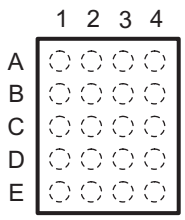
MMC, SD CARD, Memory Stick™ VOLTAGE-TRANSLATION TRANSCEIVER WITH ESD PROTECTION AND EMI FILTERING

Check for Samples: TXS0206

FEATURES

- **Level Translator**
  - **V_{CCA} and V_{CCB} Range of 1.1 V to 3.6 V**
  - **Fast Propagation Delay (4 ns Max When Translating Between 1.8 V and 3 V)**
- **Integrated EMI Filtering and ESD Protection Circuitry**
- **ESD Protection Exceeds JESD 22 (A Port)**
  - **2500-V Human-Body Model (A114-B)**
  - **250-V Machine Model (A115-A)**
  - **1500-V Charged-Device Model (C101)**
- **±8-kV Contact Discharge IEC 61000-4-2 ESD (B-port)**

YFP PACKAGE
(TOP VIEW)



TERMINAL ASSIGNMENTS

	1	2	3	4
A	DAT2A	V_{CCA}	WP	DAT2B
B	DAT3A	CD	V_{CCB}	DAT3B
C	CMDA	GND	GND	CMDB
D	DAT0A	CLKA	CLKB	DAT0B
E	DAT1A	CLK-f	EN	DAT1B

DESCRIPTION/ORDERING INFORMATION

The TXS0206 is a level shifter for interfacing microprocessors with MultiMediaCards (MMCs), secure digital (SD) cards, and Memory Stick™ cards. It includes a high-speed level translator along with ESD protection and EMI filtering circuitry.

The voltage-level translator has two supply voltage pins. V_{CCA} as well as V_{CCB} can be operated over the full range of 1.1 V to 3.6 V. The TXS0206 enables system designers to easily interface applications processors or digital basebands to memory cards and SDIO peripherals operating at a different I/O voltage level.

Memory card standards recommend high-ESD protection for devices that connect directly to the external memory card. To meet this need, the TXS0206 incorporates ±8-kV Contact Discharge protection on the card side.

The TXS0206 is offered in a 20-bump wafer chip scale package (WCSP). This package has dimensions of 1.96 mm × 1.56 mm, with a 0.4-mm ball pitch for effective board-space savings. Memory cards are widely used in mobile phones, PDAs, digital cameras, personal media players, camcorders, set-top boxes, etc. Low static power consumption and small package size make the TXS0206 an ideal choice for these applications.

ORDERING INFORMATION(1)

T_A	PACKAGE(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING(3)
–40°C to 85°C	WCSP – YFP (Pb-free)	Tape and reel	TXS0206YFPR	_ _ _3T_

(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.
(3) YFP: The actual top-side marking has three preceding characters to denote year, month, and sequence code, and one following character to designate the assembly/test site. Pin 1 identifier indicates solder-bump composition (1 = SnPb, •= Pb-free).

REFERENCE DESIGN

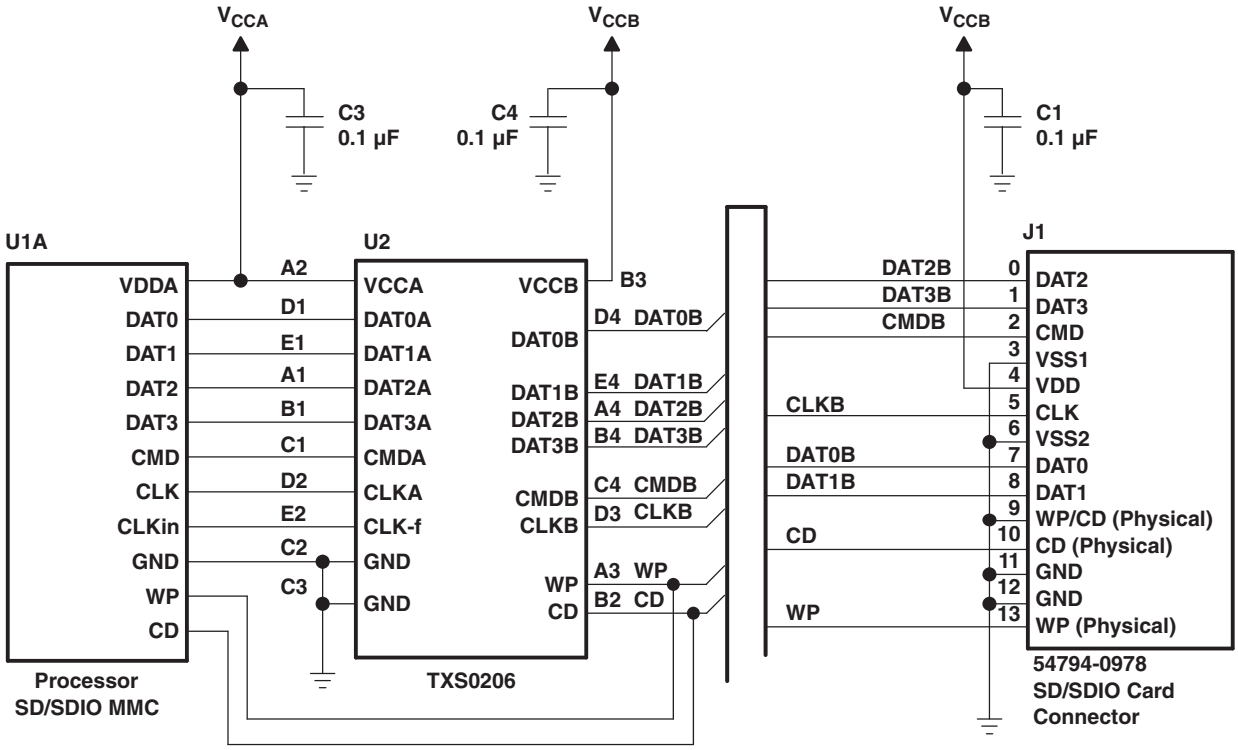
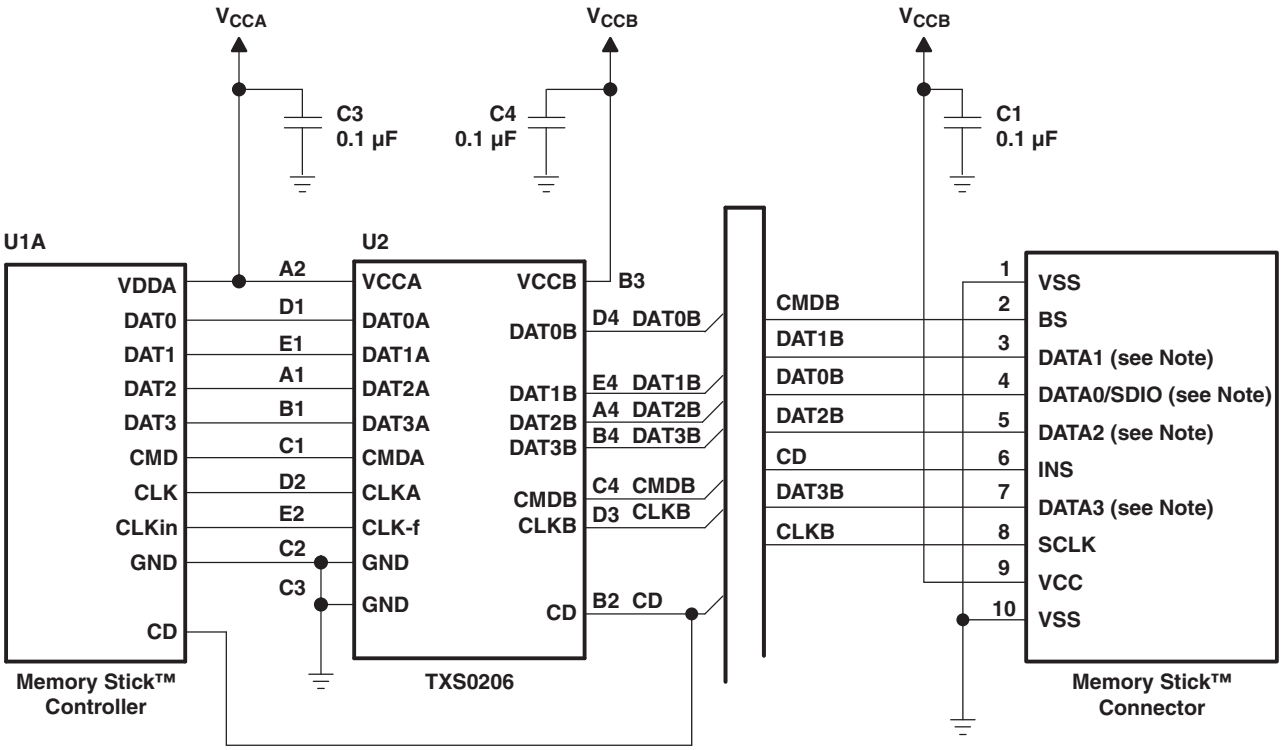


Figure 1. Interfacing With SD/SDIO Card



NOTE: The TXS0206 has integrated pullup resistor values that dynamically change value depending on whether a low or high signal is being transmitted through the device. When the output is low, the TXS0206 internal pullup value is 40 kΩ, and when the output is high, the internal pullup value change to a value of 4 kΩ. For MSA and MSH Memory Stick™ memory cards, to ensure that a valid V_{IH} (i.e., receiver input voltage high) is achieved, the internal pulldown resistors for these memory cards are not smaller than a 10-kΩ value. See the *Application Information* section of this data sheet, which explains the impact of adding too heavy (i.e., <10-kΩ value) of a pulldown resistor to the data lines of the TXS0206 device and the resulting 4-kΩ pullup/10-kΩ pulldown voltage divider network, which has a direct impact on the V_{IH} of the signal being sent into the Memory Stick™.

Figure 2. Interfacing With Memory Stick™ Card

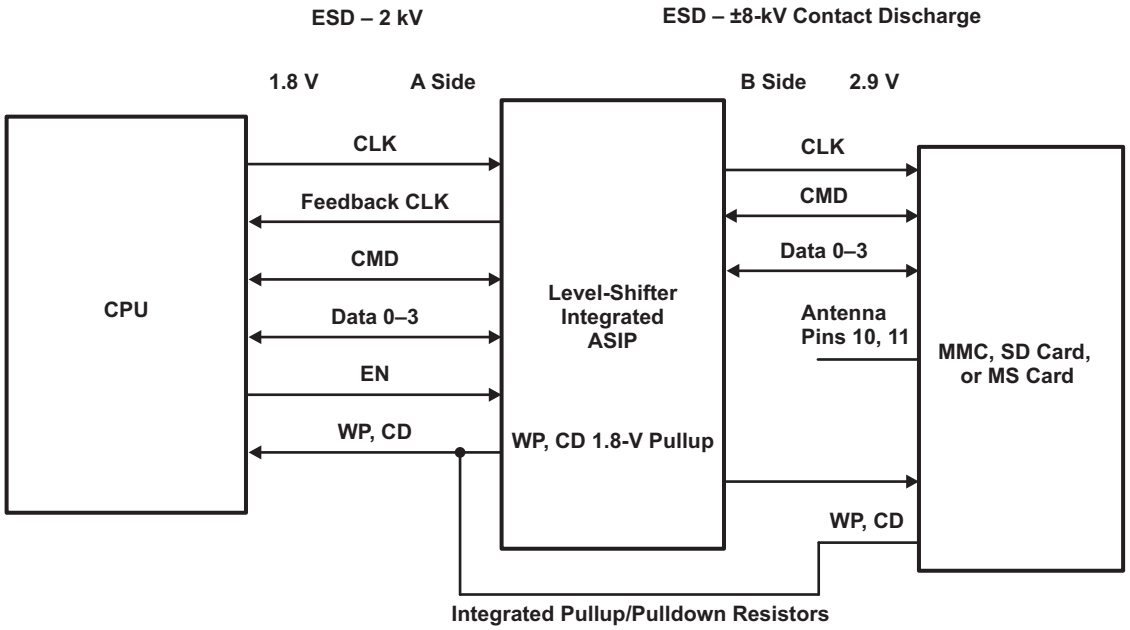


Figure 3. Typical Application Circuit

LOGIC TABLE

EN	TRANSLATOR I/Os
L	Disabled, pulled to V_{CCA}, V_{CCB} through 40 kΩ
H	Active

TERMINAL FUNCTIONS

TERMINAL		TYPE	DESCRIPTION
NO.	NAME		
A1	DAT2A	I/O	Data bit 2 connected to host. Referenced to V_{CCA}. Includes a 40-kΩ pullup resistor to $V_{CCA.}$
A2	V_{CCA}	Pwr	A-port supply voltage. V_{CCA} powers all A-port I/Os and control inputs.
A3	WP	O	Connected to write protect on the mechanical connector. The WP pin has an internal 100-kΩ pullup resistor to V_{CCA}.
A4	DAT2B	I/O	Data bit 2 connected to memory card. Referenced to V_{CCB}. Includes a 40-kΩ pullup resistor to V_{CCB}.
B1	DAT3A	I/O	Data bit 3 connected to host. Referenced to V_{CCA}. Includes a 40-kΩ pullup resistor to V_{CCA}.
B2	CD	O	Connected to card detect on the mechanical connector. The CD pin has an internal 100-kΩ pullup resistor to V_{CCA}.
B3	V_{CCB}	Pwr	B-port supply voltage. V_{CCB} powers all B-port I/Os.
B4	DAT3B	I/O	Data bit 3 connected to memory card. Referenced to V_{CCB}. Includes a 40-kΩ pullup resistor to V_{CCB}.
C1	CMDA	I/O	Command bit connected to host. Referenced to V_{CCA}. Includes a 40-kΩ pullup resistor to V_{CCA}.
C2, C3	GND		Ground
C4	CMDB	I/O	Command bit connected to memory card. Referenced to V_{CCB}. Includes a 40-kΩ pullup resistor to V_{CCB}.
D1	DAT0A	I/O	Data bit 0 connected to host. Referenced to V_{CCA}. Includes a 40-kΩ pullup resistor to V_{CCA}.
D2	CLKA	I	Clock signal connected to host. Referenced to V_{CCA}.
D3	CLKB	O	Clock signal connected to memory card. Referenced to V_{CCB}.
D4	DAT0B	I/O	Data bit 0 connected to memory card. Referenced to V_{CCB}. Includes a 40-kΩ pullup resistor to V_{CCB}.
E1	DAT1A	I/O	Data bit 1 connected to host. Referenced to V_{CCA}. Includes a 40-kΩ pullup resistor to V_{CCA}.
E2	CLK-f	O	Clock feedback to host for resynchronizing data to a processor. Leave unconnected if not used.
E3	EN	I	Enable/disable control. Pull EN low to place all outputs in Hi-Z state. Referenced to V_{CCA}.
E4	DAT1B	I/O	Data bit 1 connected to memory card. Referenced to V_{CCB}. Includes a 40-kΩ pullup resistor to V_{CCB}.

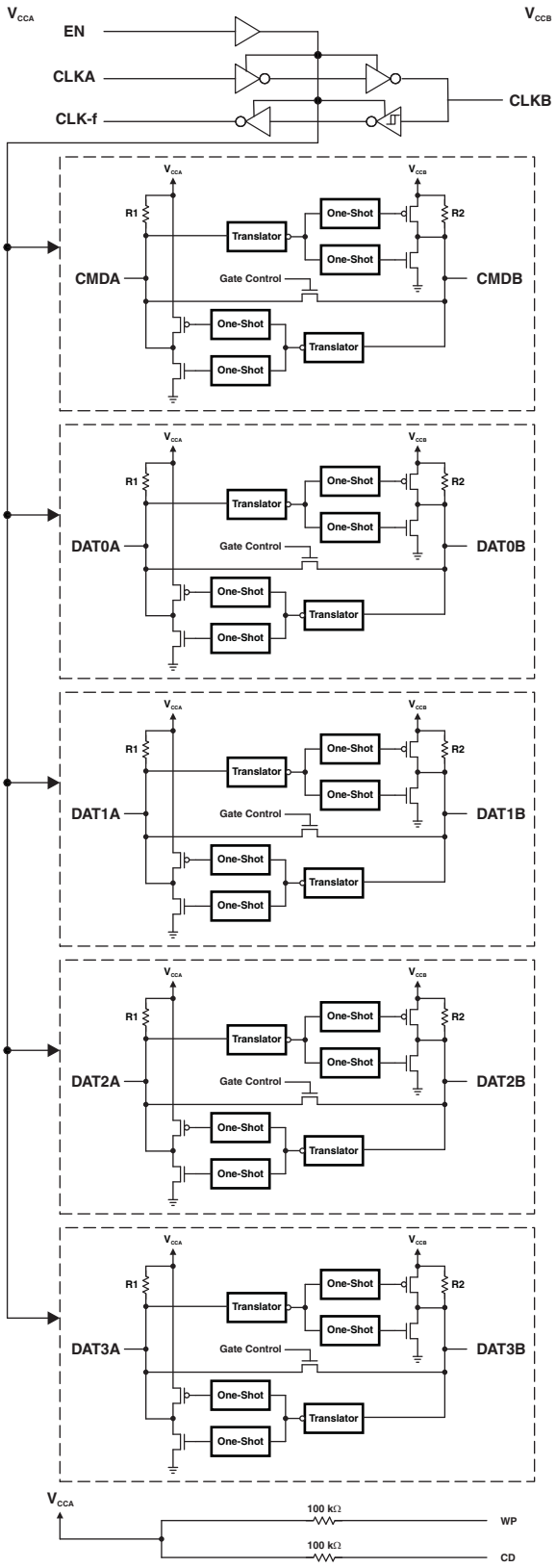
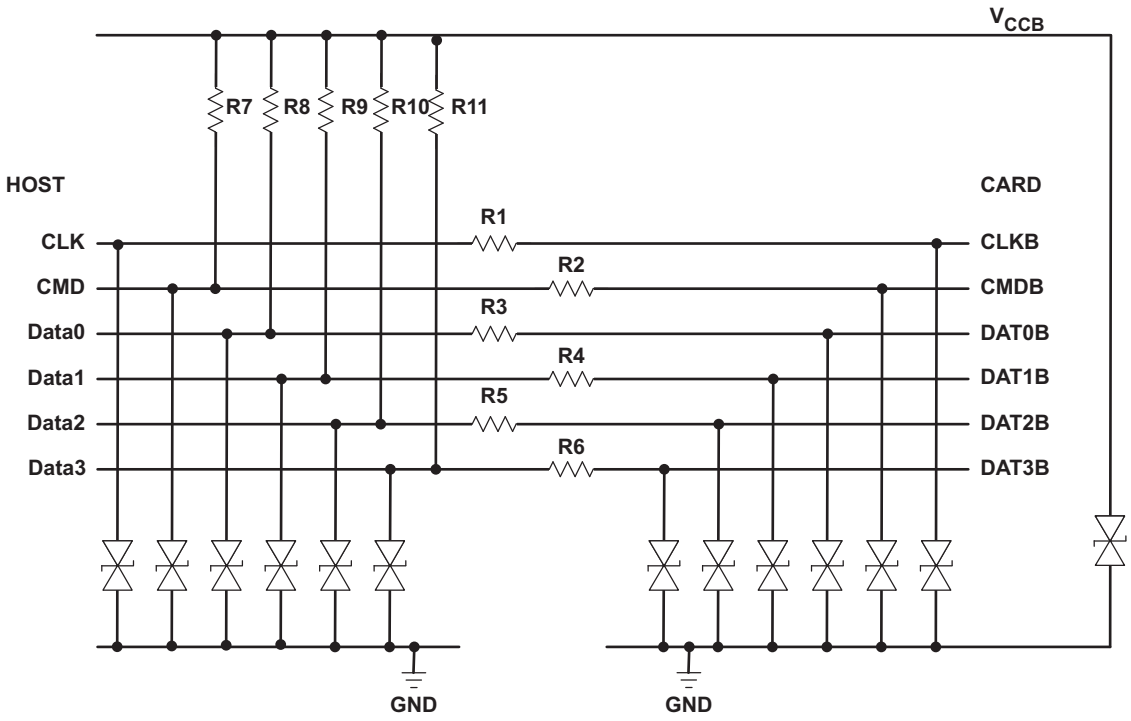


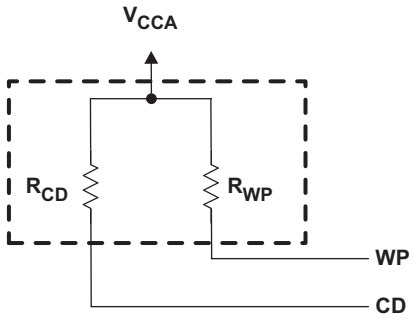
Figure 4. Logic Diagram



RESISTORS	
R1, R2, R3, R4, R5, R6	40 Ω
Tolerance	±20%
R7, R8, R9, R10, R11	40 kΩ
Tolerance	±30%

BIDIRECTIONAL ZENER DIODES	
Vbr min	14 V at 1 mA
Line capacitance	<20 pF

Figure 5. ASIP Block Diagram



RESISTORS	
R_{WP}, R_{CD}	100 kΩ
Tolerance	±30%

Figure 6. WP, CD Pullup Resistors

ABSOLUTE MAXIMUM RATINGS(1)
Level Translator

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

			MIN	MAX	UNIT
V_{CCA}	Supply voltage range		–0.5	4.6	V
V_{CCB}	Supply voltage range		–0.5	4.6	V
V_I	Input voltage range	I/O ports (A port)	–0.5	4.6	V
		I/O ports (B port)	–0.5	4.6	
		Control inputs	–0.5	4.6	
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	4.6	
V_O	Voltage range applied to any output in the high or low state	A port	–0.5	4.6	V
		B port	–0.5	4.6	
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 V_{CCA} 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

			UNIT
θ_{JA}	Package thermal impedance(1)	117	°C/W

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

RECOMMENDED OPERATING CONDITIONS(1)
Level Translator

			V_{CCA}	V_{CCB}	MIN	MAX	UNIT
V_{CCA}	Supply voltage				1.1	3.6	V
V_{CCB}	Supply voltage				1.1	3.6	V
V_{IH}	High-level input voltage	A-Port CMD and DATA I/Os	1.1 V to 1.95 V	1.1 V to 1.95 V	V_{CCI} – 0.2	V_{CCI}	V
		B-Port CMD and DATA I/Os	1.95 V to 3.6 V	1.95 V to 3.6 V			
		EN and CLKA	1.1 V to 3.6 V	1.1 V to 3.6 V	V_{CCI} x 0.65	V_{CCI}	
V_{IL}	Low-level input voltage	A-Port CMD and DATA I/Os	1.1 V to 1.95 V	1.1 V to 1.95 V	0	0.15	V
		B-Port CMD and DATA I/Os	1.95 V to 3.6 V	1.95 V to 3.6 V			
		EN and CLKA	1.1 V to 3.6 V	1.1 V to 3.6 V	0	V_{CCI} x 0.35	
V_O	Output voltage	Active state			0	V_{CCO}	V
		3-state			0	3.6	
I_{OH}	High-level output current (CLK-f output)		1.1 V to 3.6 V	1.1 V to 3.6 V		–100	µA
			1.1 V to 1.3 V			–0.5	mA
			1.4 V to 1.6 V			–1	
			1.65 V to 1.95 V			–2	
			2.3 V to 2.7 V			–4	
			3 V to 3.6 V			–8	
I_{OL}	Low-level output current (CLK-f output)		1.1 V to 3.6 V	1.1 V to 3.6 V		100	µA
			1.1 V to 1.3 V			0.5	mA
			1.4 V to 1.6 V			1	
			1.65 V to 1.95 V			2	
			2.3 V to 2.7 V			4	
			3 V to 3.6 V			8	
I_{OH}	High-level output current (CLK output)		1.1 V to 3.6 V	1.1 V to 3.6 V		–100	µA
				1.1 V to 1.3 V		–0.5	mA
				1.4 V to 1.6 V		–1	
				1.65 V to 1.95 V		–2	
				2.3 V to 2.7 V		–4	
				3 V to 3.6 V		–8	
I_{OL}	Low-level output current (CLK output)		1.1 V to 3.6 V	1.1 V to 3.6 V		100	µA
				1.1 V to 1.3 V		0.5	mA
				1.4 V to 1.6 V		1	
				1.65 V to 1.95 V		2	
				2.3 V to 2.7 V		4	
				3 V to 3.6 V		8	
Δt/Δv	Input transition rise or fall rate					5	ns/V
T_A	Operating free-air temperature				–40	85	°C

(1) All unused data inputs of the device must be held at V_{CCI} 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
Level Translator

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

PARAMETER		TEST CONDITIONS	V_{CCA}	V_{CCB}	MIN	TYP(1)	MAX	UNIT
V_{OH}	A port (CLK-f output)	I_{OH} = –100 µA	1.1 V to 3.6 V	1.1 V to 3.6 V	V_{CCA} * 0.8			V
		I_{OH} = –0.5 mA	1.1 V		0.8			
		I_{OH} = –1 mA	1.4 V		1.05			
		I_{OH} = –2 mA	1.65 V		1.2			
		I_{OH} = –4 mA	2.3 V		1.75			
		I_{OH} = –8 mA	3 V		2.3			
	A port (DAT and CMD outputs)	I_{OH} = –20 µA	1.1 V to 3.6 V		V_{CCA} × 0.8			
V_{OL}	A port (CLK-f output)	I_{OL} = 100 µA	1.1 V to 3.6 V	1.1 V to 3.6 V			V_{CCA} × 0.8	V
		I_{OL} = 0.5 mA	1.1 V				0.35	
		I_{OL} = 1 mA	1.4 V				0.35	
		I_{OL} = 2 mA	1.65 V				0.45	
		I_{OL} = 4 mA	2.3 V				0.55	
		I_{OL} = 8 mA	3 V				0.7	
	A port (DAT and CMD outputs)	I_{OL} = 135 µA	1.1 V to 3.6 V				0.4	V
		I_{OL} = 180 µA					0.4	
		I_{OL} = 220 µA					0.4	
		I_{OL} = 300 µA					0.4	
		I_{OL} = 400 µA					0.55	
V_{OH}	B port (CLK output)	I_{OH} = –100 µA	1.1 V to 3.6 V	1.1 V to 3.6 V	V_{CCA} × 0.8			V
		I_{OH} = –0.5 mA		1.1 V	0.8			
		I_{OH} = –1 mA		1.4 V	1.05			
		I_{OH} = –2 mA		1.65 V	1.2			
		I_{OH} = –4 mA		2.3 V	1.75			
		I_{OH} = –8 mA		3 V	2.3			
	B port (DAT output)	I_{OH} = –20 µA		1.1 V to 3.6 V	V_{CCA} × 0.8			

(1) All typical values are at T_A = 25°C.

ELECTRICAL CHARACTERISTICS
Level Translator (continued)

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

PARAMETER		TEST CONDITIONS	V_{CCA}	V_{CCB}	MIN	TYP(1)	MAX	UNIT
V_{OL}	B port	I_{OL} = 100 µA	1.1 V to 3.6 V	1.1 V to 3.6 V			V_{CCA} × 0.8	V
		I_{OL} = 0.5 mA		1.1 V			0.35	
		I_{OL} = 1 mA		1.4 V			0.35	
		I_{OL} = 2 mA		1.65 V			0.45	
		I_{OL} = 4 mA		2.3 V			0.55	
		I_{OL} = 8 mA		3 V			0.7	
	B port (DAT output)	I_{OL} = 135 µA	1.1 V to 3.6 V	1.1 V to 3.6 V			0.4	V
		I_{OL} = 180 µA		1.4 V			0.4	
		I_{OL} = 220 µA		1.65 V			0.4	
		I_{OL} = 300 µA		2.3 V			0.4	
		I_{OL} = 400 µA		3 V			0.55	
I_I	Control inputs	V_I = V_{CCA} or GND		1.1 V to 3.6 V			±1	µA
I_{CCA}		V_I = V_{CCI} or GND, I_O = 0	1.1 V to 3.6 V	1.1 V to 3.6 V			6	µA
I_{CCB}		V_I = V_{CCI} or GND, I_O = 0	1.1 V to 3.6 V	1.1 V to 3.6 V			5	µA
C_{io}	A port					5.5	6.5	pF
	B port					15	17.5	
C_i	Control inputs	V_I = V_{CCA} or GND				3.5	4.5	pF
	Clock input					3	4	

TIMING REQUIREMENTS
V_{CCA} = 1.2 V ± 0.1 V

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

			V_{CCB} = 1.2 V ± 0.1 V		V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate	Command	Push-pull driving		30		40		40		40		40	Mbps
		Open-drain driving		0.9		1		1		1		1	
	Clock	Push-pull driving		30		40		50		60		60	MHz
	Data			30		40		40		40		40	Mbps
t_w Pulse duration	Command	Push-pull driving	33		25		25		25		25		ns
		Open-drain driving	1		1		1		1		1		µs
	Clock	Push-pull driving	16.7		12.5		10		8.3		8.3		ns
	Data		33		25		25		25		25		ns

TIMING REQUIREMENTS
V_{CCA} = 1.5 V ± 0.1 V

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

			V_{CCB} = 1.2 V ± 0.1 V		V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate	Command	Push-pull driving		30		60		60		60		60	Mbps
		Open-drain driving		1		1		1		1		1	
	Clock	Push-pull driving		50		60		60		60		60	MHz
	Data			30		60		60		60		60	Mbps
t_w Pulse duration	Command	Push-pull driving	33		17		17		17		17		ns
		Open-drain driving	1		1		1		1		1		µs
	Clock	Push-pull driving	10		8.3		8.3		8.3		8.3		ns
	Data		33		17		17		17		17		ns

TIMING REQUIREMENTS
V_{CCA} = 1.8 V ± 0.15 V

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

			V_{CCB} = 1.2 V ± 0.1 V		V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate	Command	Push-pull driving		30		60		60		60		60	Mbps
		Open-drain driving		1		1		1		1		1	
	Clock	Push-pull driving		50		60		60		60		60	MHz
	Data			30		60		60		60		60	Mbps
t_w Pulse duration	Command	Push-pull driving	33		17		17		17		17		ns
		Open-drain driving	1		1		1		1		1		µs
	Clock	Push-pull driving	10		8.3		8.3		8.3		8.3		ns
	Data		33		17		17		17		17		ns

TIMING REQUIREMENTS
V_{CCA} = 2.5 V ± 0.2 V

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

			V_{CCB} = 1.2 V ± 0.1 V		V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate	Command	Push-pull driving		30		60		60		60		60	Mbps
		Open-drain driving		1		1		1		1		1	
	Clock	Push-pull driving		60		60		60		60		60	MHz
	Data			30		60		60		60		60	Mbps
t_w Pulse duration	Command	Push-pull driving	33		17		17		17		17		ns
		Open-drain driving	1		1		1		1		1		µs
	Clock	Push-pull driving	8.3		8.3		8.3		8.3		8.3		ns
	Data		33		17		17		17		17		ns

TIMING REQUIREMENTS
V_{CCA} = 3.3 V ± 0.3 V

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

			V_{CCB} = 1.2 V ± 0.1 V		V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Data rate	Command	Push-pull driving		30		60		60		60		60	Mbps
		Open-drain driving		0.9		1		1		1		1	
	Clock	Push-pull driving		55		55		55		55		55	MHz
	Data			30		60		60		60		60	Mbps
t_w Pulse duration	Command	Push-pull driving	33		17		17		17		17		ns
		Open-drain driving	1		1		1		1		1		µs
	Clock	Push-pull driving	9		9		9		9		9		ns
	Data		33		17		17		17		17		ns

SWITCHING CHARACTERISTICS
V_{CCA} = 1.2 V ± 0.1 V

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V_{CCB} = 1.2 V ± 0.1 V		V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	CMDA	CMDB	Push-pull driving		15.3		12.2		10.8		10.4		10.8	ns
			Open-drain driving (H-to-L)	4.1	16.6	3.7	12.6	3.4	11.5	3.3	10.6	3.2	10.3	
			Open-drain driving (L-to-H)	204	308	164	256	133	224	95	175	71	147	
	CMDB	CMDA	Push-pull driving		19.7		15.1		13.4		12		11.2	
			Open-drain driving (H-to-L)	4.7	19.4	3.8	12.4	3.4	10.5	3.1	9.2	2.9	9.4	
			Open-drain driving (L-to-H)	211	353	170	304	139	282	101	243	77	204	
	CLKA	CLKB	Push-pull driving		15.6		12.3		11.5		10.9		11.7	
	DATxA	DATxB	Push-pull driving		15.9		12.6		11.2		10.7		11.1	
	DATxB	DATxA			18.2		14.3		12.8		11.5		10.6	
	CLKA	CLK-f	Push-pull driving		37.9		30.7		26.8		24.7		24.2	
t_{en}	EN	B-port	Push-pull driving		1		1		1		1		1	µs
	EN	A-port	Push-pull driving		1		1		1		1		1	
t_{dis}	EN	B-port	Push-pull driving		68		55		46		40		38	ns
	EN	A-port	Push-pull driving		62		56		48		40		37	
t_{rA}	CMDA rise time		Push-pull driving	1.7	14.1	1.5	13	1.5	12.7	1.6	12.2	1.9	11.9	ns
			Open-drain driving	170	260	128	205	96	171	57	120	32	91	
	CLK-f rise time		Push-pull driving	0.6	10.6	0.6	10.9	0.6	12	0.6	12.3	0.6	12.7	
	DATxA rise time			1.7	13.7	1.5	12.6	1.5	12	1.6	11.6	1.9	11.5	
t_{rB}	CMDB rise time		Push-pull driving	1.9	12.4	2.3	9.2	1.9	7.3	1.8	6.7	1.7	3.9	ns
			Open-drain driving	175	300	145	261	118	245	86	214	66	181	
	CLKB rise time		Push-pull driving	1	7.7	0.8	7.1	0.8	6.2	1.7	4.8	1.7	4.3	
	DATxB rise time			2.9	11.8	2.3	8.9	1.9	7.4	0.9	4.7	0.4	6.8	
t_{fA}	CMDA fall time		Push-pull driving	1	8	1	5.4	1	4.5	1	3.9	0.8	4	ns
			Open-drain driving	2.3	8.3	1.9	4.9	1.7	4.4	1.6	3.9	1.6	3.7	
	CLK-f fall time		Push-pull driving	1	5.8	1	4.6	1	4.1	1	3.8	1	4	
	DATxA fall time			1.8	8	1.3	5.4	1	4.5	1	3.9	1	3.8	
t_{fB}	CMDB fall time		Push-pull driving	2.1	7.9	1.8	5.2	1.7	4.6	1.6	4.5	1.5	4.3	ns
			Open-drain driving	1.9	8.3	1.5	5.9	1.3	5.1	1.1	4.3	1	4.2	
	CLKB fall time		Push-pull driving	2	7.1	1.8	5.4	1.8	4.5	1.7	4	1.6	3.9	
	DATxB fall time			2.1	8.5	1.1	6.4	0.9	5	1	3.9	1.1	4.8	
$t_{SK(O)}$	Channel-to-channel skew		Push-pull driving		1		1		1		1		1	ns
Max data rate	Command		Push-pull driving		30		40		40		40		40	Mbps
			Open-drain driving		0.9		1		1		1		1	
	Clock		Push-pull driving		30		40		50		60		60	MHz
	Data				30		40		40		40		40	Mbps

SWITCHING CHARACTERISTICS
V_{CCA} = 1.5 V ± 0.1 V

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V_{CCB} = 1.2 V ± 0.1 V		V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	CMDA	CMDB	Push-pull driving		12		8.6		6.9		6.1		6	ns
			Open-drain driving (H-to-L)	3.7	12.8	3.2	8.7	2.9	7.6	2.7	6.6	2.7	6.5	
			Open-drain driving (L-to-H)	192	297	191	295	157	252	112	180	83	138	
	CMDB	CMDA	Push-pull driving		15.2		9.8		8		6.8		6.3	
			Open-drain driving (H-to-L)	3.7	20.4	2.9	11.8	2.5	9.4	2.2	7.3	2.1	6.6	
			Open-drain driving (L-to-H)	199	337	196	316	162	282	117	214	87	177	
	CLKA	CLKB	Push-pull driving		12.3		8.7		7.7		6.1		6.2	
	DATxA	DATxB	Push-pull driving		12.5		8.9		7.2		6.2		6.1	
	DATxB	DATxA			13.9		9.2		7.6		6.5		6.1	
	CLKA	CLK-f	Push-pull driving		29		20		16		13		12	
t_{en}	EN	B-port	Push-pull driving		1		1		1		1		1	µs
	EN	A-port	Push-pull driving		1		1		1		1		1	
t_{dis}	EN	B-port	Push-pull driving		57		53		46		39		37	ns
	EN	A-port	Push-pull driving		58		54		46		38		35	
t_{rA}	CMDA rise time		Push-pull driving	1.6	10.5	0.4	9.5	0.2	8.9	0.4	8.3	1	7.9	ns
			Open-drain driving	166	254	157	247	121	203	74	127	44	85	
	CLK-f rise time		Push-pull driving	0.5	5.5	0.5	5.5	0.5	6.2	0.5	7	0.5	7.2	
	DATxA rise time			2	10.3	0.7	9.4	0.5	8.9	0.6	8.4	0.7	8.3	
t_{rB}	CMDB rise time		Push-pull driving	1.9	11.2	2	8	1.9	6.5	0.5	5.6	0.5	3.1	ns
			Open-drain driving	157	273	163	264	135	253	96	196	71	165	
	CLKB rise time		Push-pull driving	1.3	7.5	0.6	6.7	0.4	5.9	1.5	4.9	1.9	4.3	
	DATxB rise time			2.2	10.9	2	8.4	1.7	6.9	0.8	5	0.6	4	
t_{fA}	CMDA fall time		Push-pull driving	1.5	5.5	1.3	3.8	0.9	2.9	0.8	2.3	0.8	2.3	ns
			Open-drain driving	2.3	8	2	4.8	1.8	4.2	1.7	3.7	1.6	3.5	
	CLK-f fall time		Push-pull driving	0.4	3.9	0.4	3.7	0.4	4	0.4	3.7	0.4	6.8	
	DATxA fall time			0.8	6	0.6	4.8	0.1	4.1	0.1	3.8	0.1	3.8	
t_{fB}	CMDB fall time		Push-pull driving	1	11.6	1.5	7.1	1.5	5.8	1.4	5.4	1.6	3.6	ns
			Open-drain driving	1.7	5.2	1.5	3.8	1.2	3	1	2.3	0.9	2.3	
	CLKB fall time		Push-pull driving	1.1	10.8	1	8.8	1.8	6	1.7	4.1	1.6	3.9	
	DATxB fall time			1.1	13.3	1.2	7.7	1.2	6.5	2.3	4.3	2.5	4.2	
$t_{SK(O)}$	Channel-to-channel skew		Push-pull driving		1		1		1		1		1	ns
Max data rate	Command		Push-pull driving		30		60		60		60		60	Mbps
			Open-drain driving		1		1		1		1		1	
	Clock		Push-pull driving		50		60		60		60		60	MHz
	Data				30		60		60		60		60	Mbps

SWITCHING CHARACTERISTICS
V_{CCA} = 1.8 V ± 0.15 V

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V_{CCB} = 1.2 V ± 0.1 V		V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	CMDA	CMDB	Push-pull driving		11.3		7.3		5.7		4.6		4.4	ns
			Open-drain driving (H-to-L)	3.4	11.8	2.9	7.6	2.7	6.5	2.5	5.5	2.4	5.1	
			Open-drain driving (L-to-H)	179	286	183	288	168	286	121	201	89	151	
	CMDB	CMDA	Push-pull driving		13.2		8.3		6.5		5.2		4.8	
			Open-drain driving (H-to-L)	3.5	19.7	2.8	11.1	2.4	8.6	2.1	6.4	2	5.7	
			Open-drain driving (L-to-H)	186	323	190	304	173	303	125	215	93	166	
	CLKA	CLKB	Push-pull driving		11.6		7.7		6.2		4.7		4.5	
	DATxA	DATxB	Push-pull driving		11.7		7.5		5.8		4.7		4.4	
	DATxB	DATxA			12.1		7.9		6.3		5		4.6	
	CLKA	CLK-f	Push-pull driving		25.1		16.5		12		8.9		7.9	
t_{en}	EN	B-port	Push-pull driving		1		1		1		1		1	µs
	EN	A-port	Push-pull driving		1		1		1		1		1	
t_{dis}	EN	B-port	Push-pull driving		39		37		37		35		35	ns
	EN	A-port	Push-pull driving		49		47		47		38		35	
t_{rA}	CMDA rise time		Push-pull driving	1.8	8.4	1.2	6.8	1.1	5.9	1.1	5.9	1.6	5.8	ns
			Open-drain driving	154	246	155	262	135	238	85	150	52	99	
	CLK-f rise time		Push-pull driving	0.4	4	0.4	4.3	0.4	4.7	0.4	4.5	0.4	4.1	
	DATxA rise time			1.9	8.6	1.2	7.1	0.9	6.8	1	6.3	1.3	6.1	
t_{rB}	CMDB rise time		Push-pull driving	1.8	10.2	2	7.7	1.7	6.5	1	5.2	1.7	3.1	ns
			Open-drain driving	137	251	148	245	141	251	100	184	73	142	
	CLKB rise time		Push-pull driving	1.5	7.3	0.7	6.6	0.4	5.9	1.5	4.9	1.9	4.3	
	DATxB rise time			2.3	10.3	1.8	8	1.5	6.8	0.9	5.2	0.2	5	
t_{fA}	CMDA fall time		Push-pull driving	0.6	4.5	0.4	3.8	0.2	3.3	0.2	2.9	0.2	3.1	ns
			Open-drain driving	2.3	7.9	2	4.8	1.8	4.2	1.7	3.7	1.6	3.5	
	CLK-f fall time		Push-pull driving	0.1	2	0.2	2.2	0.7	1.6	0.7	1.5	0.1	3	
	DATxA fall time			1	4.3	0.8	3.6	1	2.7	0.1	2.7	0.2	2.6	
t_{fB}	CMDB fall time		Push-pull driving	1	10.3	1.4	6.8	1.8	5.4	1.6	5	1.6	3.6	ns
			Open-drain driving	1.4	4	1.3	3	1.2	2.6	0.9	1.9	0.8	1.8	
	CLKB fall time		Push-pull driving	1.1	10.8	1	10.3	1.4	6.3	1.8	4.2	1.7	4	
	DATxB fall time			1	11.8	15	7	1.2	6.3	1.6	4.9	0.8	3.6	
$t_{SK(O)}$	Channel-to-channel skew		Push-pull driving		1		1		1		1		1	ns
Max data rate	Command		Push-pull driving		30		60		60		60		60	Mbps
			Open-drain driving		1		1		1		1		1	
	Clock		Push-pull driving		50		60		60		60		60	MHz
	Data				30		60		60		60		60	Mbps

SWITCHING CHARACTERISTICS
V_{CCA} = 2.5 V ± 0.2 V

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V_{CCB} = 1.2 V ± 0.1 V		V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	CMDA	CMDB	Push-pull driving		10.6		6.5		4.9		3.7		3.3	ns
			Open-drain driving (H-to-L)	3.2	10.9	2.7	6.7	2.4	5.5	2.2	4.4	2.1	4.1	
			Open-drain driving (L-to-H)	156	253	162	258	149	261	126	249	98	190	
	CMDB	CMDA	Push-pull driving		12.5		7.4		5.6		4.1		3.6	
			Open-drain driving (H-to-L)	3.5	19.2	2.7	10.5	2.3	7.9	2	5.7	1.9	4.8	
			Open-drain driving (L-to-H)	163	295	169	273	158	274	131	261	99	202	
	CLKA	CLKB	Push-pull driving		10.8		6.8		5.4		3.7		3.4	
	DATxA	DATxB	Push-pull driving		10.9		6.7		5		3.7		3.3	
	DATxB	DATxA			11.5		7.1		5.4		3.9		3.5	
	CLKA	CLK-f	Push-pull driving		23.7		14.9		10.2		6.8		5.7	
t_{en}	EN	B-port	Push-pull driving		1		1		1		1		1	µs
	EN	A-port	Push-pull driving		1		1		1		1		1	
t_{dis}	EN	B-port	Push-pull driving		48		45		45		38		36	ns
	EN	A-port	Push-pull driving		45		38		38		38		35	
t_{rA}	CMDA rise time		Push-pull driving	1.9	4.7	1.7	4.4	1.7	3.8	1.9	3.2	2.3	3.3	ns
			Open-drain driving	135	216	136	237	121	228	96	201	62	141	
	CLK-f rise time		Push-pull driving	0.8	1.6	0.3	1.9	0.6	1.8	0.7	1.5	0.7	1.3	
	DATxA rise time			1.9	6.1	1.8	4.5	1.7	4.1	1.9	4	1.8	4.2	
t_{rB}	CMDB rise time		Push-pull driving	1.7	10.8	2.9	7.6	1.8	6.6	1.5	5.2	1.5	3.8	ns
			Open-drain driving	102	205	116	197	112	207	101	214	76	165	
	CLKB rise time		Push-pull driving	1.6	7.3	0.5	6.8	0.4	5.8	1.6	5	1.7	4.4	
	DATxB rise time			2.2	10.3	1.9	7.9	1.8	6.6	1.4	5.3	0.9	4.4	
t_{fA}	CMDA fall time		Push-pull driving	0.4	2.4	0.4	1.6	0.4	1.5	0.5	1.5	0.3	1.4	ns
			Open-drain driving	2.2	7.6	1.9	4.8	1.8	4.2	1.7	3.7	1.6	3.5	
	CLK-f fall time		Push-pull driving	0.3	2.2	0.3	2.7	0.3	2.6	0.3	2.4	0.3	2.8	
	DATxA fall time			0.4	4	0.4	3.6	0.4	3.2	0.5	2.9	0.3	2.6	
t_{fB}	CMDB fall time		Push-pull driving	1	13.4	1.8	7.2	1.7	6.3	1.6	5.6	1.6	3.7	ns
			Open-drain driving	1	2.3	1	1.7	1	1.7	1	1.6	0.8	1.4	
	CLKB fall time		Push-pull driving	1.1	12.7	1	11.3	0.9	8.7	1.8	4.5	1.7	4.1	
	DATxB fall time			1	16	0.7	9	08	7	0.8	4.9	0.2	4	
$t_{SK(O)}$	Channel-to-channel skew		Push-pull driving		1		1		1		1		1	ns
Max data rate	Command		Push-pull driving		30		60		60		60		60	Mbps
			Open-drain driving		1		1		1		1		1	
	Clock		Push-pull driving		50		60		60		60		60	MHz
	Data				30		60		60		60		60	Mbps

SWITCHING CHARACTERISTICS
V_{CCA} = 3.3 V ± 0.3 V

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V_{CCB} = 1.2 V ± 0.1 V		V_{CCB} = 1.5 V ± 0.1 V		V_{CCB} = 1.8 V ± 0.15 V		V_{CCB} = 2.5 V ± 0.2 V		V_{CCB} = 3.3 V ± 0.3 V		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	CMDA	CMDB	Push-pull driving		12.5		7.2		5.3		3.8		3.2	ns
			Open-drain driving (H-to-L)	3.2	10.6	2.7	6.4	2.4	5.2	2.1	4.1	2	3.7	
			Open-drain driving (L-to-H)	136	212	141	235	129	235	112	233	101	201	
	CMDB	CMDA	Push-pull driving		10.7		6.6		5.1		3.4		3	
			Open-drain driving (H-to-L)	4.3	16.4	3.3	8.7	2.8	6.6	2.4	4.6	2.2	3.6	
			Open-drain driving (L-to-H)	142	273	148	246	139	248	122	248	105	212	
	CLKA	CLKB	Push-pull driving		10.8		6.5		4.8		3.5		3.1	
	DATxA	DATxB	Push-pull driving		11.5		6.9		5.1		3.7		3.2	
	DATxB	DATxA			23.6		14.4		9.6		6.2		5.1	
	CLKA	CLK-f	Push-pull driving		17.1		9.1		6.8		4.8		4.2	
t_{en}	EN	B-port	Push-pull driving		1		1		1		1		1	µs
	EN	A-port	Push-pull driving		1		1		1		1		1	
t_{dis}	EN	B-port	Push-pull driving		38		34		34		34		34	ns
	EN	A-port	Push-pull driving		45		37		36		36		35	
t_{rA}	CMDA rise time		Push-pull driving	0.7	5.6	0.7	5	0.7	4.2	0.8	4.1	1	4.2	ns
			Open-drain driving	117	178	118	213	104	206	85	194	74	155	
	CLK-f rise time		Push-pull driving	0.7	1.5	0.5	1.7	0.7	1.5	0.7	1.4	0.7	1.4	
	DATxA rise time			0.9	5	1.1	3.9	1.3	3.4	1.4	3.3	1.1	3	
t_{rB}	CMDB rise time		Push-pull driving	1.7	10.8	2.3	7.4	2.2	6.4	2	5	1.9	4	ns
			Open-drain driving	69	167	84	156	83	167	79	185	79	166	
	CLKB rise time		Push-pull driving	1	7.7	0.3	7.1	0.5	5.9	1.6	5.1	1.9	4.4	
	DATxB rise time			2.1	10.5	2	7.9	2	6.6	1.8	5.3	1	14	
t_{fA}	CMDA fall time		Push-pull driving	0.3	2.8	0.4	2.4	0.4	2	0.4	2	1	2.3	ns
			Open-drain driving	2	7.6	1.8	5	1.7	4.4	1.6	3.9	1.6	3.7	
	CLK-f fall time		Push-pull driving	0.6	1.3	0.6	1.3	0.6	1.3	0.6	1.3	0.6	1.3	
	DATxA fall time			0.3	2.7	0.4	2.3	0.4	1.4	0.4	1.8	0.5	1.7	
t_{fB}	CMDB fall time		Push-pull driving	1	13.3	0.7	7.9	0.9	6.2	0.8	6.3	1	5	ns
			Open-drain driving	0.7	1.5	0.7	1.4	0.8	1.4	0.9	1.3	0.9	1.3	
	CLKB fall time		Push-pull driving	1	15.5	1	9.1	0.9	7.8	0.9	5.1	0.9	4.3	
	DATxB fall time			1	15	0.9	6.8	0.9	6.8	0.8	6.9	0.8	5	
$t_{SK(O)}$	Channel-to-channel skew		Push-pull driving		1		1		1		1		1	ns
Max data rate	Command		Push-pull driving		30		60		60		60		60	Mbps
			Open-drain driving		0.9		1		1		1		1	
	Clock		Push-pull driving		55		55		55		55		55	MHz
	Data				30		60		60		60		60	Mbps

OPERATING CHARACTERISTICS

T_A = 25°C, V_{CCA} = 1.2 V

PARAMETER			TEST CONDITIONS	V_{CCB} TYP						UNIT
				1.2 V	1.5 V	1.8 V	2.5 V	3 V	3.3 V	
C_{pdA} (1)	A-port input, B-port output	CLK Enabled	C_L = 0, f = 10 MHz, $t_r = t_f$ = 1 ns	15	15	14.9	14.9	15	15	pF
		DATA Enabled		6.3	6.4	6.5	6.5	6.5	6.5	
	B-port input, A-port output	DATA Enabled		12.5	12.3	12.3	12.1	12	11.9	
	A-port input, B-port output	CLK Disabled		0.2	0.2	0.2	0.3	0.3	0.3	
		DATA Disabled		1.2	1.2	1.2	1.2	1.2	1.2	
	B-port input, A-port output	DATA Disabled		0.2	0.2	0.2	0.3	0.3	0.3	
C_{pdB} (1)	A-port input, B-port output	DATA Enabled	C_L = 0, f = 10 MHz, $t_r = t_f$ = 1 ns	26.2	27.3	28.2	29.7	30	31.2	pF
	B-port input, A-port output	CLK Enabled		25.7	25.6	25.6	26.4	27	28.1	
		DATA Enabled		13.7	12.2	11.4	12	12.5	12.9	
	A-port input, B-port output	DATA Disabled		0.6	0.5	0.5	0.5	0.5	0.6	
	B-port input, A-port output	CLK Disabled		0.6	0.5	0.5	0.5	0.5	0.6	
		DATA Disabled		1.2	1.2	1.2	1	1	0.9	

(1) Power dissipation capacitance per transceiver

OPERATING CHARACTERISTICS

T_A = 25°C, V_{CCA} = 1.5 V

PARAMETER			TEST CONDITIONS	V_{CCB} TYP						UNIT
				1.2 V	1.5 V	1.8 V	2.5 V	3 V	3.3 V	
C_{pdA} (1)	A-port input, B-port output	CLK Enabled	C_L = 0, f = 10 MHz, $t_r = t_f$ = 1 ns	15	15	15	14.9	14.9	14.9	pF
		DATA Enabled		6.4	6.3	6.2	6	6	6	
	B-port input, A-port output	DATA Enabled		13.2	12.3	12.2	12	12	11.9	
	A-port input, B-port output	CLK Disabled		0.1	0.1	0.1	0.1	0.1	0.1	
		DATA Disabled		1.2	1.2	1.2	1.2	1.2	1.2	
	B-port input, A-port output	DATA Disabled		0.1	0.1	0.1	0.1	0.1	0.1	

(1) Power dissipation capacitance per transceiver

OPERATING CHARACTERISTICS (continued)

T_A = 25°C, V_{CCA} = 1.5 V

PARAMETER			TEST CONDITIONS	V_{CCB} TYP						UNIT
				1.2 V	1.5 V	1.8 V	2.5 V	3 V	3.3 V	
C_{pdB} (1)	A-port input, B-port output	DATA Enabled	C_L = 0, f = 10 MHz, $t_r = t_f$ = 1 ns	25.8	26.3	27.3	29.2	29.2	30.6	pF
	B-port input, A-port output	CLK Enabled		25.8	25.6	25.6	26.2	26.2	27.2	
		DATA Enabled		13.7	12.3	11.4	12	12	12.8	
	A-port input, B-port output	DATA Disabled		0.1	0.1	0.1	0.1	0.1	0.1	
	B-port input, A-port output	CLK Disabled		0.1	0.1	0.1	0.1	0.1	0.1	
		DATA Disabled		1.2	1.2	1.1	1	1	0.9	

OPERATING CHARACTERISTICS

T_A = 25°C, V_{CCA} = 1.8 V

PARAMETER			TEST CONDITIONS	V_{CCB} TYP						UNIT
				1.2 V	1.5 V	1.8 V	2.5 V	3 V	3.3 V	
C_{pdA} (1)	A-port input, B-port output	CLK Enabled	C_L = 0, f = 10 MHz, $t_r = t_f$ = 1 ns	15.2	15.1	15.1	15	15	15	pF
		DATA Enabled		6.7	6.2	5.8	5.4	5.4	5.3	
	B-port input, A-port output	DATA Enabled		13.9	13.1	12.4	12.1	12	11.9	
	A-port input, B-port output	CLK Disabled		0.1	0.1	0.1	0.1	0.1	0.1	
		DATA Disabled		1.3	1.3	1.3	1.3	1.3	1.3	
	B-port input, A-port output	DATA Disabled		0.1	0.1	0.1	0.1	0.1	0.1	
C_{pdB} (1)	A-port input, B-port output	DATA Enabled	C_L = 0, f = 10 MHz, $t_r = t_f$ = 1 ns	25.9	26.1	26.7	28.8	28.8	30.3	pF
	B-port input, A-port output	CLK Enabled		25.8	25.6	25.6	26.2	26.2	27	
		DATA Enabled		13.6	12.2	11.5	12.1	12.1	12.9	
	A-port input, B-port output	DATA Disabled		0.2	0.1	0.1	0.1	0.1	0.1	
	B-port input, A-port output	CLK Disabled		0.2	0.1	0.1	0.1	0.1	0.1	
		DATA Disabled		1.2	1.2	1.1	1	1	0.8	

(1) Power dissipation capacitance per transceiver

OPERATING CHARACTERISTICS

T_A = 25°C, V_{CCA} = 2.5 V

PARAMETER			TEST CONDITIONS	V_{CCB} TYP						UNIT
				1.2 V	1.5 V	1.8 V	2.5 V	3 V	3.3 V	
C_{pdA} (1)	A-port input, B-port output	CLK Enabled	C_L = 0, f = 10 MHz, $t_r = t_f$ = 1 ns	16.2	16	15.9	15.8	15.8	15.7	pF
		DATA Enabled		7.3	6.5	5.9	5.5	5.4	5.3	
	B-port input, A-port output	DATA Enabled		15.3	14.6	14	13	12.8	12.5	
	A-port input, B-port output	CLK Disabled		0.1	0.1	0.1	0.1	0.1	0.1	
		DATA Disabled		1.3	1.3	1.3	1.3	1.3	1.3	
	B-port input, A-port output	DATA Disabled		0.1	0.1	0.1	0.1	0.1	0.1	
C_{pdB} (1)	A-port input, B-port output	DATA Enabled	C_L = 0, f = 10 MHz, $t_r = t_f$ = 1 ns	25.6	25.8	26.2	27.6	29	29.5	pF
	B-port input, A-port output	CLK Enabled		25.9	25.7	25.7	26.2	26.5	26.9	
		DATA Enabled		13.6	12.2	11.5	12.3	12.7	13.2	
	A-port input, B-port output	DATA Disabled		0.3	0.1	0.1	0.1	0.1	0.1	
	B-port input, A-port output	CLK Disabled		0.3	0.1	0.1	0.1	0.1	0.1	
		DATA Disabled		1.2	1.2	1.1	1	0.9	0.8	

(1) Power dissipation capacitance per transceiver

OPERATING CHARACTERISTICS

T_A = 25°C, V_{CCA} = 3.3 V

PARAMETER			TEST CONDITIONS	V_{CCB} TYP						UNIT
				1.2 V	1.5 V	1.8 V	2.5 V	3 V	3.3 V	
C_{pdA} (1)	A-port input, B-port output	CLK Enabled	C_L = 0, f = 10 MHz, $t_r = t_f$ = 1 ns	18.3	17.7	17.5	17.3	17.2	17.1	pF
		DATA Enabled		8.1	7	6.2	5.7	5.6	5.6	
	B-port input, A-port output	DATA Enabled		17	16.1	15.6	14.8	14.4	14	
	A-port input, B-port output	CLK Disabled		0.1	0.1	0.1	0.1	0.1	0.1	
		DATA Disabled		1.3	1.3	1.3	1.3	1.3	1.3	
	B-port input, A-port output	DATA Disabled		0.1	0.1	0.1	0.1	0.1	0.1	

(1) Power dissipation capacitance per transceiver

OPERATING CHARACTERISTICS (continued)

T_A = 25°C, V_{CCA} = 3.3 V

PARAMETER			TEST CONDITIONS	V_{CCB} TYP						UNIT
				1.2 V	1.5 V	1.8 V	2.5 V	3 V	3.3 V	
C_{pdB} (1)	A-port input, B-port output	DATA Enabled	C_L = 0, f = 10 MHz, t_r = t_f = 1 ns	25.2	25.6	26	27.1	28	28.5	pF
	B-port input, A-port output	CLK Enabled		26	25.8	25.8	26.3	26.8	27	
		DATA Enabled		13.7	12.1	11.4	12.2	12.7	13.2	
	A-port input, B-port output	DATA Disabled		0.3	0.1	0.1	0.1	0.1	0.1	
	B-port input, A-port output	CLK Disabled		0.3	0.1	0.1	0.1	0.1	0.1	
		DATA Disabled		1.2	1.2	1.1	1	0.9	0.8	

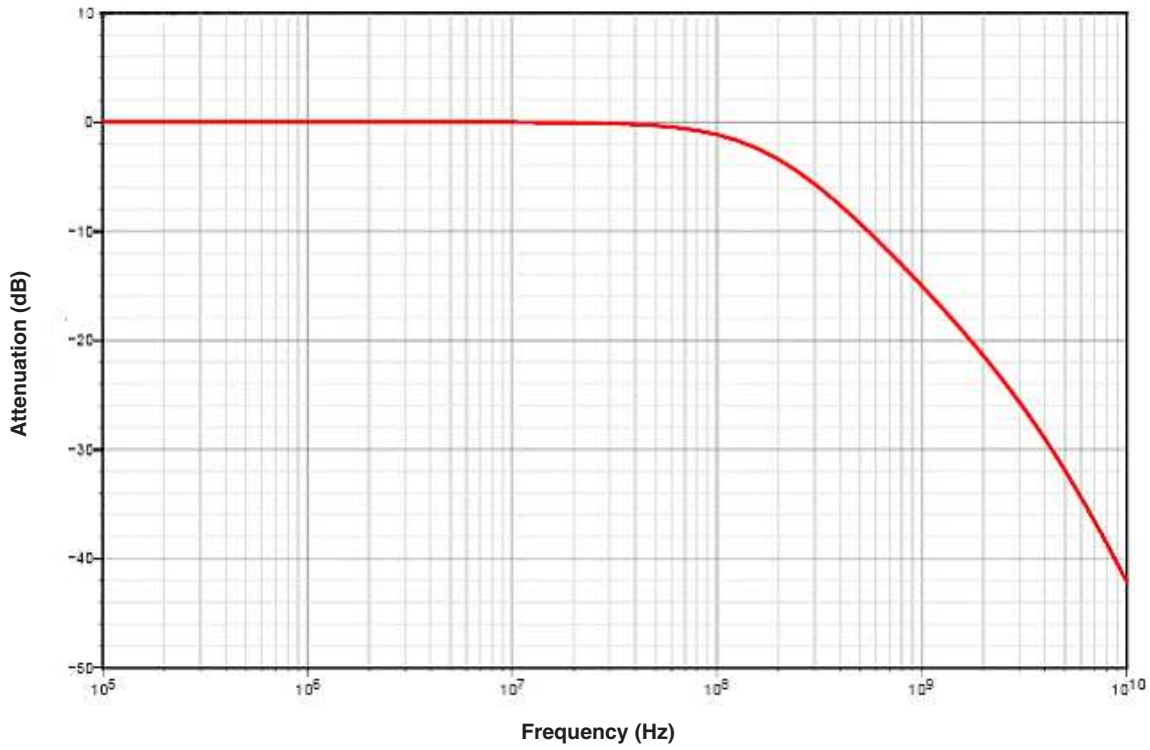
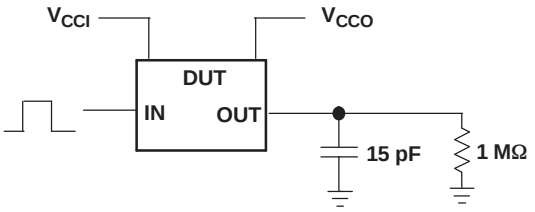
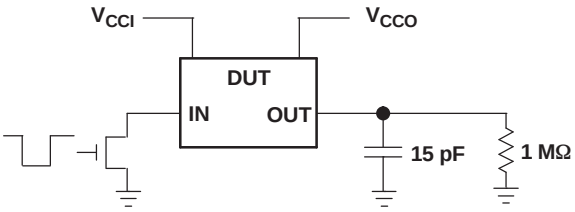


Figure 7. Typical ASIP EMI Filter Frequency Response

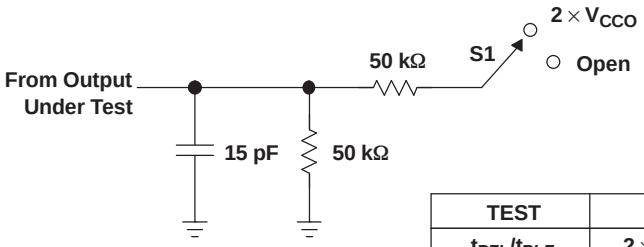
PARAMETER MEASUREMENT INFORMATION



DATA RATE, PULSE DURATION, PROPAGATION DELAY, OUTPUT RISE AND FALL TIME MEASUREMENT USING A PUSH-PULL DRIVER

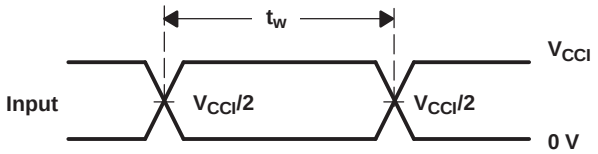


DATA RATE, PULSE DURATION, PROPAGATION DELAY, OUTPUT RISE AND FALL TIME MEASUREMENT USING AN OPEN-DRAIN DRIVER

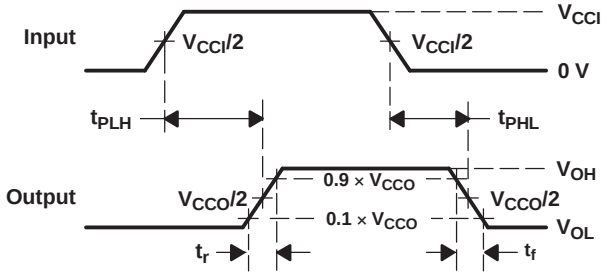


LOAD CIRCUIT FOR ENABLE/DISABLE TIME MEASUREMENT

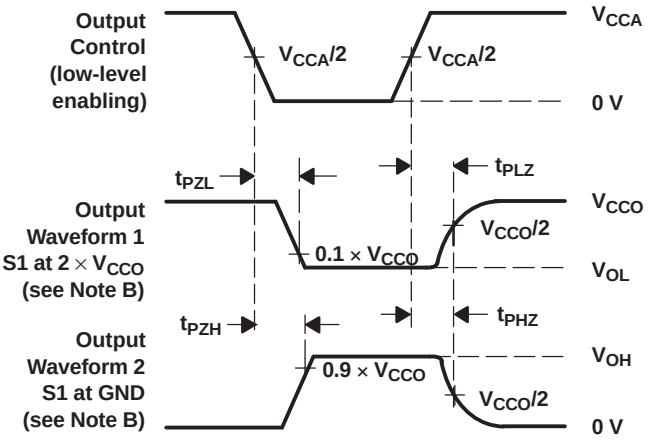
TEST	S1
t_{PZL}/t_{PLZ} t_{PHZ}/t_{PZH}	$2 \times V_{CCO}$ Open



VOLTAGE WAVEFORMS PULSE DURATION



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES

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, Z_O = 50 Ω, dv/dt ≥ 1 V/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}.
H. V_{CCI} is the V_{CC} associated with the input port.
I. V_{CCO} is the V_{CC} associated with the output port.
J. All parameters and waveforms are not applicable to all devices.

PARAMETER MEASUREMENT INFORMATION (continued)

Figure 8. Load Circuit and Voltage Waveforms

APPLICATION INFORMATION

The TXS0206 has integrated pullup resistors on the data and command ports and their values dynamically change. When the port is in a low signal state, there is a nominal pullup resistor value of 40 kΩ, and power consumption is minimized. When the port is in a high signal state, the nominal pullup resistor value changes to 4 kΩ, and simultaneous switching performance is improved as a result. The threshold at which the resistance changes is approximately $V_{CCx}/2$.

When using the TXS0206 device with MMCs, SD, and Memory Stick™ to ensure that a valid receiver input voltage high (V_{IH}) is achieved, the value of any pulldown resistors (external or internal to a memory card) must not be smaller than a 10-kΩ value. The impact of adding too heavy (i.e., <10-kΩ value) a pulldown resistor to the data and command lines of the TXS0206 device and the resulting 4-kΩ pullup / 10-kΩ pulldown voltage divider network has a direct impact on the V_{IH} of the signal being sent into the memory card and its associated logic.

The resulting V_{IH} voltage for the 10-kΩ pulldown resistor value would be:

$V_{CC} \times 10\ k\Omega / (10\ k\Omega + 4\ k\Omega) = 0.714 \times V_{CC}$

This is marginally above a valid input high voltage for a 1.8-V signal (i.e., $0.65 \times V_{CC}$).

The resulting V_{IH} voltage for 20-kΩ pulldown resistor value would be:

$V_{CC} \times 20\ k\Omega / (20\ k\Omega + 4\ k\Omega) = 0.833 \times V_{CC}$

Which is above the valid input high voltage for a 1.8-V signal of $0.65 \times V_{CC}$.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TXS0206YFPR	ACTIVE	DSBGA	YFP	20	3000	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-40 to 85	(3T2, 3TR)	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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

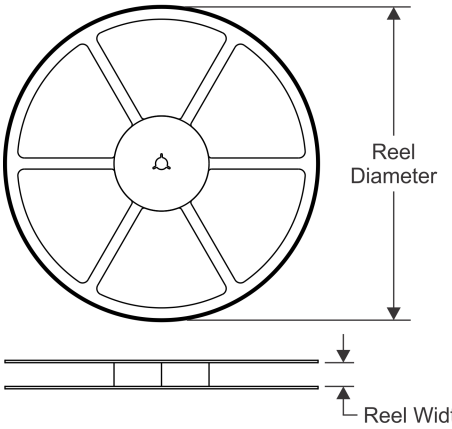
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device 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 Device Marking for that device.

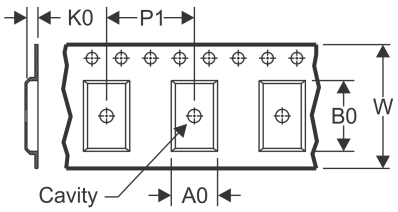
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

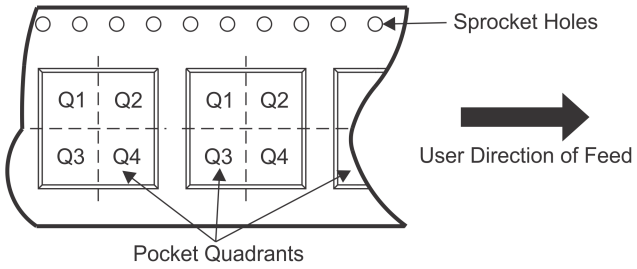


TAPE DIMENSIONS



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

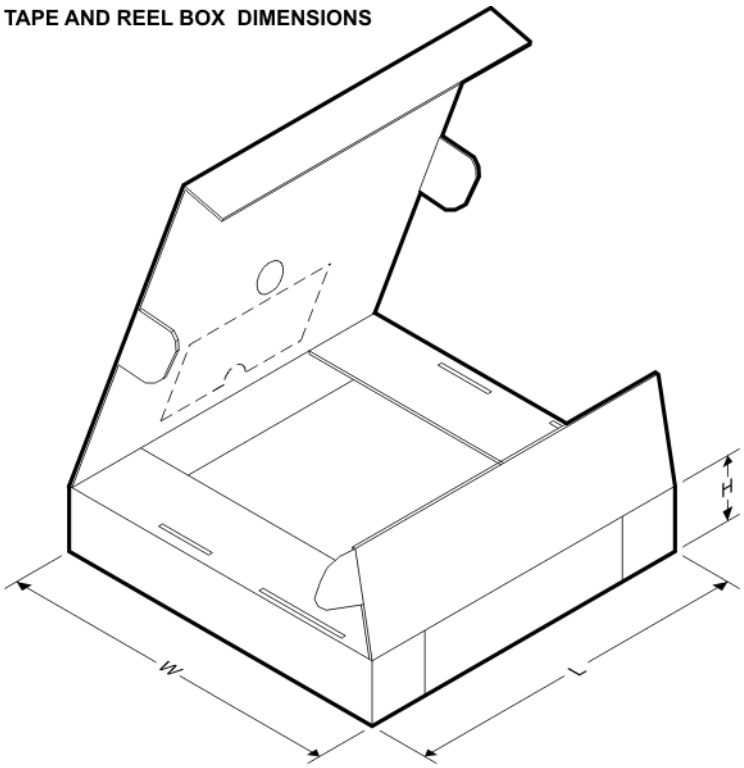
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

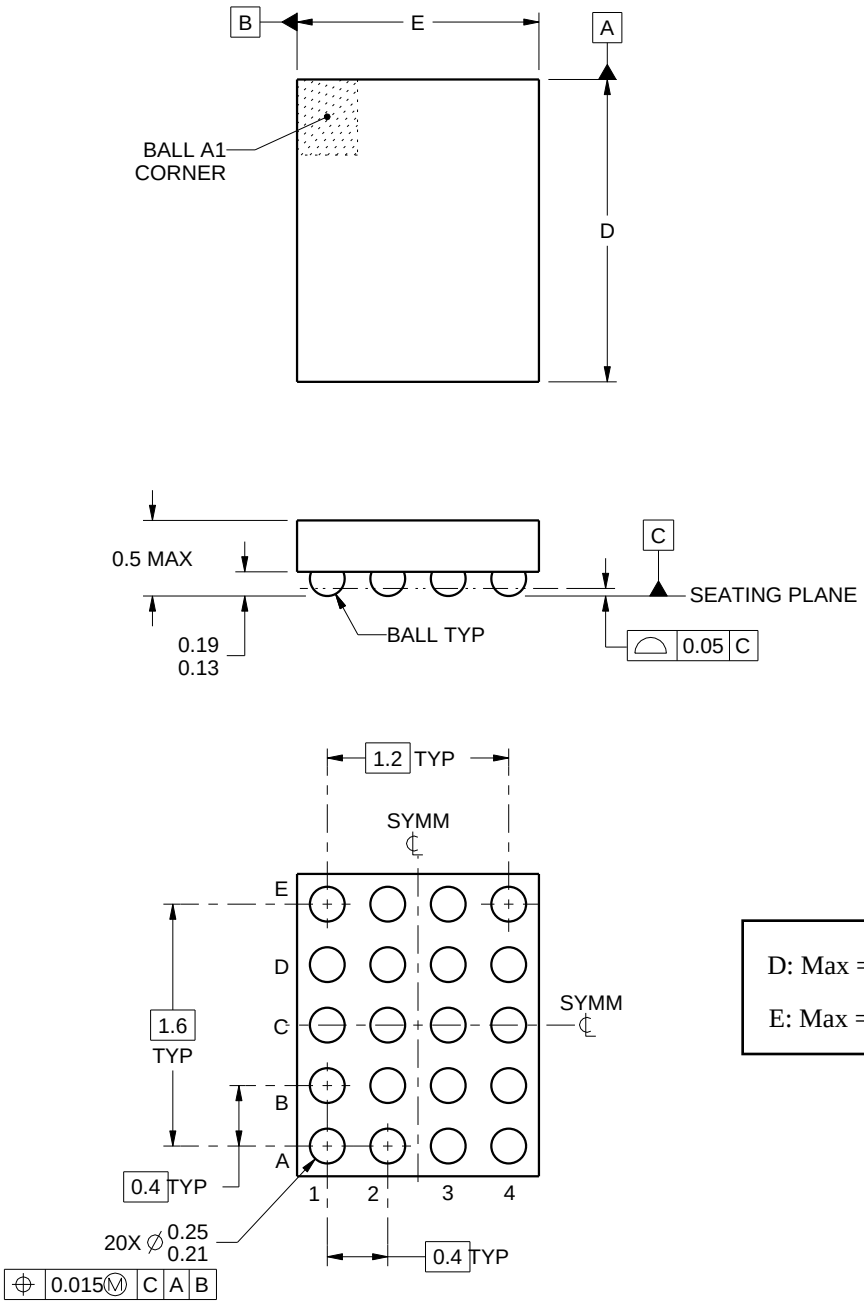
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TXS0206YFPR	DSBGA	YFP	20	3000	180.0	8.4	1.66	2.06	0.56	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TXS0206YFPR	DSBGA	YFP	20	3000	182.0	182.0	20.0



D: Max = 1.988 mm, Min =1.928 mm

E: Max = 1.588 mm, Min =1.527 mm

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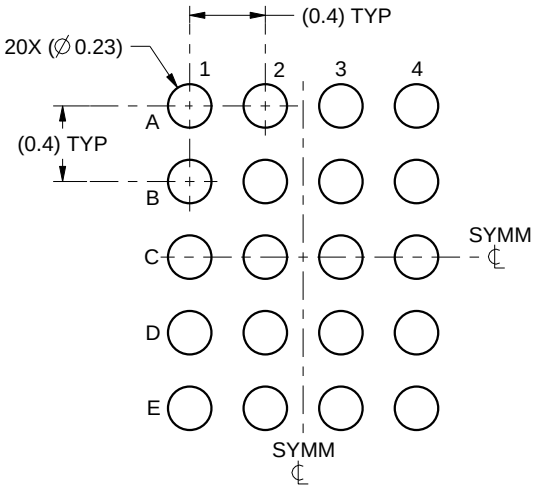
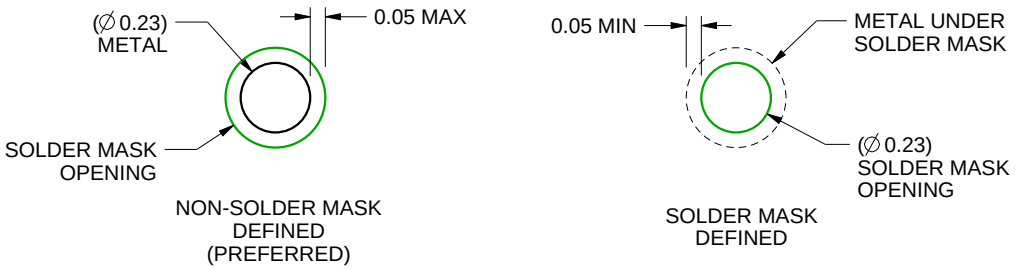
NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



LAND PATTERN EXAMPLE
SCALE:25X



SOLDER MASK DETAILS
NOT TO SCALE

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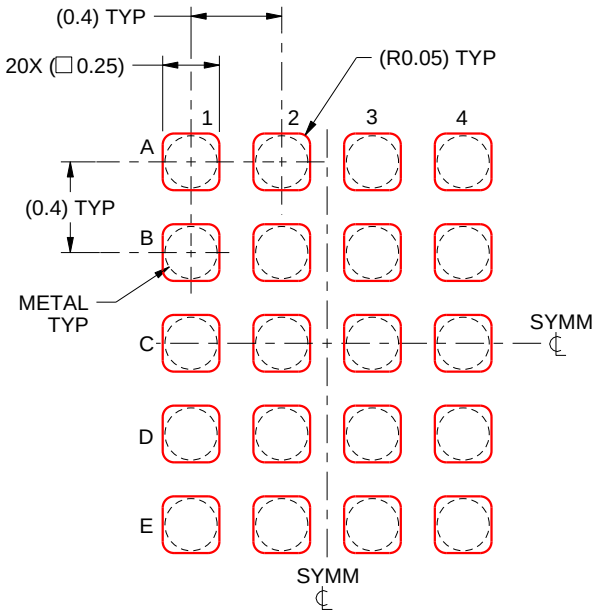
NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints.
For more information, see Texas Instruments literature number SNVA009 (www.ti.com/lit/snva009).



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE:30X

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NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

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