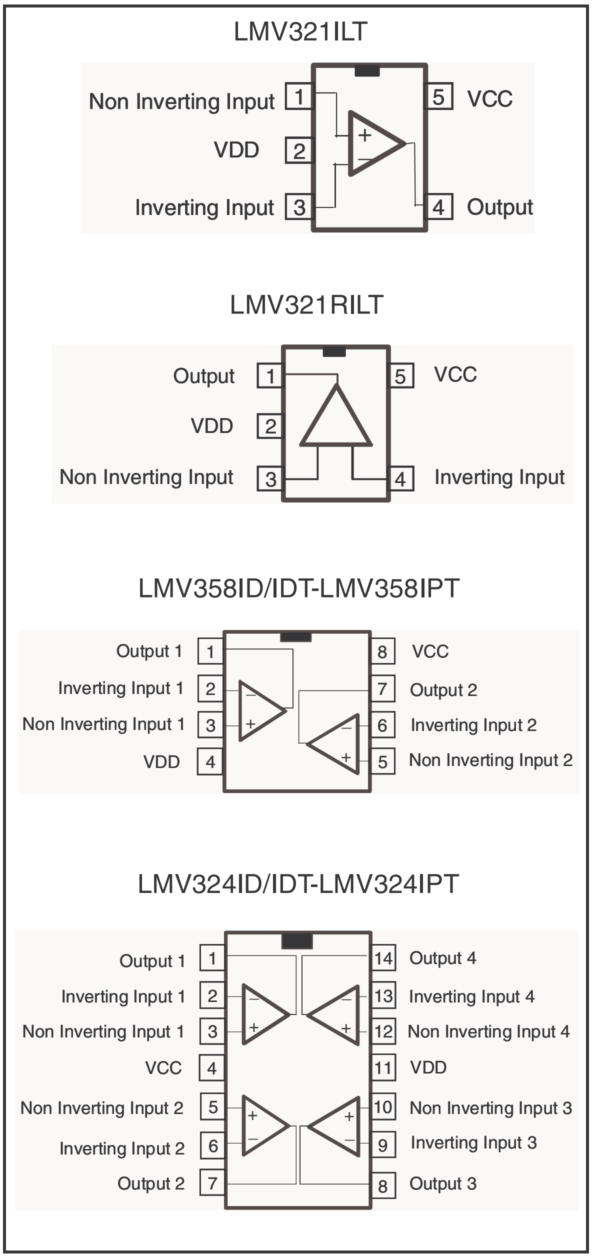
LMV321-LMV358-LMV324

Low Cost, Low Power Input/Output Rail-to-Rail Operational Amplifiers

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



Description

The LMV321/358/324 (single, dual & quad) family answer the need for low cost, general purpose operational amplifiers. It operates with voltages as low as 2.7V and features both input and output rail-to-rail, 145µA consumption current and 1MHz Gain Bandwidth Product (GBP).

With a such low consumption and a sufficient GBP for many applications, this op-amp is very well-suited for any kind of battery-supplied and portable equipment applications.

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

Applications

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

1 Order Codes

Part Number	Temperature Range	Package	Packaging	Marking
LMV321ILT	-40°C, +125 °C	SOT23-5	Tape & Reel	K177
LMV321RILT				K176
LMV358ID/IDT		SO-8	Tube or Tape & Reel	LMV358
LMV358IPT		TSSOP8 (Thin Shrink Outline Package)	Tape & Reel	MV358
LMV324ID/IDT		SO-14	Tube or Tape & Reel	LMV324
LMV324IPT		TSSOP14 (Thin Shrink Outline Package)	Tape & Reel	MV324

2 Absolute Maximum Ratings

Table 1. Key parameters and their absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage [1]	7	V
V_{id}	Differential Input Voltage[2]	±1	V
V_i	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 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 voltages 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 Vid > ±1V, the maximum input current must not exceed ±1mA. In this case (Vid > ±1V) an input serie resistor must be added to limit input current.
3. Short-circuits can cause excessive heating. Destructive dissipation can result from simultaneous short-circuit on all amplifiers. All values are typical.
4. Human body model, 100pF discharged through a 1.5kΩ resistor into pin of device.
5. Machine model ESD, a 200pF cap is charged to the specified voltage, then discharged directly into the IC with no external series resistor (internal resistor < 5Ω), into pin to pin of device.
6. No value specified for CDM on SOT23-5L package. 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 48mA, 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
Vicm	Common Mode Input Voltage Range [1]	V_{dd} -0.2 to V_{CC} + 0.2	V
Vicm	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 $2.7 \leq V_{CC} \leq 6V$, V_{icm} is extended to V_{dd} - 0.2V, V_{CC} + 0.2V.
2. In full temperature range, both Rails can be reached when V_{CC} does not exceed 5.5V.

3 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	Vicm = Vout = Vcc/2 Tmin ≤ Tamb ≤ Tmax		0.1	3 6	mV
ΔV_{io}	Input Offset Voltage Drift			2		µV/°C
I_{io}	Input Offset Current	Vicm = Vout = Vcc/2 (1) Tmin ≤ Tamb ≤ Tmax		1	9 25	nA
I_{ib}	Input Bias Current	Vicm = Vout = Vcc/2 1) Tmin ≤ Tamb ≤ Tmax		10	50 85	nA
CMR	Common Mode Rejection Ratio	$0 \leq V_{icm} \leq V_{CC}$	55	85		dB
SVR	Supply Voltage Rejection Ratio	V_{icm} = Vcc/2	70	80		dB
A_{vd}	Large Signal Voltage Gain	**Vout = 0.5V to 2.2V** R_L = 10kΩ R_L = 2kΩ	80 70	100 88		dB
V_{OH}	High Level Output Voltage	**Vid = 100mV** **Tmin ≤ Tamb ≤ Tmax** R_L = 10kΩ R_L = 2kΩ	2.6 2.55	2.65 2.6		V
V_{OL}	Low Level Output Voltage	**Vid = -100mV** **Tmin ≤ Tamb ≤ Tmax** R_L = 10kΩ R_L = 2kΩ		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)	**Vout = Vcc/2** A_{VCL} = 1, no load Tmin ≤ Tamb ≤ Tmax		145	200 230	µA
GBP	Gain Bandwidth Product	R_L = 600Ω, C_L = 100pF, f = 100kHz		1		MHz
SR	Slew Rate	R_L = 600Ω, C_L = 100pF, A_V = 1		0.35		V/µs
φm	Phase Margin	R_L = 600Ω, C_L = 100pF		44		Degrees
en	Input Voltage Noise			40		nV/√Hz
THD	Total Harmonic Distortion			0.01		%

1. Maximum values including unavoidable inaccuracies of the industrial test.

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	Vicm = Vout = Vcc/2 Tmin ≤ Tamb ≤ Tmax		0.1	3 6	mV
ΔV_{io}	Input Offset Voltage Drift			2		µV/°C
I_{io}	Input Offset Current	Vicm = Vout = Vcc/2 (1) Tmin ≤ Tamb ≤ Tmax		1	9 25	nA
I_{ib}	Input Bias Current	Vicm = Vout = Vcc/2 (1) Tmin ≤ Tamb ≤ Tmax		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} = Vcc/2	70	90		dB
A_{vd}	Large Signal Voltage Gain	**Vout = 0.5V to 4.5V** R_L = 10kΩ R_L = 2kΩ	 85 77	 97 93		dB
V_{OH}	High Level Output Voltage	**Vid = 100mV** Tmin ≤ Tamb ≤ Tmax R_L = 10kΩ R_L = 2kΩ	 4.85 4.8	 4.95 4.91		V
V_{OL}	Low Level Output Voltage	**Vid = -100mV** Tmin ≤ Tamb ≤ Tmax R_L = 10kΩ R_L = 2kΩ		 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)	**Vout = Vcc/2** A_{VCL} = 1, no load Tmin ≤ Tamb ≤ Tmax		 162	 220 250	µA
GBP	Gain Bandwidth Product	R_L = 600Ω, C_L = 100pF, f = 100kHz		1.3		MHz
SR	Slew Rate	R_L = 600Ω, C_L = 100pF, A_V = 1		0.45		V/µs
φm	Phase Margin	R_L = 600Ω, C_L = 100pF		48		Degrees
en	Input Voltage Noise			40		nV/√Hz
THD	Total Harmonic Distortion			0.01		%

1. Maximum values including unavoidable inaccuracies of the industrial test.

Figure 1. Supply current/amplifier vs. supply voltage

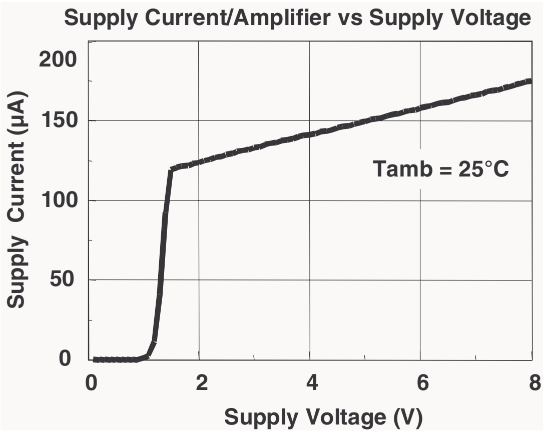


Figure 2. Input bias current vs. temp.

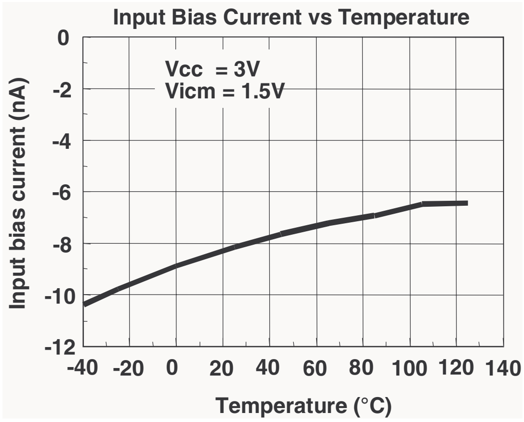


Figure 3. Input bias current vs. temp.

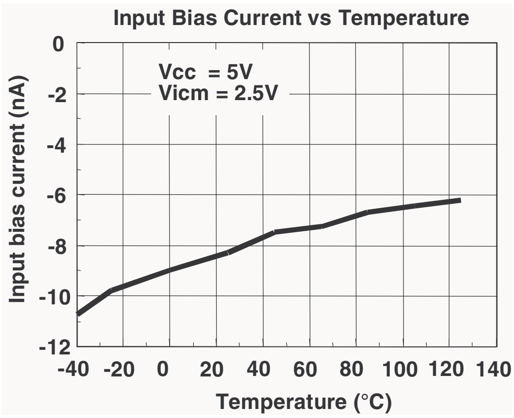


Figure 4. Common mode rejection vs. temp.

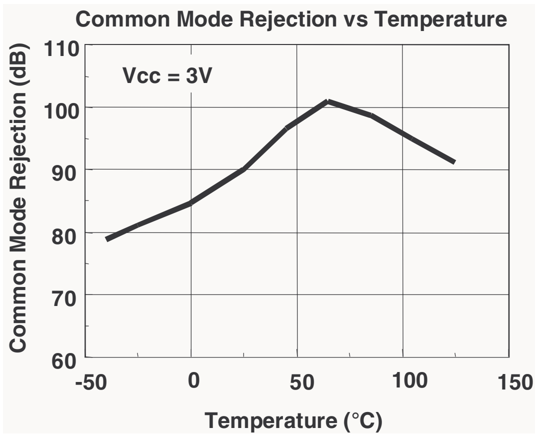


Figure 5. Common mode rejection vs. temp.

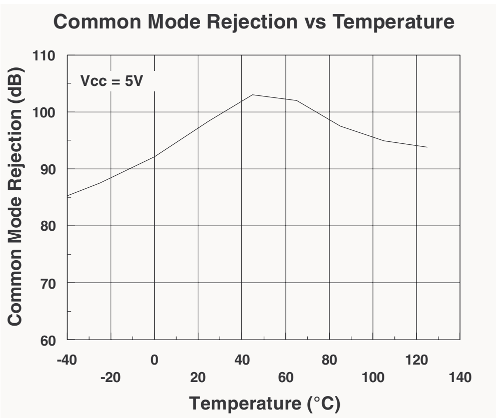


Figure 6. Supply voltage rejection vs. temp.

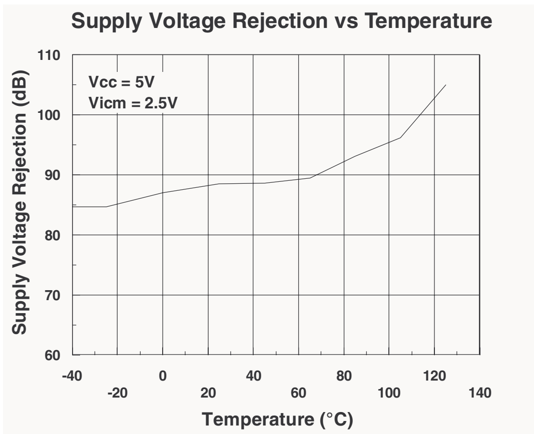


Figure 7. Open loop gain vs. temp.

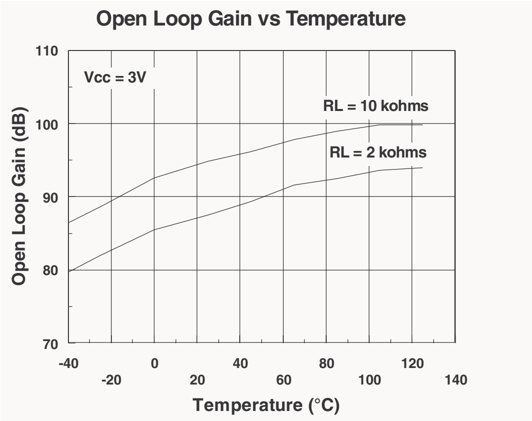


Figure 8. Open loop gain vs. temp.

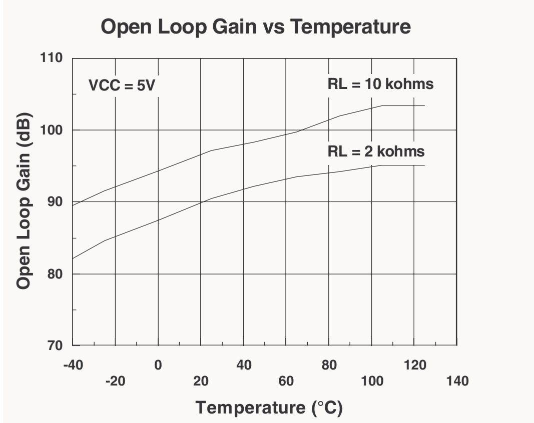


Figure 9. Supply voltage rejection vs. temp.

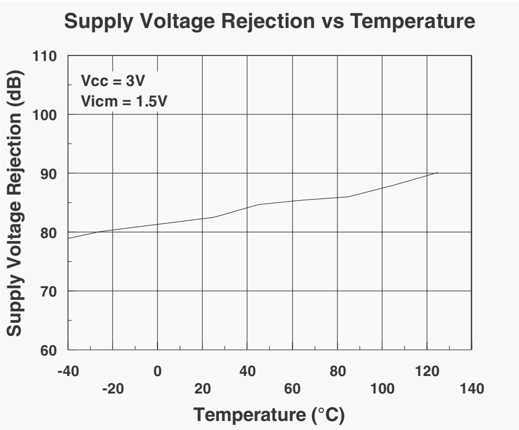


Figure 10. Output current vs. output voltage

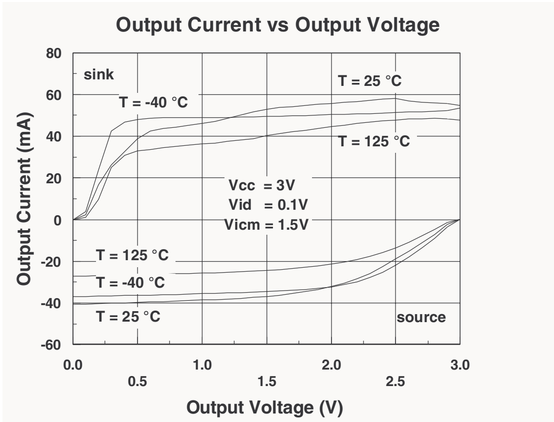
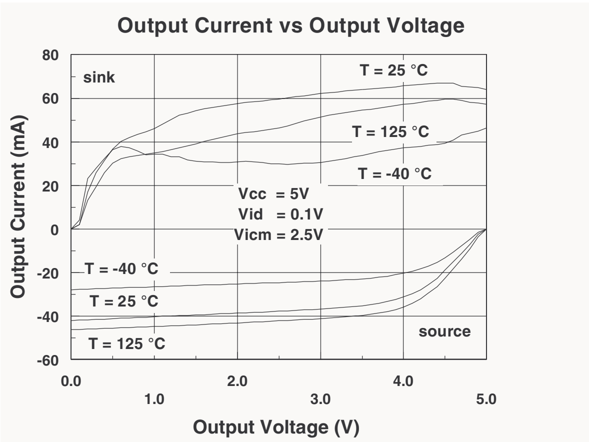


Figure 11. Output current vs. output voltage



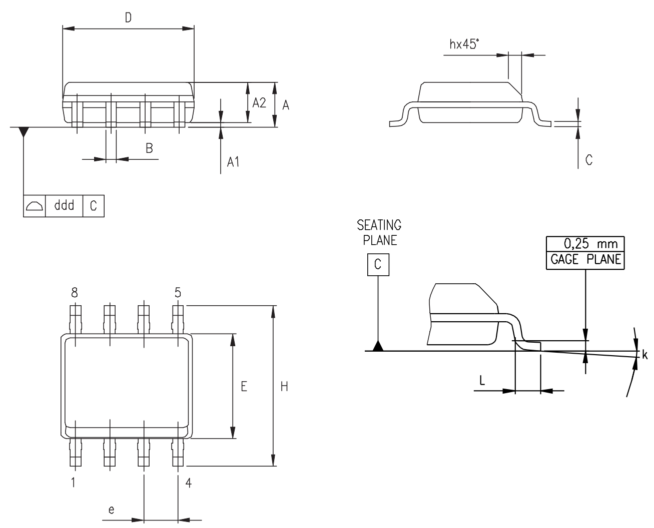
4 Package Mechanical Data

In order to meet environmental requirements, ST 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 ST trademark. ECOPACK specifications are available at: www.st.com.

4.1 SO-8 Package

SO-8 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	8° (max.)					
ddd			0.1			0.04

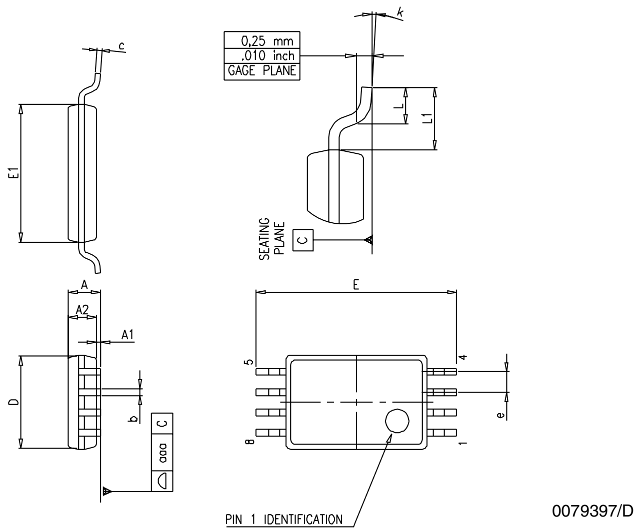


0016023/C

4.2 TSSOP8 Package

TSSOP8 MECHANICAL DATA

DIM.	mm.			inch		
	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	

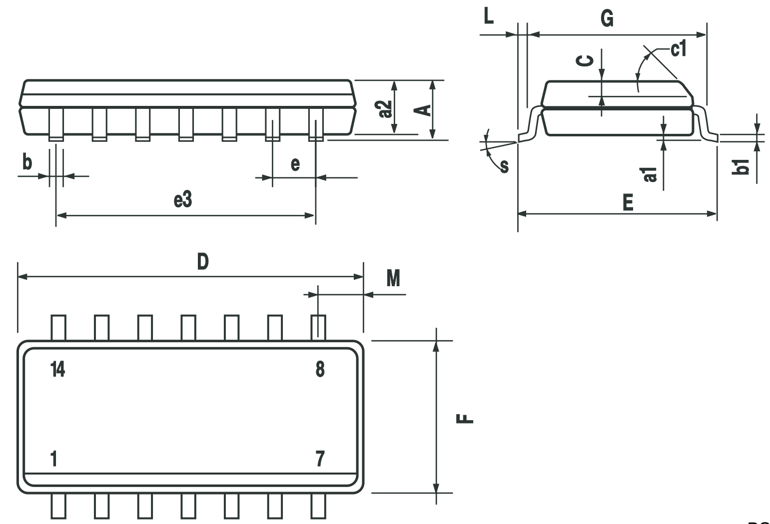


0079397/D

4.3 SO-14 Package

SO-14 MECHANICAL DATA

DIM.	mm.			inch		
	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.)					

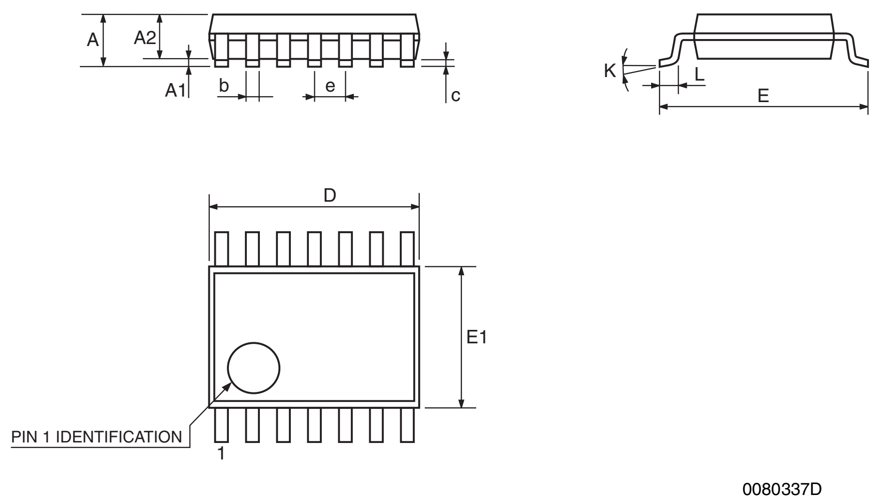


PO13G

4.4 TSSOP14 Package

TSSOP14 MECHANICAL DATA

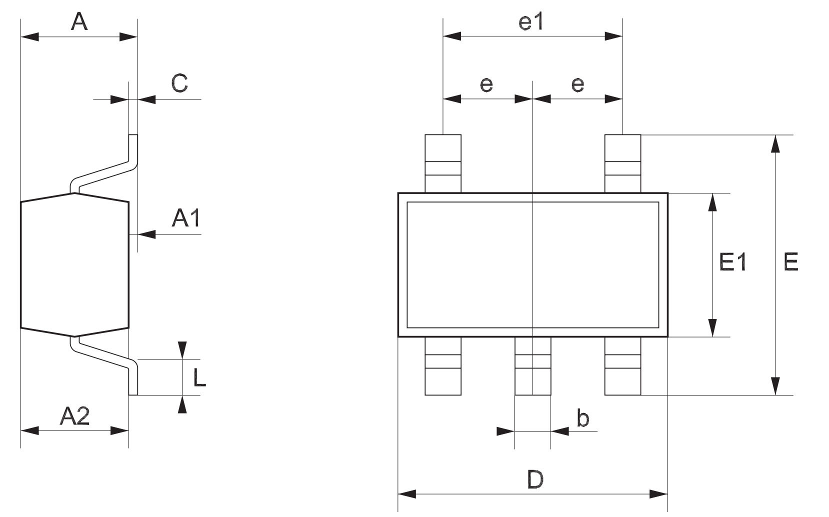
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC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



4.5 SOT23-5 Package

SOT23-5L MECHANICAL DATA

DIM.	mm.			mils		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	0.90		1.45	35.4		57.1
A1	0.00		0.15	0.0		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



5 Revision History

Table 5. Document revision history

Date	Revision	Changes
Dec. 2005	1	First Release - Products in full production.