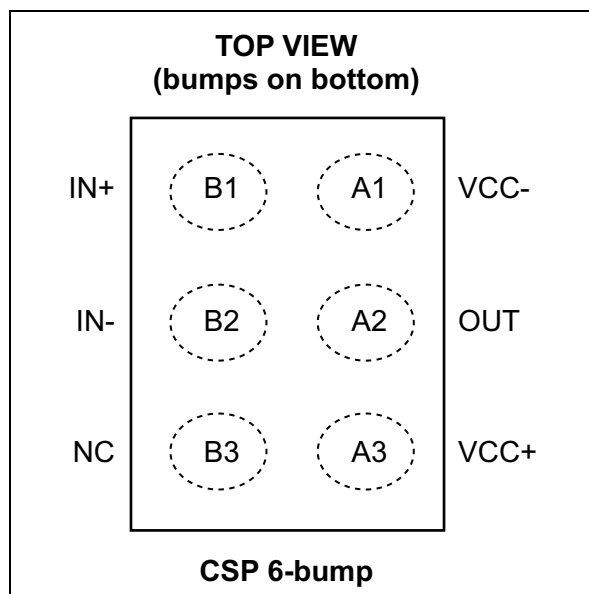


Micropower low-voltage, 1.2 x 0.8 mm CSP comparator

Datasheet - production data



Features

- Supply operation from 1.8 to 5 V
- Low current consumption: 14 μ A
- Rail to rail inputs, push-pull outputs
- Low propagation delay: 300 ns
- 60 μ A 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 μ m 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 μ A 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** 3

2 **Electrical characteristics** 4

3 **Electrical characteristic curves** 7

4 **Package information** 13

 4.1 CSP 6-bump package information 14

5 **Ordering information** 16

6 **Revision history** 17



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_{in}	Input voltage ⁽³⁾	$(V_{CC}^-) - 0.3$ to $(V_{CC}^+) + 0.3$	
V_{out}	Output voltage	5.5	
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	
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	
	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 (I_F) 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, $T_{amb} = 25\text{ °C}$	$(V_{CC}^-) - 0.25$ to $(V_{CC}^+) + 0.25$	
	Common mode input voltage range, $T_{min} \leq T_{amb} \leq T_{max}$	(V_{CC}^-) to (V_{CC}^+)	
T_{oper}	Operating free-air temperature range	-40 to 85	°C

2 Electrical characteristics

Table 3. $V_{CC}^+ = 1.8\text{ V}$, $V_{CC}^- = 0\text{ V}$, $T_{amb} = 25\text{ °C}$ (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		$\mu\text{V}/^\circ\text{C}$
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 - $V_{icm} = 0\text{ V}$		13	19	μA
	Supply current per comparator, $T_{min} \leq T_{amb} \leq T_{max}$			20	
V_{OH}	High-level output voltage, $I_{Source} = 1\text{ mA}$	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, $I_{Sink} = 1\text{ mA}$		65	80	mV
	Low-level output voltage, $T_{min} \leq T_{amb} \leq T_{max}$			95	
I_{Sink}	$V_{OUT} = 0\text{ V}$	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⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 10 mV		730		ns
	Response time high to low ⁽²⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 100 mV		300		
t_{PLH}	Response time low to high ⁽³⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 10 mV		730		
	Response time low to high ⁽³⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 100 mV		300		

1. Maximum values include unavoidable inaccuracies of the industrial tests.

2. t_{PHL} 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 $V_{ICM} + 100\text{ mV}$ to $V_{ICM} - \text{overdrive}$.

3. t_{PLH} 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 $V_{ICM} - 100\text{ mV}$ to $V_{ICM} + \text{overdrive}$.

Table 4. $V_{CC}^+ = 2.7\text{ V}$, $V_{CC}^- = 0\text{ V}$, $T_{amb} = 25\text{ }^\circ\text{C}$ (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		$\mu\text{V}/^\circ\text{C}$
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 - $V_{icm} = 0\text{ V}$		14	20	μA
	Supply current per comparator, $T_{min} \leq T_{amb} \leq T_{max}$			22	
V_{OH}	High-level output voltage, $I_{Source} = 1\text{ mA}$	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, $I_{Sink} = 1\text{ mA}$		43	55	mV
	Low-level output voltage, $T_{min} \leq T_{amb} \leq T_{max}$			65	
I_{Sink}	$V_{OUT} = 0\text{ V}$	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⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 10 mV		860		ns
	Response time high to low ⁽²⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 100 mV		330		
t_{PLH}	Response time low to high ⁽³⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 10 mV		860		
	Response time low to high ⁽³⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 100 mV		330		

1. Maximum values include unavoidable inaccuracies of the industrial tests.

2. t_{PHL} 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 $V_{ICM} + 100\text{ mV}$ to $V_{ICM} - \text{overdrive}$.

3. t_{PLH} 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 $V_{ICM} - 100\text{ mV}$ to $V_{ICM} + \text{overdrive}$.

Table 5. $V_{CC}^+ = 5\text{ V}$, $V_{CC}^- = 0\text{ V}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$ (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		$\mu\text{V}/^{\circ}\text{C}$
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 - $V_{icm} = 0\text{ V}$		16	24	μA
	Supply current per comparator, $T_{min} \leq T_{amb} \leq T_{max}$			25	
V_{OH}	High-level output voltage, $I_{Source} = 1\text{ mA}$	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, $I_{Sink} = 1\text{ mA}$		31	45	mV
	Low-level output voltage, $T_{min} \leq T_{amb} \leq T_{max}$			55	
I_{Sink}	$V_{OUT} = 0\text{ V}$	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⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 10 mV		1100		ns
	Response time high to low ⁽²⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 100 mV		420		
t_{PLH}	Response time low to high ⁽³⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 10 mV		1100		
	Response time low to high ⁽³⁾ , $V_{icm} = 0\text{ V}$, $C_L = 15\text{ pF}$, overdrive = 100 mV		420		

1. Maximum values include unavoidable inaccuracies of the industrial tests.

2. t_{PHL} 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 $V_{ICM} + 100\text{ mV}$ to $V_{ICM} - \text{overdrive}$.

3. t_{PLH} 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 $V_{ICM} - 100\text{ mV}$ to $V_{ICM} + \text{overdrive}$.

3 Electrical characteristic curves

Figure 1. Supply current vs temperature and supply voltage

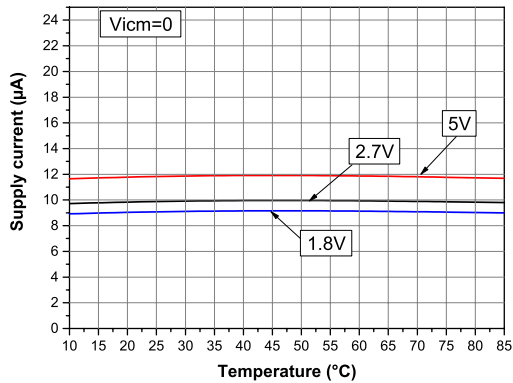


Figure 2. Supply current vs supply voltage, $V_{icm} = 0$ V, output low

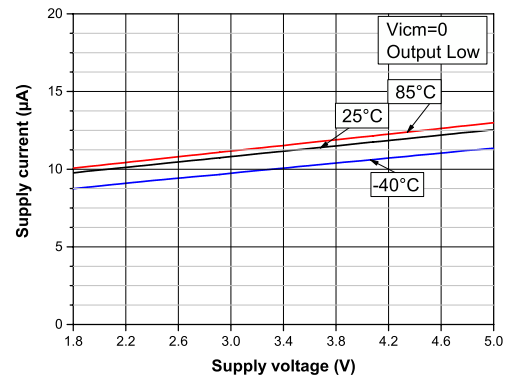


Figure 3. Supply current vs supply voltage, $V_{icm} = 0$ V, output high

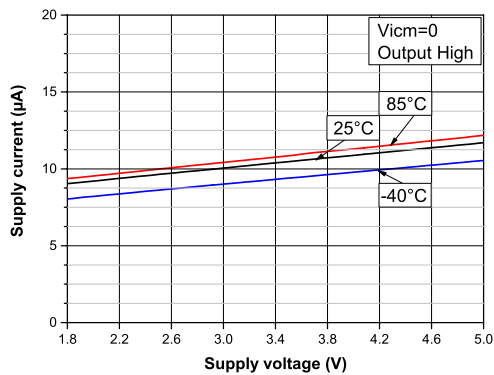


Figure 4. Supply current vs supply voltage, $V_{icm} = V_{CC}$, output low

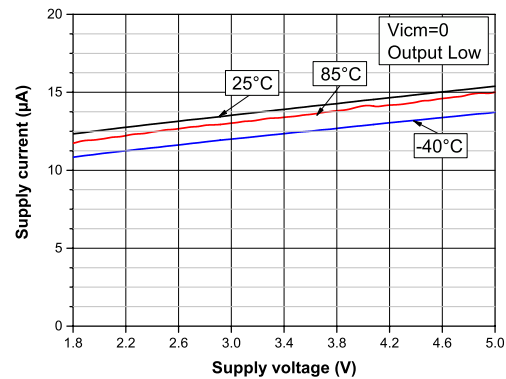


Figure 5. Supply current vs supply voltage, $V_{icm} = V_{CC}$, output high

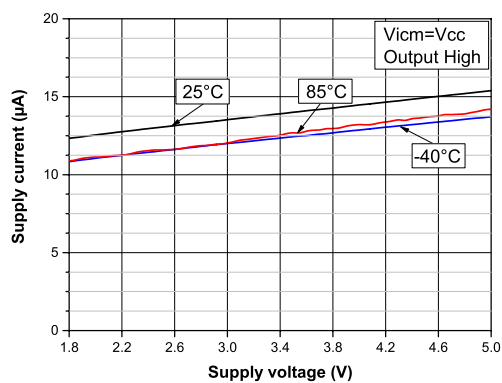


Figure 6. Input bias current vs. input common mode voltage $V_{CC} = 1.8$ V

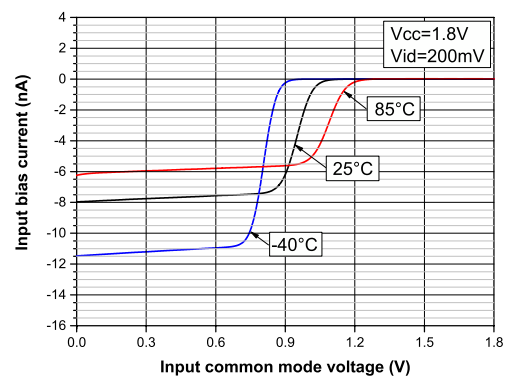


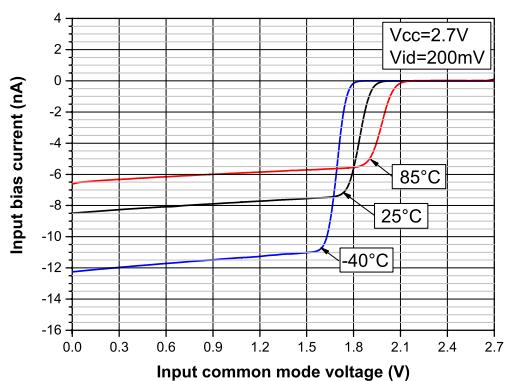
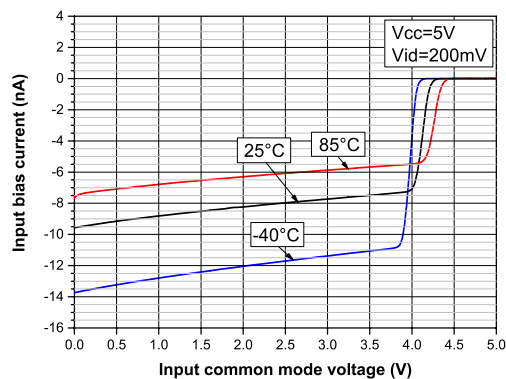
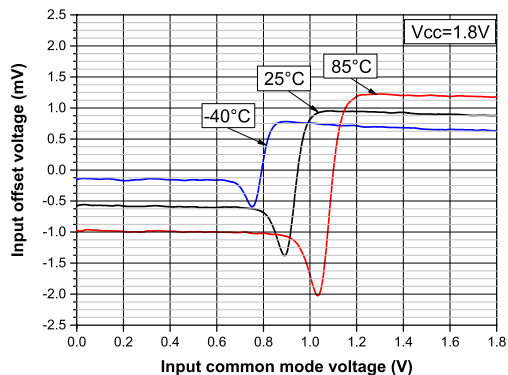
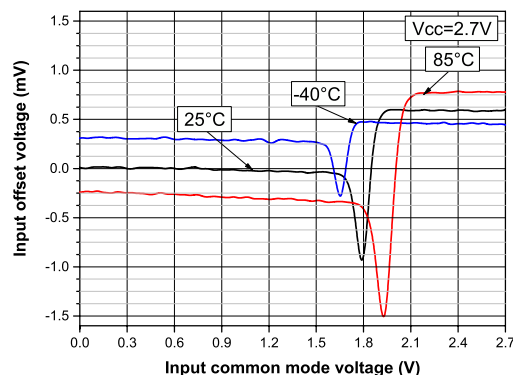
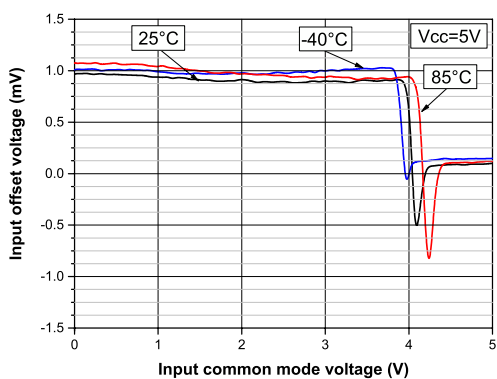
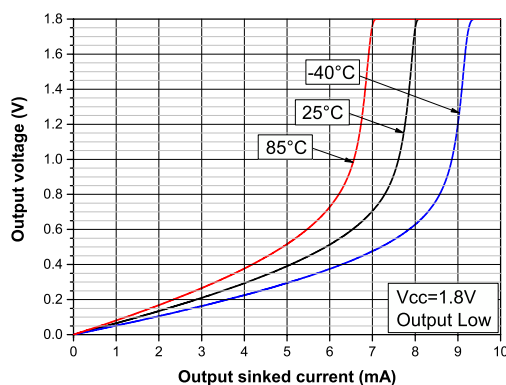
Figure 7. Input bias current vs. input common mode voltage $V_{CC} = 2.7\text{ V}$ **Figure 8. Input bias current vs. input common mode voltage $V_{CC} = 5\text{ V}$** **Figure 9. Input offset voltage vs. input common mode voltage $V_{CC} = 1.8\text{ V}$** **Figure 10. Input offset voltage vs. input common mode voltage $V_{CC} = 2.7\text{ V}$** **Figure 11. Input offset voltage vs. input common mode voltage $V_{CC} = 5\text{ V}$** **Figure 12. Output voltage vs. output sink current $V_{CC} = 1.8\text{ V}$** 

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

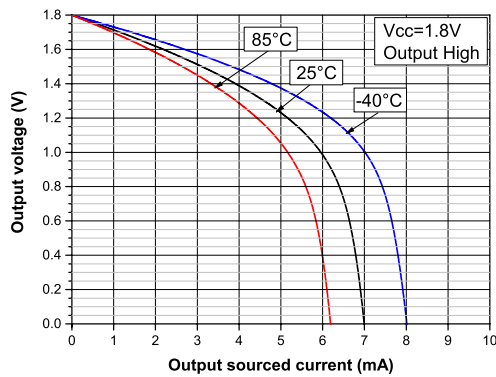


Figure 14. Output voltage vs. output sink current $V_{CC} = 2.7\text{ V}$

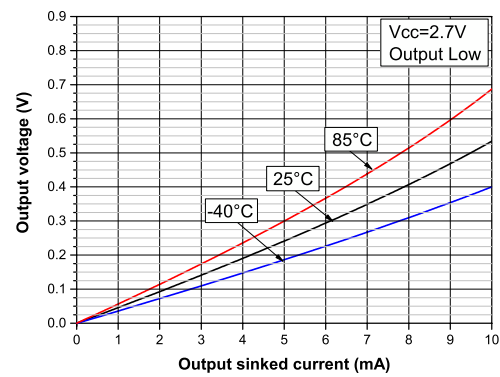


Figure 15. Output voltage vs. output source current $V_{CC} = 2.7\text{ V}$

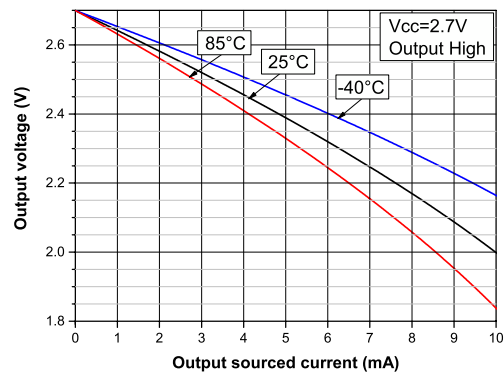


Figure 16. Output voltage vs. output sink current $V_{CC} = 5\text{ V}$

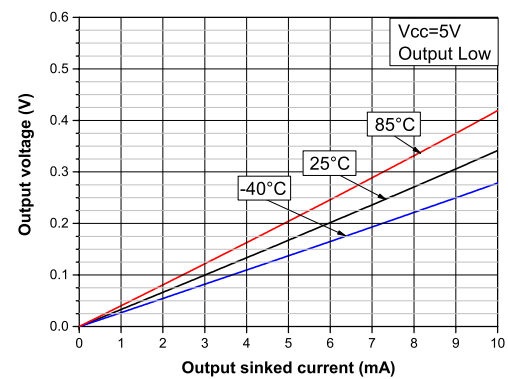


Figure 17. Output voltage vs. output source current $V_{CC} = 5\text{ V}$

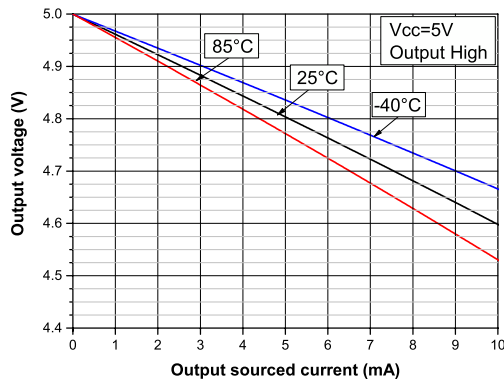


Figure 18. Propagation delay low to high vs temperature with 50 mV input overdrive

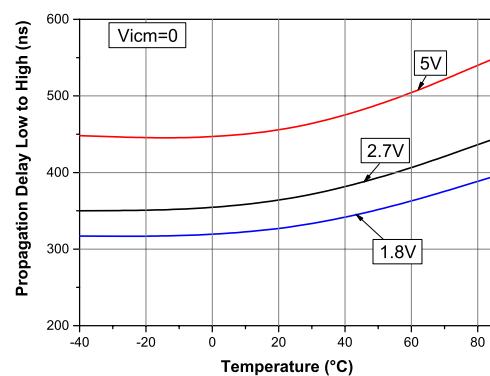


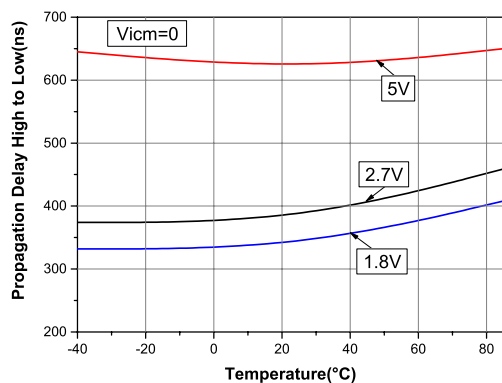
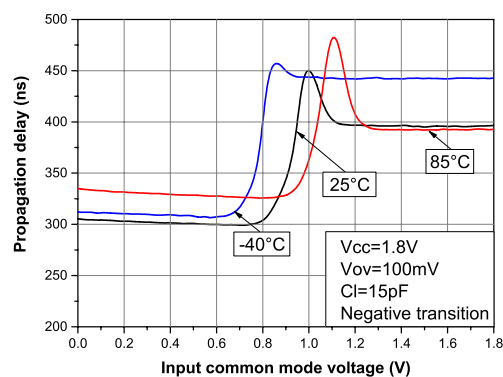
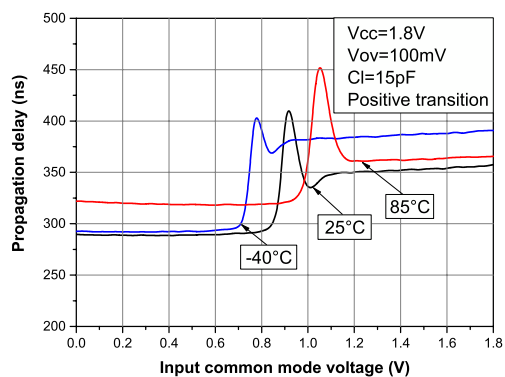
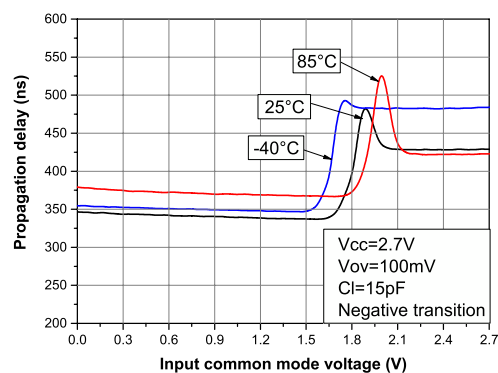
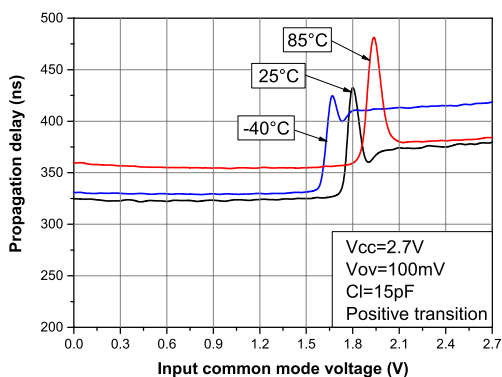
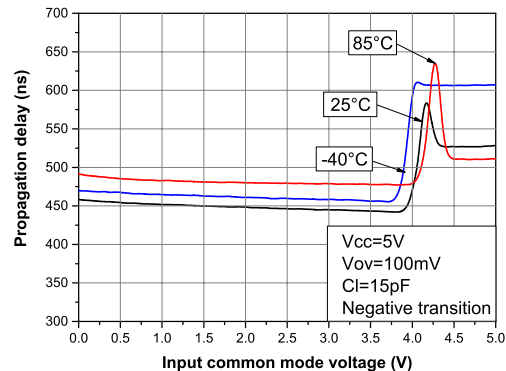
Figure 19. Propagation delay high to low vs temperature with 50 mV input overdrive**Figure 20. Propagation delay vs input common mode voltage $V_{CC} = 1.8 V$ negative transition****Figure 21. Propagation delay vs input common mode voltage $V_{CC} = 1.8 V$ positive transition****Figure 22. Propagation 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**

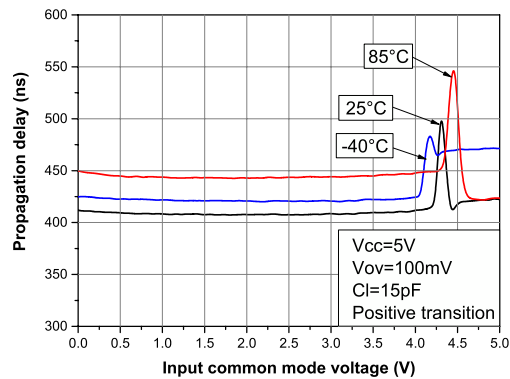
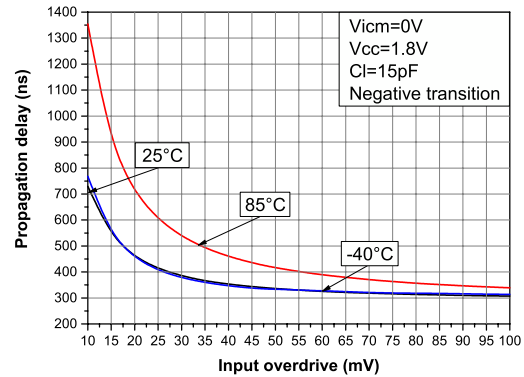
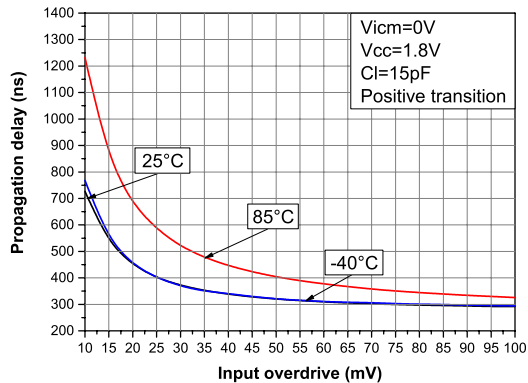
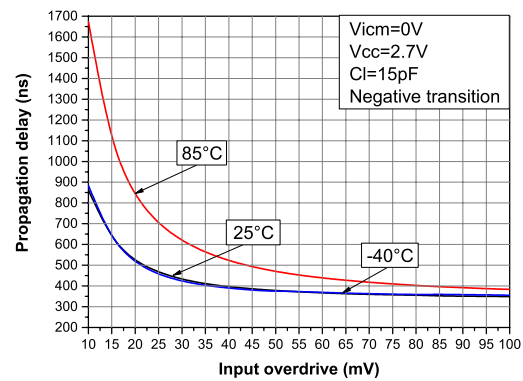
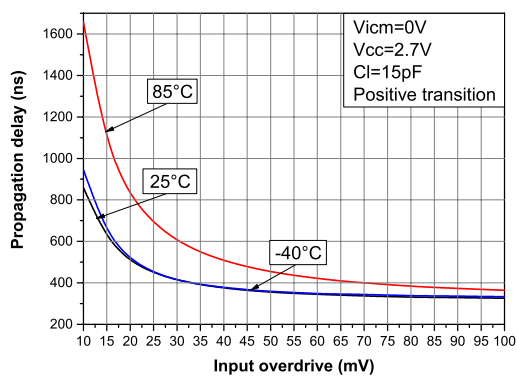
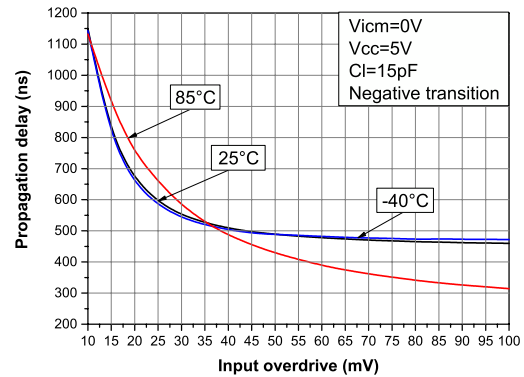
Figure 25. Propagation delay vs input common mode voltage $V_{CC} = 5\text{ V}$ positive transition**Figure 26. Propagation delay vs input overdrive voltage $V_{CC} = 1.8\text{ V}$ negative transition****Figure 27. Propagation delay vs input overdrive voltage $V_{CC} = 1.8\text{ V}$ positive transition****Figure 28. Propagation delay vs input overdrive voltage $V_{CC} = 2.7\text{ V}$ negative transition****Figure 29. Propagation delay vs input overdrive voltage $V_{CC} = 2.7\text{ V}$ positive transition****Figure 30. Propagation delay vs input overdrive voltage $V_{CC} = 5\text{ V}$ negative transition**

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

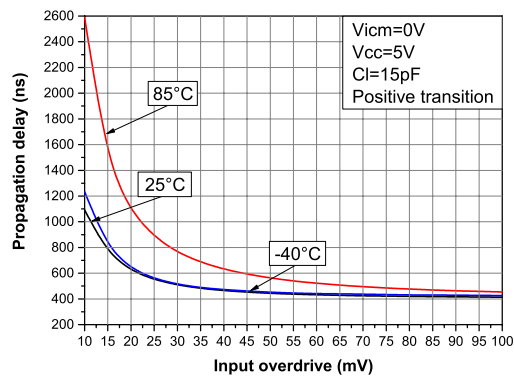
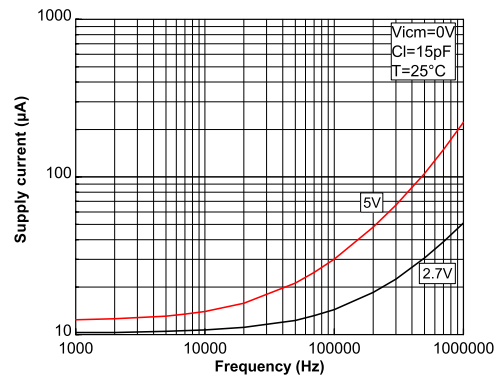


Figure 32. Supply current vs output transition frequency and supply voltage



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

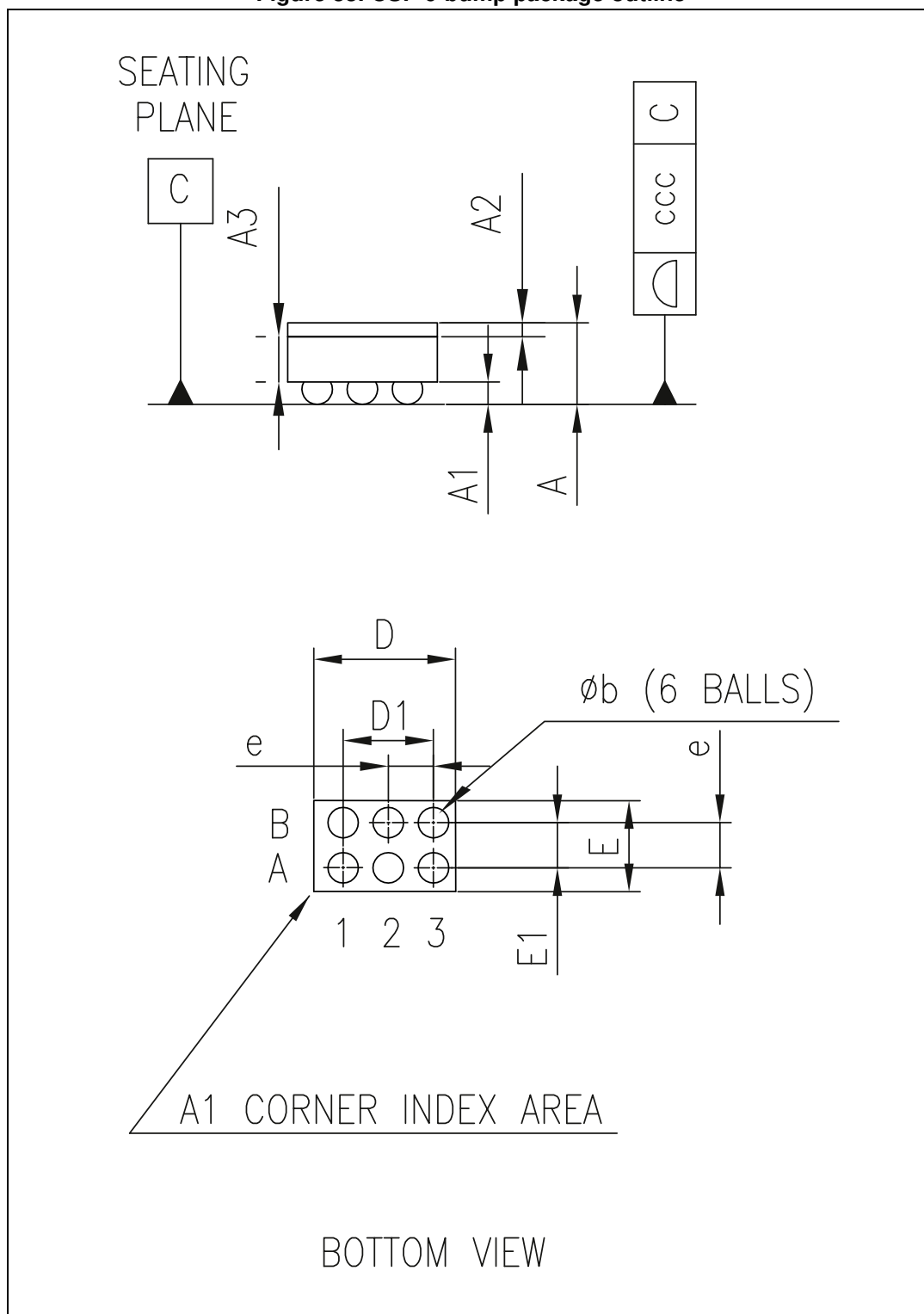


Table 6. CSP 6-bump mechanical data

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	WA9

6 Revision history

Table 8. Document revision history

Date	Revision	Changes
23-Jun-2016	1	Initial release
04-Apr-2024	2	Updated Marking in Table 7

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, please refer to www.st.com/trademarks. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2024 STMicroelectronics – All rights reserved