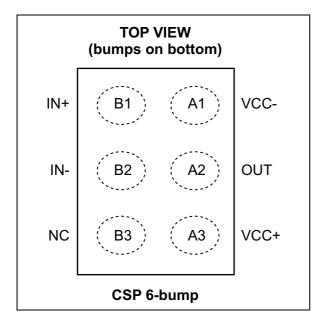


Micropower low-voltage, 1.2 x 0.8 mm CSP comparator

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 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 TS985

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2	Electrical characteristics4
3	Electrical characteristic curves
4	Package information
	4.1 CSP 6-bump package information
5	Ordering information
6	Revision history

1 Absolute maximum ratings

Table 1. Absolute maximum ratings (AMR)

Symbol	Parameter	Value	Unit
V _{CC}	Supply voltage ⁽¹⁾	5.5	
V _{id}	Differential input voltage (2)	±5.5	V
V _{in}	Input voltage $^{(3)}$ $(V_{CC}^{-}) - 0.3 \text{ to } (V_{CC}^{+}) + 0.3$		V
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	C
R _{thja}	Thermal resistance junction to ambient ⁽⁵⁾	TBA	°C/W
ESD	HBM: human body model ⁽⁶⁾	2000	V
ESD	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 $[V_{\text{icm}}=(V_{\text{in}}^+ + V_{\text{in}}^-)/2]$ 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.	Common mode input voltage range, T _{amb} = 25 °C	(V_{CC}^{-}) - 0.25 to (V_{CC}^{+}) + 0.25	V
V _{icm}	Common mode input voltage range, T _{min} ≤T _{amb} ≤T _{max}	(V _{CC} ⁻) to (V _{CC} ⁺)	
T _{oper}	Operating free-air temperature range	-40 to 85	°C



Electrical characteristics TS985

2 Electrical characteristics

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

Symbol	Parameter	Min.	Тур.	Max.	Unit	
\/	Input offset voltage, full V _{icm} range		0.5	8	mV	
V _{io}	Input offset voltage, T _{min} ≤T _{amb} ≤T _{max}			9		
ΔV _{io} /ΔΤ	Input offset voltage drift vs. temperature		4.5		uV/°C	
V _{Hyst}	Input hysteresis voltage		3		mV	
	Input bias current ⁽¹⁾ , full V _{icm} range		14	40		
l _{ib}	Input bias current $^{(1)}$, $T_{min} \le T_{amb} \le T_{max}$			100	nA	
	Input offset current, full V _{icm} range		1	10		
l _{io}	Input offset current, $T_{min} \le T_{amb} \le T_{max}$			100		
CMR	Common-mode rejection ratio, V _{icm} = 0 to 1.8 V	43			dB	
	Supply current per comparator, no load - V _{icm} = 0 V		13	19		
Icc	Supply current per comparator, $T_{min} \le T_{amb} \le T_{max}$			20	μA	
.,	High-level output voltage, I _{Source} = 1 mA	1.69	1.71		V	
V _{OH}	High-level output voltage, $T_{min} \le T_{amb} \le T_{max}$	1.67				
V	Low-level output voltage, I _{Sink} = 1 mA		65	80	mV	
V _{OL}	Low-level output voltage, $T_{min} \le T_{amb} \le T_{max}$			95		
1.	V _{OUT} = 0 V	6	8			
I _{Sink}	$T_{min} \le T_{amb} \le T_{max}$	5			mA	
1.	$V_{OUT} = V_{CC}$	4.5	7.3			
I _{Source}	$T_{min} \le T_{amb} \le T_{max}$	3.5				
	Response time high to low $^{(2)}$, V_{icm} = 0 V, C_L = 15 pF, overdrive = 10 mV		730			
t _{PHL}	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		ns	
	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.	Тур.	Max.	Unit	
\/	Input offset voltage, full V _{icm} range		0.5	8	mV	
V _{io}	Input offset voltage, T _{min} ≤T _{amb} ≤T _{max}			9	IIIV	
ΔV _{io} /ΔΤ	Input offset voltage drift vs. temperature		4.5		uV/°C	
V _{Hyst}	Input hysteresis voltage		3		mV	
	Input bias current ⁽¹⁾ , full V _{icm} range		15	40		
l _{ib}	Input bias current $^{(1)}$, $T_{min} \le T_{amb} \le T_{max}$			100	n ^	
	Input offset current, full V _{icm} range		1	10	− nA	
l _{io}	Input offset current, $T_{min} \le T_{amb} \le T_{max}$			100		
CMR	Common-mode rejection ratio, V _{icm} = 0 to 2.7 V	48			dB	
	Supply current per comparator, no load - V _{icm} = 0 V		14	20		
I _{CC}	Supply current per comparator, $T_{min} \le T_{amb} \le T_{max}$			22	μA	
.,	High-level output voltage, I _{Source} = 1 mA	2.6	2.64		V	
V _{OH}	High-level output voltage, $T_{min} \le T_{amb} \le T_{max}$	2.5				
\/	Low-level output voltage, I _{Sink} = 1 mA		43	55	mV	
V _{OL}	Low-level output voltage, $T_{min} \le T_{amb} \le T_{max}$			65	1110	
	V _{OUT} = 0 V	14	18			
I _{Sink}	$T_{min} \le T_{amb} \le T_{max}$	12			m ^	
1.	V _{OUT} = V _{CC}	14	18		mA	
I _{Source}	$T_{min} \le T_{amb} \le T_{max}$	12				
	Response time high to low $^{(2)}$, $V_{icm} = 0$ V, $C_L = 15$ pF, overdrive = 10 mV		860			
t _{PHL}	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		– ns	
	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.

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.

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.

Electrical characteristics TS985

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

Symbol	Parameter	Min.	Тур.	Max.	Unit	
\/	Input offset voltage, full V _{icm} range		0.5	8	m\/	
V _{io}	Input offset voltage, T _{min} ≤T _{amb} ≤T _{max}			9	→ mV	
ΔV _{io} /ΔΤ	Input offset voltage drift vs. temperature		4.5		uV/°C	
V _{Hyst}	Input hysteresis voltage		3		mV	
1	Input bias current ⁽¹⁾ , full V _{icm} range		17	50		
l _{ib}	Input bias current ⁽¹⁾ , T _{min} ≤T _{amb} ≤T _{max}			100	٦,	
1	Input offset current, full V _{icm} range		1	10	nA	
l _{io}	Input offset current, $T_{min} \le T_{amb} \le T_{max}$			100		
CMR	Common-mode rejection ratio, V _{icm} = 0 to 5 V	56			dB	
1	Supply current per comparator, no load - V _{icm} = 0 V		16	24		
I _{CC}	Supply current per comparator, $T_{min} \le T_{amb} \le T_{max}$			25	μA	
	High-level output voltage, I _{Source} = 1 mA	4.85	4.9		V	
V_{OH}	High-level output voltage, $T_{min} \le T_{amb} \le T_{max}$	4.8				
V	Low-level output voltage, I _{Sink} = 1 mA		31	45	m\/	
V _{OL}	Low-level output voltage, $T_{min} \le T_{amb} \le T_{max}$			55	mV	
	V _{OUT} = 0 V	35	42			
I _{Sink}	$T_{min} \le T_{amb} \le T_{max}$	30				
1.	V _{OUT} = V _{CC}	45	52		mA	
I _{Source}	$T_{min} \le T_{amb} \le T_{max}$	40				
	Response time high to low $^{(2)}$, V_{icm} = 0 V, C_L = 15 pF, overdrive = 10 mV		1100			
t _{PHL}	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		ns	
	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.

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.

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

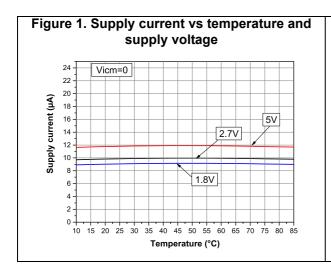
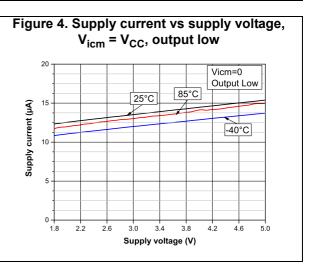


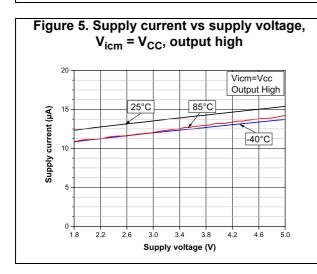
Figure 2. Supply current vs supply voltage,

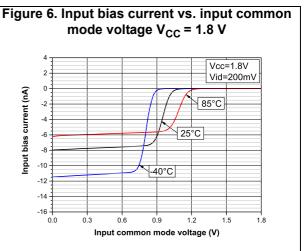
V_{icm} = 0 V, output low

Vicm=0
Output Low

15
25°C
40°C
Supply voltage (V)







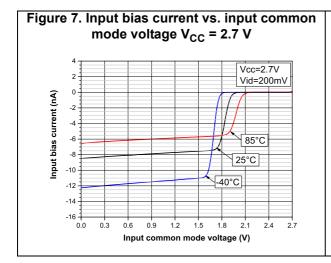
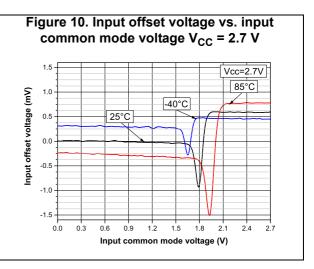
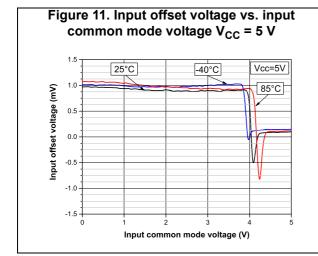


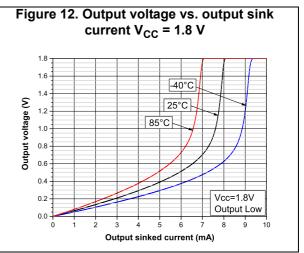
Figure 8. Input bias current vs. input common mode voltage $V_{CC} = 5 V$ Vcc=5V Vid=200mV Input bias current (nA) 85°C 25°C -10 -40°C -14 -16 -0.0 2.0 2.5 3.0 Input common mode voltage (V)

Figure 9. Input offset voltage vs. input common mode voltage V_{CC} = 1.8 V 2.5 Vcc=1.8V 2.0 85°C Input offset voltage (mV) 1.5 25°C 1.0 -40°C 0.5 0.0 -0.5 -1.0 -1.5 -2.0 0.2 0.0 0.6 0.8 1.0 1.2

Input common mode voltage (V)







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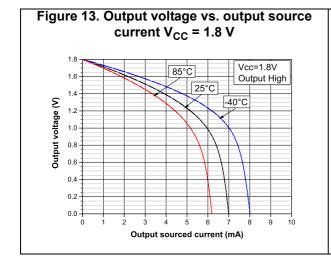


Figure 14. Output voltage vs. output sink current V_{CC} = 2.7 V 0.9 Vcc=2.7V 0.8 Output Low 0.7 Output voltage (V) 0.6 85°C 0.5 25°C 0.4 -40°C 0.3 0.1 0.0 Output sinked current (mA)

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

2.6

85°C

2.7

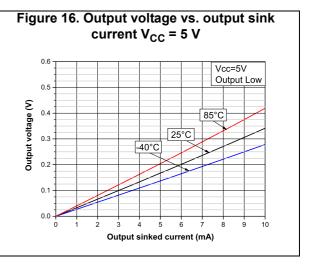
Output High

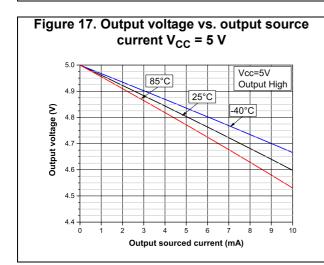
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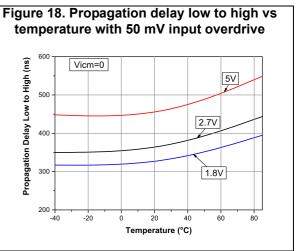
2.0

2.0

Output sourced current (mA)







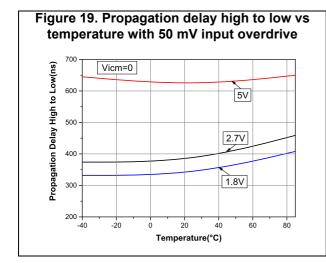
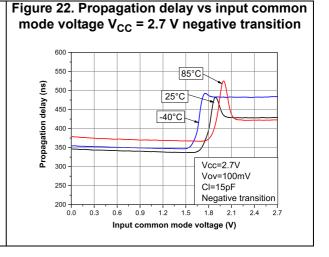
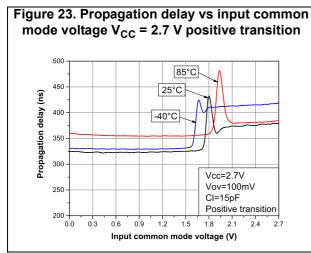
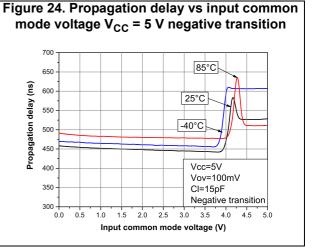


Figure 20. Propagation delay vs input common mode voltage V_{CC} = 1.8 V negative transition 450 Propagation delay (ns) 400 85°C 350 25°C 300 -40°C Vcc=1.8V Vov=100mV CI=15pF Negative transition 0.0 0.4 0.6 0.8 1.2 1.4 1.6 1.0 Input common mode voltage (V)

Figure 21. Propagation delay vs input common mode voltage V_{CC} = 1.8 V positive transition Vcc=1.8V Vov=100mV 450 CI=15pF Propagation delay (ns) Positive transition 400 350 85°C 300 25°C -40°C 250 200 0.2 0.4 0.6 0.8 1.0 1.2 1.4 Input common mode voltage (V)





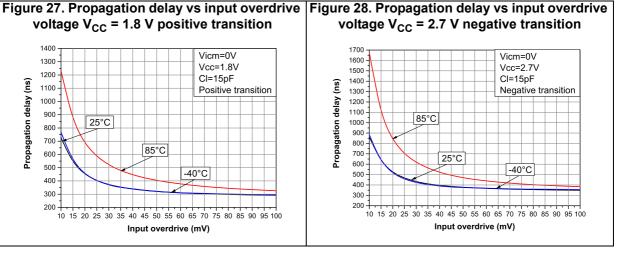


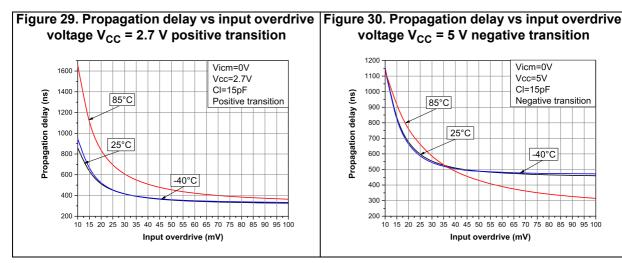
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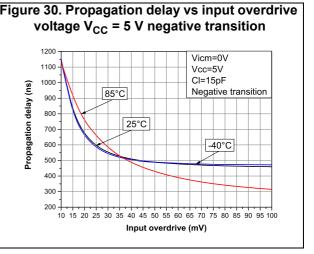
Figure 25. Propagation delay vs input common | Figure 26. Propagation delay vs input overdrive mode voltage V_{CC} = 5 V positive transition 85°C 550 (ns) 25°C Propagation delay 500 -40°C 450 400 Vcc=5V Vov=100mV 350 CI=15pF Positive transition 300 0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 Input common mode voltage (V)

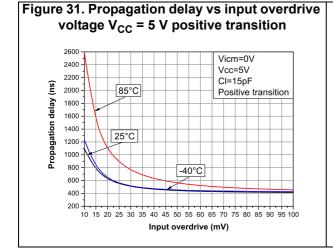
voltage V_{CC} = 1.8 V negative transition Vicm=0V 1300 Vcc=1.8V 1200 CI=15pF (ns) 1100 Negative transition Propagation delay 1000 900 25°C 800 700 85°C 600 500 -40°C 300 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 Input overdrive (mV)

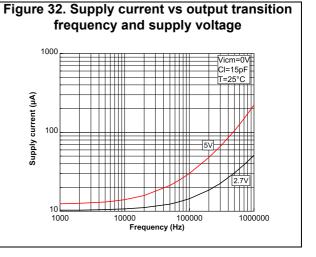
voltage V_{CC} = 1.8 V positive transition Vicm=0V 1300 Vcc=1.8V 1200 CI=15pF (ns) 1100 Positive transition 1000 Propagation delay 900 25°C 800 700 85°C 600 500 -40°C 400 300 200 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 Input overdrive (mV)











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TS985 Package information

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.



Package information TS985

4.1 CSP 6-bump package information

Figure 33. CSP 6-bump package outline SEATING PLANE øb (6 BALLS) е Φ В ليا 3 CORNER INDEX AREA BOTTOM VIEW

TS985 Package information

Table 6. CSP 6-bump mechanical data

			Dimer	nsions		
Ref.		Millimeters			Inches	
	Min.	Тур.	Max.	Min.	Тур.	Max.
А	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	
е		0.4			0.016	
ccc			0.075			0.003

Ordering information TS985

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

TS985 Revision history

6 Revision history

Table 8. Document revision history

Date	Revision	Changes
23-Jun-2016	1	Initial release

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