

# DATA SHEET

## **NE/SA/SE5532/5532A**

Internally-compensated dual low noise  
operational amplifier

Product data  
Supersedes data of 1997 Sep 29

2001 Aug 03

# Internally-compensated dual low noise operational amplifier

## NE/SA/SE5532/5532A

### DESCRIPTION

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 Ω, 10 V<sub>RMS</sub>
- Input noise voltage: 5 nV/√Hz (typical)
- DC voltage gain: 50000
- AC voltage gain: 2200 at 10 kHz
- Power bandwidth: 140 kHz
- Slew rate: 9 V/μs
- Large supply voltage range: ±3 to ±20 V
- Compensated for unity gain

### PIN CONFIGURATIONS

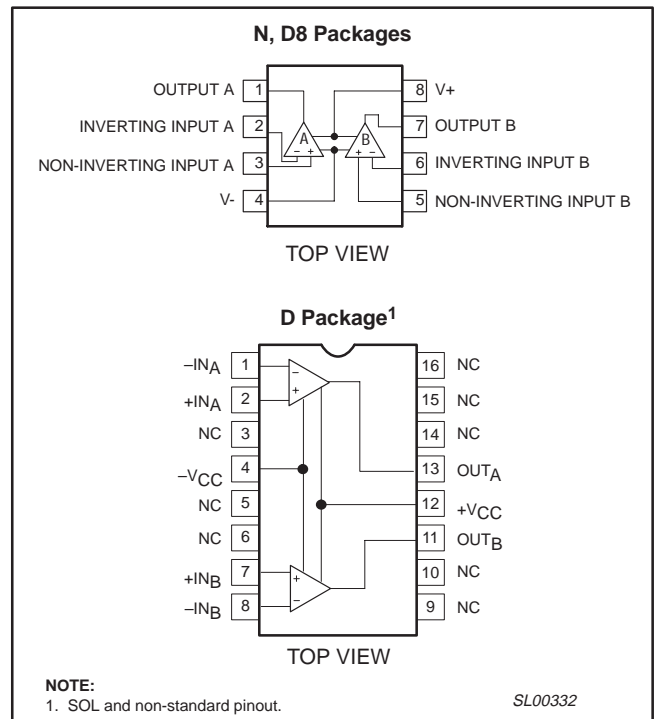


Figure 1. Pin Configurations

### ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE	DWG #
8-Pin Small Outline Package (SO)	0 °C to 70 °C	NE5532AD8	SOT96-1
8-Pin Plastic Dual In-Line Package (DIP)	0 °C to 70 °C	NE5532AN	SOT97-1
16-Pin Plastic Small Outline Large (SOL) Package	0 °C to 70 °C	NE5532D	SOT162-1
8-Pin Small Outline Package (SO)	0 °C to 70 °C	NE5532D8	SOT96-1
8-Pin Plastic Dual In-Line Package (DIP)	0 °C to 70 °C	NE5532N	SOT97-1
8-Pin Plastic Dual In-Line Package (DIP)	-40 °C to +85 °C	SA5532N	SOT97-1
8-Pin Small Outline Package (SO)	-55 °C to +125 °C	SE5532AD8	SOT96-1
16-Pin Plastic Dual In-Line Package (DIP)	-55 °C to +125 °C	SE5532N	SOT38-4

# Internally-compensated dual low noise operational amplifier

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## EQUIVALENT SCHEMATIC (EACH AMPLIFIER)

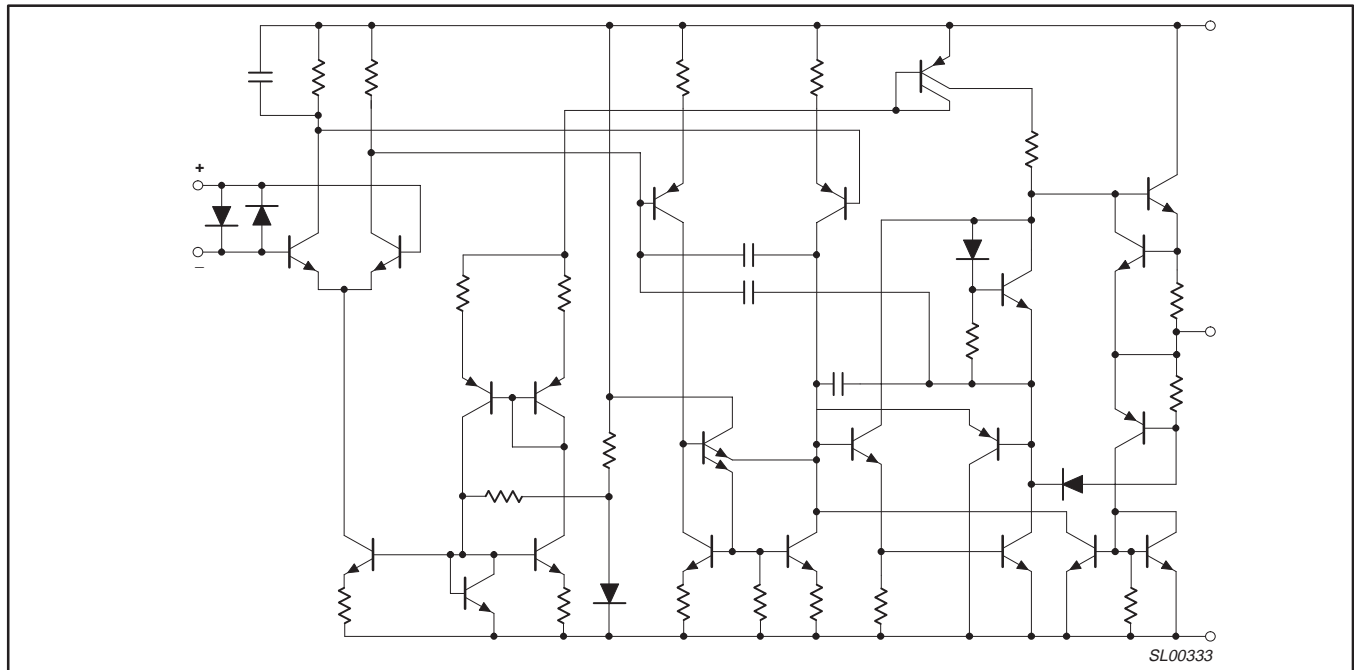


Figure 2. Equivalent Schematic (Each Amplifier)

## ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
$V_S$	Supply voltage	$\pm 22$	V
$V_{IN}$	Input voltage	$\pm V_{SUPPLY}$	V
$V_{DIFF}$	Differential input voltage <sup>1</sup>	$\pm 0.5$	V
$T_{amb}$	Operating temperature range NE5532/A SA5532 SE5532/A	0 to 70 -40 to +85 -55 to +125	$^{\circ}C$
$T_{stg}$	Storage temperature	-65 to +150	$^{\circ}C$
$T_j$	Junction temperature	150	$^{\circ}C$
$P_D$	Maximum power dissipation, $T_{amb} = 25^{\circ}C$ (still-air) <sup>2</sup> 8 D8 package 8 N package 16 D package	780 1200 1200	mW
$T_{sld}$	Lead soldering temperature (10 sec max)	230	$^{\circ}C$

### NOTES:

- Diodes protect the inputs against over-voltage. Therefore, unless current-limiting resistors are used, large currents will flow if the differential input voltage exceeds 0.6V. Maximum current should be limited to  $\pm 10$  mA.
- Thermal resistances of the above packages are as follows:  
N package at  $100^{\circ}C/W$   
D package at  $105^{\circ}C/W$   
D8 package at  $160^{\circ}C/W$

# Internally-compensated dual low noise operational amplifier

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## DC ELECTRICAL CHARACTERISTICS

 $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $V_S = \pm 15\text{ V}$ , unless otherwise specified. 1, 2, 3

SYMBOL	PARAMETER	TEST CONDITIONS	SE5532/A			NE5532/A, SA5532			UNIT
			Min	Typ	Max	Min	Typ	Max	
$V_{OS}$	Offset voltage	Over temperature		0.5	2		0.5	4	mV
$\Delta V_{OS}/\Delta T$				5			5	5	mV $\mu\text{V}/^{\circ}\text{C}$
$I_{OS}$	Offset current	Over temperature			100		10	150	nA
$\Delta I_{OS}/\Delta T$				200			200	200	nA $\text{pA}/^{\circ}\text{C}$
$I_B$	Input current	Over temperature		200	400		200	800	nA
$\Delta I_B/\Delta T$				5	700		5	1000	nA $\text{nA}/^{\circ}\text{C}$
$I_{CC}$	Supply current	Over temperature		8	10.5		8	16	mA
						13			mA
$V_{CM}$	Common-mode input range		$\pm 12$	$\pm 13$		$\pm 12$	$\pm 13$		V
CMRR	Common-mode rejection ratio		80	100		70	100		dB
PSRR	Power supply rejection ratio			10	50		10	100	$\mu\text{V}/\text{V}$
$A_{VOL}$	Large-signal voltage gain	$R_L \geq 2\text{ k}\Omega$ ; $V_O = \pm 10\text{ V}$	50	100		25	100		V/mV
		Over temperature	25			15			V/mV
		$R_L \geq 600\ \Omega$ ; $V_O = \pm 10\text{ V}$	40	50		15	50		V/mV
		Over temperature	20			10			V/mV
$V_{OUT}$	Output swing	$R_L \geq 600\ \Omega$	$\pm 12$	$\pm 13$		$\pm 12$	$\pm 13$		V
		Over temperature	$\pm 10$	$\pm 12$		$\pm 10$	$\pm 12$		
		$R_L \geq 600\ \Omega$ ; $V_S = \pm 18\text{ V}$	$\pm 15$	$\pm 16$		$\pm 15$	$\pm 16$		
		Over temperature	$\pm 12$	$\pm 14$		$\pm 12$	$\pm 14$		
		$R_L \geq 2\text{ k}\Omega$	$\pm 13$	$\pm 13.5$		$\pm 13$	$\pm 13.5$		
		Over temperature	$\pm 12$	$\pm 12.5$		$\pm 10$	$\pm 12.5$		
$R_{IN}$	Input resistance		30	300		30	300		k $\Omega$
$I_{SC}$	Output short circuit current		10	38	60	10	38	60	mA

### NOTES:

- 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  $\pm 10\text{ mA}$ .
- For operation at elevated temperature, derate packages based on the package thermal resistance.
- Output may be shorted to ground at  $V_S = \pm 15\text{ V}$ ,  $T_{amb} = 25\text{ }^{\circ}\text{C}$ . Temperature and/or supply voltages must be limited to ensure dissipation rating is not exceeded.

## AC ELECTRICAL CHARACTERISTICS

 $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $V_S = \pm 15\text{ V}$ , unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	NE/SE5532/A, SA5532			UNIT
			Min	Typ	Max	
$R_{OUT}$	Output resistance	$A_V = 30\text{ dB}$ Closed-loop $f = 10\text{ kHz}$ , $R_L = 600\ \Omega$		0.3		$\Omega$
	Overshoot	Voltage-follower $V_{IN} = 100\text{ mV}_{P-P}$ $C_L = 100\text{ pF}$ ; $R_L = 600\ \Omega$		10		%
$A_V$	Gain	$f = 10\text{ kHz}$		2.2		V/mV
GBW	Gain bandwidth product	$C_L = 100\text{ pF}$ ; $R_L = 600\ \Omega$		10		MHz
SR	Slew rate			9		V/ $\mu\text{s}$
	Power bandwidth	$V_{OUT} = \pm 10\text{ V}$ $V_{OUT} = \pm 14\text{ V}$ ; $R_L = 600\ \Omega$ , $V_{CC} = \pm 18\text{ V}$		140		kHz
				100		kHz

# Internally-compensated dual low noise operational amplifier

NE/SA/SE5532/5532A

## ELECTRICAL CHARACTERISTICS

$T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $V_S = \pm 15\text{ V}$ , unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	NE/SE5532			NE/SA/SE5532A			UNIT
			Min	Typ	Max	Min	Typ	Max	
$V_{NOISE}$	Input noise voltage	$f_O = 30\text{ Hz}$ $f_O = 1\text{ kHz}$		8			8	12	$\text{nV}/\sqrt{\text{Hz}}$
				5			5	6	$\text{nV}/\sqrt{\text{Hz}}$
$I_{NOISE}$	Input noise current	$f_O = 30\text{ Hz}$ $f_O = 1\text{ kHz}$		2.7			2.7		$\text{pA}/\sqrt{\text{Hz}}$
				0.7			0.7		$\text{pA}/\sqrt{\text{Hz}}$
	Channel separation	$f = 1\text{ kHz}$ ; $R_S = 5\text{ k}\Omega$		110			110		dB

## TYPICAL PERFORMANCE CHARACTERISTICS

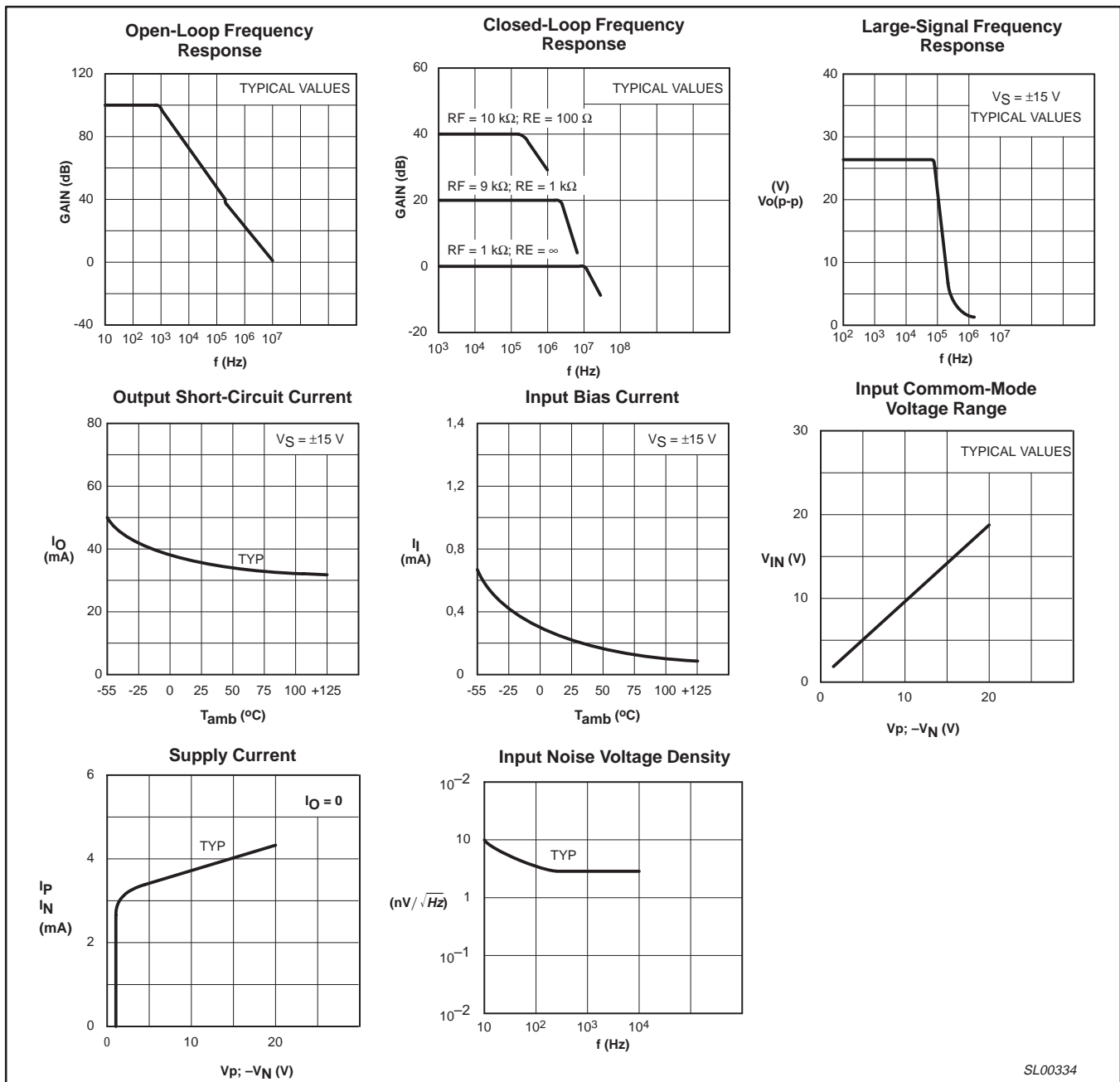


Figure 3. Typical Performance Characteristics

# Internally-compensated dual low noise operational amplifier

NE/SA/SE5532/5532A

## TEST CIRCUITS

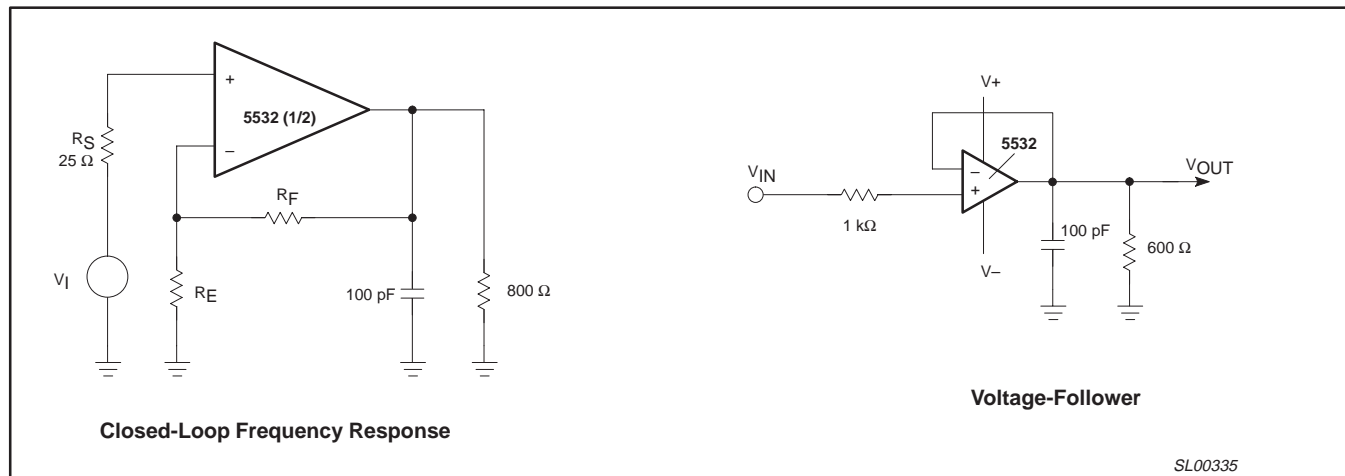


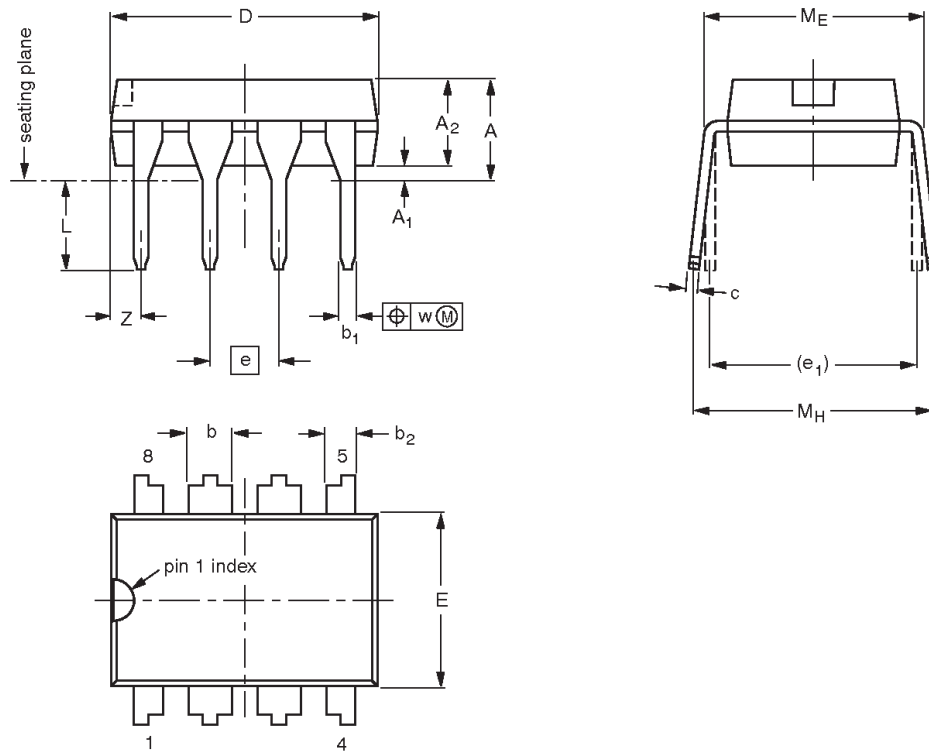
Figure 4. Test Circuits

Internally-compensated dual low noise operational amplifier

NE/SA/SE5532/5532A

DIP8: plastic dual in-line package; 8 leads (300 mil)

SOT97-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A <sub>1</sub> min.	A <sub>2</sub> max.	b	b <sub>1</sub>	b <sub>2</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	e <sub>1</sub>	L	M <sub>E</sub>	M <sub>H</sub>	w	Z <sup>(1)</sup> max.
mm	4.2	0.51	3.2	1.73 1.14	0.53 0.38	1.07 0.89	0.36 0.23	9.8 9.2	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	1.15
inches	0.17	0.020	0.13	0.068 0.045	0.021 0.015	0.042 0.035	0.014 0.009	0.39 0.36	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.045

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

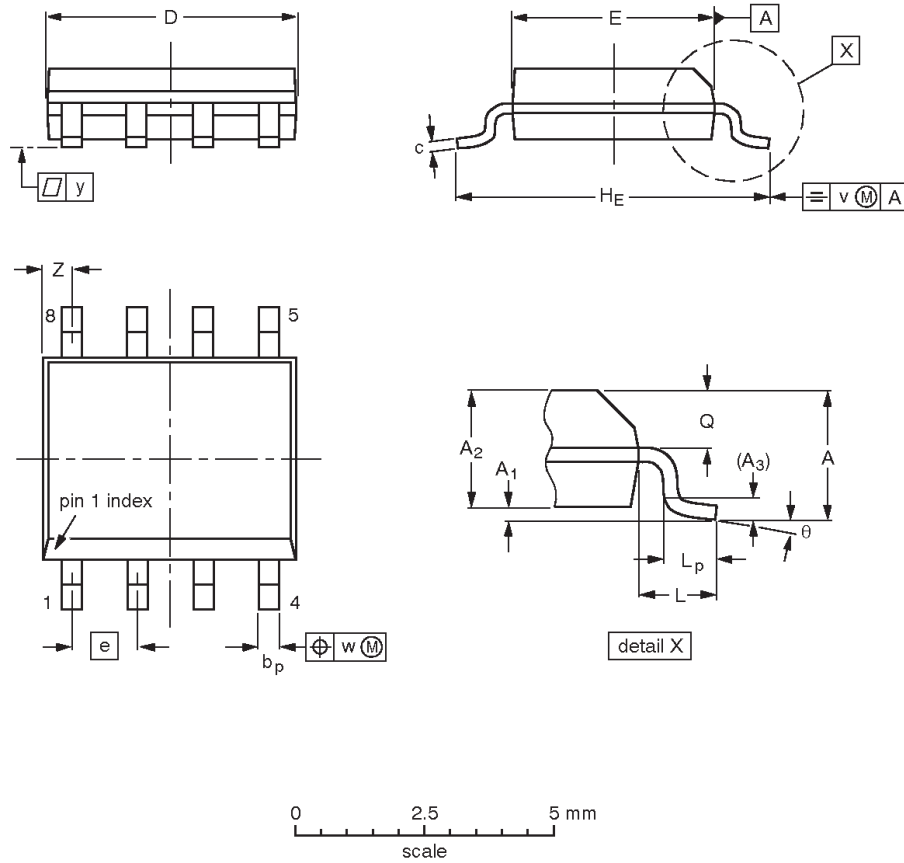
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT97-1	050G01	MO-001	SC-504-8			95-02-04 99-12-27

# Internally-compensated dual low noise operational amplifier

NE/SA/SE5532/5532A

**S08:** plastic small outline package; 8 leads; body width 3.9 mm

**SOT96-1**



**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(2)</sup>	e	HE	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	5.0 4.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.20 0.19	0.16 0.15	0.050	0.244 0.228	0.041	0.039 0.016	0.028 0.024	0.01	0.01	0.004	0.028 0.012	

**Notes**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT96-1	076E03	MS-012				97-05-22 99-12-27

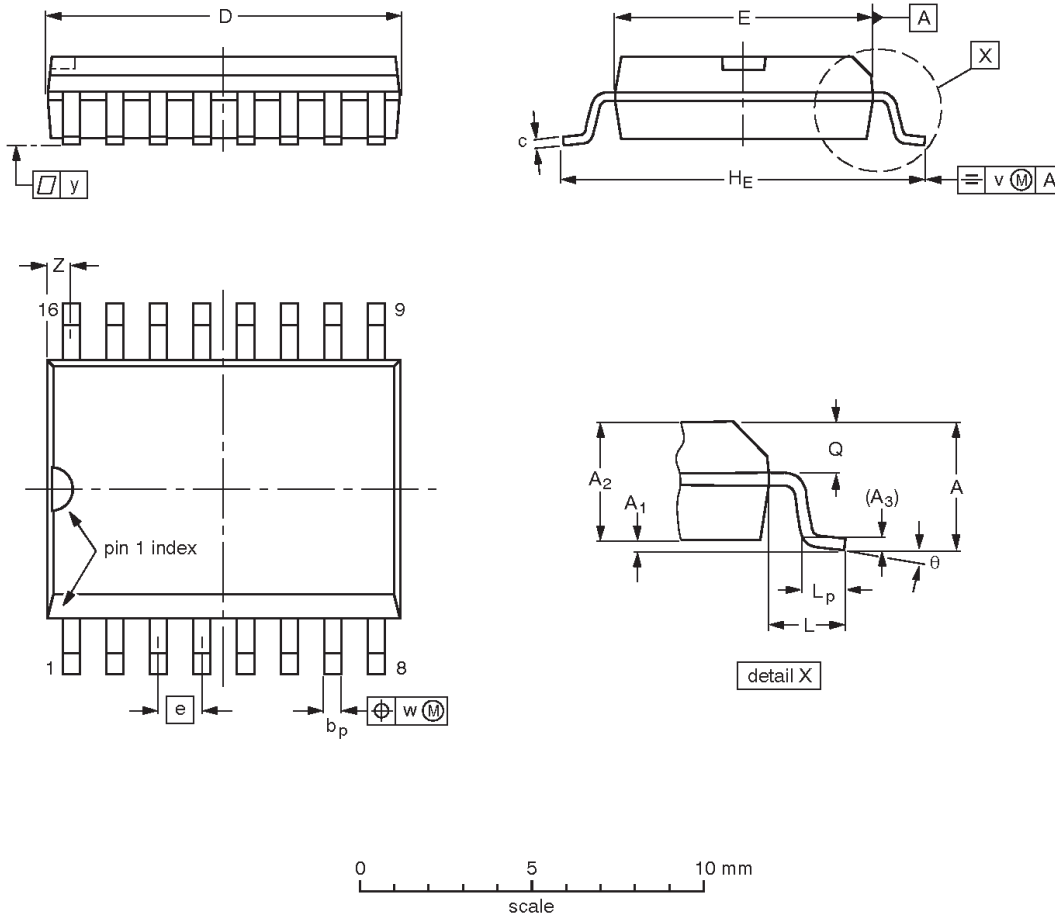


# Internally-compensated dual low noise operational amplifier

NE/SA/SE5532/5532A

SO16: plastic small outline package; 16 leads; body width 7.5 mm

SOT162-1



**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	z <sup>(1)</sup>	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	10.5 10.1	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.41 0.40	0.30 0.29	0.050	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

**Note**

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

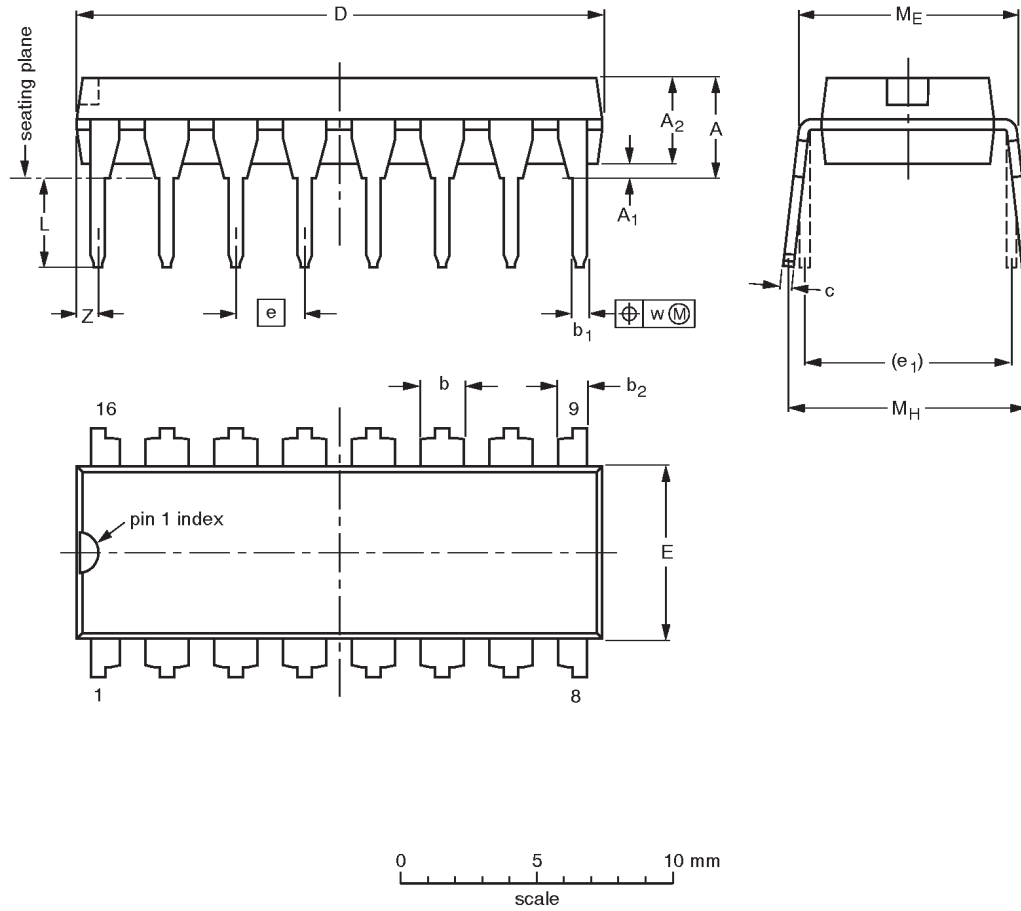
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT162-1	075E03	MS-013				-97-05-22 99-12-27

# Internally-compensated dual low noise operational amplifier

NE/SA/SE5532/5532A

DIP16: plastic dual in-line package; 16 leads (300 mil)

SOT38-4



**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

UNIT	A max.	A <sub>1</sub> min.	A <sub>2</sub> max.	b	b <sub>1</sub>	b <sub>2</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	e <sub>1</sub>	L	M <sub>E</sub>	M <sub>H</sub>	w	z <sup>(1)</sup> max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.020	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	0.10	0.30	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.030

**Note**

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-4						92-11-17 95-01-14

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Internally-compensated dual low noise  
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**NOTES**

# Internally-compensated dual low noise operational amplifier

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