# LMV821, LMV822, LMV824

# Single, Dual, Quad Low Voltage, Rail-to-Rail Operational Amplifiers

The LMV821, LMV822, and LMV824 are operational amplifiers with low input voltage offset and drift vs. temperature. In spite of low quiescent current requirements these devices have 5 MHz bandwidth and 1.4 V/μs slew rate. In addition they provide rail−to−rail output swing into 600 Ω loads. The input common−mode voltage range includes ground, and the maximum input offset voltage is only 3.5 mV. Substantially large capacitive loads can be driven by simply adding a pullup resistor or isolation resistor.

The LMV821 (single) is available in a space−saving SC70−5 while the dual and quad also come in ultra small SOIC and TSSOP packages.

### Features

- Low Offset Voltage: 3.5 mV
- Very low Offset Drift: 1.0 μV/°C
- High Bandwidth: 5 MHz
- Rail−to−Rail Output Swing into a 600 Ω load
- Capable of driving highly capacitive loads
- These Devices are Pb−Free and are RoHS Compliant

### Typical Applications

- Notebook Computers
- PDAs
- Modem Transmitter/ Receivers

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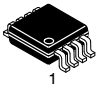
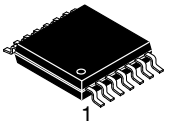
**SC−70**
**CASE 419A**




**Micro8™**
**CASE 846A**

**SOIC−8**
**CASE 751**

**SOIC−14**
**CASE 751A**




**TSSOP−14**
**CASE 948G**

### ORDERING AND MARKING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 11 of this data sheet.

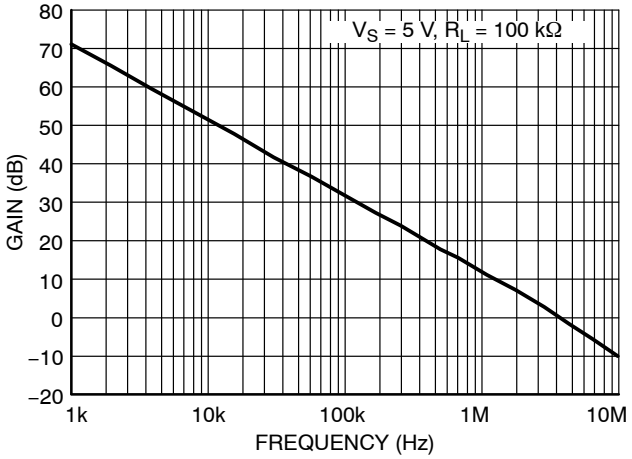



**Figure 1. Gain vs. Frequency**

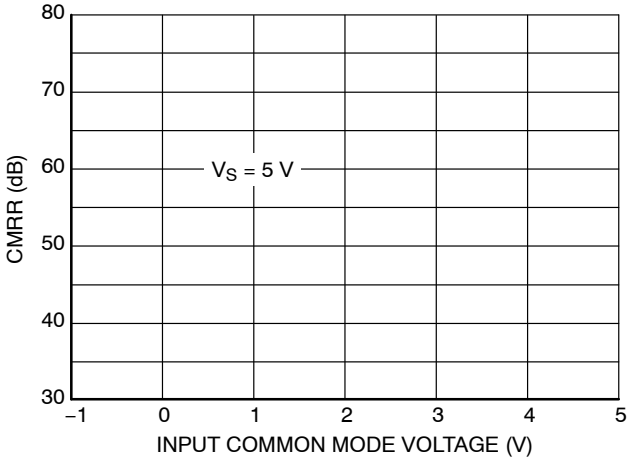



**Figure 2. CMRR vs. Input Common Mode Voltage**

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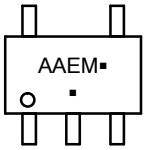
## MARKING DIAGRAMS

### SC−70

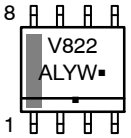



AAE = Specific Device Code
M = Date Code
▪ = Pb−Free Package
(Note: Microdot may be in either location)

### Micro8

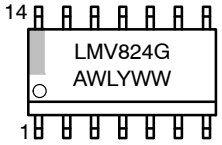
V822 = Specific Device Code
A = Assembly Location
Y = Year
W = Work Week
▪ = Pb−Free Package
(Note: Microdot may be in either location)

### SOIC−8



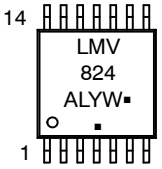

V822 = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package
(Note: Microdot may be in either location)

### SOIC−14




LMV824 = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week
G = Pb−Free Package

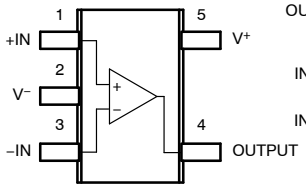
### TSSOP−14




LMV824 = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package
(Note: Microdot may be in either location)

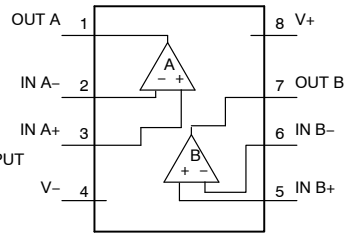
## PIN CONNECTIONS

### SC70−5



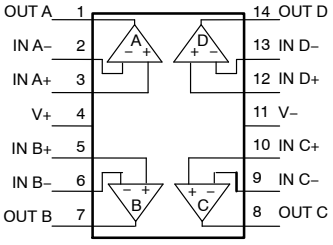

(Top View)

### Micro8/SOIC−8



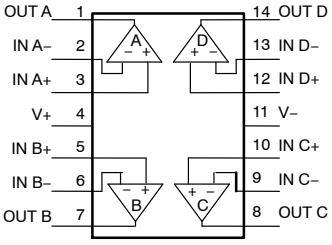

(Top View)

### SOIC−14




(Top View)

### TSSOP−14




(Top View)

**MAXIMUM RATINGS**

| Symbol | Rating | Value | Unit |
|---|---|---|---|
| $V_S$ | Supply Voltage (Operating Range $V_S$ = 2.7 V to 5.5 V) | 5.5 | V |
| $V_{IDR}$ | Input Differential Voltage | ± Supply Voltage | V |
| $V_{ICR}$ | Input Common Mode Voltage Range | −0.5 to (V+) +0.5 | V |
| | Maximum Input Current | 10 | mA |
| $t_{SO}$ | Output Short Circuit (Note 1) | Continuous | |
| $T_J$ | Maximum Junction Temperature (Operating Range −40°C to 85°C) | 150 | °C |
| $\theta_{JA}$ | Thermal Resistance | | °C/W |
| | SC−70 | 280 | |
| | Micro8 | 238 | |
| | SOIC−8 | 212 | |
| | SOIC−14 | 156 | |
| | TSSOP−14 | 190 | |
| $T_{STG}$ | Storage Temperature | −65 to 150 | °C |
| | Mounting Temperature (Infrared or Convection − 20 sec) | 235 | °C |
| $V_{ESD}$ | ESD Tolerance Machine Model<br>Human Body Model | 200<br>2000 | V |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Continuous short−circuit operation to ground at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C. Output currents in excess of 45 mA over long term may adversely affect reliability. Shorting output to either V+ or V− will adversely affect reliability.

**2.7V DC ELECTRICAL CHARACTERISTICS** Unless otherwise noted, all min/max limits are guaranteed for $T_A$ = 25°C, V+ = 2.7 V, V− = 0 V, $V_{CM}$ = V+/2, $V_O$ = V+/2 and $R_L$ > 1 MΩ. Typical specifications represent the most likely parametric norm. Min/Max specifications are guaranteed by testing, characterization, or statistical analysis.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | | | 1 | 3.5 | mV |
| | | $T_A$ = −40°C to +85°C | | | 4 | |
| Input Offset Voltage Average Drift | $TCV_{OS}$ | | | 1 | | μV/°C |
| Input Bias Current | $I_B$ | | | 105 | 210 | nA |
| | | $T_A$ = −40°C to +85°C | | | 315 | |
| Input Offset Current | $I_{IO}$ | | | 0.5 | 30 | nA |
| | | $T_A$ = −40°C to +85°C | | | 50 | |
| Common−Mode Rejection Ratio | CMRR | 0 V ≤ $V_{CM}$ ≤ 1.7 V | 70 | 85 | | dB |
| | | $T_A$ = −40°C to +85°C | 68 | | | |
| Power Supply Rejection Ratio | PSRR | 1.5 V ≤ V+ ≤ 4 V, V − = −1 V, $V_O$ = 0 V, $V_{CM}$ = 0.0 V | 75 | 85 | | dB |
| | | $T_A$ = −40°C to +85°C | 70 | | | |
| Input Common−Mode Voltage Range | $V_{CM}$ | For CMRR ≥ 53 dB and $T_A$ = −40°C to +85°C | −0.2 | −0.3 to 2.0 | 1.9 | V |
| Large Signal Voltage Gain | AV | $R_L$ = 600 Ω, $V_O$ = 0.5 V to 2.5 V | 80 | 95 | | dB |
| | | $T_A$ = −40°C to +85°C | 70 | | | |
| | | $R_L$ = 2 kΩ, $V_O$ = 0.5 V to 2.5 V | 83 | 89 | | |
| | | $T_A$ = −40°C to +85°C | 80 | | | |
| Output Swing | $V_{OH}$ | $R_L$ = 600 Ω to 1.35 V | 2.5 | 2.58 | | V |
| | | $T_A$ = −40°C to +85°C | 2.4 | | | |
| | $V_{OL}$ | $R_L$ = 600 Ω to 1.35 V | | 0.13 | 0.21 | |
| | | $T_A$ = −40°C to +85°C | | | 0.3 | |
| | $V_{OH}$ | $R_L$ = 2 kΩ to 1.35 V | 2.6 | 2.66 | | |
| | | $T_A$ = −40°C to +85°C | 2.5 | | | |
| | $V_{OL}$ | $R_L$ = 2 kΩ to 1.35 V | | 0.08 | 0.12 | |
| | | $T_A$ = −40°C to +85°C | | | 0.2 | |
| Output Current | $I_O$ | Sourcing, $V_O$ = 0 V | 12 | | | mA |
| | | Sinking, $V_O$ = 2.7 V | 12 | 26 | | |
| Supply Current | $I_{CC}$ | LMV821 (Single) | | 0.242 | 0.3 | mA |
| | | $T_A$ = −40°C to +85°C | | | 0.5 | |
| | | LMV822 (Both Applications) | | 0.5 | 0.7 | |
| | | $T_A$ = −40°C to +85°C | | | 0.9 | |
| | | LMV824 (All Four Applications) | | 1 | 1.3 | |
| | | $T_A$ = −40°C to +85°C | | | 1.5 | |

**2.5V DC ELECTRICAL CHARACTERISTICS** Unless otherwise noted, all min/max limits are guaranteed for $T_A$ = 25°C, V+ = 2.5 V, V− = 0 V, $V_{CM}$ = V+/2, $V_O$ = V+/2 and $R_L$ > 1 MΩ. Typical specifications represent the most likely parametric norm. Min/Max specifications are guaranteed by testing, characterization, or statistical analysis.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | $T_A$ = −40°C to +85°C | | 1 | 3.5 | mV |
| | | | | | 4 | |
| Output Swing | $V_{OH}$ | $R_L$ = 600 Ω to 1.25 V | 2.3 | 2.37 | | V |
| | | $T_A$ = −40°C to +85°C | 2.2 | | | |
| | $V_{OL}$ | $R_L$ = 600 Ω to 1.25 V | | 0.13 | 0.20 | |
| | | $T_A$ = −40°C to +85°C | | | 0.3 | |
| | $V_{OH}$ | $R_L$ = 2 kΩ to 1.25 V | 2.4 | 2.46 | | |
| | | $T_A$ = −40°C to +85°C | 2.3 | | | |
| | $V_{OL}$ | $R_L$ = 2 kΩ to 1.25 V | | 0.08 | 0.12 | |
| | | $T_A$ = −40°C to +85°C | | | 0.20 | |

**2.7V AC ELECTRICAL CHARACTERISTICS** Unless otherwise specified, all limits are guaranteed for $T_A$ = 25°C, V+ = 2.7 V, V− = 0 V, $V_{CM}$ = 1.0 V, $V_O$ = V+/2 and RL > 1 MΩ. Typical specifications represent the most likely parametric norm. Min/Max specifications are guaranteed by testing, characterization, or statistical analysis.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Slew Rate | SR | (Note 2) | | 1.5 | | V/uS |
| Gain Bandwidth Product | GBWP | | | 5 | | MHz |
| Phase Margin | $\theta_m$ | | | 55 | | ° |
| Gain Margin | $G_m$ | | | 12.9 | | dB |
| Input−Referred Voltage Noise | $e_n$ | f = 1 kHz, $V_{CM}$ = 1 V | | 12 | | nV/$\sqrt{Hz}$ |
| Input−Referred Current Noise | $i_n$ | f = 1kHz | | 0.2 | | pA/$\sqrt{Hz}$ |
| Total Harmonic Distortion | THD | f = 1 kHz, AV = −2, $R_L$ = 10 kΩ , $V_O$ = 1.8 $V_{PP}$ | | 0.023 | | % |
| Amplifier−to−Amplifier Isolation | | (Note 3) | | 135 | | dB |

2. Connected as voltage follower with input step from 0.5 V to 1.5 V. Number specified is the average of the positive and negative slew rates.
3. Input referred, $R_L$ = 100 kΩ connected to V+/2. Each amp excited in turn with 1kHz to produce $V_O$ = 3 $V_{PP}$. For Supply Voltages < 3 V, $V_O$ = V+.

**5V DC ELECTRICAL CHARACTERISTICS** Unless otherwise noted, all min/max limits are guaranteed for $T_A$ = 25°C, V+ = 5 V,V− = 0 V, VCM = V+/2, $V_O$ = V+/2 and $R_L$ > 1 MΩ. Typical specifications represent the most likely parametric norm. Min/Max specifications are guaranteed by testing, characterization, or statistical analysis.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | | | 1 | 3.5 | mV |
| | | $T_A$ = −40°C to +85°C | | | 4 | |
| Input Offset Voltage Average Drift | $TCV_{OS}$ | | | 1 | | μV/°C |
| Input Bias Current | $I_B$ | | | 119 | 245 | nA |
| | | $T_A$ = −40°C to +85°C | | | 380 | |
| Input Offset Current | $I_{IO}$ | | | 0.5 | 30 | nA |
| | | $T_A$ = −40°C to +85°C | | | 50 | |
| Common−Mode Rejection Ratio | CMRR | 0 V ≤ $V_{CM}$ ≤ 4.0 V | 72 | 90 | | dB |
| | | $T_A$ = −40°C to +85°C | 70 | | | |
| Power Supply Rejection Ratio | PSRR | 1.7 V ≤ V+ ≤ 4 V, V − = 1 V, $V_O$ = 0 V, $V_{CM}$ = 0.0 V | 75 | 85 | | dB |
| | | $T_A$ = −40°C to +85°C | 70 | | | |
| Input Common−Mode Voltage Range | $V_{CM}$ | For CMRR ≥ 58 dB and $T_A$ = − 40°C to +85°C | −0.2 | −0.2 to 4.3 | 4.2 | V |
| Large Signal Voltage Gain | $A_V$ | $R_L$ = 600 Ω, $V_O$ = 1.0 V to 4.0 V | 87 | 100 | | dB |
| | | $T_A$ = −40°C to +85°C | 73 | | | |
| | | $R_L$ = 2 kΩ, $V_O$ = 1.0 V to 4.0 V | 84 | 99 | | |
| | | $T_A$ = −40°C to +85°C | 82 | | | |
| Output Swing | $V_{OH}$ | $R_L$ = 600 Ω to 2.5 V | 4.75 | 4.84 | | V |
| | | $T_A$ = −40°C to +85°C | 4.7 | | | |
| | $V_{OL}$ | $R_L$ = 600 Ω to 2.5 V | | 0.17 | 0.33 | |
| | | $T_A$ = −40°C to +85°C | | | 0.4 | |
| | $V_{OH}$ | RL = 2 kΩ to 2.5 V | 4.85 | 4.9 | | |
| | | $T_A$ = −40°C to +85°C | 4.8 | | | |
| | $V_{OL}$ | $R_L$ = 2 kΩ to 2.5 V | | 0.1 | 0.15 | |
| | | $T_A$ = −40°C to +85°C | | | 0.2 | |
| Output Current | $I_O$ | Sourcing, Vo = 0 V | 20 | 45 | | mA |
| | | $T_A$ = −40°C to +85°C | 10 | | | |
| | | Sinking, Vo = 5 V | 20 | 40 | | |
| | | $T_A$ = −40°C to +85°C | 15 | | | |
| Supply Current | $I_{CC}$ | | | 0.3 | 0.4 | mA |
| | | $T_A$ = −40°C to +85°C | | | 0.6 | |
| | | LMV822 (Both Applications) | | 0.5 | 0.7 | |
| | | $T_A$ = −40°C to +85°C | | | 0.9 | |
| | | LMV824 (All Four Applications) | | 1 | 1.3 | |
| | | $T_A$ = −40°C to +85°C | | | 1.5 | |

**5V AC ELECTRICAL CHARACTERISTICS** Unless otherwise specified, all limits are guaranteed for $T_A$ = 25°C, V+ = 5 V, V− = 0 V, $V_{CM}$ = 2.0 V, $V_O$ = V+/2 and $R_L$ > 1 MΩ. Typical specifications represent the most likely parametric norm. Min/Max specifications are guaranteed by testing, characterization, or statistical analysis.

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Slew Rate | SR | (Note 4) | | 2 | | V/μS |
| Gain Bandwidth Product | GBWP | | | 5.6 | | MHz |
| Phase Margin | $\theta_m$ | | | 63 | | ° |
| Gain Margin | $G_m$ | | | 11.7 | | dB |
| Input−Referred Voltage Noise | $e_n$ | f = 1 kHz, $V_{CM}$ = 1 V | | 11 | | nV/$\sqrt{Hz}$ |
| Input−Referred Current Noise | $i_n$ | f = 1 kHz | | 0.21 | | pA/$\sqrt{Hz}$ |
| Total Harmonic Distortion | THD | f = 1 kHz, $A_V$ = −2, $R_L$ = 10 kΩ , $V_O$ = 4.11 VPP | | 0.012 | | % |
| Amplifier−to−Amplifier Isolation | | (Note 5) | | 135 | | dB |

4. Connected as voltage follower with input step from 0.5 V to 3.5 V. Number specified is the average of the positive and negative slew rates.
5. Input referred, $R_L$ = 100 kΩ connected to V+/2. Each amp excited in turn with 1 kHz to produce $V_O$ = 3 $V_{PP}$. (For Supply Voltages < 3 V, $V_O$ = V+).

## TYPICAL PERFORMANCE CHARACTERISTICS

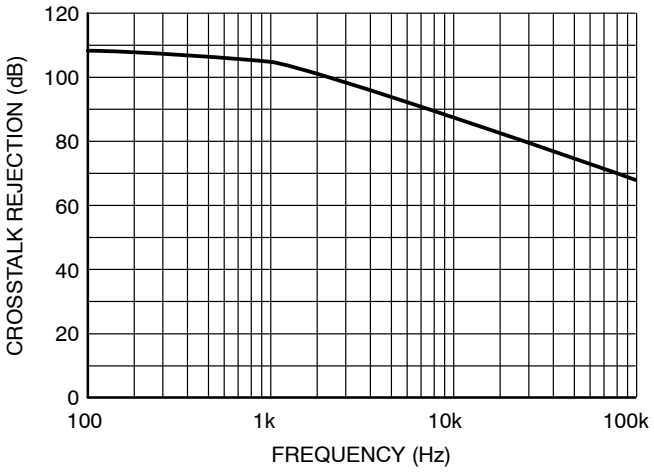



**Figure 3. Crosstalk Rejection vs. Frequency**

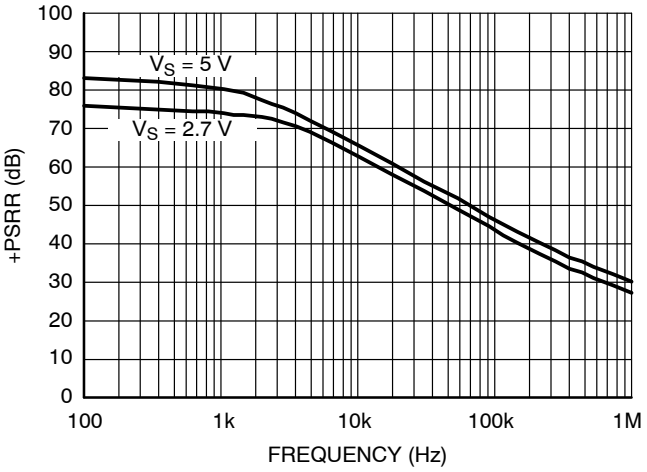



**Figure 4. +PSRR vs. Frequency**

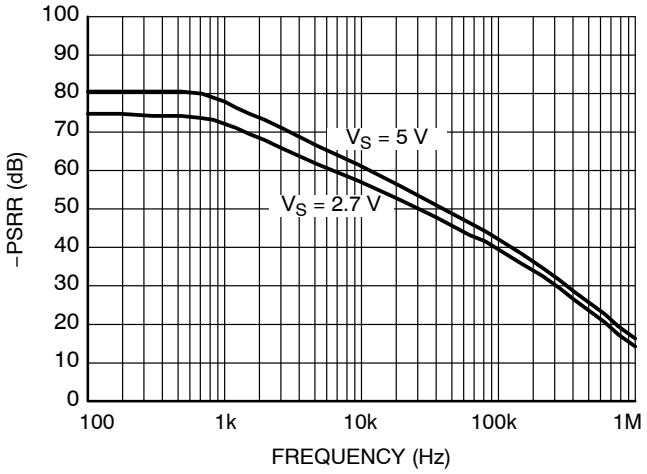



**Figure 5. −PSRR vs. Frequency**

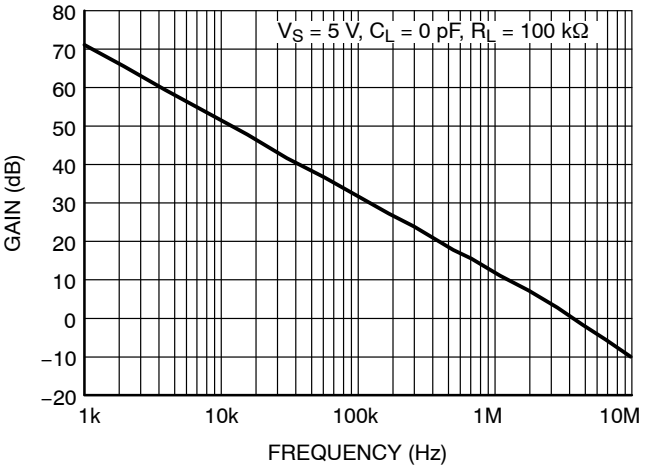



**Figure 6. Gain vs. Frequency**

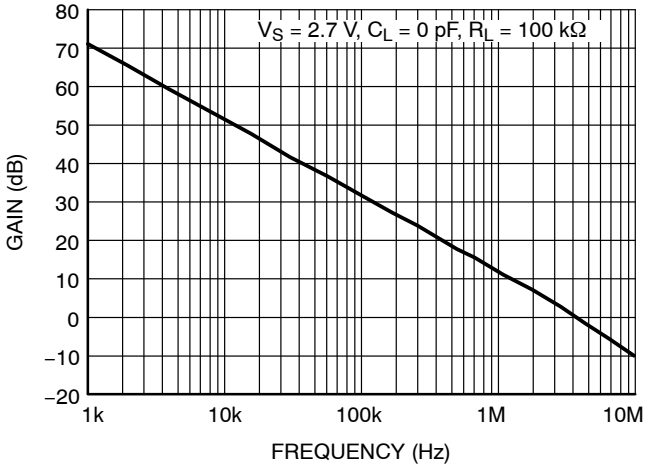



**Figure 7. Gain vs. Frequency**

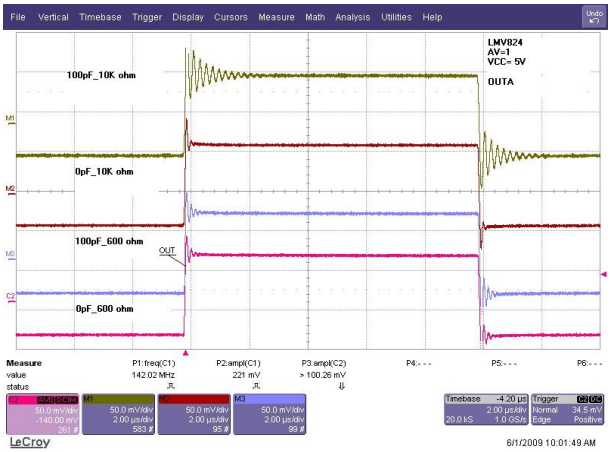



**Figure 8. Non−Inverting Stability vs. Capacitive Load**

## TYPICAL PERFORMANCE CHARACTERISTICS

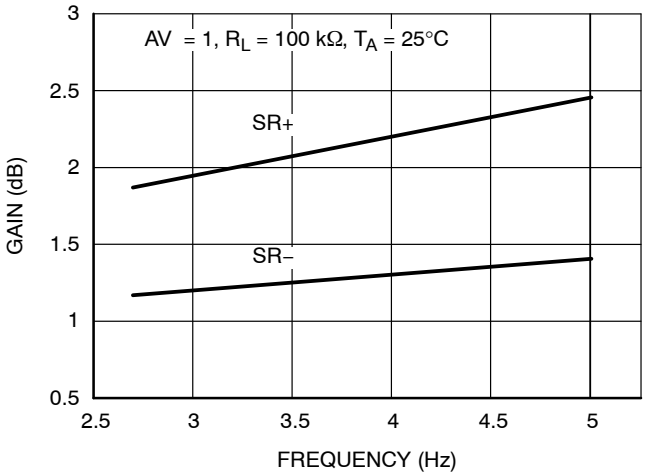



**Figure 9. Gain vs. Frequency**

**Figure 10. Non−Inverting Large Signal Step Response**

**Figure 11. Non−Inverting Small Signal Step Response**

**Figure 12. Inverting Large Signal Step Response**

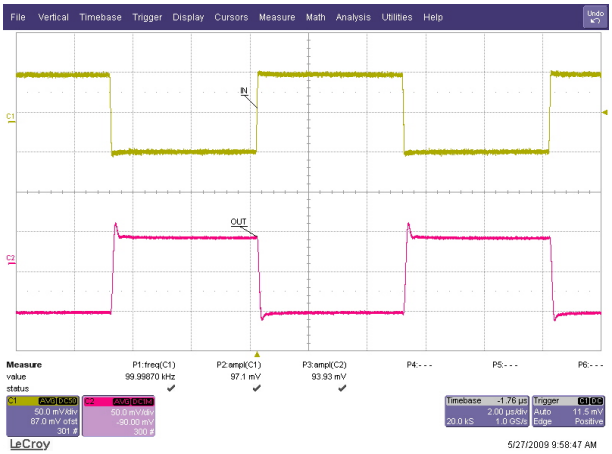



**Figure 13. Inverting Small Signal Step Response**

## APPLICATIONS INFORMATION

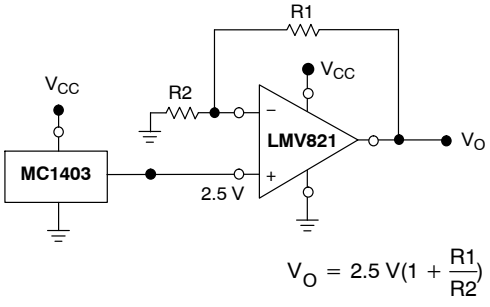



**Figure 14. Voltage Reference**

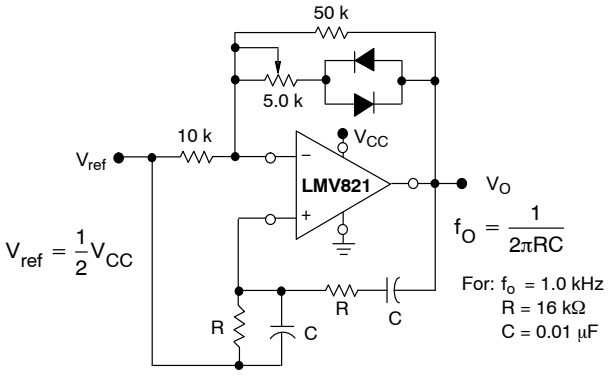
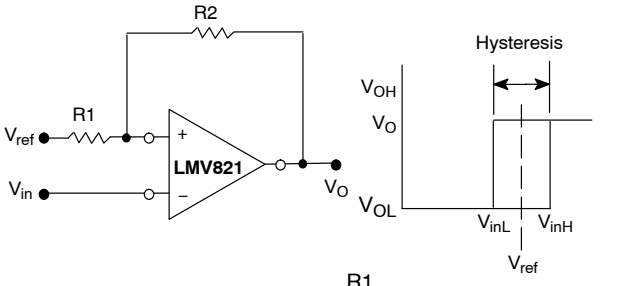



**Figure 15. Wien Bridge Oscillator**

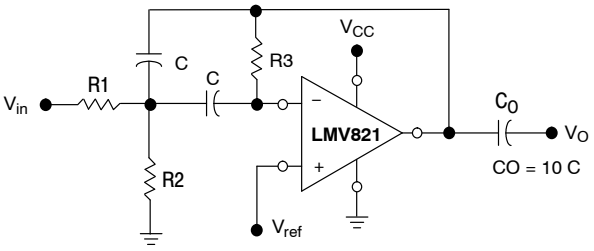



$$V_{in}L = \frac{R1}{R1 + R2} (V_{OL} - V_{ref}) + V_{ref}$$

$$V_{in}H = \frac{R1}{R1 + R2} (V_{OH} - V_{ref}) + V_{ref}$$

$$H = \frac{R1}{R1 + R2} (V_{OH} - V_{OL})$$

**Figure 16. Comparator with Hysteresis**




Given: $f_o$ = center frequency
$A(f_o)$ = gain at center frequency

Choose value $f_o$, C

Then : $R3 = \frac{Q}{\pi f_O C}$

$$R1 = \frac{R3}{2\,A(f_O)}$$

$$R2 = \frac{R1\,R3}{4Q^2\,R1 - R3}$$

For less than 10% error from operational amplifier, $((Q_O\,f_O)/BW) < 0.1$ where $f_o$ and BW are expressed in Hz. If source impedance varies, filter may be preceded with voltage follower buffer to stabilize filter parameters.

**Figure 17. Multiple Feedback Bandpass Filter**

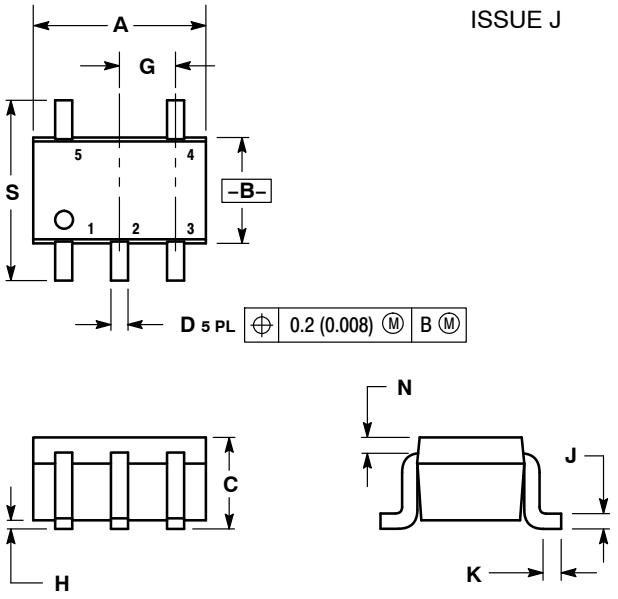
## ORDERING INFORMATION

| Order Number | Number of Channels | Specific Device Marking | Package Type | Shipping† |
|---|---|---|---|---|
| LMV821SQ3T2G* | Single | AAE | SC−70 (Pb−Free) | 3000 / Tape & Reel |
| LMV822DMR2G* | Dual | V822 | Micro8 (Pb−Free) | 4000 / Tape & Reel |
| LMV822DR2G* | Dual | V822 | SOIC−8 (Pb−Free) | 2500 / Tape & Reel |
| LMV824DR2G | Quad | LMV824 | SOIC−14 (Pb−Free) | 2500 / Tape & Reel |
| LMV824DTBR2G | Quad | LMV 824 | TSSOP−14 (Pb−Free) | 2500 / Tape & Reel |

†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.
*Contact factory.

## PACKAGE DIMENSIONS

**SC−88A, SOT−353, SC−70**
CASE 419A−02
ISSUE J

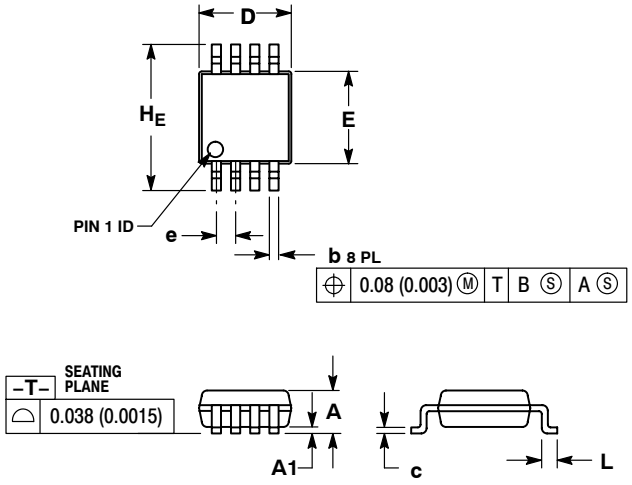



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 419A−01 OBSOLETE. NEW STANDARD 419A−02.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.071 | 0.087 | 1.80 | 2.20 |
| B | 0.045 | 0.053 | 1.15 | 1.35 |
| C | 0.031 | 0.043 | 0.80 | 1.10 |
| D | 0.004 | 0.012 | 0.10 | 0.30 |
| G | 0.026 BSC | | 0.65 BSC | |
| H | --- | 0.004 | --- | 0.10 |
| J | 0.004 | 0.010 | 0.10 | 0.25 |
| K | 0.004 | 0.012 | 0.10 | 0.30 |
| N | 0.008 REF | | 0.20 REF | |
| S | 0.079 | 0.087 | 2.00 | 2.20 |

## PACKAGE DIMENSIONS

**Micro8™**
CASE 846A−02
ISSUE H



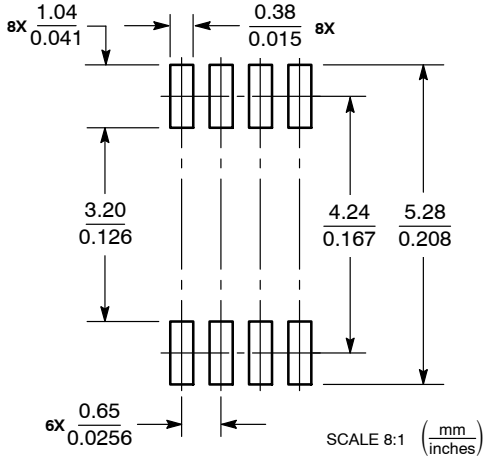




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. 846A−01 OBSOLETE, NEW STANDARD 846A−02.

| | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| DIM | MIN | NOM | MAX | MIN | NOM | MAX |
| A | −− | −− | 1.10 | −− | −− | 0.043 |
| A1 | 0.05 | 0.08 | 0.15 | 0.002 | 0.003 | 0.006 |
| b | 0.25 | 0.33 | 0.40 | 0.010 | 0.013 | 0.016 |
| c | 0.13 | 0.18 | 0.23 | 0.005 | 0.007 | 0.009 |
| D | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| E | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| e | | 0.65 BSC | | | 0.026 BSC | |
| L | 0.40 | 0.55 | 0.70 | 0.016 | 0.021 | 0.028 |
| $H_E$ | 4.75 | 4.90 | 5.05 | 0.187 | 0.193 | 0.199 |

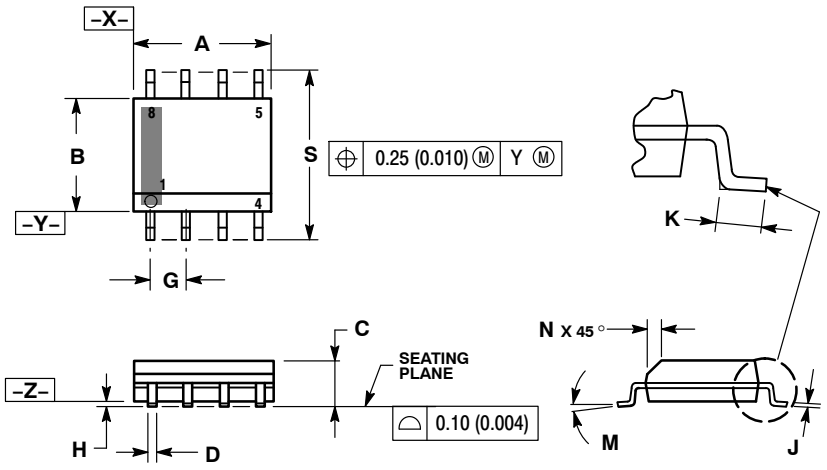
## SOLDERING FOOTPRINT*




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

## PACKAGE DIMENSIONS

**SOIC−8 NB**
CASE 751−07
ISSUE AJ

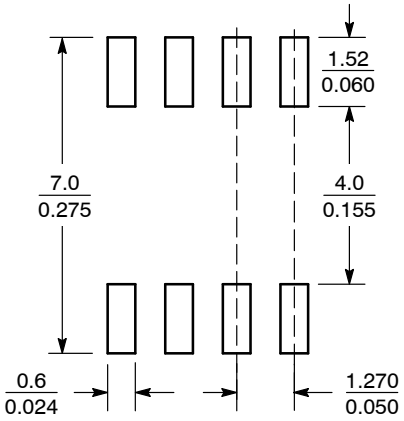



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

| | 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 |

0.25 (0.010) M Z Y S X S

**SOLDERING FOOTPRINT***

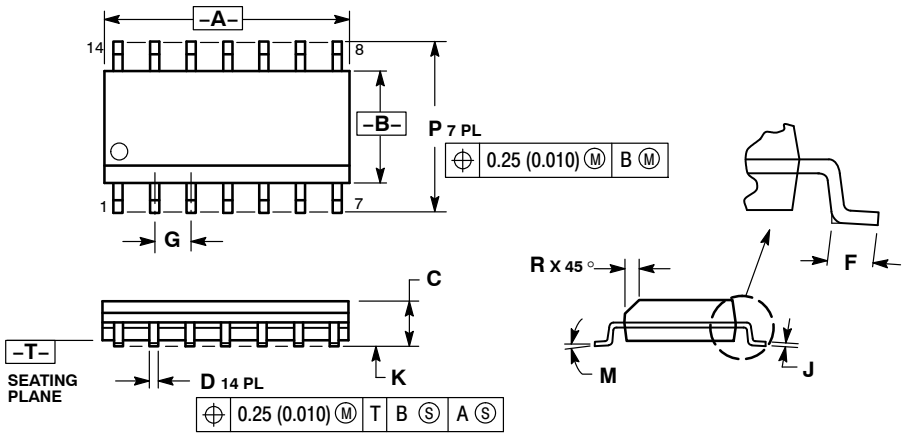



SCALE 6:1 $\left(\frac{\text{mm}}{\text{inches}}\right)$

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

## PACKAGE DIMENSIONS

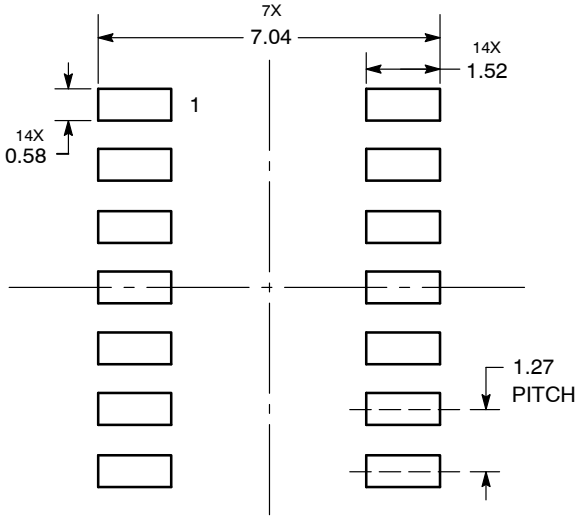
**SOIC−14**
CASE 751A−03
ISSUE J




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS 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 | 8.55 | 8.75 | 0.337 | 0.344 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.19 | 0.25 | 0.008 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0 ° | 7 ° | 0 ° | 7 ° |
| P | 5.80 | 6.20 | 0.228 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

### SOLDERING FOOTPRINT*

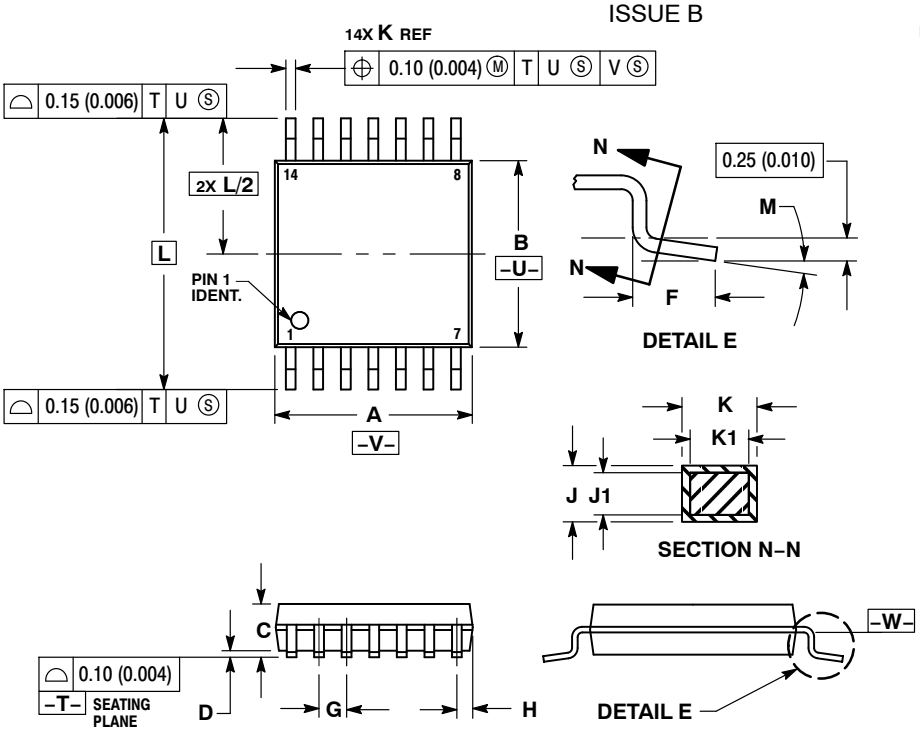



DIMENSIONS: MILLIMETERS

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

## PACKAGE DIMENSIONS

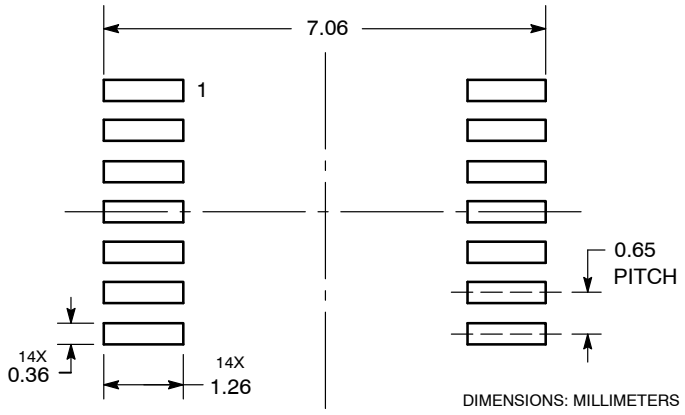
**TSSOP−14**
CASE 948G−01
ISSUE B




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 4.90 | 5.10 | 0.193 | 0.200 |
| B | 4.30 | 4.50 | 0.169 | 0.177 |
| C | −−− | 1.20 | −−− | 0.047 |
| D | 0.05 | 0.15 | 0.002 | 0.006 |
| F | 0.50 | 0.75 | 0.020 | 0.030 |
| G | 0.65 BSC | | 0.026 BSC | |
| H | 0.50 | 0.60 | 0.020 | 0.024 |
| J | 0.09 | 0.20 | 0.004 | 0.008 |
| J1 | 0.09 | 0.16 | 0.004 | 0.006 |
| K | 0.19 | 0.30 | 0.007 | 0.012 |
| K1 | 0.19 | 0.25 | 0.007 | 0.010 |
| L | 6.40 BSC | | 0.252 BSC | |
| M | 0 ° | 8 ° | 0 ° | 8 ° |

### SOLDERING FOOTPRINT

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