



# TS461-TS462-TS464

## Output Rail-to-Rail Operational Amplifiers

- High dynamic features
- Large output swing ( $\pm 2.4V$  @  $V_{CC} = \pm 2.5V$ )
- Low noise level:  $4nV/\sqrt{Hz}$
- Low distortion: 0.003%
- Operating range: 2.7V to 10V
- Available in SOT23-5 micropackage

### Description

The TS46x are a family of operational amplifiers able to operate with voltages as low as  $\pm 1.35V$  and to reach a minimum of  $\pm 2V_{pp}$  of output swing when supplied with  $\pm 2.5V$ .

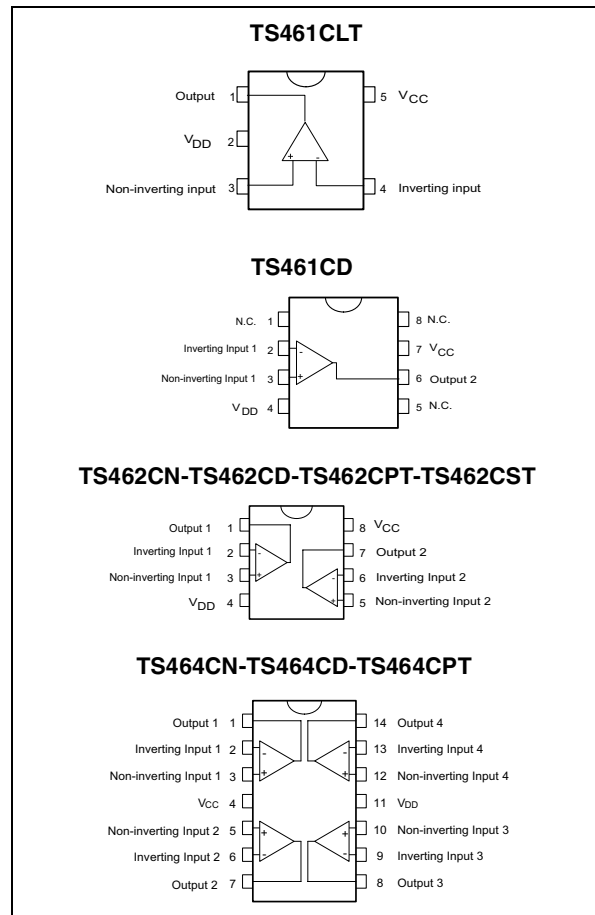
This device is well-suited for all kinds of portable and battery-supplied equipment, where low noise and low distortion are key requirements.

The TS461/2/4 offer excellent output rail-to-rail performance at an attractive cost.

### Applications

- Sound cards
- PDA
- CD players
- Recording equipment
- Multimedia
- Microphone preamplifiers

### Pin Connections (top view)



### Order Codes

Part Number	Temperature Range	Package	Packaging	Marking
TS461CLT	-20°C, +70°C	SOT23-5L	Tape & Reel	K105
TS461CD/CDT		SO-8	Tube or Tape & Reel	
TS462CST		mini SO-8	Tape & Reel	
TS462CPT		TSSOP-8 (Thin Shrink Outline Package)	Tape & Reel	
TS462CN		DIP8	Tube	
TS462CD/CDT		SO-8	Tube or Tape & Reel	
TS464CPT		TSSOP-14 (Thin Shrink Outline Package)	Tape & Reel	
TS464CN		DIP14	Tube	
TS464CD/CDT		SO-14	Tube or Tape & Reel	

## 1 Absolute Maximum Ratings

**Table 1: Key parameters and their absolute maximum ratings**

Symbol	Parameter	Value	Unit
VCC	Supply voltage <sup>1</sup>	12	V
V <sub>id</sub>	Differential Input Voltage <sup>2</sup>	±VCC	V
V <sub>in</sub>	Input Voltage Range	V <sub>dd</sub> -0.3 to V <sub>cc</sub> +0.3	V
T <sub>oper</sub>	Operating Free Air Temperature Range	-20 to +70	°C
T <sub>std</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>j</sub>	Maximum Junction Temperature	150	°C
R <sub>thja</sub>	Thermal Resistance Junction to Case <sup>3</sup>		°C/W
	SOT23-5	250	
	SO8	125	
	SO14	103	
	TSSOP8	120	
	TSSOP14	100	
ESD	HBM: Human Body Model <sup>4</sup>	2	kV
	MM: Machine Model <sup>5</sup>	200	V
	CDM: Charged Device Model	1.5	kV
	Lead Temperature (soldering, 10sec)	250	°C

1) All voltages values, except differential voltage are with respect to network group terminal.

2) Differential voltages are non-inverting input terminal with respect to the inverting input terminal.

3) Short-circuits can cause excessive heating and destructive dissipation.

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.

**Table 2: Operating conditions**

Symbol	Parameter	Value	Unit
VCC	Supply Voltage	2.7 to 10	V
V <sub>icm</sub>	Common Mode Input Voltage Range	V <sub>DD</sub> +1.15 to V <sub>CC</sub> - 1.15	V
T <sub>oper</sub>	Operating Free Air Temperature Range	-20 to +70	°C

## 2 Electrical Characteristics

Table 3:  $V_{CC} = 2.5V$ ,  $V_{DD} = -2.5V$ ,  $T_{amb} = 25^{\circ}C$  (unless otherwise specified)

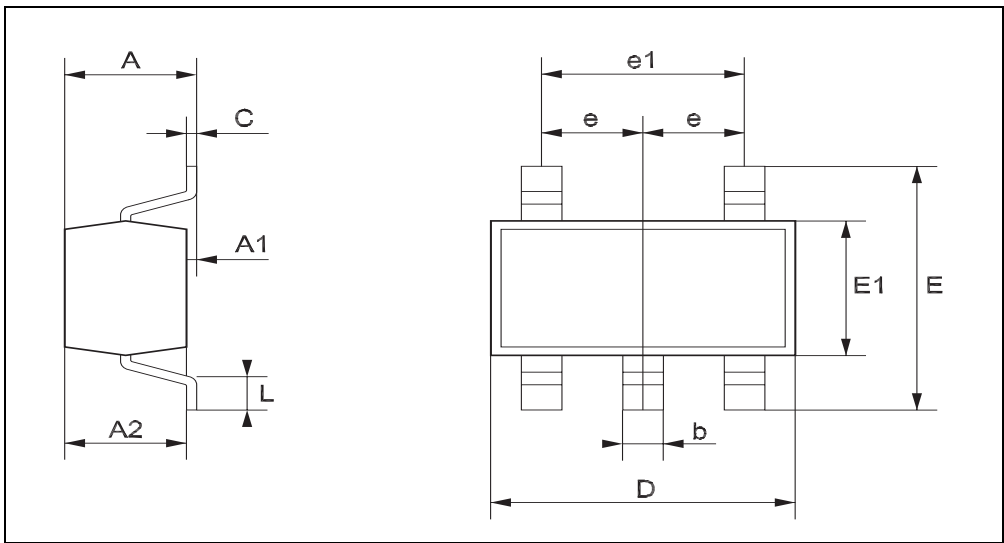
Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{io}$	Input Offset Voltage $T_{min.} \leq T_{amb} \leq T_{max.}$		1	5 7	mV
$\Delta V_{io}$	Input Offset Voltage Drift $V_{icm} = 0V, V_o = 0V$		5		$\mu V/^{\circ}C$
$I_{io}$	Input Offset Current $V_{icm} = 0V, V_o = 0V$ $T_{min.} \leq T_{amb} \leq T_{max.}$		10	150 200	nA
$I_{ib}$	Input Bias Current $V_{icm} = 0V, V_o = 0V$ $T_{min.} \leq T_{amb} \leq T_{max.}$		200 200	750 1000	nA
$V_{icm}$	Common Mode Input Voltage Range	-1.35		1.35	V
CMR	Common Mode Rejection Ratio $V_{icm} = \pm 1.35V$	60	85		dB
SVR	Supply Voltage Rejection Ratio $V_{cc} = \pm 2V$ to $\pm 3V$	60	70		dB
$A_{vd}$	Large Signal Voltage Gain $R_L = 2k\Omega$	70	80		dB
$V_{OH}$	High Level Output Voltage $R_L = 2k\Omega$	2	2.4		V
$V_{OL}$	Low Level Output Voltage $R_L = 2k\Omega$		-2.4	-2	V
$I_{CC}$	Supply Current, per amplifier Unity gain - no load		2	2.8	mA
GBP	Gain Bandwidth Product $f = 100kHz$ $R_L = 2k\Omega, C_L = 100pF$	8.5	12		MHz
SR	Slew Rate $A_V = 1, V_{in} = \pm 1V$	2.8	4		V/ $\mu s$
$e_n$	Equivalent Input Noise Voltage $f = 100kHz$		4		$\frac{nV}{\sqrt{Hz}}$
THD	Total Harmonic Distortion $f = 1kHz, A_V = -1$ $R_L = 10k\Omega$		0.003		%

3 Package Mechanical Data

3.1 SOT23-5L package

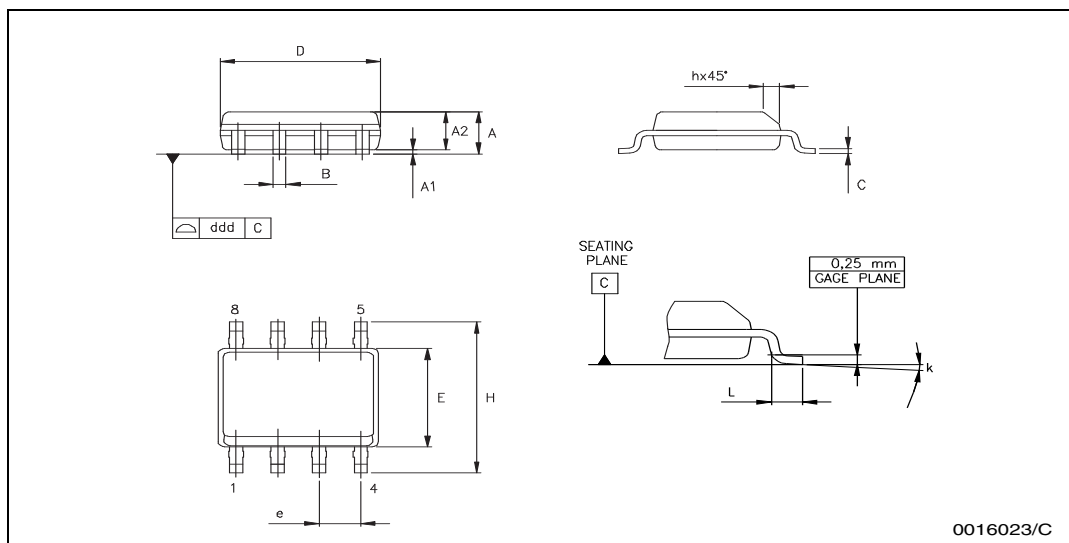
**SOT23-5L MECHANICAL DATA**

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



3.2 SO-8 package

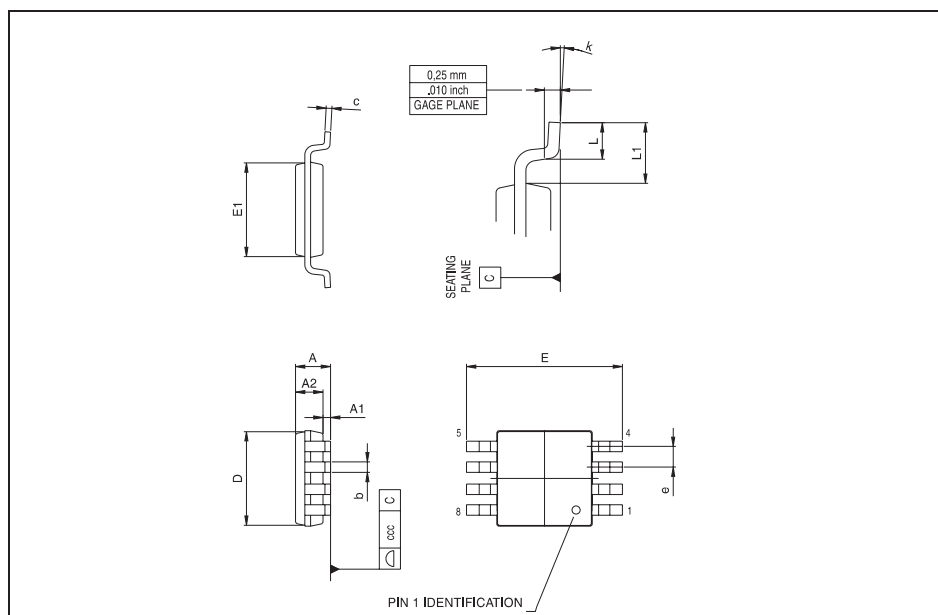
SO-8 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
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



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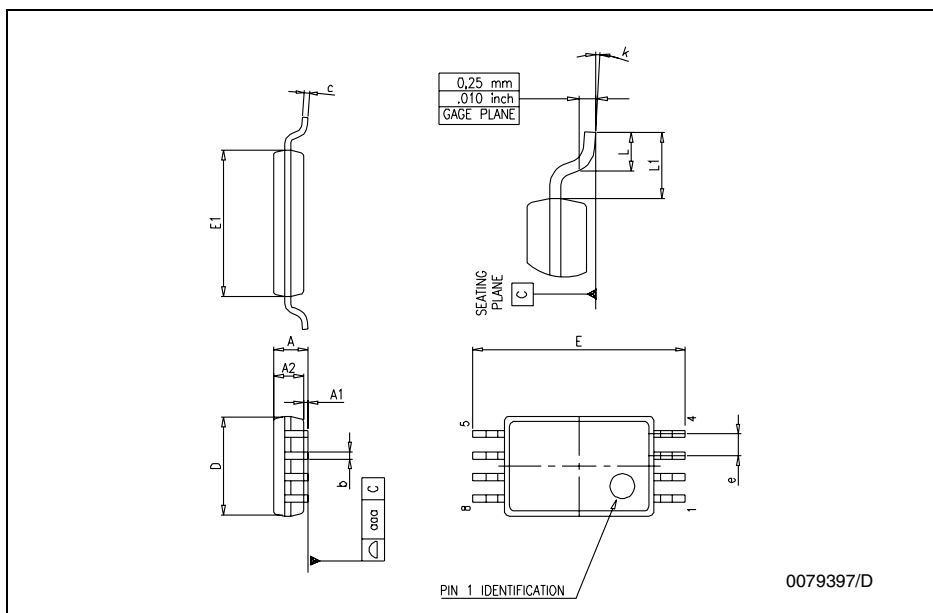
3.3 Mini SO-8 package

miniSO-8 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.1			0.043
A1	0.05	0.10	0.15	0.002	0.004	0.006
A2	0.78	0.86	0.94	0.031	0.031	0.037
b	0.25	0.33	0.40	0.010	0.13	0.013
c	0.13	0.18	0.23	0.005	0.007	0.009
D	2.90	3.00	3.10	0.114	0.118	0.122
E	4.75	4.90	5.05	0.187	0.193	0.199
E1	2.90	3.00	3.10	.0114	0.118	0.122
e		0.65			0.026	
K	0°		6°	0°		6°
L	0.40	0.55	0.70	0.016	0.022	0.028
L1			0.10			0.004



3.4 TSSOP8 package

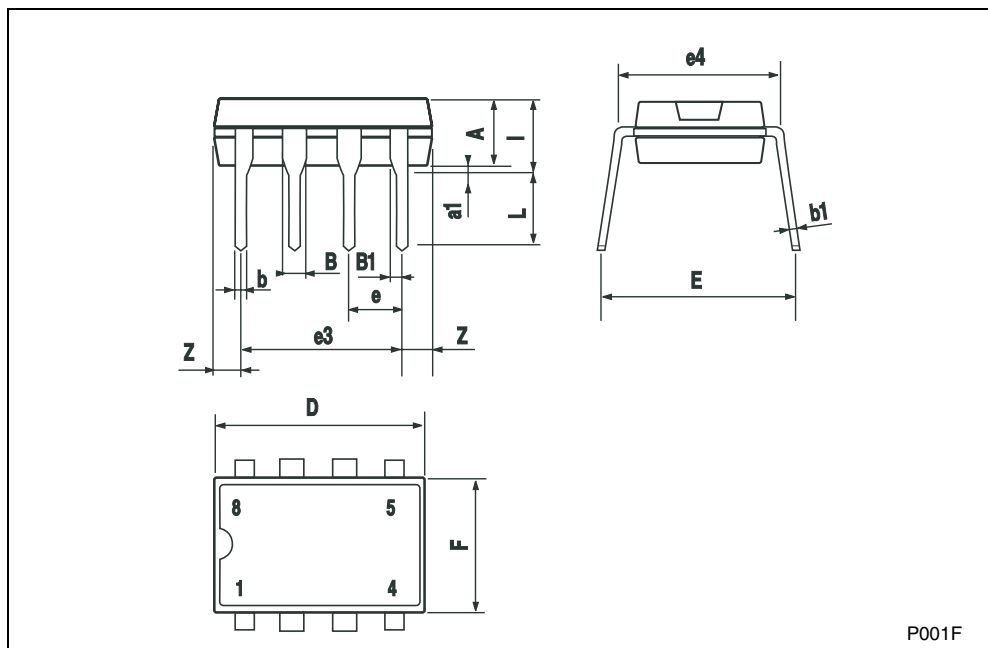
TSSOP8 MECHANICAL DATA						
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.008
D	2.90	3.00	3.10	0.114	0.118	0.122
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	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	



3.5 DIP8 package

**Plastic DIP-8 MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A		3.3			0.130	
a1	0.7			0.028		
B	1.39		1.65	0.055		0.065
B1	0.91		1.04	0.036		0.041
b		0.5			0.020	
b1	0.38		0.5	0.015		0.020
D			9.8			0.386
E		8.8			0.346	
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			7.1			0.280
l			4.8			0.189
L		3.3			0.130	
Z	0.44		1.6	0.017		0.063

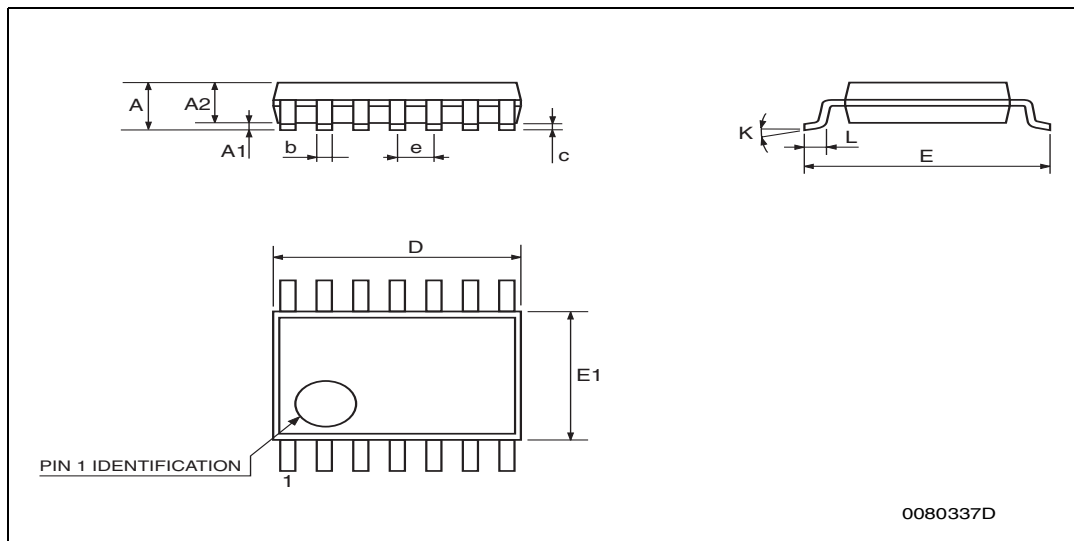




3.6 TSSOP14 package

**TSSOP14 MECHANICAL DATA**

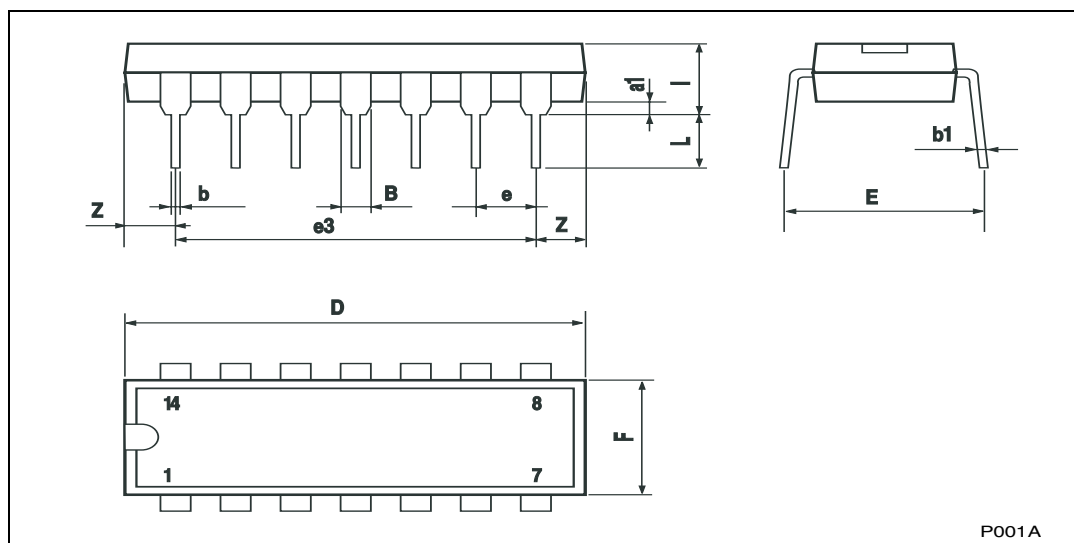
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC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



3.7 DIP14 package

**Plastic DIP-14 MECHANICAL DATA**

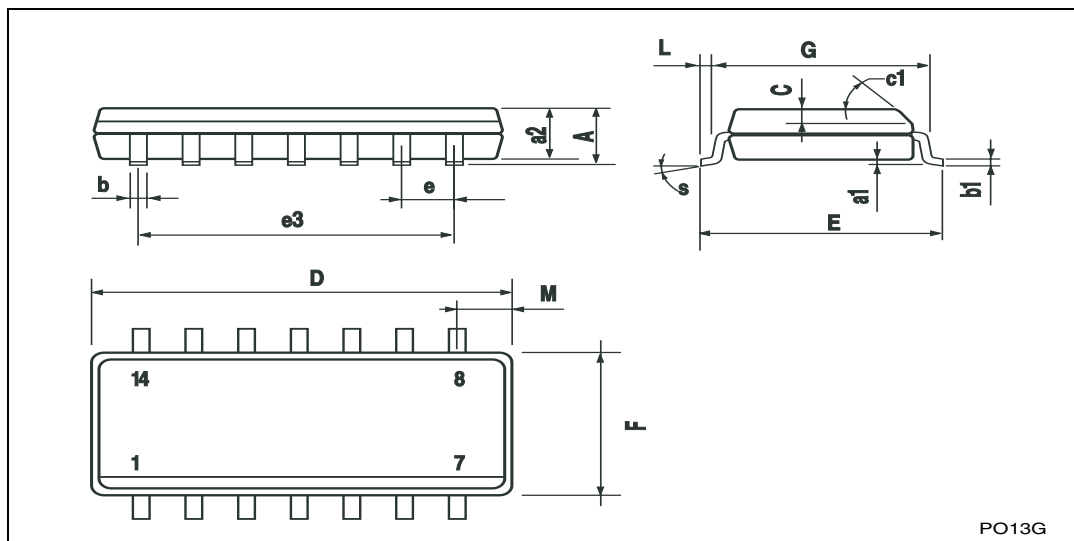
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
l			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



3.8 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	B° (max.)					



PO13G

#### 4 Revision History

Date	Revision	Description of Changes
January 2002	1	First Release
March 2005	2	Modifications on AMR <a href="#">Table 1 on page 2</a> (explanation of Vid and Vi limits)

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