严

2018　8

实验一 常用电子仪器的使用

1

1

2

3

4

2

1 DS-5000

2 TH SG10

3 FLUKE-15B

4

3

严

严

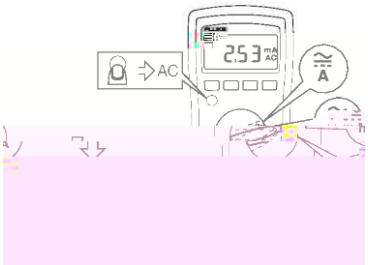
串

4

1

FLUKE-15B

; GE 1.1.1



1.1.1

串

9 F ? = 9 F ? =

+5V -5V +12V -12V 0~35V

2 TH-SG10

1.1.2 TH-SG10

TH-SG10 1.1.2 FSK PSK

TTL

串 10mHz 10MHz 串) z -)($^{-5}$Hz

串 2mV 20$V_{P\ P}$ 1mV 10$V_{P\ P}$ -(串 $V_{P\ P}$

) $V_{P\text{-}P}$ -(

严 $V_{P\ P}$ 串 -

($V_{P\ P}$,10KHz

1

2) ('

)(

3 (假 ' N

($N_{P\ P}$

4 串

f=1KHz 50m$V_{P\ P}$

串 -

3 DS-5000

1.1.3 DS-5000

DS-5000 1.1.3 ,

严

DS-5000 ;) ; =P L L A,

1 HGKALAGF 严

HGKALAGF HGKALAGF

GROUND

2 K; 9 =

K; 9 = N ' /

N' 串 - N'

1 HGKALAGF 严

2 K; 9 =

K; 9 = K' /

)(s/ 串)('

3-5

=N= E =F M 50% >G ; = =N=

E =F M

DS-5000

串

1

2 CH1 CH2;

3 9 MLG

DS-5000 -

f=1KHz　50mV$_{P\ P}$　　CH1

4

，　　，　　，

f=1KHz　50mV$_{P\ P}$

5

1

2　　位

3

4

5

实验二 单级放大电路

1

1

2

3　　A_u　　R_i　　R_o

4

2

1

2

3

4

5　　3DG6

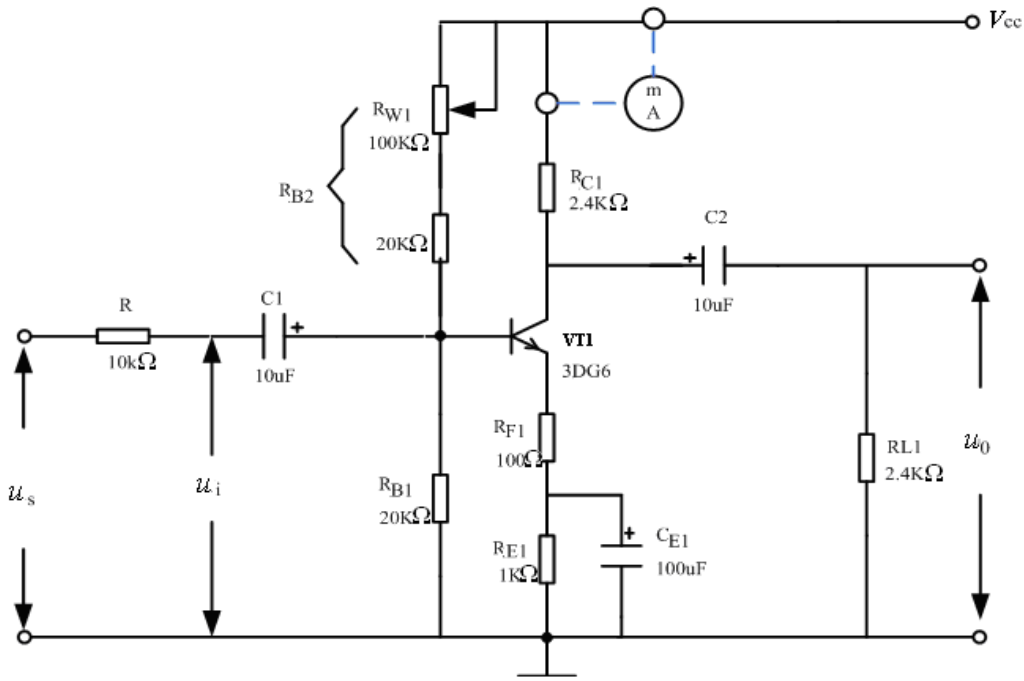
3

1

2

4

1.1.4



1.1.4

1

1)

2)

+12V u_i u_s R_{W1} V_E=2.2V U_{BEQ} U_{CEQ} R_{B2} 1.1.1

1.1.1

U_{BEQ}/V	U_{CEQ}/V	R_{B2}/

3) R_{W1} V_E=2.2V $\boldsymbol{I_C}$ VT_1 V_B $\boldsymbol{R_{B2}}$ $\boldsymbol{R_{B1}}$ 1.1.2 VT1 $\boldsymbol{I_B}$ β

$$\boldsymbol{I_B} = \frac{\boldsymbol{V_{CC}} - \boldsymbol{V_B}}{\boldsymbol{R_{B2}}} - \frac{\boldsymbol{V_B}}{\boldsymbol{R_{B1}}} \qquad \beta = \frac{\boldsymbol{I_C}}{\boldsymbol{I_B}}$$

1.1.2 严 I_B β

1.1.2

I_C /mA	V_B/V	R_{B2}/k	R_{B1}/k	I_B /mA	β

2

1 串 f=1KHz - 串 50mV

u_i u_i u_o u_i u_o 1.1.3 严

2) u_i 串 f=1KHz u_i u_o u_o

1.1.3

1.1.3

u_i/mV	u_o/V	A_u	A_u
50mV$_{P-P}$			

u_i u_o

1.1.3 严 - U_{P-P} U_{RMS}

3) u_i - 串 50mV f=1kHz R_{L1} R_{L1}

1.1.4

1.1.4

R_{C1}	R_{L1}	u_i(V)/ V_{P-P}	u_o(V)/ V_{P-P}	A_u	A_u
2.4k	2.4K				
2.4k	10K				

4) u_i - 串 50mV f=1kHz R_{W1} u_O

U_B U_C U_E 1.1.5

1.1.5

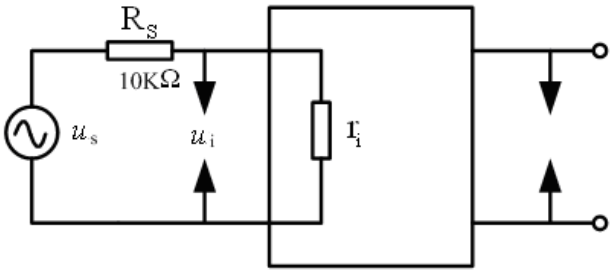
R_{W1}	U_B/V	U_C/V	U_E/V	u_O 位

U_i

5)

个 10k 1.1.5 u_s u_i

1.1.6

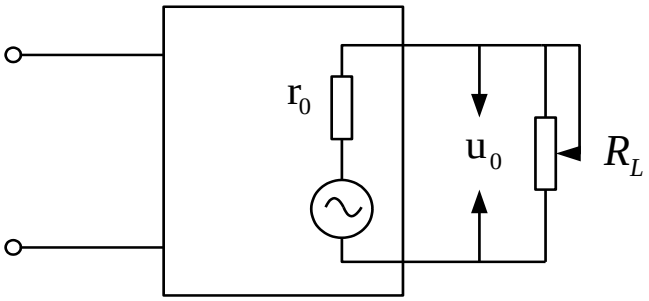


1.1.5

6)

串 1.1.6 , R_L5 ,

R_L u_O 1.1.6



1.1.6

1.1.6

U_s/mV	U_i/mV	R_i/	R_i/	U_o/V R_L5	U_o/V R_L=2.4K	R_o/	R_o/

5

1

2

3 严

实验三 射极跟随器

1

1

2

2

1

2

3

4

5

6 3DG6

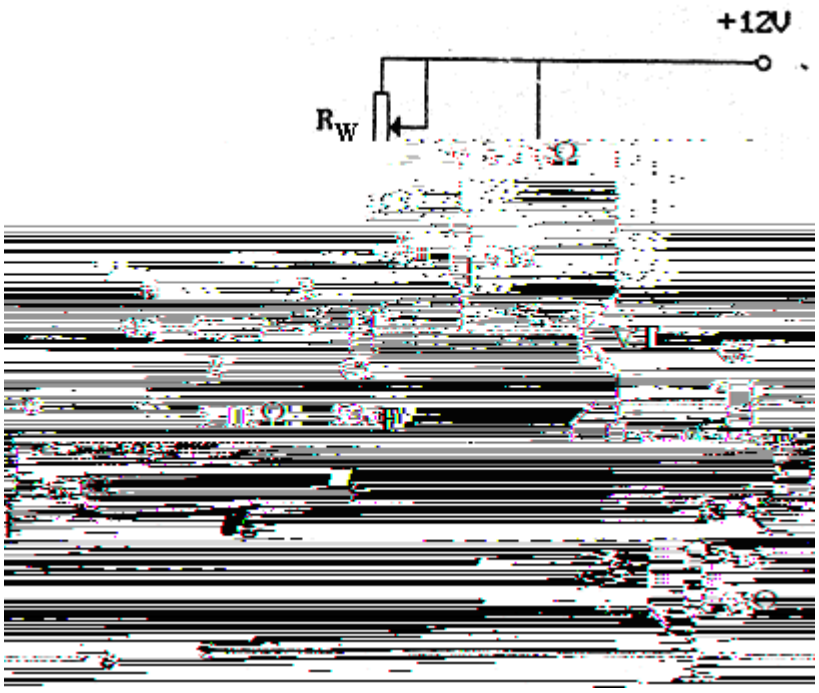
3

1

2

4

1.1.7



1.1.7

1

1.1.6 +12V B f 1KHz U_i(U_i 了 100mV)

R_W

U_i 0 1.1.7

1.1.7

U_E/V	U_B/V	U_C/V	$I_E = \frac{U_E}{R_E}$/mA

严 R_W (I_E)

2 A_u

R_L B f 1KHz U_i

U_O U_i U_L 1.1.8

1.1.8

U_i/V	U_L/V	$A_u = \frac{U_L}{U_i}$

3 R_O

R_L B f 1KHz U_i(100mV)

U_O R_L5 U_L 1.1.9

1.1.9

U_o/V	U_L/V	$R_o=(\frac{U_o}{U_L}-1)\times R_L$/

4 $\boldsymbol{R_i}$

A f 1KHz U_s U_i 100mV

A B U_S U_i 1.1.10

1.1.10

U_s/V	U_i/V	$R_i=\frac{U_i}{U_s-U_i}\times R$/

5

1 ;

2 ;

3

实验四 差动放大器

1

1 ;

2

2

1 ;

2 ;

3 ;

4 ;

5

6 3DG6×3

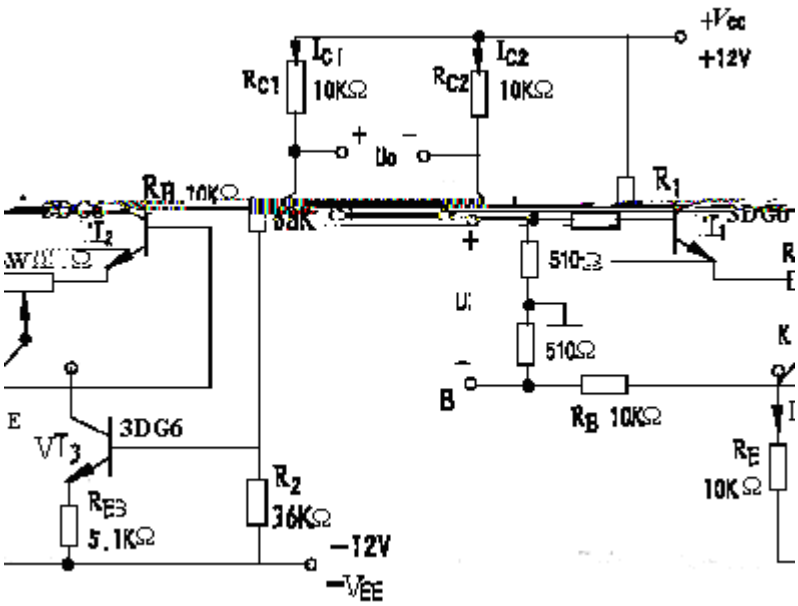
3

1

2

4

1.1.8



1.1.8

1

1.1.8 K

1)

A B ±12V U_O

R_W U_O 0

VT_1 VT_2 R_E U_{RE}

1.1.11

1.1.11

	U_{C1}/V	U_{B1}/V	U_{E1}/V	U_{C2}/V	U_{R2}/V	U_{F2}/V	U_{RE}/V
	I_c/mA		I_B/mA		U_{CE}/V		

2)

A B (

严 A B)

f 1KHz 串 0 (

C_1 C_2)

U_i(100mV) U_i U_{c1} U_{c2}

U_i U_{c1} U_{c2} U_{RE} U_i

$A_{d1}=\frac{U_{c1}}{U_i}$ $A_{d2}=\frac{U_{c2}}{U_i}$ $A_d=\frac{|U_{c1}|+|U_{c2}|}{U_i}$ A_{d1}

A_{d2} A_d

3)

A B ( ) A B

U_i=1V f=1KHz

U_{c1} U_{c2} U_i U_{c1} U_{c2} U_{RE}

U_i

$A_{c1}=\frac{\boldsymbol{U}_{c1}}{\boldsymbol{U}_i}$ $A_{c2}=\frac{\boldsymbol{U}_{c2}}{\boldsymbol{U}_i}$ $A_c=\frac{|\boldsymbol{U}_{c1}|-|\boldsymbol{U}_{c2}|}{\boldsymbol{U}_i}$ A_{C1}

A_{C2} A_C

2

1.1.8 严 K 1 严

5

1

1)

2) *CMRR*

3) *CMRR* *CMRR*

2 U_i U_{C1} U_{C2}

实验五 负反馈放大电路

1

1

2 个

3 严 位

2

1

2

3

4

5 3DG6×2

3

1 严 ;

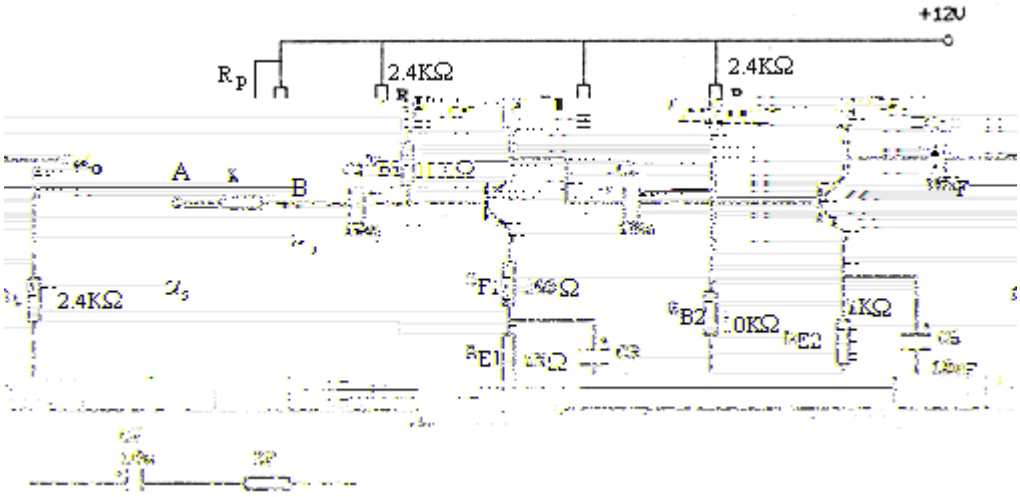
2 (β_1 β_2 100);

3 A_{uf} ? ?串 ?

4 ;

5 EWB Multisim

4



1.1.9

1.1.9

1

1

1.1.9 3DG6 R_L 串 U_i

0 1.1.12

1.1.12

	U_B/V	U_E/V	U_C/V	I_C/mA

2 严 A_u

B 串 1KHz 50mV

u_o u_o u_o

3) R_o

50mV R_L U_0

$R_o=(\frac{U_o'}{U_o}-1)R_L$ R_o

4) R_i

个 R + A 串 1KHz

U_{ipp}=50mV A U_{Spp} $R_i=\frac{U_i}{U_S-U_i}R_S$

R_i

5)

R_L B 50mV 1KHz U_L(U_L

) (U_{ipp}=50mV) f_H f_L

$f_{BW}=f_H-f_L$

2 1

1

位

2 1 R_F=2 1 严

A_{uf} R_{of} R_{if} f_{BW}

3 2

1

位

2 1 R_F=2 1 严

A_{uf} R_{of} R_{if} f_{BW}

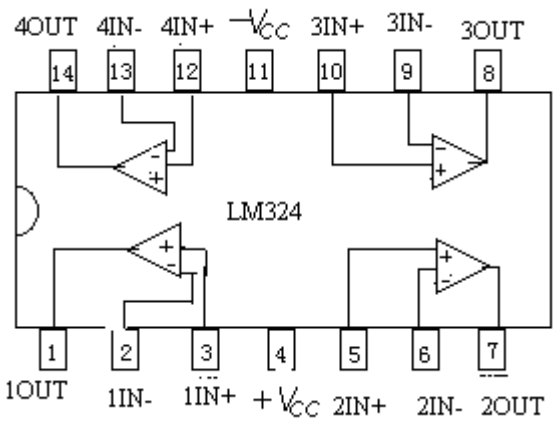
4

1) f 1KHz

2) 1)

5.

(1)



1.1.11 LM324

1.1.13

U_o	/mV				

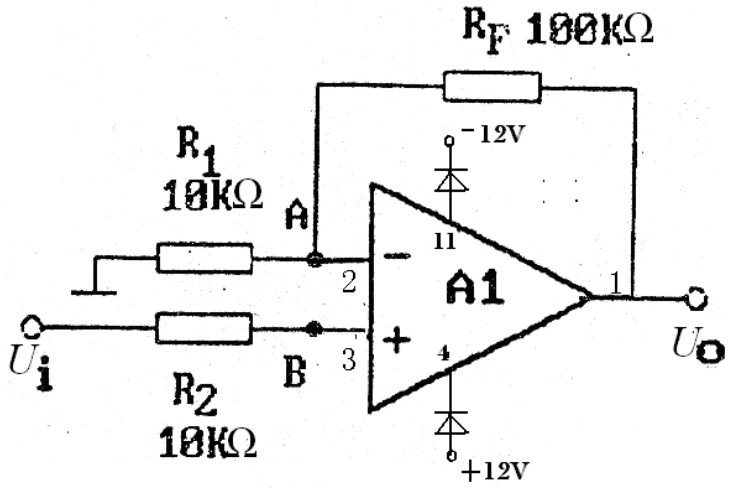
2　　1.1.15　　了　严

1.1.15

△ U_O/V	R_L U_i　0　串 800mV		
△ U_{AB}/V			
△ U_{R2}/V			
△ U_{R1}/V			
△ U_{OL}/V	U_i=800mV R_L　　串 -		

3

1.1.13　　1.1.16　1.1.17　　了　严



1.1.13

1.1.16

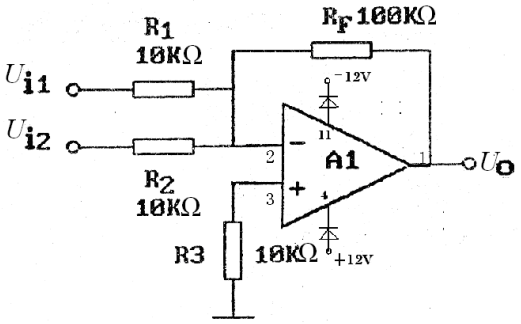
	U_i/mV	100	300	1000	3000
Uo	/mV				
	/mV				

1.1.17

△ U_O/V	R_L U_i 0 串 800mV		
△ U_{AB}/V			
△ U_{R2}/V			
△ U_{R1}/V			
△ U_{OL}/V	U_i=800mV R_L 串 -		

4

1.1.14



1.1.14

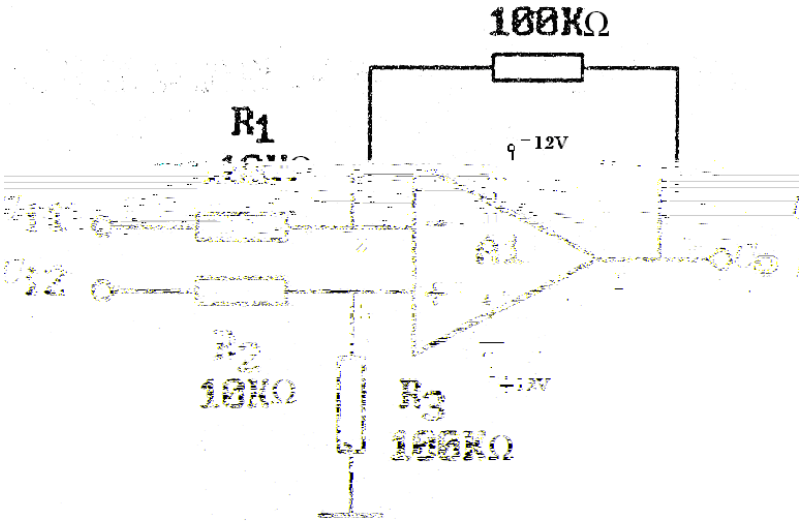
1.1.18

1.1.18

U_{i1}/V	0.3	0.1
U_{i2}/V	0.2	0.2
U_O/V		

5

串 1.1.15 1.1.19



1.1.15

1.1.19

U_{i1}/V	0.3	0.1
U_{i2}/V	0.2	0.2
U_O/V		

5.

(1) 严

(2)

实验七 信号发生与功放综合电路

1

1 OTL

2 OTL

3 RC

4

（5）

2

（1） 160Hz-20KHz

（2）

（3） 串)((

（1） 0.1W 5W

2 R_L50

3 L -□

4 η -(□

3

1 OTL

2

3 位 位

4 EWB Multisim

4

1 2

3 4

5 6 LM324

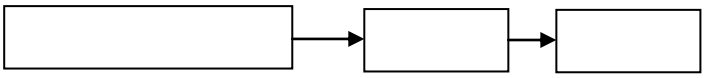
7 8

9 3DG6 (9011) 3DG12 (9013) 3CG12 (9012) IN4007 0

5.

1.1.16

串



.

(1)

RC 个 个

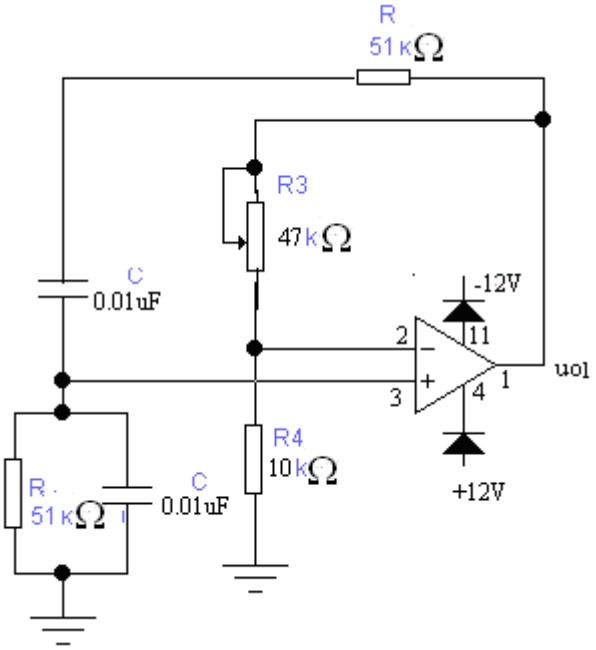


图 1.1.17　RC

RC　　1.1.17　　*RC* 个　　Z_1　　*RC*　　Z_2

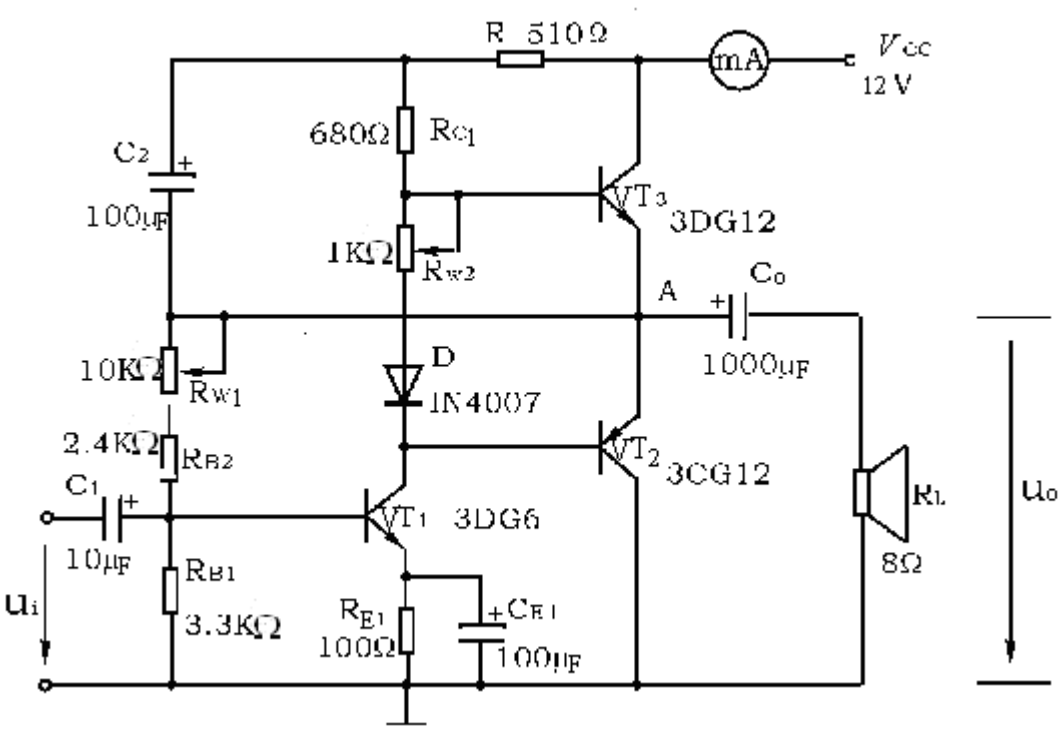
$$\boldsymbol{Z}_1 = \boldsymbol{R} + (1/\mathrm{j}\omega\boldsymbol{C}) \qquad \boldsymbol{Z}_2 = \boldsymbol{R} \;//(1/\mathrm{j}\omega\boldsymbol{C}) = \frac{\boldsymbol{R}}{1+\mathrm{j}\omega\boldsymbol{R}\,\boldsymbol{C}}$$

$$\dot{\boldsymbol{F}} = \frac{\boldsymbol{Z}_2}{\boldsymbol{Z}_1+\boldsymbol{Z}_2} = \frac{1}{3+\mathrm{j}(\omega\boldsymbol{R}\,\boldsymbol{C} - \frac{1}{\omega\boldsymbol{R}\,\boldsymbol{C}})}$$

$f_0 = \dfrac{1}{2\pi RC}$　　$\dot{\boldsymbol{F}}$　　$\left|\dot{\boldsymbol{F}}\right|_{\max} = \dfrac{1}{3}$

串　　$|\dot{A}\dot{F}|>1$　　$A_f>3$　　R_3 R_4　　个　　$\boldsymbol{A}_{\mathrm{f}} = 1 + \dfrac{\boldsymbol{R}_3}{\boldsymbol{R}_4} > 3$

(2)OTL 但



1.1.18 OTL

OTL 1.1.18 严 VT_1 ( ) VT_2 VT_3 NPN PNP OTL 了

但 VT_1 了

I_{C1}

$\eta = \frac{P_{om}}{P_E} 100\%$ P_E

η_{max}=78.5% 严 I_{dc} $P_E = V_{cc} \cdot I_{dc}$

6

1

1

$\boldsymbol{R}_{W2}$;

R_{W2}

2) P_{0m} η

a. P_{om}

f 1KHz u_i u_0 u_i

u_O R_L U_{om} 1.1.21

1.1.

a b

4

(u_i 0) 串

U_N U_N 15mV

(2) ( )

1) 1.1.17 LM324 1.1.19 ±12V

R_3 u_O

R_3 R_3 1.1.23

1.3.6

1.1.23

R_3	U_0/V	u_0	

2) R_3 u_O U_O

U_+ U_-

f_O R

1.1.20 1.1.24

1.1.24

R/k	C/uF	f_O/Hz	f_O/Hz

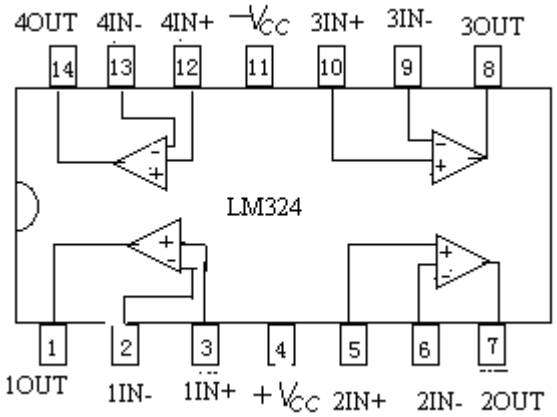
3) 1.1.21 u_{o2}

R_3 1.1.

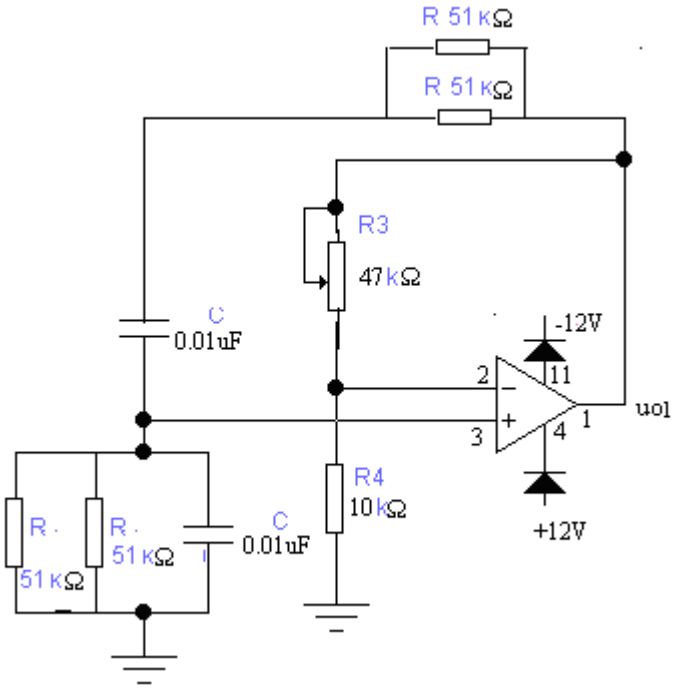
1.1.25

R_3/	u_{o2} /Hz	u_{o2} /V	

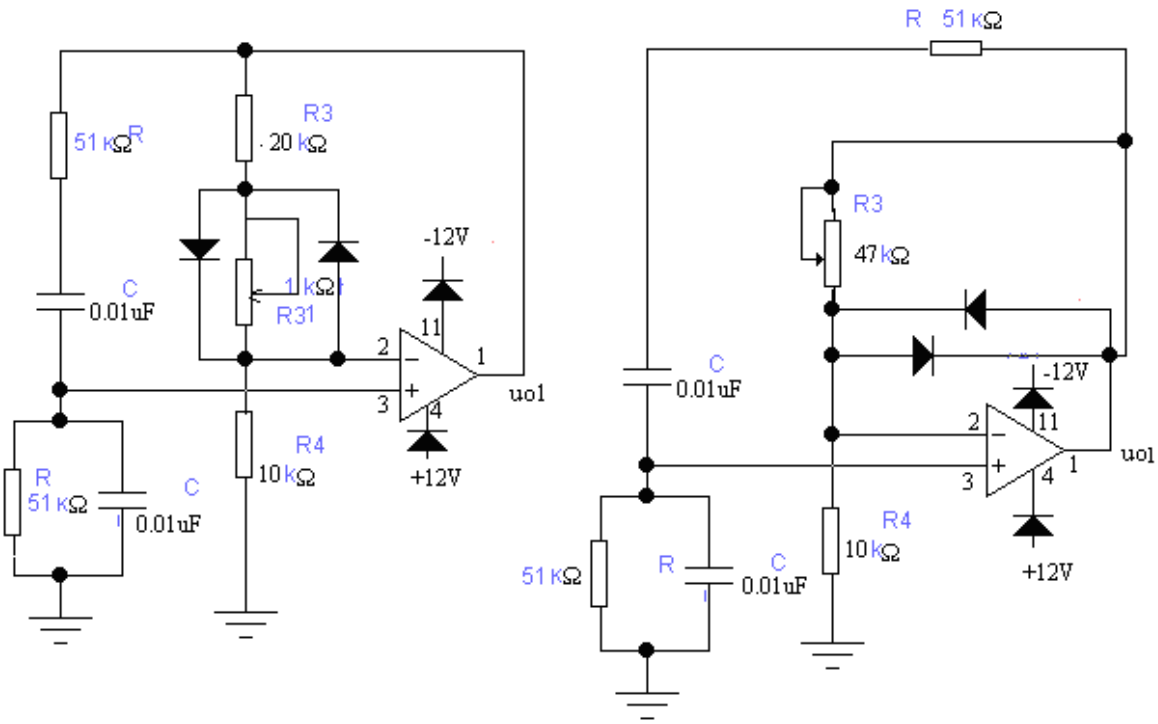
4) u_{o2} 100mV R_3



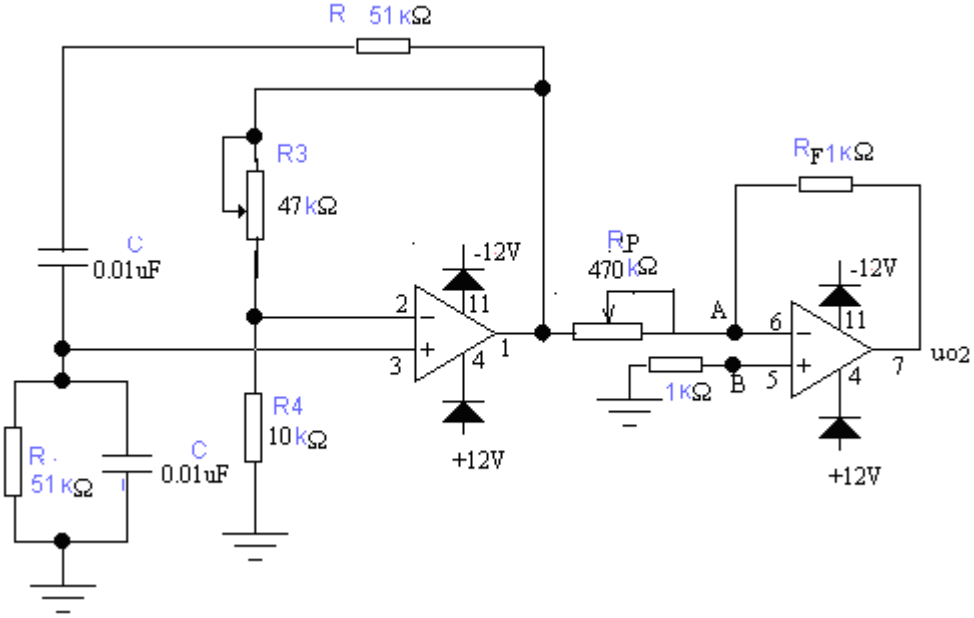
1.1.19 LM324



1.1.20



1.1.21



1.1.22

(3) u_o

,

1.1.23 1.1.24 1.1.25

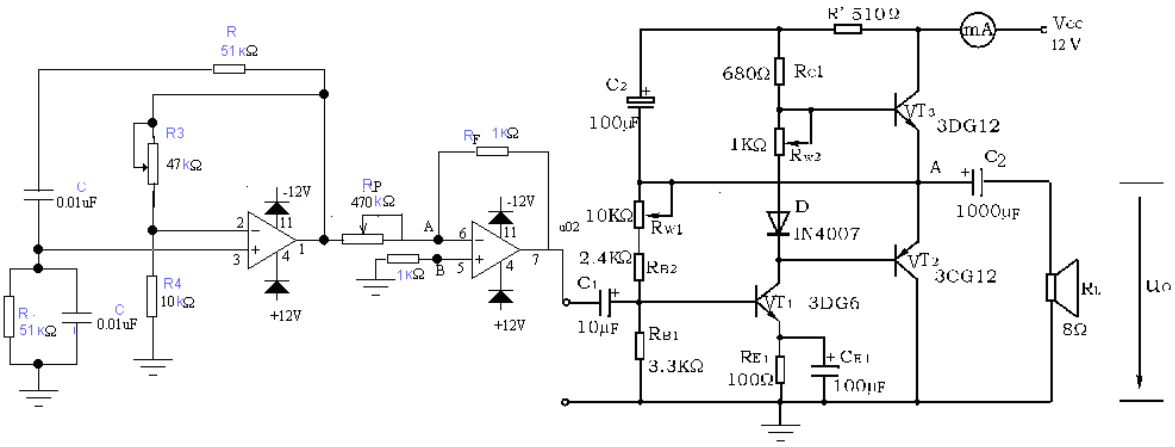


图 1.1.23

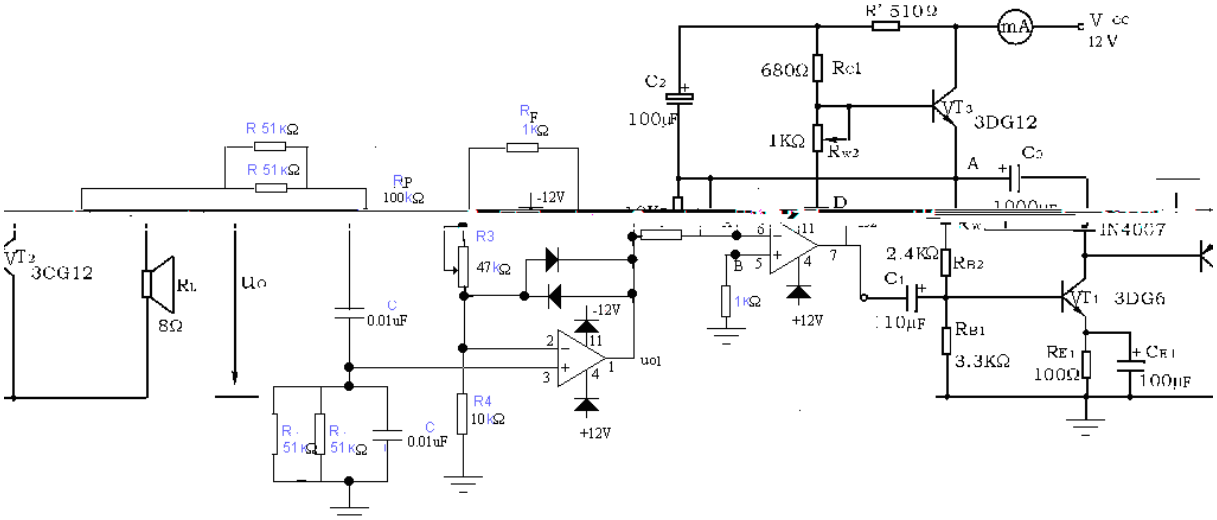


图 1.1.24

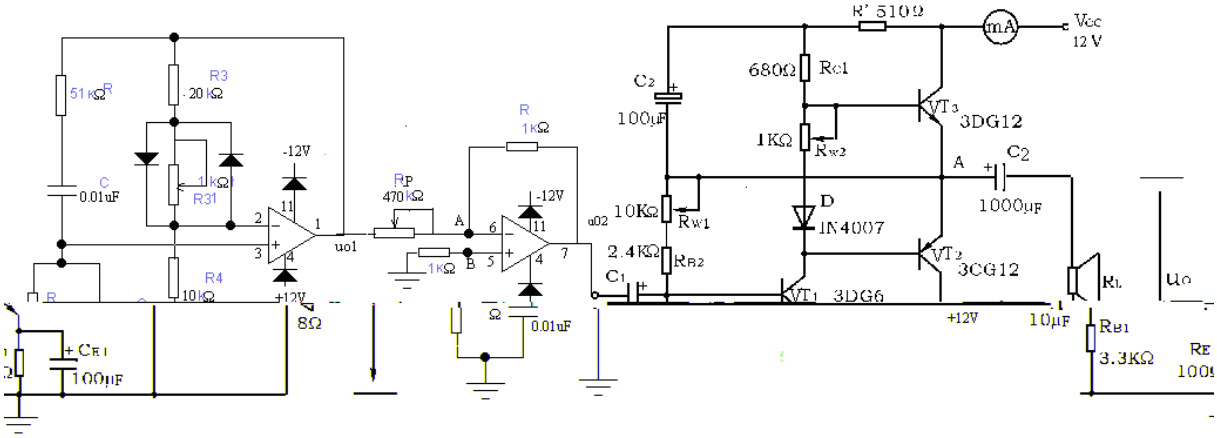


图 1.1.25

7

1

2

3

4 EWB Multisim

5

( )

6

7

实验八 直流稳压电源

1

1

2

3

2

1

2

3 个

4 U_O U_O 9V VT_1 VT_2

U_{CE1S})N

5 EWB Multisim

3

1 2

3 4

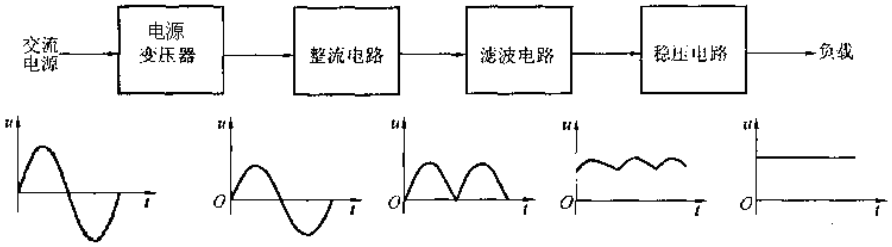
5 6

7

8 3DG6 3DG12 (9013) IN4007 IN4735

4

1.1.26 4



1.1.26

u_1(220V,50Hz) u_2

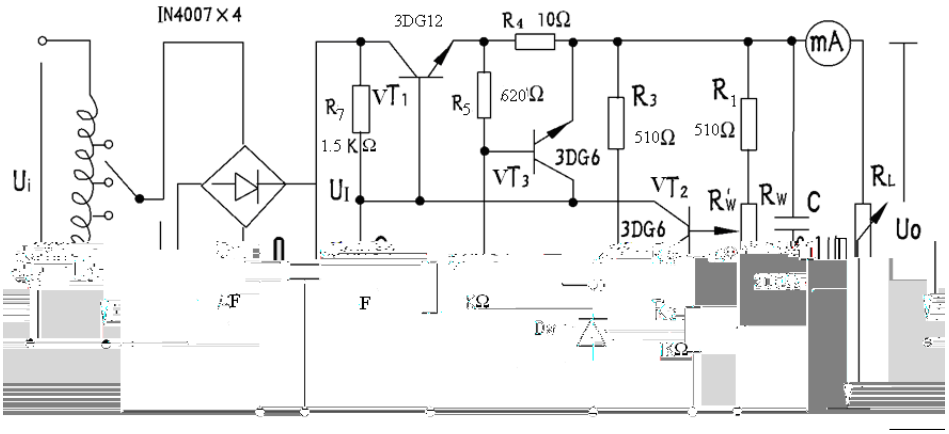
1.1.27 个 IN4007

串个 VT_1

VT_2 R_7 R_1 R_2 R_W R_3 D_W VT_3 R_4 R_5

R_6 个 串

VT_2 VT_1



1.1.27 个

了 严 个

1.3.18

严 VT_3 R_4 R_5 R_6

(1) U_O

$$U_O \quad \frac{R_1 + R_W + R_2}{R_2 + R_W''} \quad U_Z \quad U_{BE2}$$

R_W U_O

(2) R_O

R_o 串 U_I

$$R_o = \frac{\Delta U_O}{\Delta I_O} \Big|_{U_I =}$$

(3) S 串

$$S = \frac{\Delta U_O / U_O}{\Delta U_I / U_I} \Big|_{R_L =}$$

(3)

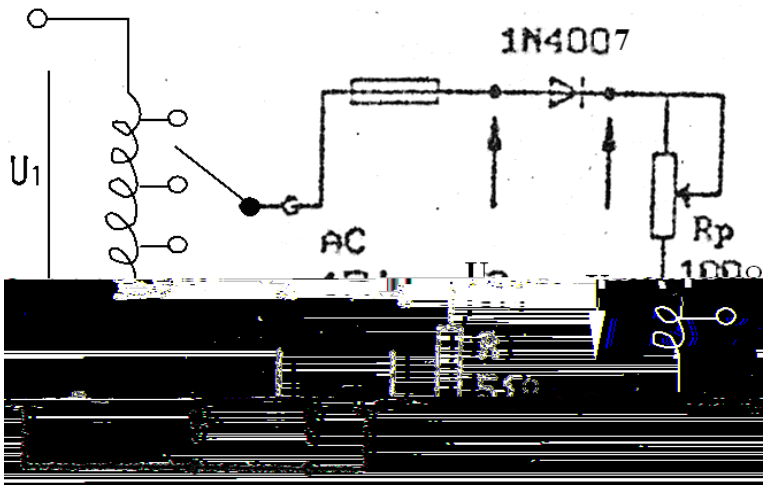
严

5

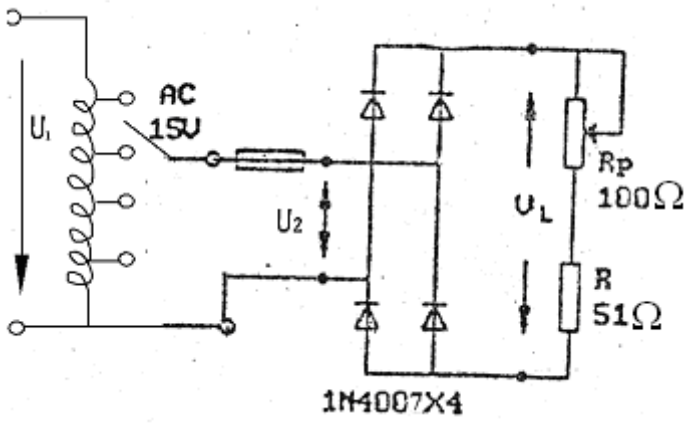
(1)

1.1.28 1.1.29

U_2 U_L U_2 U_L 了 1.1.26



1.1.28



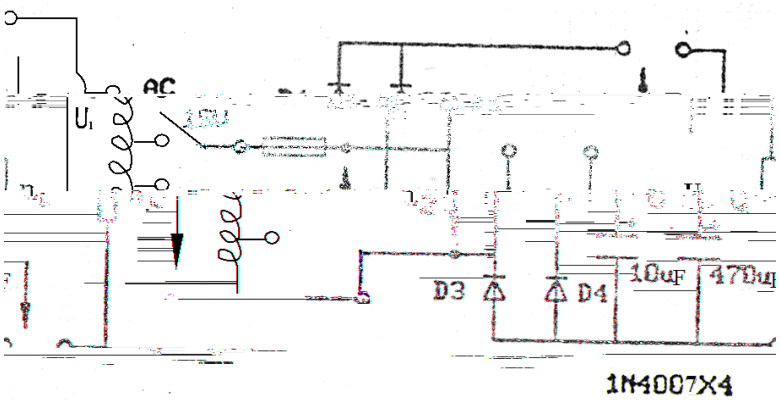
1.1.29

1.1.26

	1.3.19	1.3.20
U_2		
U_L		
U_2		
U_L		

(2)

1.1.30



1.1.30

1 R_L U_L 1.3.9

2 R_L R_L5) 1.1.27

1.1.27

		U_L	U_L

R_L5	10uF		
	470uF		
R_L5)	10uF		
	470uF		

(3) 个

1 9-15V

2 $I_o = 100mA$

3 $S_r < 0.5\%$

1 16V 串

U_I U_O R_W U_O

R_W

U_Z U_I U_O

U_{BE} U_{CE}

2

R_W U_{omin} U_{omax}

3 S

I_O 100mA 1.3.11 U_2

U_I U_O 1.1.29

1.1.29 I_O 100mA U_2=16V

U_2/V	U_I/V	U_O/V

4 R_O

U_2=16V I_O串 50mA 100mA U_O 1.1.30

1.1.30　U_2=16V

5

U_2　16V　U_O　9V　I_O　100mA　　$\overline{U}_O$

6)

a.　　R_W　R_L　U_o=9V　I_o=100mA

　　VT_3

b.　　R_L　I_O　　120mA　　U_O　　VT_3

　　R_4

c.

6

1　　严

2 串　　U_O　9V　　U_{Imin}　了

U_{2min}

3　　U_O　　R_W　　位

4

5　　S　R_O

7

1

2

3　EWB　Multisim

5

6 严