# TLV271

# Single-Channel, Rail-to-Rail Output, 3 MHz BW Operational Amplifier

The TLV271 operational amplifier provides rail−to−rail output operation. The output can swing within 320 mV to the positive rail and 50 mV to the negative rail. This rail−to−rail operation enables the user to make optimal use of the entire supply voltage range while taking advantage of 3 MHz bandwidth. The TLV271 can operate on supply voltage as low as 2.7 V over the temperature range of −40°C to 105°C. The high bandwidth provides a slew rate of 2.4 V/μs while only consuming 550 μA of quiescent current. Likewise the TLV271 can run on a supply voltage as high as 16 V making it ideal for a broad range of battery−operated applications. Since this is a CMOS device it has high input impedance and low bias currents making it ideal for interfacing to a wide variety of signal sensors. In addition it comes in a small TSOP−5 package with two pinout styles allowing for use in high−density PCB's.

### Features

- Rail−To−Rail Output
- Wide Bandwidth: 3 MHz
- High Slew Rate: 2.4 V/μs
- Wide Power−Supply Range: 2.7 V to 16 V
- Low Supply Current: 550 μA
- Low Input Bias Current: 1 pA
- Wide Temperature Range: −40°C to 105°C
- Small Package: 5 Pin TSOP−5 (same as SOT23−5)
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- Notebook Computers
- Portable Instruments

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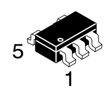
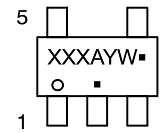
**MARKING DIAGRAM**



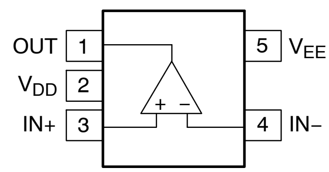

**TSOP−5 (SOT23−5) SN SUFFIX CASE 483**



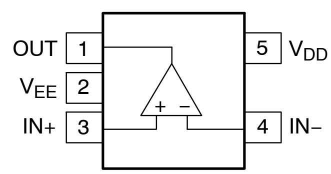

| | |
|---|---|
| A | = Assembly Location |
| Y | = Year |
| W | = Work Week |
| ▪ | = Pb−Free Package |

(Note: Microdot may be in either location)

**PIN CONNECTIONS**




Style 1 Pinout (SN1T1)
(Top View)




Style 2 Pinout (SN2T1)
(Top View)

**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| TLV271SN1T1G (Style 1 Pinout) | TSOP−5 (Pb−Free) | 3000 / Tape & Reel |
| TLV271SN2T1G (Style 2 Pinout) | TSOP−5 (Pb−Free) | 3000 / Tape & Reel |

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



May, 2012 − Rev. 2
Publication Order Number:
TLV271/D

## MAXIMUM RATINGS

| Symbol | Rating | Value | Unit |
|---|---|---|---|
| $V_{DD}$ | Supply Voltage (Note 1) | 16.5 | V |
| $V_{ID}$ | Input Differential Voltage (Note 2) | ± Supply Voltage | V |
| $V_I$ | Input Common Mode Voltage Range (Note 1) | −0.2 V to ($V_{DD}$ + 0.2 V) | V |
| $I_I$ | Maximum Input Current | ± 10 | mA |
| $I_O$ | Output Current Range | ± 100 | mA |
| | Continuous Total Power Dissipation (Note 1) | 200 | mW |
| $T_J$ | Maximum Junction Temperature | 150 | °C |
| $\theta_{JA}$ | Thermal Resistance | 333 | °C/W |
| $T_{stg}$ | Operating Temperature Range (free−air) | −40 to 105 | °C |
| $T_{stg}$ | Storage Temperature | −65 to 150 | °C |
| | Mounting Temperature (Infrared or Convection − 20 sec) | 260 | °C |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Continuous short−circuit operation to ground at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C. Output currents in excess of 45 mA over long term may adversely affect reliability. Shorting output to either V+ or V− will adversely affect reliability.
2. ESD data available upon request.

**DC ELECTRICAL CHARACTERISTICS** ($V_{DD}$ = 2.7V, 3.3V, 5V & ± 5 V (Note 3), $T_A$ = 25°C, $R_L$ ≥ 10 kΩ unless otherwise noted)

| Parameter | Symbol | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | VIC = $V_{DD}$/2, $V_O$ = $V_{DD}$/2, $R_L$ = 10 kΩ, $R_S$ = 50 Ω | | | 0.5 | 5 | mV |
| | | $T_A$ = −40°C to +105°C | | | | 7 | |
| Offset Voltage Drift | $ICV_{OS}$ | VIC = $V_{DD}$/2, $V_O$ = $V_{DD}$/2, $R_L$ = 10 kΩ, $R_S$ = 50 Ω | | | 2 | | μV/°C |
| Common Mode Rejection Ratio | CMRR | 0 V ≤ VIC ≤ $V_{DD}$ − 1.35 V, $R_S$ = 50 Ω | $V_{DD}$ = 2.7 V | 58 | 70 | | dB |
| | | $T_A$ = −40°C to +105°C | | 55 | | | |
| | | 0 V ≤ VIC ≤ $V_{DD}$ − 1.35 V, $R_S$ = 50 Ω | $V_{DD}$ = 5 V | 65 | 130 | | |
| | | $T_A$ = −40°C to +105°C | | 62 | | | |
| | | 0 V ≤ VIC ≤ $V_{DD}$ − 1.35 V, $R_S$ = 50 Ω | $V_{DD}$ = ± 5 V | 69 | 140 | | |
| | | $T_A$ = −40°C to +105°C | | 66 | | | |
| Power Supply Rejection Ratio | PSRR | $V_{DD}$ = 2.7 V to 16 V, VIC = $V_{DD}$/2, No Load | | 70 | 135 | | dB |
| | | $T_A$ = −40°C to +105°C | | 65 | | | |
| Large Signal Voltage Gain | $A_{VD}$ | $V_{O(pp)}$ = $V_{DD}$/2, $R_L$ = 10 kΩ | $V_{DD}$ = 2.7 V | 97 | 106 | | dB |
| | | $T_A$ = −40°C to +105°C | | 76 | | | |
| | | $V_{O(pp)}$ = $V_{DD}$/2, $R_L$ = 10 kΩ | $V_{DD}$ = 3.3 V | 97 | 123 | | |
| | | $T_A$ = −40°C to +105°C | | 76 | | | |
| | | $V_{O(pp)}$ = $V_{DD}$/2, $R_L$ = 10 kΩ | $V_{DD}$ = 5 V | 100 | 127 | | |
| | | $T_A$ = −40°C to +105°C | | 86 | | | |
| | | $V_{O(pp)}$ = $V_{DD}$/2, $R_L$ = 10 kΩ | $V_{DD}$ = ± 5 V | 100 | 130 | | |
| | | $T_A$ = −40°C to +105°C | | 90 | | | |
| Input Bias Current | $I_B$ | $V_{DD}$ = 5 V, VIC = $V_{DD}$/2, $V_O$ = $V_{DD}$/2, $R_S$ = 50 Ω | $T_A$ = 25°C | | 45 | 150 | pA |
| | | | $T_A$ = 105°C | | | 1000 | |

3. $V_{DD}$ = ±5 V is shorthand for $V_{DD}$ = +5 V and $V_{EE}$ = −5 V.

**DC ELECTRICAL CHARACTERISTICS** ($V_{DD}$ = 2.7V, 3.3V, 5V & ±5 V (Note 3), $T_A$ = 25°C, $R_L$ ≥ 10 kΩ unless otherwise noted)

| Parameter | Symbol | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Input Offset Current | $I_{IO}$ | $V_{DD}$ = 5 V, VIC = $V_{DD}$/2, $V_O$ = $V_{DD}$/2, $R_S$ = 50 Ω | $T_A$ = 25°C | | 45 | 150 | pA |
| | | | $T_A$ = 105°C | | | 1000 | |
| Differential Input Resistance | $r_{i(d)}$ | | | | 1000 | | GΩ |
| Common−mode Input Capacitance | $C_{IC}$ | f = 21 kHz | | | 8 | | pF |
| Output Swing (High−level) | $V_{OH}$ | VIC = $V_{DD}$/2, $I_{OH}$ = −1 mA | $V_{DD}$ = 2.7 V | 2.55 | 2.58 | | V |
| | | $T_A$ = −40°C to +105°C | | 2.48 | | | |
| | | VIC = $V_{DD}$/2, $I_{OH}$ = −1 mA | $V_{DD}$ = 3.3 V | 3.15 | 3.21 | | |
| | | $T_A$ = −40°C to +105°C | | 3.00 | | | |
| | | VIC = $V_{DD}$/2, $I_{OH}$ = −1 mA | $V_{DD}$ = 5 V | 4.8 | 4.93 | | |
| | | $T_A$ = −40°C to +105°C | | 4.75 | | | |
| | | VIC = $V_{DD}$/2, $I_{OH}$ = −1 mA | $V_{DD}$ = ±5 V | 4.92 | 4.96 | | |
| | | $T_A$ = −40°C to +105°C | | 4.9 | | | |
| | | VIC = $V_{DD}$/2, $I_{OH}$ = −5 mA | $V_{DD}$ = 2.7 V | 1.9 | 2.1 | | V |
| | | $T_A$ = −40°C to +105°C | | 1.5 | | | |
| | | VIC = $V_{DD}$/2, $I_{OH}$ = −5 mA | $V_{DD}$ = 3.3 V | 2.5 | 2.89 | | |
| | | $T_A$ = −40°C to +105°C | | 2.1 | | | |
| | | VIC = $V_{DD}$/2, $I_{OH}$ = −5 mA | $V_{DD}$ = 5 V | 4.5 | 4.68 | | |
| | | $T_A$ = −40°C to +105°C | | 4.35 | | | |
| | | VIC = $V_{DD}$/2, $I_{OH}$ = −5 mA | $V_{DD}$ = ±5 V | 4.7 | 4.78 | | |
| | | $T_A$ = −40°C to +105°C | | 4.65 | | | |
| Output Swing (Low−level) | $V_{OL}$ | VIC = $V_{DD}$/2, $I_{OL}$ = −1 mA | $V_{DD}$ = 2.7 V | | 0.1 | 0.15 | V |
| | | $T_A$ = −40°C to +105°C | | | | 0.22 | |
| | | VIC = $V_{DD}$/2, $I_{OL}$ = −1 mA | $V_{DD}$ = 3.3 V | | 0.03 | 0.15 | |
| | | $T_A$ = −40°C to +105°C | | | | 0.22 | |
| | | VIC = $V_{DD}$/2, $I_{OL}$ = −1 mA | $V_{DD}$ = 5 V | | 0.03 | 0.1 | |
| | | $T_A$ = −40°C to +105°C | | | | 0.15 | |
| | | VIC = $V_{DD}$/2, $I_{OL}$ = −1 mA | $V_{DD}$ = ±5 V | | 0.05 | 0.08 | |
| | | $T_A$ = −40°C to +105°C | | | | 0.1 | |
| | | VIC = $V_{DD}$/2, $I_{OL}$ = −5 mA | $V_{DD}$ = 2.7 V | | 0.5 | 0.7 | V |
| | | $T_A$ = −40°C to +105°C | | | | 1.1 | |
| | | VIC = $V_{DD}$/2, $I_{OL}$ = −5 mA | $V_{DD}$ = 3.3 V | | 0.13 | 0.7 | |
| | | $T_A$ = −40°C to +105°C | | | | 1.1 | |
| | | VIC = $V_{DD}$/2, $I_{OL}$ = −5 mA | $V_{DD}$ = 5 V | | 0.13 | 0.4 | |
| | | $T_A$ = −40°C to +105°C | | | | 0.5 | |
| | | VIC = $V_{DD}$/2, $I_{OL}$ = −5 mA | $V_{DD}$ = ±5 V | | 0.16 | 0.3 | |
| | | $T_A$ = −40°C to +105°C | | | | 0.35 | |

3. $V_{DD}$ = ±5 V is shorthand for $V_{DD}$ = +5 V and $V_{EE}$ = −5 V.

**DC ELECTRICAL CHARACTERISTICS** ($V_{DD}$ = 2.7V, 3.3V, 5V & ±5 V (Note 3), $T_A$ = 25°C, $R_L$ ≥ 10 kΩ unless otherwise noted)

| Parameter | Symbol | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Output Current | $I_O$ | $V_O$ = 0.5 V from rail, $V_{DD}$ = 2.7 V | Positive rail | | 4.0 | | mA |
| | | | Negative rail | | 5.0 | | |
| | | $V_O$ = 0.5 V from rail, $V_{DD}$ = 5 V | Positive rail | | 7.0 | | |
| | | | Negative rail | | 8.0 | | |
| | | $V_O$ = 0.5 V from rail, $V_{DD}$ = 10 V | Positive rail | | 13 | | |
| | | | Negative rail | | 12 | | |
| Power Supply Quiescent Current | $I_{DD}$ | $V_O = V_{DD}/2$ | $V_{DD}$ = 2.7 V | | 380 | 560 | μA |
| | | | $V_{DD}$ = 3.3 V | | 385 | 620 | |
| | | | $V_{DD}$ = 5 V | | 390 | 660 | |
| | | | $V_{DD}$ = 10 V | | 400 | 800 | |
| | | $T_A$ = −40°C to +105°C | | | | 1000 | |

3. $V_{DD}$ = ±5 V is shorthand for $V_{DD}$ = +5 V and $V_{EE}$ = −5 V.

**AC ELECTRICAL CHARACTERISTICS** ($V_{DD}$ = 2.7 V, 5 V, & ±5 V (Note 4), $T_A$ = 25°C, and $R_L$ ≥ 10 kΩ unless otherwise noted)

| Parameter | Symbol | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Unity Gain Bandwidth | UGBW | $R_L$ = 2 kΩ, $C_L$ = 10 pF | $V_{DD}$ = 2.7 V | | 3.2 | | MHz |
| | | | $V_{DD}$ = 5 V to 10 V | | 3.5 | | |
| Slew Rate at Unity Gain | SR | $V_{O(pp)} = V_{DD}/2$, $R_L$ = 10 kΩ, $C_L$ = 50 pF | $V_{DD}$ = 2.7 V | 1.35 | 2.1 | | V/μS |
| | | $T_A$ = −40°C to +105°C | | 1 | | | |
| | | $V_{O(pp)} = V_{DD}/2$, $R_L$ = 10 kΩ, $C_L$ = 50 pF | $V_{DD}$ = 5 V | 1.45 | 2.3 | | |
| | | $T_A$ = −40°C to +105°C | | 1.2 | | | |
| | | $V_{O(pp)} = V_{DD}/2$, $R_L$ = 10 kΩ, $C_L$ = 50 pF | $V_{DD}$ = ±5 V | 1.8 | 2.6 | | |
| | | $T_A$ = −40°C to +105°C | | 1.3 | | | |
| Phase Margin | $\theta_m$ | $R_L$ = 2 kΩ, $C_L$ = 10 pF | | | 45 | | ° |
| Gain Margin | | $R_L$ = 2 kΩ, $C_L$ = 10 pF | | | 14 | | dB |
| Settling Time to 0.1% | $t_S$ | V−step(pp) = 1 V, AV = −1, $R_L$ = 2 kΩ, $C_L$ = 10 pF | $V_{DD}$ = 2.7 V | | 2.9 | | μS |
| | | V−step(pp) = 1 V, AV = −1, $R_L$ = 2 kΩ, $C_L$ = 47 pF | $V_{DD}$ = 5 V, ±5 V | | 2.0 | | |
| Total Harmonic Distortion plus Noise | THD+N | $V_{DD}$ = 2.7 V, $V_{O(pp)} = V_{DD}/2$, $R_L$ = 2 kΩ, f = 10 kHz | AV = 1 | | 0.004 | | % |
| | | | AV = 10 | | 0.04 | | |
| | | | AV = 100 | | 0.3 | | |
| | | $V_{DD}$ = 5 V, ± 5 V, $V_{O(pp)} = V_{DD}/2$, $R_L$ = 2 kΩ, f = 10 kHz | AV = 1 | | 0.004 | | |
| | | | AV = 10 | | 0.04 | | |
| | | | AV = 100 | | 0.03 | | |
| Input−Referred Voltage Noise | $e_n$ | f = 1 kHz | | | 30 | | nV/√Hz |
| | | f = 10 kHz | | | 20 | | |
| Input−Referred Current Noise | $i_n$ | f = 1 kHz | | | 0.6 | | fA/√Hz |

4. $V_{DD}$ = ±5 V is shorthand for $V_{DD}$ = +5 V and $V_{EE}$ = −5 V.

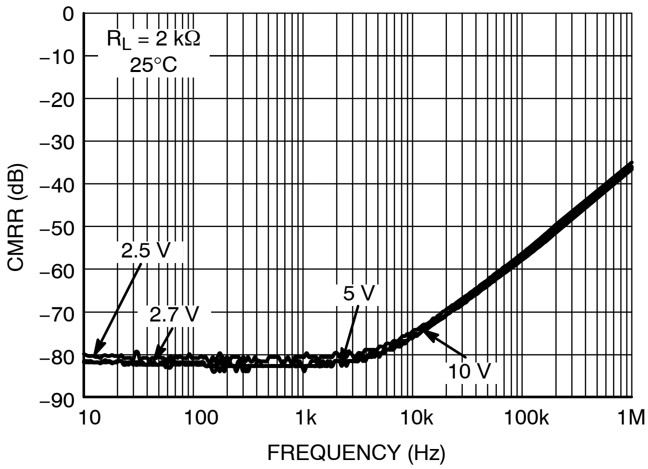



**Figure 1. CMRR vs. Frequency**

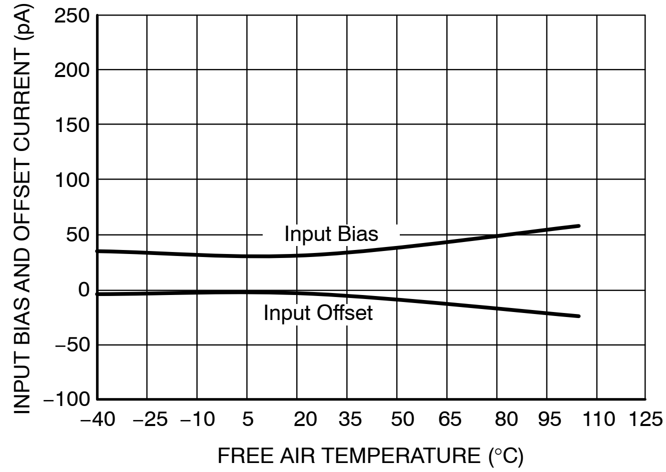



**Figure 2. Input Bias and Offset Current vs. Temperature**

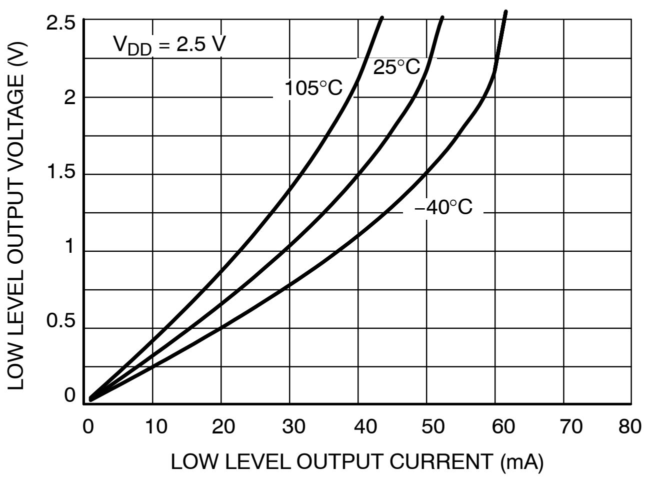



**Figure 3. 2.5 V $V_{OL}$ vs. $I_{out}$**

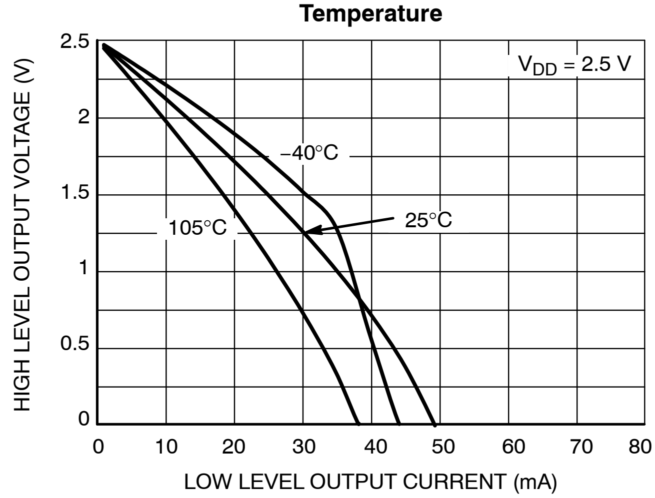



**Figure 4. 2.5 V $V_{OH}$ vs. $I_{out}$**

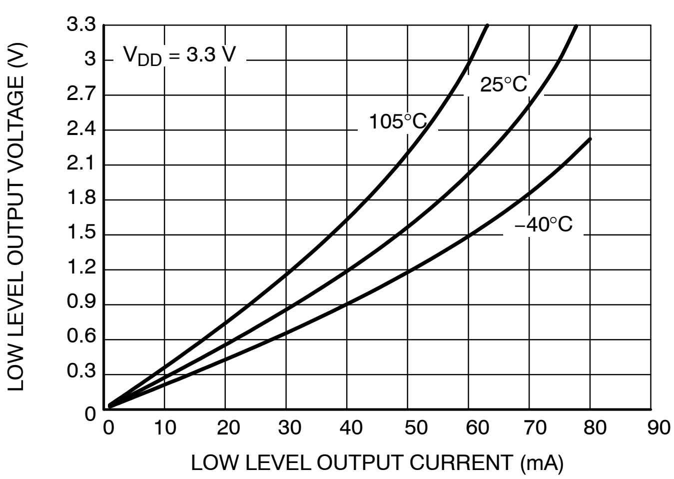



**Figure 5. 3.3 V $V_{OL}$ vs. $I_{out}$**

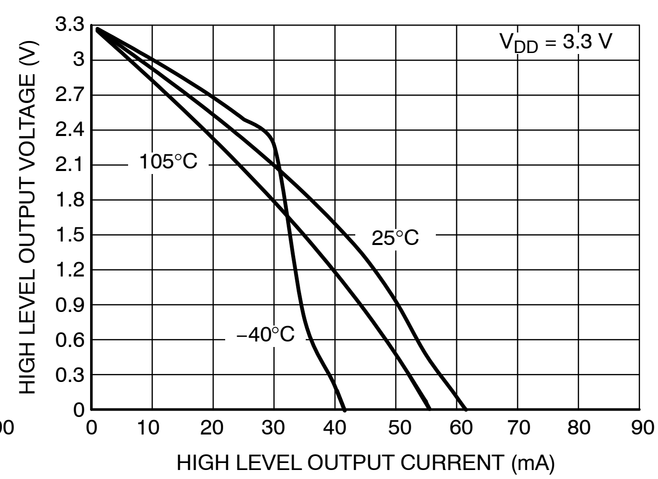



**Figure 6. 3.3 V $V_{OH}$ vs. $I_{out}$**

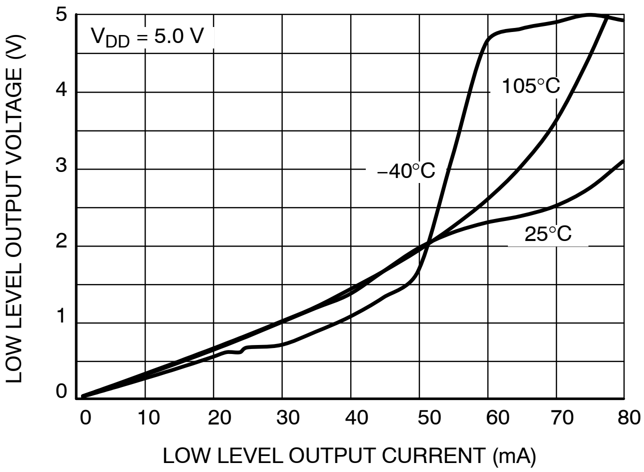



**Figure 7. $V_{OL}$ vs. $I_{out}$**

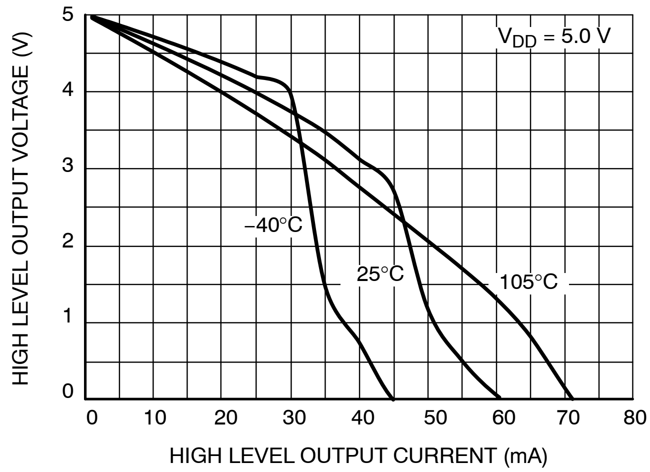



**Figure 8. $V_{OH}$ vs. $I_{out}$**

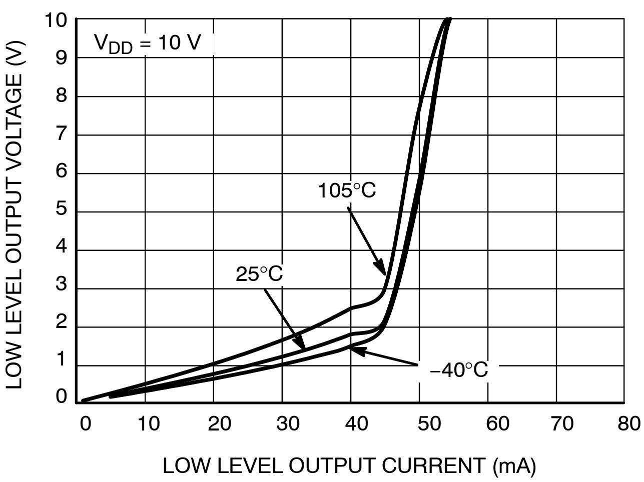



**Figure 9. 10 V $V_{OL}$ vs. $I_{out}$**

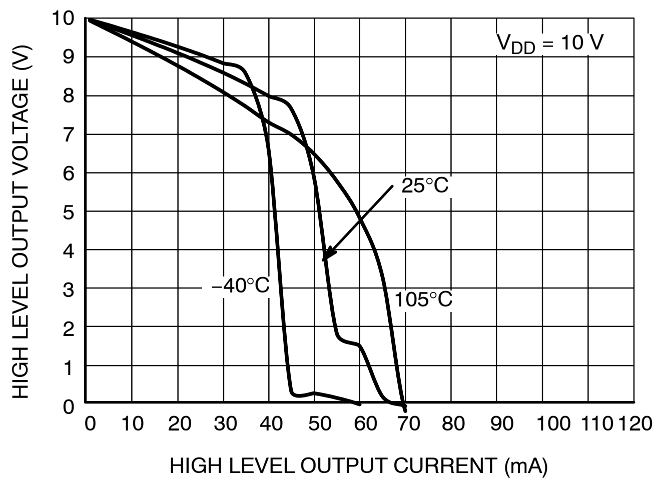



**Figure 10. 10 V $V_{OH}$ vs. $I_{out}$**

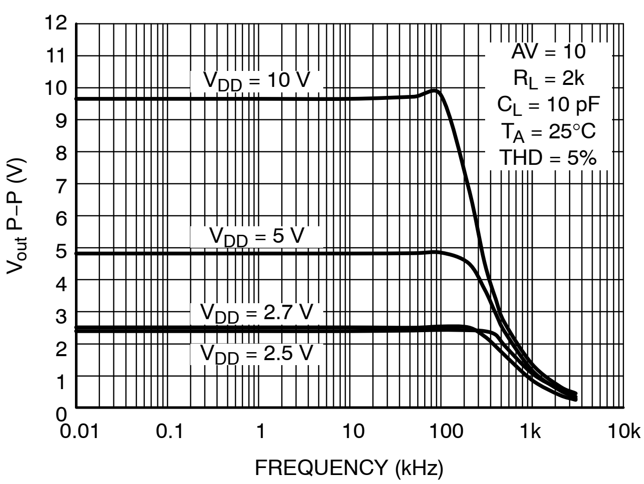



**Figure 11. Peak−to−Peak Output vs. Supply vs. Frequency**

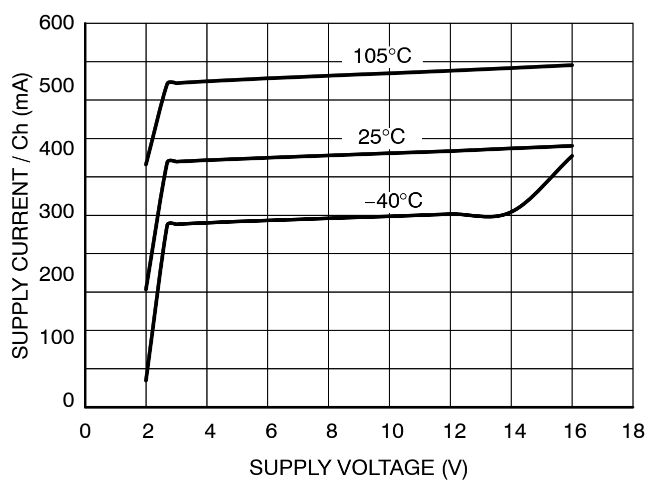



**Figure 12. Supply Current vs. Supply Voltage**

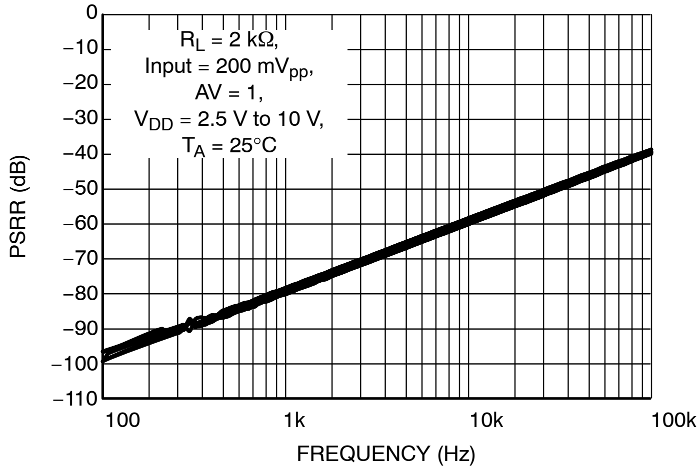



**Figure 13. PSRR vs. Frequency**

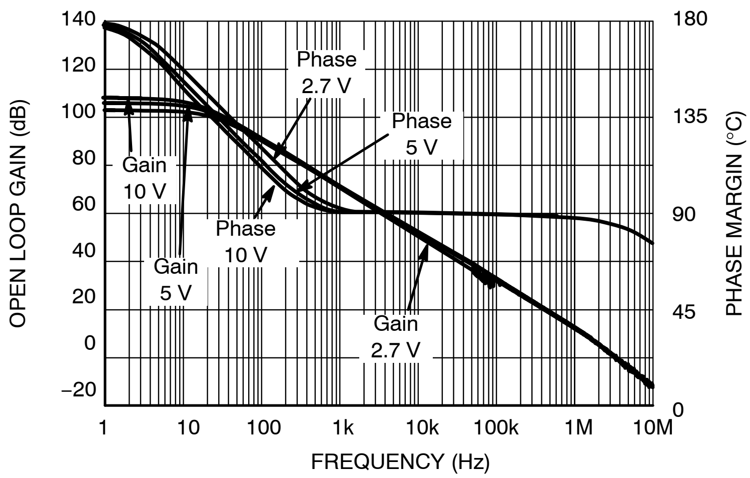



**Figure 14. Open Loop Gain and Phase vs. Frequency**

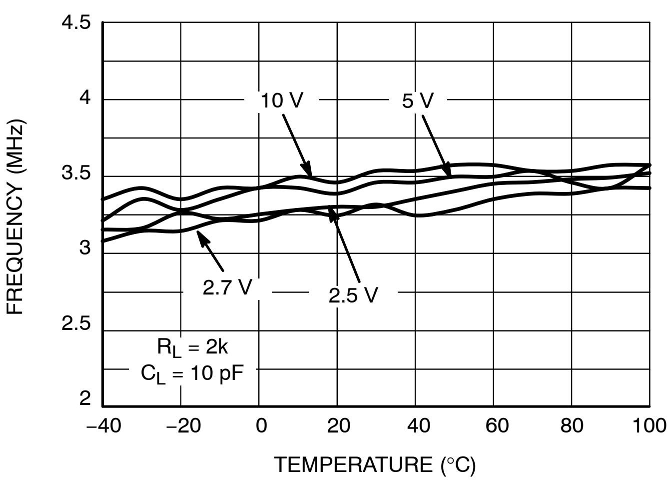



**Figure 15. Gain Bandwidth Product vs. Temperature**

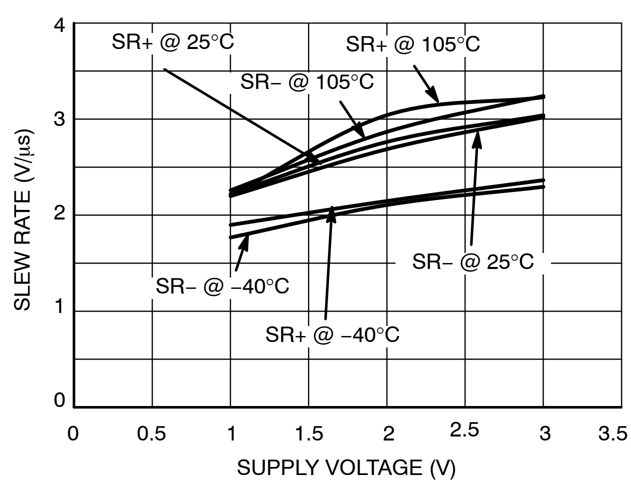



**Figure 16. Slew Rate vs. Supply Voltage**

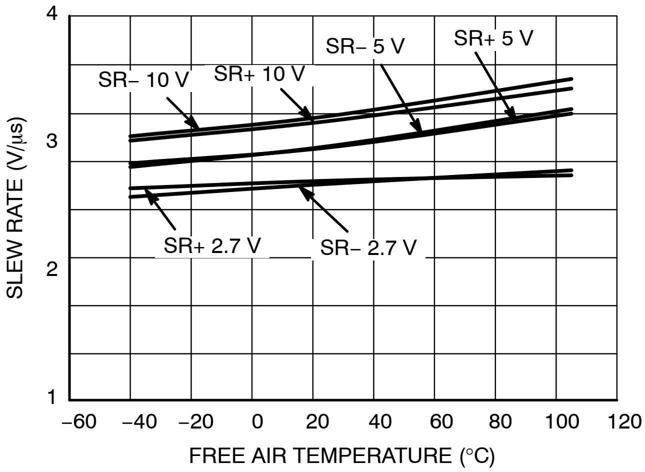



**Figure 17. Slew Rate vs. Temperature**

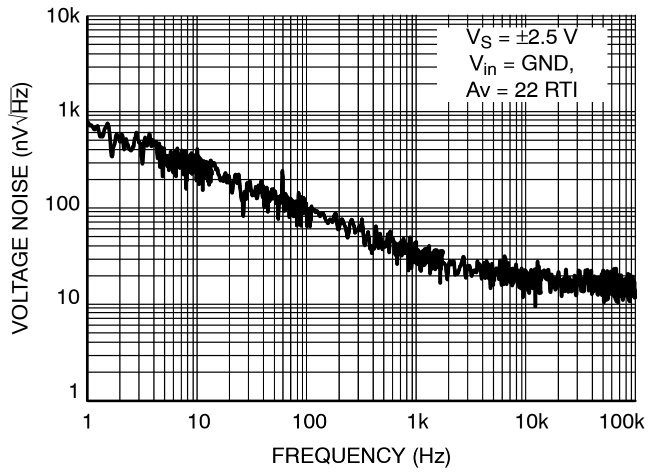



**Figure 18. Voltage Noise vs. Frequency**

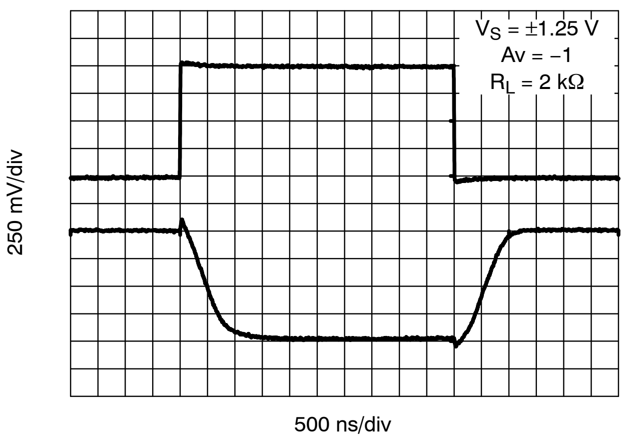



**Figure 19. 2.5 V Inverting Large Signal Pulse Response**

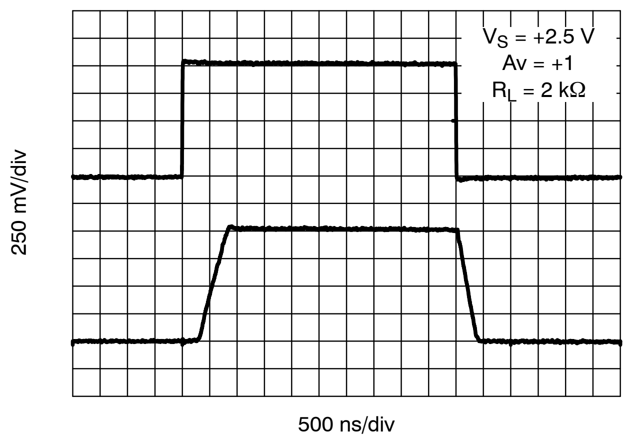



**Figure 20. 2.5 V Non−Inverting Large Signal Pulse Response**

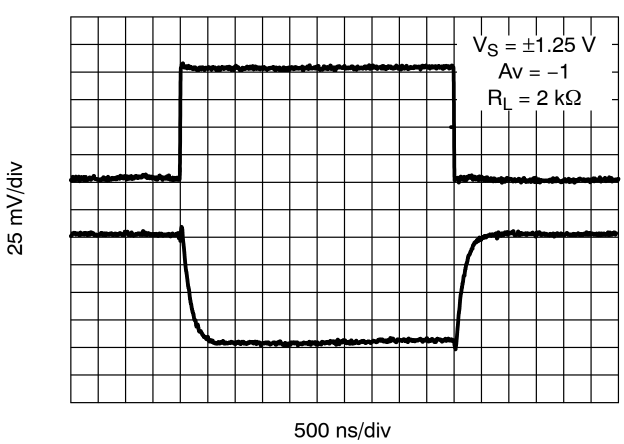



**Figure 21. 2.5 V Inverting Small Signal Pulse Response**

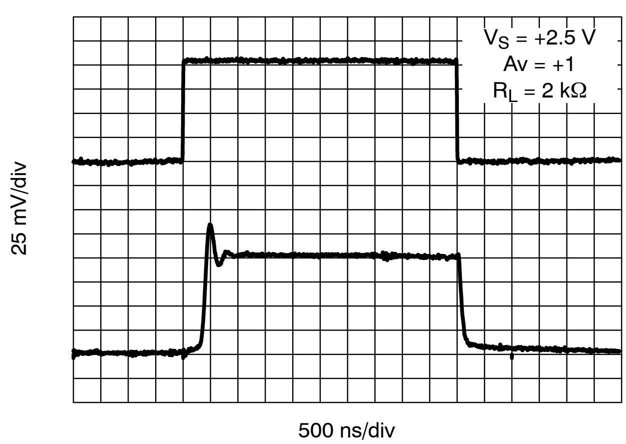



**Figure 22. 2.5 V Non−Inverting Small Signal Pulse Response**

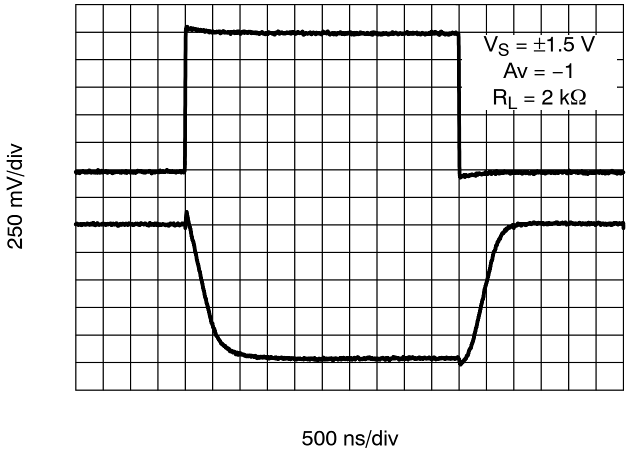



**Figure 23. 3 V Inverting Large Signal Pulse Response**

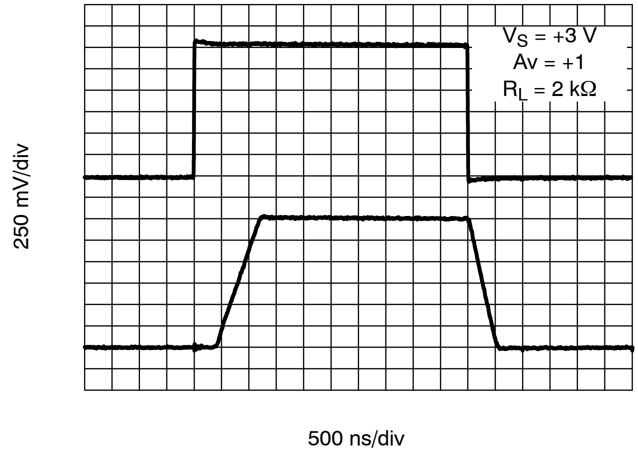



**Figure 24. 3 V Non−Inverting Large Signal Pulse Response**

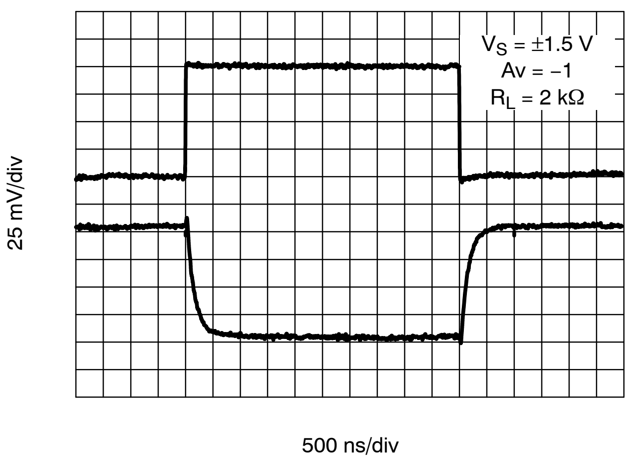



**Figure 25. 3 V Inverting Small Signal Pulse Response**

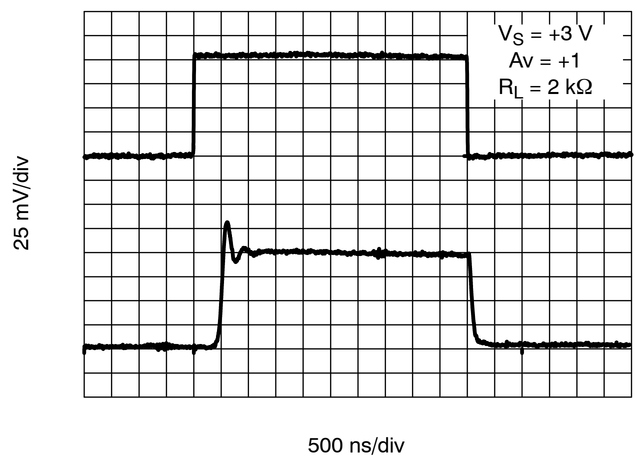



**Figure 26. 3 V Non−Inverting Small Signal Pulse Response**

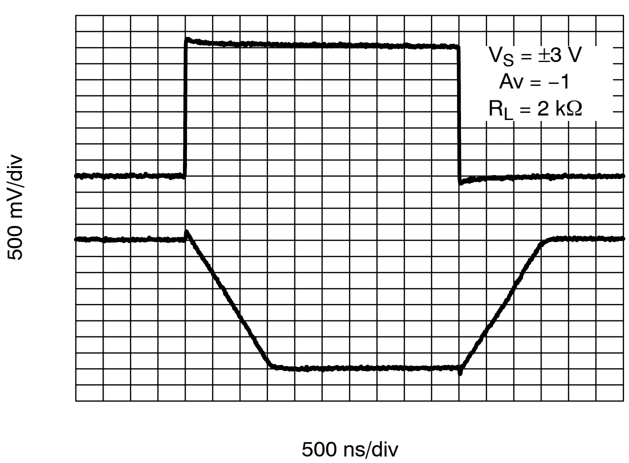



**Figure 27. 6 V Inverting Large Signal Pulse Response**

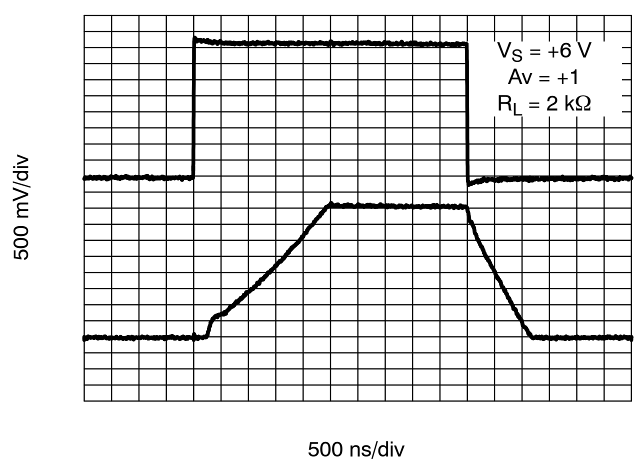



**Figure 28. 6 V Non−Inverting Large Signal Pulse Response**

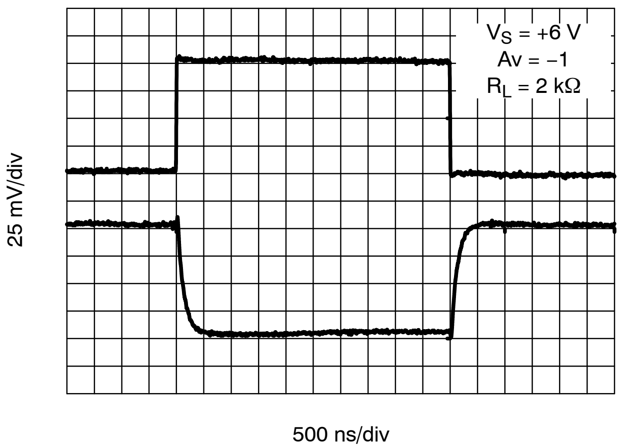



**Figure 29. 6 V Inverting Small Signal Pulse Response**

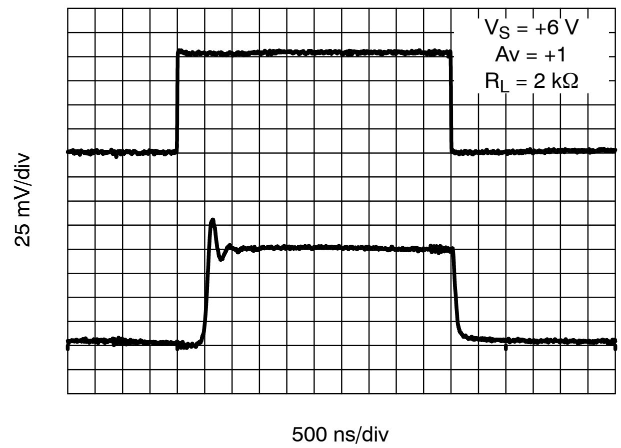
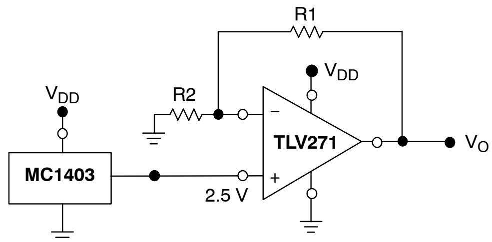


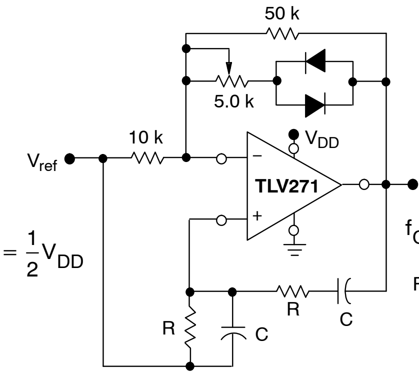

**Figure 30. 6 V Non−Inverting Small Signal Pulse Response**

## APPLICATIONS




$$V_O = 2.5\ V\left(1 + \frac{R1}{R2}\right)$$

**Figure 31. Voltage Reference**

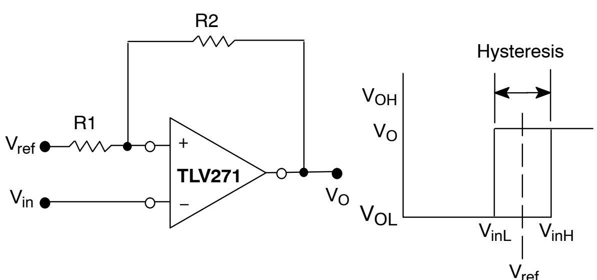



$$V_{ref} = \frac{1}{2} V_{DD}$$

$$f_O = \frac{1}{2\pi RC}$$

For: $f_o$ = 1.0 kHz
R = 16 kΩ
C = 0.01 μF

**Figure 32. Wien Bridge Oscillator**

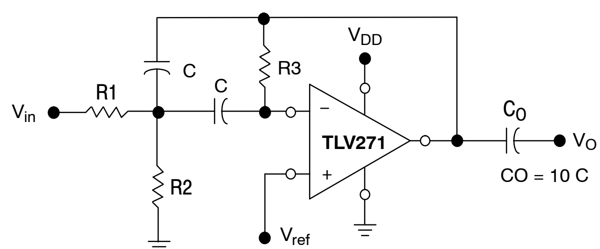



$$V_{in}L = \frac{R1}{R1 + R2}\ (V_{OL} - V_{ref}) + V_{ref}$$

$$V_{in}H = \frac{R1}{R1 + R2}\ (V_{OH} - V_{ref}) + V_{ref}$$

$$H = \frac{R1}{R1 + R2}\ (V_{OH} - V_{OL})$$

**Figure 33. Comparator with Hysteresis**




Given: $f_o$ = center frequency
$A(f_o)$ = gain at center frequency

Choose value $f_o$, C

Then : $R3 = \dfrac{Q}{\pi f_O\ C}$

$$R1 = \frac{R3}{2\ A(f_O)}$$

$$R2 = \frac{R1\ R3}{4Q^2\ R1 - R3}$$

For less than 10% error from operational amplifier, $((Q_O\ f_O)/BW) < 0.1$ where $f_o$ and BW are expressed in Hz. If source impedance varies, filter may be preceded with voltage follower buffer to stabilize filter parameters.

**Figure 34. Multiple Feedback Bandpass Filter**

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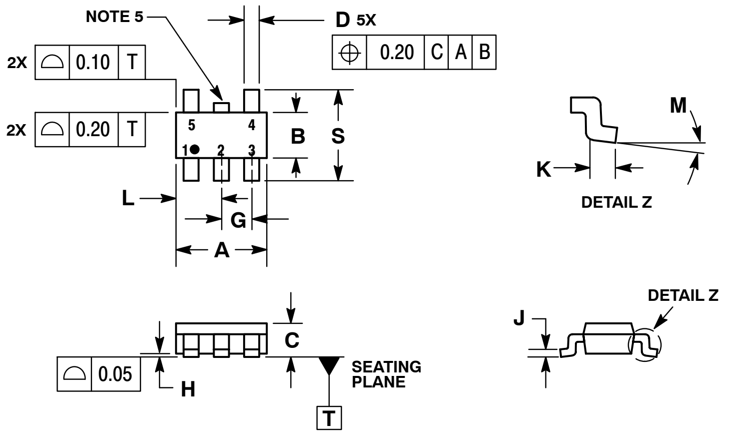
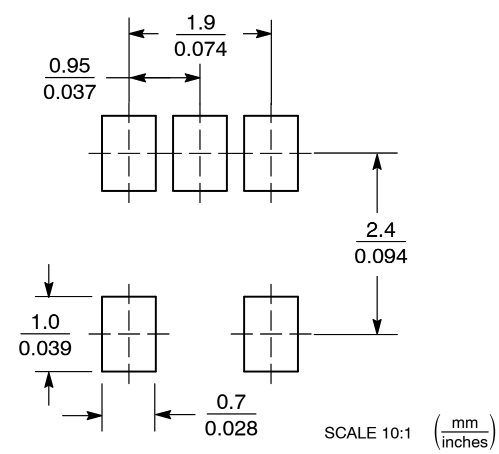



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
5. OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

| | MILLIMETERS | |
|---|---|---|
| DIM | MIN | MAX |
| A | 3.00 BSC | |
| B | 1.50 BSC | |
| C | 0.90 | 1.10 |
| D | 0.25 | 0.50 |
| G | 0.95 BSC | |
| H | 0.01 | 0.10 |
| J | 0.10 | 0.26 |
| K | 0.20 | 0.60 |
| L | 1.25 | 1.55 |
| M | 0 ° | 10 ° |
| S | 2.50 | 3.00 |

## SOLDERING FOOTPRINT*




*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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