

SN74CBTS16211 24-BIT FET BUS SWITCH WITH SCHOTTKY DIODE CLAMPING

SCDS050D – MARCH 1998 – REVISED OCTOBER 2000

- Member of Texas Instruments' Widebus™ Family
- 5-Ω Switch Connection Between Two Ports
- TTL-Compatible Input and Output Levels

description

The SN74CBTS16211 provides 24 bits of high-speed TTL-compatible bus switching with Schottky diodes on the I/Os to clamp undershoot. The low on-state resistance of the switch allows connections to be made with minimal propagation delay.

The device can operate as a dual 12-bit bus switch or as a single 24-bit bus switch. When $\overline{1OE}$ is low, 1A is connected to 1B. When $\overline{2OE}$ is low, 2A is connected to 2B.

DGG, DGV, OR DL PACKAGE (TOP VIEW)

NC	1	56	$\overline{1OE}$
1A1	2	55	$\overline{2OE}$
1A2	3	54	1B1
1A3	4	53	1B2
1A4	5	52	1B3
1A5	6	51	1B4
1A6	7	50	1B5
GND	8	49	GND
1A7	9	48	1B6
1A8	10	47	1B7
1A9	11	46	1B8
1A10	12	45	1B9
1A11	13	44	1B10
1A12	14	43	1B11
2A1	15	42	1B12
2A2	16	41	2B1
V _{CC}	17	40	2B2
2A3	18	39	2B3
GND	19	38	GND
2A4	20	37	2B4
2A5	21	36	2B5
2A6	22	35	2B6
2A7	23	34	2B7
2A8	24	33	2B8
2A9	25	32	2B9
2A10	26	31	2B10
2A11	27	30	2B11
2A12	28	29	2B12

NC – No internal connection

ORDERING INFORMATION

T _A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SSOP – DL	Tube	SN74CBTS16211DL	CBTS16211
		Tape and reel	SN74CBTS16211DLR	
	TSSOP – DGG	Tape and reel	SN74CBTS16211DGGR	CBTS16211
	TVSOP – DGV	Tape and reel	SN74CBTS16211DGVR	CYS211

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



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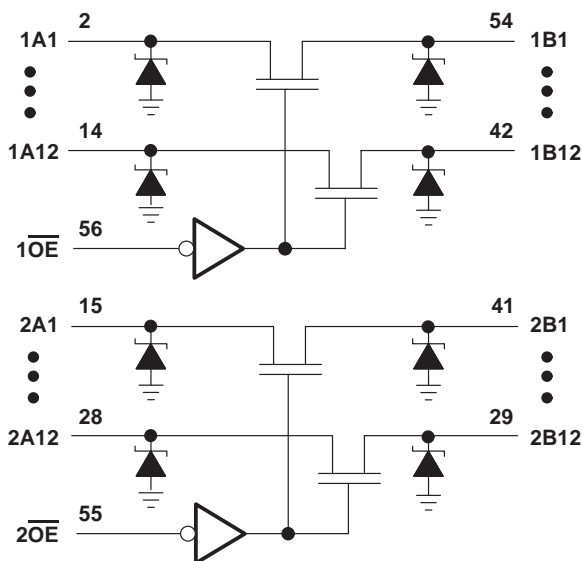
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FUNCTION TABLE
 (each 12-bit bus switch)

INPUT OE	FUNCTION
L	A port = B port
H	Disconnect

logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC}	-0.5 V to 7 V
Input voltage range, V_I (see Note 1)	-0.5 V to 7 V
Continuous channel current	128 mA
Input clamp current, I_{IK} ($V_I < 0$)	-50 mA
Package thermal impedance, θ_{JA} (see Note 2):	
DGG package	64°C/W
DGV package	48°C/W
DL package	56°C/W
Storage temperature range, T_{stg}	-65°C to 150°C

† 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.

- NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
 2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 3)

	MIN	MAX	UNIT
V_{CC} Supply voltage	4	5.5	V
V_{IH} High-level control input voltage	2		V
V_{IL} Low-level control input voltage		0.8	V
T_A Operating free-air temperature	-40	85	°C

NOTE 3: 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.



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

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{IK}		$V_{CC} = 4.5\text{ V}$,	$I_I = -18\text{ mA}$			-1.2	V
I_I	I_{IL}	$V_{CC} = 5.5\text{ V}$,	$V_I = \text{GND}$			-1	μA
	I_{IH}	$V_{CC} = 5.5\text{ V}$,	$V_I = 5.5\text{ V}$			150	
I_{CC}		$V_{CC} = 5.5\text{ V}$,	$I_O = 0$, $V_I = V_{CC}$ or GND			3	μA
ΔI_{CC}^\ddagger	Control inputs	$V_{CC} = 5.5\text{ V}$,	One input at 3.4 V, Other inputs at V_{CC} or GND			2.5	mA
C_i	Control inputs	$V_I = 3\text{ V}$ or 0				3	pF
$C_{io(\text{OFF})}$		$V_O = 3\text{ V}$ or 0,	$\overline{\text{OE}} = V_{CC}$			5.5	pF
r_{on}^\S	$V_{CC} = 4\text{ V}$, TYP at $V_{CC} = 4\text{ V}$	$V_I = 2.4\text{ V}$,	$I_I = 15\text{ mA}$			14	Ω
		$V_I = 0$	$I_I = 64\text{ mA}$			5	
	$V_{CC} = 4.5\text{ V}$	$I_I = 30\text{ mA}$			5	7	
		$V_I = 2.4\text{ V}$,	$I_I = 15\text{ mA}$			8	

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

‡ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

§ Measured by the voltage drop between the A and B terminals at the indicated current through the switch. On-state resistance is determined by the lowest voltage of the two (A or B) terminals.

switching characteristics over recommended operating free-air temperature range, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

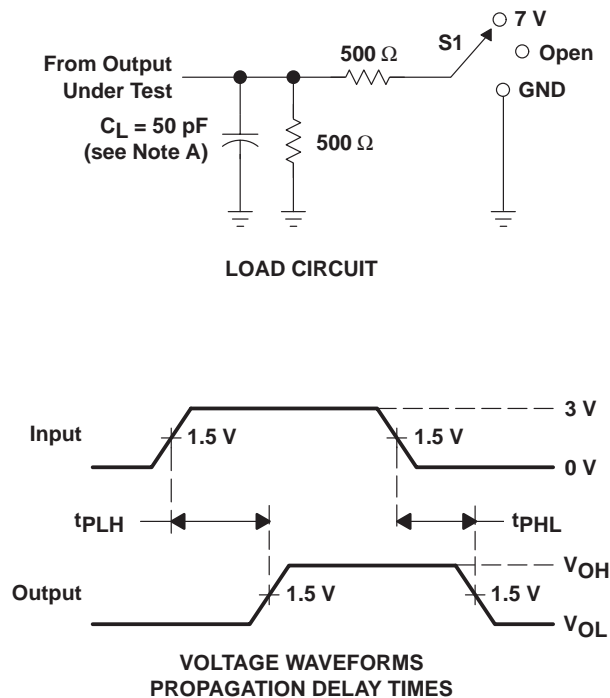
PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 4\text{ V}$		$V_{CC} = 5\text{ V} \pm 0.5\text{ V}$		UNIT
			MIN	MAX	MIN	MAX	
t_{pd}^\parallel	A or B	B or A		0.35		0.25	ns
t_{en}	$\overline{\text{OE}}$	A or B		9.3	3.3	8.6	ns
t_{dis}	$\overline{\text{OE}}$	A or B		7.1	2.8	7.9	ns

¶ 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).

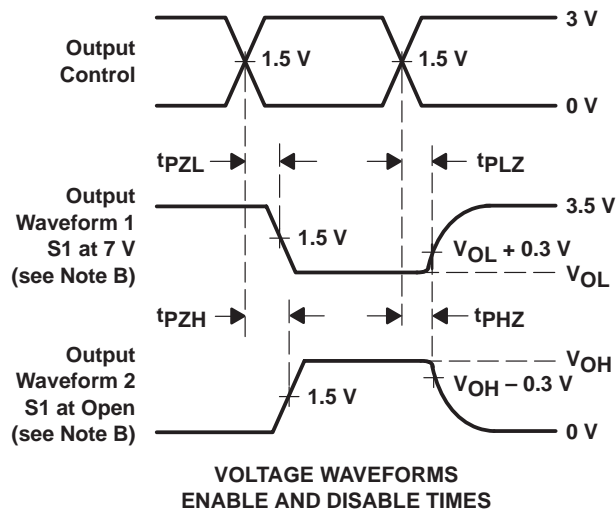
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PARAMETER MEASUREMENT INFORMATION



TEST	S1
t _{pd}	Open
t _{PLZ} /t _{PZL}	7 V
t _{PHZ} /t _{PZH}	Open



- 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 ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
 - D. The outputs are measured one at a time with one transition per measurement.
 - E. t_{PZL} 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}.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
74CBTS16211DGGRE4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74CBTS16211DGGRG4	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74CBTS16211DGVRE4	ACTIVE	TVSOP	DGV	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74CBTS16211DGVRG4	ACTIVE	TVSOP	DGV	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74CBTS16211DLRG4	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74CBTS16211DGGR	ACTIVE	TSSOP	DGG	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74CBTS16211DGVR	ACTIVE	TVSOP	DGV	56	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74CBTS16211DL	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74CBTS16211DLG4	ACTIVE	SSOP	DL	56	20	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74CBTS16211DLR	ACTIVE	SSOP	DL	56	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

⁽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⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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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	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74CBTS16211DGGR	TSSOP	DGG	56	2000	330.0	24.4	8.6	15.6	1.8	12.0	24.0	Q1
SN74CBTS16211DGVR	TVSOP	DGV	56	2000	330.0	24.4	6.8	11.7	1.6	12.0	24.0	Q1
SN74CBTS16211DLR	SSOP	DL	56	1000	330.0	32.4	11.35	18.67	3.1	16.0	32.0	Q1

TAPE AND REEL BOX DIMENSIONS



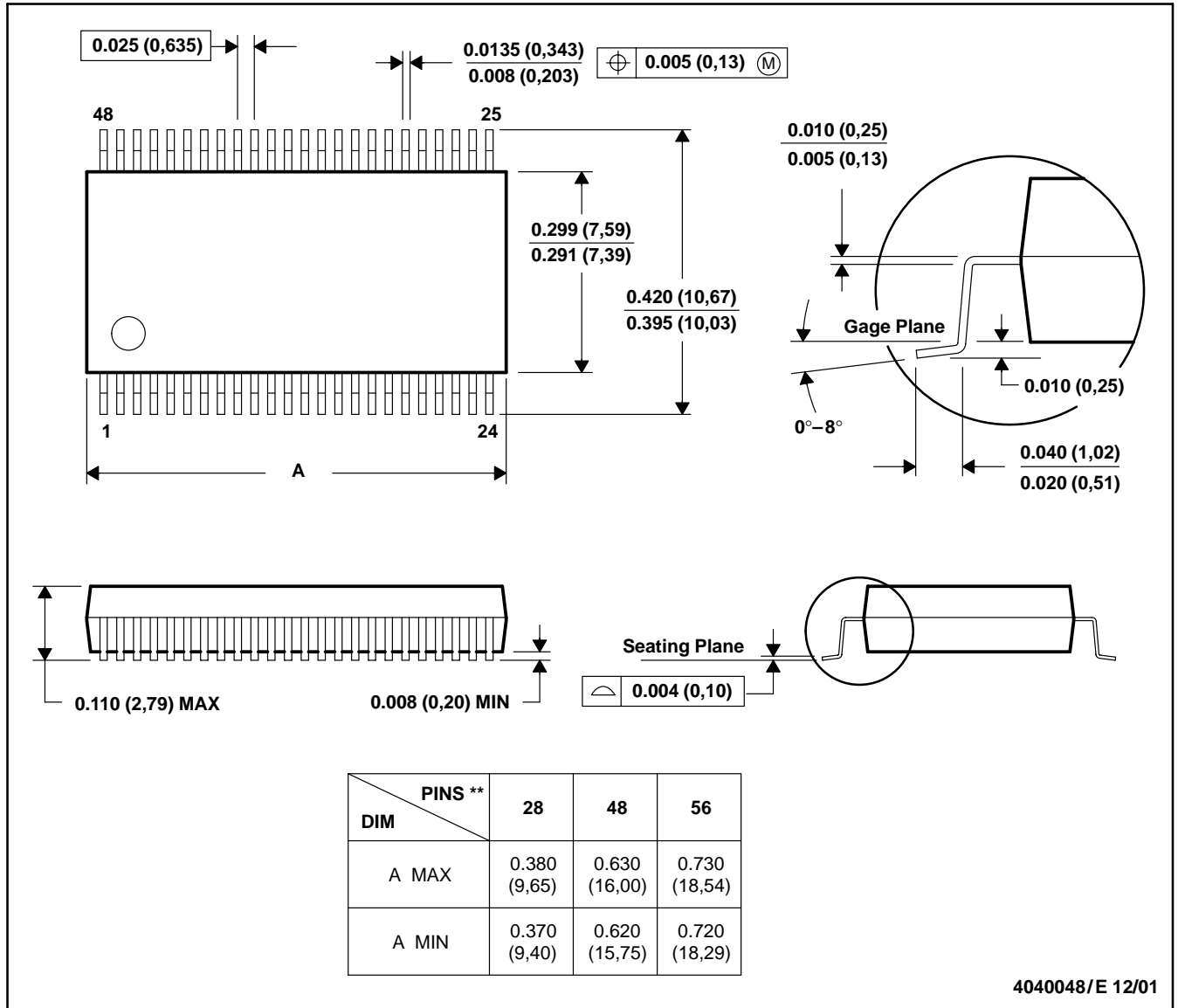
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74CBTS16211DGGR	TSSOP	DGG	56	2000	346.0	346.0	41.0
SN74CBTS16211DGVR	TVSOP	DGV	56	2000	346.0	346.0	41.0
SN74CBTS16211DLR	SSOP	DL	56	1000	346.0	346.0	49.0

DL (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 D. Falls within JEDEC MO-118

DGG (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

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