



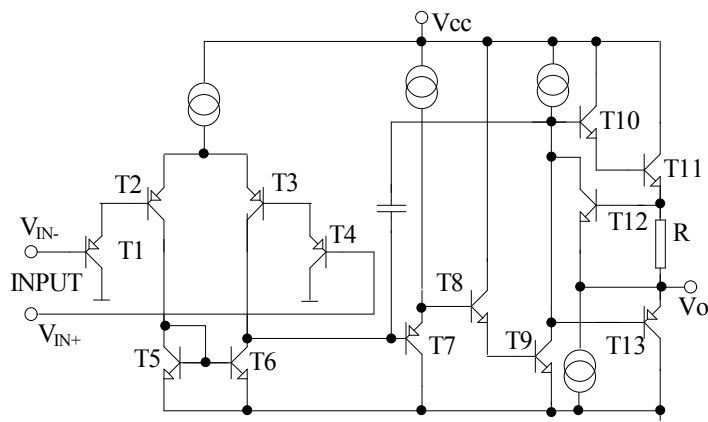
### 概述:

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:

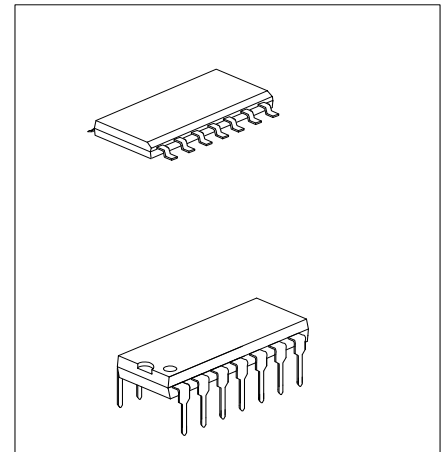
- 无需外接相位补偿电路
- 电源电压范围宽：单电源时， $V_{CC}=3\sim 20V$ ，双电源时， $V_{CC}=\pm 1.5V\sim 10V$
- 功耗电流小： $I_{CC}=0.7mA$ （典型）（ $R_L=\infty$ ）
- 输入电压范围可接近地电平

### 内部电路图



### 原理简介

324由四个完全相同的运算放大器组成，单元电路如图所示，其工作原理简要说明如下：输入信号加到  $T_1$ 、 $T_4$  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>



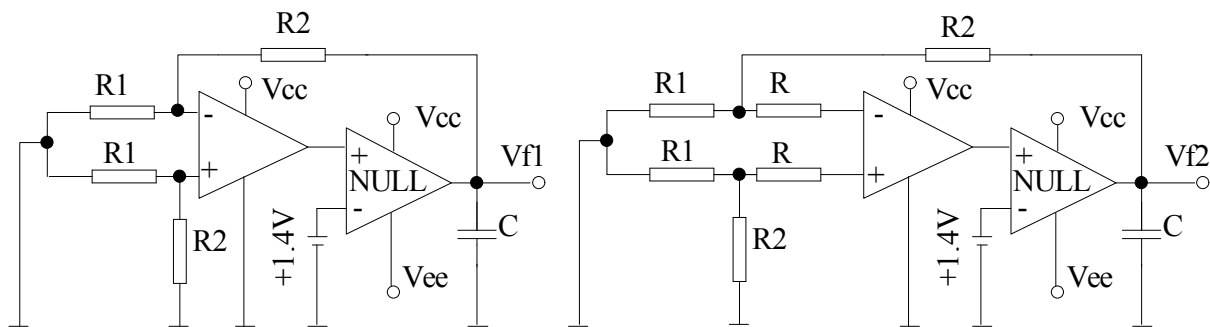
**极限值** (绝对最大额定值, 若无其它规定,  $T_{amb}=25^{\circ}C$ )

参 数	符 号	测 试 条 件	额 定 值	单 位
电源电压	V <sub>CC</sub>		24	V
差分输入电压	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	°C
贮存温度	T <sub>stg</sub>		-55~+125	°C

**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 <sub>IO</sub>			±2	±7	mV
输入失调电流	I <sub>IO</sub>	I <sub>in(+)</sub> /I <sub>in(-)</sub>		±5	±50	nA
输入偏置电流	I <sub>BA</sub>			45	250	nA
共模输入电压范围	V <sub>ICM</sub>		0		V <sub>CC</sub> -1.5	V
共模抑制比	K <sub>CMR</sub>		65	80		dB
强信号电压增益	G <sub>V</sub>	V <sub>CC</sub> =15V, R <sub>L</sub> ≥ 2 kΩ	25	100		V/mV
输出电压范围	V <sub>O</sub>		0		V <sub>CC</sub> -1.5	V
电源纹波抑制比	PSRR		65	100		dB
通道分离	C <sub>S</sub>	f=1kHz~20kHz		120		dB
消耗电流 (1)	I <sub>CC</sub>			0.7	2	mA
消耗电流 (2)	I <sub>CC</sub>	V <sub>CC</sub> =20V		1.5	3	mA
输出电流 (1)	I <sub>O</sub>	V <sub>in+</sub> =1V, V <sub>in-</sub> =0V	20	40		mA
输出电流 (2)	I <sub>O</sub>	V <sub>in+</sub> =0V, V <sub>in-</sub> =1V	10	20		mA

**测试原理图** (注: NULL 指零放大器)

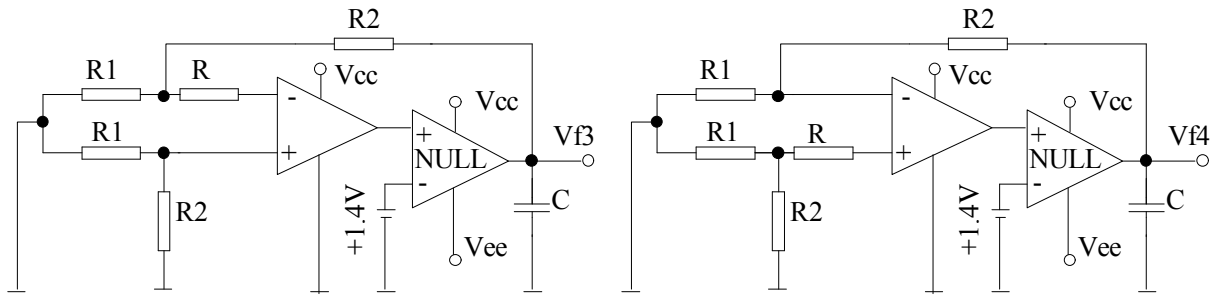


$$V_{io} = V_{f1} / (1 + R_2/R_1)$$

输入失调电压  $V_{io}$  测试图

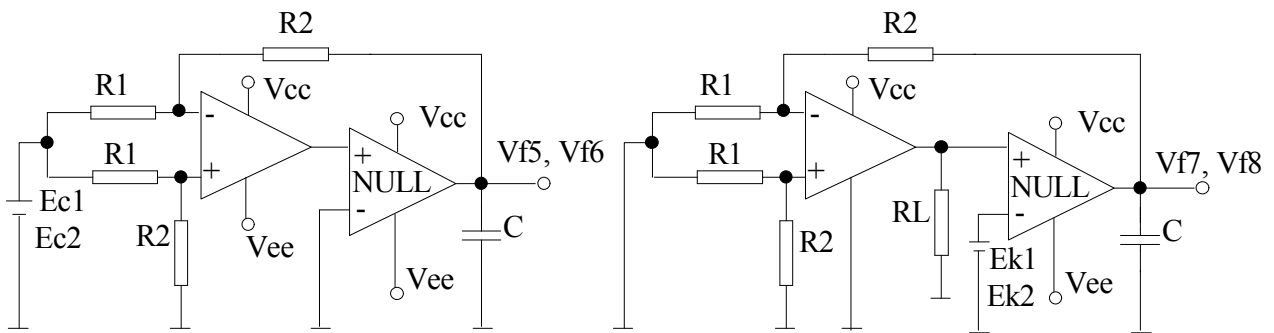
$$I_{io} = (V_{f2} - V_{f1}) / R (1 + R_2/R_1)$$

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

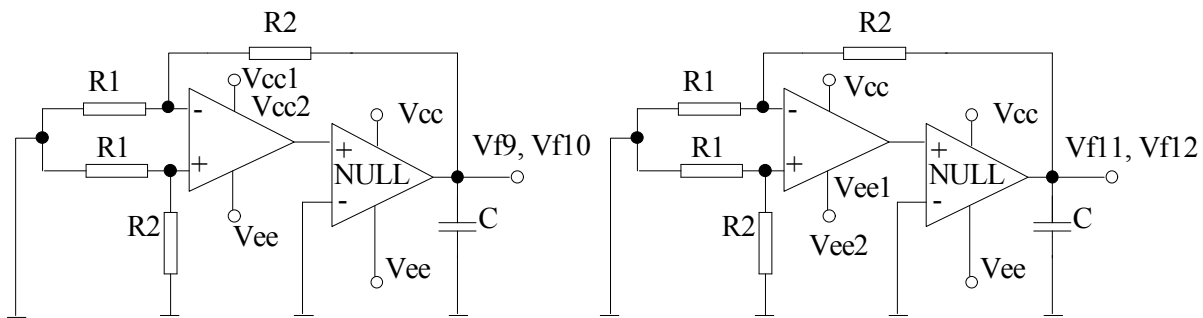


$$CMR = 20 \log \left| \frac{(E_{c1} - E_{c2}) (1 + R_2/R_1)}{(V_{f5} - V_{f6})} \right|$$

共模抑制比 CMR 及共模输入电压范围  $V_{ICM}$  测试图

$$G_v = \frac{(E_{k1} - E_{k2}) (1 + R_2/R_1)}{(V_{f8} - V_{f7})}$$

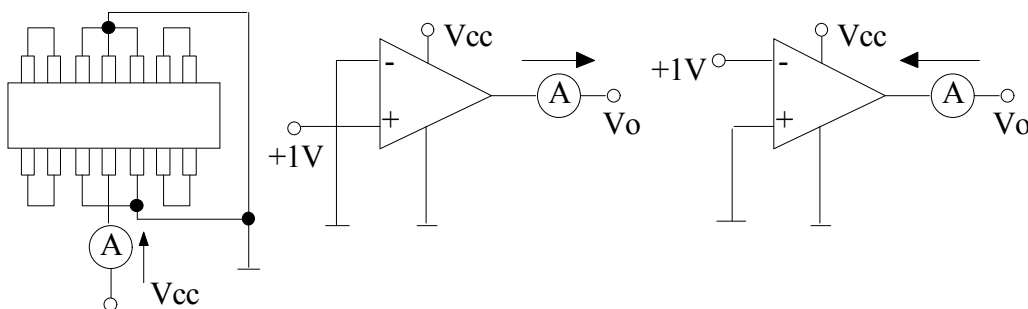
电压增益  $G_v$  测试图



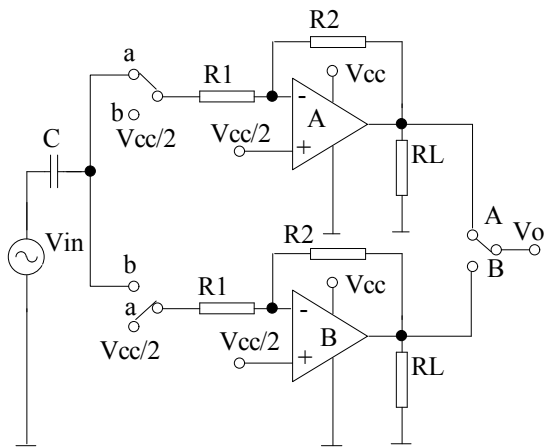
$$PSRR (+) = 20 \log \left| \frac{(V_{cc1} - V_{cc2}) (1 + R_2/R_1)}{(V_{f9} - V_{f10})} \right|$$

$$PSRR (-) = 20 \log \left| \frac{(V_{ee1} - V_{ee2}) (1 + R_2/R_1)}{(V_{f11} - V_{f12})} \right|$$

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 Cs 测试图

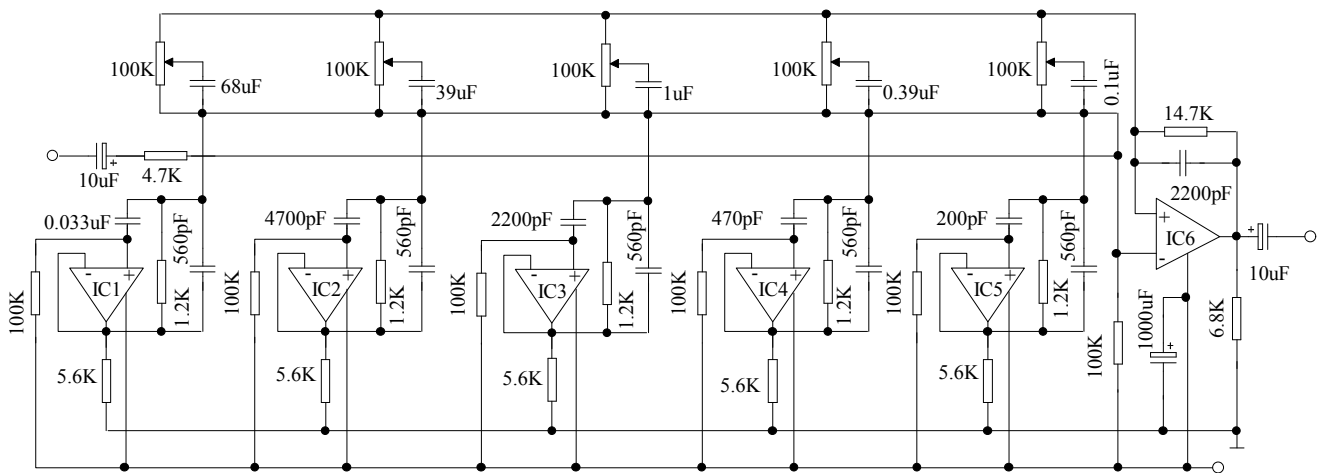
SW: A

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

SW: B

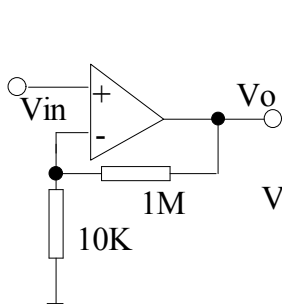
$$Cs (B \rightarrow A) = 20 \log (R2 * V_{OB}) / (R1 * V_{OA})$$

应用图

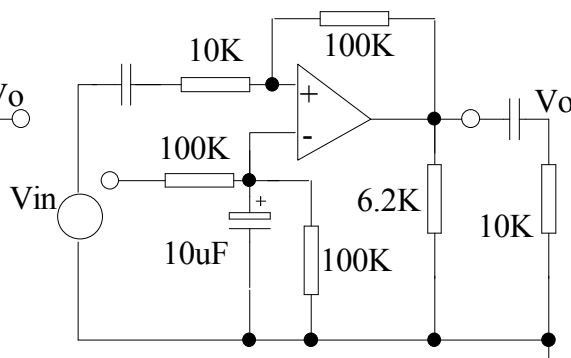


324用于五频率音调控制电路

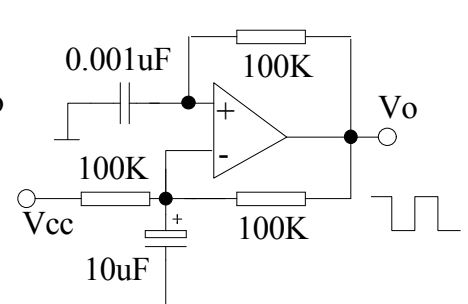
直流放大器



倒相放大器



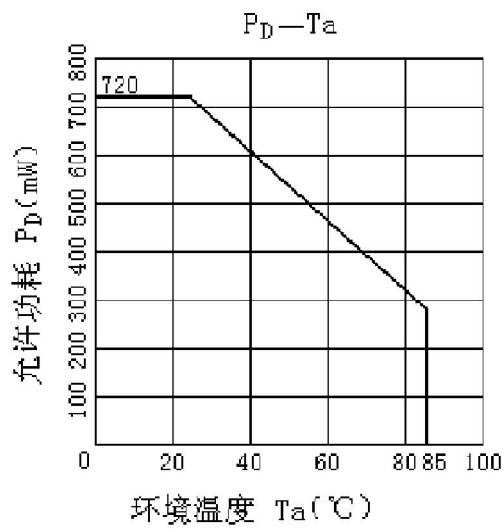
矩形波发生器



324的其它应用



特性曲线





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