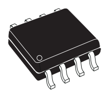
TS3022

Rail-to-rail 1.8 V high-speed dual comparator

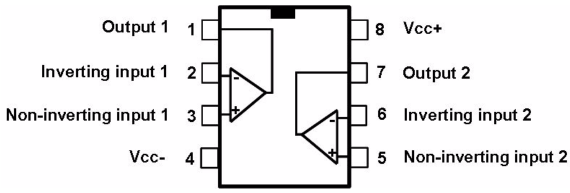
Features

- Propagation delay: 38 ns
- Low current consumption: 73 µA/Comp
- Rail-to-rail inputs
- Push-pull outputs
- Supply operation from 1.8 to 5 V
- Wide temperature range: -40° C to +125° C
- ESD tolerance: 5 kV HBM / 300 V MM
- Latch-up immunity: 200 mA
- SMD packages

TS3022
SO-8/MiniSO-8



Pin connections (top view)



Applications

- Telecommunications
- Instrumentation
- Signal conditioning
- High-speed sampling systems
- Portable communication systems

Description

The TS3022 dual comparator features a high-speed response time with rail-to-rail inputs. With a supply voltage specified from 2 to 5 V, this comparator can operate over a wide temperature range: -40° C to +125° C.

The TS3022 comparator offers micropower consumption as low as a few tens of microamperes thus providing an excellent ratio of power consumption current versus response time.

The TS3022 includes push-pull outputs and is available in small packages (SMD): SO-8 and MiniSO-8.

1 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage[(1)]	5.5	V
V_{ID}	Differential input voltage[(2)]	±5	V
V_{IN}	Input voltage range	$(V_{CC}-)$ - 0.3 to $(V_{CC}+)$ + 0.3	V
R_{THJA}	Thermal resistance junction to ambient[(3)] SO-8 MiniSO-8	 125 190	°C/W
R_{THJC}	Thermal resistance junction to case [(3)] SO-8 MiniSO-8	 40 39	°C/W
T_{STG}	Storage temperature	-65 to +150	°C
T_J	Junction temperature	150	°C
T_{LEAD}	Lead temperature (soldering 10 seconds)	260	°C
ESD	Human body model (HBM)[(4)]	5000	V
	Machine model (MM)[(5)]	300	
	Charged device model (CDM)[(6)]	1500	
	Latch-up immunity	200	mA

1. All voltage values, except differential voltage, are referenced to $V_{CC}-$. V_{CC} is defined as the difference between $V_{CC}+$ and $V_{CC}-$.
2. The magnitude of input and output voltages must never exceed the supply rail ±0.3V.
3. Short-circuits can cause excessive heating. These values are typical.
4. 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.
5. 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.
6. 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 2. Operating conditions

Symbol	Parameter	Value	Unit
T_{oper}	Operating temperature range	-40 to +125	°C
V_{CC}	Supply voltage 0° C < T_{amb} < +125° C -40° C < T_{amb} < +125° C	 1.8 to 5 2 to 5	V
V_{ICM}	Common mode input voltage range -40° C < T_{amb} < +85° C +85° C < T_{amb} < +125° C	 $(V_{CC}-)$-0.2 to $(V_{CC}+)$+0.2 $V_{CC}-$ to $V_{CC}+$	V

2 Electrical characteristics

Table 3. V_{CC} += 2 V, V_{CC} - = 0 V, T_{amb} = +25° C, full V_{ICM} range (unless otherwise specified)(1)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IO}	Input offset voltage	 -40° C < T_{amb} < +125° C	-	0.5	6 7	mV
ΔV_{IO}	Input offset voltage drift	-40° C < T_{amb} < +125° C	-	3	20	µV/°C
I_{IO}	Input offset current(2)	 -40° C < T_{amb} < +125° C	-	1	20 100	nA
I_{IB}	Input bias current(2)	 -40° C < T_{amb} < +125° C	-	86	160 300	nA
I_{CC}	Supply current/comp.	No load, output high, V_{ICM} = 0 V -40° C < T_{amb} < +125° C No load, output low, V_{ICM} = 0 V -40° C < T_{amb} < +125° C	-	73 84	90 115 105 125	µA
I_{SC}	Short-circuit current	Source Sink	-	9 10	-	mA
V_{OH}	Output voltage high	I_{Source} = 1 mA -40° C < T_{amb} < +125° C	1.88 1.80	1.92	-	V
V_{OL}	Output voltage low	I_{Sink} = 1 mA -40° C < T_{amb} < +125° C	-	60	100 150	mV
CMRR	Common mode rejection ratio	0 < V_{ICM} < 2 V	-	67	-	dB
SVR	Supply voltage rejection	ΔV_{CC} = 2 to 5 V	58	73	-	dB
TP_{LH}	Propagation delay(3) Low to high output level	V_{ICM} = 0 V, f = 10 kHz, C_L = 50 pF, Overdrive = 100 mV Overdrive = 20 mV	-	 38 48	 60 75	ns
TP_{HL}	Propagation delay(4) High to low output level	V_{ICM} = 0 V, f = 10 kHz, C_L = 50 pF, Overdrive = 100 mV Overdrive = 20 mV	-	 40 49	 60 75	ns
T_F	Fall time	f = 10 kHz, C_L = 50 pF, R_L = 10 kΩ, Overdrive = 100 mV	-	8	-	ns
T_R	Rise time	f = 10 kHz, C_L = 50 pF, R_L = 10 kΩ, Overdrive = 100 mV	-	9	-	ns

1. All values over the temperature range are guaranteed through correlation and simulation. No production test is performed at the temperature range limits.
2. Maximum values include unavoidable inaccuracies of the industrial tests.
3. Response time is measured at 50% of final output value with following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input voltage (IN+) moving from V_{ICM} - 100 mV to V_{ICM} + overdrive.
4. Response time is measured at 50% of final output value with following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input voltage (IN+) moving from V_{ICM} + 100 mV to V_{ICM} - overdrive.

Table 4. V_{CC} += 3.3 V, V_{CC} - = 0 V, T_{amb} = +25° C, full V_{ICM} range (unless otherwise specified)(1)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IO}	Input offset voltage	 -40° C < T_{amb} < +125° C	-	0.2	6 7	mV
ΔV_{IO}	Input offset voltage drift	-40° C < T_{amb} < +125° C	-	3	20	µV/°C
I_{IO}	Input offset current(2)	 -40° C < T_{amb} < +125° C	-	1	20 100	nA
I_{IB}	Input bias current(2)	 -40° C < T_{amb} < +125° C	-	86	160 300	nA
I_{CC}	Supply current / Comp.	No load, output high, V_{ICM} = 0 V -40° C < T_{amb} < +125° C No load, output low, V_{ICM} = 0 V -40° C < T_{amb} < +125° C	-	75 86	90 120 110 125	µA
I_{SC}	Short circuit current	Source Sink	-	26 24	-	mA
V_{OH}	Output voltage high	I_{Source} = 1 mA -40° C < T_{amb} < +125° C	3.20 3.10	3.25	-	V
V_{OL}	Output voltage low	I_{Sink} = 1 mA -40° C < T_{amb} < +125° C	-	40	80 150	mV
CMRR	Common mode rejection ratio	0 < V_{ICM} < 3.3 V	-	75	-	dB
SVR	Supply voltage rejection	ΔV_{CC} = 2 to 5 V	58	73	-	dB
TP_{LH}	Propagation delay (3) Low to high output level	V_{ICM} = 0 V, f = 10 kHz, C_L = 50 pF, Overdrive = 100 mV Overdrive = 20 mV	-	39 50	65 85	ns
TP_{HL}	Propagation delay(4) High to low output level	V_{ICM} = 0 V, f = 10 kHz, C_L = 50 pF, Overdrive = 100 mV Overdrive = 20 mV	-	41 51	65 80	ns
T_F	Fall time	f = 10 kHz, C_L = 50 pF, R_L = 10 kΩ, Overdrive = 100 mV	-	5	-	ns
T_R	Rise time	f = 10 kHz, C_L = 50 pF, R_L = 10 kΩ, Overdrive = 100 mV	-	7	-	ns

1. All values over the temperature range are guaranteed through correlation and simulation. No production test is performed at the temperature range limits.
2. Maximum values include unavoidable inaccuracies of the industrial tests.
3. Response time is measured at 50% of final output value with following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input voltage (IN+) moving from V_{ICM} - 100 mV to V_{ICM} + overdrive.
4. Response time is measured at 50% of final output value with following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input voltage (IN+) moving from V_{ICM} + 100 mV to V_{ICM} - overdrive.

Table 5. V_{CC} += 5 V, V_{CC} - = 0 V, T_{amb} = +25° C, full V_{ICM} range (unless otherwise specified)(1)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IO}	Input offset voltage	 -40° C < T_{amb} < +125° C	-	0.2	6 7	mV
ΔV_{IO}	Input offset voltage drift	-40° C < T_{amb} < +125° C	-	3	20	µV/°C
I_{IO}	Input offset current(2)	 -40° C < T_{amb} < +125° C	-	1	20 100	nA
I_{IB}	Input bias current(2)	 -40° C < T_{amb} < +125° C	-	86	160 300	nA
I_{CC}	Supply current / Comp.	No load, output high, V_{ICM} = 0 V -40° C < T_{amb} < +125° C No load, output low, V_{ICM} = 0 V -40° C < T_{amb} < +125° C	-	77 89	95 125 115 135	µA
I_{SC}	Short circuit current	Source Sink		51 40	-	mA
V_{OH}	Output voltage high	I_{Source} = 4 mA -40° C < T_{amb} < +125° C	4.80 4.70	4.84	-	V
V_{OL}	Output voltage low	I_{Sink} = 4 mA -40° C < T_{amb} < +125° C	-	130	180 250	mV
CMRR	Common mode rejection ratio	0 < V_{ICM} < 5 V	-	79	-	dB
SVR	Supply voltage rejection	ΔV_{CC} = 2 to 5 V	58	73	-	dB
TP_{LH}	Propagation delay (3) Low to high output level	V_{ICM} = 0 V, f = 10 kHz, C_L = 50 pF, Overdrive = 100 mV Overdrive = 20 mV	-	42 54	75 105	ns
TP_{HL}	Propagation delay(4) High to low output level	V_{ICM} = 0 V, f = 10 kHz, C_L = 50 pF, Overdrive = 100 mV Overdrive = 20 mV	-	45 55	75 95	ns
T_F	Fall time	f = 10 kHz, C_L = 50 pF, R_L = 10 kΩ, Overdrive = 100 mV	-	4	-	ns
T_R	Rise time	f = 10 kHz, C_L = 50 pF, R_L = 10 kΩ, Overdrive = 100 mV	-	4	-	ns

1. All values over the temperature range are guaranteed through correlation and simulation. No production test is performed at the temperature range limits.
2. Maximum values include unavoidable inaccuracies of the industrial tests.
3. Response time is measured at 50% of final output value with following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input voltage (IN+) moving from V_{ICM} - 100 mV to V_{ICM} + overdrive.
4. Response time is measured at 50% of final output value with following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input voltage (IN+) moving from V_{ICM} + 100 mV to V_{ICM} - overdrive.

Figure 1. Current consumption /comp. vs. power supply voltage

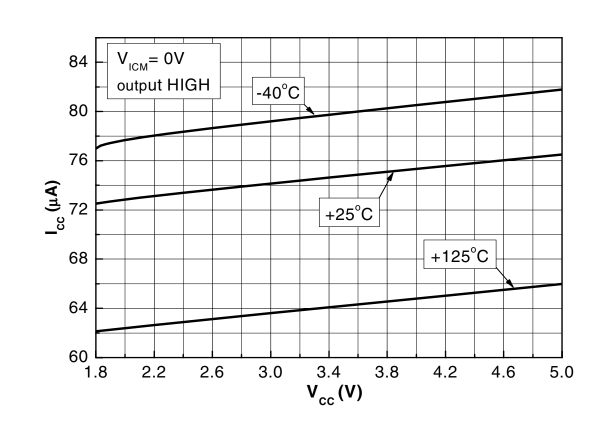


Figure 2. Current consumption /comp. vs. power supply voltage

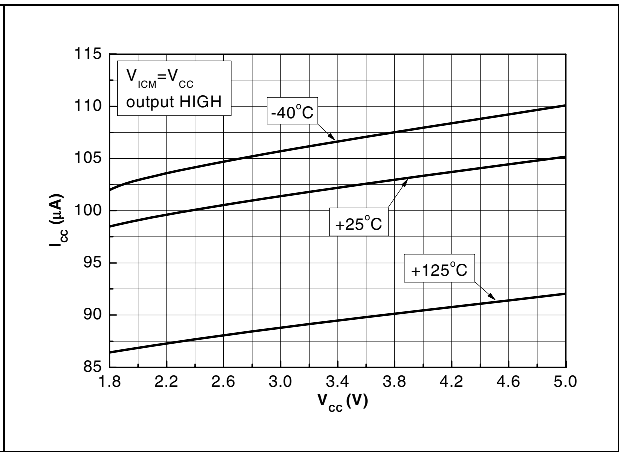


Figure 3. Current consumption /comp. vs. power supply voltage

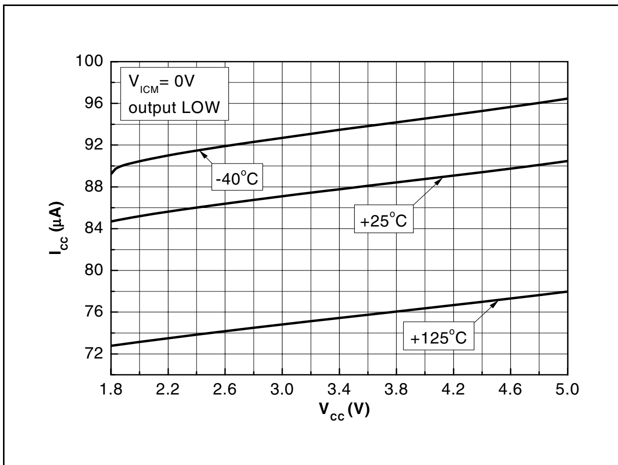


Figure 4. Current consumption /comp. vs. power supply voltage

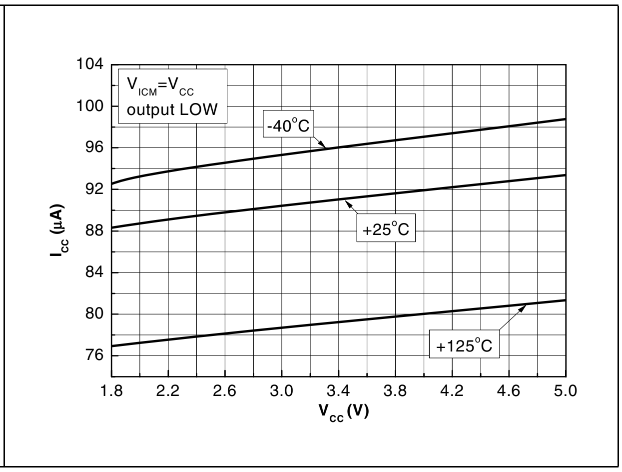


Figure 5. Output voltage vs. source current V_{CC} = 2 V

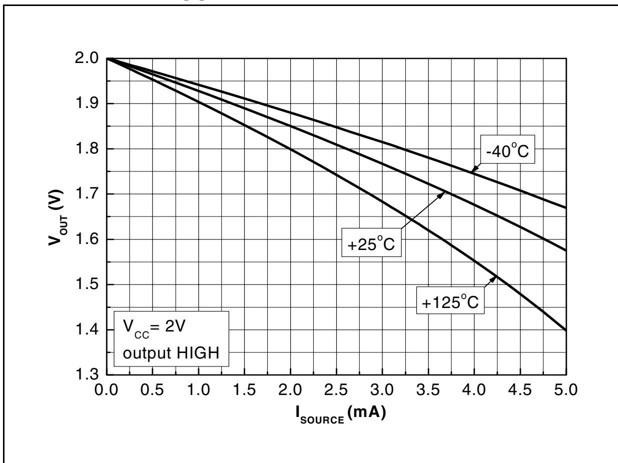


Figure 6. Output voltage vs. sink current V_{CC} = 2 V

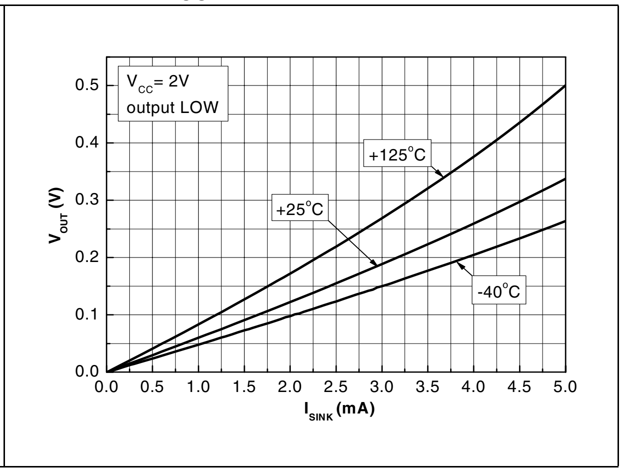


Figure 7. Output voltage vs. source current V_{CC} = 3.3 V

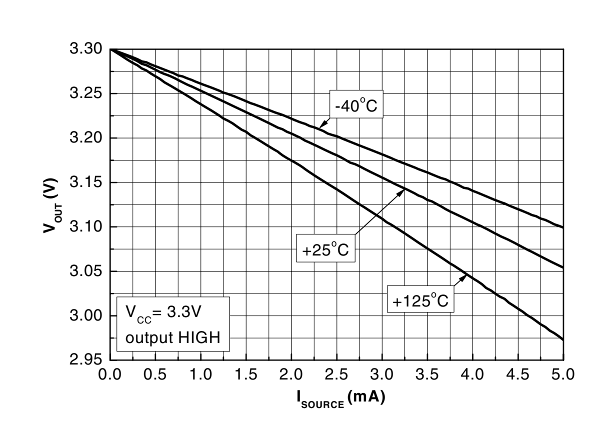


Figure 8. Output voltage vs. sink current V_{CC} = 3.3 V

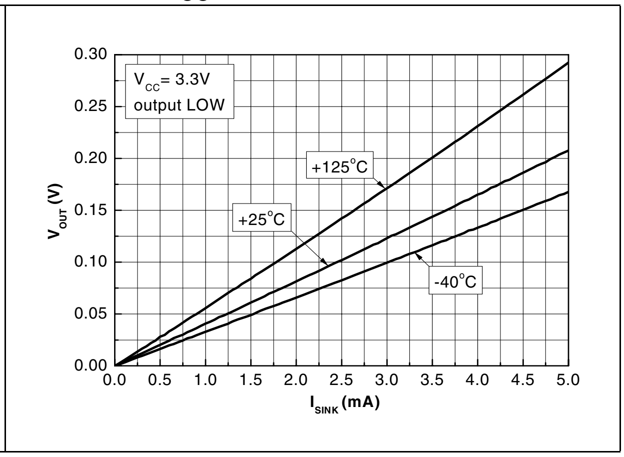


Figure 9. Output Voltage vs. source current V_{CC} = 5 V

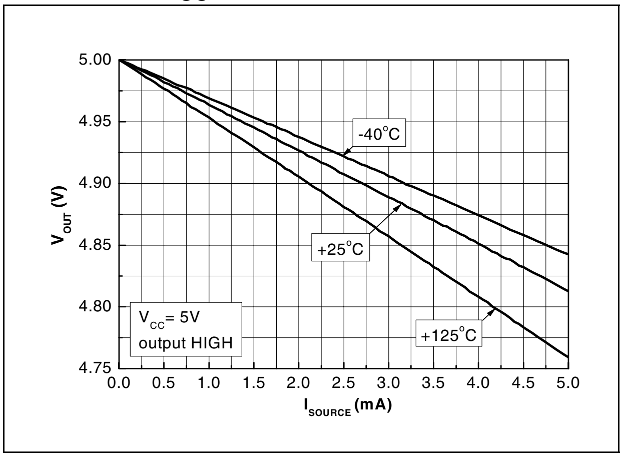


Figure 10. Output voltage vs. sink current V_{CC} = 5 V

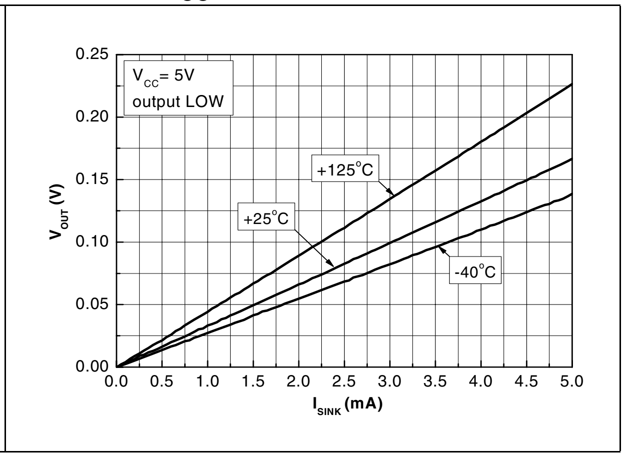


Figure 11. Input offset voltage vs. temperature and common mode voltage

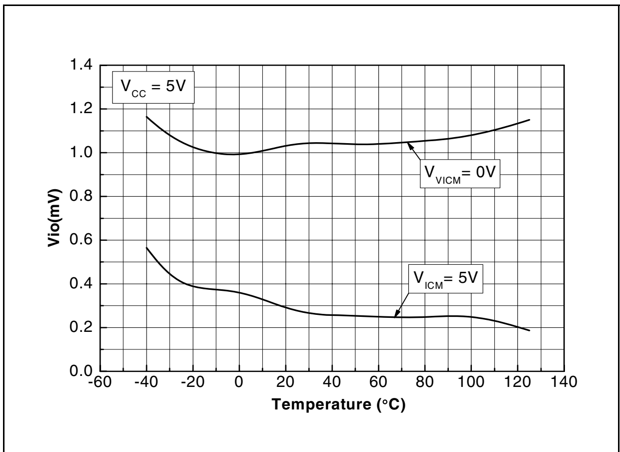


Figure 12. Input bias current vs. input voltage and temperature

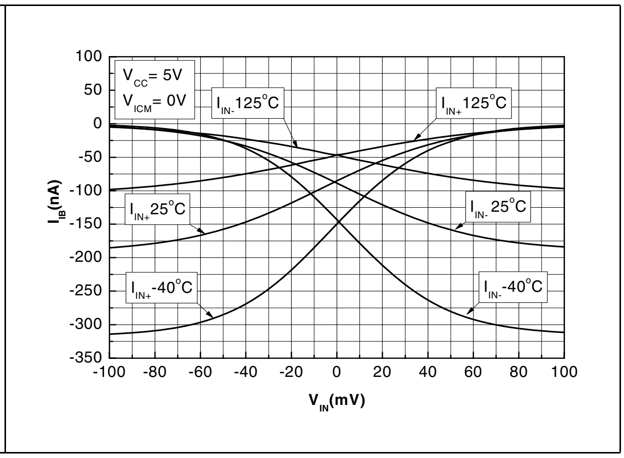


Figure 13. Current consumption vs. commutation frequency

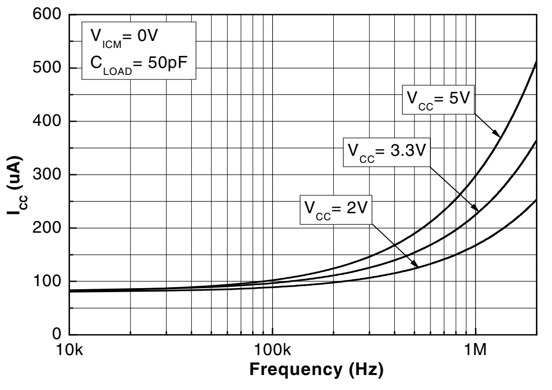


Figure 14. Propagation delay vs. overdrive $V_{CC} = 2\ V$

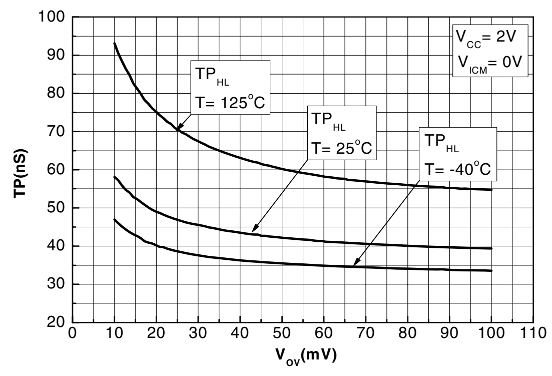


Figure 15. Propagation delay vs. overdrive $V_{CC} = 2\ V$

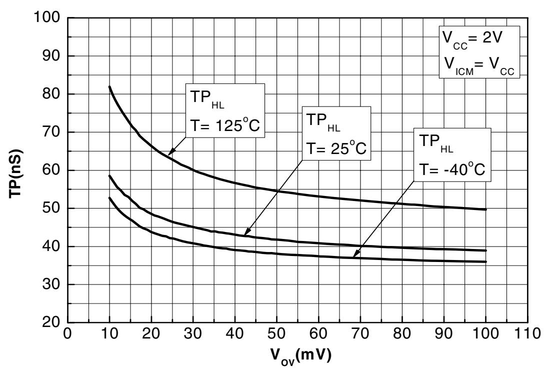


Figure 16. Propagation delay vs. overdrive $V_{CC} = 2\ V$

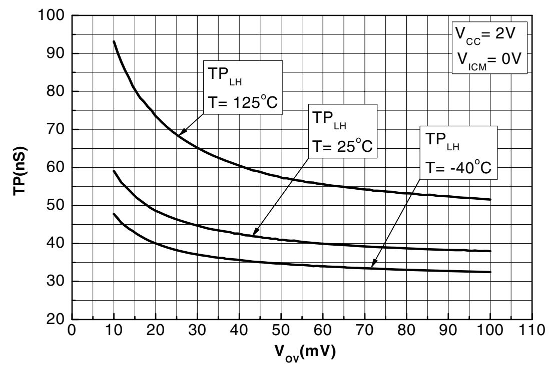


Figure 17. Propagation delay vs. overdrive $V_{CC} = 2\ V$

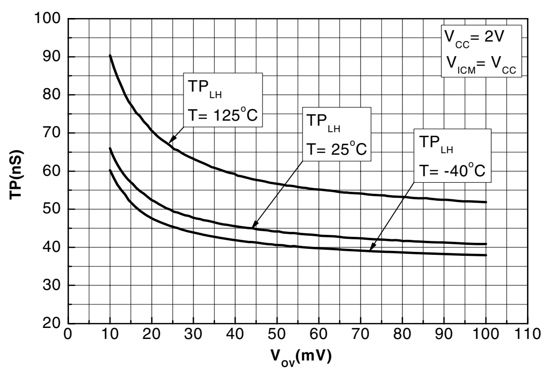


Figure 18. Propagation delay vs. overdrive $V_{CC} = 3.3\ V$

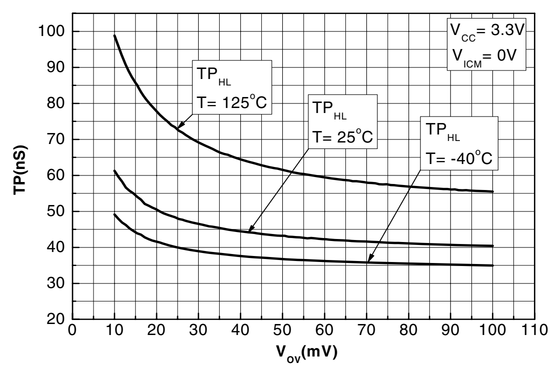


Figure 19. Propagation delay vs. overdrive V_{CC} = 3.3 V

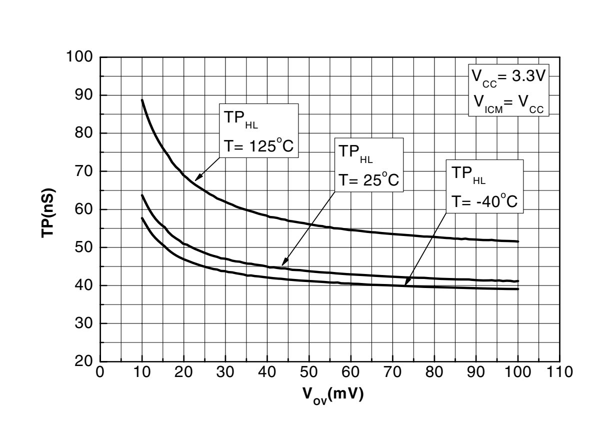


Figure 20. Propagation delay vs. overdrive V_{CC} = 3.3 V

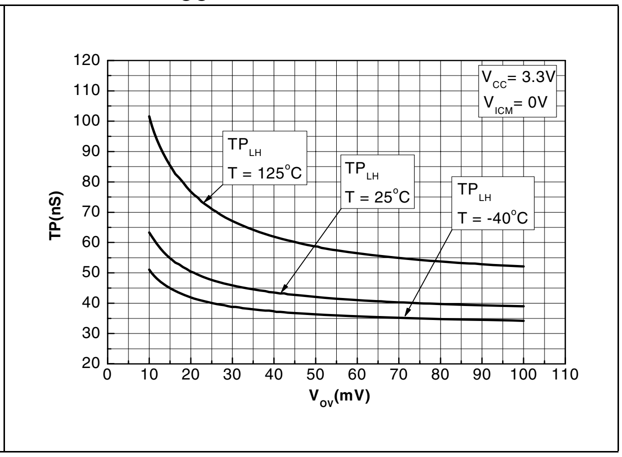


Figure 21. Propagation delay vs. overdrive V_{CC} = 3.3 V

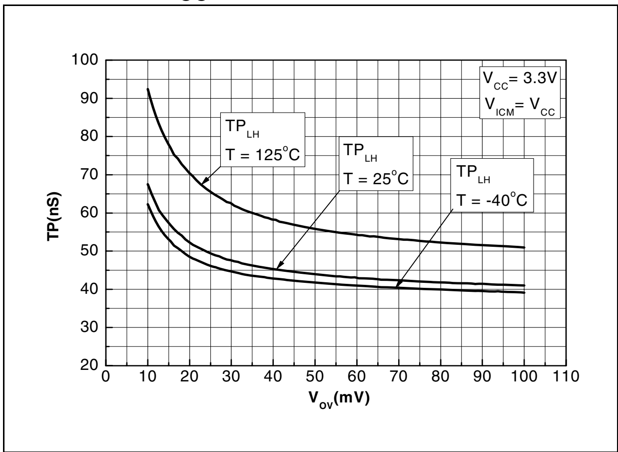


Figure 22. Propagation delay vs. overdrive V_{CC} = 5 V

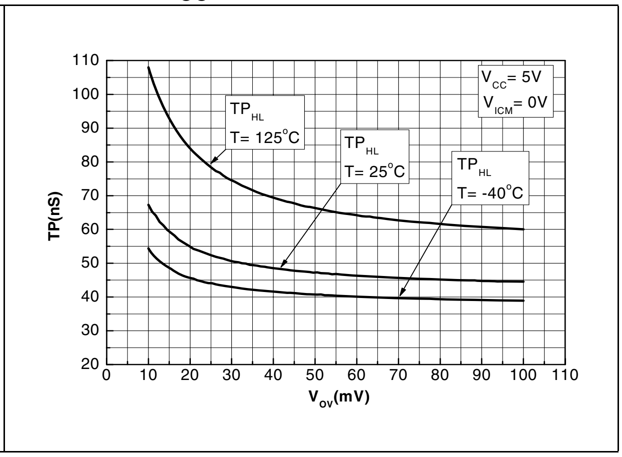


Figure 23. Propagation delay vs. overdrive V_{CC} = 5 V

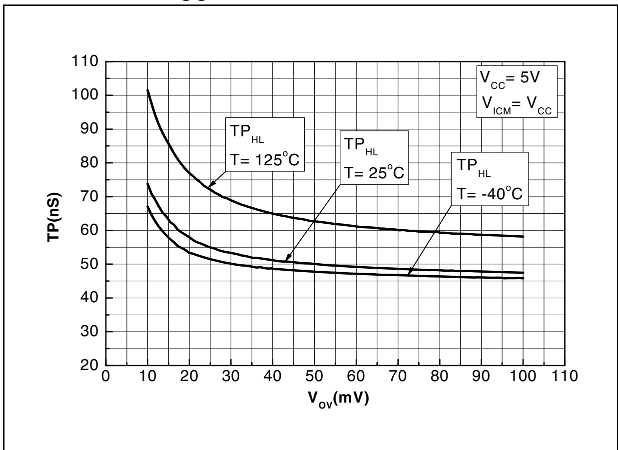


Figure 24. Propagation delay vs. overdrive V_{CC} = 5 V

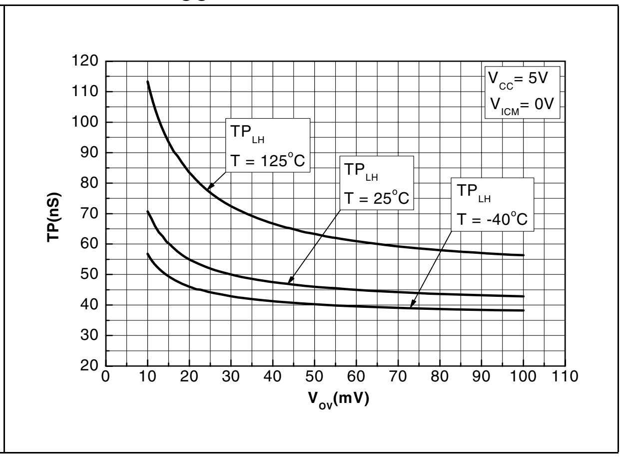


Figure 25. Propagation delay vs. overdrive V_{CC} = 5 V

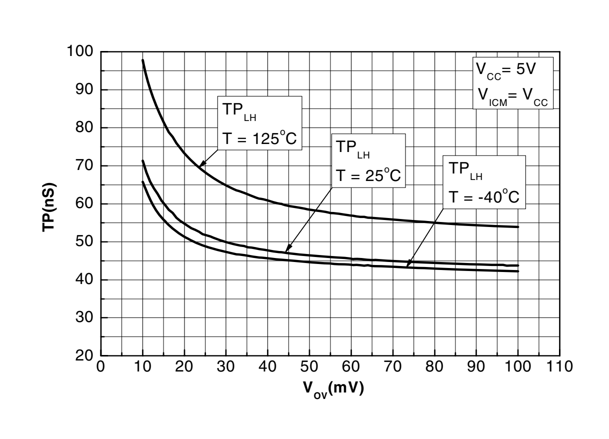


Figure 26. Propagation delay vs. temperature V_{CC} = 5 V, overdrive = 100 mV

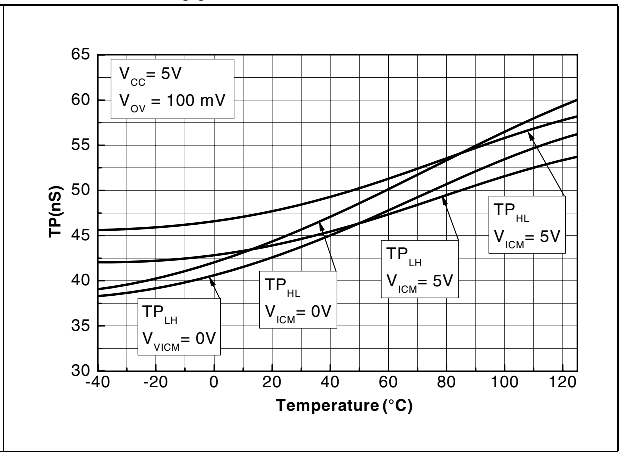
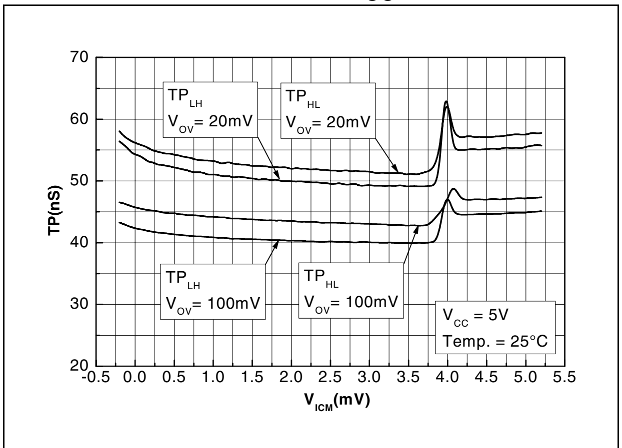


Figure 27. Propagation delay vs. common mode voltage, V_{CC} = 5 V



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 SO-8 package information

Figure 28. SO-8 package mechanical drawing

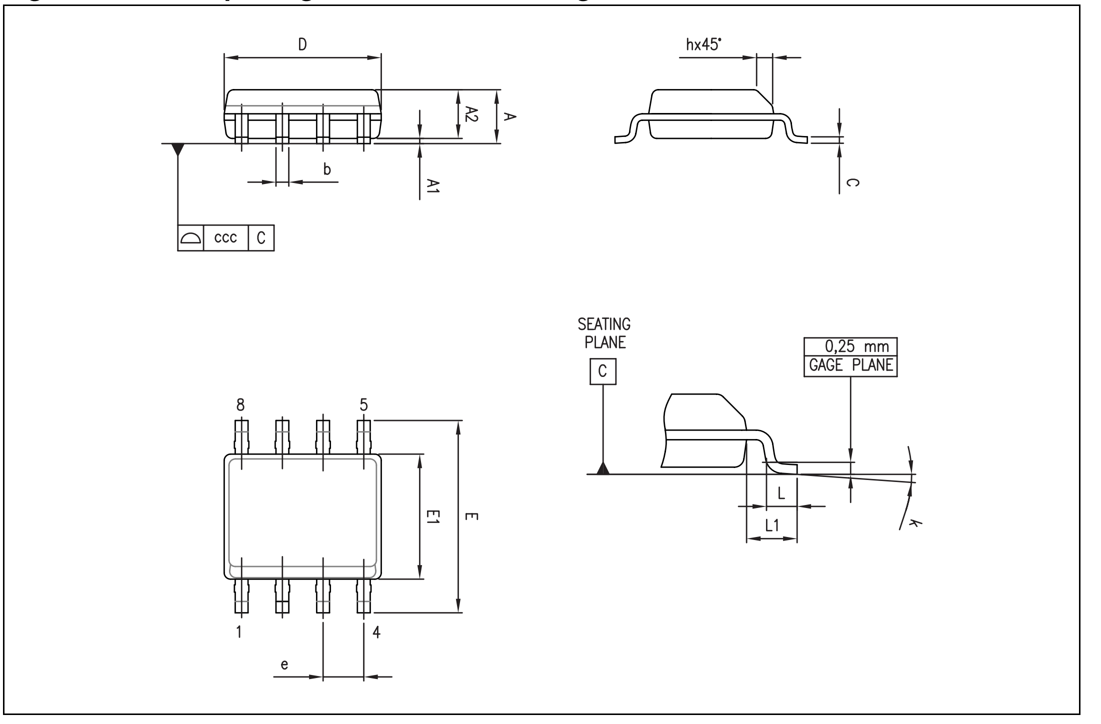


Table 6. SO-8 package mechanical data

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

3.2 MiniSO-8 package information

Figure 29. MiniSO-8 package mechanical drawing

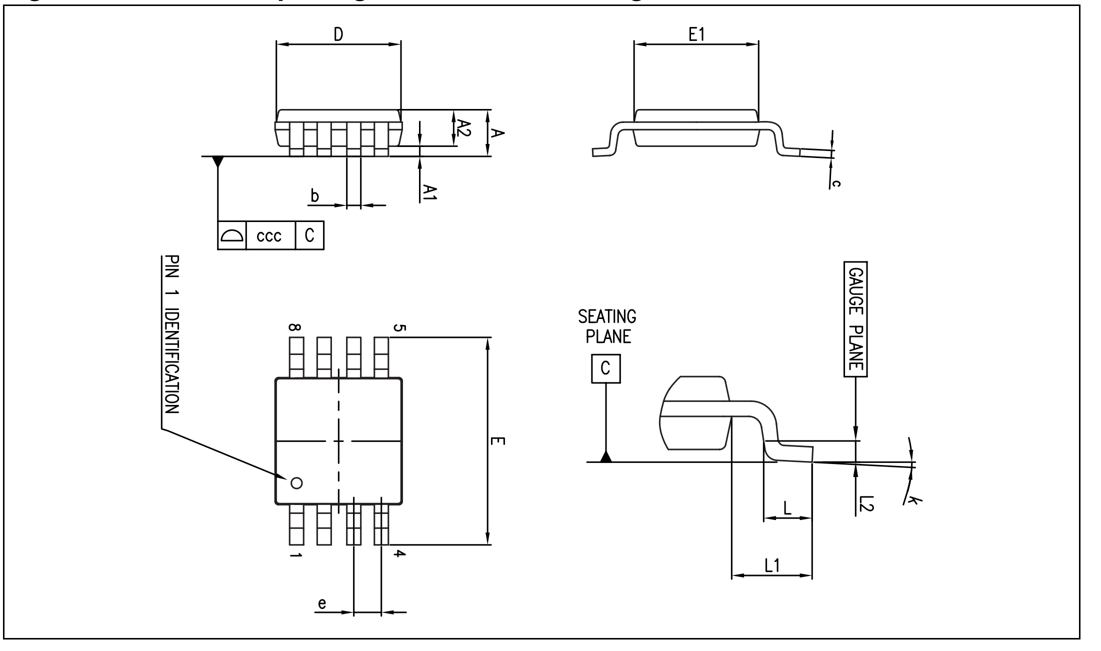


Table 7. MiniSO-8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.10			0.043
A1			0.15			0.006
A2	0.75	0.85	0.95	0.030	0.033	0.037
b	0.22		0.40	0.009		0.016
c	0.08		0.23	0.003		0.009
D	2.80	3.00	3.20	0.110	0.118	0.126
E	4.65	4.90	5.15	0.183	0.193	0.203
E1	2.80	3.00	3.10	0.110	0.118	0.122
e		0.65			0.026	
L	0.40	0.60	0.80	0.016	0.024	0.031
L1		0.95			0.037	
L2		0.25			0.010	
k	0		8			
ccc			0.10			0.004

4 Ordering information

Table 8. Order codes

Part number	Temperature range	Package	Packing	Marking
TS3022ID	-40° C, +125° C	SO-8	Tube	3022I
TS3022IDT		SO-8	Tape & reel	3022I
TS3022IST		MiniSO-8	Tape & reel	K521

5 Revision history

Table 9. Document revision history

Date	Revision	Changes
29-Jan-2009	1	Initial release. The information contained in this datasheet was previously included in the TS3021-TS3022 datasheet (revision 4 dated October 2007). The single version (TS3021) and dual version (TS3022) have now been split into two separate datasheets. Refer to the TS3021 revision 5 for a complete history of changes.
25-Jun-2009	2	Modified ESD tolerances in *Table 1: Absolute maximum ratings*. In *Table 3*, *Table 4* and *Table 5*: – modified V_{IO} typical value and maximum limits. – modified I_{IB} typical value. – modified I_{CC} typical values and corrected maximum limits. – modified I_{SC} typical values. – modified V_{OH} and V_{OL} typical values. – modified CMRR and SVR typical values. – modified TP_{HL} and TP_{LH} typical values. – modified note 3. – added note 4. Modified all curves.