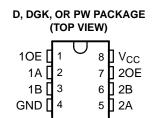


FEATURES

- Undershoot Protection for OFF Isolation on A and B Ports up to -2 V
- Bidirectional Data Flow With Near-Zero
 Propagation Delay
- Low ON-State Resistance (r_{on}) Characteristics (r_{on} = 3 Ω Typ)
- Low Input/Output Capacitance Minimizes Loading and Signal Distortion (C_{io(OFF)} = 5 pF Typ)
- Data and Control Inputs Provide Undershoot Clamp Diodes
- Low Power Consumption (I_{CC} = 3 μA Max)
- V_{cc} Operating Range From 4 V to 5.5 V
- Data I/Os Support 0- to 5-V Signaling Levels (0.8 V, 1.2 V, 1.5 V, 1.8 V, 2.5 V, 3.3 V, 5 V)

- Control Inputs Can Be Driven by TTL or 5-V/3.3-V CMOS Outputs
- I_{off} Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 100 mA Per JESD 78, ClassII
- ESD Performance Tested Per JESD 22

 2000-V Human-Body Model (A114-B, Class II)
 - 1000-V Charged-Device Model (C101)
- Supports Both Digital and Analog Applications: USB Interface, Bus Isolation, Low-Distortion Signal Gating



DESCRIPTION/ORDERING INFORMATION

The SN74CBT3305C is a high-speed TTL-compatible FET bus switch with low ON-state resistance (r_{on}), allowing for minimal propagation delay. Active undershoot-protection circuitry on the A and B ports of the device provides protection for undershoot up to -2 V by sensing an undershoot event and ensuring that the switch remains in the proper OFF state.

The SN74CBT3305C is organized as two 1-bit bus switches with separate output-enable (1OE, 2OE) inputs. It can be used as two 1-bit bus switches or as one 2-bit bus switch. When OE is high, the associated 1-bit bus switch is ON, and the A port is conncected to the B port, allowing bidirectional data flow between ports. When OE is low, the associated 1-bit bus switch is OFF, and the high-impedance state exists between the A and B ports.

T _A	P/	CKAGE ⁽¹⁾	ORDERABLE PART NUMBER	TOP-SIDE MARKING		
	SOIC – D	Tube	SN74CBT3305CD	– CU305C		
	50IC - D	Tape and reel	SN74CBT3305CDR			
–40°C to 85°C	VSSOP – DGK	Tape and reel	SN74CBT3305CDGKR	SNR		
		Tube	SN74CBT3305CPW	0110050		
	TSSOP – PW	Tape and reel	SN74CBT3305CPWR	CU305C		

ORDERING INFORMATION

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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SN74CBT3305C DUAL FET BUS SWITCH 5-V BUS SWITCH WITH –2-V UNDERSHOOT PROTECTION



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DESCRIPTION/ORDERING INFORMATION (CONTINUED)

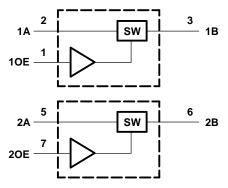
This device is fully specified for partial-power-down application using I_{off} . The I_{off} feature ensures that damaging current will not backflow through the device when it is powered down. The device has isolation during power off.

To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

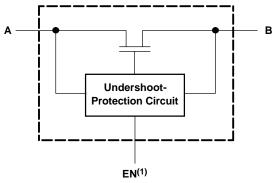
FUNCTION TABLE (EACH BUS SWITCH)

INPUT OE	INPUT/OUTPUT A	FUNCTION		
Н	В	A port = B port		
L	Z	Disconnect		

LOGIC DIAGRAM (POSITIVE LOGIC)



SIMPLIFIED SCHEMATIC, EACH FET SWITCH (SW)



⁽¹⁾ EN is the internal enable signal applied to the switch.

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Absolute Maximum Ratings⁽¹⁾

over operating free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
V _{CC}	Supply voltage		-0.5	7	V
V _{IN}	Control input voltage range ⁽²⁾⁽³⁾		-0.5	7	V
V _{I/O}	Switch I/O voltage range ⁽²⁾⁽³⁾⁽⁴⁾		-0.5	7	V
I _{IK}	Control input clamp current	V _{IN} < 0		-50	mA
I _{I/OK}	I/O port clamp current	V _{I/O} < 0		-50	mA
I _{I/O}	ON-state switch current ⁽⁵⁾			±128	mA
	Continuous current through V _{CC} or GND			±100	mA
		D package		97	
θ_{JA}	Package thermal impedance ⁽⁶⁾	DGK package		179	°C/W
		PW package		149	
T _{stg}	Storage temperature range		-65	150	°C

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) All voltages are with respect to ground unless otherwise specified.

(3) The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

(4) V_I and V_O are used to denote specific conditions for $V_{I/O}$.

(5) $I_{\rm I}$ and $I_{\rm O}$ are used to denote specific conditions for $I_{\rm I/O}$.

(6) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions⁽¹⁾

		MIN	MAX	UNIT
V _{CC}	Supply voltage	4	5.5	V
VIH	High-level control input voltage	2	5.5	V
VIL	Low-level control input voltage	0	0.8	V
V _{I/O}	Data input/output voltage	0	5.5	V
T _A	Operating free-air temperature	-40	85	°C

 All unused control inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, Implications of Slow or Floating CMOS Inputs, literature number SCBA004.

SN74CBT3305C **DUAL FET BUS SWITCH** 5-V BUS SWITCH WITH -2-V UNDERSHOOT PROTECTION

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Electrical Characteristics⁽¹⁾

over recommended operating free-air temperature range (unless otherwise noted)

Р	ARAMETER		TEST CONDITION	NS	MIN TYP ⁽²⁾	MAX	UNIT
V _{IK}	Control inputs	V _{CC} = 4.5 V,	I _{IN} = -18 mA			-1.8	V
V _{IKU}	Data inputs	V _{CC} = 5 V,	0 mA > I _I \ge -50 mA, V _{IN} = V _{CC} or GND,	Switch OFF		-2	V
I _{IN}	Control inputs	V _{CC} = 5.5 V,	$V_{IN} = V_{CC} \text{ or } GND$			±1	μΑ
I _{OZ} ⁽³⁾		V _{CC} = 5.5 V,	$V_{O} = 0$ to 5.5 V, $V_{I} = 0$,	Switch OFF, $V_{IN} = V_{CC}$ or GND		±10	μΑ
I _{off}		$V_{CC} = 0,$	$V_0 = 0$ to 5.5 V,	$V_{I} = 0$		10	μA
I _{CC}		V _{CC} = 5.5 V,	$I_{I/O} = 0,$ $V_{IN} = V_{CC}$ or GND,	Switch ON or OFF		3	μΑ
$\Delta I_{CC}^{(4)}$	Control inputs	V _{CC} = 5.5 V,	One input at 3.4 V,	Other inputs at V_{CC} or GND		2.5	mA
C _{in}	Control inputs	$V_{IN} = 3 V \text{ or } 0$			3		pF
Cio(OFF)		$V_{I/O} = 3 V \text{ or } 0,$	Switch OFF,	$V_{IN} = V_{CC}$ or GND	5		pF
C _{io(ON)}		$V_{I/O} = 3 V \text{ or } 0,$	Switch ON,	$V_{IN} = V_{CC}$ or GND	12.5		pF
		$V_{CC} = 4 V$, TYP at $V_{CC} = 4 V$	V _I = 2.4 V,	I _O = -15 mA	8	12	
r _{on} (5)			V 0	I _O = 64 mA	3	6	Ω
0		$V_{CC} = 4.5 V$	V ₁ = 0	I _O = 30 mA	3	6	
			V _I = 2.4 V,	I _O = -15 mA	5	10	

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 V_{IN} and I_{IN} refer to control inputs. V_I , V_O , I_I , and I_O refer to data pins. All typical values are at $V_{CC} = 5 V$ (unless otherwise noted), $T_A = 25^{\circ}C$. For I/O ports, the parameter I_{OZ} includes the input leakage current. (1)

(2)

(3)

This is the increase in supply current for each input that is at the specified voltage level, rather than V_{CC} or GND (4)

Measured by the voltage drop between the A and B terminals at the indicate current through the switch. ON-state resistance is (5) determined by the lower of the voltages of the two (A or B) terminals.

Switching Characteristics

over recommended operating free-air temperature range (unless otherwise noted) (see Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 4 V$	V _{CC} = 5 ± 0.5 1	UNIT	
	(INFOT)	(001701)	MIN MAX	MIN	MAX	
t _{pd} ⁽¹⁾	A or B	B or A	0.24		0.15	ns
t _{en}	OE	A or B	4.4	1.5	4.1	ns
t _{dis}	OE	A or B	5.1	1.5	4.8	ns

(1) The propagation delay is the calculated RC time constant of the typical ON-state resistance of the switch and the specified load capacitance, when driven by an ideal voltage source (zero output impedance).

Undershoot Characteristics

See Figure 1 and Figure 2

PARAMETER		TEST CONDITIO	NS	MIN	TYP ⁽¹⁾	MAX	UNIT
V _{OUTU}	V _{CC} = 5.5 V,	Switch OFF,	$V_{IN} = V_{CC}$ or GND	2	V _{OH} – 0.3		V

(1) All typical values are at V_{CC} = 5 V (unless otherwise noted), $T_A = 25^{\circ}C$.

SN74CBT3305C DUAL FET BUS SWITCH 5-V BUS SWITCH WITH –2-V UNDERSHOOT PROTECTION

SCDS125B-SEPTEMBER 2003-REVISED AUGUST 2005

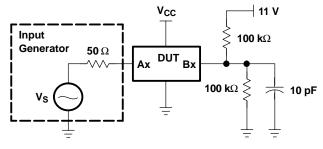


Figure 1. Device Test Setup

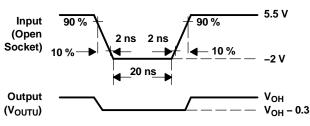


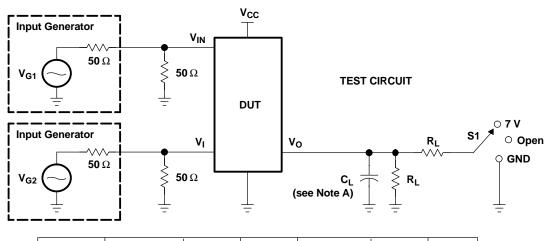
Figure 2. Transient Input Voltage (VI) and Output Voltage (VOUTU) Waveforms (Switch OFF)

SN74CBT3305C DUAL FET BUS SWITCH 5-V BUS SWITCH WITH –2-V UNDERSHOOT PROTECTION

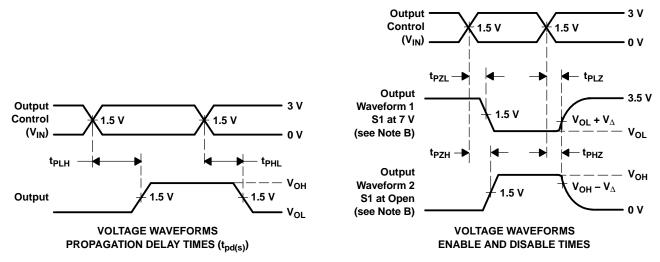
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PARAMETER MEASUREMENT INFORMATION



TEST	V _{CC}	S1	RL	VI	CL	V_{Δ}
t _{pd(s)}	$\begin{array}{c} 5 \text{ V} \pm 0.5 \text{ V} \\ 4 \text{ V} \end{array}$	Open Open	500 Ω 500 Ω	V _{CC} or GND V _{CC} or GND	50 pF 50 pF	
t _{PLZ} /t _{PZL}	$\begin{array}{c} 5 \text{ V} \pm 0.5 \text{ V} \\ 4 \text{ V} \end{array}$	7 V 7 V	500 Ω 500 Ω	GND GND	50 pF 50 pF	0.3 V 0.3 V
t _{PHZ} /t _{PZH}	$\begin{array}{c} 5 \text{ V} \pm 0.5 \text{ V} \\ 4 \text{ V} \end{array}$	Open Open	500 Ω 500 Ω	V _{CC} V _{CC}	50 pF 50 pF	0.3 V 0.3 V



NOTES: A. C_L includes probe and jig capacitance.

- B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
- C. All input pulses are supplied by generators having the following characteristics: PRR \leq 10 MHz, Z_Q = 50 Ω , t_r \leq 2.5 ns, t_f \leq 2.5 ns.
- D. The outputs are measured one at a time, with one transition per measurement.
- E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
- F. t_{PZL} and t_{PZH} are the same as t_{en} .
- G. t_{PLH} and t_{PHL} are the same as $t_{pd(s)}$. The t_{pd} propagation delay is the calculated RC time constant of the typical ON-state resistance of the switch and the specified load capacitance, when driven by an ideal voltage source (zero output impedance).
- H. All parameters and waveforms are not applicable to all devices.

Figure 3. Test Circuit and Voltage Waveforms



PACKAGING INFORMATION

Orderable Device	Status	Package Type	•	Pins	•	Eco Plan	Lead finish/	MSL Peak Temp	Op Temp (°C)	Device Marking	Samples
	(1)		Drawing		Qty	(2)	Ball material	(3)		(4/5)	
							(6)				
SN74CBT3305CD	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CU305C	Samples
SN74CBT3305CDR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CU305C	Samples
SN74CBT3305CPW	ACTIVE	TSSOP	PW	8	150	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CU305C	Samples
SN74CBT3305CPWR	ACTIVE	TSSOP	PW	8	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CU305C	Samples
SN74CBT3305CPWRG4	ACTIVE	TSSOP	PW	8	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	CU305C	Samples

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ RoHS: TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (CI) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <= 1000ppm threshold. Antimony trioxide based flame retardants must also meet the <= 1000ppm threshold requirement.

⁽³⁾ MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

⁽⁴⁾ There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

⁽⁵⁾ Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

⁽⁶⁾ Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.



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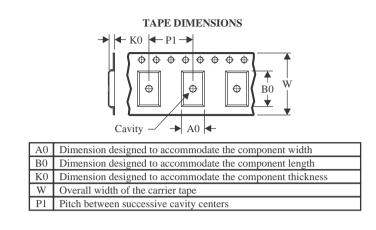


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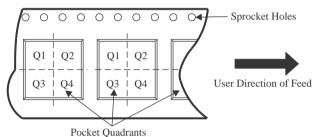
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TAPE AND REEL INFORMATION





QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



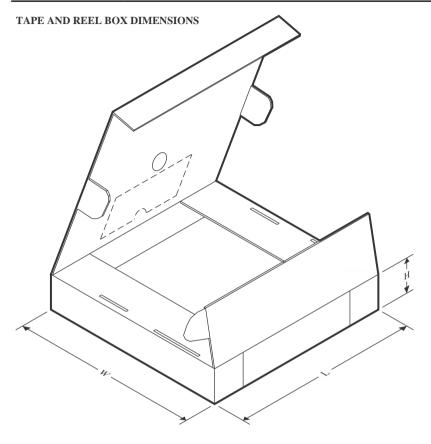
*All dimensions are nominal												
Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74CBT3305CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
SN74CBT3305CDR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
SN74CBT3305CPWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1



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PACKAGE MATERIALS INFORMATION

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*All dimensions are nominal

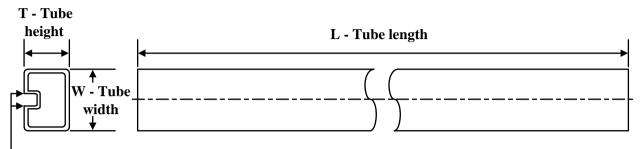
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74CBT3305CDR	SOIC	D	8	2500	356.0	356.0	35.0
SN74CBT3305CDR	SOIC	D	8	2500	340.5	336.1	25.0
SN74CBT3305CPWR	TSSOP	PW	8	2000	367.0	367.0	35.0

TEXAS INSTRUMENTS

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TUBE



- B - Alignment groove width

*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	Τ (μm)	B (mm)
SN74CBT3305CD	D	SOIC	8	75	506.6	8	3940	4.32
SN74CBT3305CD	D	SOIC	8	75	507	8	3940	4.32
SN74CBT3305CPW	PW	TSSOP	8	150	530	10.2	3600	3.5

D0008A



PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.

- 2. This drawing is subject to change without notice.
- 3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
- 4. This dimension does not include interlead flash.
- 5. Reference JEDEC registration MS-012, variation AA.



D0008A

EXAMPLE BOARD LAYOUT

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



D0008A

EXAMPLE STENCIL DESIGN

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

9. Board assembly site may have different recommendations for stencil design.



PW0008A



PACKAGE OUTLINE

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES:

- 1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M. 2. This drawing is subject to change without notice. 3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not
- exceed 0.15 mm per side.
- 4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
- 5. Reference JEDEC registration MO-153, variation AA.



PW0008A

EXAMPLE BOARD LAYOUT

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



PW0008A

EXAMPLE STENCIL DESIGN

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES: (continued)

9. Board assembly site may have different recommendations for stencil design.



^{8.} Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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