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**TS2DDR2811**

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SCDS294 – DECEMBER 2009

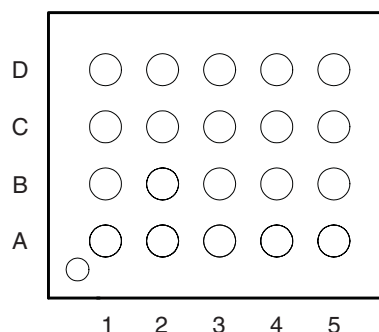
## 1-GHz BANDWIDTH, 8-CHANNEL SPST SWITCH

Check for Samples: [TS2DDR2811](#)

### FEATURES

- Wide Bandwidth (BW = 1100 MHz Typ)
- Low Crosstalk ( $X_{\text{TALK}} = -37$  dB Typ)
- Low Bit-to-Bit Skew ( $t_{\text{sk(o)}} = 100$  ps Max)
- Low and Flat ON-State Resistance ( $r_{\text{ON}} = 4 \Omega$  Typ,  $r_{\text{ON(flat)}} = 0.5 \Omega$  Typ)
- Low Input/Output Capacitance ( $C_{\text{ON}} = 8$  pF Typ)
- Rail-to-Rail Switching on Data I/O Ports (0 V to 5 V)
- $V_{\text{CC}}$  Operating Range From 3 V to 3.6 V
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Performance Tested Per JESD 22
  - 2000-V Human-Body Model (A114-B, Class II)
  - 1000-V Charged-Device Model (C101)

**ZXY PACKAGE  
(BOTTOM VIEW)**



**TERMINAL ASSIGNMENTS**

<b>D</b>	B <sub>6</sub>	B <sub>5</sub>	B <sub>3</sub>	SEL	B <sub>0</sub>
<b>C</b>	B <sub>7</sub>	B <sub>4</sub>	B <sub>2</sub>	B <sub>1</sub>	N.C.
<b>B</b>	GND	A <sub>5</sub>	A <sub>3</sub>	A <sub>1</sub>	V <sub>CC</sub>
<b>A</b>	A <sub>7</sub>	A <sub>6</sub>	A <sub>4</sub>	A <sub>2</sub>	A <sub>0</sub>
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

### APPLICATIONS

- DDR2 Signal Switching
- GbE LAN Signal Switching
- Hub and Router Signal Switching
- Audio/Video Switching

### DESCRIPTION/ORDERING INFORMATION

The TS2DDR2811 is a 8-channel single-pole single-throw (SPST) signal switch capable of switching signals with bandwidth in excess of 1 GHz. The device includes a select pin (SEL) that is used to select any 1 of the 8 channel inputs. This select pin controls the data path of the SPST switch. The device provides a low and flat ON-state resistance ( $r_{\text{ON}}$ ) and an excellent ON-state resistance match. Low input/output capacitance, high bandwidth, low skew, and low crosstalk among channels make this device suitable for various high-bandwidth applications, such as DDR2, 10/100/1000 Base-T, audio, and video.

**Table 1. ORDERING INFORMATION**

<b>T<sub>A</sub></b>	<b>PACKAGE<sup>(1)</sup> (2)</b>		<b>ORDERABLE PART NUMBER</b>	<b>TOP-SIDE MARKING</b>
–40°C to 85°C	BGA – ZXY	Tape and reel	TS2DDR2811ZXYR	SJ811

(1) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).

(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at [www.ti.com](http://www.ti.com).

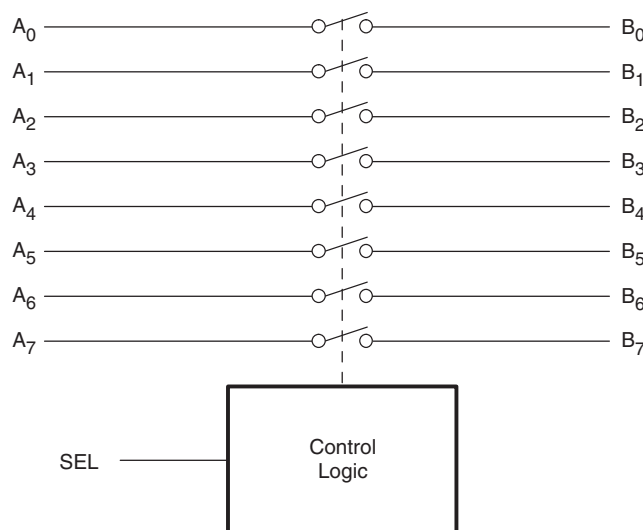


Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

### FUNCTION TABLE

INPUT SEL	INPUT	OUTPUT	FUNCTION
H	$A_n$	$B_n$	$A_n = B_n$
L	-	-	$A_n$ and $B_n$ are Hi-Z

### LOGIC DIAGRAM



### TERMINAL FUNCTIONS

BALL		DESCRIPTION
NAME	NO.	
$A_0, A_1, A_2, A_3, A_4, A_5, A_6, A_7$	$A_5, B_4, A_4, B_3, A_3, B_2, A_2, A_1$	Data I/Os
$B_0, B_1, B_2, B_3, B_4, B_5, B_6, B_7$	$D_5, C_4, C_3, D_3, C_2, D_2, D_1, C_1$	Data I/Os
GND	B1	Ground
SEL	D4	Select inputs
$V_{CC}$	B5	Supply voltage

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

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

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage range	−0.5	4.6	V
V <sub>IN</sub>	Control input voltage range <sup>(2)</sup> <sup>(3)</sup>	−0.5	7	V
V <sub>I/O</sub>	Switch I/O voltage range <sup>(2)</sup> <sup>(3)</sup> <sup>(4)</sup>	−0.5	7	V
I <sub>IK</sub>	Control input clamp current	V <sub>IN</sub> < 0 or V <sub>IN</sub> > V <sub>CC</sub>		−50 mA
I <sub>I/O</sub>	I/O port clamp current	V <sub>I/O</sub> < 0 or V <sub>I/O</sub> > V <sub>CC</sub>		−50 mA
I <sub>I/O</sub>	ON-state switch current <sup>(5)</sup>		±128	mA
	Continuous current through V <sub>DD</sub> or GND		±100	mA
θ <sub>JA</sub>	Package thermal impedance <sup>(6)</sup>		31.8	°C/W
T <sub>stg</sub>	Storage temperature range	−65	150	°C

- (1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltages are with respect to ground, unless otherwise specified.
- (3) The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
- (4) V<sub>I</sub> and V<sub>O</sub> are used to denote specific conditions for V<sub>I/O</sub>.
- (5) I<sub>I</sub> and I<sub>O</sub> are used to denote specific conditions for I<sub>I/O</sub>.
- (6) The package thermal impedance is calculated in accordance with JESD 51-7.

## RECOMMENDED OPERATING CONDITIONS<sup>(1)</sup>

		MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage	3	3.6	V
V <sub>IH</sub>	High-level control input voltage	2	5.5	V
V <sub>IL</sub>	Low-level control input voltage	0	0.8	V
V <sub>I</sub>	Input voltage	0	5.5	V
V <sub>I/O</sub>	Input/output voltage	0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating free-air temperature	−40	85	°C

- (1) All unused control inputs of the device must be held at V<sub>DD</sub> 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

for 1000 Base-T Ethernet switching over recommended operating free-air temperature range, V<sub>CC</sub> = 3.3 V ± 0.3 V

(unless otherwise noted)

PARAMETER		TEST CONDITIONS <sup>(1)</sup>	MIN	TYP <sup>(2)</sup>	MAX	UNIT
V <sub>IK</sub>	SEL	V <sub>CC</sub> = 3.6 V, I <sub>IN</sub> = −18 mA	−0.7	−1.2		V
I <sub>IH</sub>	SEL	V <sub>CC</sub> = 3.6 V, V <sub>IN</sub> = V <sub>CC</sub>		±1		μA
I <sub>IL</sub>	SEL	V <sub>CC</sub> = 3.6 V, V <sub>IN</sub> = GND		±1		μA
I <sub>CC</sub>		V <sub>CC</sub> = 3.6 V, I <sub>I/O</sub> = 0, Switch ON or OFF	250	500		μA
C <sub>IN</sub>	SEL	f = 1 M Hz, V <sub>IN</sub> = 0	2	2.5		pF
C <sub>OFF</sub>	B port	V <sub>I</sub> = 0, f = 1 MHz, Outputs open, Switch OFF	2.5	4		pF
C <sub>ON</sub>		V <sub>I</sub> = 0, f = 1 MHz, Outputs open, Switch ON	8	TBD		pF
r <sub>ON</sub>		V <sub>CC</sub> = 3 V, 1.5 V ≤ V <sub>I</sub> ≤ V <sub>CC</sub> , I <sub>O</sub> = −40 mA	4	6		Ω
r <sub>ON(flat)</sub> <sup>(3)</sup>		V <sub>CC</sub> = 3 V, V <sub>I</sub> = 1.5 V and V <sub>CC</sub> , I <sub>O</sub> = −40 mA	0.5			Ω
Δr <sub>ON</sub> <sup>(4)</sup>		V <sub>CC</sub> = 3 V, 1.5 V ≤ V <sub>I</sub> ≤ V <sub>CC</sub> , I <sub>O</sub> = −40 mA	0.4	1		Ω

- (1) V<sub>I</sub>, V<sub>O</sub>, I<sub>I</sub>, and I<sub>O</sub> refer to I/O pins. V<sub>IN</sub> refers to the control inputs.
- (2) All typical values are at V<sub>CC</sub> = 3.3 V (unless otherwise noted), T<sub>A</sub> = 25°C.
- (3) r<sub>ON(flat)</sub> is the difference of r<sub>ON</sub> in a given channel at specified voltages.
- (4) Δr<sub>ON</sub> is the difference of r<sub>ON</sub> from center (A<sub>4</sub>, A<sub>5</sub>) ports to any other port.

## ELECTRICAL CHARACTERISTICS

for 10/100 Base-T Ethernet switching over recommended operating free-air temperature range,  $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$   
(unless otherwise noted)

PARAMETER		TEST CONDITIONS <sup>(1)</sup>	MIN	TYP <sup>(2)</sup>	MAX	UNIT
$V_{IK}$	SEL	$V_{CC} = 3.6 \text{ V}$ , $I_{IN} = -18 \text{ mA}$	-0.7	-1.2		V
$I_{IH}$	SEL	$V_{CC} = 3.6 \text{ V}$ , $V_{IN} = V_{CC}$		$\pm 1$		$\mu\text{A}$
$I_{IL}$	SEL	$V_{CC} = 3.6 \text{ V}$ , $V_{IN} = \text{GND}$		$\pm 1$		$\mu\text{A}$
$I_{CC}$		$V_{CC} = 3.6 \text{ V}$ , $I_{IO} = 0$ , Switch ON or OFF		250	500	$\mu\text{A}$
$C_{IN}$	SEL	$f = 1 \text{ MHz}$ , $V_{IN} = 0$		2	2.5	pF
$C_{OFF}$	B port	$V_I = 0$ , $f = 1 \text{ MHz}$ , Outputs open, Switch OFF		2.5	4	pF
$C_{ON}$		$V_I = 0$ , $f = 1 \text{ MHz}$ , Outputs open, Switch ON		8		pF
$r_{ON}$		$V_{CC} = 3 \text{ V}$ , $1.25 \text{ V} \leq V_I \leq V_{CC}$ , $I_O = -10 \text{ mA to } -30 \text{ mA}$		4	6	$\Omega$
$r_{ON(flat)}$ <sup>(3)</sup>		$V_{CC} = 3 \text{ V}$ , $V_I = 1.25 \text{ V and } V_{CC}$ , $I_O = -10 \text{ mA to } -30 \text{ mA}$		0.5		$\Omega$
$\Delta r_{ON}$ <sup>(4)</sup>		$V_{CC} = 3 \text{ V}$ , $1.25 \text{ V} \leq V_I \leq V_{CC}$ , $I_O = -10 \text{ mA to } -30 \text{ mA}$		0.4	1	$\Omega$

- (1)  $V_I$ ,  $V_O$ ,  $I_I$ , and  $I_O$  refer to I/O pins.  $V_{IN}$  refers to the control inputs.  
(2) All typical values are at  $V_{CC} = 3.3 \text{ V}$  (unless otherwise noted),  $T_A = 25^\circ\text{C}$ .  
(3)  $r_{ON(flat)}$  is the difference of  $r_{ON}$  in a given channel at specified voltages.  
(4)  $\Delta r_{ON}$  is the difference of  $r_{ON}$  from center ( $A_4$ ,  $A_5$ ) ports to any other port.

## SWITCHING CHARACTERISTICS

over recommended operating free-air temperature range,  $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ ,  $R_L = 200 \Omega$ ,  $C_L = 10 \text{ pF}$   
(unless otherwise noted) (see Figure 5 and Figure 6)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$t_{pd}$ <sup>(2)</sup>	A or B	B or A		40		ps
$t_{PZH}$ , $t_{PZL}$	SEL	A or B	0.5		15	ns
$t_{PHZ}$ , $t_{PLZ}$	SEL	A or B	0.9		9	ns
$t_{sk(o)}$ <sup>(3)</sup>	A or B	B or A		50	100	ps
$t_{sk(p)}$ <sup>(4)</sup>				50	150	ps

- (1) All typical values are at  $V_{CC} = 3.3 \text{ V}$  (unless otherwise noted),  $T_A = 25^\circ\text{C}$ .  
(2) The propagation delay is the calculated RC time constant of the typical ON-state resistance of the switch and the specified load capacitance when driven by an ideal voltage source (zero output impedance).  
(3) Output skew between center port ( $A_4$  to  $A_5$ ) to any other port  
(4) Skew between opposite transitions of the same output in a given device  $|t_{PHL} - t_{PLH}|$

## DYNAMIC CHARACTERISTICS

over recommended operating free-air temperature range,  $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS		TYP <sup>(1)</sup>	UNIT
$X_{TALK}$	$R_L = 100 \Omega$ , $f = 250 \text{ MHz}$ , See Figure 8		-37	dB
$O_{IRR}$	$R_L = 100 \Omega$ , $f = 250 \text{ MHz}$ , See Figure 9		-37	dB
BW	$R_L = 50 \Omega$ , See Figure 7		1100	MHz

- (1) All typical values are at  $V_{CC} = 3.3 \text{ V}$  (unless otherwise noted),  $T_A = 25^\circ\text{C}$ .

## OPERATING CHARACTERISTICS

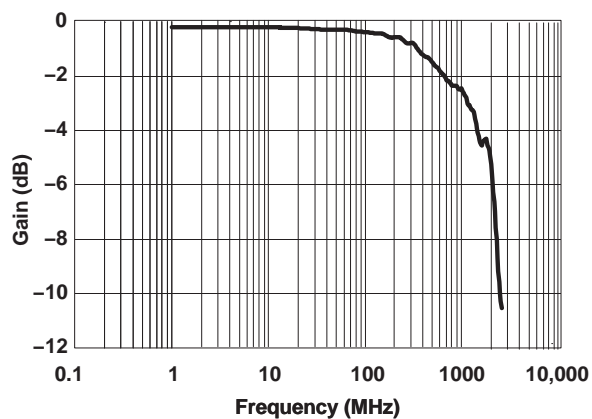


Figure 1. Gain vs Frequency

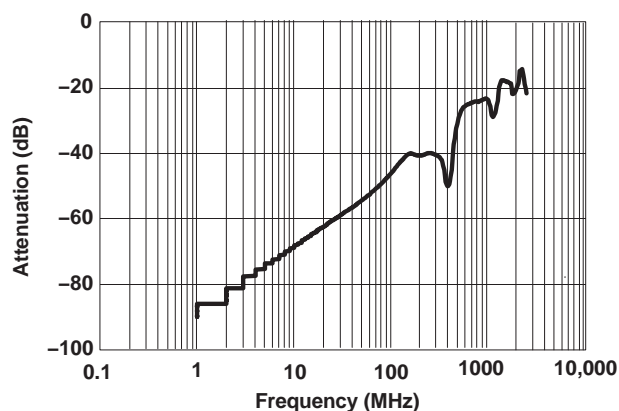


Figure 2. OFF Isolation vs Frequency

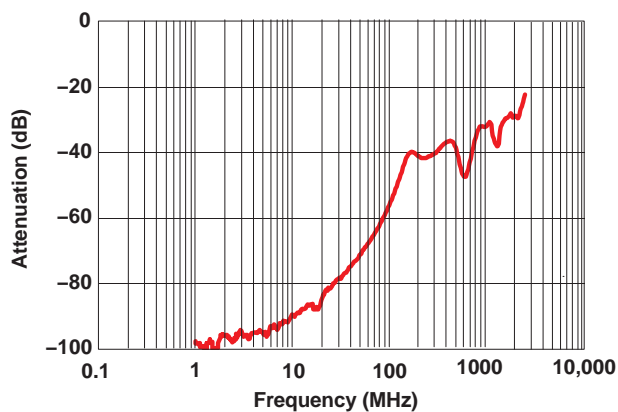


Figure 3. Crosstalk vs Frequency

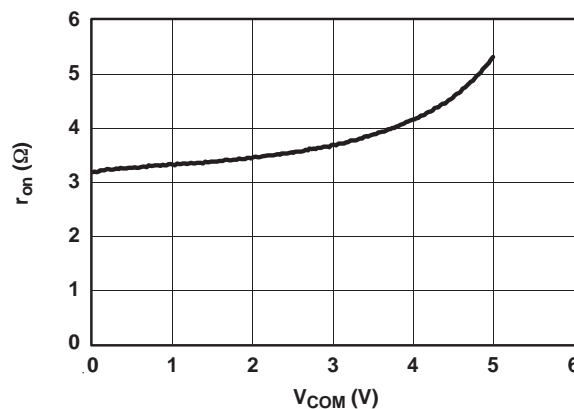
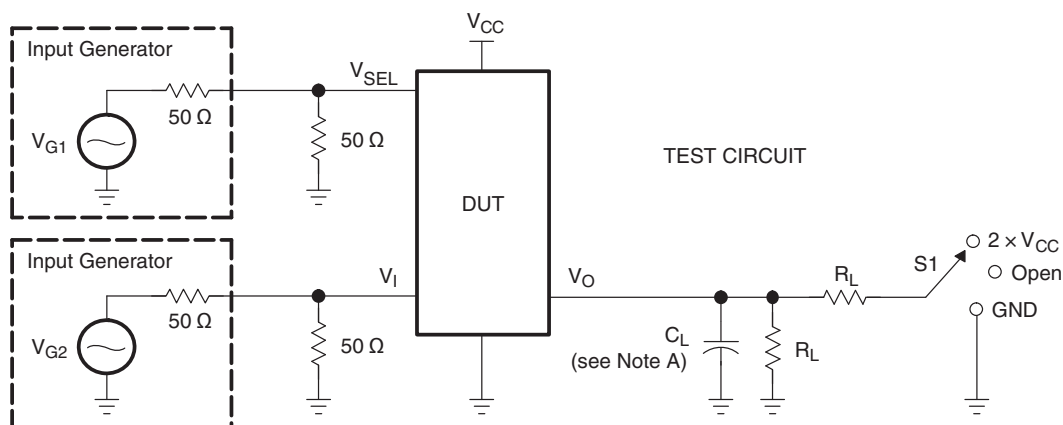
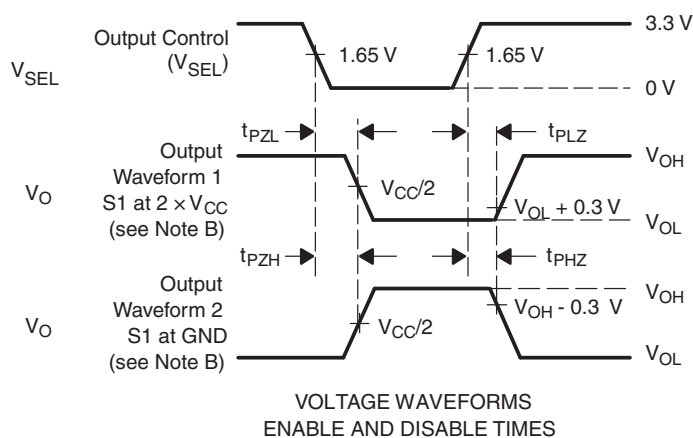


Figure 4.  $r_{ON}$  ( $\Omega$ ) vs  $V_{COM}$  (V)

## PARAMETER MEASUREMENT INFORMATION (Enable and Disable Times)



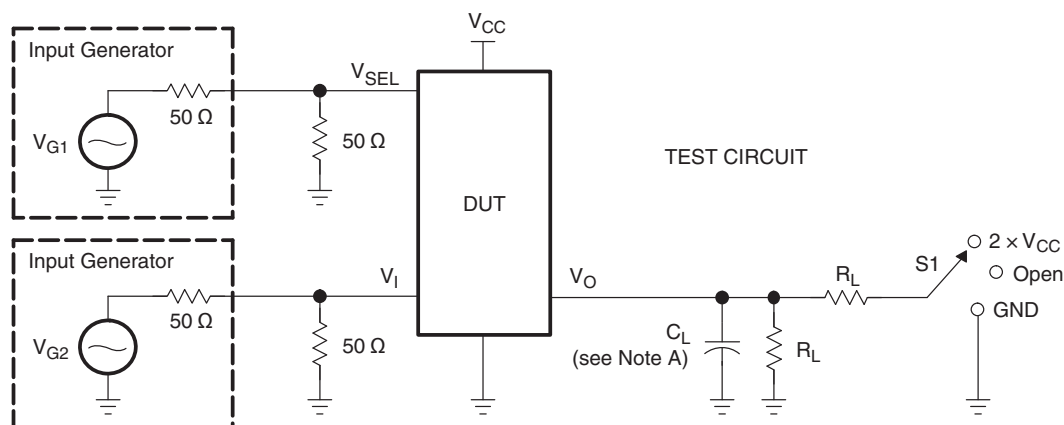
TEST	V <sub>CC</sub>	S1	R <sub>L</sub>	V <sub>I</sub>	C <sub>L</sub>	V <sub>Δ</sub>
t <sub>PLZ</sub> /t <sub>PZL</sub>	3.3 V ± 0.3 V	2 × V <sub>CC</sub>	200 Ω	GND	10 pF	0.3 V
t <sub>PHZ</sub> /t <sub>PZH</sub>	3.3 V ± 0.3 V	GND	200 Ω	V <sub>CC</sub>	10 pF	0.3 V



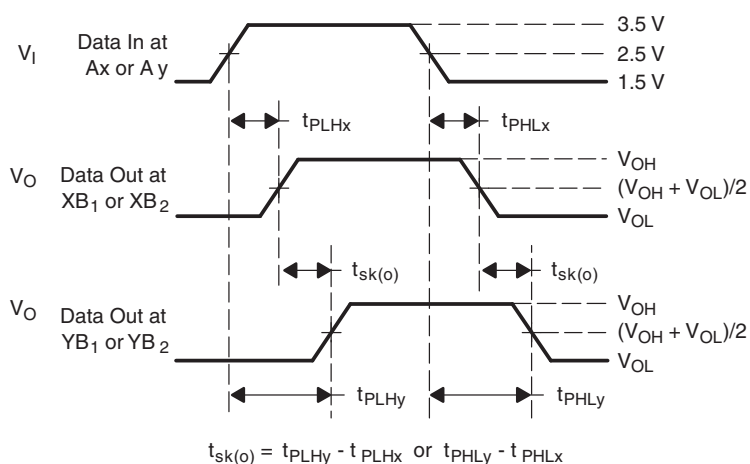
- C<sub>L</sub> includes probe and jig capacitance.
- Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
- All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z<sub>O</sub> = 50 Ω, t<sub>r</sub> ≤ 2.5 ns, t<sub>f</sub> ≤ 2.5 ns.
- The outputs are measured one at a time, with one transition per measurement.
- t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>dis</sub>.
- t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>en</sub>.

**Figure 5. Test Circuit and Voltage Waveforms**

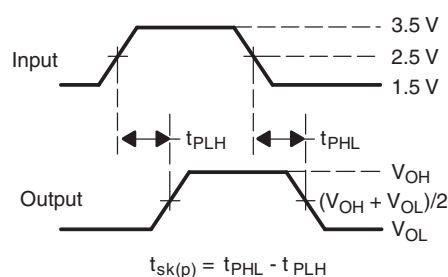
## PARAMETER MEASUREMENT INFORMATION (Skew)



TEST	V <sub>CC</sub>	S1	R <sub>L</sub>	V <sub>in</sub>	C <sub>L</sub>
t <sub>sk(o)</sub>	3.3 V ± 0.3 V	Open	200 Ω	V <sub>CC</sub> or GND	10 pF
t <sub>sk(p)</sub>	3.3 V ± 0.3 V	Open	200 Ω	V <sub>CC</sub> or GND	10 pF



VOLTAGE WAVEFORMS  
OUTPUT SKEW [t<sub>sk(o)</sub>]



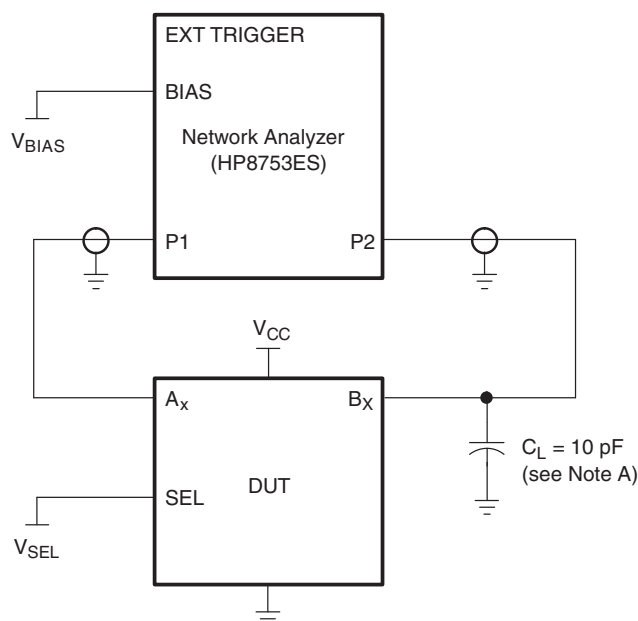
VOLTAGE WAVEFORMS  
PULSE SKEW [t<sub>sk(p)</sub>]

- C<sub>L</sub> includes probe and jig capacitance.
- 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.
- All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z<sub>O</sub> = 50 Ω, t<sub>r</sub> ≤ 2.5 ns, t<sub>f</sub> ≤ 2.5 ns.
- The outputs are measured one at a time, with one transition per measurement.

Figure 6. Test Circuit and Voltage Waveforms



## PARAMETER MEASUREMENT INFORMATION



A.  $C_L$  includes probe and jig capacitance.

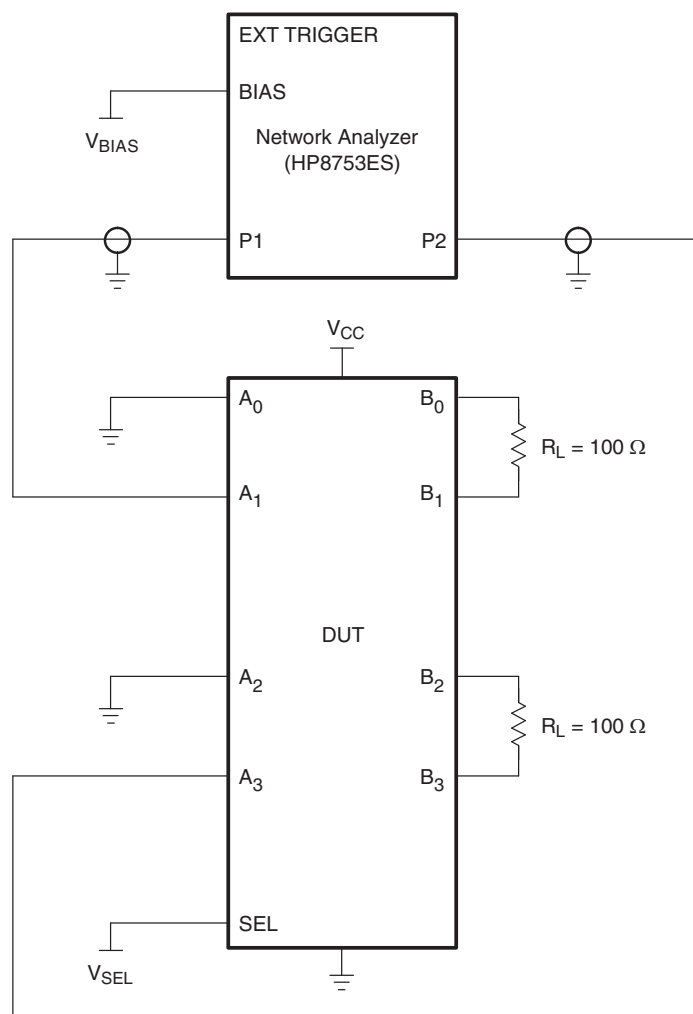
**Figure 7. Test Circuit for Frequency Response (BW)**

Frequency response is measured at the output of the ON channel. For example, when  $V_{SEL} = 0$  and  $A_0$  is the input, the output is measured at B0. All unused analog I/O ports are left open.

### HP8753ES Setup

Average = 4  
RBW = 3 kHz  
 $V_{BIAS} = 0.35$  V  
ST = 2 s  
P1 = 0 dBm

## PARAMETER MEASUREMENT INFORMATION (continued)



**Figure 8. Test Circuit for Crosstalk ( $X_{TALK}$ )**

Crosstalk is measured at the output of the nonadjacent ON channel. For example, when  $V_{SELn} = 0$  and  $A_0$  is the input, the output is measured at  $B_0$ . All unused analog input (A) ports are connected to GND, and output (B) ports are connected to GND through 50- $\Omega$  pulldown resistors.

### HP8753ES Setup

Average = 4

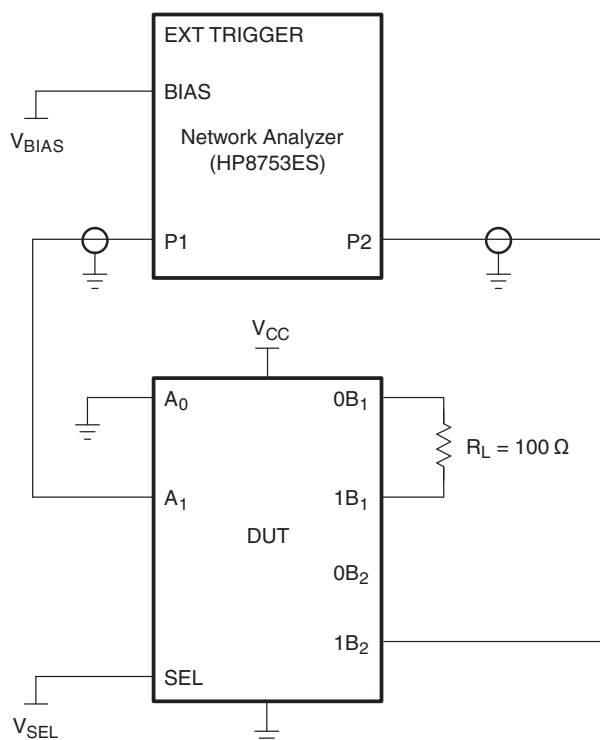
RBW = 3 kHz

$V_{BIAS} = 0.35$  V

ST = 2 s

P1 = 0 dBm

## PARAMETER MEASUREMENT INFORMATION (continued)



- A.  $C_L$  includes probe and jig capacitance.
- B. A 50- $\Omega$  termination resistor is needed to match the loading of the network analyzer.

**Figure 9. Test Circuit for Off Isolation ( $O_{IRR}$ )**

OFF isolation is measured at the output of the OFF channel. For example, when  $V_{SELn} = V_{CC}$  and  $A_0$  is the input, the output is measured at  $B_0$ . All unused analog input (A) ports are left open, and output (B) ports are connected to GND through 50- $\Omega$  pulldown resistors.

### HP8753ES Setup

Average = 4  
RBW = 3 kHz  
 $V_{BIAS} = 0.35$  V  
ST = 2 s  
P1 = 0 dBm



## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TS2DDR2811ZXYP	ACTIVE	BGA MICROSTAR JUNIOR	ZXY	20	2500	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	SJ811	<a href="#">Samples</a>

(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.

**OBSELETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

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

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

(4) 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.

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## PACKAGE MATERIALS INFORMATION

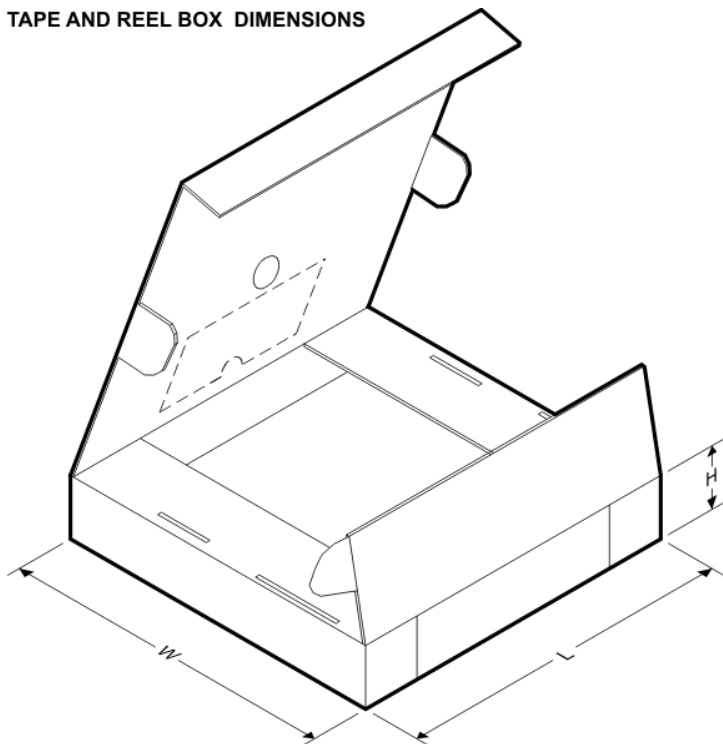
### TAPE AND REEL INFORMATION



\*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
TS2DDR2811ZXYSR	BGA MICROSTAR JUNIOR	ZXY	20	2500	330.0	12.4	2.8	3.3	1.0	4.0	12.0	Q2

**TAPE AND REEL BOX DIMENSIONS**



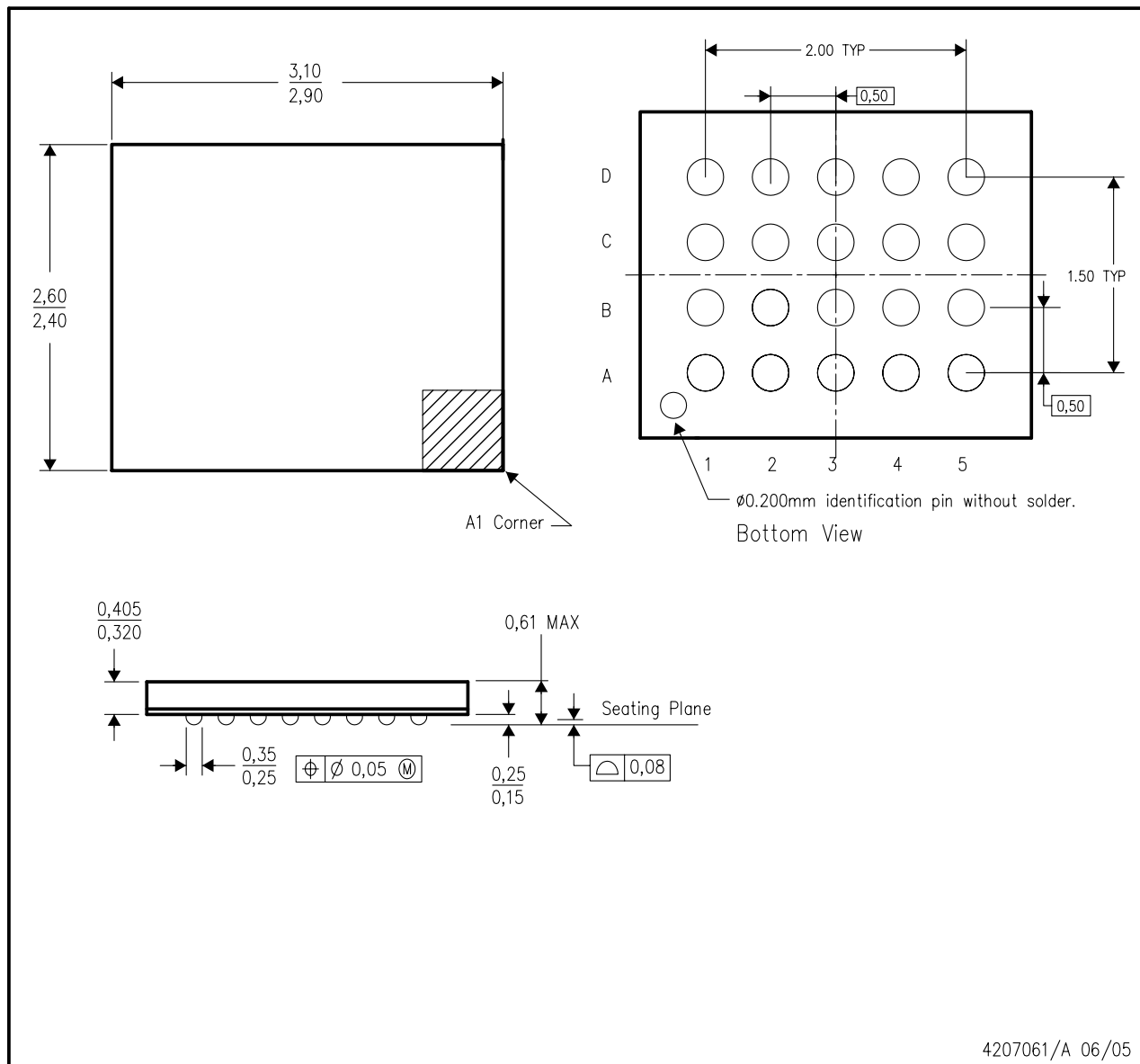
\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TS2DDR2811ZXYR	BGA MICROSTAR JUNIOR	ZXY	20	2500	338.1	338.1	20.6

## MECHANICAL DATA

### ZXY (S-PBGA-N20)

### PLASTIC BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. This package is a lead-free solder ball design.

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