

NE5534, SA5534, SE5534, NE5534A, SA5534A, SE5534A

Single Low Noise Operational Amplifier

The NE/SA/SE5534/5534A are single high-performance low noise operational amplifiers. Compared to other operational amplifiers, such as TL083, they show better noise performance, improved output drive capability, and considerably higher small-signal and power bandwidths.

This makes the devices especially suitable for application in high quality and professional audio equipment, in instrumentation and control circuits and telephone channel amplifiers. The op amps are internally compensated for gain equal to, or higher than, three. The frequency response can be optimized with an external compensation capacitor for various applications (unity gain amplifier, capacitive load, slew rate, low overshoot, etc.).

Features

- Small-Signal Bandwidth: 10 MHz
- Output Drive Capability: 600 Ω , 10 V_{RMS} at V_S = ± 18 V
- Input Noise Voltage: 4 nV/ $\sqrt{\text{Hz}}$
- DC Voltage Gain: 100000
- AC Voltage Gain: 6000 at 10 kHz
- Power Bandwidth: 200 kHz
- Slew Rate: 13 V/ μs
- Large Supply Voltage Range: ± 3.0 to ± 20 V
- Pb-Free Packages are Available

Applications

- Audio Equipment
- Instrumentation and Control Circuits
- Telephone Channel Amplifiers
- Medical Equipment

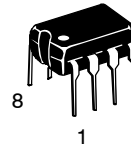


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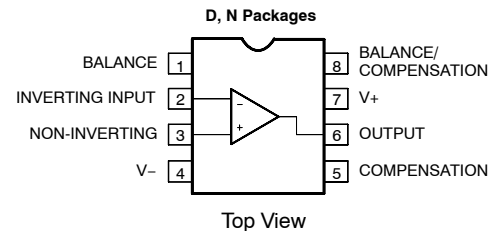


SOIC-8
D SUFFIX
CASE 751



PDIP-8
N SUFFIX
CASE 626

PIN CONNECTIONS



DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 8 of this data sheet.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

NE5534, SA5534, SE5534, NE5534A, SA5534A, SE5534A

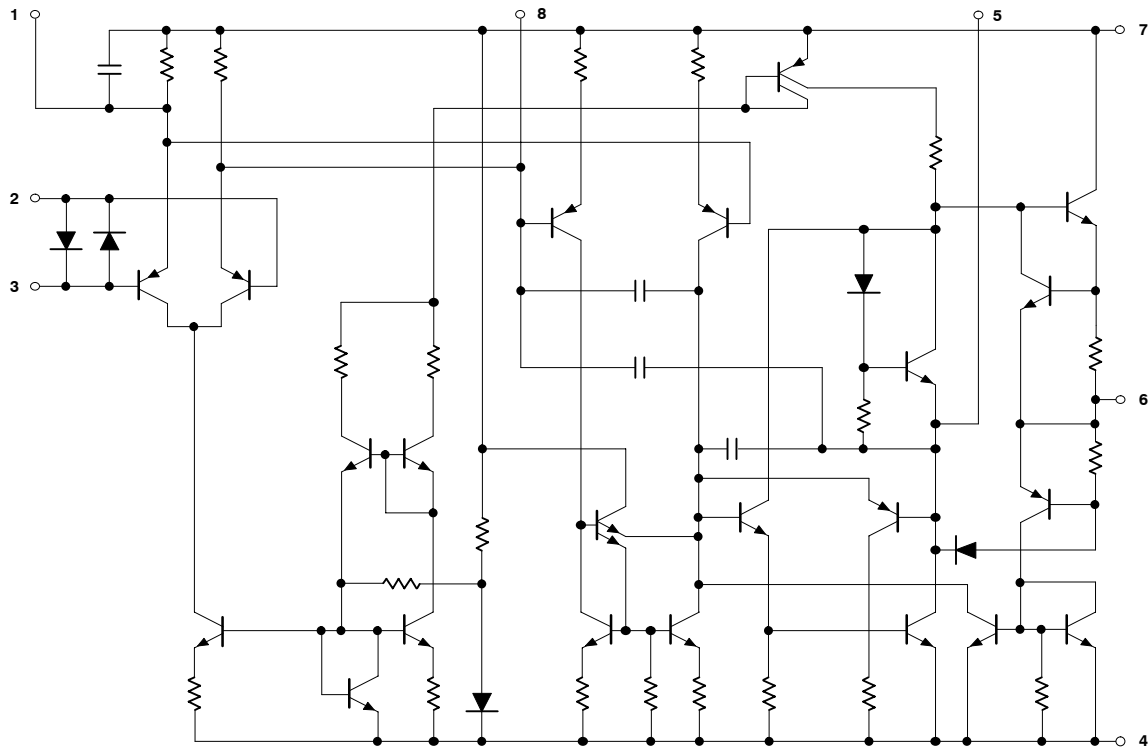


Figure 1. Equivalent Schematic

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|-----------------|---------------------------------------|---------------|
| Supply Voltage | V_S | ± 22 | V |
| Input Voltage | V_{IN} | $\pm V_{Supply}$ | V |
| Differential Input Voltage (Note 1) | V_{DIFF} | ± 0.5 | V |
| Operating Temperature Range NE SA SE | T_{amb} | 0 to +70 -40 to +85 -55 to +125 | $^{\circ}C$ |
| Storage Temperature Range | T_{stg} | -65 to +150 | $^{\circ}C$ |
| Junction Temperature | T_j | 150 | $^{\circ}C$ |
| Power Dissipation at 25 $^{\circ}C$ | P_D | N Package D Package | mW |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | N Package D Package | $^{\circ}C/W$ |
| Output Short-Circuit Duration (Note 2) | - | Indefinite | - |
| Lead Soldering Temperature (10 sec max) | T_{slid} | 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.

1. 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 ± 10 mA.
2. Output may be shorted to ground at $V_S = \pm 15$ V, $T_{amb} = 25^{\circ}C$. Temperature and/or supply voltages must be limited to ensure dissipation rating is not exceeded.

NE5534, SA5534, SE5534, NE5534A, SA5534A, SE5534A

DC ELECTRICAL CHARACTERISTICS ($T_{amb} = 25^{\circ}\text{C}$; $V_S = \pm 15\text{ V}$, unless otherwise noted.) (Notes 3, 4 and 5)

| Characteristic | Symbol | Test Conditions | NE/SA5534/5534A | | | SE5534/5534A | | | Unit |
|--|--------------------------|--|-----------------|------------|------|--------------|------------|------|--------------------------------|
| | | | Min | Typ | Max | Min | Typ | Max | |
| Offset Voltage | V_{OS} | Overtemperature | - | 0.5 | 4.0 | - | 0.5 | 2.0 | mV |
| | | | - | - | 5.0 | - | - | 3.0 | mV |
| | $\Delta V_{OS}/\Delta T$ | | - | 5.0 | - | - | 5.0 | - | $\mu\text{V}/^{\circ}\text{C}$ |
| Offset Current | I_{OS} | Overtemperature | - | 20 | 300 | - | 10 | 200 | nA |
| | | | - | - | 400 | - | - | 500 | nA |
| | $\Delta I_{OS}/\Delta T$ | | - | 200 | - | - | 200 | - | $\text{pA}/^{\circ}\text{C}$ |
| Input Current | I_B | Overtemperature | - | 500 | 1500 | - | 400 | 800 | nA |
| | | | - | - | 2000 | - | - | 1500 | nA |
| | $\Delta I_B/\Delta T$ | | - | 5.0 | - | - | 5.0 | - | $\text{nA}/^{\circ}\text{C}$ |
| Supply Current Per Op Amp | I_{CC} | Overtemperature | - | 4.0 | 8.0 | - | 4.0 | 6.5 | mA |
| | | | - | - | 10 | - | - | 9.0 | |
| Common Mode Input Range Common Mode Rejection Ratio Power Supply Rejection Ratio | V_{CM} | | ± 12 | ± 13 | - | ± 12 | ± 13 | - | V |
| | CMRR | | 70 | 100 | - | 80 | 100 | - | dB |
| | PSRR | | - | 10 | 100 | - | 10 | 50 | $\mu\text{V}/\text{V}$ |
| Large-Signal Voltage Gain | A_{VOL} | $R_L \geq 600\ \Omega$, $V_O = \pm 10\text{ V}$ Overtemperature | 25 | 100 | - | 50 | 100 | - | V/mV |
| | | | 15 | - | - | 25 | - | - | |
| Output Swing | V_{OUT} | $R_L \geq 600\ \Omega$ Overtemperature | ± 12 | ± 13 | - | ± 12 | ± 13 | - | V |
| | | | ± 10 | ± 12 | - | ± 10 | ± 12 | - | |
| | | | ± 15 | ± 16 | - | ± 15 | 16 | - | |
| | | | ± 13 | ± 13.5 | - | ± 13 | ± 13.5 | - | |
| | | | ± 12 | ± 12.5 | - | ± 12 | ± 12.5 | - | |
| Input Resistance | R_{IN} | | 30 | 100 | - | 50 | 100 | - | k Ω |
| Output Short Circuit Current | I_{SC} | | - | 38 | - | - | 38 | - | mA |

3. For NE5534/5534A, $T_{MIN} = 0^{\circ}\text{C}$, $T_{MAX} = 70^{\circ}\text{C}$.

4. For SA5534/5534A, $T_{MIN} = -40^{\circ}\text{C}$, $T_{MAX} = +85^{\circ}\text{C}$.

5. For SE5534/5534A, $T_{MIN} = -55^{\circ}\text{C}$, $T_{MAX} = +125^{\circ}\text{C}$.

NE5534, SA5534, SE5534, NE5534A, SA5534A, SE5534A

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

| Characteristic | Symbol | Test Conditions | NE/SA5534/5534A | | | SE5534/5534A | | | Unit |
|------------------------|-----------|---|-----------------|-----|-----|--------------|-----|-----|------------------|
| | | | Min | Typ | Max | Min | Typ | Max | |
| Output Resistance | R_{OUT} | $A_V = 30\text{ dB}$ closed-loop $f = 10\text{ kHz}$; $R_L = 600\ \Omega$; $C_C = 22\text{ pF}$ | – | 0.3 | – | – | 0.3 | – | Ω |
| Transient Response | | Voltage-follower $V_{IN} = 50\text{ mV}$ $R_L = 600\ \Omega$; $C_C = 22\text{ pF}$; $C_L = 100\text{ pF}$ | | | | | | | |
| Rise Time | t_R | | – | 20 | – | – | 20 | – | ns |
| Overshoot | – | | – | 20 | – | – | 20 | – | % |
| Transient Response | | $V_{IN} = 50\text{ mV}$; $R_L = 600\ \Omega$; $C_C = 47\text{ pF}$; $C_L = 500\text{ pF}$ | | | | | | | |
| Rise Time | t_R | | – | 50 | – | – | 50 | – | ns |
| Overshoot | – | | – | 35 | – | – | 35 | – | % |
| Gain | A_V | $f = 10\text{ kHz}$, $C_C = 0$ $f = 10\text{ kHz}$; $C_C = 22\text{ pF}$ | – | 6.0 | – | – | 6.0 | – | V/mV |
| Gain Bandwidth Product | GBW | $C_C = 22\text{ pF}$; $C_L = 100\text{ pF}$ | – | 10 | – | – | 10 | – | MHz |
| Slew Rate | SR | $C_C = 0$ $C_C = 22\text{ pF}$ | – | 13 | – | – | 13 | – | V/ μs |
| Power Bandwidth | – | $V_{OUT} = \pm 10\text{ V}$; $C_C = 0\text{ pF}$ $V_{OUT} = \pm 10\text{ V}$; $C_C = 22\text{ pF}$ $V_{OUT} = \pm 14\text{ V}$; $R_L = 600\ \Omega$; $C_C = 22\text{ pF}$; $V_{CC} = \pm 18\text{ V}$ | – | 200 | – | – | 200 | – | kHz |
| | | | – | 95 | – | – | 95 | – | |
| | | | – | 70 | – | – | 70 | – | |

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

| Characteristic | Symbol | Test Conditions | NE/SA/SE5534 | | | NE/SA/SE5534A | | | Unit |
|------------------------|-------------|--|--------------|-----|-----|---------------|-----|-----|------------------------|
| | | | Min | Typ | Max | Min | Typ | Max | |
| Input Noise Voltage | V_{NOISE} | $f_O = 30\text{ Hz}$ $f_O = 1.0\text{ kHz}$ | – | 7.0 | – | – | 5.5 | 7.0 | nV/ $\sqrt{\text{Hz}}$ |
| | | | – | 4.0 | – | – | 3.5 | 4.5 | |
| Input Noise Current | I_{NOISE} | $f_O = 30\text{ Hz}$ $f_O = 1.0\text{ kHz}$ | – | 2.5 | – | – | 1.5 | – | pA/ $\sqrt{\text{Hz}}$ |
| | | | – | 0.6 | – | – | 0.4 | – | |
| Broadband Noise Figure | – | $f = 10\text{ Hz}$ to 20 kHz; $R_S = 5.0\text{ k}\Omega$ | – | – | – | – | 0.9 | – | dB |
| Channel Separation | – | $f = 1.0\text{ kHz}$; $R_S = 5.0\text{ k}\Omega$ | – | 110 | – | – | 110 | – | dB |

TYPICAL PERFORMANCE CHARACTERISTICS

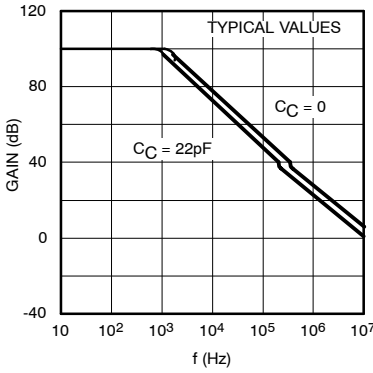


Figure 2. Open-Loop Frequency Response

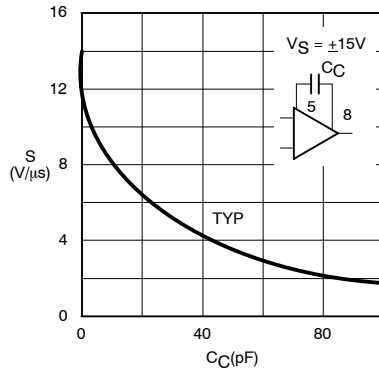


Figure 3. Slew Rate as a Function of Compensation Capacitance

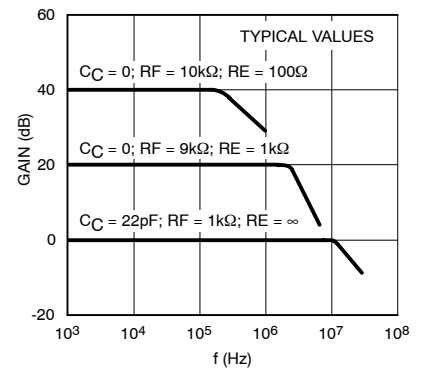


Figure 4. Closed-Loop Frequency Response

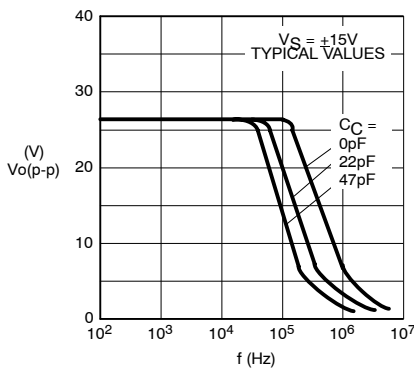


Figure 5. Large-Signal Frequency Response

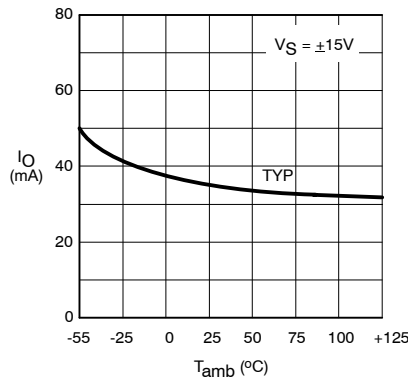


Figure 6. Output Short-Circuit Current

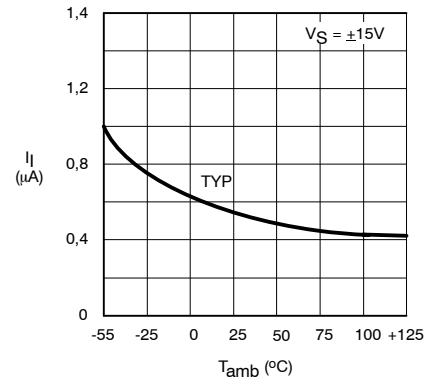


Figure 7. Input Bias Current

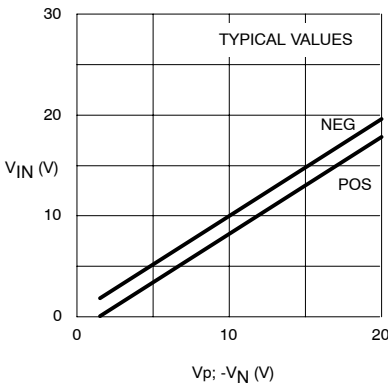


Figure 8. Input Common-Mode Voltage Range

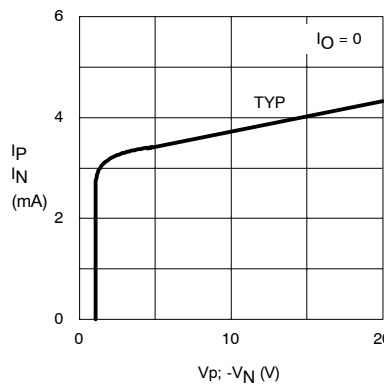


Figure 9. Supply Current Per Op Amp

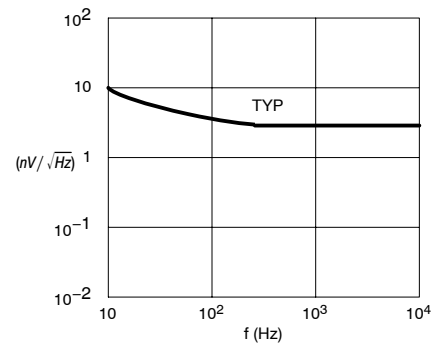


Figure 10. Input Noise Voltage Density

TYPICAL PERFORMANCE CHARACTERISTICS

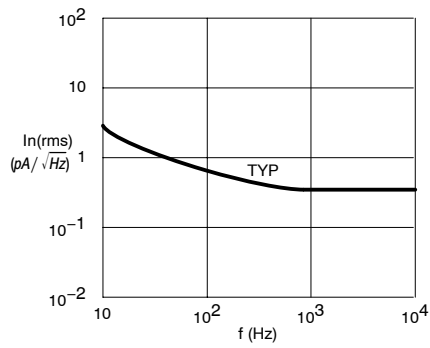


Figure 11. Input Noise Current Density

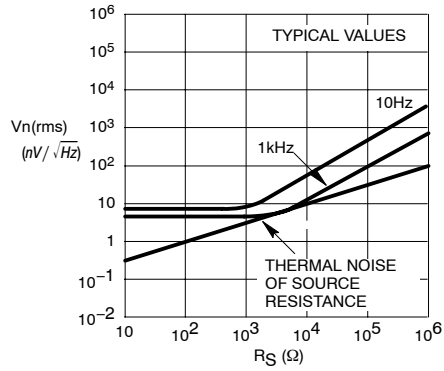


Figure 12. Total Input Noise Density

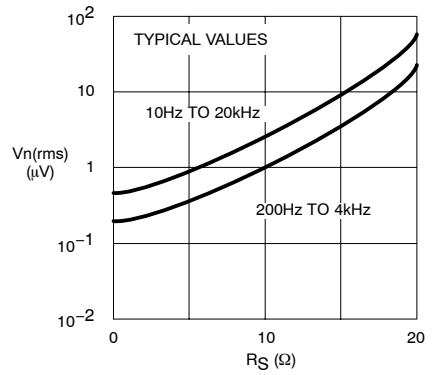


Figure 13. Broadband Input Noise Voltage

TEST LOAD CIRCUITS

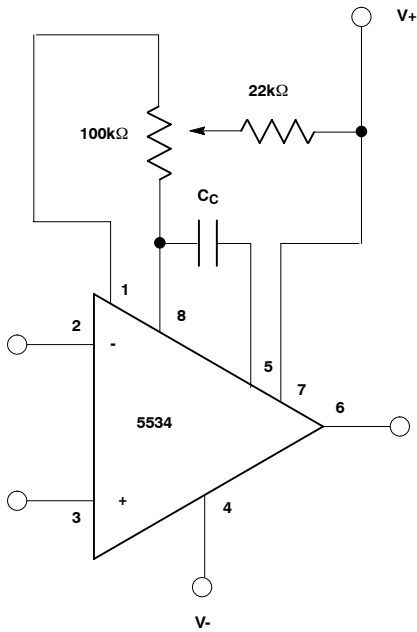


Figure 14. Frequency Compensation and Offset Voltage Adjustment Circuit

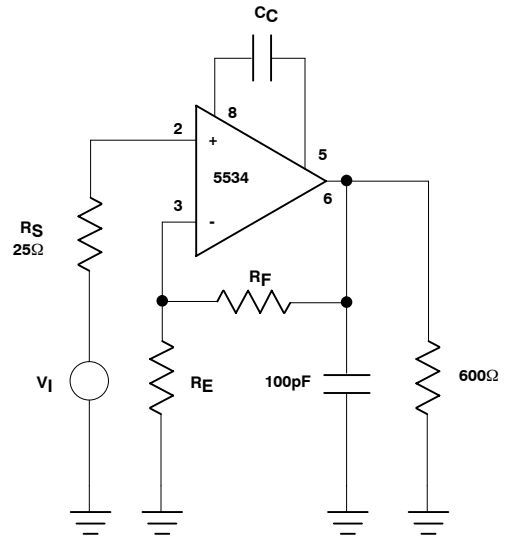


Figure 15. Closed-Loop Frequency Response

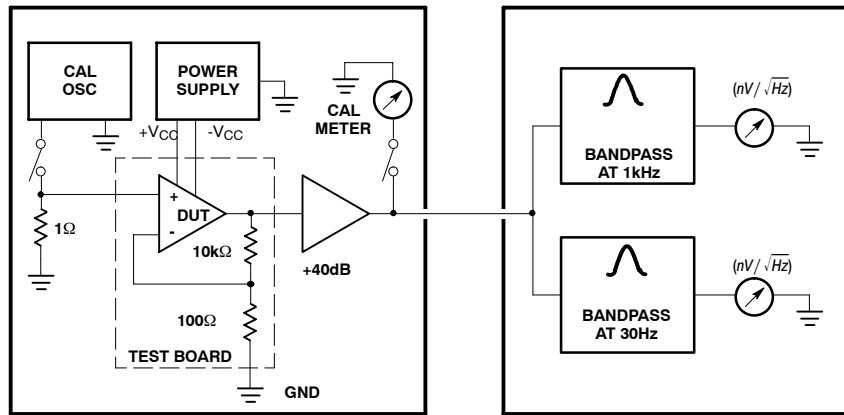
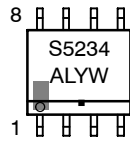
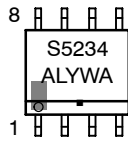
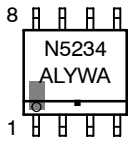


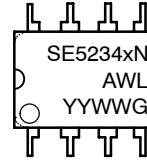
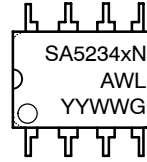
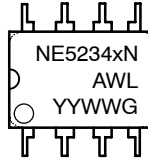
Figure 16. Noise Test Block Diagram

NE5534, SA5534, SE5534, NE5534A, SA5534A, SE5534A

MARKING DIAGRAMS



**SOIC-8
D SUFFIX
CASE 751**



**PDIP-8
N SUFFIX
CASE 626**

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

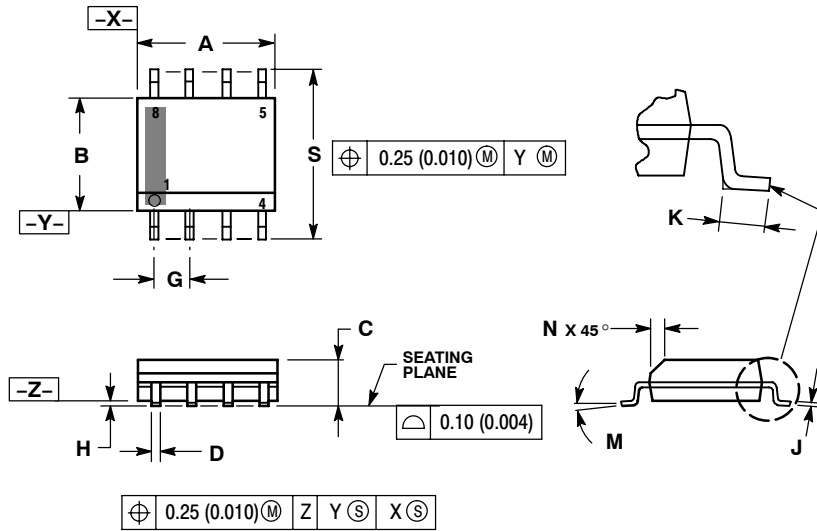
ORDERING INFORMATION

| Device | Description | Temperature Range | Shipping [†] |
|-------------|---|-------------------|-----------------------|
| NE5534AD | 8-Pin Plastic Small Outline (SO-8) Package | 0 to +70°C | 98 Units / Rail |
| NE5534ADG | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free) | 0 to +70°C | 98 Units / Rail |
| NE5534ADR2 | 8-Pin Plastic Small Outline (SO-8) Package | 0 to +70°C | 2500 / Tape & Reel |
| NE5534ADR2G | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free) | 0 to +70°C | 2500 / Tape & Reel |
| NE5534AN | 8-Pin Plastic Dual In-Line Package (PDIP-8) | 0 to +70°C | 50 Units / Rail |
| NE5534ANG | 8-Pin Plastic Dual In-Line Package (PDIP-8) (Pb-Free) | 0 to +70°C | 50 Units / Rail |
| NE5534D | 8-Pin Plastic Small Outline (SO-8) Package | 0 to +70°C | 98 Units / Rail |
| NE5534DG | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free) | 0 to +70°C | 98 Units / Rail |
| NE5534DR2 | 8-Pin Plastic Small Outline (SO-8) Package | 0 to +70°C | 2500 / Tape & Reel |
| NE5534DR2G | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free) | 0 to +70°C | 2500 / Tape & Reel |
| NE5534N | 8-Pin Plastic Dual In-Line Package (PDIP-8) | 0 to +70°C | 50 Units / Rail |
| NE5534NG | 8-Pin Plastic Dual In-Line Package (PDIP-8) (Pb-Free) | 0 to +70°C | 50 Units / Rail |
| SA5534AD | 8-Pin Plastic Small Outline (SO-8) Package | -40 to +85°C | 98 Units / Rail |
| SA5534ADG | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free) | -40 to +85°C | 98 Units / Rail |
| SA5534ADR2 | 8-Pin Plastic Small Outline (SO-8) Package | -40 to +85°C | 2500 / Tape & Reel |
| SA5534ADR2G | 8-Pin Plastic Small Outline (SO-8) Package (Pb-Free) | -40 to +85°C | 2500 / Tape & Reel |
| SA5534AN | 8-Pin Plastic Dual In-Line Package (PDIP-8) | -40 to +85°C | 50 Units / Rail |
| SA5534ANG | 8-Pin Plastic Dual In-Line Package (PDIP-8) (Pb-Free) | -40 to +85°C | 50 Units / Rail |
| SA5534N | 8-Pin Plastic Dual In-Line Package (PDIP-8) | -40 to +85°C | 50 Units / Rail |
| SA5534NG | 8-Pin Plastic Dual In-Line Package (PDIP-8) (Pb-Free) | -40 to +85°C | 50 Units / Rail |
| SE5534AN | 8-Pin Plastic Dual In-Line Package (PDIP-8) | -55 to +125°C | 50 Units / Rail |
| SE5534ANG | 8-Pin Plastic Dual In-Line Package (PDIP-8) (Pb-Free) | -55 to +125°C | 50 Units / Rail |
| SE5534N | 8-Pin Plastic Dual In-Line Package (PDIP-8) | -55 to +125°C | 50 Units / Rail |
| SE5534NG | 8-Pin Plastic Dual In-Line Package (PDIP-8) (Pb-Free) | -55 to +125°C | 50 Units / Rail |

[†]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.

PACKAGE DIMENSIONS

SOIC-8 NB
CASE 751-07
ISSUE AG

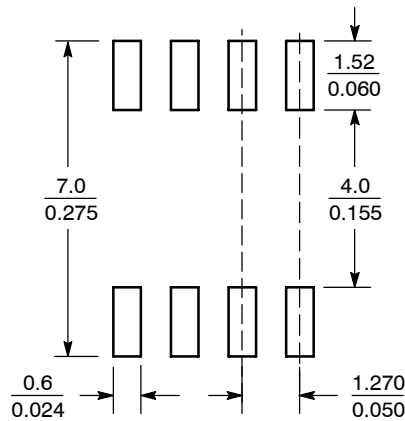


NOTES:

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 $\left(\frac{\text{mm}}{\text{inches}}\right)$

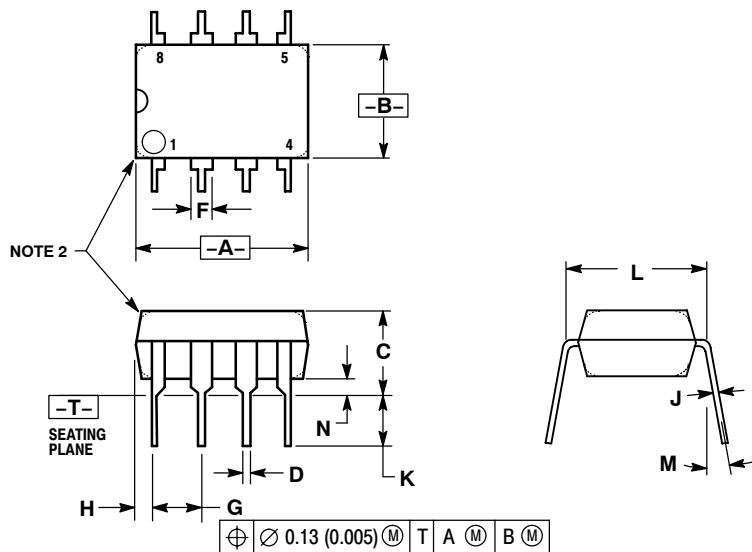
*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NE5534, SA5534, SE5534, NE5534A, SA5534A, SE5534A

PACKAGE DIMENSIONS

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

N SUFFIX
CASE 626-05
ISSUE L



NOTES:

1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 9.40 | 10.16 | 0.370 | 0.400 |
| B | 6.10 | 6.60 | 0.240 | 0.260 |
| C | 3.94 | 4.45 | 0.155 | 0.175 |
| D | 0.38 | 0.51 | 0.015 | 0.020 |
| F | 1.02 | 1.78 | 0.040 | 0.070 |
| G | 2.54 BSC | | 0.100 BSC | |
| H | 0.76 | 1.27 | 0.030 | 0.050 |
| J | 0.20 | 0.30 | 0.008 | 0.012 |
| K | 2.92 | 3.43 | 0.115 | 0.135 |
| L | 7.62 BSC | | 0.300 BSC | |
| M | --- | 10° | --- | 10° |
| N | 0.76 | 1.01 | 0.030 | 0.040 |

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