

Description

The LMV321/LMV358/LMV324 are low voltage (2.7V to 5.5V) single, dual and quad operational amplifiers. The LMV321/LMV358/LMV324 are designed to effectively reduce cost and space at low voltage levels.

These devices have the capability of rail-to-rail output swing and input common-mode voltage range includes ground. They can also achieve an efficient speed-to-power ratio, utilizing 1 MHz bandwidth and 1 V/ μ s slew rate at a low supply current. Reducing noise pickup and increasing signal integrity can be achieved by placing the device close to the signal source.

The LMV321 is available in 5-Pin SOT353/SOT25 packages that reduce space on PC boards and portable electronic devices. The LMV324 is available in the SOP-14L and TSSOP-14L package.

The LMV358 is available in the MSOP-8L and SOP-8L packages.

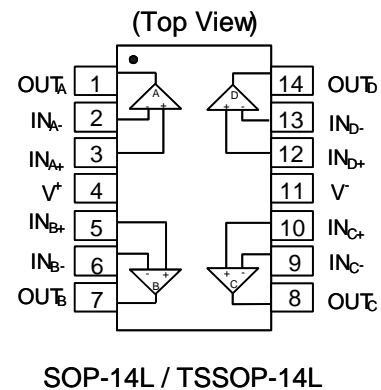
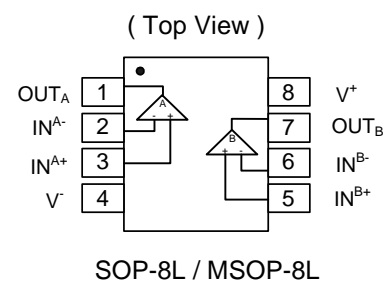
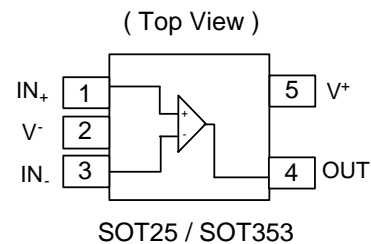
Features

(For $V^+ = 5V$ and $V^- = 0V$ typical unless otherwise noted)

- Guaranteed 2.7V and 5V performance
- Crossover distortion eliminated
- Operating temperature range (-40°C to +85°C)
- Gain-bandwidth product 1 MHz
- Low supply current
 - LMV321 110 μ A Typ
 - LMV358 190 μ A Typ
 - LMV324 340 μ A Typ
- Rail-to-rail output swing @ 10 k Ω
 - $V^+ - 10$ mV
 - $V^- + 10$ mV
- Input Common Mode Voltage Range (-0.2 to $V^+ - 0.8V$)
- Manufactured in standard CMOS process
- SOT353, SOT25, MSOP-8L, SOP-8L, SOP-14L & TSSOP-14L: Available in "Green" Molding Compound (No Br, Sb)
- Lead-free Finish/ RoHS Compliant (Note 1)

Notes: 1. EU Directive 2002/95/EC (RoHS). All applicable RoHS exemptions applied. Please visit our website at http://www.diodes.com/products/lead_free.html

Pin Assignments



Application

- Active filters
- General purpose low voltage applications
- General purpose portable devices

Absolute Maximum Ratings (Note 2)

Symbol	Description	Rating	Unit	
ESD HBM	Human Body Model ESD Protection	LMV321	4.0	KV
		LMV358	4.0	
		LMV324	4.5	
ESD MM	Machine Model ESD Protection	LMV321	350	V
		LMV358	350	
		LMV324	250	
	Differential Input Voltage	±Supply Voltage	V	
V ⁺ -V ⁻	Supply Voltage	5.5	V	
	Output Short Circuit to V ⁺	(Note 3)		
	Output Short Circuit to V ⁻	(Note 4)		
T _{ST}	Storage Temperature	-65 to 150	°C	
T _J	Maximum Junction Temperature	150	°C	

- Notes:
2. Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.
 3. Shorting output to V⁺ will adversely affect reliability.
 4. Shorting output to V⁻ will adversely affect reliability.

Recommended Operating Conditions

Symbol	Description	Rating	Unit
V ⁺ -V ⁻	Supply Voltage	2.7 to 5.5	V
T _A	Operating Ambient Temperature Range	-40 to +85	°C

Electrical Characteristics

2.7V DC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_A = 25^\circ\text{C}$, $V^+ = 2.7\text{V}$, $V^- = 0\text{V}$, $V_{\text{CM}} = 1.0\text{V}$, $V_O = V^+/2$ and $R_L > 1\text{M}\Omega$.

Symbol	Parameter	Test Conditions	Min (Note 6)	Typ. (Note 5)	Max (Note 6)	Unit
V_{OS}	Input Offset Voltage			1.7	7	mV
TCV_{OS}	Input Offset Voltage Average Drift			5		$\mu\text{V}/^\circ\text{C}$
I_B	Input Bias Current			10		nA
I_{OS}	Input Offset Current			5	50	nA
CMRR	Common Mode Rejection Ratio	$0\text{V} \leq V_{\text{CM}} \leq 1.7\text{V}$	50	63		dB
PSRR	Power Supply Rejection Ratio	$2.7\text{V} \leq V^+ \leq 5\text{V}$ $V_O = 1\text{V}$	50	60		dB
V_{CMR}	Input Common-Mode Voltage Range	For CMRR $\geq 50\text{dB}$	0	-0.2		V
				1.9	1.7	
V_O	Output Swing	$R_L = 10\text{ k}\Omega$ to 1.35V	$V^+ - 100$	$V^+ - 20$		mV
				20	100	
I_S	Supply Current	LMV321 Single amplifier		110	140	μA
		LMV358 Both amplifiers		190	340	μA
		LMV324 All four amplifiers		340	680	μA

2.7V AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_A = 25^\circ\text{C}$, $V^+ = 2.7\text{V}$, $V^- = 0\text{V}$, $V_{\text{CM}} = 1.0\text{V}$, $V_O = V^+/2$ and $R_L > 1\text{M}\Omega$.

GBWP	Gain-Bandwidth Product	$C_L = 200\text{ pF}$		1		MHz
ϕ_m	Phase Margin			60		Deg
Gm	Gain Margin			10		dB
e_n	Input-Referred Voltage Noise	$f > 50\text{ kHz}$		23		$\frac{\text{nV}}{\sqrt{\text{Hz}}}$

Electrical Characteristics (Continued)

5V DC Electrical Characteristics

Unless otherwise specified, all limits 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 $R_L > 1\text{M}\Omega$.

Symbol	Parameter	Test Conditions	Min (Note 6)	Typ. (Note 5)	Max (Note 6)	Unit		
V_{OS}	Input Offset Voltage	$T_A = 25^\circ\text{C}$		1.7	7	mV		
		$T_A = \text{full range}$			9			
TCV_{OS}	Input Offset Voltage Average Drift			5		$\mu\text{V}/^\circ\text{C}$		
I_B	Input Bias Current	$T_A = 25^\circ\text{C}$		15	250	nA		
		$T_A = \text{full range}$			500			
I_{OS}	Input Offset Current	$T_A = 25^\circ\text{C}$		5	50	nA		
		$T_A = \text{full range}$			150			
CMRR	Common Mode Rejection Ratio	$0\text{V} \leq V_{CM} \leq 4.0\text{V}$	50	65		dB		
PSRR	Power Supply Rejection Ratio	$2.7\text{V} \leq V^+ \leq 5\text{V}$ $V_O = 1\text{V}$, $V_{CM} = 1\text{V}$	50	60		dB		
V_{CMR}	Input Common-Mode Voltage Range	For CMRR $\geq 50\text{dB}$	0	-0.2		V		
				4.2	4.0			
A_V	Large Signal Voltage Gain	$R_L = 2\text{ k}\Omega$ (Note 7)	$T_A = 25^\circ\text{C}$	15	100	V/mV		
			$T_A = \text{full range}$	10				
V_O	Output Swing	$R_L = 2\text{ k}\Omega$ to 2.5V	High level	$T_A = 25^\circ\text{C}$	$V^+ - 300$	$V^+ - 50$	mV	
				$T_A = \text{full range}$	$V^+ - 400$			
			Low level	$T_A = 25^\circ\text{C}$		50		300
				$T_A = \text{full range}$				400
		$R_L = 10\text{ k}\Omega$ to 2.5V	High level	$T_A = 25^\circ\text{C}$	$V^+ - 100$	$V^+ - 10$		
				$T_A = \text{full range}$	$V^+ - 200$			
Low level	$T_A = 25^\circ\text{C}$			10	180			
	$T_A = \text{full range}$				280			
I_O	Output Short Circuit Current	Sourcing, $V_O = 0\text{V}$	5	60		mA		
		Sinking, $V_O = 5\text{V}$	10	90				
I_S	Supply Current	LMV321 Single amplifier			110	140	μA	
		LMV358 Both amplifiers	$T_A = 25^\circ\text{C}$		190	340		
			$T_A = \text{full range}$			600		
		LMV324 All four amplifiers	$T_A = 25^\circ\text{C}$		340	680		
$T_A = \text{full range}$				1100				
θ_{JA}	Thermal Resistance Junction-to-Ambient	SOT353 (Note 8)			330	$^\circ\text{C}/\text{W}$		
		SOT25 (Note 8)			250			
		TSSOP-14L (Note 8)			100			
		MSOP-8L (Note 8)			203			
		SOP-8L (Note 8)			150			
		SOP-14L (Note 8)			83			

Electrical Characteristics (Continued)

5V AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_A = 25^\circ\text{C}$, $V^+ = 5\text{V}$, $V^- = 0\text{V}$, $V_{\text{CM}} = 2.0\text{V}$, $V_O = V^+/2$ and $R_L > 1\text{M}\Omega$.

Boldface limits apply at the temperature extremes.

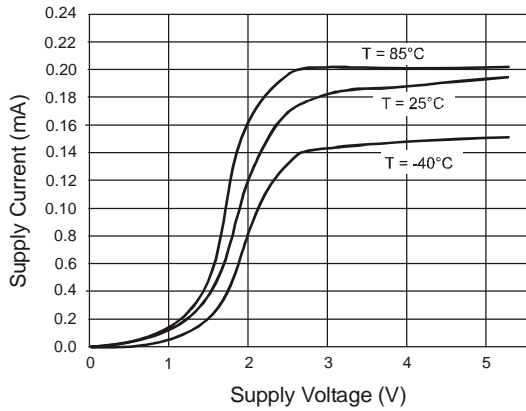
SR	Slew Rate	(Note 9)		1		V/ μs
GBWP	Gain-Bandwidth Product	$C_L = 200\text{ pF}$		1		MHz
Φ_m	Phase Margin			60		Deg
G_m	Gain Margin			10		dB
e_n	Input-Referred Voltage Noise	$f > 50\text{ kHz}$		23		$\frac{\text{nV}}{\sqrt{\text{Hz}}}$

- Notes:
- Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not guaranteed on shipped production material.
 - All limits are guaranteed by testing or statistical analysis.
 - R_L is connected to V^- . The output voltage is $0.5\text{V} \leq V_O \leq 4.5\text{V}$.
 - All numbers are typical, and apply for packages soldered directly onto a PC board in still air.
 - Connected as voltage follower with 3V step input. Number specified is the slower of the positive and negative slew rates.

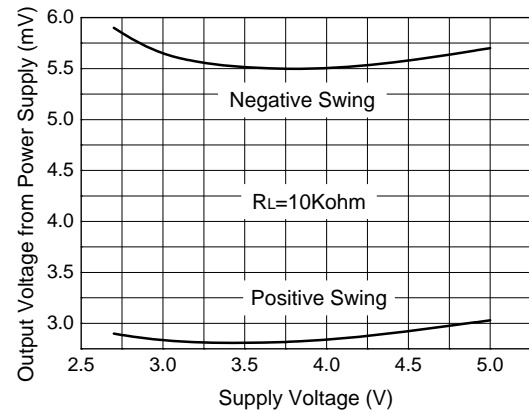
Typical Performance Characteristics

Unless otherwise specified, $V_s=+5V$, single supply, $T_A=25^\circ C$

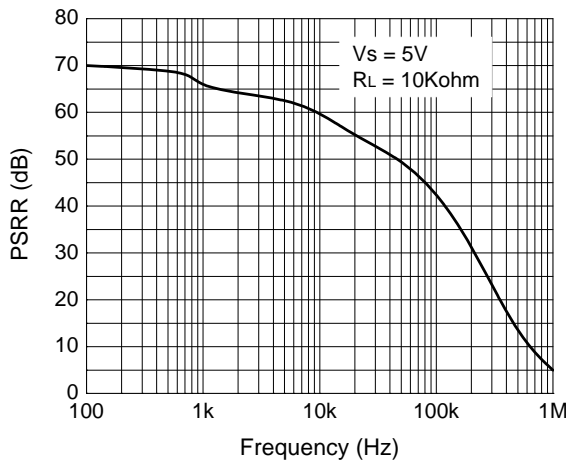
Supply Current vs. Supply Voltage



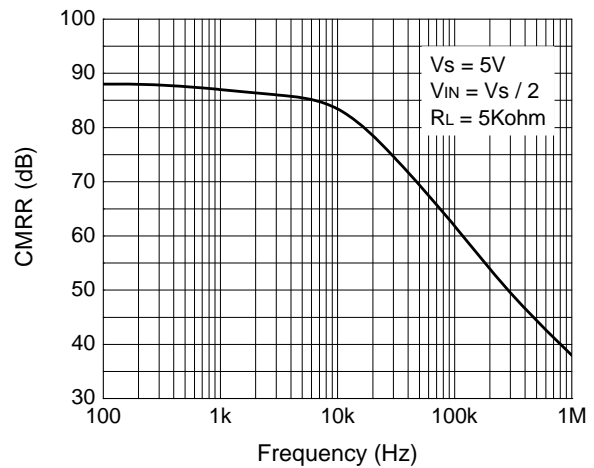
Output Voltage Swing vs. Supply Voltage



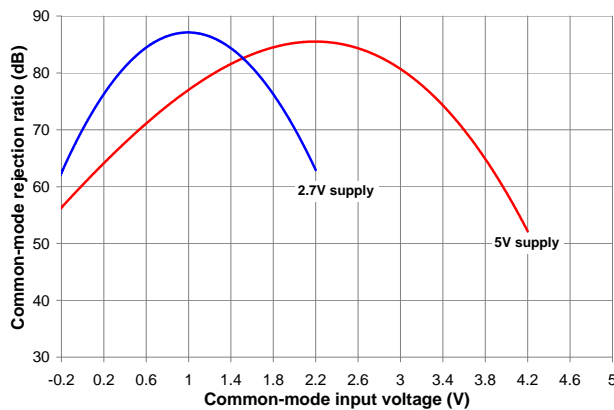
PSRR vs. Frequency



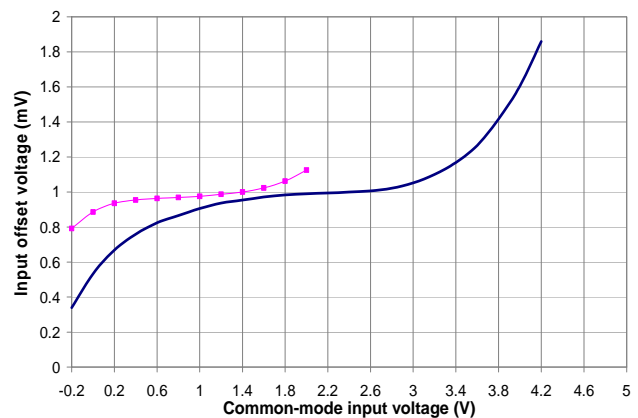
CMRR vs. Frequency



CMRR vs. Input Common Mode Voltage

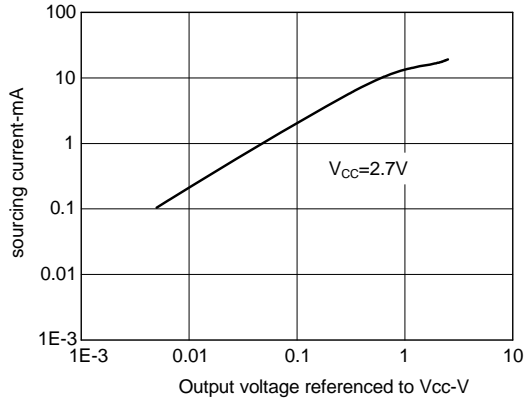


ΔV_{os} vs. CMR

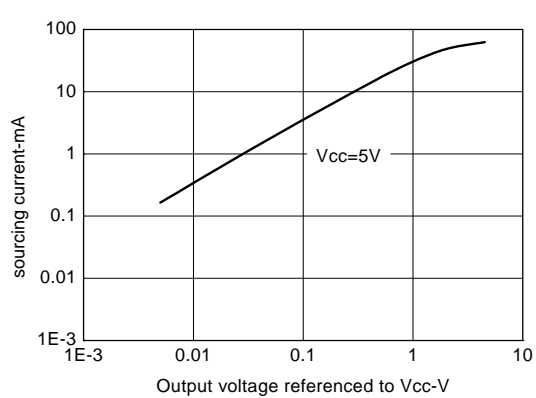


Typical Performance Characteristics (Continued)

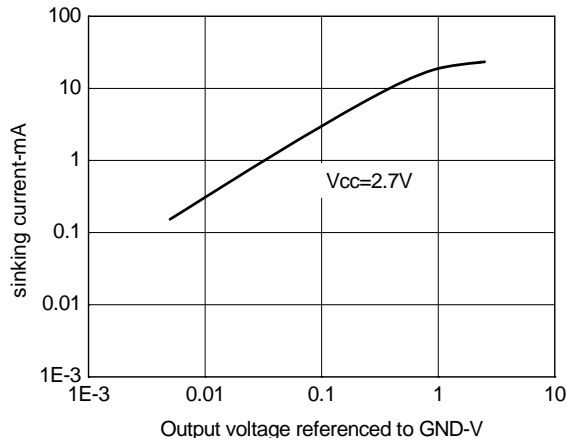
Sourcing Current vs. Output Voltage (2.7V)



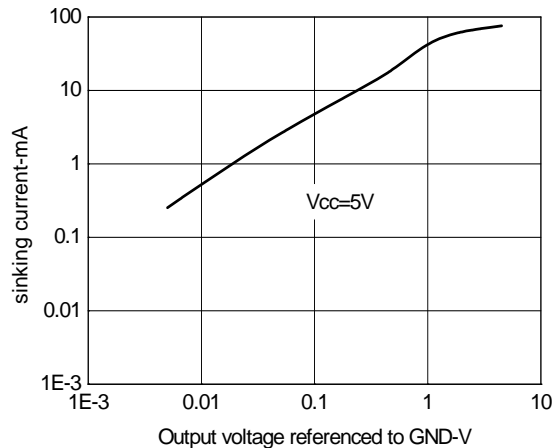
Sourcing Current vs. Output Voltage (5V)



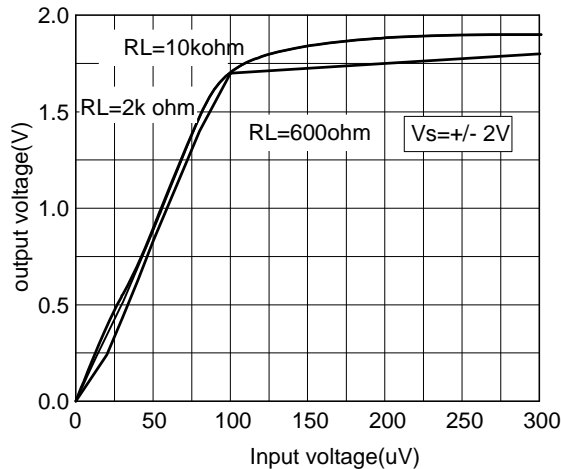
Sinking Current vs. Output Voltage (2.7V)



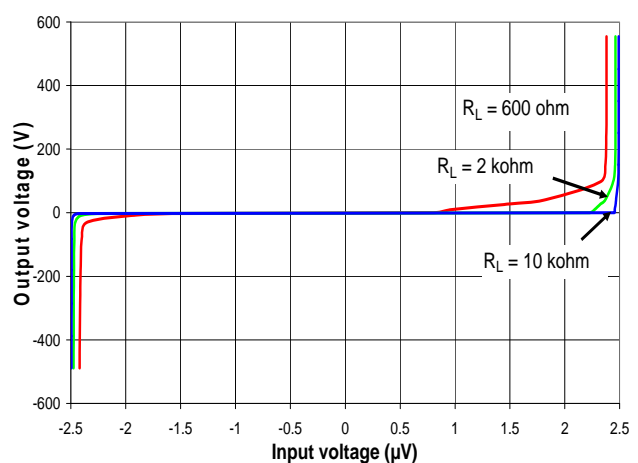
Sinking Current vs. Output Voltage (5V)



Input Voltage vs. Output Voltage

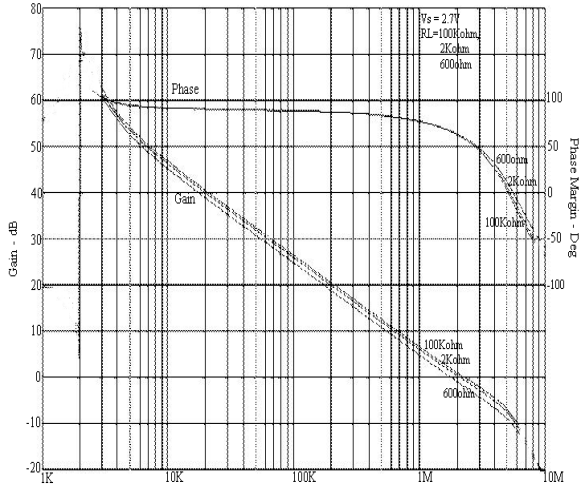


Output voltage vs. input voltage

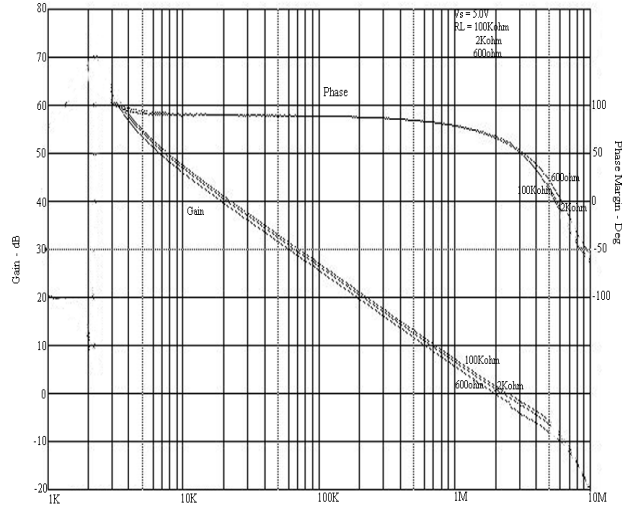


Typical Performance Characteristics (Continued)

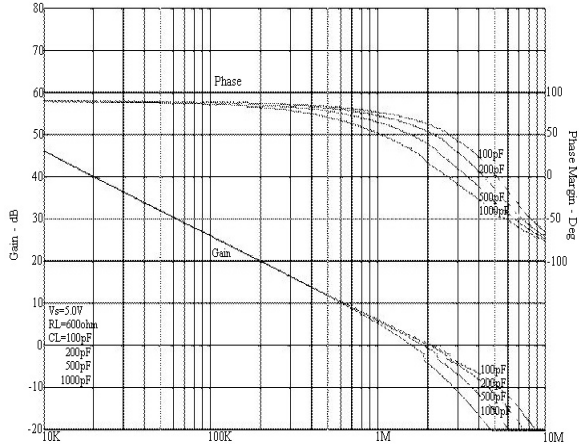
Frequency Response vs. Resistive Load (2.7V)



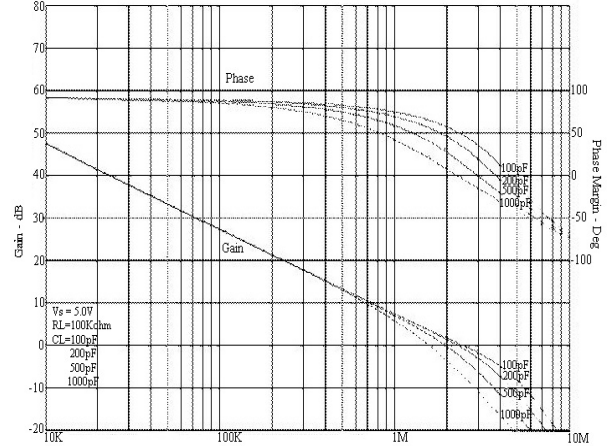
Frequency Response vs. Resistive Load (5V)



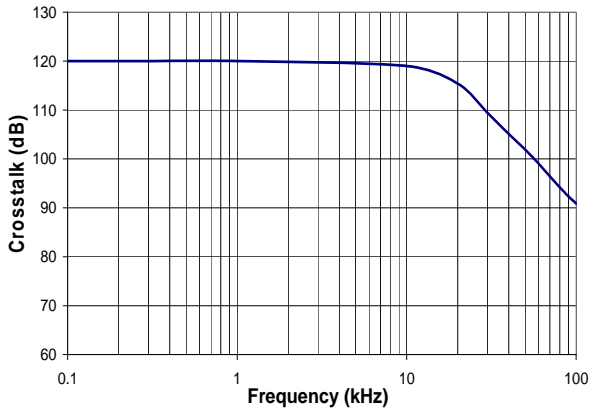
Frequency Response vs. Capacitive Load (2.7V)



Frequency Response vs. Capacitive Load (5V)

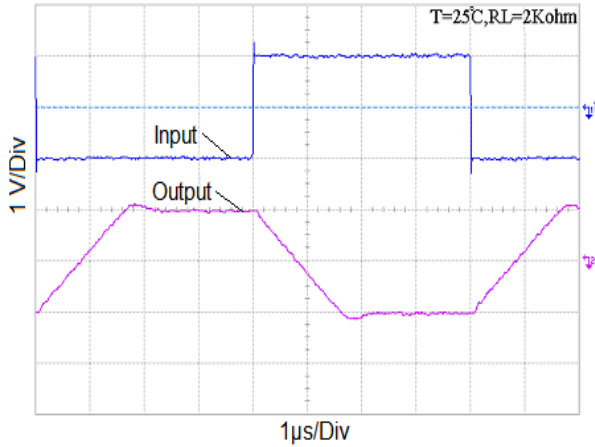


Crosstalk vs. Frequency

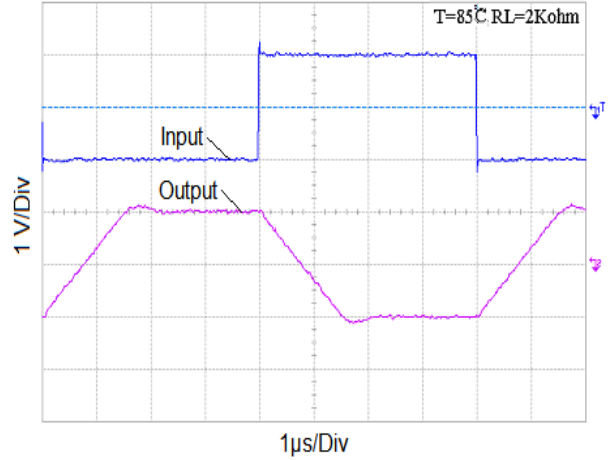


Typical Performance Characteristics (Continued)

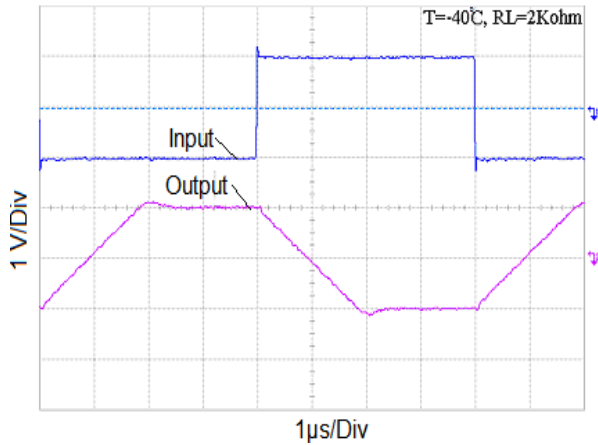
Inverting Large Signal Pulse Response



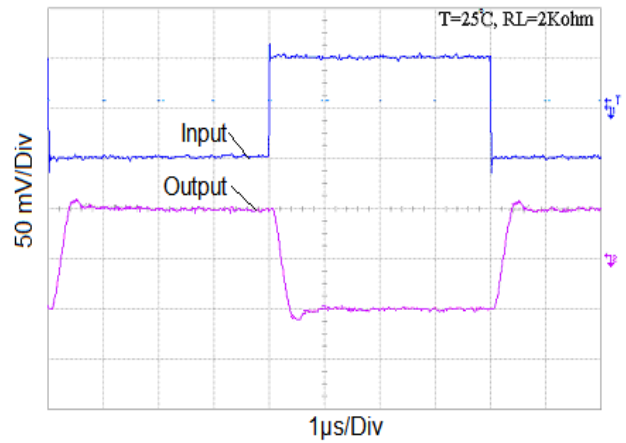
Inverting Large Signal Pulse Response



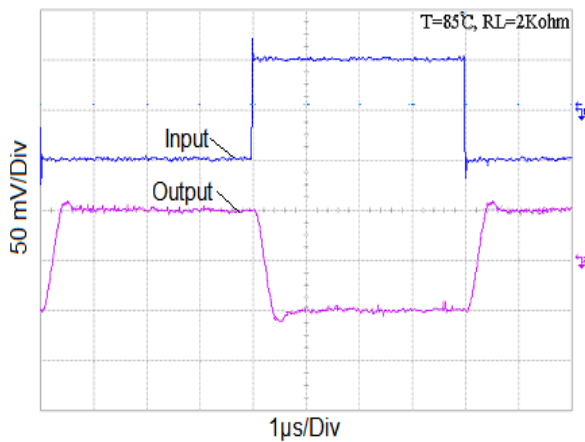
Inverting Large Signal Pulse Response



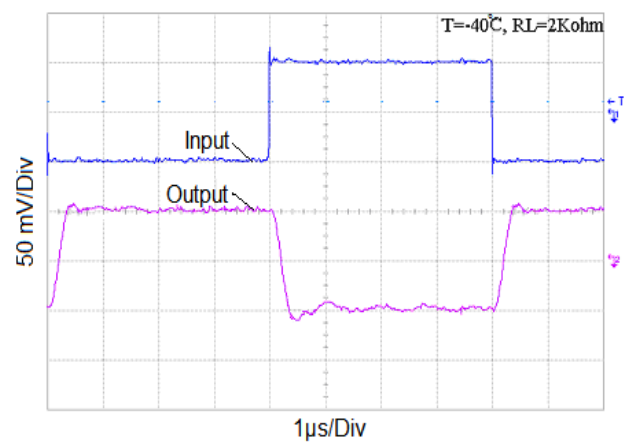
Inverting Small Signal Pulse Response



Inverting Small Signal Pulse Response

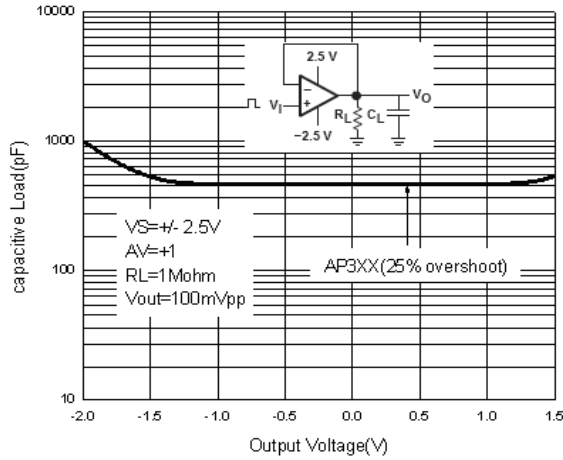


Inverting Small Signal Pulse Response

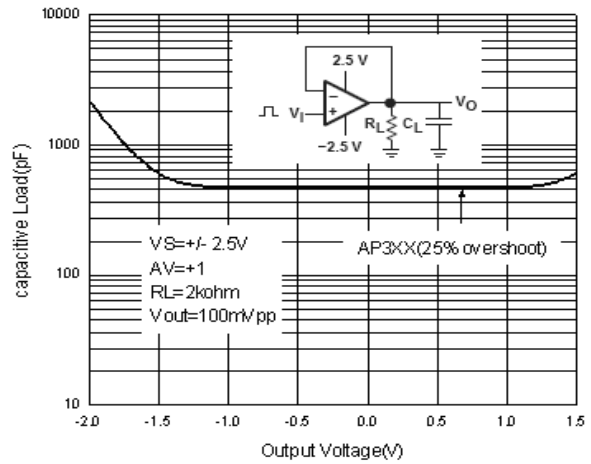


Typical Performance Characteristics (Continued)

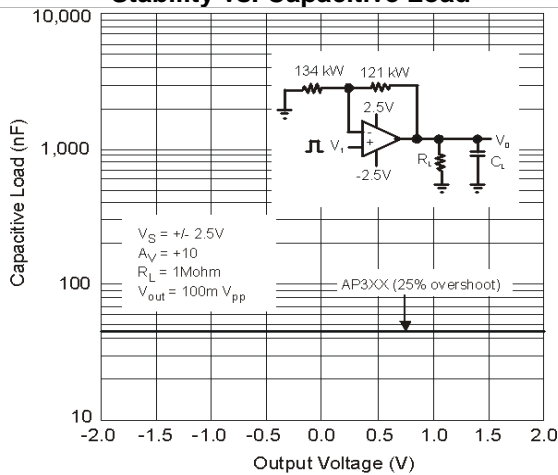
Stability vs. Capacitive Load



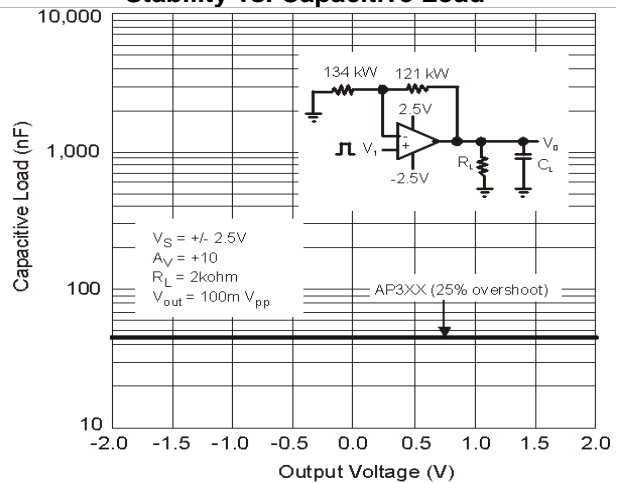
Stability vs. Capacitive Load



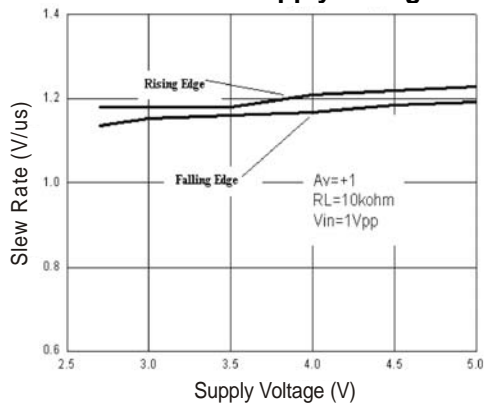
Stability vs. Capacitive Load



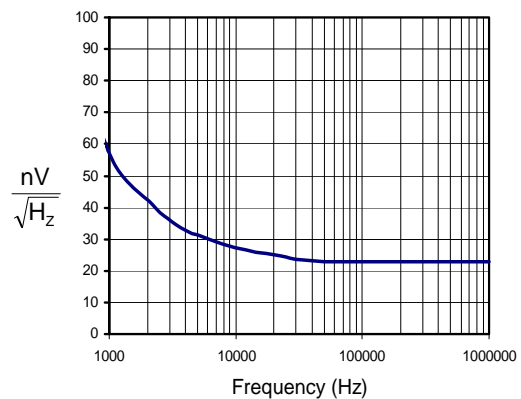
Stability vs. Capacitive Load



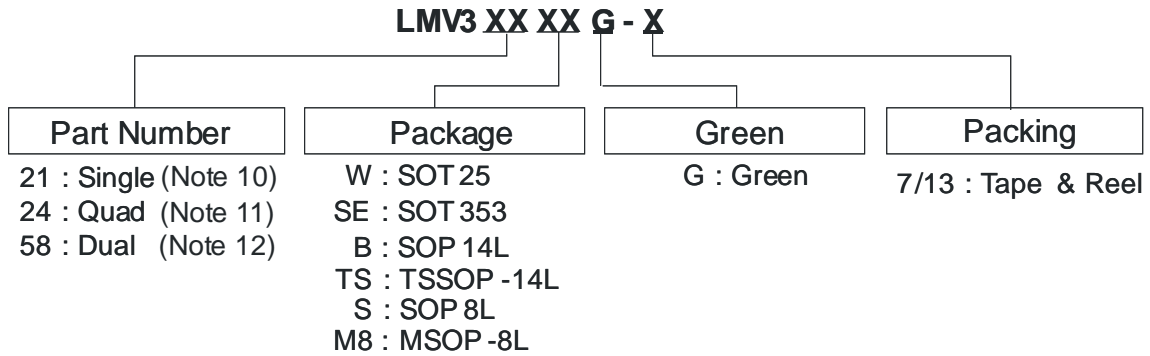
Slew Rate vs. Supply Voltage



Input Voltage Noise



Ordering Information



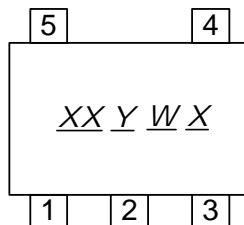
Device	Package Code	Packaging (Note 13)	7"/13" Tape and Reel	
			Quantity	Part Number Suffix
LMV321WG-7	W	SOT25	3000/Tape & Reel	-7
LMV321SEG-7	SE	SOT353	3000/Tape & Reel	-7
LMV324BG-13	B	SOP-14L	2500/Tape & Reel	-13
LMV324TSG-13	TS	TSSOP-14L	2500/Tape & Reel	-13
LMV358SG-13	S	SOP-8L	2500/Tape & Reel	-13
LMV358M8G-13	M8	MSOP-8L	2500/Tape & Reel	-13

Notes: 10. LMV321 is only available for SOT25 and SOT353.
 11. LMV324 is only available for SOP-14L and TSSOP-14L.
 12. LMV358 is only available for SOP-8L and MSOP-8L.
 13. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.

Marking Information

SOT25 / SOT353

(Top View)

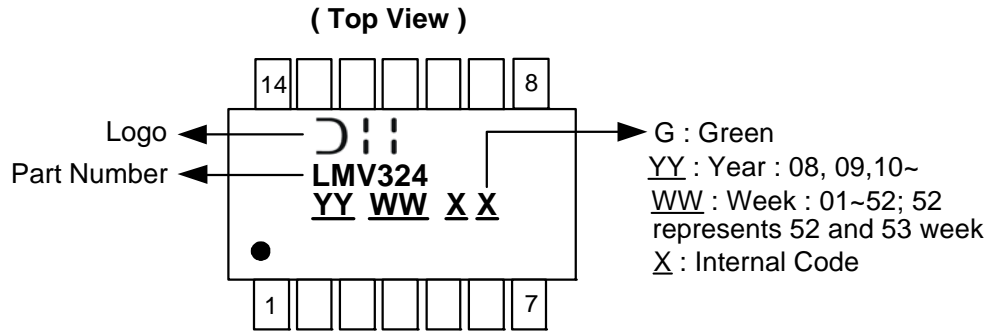


XX : Identification Code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
 a~z : 27~52 week;
 z represents 52 and 53 week
X : A~Z : Green

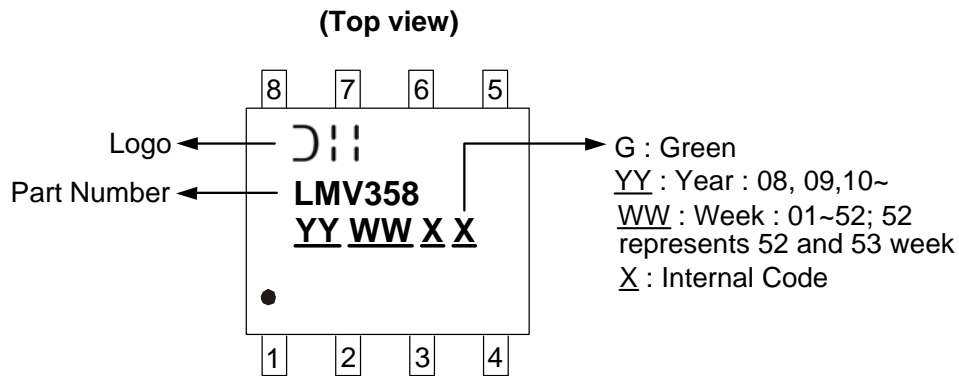
Device	Package type	Identification Code
LMV321W	SOT25	BX
LMV321SE	SOT353	BY

Marking Information (Continued)

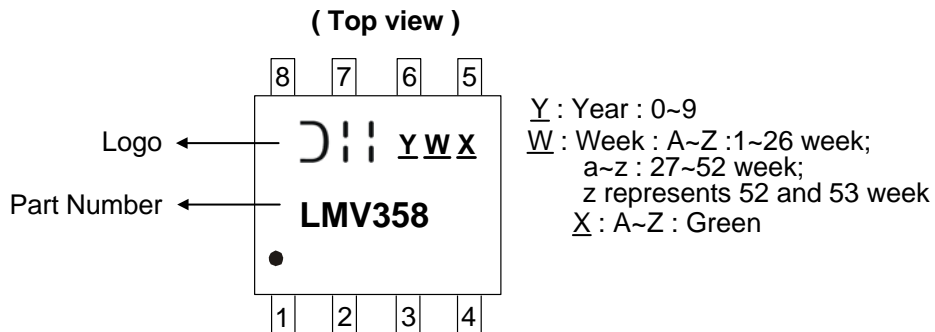
SOP-14L / TSSOP-14L



SOP-8L

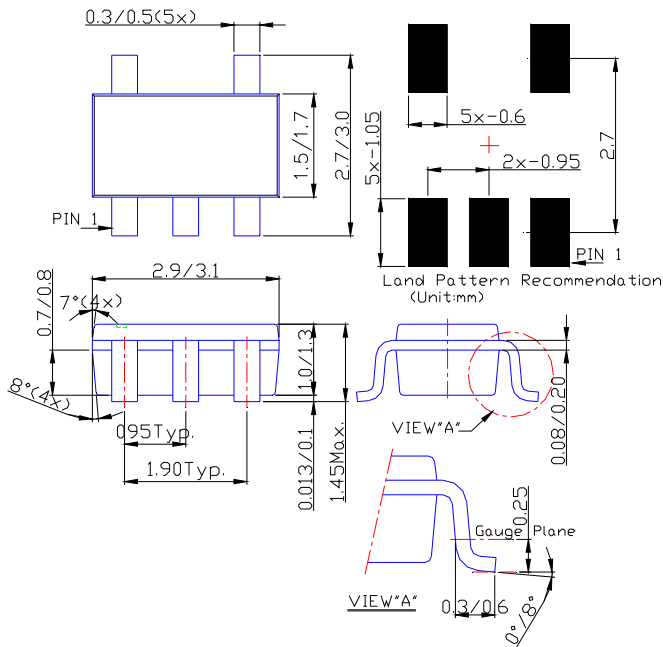


MSOP-8L

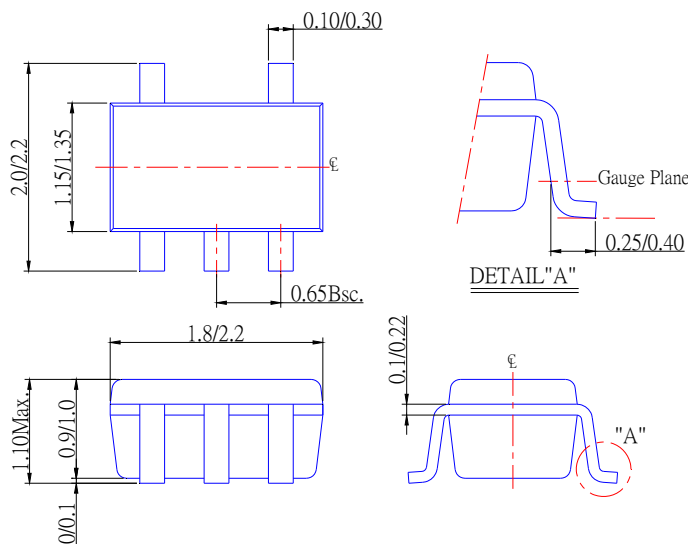


Package Information

Package Type: SOT25

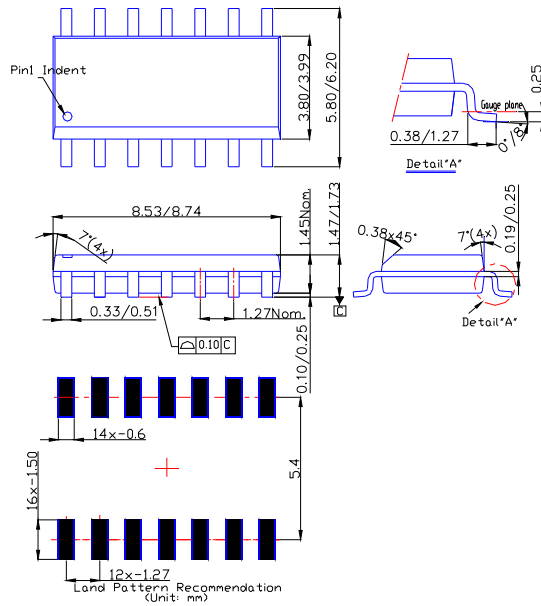


Package Type: SOT353

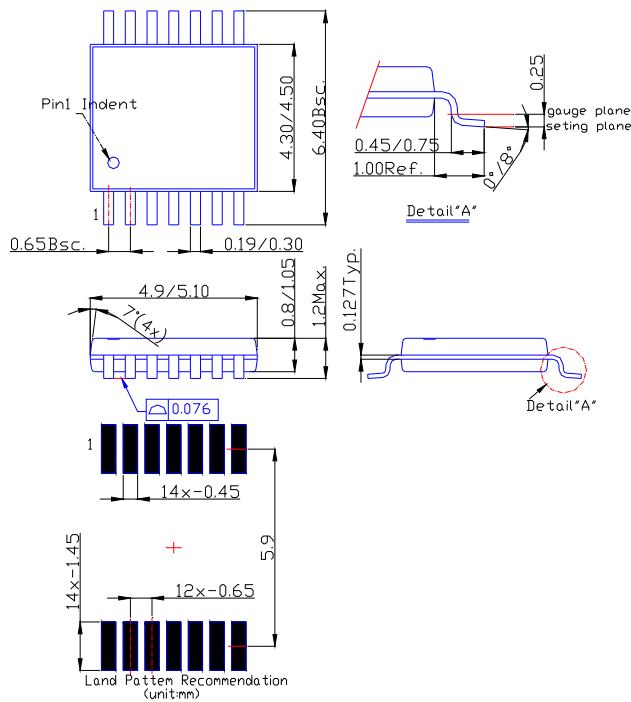


Package Information (Continued)

Package Type: SOP-14L

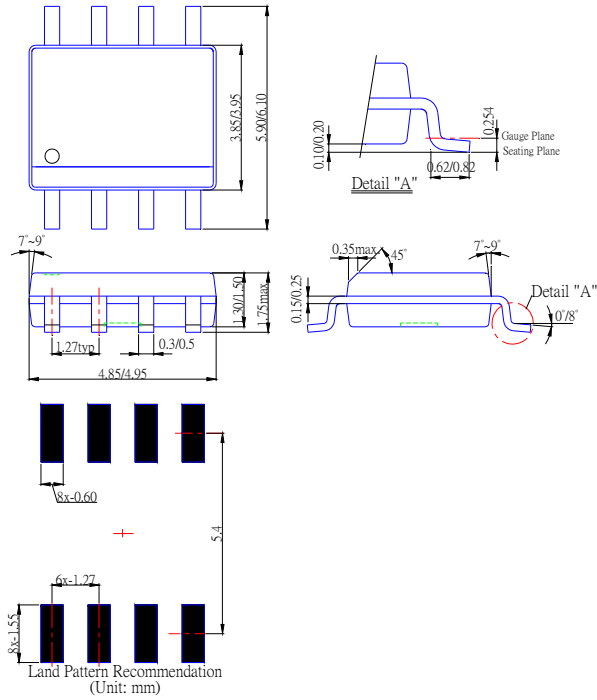


Package Type: TSSOP-14L

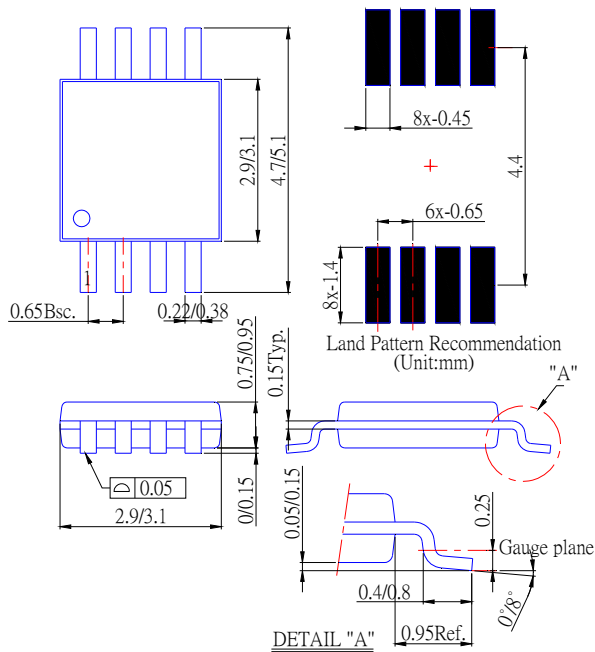


Package Information (Continued)

Package Type: SOP-8L



Package Type: MSOP-8L



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1. are intended to implant into the body, or
2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

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