

# 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:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- Low Quiescent Current 210  $\mu\text{A}$ , 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

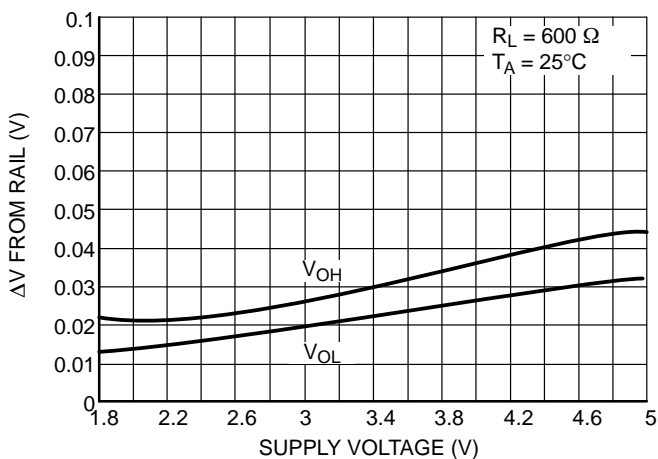


Figure 1. Output Voltage Swing vs. Supply Voltage

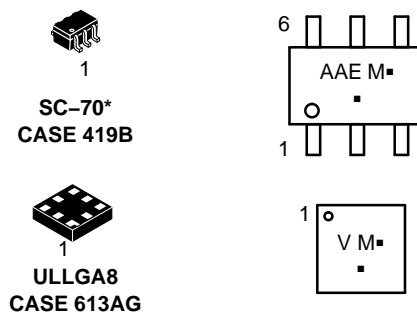


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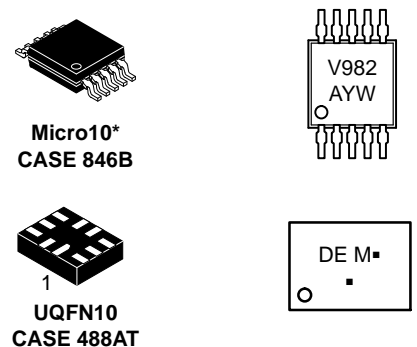
### MARKING DIAGRAMS

#### LMV981 (Single)



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

#### LMV982 (Dual)



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

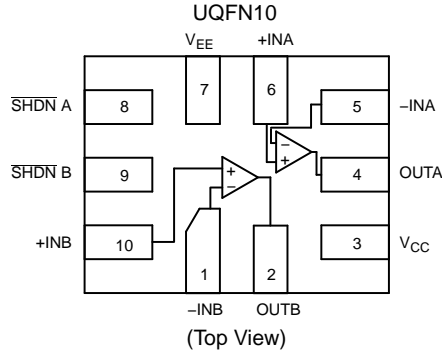
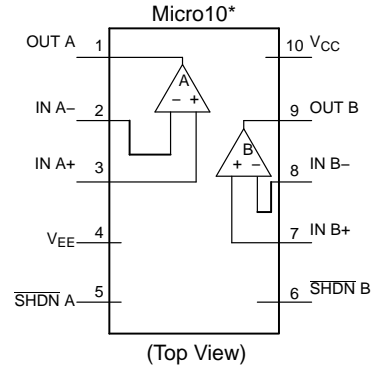
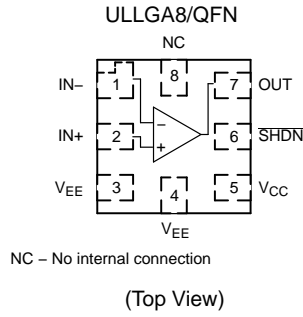
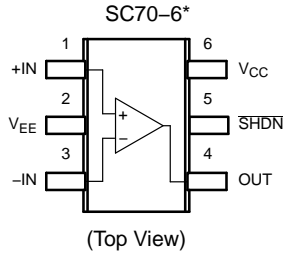
### ORDERING INFORMATION

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

\*Consult sales for package availability

# LMV981, LMV982

## PIN CONNECTIONS



\*Consult sales for package availability

## MAXIMUM RATINGS

Symbol	Rating	Value	Unit
$V_S$	Supply Voltage (Operating Range $V_S = 2.7\text{ V to }5.5\text{ V}$ )	5.5	V
$V_{IDR}$	Input Differential Voltage	$\pm$ Supply Voltage	V
$V_{ICR}$	Input Common Mode Voltage Range	$-0.5\text{ to } (V+) + 0.5$	V
	Maximum Input Current	10	mA
$t_{So}$	Output Short Circuit (Note 1)	Continuous	
$T_J$	Maximum Junction Temperature (Operating Range $-40^\circ\text{C to }85^\circ\text{C}$ )	150	$^\circ\text{C}$
$\theta_{JA}$	Thermal Resistance	SC-70 ULLGA8 Micro10 UQFN10	$^\circ\text{C/W}$
$T_{stg}$	Storage Temperature (SOT23-6)	$-65\text{ to }150$	$^\circ\text{C}$
	Mounting Temperature (Infrared or Convection -30 sec)	260	$^\circ\text{C}$

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  $150^\circ\text{C}$ . 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.

# LMV981, LMV982

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Offset Voltage	$V_{IO}$	LMV981 (Single) ( $-40^\circ\text{C}$ to $+125^\circ\text{C}$ )		1	6	mV
		LMV982 (Dual) ( $-40^\circ\text{C}$ to $+125^\circ\text{C}$ )		1	7.5	
Input Offset Voltage Average Drift	$TCV_{IO}$			5.5		$\mu\text{V}/^\circ\text{C}$
Input Bias Current (Note 2)	$I_B$	$-40^\circ\text{C}$ to $+125^\circ\text{C}$		< 1		nA
Input Offset Current (Note 2)	$I_{IO}$	$-40^\circ\text{C}$ to $+125^\circ\text{C}$		< 1		nA
Supply Current (per Channel)	$I_{CC}$	In Active Mode		75	185	$\mu\text{A}$
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			205	
		In Shutdown: LMV981 (Single)			1.0	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			2.0	
		In Shutdown: LMV982 (Dual)			3.5	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			5.0	
Common Mode Rejection Ratio	CMRR	$0\text{ V} \leq V_{CM} \leq 0.6\text{ V}$ , $1.4\text{ V} \leq V_{CM} \leq 1.8\text{ V}$		40		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$		40		
		$-0.2\text{ V} \leq V_{CM} \leq 0\text{ V}$ , $1.8\text{ V} \leq V_{CM} \leq 2\text{ V}$		40		
Power Supply Rejection Ratio	PSRR	$1.8\text{ V} \leq V^+ \leq 5\text{ V}$ , $V_{CM} = 0.5\text{ V}$	50	70		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	50			
Input Common-Mode Voltage Range	VCM	For CMRR $\geq 50\text{ dB}$ and $T_A = 25^\circ\text{C}$	$V^-$ $-0.2$	$-0.2$ to 2.1	$V^+$ $+0.2$	V
		For CMRR $\geq 50\text{ dB}$ and $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$	$V^-$		$V^+$	
		For CMRR $\geq 50\text{ dB}$ and $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$	$V^-$ $+0.2$		$V^+$ $-0.2$	
Large Signal Voltage Gain LMV981 (Single) (Note 2)	$A_V$	$R_L = 600\ \Omega$ to $0.9\text{ V}$ , $V_O = 0.2\text{ V}$ to $1.6\text{ V}$ , $V_{CM} = 0.5\text{ V}$	77	101		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	73			
Large Signal Voltage Gain LMV982 (Dual) (Note 2)	$A_V$	$R_L = 2\text{ k}\Omega$ to $0.9\text{ V}$ , $V_O = 0.2\text{ V}$ to $1.6\text{ V}$ , $V_{CM} = 0.5\text{ V}$	80	105		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	75			
		$R_L = 600\ \Omega$ to $0.9\text{ V}$ , $V_O = 0.2\text{ V}$ to $1.6\text{ V}$ , $V_{CM} = 0.5\text{ V}$	75	90		
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	72			
Output Swing	$V_{OH}$	$R_L = 600\ \Omega$ to $0.9\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$	1.65	1.72		V
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	1.63			
	$V_{OL}$	$R_L = 600\ \Omega$ to $0.9\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$		0.077	0.105	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			0.12	
	$V_{OH}$	$R_L = 2\text{ k}\Omega$ to $0.9\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$	1.75	1.77		
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	1.74			
	$V_{OL}$	$R_L = 2\text{ k}\Omega$ to $0.9\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$		0.24	0.035	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			0.04	

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.

## LMV981, LMV982

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output Short Circuit Current	$I_O$	Sourcing, $V_O = 0\text{ V}$ , $V_{IN} = +100\text{ mV}$	4.0	30		mA
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	3.3			
		Sinking, $V_O = 1.8\text{ V}$ , $V_{IN} = -100\text{ mV}$	7.0	60		
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	5.0			
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  $T_A = 25^\circ\text{C}$ ,  $V^+ = 1.8\text{ V}$ ,  $V^- = 0\text{ V}$ ,  $V_{CM} = 2.0\text{ V}$ ,  $V_O = V^+/2$  and  $R_L > 1\text{ M}\Omega$ . 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/ $\mu\text{S}$
Gain Bandwidth Product	GBWP			1.4		MHz
Phase Margin	$\Theta_m$			67		$^\circ$
Gain Margin	Gm			7		dB
Input-Referred Voltage Noise	$e_n$	$f = 50\text{ kHz}$ , $V_{CM} = 0.5\text{ V}$		60		nV/ $\sqrt{\text{Hz}}$
Total Harmonic Distortion	THD	$f = 1\text{ kHz}$ , $A_V = +1$ , $R_L = 600\ \Omega$ , $V_O = 1\text{ V}_{PP}$		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,  $R_L = 100\text{ k}\Omega$  connected to  $V^+/2$ . Each amp excited in turn with 1 kHz to produce  $V_O = 3\text{ V}_{PP}$ . (For Supply Voltages  $< 3\text{ V}$ ,  $V_O = V^+$ ).

## LMV981, LMV982

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Offset Voltage	$V_{IO}$	LMV981 (Single) ( $-40^\circ\text{C}$ to $+125^\circ\text{C}$ )		1	6	mV
		LMV982 (Dual) ( $-40^\circ\text{C}$ to $+125^\circ\text{C}$ )		1	7.5	
Input Offset Voltage Average Drift	$TCV_{IO}$			5.5		$\mu\text{V}/^\circ\text{C}$
Input Bias Current (Note 5)	$I_B$	$-40^\circ\text{C}$ to $+125^\circ\text{C}$		< 1		nA
Input Offset Current (Note 5)	$I_{IO}$	$-40^\circ\text{C}$ to $+125^\circ\text{C}$		< 1		nA
Supply Current (per Channel)	$I_{CC}$	In Active Mode		80	190	$\mu\text{A}$
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			210	
		In Shutdown: LMV981 (Single)			1.0	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			2.0	
		In Shutdown: LMV982 (Dual)			3.5	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			5.0	
Common Mode Rejection Ratio	CMRR	$0\text{ V} \leq V_{CM} \leq 1.5\text{ V}$ , $2.3\text{ V} \leq V_{CM} \leq 2.7\text{ V}$	50	70		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	50			
		$-0.2\text{ V} \leq V_{CM} \leq 0\text{ V}$ , $2.7\text{ V} \leq V_{CM} \leq 2.9\text{ V}$	50	70		
Power Supply Rejection Ratio	PSRR	$1.8\text{ V} \leq V^+ \leq 5\text{ V}$ , $V_{CM} = 0.5\text{ V}$	50	70		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	50			
Input Common-Mode Voltage Range	VCM	For CMRR $\geq 50\text{ dB}$ and $T_A = 25^\circ\text{C}$	$V^-$ $-0.2$	$-0.2$ to $3.0$	$V^+$ $+0.2$	V
		For CMRR $\geq 50\text{ dB}$ and $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$	$V^-$		$V^+$	
		For CMRR $\geq 50\text{ dB}$ and $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$	$V^-$ $+0.2$		$V^+$ $-0.2$	
Large Signal Voltage Gain LMV981 (Single) (Note 5)	$A_V$	$R_L = 600\ \Omega$ to $1.35\text{ V}$ , $V_O = 0.2\text{ V}$ to $2.5\text{ V}$	87	104		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	86			
		$R_L = 2\text{ k}\Omega$ to $1.35\text{ V}$ , $V_O = 0.2\text{ V}$ to $2.5\text{ V}$	92	110		
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	91			
Large Signal Voltage Gain LMV982 (Dual) (Note 5)	$A_V$	$R_L = 600\ \Omega$ to $1.35\text{ V}$ , $V_O = 0.2\text{ V}$ to $2.5\text{ V}$	78	90		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	75			
		$R_L = 2\text{ k}\Omega$ to $1.35\text{ V}$ , $V_O = 0.2\text{ V}$ to $2.5\text{ V}$	81	100		
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	78			
Output Swing	$V_{OH}$	$R_L = 600\ \Omega$ to $1.35\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$	2.55	2.62		V
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	2.53			
	$V_{OL}$	$R_L = 600\ \Omega$ to $1.35\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$		0.083	0.11	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			0.13	
	$V_{OH}$	$R_L = 2\text{ k}\Omega$ to $1.35\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$	2.65	2.675		
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	2.64			
	$V_{OL}$	$R_L = 2\text{ k}\Omega$ to $1.35\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$		0.025	0.04	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			0.045	

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.

## LMV981, LMV982

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output Short Circuit Current	$I_O$	Sourcing, $V_O = 0\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$	20	65		mA
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	15			
		Sinking, $V_O = 0\text{ V}$ , $V_{IN} = -100\text{ mV}$	18	75		
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	12			
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  $T_A = 25^\circ\text{C}$ ,  $V_+ = 2.7\text{ V}$ ,  $V_- = 0\text{ V}$ ,  $V_{CM} = 2.0\text{ V}$ ,  $V_O = V_+/2$  and  $R_L > 1\text{ M}\Omega$ . 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/ $\mu\text{S}$
Gain Bandwidth Product	GBWP			1.4		MHz
Phase Margin	$\Theta_m$			70		$^\circ$
Gain Margin	Gm			7.5		dB
Input-Referred Voltage Noise	$e_n$	$f = 50\text{ kHz}$ , $V_{CM} = 1.0\text{ V}$		57		nV/ $\sqrt{\text{Hz}}$
Total Harmonic Distortion	THD	$f = 1\text{ kHz}$ , $A_V = +1$ , $R_L = 600\ \Omega$ , $V_O = 1\text{ V}_{PP}$		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,  $R_L = 100\text{ k}\Omega$  connected to  $V_+/2$ . Each amp excited in turn with 1 kHz to produce  $V_O = 3\text{ V}_{PP}$ . (For Supply Voltages  $< 3\text{ V}$ ,  $V_O = V_+$ ).

## LMV981, LMV982

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Offset Voltage	$V_{IO}$	LMV981 (Single) ( $-40^\circ\text{C}$ to $+125^\circ\text{C}$ )		1	6	mV
		LMV982 (Dual) ( $-40^\circ\text{C}$ to $+125^\circ\text{C}$ )		1	7.5	
Input Offset Voltage Average Drift	$TCV_{IO}$			5.5		$\mu\text{V}/^\circ\text{C}$
Input Bias Current (Note 8)	$I_B$	$-40^\circ\text{C}$ to $+125^\circ\text{C}$		< 1		nA
Input Offset Current (Note 8)	$I_{IO}$	$-40^\circ\text{C}$ to $+125^\circ\text{C}$		< 1		nA
Supply Current (per Channel)	$I_{CC}$	In Active Mode		95	210	$\mu\text{A}$
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			230	
		In Shutdown: LMV981 (Single)			1.0	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			2.0	
		In Shutdown: LMV982 (Dual)			3.5	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			5.0	
Common-Mode Rejection Ratio	CMRR	$0\text{ V} \leq V_{CM} \leq 3.8\text{ V}$ , $4.6\text{ V} \leq V_{CM} \leq 5.0\text{ V}$	50	70		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	50			
		$-0.2\text{ V} \leq V_{CM} \leq 0\text{ V}$ , $5.0\text{ V} \leq V_{CM} \leq 5.2\text{ V}$	50	70		
Power Supply Rejection Ratio	PSRR	$1.8\text{ V} \leq V^+ \leq 5\text{ V}$ , $V_{CM} = 0.5\text{ V}$	50	70		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	50			
Input Common-Mode Voltage Range	VCM	For CMRR $\geq 50\text{ dB}$ and $T_A = 25^\circ\text{C}$	$V^-$ $-0.2$	$-0.2$ to $5.3$	$V^+$ $+0.2$	V
		For CMRR $\geq 50\text{ dB}$ and $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$	$V^-$		$V^+$	
		For CMRR $\geq 50\text{ dB}$ and $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$	$V^-$ $+0.3$		$V^+$ $-0.3$	
Large Signal Voltage Gain LMV981 (Single) (Note 8)	$A_V$	$R_L = 600\ \Omega$ to $2.5\text{ V}$ , $V_O = 0.2\text{ V}$ to $4.8\text{ V}$	88	102		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	87			
		$R_L = 2\text{ k}\Omega$ to $2.5\text{ V}$ , $V_O = 0.2\text{ V}$ to $4.8\text{ V}$	94	113		
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	93			
Large Signal Voltage Gain LMV982 (Dual) (Note 8)	$A_V$	$R_L = 600\ \Omega$ to $2.5\text{ V}$ , $V_O = 0.2\text{ V}$ to $4.8\text{ V}$	81	90		dB
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	78			
		$R_L = 2\text{ k}\Omega$ to $2.5\text{ V}$ , $V_O = 0.2\text{ V}$ to $4.8\text{ V}$	85	100		
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	82			
Output Swing	$V_{OH}$	$R_L = 600\ \Omega$ to $2.5\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$	4.855	4.89		V
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	4.835			
	$V_{OL}$	$R_L = 600\ \Omega$ to $2.5\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$		0.12	0.16	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			0.18	
	$V_{OH}$	$R_L = 2\text{ k}\Omega$ to $2.5\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$	4.945	4.967		
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	4.935			
	$V_{OL}$	$R_L = 2\text{ k}\Omega$ to $2.5\text{ V}$ , $V_{IN} = \pm 100\text{ mV}$		0.037	0.065	
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$			0.075	

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.

## LMV981, LMV982

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output Short-Circuit Current	$I_O$	Sourcing, $V_O = 0\text{ V}$ , $V_{IN} = +100\text{ mV}$	40	60		mA
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	40			
		Sinking, $V_O = 5\text{ V}$ , $V_{IN} = -100\text{ mV}$	45	65		
		$-40^\circ\text{C}$ to $+125^\circ\text{C}$	45			
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  $T_A = 25^\circ\text{C}$ ,  $V^+ = 5\text{ V}$ ,  $V^- = 0\text{ V}$ ,  $V_{CM} = 2.0\text{ V}$ ,  $V_O = V^+/2$  and  $R_L > 1\text{ M}\Omega$ . Typical specifications represent the most likely parametric norm.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Slew Rate	SR	(Note 9)		0.48		V/ $\mu\text{S}$
Gain Bandwidth Product	GBWP			1.5		MHz
Phase Margin	$\Theta_m$			65		$^\circ$
Gain Margin	Gm			8		dB
Input-Referred Voltage Noise	$e_n$	$f = 50\text{ kHz}$ , $V_{CM} = 2\text{ V}$		50		nV/ $\sqrt{\text{Hz}}$
Total Harmonic Distortion	THD	$f = 1\text{ kHz}$ , $A_V = +1$ , $R_L = 600\ \Omega$ , $V_O = 1\text{ V}_{PP}$		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,  $R_L = 100\text{ k}\Omega$  connected to  $V^+/2$ . Each amp excited in turn with  $1\text{ kHz}$  to produce  $V_O = 3\text{ V}_{PP}$ . (For Supply Voltages  $< 3\text{ V}$ ,  $V_O = V^+$ ).



# LMV981, LMV982

## TYPICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$  and  $V_S = 5\text{ V}$  unless otherwise specified)

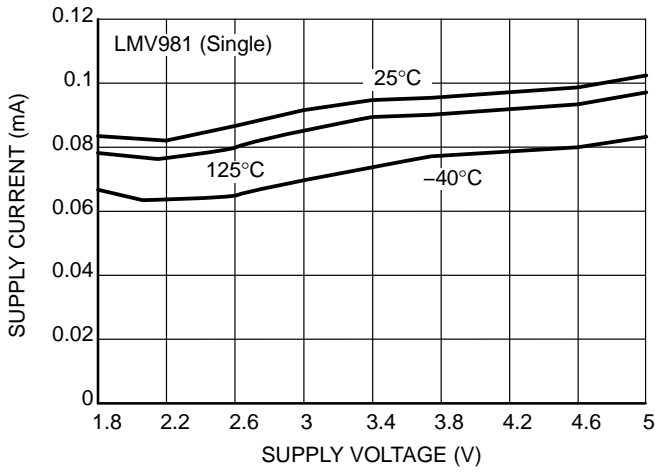


Figure 2. Supply Current vs. Supply Voltage

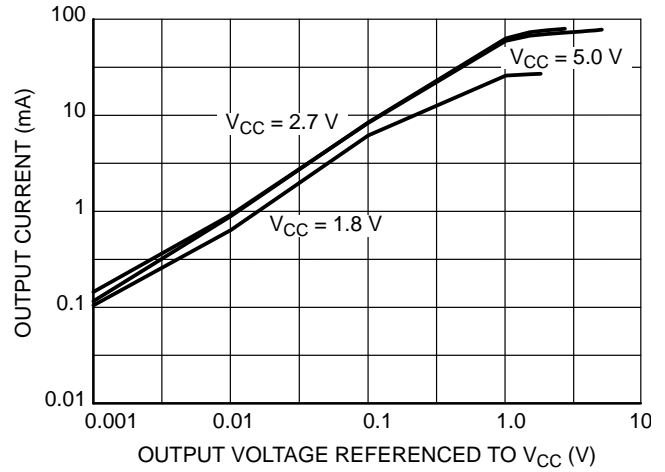


Figure 3. Sourcing Current vs. Output Voltage ( $T_A = 25^\circ\text{C}$ )

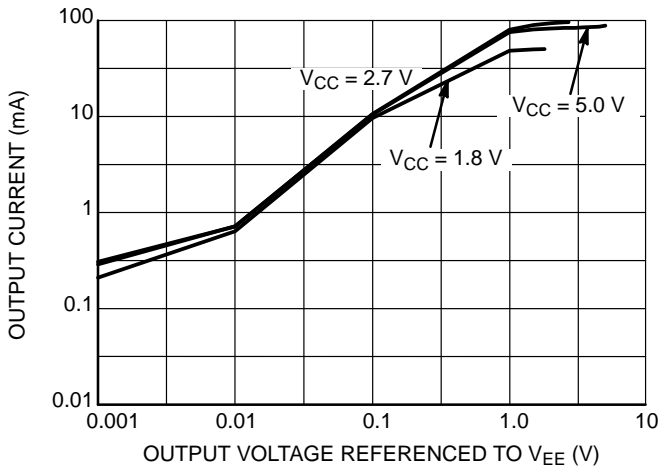


Figure 4. Sinking Current vs. Output Voltage ( $T_A = 25^\circ\text{C}$ )

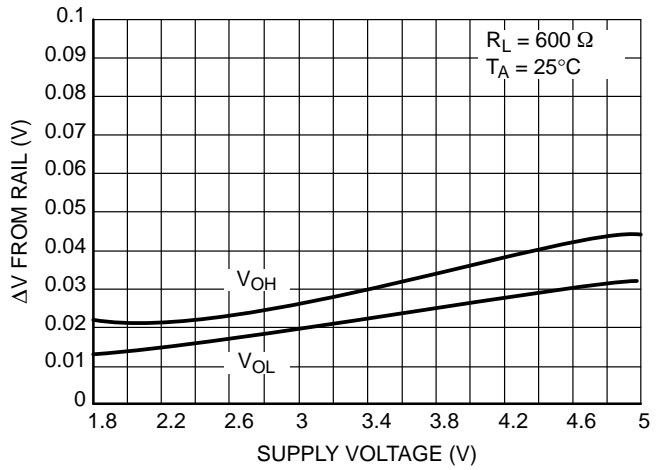


Figure 5. Output Voltage Swing vs. Supply Voltage

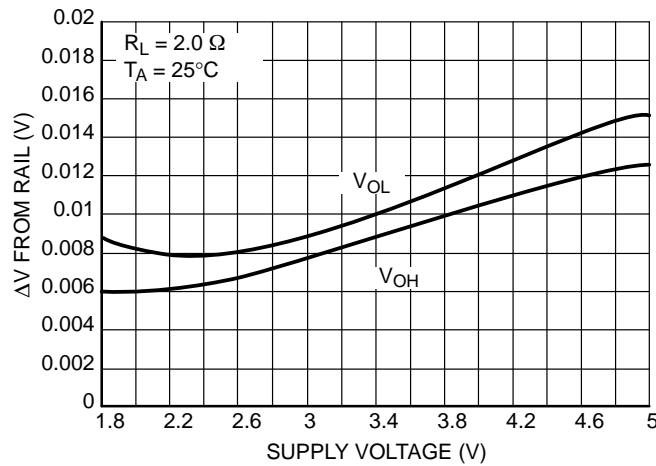


Figure 6. Output Voltage vs. Supply Voltage

# LMV981, LMV982

## TYPICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$  and  $V_S = 5\text{ V}$  unless otherwise specified)

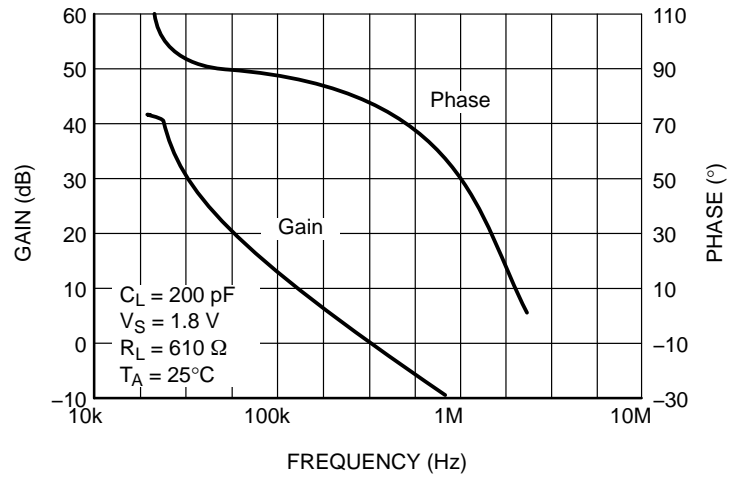


Figure 7. Gain and Phase vs. Frequency

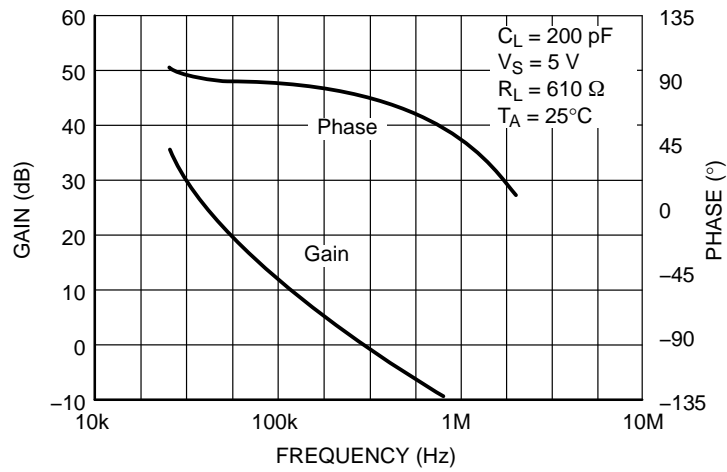


Figure 8. Gain and Phase vs. Frequency

# LMV981, LMV982

## TYPICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$  and  $V_S = 5\text{ V}$  unless otherwise specified)

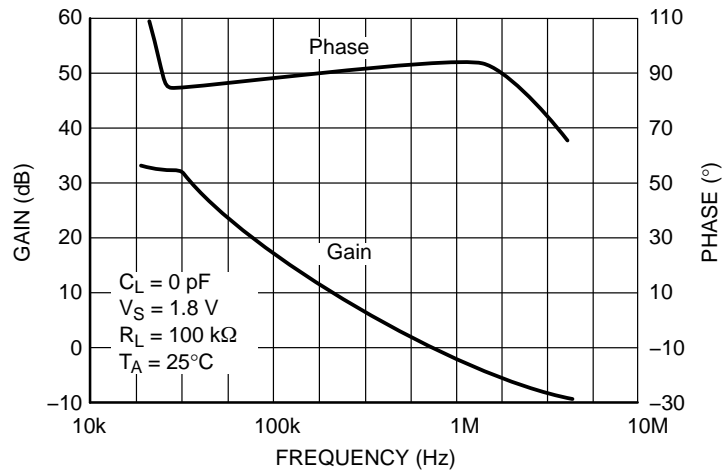


Figure 9. Gain and Phase vs. Frequency

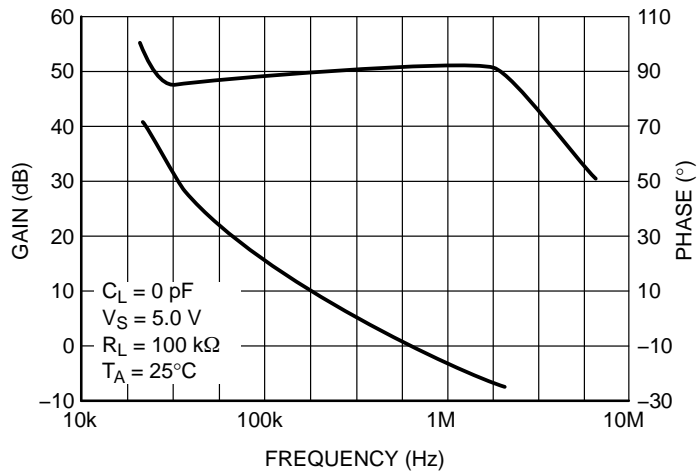


Figure 10. Gain and Phase vs. Frequency

# LMV981, LMV982

## TYPICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$  and  $V_S = 5\text{ V}$  unless otherwise specified)

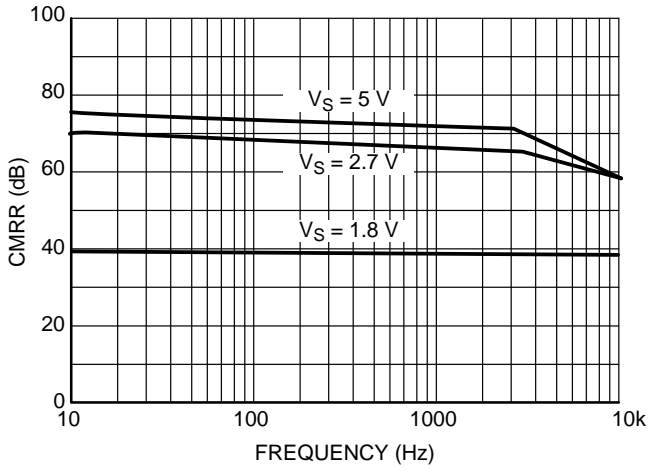


Figure 11. CMRR vs. Frequency

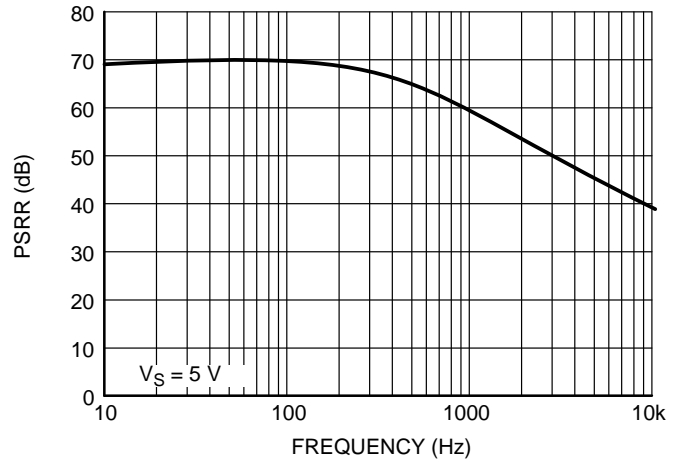


Figure 12. PSRR vs. Frequency

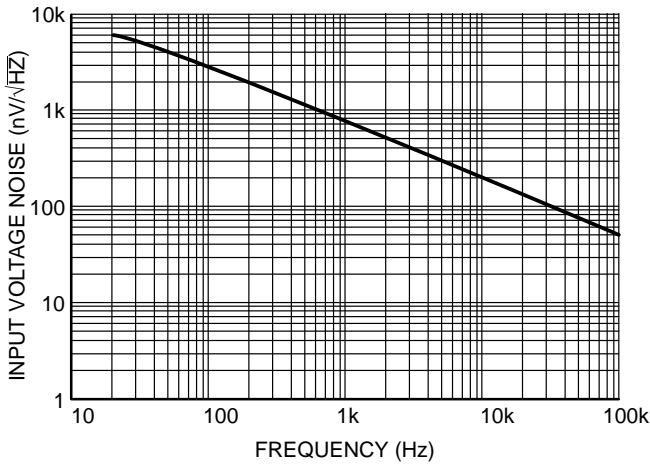


Figure 13. Input Voltage Noise vs. Frequency

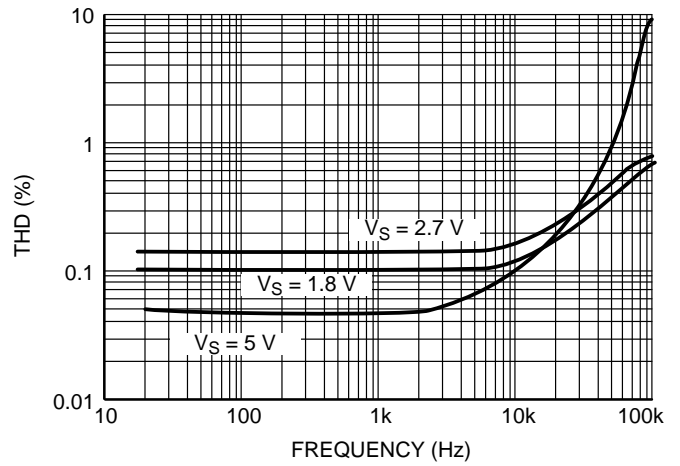


Figure 14. THD vs. Frequency

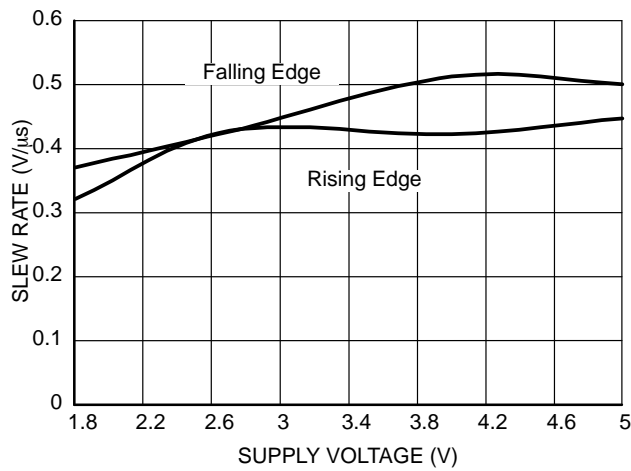


Figure 15. Slew Rate vs. Supply Voltage

# LMV981, LMV982

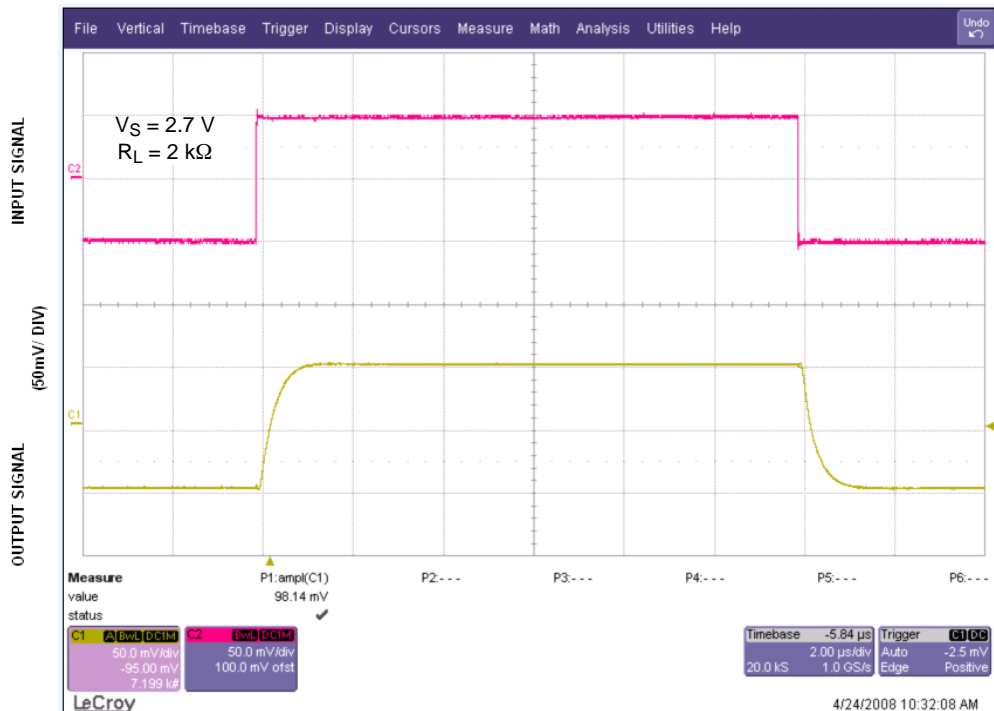
## TYPICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$  and  $V_S = 5\text{ V}$  unless otherwise specified)



TIME (2 $\mu\text{s}/\text{div}$ )

Figure 16. Small Signal Noninverting Response



TIME (2 $\mu\text{s}/\text{div}$ )

Figure 17. Small Signal Noninverting Response

# LMV981, LMV982

## TYPICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$  and  $V_S = 5\text{ V}$  unless otherwise specified)



TIME (2 $\mu\text{s}$ /div)

Figure 18. Small Signal Noninverting Response



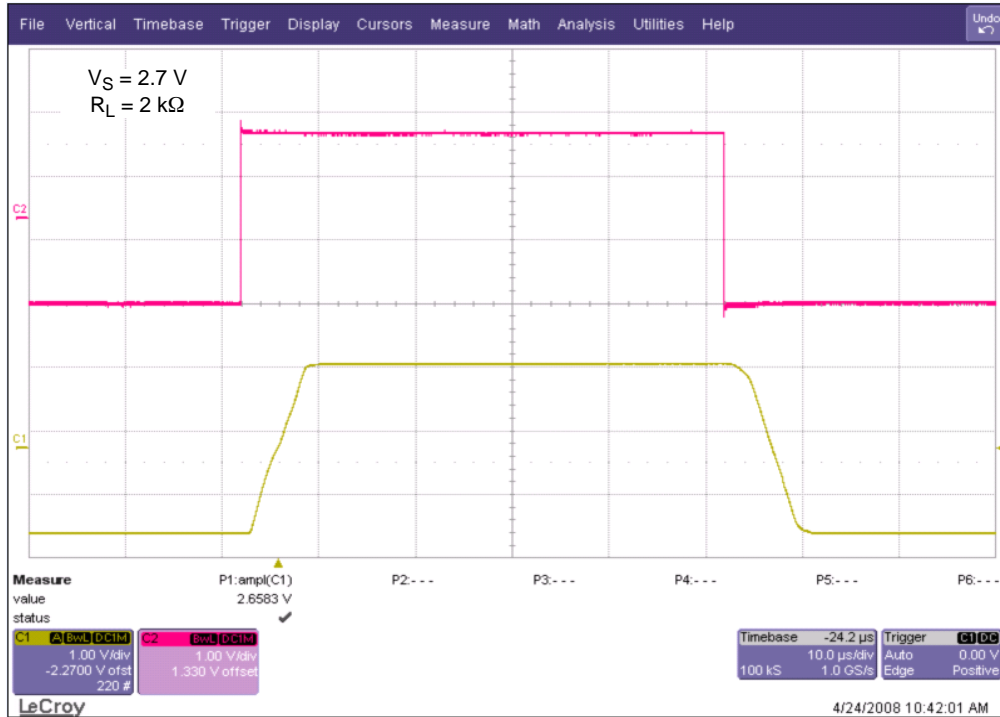
TIME (2 $\mu\text{s}$ /div)

Figure 19. Large Signal Noninverting Response

# LMV981, LMV982

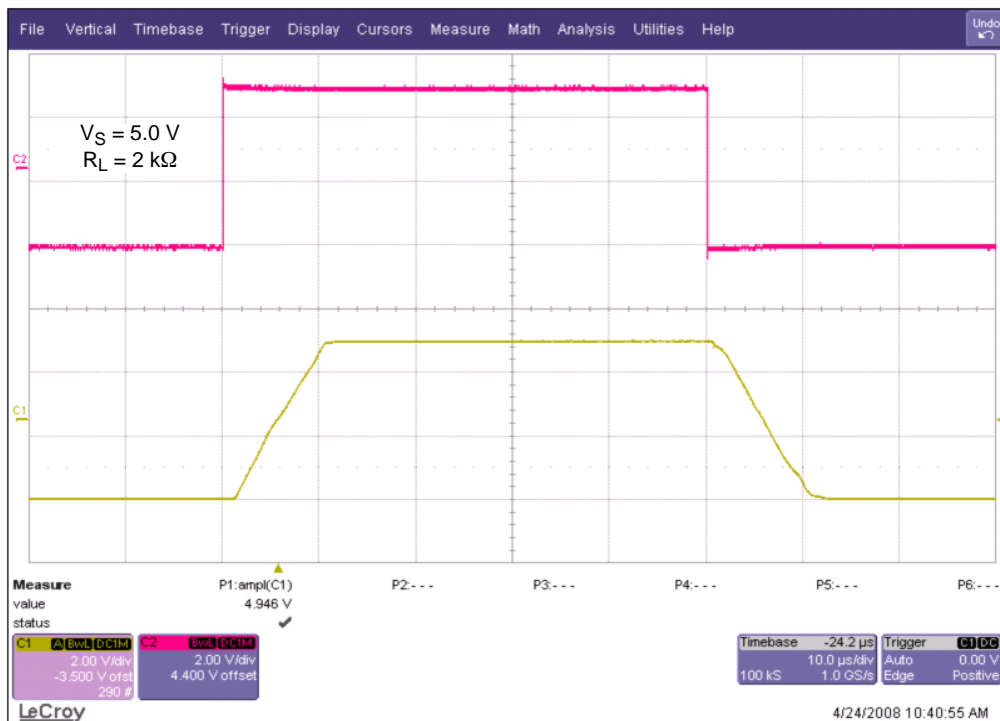
## TYPICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$  and  $V_S = 5\text{ V}$  unless otherwise specified)



TIME ( $2\mu\text{s}/\text{div}$ )

Figure 20. Large Signal Noninverting Response



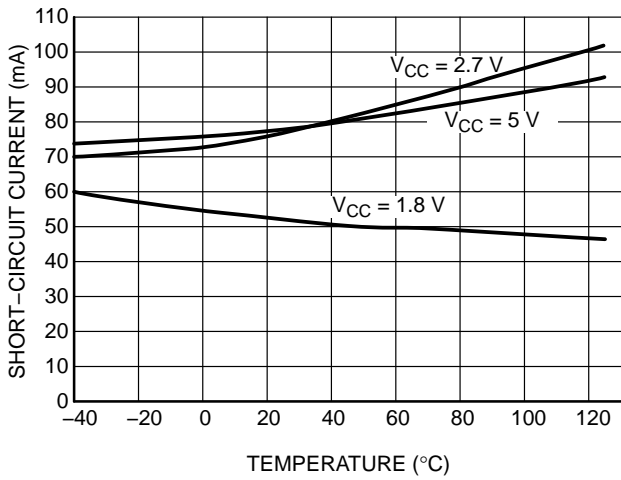
TIME ( $2\mu\text{s}/\text{div}$ )

Figure 21. Large Signal Noninverting Response

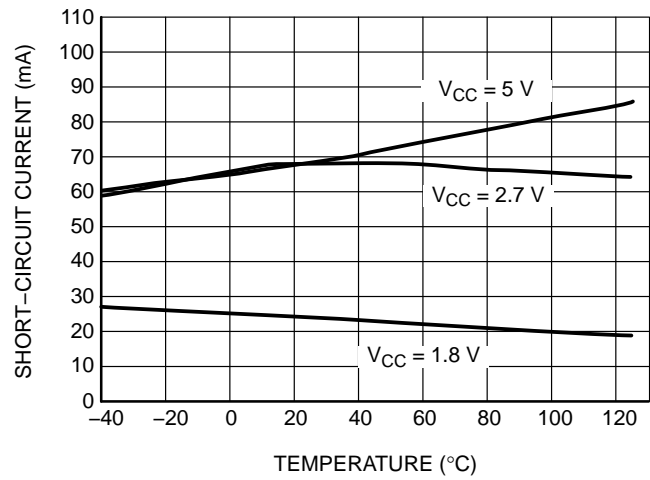
# LMV981, LMV982

## TYPICAL CHARACTERISTICS

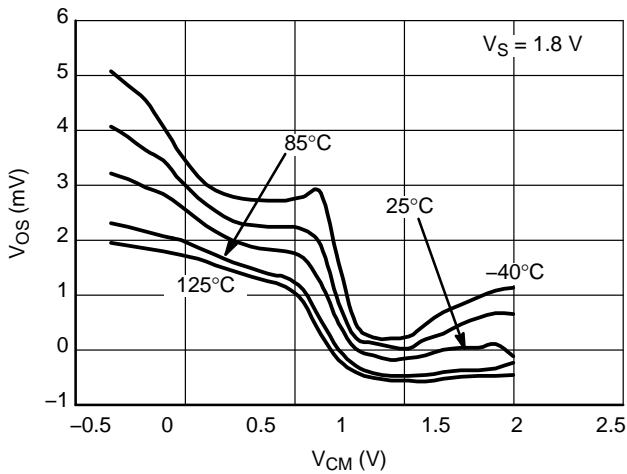
( $T_A = 25^\circ\text{C}$  and  $V_S = 5\text{ V}$  unless otherwise specified)



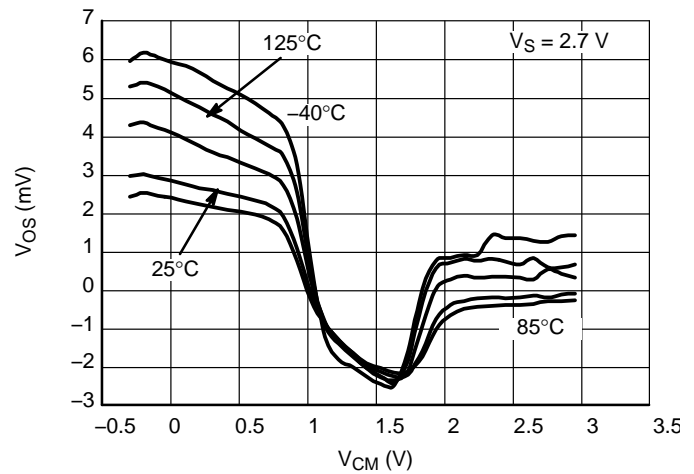
**Figure 22. Short-Circuit vs. Supply Voltage (Sinking)**



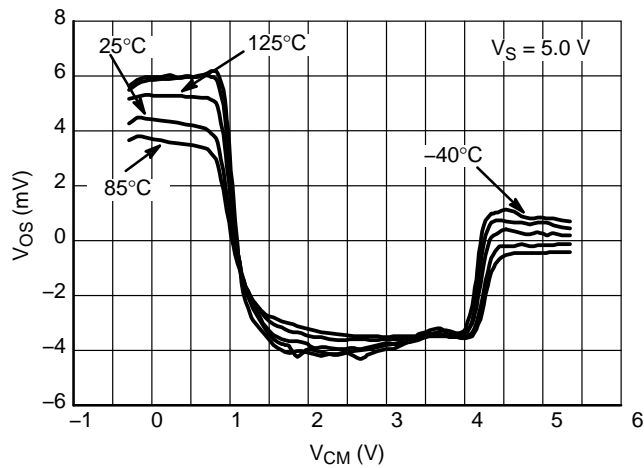
**Figure 23. Short-Circuit vs. Supply Voltage (Sourcing)**



**Figure 24. Offset Voltage vs. Common Mode Range  $V_{DD} 1.8\text{ V}$**



**Figure 25. Offset Voltage vs. Common Mode Range  $V_{DD} 2.7\text{ V}$**



**Figure 26. Offset Voltage vs. Common Mode Range  $V_{DD} 5.0\text{ V}$**



# LMV981, LMV982

## APPLICATION INFORMATION

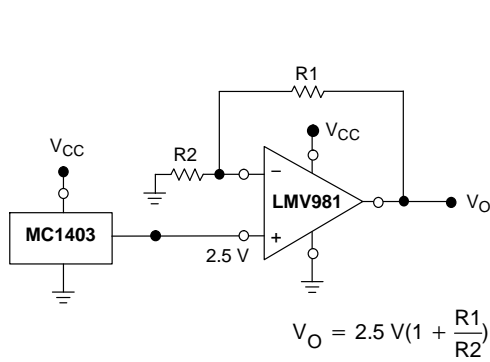


Figure 27. Voltage Reference

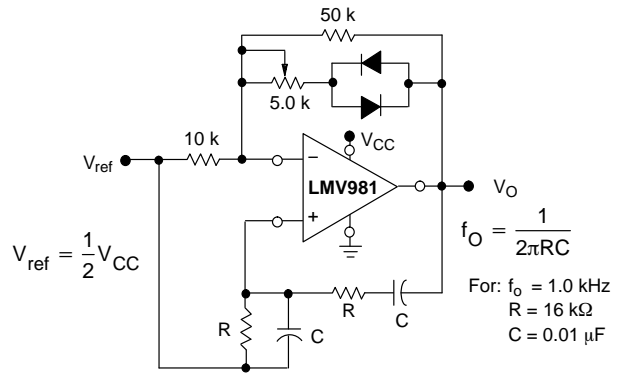


Figure 28. Wien Bridge Oscillator

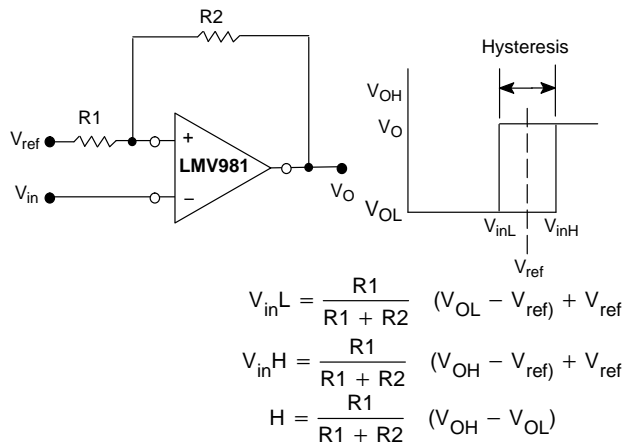
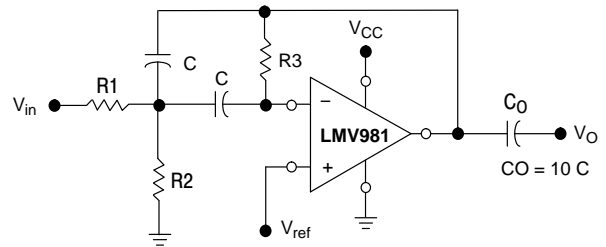


Figure 29. Comparator with Hysteresis



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

Choose value  $f_o$ ,  $C_Q$   
 Then:  $R_3 = \frac{C_Q}{\pi f_o C}$   
 $R_1 = \frac{R_3}{2 A(f_o)}$   
 $R_2 = \frac{R_1 R_3}{4Q^2 R_1 - R_3}$

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

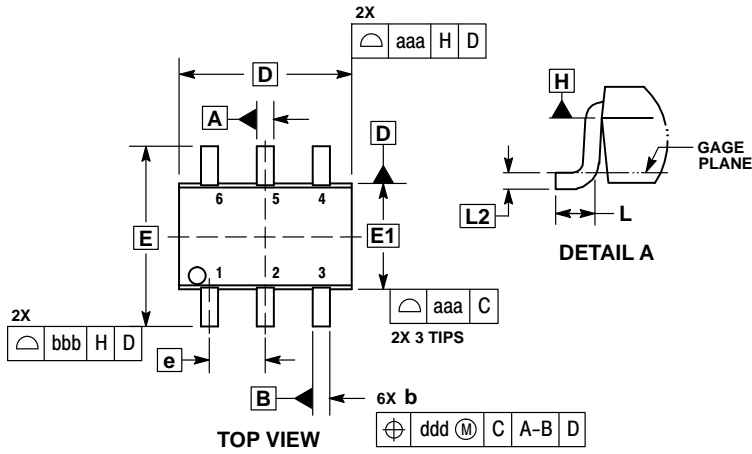
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*Consult sales for package availability.

# LMV981, LMV982

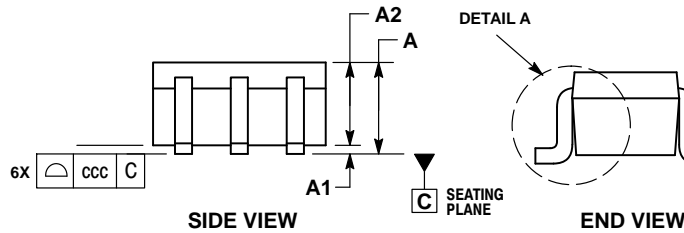
## PACKAGE DIMENSIONS

SC-88/SC70-6/SOT-363  
CASE 419B-02  
ISSUE Y

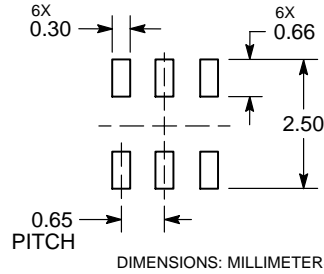


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.20 PER END.
  4. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AND DATUM H.
  5. DATUMS A AND B ARE DETERMINED AT DATUM H.
  6. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08 AND 0.15 FROM THE TIP.
  7. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF DIMENSION b AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	---	---	1.10	---	---	0.043
A1	0.00	---	0.10	0.000	---	0.004
A2	0.70	0.90	1.00	0.027	0.035	0.039
b	0.15	0.20	0.25	0.006	0.008	0.010
C	0.08	0.15	0.22	0.003	0.006	0.009
D	1.80	2.00	2.20	0.070	0.078	0.086
E	2.00	2.10	2.20	0.078	0.082	0.086
E1	1.15	1.25	1.35	0.045	0.049	0.053
e	0.65 BSC			0.026 BSC		
L	0.26	0.36	0.46	0.010	0.014	0.018
L2	0.15 BSC			0.006 BSC		
aaa	0.15			0.006		
bbb	0.30			0.012		
ccc	0.10			0.004		
ddd	0.10			0.004		



### RECOMMENDED SOLDERING FOOTPRINT\*

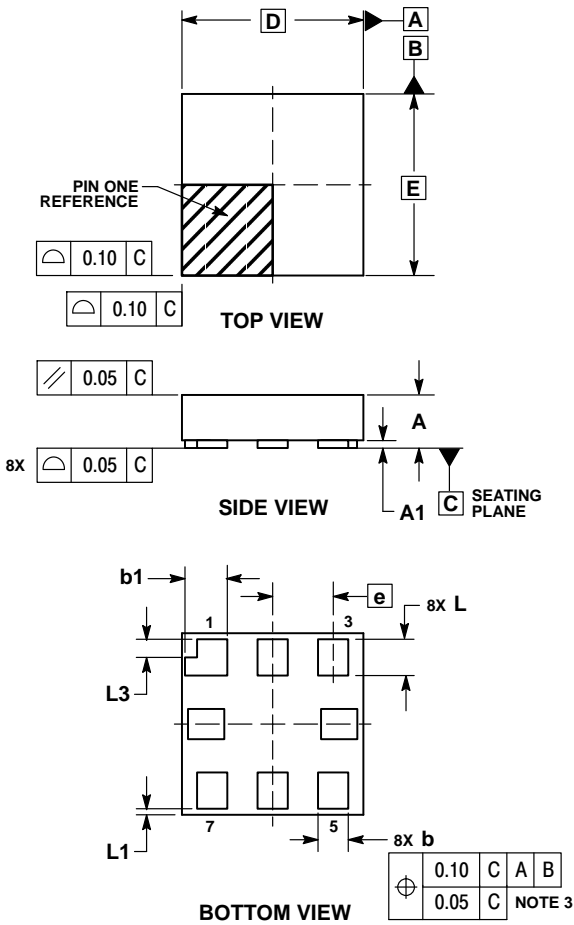


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# LMV981, LMV982

## PACKAGE DIMENSIONS

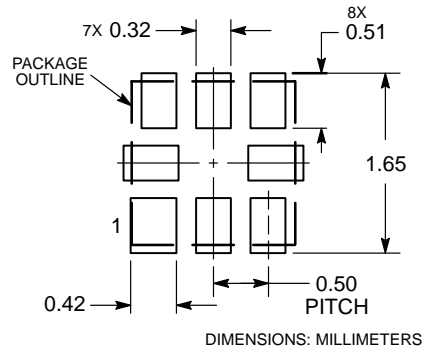
ULLGA8, 1.5x1.5, 0.5P  
CASE 613AG  
ISSUE A



- 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

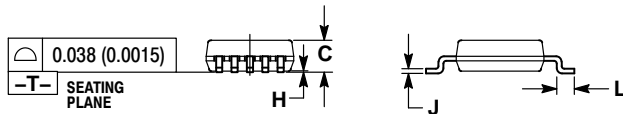
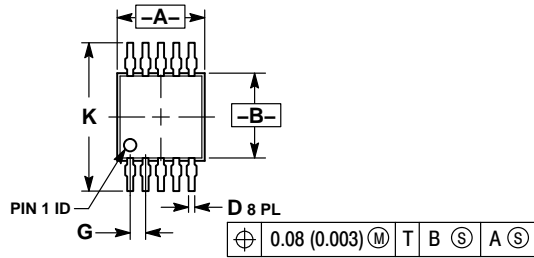


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# LMV981, LMV982

## PACKAGE DIMENSIONS

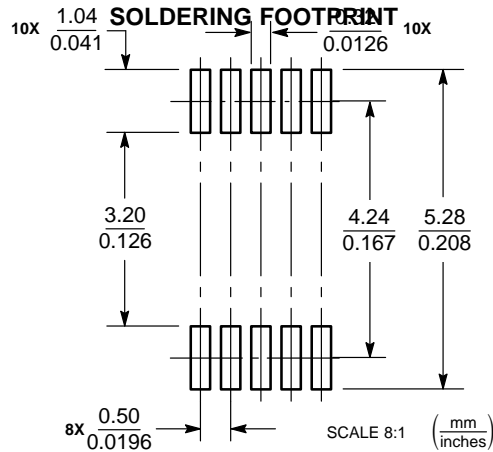
### Micro10 CASE 846B-03 ISSUE D



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

DIM	MILLIMETERS		INCHES	
	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



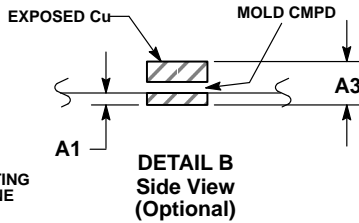
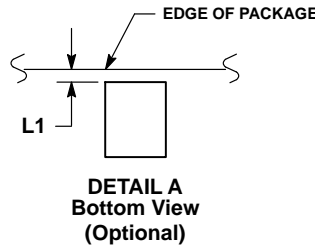
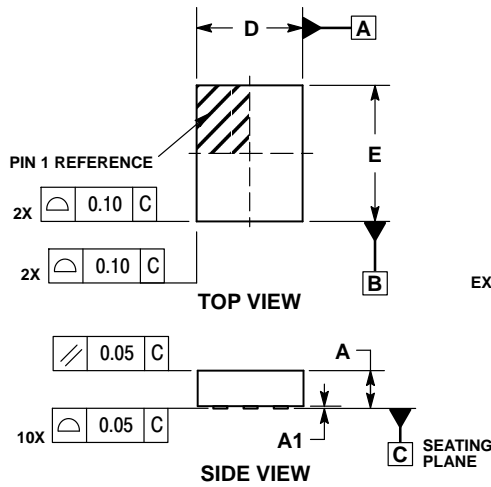
### Micro10

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

# LMV981, LMV982

## PACKAGE DIMENSIONS

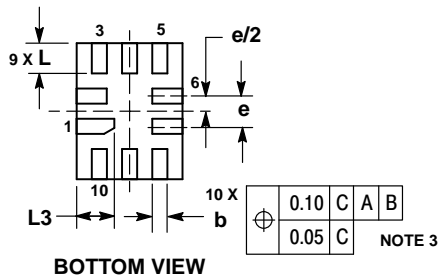
### UQFN10 1.4x1.8, 0.4P CASE 488AT ISSUE A



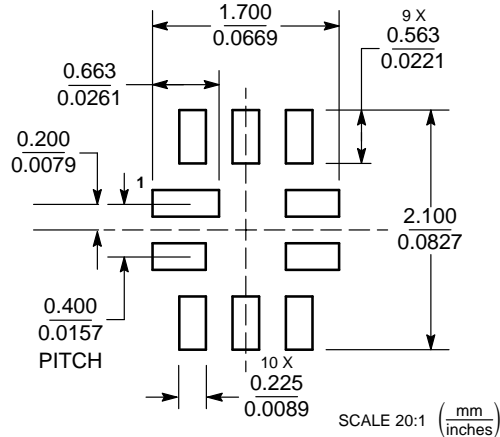
**NOTES:**

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.

DIM	MILLIMETERS	
	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.

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