UNIVERSITATEA POLITEHNICA DIN BUCUREȘTI

ORGĂ DE LUMINI CU LED-URI

Studenți:

Frunză Vladimir, 423B

Roncea Teodor Virgil, 423B

Coordonator: Prof. Dr. Ing. Norocel Dragoș Codreanu

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Facultatea de Electronică, Telecomunicații și Tehnologia Informației

Departamentul de Electronică Tehnologică și Tehnici de Interconectare

CUPRINS

I. Date initiale de proiectare

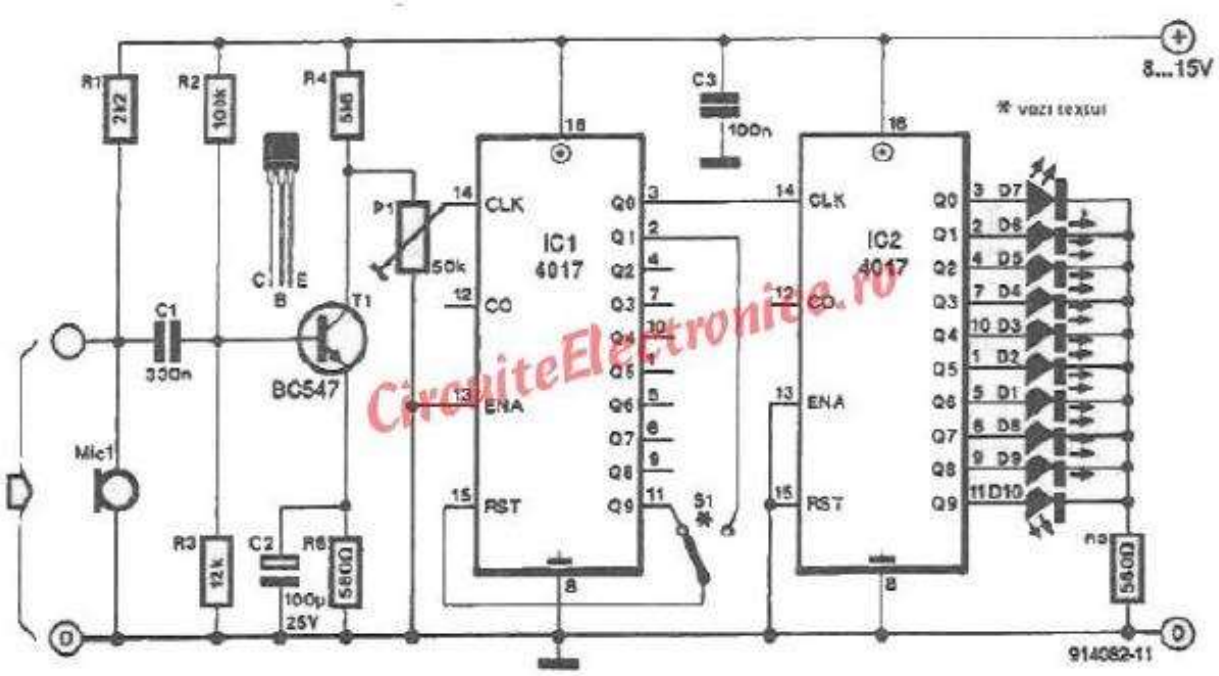
Scopul proiectului de fata este de a realiza design-ul PCB al unei orgi de lumini cu LED-uri, conform unei scheme electrice si ai unor parametrii dati. Orga de lumini este realizata din mai multe blocuri functionale: captare semnal, amplificare semnal, reglare sensibilitate, divizor de frecventa si baterie de LED-uri.

PCB-ul o sa fie realizat din doua straturi electrice, TOP si BOTTOM. Toate componentele electrice vor fi plasate pe stratul TOP, traseele de semnal vor avea latimea de 0.5 mm, traseele de alimentare vor avea latimea de 0.9 mm, conexiunea cu masa se va realiza prin intermediul unor trasee de putere individuale, iar spatierea in toate cazurile va fi de 0.35 mm.

Placa va fi una dreptunghiulara cu latimea de 45 mm si lungimea de 75 mm, se vor plasa trei gauri de prindere nemetalizate cu un diametru de 3.2mm. Fiecare gaura se va afla la o distanta de 2M de coltul in care a fost plasat. Constrangerile de proiectare se pot vedea in ANEXA 2, randul 8.

In capitolele ce urmeaza se va prezenta o scurta descriere a circuitului, schema electrica echivalenta in programul OrCAD Capture si straturile electrice si non-electrice ale PCB-ului.

Schema electrica de realizat:



II. Descriere a functionarii schemei proiectate

a. Explicatie la nivel general:

Circuitul din schema prezentata este al unei orgi de lumini cu LED-uri. Orga noastra produce jocul de lumini prin prelucrarea si “interpretarea” sunetelor prezente in mediul inconjurator.

Sunetele primite de microfon si amplificate de perechea preamplificator-amplificator au frecvente mult prea mari pentru a produce efecte vizibile. Vom utiliza doua numaratoare Johnson cascadate pe post de divizor de frecventa si vom reduce frecventa semnalului pana la un nivel la care jocurile de lumina or sa fie perceptibile vederii umane. Semnalul sonor primit de la amplificator va servi drept semnal de clock pentru primul circuit integrat. Cu ajutorul intrerupatorului SPDT vom alege in ce masura vom diviza frecventa de intrare.

b. Explicatie pe blocuri structurale:

Sunetul este transformat din simple vibratii in semnale electrice prin intermediul unui microfon tip electret, care prin variatia capacitatii stocate intre cele doua diafragme ale sale va genera semnalele electrice necesare prelucrarii.

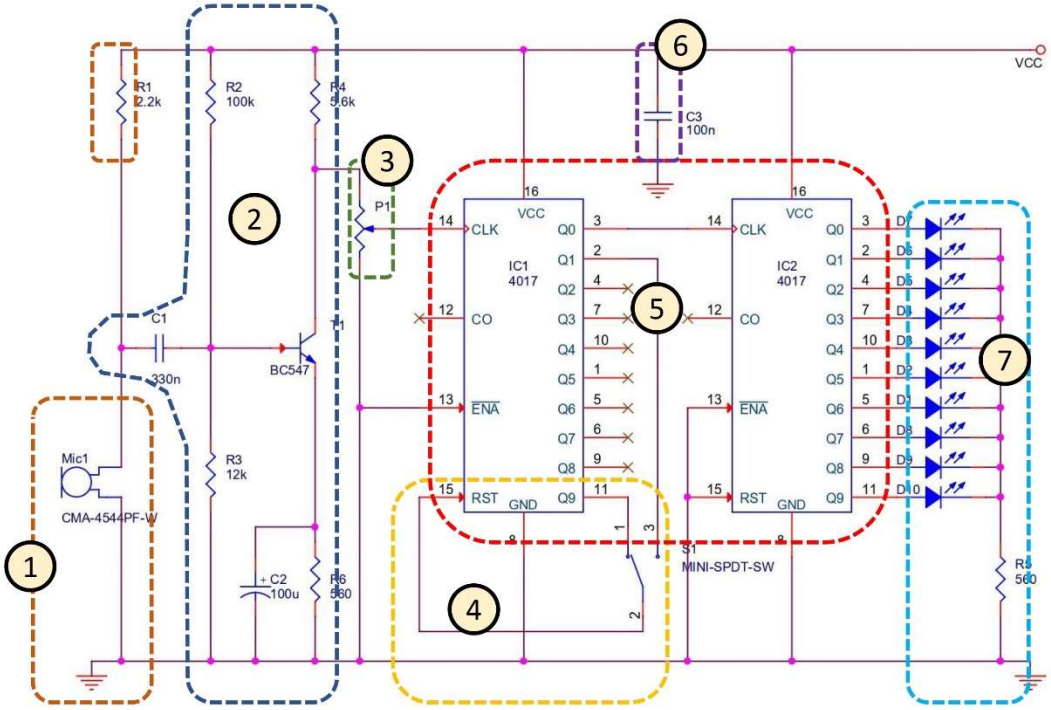
Amplitudinea semnalului de iesire este foarte mica, de ordinul catorva zeci de microvolti. In interiorul capsulei comerciale este introdus un preamplificator simplu format dintr-un N-JFET. Cu ajutorul rezistorului R1 vom forma un amplificator sursa-comuna si defazaj 180 deg.

Pentru a ajunge la voltaje ce se pot considera logic HIGH vom introduce in circuit un amplificator emitor comun ce va amplifica semnalul la niveluri adecvate si va elimina defazajul de faza introdus de preamplificator.

Potentiometrul controleaza sensibilitatea circuitului la amplitudinea semnalului sonor,actionand ca un divizor de potential. Potentiometrul controleaza offset voltageul DC provenit de la VCC, asupra caruia este supraimpus semnalul AC amplificat.

Blocul divizor de frecventa reduce frecventa semnalului pentru a putea percepe in randul ledurilor un efect vizibil.

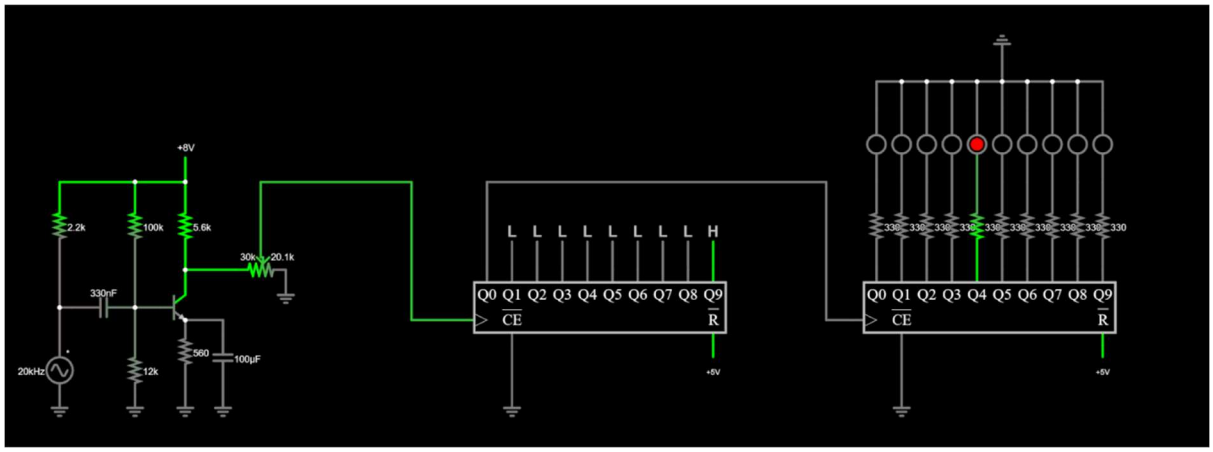
c. Ilustratie blocuri structurale:



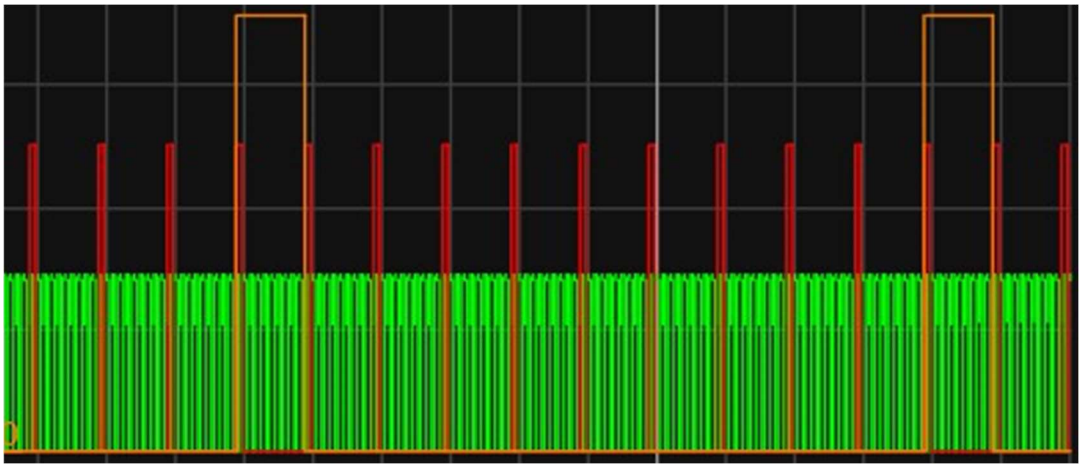
1. **Microfon și rețea de polarizare**
2. **Amplificator emitor-comun cu degenerare în emitor și polarizare tip grilă**
3. **Potențiometru pentru control sensibilitate**
4. **Selector factor de divizare frecvență**
5. **Divizor de frecvență**
6. **Condensator de decuplare**
7. **Baterie de LED-uri și rezistor limitator de curent**

d. Simulare functionalitate:

Schema electrica simplificata a circuitului a fost simulata cu ajutorul falstad.com pentru a mai bine intelege comportamentul circuitului si a vizualiza intr-o maniera facila oscilatia ledurilor.



Rezultatele simularii sunt prezentate mai jos:

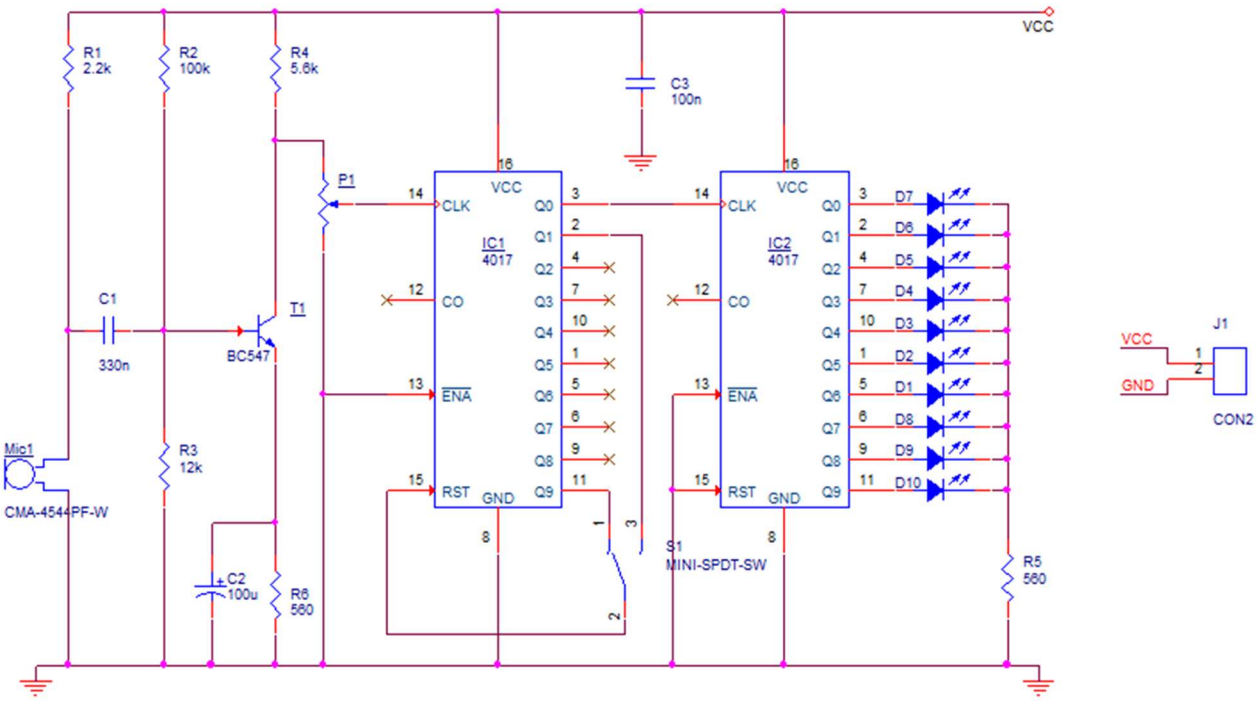


In **verde**, semnalul sinusoidal amplificat ce serveste drept clock pentru primul IC

In **rosu**, semnalul portului Q0 al primului IC ce prezinta reducerea in frecventa cu un factor de 10

In **portocaliu**, semnalul portului Q0 al celui de-al doilea IC prezinta reducerea in frecventa cu un factor de 100, semnalul va tine LED-ul deschis pana cand primul numarator se va reseta.

III. Schema Electrica



Institutie: *ETTI, UPB*	*2023/SEM2*
Lucrare: *Proiect Final TIE, P10, "Orga de lumini cu LED-uri"*	
Profesor coordonator: *Prof. Dr. Ing. Norocel Dragos Codreanu*	
Studenti: *Frunza Vladimir, 423B, T10*	*Roncea Teodor-Virgil, 423B, T10*

IV. Design Rules Check (DRC)

Date and Time : 06/07/23 21:48:02

Checking Schematic: SCHEMATIC1

Checking Electrical Rules

Checking For Single Node Nets

Checking For Unconnected Bus Nets

V. Cross Reference

Design Name: D:\PROIECT_TIE\PROIECT\PROIECT FINAL TIE.DSN

Cross Reference June 7,2023 21:41:22 Page1

Item	Part	Reference	SchematicName	Sheet	Library
1	2.2k	R1	SCHEMATIC1/PAGE1	0	E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB
2	5.6k	R4	SCHEMATIC1/PAGE1	0	E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB
3	12k	R3	SCHEMATIC1/PAGE1	0	E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB
4	100k	R2	SCHEMATIC1/PAGE1	0	E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB
5	100n	C3	SCHEMATIC1/PAGE1	0	E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB
6	100u	C2	SCHEMATIC1/PAGE1	0	E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB
7	330n	C1	SCHEMATIC1/PAGE1	0	E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB
8	560	R5	SCHEMATIC1/PAGE1	0	E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB
9	560	R6	SCHEMATIC1/PAGE1	0	E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB
10	4017	IC1	SCHEMATIC1/PAGE1	0	E:\CHESTII DE LE FAC LA TCAD\PROIECT FINAL TIE.DSN

11 4017 IC2 SCHEMATIC1/PAGE1 0

E:\CHESTII DE LE FAC LA TCAD\PROIECT FINAL TIE.DSN

12 BC547 T1 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\TRANSISTOR.OLB

13 CMA-4544PF-W Mic1 SCHEMATIC1/PAGE1 0

D:\PROIECT_TIE\PROIECT\CMA-4544PF-W.OLB

14 CON2 J1 SCHEMATIC1/PAGE1 0

D:\PROIECT_TIE\PROIECT\PROIECT FINAL TIE.DSN

15 LED D1 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB

16 LED D2 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB

17 LED D3 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB

18 LED D4 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB

19 LED D5 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB

20 LED D6 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB

21 LED D7 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB

22 LED D8 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB

23 LED D9 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB

24 LED D10 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB

25 MINI-SPDT-SW S1 SCHEMATIC1/PAGE1 0

D:\PROIECT_TIE\MINI-SPDT-SW\MINI-SPDT-SW.OLB

26 POT P1 SCHEMATIC1/PAGE1 0
E:\TCAD\TOOLS\CAPTURE\LIBRARY\DISCRETE.OLB

VI. Bill of Materials (BOM)

Nr.curent	Cantitate	Referinta	Componenta	Descriere	Montare	Capsula	Producator	Distribuitor	Cod produs	Pret pe bucata (RON)	Cantitate minima	Pret comanda (RON)
1	1	C1	330n	Multilayer Ceramic Capacitors MLCC - SMD/SMT 50V 0.33uF X7R 1206 10%	SMT	SMC1206	KEMET	https://ro.mouser.com/	C1206C334K5REC7210	1.58	1	1.58
2	1	C2	100u	Aluminium Electrolytic Capacitors - Radial Leaded LOW IMPEDANCE ELECTROLYTIC CAPACITORS	THT	CAP196	Rubycon	https://ro.mouser.com/	16ZLH100MEFC5X11	1.63	1	1.63
3	1	C3	100n	Multilayer Ceramic Capacitors MLCC - SMD/SMT WCAP-CSST 1206 100nF 10% 100VDC	SMT	SMC1206	Wurth Elektronik	https://ro.mouser.com/	885382208006	1.58	1	1.58
4	10	D1,D2,D3,D4,D5, D6,D7,D8,D9,D10	LED	LED, Low Power, Red, SMD, 0805 [2012 Metric], 20 mA, 2 V, 617 nm	SMT	SML0805	Kingbright	https://ro.farnell.com/	KP-2012EC	0,8687	5	8.69
5	2	IC1,IC2	4017	Counter ICs 10 Decade/Divider	SMT	SOIC16	TI	https://ro.mouser.com/	CD4017BNSR	4.51	1	9.02
6	1	J1	CON2	TERM BLK 2P SIDE ENT 2.54MM PCB	THT	JUMPER2	TE Connectivity	https://www.digikey.ro/	282834-2	6.36	1	6.36
7	1	Mic1	CMA-4544PF-W	MIC COND ANLG OMNI -44DB 0.382"D	THT	MIC_CMA-4544PF-W	CUI Devices	https://www.digikey.ro/	CMA-4544PF-W	3.6	1	3.6
8	1	P1	POT	Trimmer Resistors - Through Hole 50Kohms 10mm Rnd Top adj Steel Lead	THT	POT	Amphenol	https://ro.mouser.com/	PT10LV10-503A2020-S	2.62	1	2.62
9	1	R1	2.2k	Thick Film Resistors - SMD 1206 5% 2.2Kohm Anti-Sulfur AEC-Q200	THT	SMD1206	Panasonic	https://ro.mouser.com/	ERJ-U08J222V	0.89	1	0.89
10	1	R2	100k	Thick Film Resistors - SMD ResPowerQ 1206 100k 1% 1/2W TC100	THT	SMD1206	Bourns	https://ro.mouser.com/	CRM1206QFX-1003ELF	1.02	1	1.02
11	1	R3	12k	Thick Film Resistors - SMD 1206 12Kohm 1% Anti Surge AEC-Q200	THT	SMD1206	ROHM Semicond.	https://ro.mouser.com/	ESR18EZPF1202	0.79	1	0.79
12	1	R4	5.6k	Thick Film Resistors - SMD 1206 5.6Kohm 5% High VoltageAEC-Q200	THT	SMD1206	ROHM Semicond.	https://ro.mouser.com/	KTR18EZPJ562	0.74	1	0.74
13	2	R5,R6	560	Thick Film Resistors - SMD 1/4Watt 560ohms 1% Commercial Use	THT	SMD1206	Vishay	https://ro.mouser.com/	CRCW1206560RFKEAC	0.51	1	1.02
14	1	S1	MINI-SPDT-SW	Slide Switches MINI SPDT SWITCH	THT	MINI-SPDT-SW	Gravitech	https://ro.mouser.com/	SW_MINI-SPDT-SW	14.6	1	14.6
15	1	T1	BC547	Bipolar Transistors - BJT NPN 45V 100mA HFE/45	THT	TO92	Fairchild	https://ro.mouser.com/	BC547B	2.19	1	2.19

* Foile de catalog pentru CD4017, BC547B si CMA-45544PF-W sunt prezentate intr-o forma scurtata in ANEXELE:

** Foile de catalog pentru toate componentele se gasesc in forma lor completa pe stcikul usb

*** In estimarea costului total nu sunt incluse taxele de livrare

Total (RON): **56.33**

VI. Wire List

Wire List

Revised: Wednesday, June 07, 2023

C:\USERS\VLADY\DESKTOP\PROIECT\PROIECT FINAL TRevision:

<<< Component List >>>

330n	C1	SMC1206
100u	C2	CAP196
100n	C3	SMC1206
LED	D1	SML0805
LED	D10	SML0805
LED	D2	SML0805
LED	D3	SML0805
LED	D4	SML0805
LED	D5	SML0805
LED	D6	SML0805
LED	D7	SML0805
LED	D8	SML0805
LED	D9	SML0805
4017	IC1	SOIC16
4017	IC2	SOIC16
CON2	J1	JUMPER2
CMA-4544PF-W	Mic1	MIC_CMA-4544PF-W
POT	P1	POT
2.2k	R1	SMD120612

100k R2 SMD120612

12k R3 SMD120612

5.6k R4 SMD120612

560 R5 SMD120612

560 R6 SMD120612

MINI-SPDT-SW S1 SW_MINI-SPDT-SW

BC547 T1 TO92

<<< Wire List >>>

NODE	REFERENCE	PIN #	PIN NAME	PIN TYPE	PART VALUE
[00001] GND					
	R3	2	2	Passive	12k
	R5	2	2	Passive	560
	R6	2	2	Passive	560
	C2	2	2	Passive	100u
	C3	2	2	Passive	100n
	P1	3	B	Passive	POT
	IC2	13	E\N\A\	Input	4017
	IC2	15	RST	Input	4017
	IC2	8	GND	Power	4017
	IC1	13	E\N\A\	Input	4017
	IC1	8	GND	Power	4017
	J1	2	2	Power	CON2
	Mic1	2	GND	Power	CMA-4544PF-W

[00002] N0043710

IC2 6 Q7 Output 4017

D8 1 ANODE Passive LED

[00003] N0043711

IC2 9 Q8 Output 4017

D9 1 ANODE Passive LED

[00004] N0043712

IC2 11 Q9 Output 4017

D10 1 ANODE Passive LED

[00005] N004373

IC2 3 Q0 Output 4017

D7 1 ANODE Passive LED

[00006] N004374

IC2 2 Q1 Output 4017

D6 1 ANODE Passive LED

[00007] N004375

IC2 4 Q2 Output 4017

D5 1 ANODE Passive LED

[00008] N004376

IC2 7 Q3 Output 4017

D4 1 ANODE Passive LED

[00009] N004377

IC2 10 Q4 Output 4017

D3 1 ANODE Passive LED

[00010] N004378

IC2 1 Q5 Output 4017

D2 1 ANODE Passive LED

[00011] N004379

IC2 5 Q6 Output 4017

D1 1 ANODE Passive LED

[00012] N01138

R5 1 1 Passive 560

D1 2 CATHODE Passive LED

D2 2 CATHODE Passive LED

D3 2 CATHODE Passive LED

D4 2 CATHODE Passive LED

D5 2 CATHODE Passive LED

D6 2 CATHODE Passive LED

D7 2 CATHODE Passive LED

D8 2 CATHODE Passive LED

D9 2 CATHODE Passive LED

D10 2 CATHODE Passive LED

[00013] N02847

IC2 14 CLK Input 4017

IC1 3 Q0 Output 4017

[00014] N02937

IC1	11	Q9	Output	4017
S1	1	1	Passive	MINI-SPDT-SW

[00015] N02945

IC1	2	Q1	Output	4017
S1	3	3	Passive	MINI-SPDT-SW

[00016] N03485

IC1	15	RST	Input	4017
S1	2	2	Passive	MINI-SPDT-SW

[00017] N03522

P1	2	WIPER	Passive	POT
IC1	14	CLK	Input	4017

[00018] N04274

R4	2	2	Passive	5.6k
T1	3	COLLECTOR	Passive	BC547
P1	1	A	Passive	POT

[00019] N04307

R6	1	1	Passive	560
C2	1	1	Passive	100u
T1	1	EMITTER	Passive	BC547

[00020] N04445

R2	2	2	Passive	100k
R3	1	1	Passive	12k
C1	1	1	Passive	330n
T1	2	BASE	Input	BC547

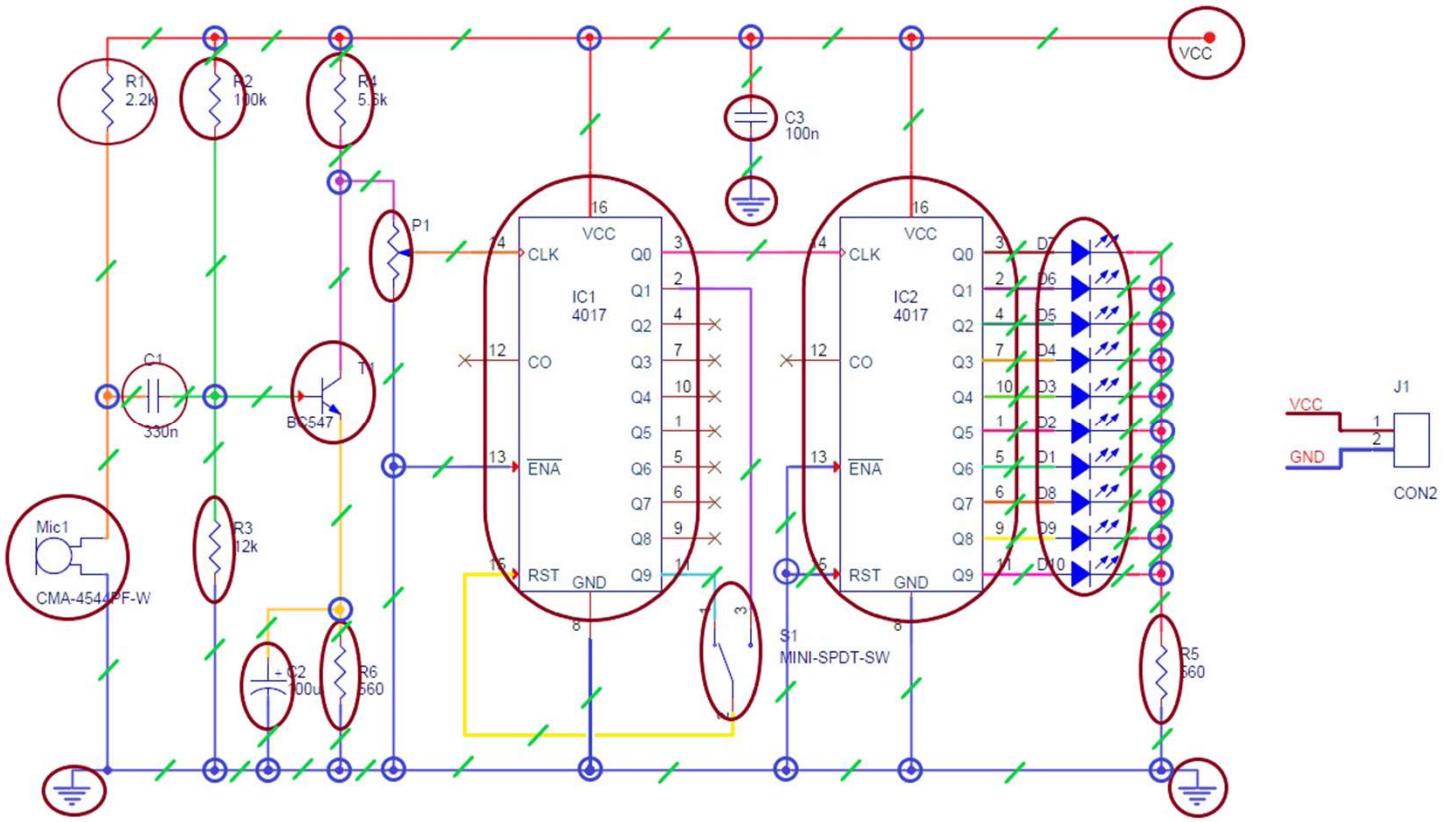
[00021] N04471

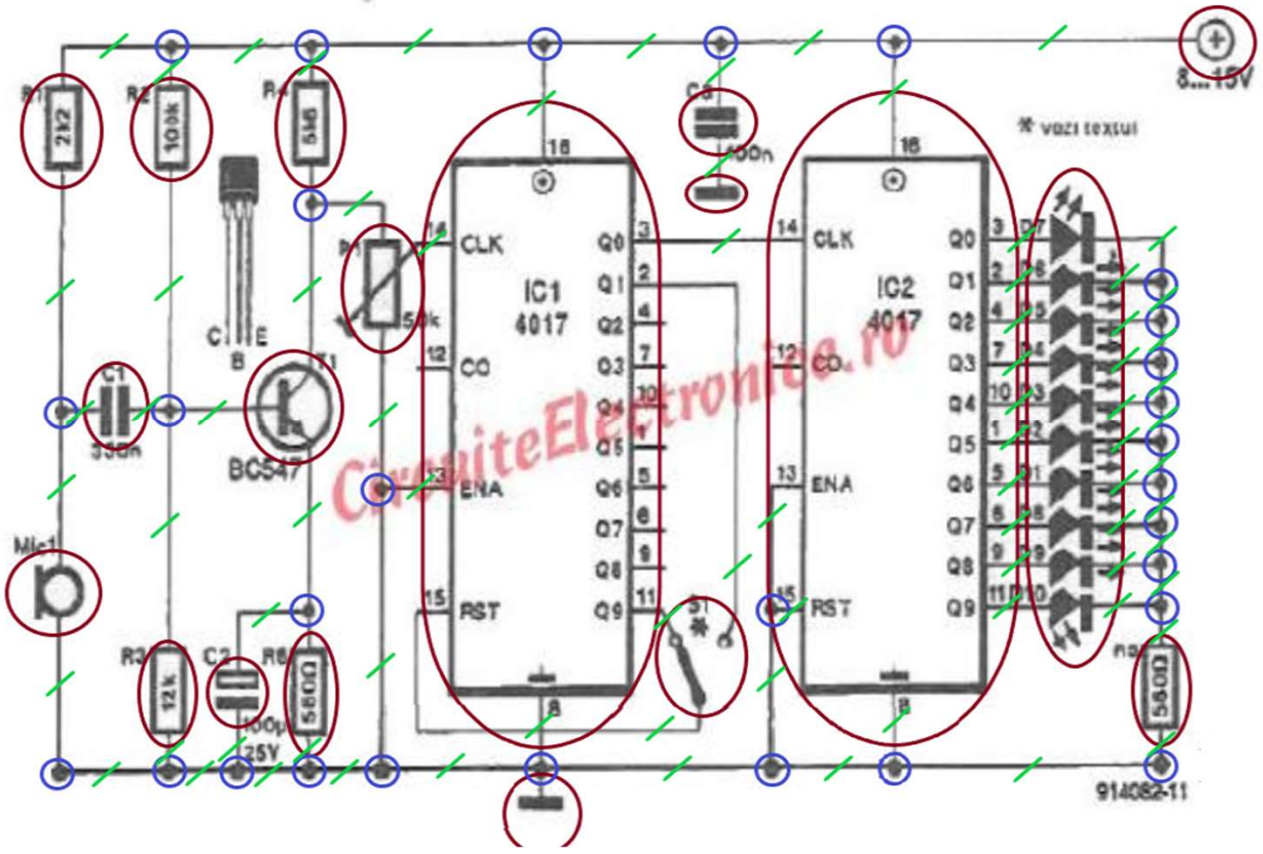
R1	2	2	Passive	2.2k
C1	2	2	Passive	330n
Mic1	1	OUT	Output	CMA-4544PF-W

[00022] VCC

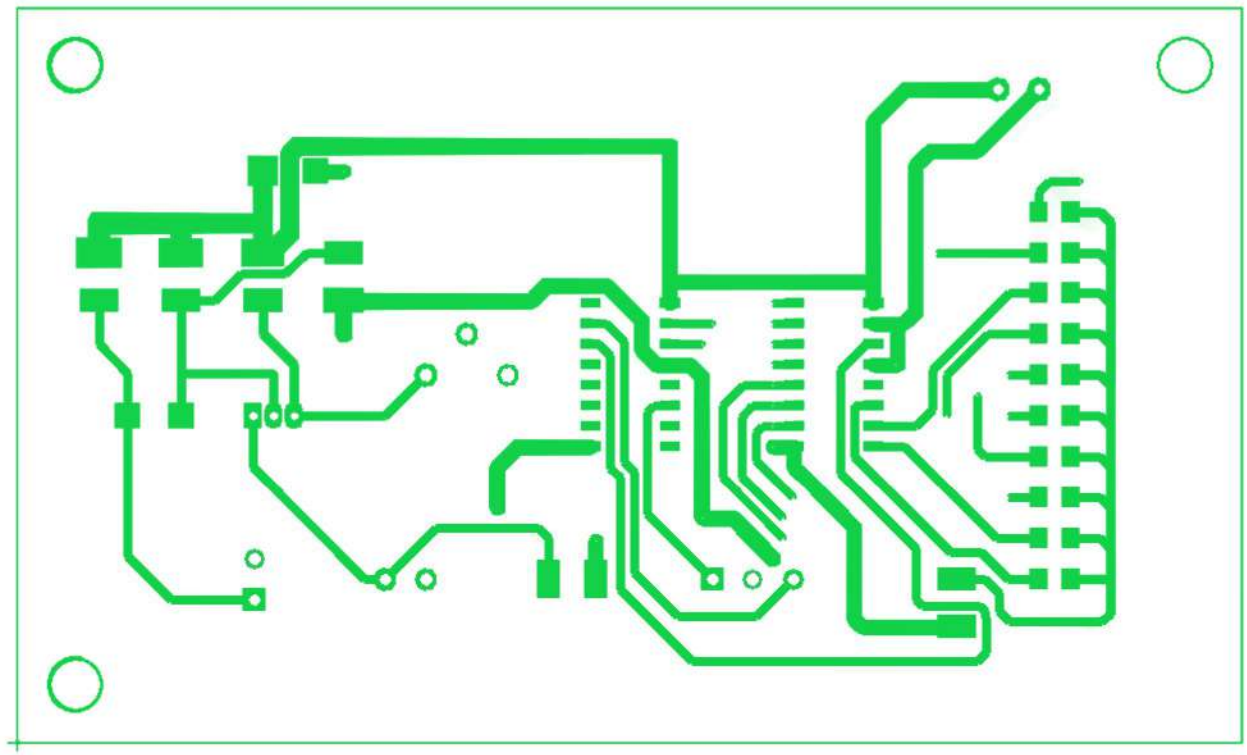
R1	1	1	Passive	2.2k
R2	1	1	Passive	100k
R4	1	1	Passive	5.6k
C3	1	1	Passive	100n
IC2	16	VCC	Power	4017
IC1	16	VCC	Power	4017
J1	1	1	Power	CON2

VIII. Verificarea net-urilor





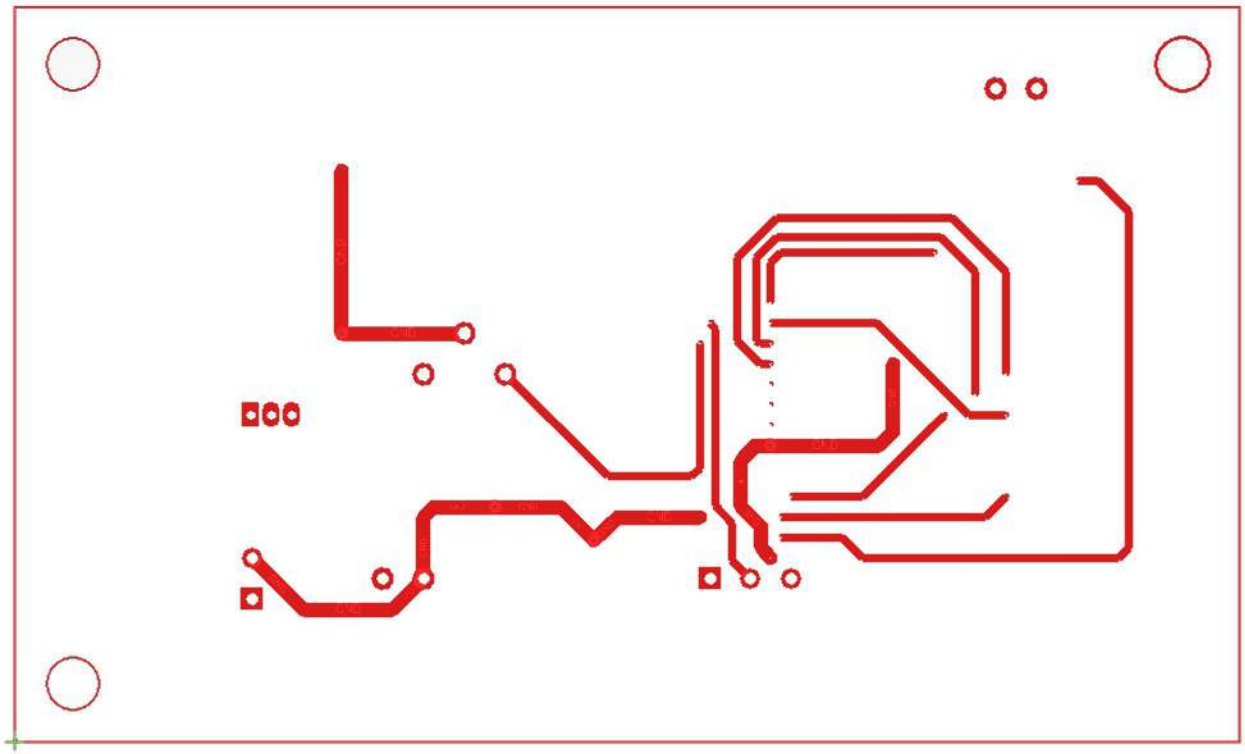
IX. TOP Layer



**Conturul placii nu face parte din layer, ci a fost adaugat drept referinta.*

Rotatia: 0
Scara: 2:1
Revizia: 1

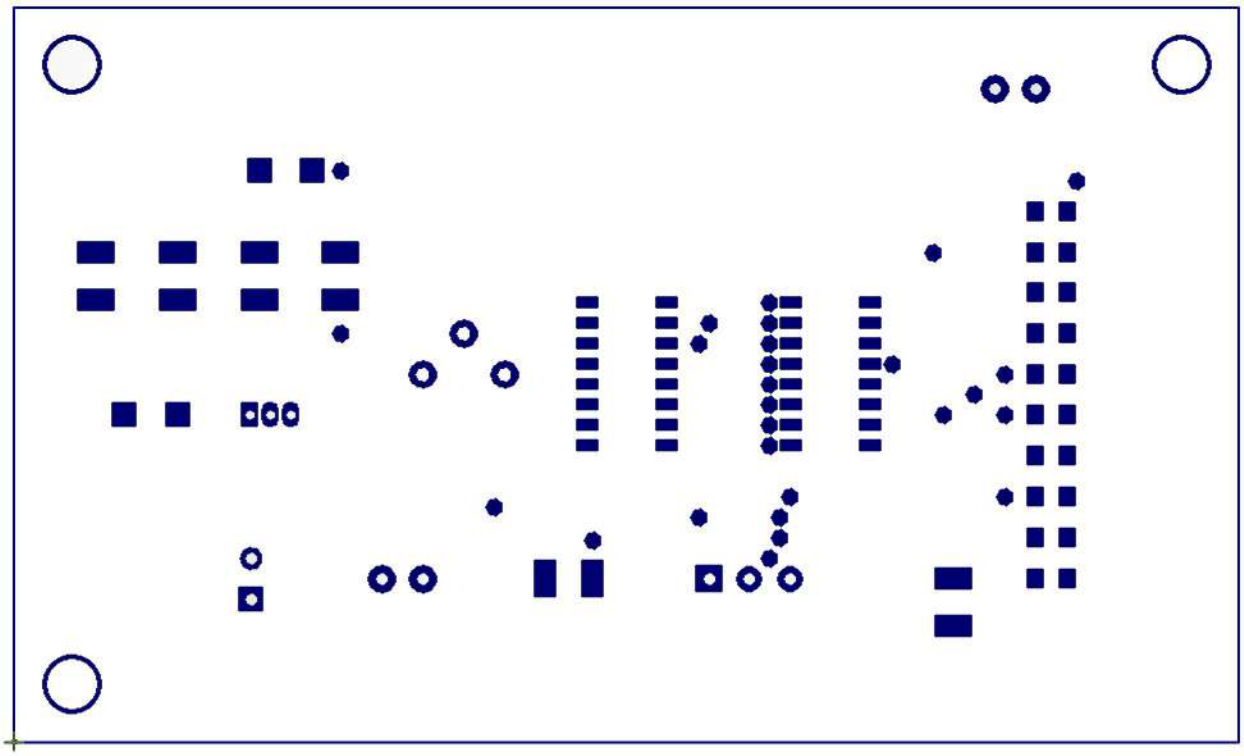
X. BOTTOM Layer



**Conturul placii nu face parte din layer, ci a fost adaugat drept referinta.*

Rotatia: 0
Scara: 2:1
Revizia: 1

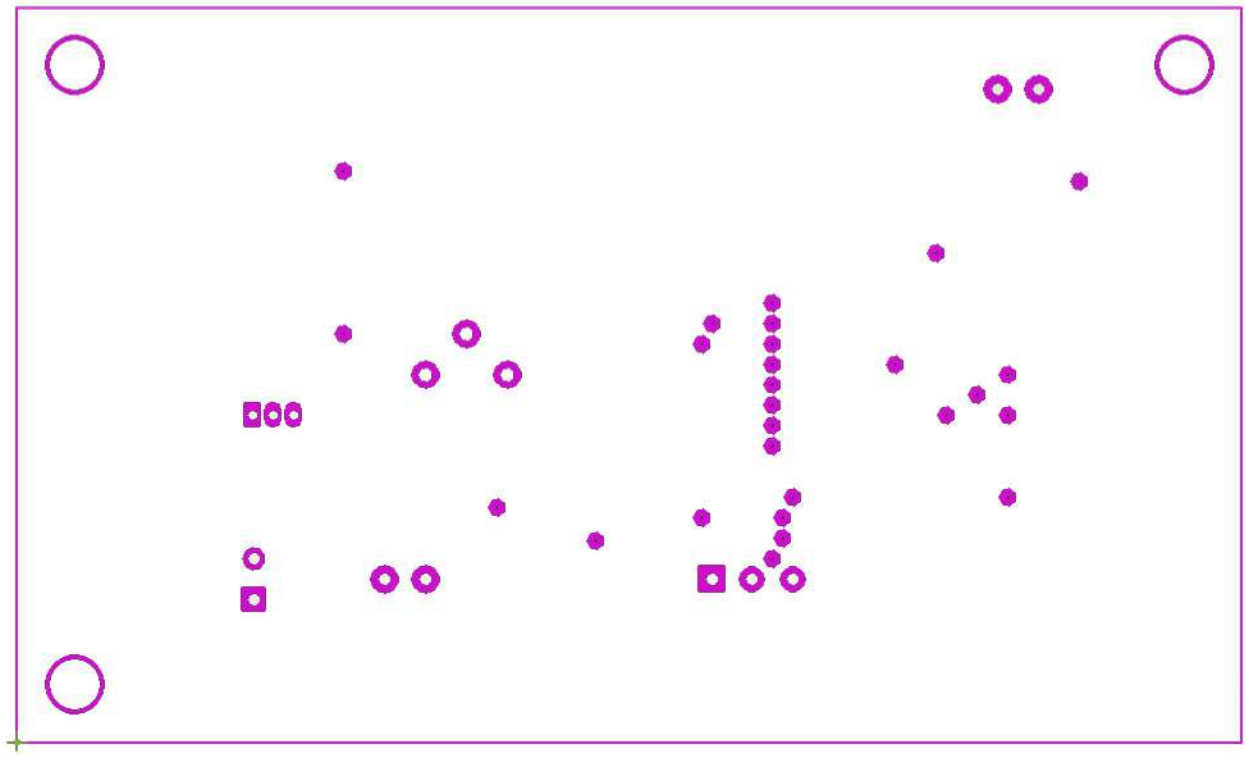
XI. Soldermask TOP Layer



**Conturul placii nu face parte din layer, ci a fost adaugat drept referinta.*

Rotatia: 0
Scara: 2:1
Revizia: 1

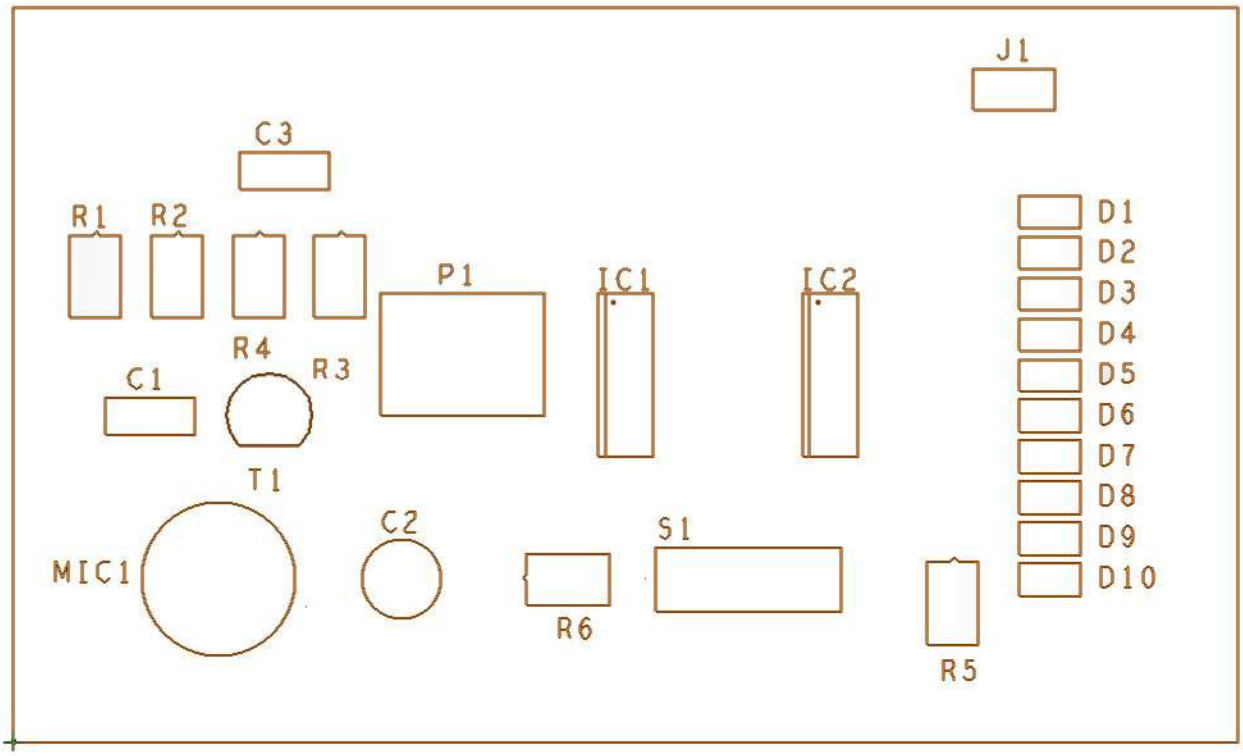
XII. Soldermask BOTTOM Layer



**Conturul placii nu face parte din layer, ci a fost adaugat drept referinta.*

Rotatia: 0
Scara: 2:1
Revizia: 1

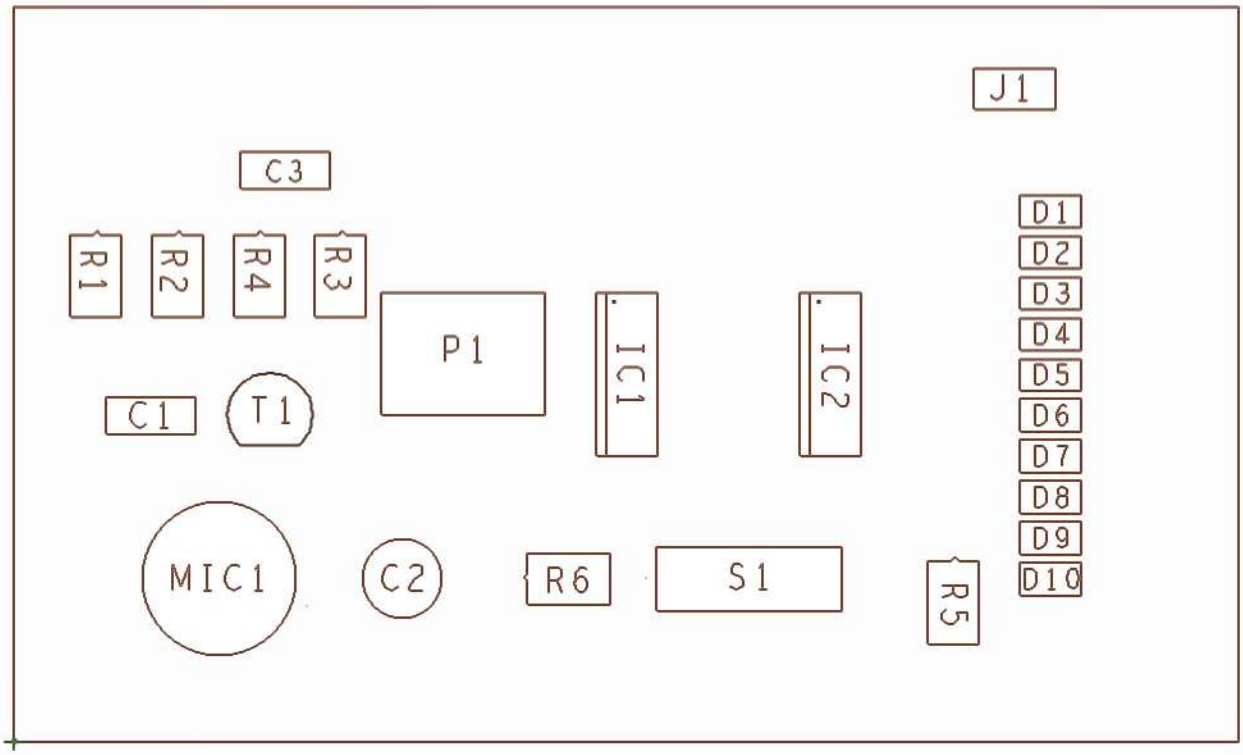
XIII. Silkscreen TOP Layer



**Conturul placii nu face parte din layer, ci a fost adaugat drept referinta.*

Rotatia: 0
Scara: 2:1
Revizia: 1

XIV. Assembly TOP Layer

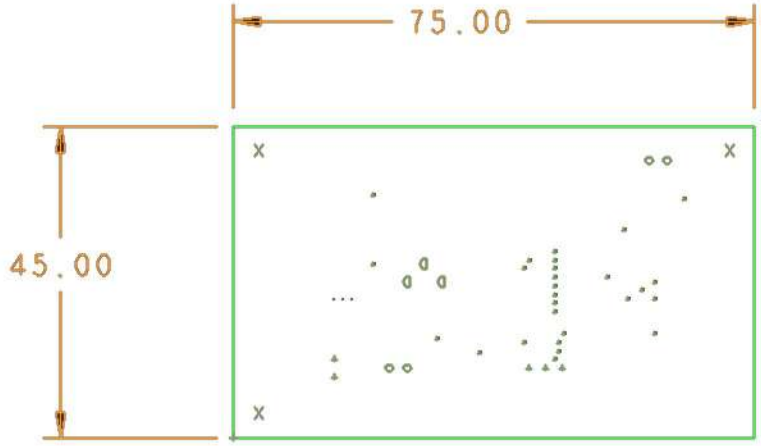


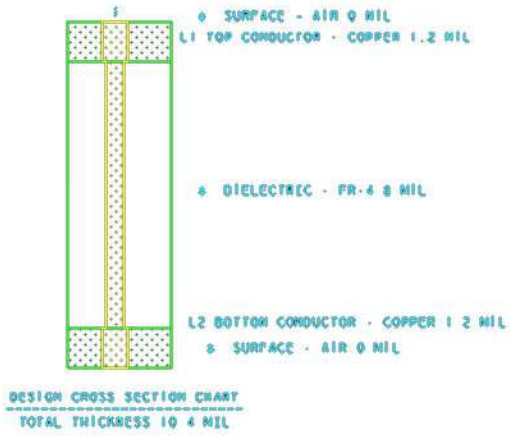
**Conturul placii nu face parte din layer, ci a fost adaugat drept referinta.*

Rotatia: 0
Scara: 2:1
Revizia: 1

XV. Fabrication Layer

DRILL CHART: TOP to BOTTOM			
ALL UNITS ARE IN MILS			
FIGURE	FINISHED_SIZE	PLATED	QTY
•	13.0	PLATED	27
·	31.0	PLATED	3
+	34.25	PLATED	2
+	35.43	PLATED	3
○	36.0	PLATED	4
◎	42.0	PLATED	3
X	128.0	NON-PLATED	3





**Conturul placii nu face parte din layer, ci a fost adaugat drept referinta.*

Rotatia: 0
Scara: 1:1
Revizia: 1

XVI. Concluzii

În procesul de dezvoltare a acestui proiect, ne-am confruntat cu diverse provocări frecvent întâlnite în industria designului de PCB-uri. După numeroase ore de muncă investite, am ajuns amândoi la concluzia că un inginer trebuie să fie mereu pregătit să înfrunte orice obstacol, de la propriile limitări de cunoștințe legate de rezolvarea task-urilor, până la problemele ce pot apărea în utilizarea software-ului sau dificultățile în îndeplinirea anumitor cerințe impuse de proiect.

Am împărțit sarcinile astfel: Vladimir s-a concentrat pe proiectarea schemei electrice și a identificat capsulele potrivite pentru componente, în timp ce Teodor s-a ocupat de plasarea componentelor și rutarea efectivă a circuitelor de cupru pe PCB, totodată respectând cerințele impuse. La final, amândoi am contribuit la finalizarea, curățarea și îmbunătățirea produsului final, combinându-ne forțele pentru realizarea acestui document.

Pe lângă dobândirea experienței de lucru cu programele din ecosistemul Cadence, am învățat pe parcursul acestei experiențe cât de importantă este atenția la detalii și cât de esențială poate fi organizarea și planificarea înainte de începerea unui proiect mai complex. De asemenea, am realizat că o colaborare eficientă între toți membrii care lucrează la același proiect este absolut crucială pentru eficiența muncii și calitatea produsului final.

XVII. Bibliografie

- Functionare si best practices pentru microfoane de tip electret:

  https://www.ti.com/lit/ug/tidu765/tidu765.pdf

- Introducere facila a utilizarii circuitului integrat CD4017:

  https://www.build-electronic-circuits.com/4000-series-integrated-circuits/ic-4017/

- Sursa footprint-uri PCB:

  https://www.snapeda.com/

ANEXA 1

Utilizand circuitul CMOS 4017 si cateva component electronice passive, poate fi realizata o orga de lumini cu Led-uri. Aceasta orga de lumen cu LED-uri este comandata de un semnal ce este preluat cu ajutorul unui microfon.

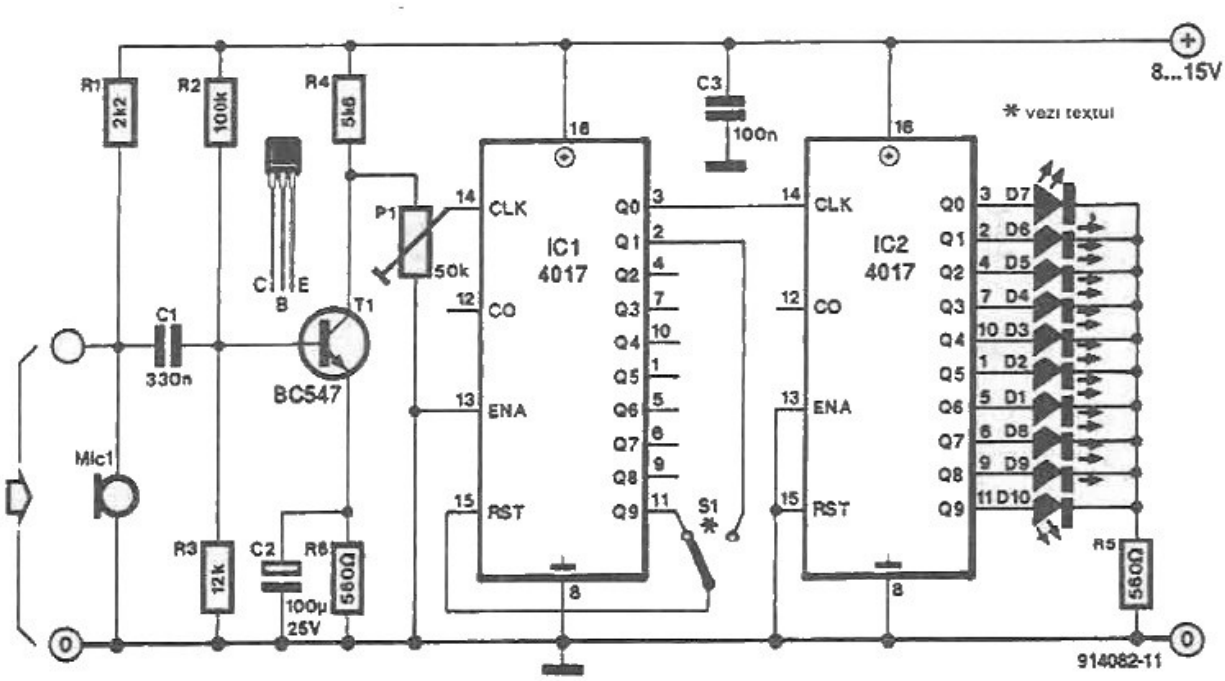
Viteza de deplasare a luminii depinde de frecventa si intensitatea sunetului.
Semnalul se aplica la intrarea de tact a numaratorului IC1 printr-un amplificator cu un singur tranzistor, T1.

Dupa amplificare, semnalul este aplicat la IC1, prin P1, care controleaza sensibilitatea circuitului. Deoarece frecventele audio sunt prea mari pentru a produce un efect vizual de calitate, frecventa semnalului este demultiplicata cu IC1 atunci cand S1 conecteaza pinul 11 cu pinul 15.

Din cele zece iesiri ale lui IC2, fiecare cuplata la cate un LED, exista intotdeauna una in starea 1.

Sursa de alimentare trebuie sa poata furniza un curent de pana la 100 mA.

Schema Electronica:



ANEXA 2

Specificatii si valori pentru proiect

Echipa ("Team")	2.3 [mm]	2.4 [mm]	2.5 [mm]	3.1, 3.2: forma şi dimensiunile plăcii [mm] & info cu privire la găurile de prindere (g.p.)
1	0,2	1,2	0,40	Dreptunghi, 70x50, cu 3 g.p. în 3 colţuri, plasate la 2 M distanţă de colţuri*
2	0,3	1,1	0,35	Dreptunghi, 70x55, cu 4 g.p. în cele 4 colţuri, plasate la 1,5 M distanţă de colţuri*
3	0,4	1,0	0,25	Dreptunghi, 70x60, cu 2 g.p. în 2 colţuri pe diagonală, plasate la 1,5 M distanţă de colţuri*
4	0,5	0,9	0,40	Pătrat, 65x65, cu 4 g.p. în cele 4 colţuri, plasate la 2 M distanţă de colţuri*
5	0,2	1,2	0,35	Pătrat, 50x50, cu 2 g.p. în 2 colţuri pe diagonală, plasate la 2 M distanţă de colţuri*
6	0,3	1,1	0,25	Pătrat, 60x60, cu 3 g.p. în 3 colţuri, plasate la 1,5 M distanţă de colţuri*
7	0,4	1,0	0,40	Dreptunghi, 65x55, cu 4 g.p. în cele 4 colţuri, plasate la 1,5 M distanţă de colţuri*
8	0,5	0,9	0,35	Dreptunghi, 75x45, cu 3 g.p. în 3 colţuri, plasate la 2 M distanţă de colţuri*
9	0,2	1,2	0,25	Dreptunghi, 70x55, cu 2 g.p. în 2 colţuri pe diagonală, plasate la 2 M distanţă de colţuri*
10	0,3	1,1	0,40	Pătrat, 70x70, cu 3 g.p. în 3 colţuri, plasate la 2 M distanţă de colţuri*
11	0,4	1,0	0,35	Pătrat, 55x55, cu 4 g.p. în cele 4 colţuri, plasate la 1,5 M distanţă de colţuri*
12	0,5	0,9	0,25	Pătrat, 65x65, cu 2 g.p. în 2 colţuri pe diagonală, plasate la 1,5 M distanţă de colţuri*
13	0,2	1,1	0,40	Dreptunghi, 75x45, cu 2 g.p. în 2 colţuri pe diagonală, plasate la 2 M distanţă de colţuri*
14	0,25	1,2	0,35	Dreptunghi, 75x60, cu 4 g.p. în colţuri, plasate la 2 M distanţă de colţuri*
15	0,35	1,0	0,3	Pătrat, 75X75, cu 3 g.p. în 3 colţuri, plasate la 1,5 M distanţă de colţuri*

*** OBS:** Distanţa față de colț (de fapt, orice distanță în electronică) se calculează pe principiul "centru la centru", deci, în acest caz, "colț la centrul găurii de prindere".

ANEXA 3

TEXAS INSTRUMENTS

Data sheet acquired from Harris Semiconductor
SCHS027C – Revised February 2004

CD4017B, CD4022B Types

CMOS Counter/Dividers

High-Voltage Types (20-Volt Rating)

CD4017B—Decade Counter with 10 Decoded Outputs

CD4022B—Octal Counter with 8 Decoded Outputs

■ CD4017B and CD4022B are 5-stage and 4-stage Johnson counters having 10 and 8 decoded outputs, respectively. Inputs include a CLOCK, a RESET, and a CLOCK INHIBIT signal. Schmitt trigger action in the CLOCK input circuit provides pulse shaping that allows unlimited clock input pulse rise and fall times.

These counters are advanced one count at the positive clock signal transition if the CLOCK INHIBIT signal is low. Counter advancement via the clock line is inhibited when the CLOCK INHIBIT signal is high. A high RESET signal clears the counter to its zero count. Use of the Johnson counter configuration permits high-speed operation, 2-input decode-gating and spike-free decoded outputs. Anti-lock gating is provided, thus assuring proper counting sequence. The decoded outputs are normally low and go high only at their respective decoded time slot. Each decoded output remains high for one full clock cycle. A CARRY-OUT signal completes one cycle every 10 clock input cycles in the CD4017B or every 8 clock input cycles in the CD4022B and is used to ripple-clock the succeeding device in a multi-device counting chain.

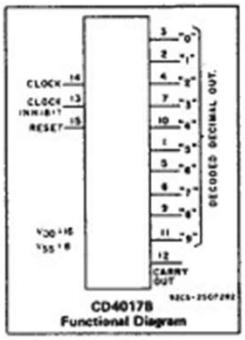
Features:

- Fully static operation
- Medium-speed operation . . . 10 MHz (typ.) at V_{DD} = 10 V
- Standardized, symmetrical output characteristics
- 100% tested for quiescent current at 20 V
- 5-V, 10-V, and 15-V parametric ratings
- Meets all requirements of JEDEC Tentative Standard No. 13A, "Standard Specifications for Description of 'B' Series CMOS Devices"

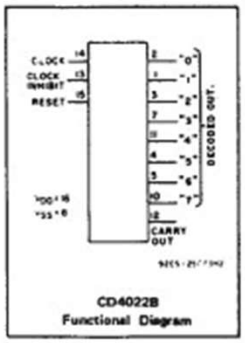
Applications:

- Decode counter/decimal decode display (CD4017B)
- Binary counter/decoder
- Frequency division
- Counter control/timers
- Divide-by-N counting
- For further application information, see ICAN-6166 "COS/MOS MSI Counter and Register Design and Applications"

The CD4017B and CD4022B types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 16-lead dual-in-line plastic package (E suffix), 16-lead small-outline packages (NSR suffix), and 16-lead thin shrink small-outline packages (PW and PWR suffixes). The CD4017B types also are supplied in 16-lead small-outline packages (M and M96 suffixes).



CD4017B
Functional Diagram



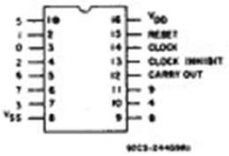
CD4022B
Functional Diagram

RECOMMENDED OPERATING CONDITIONS

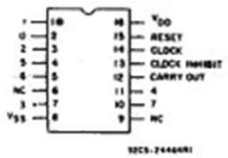
For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTICS	V_{DD} (V)	LIMITS Min.	LIMITS Max.	UNITS
Supply-Voltage Range (For T_A = Full Package-Temperature Range)		3	18	V
Clock Input Frequency, f_{CL}	5	–	2.5	MHz
	10	–	5	
	15	–	5.5	
Clock Pulse Width, t_W	5	200	–	ns
	10	90	–	
	15	60	–	
Clock Rise & Fall Time, t_{rCL}, t_{fCL}	5	UNLIMITED*		
	10			
	15			
Clock Inhibit Setup Time, t_s	5	230	–	ns
	10	100	–	
	15	70	–	
Reset Pulse Width, t_{RW}	5	260	–	ns
	10	110	–	
	15	60	–	
Reset Removal Time, t_{rem}	5	400	–	ns
	10	280	–	
	15	150	–	

*Only if Pin 14 is used as the clock input. If Pin 13 is used as the clock input and Pin 14 is tied high (for advancing count on negative transition of the clock), rise and fall time should be ≤ 15 μs.



TOP VIEW
CD4017B
TERMINAL DIAGRAM



TOP VIEW
NC = no connection
CD4022B
TERMINAL DIAGRAM

3 COMMERCIAL CMOS HIGH VOLTAGE ICs

ANEXA 4

onsemi

DATA SHEET
www.onsemi.com

NPN Epitaxial Silicon Transistor
BC546 / BC547 / BC548 / BC549 / BC550

TO−92
CASE 135AN

TO−92
CASE 135AR

1. Collector 2. Base 3. Emitter

Features

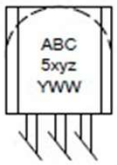
- Switching and Amplifier
- High−Voltage: BC546, V_{CEO} = 65 V
- Low−Noise: BC549, BC550
- Complement to BC556, BC557, BC558, BC559, and BC560
- These are Pb−Free Devices

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector−Base Voltage BC546 BC547 / BC550 BC548 / BC549	V_{CBO}	 80 50 30	V
Collector−Emitter Voltage BC546 BC547 / BC550 BC548 / BC549	V_{CEO}	 65 45 30	V
Emitter−Base Voltage BC546 / BC547 BC548 / BC549 / BC550	V_{EBO}	 6 5	V
Collector Current (DC)	I_C	100	mA
Collector Power Dissipation	P_C	500	mW
Junction Temperature	T_J	150	°C
Storage Temperature Range	T_{STG}	−65 to +150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

MARKING DIAGRAM



BC5xyz = Device Code
x = 4 or 5
y = 6, 7, 8, 9 or 0
z = A, B, C
A = Assembly Location
Y = Year
WW = Work Week

ORDERING INFORMATION

See detailed ordering and shipping information on page 4 of this data sheet.

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Symbol	Parameter		Test Condition	Min.	Typ.	Max.	Units
I_{CBO}	Collector Cut−off Current		V_{CB} = 30 V, I_E = 0			15	nA
h_{FE}	DC Current Gain		V_{CE} = 5 V, I_C = 2 mA	110		800	
V_{CE}(sat)	Collector−Emitter Saturation Voltage		I_C = 10 mA, I_B = 0.5 mA		90	250	mV
			I_C = 100 mA, I_B = 5 mA		250	600	
V_{BE}(sat)	Base−Emitter Saturation Voltage		I_C = 10 mA, I_B = 0.5 mA		700		mV
			I_C = 100 mA, I_B = 5 mA		900		
V_{BE}(on)	Base−Emitter On Voltage		V_{CE} = 5 V, I_C = 2 mA	580	660	700	mV
			V_{CE} = 5 V, I_C = 10 mA			720	
f_T	Current Gain Bandwidth Product		V_{CE} = 5 V, I_C = 10 mA, f = 100 MHz		300		MHz
C_{ob}	Output Capacitance		V_{CB} = 10 V, I_E = 0, f = 1 MHz		3.5	6.0	pF
C_{ib}	Input Capacitance		V_{EB} = 0.5 V, I_C = 0, f = 1 MHz		9		pF
NF	Noise Figure	BC546 / BC547 / BC548	V_{CE} = 5 V, I_C = 200 μA, f = 1 kHz, R_G = 2 kΩ		2.0	10.0	dB
		BC549 / BC550			1.2	4.0	
		BC549	V_{CE} = 5 V, I_C = 200 μA, R_G = 2 kΩ, f = 30 to 15000 MHz		1.4	4.0	
		BC550			1.4	3.0	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

h_{FE} CLASSIFICATION

Classification	A	B	C
h_{FE}	110 − 220	200 − 450	420 − 800

ANEXA 5

Additional Resources: Product Page | 3D Model | PCB Footprint

CUDEVICES

date 08/05/2022
page 1 of 4

MODEL: CMA-4544PF-W | DESCRIPTION: ELECTRET CONDENSER MICROPHONE

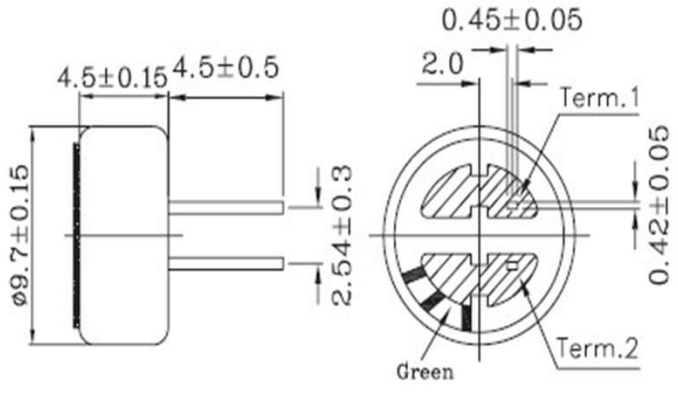
SPECIFICATIONS

parameter	conditions/description	min	typ	max	units
directivity	omnidirectional				
sensitivity (S)	f = 1 kHz, 1 Pa, 0 dB = 1 V/1 Pa	-46	-44	-42	dB
operating voltage			3	10	Vdc
output impedance (Zout)	f = 1 kHz, 1 Pa		2.2		KΩ
sensitivity reduction (ΔS-Vs)	f = 1 kHz, 1 Pa, Vs = 3.0 to 2.0 Vdc		-3		dB
frequency (f)		20		20,000	Hz
current consumption (IDSS)	Vs = 3.0 Vdc, RL = 2.2 KΩ			0.5	mA
signal to noise ratio (S/N)	f = 1 kHz, 1 Pa, A-weighted		60		dBA
operating temperature		-20		70	°C
storage temperature		-20		70	°C
dimension	ø9.7 x 4.5 mm				
weight				0.8	g
material	Al				
terminal	pin type (hand soldering only)				
RoHS	yes				

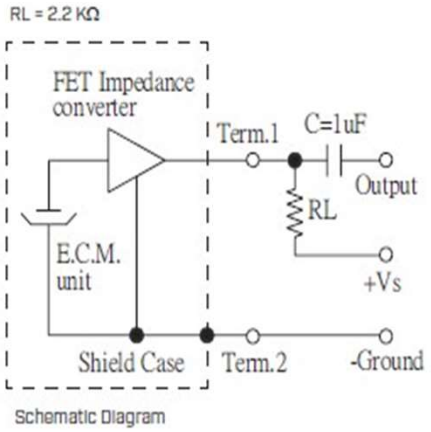
Note: We use the "Pascal (Pa)" indication of sensitivity as per the recomendation of I.E.C. (International Electrotechnical Commission). The sensitivity of "Pa" will increase 20dB compared to the "ubar" indication. Example: -60dB (0dB = 1V/ubar) = -40dB (1V/Pa)

MECHANICAL DRAWING

unit: mm



MEASUREMENT CIRCUIT



Schematic Diagram

ANEXA 6

Componenta	LINK WEB
T1	https://ro.mouser.com/ProductDetail/onsemi-Fairchild/BC547B?qs=UMEuL5FsraB3zD25tclGGQ%3D%3D
LEDS	https://ro.farnell.com/kingbright/kp-2012ec/led-0805-red-15mcd-625nm/dp/8529949
MIC	https://www.digikey.ro/en/products/detail/cui-devices/CMA-4544PF-W/1869981?utm_campaign=buynow&utm_medium=aggregator&utm_source=snapeda
SPDT	https://ro.mouser.com/ProductDetail/Gravitech/MINI-SPDT-SW?utm_campaign=mouser&qs=Vxac6xGyzPm8ENq695r3yA%3D%3D&utm_medium=online&utm_source=snapedaonline&utm_content=model
C3	https://ro.mouser.com/ProductDetail/Wurth-Elektronik/885382208006?qs=sGAEpiMZZMsh%252B1woXyUXj1p1N21vjUJQR2X3IF65aFs%3D
C1	https://ro.mouser.com/ProductDetail/KEMET/C1206C334K5REC7210?qs=55YtniHzbhDHbCvaZ9e%2FFA%3D%3D
C2	https://ro.mouser.com/ProductDetail/Rubycon/16ZLH100MEFC5X11?qs=T3oQrply3y%252BqHkLqRu3b6g%3D%3D
CD4017	https://ro.mouser.com/ProductDetail/Texas-Instruments/CD4017BNSR?qs=afYny40WCj0TIPXA7Qbixg%3D%3D
CON2	https://www.digikey.ro/en/products/detail/te-connectivity-amp-connectors/282834-2/1150135
POT	https://ro.mouser.com/ProductDetail/Amphenol-Piher/PT10LV10-503A2020-S?qs=pCZPOPZMYPjqzVGtfP%2FqKQ%3D%3D
R5,R6	https://ro.mouser.com/ProductDetail/Vishay-Dale/CRCW1206560RFKEAC?qs=E3Y5ESvWgWPfLhzRynA%252BNw%3D%3D
R1	https://ro.mouser.com/ProductDetail/Panasonic/ERJ-8ENF2201V?qs=JjxTDIFmKPQcNl%2Fy2Low0A%3D%3D
R2	https://ro.mouser.com/ProductDetail/Bourns/CRM1206QFX-1003ELF?qs=8Wlm6%252BaMh8RndkZYFfPU1w%3D%3D
R3	https://ro.mouser.com/ProductDetail/ROHM-Semiconductor/ESR18EZPF1202?qs=493kPxzlxfK7LOCMNV3P3Q%3D%3D
R4	https://ro.mouser.com/ProductDetail/ROHM-Semiconductor/KTR18EZPJ562?qs=DyUWGjl%252BcVuZPnCDNYiZBA%3D%3D