LOW POWER QUAD OP AMP — LM124/224/324/SA534

DESCRIPTION

The LM124/SA534 series consists of four independent, high gain, internally frequency compensated operational amplifiers designed specifically to operate from a single power supply over a wide range of voltages. Similar to LM2902.

UNIQUE FEATURES

In the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage.

The unity gain cross frequency is temperature compensated.

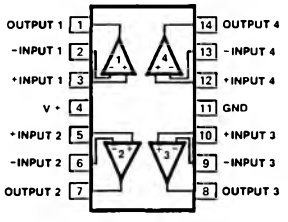
The input bias current is also temperature compensated.

FEATURES

- **Internally frequency compensated for unity gain**
- **Large dc voltage gain—(100dB)**
- **Wide bandwidth (unity gain)—1MHz (temperature compensated)**
- **Wide power supply range**
  Single supply—(3Vdc to 30Vdc) or dual supplies—(±1.5Vdc to ±15Vdc)
- **Very low supply current drain—essentially independent of supply voltage (1mW/op amp at +5Vdc)**
- **Low input biasing current—(45nAdc temperature compensated)**
- **Low input offset voltage—(2mVdc) and offset current—(5nAdc)**
- **Differential input voltage range equal to the power supply voltage**
- **Large output voltage—(0Vdc to V+—1.5Vdc swing)**
- **LM124 Mil std 883A,B,C available**

PIN CONFIGURATION

D,F,N PACKAGE



TOP VIEW

ORDER NUMBERS

LM124N	LM224N	LM324N
LM124F	LM224F	LM324F
SA534N	SA534F	LM324D

ABSOLUTE MAXIMUM RATINGS

	PARAMETER	RATING	UNIT
V+	Supply voltage	32 or ±16	Vdc
	Differential input voltage	32	Vdc
	Input voltage	-0.3 to +32	Vdc
	Power dissipation[1]		
	N package	570	mW
	F package	900	mW
	Output short-circuit to GND		
	1 amplifier[2]	Continuous	
	V+ < 15Vdc and T_A = 25°C		
	Input current (V_{IN} < -0.3V)[3]	50	mA
	Operating temperature range		
	LM324	0 to +70	°C
	LM224	-25 to +85	°C
	SA534	-40 to +85	°C
	LM124	-55 to +125	°C
	Storage temperature range	-65 to +150	°C
	Lead temperature (soldering, 10sec)	300	°C

NOTES

1. For operating at high temperatures, all devices must be derated based on a +125°C maximum junction temperature and a thermal resistance of 175°C/W which applies for the device soldered in a printed circuit board, operating in a still air ambient. LM 124/224 can be derated based on a +150°C maximum junction temperature.
2. Short circuits from the output to V+ can cause excessive heating and eventual destruction. The maximum output current is approximately 40mA independent of the magnitude of V+. At values of supply voltage in excess of +15Vdc continuous short-circuits can exceed the power dissipation ratings and cause eventual destruction.
3. The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output, so no loading change exists on the input lines.

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DC ELECTRICAL CHARACTERISTICS $V+ = 5V$, $T_A = 25°C$ unless otherwise specified.

PARAMETER		TEST CONDITIONS	LM124/LM224			LM324/SA534			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Offset voltage[1]	$R_S = 0\Omega$ $R_S = 0\Omega$, over temp.		±2	±5 ±7		±2	±7 ±9	mV mV
V_{OS}	Drift	$R_S = 0\Omega$		7			7		µV/°C
I_{BIAS}	Input current[2]	$I_{IN}(+)$ or $I_{IN}(-)$ $I_{IN}(+)$ or $I_{IN}(-)$, over temp.		45 40	150 300		45 40	250 500	nA
I_B	Drift	Over temp.		50			50		pA/°C
I_{OS}	Offset current	$I_{IN}(+) - I_{IN}(-)$ $I_{IN}(+0 - I_{IN}(-)$, over temp.		±3	±30 ±100		±5	±50 ±150	nA nA
I_{OS}	Drift	Over temp.		10			10		pA/°C
V_{CM}	Common mode voltage range[3]	$V+ = 30V$ $V+ = 30V$, over temp.	0 0		$V+ - 1.5$ $V+ - 2$	0 0		$V+ - 1.5$ $V+ - 2$	V V
C_{MRR}	Common mode rejection ratio	$V+ = 30V$	70	85		65	70		dB
V_{OUT}	Output voltage swing	$R_L = 2k\Omega$, $V+ = +30V$, over temp.	26			26			V
V_{OH}		$R_L \leq 10k\Omega$, over temp.	27	28		27	28		V
V_{OL}		$R_L \leq 10k\Omega$, $V+ = 5V$, over temp.		5	20		5	20	mV
I_{CC}	Supply current	$R_L = \infty$, $V_{CC} = 30V$, over temp. $R_L = \infty$, on all op amps, over temp.		1.5 0.7	3 1.2		1.5 0.7	3 1.2	mA
A_{VOL}	Large signal voltage gain	$V+ = +15V$ (for large V_O swing), $R_L \geq 2k\Omega$ $V+ = +15V$ (for large V_O swing), $R_L \geq 2k\Omega$, over temp.	50 25	100		25 15	100		V/mV V/mV
	Amplifier-to-amplifier coupling[5]	f = 1kHz to 20kHz, input referred		−120			−120		dB
PSRR		$R_S \leq 0\Omega$	65	100		65	100		dB
	Output current								
	Source	$V_{IN}+ = +1Vdc$, $V_{IN}- = 0Vdc$, $V+ = 15Vdc$	20	40		20	40		mA
		$V_{IN}+ = +1Vdc$, $V_{IN}+ = 0Vdc$, $V+ = 15Vdc$, over temp.	10	20		10	20		mA
	Sink	$V_{IN}- = +1Vdc$, $V_{IN}+ = 0Vdc$, $V+ = 15Vdc$	10	20		10	20		mA
		$V_{IN}- = +1Vdc$, $V_{IN}+ = 0Vdc$, $V+ = 15Vdc$, over temp.	5	8		5	8		mA
		$V_{IN}+ = 0Vdc$, $V_{IN}- = +1Vdc$, $V_O = 200mV$	12	50		12	50		µA
I_{SC}	Short circuit current[4]		10	40	60	10	40	60	mA
	Differential input voltage[6]				V+			V+	V
GBW	Unity gain bandwidth	$T_A = 25°C$		1			1		MHz
S.R.	Slew rate	$T_A = 25°C$		0.3			0.3		V/µs
Noise	Input noise voltage	$T_A = 25°C$, f = 1kHz		40			40		nV/√Hz

NOTES
1. $V_O = 1.4Vdc$, $R_S = 0\Omega$ with $V+$ from 5V to 30V and over full input common mode range (0Vdc + to V + − 1.5V).
2. The direction of the input current is out of the IC due to the pnp input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
3. The input common-mode voltage or either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is V + − 1.5, but either or both inputs can go to + 32V without damage.
4. Short circuits from the output to V+ can cause excessive heating and eventual destruction. The maximum output current is approximately 40mA independent of the magnitude of V+. At values of supply voltage in excess of + 15Vdc continuous short-circuits can exceed the power dissipation ratings and cause eventual destruction. Destructive dissipation can result from simultaneous shorts on all amplifiers.
5. Due to proximity of external components, insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of capacitive increases at higher frequencies.
6. The input common-mode voltage or either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is V + − 1.5V, but either or both inputs can go to + 32Vdc without damage.

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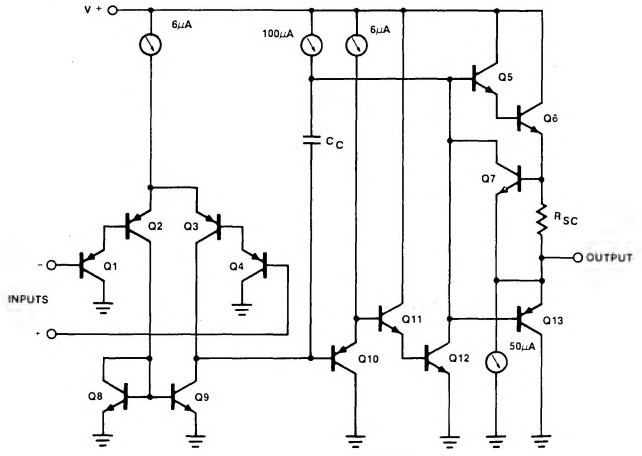
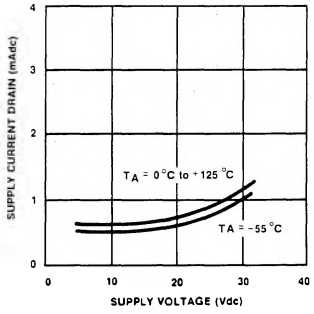
EQUIVALENT SCHEMATIC

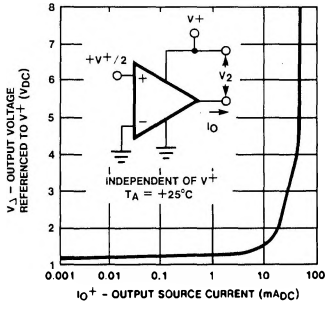


TYPICAL PERFORMANCE CHARACTERISTICS

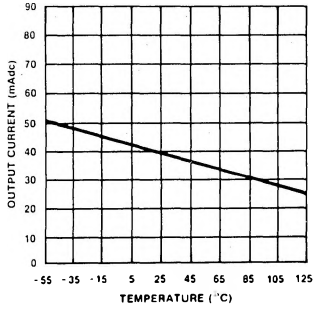
SUPPLY CURRENT



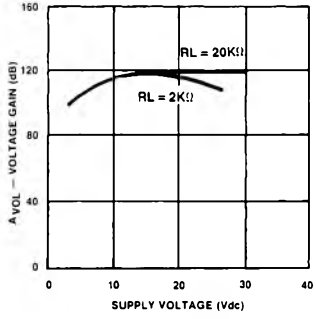
OUTPUT CHARACTERISTICS CURRENT SOURCING



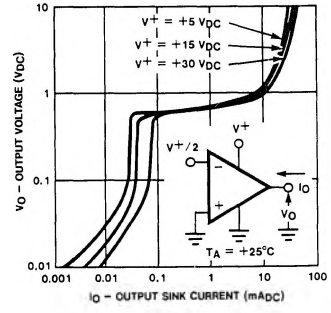
CURRENT LIMITING



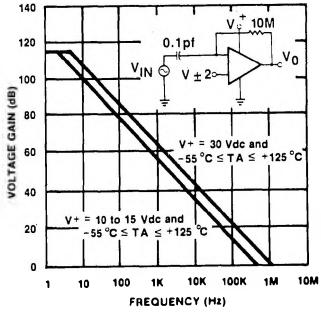
VOLTAGE GAIN



OUTPUT CHARACTERISTICS CURRENT SINKING

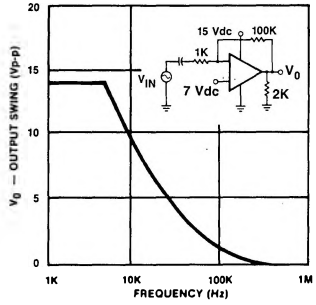


OPEN LOOP FREQUENCY RESPONSE

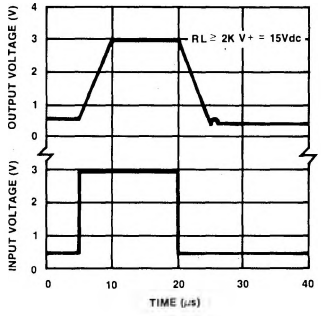


TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

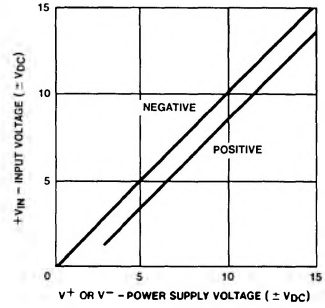
LARGE SIGNAL FREQUENCY RESPONSE



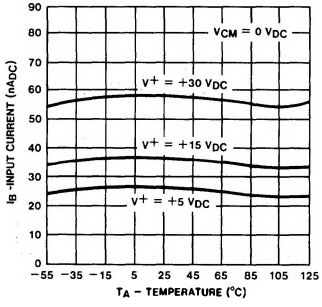
VOLTAGE FOLLOWER PULSE RESPONSE



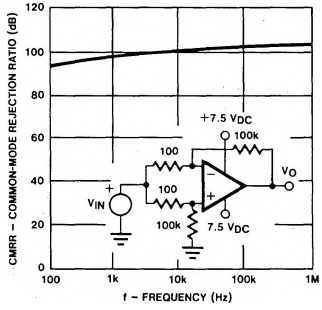
INPUT VOLTAGE RANGE



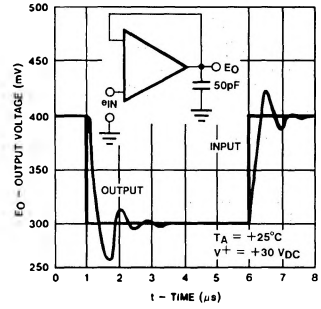
INPUT CURRENT



COMMON MODE REJECTION RATIO

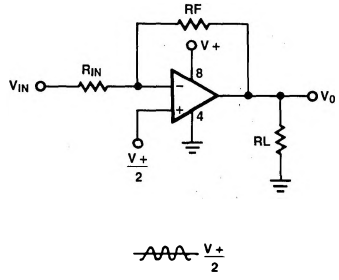


VOLTAGE FOLLOWER PULSE RESPONSE (SMALL SIGNAL)

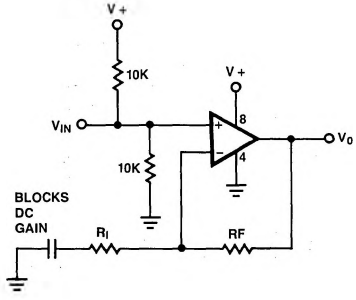


TYPICAL APPLICATIONS

SINGLE SUPPLY INVERTING AMPLIFIER



NON-INVERTING AMPLIFIER



INPUT BIASING VOLTAGE FOLLOWER