

2-Bit Bidirectional Voltage-Level Translator with Automatic Direction Sensing

Check for Samples: [TXB0302](#)

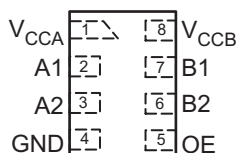
FEATURES

- **Fully Symmetric Supply Voltages.**
0.9 V to 3.6 V on A Port and 0.9 V to 3.6 V
- **V_{CC} Isolation Feature** — If Either V_{CC} Input Is at GND, All Outputs Are in the High-Impedance State
- **OE Input Circuit Referenced to V_{CCA}**
- **Low Power Consumption, 5-μA Max I_{CC}**
- **I_{off} Supports Partial-Power-Down Mode Operation**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **ESD Protection Exceeds JESD 22**
 - 4000-V Human-Body Model (A114-B)
 - 1000-V Charged-Device Model (C101)

DESCRIPTION

This 2-bit noninverting 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 bidirectional translation between 1-V, 1.2-V, 1.5-V, 1.8-V, 2.5-V and 3.3-V voltage nodes. For the TXB0302, when the output-enable (OE) input is low, all outputs are placed in the high-impedance state. To ensure the high-impedance state during power up or power down, OE should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver. The TXB0302 is designed so that the OE input circuit is supplied by V_{CCA}. This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

**DQM PACKAGE
(TOP VIEW)**



- Pull up resistors are not required on both sides for Logic I/O.
- If pull up or pull down resistors are needed, the resistor value must be over 20 kΩ.
- 20 kΩ is a safe recommended value, if the customer can accept higher V_{ol} or lower V_{oh}, smaller pull up or pull down resistor is allowed, the draft estimation is V_{ol} = V_{ccout} × 1.5k/(1.5k + R_{pu}) and V_{oh} = V_{ccout} × R_{dw}/(1.5k + R_{dw}).
- If pull up resistors are needed, please refer to the TXS0102 or contact TI.
- For detailed information, please refer to application note [SCEA043](#).

ORDERING INFORMATION⁽¹⁾

T _A	PACKAGE ⁽²⁾	ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	DQM – MicroQFN	TXB0302DQMR	77A

- (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](#).



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TXB0302

SCES837A –MARCH 2012–REVISED MAY 2012

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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.

PIN DESCRIPTION

PIN NO.	NAME	FUNCTION
DQM	TXB0302	
1	VCCA	A-port supply voltage $0.9\text{ V} \leq V_{CCA} \leq 3.6\text{ V}$
2	A1	Input/output 1. Referenced to V_{CCA} .
3	A2	Input/output 2. Referenced to V_{CCA} .
4	GND	Ground
5	OE	3-state output-mode enable. Pull OE (TXB0302) low to place all outputs in 3-state mode.
6	B2	Input/output 2. Referenced to V_{CCB} .
7	B1	Input/output 1. Referenced to V_{CCB} .
8	VCCB	B-port supply voltage $0.9\text{ V} \leq V_{CCB} \leq 3.6\text{ V}$.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

			MIN	MAX	UNIT
V_{CCA}	Supply voltage range		–0.5	4.6	V
V_{CCB}			–0.5	4.6	
V_I	Input voltage range	A port	–0.5	4.6	V
		B port	–0.5	6.5	
V_O	Voltage range applied to any output in the high-impedance or power-off state	A port	–0.5	4.6	V
		B port	–0.5	6.5	
V_O	Voltage range applied to any output in the high or low state ⁽²⁾	A port	–0.5	$V_{CCA} + 0.5$	V
		B port	–0.5	$V_{CCB} + 0.5$	
I_{IK}	Input clamp current	$V_I < 0$		–50	mA
I_{OK}	Output clamp current	$V_O < 0$		–50	mA
I_O	Continuous output current			±50	mA
	Continuous current through VCCA, VCCB, or GND			±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.

THERMAL IMPEDANCE RATINGS⁽¹⁾⁽²⁾

THERMAL METRIC		TXB0302	UNIT
		DQM	
		8 PINS	
θ_{JA}	Package thermal impedance	259	°C/W

- (1) The package thermal impedance is calculated in accordance with JESD 51-7.
(2) The package thermal impedance is calculated in accordance with JESD 51-5.

RECOMMENDED OPERATING CONDITIONS⁽¹⁾

			VCCA	VCCB	MIN	MAX	UNIT
VCCA	Supply voltage				0.9	3.6	V
VCCB					0.9	3.6	
VIH	High-level input voltage	Data inputs	0.9 V to 3.6 V	0.9 V to 3.6 V	$V_{CCI}^{(2)} \times 0.65$	$V_{CCI}^{(2)}$	V
		OE	0.9 V to 3.6 V	0.9 V to 3.6 V	$V_{CCA} \times 0.65$	3.6	
VIL	Low-level input voltage	Data inputs	0.9 V to 3.6 V	0.9 V to 3.6 V	0	$V_{CCI}^{(2)} \times 0.35$	V
		OE	0.9 V to 3.6 V	0.9 V to 3.6 V	0	$V_{CCA} \times 0.35$	
VO	Voltage range applied to any output in the high-impedance or power-off state	A-port	0.9 V to 3.6 V	0.9 V to 3.6 V	0	3.6	V
		B-port	0.9 V to 3.6 V	0.9 V to 3.6 V	0	3.6	
$\Delta t/\Delta v$	Input transition rise or fall rate	A-port inputs	0.9 V to 3.6 V	0.9 V to 3.6 V		40	ns/V
		B-port inputs	0.9 V to 3.6 V	0.9 V to 3.6 V		40	
TA	Operating free-air temperature				–40	85	°C

(1) The A and B sides of an unused data I/O pair must be held in the same state, i.e., both at VCCI or both at GND.

(2) VCCI is the supply voltage associated with the input port.

ELECTRICAL CHARACTERISTICS

PARAMETER	TEST CONDITIONS	VCCA	VCCB	TA = 25°C			–40°C to 85°C		UNIT
				MIN	TYP	MAX	MIN	MAX	
VOHA	I _{OH} = –20 µA	0.9 V to 3.6 V				0.9 × VCCA			V
VOA	I _{OL} = 20 µA	0.9 V to 3.6 V					0.2		V
VOHB	I _{OH} = –20 µA		0.9 V to 3.6 V			0.9 × VCCB			V
VOB	I _{OL} = 20 µA	0.9 V to 3.6 V					0.2		V
II	OE	VI = VCCI or GND	0.9 V to 3.6 V	0.9 V to 3.6 V		±1		±2	µA
	A port	VI or VO = 0 to 3.6 V	0 V	0 V to 3.6 V		±1		±2	µA
	B port	VI or VO = 0 to 3.6 V	0.9 V to 3.6 V	0 V		±1		±2	
IOZ	A or B port	OE = GND	0.9 V to 3.6 V	0.9 V to 3.6 V		±1		±2	µA
ICCA	VI = VCCI or GND, IO = 0	0.9 V to 3.6 V	0.9 V to 3.6 V					5	µA
ICCB	VI = VCCI or GND, IO = 0	0.9 V to 3.6 V	0.9 V to 3.6 V					5	µA
ICCA + ICCB	VI = VCCI or GND, IO = 0	0.9 V to 3.6 V	0.9 V to 3.6 V					10	µA
ICCA	VI = VCCI or GND, IO = 0, OE = GND	0.9 V to 3.6 V	0.9 V to 3.6 V					5	µA
ICCA	VI = VCCI or GND, IO = 0, OE = GND	0.9 V to 3.6 V	0.9 V to 3.6 V					5	µA
CI	OE	0.9 V to 3.6 V	0.9 V to 3.6 V		3				pF
CIO	A port	0.9 V to 3.6 V	0.9 V to 3.6 V		9				pF
	B port				12				

TIMING REQUIREMENTS

		VCCA	VCCB	MIN	MAX	UNIT
Data rate	CL = 15 pF	0.9 to 3.6 V	0.9 to 3.6 V		40	Mbps
	CL = 15 pF	1.2 to 3.6 V	1.2 to 3.6 V		100	Mbps
	CL = 15 pF	1.8 to 3.6 V	1.8 to 3.6 V		140	Mbps
	CL = 30 pF	0.9 to 3.6 V	0.9 to 3.6 V		40	Mbps
	CL = 30 pF	1.2 to 3.6 V	1.2 to 3.6 V		90	Mbps
	CL = 30 pF	1.8 to 3.6 V	1.8 to 3.6 V		120	Mbps
	CL = 50 pF	1.2 to 3.6 V	1.2 to 3.6 V		70	Mbps
	CL = 50 pF	1.8 to 3.6 V	1.8 to 3.6 V		100	Mbps

SWITCHING CHARACTERISTICS

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

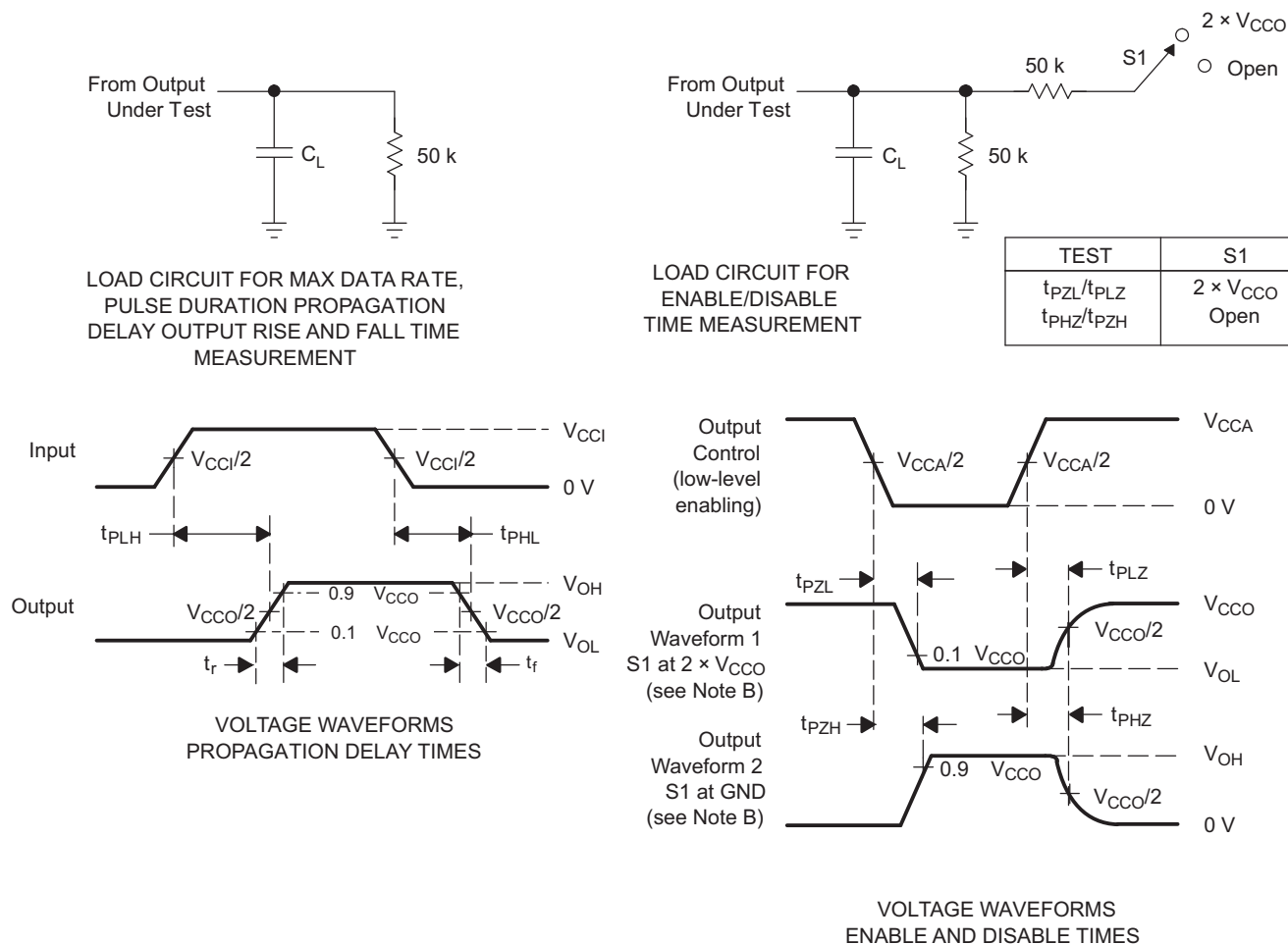
PARAMETER	FROM (INPUT)	TO (OUTPUT)		VCCA	VCCB	MIN	TYP T _A = 25°C	MAX	UNIT
t _{pd}	A	B	C _L = 15	0.9-3.6	0.9-3.6		18.9	62.5	ns
	A	B	C _L = 15	1.2-3.6	1.2-3.6		7.5	15.5	
	A	B	C _L = 15	1.8-3.6	1.8-3.6		3.7	5.8	
	A	B	C _L = 30	0.9-3.6	0.9-3.6		19.5	64.5	
	A	B	C _L = 30	1.2-3.6	1.2-3.6		7.8	16.1	
	A	B	C _L = 30	1.8-3.6	1.8-3.6		3.8	6.1	
	A	B	C _L = 50	1.2-3.6	1.2-3.6		8	16.8	
	A	B	C _L = 50	1.8-3.6	1.8-3.6		4	6.5	ns
	B	A	C _L = 15	0.9-3.6	0.9-3.6		18.9	62.6	
	B	A	C _L = 15	1.2-3.6	1.2-3.6		7.5	15.4	
	B	A	C _L = 15	1.8-3.6	1.8-3.6		3.7	5.8	
	B	A	C _L = 30	0.9-3.6	0.9-3.6		19.5	64.5	
	B	A	C _L = 30	1.2-3.6	1.2-3.6		7.8	16.1	
	B	A	C _L = 30	1.8-3.6	1.8-3.6		3.8	5.2	
	B	A	C _L = 50	1.2-3.6	1.2-3.6		8	16.9	
	B	A	C _L = 50	1.8-3.6	1.8-3.6		4	6.6	
t _{en}	OE	A	C _L = 15	0.9-3.6	0.9-3.6			504	ns
		B	C _L = 15	0.9-3.6	0.9-3.6			356	
t _{dis}	OE	A	C _L = 15	0.9-3.6	0.9-3.6			200	ns
		B	C _L = 15	0.9-3.6	0.9-3.6			200	ns
t _{FB} , t _{FB}	B-port rise and fall times		C _L = 15	0.9-3.6	0.9-3.6		2.95		ns
t _S , t _S	A-port rise and fall times		C _L = 15	0.9-3.6	0.9-3.6		3.1		ns
t _{SK(O)}	Channel-to-channel skew		C _L = 15	0.9-3.6	0.9-3.6			0.5	ns

OPERATING CHARACTERISTICS

T_A = 25°C

PARAMETER		TEST CONDITIONS	VCCA, VCCB 0.9 V to 3.6 V	UNIT
			TYP	
C _{pdA}	A-port input, B-port output	C _L = 0, f = 10 MHz, t _r = t _f = 1 ns, OE = V _{CCA} (outputs enabled)	40	pF
	B-port input, A-port output		40	
C _{pdB}	A-port input, B-port output		40	pF
	B-port input, A-port output		40	
C _{pdA}	A-port input, B-port output	C _L = 0, f = 10 MHz, t _r = t _f = 1 ns, OE = GND (outputs disabled)	0.01	pF
	B-port input, A-port output		0.01	
C _{pdB}	A-port input, B-port output		0.01	pF
	B-port input, A-port output		0.01	

PARAMETER MEASUREMENT INFORMATION



- A. C_L includes probe and jig capacitance.
- B. All input pulses are supplied by generators having the following characteristics: PRR 10 MHz, $Z_O = 50 \Omega$, $dv/dt \geq 1 \text{ V/ns}$.
- C. The outputs are measured one at a time, with one transition per measurement.
- D. t_{PLH} and t_{PHL} are the same as t_{pd} .
- E. V_{CCI} is the V_{CC} associated with the input port.
- F. V_{CCO} is the V_{CC} associated with the output port.
- G. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuits and Voltage Waveforms

REVISION HISTORY

Changes from Original (March 2012) to Revision A	Page
• Added package pin out diagram notes.	1

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)
TXB0302DQMR	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.

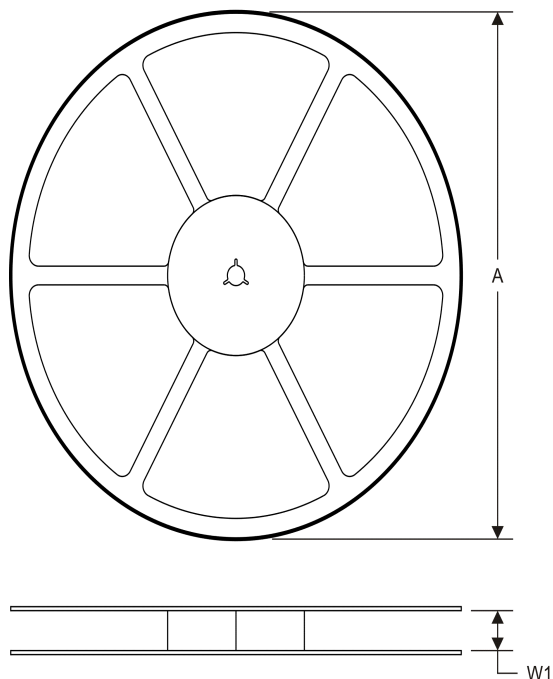
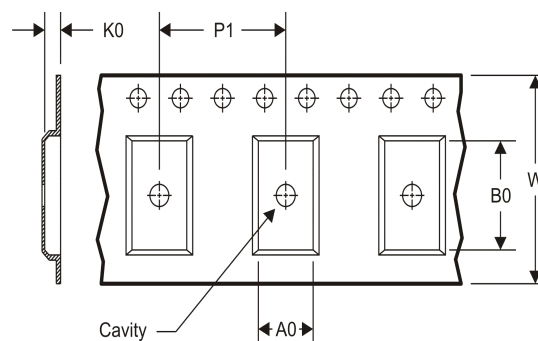
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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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TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


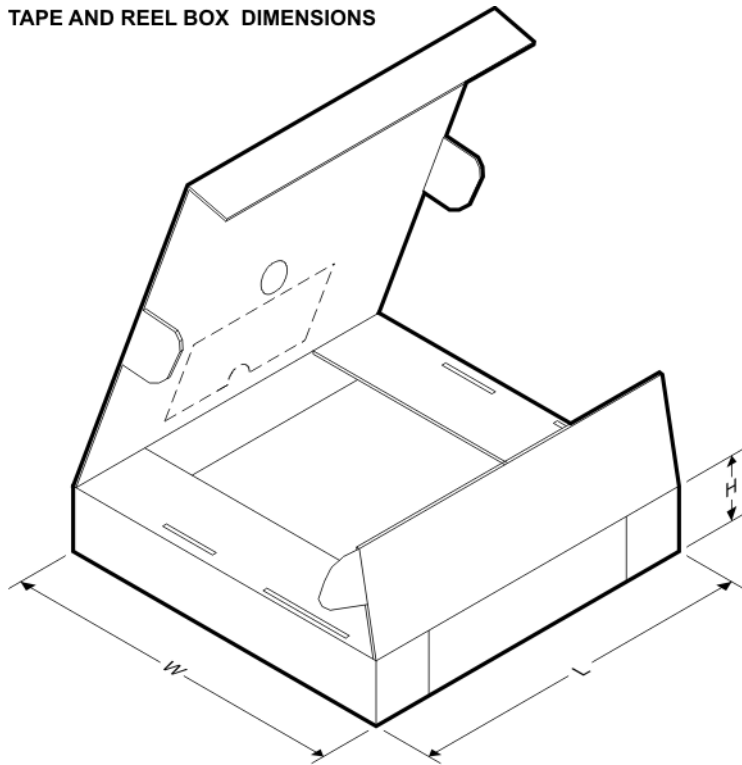
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
TXB0302DQMR	X2SON	DQM	8	3000	180.0	9.5	1.4	2.0	0.5	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS

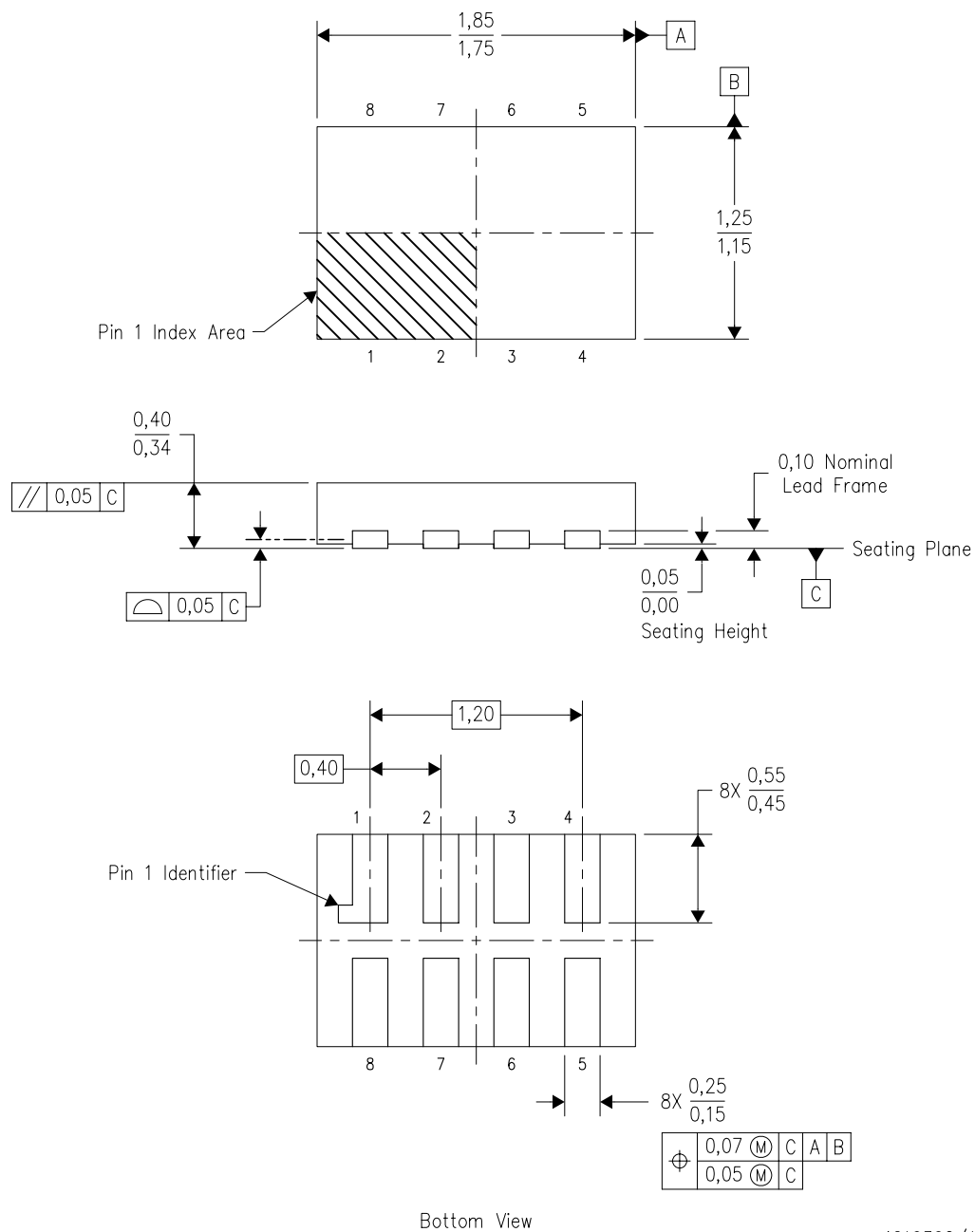


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TXB0302DQMR	X2SON	DQM	8	3000	180.0	180.0	30.0

DQM (R-PX2SON-N8)

PLASTIC SMALL OUTLINE NO-LEAD



4210302/A 06/2009

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. SON (Small Outline No-Lead) package configuration.

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