



## MIC862

### Dual Ultra Low Power Op Amp in SOT23-8

#### General Description

The MIC862 is a dual low power operational amplifier in SOT23-8 package. It is designed to operate in the 2V to 5V range, rail-to-rail output, with input common-mode to ground. The MIC862 provides 3MHz gain-bandwidth product while consuming only a 31 $\mu$ A/Channel supply current.

With low supply voltage and SOT23-8 packaging, MIC862 provides two channels as general-purpose amplifiers for portable and battery-powered applications. Its package provides the maximum performance available while maintaining an extremely slim form factor. The minimal power consumption of this IC maximizes the battery life potential.

#### Features

- SOT23-8 packaging
- 3MHz gain-bandwidth product
- 5MHz, -3dB bandwidth
- 31 $\mu$ A supply current
- Rail-to-rail output
- Ground sensing at input (common mode to GND)
- Drive large capacitive loads
- Unity gain stable

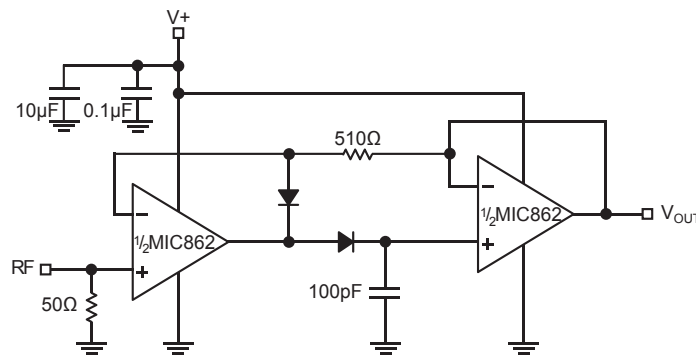
#### Applications

- Portable equipment
- Medical Instrument
- PDAs
- Pagers
- Cordless phones
- Consumer electronics

#### Ordering Information

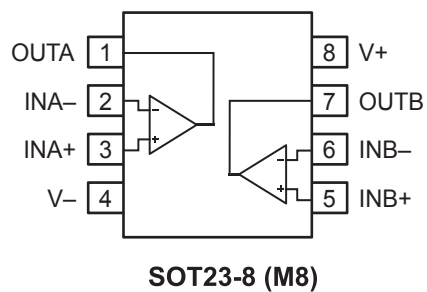
| Part Number | Marking | Ambient Temp. Range | Package            |
|-------------|---------|---------------------|--------------------|
| MIC862BM8   | A34     | -40°C to +85°C      | SOT23-8            |
| MIC862YM8   | A34     | -40°C to +85°C      | SOT23-8<br>Pb-Free |

#### Typical Application



Peak Detector Circuit for AM Radio

## Pin Configuration



## Pin Description

| Pin Number | Pin Name | Pin Function                      |
|------------|----------|-----------------------------------|
| 1          | OUTA     | Output: Amplifier A Output        |
| 2          | INA-     | Amplifier A Inverting (Input)     |
| 3          | INA+     | Amplifier A Non-Inverting (Input) |
| 4          | V-       | Negative Supply                   |
| 5          | INB+     | Amplifier B Non-Inverting (Input) |
| 6          | INB-     | Amplifier B Inverting (Input)     |
| 7          | OUTB     | Output: Amplifier B Output        |
| 8          | V+       | Positive Supply                   |

**Absolute Maximum Ratings<sup>(1)</sup>**

|                                                              |                                   |
|--------------------------------------------------------------|-----------------------------------|
| Supply Voltage ( $V_{V+} - V_{V-}$ )                         | +6.0V                             |
| Differential Input Voltage ( $ V_{IN+} - V_{IN-} $ ), Note 4 | +6.0V                             |
| Input Voltage ( $V_{IN+} - V_{IN-}$ )                        | $V_{V+} + 0.3V$ , $V_{V-} - 0.3V$ |
| Lead Temperature (soldering, 5 sec.)                         | 260°C                             |
| Output Short Circuit Current Duration                        | Indefinite                        |
| Operating Temperature                                        | -40°C to +125°C                   |
| Storage Temperature ( $T_S$ )                                | 150°C                             |
| ESD Rating, <b>Note 3</b>                                    |                                   |

**Operating Ratings<sup>(2)</sup>**

|                                      |                |
|--------------------------------------|----------------|
| Supply Voltage ( $V_{V+} - V_{V-}$ ) | +2V to +5.25V  |
| Ambient Temperature Range            | -40°C to +85°C |
| Package Thermal Resistance           | PCB boards     |
| $\theta_{JA}$ (using 4 layer PCB)    | 100°C/W        |
| $\theta_{JC}$ (using 4 layer PCB)    | 70°C/W         |

**Electrical Characteristics**

$V_{V+} = +2V$ ,  $V_{V-} = 0V$ ,  $V_{CM} = V_{V+}/2$ ;  $R_L = 500k\Omega$  to  $V_{V+}/2$ ;  $T_A = 25^\circ C$ , unless otherwise noted. **Bold** values indicate  $-40^\circ C \leq T_A \leq +85^\circ C$ .

| Symbol    | Parameter                             | Condition                                                                          | Min             | Typ      | Max           | Units            |
|-----------|---------------------------------------|------------------------------------------------------------------------------------|-----------------|----------|---------------|------------------|
| $V_{OS}$  | Input Offset Voltage                  |                                                                                    | <b>-6</b><br>-5 | 0.1      | <b>6</b><br>5 | mV               |
|           | Differential Offset Voltage           |                                                                                    |                 | 0.5      |               | mV               |
|           | Input Offset Voltage Temp Coefficient |                                                                                    |                 | 6        |               | $\mu V/^\circ C$ |
| $I_B$     | Input Bias Current                    |                                                                                    |                 | 10       |               | pA               |
| $I_{OS}$  | Input Offset Current                  |                                                                                    |                 | 5        |               | pA               |
| $V_{CM}$  | Input Voltage Range (from $V_{V-}$ )  | CMRR > 50dB                                                                        | <b>0.5</b>      | 1        |               | V                |
| CMRR      | Common-Mode Rejection Ratio           | $0 < V_{CM} < 1V$                                                                  | <b>45</b>       | 75       |               | dB               |
| PSRR      | Power Supply Rejection Ratio          | Supply voltage change of 2V to 2.7V                                                | <b>50</b>       | 78       |               | dB               |
| $A_{VOL}$ | Large-Signal Voltage Gain             | $R_L = 5k\Omega$ , $V_{OUT} = 1.4V_{P-P}$                                          | <b>66</b>       | 74       |               | dB               |
|           |                                       | $R_L = 100k\Omega$ , $V_{OUT} = 1.4V_{P-P}$                                        | <b>75</b>       | 89       |               | dB               |
|           |                                       | $R_L = 500k\Omega$ , $V_{OUT} = 1.4V_{P-P}$                                        | <b>85</b>       | 100      |               | dB               |
| $V_{OUT}$ | Maximum Output Voltage Swing          | $R_L = 5k\Omega$                                                                   | <b>V+80mV</b>   | V+55mV   |               | V                |
|           |                                       | $R_L = 500k\Omega$                                                                 | <b>V+3mV</b>    | V+1.4mV  |               | V                |
| $V_{OUT}$ | Minimum Output Voltage Swing          | $R_L = 5k\Omega$                                                                   |                 | V-14mV   | <b>V-20mV</b> | mV               |
|           |                                       | $R_L = 500k\Omega$                                                                 |                 | V-0.85mV | <b>V-3mV</b>  | mV               |
| GBW       | Gain-Bandwidth Product                | $R_L = 20k\Omega$ , $C_L = 2pF$ , $A_v = 11$                                       |                 | 2.1      |               | MHz              |
| PM        | Phase Margin                          | $R_L = 20k\Omega$ , $C_L = 2pF$ , $A_v = 11$                                       |                 | 57       |               | °                |
| BW        | -3dB Bandwidth                        | $R_L = 1M\Omega$ , $C_L = 2pF$ , $A_v = 1$                                         |                 | 4.2      |               | MHz              |
| SR        | Slew Rate                             | $R_L = 1M\Omega$ , $C_L = 2pF$ , $A_v = 1$ ,<br>Positive Slew Rate = 1.5V/ $\mu s$ |                 | 2        |               | V/ $\mu s$       |
| $I_{SC}$  | Short-Circuit Output Current          | Source                                                                             | <b>1.8</b>      | 2.6      |               | mA               |
|           |                                       | Sink                                                                               | <b>1.5</b>      | 2.2      |               | mA               |
| $I_S$     | Supply Current (per op amp)           | No Load                                                                            |                 | 27       | <b>43</b>     | $\mu A$          |
|           | Channel-to-Channel Crosstalk          | Note 5                                                                             |                 | -100     |               | dB               |

$V_{V+} = +2.7V$ ,  $V_{V-} = 0V$ ,  $V_{CM} = V_{V+}/2$ ;  $R_L = 500k\Omega$  to  $V_{V+}/2$ ;  $T_A = 25^\circ C$ , unless otherwise noted. **Bold** values indicate  $-40^\circ C \leq T_A \leq +85^\circ C$ .

|          |                                       |                      |                 |     |               |                  |
|----------|---------------------------------------|----------------------|-----------------|-----|---------------|------------------|
| $V_{OS}$ | Input Offset Voltage                  |                      | <b>-6</b><br>-5 | 0.1 | <b>6</b><br>5 | mV               |
|          | Differential Offset Voltage           |                      |                 | 0.5 |               | mV               |
|          | Input Offset Voltage Temp Coefficient |                      |                 | 6   |               | $\mu V/^\circ C$ |
| $I_B$    | Input Bias Current                    |                      |                 | 10  |               | pA               |
| $I_{OS}$ | Input Offset Current                  |                      |                 | 5   |               | pA               |
| $V_{CM}$ | Input Voltage Range                   | CMRR > 60dB          | <b>1</b>        | 1.8 |               | V                |
| CMRR     | Common-Mode Rejection Ratio           | $0 < V_{CM} < 1.35V$ | <b>65</b>       | 83  |               | dB               |

| Symbol    | Parameter                    | Condition                                                                      | Min        | Typ  | Max       | Units      |
|-----------|------------------------------|--------------------------------------------------------------------------------|------------|------|-----------|------------|
| PSRR      | Power Supply Rejection Ratio | Supply voltage change of 2.7V to 3V                                            | <b>60</b>  | 85   |           | dB         |
| $A_{VOL}$ | Large-Signal Voltage Gain    | $R_L = 5k\Omega$ , $V_{OUT} = 2V_{P-P}$                                        | <b>65</b>  | 77   |           | dB         |
|           |                              | $R_L = 100k\Omega$ , $V_{OUT} = 2V_{P-P}$                                      | <b>80</b>  | 90   |           | dB         |
|           |                              | $R_L = 500k\Omega$ , $V_{OUT} = 2V_{P-P}$                                      | <b>90</b>  | 101  |           | dB         |
| GBW       | Gain-Bandwidth Product       | $R_L = 20k\Omega$ , $C_L = 2pF$ , $A_v = 11$                                   |            | 2.3  |           | MHz        |
| PM        | Phase Margin                 | $R_L = 20k\Omega$ , $C_L = 2pF$ , $A_v = 11$                                   |            | 50   |           | °          |
| BW        | –3 dB Bandwidth              | $R_L = 1M\Omega$ , $C_L = 2pF$ , $A_v = 1$                                     |            | 4.2  |           | MHz        |
| SR        | Slew Rate                    | $R_L = 1M\Omega$ , $C_L = 2pF$ , $A_v = 1$<br>Positive Slew Rate 1.5V/ $\mu s$ |            | 3    |           | V/ $\mu s$ |
| $I_{SC}$  | Short-Circuit Output Current | Source                                                                         | <b>4.5</b> | 6.3  |           | mA         |
|           |                              | Sink                                                                           | <b>4.5</b> | 6.2  |           | mA         |
| $I_S$     | Supply Current (per op amp)  | No Load                                                                        |            | 28   | <b>45</b> | $\mu A$    |
|           | Channel-to-Channel Crosstalk | Note 5                                                                         |            | –120 |           | dB         |

$V_+ = +5V$ ,  $V_- = 0V$ ,  $V_{CM} = V_+/2$ ;  $R_L = 500k\Omega$  to  $V_+/2$ ;  $T_A = 25^\circ C$ , unless otherwise noted. **Bold** values indicate  $-40^\circ C \leq T_A \leq +85^\circ C$ .

|           |                                       |                                                                                |                                |               |                                |                  |
|-----------|---------------------------------------|--------------------------------------------------------------------------------|--------------------------------|---------------|--------------------------------|------------------|
| $V_{OS}$  | Input Offset Voltage                  |                                                                                | <b>–6</b><br><b>–5</b>         | 0.1           | <b>6</b><br><b>5</b>           | mV               |
|           | Differential Offset Voltage           |                                                                                |                                | 0.5           |                                | mV               |
|           | Input Offset Voltage Temp Coefficient |                                                                                |                                | 6             |                                | $\mu V/^\circ C$ |
| $I_B$     | Input Bias Current                    |                                                                                |                                | 10            |                                | pA               |
| $I_{OS}$  | Input Offset Current                  |                                                                                |                                | 5             |                                | pA               |
| $V_{CM}$  | Input Voltage Range (from $V_-$ )     | CMRR > 60dB                                                                    | <b>3.5</b>                     | 4.1           |                                | V                |
| CMRR      | Common-Mode Rejection Ratio           | $0 < V_{CM} < 3.5V$ ,                                                          | <b>60</b>                      | 87            |                                | dB               |
| PSRR      | Power Supply Rejection Ratio          | Supply voltage change from 3V to 5V                                            | <b>60</b>                      | 92            |                                | dB               |
| $A_{VOL}$ | Large-Signal Voltage Gain             | $R_L = 5k\Omega$ , $V_{OUT} = 4.8V_{P-P}$                                      | <b>65</b>                      | 73            |                                | dB               |
|           |                                       | $R_L = 100k\Omega$ , $V_{OUT} = 4.8V_{P-P}$                                    | <b>80</b>                      | 86            |                                | dB               |
|           |                                       | $R_L = 500k\Omega$ , $V_{OUT} = 4.8V_{P-P}$                                    | <b>89</b>                      | 96            |                                | dB               |
| $V_{OUT}$ | Maximum Output Voltage Swing          | $R_L = 5k\Omega$                                                               | <b><math>V_+ - 50mV</math></b> | $V_+ - 37mV$  |                                | V                |
|           |                                       | $R_L = 500k\Omega$                                                             | <b><math>V_+ - 3mV</math></b>  | $V_+ - 1.3mV$ |                                | V                |
| $V_{OUT}$ | Minimum Output Voltage Swing          | $R_L = 5k\Omega$                                                               |                                | $V_- + 24mV$  | <b><math>V_- + 40mV</math></b> | mV               |
|           |                                       | $R_L = 500k\Omega$                                                             |                                | $V_- + 0.7mV$ | <b><math>V_- + 3mV</math></b>  | mV               |
| GBW       | Gain-Bandwidth Product                | $R_L = 20k\Omega$ , $C_L = 2pF$ , $A_v = 11$                                   |                                | 3             |                                | MHz              |
| PM        | Phase Margin                          |                                                                                |                                | 45            |                                | °                |
| BW        | –3 dB Bandwidth                       | $R_L = 1M\Omega$ , $C_L = 2pF$ , $A_v = 1$                                     |                                | 5             |                                | MHz              |
| SR        | Slew Rate                             | $R_L = 1M\Omega$ , $C_L = 2pF$ , $A_v = 1$<br>Positive Slew Rate 1.8V/ $\mu s$ |                                | 4             |                                | V/ $\mu s$       |
| $I_{SC}$  | Short-Circuit Output Current          | Source                                                                         | <b>17</b>                      | 23            |                                | mA               |
|           |                                       | Sink                                                                           | <b>18</b>                      | 27            |                                | mA               |
| $I_S$     | Supply Current (per op amp)           | No Load                                                                        |                                | 31            | <b>47</b>                      | $\mu A$          |
|           | Channel-to-Channel Crosstalk          | Note 5                                                                         |                                | –120          |                                | dB               |

**Note 1.** Exceeding the absolute maximum rating may damage the device.

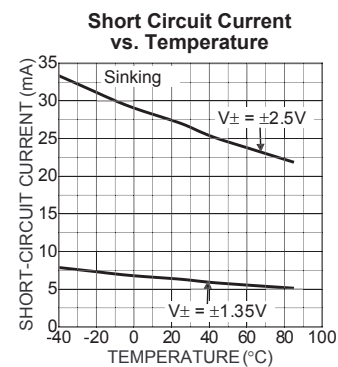
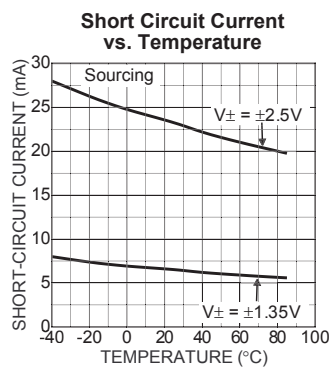
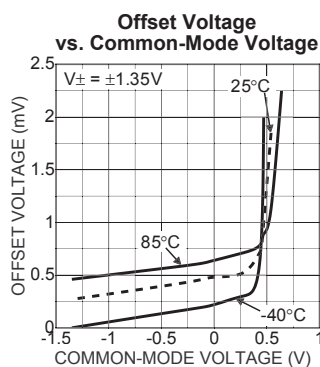
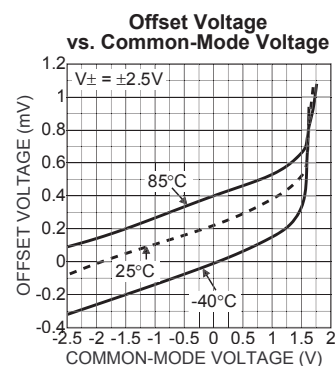
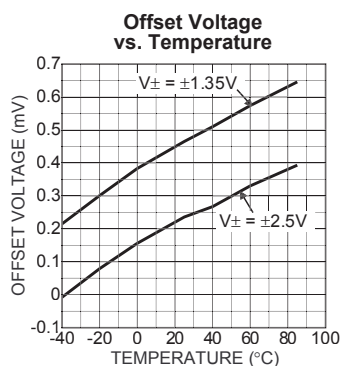
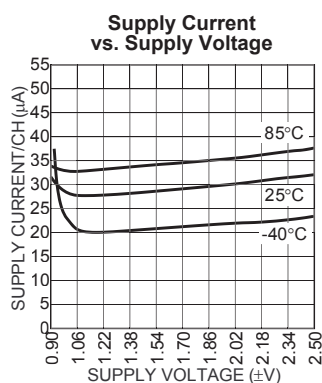
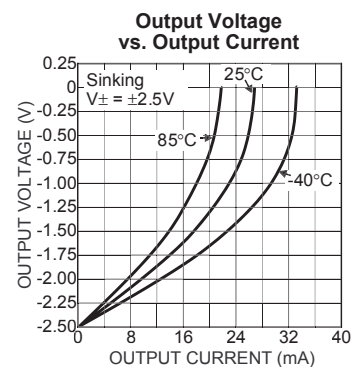
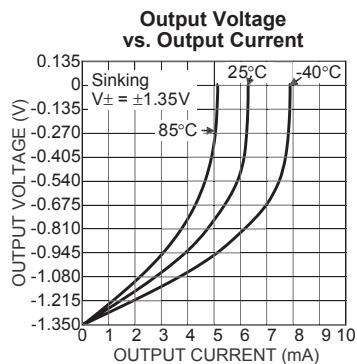
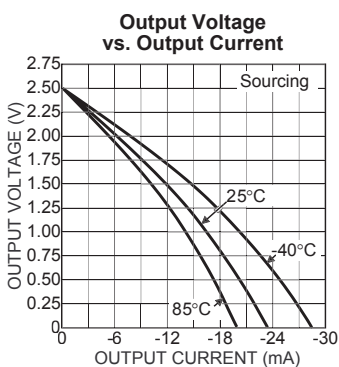
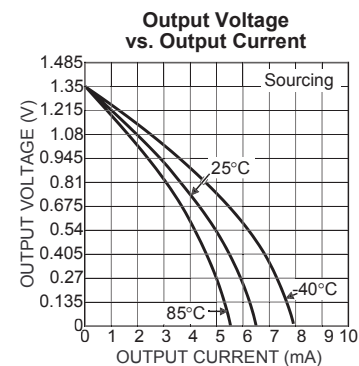
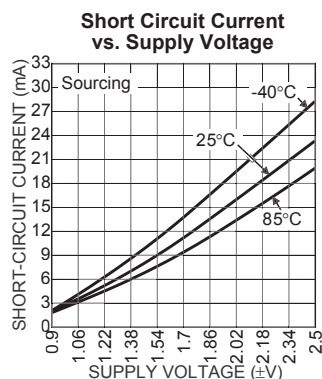
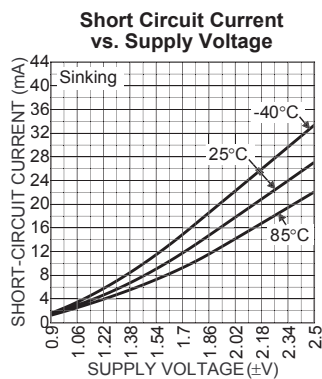
**Note 2.** The device is not guaranteed to function outside its operating rating.

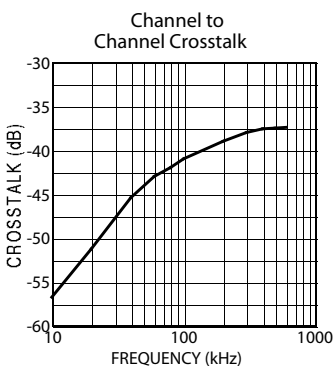
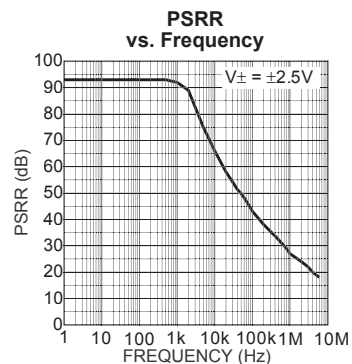
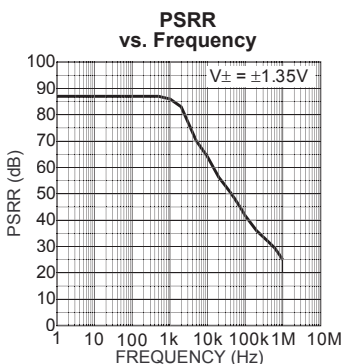
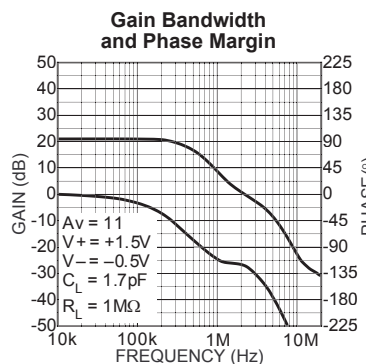
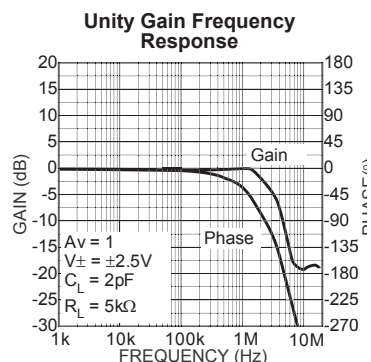
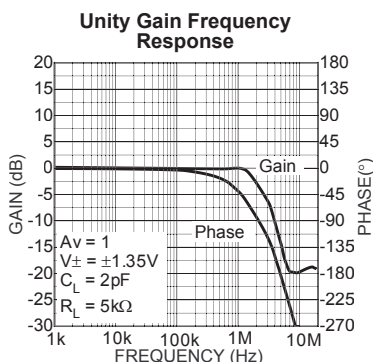
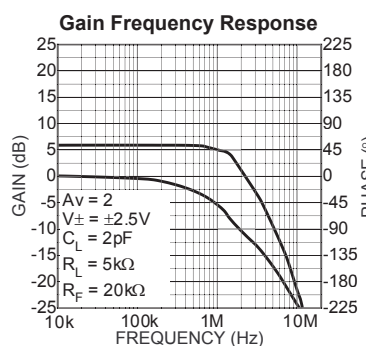
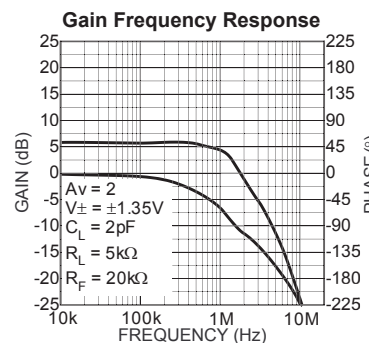
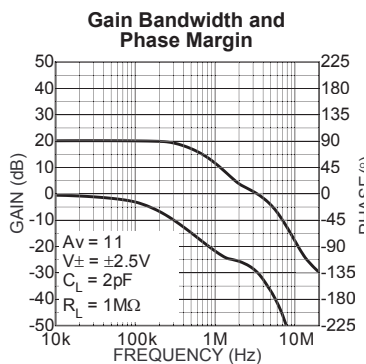
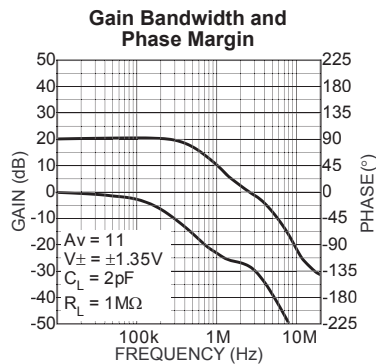
**Note 3.** Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5k in series with 100pF. Pin 4 is ESD sensitive

**Note 4.** Exceeding the maximum differential input voltage will damage the input stage and degrade performance (in particular, input bias current is likely to increase).

**Note 5.** DC signal referenced to input. Refer to Typical Characteristics graphs for AC performance.

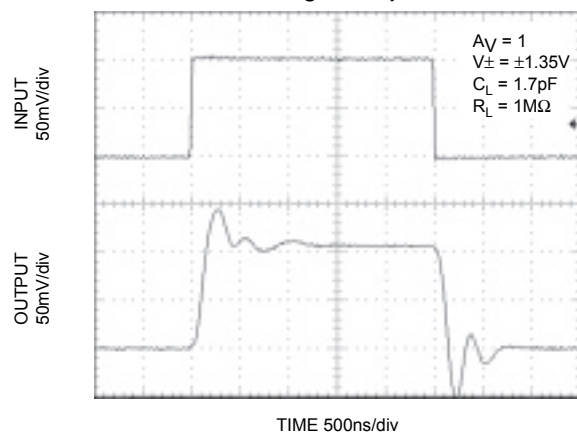
# Typical Characteristics



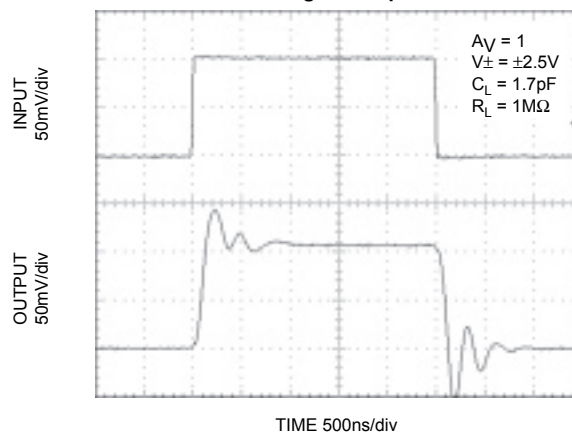


# Functional Characteristics

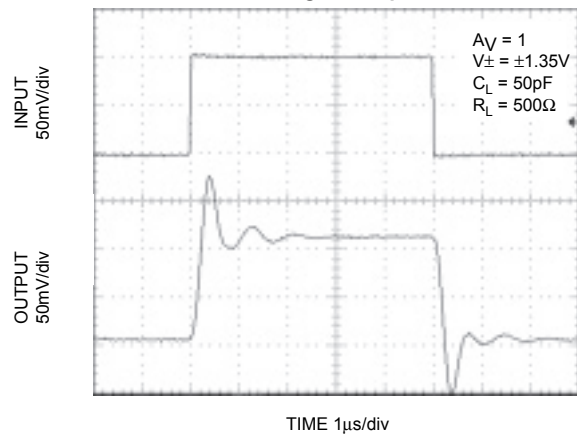
Small Signal Response



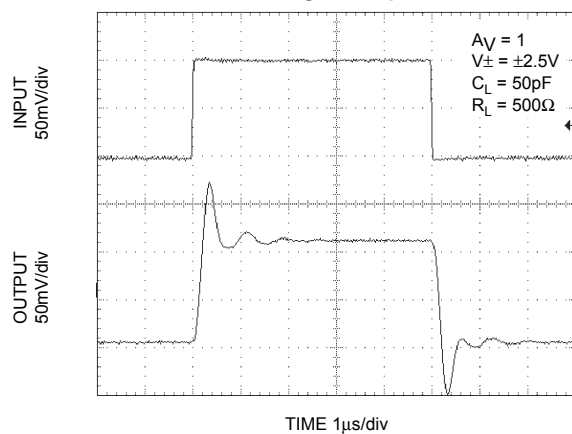
Small Signal Response



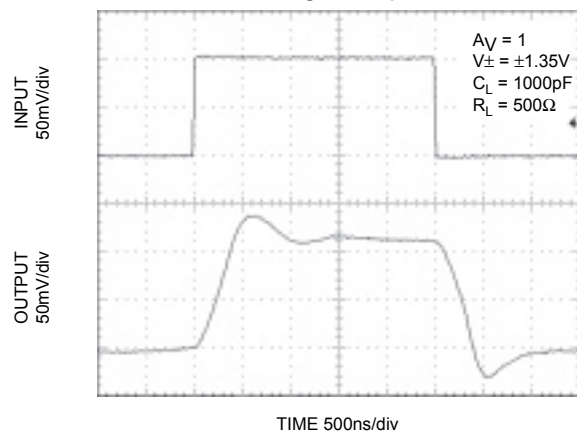
Small Signal Response



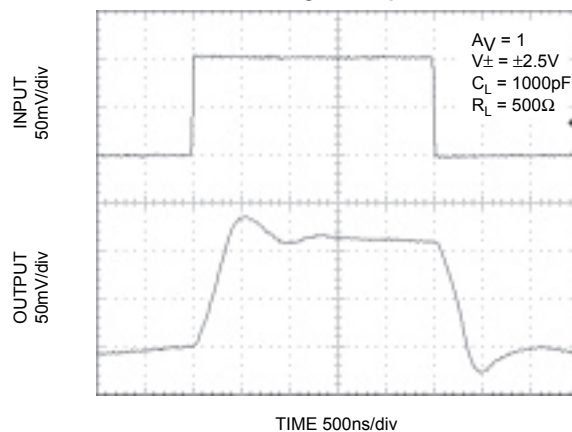
Small Signal Response



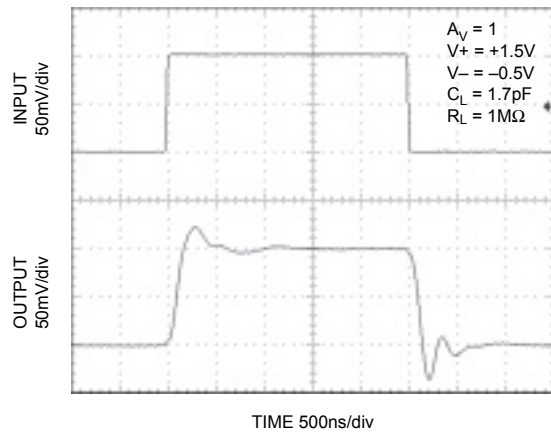
Small Signal Response



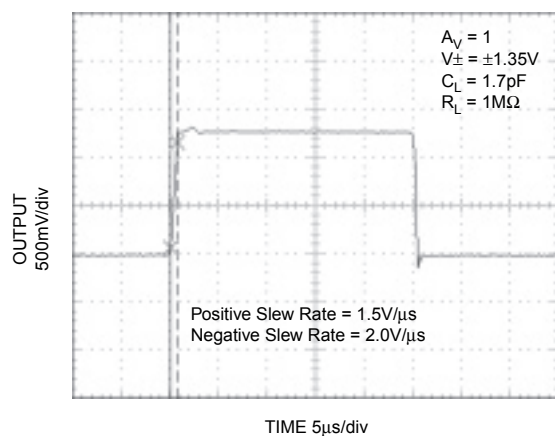
Small Signal Response



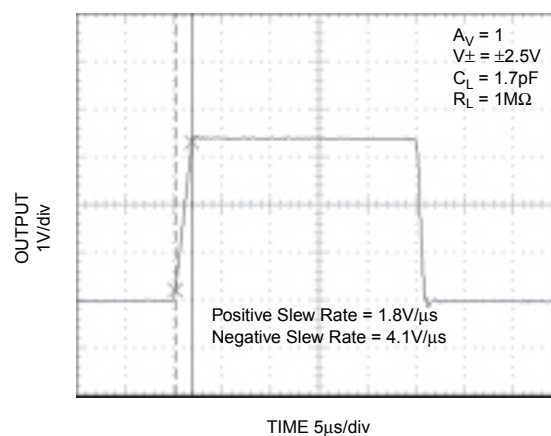
## Small Signal Pulse Response



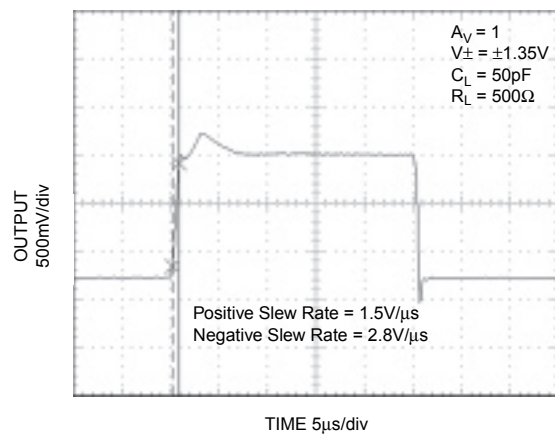
Large Signal Response



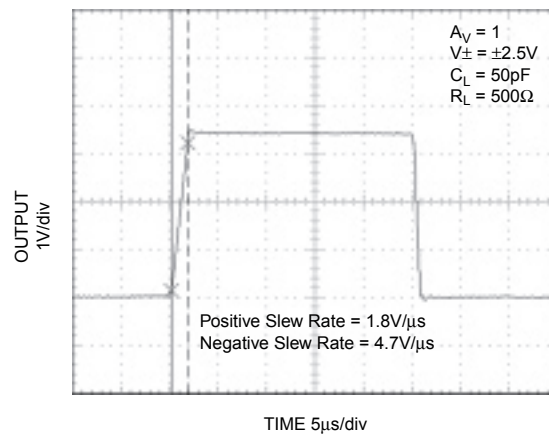
Large Signal Response



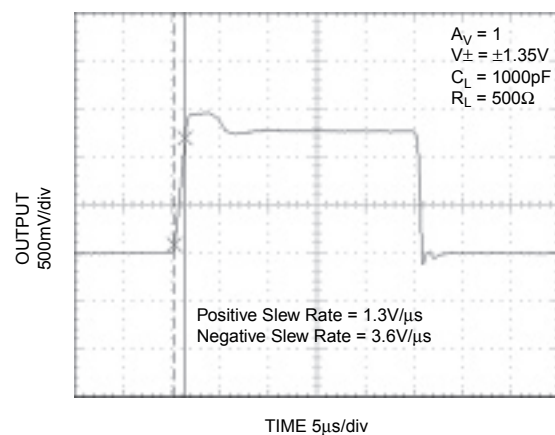
Large Signal Response



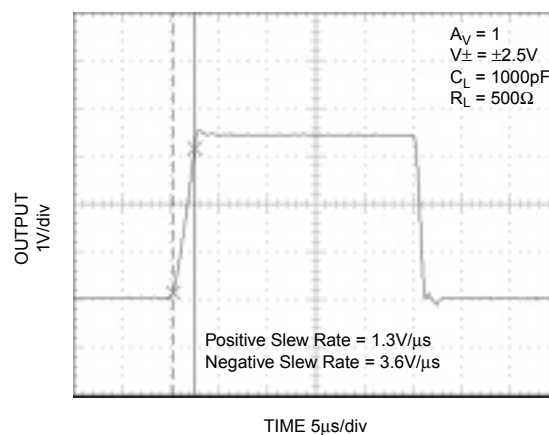
Large Signal Response



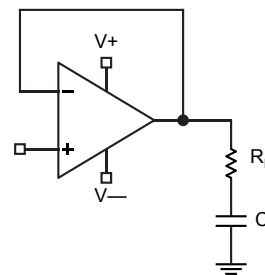
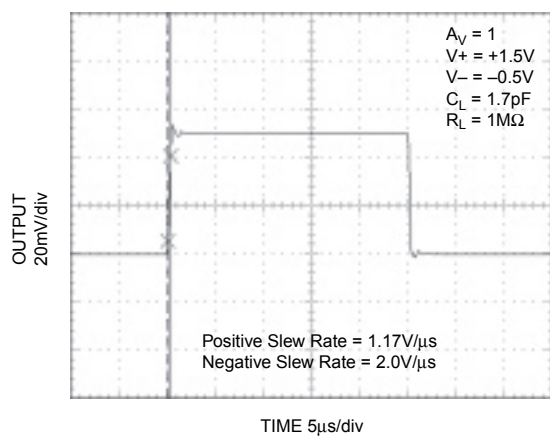
Large Signal Pulse Response



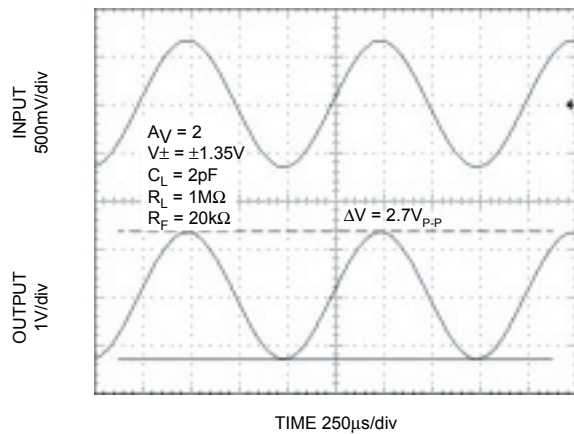
Large Signal Pulse Response



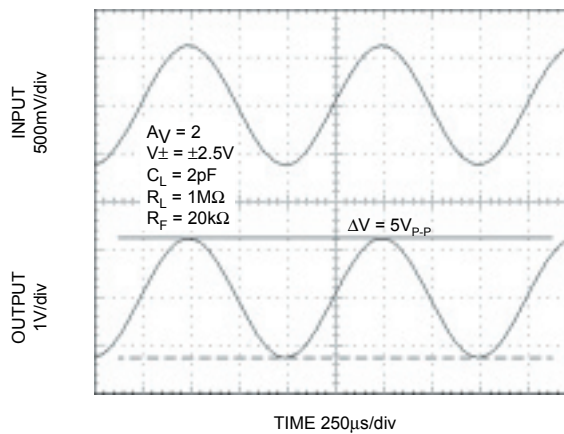
## Large Signal Pulse Response



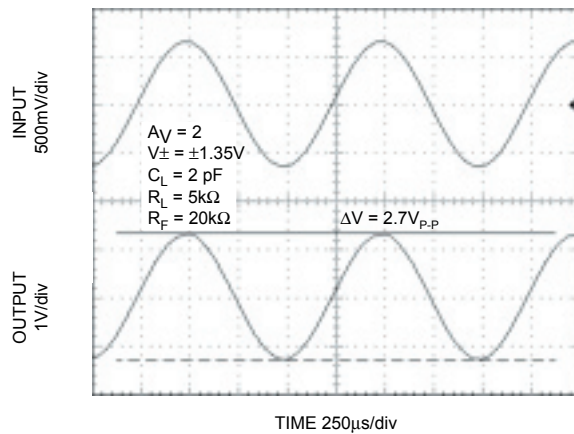
## Rail to Rail Operation



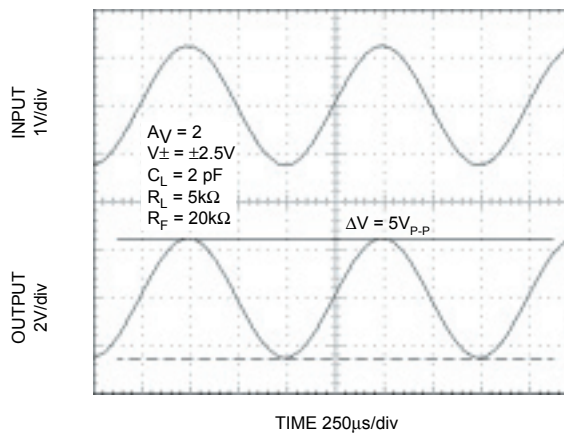
## Rail to Rail Operation



## Rail to Rail Operation



## Rail to Rail Operation



## Applications Information

### Power Supply Bypassing

Regular supply bypassing techniques are recommended. A 10 $\mu$ F capacitor in parallel with a 0.1 $\mu$ F capacitor on both the positive and negative supplies are ideal. For 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), ESR (equivalent series resistance). Surface-mount ceramic capacitors are ideal.

### Supply and Loading Resistive Considerations

The MIC862 is intended for single supply applications configured with a grounded load. It is not advisable to operate the MIC862 under either of the following conditions:

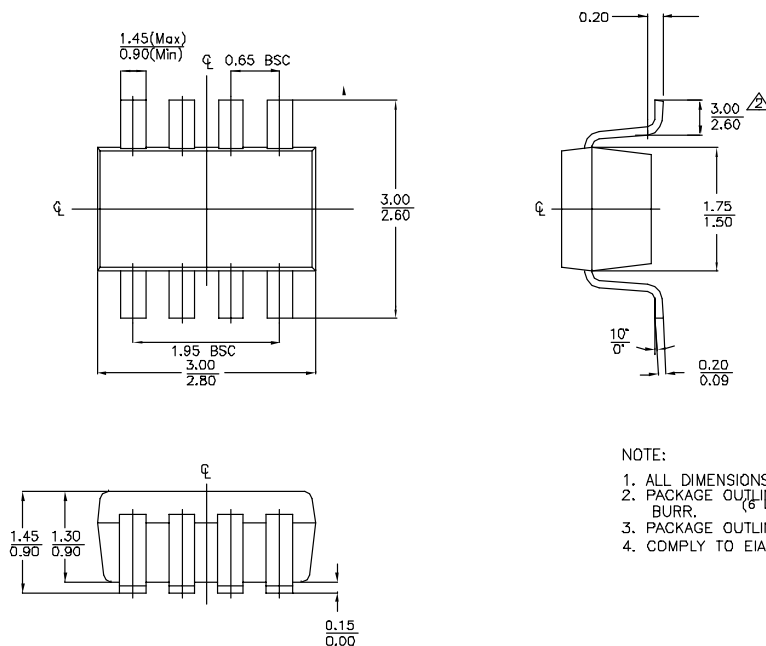
1. A grounded load and split supplies (+/-V)
2. A single supply where the load is terminated above ground.

Under the above conditions, if the load is less than 20k $\Omega$  and the output swing is greater than 1V(peak), there may be some instability when the output is sinking current.

### Capacitive Load

When driving a large capacitive load, a resistor of 500 $\Omega$  is recommended to be connected between the op-amp output and the capacitive load to avoid oscillation.

## Package Information



**NOTE:**

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.  
(6 LEAD VERSION)
3. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
4. COMPLY TO EIAJ SC74

### SOT-23-8 (M8)

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