

# DATA SHEET

勝特力材料 886-3-5753170  
勝特力电子(上海) 86-21-54151736  
勝特力电子(深圳) 86-755-83298787  
[Http://www.100y.com.tw](http://www.100y.com.tw)

## NE/SA/SE5532/5532A

Internally-compensated dual low noise  
operational amplifier

Product specification

1997 Sept 29

IC11 Data Handbook

# 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: 10MHz
- Output drive capability: 600Ω, 10V<sub>RMS</sub>
- Input noise voltage: 5nV/√Hz (typical)
- DC voltage gain: 50000
- AC voltage gain: 2200 at 10kHz
- Power bandwidth: 140kHz
- Slew rate: 9V/μs
- Large supply voltage range: ±3 to ±20V
- Compensated for unity gain

### PIN CONFIGURATIONS

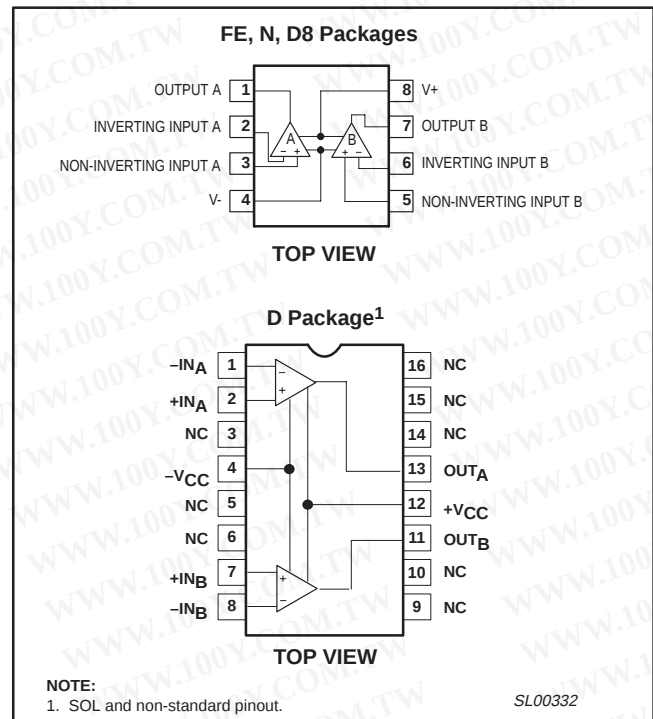


Figure 1. Pin Configurations

### ORDERING INFORMATION

| DESCRIPTION                                      | TEMPERATURE RANGE | ORDER CODE | DWG #    |
|--------------------------------------------------|-------------------|------------|----------|
| 8-Pin Plastic Dual In-Line Package (DIP)         | 0 to 70°C         | NE5532N    | SOT97-1  |
| 8-Pin Plastic Dual In-Line Package (DIP)         | -40°C to +85°C    | SA5532N    | SOT97-1  |
| 8-Pin Plastic Dual In-Line Package (DIP)         | -40°C to +85°C    | SA5532AN   | SOT97-1  |
| 8-Pin Ceramic Dual In-Line Package (CERDIP)      | 0 to 70°C         | NE5532FE   | 0580A    |
| 8-Pin Plastic Dual In-Line Package (DIP)         | 0 to 70°C         | NE5532AN   | SOT97-1  |
| 8-Pin Ceramic Dual In-Line Package (CERDIP)      | 0 to 70°C         | NE5532AF   | 0580A    |
| 8-Pin Ceramic Dual In-Line Package (CERDIP)      | -55°C to +125°C   | SE5532FE   | 0580A    |
| 8-Pin Ceramic Dual In-Line Package (CERDIP)      | -55°C to +125°C   | SE5532AF   | 0580A    |
| 8-Pin Small Outline Package (SO)                 | 0 to 70°C         | NE5532AD8  | SOT96-1  |
| 8-Pin Small Outline Package (SO)                 | -40°C to 85°C     | SA5532D8   | SOT96-1  |
| 8-Pin Small Outline Package (SO)                 | -40°C to 85°C     | SA5532AD8  | SOT96-1  |
| 8-Pin Small Outline Package (SO)                 | -55°C to +125°C   | SE5532AD8  | SOT96-1  |
| 8-Pin Small Outline Package (SO)                 | 0 to 70°C         | NE5532D8   | SOT96-1  |
| 8-Pin Small Outline Package (SO)                 | -40°C to 85°C     | SA5532D8   | SOT96-1  |
| 8-Pin Small Outline Package (SO)                 | -40°C to 85°C     | SA5532AD8  | SOT96-1  |
| 8-Pin Small Outline Package (SO)                 | -55°C to +125°C   | SE5532D8   | SOT96-1  |
| 16-Pin Plastic Small Outline Large (SOL) Package | 0 to 70°C         | NE5532D    | SOT162-1 |
| 16-Pin Plastic Dual In-Line Package (DIP)        | -55°C to +125°C   | SE5532N    | SOT38-4  |

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EQUIVALENT SCHEMATIC (EACH AMPLIFIER)

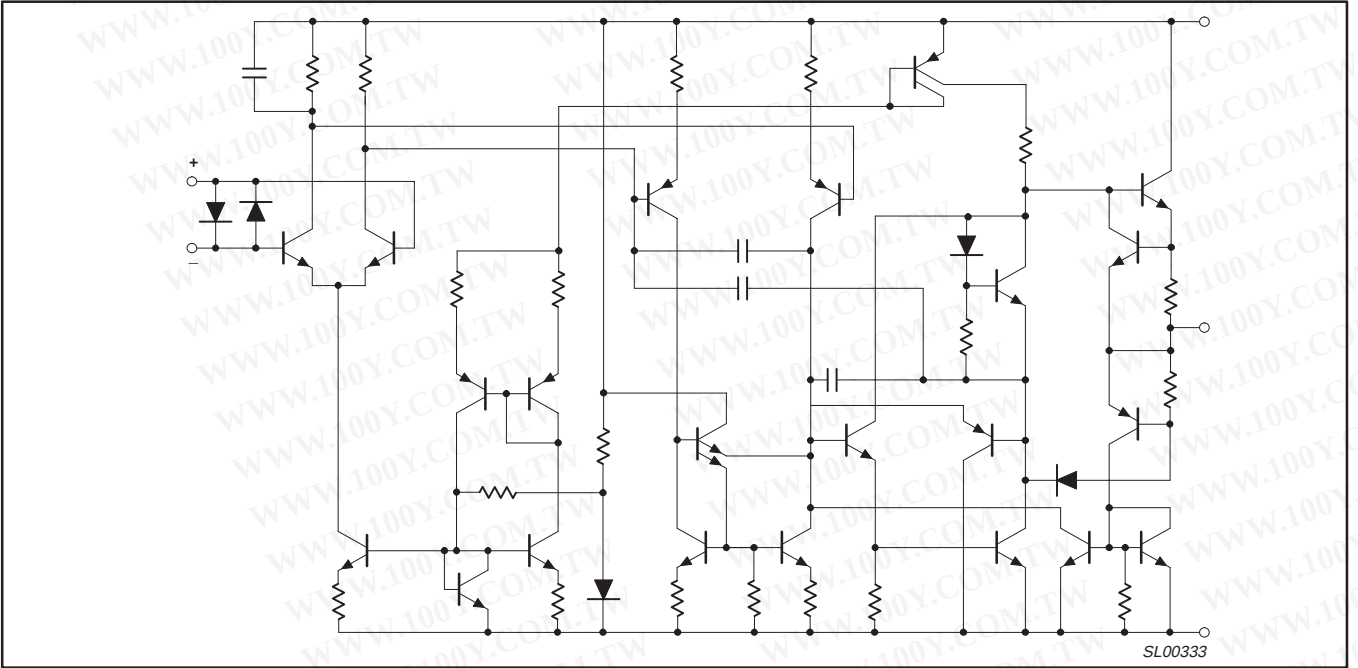


Figure 2. Equivalent Schematic (Each Amplifier)

ABSOLUTE MAXIMUM RATINGS

| SYMBOL            | PARAMETER                                                                                                                                  | RATING                               | UNIT                 |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------------------|
| V <sub>S</sub>    | Supply voltage                                                                                                                             | ±22                                  | V                    |
| V <sub>IN</sub>   | Input voltage                                                                                                                              | ±V <sub>SUPPLY</sub>                 | V                    |
| V <sub>DIFF</sub> | Differential input voltage <sup>1</sup>                                                                                                    | ±0.5                                 | V                    |
| T <sub>A</sub>    | Operating temperature range<br>SA5532/A<br>NE5532/A<br>SE5532/A                                                                            | -40 to +85<br>0 to 70<br>-55 to +125 | °C<br>°C<br>°C       |
| T <sub>STG</sub>  | Storage temperature                                                                                                                        | -65 to +150                          | °C                   |
| T <sub>J</sub>    | Junction temperature                                                                                                                       | 150                                  | °C                   |
| P <sub>D</sub>    | Maximum power dissipation,<br>T <sub>A</sub> =25°C (still-air) <sup>2</sup><br>8 D8 package<br>8 N package<br>8 FE package<br>16 D package | 780<br>1200<br>1000<br>1200          | mW<br>mW<br>mW<br>mW |
| T <sub>SOLD</sub> | Lead soldering temperature (10sec max)                                                                                                     | 300                                  | °C                   |

NOTES:

1. 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 ±10mA.
2. Thermal resistances of the above packages are as follows:  
N package at 100°C/W  
F package at 135°C/W  
D package at 105°C/W  
D8 package at 160°C/W

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## DC ELECTRICAL CHARACTERISTICS

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

| SYMBOL                   | PARAMETER                    | TEST CONDITIONS                                     | SE/5532/5532A |            |      | NE/SA/5532/5532A |            |      | 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          | 3    |                  | 5          | 5    | mV/ $^\circ\text{C}$ |
| $I_{OS}$                 | Offset current               | Over temperature                                    |               |            | 100  |                  | 10         | 150  | nA                   |
| $\Delta I_{OS}/\Delta T$ |                              |                                                     |               | 200        | 200  |                  | 200        | 200  | nA/ $^\circ\text{C}$ |
| $I_B$                    | Input current                | Over temperature                                    |               | 200        | 400  |                  | 200        | 800  | nA                   |
| $\Delta I_B/\Delta T$    |                              |                                                     |               | 5          | 700  |                  | 5          | 1000 | 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  | $\mu\text{V/V}$      |
| $A_{VOL}$                | 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 0.6V. 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  $V_S = \pm 15\text{V}$ ,  $T_A = 25^\circ\text{C}$ . Temperature and/or supply voltages must be limited to ensure dissipation rating is not exceeded.

## AC ELECTRICAL CHARACTERISTICS

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

| SYMBOL    | PARAMETER              | TEST CONDITIONS                                                                                             | NE/SA/SE5532/5532A |     |     | UNIT             |
|-----------|------------------------|-------------------------------------------------------------------------------------------------------------|--------------------|-----|-----|------------------|
|           |                        |                                                                                                             | Min                | Typ | Max |                  |
| $R_{OUT}$ | Output resistance      | $A_V = 30\text{dB}$ 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  |     | %                |
| $A_V$     | 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        | $V_{OUT} = \pm 10\text{V}$<br>$V_{OUT} = \pm 14\text{V}$ , $R_L = 600\Omega$ ,<br>$V_{CC} = \pm 18\text{V}$ |                    | 140 |     | kHz              |
|           |                        |                                                                                                             |                    | 100 |     | kHz              |

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ELECTRICAL CHARACTERISTICS

T<sub>A</sub>=25°C V<sub>S</sub>=±15V, unless otherwise specified.

| SYMBOL             | PARAMETER           | TEST CONDITIONS                              | NE/SE5532 |            |     | NE/SA/SE5532A |            |         | UNIT             |
|--------------------|---------------------|----------------------------------------------|-----------|------------|-----|---------------|------------|---------|------------------|
|                    |                     |                                              | Min       | Typ        | Max | Min           | Typ        | Max     |                  |
| V <sub>NOISE</sub> | Input noise voltage | f <sub>O</sub> =30Hz<br>f <sub>O</sub> =1kHz |           | 8<br>5     |     |               | 8<br>5     | 12<br>6 | nV/√Hz<br>nV/√Hz |
| I <sub>NOISE</sub> | Input noise current | f <sub>O</sub> =30Hz<br>f <sub>O</sub> =1kHz |           | 2.7<br>0.7 |     |               | 2.7<br>0.7 |         | pA/√Hz<br>pA/√Hz |
|                    | Channel separation  | f=1kHz, R <sub>S</sub> =5kΩ                  |           | 110        |     |               | 110        |         | dB               |

TYPICAL PERFORMANCE CHARACTERISTICS

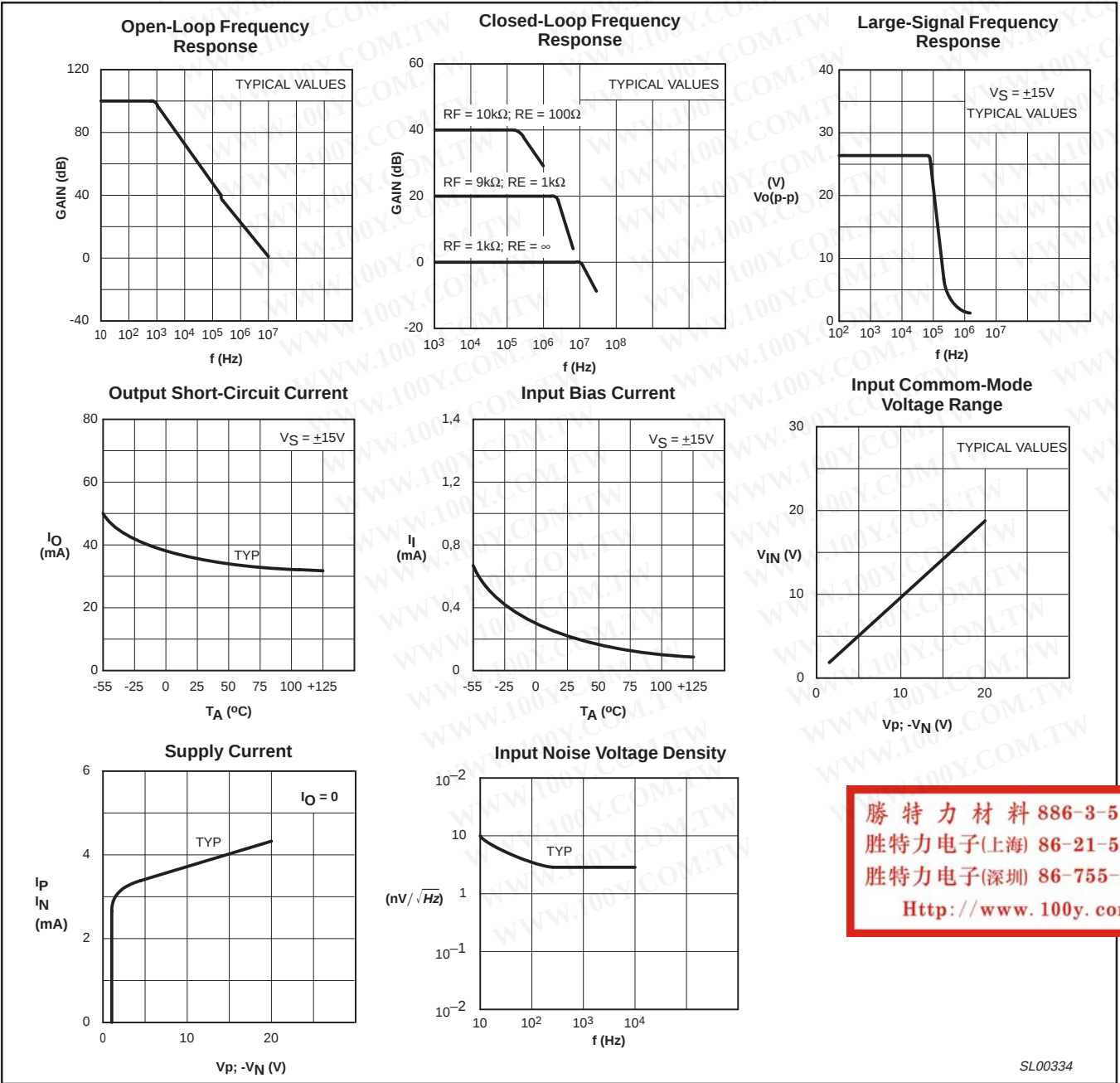


Figure 3. Typical Performance Characteristics

SL00334

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NE/SA/SE5532/5532A

## TEST CIRCUITS

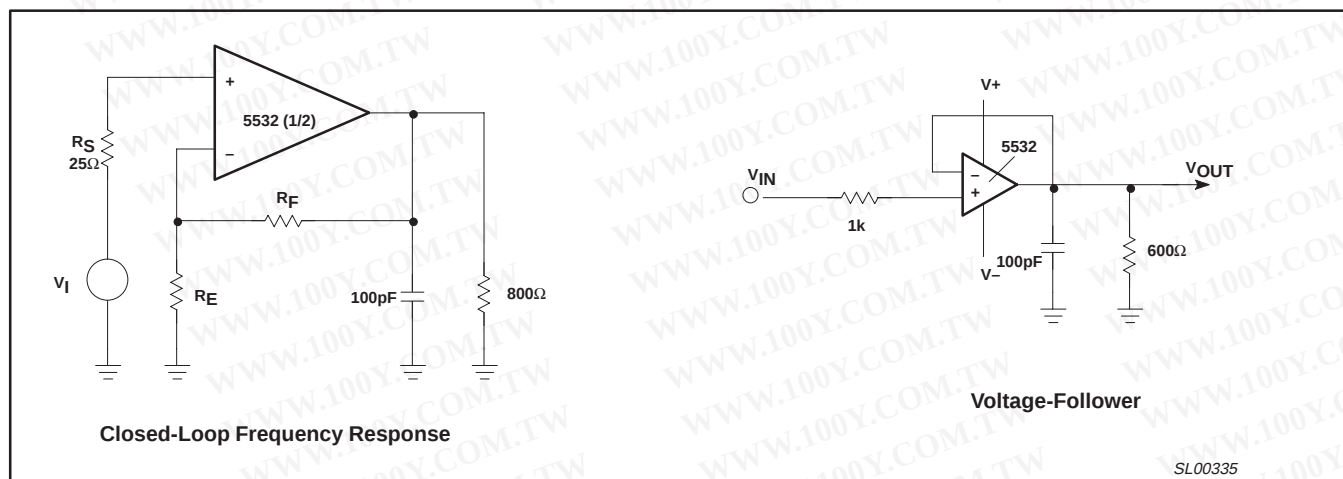


Figure 4. Test Circuits

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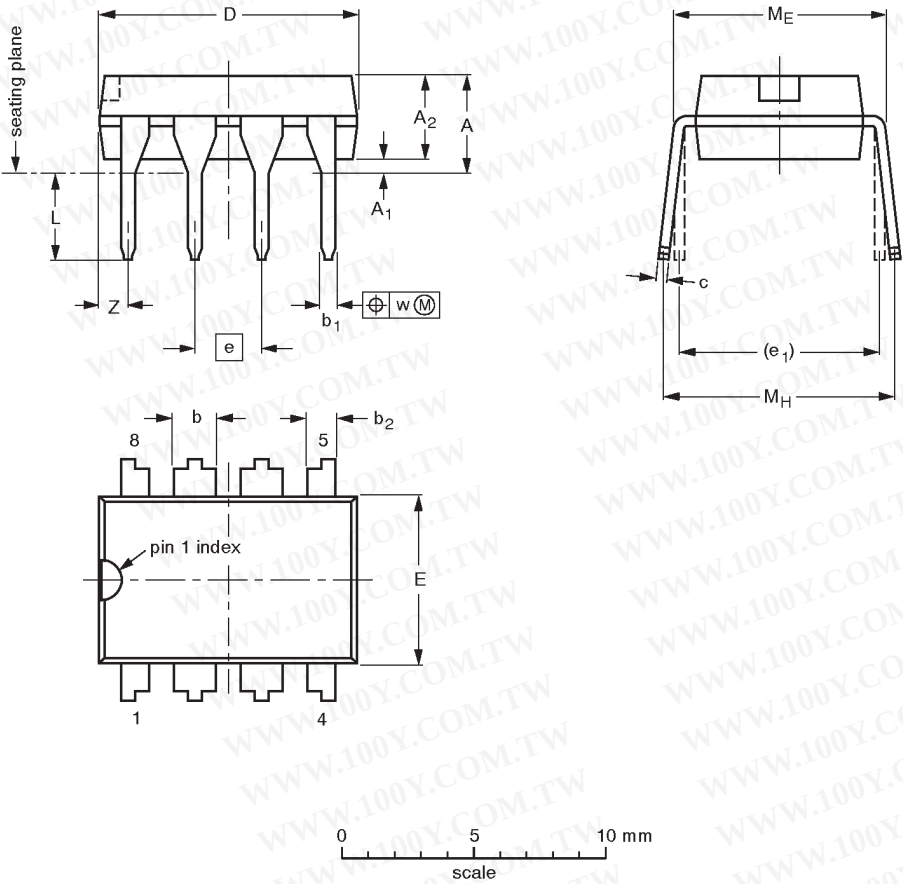
Internally-compensated dual low noise operational amplifier

NE/SA/SE5532/5532A

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

SOT97-1

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

| UNIT   | A<br>max. | A <sub>1</sub><br>min. | A <sub>2</sub><br>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><br>max. |
|--------|-----------|------------------------|------------------------|----------------|----------------|----------------|----------------|------------------|------------------|------|----------------|--------------|----------------|----------------|-------|--------------------------|
| mm     | 4.2       | 0.51                   | 3.2                    | 1.73<br>1.14   | 0.53<br>0.38   | 1.07<br>0.89   | 0.36<br>0.23   | 9.8<br>9.2       | 6.48<br>6.20     | 2.54 | 7.62           | 3.60<br>3.05 | 8.25<br>7.80   | 10.0<br>8.3    | 0.254 | 1.15                     |
| inches | 0.17      | 0.020                  | 0.13                   | 0.068<br>0.045 | 0.021<br>0.015 | 0.042<br>0.035 | 0.014<br>0.009 | 0.39<br>0.36     | 0.26<br>0.24     | 0.10 | 0.30           | 0.14<br>0.12 | 0.32<br>0.31   | 0.39<br>0.33   | 0.01  | 0.045                    |

Note

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

| OUTLINE<br>VERSION | REFERENCES |          |      |  | EUROPEAN<br>PROJECTION                                                                | ISSUE DATE           |
|--------------------|------------|----------|------|--|---------------------------------------------------------------------------------------|----------------------|
|                    | IEC        | JEDEC    | EIAJ |  |                                                                                       |                      |
| SOT97-1            | 050G01     | MO-001AN |      |  |  | 92-11-17<br>95-02-04 |

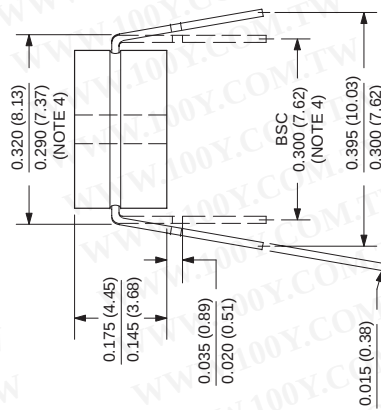
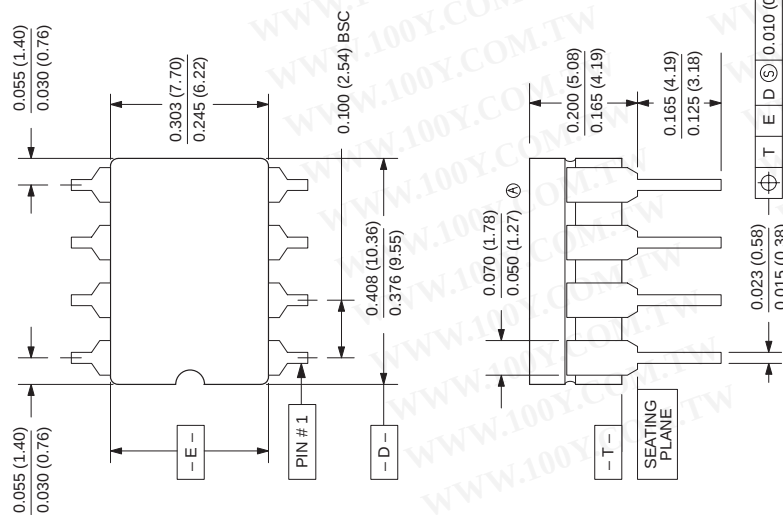
# Internally-compensated dual low noise operational amplifier

NE/SA/SE5532/5532A

## 0580A 8-PIN (300 mils wide) CERAMIC DUAL IN-LINE (F) PACKAGE

### NOTES:

1. Controlling dimension: Inches. Millimeters are shown in parentheses.
2. Dimension and tolerancing per ANSI Y14.5M-1982.
3. "T", "D", and "E" are reference datums on the body and include allowance for glass overrun and meniscus on the seal line, and lid to base mismatch.
4. These dimensions measured with the leads constrained to be perpendicular to plane T.
5. Pin numbers start with Pin #1 and continue counterclockwise to Pin #8 when viewed from the top.



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SO8: plastic small outline package; 8 leads; body width 3.9mm

SOT96-1

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0 2.5 5 mm  
scale

**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     | H <sub>E</sub> | L     | L <sub>p</sub> | Q              | v    | w    | y     | Z <sup>(1)</sup> | θ        |
|--------|--------|------------------|----------------|----------------|----------------|------------------|------------------|------------------|-------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm     | 1.75   | 0.25<br>0.10     | 1.45<br>1.25   | 0.25           | 0.49<br>0.36   | 0.25<br>0.19     | 5.0<br>4.8       | 4.0<br>3.8       | 1.27  | 6.2<br>5.8     | 1.05  | 1.0<br>0.4     | 0.7<br>0.6     | 0.25 | 0.25 | 0.1   | 0.7<br>0.3       | 8°<br>0° |
| inches | 0.069  | 0.0098<br>0.0039 | 0.057<br>0.049 | 0.01           | 0.019<br>0.014 | 0.0098<br>0.0075 | 0.20<br>0.19     | 0.16<br>0.15     | 0.050 | 0.24<br>0.23   | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 0.01 | 0.01 | 0.004 | 0.028<br>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         | 076E03S    | MS-012AA |      |  |                     | 92-11-17<br>95-02-04 |

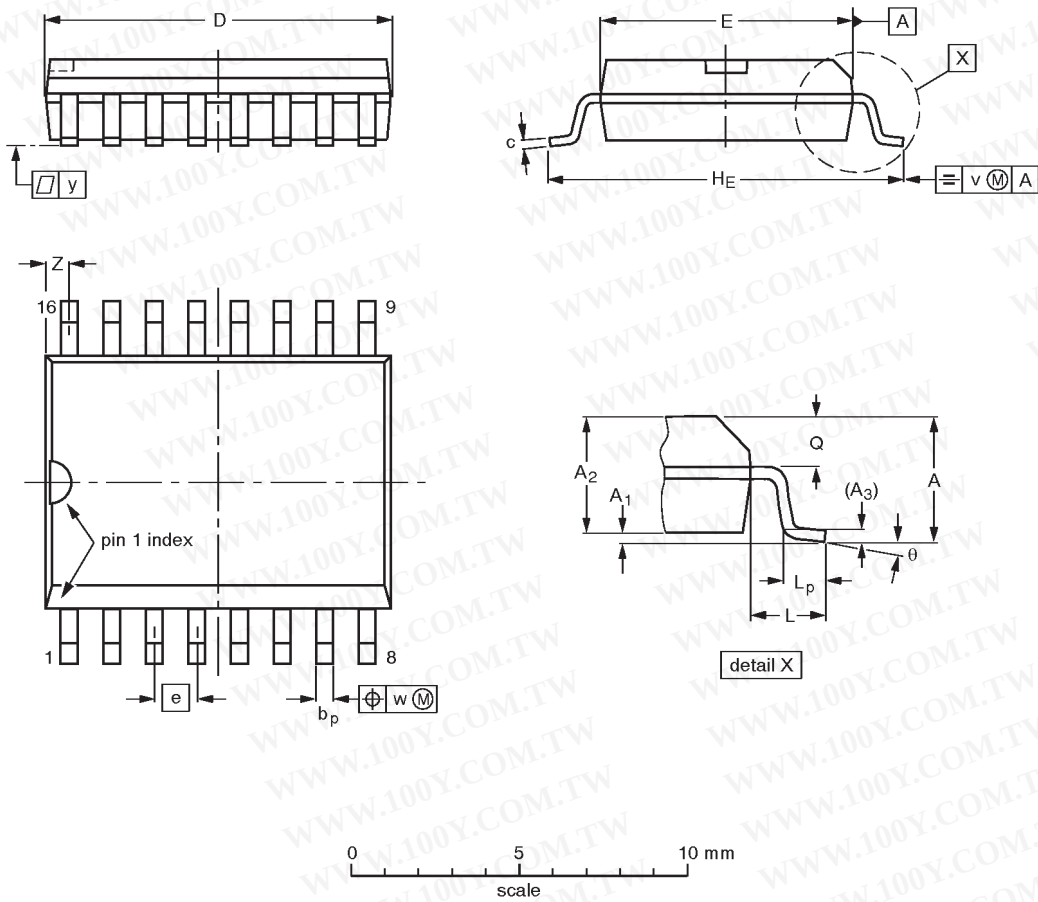
Internally-compensated dual low noise operational amplifier

NE/SA/SE5532/5532A

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

SOT162-1

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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<br>0.10   | 2.45<br>2.25   | 0.25           | 0.49<br>0.36   | 0.32<br>0.23   | 10.5<br>10.1     | 7.6<br>7.4       | 1.27  | 10.65<br>10.00 | 1.4   | 1.1<br>0.4     | 1.1<br>1.0     | 0.25 | 0.25 | 0.1   | 0.9<br>0.4       | 8°<br>0° |
| inches | 0.10   | 0.012<br>0.004 | 0.096<br>0.089 | 0.01           | 0.019<br>0.014 | 0.013<br>0.009 | 0.41<br>0.40     | 0.30<br>0.29     | 0.050 | 0.42<br>0.39   | 0.055 | 0.043<br>0.016 | 0.043<br>0.039 | 0.01 | 0.01 | 0.004 | 0.035<br>0.016   |          |

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

| OUTLINE<br>VERSION | REFERENCES |          |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE            |
|--------------------|------------|----------|------|--|------------------------|-----------------------|
|                    | IEC        | JEDEC    | EIAJ |  |                        |                       |
| SOT162-1           | 075E03     | MS-013AA |      |  |                        | -92-11-17<br>95-01-24 |

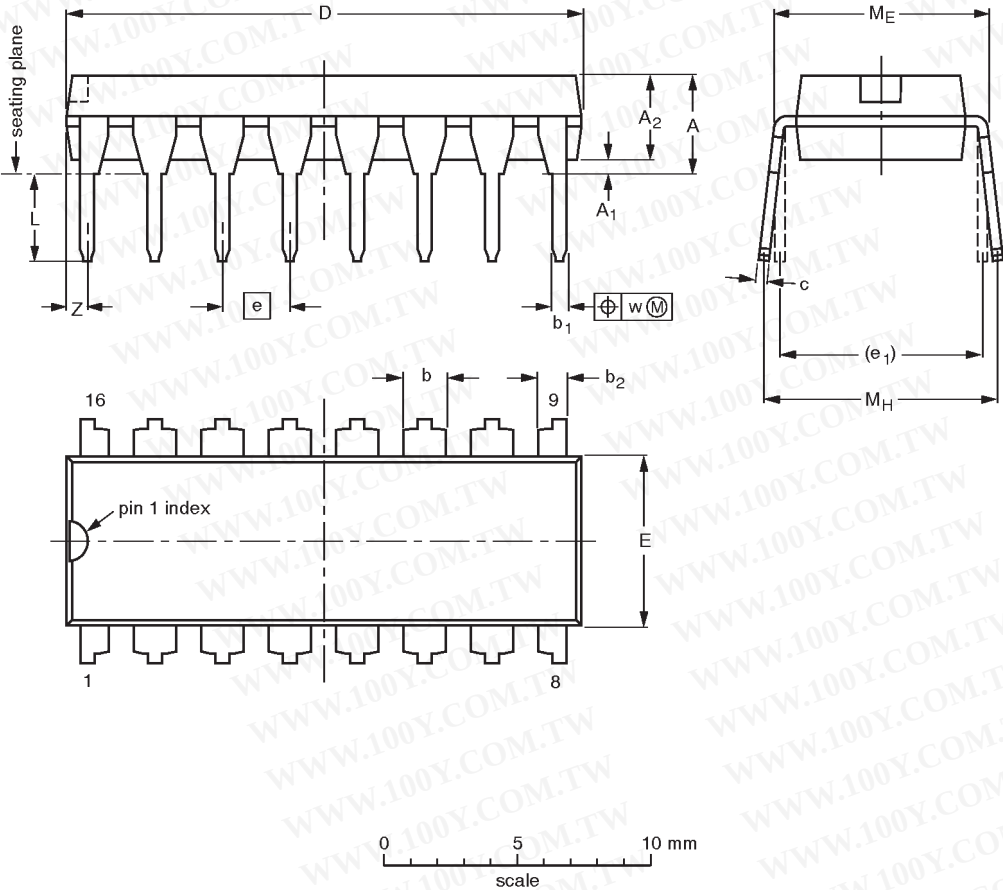
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NE/SA/SE5532/5532A

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

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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<br>1.30   | 0.53<br>0.38   | 1.25<br>0.85   | 0.36<br>0.23   | 19.50<br>18.55   | 6.48<br>6.20     | 2.54 | 7.62           | 3.60<br>3.05 | 8.25<br>7.80   | 10.0<br>8.3    | 0.254 | 0.76                  |
| inches | 0.17   | 0.020               | 0.13                | 0.068<br>0.051 | 0.021<br>0.015 | 0.049<br>0.033 | 0.014<br>0.009 | 0.77<br>0.73     | 0.26<br>0.24     | 0.10 | 0.30           | 0.14<br>0.12 | 0.32<br>0.31   | 0.39<br>0.33   | 0.01  | 0.030                 |

Note

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

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

# Internally-compensated dual low noise operational amplifier

NE/SA/SE5532/5532A

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## DEFINITIONS

| Data Sheet Identification        | Product Status                | Definition                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Objective Specification</i>   | <b>Formative or in Design</b> | This data sheet contains the design target or goal specifications for product development. Specifications may change in any manner without notice.                                                                                                                                                                                                                                                                |
| <i>Preliminary Specification</i> | <b>Preproduction Product</b>  |                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <i>Product Specification</i>     | <b>Full Production</b>        | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. Philips Semiconductors reserves the right to make changes at any time without notice, in order to improve design and supply the best possible product. |
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