

DIGITAL WE DAYS

2023



SIMPLIFY FILTER CALCULATION
AND SELECTION WITH REDEXPERT
EMI FILTER DESIGNER

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

TODAY'S SPEAKERS



PRESENTATION

Robert Schillinger
Field Application Engineer



MODERATION

Markus Eberle
Marketing Department

INFORMATION ABOUT THE WEBINAR

You are muted during the webinar.

However, you can ask us questions using the chat function.

Duration of the presentation 30 Min
Q&A: 10 – 15 Min

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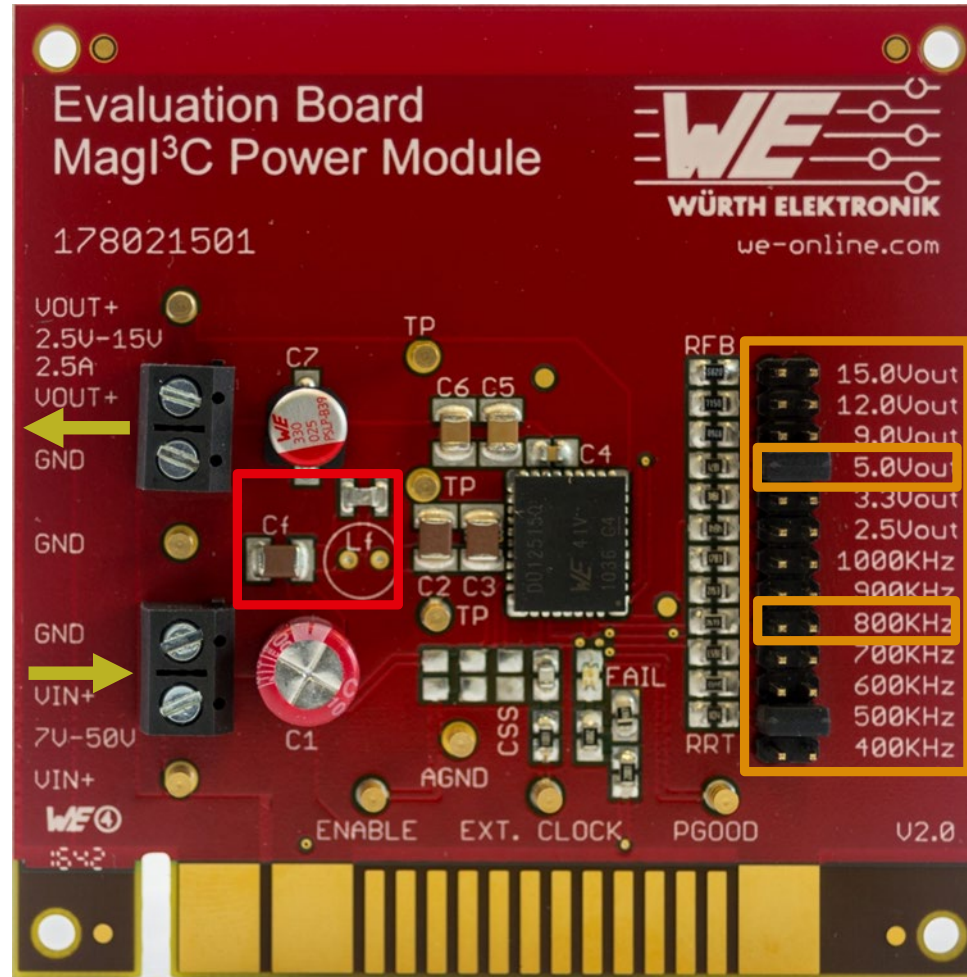


DEMO EVAL BOARD

VDRM QFN-41

Output: 2.5V-15V@2.5A

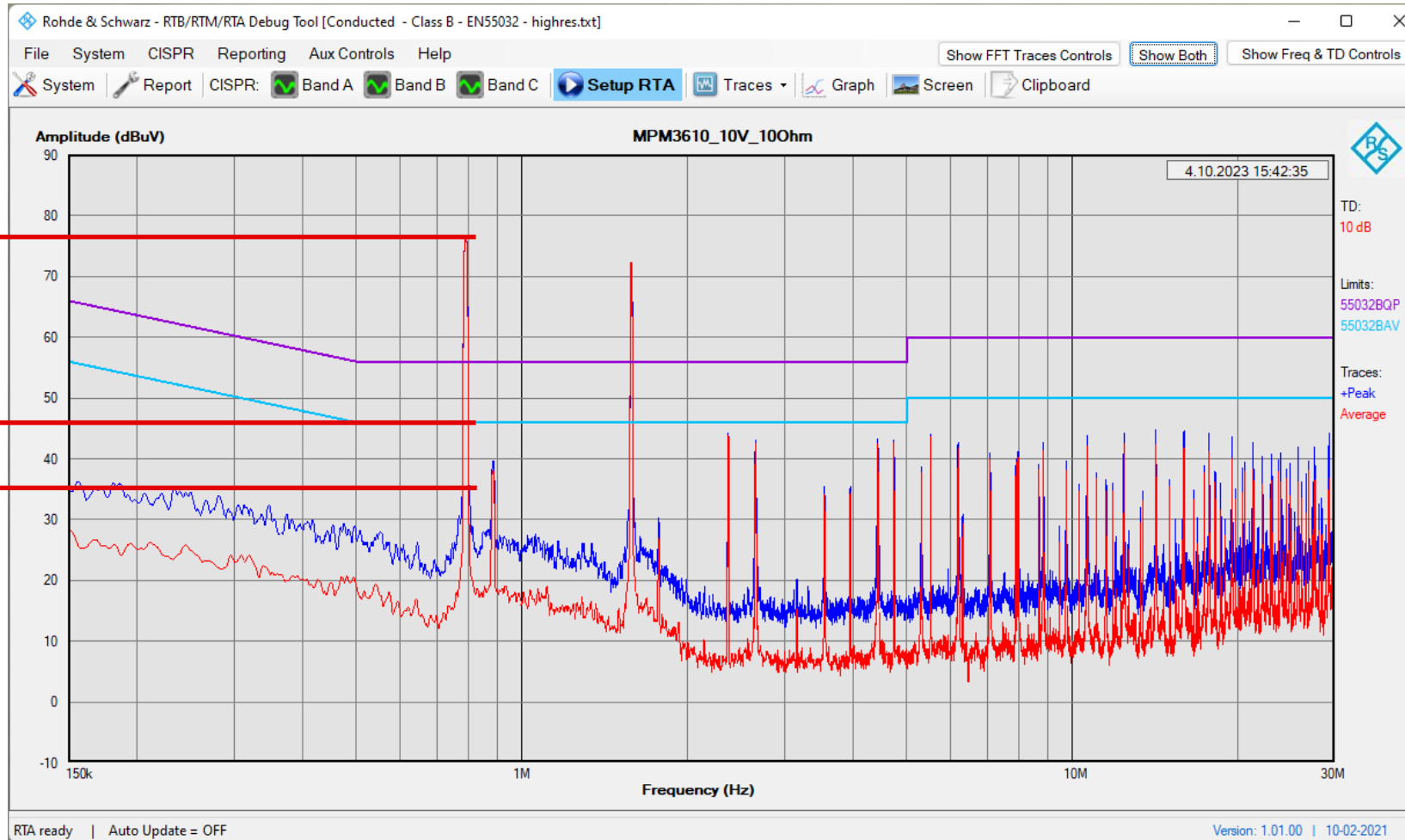
Input: 7V-50V



Configuration area for output voltage and switching frequency

DEMO EVAL BOARD

Conducted emissions without filters



76dBuV@800kHz

46dBuV avg. limit

36dBuV target

FILTER DESIGNER



From lab to desk
in seconds with
REDEXPERT

< Design Tools

- EMI Filter Designer
- Impedance Finder for PCB Ferrites
- Pulse Current for PCB-Ferrites



REDEXPERT Filter Designer



MENU

PARAMETERS

SELECTION AND SIMULATION

SUMMARY

NEXT >

EMI Filter Designer for differential mode:

Use this application to design a discrete electronic EMI filter for conducted differential noise, for example from your DC-DC converter, and evaluate the realistic response based on real components.

Project's Title:

Title
My EMI Filter project

Input parameters:

Operating voltage 12 V Operating current 0.5 A

Load / LISN impedance 50 Ω Noise source impedance 0.1 Ω

Cut-off frequency
 100 kHz

Attenuation 35 dB at Frequency 350 kHz

Topology:

RECOMMENDED

- LC
- CL
- Pi
- T-Filter
- 4th-Order LC-LC
- 4th-Order CL-CL

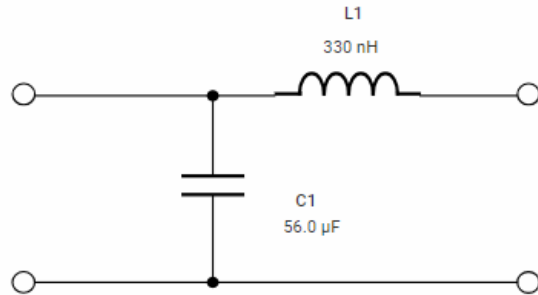
System impedance is important for power transfer

Input parameters determine recommended topology

Advanced



My EMI Filter project



Selected real components



C1		56.0 µF	63.0 V	3.90 mΩ	
L1		330 nH	800 mA	0.160 Ω	

Details

Calculated C1 Capacitance

48.3 µF

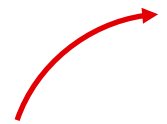
Calculated L1 Inductance

241 nH

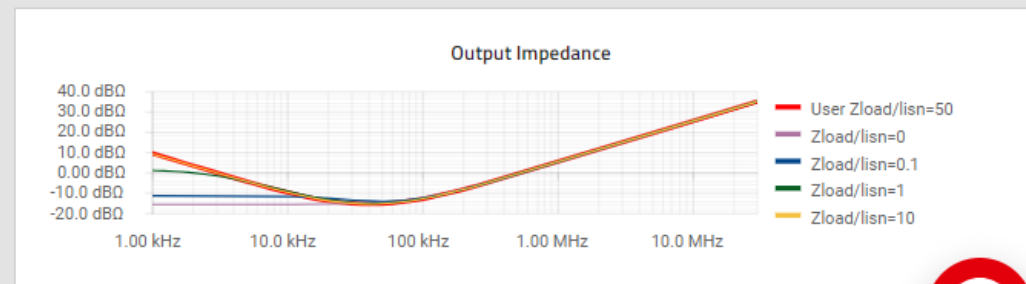
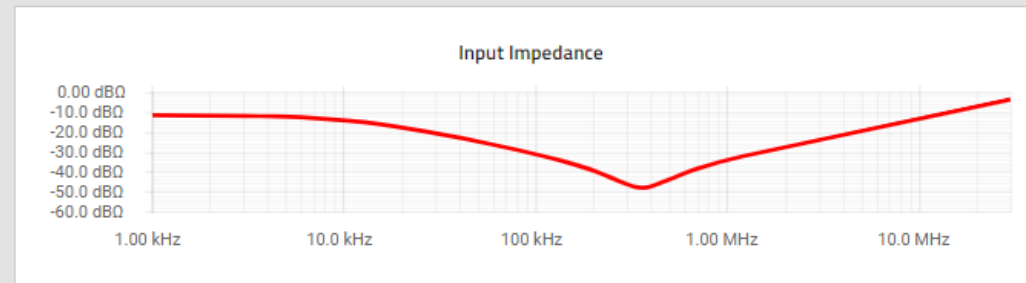
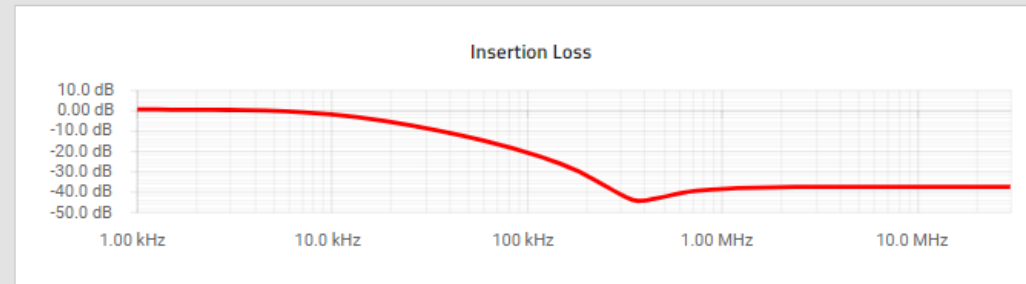
Insertion Loss

-44.3 dB@350 kHz

Calculated ideal components



Achieved attenuation at frequency with real components

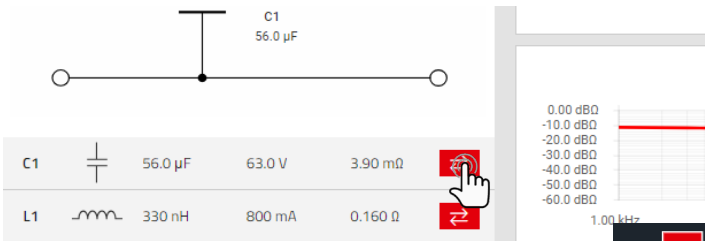


i The component selection is based on the ideal component model. The filter details and response charts show the parasitics of the real component equivalent model. Tip: If the required attenuation is not achieved, reduce the cutoff frequency, select the next bigger component value or manually select a component.

Simulation with real components

Output impedance is important for stability with SMPS





Details

Calculated C1 Capacitance

Insertion Loss

Choose another recommended component

Inspect DC-bias capacitance and other parameters

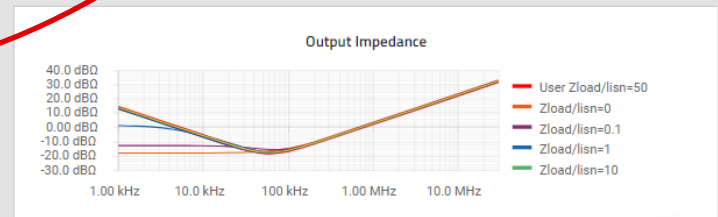
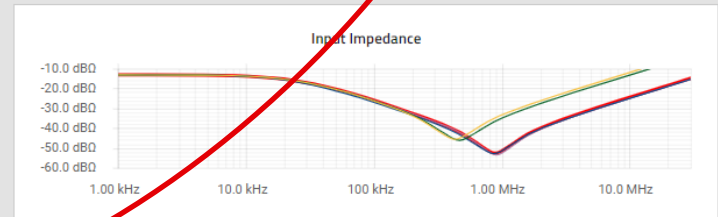
WÜRTH ELEKTRONIK **REDEXPERT** Filter Designer WURTH ELEKTRONIK WÜRTH ELEKTRONIK REDEXPERT Filter Designer WURTH ELEKTRONIK WÜRTH ELEKTRONIK REDEXPERT Filter Designer

PARAMETERS SELECTION AND SIMULATION SUMMARY **GET SUMMARY >**

HIGHLIGHTED ITEM REPLACES C1 ADD MORE

	C	C@5.00 V	Assy	ESR	V _R	Footprint	H	T _{MAX}	Att@200 kHz
<input checked="" type="checkbox"/>	47.0 μF	33.3 μF	SMT	2.31 mΩ	6.30 V	8.00 mm ²	2.50 mm	85.0 °C	-22.9 dB
<input type="checkbox"/>	47.0 μF	33.8 μF	SMT	2.10 mΩ	10.0 V	8.00 mm ²	2.50 mm	85.0 °C	-23.1 dB
<input type="checkbox"/>	47.0 μF	37.3 μF	SMT	2.26 mΩ	16.0 V	8.00 mm ²	2.50 mm	85.0 °C	-24.0 dB
<input type="checkbox"/>	33.0 μF	33.0 μF	THT	4.90 mΩ	63.0 V	78.5 mm ²	10.0 mm	105 °C	-24.1 dB
<input type="checkbox"/>	33.0 μF	33.0 μF	THT	5.20 mΩ	63.0 V	78.5 mm ²	10.0 mm	125 °C	-24.4 dB

Compare achieved attenuation



The component selection is based on the ideal component model. The filter details and response include parasitics of the real component equivalent model. Tip: If the required attenuation is not achieved, reduce the cutoff frequency, select the next bigger component value or manually select a component.



SELECTION AND SIMULATION

ADD MORE

T_{MAX} Att @ 350 kHz

125 °C -41.1 dB

10.0 dB
0.00 dB
-10.0 dB
-20.0 dB

Add a part from complete portfolio

Search part with custom filters

WÜRTH ELEKTRONIK RED EXPERT Components

Rated Voltage = [5.00 V, 3.00 kV] Capacitance = [47.0 µF, 220 µF] Assembling Technology = SMT

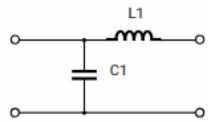
ADD 2 SELECTED TO FILTER DESIGNER

Adding Filters	P/N	C	Assy	DF	V _R	Series	H	T _{MAX}	T _{MIN}	Size	ESR	Footprint	RMS	L	W
Part Number	865060142003	47.0 µF	SMT	22.0%	6.30 V	WCAP-ASLL	5.50 mm	105 °C	-55.0 °C		0.610 Ω	28.1 mm ²		5.30 mm	5.30 mm
Capacitance	865060143004	100 µF	SMT	22.0%	6.30 V	WCAP-ASLL	5.50 mm	105 °C	-55.0 °C		0.520 Ω	43.6 mm ²		6.60 mm	6.60 mm
Assembling Technology	865060143005	150 µF	SMT	22.0%	6.30 V	WCAP-ASLL	5.50 mm	105 °C	-55.0 °C		0.430 Ω	43.6 mm ²		6.60 mm	6.60 mm
	865060145006	220 µF	SMT	22.0%	6.30 V	WCAP-ASLL	7.70 mm	105 °C	-55.0 °C		0.251 Ω	43.6 mm ²		6.60 mm	6.60 mm
	865060243003	47.0 µF	SMT	19.0%	10.0 V	WCAP-ASLL	5.50 mm	105 °C	-55.0 °C		0.330 Ω	43.6 mm ²		6.60 mm	6.60 mm
	865060243004	100 µF	SMT	19.0%	10.0 V	WCAP-ASLL	5.50 mm	105 °C	-55.0 °C		0.480 Ω	43.6 mm ²		6.60 mm	6.60 mm
	865060243005	150 µF	SMT	19.0%	10.0 V	WCAP-ASLL	5.50 mm	105 °C	-55.0 °C		0.490 Ω	43.6 mm ²		6.60 mm	6.60 mm
	865060245006	220 µF	SMT	19.0%	10.0 V	WCAP-ASLL	7.70 mm	105 °C	-55.0 °C		0.377 Ω	43.6 mm ²		6.60 mm	6.60 mm
	865060343004	47.0 µF	SMT	16.0%	16.0 V	WCAP-ASLL	5.50 mm	105 °C	-55.0 °C		0.358 Ω	43.6 mm ²		6.60 mm	6.60 mm
	865060343005	100 µF	SMT	16.0%	16.0 V	WCAP-ASLL	5.50 mm	105 °C	-55.0 °C		0.290 Ω	43.6 mm ²		6.60 mm	6.60 mm
	865060345006	150 µF	SMT	16.0%	16.0 V	WCAP-ASLL	7.70 mm	105 °C	-55.0 °C		0.233 Ω	43.6 mm ²		6.60 mm	6.60 mm

Add selected parts to simulation

Print result to paper or PDF

Circuit Schematic



Specifications [Edit](#)

"My EMI Filter project"
 TYPE: CL
 V_{op}: 5.00 V
 I_{op}: 200 mA
 LOAD / LISN IMPEDANCE: 50.0 Ω
 NOISE SOURCE IMPEDANCE: 100 mΩ
 ILOSS -22.9 dB@200 kHz

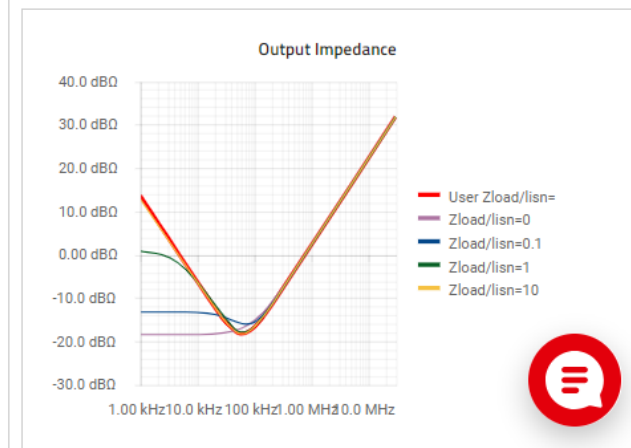
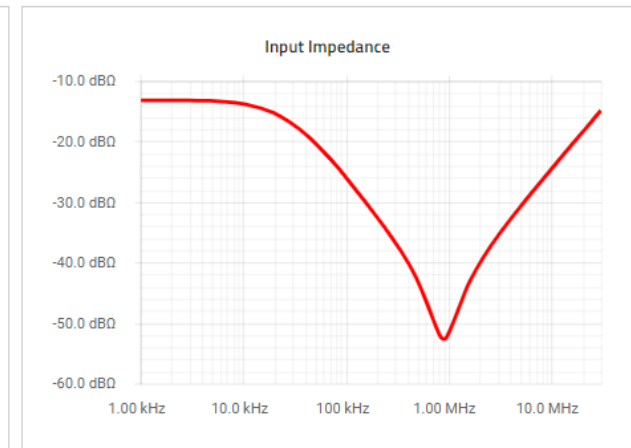
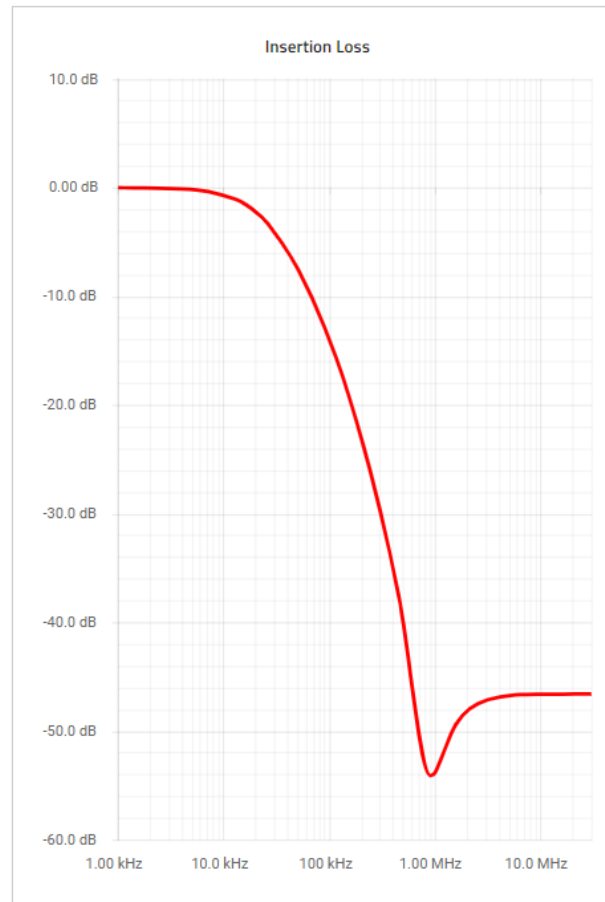
Bill of Materials

 ADD

#	Ma...	Order Code	Value	Properties	Qty
1.	C1	885012109003	47.0 μF	Assembling Technology = SMT Capacitance = 47.0 μF Rated Voltage = 6.30 V Height = 2.50 mm	1
	L1	74479762122	220 nH	Inductance = 220 nH Rated Current = 900 mA	1

Add part to basket for free samples or sending via clipboard

Simulation Responses



EMI FILTER DESIGNER

Demo eval board

The screenshot displays the REDEXPERT Filter Designer interface. The top navigation bar includes 'PARAMETERS', 'SELECTION AND SIMULATION', and 'SUMMARY'. The main content area is divided into three sections:

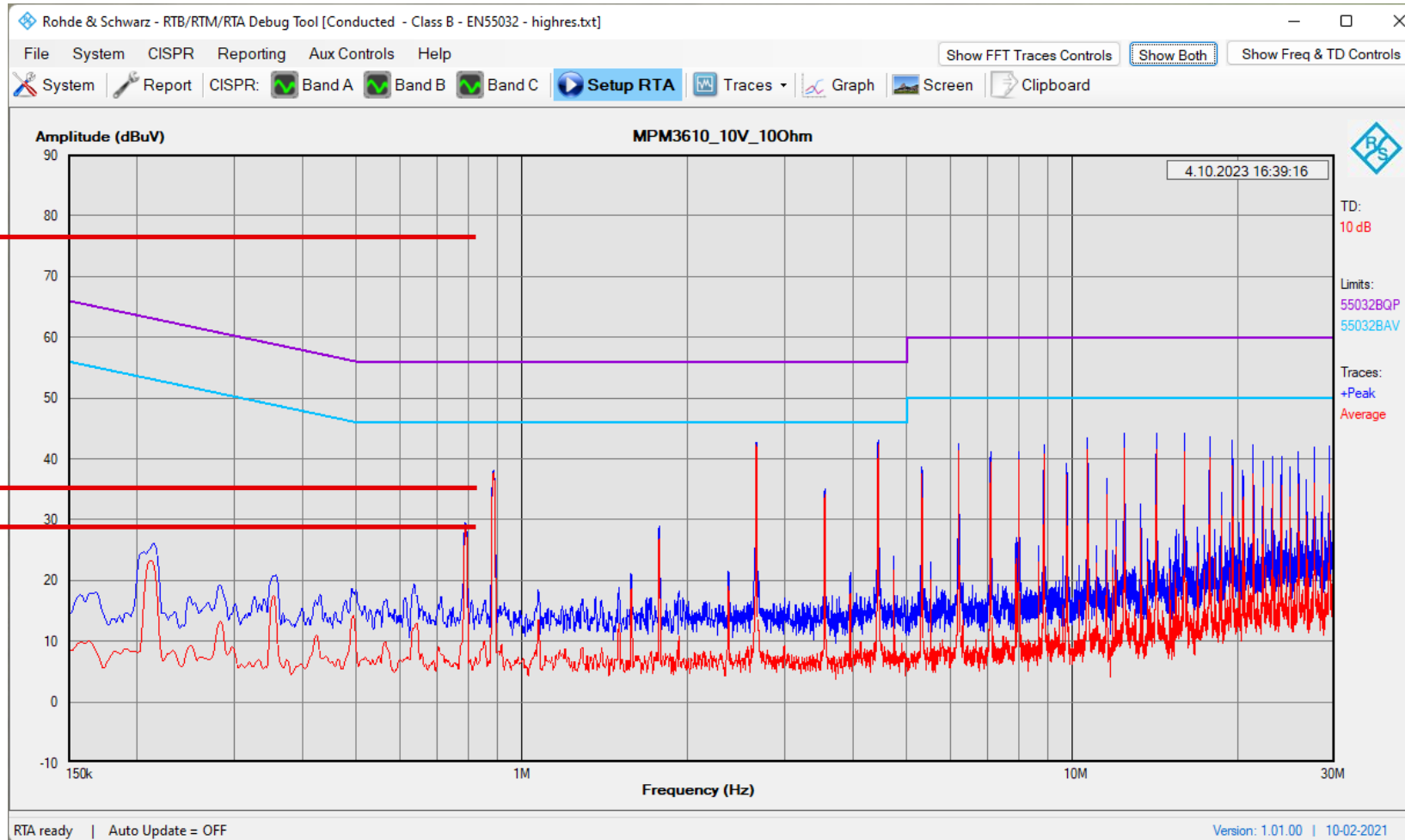
- Circuit Schematic:** Shows a simple LC filter circuit with an inductor L1 and a capacitor C1.
- Specifications:** Lists the filter type as CL, with a voltage of 24.0 V, current of 2.00 A, load/line impedance of 100 Ω, noise source impedance of 100 mΩ, and insertion loss of -19.3 dB at 80.0 kHz.
- Bill of Materials:** A table listing components C1 (2.20 μF) and L1 (22.0 μH).

The **Simulation Responses** section contains three graphs:

- Insertion Loss:** A plot showing a sharp peak at 80 kHz, reaching approximately 20 dB.
- Input Impedance:** A plot showing a resonance peak at 80 kHz, reaching about 35 dB.
- Output Impedance:** A plot showing a resonance peak at 80 kHz, reaching about 80 dB, with multiple curves for different load/line impedance ratios.

DEMO EVAL BOARD

Conducted emissions with filters



76dBuV@800kHz

36dBuV target
28dBuV with filters

Questions

& Answers



We are here for you now!
Ask us directly via our chat or via E-Mail.

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Robert.Schillinger@we-online.de