

TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A, TL081B, TL082B, TL084B

JFET-Input Operational Amplifiers

The TL08X JFET-input operational amplifiers family is designed to offer a wider selection than any previously developed operational amplifier family. Each of these JFET-input operational amplifiers incorporates well-matched, high-voltage JFET and bipolar transistors in a monolithic integrated circuit. The devices feature high slew rates, low input bias and offset currents, and low offset voltage temperature coefficient. Offset adjustment and external compensation options are available within the TL08X family.

Rochester Electronics Manufactured Components

Rochester branded components are manufactured using either die/wafers purchased from the original suppliers or Rochester wafers recreated from the original IP. All recreations are done with the approval of the OCM.

Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceeds the OCM data sheet.

Quality Overview

- ISO-9001
- AS9120 certification
- Qualified Manufacturers List (QML) MIL-PRF-38535
 - Class Q Military
 - Class V Space Level
- Qualified Suppliers List of Distributors (QSLD)
 - Rochester is a critical supplier to DLA and meets all industry and DLA standards.

Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

The original manufacturer's datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OEM specifications. 'Typical' values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.

TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A TL081B, TL082B, TL084B

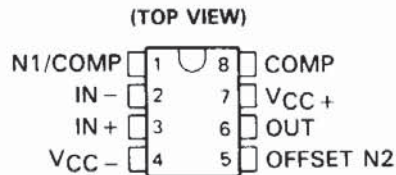
JFET-INPUT OPERATIONAL AMPLIFIERS

D2297, FEBRUARY 1977—REVISED OCTOBER 1990

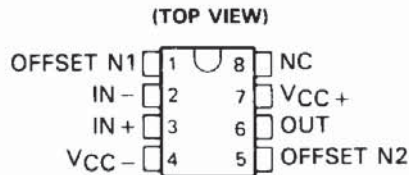
24 DEVICES COVER MILITARY, INDUSTRIAL AND COMMERCIAL TEMPERATURE RANGES

- Low-Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Total Harmonic Distortion . . . 0.003% Typ
- High Input Impedance . . . JFET-Input Stage
- Internal Frequency Compensation (Except TL080, TL080A)
- Latch-Up-Free Operation
- High Slew Rate . . . 13 V/ μ s Typ
- Common-Mode Input Voltage Range Includes $V_{CC} +$

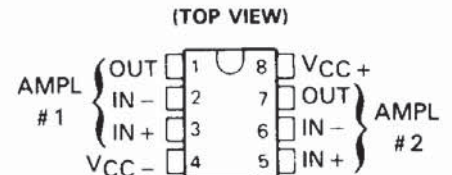
TL080
D, JG, OR P PACKAGE



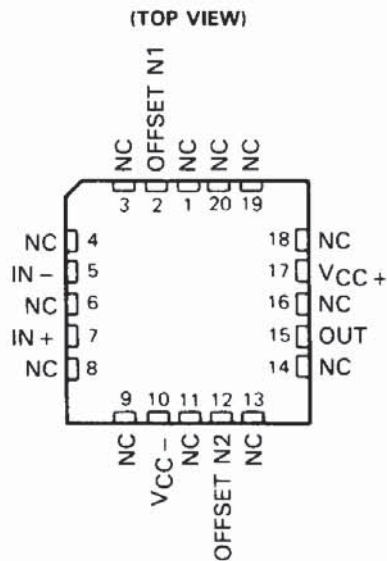
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D, JG, OR P PACKAGE



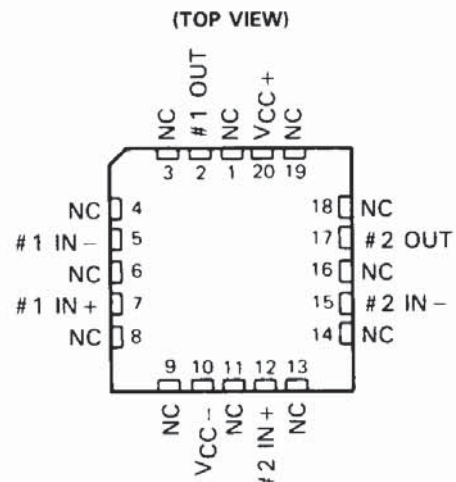
TL082, TL082A, TL082B
D, JG, OR P PACKAGE



TL081M . . . FK CHIP CARRIER PACKAGE

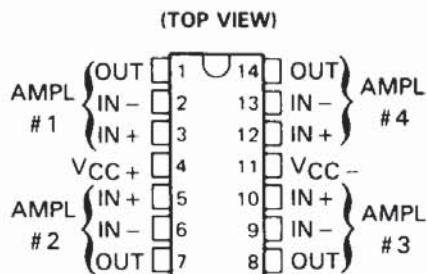


TL082M . . . FK CHIP CARRIER PACKAGE

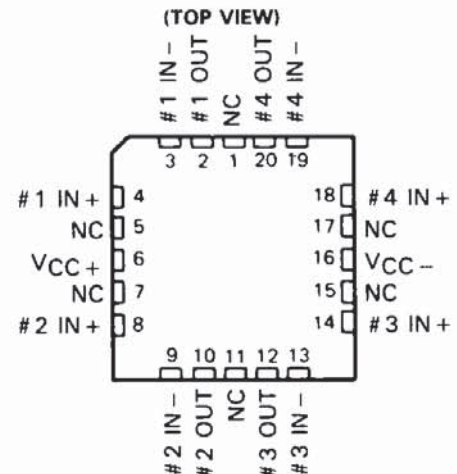


TL084, TL084A, TL084B

D, J, OR N PACKAGE



TL084M . . . FK CHIP CARRIER PACKAGE



NC—No internal connection

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

TEXAS
INSTRUMENTS

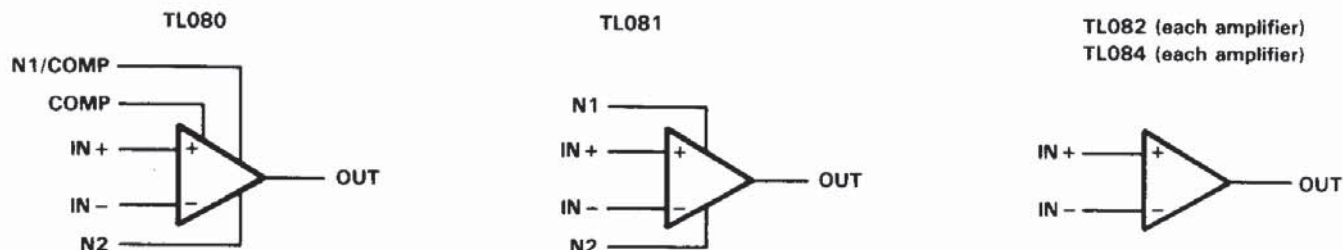
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On products compliant to MIL-STD-883, Class B, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A TL081B, TL082B, TL084B JFET-INPUT OPERATIONAL AMPLIFIERS

symbols



description

The TL08__ JFET-input operational amplifier family is designed to offer a wider selection than any previously developed operational amplifier family. Each of these JFET-input operational amplifiers incorporates well-matched, high-voltage JFET and bipolar transistors in a monolithic integrated circuit. The devices feature high slew rates, low input bias and offset currents, and low offset voltage temperature coefficient. Offset adjustment and external compensation options are available within the TL08__ family.

Device types with a "C" suffix are characterized for operation from 0°C to 70°C, those with an "I" suffix are characterized for operation from -40°C to 85°C, and those with an "M" suffix are characterized for operation over the full military temperature range of -55°C to 125°C.

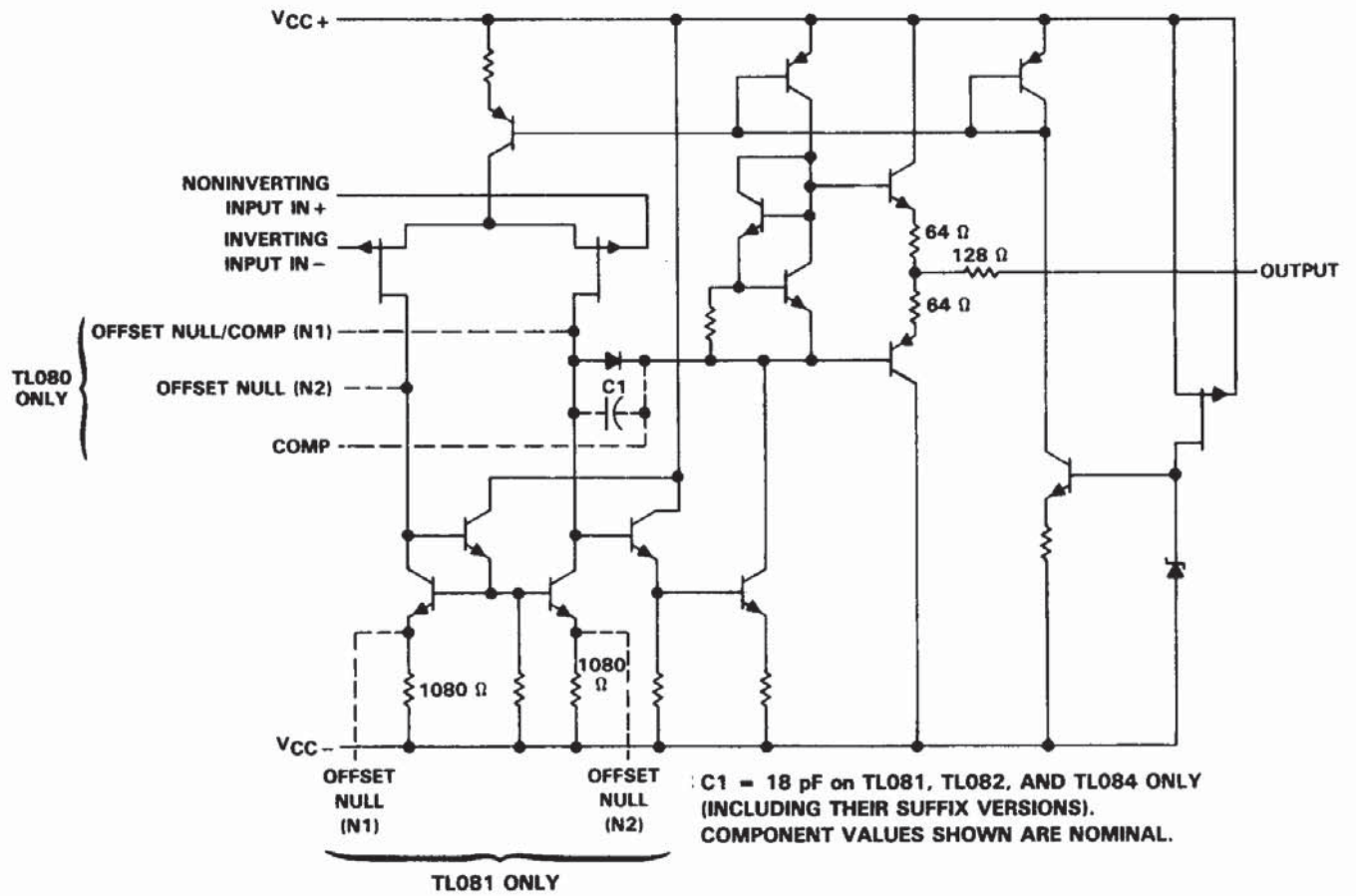
AVAILABLE OPTIONS

T _A	V _{IO} MAX AT 25°C	PACKAGE						
		SMALL OUTLINE (D008)	SMALL OUTLINE (D014)	CHIP CARRIER (FK)	CERAMIC DIP (J)	CERAMIC DIP (JG)	PLASTIC DIP (N)	PLASTIC DIP (P)
0°C to 70°C	15 mV	TL080CD						TL080CP
	15 mV	TL081CD	—	—	—	—	—	TL081CP
	6 mV	TL081ACD						TL081ACP
	3 mV	TL081BCD						TL081BCP
	15 mV	TL082CD	—	—	—	—	—	TL082CP
	6 mV	TL082ACD						TL082ACP
	3 mV	TL082BCD						TL082BCP
	15 mV		TL084CD				TL084CN	
	6 mV	—	TL084ACD	—	—	—	TL084ACN	—
	3 mV		TL084BCD				TL084BCN	
-40°C to 85°C	6 mV	TL081ID						TL081IP
	6 mV	TL082ID						TL082IP
	6 mV	TL083ID						
	6 mV	TL084ID	TL084ID				TL084IN	
-55°C to 125°C	6 mV			TL081MFK		TL081MJG		
	6 mV	—	—	TL082MFK		TL082MJG	—	—
	9 mV			TL084MFK	TL084MJ			

The D package is available taped and reeled. Add "R" suffix to device type, (e.g., TL080CDR).

TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A
TL081B, TL082B, TL084B
JFET-INPUT OPERATIONAL AMPLIFIERS

schematic (each amplifier)



TEXAS
INSTRUMENTS

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TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A
TL081B, TL082B, TL084B
JFET-INPUT OPERATIONAL AMPLIFIERS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

	TL08_C TL08_AC TL08_BC	TL08_I	TL08_M	UNIT
Supply voltage, V_{CC+} (see Note 1)	18	18	18	V
Supply voltage, V_{CC-} (see Note 1)	-18	-18	-18	V
Differential input voltage (see Note 2)	± 30	± 30	± 30	V
Input voltage (see Notes 1 and 3)	± 15	± 15	± 15	V
Duration of output short circuit (see Note 4)	unlimited	unlimited	unlimited	
Continuous total dissipation	See Dissipation Rating Table			
Operating free-air temperature range	0 to 70	-40 to 85	-55 to 125	°C
Storage temperature range	-65 to 150	-65 to 150	-65 to 150	°C
Case temperature for 60 seconds	FK package		260	°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds	J or JG package		300	°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D, N, or P package	260	260	°C

- NOTES: 1. All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-} .
2. Differential voltages are at the noninverting input terminal with respect to the inverting input terminal.
3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.
4. The output may be shorted to ground or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR	DERATE ABOVE T_A	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
D (8 Pin)	680 mW	5.8 mW/°C	32°C	464 mW	377 mW	N/A
D (14 Pin)	680 mW	7.6 mW/°C	60°C	608 mW	494 mW	N/A
FK	680 mW	11.0 mW/°C	88°C	680 mW	680 mW	275 mW
J	680 mW	11.0 mW/°C	88°C	680 mW	680 mW	275 mW
JG	680 mW	8.4 mW/°C	69°C	672 mW	546 mW	210 mW
N	680 mW	9.2 mW/°C	76°C	680 mW	598 mW	N/A
P	680 mW	8.0 mW/°C	65°C	640 mW	520 mW	N/A

**TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A
TL081B, TL082B, TL084B
JFET-INPUT OPERATIONAL AMPLIFIERS**

electrical characteristics, $V_{CC} \pm = \pm 15$ V (unless otherwise noted)

PARAMETER	TEST CONDITIONS†		TL080C		TL081AC		TL081BC		TL081I		UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	
V _{IO} Input offset voltage	V _O = 0,	T _A = 25°C	3	15	3	6	2	3	3	6	mV
	R _S = 50 Ω	T _A = full range		20		7.5		5		9	
α _{VIO} Temperature coefficient of input offset voltage	V _O = 0,	R _S = 50 Ω, T _A = full range	18		18		18		18		μV/°C
I _{IO} Input offset current‡	V _O = 0	T _A = 25°C	5	200	5	100	5	100	5	100	pA
		T _A = full range		2		2		2		10	nA
I _{IB} Input bias current‡	V _O = 0	T _A = 25°C	30	400	30	200	30	200	30	200	pA
		T _A = full range		10		7		7		20	nA
V _{ICR} Common-mode input voltage range	T _A = 25°C		±11	to 15	±12	to 15	±11	to 15	±12	to 15	V
V _{OM} Maximum peak output voltage swing	T _A = 25°C,	R _L = 10 kΩ	±12	±13.5	±12	±13.5	±12	±13.5	±12	±13.5	V
		R _L = ≥ 10 kΩ	±12		±12		±12		±12		
	T _A = full range	R _L ≥ 2 kΩ	±10	±12	±10	±12	±10	±12	±10	±12	
A _{VD} Large-signal differential voltage amplification	V _O = ±10 V,	R _L ≥ 2 kΩ,	25	200	50	200	50	200	50	200	V/mV
	T _A = 25°C										
	V _O = ±10 V,	R _L ≥ 2 kΩ,	15		25		25		25		
	T _A = full range										
B ₁ Unity-gain bandwidth	T _A = 25°C		3		3		3		3		MHz
r _i Input resistance	T _A = 25°C		10 ¹²		10 ¹²		10 ¹²		10 ¹²		Ω
CMRR Common-mode rejection ratio	V _{IC} = V _{ICR} min, V _O = 0,		70	86	80	86	80	86	80	86	dB
	R _S = 50 Ω, T _A = 25°C										
k _{SVR} Supply voltage rejection ratio	V _{CC} = ±15 V to ±9 V, V _O = 0,										dB
	R _S = 50 Ω, T _A = 25°C		70	86	80	86	80	86	80	86	
I _{CC} Supply current (per amplifier)	No load, V _O = 0,		1.4	2.8	1.4	2.8	1.4	2.8	1.4	2.8	mA
	T _A = 25°C										
V _{O1} /V _{O2} Crosstalk attenuation	A _{VD} = 100, T _A = 25°C		120		120		120		120		dB

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. Full range for T_A is 0°C to 70°C for TL080_C, TL081_AC, and TL081_BC, and -40°C to 85°C for TL081_I.

‡ Input bias currents of a FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive as shown in Figure 18. Pulse techniques must be used that will maintain the junction temperatures as close to the ambient temperature as is possible.

TL080M, TL081M, TL082M, TL084M, TL081AM, TL082AM, TL084AM
TL081BM, TL082BM, TL084BM
JFET-INPUT OPERATIONAL AMPLIFIERS

electrical characteristics, $V_{CC\pm} = \pm 15$ V (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		MIN	TYP	MAX	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	$V_O = 0$, $R_S = 50\ \Omega$	$T_A = 25^\circ\text{C}$		3	6		3	9	mV
			$T_A = -55^\circ\text{C to } 125^\circ\text{C}$			9			15	
α_{VIO}	Temperature coefficient of input offset voltage	$V_O = 0$, $T_A = -55^\circ\text{C to } 125^\circ\text{C}$	$R_S = 50\ \Omega$		18			18		$\mu\text{V}/^\circ\text{C}$
I_{IO}	Input offset current‡	$V_O = 0$	$T_A = 25^\circ\text{C}$		5	100		5	100	pA
			$T_A = 125^\circ\text{C}$			20			20	nA
I_{IB}	Input bias current‡	$V_O = 0$	$T_A = 25^\circ\text{C}$		30	200		30	200	pA
			$T_A = 125^\circ\text{C}$			50			50	nA
V_{ICR}	Common-mode input voltage range	$T_A = 25^\circ\text{C}$		± 11	-12 to 15		± 11	-12 to 15		V
V_{OM}	Maximum peak output voltage swing	$T_A = 25^\circ\text{C}$, $R_L = 10\ \text{k}\Omega$		± 12	± 13.5		± 12	± 13.5		V
		$T_A = -55^\circ\text{C to } 125^\circ\text{C}$, $R_L \geq 10\ \text{k}\Omega$		± 12			± 12			
		$R_L \geq 2\ \text{k}\Omega$		± 10	± 12		± 10	± 12		
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm 10$ V, $T_A = 25^\circ\text{C}$, $R_L \geq 2\ \text{k}\Omega$		25	200		25	200		V/mV
		$V_O = \pm 10$ V, $T_A = -55^\circ\text{C to } 125^\circ\text{C}$, $R_L \geq 2\ \text{k}\Omega$		15			15			
B_1	Unity-gain bandwidth	$T_A = 25^\circ\text{C}$			3			3		MHz
r_i	Input resistance	$T_A = 25^\circ\text{C}$			10^{12}			10^{12}		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = V_{ICR\ min}$, $R_S = 50\ \Omega$	$V_O = 0$, $T_A = 25^\circ\text{C}$	80	86		80	86		dB
k_{SVR}	Supply voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	$V_{CC} = \pm 15$ V to ± 9 V, $V_O = 0$, $R_S = 50\ \Omega$, $T_A = 25^\circ\text{C}$		80	86		80	86		dB
I_{CC}	Supply current (per amplifier)	No load, $V_O = 0$, $T_A = 25^\circ\text{C}$			1.4	2.8		1.4	2.8	mA
V_{O1}/V_{O2}	Crosstalk attenuation	$A_{VD} = 100$, $T_A = 25^\circ\text{C}$			120			120		dB

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified.

‡ Input bias currents of a FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive as shown in Figure 18. Pulse techniques must be used that will maintain the junction temperatures as close to the ambient temperature as is possible.

TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A TL081B, TL082B, TL084B JFET-INPUT OPERATIONAL AMPLIFIERS

operating characteristics, $V_{CC} \pm = \pm 15 \text{ V}$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
SR Slew rate at unity gain	$V_I = 10 \text{ V}$, $R_L = 2 \text{ k}\Omega$, $C_L = 100 \text{ pF}$, See Figure 1	8*	13		$\text{V}/\mu\text{s}$
	$V_I = 10 \text{ V}$, $R_L = 2 \text{ k}\Omega$, $C_L = 100 \text{ pF}$, See Figure 1	5*			
t_r Rise time	$V_I = 20 \text{ mV}$, $R_L = 2 \text{ k}\Omega$, $C_L = 100 \text{ pF}$, See Figure 1		0.05		μs
Overshoot factor			20%		
V_n Equivalent input noise voltage	$R_S = 100 \Omega$, $f = 1 \text{ kHz}$		18		$\text{nV}/\sqrt{\text{Hz}}$
			4		μV
I_n Equivalent input noise current	$R_S = 100 \Omega$, $f = 1 \text{ kHz}$		0.01		$\text{pA}/\sqrt{\text{Hz}}$
THD Total harmonic distortion	$V_{O(\text{rms})} = 10 \text{ V}$, $R_S \leq 1 \text{ k}\Omega$, $R_L \geq 2 \text{ k}\Omega$, $f = 1 \text{ kHz}$		0.003%		

*On products compliant to MIL-STD-883, Class B, this parameter is not production tested.

PARAMETER MEASUREMENT INFORMATION

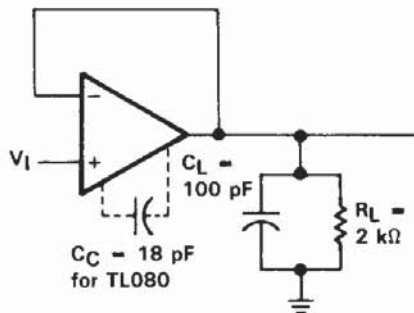


FIGURE 1. UNITY-GAIN AMPLIFIER

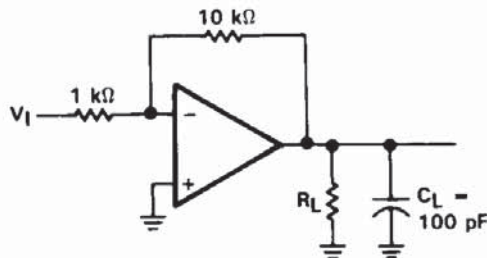


FIGURE 2. GAIN-OF-10
INVERTING AMPLIFIER

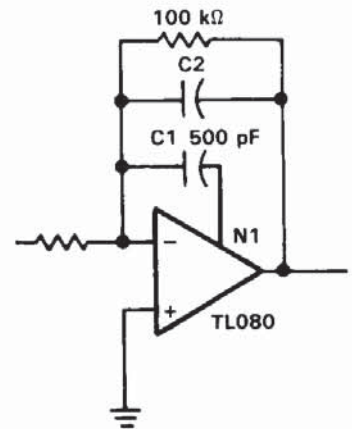


FIGURE 3. FEED-FORWARD
COMPENSATION

INPUT OFFSET VOLTAGE NULL CIRCUITS

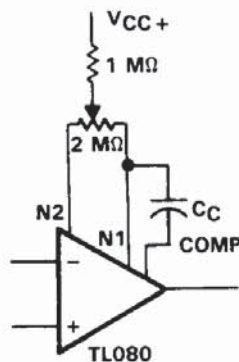


FIGURE 4

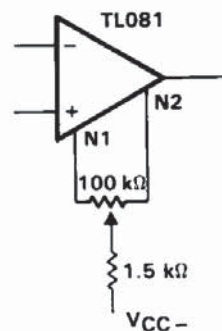


FIGURE 5

**TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A
TL081B, TL082B, TL084B
JFET-INPUT OPERATIONAL AMPLIFIERS**

TYPICAL CHARACTERISTICS†

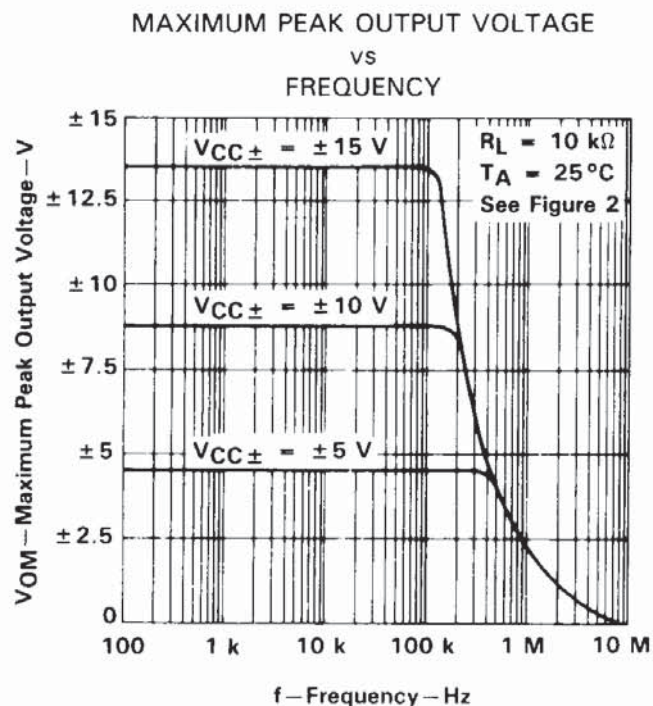


FIGURE 6

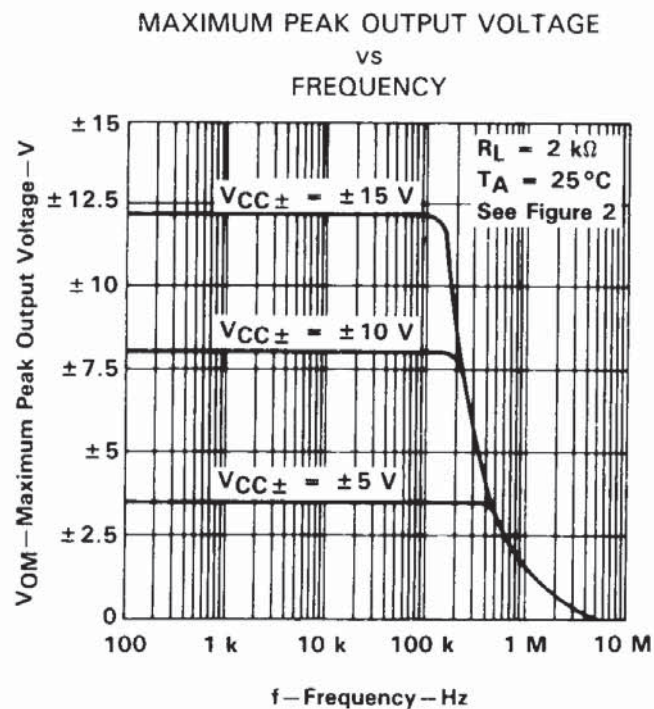


FIGURE 7

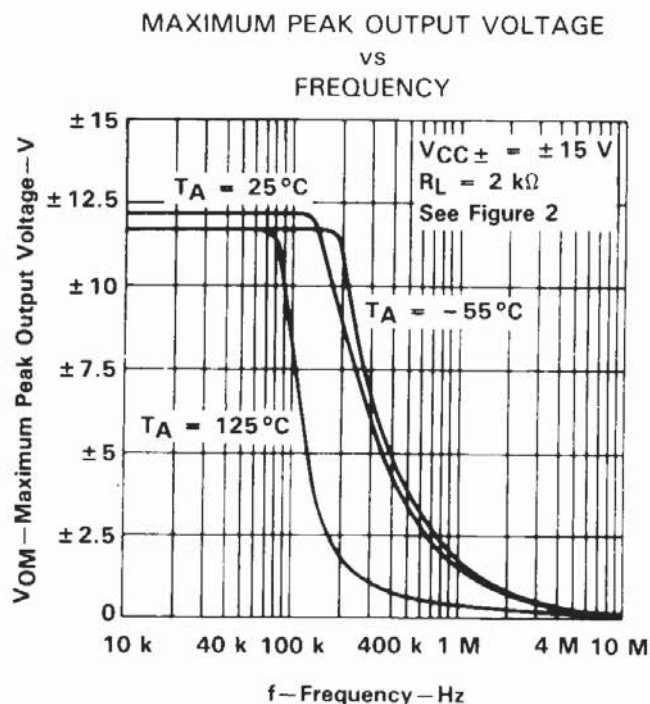


FIGURE 8

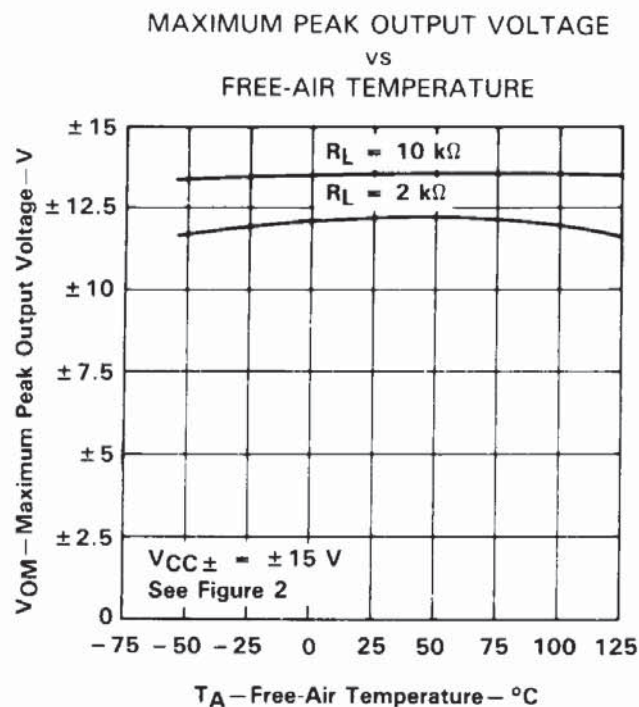
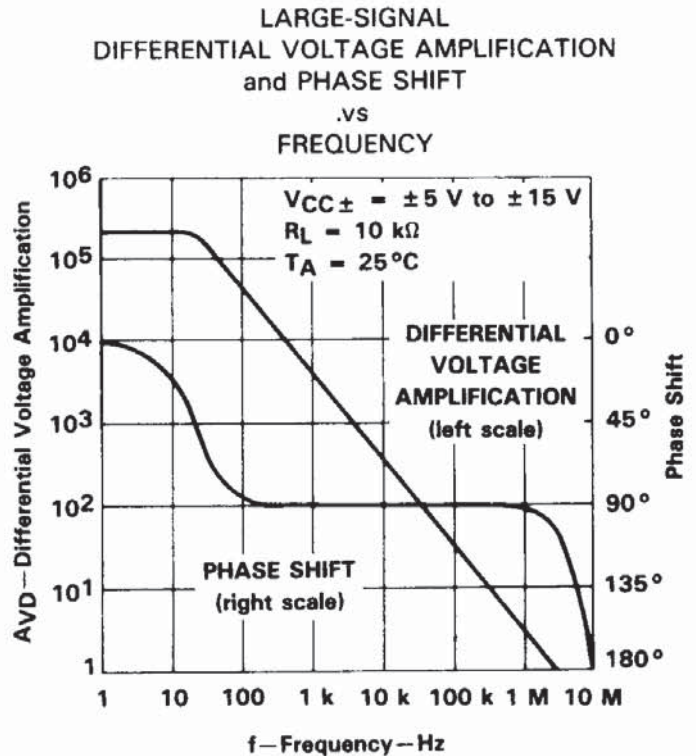
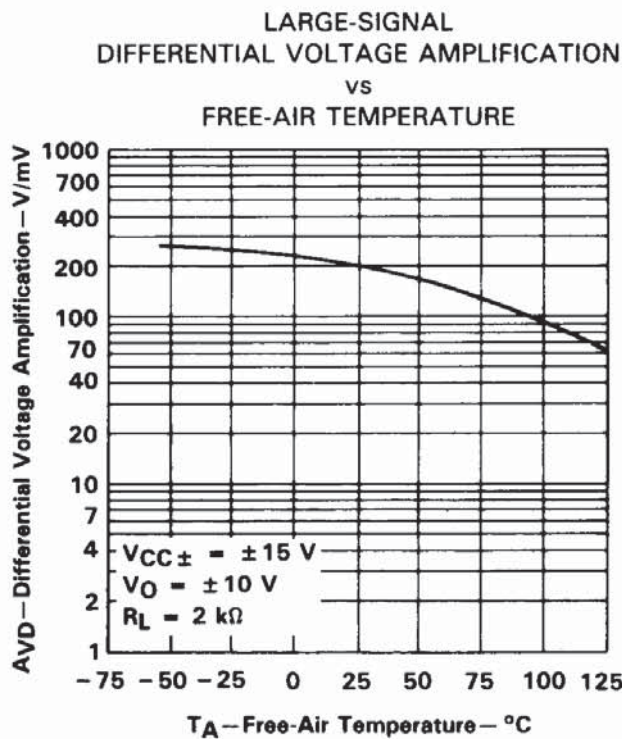
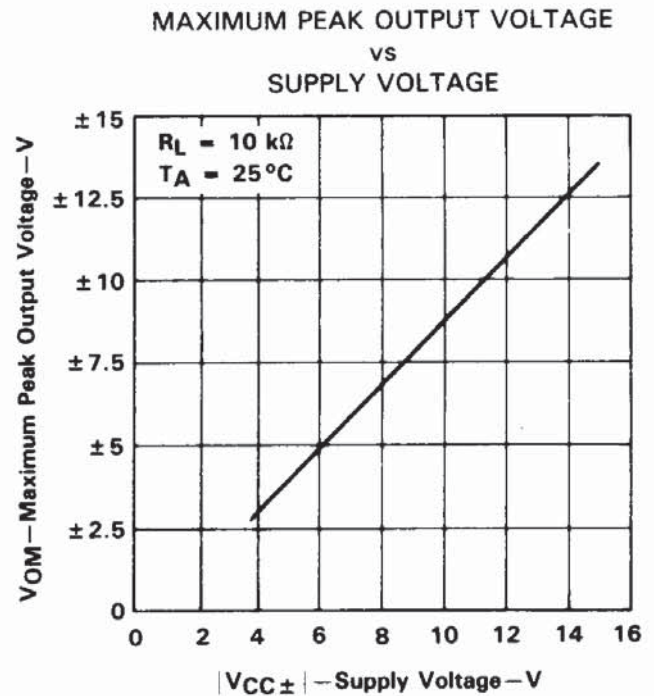
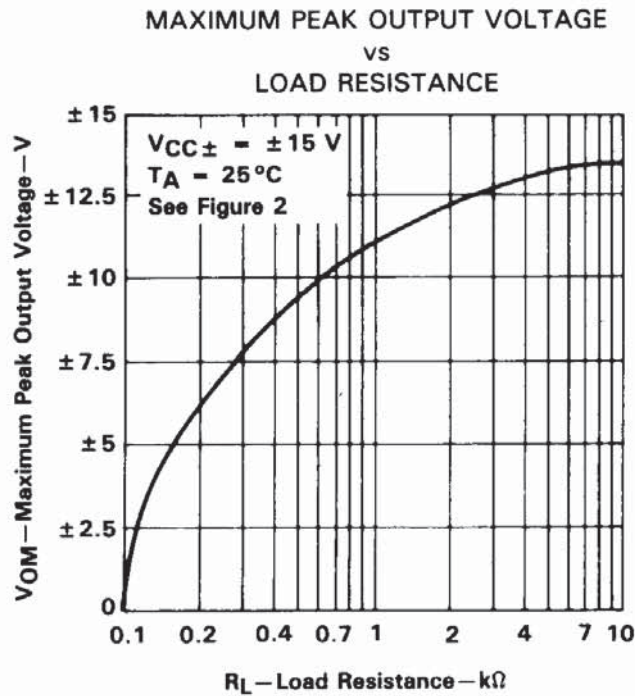


FIGURE 9

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices. A 12-pF compensation capacitor is used with TL080.

**TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A
TL081B, TL082B, TL084B
JFET-INPUT OPERATIONAL AMPLIFIERS**

TYPICAL CHARACTERISTICS†



† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices. A 12-pF compensation capacitor is used with TL080.

**TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A
TL081B, TL082B, TL084B
JFET-INPUT OPERATIONAL AMPLIFIERS**

TYPICAL CHARACTERISTICS†

TL080
DIFFERENTIAL VOLTAGE AMPLIFICATION
VS
FREQUENCY WITH FEED-FORWARD COMPENSATION

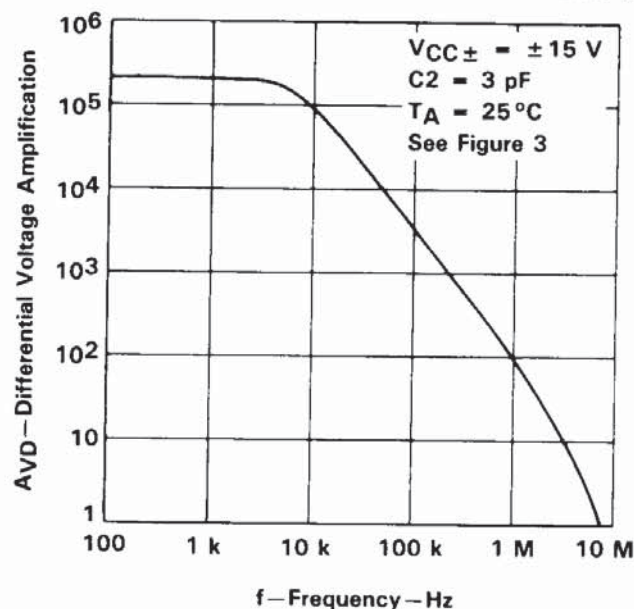


FIGURE 14

TOTAL POWER DISSIPATED
VS
FREE-AIR TEMPERATURE

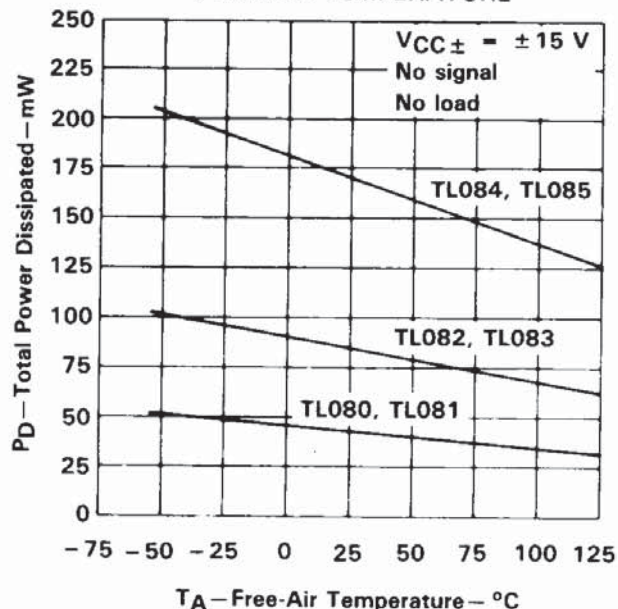


FIGURE 15

SUPPLY CURRENT PER AMPLIFIER
VS
FREE-AIR TEMPERATURE

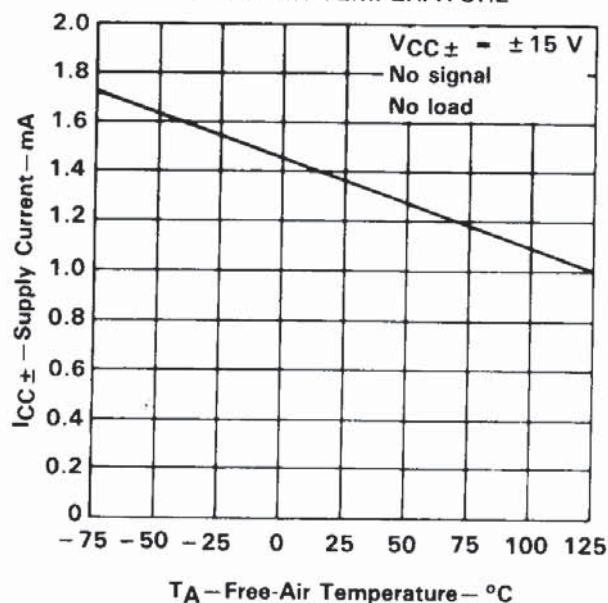


FIGURE 16

SUPPLY CURRENT
VS
SUPPLY VOLTAGE

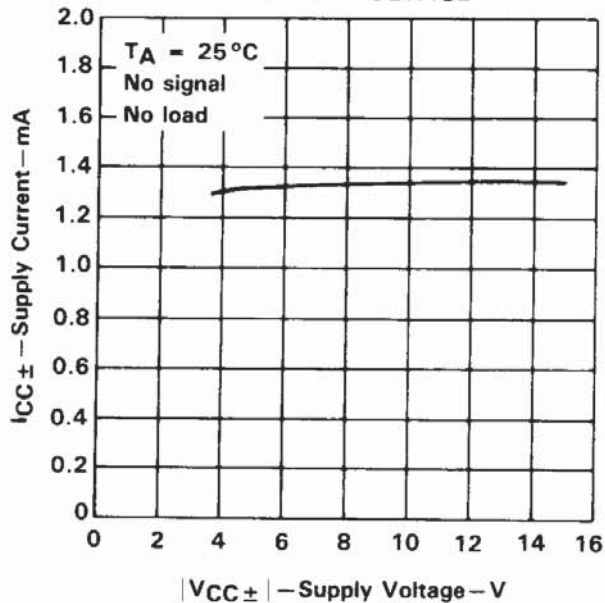


FIGURE 17

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices. A 12-pF compensation capacitor is used with TL080.

TYPICAL CHARACTERISTICS†

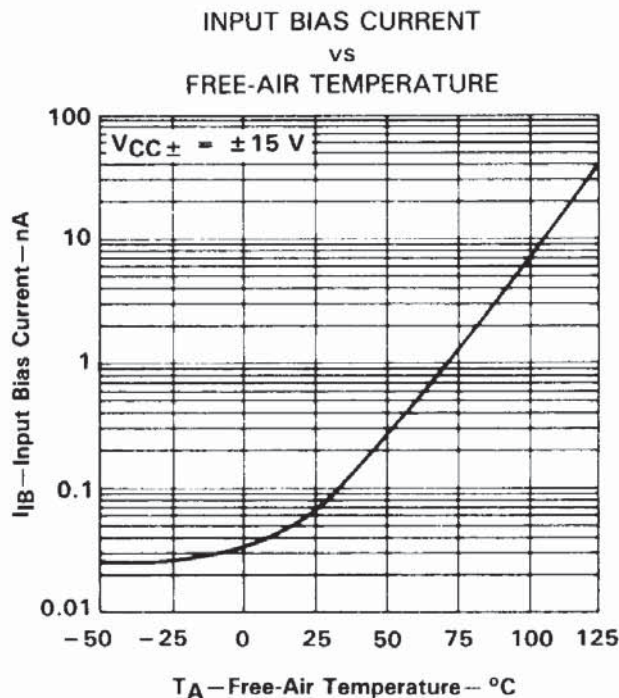


FIGURE 18

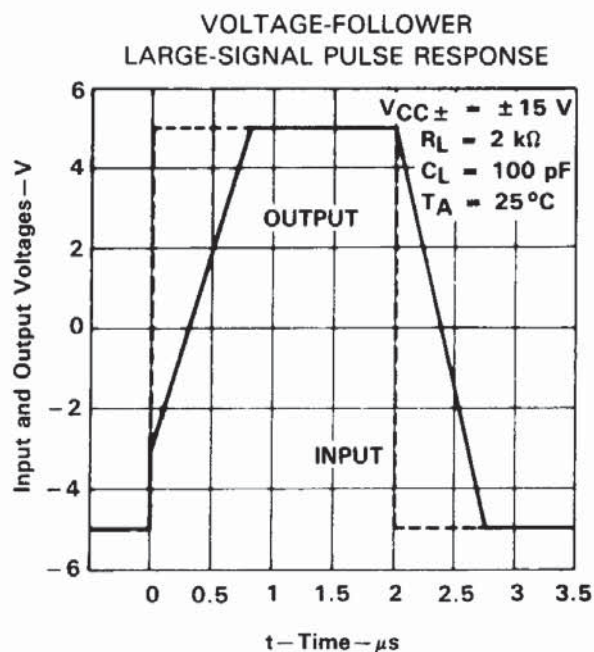


FIGURE 19

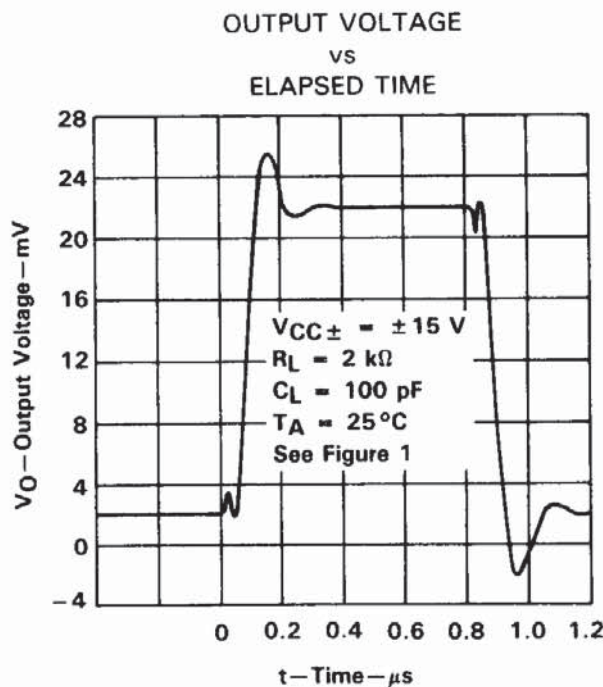


FIGURE 20

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices. A 12-pF compensation capacitor is used with TL080.

**TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A
TL081B, TL082B, TL084B
JFET-INPUT OPERATIONAL AMPLIFIERS**

TYPICAL CHARACTERISTICS†

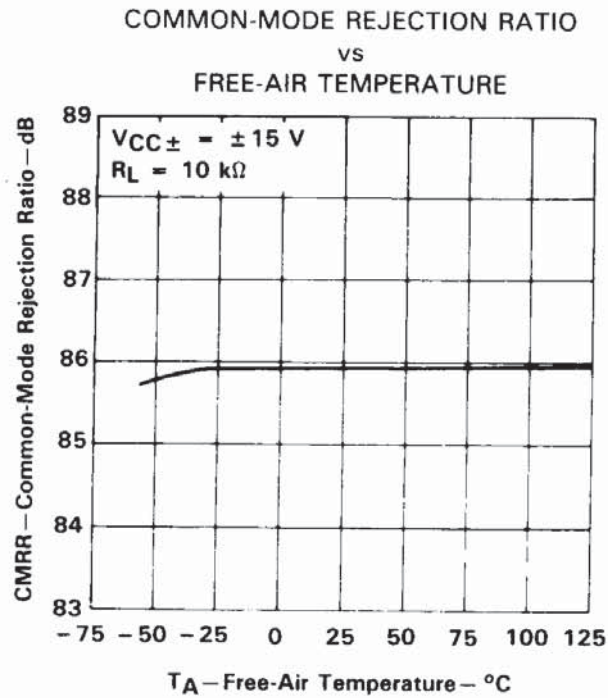


FIGURE 21

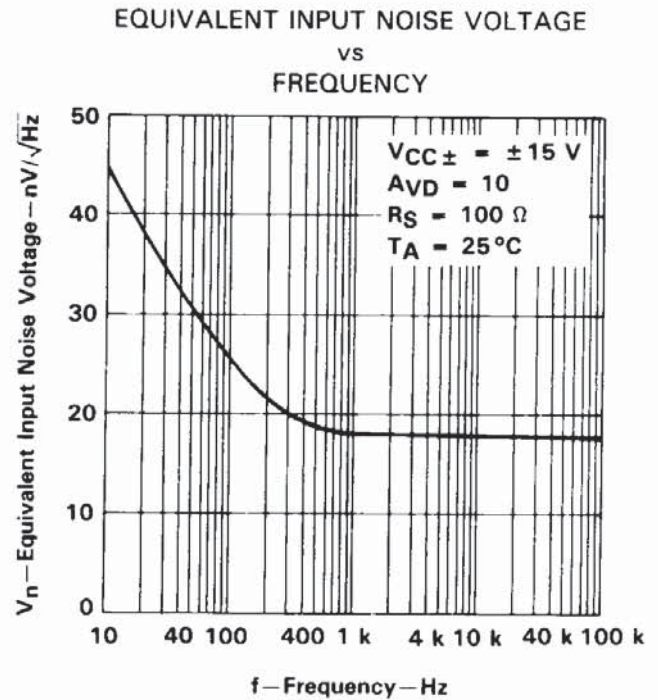


FIGURE 22

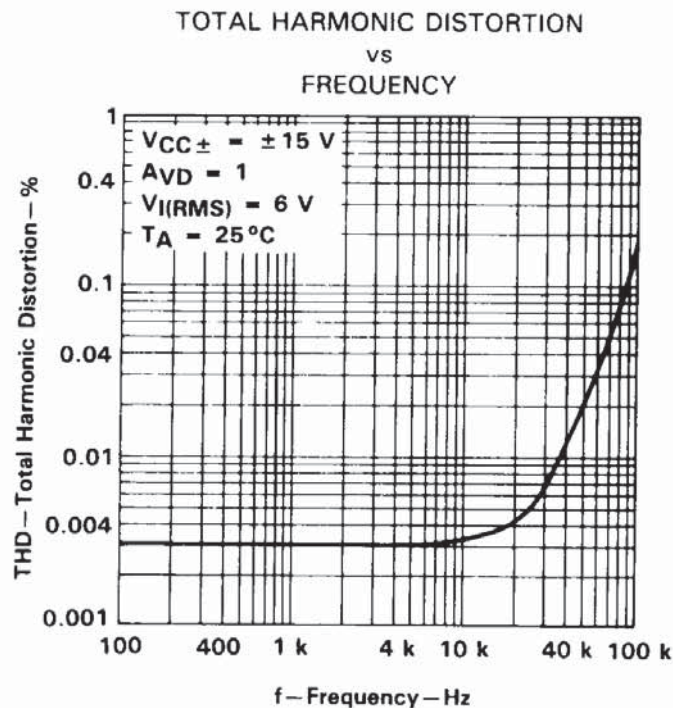


FIGURE 23

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices. A 12-pF compensation capacitor is used with TL080.

TYPICAL APPLICATION DATA

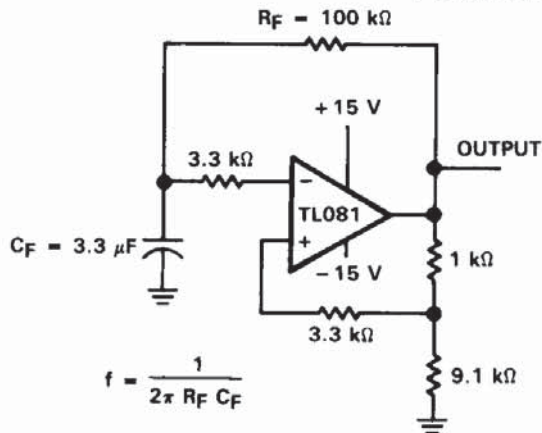


FIGURE 24. 0.5-Hz SQUARE-WAVE OSCILLATOR

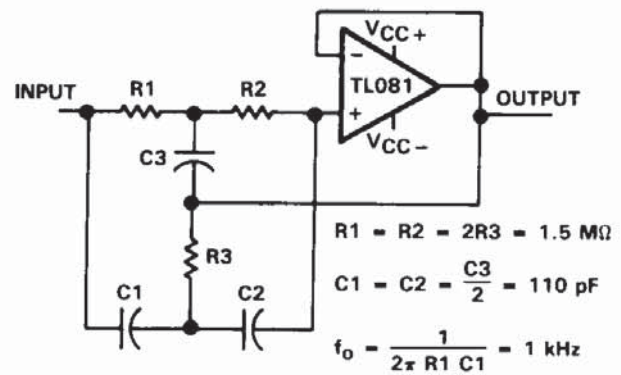


FIGURE 25. HIGH-Q NOTCH FILTER

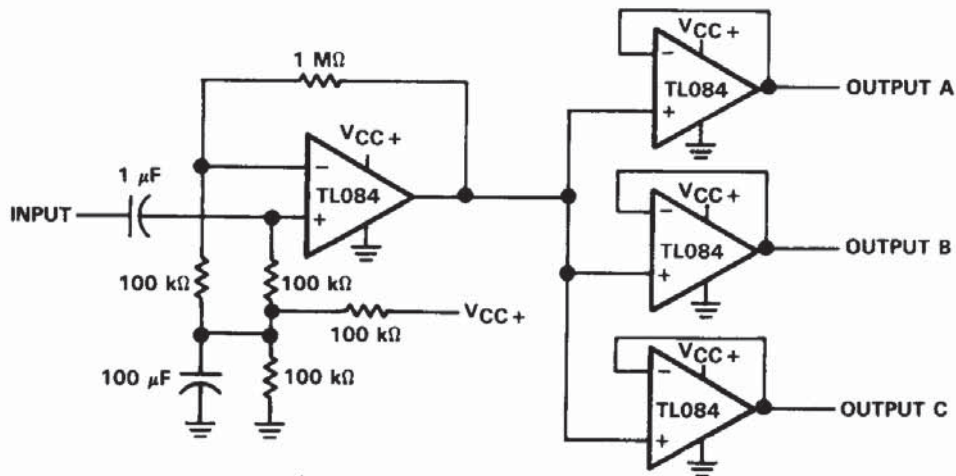
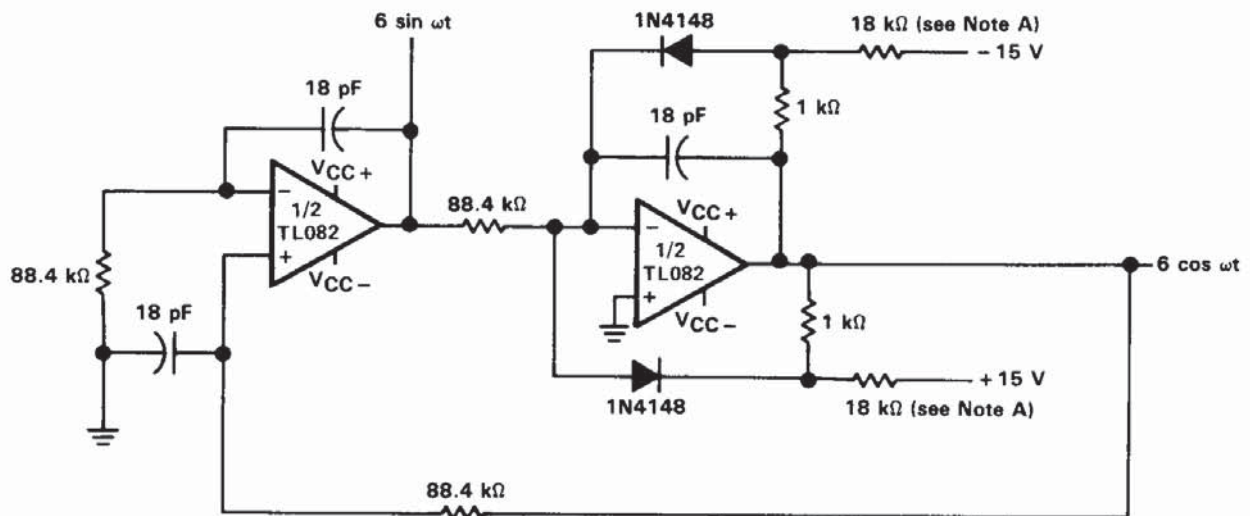


FIGURE 26. AUDIO DISTRIBUTION AMPLIFIER

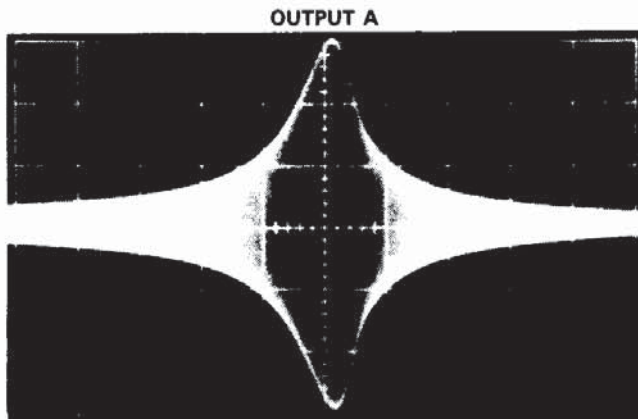
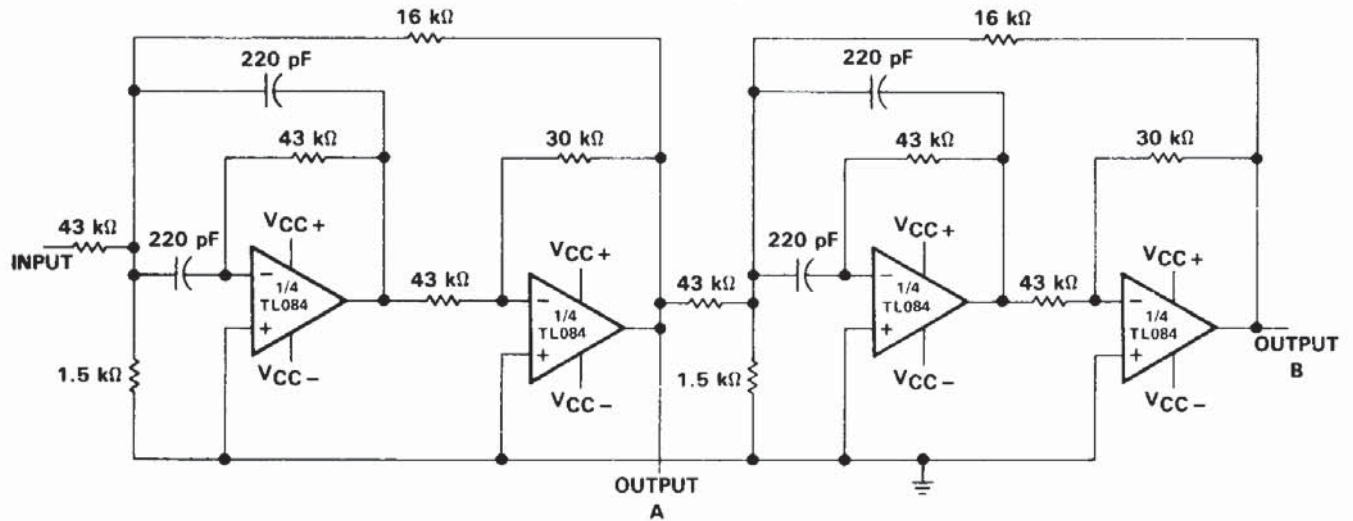


NOTE A: These resistor values may be adjusted for a symmetrical output.

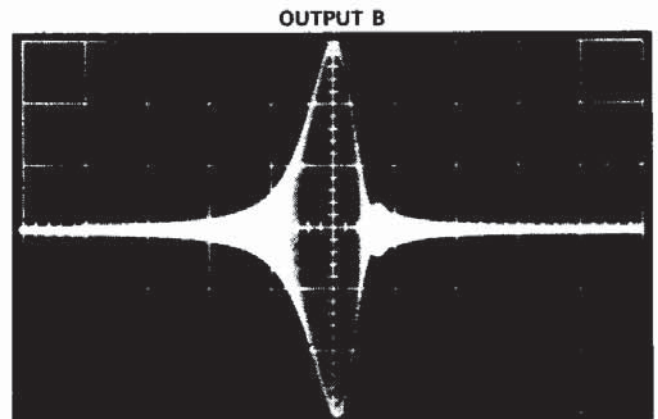
FIGURE 27. 100-KHz QUADRATURE OSCILLATOR

**TL080, TL081, TL082, TL084, TL081A, TL082A, TL084A
TL081B, TL082B, TL084B
JFET-INPUT OPERATIONAL AMPLIFIERS**

TYPICAL APPLICATION DATA



2 kHz/div
SECOND-ORDER BANDPASS FILTER
 $f_0 = 100 \text{ kHz}$, $Q = 30$, $GAIN = 4$



2 kHz/div
CASCADED BANDPASS FILTER
 $f_0 = 100 \text{ kHz}$, $Q = 69$, $GAIN = 16$

FIGURE 28. POSITIVE-FEEDBACK BANDPASS FILTER

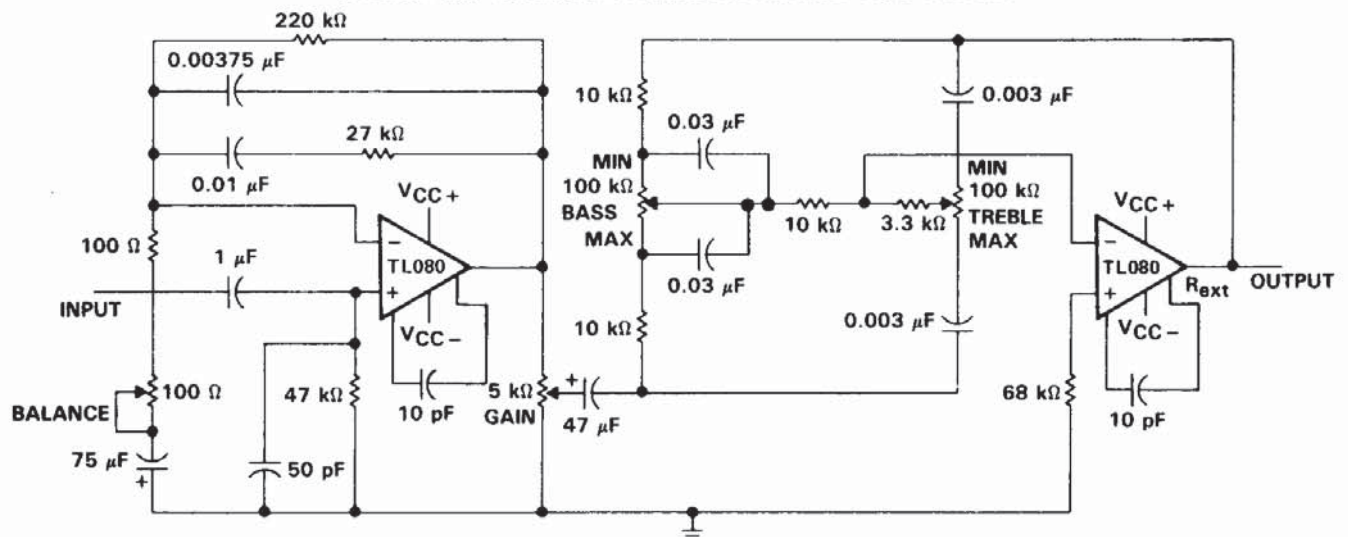


FIGURE 29. IC PREAMPLIFIER

**TEXAS
INSTRUMENTS**

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