钍地半导体
Tudi Semiconductor

Product Specification

TUDI-TS941/TS942/TS944

Output rail-to-rail micropower operational amplifiers

网址 www.sztdbdt.com

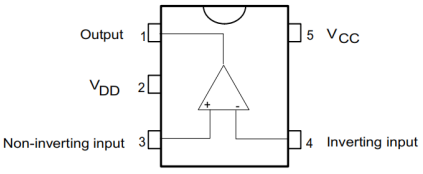
用芯智造·卓越品质

semiconductor device manufacturer

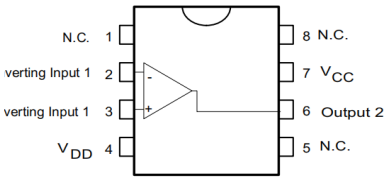
- Design
- research and development
- production
- and sales

Features

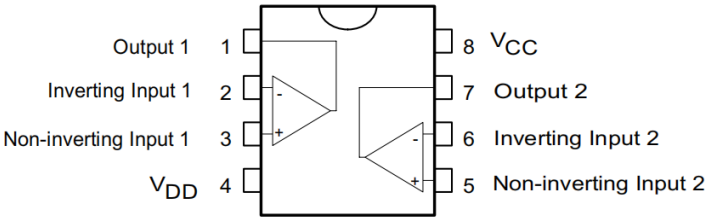
- Rail-to-rail output voltage swing
- Micropower consumption (1.2 μA)
- Single supply operation (2.5 V to 10 V)
- CMOS inputs
- Ultra low input bias current (1 pA)
- ESD protection (2 kV)
- Latch-up immunity (class A)
- Available in SOT23-5 micropackage



TS941ILT



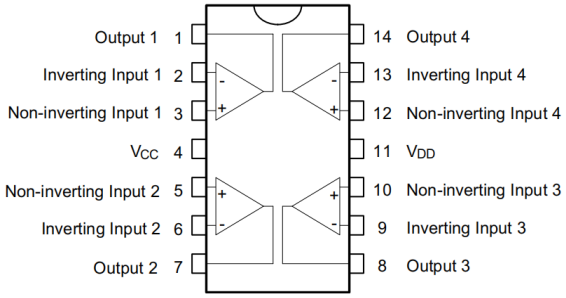
TS941ID-TS941IDT



TS942ID-TS942IDT-TS942IPT

Applications

- Battery-powered systems (alarm)
- Portable communication systems (pagers)
- Smoke/gas/fire detectors
- Instrumentation and sensoring
- PH meter



TS944ID-TS944IDT-TS944IPT

Description

The TS94x (single, dual and quad) series are operational amplifiers characterized for 2.5 V to 10 V operation over a -40 ° C to +85 ° C temperature range.
They exhibit excellent consumption -1.2 μA, while featuring 10 kHz gain bandwidth product, 1.5 mA output capability and output rail-to-rail operation - 2.85 V typical at 3 V with R_L=10 kΩ.
The TS94x op-amps are ideal for battery-powered systems, where very low supply current and output rail-to-rail are required. Their very low - 1 pA typical input bias current and constant supply current over supply voltage enhance the devices ' performance near the end of the battery charge or battery life.

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)	± V_{CC}	V
V_{in}	Input voltage range (3)	V_{DD}-0.3 to V_{CC}+0.3	V
T_{stg}	Storage temperature range	-65 to +150	°C
T_j	Maximum junction temperature	150	°C
R_{thja}	Thermal resistance junction to ambient (4) SOT23-5 SO-8 SO-14 TSSOP8 TSSOP14	 250 125 103 120 100	°C/W
R_{thjc}	Thermal resistance junction to case (4) SOT23-5 SO-8 SO-14 TSSOP8 TSSOP14	 81 40 31 37 32	°C/W
ESD	HBM: human body model (5)	2	kV
	MM: machine model (6) (TS941, TS942)	200	V
	CDM: charged device model (7) TS941 - TS944IDT TS942 - TS944IPT	 1.5 1	kV
	Latch-up immunity	200	mA
	Lead temperature (soldering, 10sec)	250	°C

1. All voltage 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.
3. The magnitude of input and output voltages must never exceed V_{CC} +0.3 V.
4. Short-circuits can cause excessive heating and destructive dissipation. R_{th} are typical values.
5. Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
6. Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of connected pin combinations while the other pins are floating.
7. Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.

Table 3. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	2.5 to 10	V
V_{icm}	Common mode input voltage range	V_{DD} -0.2 to V_{CC} -1.3	V
T_{oper}	Operating free air temperature range	-40 to + 85	°C

2 Electrical characteristics

Table 4. V_{CC} = +2.5 V, V_{DD} = 0 V, R_L connected to $V_{CC}/2$, T_{amb} = 25° C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage TS941/2/4 TS941/2/4A TS941/2/4B			 10 5 2	mV
ΔV_{io}	Input offset voltage drift		7		µV/°C
I_{io}	Input offset current (1)		1	100	pA
I_{ib}	Input bias current (1)		1	150	pA
CMR	Common mode rejection ratio	60	85		dB
SVR	Supply voltage rejection ratio	50	78		dB
A_{vd}	Large signal voltage gain V_O = 2 V_{pp}, R_L = 1 MΩ		100		dB
V_{OH}	High level output voltage V_{ID} = 100 mV, R_L = 1 MΩ R_L = 10 kΩ	 2.45 2.3	 2.49 2.4		V
V_{OL}	Low level output voltage V_{ID} = -100 mV, R_L = 1 MΩ R_L = 10 kΩ		 1 100	 5 200	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}	 350 280	 650 500		µA
I_{CC}	Supply current (per amplifier), A_{VCL} = 1, no load		1.2	1.8	µA
GBP	Gain bandwidth product, R_L = 1 MΩ, C_L = 50 pF		10		kHz
SR	Slew rate, R_L = 1 MΩ, C_L = 50 pF	3	4.5		V/ms
ϕm	Phase margin, C_L = 50 pF		65		Degrees

1. Maximum values include unavoidable inaccuracies of the industrial tests.

Table 5. V_{CC} = +3 V, V_{DD} = 0 V, R_L connected to $V_{CC}/2$, T_{amb} = 25° C (unless otherwise specified) (1)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage TS941/2/4 TS941/2/4A TS941/2/4B			 10 5 2	mV
ΔV_{io}	Input offset voltage drift		7		µV/°C
I_{io}	Input offset current (2)		1	100	pA
I_{ib}	Input bias current (2)		1	150	pA
CMR	Common mode rejection ratio	60	85		dB
SVR	Supply voltage rejection ratio	50	85		dB
A_{vd}	Large signal voltage gain V_O = 2 V_{pp}, R_L = 1 MΩ		100		dB
V_{OH}	High level output voltage V_{ID} = 100 mV, R_L = 1 MΩ R_L = 10 kΩ	 2.9 2.8	 2.99 2.85		V
V_{OL}	Low level output voltage V_{ID} = -100 mV, R_L = 1 MΩ R_L = 10 kΩ		 1 100	 5 200	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}	 680 650	 1500 1300		µA
I_{CC}	Supply current (per amplifier), A_{VCL} = 1, no load		1.2	1.8	µA
GBP	Gain bandwidth product, R_L = 1 MΩ, C_L = 50 pF		10		kHz
SR	Slew rate, R_L = 1 MΩ, C_L = 50 pF	3	4.5		V/ms
ϕm	Phase margin, C_L = 50 pF		65		Degrees

1. All electrical values are guaranteed with correlation measurements at 2.5 V and 5 V.
2. Maximum values include unavoidable inaccuracies of the industrial tests.

Table 6. V_{CC} = +5 V, V_{DD} = 0 V, R_L connected to $V_{CC}/2$, T_{amb} = 25° C (unless otherwise specified)

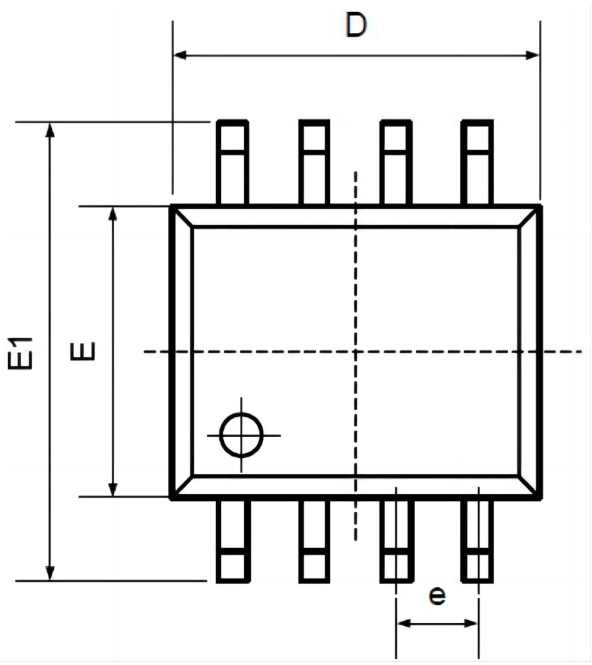
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage TS941/2/4 TS941/2/4A TS941/2/4B			 10 5 2	mV
ΔV_{io}	Input offset voltage drift		7		µV/°C
I_{io}	Input offset current (1)		1	100	pA
I_{ib}	Input bias current (1)		1	150	pA
CMR	Common mode rejection ratio	60	85		dB
SVR	Supply voltage rejection ratio	50	85		dB
A_{vd}	Large signal voltage gain V_O = 2 V_{pp}, R_L = 1 MΩ		100		dB
V_{OH}	High level output voltage V_{ID} = 100 mV, R_L = 1 MΩ R_L = 10 kΩ	 4.9 4.8	 4.99 4.85		V
V_{OL}	Low level output voltage V_{ID} = -100 mV, R_L = 1 MΩ R_L = 10 kΩ		 1 100	 5 150	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}	 3 3.7	 4.5 5		mA
I_{CC}	Supply current (per amplifier), A_{VCL} = 1, no load		1.2	1.85	µA
GBP	Gain bandwidth product, R_L = 1 MΩ, C_L = 50 pF		10		kHz
SR	Slew rate, R_L = 1 MΩ, C_L = 50 pF	3	4.5		V/ms
ϕm	Phase margin, C_L = 50 pF		65		Degrees

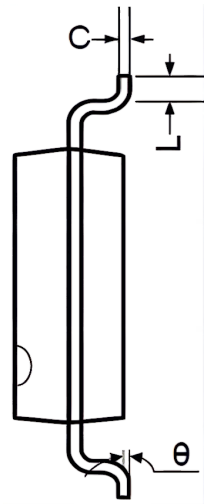
1. Maximum values include unavoidable inaccuracies of the industrial tests.

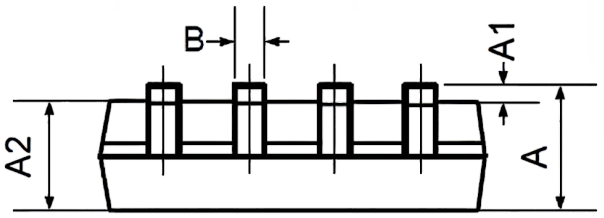
Order information

Order Number	Package	Package Quantity	Marking On The park
TS941AIDT-TUDI	SOP8	Tape,Reel,2500	TS941AIDT
TS941AILT-TUDI	SOT23	Tape,Reel,3000	TS941AILT
TS941BIDT-TUDI	SOP8	Tape,Reel,2500	TS941BIDT
TS941BILT-TUDI	SOT23	Tape,Reel,3000	TS941BILT
TS941IDT-TUDI	SOP8	Tape,Reel,2500	TS941IDT
TS941ILT-TUDI	SOT23	Tape,Reel,3000	TS941ILT
TS942AIDT-TUDI	SOP8	Tape,Reel,2500	TS942AIDT
TS942AIN-TUDI	DIP8	Tube,50,A box of 2000	TS942AIN
TS942IDT-TUDI	SOP8	Tape,Reel,2500	TS942IDT
TS942IN-TUDI	DIP8	Tube,50,A box of 2000	TS942IN
TS944AIDT-TUDI	SOP14	Tape,Reel,2500	TS944AIDT
TS944BIDT-TUDI	SOP14	Tape,Reel,2500	TS944BIDT
TS944IDT-TUDI	SOP14	Tape,Reel,2500	TS944IDT

Package SOP8

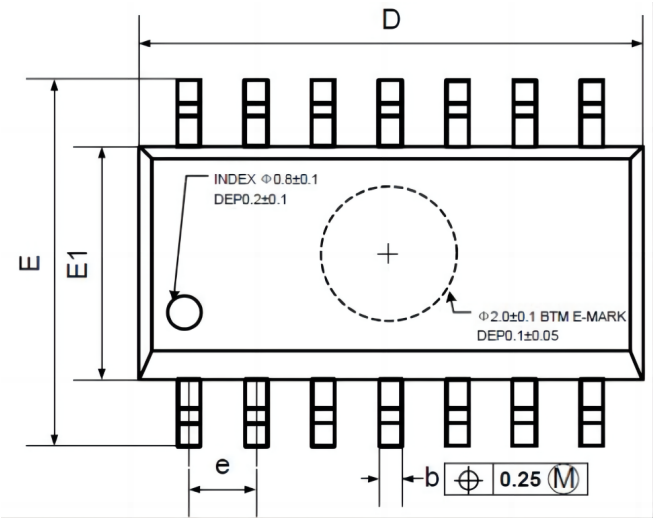


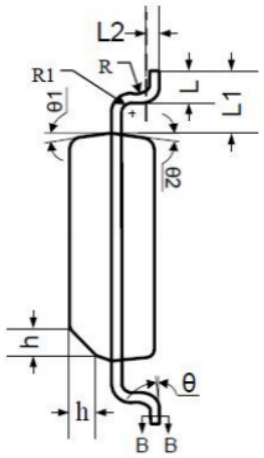


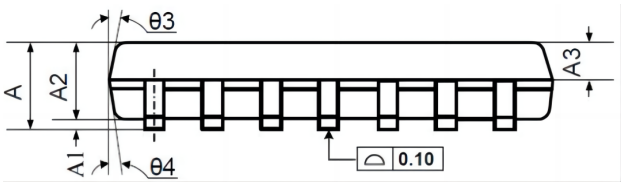


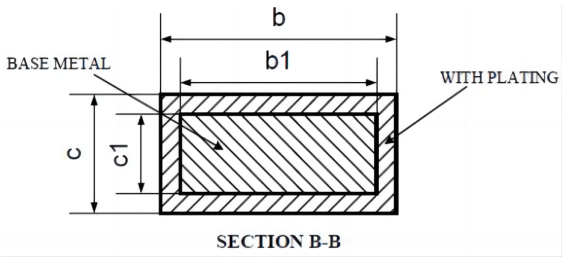
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP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

Package SOP14



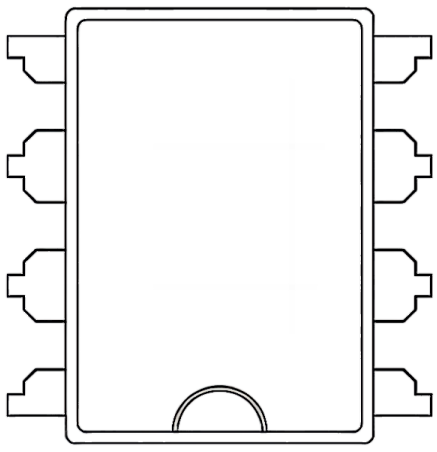


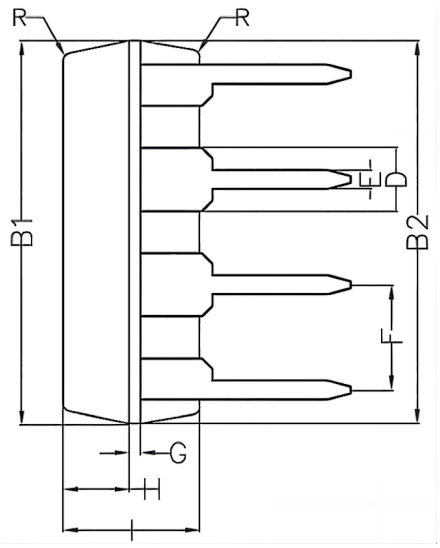


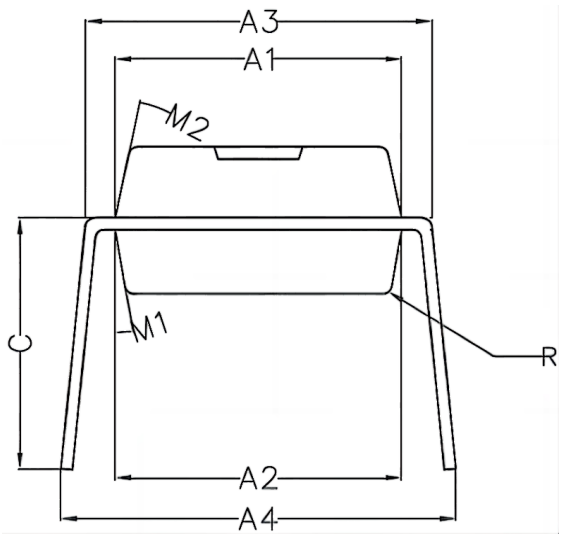


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36		0.49
b1	0.35	0.40	0.45
C	0.16		0.25
c1	0.15	0.20	0.25
D	8.53	8.63	8.73
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
L	0.45	0.60	0.80
L1	1.04 REF		
L2	0.25 BSC		
R	0.07		
R1	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 DIP8

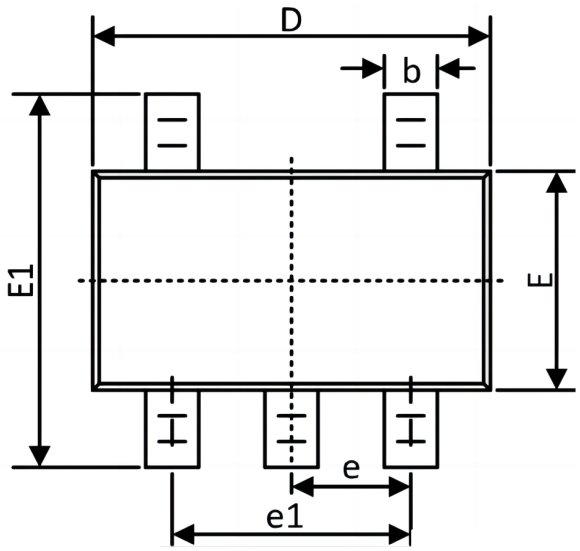


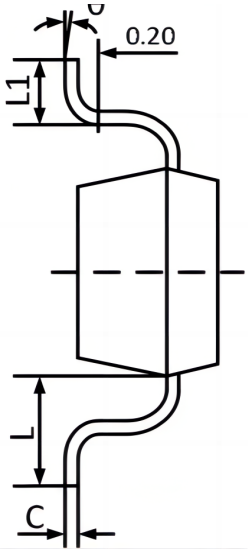


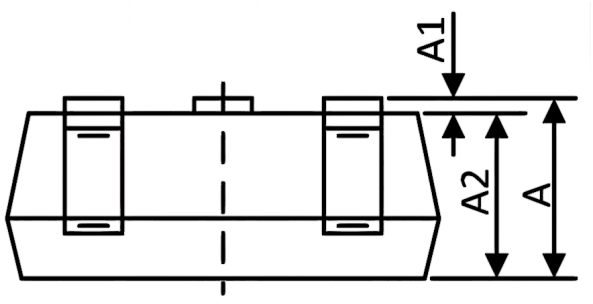


Symbol	Min	Non	Max
A1	6.28	6.33	6.38
A2	6.33	6.38	6.43
A3	7.52	7.62	7.72
A4	7.80	8.40	9.00
B1	9.15	9.20	9.25
B2	9.20	9.25	9.30
C		5.57	
D		1.52	
E	0.43	0.45	0.47
F		2.54	
G		0.25	
H	1.54	1.59	1.64
工	3.22	3.27	3.32
R		0.20	
M1	9°	10°	11°
M2	11°	12°	13°

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°

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