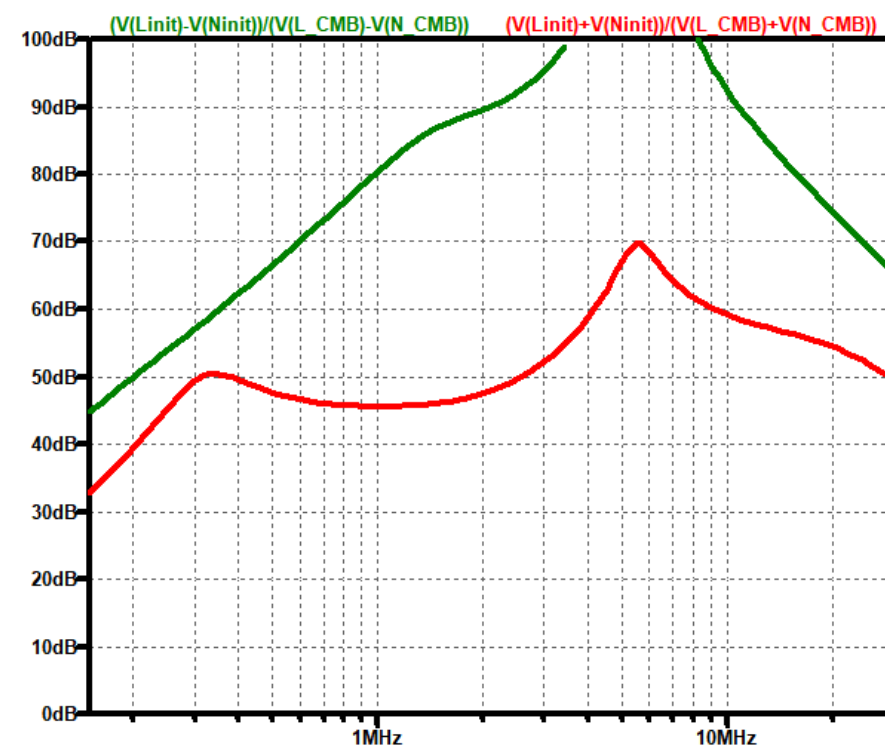
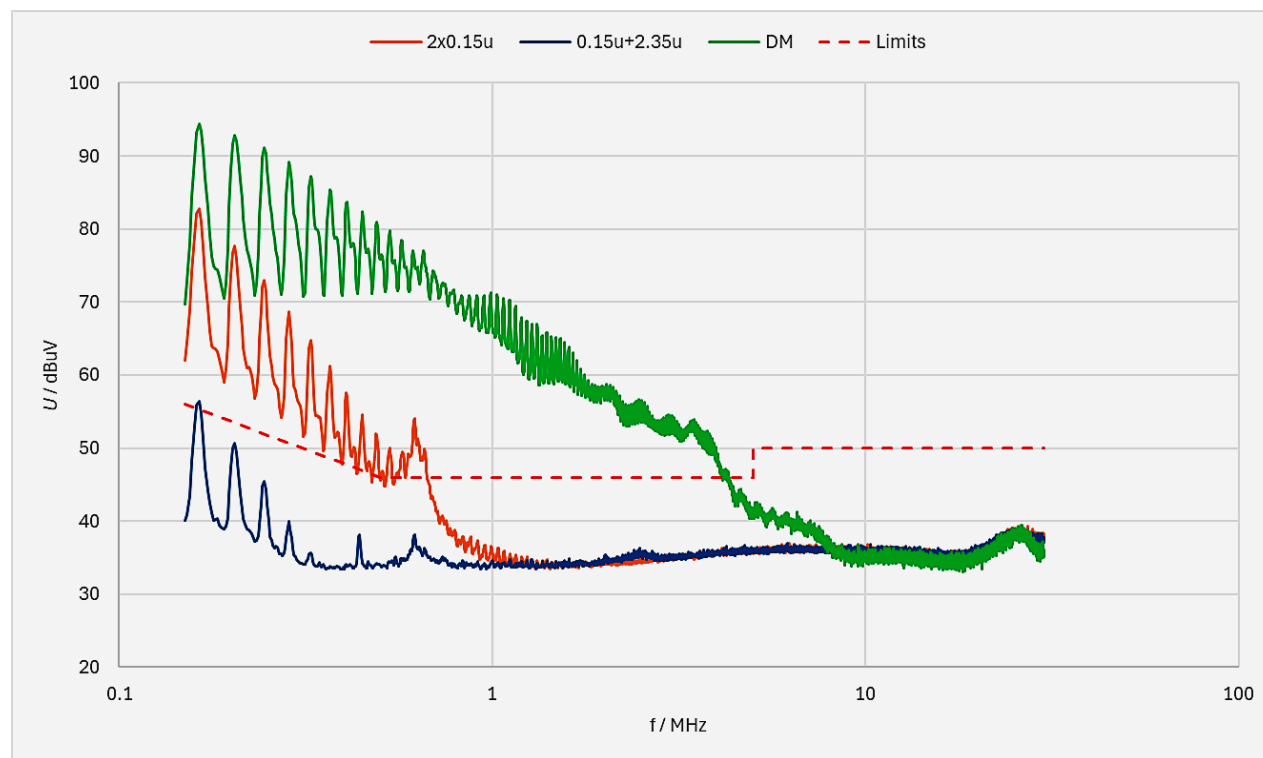
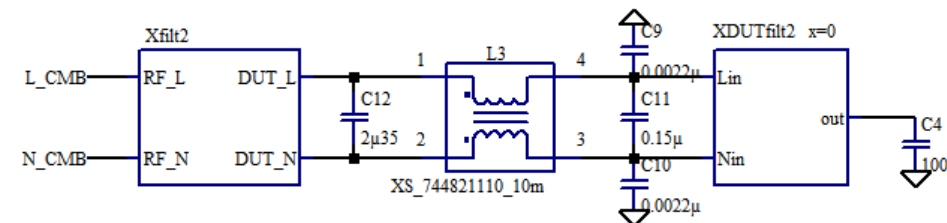
Kam postaviti x kondenzator?



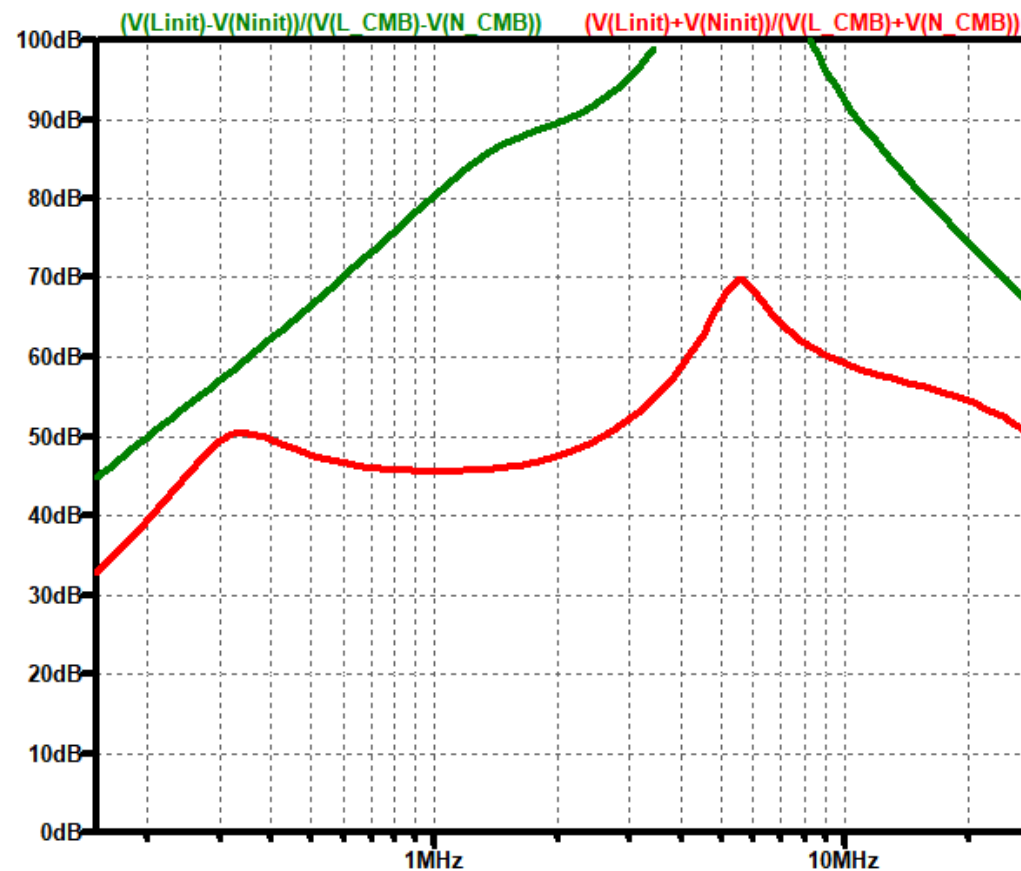
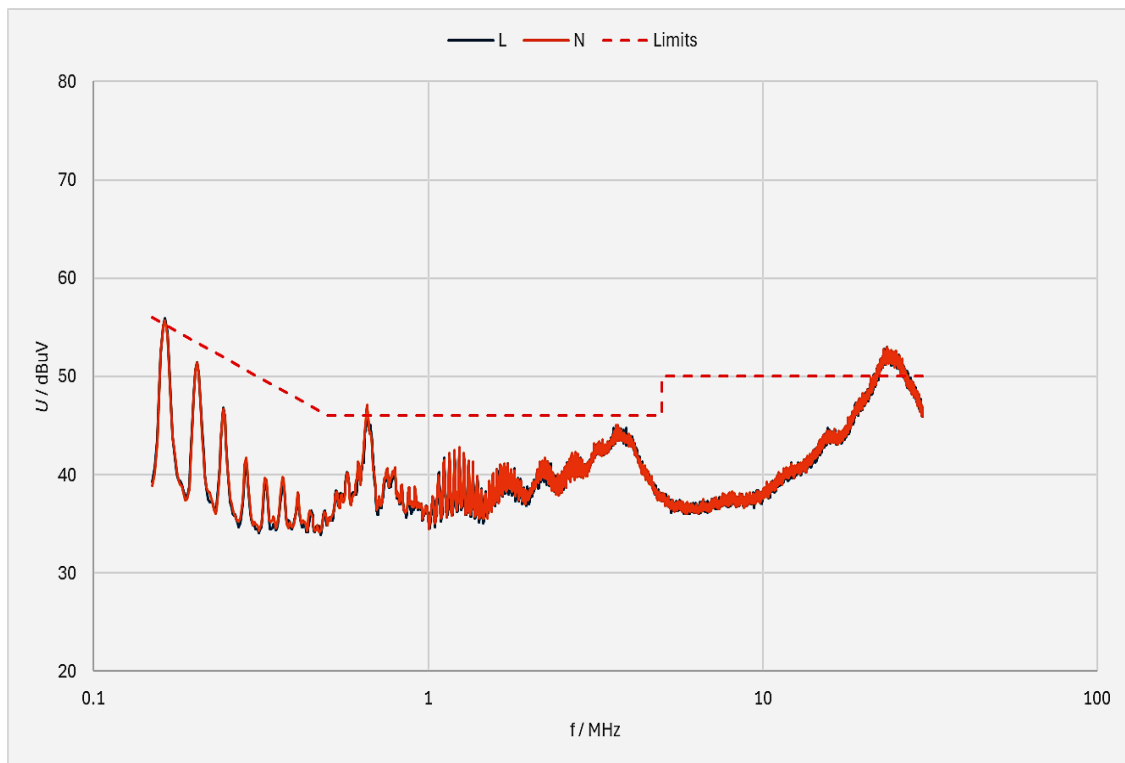
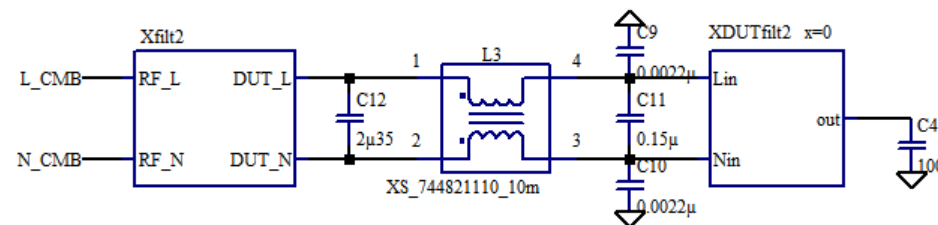
Rezultati s CMB dušilko, Cy in 2x Cx=0u15



Rezultati s CMB dušilko, Cy in 2x Cx=0u15 + 2u2



Končni rezultat



Zdaj pa zares končni rezultat

