



**THE DATASHEET OF  
MP8104DJ-LF-Z**



### DESCRIPTION

The MP8104 is a rail-to-rail output, operational amplifier in a TSOT-23 package with industry standard pin-out. This amplifier provides 400KHz bandwidth while consuming an incredibly low 11 $\mu$ A of supply current. The MP8104 can operate with a single supply voltage as low as 1.8V.

### FEATURES

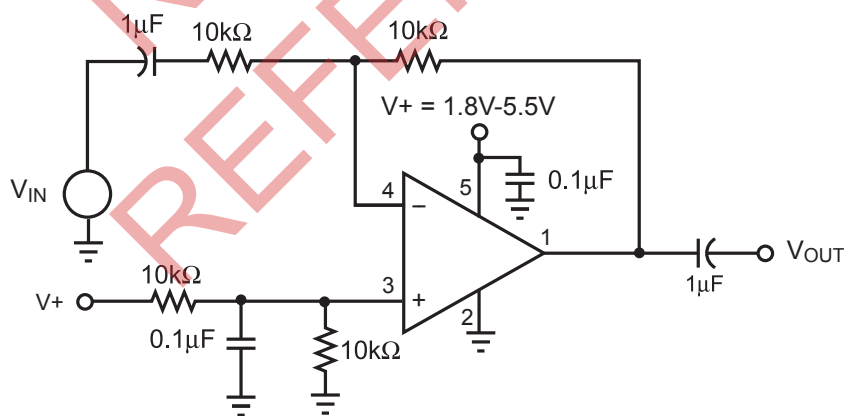
- Single Supply Operation: 1.8V to 5.5V
- TSOT23-5 Package
- 400KHz Gain Bandwidth
- 11 $\mu$ A Supply Current
- Rail-to-Rail Output
- Unity-Gain Stable
- Input Common Mode to Ground
- Drives Up to 1000pF of Capacitive Loads

### APPLICATIONS

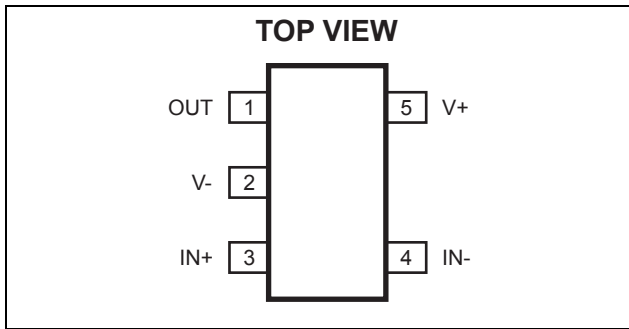
- Portable Equipment
- PDAs
- Pagers
- Cordless Phones
- Handheld GPS
- Consumer Electronics

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### TYPICAL APPLICATION



### PACKAGE REFERENCE



Part Number*	Package	Temperature
MP8104DJ	TSOT23-5	-40°C to +85°C

\* For Tape & Reel, add suffix -Z (eg. MP8104DJ-Z)  
 For Lead Free, add suffix -LF (eg. MP8104DJ-LF-Z)

### ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>

Supply Voltage (V+ to V-) ..... +6.0V  
 Differential Input Voltage ( $V_{IN+} - V_{IN-}$ ) ..... +6.0V  
 Input Voltage ( $V_{IN+} - V_{IN-}$ )..  $V_{IN+} + 0.3V$ ,  $V_{IN-} - 0.3V$

### Recommended Operating Conditions <sup>(2)</sup>

Supply Voltage ..... +1.8V to +5.5V  
 Operating Temperature ..... -40°C to +85°C

**Thermal Resistance <sup>(3)</sup>**

	$\theta_{JA}$	$\theta_{JC}$
TSOT23-5.....	220	110

°C/W

**Notes:**

- 1) Exceeding these ratings may damage the device.
- 2) The device is not guaranteed to function outside of its operating conditions.
- 3) Measured on approximately 1" square of 1 oz copper.

### ELECTRICAL CHARACTERISTICS

V+ = +5V, V- = 0V,  $V_{CM} = V+/2$ ,  $R_L = 10k\Omega$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
Input Offset Voltage	$V_{OS}$		-5	1	+5	mV
Input Offset Voltage Temp Coefficient				15		$\mu V/^\circ C$
Input Bias Current <sup>(4)</sup>	$I_B$			2		pA
Input Offset Current <sup>(4)</sup>	$I_{OS}$			0.2		pA
Input Voltage Range	$V_{CM}$	CMRR > 60dB	0		3.8	V
Common-Mode Rejection Ratio	CMRR	$0 < V_{CM} < 3.5V$		82		dB
Power Supply Rejection Ratio	PSRR	Supply Voltage change of 1.0V		80		dB
Large Signal Voltage Gain	$A_{VOL}$	$R_L = 100k\Omega$ , $V_{OUT} = 5.0$ Peak to Peak	60	88		dB
Maximum Output Voltage Swing	$V_{OUT}$	$R_L = 10k\Omega$		$(V+) - 23mV$		V
Minimum Output Voltage Swing	$V_{OUT}$	$R_L = 10k\Omega$		$(V-) + 19mV$		V
Gain-Bandwidth Product <sup>(4)</sup>	GBW	$R_L = 200k\Omega, C_L = 2pF$ , $V_{OUT} = 0$		400		KHz
-3dB Bandwidth <sup>(4)</sup>	BW	$A_V = 1, C_L = 2pF$ , $R_L = 1M\Omega$		1		MHz
Slew Rate <sup>(4)</sup>	SR	$A_V = 1, C_L = 2pF$ , $R_L = 1M\Omega$		0.2		V/ $\mu s$
Short Circuit Current	$I_{SC}$	Source		20		mA
		Sink		20		mA
Supply Current		No Load		11	20	$\mu A$

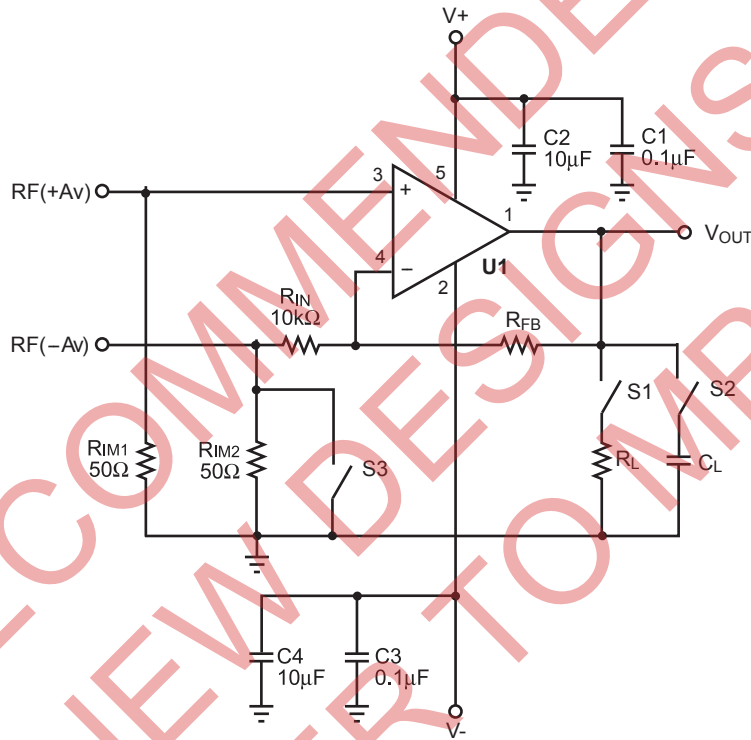
**Note:**

4) Guaranteed by design.

## PIN FUNCTIONS

Pin #	Name	Description
1	OUT	Output.
2	V-	Ground or Supply Return Pin.
3	IN+	Non-Inverting Input.
4	IN-	Inverting Input.
5	V+	Supply Voltage.

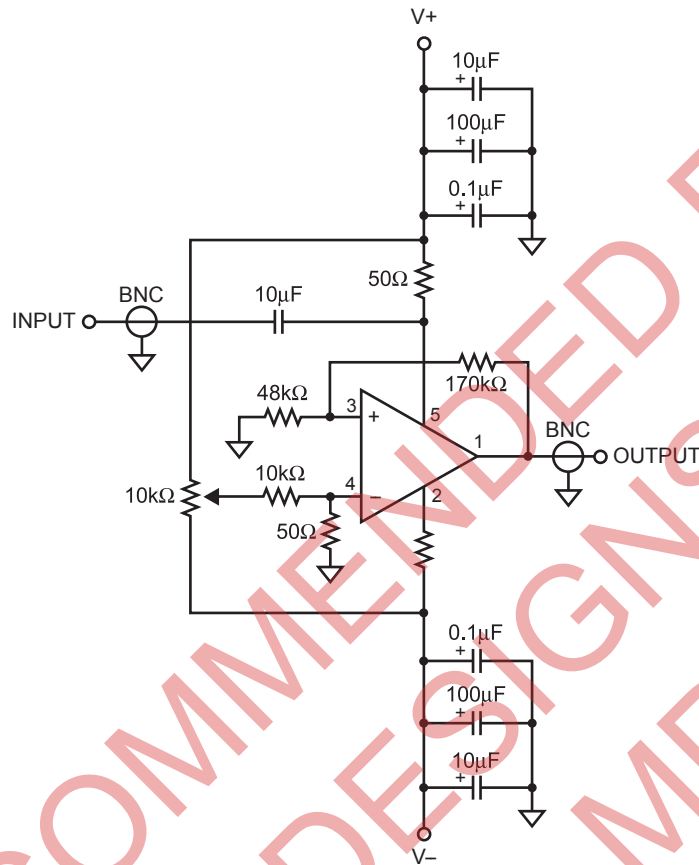
## TEST CIRCUITS



Notes: Close S3 for positive gain. Input signal to RF(+Av) connector.  
 The gain  $A_v = 1 + R_{FB}/R_{IN}$ .  
 For unity gain, remove  $R_{IN}$  and short  $R_{FB}$ .  
 Open S3 for negative gain. Input signal to RF(-Av) connector.  
 The gain  $A_v = -R_{FB}/R_{IN}$ .  
 S1 and S2 are switches for possible resistor and capacitor load connections.

**Figure 1—AC Test Circuit**

**TEST CIRCUITS** *(continued)*

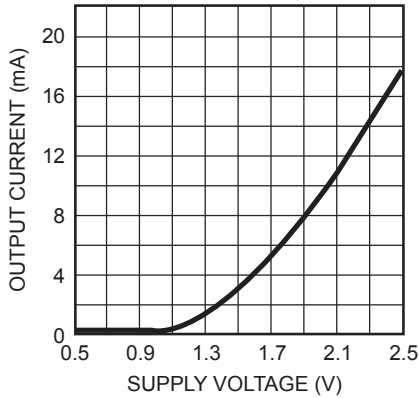


**Figure 2—Positive Power Supply Rejection Ratio Measurement**

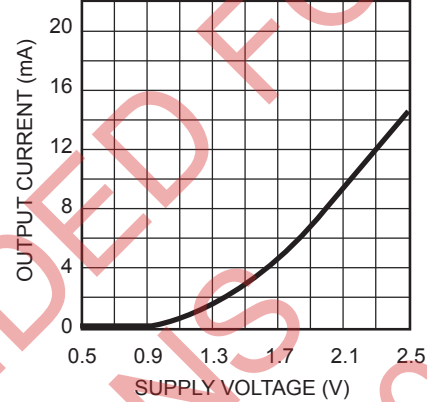
## TYPICAL PERFORMANCE CHARACTERISTICS

T<sub>A</sub> = +25°C, unless otherwise noted.

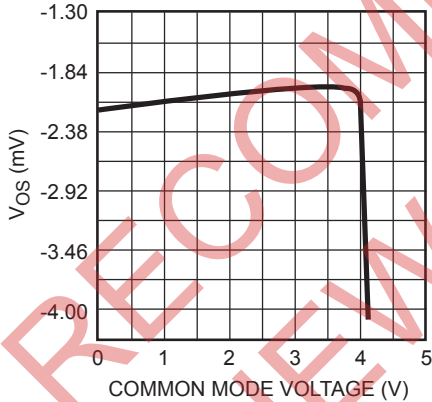
**Short Circuit Current vs Supply Voltage**  
Sourcing



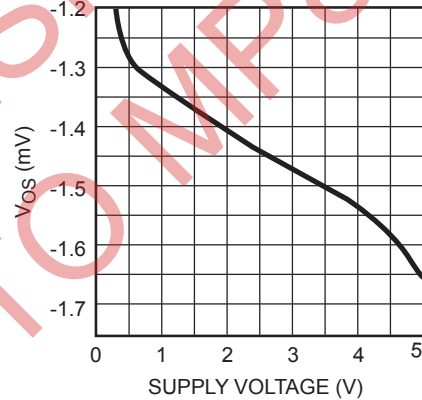
**Short Circuit Current vs Supply Voltage**  
Sinking



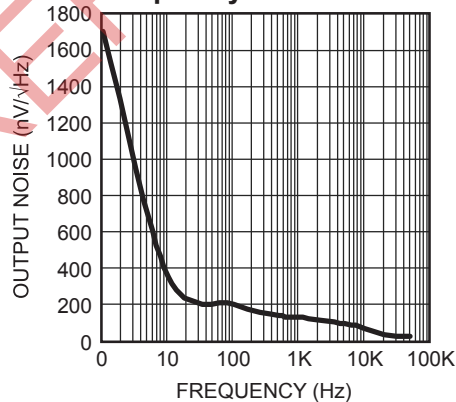
**Offset Voltage vs. Common Mode Voltage**  
R<sub>FB</sub> = 50kΩ, V<sub>-</sub> = -5V to 0V,  
V<sub>+</sub> = 0V to +5V



**Offset Voltage vs. Supply Voltage**  
R<sub>FB</sub> = 50kΩ, V<sub>-</sub> = -2.5V to 0V,  
V<sub>+</sub> = +2.5V to 0V

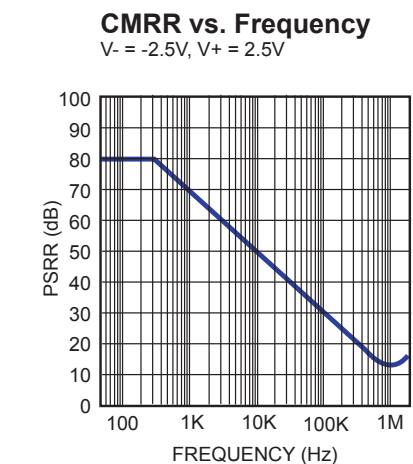
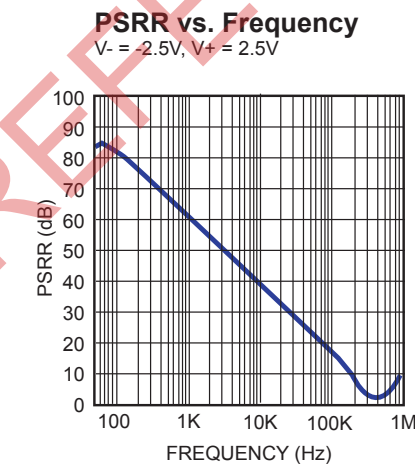
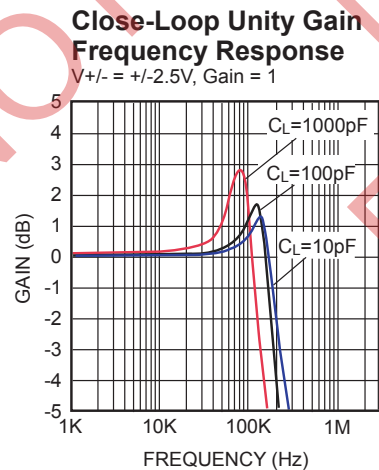
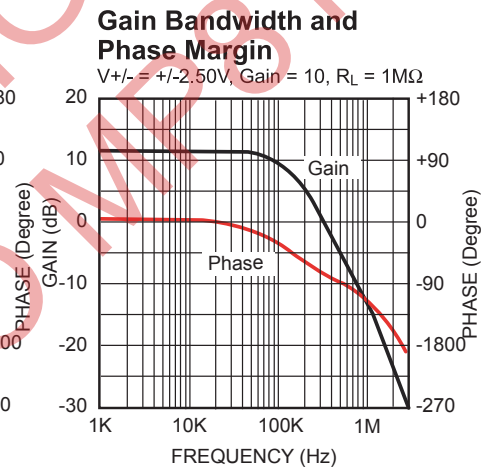
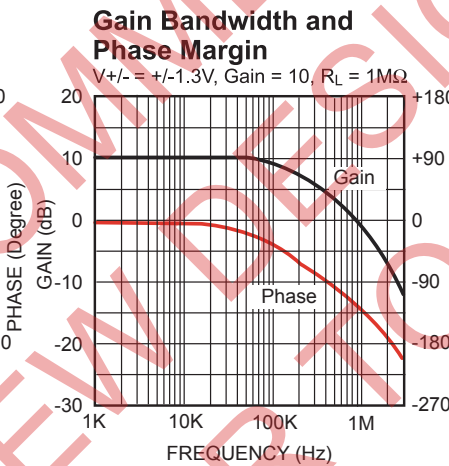
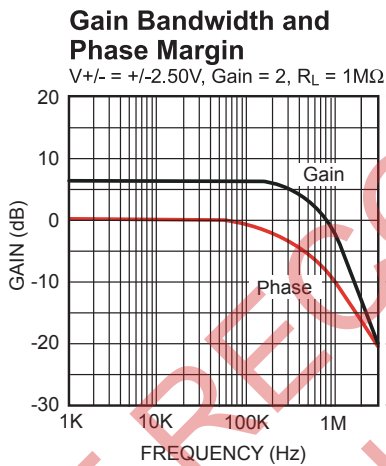
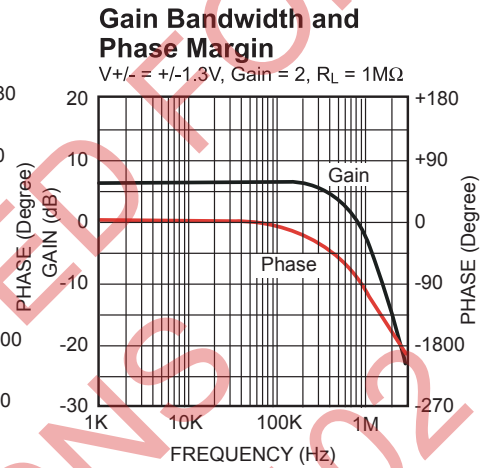
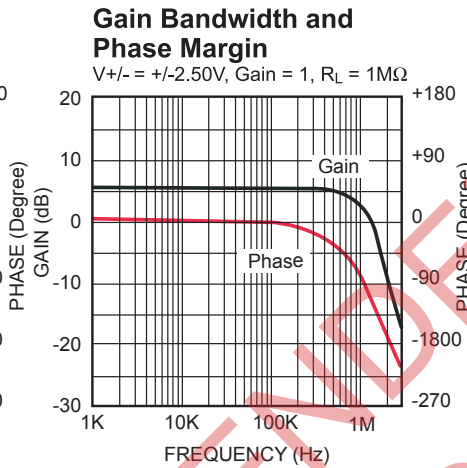
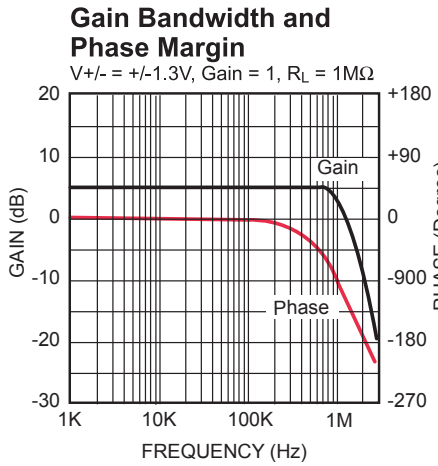


**Output Noise vs. Frequency**

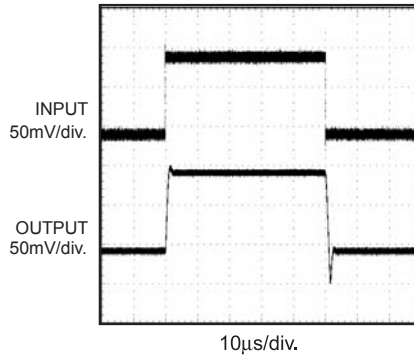
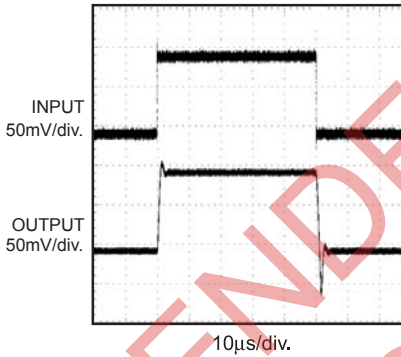
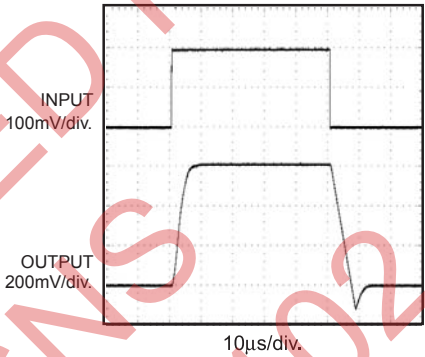
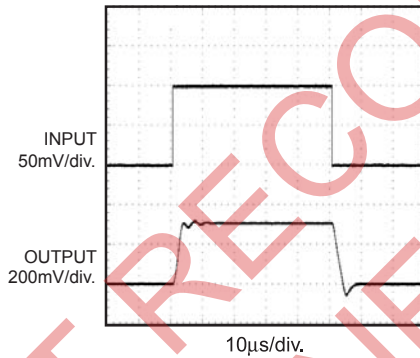
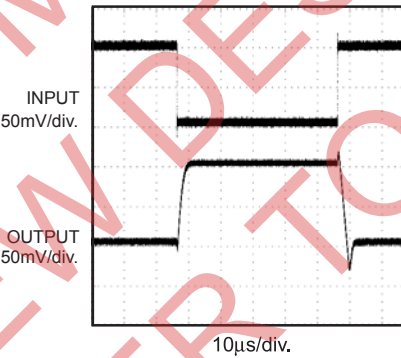
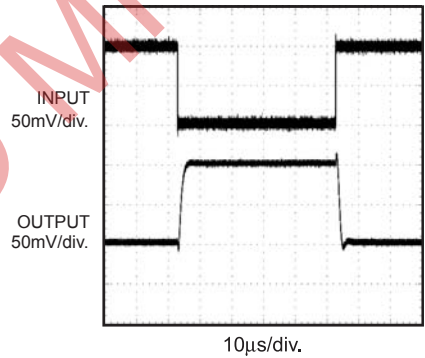
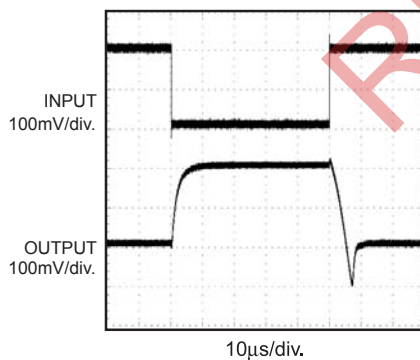
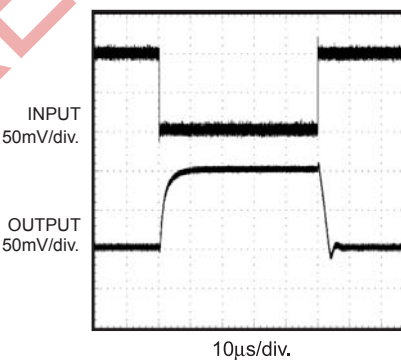


## TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

T<sub>A</sub> = +25°C, unless otherwise noted.



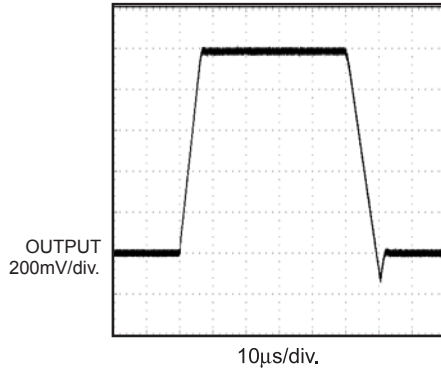
**TYPICAL PERFORMANCE CHARACTERISTICS** *(continued)*
 $T_A = +25^\circ\text{C}$ , unless otherwise noted.

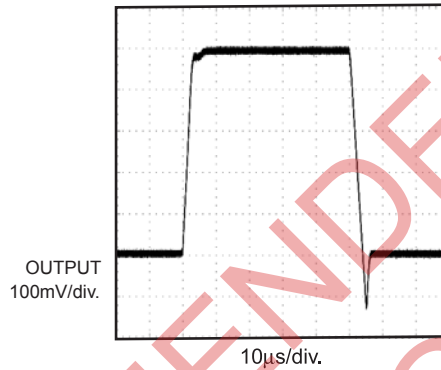
**Small Signal Pulse Response**
 $A_V = 1, V_+ = 2.5\text{V}, V_- = -2.5\text{V}$   
 $R_L = 1\text{M}\Omega, C_L = 8\text{pF}$ 

**Small Signal Pulse Response**
 $A_V = 1, V_+ = 1.3\text{V}, V_- = -1.3\text{V}$   
 $R_L = 1\text{M}\Omega, C_L = 8\text{pF}$ 

**Small Signal Pulse Response**
 $A_V = 1, V_+ = 2.5\text{V}, V_- = -2.5\text{V}$   
 $R_L = 1\text{M}\Omega, C_L = 47\text{pF}$ 

**Small Signal Pulse Response**
 $A_V = 1, V_+ = 1.3\text{V}, V_- = -1.3\text{V}$   
 $R_L = 1\text{M}\Omega, C_L = 47\text{pF}$ 

**Small Signal Pulse Response**
 $A_V = -1, V_+ = 2.5\text{V}, V_- = -2.5\text{V}$   
 $R_L = 1\text{M}\Omega, C_L = 8\text{pF}$ 

**Small Signal Pulse Response**
 $A_V = -1, V_+ = 1.3\text{V}, V_- = -1.3\text{V}$   
 $R_L = 1\text{M}\Omega, C_L = 8\text{pF}$ 

**Small Signal Pulse Response**
 $A_V = -1, V_+ = 2.5\text{V}, V_- = -2.5\text{V}$   
 $R_L = 4.7\text{k}\Omega, C_L = 8\text{pF}$ 

**Small Signal Pulse Response**
 $A_V = -1, V_+ = 1.3\text{V}, V_- = -1.3\text{V}$   
 $R_L = 4.7\text{k}\Omega, C_L = 8\text{pF}$ 


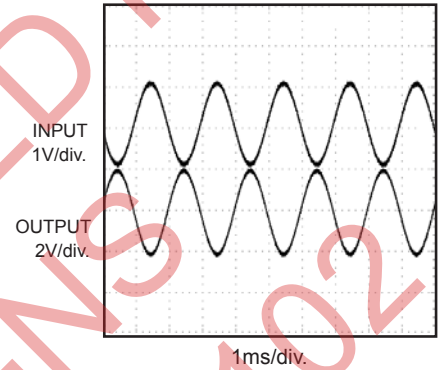
**TYPICAL PERFORMANCE CHARACTERISTICS** *(continued)*

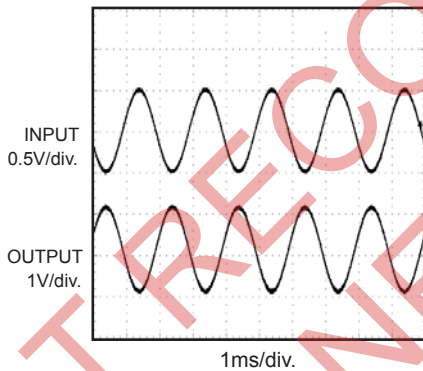
 T<sub>A</sub> = +25°C, unless otherwise noted.

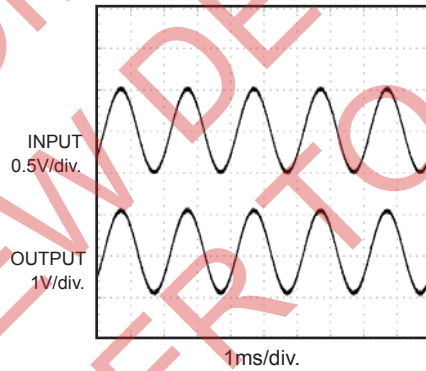
**Large Signal Pulse Response**

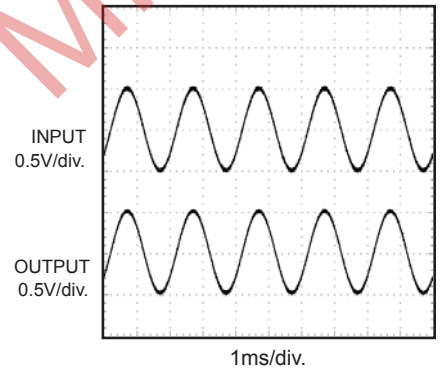
 A<sub>v</sub> = 1, V<sub>+</sub> = 2.5V, V<sub>-</sub> = -2.5V  
 R<sub>L</sub> = 1MΩ, C<sub>L</sub> = 8pF

**Large Signal Pulse Response**

 A<sub>v</sub> = 1, V<sub>+</sub> = 1.3V, V<sub>-</sub> = -1.3V  
 R<sub>L</sub> = 1MΩ, C<sub>L</sub> = 8pF

**Rail to Rail Output Operation**

 A<sub>v</sub> = -2, V<sub>+</sub> = 2.5V, V<sub>-</sub> = -2.5V  
 R<sub>L</sub> = 1MΩ, C<sub>L</sub> = 50pF

**Rail to Rail Output Operation**

 A<sub>v</sub> = -2, V<sub>+</sub> = 1.3V, V<sub>-</sub> = -1.3V  
 R<sub>L</sub> = 1MΩ, C<sub>L</sub> = 50pF

**Rail to Rail Output Operation**

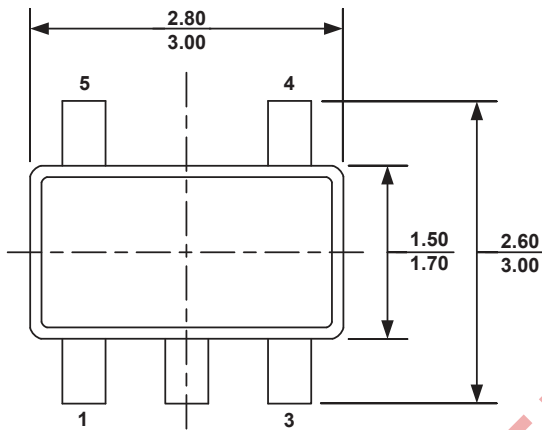
 A<sub>v</sub> = 2, V<sub>+</sub> = 2.5V, V<sub>-</sub> = -2.5V  
 R<sub>L</sub> = 1MΩ, C<sub>L</sub> = 8pF

**Rail to Rail Output Operation**

 A<sub>v</sub> = 2, V<sub>+</sub> = 1.3V, V<sub>-</sub> = -1.3V  
 R<sub>L</sub> = 1MΩ, C<sub>L</sub> = 8pF


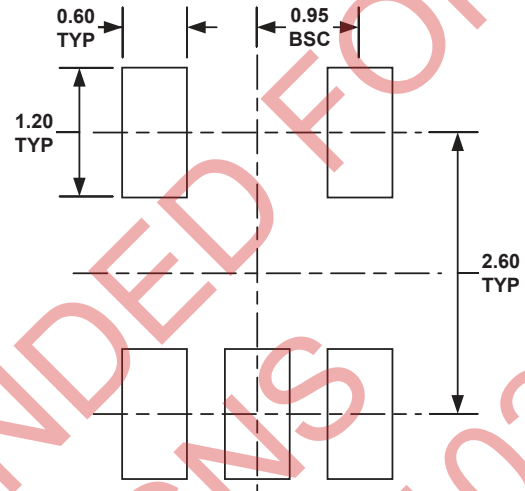


## PACKAGE INFORMATION

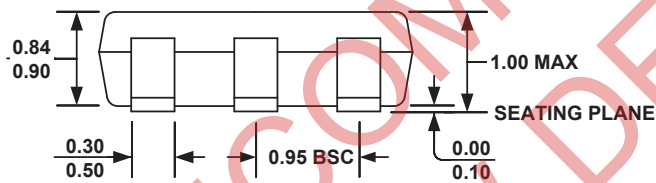
### TSOT23-5



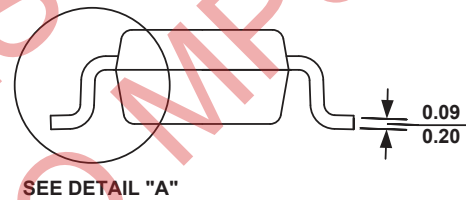
**TOP VIEW**



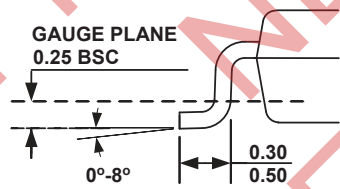
**RECOMMENDED LAND PATTERN**



**FRONT VIEW**



**SIDE VIEW**



**DETAIL A**

**NOTE:**

- 1) ALL DIMENSIONS ARE IN MILLIMETERS.
- 2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURR.
- 3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION.
- 4) LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.10 MILLIMETERS MAX.
- 5) DRAWING CONFORMS TO JEDEC MO-193, VARIATION AA.
- 6) DRAWING IS NOT TO SCALE.

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- ✓ Cost Control Management
- ✓ Shortage Management
- ✓ Alternative Solution
- ✓ Excess Inventory Management