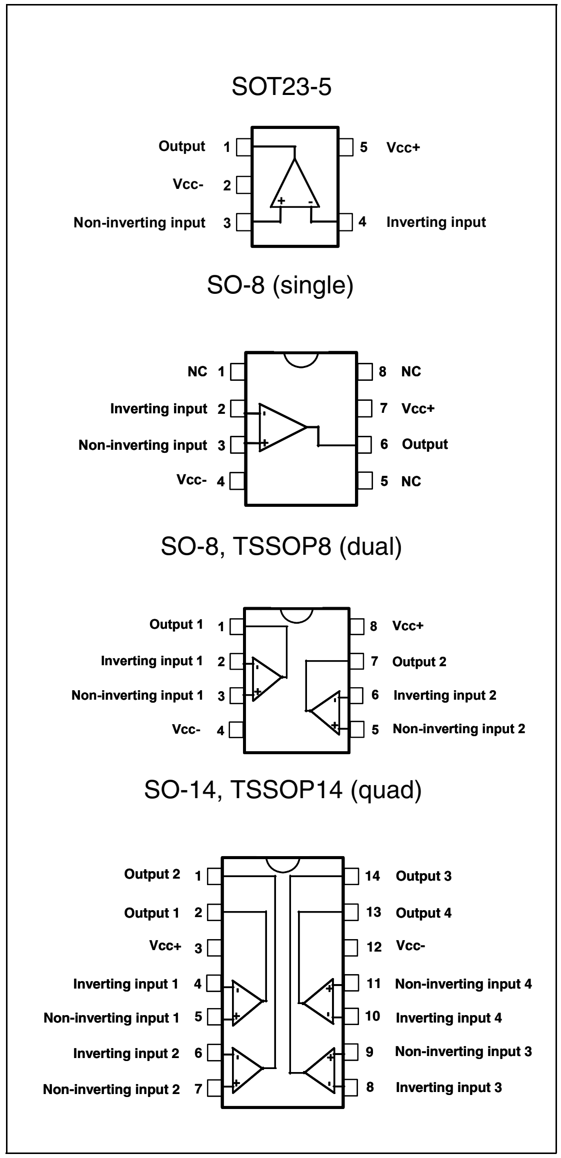
TS861, TS862, TS864

Rail-to-rail micropower BiCMOS comparators

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



Applications

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

Description

The TS86x (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 µA 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.

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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 SO8 SO14 TSSOP8 TSSOP14	 250 125 105 120 100	°C/W
R_{THJC}	Thermal resistance junction to case (4) SOT23-5 SO8 SO14 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 V_{CC} +0.3V.
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	V
V_{ICM}	Common mode input voltage range	V_{CC}^- - 0.3 to V_{CC}^+ + 0.3	V
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.	Typ.	Max.	Unit
V_{IO}	Input offset voltage TS861/2/4 Tmin<T<Tmax TS861/2/4A Tmin<T<Tmax		3 3	15 18 7 10	mV
ΔV_{IO}	Input offset voltage drift		6		µV/°C
I_{IO}	Input offset current(1) Tmin<T<Tmax		1	150 300	pA
I_{IB}	Input bias current (1) Tmin<T<Tmax		1	300 600	pA
V_{OH}	High level output voltage I_{SOURCE}=2.5mA Tmin<T<Tmax	2.35 2.15	2.45		V
V_{OL}	Low level output voltage I_{SINK} = 2.5 mA Tmin<T<Tmax		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} < 10V		80		dB
I_{CC}	Supply current per comparator no load, output low no load, output high		6 8	12 14	µA
T_{PLH}	Propagation delay from output low to output high V_{ICM} = 1.35 V, f = 10 kHz, C_L = 50 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 V, f = 10 kHz, C_L = 50 pF overdrive = 10 mV overdrive = 100 mV		1.5 0.5		µs

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_F	Fall time f = 10 kHz, C_L = 50 pF, overdrive = 100 mV		20		ns
T_R	Rise time f = 10 kHz, C_L = 50 pF, overdrive = 100 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.

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{IO}	Input offset voltage TS861/2/4 Tmin<T<Tmax TS861/2/4A Tmin<T<Tmax		3 3	15 18 7 10	mV
ΔV_{IO}	Input offset voltage drift		6		µV/°C
I_{IO}	Input offset current[1] Tmin<T<Tmax		1	150 300	pA
I_{IB}	Input bias current [1] Tmin<T<Tmax		1	300 600	pA
V_{OH}	High level output voltage I_{SOURCE} = 5 mA Tmin<T<Tmax	4.6 4.45	4.8		V
V_{OL}	Low level output voltage I_{SINK} = 5 mA Tmin<T<Tmax		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	µA
T_{PLH}	Propagation delay from output low to output high V_{ICM} = 2.5 V, f = 10 kHz, C_L = 50 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 V, f = 10 kHz, C_L = 50 pF overdrive = 10 mV overdrive = 100 mV		2 0.4		µs
T_F	Fall time f = 10 kHz, C_L = 50 pF, overdrive = 100 mV		20		ns
T_R	Rise time f = 10 kHz, C_L = 50 pF, overdrive = 100 mV		20		ns

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

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

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{IO}	Input offset voltage ($V_{ICM} = V_{CC} / 2$) TS861/2/4 Tmin<T<Tmax		3	15 18	mV
ΔV_{IO}	Input offset voltage drift		6		µV/°C
I_{IO}	Input offset current(1) Tmin<T<Tmax		1	150 300	pA
I_{IB}	Input bias current (1) Tmin<T<Tmax		1	300 600	pA
V_{OH}	High level output voltage I_{SOURCE} = 5 mA Tmin<T<Tmax	9.6 9.45	9.8		V
V_{OL}	Low level output voltage I_{SINK} = 5 mA Tmin<T<Tmax		0.2	0.4 0.55	V
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	µA
T_{PLH}	Propagation delay from output low to output high V_{ICM} = 5 V, f = 10 kHz, C_L = 50 pF overdrive = 10 mV overdrive = 100 mV		3 0.5		µs
T_{PHL}	Propagation delay from output high to output low V_{ICM} = 5 V, f = 10 kHz, C_L = 50 pF overdrive = 10 mV overdrive = 100 mV		2.6 0.4		µs
T_F	Fall time f = 10 kHz, C_L = 50 pF, overdrive = 100 mV		20		ns
T_R	Rise time f = 10 kHz, C_L = 50 pF, overdrive = 100 mV		20		ns

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

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

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

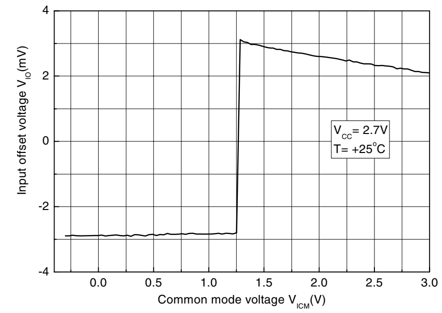

Figure 2. V_{IO} versus V_{ICM} and temperature at V_{CC} = 2.7 V

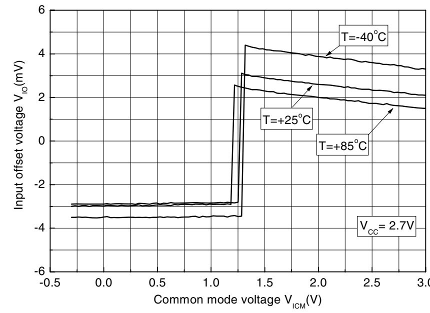

Figure 3. V_{IO} versus V_{ICM} at V_{CC} = 5 V

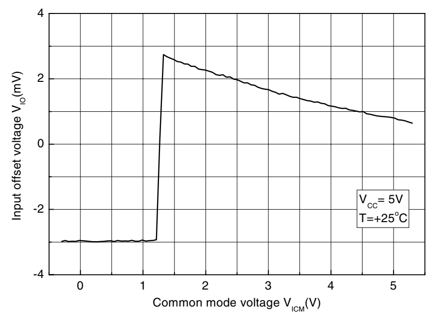

Figure 4. V_{IO} versus V_{ICM} and temperature at V_{CC} = 5 V

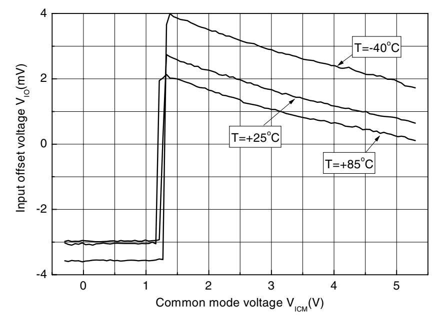

Figure 5. V_{IO} versus V_{ICM} at V_{CC} = 10 V

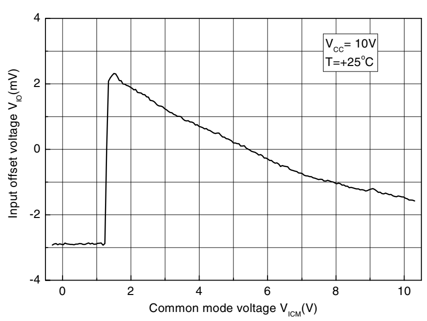

Figure 6. V_{IO} versus V_{ICM} and temperature at V_{CC} = 10 V

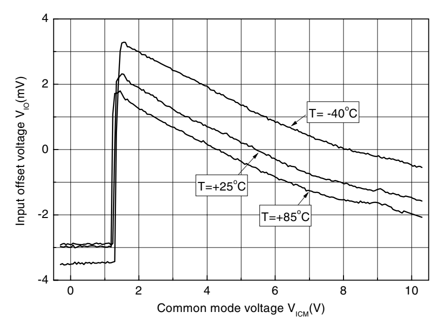

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Figure 7. V_{IO} versus V_{CC} at $V_{ICM} = V_{CC}/2$

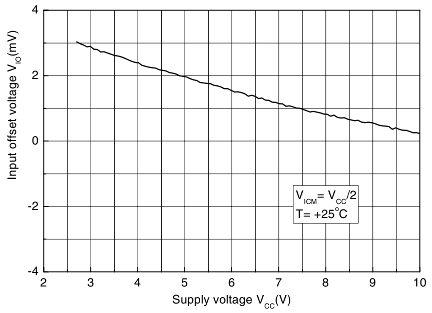

Figure 8. V_{IO} versus temperature at V_{CC} = 5 V

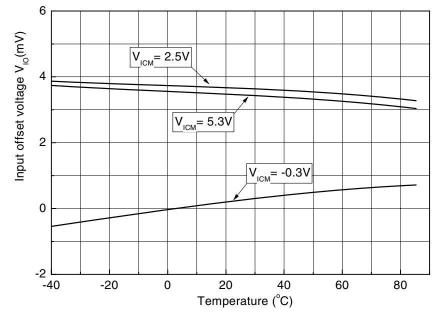

Figure 9. Supply current (I_{CC}) versus supply voltage (V_{CC})

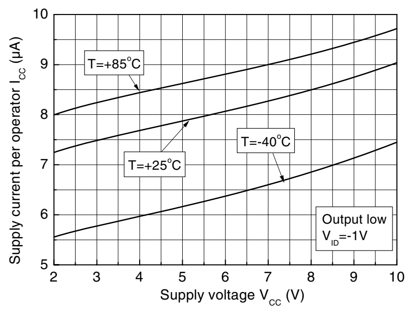

Figure 10. Supply current (I_{CC}) versus supply voltage (V_{CC})

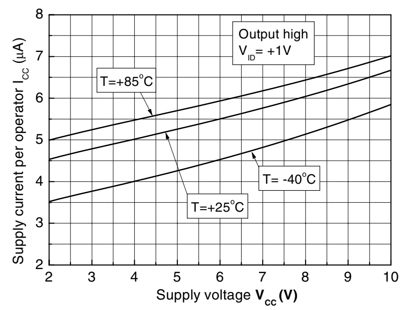

Figure 11. Supply current (I_{CC}) versus temperature

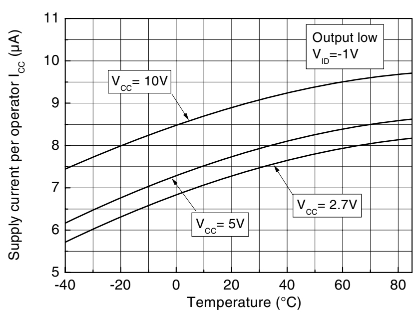

Figure 12. Supply current (I_{CC}) versus temperature

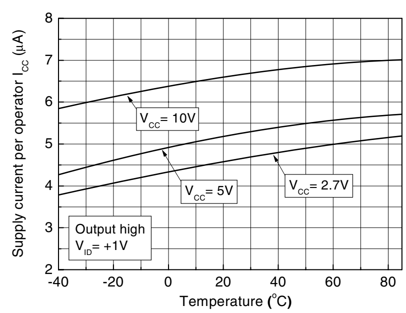

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Figure 13. V_{OL} versus I_{SINK} and temperature at V_{CC} = 5 V

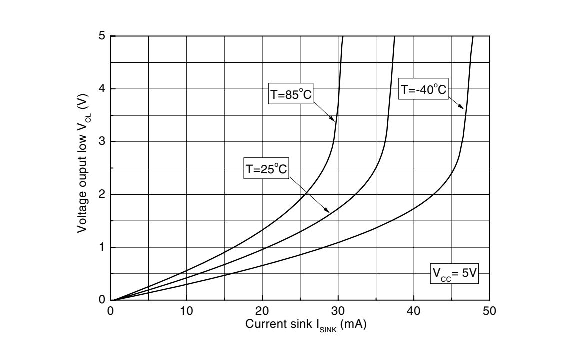

Figure 14. V_{OH} versus I_{SOURCE} and temperature at V_{CC} = 5 V

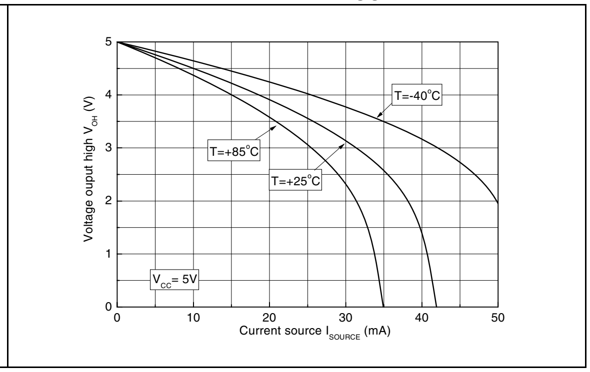

Figure 15. Propagation delay T_{PLH} versus V_{ICM} with V_{OVD} = 100 mV

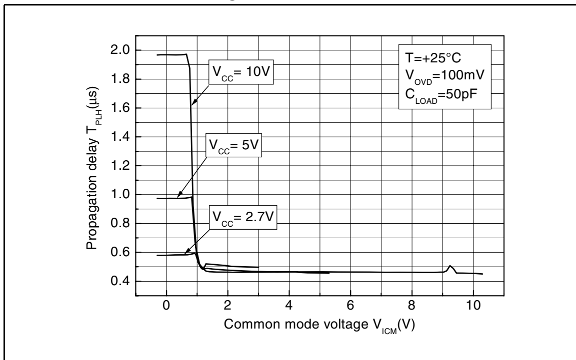

Figure 16. Propagation delay T_{PHL} versus V_{ICM} with V_{OVD} = 100 mV

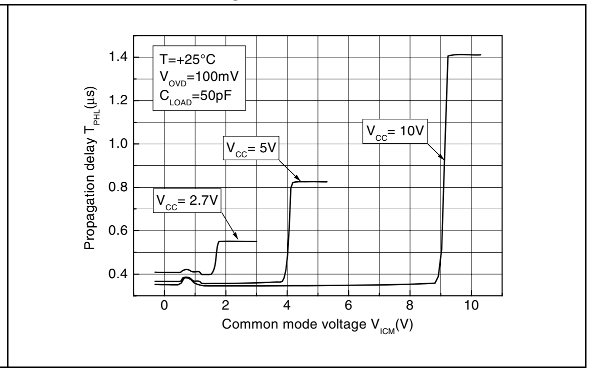

Figure 17. Propagation delay T_{PLH} versus V_{ICM} with V_{OVD} = 10 mV

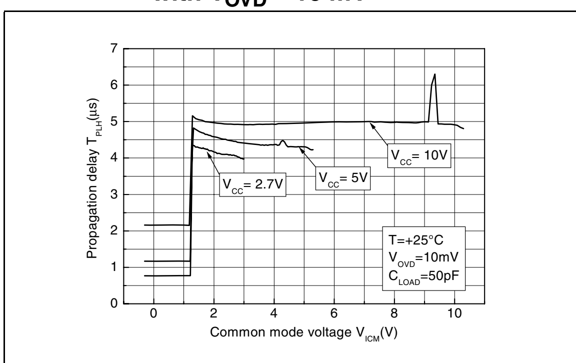

Figure 18. Propagation delay T_{PHL} versus V_{ICM} with V_{OVD} = 10 mV

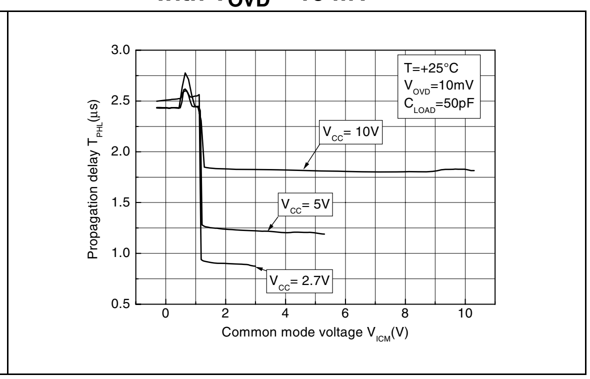

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Figure 19. Propagation delay versus V_{CC} with V_{OVD} = 10 mV

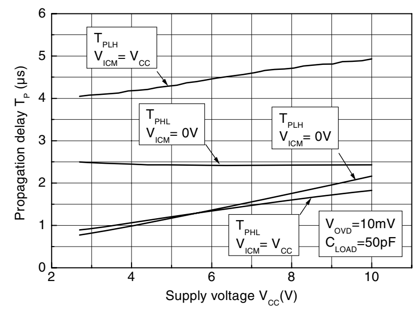


Figure 20. Propagation delay versus V_{CC} with V_{OVD} = 100 mV

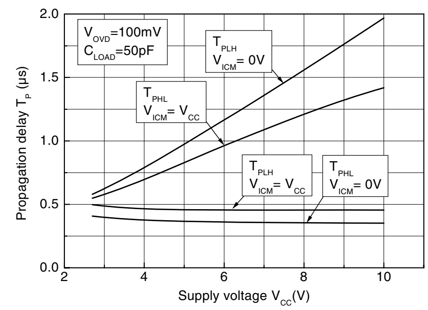


Figure 21. Propagation delay versus overdrive voltage at V_{CC} = 2.7 V

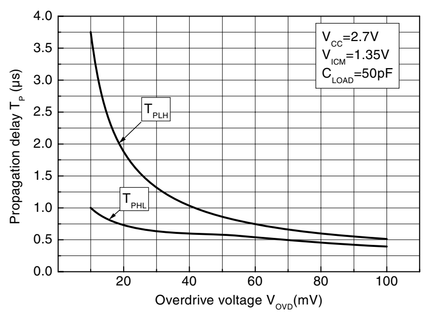


Figure 22. Propagation delay versus overdrive voltage at V_{CC} = 5 V

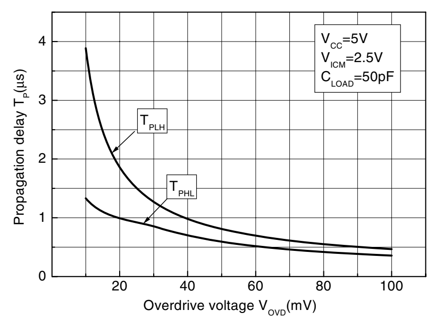
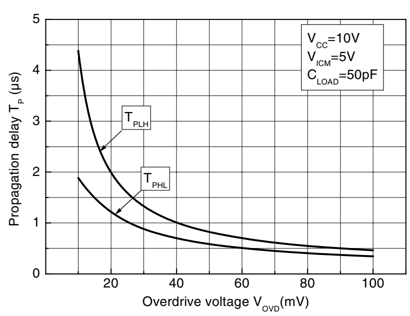


Figure 23. Propagation delay versus overdrive voltage at V_{CC} = 10 V



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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.

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3.1 SO-8 package information

Figure 24. SO-8 package mechanical drawing

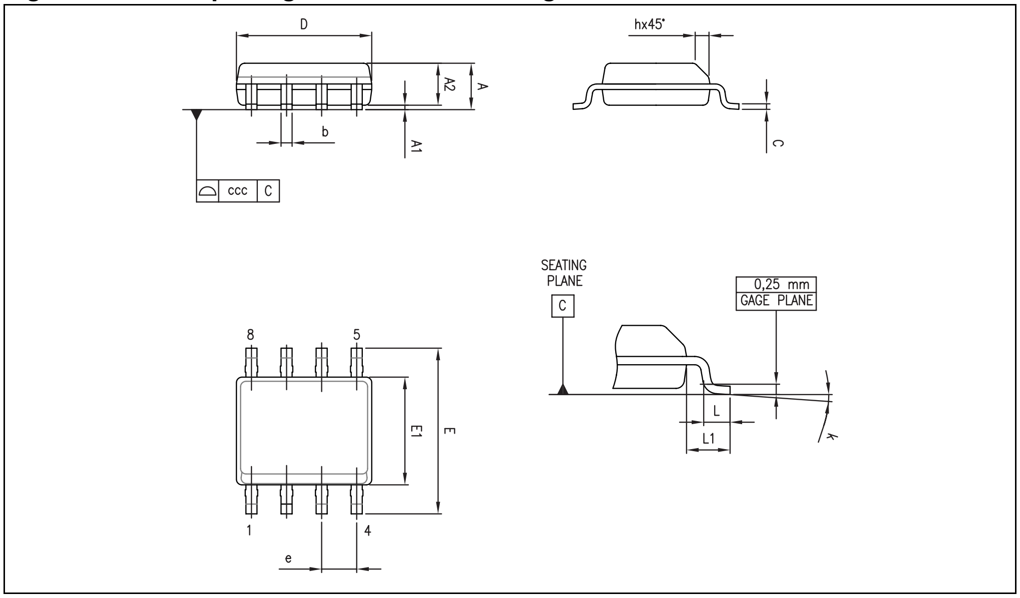

Table 6. SO-8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			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
c	0.17		0.23	0.007		0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	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
e		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

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3.2 TSSOP8 package information

Figure 25. TSSOP8 package mechanical drawing

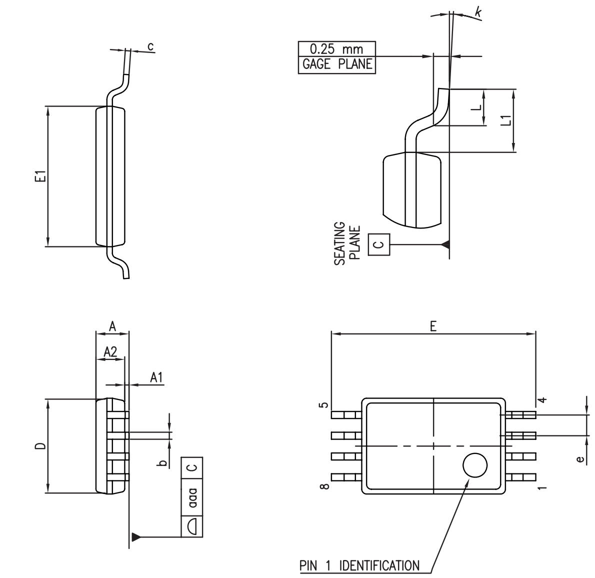

Table 7. TSSOP8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			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
c	0.09		0.20	0.004		0.008
D	2.90	3.00	3.10	0.114	0.118	0.122
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		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

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3.3 SO-14 package information

Figure 26. SO-14 package mechanical drawing

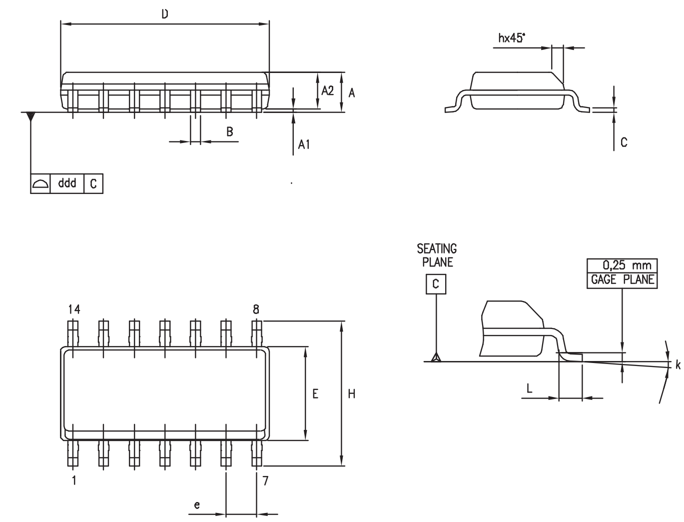

Table 8. SO-14 package mechanical data

Dimensions						
Ref.	**Millimeters**			**Inches**		
	Min.	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**
A	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
B	0.33		0.51	0.01		0.02
C	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
e		1.27			0.05	
H	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

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3.4 TSSOP14 package information

Figure 27. TSSOP14 package mechanical drawing

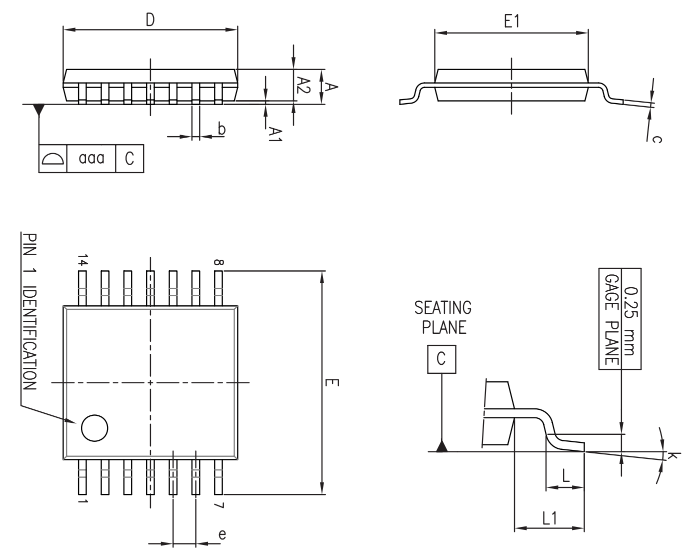

Table 9. TSSOP14 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			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
c	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
e		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

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3.5 SOT23-5 package information

Figure 28. SOT23-5L package mechanical drawing

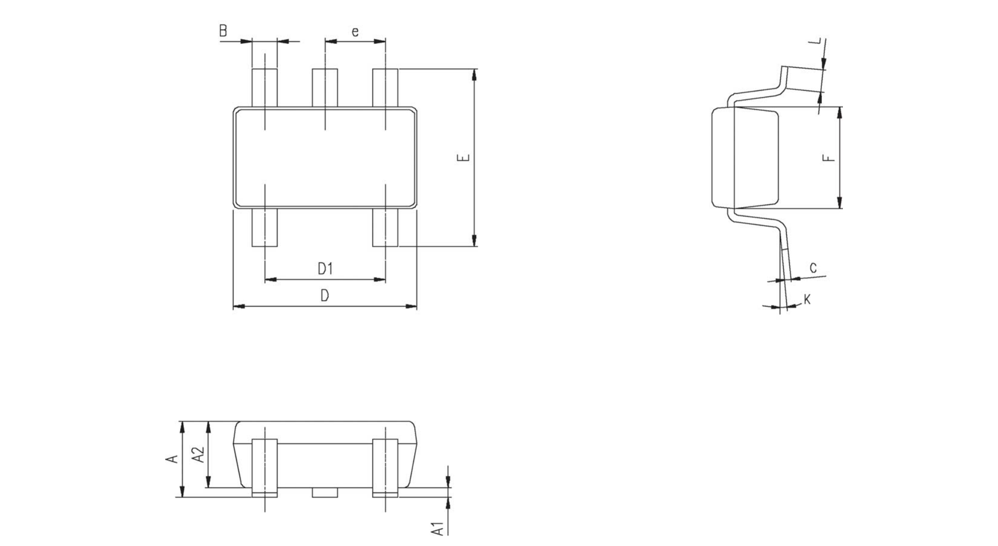

Table 10. SOT23-5L package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	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
B	0.35	0.40	0.50	0.013	0.015	0.019
C	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	
e		0.95			0.037	
E	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 degrees		10 degrees			

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4 Ordering information

Table 11. Order codes

Part number	Temperature range	Package	Packing	Marking
TS861ILT TS861AILT	-40°C, +85°C	SOT-23	Tape & reel	K501 K502
TS861ID TS861IDT		SO-8	Tube Tape & reel	861I
TS861AID TS861AIDT			Tube Tape & reel	861AI
TS861IYLT(1) TS861AIYLT(1)		SOT-23 (Automotive grade)	Tape & reel	K504 K505
TS862ID TS862IDT	-40°C, +85°C	SO-8	Tube Tape & reel	862I
TS862AID TS862AIDT			Tube Tape & reel	862AI
TS862IPT TS862AIPT		TSSOP8	Tape & reel	862I 862AI
TS862IYDT(1) TS862AIYDT(1)		SO-8 (Automotive grade)	Tape & reel	862IY 862AIY
TS864ID TS864IDT	-40°C, +85°C	SO-14	Tube Tape & reel	864I
TS864AID TS864AIDT			Tube Tape & reel	864AI
TS864IPT TS864AIPT		TSSOP14	Tape & reel	864I 864AI
TS864IYDT(1) TS864AIYDT(1)		SO-14 (Automotive grade)	Tape & reel	864IY 864AIY

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent are on-going.

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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 *Table 1: Absolute maximum ratings*. Added Rthja and Rthjc values and ESD notes in *Table 1*. Updated curves in *Figure 1* to *Figure 14*. Changed *Figure 15*, *Figure 16*, *Figure 17* and *Figure 18*. Added *Figure 19*, *Figure 20*, *Figure 21*, *Figure 22* and *Figure 23*. Removed DIP package information in *Chapter 3* and *Chapter 4*. Added ordering information in *Table 11: Order codes*.

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