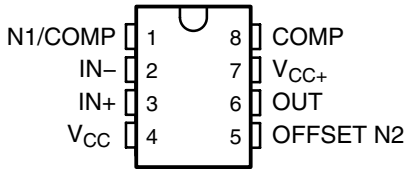
- **Low Power Consumption**
- **Wide Common-Mode and Differential Voltage Ranges**
- **Low Input Bias and Offset Currents**
- **Output Short-Circuit Protection**
- **Low Total Harmonic Distortion . . . 0.003% Typ**
- **High Input Impedance . . . JFET Input Stage**
- **External Frequency Compensation**
- **Common-Mode Input Voltage Range Includes V_{CC+}**
- **Latch-Up-Free Operation**
- **High Slew Rate . . . 13 V/μs Typ**

P PACKAGE
(TOP VIEW)



description

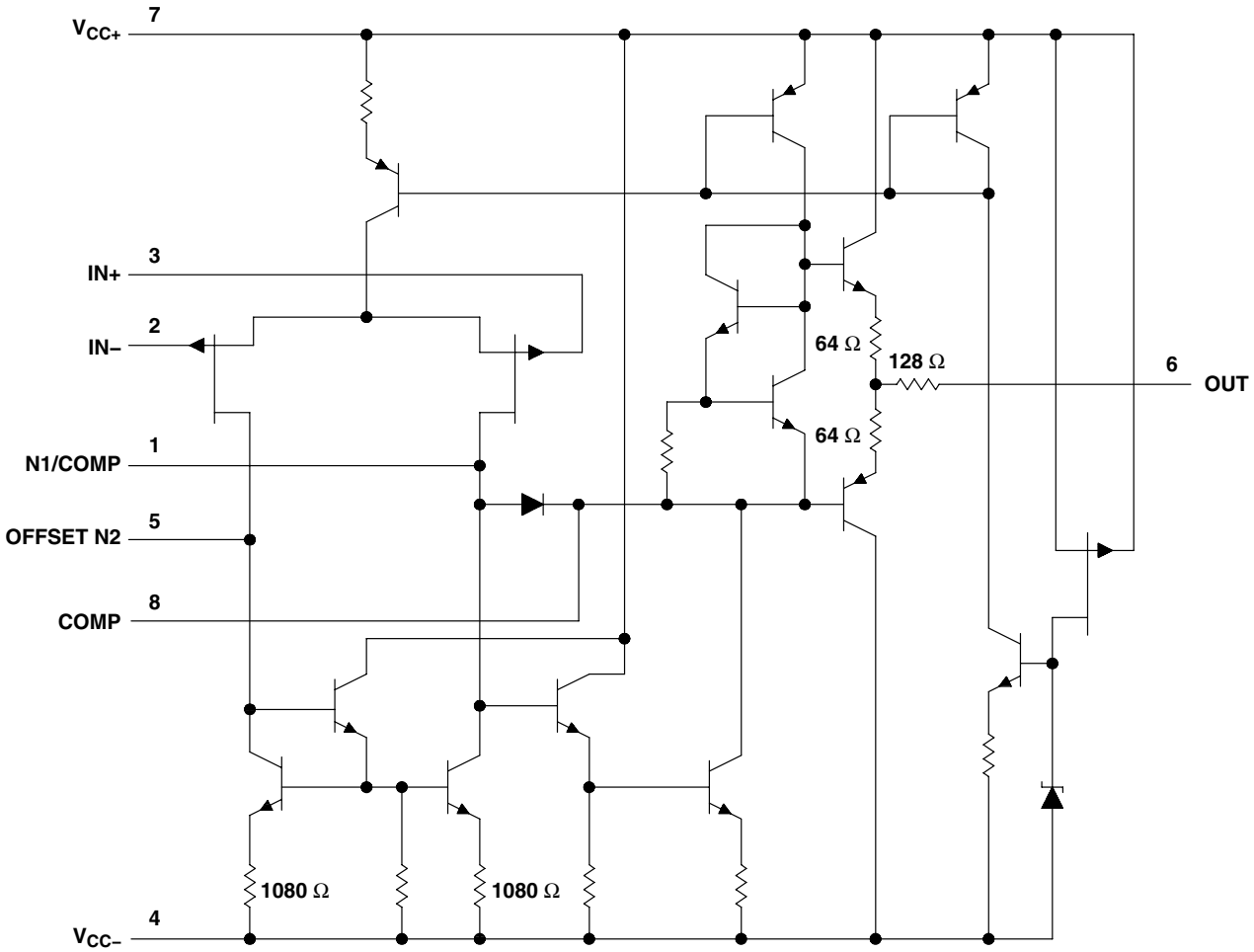
The TL080 JFET-input operational amplifier incorporates well-matched, high-voltage JFET and bipolar transistors in an integrated circuit. This device features high slew rates, low input bias and offset currents, and a low offset-voltage temperature coefficient. Offset adjustment and external-compensation options are available.

The TL080C is characterized for operation from 0°C to 70°C.

AVAILABLE OPTIONS

T_A	V_{IO}max AT 25°C	PACKAGE
		PLASTIC DIP (P)
0°C to 70°C	10 mV	TL080CP

schematic



All component values shown are nominal.

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

Supply voltage (see Note 1): V_{CC+} . . . . . 18 V
V_{CC-} . . . . . –18 V
Differential input voltage, V_{ID} (see Note 2) . . . . . ±30 V
Input voltage, V_I (see Notes 1 and 3) . . . . . ±15 V
Duration of short-circuit current (see Note 4) . . . . . Unlimited
Package thermal impedance, θ_{JA} (see Notes 5 and 6) . . . . . 85°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°C
Storage temperature range, T_{stg} . . . . . –65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

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 IN+ with respect to IN–.
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 can 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.
5. Maximum power dissipation is a function of $T_J(max)$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can impact reliability.
6. The package thermal impedance is calculated in accordance with JESD 51-7.

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

PARAMETER		TEST CONDITIONS	T_A†	MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	V_O = 0, R_S = 50 Ω	25°C		3	15	mV
			Full range			20	
$\alpha_{V_{IO}}$	Temperature coefficient of input offset voltage	V_O = 0, R_S = 50 Ω	Full range		18		μV/°C
I_{IO}	Input offset current‡	V_O = 0	25°C		5	200	pA
			Full range			2	nA
I_{IB}	Input bias current‡	V_O = 0	25°C		30	400	pA
			Full range			10	nA
V_{ICR}	Common-mode input voltage range		25°C	±11	–12 to 15		V
V_{OM}	Maximum peak output voltage swing	R_L = 10 kΩ	25°C	±12	±13.5		V
		R_L ≥ 10 kΩ	Full range	±12			
		R_L ≥ 2 kΩ		±10	±12		
A_{VD}	Large-signal differential voltage amplification	V_O = ±10 V, R_L ≥ 2 kΩ	25°C	25	200		V/mV
			Full range	15			
B_1	Unity-gain bandwidth		25°C		3		MHz
r_i	Input resistance		25°C		10^{12}		Ω
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, V_O = 0, R_S = 50 Ω	25°C	70	86		dB
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$)	V_{CC} = ±15 V to ±9 V, V_O = 0, R_S = 50 Ω	25°C	70	86		dB
I_{CC}	Supply current	V_O = 0, No load	25°C		1.4	2.8	mA
V_{O1}/V_{O2}	Crosstalk attenuation	A_{VD} = 100	25°C		120		dB

† All characteristics are measured under open-loop conditions with zero common-mode voltage unless otherwise specified. Full range for T_A is –40°C to 85°C.

‡ Input bias currents of a FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive, as shown in Figure 5. Pulse techniques must be used that will maintain the junction temperature as close to the ambient temperature as possible.

operating characteristics, $V_{CC\pm}$ = ±15 V, T_A = 25°C

PARAMETER		TEST CONDITIONS				MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	V_I = 10 V,	R_L = 2 kΩ,	C_L = 100 pF,	See Figure 1	8	13		V/μs
t_r	Rise-time overshoot factor	V_I = 20 mV,	R_L = 2 kΩ,	C_L = 100 pF,	See Figure 1		0.05		μs
							20%		
V_n	Equivalent input noise voltage	R_S = 100 Ω	f = 1 kHz				18		nV/√Hz
			f = 10 Hz to 10 kHz				4		μV
I_n	Equivalent input noise current	R_S = 100 Ω,	f = 1 kHz				0.01		pA/√Hz
THD	Total harmonic distortion	$V_{O(rms)}$ = 10 V,	$R_S \le$ 1 kΩ,	$R_L \ge$ 2 kΩ,	f = 1 kHz		0.003%		

APPLICATION INFORMATION

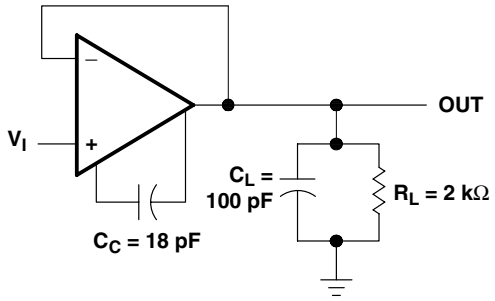


Figure 1. Unity-Gain Amplifier

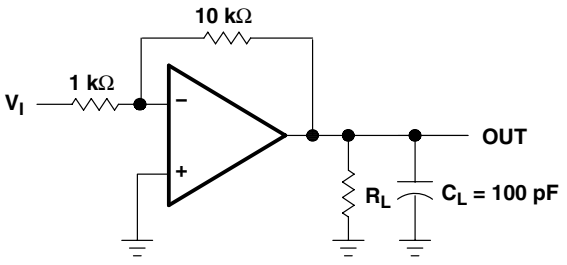


Figure 2. Gain-of-10 Inverting Amplifier

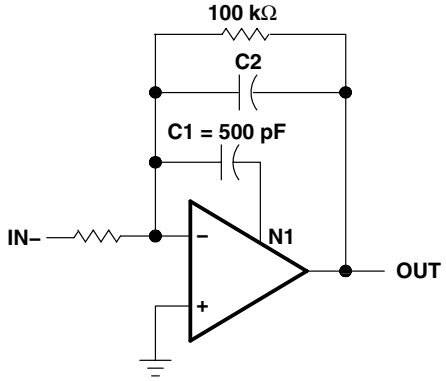


Figure 3. Feed-Forward Compensation

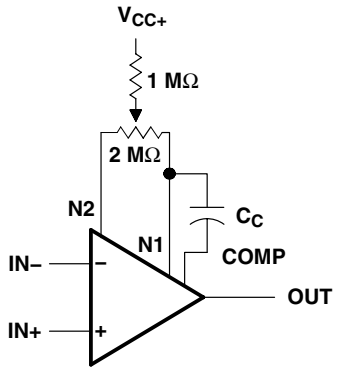


Figure 4. Input Offset Voltage Null Circuit

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
V_{OM}	Maximum peak output voltage	vs Frequency vs Free-air temperature vs Load resistance vs Supply voltage	5, 6, 7 8 9 10
A_{VD}	Large-signal differential voltage amplification	vs Free-air temperature vs Frequency	11 12
	Differential voltage amplification	vs Frequency	13
P_D	Total power dissipation	vs Free-air temperature	14
I_{CC}	Supply current	vs Free-air temperature vs Supply voltage	14 15
I_{IB}	Input bias current	vs Free-air temperature	16
	Large-signal pulse response	vs Time	17
V_O	Output voltage	vs Elapsed time	18
CMRR	Common-mode rejection ratio	vs Free-air temperature	19
V_n	Equivalent input noise voltage	vs Frequency	20
THD	Total harmonic distortion	vs Frequency	21

MAXIMUM PEAK OUTPUT VOLTAGE vs FREQUENCY

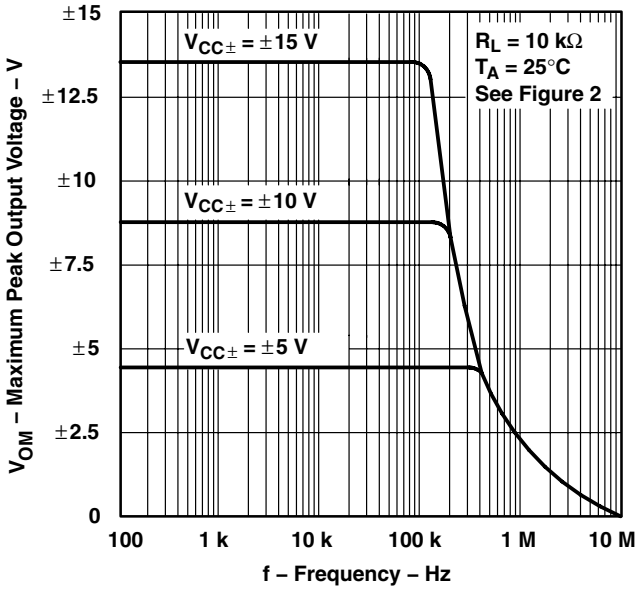


Figure 5

MAXIMUM PEAK OUTPUT VOLTAGE vs FREQUENCY

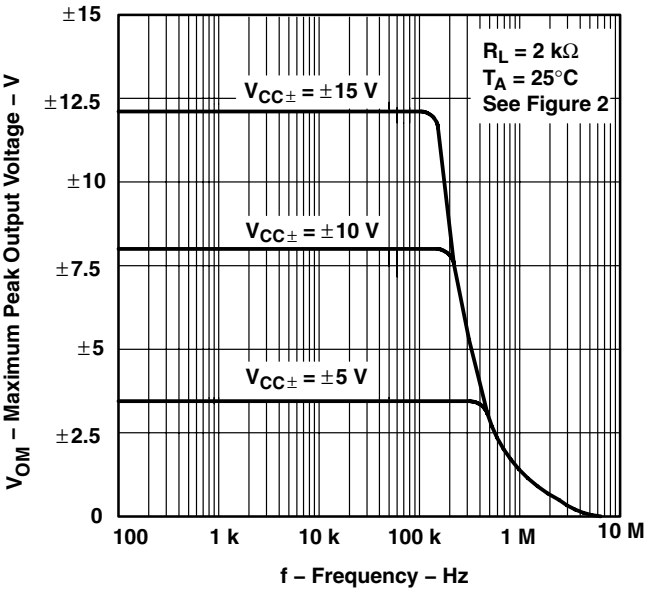


Figure 6

TYPICAL CHARACTERISTICS

MAXIMUM PEAK OUTPUT VOLTAGE vs FREQUENCY

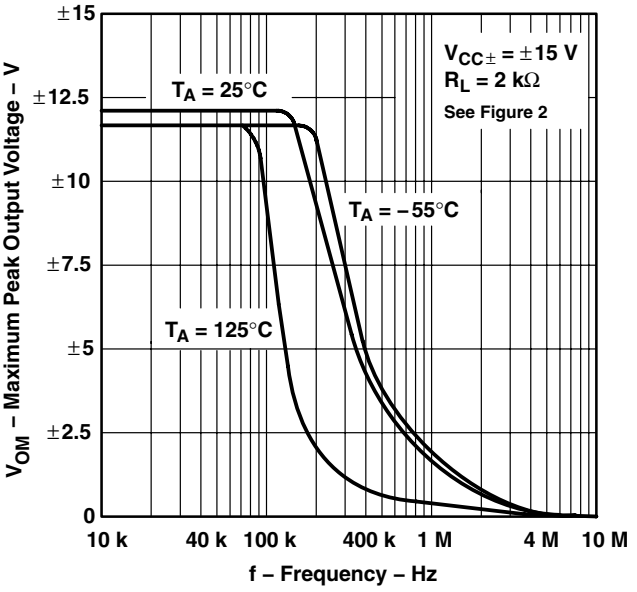


Figure 7

MAXIMUM PEAK OUTPUT VOLTAGE vs FREE-AIR TEMPERATURE

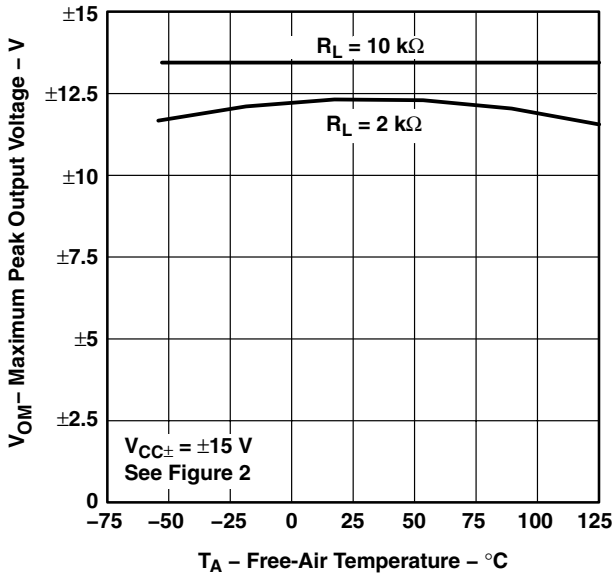


Figure 8

MAXIMUM PEAK OUTPUT VOLTAGE vs LOAD RESISTANCE

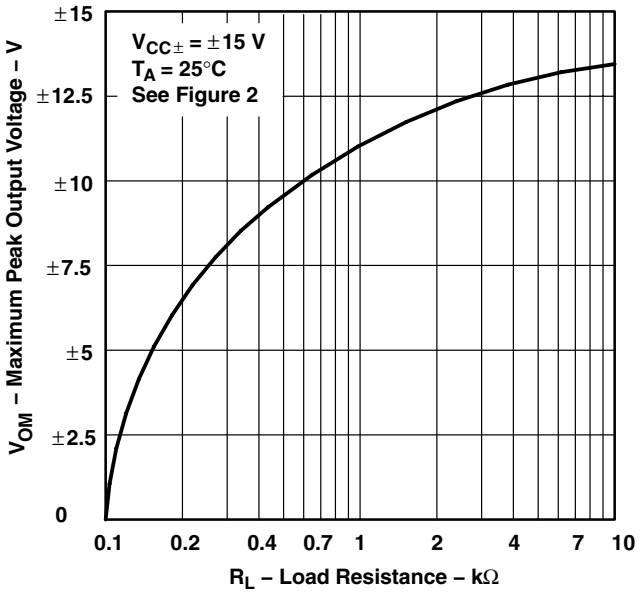


Figure 9

MAXIMUM PEAK OUTPUT VOLTAGE vs SUPPLY VOLTAGE

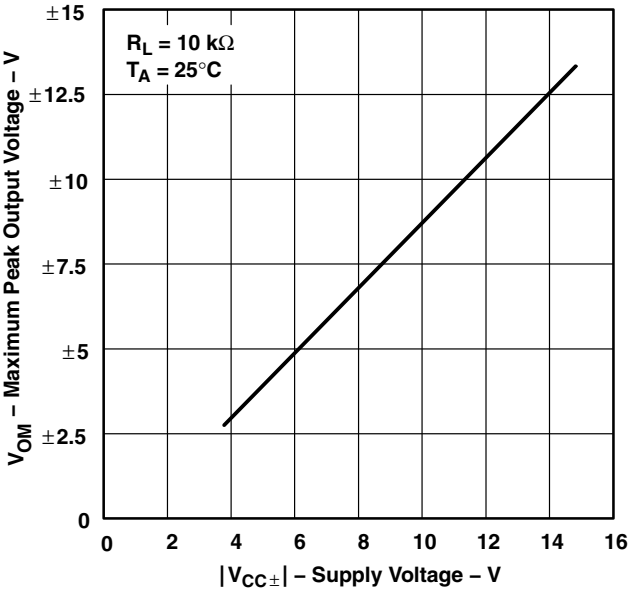


Figure 10

TYPICAL CHARACTERISTICS

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE

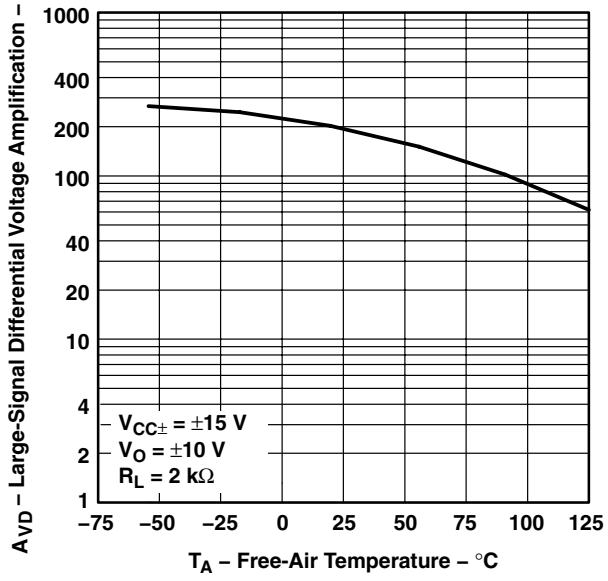


Figure 11

LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT vs FREQUENCY

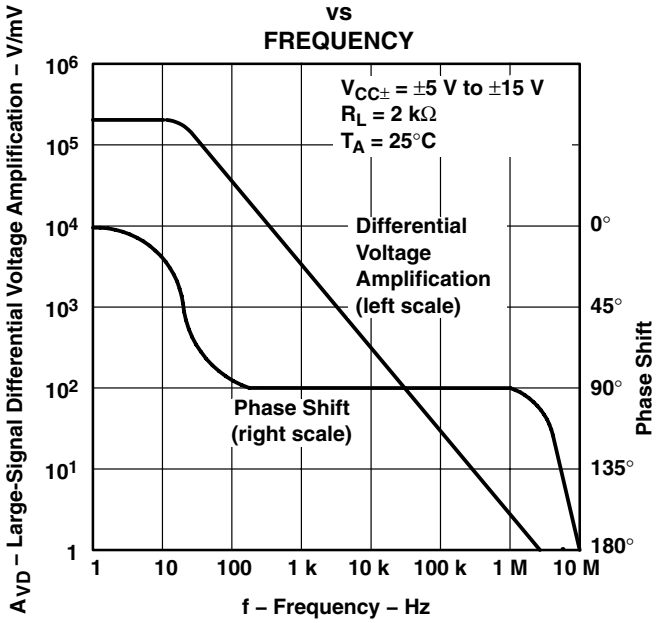


Figure 12

DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREQUENCY WITH FEED-FORWARD COMPENSATION

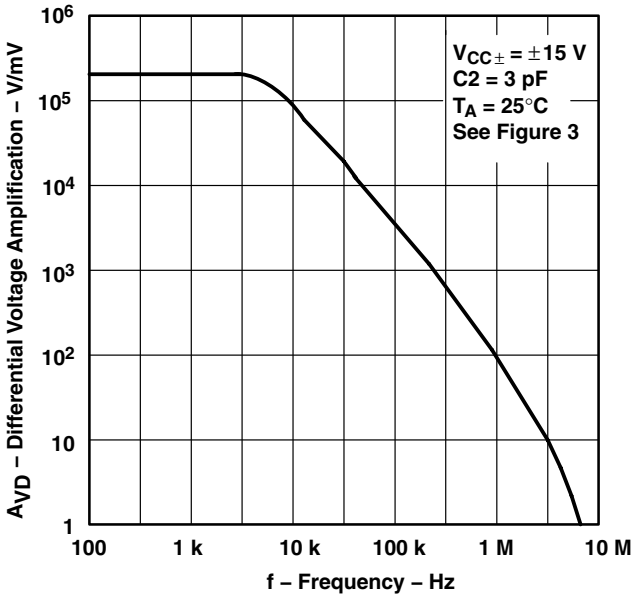


Figure 13

SUPPLY CURRENT PER AMPLIFIER vs FREE-AIR TEMPERATURE

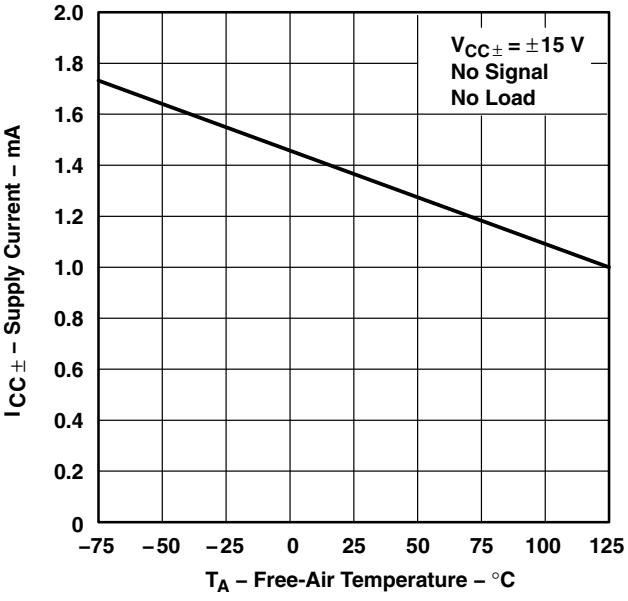


Figure 14

TYPICAL CHARACTERISTICS

SUPPLY CURRENT vs SUPPLY VOLTAGE

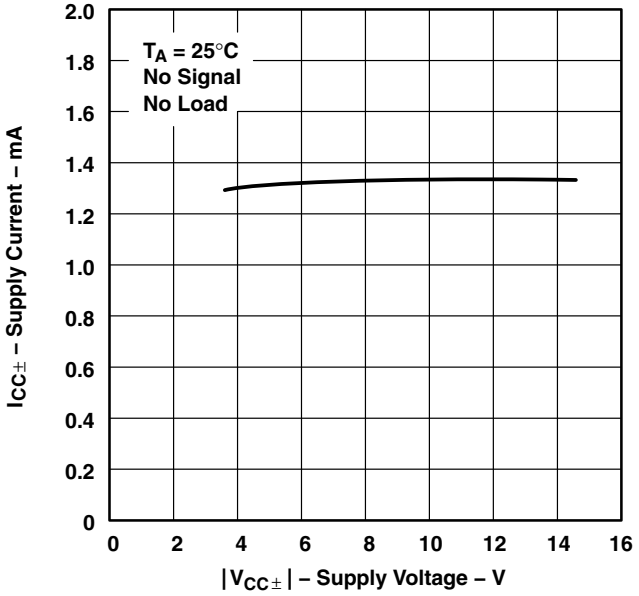


Figure 15

INPUT BIAS CURRENT vs FREE-AIR TEMPERATURE

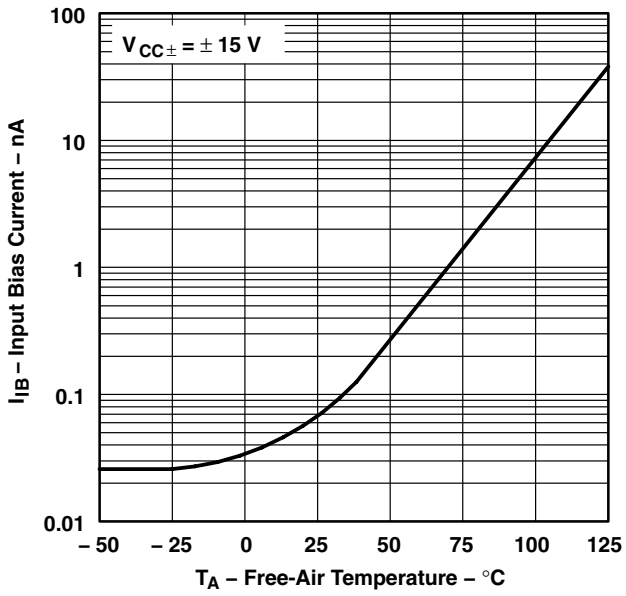


Figure 16

VOLTAGE-FOLLOWER LARGE-SIGNAL PULSE RESPONSE

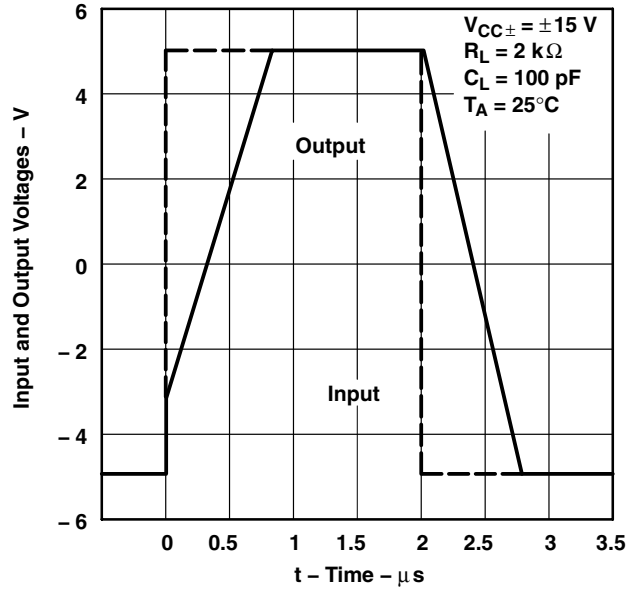


Figure 17

OUTPUT VOLTAGE vs ELAPSED TIME

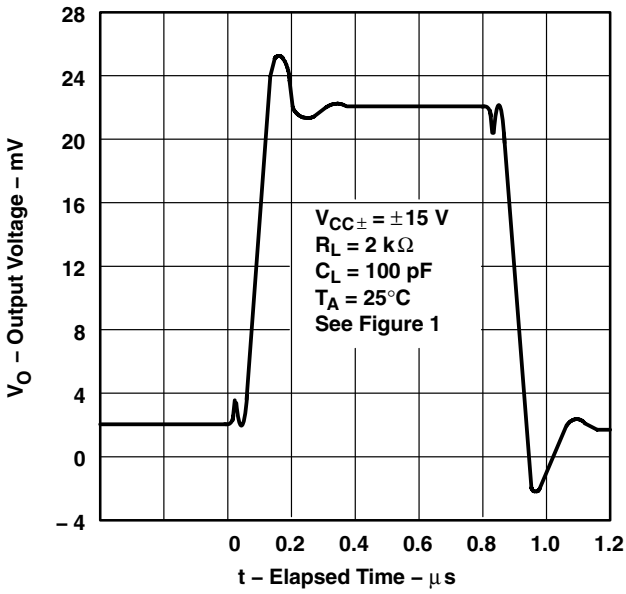


Figure 18

TYPICAL CHARACTERISTICS

COMMON-MODE REJECTION RATIO vs FREE-AIR TEMPERATURE

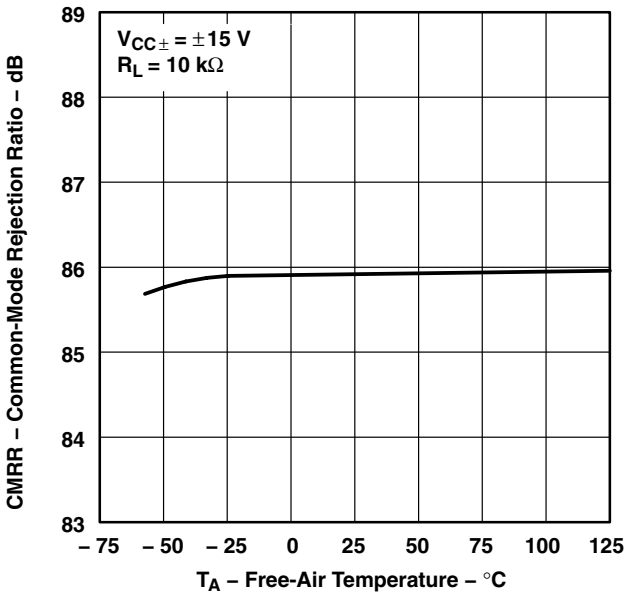


Figure 19

EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY

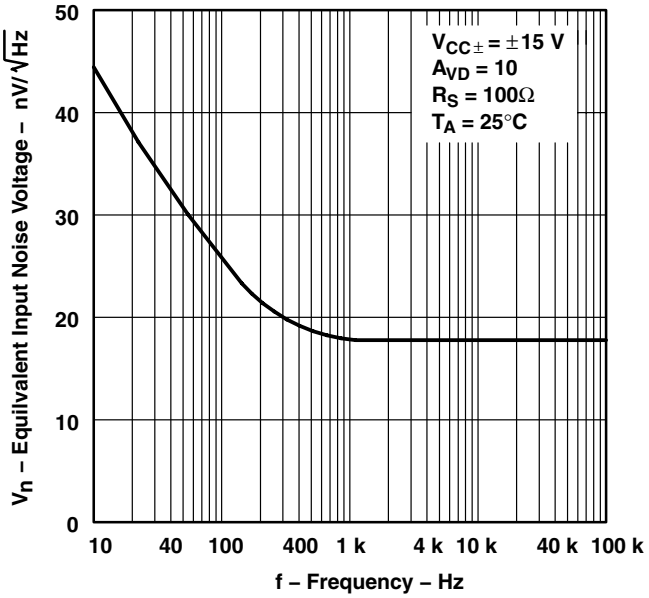


Figure 20

TOTAL HARMONIC DISTORTION vs FREQUENCY

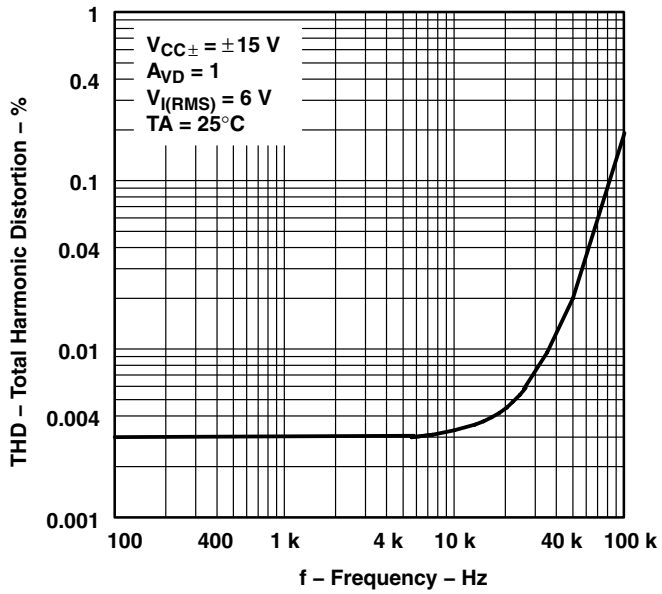


Figure 21

APPLICATION INFORMATION

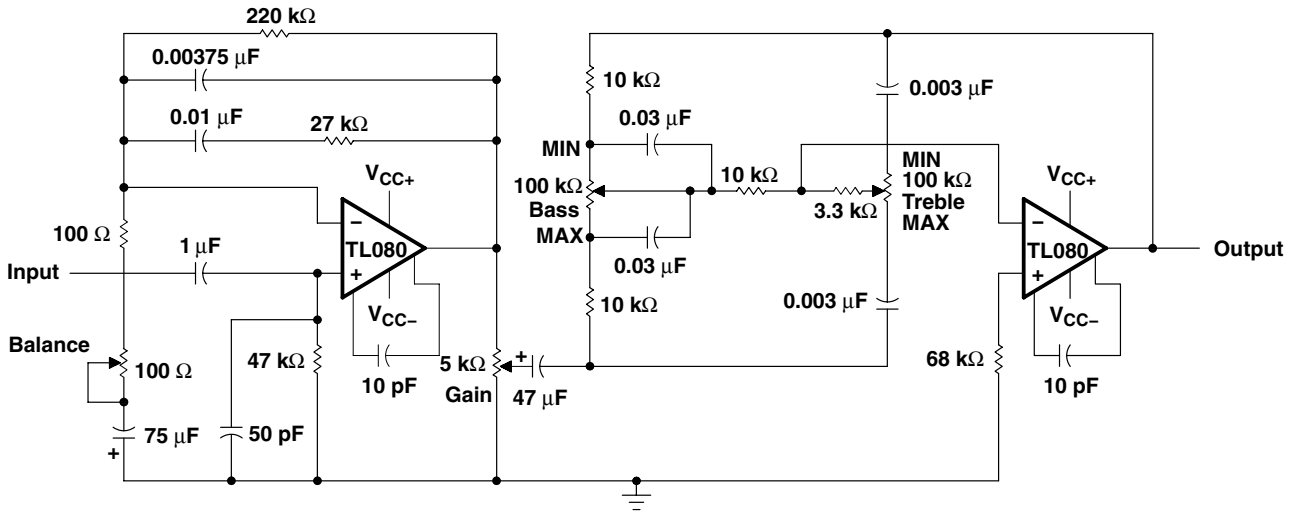


Figure 22. IC Preamplifier

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
TL080CP	NRND	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	TL080CP	
TL080CPE4	NRND	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	TL080CP	
TL080IP	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI	-40 to 85		

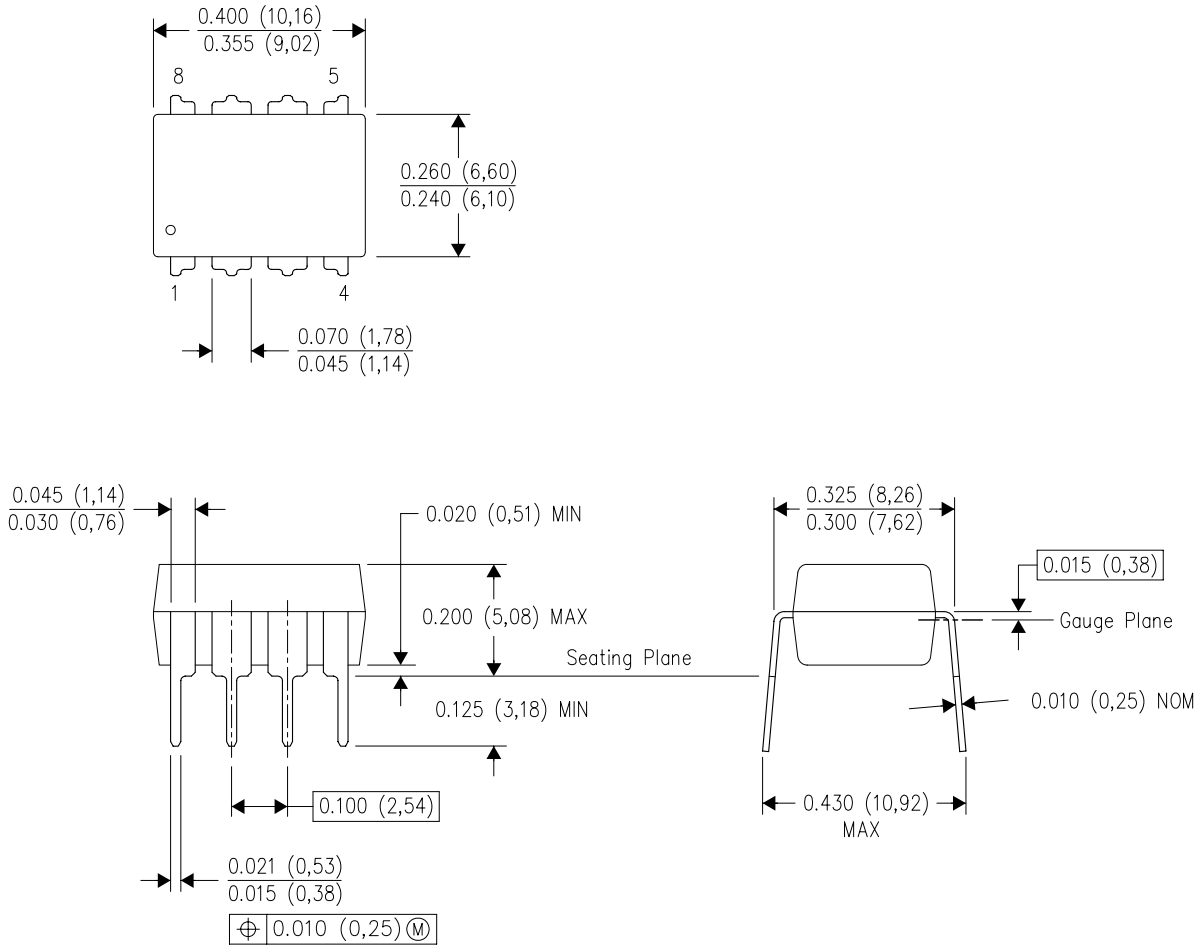
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

P (R–PDIP–T8) PLASTIC DUAL–IN–LINE PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001 variation BA.

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