LMV981, LMV982

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

The LMV981 Single and LMV982 Dual are low−voltage operational amplifiers which can operate on single−sided power supplies (1.8 V to 5.0 V) with rail−to−rail input and output swing. Both devices come in small state−of−the−art packages and require very low quiescent current making them 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 packages allow for closer placement to signal sources further enhancing overall signal chain performance.

The LMV981 Single and LMV982 Dual both have 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 Packages:
  - LMV981 in a SC−70 and uLLGA (1.5mm x 1.5mm x 0.4mm)
  - LMV982 in a Micro10 and uQFN (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

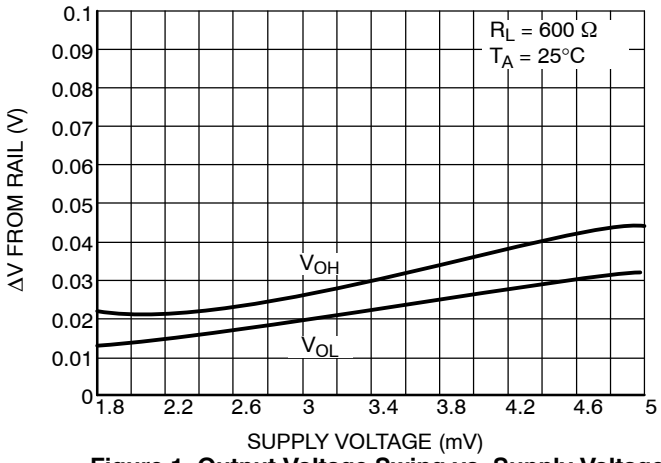


Figure 1. Output Voltage Swing vs. Supply Voltage

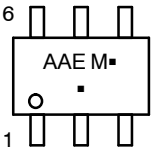
ON Semiconductor®

http://onsemi.com

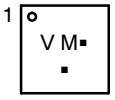
MARKING DIAGRAMS

LMV981 (Single)

SC−70
CASE 419B

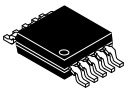


ULLGA8
CASE 613AG

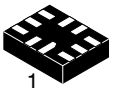


M = Date Code
▪ = Pb−Free Package
(Note: Microdot may be in either location)

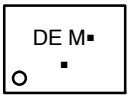
LMV982 (Dual)



Micro10
CASE 846B



UQFN10
CASE 488AT



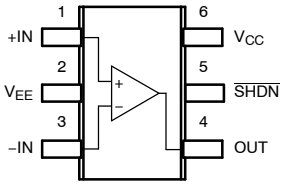
A = Assembly Location
Y = Year
W = Work Week
▪ = Pb−Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 17 of this data sheet.

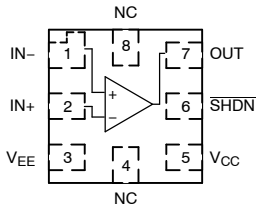
PIN CONNECTIONS

SC70−6



(Top View)

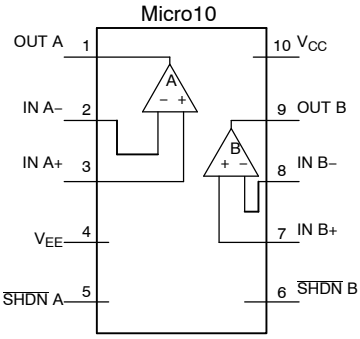
ULLGA8/QFN



NC − No internal connection

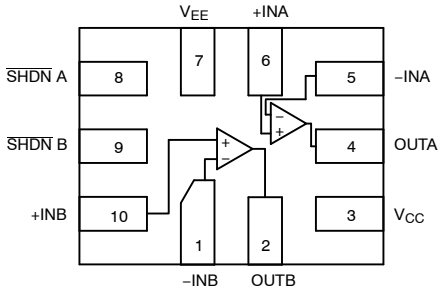
(Top View)

Micro10



(Top View)

UQFN10



(Top View)

MAXIMUM RATINGS

Symbol	Rating	Value	Unit
V_S	Supply Voltage (Operating Range V_S = 2.7 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 SC−70 ULLGA8 Micro10 UQFN10	280 340 200 300	°C/W
T_{stg}	Storage Temperature (SOT23−6)	−65 to 150	°C
	Mounting Temperature (Infrared or Convection −30 sec)	260	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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
Input Offset Voltage	V_{IO}	LMV981 (Single) (−40°C to +125°C)		1	6	mV
		LMV982 (Dual) (−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: LMV981 (Single)			1.0	
		−40°C to +125°C			2.0	
		In Shutdown: LMV982 (Dual)			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 LMV981 (Single) (Note 2)	A_V	R_L = 600 Ω to 0.9 V, V_O = 0.2 V to 1.6 V, V_{CM} = 0.5 V	77	101		dB
		−40°C to +125°C	73			
		R_L = 2 kΩ to 0.9V, V_O = 0.2 V to 1.6 V, V_{CM} = 0.5 V	80	105		
		−40°C to +125°C	75			
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	

2. Guaranteed by design and/or characterization.

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
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		

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/$\sqrt{\text{Hz}}$
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
Input Offset Voltage	V_{IO}	LMV981 (Single) (−40°C to +125°C)		1	6	mV
		LMV982 (Dual) (−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: LMV981 (Single)			1.0	
		−40°C to +125°C			2.0	
		In Shutdown: LMV982 (Dual)			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	V_{CM}	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 LMV981 (Single) (Note 5)	A_V	R_L = 600 Ω to 1.35 V, V_O = 0.2 V to 2.5 V	87	104		dB
		−40°C to +125°C	86			
		R_L = 2 kΩ to 1.35 V, V_O = 0.2 V to 2.5 V	92	110		
		−40°C to +125°C	91			
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	

5. Guaranteed by design and/or characterization.

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
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		

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/uS
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/$\sqrt{\text{Hz}}$
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
Input Offset Voltage	V_{IO}	LMV981 (Single) (−40°C to +125°C)		1	6	mV
		LMV982 (Dual) (−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: LMV981 (Single)			1.0	
		−40°C to +125°C			2.0	
		In Shutdown: LMV982 (Dual)			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 LMV981 (Single) (Note 8)	A_V	R_L = 600 Ω to 2.5 V, V_O = 0.2 V to 4.8 V	88	102		dB
		−40°C to +125°C	87			
		R_L = 2 kΩ to 2.5 V, V_O = 0.2 V to 4.8 V	94	113		
		−40°C to +125°C	93			
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	

8. Guaranteed by design and/or characterization.

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
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		

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/uS
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/$\sqrt{\text{Hz}}$
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)

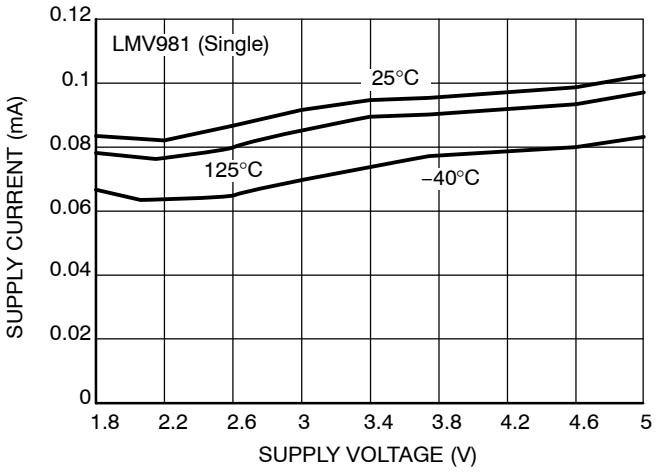


Figure 2. Supply Current vs. Supply Voltage

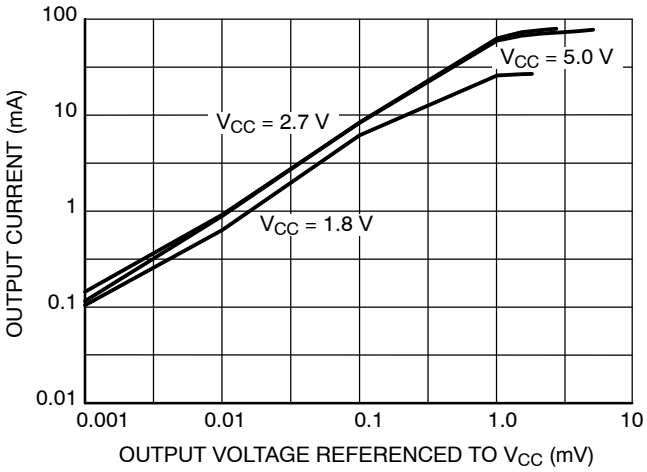


Figure 3. Sourcing Current vs. Output Voltage (T_A = 25°C)

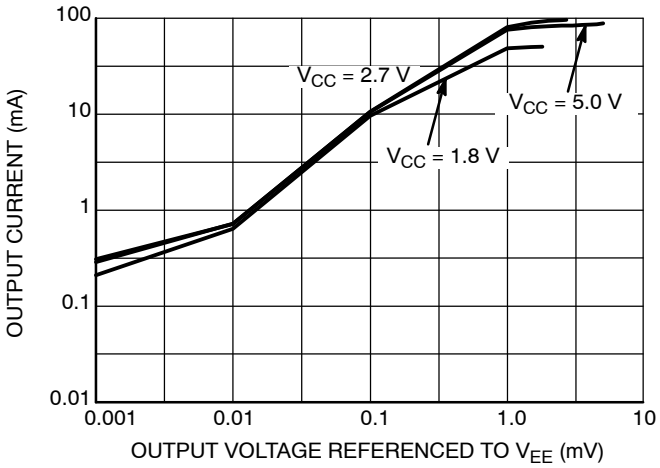


Figure 4. Sinking Current vs. Output Voltage (T_A = 25°C)

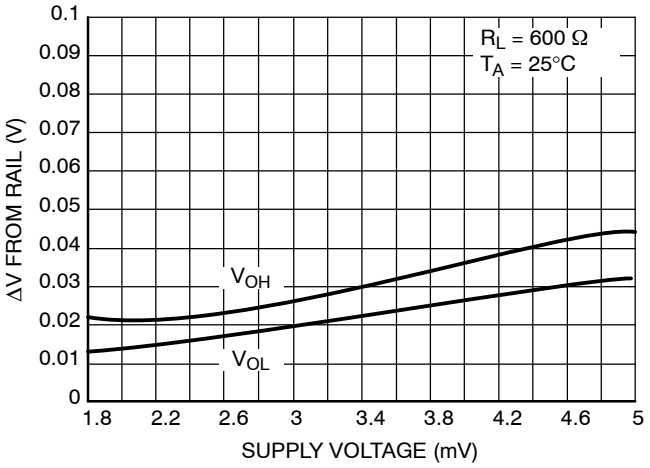


Figure 5. Output Voltage Swing vs. Supply Voltage

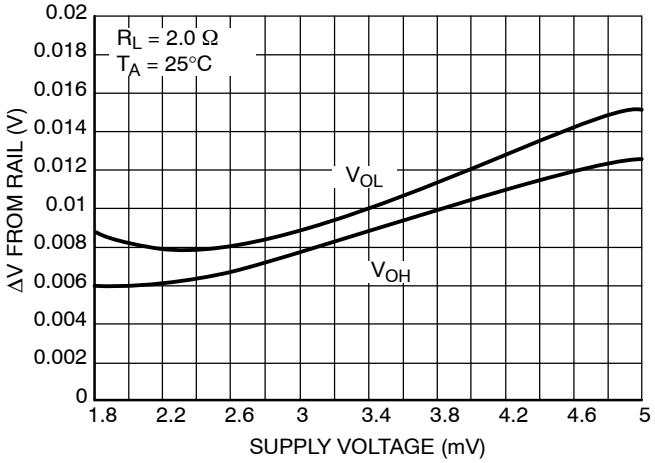


Figure 6. Output Voltage vs. Supply Voltage

TYPICAL CHARACTERISTICS

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

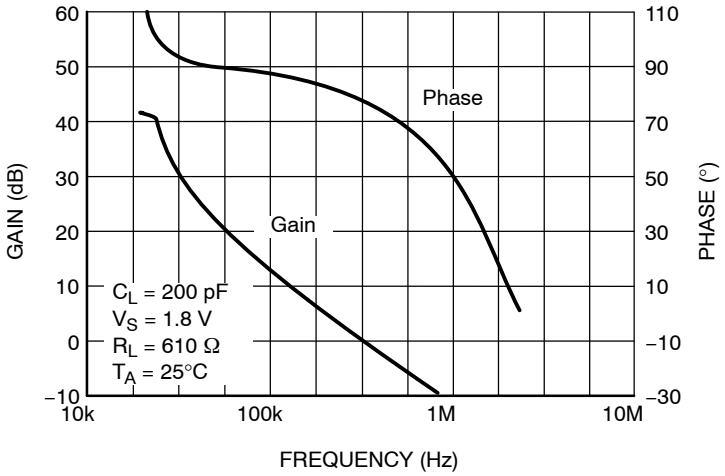


Figure 7. Gain and Phase vs. Frequency

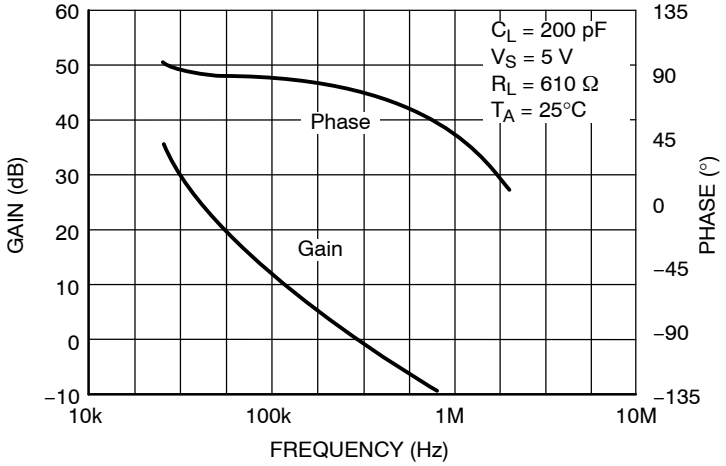


Figure 8. Gain and Phase vs. Frequency

TYPICAL CHARACTERISTICS

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

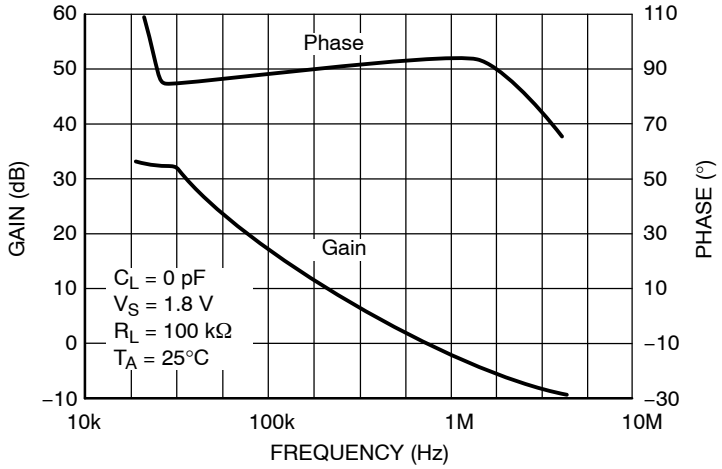


Figure 9. Gain and Phase vs. Frequency

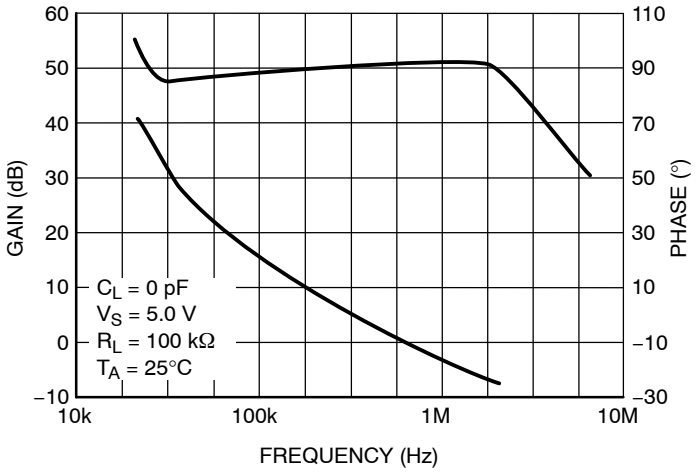


Figure 10. Gain and Phase vs. Frequency

TYPICAL CHARACTERISTICS

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

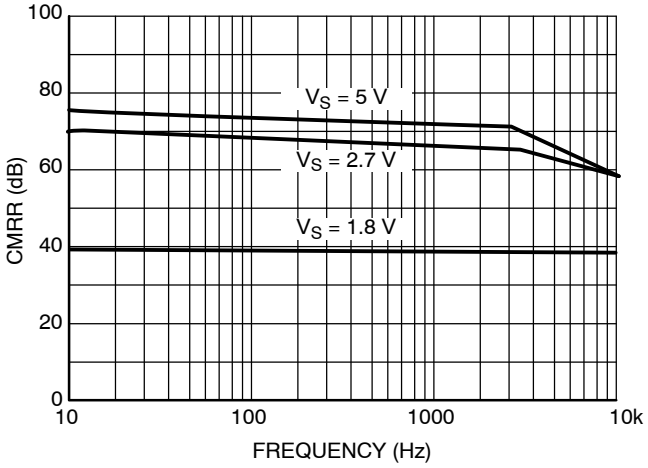


Figure 11. CMRR vs. Frequency

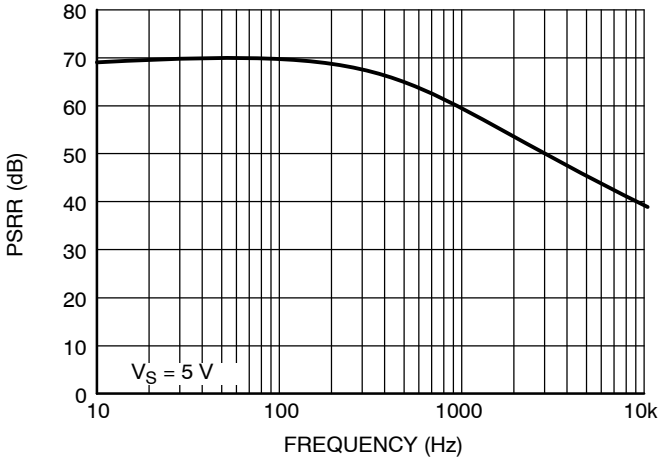


Figure 12. PSRR vs. Frequency

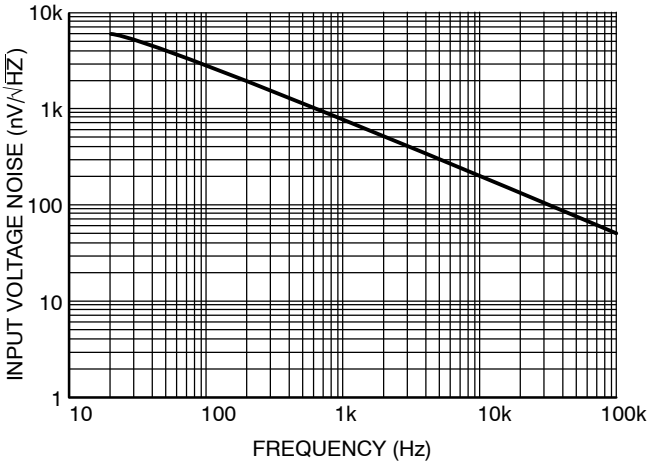


Figure 13. Input Voltage Noise vs. Frequency

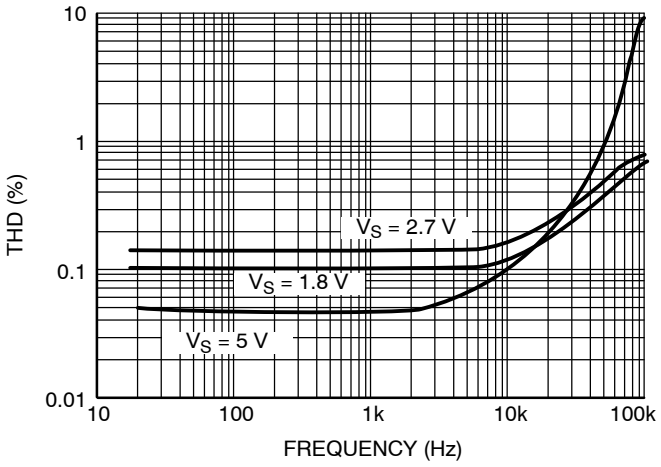


Figure 14. THD vs. Frequency

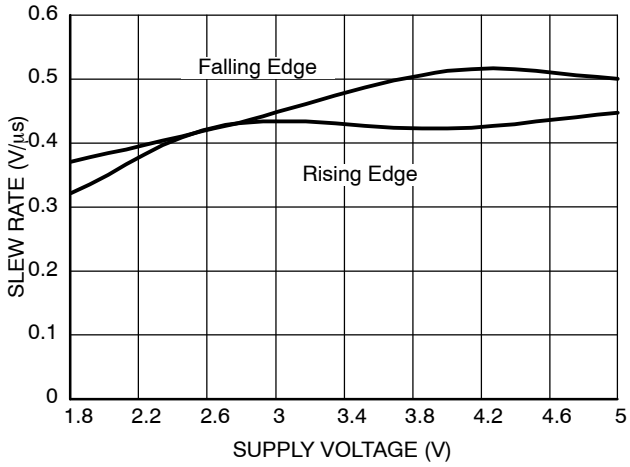
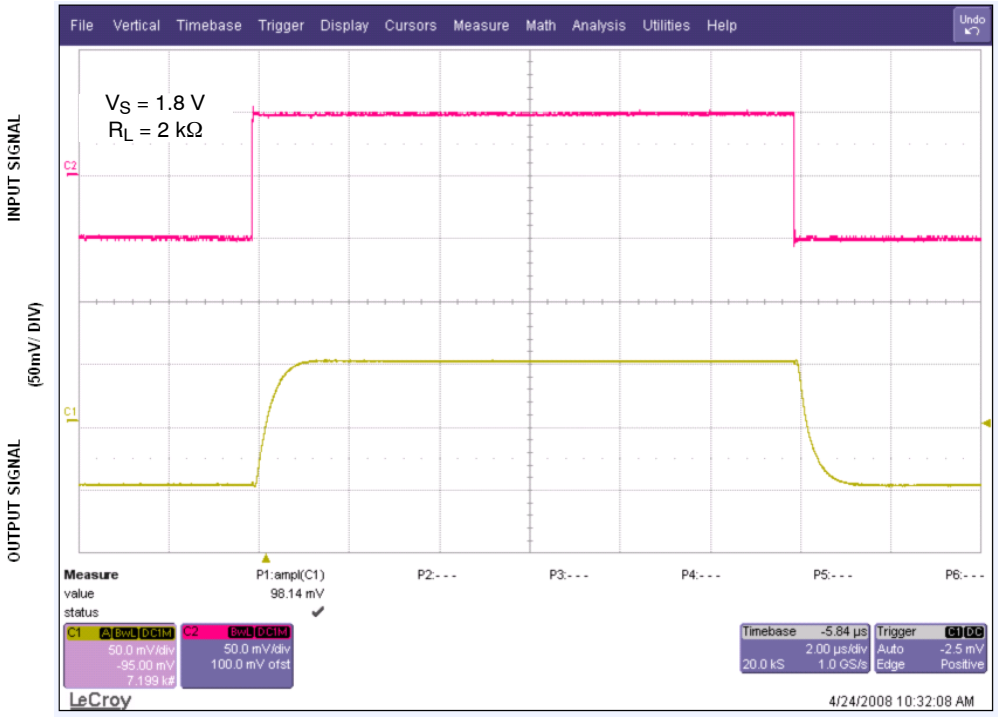


Figure 15. Slew Rate vs. Supply Voltage

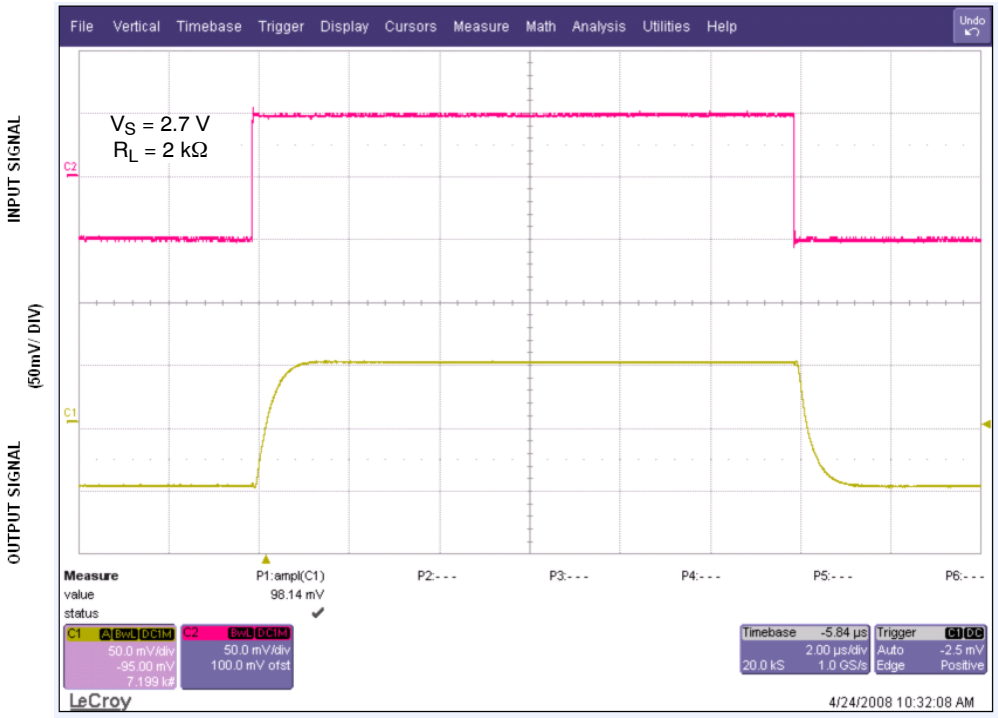
TYPICAL CHARACTERISTICS

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



TIME (2µs/div)

Figure 16. Small Signal Noninverting Response



TIME (2µs/div)

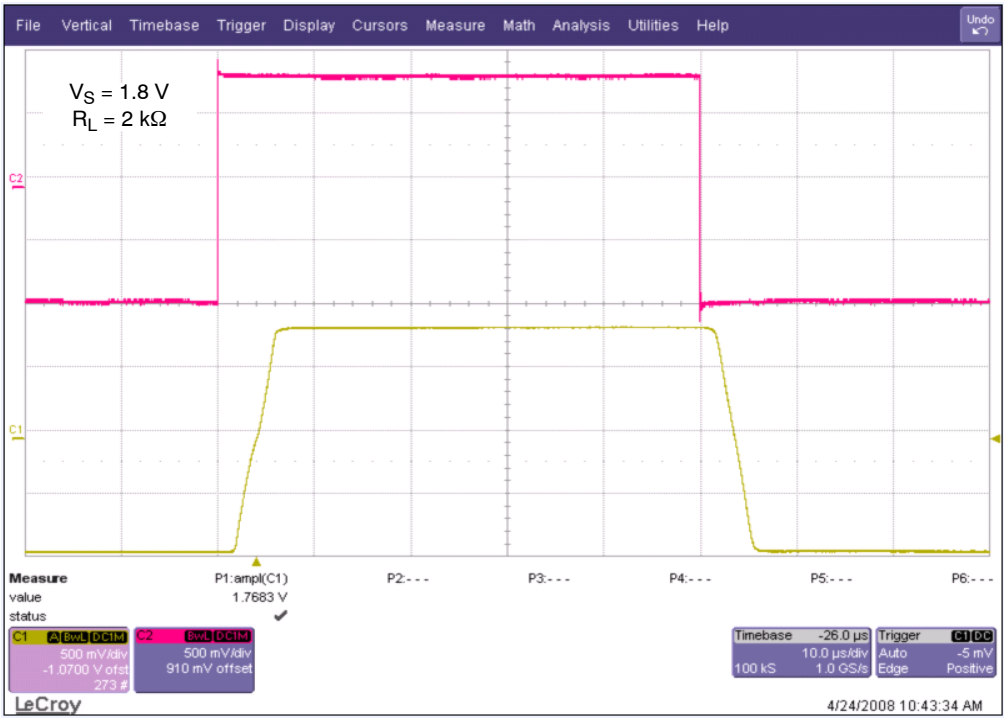
Figure 17. Small Signal Noninverting Response

TYPICAL CHARACTERISTICS

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

TIME (2µs/div)

Figure 18. Small Signal Noninverting Response

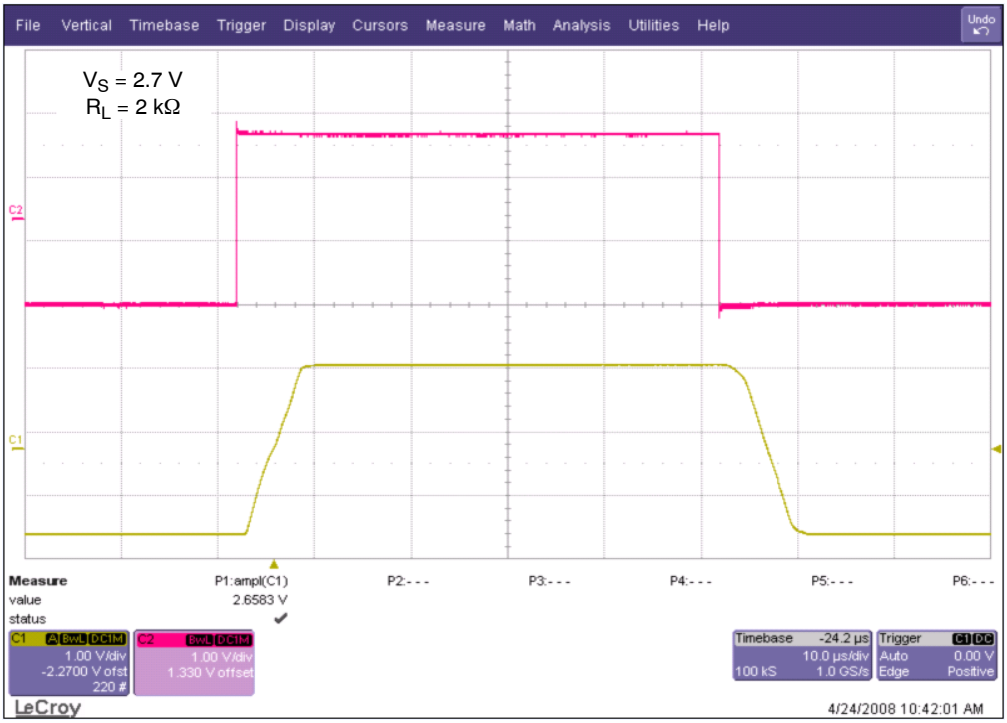


TIME (2µs/div)

Figure 19. Large Signal Noninverting Response

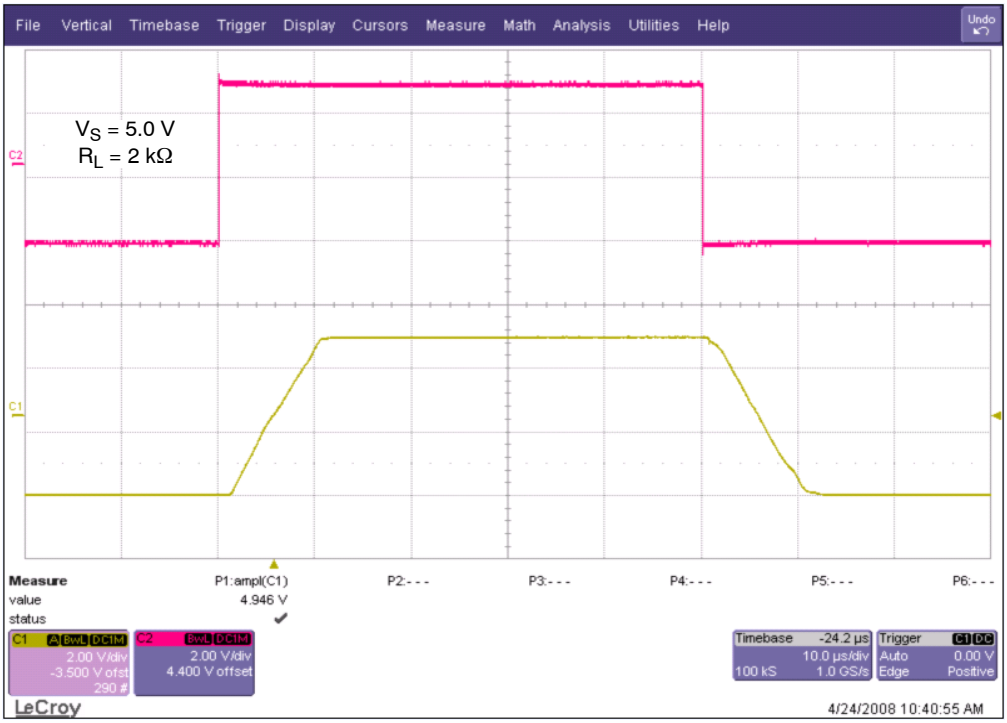
TYPICAL CHARACTERISTICS

(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)

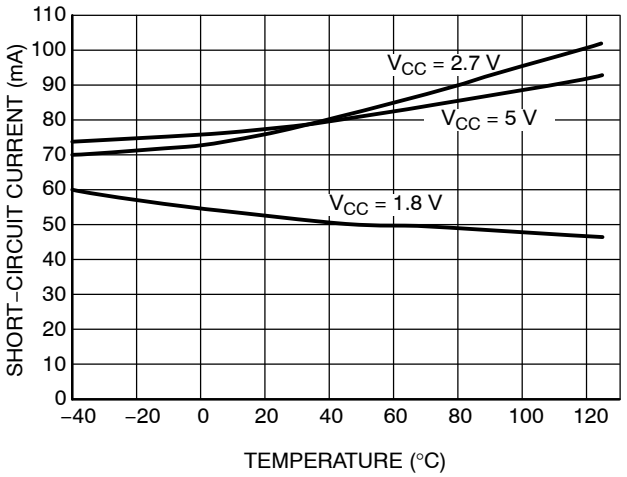


Figure 22. Short−Circuit vs. Supply Voltage (Sinking)

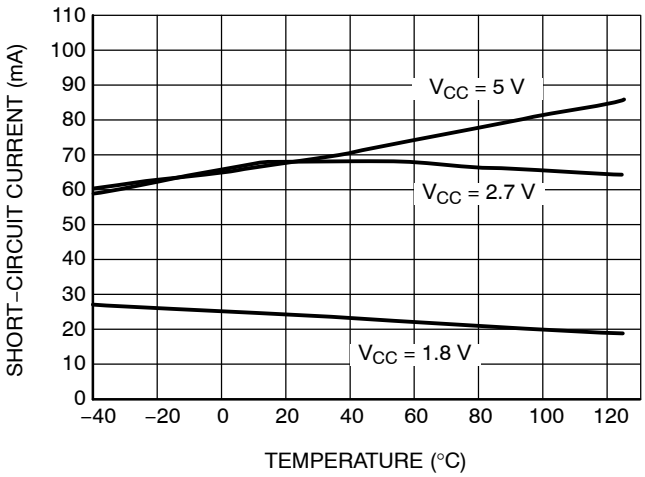


Figure 23. Short−Circuit vs. Supply Voltage (Sourcing)

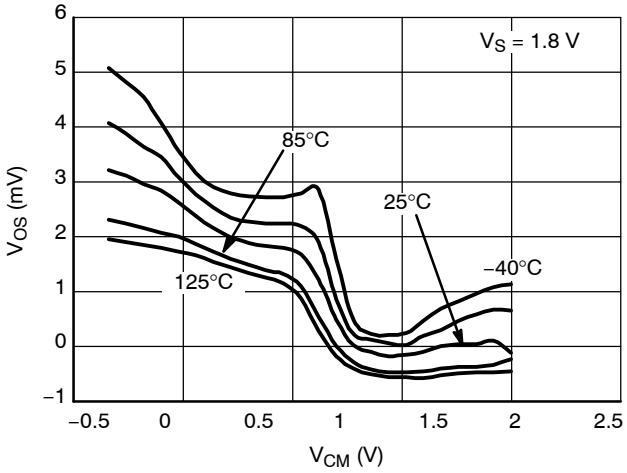


Figure 24. Offset Voltage vs. Common Mode Range V_{DD} 1.8 V

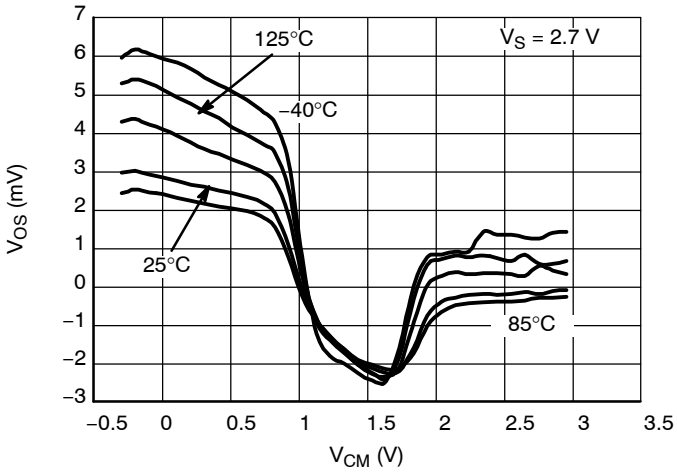


Figure 25. Offset Voltage vs. Common Mode Range V_{DD} 2.7 V

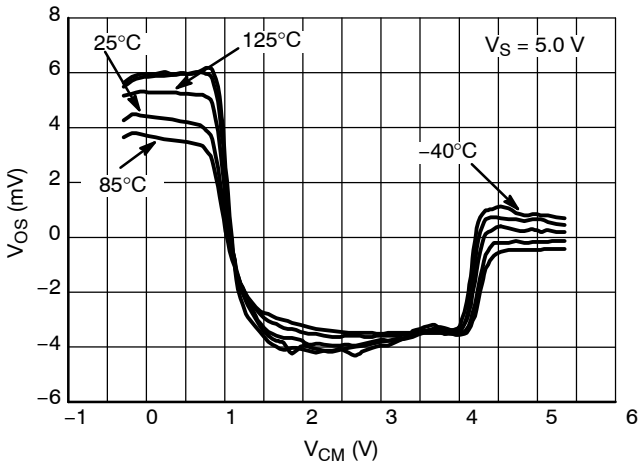


Figure 26. Offset Voltage vs. Common Mode Range V_{DD} 5.0 V

APPLICATION INFORMATION

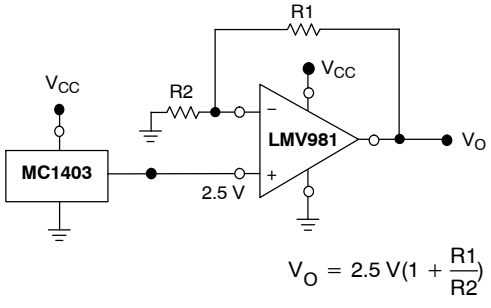


Figure 27. Voltage Reference

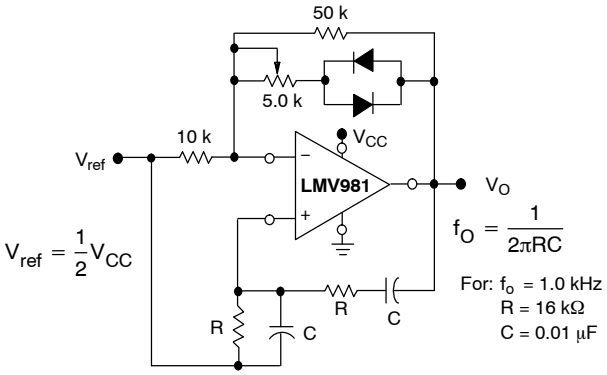
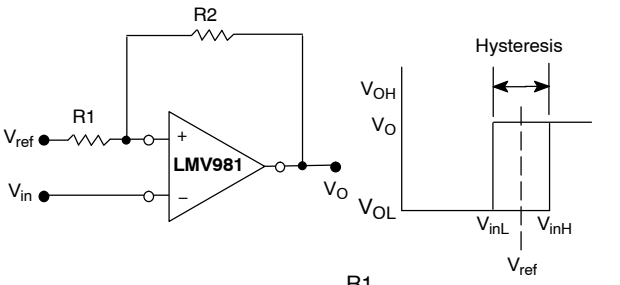


Figure 28. Wien Bridge Oscillator

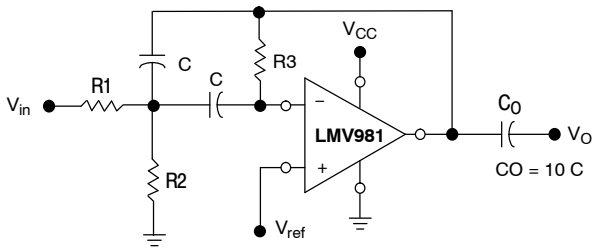


$$V_{in}L = \frac{R1}{R1 + R2} (V_{OL} - V_{ref}) + V_{ref}$$

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

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

Figure 29. Comparator with Hysteresis



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

Choose value f_o, C

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

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

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

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

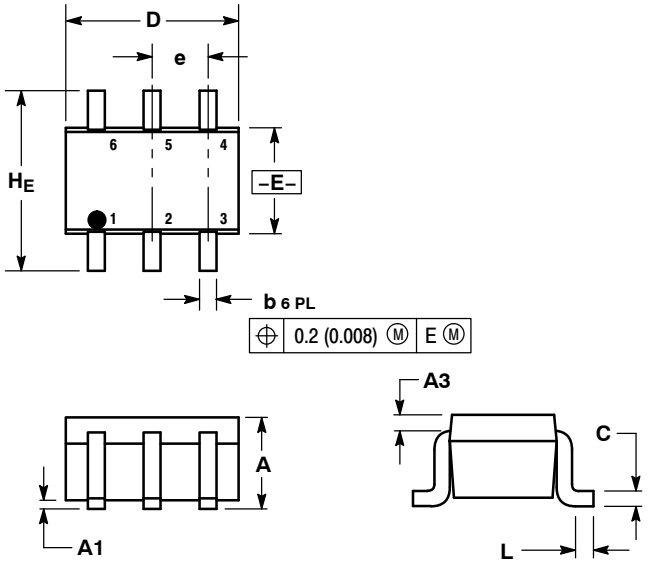
ORDERING INFORMATION

Order Number	# of Channels	Specific Device Marking	Package Type	Shipping†
LMV981SQ3T2G*	Single	AAE	SC70−6 (Pb−Free)	3000 / Tape & Reel
LMV981MU3TBG	Single	V	ULLGA8 (Pb−Free)	3000 / Tape & Reel
LMV982DMR2G*	Dual	V982	Micro10 (Pb−Free)	4000 / Tape & Reel
LMV982MUTAG*	Dual	DE	UQFN10 (Pb−Free)	3000 / 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.
*Contact factory.

PACKAGE DIMENSIONS

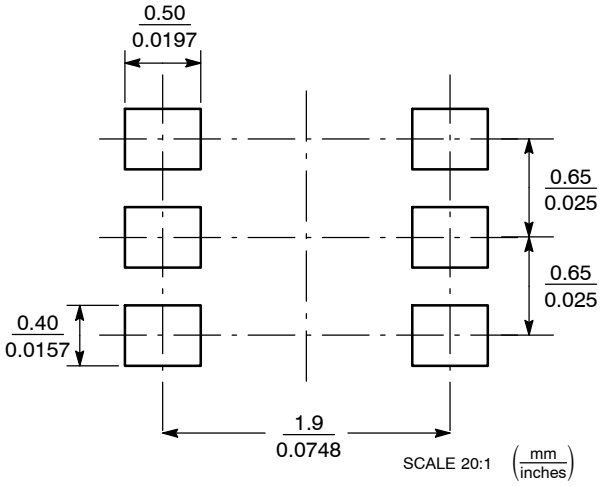
SC−88/SC70−6/SOT−363
CASE 419B−02
ISSUE W



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 419B−01 OBSOLETE, NEW STANDARD 419B−02.

	MILLIMETERS			INCHES		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	0.80	0.95	1.10	0.031	0.037	0.043
A1	0.00	0.05	0.10	0.000	0.002	0.004
A3	0.20 REF			0.008 REF		
b	0.10	0.21	0.30	0.004	0.008	0.012
C	0.10	0.14	0.25	0.004	0.005	0.010
D	1.80	2.00	2.20	0.070	0.078	0.086
E	1.15	1.25	1.35	0.045	0.049	0.053
e	0.65 BSC			0.026 BSC		
L	0.10	0.20	0.30	0.004	0.008	0.012
H_E	2.00	2.10	2.20	0.078	0.082	0.086

SOLDERING FOOTPRINT*

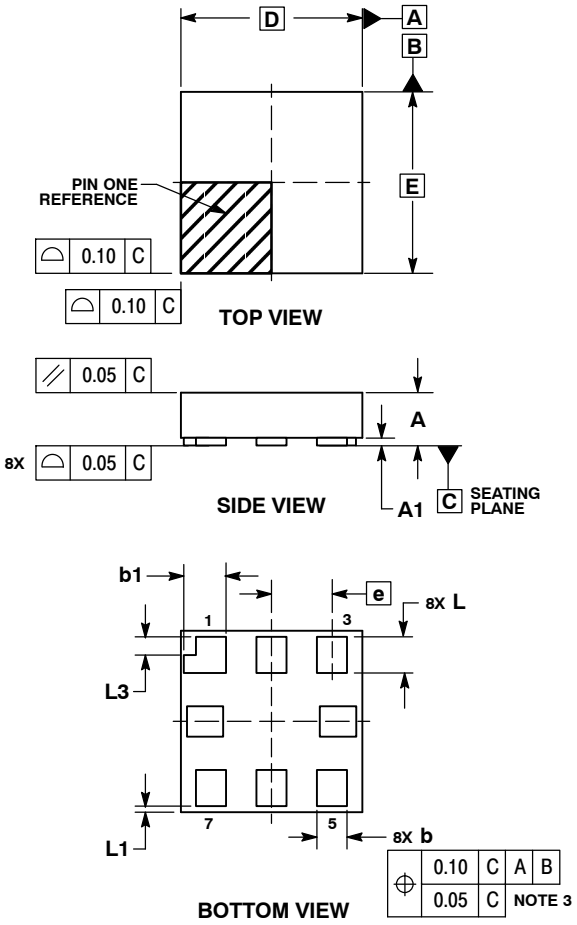


SC−88/SC70−6/SOT−363

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

PACKAGE DIMENSIONS

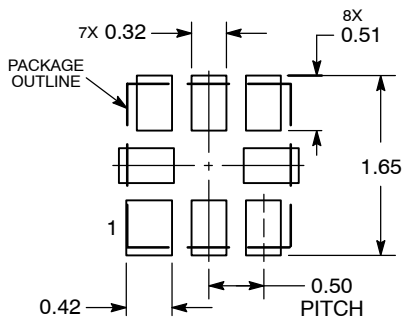
ULLGA8, 1.5x1.5, 0.5P
CASE 613AG−01
ISSUE A



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 0.15 AND 0.30 mm FROM THE TERMINAL TIP.

	MILLIMETERS	
DIM	MIN	MAX
A	−−−	0.40
A1	0.00	0.05
b	0.20	0.30
b1	0.30	0.40
D	1.50 BSC	
E	1.50 BSC	
e	0.50 BSC	
L	0.25	0.35
L1	0.05 REF	
L3	0.15 REF	

MOUNTING FOOTPRINT

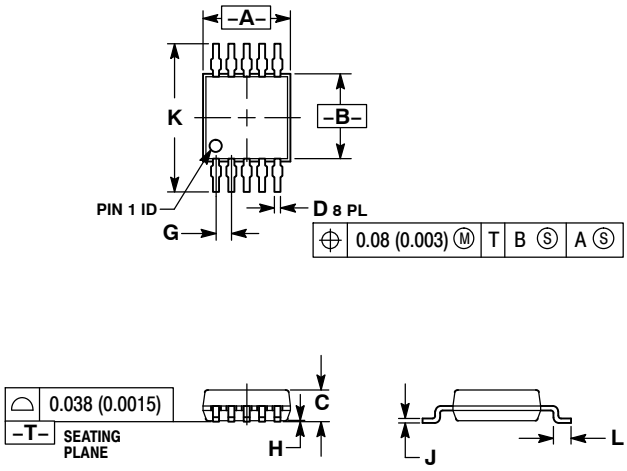


DIMENSIONS: MILLIMETERS

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

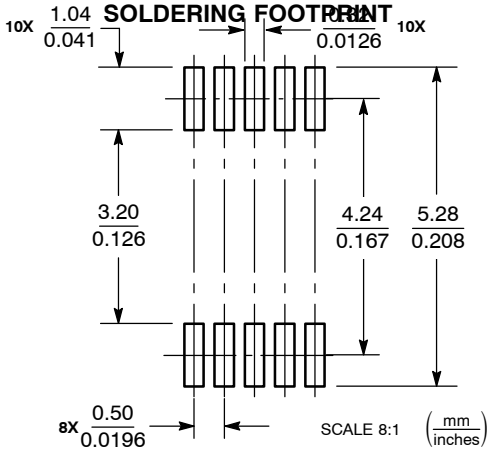
PACKAGE DIMENSIONS

Micro10
CASE 846B−03
ISSUE D



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION “A” DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION “B” DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. 846B−01 OBSOLETE. NEW STANDARD 846B−02

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.90	3.10	0.114	0.122
B	2.90	3.10	0.114	0.122
C	0.95	1.10	0.037	0.043
D	0.20	0.30	0.008	0.012
G	0.50 BSC		0.020 BSC	
H	0.05	0.15	0.002	0.006
J	0.10	0.21	0.004	0.008
K	4.75	5.05	0.187	0.199
L	0.40	0.70	0.016	0.028

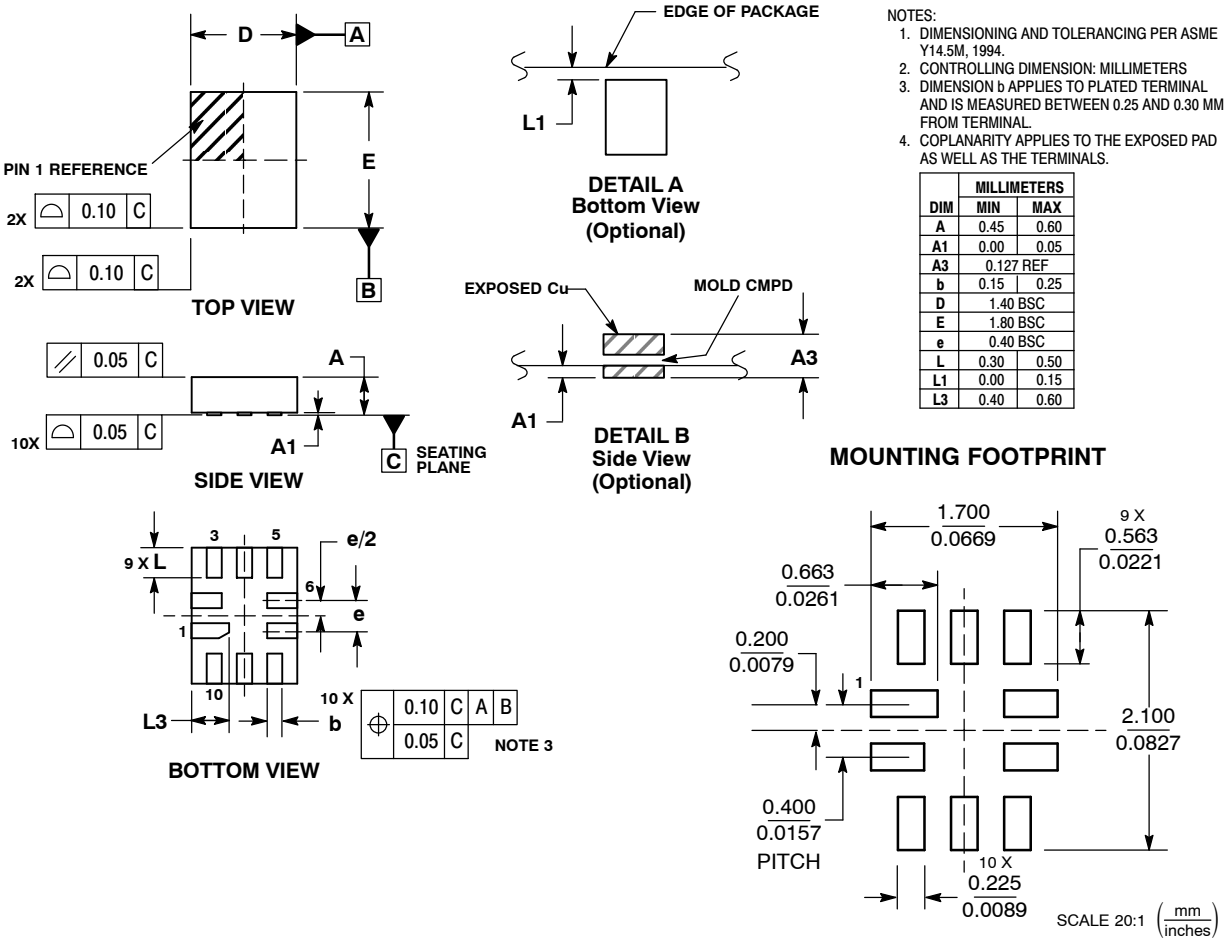


Micro10

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

PACKAGE DIMENSIONS

UQFN10 1.4x1.8, 0.4P
CASE 488AT−01
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
P.O. Box 5163, Denver, Colorado 80217 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
Japan Customer Focus Center
Phone: 81−3−5773−3850

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

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

For additional information, please contact your local Sales Representative