

Dual and single low noise op amp

NE5533/5533A/ NE/SA/SE5534/5534A

DESCRIPTION

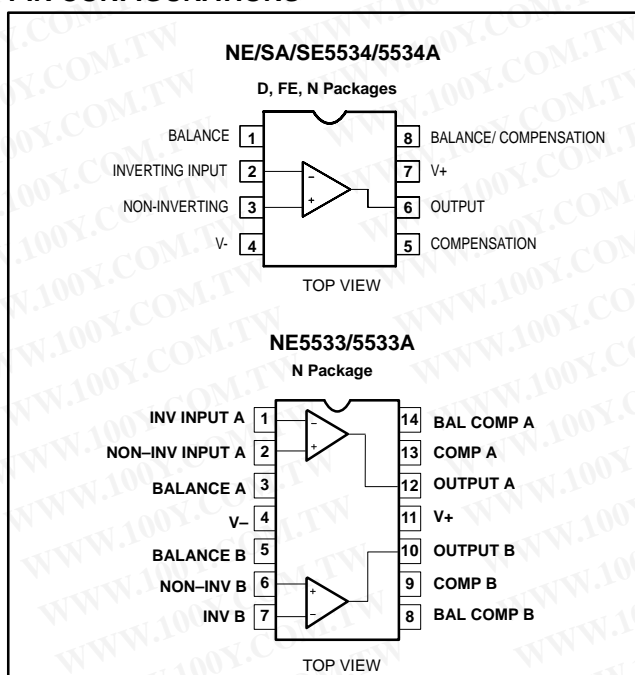
The 5533/5534 are dual and single high-performance low noise operational amplifiers. Compared to other operational amplifiers, such as TL083, they show better noise performance, improved output drive capability and considerably higher small-signal and power bandwidths.

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.) If very low noise is of prime importance, it is recommended that the 5533A/5534A version be used which has guaranteed noise specifications.

FEATURES

- Small-signal bandwidth: 10MHz
- Output drive capability: 600Ω, 10V_{RMS} at V_S=±18V
- Input noise voltage: $4nV/\sqrt{Hz}$
- DC voltage gain: 100000
- AC voltage gain: 6000 at 10kHz
- Power bandwidth: 200kHz
- Slew rate: 13V/μs
- Large supply voltage range: ±3 to ±20V

PIN CONFIGURATIONS



APPLICATIONS

- Audio equipment
- Instrumentation and control circuits
- Telephone channel amplifiers
- Medical equipment

ORDERING INFORMATION

| DESCRIPTION | TEMPERATURE RANGE | ORDER CODE | DWG # |
|--|-------------------|------------|-------|
| 14-Pin Plastic Dual In-Line Package (DIP) | 0 to +70°C | NE5533N | 0405B |
| 14-Pin Plastic Dual In-Line Package (DIP) | 0 to +70°C | NE5533AN | 0405B |
| 8-Pin Plastic Small Outline (SO) package | 0 to +70°C | NE5534D | 0174C |
| 8-Pin Hermetic Ceramic Dual In-Line Package (CERDIP) | 0 to +70°C | NE5534FE | |
| 8-Pin Plastic Dual In-Line Package (DIP) | 0 to +70°C | NE5534N | 0404B |
| 8-Pin Plastic Small Outline (SO) package | 0 to +70°C | NE5534AD | 0174C |
| 8-Pin Hermetic Ceramic Dual In-Line Package (CERDIP) | 0 to +70°C | NE5534AF | |
| 8-Pin Plastic Dual In-Line Package (DIP) | 0 to +70°C | NE5534AN | 0404B |
| 8-Pin Plastic Dual In-Line Package (DIP) | -40°C to +85°C | SA5534N | 0404B |
| 8-Pin Plastic Small Outline (SO) package | -40°C to +85°C | SA5534AD | 0174C |
| 8-Pin Plastic Dual In-Line Package (DIP) | -55°C to +125°C | SE5534N | 0404B |
| 8-Pin Hermetic Ceramic Dual In-Line Package (CERDIP) | -55°C to +125°C | SE5534AF | |
| 8-Pin Plastic Dual In-Line Package (DIP) | -55°C to +125°C | SE5534AN | 0404B |
| 8-Pin Plastic Dual In-Line Package (DIP) | -40°C to +85°C | SA5534AN | 0404B |

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ABSOLUTE MAXIMUM RATINGS

| SYMBOL | PARAMETER | RATING | UNIT |
|-------------------|--|-------------|------|
| V _S | Supply voltage | ±22 | V |
| V _{IN} | Input voltage | ±V supply | V |
| V _{DIFF} | Differential input voltage ¹ | ±0.5 | V |
| T _A | Operating temperature range | | |
| | SE | -55 to +125 | °C |
| | SA | -40 to +85 | °C |
| | NE | 0 to +70 | °C |
| T _{STG} | Storage temperature range | -65 to +150 | °C |
| T _J | Junction temperature | 150 | °C |
| P _D | Power dissipation at 25°C ² | | |
| | 16D Pkg | 1350 | mW |
| | 16N Pkg | 1500 | mW |
| | 8D Pkg | 750 | mW |
| | 8FE Pkg | 800 | mW |
| | 8N Pkg | 1150 | mW |
| | Output short-circuit duration ³ | Indefinite | |
| T _{SOLD} | Lead soldering temperature (10sec max) | 300 | °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 ±10mA.
- For operation at elevated temperature, derate packages based on the following junction-to-ambient thermal resistance:
 - 8-pin ceramic DIP 150°C/W
 - 8-pin plastic DIP 105°C/W
 - 8-pin plastic SO 160°C/W
 - 16-pin plastic DIP 80°C/W
 - 16-pin plastic SO 90°C/W
- Output may be shorted to ground at V_S=±15V, T_A=25°C. Temperature and/or supply voltages must be limited to ensure dissipation rating is not exceeded.

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NE5533/5533A/
NE/SA/SE5534/5534A**DC ELECTRICAL CHARACTERISTICS**T_A=25°C, V_S=±15V, unless otherwise specified. 1, 2, 3

| SYMBOL | PARAMETER | TEST CONDITIONS | SE5534/5534A | | | NE5533/5533A NE/SA5534/5534A | | | UNIT |
|----------------------|------------------------------|--|--------------|-------|------|---------------------------------|-------|------|-------|
| | | | Min | Typ | Max | Min | Typ | Max | |
| V _{OS} | Offset voltage | Over temperature | | 0.5 | 2 | | 0.5 | 4 | mV |
| ΔV _{OS} /ΔT | | | | 5 | 3 | | 5 | 5 | μV/°C |
| I _{OS} | Offset current | Over temperature | | 10 | 200 | | 20 | 300 | nA |
| ΔI _{OS} /ΔT | | | | 200 | 500 | | 200 | 400 | nA |
| I _B | Input current | Over temperature | | 400 | 800 | | 500 | 1500 | nA |
| ΔI _B /ΔT | | | | 5 | 1500 | | 5 | 2000 | nA |
| I _{CC} | Supply current per op amp | Over temperature | | 4 | 6.5 | | 4 | 8 | mA |
| | | | | 9 | | | 10 | 10 | mA |
| V _{CM} | Common mode input range | | ±12 | ±13 | | ±12 | ±13 | | V |
| CMRR | Common mode rejection ratio | | 80 | 100 | | 70 | 100 | | dB |
| PSRR | Power supply rejection ratio | | | 10 | 50 | | 10 | 100 | μV/V |
| A _{VOL} | Large-signal voltage gain | R _L ≥600Ω, V _O =±10V Over temperature | 50 | 100 | | 25 | 100 | | V/mV |
| | | | 25 | | | 15 | | | V/mV |
| V _{OUT} | Output swing | R _L ≥600Ω | ±12 | ±13 | | ±12 | ±13 | | V |
| | | Over temperature | ±10 | ±12 | | ±10 | ±12 | | V |
| | | R _L ≥600Ω, V _S =±18V | ±15 | ±16 | | ±15 | ±16 | | V |
| | | R _L ≥2kΩ | ±13 | ±13.5 | | ±13 | ±13.5 | | V |
| | | Over temperature | ±12 | ±12.5 | | ±12 | ±12.5 | | V |
| R _{IN} | Input resistance | | 50 | 100 | | 30 | 100 | | kΩ |
| I _{SC} | Output short circuit current | | | 38 | | | 38 | | mA |

NOTES:

- For NE5533/5533A/5534/5534A, T_{MIN} = 0°C, T_{MAX} = 70°C
- For SE5534/5534A, T_{MIN} = -55°C, T_{MAX} = +125°C
- For SA5534/5534A, T_{MIN} = -40°C, T_{MAX} = +125°C

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| SYMBOL | PARAMETER | TEST CONDITIONS | SE5534/5534A | | | NE5533/5533A NE/SA5534/5534A | | | UNIT |
|-----------|------------------------|---|--------------|-----------------|-----|---------------------------------|-----------------|-----|--------------------------------------|
| | | | Min | Typ | Max | Min | Typ | Max | |
| R_{OUT} | Output resistance | $A_V=30\text{dB}$ closed-loop $f=10\text{kHz}$, $R_L=600\Omega$, $C_C=22\text{pF}$ | | 0.3 | | | 0.3 | | Ω |
| | Transient response | Voltage-follower, $V_{IN}=50\text{mV}$ $R_L=600\Omega$, $C_C=22\text{pF}$, $C_L=100\text{pF}$ | | | | | | | |
| t_R | Rise time | | | 20 | | | 20 | | ns |
| | Overshoot | | | 20 | | | 20 | | % |
| | Transient response | $V_{IN}=50\text{mV}$, $R_L=600\Omega$ $C_C=47\text{pF}$, $C_L=500\text{pF}$ | | | | | | | |
| t_R | Rise time | | | 50 | | | 50 | | ns |
| | Overshoot | | | 35 | | | 35 | | % |
| A_V | Gain | $f=10\text{kHz}$, $C_C=0$ $f=10\text{kHz}$, $C_C=22\text{pF}$ | | 6 2.2 | | | 6 2.2 | | V/mV V/mV |
| GBW | Gain bandwidth product | $C_C=22\text{pF}$, $C_L=100\text{pF}$ | | 10 | | | 10 | | MHz |
| SR | Slew rate | $C_C=0$ $C_C=22\text{pF}$ | | 13 6 | | | 13 6 | | V/ μs V/ μs |
| | Power bandwidth | $V_{OUT}=\pm 10\text{V}$, $C_C=0$ $V_{OUT}=\pm 10\text{V}$, $C_C=22\text{pF}$ $V_{OUT}=\pm 14\text{V}$, $R_L=600\Omega$ $C_C=22\text{pF}$, $V_{CC}=\pm 18\text{V}$ | | 200 95 70 | | | 200 95 70 | | kHz kHz kHz |

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

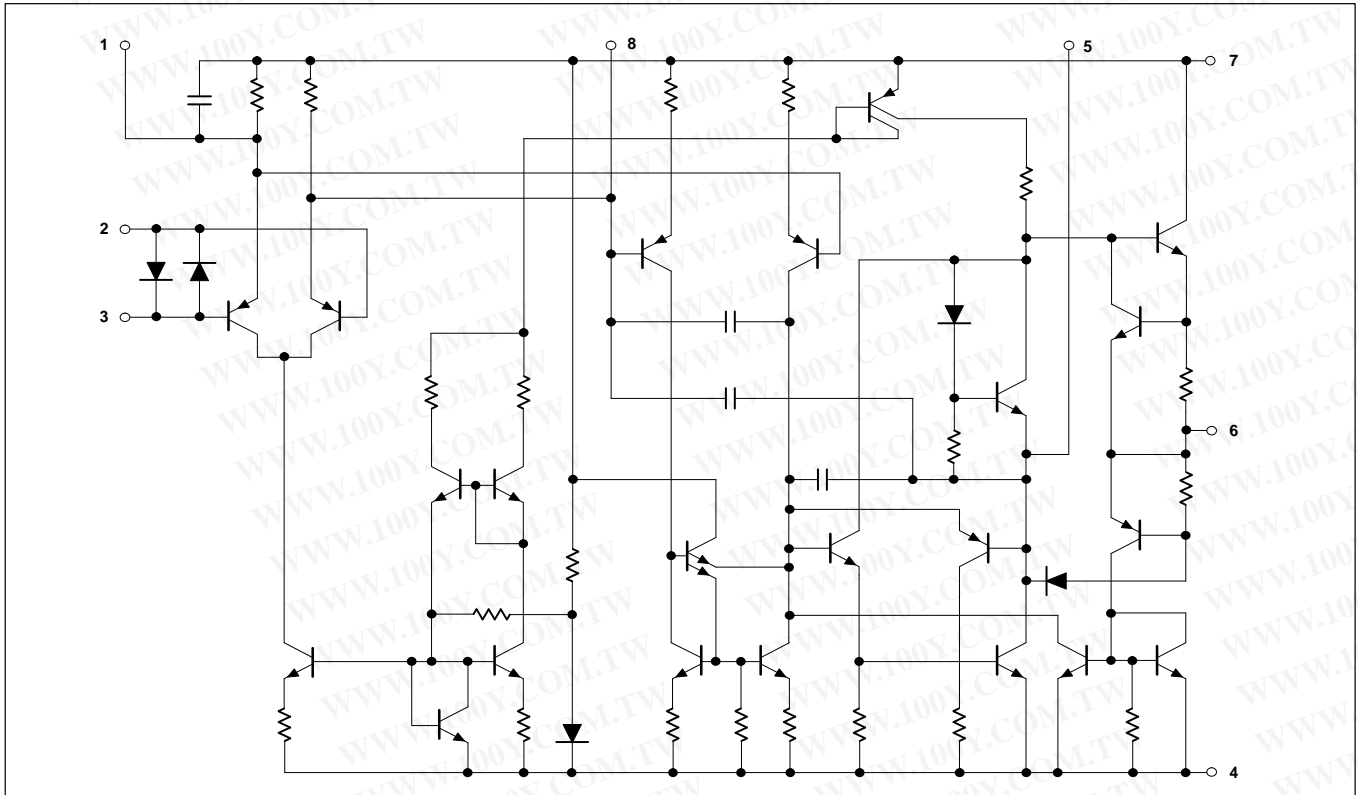
| SYMBOL | PARAMETER | TEST CONDITIONS | 5533/5534 | | | 5533A/5534A | | | UNIT |
|-------------|------------------------|--|-----------|-----|-----|-------------|-----|-----|------------------------------|
| | | | Min | Typ | Max | Min | Typ | Max | |
| V_{NOISE} | Input noise voltage | $f_O=30\text{Hz}$ | | 7 | | | 5.5 | 7 | $\text{nV}/\sqrt{\text{Hz}}$ |
| | | $f_O=1\text{kHz}$ | | 4 | | | 3.5 | 4.5 | $\text{nV}/\sqrt{\text{Hz}}$ |
| I_{NOISE} | Input noise current | $f_O=30\text{Hz}$ | | 2.5 | | | 1.5 | | $\text{pA}/\sqrt{\text{Hz}}$ |
| | | $f_O=1\text{kHz}$ | | 0.6 | | | 0.4 | | $\text{pA}/\sqrt{\text{Hz}}$ |
| | Broadband noise figure | $f=10\text{Hz}-20\text{kHz}$, $R_S=5\text{k}\Omega$ | | | | | 0.9 | | dB |
| | Channel separation | $f=1\text{kHz}$, $R_S=5\text{k}\Omega$ | | 110 | | | 110 | | dB |

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EQUIVALENT SCHEMATIC



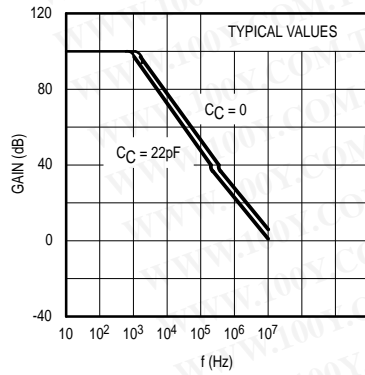
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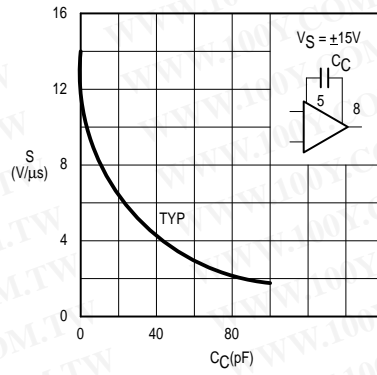
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TYPICAL PERFORMANCE CHARACTERISTICS

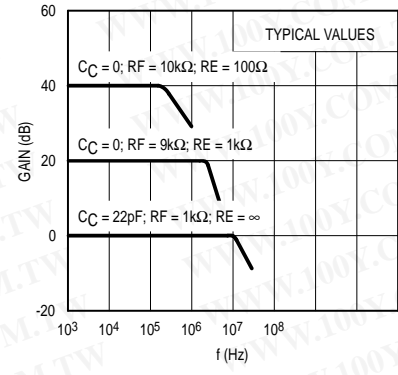
Open-Loop Frequency Response



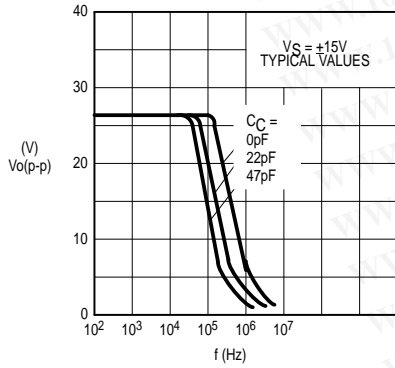
Slew Rate as a Function of Compensation Capacitance



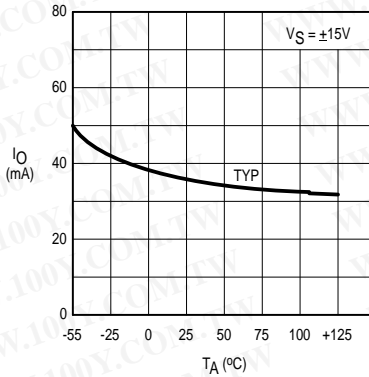
Closed-Loop Frequency Response



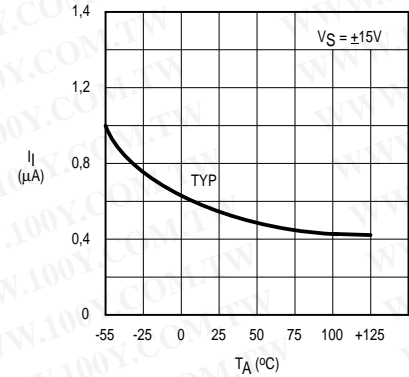
Large-Signal Frequency Response



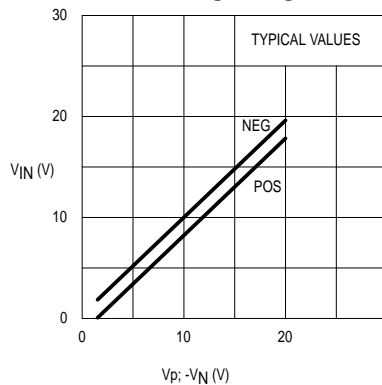
Output Short-Circuit Current



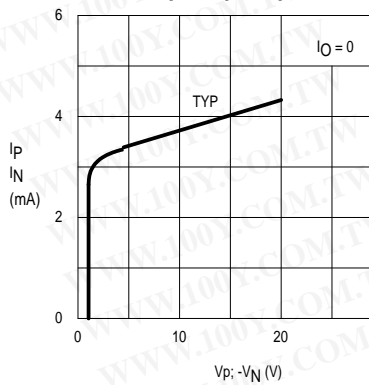
Input Bias Current



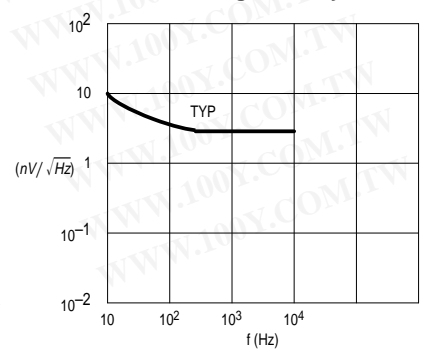
Input Common-Mode Voltage Range



Supply Current per Op Amp



Input Noise Voltage Density

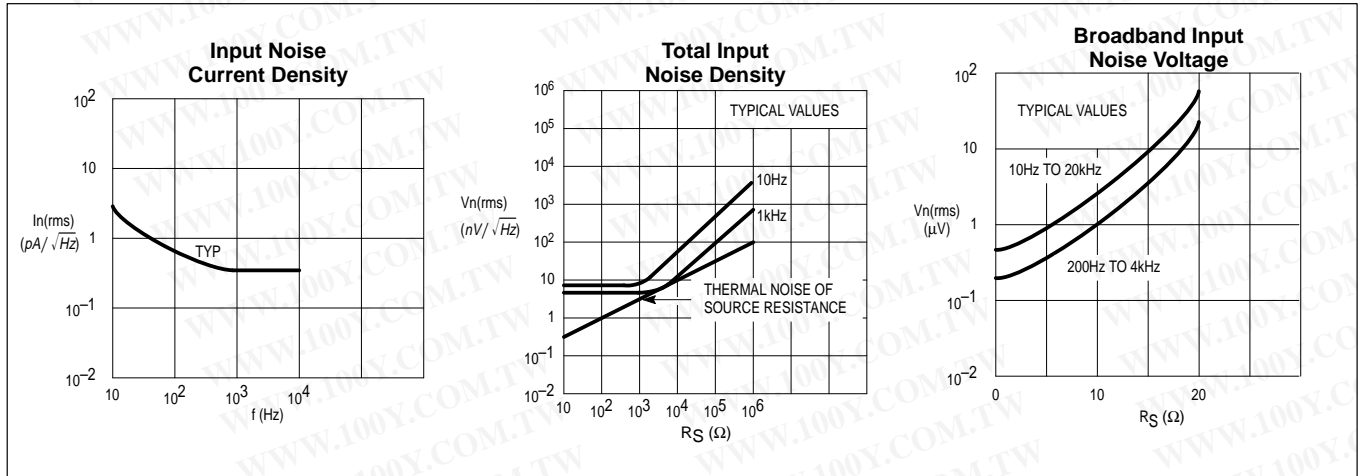


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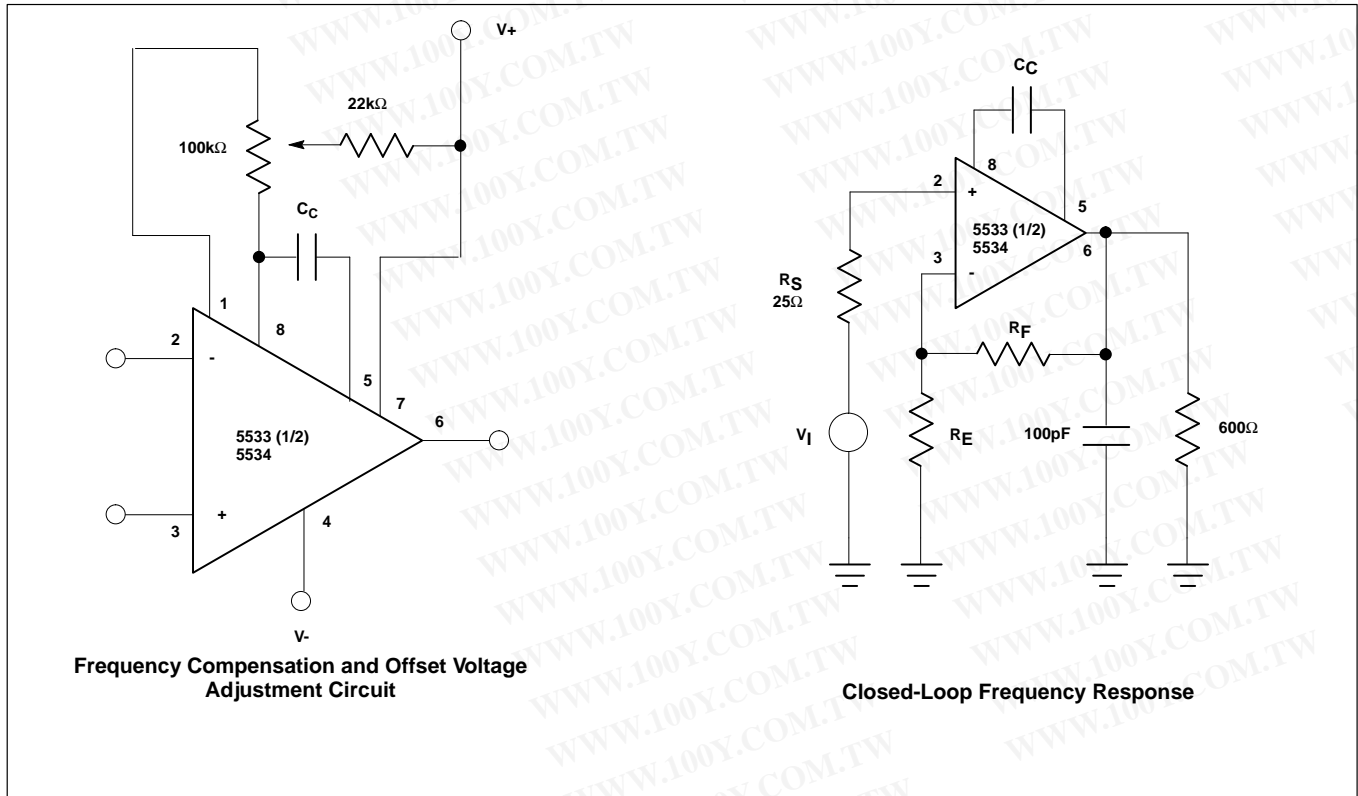
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TYPICAL PERFORMANCE CHARACTERISTICS (Continued)



TEST LOAD CIRCUITS

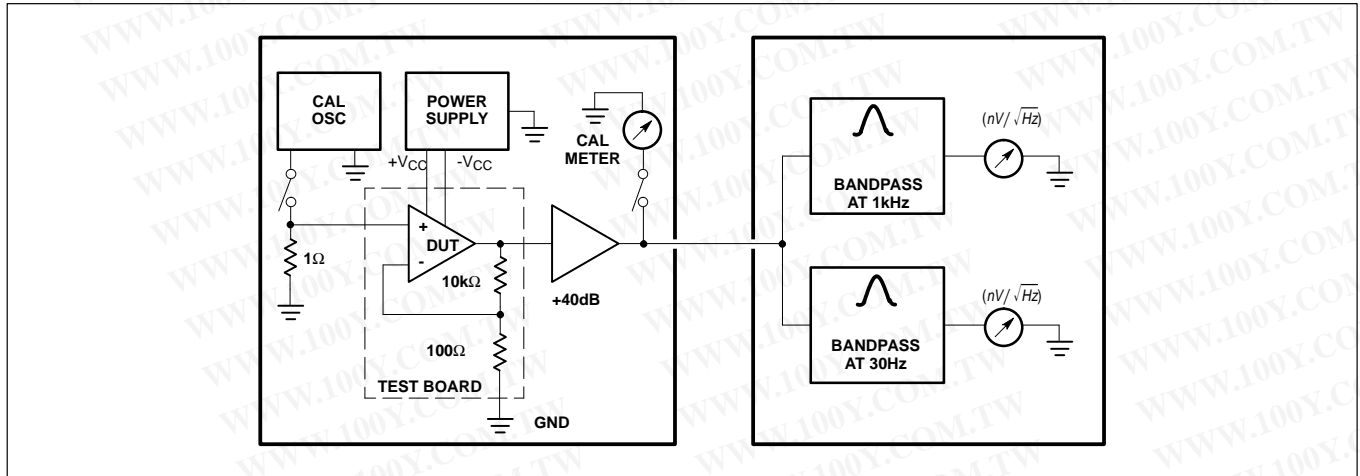


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NOISE TEST BLOCK DIAGRAM



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