1. DESCRIPTION

These circuits consist of four independent, high gain operational amplifiers with frequency compensation implemented internally. They operate from a single power supply over a wide range of voltages.

Operation from split power supplies is also possible and the low-power supply current drain is independent of the magnitude of the power supply voltage.

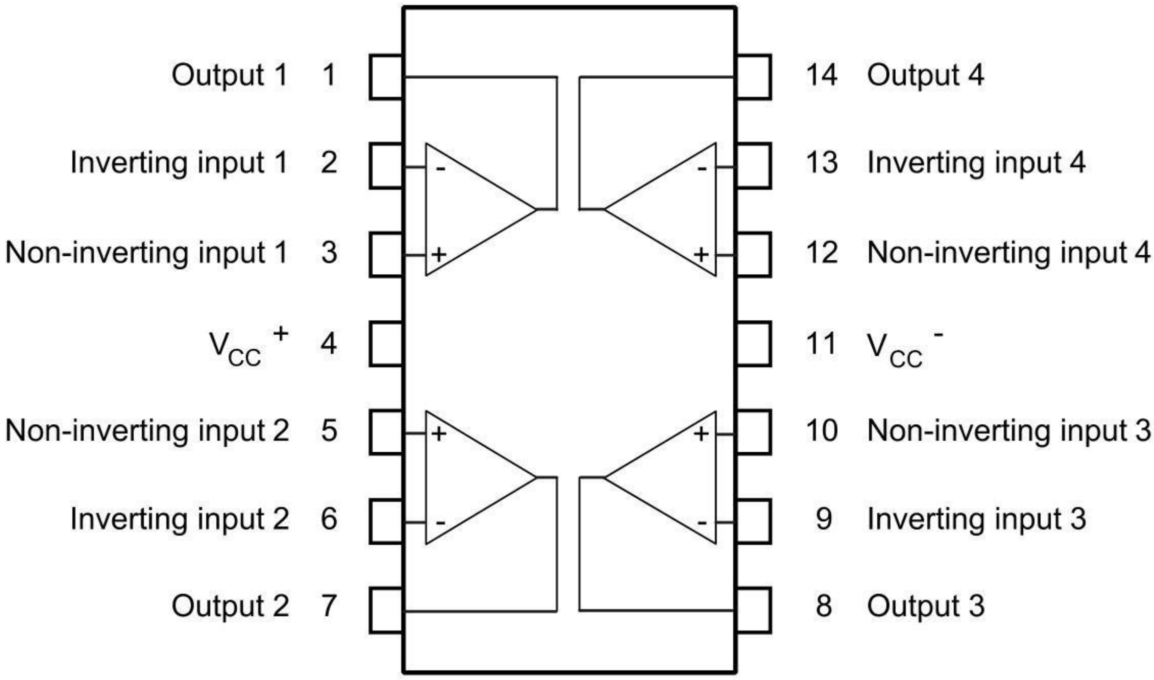
2. FEATURES

- Wide gain bandwidth: 1.3 MHz
- Input common mode voltage range includes ground
- Large voltage gain: 100 dB
- Very low supply current/amplifier: 375 µA Low input bias current: 20 nA
- Low input voltage: 3 mV max
- Low input offset current: 2 nA
- Wide power supply range:

  -- Single supply: 3 V to 30 V

  -- Dual supplies: ±1.5 V to ±15 V

3. PIN CONNECTIONS AND SCHEMATIC DIAGRAM



(Top View)
Figure 1: Pin connections

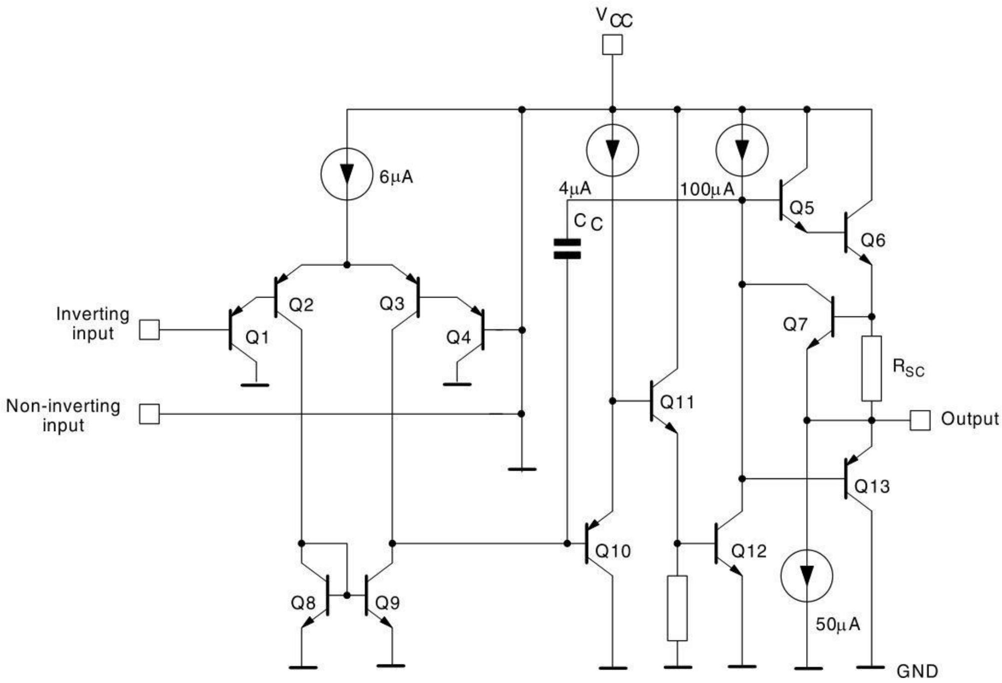


Figure 2: Schematic diagram

4. ABSOLUTE MAXIMUM RATINGS AND OPERATING CONDITIONS

Table 2: Absolute maximum ratings

Symbol	Parameter		Value	Unit
V_{CC}	Supply voltage		±16 or 32	V
V_i	Input voltage		-0.3 to V_{CC} + 0.3	
V_{id}	Differential input voltage (1)		32	
P_{tot}	Power dissipation: D suffix		400	mW
	Output short-circuit duration (2)		Infinite	
I_{in}	Input current (3)		50	mA
T_{stg}	Storage temperature range		-65 to 150	°C
T_j	Maximum junction temperature		150	
R_{thja}	Thermal resistance junction to ambient (4)	SOP14	103	°C/W
R_{thjc}	Thermal resistance junction to case	SOP14	31	
ESD	HBM: human body model (5)	XD/XL124	250	V
	MM: machine model (6)		100	
	CDM: charged device model		1500	

Notes:

(1)Neither of the input voltages must exceed the magnitude of (V_{CC}^+) or (V_{CC}^-).

(2)Short-circuits from the output to V_{CC} can cause excessive heating if V_{CC} > 15 V. The maximum output current is approximately 40 mA independent of the magnitude of V_{CC}. Destructive dissipation can result from simultaneous short-circuits on all amplifiers.

(3)This input current only exists when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistor becoming forward biased and thereby acting as an input diode clamp. In addition to this diode action, there is also an NPN parasitic action on the IC chip. This transistor action can cause the output voltages of the op amps to go to the V_{CC} voltage level (or to ground for a large overdrive) for the time during which an input is driven negative. This is not destructive and normal output starts up again for input voltages higher than -0.3 V.

(4)Short-circuits can cause excessive heating. Destructive dissipation can result from simultaneous short-circuits on all amplifiers. These are typical values given for a single layer board

(5)Human body model: 100 pF discharged through a 1.5 kΩ resistor between two pins of thedevice , done for all couples of pin combinations with other pins floating.

(6)Machine model: a 200 pF cap is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω), done for all couples of pin combinations with other pins floating.

Table 3: Operating conditions

Symbol	Parameter		Value	Unit
V_{CC}	Supply voltage	Single supply	3 to 30	V
		Dual supply	±1.5 to ±15	
V_{ICM}	Common-mode input voltage range		$(V_{CC}^{-}) - 0.1$ to $(V_{CC}^{+}) - 1$	
T_{Oper}	Operating temperature range	XD/XL124	-40 to 105	℃

5. ELECTRICAL CHARACTERISTICS

Table 4: VCC+ = 5 V, VCC- = Ground, Vo = 1.4 V, Tamb = 25 °C (unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{io} LM224A, LM224W, LM324A, LM324W	Input offset voltage [1]	T_{amb} = 25 °C		2	3	mV
		$T_{min} \le T_{amb} \le T_{max}$			5	
V_{io} LM124, LM224, LM324		T_{amb} = 25 °C, XD/XL124		2	5	
		$T_{min} \le T_{amb} \le T_{max}$, XD/XL124			7	
I_{io}	Input offset current	T_{amb} = 25 °C		2	20	nA
		$T_{min} \le T_{amb} \le T_{max}$			40	
I_{ib}	Input bias current [2]	T_{amb} = 25 °C		20	100	
		$T_{min} \le T_{amb} \le T_{max}$			200	
A_{vd}	Large signal voltage gain, V_{CC}^{+} = 15 V, R_L = 2 kΩ, V_o = 1.4 V to 11.4 V	T_{amb} = 25 °C	50	100		V/mV
		$T_{min} \le T_{amb} \le T_{max}$	25			
SVR	Supply voltage rejection ratio, $R_s \le$ 10 kΩ, V_{CC}^{+} = 5 V to 30 V	T_{amb} = 25 °C	65	110		dB
		$T_{min} \le T_{amb} \le T_{max}$	65			
I_{CC}	Supply current, all amps, no load	T_{amb} = 25 °C, V_{CC} = 5V		0.7	1.2	mA
		T_{amb} = 25 °C, V_{CC} = 30 V		1.5	3	
		$T_{min} \le T_{amb} \le T_{max}$, V_{CC} = 5 V		0.8	1.2	
		$T_{min} \le T_{amb} \le T_{max}$, V_{CC} = 30 V		1.5	3	
V_{icm}	Input common mode voltage range [3]	V_{CC} = 30 V, T_{amb} = 25 °C	0		28.5	V
		V_{CC} = 30 V, $T_{min} \le T_{amb} \le T_{max}$	0		28	
CMR	Common mode rejection ratio, $R_s \le$ 10 kΩ	T_{amb} = 25 °C	70	80		dB
		$T_{min} \le T_{amb} \le T_{max}$	60			
I_{source}	Output current source, V_{id} = 1 V	V_{CC} = 15 V, V_o = 2 V	20	40	70	mA
I_{sink}	Output sink current, V_{id} = -1 V	V_{CC} = 15 V, V_o = 2 V	10	20		mA
		V_{CC} = 15 V, V_o = 0.2 V	12	50		µA
V_{OH}	High level output voltage, V_{CC} = 30 V, R_L = 2 kΩ	T_{amb} = 25 °C	26	27		V
		$T_{min} \le T_{amb} \le T_{max}$	26			
	High level output voltage, V_{CC} = 30 V, R_L = 10 kΩ	T_{amb} = 25 °C	27	28		
		$T_{min} \le T_{amb} \le T_{max}$	27			
	High level output voltage, V_{CC} = 5 V, R_L = 2 kΩ	T_{amb} = 25 °C	3.5			
		$T_{min} \le T_{amb} \le T_{max}$	3			

Symbol	Parameter		Min.	Typ.	Max.	Unit
V_{OL}	Low level output voltage, R_L = 10kΩ	T_{amb} = 25 °C		5	20	mV
		T_{min} ≤ T_{amb} ≤ T_{max}			20	
SR	Slew rate	V_{CC} = 15 V, V_i = 0.5 to 3 V, R_L = 2 kΩ, C_L = 100 pF, unity gain		0.4		V/µs
GBP	Gain bandwidth product	V_{CC} = 30 V, f = 100 kHz, V_{in} = 10 mV, R_L = 2 kΩ, C_L = 100 pF		1.3		MHz
THD	Total harmonic distortion	f = 1kHz, A_v = 20 dB, R_L = 2 kΩ, V_o = 2 V_{pp}, C_L = 100 pF, V_{CC} = 30 V		0.015		%
e_n	Equivalent input noise voltage	f = 1 kHz, R_s = 100 Ω, V_{CC} = 30 V		40		nV/√Hz
DV_{io}	Input offset voltage drift			7	30	µV/°C
DI_{io}	Input offset current drift			10	200	pA/°C
V_{o1}/V_{o2}	Channel separation [4]	1 kHz ≤ f ≤ 20 kHZ		120		kHz

Notes:

(1) V_o = 1.4 V, R_s = 0 Ω, 5 V < V_{CC}^+ < 30 V, 0 < V_{ic} < V_{CC}^+ - 1.5 V

(2) The direction of the input current is out of the IC. This current is essentially constant, independent of the state of the output so there is no load change on the input lines.

(3) The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is (V_{CC}^+) - 1.5 V, but either or both inputs can go to 32 V without damage.

(4) Due to the proximity of external components, ensure that there is no coupling originating from stray capacitance between these external parts. Typically, this can be detected at higher frequencies because this type of capacitance increases.

6. ELECTRICAL CHARACTERISTICS CURVES

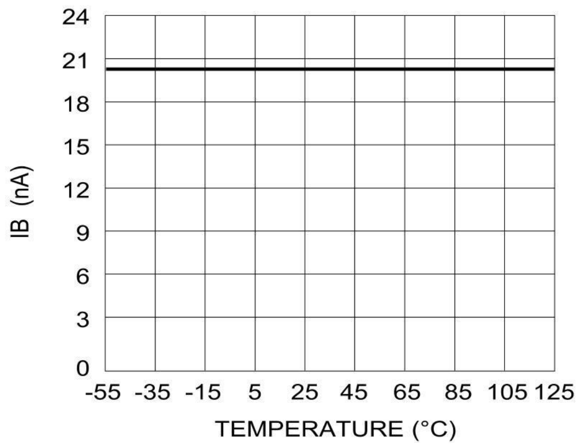


Figure 3: Input bias current vs. temperature

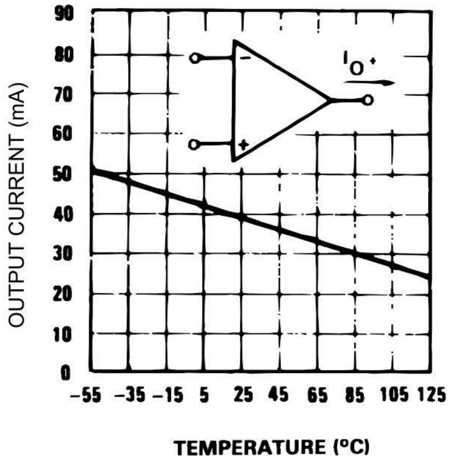


Figure 4: Output current limitation

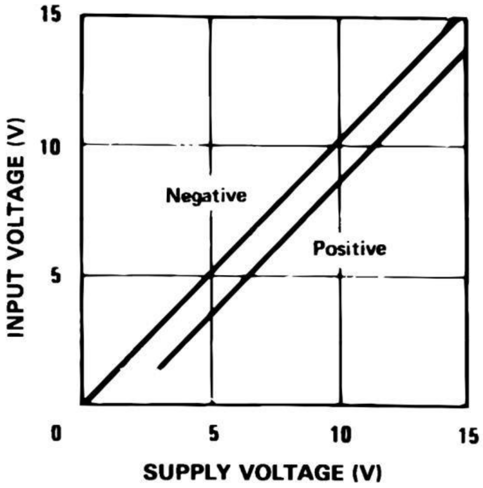


Figure 5: Input voltage range

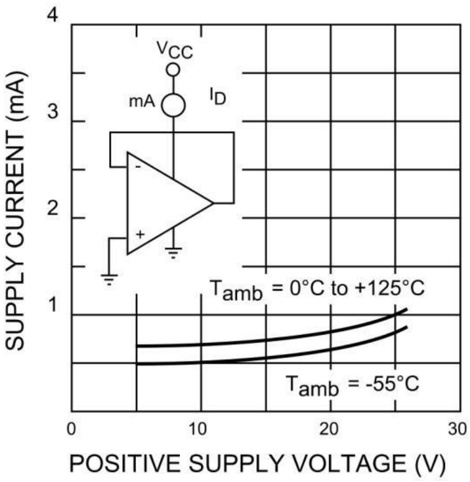


Figure 6: Supply current vs. supply voltage

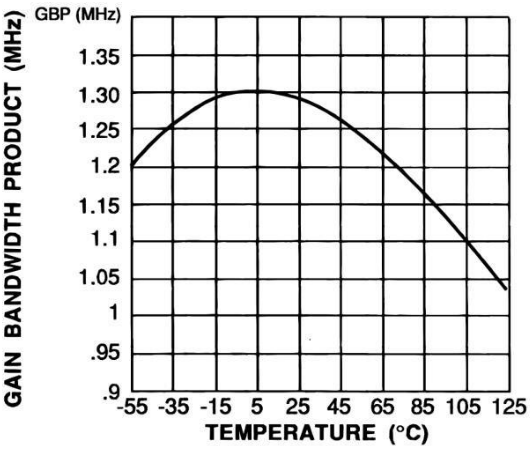


Figure 7: Gain bandwidth product vs. temperature

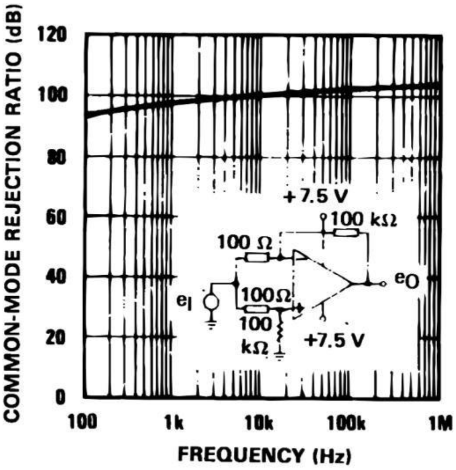


Figure 8: Common-mode rejection ratio

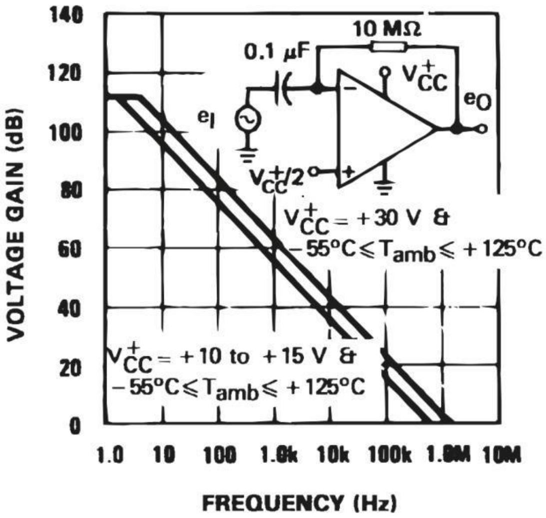


Figure 9: Open loop frequency response

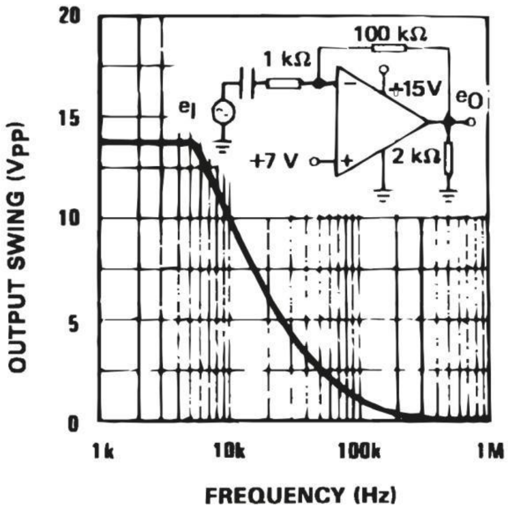


Figure 10: Large signal frequency response

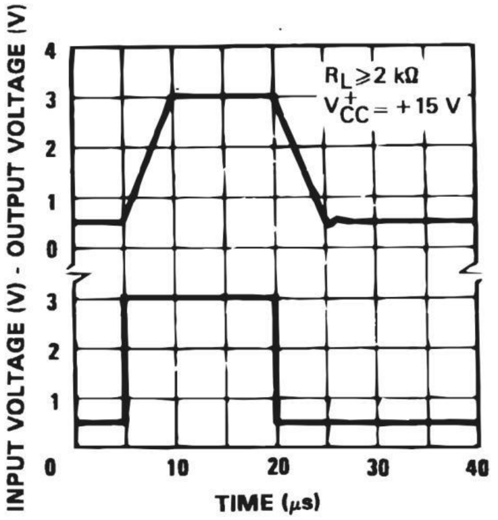


Figure 11: Voltage follower pulse response

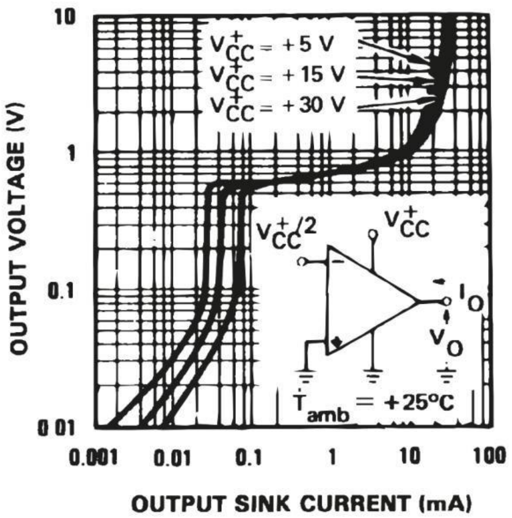


Figure 12: Output characteristics (current sinking)

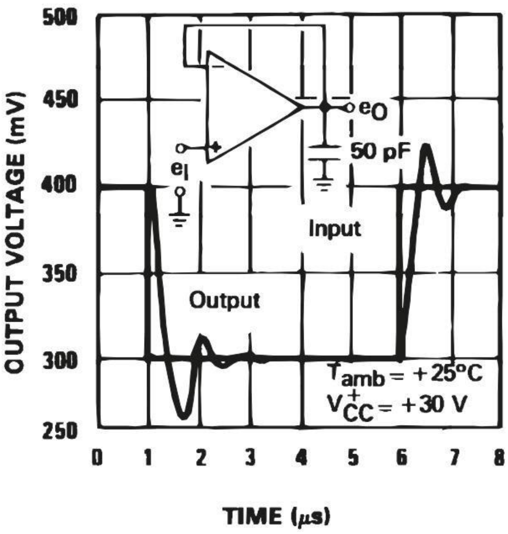


Figure 13: Voltage follower pulse response
(small signal)

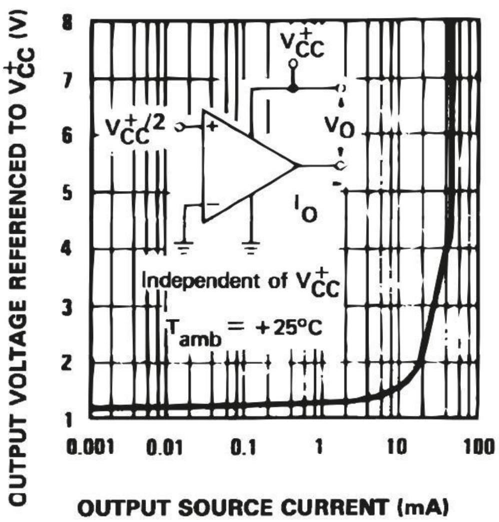


Figure 14: Output characteristics
(current sourcing)

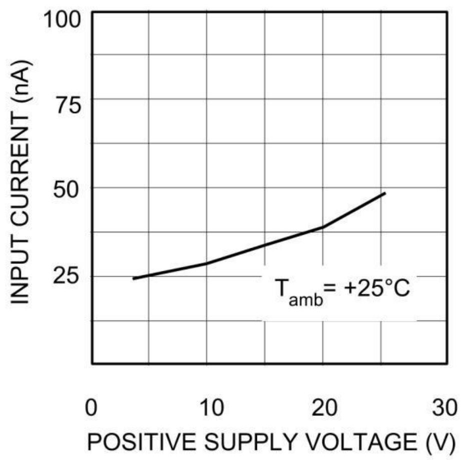


Figure 15: Input current vs. supply voltage

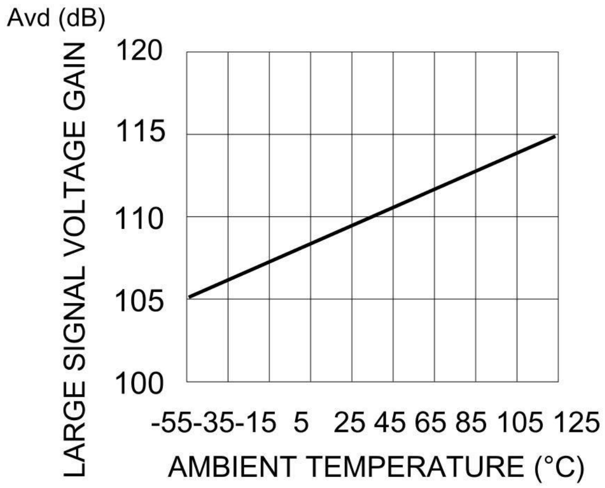


Figure 15: Large signal voltage gain vs. temperature

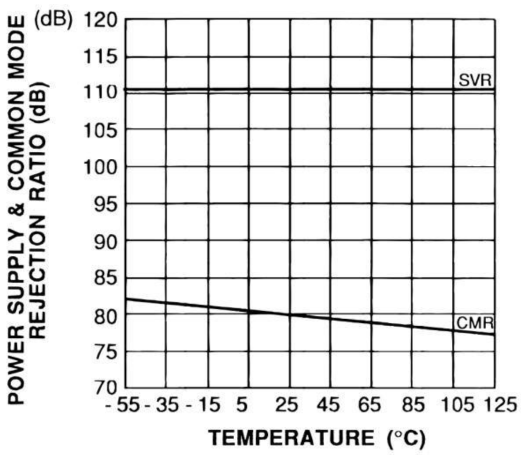


Figure 17: Power supply and common mode rejection ratio vs. temperature

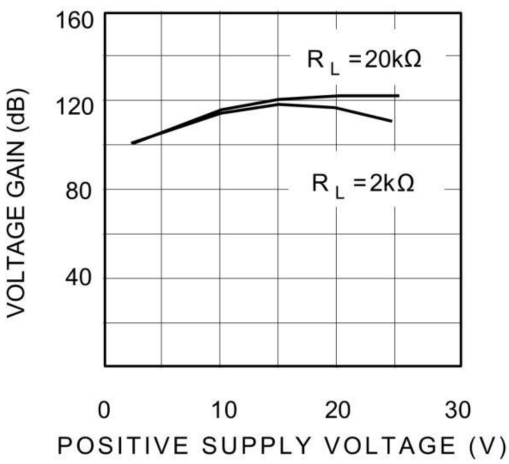


Figure 18: Voltage gain vs. supply voltage

7. TYPICAL SINGLE-SUPPLY APPLICATIONS

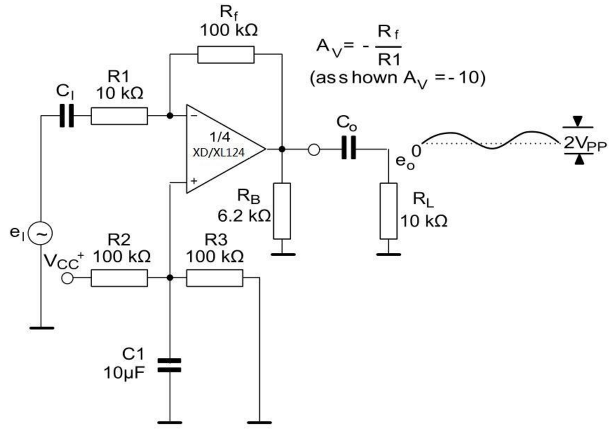


Figure 19: AC coupled inverting amplifier

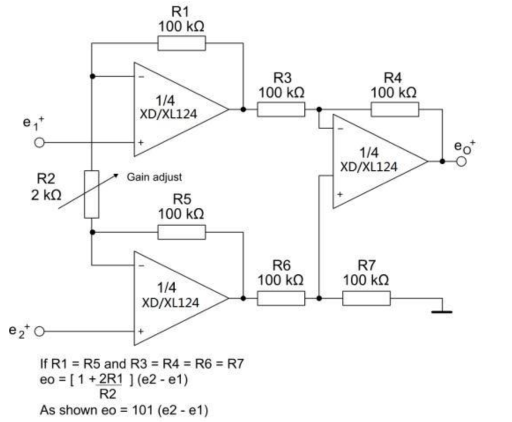


Figure 20: High input Z adjustable gain DC instrumentation amplifier

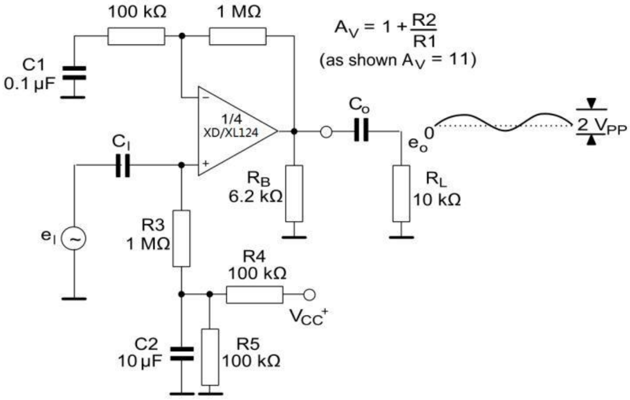


Figure 21: AC coupled non inverting amplifier

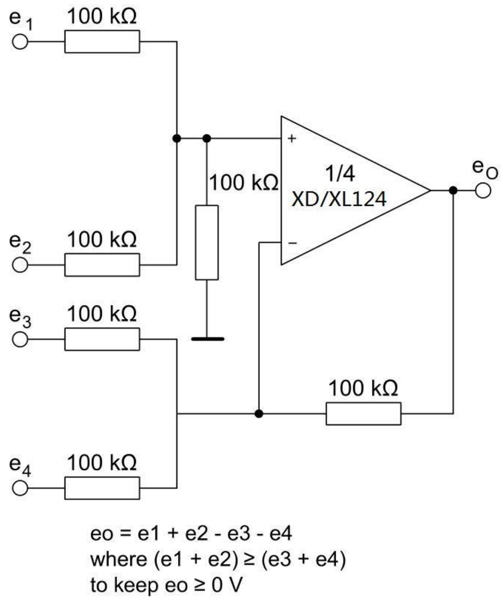


Figure 22: DC summing amplifier

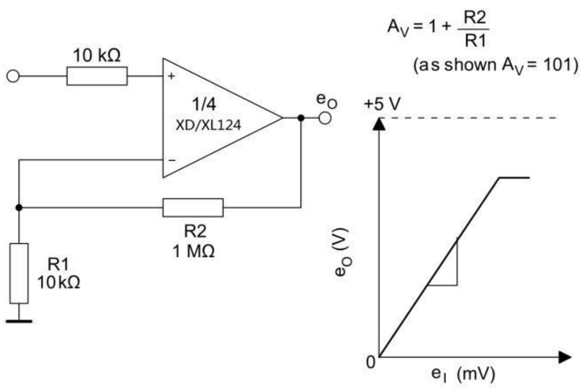


Figure 23: Non-inverting DC gain

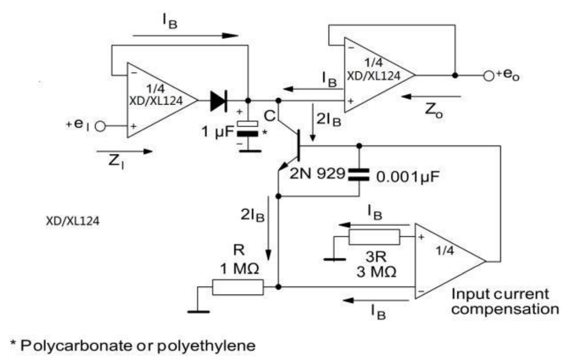


Figure 24: Low drift peak detector

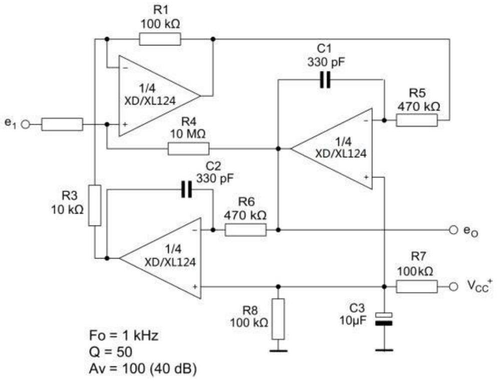


Figure 25: Active bandpass filter

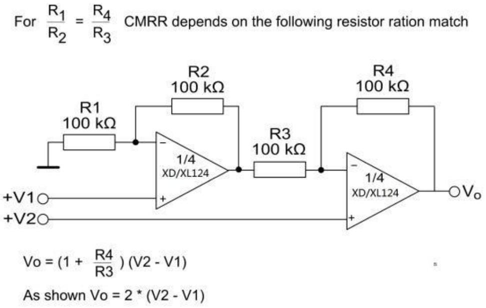


Figure 26: High input Z, DC differential amplifier

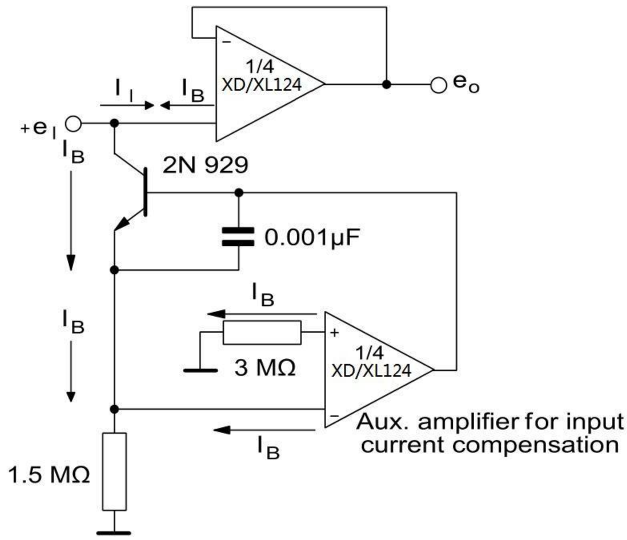


Figure 27: Using symmetrical amplifiers to reduce input current (general concept)

8. ORDERING INFORMATION

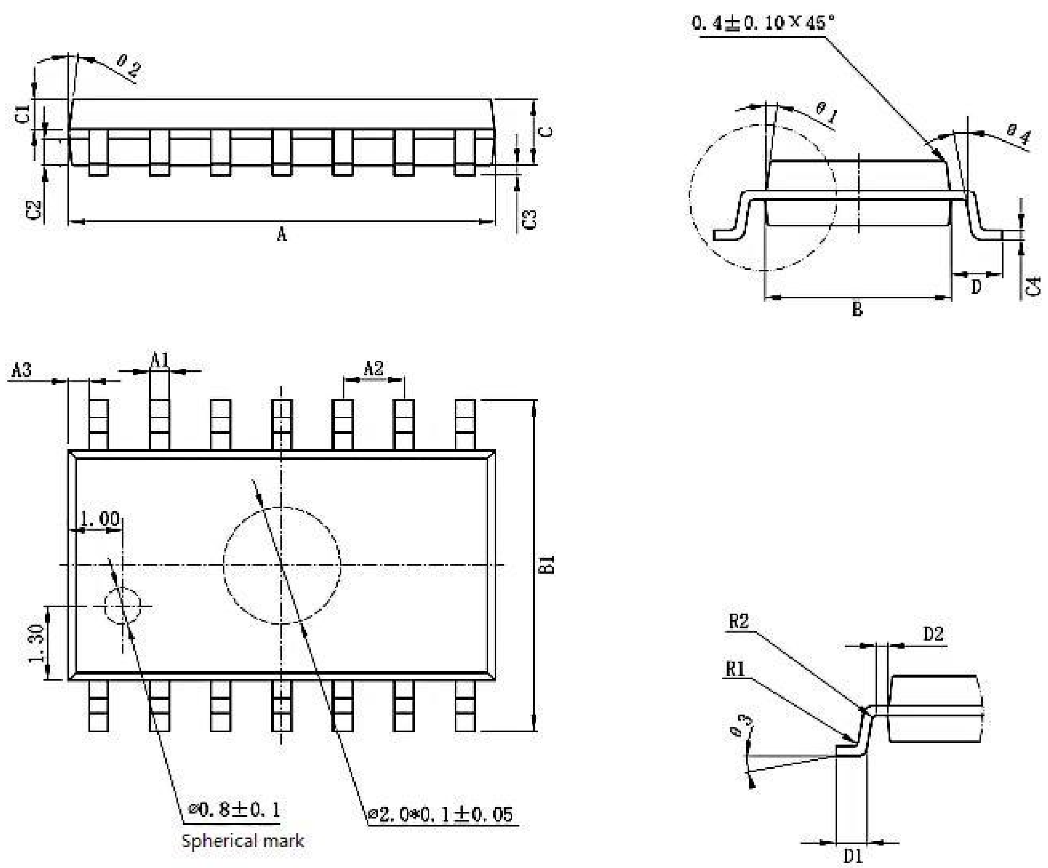
Ordering Information

Part Number	Device Marking	Package Type	Body size (mm)	Temperature (℃)	MSL	Transport Media	Package Quantity
XL124	XL124	SOP14	8.75 * 4.00	- 40 to 105	MSL3	T&R	2500
XD124	XD142	DIP14	19.05 * 6.35	- 40 to 105	MSL3	Tube 25	1000

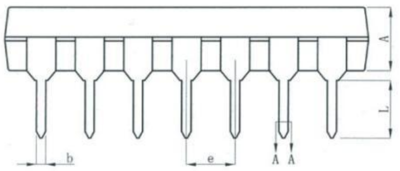
9. DIMENSIONAL DRAWINGS

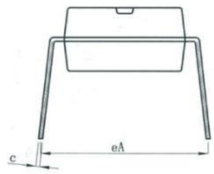
SOP14

SYM MARK	MIN(mm)	MAX(mm)	SYM MARK	MIN(mm)	MAX(mm)
A	8.55	8.75	C4	0.193	0.213
A1	0.356	0.456	D	0.95	1.15
A2	1.27TYP		D1	0.40	0.70
A3	0.312TYP		D2	0.20TYP	
B	3.80	4.00	R1	0.20TYP	
B1	5.80	6.20	R2	0.20TYP	
C	1.40	1.60	θ1	8° ~ 12° TYP4	
C1	0.60	0.70	θ2	8° ~ 12° TYP4	
C2	0.55	0.65	θ3	0° ~ 8°	
C3	0.05	0.25	θ4	4° ~ 12°	

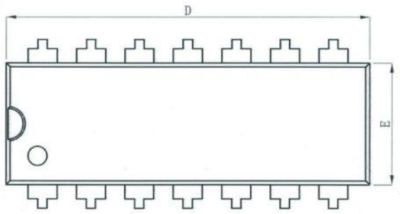


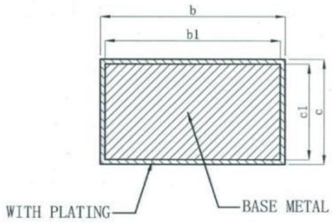
DIP14





symbol	millimeter		
	Min	Nom	Max
A	3.20	3.30	3.40
b	0.44	——	0.53
b1	0.43	0.46	0.49
c	0.25	——	0.30
c1	0.24	0.25	0.26
D	18.95	19.05	19.15
E	6.25	6.35	6.45
e	2.54BSC		
eA	8.30	8.80	9.30
L	3.00	——	——





SECTION A-A

[if you need helpcontact us. Xinluda reserves the right to changethe above information withoutpriornotice]