

## 110MHz, High Slew Rate, High Output Current Buffer

The HA-5002 is a monolithic, wideband, high slew rate, high output current, buffer amplifier.

Utilizing the advantages of the Intersil D.I. technologies, the HA-5002 current buffer offers 1300V/μs slew rate with 110MHz of bandwidth. The ±200mA output current capability is enhanced by a 3Ω output impedance.

The monolithic HA-5002 will replace the hybrid LH0002 with corresponding performance increases. These characteristics range from the 3000kΩ input impedance to the increased output voltage swing. Monolithic design technologies have allowed a more precise buffer to be developed with more than an order of magnitude smaller gain error.

The HA-5002 will provide many present hybrid users with a higher degree of reliability and at the same time increase overall circuit performance.

For the military grade product, refer to the HA-5002/883 datasheet.

## Features

- Voltage Gain . . . . . 0.995
- High Input Impedance . . . . . 3000kΩ
- Low Output Impedance . . . . . 3Ω
- Very High Slew Rate . . . . . 1300V/μs
- Very Wide Bandwidth . . . . . 110MHz
- High Output Current . . . . . ±200mA
- Pulsed Output Current . . . . . 400mA
- Monolithic Construction
- Pb-Free Plus Anneal Available (RoHS Compliant)

## Applications

- Line Driver
- Data Acquisition
- 110MHz Buffer
- Radara Cable Driver
- High Power Current Booster
- High Power Current Source
- Sample and Holds
- Video Products

## Ordering Information

| PART NUMBER        | PART MARKING | TEMP. RANGE (°C) | PACKAGE              | PKG. DWG. # |
|--------------------|--------------|------------------|----------------------|-------------|
| HA2-5002-2         | HA2-5002-2   | -55 to 125       | 8 Pin Metal Can      | T8.C        |
| HA2-5002-5         | HA2-5002-5   | 0 to 75          | 8 Pin Metal Can      | T8.C        |
| HA3-5002-5         | HA3-5002-5   | 0 to 75          | 8 Ld PDIP            | E8.3        |
| HA3-5002-5Z (Note) | HA3-5002-5Z  | 0 to 75          | 8 Ld PDIP* (Pb-free) | E8.3        |
| HA4P5002-5         | HA4P5002-5   | 0 to 75          | 20 Ld PLCC           | N20.35      |
| HA4P5002-5Z (Note) | HA4P5002-5Z  | 0 to 75          | 20 Ld PLCC (Pb-free) | N20.35      |
| HA9P5002-5         | 50025        | 0 to 75          | 8 Ld SOIC            | M8.15       |
| HA9P5002-5Z (Note) | 50025Z       | 0 to 75          | 8 Ld SOIC (Pb-free)  | M8.15       |
| HA9P5002-9         | 50029        | -40 to 85        | 8 Ld SOIC            | M8.15       |
| HA9P5002-9Z (Note) | 50029Z       | -40 to 85        | 8 Ld SOIC (Pb-free)  | M8.15       |

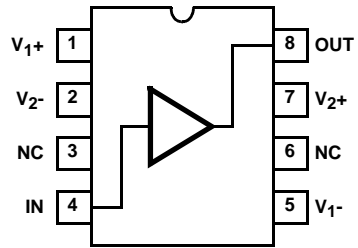
\*Pb-free PDIPs can be used for through hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

NOTE: Intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.

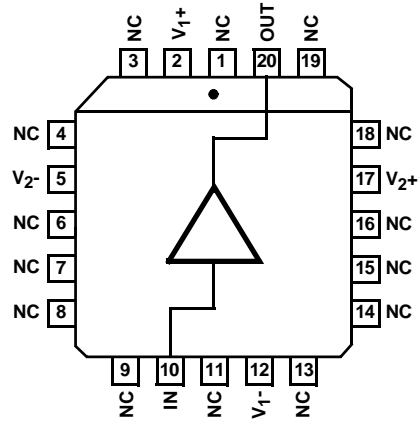
## HA-5002

### Pinouts

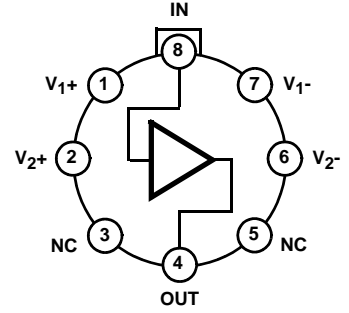
HA-5002 (PDIP, SOIC)  
TOP VIEW



HA-5002 (PLCC)  
TOP VIEW



HA-5002 (METAL CAN)  
TOP VIEW



NOTE: Case Voltage = Floating

## HA-5002

### Absolute Maximum Ratings

|                                     |                                    |
|-------------------------------------|------------------------------------|
| Voltage Between V+ and V- Terminals | 44V                                |
| Input Voltage                       | V <sub>I+</sub> to V <sub>I-</sub> |
| Output Current (Continuous)         | ±200mA                             |
| Output Current (50ms On, 1s Off)    | ±400mA                             |

### Operating Conditions

|                   |                |
|-------------------|----------------|
| Temperature Range |                |
| HA-5002-2         | -55°C to 125°C |
| HA-5002-5         | 0°C to 75°C    |
| HA-5002-9         | -40°C to 85°C  |

### Thermal Information

| Thermal Resistance (Typical, Note 2)                 | $\theta_{JA}$ (°C/W) | $\theta_{JC}$ (°C/W) |
|--|----------------------|----------------------|
| PDIP Package*  | 92                   | N/A                  |
| Metal Can Package                                    | 155                  | 67                   |
| PLCC Package   | 74                   | N/A                  |
| SOIC Package   | 157                  | N/A                  |
| Max Junction Temperature (Hermetic Packages, Note 1) | 175°C                |                      |
| Max Junction Temperature (Plastic Packages, Note 1)  | 150°C                |                      |
| Max Storage Temperature Range                        | -65°C to 150°C       |                      |
| Max Lead Temperature (Soldering 10s)                 | 300°C                |                      |
| (PLCC and SOIC - Lead Tips Only)                     |                      |                      |

\*Pb-free PDIPs can be used for through hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### NOTES:

- Maximum power dissipation, including load conditions, must be designed to maintain the maximum junction temperature below 175°C for the can packages, and below 150°C for the plastic packages.
- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.

### Electrical Specifications $V_{SUPPLY} = \pm 12V$ to $\pm 15V$ , $R_S = 50\Omega$ , $R_L = 1k\Omega$ , $C_L = 10pF$ , Unless Otherwise Specified

| PARAMETER                                 | TEST CONDITIONS                                 | TEMP (°C) | HA-5002-2 |        |     | HA-5002-5, -9 |        |     | UNITS             |
|---|---|-----------|-----------|--------|-----|---------------|--------|-----|-------------------|
|   |   |           | MIN       | TYP    | MAX | MIN           | TYP    | MAX |                   |
| INPUT CHARACTERISTICS                     |   |           |           |        |     |               |        |     |                   |
| Offset Voltage                            |   | 25        | -         | 5      | 20  | -             | 5      | 20  | mV                |
|   |   | Full      | -         | 10     | 30  | -             | 10     | 30  | mV                |
| Average Offset Voltage Drift              |   | Full      | -         | 30     | -   | -             | 30     | -   | μV/°C             |
| Bias Current                              |   | 25        | -         | 2      | 7   | -             | 2      | 7   | μA                |
|   |   | Full      | -         | 3.4    | 10  | -             | 2.4    | 10  | μA                |
| Input Resistance                          |   | Full      | 1.5       | 3      | -   | 1.5           | 3      | -   | MΩ                |
| Input Noise Voltage                       | 10Hz-1MHz                                       | 25        | -         | 18     | -   | -             | 18     | -   | μV <sub>P-P</sub> |
| TRANSFER CHARACTERISTICS                  |   |           |           |        |     |               |        |     |                   |
| Voltage Gain<br>(V <sub>OUT</sub> = ±10V) | R <sub>L</sub> = 50Ω                            | 25        | -         | 0.900  | -   | -             | 0.900  | -   | V/V               |
|   | R <sub>L</sub> = 100Ω                           | 25        | -         | 0.971  | -   | -             | 0.971  | -   | V/V               |
|   | R <sub>L</sub> = 1kΩ                            | 25        | -         | 0.995  | -   | -             | 0.995  | -   | V/V               |
|   | R <sub>L</sub> = 1kΩ                            | Full      | 0.980     | -      | -   | 0.980         | -      | -   | V/V               |
| -3dB Bandwidth                            | V <sub>IN</sub> = 1V <sub>P-P</sub>             | 25        | -         | 110    | -   | -             | 110    | -   | MHz               |
| AC Current Gain                           |   | 25        | -         | 40     | -   | -             | 40     | -   | A/mA              |
| OUTPUT CHARACTERISTICS                    |   |           |           |        |     |               |        |     |                   |
| Output Voltage Swing                      | R <sub>L</sub> = 100Ω                           | 25        | ±10       | ±10.7  | -   | ±10           | ±11.2  | -   | V                 |
|   | R <sub>L</sub> = 1kΩ, V <sub>S</sub> = ±15V     | Full      | ±10       | ±13.5  | -   | ±10           | ±13.9  | -   | V                 |
|   | R <sub>L</sub> = 1kΩ, V <sub>S</sub> = ±12V     | Full      | ±10       | ±10.5  | -   | ±10           | ±10.5  | -   | V                 |
| Output Current                            | V <sub>IN</sub> = ±10V, R <sub>L</sub> = 40Ω    | 25        | -         | 220    | -   | -             | 220    | -   | mA                |
| Output Resistance                         |   | Full      | -         | 3      | 10  | -             | 3      | 10  | Ω                 |
| Harmonic Distortion                       | V <sub>IN</sub> = 1V <sub>RMS</sub> , f = 10kHz | 25        | -         | <0.005 | -   | -             | <0.005 | -   | %                 |
| TRANSIENT RESPONSE                        |   |           |           |        |     |               |        |     |                   |
| Full Power Bandwidth (Note 3)             |   | 25        | -         | 20.7   | -   | -             | 20.7   | -   | MHz               |
| Rise Time                                 |   | 25        | -         | 3.6    | -   | -             | 3.6    | -   | ns                |
| Propagation Delay                         |   | 25        | -         | 2      | -   | -             | 2      | -   | ns                |
| Overshoot                                 |   | 25        | -         | 30     | -   | -             | 30     | -   | %                 |
| Slew Rate                                 |   | 25        | 1.0       | 1.3    | -   | 1.0           | 1.3    | -   | V/ns              |
| Settling Time                             | To 0.1%   | 25        | -         | 50     | -   | -             | 50     | -   | ns                |

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### Electrical Specifications $V_{\text{SUPPLY}} = \pm 12\text{V}$ to $\pm 15\text{V}$ , $R_S = 50\Omega$ , $R_L = 1\text{k}\Omega$ , $C_L = 10\text{pF}$ , Unless Otherwise Specified (Continued)

| PARAMETER                    | TEST CONDITIONS    | TEMP (°C) | HA-5002-2 |      |     | HA-5002-5, -9 |      |     | UNITS   |
|------------------------------|--------------------|-----------|-----------|------|-----|---------------|------|-----|---------|
|                              |                    |           | MIN       | TYP  | MAX | MIN           | TYP  | MAX |         |
| Differential Gain            | $R_L = 500\Omega$  | 25        | -         | 0.06 | -   | -             | 0.06 | -   | %       |
| Differential Phase           | $R_L = 500\Omega$  | 25        | -         | 0.22 | -   | -             | 0.22 | -   | Degrees |
| <b>POWER REQUIREMENTS</b>    |                    |           |           |      |     |               |      |     |         |
| Supply Current               |                    | 25        | -         | 8.3  | -   | -             | 8.3  | -   | mA      |
|                              |                    | Full      | -         | -    | 10  | -             | -    | 10  | mA      |
| Power Supply Rejection Ratio | $A_V = 10\text{V}$ | Full      | 54        | 64   | -   | 54            | 64   | -   | dB      |

NOTE:

$$3. \text{FPBW} = \frac{\text{Slew Rate}}{2\pi V_{\text{PEAK}}}; V_P = 10\text{V}$$

### Test Circuit and Waveforms

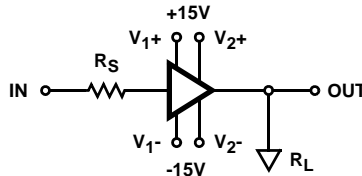
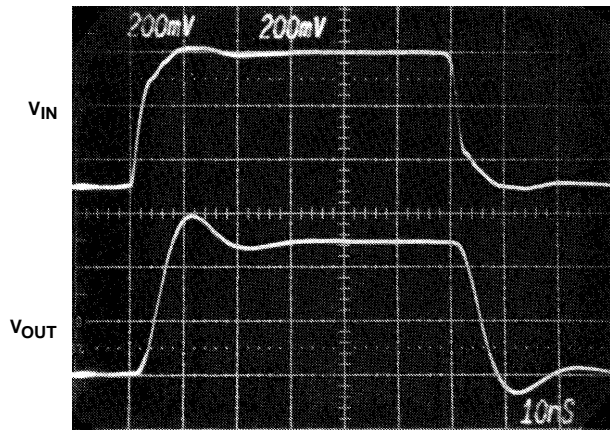
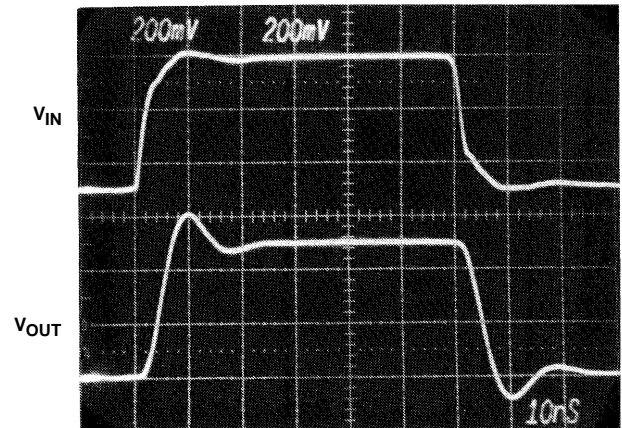


FIGURE 1. LARGE AND SMALL SIGNAL RESPONSE



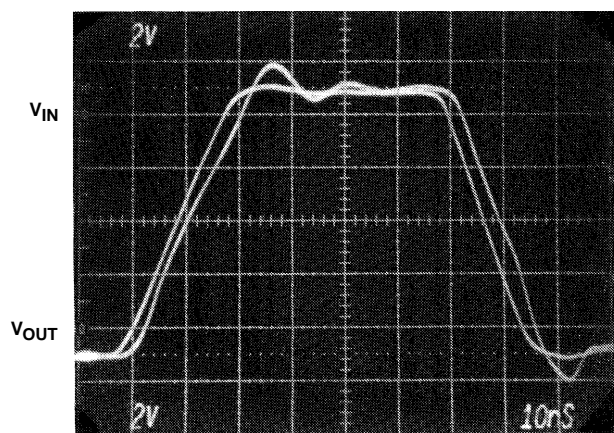
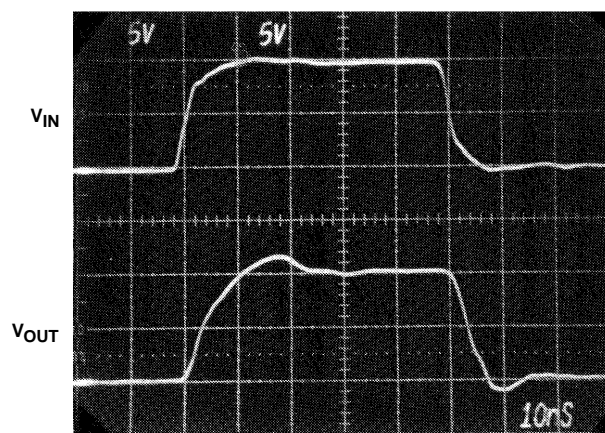
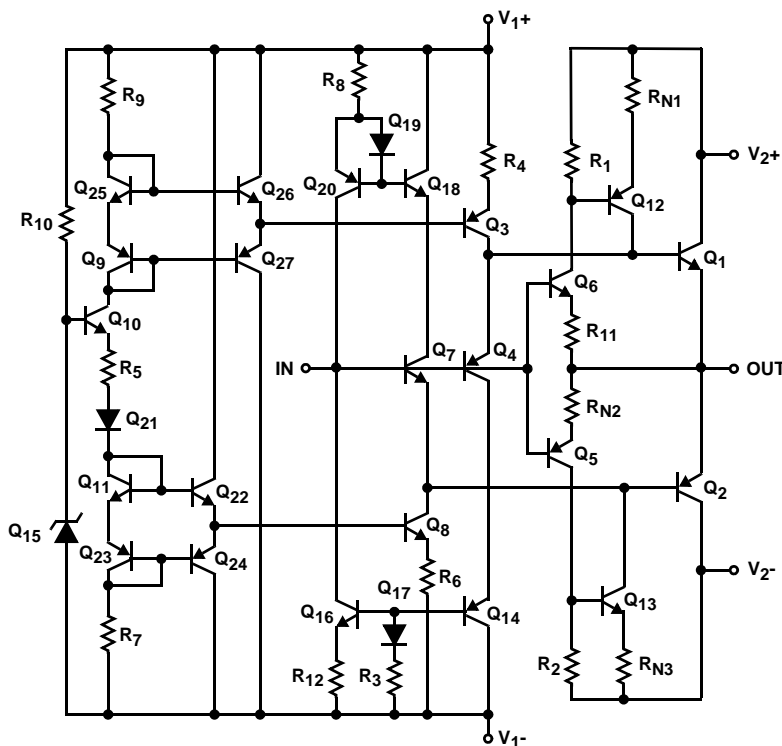
$R_S = 50\Omega$ ,  $R_L = 100\Omega$

SMALL SIGNAL WAVEFORMS



$R_S = 50\Omega$ ,  $R_L = 1\text{k}\Omega$

SMALL SIGNAL WAVEFORMS

**Test Circuit and Waveforms (Continued)** $R_S = 50\Omega, R_L = 100\Omega$ **LARGE SIGNAL WAVEFORMS** $R_S = 50\Omega, R_L = 1k\Omega$ **LARGE SIGNAL WAVEFORMS****Schematic Diagram****Application Information****Layout Considerations**

The wide bandwidth of the HA-5002 necessitates that high frequency circuit layout procedures be followed. Failure to follow these guidelines can result in marginal performance.

Probably the most crucial of the RF/video layout rules is the use of a ground plane. A ground plane provides isolation and minimizes distributed circuit capacitance and inductance which will degrade high frequency performance.

Other considerations are proper power supply bypassing and keeping the input and output connections as short as possible which minimizes distributed capacitance and reduces board space.

**Power Supply Decoupling**

For optimal device performance, it is recommended that the positive and negative power supplies be bypassed with capacitors to ground. Ceramic capacitors ranging in value from 0.01 to 0.1  $\mu\text{F}$  will minimize high frequency variations in supply voltage, while low frequency bypassing requires

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larger valued capacitors since the impedance of the capacitor is dependent on frequency.

It is also recommended that the bypass capacitors be connected close to the HA-5002 (preferably directly to the supply pins).

### Operation at Reduced Supply Levels

The HA-5002 can operate at supply voltage levels as low as  $\pm 5V$  and lower. Output swing is directly affected as well as slight reductions in slew rate and bandwidth.

### Short Circuit Protection

The output current can be limited by using the following circuit:

$$R_{LIM} = \frac{V_+}{I_{OUTMAX}} = \frac{V_-}{I_{OUTMAX}}$$

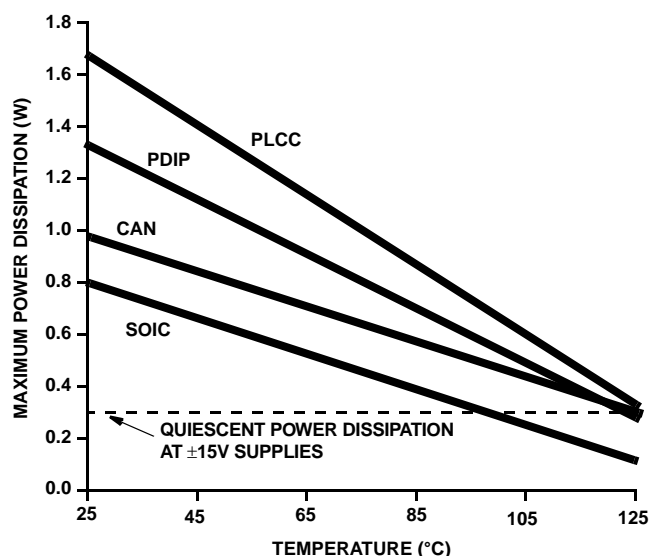
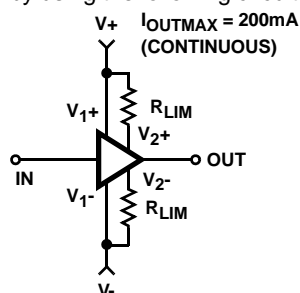


FIGURE 2. MAXIMUM POWER DISSIPATION vs TEMPERATURE

### Capacitive Loading

The HA-5002 will drive large capacitive loads without oscillation but peak current limits should not be exceeded. Following the formula  $I = Cdv/dt$  implies that the slew rate or the capacitive load must be controlled to keep peak current below the maximum or use the current limiting approach as shown. The HA-5002 can become unstable with small capacitive loads (50pF) if certain precautions are not taken. Stability is enhanced by any one of the following: a source resistance in series with the input of  $50\Omega$  to  $1k\Omega$ ; increasing capacitive load to 150pF or greater; decreasing  $C_{LOAD}$  to 20pF or less; adding an output resistor of  $10\Omega$  to  $50\Omega$ ; or adding feedback capacitance of 50pF or greater. Adding source resistance generally yields the best results.

$$P_{DMAX} = \frac{T_{JMAX} - T_A}{\theta_{JC} + \theta_{CS} + \theta_{SA}}$$

Where:  $T_{JMAX}$  = Maximum Junction Temperature of the Device

$T_A$  = Ambient

$\theta_{JC}$  = Junction to Case Thermal Resistance

$\theta_{CS}$  = Case to Heat Sink Thermal Resistance

$\theta_{SA}$  = Heat Sink to Ambient Thermal Resistance

Graph is based on: 
$$P_{DMAX} = \frac{T_{JMAX} - T_A}{\theta_{JA}}$$

## Typical Application

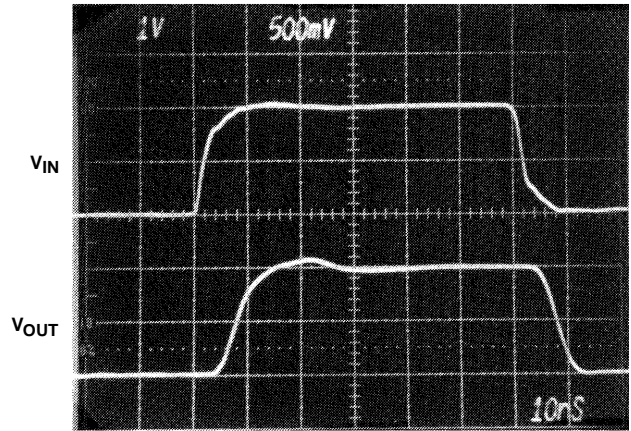
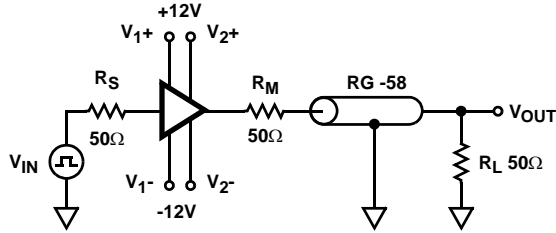
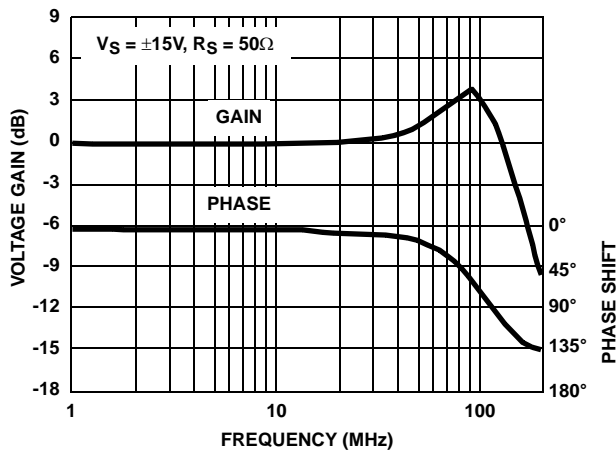
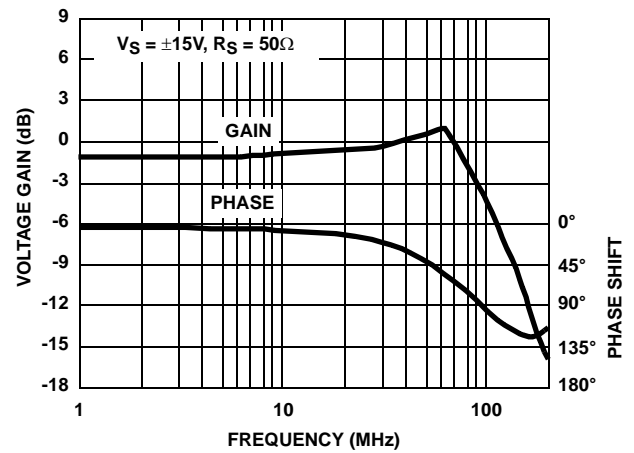
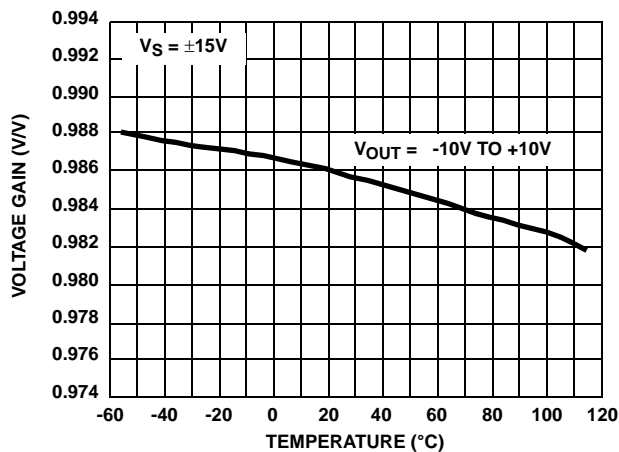
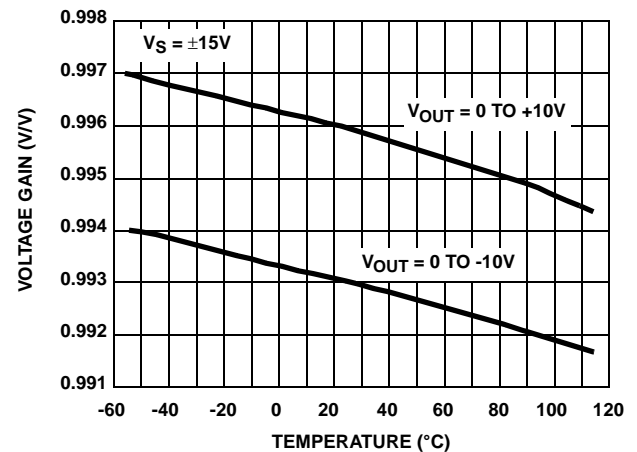


FIGURE 3. COAXIAL CABLE DRIVER - 50Ω SYSTEM

## Typical Performance Curves

FIGURE 4. GAIN/PHASE vs FREQUENCY ( $R_L = 1k\Omega$ )FIGURE 5. GAIN/PHASE vs FREQUENCY ( $R_L = 50\Omega$ )FIGURE 6. VOLTAGE GAIN vs TEMPERATURE ( $R_L = 100\Omega$ )FIGURE 7. VOLTAGE GAIN vs TEMPERATURE ( $R_L = 1k\Omega$ )



## Typical Performance Curves (Continued)

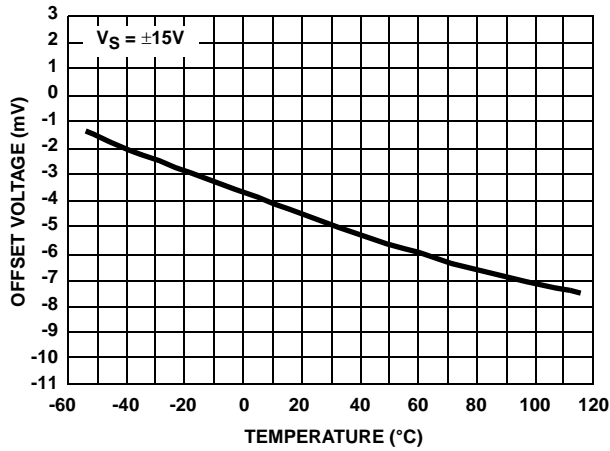


FIGURE 8. OFFSET VOLTAGE vs TEMPERATURE

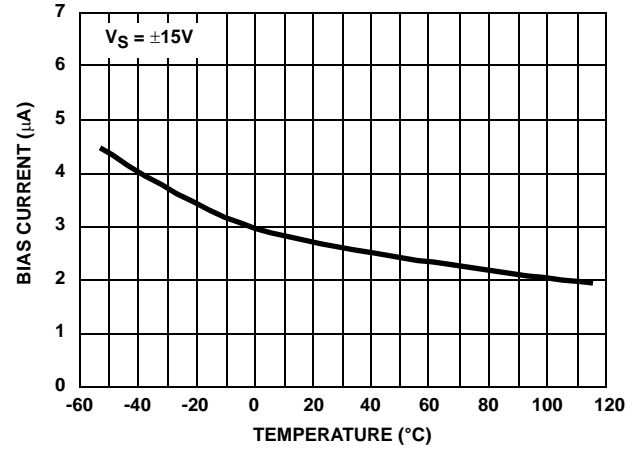


FIGURE 9. BIAS CURRENT vs TEMPERATURE

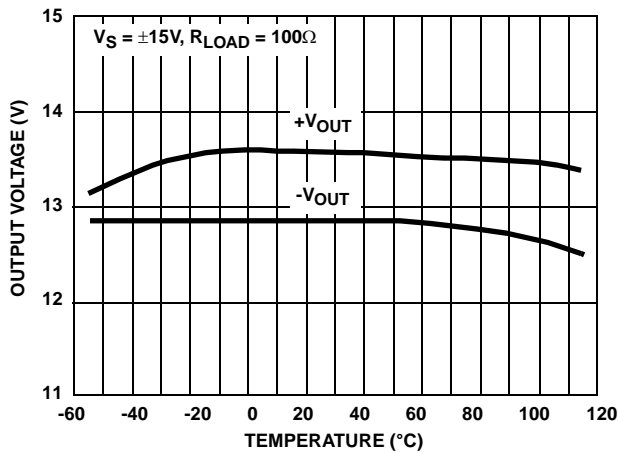


FIGURE 10. MAXIMUM OUTPUT VOLTAGE vs TEMPERATURE

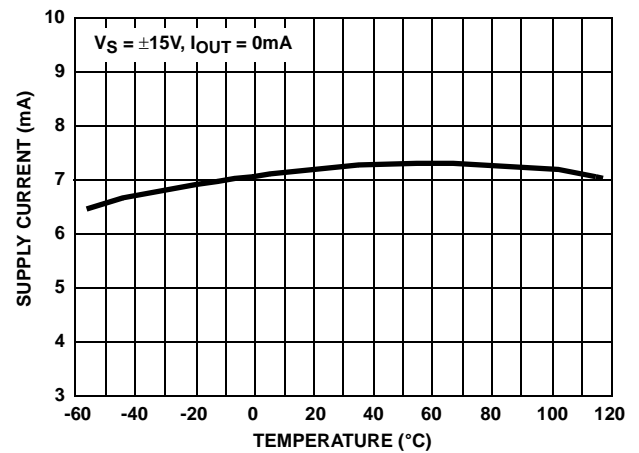


FIGURE 11. SUPPLY CURRENT vs TEMPERATURE

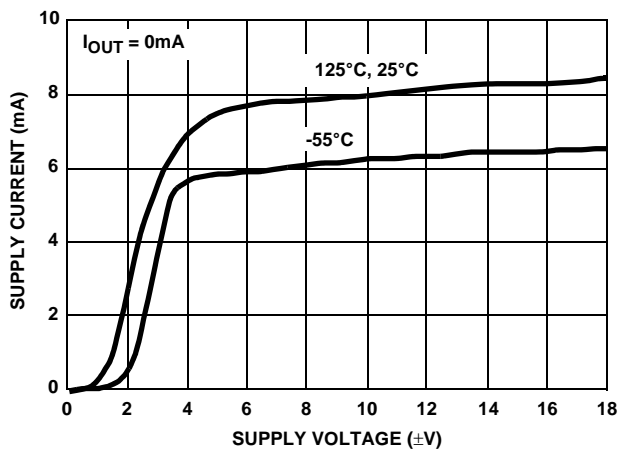


FIGURE 12. SUPPLY CURRENT vs SUPPLY VOLTAGE

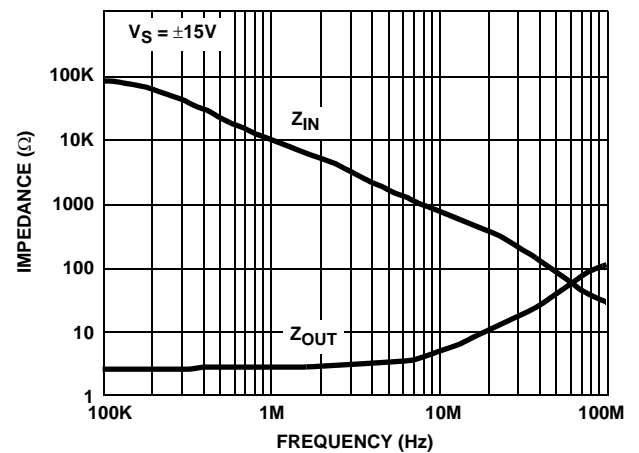


FIGURE 13. INPUT/OUTPUT IMPEDANCE vs FREQUENCY



### Typical Performance Curves (Continued)

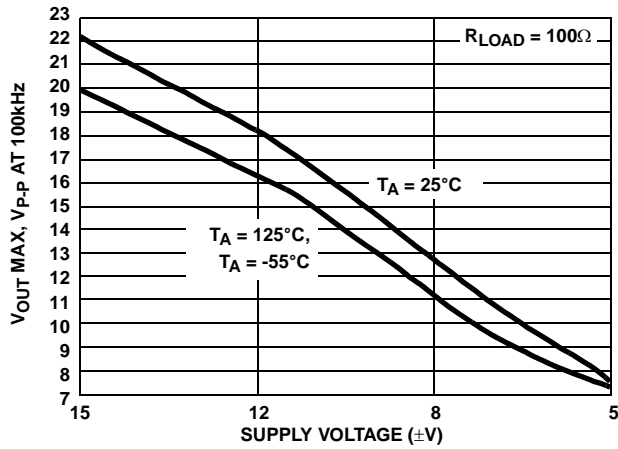
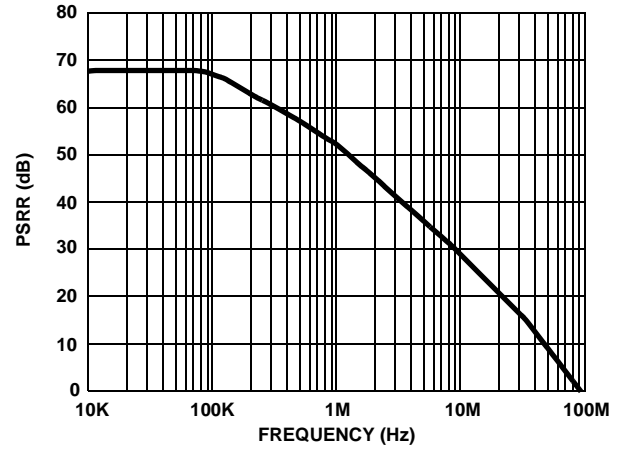
FIGURE 14.  $V_{OUT}$  MAXIMUM vs  $V_{SUPPLY}$ 

FIGURE 15. PSRR vs FREQUENCY

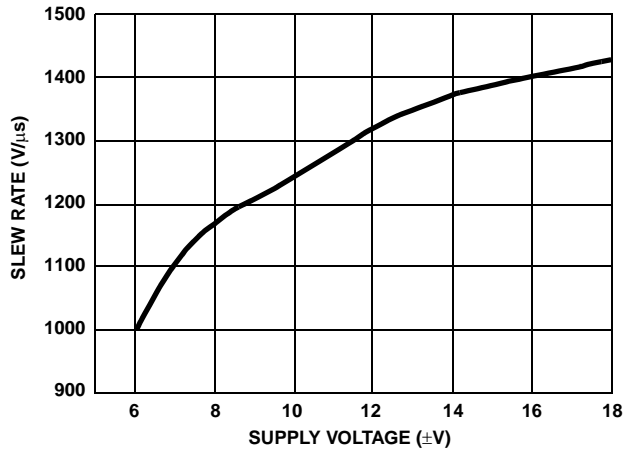


FIGURE 16. SLEW RATE vs SUPPLY VOLTAGE

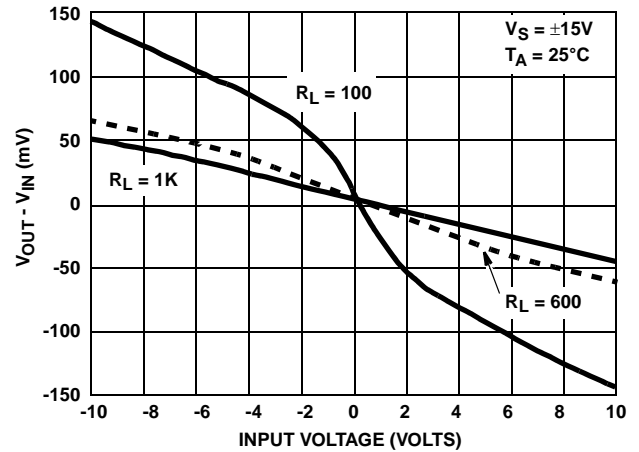


FIGURE 17. GAIN ERROR vs INPUT VOLTAGE

### Die Characteristics

SUBSTRATE POTENTIAL (POWERED UP):

$V_{1-}$

TRANSISTOR COUNT:

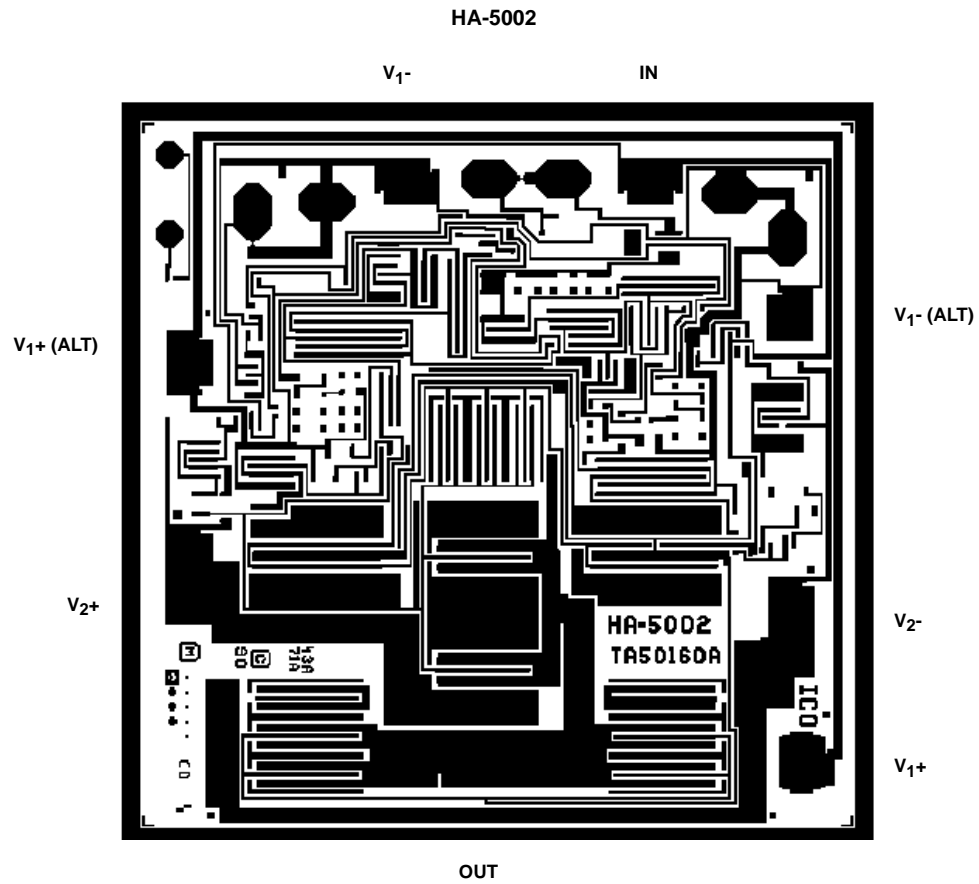
27

PROCESS:

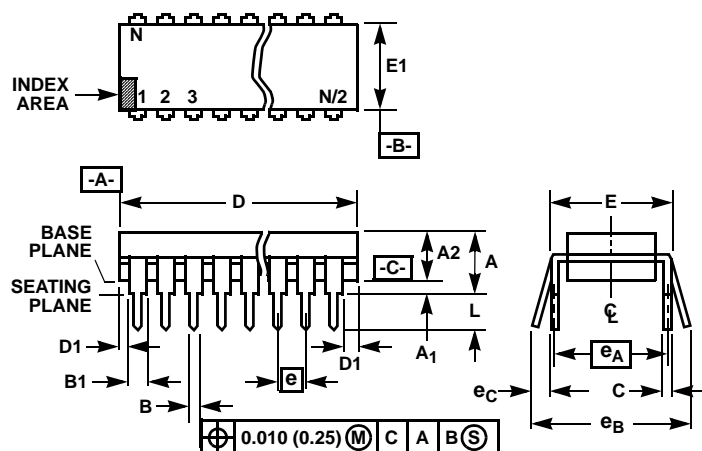
Bipolar Dielectric Isolation

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### Metallization Mask Layout



## Dual-In-Line Plastic Packages (PDIP)



## NOTES:

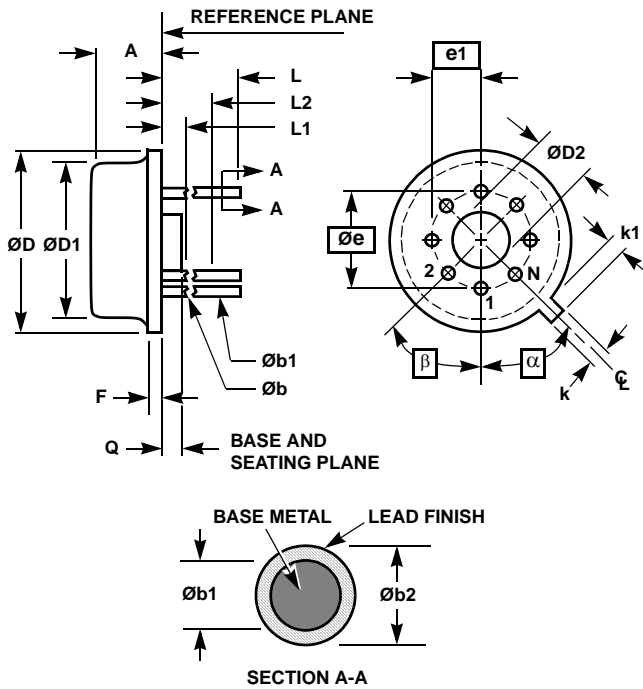
- Controlling Dimensions: INCH. In case of conflict between English and Metric dimensions, the inch dimensions control.
- Dimensioning and tolerancing per ANSI Y14.5M-1982.
- Symbols are defined in the "MO Series Symbol List" in Section 2.2 of Publication No. 95.
- Dimensions A, A1 and L are measured with the package seated in JEDEC seating plane gauge GS-3.
- D, D1, and E1 dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 inch (0.25mm).
- E and  $e_A$  are measured with the leads constrained to be perpendicular to datum  $-C-$ .
- $e_B$  and  $e_C$  are measured at the lead tips with the leads unconstrained.  $e_C$  must be zero or greater.
- B1 maximum dimensions do not include dambar protrusions. Dambar protrusions shall not exceed 0.010 inch (0.25mm).
- N is the maximum number of terminal positions.
- Corner leads (1, N, N/2 and N/2 + 1) for E8.3, E16.3, E18.3, E28.3, E42.6 will have a B1 dimension of 0.030 - 0.045 inch (0.76 - 1.14mm).

**E8.3 (JEDEC MS-001-BA ISSUE D)**  
**8 LEAD DUAL-IN-LINE PLASTIC PACKAGE**

| SYMBOL | INCHES    |       | MILLIMETERS |       | NOTES |
|--------|-----------|-------|-------------|-------|-------|
|        | MIN       | MAX   | MIN         | MAX   |       |
| A      | -         | 0.210 | -           | 5.33  | 4     |
| A1     | 0.015     | -     | 0.39        | -     | 4     |
| A2     | 0.115     | 0.195 | 2.93        | 4.95  | -     |
| B      | 0.014     | 0.022 | 0.356       | 0.558 | -     |
| B1     | 0.045     | 0.070 | 1.15        | 1.77  | 8, 10 |
| C      | 0.008     | 0.014 | 0.204       | 0.355 | -     |
| D      | 0.355     | 0.400 | 9.01        | 10.16 | 5     |
| D1     | 0.005     | -     | 0.13        | -     | 5     |
| E      | 0.300     | 0.325 | 7.62        | 8.25  | 6     |
| E1     | 0.240     | 0.280 | 6.10        | 7.11  | 5     |
| e      | 0.100 BSC |       | 2.54 BSC    |       | -     |
| $e_A$  | 0.300 BSC |       | 7.62 BSC    |       | 6     |
| $e_B$  | -         | 0.430 | -           | 10.92 | 7     |
| L      | 0.115     | 0.150 | 2.93        | 3.81  | 4     |
| N      | 8         |       | 8           |       | 9     |

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## Metal Can Packages (Can)



### NOTES:

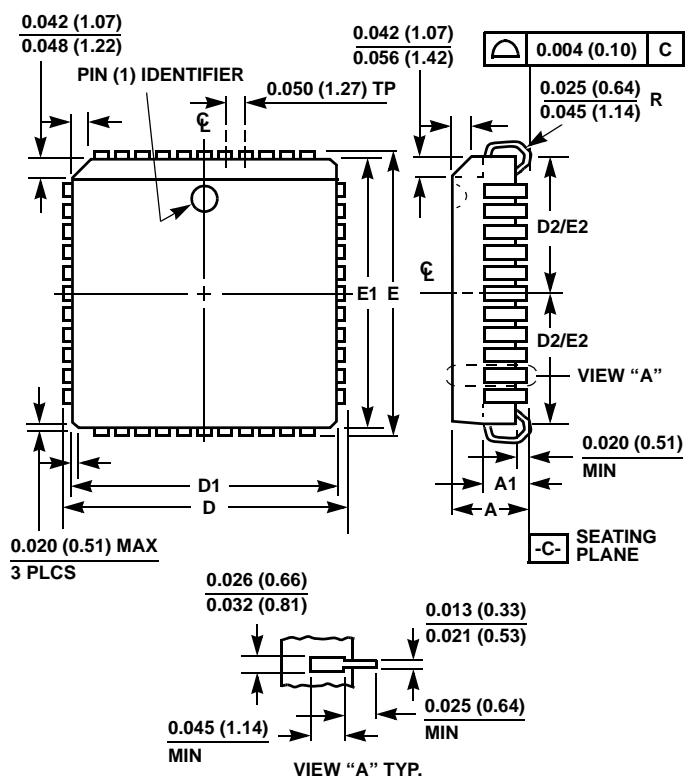
1. (All leads)  $\varnothing b$  applies between L1 and L2.  $\varnothing b1$  applies between L2 and 0.500 from the reference plane. Diameter is uncontrolled in L1 and beyond 0.500 from the reference plane.
2. Measured from maximum diameter of the product.
3.  $\alpha$  is the basic spacing from the centerline of the tab to terminal 1 and  $\beta$  is the basic spacing of each lead or lead position (N - 1 places) from  $\alpha$ , looking at the bottom of the package.
4. N is the maximum number of terminal positions.
5. Dimensioning and tolerancing per ANSI Y14.5M - 1982.
6. Controlling dimension: INCH.

### T8.C MIL-STD-1835 MACY1-X8 (A1) 8 LEAD METAL CAN PACKAGE

| SYMBOL           | INCHES    |       | MILLIMETERS |       | NOTES |
|------------------|-----------|-------|-------------|-------|-------|
|                  | MIN       | MAX   | MIN         | MAX   |       |
| A                | 0.165     | 0.185 | 4.19        | 4.70  | -     |
| $\varnothing b$  | 0.016     | 0.019 | 0.41        | 0.48  | 1     |
| $\varnothing b1$ | 0.016     | 0.021 | 0.41        | 0.53  | 1     |
| $\varnothing b2$ | 0.016     | 0.024 | 0.41        | 0.61  | -     |
| $\varnothing D$  | 0.335     | 0.375 | 8.51        | 9.40  | -     |
| $\varnothing D1$ | 0.305     | 0.335 | 7.75        | 8.51  | -     |
| $\varnothing D2$ | 0.110     | 0.160 | 2.79        | 4.06  | -     |
| e                | 0.200 BSC |       | 5.08 BSC    |       | -     |
| e1               | 0.100 BSC |       | 2.54 BSC    |       | -     |
| F                | -         | 0.040 | -           | 1.02  | -     |
| k                | 0.027     | 0.034 | 0.69        | 0.86  | -     |
| k1               | 0.027     | 0.045 | 0.69        | 1.14  | 2     |
| L                | 0.500     | 0.750 | 12.70       | 19.05 | 1     |
| L1               | -         | 0.050 | -           | 1.27  | 1     |
| L2               | 0.250     | -     | 6.35        | -     | 1     |
| Q                | 0.010     | 0.045 | 0.25        | 1.14  | -     |
| $\alpha$         | 45° BSC   |       | 45° BSC     |       | 3     |
| $\beta$          | 45° BSC   |       | 45° BSC     |       | 3     |
| N                | 8         |       | 8           |       | 4     |

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## Plastic Leaded Chip Carrier Packages (PLCC)



### N20.35 (JEDEC MS-018AA ISSUE A) 20 LEAD PLASTIC LEADED CHIP CARRIER PACKAGE

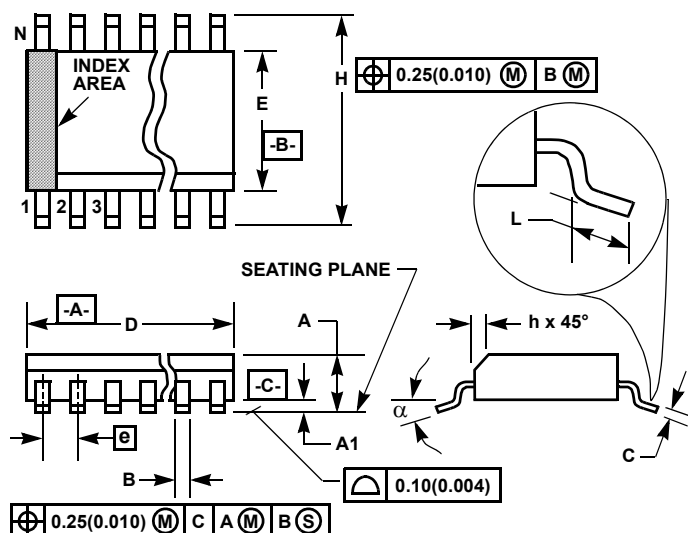
| SYMBOL | INCHES |       | MILLIMETERS |       | NOTES |
|--------|--------|-------|-------------|-------|-------|
|        | MIN    | MAX   | MIN         | MAX   |       |
| A      | 0.165  | 0.180 | 4.20        | 4.57  | -     |
| A1     | 0.090  | 0.120 | 2.29        | 3.04  | -     |
| D      | 0.385  | 0.395 | 9.78        | 10.03 | -     |
| D1     | 0.350  | 0.356 | 8.89        | 9.04  | 3     |
| D2     | 0.141  | 0.169 | 3.59        | 4.29  | 4, 5  |
| E      | 0.385  | 0.395 | 9.78        | 10.03 | -     |
| E1     | 0.350  | 0.356 | 8.89        | 9.04  | 3     |
| E2     | 0.141  | 0.169 | 3.59        | 4.29  | 4, 5  |
| N      | 20     |       | 20          |       | 6     |

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#### NOTES:

1. Controlling dimension: INCH. Converted millimeter dimensions are not necessarily exact.
2. Dimensions and tolerancing per ANSI Y14.5M-1982.
3. Dimensions D1 and E1 do not include mold protrusions. Allowable mold protrusion is 0.010 inch (0.25mm) per side. Dimensions D1 and E1 include mold mismatch and are measured at the extreme material condition at the body parting line.
4. To be measured at seating plane -C- contact point.
5. Centerline to be determined where center leads exit plastic body.
6. "N" is the number of terminal positions.

## Small Outline Plastic Packages (SOIC)



### NOTES:

1. Symbols are defined in the "MO Series Symbol List" in Section 2.2 of Publication Number 95.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion and gate burrs shall not exceed 0.15mm (0.006 inch) per side.
4. Dimension "E" does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
5. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
6. "L" is the length of terminal for soldering to a substrate.
7. "N" is the number of terminal positions.
8. Terminal numbers are shown for reference only.
9. The lead width "B", as measured 0.36mm (0.014 inch) or greater above the seating plane, shall not exceed a maximum value of 0.61mm (0.024 inch).
10. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.

### M8.15 (JEDEC MS-012-AA ISSUE C)

#### 8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

| SYMBOL   | INCHES    |        | MILLIMETERS |      | NOTES |
|----------|-----------|--------|-------------|------|-------|
|          | MIN       | MAX    | MIN         | MAX  |       |
| A        | 0.0532    | 0.0688 | 1.35        | 1.75 | -     |
| A1       | 0.0040    | 0.0098 | 0.10        | 0.25 | -     |
| B        | 0.013     | 0.020  | 0.33        | 0.51 | 9     |
| C        | 0.0075    | 0.0098 | 0.19        | 0.25 | -     |
| D        | 0.1890    | 0.1968 | 4.80        | 5.00 | 3     |
| E        | 0.1497    | 0.1574 | 3.80        | 4.00 | 4     |
| e        | 0.050 BSC |        | 1.27 BSC    |      | -     |
| H        | 0.2284    | 0.2440 | 5.80        | 6.20 | -     |
| h        | 0.0099    | 0.0196 | 0.25        | 0.50 | 5     |
| L        | 0.016     | 0.050  | 0.40        | 1.27 | 6     |
| N        | 8         |        | 8           |      | 7     |
| $\alpha$ | 0°        | 8°     | 0°          | 8°   | -     |

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