

# NE521

## High-Speed Dual-Differential Comparator/Sense Amp

### Features

- TTL-Compatible Strobes and Outputs
- Large Common-Mode Input Voltage Range
- Operates from Standard Supply Voltages
- Pb-Free Packages are Available

### Applications

- MOS Memory Sense Amp
- A-to-D Conversion
- High-Speed Line Receiver

### MAXIMUM RATINGS

| Rating  | Symbol            | Value                  | Unit         |    |
|---|-------------------|------------------------|--------------|----|
| Supply Voltage<br>Positive<br>Negative                                  | V+<br>V-          | +7.0<br>-7.0           | V            |    |
| Differential Input Voltage  | V <sub>IDR</sub>  | ±6.0                   | V            |    |
| Input Voltage<br>Common Mode<br>Strobe/Gate                             | V <sub>IN</sub>   | ±5.0<br>+5.25          | V            |    |
| Maximum Power Dissipation (Note 1)<br>T <sub>A</sub> = 25°C (Still-Air) | P <sub>D</sub>    | N Package<br>D Package | 1420<br>1040 | mW |
| Thermal Resistance, Junction-to-Ambient<br>N Package<br>D Package       | R <sub>θJA</sub>  | 100<br>145             | °C/W         |    |
| Operating Temperature Range   | T <sub>A</sub>    | 0 to 70                | °C           |    |
| Storage Temperature Range   | T <sub>stg</sub>  | -65 to +150            | °C           |    |
| Operating Junction Temperature  | T <sub>J</sub>    | 150                    | °C           |    |
| Lead Soldering Temperature (10 sec max)                                 | T <sub>slid</sub> | +230                   | °C           |    |

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. Derate above 25°C at the following rates:

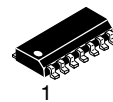
- N package at 10 mW/°C
- D package at 6.9 mW/°C.



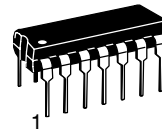
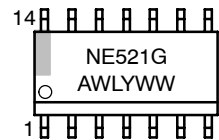
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### MARKING DIAGRAMS



SOIC-14  
D SUFFIX  
CASE 751A



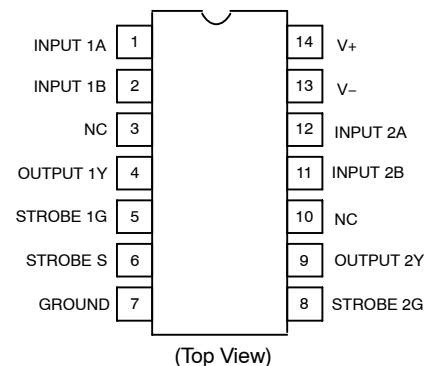
PDIP-14  
N SUFFIX  
CASE 646



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

### PIN CONNECTIONS

#### D, N Packages



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 5 of this data sheet.

# NE521

## LOGIC FUNCTION TABLE

| $V_{ID} (A^+, B)$           | Strobe S | Strobe G | Output (Y) |
|-----------------------------|----------|----------|------------|
| $V_{ID} \leq -V_{OS}$       | H        | H        | L          |
| $-V_{OS} < V_{ID} < V_{OS}$ | H        | H        | Undefined  |
| $V_{ID} \geq V_{OS}$        | H        | H        | H          |
| X                           | L        | X        | H          |
| X                           | X        | L        | H          |

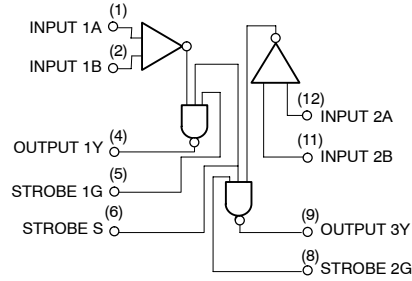


Figure 1. Block Diagram

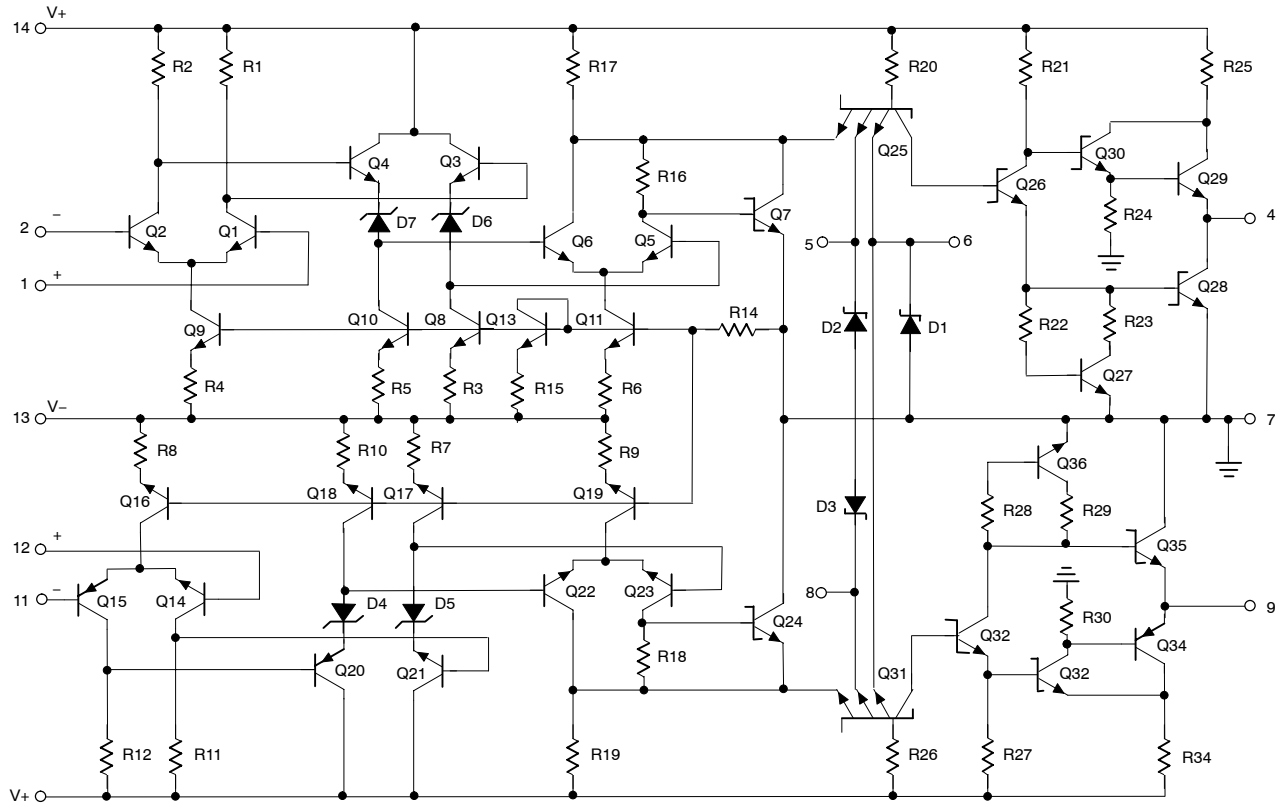


Figure 2. Equivalent Schematic

# NE521

## DC ELECTRICAL CHARACTERISTICS ( $V_+ = +5.0\text{ V}$ ; $V_- = -5.0\text{ V}$ , $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$ , unless otherwise noted.)

| Characteristic   | Test Conditions  | Symbol     | Limits |          |              | Unit          |
|--|--|------------|--------|----------|--------------|---------------|
|  |  |            | Min    | Typ      | Max          |               |
| Input Offset Voltage<br>At 25°C<br>Overtemperature Range | $V_+ = +4.75\text{ V}$ ; $V_- = -4.75\text{ V}$  | $V_{OS}$   | –<br>– | 6.0<br>– | 7.5<br>10    | mV            |
| Input Bias Current<br>At 25°C<br>Overtemperature Range   | $V_+ = +5.25\text{ V}$ ; $V_- = -5.25\text{ V}$  | $I_{BIAS}$ | –<br>– | 7.5<br>– | 20<br>40     | $\mu\text{A}$ |
| Input Offset Current<br>At 25°C<br>Overtemperature Range | $V_+ = +5.25\text{ V}$ ; $V_- = -5.25\text{ V}$  | $I_{OS}$   | –<br>– | 1.0<br>– | 5.0<br>12    | $\mu\text{A}$ |
| Common-Mode Voltage Range                                | $V_+ = +4.75\text{ V}$ ; $V_- = -4.75\text{ V}$  | $V_{CM}$   | –3.0   | –        | +3.0         | V             |
| Input Current<br>High                                    | $V_+ = +5.25\text{ V}$ ; $V_- = -5.25\text{ V}$<br>$V_{IH} = 2.7\text{ V}$<br>1G or 2G Strobe<br>Common Strobe S | $I_{IH}$   | –<br>– | –<br>–   | 50<br>100    | $\mu\text{A}$ |
| Input Current<br>Low                                     | $V_{IL} = 0.5\text{ V}$<br>1G or 2G Strobe<br>Common Strobe S  | $I_{IL}$   | –<br>– | –<br>–   | –2.0<br>–4.0 | mA            |
| Output Voltage<br>High                                   | $V_{I(S)} = 2.0\text{ V}$<br>$V_+ = +4.75\text{ V}$ ; $V_- = -4.75\text{ V}$ ;<br>$I_{LOAD} = -1.0\text{ mA}$    | $V_{OH}$   | 2.7    | 3.4      |              | V             |
| Output Voltage<br>Low                                    | $V_+ = +5.25\text{ V}$ ; $V_- = -5.25\text{ V}$ ;<br>$I_{LOAD} = 20\text{ mA}$                                   | $V_{OL}$   |        |          | 0.5          | V             |
| Supply Voltage<br>Positive                               | –  | $V_+$      | 4.75   | 5.0      | 5.25         | V             |
| Supply Voltage<br>Negative                               | –  | $V_-$      | –4.75  | –5.0     | –5.25        | V             |
| Supply Current<br>Positive                               | $V_+ = +5.25\text{ V}$ ; $V_- = -5.25\text{ V}$ ;<br>$T_A = 25^\circ\text{C}$                                    | $I_{CC+}$  | –      | 27       | 35           | mA            |
| Supply Current<br>Negative                               |  | $I_{CC-}$  | –      | –15      | –28          | mA            |
| Short-Circuit Output Current                             | –  | $I_{SC}$   | –40    | –        | –100         | mA            |

## AC ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ ; $R_L = 280\ \Omega$ ; $C_L = 15\text{ pF}$ , $V_+ = 5.0\text{ V}$ ; $V_- = 5.0\text{ V}$ , guaranteed by characterization)

| Characteristic                      | From Input | To Output | Symbol       | Limits |     |     | Unit |
|-------------------------------------|------------|-----------|--------------|--------|-----|-----|------|
|                                     |            |           |              | Min    | Typ | Max |      |
| <b>Large-Signal Switching Speed</b> |            |           |              |        |     |     |      |
| Propagation Delay                   |            |           |              |        |     |     | ns   |
| Low to High (Note 2)                | Amp        | Output    | $t_{PLH(D)}$ | –      | 9.6 | 12  |      |
| High to Low (Note 2)                | Amp        | Output    | $t_{PHL(D)}$ | –      | 8.2 | 9.0 |      |
| Low to High (Note 3)                | Strobe     | Output    | $t_{PLH(S)}$ | –      | 4.8 | 10  |      |
| High to Low (Note 3)                | Strobe     | Output    | $t_{PHL(S)}$ | –      | 3.9 | 6.0 |      |
| Max. Operating Frequency            | –          | –         | $f_{MAX}$    | 40     | 55  | –   | MHz  |

2. Response time measured from 0 V point of  $\pm 100\text{ mV}_{P-P}$  10 MHz square wave to the 1.5 V point of the output.

3. Response time measured from 1.5 V point of input to 1.5 V point of the output.

TYPICAL PERFORMANCE CHARACTERISTICS

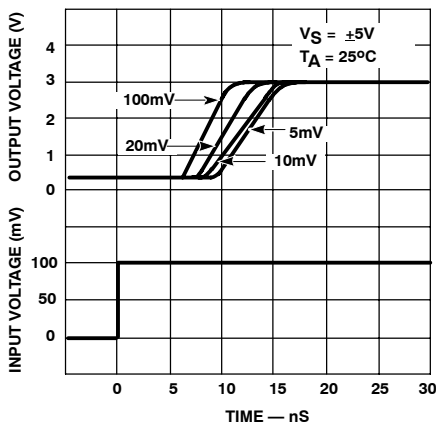


Figure 3. Response Time for Various Input Overdrives

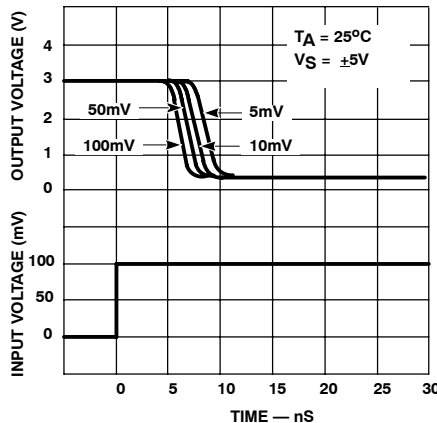


Figure 4. Response Time for Various Input Overdrives

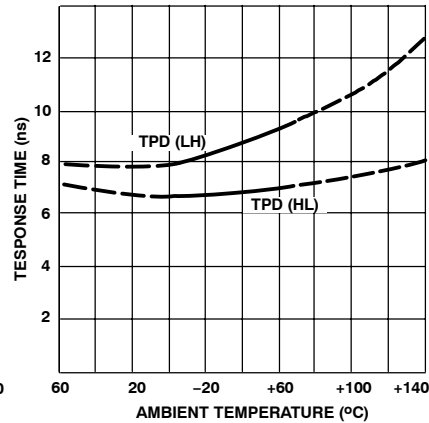


Figure 5. Response Time vs. Temperature

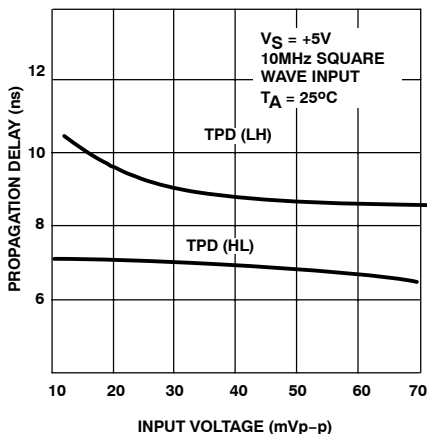


Figure 6. Propagation Delay for Various Input Voltages

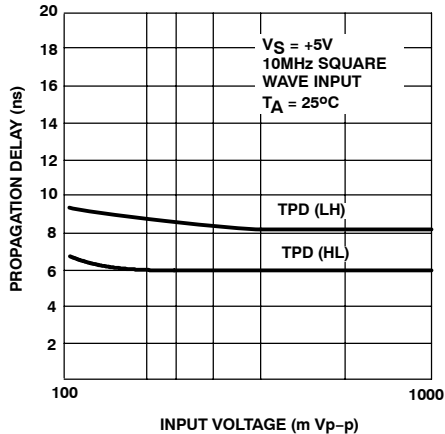


Figure 7. Propagation Delay for Various Input Voltages

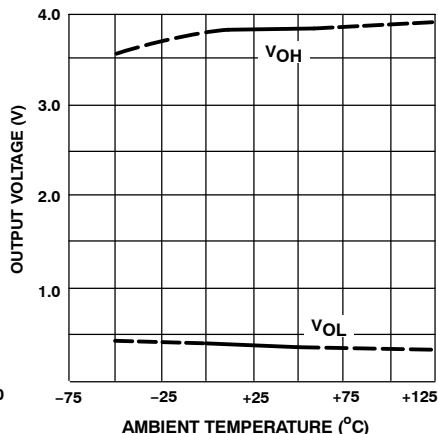


Figure 8. Output Voltage vs. Ambient Temperature

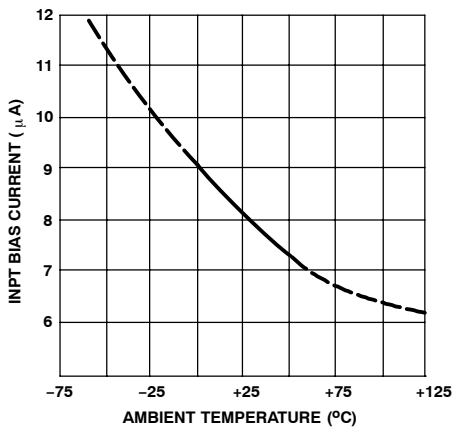


Figure 9. Input Bias Current vs. Ambient Temperature

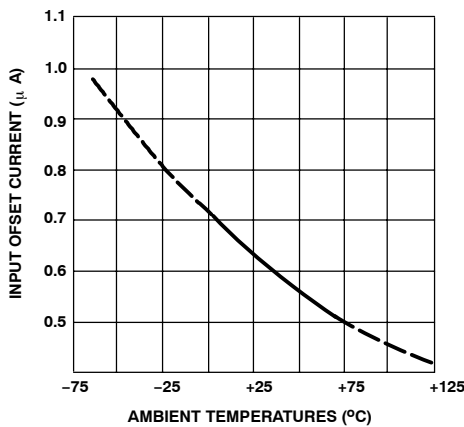


Figure 10. Input Offset Current vs. Ambient Temperature

# NE521

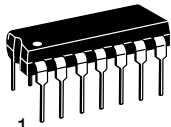
## ORDERING INFORMATION

| Device    | Temperature Range | Package              | Shipping†        |
|-----------|-------------------|----------------------|------------------|
| NE521D    | 0 to +70°C        | SOIC-14              | 55 Units/Rail    |
| NE521DG   |                   | SOIC-14<br>(Pb-Free) |                  |
| NE521DR2  |                   | SOIC-14              | 2500/Tape & Reel |
| NE521DR2G |                   | SOIC-14<br>(Pb-Free) |                  |
| NE521N    |                   | PDIP-14              | 25 Units/Rail    |
| NE521NG   |                   | PDIP-14<br>(Pb-Free) |                  |

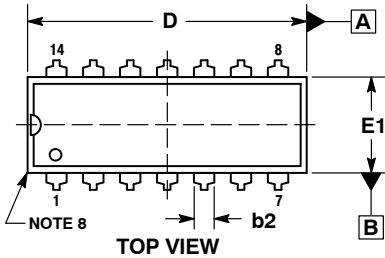
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

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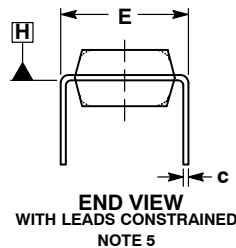


SCALE 1:1



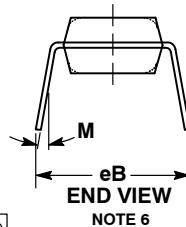
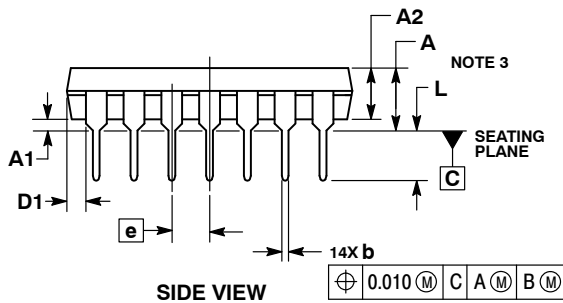
PDIP-14  
CASE 646-06  
ISSUE S

DATE 22 APR 2015



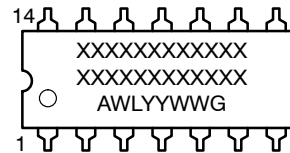
NOTES:

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.

STYLES ON PAGE 2

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

DATE 22 APR 2015

**STYLE 1:**  
 PIN 1. COLLECTOR  
 2. BASE  
 3. EMITTER  
 4. NO  
**CONNECTION**  
 5. EMITTER  
 6. BASE  
 7. COLLECTOR  
 8. COLLECTOR  
 9. BASE  
 10. EMITTER  
 11. NO  
**CONNECTION**  
 12. EMITTER  
 13. BASE  
 14. COLLECTOR

**STYLE 2:**  
 CANCELLED

**STYLE 3:**  
 CANCELLED

**STYLE 4:**  
 PIN 1. DRAIN  
 2. SOURCE  
 3. GATE  
 4. NO  
**CONNECTION**  
 5. GATE  
 6. SOURCE  
 7. DRAIN  
 8. DRAIN  
 9. SOURCE  
 10. GATE  
 11. NO  
**CONNECTION**  
 12. GATE  
 13. SOURCE  
 14. DRAIN

**STYLE 5:**  
 PIN 1. GATE  
 2. DRAIN  
 3. SOURCE  
 4. NO CONNECTION  
 5. SOURCE  
 6. DRAIN  
 7. GATE  
 8. GATE  
 9. DRAIN  
 10. SOURCE  
 11. NO CONNECTION  
 12. SOURCE  
 13. DRAIN  
 14. GATE

**STYLE 6:**  
 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 7:**  
 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 8:**  
 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 9:**  
 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

**STYLE 10:**  
 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

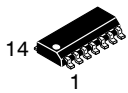
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 PIN 1. CATHODE  
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 3. CATHODE  
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 5. CATHODE  
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 7. CATHODE  
 8. ANODE  
 9. ANODE  
 10. ANODE  
 11. ANODE  
 12. ANODE  
 13. ANODE  
 14. ANODE

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

|                         |                    |   |
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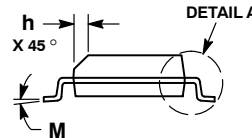
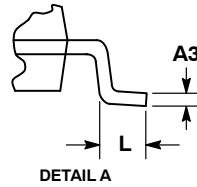
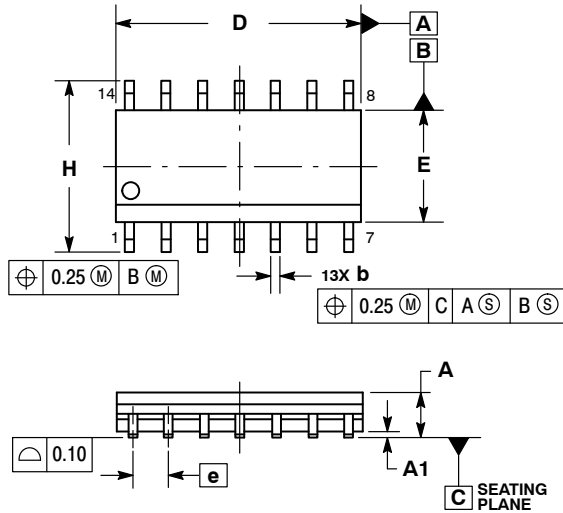
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 1:1

SOIC-14 NB  
CASE 751A-03  
ISSUE L

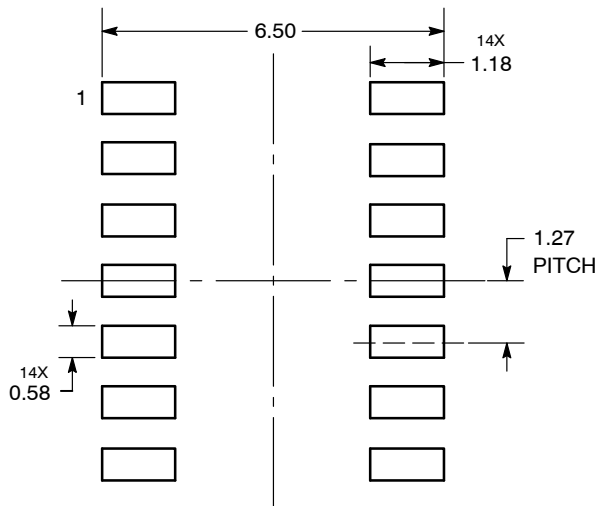
DATE 03 FEB 2016



- 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°    |

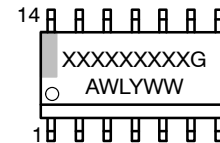
### SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor 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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