



**TS1871
TS1872
TS1874**

1.8V, INPUT/OUTPUT RAIL TO RAIL LOW POWER OPERATIONAL AMPLIFIERS

- OPERATING AT $V_{CC} = 1.8V$ to 6V
- RAIL TO RAIL INPUT & OUTPUT
- EXTENDED V_{icm} ($V_{ee} - 0.2V$ to $V_{CC} + 0.2V$)
- LOW SUPPLY CURRENT (400 μ A)
- GAIN BANDWIDTH PRODUCT (1.6MHz)
- HIGH STABILITY
- ESD TOLERANCE (2kV)
- LATCH-UP IMMUNITY (Class A)
- AVAILABLE IN SOT23-5 MICROPACKAGE

DESCRIPTION

The TS187x (Single, Dual & Quad) is operational amplifier able to operate with voltages as low as 1.8V and features both I/O Rail to Rail.

The common mode input voltage extends 200mV @ 25°C beyond the supply voltages while the output voltage swing is within 100mV of each Rail for a 600 Ω load resistor. This I/O Rail to Rail configuration gives the chance to the user to have the entire supply voltage range available. Offering 20mA min., 65mA typ. value and exhibiting an excellent speed-power ratio, 1.6MHz GBP & 400 μ A supply current, this Op-Amp is very well-suited for battery-supplied and portable applications.

Stability and minimum overshoot with capacitive loads is maintained by 53° typ. of phase margin with 100pF load capacitor @ 1.8V.

APPLICATIONS

- Battery-powered applications
- Portable communication devices (cell phone)
- Active filters
- Audio drivers
- Line drivers

ORDER CODES

Part Number	Temperature Range	Package				SOT23 Marking
		N	D	P	L	
TS1871I/AI	-40, +125°C		•		•	K171/172
TS1872I/AI	-40, +125°C	•	•	•		
TS1874I/AI	-40, +125°C	•	•	•		

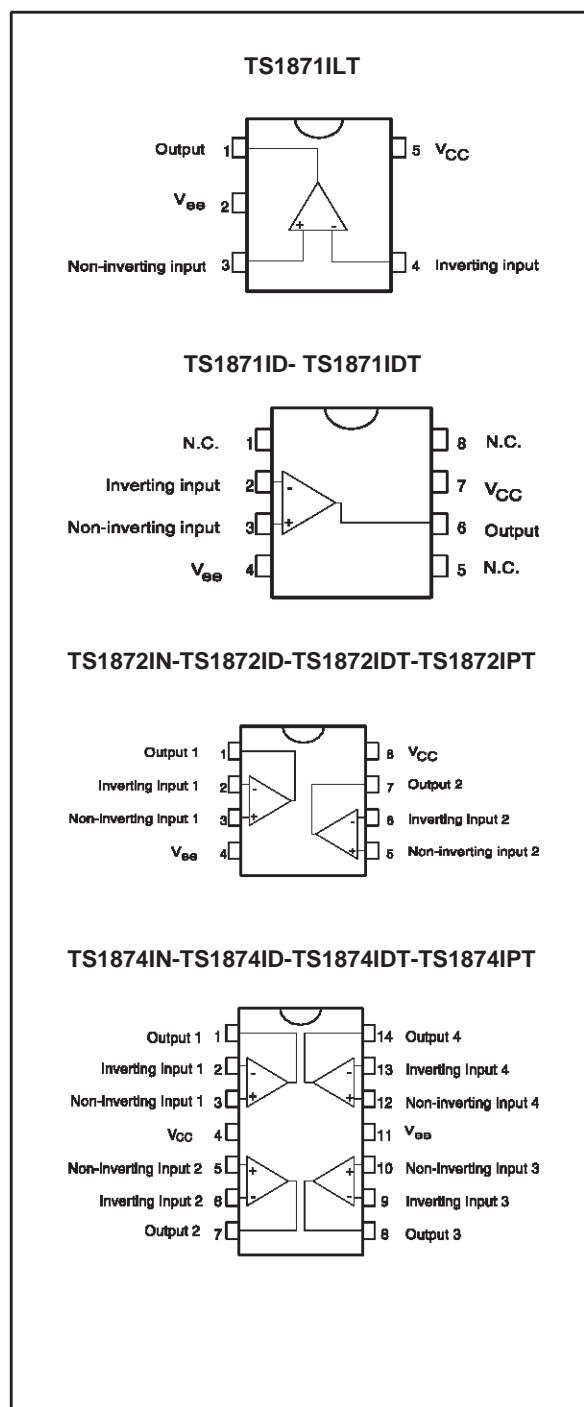
N = Dual in Line Package (DIP)

D = Small Outline Package (SO) - also available in Tape & Reel (DT)

P = Thin Shrink Small Outline Package (TSSOP) - only available in Tape & Reel (PT)

L = Tiny Package (SOT23-5) - only available in Tape & Reel (LT)

PIN CONNECTIONS (top view)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage - note 1	7	V
V_{id}	Differential Input Voltage - note 2	-1	V
V_i	Input Voltage - note 3	-0.3 to $V_{CC} + 0.3$	V
T_{oper}	Operating Free Air Temperature Range	-40 to +125	°C
T_{stg}	Storage Temperature	-65 to +150	°C
T_j	Maximum Junction Temperature	150	°C
R_{thjc}	Thermal Resistance Junction to Case - note 4		°C/W
	SOT23-5	81	
	DIP8	42	
	DIP14	32	
	SO8	28	
	SO14	22	
	TSSOP8	26	
	TSSOP14	21	
R_{thja}	Thermal Resistance Junction to Ambient - SOT23-5	256	°C/W
ESD	Human Body Model	2	kV
	Latch-up Immunity	Class A	
	Lead Temperature (soldering, 10sec)	260	°C

- Notes :**
1. All voltage values, except differential voltage are with respect to network ground terminal.
 2. Differential voltages are the non-inverting input terminal with respect to the inverting terminal.
 3. The magnitude of input and output voltages must never exceed $V_{CC} + 0.3V$.
 4. Short-circuits can cause excessive heating. Destructive dissipation can result from simultaneous short-circuit on all amplifiers.

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	1.8 to 6	V
V_{icm}	Common Mode Input Voltage Range - note1	$V_{ee} - 0.2$ to $V_{CC} + 0.2$	V
V_{icm}	Common Mode Input Voltage Range - note2	V_{ee} to V_{CC}	V

- Notes :**
1. At 25°C, for 1.8 ≤ V_{CC} ≤ 6V, V_{icm} is extended to $V_{ee} - 0.2V$, $V_{CC} + 0.2V$.
 2. In full temperature range, both Rails can be reached when V_{CC} does not exceed 5.5V

ELECTRICAL CHARACTERISTICS

$V_{CC} = +1.8V$, $V_{EE} = 0V$, $T_{amb} = 25^{\circ}C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage TS1871/2/4 TS1871A/2A/4A		0.1	3 1	mV
DV_{io}	Input Offset Voltage Drift		2		mV/°C
I_{io}	Input Offset Current - note 1		3	28	nA
I_b	Input Bias Current - note 1		40	125	nA
CMR	Common Mode Rejection Ratio $0 \leq V_{icm} \leq V_{CC}$	55	77		dB
SVR	Supply Voltage Rejection Ratio $V_{icm} = 0.5V$	70	80		dB
A_{vd}	Large Signal Voltage Gain $R_L = 2kW$ $R_L = 600W$	77 70	92 85		dB
V_{OH}	High Level Output Voltage $R_L = 2kW$ $R_L = 600W$	1.65 1.62	1.77 1.74		V
V_{OL}	Low Level Output Voltage $R_L = 2kW$ $R_L = 600W$		88 115	110 150	mV
I_o	Output Source Current $V_{ID} = 100mV$, $V_o = V_{DD}$ Output Sink Current $V_{ID} = -100mV$, $V_o = V_{CC}$	20 20	65 65		mA
I_{CC}	Supply Current (per amplifier) AVCL = 1, no load		400	560	mA
GBP	Gain Bandwidth Product $R_L = 10kW$, $C_L = 100pF$, $f = 100kHz$	0.9	1.6		MHz
SR	Slew Rate $R_L = 10kW$, $C_L = 100pF$, $AV = 1$	0.38	0.54		V/ns
f m	Phase Margin $C_L = 100pF$		53		Degrees
en	Input Voltage Noise $f = 1kHz$		40		nV/ Hz
THD	Total Harmonic Distortion		0.01		%

Note : 1. Maximum values including unavoidable inaccuracies of the industrial test.

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ELECTRICAL CHARACTERISTICS

$V_{CC} = +3V$, $V_{EE} = 0V$, $T_{amb} = 25^{\circ}C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage TS1871/2/4 TS1871A/2A/4A		0.1	3 1	mV
DV_{io}	Input Offset Voltage Drift		2		mV/°C
I_{io}	Input Offset Current - note 1		3	28	nA
I_{ib}	Input Bias Current - note 1		4	125	nA
CMR	Common Mode Rejection Ratio $0 \leq V_{icm} \leq V_{CC}$	60	80		dB
SVR	Supply Voltage Rejection Ratio $V_{icm} = V_{CC/2}$	70	85		dB
A_{vd}	Large Signal Voltage Gain $R_L = 2kW$ $R_L = 600W$	80 74	92 95		dB
V_{OH}	High Level Output Voltage $R_L = 2kW$ $R_L = 600W$	2.82 2.80	2.95 2.95		V
V_{OL}	Low Level Output Voltage $R_L = 2kW$ $R_L = 600W$		88 115	120 160	mV
I_o	Output Source Current $V_{ID} = 100mV$, $V_o = V_{DD}$ Output Sink Current $V_{ID} = -100mV$, $V_o = V_{CC}$	20 20	80 80		mA
I_{CC}	Supply Current (per amplifier) AVCL = 1, no load		450	650	mA
GBP	Gain Bandwidth Product $R_L = 10kW$, $C_L = 100pF$, $f = 100kHz$	1	1.7		MHz
SR	Slew Rate $R_L = 10kW$, $C_L = 100pF$, $AV = 1$	0.42	0.6		V/ns
f_m	Phase Margin $C_L = 100pF$		53		Degrees
en	Input Voltage Noise $f = 1kHz$		40		nV/ Hz
THD	Total Harmonic Distortion		0.01		%

Note : 1. Maximum values including unavoidable inaccuracies of the industrial test.

ELECTRICAL CHARACTERISTICS

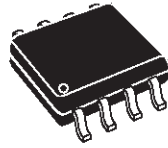
$V_{CC} = +5V$, $V_{EE} = 0V$, $T_{amb} = 25^{\circ}C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage TS1871/2/4 TS1871A/2A/4A		0.1	3 1	mV
DV_{io}	Input Offset Voltage Drift		2		mV/°C
I_{io}	Input Offset Current - note 1		3	30	nA
I_{ib}	Input Bias Current - note 1		48	130	nA
CMR	Common Mode Rejection Ratio $0 \leq V_{icm} \leq V_{CC}$	65	85		dB
SVR	Supply Voltage Rejection Ratio $V_{icm} = V_{CC/2}$	70	90		dB
A_{vd}	Large Signal Voltage Gain $R_L = 2kW$ $R_L = 600W$	83 77	92 85		dB
V_{OH}	High Level Output Voltage $R_L = 2kW$ $R_L = 600W$	4.80 4.75	4.95 4.90		V
V_{OL}	Low Level Output Voltage $R_L = 2kW$ $R_L = 600W$		88 115	130 188	mV
I_o	Output Source Current $V_{ID} = 100mV, V_o = V_{DD}$ Output Sink Current $V_{ID} = -100mV, V_o = V_{CC}$	20 20	80 80		mA
I_{CC}	Supply Current (per amplifier) AVCL = 1, no load		513	835	mA
GBP	Gain Bandwidth Product $R_L = 10kW, C_L = 100pF, f = 100kHz$	1	1.8		MHz
SR	Slew Rate $R_L = 10kW, C_L = 100pF, AV = 1$	0.42	0.6		V/ns
f _m	Phase Margin $C_L = 100pF$		55		Degrees
en	Input Voltage Noise f = 1kHz		40		nV/ Hz
THD	Total Harmonic Distortion		0.01		%

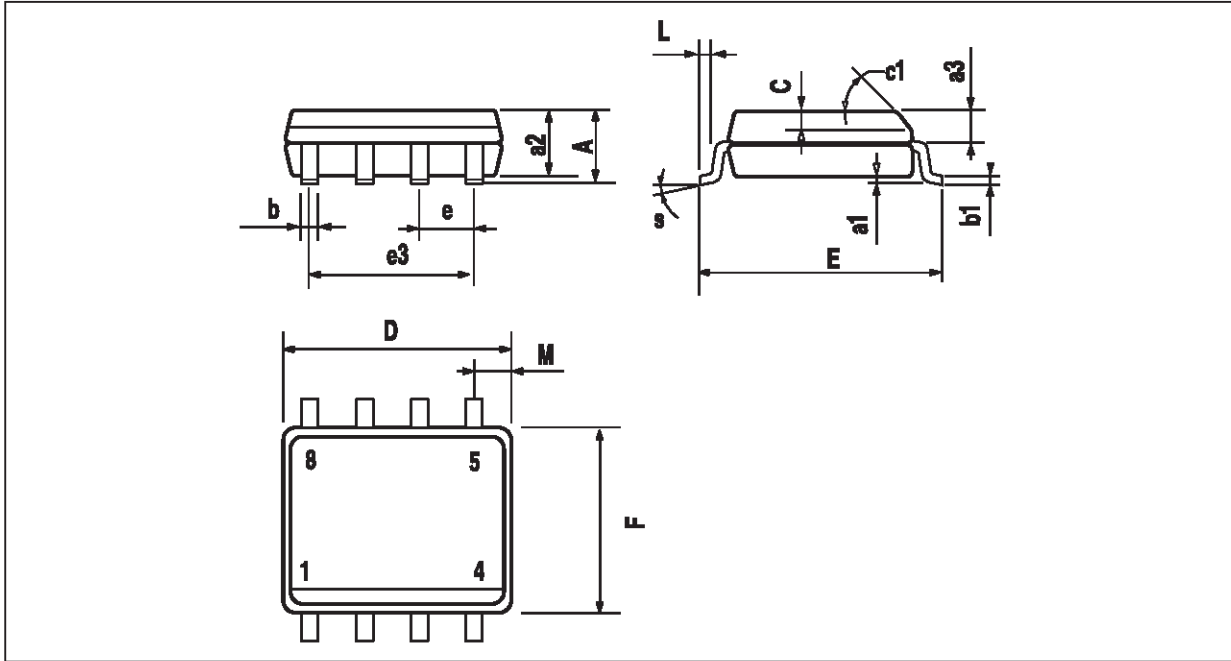
Note : 1. Maximum values including unavoidable inaccuracies of the industrial test.

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TS1871ID-TS1872ID

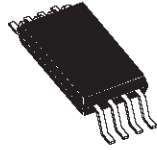


PACKAGE MECHANICAL DATA
8 PINS - PLASTIC MICROPACKAGE (SO)



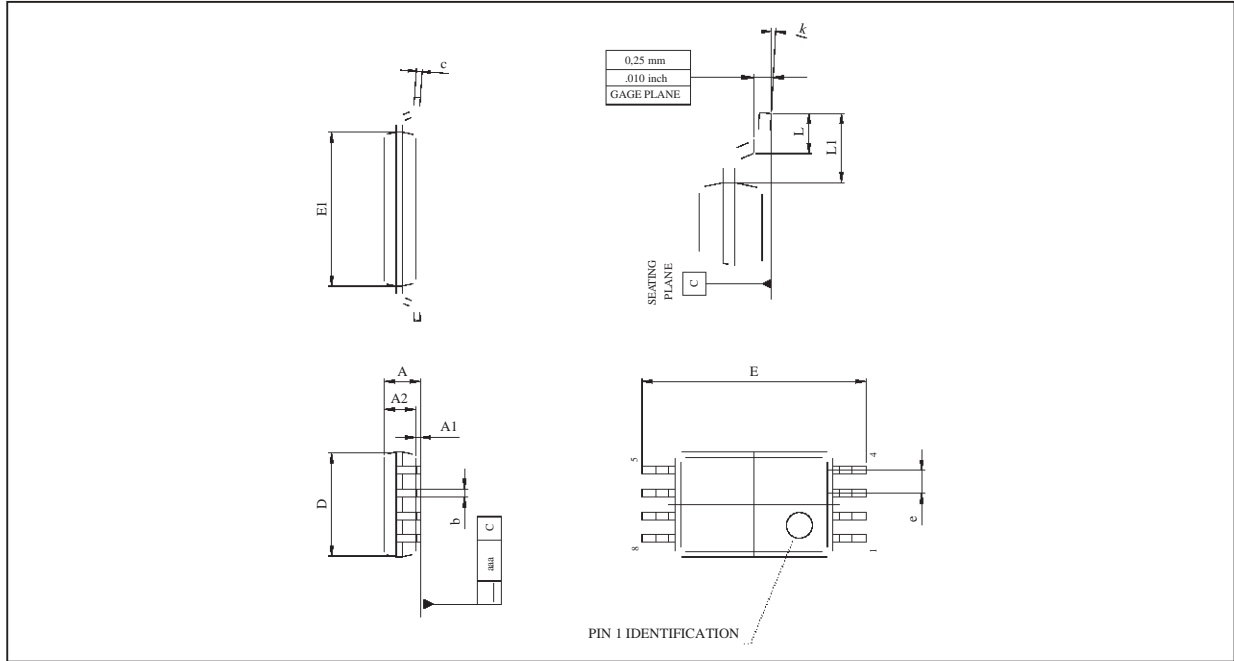
Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.150		0.157
L	0.4		1.27	0.016		0.050
M			0.6			0.024
S	8° (max.)					

TS1872IPT



PACKAGE MECHANICAL DATA

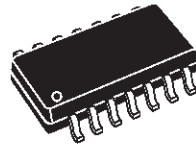
8 PINS - THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP)



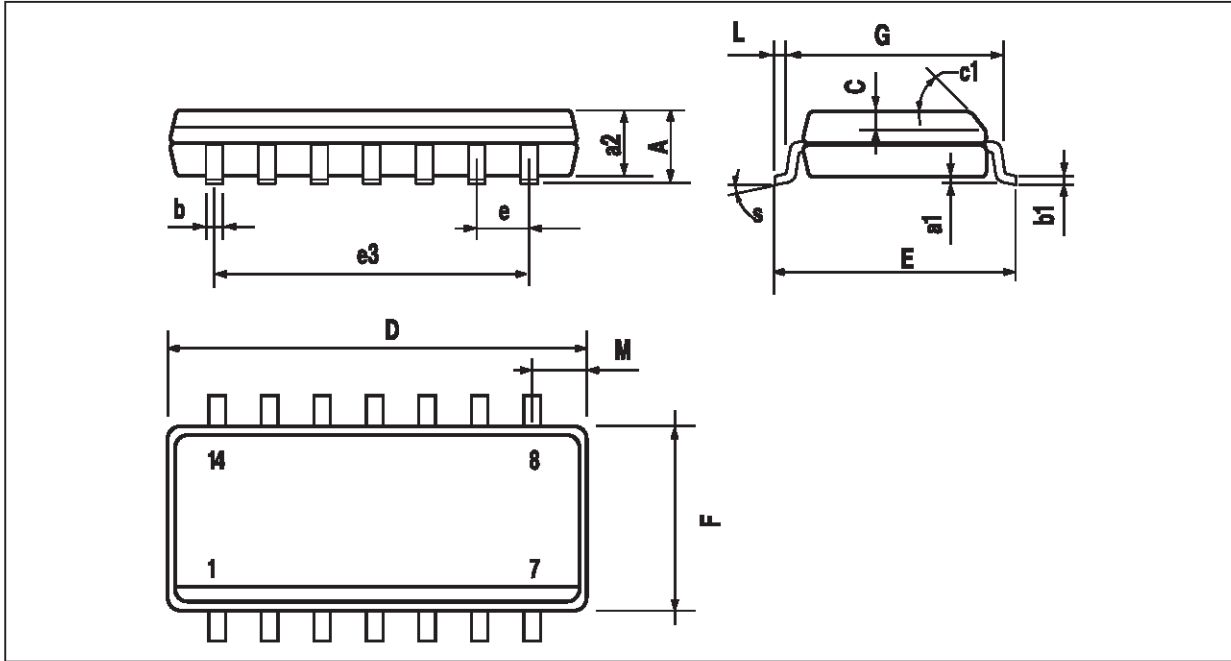
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	2.90	3.00	3.10	0.114	0.118	0.122
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°	0°		8°
l	0.50	0.60	0.75	0.09	0.0236	0.030

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TS1874ID

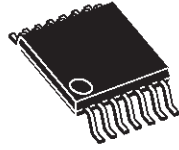


PACKAGE MECHANICAL DATA
14 PINS - PLASTIC MICROPACKAGE (SO)



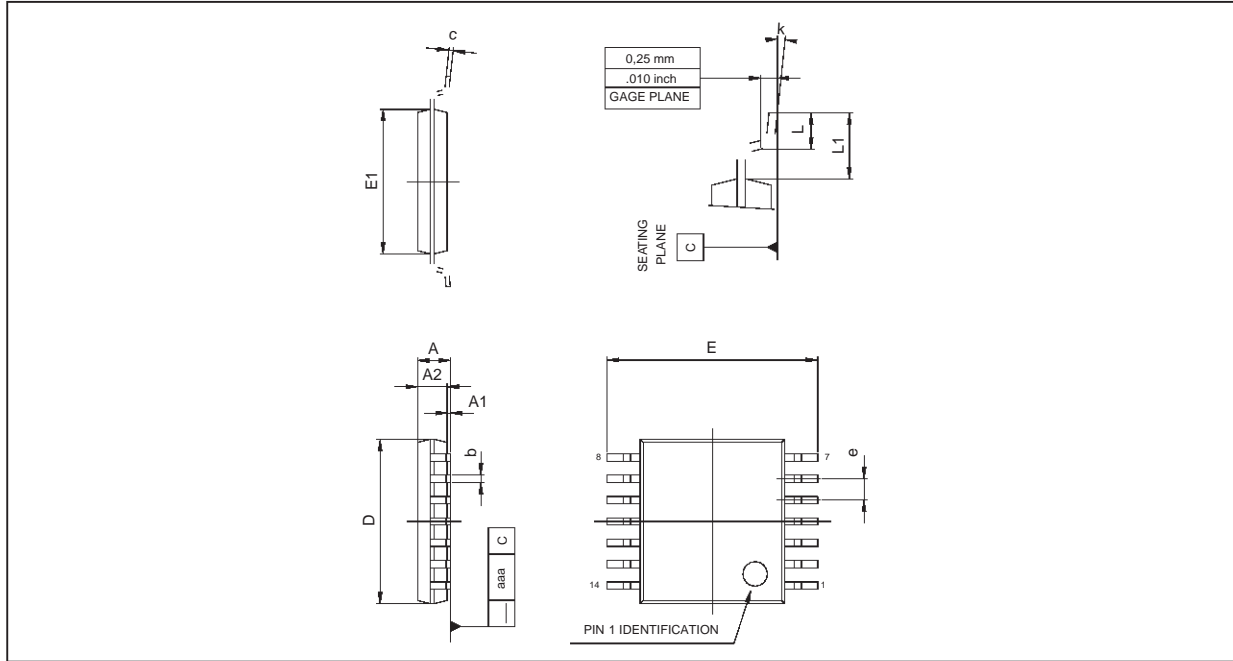
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.334
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S	8° (max.)					

TS1874IPT



PACKAGE MECHANICAL DATA

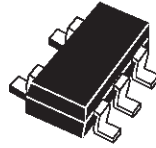
14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP)



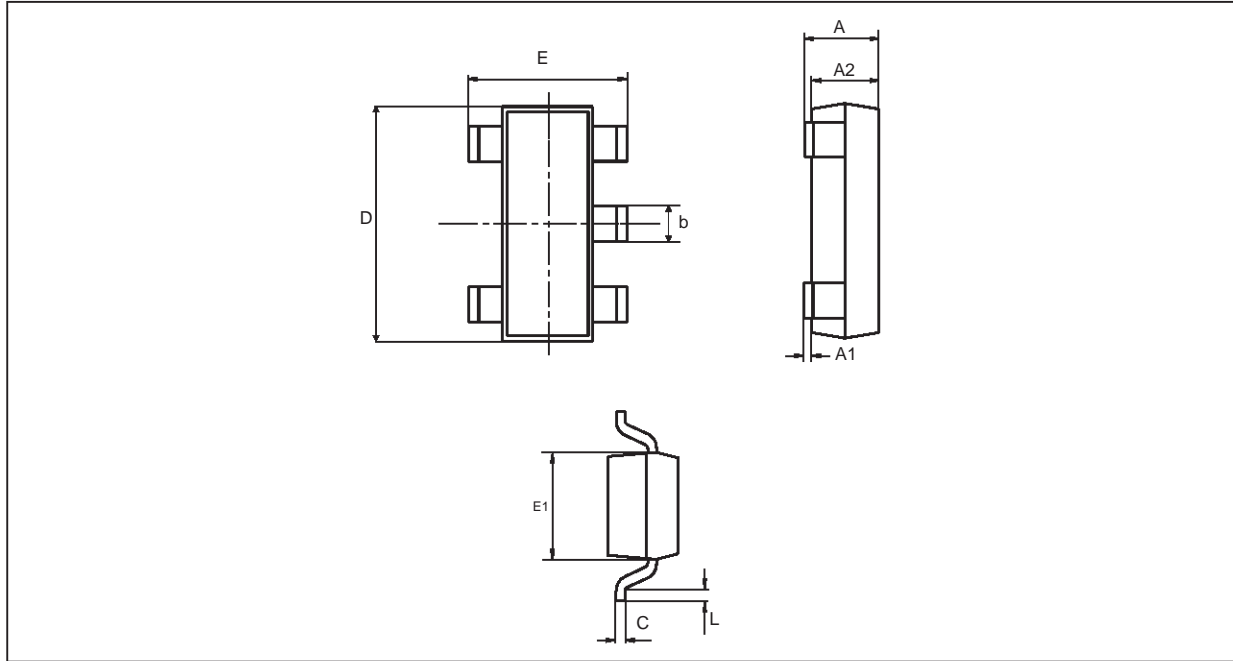
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	4.90	5.00	5.10	0.192	0.196	0.20
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°	0°		8°
l	0.50	0.60	0.75	0.09	0.0236	0.030

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TS1871ILT



PACKAGE MECHANICAL DATA 5 PINS -TINY PACKAGE (SOT23)



Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.90	1.45	0.034	0.057
A1	0	0.15		0.006
A2	0.90	1.30	0.034	0.051
b	0.35	0.50	0.013	0.020
C	0.09	0.20	0.003	0.008
D	2.80	3.00	0.110	0.118
E	2.60	3.00	0.102	0.118
E1	1.50	1.75	0.059	0.069
L	0.10	0.60	0.003	0.024

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