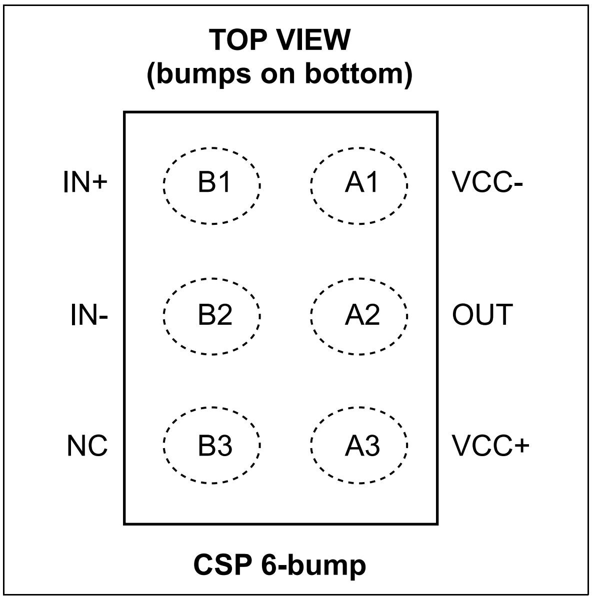
TS985

Micropower low-voltage, 1.2 x 0.8 mm CSP comparator

Datasheet - production data



Features

- Supply operation from 1.8 to 5 V
- Low current consumption: 14 µA
- Rail to rail inputs, push-pull outputs
- Low propagation delay: 300 ns
- 60 µA supply current at 1 MHz switching frequency
- Low output saturation voltage
- Internal hysteresis
- Wide temperature range: -40 ° to 85 °C
- ESD tolerance: 2 kV HBM
- 6-bump CSP, 1.2 x 0.8 mm, 400 µm pitch

Applications

- Mobiles phones
- Battery supplied electronics
- General purpose portable devices
- General purpose low voltage applications

Description

The TS985 is a single micropower and low voltage comparator. It can operate with a supply voltage ranging from 1.8 V to 5 V with a typical current consumption as low as 14 µA while achieving a 300 ns propagation delay. In addition, rail-to-rail inputs make it a perfect choice for low voltage applications.

The 6-bump chip scale package (CSP) is a real advantage for overcoming space constraints.

TS985 is specified for temperature between -40 °C to 85 °C, making it ideal for a wide range of applications.

Contents

1 Absolute maximum ratings

Table 1. Absolute maximum ratings (AMR)

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage (1)	5.5	V
V_{id}	Differential input voltage (2)	±5.5	V
V_{in}	Input voltage (3)	(V_{CC}^-) - 0.3 to (V_{CC}^+) + 0.3	V
V_{out}	Output voltage	5.5	V
I_F	Forward current in ESD protection diodes on inputs (4)	10	mA
T_j	Maximum junction temperature	150	°C
T_{stg}	Storage temperature range	-65 to 150	°C
R_{thja}	Thermal resistance junction to ambient (5)	TBA	°C/W
ESD	HBM: human body model (6)	2000	V
	CDM: charged device model (7)	1500	V
	Latch-up immunity	200	mA

1. All voltage values, except differential voltage, are with respect to network ground terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
3. Excursions of input voltages may exceed the power supply level. As long as the common mode voltage $[V_{icm}=(V_{in}^+ + V_{in}^-)/2]$ remains within the specified range, the comparator will provide a stable output state. However, the maximum current through the ESD diodes (IF) of the input stage must strictly be observed.
4. Guaranteed by design.
5. Short-circuits can cause excessive heating and destructive dissipation. Values are typical
6. According to JEDEC standard JESD22-A114F.
7. According to ANSI/ESD STM5.3.1.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}^+	Supply voltage	1.8 to 5.0	V
V_{icm}	Common mode input voltage range, T_{amb} = 25 °C	(V_{CC}^-) - 0.25 to (V_{CC}^+) + 0.25	V
	Common mode input voltage range, $T_{min} \leq T_{amb} \leq T_{max}$	(V_{CC}^-) to (V_{CC}^+)	V
T_{oper}	Operating free-air temperature range	-40 to 85	°C

2 Electrical characteristics

Table 3. V_{CC}^+ = 1.8 V, V_{CC}^- = 0 V, T_{amb} = 25 °C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage, full V_{icm} range		0.5	8	mV
	Input offset voltage, $T_{min} \leq T_{amb} \leq T_{max}$			9	
$\Delta V_{io}/\Delta T$	Input offset voltage drift vs. temperature		4.5		uV/°C
V_{Hyst}	Input hysteresis voltage		3		mV
I_{ib}	Input bias current (1), full V_{icm} range		14	40	nA
	Input bias current (1), $T_{min} \leq T_{amb} \leq T_{max}$			100	
I_{io}	Input offset current, full V_{icm} range		1	10	
	Input offset current, $T_{min} \leq T_{amb} \leq T_{max}$			100	
CMR	Common-mode rejection ratio, V_{icm} = 0 to 1.8 V	43			dB
I_{CC}	Supply current per comparator, no load - V_{icm} = 0 V		13	19	µA
	Supply current per comparator, $T_{min} \leq T_{amb} \leq T_{max}$			20	
V_{OH}	High-level output voltage, I_{Source} = 1 mA	1.69	1.71		V
	High-level output voltage, $T_{min} \leq T_{amb} \leq T_{max}$	1.67			
V_{OL}	Low-level output voltage, I_{Sink} = 1 mA		65	80	mV
	Low-level output voltage, $T_{min} \leq T_{amb} \leq T_{max}$			95	
I_{Sink}	V_{OUT} = 0 V	6	8		mA
	$T_{min} \leq T_{amb} \leq T_{max}$	5			
I_{Source}	V_{OUT} = V_{CC}	4.5	7.3		
	$T_{min} \leq T_{amb} \leq T_{max}$	3.5			
t_{PHL}	Response time high to low (2), V_{icm} = 0 V, C_L = 15 pF, overdrive = 10 mV		730		ns
	Response time high to low (2), V_{icm} = 0 V, C_L = 15 pF, overdrive = 100 mV		300		
t_{PLH}	Response time low to high (3), V_{icm} = 0 V, C_L = 15 pF, overdrive = 10 mV		730		
	Response time low to high (3), V_{icm} = 0 V, C_L = 15 pF, overdrive = 100 mV		300		

1. Maximum values include unavoidable inaccuracies of the industrial tests.
2. TP_{HL} is measured when the output signal crosses a voltage level at 50% of V_{CC} with the following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input (IN+), moving from V_{ICM} + 100mV to V_{ICM} - overdrive.
3. TP_{LH} is measured when the output signal crosses a voltage level at 50 % of V_{CC} with the following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input (IN+), moving from V_{ICM} - 100 mV to V_{ICM} + overdrive.

Table 4. V_{CC}^+ = 2.7 V, V_{CC}^- = 0 V, T_{amb} = 25 °C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage, full V_{icm} range		0.5	8	mV
	Input offset voltage, $T_{min} \leq T_{amb} \leq T_{max}$			9	
$\Delta V_{io}/\Delta T$	Input offset voltage drift vs. temperature		4.5		uV/°C
V_{Hyst}	Input hysteresis voltage		3		mV
I_{ib}	Input bias current (1), full V_{icm} range		15	40	nA
	Input bias current (1), $T_{min} \leq T_{amb} \leq T_{max}$			100	
I_{io}	Input offset current, full V_{icm} range		1	10	
	Input offset current, $T_{min} \leq T_{amb} \leq T_{max}$			100	
CMR	Common-mode rejection ratio, V_{icm} = 0 to 2.7 V	48			dB
I_{CC}	Supply current per comparator, no load - V_{icm} = 0 V		14	20	µA
	Supply current per comparator, $T_{min} \leq T_{amb} \leq T_{max}$			22	
V_{OH}	High-level output voltage, I_{Source} = 1 mA	2.6	2.64		V
	High-level output voltage, $T_{min} \leq T_{amb} \leq T_{max}$	2.5			
V_{OL}	Low-level output voltage, I_{Sink} = 1 mA		43	55	mV
	Low-level output voltage, $T_{min} \leq T_{amb} \leq T_{max}$			65	
I_{Sink}	V_{OUT} = 0 V	14	18		mA
	$T_{min} \leq T_{amb} \leq T_{max}$	12			
I_{Source}	$V_{OUT} = V_{CC}$	14	18		
	$T_{min} \leq T_{amb} \leq T_{max}$	12			
t_{PHL}	Response time high to low (2), V_{icm} = 0 V, C_L = 15 pF, overdrive = 10 mV		860		ns
	Response time high to low (2), V_{icm} = 0 V, C_L = 15 pF, overdrive = 100 mV		330		
t_{PLH}	Response time low to high (3), V_{icm} = 0 V, C_L = 15 pF, overdrive = 10 mV		860		
	Response time low to high (3), V_{icm} = 0 V, C_L = 15 pF, overdrive = 100 mV		330		

1. Maximum values include unavoidable inaccuracies of the industrial tests.
2. TP_{HL} is measured when the output signal crosses a voltage level at 50% of V_{CC} with the following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input (IN+), moving from V_{ICM} + 100mV to V_{ICM} - overdrive.
3. TP_{LH} is measured when the output signal crosses a voltage level at 50 % of V_{CC} with the following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input (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 (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage, full V_{icm} range		0.5	8	mV
	Input offset voltage, $T_{min} \leq T_{amb} \leq T_{max}$			9	
$\Delta V_{io}/\Delta T$	Input offset voltage drift vs. temperature		4.5		uV/°C
V_{Hyst}	Input hysteresis voltage		3		mV
I_{ib}	Input bias current (1), full V_{icm} range		17	50	nA
	Input bias current (1), $T_{min} \leq T_{amb} \leq T_{max}$			100	
I_{io}	Input offset current, full V_{icm} range		1	10	
	Input offset current, $T_{min} \leq T_{amb} \leq T_{max}$			100	
CMR	Common-mode rejection ratio, V_{icm} = 0 to 5 V	56			dB
I_{CC}	Supply current per comparator, no load - V_{icm} = 0 V		16	24	µA
	Supply current per comparator, $T_{min} \leq T_{amb} \leq T_{max}$			25	
V_{OH}	High-level output voltage, I_{Source} = 1 mA	4.85	4.9		V
	High-level output voltage, $T_{min} \leq T_{amb} \leq T_{max}$	4.8			
V_{OL}	Low-level output voltage, I_{Sink} = 1 mA		31	45	mV
	Low-level output voltage, $T_{min} \leq T_{amb} \leq T_{max}$			55	
I_{Sink}	V_{OUT} = 0 V	35	42		mA
	$T_{min} \leq T_{amb} \leq T_{max}$	30			
I_{Source}	V_{OUT} = V_{CC}	45	52		
	$T_{min} \leq T_{amb} \leq T_{max}$	40			
t_{PHL}	Response time high to low (2), V_{icm} = 0 V, C_L = 15 pF, overdrive = 10 mV		1100		ns
	Response time high to low (2), V_{icm} = 0 V, C_L = 15 pF, overdrive = 100 mV		420		
t_{PLH}	Response time low to high (3), V_{icm} = 0 V, C_L = 15 pF, overdrive = 10 mV		1100		
	Response time low to high (3), V_{icm} = 0 V, C_L = 15 pF, overdrive = 100 mV		420		

1. Maximum values include unavoidable inaccuracies of the industrial tests.
2. TP_{HL} is measured when the output signal crosses a voltage level at 50% of V_{CC} with the following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input (IN+), moving from V_{ICM} + 100mV to V_{ICM} - overdrive.
3. TP_{LH} is measured when the output signal crosses a voltage level at 50 % of V_{CC} with the following conditions: inverting input voltage (IN-) = V_{ICM} and non-inverting input (IN+), moving from V_{ICM} - 100 mV to V_{ICM} + overdrive.

3 Electrical characteristic curves

Figure 1. Supply current vs temperature and supply voltage

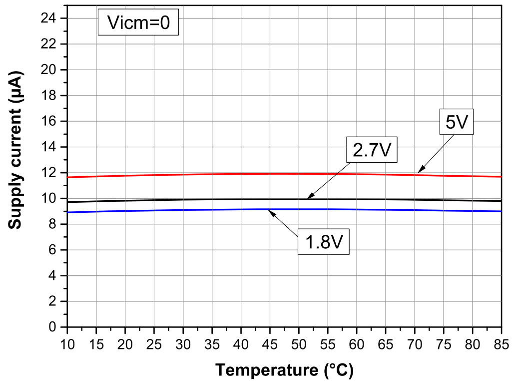


Figure 2. Supply current vs supply voltage, V_{icm} = 0 V, output low

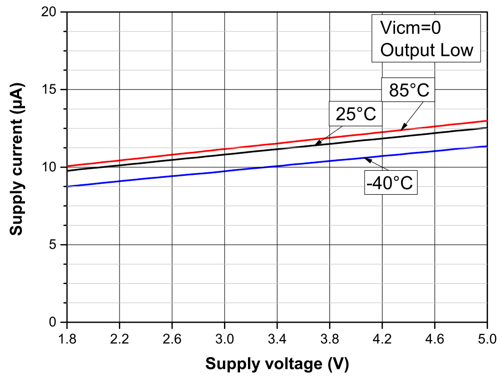


Figure 3. Supply current vs supply voltage, V_{icm} = 0 V, output high

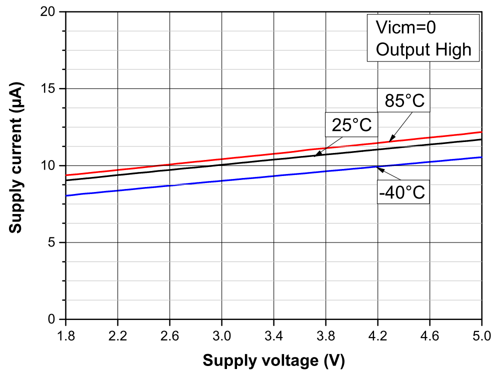


Figure 4. Supply current vs supply voltage, V_{icm} = V_{CC}, output low

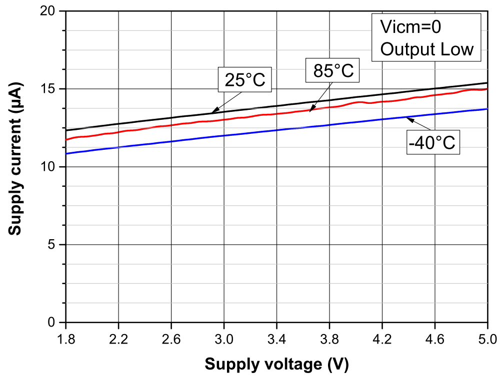


Figure 5. Supply current vs supply voltage, V_{icm} = V_{CC}, output high

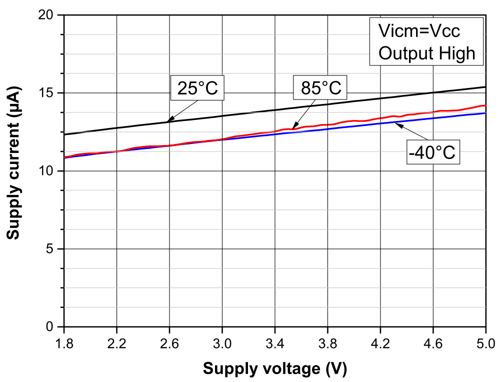


Figure 6. Input bias current vs. input common mode voltage V_{CC} = 1.8 V

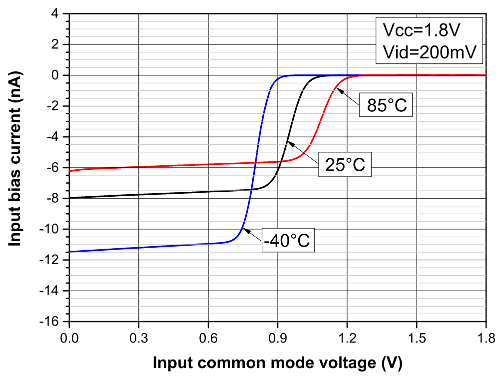


Figure 7. Input bias current vs. input common mode voltage V_{CC} = 2.7 V

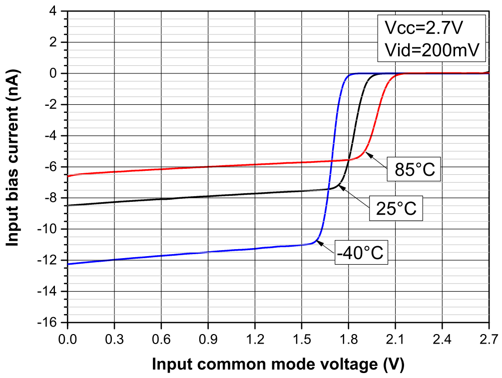


Figure 8. Input bias current vs. input common mode voltage V_{CC} = 5 V

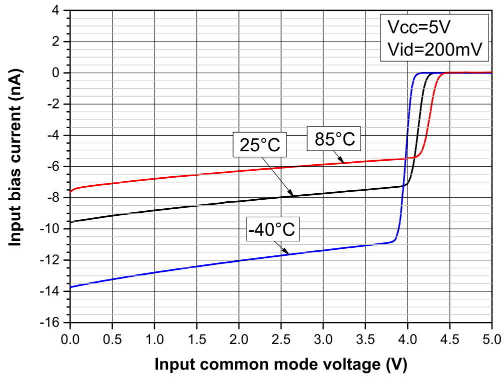


Figure 9. Input offset voltage vs. input common mode voltage V_{CC} = 1.8 V

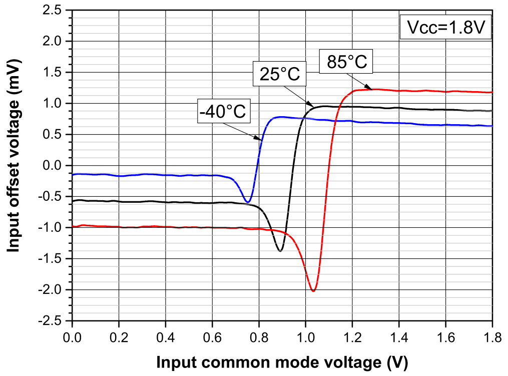


Figure 10. Input offset voltage vs. input common mode voltage V_{CC} = 2.7 V

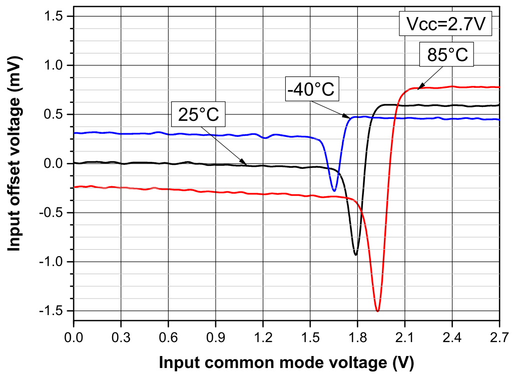


Figure 11. Input offset voltage vs. input common mode voltage V_{CC} = 5 V

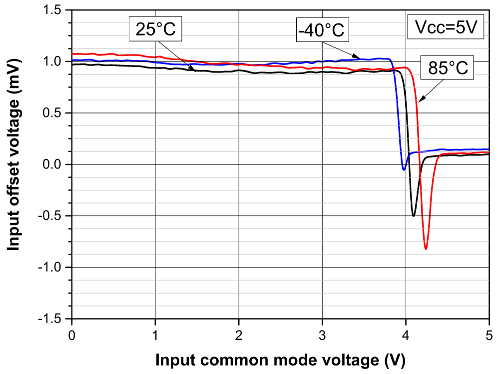


Figure 12. Output voltage vs. output sink current V_{CC} = 1.8 V

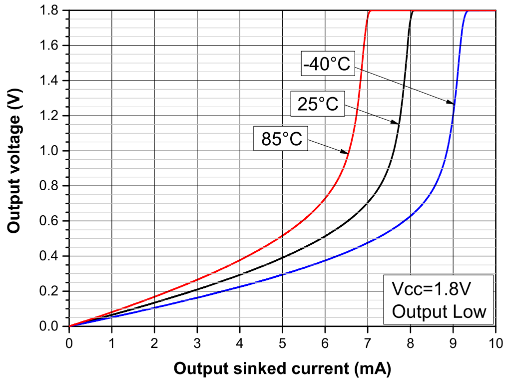


Figure 13. Output voltage vs. output source current V_{CC} = 1.8 V

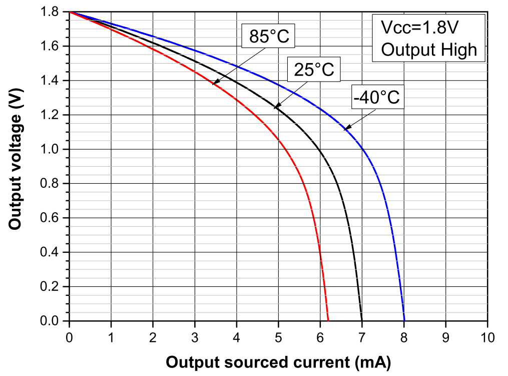


Figure 14. Output voltage vs. output sink current V_{CC} = 2.7 V

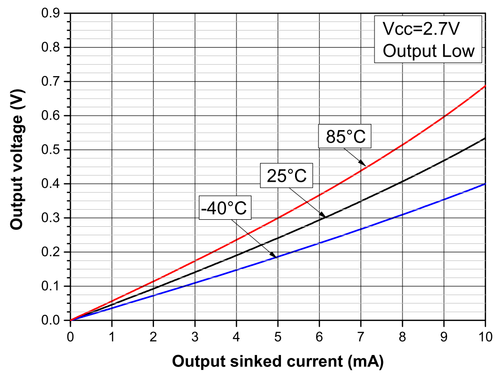


Figure 15. Output voltage vs. output source current V_{CC} = 2.7 V

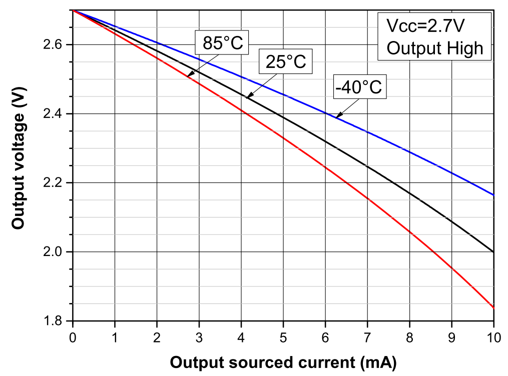


Figure 16. Output voltage vs. output sink current V_{CC} = 5 V

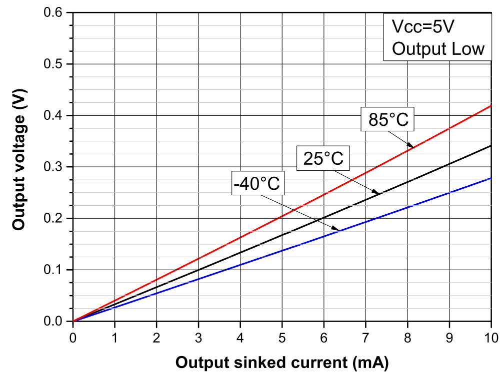


Figure 17. Output voltage vs. output source current V_{CC} = 5 V

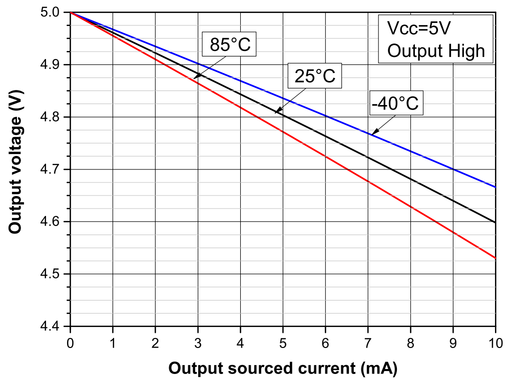


Figure 18. Propagation delay low to high vs temperature with 50 mV input overdrive

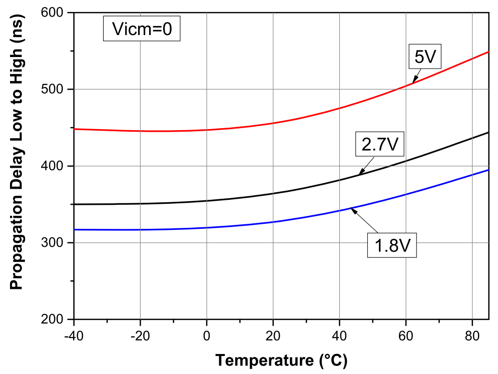


Figure 19. Propagation delay high to low vs temperature with 50 mV input overdrive

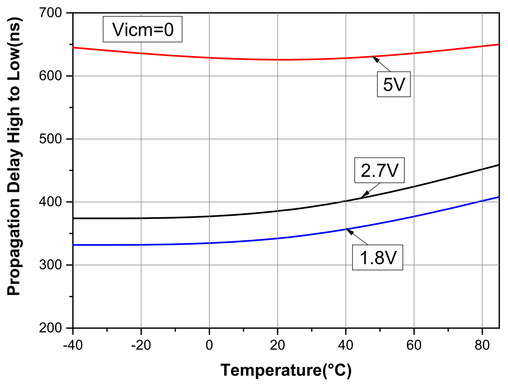


Figure 20. Propagation delay vs input common mode voltage V_{CC} = 1.8 V negative transition

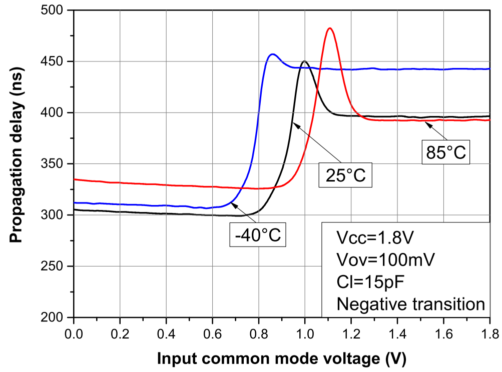


Figure 21. Propagation delay vs input common mode voltage V_{CC} = 1.8 V positive transition

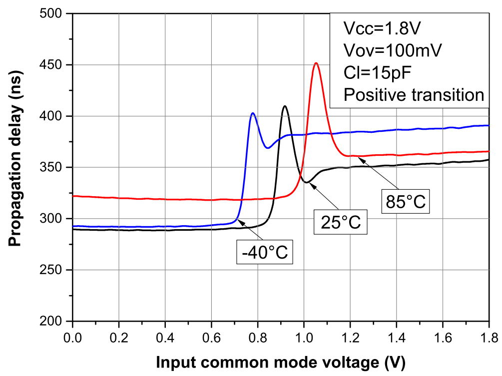


Figure 22. Propagation delay vs input common mode voltage V_{CC} = 2.7 V negative transition

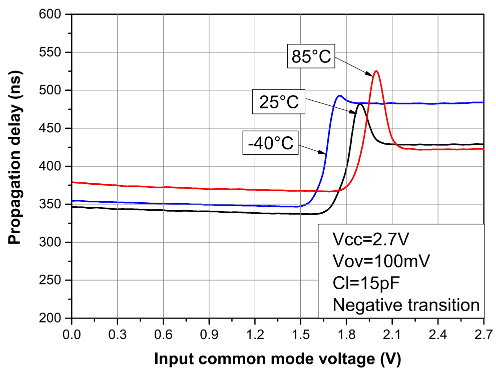


Figure 23. Propagation delay vs input common mode voltage V_{CC} = 2.7 V positive transition

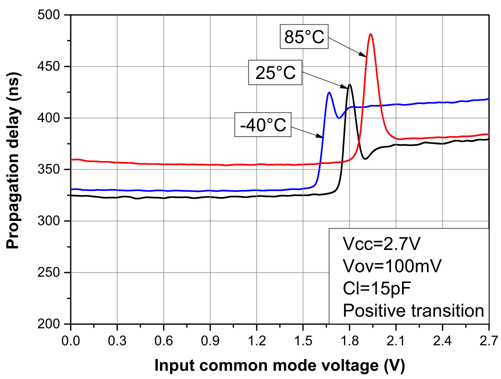


Figure 24. Propagation delay vs input common mode voltage V_{CC} = 5 V negative transition

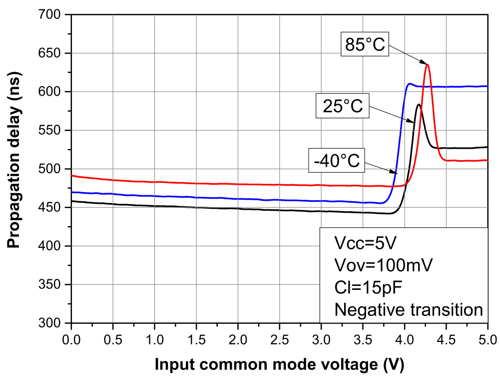


Figure 25. Propagation delay vs input common mode voltage V_{CC} = 5 V positive transition

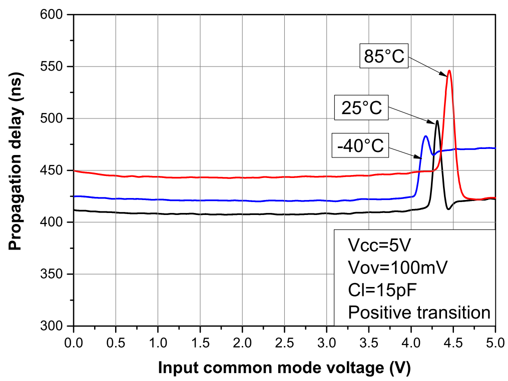


Figure 26. Propagation delay vs input overdrive voltage V_{CC} = 1.8 V negative transition

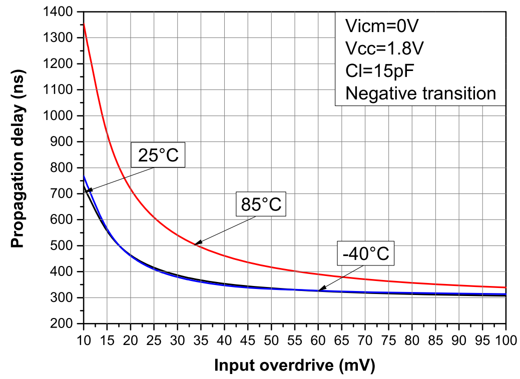


Figure 27. Propagation delay vs input overdrive voltage V_{CC} = 1.8 V positive transition

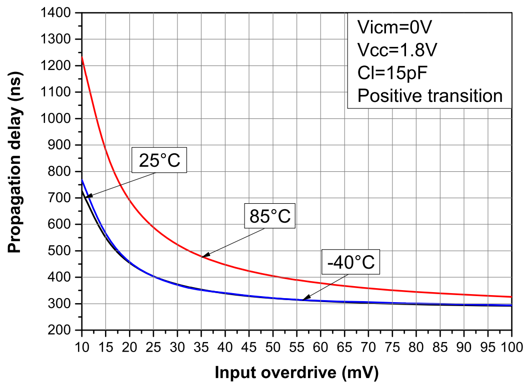


Figure 28. Propagation delay vs input overdrive voltage V_{CC} = 2.7 V negative transition

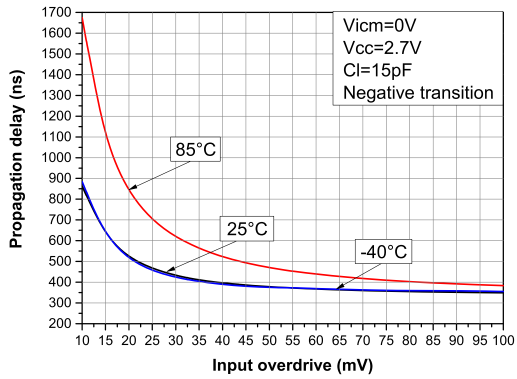


Figure 29. Propagation delay vs input overdrive voltage V_{CC} = 2.7 V positive transition

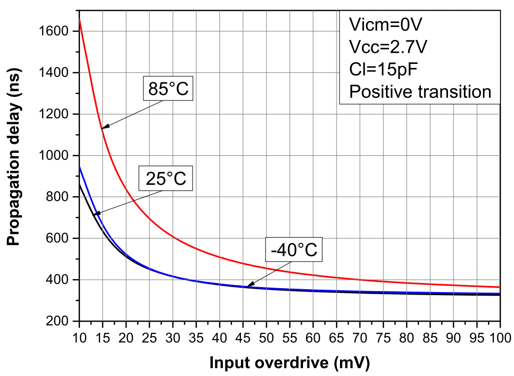


Figure 30. Propagation delay vs input overdrive voltage V_{CC} = 5 V negative transition

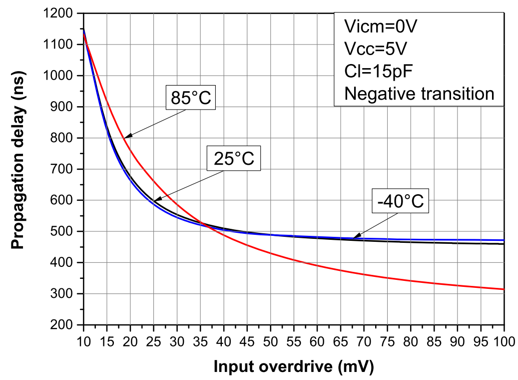


Figure 31. Propagation delay vs input overdrive voltage V_{CC} = 5 V positive transition

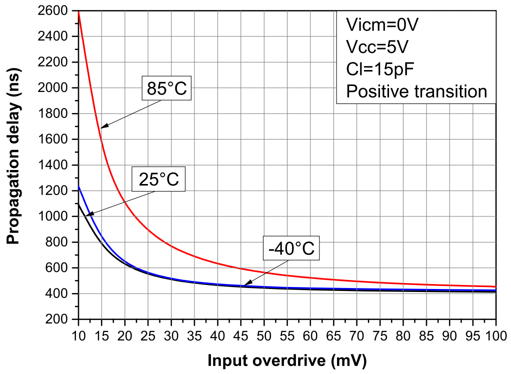
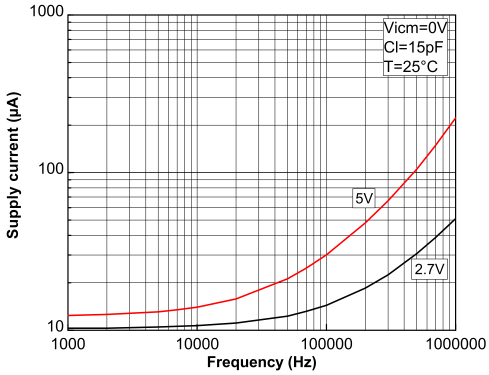


Figure 32. Supply current vs output transition frequency and supply voltage



4 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.

4.1 CSP 6-bump package information

Figure 33. CSP 6-bump package outline

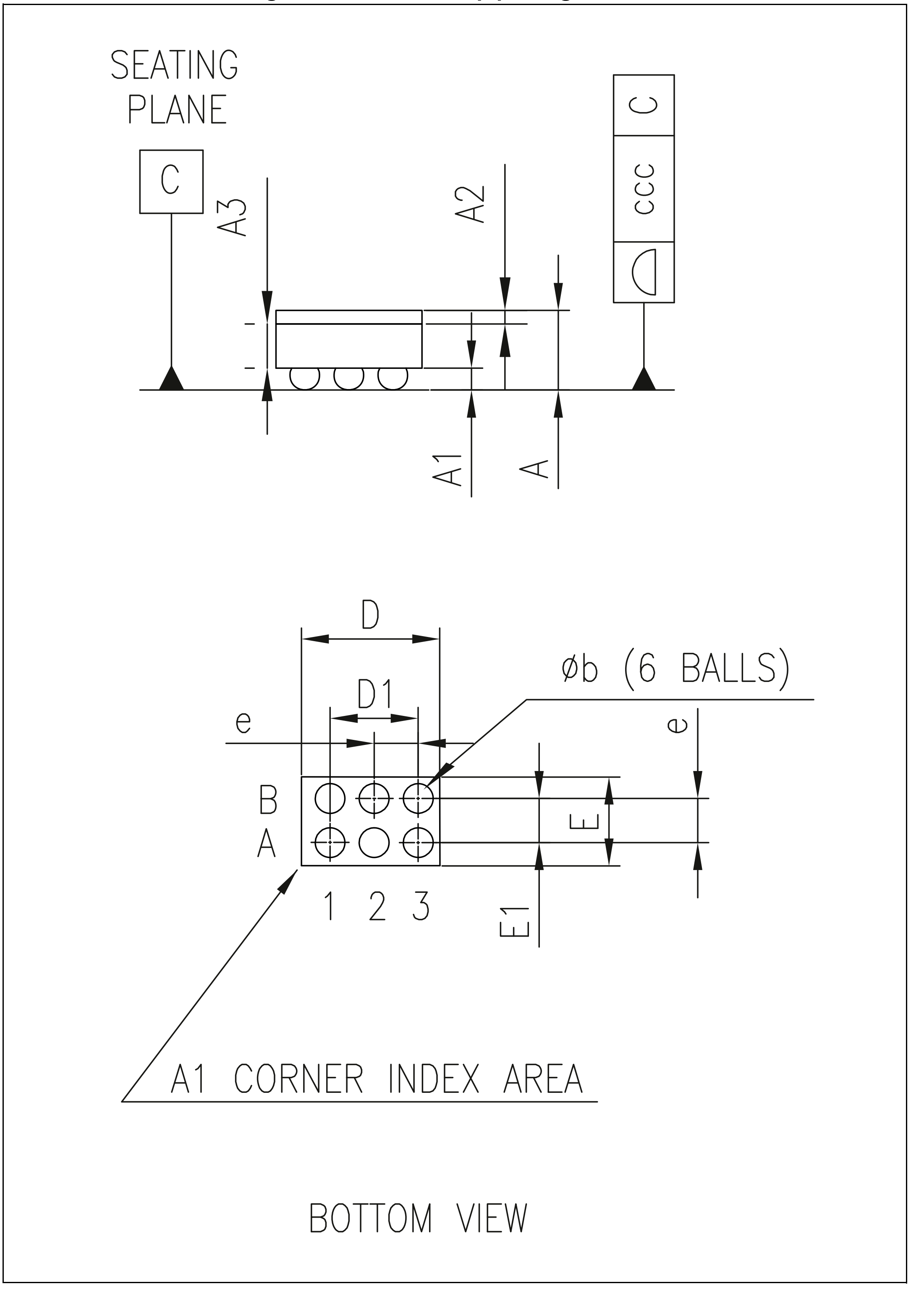


Table 6. CSP 6-bump mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.485	0.525	0.57	0.019	0.021	0.022
A1	0.17		0.23	0.007		0.009
A2		0.025	0.03		0.001	0.001
A3	0.275	0.3	0.325	0.011	0.012	0.013
b	0.23	0.26	0.29	0.009	0.01	0.011
D	1.18	1.2	1.22	0.046	0.047	0.048
D1		0.8			0.031	
E	0.78	0.8	0.82	0.031	0.031	0.032
E1		0.4			0.016	
e		0.4			0.016	
ccc			0.075			0.003

5 Ordering information

Table 7. Order codes

Order code	Temperature range	Package	Packing	Marking
TS985IJT	-40 °C to 85 °C	CSP 6-bump	Tape and reel	TBA

6 Revision history

Table 8. Document revision history

Date	Revision	Changes
23-Jun-2016	1	Initial release