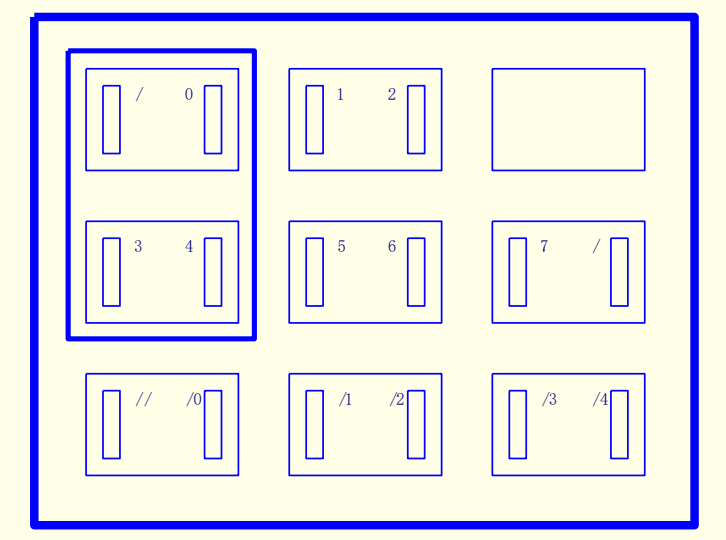
之



A/D D/A

U/F F/U

JP11 JP12 JP13 JP14 JP15

220V

220V ±5V ±12V ±15V 0 30V

ON

OFF

220V

1

2

3

4 什 什

5 什

6

7

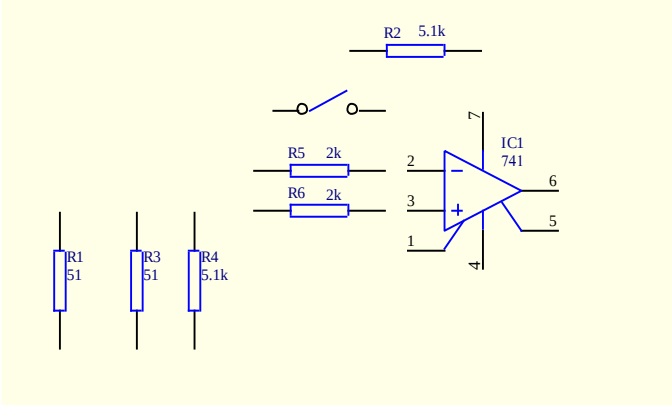
1 U_{OS} I_{OS}
A_{ud} *CMRR* U_{oppm} *GW*
2
3
4

1
2
3
4

1 $\boldsymbol{U_{OS}}$

mV U_{OS}

8-DIP
TO-99
2 3 6 7 4
8 1 5 1 5
1 5
1-1



1-1

S1 S2 U_{O1}

$$A_{uf} = \frac{U_{O1}}{U_{OS}} = \frac{R_1 + R_2}{R_1}$$

$$U_{OS} = \frac{R_1}{R_1 + R_2} \cdot U_{O1} = \frac{1}{101} \cdot U_{O1} \qquad 1\text{-}1$$

U_{OS} ± 1 20 mV U_{OS} 1mV

2 ***I*OS**

之

$$I_{OS} = \left| I_{B+} - I_{B-} \right|$$

I_{OS}

之

1-1 I_{OS} S1 S2 U_{O1}´

$$I_{OS} = \frac{U_{O1}' - U_{O1}}{A_{uf} \cdot R_5} = \frac{R_1}{R_1 + R_2} \cdot \frac{U_{O1}' - U_{O1}}{R_5} \qquad 1\text{-}2$$

I_{OS} 1nA

3 ***A*ud**

ΔU_o

ΔU_{id}

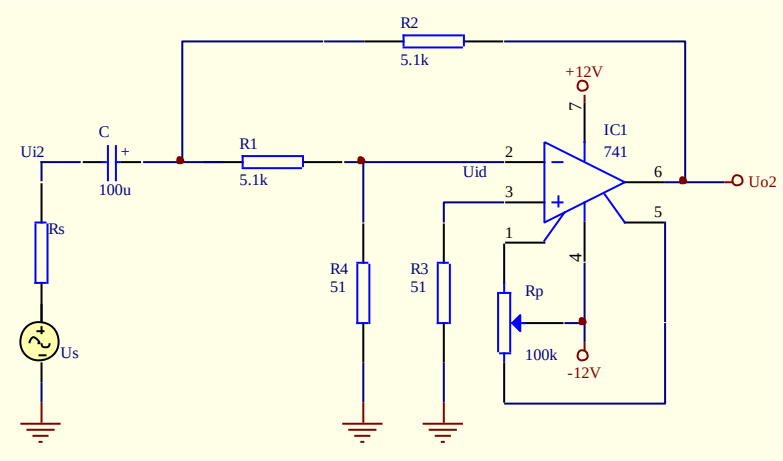
$$A_{ud} = \frac{\Delta U_o}{\Delta U_{id}}$$

dB

$$A_{ud}(\text{dB}) = 20\lg\left(\frac{\Delta U_o}{\Delta U_{id}}\right) \ (\text{dB})$$

Hz

1-2



1-2

1-2 R_2 R_1 R_4 R_2 Rs R_1 R_4 U_{id} C A_{ud}

$$A_{ud}(\mathrm{dB}) = 20\lg\left(\frac{\Delta U_{o2}}{\Delta U_{id}}\right) = 20\lg\left[\left(1+\frac{R_1}{R_4}\right)\cdot\frac{U_{O2}}{U_{i2}}\right]\cdot(\mathrm{dB}) \qquad 1\text{-}3$$

A_{ud} 60 70dB A_{ud} 80dB A_{ud} 100dB

4 ***CMRR***

A_{ud} A_{uc}

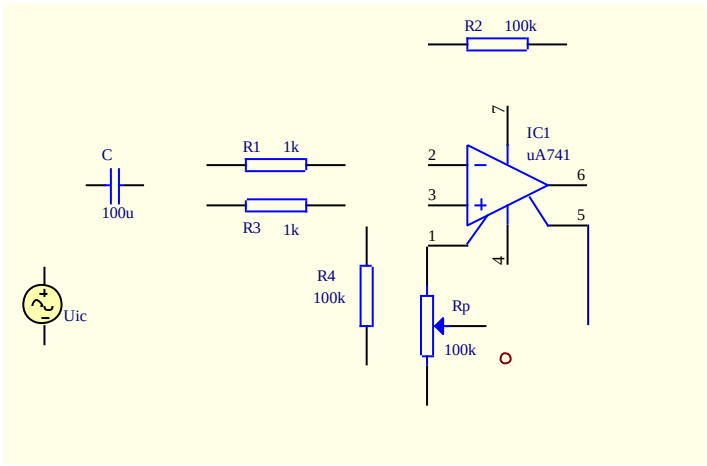
$$CMRR = \frac{A_{ud}}{A_{uc}}$$

dB *CMRR*

$$\mathrm{CMRR} = 20\lg\left(\frac{A_{ud}}{A_{uc}}\right)(\mathrm{dB})$$

CMRR 之 *CMRR*

1-3 *CMRR*



1-3 *CMRR*

$$|A_{ud}| = \frac{R_2}{R_1}$$

$|A_{uc}| = \frac{U_{oc}}{U_{ic}}$ *CMRR*

$$CMRR = 20\lg\left(\frac{R_2 U_{ic}}{R_1 U_{oc}}\right) \text{ (dB)} \qquad 1\text{-}4$$

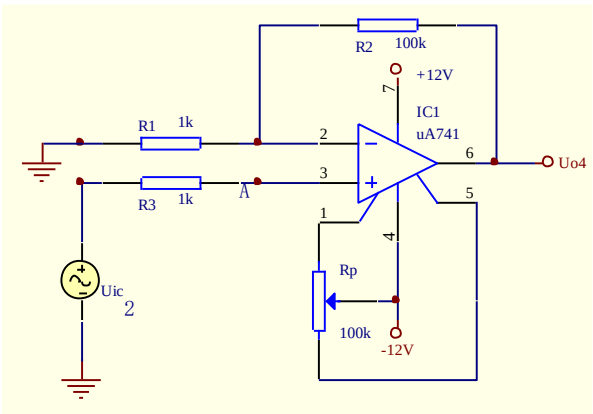
U_{oc} U_{ic} *CMRR* *CMRR* 80dB

5 $\boldsymbol{U_{oppm}}$

U_{oppm}

10V

1-4 U_{oppm}



1-4 U_{oppm}

6 ***GW***

GW 1

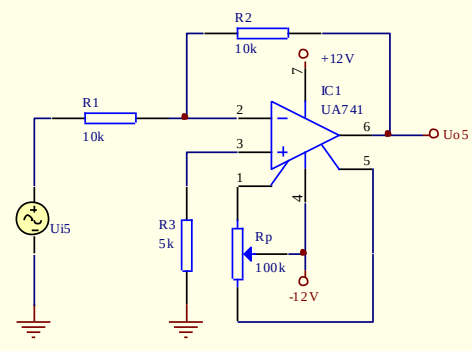
0.707

$$GW = A_{ud} f \qquad 1\text{-}5$$

GW

100~200mV

1-5 *GW*



1-5 *GW*

1 ***U*os** ***I*os**

1 Sa ON

2 S1 S2

U_{O1} U_{O1}

3 S1 S2 U_{O1}'

U_{O1}'

4 1-1 1-2 U_{OS} I_{OS}

Sa OFF

2 ***A*ud**

1 Sb ON

2 U_{i2} 100Hz 50mV

U_{O2} U_{i2} U_{O2}

3 1-3 A_{ud}

Sb OFF

3 ***CMRR***

1 Sc ON S3 S5 S7

2 U_{i3} 100Hz 1V

U_{O3} U_{i3} U_{O3} 之

U_{O3} U_{O3} A1

3 1-4 *CMRR*

Sc OFF

4 ***U*oppm**

1 Sc ON S4 S6 S8

2 U_{i4} 100Hz

U_{O4}

U_{oppm}

Sc OFF

5 ***GW***

1 Sd ON

2 U_{i5} 100mV

S_{R2}

$$A_u = \frac{U_{o5}}{U_{i5}} = 0.707$$

Sd OFF

1 U_{OS} I_{OS} A_{ud} *CMRR* U_{oppm} *GW*

2

3

1 U_{OS} I_{OS}

2 U_{OS} I_{OS}

3

4

5

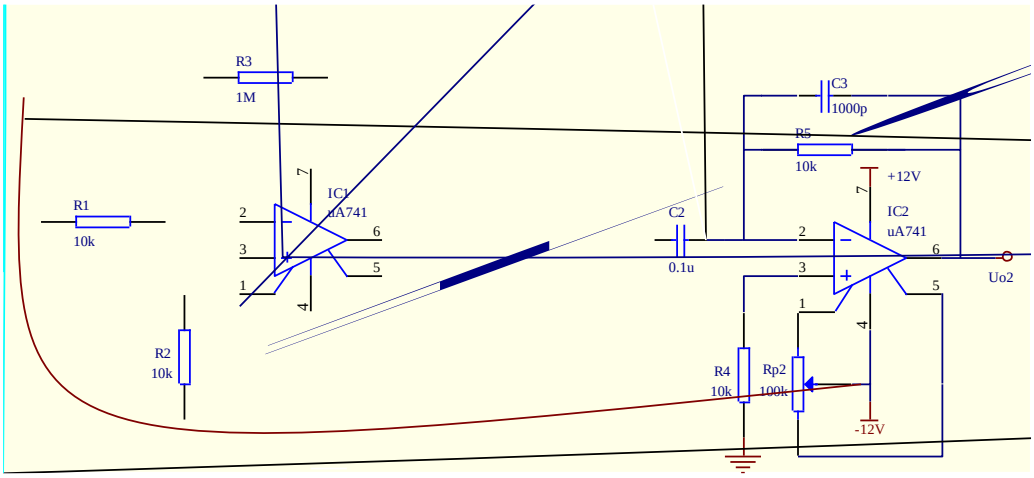
30

1
2

1
2
3
4

1 30

8-DIP TO-99



2-1

2-1 S1 IC1

$$u_{o1}(t) = -\frac{1}{R_1 C_1}\int u_{i1}(t)\mathrm{d}t \qquad 2\text{-}1$$

3

2-1 S1 S2 IC2

$$u_{o2}(t) = -R_5 C_2 \frac{\mathrm{d}u_{i2(t)}}{\mathrm{d}t} \qquad 2\text{-}2$$

4

2-1 S2 S1 IC1 IC2

1

1 S1

2 u_{i1} u_{O1} Rp1 U_{O1}=0 U_{O1}

3 u_{i1} 1kHz ±2V u_{i1} u_{O1} u_{i1} u_{O1} u_{i1} u_{O1} u_{i1} u_{O1}

4 u_{i1} 160Hz 1V u_{i1} u_{O1} u_{i1} u_{O1} u_{i1} u_{O1}

2

1 S1 S2

2 u_{i2} u_{O2} Rp2

u_{O2}=0 U_{O2}

3 u_{i2} 300Hz

±2V u_{i2} u_{O2} u_{i2} u_{O2}

4 u_{i2} 160Hz

1V u_{i2} u_{O2}

u_{i2} u_{O2}

3

1 S2 S1

2 u_{i1} 300Hz

±2V u_{O1} u_{O2} u_{O1} u_{O2}

1

2

3

LM311

1
2 LM311
3

1
2
3
4
5

之

3

5ns

TTL ECL HTL NMOS PMOS

LM311

1 LM311

LM311 ±5V ±l5V 100nA

6.0nA ±30V TTL DTL MOS

之

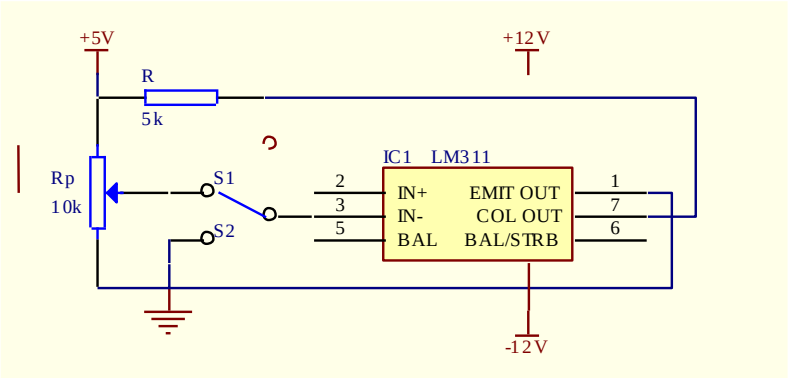
LM311 8-DIP TO-99 3-1 LM311

3-1 LM311

1	GND	3	IN	5	BALANCE	7	OUT
2	IN+	4	V	6	BALANCE/STROBE	8	V+

2

3-1



3-1

1

S2 S1 U_i

U_o'=5V U_i'（ 0 U_o'=0

2

S1 S2 Rp

E_r 0（ E_r U_i E_r U_o'=5V

U_i'（ E_r U_o'=0

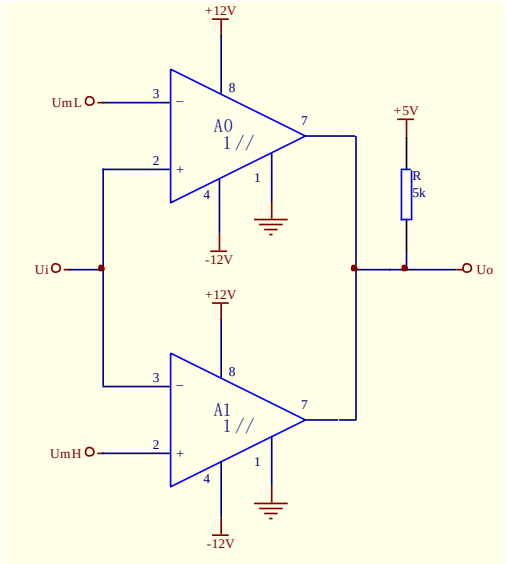
3

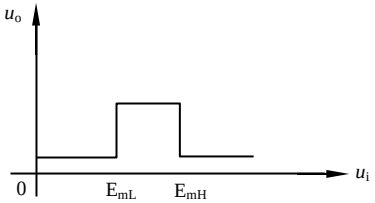
u_i

E_{mL} E_{mH}

ΔE_m u_i ΔE_m

3-2





3-2 3-3

3-2 IC2 IC3 LM311 LM311

U_i（ E_{mL} （ E_{mH} IC2 IC3

U_i E_{mH} IC2 IC3

E_{mL}（ U_i（ E_{mH} IC2 IC3

3-3

1

1

S2 u_i' 1kHz 2V u_i' u_o' 之 u_o' u_o' A1

S2 u_i' u_i' u_o' u_i' u_o' 之 u_o' u_o' A1

2

S1 Rp E_r u_i' 1kHz 2V u_i' u_o' 之 u_o' u_o' A1

S1 Rp E_r u_i' u_i' u_o' u_i' u_o' 之 u_o' u_o' A1

2

1 E_{mL} E_{mH} E_{mL}=2V E_{mH}=4V u_i 1kHz 10V u_i u_o

2 E_{mH} E_{mL} u_i u_o

1

2

3

ICL8038

1 ICL8038
2 ICL8038
3

1
2

1 ICL8038

ICL8038
代 IC ICL8038 IC
之
ICL8038
0.001Hz 500kHz
0.5

+10V +30V ±5V ±15V
50ppm/ºC

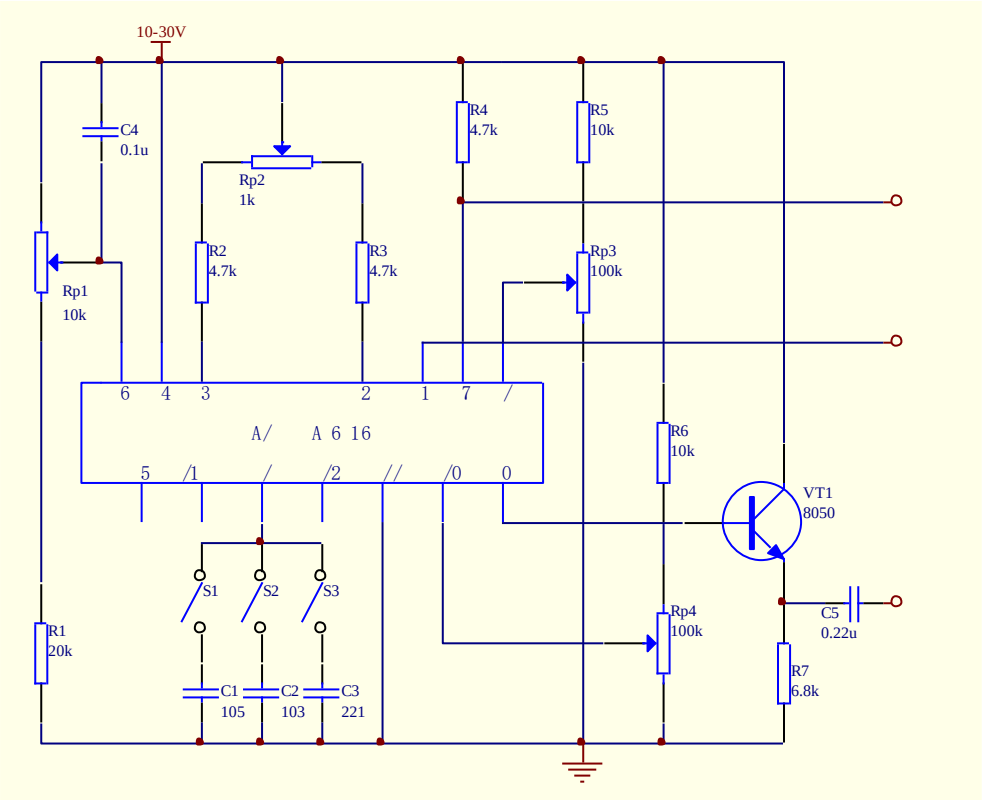
ICL8038 14-DIP 4-1 ICL8038

4-1 ICL8038

1	SINE WAVE SINADJ$_1$	6	V_+	11	V^- OR AND
2	SINE WAVE OUT	7	FM BIAS	12	SINE WAVE SINADJ$_2$
3	TRIANGLE OUT	8	FM SWEEP INPUT	13	NC
4	DUTY CYCLE	9	SQUARE WAVE OUT	14	NC
5	FREQUENCY DFADJ	10	TIMING CAPACITOR		

2 ICL8038

4-1 ICL8038



4-1 ICL8038

4-1 8

9 R_3=4.7K R_{P2}

R_{P1} R_{P2} R_{P3}

R_{P1} R_{P3} R_{P2}

R_{P1} $+V_{CC}$ 8

R_{P2} R_{P2}

1 S2 S1 S3

R_{p2} 50

R_{p1}

R_{p1}

2 S2 S1 S3 50

R_{p4} R_{p3} R_{p1}

R_{p1}

3 S2 S1 S3 50

R_{p1}

4 3 S1 S2 S3 S2
S1 S3 S3 S1 S2 R_{p2}
10 90
5 4 R_{p1} R_{p2} R_{p3} R_{p4}

1 1 2 3
2 4
3 5
4