

# SN74CBTD16210 20-BIT FET BUS SWITCH WITH LEVEL SHIFTING

SCDS049H – MARCH 1998 – REVISED JULY 2002

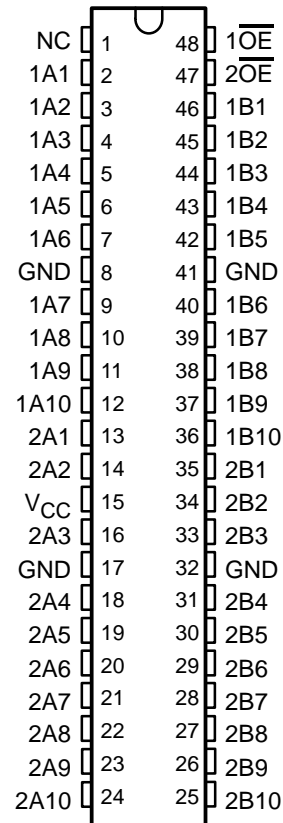
- Member of Texas Instruments Widebus™ Family
- 5-Ω Switch Connection Between Two Ports
- TTL-Compatible Input Levels
- Designed to Be Used in Level-Shifting Applications

## description/ordering information

The SN74CBTD16210 provides 20 bits of high-speed TTL-compatible bus switching. The low on-state resistance of the switch allows connections to be made with minimal propagation delay. A diode to  $V_{CC}$  is integrated in the circuit to allow for level shifting from 5-V signals at the device inputs to 3.3-V signals at the device outputs.

The device is organized as a dual 10-bit bus switch with separate output-enable ( $\overline{OE}$ ) inputs. It can be used as two 10-bit bus switches or as one 20-bit bus switch. When  $\overline{OE}$  is low, the associated 10-bit bus switch is on, and port A is connected to port B. When  $\overline{OE}$  is high, the switch is open, and the high-impedance state exists between the ports.

## DGG, DGV, OR DL PACKAGE (TOP VIEW)



NC – No internal connection

## ORDERING INFORMATION

$T_A$	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SSOP – DL	Tube	SN74CBTD16210DL	CBTD16210
		Tape and reel	SN74CBTD16210DLR	
	TSSOP – DGG	Tape and reel	SN74CBTD16210DGGR	CBTD16210
		TVSOP – DGV	Tape and reel	SN74CBTD16210DGV

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

## FUNCTION TABLE (each 10-bit bus switch)

INPUT OE	FUNCTION
L	A port = B port
H	Z



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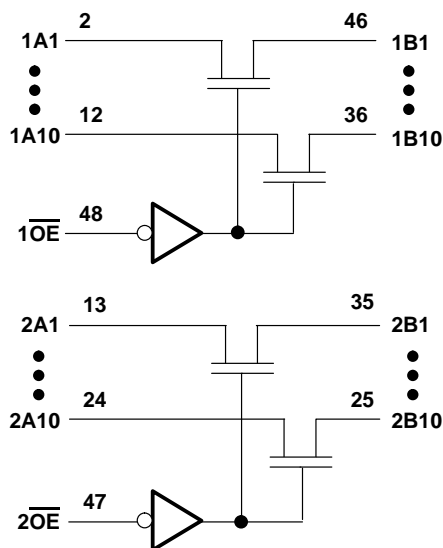
# SN74CBTD16210

## 20-BIT FET BUS SWITCH

### WITH LEVEL SHIFTING

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#### 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, $\theta_{JA}$ (see Note 2):	
DGG package .....	70°C/W
DGV package .....	58°C/W
DL package .....	63°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	5.5	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

In applications with fast edge rates, multiple outputs switching, and operating at high frequencies, the output may have little or no level-shifting effect.

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	
$V_{OH}$		See Figure 2						
$I_I$		$V_{CC} = 0\text{ V}$ ,	$V_I = 5.5\text{ V}$			10	$\mu\text{A}$	
		$V_{CC} = 5.5\text{ V}$ ,	$V_I = 5.5\text{ V or GND}$			$\pm 1$		
$I_{CC}$		$V_{CC} = 5.5\text{ V}$ ,	$I_O = 0$ ,			$V_I = V_{CC}$ or GND	1.5	mA
$\Delta I_{CC}^\ddagger$	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	$V_I = 3\text{ V or 0}$				4.5	pF	
$C_{io(OFF)}$		$V_O = 3\text{ V or 0}$ ,	$\overline{OE} = V_{CC}$			5.5	pF	
$r_{on}^\S$		$V_{CC} = 4.5\text{ V}$	$V_I = 0$	$I_I = 64\text{ mA}$		5	7	$\Omega$
				$I_I = 30\text{ mA}$		5	7	
			$V_I = 2.4\text{ V}$ ,	$I_I = 15\text{ mA}$		35	50	

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

‡ 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)**

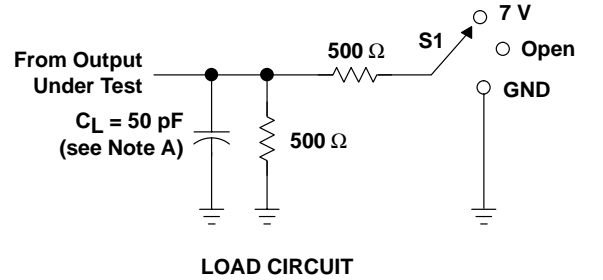
PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	MAX	UNIT
$t_{pd}^\parallel$	A or B	B or A		0.25	ns
$t_{en}$	$\overline{OE}$	A or B	1.5	9.8	ns
$t_{dis}$	$\overline{OE}$	A or B	1.5	8.9	ns

¶ 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).

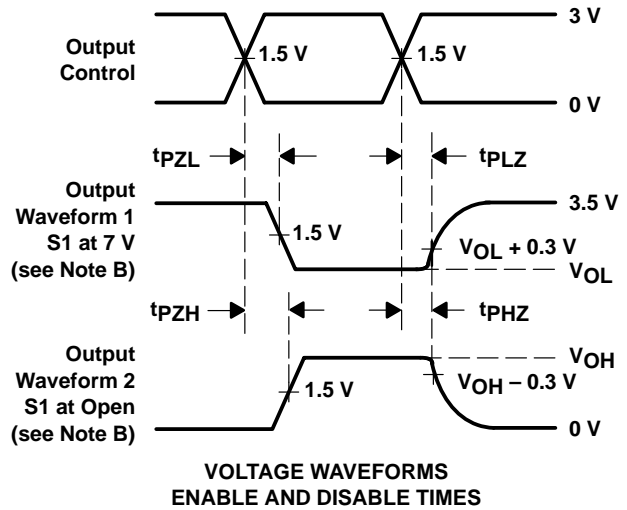
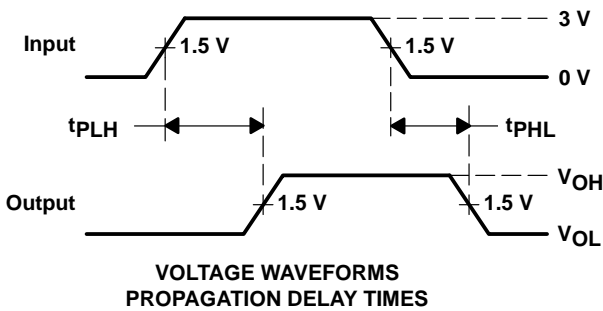
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## PARAMETER MEASUREMENT INFORMATION



TEST	S1
$t_{pd}$	Open
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	Open



- NOTES:
- $C_L$  includes probe and jig capacitance.
  - 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.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .
  - The outputs are measured one at a time with one transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

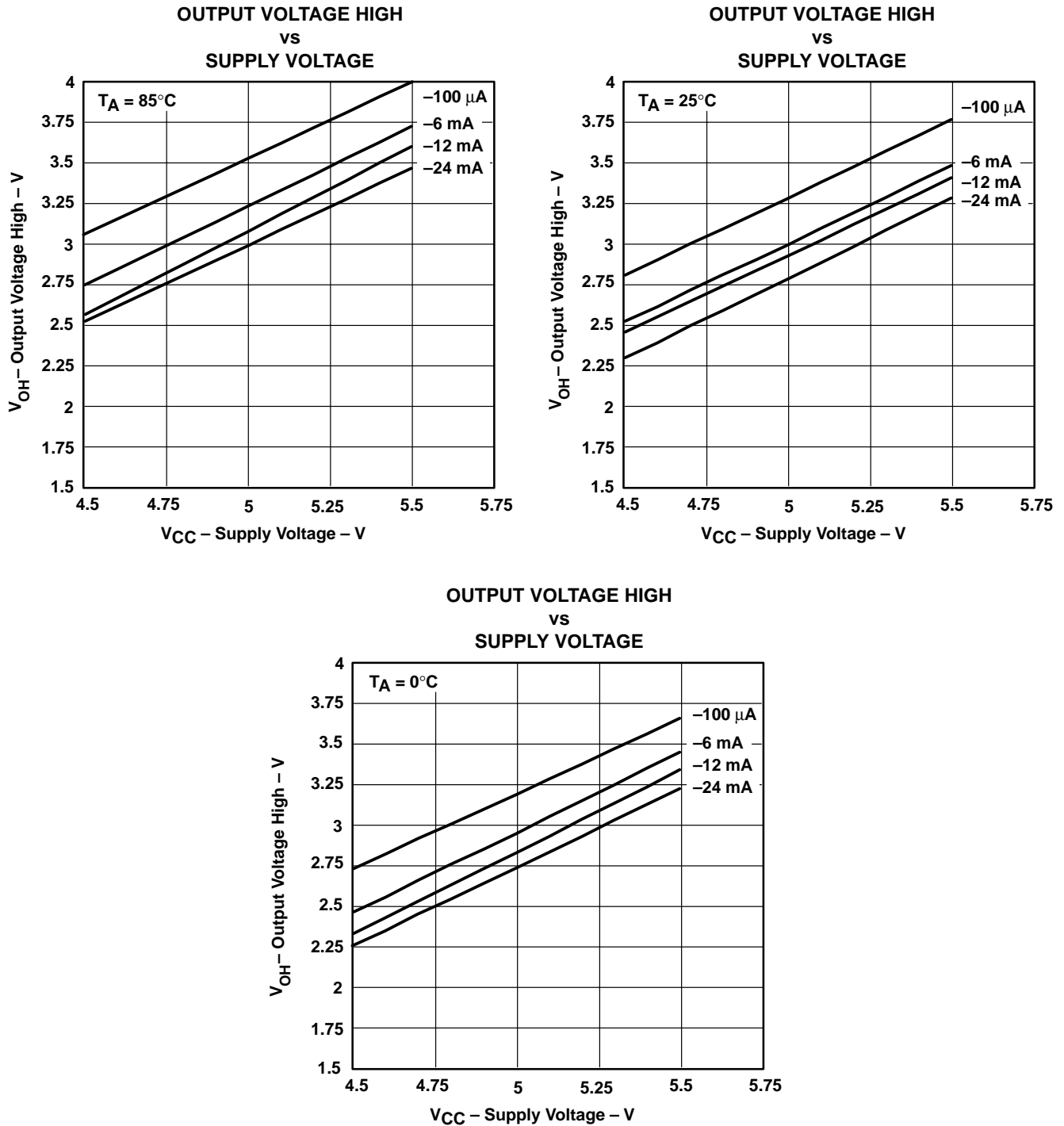


Figure 2.  $V_{OH}$  Values

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