TS3021-TS3022

Rail-to-rail 1.8V high-speed comparator

Features

- Propagation delay: 33ns
- Low current consumption: 64µA
- Rail-to-rail inputs
- Push-pull outputs
- Supply operation from 1.8V to 5V
- Wide temperature range: -40°C to +125°C
- ESD tolerance: 2kV HBM / 200V MM
- Latch-up immunity: 200mA
- SMD packages

Applications

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

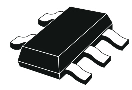
Description

The TS3021 and TS3022 single and dual comparators feature high-speed response time with rail-to-rail inputs. Specified from 2V to 5V supply voltage, these comparators can operate over a wide temperature range: -40°C to +125°C.

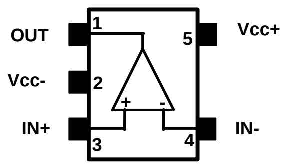
The TS3021 and TS3022 comparators offer micropower consumption as low as a few tens of microamperes thus providing an excellent ratio of power consumption current versus response time.

The TS3021 and TS3022 include push-pull outputs and are available in small packages (SMD).

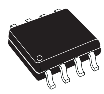
TS3021
SOT23-5 / SC70-5



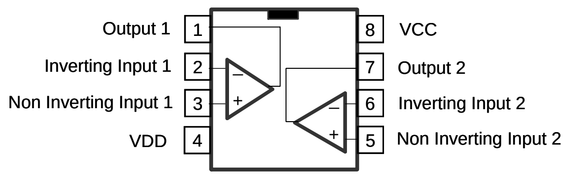
Pin connections (top view)



TS3022
SO-8 / MiniSO-8



Pin connections (top view)



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_{DD}-0.3 to V_{CC}+0.3	V
R_{thja}	Thermal resistance junction to ambient(3) SC70-5 SOT23-5 SO-8 MiniSO-8	 205 250 125 190	°C/W
R_{thjc}	Thermal resistance junction to case (3) SC70-5 SOT23-5 SO-8 MiniSO-8	 172 81 40 39	°C/W
P_D	Power dissipation(4) SC70-5 SOT23-5 SO-8 MiniSO-8	 600 500 1000 650	mW
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)(5)	2000	V
	Machine model (MM)(6)	200	
	Latch-up immunity	200	mA

1. All voltage values, except differential voltage, are referenced to V_{DD}.
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. P_D is calculated with T_{amb}=+25°C, T_j =+150°C and corresponding R_{thja} .
5. Human body model: A 100pF capacitor is charged to the specified voltage, then discharged through a 1.5kΩ 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 200pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5Ω). This is done for all couples of connected pin combinations while the other pins are floating.

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_{DD}-0.2 to V_{CC}+0.2 V_{DD} to V_{CC}	V

2 Electrical characteristics

Table 3. V_{CC}=+2V, 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	8 10	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	-	80	160 300	nA
I_{CC}	Supply current	No load, output low, V_{icm}=0V -40°C < T_{amb} < +125°C No load, output high, V_{icm}=0V -40°C < T_{amb} < +125°C	-	75 64	105 115 90 125	µA
I_{SC}	Short-circuit current	Source Sink	-	12 13	-	mA
V_{OH}	Output voltage high	I_{source}=1mA -40°C < T_{amb} < +125°C	1.88 1.80	1.94	-	V
V_{OL}	Output voltage low	I_{source}=1mA -40°C < T_{amb} < +125°C	-	50	100 150	mV
CMRR	Common mode rejection ratio	0 < V_{icm} < 2V	-	67	-	dB
SVR	Supply voltage rejection	ΔV_{CC}= 2 to 5V	58	69	-	dB
TP_{LH}	Propagation delay Low to high output level	V_{icm}= 0V, f=10kHz, C_L=50pF, Overdrive = 20mV Overdrive = 100mV	-	 39 33	 75 60	ns
TP_{HL}	Propagation delay High to low output level	V_{icm}= 0V, f=10kHz, C_L=50pF, Overdrive = 20mV Overdrive = 100mV	-	 39 33	 75 60	ns
T_F	Fall time	f=10kHz, C_L=50pF, R_L=10kΩ Overdrive = 100mV	-	8	-	ns
T_R	Rise time	f=10kHz, C_L=50pF, R_L=10kΩ Overdrive = 100mV	-	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.

Table 4. V_{CC}=+3.3V, 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	8 10	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	-	80	160 300	nA
I_{CC}	Supply current	No load, output low, V_{icm}=0V -40°C < T_{amb} < +125°C No load, output high, V_{icm}=0V -40°C < T_{amb} < +125°C	-	77 65	110 120 90 125	µA
I_{SC}	Short circuit current	Source Sink	-	33 28	-	mA
V_{OH}	Output voltage high	I_{source}=1mA -40°C < T_{amb} < +125°C	3.20 3.10	3.26	-	V
V_{OL}	Output voltage low	I_{source}=1mA -40°C < T_{amb} < +125°C	-	30	80 150	mV
CMRR	Common mode rejection ratio	0 < V_{icm} < 3.3V	-	71	-	dB
SVR	Supply voltage rejection	ΔV_{CC}= 2 to 5V	58	69	-	dB
TP_{LH}	Propagation delay Low to high output level	V_{icm}= 0V, f=10kHz, C_L=50pF, Overdrive = 20mV Overdrive = 100mV	-	42 34	85 65	ns
TP_{HL}	Propagation delay High to low output level	V_{icm}= 0V, f=10kHz, C_L=50pF, Overdrive = 20mV Overdrive = 100mV	-	41 34	80 65	ns
T_F	Fall time	f=10kHz, C_L=50pF,R_L=10kΩ Overdrive = 100mV	-	5	-	ns
T_R	Rise time	f=10kHz, C_L=50pF,R_L=10kΩ Overdrive = 100mV	-	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.

Table 5. V_{CC}=+5V, 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	8 10	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	-	80	160 300	nA
I_{CC}	Supply current	No load, output low, V_{icm}=0V -40°C < T_{amb} < +125°C No load, output high, V_{icm}=0V -40°C < T_{amb} < +125°C	-	80 67	115 125 95 135	µA
I_{SC}	Short circuit current	Source Sink		62 47	-	mA
V_{OH}	Output voltage high	I_{source}=4mA -40°C < T_{amb} < +125°C	4.80 4.70	4.87	-	V
V_{OL}	Output voltage low	I_{source}=4mA -40°C < T_{amb} < +125°C	-	110	180 250	mV
CMRR	Common mode rejection ratio	0 < V_{icm} < 5V	-	72	-	dB
SVR	Supply voltage rejection	ΔV_{CC}= 2 to 5V	58	69	-	dB
TP_{LH}	Propagation delay Low to high output level	V_{icm}= 0V, f=10kHz, C_L=50pF, Overdrive = 20mV Overdrive = 100mV	-	48 38	105 75	ns
TP_{HL}	Propagation delay High to low output level	V_{icm}= 0V, f=10kHz, C_L=50pF, Overdrive = 20mV Overdrive = 100mV	-	46 38	95 75	ns
T_F	Fall time	f=10kHz, C_L=50pF,R_L=10kΩ Overdrive = 100mV	-	4	-	ns
T_R	Rise time	f=10kHz, C_L=50pF,R_L=10kΩ Overdrive = 100mV	-	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.

Figure 1. Current consumption vs. power supply voltage

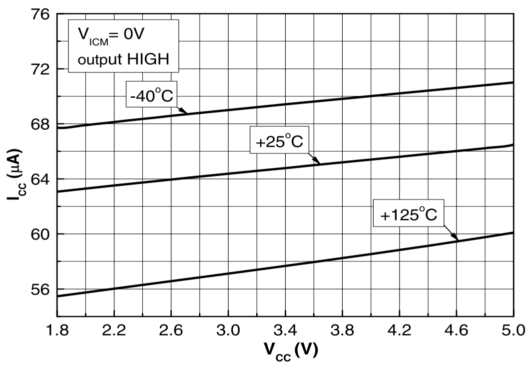


Figure 2. Current consumption vs. power supply voltage

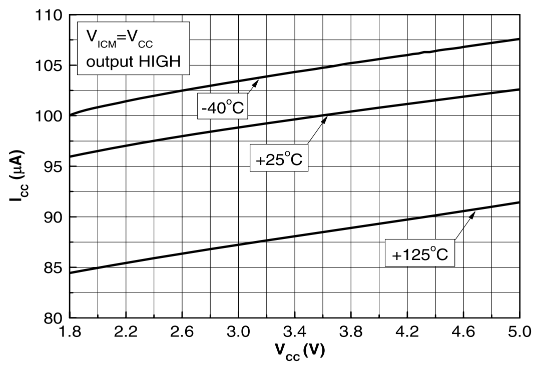


Figure 3. Current consumption vs. power supply voltage

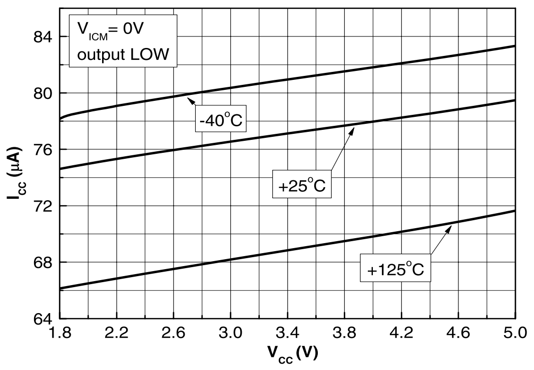


Figure 4. Current consumption vs. power supply voltage

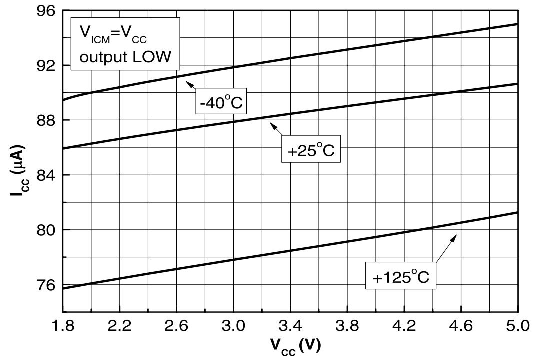


Figure 5. Output voltage vs. source current V_{CC}=2V

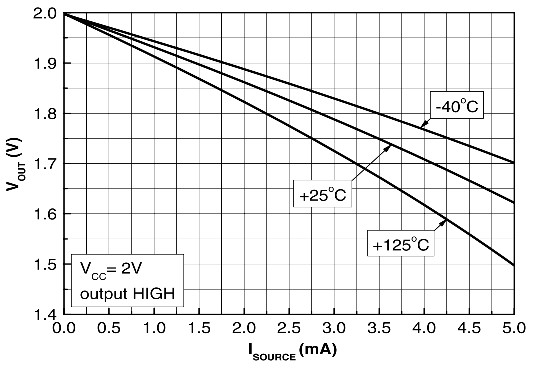


Figure 6. Output voltage vs. sink current V_{CC}=2V

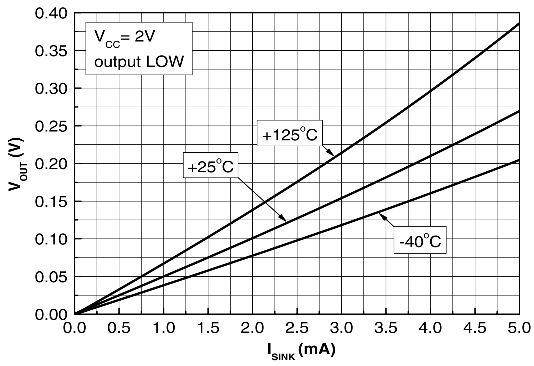


Figure 7. Output voltage vs. source current V_{CC}=3.3V

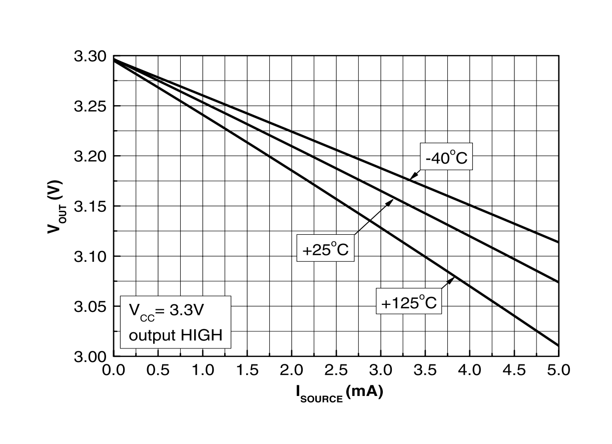


Figure 8. Output voltage vs. sink current V_{CC}=3.3V

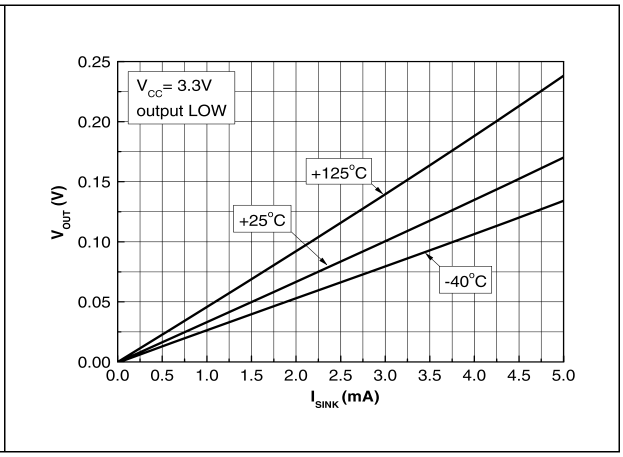


Figure 9. Output Voltage vs. source current V_{CC}=5V

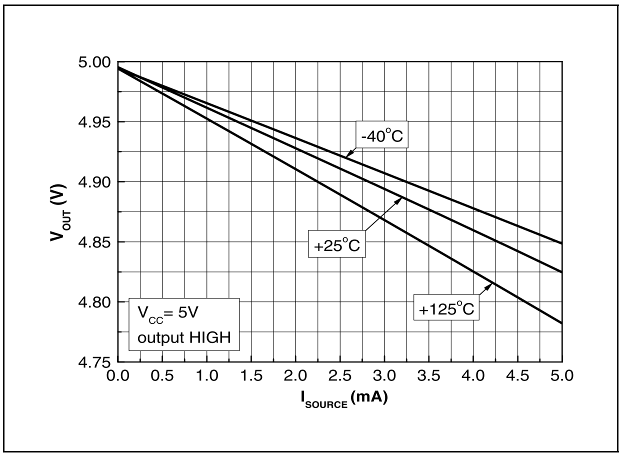


Figure 10. Output voltage vs. sink current V_{CC}=5V

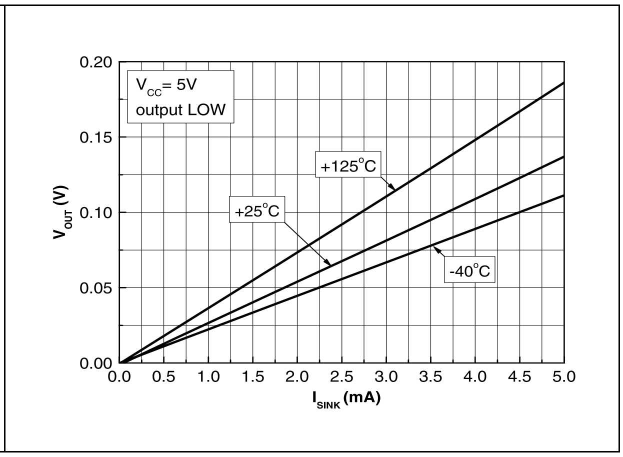


Figure 11. Input offset voltage vs. temperature and common mode voltage

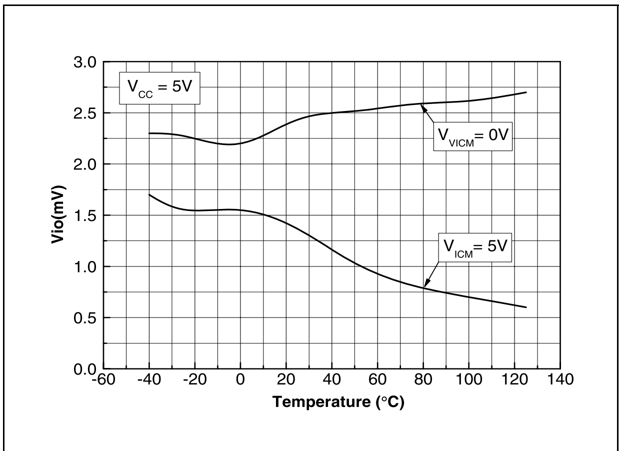


Figure 12. Input bias current vs. temperature and input voltage

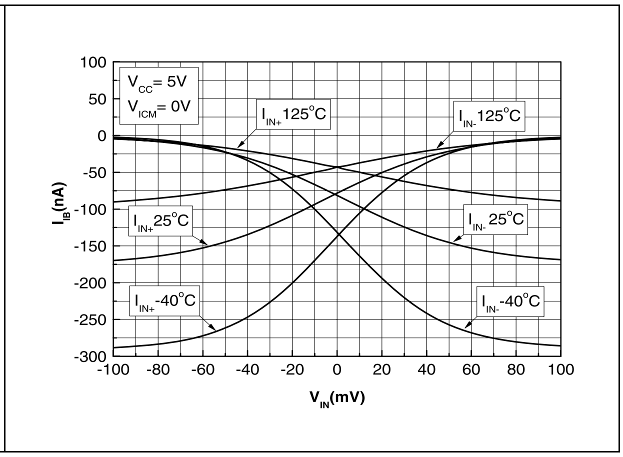


Figure 13. Current consumption vs. commutation frequency

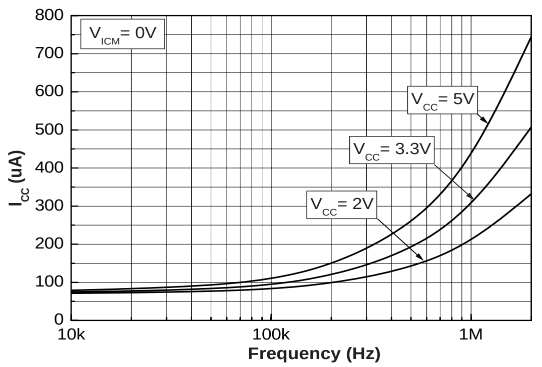


Figure 14. Propagation delay vs. overdrive V_{CC}=2V

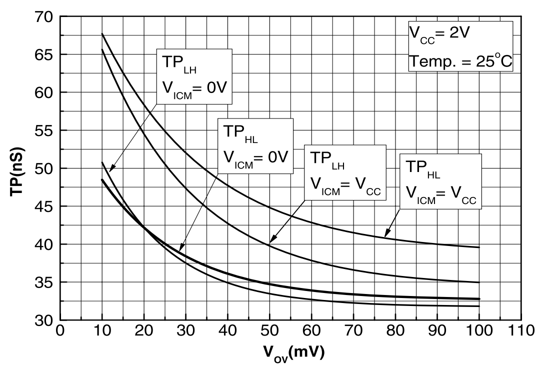


Figure 15. Propagation delay vs. overdrive V_{CC}=2V

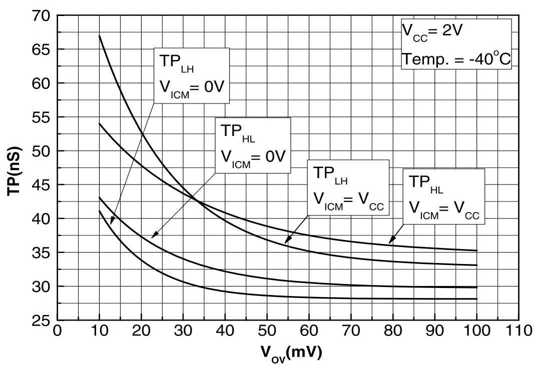


Figure 16. Propagation delay vs. overdrive V_{CC}=2V

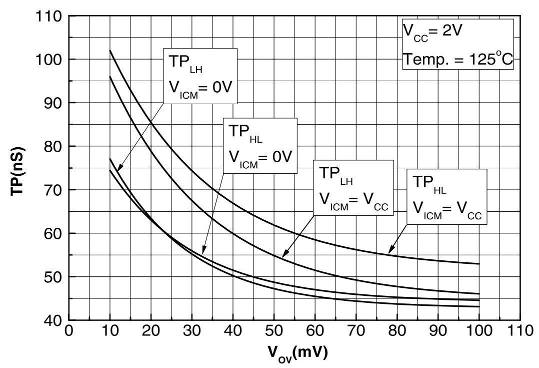


Figure 17. Propagation delay vs. overdrive V_{CC}=3.3V

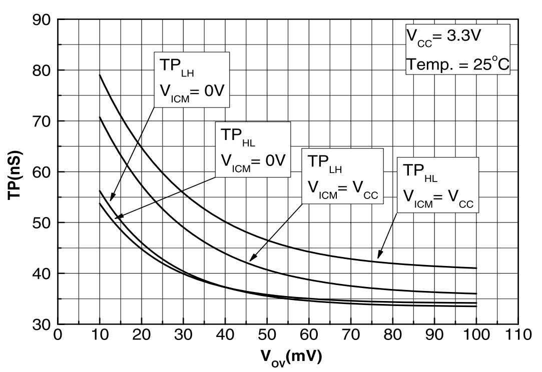


Figure 18. Propagation delay vs. overdrive V_{CC}=3.3V

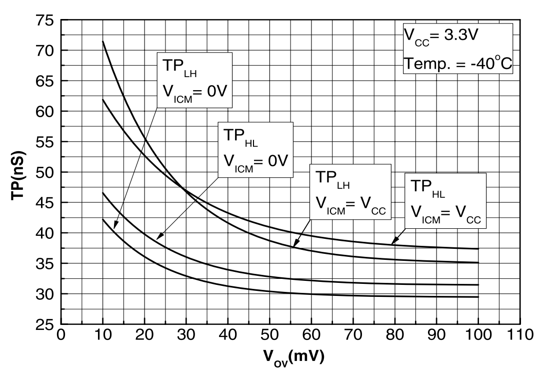


Figure 19. Propagation delay vs. overdrive V_{CC}=3.3V

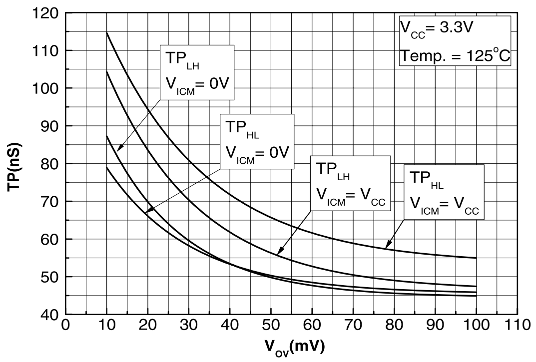


Figure 20. Propagation delay vs. overdrive V_{CC}=5V

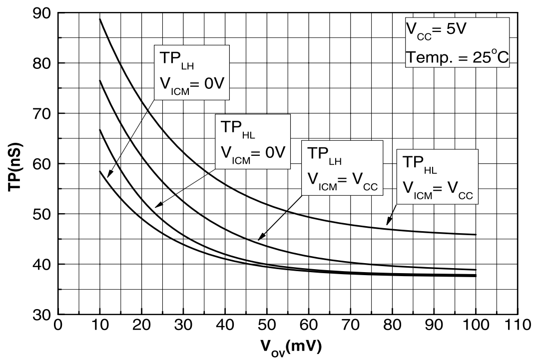


Figure 21. Propagation delay vs. overdrive V_{CC}=5V

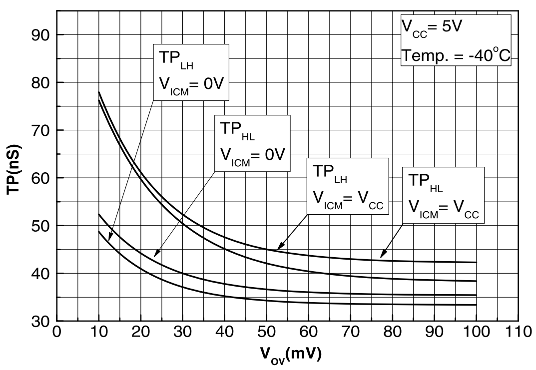


Figure 22. Propagation delay vs. overdrive V_{CC}=5V

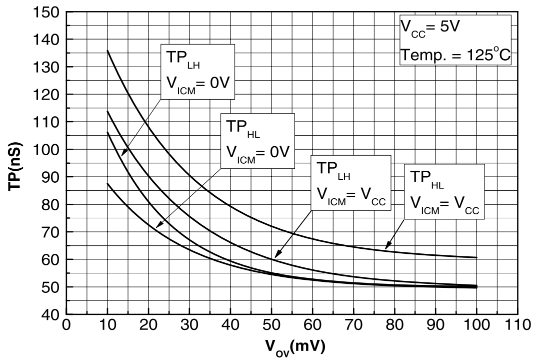


Figure 23. Propagation delay vs. temperature V_{CC}=5V, overdrive=100mV

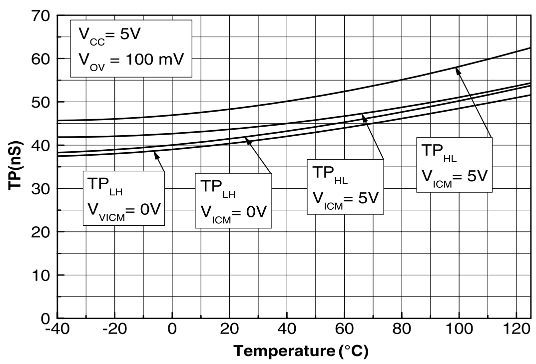
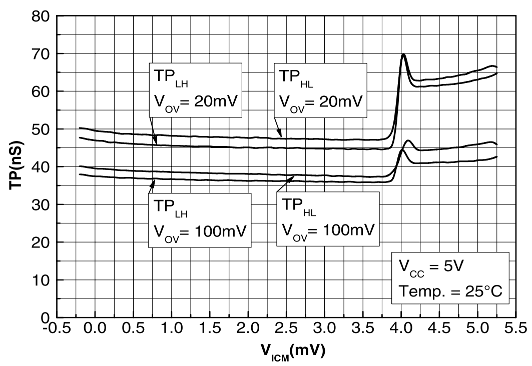


Figure 24. Propagation delay vs. common mode voltage, V_{CC}=5V

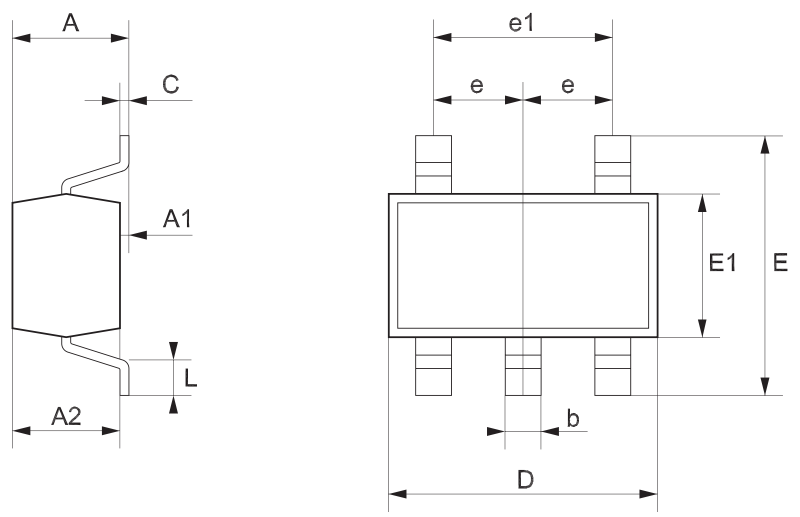


3 Package information

In order to meet environmental requirements, STMicroelectronics offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an STMicroelectronics trademark. ECOPACK specifications are available at: www.st.com.

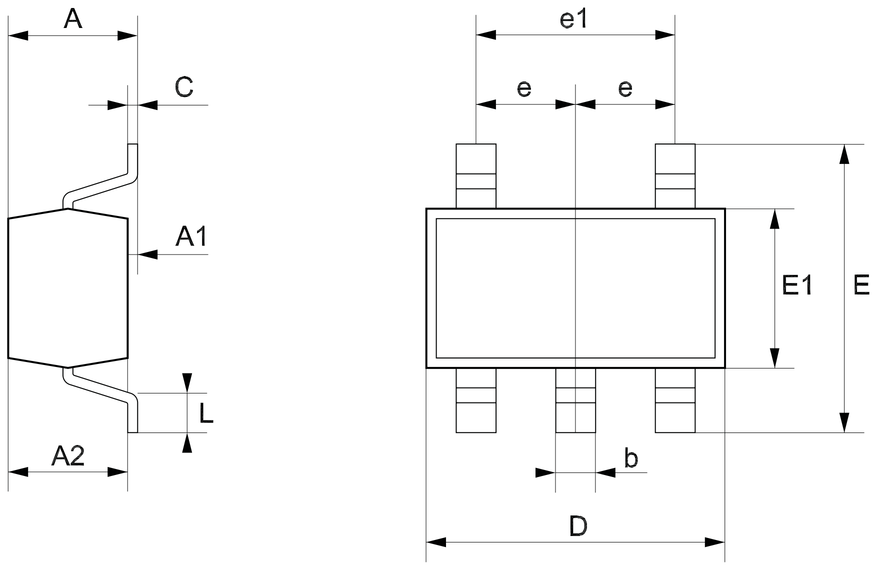
3.1 SOT23-5 package mechanical data

Ref.	Dimensions					
	Millimeters			Mils		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90		1.45	35.4		57.1
A1	0.00		0.15	0.00		5.9
A2	0.90		1.30	35.4		51.2
b	0.35		0.50	13.7		19.7
C	0.09		0.20	3.5		7.8
D	2.80		3.00	110.2		118.1
E	2.60		3.00	102.3		118.1
E1	1.50		1.75	59.0		68.8
e		0.95			37.4	
e1		1.9			74.8	
L	0.35		0.55	13.7		21.6



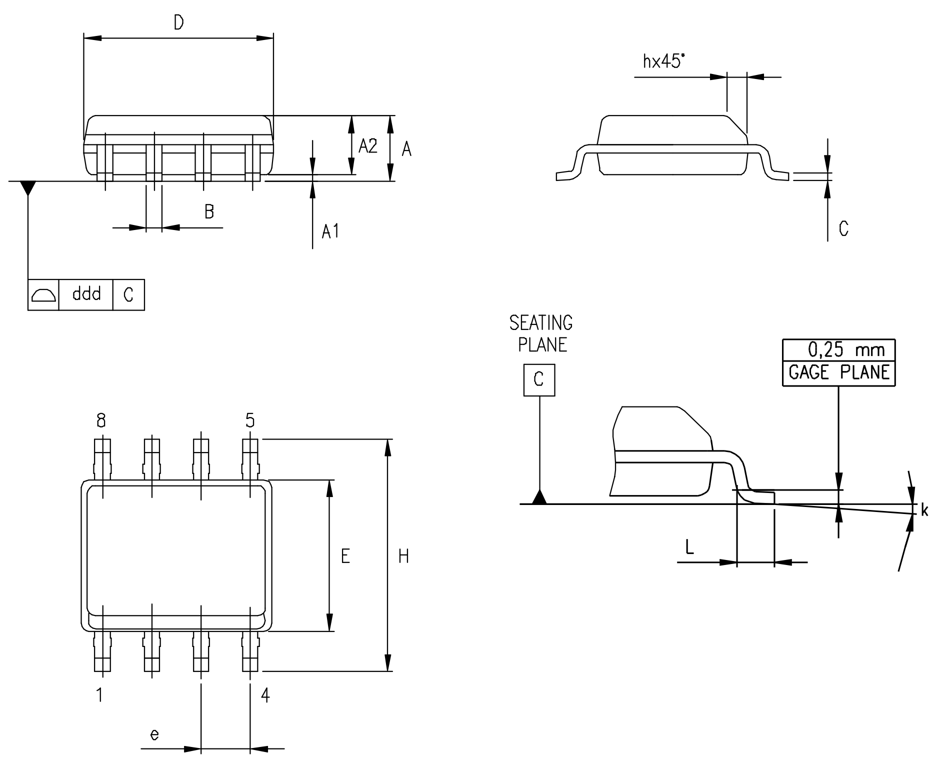
3.2 SC70-5 (SOT323-5) package mechanical data

Ref	Dimensions					
	Millimeters			Mils		
	Min	Typ	Max	Min	Typ	Max
A	0.80		1.10	31.5		43.3
A1	0.00		0.10	0.0		3.9
A2	0.80		1.00	31.5		39.4
b	0.15		0.30	5.9		11.8
C	0.10		0.18	3.9		7.1
D	1.80		2.20	70.9		86.6
E	1.80		2.40	70.9		94.5
E1	1.15		1.35	45.3		53.1
e		0.65			25.6	
e1		1.3			51.2	
L	0.10		0.30	3.9		11.8



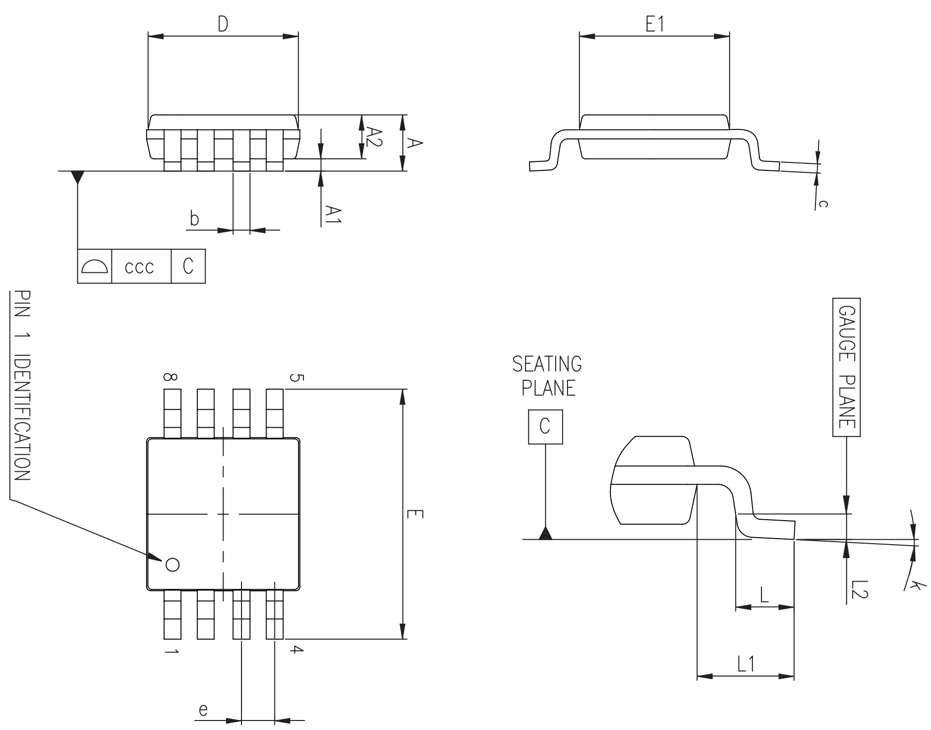
3.3 SO-8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	8° (max.)					
ddd			0.1			0.04



3.4 MiniSO-8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.1			0.043
A1	0		0.15	0		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	0.11	0.118	0.126
E	4.65	4.90	5.15	0.183	0.193	0.203
E1	2.80	3.00	3.10	0.11	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°	0°		8°
ccc			0.10			0.004



4 Ordering information

Table 6. Order codes

Part number	Temperature range	Package	Packaging	Marking
TS3021ILT	-40°C, +125°C	SOT23-5	Tape & reel	K520
TS3021ICT		SC70-5	Tape & reel	K52
TS3022ID		SO-8	Tube	3022I
TS3022IDT		SO-8	Tape & reel	3022I
TS3022IST		MiniSO-8	Tape & reel	K521

5 Revision history

Date	Revision	Changes
1-Jun-2006	1	Initial release.
1-Sep-2006	2	Dual version added. Pinout of single TS3021 corrected. Modified temperature range for input common mode voltage.
22-Feb-2007	3	Addition of MiniSO-8 package for dual version.
17-Oct-2007	4	Marking corrected for SO-8 package. Thermal resistance values corrected in AMR table. Notes on ESD added in AMR table.

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