钍地半导体
Tudi Semiconductor

Product Specification

TUDI-TSV321/TSV358/TSV324

General purpose input/output rail-to-rail low-power operational amplifiers

网址 www.sztdbdt.com

用芯智造 · 卓越品质

semiconductor device manufacturer

- Design
- research and development
- production
- and sales

Features

- Low-power consumption: 250 µA max at 5 V
- Low offset voltage: 7 mV max at 25 °C
- Industrial temperature range: -40 °C to +125 °C
- Low supply voltage: 2.7 V - 5.5 V
- Gain bandwidth product: 1.3 MHz
- Tiny packages

Description

The TSV321, TSV358, and TSV324 are single, dual, and quad operational amplifiers with rail-to-rail output capabilities. They are specifically designed to operate at low voltages (2.7 V to 5.5 V) with enhanced performances compared to the industry standard LM3xx series.

The TSV321, TSV358, and TSV324 are offered in tiny packages, allowing the devices to be used in small portable electronic applications and to be placed closer to the actual signal.

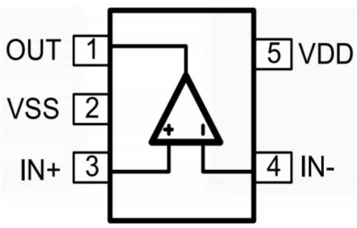
The TSV321, TSV358, and TSV324 are complete cost-effective solutions for application designs where cost is of primary importance.

Applications

- Battery powered applications
- Audio driver (headphone driver)
- Sensor signal conditioning
- Laptop/notebook computers

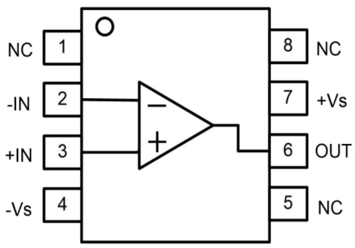
Pin Diagram And Pin Functions

SOT23



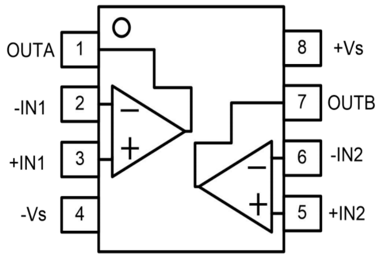
TSV321

SOP8



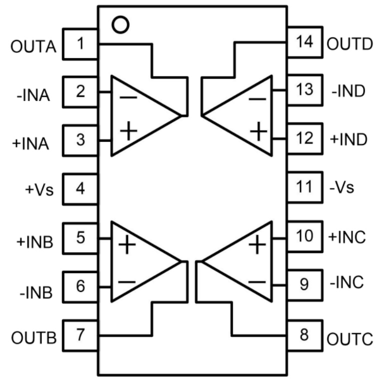
TSV321

SOP8/MSOP8/TSSOP8



TSV358

SOP14/TSSOP14



TSV324

Name	Description	Note
+Vs	Positive power supply	A bypass capacitor of 0.1μF as close to the part as possible should be placed between power supply pins or between supply pins and ground.
-Vs	Negative power supply or ground	If it is not connected to ground,bypass it with a capacitor of 0.1μF as close to the part as possible
-IN	Negative input	Inverting input of the amplifier.Voltage range of this pin can go from-Vs-0.3V to +Vs-1V.
+IN	Positive input	Non-inverting input of the amplifier.This pin has the same voltage range as-IN.
OUT	Output	The output voltage range extends to within millivolts of each supply rail.
NC	No connection	

Product Specification

Recommended Operating Conditions

Parameter	Rating	Unit
DC Supply Voltage	2.7V～5.5V	V
Input common-mode voltage range	-Vs～+Vs	V
Operating ambient temperature	- 40°C to 125°C	℃

Electrical Characteristics

(+Vs=+5V,-Vs=0,VeM=Vs/2,TA=+25℃,RL=10kQto Vs/2,unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Characteristics						
Input Offset Voltage	Vos			1.0	5.0	mV
Input Offset Voltage Drift	△Vos/△T	-40 to 125℃		5		μV/℃
Input Bias Current	IB			2.5		pA
Input Offset Current	los			2.5		pA
Common-Mode Voltage Range	VcM	Vs=5.5V	-0.1		4.5	V
Common-Mode Rejection Ratio	CMRR	VCM=0.1V to 4.5V		125		dB
Open-Loop Voltage Gain	AOL	Vo=0.2V to 4.5V		120		dB
Output Characteristics						
Output Voltage Swing from Rail		RL=100kΩ		1		mV
		RL=10kΩ		10		mV
		RL=2kΩ		40		mV
Short-Circuit Current	IsR	Sourcing		45		mA
	Isk	Sinking		50		mA
Power Supply						
Operating Voltage Range			2.7		5.5	V
Power Supply Rejection Ratio	PSRR	Vs=+1.8V to +5.5V	80	100		dB
Quiescent Current /Amplifier	IQ			85		μA
Dynamic Performance						
Gain Bandwidth Product	GBWP	G=+1		1.5		MHz
Slew Rate	SR	G=+1,2V Output Step		1		V/μs
Noise Performance						
Voltage Noise Density	en	f=1kHz		28		nVI √Hz

Absolute Maximum Ratings

Parameter	Rating	Units
Power Supply:+Vs to-Vs	6.0	V
Input Voltage	-Vs -0.5V to+Vs+0.5V	V
Input Current(2)	10	mA
Storage Temperature Range	-65 to 150	℃
Junction Temperature	150	℃
Operating Temperature Range	-40 to 125	℃
ESD Susceptibility,HBM	2000	V

(1) Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.
(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less.

Application Notes

Driving Capacitive Loads

Driving large capacitive loads can cause staility problems for voltage feedback op amps.As the load capacitance increases,the feedback loop's phase margin decreases,and the closed loop bandwidth is reduced.This produces gain peaking in the frequency response,with overshoot and ringing in the step response.A unity gain buffer(G=+1)is the most sensitive to capacitive loads, butall gains show the same general behavior.
When driving large capacitive loads with these op amps(e.g.,>100 pF when G=+1),a small series resistor at the output (RISO in Figure 1)improves the feedback loop's phase margin(stability) bymaking the output load resistive at higher frequencies.It does not,however,improve the bandwidth.To select RISO,check the frequency response peaking(or step response overshoot)on the bench.If the response is reasonable,you do not need RISO.Otherwise,start Riso at 1kΩ and modify its valueuntil the response is reasonable.

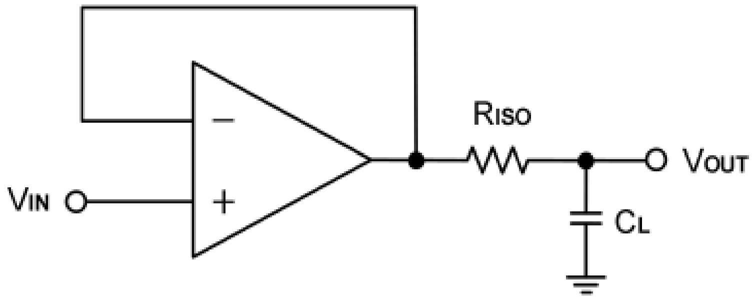


Figure 1. Indirectly Driving Heavy Capacitive Load

An improvement circuit is shown in Figure 2. It provides DC accuracy as well as AC stability. R_F provides the DC accuracy by connecting the inverting signal with the output, C_F and R_{ISO} serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the amplifier ’ s inverting input, thereby preserving phase margin in the overall feedback loop.

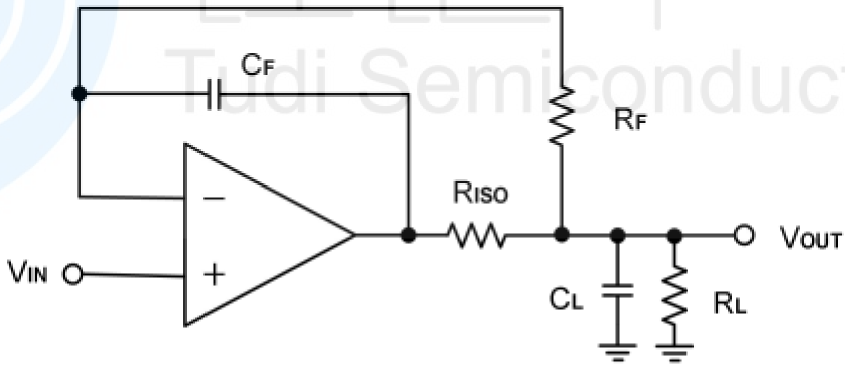


Figure 2. Indirectly Driving Heavy Capacitive Load with DC Accuracy

For non-inverting configuration, there are two others ways to increase the phase margin:
(a) by increasing the amplifier ’ s gain or
(b) by placing a capacitor in parallel with the feedback resistor to counteract the parasitic capacitance associated with inverting node, as shown in Figure 3.

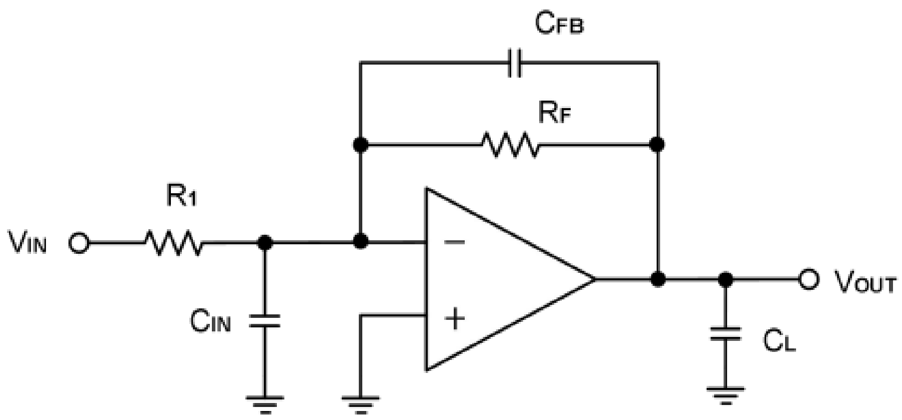


Figure 3. Adding a Feedback Capacitor in the Non-inverting Configuration

Power-Supply Bypassing and Layout

The TSV321/2/4 operates from a single +2.7V to +5.5V supply or dual ±1.05V to ±2.75Vsupplies. For single-supply operation, bypass the power supply +Vs with a 0.1μF ceramic capacitor which should beplaced close to the +Vs pin. For dual-supply operation, both the +Vs and the -Vs supplies should be bypassed to ground with separate 0.1μF ceramic capacitors. 2.2μF tantalum capacitor can be added for better performance.

The length of the current path is directly proportional to the magnitude of parasitic inductances and thus the high frequency impedance of the path. High speed currents in an inductive ground return create an unwanted voltage noise. Broad ground plane areas will reduce the parasitic inductance. Thus a ground plane layer is important for high speed circuit design.

Typical Application Circuits

Differential Amplifier

The circuit shown in Figure 4 performs the differential function. If the resistors ratios are equal ($R_4 / R_3 = R_2 / R_1$), then $V_{OUT} = (V_{IP} - V_{IN}) \times R_2 / R_1 + V_{REF}$.

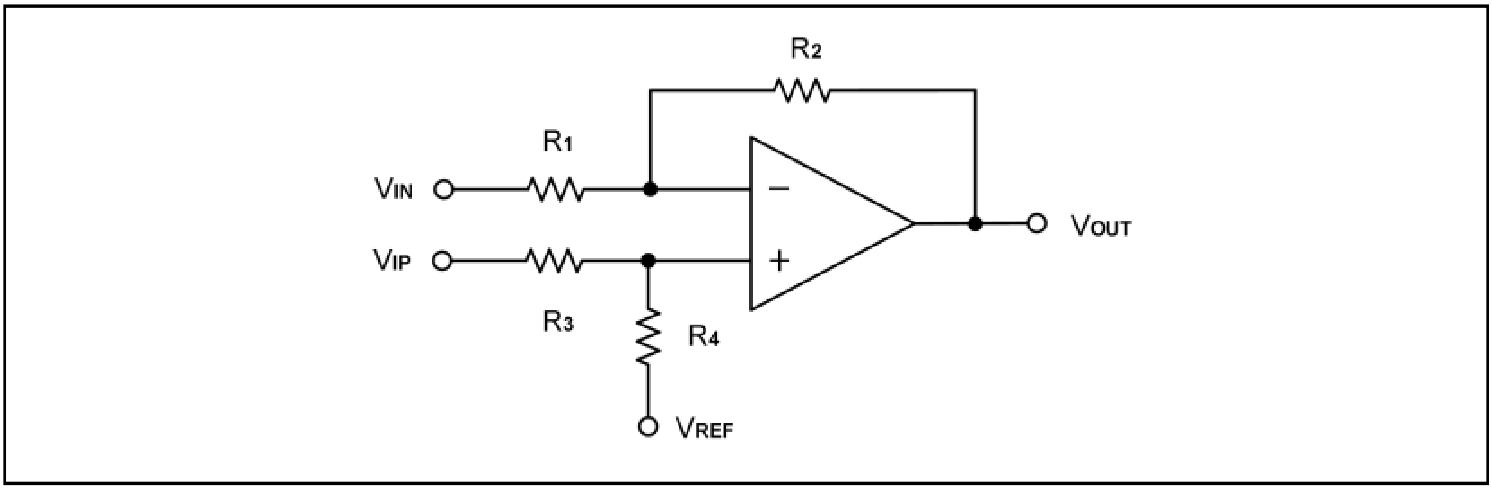


Figure 4. Differential Amplifier

Low Pass Active Fiter

When receiving low-level signals, limiting the bandwidth of the incoming signals into the system is often required. The simplest way to establish this limited bandwidth is to place an RC filter at the noninverting terminal of the amplifier. If even more attenuation is needed, a multiple pole filter is required. The Sallen-Key filter can be used for this task, as Figure 5. For best results, the amplifier should have a bandwidth that is 8 to 10 times the filter frequency bandwidth. Failure to follow this guideline can result in reduction of phase margin. The large values of feedback resistors can couple with parasitic capacitance and cause undesired effects such as ringing or oscillation in high-speed amplifiers. Keep resistors value as low as possible and consistent with output loading consideration.

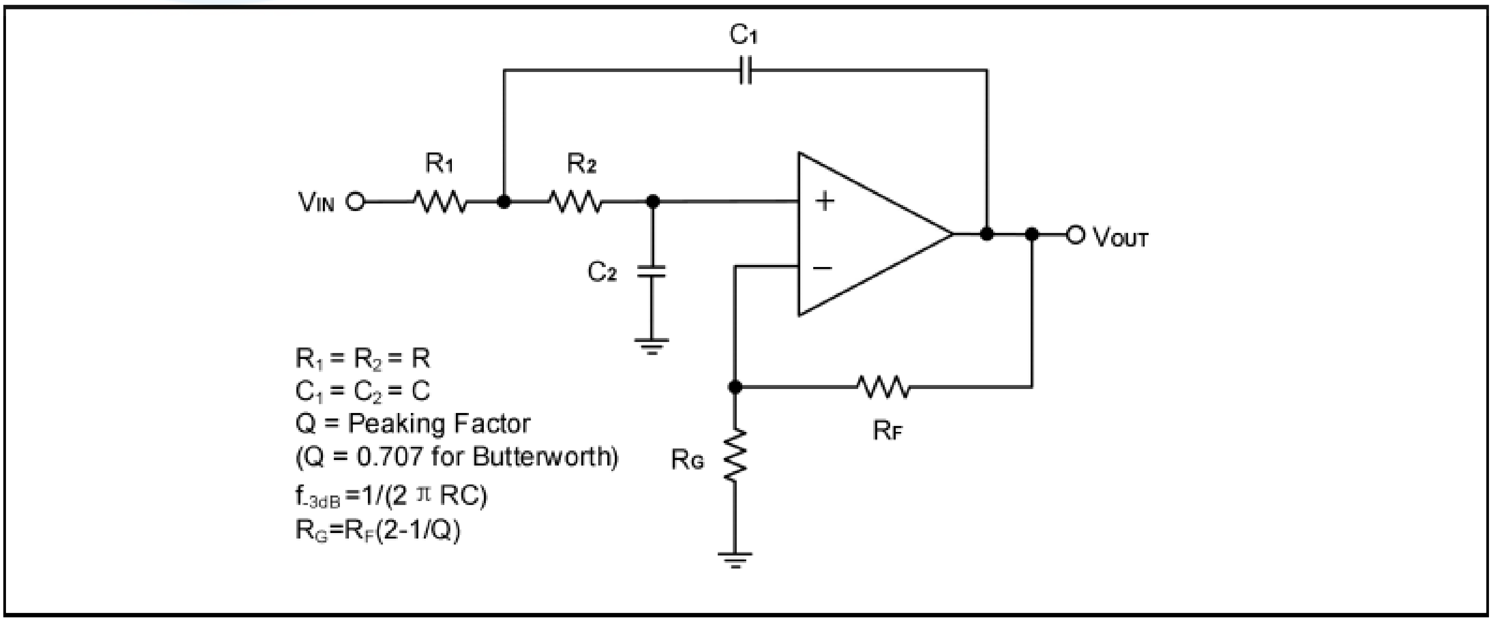
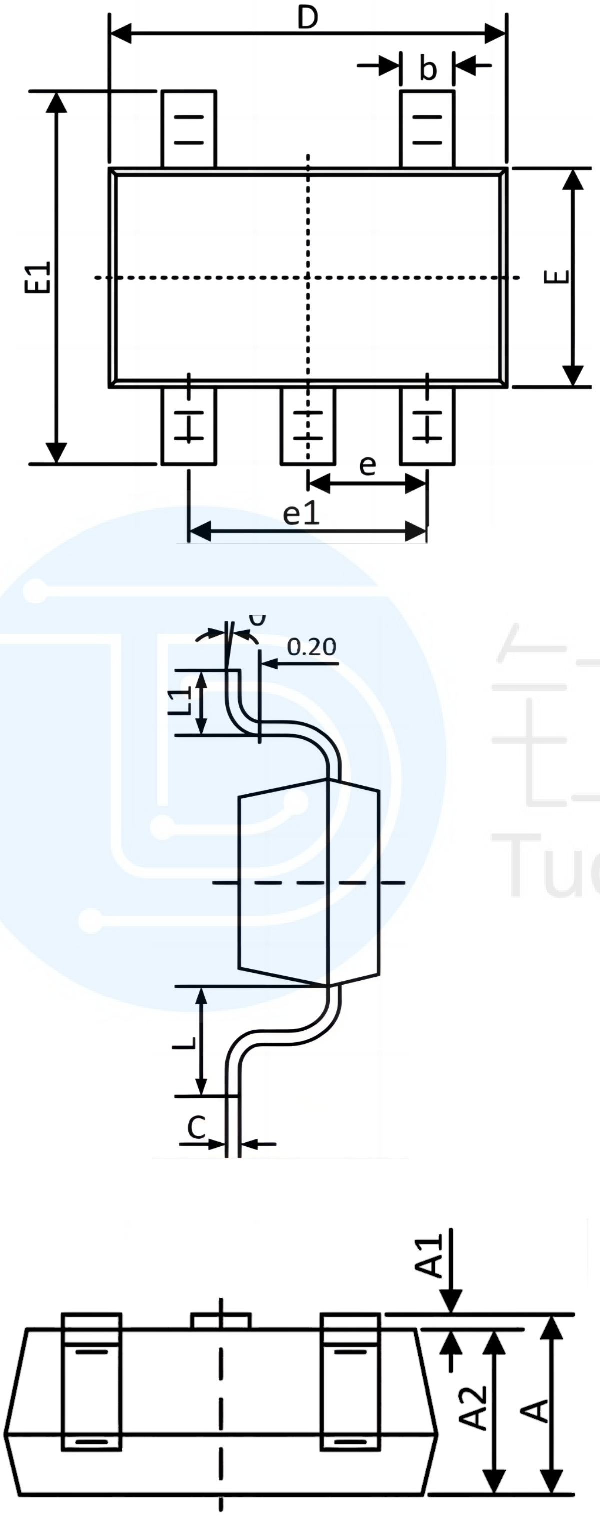


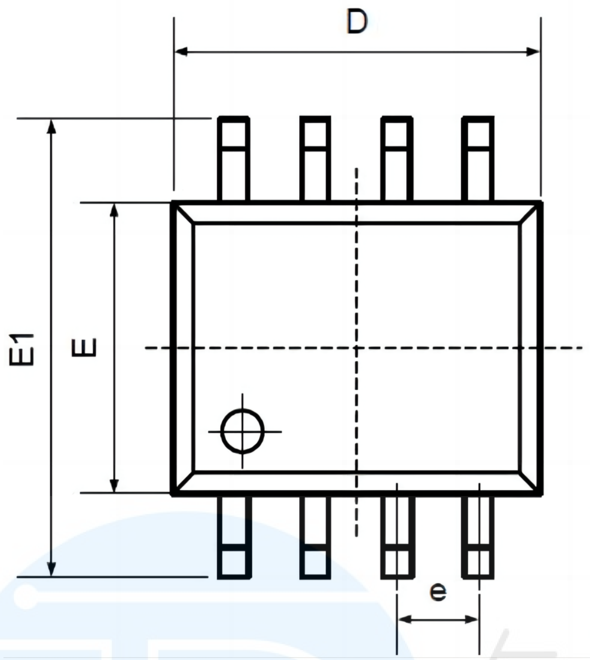
Figure 5. Two-Pole Low-Pass Sallen-Key Active Filter

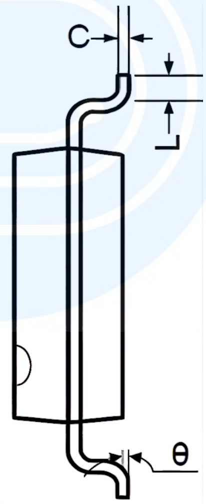
Package SOT23-5

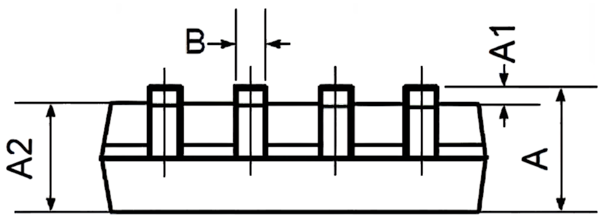


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
C	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

Package SOP8

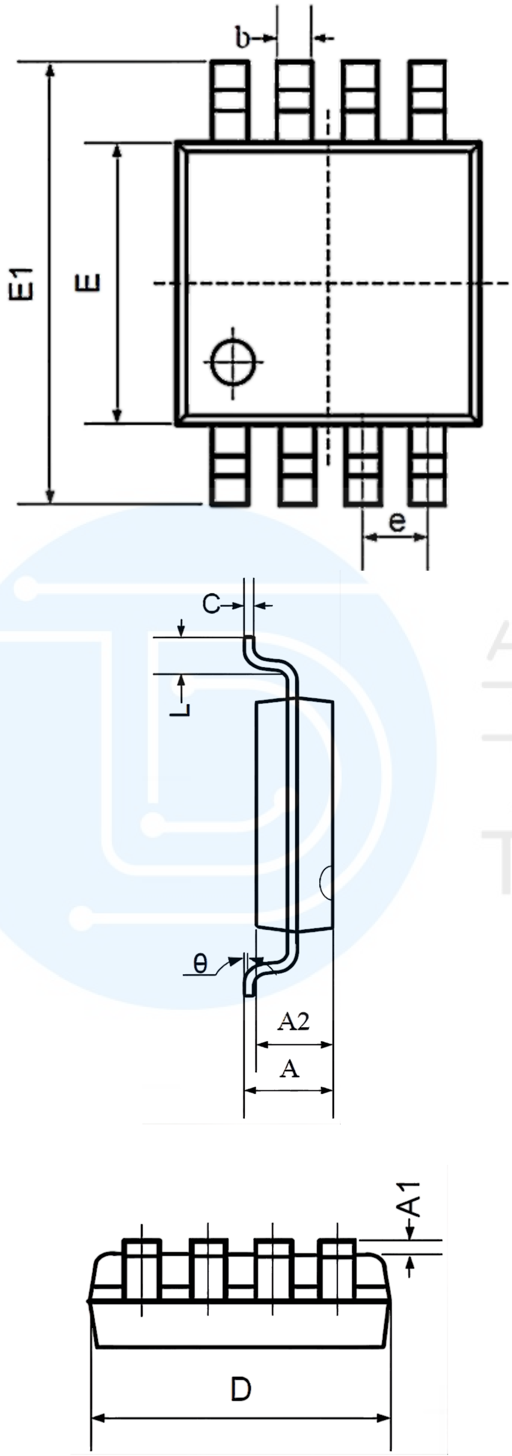






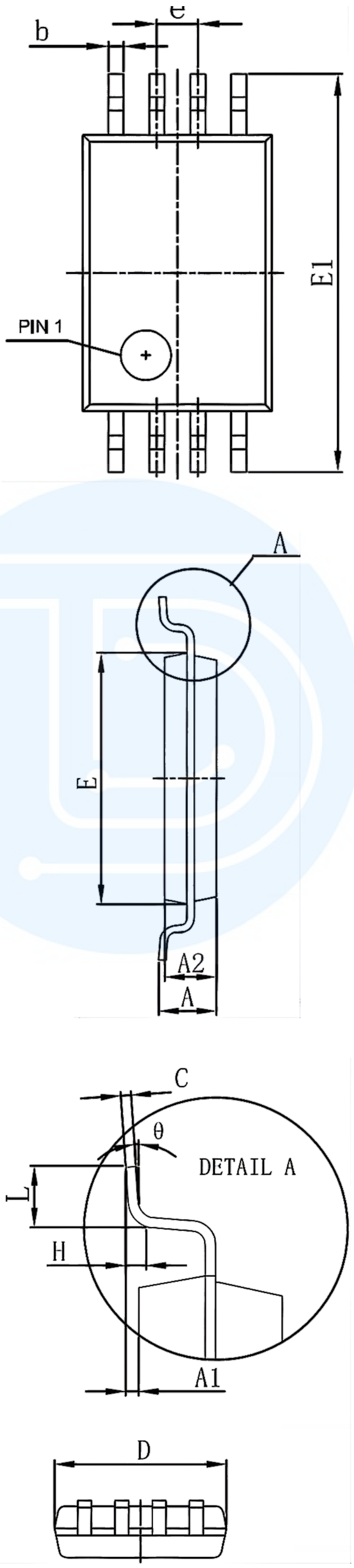
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Package MSOP8



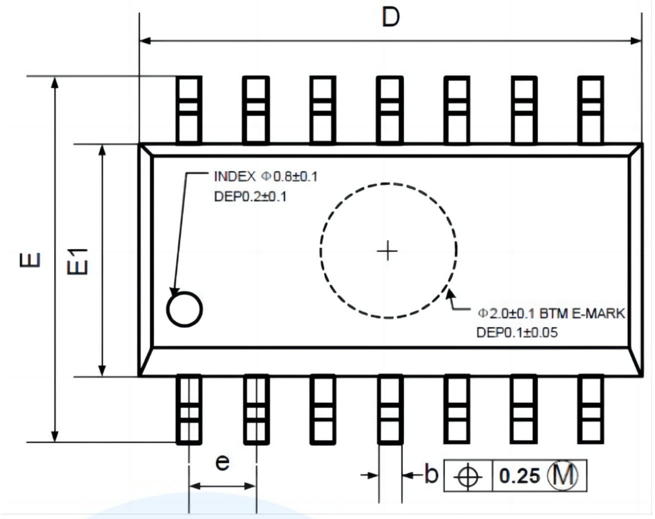
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.200	0.031	0.047
A1	0.000	0.200	0.000	0.008
A2	0.760	0.970	0.030	0.038
b	0.30 TYP		0.012 TYP	
C	0.15 TYP		0.006 TYP	
D	2.900	3.100	0.114	0.122
e	0.65 TYP		0.026 TYP	
E	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.201
L	0.410	0.650	0.016	0.026
θ	0°	6°	0°	6°

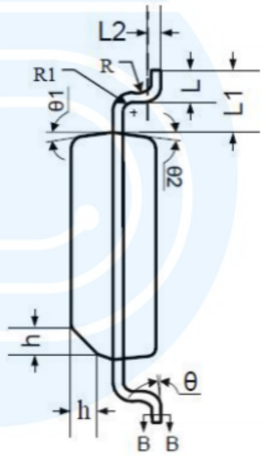
Package TSSOP8

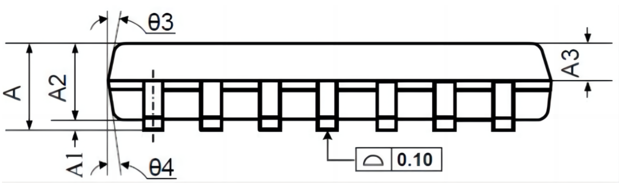


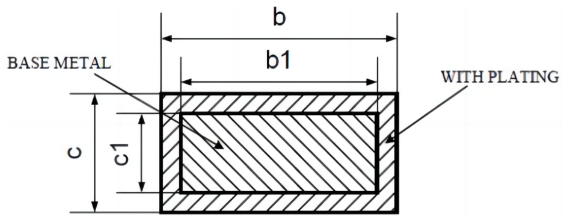
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
D	2.900	3.100	0.114	0.122
E	4.300	4.500	0.169	0.177
b	0.190	0.300	0.007	0.012
C	0.090	0.200	0.004	0.008
E1	6.250	6.550	0.246	0.258
A		1.200		0.047
A2	0.800	1.000	0.031	0.039
A1	0.050	0.150	0.002	0.006
e	0.65(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°		1°	

Package SOP14





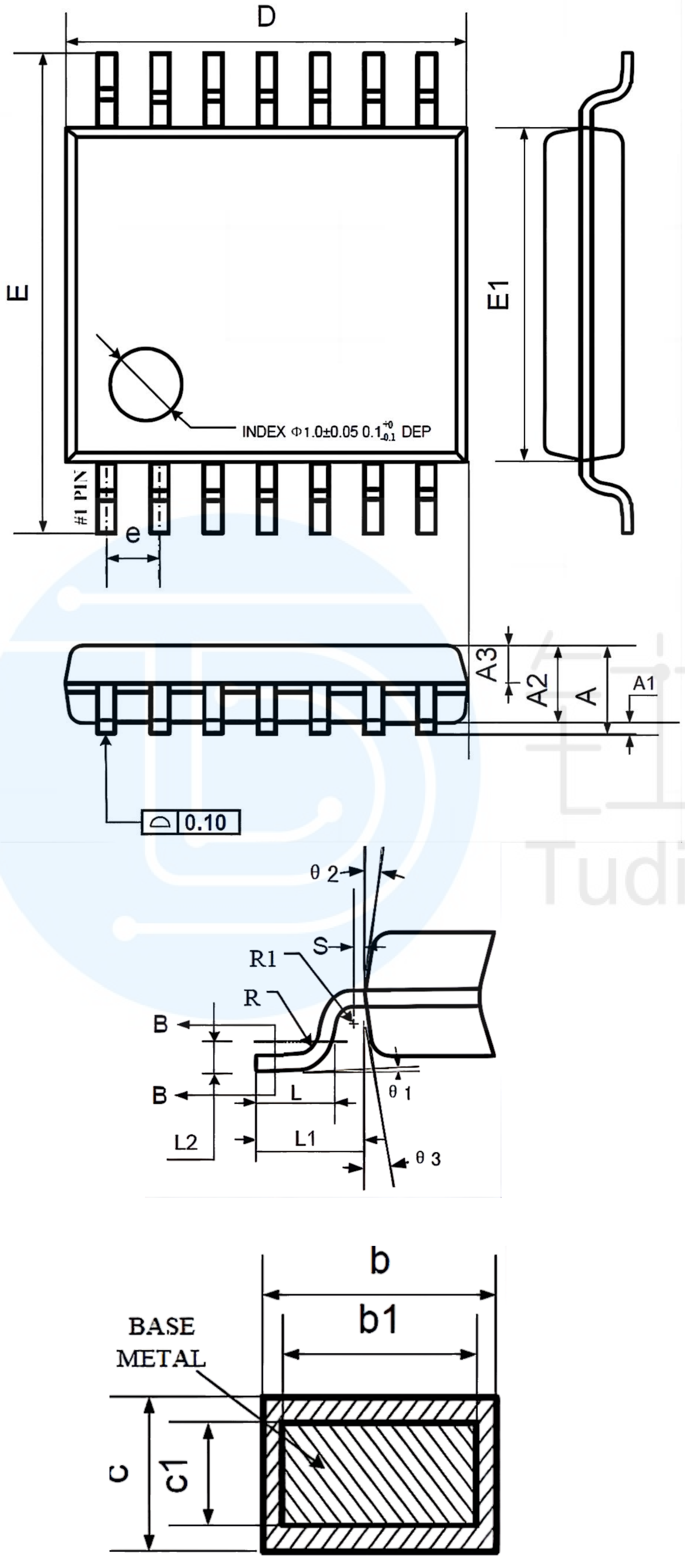




SECTION B-B

Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36		0.49
b1	0.35	0.40	0.45
C	0.16		0.25
c1	0.15	0.20	0.25
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1	0.07		
h	0.30	0.40	0.50
θ	0°		8°
θ1	6°	8°	10°
θ2	6°	8°	10°
θ3	5°	7°	9°
θ4	5°	7°	9°

Package TSSOP14



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.34	0.44	0.54
b	0.20	—	0.28
b1	0.20	0.22	0.24
C	0.10	—	0.19
c1	0.10	0.13	0.15
D	4.86	4.96	5.06
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65 BSC		
L	0.45	0.60	0.75
L1	1.00 REF		
L2	0.25 BSC		
R	0.09	—	—
R1	0.09	—	—
S	0.20	—	—
θ1	0°	—	8°
θ2	10°	12°	14°
θ3	10°	12°	14°

Order information

Order Number	Package	Package Quantity	Marking On The park	Temperature
TSV321RILT-TUDI	SOT23-5	Tape,Reel,3000	K174	-40 to 125
TSV321RAILT-TUDI	SOT23-5	Tape,Reel,3000	K178	
TSV321IDT-TUDI	SOP8	Tape,Reel,2500	V321ID	
TSV358IDT-TUDI	SOP8	Tape,Reel,2500	V358ID	
TSV358IPT-TUDI	TSSOP8	Tape,Reel,2500	V3581	
TSV358IST-TUDI	MSOP8	Tape,Reel,2500	K175	
TSV324IDT-TUDI	SOP14	Tape,Reel,2500	V324ID	
TSV324IPT-TUDI	TSSOP14	Tape,Reel,2500	V324IP	
TSV321AIDT-TUDI	SOP8	Tape,Reel,2500	V321AI	
TSV358AIDT-TUDI	SOP8	Tape,Reel,2500	V358AID	
TSV358AIPT-TUDI	TSSOP8	Tape,Reel,2500	V358A	
TSV358AIST-TUDI	MSOP8	Tape,Reel,2500	K184	
TSV324AIPT-TUDI	TSSOP14	Tape,Reel,2500	V324A	
TSV324AIDT-TUDI	SOP14	Tape,Reel,2500	V324AI	

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