

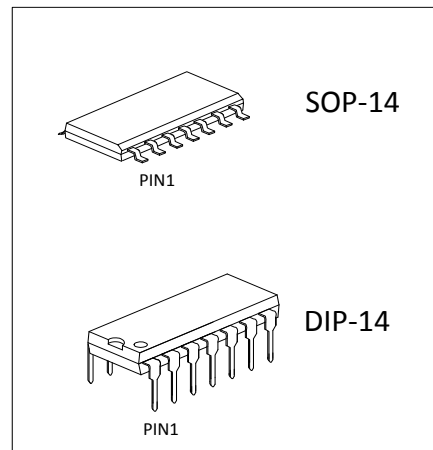


### 概述:

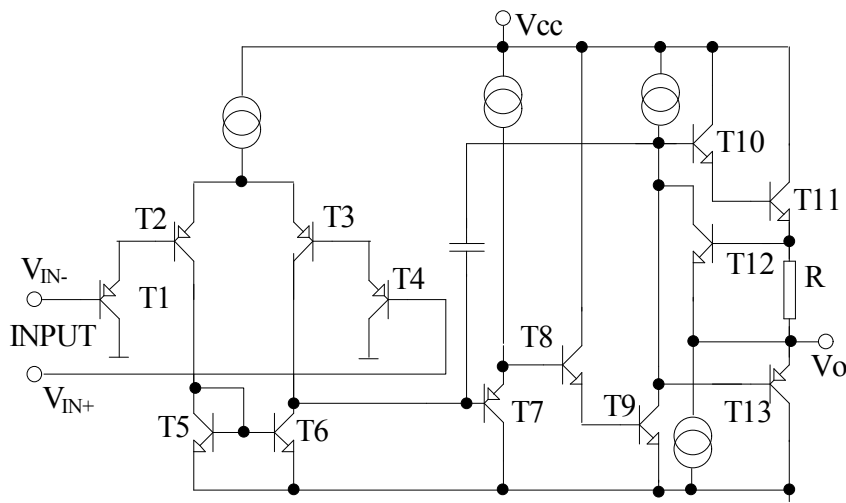
本电路为高性能、具有四个独立的运算放大器，内含相位补偿电路，适用于收录机和音调系统作音调均衡网络，也用于其他场合。采用SOP14/DIP14塑料封装。

### 主要特点:

- 无需外接相位补偿电路
- 电源电压范围宽：单电源时， $V_{CC}=3\sim 20V$ ，双电源时， $V_{CC}=\pm 1.5V\sim 10V$
- 功耗电流小： $I_{CC}=0.7mA$ （典型）（ $R_L=\infty$ ）
- 输入电压范围可接近地电平



### 内部电路图

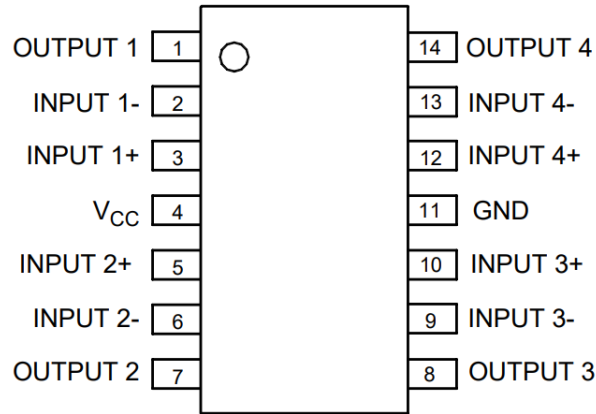


### 原理简介

LM324N 由四个完全相同的运算放大器组成，单元电路如上图所示，其工作原理简要说明如下：输入信号加 $T_1$ 、 $T_4$ 基极，经差分放大后； $T_8$ 、 $T_9$ 复合放大构成中间级；输出级由 $T_{10}\sim T_{13}$ 组成。其中 $T_{12}$ 为保护管，当输出电流过大时， $R$ 上压降增大使 $T_{12}$ 饱和导通， $T_{12}$ 集电极电位下降，接近 $1/2V_{CC}$ ，使得推挽管 $T_{10}$ 、 $T_{11}$ 和 $T_{13}$ 截止，从而起到保护作用。电容 $C$ 为相位补偿电容。



### 引出端功能符号



引出端序号	功 能	符 号	引出端序号	功 能	符 号
1	输出 1	OUT <sub>1</sub>	8	输出 3	OUT <sub>3</sub>
2	反向输入 1	IN- (1)	9	反向输入 3	IN- (3)
3	正向输入 2	IN+ (2)	10	正向输入 3	IN+ (3)
4	电源	V <sub>cc</sub>	11	地	GND
5	正向输入 2	IN+ (2)	12	正向输入 4	IN+ (4)
6	反向输入 2	IN- (2)	13	反向输入 4	IN- (4)
7	输出 2	OUT <sub>2</sub>	14	输出 4	OUT <sub>4</sub>

### 极限值 (绝对最大额定值, 若无其它规定, T<sub>amb</sub>=25℃)

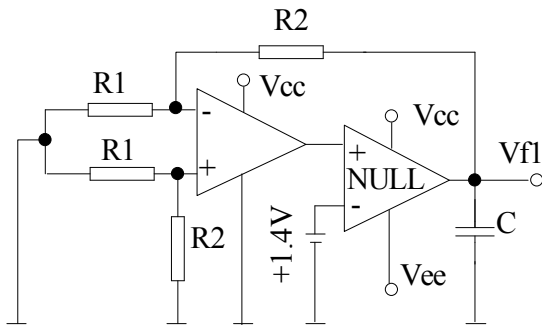
参 数	符 号	测 试 条 件	额 定 值	单 位
电源电压	V <sub>cc</sub>		24	V
差动输入电压	V <sub>ID</sub>		24	V
最大输入电压	V <sub>IN</sub>		-0.3~24	V
允许功耗	P <sub>D</sub>		600	mW
工作温度	T <sub>opr</sub>		0~+70	℃
贮存温度	T <sub>stg</sub>		-55~+125	℃



电特性 (若无其它规定,  $V_{cc}=5V$ ,  $T_{amb}=25^{\circ}C$ )

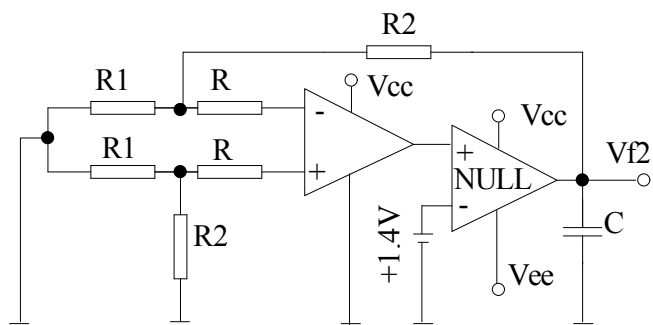
参数	符号	测试条件	最小值	典型值	最大值	单位
失调输入电压	$V_{IO}$			$\pm 2$	$\pm 7$	mV
输入失调电流	$I_{IO}$	$I_{in(+)} / I_{in(-)}$		$\pm 5$	$\pm 50$	nA
输入偏置电流	$I_{BA}$		45	250	nA	
共模输入电压范围	$V_{ICM}$		0		$V_{cc}-1.5$	V
共模抑制比	$K_{CMR}$		65	80		dB
强信号电压增益	$G_V$	$V_{cc}=15V, R_L \geq 2k\Omega$	25	100		V/mV
输出电压范围	$V_o$		0		$V_{cc}-1.5$	V
电源纹波抑制比	PSRR		65	100		dB
通道分离	$C_s$	$f=1kHz \sim 20kHz$		120		dB
消耗电流 (1)	$I_{cc}$			0.7	2	mA
消耗电流 (2)	$I_{cc}$	$V_{cc}=20V$		1.5	3	mA
输出电流 (1)	$I_o$	$V_{in}^+=1V, V_{in}^-=0V$	20	40		mA
输出电流 (2)	$I_o$	$V_{in}^+=0V, V_{in}^-=1V$	10	20		mA

测试原理图 (注: NULL 指零放大器)



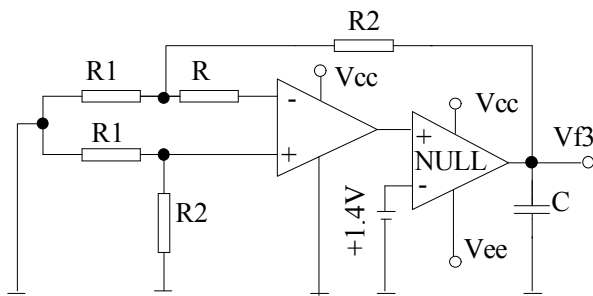
$$V_{io} = V_{f1} / (1 + R_2/R_1)$$

输入失调电压  $V_{io}$  测试图



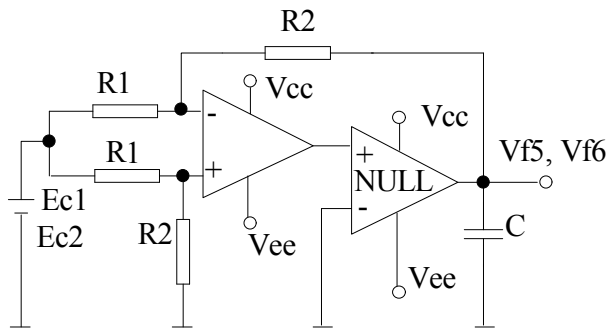
$$I_{io} = (V_{f2} - V_{f1}) / R (1 + R_2/R_1)$$

输入失调电流  $I_{io}$  测试图

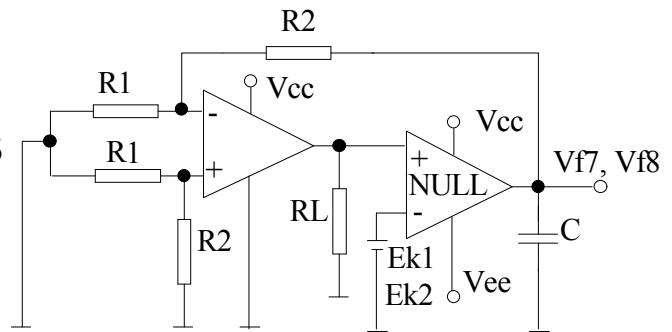


$$I_{BA} = (V_{f4} - V_{f3}) / 2R (1 + R_2/R_1)$$

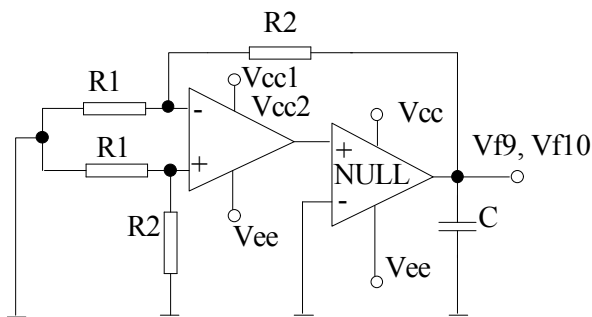
输入偏置电流  $I_{BA}$  测试图



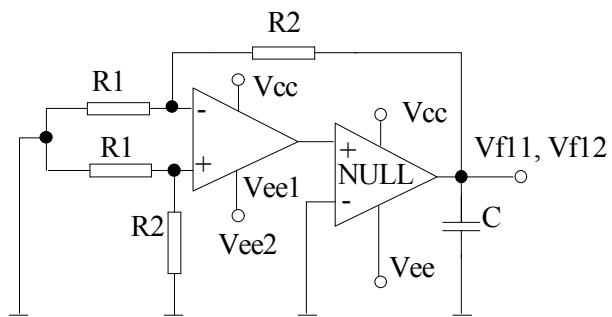
$CMR=20\log \left| \frac{(Ec1-Ec2)(1+R2/R1)}{(Vf5-Vf6)} \right|$   
共模抑制比 CMR 及共模输入电压范围  $V_{icm}$  测试图



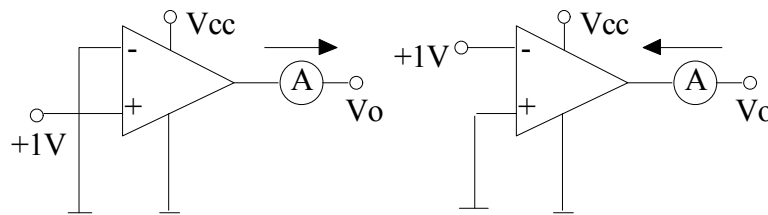
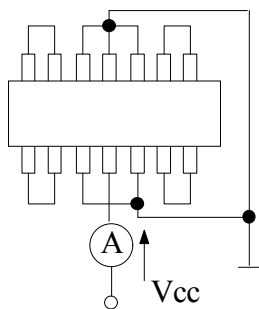
$G_v = \frac{(Ek1-Ek2)(1+R2/R1)}{(Vf8-Vf7)}$   
电压增益  $G_v$  测试图



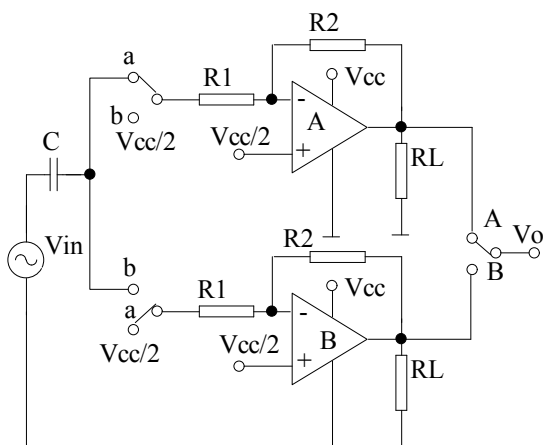
$PSRR (+) = 20\log \left| \frac{(Vcc1-Vcc2)(1+R2/R1)}{(Vf9-Vf10)} \right|$   
电源纹波抑制比 PSRR 测试图



$PSRR (-) = 20\log \left| \frac{(Vee1-Vee2)(1+R2/R1)}{(Vf11-Vf12)} \right|$   
电源纹波抑制比 PSRR 测试图



消耗电流  $I_{cc}$  及输出电流  $I_o$  测试图



通道分离度  $C_s$  测试图

SW: A

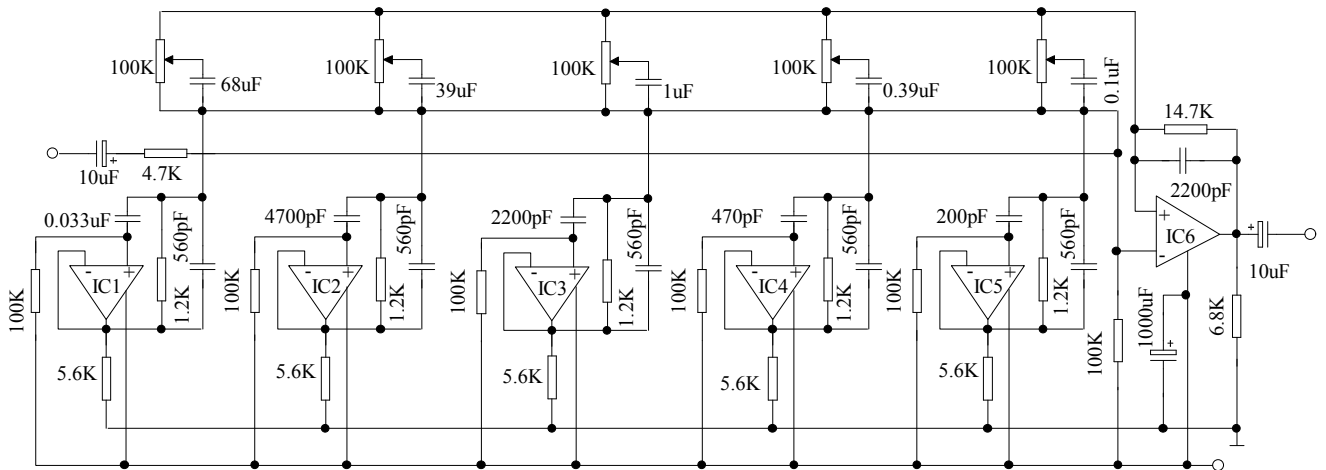
$$C_s (A \rightarrow B) = 20\log \left( \frac{R2 \cdot V_{oA}}{R1 \cdot V_{oB}} \right)$$

SW: B

$$C_s (B \rightarrow A) = 20\log \left( \frac{R2 \cdot V_{oB}}{R1 \cdot V_{oA}} \right)$$

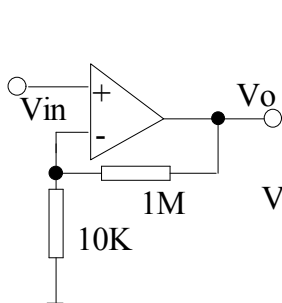


### 应用图

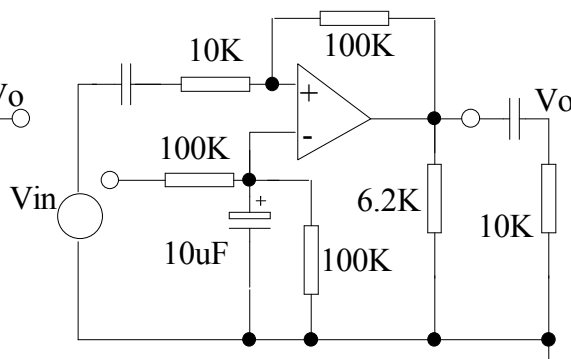


LM324N 用于五频率音调控制电路

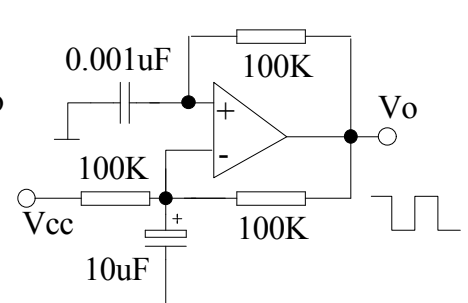
直流放大器



倒相放大器

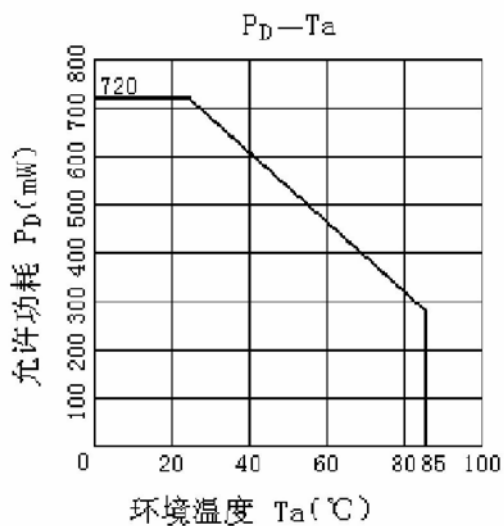


矩形波发生器



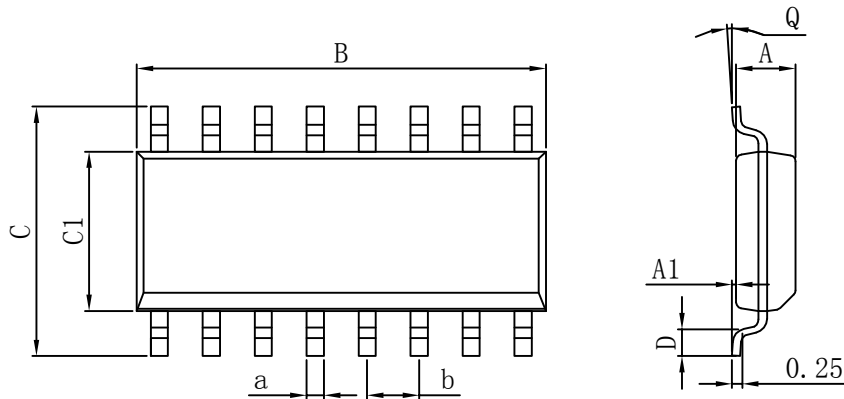
LM324N 的其它应用

### 特性曲线



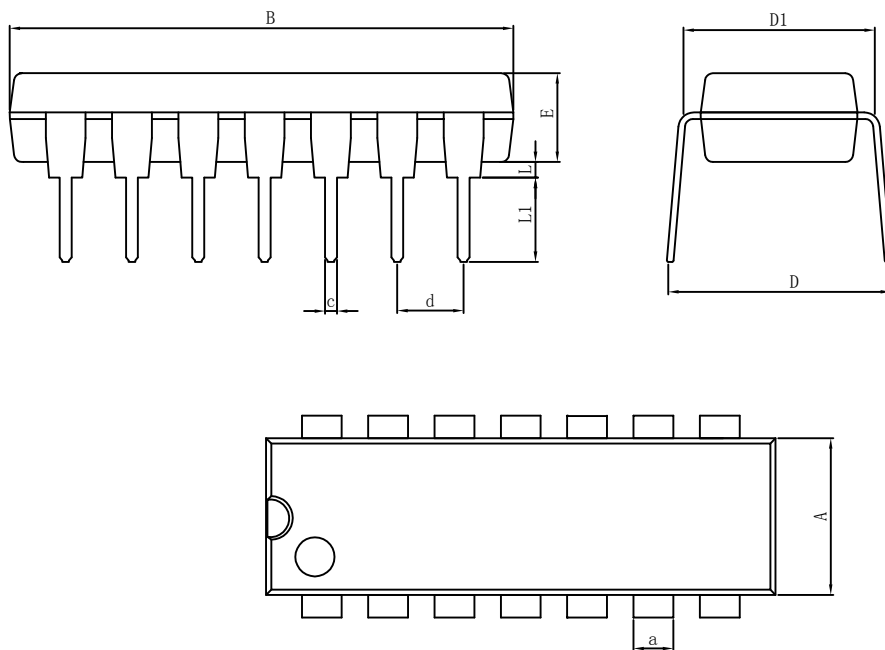


SOP14



UNIT: mm							
DIM.	MIN	TYP	MAX	DIM.	MIN	TYP	MAX
A	4.520	4.570	4.620	a	0.400	0.420	0.440
A1	0.100	-	0.250	b	1.260	1.270	1.280
B	8.500	8.750	9.000	Q	0°	-	8°
C	5.800	6.100	6.250				
C1	3.800	3.900	4.000				
D	0.400	-	0.950				

DIP14



UNIT: mm							
DIM.	MIN	TYP	MAX	DIM.	MIN	TYP	MAX
A	6.100	6.300	6.680	a	1.504	1.524	1.544
B	18.940	19.200	19.560	c	0.437	0.457	0.477
D	8.200	8.700	9.200	d	2.530	2.540	2.550
D1	7.42	7.62	7.82	L	0.500	-	0.800
E	3.100	3.300	3.550	L1	3.000	3.200	3.600



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