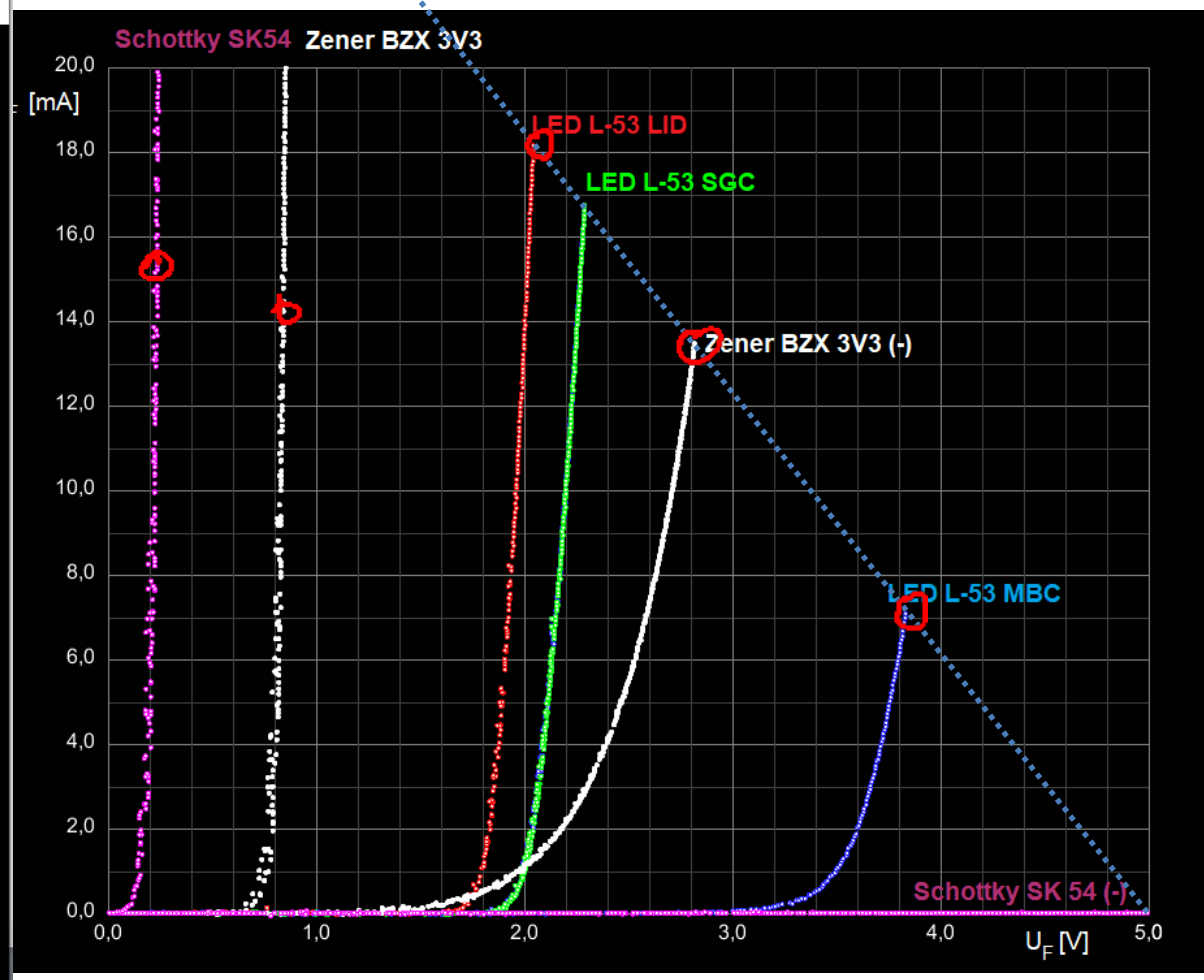
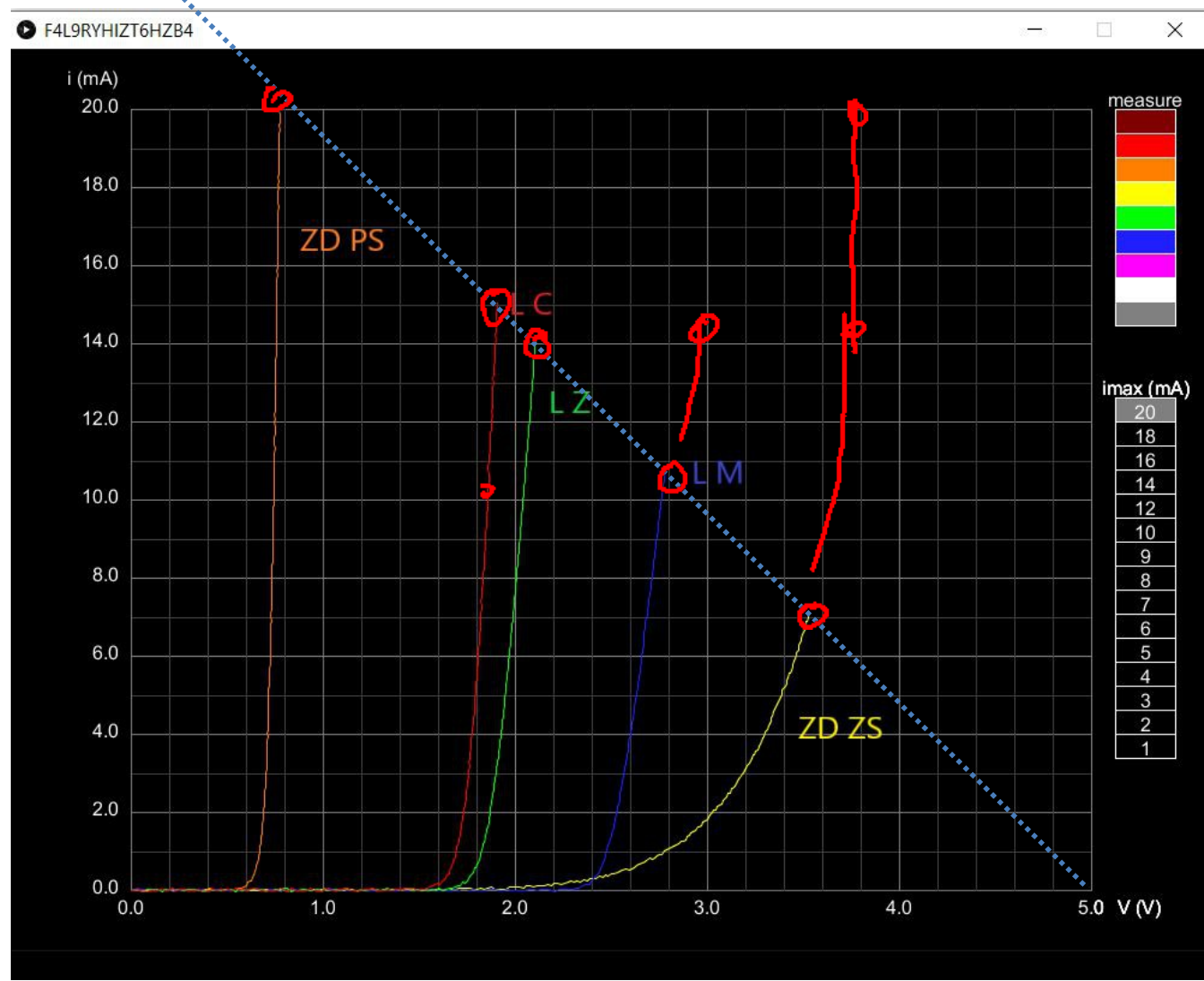


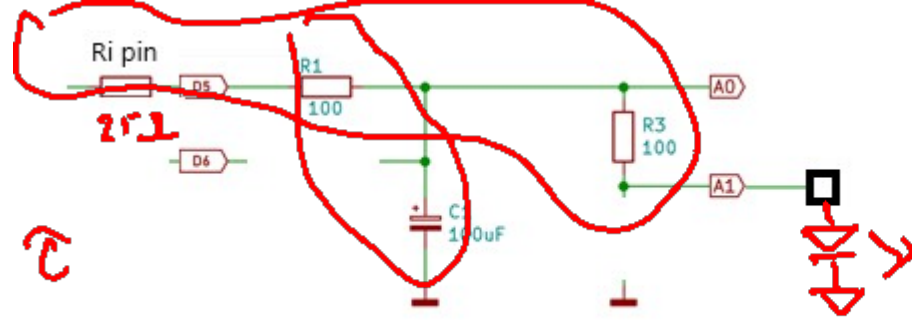
f_{op1}

f_{op}



1

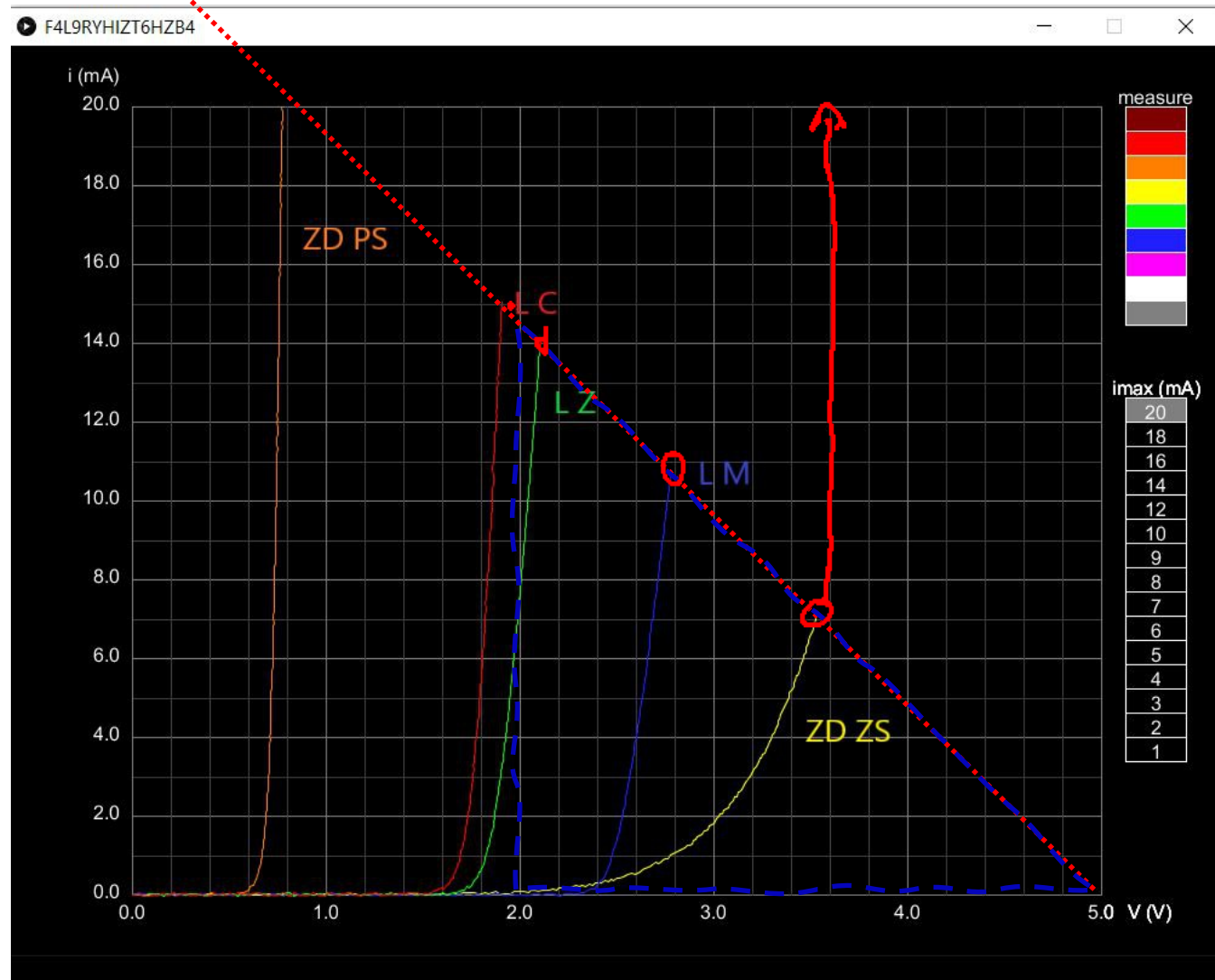
1

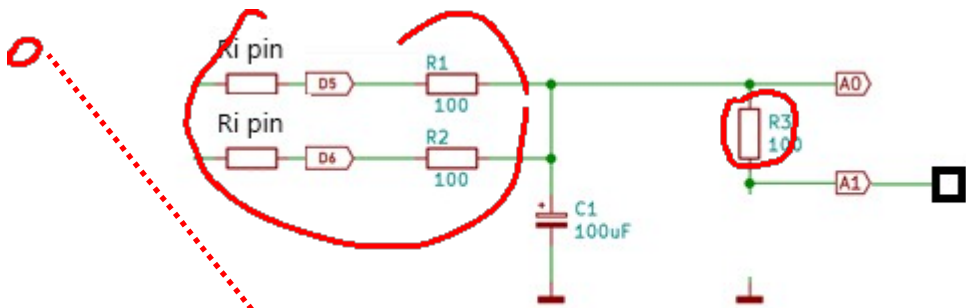


$$R_{C\text{ teor}} = \underline{R_{i\text{ pin}}} + R_1 + R_3 = \text{viac ako } 200 \Omega$$

„Trojuholník“:

$$R_{C\text{ namerane}} = \frac{\Delta U}{\Delta I} = \frac{3\text{ V}}{14,5\text{ mA}} \doteq \underline{207 \Omega}$$



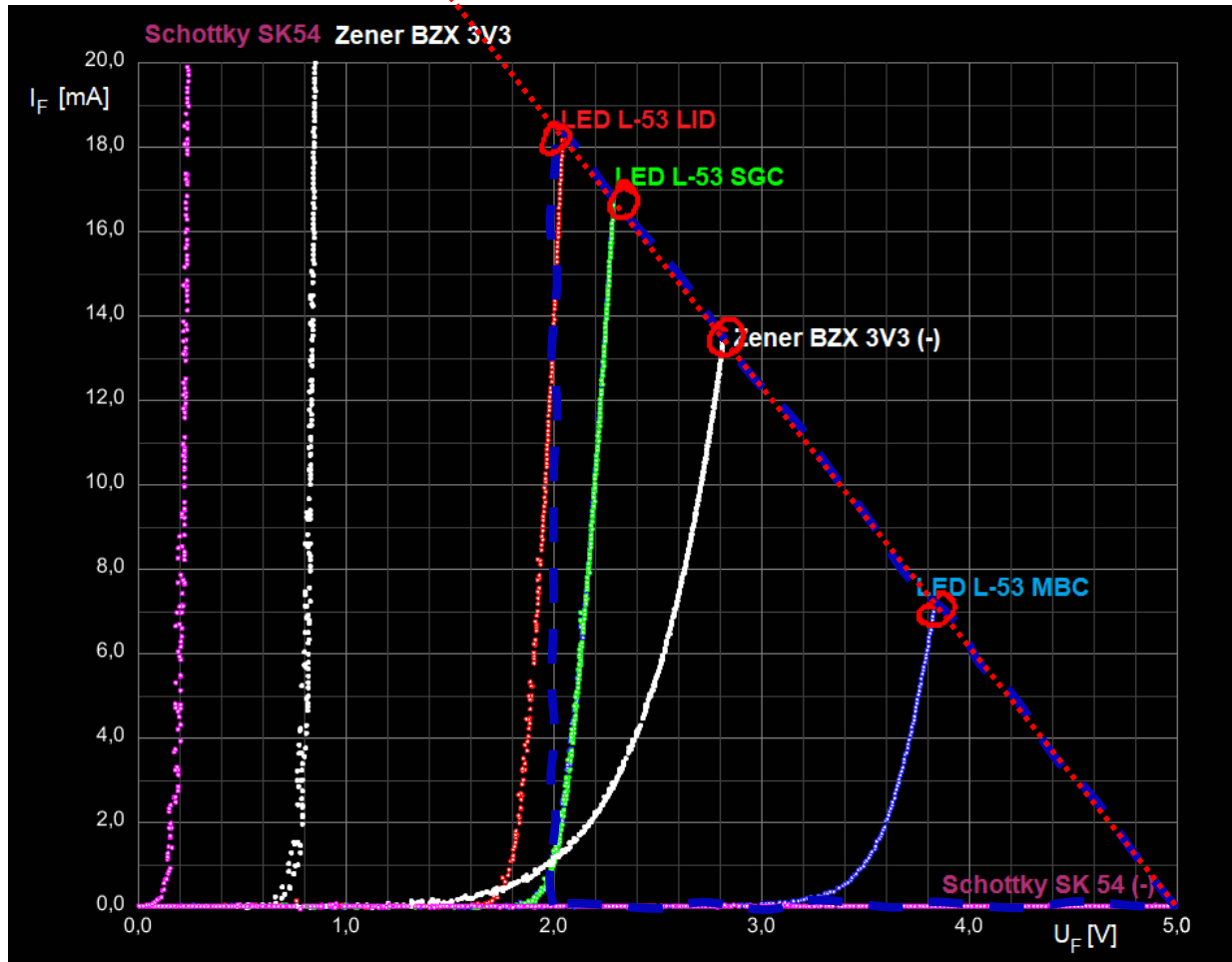


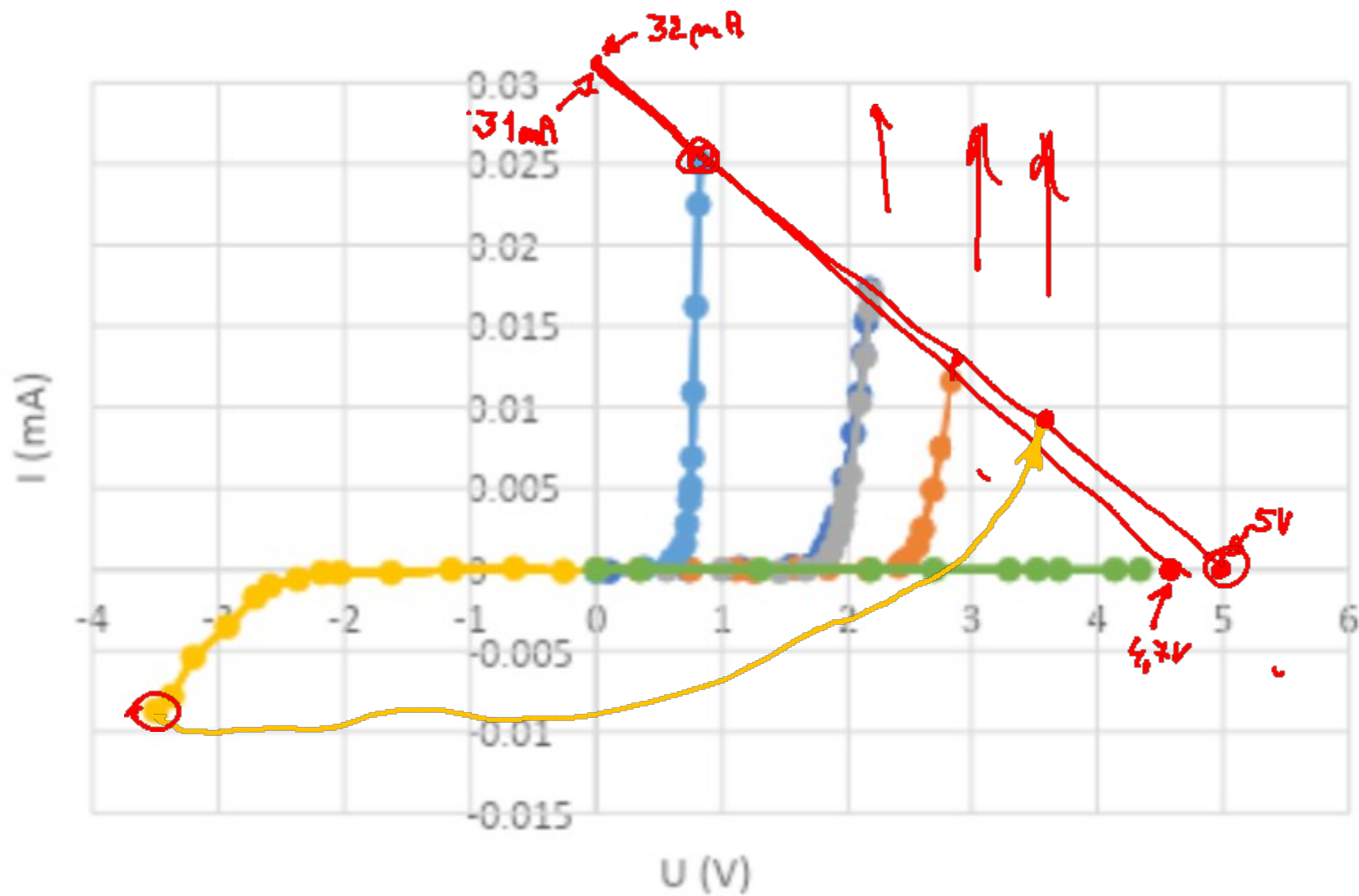
$$R_{X \text{ teor}} = (R_{i \text{ pin}} + R_1) \parallel (R_{i \text{ pin}} + R_2) = \text{viac ako } 50 \Omega$$

$$R_{C \text{ teor}} = R_{X \text{ teor}} + R_3 = \text{viac ako } 150 \Omega$$

„Trojuholník“:

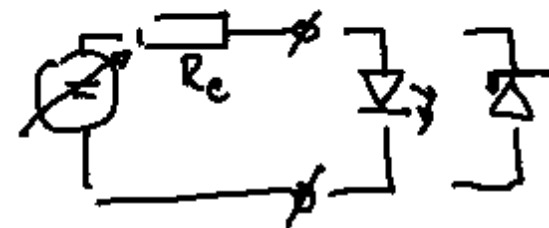
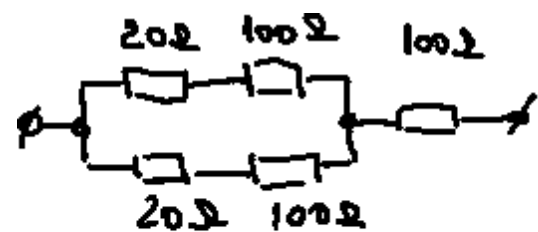
$$R_{C \text{ namerane}} = \frac{\Delta U}{\Delta I} = \frac{3 \text{ V}}{18,5 \text{ mA}} \doteq \underline{162 \Omega}$$





$$R_{C\text{ nam}} = \frac{\Delta U}{\Delta I} = \frac{4,7\text{ V}}{32\text{ mA}} \doteq 147\ \Omega$$

$$R_{C\text{ nam}} = \frac{\Delta U}{\Delta I} = \frac{5,0\text{ V}}{31\text{ mA}} \doteq \underline{\underline{161\ \Omega}}$$



Katalógové údaje:
 Modrá led: LUB50343

◆ **Absolute Maximum Rating** (Ta=25°C)

Parameter	Symbol	Ultra Super Blue				Unit
Power Dissipation	P_d	100				mW
Pulse Forward Current	I_{FP}	100				mA
DC Forward Current	I_F	25				mA
Reverse Voltage	V_R	5				V
Forward Voltage	V_F	2.9	--	3.4	V	$I_F=20\text{mA}$

Cervená led: LTL2R3KRD-EM

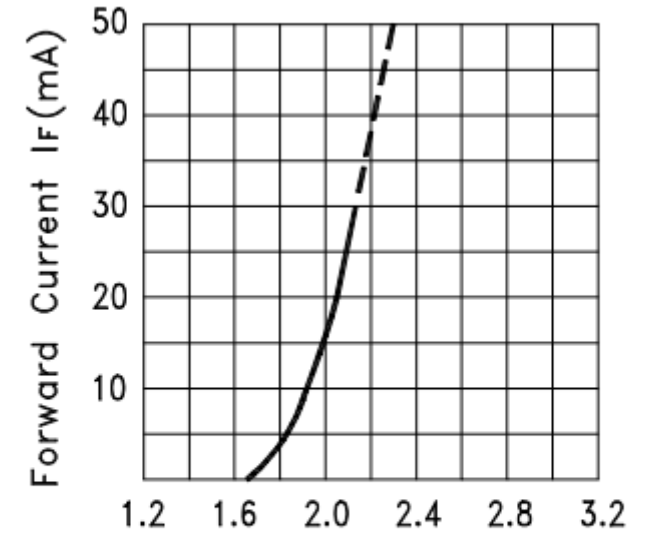
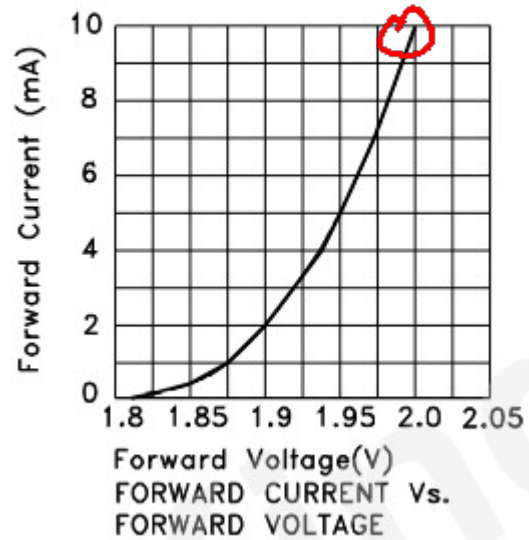


Fig.2 Forward Current vs. Forward Voltage

Katalógové údaje:
Zelená led: L-7113LGD

L-7113LGD



Absolute Maximum Ratings at TA=25°C

Parameter	Values	Units
Power dissipation	62.5	mW
DC Forward Current	25	mA
Peak Forward Current [1]	140	mA
Reverse Voltage	5	V

Zenerová dióda: BZX79C3V3

ELECTRICAL CHARACTERISTICS Values are at $T_A = 25^\circ\text{C}$ unless otherwise noted.

Device	Zener Voltage (Note 2)		Z _Z @ I _Z (Ω)	Leakage Current		T _C (mV/C)		C (pF)	
	Min.	Max.	I _Z (mA)	Max.	I _R (μA)	V _R (V)	Min.	Max.	V _Z = 0, f = 1 MHz
BZX79C3V3	3.1	3.5	5	95	25	1	-3.5	0	200

ABSOLUTE MAXIMUM RATINGS (Note 1)

Values are at $T_A = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	Value	Unit
P _D	Power Dissipation @ T _L ≤ 75°C, Lead Length = 3/8"	500	mW
	Derate above 75°C	4.0	mW/°C

Okrem iného sme uviedli, že filtrovaný PWM signál nemôže „veľmi“ zaťažiť.

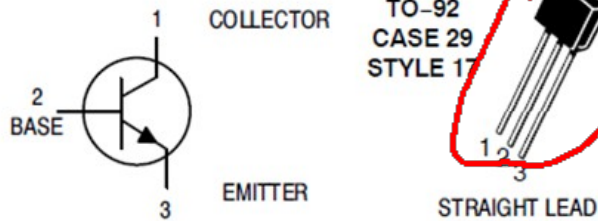
Riešenie problematiky:

Jedna z možností je použiť H/2. Ten ale nemáte k dispozícii.

Druhá možnosť použiť tranzistor: BC-546B.

NPN Silicon

BC546B



MAXIMUM RATINGS

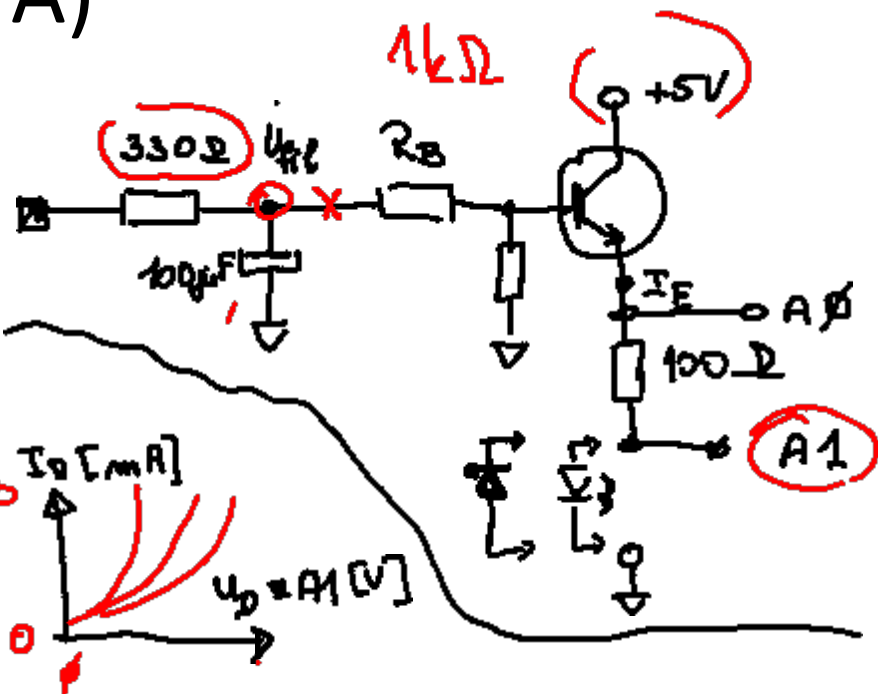
Rating	Symbol	Value	Unit
Collector - Emitter Voltage	V_{CEO}	65	Vdc
	BC546	45	
	BC547	30	
	BC548		
Collector - Base Voltage	V_{CBO}	80	Vdc
	BC546	50	
	BC547	30	
	BC548		
Emitter - Base Voltage	V_{EBO}	6.0	Vdc
Collector Current - Continuous	I_C	100	mAdc

ON CHARACTERISTICS

DC Current Gain ($I_C = 10 \mu A, V_{CE} = 5.0 V$)	BC547A	h_{FE}	-	90	-	-
	BC546B/547B/548B		-	150	-	-
	BC548C		-	270	-	-
($I_C = 2.0 mA, V_{CE} = 5.0 V$)	BC546		110	-	450	
	BC547		110	-	800	
	BC548		110	-	800	
	BC547A		110	180	220	
	BC546B/547B/548B		200	290	450	
($I_C = 100 mA, V_{CE} = 5.0 V$)	BC547C/BC548C		420	520	800	
	BC547A/548A		-	120	-	
	BC546B/547B/548B		-	180	-	
	BC548C		-	300	-	
Collector - Emitter Saturation Voltage ($I_C = 10 mA, I_B = 0.5 mA$) ($I_C = 100 mA, I_B = 5.0 mA$) ($I_C = 10 mA, I_B = \text{See Note 1}$)		$V_{CE(sat)}$	-	0.09	0.25	V
			-	0.2	0.6	
			-	0.3	0.6	
Base - Emitter Saturation Voltage ($I_C = 10 mA, I_B = 0.5 mA$)		$V_{BE(sat)}$	-	0.7	-	V
Base - Emitter On Voltage ($I_C = 2.0 mA, V_{CE} = 5.0 V$) ($I_C = 10 mA, V_{CE} = 5.0 V$)		$V_{BE(on)}$	0.55	-	0.7	V
			-	-	0.77	

Máme dve možnosti ako zapojiť tranzistor:

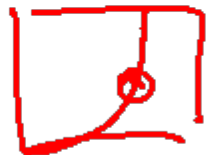
A)



Poznámka:

$$I_D [A] = \frac{A0 [V] - A1 [V]}{100 \Omega}$$

$$I_D [mA] = \frac{A0 [mV] - A1 [mV]}{100 \Omega}$$



Úloha 1.:

Vypočítajte zvlnenie signálu v bode Ufil, ak

$f_{PWM} = 490 \text{ Hz}$, PWM pin:10

$f_{PWM} = 980 \text{ Hz}$, PWM pin:5, reps.

$f_{PWM} = 62,45 \text{ kHz}$, PWM pin:3.

$\alpha = 0,5$

Úlohy 2.:

Maximálna teoretická hodnota $I_E = 48 \text{ mA}$ (tranzistor plne vybudovaný $U_{CE} = 0,2 \text{ V}$). A1 skratkujeme na GND, a $U_{fil} = 5,0 \text{ V}$ (Priamo pripojíme na 5V).

„Vybrali sme“ $R_B = 1k$. Vysvetlite PREČO nenameriame na Emitore (A0) napätie blízke 5V, teda $5 \text{ V} - 0,2 \text{ V} = 4,8 \text{ V}$?

Úlohy 3.:

V predchádzajúcej úlohe zabudneme pripojiť na kolektor 5V. Vysvetlite prečo nameriame na emitore napätie $A0 = (\text{cca}) 0,38 \text{ V}$?

Úlohy 4.:

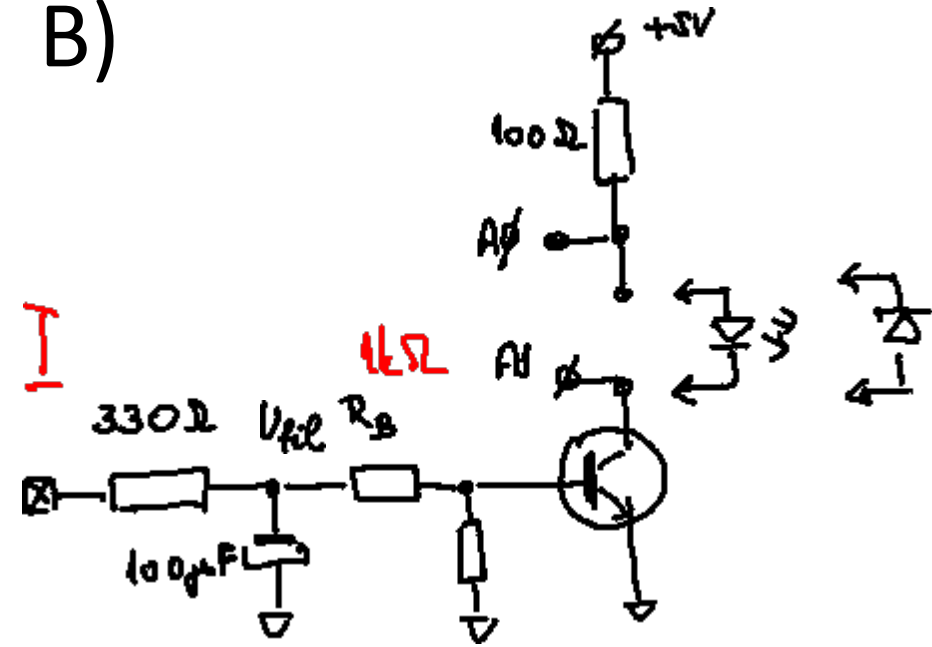
Zmerajte VA charakteristiky: Modrej LED diódy a zenerovej diódy v oboch smeroch. Rozsah prúdov 0 až 20mA.

Ufil generujeme ako filtrovaný PWM signál v intervale 0 až 5V.

Vysvetlite, prečo sa Vám nepodarí namerať Vach zenerovej diódy v závernom smere v celom rozsahu prúdu? 8

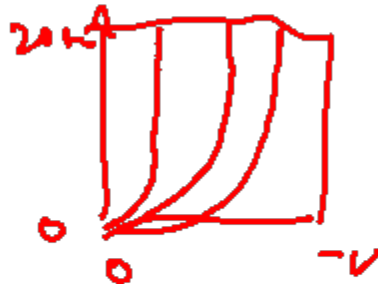
Máme dve možnosti ako zapojiť tranzistor:

B)



Úlohy 5.:

Opäť zmerajte VA charakteristiky: Modrej LED diódy a zenerovej diódy v oboch smeroch. Rozsah prúdov 0 až 20mA. Predpokladajme, že $R_B = 1k$. Najskôr sa pokúste vypočítať rozsah zmien U_{fil} min a max hodnotu, ak chceme zmerať VA charakteristiky v rozsahu prúdov 0 až 20 mA.



Poznámka:

$$I_D [mA] = \frac{5000 [mV] - A_0 [mV]}{100 \Omega}$$

