

NE5534, NE5534A, SE5534, SE5534A LOW-NOISE OPERATIONAL AMPLIFIERS

SLOS070 – JULY 1979 – REVISED SEPTEMBER 1990

- **Equivalent Input Noise Voltage**
3.5 nV/ $\sqrt{\text{Hz}}$
- **Unity-Gain Bandwidth . . . 10 MHz Typ**
- **Common-Mode Rejection Ratio**
100 dB Typ
- **High DC Voltage Gain . . . 100 V/mV Typ**
- **Peak-to-Peak Output Voltage Swing**
32 V Typ With $V_{CC\pm} = \pm 18 \text{ V}$ and $R_L = 600 \Omega$
- **High Slew Rate . . . 13 V/ μs Typ**
- **Wide Supply Voltage Range $\pm 3 \text{ V}$ to $\pm 20 \text{ V}$**
- **Low Harmonic Distortion**
- **Designed to Be Interchangeable With**
Signetics NE5534, NE5534A, SE5534,
and SE5534A

description

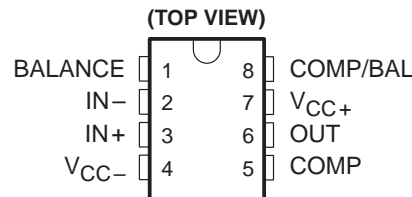
The NE5534, NE5534A, SE5534, and SE5534A are monolithic high-performance operational amplifiers combining excellent dc and ac characteristics. Some of the features include very low noise, high output drive capability, high unity-gain and maximum-output-swing bandwidths, low distortion, and high slew rate.

These operational amplifiers are internally compensated for a gain equal to or greater than three. Optimization of the frequency response for various applications can be obtained by use of an external compensation capacitor between COMP and COMP/BAL. The devices feature input-protection diodes, output short-circuit protection, and offset-voltage nulling capability.

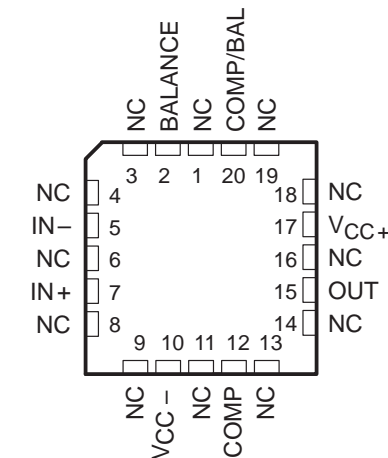
For the NE5534A, a maximum limit is specified for equivalent input noise voltage.

The NE5534 and NE5534A are characterized for operation from 0°C to 70°C. The SE5534 and SE5534A are characterized for operation over the full military temperature range of –55°C to 125°C.

NE5534, NE5534A . . . D OR P PACKAGE
SE5534, SE5534A . . . JG PACKAGE

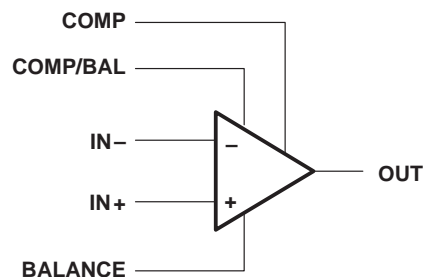


SE5534, SE5534A . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

symbol



**SE5534A FROM TI NOT RECOMMENDED
FOR NEW DESIGNS**

AVAILABLE OPTIONS

| T _A | V _{IO} max AT 25°C | PACKAGE | | | |
|----------------|--------------------------------|----------------------|-----------------------|-----------------------|---------------------|
| | | SMALL OUTLINE (D) | CERAMIC (FK) | CERAMIC DIP (JG) | PLASTIC DIP (P) |
| 0°C to 70°C | 4 mV | NE5534D NE5534AD | — — | — — | NE5534P NE5534AP |
| –55°C to 125°C | 2 mV | — — | SE5534FK SE5534AFK | SE5534JG SE5534AJG | — — |

The D package is available taped and reeled. Add the suffix R to the device type (e.g., NE5534DR).

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS
INSTRUMENTS**

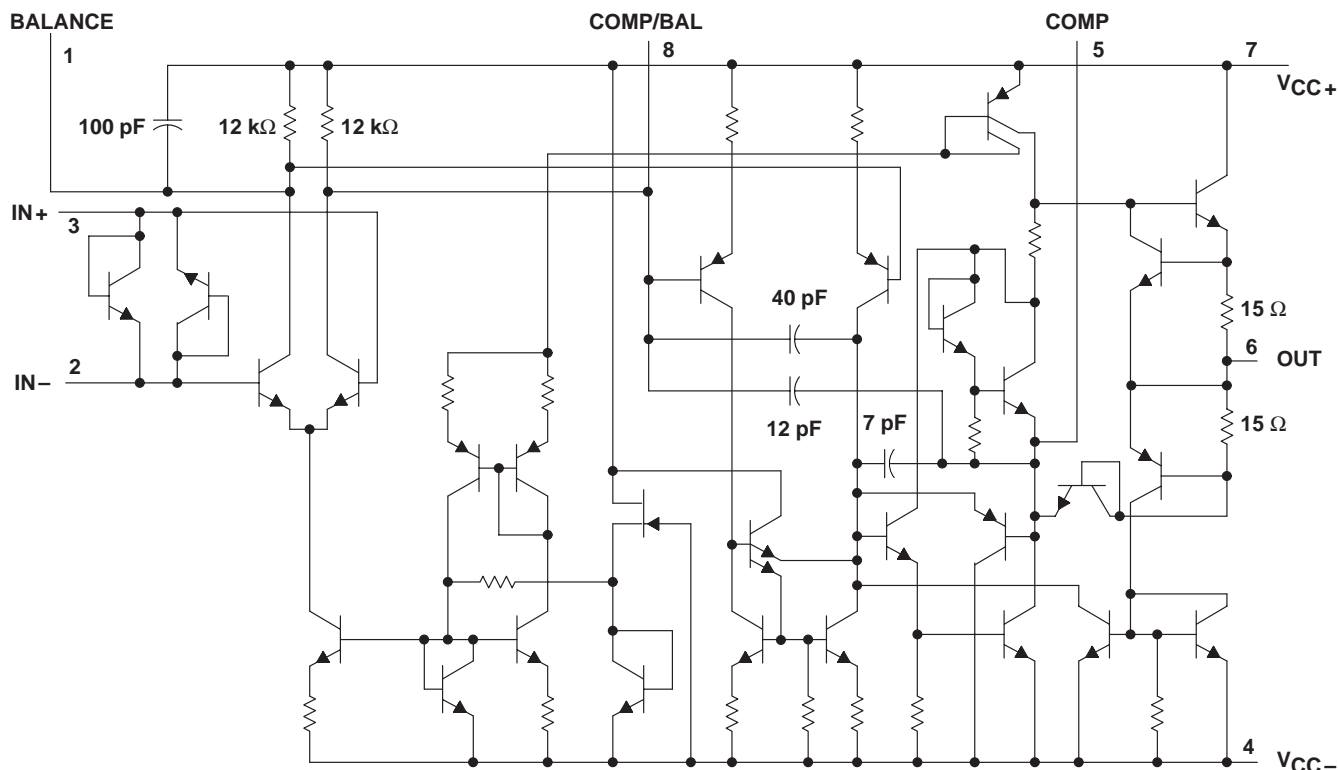
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NE5534, NE5534A, SE5534, SE5534A LOW-NOISE OPERATIONAL AMPLIFIERS

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schematic



All component values shown are nominal.
Pin numbers shown are for D, JG, and P packages.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

| | |
|--|------------------------------|
| Supply voltage, V_{CC+} (see Note 1) | 22 V |
| Supply voltage, V_{CC-} (see Note 1) | -22 V |
| Input voltage either input (see Notes 1 and 2) | V_{CC+} |
| Input current (see Note 3) | ± 10 mA |
| Duration of output short circuit (see Note 4) | unlimited |
| Continuous total power dissipation | See Dissipation Rating Table |
| Operating free-air temperature range: | |
| NE5534, NE5534A | 0°C to 70°C |
| SE5534, SE5534A | -55°C to 125°C |
| Storage temperature range | -65°C to 150°C |
| Case temperature for 60 seconds: FK package | 260°C |
| Lead temperature range 1,6 mm (1/16 inch) from case for 60 seconds: JG package | 300°C |
| Lead temperature range 1,6 mm (1/16 inch) from case for 10 seconds: D or P package | 260°C |

- NOTES:
1. All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-} .
 2. The magnitude of the input voltage must never exceed the magnitude of the supply voltage.
 3. Excessive current will flow if a differential input voltage in excess of approximately 0.6 V is applied between the inputs unless some limiting resistance is used.
 4. The output may be shorted to ground or to either power supply. Temperature and/or supply voltages must be limited to ensure the maximum dissipation rating is not exceeded.



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DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^\circ\text{C}$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$ POWER RATING | $T_A = 125^\circ\text{C}$ POWER RATING |
|-----------------|---|---|--|---|
| D | 725 mW | 5.8 mW/ $^\circ\text{C}$ | 464 mW | N/A |
| FK (see Note 5) | 1375 mW | 11.0 mW/ $^\circ\text{C}$ | 880 mW | 275 mW |
| JG | 1050 mW | 8.4 mW/ $^\circ\text{C}$ | 672 mW | 210 mW |
| P | 1000 mW | 8.0 mW/ $^\circ\text{C}$ | 640 mW | N/A |

NOTE 5: For the FK package, power rating and derating factor will vary with actual mounting technique used. The values stated here are believed to be conservative.

recommended operating conditions

| | MIN | NOM | MAX | UNIT |
|---------------------------|-----|-----|-----|------|
| Supply voltage, V_{CC+} | 5 | | 15 | V |
| Supply voltage, V_{CC-} | -5 | | -15 | V |

electrical characteristics, $V_{CC} \pm = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | | NE5534, NE5534A | | | SE5534, SE5534A | | | UNIT |
|--|---|-------------------------------|-----------------|----------|----------|-----------------|------|-----|------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V_{IO} Input offset voltage | $V_O = 0$, $R_S = 50\ \Omega$ | $T_A = 25^\circ\text{C}$ | 0.5 | 4 | 0.5 | 2 | mV | | |
| | | $T_A = \text{Full range}$ | 5 | | | 3 | | | |
| I_{IO} Input offset current | $V_O = 0$ | $T_A = 25^\circ\text{C}$ | 20 | 300 | 10 | 200 | nA | | |
| | | $T_A = \text{Full range}$ | 400 | | | 500 | | | |
| I_{IB} Input bias current | $V_O = 0$ | $T_A = 25^\circ\text{C}$ | 500 | 1500 | 400 | 800 | nA | | |
| | | $T_A = \text{Full range}$ | 2000 | | | 1500 | | | |
| V_{ICR} Common-mode input voltage range | | | ± 12 | ± 13 | ± 12 | ± 13 | V | | |
| $V_{O(PP)}$ Maximum peak-to-peak output voltage swing | $R_L \geq 600\ \Omega$ | $V_{CC\pm} = \pm 15\text{ V}$ | 24 | 26 | 24 | 26 | V | | |
| | | $V_{CC\pm} = \pm 18\text{ V}$ | 30 | 32 | 30 | 32 | | | |
| A_{VD} Large-signal differential voltage amplification | $V_O = \pm 10\text{ V}$, $R_L \geq 600\ \Omega$ | $T_A = 25^\circ\text{C}$ | 25 | 100 | 50 | 100 | V/mV | | |
| | | $T_A = \text{Full range}$ | 15 | | | 25 | | | |
| A_{vd} Small-signal differential voltage amplification | $f = 10\text{ kHz}$ | $C_C = 0$ | 6 | | 6 | | V/mV | | |
| | | $C_C = 22\text{ pF}$ | 2.2 | | 2.2 | | | | |
| B_{OM} Maximum-output-swing bandwidth | $V_O = \pm 10\text{ V}$, $C_C = 0$ | 200 | | 200 | | kHz | | | |
| | $V_O = \pm 10\text{ V}$, $C_C = 22\text{ pF}$ | 95 | | 95 | | | | | |
| | $V_{CC\pm} = \pm 18\text{ V}$, $R_L \geq 600\ \Omega$, $C_C = 22\text{ pF}$ | 70 | | 70 | | | | | |
| B_1 Unity-gain bandwidth | $C_C = 22\text{ pF}$, $C_L = 100\text{ pF}$ | 10 | | 10 | | MHz | | | |
| r_i Input resistance | | 30 | 100 | 50 | 100 | k Ω | | | |
| z_o Output impedance | $A_{VD} = 30\text{ dB}$, $C_C = 22\text{ pF}$, $f = 10\text{ kHz}$ | 0.3 | | 0.3 | | Ω | | | |
| CMRR Common-mode rejection ratio | $V_O = 0$, $R_S = 50\ \Omega$ | $V_{IC} = V_{ICRmin}$ | 70 | 100 | 80 | 100 | dB | | |
| k_{SVR} Supply voltage rejection ratio ($\Delta V_{CC}/\Delta V_{IO}$) | $V_{CC+} = \pm 9\text{ V to } \pm 15\text{ V}$, $V_O = 0$ | $R_S = 50\ \Omega$ | 80 | 100 | 86 | 100 | dB | | |
| I_{OS} Output short-circuit current | | | 38 | | 38 | | mA | | |
| I_{CC} Supply current | $V_O = 0$, No load | $T_A = 25^\circ\text{C}$ | 4 | 8 | 4 | 6.5 | mA | | |
| | | $T_A = \text{Full range}$ | 9 | | | | | | |

† All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified. Full range is $T_A = 0^\circ\text{C}$ to 70°C for NE5534 and NE5534A and -55°C to 125°C for SE5534 and SE5534A.



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operating characteristics, $V_{CC} \pm = \pm 15\text{ V}$, $T_A = 25^\circ\text{C}$

| PARAMETER | TEST CONDITIONS | SE5534, NE5534 | | | SE5534A, NE5534A | | | UNIT |
|--------------------------------------|---|----------------|-----|-----|------------------|-----|-----|------------------------|
| | | MIN | TYP | MAX | MIN | TYP | MAX | |
| SR Slew rate at unity gain | $C_C = 0$ | 13 | | | 13 | | | V/ μs |
| | $C_C = 22\text{ pF}$ | 6 | | | 6 | | | |
| t_r Rise time | $V_I = 50\text{ mV}$, $A_{VD} = 1$, $R_L = 600\ \Omega$, $C_C = 22\text{ pF}$, | 20 | | | 20 | | | ns |
| Overshoot factor | $C_L = 100\text{ pF}$ | 20% | | | 20% | | | |
| t_r Rise time | $V_I = 50\text{ mV}$, $A_{VD} = 1$, $R_L = 600\ \Omega$, $C_C = 47\text{ pF}$, | 50 | | | 50 | | | ns |
| Overshoot factor | $C_L = 500\text{ pF}$ | 35% | | | 35% | | | |
| V_n Equivalent input noise voltage | $f = 30\text{ Hz}$ | 7 | | | 5.5 | 7 | | nV/ $\sqrt{\text{Hz}}$ |
| | $f = 1\text{ kHz}$ | 4 | | | 3.5 | 4.5 | | |
| I_n Equivalent input noise current | $f = 30\text{ Hz}$ | 2.5 | | | 1.5 | | | pA/ $\sqrt{\text{Hz}}$ |
| | $f = 1\text{ kHz}$ | 0.6 | | | 0.4 | | | |
| \bar{F} Average noise figure | $R_S = 5\text{ k}\Omega$, $f = 10\text{ Hz to } 20\text{ kHz}$ | | | | 0.9 | | | dB |

TYPICAL CHARACTERISTICS†

NORMALIZED INPUT BIAS CURRENT
AND INPUT OFFSET CURRENT
vs
FREE-AIR TEMPERATURE

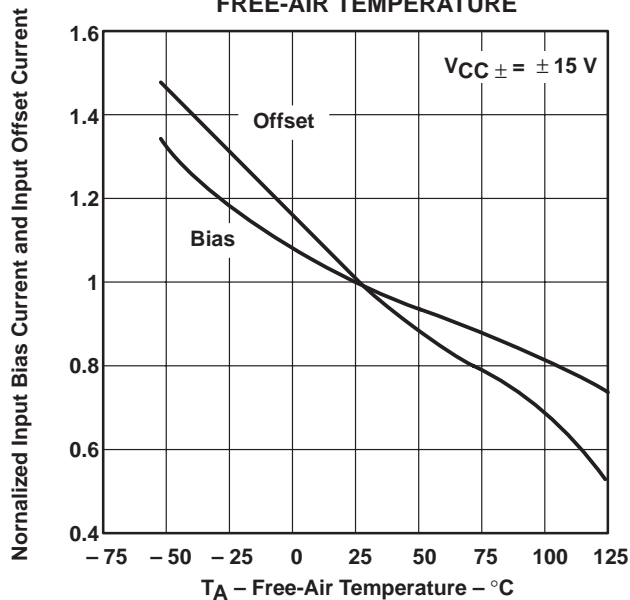


Figure 1

MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE
vs
FREQUENCY

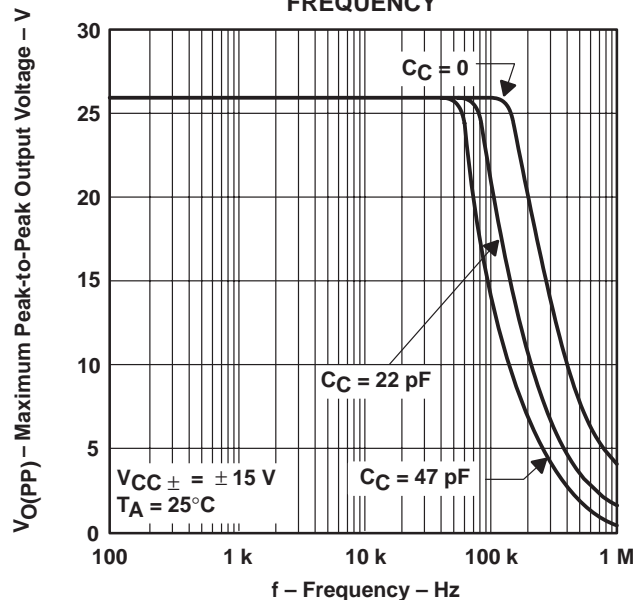
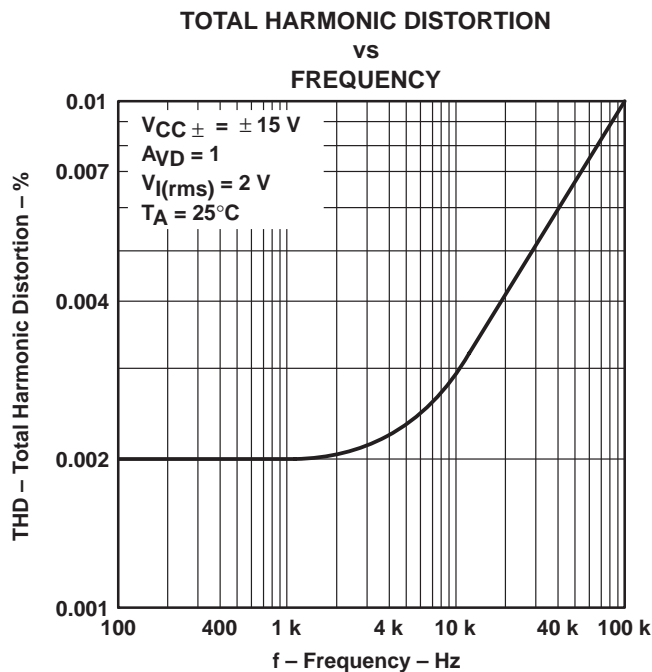
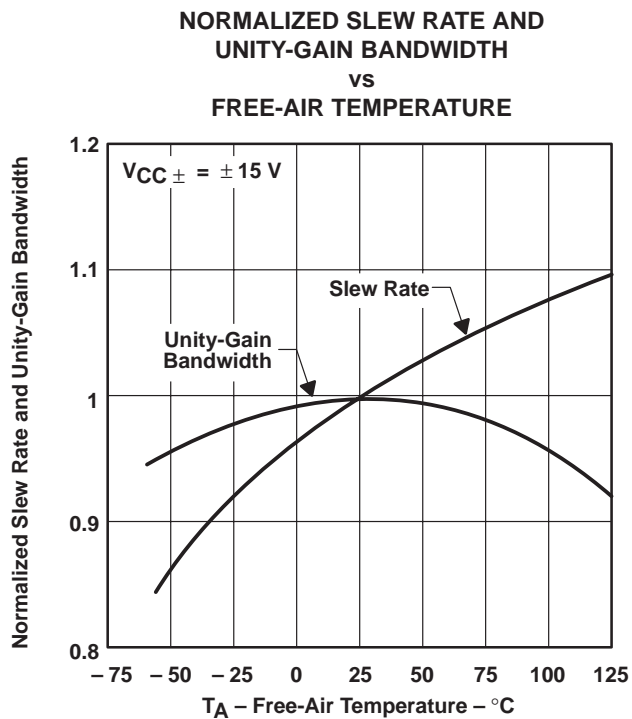
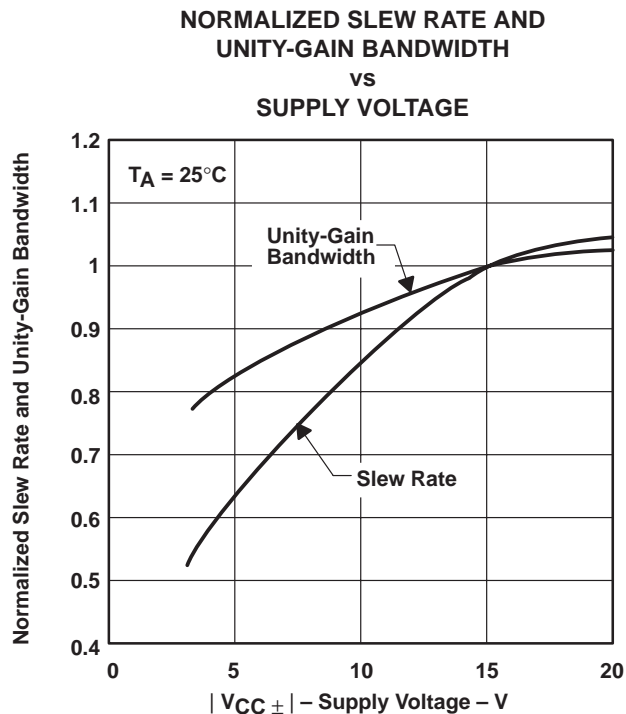
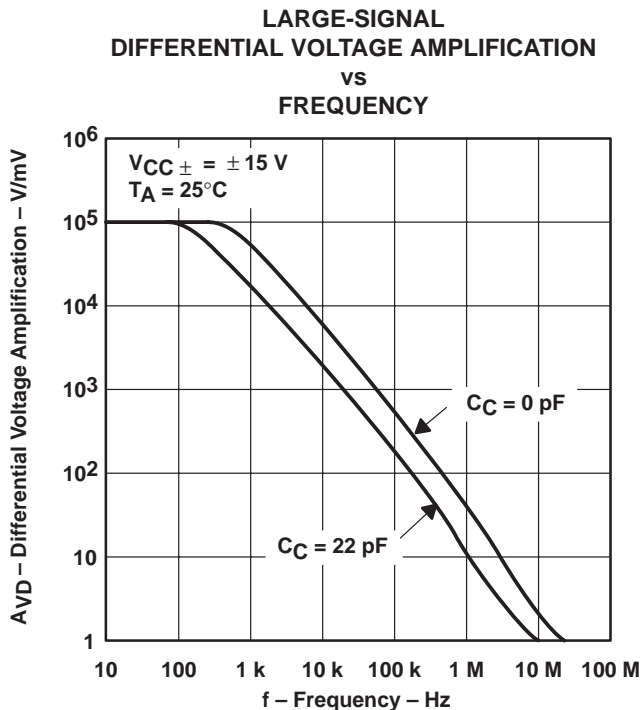


Figure 2

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.



TYPICAL CHARACTERISTICS†



† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

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TYPICAL CHARACTERISTICS

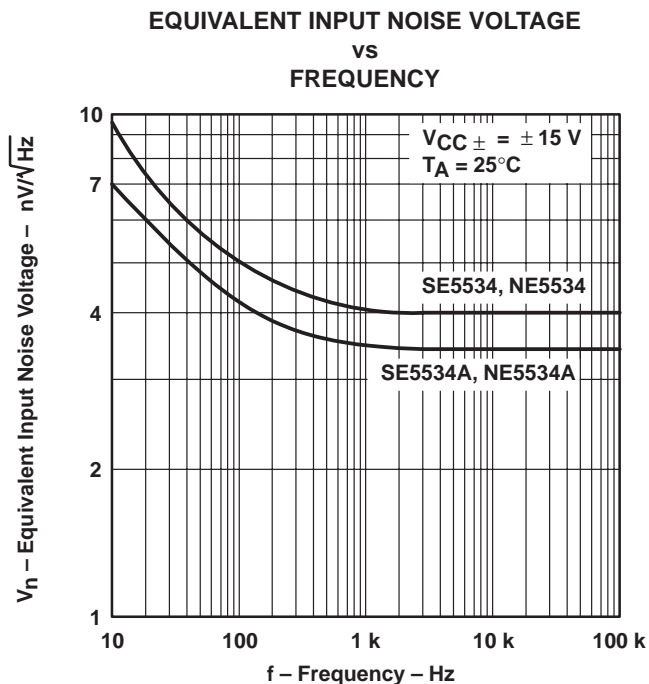


Figure 7

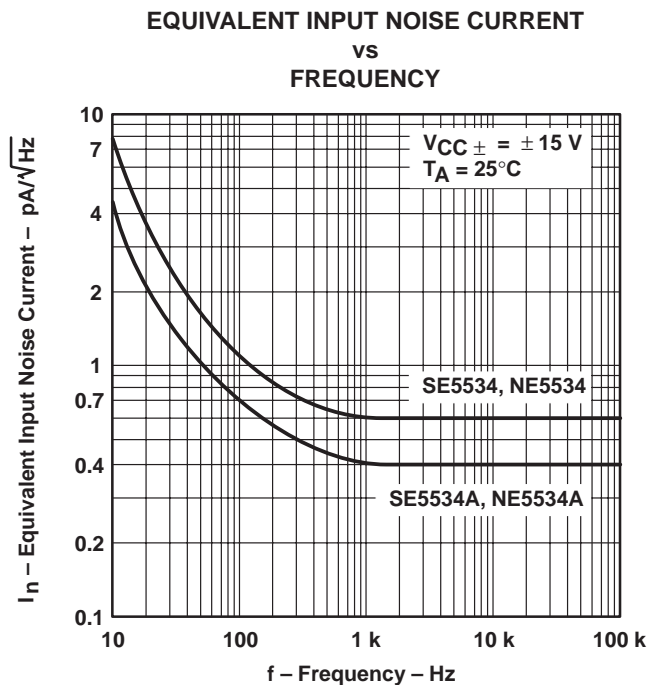


Figure 8

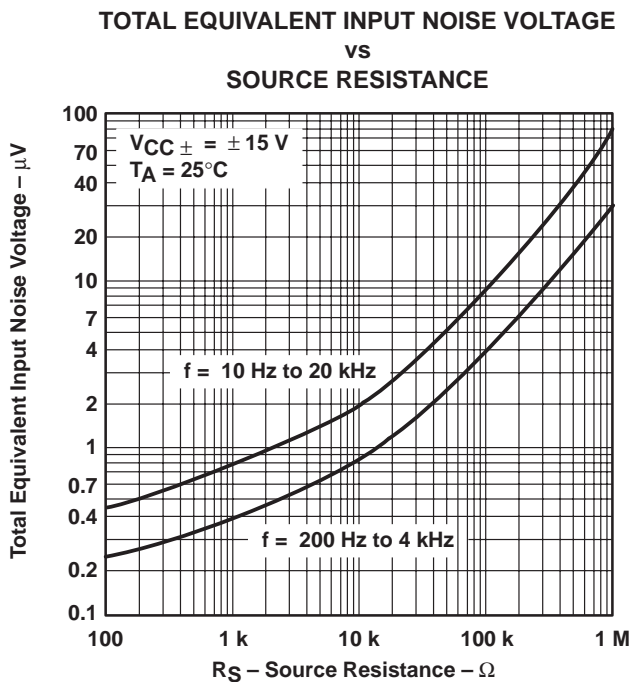


Figure 9

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PRODUCT SUPPORT: [DEVELOPMENT TOOLS](#) | [APPLICATIONS](#)

SE5534, Low-Noise Operational

DEVICE STATUS: **ACTIVE**

FEATURES

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- Equivalent Input Noise Voltage
3.5 nV/√(Hz)
- Unity-Gain Bandwidth...10 MHz Typ
- Common-Mode Rejection Ratio
100 dB Typ
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32 V Typ With $V_{CC\pm} = \pm 18 V$ and $R_L = 600 \Omega$
- High Slew Rate...13 V/us Typ
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- Low Harmonic Distortion
- Designed to Be Interchangeable With Signetics NE5534, NE5534A, SE5534, and SE5534A

DESCRIPTION

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The NE5534, NE5534A, SE5534, and SE5534A are monolithic high-performance operational amplifiers combining excellent dc and ac characteristics. Some of the features include very low noise, high output drive capability, high unity-gain and maximum-output-swing bandwidths, low distortion, and high slew rate.

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For the NE5534A, a maximum limit is specified for equivalent input noise voltage.

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SE5534A are characterized for operation over the full military temperature range of - 55°C to 125°C.

The D package is available taped and reeled. Add the suffix R to the device type (e.g., NE5534DR).

TECHNICAL DOCUMENTS

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To download a document to your hard drive, right-click on the link and choose 'Save'.

DATASHEET

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Full datasheet in Acrobat PDF: [slos070.pdf](#) (119 KB) (Updated: 09/01/1990)

Full datasheet in Zipped PostScript: [slos070.psz](#) (109 KB)

APPLICATION NOTES

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View Application Reports for [Signal Amplifiers \(Less than equal to 100MHz\)](#)

- [Analog Applications Journal May 2000](#) (SLYT015 - Updated: 04/20/2000)
- [Analog Applications Journal, September 1999 edition](#) (SLYT005 - Updated: 07/15/1999)
- [Analysis Of The Sallen-Key Architecture](#) (SLOA024A - Updated: 07/27/1999)

USER MANUALS

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- [Universal Op Amp Single, Dual, Quad \(SOIC\) Evaluation Module With Shutdown](#) (SLOU061, 1160 KB - Updated: 10/22/1999)
- [Universal Operational Amplifier EVM](#) (SLVU006A, 387 KB - Updated: 03/22/1999)
- [Universal Operational Amplifier Evaluation Module Selection Guide](#) (SLOU060A, 16 KB - Updated: 09/28/2000)
- [Universal Operational Amplifier Single, Dual, Quad \(MSOP/TSSOP\)](#) (SLOU055, 1196 KB - Updated: 10/22/1999)
- [Universal Operational Amplifier Single, Dual, Quad \(PDIP\)](#) (SLOU062, 1211 KB - Updated: 10/22/1999)

PRICING/AVAILABILITY

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| <u>ORDERABLE DEVICE</u> | <u>PACKAGE</u> | <u>PINS</u> | <u>TEMP (°C)</u> | <u>STATUS</u> | <u>BUDGETARY PRICE US\$/UNIT QTY=1000+</u> | <u>PACK QTY</u> | <u>DSCC NUMBER</u> | <u>PRICING/AVAILABILITY</u> |
|-------------------------|--------------------|-------------|------------------|---------------|--|-----------------|--------------------|--------------------------------------|
| SE5534FKB | FK | 20 | -55 TO 125 | ACTIVE | 11.15 | 1 | | Check stock or order |
| SE5534JG | JG | 8 | -55 TO 125 | ACTIVE | 4.22 | 1 | | Check stock or order |
| SE5534JGB | JG | 8 | -55 TO 125 | ACTIVE | 4.95 | 1 | | Check stock or order |

DEVELOPMENT TOOLS

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| <u>Tool Part Number</u> | <u>Tool Title</u> | <u>Tool Type</u> |
|-------------------------------|--|--------------------------|
| UNIV-OPAMP-1B | Universal EVM for Single/Dual OpAmps without Shutdown in MSOP/SOIC/SOT-23 packages | Evaluation Modules (EVM) |
| UNIV-OPAMP- | Universal EVM for Single/Dual OpAmps with Shutdown in | Evaluation Modules |

| | | |
|-------------------------------|--|--------------------------|
| 2B | MSOP/SOIC/SOT-23 packages | (EVM) |
| UNIV-OPAMP-3B | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in MSOP/TSSOP packages | Evaluation Modules (EVM) |
| UNIV-OPAMP-4B | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in SOIC packages | Evaluation Modules (EVM) |
| UNIV-OPAMP-5B | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in PDIP packages | Evaluation Modules (EVM) |

Table Data Updated on: 11/12/2000

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