

# Low Noise Dual/Quad Operational Amplifiers

## MC33078, MC33079, NCV33078, NCV33079

The MC33078/9 series is a family of high quality monolithic amplifiers employing Bipolar technology with innovative high performance concepts for quality audio and data signal processing applications. This family incorporates the use of high frequency PNP input transistors to produce amplifiers exhibiting low input voltage noise with high gain bandwidth product and slew rate. 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 MC33078/9 family offers both dual and quad amplifier versions and is available in the plastic DIP and SOIC packages (P and D suffixes).

### Features

- Dual Supply Operation:  $\pm 5.0$  V to  $\pm 18$  V
- Low Voltage Noise:  $4.5$  nV/ $\sqrt{\text{Hz}}$
- Low Input Offset Voltage:  $0.15$  mV
- Low T.C. of Input Offset Voltage:  $2.0$   $\mu\text{V}/^\circ\text{C}$
- Low Total Harmonic Distortion:  $0.002\%$
- High Gain Bandwidth Product:  $16$  MHz
- High Slew Rate:  $7.0$  V/ $\mu\text{s}$
- High Open Loop AC Gain:  $800$  @  $20$  kHz
- Excellent Frequency Stability
- Large Output Voltage Swing:  $+14.1$  V /  $-14.6$  V
- ESD Diodes Provided on the Inputs
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

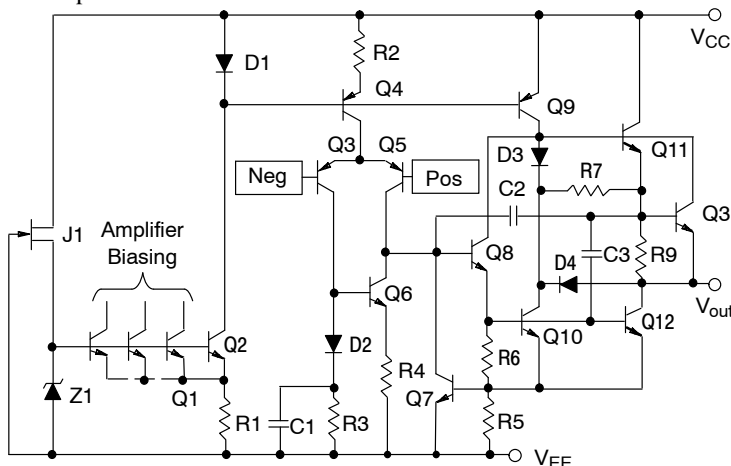
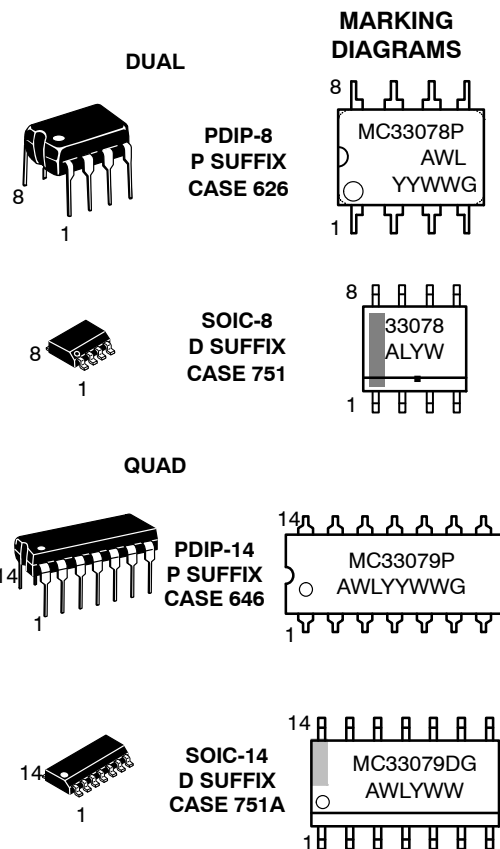


Figure 1. Representative Schematic Diagram  
(Each Amplifier)



A = Assembly Location  
 WL, L = Wafer Lot  
 YY, Y = Year  
 WW, W = Work Week  
 G or ■ = Pb-Free Package

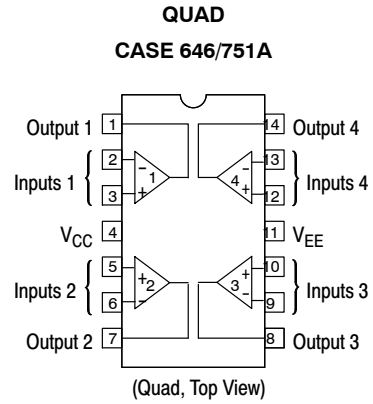
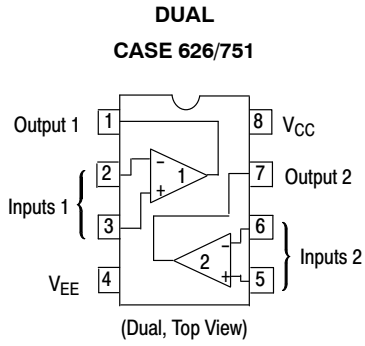
### ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 10.

# MC33078, MC33079, NCV33078, NCV33079

## PIN CONNECTIONS



## MAXIMUM RATINGS

| Rating                                                            | Symbol    | Value                    | Unit |
|-------------------------------------------------------------------|-----------|--------------------------|------|
| Supply Voltage ( $V_{CC}$ to $V_{EE}$ )                           | $V_S$     | +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)                            | $t_{SC}$  | Indefinite               | sec  |
| Maximum Junction Temperature                                      | $T_J$     | +150                     | °C   |
| Storage Temperature                                               | $T_{stg}$ | -60 to +150              | °C   |
| ESD Protection at any Pin<br>MC33078/NCV33078<br>MC33079/NCV33079 | $V_{esd}$ | 600<br>200<br>550<br>150 | V    |
| Maximum Power Dissipation                                         | $P_D$     | Note 2                   | mW   |
| Operating Temperature Range                                       | $T_A$     | -40 to +85               | °C   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Either or both input voltages must not exceed the magnitude of  $V_{CC}$  or  $V_{EE}$ .
2. Power dissipation must be considered to ensure maximum junction temperature ( $T_J$ ) is not exceeded (see Figure 2).

# MC33078, MC33079, NCV33078, NCV33079

## DC ELECTRICAL CHARACTERISTICS ( $V_{CC} = +15\text{ V}$ , $V_{EE} = -15\text{ V}$ , $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted.)

| Characteristics                                                                                                                                                                                                                                                                                                                                  | Symbol                                                               | Min                                    | Typ                                                            | Max                                  | Unit                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------|----------------------------------------------------------------|--------------------------------------|--------------------------------|
| Input Offset Voltage ( $R_S = 10\text{ }\Omega$ , $V_{CM} = 0\text{ V}$ , $V_O = 0\text{ V}$ )<br>(MC33078) $T_A = +25\text{ }^{\circ}\text{C}$<br>$T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$<br>(MC33079) $T_A = +25\text{ }^{\circ}\text{C}$<br>$T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ | $ V_{IO} $                                                           | –<br>–<br>–<br>–                       | 0.15<br>–<br>0.15<br>–                                         | 2.0<br>3.0<br>2.5<br>3.5             | mV                             |
| Average Temperature Coefficient of Input Offset Voltage<br>$R_S = 10\text{ }\Omega$ , $V_{CM} = 0\text{ V}$ , $V_O = 0\text{ V}$ , $T_A = T_{low}$ to $T_{high}$                                                                                                                                                                                 | $\Delta V_{IO}/\Delta T$                                             | –                                      | 2.0                                                            | –                                    | $\mu\text{V}/^{\circ}\text{C}$ |
| Input Bias Current ( $V_{CM} = 0\text{ V}$ , $V_O = 0\text{ V}$ )<br>$T_A = +25\text{ }^{\circ}\text{C}$<br>$T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$                                                                                                                                                                 | $I_{IB}$                                                             | –<br>–                                 | 300<br>–                                                       | 750<br>800                           | nA                             |
| Input Offset Current ( $V_{CM} = 0\text{ V}$ , $V_O = 0\text{ V}$ )<br>$T_A = +25\text{ }^{\circ}\text{C}$<br>$T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$                                                                                                                                                               | $I_{IO}$                                                             | –<br>–                                 | 25<br>–                                                        | 150<br>175                           | nA                             |
| Common Mode Input Voltage Range ( $\Delta V_{IO} = 5.0\text{ mV}$ , $V_O = 0\text{ V}$ )                                                                                                                                                                                                                                                         | $V_{ICR}$                                                            | $\pm 13$                               | $\pm 14$                                                       | –                                    | V                              |
| Large Signal Voltage Gain ( $V_O = \pm 10\text{ V}$ , $R_L = 2.0\text{ k}\Omega$ )<br>$T_A = +25\text{ }^{\circ}\text{C}$<br>$T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$                                                                                                                                                | $A_{VOL}$                                                            | 90<br>85                               | 110<br>–                                                       | –<br>–                               | dB                             |
| Output Voltage Swing ( $V_{ID} = \pm 1.0\text{ V}$ )<br>$R_L = 600\text{ }\Omega$<br>$R_L = 600\text{ }\Omega$<br>$R_L = 2.0\text{ k}\Omega$<br>$R_L = 2.0\text{ k}\Omega$<br>$R_L = 10\text{ k}\Omega$<br>$R_L = 10\text{ k}\Omega$                                                                                                             | $V_{O+}$<br>$V_{O-}$<br>$V_{O+}$<br>$V_{O-}$<br>$V_{O+}$<br>$V_{O-}$ | –<br>–<br>$+13.2$<br>–<br>$+13.5$<br>– | $+10.7$<br>$-11.9$<br>$+13.8$<br>$-13.7$<br>$+14.1$<br>$-14.6$ | –<br>–<br>–<br>$-13.2$<br>–<br>$-14$ | V                              |
| Common Mode Rejection ( $V_{in} = \pm 13\text{ V}$ )                                                                                                                                                                                                                                                                                             | CMR                                                                  | 80                                     | 100                                                            | –                                    | dB                             |
| Power Supply Rejection (Note 3)<br>$V_{CC}/V_{EE} = +15\text{ V}/-15\text{ V}$ to $+5.0\text{ V}/-5.0\text{ V}$                                                                                                                                                                                                                                  | PSR                                                                  | 80                                     | 105                                                            | –                                    | dB                             |
| Output Short Circuit Current ( $V_{ID} = 1.0\text{ V}$ , Output to Ground)<br>Source<br>Sink                                                                                                                                                                                                                                                     | $I_{SC}$                                                             | $+15$<br>$-20$                         | $+29$<br>$-37$                                                 | –<br>–                               | mA                             |
| Power Supply Current ( $V_O = 0\text{ V}$ , All Amplifiers)<br>(MC33078) $T_A = +25\text{ }^{\circ}\text{C}$<br>$T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$<br>(MC33079) $T_A = +25\text{ }^{\circ}\text{C}$<br>$T_A = -40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$                                    | $I_D$                                                                | –<br>–<br>–<br>–                       | 4.1<br>–<br>8.4<br>–                                           | 5.0<br>5.5<br>10<br>11               | mA                             |

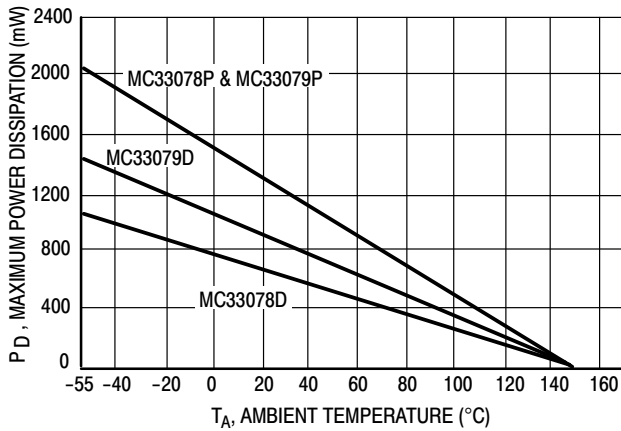
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. Measured with  $V_{CC}$  and  $V_{EE}$  differentially varied simultaneously.

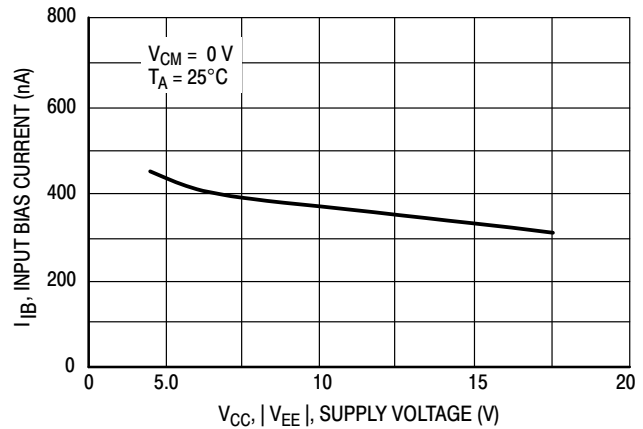
# MC33078, MC33079, NCV33078, NCV33079

**AC ELECTRICAL CHARACTERISTICS** ( $V_{CC} = +15\text{ V}$ ,  $V_{EE} = -15\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

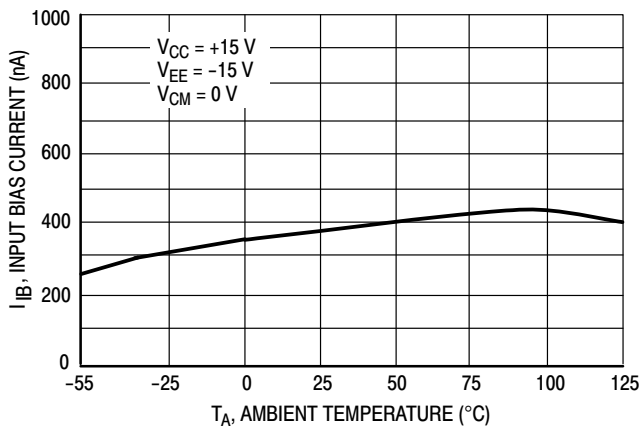
| Characteristics                                                                                                                                 | Symbol   | Min    | Typ         | Max    | Unit                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------|-------------|--------|------------------------------|
| Slew Rate ( $V_{in} = -10\text{ V}$ to $+10\text{ V}$ , $R_L = 2.0\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , $A_V = +1.0$ )                     | SR       | 5.0    | 7.0         | –      | V/ $\mu\text{s}$             |
| Gain Bandwidth Product ( $f = 100\text{ kHz}$ )                                                                                                 | GBW      | 10     | 16          | –      | MHz                          |
| Unity Gain Bandwidth (Open Loop)                                                                                                                | BW       | –      | 9.0         | –      | MHz                          |
| Gain Margin ( $R_L = 2.0\text{ k}\Omega$<br>$C_L = 0\text{ pF}$<br>$C_L = 100\text{ pF}$ )                                                      | $A_m$    | –<br>– | –11<br>–6.0 | –<br>– | dB                           |
| Phase Margin ( $R_L = 2.0\text{ k}\Omega$<br>$C_L = 0\text{ pF}$<br>$C_L = 100\text{ pF}$ )                                                     | $\phi_m$ | –<br>– | 55<br>40    | –<br>– | Deg                          |
| Channel Separation ( $f = 20\text{ Hz}$ to $20\text{ kHz}$ )                                                                                    | CS       | –      | –120        | –      | dB                           |
| Power Bandwidth ( $V_O = 27\text{ V}_{pp}$ , $R_L = 2.0\text{ k}\Omega$ , THD $\pm 1.0\%$ )                                                     | $BW_p$   | –      | 120         | –      | kHz                          |
| Total Harmonic Distortion<br>( $R_L = 2.0\text{ k}\Omega$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$ , $V_O = 3.0\text{ V}_{rms}$ , $A_V = +1.0$ ) | THD      | –      | 0.002       | –      | %                            |
| Open Loop Output Impedance ( $V_O = 0\text{ V}$ , $f = 9.0\text{ MHz}$ )                                                                        | $ Z_O $  | –      | 37          | –      | $\Omega$                     |
| Differential Input Resistance ( $V_{CM} = 0\text{ V}$ )                                                                                         | $R_{in}$ | –      | 175         | –      | $\text{k}\Omega$             |
| Differential Input Capacitance ( $V_{CM} = 0\text{ V}$ )                                                                                        | $C_{in}$ | –      | 12          | –      | pF                           |
| Equivalent Input Noise Voltage ( $R_S = 100\text{ }\Omega$ , $f = 1.0\text{ kHz}$ )                                                             | $e_n$    | –      | 4.5         | –      | $\text{nV}/\sqrt{\text{Hz}}$ |
| Equivalent Input Noise Current ( $f = 1.0\text{ kHz}$ )                                                                                         | $i_n$    | –      | 0.5         | –      | $\text{Hz}\sqrt{\text{pA}}$  |



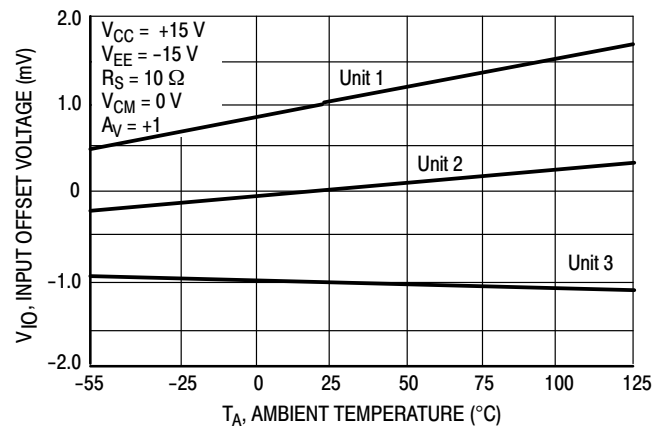
**Figure 2. Maximum Power Dissipation versus Temperature**



**Figure 3. Input Bias Current versus Supply Voltage**

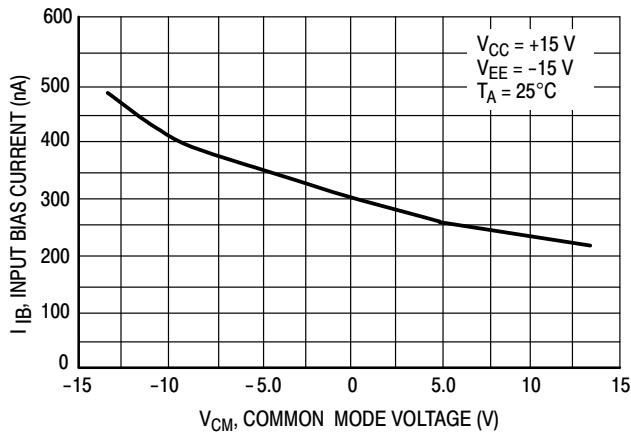


**Figure 4. Input Bias Current versus Temperature**

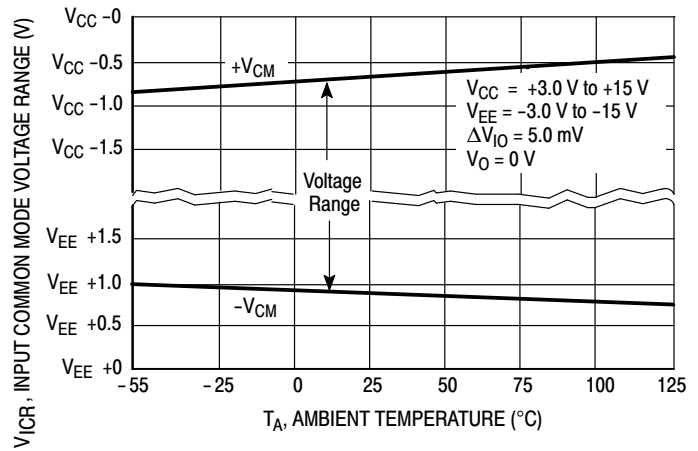


**Figure 5. Input Offset Voltage versus Temperature**

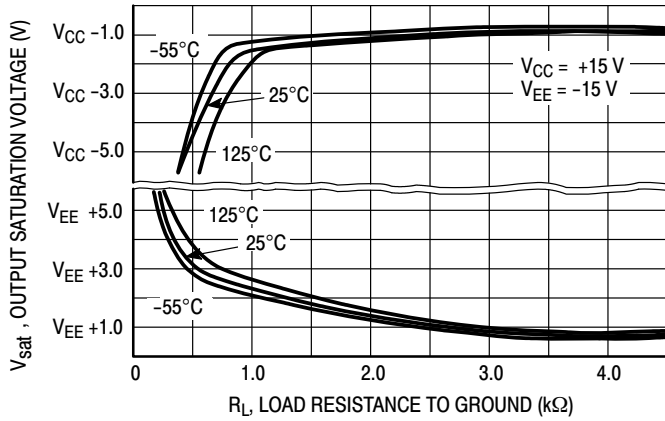
# MC33078, MC33079, NCV33078, NCV33079



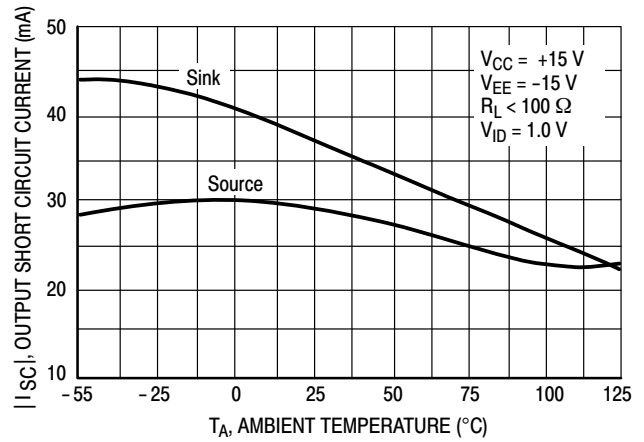
**Figure 6. Input Bias Current versus Common Mode Voltage**



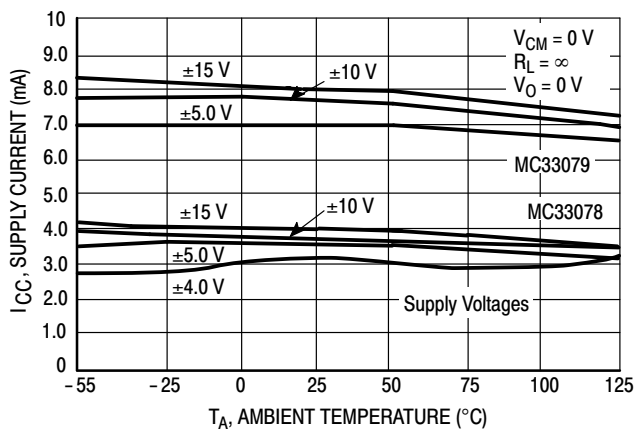
**Figure 7. Input Common Mode Voltage Range versus Temperature**



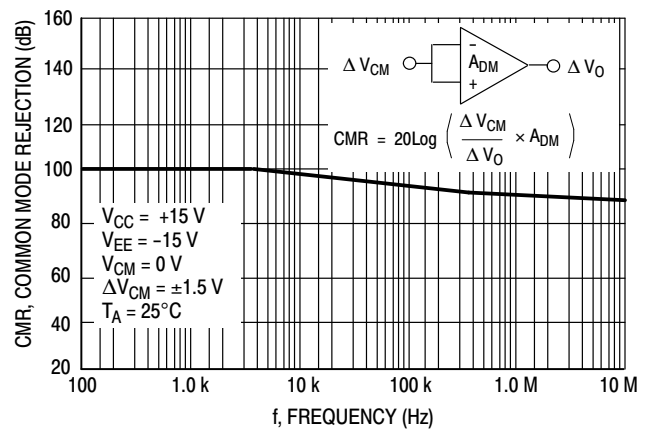
**Figure 8. Output Saturation Voltage versus Load Resistance to Ground**



**Figure 9. Output Short Circuit Current versus Temperature**



**Figure 10. Supply Current versus Temperature**



**Figure 11. Common Mode Rejection versus Frequency**

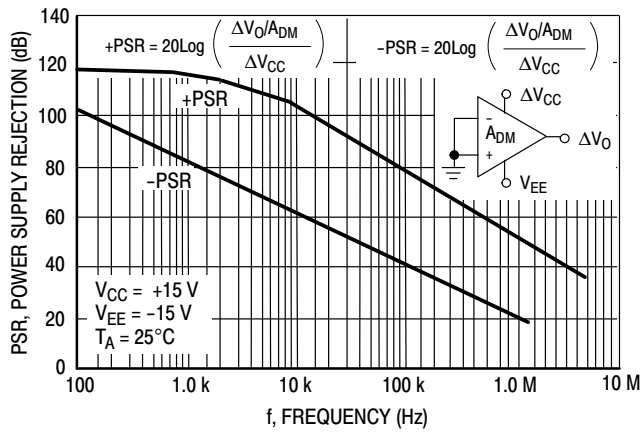


Figure 12. Power Supply Rejection versus Frequency

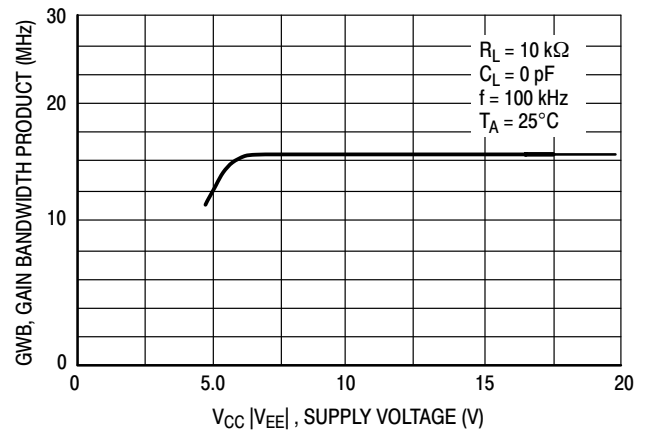


Figure 13. Gain Bandwidth Product versus Supply Voltage

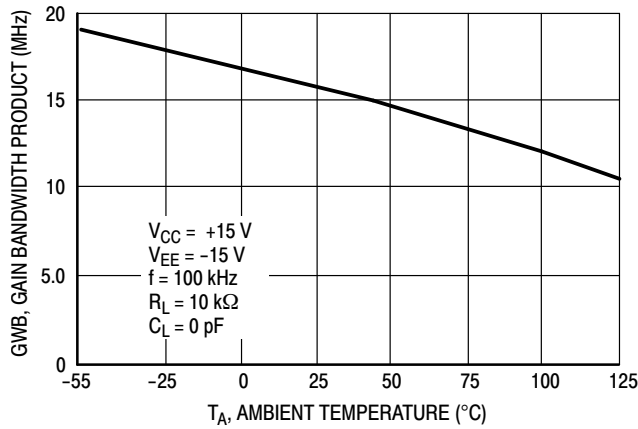


Figure 14. Gain Bandwidth Product versus Temperature

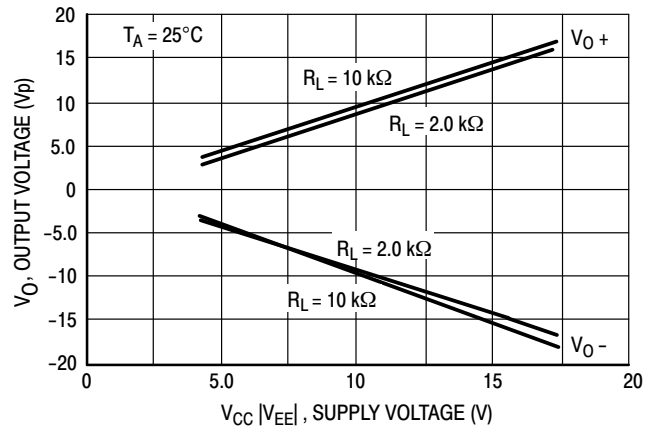


Figure 15. Maximum Output Voltage versus Supply Voltage

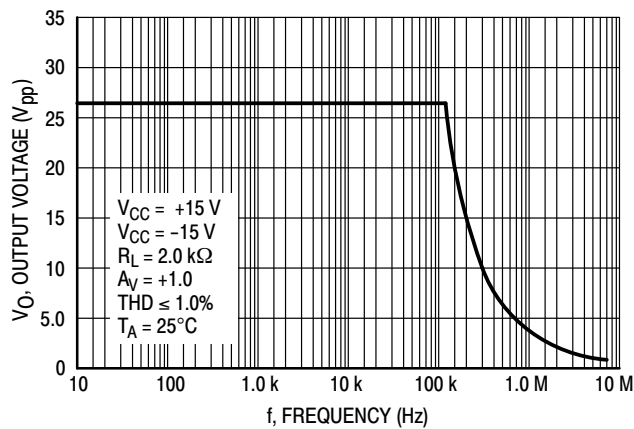


Figure 16. Output Voltage versus Frequency

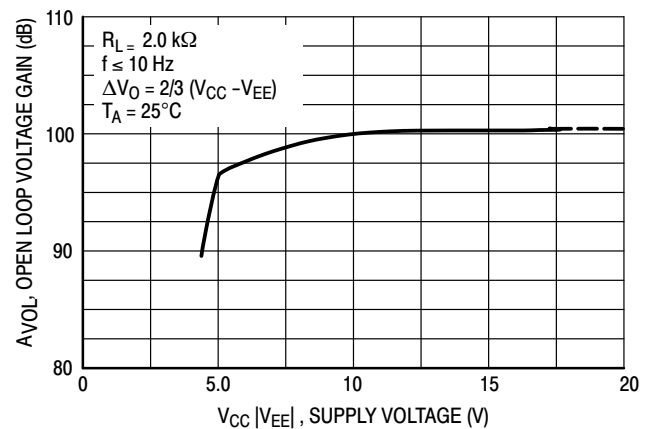
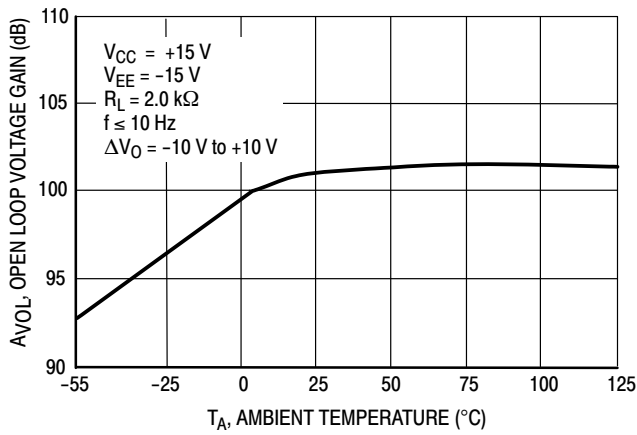
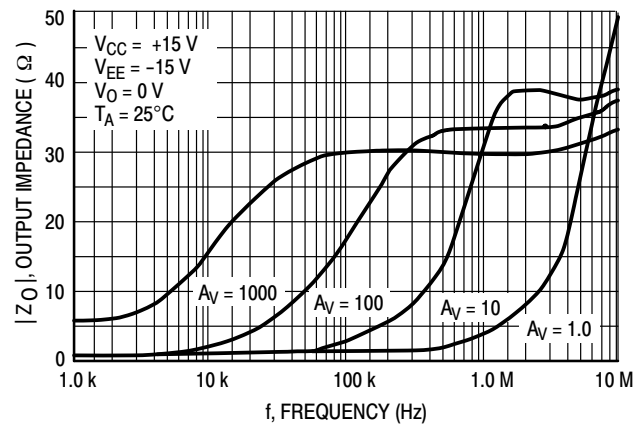


Figure 17. Open Loop Voltage Gain versus Supply Voltage

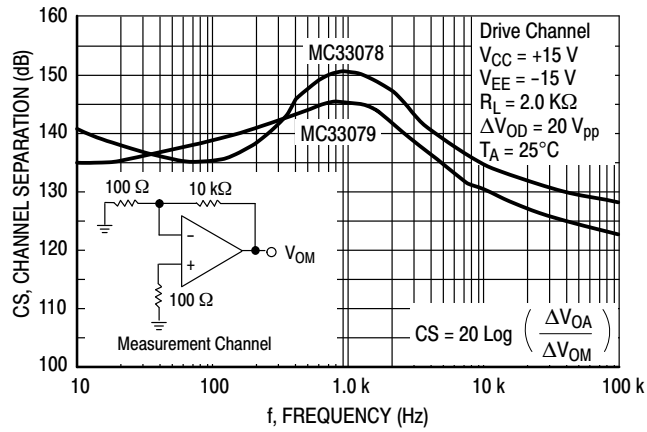
# MC33078, MC33079, NCV33078, NCV33079



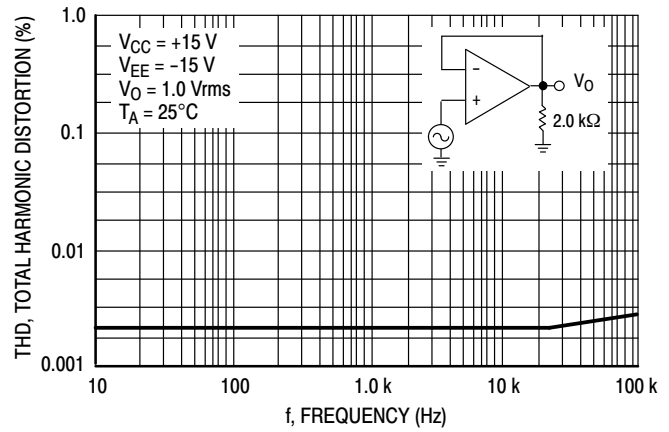
**Figure 18. Open Loop Voltage Gain versus Temperature**



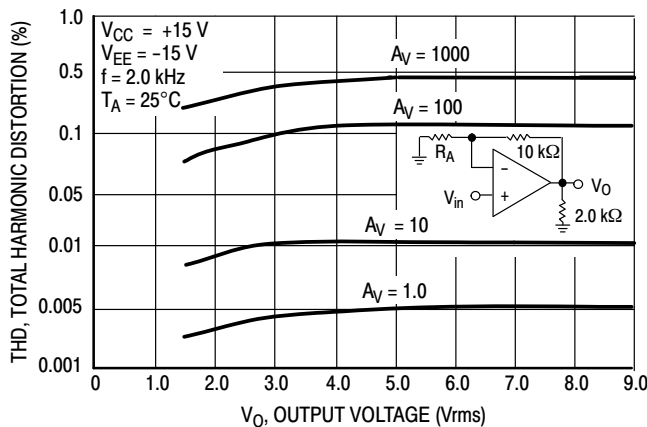
**Figure 19. Output Impedance versus Frequency**



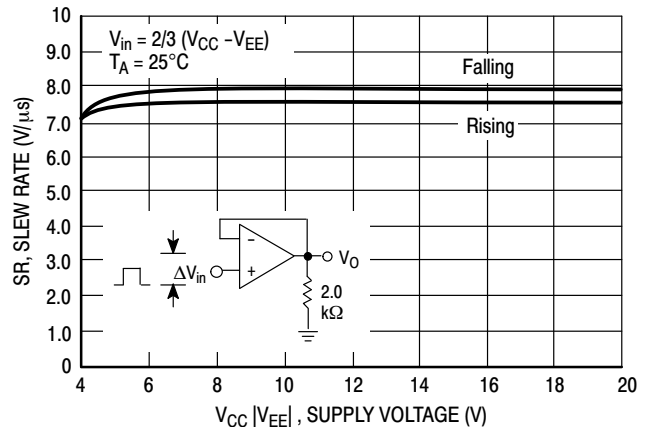
**Figure 20. Channel Separation versus Frequency**



**Figure 21. Total Harmonic Distortion versus Frequency**



**Figure 22. Total Harmonic Distortion versus Output Voltage**



**Figure 23. Slew Rate versus Supply Voltage**

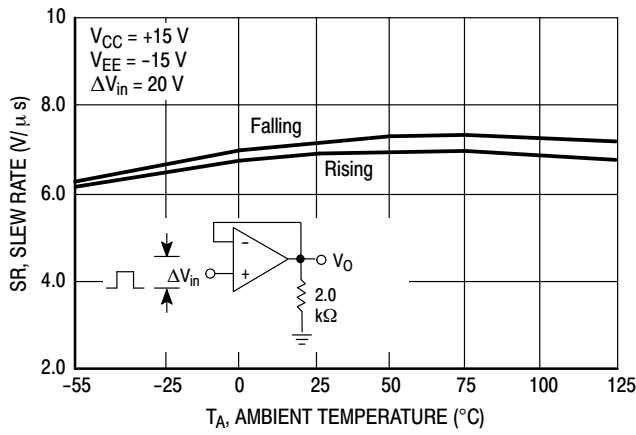


Figure 24. Slew Rate versus Temperature

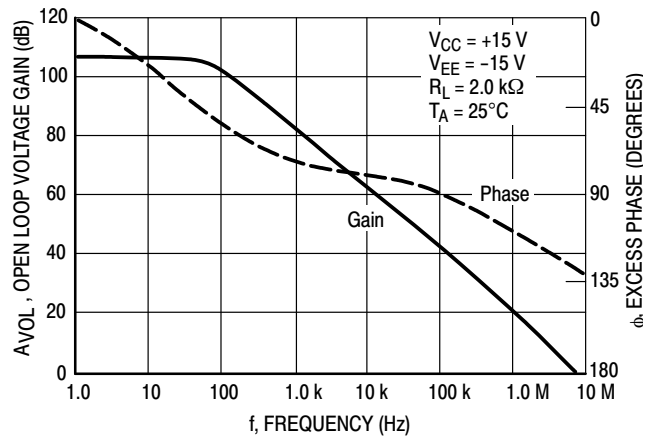


Figure 25. Voltage Gain and Phase versus Frequency

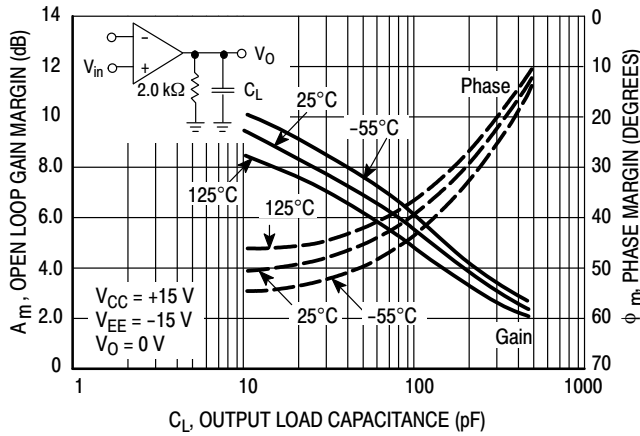


Figure 26. Open Loop Gain Margin and Phase Margin versus Load Capacitance

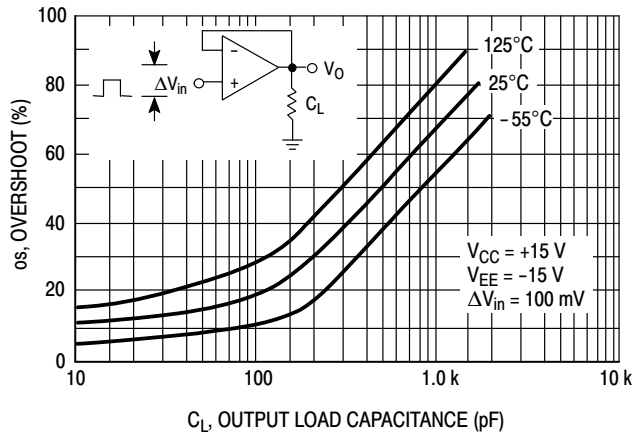


Figure 27. Overshoot versus Output Load Capacitance

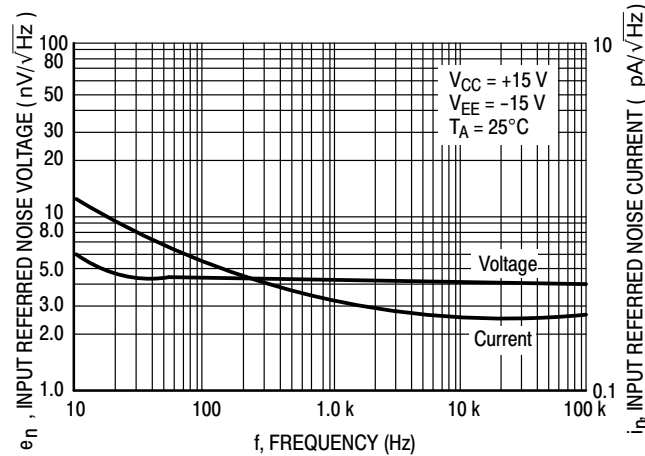


Figure 28. Input Referred Noise Voltage and Current versus Frequency

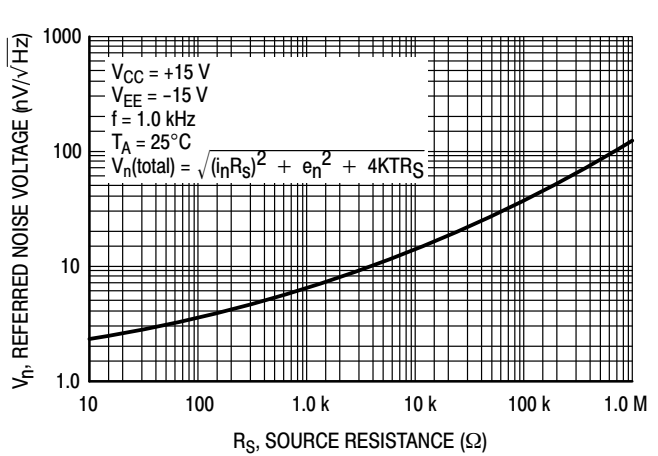


Figure 29. Total Input Referred Noise Voltage versus Source Resistance



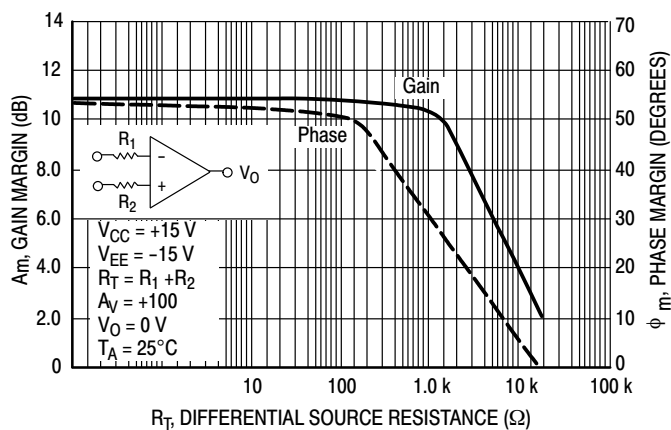


Figure 30. Phase Margin and Gain Margin versus Differential Source Resistance

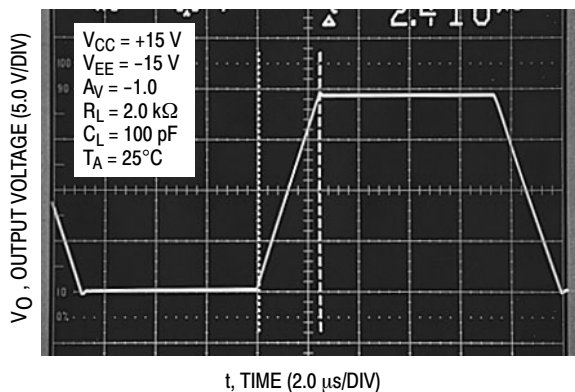


Figure 31. Inverting Amplifier Slew Rate

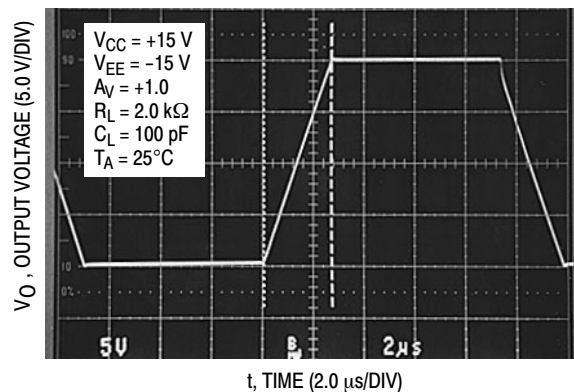


Figure 32. Non-inverting Amplifier Slew Rate

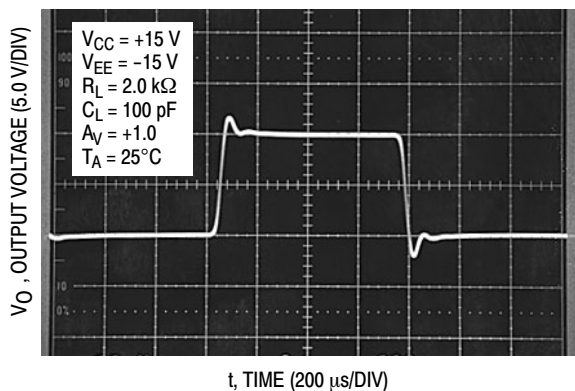


Figure 33. Non-inverting Amplifier Overshoot

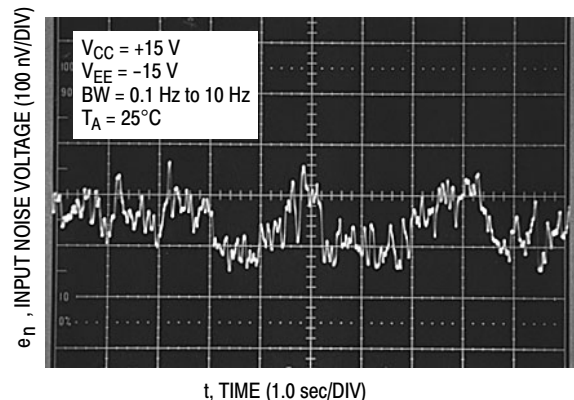
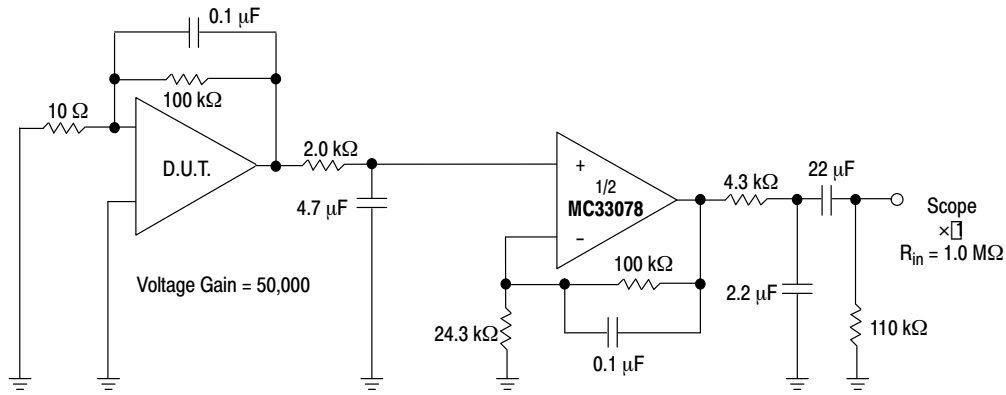


Figure 34. Low Frequency Noise Voltage versus Time

## MC33078, MC33079, NCV33078, NCV33079



Note: All capacitors are non-polarized.

**Figure 35. Voltage Noise Test Circuit**  
(0.1 Hz to 10 Hz<sub>p-p</sub>)

### ORDERING INFORMATION

| Device        | Package              | Shipping <sup>†</sup> |
|---------------|----------------------|-----------------------|
| MC33078DR2G   | SOIC-8<br>(Pb-Free)  | 2500 / Tape & Reel    |
| MC33079DR2G   | SOIC-14<br>(Pb-Free) | 2500 / Tape & Reel    |
| NCV33079DR2G* |                      |                       |

### DISCONTINUED (Note 4)

|               |                      |                    |
|---------------|----------------------|--------------------|
| MC33078DG     | SOIC-8<br>(Pb-Free)  | 98 Units / Rail    |
| NCV33078DR2G* | SOIC-8<br>(Pb-Free)  | 2500 / Tape & Reel |
| MC33078P      | PDIP-8               | 50 Units / Rail    |
| MC33078PG     | PDIP-8<br>(Pb-Free)  | 50 Units / Rail    |
| MC33079DG     | SOIC-14<br>(Pb-Free) | 55 Units / Rail    |
| MC33079P      | PDIP-14              | 25 Units / Rail    |
| MC33079PG     | PDIP-14<br>(Pb-Free) | 25 Units / Rail    |

<sup>†</sup> For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

\* NCV devices are qualified for automotive use.

4. **DISCONTINUED:** These devices are not available. Please contact your **onsemi** representative for information. The most current information on these devices may be available on [www.onsemi.com](http://www.onsemi.com).

## MC33078, MC33079, NCV33078, NCV33079

### REVISION HISTORY

| Revision | Description of Changes                                                                                                                                            | Date       |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 10       | Rebranded the Data Sheet to <b>onsemi</b> format.<br>MC33078DG, NCV33078DR2G, MC33078P, MC33078PG, MC33079DG, MC33079P,<br>MC33079PG OPNs Marked as Discontinued. | 07/30/2025 |

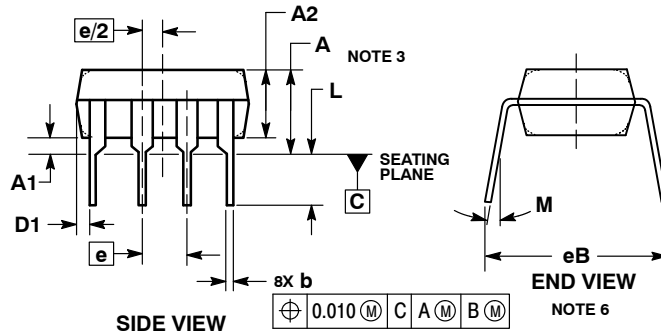
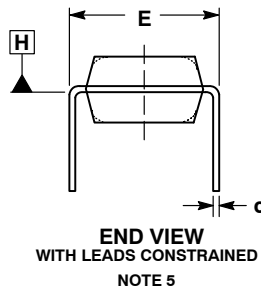
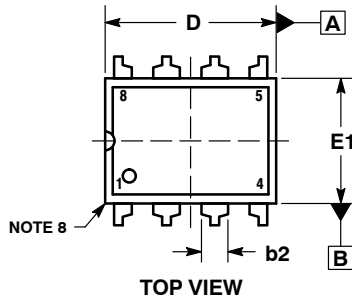
This document has undergone updates prior to the inclusion of this revision history table. The changes tracked here only reflect updates made on the noted approval dates.



SCALE 1:1

PDIP-8  
CASE 626-05  
ISSUE P

DATE 22 APR 2015

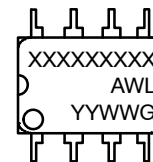


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSIONS A, A1 AND L ARE MEASURED WITH THE PACKAGE SEATED IN JEDEC SEATING PLANE GAUGE GS-3.
4. DIMENSIONS D, D1 AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 0.10 INCH.
5. DIMENSION E IS MEASURED AT A POINT 0.015 BELOW DATUM PLANE H WITH THE LEADS CONSTRAINED PERPENDICULAR TO DATUM C.
6. DIMENSION eB IS MEASURED AT THE LEAD TIPS WITH THE LEADS UNCONSTRAINED.
7. DATUM PLANE H IS COINCIDENT WITH THE BOTTOM OF THE LEADS, WHERE THE LEADS EXIT THE BODY.
8. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).

|     | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
| DIM | MIN       | MAX   | MIN         | MAX   |
| A   | ---       | 0.210 | ---         | 5.33  |
| A1  | 0.015     | ---   | 0.38        | ---   |
| A2  | 0.115     | 0.195 | 2.92        | 4.95  |
| b   | 0.014     | 0.022 | 0.35        | 0.56  |
| b2  | 0.060 TYP | ---   | 1.52 TYP    | ---   |
| C   | 0.008     | 0.014 | 0.20        | 0.36  |
| D   | 0.355     | 0.400 | 9.02        | 10.16 |
| D1  | 0.005     | ---   | 0.13        | ---   |
| E   | 0.300     | 0.325 | 7.62        | 8.26  |
| E1  | 0.240     | 0.280 | 6.10        | 7.11  |
| e   | 0.100 BSC | ---   | 2.54 BSC    | ---   |
| eB  | ---       | 0.430 | ---         | 10.92 |
| L   | 0.115     | 0.150 | 2.92        | 3.81  |
| M   | ---       | 10°   | ---         | 10°   |

GENERIC  
MARKING DIAGRAM\*



- XXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G = Pb-Free Package

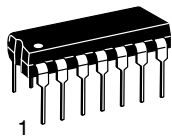
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

STYLE 1:

- PIN 1. AC IN  
2. DC + IN  
3. DC - IN  
4. AC IN  
5. GROUND  
6. OUTPUT  
7. AUXILIARY  
8. V<sub>CC</sub>

|                  |             |                                                                                                                                                                                     |
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| DESCRIPTION:     | PDIP-8      | PAGE 1 OF 1                                                                                                                                                                         |

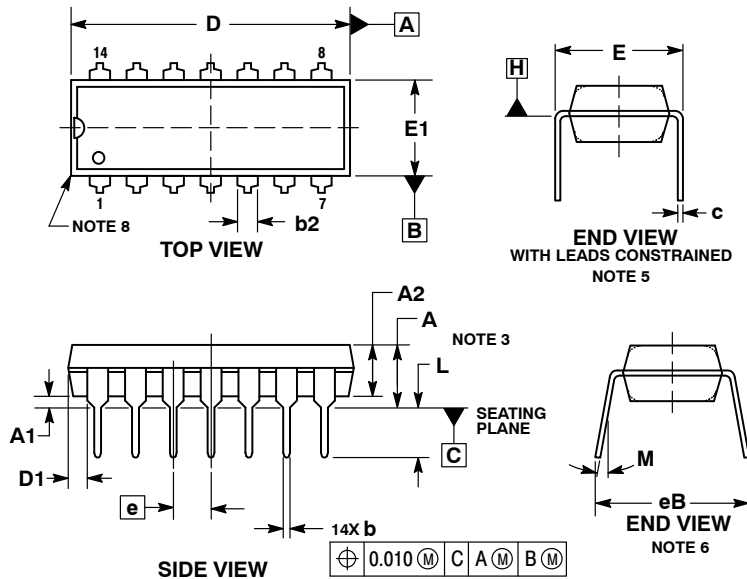
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SCALE 1:1

PDIP-14  
CASE 646-06  
ISSUE S

DATE 22 APR 2015



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSIONS A, A1 AND L ARE MEASURED WITH THE PACKAGE SEATED IN JEDEC SEATING PLANE GAUGE GS-3.
4. DIMENSIONS D, D1 AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 0.10 INCH.
5. DIMENSION E IS MEASURED AT A POINT 0.015 BELOW DATUM PLANE H WITH THE LEADS CONSTRAINED PERPENDICULAR TO DATUM C.
6. DIMENSION eB IS MEASURED AT THE LEAD TIPS WITH THE LEADS UNCONSTRAINED.
7. DATUM PLANE H IS COINCIDENT WITH THE BOTTOM OF THE LEADS, WHERE THE LEADS EXIT THE BODY.
8. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).

| DIM | INCHES             |       | MILLIMETERS |       |
|-----|--------------------|-------|-------------|-------|
|     | MIN                | MAX   | MIN         | MAX   |
| A   | ---                | 0.210 | ---         | 5.33  |
| A1  | 0.015              | ---   | 0.38        | ---   |
| A2  | 0.115              | 0.195 | 2.92        | 4.95  |
| b   | 0.014              | 0.022 | 0.35        | 0.56  |
| b2  | 0.060 TYP 1.52 TYP |       |             |       |
| C   | 0.008              | 0.014 | 0.20        | 0.36  |
| D   | 0.735              | 0.775 | 18.67       | 19.69 |
| D1  | 0.005              | ---   | 0.13        | ---   |
| E   | 0.300              | 0.325 | 7.62        | 8.26  |
| E1  | 0.240              | 0.280 | 6.10        | 7.11  |
| e   | 0.100 BSC          |       | 2.54 BSC    |       |
| eB  | ---                | 0.430 | ---         | 10.92 |
| L   | 0.115              | 0.150 | 2.92        | 3.81  |
| M   | ---                | 10°   | ---         | 10°   |

GENERIC  
MARKING DIAGRAM\*



XXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

|                  |             |                                                                                                                                                                                     |
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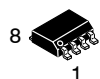
PDIP-14  
CASE 646-06  
ISSUE S

DATE 22 APR 2015

|                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| STYLE 1:<br>PIN 1. COLLECTOR<br>2. BASE<br>3. EMITTER<br>4. NO<br>CONNECTION<br>5. EMITTER<br>6. BASE<br>7. COLLECTOR<br>8. COLLECTOR<br>9. BASE<br>10. EMITTER<br>11. NO<br>CONNECTION<br>12. EMITTER<br>13. BASE<br>14. COLLECTOR                                                                       | STYLE 2:<br>CANCELLED                                                                                                                                                                                                                                                                                            | STYLE 3:<br>CANCELLED                                                                                                                                                                                                                         | STYLE 4:<br>PIN 1. DRAIN<br>2. SOURCE<br>3. GATE<br>4. NO<br>CONNECTION<br>5. GATE<br>6. SOURCE<br>7. DRAIN<br>8. DRAIN<br>9. SOURCE<br>10. GATE<br>11. NO<br>CONNECTION<br>12. GATE<br>13. SOURCE<br>14. DRAIN                                                                                            |
| STYLE 5:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE<br>4. NO CONNECTION<br>5. SOURCE<br>6. DRAIN<br>7. GATE<br>8. GATE<br>9. DRAIN<br>10. SOURCE<br>11. NO CONNECTION<br>12. SOURCE<br>13. DRAIN<br>14. GATE                                                                                                 | STYLE 6:<br>PIN 1. COMMON CATHODE<br>2. ANODE/CATHODE<br>3. ANODE/CATHODE<br>4. NO CONNECTION<br>5. ANODE/CATHODE<br>6. NO CONNECTION<br>7. ANODE/CATHODE<br>8. ANODE/CATHODE<br>9. ANODE/CATHODE<br>10. NO CONNECTION<br>11. ANODE/CATHODE<br>12. ANODE/CATHODE<br>13. NO CONNECTION<br>14. COMMON ANODE        | STYLE 7:<br>PIN 1. NO CONNECTION<br>2. ANODE<br>3. ANODE<br>4. NO CONNECTION<br>5. ANODE<br>6. NO CONNECTION<br>7. ANODE<br>8. ANODE<br>9. ANODE<br>10. NO CONNECTION<br>11. ANODE<br>12. ANODE<br>13. NO CONNECTION<br>14. COMMON<br>CATHODE | STYLE 8:<br>PIN 1. NO CONNECTION<br>2. CATHODE<br>3. CATHODE<br>4. NO CONNECTION<br>5. CATHODE<br>6. NO CONNECTION<br>7. CATHODE<br>8. CATHODE<br>9. CATHODE<br>10. NO CONNECTION<br>11. CATHODE<br>12. CATHODE<br>13. NO CONNECTION<br>14. COMMON ANODE                                                   |
| STYLE 9:<br>PIN 1. COMMON CATHODE<br>2. ANODE/CATHODE<br>3. ANODE/CATHODE<br>4. NO CONNECTION<br>5. ANODE/CATHODE<br>6. ANODE/CATHODE<br>7. COMMON ANODE<br>8. COMMON ANODE<br>9. ANODE/CATHODE<br>10. ANODE/CATHODE<br>11. NO CONNECTION<br>12. ANODE/CATHODE<br>13. ANODE/CATHODE<br>14. COMMON CATHODE | STYLE 10:<br>PIN 1. COMMON<br>CATHODE<br>2. ANODE/CATHODE<br>3. ANODE/CATHODE<br>4. ANODE/CATHODE<br>5. ANODE/CATHODE<br>6. NO CONNECTION<br>7. COMMON ANODE<br>8. COMMON<br>CATHODE<br>9. ANODE/CATHODE<br>10. ANODE/CATHODE<br>11. ANODE/CATHODE<br>12. ANODE/CATHODE<br>13. NO CONNECTION<br>14. COMMON ANODE | STYLE 11:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. CATHODE<br>4. CATHODE<br>5. CATHODE<br>6. CATHODE<br>7. CATHODE<br>8. ANODE<br>9. ANODE<br>10. ANODE<br>11. ANODE<br>12. ANODE<br>13. ANODE<br>14. ANODE                                      | STYLE 12:<br>PIN 1. COMMON CATHODE<br>2. COMMON ANODE<br>3. ANODE/CATHODE<br>4. ANODE/CATHODE<br>5. ANODE/CATHODE<br>6. COMMON ANODE<br>7. COMMON CATHODE<br>8. ANODE/CATHODE<br>9. ANODE/CATHODE<br>10. ANODE/CATHODE<br>11. ANODE/CATHODE<br>12. ANODE/CATHODE<br>13. ANODE/CATHODE<br>14. ANODE/CATHODE |

|                  |             |                                                                                                                                                                                     |
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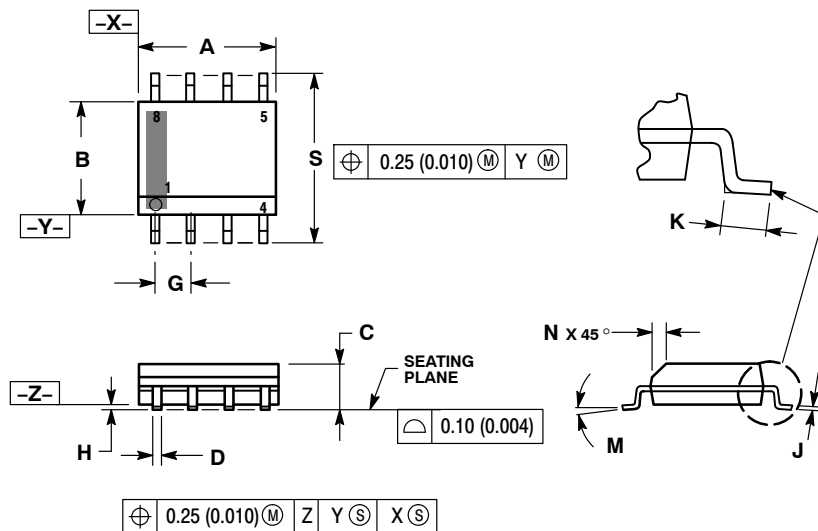
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SCALE 1:1

**SOIC-8 NB**  
CASE 751-07  
ISSUE AK

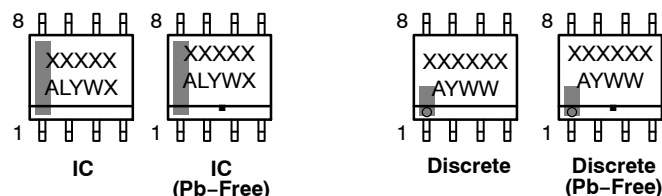
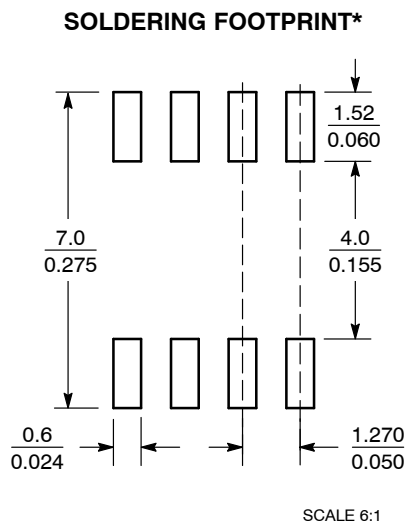
DATE 16 FEB 2011



## 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.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | 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 |

**GENERIC**  
**MARKING DIAGRAM\***


XXXXXX = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

XXXXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
▪ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**STYLES ON PAGE 2**

|                         |                    |                                                                                                                                                                                     |
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**SOIC-8 NB**  
**CASE 751-07**  
**ISSUE AK**

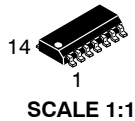
DATE 16 FEB 2011

|                                                                                                                                                                                                   |                                                                                                                                                                                          |                                                                                                                                                                                    |                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>STYLE 1:</b><br>PIN 1. EMITTER<br>2. COLLECTOR<br>3. COLLECTOR<br>4. EMITTER<br>5. EMITTER<br>6. BASE<br>7. BASE<br>8. EMITTER                                                                 | <b>STYLE 2:</b><br>PIN 1. COLLECTOR, DIE, #1<br>2. COLLECTOR, #1<br>3. COLLECTOR, #2<br>4. COLLECTOR, #2<br>5. BASE, #2<br>6. EMITTER, #2<br>7. BASE, #1<br>8. EMITTER, #1               | <b>STYLE 3:</b><br>PIN 1. DRAIN, DIE #1<br>2. DRAIN, #1<br>3. DRAIN, #2<br>4. DRAIN, #2<br>5. GATE, #2<br>6. SOURCE, #2<br>7. GATE, #1<br>8. SOURCE, #1                            | <b>STYLE 4:</b><br>PIN 1. ANODE<br>2. ANODE<br>3. ANODE<br>4. ANODE<br>5. ANODE<br>6. ANODE<br>7. ANODE<br>8. COMMON CATHODE                                                                           |
| <b>STYLE 5:</b><br>PIN 1. DRAIN<br>2. DRAIN<br>3. DRAIN<br>4. DRAIN<br>5. GATE<br>6. GATE<br>7. SOURCE<br>8. SOURCE                                                                               | <b>STYLE 6:</b><br>PIN 1. SOURCE<br>2. DRAIN<br>3. DRAIN<br>4. SOURCE<br>5. SOURCE<br>6. GATE<br>7. GATE<br>8. SOURCE                                                                    | <b>STYLE 7:</b><br>PIN 1. INPUT<br>2. EXTERNAL BYPASS<br>3. THIRD STAGE SOURCE<br>4. GROUND<br>5. DRAIN<br>6. GATE 3<br>7. SECOND STAGE Vd<br>8. FIRST STAGE Vd                    | <b>STYLE 8:</b><br>PIN 1. COLLECTOR, DIE #1<br>2. BASE, #1<br>3. BASE, #2<br>4. COLLECTOR, #2<br>5. COLLECTOR, #2<br>6. EMITTER, #2<br>7. EMITTER, #1<br>8. COLLECTOR, #1                              |
| <b>STYLE 9:</b><br>PIN 1. EMITTER, COMMON<br>2. COLLECTOR, DIE #1<br>3. COLLECTOR, DIE #2<br>4. EMITTER, COMMON<br>5. EMITTER, COMMON<br>6. BASE, DIE #2<br>7. BASE, DIE #1<br>8. EMITTER, COMMON | <b>STYLE 10:</b><br>PIN 1. GROUND<br>2. BIAS 1<br>3. OUTPUT<br>4. GROUND<br>5. GROUND<br>6. BIAS 2<br>7. INPUT<br>8. GROUND                                                              | <b>STYLE 11:</b><br>PIN 1. SOURCE 1<br>2. GATE 1<br>3. SOURCE 2<br>4. GATE 2<br>5. DRAIN 2<br>6. DRAIN 2<br>7. DRAIN 1<br>8. DRAIN 1                                               | <b>STYLE 12:</b><br>PIN 1. SOURCE<br>2. SOURCE<br>3. SOURCE<br>4. GATE<br>5. DRAIN<br>6. DRAIN<br>7. DRAIN<br>8. DRAIN                                                                                 |
| <b>STYLE 13:</b><br>PIN 1. N.C.<br>2. SOURCE<br>3. SOURCE<br>4. GATE<br>5. DRAIN<br>6. DRAIN<br>7. DRAIN<br>8. DRAIN                                                                              | <b>STYLE 14:</b><br>PIN 1. N-SOURCE<br>2. N-GATE<br>3. P-SOURCE<br>4. P-GATE<br>5. P-DRAIN<br>6. P-DRAIN<br>7. N-DRAIN<br>8. N-DRAIN                                                     | <b>STYLE 15:</b><br>PIN 1. ANODE 1<br>2. ANODE 1<br>3. ANODE 1<br>4. ANODE 1<br>5. CATHODE, COMMON<br>6. CATHODE, COMMON<br>7. CATHODE, COMMON<br>8. CATHODE, COMMON               | <b>STYLE 16:</b><br>PIN 1. EMITTER, DIE #1<br>2. BASE, DIE #1<br>3. EMITTER, DIE #2<br>4. BASE, DIE #2<br>5. COLLECTOR, DIE #2<br>6. COLLECTOR, DIE #2<br>7. COLLECTOR, DIE #1<br>8. COLLECTOR, DIE #1 |
| <b>STYLE 17:</b><br>PIN 1. VCC<br>2. V2OUT<br>3. V1OUT<br>4. TXE<br>5. RXE<br>6. VEE<br>7. GND<br>8. ACC                                                                                          | <b>STYLE 18:</b><br>PIN 1. ANODE<br>2. ANODE<br>3. SOURCE<br>4. GATE<br>5. DRAIN<br>6. DRAIN<br>7. CATHODE<br>8. CATHODE                                                                 | <b>STYLE 19:</b><br>PIN 1. SOURCE 1<br>2. GATE 1<br>3. SOURCE 2<br>4. GATE 2<br>5. DRAIN 2<br>6. MIRROR 2<br>7. DRAIN 1<br>8. MIRROR 1                                             | <b>STYLE 20:</b><br>PIN 1. SOURCE (N)<br>2. GATE (N)<br>3. SOURCE (P)<br>4. GATE (P)<br>5. DRAIN<br>6. DRAIN<br>7. DRAIN<br>8. DRAIN                                                                   |
| <b>STYLE 21:</b><br>PIN 1. CATHODE 1<br>2. CATHODE 2<br>3. CATHODE 3<br>4. CATHODE 4<br>5. CATHODE 5<br>6. COMMON ANODE<br>7. COMMON ANODE<br>8. CATHODE 6                                        | <b>STYLE 22:</b><br>PIN 1. I/O LINE 1<br>2. COMMON CATHODE/VCC<br>3. COMMON CATHODE/VCC<br>4. I/O LINE 3<br>5. COMMON ANODE/GND<br>6. I/O LINE 4<br>7. I/O LINE 5<br>8. COMMON ANODE/GND | <b>STYLE 23:</b><br>PIN 1. LINE 1 IN<br>2. COMMON ANODE/GND<br>3. COMMON ANODE/GND<br>4. LINE 2 IN<br>5. LINE 2 OUT<br>6. COMMON ANODE/GND<br>7. COMMON ANODE/GND<br>8. LINE 1 OUT | <b>STYLE 24:</b><br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR/ANODE<br>4. COLLECTOR/ANODE<br>5. CATHODE<br>6. CATHODE<br>7. COLLECTOR/ANODE<br>8. COLLECTOR/ANODE                                      |
| <b>STYLE 25:</b><br>PIN 1. VIN<br>2. N/C<br>3. REXT<br>4. GND<br>5. IOUT<br>6. IOUT<br>7. IOUT<br>8. IOUT                                                                                         | <b>STYLE 26:</b><br>PIN 1. GND<br>2. dv/dt<br>3. ENABLE<br>4. ILIMIT<br>5. SOURCE<br>6. SOURCE<br>7. SOURCE<br>8. VCC                                                                    | <b>STYLE 27:</b><br>PIN 1. ILIMIT<br>2. OVLO<br>3. UVLO<br>4. INPUT+<br>5. SOURCE<br>6. SOURCE<br>7. SOURCE<br>8. DRAIN                                                            | <b>STYLE 28:</b><br>PIN 1. SW_TO_GND<br>2. DASIC_OFF<br>3. DASIC_SW_DET<br>4. GND<br>5. V_MON<br>6. VBULK<br>7. VBULK<br>8. VIN                                                                        |
| <b>STYLE 29:</b><br>PIN 1. BASE, DIE #1<br>2. EMITTER, #1<br>3. BASE, #2<br>4. EMITTER, #2<br>5. COLLECTOR, #2<br>6. COLLECTOR, #2<br>7. COLLECTOR, #1<br>8. COLLECTOR, #1                        | <b>STYLE 30:</b><br>PIN 1. DRAIN 1<br>2. DRAIN 1<br>3. GATE 2<br>4. SOURCE 2<br>5. SOURCE 1/DRAIN 2<br>6. SOURCE 1/DRAIN 2<br>7. SOURCE 1/DRAIN 2<br>8. GATE 1                           |                                                                                                                                                                                    |                                                                                                                                                                                                        |

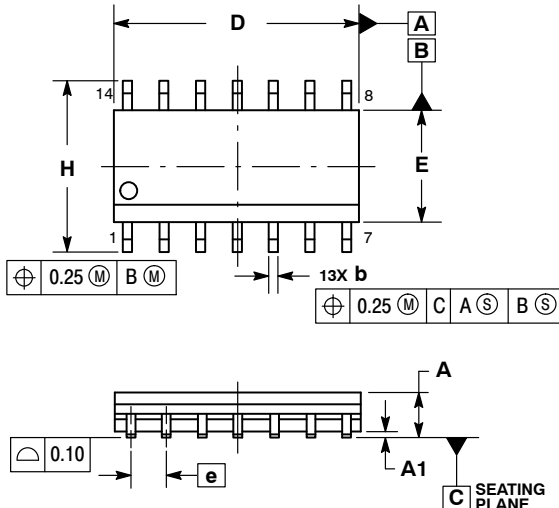
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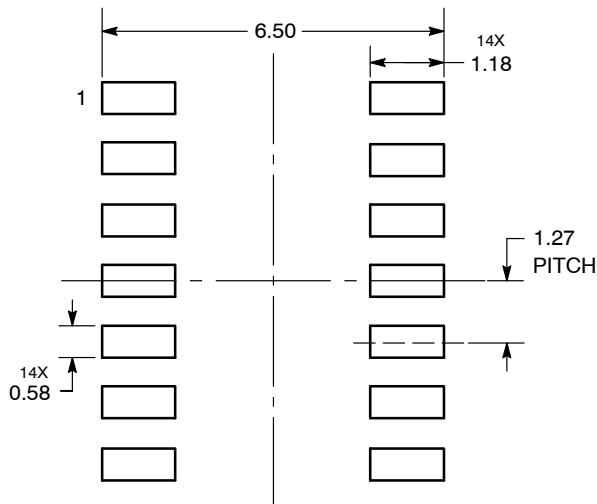

**SOIC-14 NB**  
**CASE 751A-03**  
**ISSUE L**

DATE 03 FEB 2016


**NOTES:**

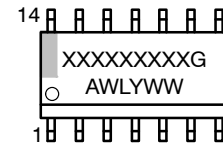
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 1.35        | 1.75 | 0.054     | 0.068 |
| A1  | 0.10        | 0.25 | 0.004     | 0.010 |
| A3  | 0.19        | 0.25 | 0.008     | 0.010 |
| b   | 0.35        | 0.49 | 0.014     | 0.019 |
| D   | 8.55        | 8.75 | 0.337     | 0.344 |
| E   | 3.80        | 4.00 | 0.150     | 0.157 |
| e   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 5.80        | 6.20 | 0.228     | 0.244 |
| h   | 0.25        | 0.50 | 0.010     | 0.019 |
| L   | 0.40        | 1.25 | 0.016     | 0.049 |
| M   | 0°          | 7°   | 0°        | 7°    |

**SOLDERING FOOTPRINT\***


DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**GENERIC MARKING DIAGRAM\***


XXXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
WW = Work Week  
G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

**STYLES ON PAGE 2**

|                         |                    |                                                                                                                                                                                     |
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**SOIC-14**  
**CASE 751A-03**  
**ISSUE L**

**DATE 03 FEB 2016**

**STYLE 1:**  
PIN 1. COMMON CATHODE  
2. ANODE/CATHODE  
3. ANODE/CATHODE  
4. NO CONNECTION  
5. ANODE/CATHODE  
6. NO CONNECTION  
7. ANODE/CATHODE  
8. ANODE/CATHODE  
9. ANODE/CATHODE  
10. NO CONNECTION  
11. ANODE/CATHODE  
12. ANODE/CATHODE  
13. NO CONNECTION  
14. COMMON ANODE

**STYLE 2:**  
CANCELLED

**STYLE 3:**  
PIN 1. NO CONNECTION  
2. ANODE  
3. ANODE  
4. NO CONNECTION  
5. ANODE  
6. NO CONNECTION  
7. ANODE  
8. ANODE  
9. ANODE  
10. NO CONNECTION  
11. ANODE  
12. ANODE  
13. NO CONNECTION  
14. COMMON CATHODE

**STYLE 4:**  
PIN 1. NO CONNECTION  
2. CATHODE  
3. CATHODE  
4. NO CONNECTION  
5. CATHODE  
6. NO CONNECTION  
7. CATHODE  
8. CATHODE  
9. CATHODE  
10. NO CONNECTION  
11. CATHODE  
12. CATHODE  
13. NO CONNECTION  
14. COMMON ANODE

**STYLE 5:**  
PIN 1. COMMON CATHODE  
2. ANODE/CATHODE  
3. ANODE/CATHODE  
4. ANODE/CATHODE  
5. ANODE/CATHODE  
6. NO CONNECTION  
7. COMMON ANODE  
8. COMMON CATHODE  
9. ANODE/CATHODE  
10. ANODE/CATHODE  
11. ANODE/CATHODE  
12. ANODE/CATHODE  
13. NO CONNECTION  
14. COMMON ANODE

**STYLE 6:**  
PIN 1. CATHODE  
2. CATHODE  
3. CATHODE  
4. CATHODE  
5. CATHODE  
6. CATHODE  
7. CATHODE  
8. ANODE  
9. ANODE  
10. ANODE  
11. ANODE  
12. ANODE  
13. ANODE  
14. ANODE

**STYLE 7:**  
PIN 1. ANODE/CATHODE  
2. COMMON ANODE  
3. COMMON CATHODE  
4. ANODE/CATHODE  
5. ANODE/CATHODE  
6. ANODE/CATHODE  
7. ANODE/CATHODE  
8. ANODE/CATHODE  
9. ANODE/CATHODE  
10. ANODE/CATHODE  
11. COMMON CATHODE  
12. COMMON ANODE  
13. ANODE/CATHODE  
14. ANODE/CATHODE

**STYLE 8:**  
PIN 1. COMMON CATHODE  
2. ANODE/CATHODE  
3. ANODE/CATHODE  
4. NO CONNECTION  
5. ANODE/CATHODE  
6. ANODE/CATHODE  
7. COMMON ANODE  
8. COMMON ANODE  
9. ANODE/CATHODE  
10. ANODE/CATHODE  
11. NO CONNECTION  
12. ANODE/CATHODE  
13. ANODE/CATHODE  
14. COMMON CATHODE

|                         |                    |                                                                                                                                                                                     |
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