

### DESCRIPTION

The MP8130 is a rail-to-rail output, high voltage operational amplifier in a TSOT-23 package. This amplifier provides 200KHz bandwidth while consuming an incredibly low 10 $\mu$ A of supply current. The MP8130 can operate over a single supply range of 2.7V to 36V. It is available in tiny TSOT23-5 packages.

### FEATURES

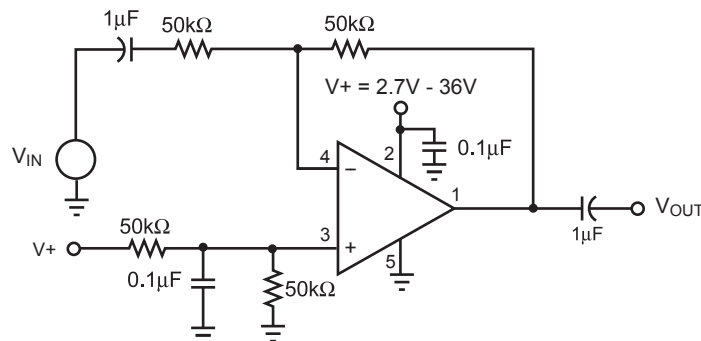
- Single Supply Operation: 2.7V to 36V
- TSOT23-5 Package
- 200KHz -3dB Bandwidth
- 10 $\mu$ A Supply Current
- Rail-to-Rail Output
- Unity-Gain Stable
- Input Common Mode to Ground
- Drives Up to 1000pF of Capacitive Loads
- Available in a TSOT23-5 Package

### APPLICATIONS

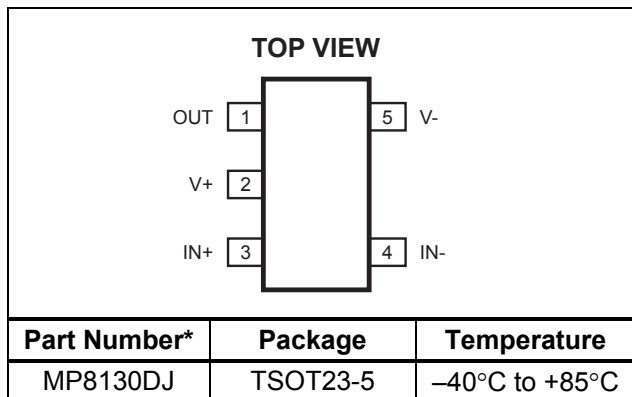
- Precision Micropower Amplifiers
- Micropower Signal Processing
- Test Equipment

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### TYPICAL APPLICATION



## PACKAGE REFERENCE



\* For Tape & Reel, add suffix -Z (eg. MP8130DJ-Z)  
For RoHS compliant packaging, add suffix -LF (eg. MP8130DJ-LF-Z)

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

Supply Voltage (V+ to V-) ..... +40.0V  
Differential Input Voltage (V<sub>IN+</sub> - V<sub>IN-</sub>) ..... +6.0V  
Input Voltage  
V<sub>IN+</sub> = V<sub>IN-</sub> ..... (V-) - 0.3V, (V+) + 0.3V

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

Supply Voltage ..... +2.7V to +36V  
Operating Temperature ..... -40°C to +85°C

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

$\theta_{JA}$   $\theta_{JC}$   
TSOT23-5 ..... 220 .... 110.. °C/W

### Notes:

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

## ELECTRICAL CHARACTERISTICS

V<sub>+</sub> = +20V, V<sub>-</sub> = 0V, V<sub>CM</sub> = V<sub>+</sub>/2, R<sub>L</sub> = 50kΩ, T<sub>A</sub> = +25°C, unless otherwise noted.

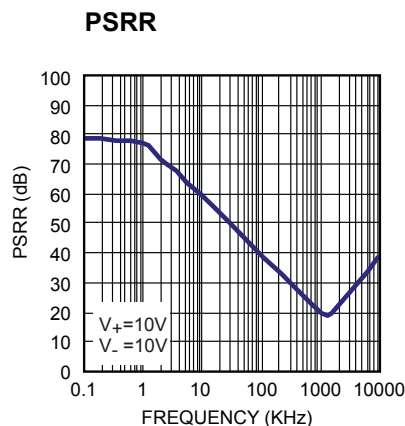
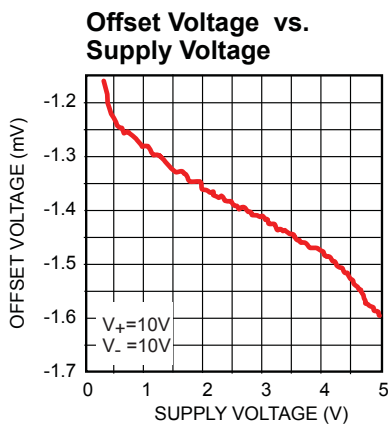
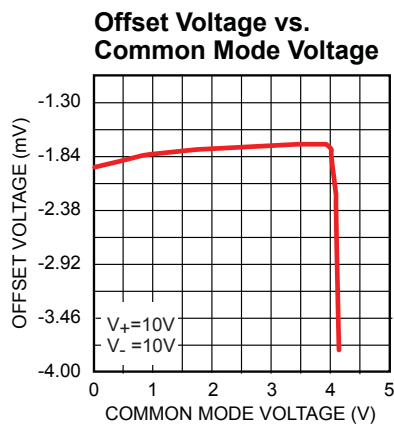
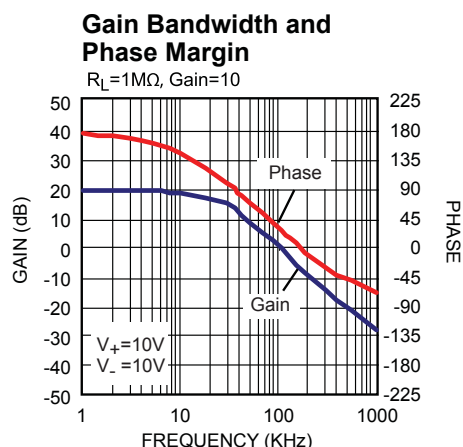
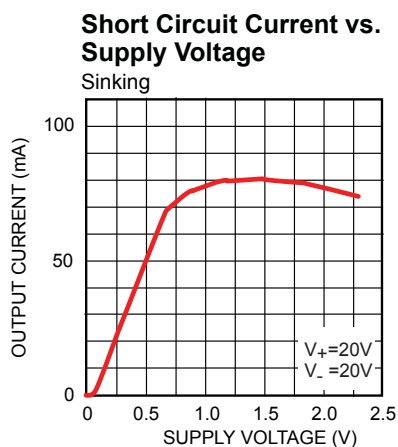
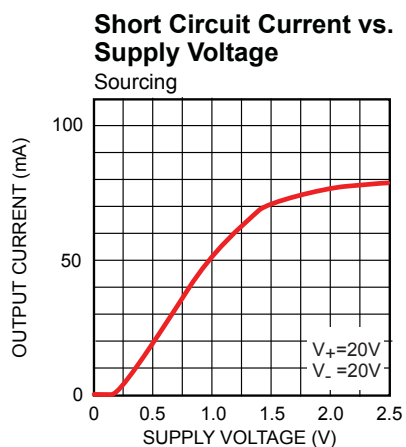
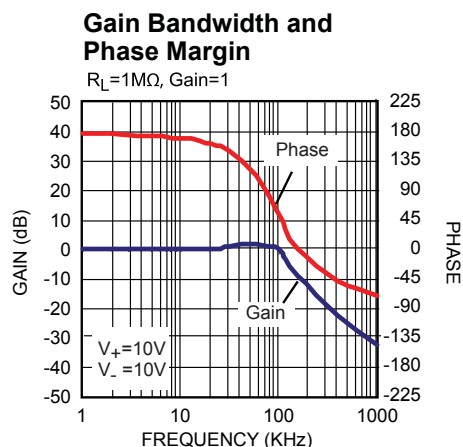
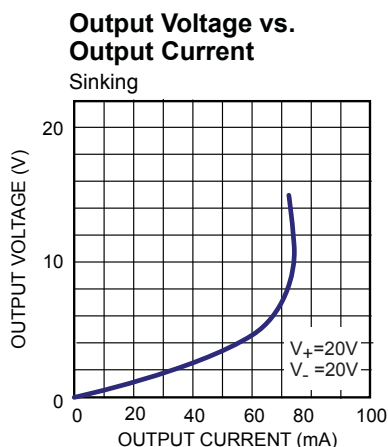
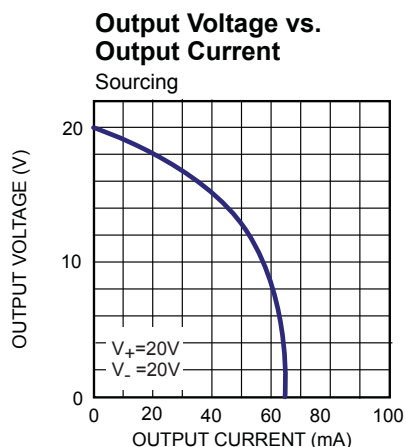
| Parameter                             | Symbol           | Condition                                                         | Min | Typ                      | Max | Units |
|---------------------------------------|------------------|-------------------------------------------------------------------|-----|--------------------------|-----|-------|
| Input Offset Voltage                  | V <sub>OS</sub>  |                                                                   | -5  | 1                        | +5  | mV    |
| Input Offset Voltage Temp Coefficient |                  |                                                                   |     | 15                       |     | μV/°C |
| Input Bias Current <sup>(4)</sup>     | I <sub>B</sub>   |                                                                   |     | 2                        |     | pA    |
| Input Offset Current <sup>(4)</sup>   | I <sub>OS</sub>  |                                                                   |     | 0.2                      |     | pA    |
| Input Voltage Range                   | V <sub>CM</sub>  | CMRR > 60dB (V <sub>+</sub> = 36V)                                | 0   |                          | 36  | V     |
| Common-Mode Rejection Ratio           | CMRR             | 0 < V <sub>CM</sub> < 36.0V (V <sub>+</sub> = 36V)                | 80  | 82                       |     | dB    |
| Power Supply Rejection Ratio          | PSRR             | Supply Voltage change of 2.7V/ 36V                                |     | 80                       |     | dB    |
| Large Signal Voltage Gain             | A <sub>VOL</sub> | R <sub>L</sub> = 100kΩ, V <sub>OUT</sub> = 5.0 Peak to Peak       | 60  | 88                       |     | dB    |
| Maximum Output Voltage Swing          | V <sub>OUT</sub> | R <sub>L</sub> = 100k                                             |     | (V <sub>+</sub> ) - 50mV |     | V     |
| Minimum Output Voltage Swing          | V <sub>OUT</sub> | R <sub>L</sub> = 100k                                             |     | (V <sub>-</sub> ) + 50mV |     | V     |
| Gain-Bandwidth Product <sup>(4)</sup> | GBW              | R <sub>L</sub> = 1MΩ, C <sub>L</sub> = 2pF, V <sub>OUT</sub> = 0V |     | 100                      |     | KHz   |
| -3dB Bandwidth <sup>(4)</sup>         | BW               | A <sub>V</sub> = 1, C <sub>L</sub> = 2pF, R <sub>L</sub> = 1MΩ    |     | 200                      |     | KHz   |
| Slew Rate <sup>(4)</sup>              | SR               | A <sub>V</sub> = 1, C <sub>L</sub> = 2pF, R <sub>L</sub> = 1MΩ    |     | 0.1                      |     | V/μs  |
| Short Circuit Current                 | I <sub>SC</sub>  | Source                                                            | -20 |                          |     | mA    |
|                                       |                  | Sink                                                              | 20  |                          |     | mA    |
| Supply Current                        | I <sub>sup</sub> | No Load                                                           |     | 10                       | 15  | μA    |

### Note:

4) Guaranteed by design.

## TYPICAL PERFORMANCE CHARACTERISTICS

C1= C3 =0.1 $\mu$ F, C2=C4=10 $\mu$ F, R<sub>L</sub> = 1M $\Omega$  (Reference Figure 3)

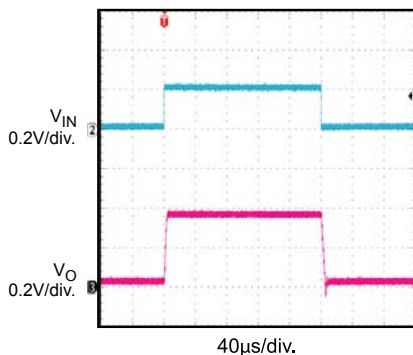


## TYPICAL PERFORMANCE CHARACTERISTICS

C1= C3 =0.1μF, C2=C4=10μF, R<sub>L</sub> = 1MΩ (Reference Figure 3)

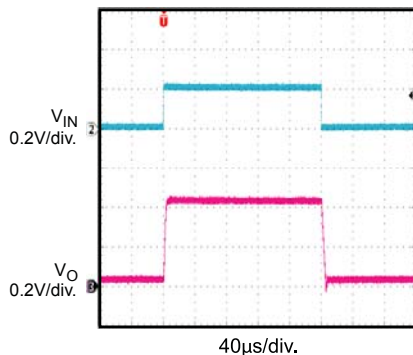
**Small Signal Pulse Response**

A<sub>V</sub> = 2, V<sub>+</sub> = V<sub>-</sub> = 10V, R<sub>L</sub> = 1MΩ



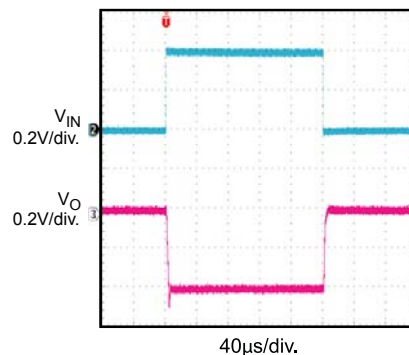
**Small Signal Pulse Response**

A<sub>V</sub> = 2, V<sub>+</sub> = V<sub>-</sub> = 15V, R<sub>L</sub> = 1MΩ



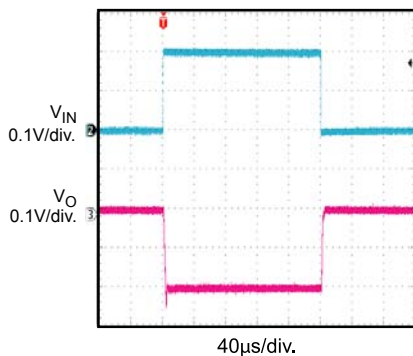
**Small Signal Pulse Response**

A<sub>V</sub> = -1, V<sub>+</sub> = V<sub>-</sub> = 5V, R<sub>L</sub> = 1MΩ



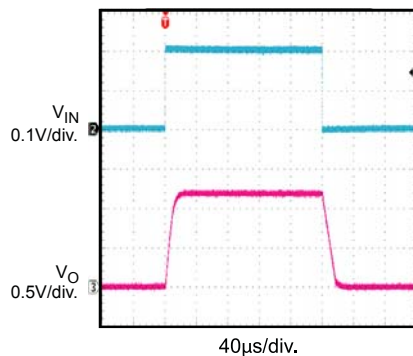
**Small Signal Pulse Response**

A<sub>V</sub> = -1, V<sub>+</sub> = V<sub>-</sub> = 12V, R<sub>L</sub> = 1MΩ



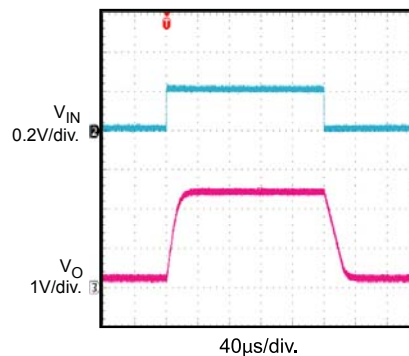
**Small Signal Pulse Response**

A<sub>V</sub> = 6, V<sub>+</sub> = V<sub>-</sub> = 5V, R<sub>L</sub> = 1MΩ



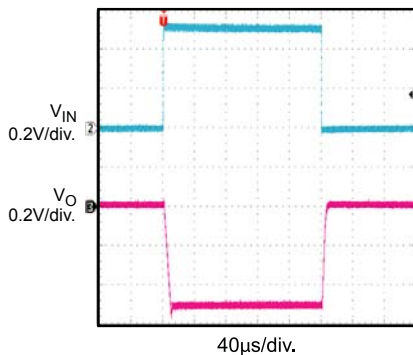
**Small Signal Pulse Response**

A<sub>V</sub> = 6, V<sub>+</sub> = V<sub>-</sub> = 15V, R<sub>L</sub> = 1MΩ



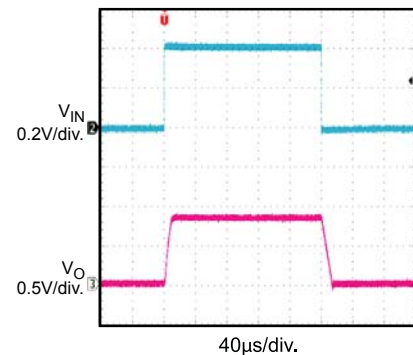
**Small Signal Pulse Response**

A<sub>V</sub> = -1, V<sub>+</sub> = V<sub>-</sub> = 2.5V, R<sub>L</sub> = 1MΩ



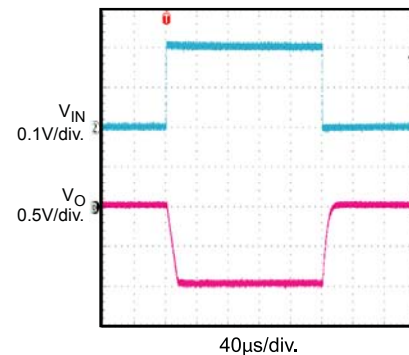
**Small Signal Pulse Response**

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



**Small Signal Pulse Response**

A<sub>V</sub> = -5, V<sub>+</sub> = V<sub>-</sub> = 12V, R<sub>L</sub> = 1MΩ

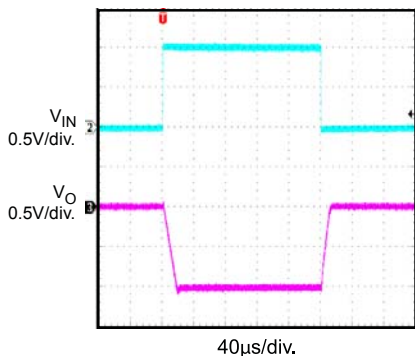


## TYPICAL PERFORMANCE CHARACTERISTICS

$C1 = C3 = 0.1\mu\text{F}$ ,  $C2 = C4 = 10\mu\text{F}$ ,  $R_L = 1\text{M}\Omega$  (Reference Figure 3)

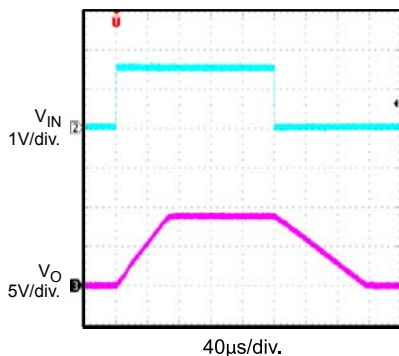
**Large Signal Pulse Response**

$A_V = -1$ ,  $V_+ = V_- = 2.5\text{V}$ ,  $R_L = 1\text{M}\Omega$



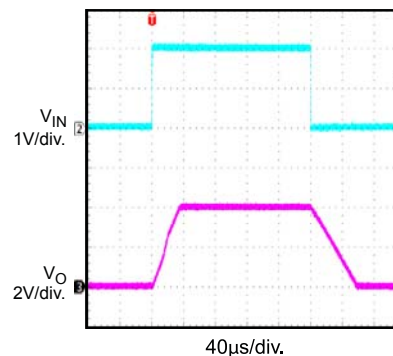
**Large Signal Pulse Response**

$A_V = 6$ ,  $V_+ = V_- = 12\text{V}$ ,  $R_L = 1\text{M}\Omega$



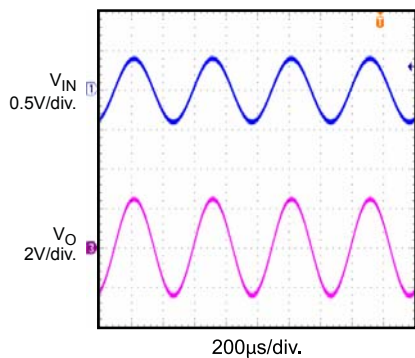
**Large Signal Pulse Response**

$A_V = 2$ ,  $V_+ = V_- = 5\text{V}$ ,  $R_L = 1\text{M}\Omega$



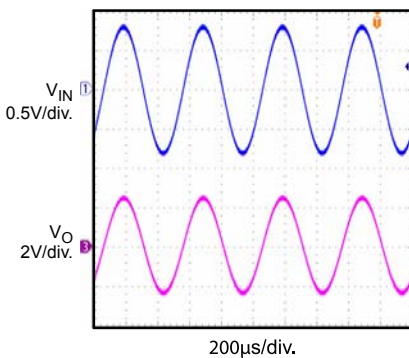
**Rail to Rail Output Operation**

$A_V = 6$ ,  $V_+ = V_- = 2.5\text{V}$ ,  $R_L = 1\text{M}\Omega$



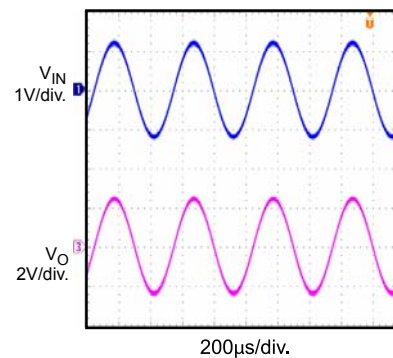
**Rail to Rail Output Operation**

$A_V = 3$ ,  $V_+ = V_- = 2.5\text{V}$ ,  $R_L = 1\text{M}\Omega$



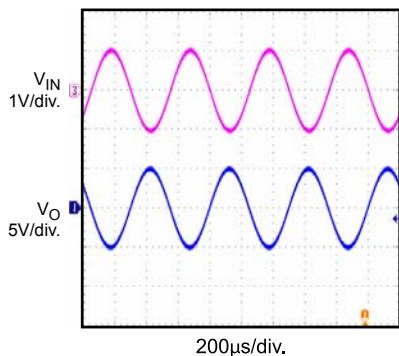
**Rail to Rail Output Operation**

$A_V = 2$ ,  $V_+ = V_- = 2.5\text{V}$ ,  $R_L = 1\text{M}\Omega$



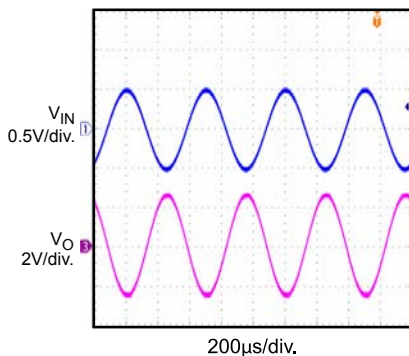
**Rail to Rail Output Operation**

$A_V = -5$ ,  $V_+ = V_- = 5\text{V}$ ,  $R_L = 1\text{M}\Omega$



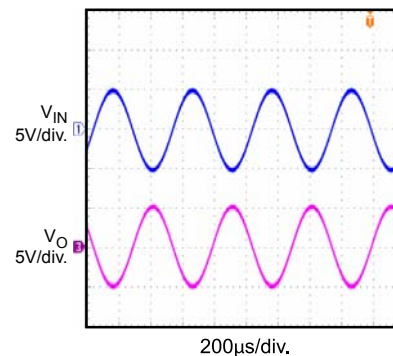
**Rail to Rail Output Operation**

$A_V = -5$ ,  $V_+ = V_- = 2.5\text{V}$ ,  $R_L = 1\text{M}\Omega$



**Rail to Rail Output Operation**

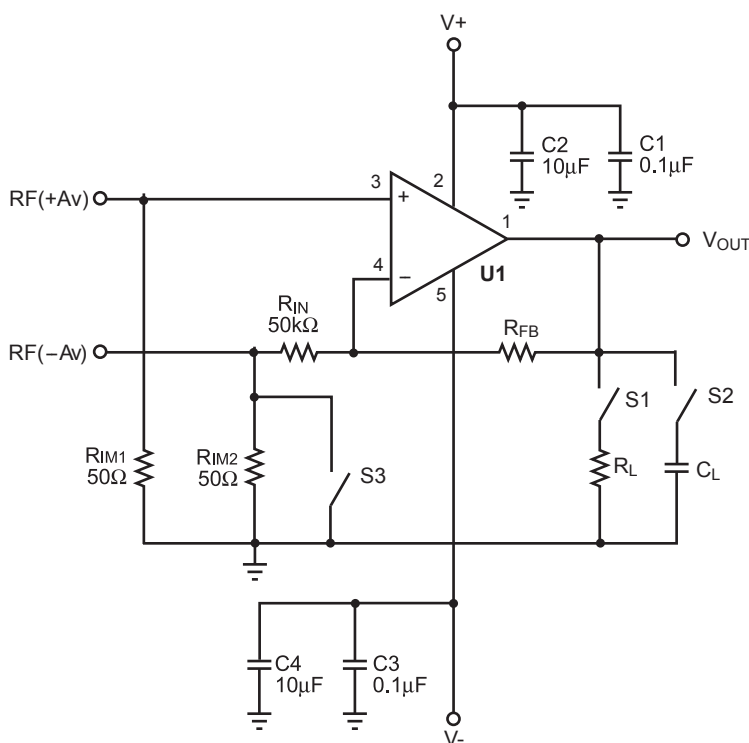
$A_V = -1$ ,  $V_+ = V_- = 5\text{V}$ ,  $R_L = 1\text{M}\Omega$



## PIN FUNCTIONS

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

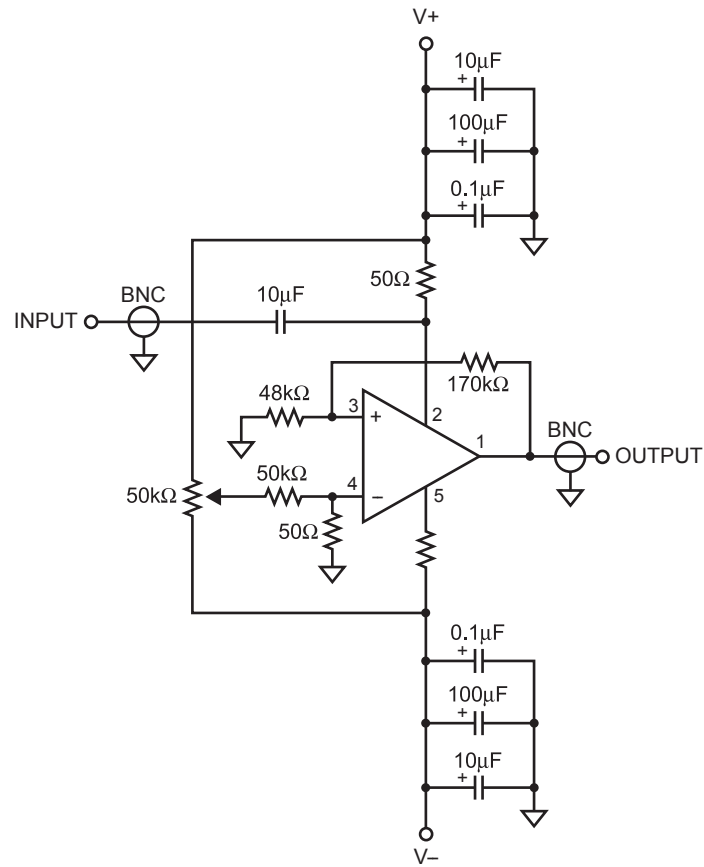
## TEST CIRCUITS



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**

## APPLICATION INFORMATION

### Power Supply Bypassing

Regular supply bypassing techniques are recommended. A  $10\mu\text{F}$  capacitor in parallel with a  $0.1\mu\text{F}$  capacitor on both the positive and negative supplies is ideal. For the best performance, all bypassing capacitors should be located as close to the op amp as possible and all capacitors should be low ESL (Equivalent Series Inductance) and low ESR

(Equivalent Series Resistance). Surface mount ceramic capacitors are ideal.

For large input signals, the op amp needs two clamp diodes to the input side. (See Figure 3 Large Input Signal Schematic).

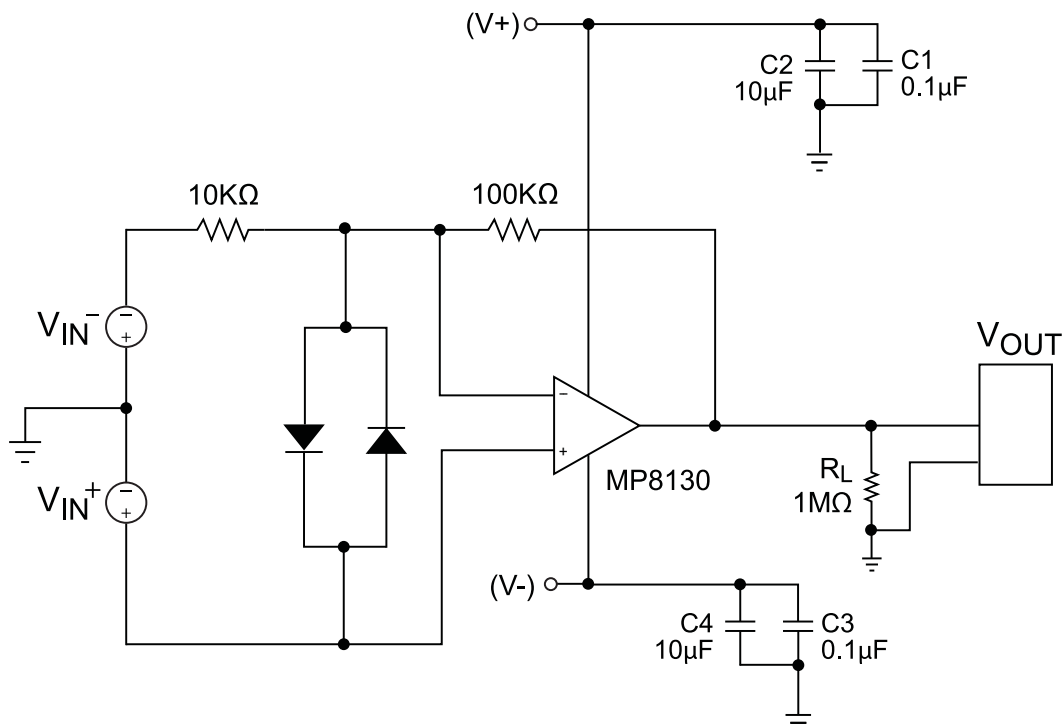
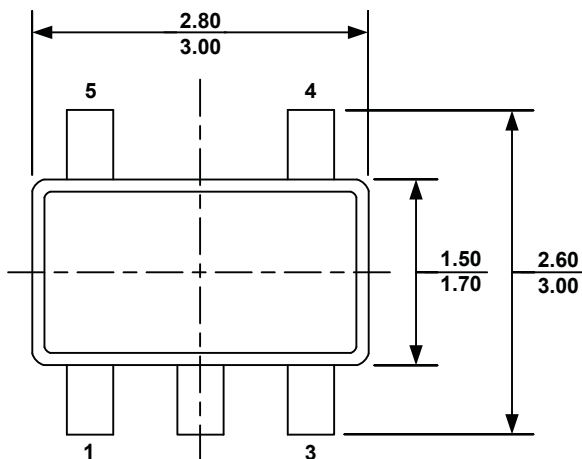


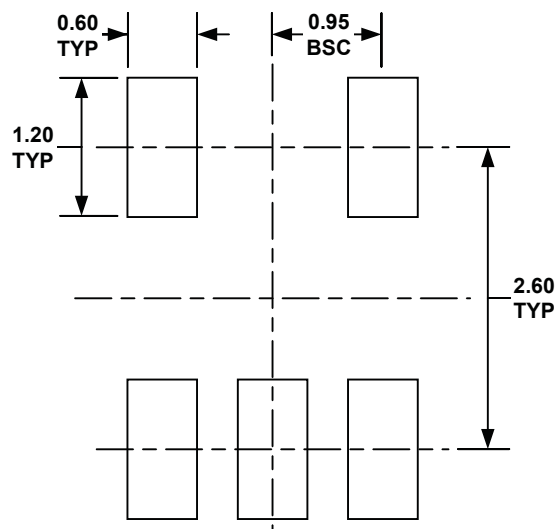
Figure 3—Large Input Signal Schematic

# PACKAGE INFORMATION

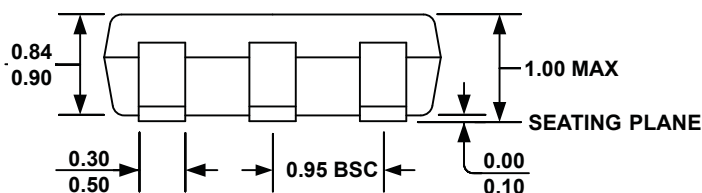
## TSOT23-5



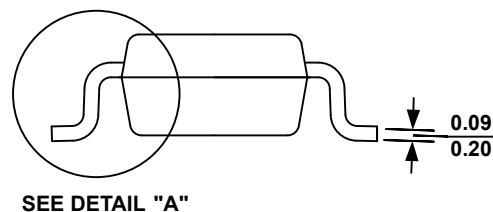
**TOP VIEW**



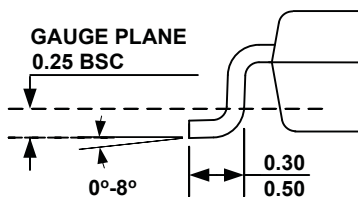
**RECOMMENDED LAND PATTERN**



**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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