TECH PUBLIC
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# TPA356AIDBVR

## 200MHZ,High Speed,CMOS Rail-to-Rail Operational Amplifier

WWW.SOT23.COM.TW

## Features

- Single-Supply Operation from +2.5V ~ +5.5V
- Rail-to-Rail Input / Output
- Gain-Bandwidth Product: 200MHz (Typ.)
- Low Input Bias Current: 10pA (Typ.)

## Applications

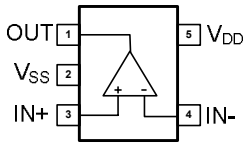
- Low Offset Voltage: 5mV (Max.)
- Quiescent Current: 2.8mA (Typ.)
- Operating Temperature: -40°C ~ +125°C
- Available in SOT23-5 and SOP8 Packages

## General Description

The TPA356 is wideband, low-noise, low-distortion operational amplifier, that offer rail-to-rail output and single-supply operation down to 2.5V. They draw 2.8mA of quiescent supply current, as well as low input voltage-noise density (13nV/√Hz) and low input current-noise density (400fA/√Hz). These features make the devices an ideal choice for applications that require low distortion and low noise.The TP8111 has output which swing rail-to-rail and their input common-mode voltage range includes ground and offer wide bandwidth to 200MHz (G=+1) .They are specified over the extended industrial temperature range (-45°C ~ 125°C).The singleTP8111 is available in space-saving, SOT23-5 packages.



## Pin Assignments




SOT23-5

## Package/Ordering Information

| Order Number | Package Description | Package Option |
|---|---|---|
| TPA356AIDBVR | SOT23-5 | Tape and Reel 3000 |

## Absolute Maximum Ratigs

| Condition | Min | Max |
|---|---|---|
| Power Supply Voltage ($V_{DD}$ to Vss) | -0.5V | +7V |
| Analog Input Voltage (IN+ or IN-) | Vss-0.5V | $V_{DD}$+0.5V |
| PDB Input Voltage | Vss-0.5V | +7V |
| Operating Temperature Range | -40°C | +125°C |
| Junction Temperature | +150°C | |
| Storage Temperature Range | -65°C | +150°C |
| Lead Temperature (soldering, 10sec) | +300°C | |
| Package Thermal Resistance ($T_A$=+25°C) | | |
| SOP23-5, $\theta_{JA}$ | 190°C | |
| SOP8, $\theta_{JA}$ | 130°C | |

**Note:** Stress greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions outside those indicated in the operational sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## Electrical Characteristics ($T_A$=25°C unless otherwise noted)

**($V_{DD}$ = +5V, Vss = 0V, $V_{CM}$ = 0V, $V_{OUT}$ = $V_{DD}$/2, $R_L$=100K tied to $V_{DD}$/2, SHDNB = $V_{DD}$, $T_A$ = -40°C to +125°C, unless otherwise noted. Typical values are at $T_A$ =+25°C.) (Notes 1,2)**

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Supply-Voltage Range | $V_{DD}$ | Guaranteed by the PSRR test | 2.5 | - | 5.5 | V |
| Quiescent Supply Current (per Amplifier) | | $V_{DD}$ = 5V | - | 2.8 | 3.5 | mA |
| Input Offset Voltage | $V_{OS}$ | $T_A$=25°C | - | ±1 | - | mV |
| | | $T_A$=-40°C~+85°C | - | ±8 | - | |
| | | $T_A$=-40°C~+125°C | - | - | ±10 | |
| Input Offset Voltage Tempco | $\Delta V_{OS}/\Delta T$ | | - | ±2 | - | µV/°C |
| Input Bias Current | $I_B$ | (Note 3) | - | ±10 | ±100 | pA |
| Input Offset Current | $I_{OS}$ | (Note 3) | - | ±10 | ±100 | pA |
| Input Common-Mode Voltage Range | $V_{CM}$ | Guaranteed by the $T_A$ = 25°C<br>CMRR test, $T_A$ = -40°C ~ +125°C | -0.1 | - | $V_{DD}$+0.1.5 | V |
| Common-Mode Rejection Ratio | CMRR | Vss-0.1V≤$V_{CM}$≤$V_{DD}$+0.1V<br>$T_A$ = 25°C | - | 75 | - | dB |
| | | Vss≤$V_{CM}$≤5$V_{DD}$<br>$T_A$ = 25°C | 72 | 90 | - | |
| | | Vss-0.1V≤$V_{CM}$≤$V_{DD}$+0.1V<br>$T_A$ = -40°C ~ +125°C | - | 68 | - | |
| Power-Supply Rejection Ratio | PSRR | $V_{DD}$ = +2.5V to +5.5V | 75 | 90 | - | dB |
| Open-Loop Voltage Gain | $A_V$ | $R_L$ = 10kΩ to $V_{DD}$/2<br>$V_{OUT}$ = 100mV to $V_{DD}$-125mV | 90 | 100 | - | dB |
| | | $R_L$ = 1kΩ to $V_{DD}$/2<br>$V_{OUT}$ = 200mV to $V_{DD}$-250mV | 80 | 95 | - | |
| | | $R_L$ = 500Ω to $V_{DD}$/2<br>$V_{OUT}$ = 350mV to $V_{DD}$-500mV | 70 | 80 | - | |
| Output Voltage Swing | $V_{OUT}$ | \|$V_{IN+}$-$V_{IN-}$\| ≥ 10mV $V_{DD}$-$V_{OH}$ | - | 10 | 30 | mV |
| | | $R_L$ = 10kΩ to $V_{DD}$/2 $V_{OL}$-$V_{SS}$ | - | 10 | 35 | |
| | | \|$V_{IN+}$-$V_{IN-}$\| ≥ 10mV $V_{DD}$-$V_{OH}$ | - | 80 | 50 | |
| | | $R_L$ = 1kΩ to $V_{DD}$/2 $V_{OL}$-$V_{SS}$ | - | 30 | 50 | |
| | | \|$V_{IN+}$-$V_{IN-}$\| ≥ 10mV $V_{DD}$-$V_{OH}$ | - | 100 | 140 | |
| | | $R_L$ = 500Ω to $V_{DD}$/2 $V_{OL}$-$V_{SS}$ | - | 100 | 140 | |
| Output Short-Circuit Current | $I_{SC}$ | Sinking or Sourcing | - | ±100 | - | mA |
| -3 dB Gain Bandwidth Product | GBW | $A_V$ = +1V/V | - | 200 | - | MHz |
| Slew Rate | SR | $A_V$ = +1V/V | - | 125 | - | V/µs |

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Differential Phase error (NTSC) | DP | G=2,$R_L$=150Ω | - | 0.03 | - | deg |
| Differential Gain error (NTSC) | DG | G=2,$R_L$=150Ω | - | 0.09 | - | dB |
| Settling Time | $t_S$ | To 0.01%, $V_{OUT}$ = 2V step<br>$A_V$ = +1V/V | - | 42 | - | ns |
| Over Load Recovery Time | | $V_{IN}$ × Gain=$V_S$ | - | 35 | - | ns |
| Input Voltage Noise Density | $e_n$ | $f$ = 1MHz | - | 16 | - | nV/√Hz |
| Total Harmonic Distortion plus Noise | THD+N | $f_C$=5MHZ,$V_{OUT}$=2Vp-p,G=+2 | - | -60 | - | dB |

**Note 1:** All devices are 100% production tested at $T_A$ = +25°C; all specifications over the automotive temperature range is guaranteed by design, not production tested.

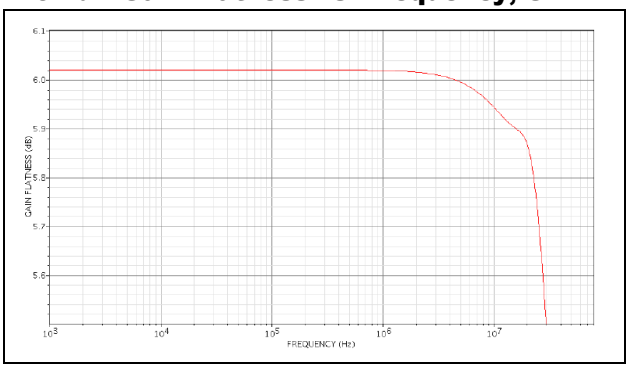
**Note 2:** Parameter is guaranteed by design.

**Note 3:** Peak-to-peak input noise voltage is defined as six times rms value of input noise voltage.

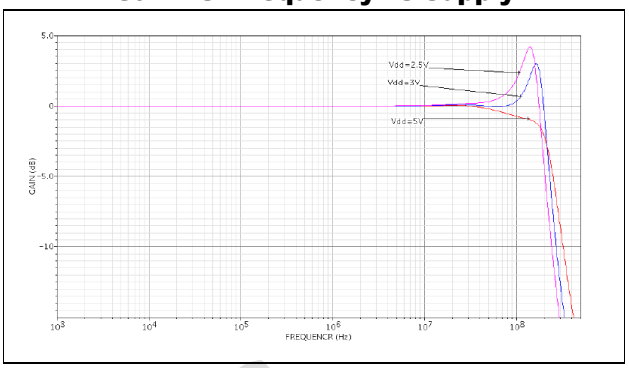
## TYPICAL PERFORMANCE CHARACTERISTICS



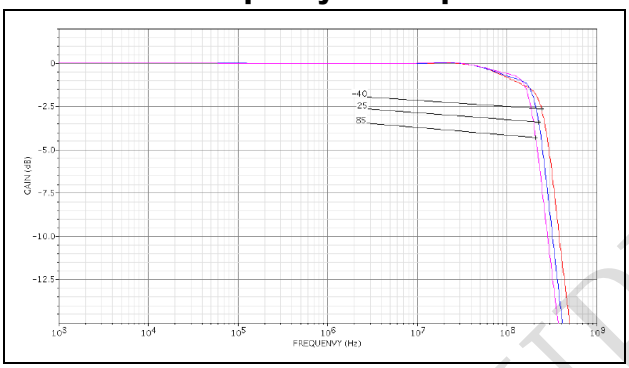
**0.1dB Gain Flatness vs. Frequency; G=+2**



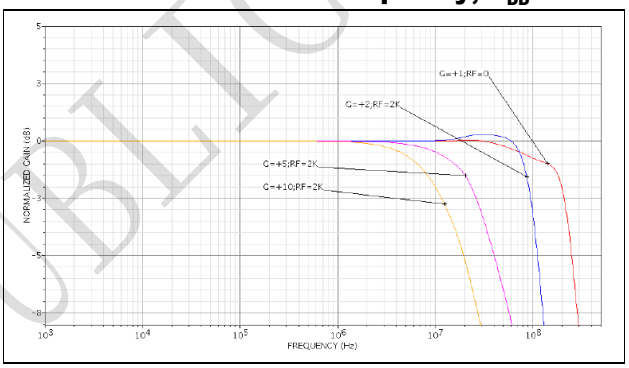

**Gain vs. Frequency vs Supply**



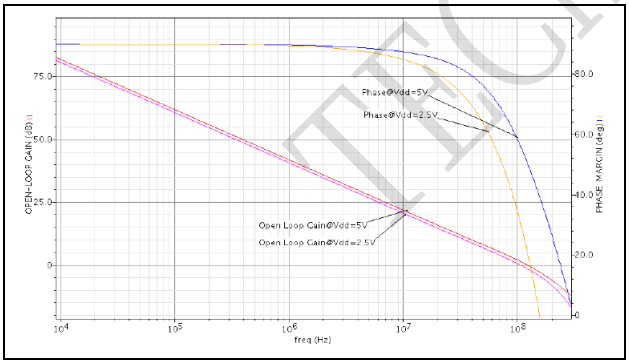

**Gain vs. Frequency vs Temperature**



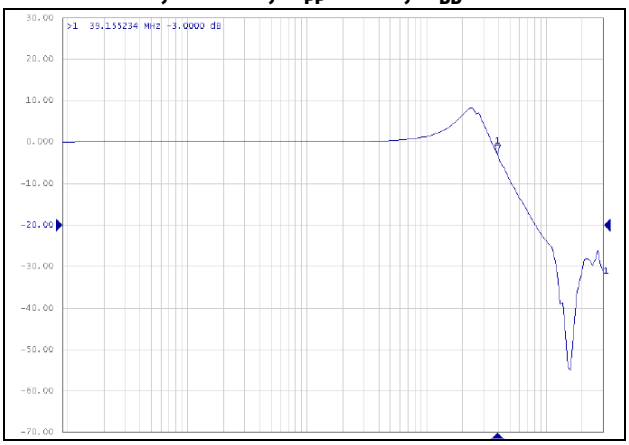

**Normalized Gain vs. Frequency; $V_{DD}$=5V**



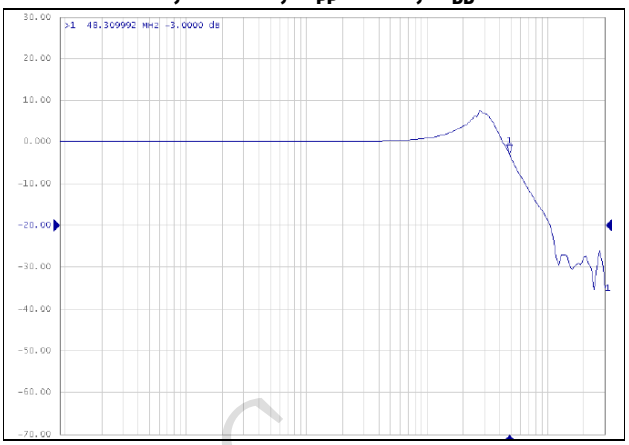

**STB_RL=2K**



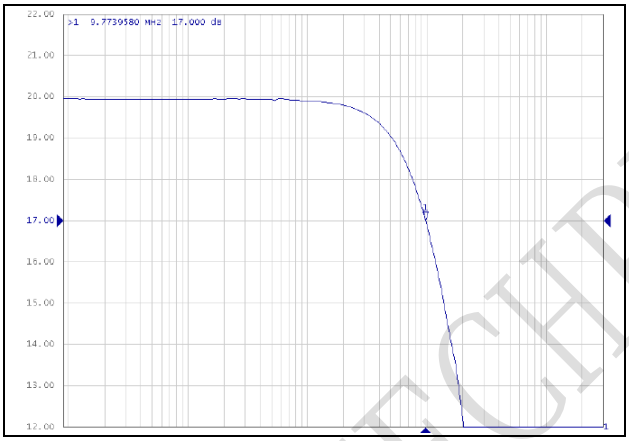
**G=+1; RF=2K; $V_{PP}$=0.2V; $V_{DD}$=2.5V**



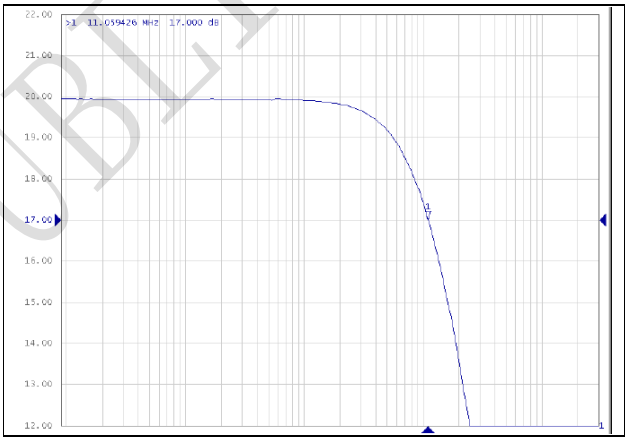
**G=+1; RF=2K; $V_{PP}$=0.2V; $V_{DD}$=5V**



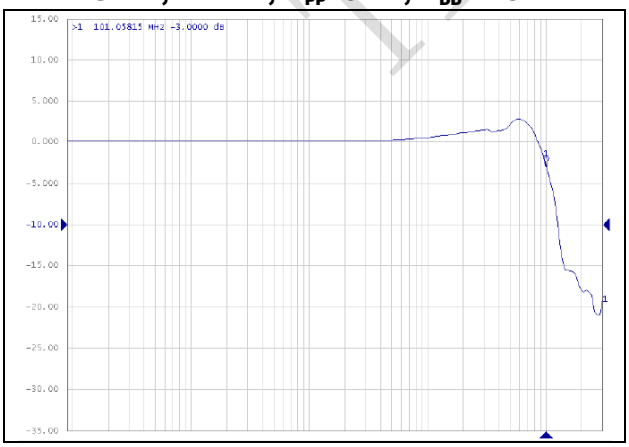
**G=+2;RF=100Ω; RI=150 Ω $V_{PP}$=0.2V; $V_{DD}$=2.5V**



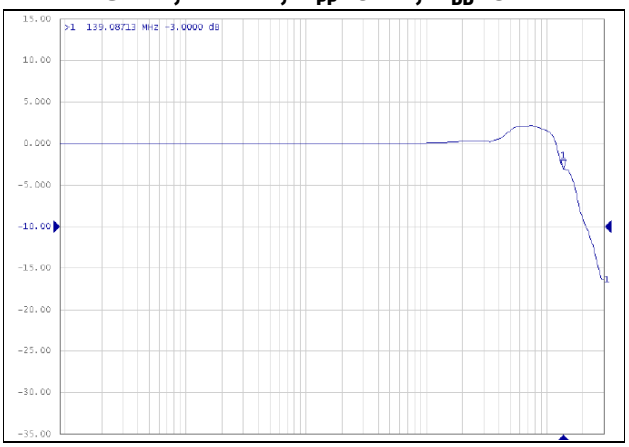
**G=-10; RF=2K; $V_{PP}$=0.2V; $V_{DD}$=5V**



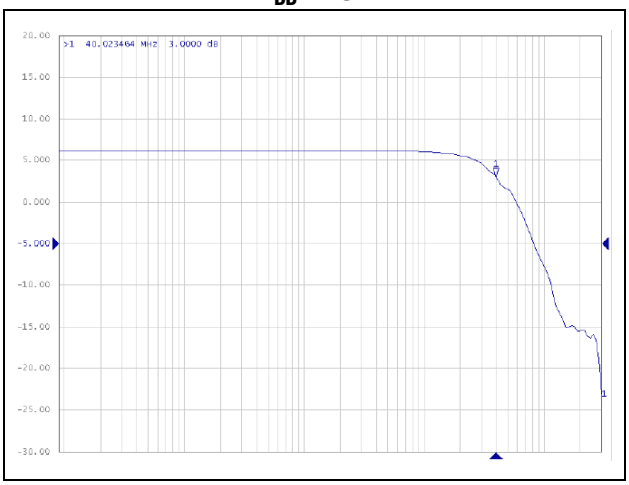
**G=+1; RF=2K; $V_{PP}$=0.2V; $V_{DD}$=2.5V**



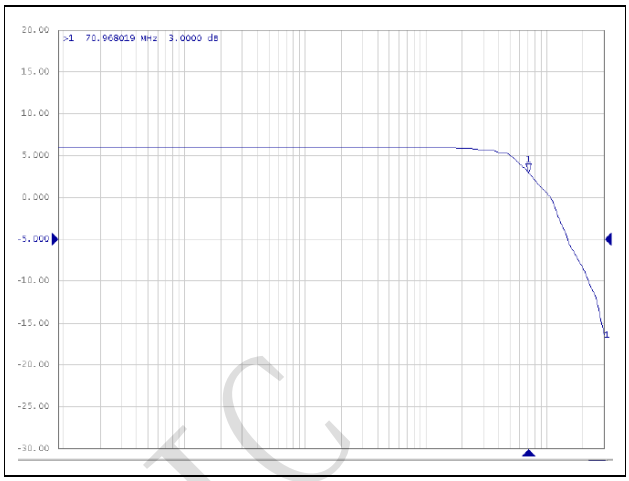
**G=+1; RF=2K; $V_{PP}$=0.2V; $V_{DD}$=5V**



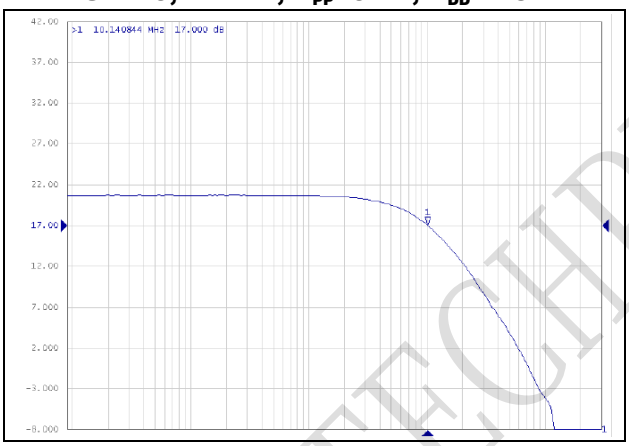
**G=+2; RF=100 Ω; RI=150 Ω $V_{PP}$=0.2V; $V_{DD}$=2.5V**



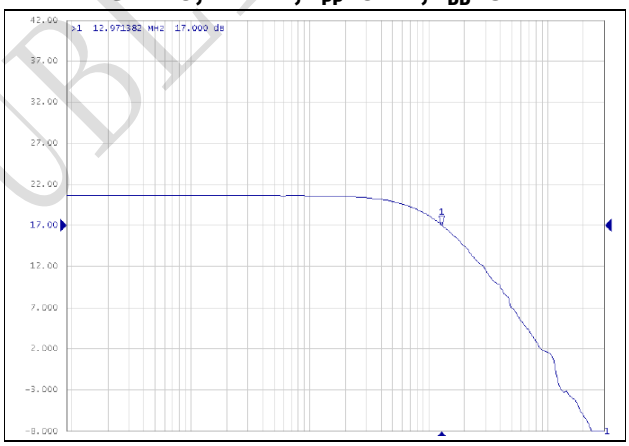

**G=+2; RF=100 Ω; RI=150 Ω $V_{PP}$=0.2V; $V_{DD}$=5V**



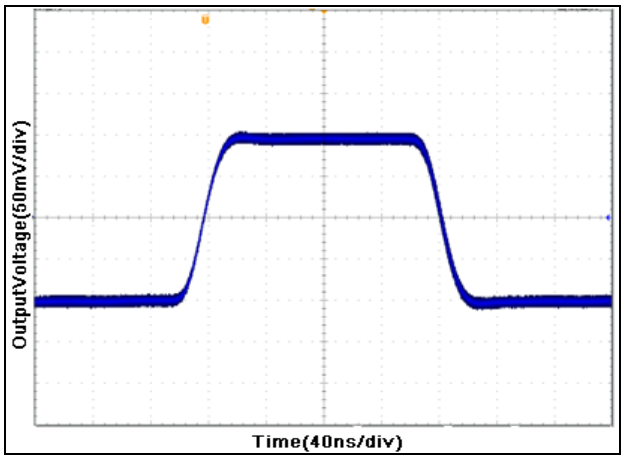

**G=+10; RF=2K; $V_{PP}$=0.2V; $V_{DD}$=2.5V**



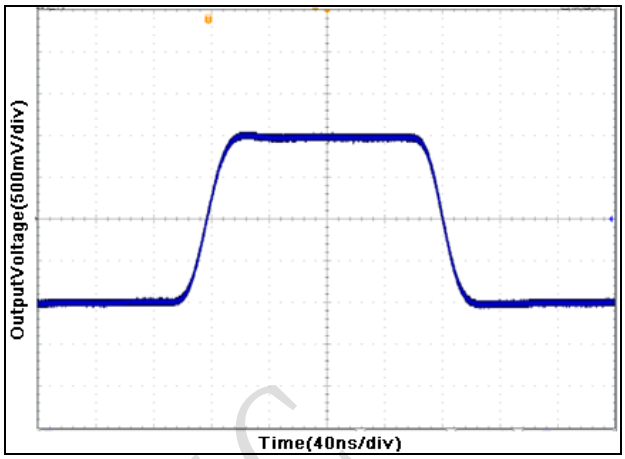

**G=+10;RF=2K;$V_{PP}$=0.2V;$V_{DD}$=5V**



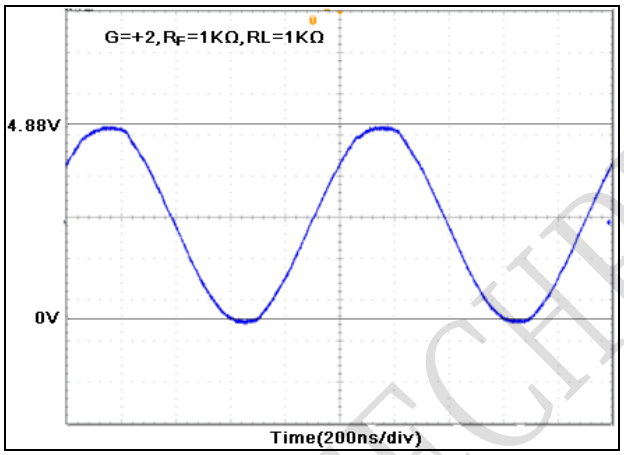
**Non-Inverting Small Signal Step Response**



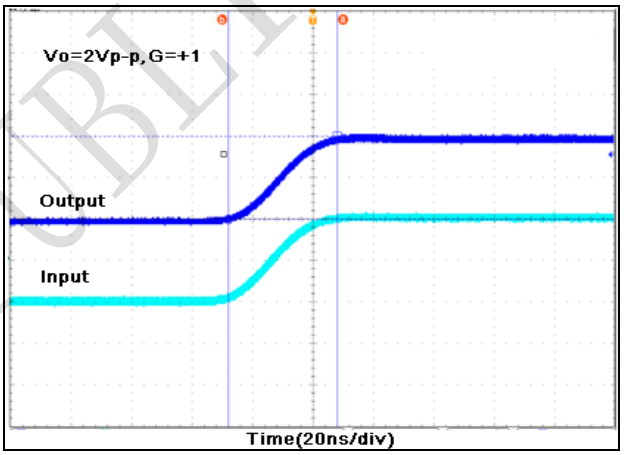

**Non-Inverting Large Signal Step Response**



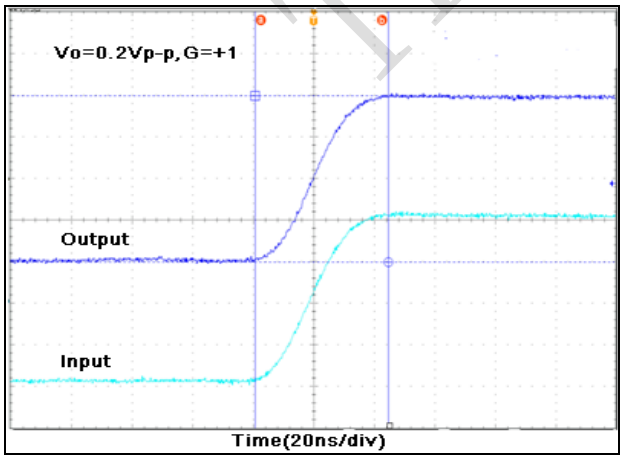

**Rail-To-Rail**




**Output Settling Time(large signal)**

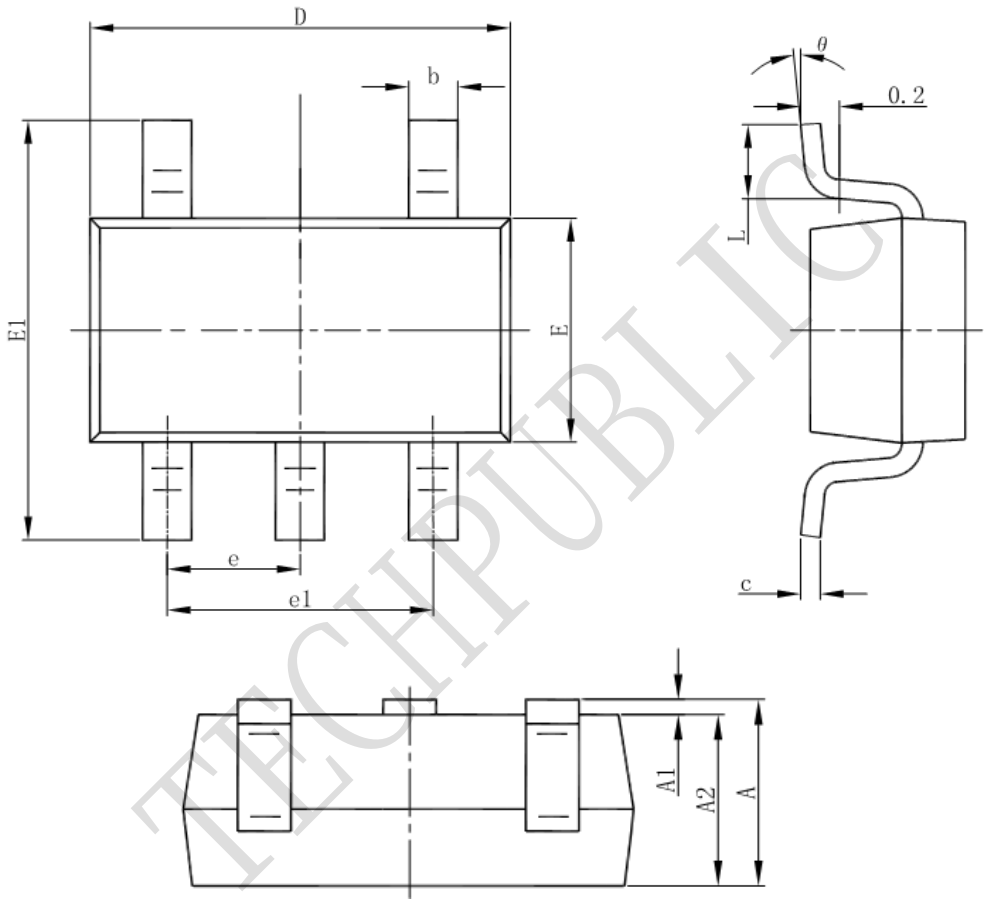



**Output Settling Time(small signal)**



## Package Information

**SOT23-5**






| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| D | 2.820 | 3.020 | 0.111 | 0.119 |
| E | 1.500 | 1.700 | 0.059 | 0.067 |
| E1 | 2.650 | 2.950 | 0.104 | 0.116 |
| e | 0.950(BSC) | | 0.037(BSC) | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |