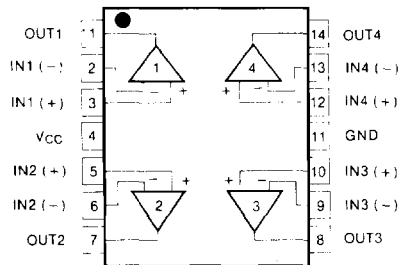


QUAD LOW POWER OP AMP

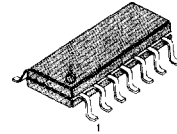
The LM324 of quad operational amplifiers are very low power operation, and can operate at supply voltages from 3 volts to 32 volts.

FEATURES

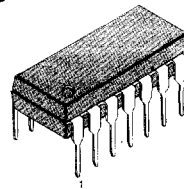
- Low power operation: typ 1mA
- Input common mode voltage range: $0 - V_{CC} - 1.5$
- Large signal voltage gain: typ 100V/mV
- Short circuit protection in outputs

BLOCK DIAGRAM

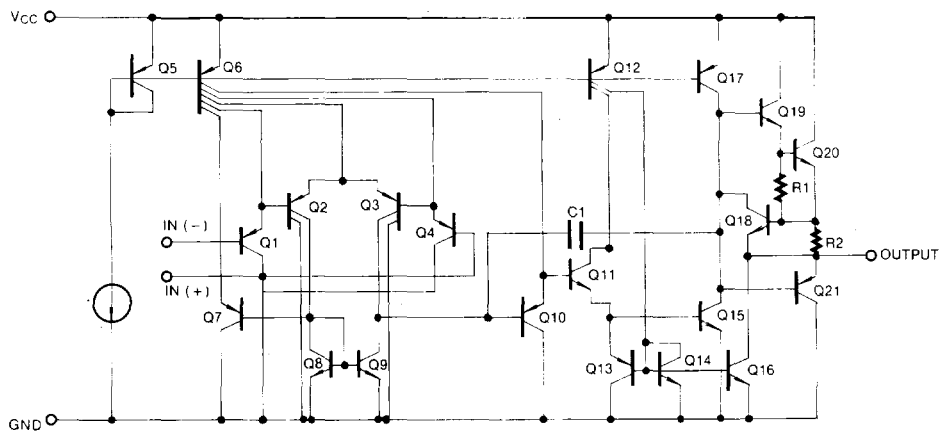
14 SOP



14 DIP

**ORDERING INFORMATION**

Device	Package	Operating Temperature
LM324N	14 DIP	0 ~ +70°C
LM324D	14 SOP	

SCHEMATIC DIAGRAM (One Section Only)

ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Value	Unit
Power Supply Voltage	V_S	± 18 or 36	V
Differential Input Voltage	V_{ID}	36	V
Input Voltage	V_I	-0.3 to +36	V
Output Short Circuit to GND $V_{CC} \leq 15V$, $T_a = 25^\circ C$ (One Amp)		Continuous	
Power Dissipation	P_D	570	mW
Operating Temperature Range	T_{opr}	0 ~ +70	$^\circ C$
Storage Temperature Range	T_{stg}	-65..150	$^\circ C$

2

ELECTRICAL CHARACTERISTICS

(V_{CC} = 5.0V, V_{EE} = GND, T_a = 25 $^\circ$ C, unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ	Max	Unit
Input Offset Voltage	V_{IO}	$V_{ICM} = 0V$ to $V_{CC} - 1.5V$ $V_O = 1.4V$, $R_S = 0$ (ohm)		1.5	7.0	mV
Input Offset Current	I_{IO}			3.0	50	nA
Input Bias Current	I_{IB}			20	250	nA
Input Common Mode Voltage Range	V_{ICR}	$V_{CC} = 30V$	0		$V_{CC} - 1.5$	V
Supply Current (All Amp)	I_{CC}	$R_L = \infty$, $V_{CC} = 30V$		1.0	3	mA
		$R_L = \infty$, $V_{CC} = 5V$		0.7	1.2	
Large Signal Voltage Gain	A_V	$V_{CC} = 15V$, $R_L \geq 2$ Kohm $V_O = 1V$ to 11V	25	350		V/mV
Output Voltage Swing	V_{OH}	$V_{CC} = 30V$ $R_L = 2K$	26			V
	V_{OL}	$R_L = 10K$	27	28		
		$V_{CC} = 5V$, $R_L \geq 10K$		1.5	20	mV
Common Mode Rejection Ratio	CMRR		65	100		dB
Power Supply Rejection Ratio	PSRR		65	100		dB
Channel Separation	CS	$f = 1KHz$ to 20KHz		110		dB
Short Circuit to Ground	I_{OS}			45	60	mA
Output Current	I_{source}	$V_{IN-} = 1V$, $V_{IN+} = 0V$ $V_{CC} = 15V$	20	45		mA
	I_{sink}	$V_{IN+} = 0V$, $V_{IN-} = 1V$ $V_{CC} = 15V$, $V_O = 2V$	10	25		
		$V_{IN+} = 0V$, $V_{IN-} = 1V$ $V_{CC} = 15V$, $V_O = 200mV$	12	45		μA
Differential Input Voltage	V_{ID}				V_{CC}	V

ELECTRICAL CHARACTERISTICS(V_{CC} = 5.0V, V_{EE} = GND, 0°C ≤ T_a ≤ +70°C, unless otherwise specified)

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Offset Voltage	V _{IO}	V _{ICM} = 0V to V _{CC} - 1.5V V _O = 1.4V, R _S = 0Ω			9.0	mV
Input Offset Voltage Drift	ΔV _{IO} /ΔT			7.0		μV/°C
Input Offset Current	I _{IO}				150	nA
Input Offset Current Drift	ΔI _{IO} /ΔT			10		pA/°C
Input Bias Current	I _{IB}				500	nA
Input Common-Mode Voltage Range	V _{ICR}	V _{CC} = 30V	0		V _{CC} - 2.0	V
Large Signal Voltage Gain	A _V	V _{CC} = 15V, R _L ≥ 2.0KΩ V _O = 1V to 11V	15			V/mV
Output Voltage Swing	V _{OH}	V _{CC} = 30V, R _L = 2KΩ	26			V
		R _L = 10KΩ	27	28		V
	V _{OL}	V _{CC} = 5V, R _L ≥ 10KΩ		2	20	mV
Output Current	I _{source}	V _{IN+} = 1V, V _{IN-} = 0V V _{CC} = 15V, V _O = 2V	10	35		mA
	I _{sink}	V _{IN+} = 0V, V _{IN-} = 1V V _{CC} = 15V, V _O = 2V	15	8		mA
Differential Input Voltage	V _{ID}				V _{CC}	V

Fig. 1 INPUT VOLTAGE RANGE

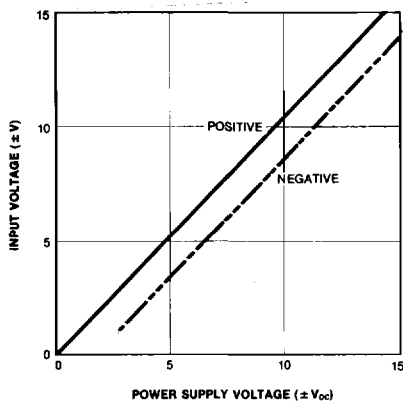


Fig. 2 INPUT CURRENT

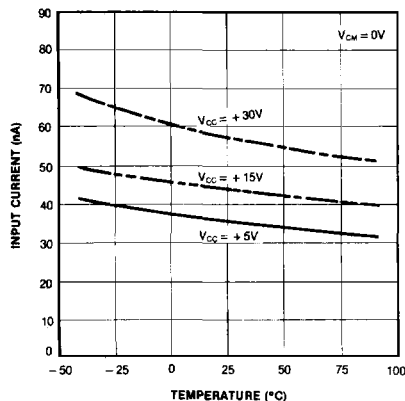


Fig. 3 SUPPLY CURRENT

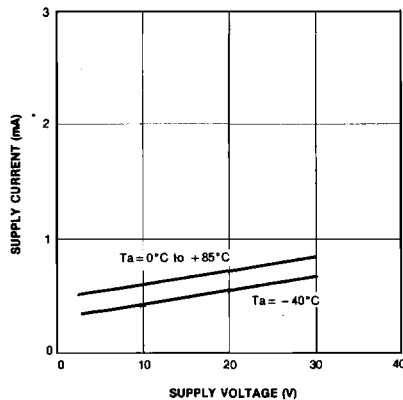


Fig. 4 VOLTAGE GAIN

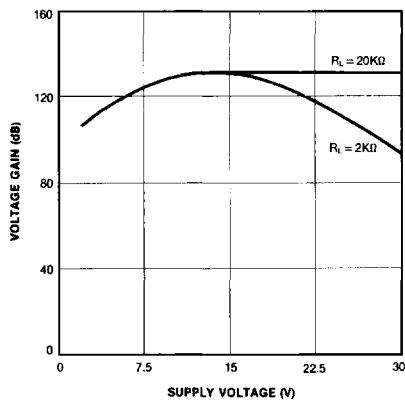


Fig. 5 OPEN LOOP FREQUENCY RESPONSE

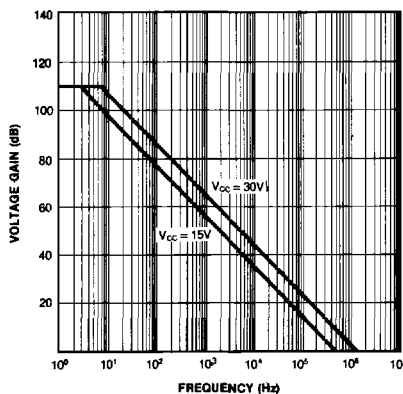
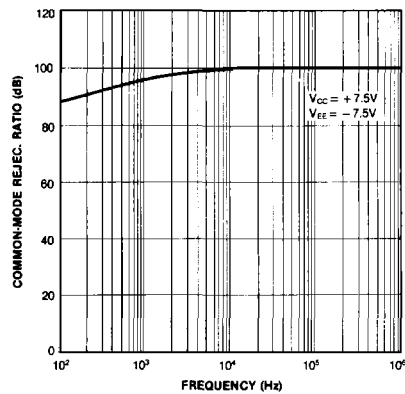


Fig. 6 COMMON-MODE REJECTION RATIO



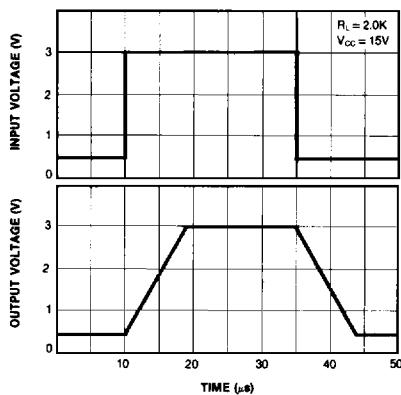


Fig. 9 LARGE SIGNAL FREQUENCY RESPONSE

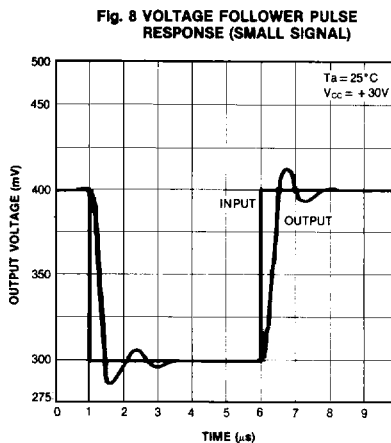


Fig. 8 VOLTAGE FOLLOWER PULSE RESPONSE (SMALL SIGNAL)

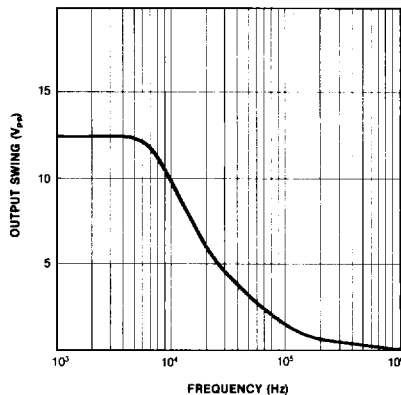


Fig. 11 OUTPUT CHARACTERISTICS CURRENT SINKING

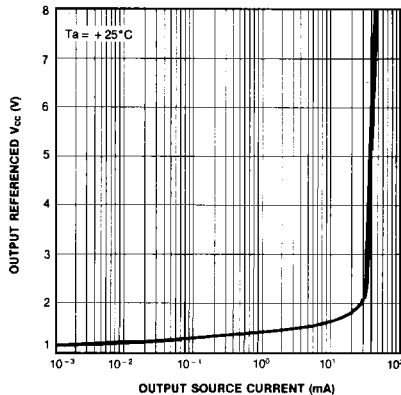


Fig. 12 CURRENT LIMITING

