

# 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  $\Omega$ , 10 V<sub>RMS</sub> at V<sub>S</sub> =  $\pm 18$  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/ $\mu\text{s}$
- Large Supply Voltage Range:  $\pm 3.0$  to  $\pm 20$  V

### Applications

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

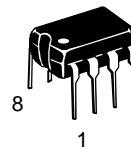


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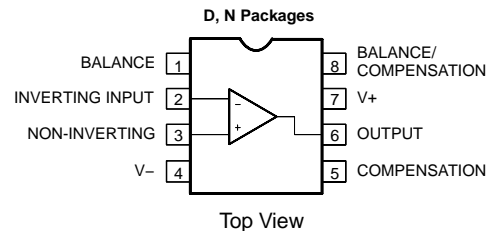


SOIC-8  
D SUFFIX  
CASE 751



PDIP-8  
N SUFFIX  
CASE 626

### PIN CONNECTIONS



### ORDERING INFORMATION

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

### DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 10 of this data sheet.

# NE5534, SA5534, SE5534, NE5534A, SA5534A, SE5534A

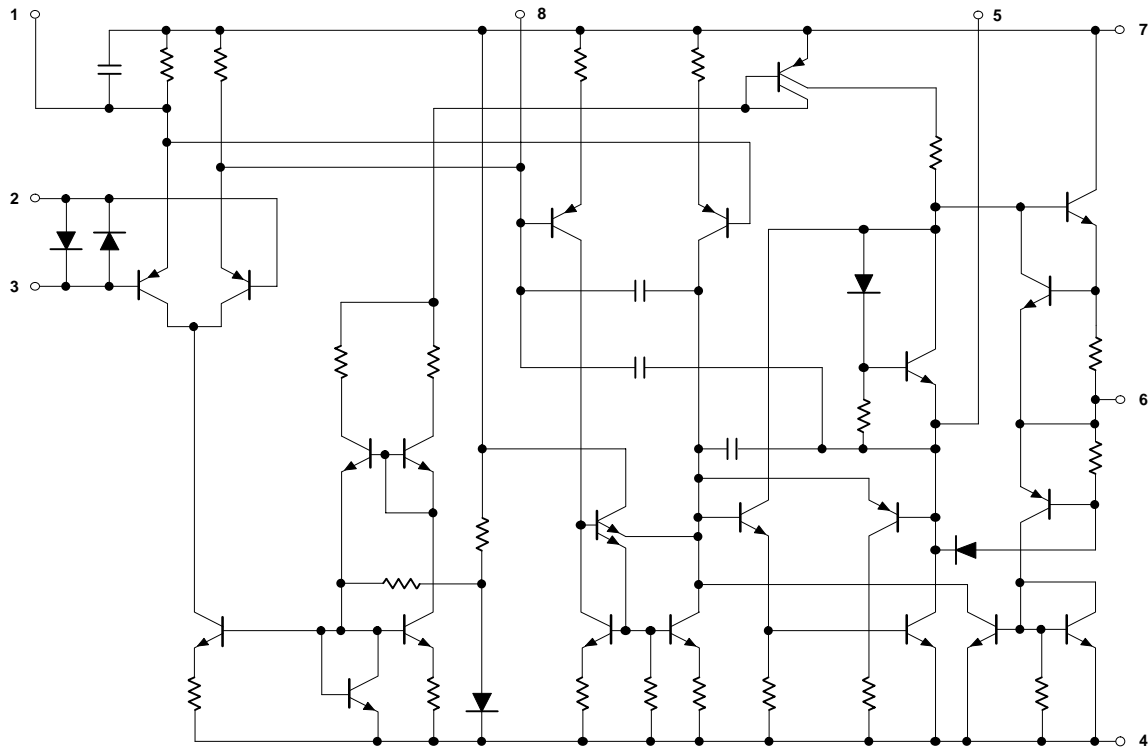


Figure 1. Equivalent Schematic

## 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 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 1150 750	mW
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	N Package D Package 130 158	$^{\circ}C/W$
Output Short-Circuit Duration (Note 2)	-	Indefinite	-
Lead Soldering Temperature (10 sec max)	$T_{slid}$	230	$^{\circ}C$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

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  $\pm 10$  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	$V_{CM}$		$\pm 12$	$\pm 13$	-	$\pm 12$	$\pm 13$	-	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	$\pm 12$	$\pm 13$	-	$\pm 12$	$\pm 13$	-	V
			$\pm 10$	$\pm 12$	-	$\pm 10$	$\pm 12$	-	
			$\pm 15$	$\pm 16$	-	$\pm 15$	16	-	
			$\pm 13$	$\pm 13.5$	-	$\pm 13$	$\pm 13.5$	-	
			$\pm 12$	$\pm 12.5$	-	$\pm 12$	$\pm 12.5$	-	
Input Resistance	$R_{IN}$		30	100	-	50	100	-	k $\Omega$
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	–	$\Omega$
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 2.2	–	–	6.0 2.2	–	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 6.0	–	–	13 6.0	–	V/ $\mu\text{s}$
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 95 70	–	–	200 95 70	–	kHz

## 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 4.0	–	–	5.5 3.5	7.0 4.5	nV/ $\sqrt{\text{Hz}}$
Input Noise Current	$I_{NOISE}$	$f_O = 30\text{ Hz}$ $f_O = 1.0\text{ kHz}$	–	2.5 0.6	–	–	1.5 0.4	–	pA/ $\sqrt{\text{Hz}}$
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

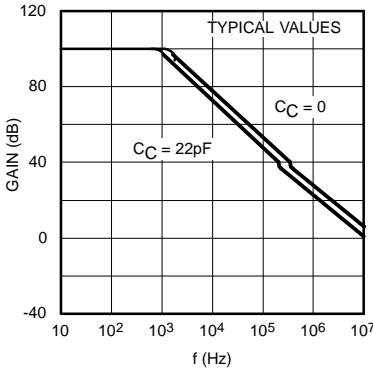


Figure 2. Open-Loop Frequency Response

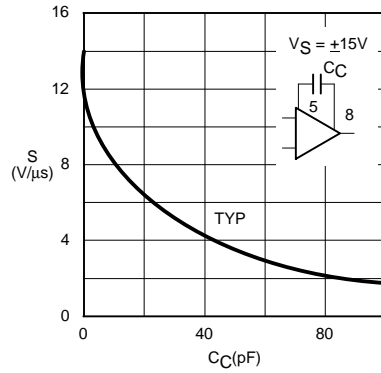


Figure 3. Slew Rate as a Function of Compensation Capacitance

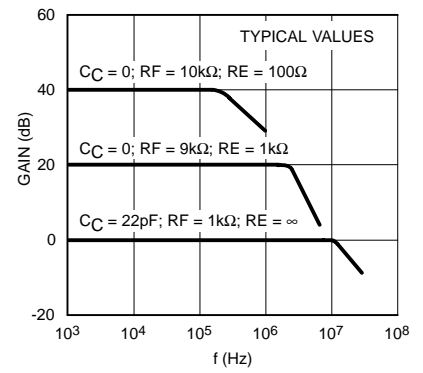


Figure 4. Closed-Loop Frequency Response

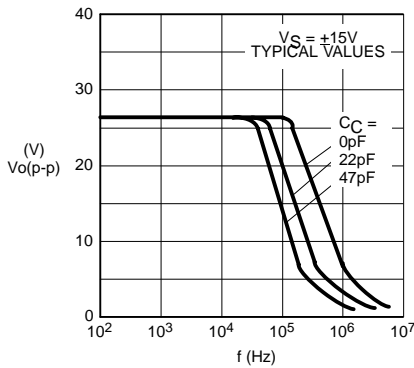


Figure 5. Large-Signal Frequency Response

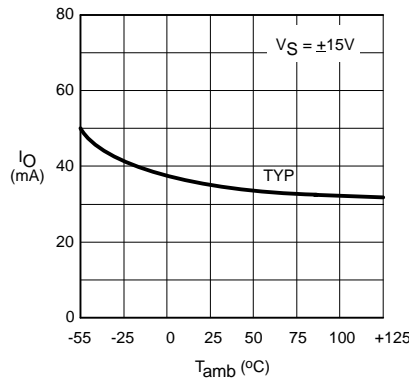


Figure 6. Output Short-Circuit Current

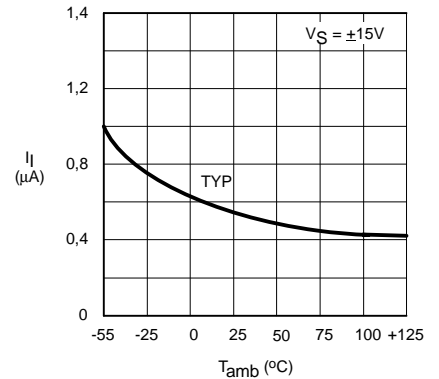


Figure 7. Input Bias Current

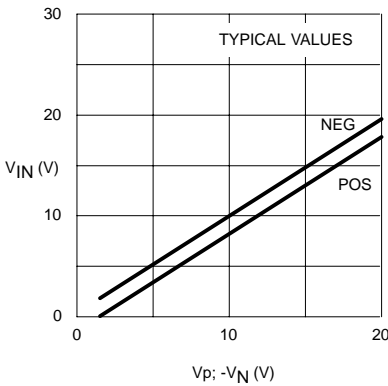


Figure 8. Input Common-Mode Voltage Range

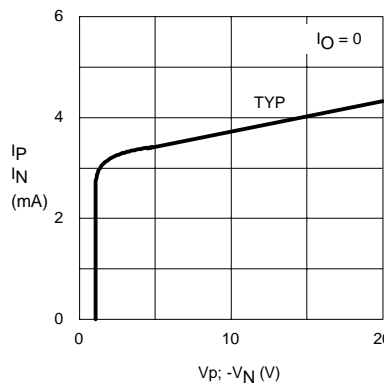


Figure 9. Supply Current Per Op Amp

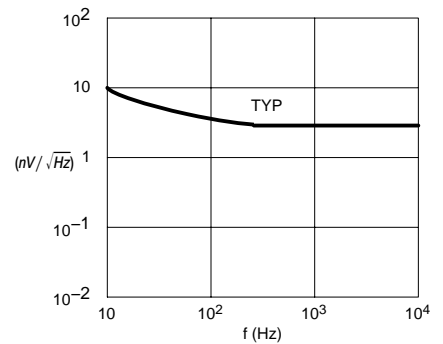


Figure 10. Input Noise Voltage Density

TYPICAL PERFORMANCE CHARACTERISTICS

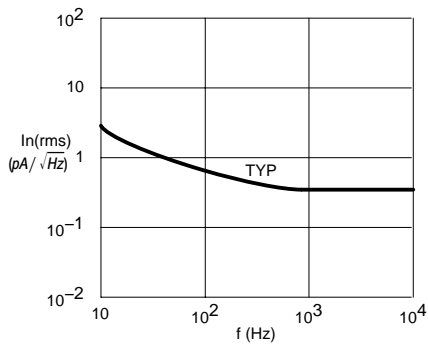


Figure 11. Input Noise Current Density

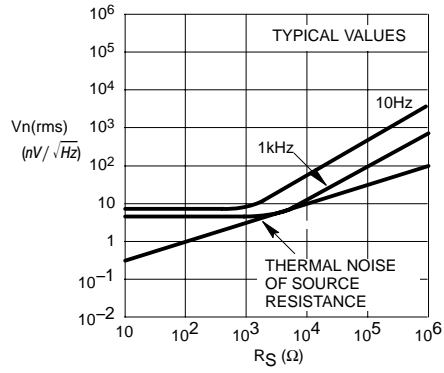


Figure 12. Total Input Noise Density

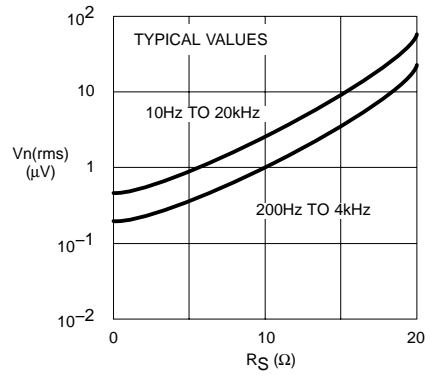


Figure 13. Broadband Input Noise Voltage

TEST LOAD CIRCUITS

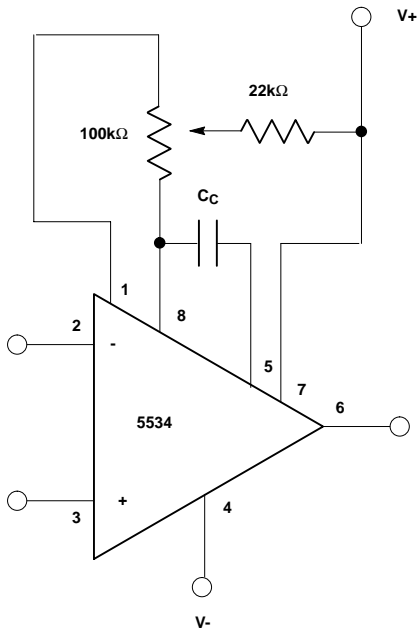


Figure 14. Frequency Compensation and Offset Voltage Adjustment Circuit

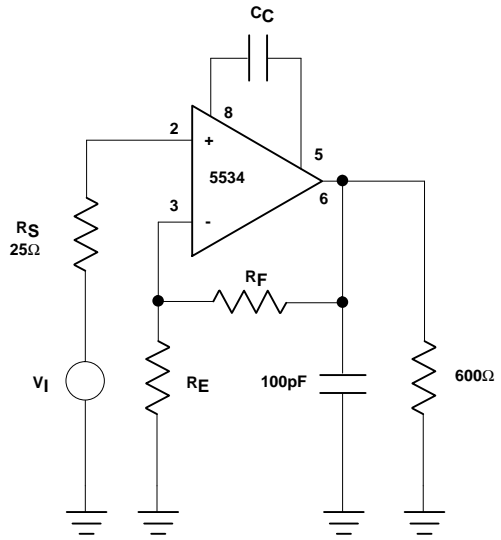


Figure 15. Closed-Loop Frequency Response

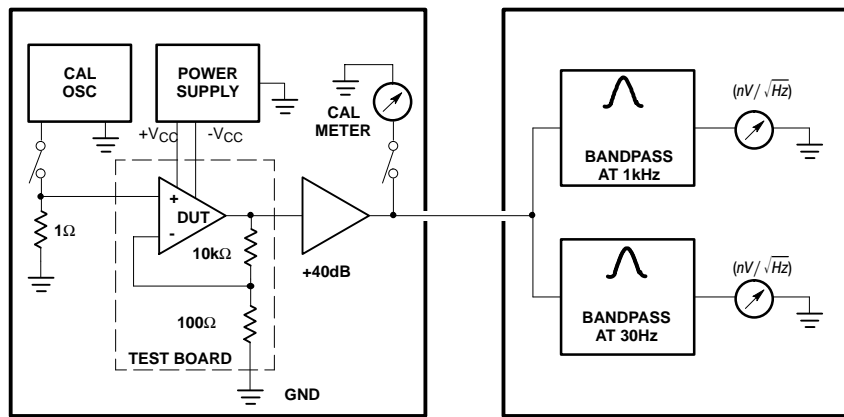


Figure 16. Noise Test Block Diagram

# NE5534, SA5534, SE5534, NE5534A, SA5534A, SE5534A

## ORDERING INFORMATION

Device	Description	Temperature Range	Shipping†
NE5534AD	8-Pin Plastic Small Outline Package	0 to +70°C	98 Units/Rail
NE5534ADR2	8-Pin Plastic Small Outline Package	0 to +70°C	2500 Tape & Reel
NE5534AN	8-Pin Plastic Dual In-Line Package	0 to +70°C	50 Units/Rail
NE5534D	8-Pin Plastic Small Outline Package	0 to +70°C	98 Units/Rail
NE5534DR2	8-Pin Plastic Small Outline Package	0 to +70°C	2500 Tape & Reel
NE5534N	8-Pin Plastic Dual In-Line Package	0 to +70°C	50 Units/Rail
SA5534AD	8-Pin Plastic Small Outline Package	-40 to +85°C	98 Units/Rail
SA5534ADR2	8-Pin Plastic Small Outline Package	-40 to +85°C	2500 Tape & Reel
SA5534AN	8-Pin Plastic Dual In-Line Package	-40 to +85°C	50 Units/Rail
SA5534N	8-Pin Plastic Dual In-Line Package	-40 to +85°C	50 Units/Rail
SE5534AN	8-Pin Plastic Dual In-Line Package	-55 to +125°C	50 Units/Rail
SE5534N	8-Pin Plastic Dual In-Line Package	-55 to +125°C	50 Units/Rail

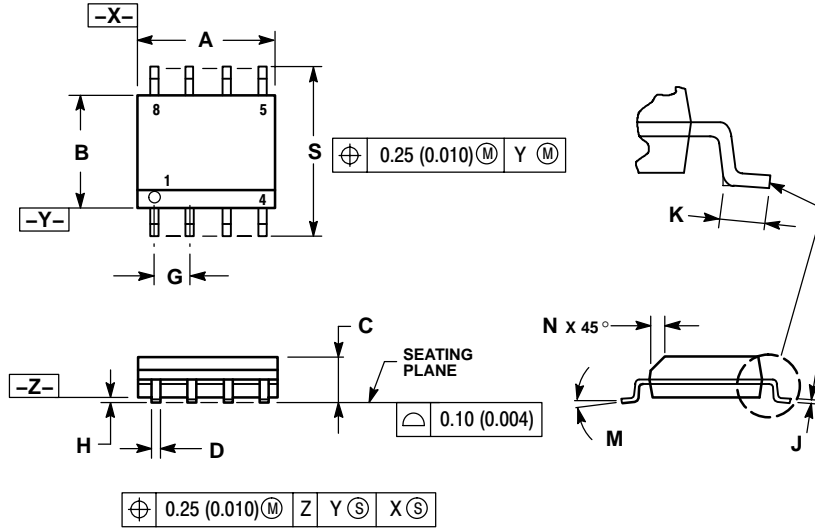
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.



# NE5534, SA5534, SE5534, NE5534A, SA5534A, SE5534A

## PACKAGE DIMENSIONS

SOIC-8 NB  
D SUFFIX  
CASE 751-07  
ISSUE AB

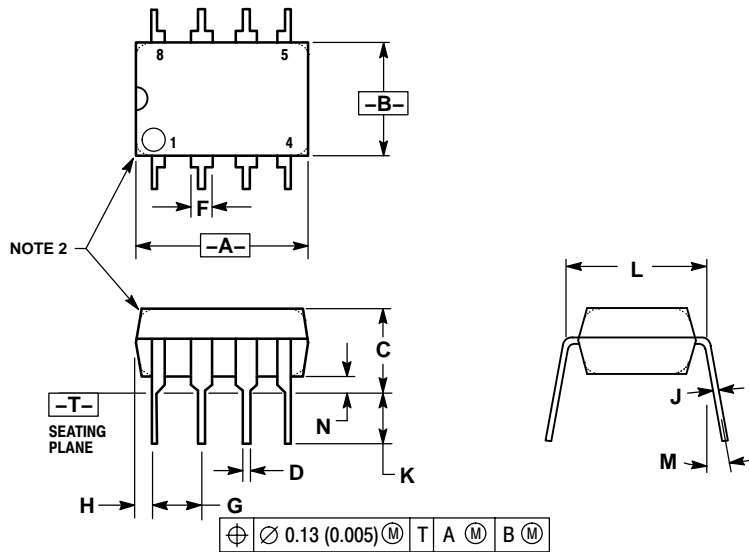


### NOTES:

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

PDIP-8  
N SUFFIX  
CASE 626-05  
ISSUE L



### NOTES:

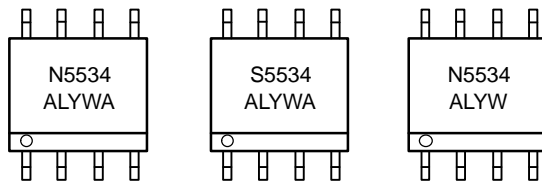
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

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

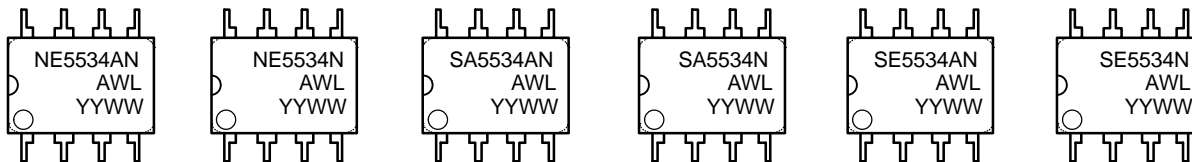
# NE5534, SA5534, SE5534, NE5534A, SA5534A, SE5534A

## MARKING DIAGRAMS


### SOIC-8 D SUFFIX CASE 751



### PDIP-8 N SUFFIX CASE 626



A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week

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