Single Low Bias Current, Low Voltage, Rail-to-Rail Input/Output CMOS Operational Amplifier

AZV831

General Description

The AZV831 is low bias current, low voltage operational amplifiers which can be designed into a wide range of applications. The AZV831 has a quiescent current of 70µA per amplifier at 1.6V.

The AZV831 features optimal performance in low voltage, low bias current systems. The IC can provide rail-to-rail output swing under heavy loads. The common-mode input voltage range could be designed 200mV exceeding the supply voltage range, thus enables the customer to expand its application scope. The AZV831 has a maximum input offset voltage of 2.5mV and its operating range is from 1.6V to 5.5V.

AZV831 is available in SC-70-5 and SOT-23-5 packages.

Features

- Single Supply Voltage Range: 1.6V to 5.5V
- Ultra-low Input Bias Current: 1pA (Typ.)
- Offset Voltage: 0.5mV (Typ.), 2.5mV (Max.)
- Rail-to-Rail Input
  V_{CM}: 200mV beyond Rails
  Rail-to-Rail Output Swing
  20kΩ Load
- Supply Current: 70µA
- Unity Gain Stable
  Gain Bandwidth Product: 1.0MHz
- Slew Rate: 0.45V/µs @ V_{CC}=5.0V
- Operation Ambient Temperature Range: -40ºC to 85ºC

Applications

- Sensors
- Photodiode Amplification
- Battery-Powered Instrumentation
- Pulse Blood Oximeter, Glucose Meter

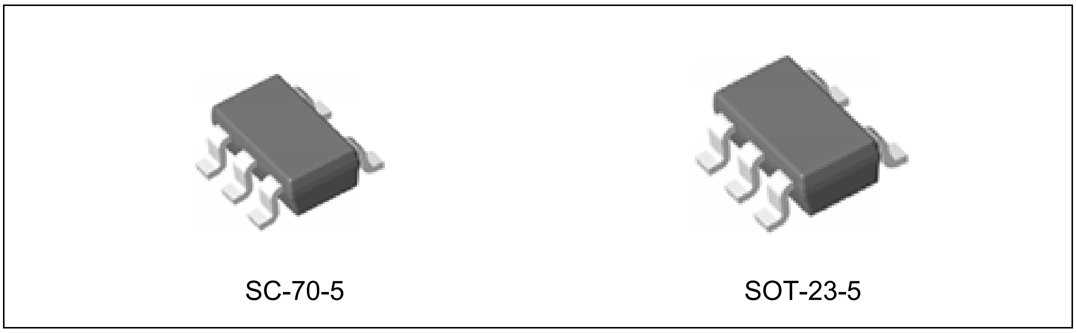


Figure 1. Package Types of AZV831

Pin Configuration

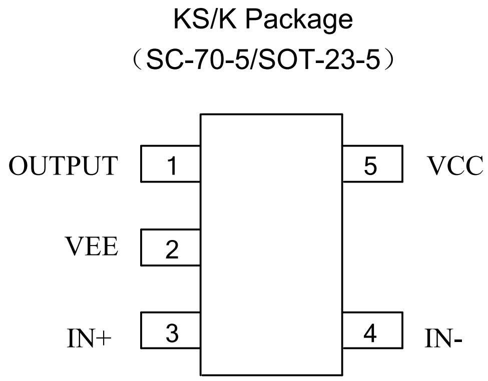


Figure 2. Pin Configuration of AZV831 (Top View)

Function Block Diagram

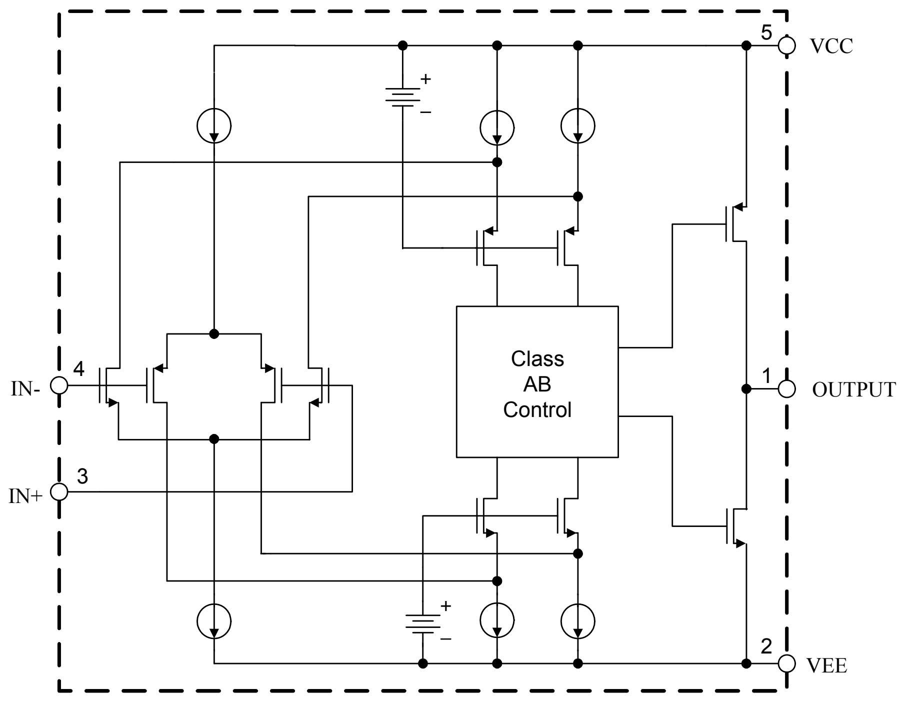
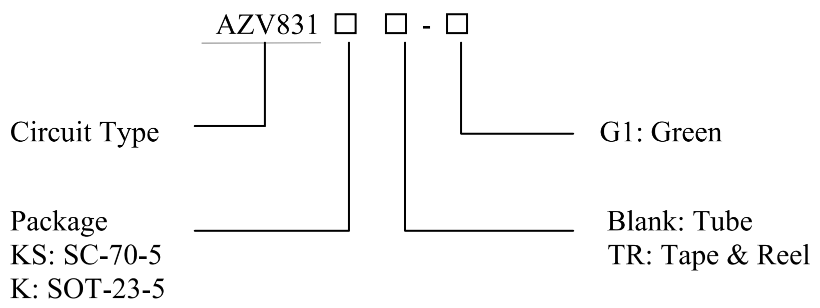


Figure 3. Functional Block Diagram of AZV831

Ordering Information



Package	Temperature Range	Part Number	Marking ID	Packing Type
SC-70-5	-40 to 85°C	AZV831KSTR-G1	L3	Tape & Reel
SOT-23-5	-40 to 85°C	AZV831KTR-G1	G4D	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "G1" suffix in the part number, are RoHS compliant and green.

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value		Unit
Power Supply Voltage	V_{CC}	6.0		V
Differential Input Voltage	V_{ID}	6.0		V
Input Voltage	V_{IN}	-0.3 to V_{CC}+0.5		V
Operating Junction Temperature	T_J	150		ºC
Thermal Resistance (Junction to Ambient)	θ_{JA}	SC-70-5	270	ºC /W
		SOT-23-5	220	
Storage Temperature Range	T_{STG}	-65 to 150		ºC
Lead Temperature (Soldering,10 Seconds)	T_{LEAD}	260		ºC
ESD (Human Body Model)		6000		V
ESD (Machine Model)		400		V

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{CC}	1.6	5.5	V
Operation Ambient Temperature Range	T_A	-40	85	ºC

1.6V DC Electrical Characteristics

V_{CC}=1.6V, V_{EE}=0, V_{CM}=V_{CC}/2, T_A=25°C, unless otherwise noted.

Parameter		Symbol	Conditions	Min	Typ	Max	Unit
Input Offset Voltage		V_{OS}			0.5	2.5	mV
Input Bias Current		I_B			1.0	5.0	pA
Input Offset Current		I_{OS}				2.0	pA
Input Common-mode Voltage Range		V_{CM}		-0.2		1.8	V
Common-mode Rejection Ratio		CMRR	V_{CM}=-0.2V to 1.8V	55	75		dB
Large Signal Voltage Gain		G_V	R_L=10kΩ connect to V_{CC}/2, V_O=0.2V to 1.4V	90	110		dB
Input Offset Voltage Drift		$\Delta V_{OS}/\Delta T$			2.0		μV/ °C
Output Voltage Swing from Rail		V_{OL}/V_{OH}	V_{ID}=0.5V, R_L=1kΩ connect to V_{CC}/2		30	50	mV
			V_{ID}=0.5V, R_L=10kΩ connect to V_{CC}/2		3	15	mV
Output Current	Sink	I_{SINK}	V_{OUT}=V_{CC}	8	10		mA
	Source	I_{SOURCE}	V_{OUT}=0V	5	8.5		mA
Closed-loop Output Impedance		Z_{OUT}	f=10kHz, G=1 (Note 2)		9		Ω
Power Supply Rejection Ratio		PSRR	V_{CC}=1.6V to 5.0V, V_{CM}=0.5V	70	80		dB
Supply Current		I_{CC}	V_{CM}<V_{CC}-1V, I_{OUT}=0		70	90	μA

1.6V AC Electrical Characteristics

V_{CC}=1.6V, V_{EE}=0, V_{CM}=V_{CC}/2, T_A=25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Gain Bandwidth Product	GBP	R_L=100kΩ		1.0		MHz
Slew Rate	SR	G=1, 1V Step, C_L=100pF, R_L=10kΩ		0.32		V/μs
Phase Margin	φ_M	R_L=100kΩ		67		Degrees
Total Harmonic Distortion+Noise	THD+N	f=1kHz, G=1, V_{IN}=1V_{pp} R_L=10kΩ, C_L=100pF		-70		dB
Voltage Noise Density	e_n	f=1kHz		27		$nV/\sqrt{Hz}$

Note 2: G is Closed-Loop Voltage Gain.

1.8V DC Electrical Characteristics

V_{CC}=1.8V, V_{EE}=0, V_{CM}=V_{CC}/2, T_A=25°C, unless otherwise noted.

Parameter		Symbol	Conditions	Min	Typ	Max	Unit
Input Offset Voltage		V_{OS}			0.5	2.5	mV
Input Bias Current		I_B			1.0	5.0	pA
Input Offset Current		I_{OS}				2.0	pA
Input Common-mode Voltage Range		V_{CM}		-0.2		2.0	V
Common-mode Rejection Ratio		CMRR	V_{CM}=-0.2V to 2.0V	55	75		dB
Large Signal Voltage Gain		G_V	R_L=10kΩ connect to V_{CC}/2, V_O=0.2V to 1.6V	90	112		dB
Input Offset Voltage Drift		$\Delta V_{OS}/\Delta T$			2.0		μV/ °C
Output Voltage Swing from Rail		V_{OL}/V_{OH}	V_{ID}=0.5V, R_L=1kΩ connect to V_{CC}/2		25	50	mV
			V_{ID}=0.5V, R_L=10kΩ connect to V_{CC}/2		3	15	
Output Current	Sink	I_{SINK}	V_{OUT}=V_{CC}	12	16		mA
	Source	I_{SOURCE}	V_{OUT}=0V	10	14		
Closed-loop Output Impedance		Z_{OUT}	f=10kHz, G=1 (Note 2)		9		Ω
Power Supply Rejection Ratio		PSRR	V_{CC}=1.6V to 5.0V, V_{CM}=0.5V	70	80		dB
Supply Current		I_{CC}	V_{CM}<V_{CC}-1V, I_{OUT}=0		70	90	μA

1.8V AC Electrical Characteristics

V_{CC}=1.8V, V_{EE}=0, V_{CM}=V_{CC}/2, T_A=25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Gain Bandwidth Product	GBP	R_L=100kΩ		1.0		MHz
Slew Rate	SR	G=1, 1V Step, C_L=100pF, R_L=10kΩ		0.34		V/μs
Phase Margin	φ_M	R_L=100kΩ		67		Degrees
Total Harmonic Distortion+Noise	THD+N	f=1kHz, G=1, V_{IN}=1V_{pp} R_L=10kΩ, C_L=100pF		-70		dB
Voltage Noise Density	e_n	f=1kHz		27		$nV/\sqrt{Hz}$

Note 2: G is Closed-Loop Voltage Gain.

3.0V DC Electrical Characteristics

V_{CC}=3.0V, V_{EE}=0, V_{CM}=V_{CC}/2, T_A=25°C, unless otherwise noted.

Parameter		Symbol	Conditions	Min	Typ	Max	Unit
Input Offset Voltage		V_{OS}			0.5	2.5	mV
Input Bias Current		I_B			1.0	5.0	pA
Input Offset Current		I_{OS}				2.0	pA
Input Common-mode Voltage Range		V_{CM}		-0.3		3.3	V
Common-mode Rejection Ratio		CMRR	V_{CM}=-0.3V to 1.9V	62	80		dB
			V_{CM}=-0.3V to 3.3V	58	75		
Large Signal Voltage Gain		G_V	R_L=1kΩ connect to V_{CC}/2, V_O=0.2V to 2.8V	90	110		dB
			R_L=10kΩ connect to V_{CC}/2, V_O=0.1V to 2.9V	95	115		
Input Offset Voltage Drift		$\Delta V_{OS}/\Delta T$			2.0		μV/ °C
Output Voltage Swing from Rail		V_{OL}/V_{OH}	V_{IN}=0.5V, R_L=1kΩ connect to V_{CC}/2		20	50	mV
			V_{IN}=0.5V, R_L=10kΩ connect to V_{CC}/2		3	15	
Output Current	Sink	I_{SINK}	V_{OUT}=V_{CC}	50	60		mA
	Source	I_{SOURCE}	V_{OUT}=0V	50	65		
Closed-loop Output Impedance		Z_{OUT}	f=10kHz, G=1 (Note 2)		9		Ω
Power Supply Rejection Ratio		PSRR	V_{CC}=1.6V to 5.0V, V_{CM}=0.5V	70	80		dB
Supply Current		I_{CC}	V_{CM}<V_{CC}-1V, I_{OUT}=0		70	90	μA

3.0V AC Electrical Characteristics

V_{CC}=3.0V, V_{EE}=0, V_{CM}=V_{CC}/2, T_A=25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Gain Bandwidth Product	GBP	R_L=100kΩ		1.0		MHz
Slew Rate	SR	G=1, 2V Step, C_L=100pF, R_L=10kΩ		0.40		V/μs
Phase Margin	φ_M	R_L=100kΩ		67		Degrees
Total Harmonic Distortion+Noise	THD+N	f=1kHz, G=1, V_{IN}=1V_{pp} R_L=10kΩ, C_L=100pF		-70		dB
Voltage Noise Density	e_n	f=1kHz		27		$nV/\sqrt{Hz}$

Note 2: G is Closed-Loop Voltage Gain.

5.0V DC Electrical Characteristics

V_{CC}=5.0V, V_{EE}=0, V_{CM}=V_{CC}/2, T_A=25°C, unless otherwise noted.

Parameter		Symbol	Conditions	Min	Typ	Max	Unit
Input Offset Voltage		V_{OS}			0.5	2.5	mV
Input Bias Current		I_B			1.0	5.0	pA
Input Offset Current		I_{OS}				2.0	pA
Input Common-mode Voltage Range		V_{CM}		-0.3		5.3	V
Common-mode Rejection Ratio		CMRR	V_{CM}=-0.3V to 3.9V	70	85		dB
			V_{CM}=-0.3V to 5.3V	65	90		
Large Signal Voltage Gain		G_V	R_L=1kΩ connect to V_{CC}/2, V_O=0.2V to 4.8V	80	92		dB
			R_L=10kΩ connect to V_{CC}/2, V_O=0.05V to 4.95V	85	98		
Input Offset Voltage Drift		$\Delta V_{OS}/\Delta T$			2.0		μV/°C
Output Voltage Swing from Rail		V_{OL}/V_{OH}	V_{IN}=0.5V, R_L=1kΩ connect to V_{CC}/2		25	50	mV
			V_{IN}=0.5V, R_L=10kΩ connect to V_{CC}/2		4	15	
Output Current	Sink	I_{SINK}	V_{OUT}=V_{CC}	100	150		mA
	Source	I_{SOURCE}	V_{OUT}=0V	110	185		
Closed-loop Output Impedance			f=1kHz, G=1 (note 2)		9		Ω
Power Supply Rejection Ratio		PSRR	V_{CC}=1.6V to 5.0V, V_{CM}=0.5V	70	80		dB
Supply Current		I_{CC}	V_{CM}<V_{CC}-1V, I_{OUT}=0		70	90	μA

5V AC Electrical Characteristics

V_{CC}=5.0V, V_{EE}=0, V_{CM}=V_{CC}/2, T_A=25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Gain Bandwidth Product	GBP	R_L=100kΩ		1.0		MHz
Slew Rate	SR	G=1, 2V Step, C_L=100pF, R_L=10kΩ		0.45		V/μs
Phase Margin	φ_M	R_L=100kΩ		67		Degrees
THD+N	THD+N	f=1kHz, G=1, V_{IN}=1V_{PP} R_L=10kΩ,C_L=100pF		-70		dB
Voltage Noise Density	e_n	f=1kHz		27		$nV/\sqrt{Hz}$

Note 2: G is Closed-loop Voltage Gain.

Typical Performance Characteristics

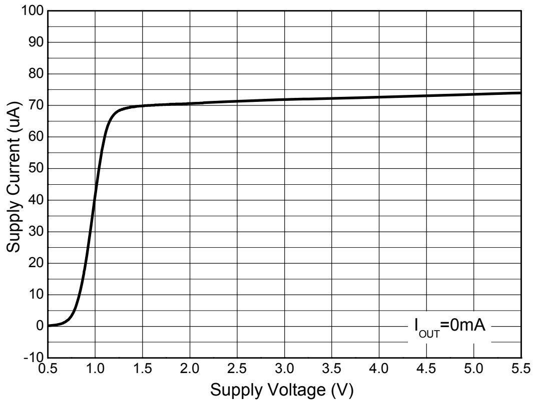


Figure 4. Supply Current vs. Supply Voltage

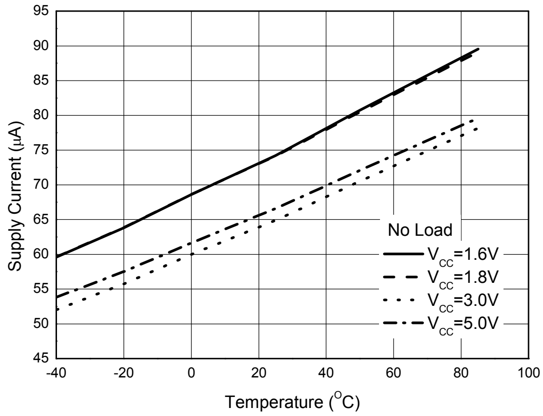


Figure 5. Supply Current vs. Temperature

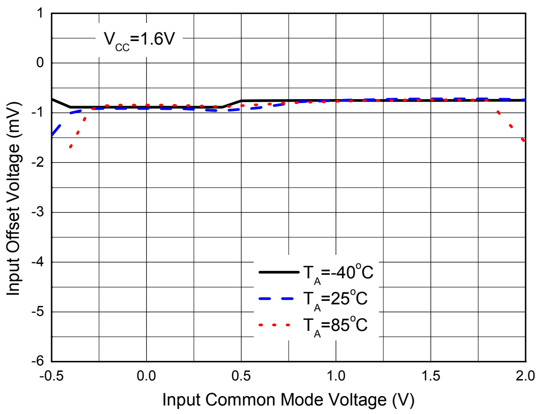


Figure 6. Offset Voltage vs. Common Mode Voltage

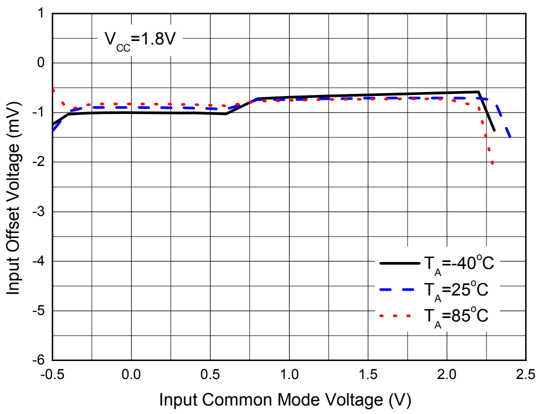


Figure 7. Offset Voltage vs. Common Mode Voltage

Typical Performance Characteristics (Continued)

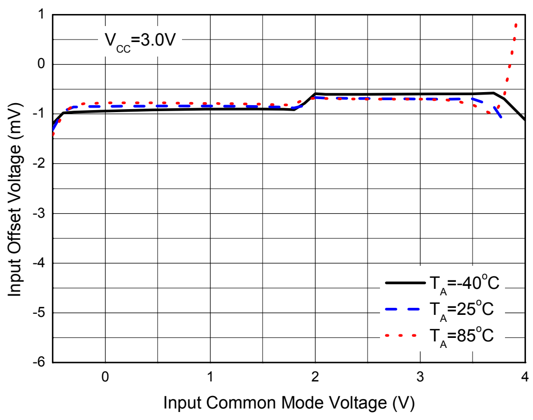


Figure 8. Offset Voltage vs. Common Mode Voltage

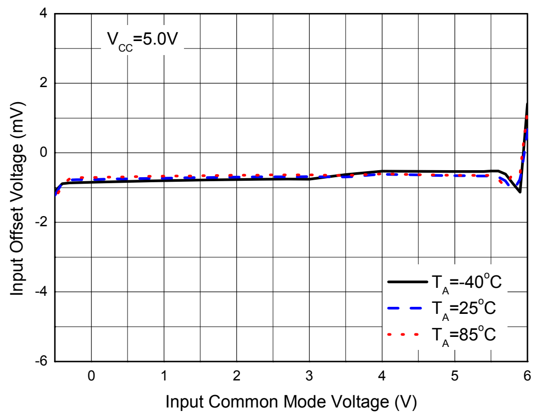


Figure 9. Offset Voltage vs. Common Mode Voltage

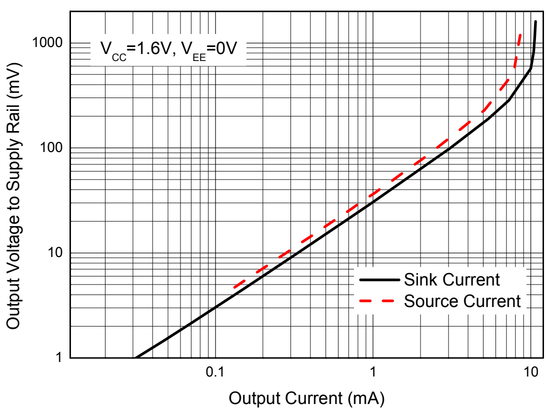


Figure 10. Output Voltage vs. Output Current

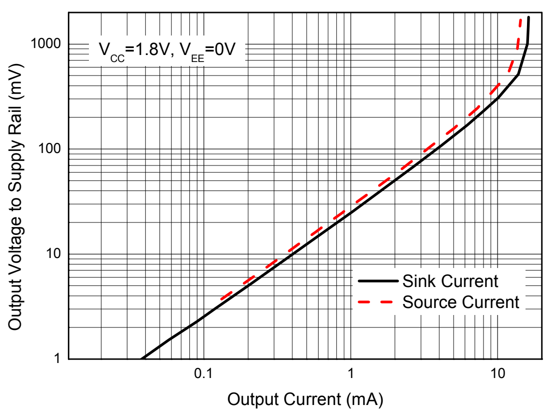


Figure 11. Output Voltage vs. Output Current

Typical Performance Characteristics (Continued)

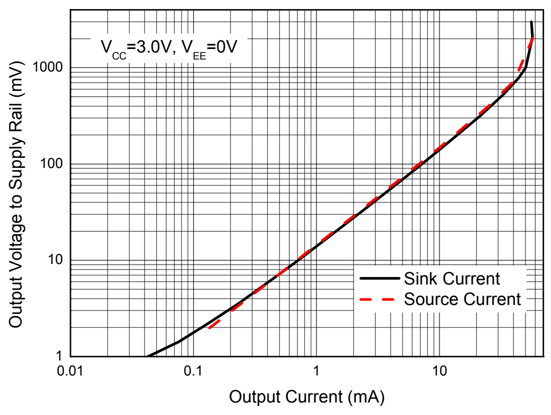


Figure 12. Output Voltage vs. Output Current

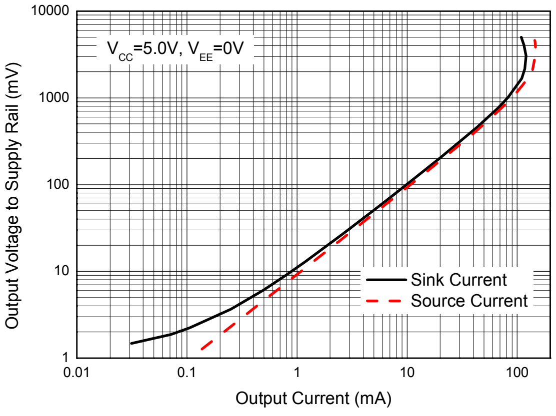


Figure 13. Output Voltage vs. Output Current

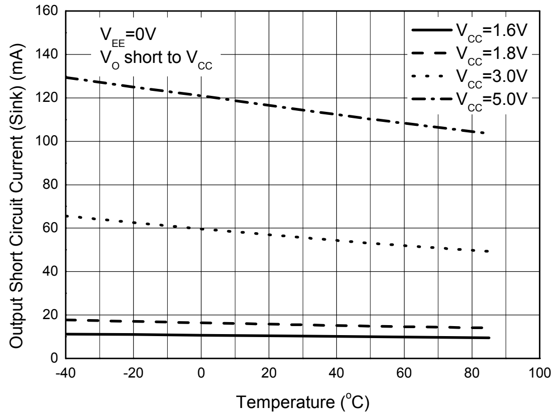


Figure 14. Output Short Circuit Current vs. Temperature

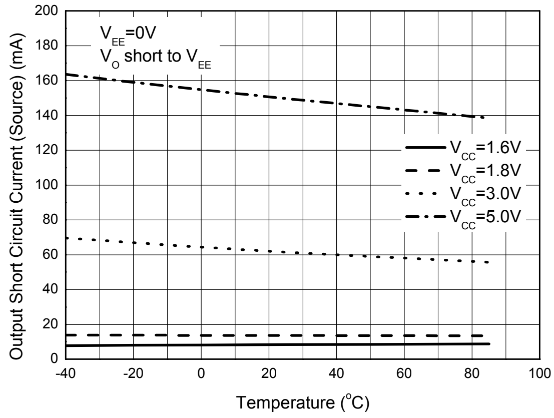


Figure 15. Output Short Circuit Current vs. Temperature

Typical Performance Characteristics (Continued)

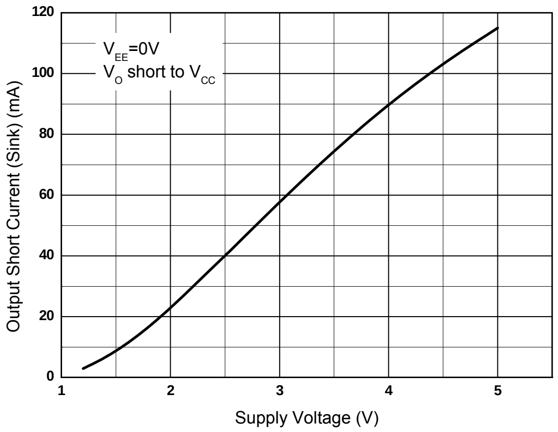


Figure 16. Output Short Circuit Current vs. Supply Voltage

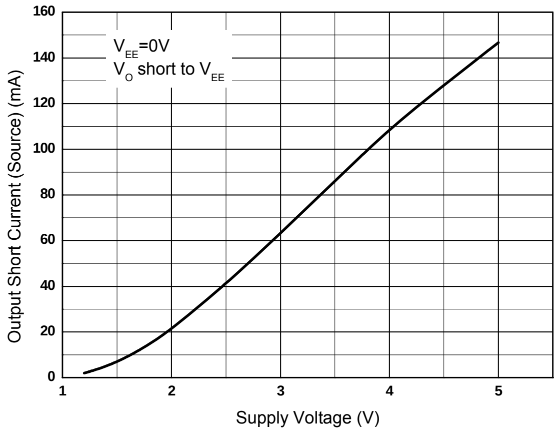


Figure 17. Output Short Circuit Current vs. Supply Voltage

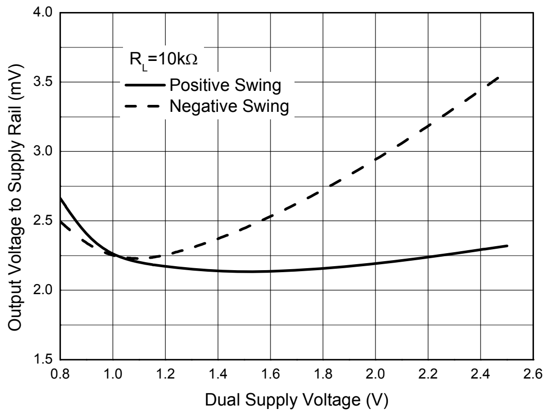


Figure 18. Output Voltage Swing vs. Supply Voltage

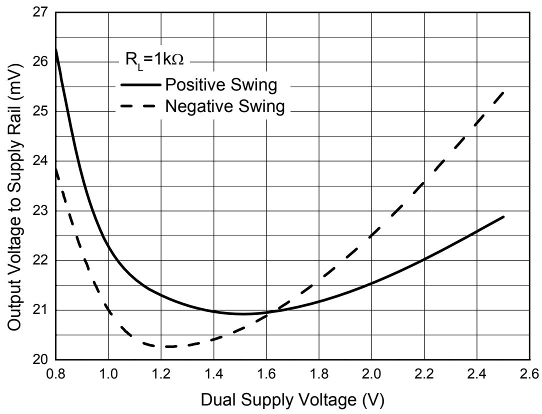


Figure 19. Output Voltage Swing vs. Supply Voltage

Typical Performance Characteristics (Continued)

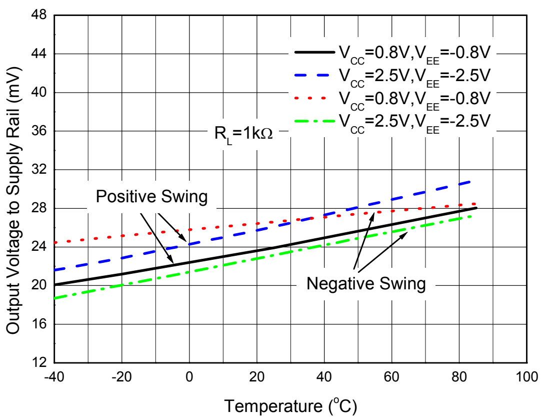


Figure 20. Output Voltage Swing vs. Temperature

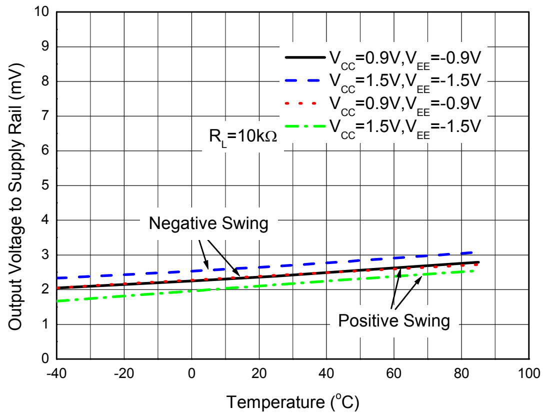


Figure 21. Output Voltage Swing vs. Temperature

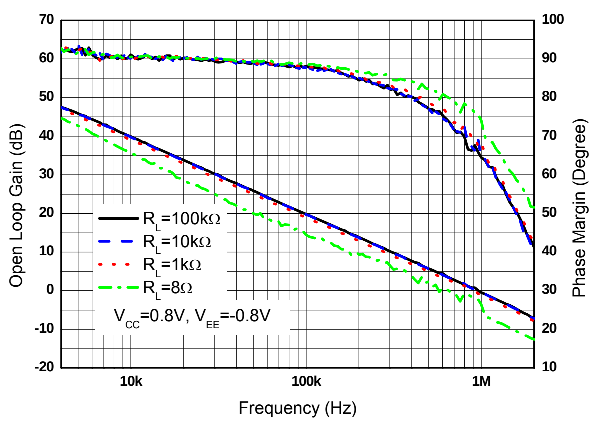


Figure 22. Gain and Phase vs. Frequency and Resistive Load

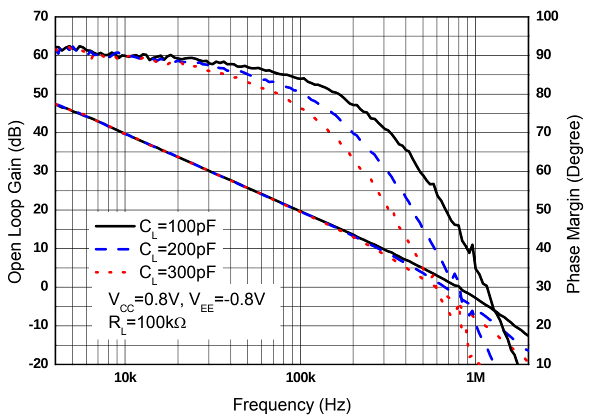


Figure 23. Gain and Phase vs. Frequency and Capacitive Load

Typical Performance Characteristics (Continued)

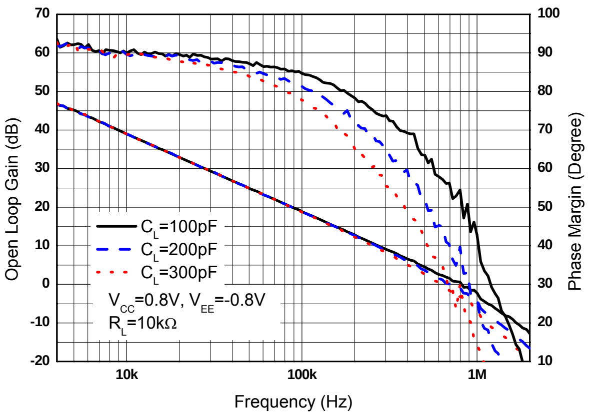


Figure 24. Gain and Phase vs. Frequency and Capacitive Load

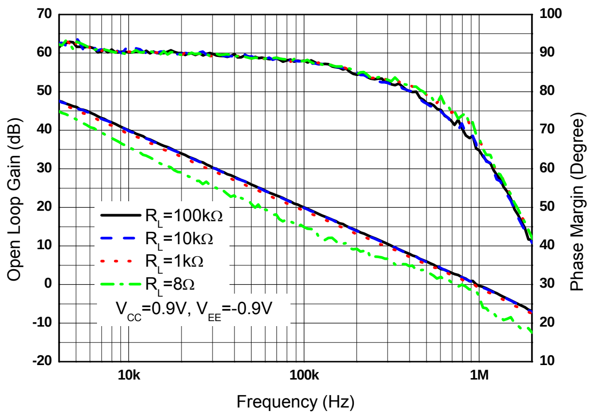


Figure 25. Gain and Phase vs. Frequency and Resistive Load

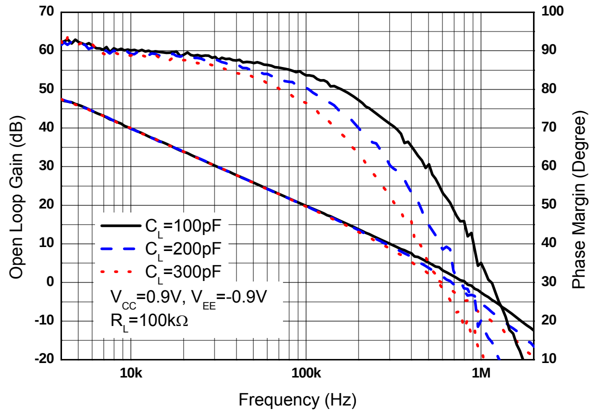


Figure 26. Gain and Phase vs. Frequency and Capacitive Load

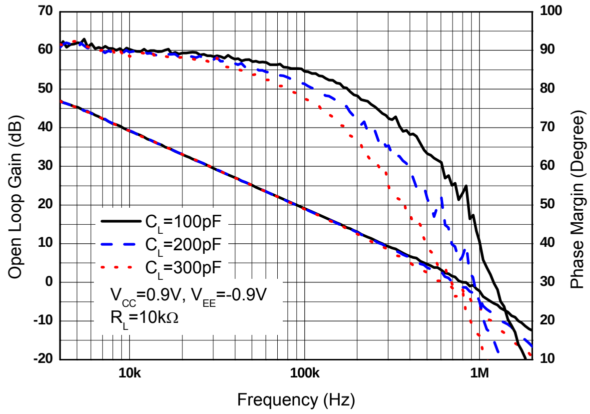


Figure 27. Gain and Phase vs. Frequency and Capacitive Load

Typical Performance Characteristics (Continued)

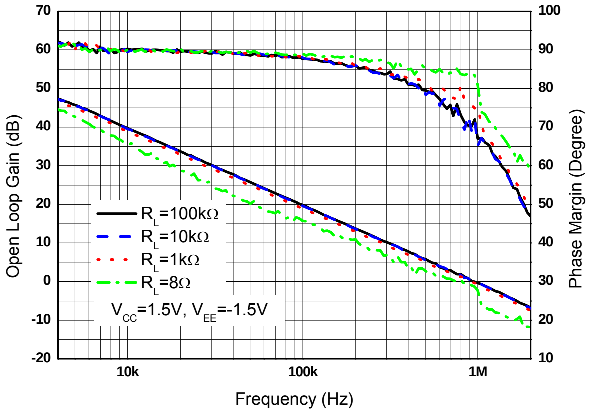


Figure 28. Gain and Phase vs. Frequency and Resistive Load

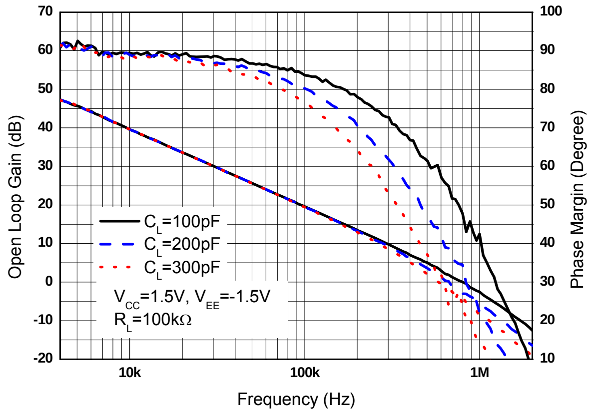


Figure 29. Gain and Phase vs. Frequency and Capacitive Load

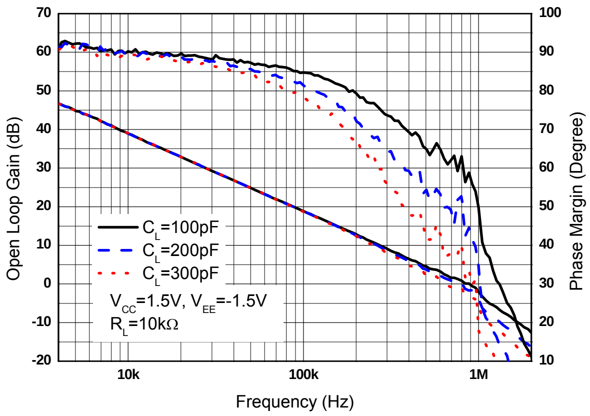


Figure 30. Gain and Phase vs. Frequency and Capacitive Load

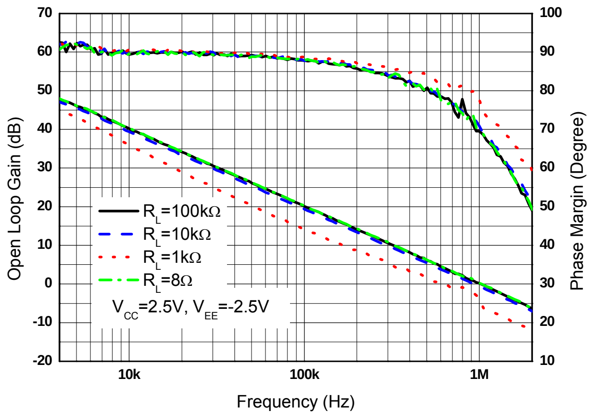


Figure 31. Gain and Phase vs. Frequency and Resistive Load

Typical Performance Characteristics (Continued)

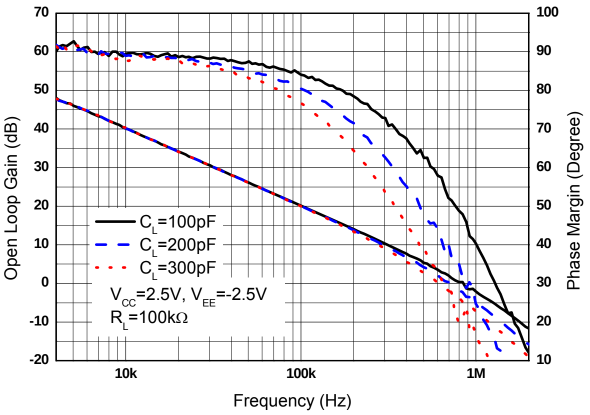


Figure 32. Gain and Phase vs. Frequency and Capacitive Load

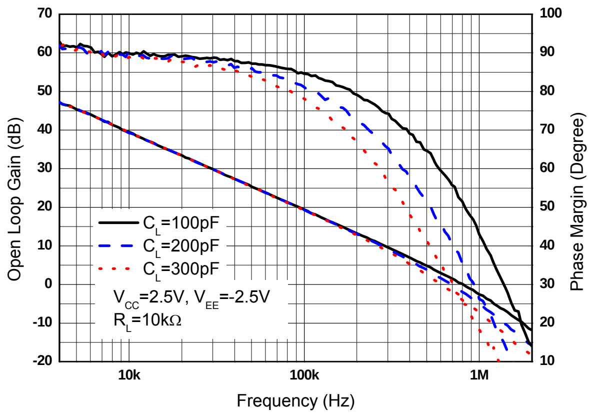


Figure 33. Gain and Phase vs. Frequency and Capacitive Load

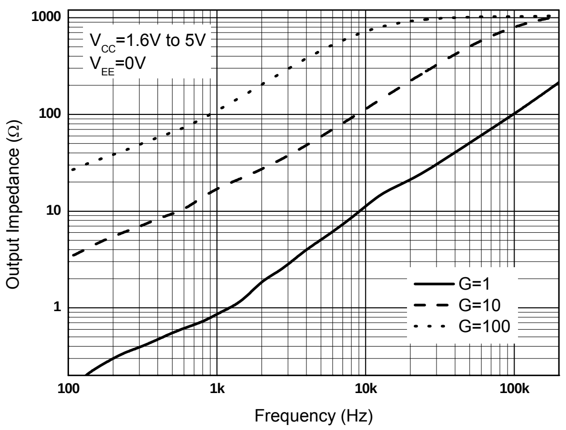


Figure 34. Output Impedance vs. Frequency

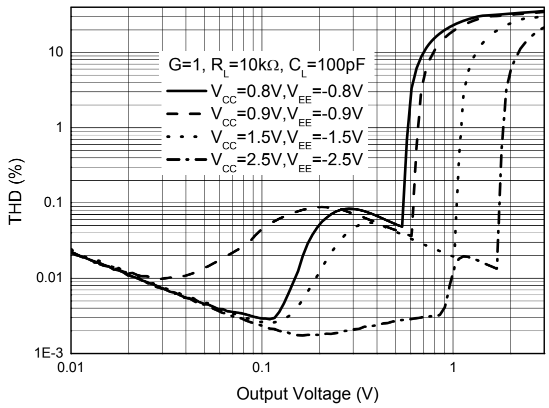


Figure 35. THD+N vs. Output Voltage

Typical Performance Characteristics (Continued)

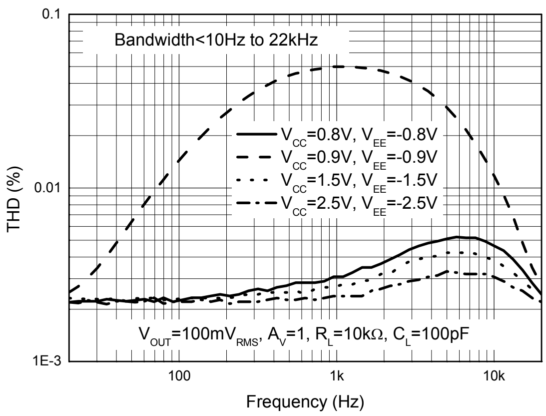


Figure 36. THD+N vs. Frequency

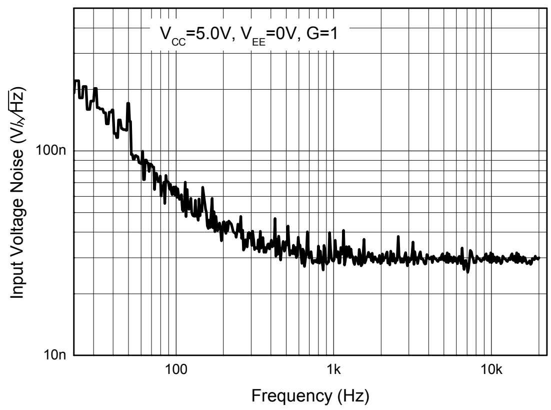


Figure 37. Input Voltage Noise Density

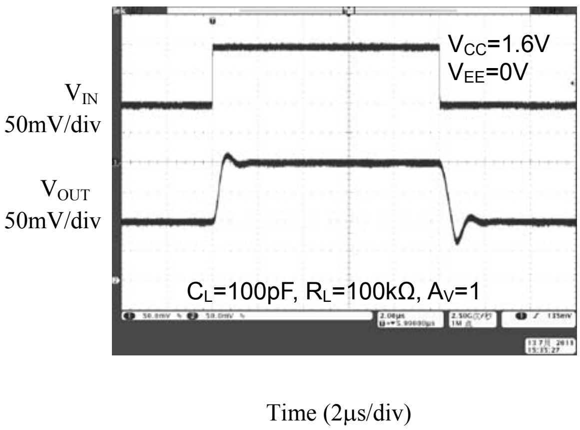


Figure 38. Small Signal Pulse Response

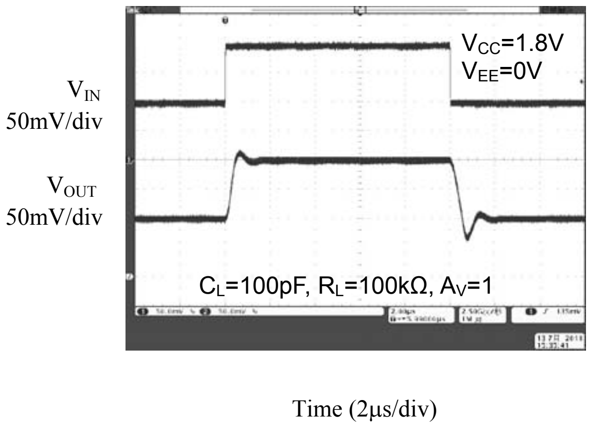


Figure 39. Small Signal Pulse Response

Typical Performance Characteristics (Continued)

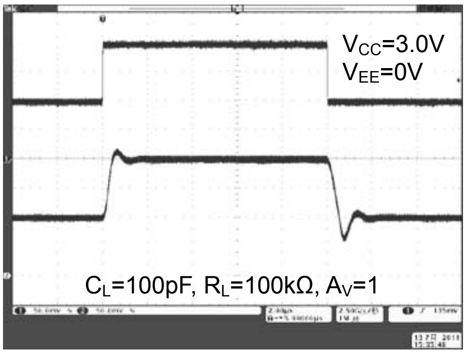


Figure 40. Small Signal Pulse Response

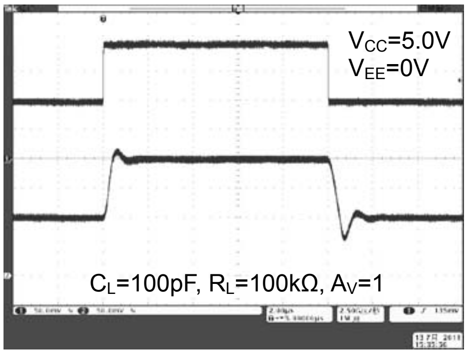


Figure 41. Small Signal Pulse Response

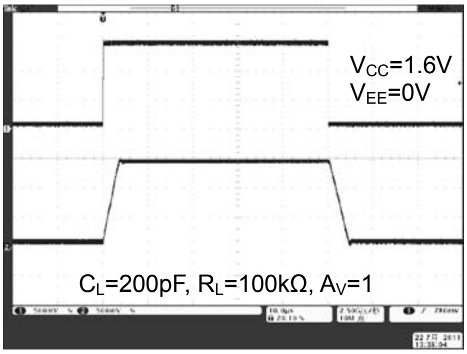


Figure 42. Large Signal Pulse Response

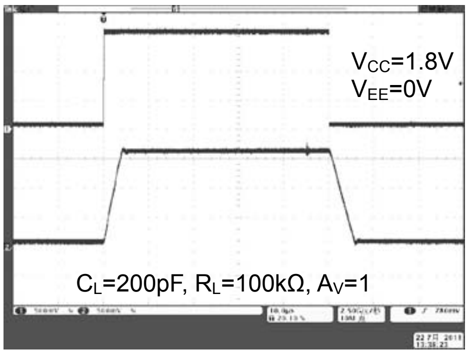


Figure 43. Large Signal Pulse Response

Typical Performance Characteristics (Continued)

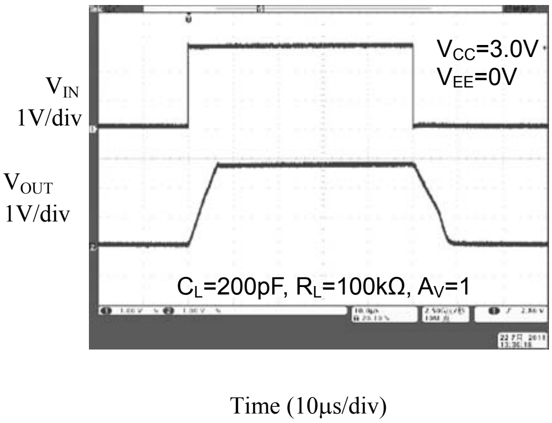


Figure 44. Large Signal Pulse Response

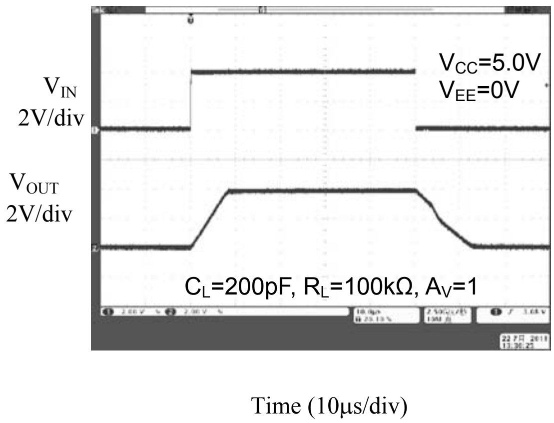


Figure 45. Large Signal Pulse Response

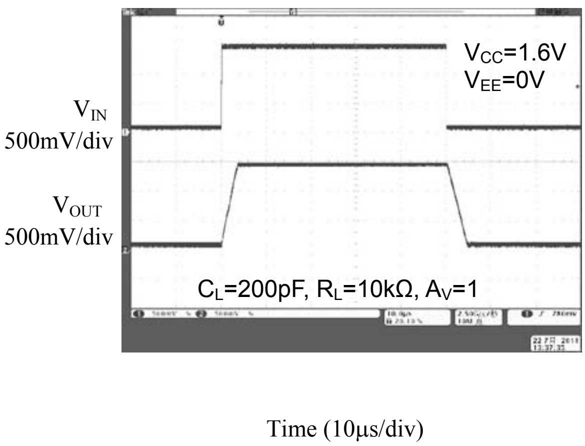


Figure 46. Large Signal Pulse Response

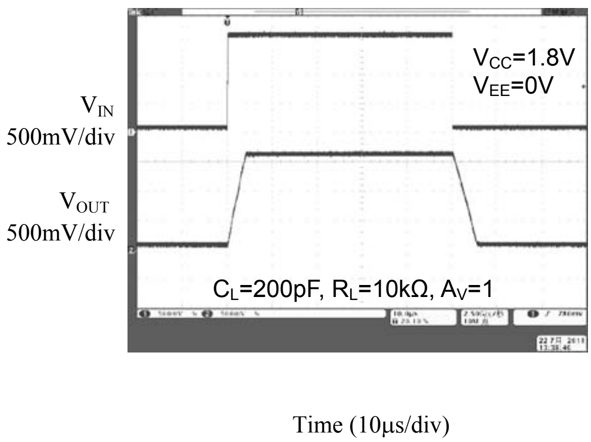


Figure 47. Large Signal Pulse Response

Typical Performance Characteristics (Continued)

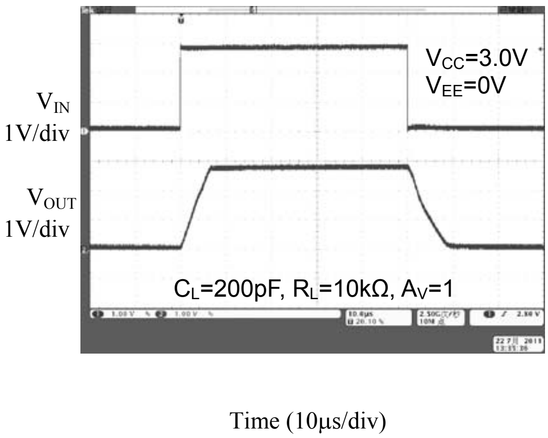


Figure 48. Large Signal Pulse Response

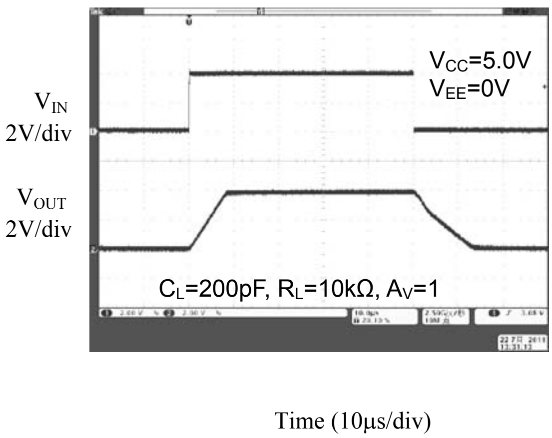


Figure 49. Large Signal Pulse Response

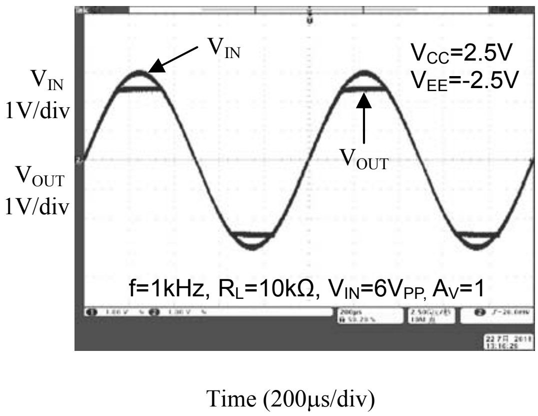


Figure 50. No phase Reversal

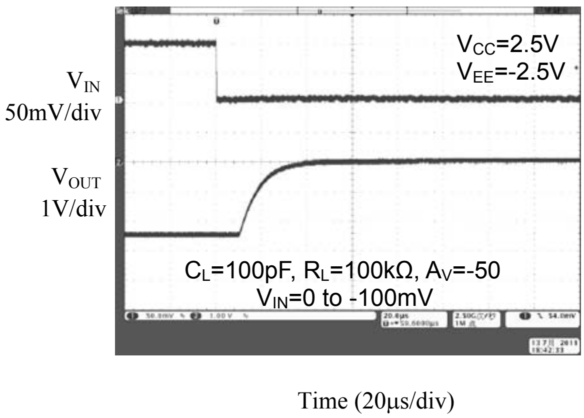


Figure 51. Overload Recovery Time

Typical Performance Characteristics (Continued)

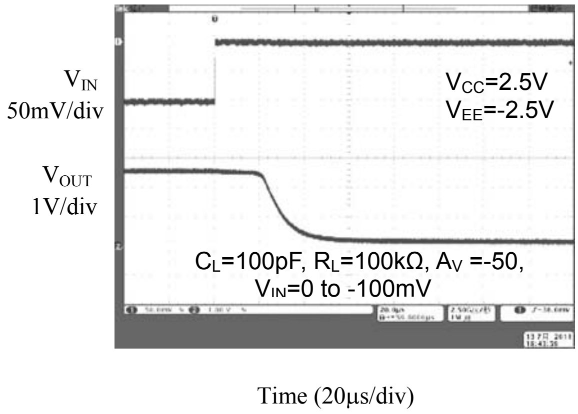
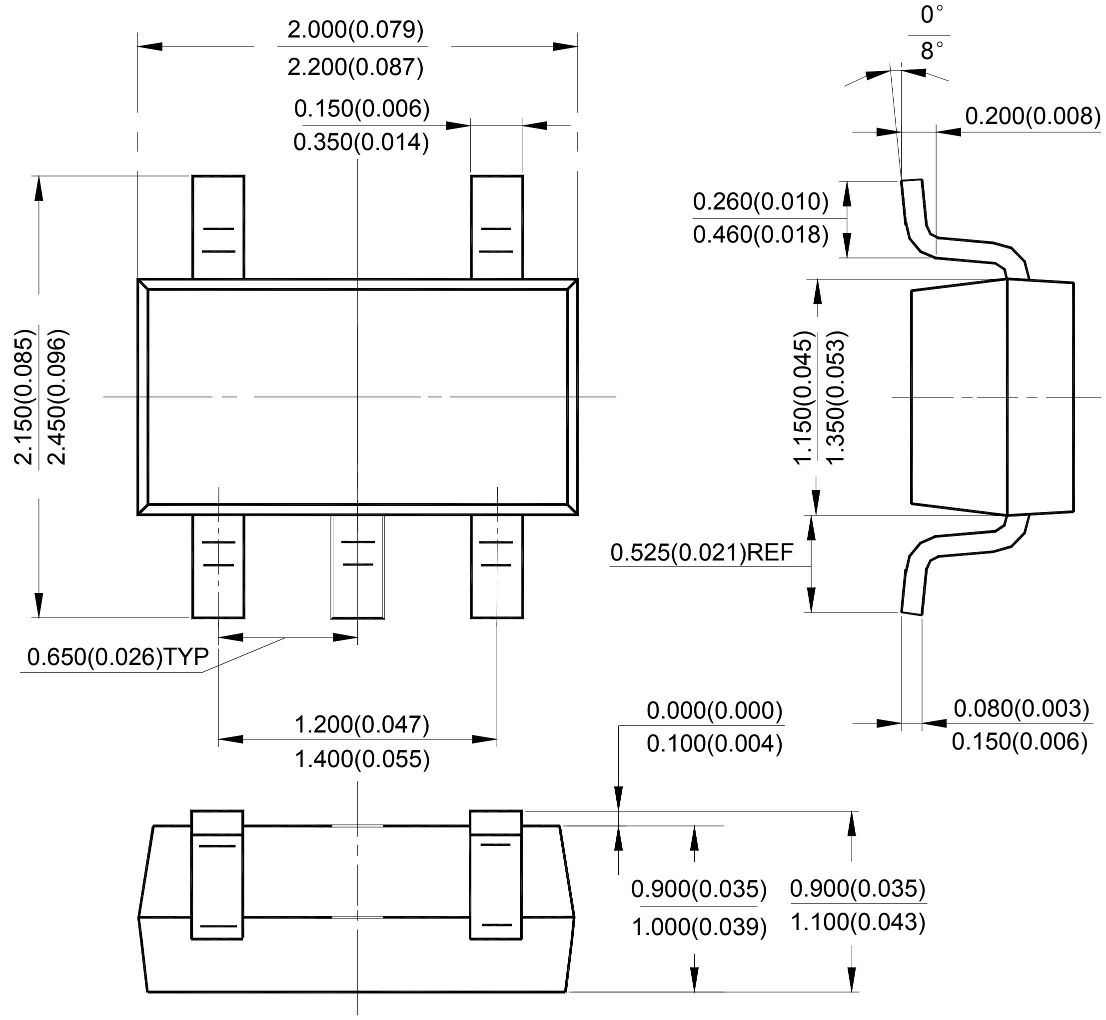


Figure 52. Overload Recovery Time

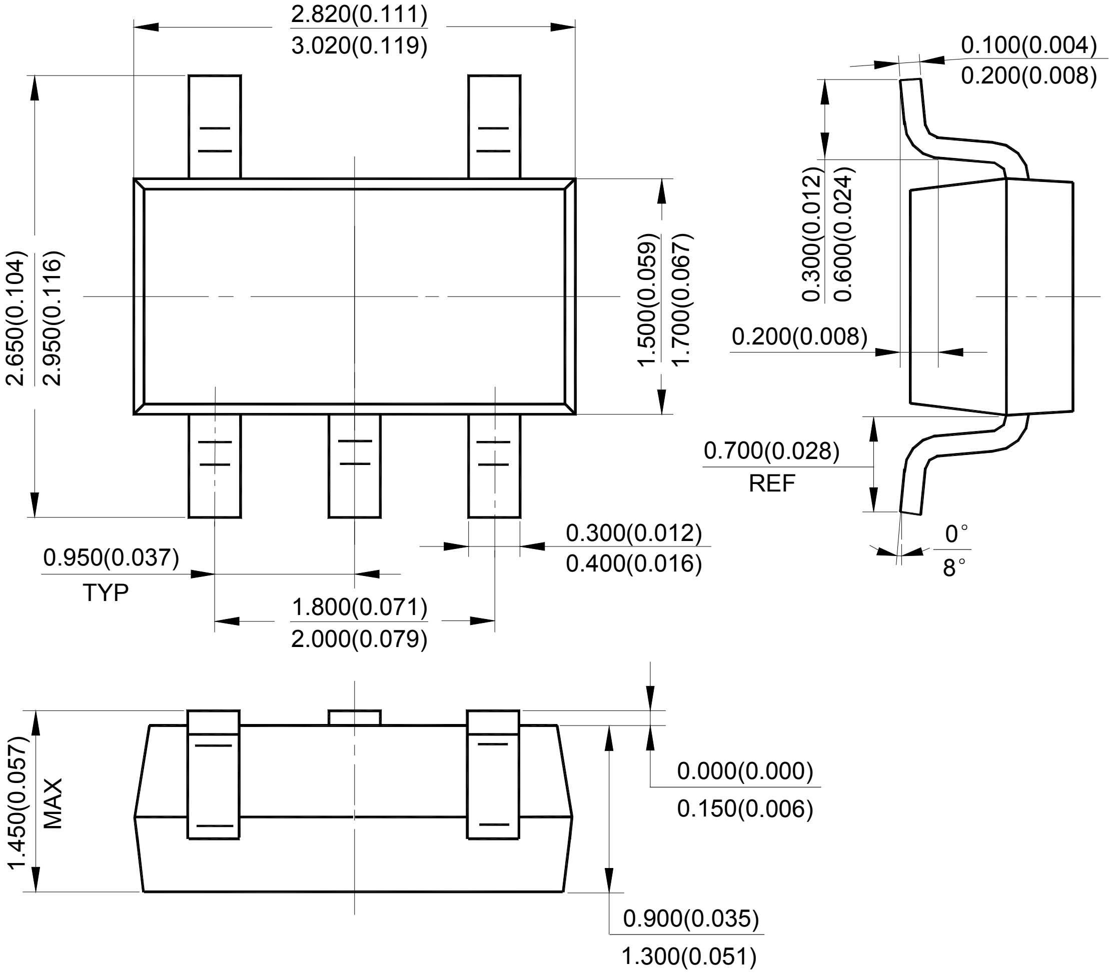
Mechanical Dimensions

SC-70-5 **Unit: mm(inch)**



Mechanical Dimensions (Continued)

SOT-23-5 **Unit: mm(inch)**



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