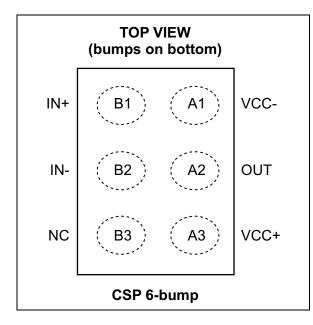


Micropower low-voltage, 1.2 x 0.8 mm CSP comparator

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

Contents

1	Absolute maximum ratings
2	Electrical characteristics
3	Electrical characteristic curves
4	Package information
	4.1 CSP 6-bump package information
5	Ordering information
6	Revision history



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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 to (V_{CC}^{+}) + 0.3	V
V _{out}	Output voltage	5.5	
IF	Forward current in ESD protection diodes on inputs ⁽⁴⁾	10	mA
Tj	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.
- 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.	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	
V	Input offset voltage, full V _{icm} range		0.5	8	mV	
V _{io}	Input offset voltage, T _{min} ≤T _{amb} ≤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	
	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		
I _{CC}	Supply current per comparator, $T_{min} \le T_{amb} \le T_{max}$			20	μA	
V	High-level output voltage, I _{Source} = 1 mA	1.69	1.71		V	
V _{OH}	ligh-level output voltage, $T_{min} \le T_{amb} \le T_{max}$ 1.67			ן י ן		
\/	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			
	Response time low to high $^{(3)}$, V_{icm} = 0 V, C_L = 15 pF, overdrive = 10 mV		730		- ns	
t _{PLH}	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.

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	
$\Delta V_{io}/\Delta T$	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		15	40		
l _{ib}	Input bias current $^{(1)}$, $T_{min} \le T_{amb} \le T_{max}$			100	nΛ	
	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	T	
I _{CC}	Supply current per comparator, $T_{min} \le T_{amb} \le T_{max}$	v current per comparator, $T_{min} \le T_{amb} \le T_{max}$ 22		22	<u>μ</u> Α	
	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	m\/	
V_{OL}	Low-level output voltage, $T_{min} \le T_{amb} \le T_{max}$			65	mV	
	V _{OUT} = 0 V	14	18			
I _{Sink}	$T_{min} \le T_{amb} \le T_{max}$	12				
	V _{OUT} = V _{CC}	14	18		— mA	
I _{Source}	$T_{min} \le T_{amb} \le T_{max}$	12				
4	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.

^{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.

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	
V	Input offset voltage, full V _{icm} range		0.5	8	mV	
V _{io}	Input offset voltage, T _{min} ≤T _{amb} ≤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	
	Input bias current ⁽¹⁾ , full V _{icm} range		17	50		
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 5 V	56			dB	
1	Supply current per comparator, no load - V _{icm} = 0 V		16	24	11Δ	
I _{CC}	Supply current per comparator, $T_{min} \le T_{amb} \le T_{max}$	χ 25				
V	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	45 mV	
V _{OL}	Low-level output voltage, $T_{min} \le T_{amb} \le T_{max}$			55		
	V _{OUT} = 0 V	35	42			
I _{Sink}	$T_{min} \le T_{amb} \le T_{max}$	30			mA	
I.	V _{OUT} = V _{CC}	45	52			
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]	
	Response time low to high $^{(3)}$, V_{icm} = 0 V, C_L = 15 pF, overdrive = 10 mV		1100		– ns	
t _{PLH}	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.

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

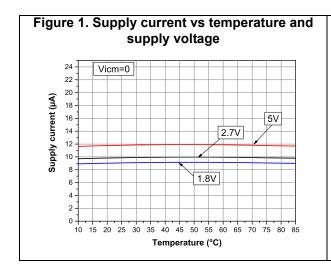


Figure 2. Supply current vs supply voltage,

V_{icm} = 0 V, output low

Vicm=0
Output Low

15
25°C
40°C
Supply voltage (V)

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

Vicm=0 Output High

Vicm=0 Output High

Vicm=0 Output High

40°C

Supply voltage (V)

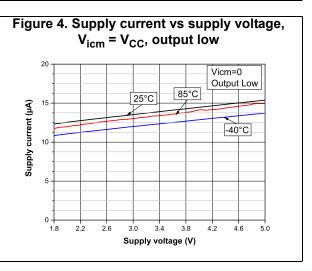


Figure 5. Supply current vs supply voltage,

V_{icm} = V_{CC}, output high

Vicm=V_{CC}

Output High

15

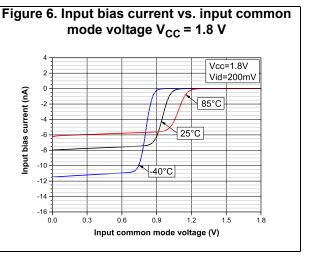
25°C

85°C

40°C

40°C

Supply voltage (V)



577

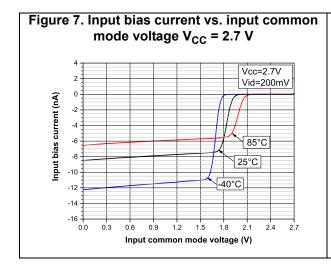


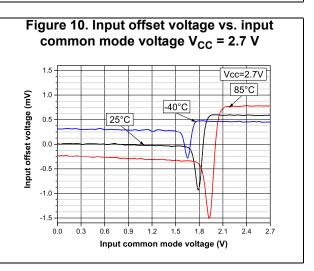
Figure 8. Input bias current vs. input common mode voltage V_{CC} = 5 V

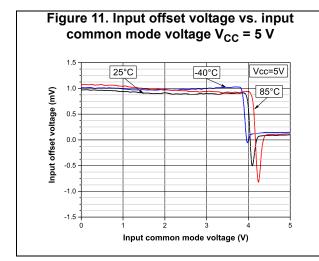
Figure 9. Input offset voltage vs. input common mode voltage V_{CC} = 1.8 V 2.5 Vcc=1.8V 2.0 85°C Input offset voltage (mV) 1.5 25°C 1.0 -40°C 0.5 0.0 -0.5 -1.0 -1.5 -2.0

0.6 0.8 1.0 1.2

Input common mode voltage (V)

0.2





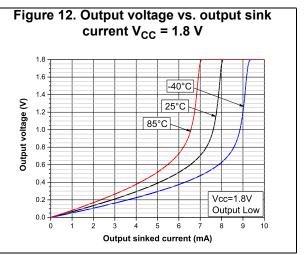
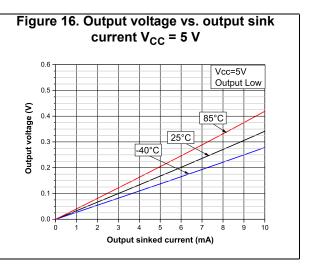
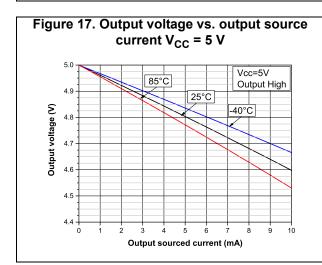


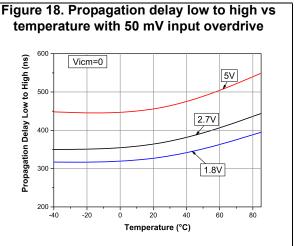
Figure 13. Output voltage vs. output source current V_{CC} = 1.8 V Vcc=1.8V 85°C Output High 25°C 1.4 -40°C Output voltage (V) 1.2 1.0 0.8 0.6 0.2 0.0 Output sourced current (mA)

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 0.2 0.1 0.0 Output sinked current (mA)

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







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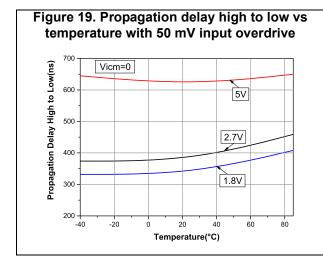


Figure 20. Propagation delay vs input common mode voltage V_{CC} = 1.8 V negative transition 450 Propagation delay (ns) 400 85°C 350 25°C 300 -40°C Vcc=1.8V Vov=100mV CI=15pF Negative transition 200 0.4 0.6 0.8 1.2 1.4 1.6 0.0 1.0 Input common mode voltage (V)

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 0.8 0.4 0.6 1.0 1.2 Input common mode voltage (V)

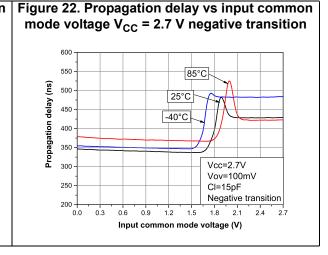


Figure 23. Propagation delay vs input common mode voltage V_{CC} = 2.7 V positive transition 85°C 450 25°C Propagation delay (ns) 400 -40°C 350 Vcc=2.7V Vov=100mV 250 CI=15pF Positive transition 200 1.2 Input common mode voltage (V)

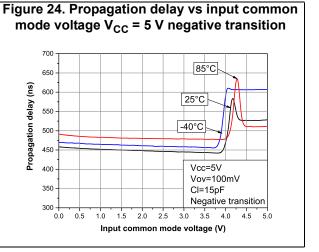
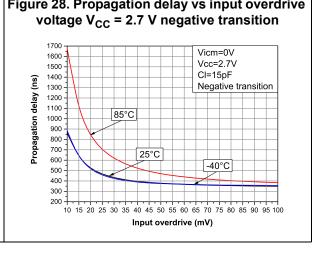
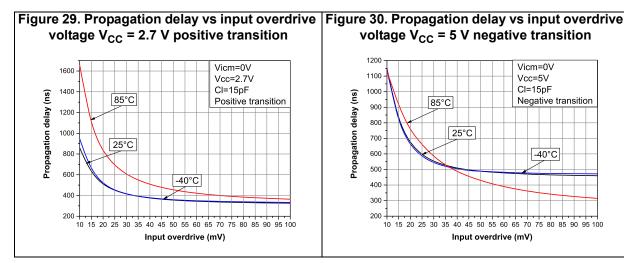


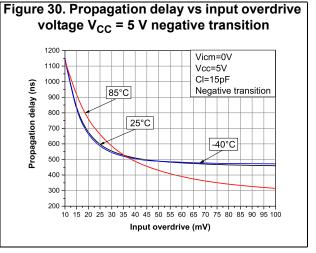
Figure 25. Propagation delay vs input common | Figure 26. Propagation delay vs input overdrive mode voltage V_{CC} = 5 V positive transition 85°C 550 (ns) 25°C Propagation delay 500 -40°C 450 400 Vcc=5V Vov=100mV 350 CI=15pF Positive transition 300 -3.0 3.5 4.0 4.5 5.0 0.0 0.5 1.0 2.0 2.5 Input common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

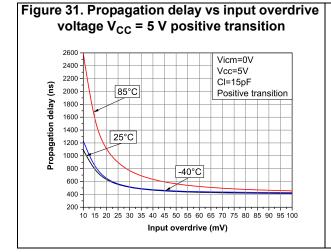
voltage V_{CC} = 1.8 V negative transition Vicm=0V 1300 Vcc=1.8V 1200 CI=15pF (ns) 1100 Negative transition Propagation delay 1000 900 25°C 800 700 85°C 600 500 -40°C 400 300 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 Input overdrive (mV)

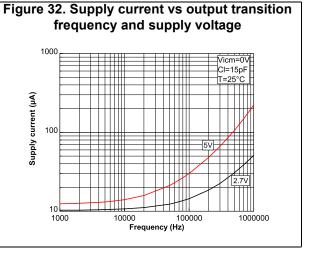
Figure 27. Propagation delay vs input overdrive | Figure 28. Propagation delay vs input overdrive voltage V_{CC} = 1.8 V positive transition Vicm=0V 1300 Vcc=1.8V 1200 CI=15pF (ns) 1100 Positive transition 1000 Propagation delay 900 25°C 800 700 85°C 600 500 -40°C 400 300 200 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 Input overdrive (mV)











57

TS985 Package information

4 Package information

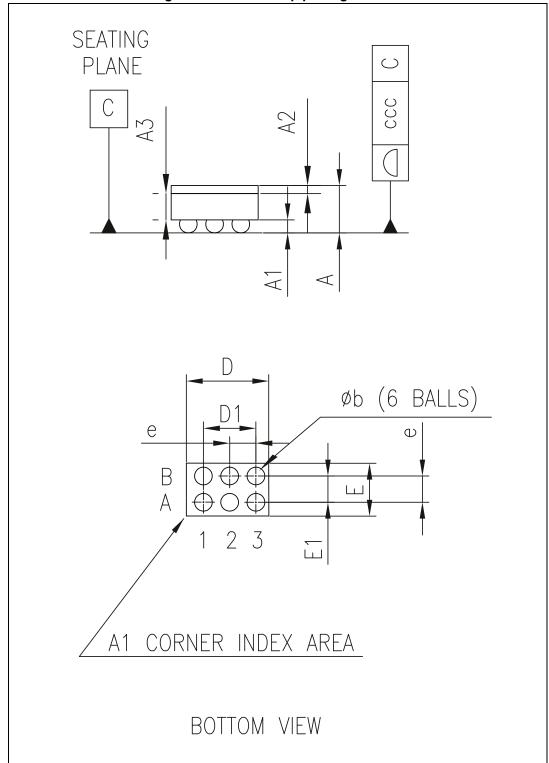
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] packages, depending on their level of environmental compliance. ECOPACK[®] specifications, grade definitions and product status are available at: www.st.com. ECOPACK[®] is an ST trademark.



Package information TS985

4.1 CSP 6-bump package information

Figure 33. CSP 6-bump package outline



57/

TS985 Package information

Table 6. CSP 6-bump mechanical data

			Dimer	nsions		
Ref.		Millimeters			Inches	
	Min.	Тур.	Max.	Min.	Тур.	Max.
Α	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
ĺ	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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47/