



1

2

3

4

5

1

2

3

3

6

	1
	4
	9
	11
	14
	15
SMT	21
SMT	26
	32
PCB	35

1.

1

2

3

4

5

2.

1

0.6 1.5

1.1

0.7

2

16

10.5

3

3.

1

( )

2

3

4

4.

1

36V

2

3

250V

250V

5.

1

2

6.

1

2

3

4

5

6

7

1

2

1

2

3

4

**1**

1

2

**2**

1

2

**3**

1

2

3

C 0.1 F

4

+

+

5

**4**

1

2

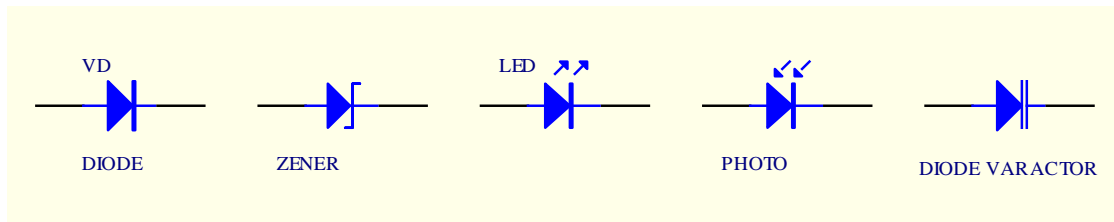
3

4

5  
 1  
 24V 35V 220V 15V  
 2 /

3  
 1 200

6  
 1  
 Diode A  
 K PN  
 2-1



2-1  
 2  
 VD D  
 ZD

+  
 +

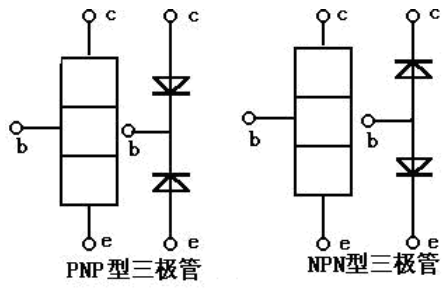
3  
 +  
 0.15 0.30V 0.4 0.70V

LED LED LED  
 NPN C E H<sub>FE</sub> LED

7  
 1  
 Transistor Bipolar  
 Junction Transistor BJT

2-2





2-2

PNP

NPN

2

e  
e b c  
e

b c  
e b c  
c b

3

PNP

PN

b c

PN

PN

0.2V

0.4V

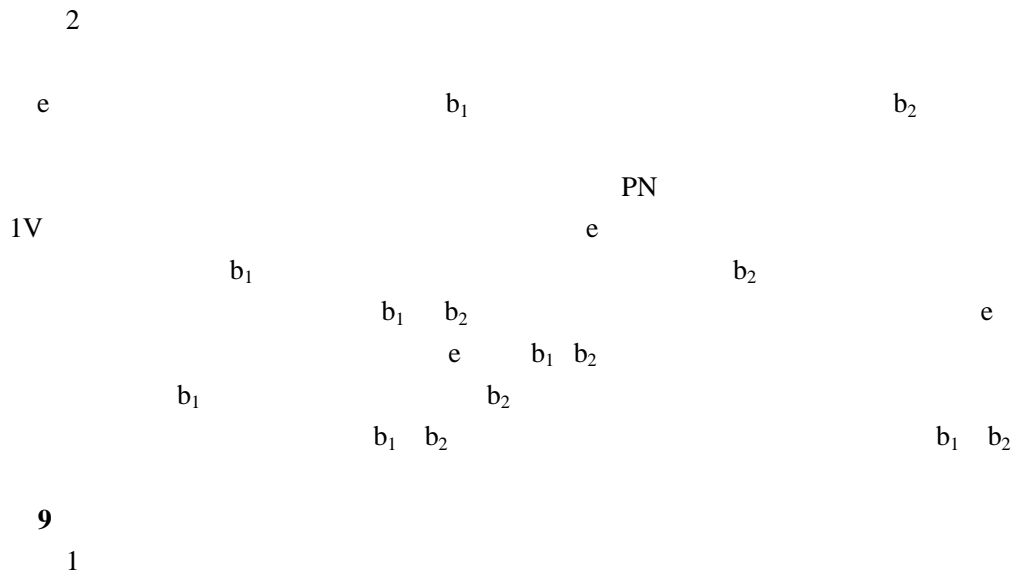
0.6V

NPN

1V

e

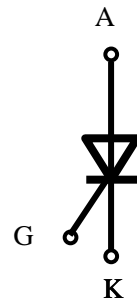
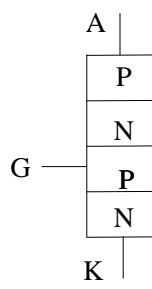
$h_{FE}$



Thyristor

SCR

2-4



2-4

2  
T2    G    T1

10                                      G                                      K                                      K                                      1V                                      1V

   1                                      K                                      6                                      6

1                                      6                                      6

2                                      3

3	6	3
4	6	
5	2	
6	6	3
7	6	
8	3	
9	3	
10.	3	
11.		

1  
2  
3  
4

1  
2  
3  
4

1

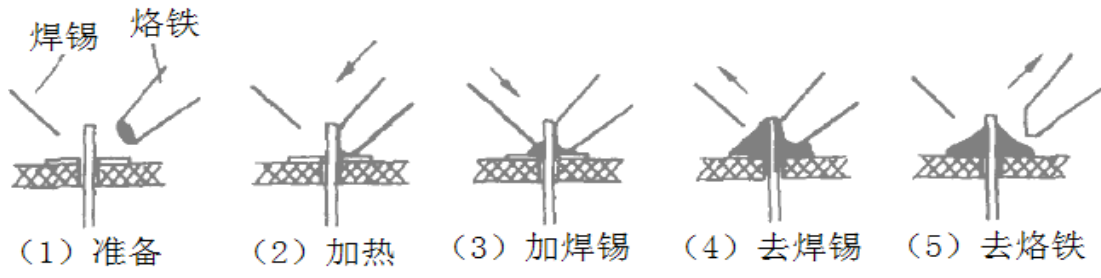
2

20 50W

3

4

3-2



3-2

1

2

3

4

5

45°

5

1

2

3

4

5

6

1

2

3

4

5

6

1

2

1

2

3

4

5

6

1

1999 19999 199999

2

1

2

3

4

5

COM

6

PN

7

8

9

36V

25V

1000V

750V

36V

10

MPS-3000L

1  
MPS-3000L 0 30V 0 3A

5V/3A

2  
15 14  
MPS-3000L  
6 8 5  
7  
+5V 0 30V  
5 7 6  
8 6 8

3

1

DS5152CA  
2 DS5152CA  
150MHz  
20  
FFT

3 DS5152CA  
1  
2

10 10  
1(CH1)  
1 <CH1> <AUTO>

3  
<AUTO> 1(CH1) 10

4  
1  
  
2  
3  
  
1

NW1641B /  
2 NW1641B /  
1

2 0.1Hz 3MHz  
3  
4  
5

10 V<sub>P-P</sub>±10% 50 20 V<sub>P-P</sub>±10% 1M  
0.1V<sub>P-P</sub> 0dB 10mV<sub>P-P</sub> 20dB 1mV<sub>P</sub>.



1  
2  
3  
4

1  
2  
3  
4  
5

4-1

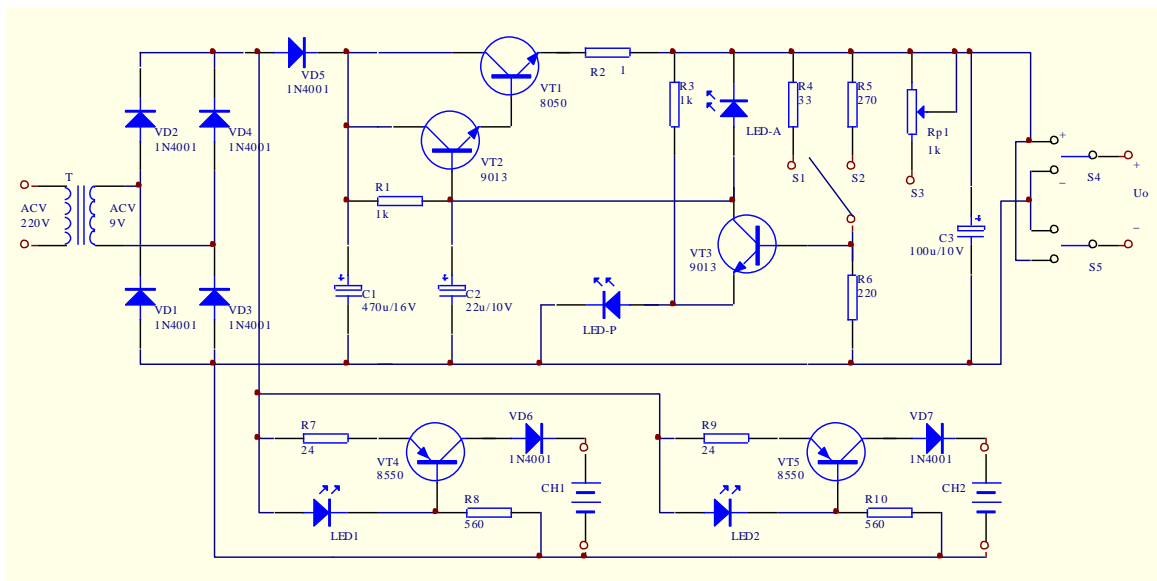
**5-1**

1	ChongDianQi			1
2	R1 R3		1k 1/8W	2
3	R2		1 1/8W	1
4	R4		33 1/8W	1
5	R5		270 1/8W	1
6	R6		220 1/8W	1
7	R7 R9		24 1/8W	2
8	R8 R10		560 1/8W	2
9	Rp1		1k	1
10	C1		470 F/16V	1
11	C2		22 F/10V	1
12	C3		100 F/10V	1
13	VD1 VD7		1N4001	7
14	LED1 LED2 LED-A		3	3
15	LED-P		3	1
16	VT1		8050 NPN	1
17	VT2 VT3		9013 NPN	2
18	VT4 VT5		8550 PNP	2
19	T		3W 9V	1
20	L1			1
21	S4 S5		3	2
22	S1 S2 S3		2	3

23	ACV9V U <sub>o</sub> CH1 CH2 GND			9
24	S1 S2 S3 S4 S5			3

220V  
1 4      3 9V

1  
1 AC 220V  
3V 6V ±10%  
2 300mA  
3  
4 60mA ±10% 1 4 10 12  
2  
5-1



5-1  
5-1 T VD1 VD4 C1  
R1 LED-A  
LED-P  
1.9V  
R2 LED-A  
R2 LED-A  
LED-A  
LED-A  
VT1 VT2

S1 S2 S3 3V 6V S4  
 S5 S4 S5 + S4 S5

VT4 VT5 VT4  
 LED1 VD6  
 R7

$$I_o = \frac{U_z - U_{be}}{R_7} \quad 5-1$$

$I_o$   $U_z$  LED1 1.9V  
 5-1  $U_z$   
 R7

- 1
- 2
- 3.
- 4.
- 5.

- 1
- 2.
3. 5-1

- 4
- 5.

1  
 2 S1 S2 S3 3V  
 6V Rp1  
 3 S4 S5 S4 S5 +  
 S4 S5  
 4 200mA 60mA ±10%  
 6. +

1  
2  
3 Proteus Multisim  
4

1 6-1  
2  
3  
4  
5

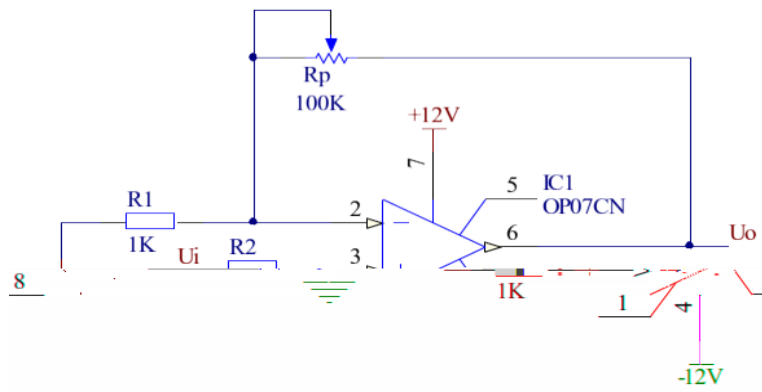
**6-1**

6-1	IC		OP07	1
6-1			DIP8	1
6-1	R1 R2		1k	2
6-1	Rp		100k 104	1
6-2	IC		uA741	1
6-2			DIP8	1
6-2	R1 R2		1k	2
6-2	Rp		100k 104	1
6-3	IC		uA741	1
6-3			DIP8	1
6-3	R1 R2		10k	2
6-3	R3		1M	1
6-3	Rp1		100k 104	1
				1

1  
1 OP07  
6-1 OP07

$$U_o = \left(1 + \frac{R_p}{R_1}\right) \cdot U_i \quad 6-1$$

$$A_u = 1 + \frac{R_p}{R_1} \quad A_u(\text{dB}) = 20\lg\left(1 + \frac{R_p}{R_1}\right) \quad 6-2$$



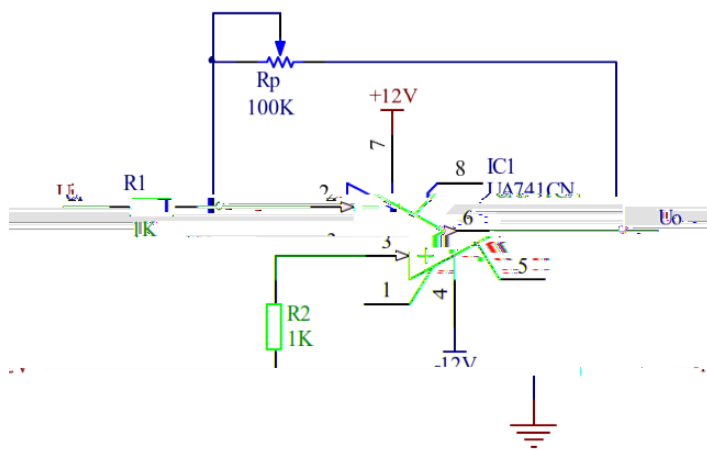
6-1 OP07

2 A741

6-2 A741

$$U_o = -\frac{R_p}{R_1} U_i \quad 6-3$$

$$A_u = \frac{R_p}{R_1} \quad A_u (\text{dB}) = 20 \lg\left(\frac{R_p}{R_1}\right) \quad 6-4$$

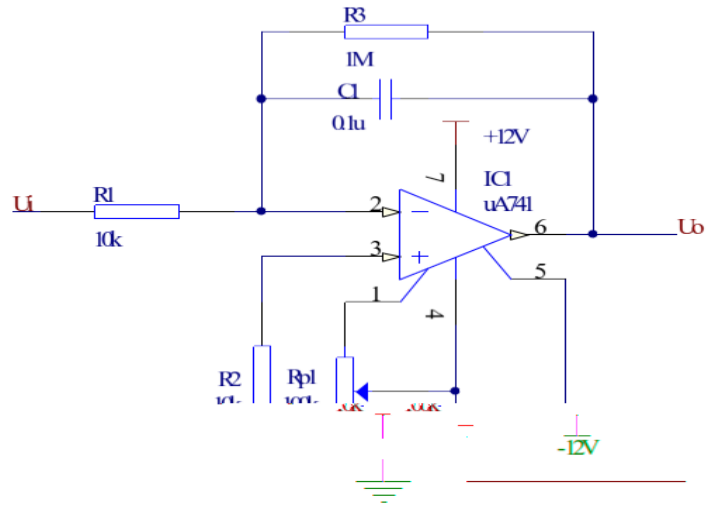


6-2 A741

2

A/D

6-3



6-3

IC1

$R_{p1}$

$R_{p1}$

$$u_o(t) = -\frac{1}{R_1 C_1} \int u_i(t) dt$$

6-5

3 Proteus  
6-1

Multisim  
6-2  
 $R_p$

- 1.
- 2.
- 3.
- 4.
- 5.

- 1.
- 2.
- 3.
- 4.
- 5.

6-1

1

2

6-1 6-2

1kHz

200mV

$R_{p1}$

3  
 $U_o=0$     $U_o$  0

6-3

$u_i$

$u_o$

$R_{p1}$

$\pm 2V$

$u_i$   $u_o$

$u_i$

100Hz

$u_i$   $u_o$

$u_i$   $u_o$

100Hz

1V

$u_i$   $u_o$

$u_i$

$u_i$   $u_o$

$u_i$   $u_o$

# SMT

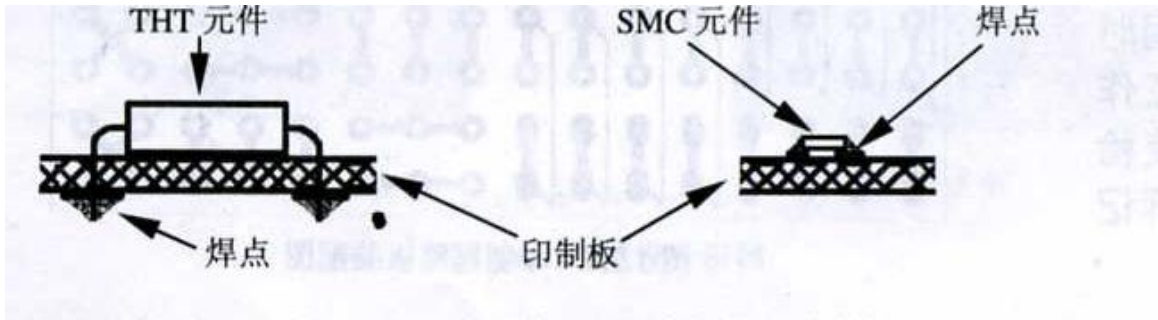
- 1 SMT
- 2 SMT SMT
- 3 SMT
- 4 SMT

- 1 SMT
- 2
- 3
- 4
- 5

- 1 SMT

		20	70	80	
	Surface Mounting Technology	SMT			PCB
		SMT			Through Hole
Technology	THT		90%		SMT
	SMT				

- 2. THT SMT
- 7-1 THT SMT
- 7-1 THT SMT



7-1 THT SMT



7-1 THT SMT

	20 60 70	THT		PCB	/	
	70 80		IC	PCB		
	20 80	SMT	SMC SMD VSI VLSI	SMB		

3. SMT

1 SMC SMD 1/3 1/10 PCB  
SMT

40% 60% 60% 80%

2 SMC SMD

THT

3 SM

4 SMT CIMS

5 SMT PCB SMD,SMC

SMT 30%

4. SMT

SMT

THT

SMT

SMT

SMT

SMD Surface Mounting Devices

1

7-2

7-2

\	1608*0603	2012*0805	3216*1206	3225*1210	5025*2010	6332*2512
×	1.6×0.8	2.0×1.25	3.2×1.6	3.2×2.5	5.0×2.5	6.3×3.2
W	1/16	1/10	1/8	1/4	1/2	1
V		100	200	200	200	200

a. \*

b. 0.4 0.6mm

c. 1005 0402 0603(0201) 0402(01005)  
 d. 10 R 8R2  
 8.2 0R 2A

1005/\*0402 1608/\*0603 2012/\*0805 3216/\*1206 3225/\*1210 4532/\*1812 5664/\*2225  
 0.9 4.0

NPO  
 X7R  
 Y5V

2

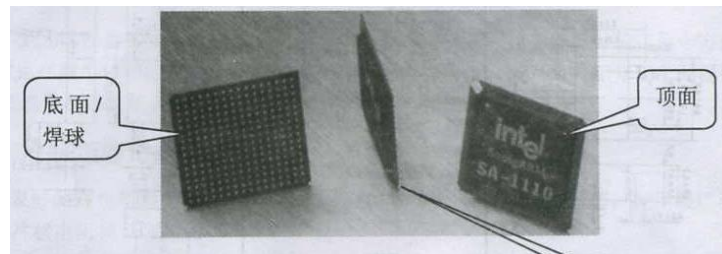
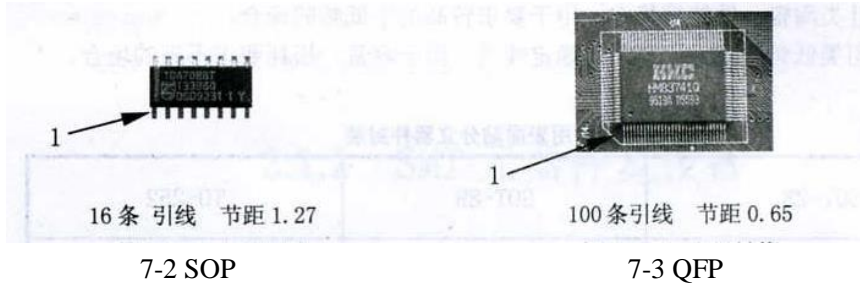
FET/

SOP(Small Outline

Package) TO SC-70(2.0×1.25) SO-8(5.0×4.4)

SOP QFP(Quad Flat Package) 7-2 7-3

SMD 7-4 BGA

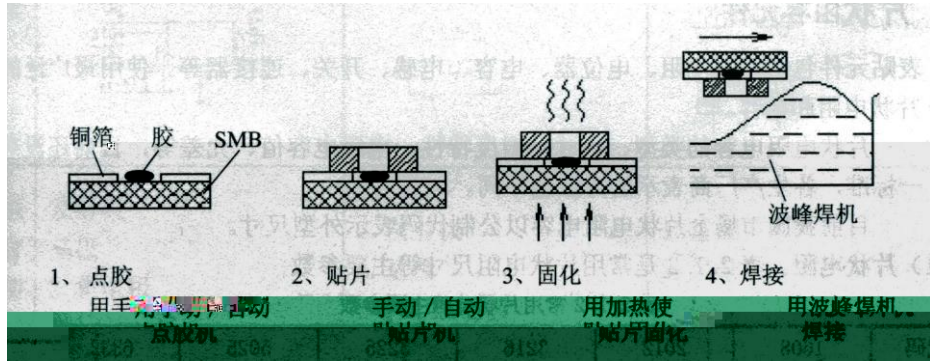


7-4 BGA

5. SMT

SMT

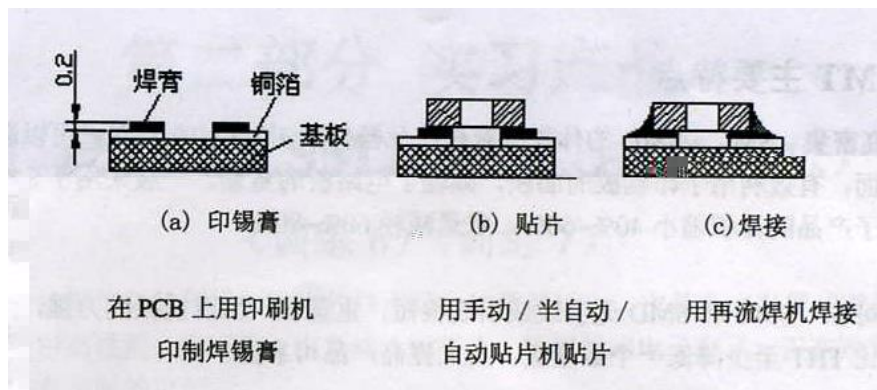
1 7-5



7-7 SMT 1

2

7-6



7-6 SMT 2

6.

1

2

6

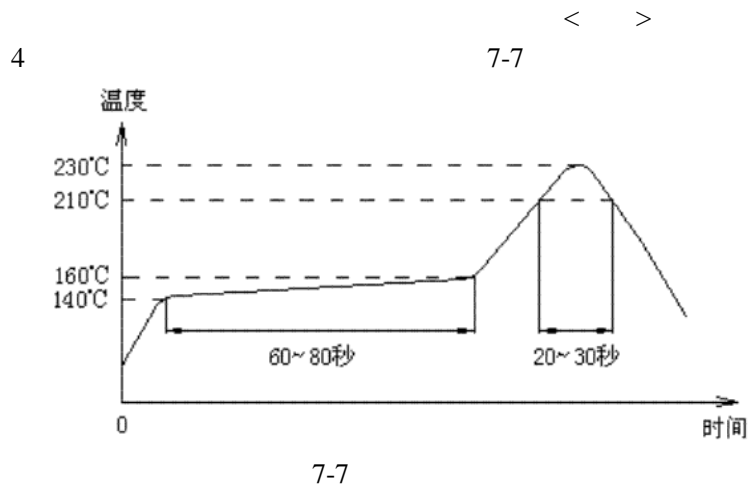
7.

1

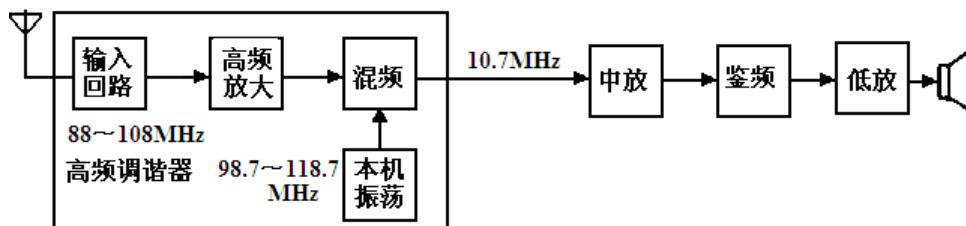
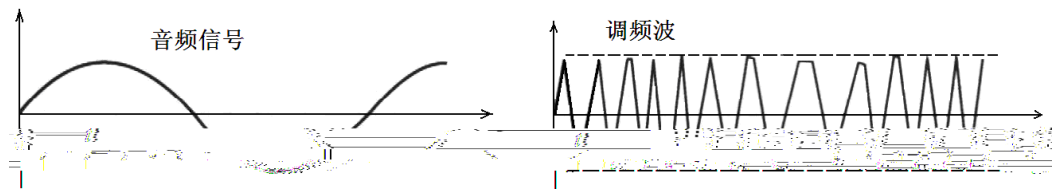
2

8.  
1

2



- 1 SMT
- 2. SMT
- 3. SMT
- 4 SMT
- 5.






1	RW-2980	1		22	/0805-102P	3	C1 13 18
2	SP7021	1	IC1	23	/0805-332P	1	C3
3	TDA2822	1	IC2	24	/0805-103P	4	C10 15 16 20
4		1	L1	25	/0805-403P	1	C12
5	20P	1	VC1	26	/0805-104P	3	C5 9 11
6		1	LED	27	/0805-104P	3	C14 21 C23
7	EJ-3570	1	J2	28	1.2*120mm	5	
8	B10K	1	VR	29	8 0.5W	1	
9	10 F/16V	1	C19	30		1	
10	100 F/16V	1	C17	31	M2.5*4.5	3	
11	220 F/16V	1	C22	32	M1.7*4	1	
12	/0805-10R	1	R3	33	M2*6	1	
13	/0805-22K	1	R2	34	BM2*3.5	1	
14	/0805-1K	1	R5	35		1	
15	/0805-1.5K	1	R1	36		1	
16	/0805-10K	1	R4	37		1	
17	/0805-22P	1	C6	38		1	
18	/0805-472P	1	C4	39		1	
19	/0805-221P	1	C2	40		1	
20	/0805-681P	1	C7	41		1	
21	/0805-152P	1	C8	42			








FM88

1  
 2  
 3 TDA2822M D2822  
 4  
 5  
 6

1  
 2  
 3

**1 TDA2822M**

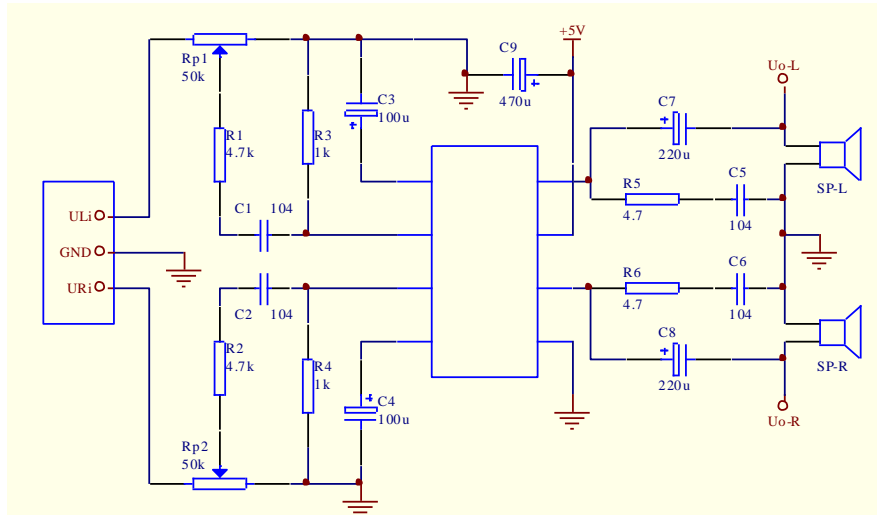
TDA2822M SGS 1.8 15V  
 2 V 120kHz 1A 2.7V 41dB  
 4/8/16/32  
 BTL 1W×2  $V_{cc}=9V$   $R_L=8$   
 THD 10 110mW×2  $V_{cc}=3V$   $R_L=4$  THD 10

TDA2822M 8-DIP 9-1 TDA2822M

9-1 DTA2822M

1	OUTPUT(1)	3	OUTPUT(2)	5	INPUT 2	7	INPUT+ 1
2	+Vcc	4	GROUND	6	INPUT+ 2	8	INPUT 1

**2**  
 9-1



9-1

9-1

$U_{i-L}$   $U_{i-R}$

LED  
6V DC

$R_{P1}$   $R_{P2}$

9-1

9-1

1		ADS-228	1	
2		TDA2822M D2822	1	IC1
3		3mm	1	D1
4		B50K	1	$R_{P1}$ $R_{P2}$
5	DC			DC
6		SK22D03VG2		K1
7		4.7K 4.7	2	$R_3$ $R_6$ $R_1$ $R_4$
8		1K	3	$R_2$ $R_5$ $R_7$
9		104P	4	$C_1$ $C_2$ $C_4$ $C_5$
10		100uF 220uF	2	$C_7$ $C_9$ $C_3$ $C_6$
11		470uF/16V	1	$C_8$
12			1	
13		4 /5W	2	
14			1	
15			4	
16		1.0*90mm*2P	2	SP-L SP-R
17		1.0*60mm	2	B+ B-
18		PA2*6	10	
19		PA2*8	12	
20			1	

- 1
- 2
- 3.
- 4.

- 1
- 2.
- 3.

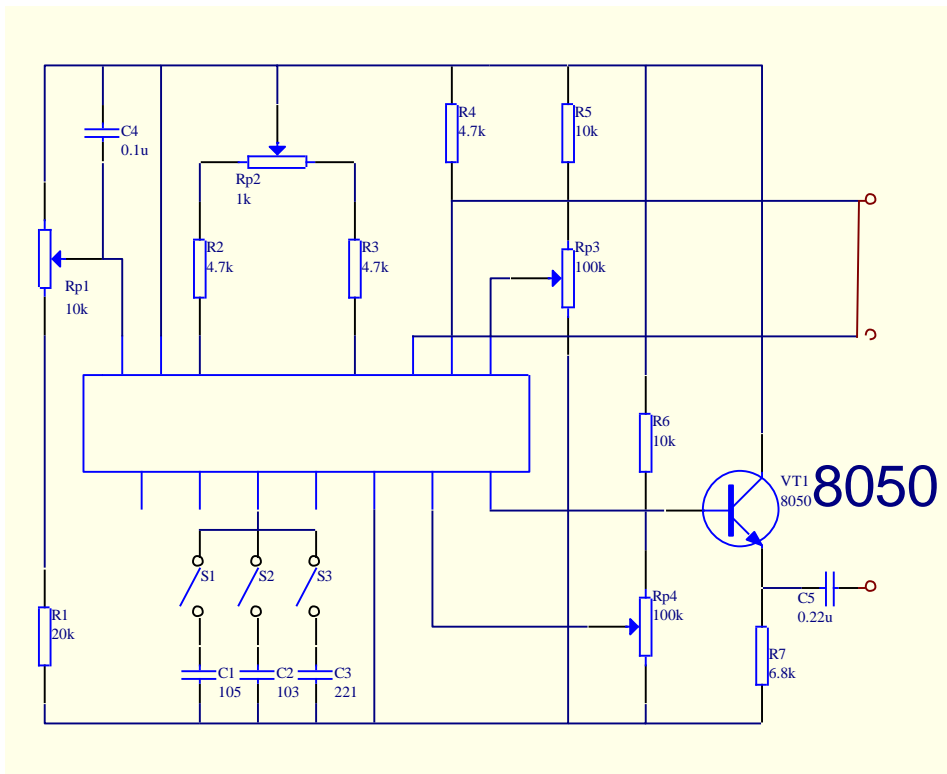
- 5
- 6.
- 7.

# PCB

- 1 PCB
- 2 Altium Designer Protel SCH PCB
- 3 PCB
- 4 PCB
- 5
- 6
- 7
- 8

- 1 PCB
- 2
- 3
- 4
- 5

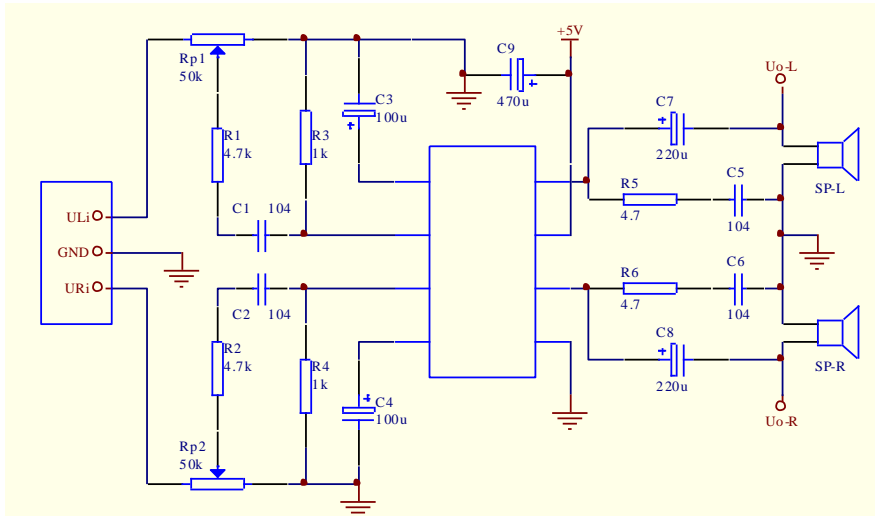
- 1 10-1



10-1

2

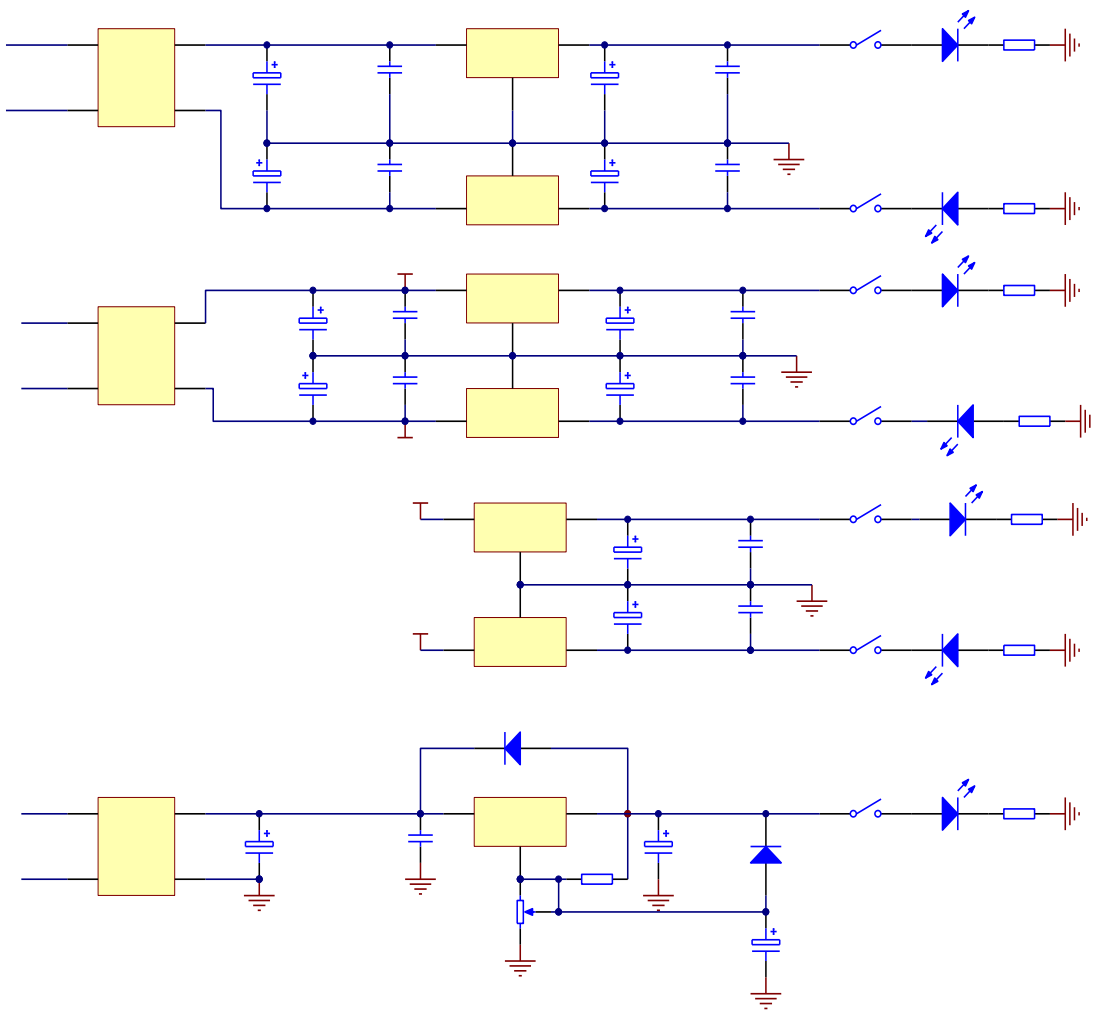
10-2



10-2

3

10-3



10-3

4				
1				
2		SCH		
3				
4				
5				
6				
7				
8				
9				
5	PCB			
1				
2		PCB		
3				
4				
5				
6				
7				
8				
9				
6	PCB			
1				
2		PCB		
3				
4				
5				
6				
7				
8				
9				
7	PCB			
1			20mil	
2			10mil	
3			40	60mil
8	PCB			
1		SCH		
2		PCB		
3			PCB	
4				PCB
5		PCB		
6				10 15
7				
8				



9

PCB

1 Altium Designer Protel SCH PCB

2

3

PCB

4 PCB

PCB

5

6

1 Altium Designer Protel

2 SCH PCB

3

4

PCB

5 PCB

PCB

6

PCB

7

8

9

10