# 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

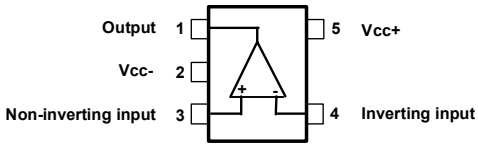
- Battery powered systems such as alarms
- Portable communication systems
- Smoke/gas/fire detectors
- Portable computers

## Description

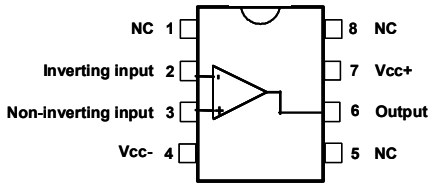
The TS86x device (single, dual and quad) is a rail-to-rail comparator characterized for 2.7 to 10 V operation over -40 °C to +85 °C temperature ranges. It exhibits an excellent speed-to-power ratio, featuring a current consumption of 6 µA per comparator and a response time of 500 ns at 2.7 V for a 100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

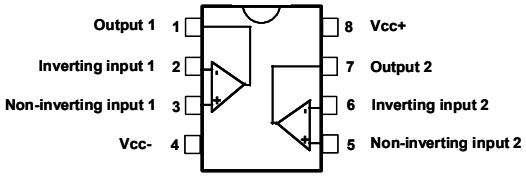
SOT23-5



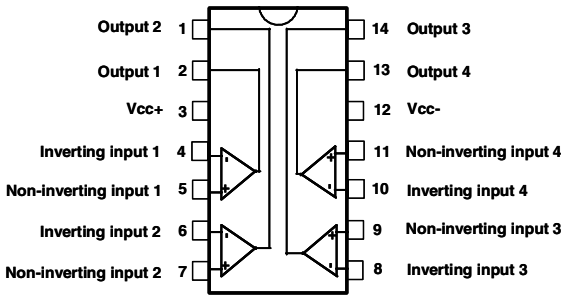

SO-8 (single)




SO-8, TSSOP8 (dual)




SO-14, TSSOP14 (quad)






This is information on a product in full production. www.st.com

# 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)<br>SOT23-5<br>SO-8<br>SO-14<br>TSSOP8<br>TSSOP14 | <br>250<br>125<br>105<br>120<br>100 | °C/W |
| $R_{THJC}$ | Thermal resistance junction-to-case(4)<br>SOT23-5<br>SO-8<br>SO-14<br>TSSOP8<br>TSSOP14 | <br>81<br>40<br>31<br>37<br>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)<br>Machine model (MM)(6) | 2<br>200 | kV<br>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 $V_{CC}$ +0.3 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 | 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 |

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

**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<br>f = 10 kHz, $C_L$ = 50 pF, overdrive = 100 mV | | 20 | | ns |
| $T_R$ | Rise time<br>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.*

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

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

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

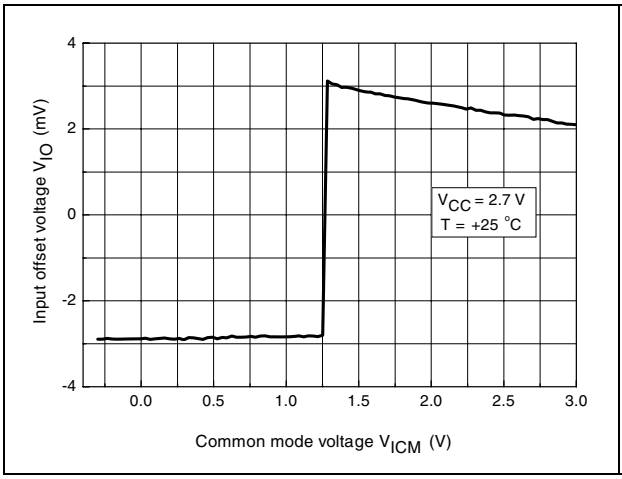



**Figure 2. $V_{IO}$ vs. $V_{ICM}$ and temperature at $V_{CC}$ = 2.7 V**

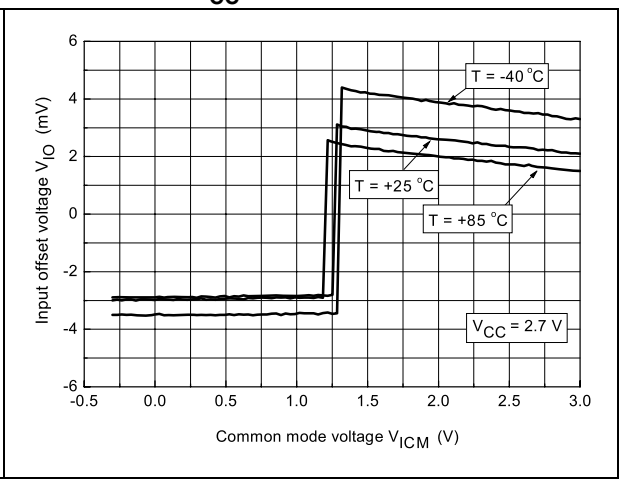



**Figure 3. $V_{IO}$ vs. $V_{ICM}$ at $V_{CC}$ = 5 V**

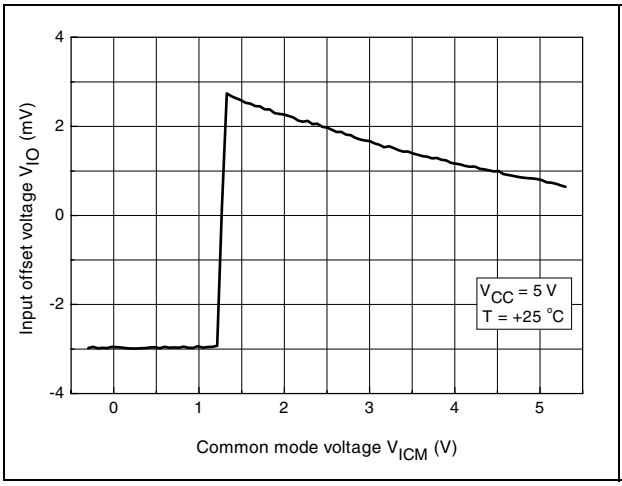



**Figure 4. $V_{IO}$ vs. $V_{ICM}$ and temperature at $V_{CC}$ = 5 V**

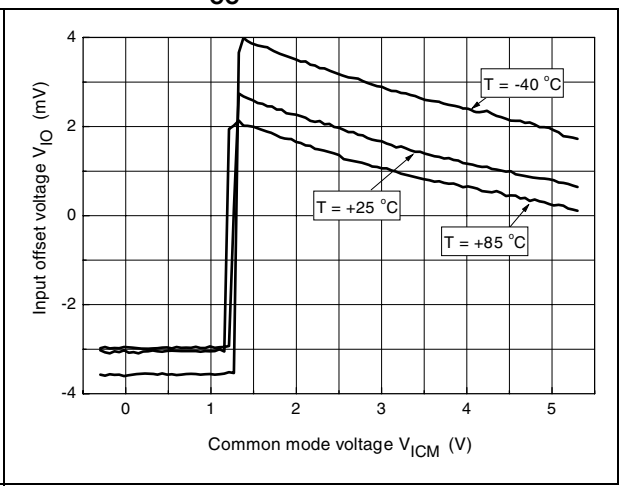



**Figure 5. $V_{IO}$ vs. $V_{ICM}$ at $V_{CC}$ = 10 V**

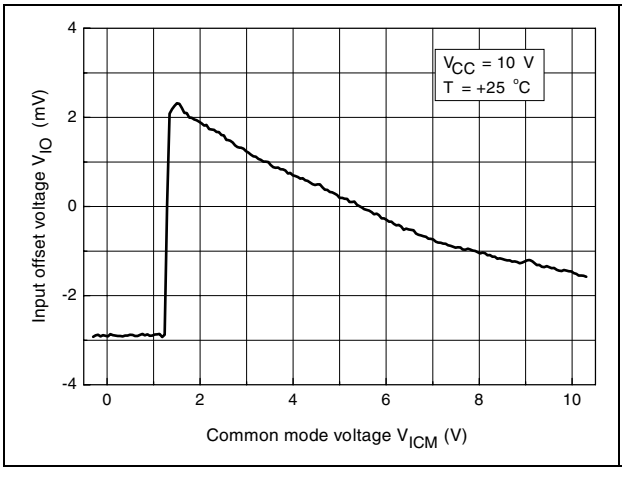



**Figure 6. $V_{IO}$ vs. $V_{ICM}$ and temperature at $V_{CC}$ = 10 V**

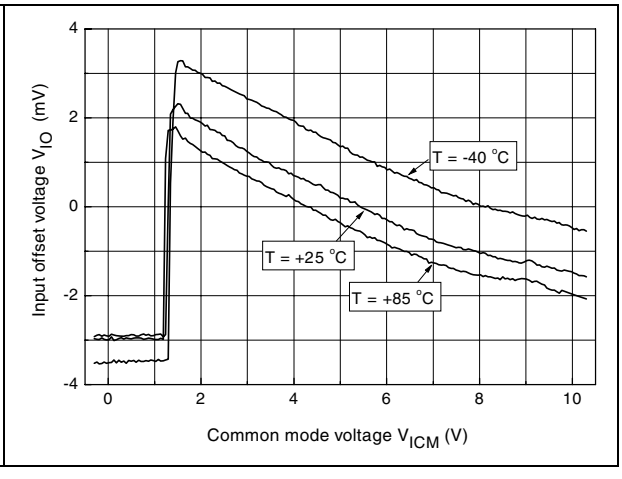


**Figure 7. $V_{IO}$ vs. $V_{CC}$ at $V_{ICM} = V_{CC}/2$**

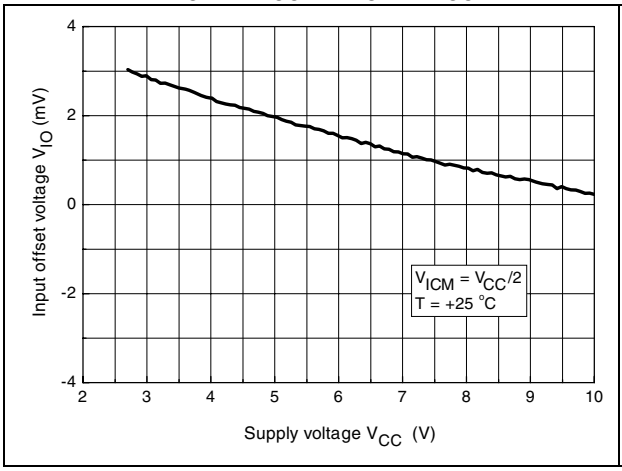



**Figure 8. $V_{IO}$ vs. temperature at $V_{CC}$ = 5 V**

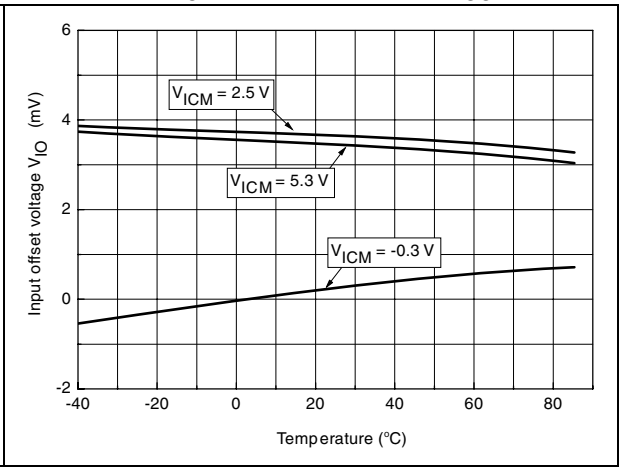



**Figure 9. Supply current ($I_{CC}$) vs. supply voltage ($V_{CC}$) ($V_{ID}$ = -1 V)**

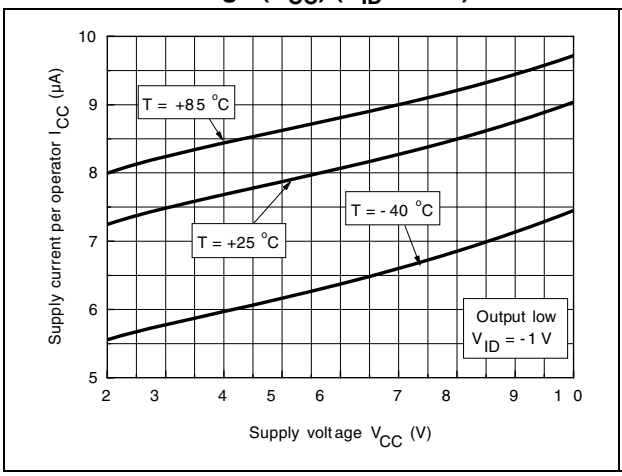



**Figure 10. Supply current ($I_{CC}$) vs. supply voltage ($V_{CC}$) ($V_{ID}$ = +1 V)**

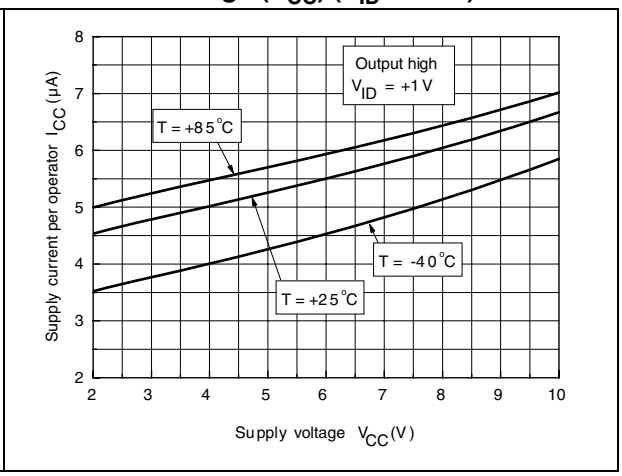



**Figure 11. Supply current ($I_{CC}$) vs. temperature ($V_{ID}$ = -1 V)**

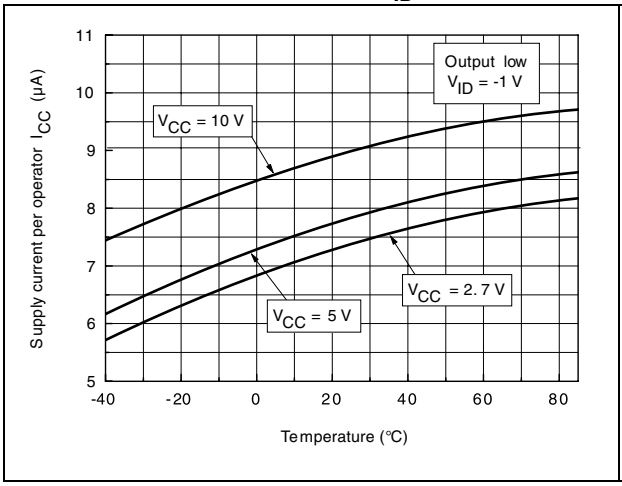



**Figure 12. Supply current ($I_{CC}$) vs. temperature ($V_{ID}$ = +1 V)**

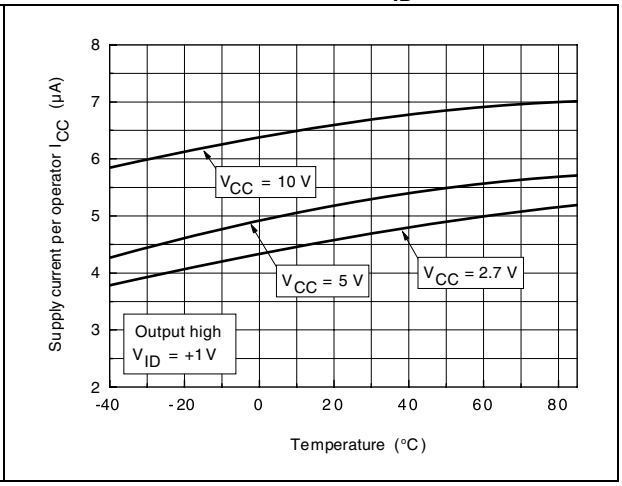


**Figure 13. $V_{OL}$ vs. $I_{SINK}$ and temperature at $V_{CC}$ = 5 V**

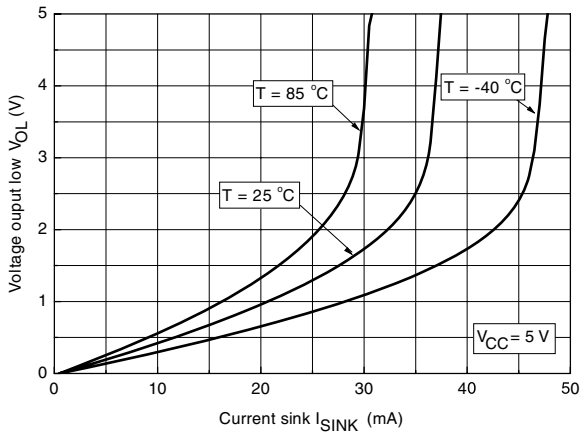



**Figure 14. $V_{OH}$ vs. $I_{SOURCE}$ and temperature at $V_{CC}$ = 5 V**

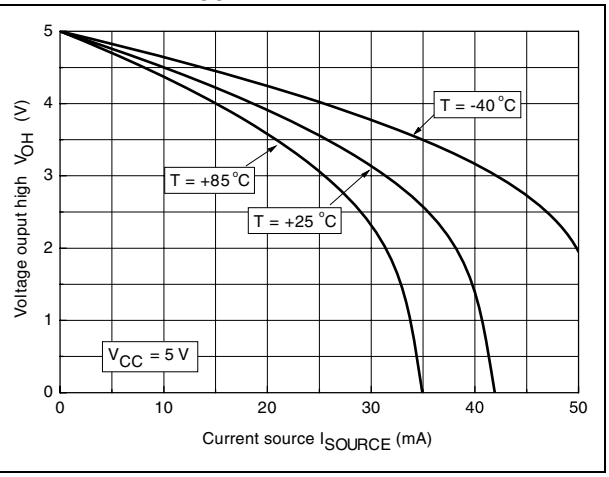



**Figure 15. Propagation delay $T_{PLH}$ vs. $V_{ICM}$ with $V_{OVD}$ = 100 mV**

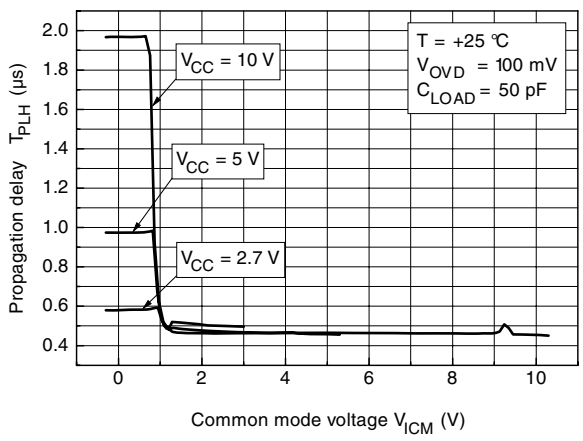



**Figure 16. Propagation delay $T_{PHL}$ vs. $V_{ICM}$ with $V_{OVD}$ = 100 mV**

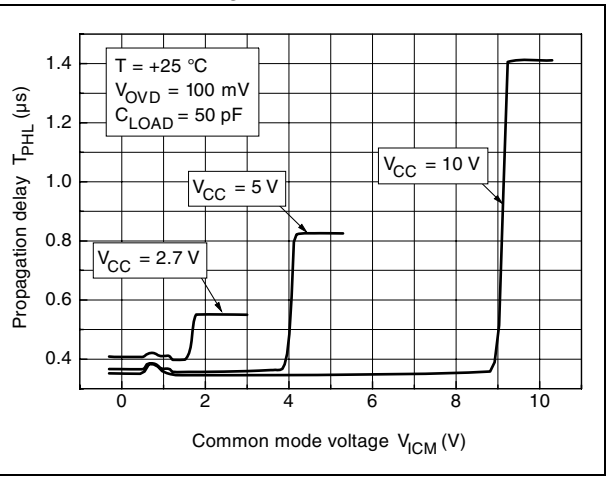



**Figure 17. Propagation delay $T_{PLH}$ vs. $V_{ICM}$ with $V_{OVD}$ = 10 mV**

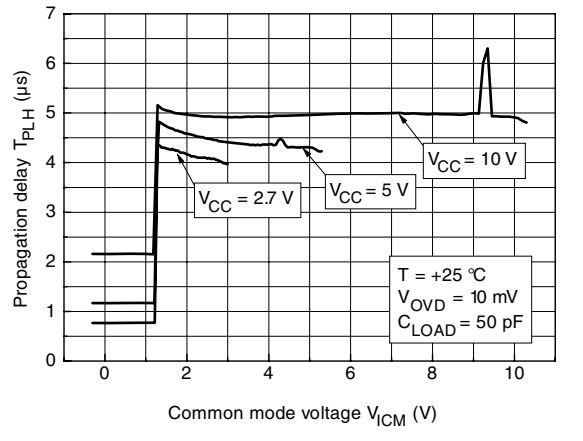



**Figure 18. Propagation delay $T_{PHL}$ vs. $V_{ICM}$ with $V_{OVD}$ = 10 mV**

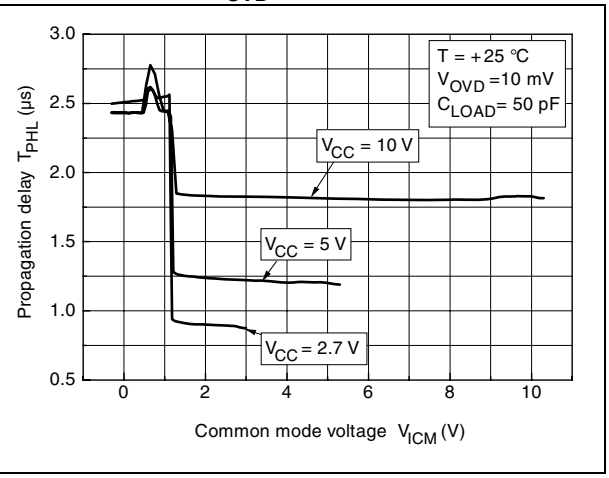


**Figure 19. Propagation delay vs. $V_{CC}$ with $V_{OVD}$ = 10 mV**

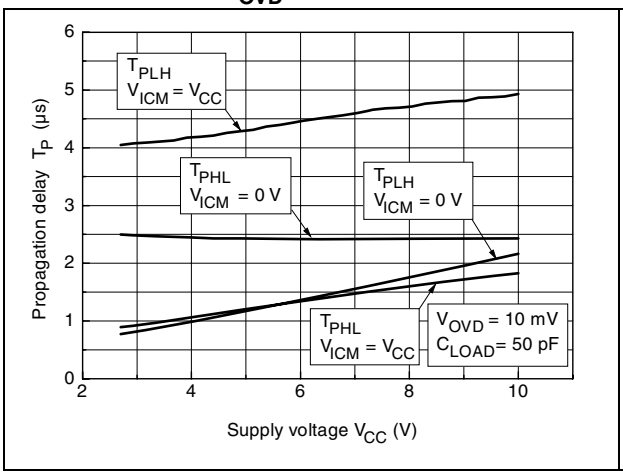



**Figure 20. Propagation delay vs. $V_{CC}$ with $V_{OVD}$ = 100 mV**

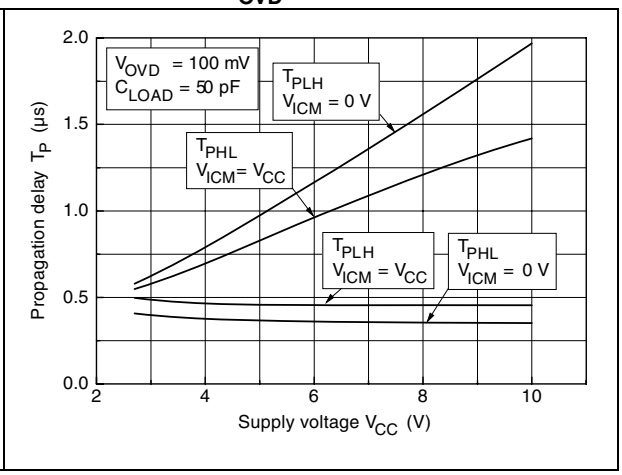



**Figure 21. Propagation delay vs. overdrive voltage at $V_{CC}$ = 2.7 V**

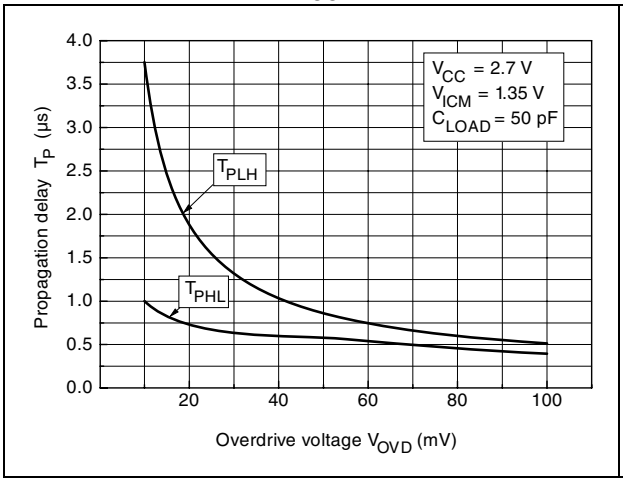



**Figure 22. Propagation delay vs. overdrive voltage at $V_{CC}$ = 5 V**

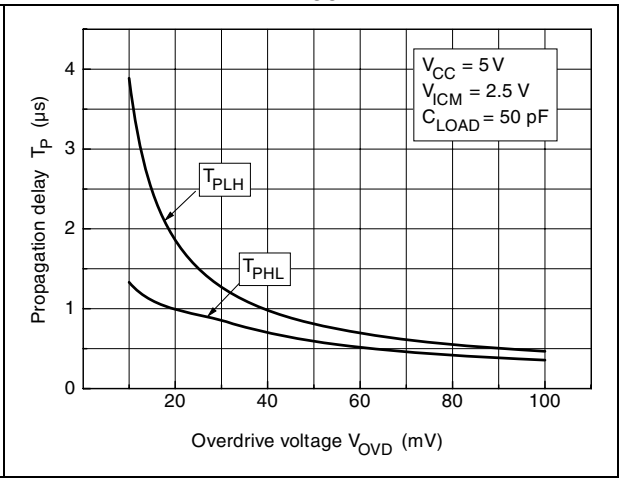
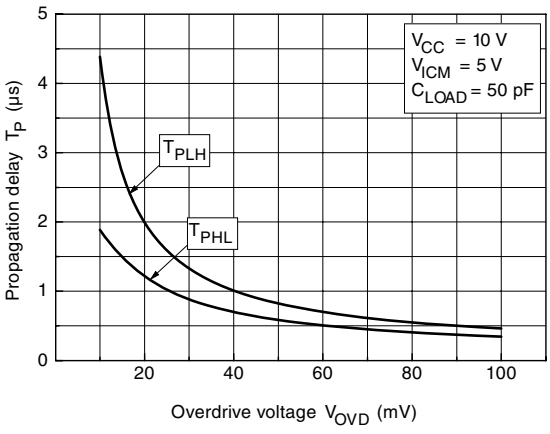



**Figure 23. Propagation delay vs. overdrive voltage at $V_{CC}$ = 10 V**



# 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**

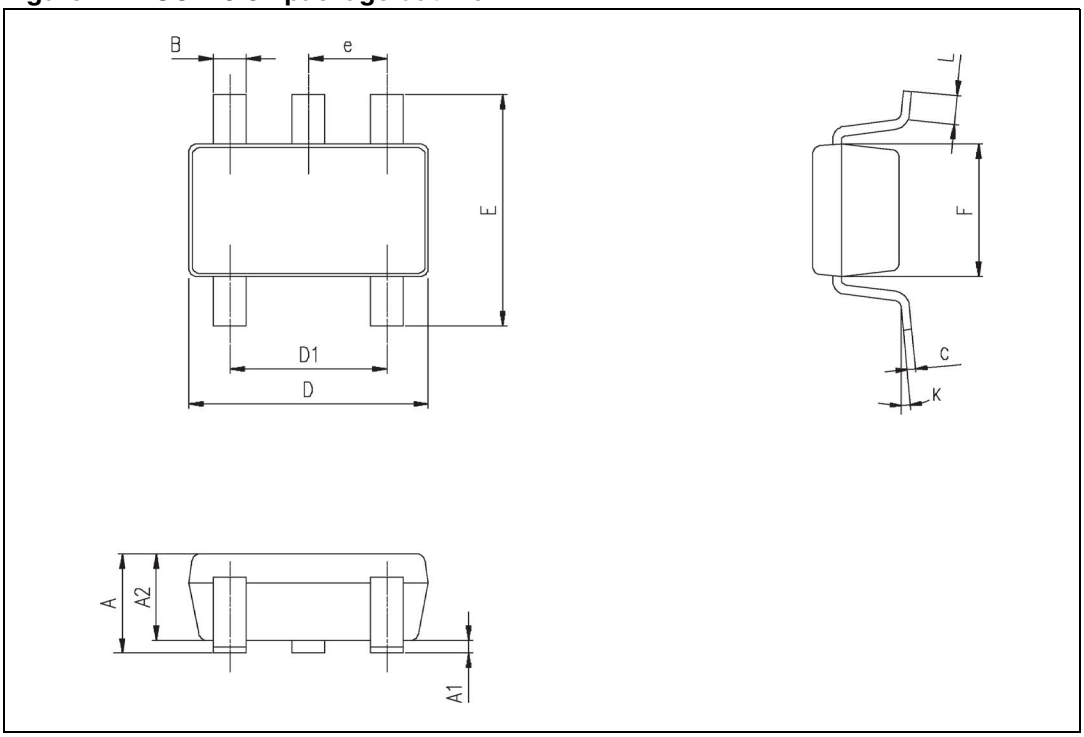



**Table 6. SOT23-5L package mechanical data**

| Symbol | 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° | | 10° | | | |

## 3.2 SO-8 package information

**Figure 25. SO-8 package outline**

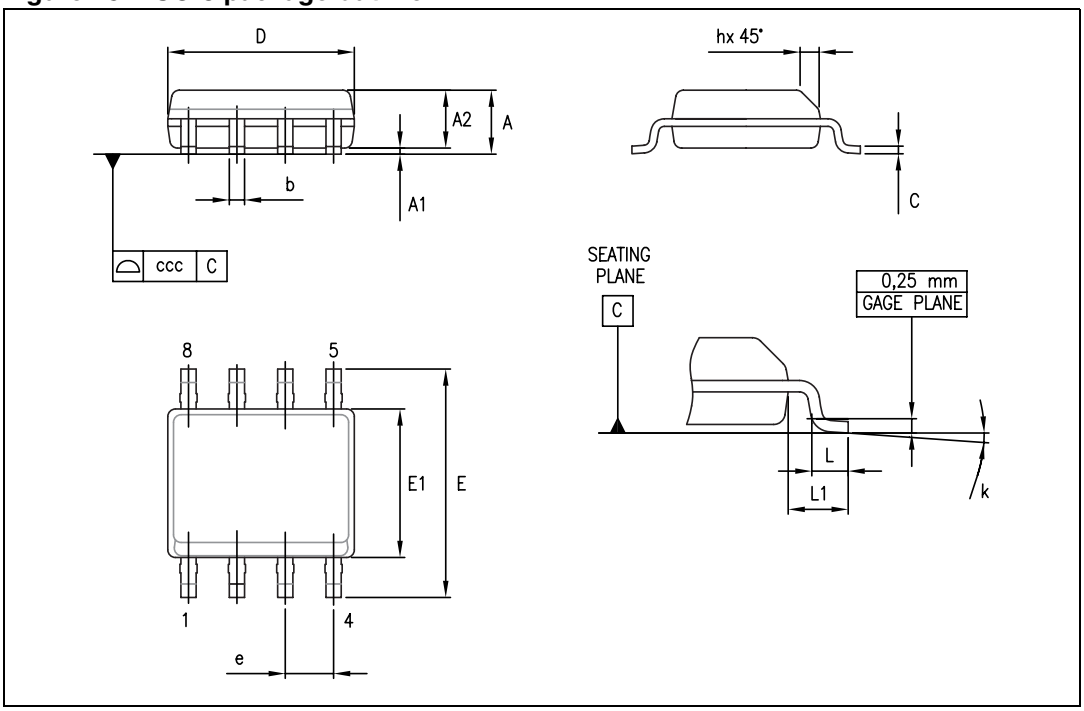



**Table 7. SO-8 package mechanical data**

| Symbol | 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 |

## 3.3 SO-14 package information

**Figure 26. SO-14 package outline**

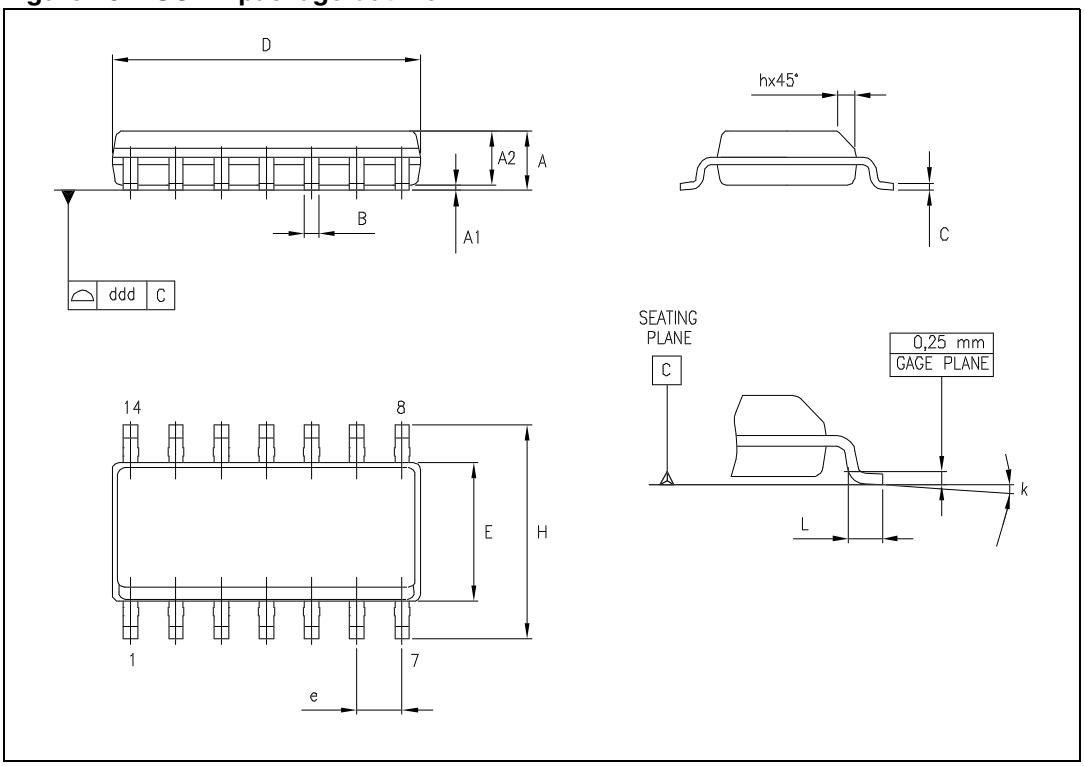



**Table 8. SO-14 package mechanical data**

| Symbol | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | 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 |

## 3.4 TSSOP8 package information

**Figure 27. TSSOP8 package outline**

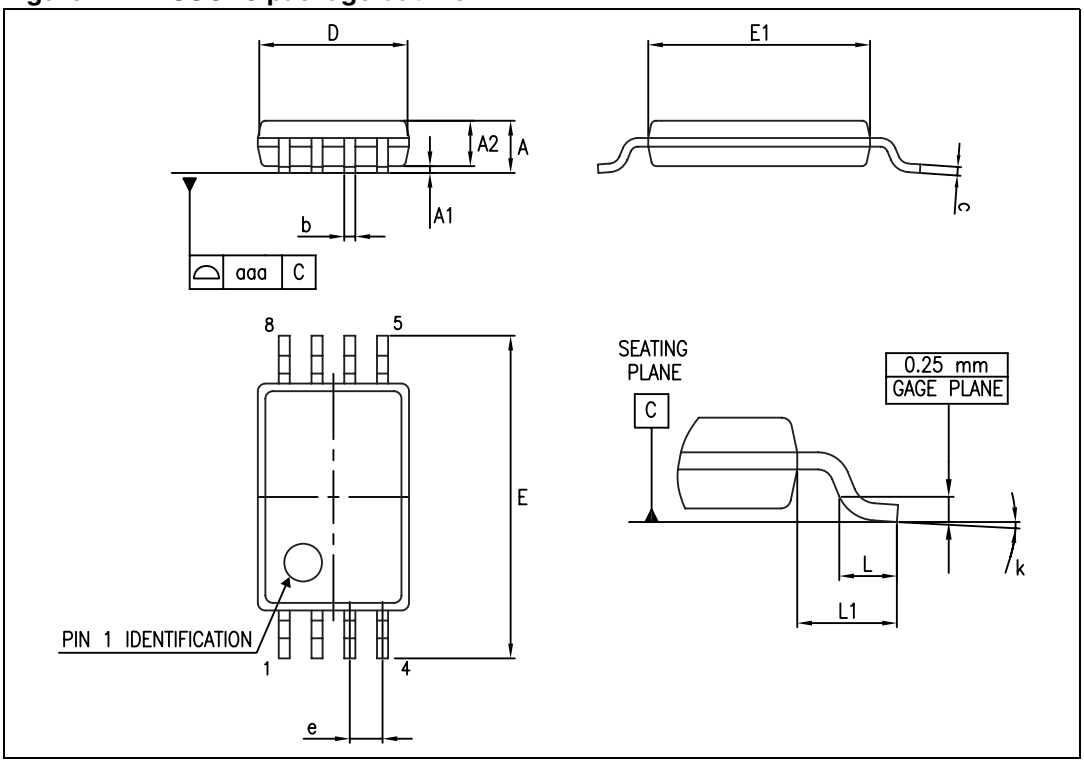



**Table 9. TSSOP8 package mechanical data**

| Symbol | 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 |

## 3.5 TSSOP14 package information

**Figure 28. TSSOP14 package outline**

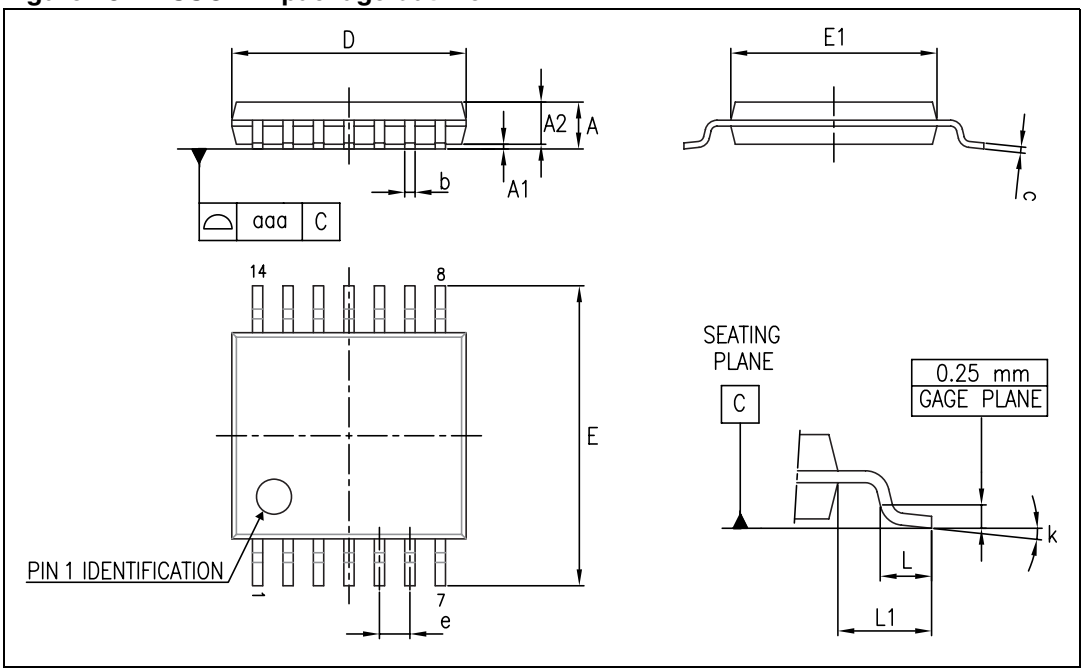



**Table 10. TSSOP14 package mechanical data**

| Symbol | 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 |

# 4 Ordering information

**Table 11. Order codes**

| Part number | Temperature range | Package | Packaging | Marking |
|---|---|---|---|---|
| TS861ILT<br>TS861AILT | -40 °C, +85 °C | SOT-23 | Tape and reel | K501<br>K502 |
| TS861ID<br>TS861IDT | | SO-8 | Tube<br>Tape and reel | 861I |
| TS861AID<br>TS861AIDT | | | Tube<br>Tape and reel | 861AI |
| TS862ID<br>TS862IDT | -40 °C, +85 °C | SO-8 | Tube<br>Tape and reel | 862I |
| TS862AID<br>TS862AIDT | | | Tube<br>Tape and reel | 862AI |
| TS862IPT<br>TS862AIPT | | TSSOP8 | Tape and reel | 862I<br>862AI |
| TS864ID<br>TS864IDT | -40 °C, +85 °C | SO-14 | Tube<br>Tape and reel | 864I |
| TS864AID<br>TS864AIDT | | | Tube<br>Tape and reel | 864AI |
| TS864IPT<br>TS864AIPT | | TSSOP14 | Tape and reel | 864I<br>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.<br>Removed power dissipation from *Table 1: Absolute maximum ratings*.<br>Added Rthja and Rthjc values and ESD notes in *Table 1*.<br>Updated curves in *Figure 1* to *Figure 14*.<br>Changed *Figure 15*, *Figure 16*, *Figure 17* and *Figure 18*.<br>Added *Figure 19*, *Figure 20*, *Figure 21*, *Figure 22* and *Figure 23*.<br>Removed DIP package information in *Chapter 3* and *Chapter 4*.<br>Added ordering information in *Table 11: Order codes*. |
| 06-Nov-2012 | 3 | Updated titles of *Figure 9* to *Figure 12* (added conditions).<br>Removed TS861IYLT, TS861AIYLT, TS862IYDT, TS862AIYDT, TS864IYDT, and TS864AIYDT order codes from *Table 11*.<br>Minor corrections throughout document. |

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