

SCES767B-SEPTEMBER 2011-REVISED SEPTEMBER 2011

2-BIT UNDIRECTIONAL VOLTAGE-LEVEL TRANSLATOR

Check for Samples: SN74AVC2T244

FEATURES

- Wide Operating V_{CC} Range of 0.9 V to 3.6 V
- Low Static-Power Consumption, 6-µA Max I_{CC}
- Output Enable Feature Allows User to Disable Outputs to Reduce Power Consumption
- ±24-mA Output Drive at 3.0 V
- I_{off} Supports Partial Power-Down-Mode Operation
- Input Hysteresis Allows Slow Input Transition and Better Switching Noise Immunity at Input
- Maximum Data Rates
 - 380 Mbps (1.8-V to 3.3-V Translation)
 - 200 Mbps (<1.8-V to 3.3-V Translation)
 - 200 Mbps (Translate to 2.5 V or 1.8 V)
 - 150 Mbps (Translate to 1.5 V)
 - 100 Mbps (Translate to 1.2 V)

DESCRIPTION/ORDERING INFORMATION

Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II

ESD Protection Exceeds JESD 22
 5000-V Human-Body Model (A114-A)

APPLICATIONS

Handset, Smartphone, Tablet, Server

DQE	/DQM PACKAGE (TOP VIEW)
V	

V_{CCA}	[[]]	1_8_	V_{CCB}
A1	2	17	B1
A2	3_1	ī_6_	B2
ŌĒ	_4_I	ī_5_	GND

This 2-bit unidirectional translator uses two separate configurable power-supply rails. The A port is designed to track V_{CCA} . V_{CCA} accepts any supply voltage from 0.9 V to 3.6 V. The B port is designed to track V_{CCB} . V_{CCB} accepts any supply voltage from 0.9 V to 3.6 V. This allows for low-voltage translation between 0.9-V, 1.2-V, 1.5-V, 1.8-V, 2.5-V and 3.6-V voltage nodes. For the SN74AVC2T244, when the output-enable (\overline{OE}) input is high, all outputs are placed in the high-impedance state. The SN74AVC2T244 is designed so that the \overline{OE} input circuit is referenced to V_{CCA} . This device is fully specified for partial-power-down applications using loff. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

ORDERING INFORMATION⁽¹⁾

T _A	PACKAGE ⁽²⁾	ORDERABLE PART NUMBER	TOP-SIDE MARKING	
40°C to 05°C	DQE – MicroQFN	SN74AVC2T244DQER	VA	
–40°C to 85°C	DQM – MicroQFN	SN74AVC2T244DQMR	VAH	

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.

(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

DEVICE INFORMATION

PIN DESCRIPTION

PIN	UNCTION			
VCCA	Input Port DC Power Supply			
VCCB	utput Port DC Power Supply			
GND	Ground			
An	Input Port			
Bn	Output Port			
OE	Output Enable			

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

				MIN	MAX	UNIT
	DC Supply voltage, V _{CCA} V _{CCB}		-0.5	4.6	V	
	DC Input voltage, V _I	A _n	-0.5	4.6	V	
	Control Input, V _C		ŌĒ	-0.5	4.6	V
Voltage	DC Output voltage, V_O , $V_{CCA} = V_{CCB} = 0$ (Power Down)		B _n	-0.5	4.6	
		(Active Mode)	B _n	-0.5	4.6	V
		3-State Mode	B _n	-0.5	4.6	
	DC Input Diode current, IIK	V _I < GND			-20	mA
	DC Output Diode current, I _{OK}	V _O < GND			-50	mA
	DC Output Source/Sink current, I _O				±50	mA
	DC Supply current per supply pin, I _{CCA} , I _{CCB}			±100	mA	
GND	DC Ground current per ground pin				±100	mA
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.

RECOMMENDED OPERATING CONDITIONS

				MIN	MAX	UNIT
V _{CCA} , V _{CCB}	Positive DC Supply voltage			0.9	3.6	V
VI	Bus input voltage			GND	3.6	V
VI	Input voltage			GND	3.6	V
V _C	Control input	Control input OE				V
		(Power Down Mode)	B _n	GND	3.6	V
Vo	Bus output voltage	(Active Mode)	B _n	GND	V _{CCB}	V
		3-State Mode	B _n	GND	3.6	V
T _A	Operating free-air temperature				85	°C
Δt/Δv	Input transition rise or fall rate V _I from 30% to 70% of V _{CC} ; V _{CC} = 3.3 V \pm 0.3 V				10	nS



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ELECTRICAL CHARACTERISTICS⁽¹⁾ ⁽²⁾

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

	PARAMETER	TEST CONDITIONS	V _{CCA} (V)	V _{CCB} (V)	-40°C to	85°C	UNIT	
		TEST CONDITIONS			MIN MAX			
			2.7 – 3.6		2.0	-		
			2.3 – 2.7		1.6	_		
V _{IH}	Input <u>HI</u> GH Voltage (An, OE)		1.4 – 2.3	0.9 – 3.6	0.65 × V _{CCA}	-	V	
			0.9 – 1.4		0.9 × V _{CCA}	_		
			2.7 – 3.6		_	0.8		
			2.3 – 2.7		-	0.7		
√ _{IL}	Input LOW voltage (An, OE)		1.4 – 2.3	0.9 – 3.6	-	$0.35 \times V_{CCA}$	V	
			0.9 – 1.5		_	0.1 × V _{CCA}		
		$I_{OH} = -100 \ \mu A; \ V_I = V_H$	0.9 – 3.6	0.9 – 3.6	V _{CCB} – 0.2	-		
		$I_{OH} = -0.5 \text{ mA}; V_I = V_H$	0.9	0.9	0.75 × V _{ССВ}	-		
		$I_{OH} = -2 \text{ mA}; V_I = V_H$	1.4	1.4	1.05	_		
		$I_{OH} = -6 \text{ mA}; V_1 = V_H$	1.65	1.65	1.25	_		
V _{OH}	Output HIGH voltage	$v_{OH} = -0 \text{ mA}, v_I = v_H$	2.3	2.3	2.0	_	V	
		$I_{OH} = -12 \text{ mA}; V_{I} = V_{H}$	2.3	2.3	1.8	_		
		$v_{OH} = -12 \text{ mA}; v_1 = v_H$	2.7	2.7	2.2	_		
		10	2.3	2.3	1.7	_		
		$I_{OH} = -18 \text{ mA}; V_I = V_H$	3.0	3.0	2.4	_		
		$I_{OH} = -24 \text{ mA}; V_{I} = V_{H}$	3.0	3.0	2.2	-		
		I _{OH} = 100 μA; V _I = V _H	0.9 – 3.6	0.9 – 3.6	-	0.2		
		I _{OH} = 0.5 mA; V _I = V _H	1.1	1.1	-	0.3		
		$I_{OH} = 2 \text{ mA}; V_I = V_H$	1.4	1.4	-	0.35		
		$I_{OH} = 6 \text{ mA}; V_I = V_H$	1.65	1.65	-	0.3		
V _{OL}	Output LOW voltage		2.3	2.3	-	0.4	V	
		$I_{OH} = 12 \text{ mA}; V_I = V_H$	2.7	2.7	-	0.4		
			2.3	2.3	-	0.6		
		$I_{OH} = 18 \text{ mA}; V_I = V_H$	3.0	3.0	-	0.4		
		I _{OH} = 24 mA; V _I = V _H	3.0	3.0	-	0.55		
I	Input Leakage Current	$V_{I} = V_{CCA}$ or GND	0.9 – 3.6	0.9 – 3.6	-1.0	1.5	μA	
	Power-Off Leakage	$\overline{OE} = 0V$	0	0.9 – 3.6	-1.0	1.3		
OFF	Current		0.9 – 3.6	0	-1.0	1.5	μA	
CCA	Quiescent Supply Current	$V_I = V_{CCA}$ or GND; $I_O = 0$	0.9 – 3.6	0.9 – 3.6	-	3.0	μA	
ССВ	Quiescent Supply Current	$V_I = V_{CCA}$ or GND; $I_O = 0$	0.9 – 3.6	0.9 – 3.6	-	3.0	μA	
сса + ссв	Quiescent Supply Current	$V_I = V_{CCA}$ or GND; $I_O = 0$	0.9 – 3.6	0.9 – 3.6	-	6.0	μA	
∕I _{CCA}	Increase in $I_{\rm CC}$ per Input Voltage, Other inputs at $V_{\rm CCA}$ or GND		3.6	3.6	-	5.0	μA	

 $\begin{array}{ll} \mbox{(1)} & V_{CCO} \mbox{ is the } V_{CC} \mbox{ associated with the output port.} \\ \mbox{(2)} & V_{CCI} \mbox{ is the } V_{CC} \mbox{ associated with the input port.} \end{array}$

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TEXAS INSTRUMENTS

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ELECTRICAL CHARACTERISTICS^{(1) (2)} (continued)

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

		TEST CONDITIONS	V 00	V 00	–40°C to		
	PARAMETER	TEST CONDITIONS	V _{CCA} (V)	V _{CCB} (V)	MIN	MAX	UNIT
ΔI _{CCB}	Increase in I_{CC} per Input Voltage, Other inputs at V_{CCA} or GND		3.6	3.6	_	5.0	μA
I _{OZ}	I/O Tri-State Output Leakage Current	$TA = 25^{\circ}C, \overline{OE} = 0 V$	0.9 – 3.6	0.9 – 3.6	-1.0	1.0	μA



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AC ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter	V _{CCA} (V)	VCCB (V)	MIN	MAX	UNIT
		0.9 – 3.6	0.9 – 3.6		20	
t _{PLH} , t _{PHL}	Propagation Delay, A _n to B _n	1.2 – 3.6	1.2 – 3.6		7	nS
		1.8 – 3.6	1.8 – 3.6		3.5	
t _{PZH} , t _{PZL}		0.9 – 3.6	0.9 - 3.6		23	
	Output Enable, \overline{OE} to B_n	1.2 – 3.6	1.2 – 3.6		6.5	nS
		1.8 – 3.6	1.8 – 3.6		4.1	1
		0.9 – 3.6	0.9 - 3.6		17	
t _{PHZ} , t _{PLZ}	Output Disable, \overline{OE} to B_n	1.2 – 3.6	1.2 – 3.6		7	nS
		1.8 – 3.6	1.8 – 3.6		4.3	
t _{OSHL} , t _{OSLH}		0.9 – 3.6	0.9 - 3.6		0.15	
	Output to Output Skew, Time	1.2 – 3.6	1.2 – 3.6		0.15	nS
		1.8 – 3.6	1.8 – 3.6		0.15	-

Table 1. CAPACITANCE⁽¹⁾

Symbol	Parameter	Test Conditions	TYP ⁽²⁾	Unit
C _{IN}	Control Pin Input Capacitance	V_{CCA} = V_{CCB} = 3.3 V, V_{I} = 0 V or $V_{CCA/B}$	3.5	pF
C _{I/O}	I/O Pin Input capacitance	V_{CCA} = V_{CCB} = 3.3 V, V_{I} = 0 V or $V_{CCA/B}$	5.0	pF
C _{PD}	Power Dissipation Capacitance	V_{CCA} = V_{CCB} = 3.3 V, V_{I} = 0 V or $V_{CCA/B},f$ = 10 MHz	33	pF

C_{PD} is defined as the value of the IC's equivalent capacitance from which the operating current can be calculated from: I_{CC(operating)} ≈ C_{PD} × V_{CC} × f_{IN} × N_{SW} where I_{CC} = I_{CCA} + I_{CCB} and N_{SW} = total number of outputs switching.
 Typical values are at TA = +25°C.



PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
SN74AVC2T244DQER	ACTIVE	X2SON	DQE	8	5000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
SN74AVC2T244DQMR	ACTIVE	X2SON	DQM	8	3000	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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PACKAGE MATERIALS INFORMATION

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TAPE AND REEL INFORMATION

REEL DIMENSIONS

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TAPE AND REEL INFORMATION

TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

*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
SN74AVC2T244DQER	X2SON	DQE	8	5000	180.0	8.4	1.2	1.6	0.55	4.0	8.0	Q1
SN74AVC2T244DQMR	X2SON	DQM	8	3000	180.0	8.4	1.57	2.21	0.59	4.0	8.0	Q1

TEXAS INSTRUMENTS

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PACKAGE MATERIALS INFORMATION

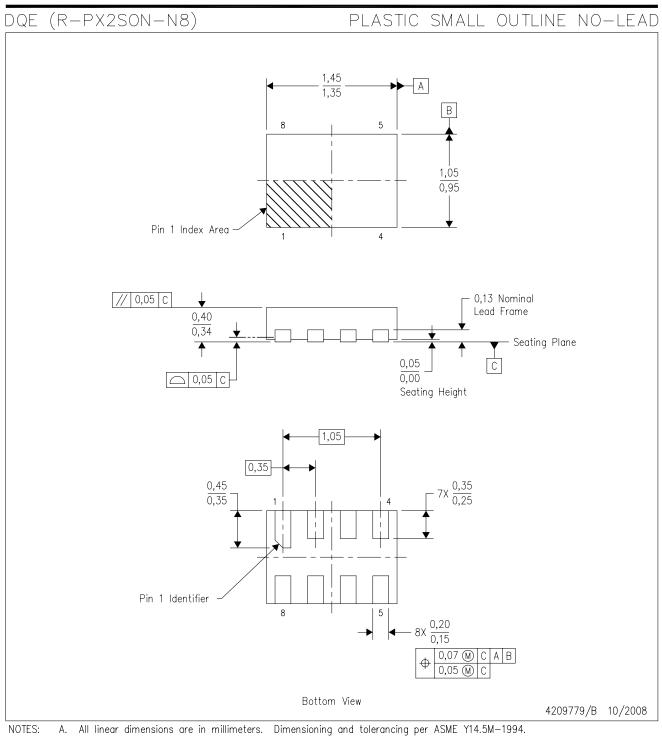
8-Sep-2012



*All dimensions are nominal

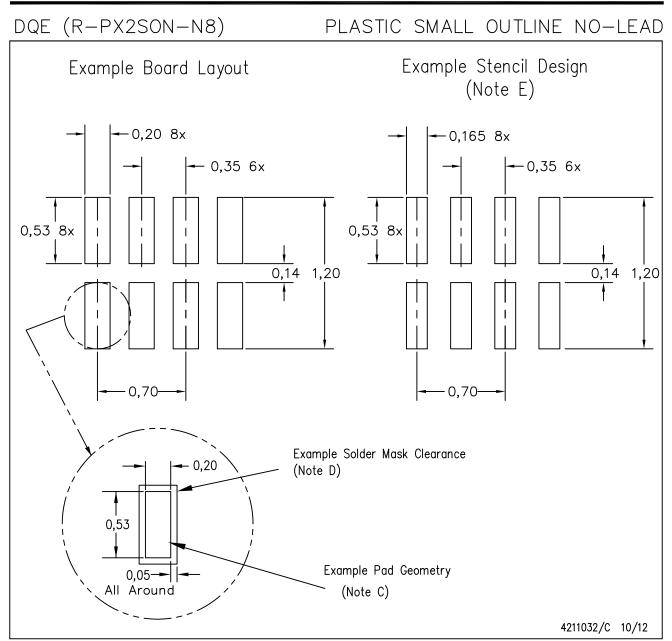
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AVC2T244DQER	X2SON	DQE	8	5000	202.0	201.0	28.0
SN74AVC2T244DQMR	X2SON	DQM	8	3000	202.0	201.0	28.0

MECHANICAL DATA



- B. This drawing is subject to change without notice.
 C. SON (Small Outline No-Lead) package configuration.
 D. This package complies to JEDEC M0-287 variation X2EAF.



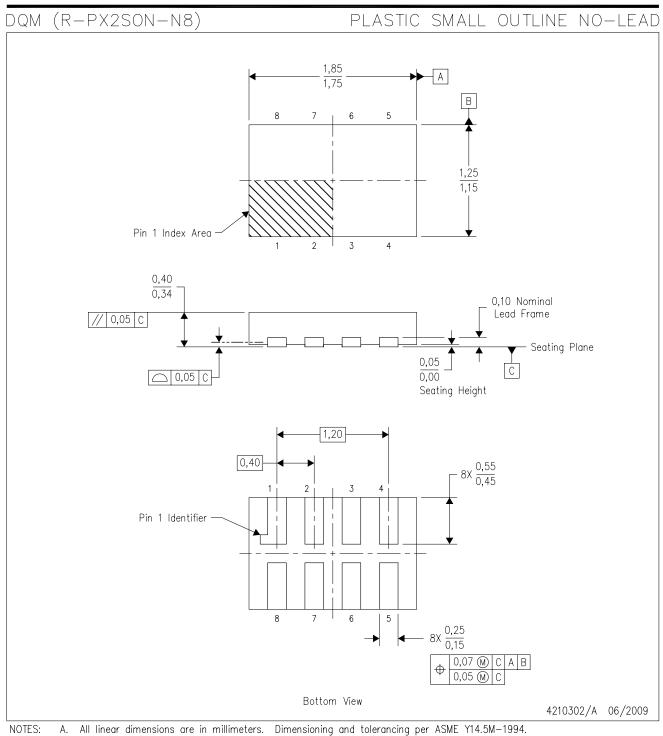


NOTES: A. All linear dimensions are in millimeters.

- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads. If 2 mil solder mask is outside PCB vendor capability, it is advised to omit solder mask.
- E. Maximum stencil thickness 0,1016 mm (4 mils). All linear dimensions are in millimeters.
- F. 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. Refer to IPC 7525 for stencil design considerations.
- G. Over-printing land for acceptable area ratio is not viable due to land width and bridging potential. Customer may further reduce side aperture dimensions if stencil manufacturing process allows for sufficient release at smaller opening.
- H. Suggest stencils cut with lasers such as Fiber Laser that produce the greatest positional accuracy.
- I. Component placement force should be minimized to prevent excessive paste block deformation.



MECHANICAL DATA



- B. This drawing is subject to change without notice.C. SON (Small Outline No-Lead) package configuration.



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