

# Single, Dual, Quad Low-Voltage, Rail-to-Rail Operational Amplifiers

## LMV321, NCV321, LMV358, LMV324

The LMV321, LMV321I, NCV321, LMV358/LMV358I and LMV324 are CMOS single, dual, and quad low voltage operational amplifiers with rail-to-rail output swing. These amplifiers are a cost-effective solution for applications where low power consumption and space saving packages are critical. Specification tables are provided for operation from power supply voltages at 2.7 V and 5 V. Rail-to-Rail operation provides improved signal-to-noise performance. Ultra low quiescent current makes this series of amplifiers ideal for portable, battery operated equipment. The common mode input range includes ground making the device useful for low-side current-shunt measurements. The ultra small packages allow for placement on the PCB in close proximity to the signal source thereby reducing noise pickup.

### Features

- Operation from 2.7 V to 5.0 V Single-Sided Power Supply
- LMV321 Single Available in Ultra Small 5 Pin SC70 Package
- No Output Crossover Distortion
- Rail-to-Rail Output
- Low Quiescent Current: LMV358 Dual – 220  $\mu$ A, Max per Channel
- No Output Phase-Reversal from Overdriven Input
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

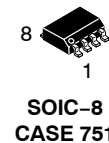
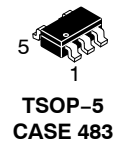
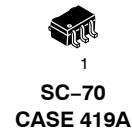
### Typical Applications

- Notebook Computers and PDA's
- Portable Battery-Operated Instruments
- Active Filters



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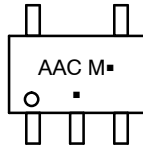
### ORDERING AND MARKING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 12 of this data sheet.

# LMV321, NCV321, LMV358, LMV324

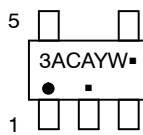
## MARKING DIAGRAMS

SC-70



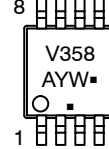
AAC = Specific Device Code  
 M = Date Code  
 ■ = Pb-Free Package  
 (Note: Microdot may be in either location)

TSOP-5



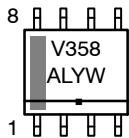
3AC = Specific Device Code  
 A = Assembly Location  
 Y = Year  
 W = Work Week  
 ■ = Pb-Free Package  
 (Note: Microdot may be in either location)

Micro8



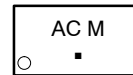
V358 = Specific Device Code  
 A = Assembly Location  
 Y = Year  
 W = Work Week  
 ■ = Pb-Free Package  
 (Note: Microdot may be in either location)

SOIC-8



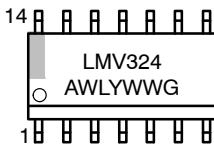
V358 = Specific Device Code  
 A = Assembly Location  
 L = Wafer Lot  
 Y = Year  
 W = Work Week  
 ■ = Pb-Free Package

UDFN8



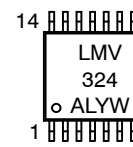
AC = Specific Device Code  
 M = Date Code  
 ■ = Pb-Free Package

SOIC-14



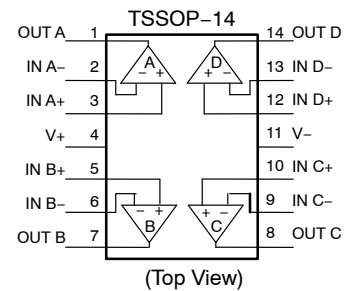
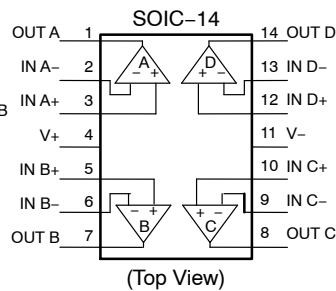
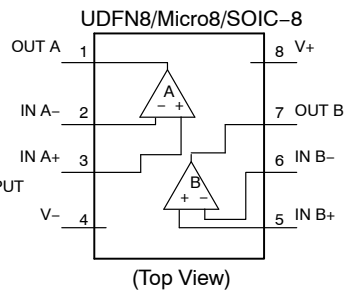
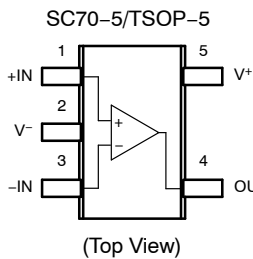
LMV324 = Specific Device Code  
 A = Assembly Location  
 WL = Wafer Lot  
 Y = Year  
 WW = Work Week  
 G = Pb-Free Package

TSSOP-14



LMV324 = Specific Device Code  
 A = Assembly Location  
 L = Wafer Lot  
 Y = Year  
 W = Work Week  
 ■ = Pb-Free Package

## PIN CONNECTIONS



# LMV321, NCV321, LMV358, LMV324

## 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	150	$^{\circ}\text{C}$
$T_A$	Operating Ambient Temperature Range	LMV321, LMV358, LMV324 LMV321, LMV358I NCV321 (Note 2)	$^{\circ}\text{C}$ $^{\circ}\text{C}$ $^{\circ}\text{C}$
$\theta_{JA}$	Thermal Resistance:		$^{\circ}\text{C}/\text{W}$
	SC-70	280	
	Micro8	238	
	TSOP-5	333	
	UDFN8 (1.2 mm x 1.8 mm x 0.5 mm)	350	
	SOIC-8	212	
	SOIC-14	156	
	TSSOP-14	190	
$T_{stg}$	Storage Temperature	$-65\text{ to }150$	$^{\circ}\text{C}$
	Mounting Temperature (Infrared or Convection $-20\text{ sec}$ )	260	$^{\circ}\text{C}$
$V_{ESD}$	ESD Tolerance (Note 3)		V
	LMV321, LMV321I, NCV321		
	Machine Model	100	
	Human Body Model	1000	
LMV358/358I/324			
Machine Model	100		
Human Body Mode	2000		

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.

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.
2. NCV prefix is qualified for automotive usage.
3. Human Body Model, applicable std. MIL-STD-883, Method 3015.7  
Machine Model, applicable std. JESD22-A115-A (ESD MM std. of JEDEC)  
Field-Induced Charge-Device Model, applicable std. JESD22-C101-C (ESD FICDM std. of JEDEC).

## LMV321, NCV321, LMV358, LMV324

**2.7 V DC ELECTRICAL CHARACTERISTICS** (Unless otherwise specified, all limits are guaranteed for  $T_A = 25^\circ\text{C}$ ,  $V^+ = 2.7\text{ V}$ ,  $R_L = 1\text{ M}\Omega$ ,  $V^- = 0\text{ V}$ ,  $V_O = V^+/2$ )

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Offset Voltage	$V_{IO}$	$T_A = T_{Low}$ to $T_{High}$ (Note 4)		1.7	9	mV
Input Offset Voltage Average Drift	$ICV_{OS}$	$T_A = T_{Low}$ to $T_{High}$ (Note 4)		5		$\mu\text{V}/^\circ\text{C}$
Input Bias Current	$I_B$	$T_A = T_{Low}$ to $T_{High}$ (Note 4)		<1		nA
Input Offset Current	$I_{IO}$	$T_A = T_{Low}$ to $T_{High}$ (Note 4)		<1		nA
Common Mode Rejection Ratio	CMRR	$0\text{ V} \leq V_{CM} \leq 1.7\text{ V}$	50	63		dB
Power Supply Rejection Ratio	PSRR	$2.7\text{ V} \leq V^+ \leq 5\text{ V}$ , $V_O = 1\text{ V}$	50	60		dB
Input Common-Mode Voltage Range	$V_{CM}$	For CMRR $\geq 50\text{ dB}$	0 to 1.7	-0.2 to 1.9		V
Output Swing	$V_{OH}$	$R_L = 10\text{ k}\Omega$ to $1.35\text{ V}$	$V_{CC} - 100$	$V_{CC} - 10$		mV
	$V_{OL}$	$R_L = 10\text{ k}\Omega$ to $1.35\text{ V}$ (Note 5)		60	180	mV
Supply Current LMV321, NCV321 LMV358/LMV358I (Both Amplifiers) LMV324 (4 Amplifiers)	$I_{CC}$			80 140 260	185 340 680	$\mu\text{A}$

**2.7 V AC ELECTRICAL CHARACTERISTICS** (Unless otherwise specified, all limits are guaranteed for  $T_A = 25^\circ\text{C}$ ,  $V^+ = 2.7\text{ V}$ ,  $R_L = 1\text{ M}\Omega$ ,  $V^- = 0\text{ V}$ ,  $V_O = V^+/2$ )

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Gain Bandwidth Product	GBWP	$C_L = 200\text{ pF}$		1		MHz
Phase Margin	$\Theta_m$			60		$^\circ$
Gain Margin	$G_m$			10		dB
Input-Referred Voltage Noise	$e_n$	$f = 50\text{ kHz}$		50		$\text{nV}/\sqrt{\text{Hz}}$

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.

4. For LMV321, LMV358, LMV324:  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$   
For LMV321I, LMV358I, NCV321:  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .
5. Guaranteed by design and/or characterization.

## LMV321, NCV321, LMV358, LMV324

**5.0 V DC ELECTRICAL CHARACTERISTICS** (Unless otherwise specified, all limits are guaranteed for  $T_A = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{ V}$ ,  $R_L = 1\text{ M}\Omega$ ,  $V^- = 0\text{ V}$ ,  $V_O = V^+/2$ )

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Offset Voltage	$V_{IO}$	$T_A = T_{Low}$ to $T_{High}$ (Note 6)		1.7	9	mV
Input Offset Voltage Average Drift	$T_C V_{IO}$	$T_A = T_{Low}$ to $T_{High}$ (Note 6)		5		$\mu\text{V}/^\circ\text{C}$
Input Bias Current (Note 7)	$I_B$	$T_A = T_{Low}$ to $T_{High}$ (Note 6)		< 1		nA
Input Offset Current (Note 7)	$I_{IO}$	$T_A = T_{Low}$ to $T_{High}$ (Note 6)		< 1		nA
Common Mode Rejection Ratio	CMRR	$0\text{ V} \leq V_{CM} \leq 4\text{ V}$	50	65		dB
Power Supply Rejection Ratio	PSRR	$2.7\text{ V} \leq V^+ \leq 5\text{ V}$ , $V_O = 1\text{ V}$ , $V_{CM} = 1\text{ V}$	50	60		dB
Input Common-Mode Voltage Range	$V_{CM}$	For CMRR $\geq 50\text{ dB}$	0 to 4	-0.2 to 4.2		V
Large Signal Voltage Gain (Note 7)	$A_V$	$R_L = 2\text{ k}\Omega$	15	100		V/mV
		$T_A = T_{Low}$ to $T_{High}$ (Note 6)	10			
Output Swing	$V_{OH}$	$R_L = 2\text{ k}\Omega$ to $2.5\text{ V}$ $T_A = T_{Low}$ to $T_{High}$ (Note 6)	$V_{CC} - 300$ $V_{CC} - 400$	$V_{CC} - 40$		mV
	$V_{OL}$	$R_L = 2\text{ k}\Omega$ to $2.5\text{ V}$ (Note 7) $T_A = T_{Low}$ to $T_{High}$ (Note 6)		120	300 400	mV
	$V_{OH}$	$R_L = 10\text{ k}\Omega$ to $2.5\text{ V}$ (Note 7) $T_A = T_{Low}$ to $T_{High}$ (Note 6)	$V_{CC} - 100$ $V_{CC} - 200$			mV
	$V_{OL}$	$R_L = 10\text{ k}\Omega$ to $2.5\text{ V}$ $T_A = T_{Low}$ to $T_{High}$ (Note 6)		65	180 280	mV
Output Short Circuit Current	$I_O$	Sourcing = $V_O = 0\text{ V}$ (Note 7)	10	60		mA
		Sinking = $V_O = 5\text{ V}$ (Note 7)	10	160		
Supply Current	$I_{CC}$	LMV321 $T_A = T_{Low}$ to $T_{High}$ (Note 6)		130	250 350	$\mu\text{A}$
		NCV321 $T_A = T_{Low}$ to $T_{High}$ (Note 6)		130	250 350	
		LMV358/358I Both Amplifiers $T_A = T_{Low}$ to $T_{High}$ (Note 6)		210	440 615	
		LMV324 All Four Amplifiers $T_A = T_{Low}$ to $T_{High}$ (Note 6)		410	830 1160	

**5.0 V AC ELECTRICAL CHARACTERISTICS** (Unless otherwise specified, all limits are guaranteed for  $T_A = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{ V}$ ,  $R_L = 1\text{ M}\Omega$ ,  $V^- = 0\text{ V}$ ,  $V_O = V^+/2$ )

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Slew Rate	$S_R$			1		V/ $\mu\text{s}$
Gain Bandwidth Product	GBWP	$C_L = 200\text{ pF}$		1		MHz
Phase Margin	$\theta_m$			60		$^\circ$
Gain Margin	$G_m$			10		dB
Input-Referred Voltage Noise	$e_n$	$f = 50\text{ kHz}$		50		$\text{nV}/\sqrt{\text{Hz}}$

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.

6. For LMV321, LMV358, LMV324:  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$   
 For LMV321I, LMV358I, NCV321:  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .
7. Guaranteed by design and/or characterization.

TYPICAL CHARACTERISTICS

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

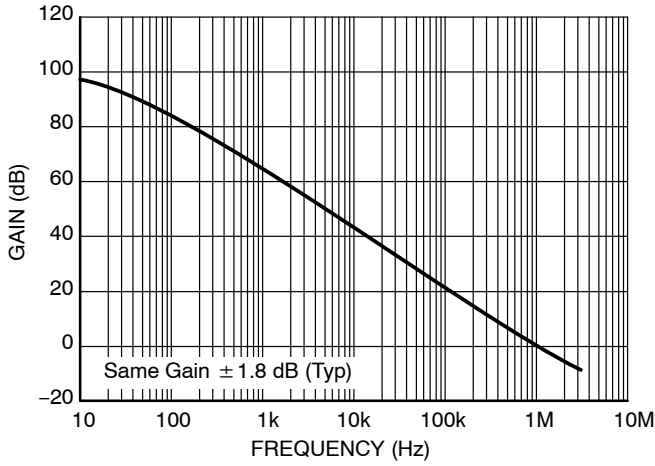


Figure 1. Open Loop Frequency Response  
( $R_L = 2\text{ k}\Omega$ ,  $T_A = 25^\circ\text{C}$ ,  $V_S = 5\text{ V}$ )

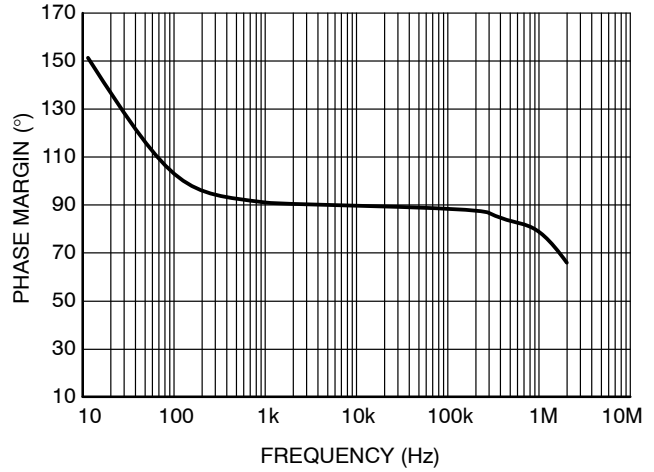


Figure 2. Open Loop Phase Margin  
( $R_L = 2\text{ k}\Omega$ ,  $T_A = 25^\circ\text{C}$ ,  $V_S = 5\text{ V}$ )

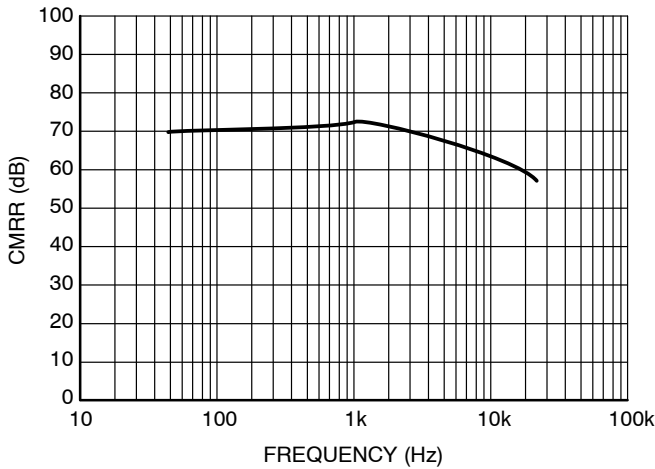


Figure 3. CMRR vs. Frequency  
( $R_L = 5\text{ k}\Omega$ ,  $V_S = 5\text{ V}$ )

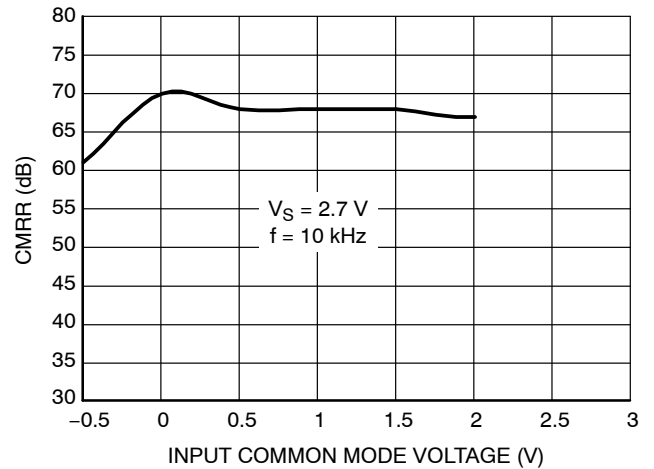


Figure 4. CMRR vs. Input Common Mode Voltage

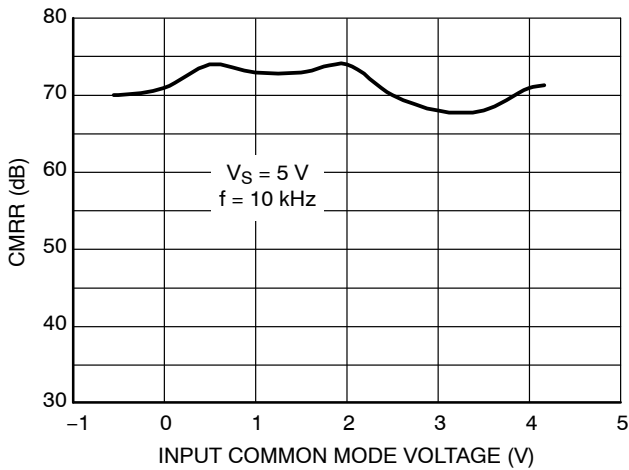


Figure 5. CMRR vs. Input Common Mode Voltage

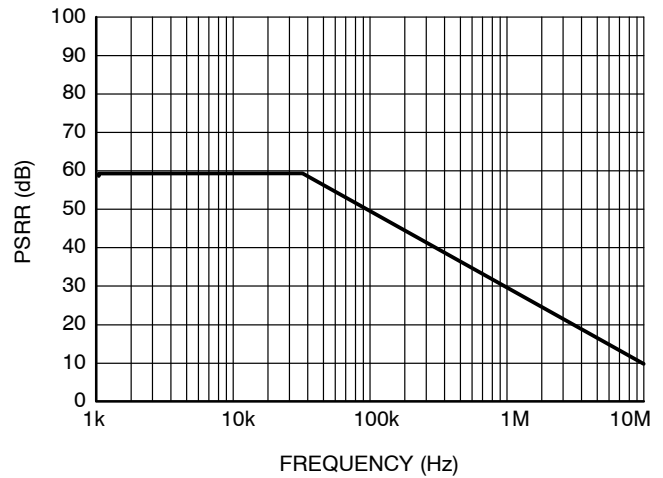
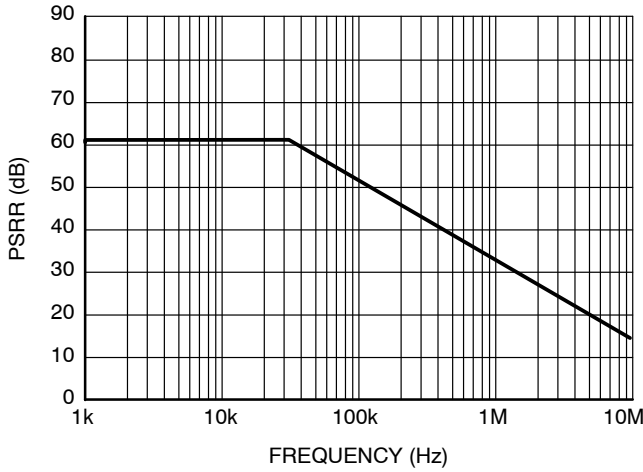


Figure 6. PSRR vs. Frequency  
( $R_L = 5\text{ k}\Omega$ ,  $V_S = 2.7\text{ V}$ , +PSRR)

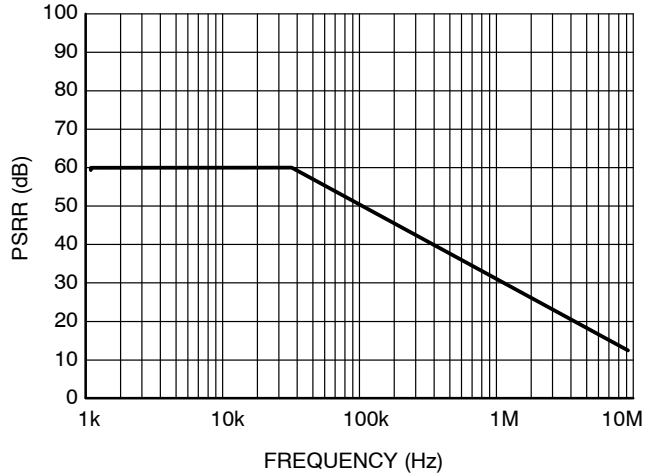
# LMV321, NCV321, LMV358, LMV324

## TYPICAL CHARACTERISTICS

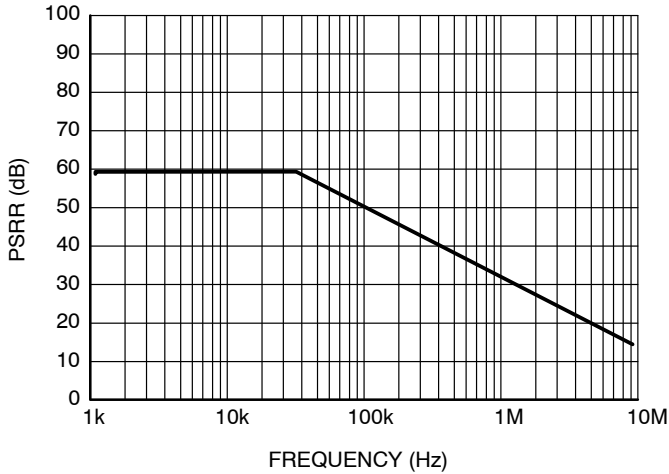
( $T_A = 25^\circ\text{C}$  and  $V_S = 5\text{ V}$  unless otherwise specified)



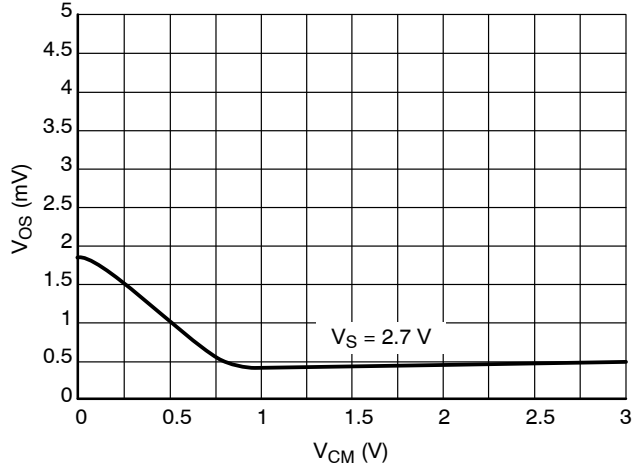
**Figure 7. PSRR vs. Frequency**  
( $R_L = 5\text{ k}\Omega$ ,  $V_S = 2.7\text{ V}$ , -PSRR)



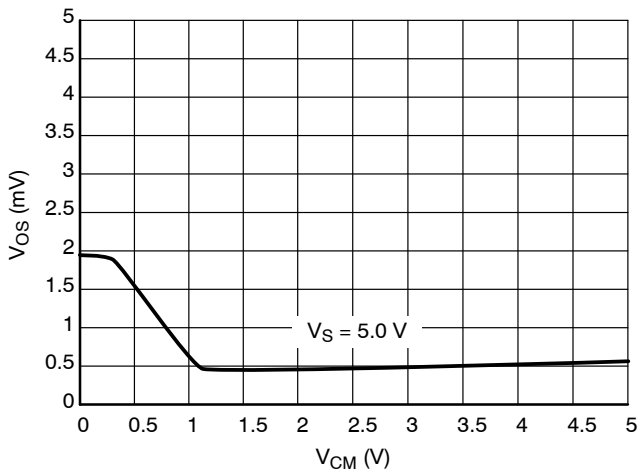
**Figure 8. PSRR vs. Frequency**  
( $R_L = 5\text{ k}\Omega$ ,  $V_S = 5\text{ V}$ , +PSRR)



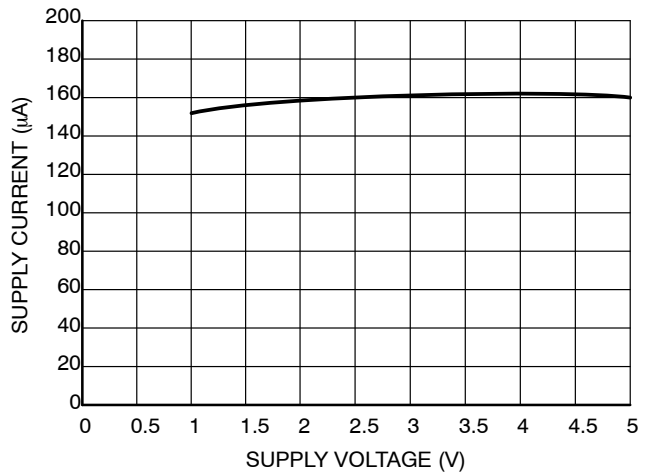
**Figure 9. PSRR vs. Frequency**  
( $R_L = 5\text{ k}\Omega$ ,  $V_S = 5\text{ V}$ , -PSRR)



**Figure 10.  $V_{OS}$  vs. CMR**



**Figure 11.  $V_{OS}$  vs. CMR**



**Figure 12. Supply Current vs. Supply Voltage**

# LMV321, NCV321, LMV358, LMV324

## TYPICAL CHARACTERISTICS

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

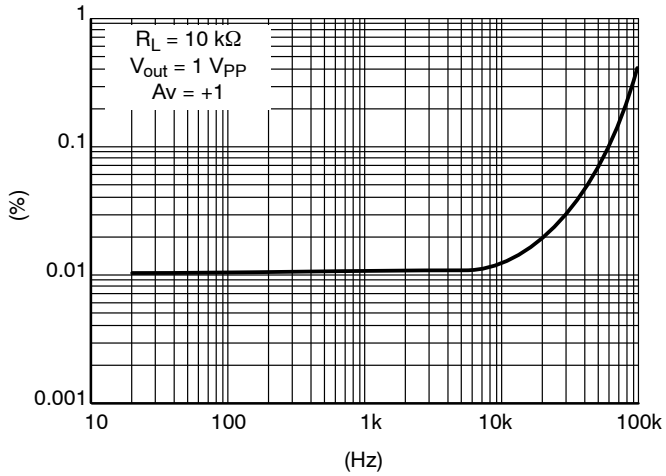


Figure 13. THD+N vs Frequency

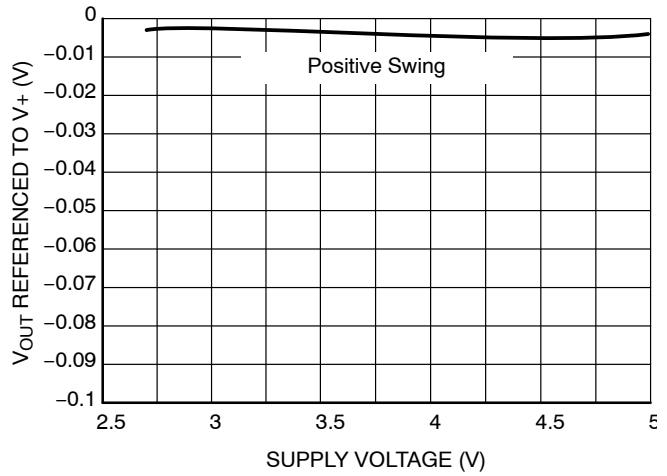


Figure 14. Output Voltage Swing vs Supply Voltage ( $R_L = 10\text{ k}$ )

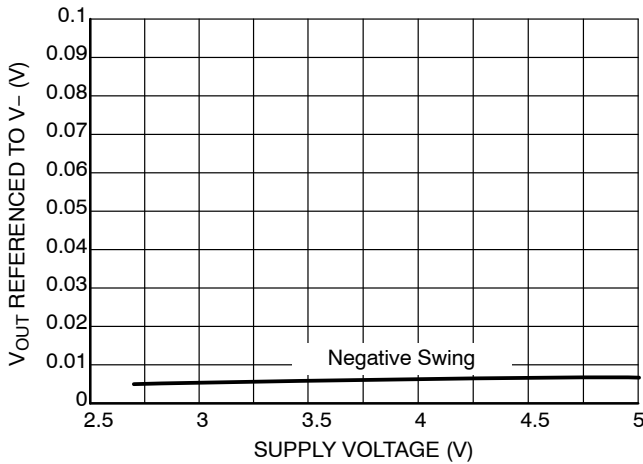


Figure 15. Output Voltage Swing vs Supply Voltage ( $R_L = 10\text{ k}$ )

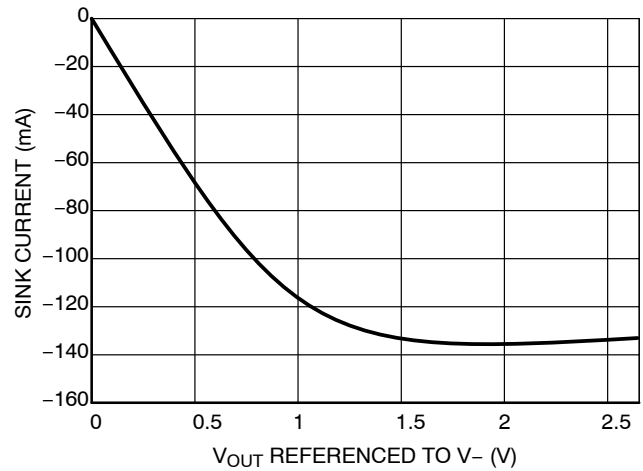


Figure 16. Sink Current vs. Output Voltage  
 $V_S = 2.7\text{ V}$

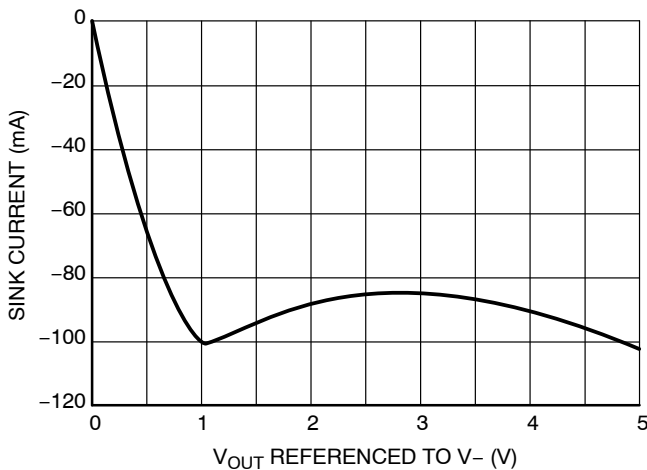


Figure 17. Sink Current vs. Output Voltage  
 $V_S = 5.0\text{ V}$

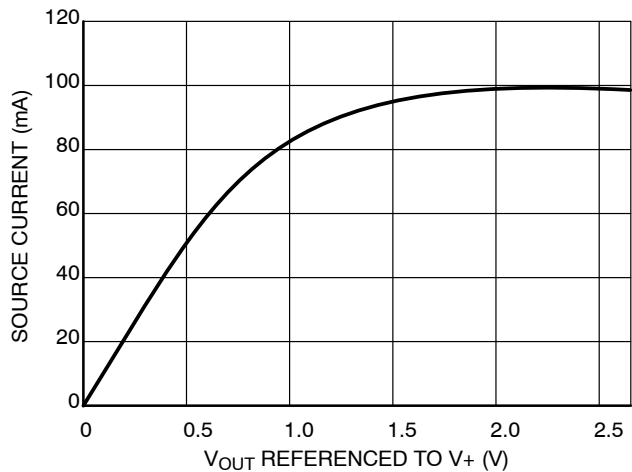


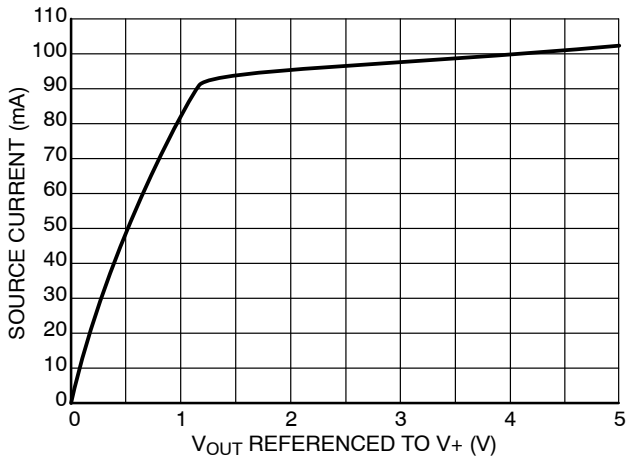
Figure 18. Source Current vs. Output Voltage  
 $V_S = 2.7\text{ V}$



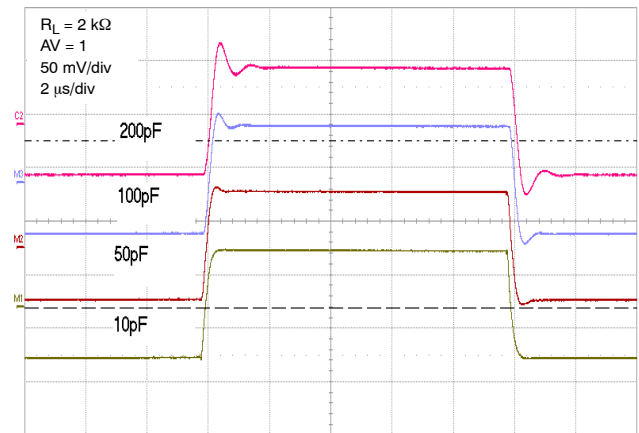
# LMV321, NCV321, LMV358, LMV324

## TYPICAL CHARACTERISTICS

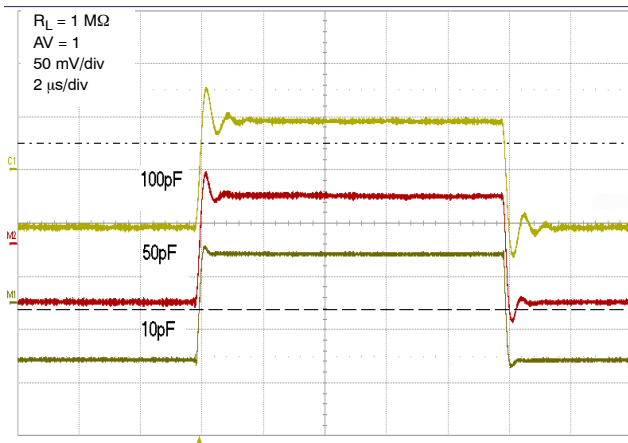
( $T_A = 25^\circ\text{C}$  and  $V_S = 5\text{ V}$  unless otherwise specified)



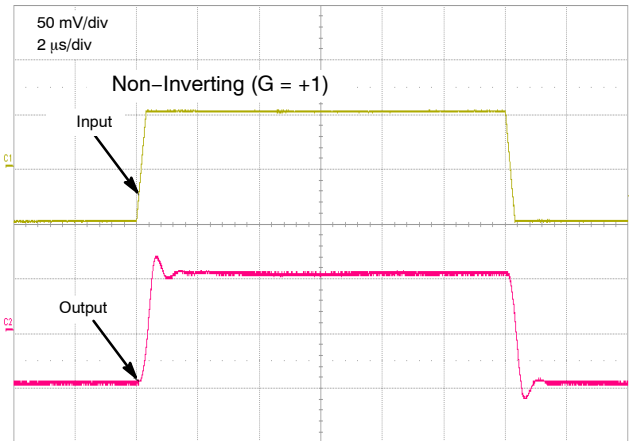
**Figure 19. Source Current vs. Output Voltage**  
 $V_S = 5.0\text{ V}$



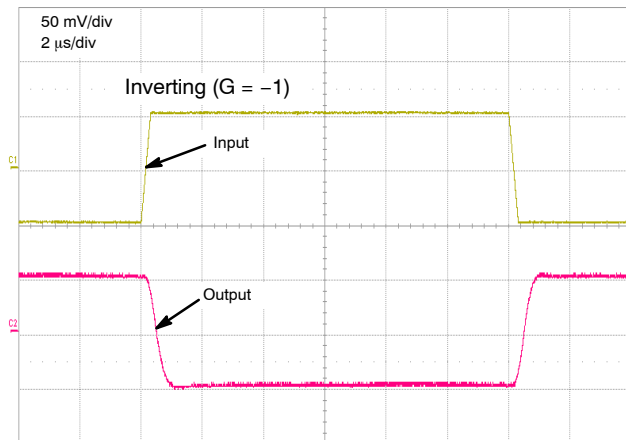
**Figure 20. Settling Time vs. Capacitive Load**



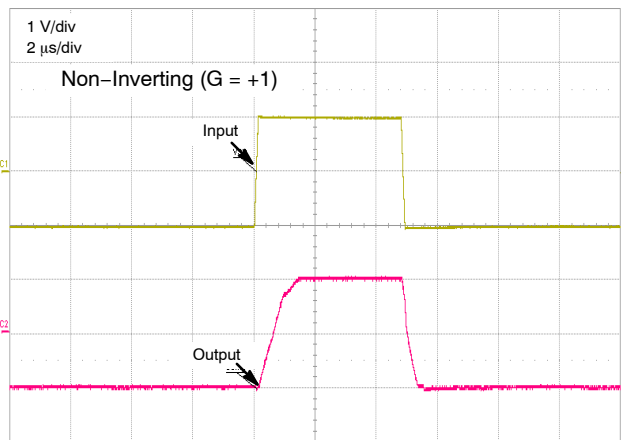
**Figure 21. Settling Time vs. Capacitive Load**



**Figure 22. Step Response - Small Signal**



**Figure 23. Step Response - Small Signal**

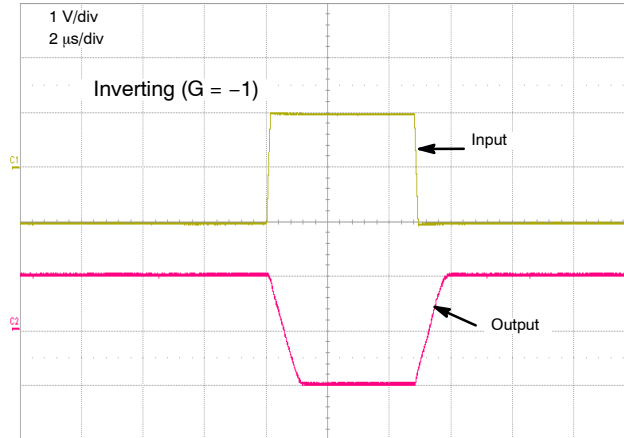


**Figure 24. Step Response - Large Signal**

# LMV321, NCV321, LMV358, LMV324

## TYPICAL CHARACTERISTICS

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



**Figure 25. Step Response – Large Signal**

APPLICATIONS

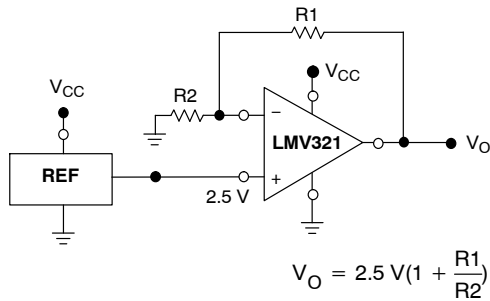


Figure 26. Voltage Reference

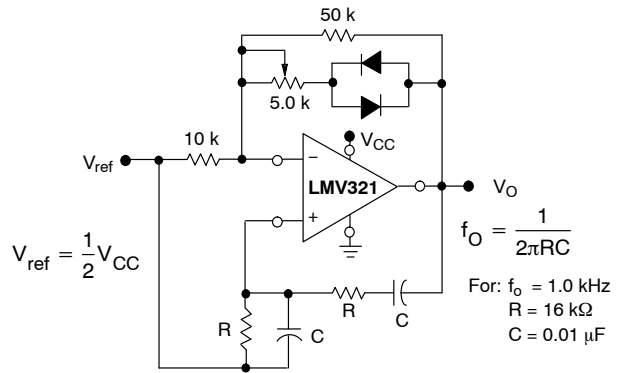


Figure 27. Wien Bridge Oscillator

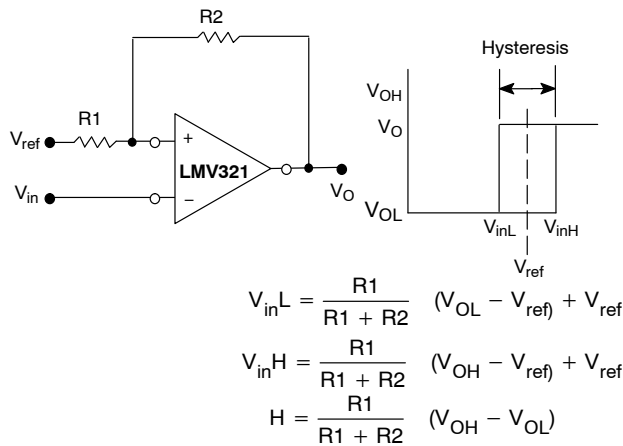
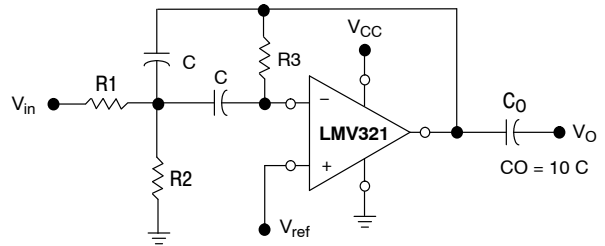


Figure 28. Comparator with Hysteresis



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

Choose value  $f_o, C$

Then:  $R_3 = \frac{Q}{\pi f_o C}$

$$R_1 = \frac{R_3}{2 A(f_o)}$$

$$R_2 = \frac{R_1 R_3}{4Q^2 R_1 - R_3}$$

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 29. Multiple Feedback Bandpass Filter

## LMV321, NCV321, LMV358, LMV324

### ORDERING INFORMATION

Order Number	Number of Channels	Specific Device Marking	Package Type	Shipping <sup>†</sup>
LMV321SQ3T2G	Single	AAC	SC-70 (Pb-Free)	3000 / Tape & Reel
LMV321SN3T1G	Single	3AC	TSOP-5 (Pb-Free)	3000 / Tape & Reel
LMV321ISN3T1G	Single	3AC	TSOP-5 (Pb-Free)	3000 / Tape & Reel
NCV321SN3T1G*	Single	3AC	TSOP-5 (Pb-Free)	3000 / Tape & Reel
LMV358DMR2G	Dual	V358	Micro8 (Pb-Free)	4000 / Tape & Reel
LMV358MUTAG	Dual	AC	UDFN8 (Pb-Free)	3000 / Tape & Reel
LMV358DR2G	Dual	V358	SOIC-8 (Pb-Free)	2500 / Tape & Reel
LMV358IDR2G	Dual	V358	SOIC-8 (Pb-Free)	2500 / Tape & Reel
LMV324DR2G	Quad	LMV324	SOIC-14 (Pb-Free)	2500 / Tape & Reel
LMV324DTBR2G	Quad	LMV324	TSSOP-14 (Pb-Free)	2500 / Tape & Reel

<sup>†</sup>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.

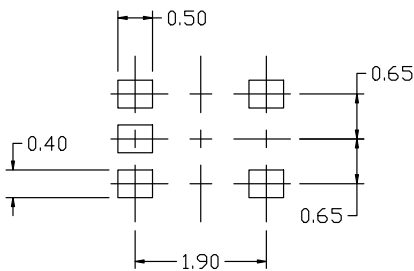
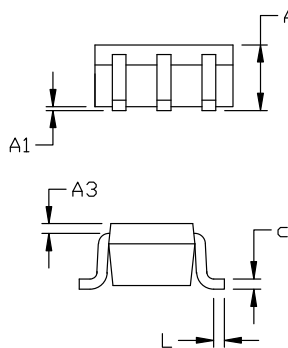
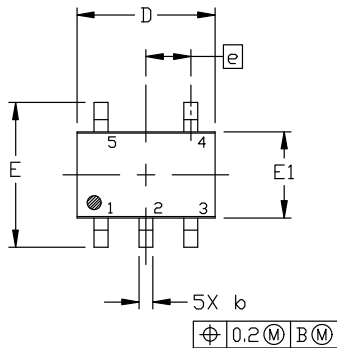
\*NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.



SCALE 2:1

SC-88A (SC-70-5/SOT-353)  
CASE 419A-02  
ISSUE M

DATE 11 APR 2023



RECOMMENDED MOUNTING FOOTPRINT

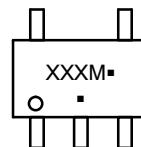
\* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. 419A-01 OBSOLETE. NEW STANDARD 419A-02
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.1016MM PER SIDE.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.80	0.95	1.10
A1	---	---	0.10
A3	0.20 REF		
b	0.10	0.20	0.30
c	0.10	---	0.25
D	1.80	2.00	2.20
E	2.00	2.10	2.20
E1	1.15	1.25	1.35
e	0.65 BSC		
L	0.10	0.15	0.30

GENERIC MARKING DIAGRAM\*



\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

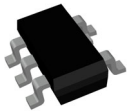
XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

- |  |  |  |  |  |
|--|--|--|--|--|
| <p>STYLE 1:<br/>PIN 1. BASE<br/>2. EMITTER<br/>3. BASE<br/>4. COLLECTOR<br/>5. COLLECTOR</p>                   | <p>STYLE 2:<br/>PIN 1. ANODE<br/>2. EMITTER<br/>3. BASE<br/>4. COLLECTOR<br/>5. CATHODE</p>  | <p>STYLE 3:<br/>PIN 1. ANODE 1<br/>2. N/C<br/>3. ANODE 2<br/>4. CATHODE 2<br/>5. CATHODE 1</p> | <p>STYLE 4:<br/>PIN 1. SOURCE 1<br/>2. DRAIN 1/2<br/>3. SOURCE 1<br/>4. GATE 1<br/>5. GATE 2</p> | <p>STYLE 5:<br/>PIN 1. CATHODE<br/>2. COMMON ANODE<br/>3. CATHODE 2<br/>4. CATHODE 3<br/>5. CATHODE 4</p>  |
| <p>STYLE 6:<br/>PIN 1. EMITTER 2<br/>2. BASE 2<br/>3. EMITTER 1<br/>4. COLLECTOR<br/>5. COLLECTOR 2/BASE 1</p> | <p>STYLE 7:<br/>PIN 1. BASE<br/>2. EMITTER<br/>3. BASE<br/>4. COLLECTOR<br/>5. COLLECTOR</p> | <p>STYLE 8:<br/>PIN 1. CATHODE<br/>2. COLLECTOR<br/>3. N/C<br/>4. BASE<br/>5. EMITTER</p>      | <p>STYLE 9:<br/>PIN 1. ANODE<br/>2. CATHODE<br/>3. ANODE<br/>4. ANODE<br/>5. ANODE</p>           | <p>Note: Please refer to datasheet for style callout. If style type is not called out in the datasheet refer to the device datasheet pinout or pin assignment.</p> |

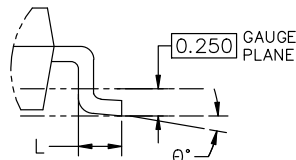
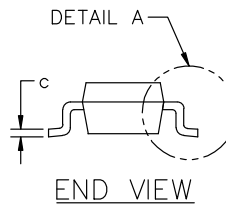
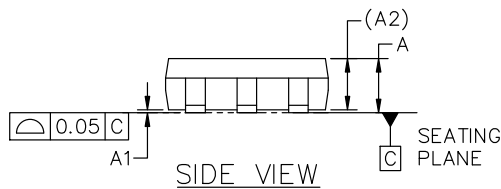
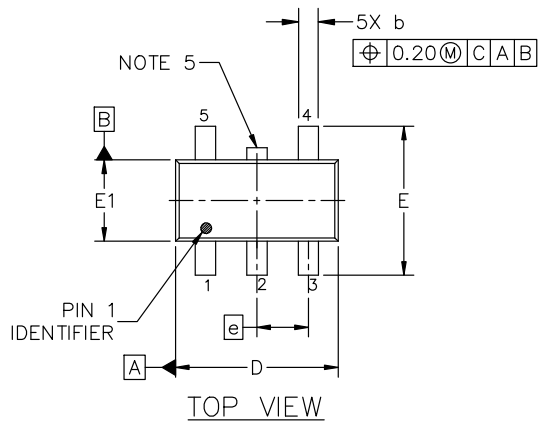
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DESCRIPTION:	SC-88A (SC-70-5/SOT-353)	PAGE 1 OF 1

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TSOP-5 3.00x1.50x0.95, 0.95P  
CASE 483  
ISSUE P

DATE 01 APR 2024



DETAIL "A"  
SCALE 2:1

GENERIC  
MARKING DIAGRAM\*



- XXX = Specific Device Code
- A = Assembly Location
- Y = Year
- W = Work Week
- = Pb-Free Package
- XXX = Specific Device Code
- M = Date Code
- = Pb-Free Package

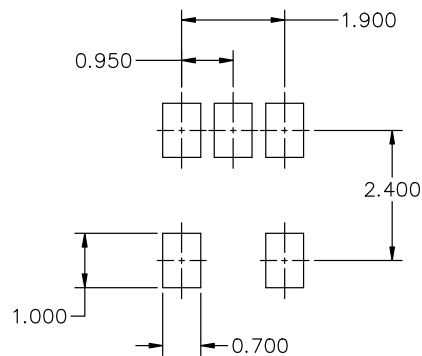
(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

NOTES:

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5-2018.
2. ALL DIMENSION ARE IN MILLIMETERS (ANGLES IN DEGREES).
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OF GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE. DIMENSION D.
5. OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.900	1.000	1.100
A1	0.010	0.055	0.100
A2	0.950 REF.		
b	0.250	0.375	0.500
c	0.100	0.180	0.260
D	2.850	3.000	3.150
E	2.500	2.750	3.000
E1	1.350	1.500	1.650
e	0.950 BSC		
L	0.200	0.400	0.600
θ	0°	5°	10°

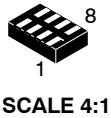


RECOMMENDED MOUNTING FOOTPRINT\*

\* FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

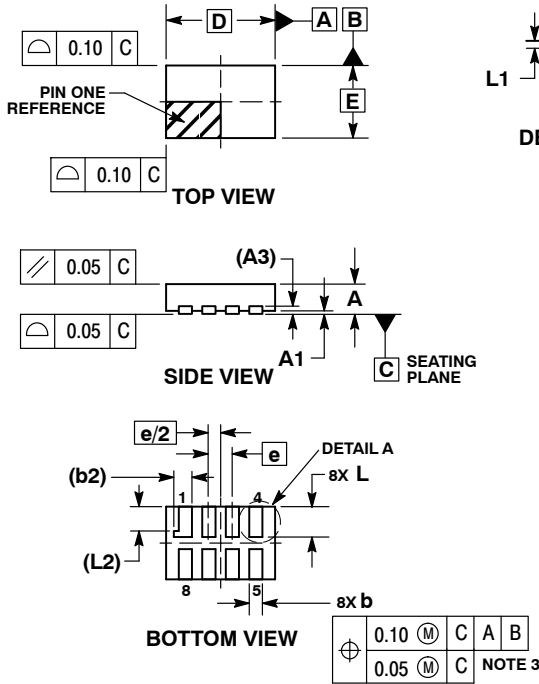
DOCUMENT NUMBER:	98ARB18753C	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TSOP-5 3.00x1.50x0.95, 0.95P	PAGE 1 OF 1

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**UDFN8 1.8x1.2, 0.4P**  
CASE 517AJ  
ISSUE O

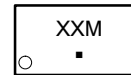
DATE 08 NOV 2006



- 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 TERMINAL TIP.
  4. MOLD FLASH ALLOWED ON TERMINALS ALONG EDGE OF PACKAGE. FLASH MAY NOT EXCEED 0.03 ONTO BOTTOM SURFACE OF TERMINALS.
  5. DETAIL A SHOWS OPTIONAL CONSTRUCTION FOR TERMINALS.

MILLIMETERS		
DIM	MIN	MAX
A	0.45	0.55
A1	0.00	0.05
A3	0.127	REF
b	0.15	0.25
b2	0.30	REF
D	1.80	BSC
E	1.20	BSC
e	0.40	BSC
L	0.45	0.55
L1	0.00	0.03
L2	0.40	REF

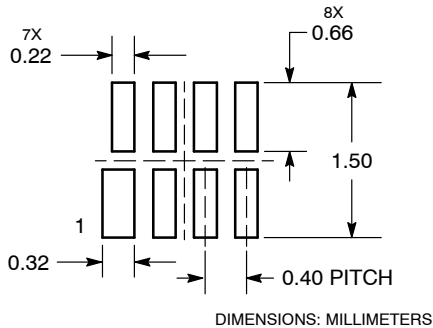
**GENERIC MARKING DIAGRAM\***



- XX = Specific Device Code
- M = Date Code
- = Pb-Free Package

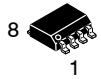
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present.

**MOUNTING FOOTPRINT SOLDERMASK DEFINED**



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<b>DESCRIPTION:</b>	<b>UDFN8 1.8X1.2, 0.4P</b>	<b>PAGE 1 OF 1</b>

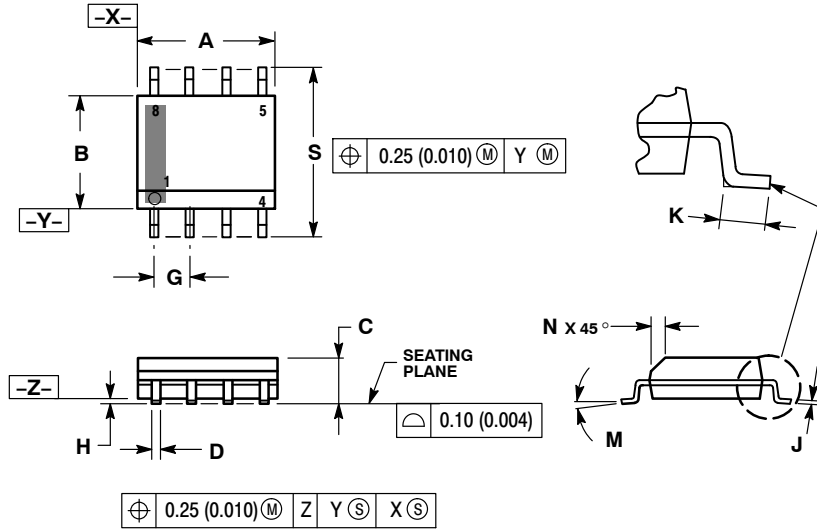
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SCALE 1:1

SOIC-8 NB  
CASE 751-07  
ISSUE AK

DATE 16 FEB 2011



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
  5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
  6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

SOLDERING FOOTPRINT\*



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

GENERIC MARKING DIAGRAM\*



XXXXXX = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

XXXXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
▪ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

DOCUMENT NUMBER:	98ASB42564B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
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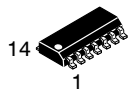
**SOIC-8 NB**  
**CASE 751-07**  
**ISSUE AK**

DATE 16 FEB 2011

- |  |   |   |   |
|--|---|---|---|
| <p><b>STYLE 1:</b><br/> PIN 1. EMITTER<br/> 2. COLLECTOR<br/> 3. COLLECTOR<br/> 4. EMITTER<br/> 5. EMITTER<br/> 6. BASE<br/> 7. BASE<br/> 8. EMITTER</p>   | <p><b>STYLE 2:</b><br/> PIN 1. COLLECTOR, DIE, #1<br/> 2. COLLECTOR, #1<br/> 3. COLLECTOR, #2<br/> 4. COLLECTOR, #2<br/> 5. BASE, #2<br/> 6. EMITTER, #2<br/> 7. BASE, #1<br/> 8. EMITTER, #1</p>               | <p><b>STYLE 3:</b><br/> PIN 1. DRAIN, DIE #1<br/> 2. DRAIN, #1<br/> 3. DRAIN, #2<br/> 4. DRAIN, #2<br/> 5. GATE, #2<br/> 6. SOURCE, #2<br/> 7. GATE, #1<br/> 8. SOURCE, #1</p>                            | <p><b>STYLE 4:</b><br/> PIN 1. ANODE<br/> 2. ANODE<br/> 3. ANODE<br/> 4. ANODE<br/> 5. ANODE<br/> 6. ANODE<br/> 7. ANODE<br/> 8. COMMON CATHODE</p>   |
| <p><b>STYLE 5:</b><br/> PIN 1. DRAIN<br/> 2. DRAIN<br/> 3. DRAIN<br/> 4. DRAIN<br/> 5. GATE<br/> 6. GATE<br/> 7. SOURCE<br/> 8. SOURCE</p>   | <p><b>STYLE 6:</b><br/> PIN 1. SOURCE<br/> 2. DRAIN<br/> 3. DRAIN<br/> 4. SOURCE<br/> 5. SOURCE<br/> 6. GATE<br/> 7. GATE<br/> 8. SOURCE</p>  | <p><b>STYLE 7:</b><br/> PIN 1. INPUT<br/> 2. EXTERNAL BYPASS<br/> 3. THIRD STAGE SOURCE<br/> 4. GROUND<br/> 5. DRAIN<br/> 6. GATE 3<br/> 7. SECOND STAGE Vd<br/> 8. FIRST STAGE Vd</p>                    | <p><b>STYLE 8:</b><br/> PIN 1. COLLECTOR, DIE #1<br/> 2. BASE, #1<br/> 3. BASE, #2<br/> 4. COLLECTOR, #2<br/> 5. COLLECTOR, #2<br/> 6. EMITTER, #2<br/> 7. EMITTER, #1<br/> 8. COLLECTOR, #1</p>                              |
| <p><b>STYLE 9:</b><br/> PIN 1. EMITTER, COMMON<br/> 2. COLLECTOR, DIE #1<br/> 3. COLLECTOR, DIE #2<br/> 4. EMITTER, COMMON<br/> 5. EMITTER, COMMON<br/> 6. BASE, DIE #2<br/> 7. BASE, DIE #1<br/> 8. EMITTER, COMMON</p> | <p><b>STYLE 10:</b><br/> PIN 1. GROUND<br/> 2. BIAS 1<br/> 3. OUTPUT<br/> 4. GROUND<br/> 5. GROUND<br/> 6. BIAS 2<br/> 7. INPUT<br/> 8. GROUND</p>  | <p><b>STYLE 11:</b><br/> PIN 1. SOURCE 1<br/> 2. GATE 1<br/> 3. SOURCE 2<br/> 4. GATE 2<br/> 5. DRAIN 2<br/> 6. DRAIN 2<br/> 7. DRAIN 1<br/> 8. DRAIN 1</p>   | <p><b>STYLE 12:</b><br/> PIN 1. SOURCE<br/> 2. SOURCE<br/> 3. SOURCE<br/> 4. GATE<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. DRAIN<br/> 8. DRAIN</p>   |
| <p><b>STYLE 13:</b><br/> PIN 1. N.C.<br/> 2. SOURCE<br/> 3. SOURCE<br/> 4. GATE<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. DRAIN<br/> 8. DRAIN</p>  | <p><b>STYLE 14:</b><br/> PIN 1. N-SOURCE<br/> 2. N-GATE<br/> 3. P-SOURCE<br/> 4. P-GATE<br/> 5. P-DRAIN<br/> 6. P-DRAIN<br/> 7. N-DRAIN<br/> 8. N-DRAIN</p>   | <p><b>STYLE 15:</b><br/> PIN 1. ANODE 1<br/> 2. ANODE 1<br/> 3. ANODE 1<br/> 4. ANODE 1<br/> 5. CATHODE, COMMON<br/> 6. CATHODE, COMMON<br/> 7. CATHODE, COMMON<br/> 8. CATHODE, COMMON</p>               | <p><b>STYLE 16:</b><br/> PIN 1. EMITTER, DIE #1<br/> 2. BASE, DIE #1<br/> 3. EMITTER, DIE #2<br/> 4. BASE, DIE #2<br/> 5. COLLECTOR, DIE #2<br/> 6. COLLECTOR, DIE #2<br/> 7. COLLECTOR, DIE #1<br/> 8. COLLECTOR, DIE #1</p> |
| <p><b>STYLE 17:</b><br/> PIN 1. VCC<br/> 2. V2OUT<br/> 3. V1OUT<br/> 4. TXE<br/> 5. RXE<br/> 6. VEE<br/> 7. GND<br/> 8. ACC</p>  | <p><b>STYLE 18:</b><br/> PIN 1. ANODE<br/> 2. ANODE<br/> 3. SOURCE<br/> 4. GATE<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. CATHODE<br/> 8. CATHODE</p>   | <p><b>STYLE 19:</b><br/> PIN 1. SOURCE 1<br/> 2. GATE 1<br/> 3. SOURCE 2<br/> 4. GATE 2<br/> 5. DRAIN 2<br/> 6. MIRROR 2<br/> 7. DRAIN 1<br/> 8. MIRROR 1</p>   | <p><b>STYLE 20:</b><br/> PIN 1. SOURCE (N)<br/> 2. GATE (N)<br/> 3. SOURCE (P)<br/> 4. GATE (P)<br/> 5. DRAIN<br/> 6. DRAIN<br/> 7. DRAIN<br/> 8. DRAIN</p>   |
| <p><b>STYLE 21:</b><br/> PIN 1. CATHODE 1<br/> 2. CATHODE 2<br/> 3. CATHODE 3<br/> 4. CATHODE 4<br/> 5. CATHODE 5<br/> 6. COMMON ANODE<br/> 7. COMMON ANODE<br/> 8. CATHODE 6</p>  | <p><b>STYLE 22:</b><br/> PIN 1. I/O LINE 1<br/> 2. COMMON CATHODE/VCC<br/> 3. COMMON CATHODE/VCC<br/> 4. I/O LINE 3<br/> 5. COMMON ANODE/GND<br/> 6. I/O LINE 4<br/> 7. I/O LINE 5<br/> 8. COMMON ANODE/GND</p> | <p><b>STYLE 23:</b><br/> PIN 1. LINE 1 IN<br/> 2. COMMON ANODE/GND<br/> 3. COMMON ANODE/GND<br/> 4. LINE 2 IN<br/> 5. LINE 2 OUT<br/> 6. COMMON ANODE/GND<br/> 7. COMMON ANODE/GND<br/> 8. LINE 1 OUT</p> | <p><b>STYLE 24:</b><br/> PIN 1. BASE<br/> 2. EMITTER<br/> 3. COLLECTOR/ANODE<br/> 4. COLLECTOR/ANODE<br/> 5. CATHODE<br/> 6. CATHODE<br/> 7. COLLECTOR/ANODE<br/> 8. COLLECTOR/ANODE</p>                                      |
| <p><b>STYLE 25:</b><br/> PIN 1. VIN<br/> 2. N/C<br/> 3. REXT<br/> 4. GND<br/> 5. IOUT<br/> 6. IOUT<br/> 7. IOUT<br/> 8. IOUT</p>   | <p><b>STYLE 26:</b><br/> PIN 1. GND<br/> 2. dv/dt<br/> 3. ENABLE<br/> 4. ILIMIT<br/> 5. SOURCE<br/> 6. SOURCE<br/> 7. SOURCE<br/> 8. VCC</p>  | <p><b>STYLE 27:</b><br/> PIN 1. ILIMIT<br/> 2. OVLO<br/> 3. UVLO<br/> 4. INPUT+<br/> 5. SOURCE<br/> 6. SOURCE<br/> 7. SOURCE<br/> 8. DRAIN</p>  | <p><b>STYLE 28:</b><br/> PIN 1. SW_TO_GND<br/> 2. DASIC OFF<br/> 3. DASIC_SW_DET<br/> 4. GND<br/> 5. V_MON<br/> 6. VBULK<br/> 7. VBULK<br/> 8. VIN</p>  |
| <p><b>STYLE 29:</b><br/> PIN 1. BASE, DIE #1<br/> 2. EMITTER, #1<br/> 3. BASE, #2<br/> 4. EMITTER, #2<br/> 5. COLLECTOR, #2<br/> 6. COLLECTOR, #2<br/> 7. COLLECTOR, #1<br/> 8. COLLECTOR, #1</p>                        | <p><b>STYLE 30:</b><br/> PIN 1. DRAIN 1<br/> 2. DRAIN 1<br/> 3. GATE 2<br/> 4. SOURCE 2<br/> 5. SOURCE 1/DRAIN 2<br/> 6. SOURCE 1/DRAIN 2<br/> 7. SOURCE 1/DRAIN 2<br/> 8. GATE 1</p>                           |   |   |

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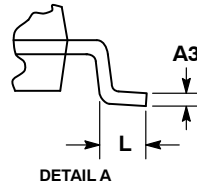
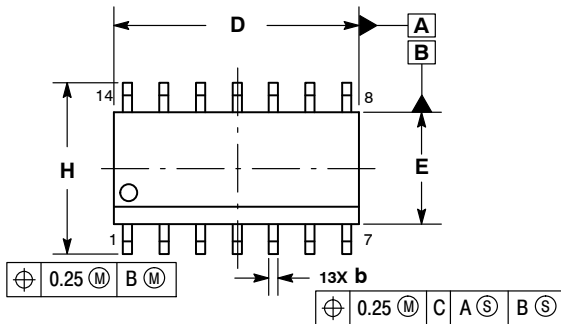
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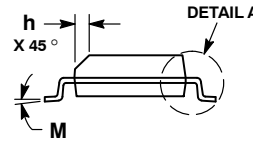
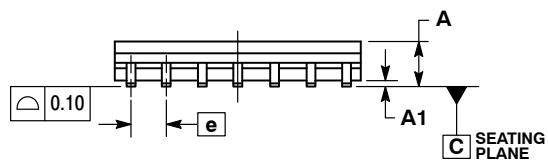
SOIC-14 NB  
CASE 751A-03  
ISSUE L

DATE 03 FEB 2016

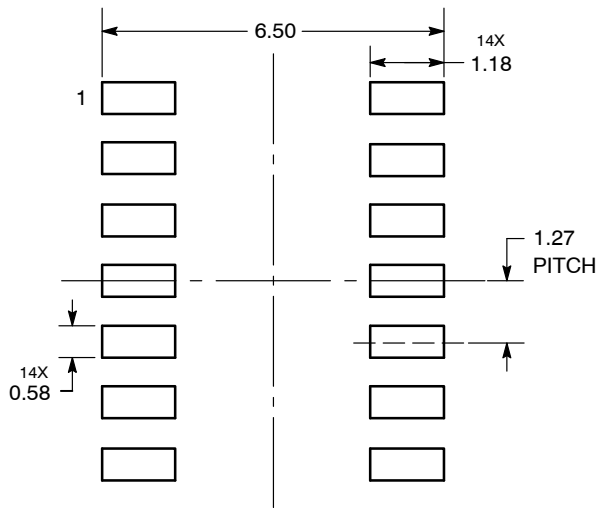


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
  4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
  5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0°	7°	0°	7°



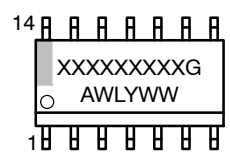
SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

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

GENERIC MARKING DIAGRAM\*



- XXXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- Y = Year
- WW = Work Week
- G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

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**SOIC-14**  
**CASE 751A-03**  
**ISSUE L**

DATE 03 FEB 2016

STYLE 1:  
 PIN 1. COMMON CATHODE  
 2. ANODE/CATHODE  
 3. ANODE/CATHODE  
 4. NO CONNECTION  
 5. ANODE/CATHODE  
 6. NO CONNECTION  
 7. ANODE/CATHODE  
 8. ANODE/CATHODE  
 9. ANODE/CATHODE  
 10. NO CONNECTION  
 11. ANODE/CATHODE  
 12. ANODE/CATHODE  
 13. NO CONNECTION  
 14. COMMON ANODE

STYLE 2:  
 CANCELLED

STYLE 3:  
 PIN 1. NO CONNECTION  
 2. ANODE  
 3. ANODE  
 4. NO CONNECTION  
 5. ANODE  
 6. NO CONNECTION  
 7. ANODE  
 8. ANODE  
 9. ANODE  
 10. NO CONNECTION  
 11. ANODE  
 12. ANODE  
 13. NO CONNECTION  
 14. COMMON CATHODE

STYLE 4:  
 PIN 1. NO CONNECTION  
 2. CATHODE  
 3. CATHODE  
 4. NO CONNECTION  
 5. CATHODE  
 6. NO CONNECTION  
 7. CATHODE  
 8. CATHODE  
 9. CATHODE  
 10. NO CONNECTION  
 11. CATHODE  
 12. CATHODE  
 13. NO CONNECTION  
 14. COMMON ANODE

STYLE 5:  
 PIN 1. COMMON CATHODE  
 2. ANODE/CATHODE  
 3. ANODE/CATHODE  
 4. ANODE/CATHODE  
 5. ANODE/CATHODE  
 6. NO CONNECTION  
 7. COMMON ANODE  
 8. COMMON CATHODE  
 9. ANODE/CATHODE  
 10. ANODE/CATHODE  
 11. ANODE/CATHODE  
 12. ANODE/CATHODE  
 13. NO CONNECTION  
 14. COMMON ANODE

STYLE 6:  
 PIN 1. CATHODE  
 2. CATHODE  
 3. CATHODE  
 4. CATHODE  
 5. CATHODE  
 6. CATHODE  
 7. CATHODE  
 8. ANODE  
 9. ANODE  
 10. ANODE  
 11. ANODE  
 12. ANODE  
 13. ANODE  
 14. ANODE

STYLE 7:  
 PIN 1. ANODE/CATHODE  
 2. COMMON ANODE  
 3. COMMON CATHODE  
 4. ANODE/CATHODE  
 5. ANODE/CATHODE  
 6. ANODE/CATHODE  
 7. ANODE/CATHODE  
 8. ANODE/CATHODE  
 9. ANODE/CATHODE  
 10. ANODE/CATHODE  
 11. COMMON CATHODE  
 12. COMMON ANODE  
 13. ANODE/CATHODE  
 14. ANODE/CATHODE

STYLE 8:  
 PIN 1. COMMON CATHODE  
 2. ANODE/CATHODE  
 3. ANODE/CATHODE  
 4. NO CONNECTION  
 5. ANODE/CATHODE  
 6. ANODE/CATHODE  
 7. COMMON ANODE  
 8. COMMON ANODE  
 9. ANODE/CATHODE  
 10. ANODE/CATHODE  
 11. NO CONNECTION  
 12. ANODE/CATHODE  
 13. ANODE/CATHODE  
 14. COMMON CATHODE

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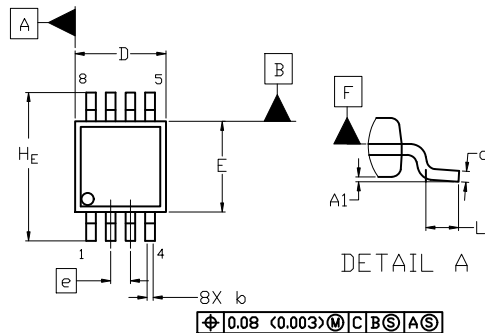
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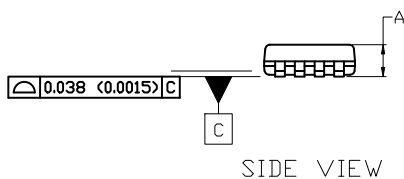
Micro8  
CASE 846A-02  
ISSUE K

DATE 16 JUL 2020

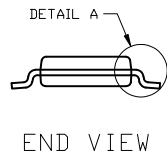


TOP VIEW

NOTE 3



SIDE VIEW



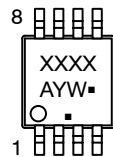
END VIEW

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION *b* DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.10 mm IN EXCESS OF MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS *D* AND *E* DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 mm PER SIDE. DIMENSION *E* DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 mm PER SIDE. DIMENSIONS *D* AND *E* ARE DETERMINED AT DATUM *F*.
5. DATUMS *A* AND *B* ARE TO BE DETERMINED AT DATUM *F*.
6. *A1* IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

⌀ 0.08 (0.003) M C B S A S

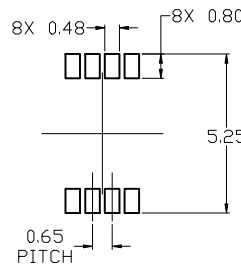
GENERIC MARKING DIAGRAM\*



- XXXX = Specific Device Code
- A = Assembly Location
- Y = Year
- W = Work Week
- = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.



RECOMMENDED MOUNTING FOOTPRINT

For additional information on our Pb-Free strategy and soldering details, please download the [DN Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D](#).

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	---	---	1.10
A1	0.05	0.08	0.15
b	0.25	0.33	0.40
c	0.13	0.18	0.23
D	2.90	3.00	3.10
E	2.90	3.00	3.10
e	0.65 BSC		
HE	4.75	4.90	5.05
L	0.40	0.55	0.70

STYLE 1:

1. SOURCE
2. SOURCE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

STYLE 2:

1. SOURCE 1
2. GATE 1
3. SOURCE 2
4. GATE 2
5. DRAIN 2
6. DRAIN 2
7. DRAIN 1
8. DRAIN 1

STYLE 3:

1. N-SOURCE
2. N-GATE
3. P-SOURCE
4. P-GATE
5. P-DRAIN
6. P-DRAIN
7. N-DRAIN
8. N-DRAIN

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