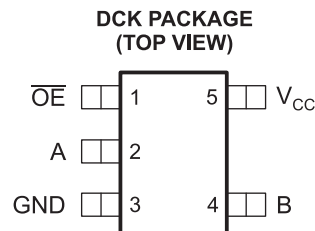


SINGLE FET BUS SWITCH 2.5-V/3.3-V LOW-VOLTAGE SWITCH WITH 5-V-TOLERANT LEVEL SHIFTER

Check for Samples: [SN74CB3T1G125-Q1](#)

FEATURES

- Qualified for Automotive Applications
- Output Voltage Translation Tracks V_{CC}
- Supports Mixed-Mode Signal Operation on All Data I/O Ports
 - 5-V Input Down to 3.3-V Output Level Shift With 3.3-V V_{CC}
 - 5-V/3.3-V Input Down to 2.5-V Output Level Shift With 2.5-V V_{CC}
- 5-V-Tolerant I/Os, With Device Powered Up or Powered Down
- Bidirectional Data Flow With Near-Zero Propagation Delay
- Low ON-State Resistance (r_{on}) Characteristics ($r_{on} = 5\ \Omega$ Typ)
- Low Input/Output Capacitance Minimizes Loading ($C_{io(OFF)} = 5\text{ pF}$ Typ)
- Data and Control Inputs Provide Undershoot Clamp Diodes
- Low Power Consumption ($I_{CC} = 20\ \mu\text{A}$ Max)
- 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
- Supports Digital Applications: Level Translation, USB Interface, Bus Isolation
- Ideal for Low-Power Portable Equipment



DESCRIPTION

The SN74CB3T1G125-Q1 is a high-speed TTL-compatible FET bus switch with low ON-state resistance (r_{on}), allowing for minimal propagation delay. The device fully supports mixed-mode signal operation on all data I/O ports by providing voltage translation that tracks V_{CC} . The SN74CB3T1G125-Q1 supports systems using 5-V TTL, 3.3-V LVTTTL, and 2.5-V CMOS switching standards, as well as user-defined switching levels (see [Figure 1](#)).

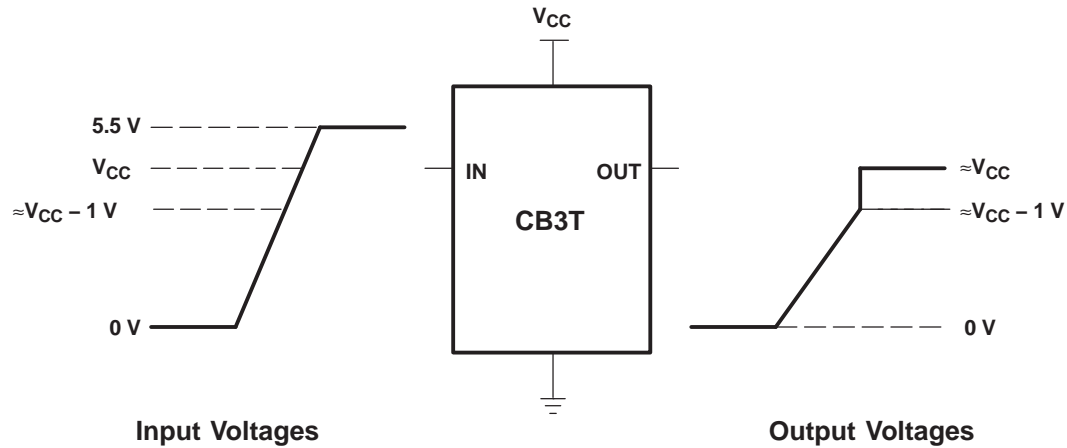
The SN74CB3T1G125-Q1 is a 1-bit bus switch with a single output-enable (\overline{OE}) input. When \overline{OE} is low, the bus switch is ON, and the A port is connected to the B port, allowing bidirectional data flow between ports. When \overline{OE} is high, the bus switch is OFF, and a high-impedance state exists between the A and B ports.

This device is fully specified for partial-power-down applications using I_{off} . The I_{off} 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, \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.



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NOTE A: If the input high voltage (V_{IH}) level is greater than or equal to $V_{CC} - 1\text{ V}$, and less than or equal to 5.5 V , then the output high voltage (V_{OH}) level will be equal to approximately the V_{CC} voltage level.

Figure 1. Typical DC Voltage Translation Characteristics

ORDERING INFORMATION

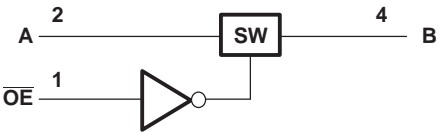
T_A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING ⁽²⁾
-40°C to 125°C	SOT (SC-70) – DCK	Reel of 3000	CCB3T1G125QDCKRQ1	72_

- (1) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
(2) The actual top-side marking has one additional character that designates the assembly/test site.

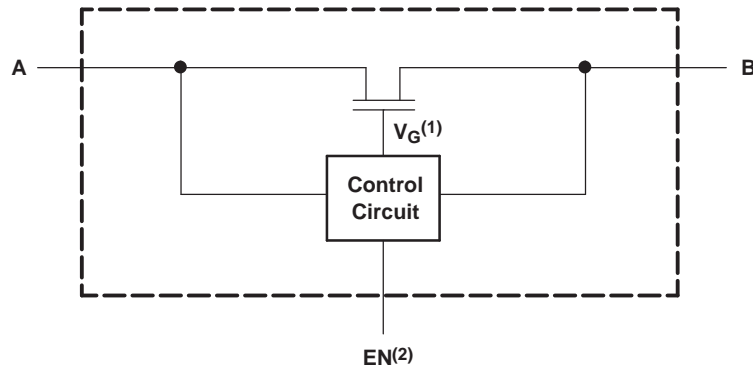
FUNCTION TABLE

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

LOGIC DIAGRAM (POSITIVE LOGIC)



SIMPLIFIED SCHEMATIC, EACH FET SWITCH (SW)



- (1) Gate voltage (V_G) is equal to approximately $V_{CC} + V_T$ when the switch is ON and $V_I > V_{CC} + V_T$.
 (2) EN is the internal enable signal applied to the switch.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

		MIN	MAX	UNIT
V_{CC}	Supply voltage range	–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		–50	mA
$I_{I/OK}$	I/O port clamp current		–50	mA
I_{IO}	ON-state switch current ⁽⁵⁾		±128	mA
	Continuous current through V_{CC} or GND		±100	mA
θ_{JA}	Package thermal impedance ⁽⁶⁾		252	°C/W
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
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ 2	5.5	V
V_{IL}	Low-level control input voltage	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$ 0	0.7	V
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$ 0	0.8	V
$V_{I/O}$	Data input/output voltage	0	5.5	V
T_A	Operating free-air temperature	–40	125	°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 V, I _I = −18 mA				−1.2	V
V _{OH}		See Figure 3 and Figure 4					
I _{IN}	Control inputs	V _{CC} = 3.6 V, V _{IN} = 3.6 V to 5.5 V or GND				±10	μA
I _I		V _{CC} = 3.6 V, Switch ON, V _{IN} = V _{CC} or GND	V _I = V _{CC} − 0.7 V to 5.5 V		±20	μA	
			V _I = 0.7 V to V _{CC} − 0.7 V		−40		
			V _I = 0 to 0.7 V		±5		
I _{OZ} ⁽³⁾		V _{CC} = 3.6 V, V _O = 0 to 5.5 V, V _I = 0, Switch OFF, V _{IN} = V _{CC} or GND				±10	μA
I _{off}		V _{CC} = 0, V _O = 0 to 5.5 V, V _I = 0				10	μA
I _{CC}		V _{CC} = 3.6 V, I _{I/O} = 0, Switch ON or OFF, V _{IN} = V _{CC} or GND	V _I = V _{CC} or GND		20	μA	
			V _I = 5.5 V		20		
ΔI _{CC} ⁽⁴⁾	Control inputs	V _{CC} = 3 V to 3.6 V, One input at V _{CC} − 0.6 V, Other inputs at V _{CC} or GND				300	μA
C _{in}	Control inputs	V _{CC} = 3.3 V, V _{IN} = V _{CC} or GND				3	pF
C _{io(OFF)}		V _{CC} = 3.3 V, V _{I/O} = 5.5 V, 3.3 V, or GND, Switch OFF, V _{IN} = V _{CC} or GND				5	pF
C _{io(ON)}		V _{CC} = 3.3 V, Switch ON, V _{IN} = V _{CC} or GND	V _{I/O} = 5.5 V or 3.3 V		4	pF	
			V _{I/O} = GND		12		
r _{on} ⁽⁵⁾		V _{CC} = 2.3 V, TYP at V _{CC} = 2.5 V, V _I = 0	I _O = 24 mA		5	10	Ω
			I _O = 16 mA		5	10	
		V _{CC} = 3 V, V _I = 0	I _O = 24 mA		5	9	
			I _O = 16 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.

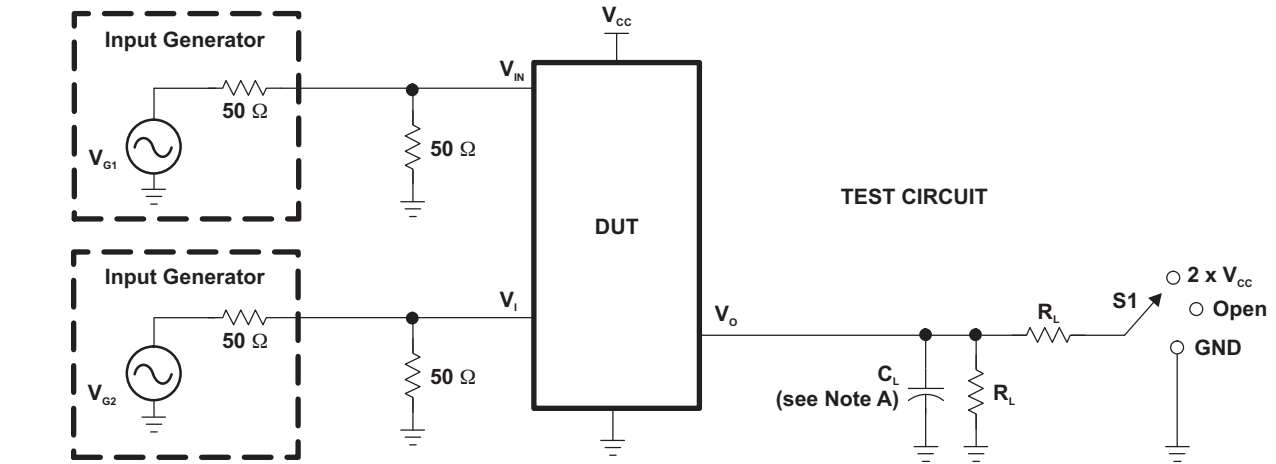
(5) Measured by the voltage drop between A and B terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two (A or B) terminals.

SWITCHING CHARACTERISTICS

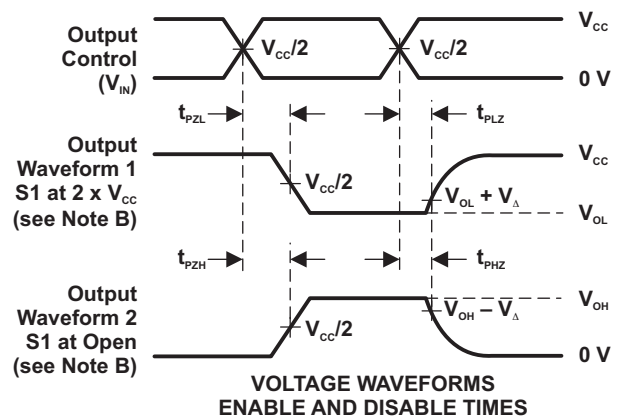
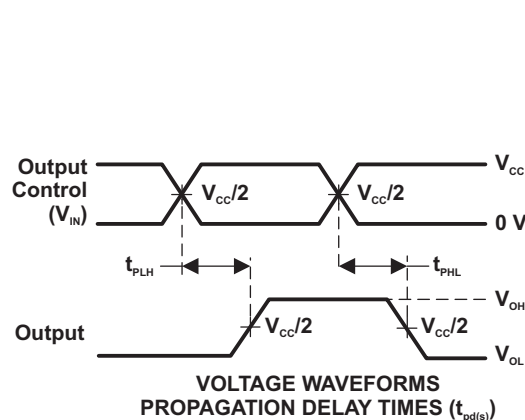
over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 2](#))

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	
t_{en}	\overline{OE}	A or B	1	10.5	1	9.5	ns
t_{dis}	\overline{OE}	A or B	1	8.5	1	9	ns

PARAMETER MEASUREMENT INFORMATION



TEST	V _{CC}	S1	R _L	V _I	C _L	V _A
t _{pd(s)}	2.5 V ± 0.2 V 3.3 V ± 0.3 V	Open Open	500 Ω 500 Ω	3.6 V or GND 5.5 V or GND	30 pF 50 pF	
t _{PLZ} /t _{PZL}	2.5 V ± 0.2 V 3.3 V ± 0.3 V	2 x V _{CC} 2 x V _{CC}	500 Ω 500 Ω	GND GND	30 pF 50 pF	0.15 V 0.15 V
t _{PHZ} /t _{PZH}	2.5 V ± 0.2 V 3.3 V ± 0.3 V	Open Open	500 Ω 500 Ω	3.6 V 5.5 V	30 pF 50 pF	0.15 V 0.15 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 ≤ 10 MHz, Z₀ = 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_{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 2. Test Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

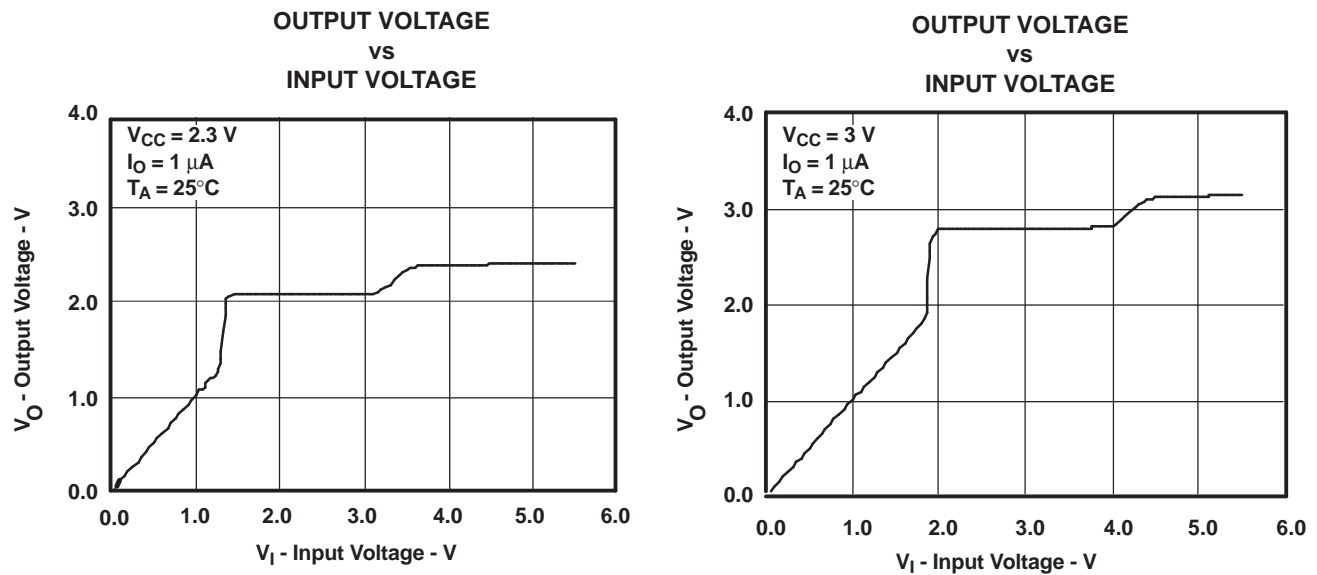


Figure 3. Data Output Voltage vs Data Input Voltage

TYPICAL CHARACTERISTICS

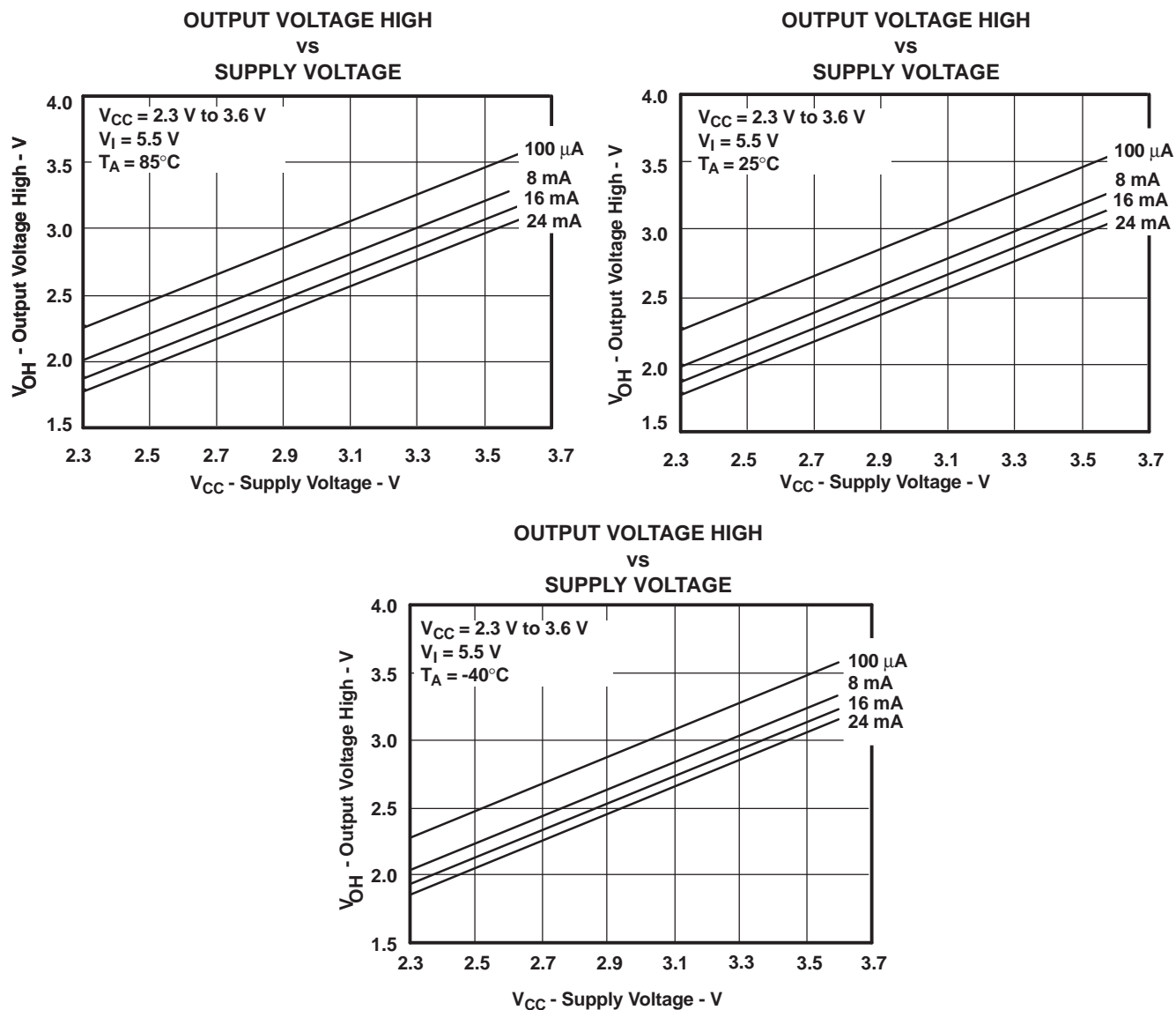


Figure 4. V_{OH} Values

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
CCB3T1G125QDCKRQ1	ACTIVE	SC70	DCK	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	72R	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) 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.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

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OTHER QUALIFIED VERSIONS OF SN74CB3T1G125-Q1 :

- Catalog: [SN74CB3T1G125](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

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
CCB3T1G125QDCKRQ1	SC70	DCK	5	3000	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CCB3T1G125QDCKRQ1	SC70	DCK	5	3000	202.0	201.0	28.0

DCK (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



4093553-3/G 01/2007

- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
 - Falls within JEDEC MO-203 variation AA.

DCK (R-PDSO-G5)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
 - D. Publication IPC-7351 is recommended for alternate designs.
 - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

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