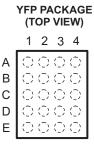
MMC, SD CARD, Memory Stick™ VOLTAGE-TRANSLATION TRANSCEIVER WITH ESD PROTECTION AND EMI FILTERING

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)



TERMINAL ASSIGNMENTS

	1	2	3	4
Α	DAT2A	V_{CCA}	WP	DAT2B
В	DAT3A	CD	V_{CCB}	DAT3B
С	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 x 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	PACKAG	E ⁽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.

AA.

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⁽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).



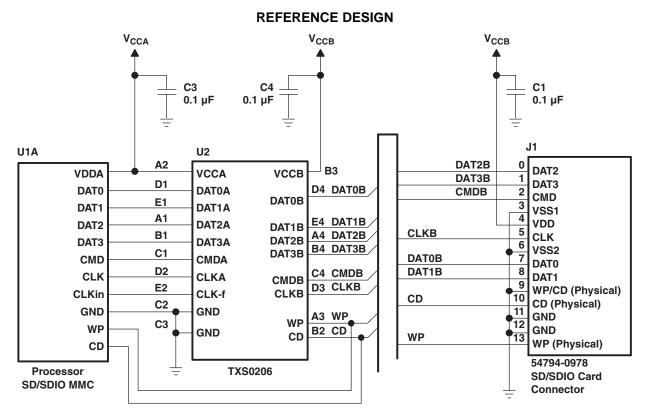
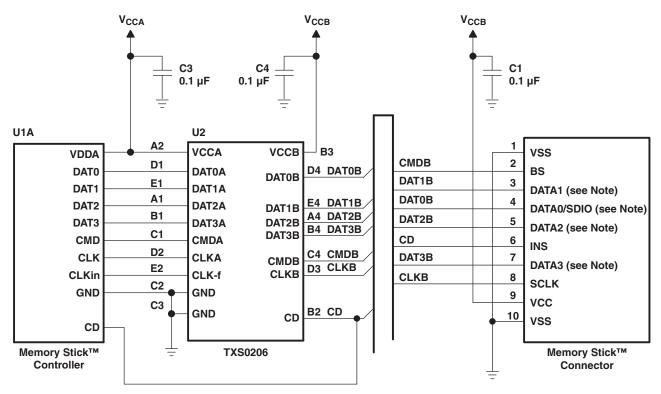


Figure 1. Interfacing With SD/SDIO Card





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 StickTM 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 StickTM.

Figure 2. Interfacing With Memory Stick™ Card



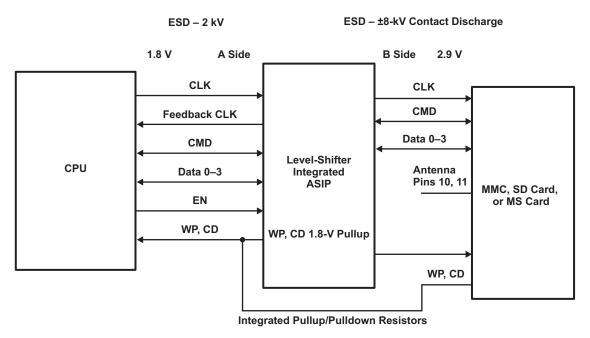


Figure 3. Typical Application Circuit

LOGIC TABLE

EN	TRANSLATOR I/Os
L	Disabled, pulled to V_{CCA} , V_{CCB} through 40 k Ω
Н	Active

TERMINAL FUNCTIONS

TER	TERMINAL		DECORPORTION							
NO.	NAME	TYPE	DESCRIPTION							
A1	DAT2A	I/O	Data bit 2 connected to host. Referenced to V_{CCA} . Includes a 40-k Ω pullup resistor to V_{CCA} .							
A2	V_{CCA}	Pwr	A-port supply voltage. V _{CCA} powers all A-port I/Os and control inputs.							
А3	WP	0	Connected to write protect on the mechanical connector. The WP pin has an internal 100-k Ω pullup resistor to V_{CCA} .							
A4	DAT2B	I/O	Data bit 2 connected to memory card. Referenced to V_{CCB} . Includes a 40-k Ω pullup resistor to V_{CCB} .							
B1	DAT3A	I/O	Data bit 3 connected to host. Referenced to V_{CCA} . Includes a 40-k Ω pullup resistor to V_{CCA} .							
B2	CD	0	Connected to card detect on the mechanical connector. The CD pin has an internal 100-k Ω pullup resistor to V_{CCA} .							
В3	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-k Ω pullup resistor to V_{CCB} .							
C1	CMDA	I/O	Command bit connected to host. Referenced to V_{CCA} . Includes a 40-k Ω 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-k Ω pullup resistor to V_{CCB} .							
D1	DAT0A	I/O	Data bit 0 connected to host. Referenced to V_{CCA} . Includes a 40-k Ω pullup resistor to V_{CCA} .							
D2	CLKA	- 1	Clock signal connected to host. Referenced to V _{CCA} .							
D3	CLKB	0	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-k Ω pullup resistor to V_{CCB} .							
E1	DAT1A	I/O	Data bit 1 connected to host. Referenced to V_{CCA} . Includes a 40-k Ω pullup resistor to V_{CCA} .							
E2	CLK-f	0	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-k Ω pullup resistor to V_{CCB} .							



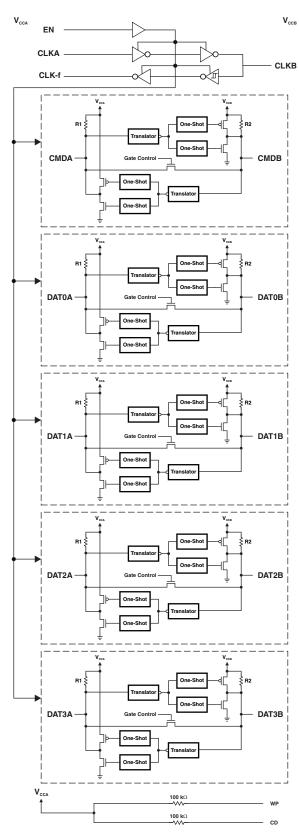


Figure 4. Logic Diagram



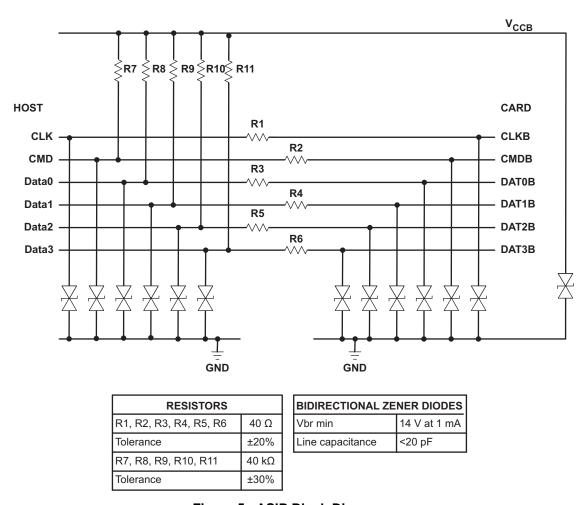
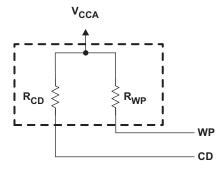


Figure 5. ASIP Block Diagram



RESI	STORS
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		
		I/O ports (A port)	-0.5	4.6			
V_{I}	Input voltage range	I/O ports (B port)	-0.5	4.6	V		
		Control inputs	-0.5	4.6			
.,	Voltage range applied to any output in the high-impedance or power-off	A port	-0.5 4.6		V		
Vo	state	B port	-0.5	4.6	V 		
.,	Valtage was a smalled to any systematic the binds on law state	A port	-0.5	4.6			
Vo	Voltage range applied to any output in the high or low state	B port	-0.5	4.6	V		
I _{IK}	Input clamp current	V _I < 0		-50	mA		
I _{OK}	Output clamp current	V _O < 0		-50	mA		
Io	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	
		A-Port CMD and	1.1 V to 1.95 V	1.1 V to 1.95 V				
V_{IH}	High-level input voltage	DATA I/Os B-Port CMD and DATA I/Os	1.95 V to 3.6 V	1.95 V to 3.6 V	V _{CCI} - 0.2	V _{CCI}	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}		
		A-Port CMD and	1.1 V to 1.95 V	1.1 V to 1.95 V				
V_{IL}	Low-level input voltage	DATA I/Os B-Port CMD and DATA I/Os	1.95 V to 3.6 V	1.95 V to 3.6 V	0	0.15	V	
		EN and CLKA	1.1 V to 3.6 V	1.1 V to 3.6 V	0	V _{CCI} x 0.35		
\ <u>'</u>	Output valtage	Active state			0	V _{CCO}		
Vo	Output voltage	3-state			0	3.6	V	
			1.1 V to 3.6 V			-100	μΑ	
			1.1 V to 1.3 V			-0.5		
	I limb lavel autout av		1.4 V to 1.6 V	4.4.1/ += 0.0.1/		-1		
I _{OH}	High-level output cu	rrent (CLK-r output)	1.65 V to 1.95 V	1.1 V to 3.6 V		mA		
			2.3 V to 2.7 V			-4		
			3 V to 3.6 V			-8		
			1.1 V to 3.6 V			100	μΑ	
			1.1 V to 1.3 V		0.5			
	Laurianal autaut au		1.4 V to 1.6 V	4.4.1/ += 0.0.1/	1			
l _{OL}	Low-level output cur	v-level output current (CLK-f output)	1.65 V to 1.95 V	1.1 V to 3.6 V		2	mA	
			2.3 V to 2.7 V			4		
			3 V to 3.6 V					
				1.1 V to 3.6 V		-100	μΑ	
				1.1 V to 1.3 V		-0.5		
	High-level output cu	rrant (CLK autaut)	1.1 V to 3.6 V	1.4 V to 1.6 V		-1		
I _{OH}	nign-level output cu	ment (CER output)	1.1 V tO 3.6 V	1.65 V to 1.95 V		-2	mA	
				2.3 V to 2.7 V		-4		
				3 V to 3.6 V		-8		
-				1.1 V to 3.6 V		100	μΑ	
				1.1 V to 1.3 V		0.5		
	Low lovel output com	ront (CLK cutout)	1.1 V to 3.6 V	1.4 V to 1.6 V	1			
I _{OL}	Low-level output cur	Low-level output current (CLK output) 1.1 V to 3.6 V		1.65 V to 1.95 V		mA		
						2.3 V to 2.7 V		
				3 V to 3.6 V		8		
Δt/Δν	Input transition rise	or fall rate				5	ns/V	
T _A	Operating free-air te	mperature			-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.

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ELECTRICAL CHARACTERISTICS Level Translator

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

F	PARAMETER	TEST CONDITIONS	V _{CCA}	V _{CCB}	MIN	TYP ⁽¹⁾ MAX	UNIT
		I _{OH} = -100 μA	1.1 V to 3.6 V		V _{CCA} * 0.8		
	A port	$I_{OH} = -0.5 \text{ mA}$	1.1 V		0.8		
		$I_{OH} = -1 \text{ mA}$	1.4 V		1.05		
	(CLK-f output)	$I_{OH} = -2 \text{ mA}$	1.65 V		1.2		
V_{OH}		$I_{OH} = -4 \text{ mA}$	2.3 V	1.1 V to 3.6 V	1.75		V
		$I_{OH} = -8 \text{ mA}$	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		
		I _{OL} = 100 μA	1.1 V to 3.6 V			V _{CCA} × 0.8	
		I _{OL} = 0.5 mA	1.1 V			0.35	
	A port (CLK-f output)	I _{OL} = 1 mA	1.4 V	441/4-261/		0.35	V
		I _{OL} = 2 mA	1.65 V	1.1 V to 3.6 V		0.45	V
		I _{OL} = 4 mA	2.3 V			0.55	
V_{OL}		$I_{OL} = 8 \text{ mA}$	3 V			0.7	
		I _{OL} = 135 μA				0.4	
	A port	$I_{OL} = 180 \ \mu A$				0.4	
	(DAT and CMD	I _{OL} = 220 μA	1.1 V to 3.6 V			0.4	V
	outputs)	$I_{OL} = 300 \ \mu A$				0.4	
		$I_{OL} = 400 \mu A$				0.55	
		$I_{OH} = -100 \mu A$		1.1 V to 3.6 V	$V_{CCA} \times 0.8$		
		$I_{OH} = -0.5 \text{ mA}$		1.1 V	0.8		
	B port	$I_{OH} = -1 \text{ mA}$		1.4 V	1.05		
V _{OH}	(CLK output)	$I_{OH} = -2 \text{ mA}$	1.1 V to 3.6 V	1.65 V	1.2		V
· OH		$I_{OH} = -4 \text{ mA}$		2.3 V	1.75		
		$I_{OH} = -8 \text{ mA}$		3 V	2.3		
	B port (DAT output)	I _{OH} = -20 μA		1.1 V to 3.6 V	$V_{CCA} \times 0.8$		

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

10

Product Folder Link(s): TXS0206

ELECTRICAL CHARACTERISTICS Level Translator (continued)

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

F	PARAMETER	TEST CONDITIONS	V _{CCA}	V _{CCB}	MIN TYP ⁽¹⁾ MA	X UNIT
		I _{OL} = 100 μA		1.1 V to 3.6 V	$V_{CCA} \times 0$.	8
		$I_{OL} = 0.5 \text{ mA}$		1.1 V	0.3	5
	Doort	$I_{OL} = 1 \text{ mA}$	1 1 \/ to 2 6 \/	1.4 V	0.3	5 V
	B port	$I_{OL} = 2 \text{ mA}$	1.1 V to 3.6 V	1.65 V	0.4	5 V
		$I_{OL} = 4 \text{ mA}$		2.3 V	0.5	5
V_{OL}		I _{OL} = 8 mA		3 V	0.	7
		I _{OL} = 135 μA		1.1 V to 3.6 V	0.	4
	B port (DAT output)	$I_{OL} = 180 \mu A$		1.4 V	0.	4
		$I_{OL} = 220 \ \mu A$	1.1 V to 3.6 V	1.65 V	0.	4 V
		$I_{OL} = 300 \mu A$		2.3 V	0.	4
		I _{OL} = 400 μA		3 V	0.5	5
I	Control inputs	V _I = V _{CCA} or GND		1.1 V to 3.6 V	±	1 μΑ
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 μΑ
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 μΑ
_	A port				5.5 6.	5 ~-
C _{io}	B port				15 17.	pF
_	Control inputs	V V as CND			3.5 4.	5
C _i	Clock input	$V_I = V_{CCA}$ or GND			3	pF

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TIMING REQUIREMENTS

 $V_{CCA} = 1.2 \text{ V} \pm 0.1 \text{ V}$

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		
	Command	Push-pull driving		30		40		40		40		40	Mhna
Data rate	Command	Open-drain driving		0.9		1		1		1		1	Mbps
	Clock	Duch pull driving		30		40		50		60		60	MHz
	Data	Push-pull driving		30		40		40		40		40	Mbps
	Command	Push-pull driving	33		25		25		25		25		ns
t _W Pulse duration		Open-drain driving	1		1		1		1		1		μs
	Clock	Decade meetly alwhydra ar	16.7		12.5		10		8.3		8.3		ns
	Data	Push-pull driving	33	·	25		25		25		25		ns

TIMING REQUIREMENTS

 $V_{CCA} = 1.5 \text{ V} \pm 0.1 \text{ V}$

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			
	Command	Push-pull driving		30		60		60		60		60	Mbps	
Data rate	Command	Open-drain driving		1		1		1		1		1		
Dala Tale	Clock	Duch null driving		50		60		60		60		60	MHz	
	Data	Push-pull driving		30		60		60		60		60	Mbps	
	Command	Push-pull driving	33		17		17		17		17		ns	
t _W Pulse duration		Open-drain driving	1		1		1		1		1		μs	
	Clock	Decade meet administration	10		8.3		8.3		8.3		8.3		ns	
	Data	Push-pull driving	33		17		17	<u>'</u>	17		17		ns	

TIMING REQUIREMENTS $V_{CCA} = 1.8 \text{ V} \pm 0.15 \text{ V}$

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

			V _{CCB} = ± 0.1		V _{CCB} = ± 0.		V _{CCB} = ± 0.1		V _{CCB} = ± 0.2		V _{CCB} = ± 0.3		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
	Command	Push-pull driving		30		60		60		60		60	Mhna
Data sata	Command	Open-drain driving		1		1		1		1		1	Mbps
Data rate	Clock	Decelor medical desiration of		50		60		60		60		60	MHz
	Data	Push-pull driving		30		60		60		60		60	Mbps
	Command	Push-pull driving	33		17		17		17		17		ns
, Pulse	Command	Open-drain driving	1		1		1		1		1		μs
t _W duration	Clock	Duck pull driving	10		8.3		8.3		8.3		8.3		ns
	Data	Push-pull driving	33		17		17		17		17		ns

TIMING REQUIREMENTS $V_{CCA} = 2.5 \text{ V} \pm 0.2 \text{ V}$

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

			V _{CCB} = ± 0.1		V _{CCB} = ± 0.		V _{CCB} = ± 0.1		V _{CCB} = ± 0.2		V _{CCB} = ± 0.3		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
	C	Push-pull driving		30		60		60		60		60	Mhma
Data rata	Command	Open-drain driving		1		1		1		1		1	Mbps
Data rate	Clock	Push-pull driving		60		60		60		60		60	MHz
	Data	Push-pull driving		30		60		60		60		60	Mbps
	Command	Push-pull driving	33		17		17		17		17		ns
, Pulse	Command	Open-drain driving	1		1		1		1		1		μs
t _W duration	Clock	Duch null driving	8.3		8.3		8.3		8.3		8.3		ns
	Data	Push-pull driving	33		17		17		17		17		ns

TIMING REQUIREMENTS

 $V_{CCA} = 3.3 \text{ V} \pm 0.3 \text{ V}$

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

			V _{CCB} = ± 0.1		V _{CCB} = ± 0.		V _{CCB} = ± 0.1		V _{CCB} = ± 0.2		V _{CCB} = ± 0.3		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
	Command	Push-pull driving		30		60		60		60		60	Mhna
Data rata	Command	Open-drain driving		0.9		1		1		1		1	Mbps
Data rate	Clock	Decelor medical desiration of		55		55		55		55		55	MHz
	Data	Push-pull driving		30		60		60		60		60	Mbps
	Command	Push-pull driving	33		17		17		17		17		ns
, Pulse	Command	Open-drain driving	1		1		1		1		1		μs
t _W duration	Clock	Duch null driving	9		9		9		9		9		ns
	Data	Push-pull driving	33		17		17		17		17		ns

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SWITCHING CHARACTERISTICS V_{CCA} = 1.2 V \pm 0.1 V

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V _C = 1. ± 0.	2 V	V _C = 1. ± 0.	5 V	V _C = 1. ± 0.1	8 V	V _C = 2. ± 0.	5 V	V _C ; = 3. ± 0.	3 V	UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
			Push-pull driving		15.3		12.2		10.8		10.4		10.8	
	CMDA	CMDB	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	
			Push-pull driving		19.7		15.1		13.4		12		11.2	
t _{pd}	CMDB	CMDA	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	ns
			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	Duch pull driving		15.9		12.6		11.2		10.7		11.1	
	DATxB	DATxA	Push-pull driving		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	
	EN	B-port	Push-pull driving		1		1		1		1		1	
t _{en}	EN	A-port	Push-pull driving		1		1		1		1		1	μs
	EN	B-port	Push-pull driving		68		55		46		40		38	
t _{dis}	EN	A-port	Push-pull driving		62		56		48		40		37	ns
	CMDA	-i ti	Push-pull driving	1.7	14.1	1.5	13	1.5	12.7	1.6	12.2	1.9	11.9	
	CMDA	rise time	Open-drain driving	170	260	128	205	96	171	57	120	32	91	
t _{rA}	CLK-f	rise time	December and Industrian	0.6	10.6	0.6	10.9	0.6	12	0.6	12.3	0.6	12.7	ns
	DATxA	rise time	Push-pull driving	1.7	13.7	1.5	12.6	1.5	12	1.6	11.6	1.9	11.5	
	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	
	CIVIDB	rise urrie	Open-drain driving	175	300	145	261	118	245	86	214	66	181	
t _{rB}	CLKB	rise time	Duah mull driving	1	7.7	8.0	7.1	0.8	6.2	1.7	4.8	1.7	4.3	ns
	DATxB	rise time	Push-pull driving	2.9	11.8	2.3	8.9	1.9	7.4	0.9	4.7	0.4	6.8	
	CMDA	fall time	Push-pull driving	1	8	1	5.4	1	4.5	1	3.9	0.8	4	
	CIVIDA	fall time	Open-drain driving	2.3	8.3	1.9	4.9	1.7	4.4	1.6	3.9	1.6	3.7	
t_fA	CLK-f	fall time	Duch pull driving	1	5.8	1	4.6	1	4.1	1	3.8	1	4	ns
	DATxA	fall time	Push-pull driving	1.8	8	1.3	5.4	1	4.5	1	3.9	1	3.8	
	CMDD	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	
	CINIDB	fall time	Open-drain driving	1.9	8.3	1.5	5.9	1.3	5.1	1.1	4.3	1	4.2	n
t_fB	CLKB	fall time	Duah auli deixiaa	2	7.1	1.8	5.4	1.8	4.5	1.7	4	1.6	3.9	ns
	DATxE	3 fall time	Push-pull driving	2.1	8.5	1.1	6.4	0.9	5	1	3.9	1.1	4.8	
t _{SK(O)}		-to-channel kew	Push-pull driving		1		1		1		1		1	ns
	_		Push-pull driving		30		40		40		40		40	N.Al-
Manualati	Com	nmand	Open-drain driving		0.9		1		1		1		1	Mbps
Max data rate	С	lock	D 1 11111		30		40		50		60		60	MHz
	D	ata	Push-pull driving		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 _C = 1. ± 0.	2 V	V _C ; = 1. ± 0.	5 V	V _C = 1. ± 0.1	8 V	V _C = 2. ± 0.		V _C = 3. ± 0.	3 V	UNIT
	((,		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
			Push-pull driving		12		8.6		6.9		6.1		6	
	CMDA	CMDB	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	
			Push-pull driving		15.2		9.8		8		6.8		6.3	
t _{pd}	CMDB	CMDA	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	ns
			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	Duch pull driving		12.5		8.9		7.2		6.2		6.1	
	DATxB	DATxA	Push-pull driving		13.9		9.2		7.6		6.5		6.1	
	CLKA	CLK-f	Push-pull driving		29		20		16		13		12	
	EN	B-port	Push-pull driving		1		1		1		1		1	
t _{en}	EN	A-port	Push-pull driving		1		1		1		1		1	μs
	EN	B-port	Push-pull driving		57		53		46		39		37	
t _{dis}	EN	A-port	Push-pull driving		58		54		46		38		35	ns
	01.10.1		Push-pull driving	1.6	10.5	0.4	9.5	0.2	8.9	0.4	8.3	1	7.9	
	CMDA	rise time	Open-drain driving	166	254	157	247	121	203	74	127	44	85	
t _{rA}	CLK-f	rise time	5	0.5	5.5	0.5	5.5	0.5	6.2	0.5	7	0.5	7.2	ns
	DATxA	rise time	Push-pull driving	2	10.3	0.7	9.4	0.5	8.9	0.6	8.4	0.7	8.3	
	01.100		Push-pull driving	1.9	11.2	2	8	1.9	6.5	0.5	5.6	0.5	3.1	
	CMDB	rise time	Open-drain driving	157	273	163	264	135	253	96	196	71	165	
t _{rB}	CLKB	rise time	D	1.3	7.5	0.6	6.7	0.4	5.9	1.5	4.9	1.9	4.3	ns
	DATxB	rise time	Push-pull driving	2.2	10.9	2	8.4	1.7	6.9	0.8	5	0.6	4	
	ON AD A	6.11.6	Push-pull driving	1.5	5.5	1.3	3.8	0.9	2.9	0.8	2.3	0.8	2.3	
	CMDA	fall time	Open-drain driving	2.3	8	2	4.8	1.8	4.2	1.7	3.7	1.6	3.5	
t _{fA}	CLK-f	fall time	B . I . II I	0.4	3.9	0.4	3.7	0.4	4	0.4	3.7	0.4	6.8	ns
	DATxA	fall time	Push-pull driving	0.8	6	0.6	4.8	0.1	4.1	0.1	3.8	0.1	3.8	
			Push-pull driving	1	11.6	1.5	7.1	1.5	5.8	1.4	5.4	1.6	3.6	
	CMDB	fall time	Open-drain driving	1.7	5.2	1.5	3.8	1.2	3	1	2.3	0.9	2.3	
t_fB	CLKB	fall time		1.1	10.8	1	8.8	1.8	6	1.7	4.1	1.6	3.9	ns
	DATxB	fall time	Push-pull driving	1.1	13.3	1.2	7.7	1.2	6.5	2.3	4.3	2.5	4.2	
t _{SK(O)}		to-channel kew	Push-pull driving		1		1		1		1		1	ns
	0.		Push-pull driving		30		60		60		60		60	p at
A	Com	nmand	Open-drain driving		1		1		1		1		1	Mbp
Max data rate	C	lock	B		50		60		60		60		60	МН
	D	ata	Push-pull driving		30		60		60		60		60	Mbr

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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 _C = 1. ± 0.	2 V	V _C (= 1. ± 0.	5 V	V _C = 1. ± 0.1	8 V	V _C = 2. ± 0.	5 V	V _C ; = 3. ± 0.	3 V	UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
			Push-pull driving		11.3		7.3		5.7		4.6		4.4	
	CMDA	CMDB	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	
			Push-pull driving		13.2		8.3		6.5		5.2		4.8	
t _{pd}	CMDB	CMDA	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	ns
			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	Duch pull driving		11.7		7.5		5.8		4.7		4.4	
	DATxB	DATxA	Push-pull driving		12.1		7.9		6.3		5		4.6	
	CLKA	CLK-f	Push-pull driving		25.1		16.5		12		8.9		7.9	
	EN	B-port	Push-pull driving		1		1		1		1		1	
t _{en}	EN	A-port	Push-pull driving		1		1		1		1		1	μs
	EN	B-port	Push-pull driving		39		37		37		35		35	
t _{dis}	EN	A-port	Push-pull driving		49		47		47		38		35	ns
	CMDA	-i ti	Push-pull driving	1.8	8.4	1.2	6.8	1.1	5.9	1.1	5.9	1.6	5.8	
	CMDA	rise time	Open-drain driving	154	246	155	262	135	238	85	150	52	99	
t _{rA}	CLK-f	rise time	Duah mull deisting	0.4	4	0.4	4.3	0.4	4.7	0.4	4.5	0.4	4.1	ns
	DATxA	rise time	Push-pull driving	1.9	8.6	1.2	7.1	0.9	6.8	1	6.3	1.3	6.1	
	CMDB	rise time	Push-pull driving	1.8	10.2	2	7.7	1.7	6.5	1	5.2	1.7	3.1	
	CIVIDB	nse ume	Open-drain driving	137	251	148	245	141	251	100	184	73	142	
t _{rB}	CLKB	rise time	Duch pull driving	1.5	7.3	0.7	6.6	0.4	5.9	1.5	4.9	1.9	4.3	ns
	DATxB	rise time	Push-pull driving	2.3	10.3	1.8	8	1.5	6.8	0.9	5.2	0.2	5	
	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	
	CIVIDA	iaii tiirie	Open-drain driving	2.3	7.9	2	4.8	1.8	4.2	1.7	3.7	1.6	3.5	ns
t _{fA}	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	115
	DATxA	fall time	Push-pull driving	1	4.3	0.8	3.6	1	2.7	0.1	2.7	0.2	2.6	
	CMDD	fall time	Push-pull driving	1	10.3	1.4	6.8	1.8	5.4	1.6	5	1.6	3.6	
•	CIVIDB	fall time	Open-drain driving	1.4	4	1.3	3	1.2	2.6	0.9	1.9	0.8	1.8	ne
t_fB	CLKB	fall time	Duch pull driving	1.1	10.8	1	10.3	1.4	6.3	1.8	4.2	1.7	4	ns
	DATxB	fall time	Push-pull driving	1	11.8	15	7	1.2	6.3	1.6	4.9	0.8	3.6	
t _{SK(O)}		to-channel cew	Push-pull driving		1		1		1		1		1	ns
	0	mand	Push-pull driving		30		60		60		60		60	Mess
Max data rate	Con	ımand	Open-drain driving		1		1		1		1		1	Mbps
iviax data rate	C	ock	Duch pull driving		50		60		60		60		60	MHz
	D	ata	Push-pull driving		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 _C = 1. ± 0.	2 V	V _C = 1. ± 0.	5 V	V _C = 1. ± 0.1	8 V	V _C = 2. ± 0.	5 V	V _C = 3. ± 0.	3 V	UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
			Push-pull driving		10.6		6.5		4.9		3.7		3.3	
	CMDA	CMDB	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	
			Push-pull driving		12.5		7.4		5.6		4.1		3.6	
t _{pd}	CMDB	CMDA	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	ns
			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	Push-pull unvillig		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	
	EN	B-port	Push-pull driving		1		1		1		1		1	
t _{en}	EN	A-port	Push-pull driving		1		1		1		1		1	μs
	EN	B-port	Push-pull driving		48		45		45		38		36	no
t _{dis}	EN	A-port	Push-pull driving		45		38		38		38		35	ns
	CMDA	riaa tima	Push-pull driving	1.9	4.7	1.7	4.4	1.7	3.8	1.9	3.2	2.3	3.3	
	CIVIDA	rise time	Open-drain driving	135	216	136	237	121	228	96	201	62	141	
t _{rA}	CLK-f	rise time	Duch pull driving	0.8	1.6	0.3	1.9	0.6	1.8	0.7	1.5	0.7	1.3	ns
	DATxA	rise time	Push-pull driving	1.9	6.1	1.8	4.5	1.7	4.1	1.9	4	1.8	4.2	
	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	
	CIVIDB	iise tiiile	Open-drain driving	102	205	116	197	112	207	101	214	76	165	no
t_{rB}	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	ns
	DATxB	rise time	r usii-puli ulivilig	2.2	10.3	1.9	7.9	1.8	6.6	1.4	5.3	0.9	4.4	
	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	
+	CIVIDA	i iaii tiirie	Open-drain driving	2.2	7.6	1.9	4.8	1.8	4.2	1.7	3.7	1.6	3.5	ns
t _{fA}	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	115
	DATxA	fall time	i dan-pail anving	0.4	4	0.4	3.6	0.4	3.2	0.5	2.9	0.3	2.6	
	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	
+	CIVIDB	iali liille	Open-drain driving	1	2.3	1	1.7	1	1.7	1	1.6	8.0	1.4	ns
t _{fB}	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	115
	DATxE	3 fall time	Push-pull driving	1	16	0.7	9	80	7	8.0	4.9	0.2	4	
t _{SK(O)}		-to-channel kew	Push-pull driving		1		1		1		1		1	ns
	0		Push-pull driving		30		60		60	<u> </u>	60	-	60	Mhns
May det	Com	nmand	Open-drain driving		1		1		1		1		1	Mbps
Max data rate	С	lock	Dunk mult detected		50		60		60		60		60	MHz
	D	ata	Push-pull driving		30		60		60		60		60	Mbps

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SWITCHING CHARACTERISTICS $V_{\text{CCA}} = 3.3 \ V \pm 0.3 \ V$

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V _C = 1. ± 0.	2 V	V _C = 1. ± 0.	5 V	V _C = 1. ± 0.1	8 V	V _C = 2. ± 0.	5 V	V _C = 3. ± 0.	3 V	UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
			Push-pull driving		12.5		7.2		5.3		3.8		3.2	
	CMDA	CMDB	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	
			Push-pull driving		10.7		6.6		5.1		3.4		3	
t _{pd}	CMDB	CMDA	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	ns
			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	Duch pull driving		11.5		6.9		5.1		3.7		3.2	
	DATxB	DATxA	Push-pull driving		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	
	EN	B-port	Push-pull driving		1		1		1		1		1	
t _{en}	EN	A-port	Push-pull driving		1		1		1		1		1	μs
	EN	B-port	Push-pull driving		38		34		34		34		34	no
t _{dis}	EN	A-port	Push-pull driving		45		37		36		36		35	ns
	CMDA	riaa tima	Push-pull driving	0.7	5.6	0.7	5	0.7	4.2	8.0	4.1	1	4.2	
	CIVIDA	rise time	Open-drain driving	117	178	118	213	104	206	85	194	74	155	
t_{rA}	CLK-f	rise time	Duch pull driving	0.7	1.5	0.5	1.7	0.7	1.5	0.7	1.4	0.7	1.4	ns
	DATxA	rise time	Push-pull driving	0.9	5	1.1	3.9	1.3	3.4	1.4	3.3	1.1	3	
	CMDB	rise time	Push-pull driving	1.7	10.8	2.3	7.4	2.2	6.4	2	5	1.9	4	
+	CIVIDB	iise tiiile	Open-drain driving	69	167	84	156	83	167	79	185	79	166	ns
t _{rB}	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	115
	DATxB	rise time	r ush-pull unvillg	2.1	10.5	2	7.9	2	6.6	1.8	5.3	1	14	
	CMDA	fall time	Push-pull driving	0.3	2.8	0.4	2.4	0.4	2	0.4	2	1	2.3	
+	CIVIDA	iaii tiirie	Open-drain driving	2	7.6	1.8	5	1.7	4.4	1.6	3.9	1.6	3.7	ns
t_fA	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	113
	DATxA	fall time	i dan-pun unving	0.3	2.7	0.4	2.3	0.4	1.4	0.4	1.8	0.5	1.7	
	CMDB	fall time	Push-pull driving	1	13.3	0.7	7.9	0.9	6.2	8.0	6.3	1	5	
t.	CIVIDB	iaii uiiie	Open-drain driving	0.7	1.5	0.7	1.4	0.8	1.4	0.9	1.3	0.9	1.3	ns
t _{fB}	CLKB	fall time	Push-pull driving	1	15.5	1	9.1	0.9	7.8	0.9	5.1	0.9	4.3	113
	DATxB	fall time	i dan-pun unving	1	15	0.9	6.8	0.9	6.8	8.0	6.9	0.8	5	
$t_{SK(O)}$		to-channel kew	Push-pull driving		1		1		1		1		1	ns
	C	mand	Push-pull driving		30		60		60		60		60	Mhna
May data rata	Con	nmand	Open-drain driving		0.9		1		1		1		1	Mbps
Max data rate	CI	lock	Duch pull driving		55		55		55		55		55	MHz
	D	ata	Push-pull driving		30		60		60		60		60	Mbps

OPERATING CHARACTERISTICS

 $T_A = 25^{\circ}C, V_{CCA} = 1.2 \text{ V}$

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

⁽¹⁾ Power dissipation capacitance per transceiver

OPERATING CHARACTERISTICS

 $T_A = 25^{\circ}C, V_{CCA} = 1.5 \text{ V}$

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

 $T_A = 25^{\circ}C, V_{CCA} = 1.5 V$

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

OPERATING CHARACTERISTICS

 $T_A = 25^{\circ}C, V_{CCA} = 1.8 \text{ V}$

	DADAMET	-n	TEST			V _{CCE}	TYP			LINUT
	PARAMETE	=K	CONDITIONS	1.2 V	1.5 V	1.8 V	2.5 V	3 V	3.3 V	UNIT
	A-port input,	CLK Enabled		15.2	15.1	15.1	15	15	15	
	B-port output	DATA Enabled		6.7	6.2	5.8	5.4	5.4	5.3	
C (1)	B-port input, A-port output	DATA Enabled	$C_L = 0,$ f = 10 MHz,	13.9	13.1	12.4	12.1	12	11.9	, F
C _{pdA} ⁽¹⁾	A-port input,	CLK Disabled	$t_r = t_f = 1 \text{ ns}$	0.1	0.1	0.1	0.1	0.1	0.1	pF
	B-port output	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	
	A-port input, B-port output	DATA Enabled		25.9	26.1	26.7	28.8	28.8	30.3	
	B-port input, A-port	CLK Enabled		25.8	25.6	25.6	26.2	26.2	27	
C _{pdB} ⁽¹⁾	output	DATA Enabled	$C_L = 0,$ f = 10 MHz,	13.6	12.2	11.5	12.1	12.1	12.9	pF
O pdB √	A-port input, B-port output	DATA Disabled	$t_r = t_f = 1 \text{ ns}$	0.2	0.1	0.1	0.1	0.1	0.1	рг
	B-port input,	CLK Disabled		0.2	0.1	0.1	0.1	0.1	0.1	
	A-port output	DATA Disabled		1.2	1.2	1.1	1	1	0.8	

⁽¹⁾ Power dissipation capacitance per transceiver

Product Folder Link(s): TXS0206

OPERATING CHARACTERISTICS

 $T_A = 25^{\circ}C, V_{CCA} = 2.5 \text{ V}$

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

⁽¹⁾ Power dissipation capacitance per transceiver

OPERATING CHARACTERISTICS

 $T_A = 25^{\circ}C, V_{CCA} = 3.3 \text{ V}$

	DADAMET	-n	TEST			V _{CCB}	TYP			LINUT
	PARAMETER CONDIT			1.2 V	1.5 V	1.8 V	2.5 V	3 V	3.3 V	UNIT
	A-port input, B-port output	CLK Enabled	$C_{L} = 0,$ f = 10 MHz, $t_{r} = t_{f} = 1 \text{ ns}$	18.3	17.7	17.5	17.3	17.2	17.1	
		DATA Enabled		8.1	7	6.2	5.7	5.6	5.6	
C (1)	B-port input, A-port output	DATA Enabled		17	16.1	15.6	14.8	14.4	14	
C _{pdA} ⁽¹⁾	A-port input, B-port output	CLK Disabled		0.1	0.1	0.1	0.1	0.1	0.1	pF
		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)

 $T_A = 25^{\circ}C, V_{CCA} = 3.3 \text{ V}$

	DADAMET	-n	TEST			V _{CCB}	TYP			LINUT
	PARAMETER CONDITION			1.2 V	1.5 V	1.8 V	2.5 V	3 V	3.3 V	UNIT
	A-port input, B-port output	DATA Enabled	$C_L = 0,$ $f = 10 \text{ MHz},$ $t_r = t_f = 1 \text{ ns}$	25.2	25.6	26	27.1	28	28.5	
	B-port input, A-port output	CLK Enabled		26	25.8	25.8	26.3	26.8	27	
C _{pdB} ⁽¹⁾		DATA Enabled		13.7	12.1	11.4	12.2	12.7	13.2	
C _{pdB} (*)	A-port input, B-port output	DATA Disabled		0.3	0.1	0.1	0.1	0.1	0.1	pF
	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	

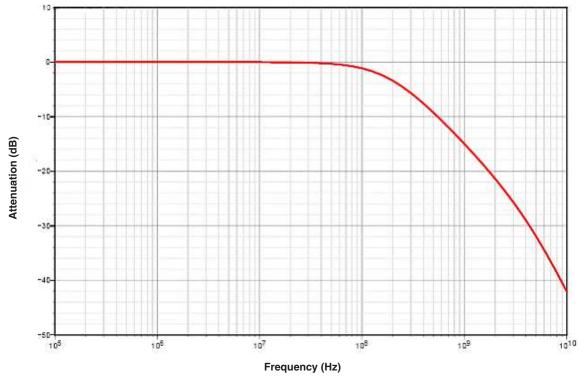
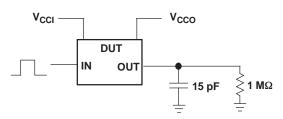
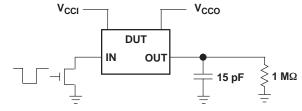


Figure 7. Typical ASIP EMI Filter Frequency Response



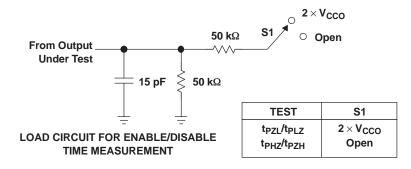
PARAMETER MEASUREMENT INFORMATION

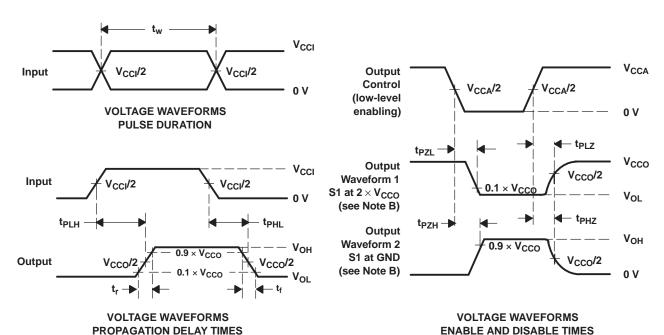




DATA RATE, PULSE DURATION, PROPAGATION DELAY, OUTPUT RISE AND FALL TIME MEASUREMENT USING A PUSH-PULL DRIVER

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





- 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 \leq 10 MHz, $Z_0 = 50 \Omega$, $dv/dt \geq$ 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

24

Product Folder Link(s): TXS0206



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 k Ω , and power consumption is minimized. When the port is in a high signal state, the nominal pullup resistor value changes to 4 k Ω , 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 StickTM 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-k Ω value. The impact of adding too heavy (i.e., <10-k Ω value) a pulldown resistor to the data and command lines of the TXS0206 device and the resulting 4-k Ω pullup / 10-k Ω 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-k Ω pulldown resistor value would be:

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

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-k Ω pulldown resistor value would be:

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

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



PACKAGE OPTION ADDENDUM

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PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins P	ackage Qty	e Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
TXS0206YFPR	ACTIVE	DSBGA	YFP	20	3000	Green (RoHS & no Sb/Br)	SNAGCU	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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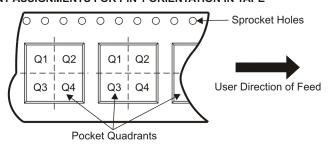
TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
В0	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			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	1.65	2.05	0.6	4.0	8.0	Q1

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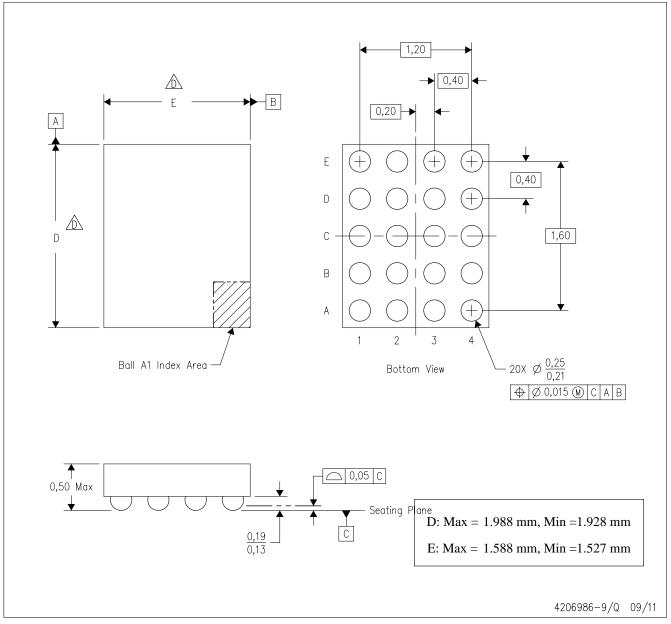


*All dimensions are nominal

ĺ	Device Package Type		Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)	
	TXS0206YFPR	DSBGA	YFP	20	3000	220.0	220.0	34.0	

YFP (R-XBGA-N20)

DIE-SIZE BALL GRID ARRAY



- 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. NanoFree™ package configuration.
 - The package size (Dimension D and E) of a particular device is specified in the device Product Data Sheet version of this drawing, in case it cannot be found in the product data sheet please contact a local TI representative.
 - E. Reference Product Data Sheet for array population. 2 x 2 matrix pattern is shown for illustration only.
 - F. This package contains Pb-free balls.

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