

# NE5532, SA5532, SE5532, NE5532A, SE5532A

## Internally Compensated Dual Low Noise Operational Amplifier

The 5532 is a dual high-performance low noise operational amplifier. Compared to most of the standard operational amplifiers, such as the 1458, it shows better noise performance, improved output drive capability and considerably higher small-signal and power bandwidths.

This makes the device especially suitable for application in high-quality and professional audio equipment, instrumentation and control circuits, and telephone channel amplifiers. The op amp is internally compensated for gains equal to one. If very low noise is of prime importance, it is recommended that the 5532A version be used because it has guaranteed noise voltage specifications.

### Features

- Small-Signal Bandwidth: 10 MHz
- Output Drive Capability: 600  $\Omega$ , 10  $V_{RMS}$
- Input Noise Voltage: 5.0 nV/ $\sqrt{\text{Hz}}$  (Typical)
- DC Voltage Gain: 50000
- AC Voltage Gain: 2200 at 10 kHz
- Power Bandwidth: 140 kHz
- Slew Rate: 9.0 V/ $\mu\text{s}$
- Large Supply Voltage Range:  $\pm 3.0$  to  $\pm 20$  V
- Compensated for Unity Gain
- Pb-Free Packages are Available

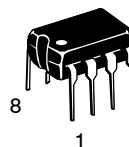


ON Semiconductor®

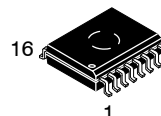
<http://onsemi.com>



SOIC-8  
D SUFFIX  
CASE 751



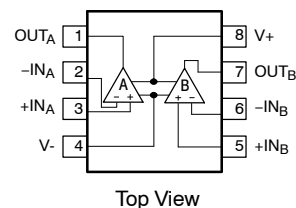
PDIP-8  
N SUFFIX  
CASE 626



SOIC-16 WB  
D SUFFIX  
CASE 751G

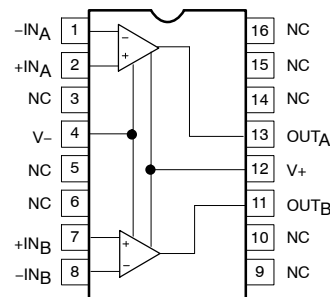
### PIN CONNECTIONS

#### N, D8 Packages



Top View

#### D Package\*



Top View

\*SOL and non-standard pinout.

### DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 6 of this data sheet.

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

# NE5532, SA5532, SE5532, NE5532A, SE5532A

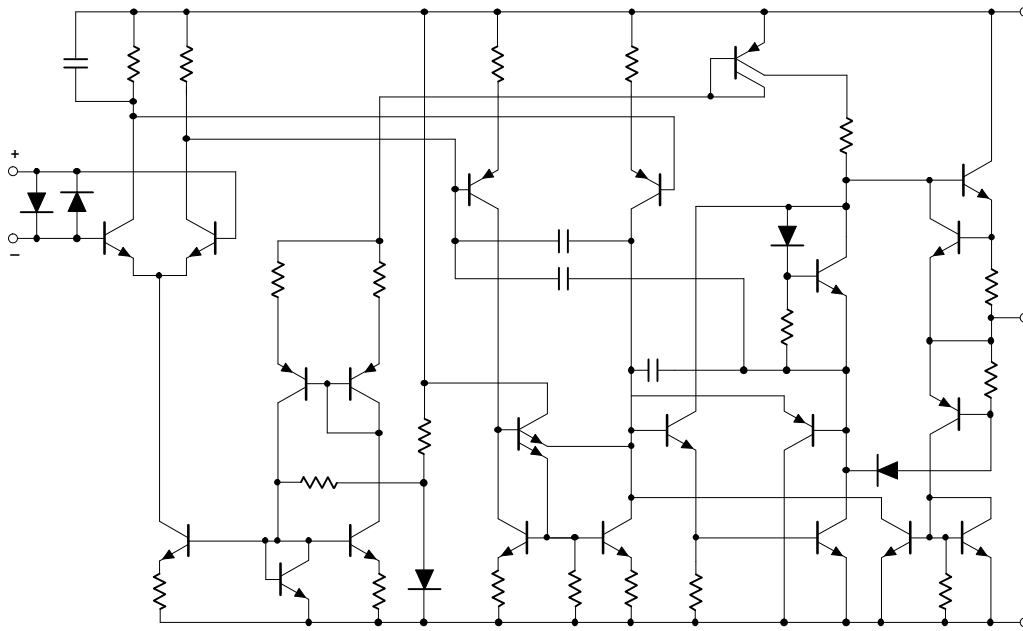


Figure 1. Equivalent Schematic (Each Amplifier)

## MAXIMUM RATINGS

| Rating  | Symbol          | Value                                | Unit          |
|---|-----------------|--------------------------------------|---------------|
| Supply Voltage  | $V_S$           | $\pm 22$                             | V             |
| Input Voltage   | $V_{IN}$        | $\pm V_{SUPPLY}$                     | V             |
| Differential Input Voltage (Note 1)   | $V_{DIFF}$      | $\pm 0.5$                            | V             |
| Operating Temperature Range<br>NE5532/A<br>SA5532<br>SE5532/A   | $T_{amb}$       | 0 to 70<br>-40 to +85<br>-55 to +125 | $^{\circ}C$   |
| Storage Temperature   | $T_{stg}$       | -65 to +150                          | $^{\circ}C$   |
| Junction Temperature  | $T_j$           | 150                                  | $^{\circ}C$   |
| Maximum Power Dissipation, $T_{amb} = 25^{\circ}C$ (Still-Air)<br>8 D8 Package<br>8 N Package<br>16 D Package | $P_D$           | 780<br>1200<br>1200                  | mW            |
| Thermal Resistance, Junction-to-Ambient<br>8 D8 Package<br>8 N Package<br>16 D Package                        | $R_{\theta JA}$ | 182<br>130<br>140                    | $^{\circ}C/W$ |
| Lead Soldering Temperature (10 sec max)   | $T_{sld}$       | 230                                  | $^{\circ}C$   |

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.

- Diodes protect the inputs against overvoltage. Therefore, unless current-limiting resistors are used, large currents will flow if the differential input voltage exceeds 0.6 V. Maximum current should be limited to  $\pm 10$  mA.

# NE5532, SA5532, SE5532, NE5532A, SE5532A

## DC ELECTRICAL CHARACTERISTICS ( $T_{amb} = 25^{\circ}\text{C}$ ; $V_S = \pm 15\text{ V}$ , unless otherwise noted.) (Notes 2, 3 and 4)

| Characteristic               | Symbol                   | Test Conditions   | SE5532/A |            |            | NE5532/A, SA5532 |            |      | Unit                           |
|------------------------------|--------------------------|---|----------|------------|------------|------------------|------------|------|--------------------------------|
|                              |                          |   | Min      | Typ        | Max        | Min              | Typ        | Max  |                                |
| Offset Voltage               | $V_{OS}$                 | -   | -        | 0.5        | 2.0        | -                | 0.5        | 4.0  | mV                             |
|                              | -                        | Overtemperature   | -        | -          | 3.0        | -                | -          | 5.0  | mV                             |
|                              | $\Delta V_{OS}/\Delta T$ | -   | -        | 5.0        | -          | -                | 5.0        | -    | $\mu\text{V}/^{\circ}\text{C}$ |
| Offset Current               | $I_{OS}$                 | -   | -        | -          | 100        | -                | 10         | 150  | nA                             |
|                              | -                        | Overtemperature   | -        | -          | 200        | -                | -          | 200  | nA                             |
|                              | $\Delta I_{OS}/\Delta T$ | -   | -        | 200        | -          | -                | 200        | -    | $\text{pA}/^{\circ}\text{C}$   |
| Input Current                | $I_B$                    | -   | -        | 300        | 500        | -                | 300        | 800  | nA                             |
|                              | -                        | Overtemperature   | -        | -          | 700        | -                | -          | 1000 | nA                             |
|                              | $\Delta I_B/\Delta T$    | -   | -        | 5.0        | -          | -                | 5.0        | -    | $\text{nA}/^{\circ}\text{C}$   |
| Supply Current               | $I_{CC}$                 | -   | -        | 8.0        | 10.5       | -                | 8.0        | 16   | mA                             |
|                              | -                        | Overtemperature   | -        | -          | 13         | -                | -          | -    |                                |
| Common-Mode Input Range      | $V_{CM}$                 | -   | $\pm 12$ | $\pm 13$   | -          | $\pm 12$         | $\pm 13$   | -    | V                              |
| Common-Mode Rejection Ratio  | CMRR                     | -   | 80       | 100        | -          | 70               | 100        | -    | dB                             |
| Power Supply Rejection Ratio | PSRR                     | -   | -        | 10         | 50         | -                | 10         | 100  | $\mu\text{V}/\text{V}$         |
| Large-Signal Voltage Gain    | $A_{VOL}$                | $R_L \geq 2.0\text{ k}\Omega$ ; $V_O = \pm 10\text{ V}$ | 50       | 100        | -          | 25               | 100        | -    | V/mV                           |
|                              |                          | Overtemperature   | 25       | -          | -          | 15               | -          | -    |                                |
|                              |                          | $R_L \geq 600\ \Omega$ ; $V_O = \pm 10\text{ V}$        | 40       | 50         | -          | 15               | 50         | -    |                                |
|                              |                          | Overtemperature   | 20       | -          | -          | 10               | -          | -    |                                |
| Output Swing                 | $V_{OUT}$                | $R_L \geq 600\ \Omega$                                  | $\pm 12$ | $\pm 13$   | -          | $\pm 12$         | $\pm 13$   | -    | V                              |
|                              |                          | Overtemperature   | $\pm 10$ | $\pm 12$   | -          | $\pm 10$         | $\pm 12$   | -    |                                |
|                              |                          | $R_L \geq 600\ \Omega$ ; $V_S = \pm 18\text{ V}$        | $\pm 15$ | $\pm 16$   | -          | $\pm 15$         | $\pm 16$   | -    |                                |
|                              |                          | Overtemperature   | $\pm 12$ | $\pm 14$   | -          | $\pm 12$         | $\pm 14$   | -    |                                |
|                              |                          | $R_L \geq 2.0\text{ k}\Omega$                           | $\pm 13$ | $\pm 13.5$ | -          | $\pm 13$         | $\pm 13.5$ | -    |                                |
| Overtemperature              | $\pm 12$                 | $\pm 12.5$  | -        | $\pm 10$   | $\pm 12.5$ | -                |            |      |                                |
| Input Resistance             | $R_{IN}$                 | -   | 30       | 300        | -          | 30               | 300        | -    | $\text{k}\Omega$               |
| Output Short Circuit Current | $I_{SC}$                 | -   | 10       | 38         | 60         | 10               | 38         | 60   | mA                             |

2. Diodes protect the inputs against overvoltage. Therefore, unless current-limiting resistors are used, large currents will flow if the differential input voltage exceeds 0.6 V. Maximum current should be limited to  $\pm 10\text{ mA}$ .
3. For operation at elevated temperature, derate packages based on the package thermal resistance.
4. Output may be shorted to ground at  $V_S = \pm 15\text{ V}$ ,  $T_{amb} = 25^{\circ}\text{C}$ . Temperature and/or supply voltages must be limited to ensure dissipation rating is not exceeded.

# NE5532, SA5532, SE5532, NE5532A, SE5532A

## AC ELECTRICAL CHARACTERISTICS ( $T_{amb} = 25^{\circ}\text{C}$ ; $V_S = \pm 15\text{ V}$ , unless otherwise noted.)

| Characteristic         | Symbol    | Test Conditions   | NE/SE5532/A, SA5532 |            |     | Unit             |
|------------------------|-----------|---|---------------------|------------|-----|------------------|
|                        |           |   | Min                 | Typ        | Max |                  |
| Output Resistance      | $R_{OUT}$ | $A_V = 30\text{ dB}$ Closed-loop<br>$f = 10\text{ kHz}$ , $R_L = 600\ \Omega$   | –                   | 0.3        | –   | $\Omega$         |
| Overshoot              | –         | Voltage-Follower<br>$V_{IN} = 100\text{ mV}_{P-P}$<br>$C_L = 100\text{ pF}$ ; $R_L = 600\ \Omega$                     | –                   | 10         | –   | %                |
| Gain                   | $A_V$     | $f = 10\text{ kHz}$   | –                   | 2.2        | –   | V/mV             |
| Gain Bandwidth Product | GBW       | $C_L = 100\text{ pF}$ ; $R_L = 600\ \Omega$   | –                   | 10         | –   | MHz              |
| Slew Rate              | SR        | –   | –                   | 9.0        | –   | V/ $\mu\text{s}$ |
| Power Bandwidth        | –         | $V_{OUT} = \pm 10\text{ V}$<br>$V_{OUT} = \pm 14\text{ V}$ ;<br>$R_L = 600\ \Omega$<br><br>$V_{CC} = \pm 18\text{ V}$ | –                   | 140<br>100 | –   | kHz              |

## ELECTRICAL CHARACTERISTICS ( $T_{amb} = 25^{\circ}\text{C}$ ; $V_S = \pm 15\text{ V}$ , unless otherwise noted.)

| Characteristic      | Symbol      | Test Conditions                                   | NE/SE5532 |     |     | NE/SA/SE5532A |     |     | Unit                   |
|---------------------|-------------|---|-----------|-----|-----|---------------|-----|-----|------------------------|
|                     |             |   | Min       | Typ | Max | Min           | Typ | Max |                        |
| Input Noise Voltage | $V_{NOISE}$ | $f_O = 30\text{ Hz}$                              | –         | 8.0 | –   | –             | 8.0 | 12  | nV/ $\sqrt{\text{Hz}}$ |
|                     |             | $f_O = 1.0\text{ kHz}$                            | –         | 5.0 | –   | –             | 5.0 | 6.0 |                        |
| Input Noise Current | $I_{NOISE}$ | $f_O = 30\text{ Hz}$                              | –         | 2.7 | –   | –             | 2.7 | –   | pA/ $\sqrt{\text{Hz}}$ |
|                     |             | $f_O = 1.0\text{ kHz}$                            | –         | 0.7 | –   | –             | 0.7 | –   |                        |
| Channel Separation  | –           | $f = 1.0\text{ kHz}$ ; $R_S = 5.0\text{ k}\Omega$ | –         | 110 | –   | –             | 110 | –   | dB                     |

TYPICAL PERFORMANCE CHARACTERISTICS

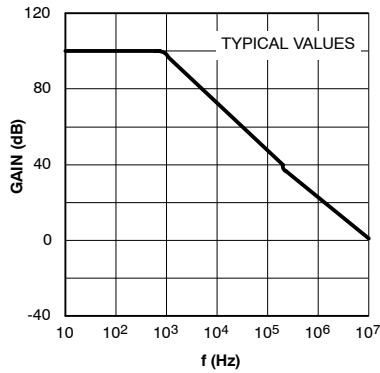


Figure 2. Open-Loop Frequency Response

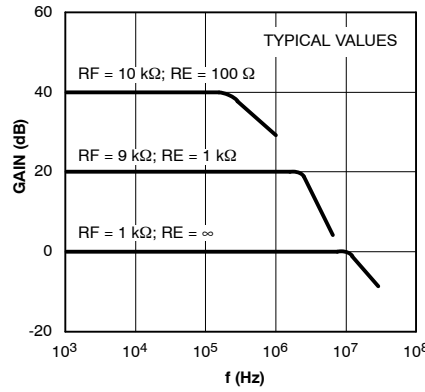


Figure 3. Closed-Loop Frequency Response

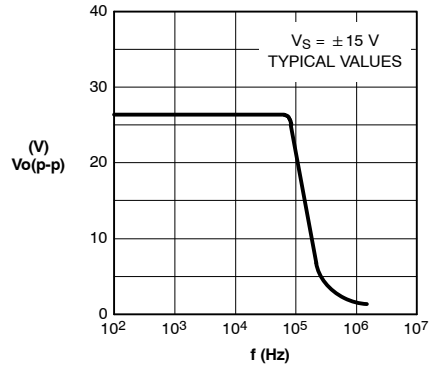


Figure 4. Large-Signal Frequency Response

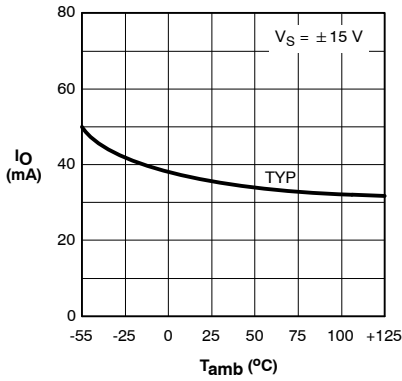


Figure 5. Output Short-Circuit Current

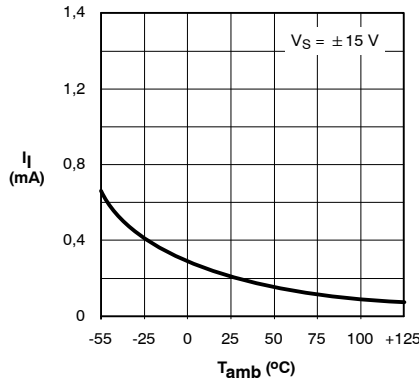


Figure 6. Input Bias Current

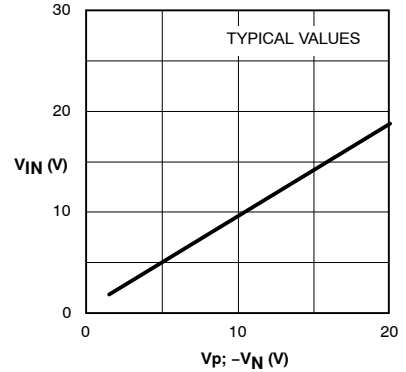


Figure 7. Input Common-Mode Voltage Range

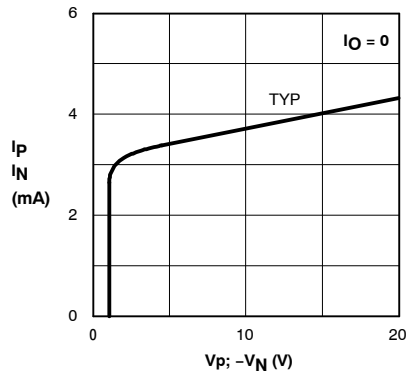


Figure 8. Supply Current

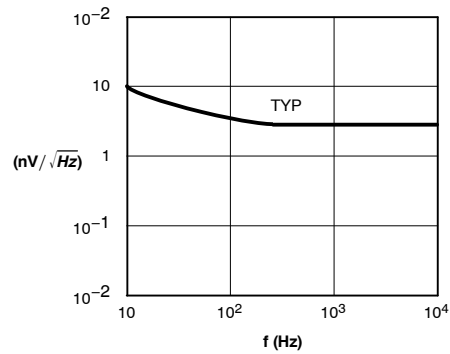
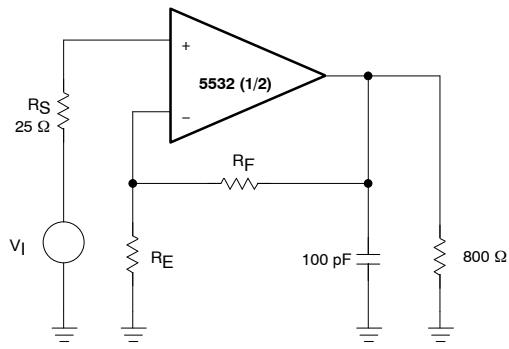
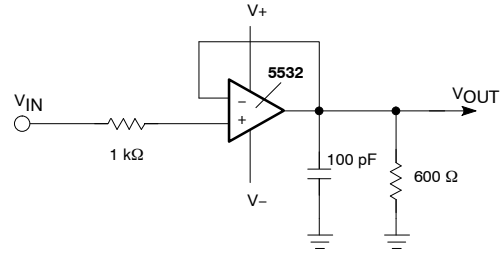


Figure 9. Input Noise Voltage Density

# NE5532, SA5532, SE5532, NE5532A, SE5532A



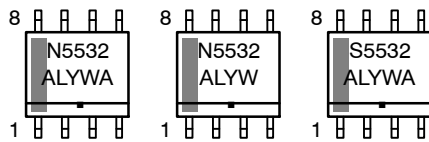
**Closed-Loop Frequency Response**



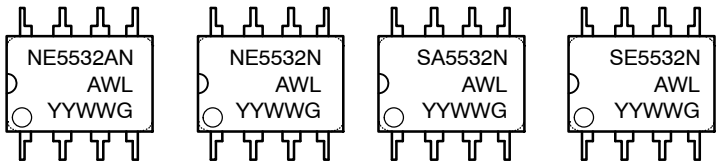
**Voltage-Follower**

**Figure 10. Test Circuits**

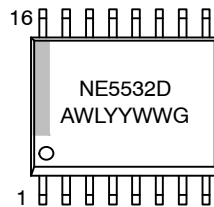
## MARKING DIAGRAMS



**SOIC-8  
D SUFFIX  
CASE 751**



**PDIP-8  
N SUFFIX  
CASE 626**



**SOIC-16 WB  
D SUFFIX  
CASE 751G**

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

# NE5532, SA5532, SE5532, NE5532A, SE5532A

## ORDERING INFORMATION

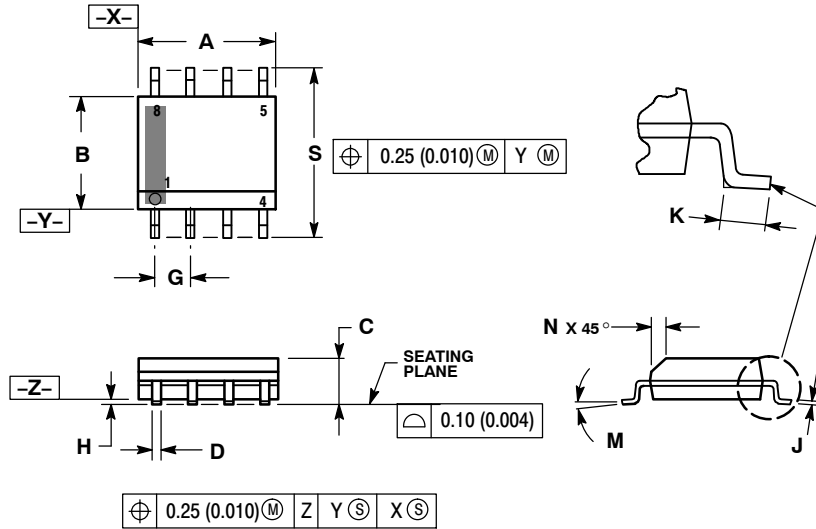
| Device       | Description   | Temperature Range | Shipping†          |                 |
|--------------|---|-------------------|--------------------|-----------------|
| NE5532AD8    | 8-Pin Plastic Small Outline (SO-8) Package                | 0 to 70°C         | 98 Units / Rail    |                 |
| NE5532AD8G   | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free)      |                   | 98 Units / Rail    |                 |
| NE5532AD8R2  | 8-Pin Plastic Small Outline (SO-8) Package                |                   | 2500 / Tape & Reel |                 |
| NE5532AD8R2G | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free)      |                   | 2500 / Tape & Reel |                 |
| NE5532AN     | 8-Pin Plastic Dual In-Line Package (PDIP-8)               |                   | 50 Units / Rail    |                 |
| NE5532ANG    | 8-Pin Plastic Dual In-Line Package (PDIP-8) (Pb-Free)     |                   | 50 Units / Rail    |                 |
| NE5532D      | 16-Pin Plastic Small Outline (SO-16 WB) Package           |                   | 47 Units / Rail    |                 |
| NE5532DG     | 16-Pin Plastic Small Outline (SO-16 WB) Package (Pb-Free) |                   | 47 Units / Rail    |                 |
| NE5532DR2    | 16-Pin Plastic Small Outline (SO-16 WB) Package           |                   | 1000 Tape & Reel   |                 |
| NE5532DR2G   | 16-Pin Plastic Small Outline (SO-16 WB) Package (Pb-Free) |                   | 1000 Tape & Reel   |                 |
| NE5532D8     | 8-Pin Plastic Small Outline (SO-8) Package                |                   | 98 Units / Rail    |                 |
| NE5532D8G    | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free)      |                   | 98 Units / Rail    |                 |
| NE5532D8R2   | 8-Pin Plastic Small Outline (SO-8) Package                |                   | 2500 / Tape & Reel |                 |
| NE5532D8R2G  | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free)      |                   | 2500 / Tape & Reel |                 |
| NE5532N      | 8-Pin Plastic Dual In-Line Package (PDIP-8)               |                   | 50 Units / Rail    |                 |
| NE5532NG     | 8-Pin Plastic Dual In-Line Package (PDIP-8) (Pb-Free)     |                   | 50 Units / Rail    |                 |
| SA5532N      | 8-Pin Plastic Dual In-Line Package (PDIP-8)               |                   | -40 to +85°C       | 50 Units / Rail |
| SA5532NG     | 8-Pin Plastic Dual In-Line Package (PDIP-8) (Pb-Free)     |                   |                    | 50 Units / Rail |
| SE5532AD8    | 8-Pin Plastic Small Outline (SO-8) Package                | -55 to +125°C     | 98 Units / Rail    |                 |
| SE5532AD8G   | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free)      |                   | 98 Units / Rail    |                 |
| SE5532AD8R2  | 8-Pin Plastic Small Outline (SO-8) Package                |                   | 2500 / Tape & Reel |                 |
| SE5532AD8R2G | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free)      |                   | 2500 / Tape & Reel |                 |
| SE5532N      | 8-Pin Plastic Dual In-Line Package (PDIP-8)               |                   | 50 Units / Rail    |                 |
| SE5532NG     | 8-Pin Plastic Dual In-Line Package (PDIP-8) (Pb-Free)     |                   | 50 Units / Rail    |                 |

†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.

# NE5532, SA5532, SE5532, NE5532A, SE5532A

## PACKAGE DIMENSIONS

SOIC-8 NB  
CASE 751-07  
ISSUE AK

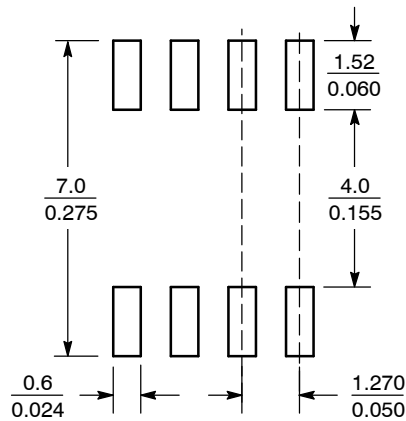


### NOTES:

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 |

### 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.

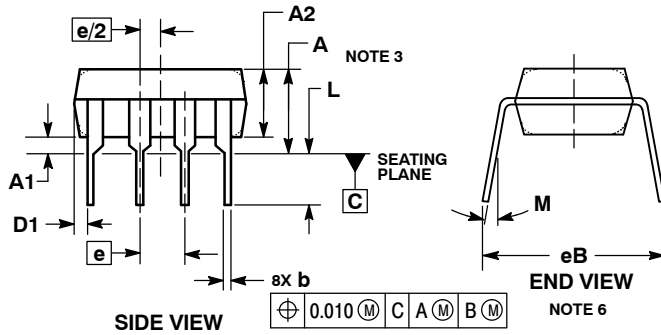
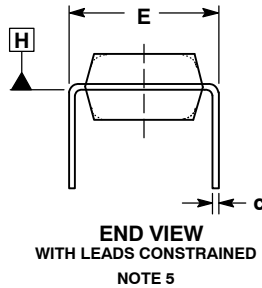
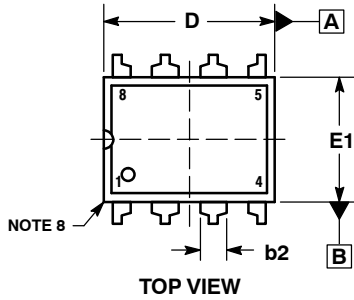


# NE5532, SA5532, SE5532, NE5532A, SE5532A

## PACKAGE DIMENSIONS

### 8-Pin Plastic Dual In-Line Package (PDIP-8)

N SUFFIX  
CASE 626-05  
ISSUE N



**NOTES:**

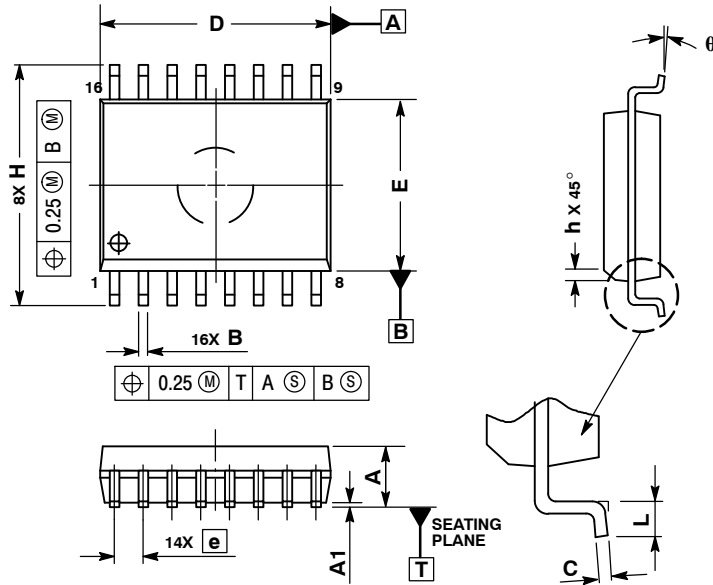
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSIONS A, A1 AND L ARE MEASURED WITH THE PACKAGE SEATED IN JEDEC SEATING PLANE GAUGE GS-3.
4. DIMENSIONS D, D1 AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 0.10 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 E3 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   | 0.355     | 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°   |

# NE5532, SA5532, SE5532, NE5532A, SE5532A

## PACKAGE DIMENSIONS

SOIC-16 WB  
D SUFFIX  
CASE 751G-03  
ISSUE D

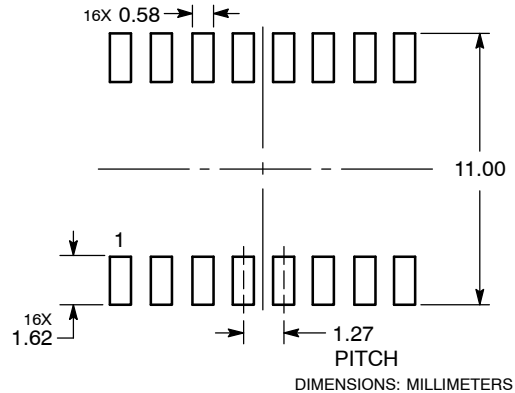


NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | MIN         | MAX   |
| A   | 2.35        | 2.65  |
| A1  | 0.10        | 0.25  |
| B   | 0.35        | 0.49  |
| C   | 0.23        | 0.32  |
| D   | 10.15       | 10.45 |
| E   | 7.40        | 7.60  |
| e   | 1.27 BSC    |       |
| H   | 10.05       | 10.55 |
| h   | 0.25        | 0.75  |
| L   | 0.50        | 0.90  |
| q   | 0°          | 7°    |

### SOLDERING FOOTPRINT



ON Semiconductor and are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

### PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT:**  
Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910  
**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative