

FEATURES

- Member of the Texas Instruments Widebus™ Family
 - High-Bandwidth Data Path (up to 500 MHz ⁽¹⁾)
 - 5-V Tolerant I/Os With Device Powered Up or Powered Down
 - Low and Flat ON-State Resistance (r_{on}) Characteristics Over Operating Range ($r_{on} = 5\ \Omega$ Typ)
 - Rail-to-Rail Switching on Data I/O Ports
 - 0- to 5-V Switching With 3.3-V V_{CC}
 - 0- to 3.3-V Switching With 2.5-V V_{CC}
 - Bidirectional Data Flow With Near-Zero Propagation Delay
 - Low Input/Output Capacitance Minimizes Loading and Signal Distortion ($C_{io(OFF)} = 4\text{ pF}$ Typ)
 - Fast Switching Frequency ($f_{OE} = 20\text{ MHz}$ Max)
 - Data and Control Inputs Provide Undershoot Clamp Diodes
 - Low Power Consumption ($I_{CC} = 1\text{ mA}$ Typ)
 - V_{CC} Operating Range From 2.3 V to 3.6 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, Class II
 - 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: PCI Interface, Differential Signal Interface, Memory Interleaving, Bus Isolation, Low-Distortion Signal Gating
- (1) For additional information regarding the performance characteristics of the CB3Q family, refer to the TI application report, *CBT-C, CB3T, and CB3Q Signal-Switch Families*, literature number SCDA008.

DGG, DGV, OR DL PACKAGE
(TOP VIEW)

NC	1	48	$\overline{1OE}$
1B1	2	47	1A1
1B2	3	46	1A2
GND	4	45	GND
1B3	5	44	1A3
1B4	6	43	1A4
V_{CC}	7	42	V_{CC}
1B5	8	41	1A5
1B6	9	40	1A6
GND	10	39	GND
1B7	11	38	1A7
1B8	12	37	1A8
2B1	13	36	2A1
2B2	14	35	2A2
GND	15	34	GND
2B3	16	33	2A3
2B4	17	32	2A4
V_{CC}	18	31	V_{CC}
2B5	19	30	2A5
2B6	20	29	2A6
GND	21	28	GND
2B7	22	27	2A7
2B8	23	26	2A8
NC	24	25	$\overline{2OE}$

NC - No internal connection



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SN74CB3Q16245
16-BIT SWITCH
2.5-V/3.3-V LOW-VOLTAGE FET BUS SWITCH

SCDS171A–JULY 2004–REVISED MARCH 2005

DESCRIPTION/ORDERING INFORMATION

The SN74CB3Q16245 is a high-bandwidth FET bus switch utilizing a charge pump to elevate the gate voltage of the pass transistor, providing a low and flat ON-state resistance (r_{on}). The low and flat ON-state resistance allows for minimal propagation delay and supports rail-to-rail switching on the data input/output (I/O) ports. The device also features low data I/O capacitance to minimize capacitive loading and signal distortion on the data bus. Specifically designed to support high-bandwidth applications, the SN74CB3Q16245 provides an optimized interface solution ideally suited for broadband communications, networking, and data-intensive computing systems.

The SN74CB3Q16245 is organized as two 8-bit bus switches with separate output-enable ($1\overline{OE}$, $2\overline{OE}$) inputs. It can be used as two 8-bit bus switches, or as one 16-bit bus switch. When $\overline{OE}$ is low, the associated 8-bit bus switch is ON, and the A port is connected to the B port, allowing bidirectional data flow between ports. When $\overline{OE}$ is high, the associated 8-bit bus switch is OFF, and a high-impedance state exists between the A and B ports.

This device is fully specified for partial-power-down applications using I_{off} . The I_{off} circuitry prevents damaging current 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, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

ORDERING INFORMATION

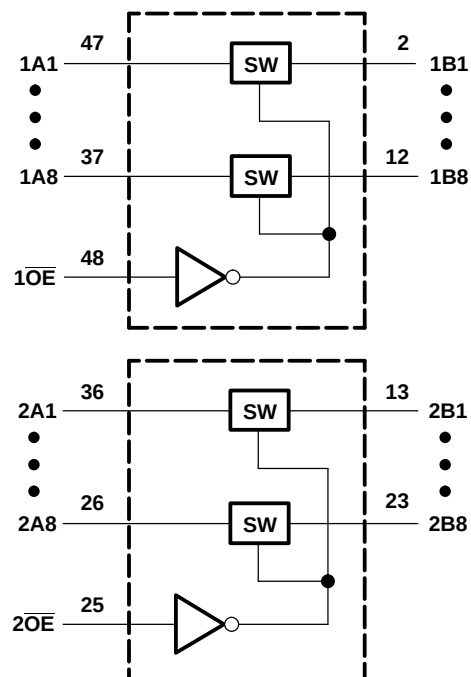
T_A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	SSOP – DL	Tube	SN74CB3Q16245DL	CB3Q16245
		Tape and reel	SN74CB3Q16245DLR	
	TSSOP – DGG	Tube	SN74CB3Q16245DGG	CB3Q16245
		Tape and reel	SN74CB3Q16245DGGR	
	TVSOP – DGV	Tape and reel	SN74CB3Q16245DGVR	BW245

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

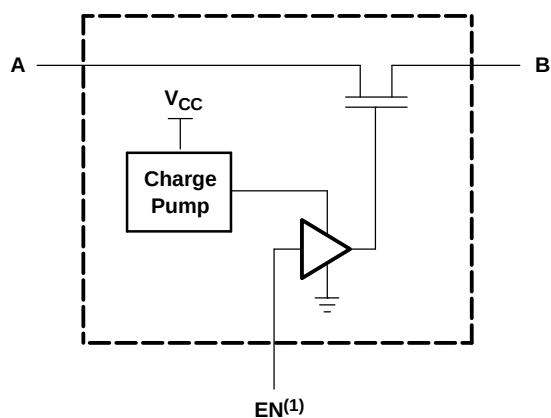
FUNCTION TABLE (EACH 8-BIT BUS SWITCH)

INPUT $\overline{OE}$	INPUT/OUTPUT A	FUNCTION
L	B	A port = B port
H	Z	Disconnect

LOGIC DIAGRAM (POSITIVE LOGIC)



SIMPLIFIED SCHEMATIC, EACH FET SWITCH (SW)



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

SN74CB3Q16245
16-BIT SWITCH
2.5-V/3.3-V LOW-VOLTAGE FET BUS SWITCH

SCDS171A—JULY 2004—REVISED MARCH 2005



Absolute Maximum Ratings⁽¹⁾

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

		MIN	MAX	UNIT
V_{CC}	Supply voltage range	−0.5	4.6	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⁾		±64	mA
	Continuous current through V_{CC} or GND		±100	mA
θ_{JA}	Package thermal impedance ⁽⁶⁾	DGG package		70
		DGV package		58
		DL package		63
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_I and I_O are used to denote specific conditions for $I_{I/O}$.
- (6) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions⁽¹⁾

		MIN	MAX	UNIT
V_{CC}	Supply voltage	2.3	3.6	V
V_{IH}	High-level control input voltage	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	1.7	5.5
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	2	5.5
V_{IL}	Low-level control input voltage	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	0	0.7
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	0	0.8
$V_{I/O}$	Data input/output voltage	0	5.5	V
T_A	Operating free-air temperature	−40	85	°C

- (1) 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.

Electrical Characteristics⁽¹⁾

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

PARAMETER		TEST CONDITIONS		MIN	TYP ⁽²⁾	MAX	UNIT
V_{IK}		$V_{CC} = 3.6\text{ V}$, $I_I = -18\text{ mA}$				-1.8	V
I_{IN}	Control inputs	$V_{CC} = 3.6\text{ V}$, $V_{IN} = 0\text{ to }5.5\text{ V}$				± 1	μA
I_{OZ} ⁽³⁾		$V_{CC} = 3.6\text{ V}$, $V_O = 0\text{ to }5.5\text{ V}$, $V_I = 0$, Switch OFF, $V_{IN} = V_{CC}\text{ or GND}$				± 1	μA
I_{off}		$V_{CC} = 0$, $V_O = 0\text{ to }5.5\text{ V}$, $V_I = 0$				1	μA
I_{CC}		$V_{CC} = 3.6\text{ V}$, $I_{I/O} = 0$, Switch ON or OFF, $V_{IN} = V_{CC}\text{ or GND}$			1	2	mA
ΔI_{CC} ⁽⁴⁾	Control inputs	$V_{CC} = 3.6\text{ V}$, One input at 3 V, Other inputs at $V_{CC}\text{ or GND}$				30	μA
I_{CCD} ⁽⁵⁾	Per control input	$V_{CC} = 3.6\text{ V}$, A and B ports open, Control input switching at 50% duty cycle			0.15	0.25	mA/ MHz
C_{in}	Control inputs	$V_{CC} = 3.3\text{ V}$, $V_{IN} = 5.5\text{ V}, 3.3\text{ V}, \text{ or }0$			3.5	5	pF
$C_{io(OFF)}$		$V_{CC} = 3.3\text{ V}$, Switch OFF, $V_{IN} = V_{CC}\text{ or GND}$, $V_{I/O} = 5.5\text{ V}, 3.3\text{ V}, \text{ or }0$			4	6	pF
$C_{io(ON)}$		$V_{CC} = 3.3\text{ V}$, Switch ON, $V_{IN} = V_{CC}\text{ or GND}$, $V_{I/O} = 5.5\text{ V}, 3.3\text{ V}, \text{ or }0$			10	13	pF
r_{on} ⁽⁶⁾		$V_{CC} = 2.3\text{ V}$, TYP at $V_{CC} = 2.5\text{ V}$	$V_I = 0$, $I_O = 30\text{ mA}$		6	8	Ω
			$V_I = 1.7\text{ V}$, $I_O = -15\text{ mA}$		5	10	
		$V_{CC} = 3\text{ V}$	$V_I = 0$, $I_O = 30\text{ mA}$		6	8	
			$V_I = 2.4\text{ V}$, $I_O = -15\text{ mA}$		5	9	

- (1) V_{IN} and I_{IN} refer to control inputs. V_I , V_O , I_I , and I_O refer to data pins.
- (2) All typical values are at $V_{CC} = 3.3\text{ V}$ (unless otherwise noted), $T_A = 25^\circ\text{C}$.
- (3) For I/O ports, the parameter I_{OZ} includes the input leakage current.
- (4) This is the increase in supply current for each input that is at the specified TTL voltage level, rather than V_{CC} or GND.
- (5) This parameter specifies the dynamic power-supply current associated with the operating frequency of a single control input (see Figure 2).
- (6) 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 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)	$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		UNIT
			MIN	MAX	MIN	MAX	
f_{OE} ⁽¹⁾	$\overline{OE}$	A or B		10		20	MHz
t_{pd} ⁽²⁾	A or B	B or A		0.18		0.3	ns
t_{en}	$\overline{OE}$	A or B	1.5	8	1.5	7	ns
t_{dis}	$\overline{OE}$	A or B	1	8	1	7	ns

- (1) Maximum toggle frequency for $\overline{OE}$ control input ($V_O > V_{CC}$, $V_I = 5\text{ V}$, $R_L \geq 1\text{ M}\Omega$, $C_L = 0$)
- (2) 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).

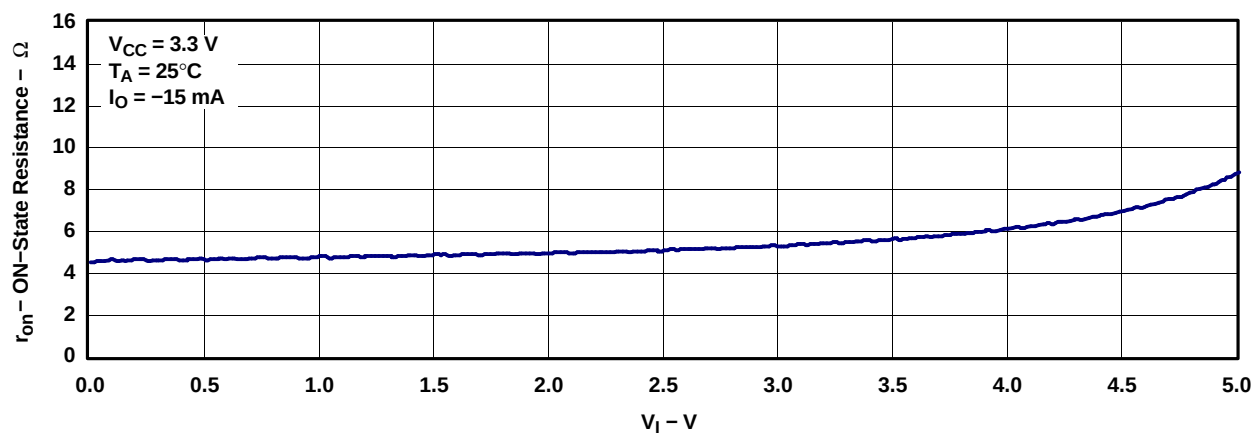


Figure 1. Typical r_{on} vs V_I

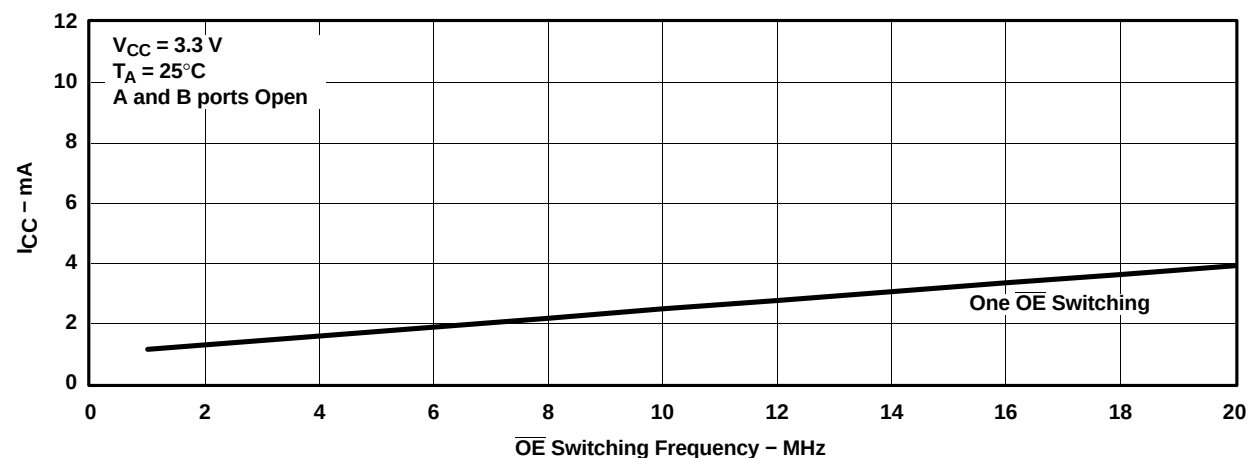
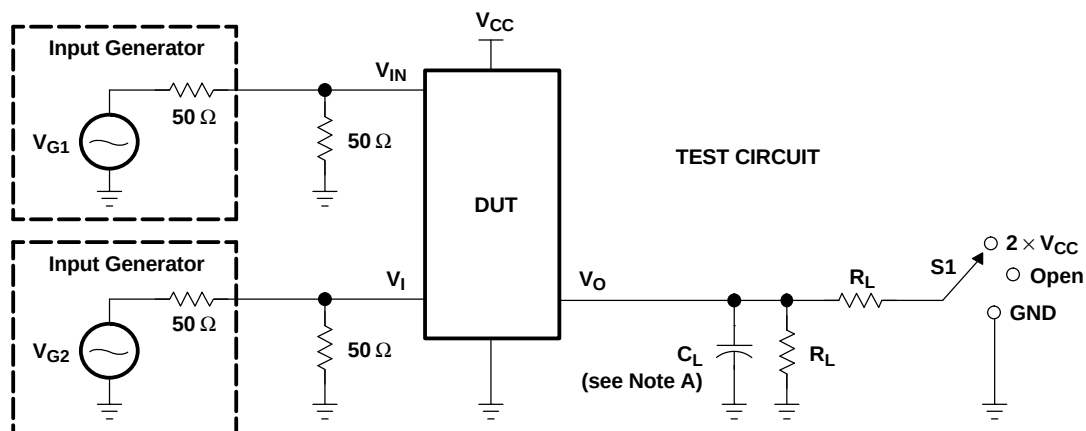
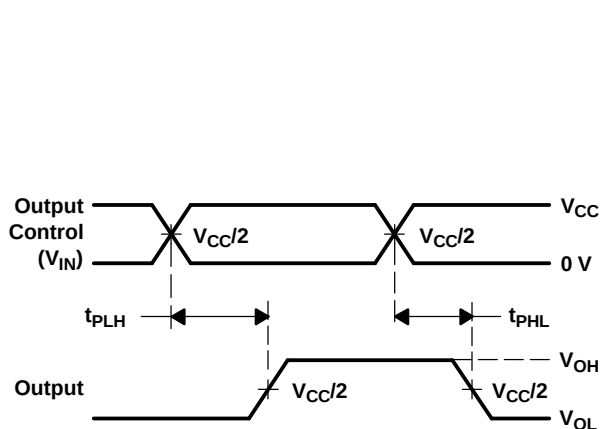


Figure 2. Typical I_{CC} vs OE Switching Frequency

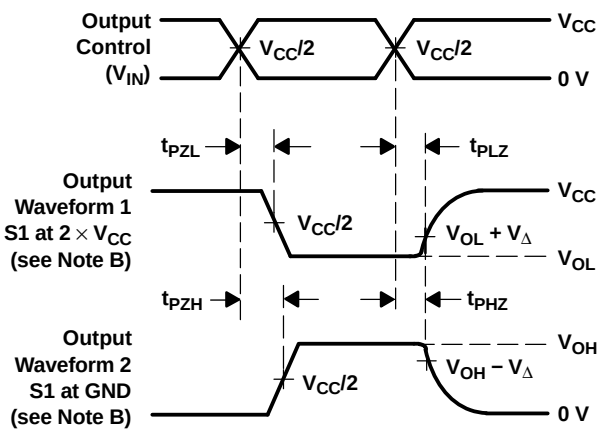
PARAMETER MEASUREMENT INFORMATION



TEST	V _{CC}	S1	R _L	V _I	C _L	V _Δ
t _{pd(s)}	2.5 V ± 0.2 V 3.3 V ± 0.3 V	Open Open	500 Ω 500 Ω	V _{CC} or GND V _{CC} or GND	30 pF 50 pF	
t _{PLZ} /t _{PZL}	2.5 V ± 0.2 V 3.3 V ± 0.3 V	2 × V _{CC} 2 × V _{CC}	500 Ω 500 Ω	GND GND	30 pF 50 pF	0.15 V 0.3 V
t _{PHZ} /t _{PZH}	2.5 V ± 0.2 V 3.3 V ± 0.3 V	GND GND	500 Ω 500 Ω	V _{CC} V _{CC}	30 pF 50 pF	0.15 V 0.3 V



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES (t_{pd(s)})



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

- 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 ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
 - The outputs are measured one at a time, with one transition per measurement.
 - t_{PLZ} and t_{PZH} 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(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).
 - All parameters and waveforms are not applicable to all devices.

Figure 3. Test 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⁾
74CB3Q16245DGGRE4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74CB3Q16245DGGRG4	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74CB3Q16245DGVRE4	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74CB3Q16245DGVRG4	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
74CB3Q16245DLRG4	ACTIVE	SSOP	DL	48	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74CB3Q16245DGGR	ACTIVE	TSSOP	DGG	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74CB3Q16245DGVR	ACTIVE	TVSOP	DGV	48	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74CB3Q16245DL	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74CB3Q16245DLG4	ACTIVE	SSOP	DL	48	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74CB3Q16245DLR	ACTIVE	SSOP	DL	48	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.

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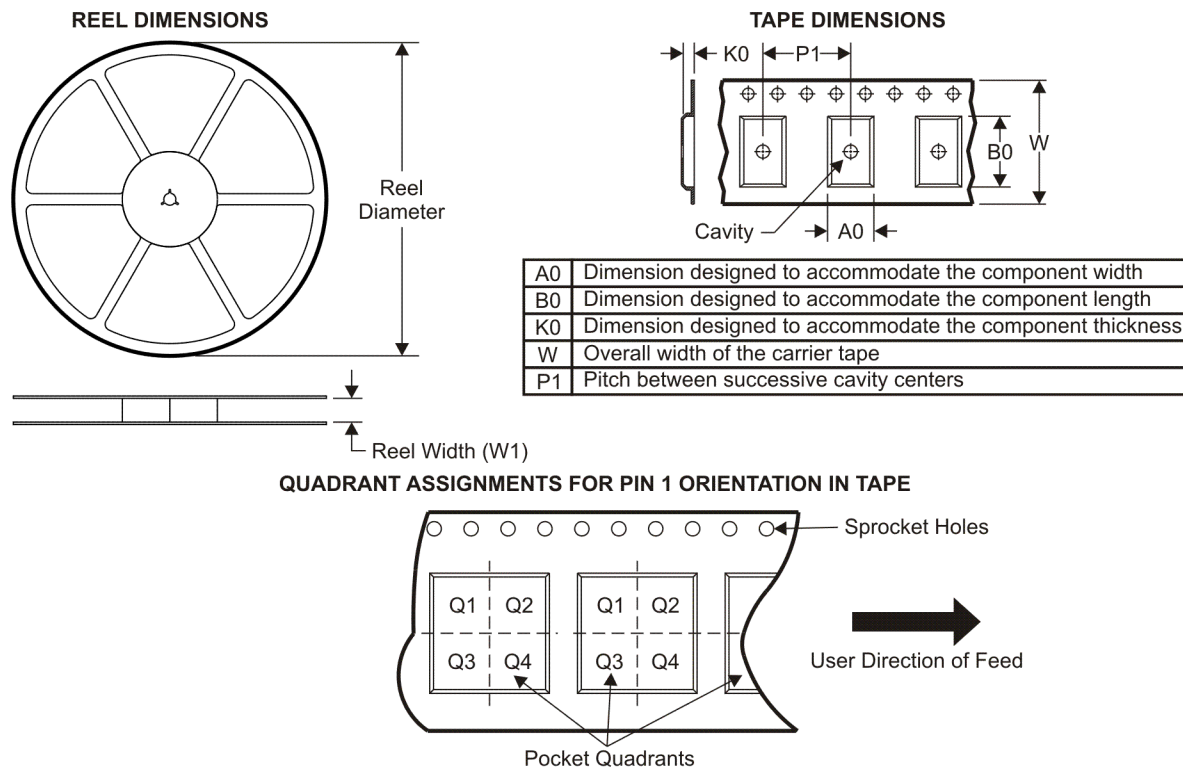
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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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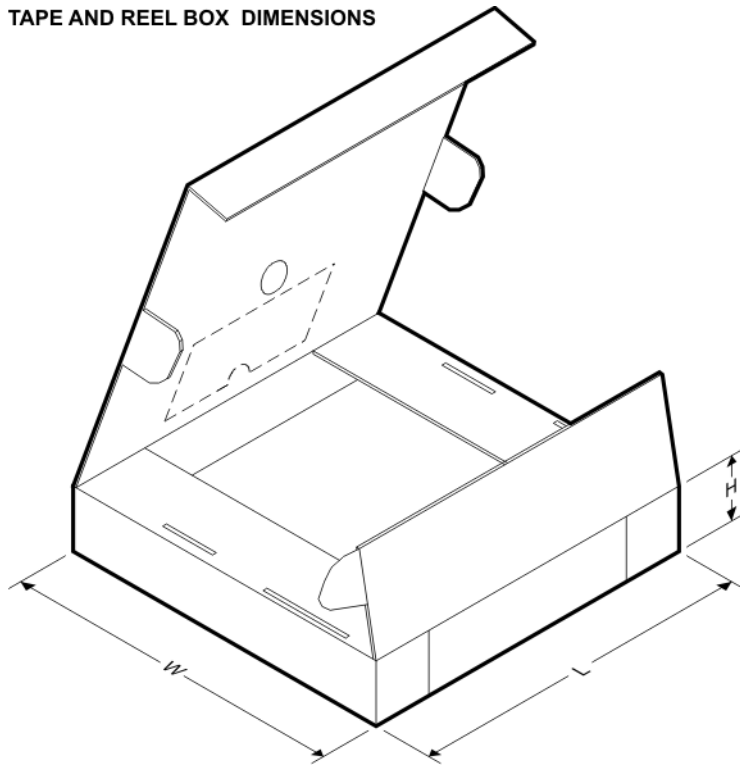
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TAPE AND REEL INFORMATION


*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
SN74CB3Q16245DGGR	TSSOP	DGG	48	2000	330.0	24.4	8.6	15.8	1.8	12.0	24.0	Q1
SN74CB3Q16245DGVR	TVSOP	DGV	48	2000	330.0	16.4	7.1	10.2	1.6	12.0	16.0	Q1
SN74CB3Q16245DLR	SSOP	DL	48	1000	330.0	32.4	11.35	16.2	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)
SN74CB3Q16245DGGR	TSSOP	DGG	48	2000	346.0	346.0	41.0
SN74CB3Q16245DGVR	TVSOP	DGV	48	2000	346.0	346.0	33.0
SN74CB3Q16245DLR	SSOP	DL	48	1000	346.0	346.0	49.0

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