



*The Infinite Bandwidth Company™*

## MIC863

Dual Ultra Low Power Op Amp in SOT23-8

### Final Information

### General Description

The MIC863 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 MIC863 provides 450kHz gain-bandwidth product while consuming only a 4.2μA supply current.

With low supply voltage and SOT23-8 packaging, MIC863 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
- 450kHz gain-bandwidth product
- 800kHz, -3dB bandwidth
- 4.2μA supply current/channel
- Rail-to-rail output
- Ground sensing at input (common mode to GND)
- Drives large capacitive loads (0.02μF)
- Unity gain stable

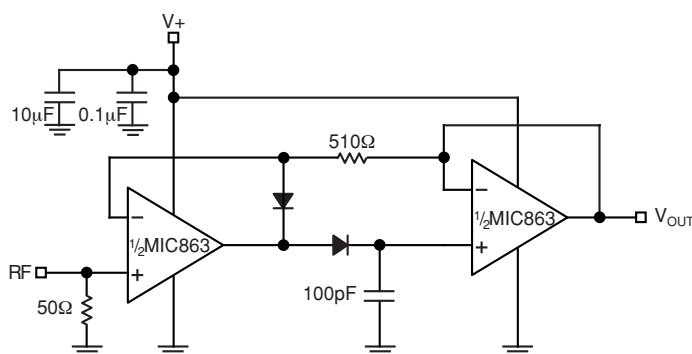
### Applications

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

### Ordering Information

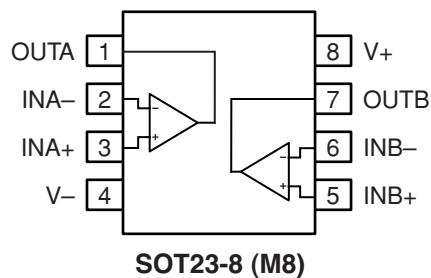
Part Number				Ambient Temp. Range	Package
Standard	Marking	Pb-Free	Marking		
MIC863BM8	A35	MIC863YM8	A35	-40°C to +85°C	SOT23-8

### 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 (Note 1)**

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

**Operating Ratings (Note 2)**

Supply Voltage ( $V_{+} - V_{-}$ )	+2.0V to +5.25V
Ambient Temperature Range	-40°C to +85°C
Package Thermal Resistance	
$\theta_{JA}$ (Using 4 layer PCB)	100°C/W
$\theta_{CA}$ (Using 4 layer PCB)	70°C/W

**Electrical Characteristics**

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

Symbol	Parameter	Condition	Min	Typ	Max	Units
$V_{OS}$	Input Offset Voltage		<b>-6</b> -5	0.1	<b>6</b> 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 > 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>	85		dB
$A_{VOL}$	Large-Signal Voltage Gain	$R_L = 100k\Omega$ , $V_{OUT} 1.4V_{PP}$	<b>66</b>	81		dB
		$R_L = 500k\Omega$ , $V_{OUT} 1.4V_{PP}$	<b>73</b>	90		dB
$V_{OUT}$	Maximum Output Voltage Swing	$R_L = 500k\Omega$	<b>V+3mV</b>	$V_{+} - 1.4mV$		V
$V_{OUT}$	Minimum Output Voltage Swing	$R_L = 500k\Omega$		$V_{-} + 0.5mV$	<b>V-3mV</b>	V
GBW	Gain-Bandwidth Product	$R_L = 200k\Omega$ , $C_L = 2pF$ , $A_v = 11$		320		kHz
PM	Phase Margin	$R_L = 200k\Omega$ , $C_L = 2pF$ , $A_v = 11$		69		°
BW	-3dB Bandwidth	$A_v = 1$ , $C_L = 2pF$ , $R_L = 1M\Omega$		600		kHz
SR	Slew Rate	$A_v = 1$ , $C_L = 2pF$ , $R_L = 1M\Omega$ , Positive Slew Rate = 0.17V/ $\mu s$		0.33		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		3.5	<b>7</b>	$\mu A$
	Channel to Channel Crosstalk	<b>Note 5</b>		-100		dB

$V_{+} = +2.7V$ ,  $V_{-} = 0V$ ,  $V_{CM} = V_{+}/2$ ;  $R_L = 500k\Omega$  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> -5	0.1	<b>6</b> 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>60</b>	83		dB
PSRR	Power Supply Rejection Ratio	Supply voltage change from 2.7V to 3V	<b>55</b>	85		dB
$A_{VOL}$	Large-Signal Voltage Gain	$R_L = 100k$ , $V_{OUT} 2V_{PP}$	<b>70</b>	83		dB
		$R_L = 500k$ , $V_{OUT} 2V_{PP}$	<b>78</b>	91		dB

Symbol	Parameter	Condition	Min	Typ	Max	Units
GBW	Gain-Bandwidth Product	$R_L = 200k\Omega$ , $C_L = 2pF$ , $A_v = 11$		350		kHz
PM	Phase Margin	$R_L = 200k\Omega$ , $C_L = 2pF$ , $A_v = 11$		65		°
BW	–3dB Bandwidth	$A_v = 1$ , $C_L = 2pF$ , $R_L = 1M\Omega$		600		kHz
SR	Slew Rate	$A_v = 1$ , $C_L = 2pF$ , $R_L = 1M\Omega$ Positive Slew Rate = $0.17V/\mu s$		0.35		$V/\mu s$
$I_{SC}$	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		3.6	<b>7</b>	$\mu A$
	Channel to Channel Crosstalk	<b>Note 5</b>		–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> <b>–5</b>	0.1	<b>6</b> <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>	85		dB
PSRR	Power Supply Rejection Ratio	Supply voltage change from 3V to 5V	<b>60</b>	86		dB
$A_{VOL}$	Large-Signal Voltage Gain	$R_L = 100k\Omega$ , $V_{OUT} 4.0V_{PP}$	<b>73</b>	81		dB
		$R_L = 500k\Omega$ , $V_{OUT} 4.0V_{PP}$	<b>78</b>	88		dB
$V_{OUT}$	Maximum Output Voltage Swing	$R_L = 500k\Omega$	<b><math>V_{+}-3mV</math></b>	$V_{+}-1.3mV$		V
$V_{OUT}$	Minimum Output Voltage Swing	$R_L = 500k\Omega$		$V_{-}+0.7mV$	<b><math>V_{-}+3mV</math></b>	V
GBW	Gain-Bandwidth Product	$R_L = 200k\Omega$ , $C_L = 2pF$ , $A_v = 11$		450		kHz
PM	Phase Margin			63		°
BW	–3dB Bandwidth	$A_v = 1$ , $C_L = 2pF$ , $R_L = 1M\Omega$		800		kHz
SR	Slew Rate	$A_v = 1$ , $C_L = 2pF$ , $R_L = 1M\Omega$ Positive Slew Rate = $0.2V/\mu s$		0.35		$V/\mu s$
$I_{SC}$	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		4.2	<b>8</b>	$\mu A$
	Channel to Channel Crosstalk	<b>Note 5</b>		–120		dB

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

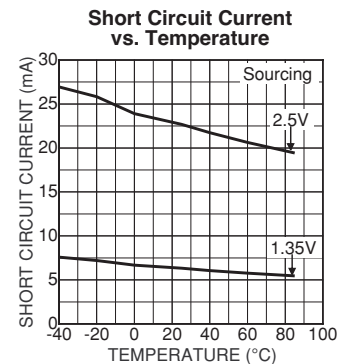
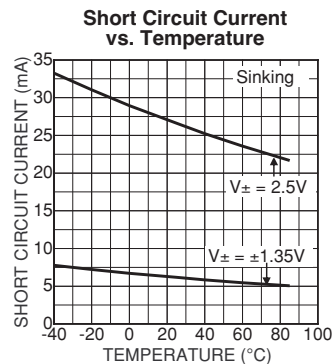
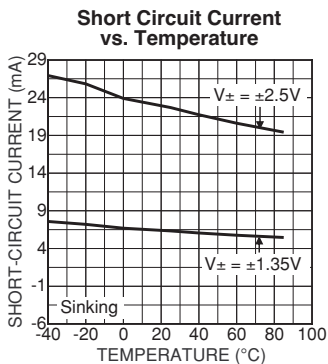
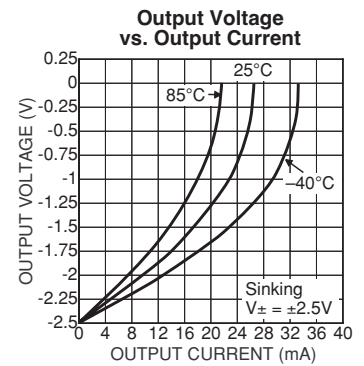
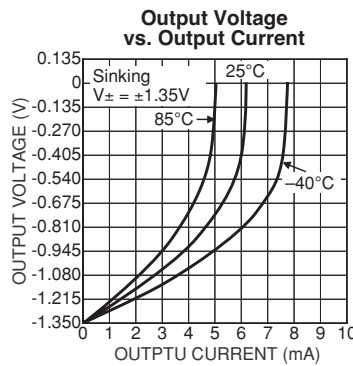
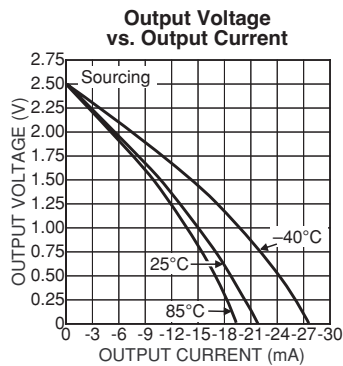
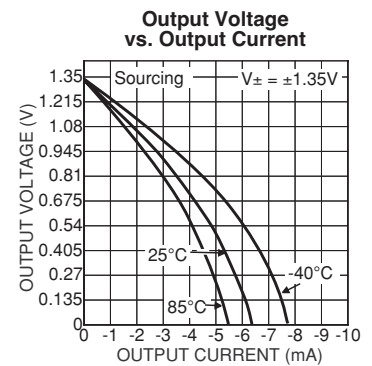
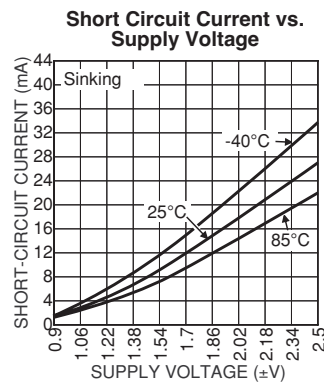
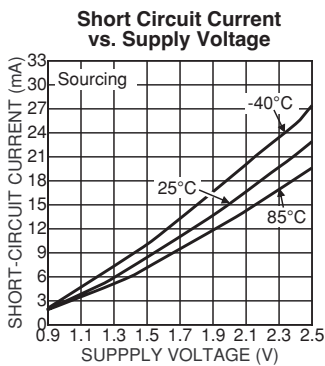
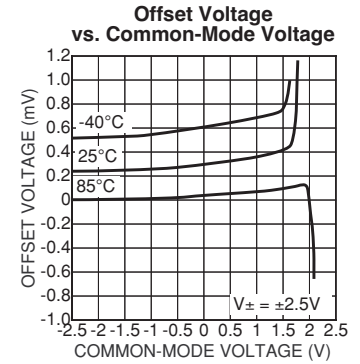
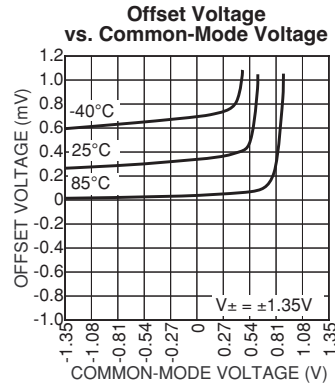
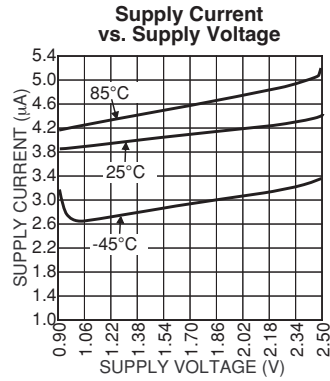
**Note 2.** The device is not guaranteed to function outside its operating rating.

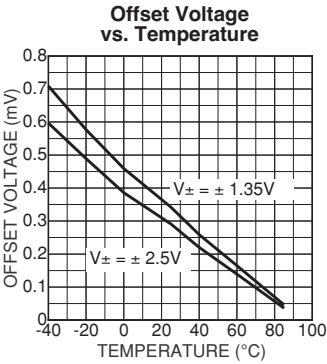
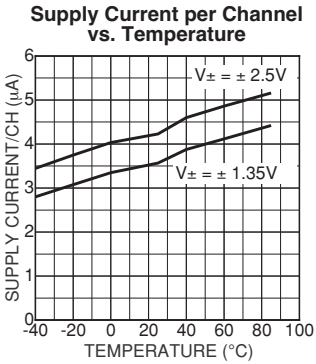
**Note 3.** Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5k in series with 100pF. Pin 4 is ESD sensitive

**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).

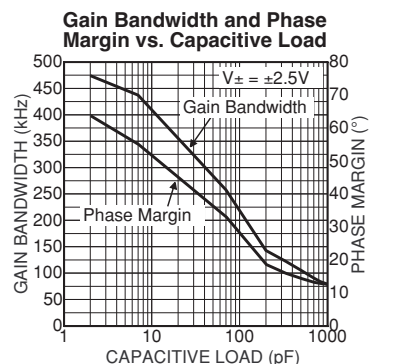
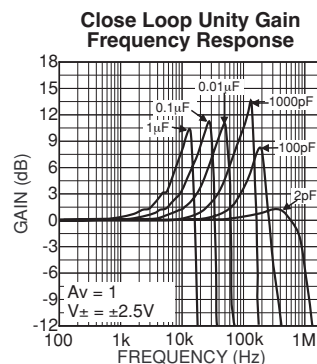
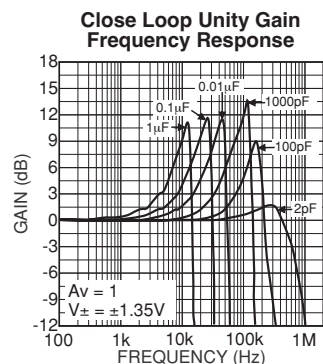
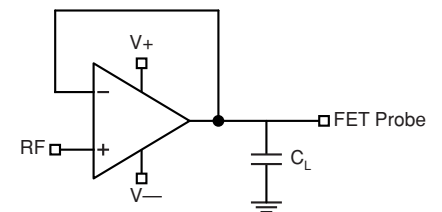
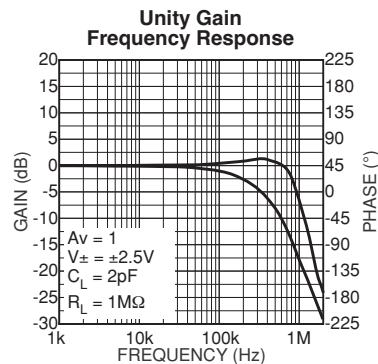
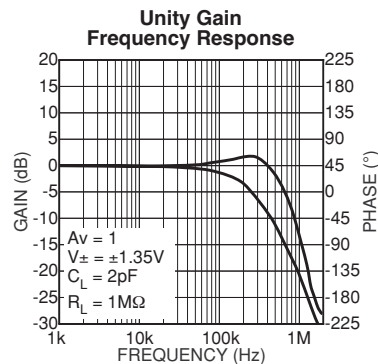
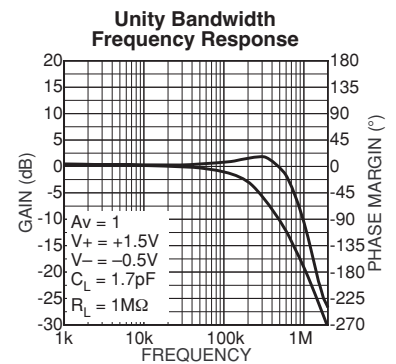
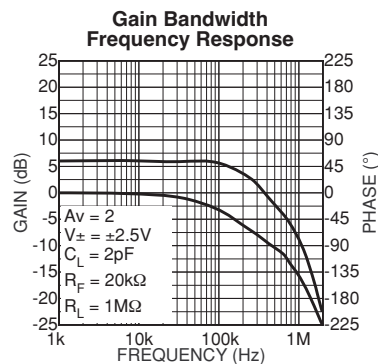
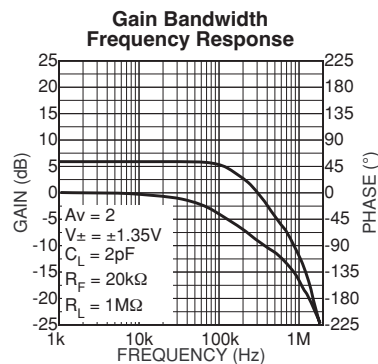
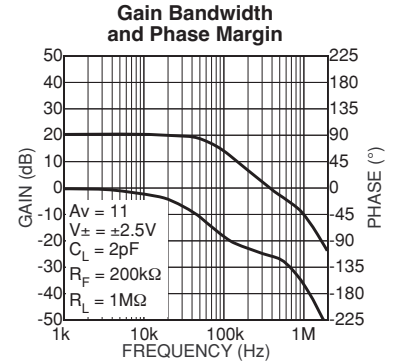
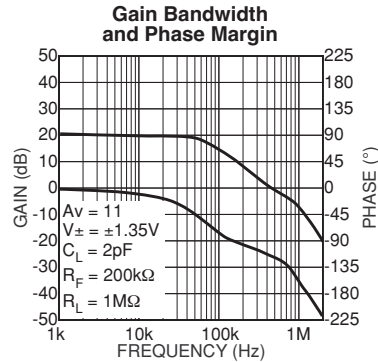
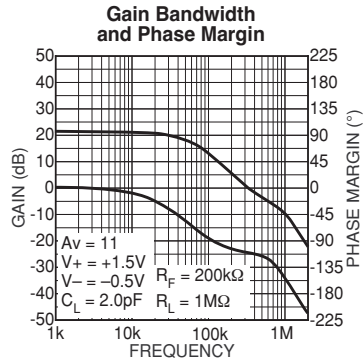
**Note 5.** DC signal referenced to input. Refer to Typical Characteristics graphs for AC performance.

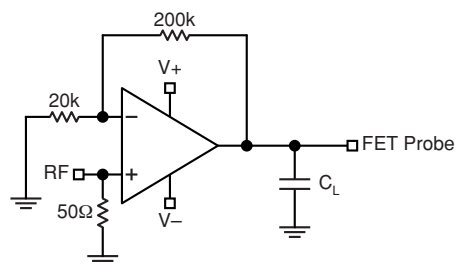
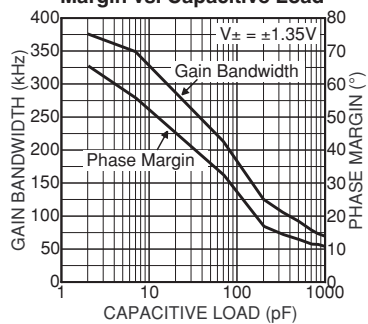
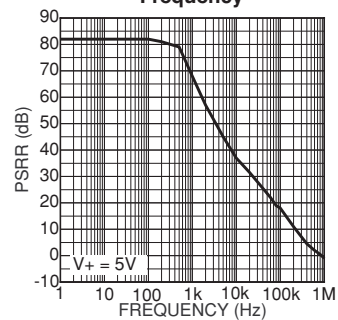
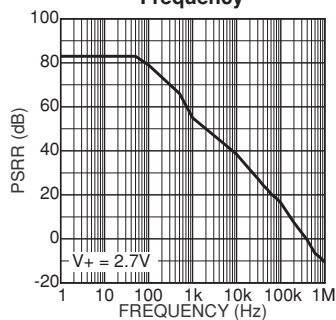
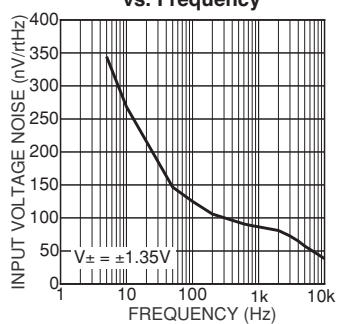
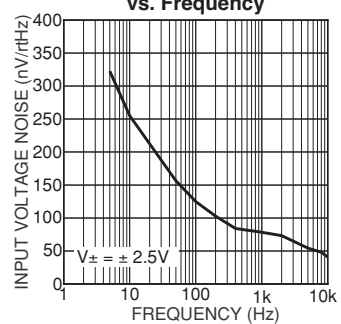
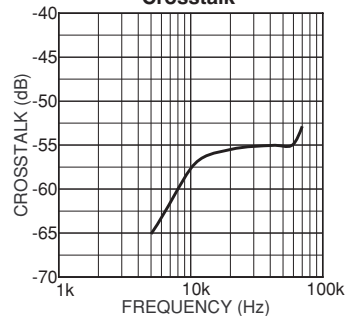
## DC Performance Characteristics





# AC Performance Characteristics

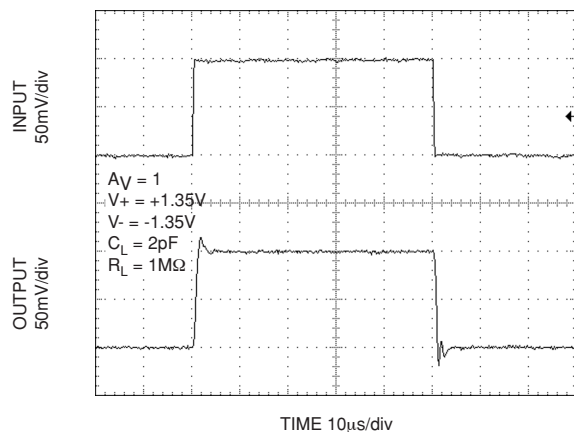


**Gain Bandwidth and Phase Margin vs. Capacitive Load**

**PSRR vs. Frequency**

**PSRR vs. Frequency**

**MIC863 Input Voltage Noise vs. Frequency**

**MIC863 Input Voltage Noise vs. Frequency**

**Channel-to-Channel Crosstalk**


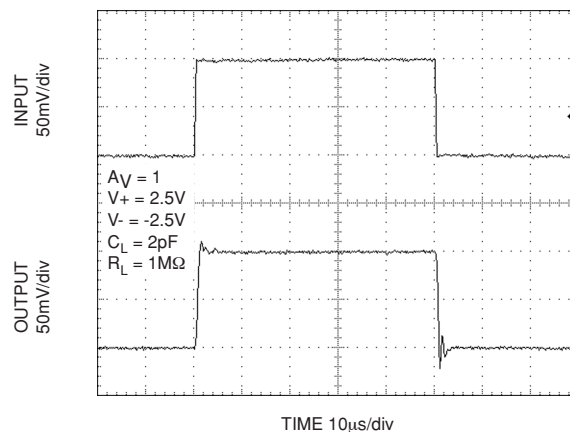


## Functional Characteristics

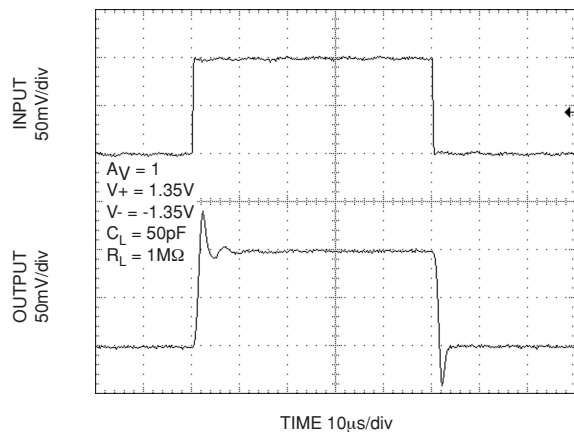
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Test Circuit 3:  $A_V = 1$



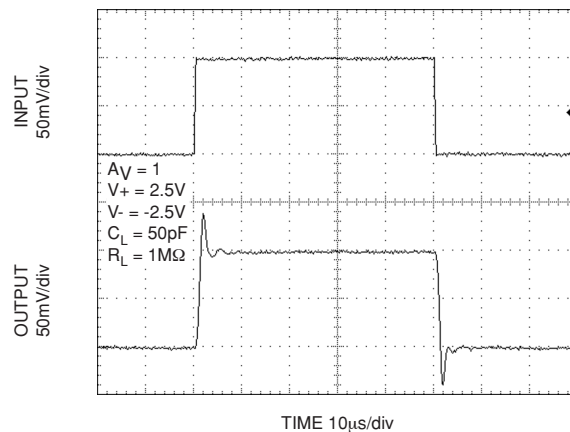
Small Signal Pulse Response  
Test Circuit 3:  $A_V = 1$



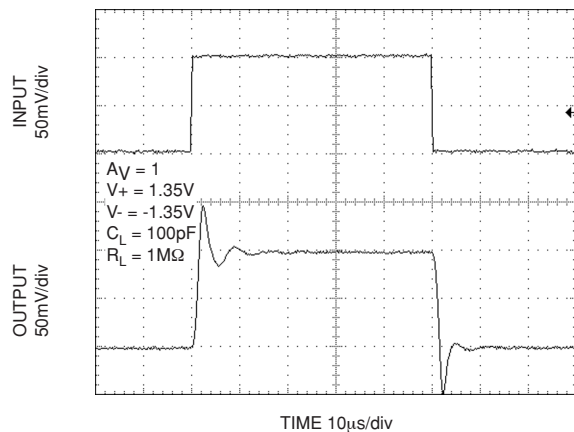
Small Signal Pulse Response  
Test Circuit 3:  $A_V = 1$



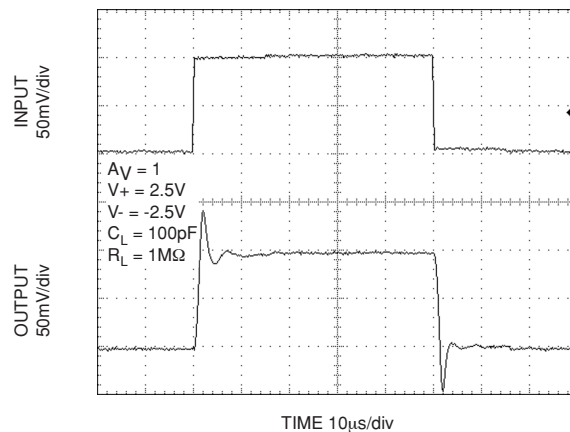
Small Signal Pulse Response  
Test Circuit 3:  $A_V = 1$



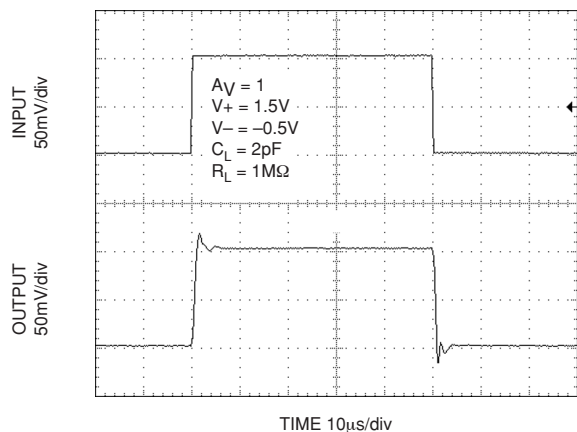
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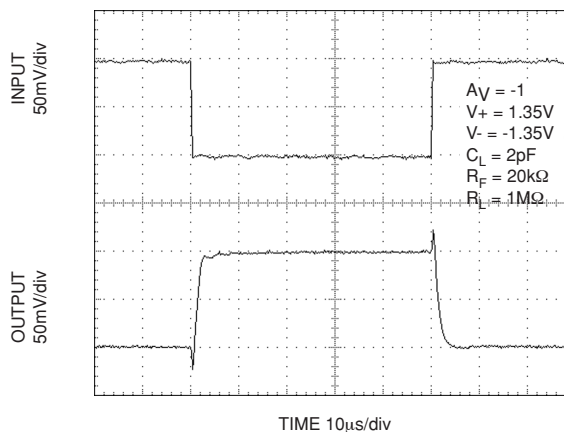
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Test Circuit 3:  $A_V = 1$



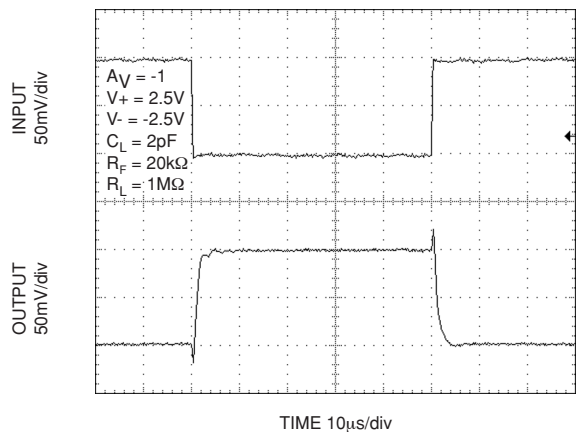
Small Signal Pulse Response  
Test Circuit 3:  $A_V = 1$



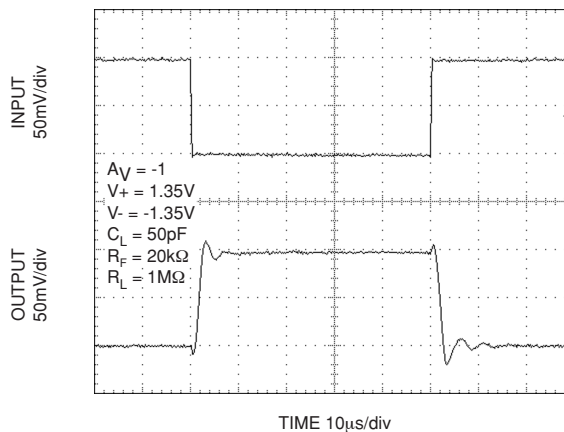
Small Signal Pulse Response  
Test Circuit 4:  $A_V = -1$



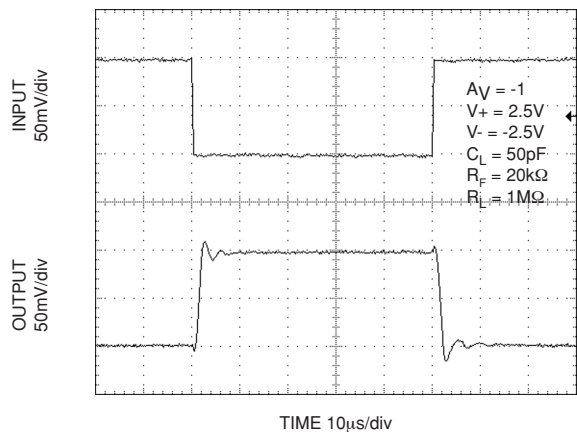
Small Signal Pulse Response  
Test Circuit 4:  $A_V = -1$



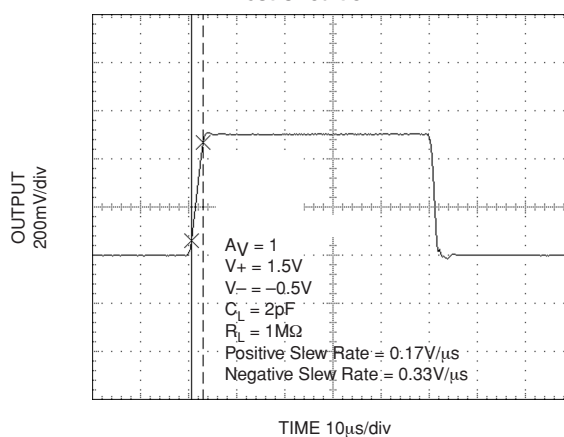
Small Signal Pulse Response  
Test Circuit 4:  $A_V = -1$

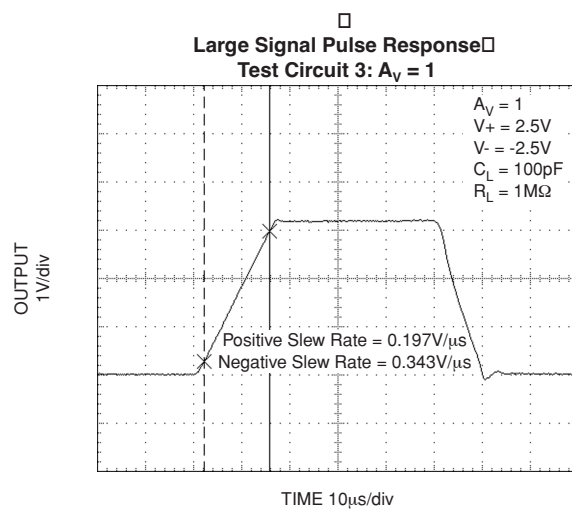
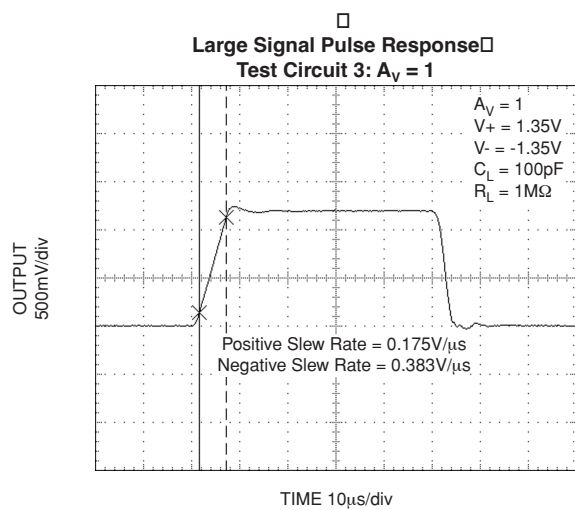
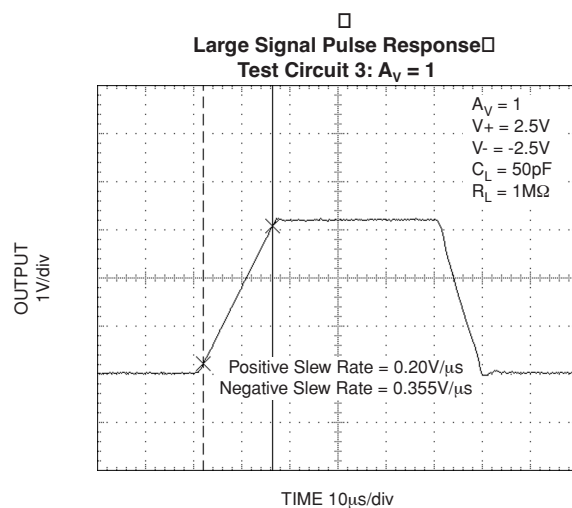
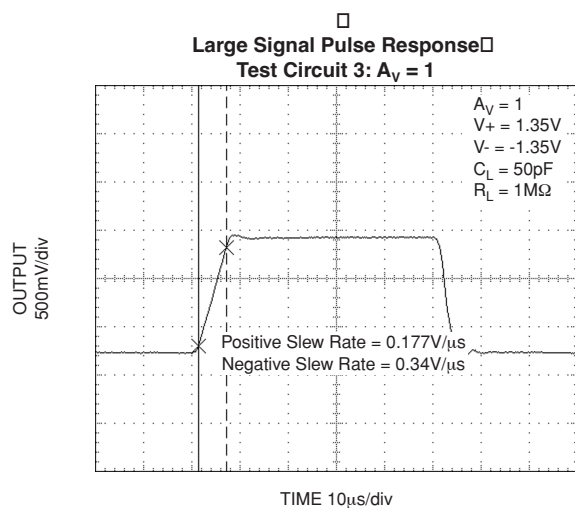
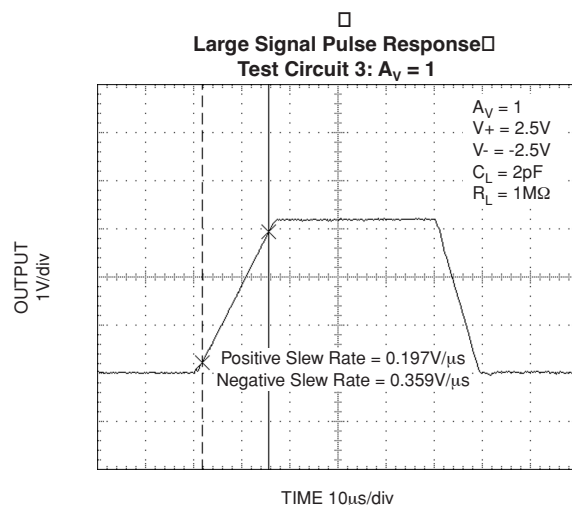
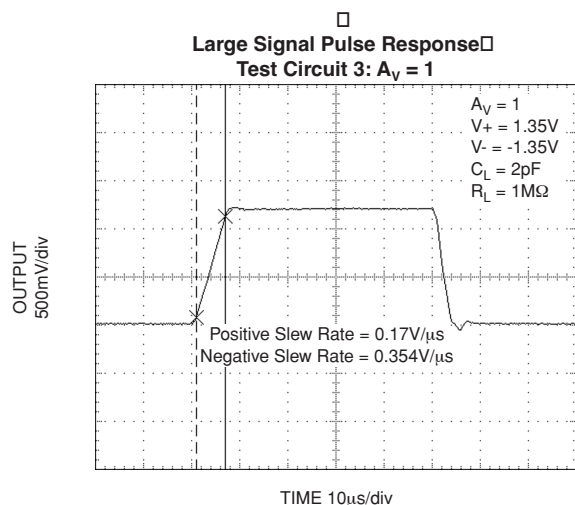


Small Signal Pulse Response  
Test Circuit 4:  $A_V = -1$

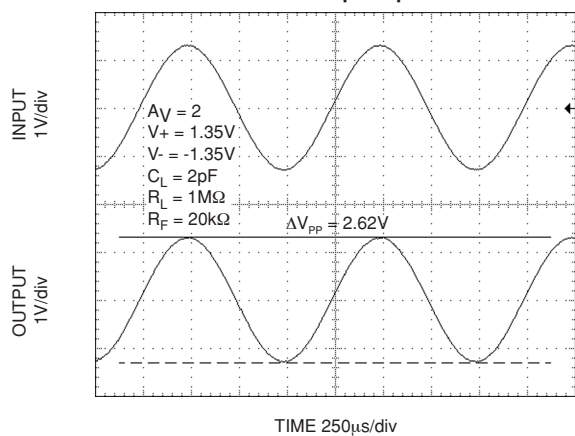


Large Signal Pulse Response  
Test Circuit 3:  $A_V = 1$

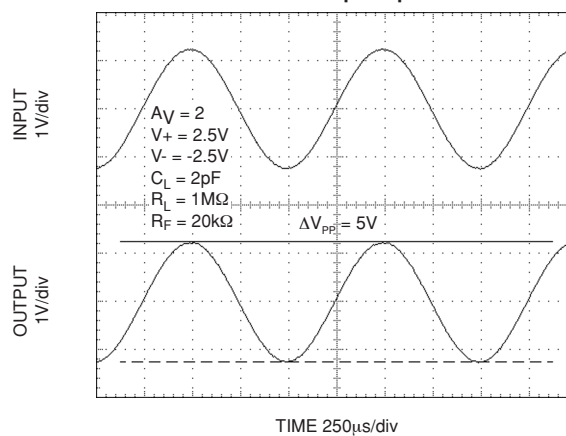




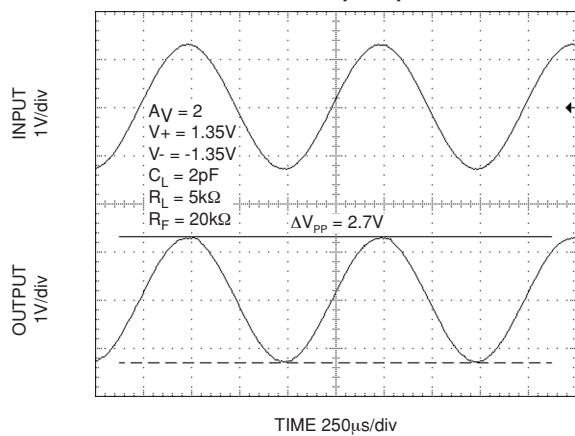
□  
Rail-to-Rail Output Operation



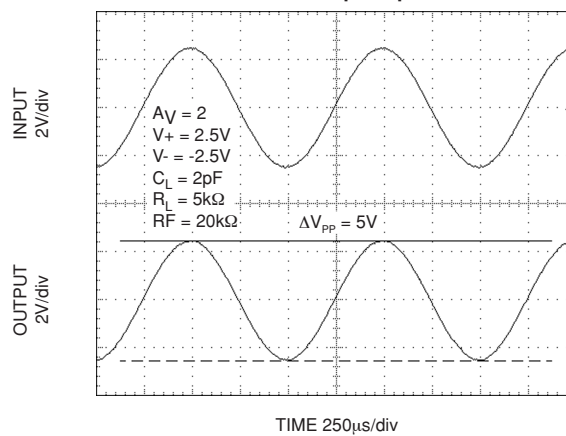
□  
Rail-to-Rail Output Operation



□  
Rail-to-Rail Output Operation



□  
Rail-to-Rail Output 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.

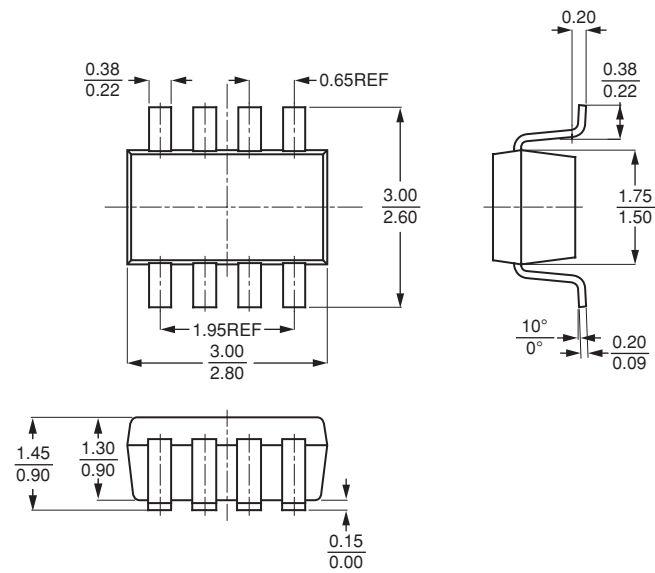
### Supply and Loading Resistive Considerations

The MIC863 is intended for single supply applications configured with a grounded load. It is not advisable to operate the MIC863 under either of the following conditions when the load is less than 20k $\Omega$  and the output swing is greater than 1V(peak-to-peak):

- 1). A grounded load and split supplies ( $\pm V$ ) or
- 2). A single supply where the load is terminated above ground.

Under the above conditions, there may be some instability when the output is sinking current.

## Package Information



**SOT23-8 (M8)**



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**MICREL, INC. 1849 FORTUNE DRIVE SAN JOSE, CA 95131 USA**

TEL + 1 (408) 944-0800 FAX + 1 (408) 944-0970 WEB <http://www.micrel.com>

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