MC33076

Dual High Output Current, Low Power, Low Noise Bipolar Operational Amplifier

ON Semiconductor™

http://onsemi.com

The MC33076 operational amplifier employs bipolar technology with innovative high performance concepts for audio and industrial applications. This device uses high frequency PNP input transistors to improve frequency response. In addition, the amplifier provides high output current drive capability while minimizing the drain current. The all NPN output stage exhibits no deadband crossover distortion, large output voltage swing, excellent phase and gain margins, low open loop high frequency output impedance and symmetrical source and sink AC frequency performance.

The MC33076 is tested over the automotive temperature range and is available in an 8–pin SOIC package (D suffix) and in the standard 8 pin DIP package for high power applications.

- 100 Ω Output Drive Capability
- Large Output Voltage Swing
- Low Total Harmonic Distortion
- High Gain Bandwidth: 7.4 MHz
- High Slew Rate: 2.6 V/μs
- Dual Supply Operation: ±2.0 V to ±18 V
- High Output Current: ISC = 250 mA typ
- Similar Performance to MC33178

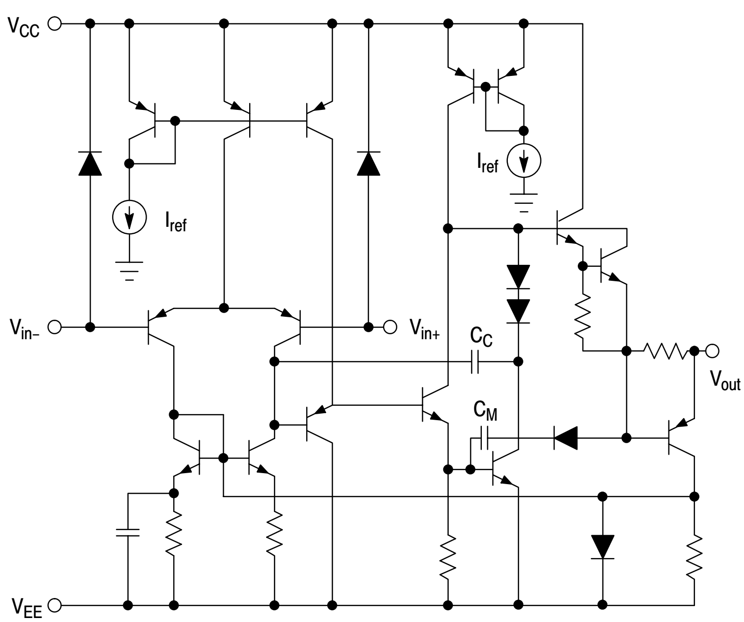
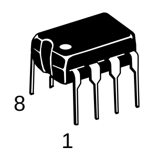
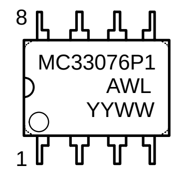


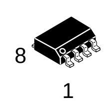
Figure 1. Equivalent Circuit Schematic
(Each Amplifier)

MARKING DIAGRAMS

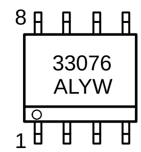


PDIP–8
P1 SUFFIX
CASE 626



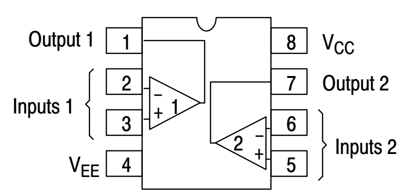


SO–8
D SUFFIX
CASE 751



A	= Assembly Location
WL, L	= Wafer Lot
YY, Y	= Year
WW, W	= Work Week

PIN CONNECTIONS



(8 Pin Pkg, Top View)

ORDERING INFORMATION

Device	Package	Shipping
MC33076D	SO–8	98 Units/Rail
MC33076DR2	SO–8	2500 Tape & Reel
MC33076P1	PDIP–8	50 Units/Rail

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage (Note 2.)	V_{CC} to V_{EE}	+36	V
Input Differential Voltage Range	V_{IDR}	Note 1.	V
Input Voltage Range	V_{IR}	Note 1.	V
Output Short Circuit Duration (Note 2.)	t_{SC}	5.0	sec
Maximum Junction Temperature	T_J	+150	°C
Storage Temperature	T_{stg}	–60 to +150	°C
Maximum Power Dissipation	P_D	Note 2.	mW

1. Either or both input voltages should not exceed V_{CC} or V_{EE}.
2. **Power dissipation must be considered to ensure maximum junction temperature (T_J) is not exceeded** (see power dissipation performance characteristic, Figure 2). See applications section for further information.

DC ELECTRICAL CHARACTERICISTICS (V_{CC} = +15 V, V_{EE} = –15 V, T_A = 25°C, unless otherwise noted.)

Characteristics	Figure	Symbol	Min	Typ	Max	Unit
Input Offset Voltage (R_S = 50 Ω, V_{CM} = 0 V) (V_S = ±2.5 V to ±15 V) T_A = +25°C T_A = –40° to +85°C	3	$\|V_{IO}\|$	 – –	 0.5 0.5	 4.0 5.0	mV
Input Offset Voltage Temperature Coefficient (R_S = 50 Ω, V_{CM} = 0 V) T_A = –40° to +85°C		$\Delta V_{IO}/\Delta T$	 –	 2.0	 –	µV/°C
Input Bias Current (V_{CM} = 0 V) T_A = +25°C T_A = –40° to +85°C	4, 5	I_{IB}	 – –	 100 –	 500 600	nA
Input Offset Current (V_{CM} = 0 V) T_A = +25°C T_A = –40° to +85°C		$\|I_{IO}\|$	 – –	 5.0 –	 70 100	nA
Common Mode Input Voltage Range	6	V_{ICR}	–13	–14 +14	 13	V
Large Signal Voltage Gain (V_O = –10 V to +10 V) (T_A = +25°C) R_L = 100 Ω R_L = 600 Ω (T_A = –40° to +85°C) R_L = 600 Ω	7	A_{VOL}	 25 50 25	 – 200 –	 – – –	kV/V
Output Voltage Swing (V_{ID} = ±1.0 V) (V_{CC} = +15 V, V_{EE} = –15 V) R_L = 100 Ω R_L = 100 Ω R_L = 600 Ω R_L = 600 Ω (V_{CC} = +2.5 V, V_{EE} = –2.5 V) R_L = 100 Ω R_L = 100 Ω	8, 9, 10	 V_{O+} V_{O-} V_{O+} V_{O-} V_{O+} V_{O-}	 10 – 13 – 1.2 –	 +11.7 –11.7 +13.8 –13.8 +1.66 –1.74	 – –10 – –13 – –1.2	V
Common Mode Rejection (V_{in} = ±13 V)	11	CMR	80	116	–	dB
Power Supply Rejection (V_{CC}/V_{EE} = +15 V/–15 V, +5.0 V/–15 V, +15 V/–5.0 V)	12	PSR	 80	 120	 –	dB

DC ELECTRICAL CHARACTERICISTICS (V_{CC} = +15 V, V_{EE} = –15 V, T_A = 25°C, unless otherwise noted.)

Characteristics	Figure	Symbol	Min	Typ	Max	Unit
Output Short Circuit Current (V_{ID} = ±1.0 V Output to Gnd) (V_{CC} = +15 V, V_{EE} = –15 V) Source Sink (V_{CC} = +2.5 V, V_{EE} = –2.5 V) Source Sink	13, 14	I_{SC}	 190 – 63 –	 +250 –280 +94 –80	 – –215 – –46	mA
Power Supply Current per Amplifier (V_O = 0 V) (V_S = ±2.5 V to ±15 V) T_A = +25°C T_A = –40° to +85°C	15	I_D	 – –	 2.2 –	 2.8 3.3	mA

AC ELECTRICAL CHARACTERICISTICS (V_{CC} = +15 V, V_{EE} = –15 V, T_A = 25°C, unless otherwise noted.)

Characteristics	Figure	Symbol	Min	Typ	Max	Unit
Slew Rate (V_{in} = –10 V to +10 V, R_L = 100 Ω, C_L = 100 pF, A_V = 1.0)	16	SR	1.2	2.6	–	V/µs
Gain Bandwidth Product (f = 20 kHz)	17	GBW	4.0	7.4	–	MHz
Unity Gain Bandwidth (Open Loop) (R_L = 600 Ω, C_L = 0 pF)	–	BW	–	3.5	–	MHz
Gain Margin (R_L = 600 Ω, C_L = 0 pF)	20, 21	A_m	–	15	–	dB
Phase Margin (R_L = 600 Ω, C_L = 0 pF)	20, 21	$\varnothing_m$	–	52	–	Deg
Channel Separation (f = 100 Hz to 20 kHz)	22	CS	–	–120	–	dB
Power Bandwidth (V_O = 20 V_{pp}, R_L = 600 Ω, THD ≤ 1%)	–	BW_p	–	32	–	kHz
Total Harmonic Distortion (R_L = 600 Ω, V_O = 2.0 V_{pp}, A_V = 1.0) f = 1.0 kHz f = 10 kHz f = 20 kHz	23	THD	 – – –	 0.0027 0.011 0.022	 – – –	%
Open Loop Output Impedance (V_O = 0 V, f = 2.5 MHz, A_V = 10)	24	$\|Z_O\|$	–	75	–	Ω
Differential Input Resistance (V_{CM} = 0 V)	–	R_{in}	–	200	–	kΩ
Differential Input Capacitance (V_{CM} = 0 V)	–	C_{in}	–	10	–	pF
Equivalent Input Noise Voltage (R_S = 100 Ω) f = 10 Hz f = 1.0 kHz	25	e_n	 – –	 7.5 5.0	 –	$nV/\sqrt{Hz}$
Equivalent Input Noise Current f = 10 Hz f = 1.0 kHz	–	i_n	 – –	 0.33 0.15	 – –	$pA/\sqrt{Hz}$

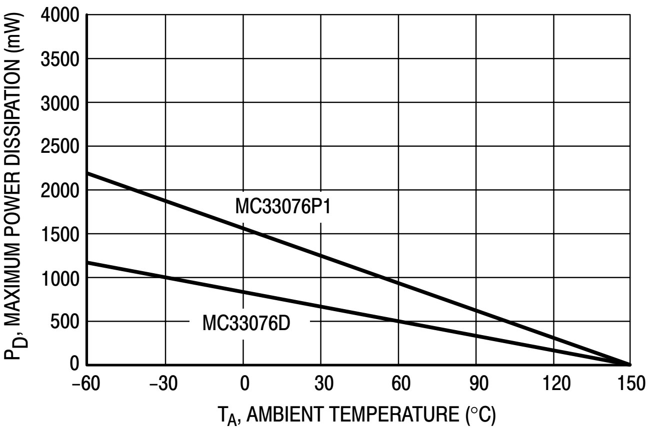


Figure 2. Maximum Power Dissipation versus Temperature

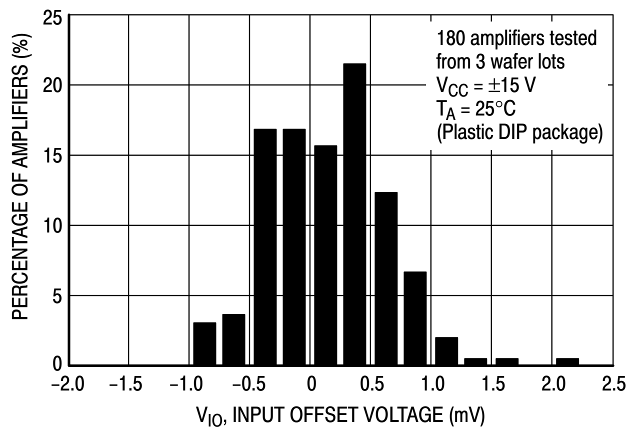


Figure 3. Distribution of Input Offset Voltage

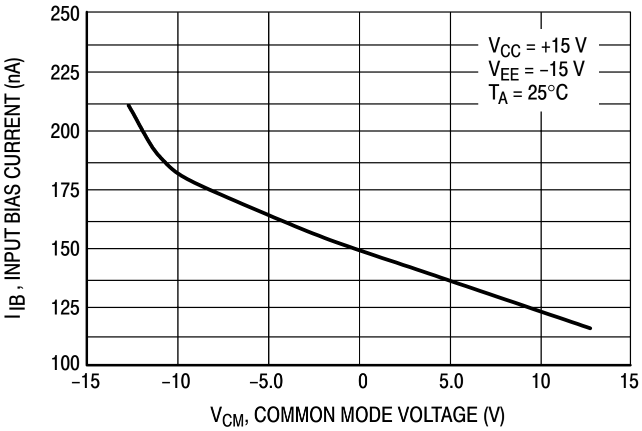


Figure 4. Input Bias Current versus Common Mode Voltage

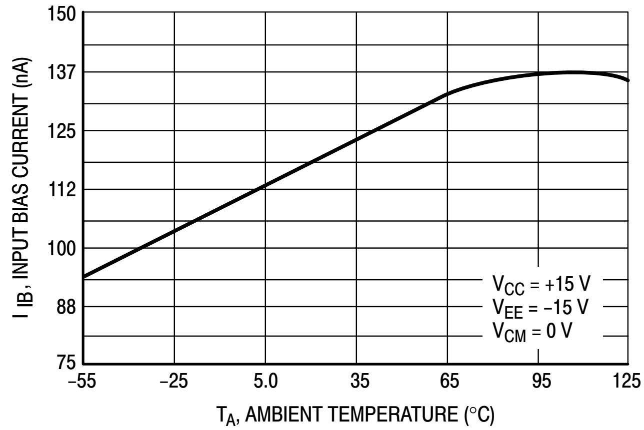


Figure 5. Input Bias Current versus Temperature

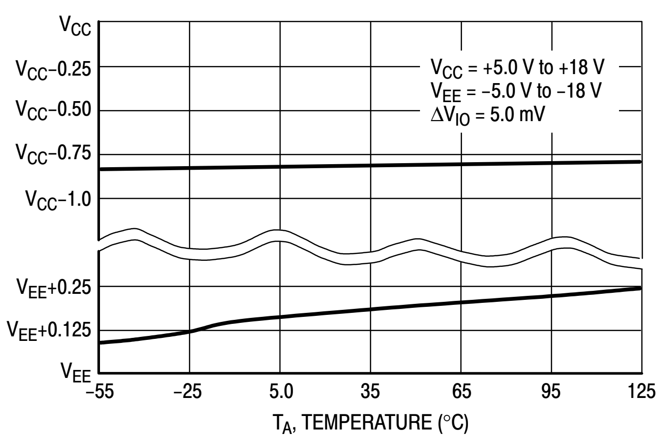


Figure 6. Input Common Mode Voltage Range versus Temperature

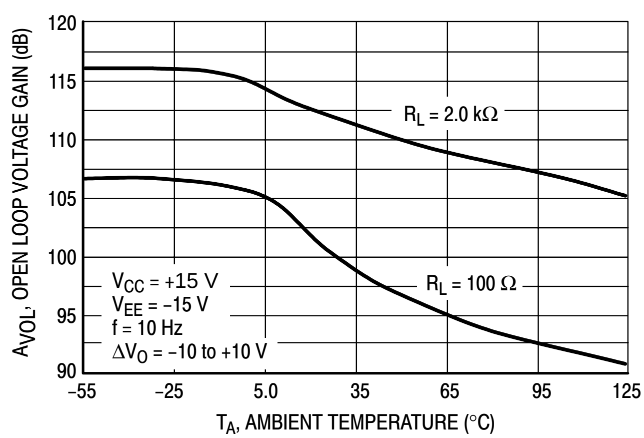


Figure 7. Open Loop Voltage Gain versus Temperature

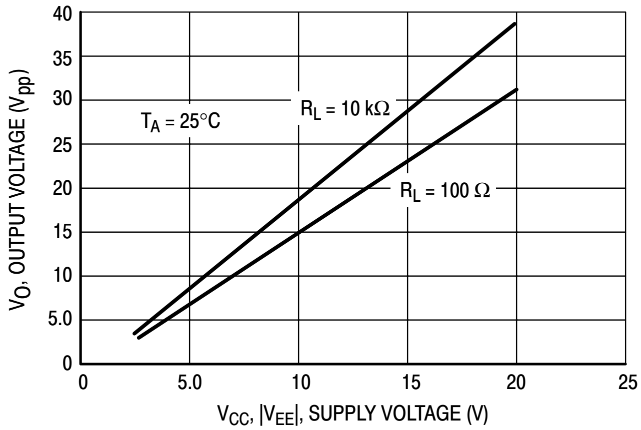


Figure 8. Output Voltage Swing versus Supply Voltage

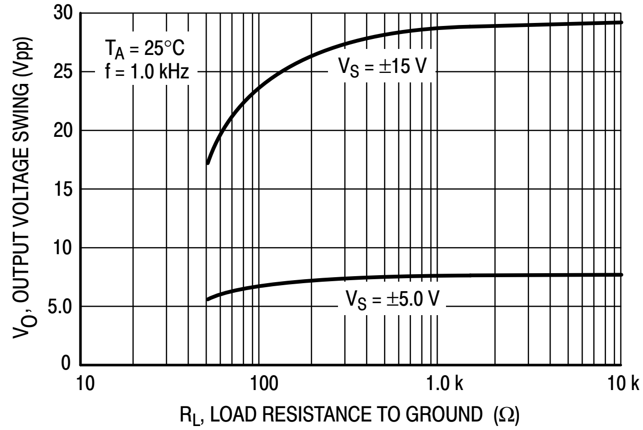


Figure 9. Maximum Peak–to–Peak Output Voltage Swing versus Load Resistance

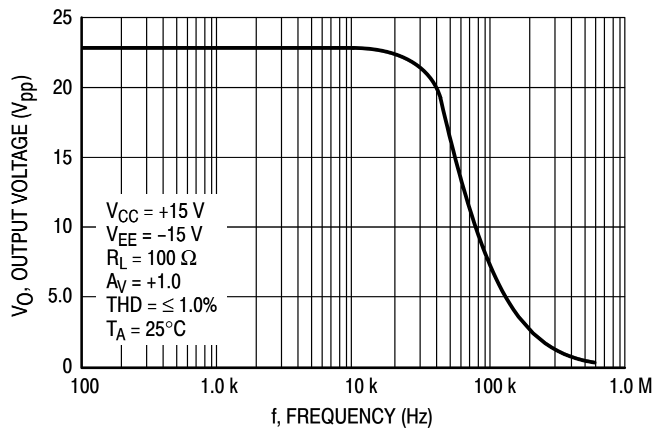


Figure 10. Output Voltage versus Frequency

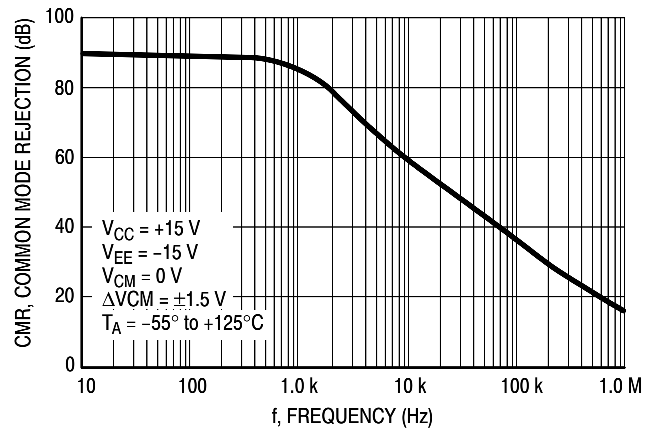


Figure 11. Common Mode Rejection versus Frequency Over Temperature

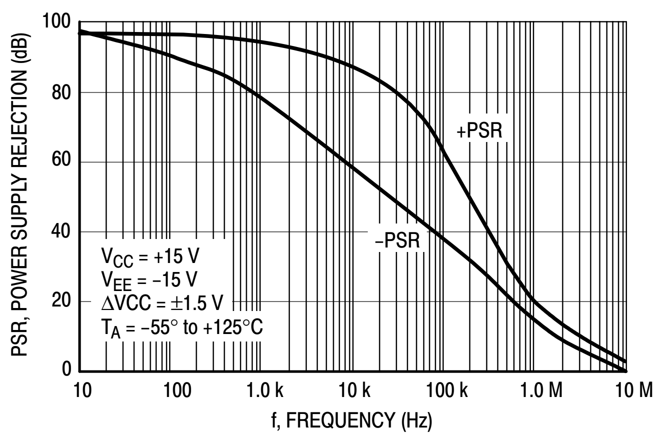


Figure 12. Power Supply Rejection versus Frequency Over Temperature

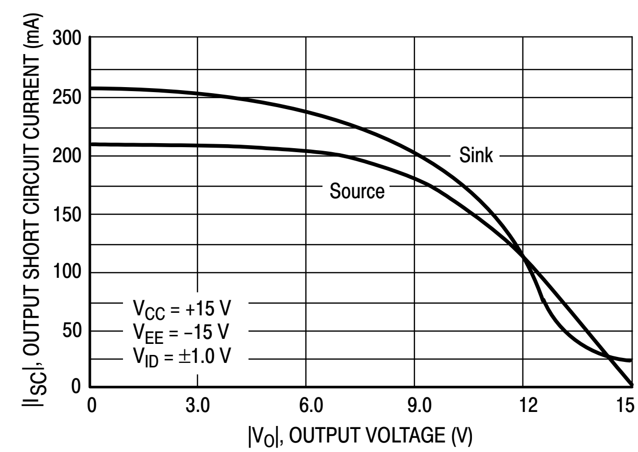


Figure 13. Output Short Circuit Current versus Output Voltage

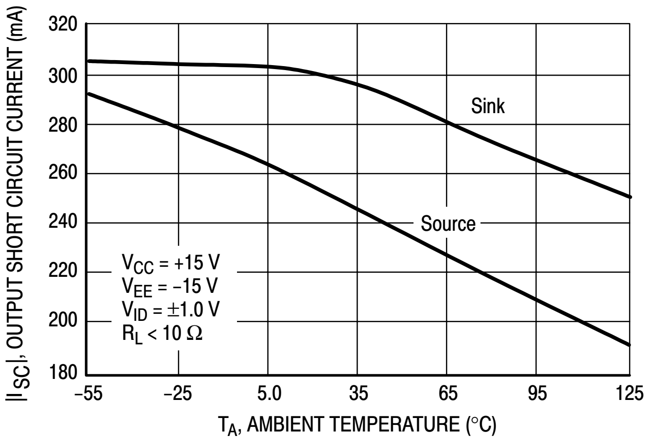


Figure 14. Output Short Circuit Current versus Temperature

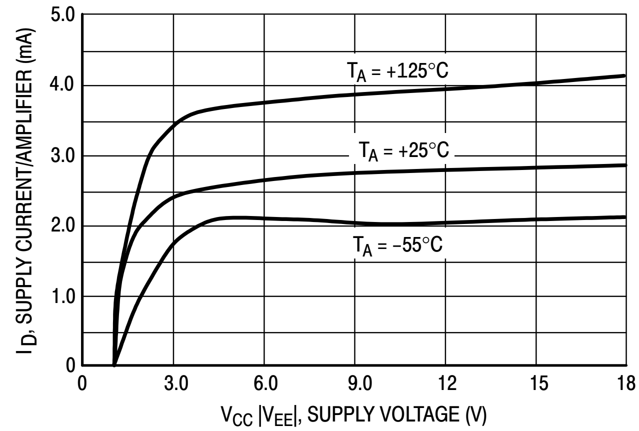


Figure 15. Supply Current versus Supply Voltage with No Load

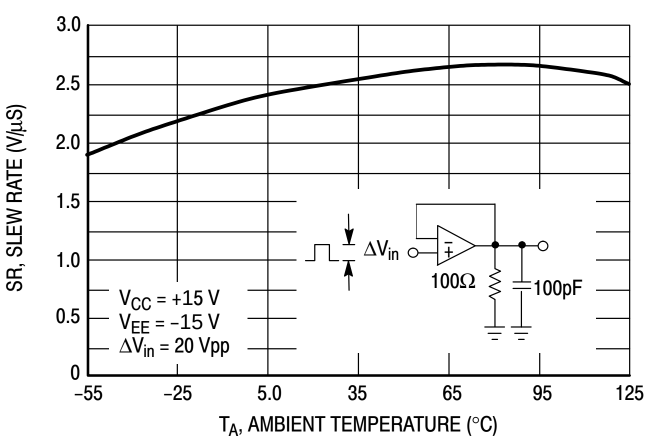


Figure 16. Slew Rate versus Temperature

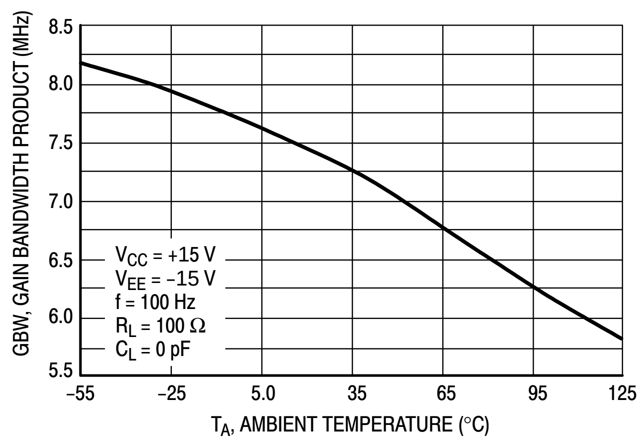


Figure 17. Gain Bandwidth Product versus Temperature

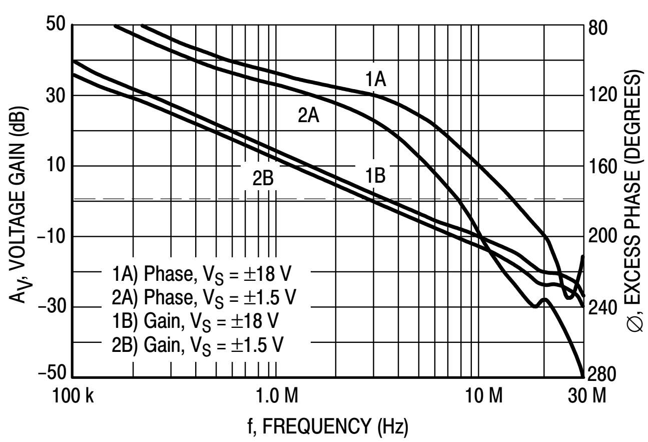


Figure 18. Voltage Gain and Phase versus Frequency

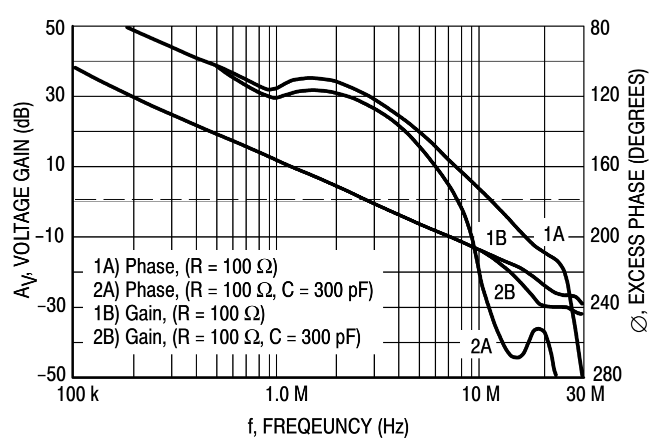


Figure 19. Voltage Gain and Phase versus Frequency

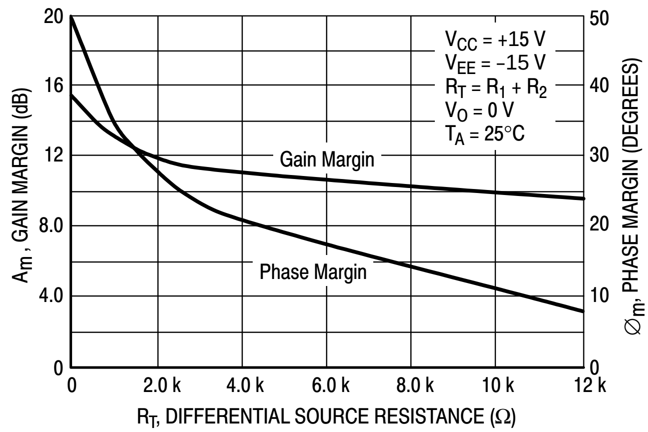


Figure 20. Phase Margin and Gain Margin versus Differential Source Resistance

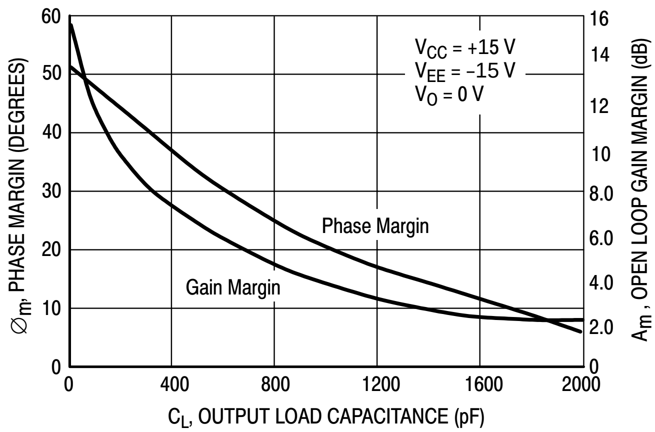


Figure 21. Open Loop Gain Margin and Phase Margin versus Output Load Capacitance

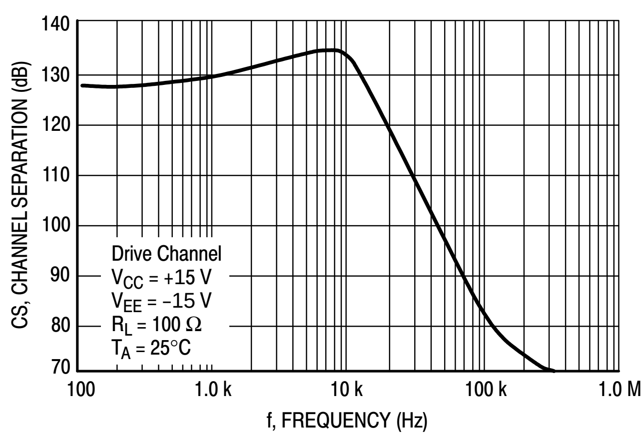


Figure 22. Channel Separation versus Frequency

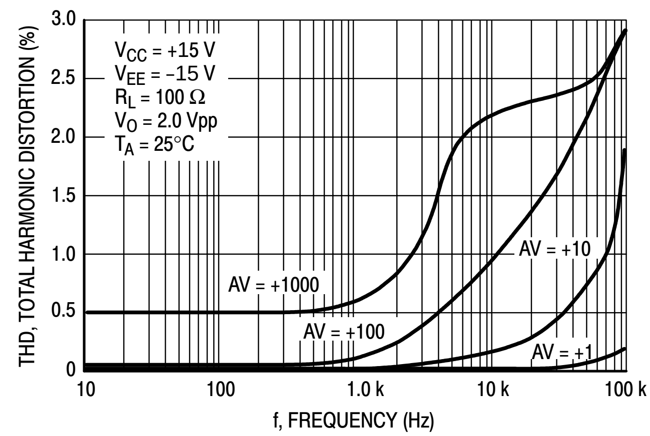


Figure 23. Total Harmonic Distortion versus Frequency

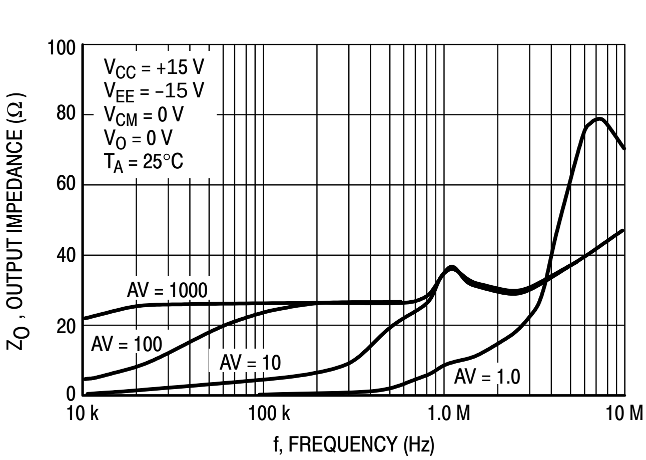


Figure 24. Output Impedance versus Frequency

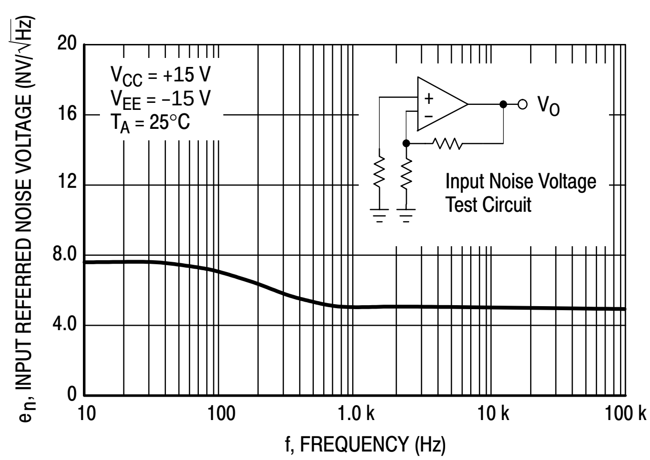


Figure 25. Input Referred Noise Voltage versus Frequency

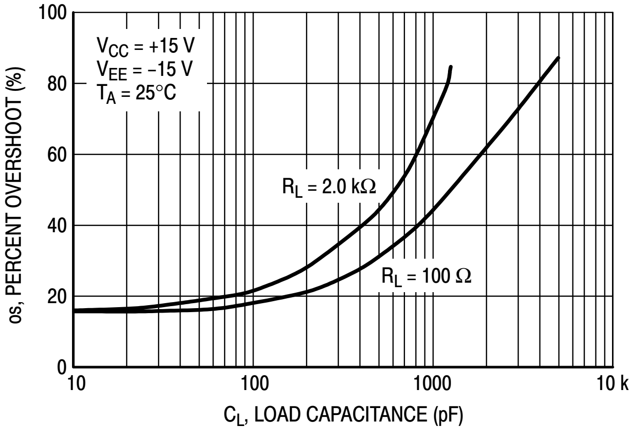


Figure 26. Percent Overshoot versus Load Capacitance

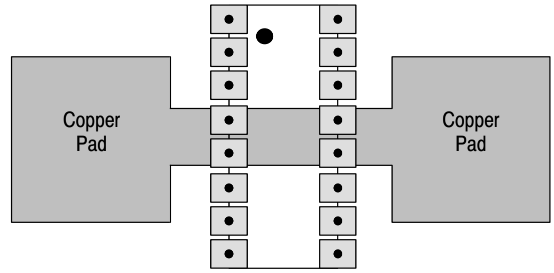


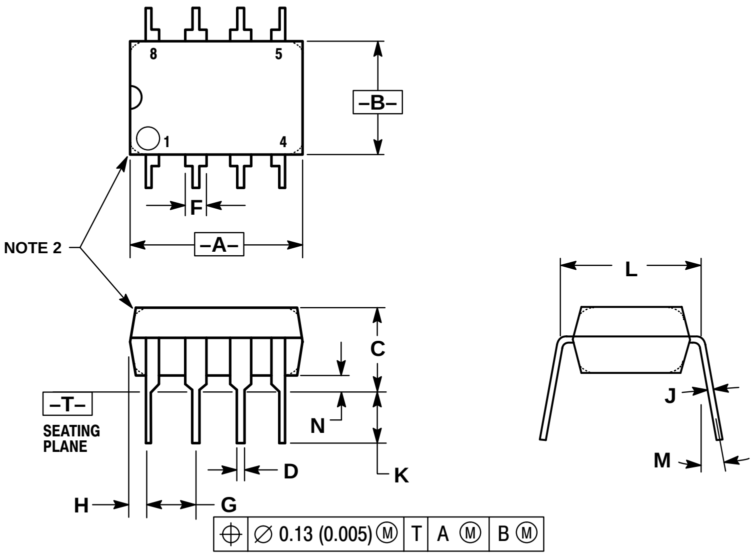
Figure 27. PC Board Heatsink Example

APPLICATIONS INFORMATION

The MC33076 dual operational amplifier is available in the standard 8–pin plastic dual–in–line (DIP) and surface mount packages, and also in a 16–pin batwing power package. To enhance the power dissipation capability of the power package, Pins 4, 5, 12, and 13 are tied together on the leadframe, giving it an ambient thermal resistance of 52°C/W typically, in still air. The junction–to–ambient thermal resistance ($R_{\theta JA}$) can be decreased further by using a copper padb on the printed circuit board (as shown in Figure 27) to draw the heat away from the package. *Care must be taken not to exceed the maximum junction temperature or damage to the device may occur.*

PACKAGE DIMENSIONS

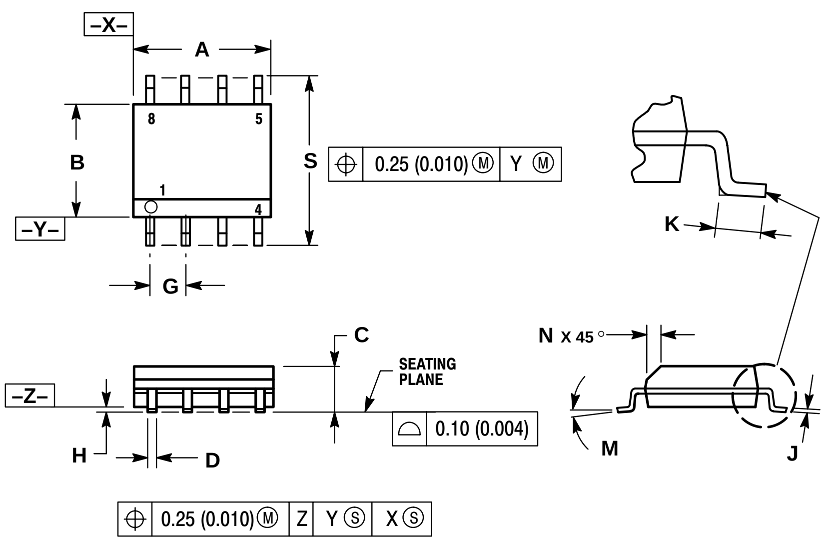
PDIP–8
P1 SUFFIX
CASE 626–05
ISSUE L



NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	---	10°	---	10°
N	0.76	1.01	0.030	0.040

SO–8
D SUFFIX
CASE 751–07
ISSUE W



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

Notes

Notes

PUBLICATION ORDERING INFORMATION

NORTH AMERICA Literature Fulfillment:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303–675–2175 or 800–344–3860 Toll Free USA/Canada
Fax: 303–675–2176 or 800–344–3867 Toll Free USA/Canada
Email: ONlit@hibbertco.com
Fax Response Line: 303–675–2167 or 800–344–3810 Toll Free USA/Canada

N. American Technical Support: 800–282–9855 Toll Free USA/Canada

EUROPE: LDC for ON Semiconductor – European Support
German **Phone**: (+1) 303–308–7140 (Mon–Fri 2:30pm to 7:00pm CET)
Email: ONlit–german@hibbertco.com
French **Phone**: (+1) 303–308–7141 (Mon–Fri 2:00pm to 7:00pm CET)
Email: ONlit–french@hibbertco.com
English **Phone**: (+1) 303–308–7142 (Mon–Fri 12:00pm to 5:00pm GMT)
Email: ONlit@hibbertco.com

EUROPEAN TOLL–FREE ACCESS*: 00–800–4422–3781
*Available from Germany, France, Italy, UK, Ireland

CENTRAL/SOUTH AMERICA:
Spanish Phone: 303–308–7143 (Mon–Fri 8:00am to 5:00pm MST)
Email: ONlit–spanish@hibbertco.com
Toll–Free from Mexico: Dial 01–800–288–2872 for Access – then Dial 866–297–9322

ASIA/PACIFIC: LDC for ON Semiconductor – Asia Support
Phone: 303–675–2121 (Tue–Fri 9:00am to 1:00pm, Hong Kong Time)
Toll Free from Hong Kong & Singapore:
001–800–4422–3781
Email: ONlit–asia@hibbertco.com

JAPAN: ON Semiconductor, Japan Customer Focus Center
4–32–1 Nishi–Gotanda, Shinagawa–ku, Tokyo, Japan 141–0031
Phone: 81–3–5740–2700
Email: r14525@onsemi.com

ON Semiconductor Website: http://onsemi.com

For additional information, please contact your local
Sales Representative.