

LPVO Laboratorij za fotovoltaike
in optoelektroniko

LES Laboratorij za
električne stroje

LRTME Laboratorij za regulacijsko tehniko
in močnostno elektroniko

GEMmotors

MAHLE

SIQ

FORVIA

HELLA

**INSTRUMENTATION
TECHNOLOGIES**

AMITEH

INTECTIV

goap

ISKRAEMECO +

WE
WÜRTH ELEKTRONIK

**COMPUTER
CONTROLS**

ELEKTRONIKE svet

Načrtovanje elektronike za

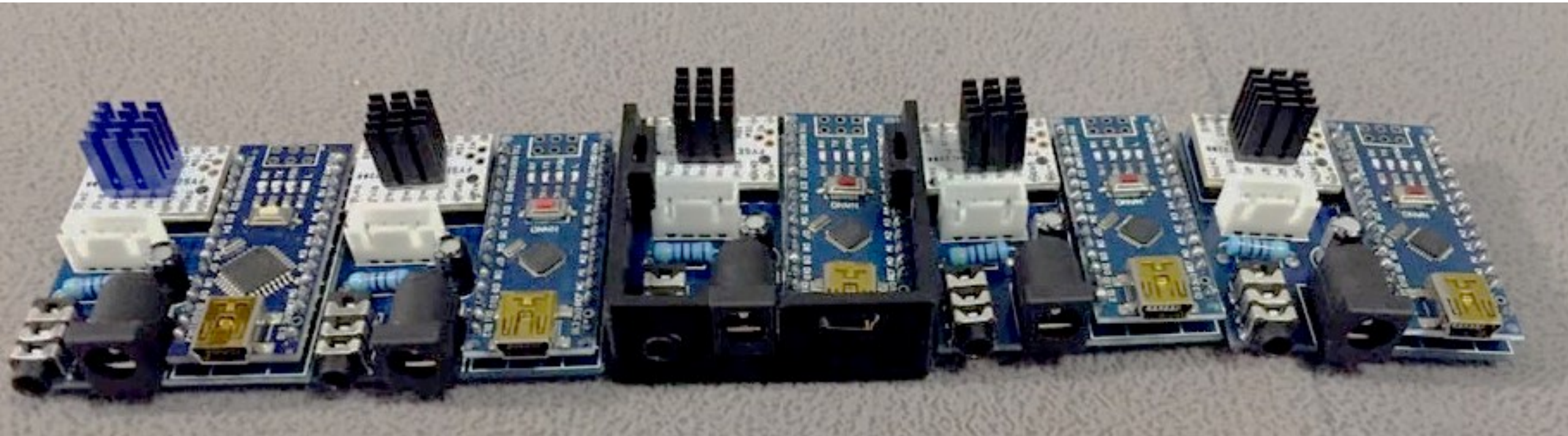
EMC²

60 YEARS

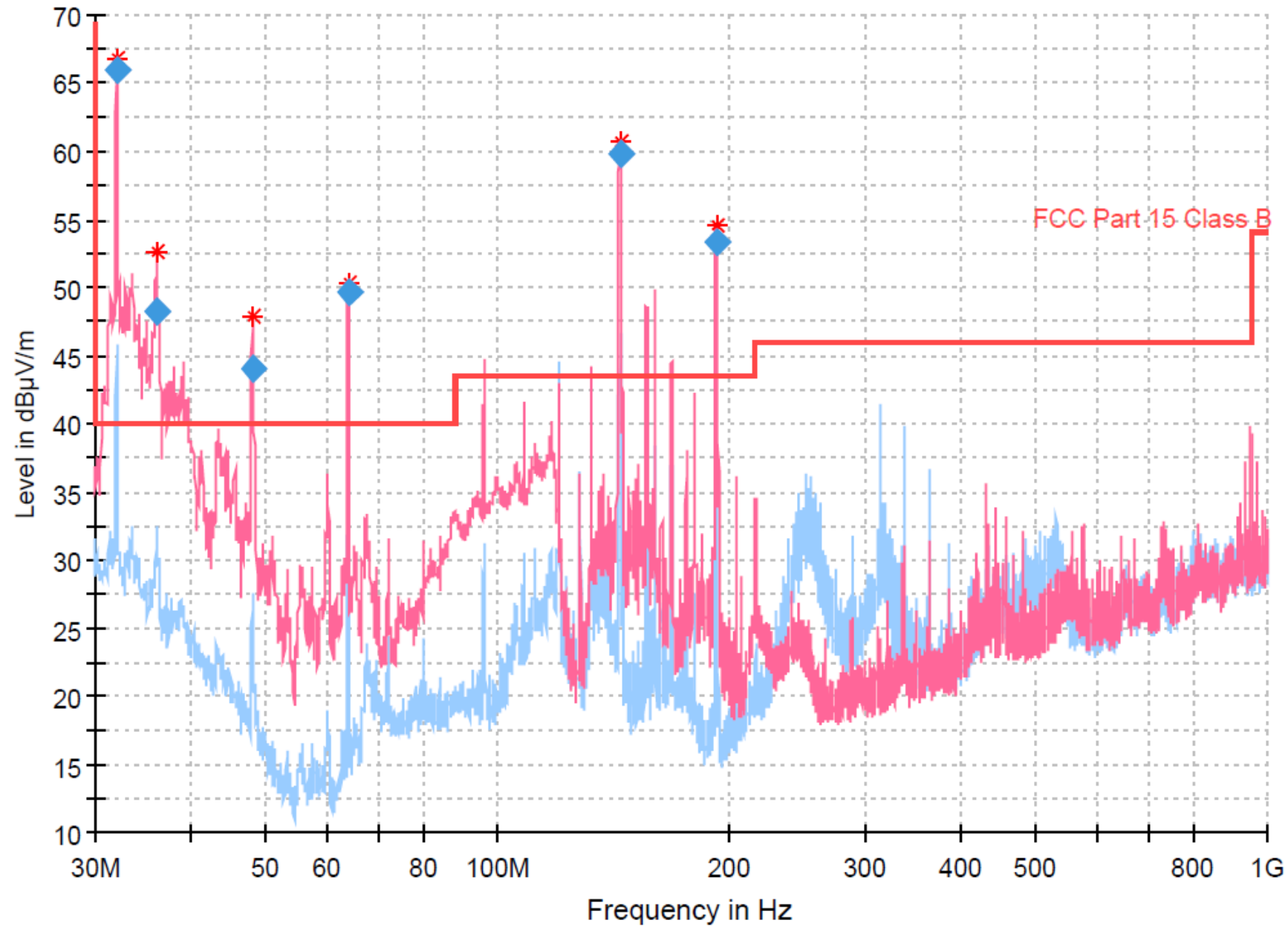
KOLEKTOR

Torki ob 16:15 v P3-C0

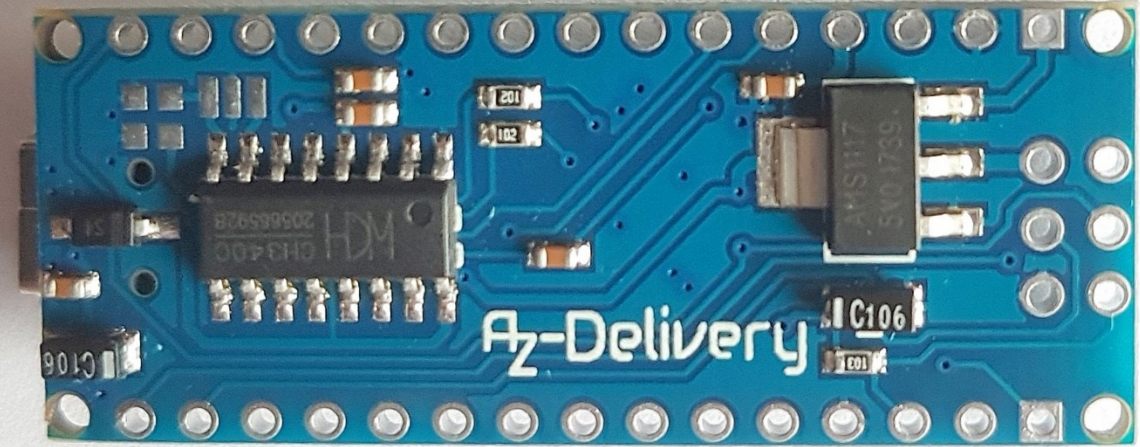
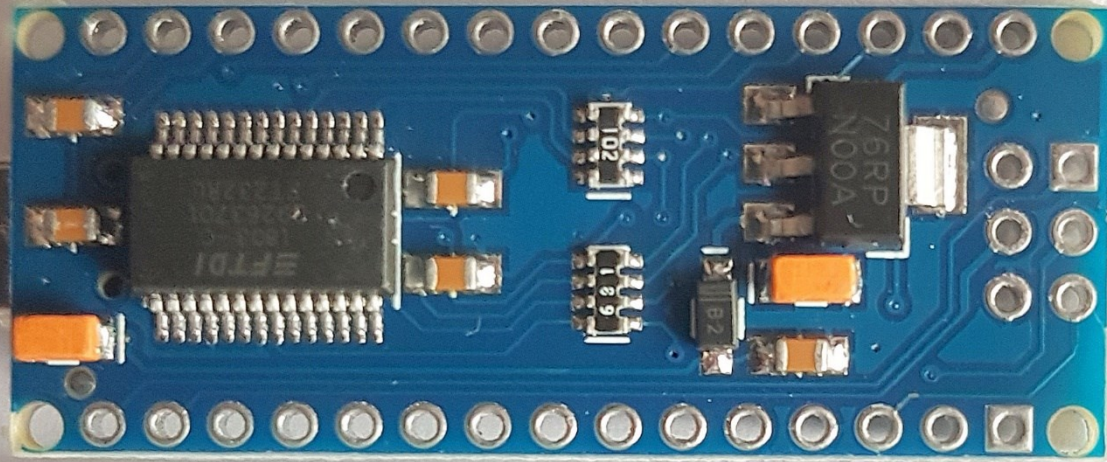
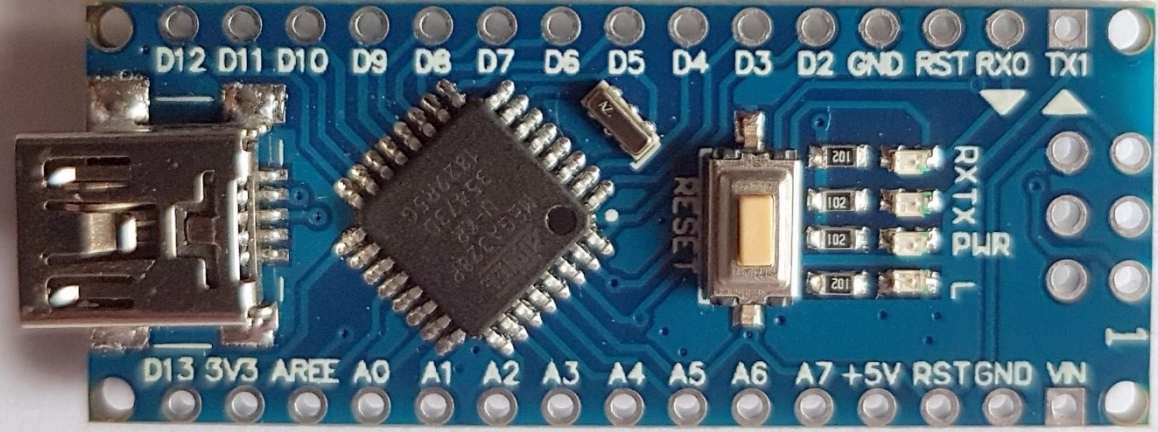
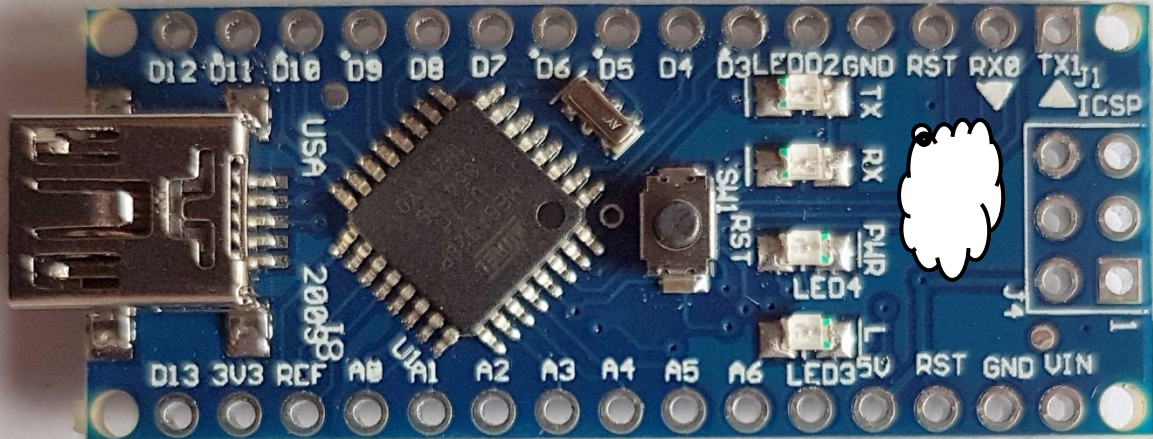
Zakaj?



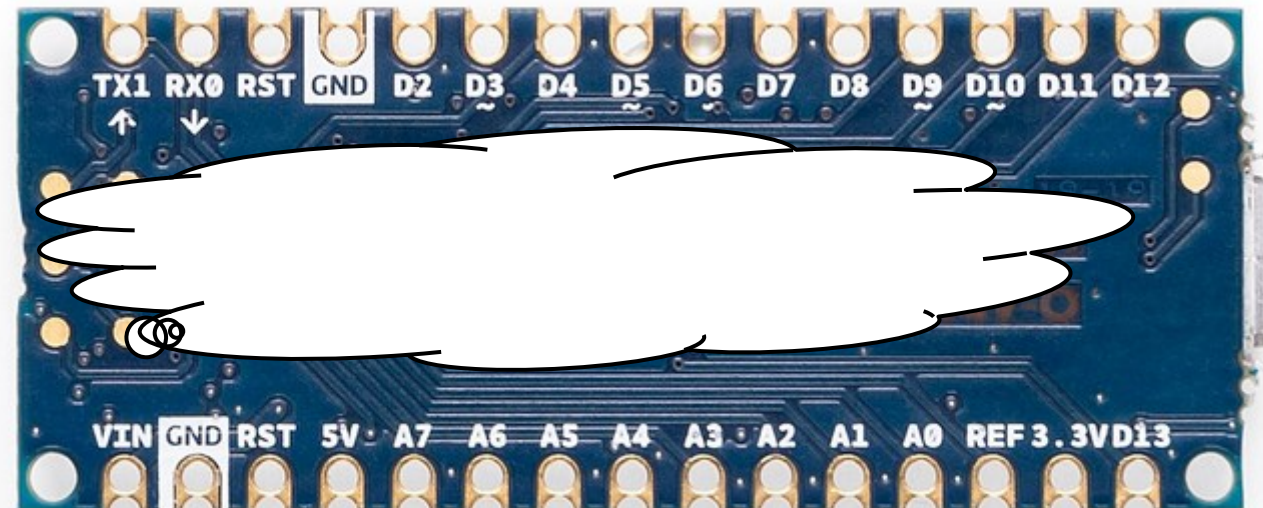
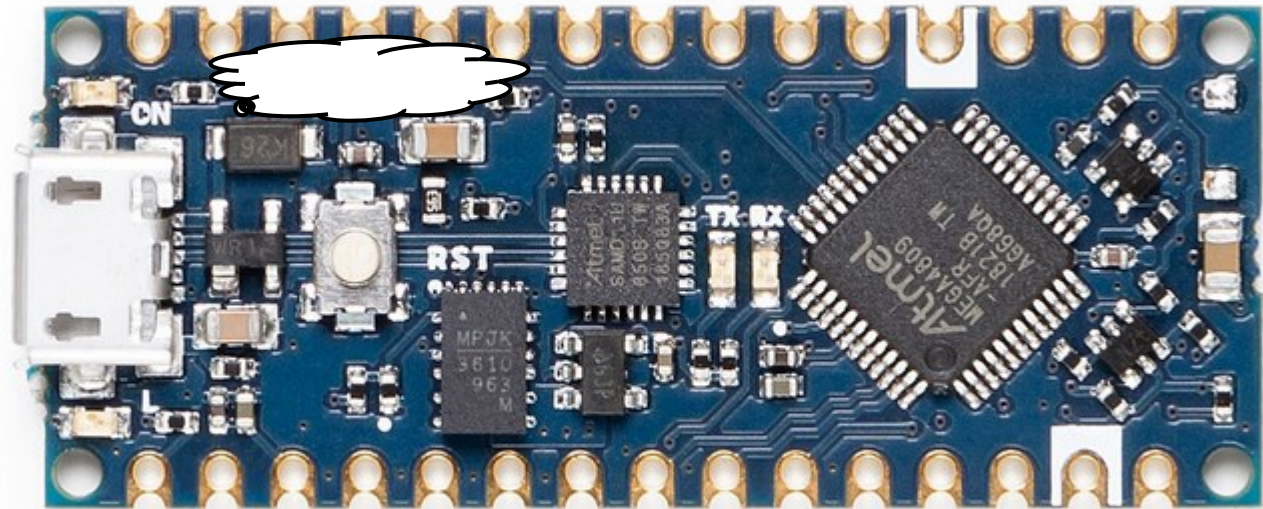
Zato!



Zakaj?

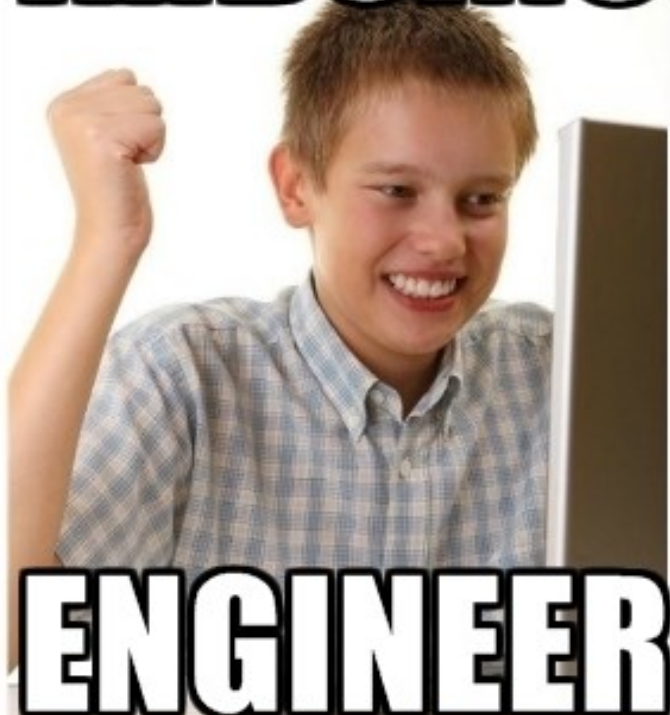


Rešitev?



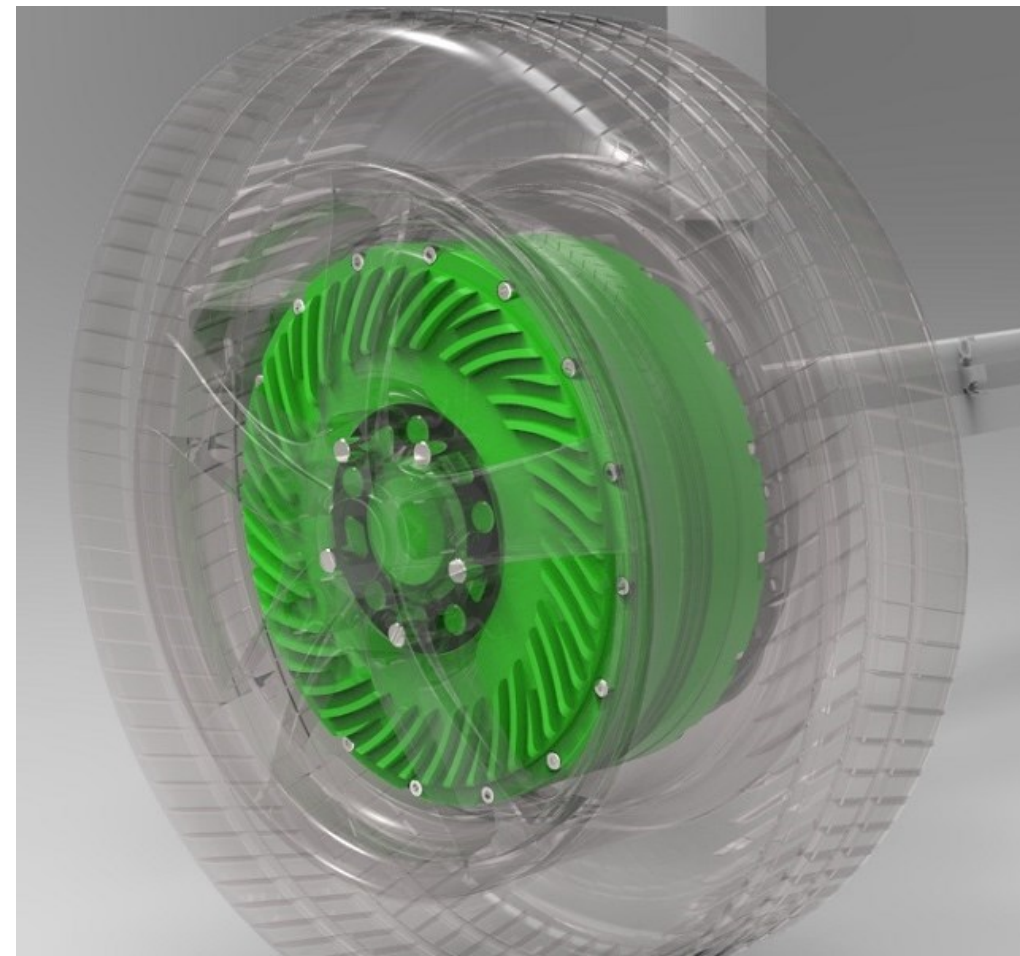
Čemu?

ARDUINO



ENGINEER

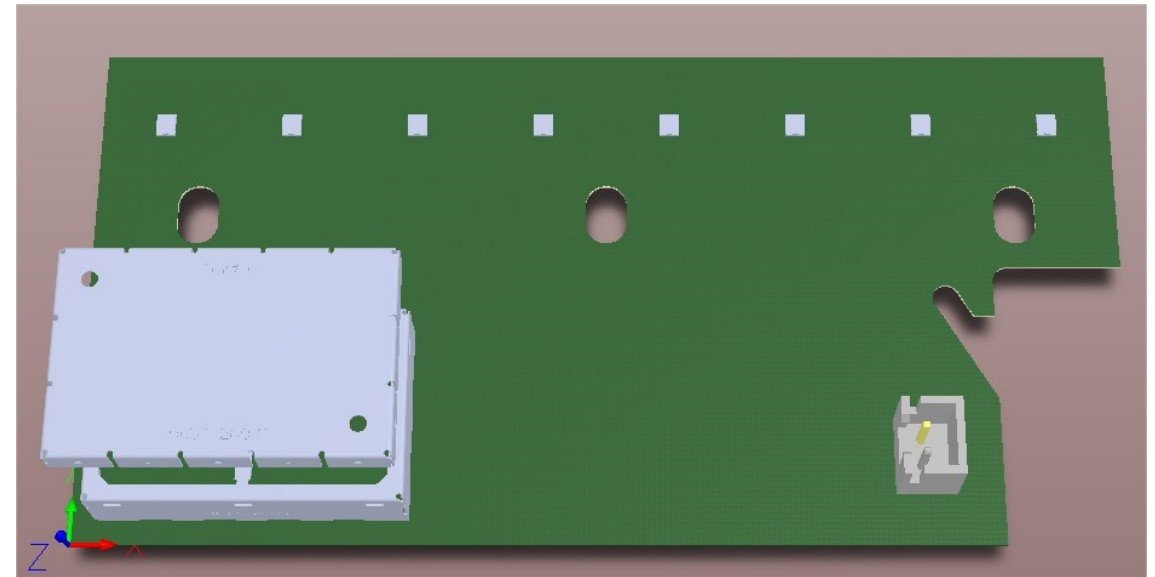
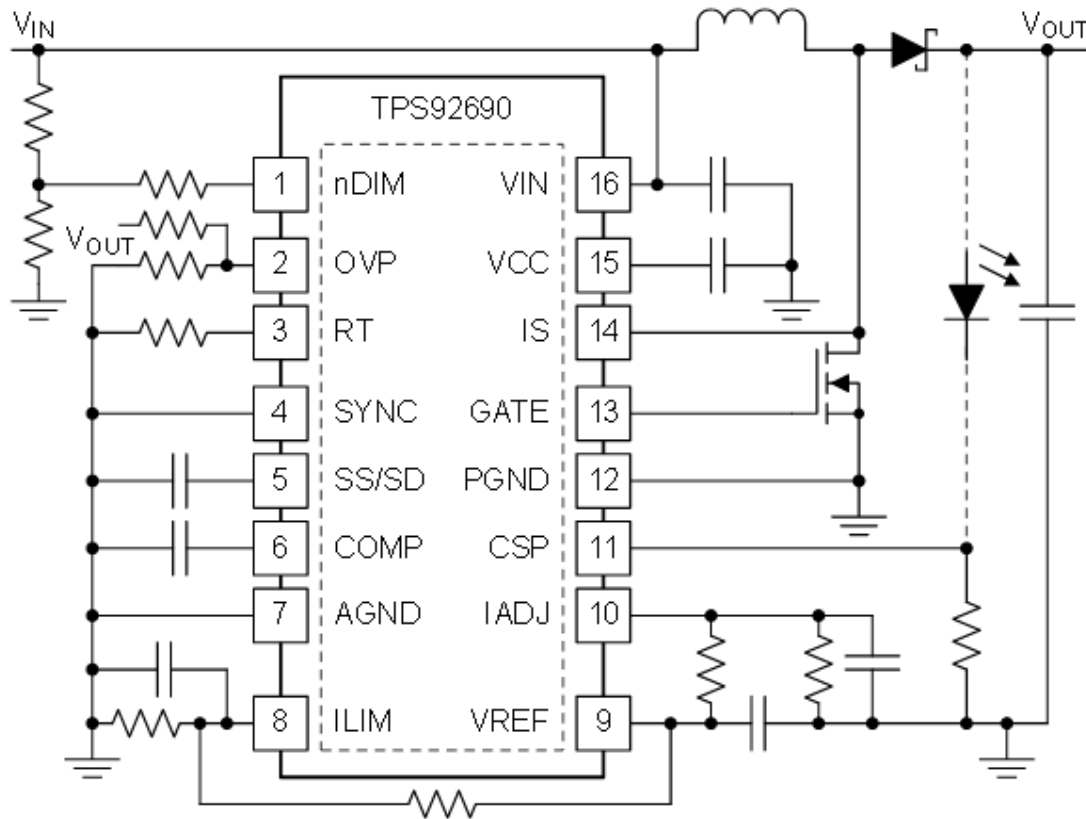
memegenerator.net



1. EMC delavnica 2016



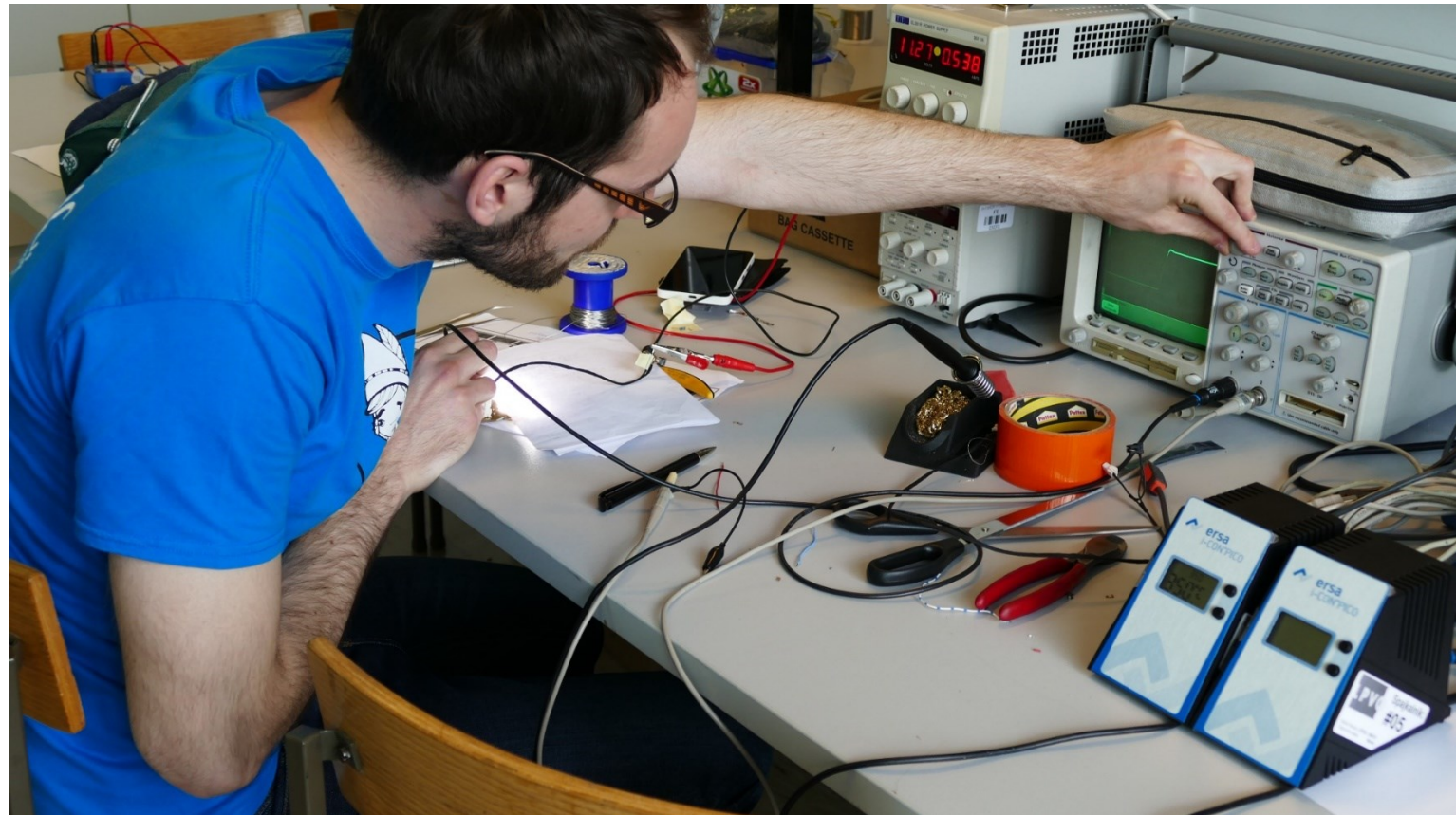
Simplified Application



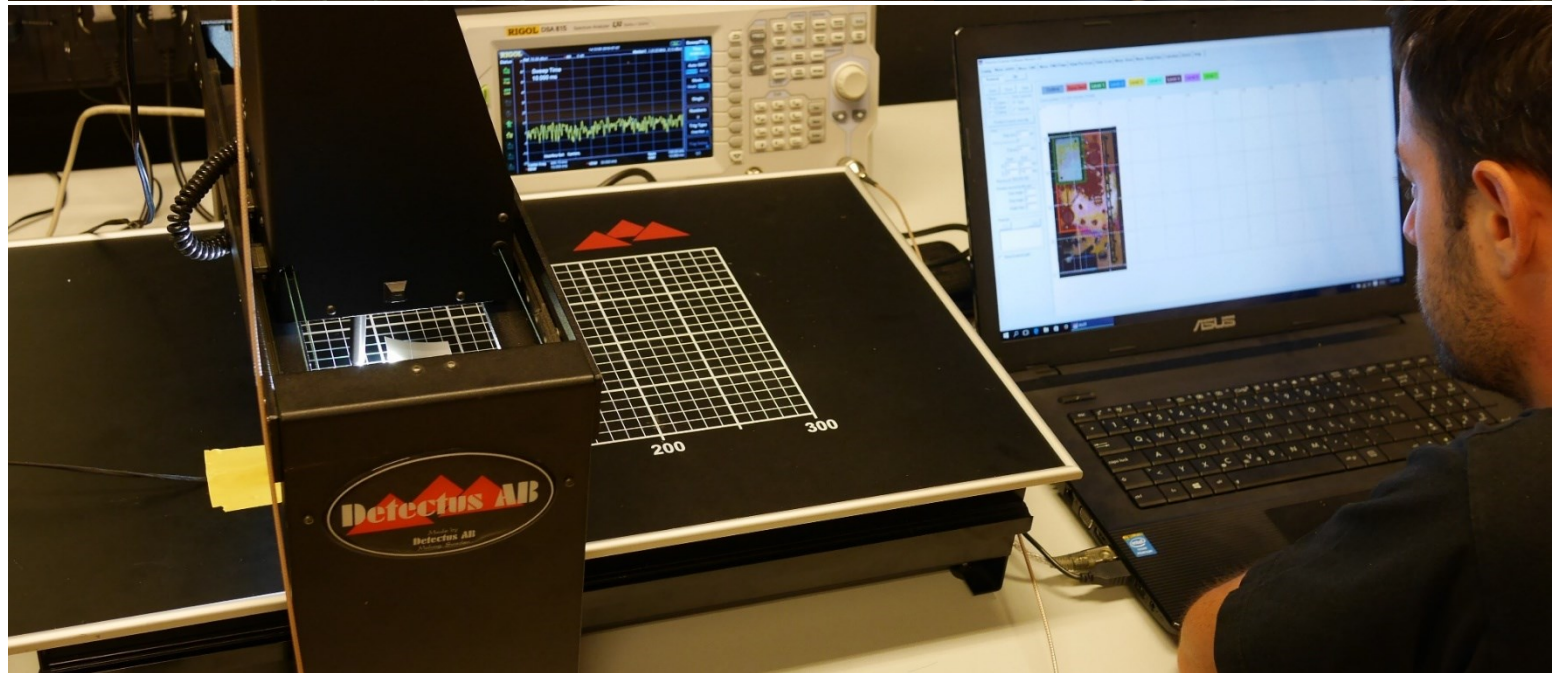
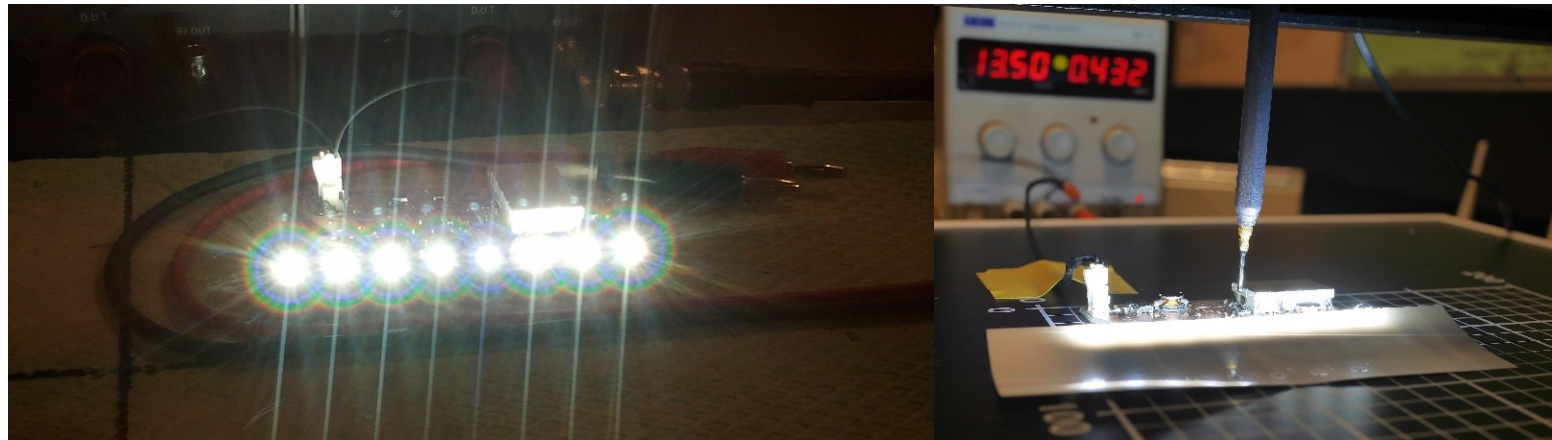
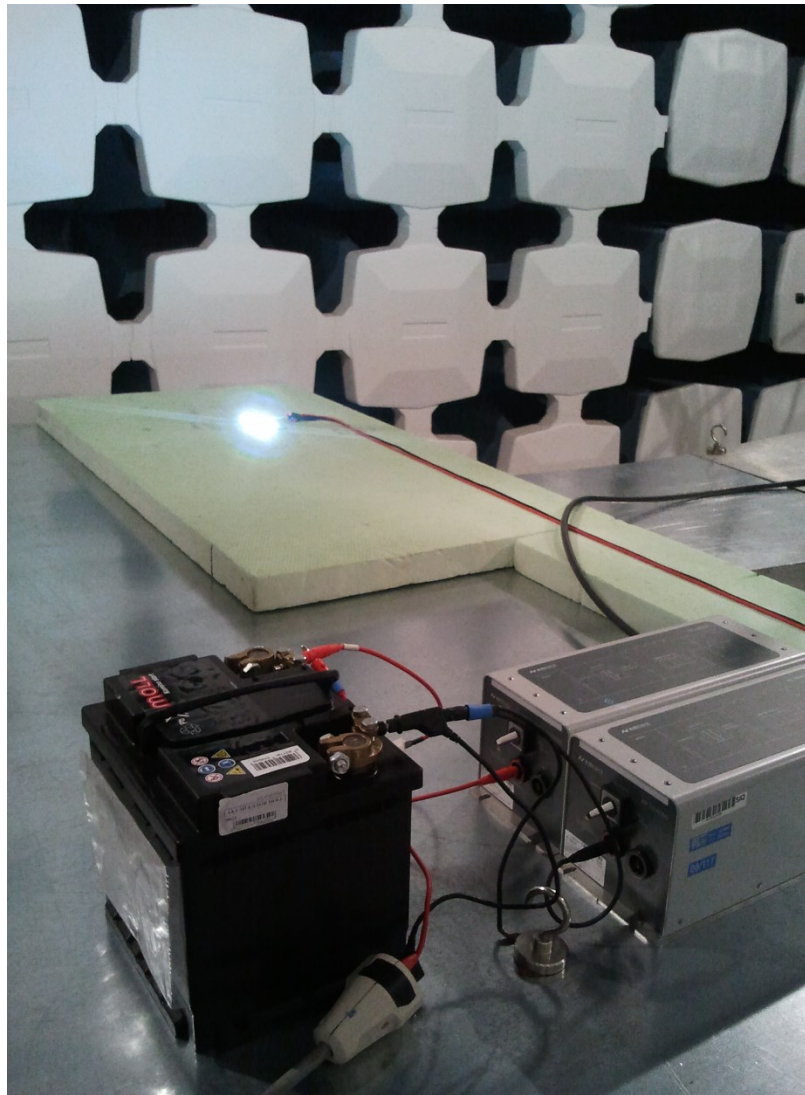
Predavanja in ekskurzije



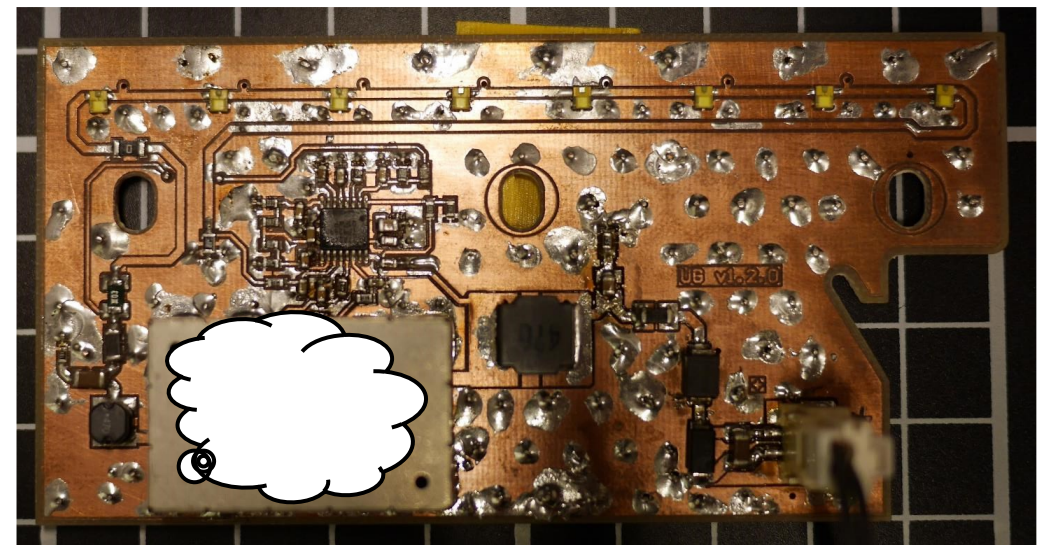
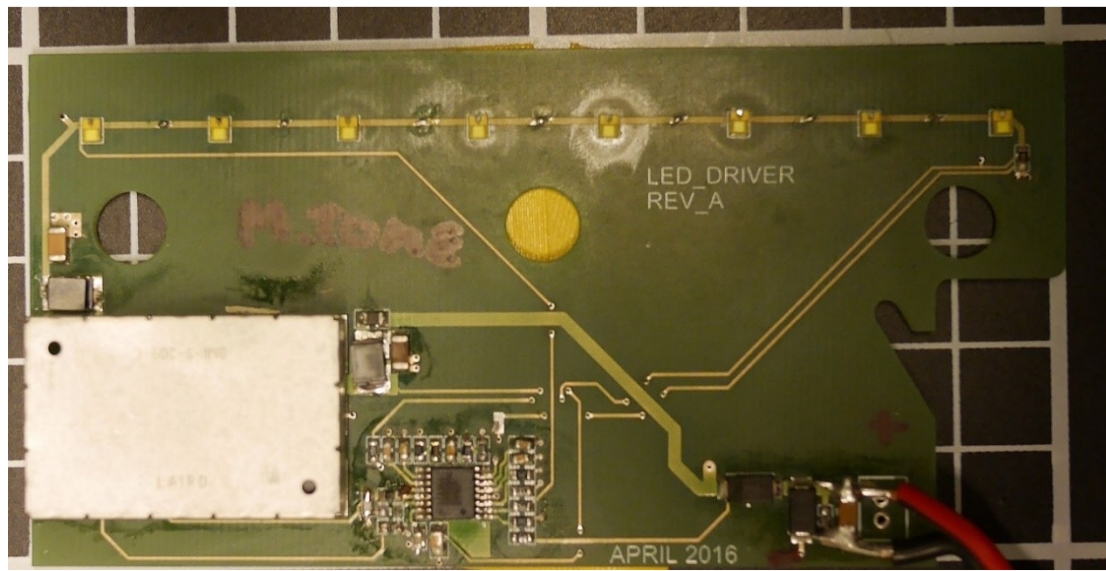
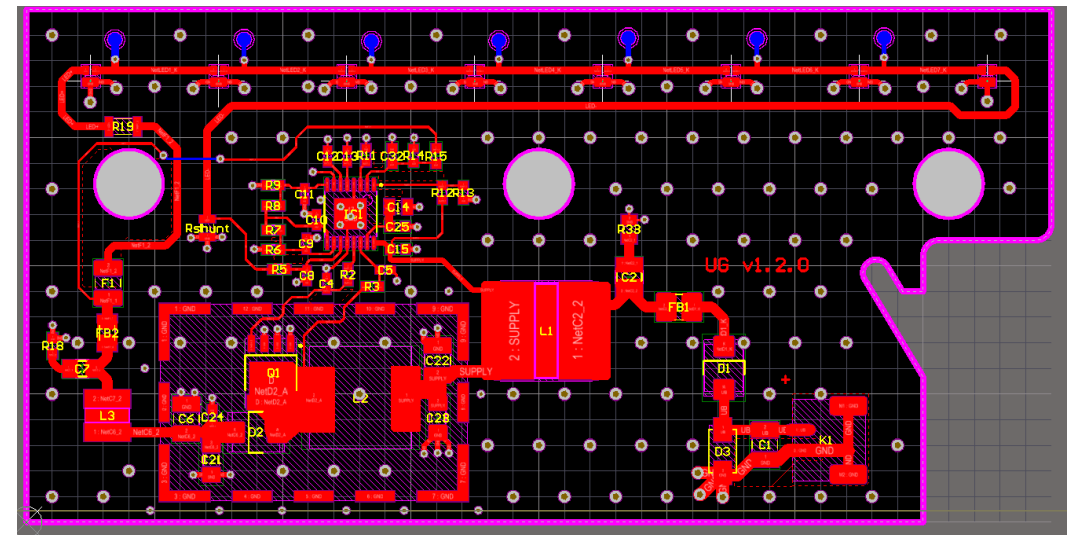
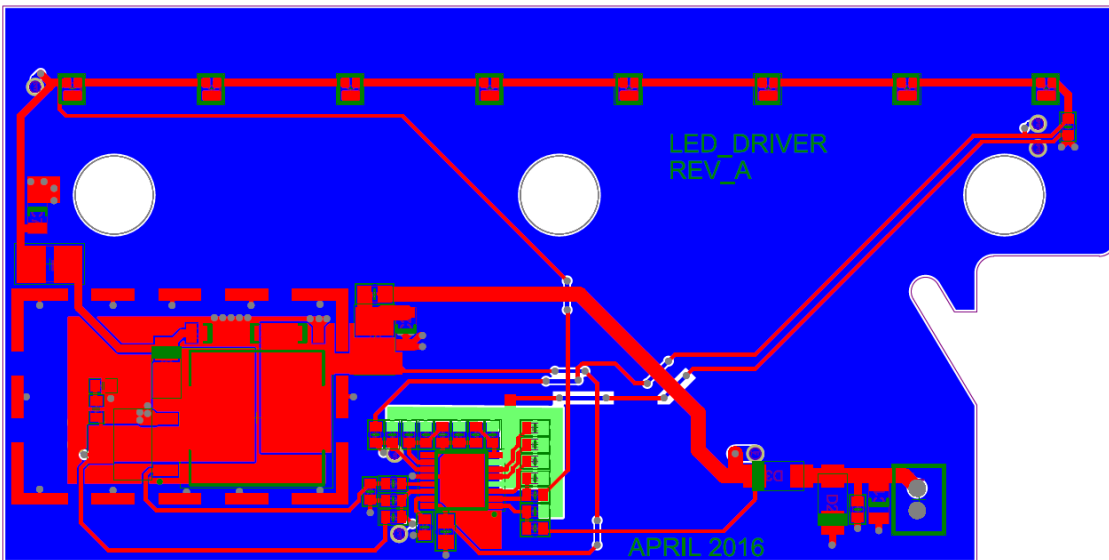
Izdelava projektov



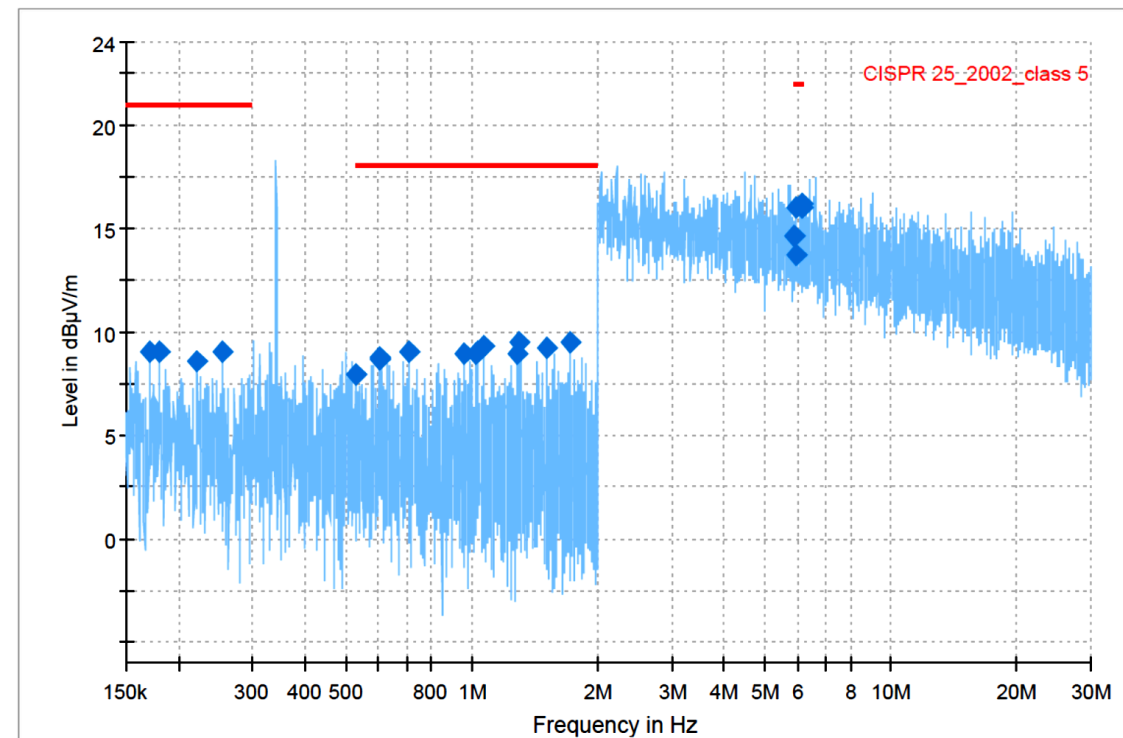
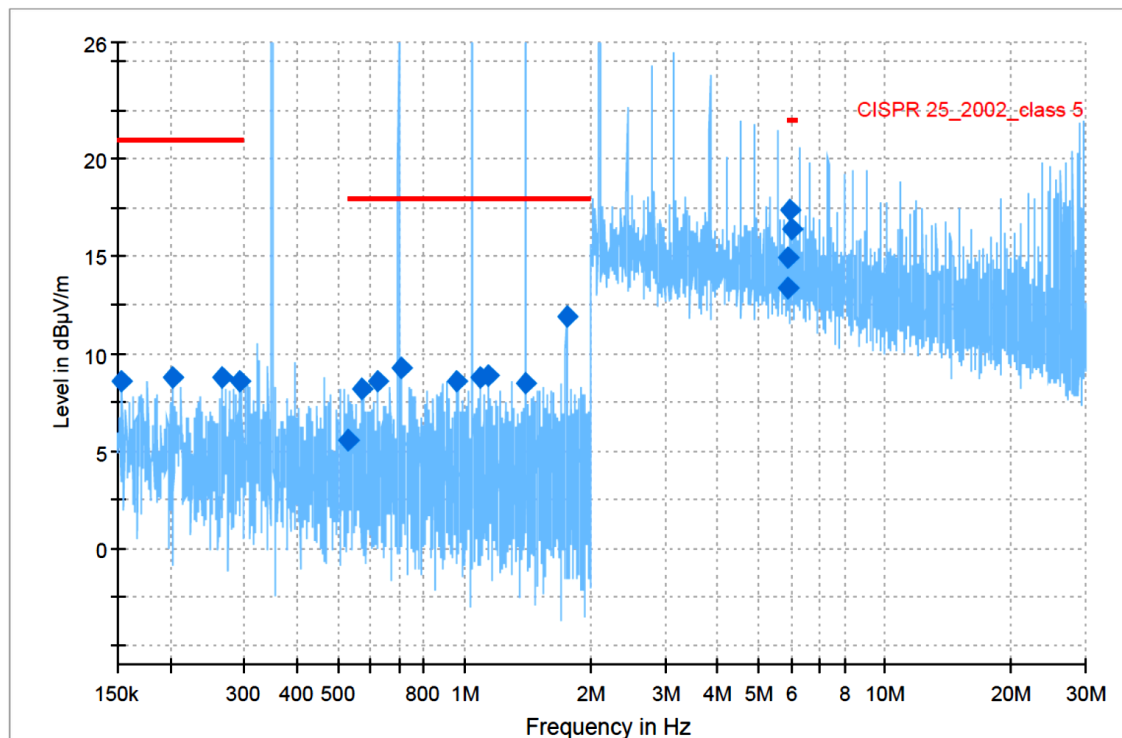
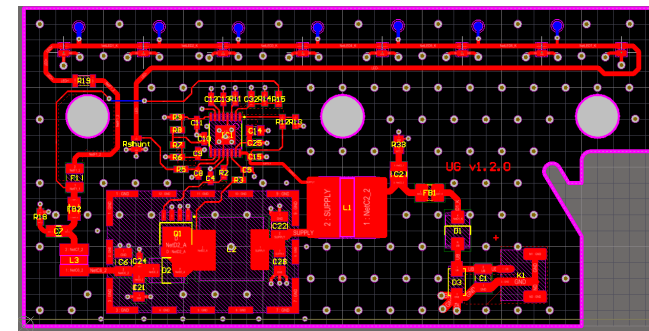
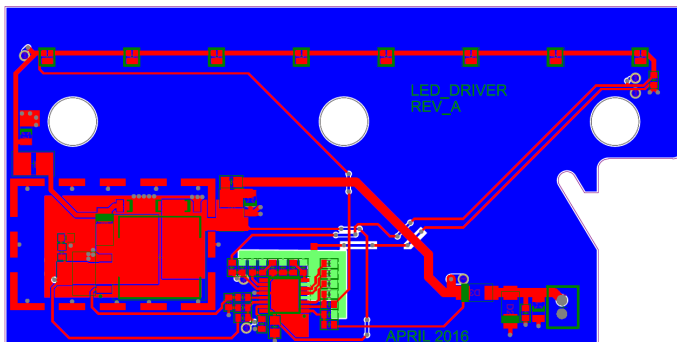
Meritve izdelkov



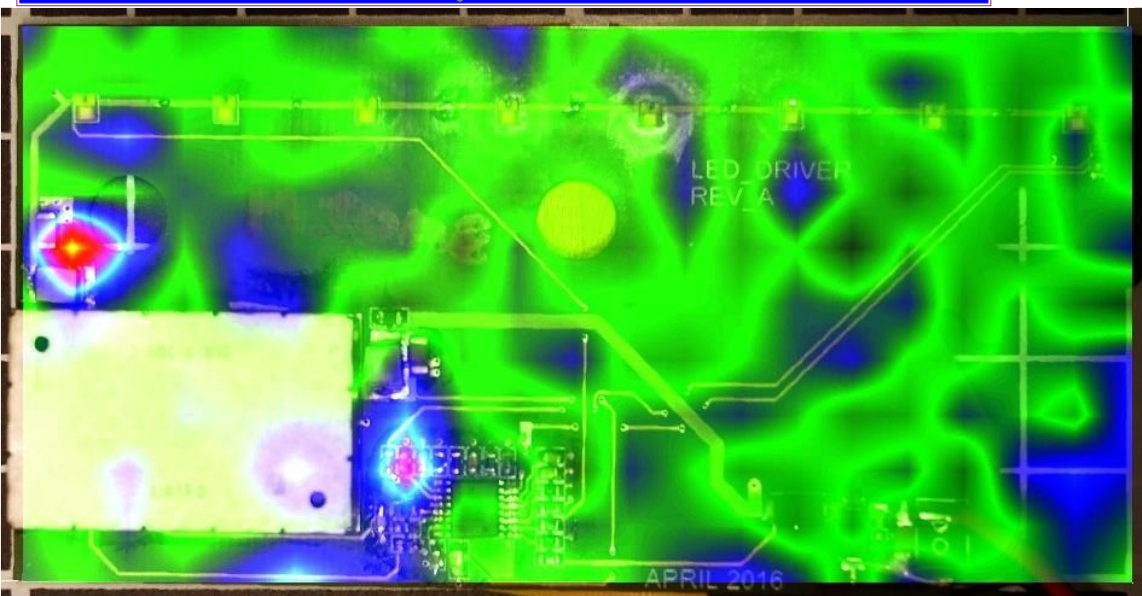
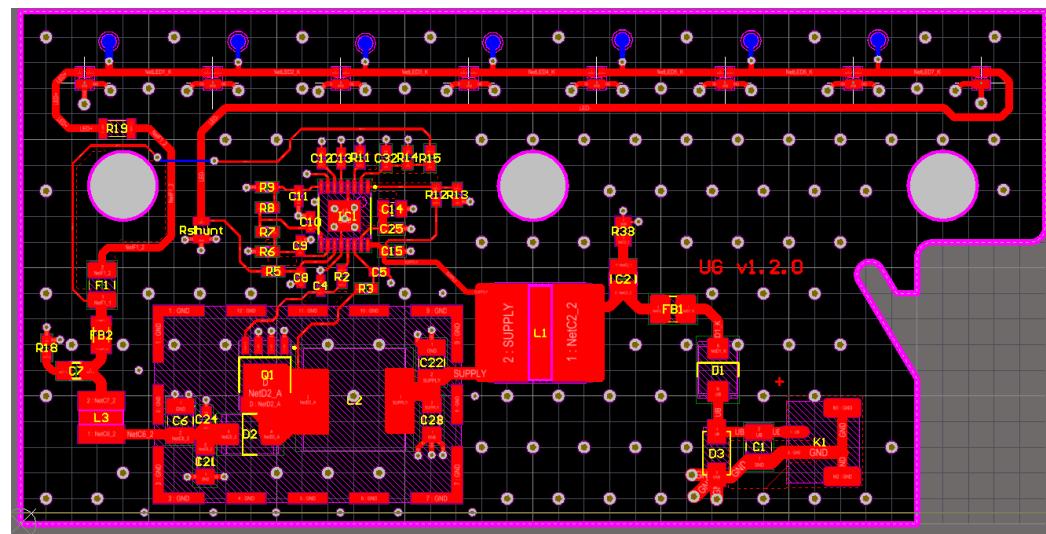
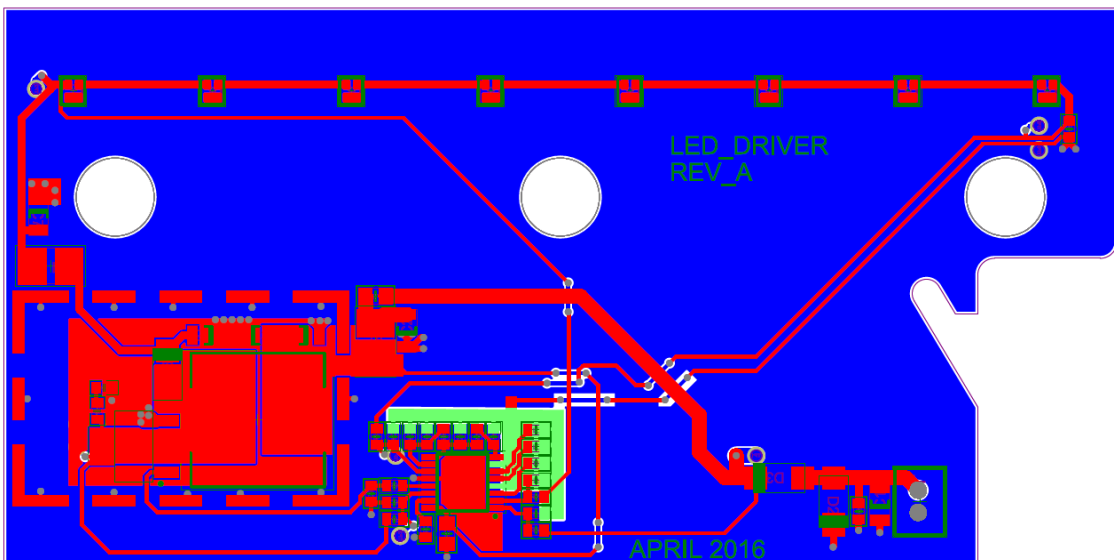
Rezultati



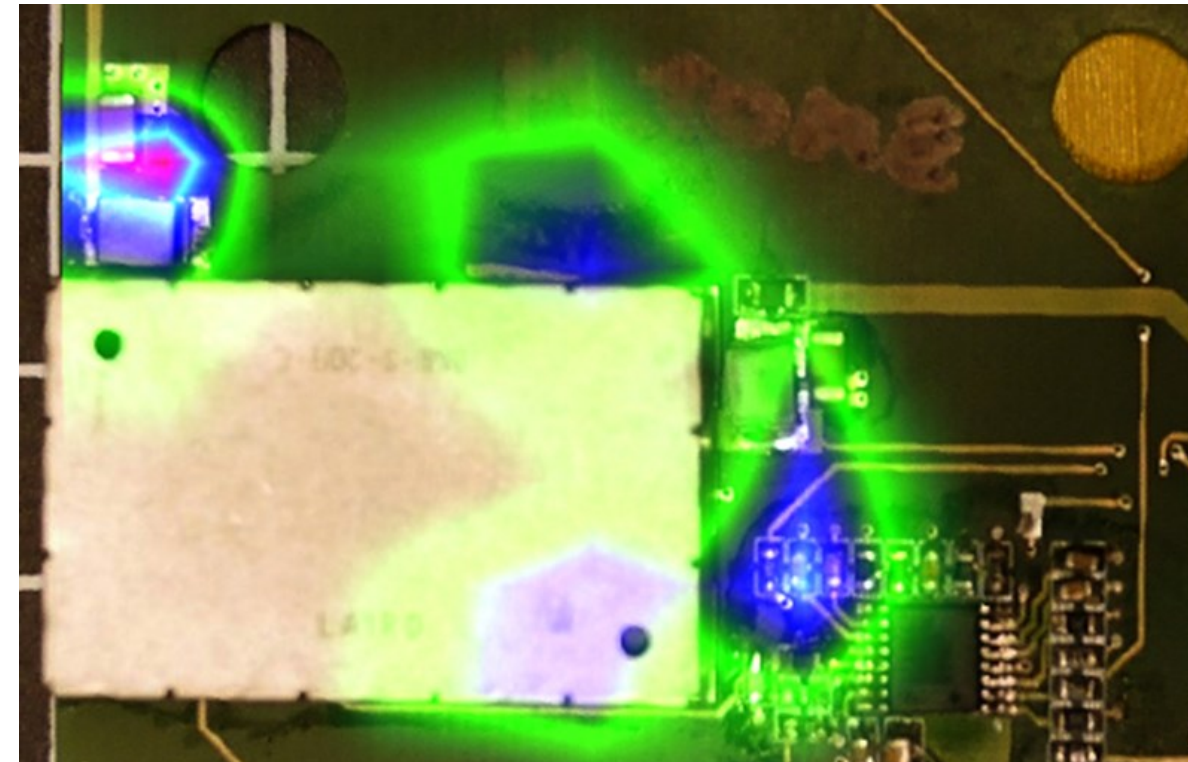
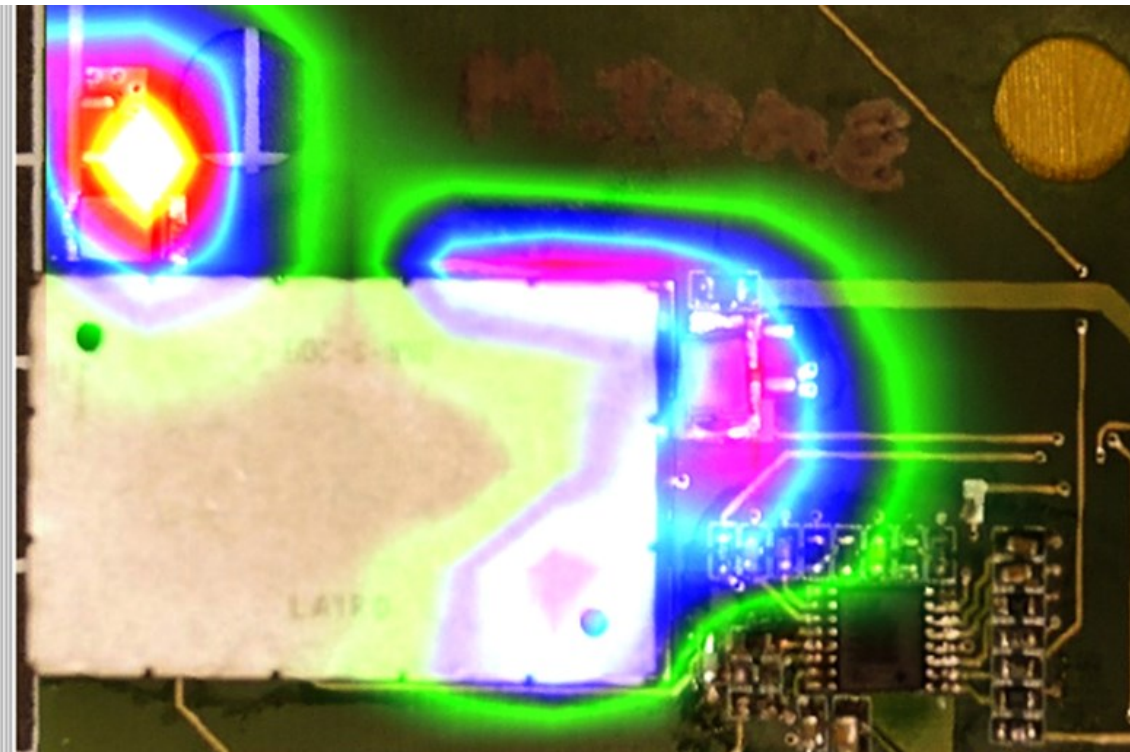
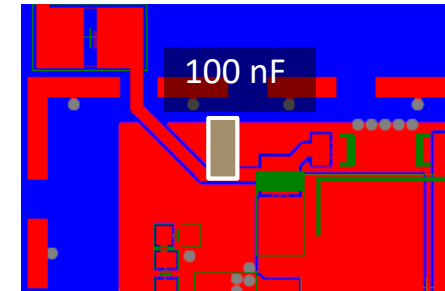
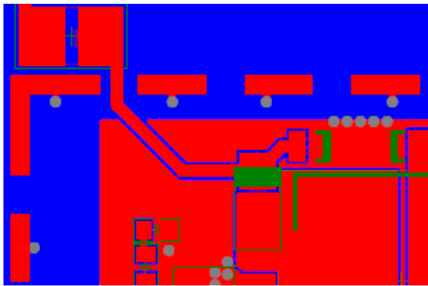
Rezultati



Rezultati



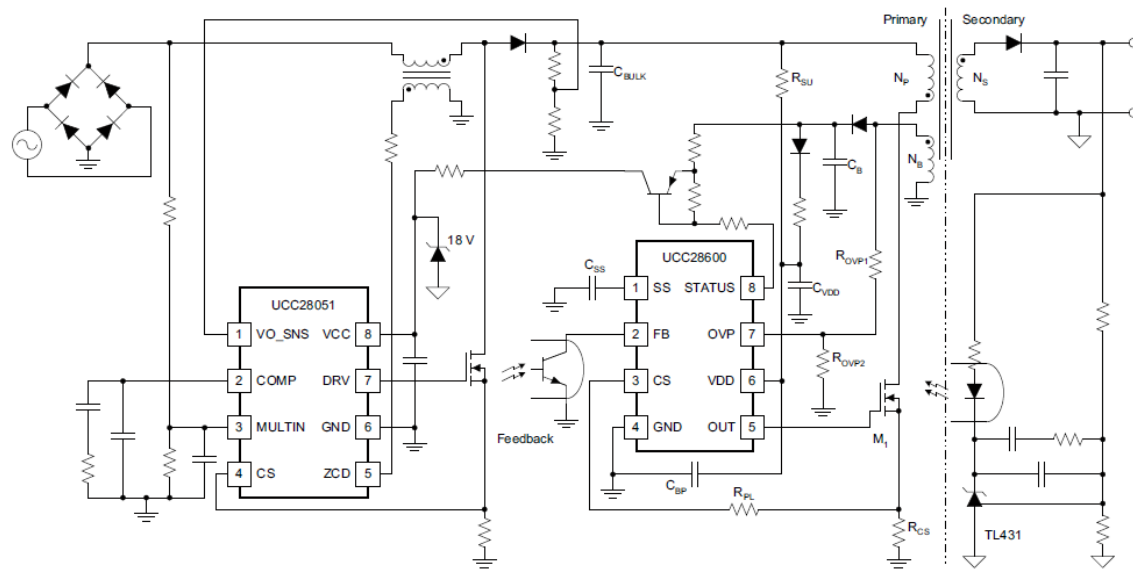
Analiza



Rezultati

Funkcionalnost		Min dB pod limito			Točke					Rezultat	
Vklop	RP	CE	RE 30M	RE 1G	OP	T CE	T RE 30M	T RE 1G	BCI	Vsota	Mesto
OK	OK	12	5,83	7,35	10	10	5,83	7,35	10	43,18	1
OK	OK	10	4,04	7,74	10	10	4,04	7,74	10	41,78	2
OK	OK	11	3,94	7,42	10	10	3,94	7,42	10	41,36	3
OK	OK	5	0,51	7,04	10	5	0,51	7,04	10	32,55	4
Fail	OK	12			0	10	4	7	10	31	5
OK	OK	-0,5	-13,19	0,97	10	-0,5	-13,19	0,97	10	7,28	6
OK	OK	-9	4,19	-8,44	10	-9	4,19	-8,44	10	6,75	7

2. EMC delavnica 2017

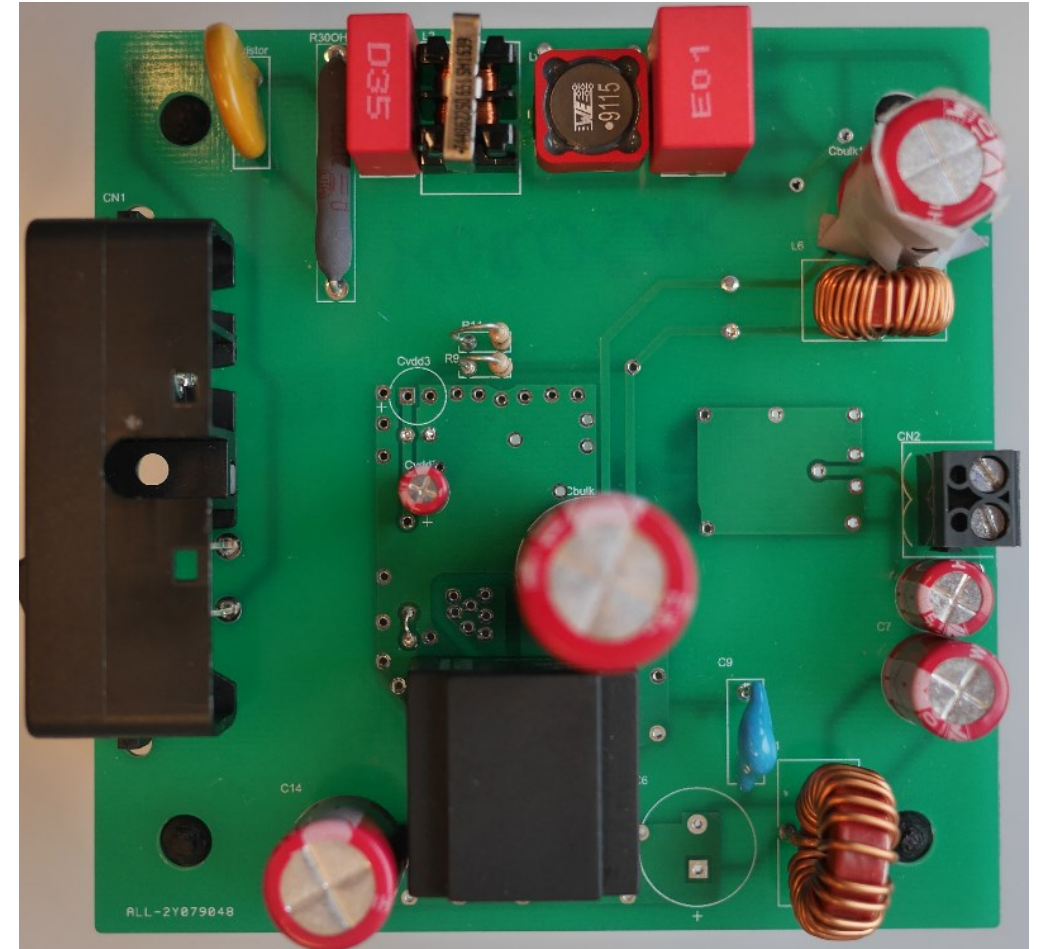
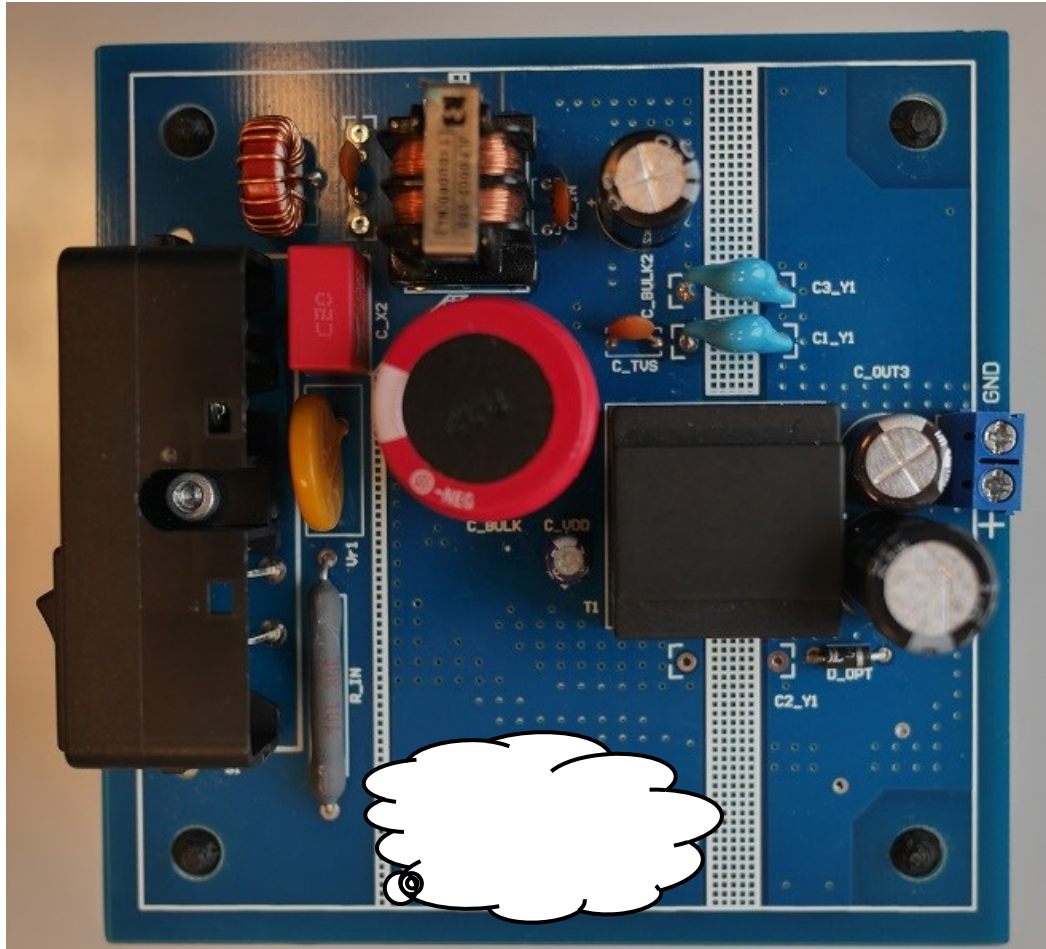


UCC28600
(MOS)

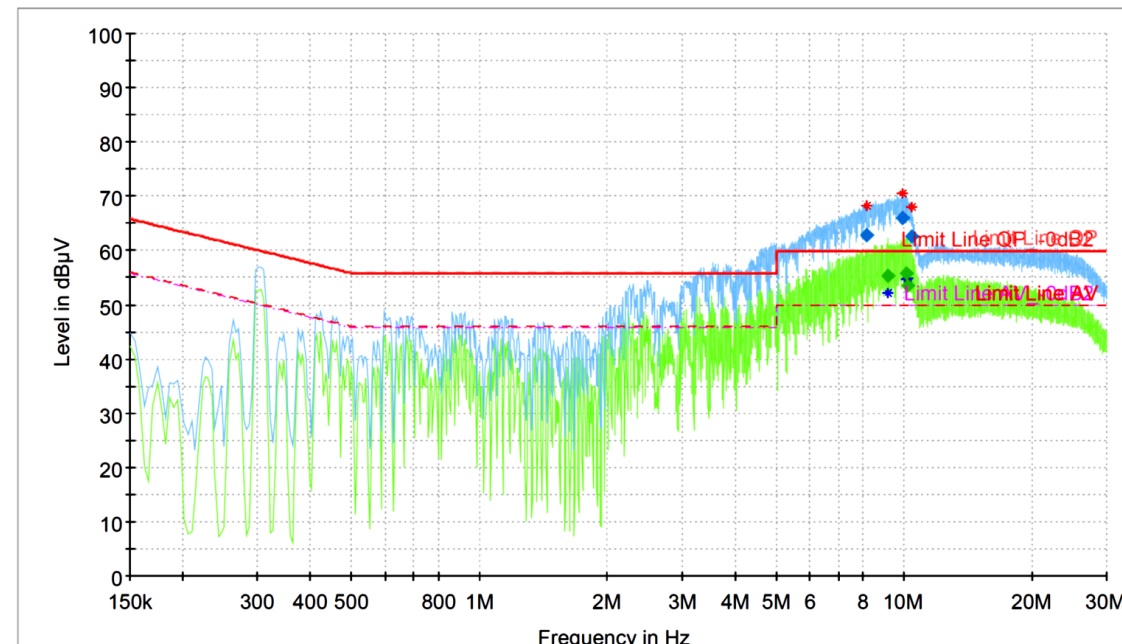
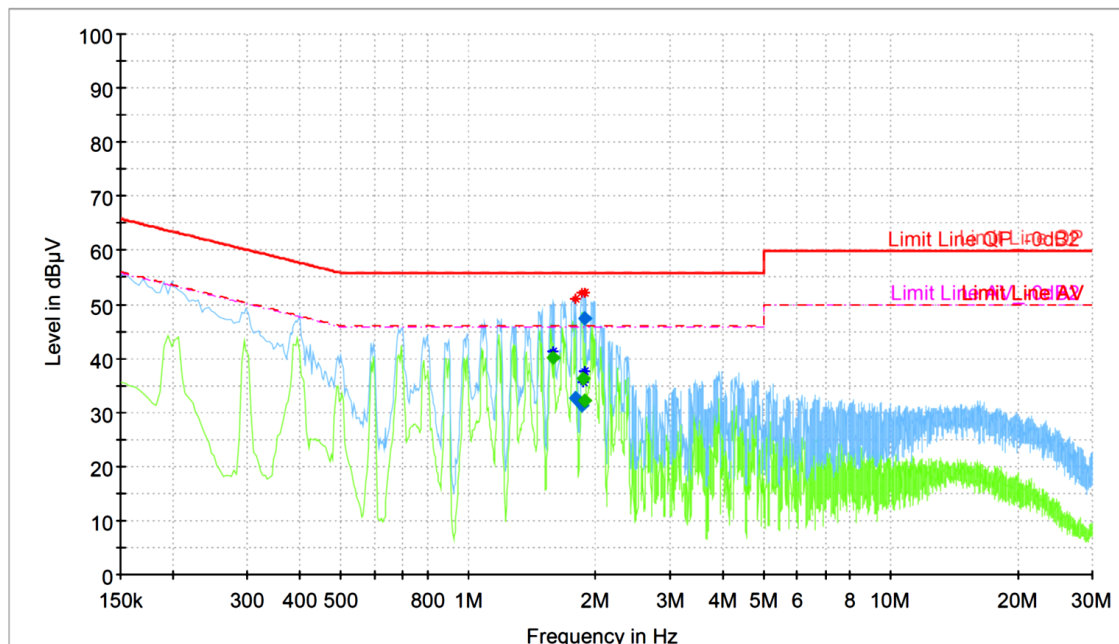
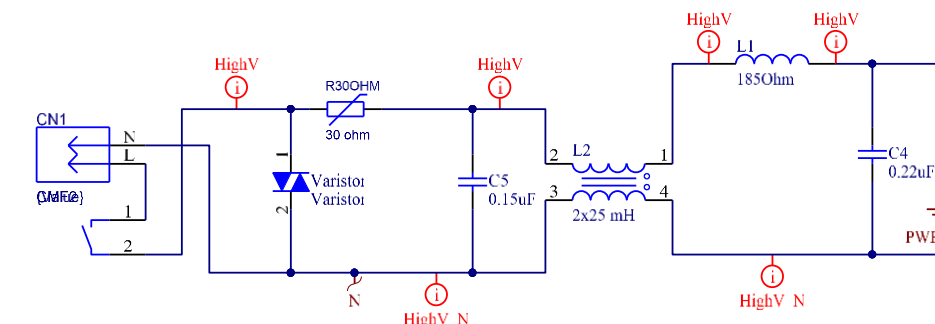
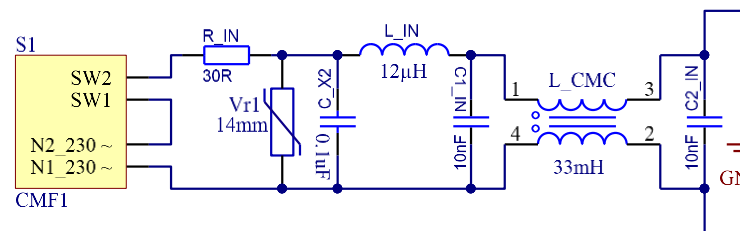
UCC28720
(BJT)



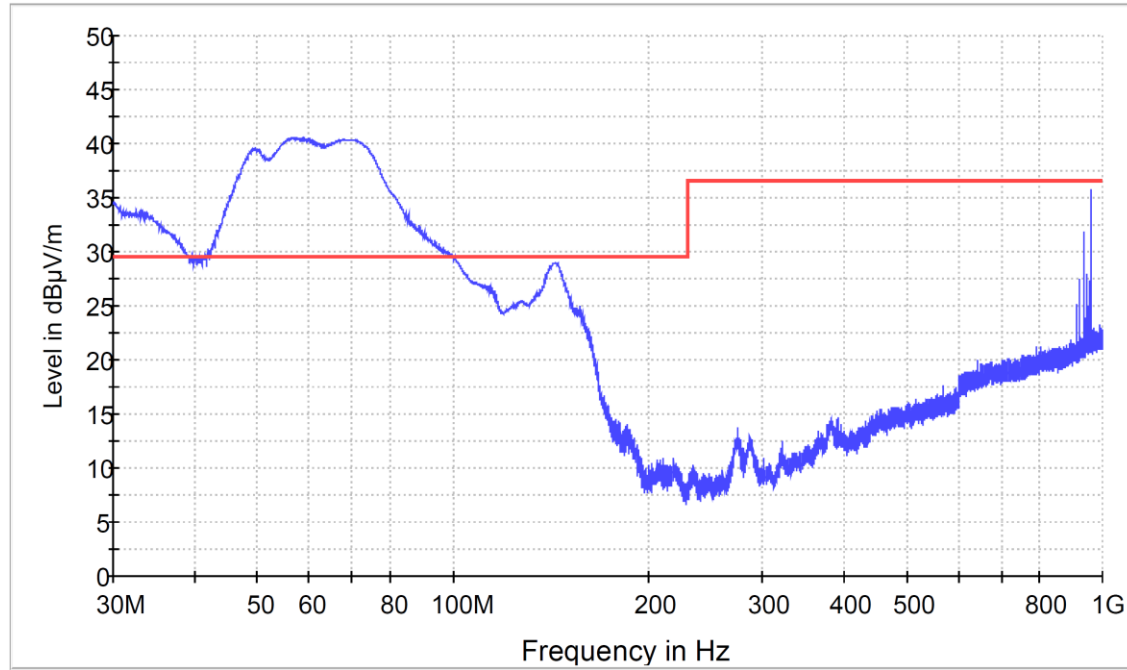
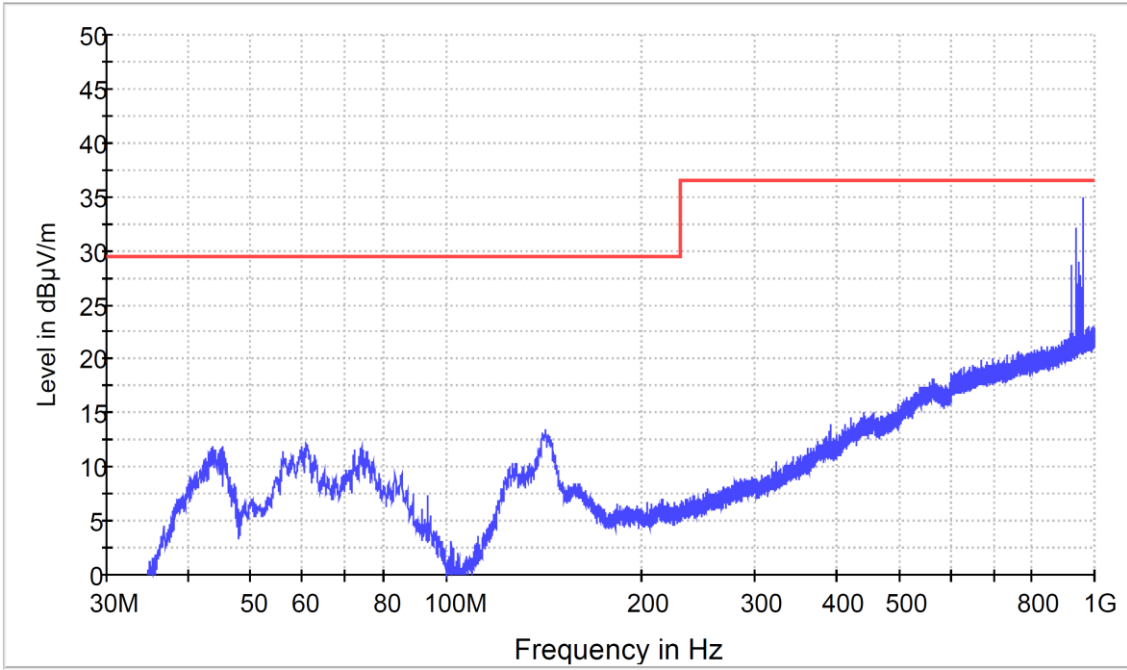
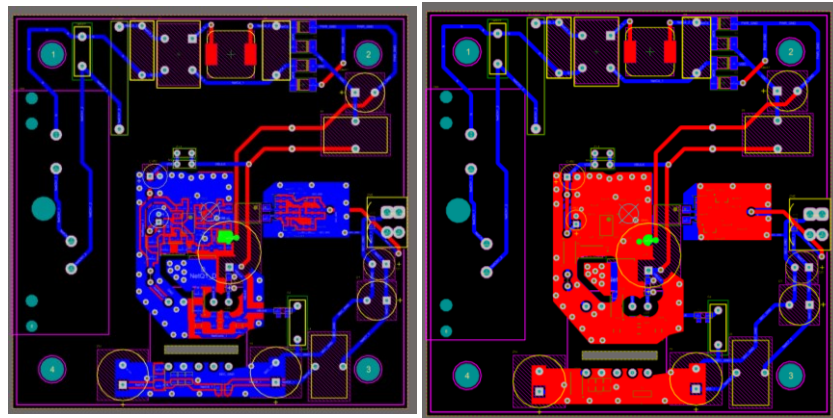
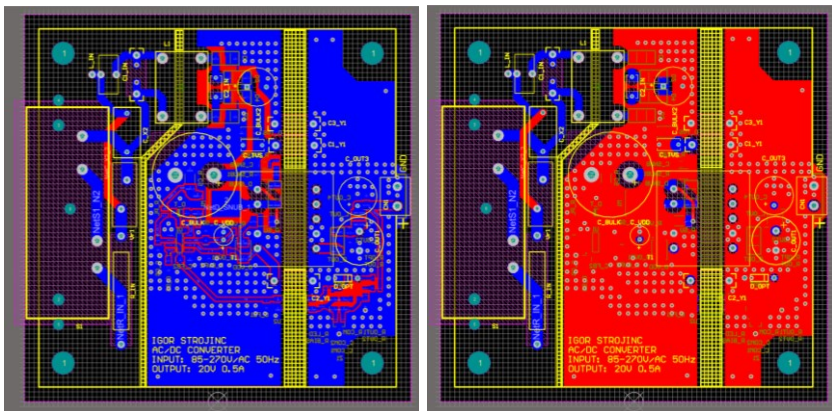
Rezultati



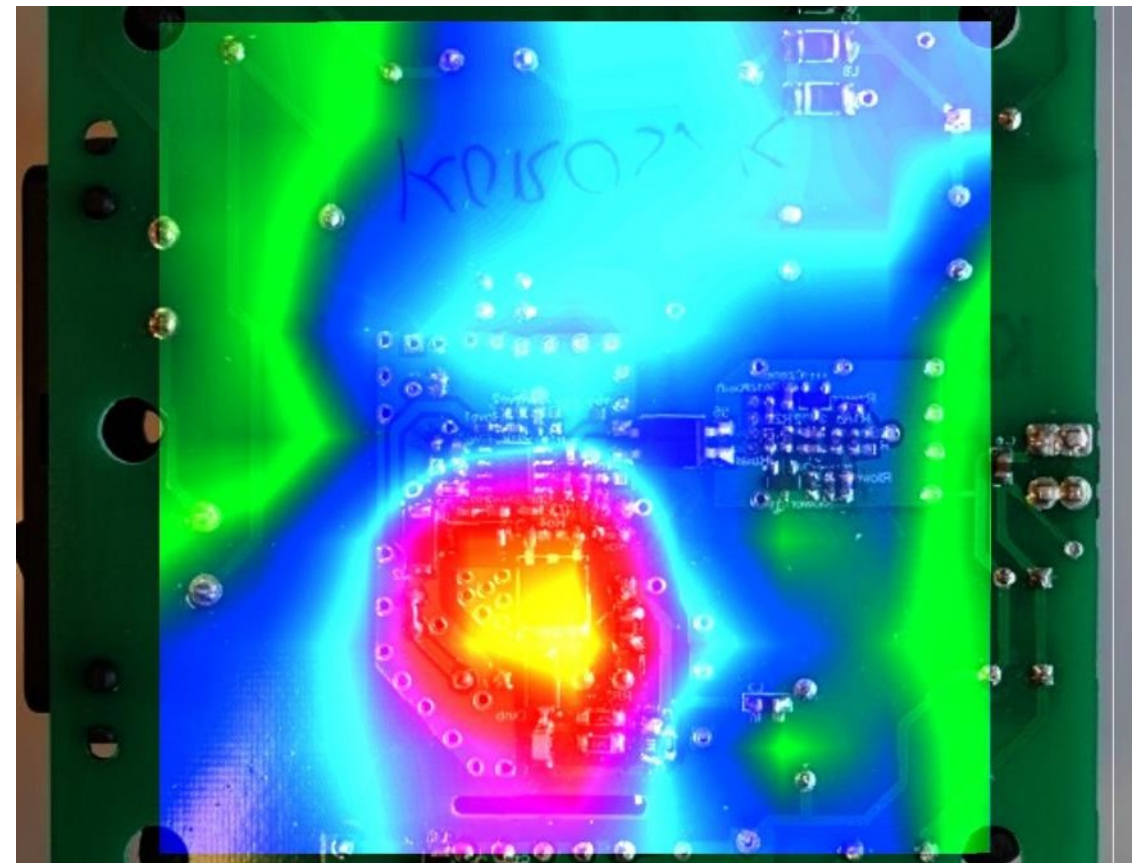
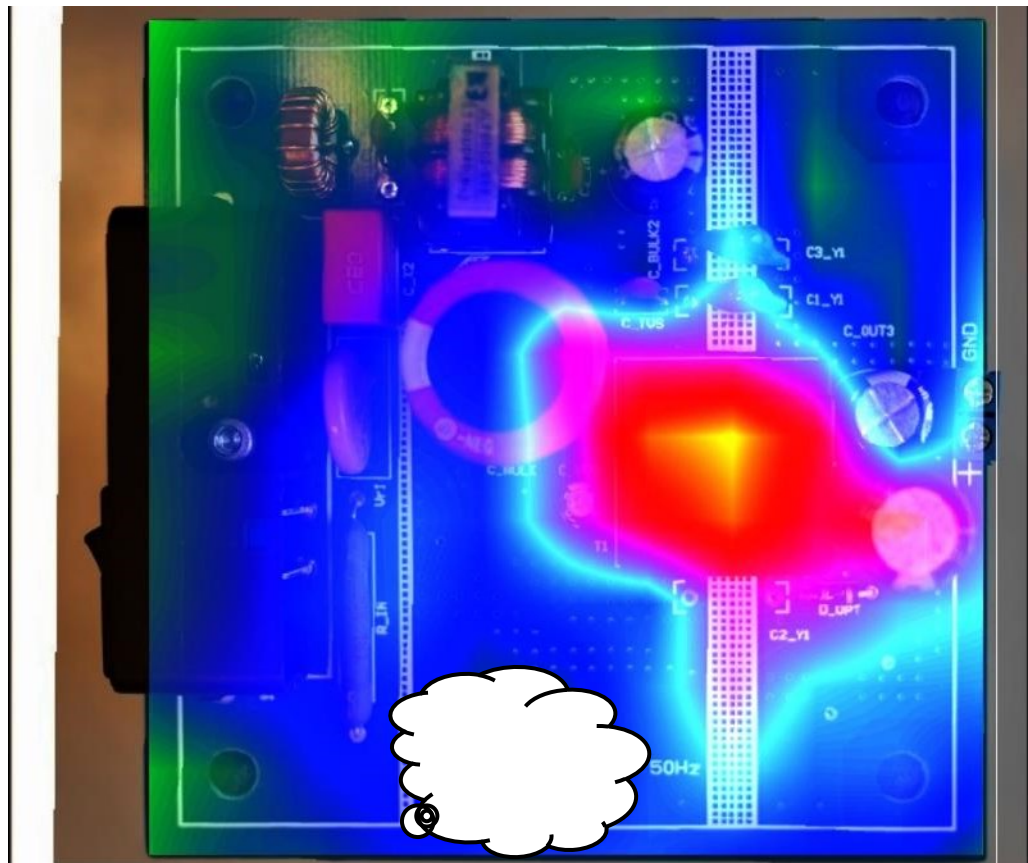
Rezultati



Rezultati



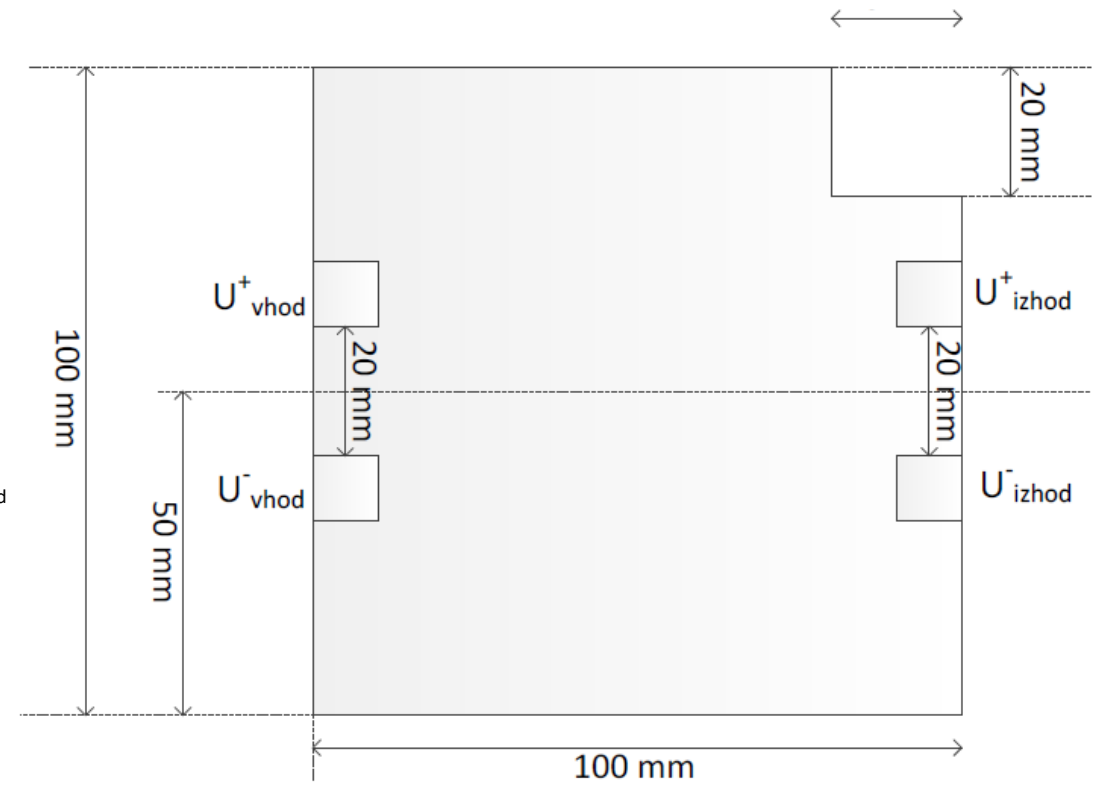
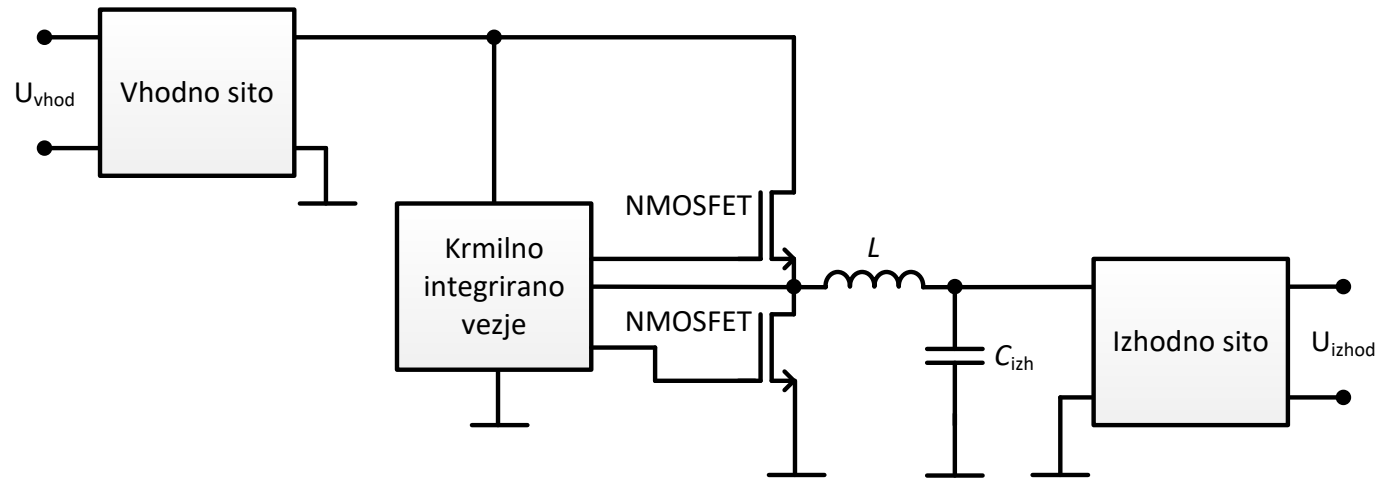
Rezultati



Rezultati

Funkcionalnost				Min dB pod limito				Točke				Rezultat	
Vklop	KS	Uout	VF šum	CE	RE	OP	T CE	T RE	Surge	Vsota	Mesto		
OK	OK	OK	OK	5.56	17	10	5.56	10	0	6.9	1		
OK	OK	OK	OK	-4.43	14	10	-4.43	10	0	4.4	2		
OK	OK	OK	OK	-5.03	4	10	-5.03	7	0	3.5	3		
OK	OK	OK	OK	-7.45	2	10	-7.45	2	0	1.6	4		
OK	OK	OK	OK	-4.88	-12	10	-4.88	-12	0	-1.2	5		
OK	OK	OK	OK	-6.16	-11	10	-6.16	-11	0	-1.3	6		
Fail	Fail	Fail	Fail			0	0	0	0	0.0	7		

3. EMC delavnica 2018

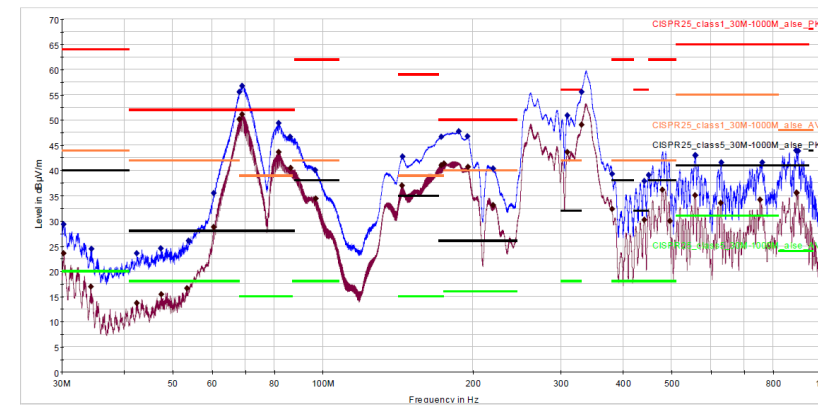
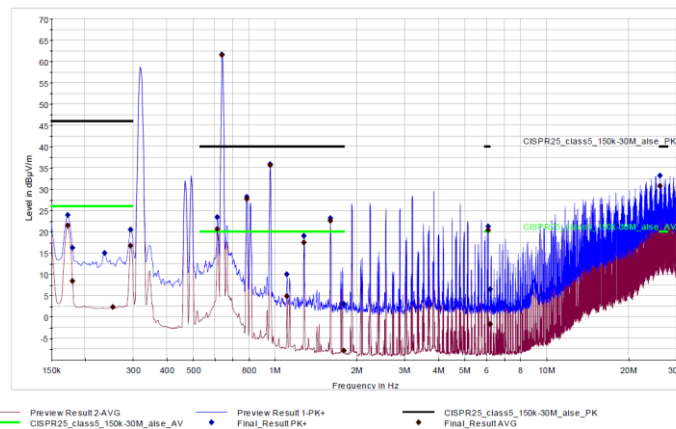
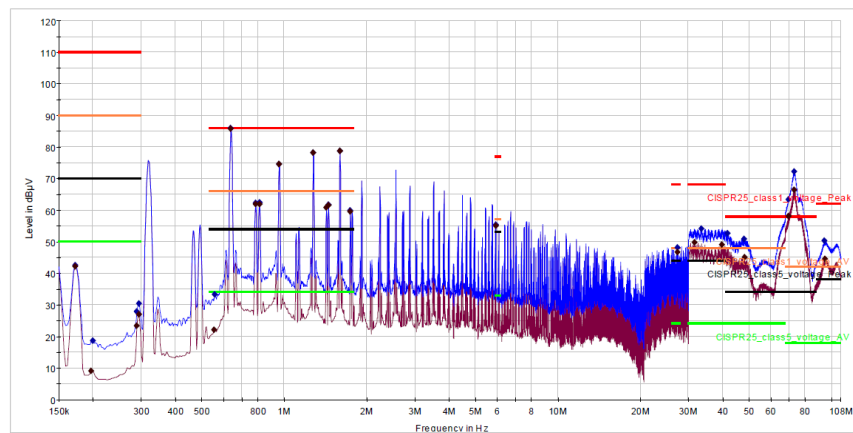


Ekскурzije



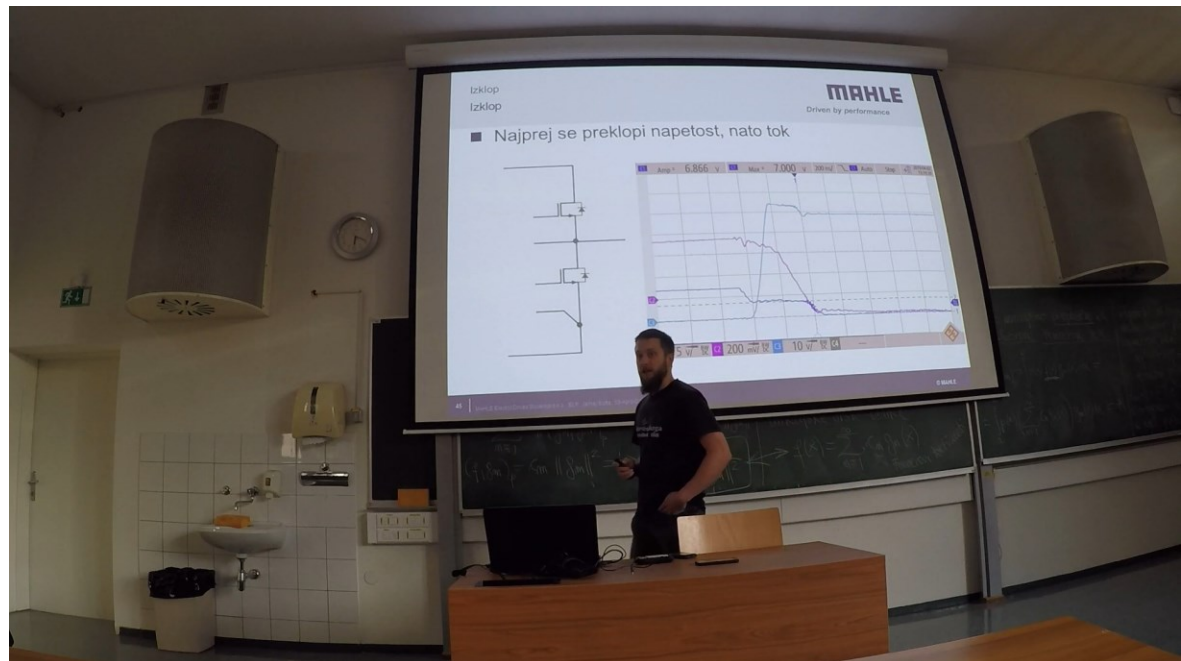
Rezultati

Mesto		Delovanje	Prevodne EMC	Konduktivne EMC	Cena	Skupaj
1		25	-24,47	-12,08	-23,64	-35,19
2		22	-30,44	-27,83	-33,6	-69,87
3		22	-36,37	-29,49	-28,1	-71,96
4		½	-	-	-	-
4		½	-	-	-	-
5		-	-	-	-	-
5		-	-	-	-	-
5		-	-	-	-	-



4. EMC delavnica 2019 - ponovitev

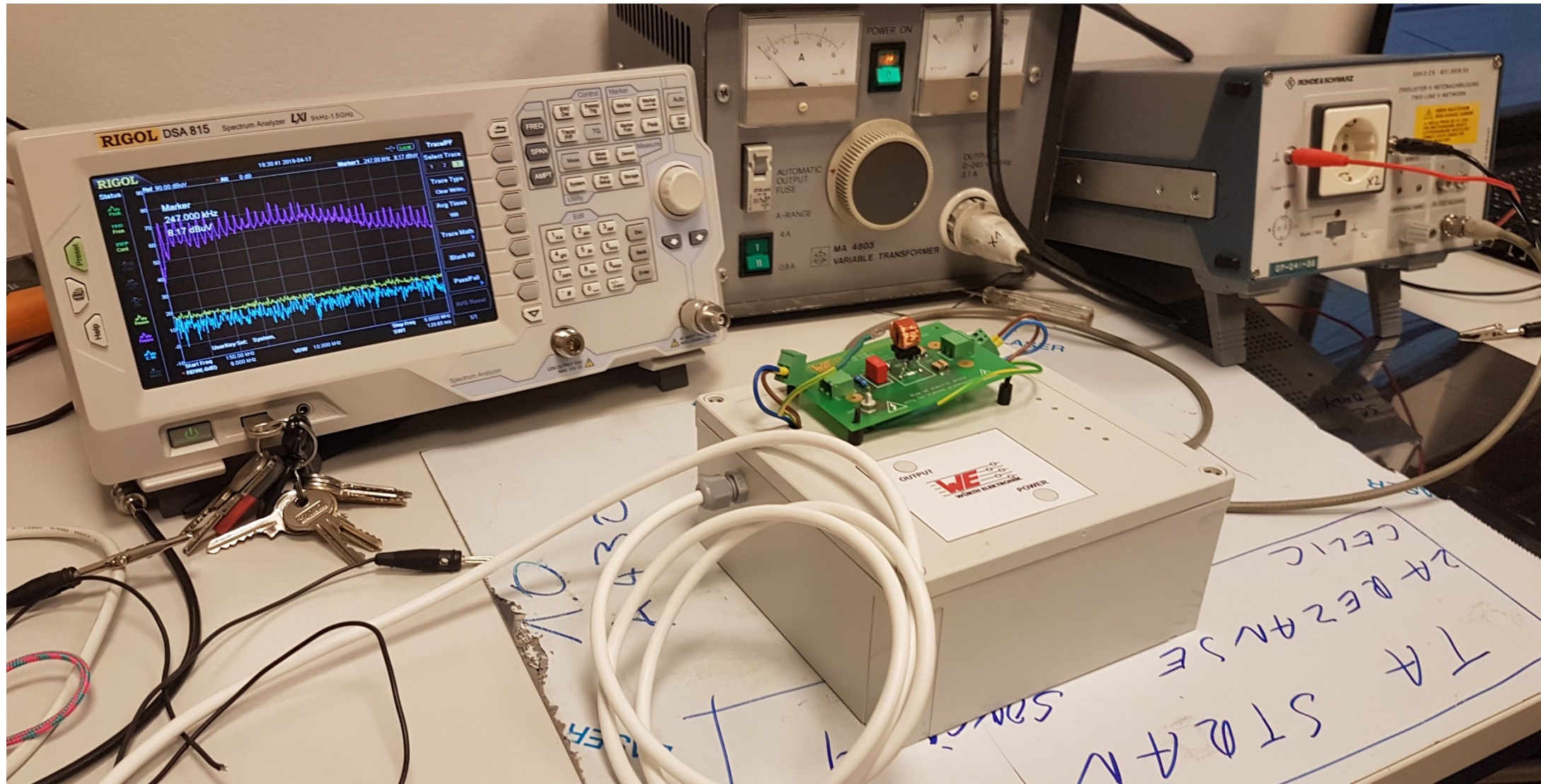
MAHLE



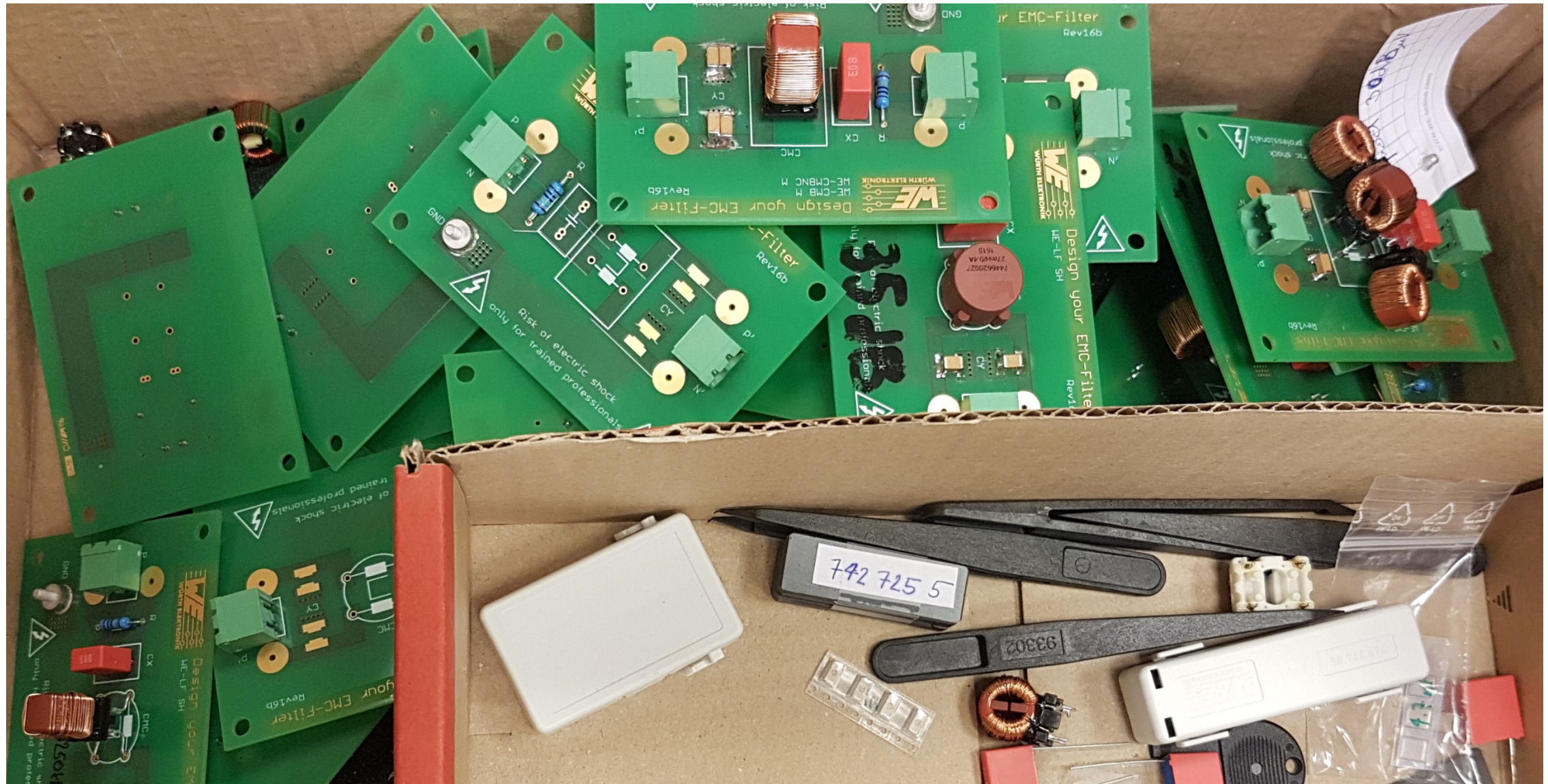
Delavnica načrtovanja filtrov – Würth elektronik



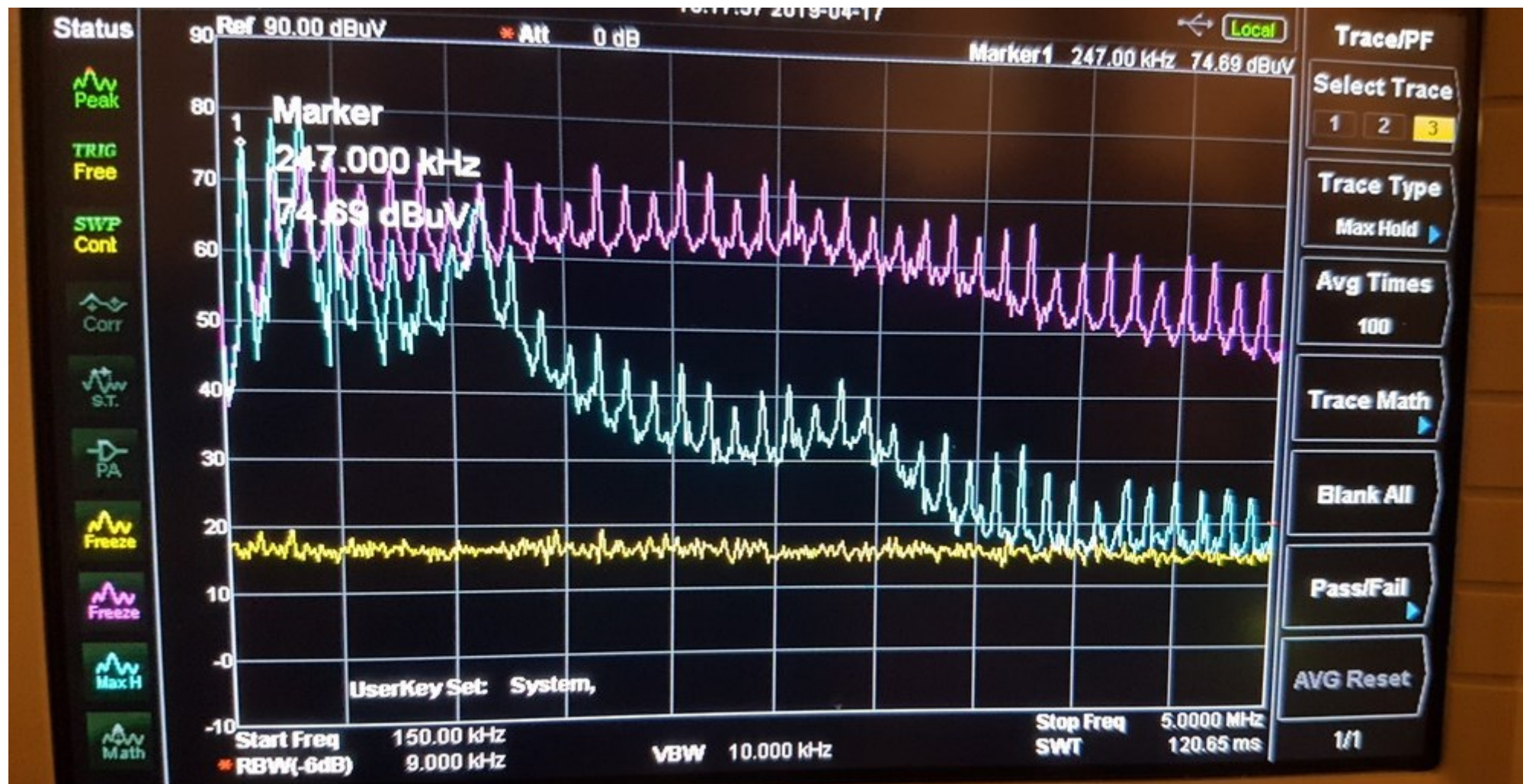
Delavnica načrtovanja filtrov – Würth elektronik



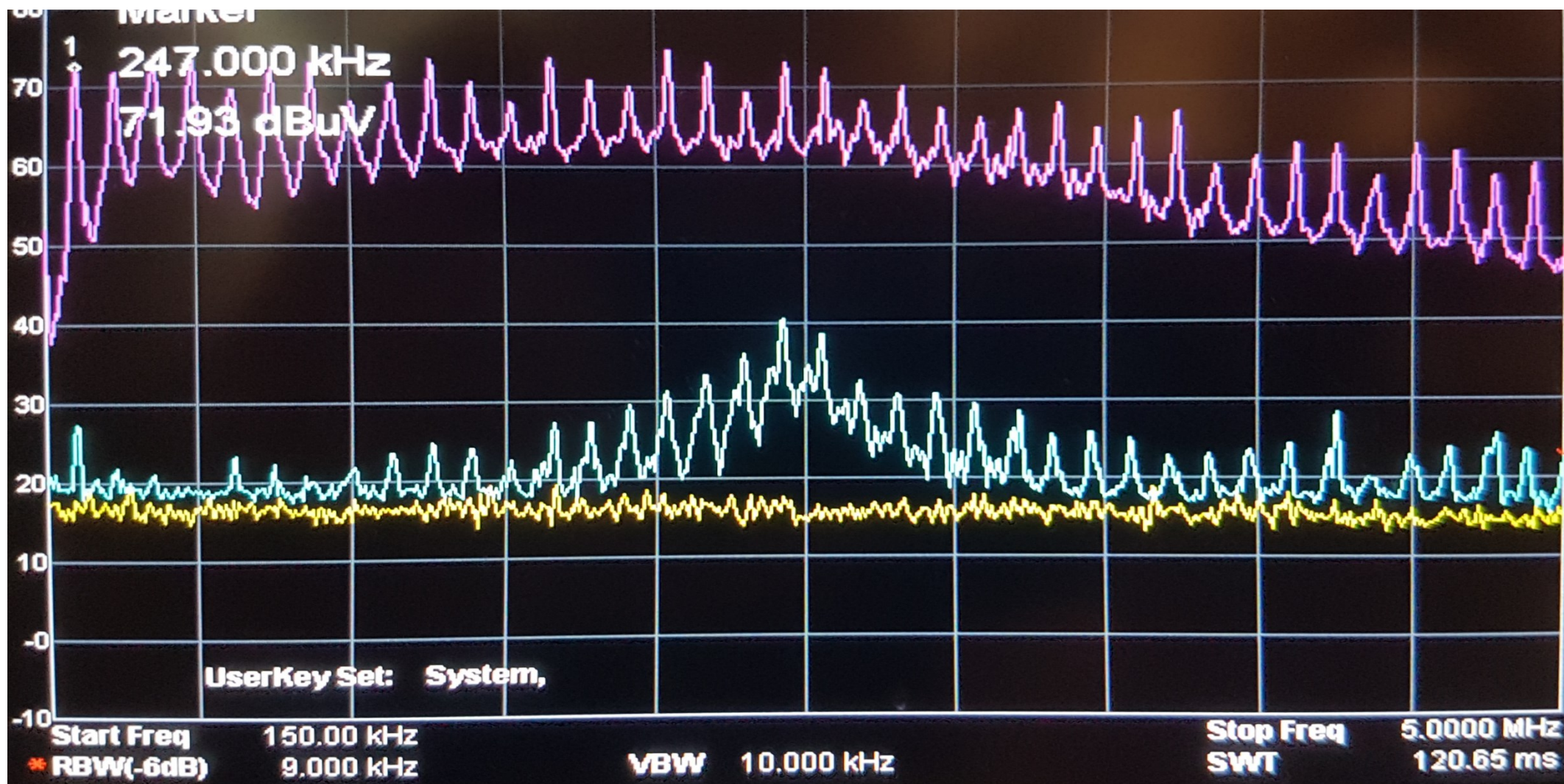
Delavnica načrtovanja filtrov – Würth elektronik



Delavnica načrtovanja filtrov – Würth elektronik



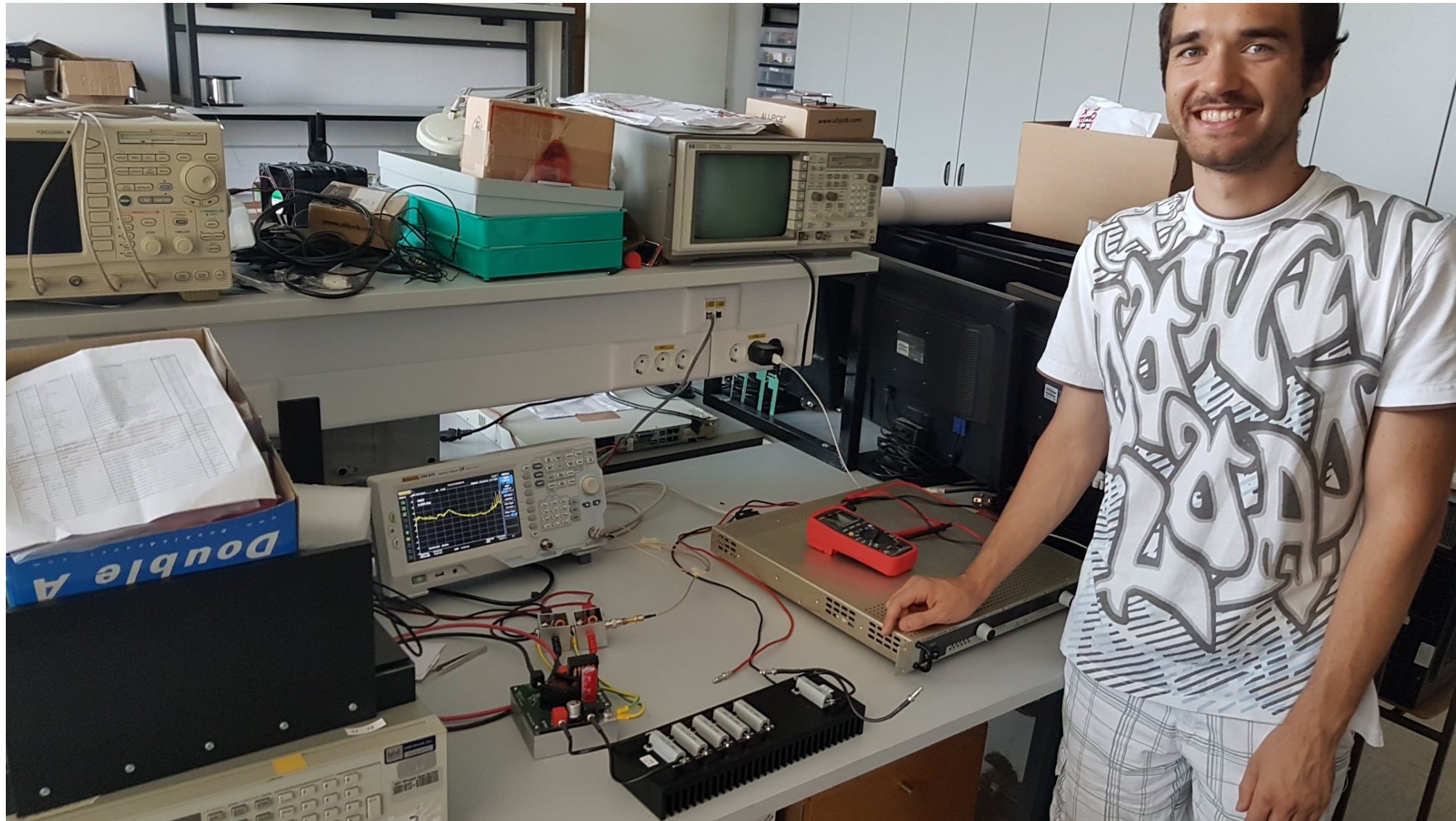
Delavnica načrtovanja filtrov – Würth elektronik



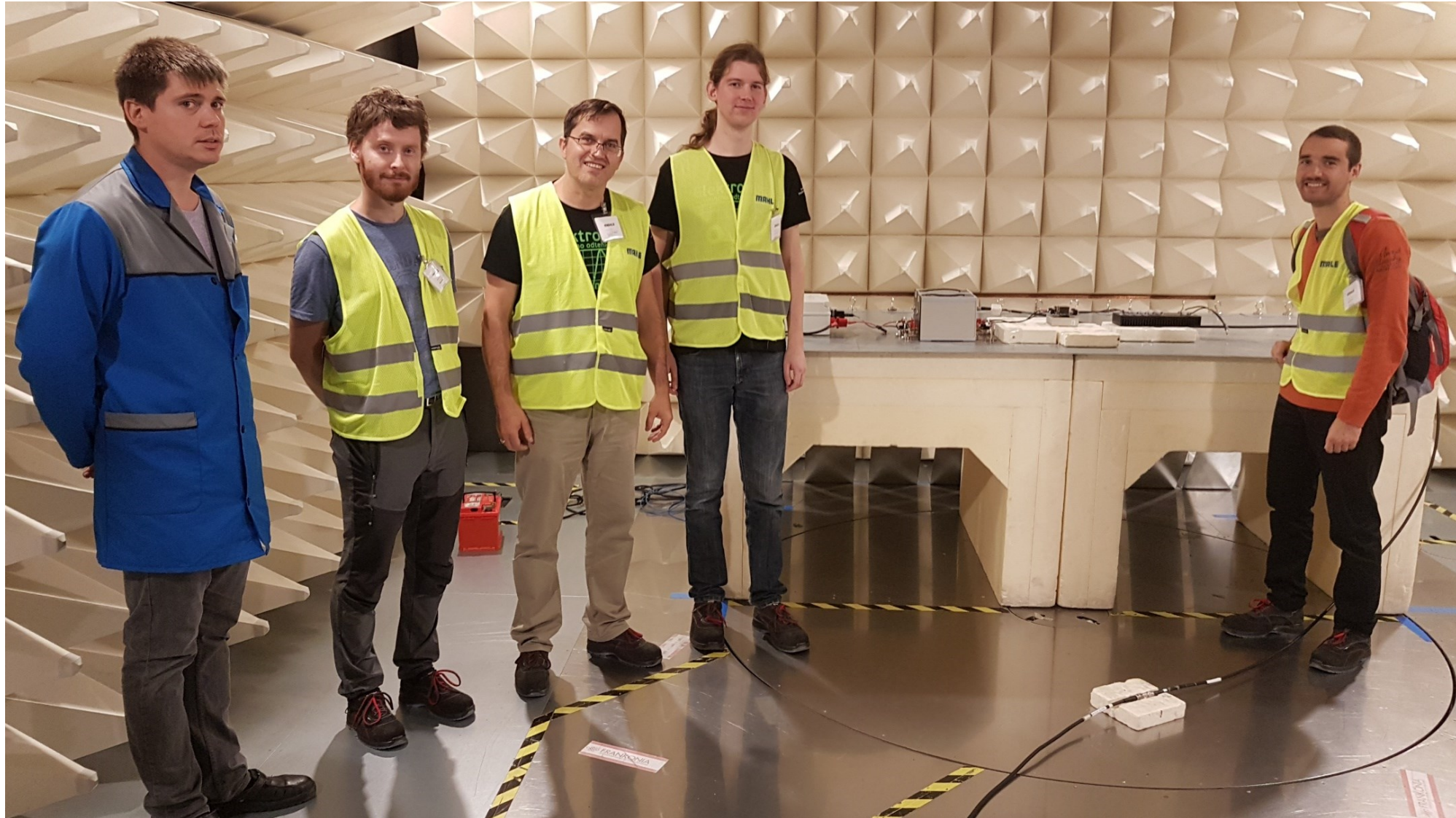
Delavnica načrtovanja filtrov – Würth elektronik



Preizkušanje



Meritve v MAHLE



Zaključek

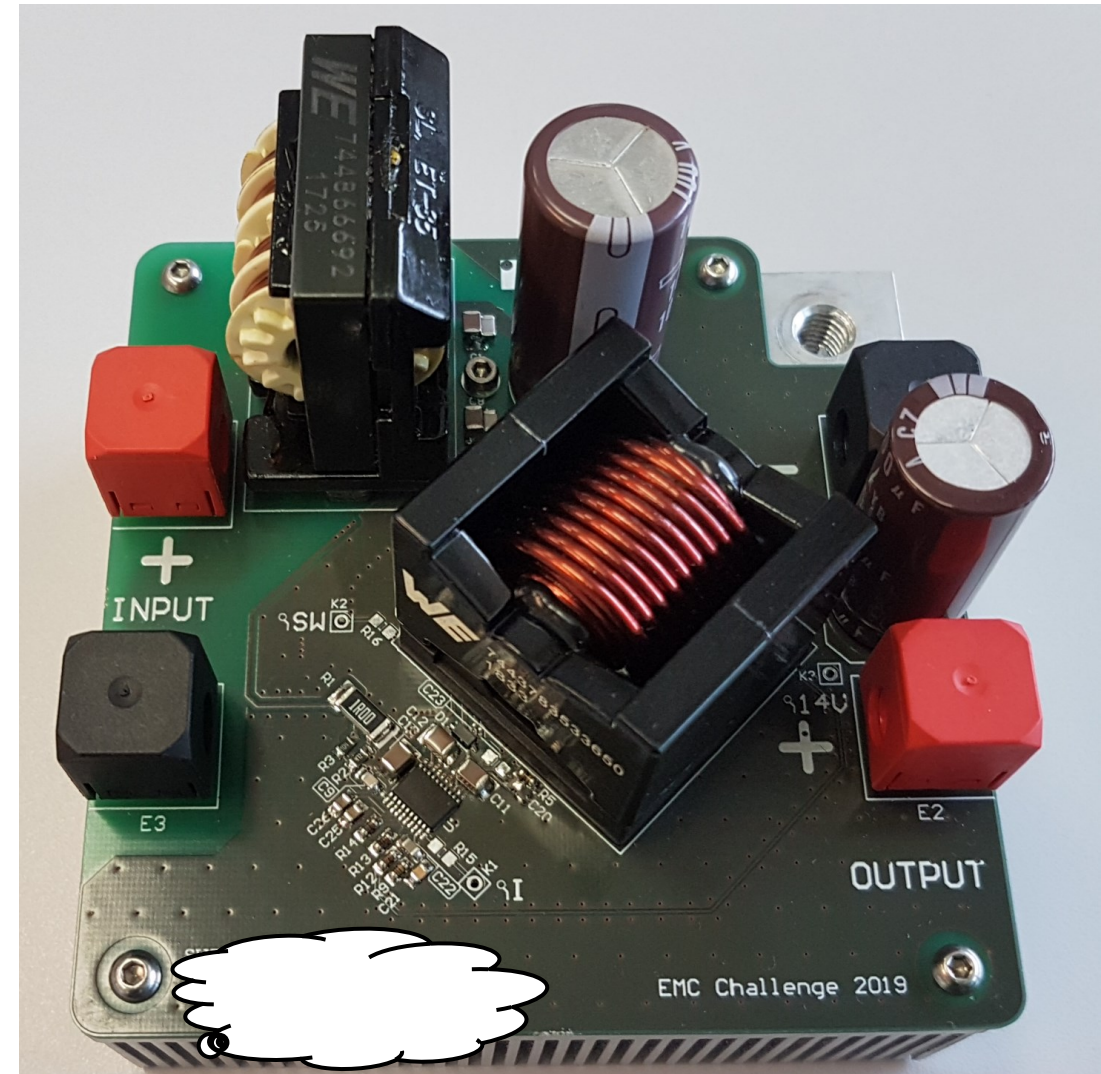
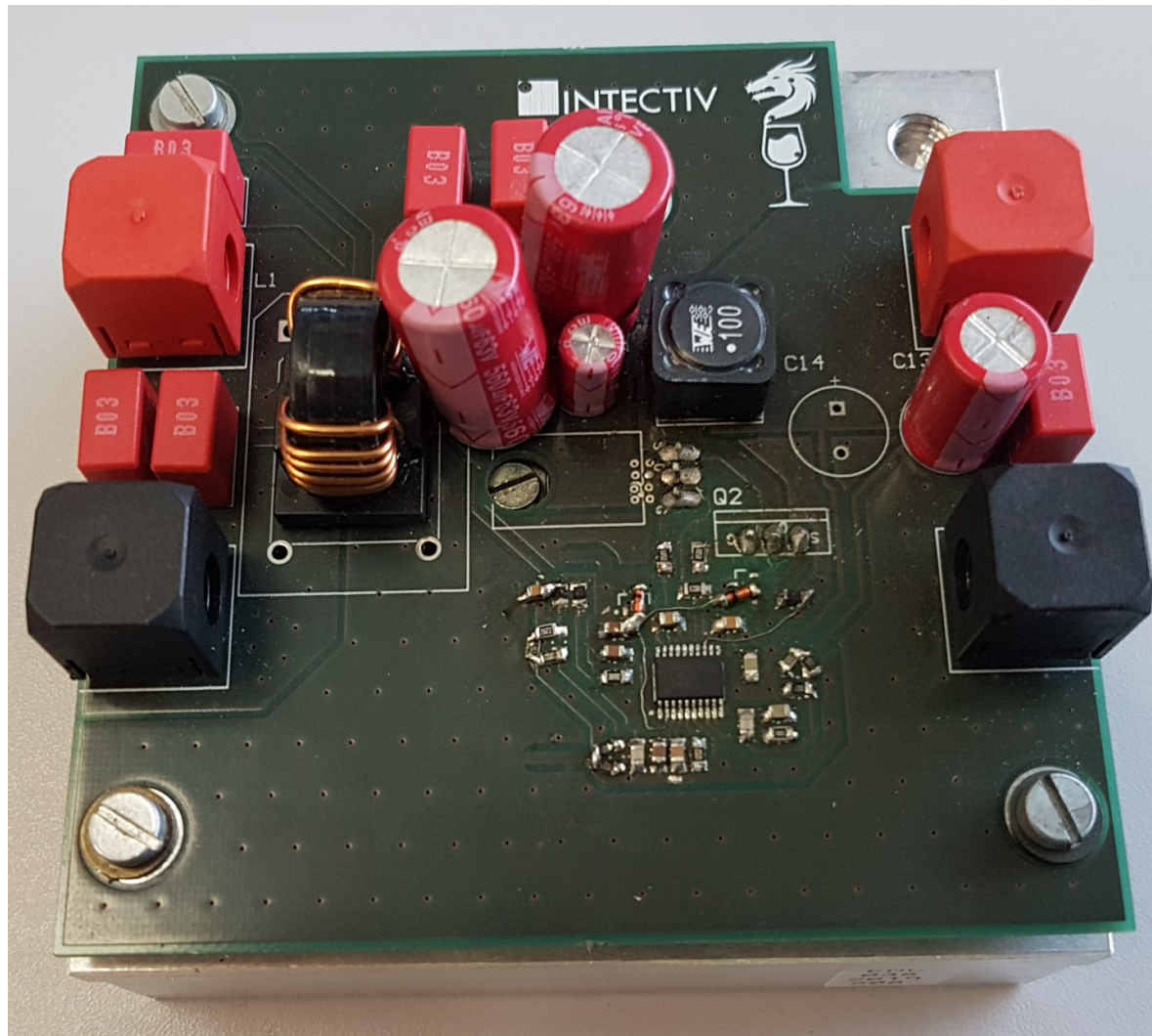


Zaključek

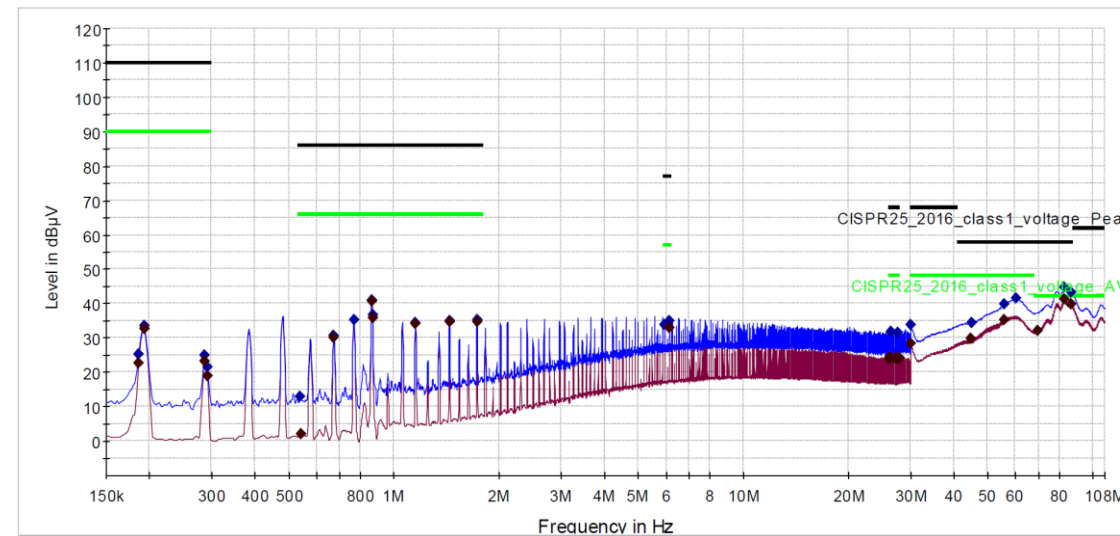
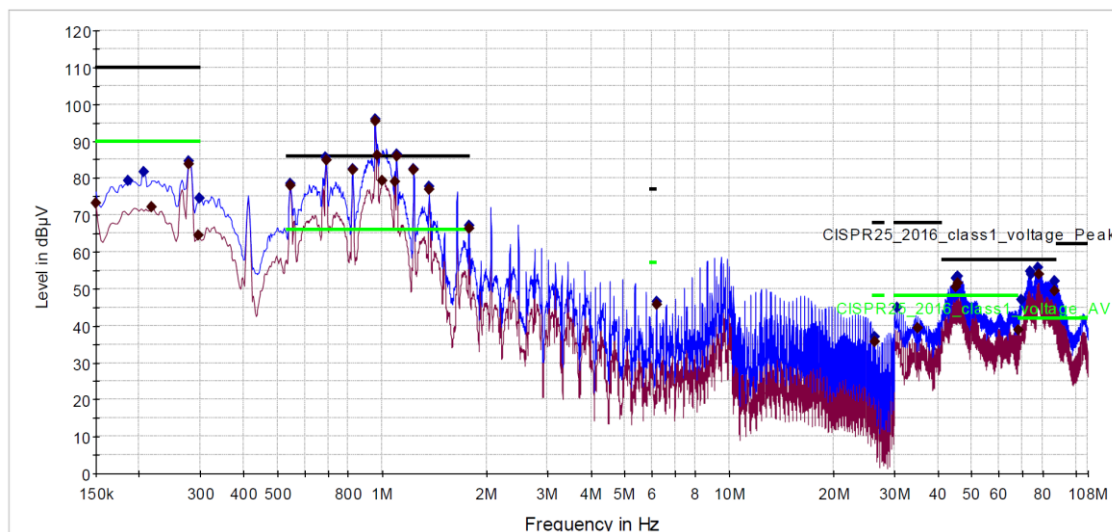
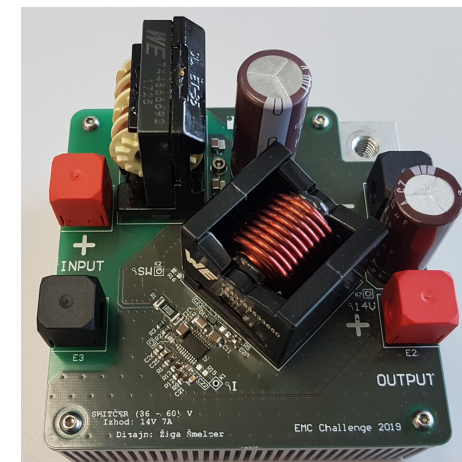
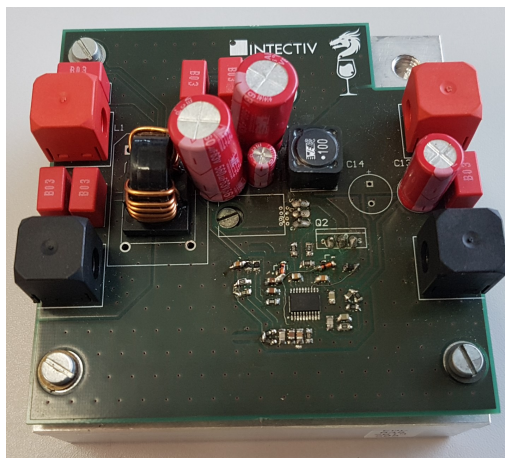


<http://lpvo.fe.uni-lj.si/izobrazevanje/seminarji/>

Rezultati



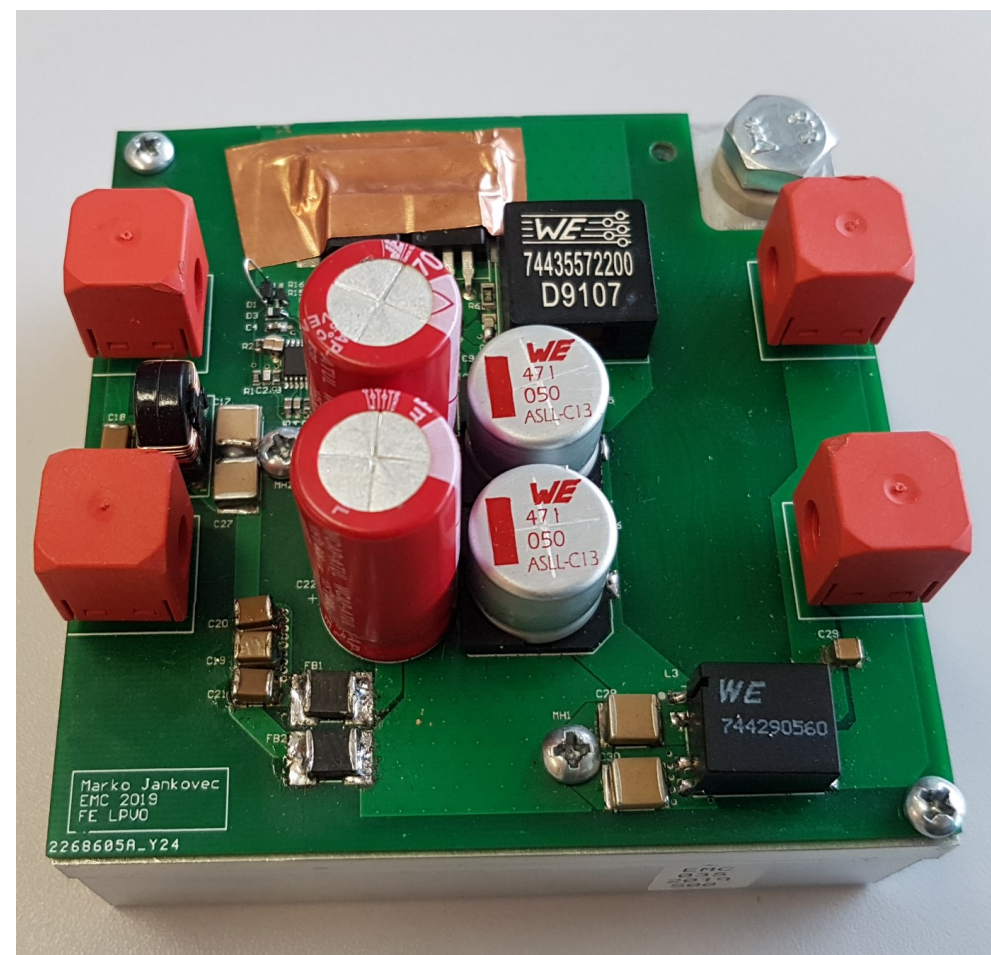
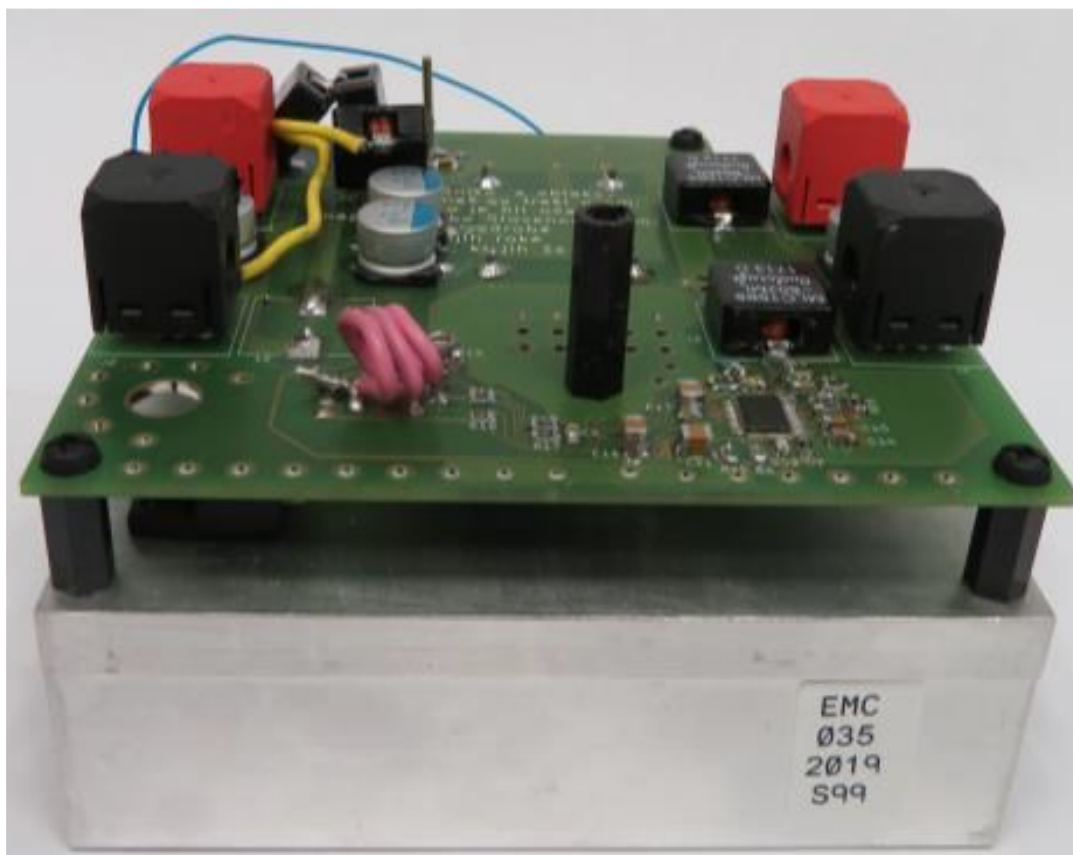
Rezultati



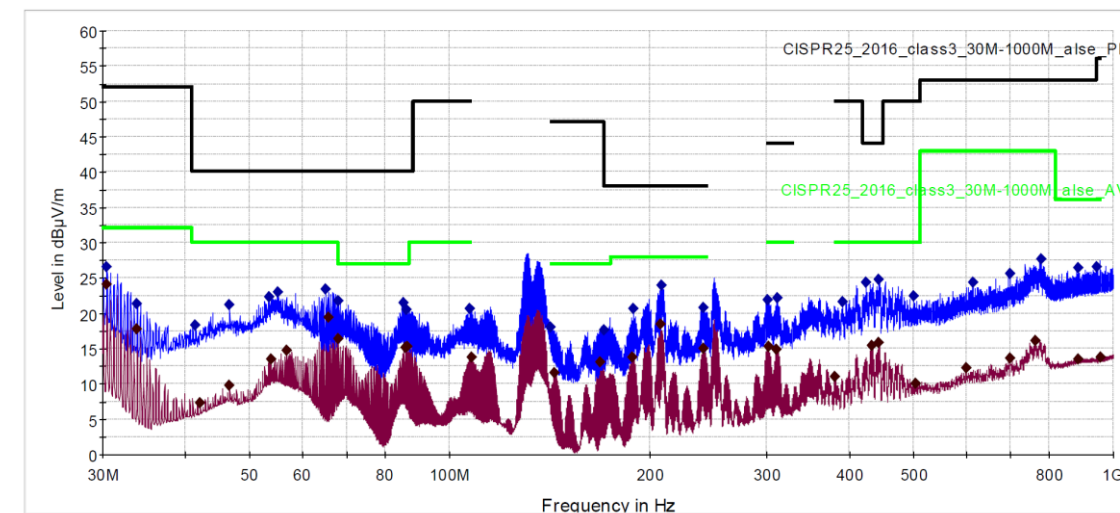
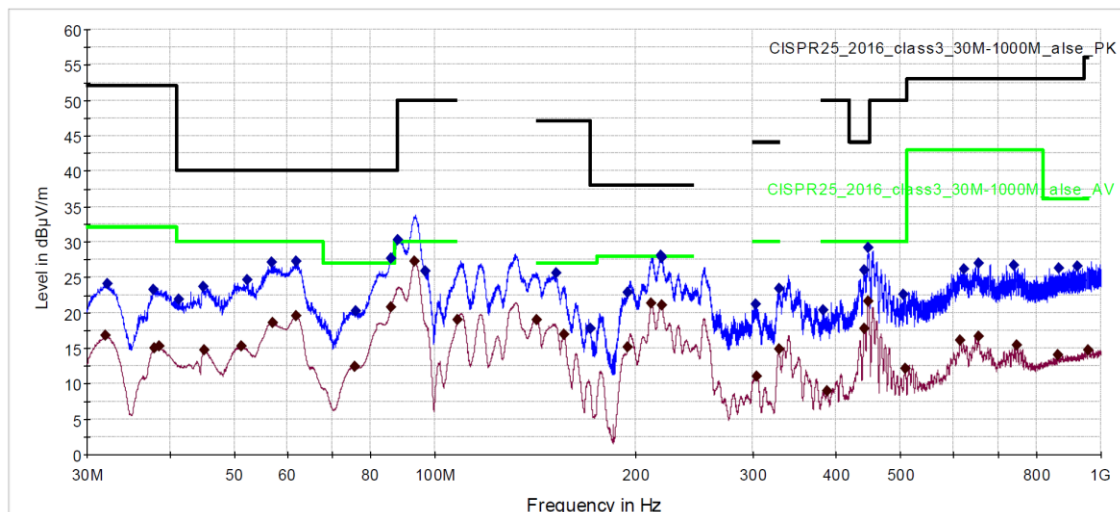
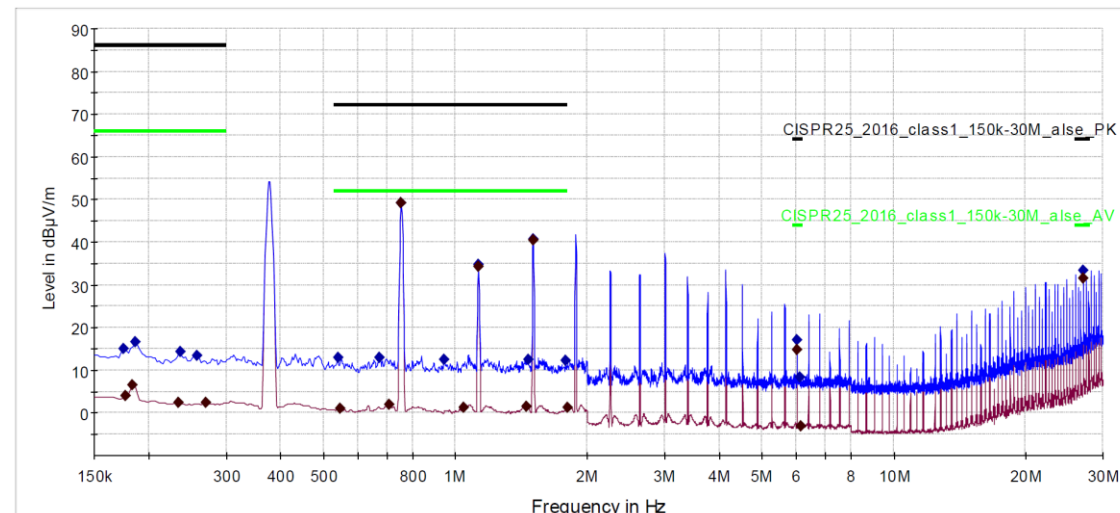
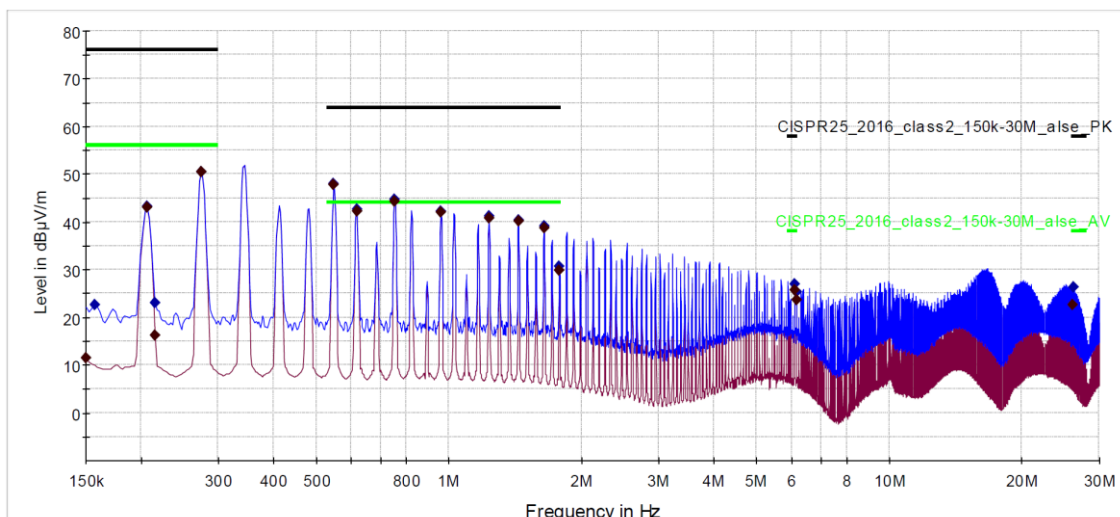
Rezultati

Funkcionalnost				Valovitost / mV		Emisije				Točke						Rezultat	
Meh.	Del.	Cena	Izk.	Osn.	Cel.	CE	class	RE	class	Zam.	Fun.	Cena	Izk.	CE	RE	Vsota	Mesto
NE	DA	20.85 €	93%	24.7	102	0.79	1	-2.54	0		8	19.53	19.6	0.66	-2.54	45.25	1
DA	DA	30.61 €	92%	15.3	443	2.62	1	-5.81	0	-10	10	0	21.4	2.18	-5.81	17.77	2
DA	DA	28.25 €	90%	24.2	232	-10.3	0	-12.1	0		10	4.72	13.4	-10.3	-12.1	5.66	3
NE	DA	11.71 €	88%	53.5	1290	-33.6	0	-30.7	0		6	37.81	18.2	-33.6	-30.7	-2.274	4
DA	DA	13.59 €	95%	25.3	1050	-35.3	0	-32.3	0		8	34.04	14.2	-35.3	-32.3	-11.41	5
DA	DA	23.17 €	96%	110	1118	-29.5	0	-18.1	0		6	14.89	14.5	-29.5	-18.1	-12.26	6
DA	NE	21.74 €															DNF
DA	NE	24.13 €															DNF
DA	DA	25.31 €	91%							-10							DNF

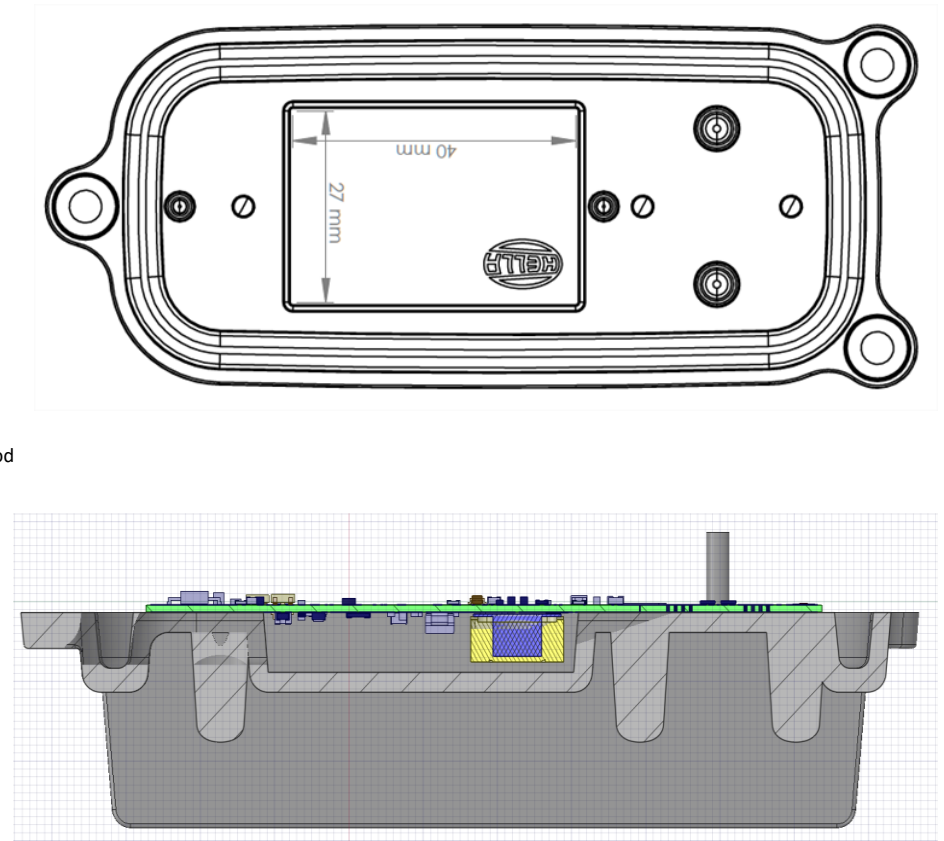
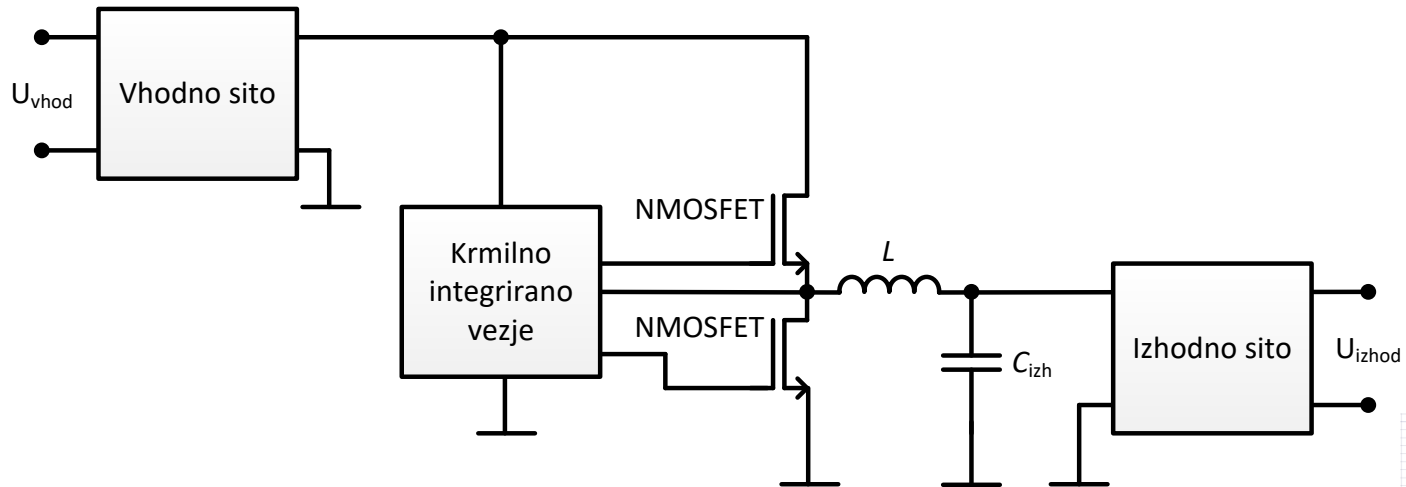
Kaj pa MAHLE in FE?



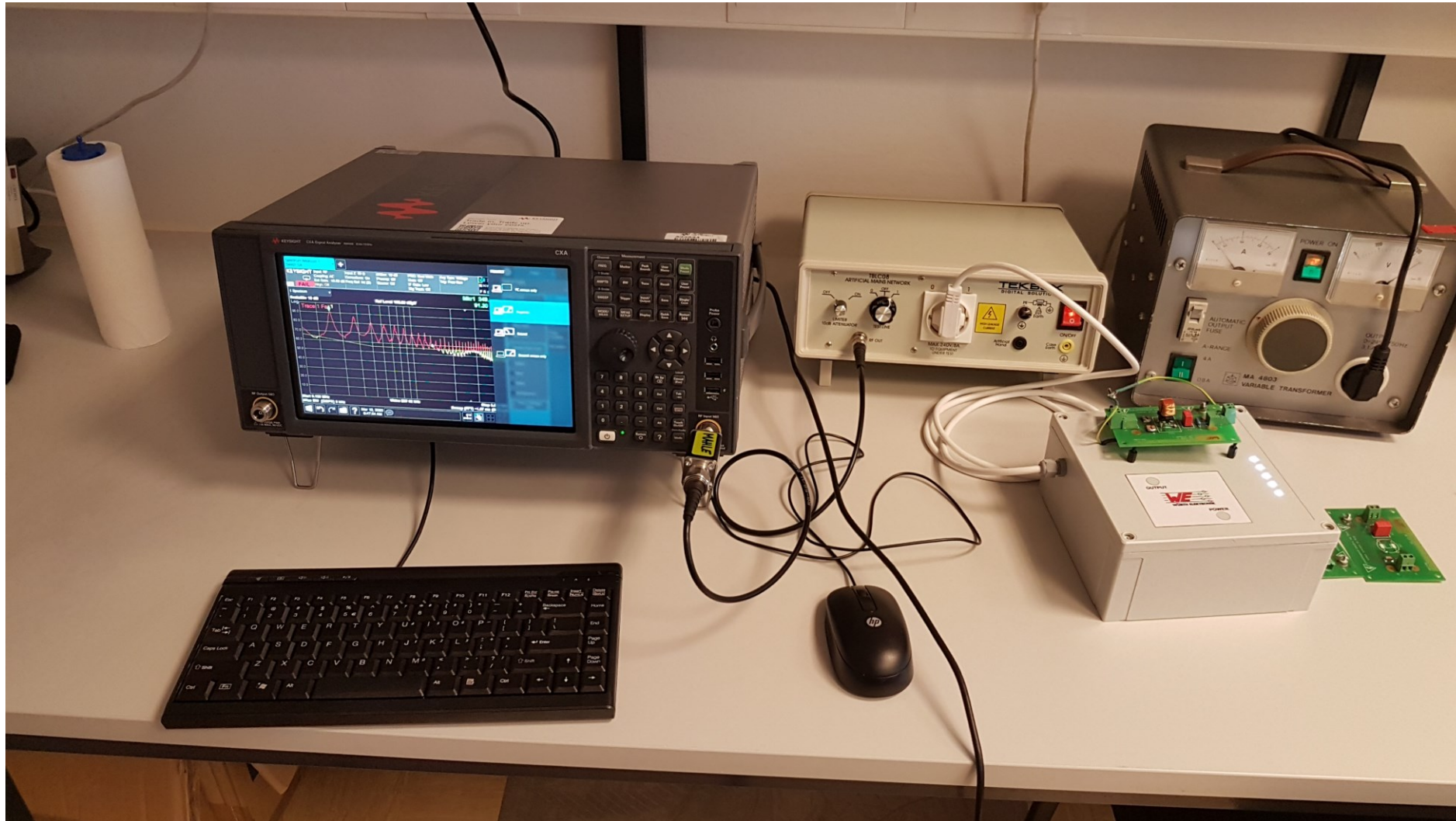
Kaj pa MAHLE in FE?



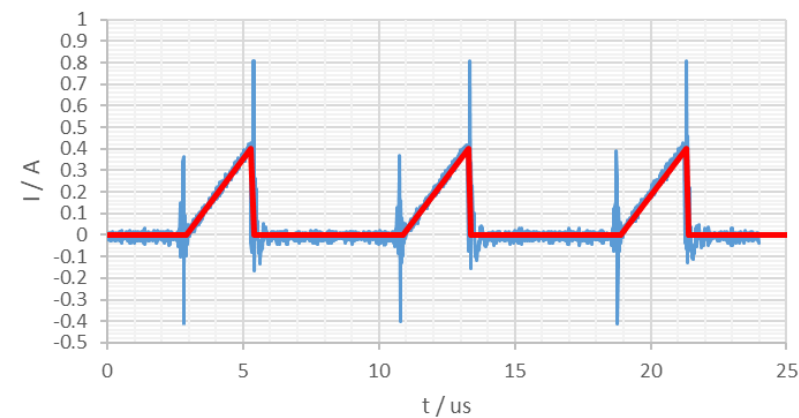
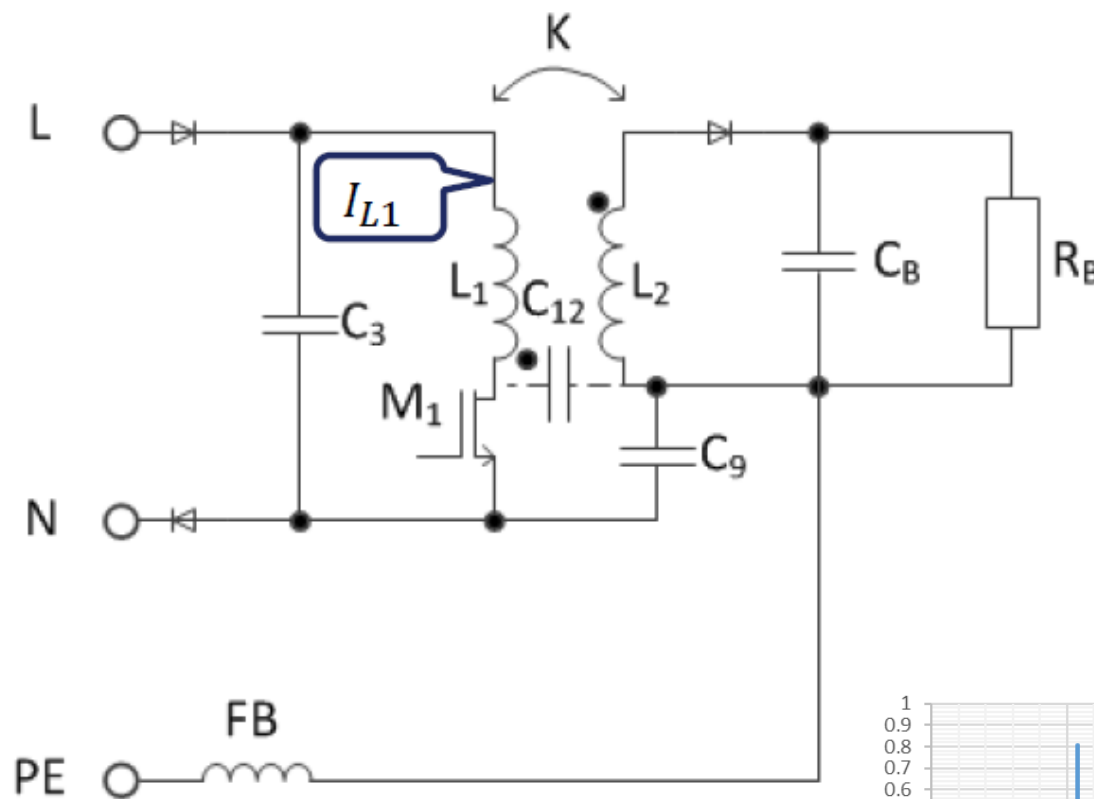
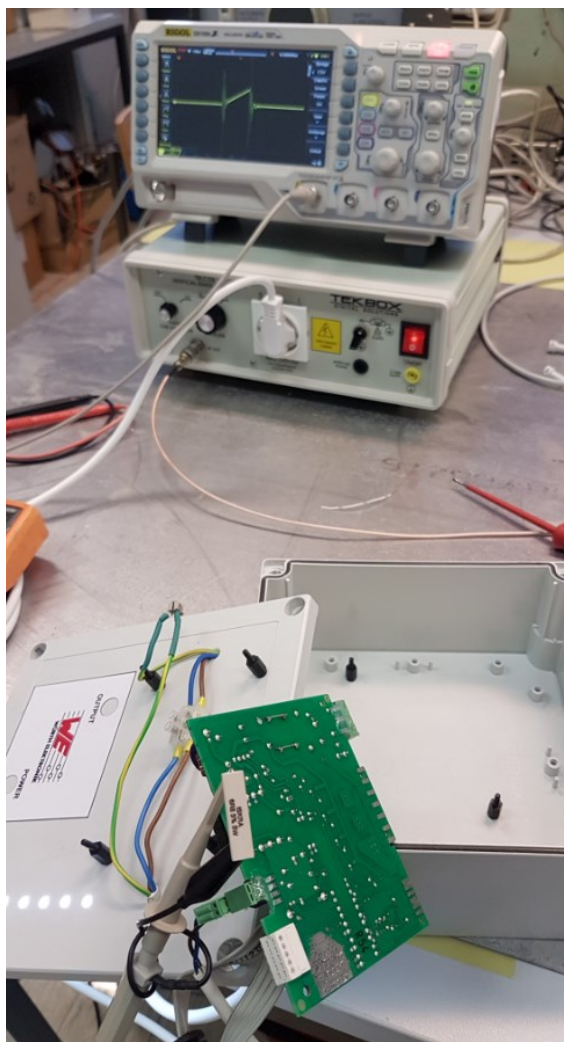
5. EMC delavnica 2020



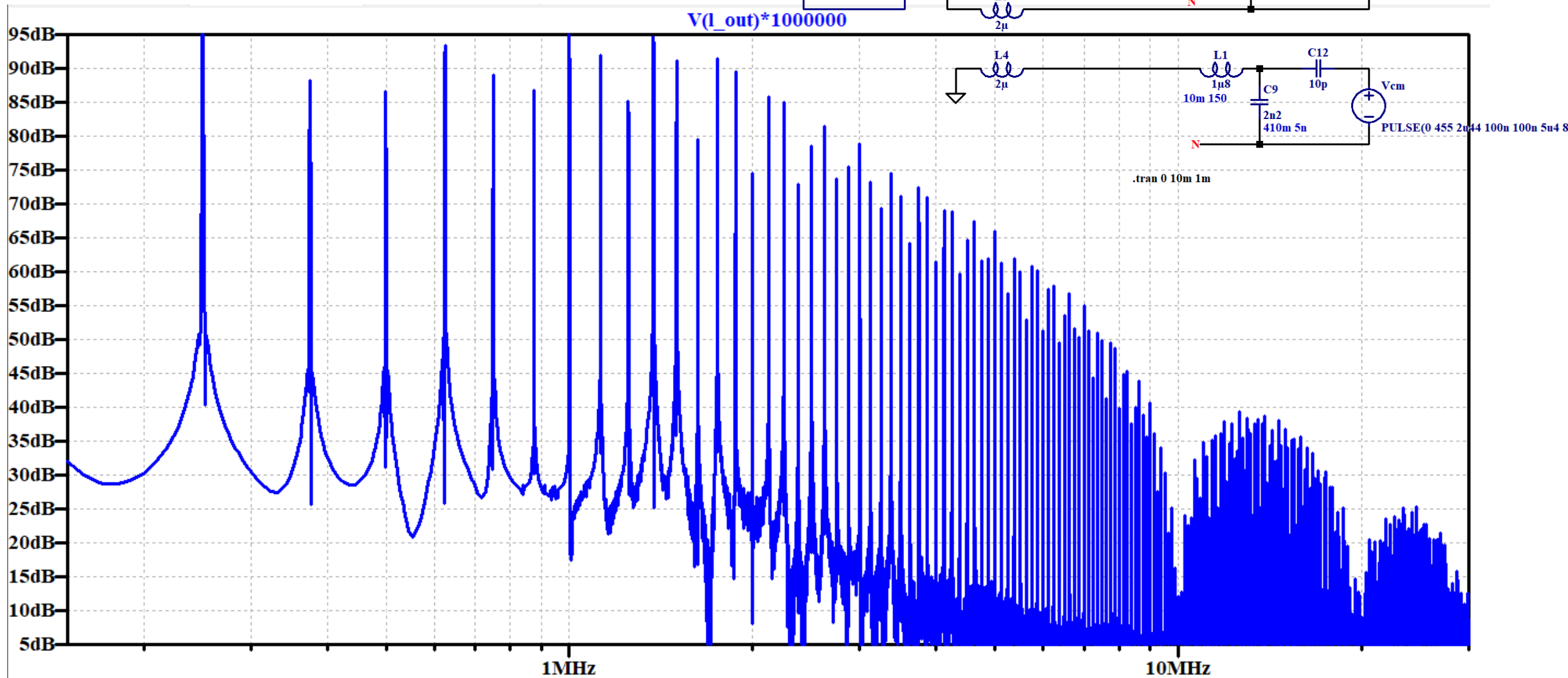
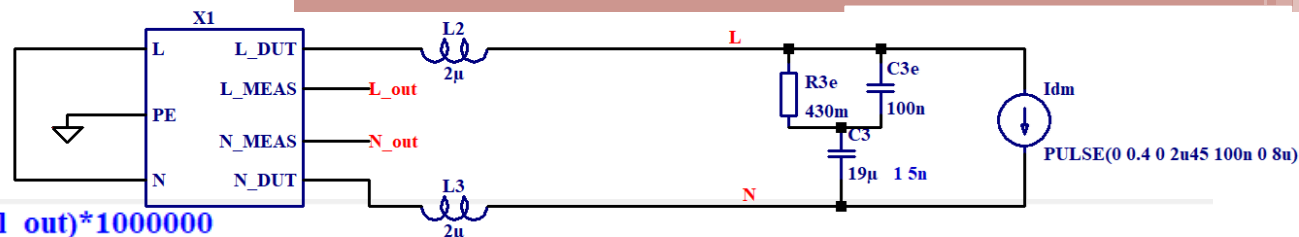
Wurth praktična delavnica načrtovanja filtrov



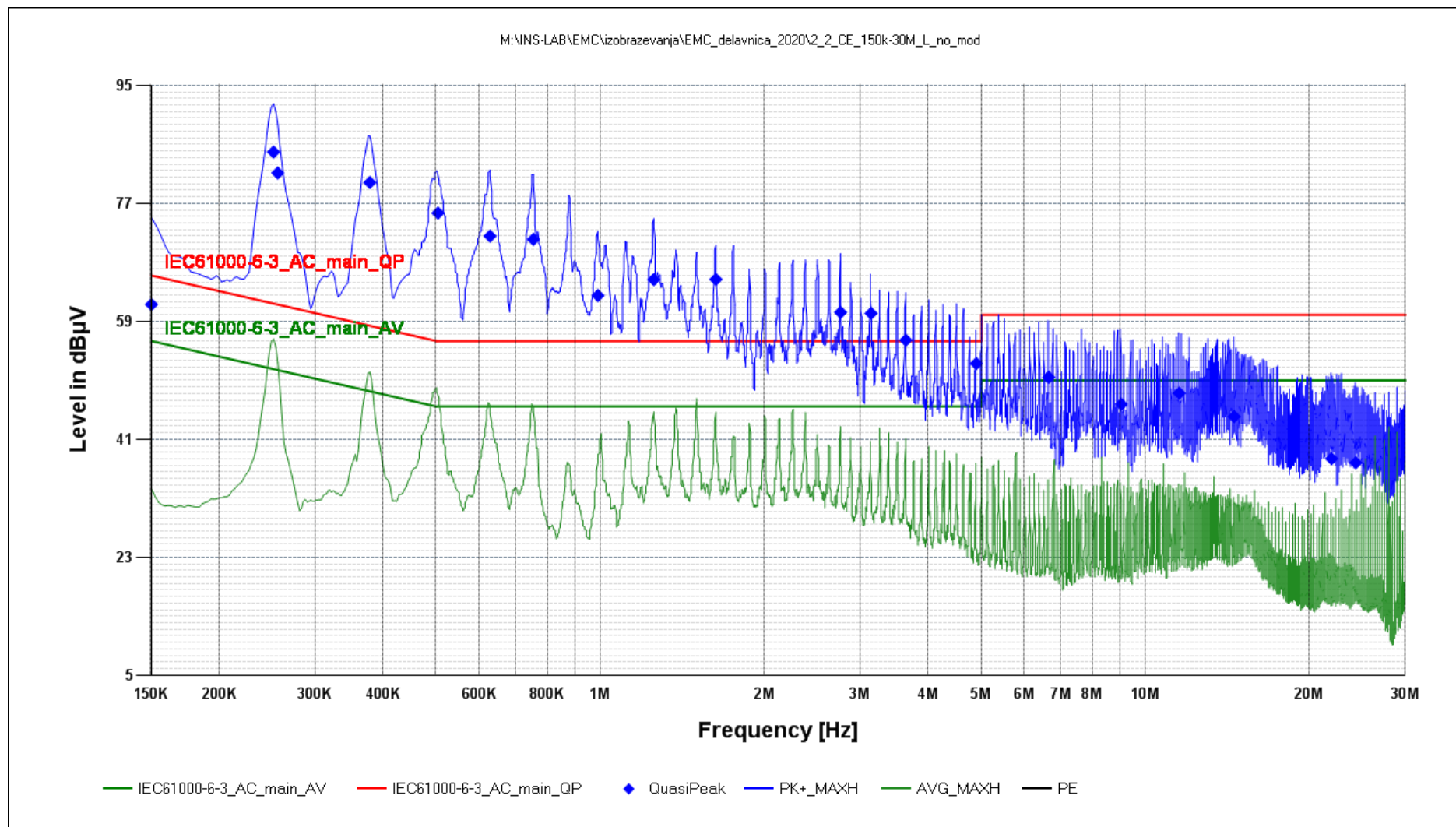
Karakterizacija agresorja in merilne postavitve



Simulacije agresorja

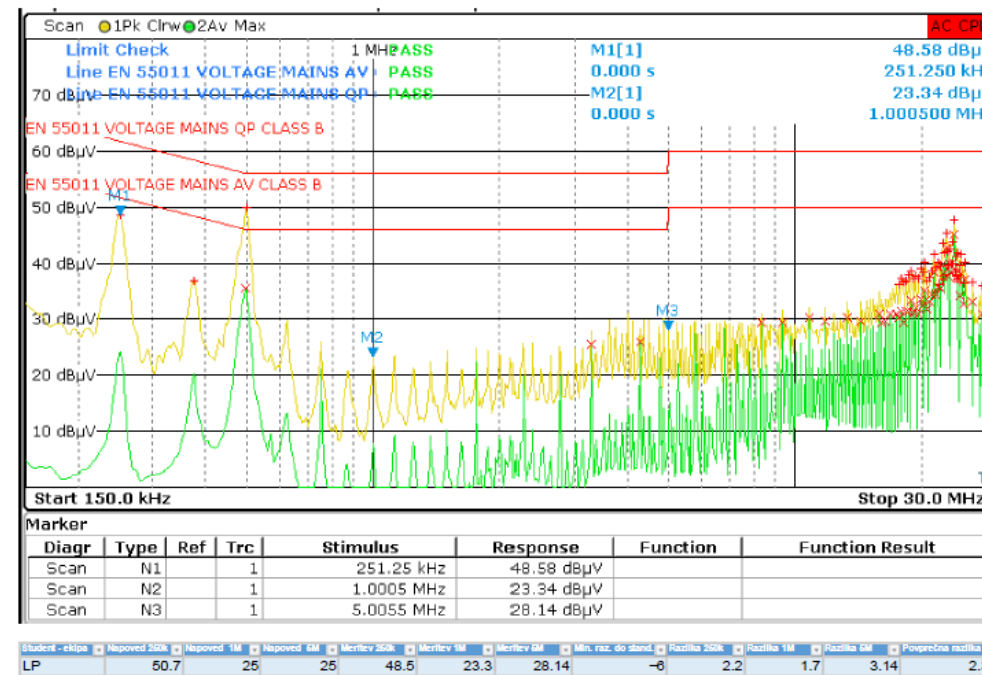
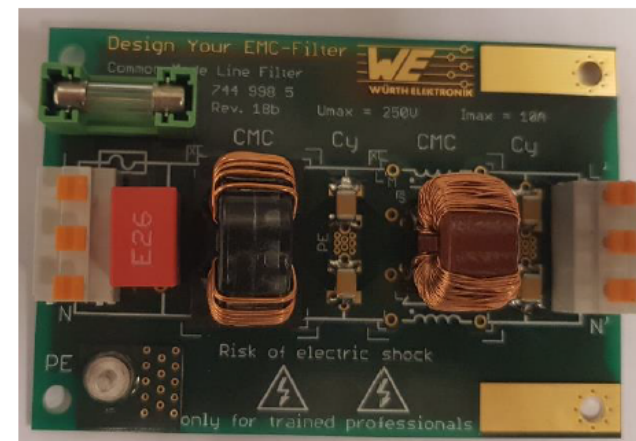
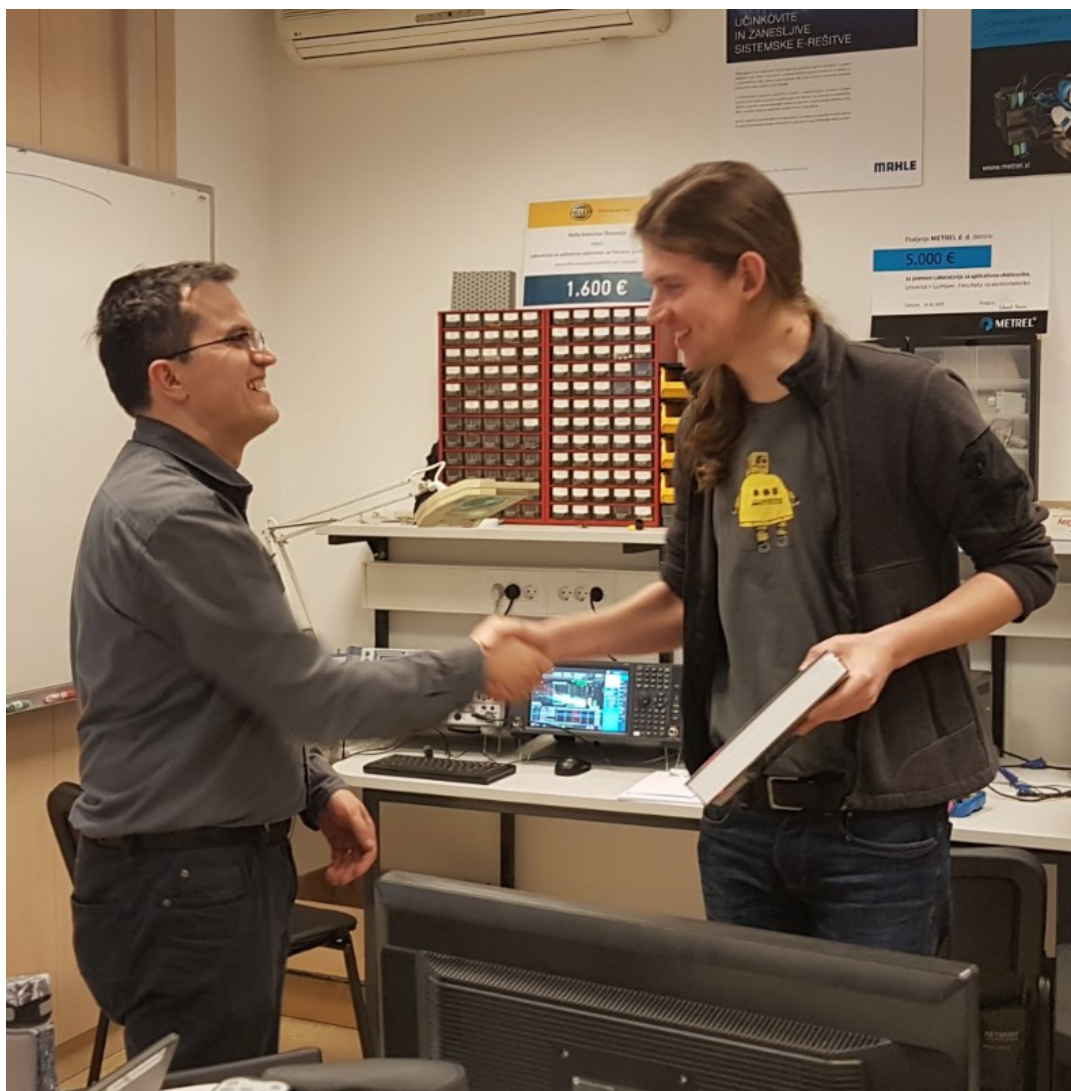


Meritve agresorja

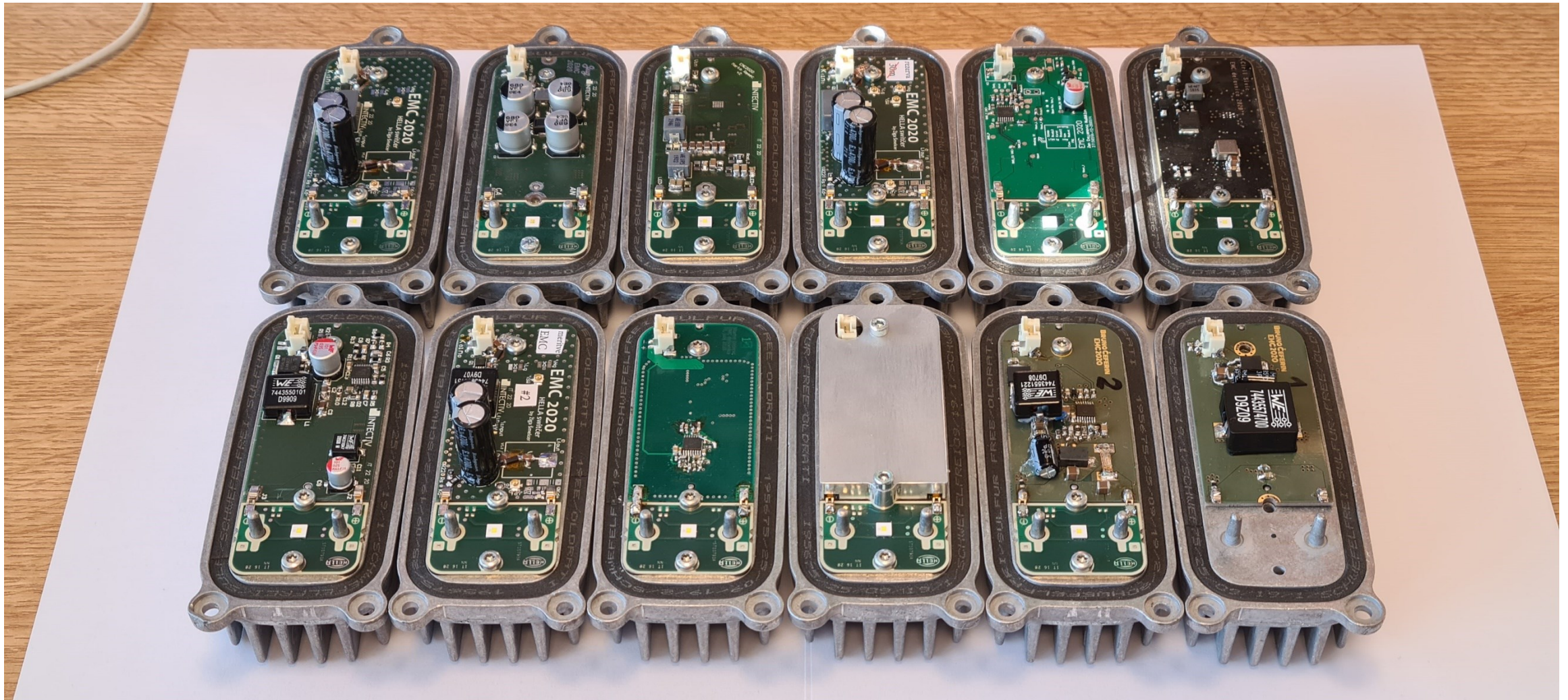


Zmagovalec

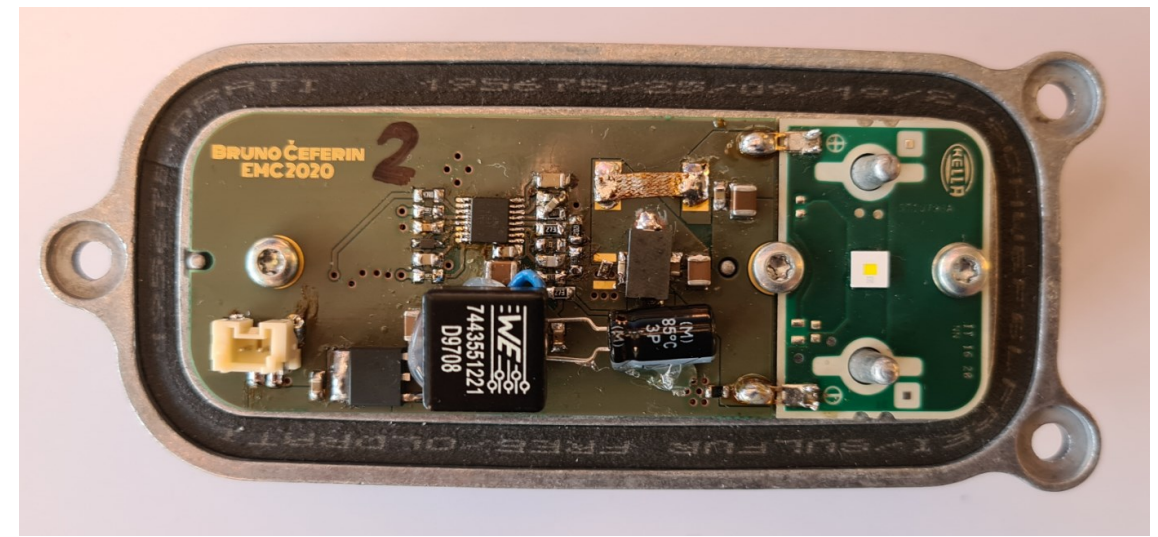
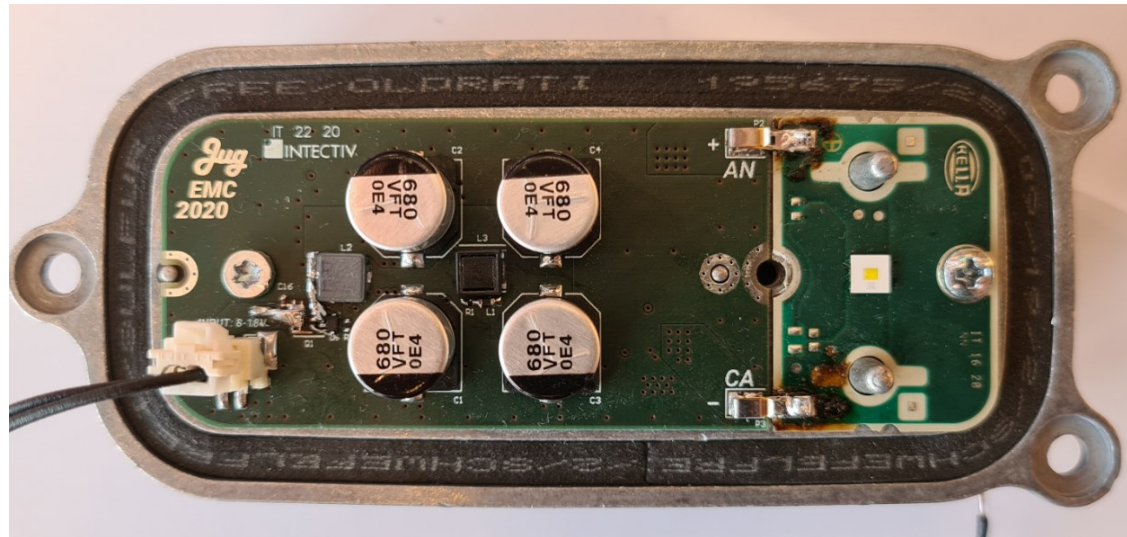
Luka Pogačnik



Oddani izdelki

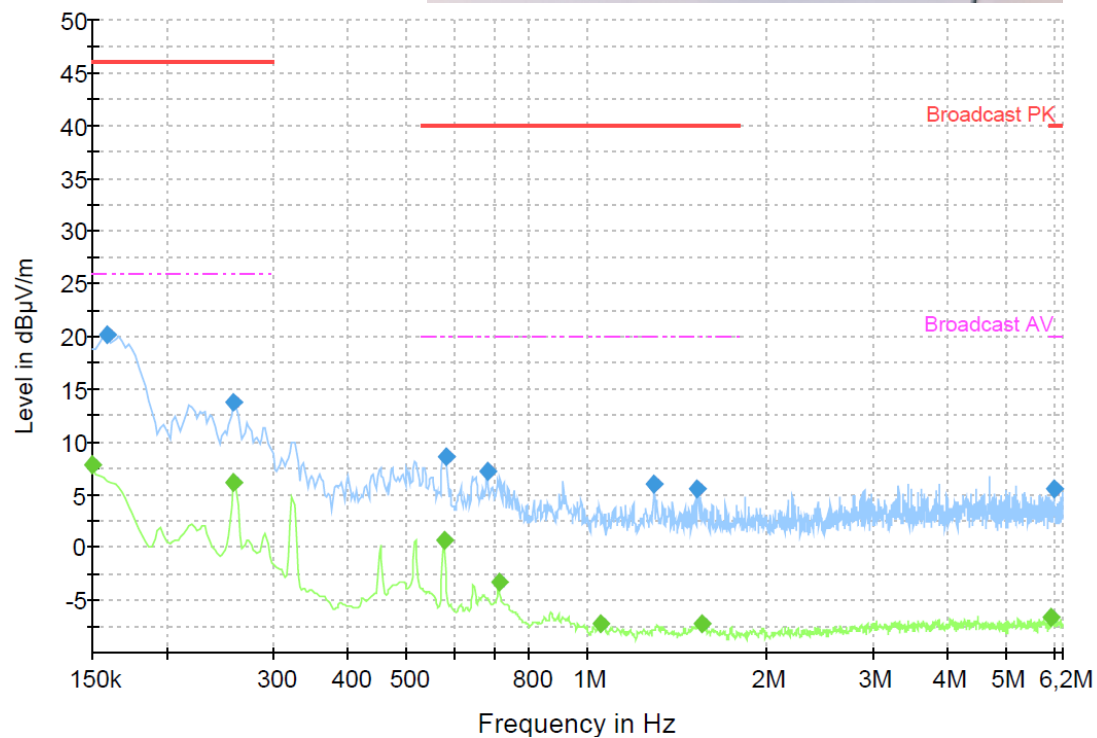
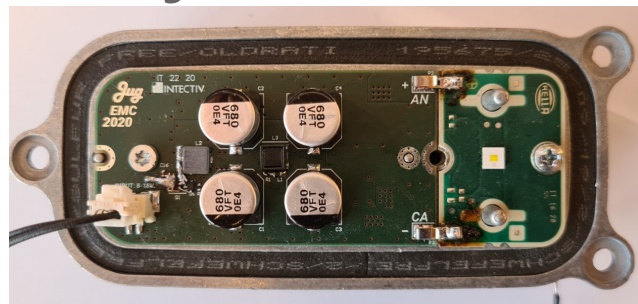


Sevalne motnje

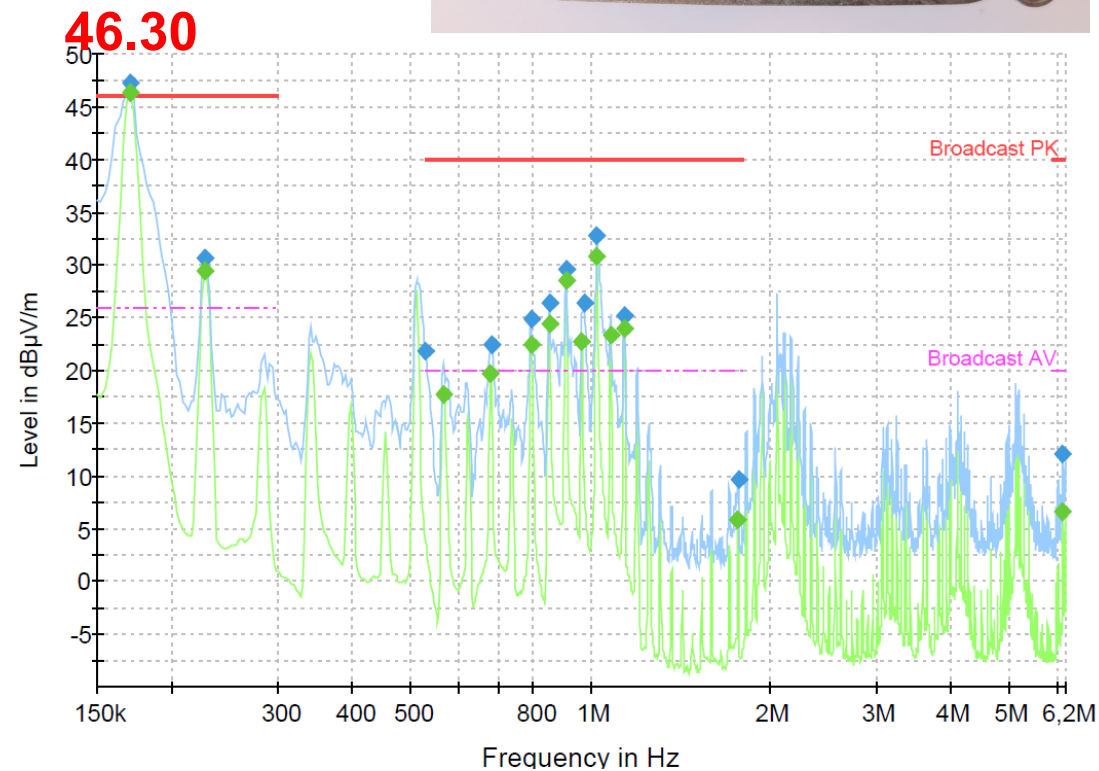


Sevalne motnje

Razred 5



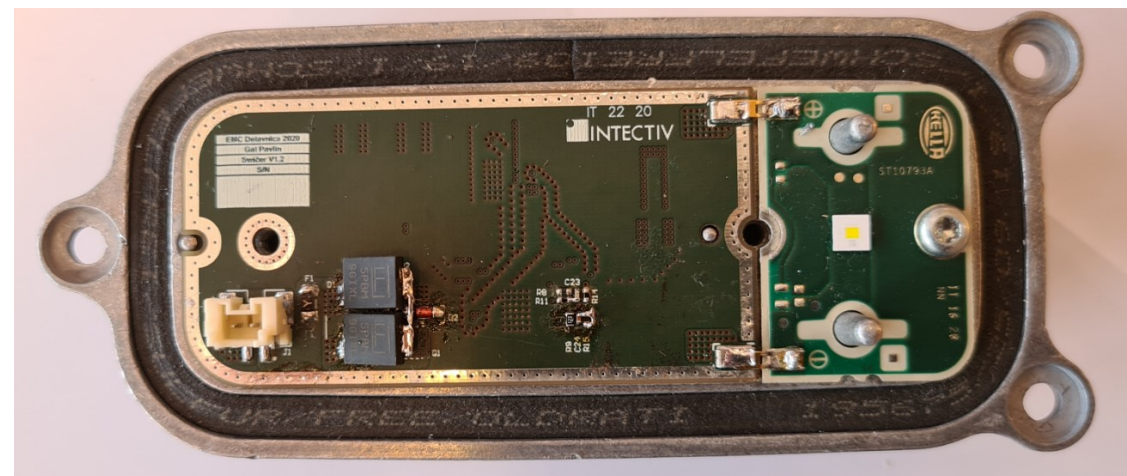
Razred 2



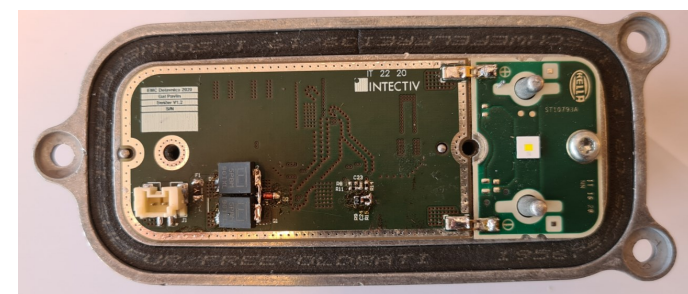
Sevalne motnje

RE	Class	Limita (class)	Limita (class+1)	Točke (class)	Točke (class+1)	Dodatne točke	Točke skupaj
-9.34	5			35			35.0
-8.98	5			35			35.0
-8.76	5			35			35.0
-8.54	5			35			35.0
-7.53	5			35			35.0
-5.33	5			35			35.0
-4.03	5			35			35.0
-0.55	5			35			35.0
19.98	4	22	16	20	35	5.1	25.1
31.95	4	32	26	20	35	0.1	20.1
31.42	3	36	28	10	20	5.7	15.7
24.78	3	27	21	10	20	3.7	13.7
46.3	2	56	46	5	10	4.9	9.9

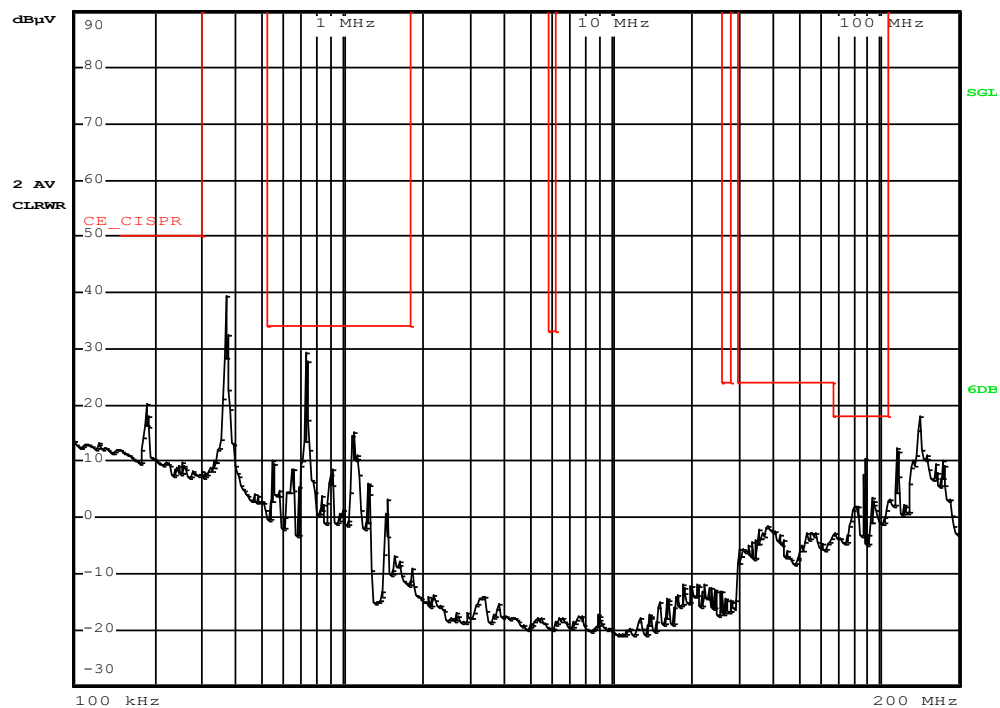
Prevodne motnje



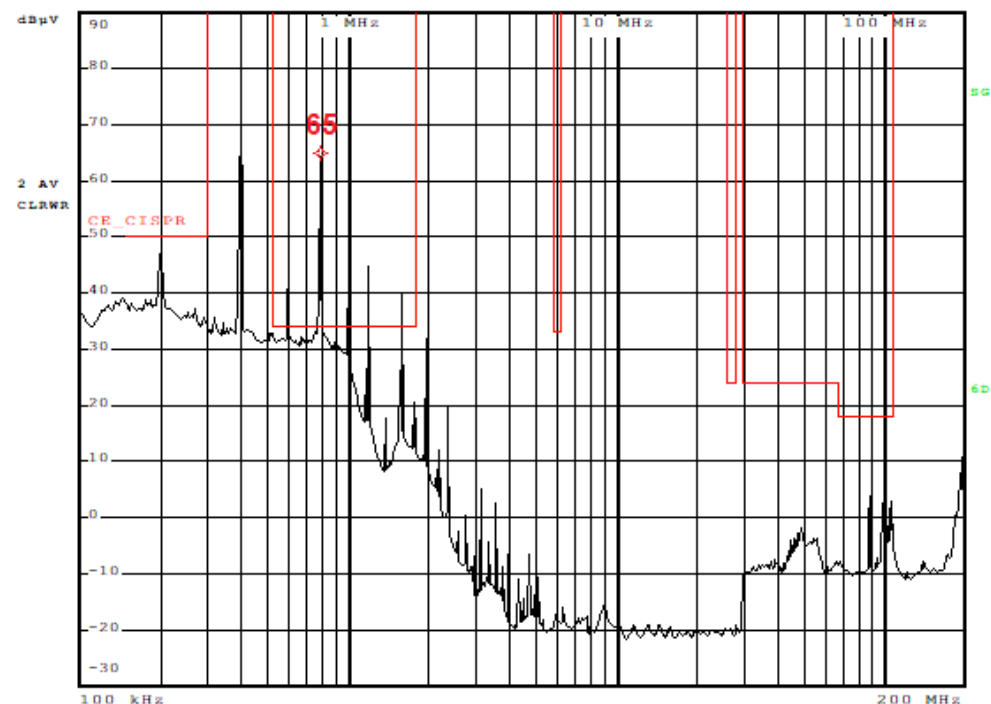
Prevodne motnje



Razred 5



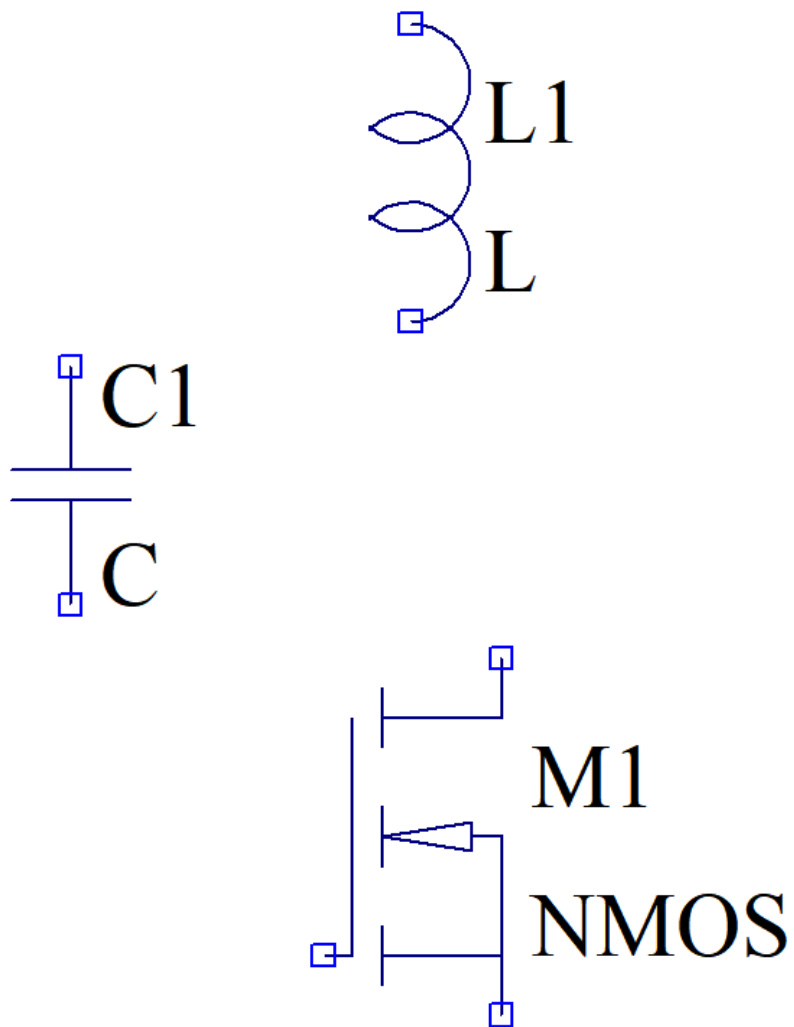
Za 1 dB pod razred 1



Prevodne motnje

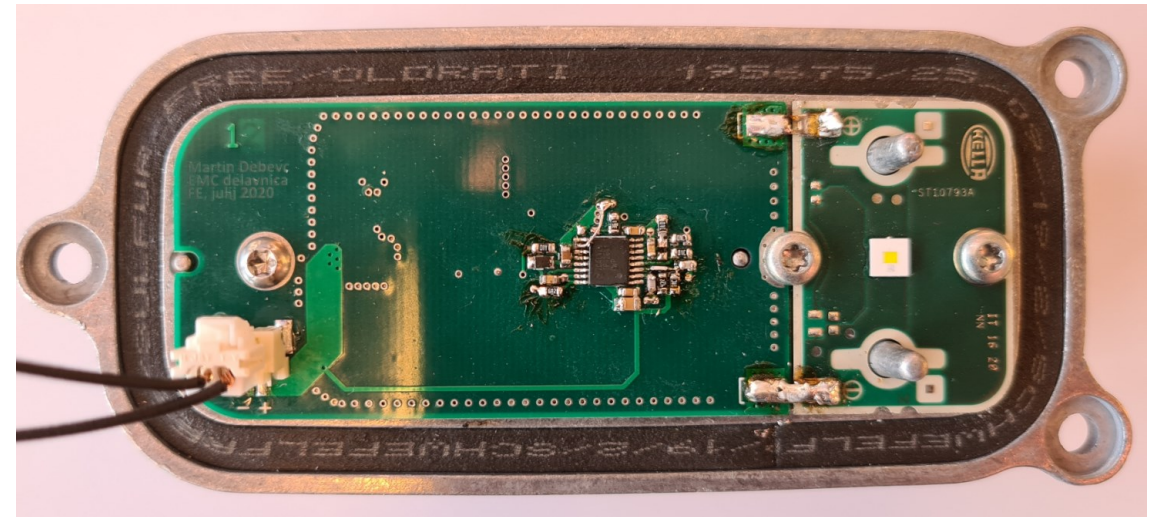
CE	Class	Limita (class)	Limita (class+1)	Točke (class)	Točke (class+1)	Dodatne točke	Točke skupaj
-8	5			35			35.0
-4.5	5			35			35.0
-4	5			35			35.0
-3.5	5			35			35.0
0	5			35			35.0
37.5	4	42	34	20	35	8.4	28.4
44	3	50	42	10	20	7.5	17.5
51	2	58	50	5	10	4.4	9.4
32	2	36	30	5	10	3.3	8.3
36	2	36	30	5	10	0.0	5.0
80	2	80	70	5	10	0.0	5.0
60	1	66	58	0	5	3.8	3.8
68	0	66		0		-2.0	-2.0

Cena materiala

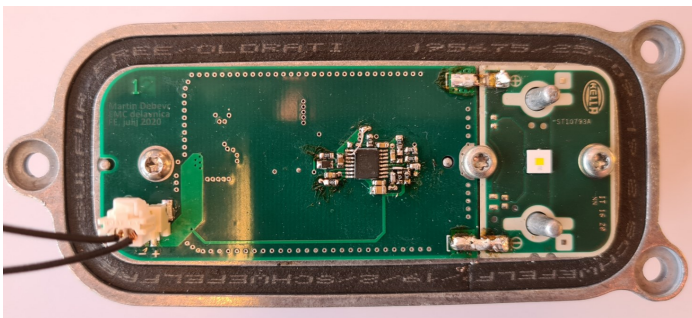


Cena komponent	Točke
4.11 €	-20.55
4.11 €	-20.55
4.97 €	-24.85
5.10 €	-25.5
5.41 €	-27.05
6.06 €	-30.29
6.06 €	-30.29
6.06 €	-30.29
6.52 €	-32.6
6.99 €	-34.95
7.95 €	-39.755
8.49 €	-42.43
10.40 €	-52

Končna razvrstitev

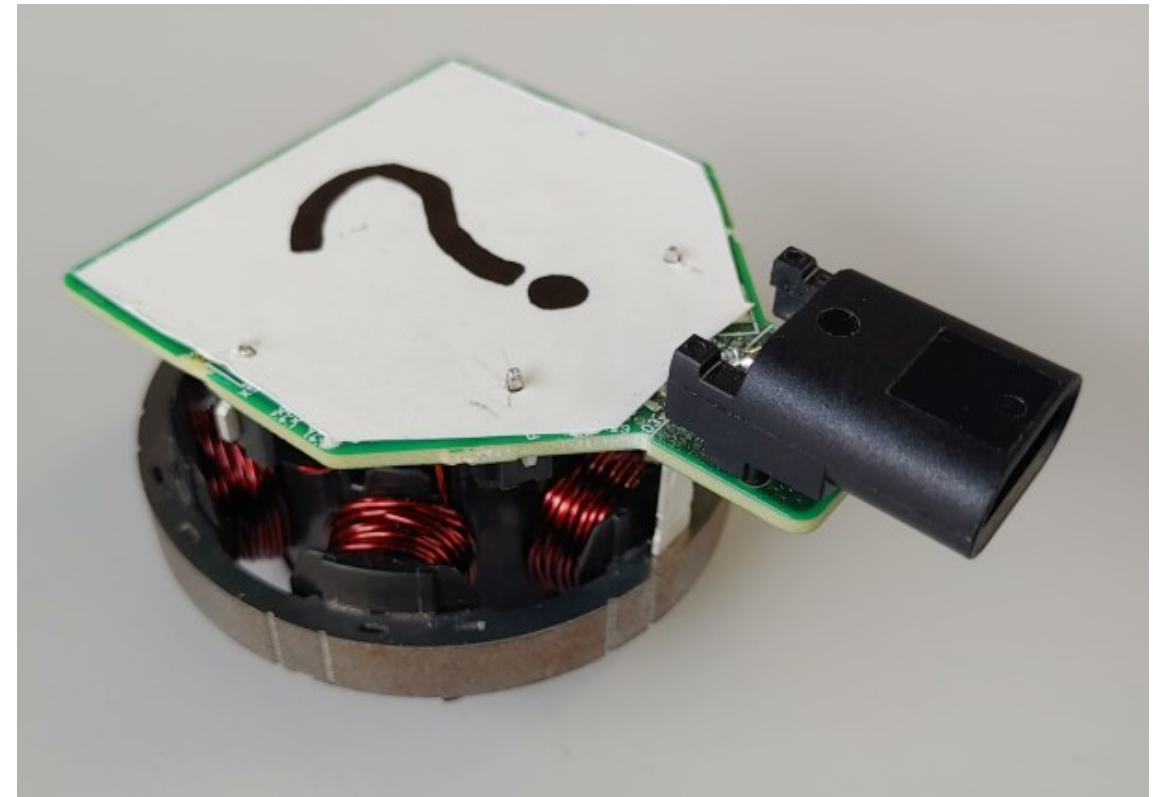
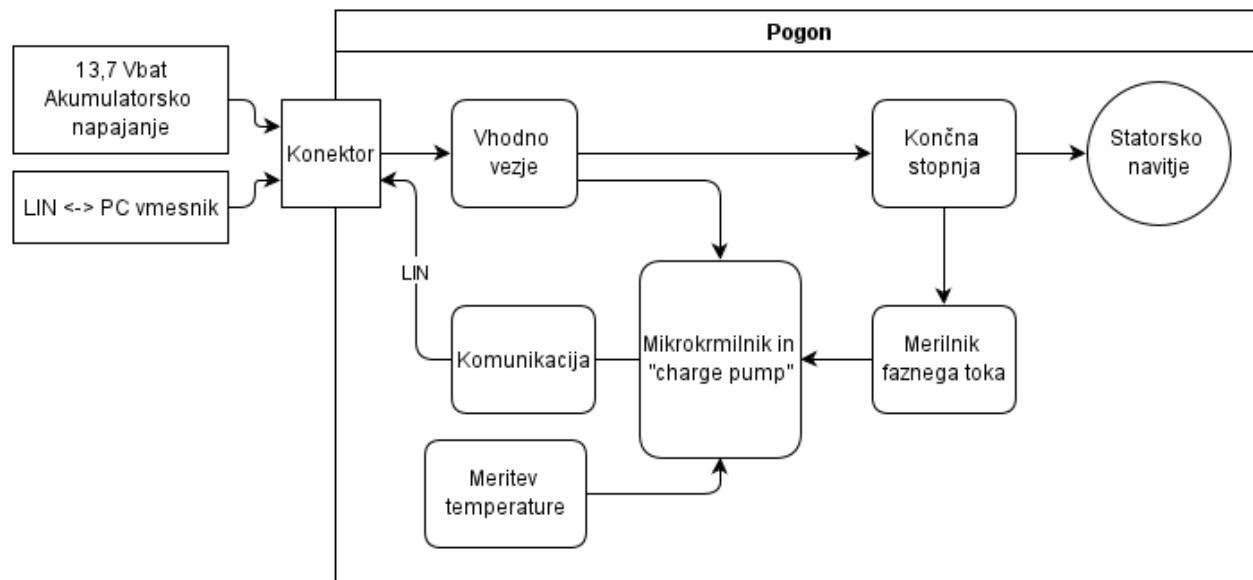


Končna razvrstitev



Doseganje zahtev	Izkoristek	CE	RE	BCI	Cena	Vsota	Mesto
50	52.0	35.0	35.0	30	-32.6	169.4	1
50	12.9	28.4	35.0	30	-24.9	131.5	2
35	11.5	35.0	35.0	30	-20.6	125.9	
50	5.7	35.0	35.0	30	-30.3	125.4	3
50	-0.3	35.0	35.0	30	-30.3	119.4	3
50	-7.3	35.0	35.0	30	-30.3	112.4	3
50	9.6	3.8	15.7	30	-20.6	88.6	4
50	9.4	-2.0	35.0	30	-35.0	87.5	5
35	-10.7	17.5	35.0	30	-25.5	81.3	6
50	-14.4	9.4	25.1	30	-27.1	73.0	7
50	4.5	8.3	13.7	30	-42.4	64.2	8
45	-5.5	5.0	9.9	30	-39.8	44.6	7
25	-54.6	5.0	20.1	30	-52.0	-26.5	9

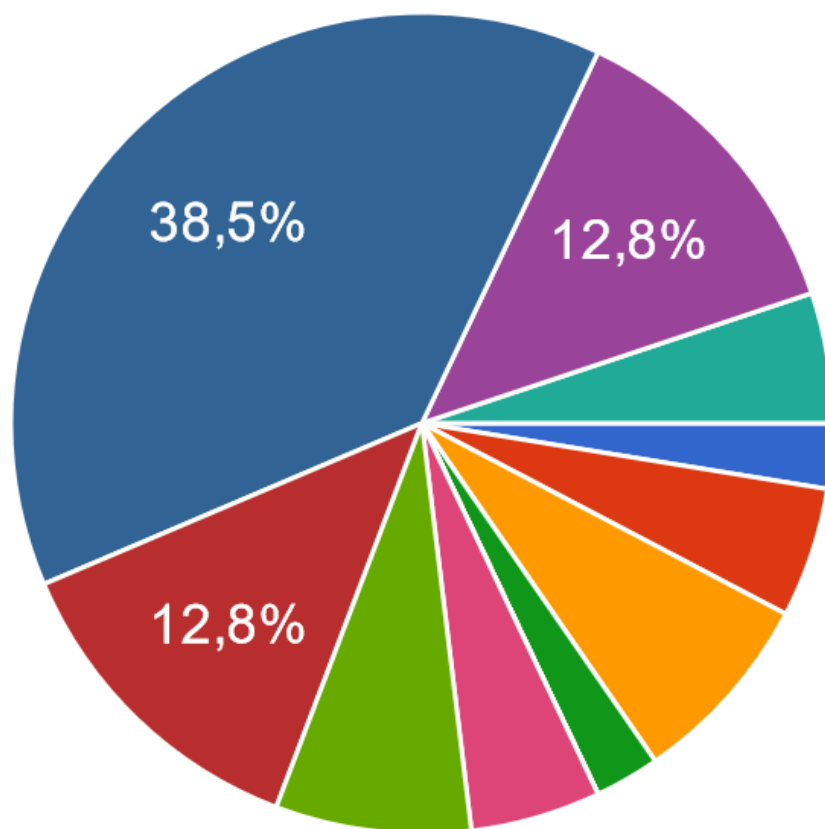
6. EMC delavnica 2023

60
YEARS**KOLEKTOR**

Kako?

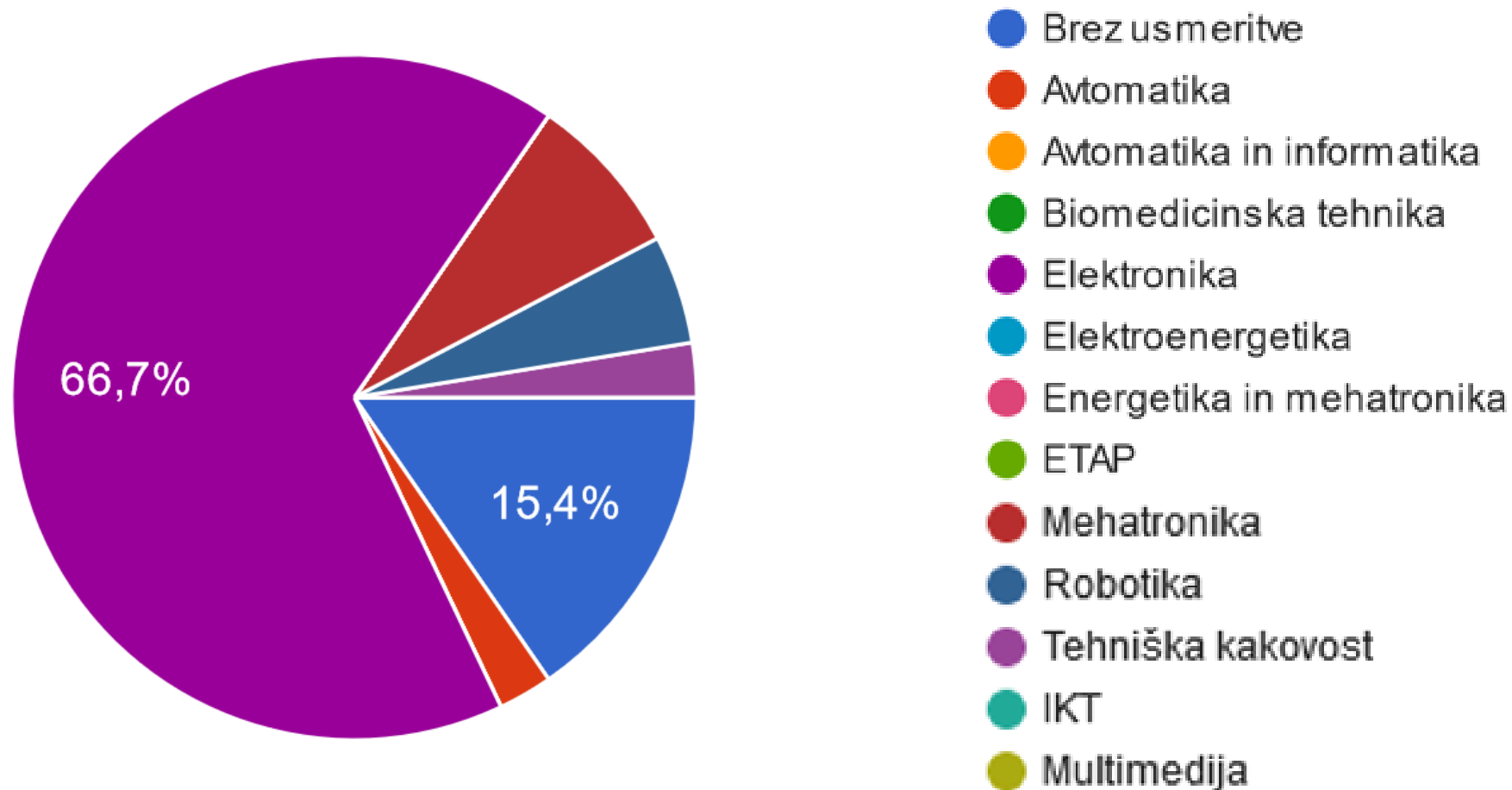
Termin	Vsebina	Predavatelj
torek 21.2.	Predstavitev EMC delavnice in izziva	Marko Jankovec (FE LPVO), Jaka Ivančič (Kolektor)
torek 28.2.	Osnove BLAC motorjev	Damjan Miljavec (FE LES). Simon Mandelj (GEM m.)
torek 7.3.	Osnove krmiljenja BLAC motorjev	Peter Zajec (FE LRTME). Jaka Ivančič (Kolektor)
torek 14.3	Elektromagnetna združljivost	Marko Jankovec (FE LPVO), Mirko Ivančič (Amiteh)
torek 21.3	Načrtovanje filtrov	Gregor Ergaver in Kristijan Saksida (Mahle EDS)
torek 28.3.	Praktična delavnica načrtovanja filtrov	Tomo Kozeljnik in (Wurth elektronik)
torek 4.4.	Novosti v Altium designerju	Matija Markovič (computer Controls)
torek 11.4.	Dizajn za proizvodnjo v avtomobilski industriji	Hella Saturnus
nedelja 16.4.	Oddaja PCB in BOM	
petek 5.5.	Ekskurzija v Kolektor mobility	
ponedeljek 5.6.	Oddaja končnih projektov	
12-16.6	Meritve EMC	
torek 27.6.	Zaključek EMC delavnice	

Prijave po letnikih

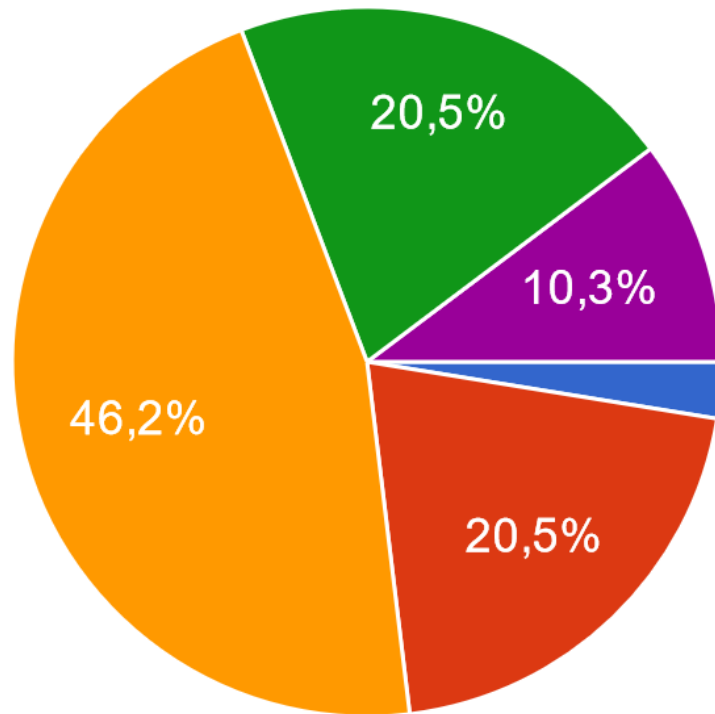


- Dijak
- 1. stopnja VS-EL, 1. letnik
- 1. stopnja VS-EL, 2. letnik
- 1. stopnja VS-EL, 3. letnik
- 1. stopnja UN-MM, 1. letnik
- 1. stopnja UN-MM, 2. letnik
- 1. stopnja UN-EL, 1. letnik
- 1. stopnja UN-EL, 2. letnik
- 1. stopnja UN-EL, 3. letnik
- 2. stopnja UN-EL, 1. letnik
- 2. stopnja UN-EL, 2. letnik
- Doktorski študij

Prijave po smereh

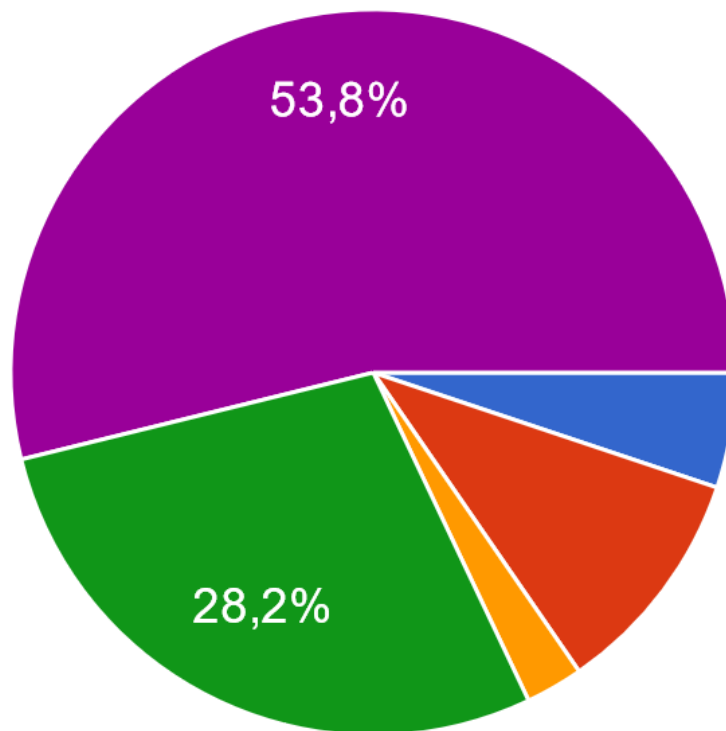


Izkušnje z načrtovanjem vezij



- Jih nimam.
- Sem že enkrat poizkusil.
- Sem že izdelal svoje vezje.
- Sem že izdelal več vezij, tudi kompleksnejša za lastne potrebe.
- Sem že delak kompleksna vezja po naročilu za podjetja.

Sodelovanje pri tekmovanju



- Tekmovanje me ne zanima.
- Bi, a nimam časa.
- Bi, če bi bila mamljiva nagrada.
- Bi, če le ne bo prezahtevno.
- Vsekakor.

Nagrade tekmovalcem

Podjetje	Nagrada
Kolektor	2000 €
Mahle EDS	?
Hella Saturnus	700 €
GEM motors	500 €
SIQ	storitve in darilo v vrednosti 500 €
Goap	300 €
Amiteh	Inštrument v vrednosti 300 €
Iskra emeco	200 €
Instrumentation technologies	Red pitaya STEM-lab
Intectiv	Izdelava tiskanih vezij
Wurth elektronik	elektromaterial in free-refill design kiti