Features

- Single-Supply Operation from +2.1V ~ +5.5V
- Gain-Bandwidth Product: 1MHz (Typ)
- Low Offset Voltage: 3.5mV (Max)
- Low Input Bias Current: 1pA (Typ)
- Quiescent Current: 40μA per Amplifier (Typ)
- Rail-to-Rail Input / Output
- Operating Temperature: -40°C ~ +125°C
- Small Package:
  BL321L Available in SOT23-5 Packages
  BL358L Available in SOP-8 Packages
  BL324L Available in SOP-14 and TSSOP-14 Packages

General Description

BL321L/358L/324L family series operates from a single 2.1V to 5.5V supply or dual ±1.05V to ±2.75V supplies The BL321L single is available in Green SOT-23-5 packages. The BL358L Dual is available in Green SOP-8 packages. The BL324L Quad is available in Green SOP-14 and TSSOP-14 packages.

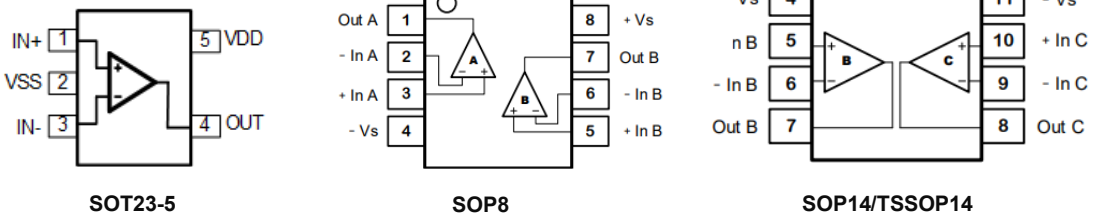
Applications

- Smoke Detectors
- Medical Instrumentation
- Portable Systems

Package/Ordering Information

MODEL	CHANNEL	ORDER NUMBER	PACKAGE DESCRIPTION	PACKAGE OPTION
BL321L	Single	BL321LFR	SOT23-5	Tape and Reel,3000
BL358L	Dual	BL358LSR	SOP-8	Tape and Reel,4000
BL324L	Quad	BL324LTR	TSSOP-14	Tape and Reel,3000
		BL324LSR	SOP-14	Tape and Reel,2500

Pin Configuration



SOT23-5 **SOP8** **SOP14/TSSOP14**

Figure 1. Pin Assignment Diagram

Absolute Maximum Ratings

Condition	Min	Max
Power Supply Voltage (V_{DD} to Vss)	-0.5V	+7.5V
Analog Input Voltage (IN+ or IN-)	Vss-0.5V	V_{DD}+0.5V
PDB Input Voltage	Vss-0.5V	+7V
Operating Temperature Range	-40°C	+125°C
Junction Temperature	+160°C	
Storage Temperature Range	-55°C	+150°C
Lead Temperature (soldering, 10sec)	+260°C	
Package Thermal Resistance (T_A=+25℃)		
SOP-8, θ_{JA}	125°C/W	
MSOP-8, θ_{JA}	216°C/W	
SOT23-5, θ_{JA}	190°C/W	
SC70-5, θ_{JA}	333°C/W	
ESD Susceptibility		
HBM	6KV	
MM	300V	

Note: Stress greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions outside those indicated in the operational sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Electrical Characteristics

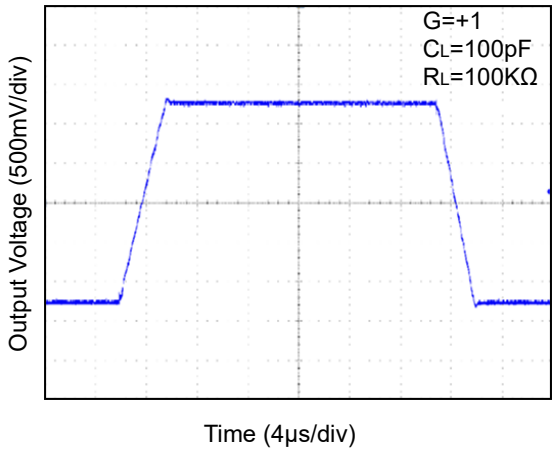
(At V_S = +5V, R_L = 100kΩ connected to V_S/2, and V_{OUT} = V_S/2, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	BL321L/358L/324L				
			TYP	MIN/MAX OVER TEMPERATURE			
			+25℃	+25℃	-40℃ to +85℃	UNITS	MIN/MAX
INPUT CHARACTERISTICS							
Input Offset Voltage	V_{OS}	V_{CM} = V_S/2	0.4	3.5	5.6	mV	MAX
Input Bias Current	I_B		1			pA	TYP
Input Offset Current	I_{OS}		1			pA	TYP
Common-Mode Voltage Range	V_{CM}	V_S = 5.5V	-0.1 to +5.6			V	TYP
Common-Mode Rejection Ratio	CMRR	V_S = 5.5V, V_{CM} = -0.1V to 4V	70	62	62	dB	MIN
		V_S = 5.5V, V_{CM} = -0.1V to 5.6V	68	56	55		
Open-Loop Voltage Gain	A_{OL}	R_L = 5kΩ, V_O = +0.1V to +4.9V	80	70	70	dB	MIN
		R_L = 10kΩ, V_O = +0.1V to +4.9V	100	94	85		
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta_T$		2.7			μV/℃	TYP
OUTPUT CHARACTERISTICS							
Output Voltage Swing from Rail	V_{OH}	R_L = 100kΩ	4.997	4.990	4.980	V	MIN
	V_{OL}	R_L = 100kΩ	3	10	20	mV	MAX
	V_{OH}	R_L = 10kΩ	4.992	4.970	4.960	V	MIN
	V_{OL}	R_L = 10kΩ	8	30	40	mV	MAX
Output Current	I_{SOURCE}	R_L = 10Ω to V_S/2	84	60	45	mA	MIN
	I_{SINK}		75	60	45		
POWER SUPPLY							
Operating Voltage Range				2.1	2.5	V	MIN
				5.5	5.5	V	MAX
Power Supply Rejection Ratio	PSRR	V_S = +2.5V to +5.5V, V_{CM} = +0.5V	82	60	58	dB	MIN
Quiescent Current / Amplifier	I_Q		40			μA	TYP
DYNAMIC PERFORMANCE (CL = 100pF)							
Gain-Bandwidth Product	GBP		1			MHz	TYP
Slew Rate	SR	G = +1, 2V Output Step	0.6			V/μs	TYP
Settling Time to 0.1%	t_S	G = +1, 2V Output Step	5			μs	TYP
Overload Recovery Time		V_{IN} ·Gain = V_S	2.6			μs	TYP
NOISE PERFORMANCE							
Voltage Noise Density	e_n	f = 1kHz	27			$nV/\sqrt{Hz}$	TYP
		f = 10kHz	20			$nV/\sqrt{Hz}$	TYP

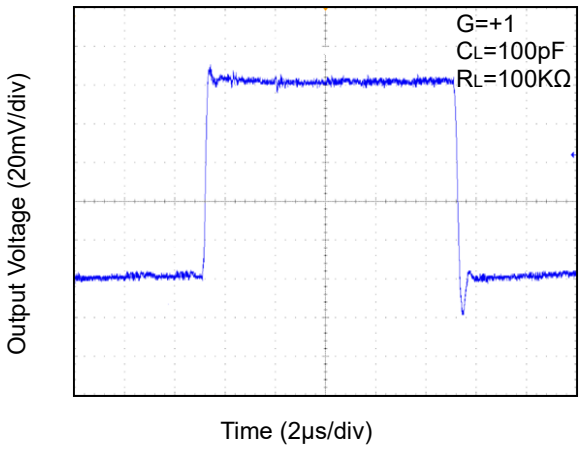
Typical Performance characteristics

At T_A=+25°C, V_S=+5V, and R_L=100KΩ connected to V_S/2, unless otherwise noted.

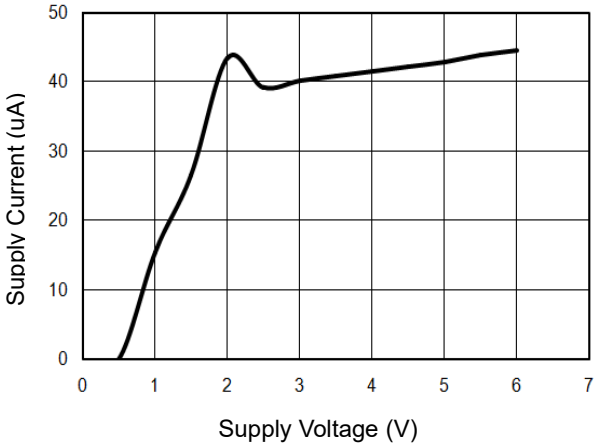
Large-Signal Step Response



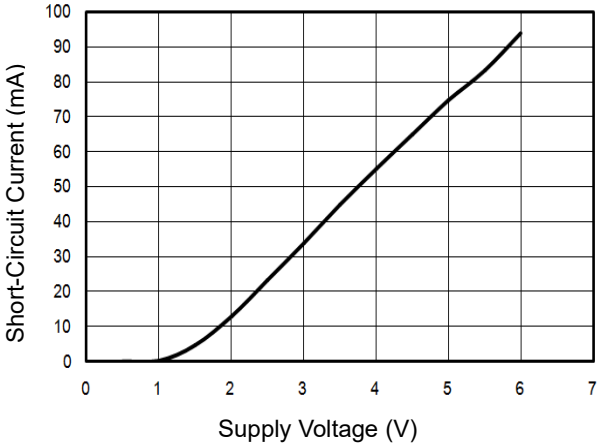
Small-Signal Step Response



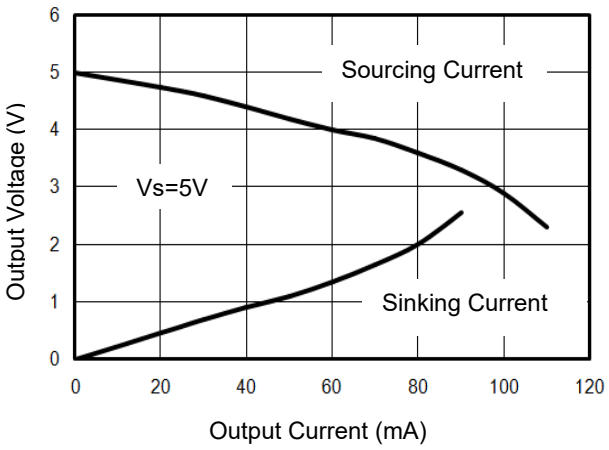
Supply Current vs. Supply Voltage



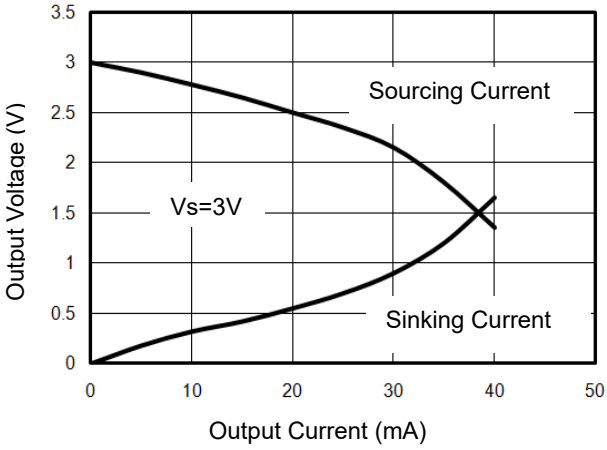
Short-Circuit Current vs. Supply Voltage



Output Voltage vs. Output Current



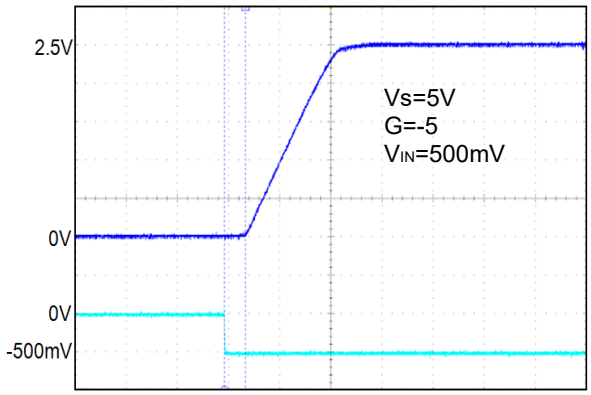
Output Voltage vs. Output Current



Typical Performance characteristics

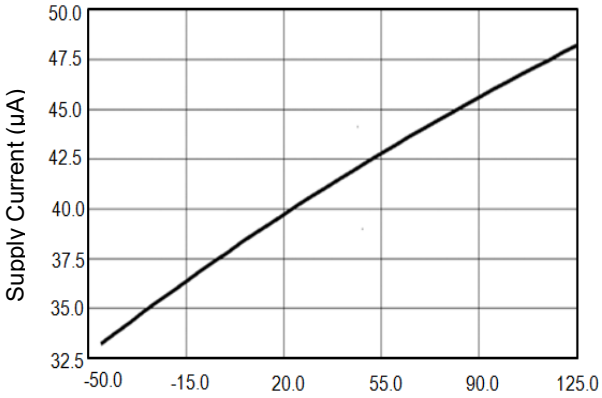
At T_A=+25°C, V_S=+5V, and R_L=100KΩ connected to V_S/2, unless otherwise noted.

Overload Recovery Time



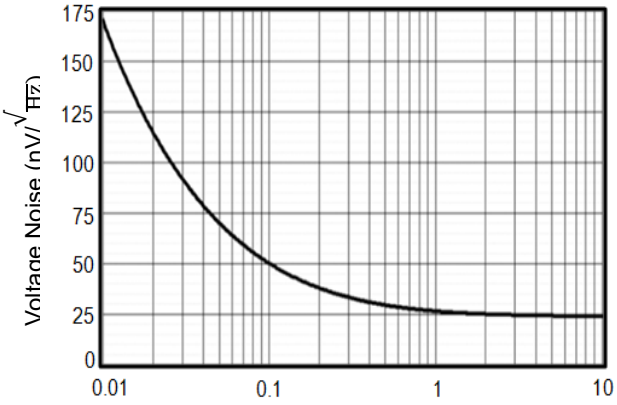
Time (2μs/div)

Supply Current vs. Temperature



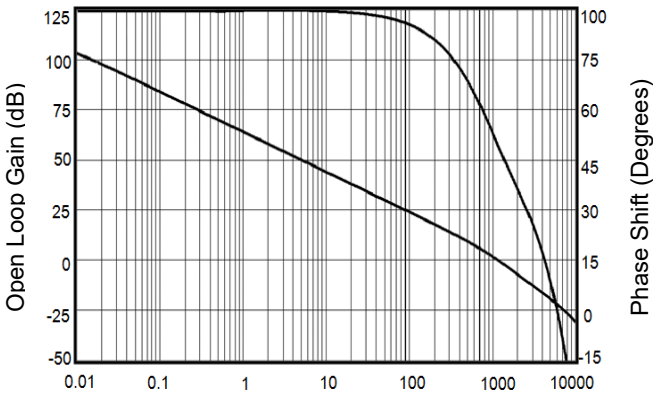
Temperature (℃)

Input Voltage Noise Spectral Density vs. Frequency



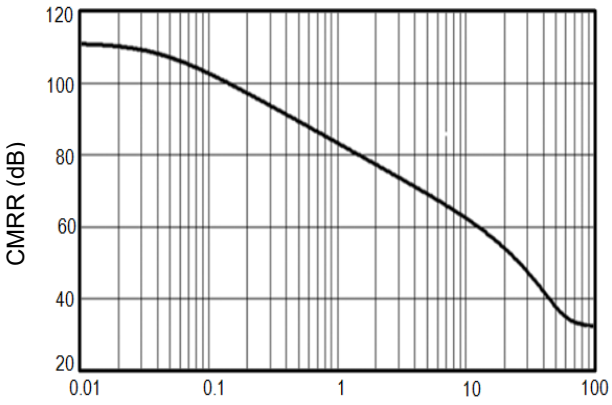
Frequency (kHz)

Open Loop Gain, Phase Shift vs. Frequency at +5V



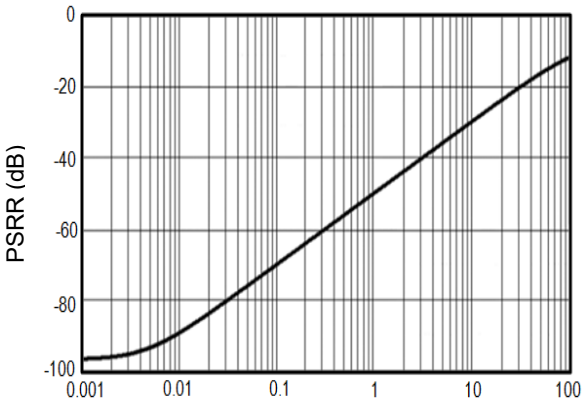
Frequency (kHz)

CMRR vs. Frequency



Frequency (kHz)

PSRR vs. Frequency



Frequency (kHz)

Typical Application Circuits

Differential amplifier

The differential amplifier allows the subtraction of two input voltages or cancellation of a signal common the two inputs. It is useful as a computational amplifier in making a differential to single-end conversion or in rejecting a common mode signal. Figure 1. shown the differential amplifier using BL321L/358L/324L family.

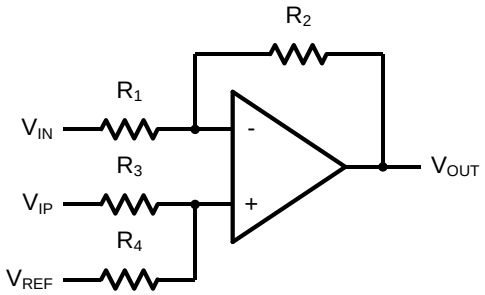


Figure 1. Differential Amplifier

$$V_{OUT}=(\frac{R_1+R_2}{R_3+R_4})\frac{R_4}{R_1}V_{IN}-\frac{R2}{R1}V_{IP}+(\frac{R_1+R_2}{R_3+R_4})\frac{R_3}{R_1}V_{REF}$$

If the resistor ratios are equal (i.e. R_1=R_3 and R_2=R_4), then

$$V_{OUT}=\frac{R_2}{R_1}(V_{IP}-V_{IN})+V_{REF}$$

Instrumentation Amplifier

The triple BL321L/358L/324L family can be used to build a three-op-amp instrumentation amplifier as shown in Figure 2. The amplifier in Figure 2 is a high input impedance differential amplifier with gain of R2/R1. The two differential voltage followers assure the high input impedance of the amplifier.

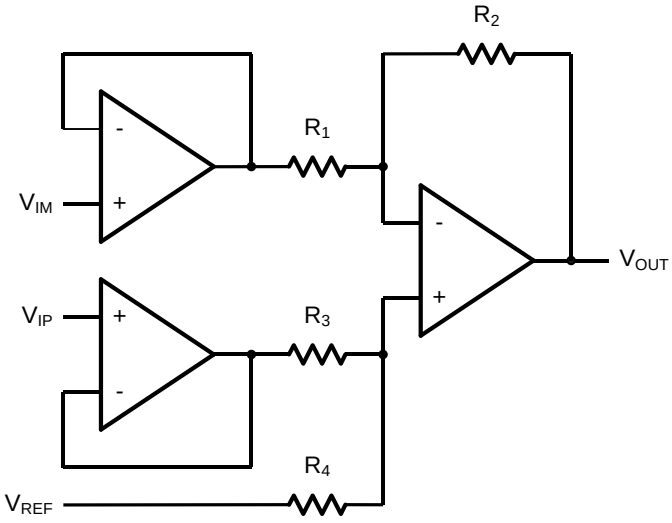


Figure 2. Instrument Amplifier

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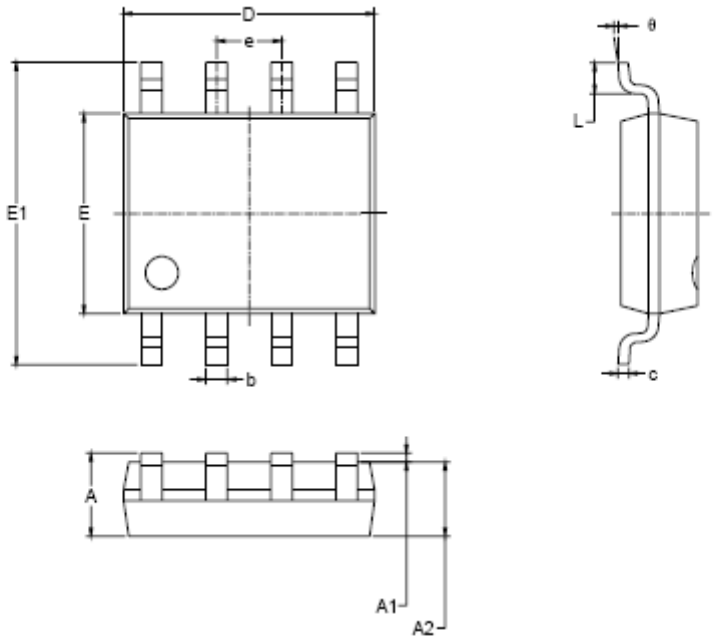
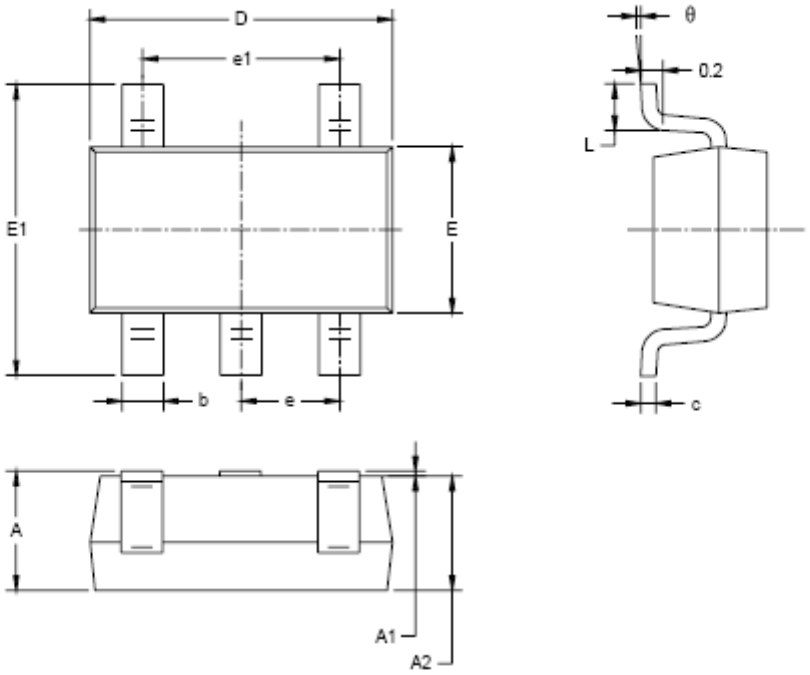
SOP-8



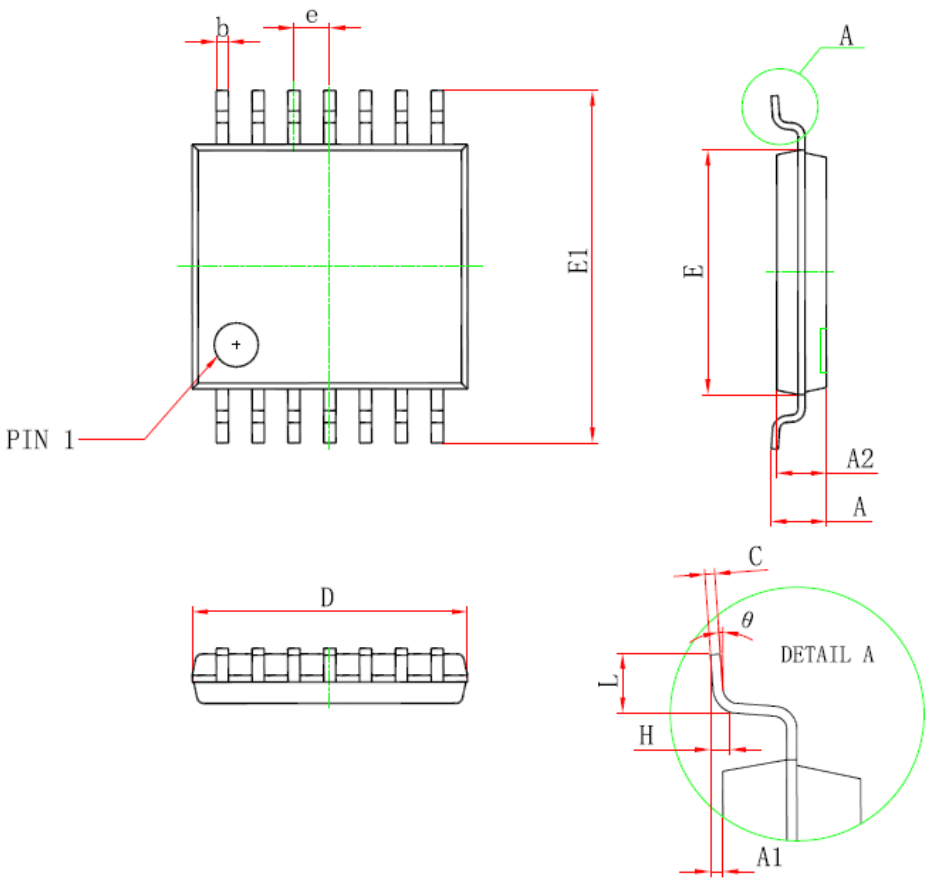
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOT23-5



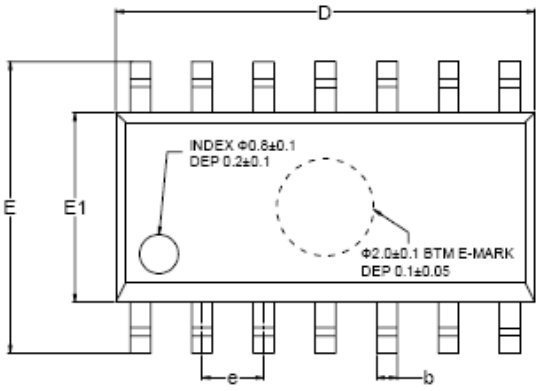
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

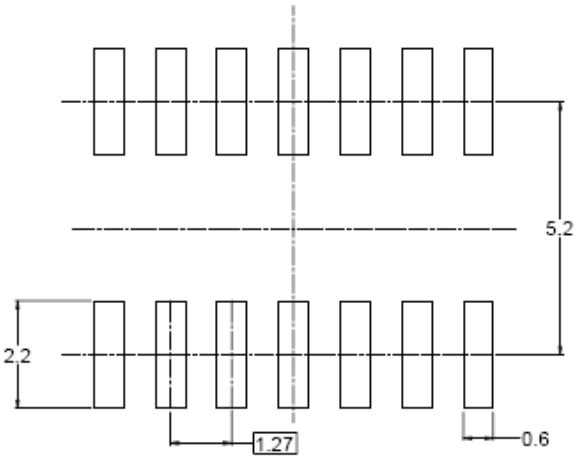
TSSOP-14



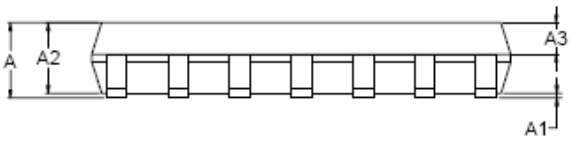
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	**Max**	**Min**	**Max**
D	4.900	5.100	0.193	0.201
E	4.300	4.500	0.169	0.177
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
E1	6.250	6.550	0.246	0.258
A		1.200		0.047
A2	0.800	1.000	0.031	0.039
A1	0.050	0.150	0.002	0.006
e	0.65 (BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

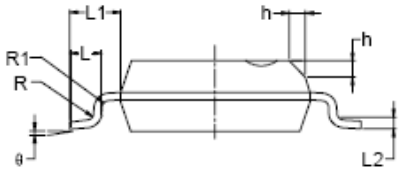
SOP-14





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters			Dimensions In Inches		
	MIN	MOD	MAX	MIN	MOD	MAX
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.004		0.010
A2	1.25		1.65	0.049		0.065
A3	0.55		0.75	0.022		0.030
b	0.36		0.49	0.014		0.019
D	8.53		8.73	0.336		0.344
E	5.80		6.20	0.228		0.244
E1	3.80		4.00	0.150		0.157
e	1.27 BSC			0.050 BSC		
L	0.45		0.80	0.018		0.032
L1	1.04 REF			0.040 REF		
L2	0.25 BSC			0.01 BSC		
R	0.07			0.003		
R1	0.07			0.003		
h	0.30		0.50	0.012		0.020
θ	0°		8°	0°		8°