LMV982

Dual Low Voltage, Rail-to-Rail Input and Output, Operational Amplifier with Shutdown

The LMV982 Dual is a low−voltage operational amplifier which can operate on single−sided power supplies (1.8 V to 5.0 V) with rail−to−rail input and output swing. This device comes in a small state−of−the−art package and requires very low quiescent current making it ideal for battery−operated, portable applications such as notebook computers and hand−held instruments. Rail−to−Rail operation allows for optimal signal−to−noise applications plus the small package allows for closer placement to signal sources further enhancing overall signal chain performance.

The LMV982 Dual has a shutdown pin that can be used to disable the device and further reduce power consumption. Shutdown is implemented by driving the $\overline{\text{SHDN}}$ Pin LOW.

Features

- Specified at Single−Sided Power Supply: 1.8 V, 2.7 V, and 5 V
- Small Package:
  LMV982 in a UQFN10 (1.4mm x 1.8mm x 0.6 mm)
- No Output Crossover Distortion
- Extended Industrial Temperature Range: −40°C to +125°C
- Low Quiescent Current 210 μA, max per channel
- No Output Phase−Reversal from Overdriven Input
- These are Pb−Free Devices

Typical Applications

- Notebook Computers, Portable Battery−Operated Instruments, PDA's
- Active Filters, Supply−Current Monitoring

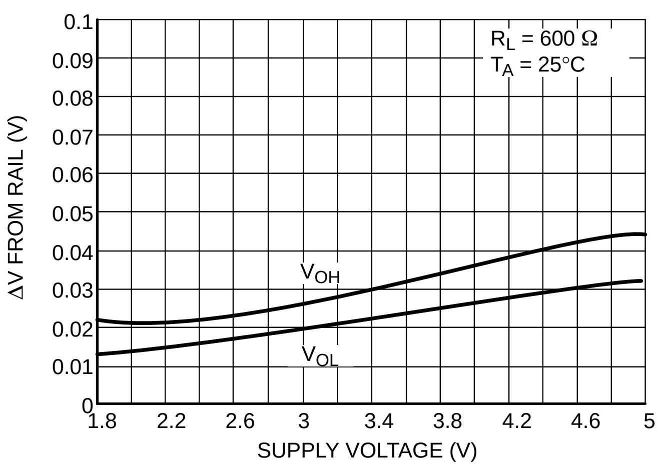
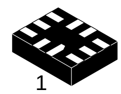


Figure 1. Output Voltage Swing vs. Supply Voltage

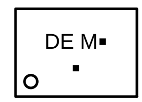
ON Semiconductor®

www.onsemi.com

MARKING DIAGRAMS



UQFN10
CASE 488AT



LMV982 (Dual)

A = Assembly Location
Y = Year
W = Work Week
▪ = Pb−Free Package
(Note: Microdot may be in either location)

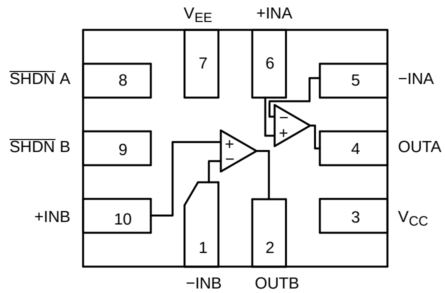
ORDERING INFORMATION

Device	Package	Shipping†
LMV982MUTAG	UQFN10 (Pb−Free)	3,000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

PIN CONNECTIONS

UQFN10



(Top View)

*Consult sales for package availability

MAXIMUM RATINGS

Symbol	Rating	Value	Unit
V_S	Supply Voltage (Operating Range V_S = 1.8 V to 5.5 V)	5.5	V
V_{IDR}	Input Differential Voltage	± Supply Voltage	V
V_{ICR}	Input Common Mode Voltage Range	−0.5 to (V+) + 0.5	V
	Maximum Input Current	10	mA
t_{So}	Output Short Circuit (Note 1)	Continuous	
T_J	Maximum Junction Temperature (Operating Range −40°C to 85°C)	150	°C
θ_{JA}	Thermal Resistance UQFN10	300	°C/W
T_{stg}	Storage Temperature	−65 to 150	°C
	Mounting Temperature (Infrared or Convection −30 sec)	260	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

ESD data available upon request.

1. Continuous short−circuit operation to ground at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C. Output currents in excess of 45 mA over long term may adversely affect reliability. Shorting output to either V+ or V− will adversely affect reliability.

1.8 V DC ELECTRICAL CHARACTERISTICS Unless otherwise noted, all min/max limits are guaranteed for T_A = 25°C, V^+ = 1.8 V, V^- = 0 V, V_{CM} = V+/2, V_O = V^+/2 and R_L > 1 MΩ. Typical specifications represent the most likely parametric norm.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
		−40°C to +125°C		1	7.5	
Input Offset Voltage Average Drift	TCV_{IO}			5.5		μV/°C
Input Bias Current (Note 2)	I_B	−40°C to +125°C		< 1		nA
Input Offset Current (Note 2)	I_{IO}	−40°C to +125°C		< 1		nA
Supply Current (per Channel)	I_{CC}	In Active Mode		75	185	μA
		−40°C to +125°C			205	
		In Shutdown:			3.5	
		−40°C to +125°C			5.0	
Common Mode Rejection Ratio	CMRR	0 V ≤ V_{CM} ≤ 0.6 V, 1.4 V ≤ V_{CM} ≤ 1.8 V		40		dB
		− 40°C to +125°C		40		
		−0.2 V ≤ V_{CM} ≤ 0 V, 1.8 V ≤ V_{CM} ≤ 2 V		40		
Power Supply Rejection Ratio	PSRR	1.8 V ≤ V^+ ≤ 5 V, V_{CM} = 0.5 V	50	70		dB
		−40°C to +125°C	50			
Input Common−Mode Voltage Range	VCM	For CMRR ≥ 50 dB and T_A = 25°C	V^- − 0.2	−0.2 to 2.1	V^+ + 0.2	V
		For CMRR ≥ 50 dB and T_A = − 40°C to +85°C	V^-		V^+	
		For CMRR ≥ 50 dB and T_A = − 40°C to +125°C	V^- + 0.2		V^+ − 0.2	
Large Signal Voltage Gain LMV982 (Dual) (Note 2)		R_L = 600 Ω to 0.9 V, V_O = 0.2 V to 1.6 V, V_{CM} = 0.5 V	75	90		
		−40°C to +125°C	72			
		R_L = 2 kΩ to 0.9 V, V_O = 0.2 V to 1.6 V, V_{CM} = 0.5 V	78	100		
		−40°C to +125°C	75			
Output Swing	V_{OH}	R_L = 600 Ω to 0.9V, V_{IN} = ±100 mV	1.65	1.72		V
		−40°C to +125°C	1.63			
	V_{OL}	R_L = 600 Ω to 0.9V, V_{IN} = ±100 mV		0.077	0.105	
		−40°C to +125°C			0.12	
	V_{OH}	R_L = 2 kΩ to 0.9V, V_{IN} = ±100 mV	1.75	1.77		
		−40°C to +125°C	1.74			
	V_{OL}	R_L = 2 kΩ to 0.9 V, V_{IN} = ±100 mV		0.24	0.035	
		−40°C to +125°C			0.04	
Output Short Circuit Current	I_O	Sourcing, Vo = 0 V, V_{IN} = +100 mV	4.0	30		mA
		−40°C to +125°C	3.3			
		Sinking, Vo = 1.8V, V_{IN} = −100 mV	7.0	60		
		−40°C to +125°C	5.0			
$\overline{\text{Shutdown}}$ Enable Control	V_{SHDN}	Turn−on Voltage to Enable Device		1.0		V
		Turn−off Voltage to Shutdown Device		0.55		

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Guaranteed by design and/or characterization.

1.8V AC ELECTRICAL CHARACTERISTICS Unless otherwise specified, all limits are guaranteed for T_A = 25°C, V+ = 1.8 V, V− = 0 V, V_{CM} = 2.0 V,Vo = V+/2 and R_L > 1 MΩ. Typical specifications represent the most likely parametric norm. Min/Max specifications are guaranteed by testing, characterization, or statistical analysis.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Slew Rate	SR	(Note 3)		0.35		V/μs
Gain Bandwidth Product	GBWP			1.4		MHz
Phase Margin	Θm			67		°
Gain Margin	Gm			7		dB
Input−Referred Voltage Noise	e_n	f = 50 kHz, V_{CM} = 0.5 V		60		$nV/\sqrt{Hz}$
Total Harmonic Distortion	THD	f = 1 kHz, A_V = +1, R_L = 600 Ω, V_O = 1 V_{PP}		0.023		%
Amplifier−to−Amplifier Isolation		(Note 4)		123		dB

3. Connected as voltage follower with input step from V− to V+. Number specified is the slower of the positive and negative slew rates.
4. Input referred, R_L = 100 kΩ connected to V+/2. Each amp excited in turn with 1 kHz to produce V_O = 3 V_{PP}. (For Supply Voltages < 3 V, V_O = V+).

2.7V DC ELECTRICAL CHARACTERISTICS Unless otherwise noted, all min/max limits are guaranteed for T_A = 25°C, V^+ = 2.7 V, V^- = 0 V, V_{CM} = V+/2, V_O = V^+/2 and R_L > 1 MΩ. Typical specifications represent the most likely parametric norm.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
		−40°C to +125°C		1	7.5	
Input Offset Voltage Average Drift	TCV_{IO}			5.5		μV/°C
Input Bias Current (Note 5)	I_B	−40°C to +125°C		< 1		nA
Input Offset Current (Note 5)	I_{IO}	−40°C to +125°C		< 1		nA
Supply Current (per Channel)	I_{CC}	In Active Mode		80	190	μA
		−40°C to +125°C			210	
		In Shutdown:			3.5	
		−40°C to +125°C			5.0	
Common Mode Rejection Ratio	CMRR	0 V ≤ V_{CM} ≤ 1.5 V, 2.3 V ≤ V_{CM} ≤ 2.7 V	50	70		dB
		−40°C to +125°C	50			
		−0.2 V ≤ V_{CM} ≤ 0 V, 2.7 V ≤ V_{CM} ≤ 2.9 V	50	70		
Power Supply Rejection Ratio	PSRR	1.8 V ≤ V^+ ≤ 5 V, V_{CM} = 0.5 V	50	70		dB
		−40°C to +125°C	50			
Input Common−Mode Voltage Range	VCM	For CMRR ≥ 50 dB and T_A = 25°C	V− − 0.2	−0.2 to 3.0	V+ + 0.2	V
		For CMRR ≥ 50 dB and T_A = −40°C to +85°C	V^-		V^+	
		For CMRR ≥ 50 dB and T_A = −40°C to +125°C	V− + 0.2		V^+ − 0.2	
Large Signal Voltage Gain LMV982 (Dual) (Note 5)	A_V	R_L = 600 Ω to 1.35 V, V_O = 0.2 V to 2.5 V	78	90		
		−40°C to +125°C	75			
		R_L= 2 kΩ to 1.35 V, V_O = 0.2 V to 2.5 V	81	100		
		−40°C to +125°C	78			
Output Swing	V_{OH}	R_L = 600 Ω to 1.35 V, V_{IN} = ±100 mV	2.55	2.62		V
		−40°C to +125°C	2.53			
	V_{OL}	R_L = 600 Ω to 1.35 V, V_{IN} = ±100 mV		0.083	0.11	
		−40°C to +125°C			0.13	
	V_{OH}	R_L = 2 kΩ to 1.35 V, V_{IN} = ±100 mV	2.65	2.675		
		−40°C to +125°C	2.64			
	V_{OL}	R_L = 2 kΩ to 1.35 V, V_{IN} = ±100 mV		0.025	0.04	
		−40°C to +125°C			0.045	
Output Short Circuit Current	I_O	Sourcing, Vo = 0 V, V_{IN} = ±100 mV	20	65		mA
		−40°C to +125°C	15			
		Sinking, Vo = 0 V, V_{IN} = −100 mV	18	75		
		−40°C to +125°C	12			
$\overline{\text{Shutdown}}$ Enable Control	V_{SHDN}	Turn−on Voltage to Enable Device		1.9		V
		Turn−off Voltage to Shutdown Device		0.55		

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

5. Guaranteed by design and/or characterization.

2.7V AC ELECTRICAL CHARACTERISTICS Unless otherwise specified, all limits are guaranteed for T_A = 25°C, V+ = 2.7 V, V− = 0 V, V_{CM} = 2.0V ,Vo = V+/2 and R_L > 1 MΩ. Typical specifications represent the most likely parametric norm. Min/Max specifications are guaranteed by testing, characterization, or statistical analysis.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Slew Rate	SR	(Note 6)		0.4		V/μs
Gain Bandwidth Product	GBWP			1.4		MHz
Phase Margin	Θm			70		°
Gain Margin	Gm			7.5		dB
Input−Referred Voltage Noise	e_n	f = 50 kHz, V_{CM} = 1.0 V		57		$nV/\sqrt{Hz}$
Total Harmonic Distortion	THD	f = 1 kHz, A_V = +1, R_L = 600 Ω, V_O = 1 V_{PP}		0.022		%
Amplifier−to−Amplifier Isolation		(Note 7)		123		dB

6. Connected as voltage follower with input step from V− to V+. Number specified is the slower of the positive and negative slew rates.
7. Input referred, R_L = 100 kΩ connected to V+/2. Each amp excited in turn with 1 kHz to produce V_O = 3 V_{PP}. (For Supply Voltages < 3 V, V_O = V+).

5V DC ELECTRICAL CHARACTERISTICS Unless otherwise noted, all min/max limits are guaranteed for T_A = 25°C, V^+ = 5 V, V^- = 0 V, V_{CM} = V+/2, V_O = V^+/2 and R_L > 1 MΩ. Typical specifications represent the most likely parametric norm.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
		−40°C to +125°C		1	7.5	
Input Offset Voltage Average Drift	TCV_{IO}			5.5		μV/°C
Input Bias Current (Note 8)	I_B	−40°C to +125°C		< 1		nA
Input Offset Current (Note 8)	I_{IO}	−40°C to +125°C		< 1		nA
Supply Current (per Channel)	I_{CC}	In Active Mode		95	210	μA
		−40°C to +125°C			230	
		In Shutdown:			3.5	
		−40°C to +125°C			5.0	
Common−Mode Rejection Ratio	CMRR	0 V ≤ V_{CM} ≤ 3.8 V, 4.6 V ≤ V_{CM} ≤ 5.0 V	50	70		dB
		−40°C to +125°C	50			
		−0.2 V ≤ V_{CM} ≤ 0 V, 5.0 V ≤ V_{CM} ≤ 5. 2V	50	70		
Power Supply Rejection Ratio	PSRR	1.8 V ≤ V^+ ≤ 5 V, V_{CM} = 0.5 V	50	70		dB
		−40°C to +125°C	50			
Input Common−Mode Voltage Range	VCM	For CMRR ≥ 50 dB and T_A = 25°C	V^- − 0.2	−0.2 to 5.3	V^+ + 0.2	V
		For CMRR ≥ 50 dB and T_A = −40°C to +85°C	V^-		V^+	
		For CMRR ≥ 50 dB and T_A = −40°C to +125°C	V^- + 0.3		V^+ − 0.3	
Large Signal Voltage Gain LMV982 (Dual) (Note 8)	A_V	R_L = 600 Ω to 2.5 V, V_O = 0.2 V to 4.8 V	81	90		
		−40°C to +125°C	78			
		R_L = 2 kΩ to 2.5 V, V_O = 0.2 V to 4.8 V	85	100		
		−40°C to +125°C	82			
Output Swing	V_{OH}	R_L = 600 Ω to 2.5 V, V_{IN} = ±100 mV	4.855	4.89		V
		−40°C to +125°C	4.835			
	V_{OL}	R_L = 600 Ω to 2.5 V, V_{IN} = ±100 mV		0.12	0.16	
		−40°C to +125°C			0.18	
	V_{OH}	R_L = 2 kΩ to 2.5 V, V_{IN} = ±100 mV	4.945	4.967		
		−40°C to +125°C	4.935			
	V_{OL}	R_L = 2 kΩ to 2.5 V, V_{IN} = ±100 mV		0.037	0.065	
		−40°C to +125°C			0.075	
Output Short−Circuit Current	I_O	Sourcing, Vo = 0 V, V_{IN} = +100 mV	40	60		mA
		−40°C to +125°C	40			
		Sinking, Vo = 5 V, V_{IN} = −100 mV	45	65		
		−40°C to +125°C	45			
$\overline{\text{Shutdown}}$ Enable Control	V_{SHDN}	Turn−on Voltage to Enable Device		4.2		V
		Turn−off Voltage to Shutdown Device		0.55		

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

8. Guaranteed by design and/or characterization.

5V AC ELECTRICAL CHARACTERISTICS Unless otherwise specified, all limits are guaranteed for T_A = 25°C, V+ = 5 V, V− = 0 V, V_{CM} = 2.0 V,Vo = V+/2 and R_L > 1 MΩ. Typical specifications represent the most likely parametric norm.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Slew Rate	SR	(Note 9)		0.48		V/μs
Gain Bandwidth Product	GBWP			1.5		MHz
Phase Margin	Θm			65		°
Gain Margin	Gm			8		dB
Input−Referred Voltage Noise	e_n	f = 50 kHz, V_{CM} = 2 V		50		nV/$\sqrt{Hz}$
Total Harmonic Distortion	THD	f = 1 kHz, A_V = +1, R_L = 600 Ω, V_O = 1 V_{PP}		0.022		%
Amplifier−to−Amplifier Isolation		(Note 10)		123		dB

9. Connected as voltage follower with input step from V− to V+. Number specified is the slower of the positive and negative slew rates.
10. Input referred, R_L = 100 kΩ connected to V+/2. Each amp excited in turn with 1 kHz to produce V_O = 3 V_{PP}. (For Supply Voltages < 3 V, V_O = V+).

TYPICAL CHARACTERISTICS

(T_A = 25°C and V_S = 5 V unless otherwise specified)

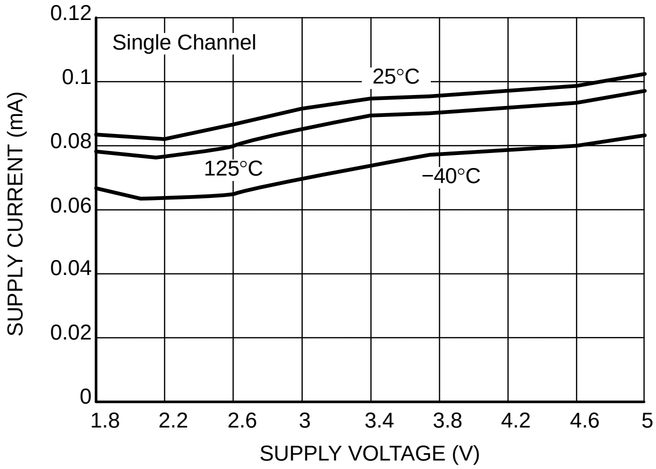


Figure 2. Supply Current vs. Supply Voltage

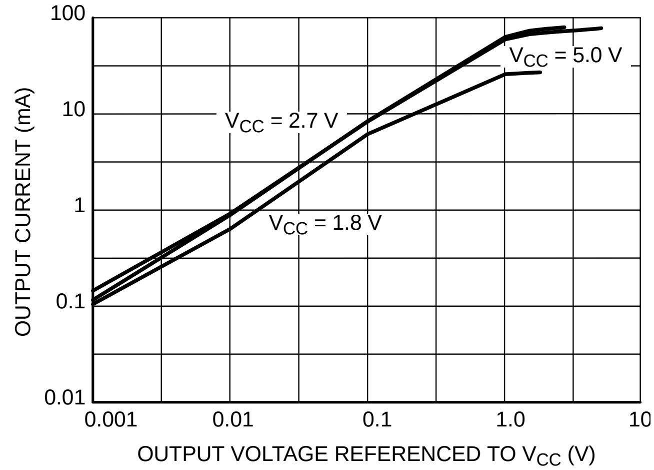


Figure 3. Sourcing Current vs. Output Voltage (T_A = 25°C)

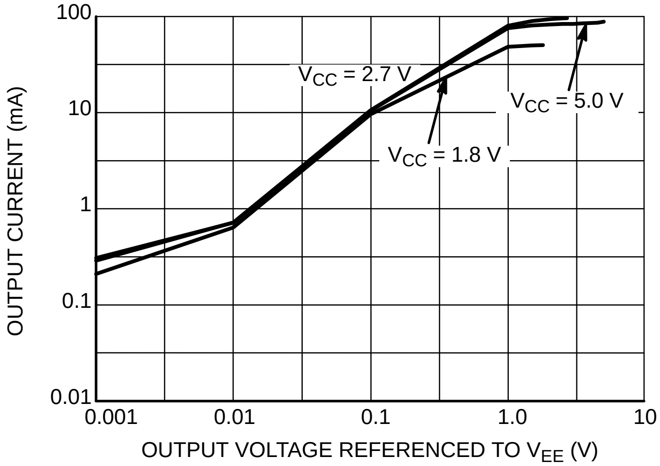


Figure 4. Sinking Current vs. Output Voltage (T_A = 25°C)

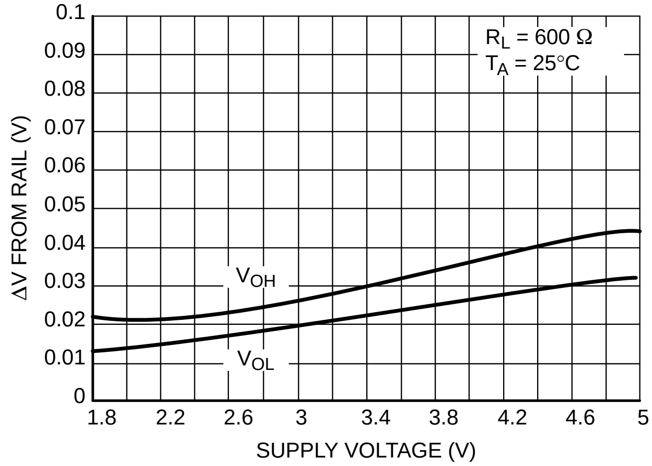


Figure 5. Output Voltage Swing vs. Supply Voltage

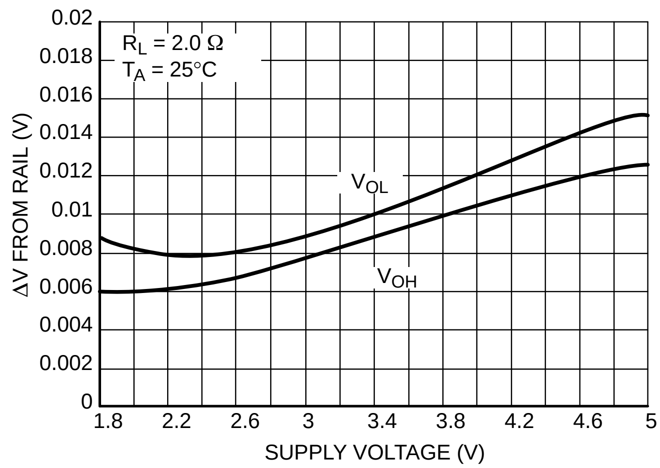


Figure 6. Output Voltage vs. Supply Voltage

TYPICAL CHARACTERISTICS

(T_A = 25°C and V_S = 5 V unless otherwise specified)

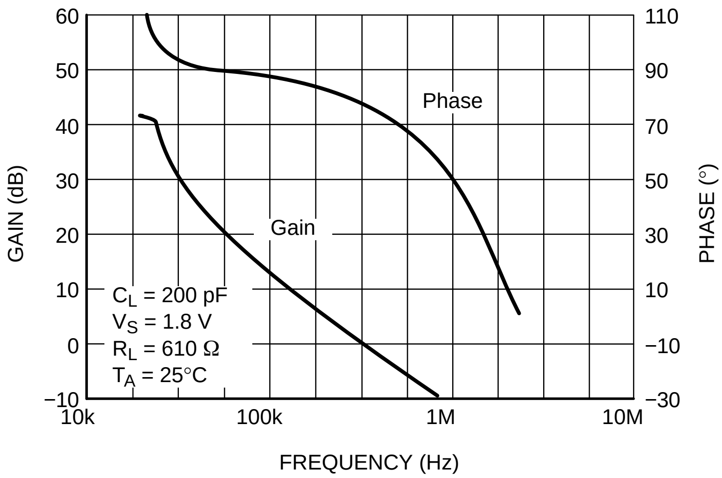


Figure 7. Gain and Phase vs. Frequency

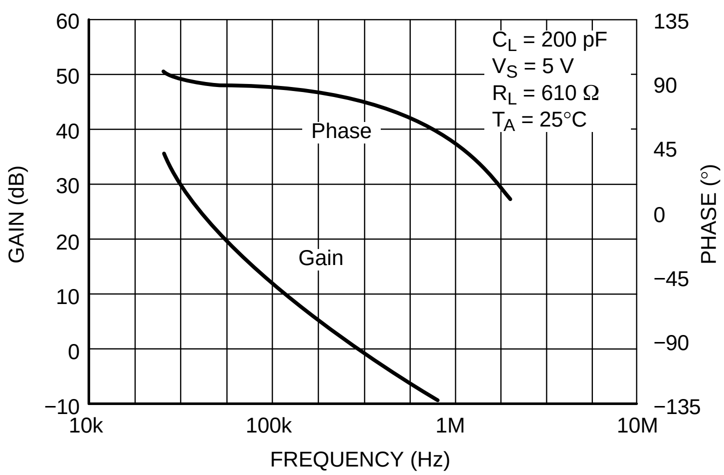


Figure 8. Gain and Phase vs. Frequency

TYPICAL CHARACTERISTICS

(T_A = 25°C and V_S = 5 V unless otherwise specified)

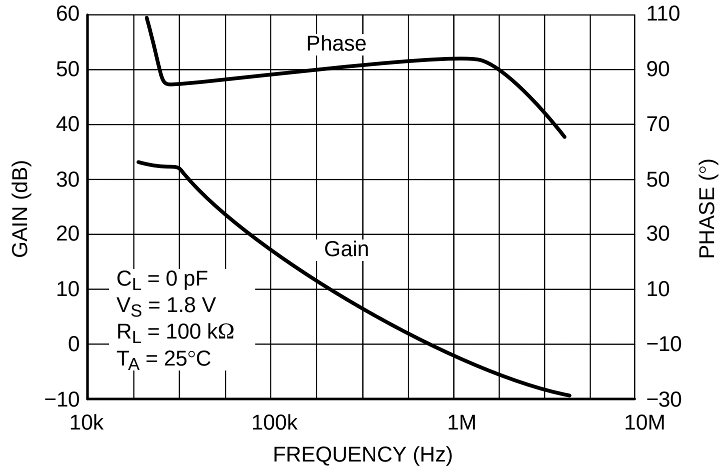


Figure 9. Gain and Phase vs. Frequency

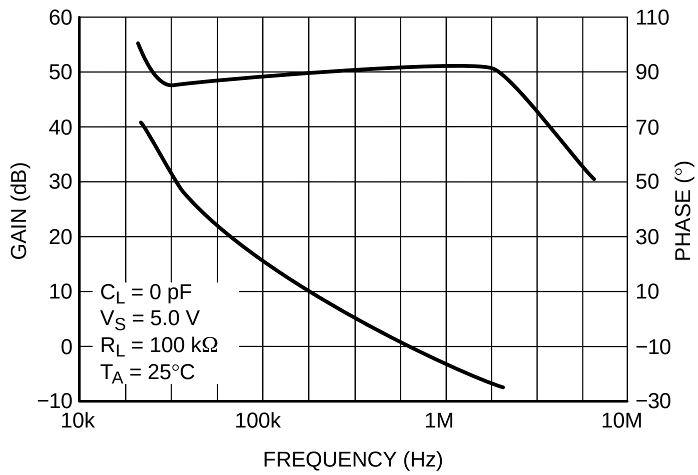


Figure 10. Gain and Phase vs. Frequency

TYPICAL CHARACTERISTICS

(T_A = 25°C and V_S = 5 V unless otherwise specified)

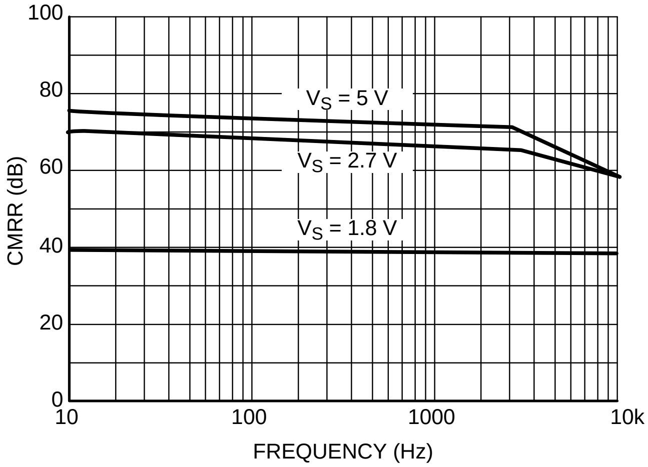


Figure 11. CMRR vs. Frequency

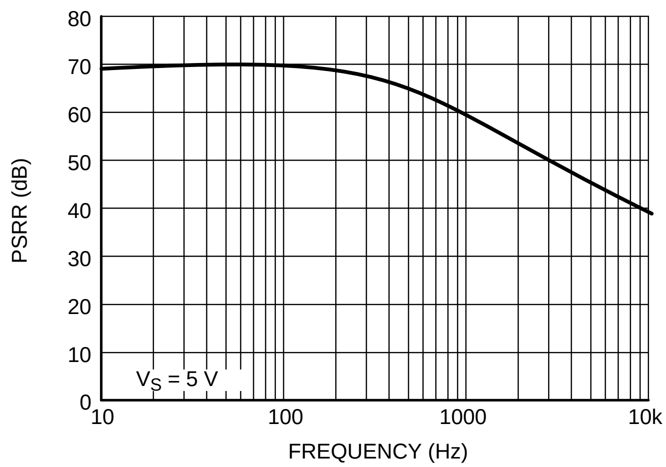


Figure 12. PSRR vs. Frequency

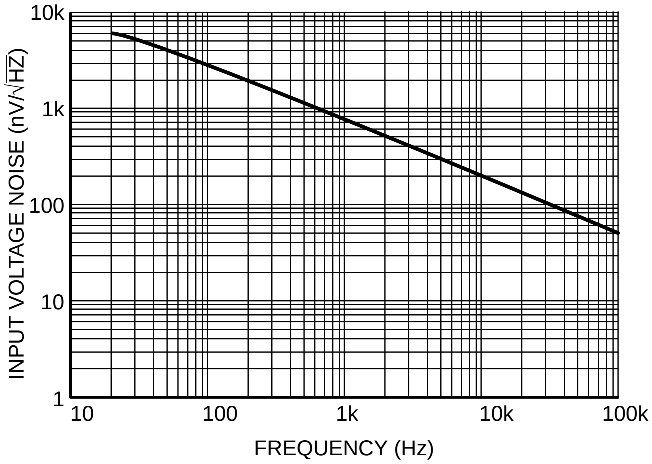


Figure 13. Input Voltage Noise vs. Frequency

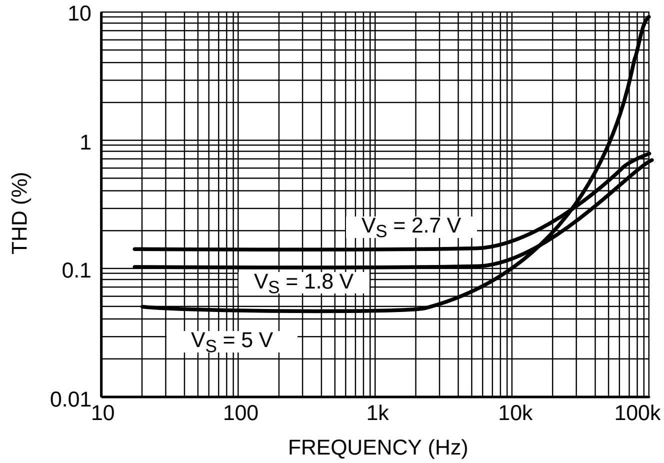


Figure 14. THD vs. Frequency

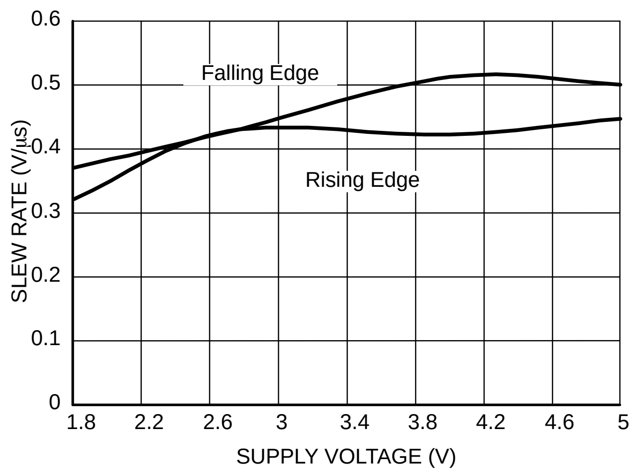
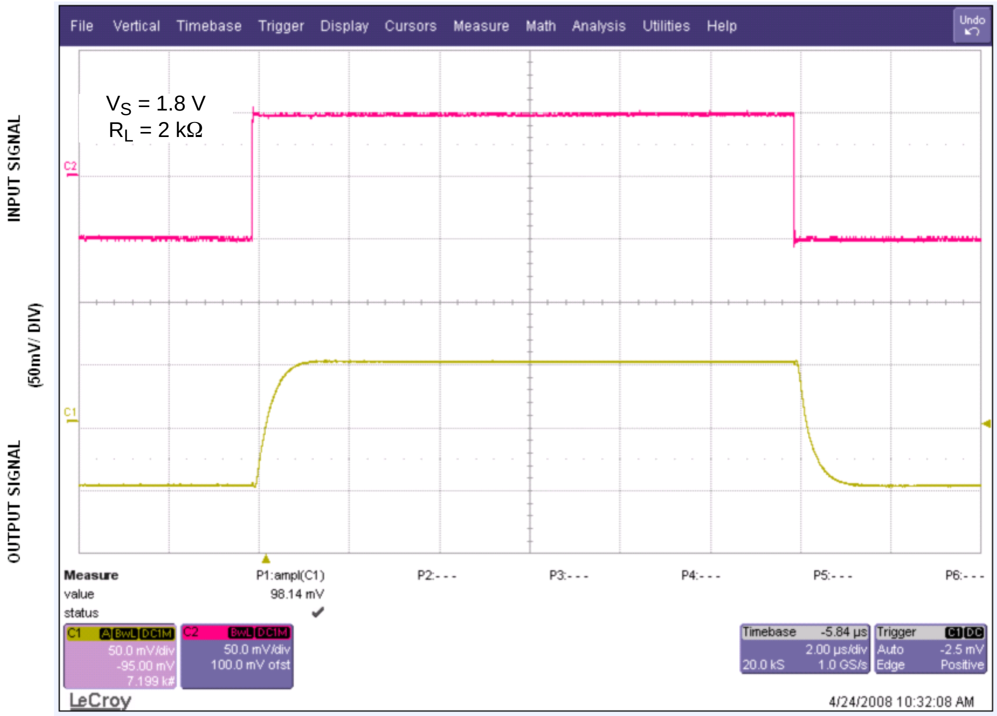


Figure 15. Slew Rate vs. Supply Voltage

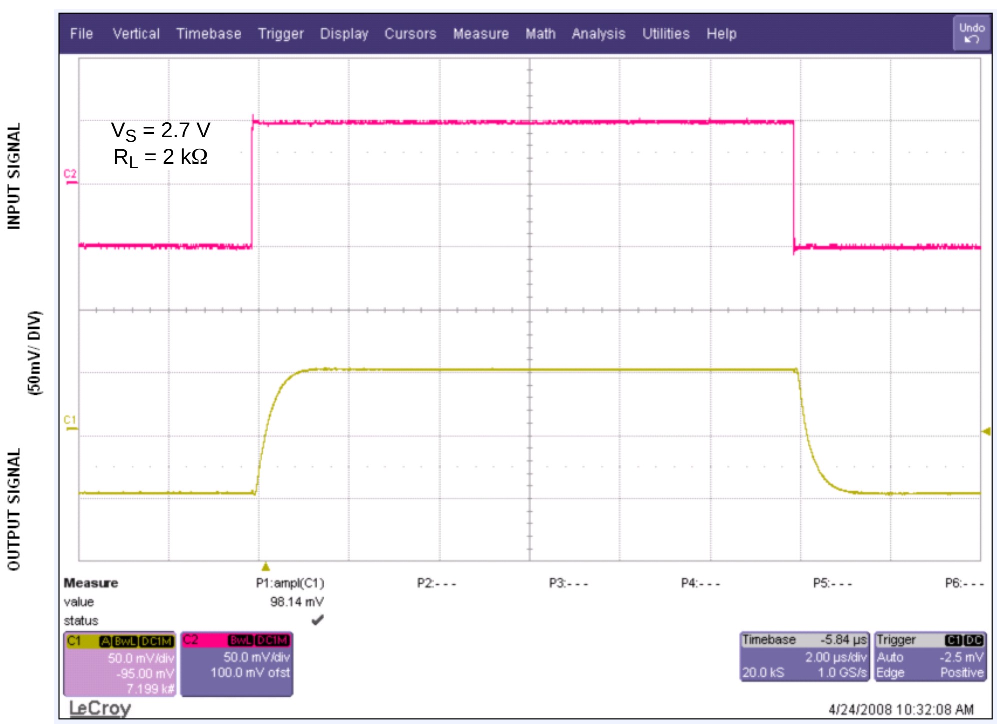
TYPICAL CHARACTERISTICS

(T_A = 25°C and V_S = 5 V unless otherwise specified)



TIME (2µs/div)

Figure 16. Small Signal Noninverting Response



TIME (2µs/div)

Figure 17. Small Signal Noninverting Response

TYPICAL CHARACTERISTICS

(T_A = 25°C and V_S = 5 V unless otherwise specified)

TIME (2µs/div)

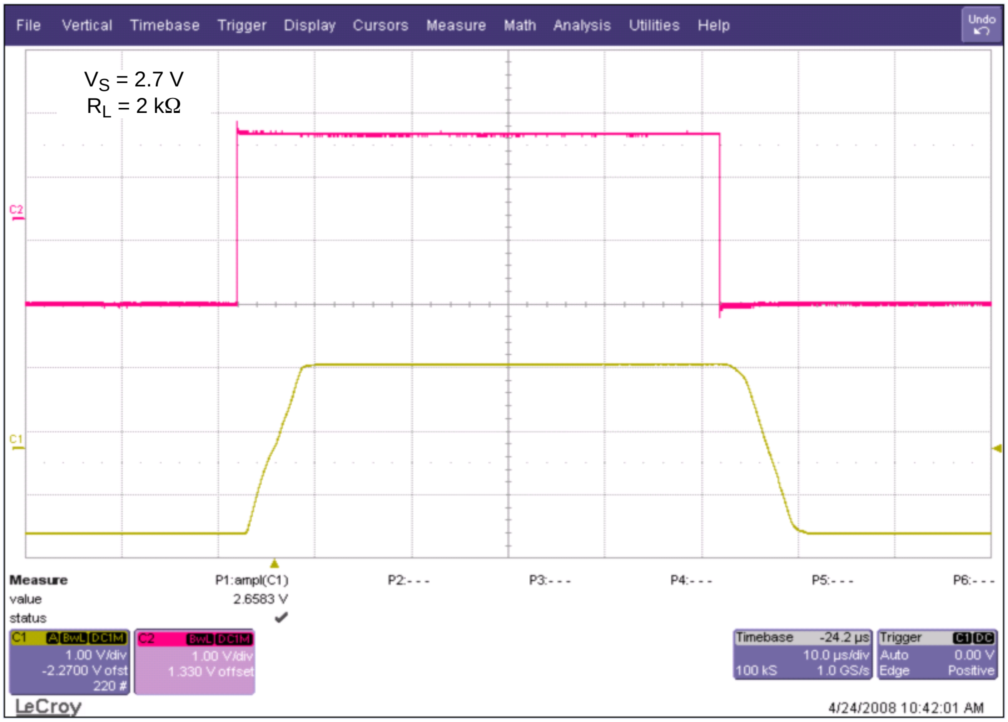
Figure 18. Small Signal Noninverting Response

TIME (2µs/div)

Figure 19. Large Signal Noninverting Response

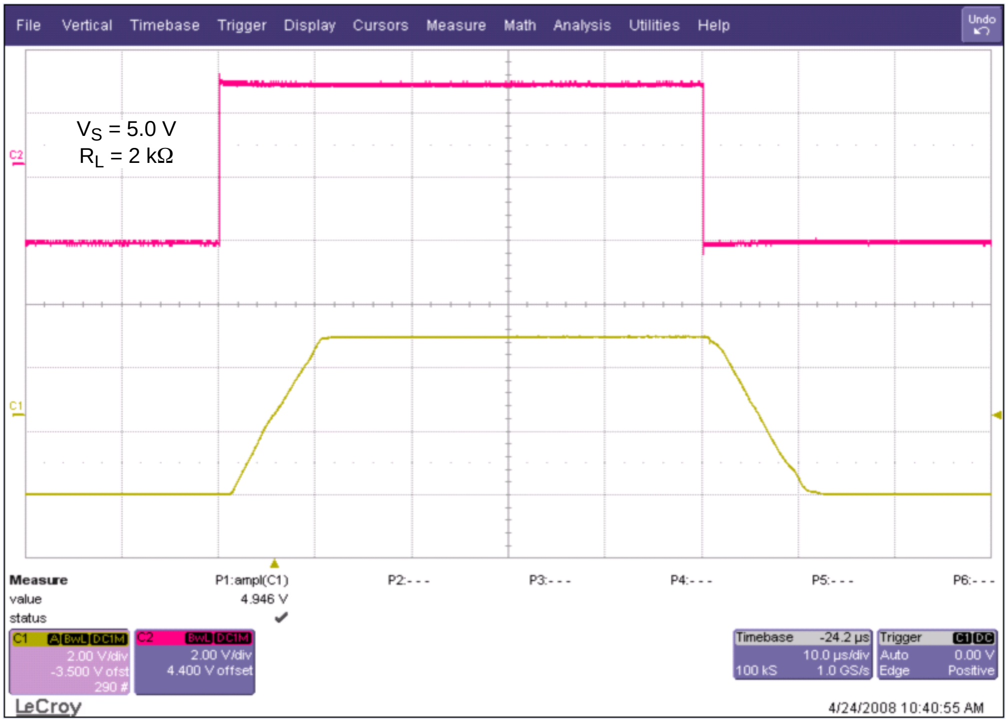
TYPICAL CHARACTERISTICS

(T_A = 25°C and V_S = 5 V unless otherwise specified)



TIME (2μs/div)

Figure 20. Large Signal Noninverting Response



TIME (2μs/div)

Figure 21. Large Signal Noninverting Response

TYPICAL CHARACTERISTICS

(T_A = 25°C and V_S = 5 V unless otherwise specified)

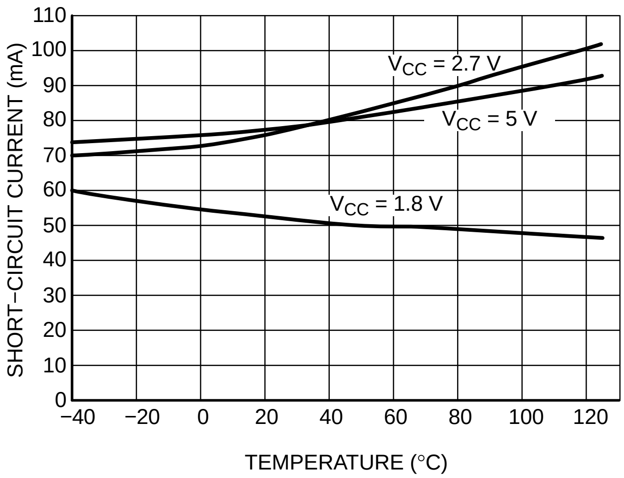


Figure 22. Short−Circuit vs. Supply Voltage (Sinking)

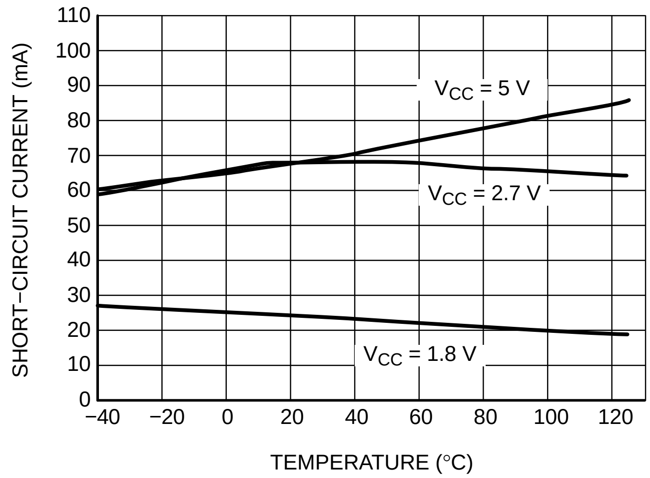


Figure 23. Short−Circuit vs. Supply Voltage (Sourcing)

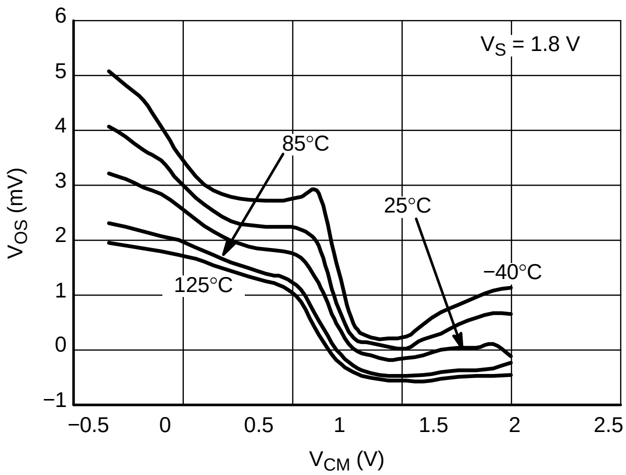


Figure 24. Offset Voltage vs. Common Mode Range V_{DD} 1.8 V

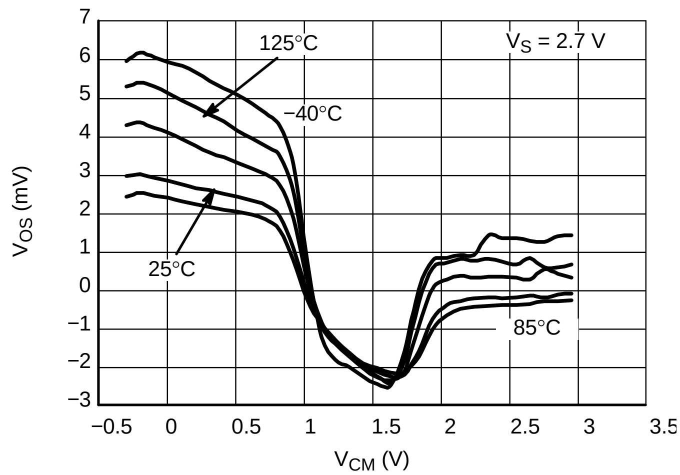


Figure 25. Offset Voltage vs. Common Mode Range V_{DD} 2.7 V

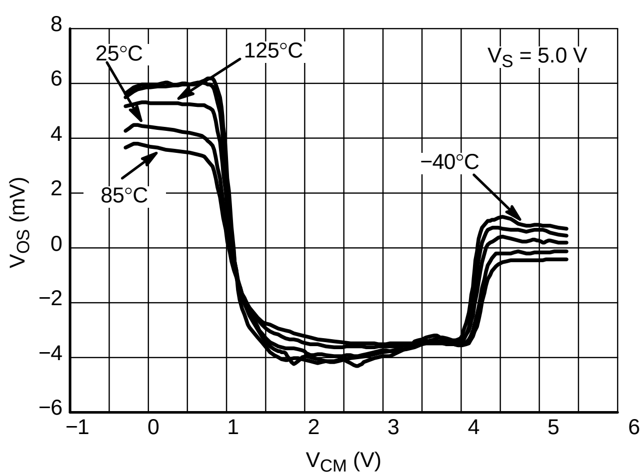
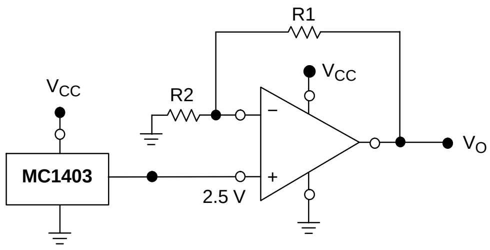


Figure 26. Offset Voltage vs. Common Mode Range V_{DD} 5.0 V

APPLICATION INFORMATION



$$V_O = 2.5\ V\left(1 + \frac{R1}{R2}\right)$$

Figure 27. Voltage Reference

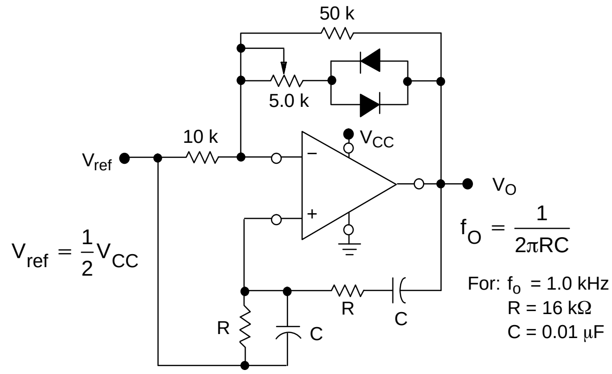
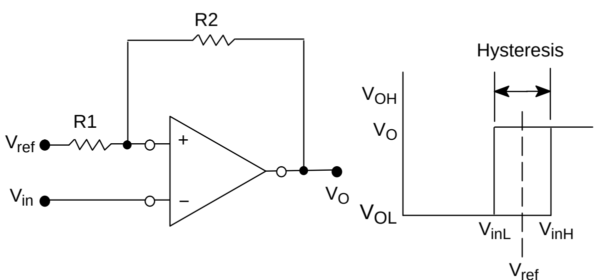


Figure 28. Wien Bridge Oscillator

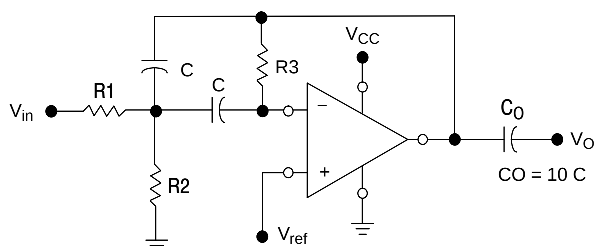


$$V_{in}L = \frac{R1}{R1 + R2}\left(V_{OL} - V_{ref}\right) + V_{ref}$$

$$V_{in}H = \frac{R1}{R1 + R2}\left(V_{OH} - V_{ref}\right) + V_{ref}$$

$$H = \frac{R1}{R1 + R2}\left(V_{OH} - V_{OL}\right)$$

Figure 29. Comparator with Hysteresis



Given: f_o = center frequency
$A(f_o)$ = gain at center frequency

Choose value f_o, C

Then : $R3 = \dfrac{Q}{\pi f_O C}$

$$R1 = \frac{R3}{2\,A(f_O)}$$

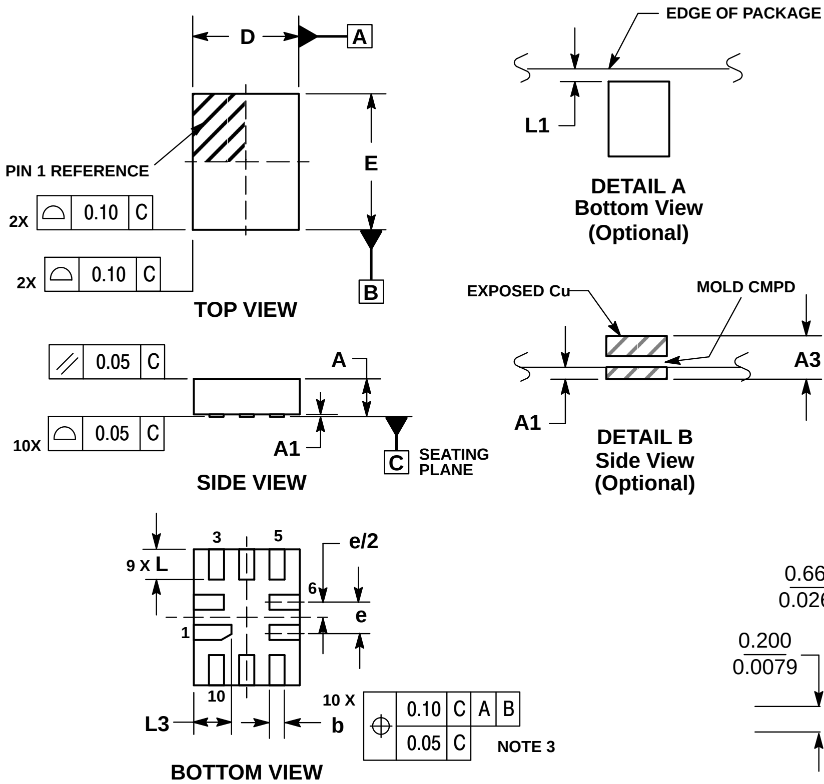
$$R2 = \frac{R1\ R3}{4Q^2\,R1 - R3}$$

For less than 10% error from operational amplifier, $((Q_O\ f_O)/BW) < 0.1$ where f_o and BW are expressed in Hz. If source impedance varies, filter may be preceded with voltage follower buffer to stabilize filter parameters.

Figure 30. Multiple Feedback Bandpass Filter

PACKAGE DIMENSIONS

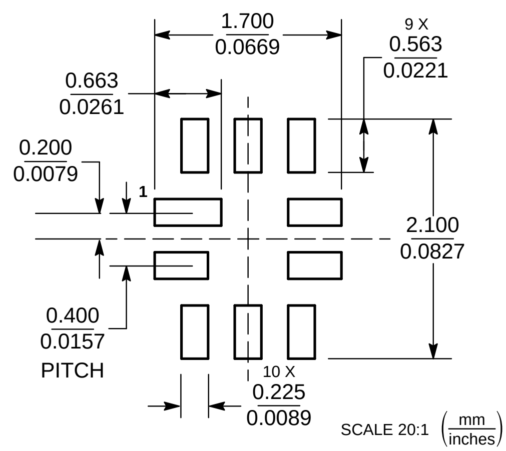
UQFN10 1.4x1.8, 0.4P
CASE 488AT
ISSUE A



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS	
DIM	MIN	MAX
A	0.45	0.60
A1	0.00	0.05
A3	0.127 REF	
b	0.15	0.25
D	1.40 BSC	
E	1.80 BSC	
e	0.40 BSC	
L	0.30	0.50
L1	0.00	0.15
L3	0.40	0.60

MOUNTING FOOTPRINT



*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative