



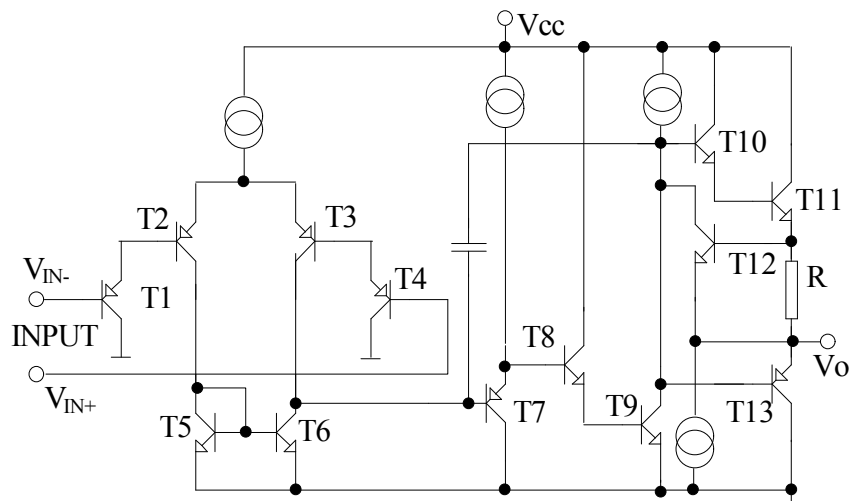
概述:

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SOP-14/DIP-14(PDIP-14)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

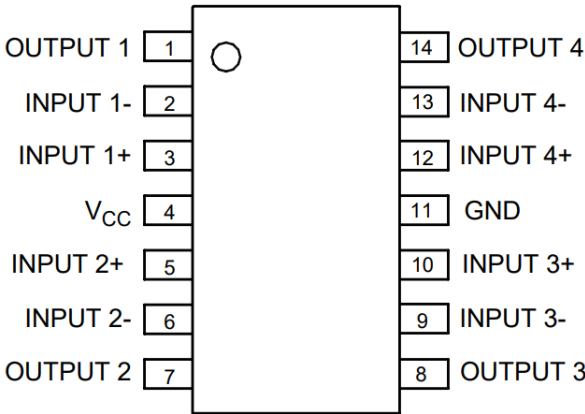


原理简介

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 ₁	8	输出 3	OUT ₃
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 _{CC}	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 ₂	14	输出 4	OUT ₄

极限值 (绝对最大额定值, 若无其它规定, Tamb=25℃)

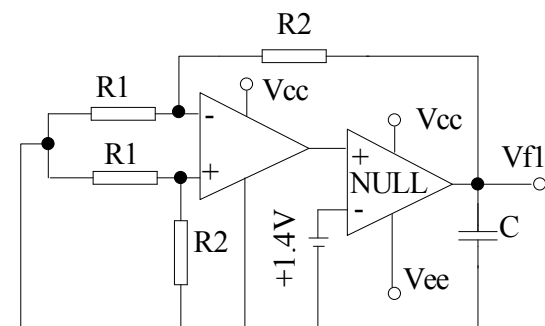
参 数	符 号	测 试 条 件	额 定 值	单 位
电源电压	V _{CC}		24	V
差动输入电压	V _{ID}		24	V
最大输入电压	V _{IN}		-0.3~24	V
允许功耗	P _D		600	mW
工作温度	T _{opr}		0~+70	℃
贮存温度	T _{stg}		-55~+125	℃



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

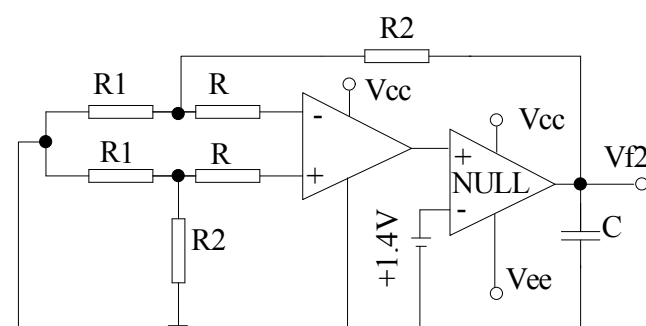
参数	符号	测试条件	最小植	典型值	最大值	单位
失调输入电压	V_{IO}			± 2	± 7	mV
输入失调电流	I_{IO}	$I_{in(+)} / I_{in(-)}$		± 5	± 50	nA
输入偏置电流	I_{BA}			45	250	nA
共模输入电压范围	V_{ICM}		0		$V_{CC}-1.5$	V
共模抑制比	K_{CMR}		65	80		dB
强信号电压增益	G_V	$V_{CC}=15V, R_L \geq 2k\Omega$	25	100		V/mV
输出电压范围	V_O		0		$V_{CC}-1.5$	V
电源纹波抑制比	$PSRR$		65	100		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)



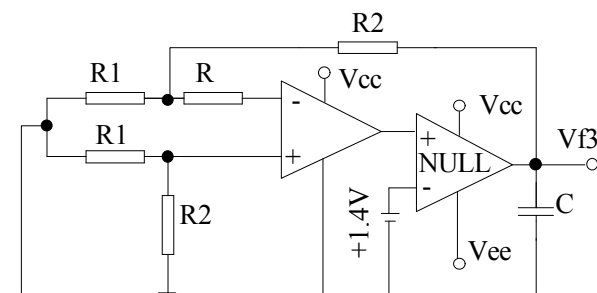
$$V_{IO} = V_{f1} / (1 + R_2/R_1)$$

输入失调电压 V_{IO} 测试图



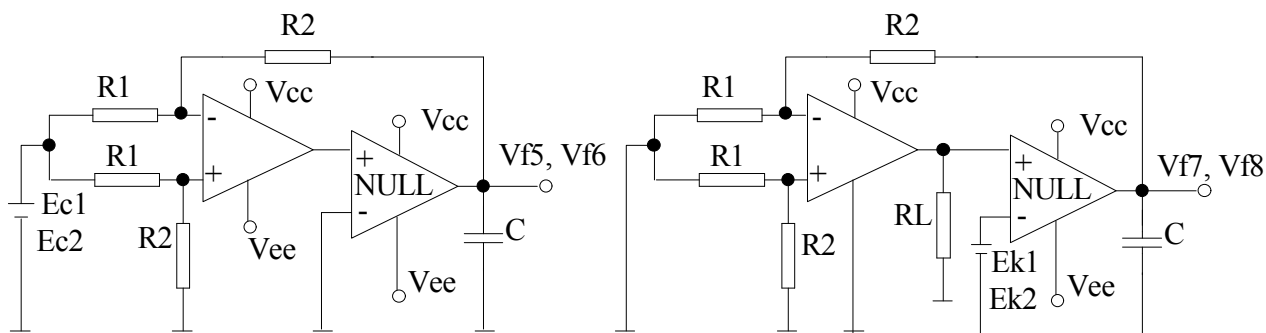
$$I_{IO} = (V_{f2} - V_{f1}) / R (1 + R_2/R_1)$$

输入失调电流 I_{IO} 测试图



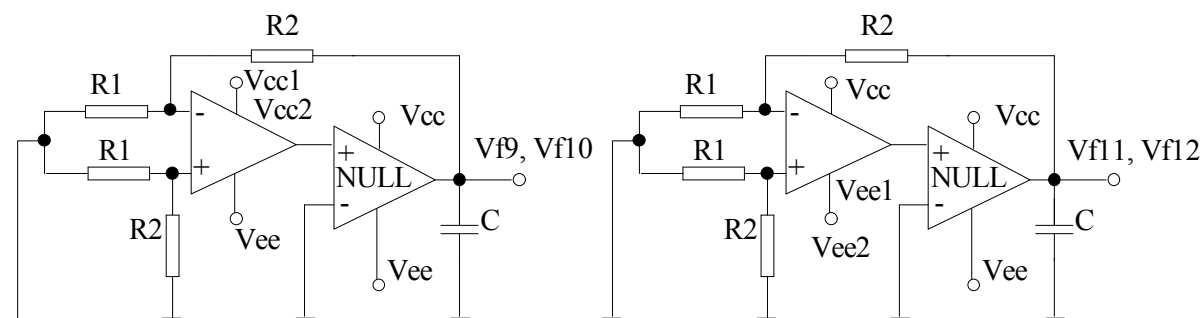
$$I_{BA} = (V_{f4} - V_{f3}) / 2R (1 + R_2/R_1)$$

输入偏置电流 I_{BA} 测试图

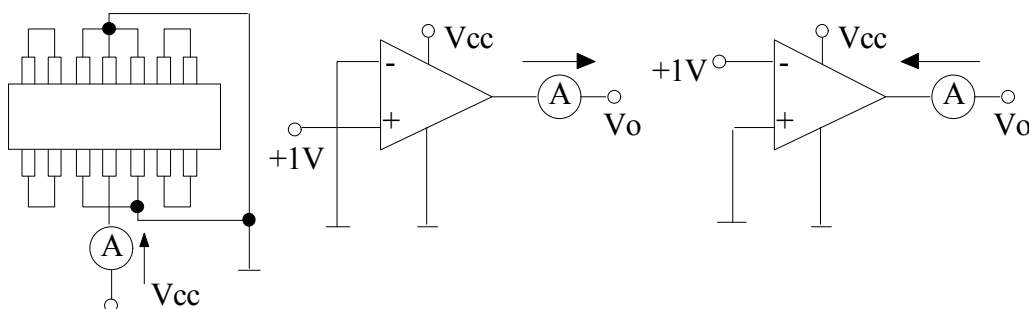


$CMR=20\log \left| (Ec1-Ec2) (1+R2/R1) / (Vf5-Vf6) \right|$
共模抑制比 CMR 及共模输入电压范围 V_{ICM} 测试图

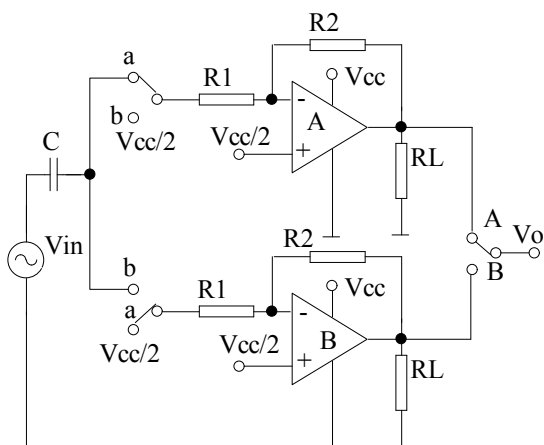
$G_v = (Ek1-Ek2) (1+R2/R1) / (Vf8-Vf7)$
电压增益 G_v 测试图



$PSRR (+) = 20\log \left| (Vcc1-Vcc2) (1+R2/R1) / (Vf9-Vf10) \right|$
 $PSRR (-) = 20\log \left| (Vee1-Vee2) (1+R2/R1) / (Vf11-Vf12) \right|$
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

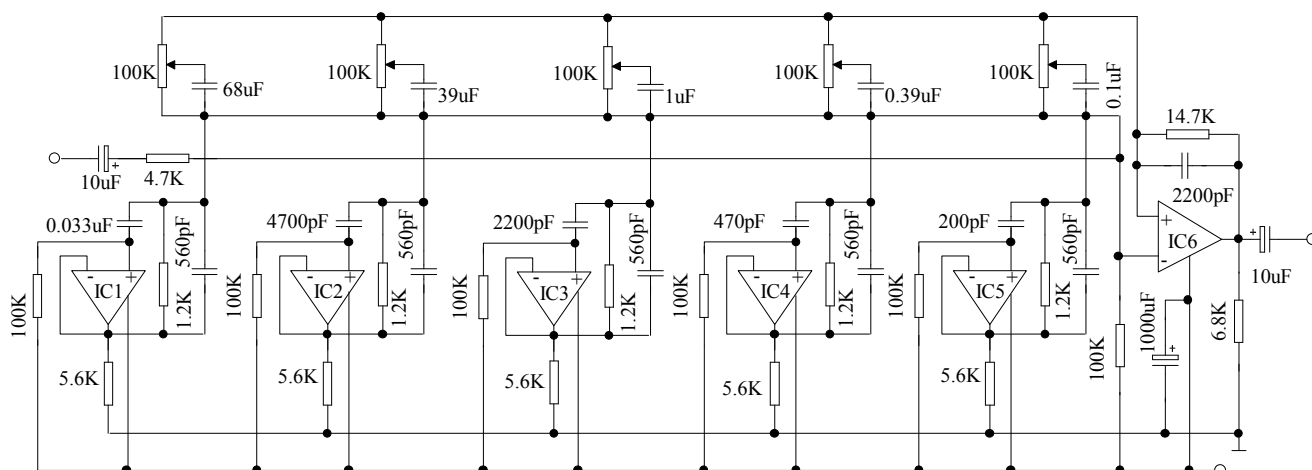
$$C_s (A \rightarrow B) = 20\log (R2*V_{OA}) / (R1*V_{OB})$$

SW: B

$$C_s (B \rightarrow A) = 20\log (R2*V_{OB}) / (R1*V_{OA})$$

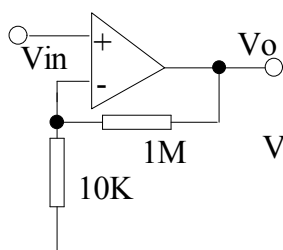


应用图

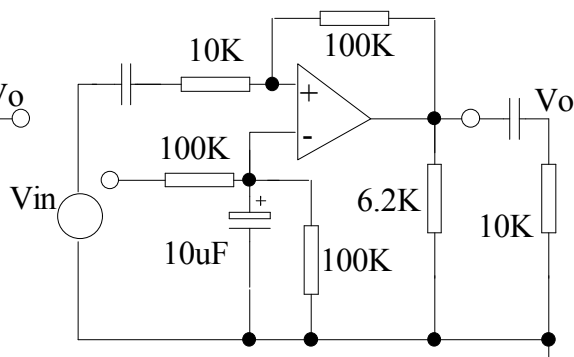


LM324N 用于五频率音调控制电路

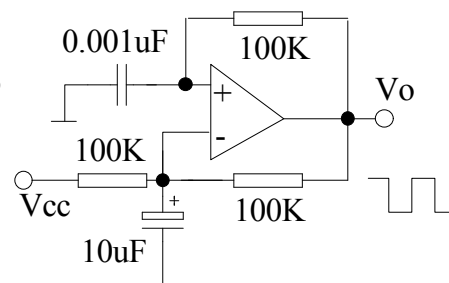
直流放大器



倒相放大器

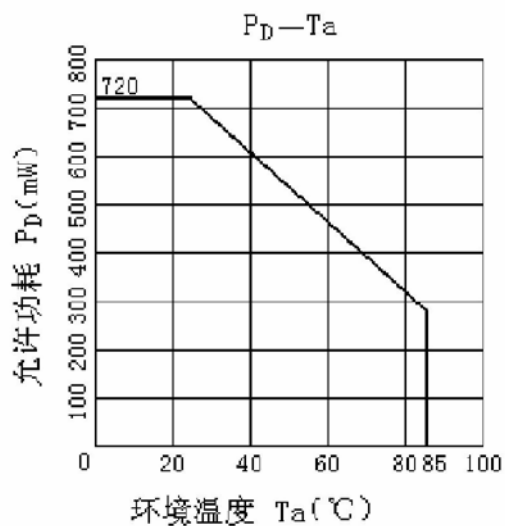


矩形波发生器



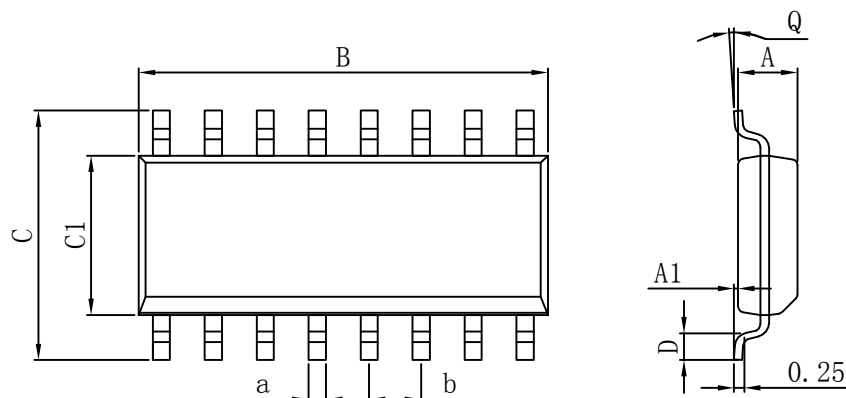
LM324N 的其它应用

特性曲线



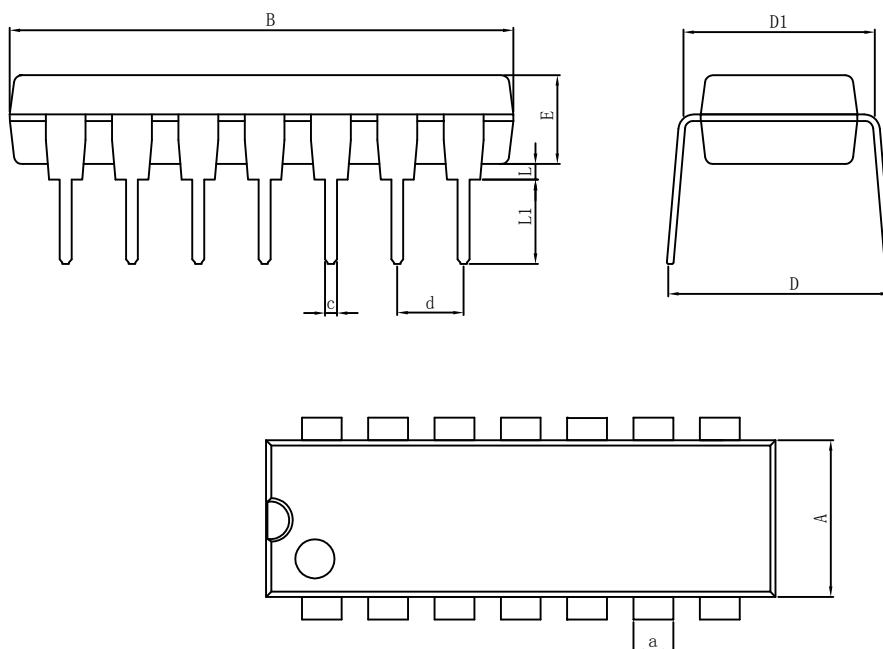


SOP-14



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				

DIP-14(PDIP-14)



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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