

TS861, TS862, TS864

Rail-to-rail micropower BiCMOS comparators

Datasheet -production data

Features

- Ultra low current consumption (6 µA/comp. at V_{CC} = 2.7 V)
- Rail-to-rail CMOS inputs
- Push-pull outputs
- Supply operation from 2.7 to 10 V
- Low propagation delay
- ESD protection (2 kV)
- Latch-up immunity (class A)
- Available in SOT23-5 micropackage, SO-8, SO-14,TSSOP8, and TSSOP14 package

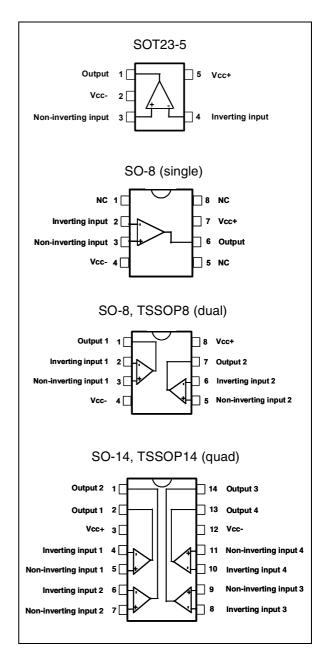
Applications

- Battery powered systems such as alarms
- Portable communication systems
- Smoke/gas/fire detectors
- Portable computers

Description

The TS86x device (single, dual and quad) is a rail-to-rail comparator characterized for 2.7 to 10 V operation over -40 °C to +85 °C temperature ranges. It exhibits an excellent speed-to-power ratio, featuring a current consumption of 6 μ A per comparator and a response time of 500 ns at 2.7 V for a 100 mV overdrive.

Due to its ultra low power consumption and its availability in a tiny package, the TS86x comparator family is perfectly suited to battery-powered systems. The output stage is designed with a push-pull structure allowing a direct connection to the microcontroller without additional pull-up resistors.



1 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage ⁽¹⁾	12	V
V _{ID}	Differential input voltage ⁽²⁾	±12	V
V _{IN}	Input voltage range ⁽³⁾	-0.3 to 12.3	V
R _{THJA}	Thermal resistance junction-to-ambient ⁽⁴⁾ SOT23-5 SO-8 SO-14 TSSOP8 TSSOP14	250 125 105 120 100	°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
T _{STG}	Storage temperature range	-65 to +150	°C
T _J	Maximum junction temperature	150	°C
T _{LEAD}	Lead temperature (soldering, 10 sec.)	260	°C
ESD	Human body model (HBM) ⁽⁵⁾ Machine model (MM) ⁽⁶⁾	2 200	kV V
	Latch-up immunity	Class A	

- 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 $\mbox{V}_{\mbox{\scriptsize CC}}$ +0.3 V.
- 4. Short-circuits can cause excessive heating. These values are typical.
- 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.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V _{CC}	Supply voltage	2.7 to 10	٧
V _{ICM}	Common mode input voltage range	V_{CC}^- - 0.3 to V_{CC}^+ + 0.3	٧
T _{Oper}	Operating free air temperature range	-40 to + 85	°C

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2 Electrical characteristics

Table 3. Electrical characteristics at V_{CC} = 2.7 V, T_{amb} = 25 °C (unless otherwise specified)

Symbol	Parameter	Min.	Тур.	Max.	Unit
V _{IO}	Input offset voltage TS861/2/4 T _{min} < T < T _{max} TS861/2/4A T _{min} < T < T _{max}		3	15 18 7 10	mV
ΔV _{IO}	Input offset voltage drift		6		μV/°C
I _{IO}	Input offset current ⁽¹⁾ $T_{min} < T < T_{max}$		1	150 300	pА
I _{IB}	Input bias current ⁽¹⁾ $T_{min} < T < T_{max}$		1	300 600	pА
V _{OH}	High level output voltage $I_{SOURCE} = 2.5 \text{ mA} $ $T_{min} < T < T_{max}$	2.35 2.15	2.45		V
V _{OL}	Low level output voltage $I_{SINK} = 2.5 \text{ mA} $ $T_{min} < T < T_{max}$		0.2	0.35 0.45	V
A _{VD}	Large signal voltage gain ⁽²⁾		240		dB
CMR	Common mode rejection ratio 0 < V _{ICM} < 2.7 V		65		dB
SVR	Supply voltage rejection ratio 0 < V _{CC} < 10 V		80		dB
I _{CC}	Supply current per comparator No load, output low No load, output high		6 8	12 14	μΑ
T _{PLH}	Propagation delay from output low to output high $V_{ICM} = 1.35 \text{ V}$, $f = 10 \text{ kHz}$, $C_L = 50 \text{ pF}$ Overdrive = 10 mV Overdrive = 100 mV		1.5 0.6		μs
T _{PHL}	Propagation delay from output high to output low $V_{ICM} = 1.35 \text{ V}$, $f = 10 \text{ kHz}$, $C_L = 50 \text{ pF}$ Overdrive = 10 mV Overdrive = 100 mV		1.5 0.5		μs

Table 3. Electrical characteristics at V_{CC} = 2.7 V, T_{amb} = 25 °C (unless otherwise specified) (continued)

Symbol	Parameter	Min.	Тур.	Max.	Unit
T _F	Fall time $f = 10 \text{ kHz}$, $C_L = 50 \text{ pF}$, overdrive = 100 mV		20		ns
T _R	Rise time $f = 10 \text{ kHz}, C_L = 50 \text{ pF}, \text{ overdrive} = 100 \text{ mV}$		20		ns

- 1. Maximum values including unavoidable inaccuracies of the industrial tests.
- 2. Design evaluation.

Note: Limits are 100% production tested at 25 °C. Limits over temperature are guaranteed through correlation and by design.

Table 4. Electrical characteristics at V_{CC} = 5 V, T_{amb} = 25 °C (unless otherwise specified)

Symbol	Parameter	Min.	Тур.	Max.	Unit
V _{IO}	Input offset voltage TS861/2/4 T _{min} < T < T _{max} TS861/2/4A T _{min} < T < T _{max}		3	15 18 7 10	mV
ΔV_{IO}	Input offset voltage drift		6		μV/°C
I _{IO}	Input offset current ⁽¹⁾ T _{min} < T < T _{max}		1	150 300	pA
I _{IB}	Input bias current ⁽¹⁾ T _{min} < T < T _{max}		1	300 600	pA
V _{OH}	High level output voltage $I_{SOURCE} = 5 \text{ mA} $ $T_{min} < T < T_{max}$	4.6 4.45	4.8		٧
V _{OL}	Low level output voltage $I_{SINK} = 5 \text{ mA}$ $T_{min} < T < T_{max}$		0.2	0.4 0.55	V
A _{VD}	Large signal voltage gain ⁽²⁾		240		dB
CMR	Common mode rejection ratio 0 < V _{ICM} < 5 V		70		dB
SVR	Supply voltage rejection ratio 2.7 < V _{CC} < 10 V		80		dB
I _{CC}	Supply current per comparator No load, output low No load, output high		6 8	12 14	μА
T _{PLH}	Propagation delay from output low to output high $V_{ICM} = 2.5 \text{ V}$, $f = 10 \text{ kHz}$, $C_L = 50 \text{ pF}$ Overdrive = 10 mV Overdrive = 100 mV		2 0.5		μs
T _{PHL}	Propagation delay from output high to output low $V_{ICM} = 2.5 \text{ V}$, $f = 10 \text{ kHz}$, $C_L = 50 \text{ pF}$ Overdrive = 10 mV Overdrive = 100 mV		2 0.4		μs
T _F	Fall time $f = 10 \text{ kHz}, C_L = 50 \text{ pF}, \text{ overdrive} = 100 \text{ mV}$		20		ns
T _R	Rise time $f = 10 \text{ kHz}, C_L = 50 \text{ pF}, \text{ overdrive} = 100 \text{ mV}$		20		ns

^{1.} Maximum values including unavoidable inaccuracies of the industrial test.

Note: Limits are 100% production tested at 25 °C. Limits over temperature are guaranteed through correlation and by design.



^{2.} Design evaluation.

Table 5. Electrical characteristics at V_{CC} = +10 V, T_{amb} = 25 °C (unless otherwise specified)

Symbol	Parameter	Min.	Тур.	Max.	Unit
V _{IO}	Input offset voltage ($V_{ICM} = V_{CC} / 2$) TS861/2/4 $T_{min} < T < T_{max}$		3	15 18	mV
ΔV _{IO}	Input offset voltage drift		6		μV/°C
I _{IO}	Input offset current ⁽¹⁾ $T_{min} < T < T_{max}$		1	150 300	pA
I _{IB}	Input bias current ⁽¹⁾ $T_{min} < T < T_{max}$		1	300 600	pA
V _{OH}	High level output voltage $I_{\text{SOURCE}} = 5 \text{ mA} $ $T_{\text{min}} < T < T_{\text{max}}$	9.6 9.45	9.8		V
V _{OL}	Low level output voltage $I_{SINK} = 5 \text{ mA}$ $T_{min} < T < T_{max}$		0.2	0.4 0.55	٧
A _{VD}	Large signal voltage gain ⁽²⁾		240		dB
CMR	Common mode rejection ratio 0 < V _{ICM} < 10 V		75		dB
SVR	Supply voltage rejection ratio 2.7 < V _{CC} < 10 V		80		dB
I _{CC}	Supply current per comparator No load, output low No load, output high		7 10	14 16	μΑ
T _{PLH}	Propagation delay from output low to output high $V_{ICM} = 5 \text{ V}$, $f = 10 \text{ kHz}$, $C_L = 50 \text{ pF}$ Overdrive = 10 mV Overdrive = 100 mV		3 0.5		μs
T _{PHL}	Propagation delay from output high to output low $V_{ICM} = 5 \text{ V}$, $f = 10 \text{ kHz}$, $C_L = 50 \text{ pF}$ Overdrive = 10 mV Overdrive = 100 mV		2.6 0.4		μs
T _F	Fall time $f = 10 \text{ kHz}, C_L = 50 \text{ pF}, \text{ overdrive} = 100 \text{ mV}$		20		ns
T _R	Rise time $f = 10 \text{ kHz}, C_L = 50 \text{ pF}, \text{ overdrive} = 100 \text{ mV}$		20		ns

 $^{{\}bf 1.} \quad {\bf Maximum\ values\ including\ unavoidable\ inaccuracies\ of\ the\ industrial\ test.}$

Note: Limits are 100% production tested at 25 °C. Limits over temperature are guaranteed through correlation and by design.

^{2.} Design evaluation.

Figure 1. V_{IO} vs. V_{ICM} at V_{CC} = 2.7 V

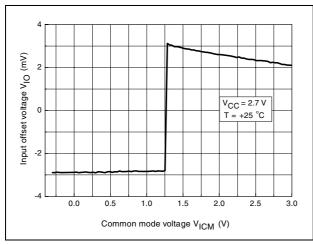


Figure 2. V_{IO} vs. V_{ICM} and temperature at V_{CC} = 2.7 V

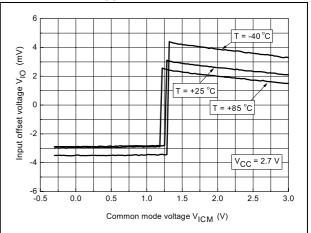


Figure 3. V_{IO} vs. V_{ICM} at $V_{CC} = 5$ V

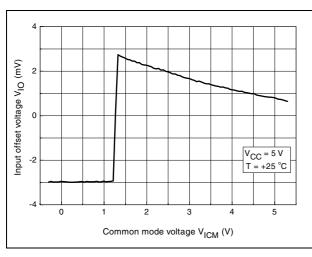


Figure 4. V_{IO} vs. V_{ICM} and temperature at $V_{CC} = 5$ V

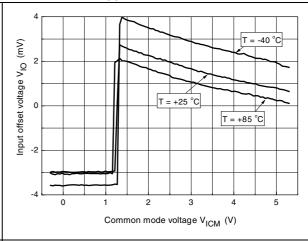


Figure 5. V_{IO} vs. V_{ICM} at V_{CC} = 10 V

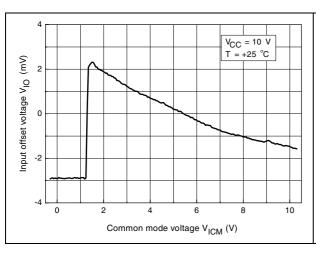
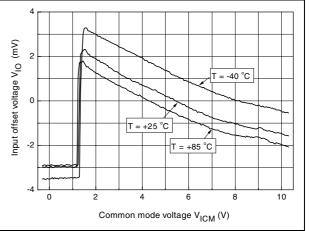


Figure 6. V_{IO} vs. V_{ICM} and temperature at V_{CC} = 10 V



 V_{IO} vs. V_{CC} at $V_{ICM} = V_{CC}/2$ Figure 7.

Input offset voltage V_{IO} (mV) $V_{ICM} = V_{CC}/2$ T = +25 °C 3 5 6 10 Supply voltage V_{CC} (V)

 V_{IO} vs. temperature at V_{CC} = 5 V Figure 8.

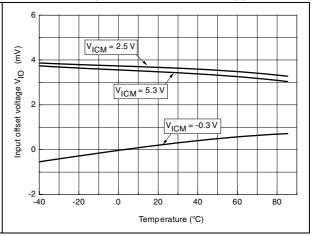


Figure 9. Supply current (I_{CC}) vs. supply voltage $(V_{CC}) (V_{ID} = -1 V)$

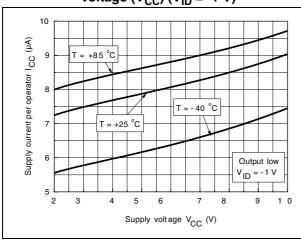


Figure 10. Supply current (I_{CC}) vs. supply voltage $(V_{CC})(V_{ID} = +1 V)$

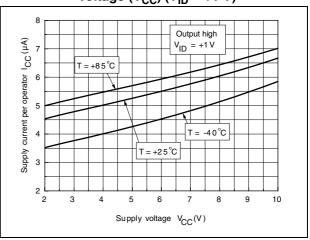


Figure 11. Supply current (I_{CC}) vs. temperature $(V_{ID} = -1 V)$

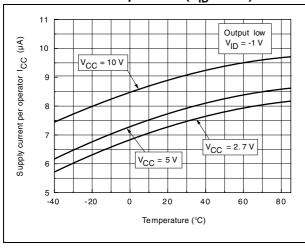
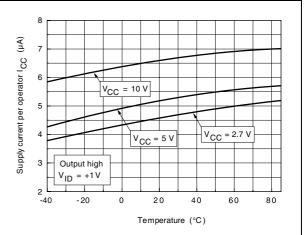


Figure 12. Supply current (I_{CC}) vs. temperature ($V_{ID} = +1 V$)



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Figure 13. V_{OL} vs. I_{SINK} and temperature at $V_{CC} = 5 \text{ V}$

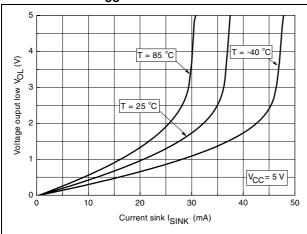


Figure 14. V_{OH} vs. I_{SOURCE} and temperature at V_{CC} = 5 V

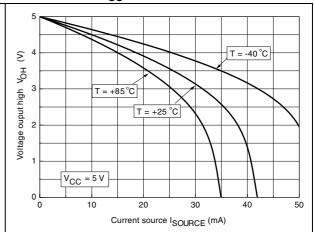


Figure 15. Propagation delay T_{PLH} vs. V_{ICM} with $V_{OVD} = 100 \text{ mV}$

2.0 T = +25 ℃ $V_{CC} = 10 \text{ V}$ $V_{OVD} = 100 \text{ mV}$ 1.8 (st) $C_{LOAD}^{-1} = 50 pF$ ТРГН 1.6 1.4 $V_{CC} = 5 V$ Propagation delay 1.2 1.0 $V_{CC} = 2.7 V$ 0.8 0.6 0.4 0 10 Common mode voltage V_{ICM} (V)

Figure 16. Propagation delay T_{PHL} vs. V_{ICM} with $V_{OVD} = 100 \text{ mV}$

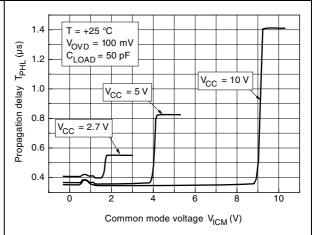


Figure 17. Propagation delay T_{PLH} vs. V_{ICM} with $V_{OVD} = 10 \text{ mV}$

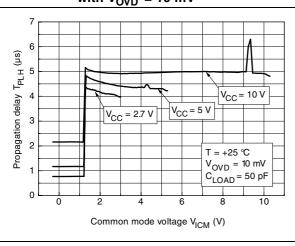


Figure 18. Propagation delay T_{PHL} vs. V_{ICM} with $V_{OVD} = 10 \text{ mV}$

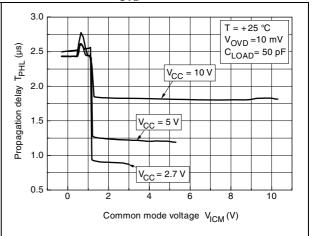


Figure 19. Propagation delay vs. V_{CC} with $V_{OVD} = 10 \text{ mV}$

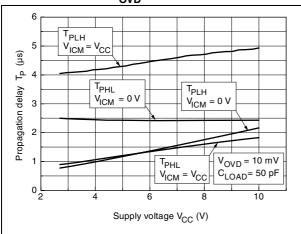


Figure 20. Propagation delay vs. V_{CC} with $V_{OVD} = 100 \text{ mV}$

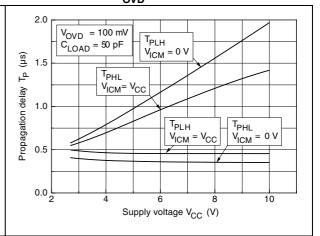


Figure 21. Propagation delay vs. overdrive voltage at $V_{CC} = 2.7 \text{ V}$

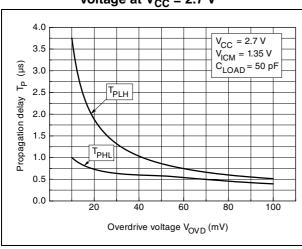


Figure 22. Propagation delay vs. overdrive voltage at $V_{CC} = 5 \text{ V}$

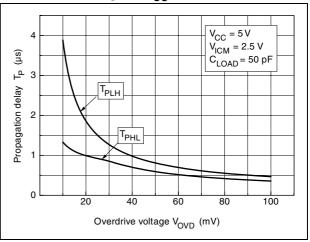
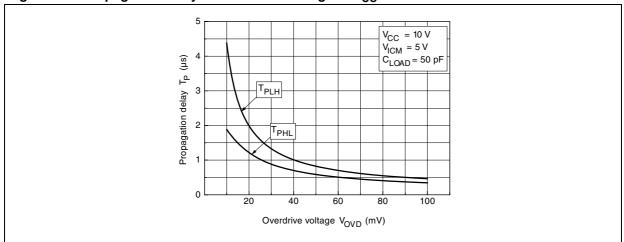


Figure 23. Propagation delay vs. overdrive voltage at $V_{CC} = 10 \text{ V}$



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3 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

3.1 SOT23-5 package information

Figure 24. SOT23-5L package outline

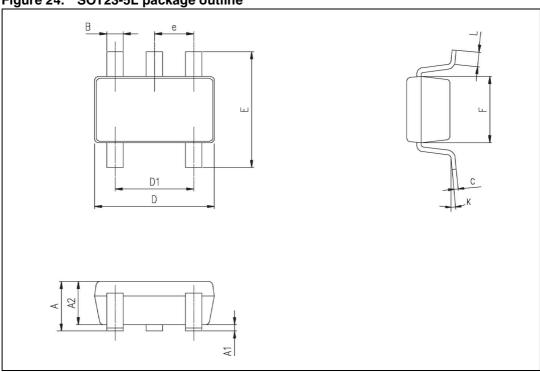


Table 6. SOT23-5L package mechanical data

	Dimensions						
Symbol		Millimeters			Inches		
	Min.	Тур.	Max.	Min.	Тур.	Max.	
Α	0.90	1.20	1.45	0.035	0.047	0.057	
A1			0.15			0.006	
A2	0.90	1.05	1.30	0.035	0.041	0.051	
В	0.35	0.40	0.50	0.013	0.015	0.019	
С	0.09	0.15	0.20	0.003	0.006	0.008	
D	2.80	2.90	3.00	0.110	0.114	0.118	
D1		1.90			0.075		
е		0.95			0.037		
Е	2.60	2.80	3.00	0.102	0.110	0.118	
F	1.50	1.60	1.75	0.059	0.063	0.069	
L	0.10	0.35	0.60	0.004	0.013	0.023	
K	0°		10°				

3.2 SO-8 package information

Figure 25. SO-8 package outline

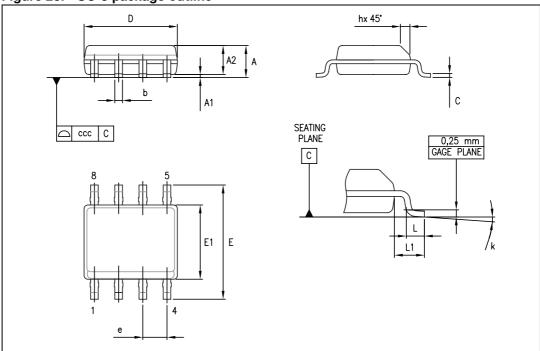


Table 7. SO-8 package mechanical data

	Dimensions						
Symbol		Millimeters			Inches		
	Min.	Тур.	Max.	Min.	Тур.	Max.	
А			1.75			0.069	
A1	0.10		0.25	0.004		0.010	
A2	1.25			0.049			
b	0.28		0.48	0.011		0.019	
С	0.17		0.23	0.007		0.010	
D	4.80	4.90	5.00	0.189	0.193	0.197	
Е	5.80	6.00	6.20	0.228	0.236	0.244	
E1	3.80	3.90	4.00	0.150	0.154	0.157	
е		1.27			0.050		
h	0.25		0.50	0.010		0.020	
L	0.40		1.27	0.016		0.050	
L1		1.04			0.040		
k	0		8°	1°		8°	
ccc			0.10			0.004	

3.3 SO-14 package information

Figure 26. SO-14 package outline

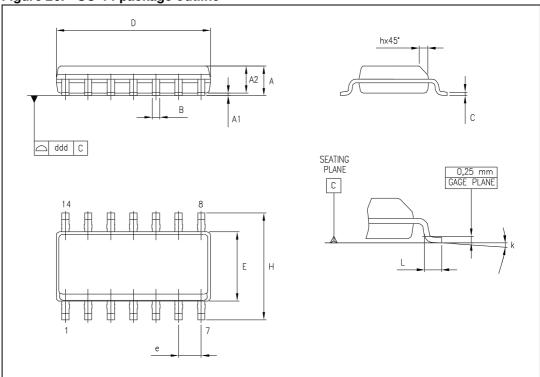


Table 8. SO-14 package mechanical data

	Dimensions						
Symbol	Millimeters			Inches			
	Min.	Тур.	Max.	Min.	Тур.	Max.	
А	1.35		1.75	0.05		0.068	
A1	0.10		0.25	0.004		0.009	
A2	1.10		1.65	0.04		0.06	
В	0.33		0.51	0.01		0.02	
С	0.19		0.25	0.007		0.009	
D	8.55		8.75	0.33		0.34	
E	3.80		4.0	0.15		0.15	
е		1.27			0.05		
Н	5.80		6.20	0.22		0.24	
h	0.25		0.50	0.009		0.02	
L	0.40		1.27	0.015		0.05	
k	8° (max.)						
ddd			0.10			0.004	

3.4 TSSOP8 package information

Figure 27. TSSOP8 package outline

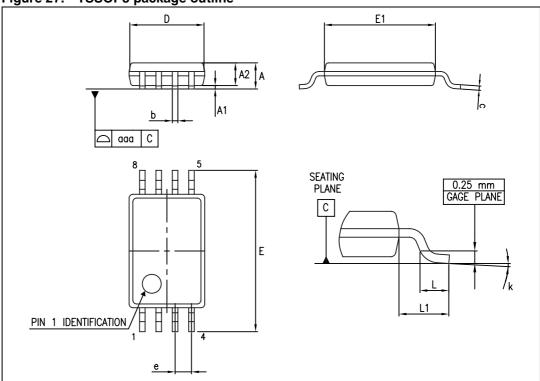


Table 9. TSSOP8 package mechanical data

	Dimensions						
Symbol	Millimeters			Inches			
	Min.	Тур.	Max.	Min.	Тур.	Max.	
Α			1.20			0.047	
A1	0.05		0.15	0.002		0.006	
A2	0.80	1.00	1.05	0.031	0.039	0.041	
b	0.19		0.30	0.007		0.012	
С	0.09		0.20	0.004		0.008	
D	2.90	3.00	3.10	0.114	0.118	0.122	
Е	6.20	6.40	6.60	0.244	0.252	0.260	
E1	4.30	4.40	4.50	0.169	0.173	0.177	
е		0.65			0.0256		
k	0°		8°	0°		8°	
L	0.45	0.60	0.75	0.018	0.024	0.030	
L1		1			0.039		
aaa			0.10			0.004	

3.5 TSSOP14 package information

Figure 28. TSSOP14 package outline

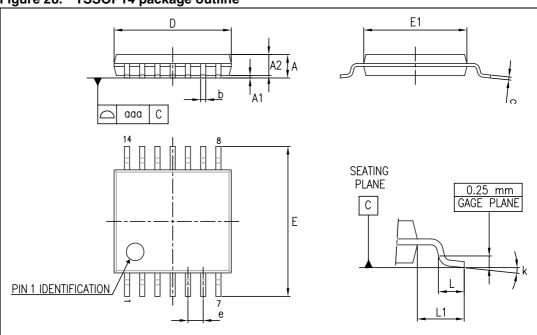


Table 10. TSSOP14 package mechanical data

Table 10.	10001 17 P	ackage illecii	arnour data					
	Dimensions							
Symbol		Millimeters			Inches			
	Min.	Тур.	Max.	Min.	Тур.	Max.		
Α			1.20			0.047		
A1	0.05		0.15	0.002	0.004	0.006		
A2	0.80	1.00	1.05	0.031	0.039	0.041		
b	0.19		0.30	0.007		0.012		
С	0.09		0.20	0.004		0.0089		
D	4.90	5.00	5.10	0.193	0.197	0.201		
E	6.20	6.40	6.60	0.244	0.252	0.260		
E1	4.30	4.40	4.50	0.169	0.173	0.176		
е		0.65			0.0256			
L	0.45	0.60	0.75	0.018	0.024	0.030		
L1		1.00			0.039			
k	0°		8°	0°		8°		
aaa			0.10			0.004		

4 Ordering information

Table 11. Order codes

Part number	Temperature range	Package	Packaging	Marking
TS861ILT TS861AILT	-40 °C, +85 °C	SOT-23	Tape and reel	K501 K502
TS861ID TS861IDT		SO-8	Tube Tape and reel	8611
TS861AID TS861AIDT		30-6	Tube Tape and reel	861AI
TS862ID TS862IDT		SO-8	Tube Tape and reel	8621
TS862AID TS862AIDT	-40 °C, +85 °C	50-6	Tube Tape and reel	862AI
TS862IPT TS862AIPT		TSSOP8	Tape and reel	862I 862AI
TS864ID TS864IDT		SO-14	Tube Tape and reel	8641
TS864AID TS864AIDT	-40 °C, +85 °C	3U-14	Tube Tape and reel	864AI
TS864IPT TS864AIPT		TSSOP14	Tape and reel	864I 864AI

5 Revision history

Table 12. Document revision history

Date	Revision	Changes
01-Feb-2002	1	Initial release.
28-Apr-2009	2	Updated document format. Removed power dissipation from <i>Table 1: Absolute maximum ratings</i> . Added Rthja and Rthjc values and ESD notes in <i>Table 1</i> . Updated curves in <i>Figure 1</i> to <i>Figure 14</i> . Changed <i>Figure 15</i> , <i>Figure 16</i> , <i>Figure 17</i> and <i>Figure 18</i> . Added <i>Figure 19</i> , <i>Figure 20</i> , <i>Figure 21</i> , <i>Figure 22</i> and <i>Figure 23</i> . Removed DIP package information in <i>Chapter 3</i> and <i>Chapter 4</i> . Added ordering information in <i>Table 11: Order codes</i> .
06-Nov-2012	3	Updated titles of <i>Figure 9</i> to <i>Figure 12</i> (added conditions). Removed TS861IYLT, TS861AIYLT, TS862IYDT, TS862AIYDT, TS864IYDT, and TS864AIYDT order codes from <i>Table 11</i> . Minor corrections throughout document.

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