



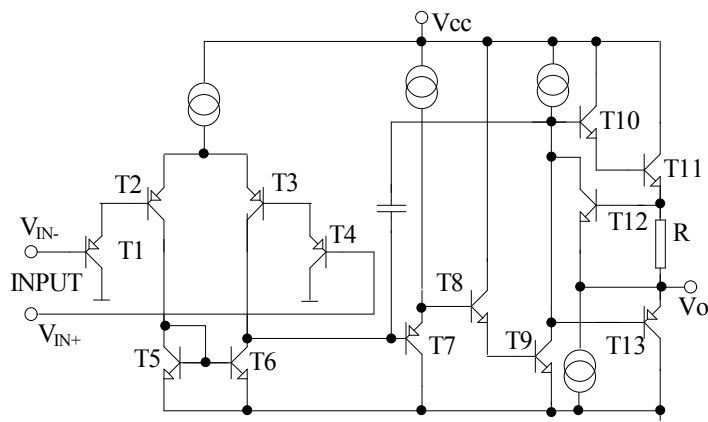
概述:

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:

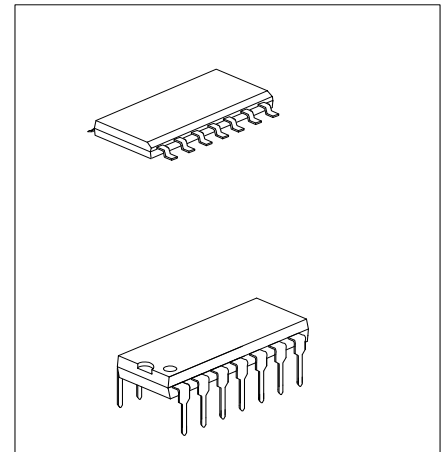
- 无需外接相位补偿电路
- 电源电压范围宽：单电源时， $V_{CC}=3\sim 20V$ ，双电源时， $V_{CC}=\pm 1.5V\sim 10V$
- 功耗电流小： $I_{CC}=0.7mA$ （典型）（ $R_L=\infty$ ）
- 输入电压范围可接近地电平

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 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



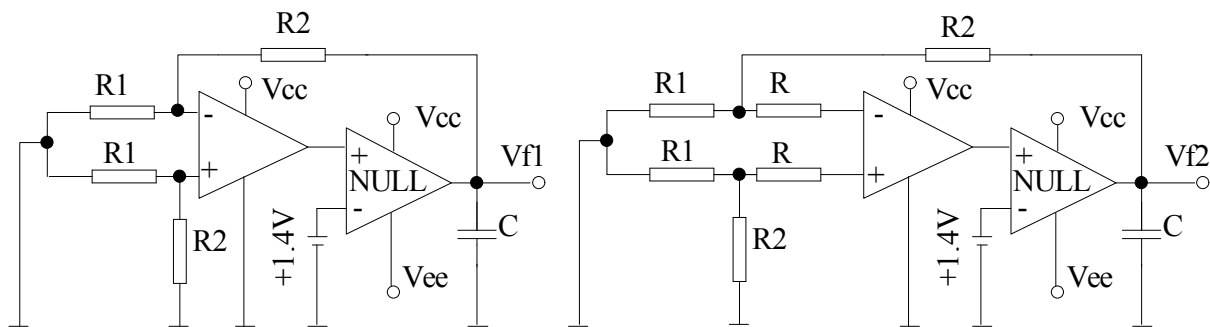
极限值（绝对最大额定值，若无其它规定， $T_{amb}=25^{\circ}C$ ）

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	$^{\circ}C$
贮存温度	T_{stg}		-55~+125	$^{\circ}C$

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）

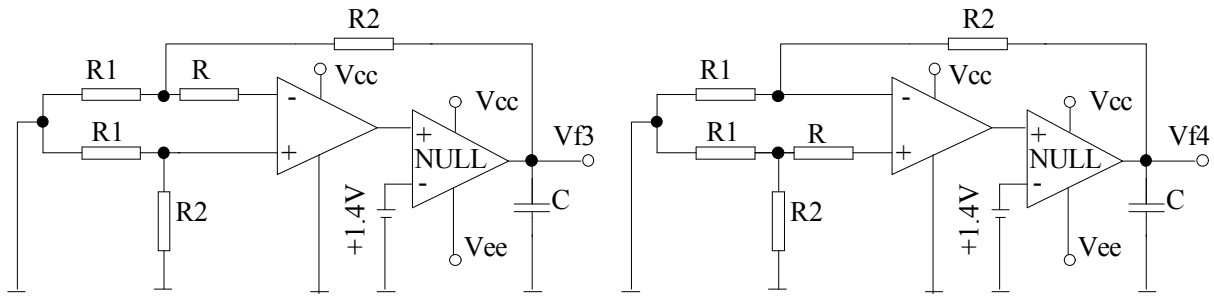


$$V_{io} = V_{f1} / (1 + R_2/R_1)$$

输入失调电压 V_{io} 测试图

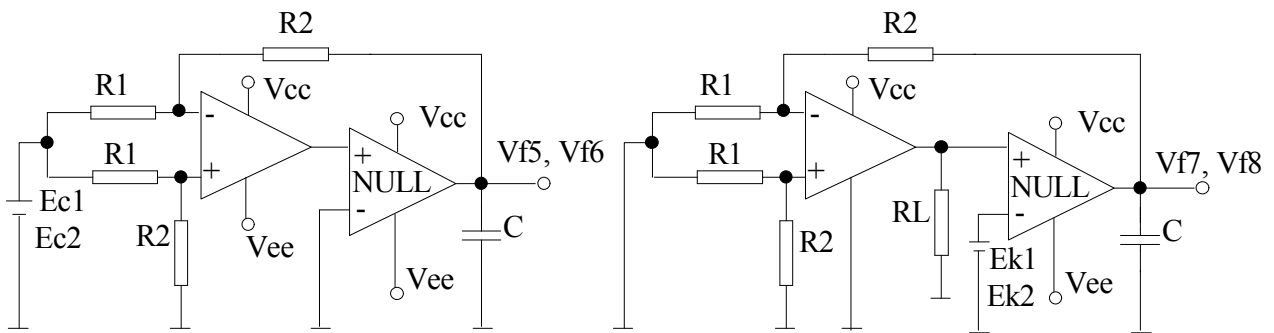
$$I_{io} = (V_{f2} - V_{f1}) / R (1 + R_2/R_1)$$

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

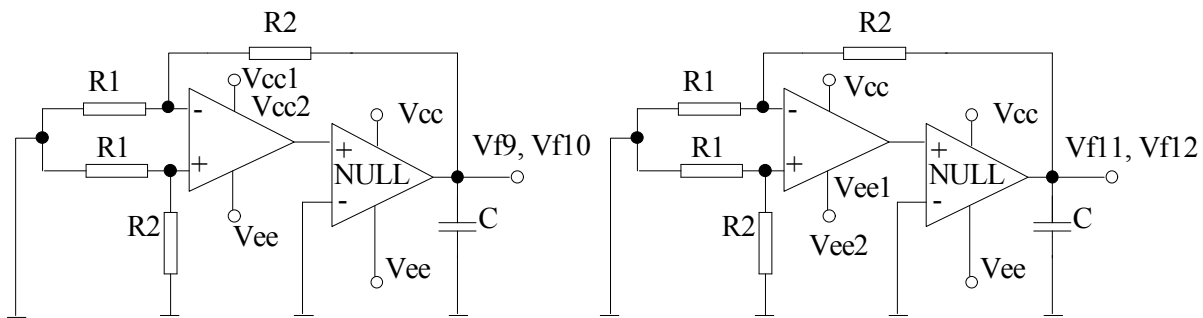


$$CMR = 20 \log \left| \frac{(E_{c1} - E_{c2}) (1 + R_2/R_1)}{(V_{f5} - V_{f6})} \right|$$

共模抑制比 CMR 及共模输入电压范围 V_{ICM} 测试图

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

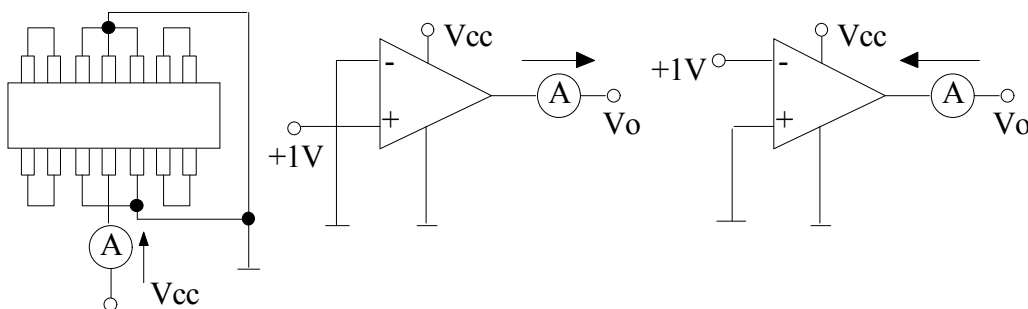
电压增益 G_v 测试图



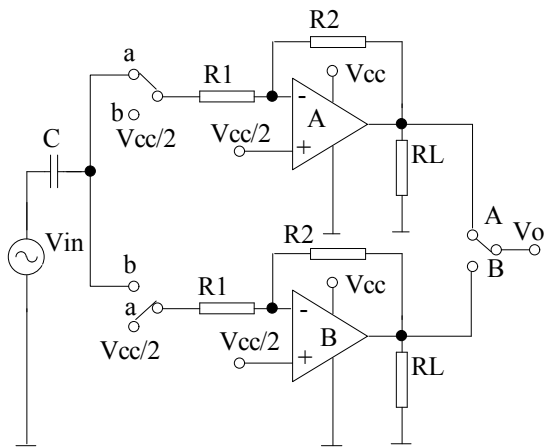
$$PSRR (+) = 20 \log \left| \frac{(V_{cc1} - V_{cc2}) (1 + R_2/R_1)}{(V_{f9} - V_{f10})} \right|$$

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

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

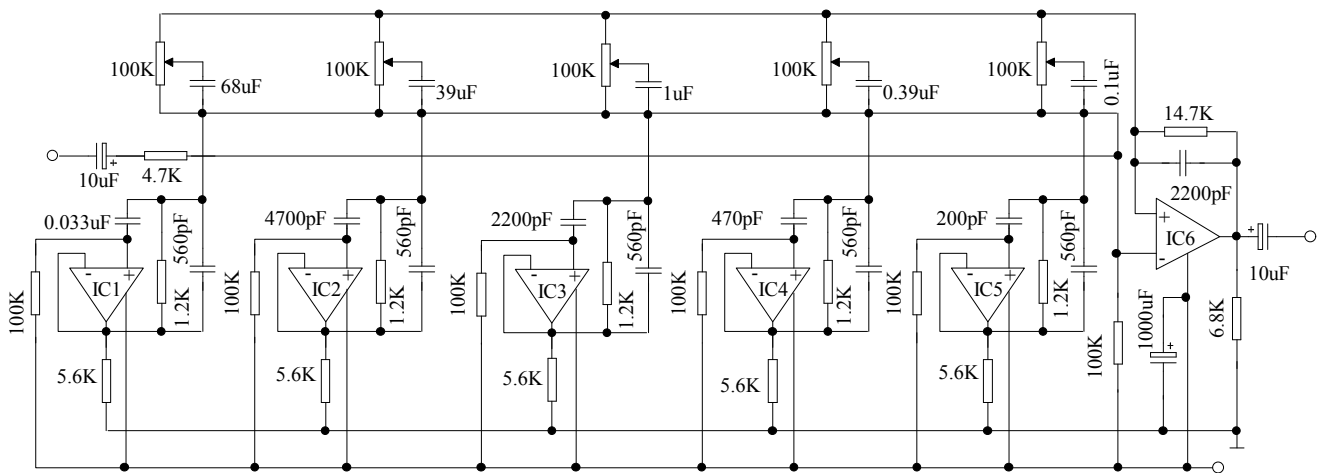
SW: A

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

SW: B

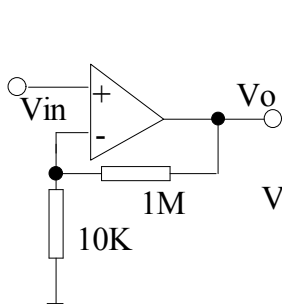
$$Cs (B \rightarrow A) = 20 \log (R2 * V_{OB}) / (R1 * V_{OA})$$

应用图

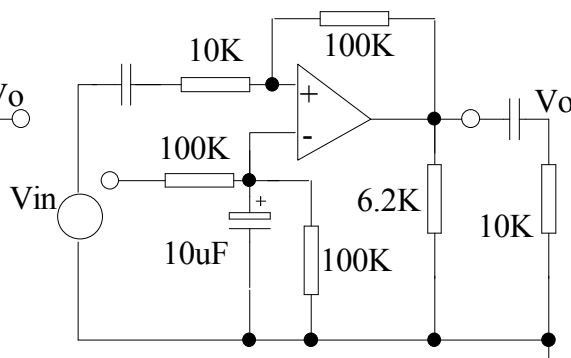


324用于五频率音调控制电路

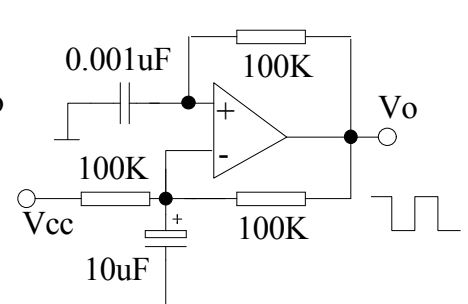
直流放大器



倒相放大器



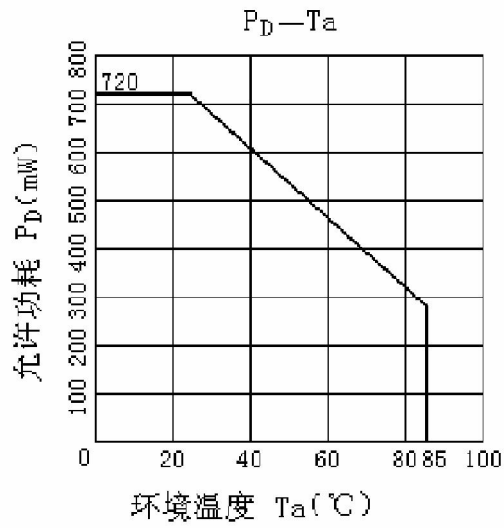
矩形波发生器



324的其它应用



特性曲线





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