Facultatea de Electronica, Telecomunicatii si Tehnologia Informatiei

PROIECT TEHNICI CAD

INDICATOR DE NIVEL AUDIO

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Grupa 2122

Profesori indrumatori

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Cuprins

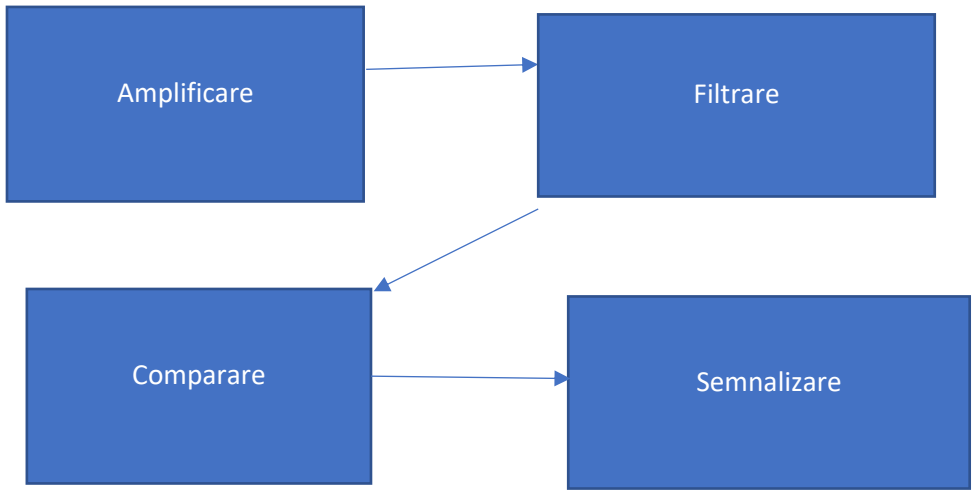
1.Cerinta proiect

Să se proiecteze un circuit electronic care să indice pe un afișaj cu leduri nivelul semnalului audio dintr-o bandă de frecvență specificată (VU-metru). Circuitul este alimentat de la tensiunea ±VCC. LED-urile trebuie să fie de culori diferite. Numărul LED-urilor este specificat în coloana "Semnalizări". LED-urile se vor aprinde succesiv la depășirea fiecărui prag audio stabilit de proiectant.

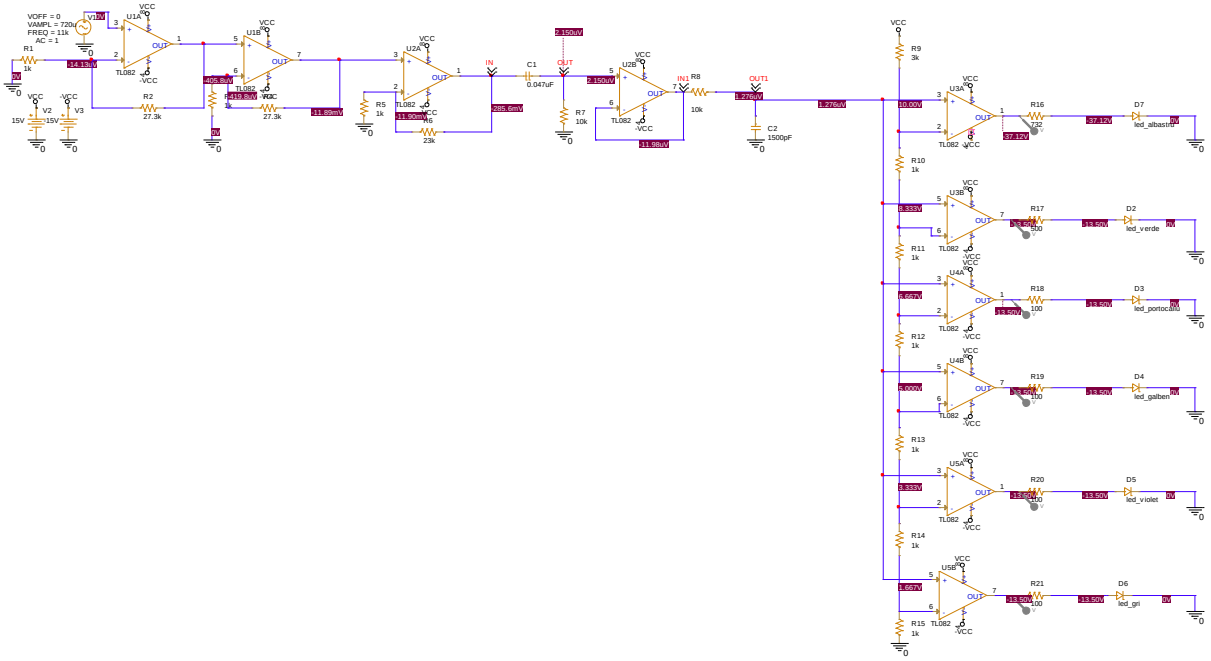
2.Specificatii de proiectare

Amplitudinea semnalului de intrare	720uV
Banda de frecvente [HZ]	340-11000
Tensiunea de alimentare[VCC]	15V
Semnalizari	6

3.Schema Bloc

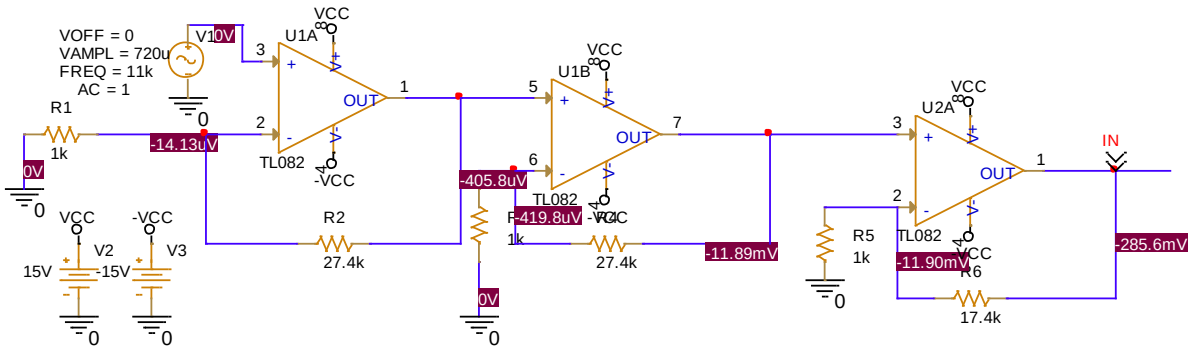


4.Schema electrica



5. Dimensionarea componentelor

1. Cele 3 etaje de amplificare:



Calcule:

$$Av1 = 1 + \frac{R2}{R1}$$

$$Vout = Av1 * Vin$$

$$Av1 = 1 + \frac{27.4k}{1k} = 28.4\text{k}$$

$$Vout1 = 28.4 * 720 * 0.0000001 = 0.020V$$

$$Av2 = 28.4$$

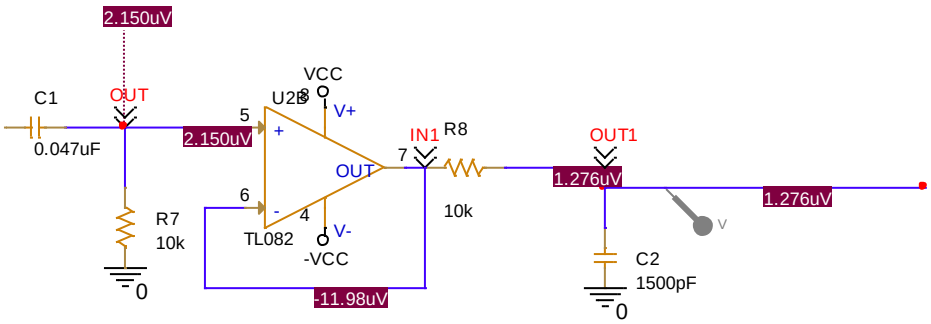
$$Vout2 = 28.4 * 0.029 = 0.82V$$

$$Av3 = 1 + \frac{R6}{R5} = 1 + \frac{17.4kk}{1k} = 18.4k$$

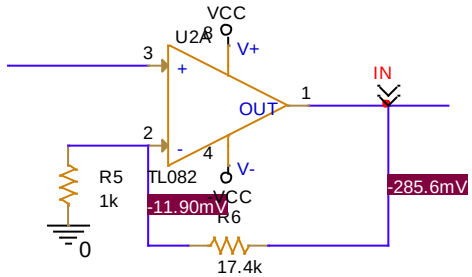
$$Vout3 = 18.4k * 0.82V = 15V$$

- ⇨ R1=R3=R6=1k
- ⇨ R2=R4=27.4K
- ⇨ R6=17.4K

2.FTB



Adaptor de impedanta

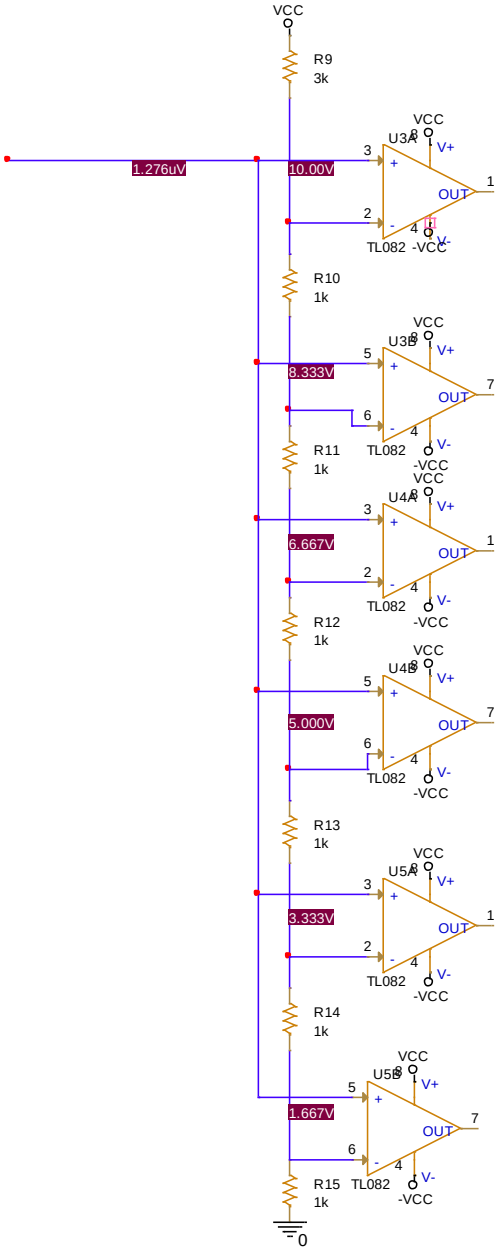


Calcule:

$$C1 = \frac{1}{2 * \pi * Fl * R7} = \frac{1}{2 * 3.14 * 340 * 10000} = 0.047uF$$

$$C2 = \frac{1}{2 * \pi * Fh * r} = \frac{1}{2 * 3.14 * 11000 * 10000} = 1500pF$$

3.Comparatoare



Calcule:

$$V1(-) = \frac{R10 + R11 + R12 + R13 + R14 + R15}{R} * VCC;\ V1(-) = 10$$

$$V2(-) = \frac{R11 + R12 + R13 + R14 + R15}{R} * VCC;\ V2(-) = 8{,}33$$

$$V3(-) = \frac{R12 + R13 + R14 + R15}{R} * VCC;\ V3(-) = 6.66$$

$$V4(-) = \frac{(R13 + R14 + R15)}{R} * VCC;\ V4(-) - 4.99$$

$$V5(-) = \frac{R14 + R15}{R} * VCC => R14 + R15 = 0.22;\ \ V5(-) = 3.32$$

$$V6(-) = \frac{R15}{R} * VCC;\ \ V6(-) = 1.65 => \frac{R15}{R} = 0.11 => R15 = 0.11R$$

$$R14 + 0.11R = 0.22R => R1R = 0.11R$$

$$\frac{R10 + R11 + R12 + R13 + R14 + R15}{(R9 + R10 + R11 + R12 + R13 + R14 + R15)} = \frac{2}{3} = \frac{10}{5}$$

V(-)=10

VCC=15

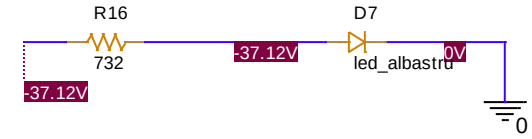
$$2R9 + 2R10 + 2R11 + 2R12 + 2R13 + 2R14 + 2R15$$
$$= 3R10 + 3R11 + 3R12 + 3R13 + 3R14 + 3R15$$

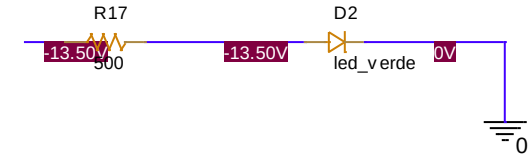
$$=> 2R9 = R10 + R11 + R12 + R13 + R14 + R15$$

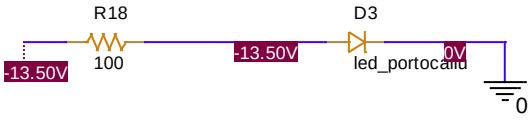
$$=> R9 = (R10 + R11 + R12 + R13 + R14 + R15)2$$

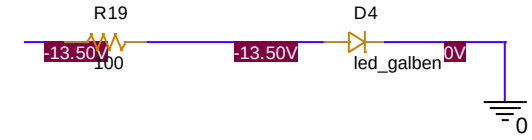
5. LED-URI

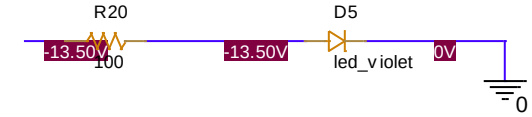
Am modelat aceste led-uri conform „datasheet” al unor modele deja existente.

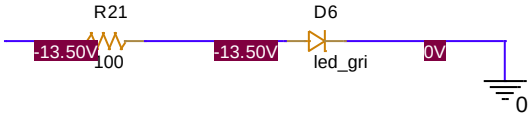












LED-UL albastru

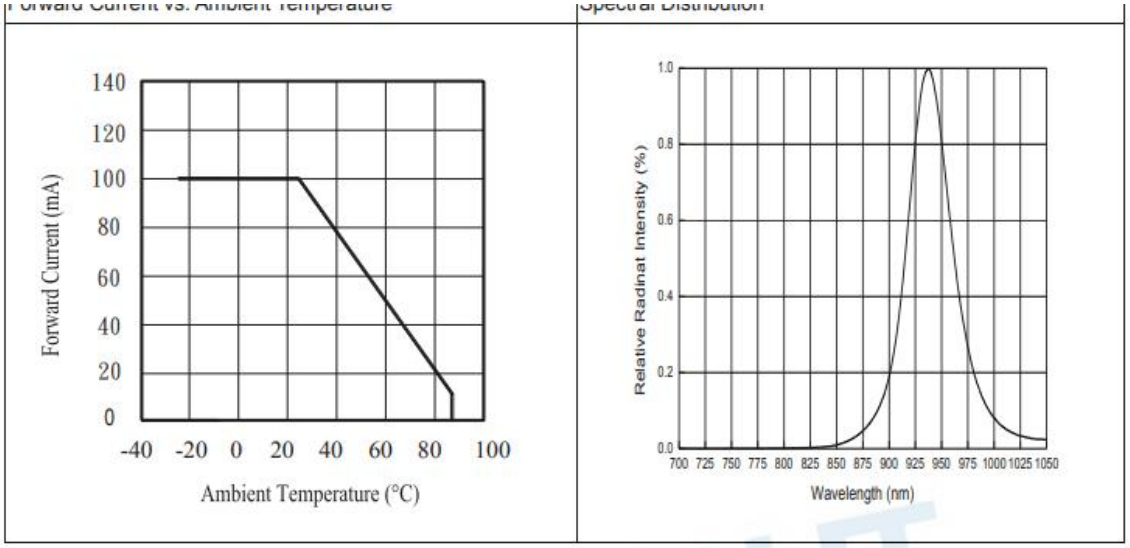
Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Radiant Intensity	I_e	15.0	28.0	67	mW/sr	I_F=20mA
		-----	120	-----		I_F=100mA Pulse Width≦100μs and Duty≦1%
		-----	1000	-----		I_F=1A Pulse Width≦100μs and Duty≦1%
Peak Wavelength	λp	-----	940	-----	nm	I_F=20mA
Spectral Bandwidth	Δλ	-----	45	-----	nm	I_F=20mA
Forward Voltage	VF	-----	1.2	1.5	V	I_F=20mA
		-----	1.4	1.7		I_F=100mA
		-----	2.6	4.0		I_F=1A Pulse Width≦100μs and Duty≦1%
Reverse Current	I_R	----	----	10	uA	V_R=5V
View Angle	2θ1/2	----	20	----	deg	I_F=20mA

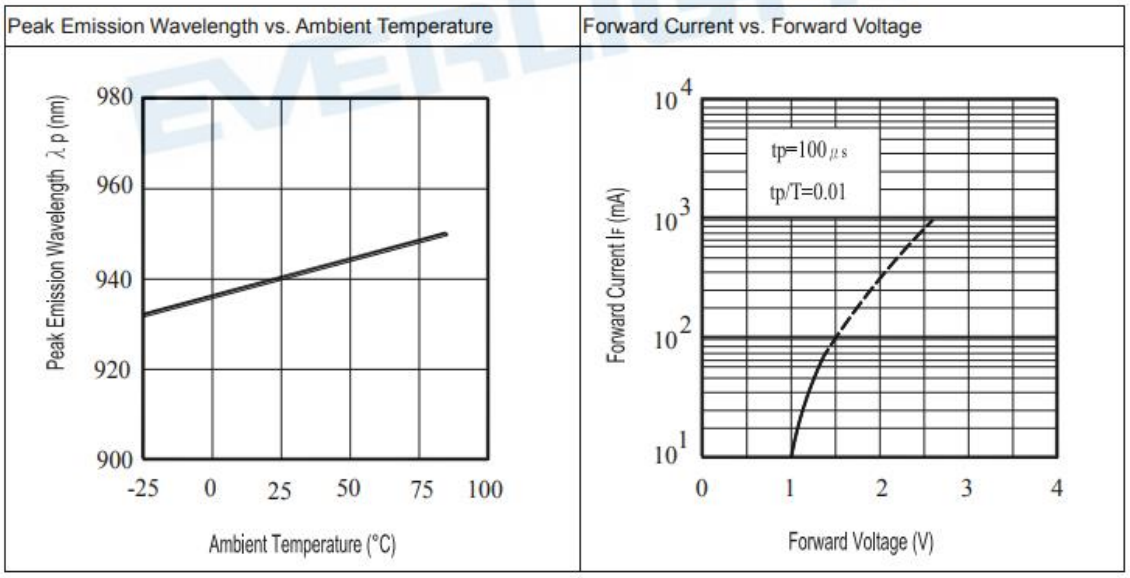
Rank

Condition:I_F=20mA Unit：mW/sr

Bin Number	P	Q	R	S
Min	15.0	21.0	30.0	42.0
Max	24.0	34.0	48.0	67.0

ote:
Measurement Uncertainty of Forward Voltage: ±0.1V
Measurement Uncertainty of Luminous Intensity: ±10%
Measurement Uncertainty of Dominant Wavelength ±1.0nm





Dimensionare rezistenta R16

Forward voltage 1.2V

Forward current 20mA

$$R16 = \frac{VCC - Vf}{If} = \frac{15 - 1.2}{100} = 138\ Ohm$$

LED=UL verde

Kingbright

Selection Guide

Part No.	Dice	Lens Type	Iv (mcd) @ 20 mA		Viewing Angle
			Min.	Typ.	2θ1/2
L-813GD	GREEN (GaP)	GREEN DIFFUSED	18	60	60°

Note:
1. θ1/2 is the angle from optical centerline where the luminous intensity is 1/2 the optical centerline value.

Electrical / Optical Characteristics at T_A=25°C

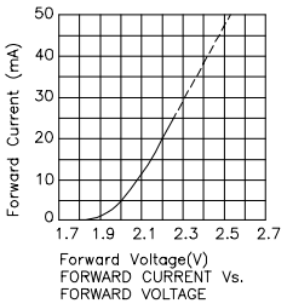
Symbol	Parameter	Device	Typ.	Max.	Units	Test Conditions
λpeak	Peak Wavelength	Green	565		nm	I_F=20mA
λ D	Dominate Wavelength	Green	568		nm	I_F=20mA
Δλ1/2	Spectral Line Half-width	Green	30		nm	I_F=20mA
C	Capacitance	Green	15		pF	V_F=0V;f=1MHz
V_F	Forward Voltage	Green	2.2	2.5	V	I_F=20mA
I_R	Reverse Current	Green		10	uA	V_R = 5V

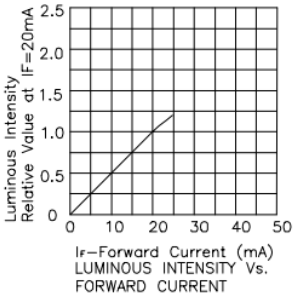
Absolute Maximum Ratings at T_A=25°C

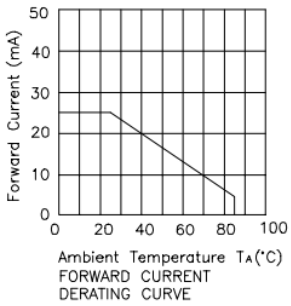
Parameter	Green	Units
Power dissipation	105	mW
DC Forward Current	25	mA
Peak Forward Current [1]	140	mA
Reverse Voltage	5	V
Operating/Storage Temperature	-40°C To +85°C	
Lead Solder Temperature [2]	260°C For 5 Seconds	

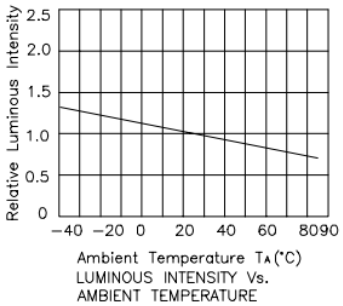
Notes:
1. 1/10 Duty Cycle, 0.1ms Pulse Width.
2. 2mm below package base.

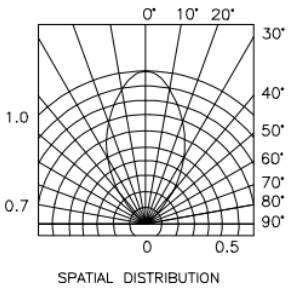
Green **L-813GD**











Dimensionare rezistenta R17

Forward voltage 12.5V

Forward current 25mA

$$R17 = \frac{VCC - Vf}{If} = \frac{15 - 2.5}{25} = 0.5\ kOhm$$

LED-UL portocaliu

Absolute Maximum Ratings (T_A = 25°C unless otherwise specified)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Rating	Units
T_{OPR}	Operating Temperature	-40 to +100	°C
T_{STG}	Storage Temperature	-40 to +100	°C
T_{SOL-I}	Soldering Temperature (Iron)[2][3][4]	240 for 5 sec	°C
T_{SOL-F}	Soldering Temperature (Flow)[2][3]	260 for 10 sec	°C
I_F	Continuous Forward Current	100	mA
V_R	Reverse Voltage	5	V
P_D	Power Dissipation[1]	200	mW

Notes:

1. Derate power dissipation linearly 2.67mW/°C above 25°C.
2. RMA flux is recommended.
3. Methanol or isopropyl alcohols are recommended as cleaning agents.
4. Soldering iron 1/16" (1.6mm) minimum from housing.

Electrical / Optical Characteristics (T_A = 25°C)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
λ_{PE}	Peak Emission Wavelength	I_F = 20mA		890		nm
TC_λ	Temperature Coefficient			0.2		nm / °C
$2\Theta^1/2$	Emission Angle	I_F = 100mA		16		°
V_F	Forward Voltage	I_F = 100mA, tp = 20ms			1.7	V
TC_{VF}	Temperature Coefficient			-6		mV / °C
I_R	Reverse Current	V_R = 5V			10	µA
I_E	Radiant Intensity QED121	I_F = 100mA, tp = 20ms	16		40	mW/sr
I_E	Radiant Intensity QED122	I_F = 100mA, tp = 20ms	32		100	mW/sr
I_E	Radiant Intensity QED123	I_F = 100mA, tp = 20ms	50	70		mW/sr
TC_{IE}	Temperature Coefficient			-0.3		% / °C
t_r	Rise Time	I_F = 100mA		900		ns
t_f	Fall Time			800		ns
C_j	Junction Capacitance	V_R = 0V		11		pF

Typical Performance Curves

Figure 1. Normalized Intensity vs. Wavelength

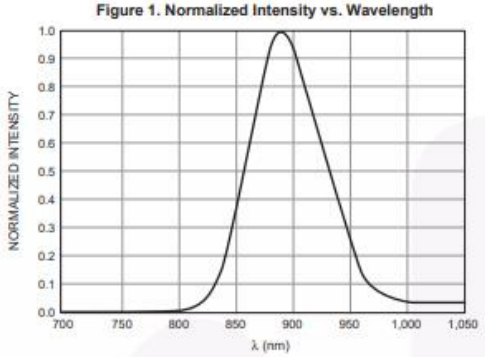


Figure 2. Peak Wavelength vs. Ambient Temperature

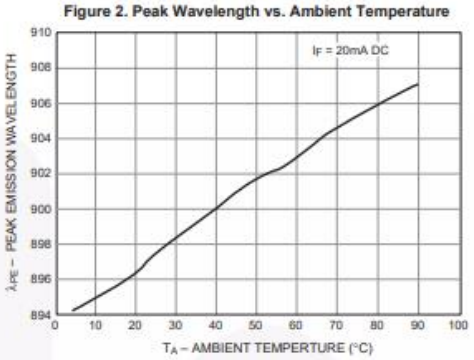


Figure 3. Normalized Radiant Intensity vs. Forward Current

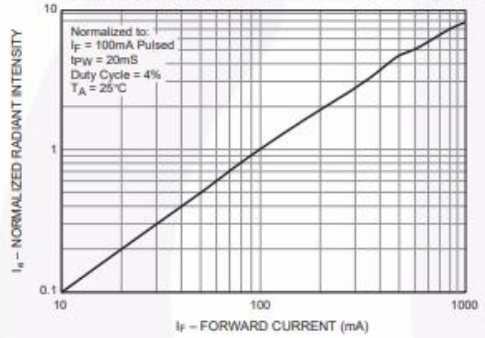


Figure 4. Normalized Radient Intensity vs. Ambient Temperature

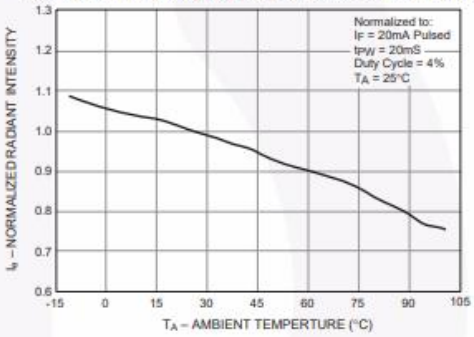


Figure 5. Forward Voltage vs. Forward Current

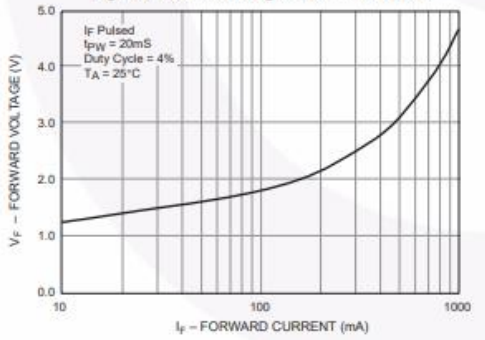
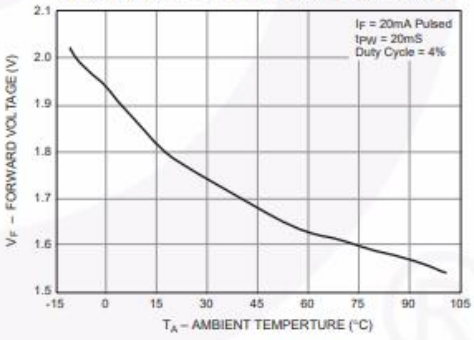


Figure 6. Forward Voltage vs. Ambient Temperature



Dimensionare rezistenta R18

Forward voltage 1.7V

Forward current 100mA

$$R18 = \frac{VCC - Vf}{If} = \frac{15 - 1.7}{100} = 133\ Ohm$$

LED galben

Luckylight

Absolute Maximum Ratings at Ta=25℃

Parameters	Symbol	Max.	Unit
Power Dissipation	PD	65	mW
Peak Forward Current (1/10 Duty Cycle, 0.1ms Pulse Width)	IFP	100	mA
Forward Current	IF	25	mA
Reverse Voltage	VR	5	V
Operating Temperature Range	Topr	-40℃ to +85℃	
Storage Temperature Range	Tstg	-40℃ to +100℃	
Lead Soldering Temperature [4mm (.157") From Body]	Tsld	260℃ for 5 Seconds	

Electrical Optical Characteristics at Ta=25℃

Parameters	Symbol	Min.	Typ.	Max.	Unit	Test Condition
Luminous Intensity	IV	120	210	---	mcd	IF=20mA (Note 1)
Viewing Angle*	$2\theta_{1/2}$	---	60	---	Deg	IF=20mA (Note 2)
Peak Emission Wavelength	λp	---	592	---	nm	IF=20mA
Dominant Wavelength	λd	---	590	---	nm	IF=20mA (Note 3)
Spectral Line Half-Width	△λ	---	15	---	nm	IF=20mA
Forward Voltage	V_F	1.60	2.00	2.60	V	IF=20mA
Reverse Current	I_R	---	---	10	μA	V_R=5V

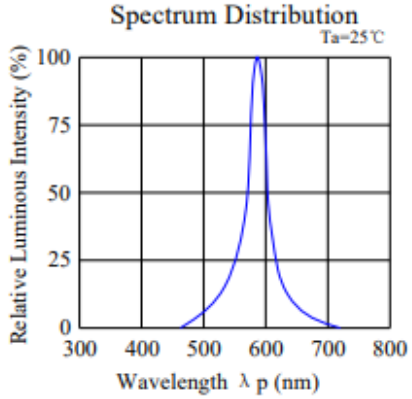
Notes:

1. Luminous Intensity Measurement allowance is ± 10%.
2. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.

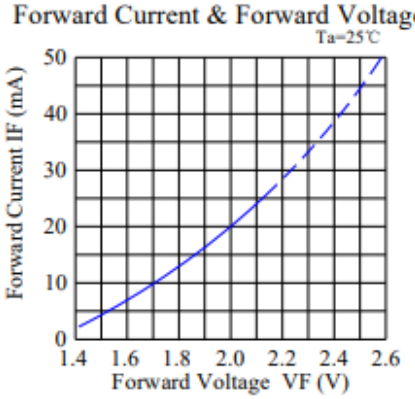
Luckylight

Typical Electrical / Optical Characteristics Curves
(25℃ Ambient Temperature Unless Otherwise Noted)

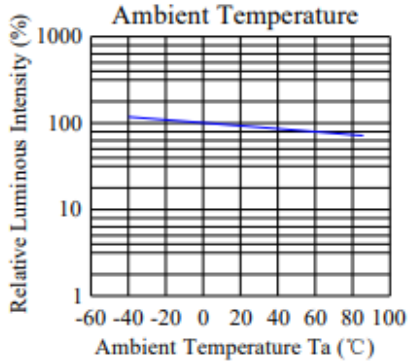
Spectrum Distribution



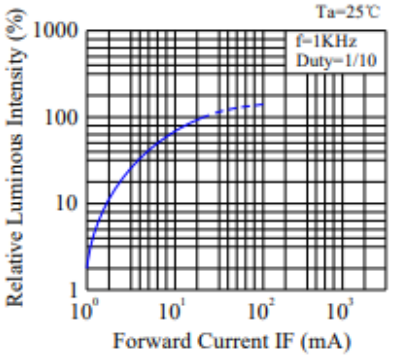
Forward Current & Forward Voltage



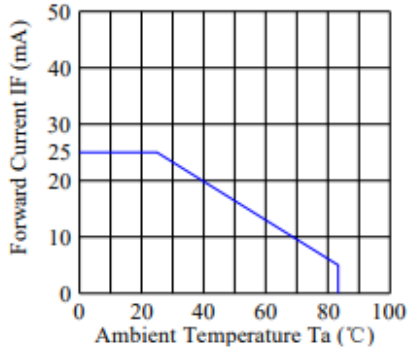
Luminous Intensity & Ambient Temperature



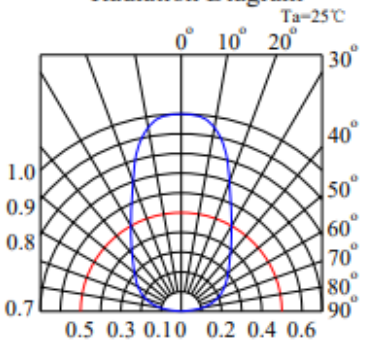
Luminous Intensity & Forward Current



Forward Current Derating Curve



Radiation Diagram



Dimensionare rezistenta R19

Forward voltage 1.7V

Forward current 100mA

$$R19 = \frac{VCC - Vf}{If} = \frac{15 - 1.7}{100} = 133\ Ohm$$

LED-UL violet

Absolute Maximum Ratings (T_A = 25°C unless otherwise specified)

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Rating	Units
T_{OPR}	Operating Temperature	-40 to +100	°C
T_{STG}	Storage Temperature	-40 to +100	°C
T_{SOL-I}	Soldering Temperature (Iron)(2)(3)(4)	240 for 5 sec	°C
T_{SOL-F}	Soldering Temperature (Flow)(2)(3)	260 for 10 sec	°C
I_F	Continuous Forward Current	100	mA
V_R	Reverse Voltage	5	V
P_D	Power Dissipation(1)	200	mW
$I_{F(Peak)}$	Peak Forward Current(5)	1.5	A

Notes:

1. Derate power dissipation linearly 2.67mW/°C above 25°C.
2. RMA flux is recommended.
3. Methanol or isopropyl alcohols are recommended as cleaning agents.
4. Soldering iron 1/16" (1.6mm) minimum from housing.
5. Pulse conditions; tp = 100µs, T = 10ms.

Electrical / Optical Characteristics (T_A = 25°C)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
λ_{PE}	Peak Emission Wavelength	I_F = 20mA		890		nm
TC_λ	Temperature Coefficient			0.2		nm / °C
$2\Theta^1/2$	Emission Angle	I_F = 100mA		30		°
V_F	Forward Voltage	I_F = 100mA, tp = 20ms			1.7	V
TC_{VF}	Temperature Coefficient			-6		mV / °C
I_R	Reverse Current	V_R = 5V			10	µA
I_E	Radiant Intensity	I_F = 100mA, tp = 20ms	25			mW/sr
TC_{IE}	Temperature Coefficient			-0.3		% / °C
t_r	Rise Time	I_F = 100mA		900		ns
t_f	Fall Time			800		ns
C_j	Junction Capacitance	V_R = 0V		11		pF

Typical Performance Curves

Figure 1. Normalized Intensity vs. Wavelength

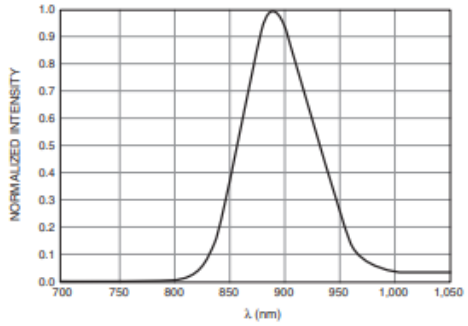


Figure 2. Peak Wavelength vs. Ambient Temperature

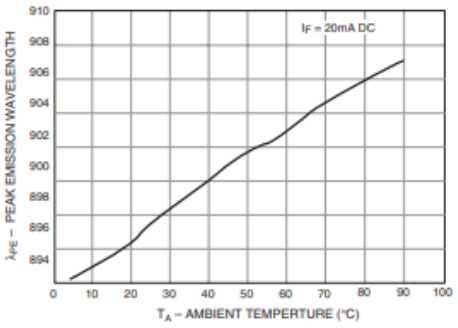


Figure 3. Normalized Radiant Intensity vs. Forward Current

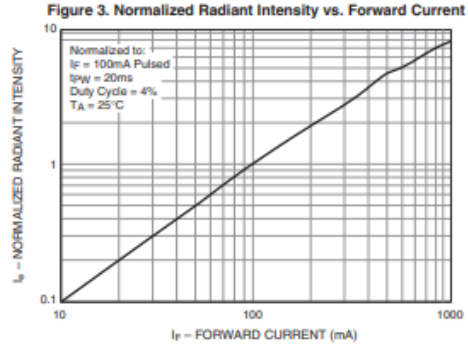


Figure 4. Normalized Radient Intensity vs. Ambient Temperature

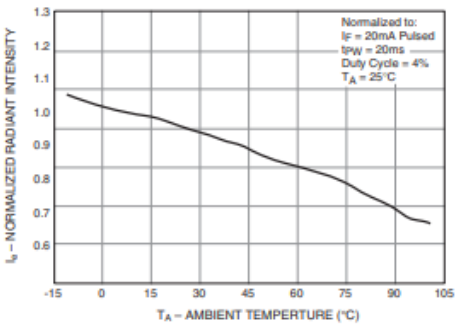


Figure 5. Forward Voltage vs. Forward Current

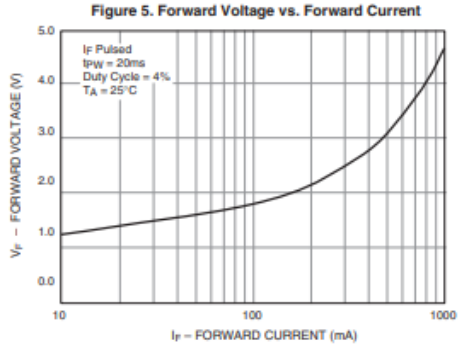
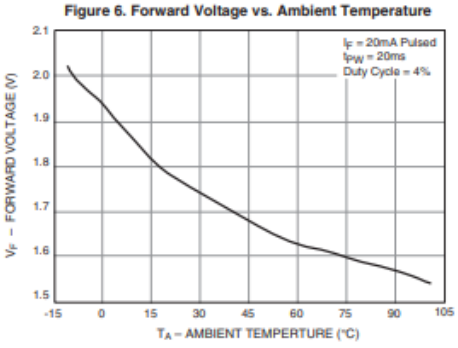


Figure 6. Forward Voltage vs. Ambient Temperature



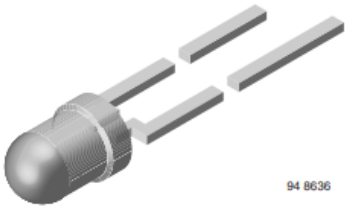
Dimensionare rezistenta R20

Forward voltage 5V

Forward current 100mA

$$R20 = \frac{VCC - Vf}{If} = \frac{15 - 5}{100} = 100\ Ohm$$

LED-UL gri



FEATURES

- Package type: leaded
- Package form: T-1
- Dimensions (in mm): Ø 3
- Peak wavelength: λ_p = 940 nm
- High reliability
- High radiant power
- High radiant intensity
- Angle of half intensity: φ = ± 25°
- Low forward voltage
- Suitable for high pulse current operation
- Good spectral matching with Si photodetectors
- Package matches with detector TEFT4300
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
e2
RoHS COMPLIANT
HALOGEN FREE
GREEN (5-2008)

DESCRIPTION

TSAL4400 is an infrared, 940 nm emitting diode in GaAlAs, MQW technology with high radiant power molded in a blue-gray plastic package.

APPLICATIONS

- Infrared remote control units
- Free air transmission systems
- Infrared source for optical counters and card readers

PRODUCT SUMMARY

COMPONENT	I_e (mW/sr)	φ (deg)	λ_p (nm)	t_r (ns)
TSAL4400	36	± 25	940	15

Note

- Test conditions see table "Basic Characteristics"

ORDERING INFORMATION

ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
TSAL4400	bulk	MOQ: 5000 pcs, 5000 pcs/bulk	T-1

Note

- MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V_R	5	V
Forward current		I_F	100	mA
Peak forward current	t_p/T = 0.5, t_p = 100 µs	I_{FM}	200	mA
Surge forward current	t_p = 100 µs	I_{FSM}	1.5	A
Power dissipation		P_V	160	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	-40 to +85	°C
Storage temperature range		T_{stg}	-40 to +100	°C
Soldering temperature	t ≤ 5 s, 2 mm from case	T_{sd}	260	°C
Thermal resistance junction/ambient	J-STD-051, leads 7 mm, soldered on PCB	R_{thJA}	300	K/W

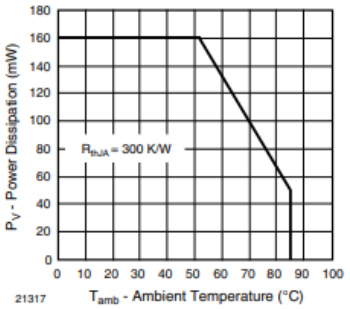


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

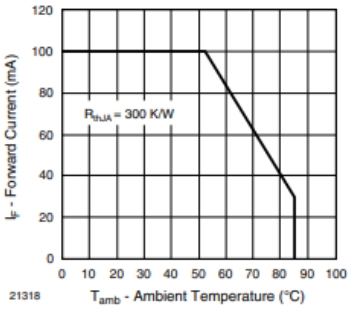


Fig. 2 - Forward Current Limit vs. Ambient Temperature

BASIC CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.35	1.6	V
	I_F = 1 A, t_p = 100 µs	V_F		2.6	3	V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		-1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		60		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	16	36	80	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e	135	290		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		40		mW
Temperature coefficient of ϕ_e	I_F = 20 mA	$TK\phi_e$		-0.6		%/K
Angle of half intensity		φ		± 25		deg
Peak wavelength	I_F = 100 mA	λ_p		940		nm
Spectral bandwidth	I_F = 100 mA	$\Delta\lambda$		25		nm
Temperature coefficient of λ_p	I_F = 100 mA	$TK\lambda_p$		0.25		nm/K
Rise time	I_F = 100 mA	t_r		15		ns
Fall time	I_F = 100 mA	t_f		15		ns

BASIC CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

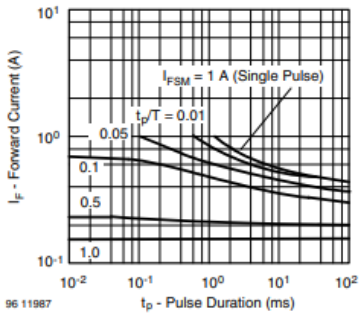


Fig. 3 - Pulse Forward Current vs. Pulse Duration

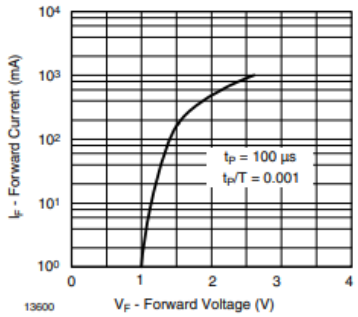


Fig. 4 - Forward Current vs. Forward Voltage

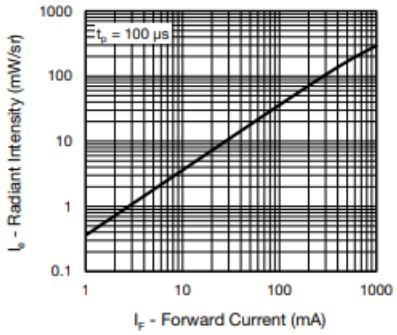


Fig. 5 - Radiant Intensity vs. Forward Current

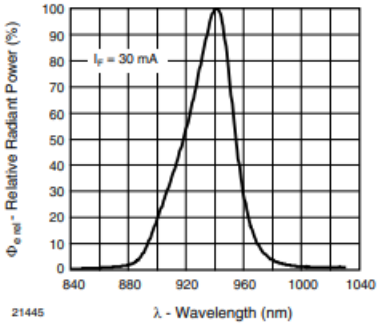


Fig. 8 - Relative Radiant Power vs. Wavelength

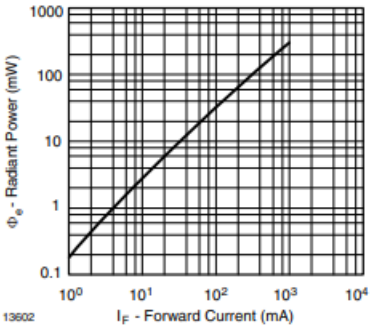


Fig. 6 - Radiant Power vs. Forward Current

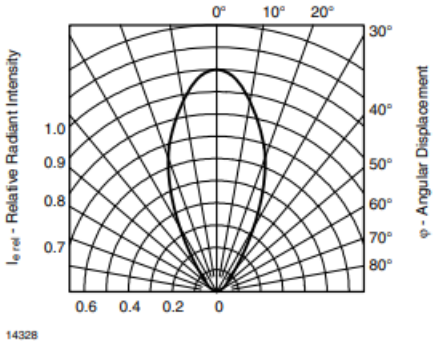


Fig. 9 - Relative Radiant Intensity vs. Angular Displacement

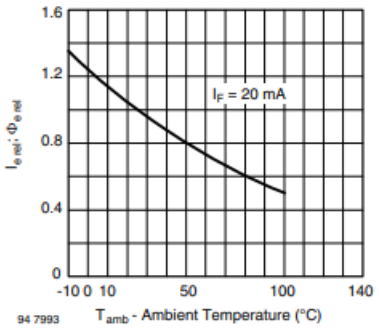


Fig. 7 - Rel. Radiant Intensity/Power vs. Ambient Temperature

Dimensionare rezistenta R21

Forward voltage 5V

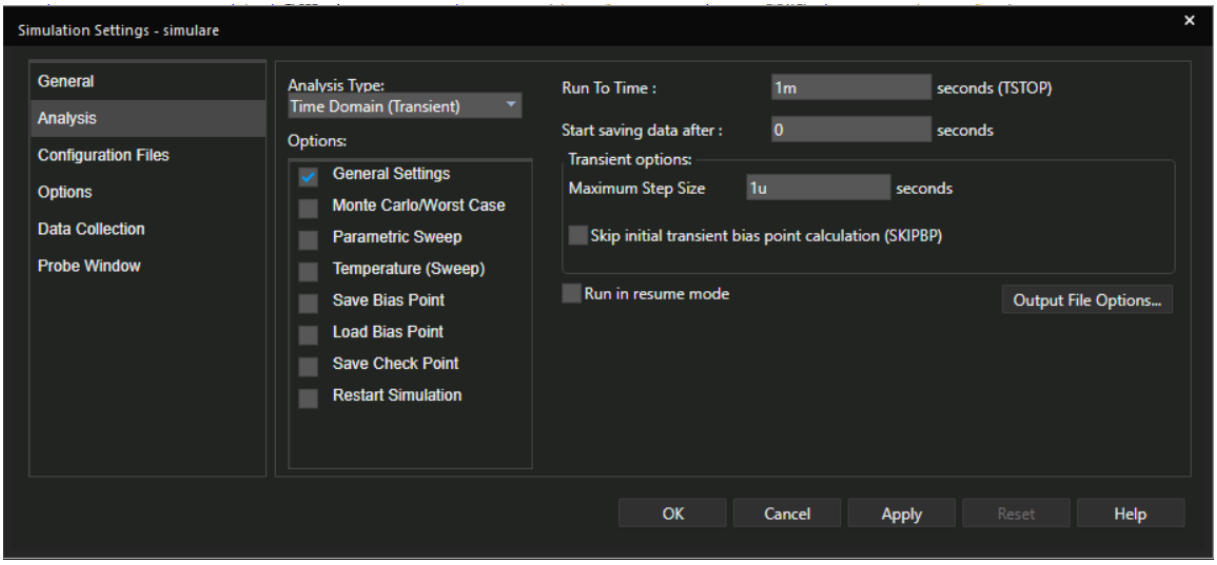
Forward current 100mA

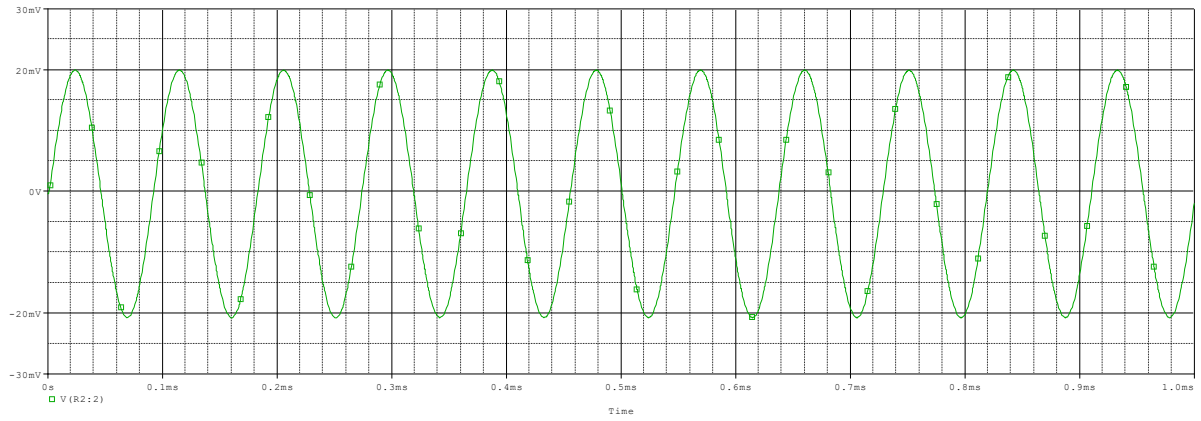
$$R21 = \frac{VCC - Vf}{If} = \frac{15 - 5}{100} = 100\ Ohm$$

6.Simulari

1.Analiza in timp pentru:

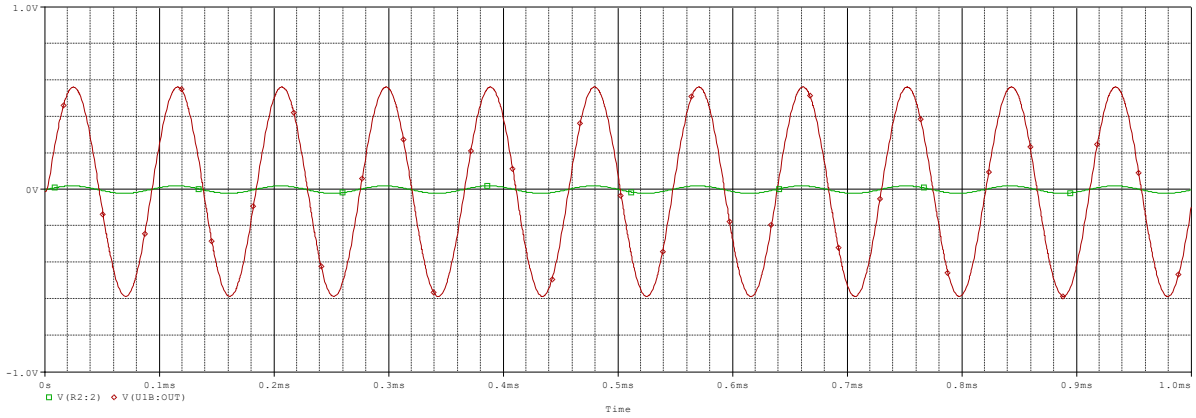
- verificarea primului prag de amplificare.





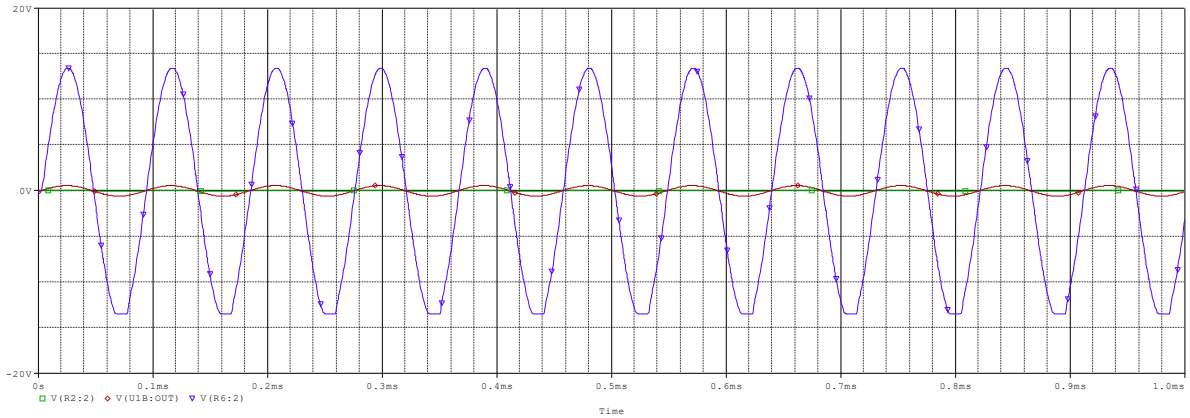
	Trace Color	Trace Name	Y1	Y2	Y1 - Y2
		X Values	384.852u	0.000	384.852u
	CURSOR 1,2	V(R2:2)	19.599m	-405.765u	20.005m

- verificarea celui de al doilea prag de amplificare

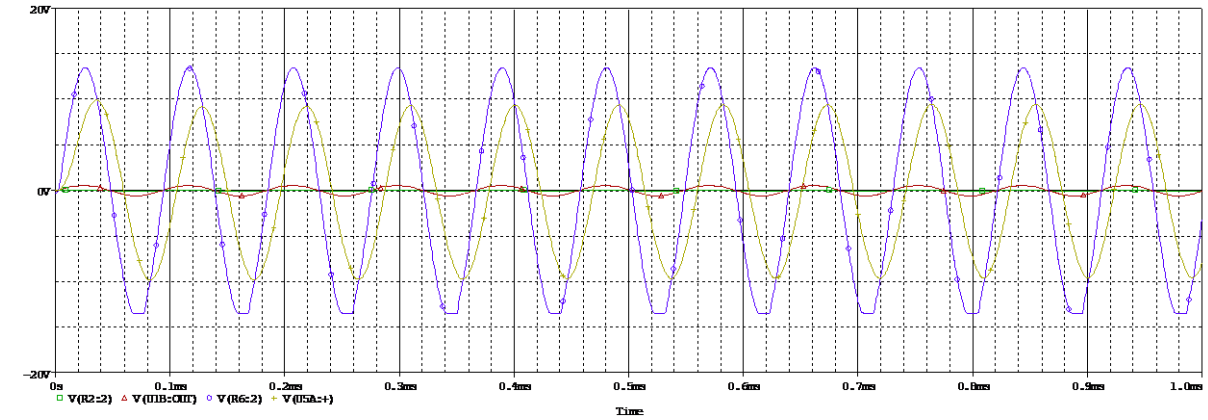


	Trace Color	Trace Name	Y1	Y2	Y1 - Y2
		X Values	389.060u	0.000	389.060u
	CURSOR 2	V(R2:2)	19.905m	-405.765u	20.311m
	CURSOR 1	V(U1B:OUT)	563.474m	-11.887m	575.362m

- verificarea celui de al treilea prag de amplificare

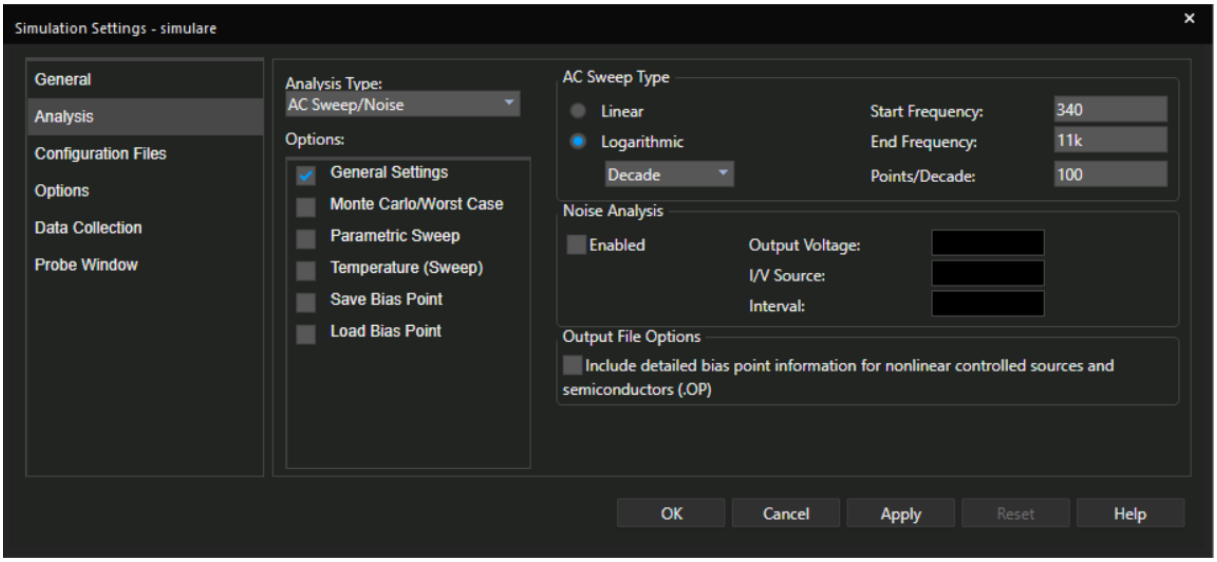


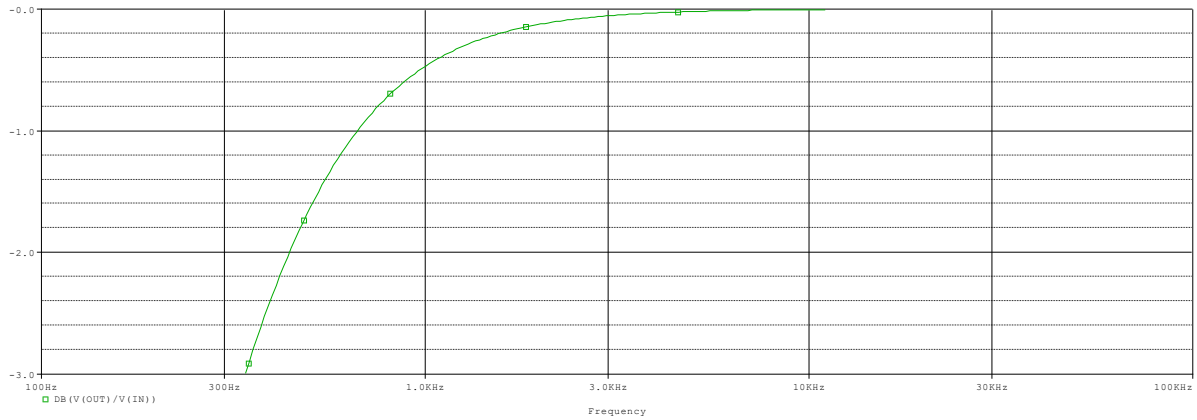
Trace Color	Trace Name	Y1	Y2	Y1 - Y2
	X Values	389.060u	0.000	389.060u
CURSOR 2	V(R2:2)	19.755m	-405.765u	20.161m
	V(U1B:OUT)	560.997m	-11.887m	572.885m
CURSOR 1	V(R6:2)	13.414	-285.607m	13.700

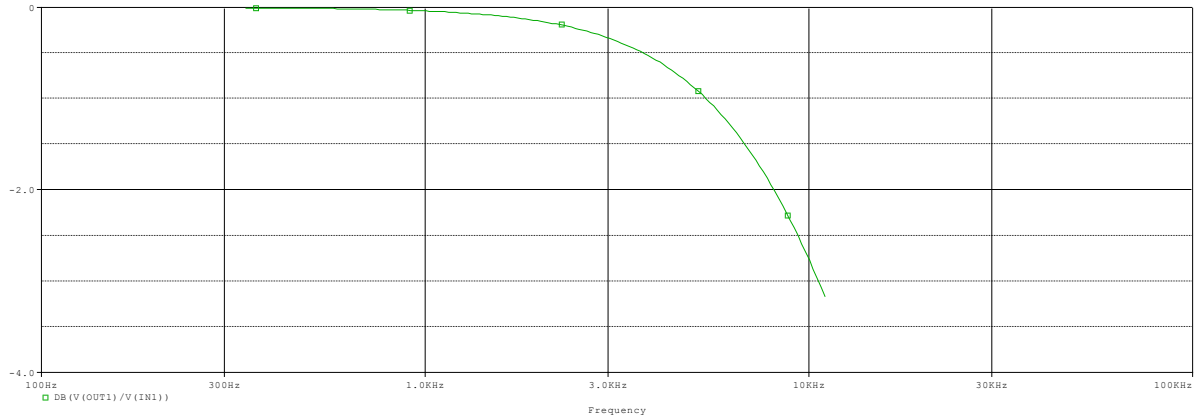


Trace Color	Trace Name	Y1	Y2	Y1 - Y2
	X Values	400.709u	0.000	400.709u
CURSOR 2	V(R2:2)	11.930m	-405.765u	12.336m
	V(U1B:OUT)	368.788m	-11.887m	380.675m
	V(R6:2)	9.4878	-285.607m	9.773
CURSOR 1	V(U5A:+)	9.3336	1.2757u	9.3336

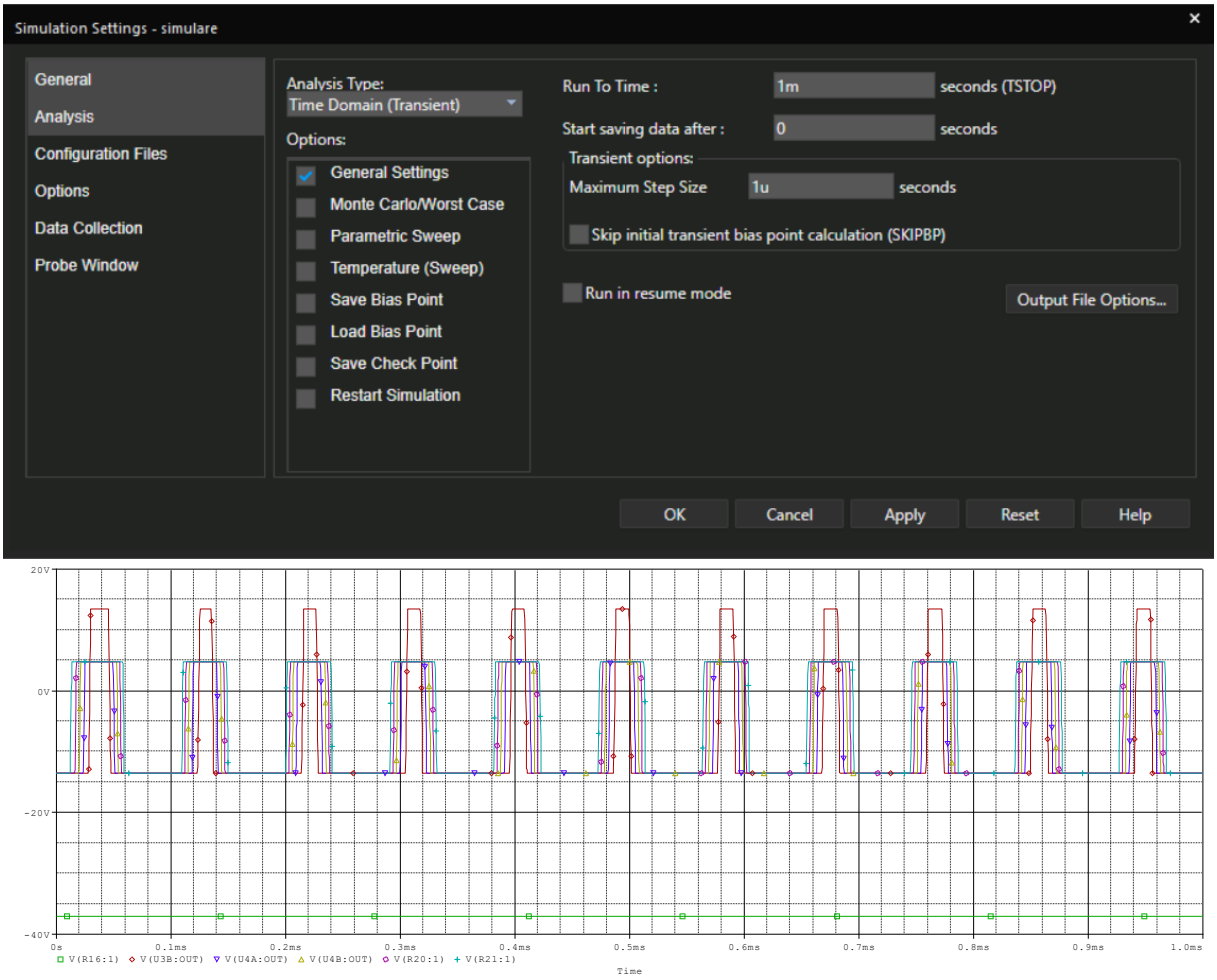
Analiza AC SWEEP pentru diagramele bode




-0.0
-1.0
-2.0
-3.0
100Hz
300Hz
1.0KHz
3.0KHz
10KHz
30KHz
100KHz
DB(V(OUT)/V(IN))
Frequency


0
-2.0
-4.0
100Hz
300Hz
1.0KHz
3.0KHz
10KHz
30KHz
100KHz
DB(V(OUT1)/V(IN1))
Frequency

Anzaliza pentru a vizualiza comportamentul diodelor in timp.



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- Curs „Circuite electronice fundamentale” – Pop Ovidiu Aurel
- Curs „Dispozitive electronice” – Pop Ovidiu Aurel
- https://www.tme.eu/ro/katalog/led-uri_100684/?s_order=desc&search=LED&s_field=1000011
- https://www.tme.eu/ro/katalog/rezistente_100299/?s_order=desc&search=rezistente&s_field=1000011