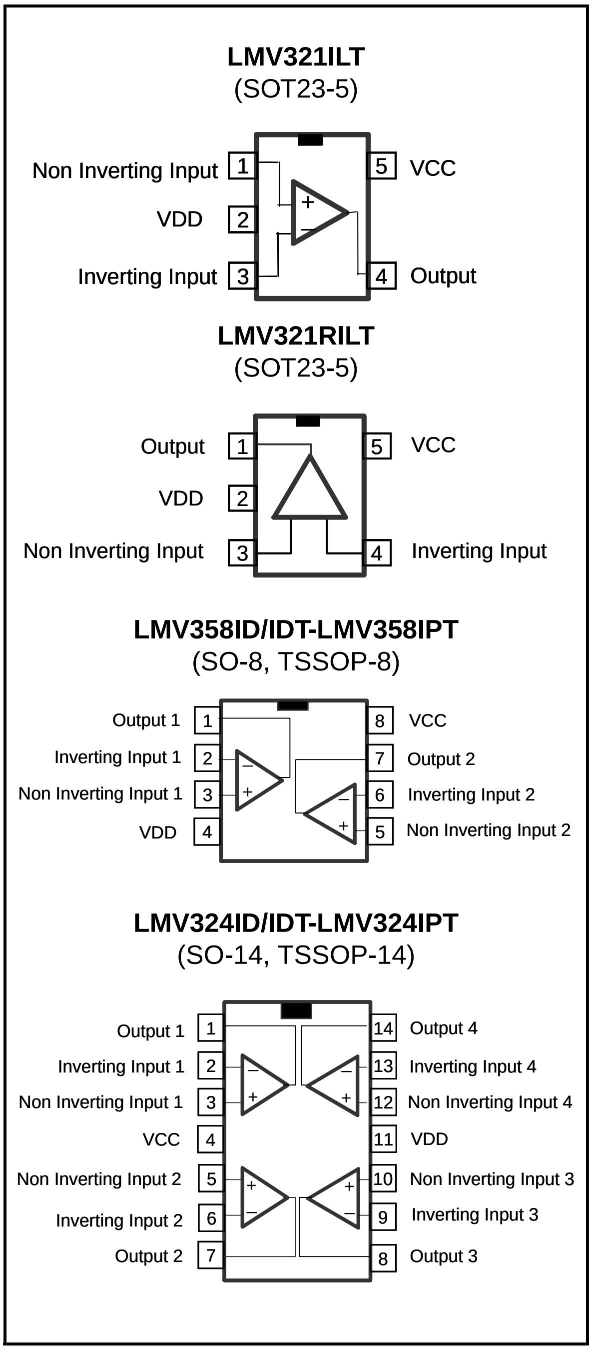
LMV321-LMV358-LMV324

Low cost low power input/output rail-to-rail operational amplifiers

Features

- Operating range from V_{CC} = 2.7 V to 6 V
- Rail-to-rail input and output
- Extended V_{icm} (V_{DD} - 0.2 V to V_{CC} + 0.2 V)
- Low supply current (145 µA)
- Gain bandwidth product (1 MHz)
- ESD tolerance (2 kV)
- Latch-up immunity
- Available in SOT23-5 micropackage



Applications

- Two-cell battery-powered systems
- Battery-powered electronic equipment
- Cordless phones
- Personal medical care (glucose meter)
- Laptops
- PDAs

Description

The LMV321/358/324 family (single, dual and quad) answers the need for low cost, general purpose operational amplifiers. They operate with voltages as low as 2.7 V and feature both input and output rail-to-rail, 145 µA consumption current and 1 MHz gain bandwidth product (GBP).

With a such low consumption and a sufficient GBP for many applications, these op-amps are very well-suited for any kind of battery-supplied and portable equipment application.

The LMV321 is housed in the space-saving 5-pin SOT23-5 package which simplifies the board design (overall dimensions are 2.8 mm x 2.9 mm). The SOT23-5 has two pinning configurations to answer all application requirements.

1 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage (1)	7	V
V_{id}	Differential input voltage(2)	±1	V
V_{in}	Input voltage	V_{DD}-0.3 to V_{CC}+0.3	V
T_{oper}	Operating free air temperature range	-40 to + 125	°C
T_{stg}	Storage temperature	-65 to +150	°C
T_j	Maximum junction temperature	150	°C
R_{thja}	Thermal resistance junction to ambient (3) SOT23-5 SO-8 SO-14 TSSOP8 TSSOP14	 250 125 103 120 100	°C/W
R_{thjc}	Thermal resistance junction to case(3) SOT23-5 SO-8 SO-14 TSSOP8 TSSOP14	 81 40 31 37 32	°C/W
ESD	HBM: human body model(4)	2	kV
	MM: machine model(5)	200	V
	CDM: charged device model (6)	1.5	kV
	Lead temperature (soldering, 10sec)	250	°C
	Output short-circuit duration	see note(7)	

1. All voltage values, except differential voltage are with respect to network terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal. If V_{id} > ±1 V, the maximum input current must not exceed ±1 mA. In this case (V_{id} > ±1 V), an input series resistor must be added to limit input current.
3. Short-circuits can cause excessive heating. Destructive dissipation can result from simultaneous short-circuits on all amplifiers. All values are typical.
4. Human body model: A 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
5. Machine model: A 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of connected pin combinations while the other pins are floating.
6. Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.
No value specified for CDM on SOT23-5L package. The value is given for SO and TSSOP packages.
7. Short-circuits from the output to V_{CC} can cause excessive heating. The maximum output current is approximately 48 mA, independent of the magnitude of V_{CC}. Destructive dissipation can result from simultaneous short-circuits on all amplifiers.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	2.7 to 6	V
V_{icm}	Common mode input voltage range (1)	V_{DD} -0.2 to V_{CC} + 0.2	V
V_{icm}	Common mode input voltage range (2)	V_{DD} to V_{CC}	V
T_{oper}	Operating free air temperature range	-40 to + 125	°C

1. At 25°C, for $2.7 \leq V_{CC} \leq 6$ V, V_{icm} is extended to V_{DD} - 0.2 V, V_{CC} + 0.2 V.
2. In full temperature range, both rails can be reached when V_{CC} does not exceed 5.5 V.

2 Electrical characteristics

Table 3. V_{CC} = +2.7V, V_{DD} = 0V, C_L & R_L connected to $V_{CC}/2$, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage	$V_{icm} = V_{out} = V_{CC}/2$ $T_{min} \le T_{amb} \le T_{max}$		0.1	3 6	mV
ΔV_{io}	Input offset voltage drift			2		µV/°C
I_{io}	Input offset current	$V_{icm} = V_{out} = V_{CC}/2$ (1) $T_{min} \le T_{amb} \le T_{max}$		1	9 25	nA
I_{ib}	Input bias current	$V_{icm} = V_{out} = V_{CC}/2$(1) $T_{min} \le T_{amb} \le T_{max}$		10	50 85	nA
CMR	Common mode rejection ratio	$0 \le V_{icm} \le V_{CC}$	55	85		dB
SVR	Supply voltage rejection ratio	$V_{icm} = V_{CC}/2$	70	80		dB
A_{vd}	Large signal voltage gain	V_{out} = 0.5V to 2.2V $R_L = 10k\Omega$ $R_L = 2k\Omega$	 80 70	 100 88		dB
V_{OH}	High level output voltage	V_{id} = 100mV $T_{min} \le T_{amb} \le T_{max}$ $R_L = 10k\Omega$ $R_L = 2k\Omega$	 2.6 2.55	 2.65 2.6		V
V_{OL}	Low level output voltage	V_{id} = -100mV $T_{min} \le T_{amb} \le T_{max}$ $R_L = 10k\Omega$ $R_L = 2k\Omega$		 15 50	 90 100	mV
I_o	Output current	Output source current V_{id} = 100mV, $V_O = V_{DD}$ Output sink current V_{id} = -100mV, $V_O = V_{CC}$	 5 5	 46 46		mA
I_{CC}	Supply current (per amplifier)	$V_{out} = V_{CC}/2$ A_{VCL} = 1, no load $T_{min} \le T_{amb} \le T_{max}$		145	200 230	µA
GBP	Gain bandwidth product	$R_L = 10k\Omega$, C_L = 100pF, f = 100kHz		1		MHz
SR	Slew rate	$R_L = 600\Omega$, C_L = 100pF, A_V = 1		0.35		V/µs
ϕm	Phase margin	$R_L = 600\Omega$, C_L = 100pF		44		Degrees
en	Input voltage noise			40		nV/√Hz
THD	Total harmonic distortion			0.01		%

1. Maximum values include unavoidable inaccuracies of the industrial tests.

Table 4. V_{CC} = +5V, V_{DD} = 0V, C_L & R_L connected to $V_{CC}/2$, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage	$V_{icm} = V_{out} = V_{CC}/2$ $T_{min} \leq T_{amb} \leq T_{max}$		0.1	3 6	mV
ΔV_{io}	Input offset voltage drift			2		µV/°C
I_{io}	Input offset current	$V_{icm} = V_{out} = V_{CC}/2$ (1) $T_{min} \leq T_{amb} \leq T_{max}$		1	9 25	nA
I_{ib}	Input bias current	$V_{icm} = V_{out} = V_{CC}/2$(1) $T_{min} \leq T_{amb} \leq T_{max}$		16	63 95	nA
CMR	Common mode rejection ratio	$0 \leq V_{icm} \leq V_{CC}$	65	95		dB
SVR	Supply voltage rejection ratio	$V_{icm} = V_{CC}/2$	70	90		dB
A_{vd}	Large signal voltage gain	V_{out} = 0.5V to 4.5V $R_L = 10k\Omega$ $R_L = 2k\Omega$	 85 77	 97 93		dB
V_{OH}	High level output voltage	V_{id} = 100mV $T_{min} \leq T_{amb} \leq T_{max}$ $R_L = 10k\Omega$ $R_L = 2k\Omega$	 4.85 4.8	 4.95 4.91		V
V_{OL}	Low level output voltage	V_{id} = -100mV $T_{min} \leq T_{amb} \leq T_{max}$ $R_L = 10k\Omega$ $R_L = 2k\Omega$		 40 80	 180 200	mV
I_o	Output current	Output source current $V_{id} = 100mV, V_O = V_{DD}$ Output sink current $V_{id} = -100mV, V_O = V_{CC}$	 7 7	 48 48		mA
I_{CC}	Supply current (per amplifier)	$V_{out} = V_{CC}/2$ A_{VCL} = 1, no load $T_{min} \leq T_{amb} \leq T_{max}$		162	220 250	µA
GBP	Gain bandwidth product	$R_L = 10k\Omega$, C_L = 100pF, f = 100kHz		1.3		MHz
SR	Slew rate	$R_L = 600\Omega$, C_L = 100pF, $A_V = 1$		0.45		V/µs
ϕm	Phase margin	$R_L = 600\Omega$, C_L = 100pF		48		Degrees
en	Input voltage noise			40		nV/√Hz
THD	Total harmonic distortion			0.01		%

1. Maximum values include unavoidable inaccuracies of the industrial tests.

Figure 1. Supply current/amplifier vs. supply voltage

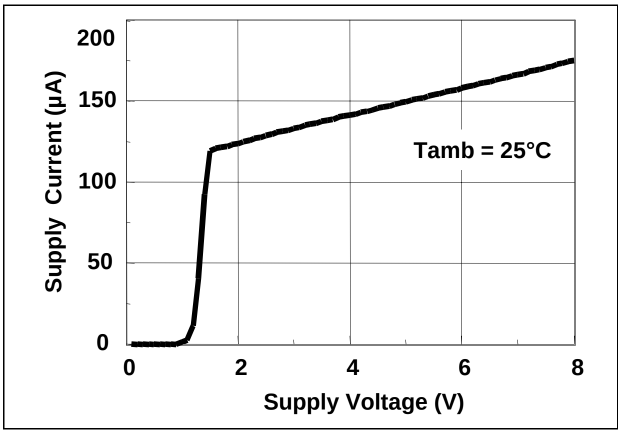


Figure 2. Input bias current vs. temperature

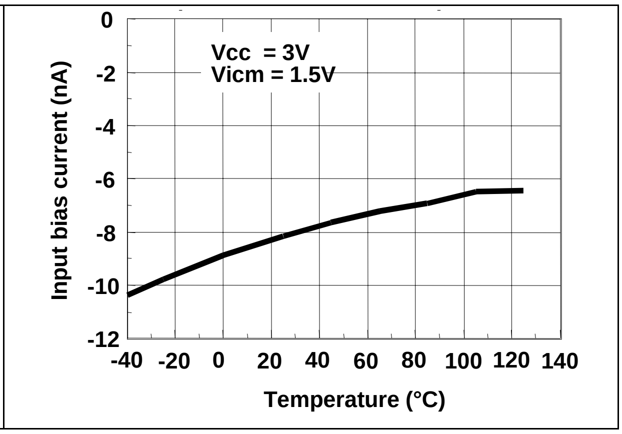


Figure 3. Input bias current vs. temperature

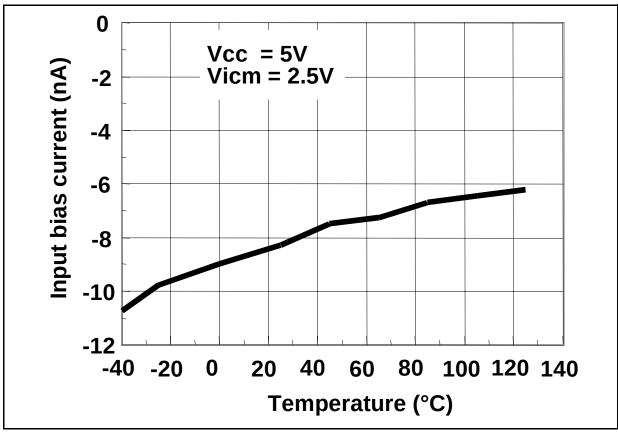


Figure 4. Common mode rejection vs. temperature

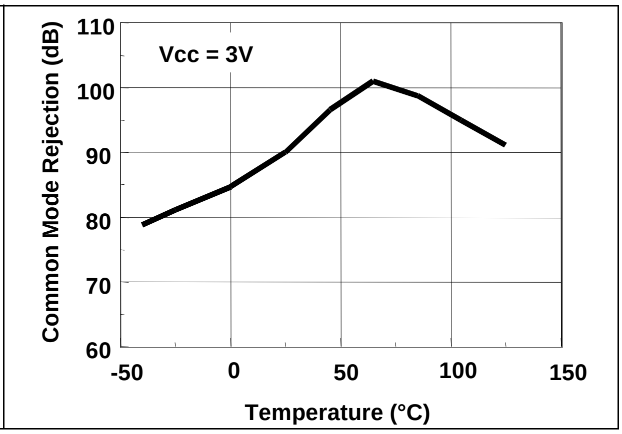


Figure 5. Common mode rejection vs. temperature

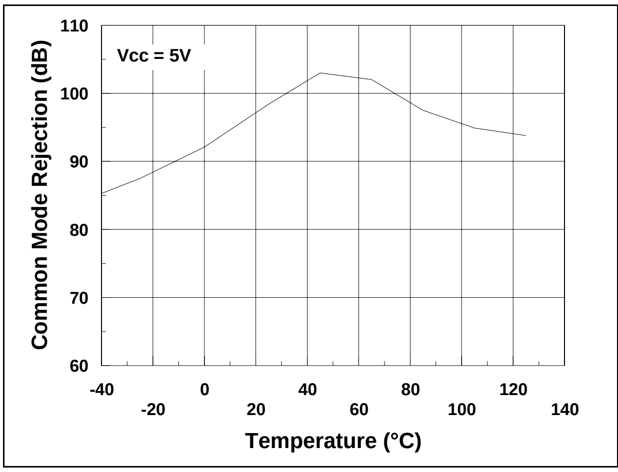


Figure 6. Supply voltage rejection vs. temperature

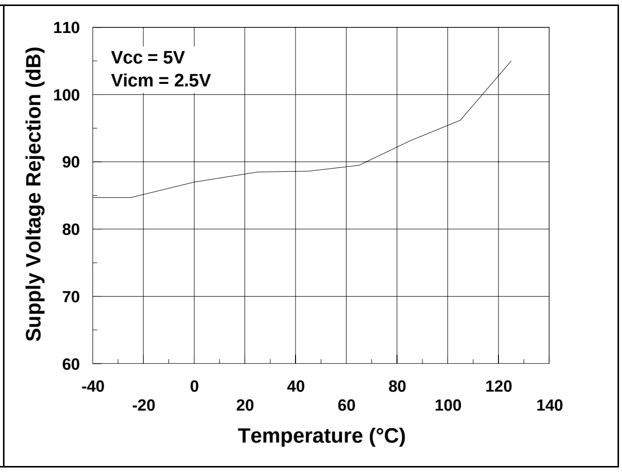


Figure 7. Open loop gain vs. temperature

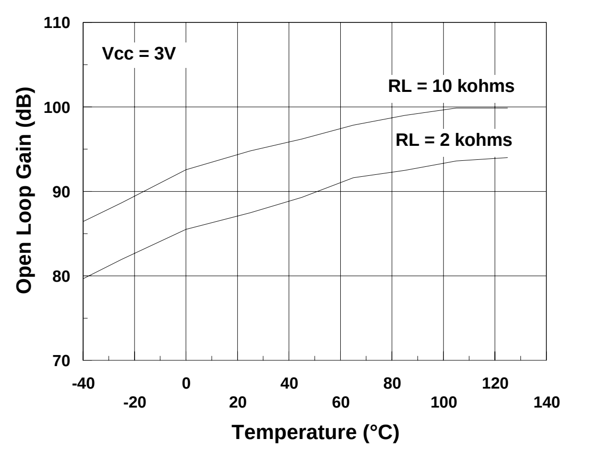


Figure 8. Open loop gain vs. temperature

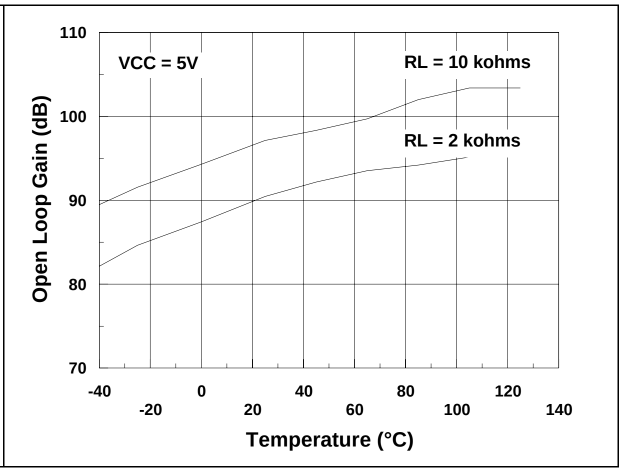


Figure 9. Supply voltage rejection vs. temperature

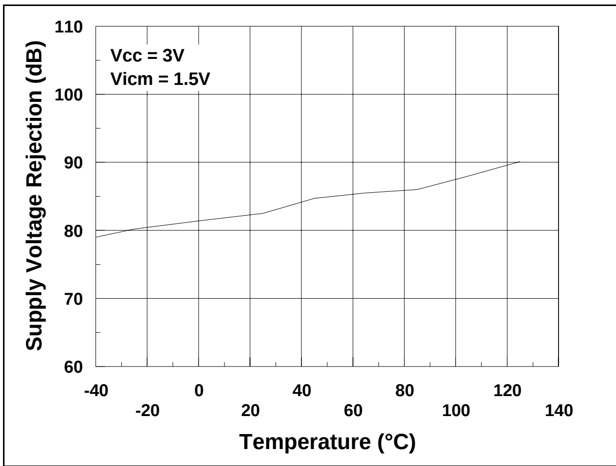


Figure 10. Output current vs. output voltage

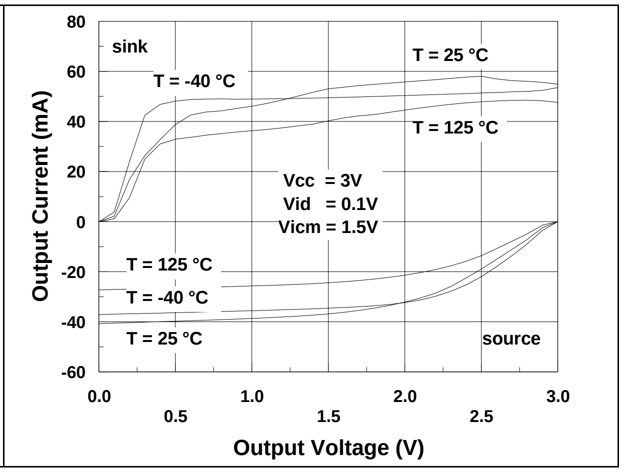


Figure 11. Output current vs. output voltage

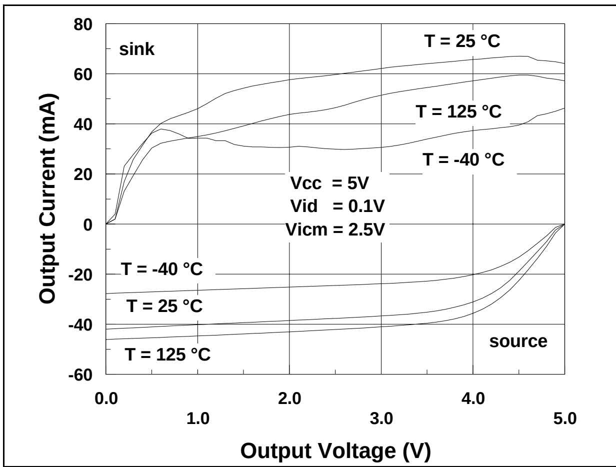
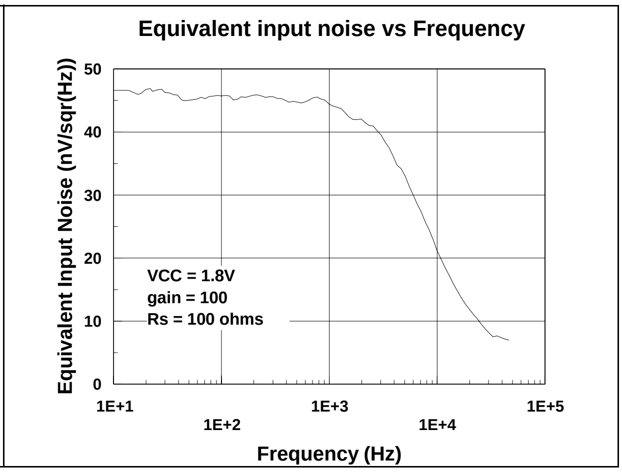


Figure 12. Noise versus frequency



3 Package information

In order to meet environmental requirements, STMicroelectronics offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an STMicroelectronics trademark. ECOPACK specifications are available at: www.st.com.

3.1 SOT23-5 package information

Figure 13. SOT23-5 package mechanical drawing

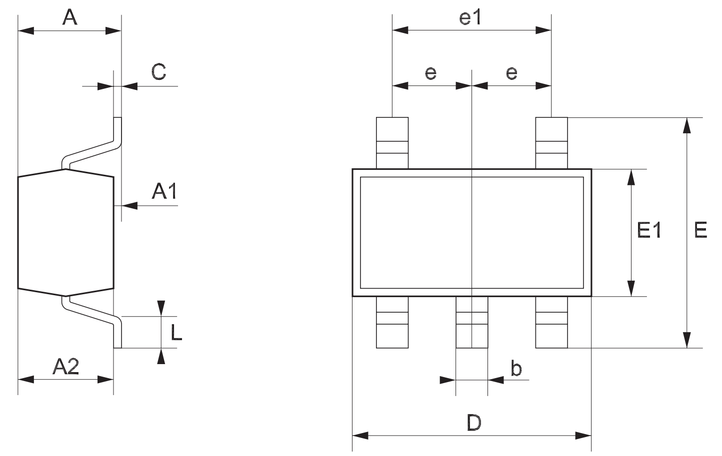


Table 5. SOT23-5 package mechanical data

Ref.	Dimensions					
	Millimeters			Mils		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90		1.45	35.4		57.1
A1	0.00		0.15	0.00		5.9
A2	0.90		1.30	35.4		51.2
b	0.35		0.50	13.7		19.7
C	0.09		0.20	3.5		7.8
D	2.80		3.00	110.2		118.1
E	2.60		3.00	102.3		118.1
E1	1.50		1.75	59.0		68.8
e		0.95			37.4	
e1		1.9			74.8	
L	0.35		0.55	13.7		21.6

3.2 SO-8 package information

Figure 14. SO-8 package mechanical drawing

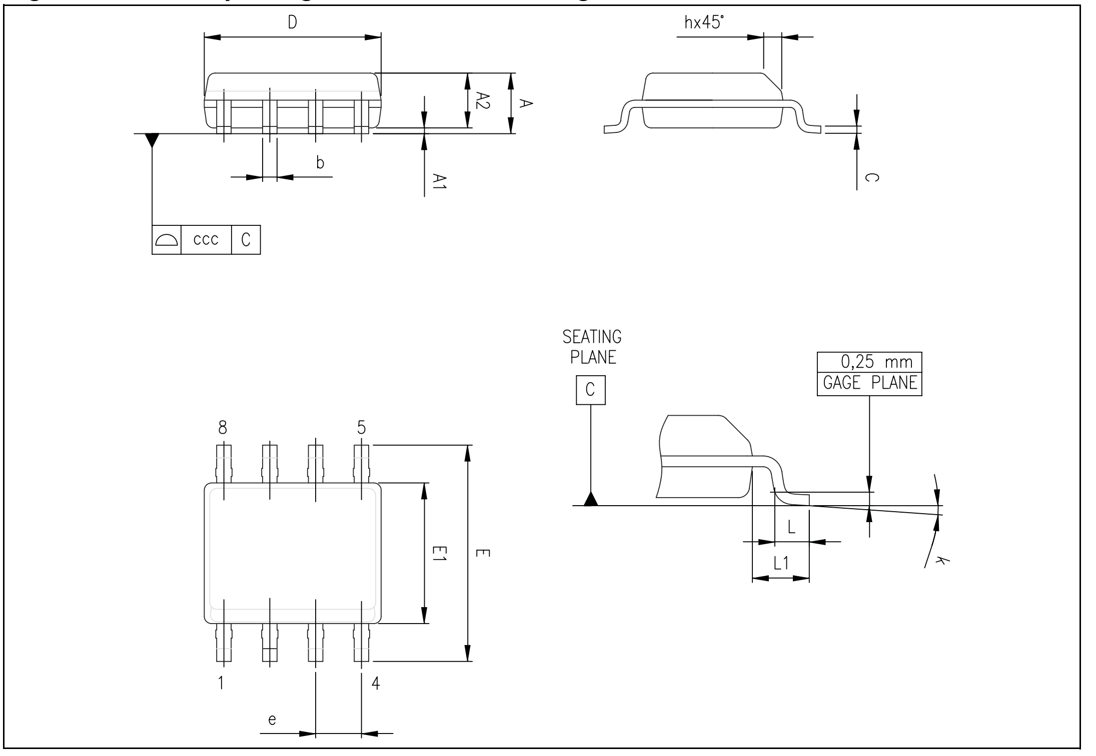


Table 6. SO-8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.10		0.25	0.004		0.010
A2	1.25			0.049		
b	0.28		0.48	0.011		0.019
c	0.17		0.23	0.007		0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	1°		8°	1°		8°
ccc			0.10			0.004

3.3 TSSOP8 package information

Figure 15. TSSOP8 package mechanical drawing

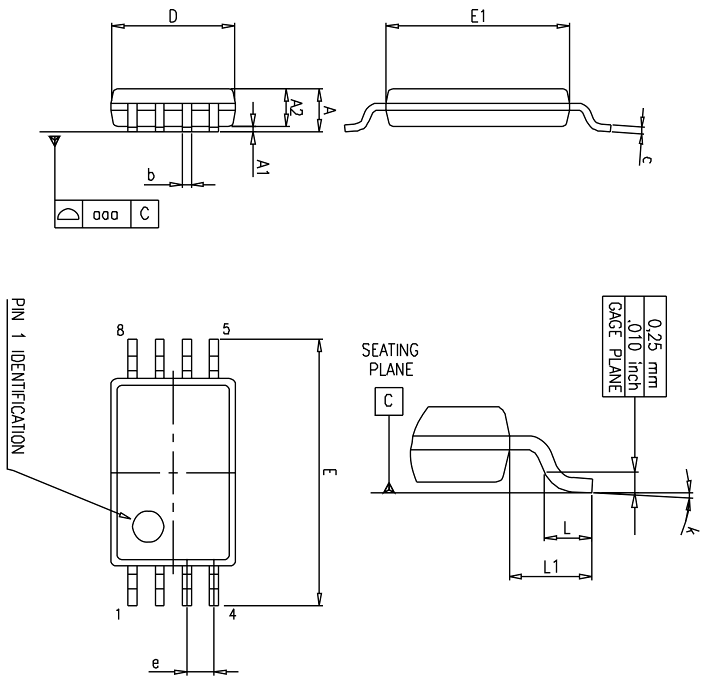


Table 7. TSSOP8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.2			0.047
A1	0.05		0.15	0.002		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.008
D	2.90	3.00	3.10	0.114	0.118	0.122
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.0256	
k	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030
L1		1			0.039	
aaa		0.1			0.004	

3.4 SO-14 package information

Figure 16. SO-14 package mechanical drawing

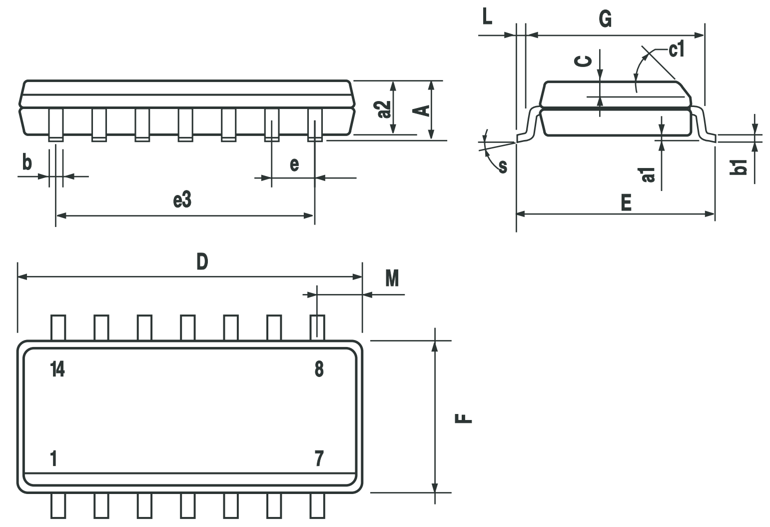


Table 8. SO-14 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
S	8° (max.)					

3.5 TSSOP14 package information

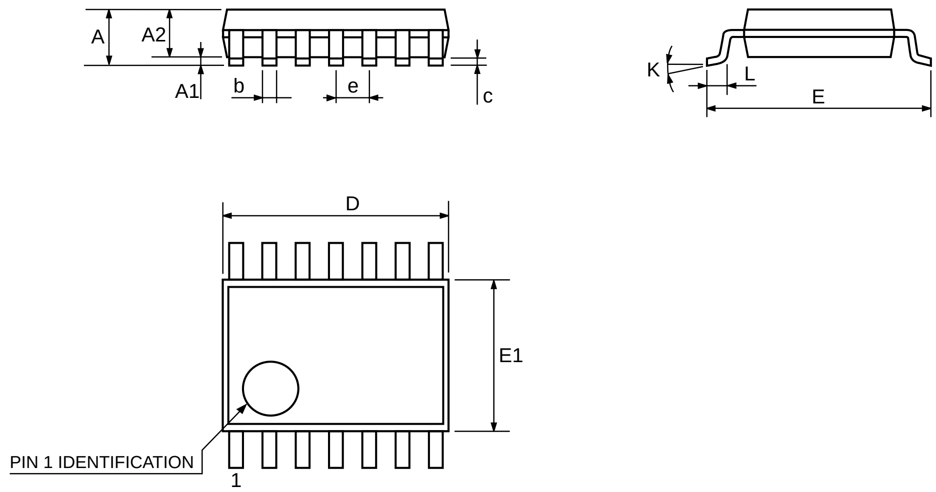


Figure 17. TSSOP14 package mechanical drawing

Figure 18. TSSOP14 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L1	0.45	0.60	0.75	0.018	0.024	0.030

4 Ordering information

Table 9. Order codes

Order code	Temperature range	Package	Packaging	Marking
LMV321ILT	-40°C, +125 °C	SOT23-5	Tape & reel	K177
LMV321RILT				K176
LMV321IYLT(1)		SOT23-5 (Automotive grade)	Tape & reel	K180
LMV321RIYLT(1)				K185
LMV358ID LMV358IDT		SO-8	Tube or tape & reel	LMV358
LMV358IYD(1) LMV358IYDT(1)		SO-8 (Automotive grade)	Tube or tape & reel	LMV358IY
LMV358IPT		TSSOP8	Tape & reel	MV358
LMV358IYPT(1)		TSSOP8 (Automotive grade)	Tape & reel	K181Y
LMV324ID LMV324IDT		SO-14	Tube or tape & reel	LMV324
LMV324IYD(1) LMV324IYDT(1)		SO-14 (Automotive grade)	Tube or tape & reel	V324Y
LMV324IPT		TSSOP14	Tape & reel	MV324
LMV324IYPT(1)		TSSOP14 (Automotive grade)	Tape & reel	V324IY

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent are on-going.

5 Revision history

Table 10. Document revision history

Date	Revision	Changes
1-Dec-2005	1	First release - Products in full production.
25-May-2007	2	Added automotive grade part numbers to order codes table. Moved order codes table to *Section 4 on page 13*.
20-Feb-2008	3	Added *Figure 12: Noise versus frequency on page 7*. Updated presentation of package information. Corrected footnote for automotive grade part numbers in order codes table.