Sistem de alarmă împotriva incendiilor

Nume: Gorgan Raluca-Sara

Grupa: 2127

Seria: B

Profesorii îndrumători: Prof. Dr. Ing. Pop Ovidiu, Dr. Ing. Alexandra Fodor

Cuprins

1. Tematica proiectului

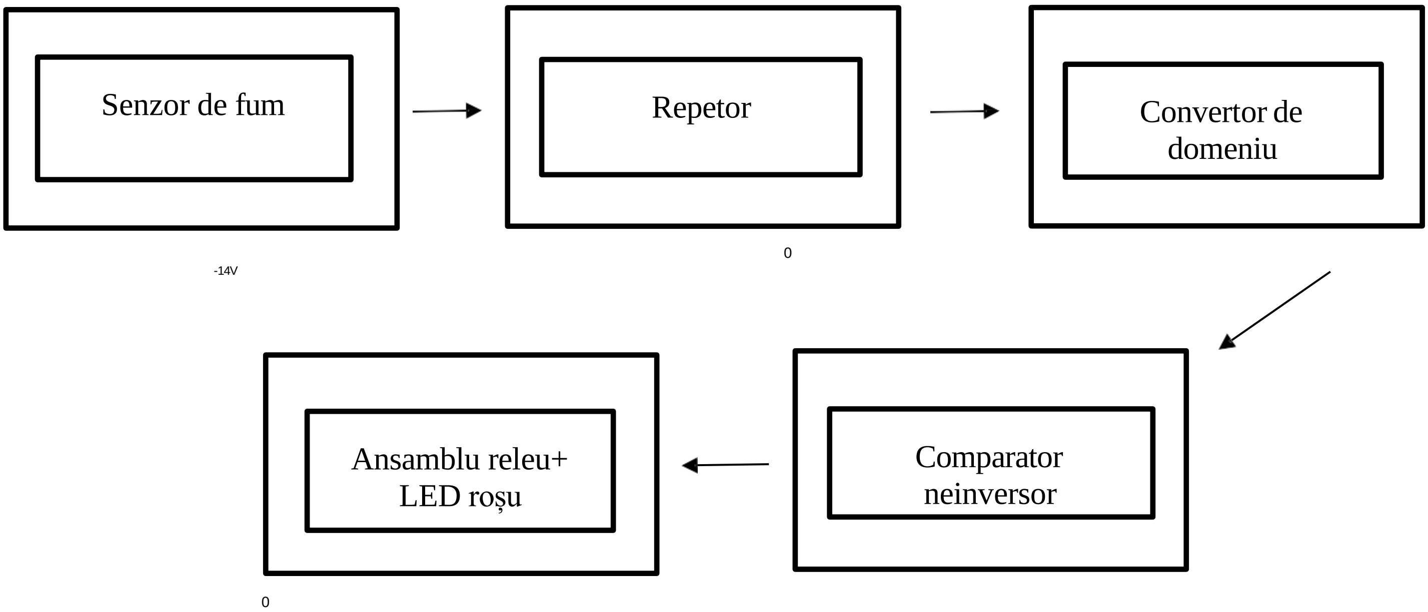
Să se proiecteze un sistem de alarmă împotriva incendiilor. Știind că senzorul de fum folosit poate să măsoare concentrația de fum liniar în domeniul specificat în tabel în coloana C, sistemul se va proiecta astfel încât alarma să se declanşeze la nivelul de fum menționat in coloana D. Alarma se va opri după ce nivelul de fum scade pana la valoarea din coloana E. Senzorul de fum se va modela cu ajutorul unui rezistor. Variația liniară a rezistenței electrice a senzorului cu concentrația de fum este specificată în coloana F și trebuie convertită într-o variație de tensiune în domeniul [0 – (VCC-2V)], VCC fiind precizat in coloana G. Alarma este comandată de un comparator cu histereză prin intermediul unui releu care este modelat cu un rezistor. Starea alarmei (pornit/oprit) este semnalizată de un LED având culoarea specificată în tabel, in coloana H

2. Specificatii de proiectare

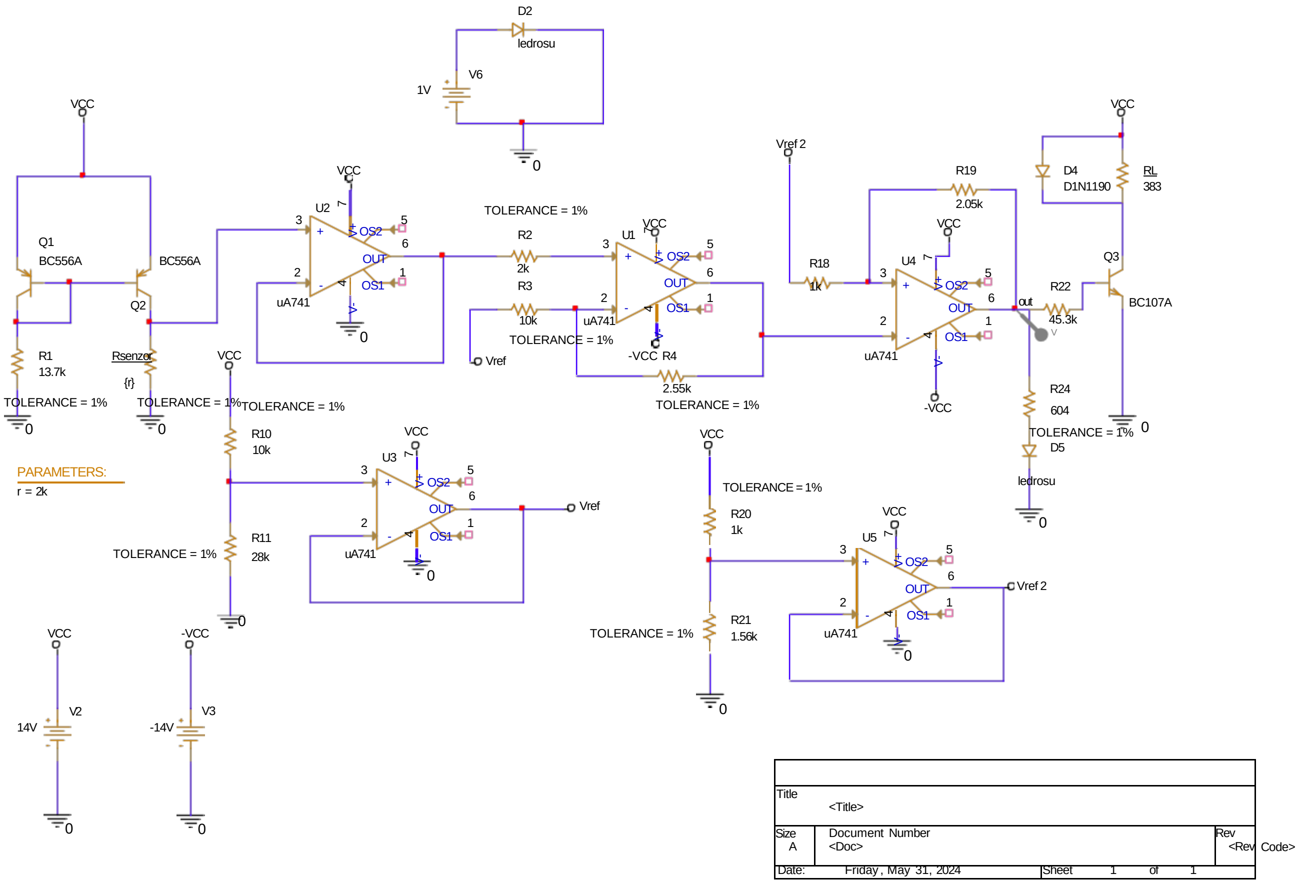
Tabel : Specificații

C	D	E	F	G	H
Domeniul masurabil al concentratiei de fum	Nivelul concentrației de fum pentru pornirea alarmei [ppm]	Nivelul concentrației de fum pentru pornirea alarmei [ppm]	Rezistenta senzorului[Ω]	VCC[V]	Culoare LED de semnalizare
1110-1550	1500	1150	2k-12k	14	Roșu

3. Schema bloc



4. Schema electrică a circuitului



Schema include oglinda de curent, repetorul, amplificatorul operațional, comparatorul neinversor si ansamblul Releu+LED

5. Serii de valori standardizate

Pentru acest proiect am ales rezistente care sa apartină seriei standardizate E96 cu toleranta de 1%.

Prin urmare, uitandu-mă in tabel, dupa ce am făcut calculele am realizat următoarele ajustări:

E-96 (toleranta 1%)

1.00	2.00	3.01	4.02	5.11	6.04	7.15	8.06	9.09
1.02	2.05	3.09	4.12	5.23	6.19	7.32	8.25	9.31
1.05	2.10	3.16	4.22	5.36	6.34	7.50	8.45	9.53
1.07	2.15	3.24	4.32	5.49	6.49	7.68	8.66	9.76
1.10	2.21	3.32	4.42	5.62	6.65	7.87	8.87	
1.13	2.26	3.40	4.53	5.76	6.81			
1.15	2.32	3.48	4.64	5.90	6.98			
1.18	2.37	3.57	4.75					
1.21	2.43	3.65	4.87					
1.24	2.49	3.74	4.99					
1.27	2.55	3.83						
1.30	2.61	3.92						
1.33	2.67							
1.37	2.74							
1.40	2.80							
1.43	2.87							
1.47	2.94							
1.50								
1.54								
1.58								
1.62								
1.65								
1.69								
1.74								
1.78								
1.82								
1.87								
1.91								
1.96								

R17=13.65K -> 13.7K

R20=1K, R18=1K, R18=1K

R21=1,56K->

R3=10K, R10=10K

R11=27.6K -> 28K

R19=2.03K -> 2.05K

R24=600 Ohm -> 604 Ohm

RL=378 Ohm -> 383 Ohm

6. Oglindă de curent

Pentru a realiza oglinda de curent, mi-am ales tranzistoare pnp low-current de tip BC556A, e important ca tranzistoarele sa fie la fel deoarece se fac pe aceiasi pastila de siliciu si am urmărit foaia de catalog

Philips Semiconductors — Product specification

PNP general purpose transistors — BC556; BC557

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 65 V).

APPLICATIONS

- General purpose switching and amplification.

DESCRIPTION

PNP transistor in a TO-92; SOT54 plastic package.
NPN complements: BC546 and BC547.

PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector

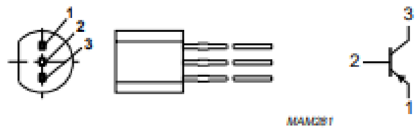


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter			
	BC556		–	–80	V
	BC557		–	–50	V
V_{CEO}	collector-emitter voltage	open base			
	BC556		–	–65	V
	BC557		–	–45	V
V_{EBO}	emitter-base voltage	open collector	–	–5	V
I_C	collector current (DC)		–	–100	mA
I_{CM}	peak collector current		–	–200	mA
I_{BM}	peak base current		–	–200	mA
P_{tot}	total power dissipation	$T_{amb} \le 25$ °C	–	500	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		–65	+150	°C

cu specificațiile acestora.

UNIVERSITATEA TEHNICĂ DIN CLUJ-NAPOCA
Facultatea de Electronică, Telecomunicații și Tehnologia Informației
www.etti.utcluj.ro

Philips Semiconductors | Product specification

PNP general purpose transistors — BC556; BC557

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

Note

1. Transistor mounted on an FR4 printed-circuit board.

CHARACTERISTICS

$T_j = 25\ °C$ unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = -30$ V	–	–1	–15	nA
		$I_E = 0$; $V_{CB} = -30$ V; $T_j = 150\ °C$	–	–	–4	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = -5$ V	–	–	–100	nA
h_{FE}	DC current gain	$I_C = -2$ mA; $V_{CE} = -5$ V; see Figs 2, 3 and 4				
	BC556		125	–	475	
	BC557		125	–	800	
	BC556A		125	–	250	
	BC556B; BC557B		220	–	475	
	BC557C		420	–	800	
V_{CEsat}	collector-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA	–	–60	–300	mV
		$I_C = -100$ mA; $I_B = -5$ mA	–	–180	–650	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = -10$ mA; $I_B = -0.5$ mA; note 1	–	–750	–	mV
		$I_C = -100$ mA; $I_B = -5$ mA; note 1	–	–930	–	mV
V_{BE}	base-emitter voltage	$I_C = -2$ mA; $V_{CE} = -5$ V; note 2	–600	–650	–750	mV
		$I_C = -10$ mA; $V_{CE} = -5$ V; note 2	–	–	–820	mV
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = -10$ V; f = 1 MHz	–	3	–	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = -0.5$ V; f = 1 MHz	–	10	–	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -5$ V; f = 100 MHz	100	–	–	MHz
F	noise figure	$I_C = -200$ μA; $V_{CE} = -5$ V; $R_S = 2$ kΩ; f = 1 kHz; B = 200 Hz	–	2	10	dB

Notes

1. V_{BEsat} decreases by about –1.7 mV/K with increasing temperature.
2. V_{BE} decreases by about –2 mV/K with increasing temperature.

Calcule

$$(R_m \cdot I)_{max} = 12V$$

$$I = \frac{12V}{R_{mmax}} = \frac{12V}{12kOhm} = 1mA \quad (1)$$

$$R_{mmin}. I = 2k \cdot 1mA = 2V$$

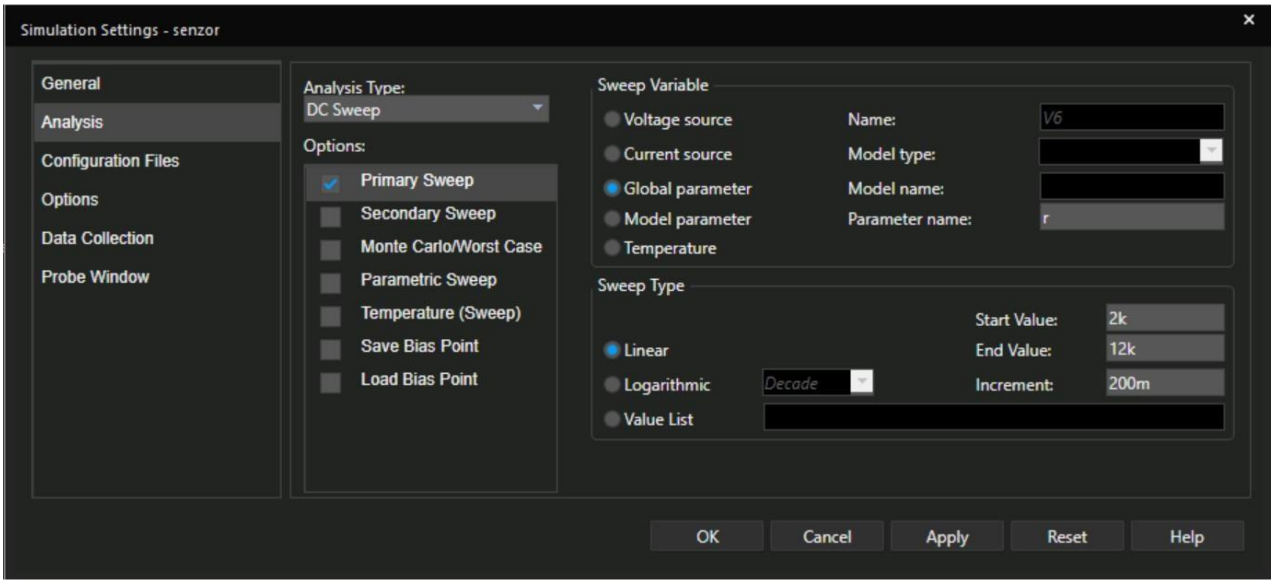
$$R_{mmax}. I = 12k \cdot 1mA = 12V$$

$$V_{senzor} \in [2V, 12V]$$

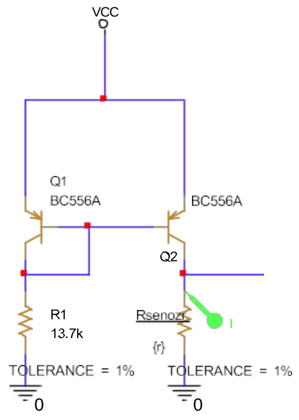
$$I = \frac{V_{cc} - V_{BE}}{R} => R = \frac{V_{cc} - V_{BE}}{I} \quad (2)$$

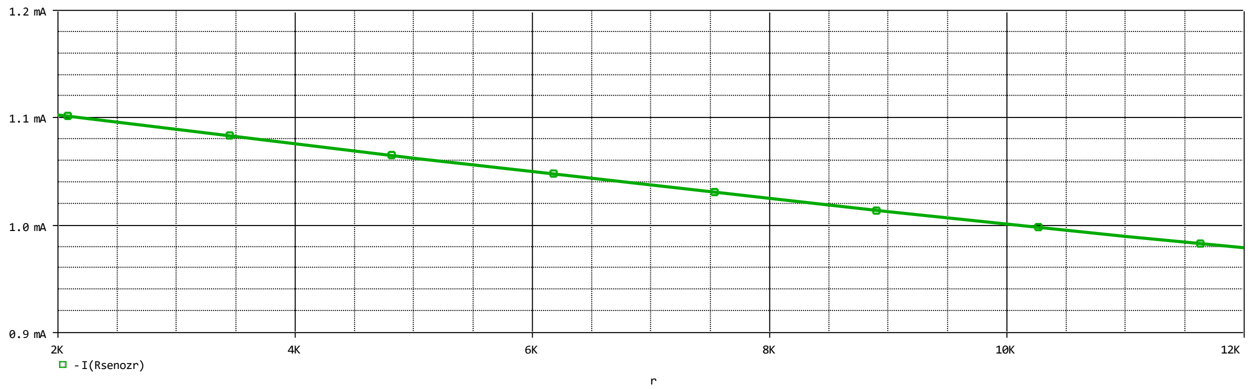
$$R = \frac{14 - 0{,}65V}{1mA} = \frac{13{,}65}{1mA} = 13{,}65kOhm => 13{,}7kOhm$$

Am realizat o analiză DC Sweep cu parametru global pe care l-am declarat si inițializat.

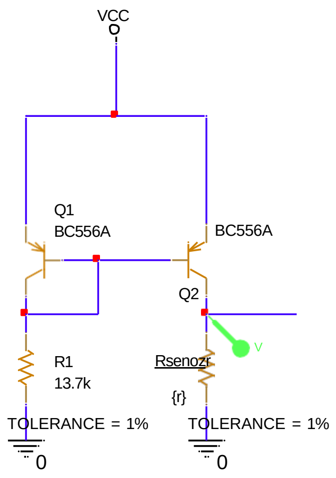


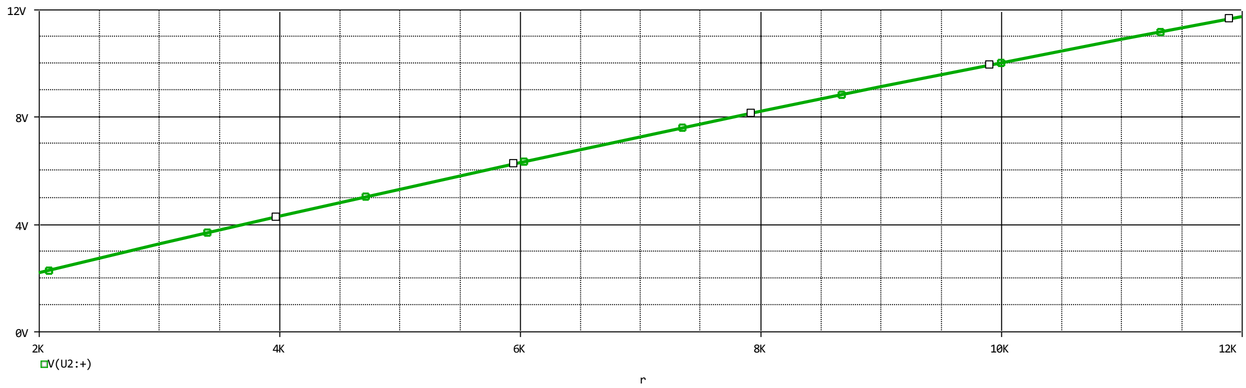
Variația curentului





Variația tensiunii pe senzor





Cu ajutorul formulelor învățate în timpul laboratorului “MIN respectiv MAX” am obținut rezistenta minima si maxima iar apoi cu ajutorul cursorului am obținut exact valoarea acestora.

->MIN=2,20k

->MAX=11,74k

7. Repetor

Pentru a realiza repetorul, AO operațional si Comparatorul, am ales amplificatorul operational uA741, urmărind specificațiile din foaia de catalog.

FAIRCHILD LINEAR INTEGRATED CIRCUITS • μA741

μA741A

ELECTRICAL CHARACTERISTICS (V_S = ±15V, T_A = 25°C unless otherwise specified)

PARAMETERS (see definitions)		CONDITIONS		MIN	TYP	MAX	UNITS
Input Offset Voltage		R_S < 50Ω			0.8	3.0	mV
Average Input Offset Voltage Drift						15	μV/°C
Input Offset Current					3.0	30	nA
Average Input Offset Current Drift						0.5	nA/°C
Input Bias Current					30	80	nA
Power Supply Rejection Ratio		V_S = +10, −20; V_S = +20, −10V, R_S = 50Ω			15	50	μV/V
Output Short Circuit Current				10	25	35	mA
Power Dissipation		V_S = ±20V			80	150	mW
Input Impedance		V_S = ±20V		1.0	6.0		MΩ
Large Signal Voltage Gain		V_S = ±20V, R_L = 2kΩ, V_{OUT} = ±15V		50			V/mV
Transient Response (Unity Gain)	Rise Time				0.25	0.8	μs
	Overshoot				6.0	20	%
Bandwidth (Note 4)				.437	1.5		MHz
Slew Rate (Unity Gain)		V_{IN} = ±10V		0.3	0.7		V/μs
The following specifications apply for −55°C < T_A < +125°C							
Input Offset Voltage						4.0	mV
Input Offset Current						70	nA
Input Bias Current						210	nA
Common Mode Rejection Ratio		V_S = ±20V, V_{IN} = ±15V, R_S = 50Ω		80	95		dB
Adjustment For Input Offset Voltage		V_S = ±20V		10			mV
Output Short Circuit Current				10		40	mA
Power Dissipation		V_S = ±20V	−55°C			165	mW
			+125°C			135	mW
Input Impedance		V_S = ±20V		0.5			MΩ
Output Voltage Swing		V_S = ±20V,	R_L = 10kΩ	±16			V
			R_L = 2kΩ	±15			V
Large Signal Voltage Gain		V_S = ±20V, R_L = 2kΩ, V_{OUT} = ±15V		32			V/mV
		V_S = ±5V, R_L = 2kΩ, V_{OUT} = ±2 V		10			V/mV

NOTES
1. Rating applies to ambient temperatures up to 70°C. Above 70°C ambient derate linearly at 6.3mW/°C for the metal can, 8.3mW/°C for the DIP and 7.1mW/°C for the Flatpak.
2. For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.
3. Short circuit may be to ground or either supply. Rating applies to +125°C case temperature or 75°C ambient temperature.
4. Calculated value from: $BW(MHz) = \frac{0.35}{\text{Rise Time } (\mu s)}$

FAIRCHILD LINEAR INTEGRATED CIRCUITS • μA741

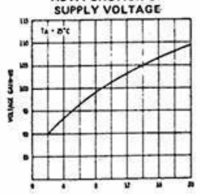
μA741

ELECTRICAL CHARACTERISTICS ($V_S = \pm 15$ V, $T_A = 25°C$ unless otherwise specified)

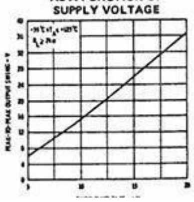
PARAMETERS (see definitions)		CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage		$R_S < 10$ kΩ		1.0	5.0	mV
Input Offset Current				20	200	nA
Input Bias Current				80	500	nA
Input Resistance			0.3	2.0		MΩ
Input Capacitance				1.4		pF
Offset Voltage Adjustment Range				±15		mV
Large Signal Voltage Gain		$R_L > 2$ kΩ, $V_{OUT} = \pm 10$ V	50,000	200,000		
Output Resistance				75		Ω
Output Short Circuit Current				25		mA
Supply Current				1.7	2.8	mA
Power Consumption				50	85	mW
Transient Response (Unity Gain)	Rise time	$V_{IN} = 20$ mV, $R_L = 2$ kΩ, $C_L < 100$ pF		0.3		μs
	Overshoot			5.0		%
Slew Rate		$R_L > 2$ kΩ		0.5		V/μs
The following specifications apply for $-55°C < T_A < +125°C$:						
Input Offset Voltage		$R_S < 10$ kΩ		1.0	6.0	mV
Input Offset Current		$T_A = +125°C$		7.0	200	nA
		$T_A = -55°C$		85	500	nA
Input Bias Current		$T_A = +125°C$		0.03	0.5	μA
		$T_A = -55°C$		0.3	1.5	μA
Input Voltage Range			±12	±13		V
Common Mode Rejection Ratio		$R_S < 10$ kΩ	70	90		dB
Supply Voltage Rejection Ratio		$R_S < 10$ kΩ		30	150	μV/V
Large Signal Voltage Gain		$R_L > 2$ kΩ, $V_{OUT} = \pm 10$ V	25,000			
Output Voltage Swing		$R_L > 10$ kΩ	±12	±14		V
		$R_L > 2$ kΩ	±10	±13		V
Supply Current		$T_A = +125°C$		1.5	2.5	mA
		$T_A = -55°C$		2.0	3.3	mA
Power Consumption		$T_A = +125°C$		45	75	mW
		$T_A = -55°C$		60	100	mW

TYPICAL PERFORMANCE CURVES FOR μA741A AND μA741

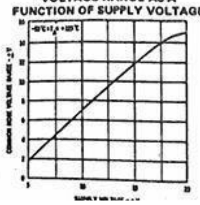
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF SUPPLY VOLTAGE

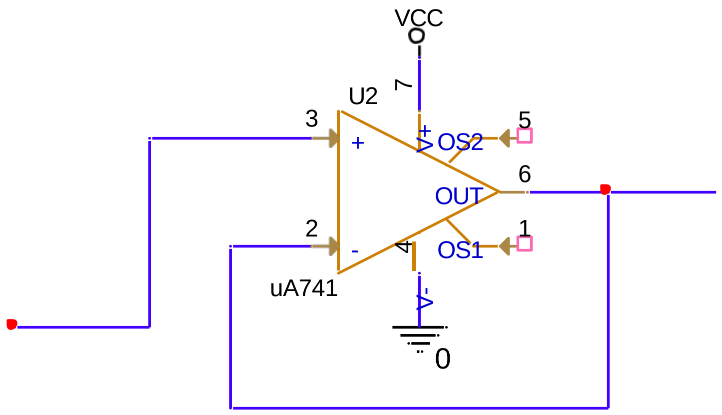


OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGE



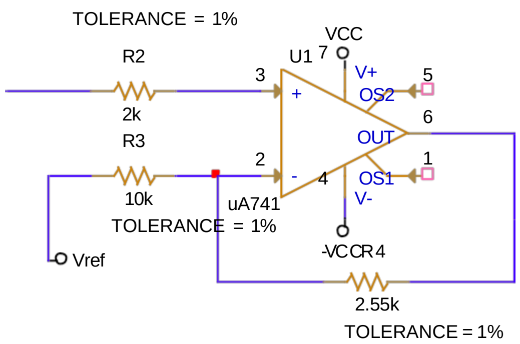
INPUT COMMON MODE VOLTAGE RANGE AS A FUNCTION OF SUPPLY VOLTAGE



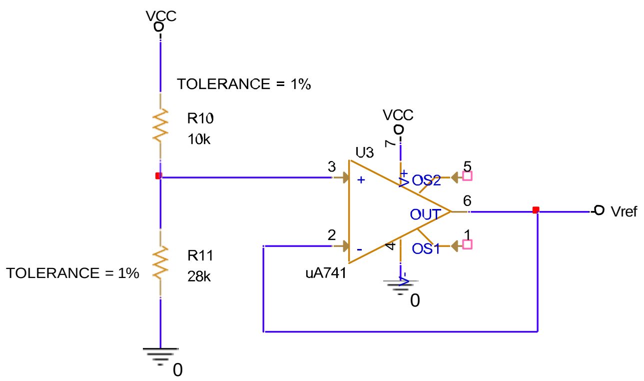


Un amplificator tampon, cunoscut și sub denumirea de buffer, este un circuit electronic folosit pentru a izola etapele unui sistem electronic. Funcția principală a unui amplificator tampon este de a transfera un semnal de la o etapă la alta fără a influența caracteristicile semnalului, cum ar fi amplitudinea sau impedanța.

8. Amplificator operațional



Am realizat un divizor de tensiune pentru Vref.



Calcule

$$\frac{R4}{R3} = \frac{V_{Omax} - V_{Omin}}{V_{cdmax} - V_{cdmin}} \quad (3)$$

$$\frac{R4}{R3} = \frac{12 - 0}{11,74 - 2,20} - 1 => 1,25 - 1 = 0.25$$

$$\frac{R4}{R3} = 0,25$$

Am ales R3 = 10k

$$R4 = 10 \cdot 0,25 => 2,5k$$

În final => R3 = 10k iar R4 = 2,5k

$$V_{ref} = \frac{(1+\frac{R2}{R1}) \cdot V_{cdmax} - V_{Omax}}{\frac{R2}{R1}} \quad (4)$$

$$V_{ref} = \frac{1,25 \cdot 11,74 - 12}{0,26} = \frac{2,675}{0,26} = 10,28V$$

Calcule pentru divizorul de tensiune

$$\frac{R11}{R11+R10} \cdot V_{CC} = V_{REF} \quad (5)$$

$$\frac{R11}{R11 + R10} \cdot 14 = 10,28V$$

$$\frac{14R11}{R11 + R10} = 10,28V$$

$$14R11 = 10,28R11 + 10,28R10$$

$$14R11 - 10{,}28R11 = 10{,}28R10$$

$$3{,}72R11 = 10{,}28R1$$

$$\frac{R11}{R10} = \frac{10{,}28V}{3{,}72V}$$

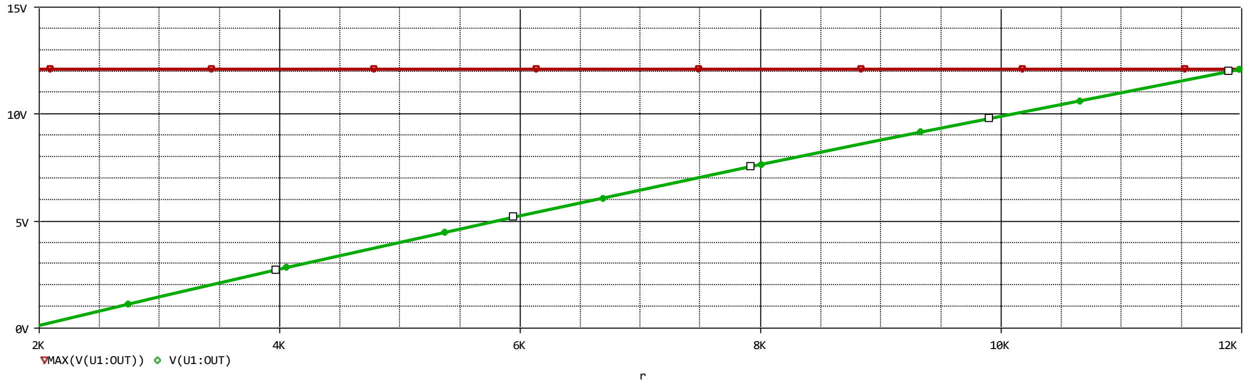
$$\frac{R11}{R10} = 2{,}76$$

Am ales R10=10k

=>$R11$ =27,6k =>28k

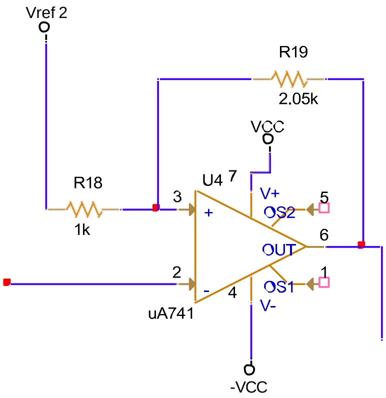
E96 1%

În urma simulării se observă ca am o variație de tensiune intre [0- (V_{CC}-2V)] și anume [0-12V]



9. Comparator neinversor

Sistemul se va proiecta astfel încat ca la atingerea nivelului de fum de 1500 [ppm] led-ul să se aprinda iar la atingerea nivelului de fum de 1150 led-ul sa se stinga. O să realizez acest lucru folosind un comparator neinversor



Calcule

$$Rsenzor \in [2K - 12K]$$

$$Rezistenta\ variaza\ 10K$$

$$Presiunea\ variaza\ 440ppm$$

$$\frac{10K}{440ppm} = \frac{10 \times 10^3 Ohm}{440ppm}$$

$$=> 22.72\ Ohm/ppm$$

$$R1 = 2K + 40ppm \times \frac{22,72}{ppm} = 2K + 908,8m = 2,908K$$

$$R2 = 12K - 50ppm \times \frac{22,72}{ppm} = 12K - 1,136K = 10,864K$$

$$V \in [0,12V] \quad => \quad Variază\ 12\ V$$

$$\frac{12V}{440m} = \frac{0.027V}{ppm}$$

$$0.027V \ldots 1ppm$$

$$x \ldots 40ppm$$

$$x = \frac{40ppm \times 0.027V}{1ppm} = 1{,}09V$$

$$0.027V \ldots 1ppm$$

$$y \ldots 390ppm$$

$$y = 10{,}53V$$

V_{PH}=10,86V->1500 [ppm]

V_{PL}=2,90V->1150 [ppm]

$$VPH = -\frac{R18}{R18+R19} \times Vcc + \frac{R19}{R18+R19} \times Vref \quad (6)$$

$$VPL = \frac{R18}{R18+R19} \times Vcc + \frac{R19}{R18+R19} \times Vref \quad (7)$$

Am scazut cele doua ecuatii =>

$$V_{PH} - V_{PL} = 2 \times Vcc \times \frac{R18}{R18+R19} \quad (8)$$

$$10{,}53 - 1{,}09 = 2 \times 14 \times \frac{R18}{R18 + R19}$$

$$9{,}44 = 28 \times \frac{R18}{R18 + R19}$$

$$\frac{R18}{R18 + R19} = \frac{9{,}44}{28}$$

$$\frac{R18}{R18 + R19} = 0{,}33$$

$$R18 = 0{,}33 \times R18 + 0{,}33 \times R19$$

$$0{,}67 \times R18 = 0{,}33 \times R19$$

$$\frac{R19}{R18} = \frac{0{,}67}{0{,}33}$$

$$\frac{R19}{R18} = 2{,}03$$

Am ales R18=1K

R19=2,03K -> 2,05K

E96 1%

Am adunat cele 2 ecuatii =>

$$V_{PH} + V_{PL} = 2 \times \frac{R2}{R1+R2} \times Vref \qquad (9)$$

$$11{,}62 = 2 \times \frac{2{,}03}{3{,}03} \times Vref \qquad (10)$$

$$11{,}62 = 1{,}33 \times Vref$$

$$Vref = 8{,}67V$$

$$Vref = \frac{R20}{R20+R21} \times Vcc \qquad (11)$$

$$8{,}67 = \frac{R20}{R20+R21} \times 14 \qquad (12)$$

$$\frac{R20}{R20 + R21} = 0{,}61$$

$$R21 = 0{,}61 \times R20 + 0{,}61 \times R21$$

$$0{,}39 \times R21 = 0{,}61 \times R20$$

$$\frac{R21}{R20} = \frac{0{,}61}{0{,}39}$$

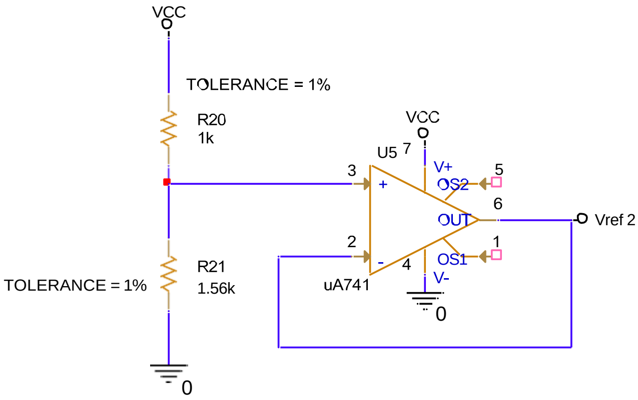
$$\frac{R21}{R20} = 1{,}56k$$

Am ales R20=1K

=> R21=1,56k -> 1,58K

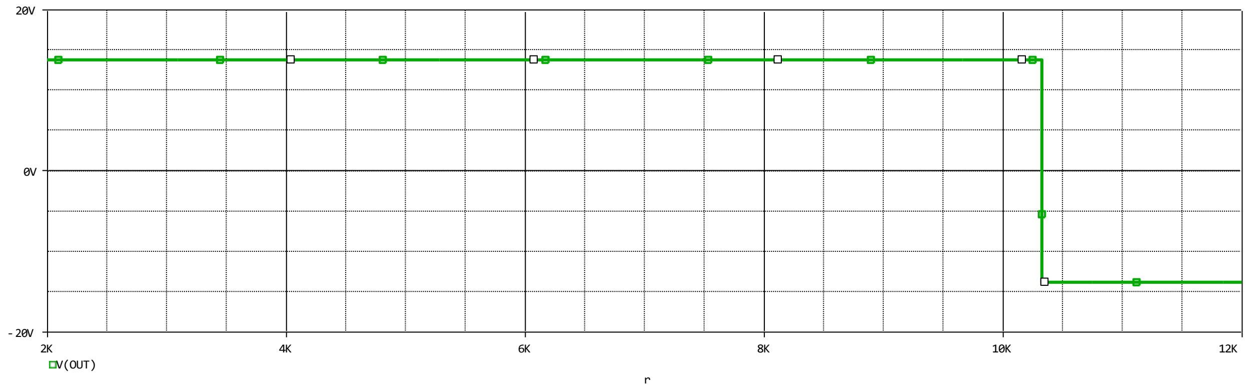
E96 1%

Am realizat înca un divizor de tensiune pentru Vref 2.



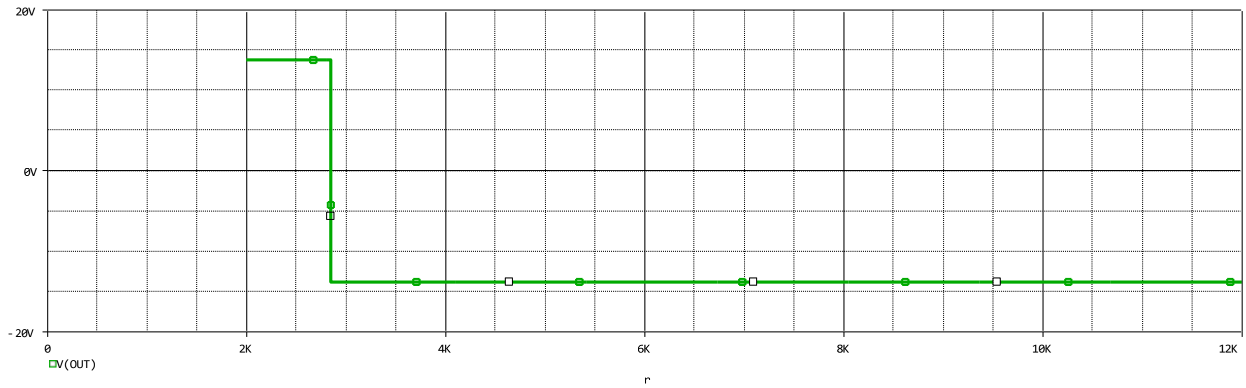
După cum se poate observa, pentru concentrația fumului de 1500 se aprinde alarma

V_{PH}=10,86V



Dupa cum se poate observa, pentru concentrația fumului de 1150 se stinge alarma

V_{PL}=2,90V



10. LED-ul si rezistența

M-am uitat in foaia de catalog a led-ului roșu

Standard LED

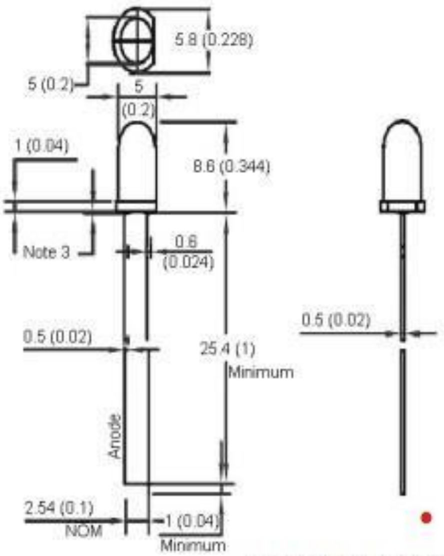
Red Emitting Colour

multicomp

Features:

- High intensity
- Standard T-1 3/4 diameter package
- General purpose leads
- Reliable and rugged

Package Dimensions:



Dimensions : Millimetres (Inches)

Specification Table

Chip Material	Lens Colour	Source Colour	Part Number
AlGaAs	Diffused	Red	MV5754A

Notes:

1. Tolerance is ±0.25 mm (0.01") unless otherwise noted
2. Protruded resin under flange is 1 mm (0.04") maximum
3. Lead spacing is measured where the leads emerge from the package

Standard LED

Red Emitting Colour

multicomp

Absolute Maximum Ratings at T_a = 25°C

Parameter	Maximum	Unit
Power Dissipation	80	mW
Peak Forward Current (1/10 Duty Cycle, 0.1 ms Pulse Width)	100	mA
Continuous Forward Current	20	
Derating Linear From 50°C	0.4	mA / °C
Reverse Voltage	5	V
Operating Temperature Range	-25°C to +80°C	
Storage Temperature Range	-40°C to +100°C	
Lead Soldering Temperature (4 mm (0.157) Inches from Body)	260°C for 5 s	

Electrical Optical Characteristics at T_a = 25°C

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Test Condition
Luminous Intensity	I_v		40		mcd	I_f = 20 mA (Note 1)
Viewing Angle	$2\theta_{1/2}$		25		Deg	(Note 2)
Peak Emission Wavelength	λp		640		nm	I_f = 20 mA
Dominant Wavelength	λd		635		nm	I_f = 20 mA (Note 3)
Spectral Line Half-Width	Δλ		25		nm	I_f = 20 mA
Forward Voltage	V_f		2	2.5	V	I_f = 20 mA
Reverse Current	I_R	-	-	100	µA	V_R = 5 V

Notes:

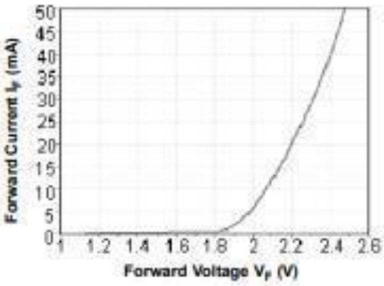
1. Luminous intensity is measured with a light sensor and filter combination that approximates the CIE eye-response curve
2. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity
3. The dominant wavelength (λd) is derived from the CIE chromaticity diagram and represents the single wavelength which defines the colour of the device

Standard LED

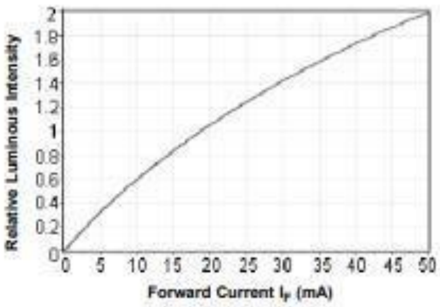
Red Emitting Colour

Typical Characteristics

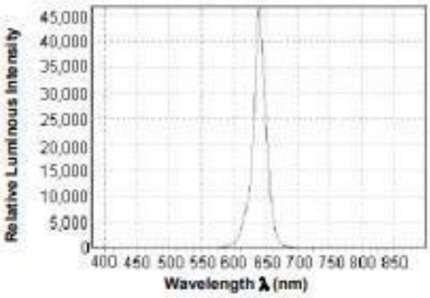
I_F - V_F (T_a = 25°C)



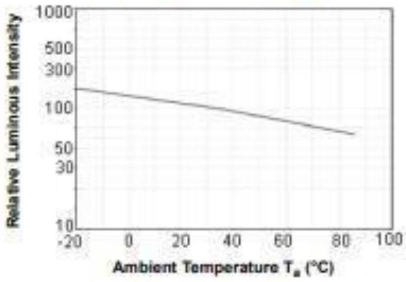
Relative Luminous Intensity - I_F (T_a = 25°C)



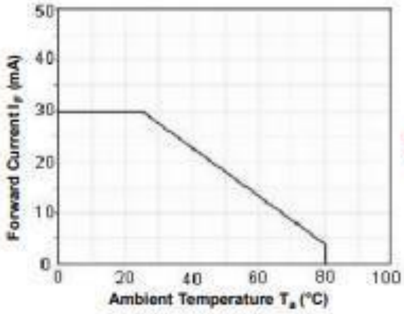
Wavelength Characteristics (T_a = 25°C)



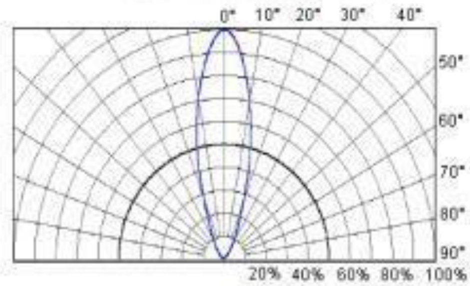
Relative Luminous Intensity - T_a

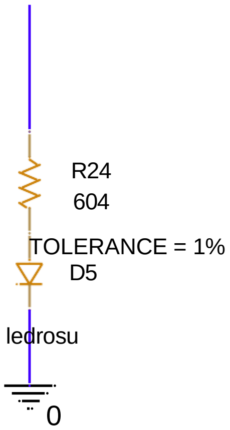


I_F - T_a



Directive Characteristics (T_a = 25°C)





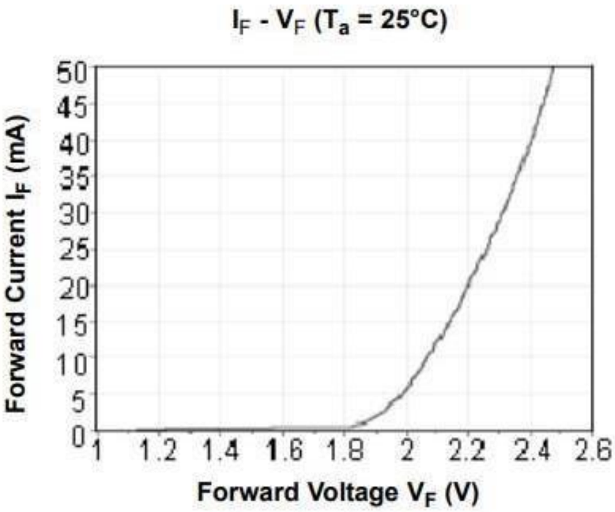
Din foaia de catalog=>$Iled \cong 30mA$

$$R8 = \frac{E - Vled}{Iled} = \frac{20V - 2V}{30mA} = \frac{18V}{30mA} = 0.6 \times 10^3\, Ohm = 600\, Oh \rightarrow 604\, Ohm$$

E96 1%

Pentru a ridica caracteristica LED-ului roșu o sa mă folosesc de foaia de catalog a acestuia.

În cadrul foii de catalog, sunt expuse mai multe caracteristici cea de mai jos e cea mai utila în cazul meu deoarece arata modul in care variază curentul prin LED in funcție de tensiune.

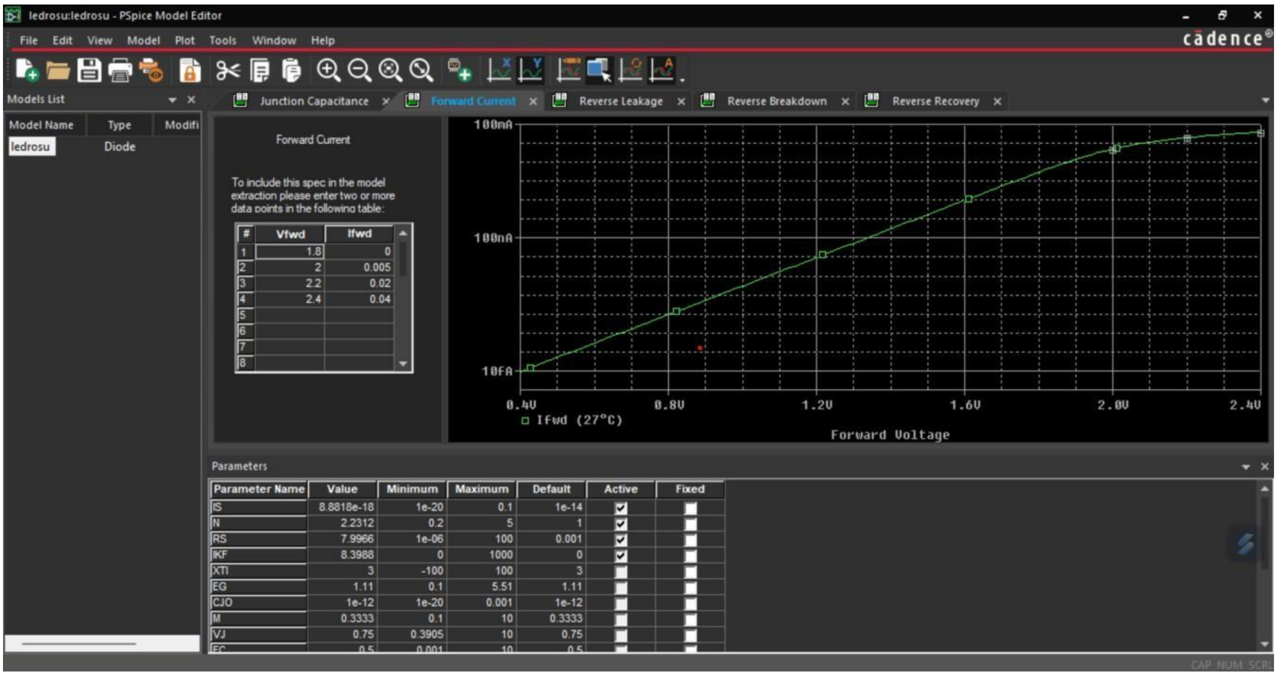


Observăm faptul ca tensiunea de prag a LED-ului roșu este in jur de 2V.

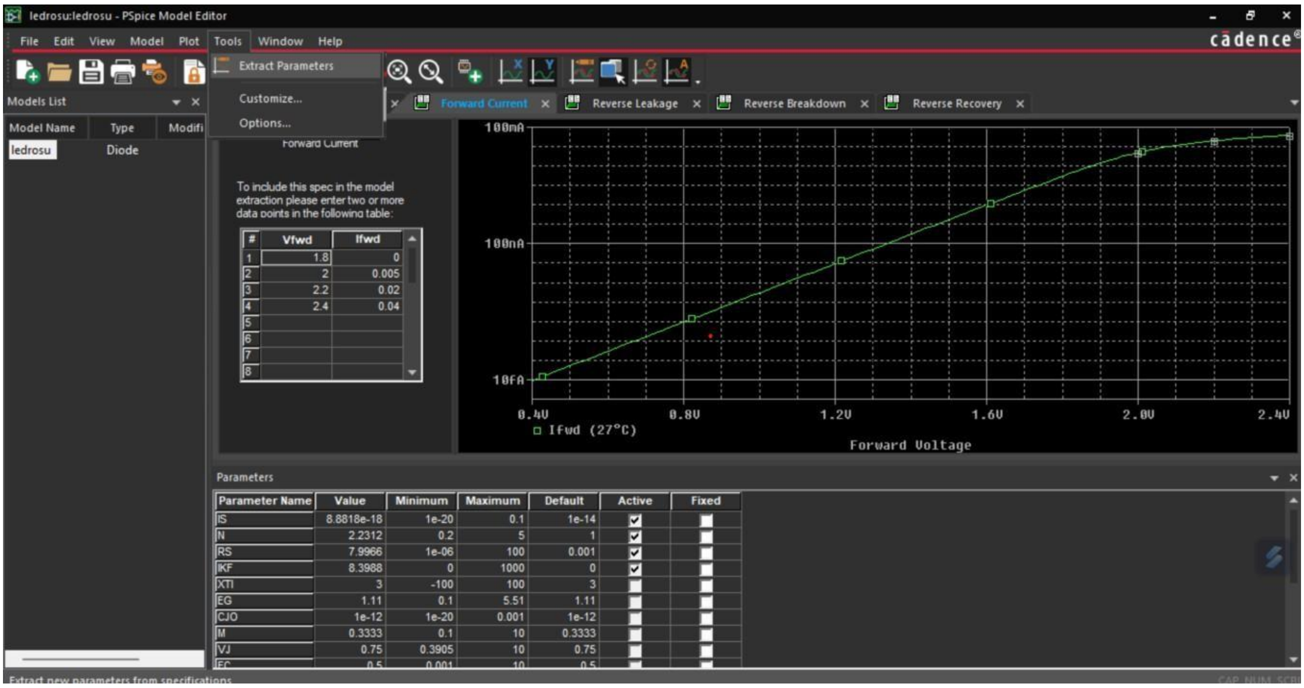
Modelare LED

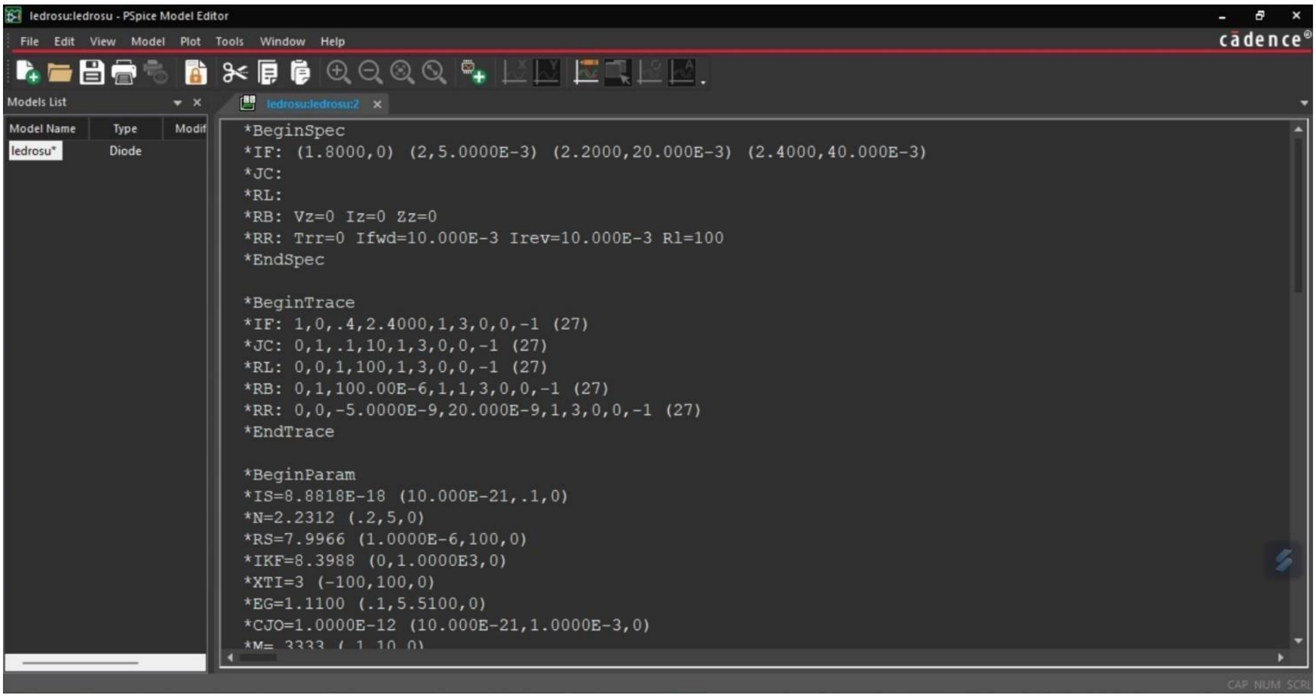
Pentru a modela LED-ul am folosit Pspice Model Editor.

Am adăugat valorile in urma analizei caracteristicii de mai sus

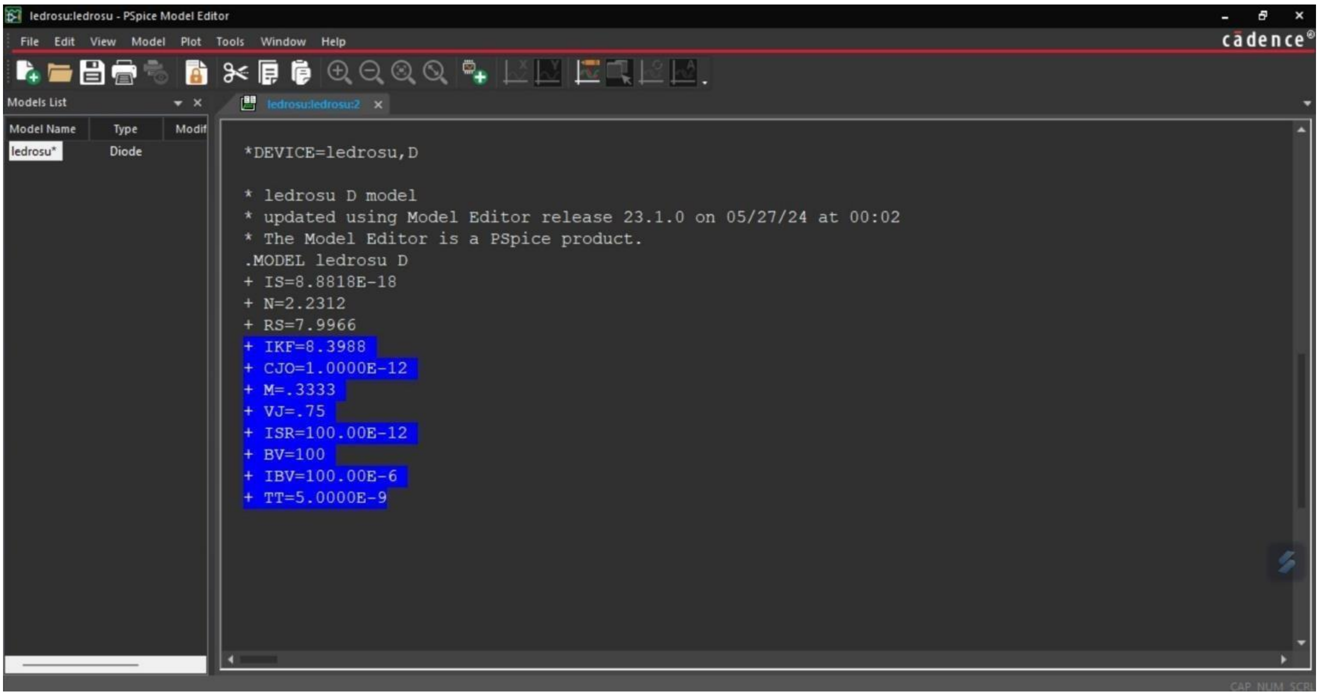


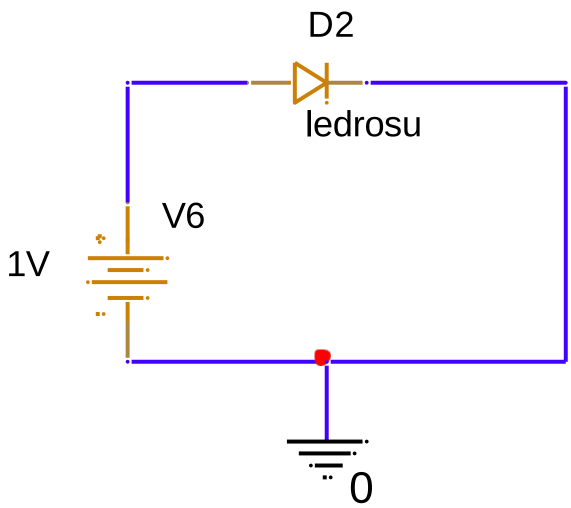
Am extras parametrii



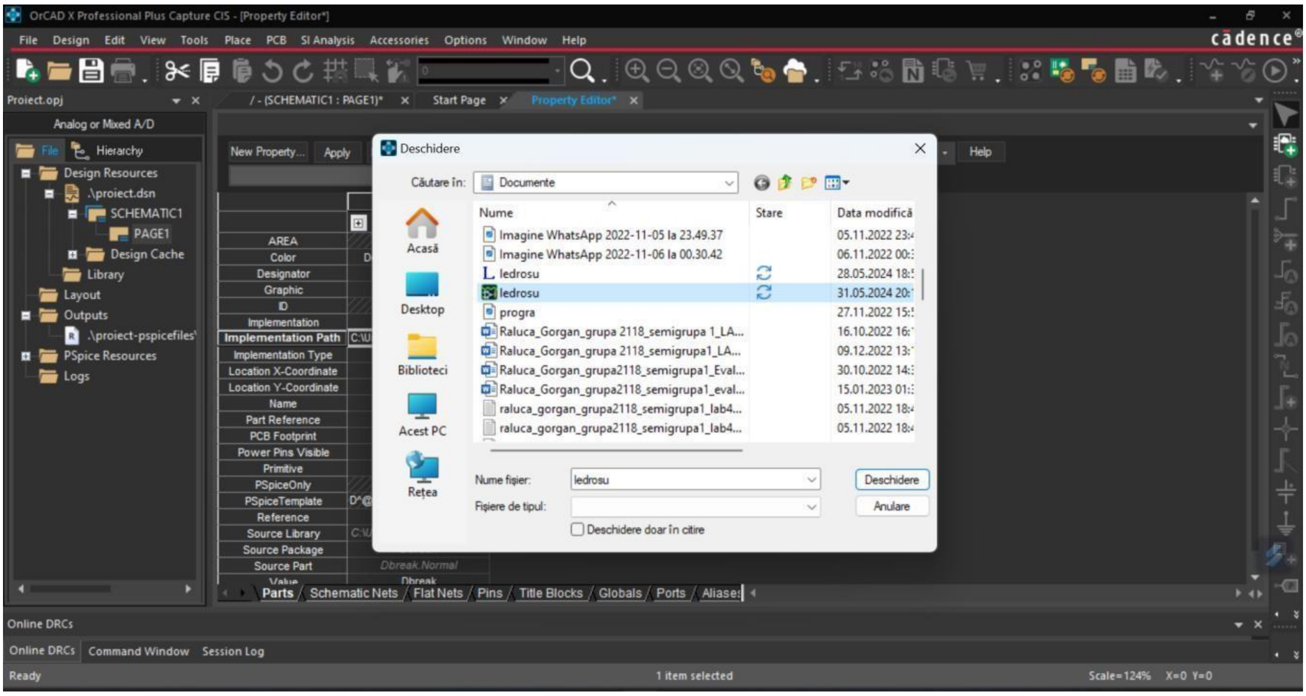


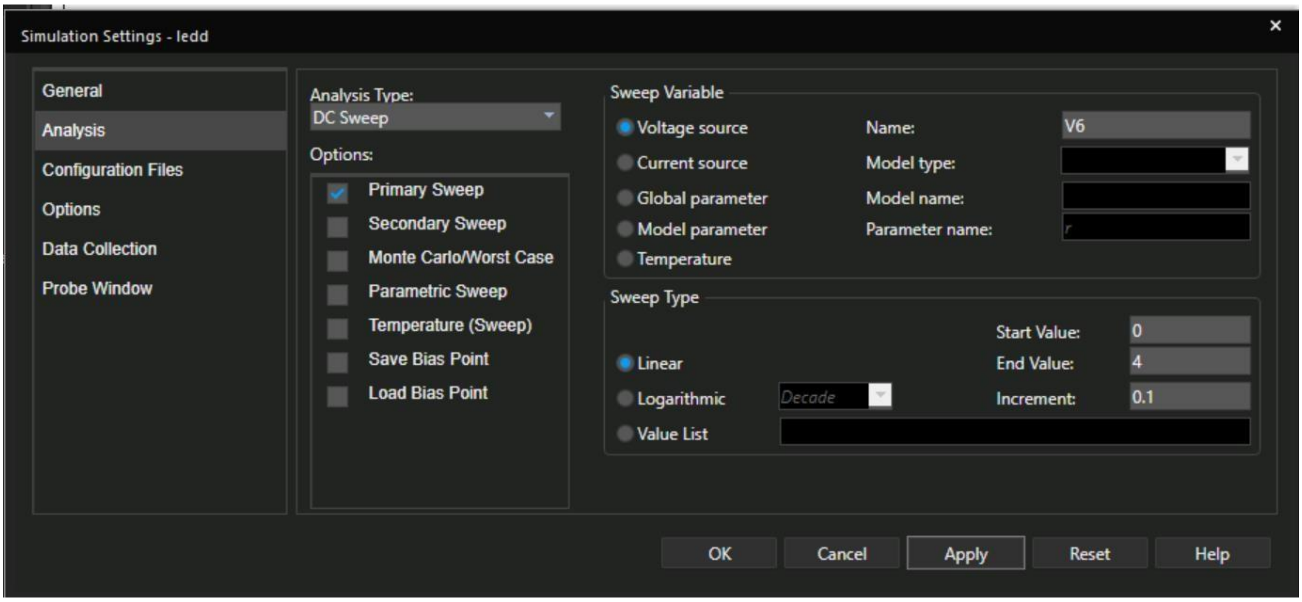
Am șters tot de la Rs în jos iar apoi l-am salvat cu numele “ledrosu”



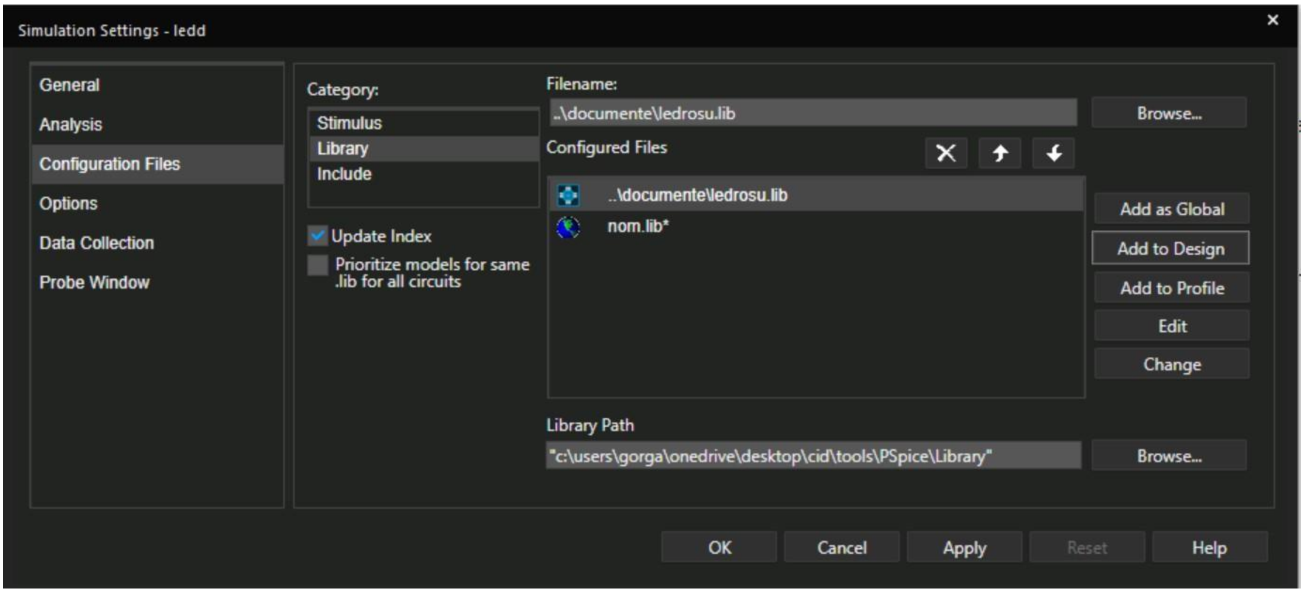


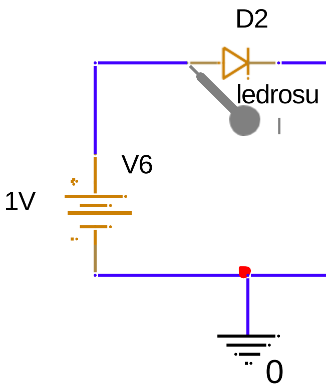
Punem în proiectul Orcad unde este circuitul o componentă Dbreak. Dăm click dreapta pe această componentă și la Implementation Path ne punem fișierul .lib creat în model editor.

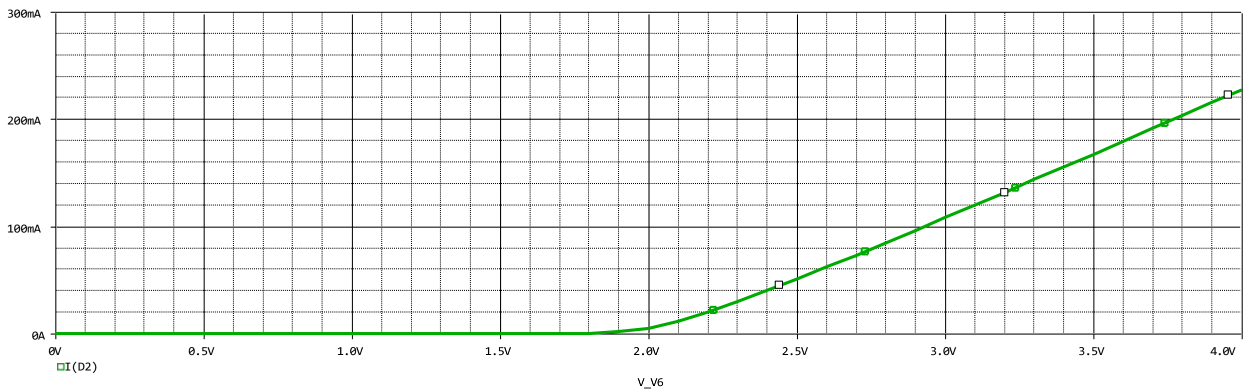




Dăm la Configuration Files->Library si adăugăm fișierul .lib, apoi apăsăm Add to Design, apoi Apply și Ok.


Simulation Settings - ledd
General
Analysis
Configuration Files
Options
Data Collection
Probe Window
Category:
Stimulus
Library
Include
Update Index
Prioritize models for same .lib for all circuits
Filename:
..\documente\ledrosu.lib
Browse...
Configured Files
..\documente\ledrosu.lib
nom.lib*
Add as Global
Add to Design
Add to Profile
Edit
Change
Library Path
"c:\users\gorga\onedrive\desktop\cid\tools\PSpice\Library"
Browse...
OK
Cancel
Apply
Reset
Help


D2
ledrosu
V6
1V
0


300mA
200mA
100mA
0A
0V
0.5V
1.0V
1.5V
2.0V
2.5V
3.0V
3.5V
4.0V
I(D2)
V_V6

11. Releul

Am ales un tranzistor npn de tip BC107A, urmărind foaia de catalog a acestuia.

BC107,A,B
BC108B,C
BC109B,C

NPN SILICON TRANSISTOR

TO-18 CASE

Central Semiconductor Corp.

www.centralsemi.com

DESCRIPTION:
The CENTRAL SEMICONDUCTOR BC107, BC108, BC109 series types are small signal NPN silicon transistors, manufactured by the epitaxial planar process, designed for general purpose amplifier applications.

MARKING: FULL PART NUMBER

MAXIMUM RATINGS: (T_A=25°C)	SYMBOL	BC107	BC108	BC109	UNITS
Collector-Base Voltage	V_{CBO}	50	30	30	V
Collector-Emitter Voltage	V_{CEO}	45	25	25	V
Emitter-Base Voltage	V_{EBO}	6.0	5.0	5.0	V
Continuous Collector Current	I_C		200		mA
Power Dissipation	P_D		600		mW
Operating and Storage Junction Temperature	T_J, T_{stg}		-65 to +200		°C
Thermal Resistance	Θ_{JC}		175		°C/W

ELECTRICAL CHARACTERISTICS: (T_A=25°C unless otherwise noted)

SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
I_{CBO}	V_{CB}=45V (BC107)			15	nA
I_{CBO}	V_{CB}=45V, T_A=125°C (BC107)			4.0	µA
I_{CBO}	V_{CB}=25V (BC108, BC109)			15	nA
I_{CBO}	V_{CB}=25V, T_A=125°C (BC108, BC109)			4.0	µA
BV_{CEO}	I_C=2.0mA (BC107)	45			V
BV_{CEO}	I_C=2.0mA (BC108, BC109)	25			V
BV_{EBO}	I_E=10µA (BC107)	6.0			V
BV_{EBO}	I_E=10µA (BC108, BC109)	5.0			V
$V_{CE(SAT)}$	I_C=10mA, I_B=0.5mA			0.25	V
$V_{CE(SAT)}$	I_C=100mA, I_B=5.0mA			0.6	V
$V_{BE(SAT)}$	I_C=10mA, I_B=0.5mA		0.7	0.83	V
$V_{BE(SAT)}$	I_C=100mA, I_B=5.0mA		1.0	1.05	V
$V_{BE(ON)}$	V_{CE}=5.0V, I_C=2.0mA	0.55		0.7	V
$V_{BE(ON)}$	V_{CE}=5.0V, I_C=10mA			0.77	V
h_{FE}	V_{CE}=5.0V, I_C=10µA (BC107B, BC108B, BC109B)	40			
h_{FE}	V_{CE}=5.0V, I_C=10µA (BC108C, BC109C)	100			
h_{FE}	V_{CE}=5.0V, I_C=2.0mA (BC107)	110		450	
h_{FE}	V_{CE}=5.0V, I_C=2.0mA (BC107A)	110		220	
h_{FE}	V_{CE}=5.0V, I_C=2.0mA (BC107B, BC108B, BC109B)	200		450	
h_{FE}	V_{CE}=5.0V, I_C=2.0mA (BC108C, BC109C)	420		800	

R1 (16-August 2012)

BC107,A,B
BC108B,C
BC109B,C

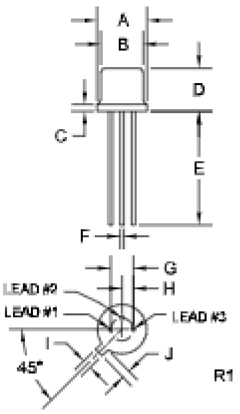
NPN SILICON TRANSISTOR

Central Semiconductor Corp.

ELECTRICAL CHARACTERISTICS - Continued: (T_A=25°C unless otherwise noted)

SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
h_{fe}	V_{CE}=5.0V, I_C=2.0mA, f=1.0kHz (BC107)	125		500	
h_{fe}	V_{CE}=5.0V, I_C=2.0mA, f=1.0kHz (BC107A)	125		260	
h_{fe}	V_{CE}=5.0V, I_C=2.0mA, f=1.0kHz (BC107B, BC108B, BC109B)	240		500	
h_{fe}	V_{CE}=5.0V, I_C=2.0mA, f=1.0kHz (BC108C)		500		
h_{fe}	V_{CE}=5.0V, I_C=2.0mA, f=1.0kHz (BC109C)	450		900	
f_T	V_{CE}=5.0V, I_C=10mA, f=100MHz	150			MHz
C_{ob}	V_{CB}=10V, I_E=0, f=1.0MHz			4.5	pF
NF	V_{CE}=5.0V, I_C=0.2mA, R_g=2.0kΩ, B=200Hz, f=1.0kHz (BC107, BC108)			10	dB
NF	V_{CE}=5.0V, I_C=0.2mA, R_g=2.0kΩ, B=200Hz, f=1.0kHz (BC109)			4.0	dB

TO-18 CASE - MECHANICAL OUTLINE



DIMENSIONS				
	INCHES		MILLIMETERS	
SYMBOL	MIN	MAX	MIN	MAX
A (DIA)	0.209	0.230	5.31	5.84
B (DIA)	0.178	0.195	4.52	4.95
C	-	0.030	-	0.76
D	0.170	0.210	4.32	5.33
E	0.500	-	12.70	-
F (DIA)	0.016	0.019	0.41	0.48
G (DIA)	0.100		2.54	
H	0.050		1.27	
I	0.036	0.046	0.91	1.17
J	0.028	0.048	0.71	1.22

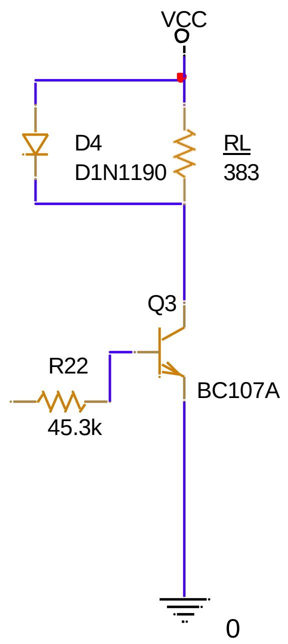
TO-18 (REV: R1)

LEAD CODE:
1) Emitter
2) Base
3) Collector

MARKING:
FULL PART NUMBER

R1 (16-August 2012)

www.centralsemi.com



Am ales factorul de amplificare in curent: β=100

Vcc=14V VCEmin=2V VBE=0,65V

Ireleu=30mA=IC=IE

$$RL = \frac{Vcc - (VCE + VBE)}{Ireleu} => RL = \frac{14V - (2V + 0{,}65V)}{30mA}$$

$\frac{14V-2{,}65V}{30mA} = \frac{11{,}35V}{30mA} = 0{,}378 \times 10^3$ Ohm=378 Ohm -> 383 Ohm

E96 1%

$$IC = \beta \times IB => IB = \frac{IC}{\beta} => IB = \frac{30mA}{100} = 0{,}3mA = 300\mu A$$

R9=$R9 = \frac{Vcc-VBE}{IB} = \frac{14V-0{,}65V}{300\mu A} = \frac{13{,}35V}{0{,}3mA} = 44{,}5 \times 10^3\ Ohm = 44{,}5\ KOhm \rightarrow 44{,}5\ KOhm$

12. Analize Monte Carlo/Worst Case

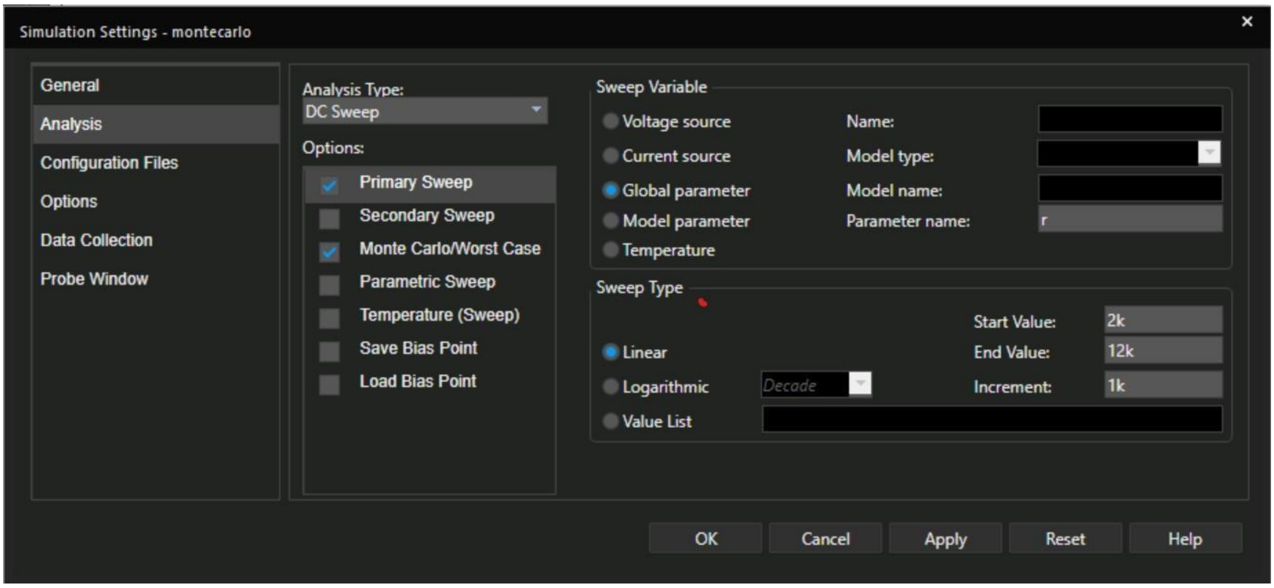
Analiza Monte Carlo constituie cel mai bun mod de analiza a unui circuit din punct de vedere statistic, de a vedea cum se comporta acel circuit la variatii ale valorilor componentelor.

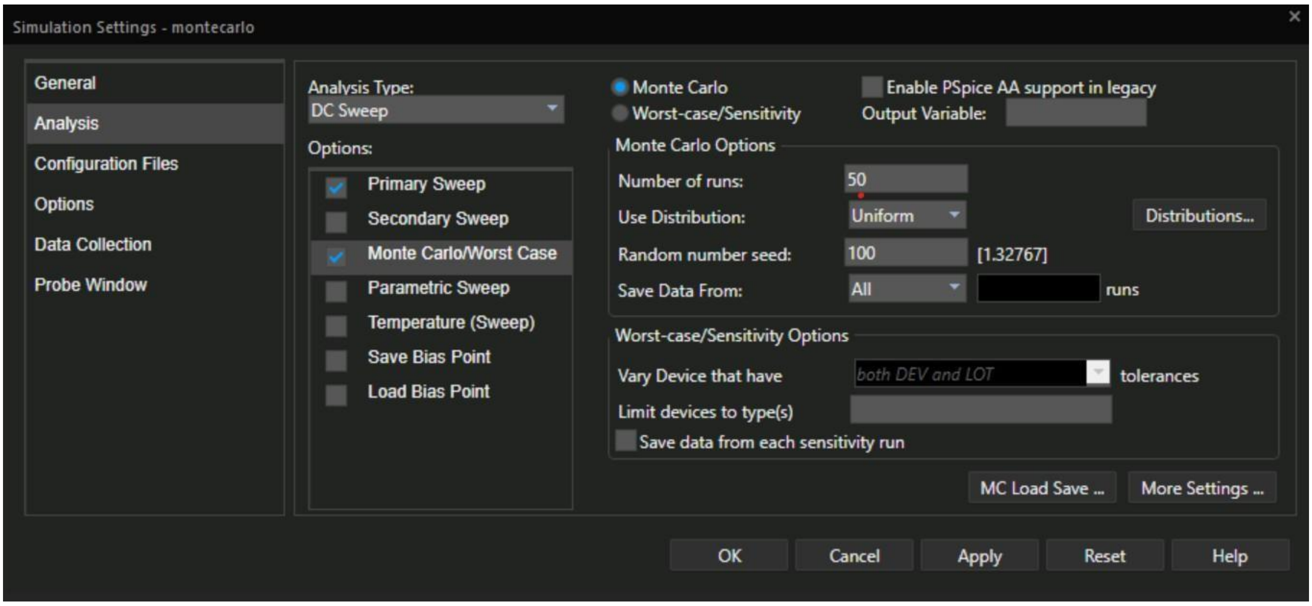
Analiza Worst-case/Sensitivity

Sensitivity identifică care parametrii ai componentelor sunt critici pentru funcționarea circuitului. Această analiză determină în ce masură fiecare componenta afectează funcționarea circuitului. De asemenea modifică toate valorile pentru a simula cel mai defavorabil caz.

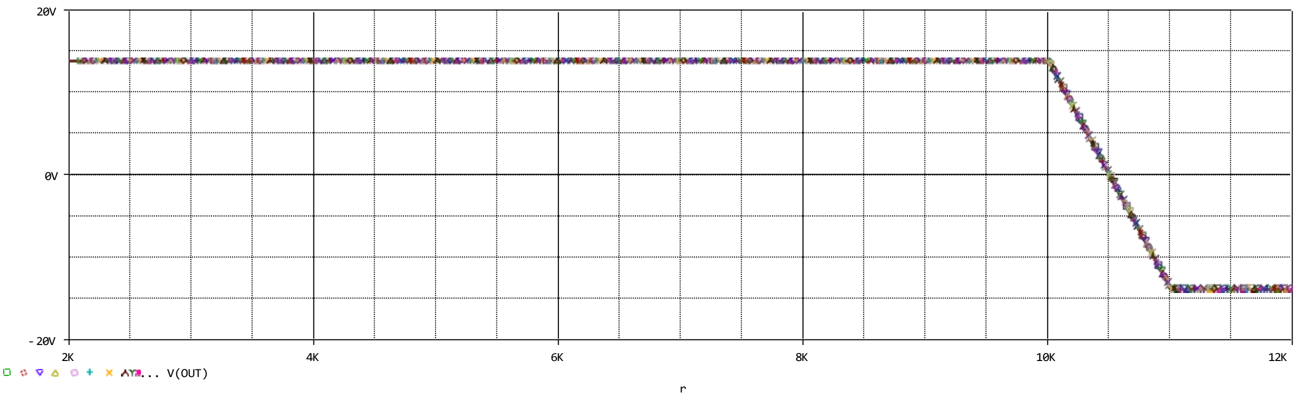
Analiza Monte Carlo

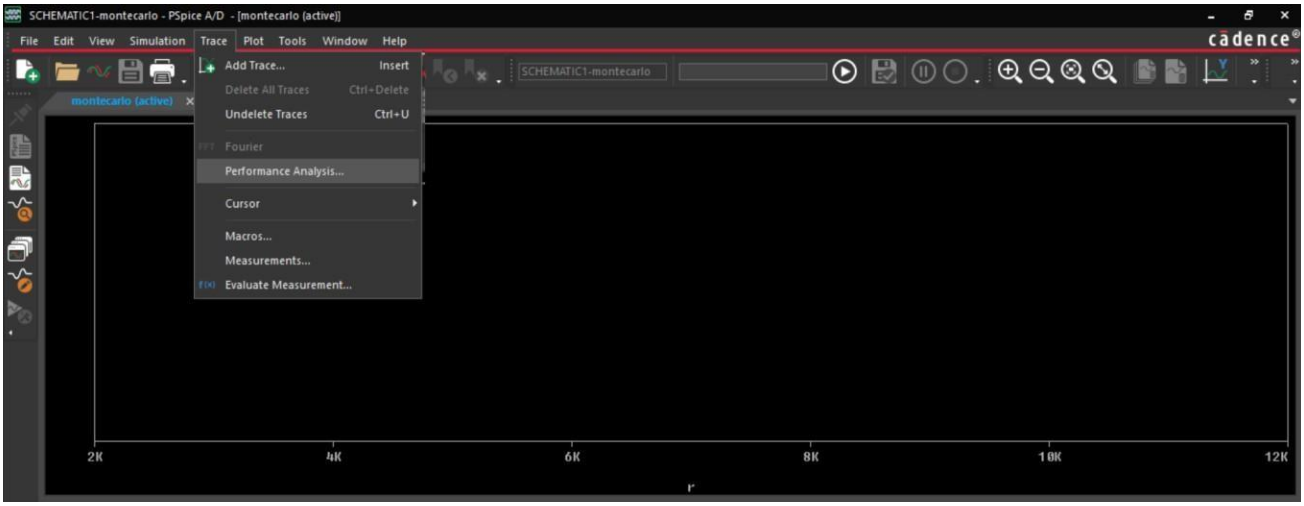
Facem profilul de simulare

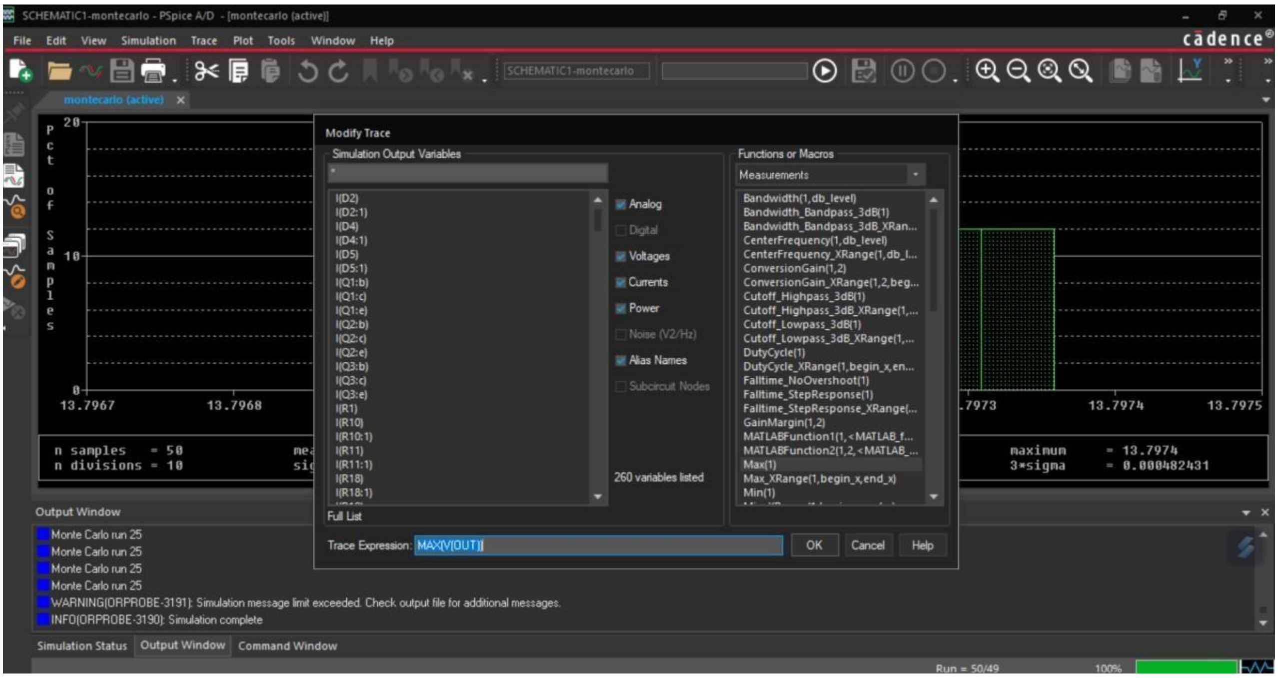


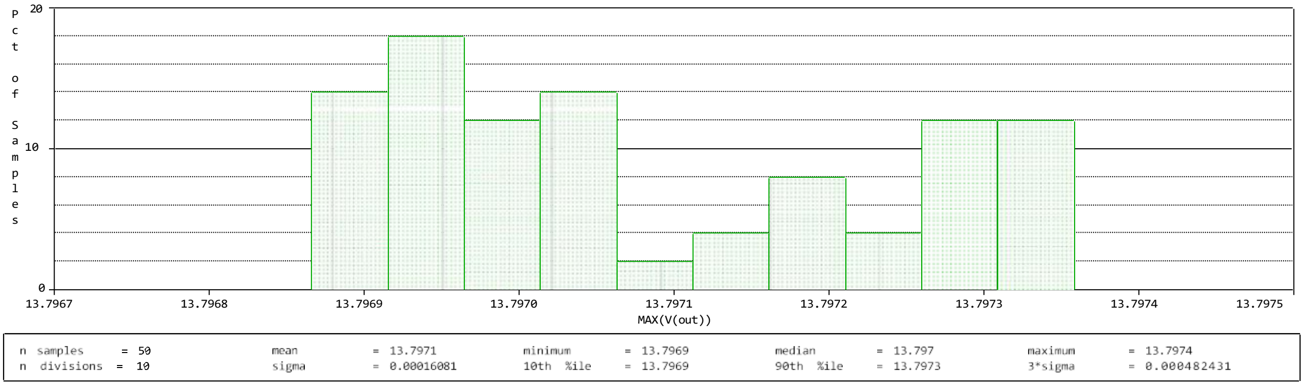

Simulation Settings - montecarlo
General
Analysis
Configuration Files
Options
Data Collection
Probe Window
Analysis Type:
DC Sweep
Options:
Primary Sweep
Secondary Sweep
Monte Carlo/Worst Case
Parametric Sweep
Temperature (Sweep)
Save Bias Point
Load Bias Point
Monte Carlo
Worst-case/Sensitivity
Enable PSpice AA support in legacy
Output Variable:
Monte Carlo Options
Number of runs:
50
Use Distribution:
Uniform
Distributions...
Random number seed:
100
[1.32767]
Save Data From:
All
runs
Worst-case/Sensitivity Options
Vary Device that have
both DEV and LOT
tolerances
Limit devices to type(s)
Save data from each sensitivity run
MC Load Save ...
More Settings ...
OK
Cancel
Apply
Reset
Help

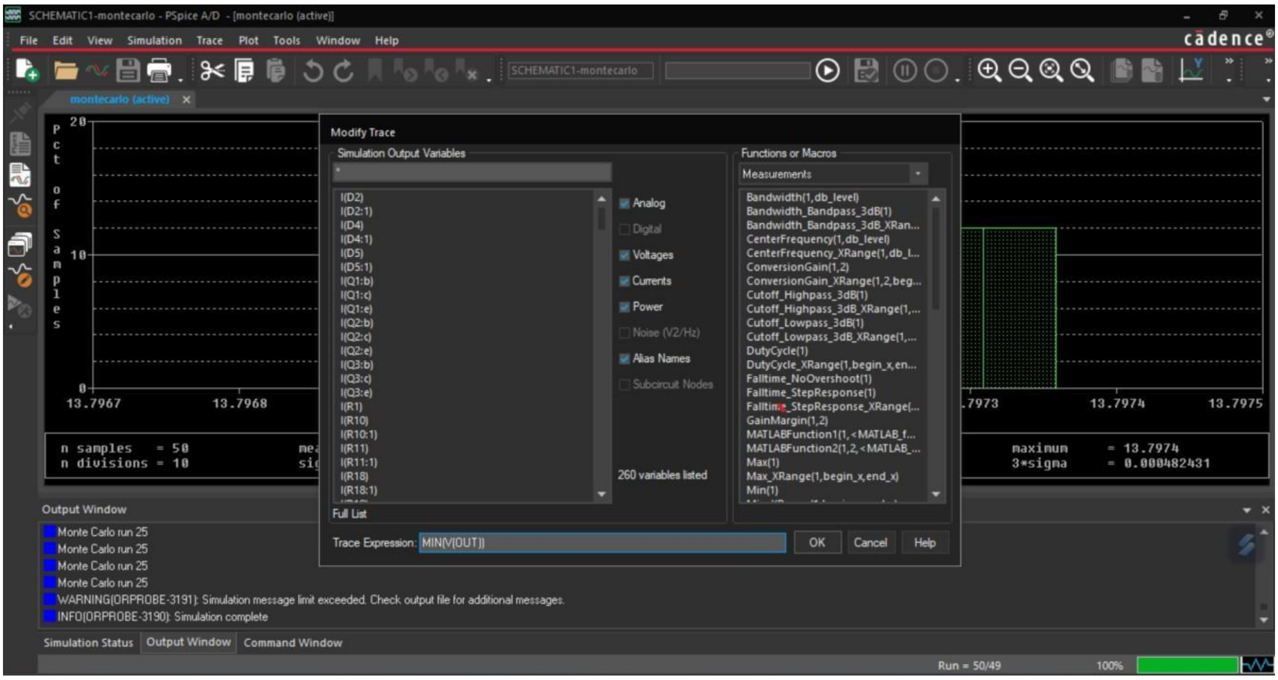
Simulare


20V
0V
-20V
2K
4K
6K
8K
10K
12K
V(OUT)

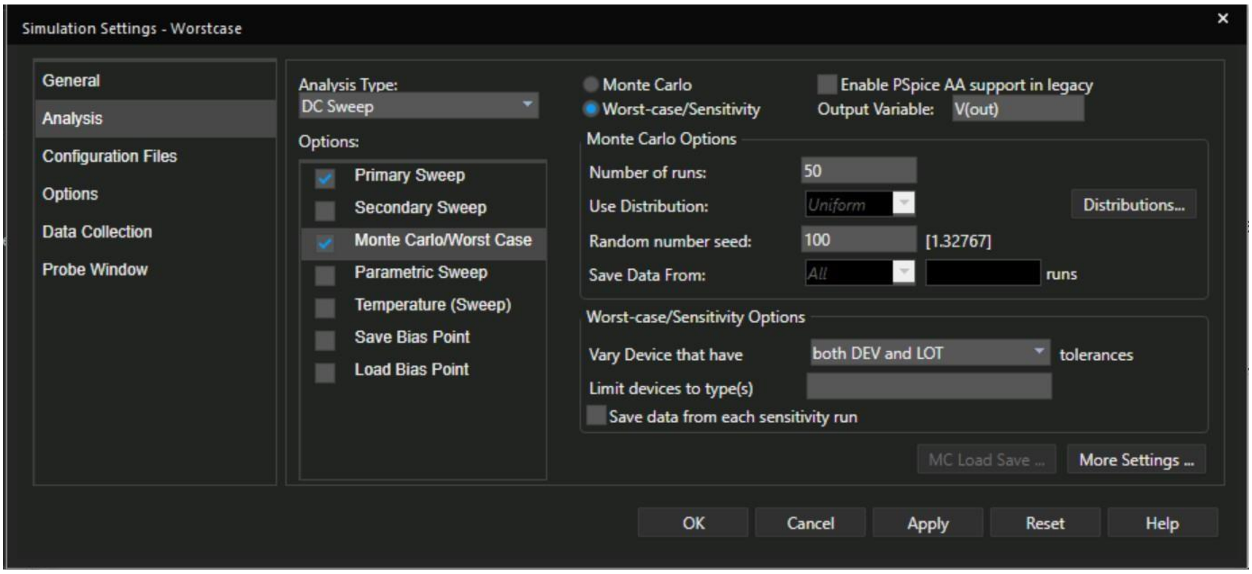

SCHEMATIC1-montecarlo - PSpice A/D - [montecarlo (active)]
File Edit View Simulation Trace Plot Tools Window Help
Add Trace... Insert
Delete All Traces Ctrl+Delete
Undelete Traces Ctrl+U
Fourier
Performance Analysis...
Cursor
Macros...
Measurements...
Evaluate Measurement...
2K 4K 6K 8K 10K 12K


SCHEMATIC1-montecarlo - PSpice A/D - [montecarlo (active)]
Modify Trace
Simulation Output Variables
Functions or Macros
Measurements
Analog
Digital
Voltages
Currents
Power
Noise (V2/Hz)
Alias Names
Subcircuit Nodes
260 variables listed
Full List
Trace Expression: MAX(V(OUT))
OK Cancel Help
n samples = 50
n divisions = 10
maximum = 13.7974
3*sigma = 0.000482431
Output Window
Monte Carlo run 25
WARNING(ORPROBE-3191): Simulation message limit exceeded. Check output file for additional messages.
INFO(ORPROBE-3190): Simulation complete
Simulation Status Output Window Command Window

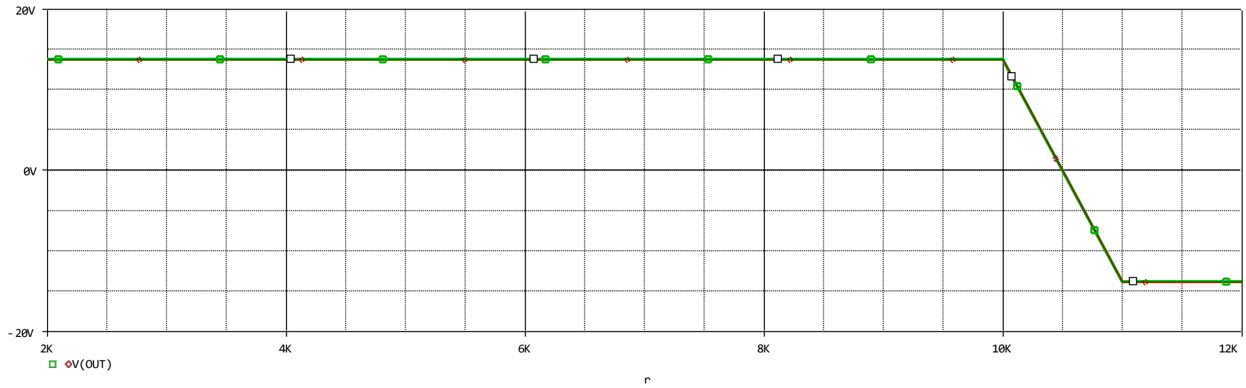

Pct of Samples
20
10
0
13.7967
13.7968
13.7969
13.7970
13.7971
13.7972
13.7973
13.7974
13.7975
MAX(V(out))
n samples = 50
n divisions = 10
mean = 13.7971
sigma = 0.00016081
minimum = 13.7969
10th %ile = 13.7969
median = 13.797
90th %ile = 13.7973
maximum = 13.7974
3*sigma = 0.000482431


SCHEMATIC1-montecarlo - PSpice A/D - [montecarlo (active)]
File Edit View Simulation Trace Plot Tools Window Help
Modify Trace
Simulation Output Variables
Functions or Macros
Measurements
Analog
Digital
Voltages
Currents
Power
Noise (V2/Hz)
Alias Names
Subcircuit Nodes
260 variables listed
Full List
Trace Expression: MIN(V(OUT))
OK
Cancel
Help
Output Window
Monte Carlo run 25
WARNING(ORPROBE-3191): Simulation message limit exceeded. Check output file for additional messages.
INFO(ORPROBE-3190): Simulation complete
Simulation Status
Output Window
Command Window
Run = 50/49
100%

Analiza Worst-case/Sensitivity



Simulare



13. Bibliografie

Editare Bibliografie

- Site web [1]
- Foaie de catalog [2]
- Cursuri [3]

Bibliografie

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[2] Tranzistor uA741 , Tranzistor BC107A, Led Roșu

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http://193.226.6.189/dce/didactic/de/DE_Curs7.pdf- Comparatoare cu AO cu RP. Amplificatoare electronice

http://193.226.6.189/dce/didactic/de/DE_Curs10.pdf- Aplicații cu AO

http://193.226.6.189/dce/didactic/de/DE_Curs13.pdf- TB. Tranzistoare MOS