钍地半导体
Tudi Semiconductor

Product Specification

TUDI-TS931/TS932/TS934

Output rail-to-rail micropower operational amplifiers

网址 www.sztdbdt.com

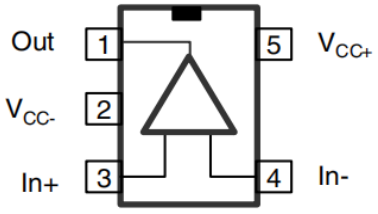
用芯智造·卓越品质

semiconductor device manufacturer

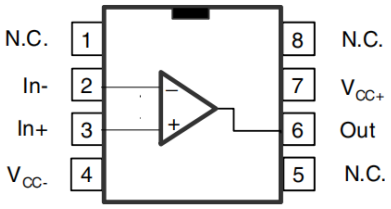
- Design
- research and development
- production
- and sales

Features

- Rail-to-rail output voltage swing
- Micropower consumption (20 A)
- Single supply operation (2.7 to 10 V)
- Low offset (2 mV max. for TS93xB)
- CMOS inputs
- Ultra low input bias current (1 pA)
- ESD protection (2 kV)
- Latch-up immunity (class A)
- Available in SO-8, SO-14, SOT23-5, and TSSOP-14 package
- Automotive grade



TS931ILT



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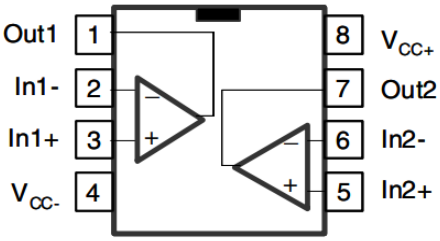

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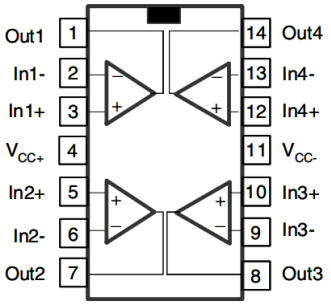


TS934ID-TS934IDT-TS934IPT

Applications

- Battery powered systems
- Portable communication systems
- Alarms, smoke detectors
- Instrumentation and sensoring
- PH meters
- Digital scales
- Automotive

Description

The TS93x (single, dual and quad) series are operational amplifiers that can operate with voltages as low as 2.7 V and reach a 2.9 Vpp output swing with RL = 100 k when supplied at 3 V.
Offering a typical consumption of only 20 A, these devices are particularly well suited to battery powered applications.
The amplifiers space saving 5-pin SOT23-5 package with outer dimensions of 2.8 mm x 2.9 mm make them very easy to implement on a board design.

1 Absolute maximum ratings and operating conditions

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage(1)	12	V
V_{id}	Differential input voltage(2)	$\pm V_{CC}$	V
V_{in}	Input voltage range(3)	V_{CC-} -0.3 to V_{CC+} +0.3	V
I_{in}	Input current range(4)	10	mA
T_{std}	Storage temperature range	-65 to +150	°C
T_j	Maximum junction temperature	150	°C
R_{thja}	Thermal resistance junction-to-ambient(5) – SOT23-5 – SO8 – SO14 – TSSOP14	 250 125 103 100	°C/W
ESD	HBM: human body model(6)	2	kV
	MM: machine model(7)	200	V
	CDM: charged device model(8)	2	kV
	Latch-up immunity	200	mA
	Soldering temperature (10 sec.), leaded version	250	°C

1. All voltages values, except differential voltage are with respect to network terminal.
2. Differential voltages are non-inverting input terminal with respect to the inverting input terminal.
3. The magnitude of input and output voltages must never exceed V_{CC+} +0.3 V.
4. Input current must be limited by a resistor in series with the inputs.
5. Short-circuits can cause excessive heating and destructive dissipation.
6. Human body model: 100 pF discharged through a 1.5 kΩ resistor into pin of device.
7. Machine model ESD: a 200 pF capacitor is charged to the specified voltage, then discharged directly into the IC with no external series resistor (internal resistor < 5 Ω), into pin-to-pin of device.
8. Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to ground through only one pin. This is done for all pins.

Table 3. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	2.7 to 10	V
V_{icm}	Common mode input voltage range	V_{CC-} -0.2 to V_{CC+} -1.5	V
T_{oper}	Operating free air temperature range	-40 to +105	°C

2 Electrical characteristics

Table 4 and *Table 5* give the electrical characteristics at each V_{CC} value.

Table 4. Electrical characteristics at V_{CC}+ = +3 V, V_{CC}- = 0 V, T_{amb} = 25 °C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage TS931/2/4 TS931/2/4A TS931/2/4B			 10 5 2	mV
	$T_{min} < T_{op} < T_{max}$ TS931/2/4 TS931/2/4A TS931/2/4B			 15 10 6	
ΔV_{io}	Input offset voltage drift		3		µV/°C
I_{io}	Input offset current(1) $T_{min} < T_{op} < T_{max}$		1	100 200	pA
I_{ib}	Input bias current(1) $T_{min} < T_{op} < T_{max}$		1	150 300	pA
CMR	Common mode rejection ratio, $0 \le V_{icm} \le V_{CC+}$ -1.7 $T_{min} < T_{op} < T_{max}$	55 55	85 85		dB
SVR	Supply voltage rejection ratio(2) $T_{min} < T_{op} < T_{max}$	55 55	85 85		dB
A_{vd}	Large signal voltage gain V_O = 2 Vpp, R_L = 1 MΩ R_L = 100 kΩ		 120 106		dB
V_{OH}	High level output voltage, V_{ID} = 100 mV, R_L = 100 kΩ $T_{min} < T_{op} < T_{max}$	2.95 2.95	2.99		V
V_{OL}	Low level output voltage, V_{ID} = -100 mV, R_L = 100 kΩ $T_{min} < T_{op} < T_{max}$		10	50 50	mV
I_o	Output source current V_{ID} = 100 mV, V_O = V_{CC-} Output sink current V_{ID} = -100 mV, V_O = V_{CC+}		 1.5 1.5		mA
I_{CC}	Supply current (per amplifier), A_{VCL} = 1, no load $T_{min} < T_{op} < T_{max}$		20	31 33	µA
GBP	Gain bandwidth product R_L = 100 kΩ, C_L = 50 pF		100		kHz
SR	Slew rate R_L = 100 kΩ, C_L = 50 pF		50		V/ms

Table 4. Electrical characteristics at V_{CC}+ = +3 V, V_{CC}- = 0 V, T_{amb} = 25 °C (unless otherwise specified) (continued)

Symbol	Parameter	Min.	Typ.	Max.	Unit
ϕm	Phase margin C_L = 50 pF		 65		Degrees
en	Input voltage noise		75		nV/√Hz

1. Maximum values including unavoidable inaccuracies of the industrial test.
2. V_{CC} has a 0.2 V variation.

Table 5. Electrical characteristics at V_{CC}+ = +5 V, V_{CC}- = 0 V, T_{amb} = 25 °C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage TS931/2/4 TS931/2/4A TS931/2/4B			 10 5 2	mV
	$T_{min} < T_{op} < T_{max}$ TS931/2/4 TS931/2/4A TS931/2/4B			 15 10 6	
ΔV_{io}	Input offset voltage drift		3		µV/°C
I_{io}	Input offset current(1) $T_{min} < T_{op} < T_{max}$		1	100 200	pA
I_{ib}	Input bias current(1) $T_{min} < T_{op} < T_{max}$		1	150 300	pA
CMR	Common mode rejection ratio, $0 \le V_{icm} \le V_{CC+}$ - 1.7 $T_{min} < T_{op} < T_{max}$	55 55	85 85		dB
SVR	Supply voltage rejection ratio(2) $T_{min} < T_{op} < T_{max}$	55 55	85 85		dB
A_{vd}	Large signal voltage gain V_O = 4 Vpp, R_L = 1 MΩ R_L = 100 kΩ		 120 112		dB
V_{OH}	High level output voltage, V_{ID} = 100 mV, R_L = 100 kΩ $T_{min} < T_{op} < T_{max}$	4.95 4.95	4.99		V
V_{OL}	Low level output voltage, V_{ID} = -100 mV, R_L = 100 kΩ $T_{min} < T_{op} < T_{max}$		10	50 50	mV
I_o	Output source current V_{ID} = 100 mV, V_O = V_{DD} Output sink current V_{ID} = -100 mV, V_O = V_{CC}		5 5		mA
I_{CC}	Supply current (per amplifier), A_{VCL} = 1, no load $T_{min} < T_{op} < T_{max}$		20	33 35	µA

Table 5. Electrical characteristics at V_{CC}+ = +5 V, V_{CC}- = 0 V, T_{amb} = 25 °C (unless otherwise specified) (continued)

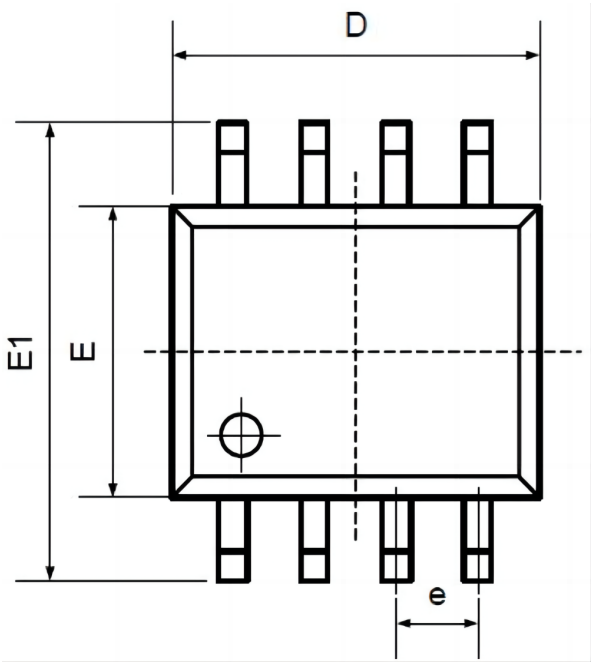
Symbol	Parameter	Min.	Typ.	Max.	Unit
GBP	Gain bandwidth product R_L = 100 KΩ, C_L = 50 pF		100		kHz
SR	Slew rate R_L = 100 KΩ, C_L = 50 pF		50		V/ms
ϕm	Phase margin C_L = 50 pF		65		Degrees
en	Input voltage noise		76		nV/√Hz

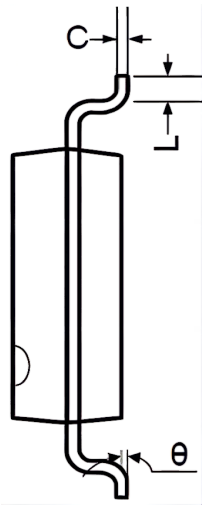
1. Maximum values including unavoidable inaccuracies of the industrial test.
2. V_{CC} has a 0.2 V variation.

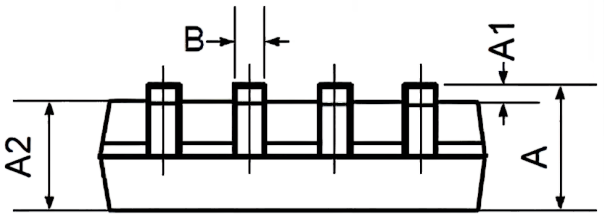
Order information

Order Number	Package	Package Quantity	Marking On The park
TS931BILT-TUDI	SOT23	Tape,Reel,3000	TS931BILT
TS931IDT-TUDI	SOP8	Tape,Reel,2500	TS931IDT
TS931ILT-TUDI	SOT23	Tape,Reel,3000	TS931ILT
TS932AIDT-TUDI	SOP8	Tape,Reel,2500	TS932AIDT
TS932AIN-TUDI	DIP8	Tube,50,A box of 2000	TS932AIN
TS932BIN-TUDI	DIP8	Tube,50,A box of 2000	TS932BIN
TS932IDT-TUDI	SOP8	Tape,Reel,2500	TS932IDT
TS932IN-TUDI	DIP8	Tube,50,A box of 2000	TS932IN
TS934AIDT-TUDI	SOP14	Tape,Reel,2500	TS934AIDT
TS934BIDT-TUDI	SOP14	Tape,Reel,2500	TS934BIDT
TS934IDT-TUDI	SOP14	Tape,Reel,2500	TS934IDT

Package SOP8

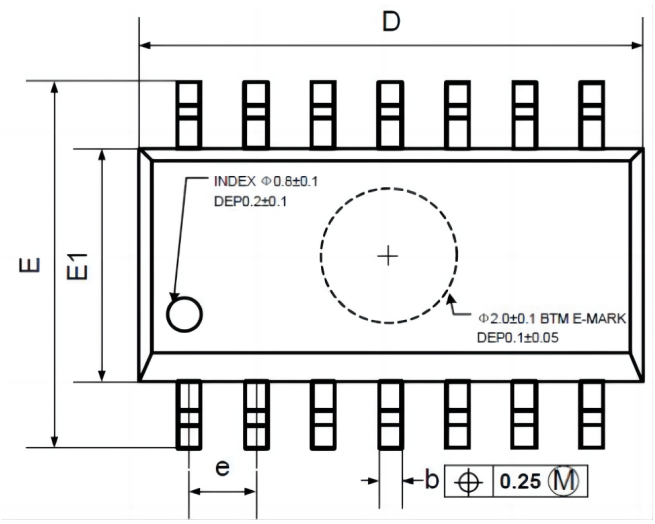


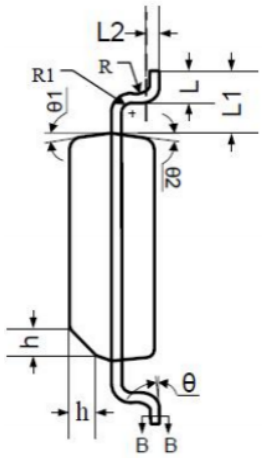


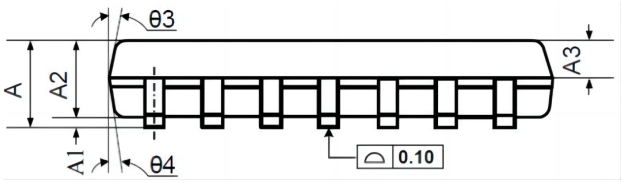


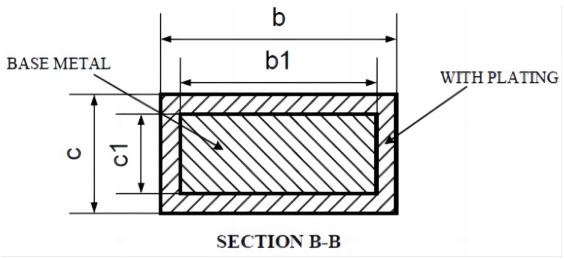
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP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

Package SOP14



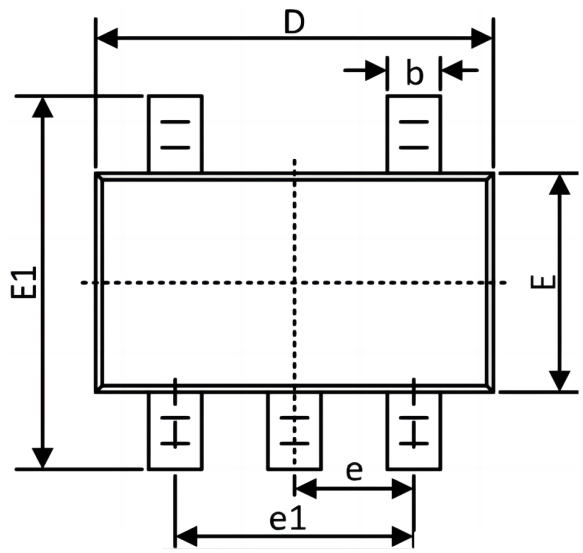


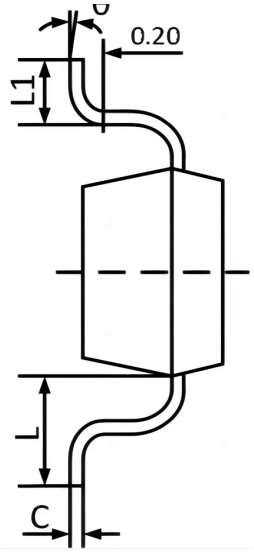


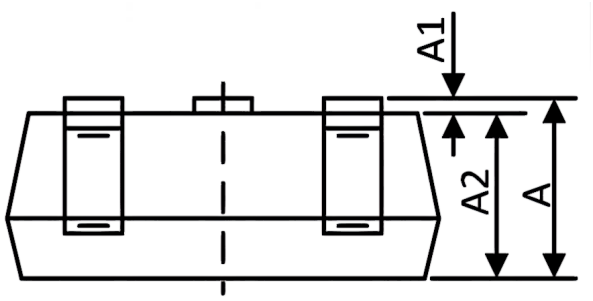


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36		0.49
b1	0.35	0.40	0.45
C	0.16		0.25
c1	0.15	0.20	0.25
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1	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 SOT23-5

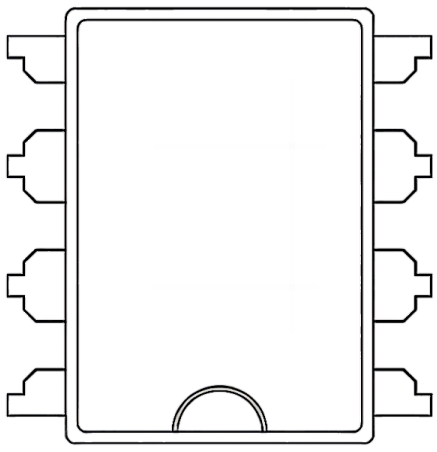


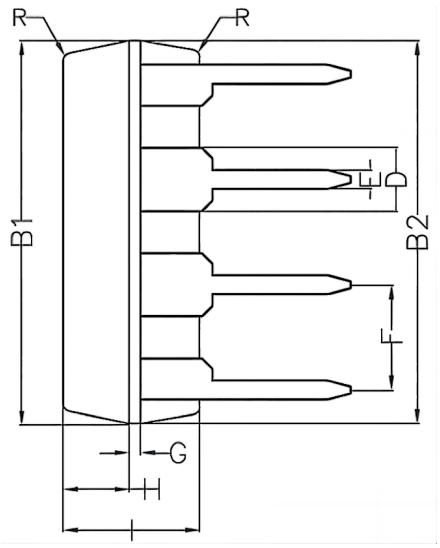


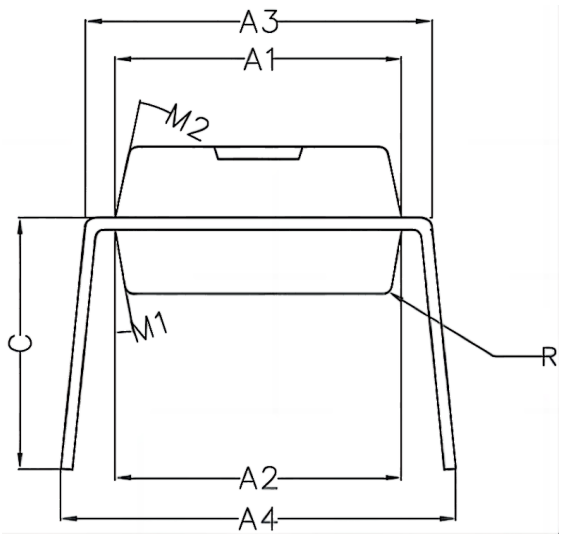


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
C	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
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 DIP8







Symbol	Min	Non	Max
A1	6.28	6.33	6.38
A2	6.33	6.38	6.43
A3	7.52	7.62	7.72
A4	7.80	8.40	9.00
B1	9.15	9.20	9.25
B2	9.20	9.25	9.30
C		5.57	
D		1.52	
E	0.43	0.45	0.47
F		2.54	
G		0.25	
H	1.54	1.59	1.64
工	3.22	3.27	3.32
R		0.20	
M1	9°	10°	11°
M2	11°	12°	13°

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