MIC861

Teeny™ Ultra Low Power Op Amp

Preliminary Information

The Infinite Bandwidth Company™

General Description

The MIC861 is a rail-to-rail output, input common-mode to ground, operational amplifier in *Teeny*™ SC70 packaging. The MIC861 provides 400kHz gain-bandwidth product while consuming an incredibly low 4.6µA supply current.

The SC70 packaging achieves significant board space savings over devices packaged in SOT-23 or MSOP-8 packaging. The SC70 occupies approximately half the board area of a SOT-23 package.

Features

- *Teeny*™ SC70 packaging
- 400kHz gain-bandwidth product
- 650kHz, –3dB bandwidth
- 4.6µA supply current
- Rail-to-Rail output
- Ground sensing at input (common mode to GND)
- Drives large capactive loads (1000pF)
- Unity gain stable

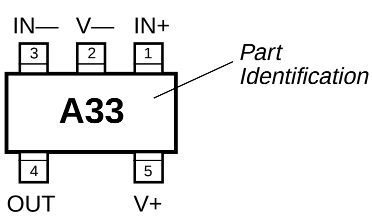
Applications

- Portable equipment
- PDAs
- Pagers
- Cordless Phones
- Consumer Electronics

Ordering Information

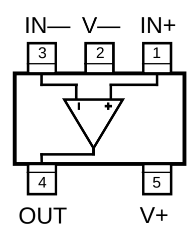
Part Number	Marking	Ambient Temp. Range*	Package
MIC861BC5	A33	–40°C to +85°C	SC70-5

Pin Configuration



SC-70

Functional Pinout



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Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{V+} – V–) .... +6.0V
Differentail 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, **Note 3**

Operating Ratings (Note 2)

Supply Voltage (V+ – V–) .... +2.43V to +5.25V
Ambient Temperature Range .... –40°C to +85°C
Package Thermal Resistance .... 450°C/W

Electrical Characteristics

V+ = +2.7V, V– = 0V, V_{CM} = V+/2; R_L= 500kΩ to V+/2; T_A= 25°C, unless otherwise noted. **Bold** values indicate –40°C≤ T_A≤ +85°C.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{OS}	Input Offset Voltage	**Note 5**	**–10**	2	**10**	mV
	Input Offset Voltage Temp Coefficient			15		µV/°C
I_B	Input Bias Current			20		pA
I_{OS}	Input Offset Current			10		pA
V_{CM}	Input Voltage Range	CMRR > 60dB		1.8		V
CMRR	Common-Mode Rejection Ratio	0 < V_{CM} < 1.35V	**45**	77		dB
PSRR	Power Supply Rejection Ratio	Supply voltage change of 3V	**50**	83		dB
A_{VOL}	Large-Signal Voltage Gain	R_L = 100k, V_{OUT} 2V peak to peak	**60**	74		dB
		R_L = 500k, V_{OUT} 2V peak to peak	**73**	83		dB
V_{OUT}	Maximum Output Voltage Swing	R_L = 500k	**V+–2mV**	V+–0.7mV		V
V_{OUT}	Minimum Output Voltage Swing	R_L = 500k		V–+0.2mV	**V–+ 2mV**	V
GBW	Gain-Bandwidth Product	R_L = 200kΩ, C_L = 2pF, V_{OUT} = 0		350		kHz
BW	–3dB Bandwidth	A_V = 1, C_L = 2pF, R_L = 1MΩ		500		kHz
SR	Slew Rate	A_V = 1, C_L = 2pF, R_L = 1MΩ		0.12		V/µs
I_{SC}	Short-Circuit Output Current	Source		6		mA
		Sink		5		mA
I_S	Supply Current	No Load		4.2	**9**	µA

V+= +5V, V–= 0V, V_{CM}= V+/2; R_L= 500kΩ to V+/2; T_A= 25°C, unless otherwise noted. **Bold** values indicate –40°C≤ T_A≤ +85°C.

V_{OS}	Input Offset Voltage	**Note 5**	**–10**	2	**10**	mV
	Input Offset Voltage Temp Coefficient			15		µV/°C
I_B	Input Bias Current			20		pA
I_{OS}	Input Offset Current			10		pA
V_{CM}	Input Voltage Range	CMRR > 60dB		4.2		V
CMRR	Common-Mode Rejection Ratio	0 < V_{CM} < 3.5V	**60**	80		dB
PSRR	Power Supply Rejection Ratio	Supply voltage change of 1V	**45**	85		dB
A_{VOL}	Large-Signal Voltage Gain	R_L = 100k, V_{OUT} 4.0V peak to peak	**60**	76		dB
		R_L = 500k, V_{OUT} 4.0V peak to peak	**68**	83		dB
V_{OUT}	Maximum Output Voltage Swing	R_L = 500k	**V+–2mV**	V+–0.7mV		V
V_{OUT}	Minimum Output Voltage Swing	R_L = 500k		V–+0.7mV	**V–+ 2mV**	V
GBW	Gain-Bandwidth Product	R_L = 200kΩ, C_L = 2pF, V_{OUT} = 0		400		kHz
BW	–3dB Bandwidth	A_V = 1, C_L = 2pF, R_L = 1MΩ		650		kHz

Symbol	Parameter	Condition	Min	Typ	Max	Units
SR	Slew Rate	$A_V = 1$, $C_L = 2pF$, $R_L = 1M\Omega$		0.12		V/µs
I_{SC}	Short-Circuit Output Current	Source	**10**	24		mA
		Sink	**10**	24		mA
I_S	Supply Current	No Load		4.6	**9**	µA

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

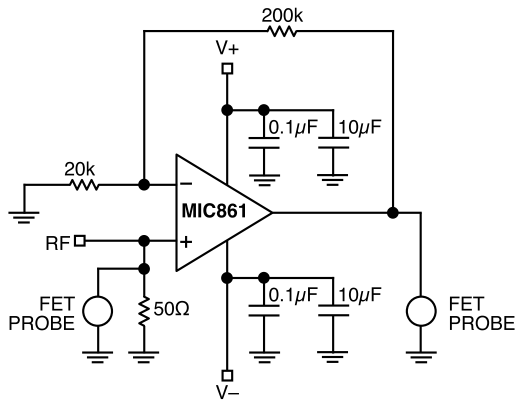
Note 2. The device is not guaranteed to function outside its operating rating.

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

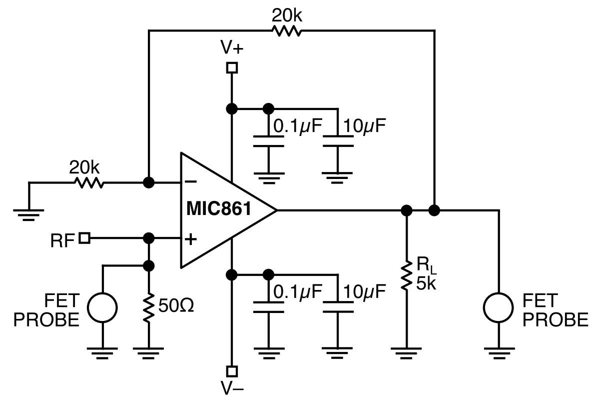
Note 4. Exceeding the maximum differential input voltage will damage the input stage and degrade performance (in particular, input bias current is likely to increase.

Note 5. The offset voltage distribution is centered around 0V. The typical offset number shown, is equal to the standard deviation of the voltage offset distribution.

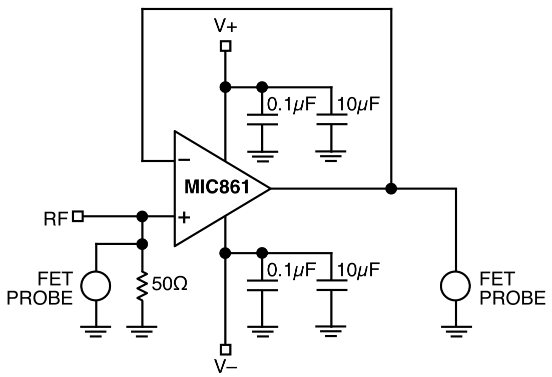
Test Circuits



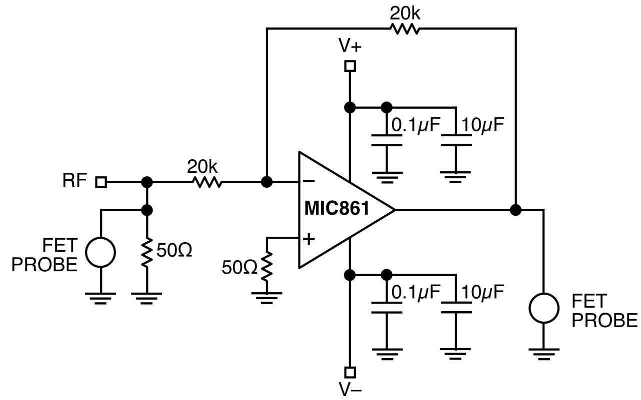
Test Circuit 1. $A_V = 11$



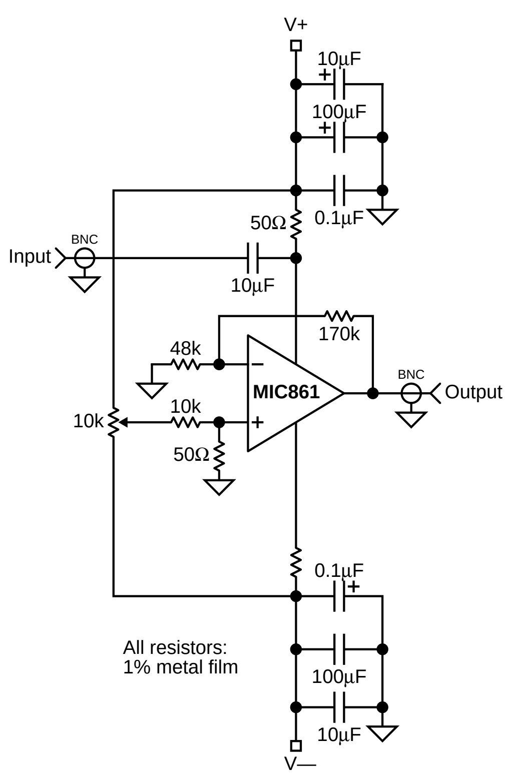
Test Circuit 2: $A_V = 2$



Test Circuit 3. $A_V = 1$



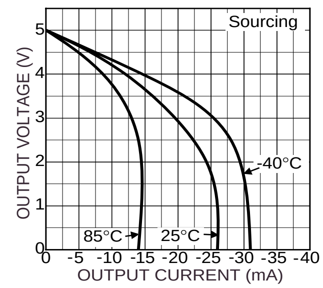
Test Circuit 4. $A_V = -1$



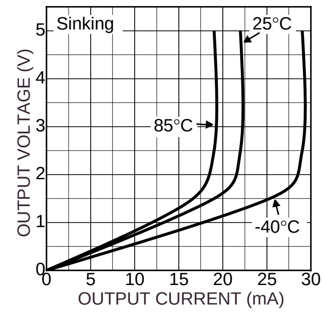
Test Circuit 5. Positive Power Supply Rejection Ratio Measurement

DC Performance Characteristics

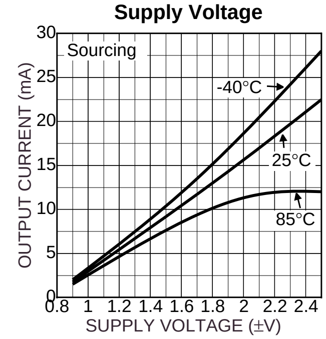
Output Voltage vs. Output Current



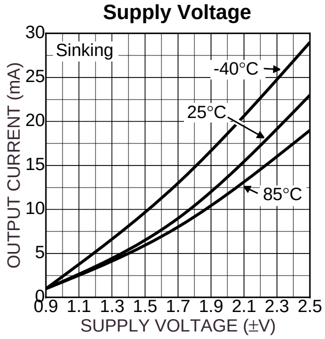
Output Voltage vs. Output Current



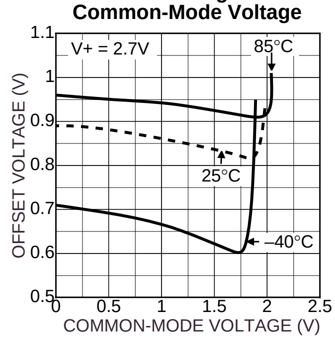
Short Circuit Current vs. Supply Voltage



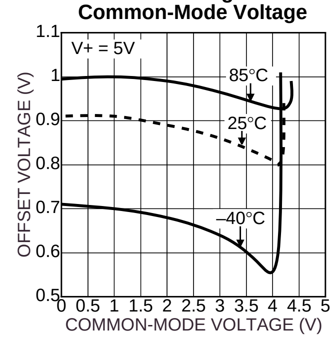
Short Circuit Current vs. Supply Voltage



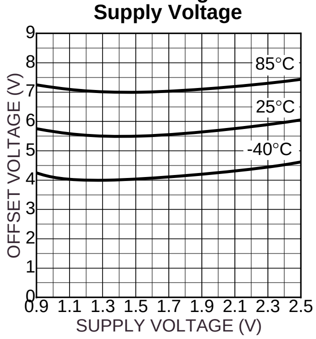
Offset Voltage vs. Common-Mode Voltage



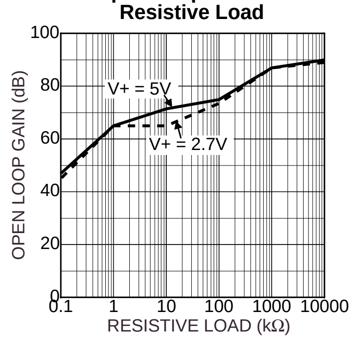
Offset Voltage vs. Common-Mode Voltage



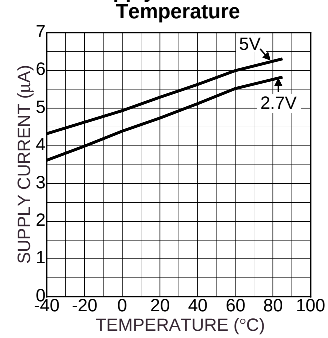
Offset Voltage vs. Supply Voltage



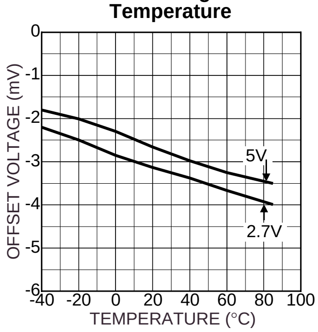
Open Loop Gain vs. Resistive Load



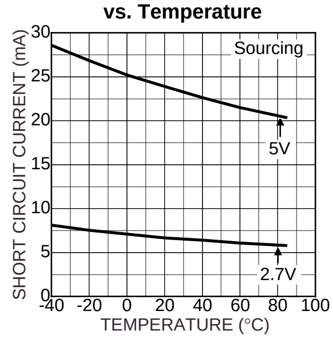
Supply Current vs. Temperature



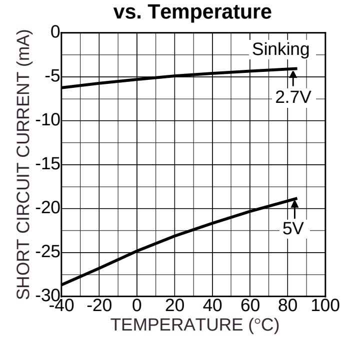
Offset Voltage vs. Temperature



Short Circuit Current vs. Temperature

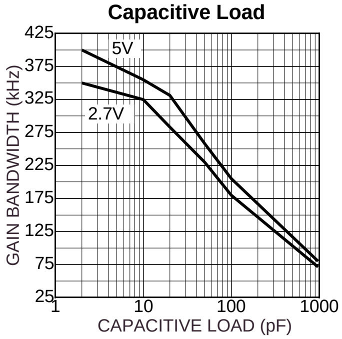


Short Circuit Current vs. Temperature

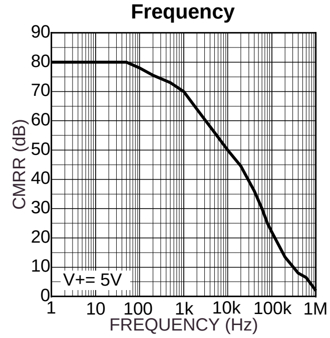


AC Perfomance Characteristics

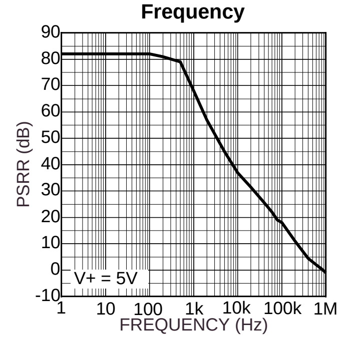
Gain Bandwidth vs. Capacitive Load



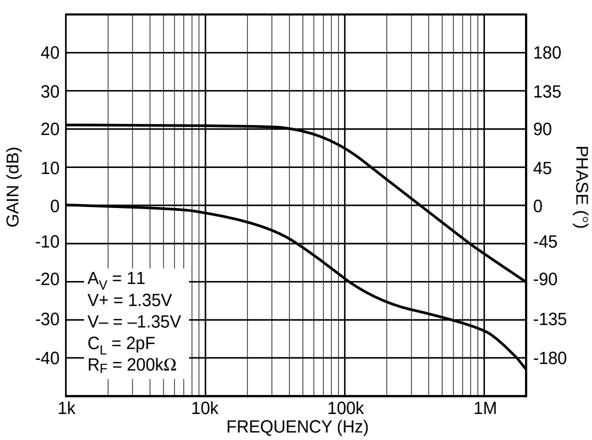
CMRR vs. Frequency



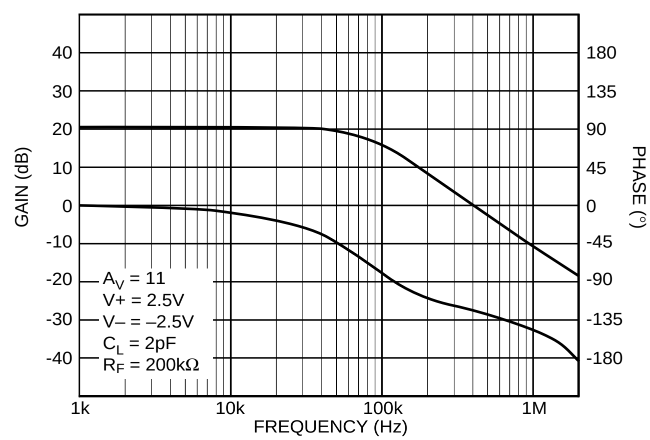
PSRR vs. Frequency



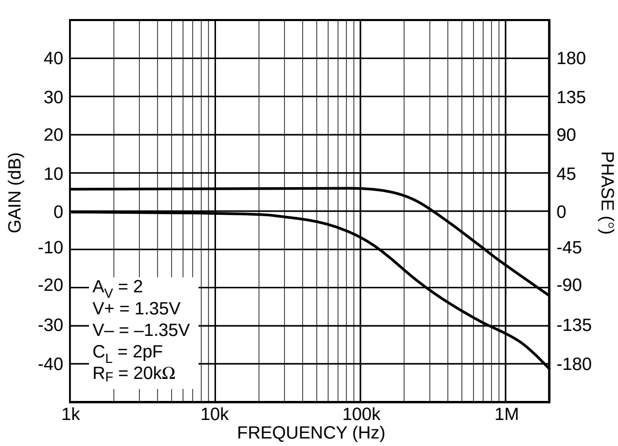
Gain Bandwidth and Phase Margin



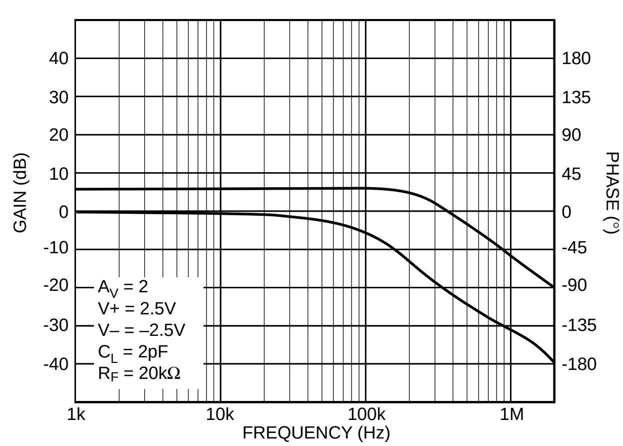
Gain Bandwidth and Phase Margin



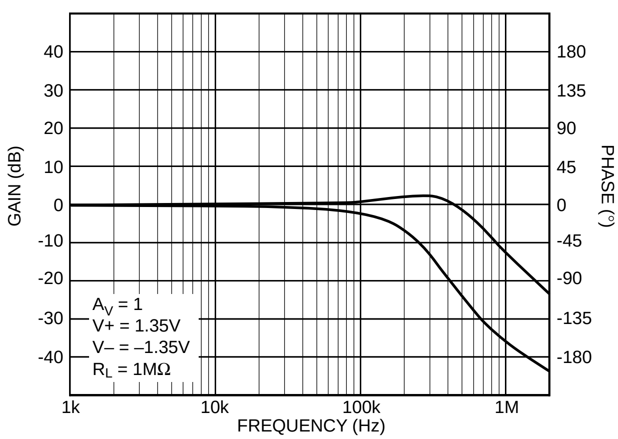
Gain Frequency Response



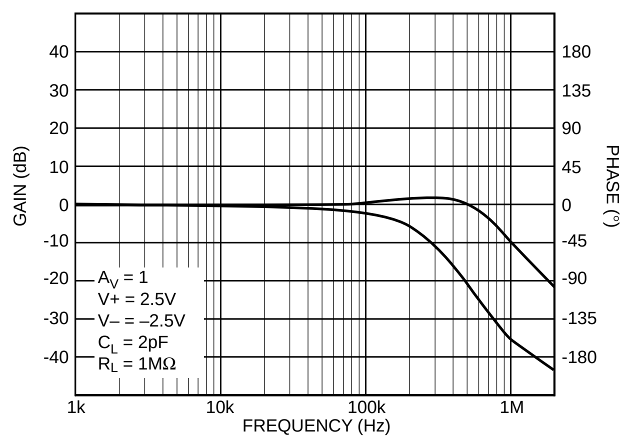
Gain Bandwidth and Phase Margin



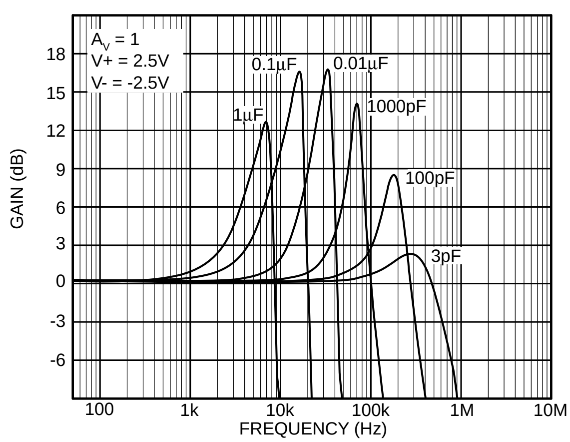
Unity Gain Frequency Response

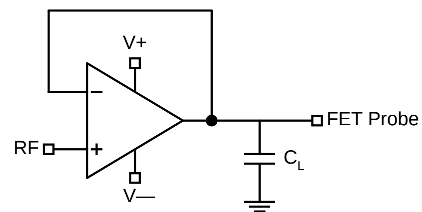


Unity Gain Frequency Response

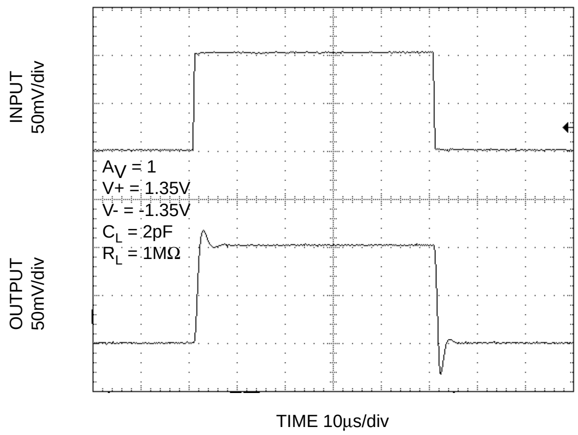


Close-loop Unity Gain Frequency Response

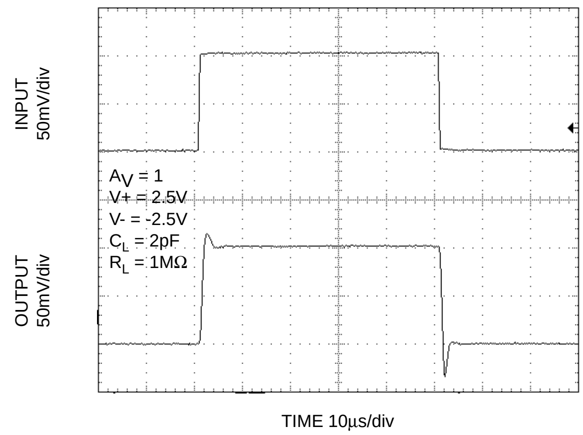




Small Signal Pulse Response
Test Circuit 3: A_V = 1



Small Signal Pulse Response
Test Circuit 3: A_V = 1



Small Signal Pulse Response
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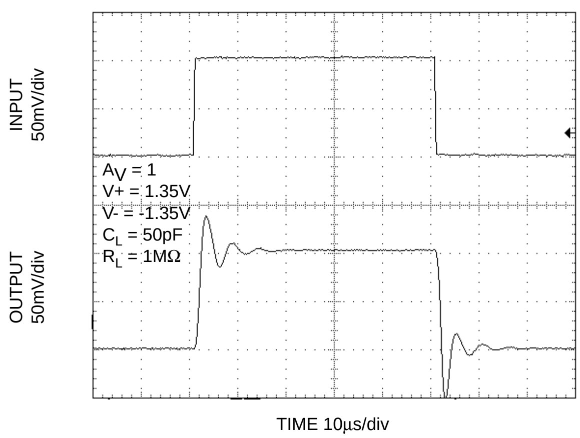

Small Signal Pulse Response
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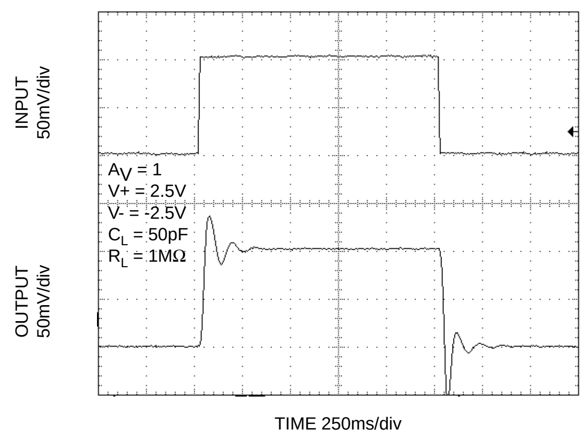
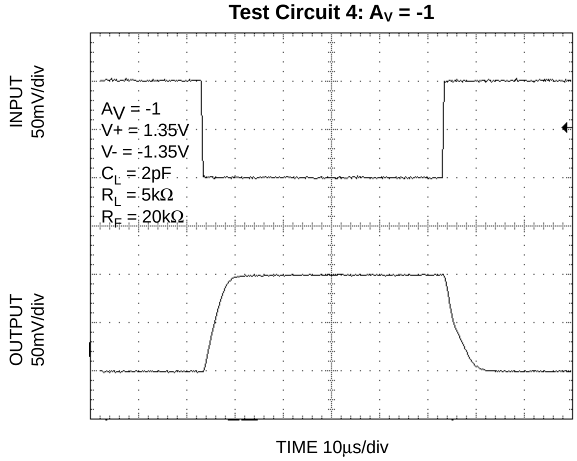


Small Signal Pulse Response
Test Circuit 4: A_V = -1



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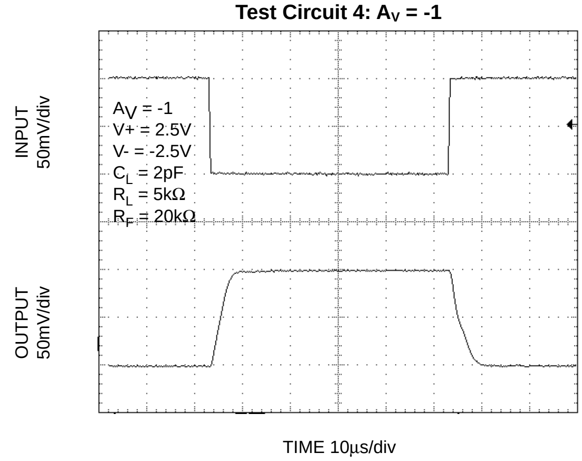
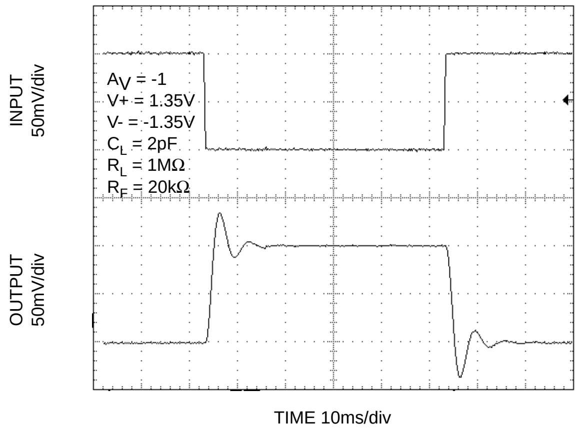
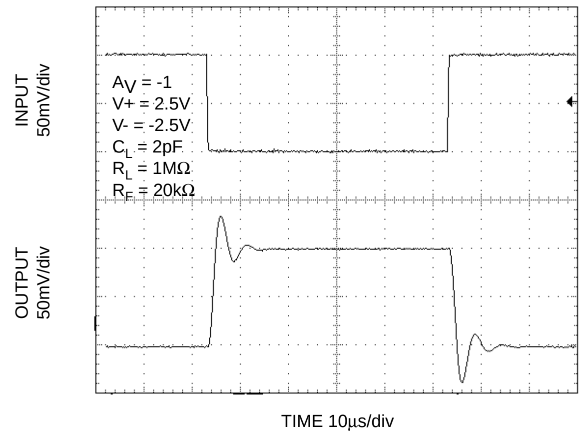
Test Circuit 4: A_V = -1



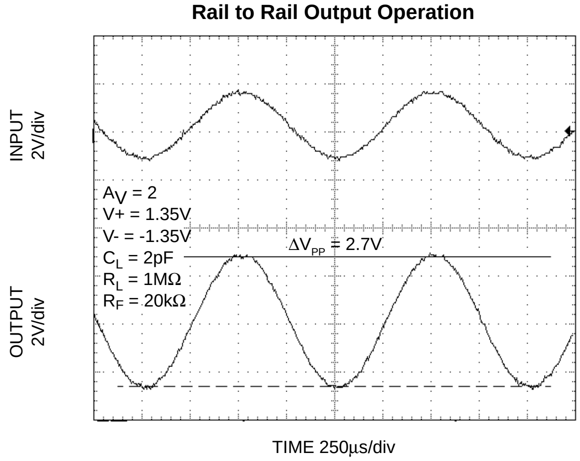
Small Signal Pulse Response
Test Circuit 4: $A_V = -1$



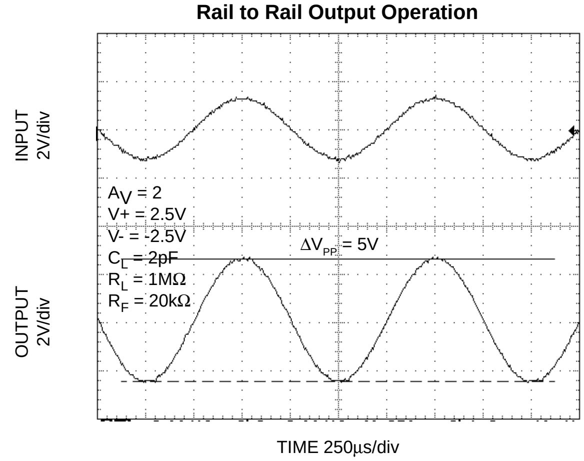
Small Signal Pulse Response
Test Circuit 4: $A_V = -1$



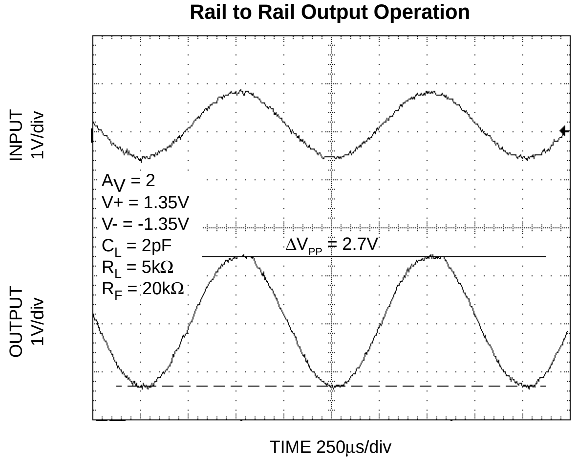
Rail to Rail Output Operation



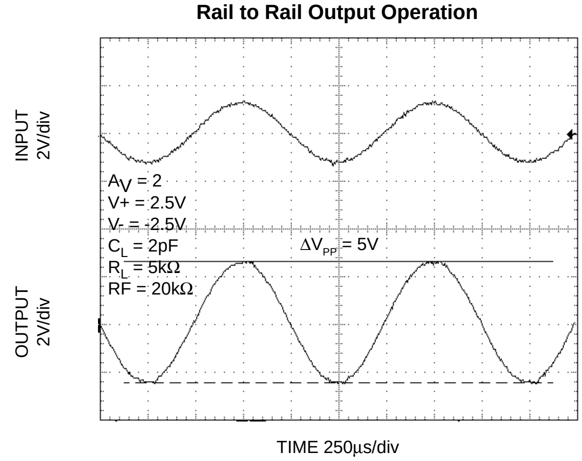
Rail to Rail Output Operation



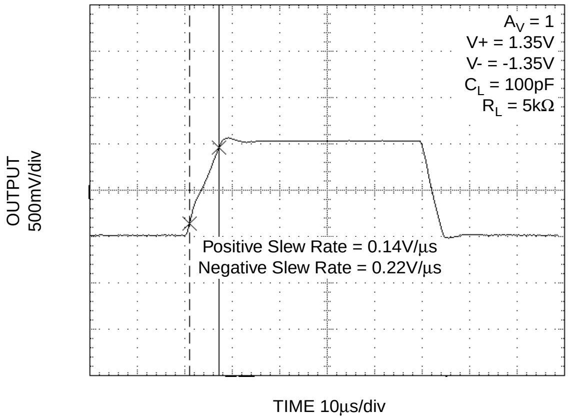
Rail to Rail Output Operation



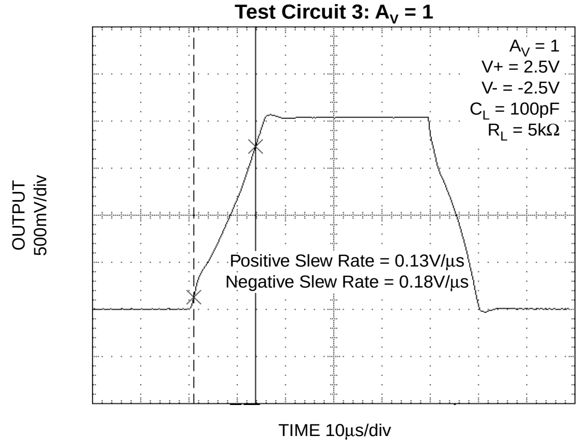
Rail to Rail Output Operation



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



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

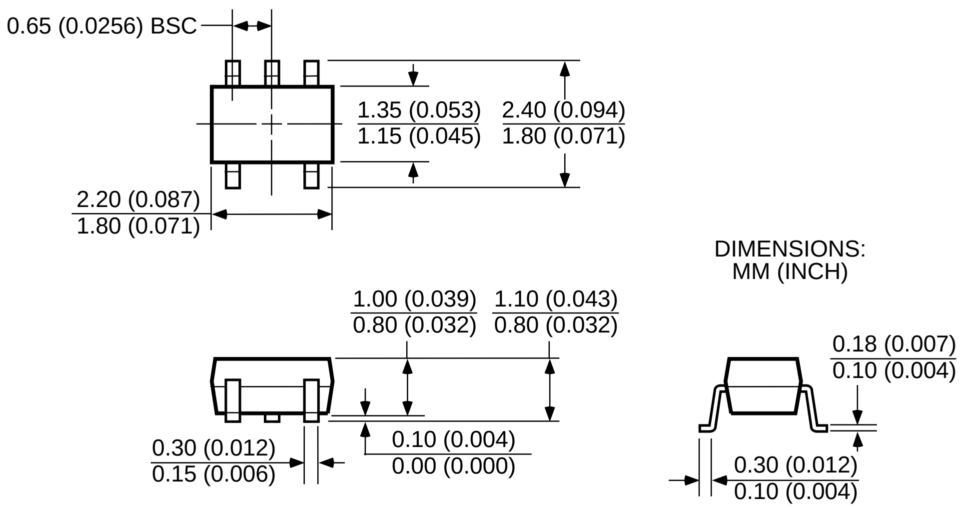


Applications Information

Power Supply Bypassing

Regular supply bypassing techniques are recommended. A 10µF capacitor in parallel with a 0.1µF 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.

Package Information



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