

# TS3DDR4000 12 ビット 1:2 高速 DDR2/DDR3/DDR4 スイッチ/マルチプレクサ

## 1 特長

- 広い  $V_{DD}$  範囲：2.375V～3.6V
- 広帯域幅：5.6GHz (シングル・エンド、標準値)、6.0GHz (差動、標準値)
- 低いスイッチ・オン抵抗 ( $R_{ON}$ )：8 $\Omega$  (標準値)
- 低いビット間スキュー：3ps (標準値)、全チャンネル間の最大値 6ps
- 低いクロストーク：1067MHz で -34dB (標準値)
- 低い動作電流：40 $\mu$ A (標準値)
- 低消費電力モードでの低い消費電流：2 $\mu$ A (標準値)
- $I_{OFF}$  保護により、パワー・ダウン状態 ( $V_{DD} = 0V$ ) での電流リークを防止
- POD\_12、SSTL\_12、SSTL\_15、SSTL\_18 信号をサポート
- ESD 性能
  - 3kV 人体モデル (A114B、Class II)
  - 1kV 荷電デバイス・モデル (C101)
- 8mmx3mm、48 ボール、0.65mm ピッチの ZBA パッケージ

## 2 アプリケーション

- NVDIMM モジュール
- エンタープライズ用データ・システムおよびサーバー
- ノート PC およびデスクトップ PC
- 汎用 DDR3/DDR4 信号スイッチング
- 汎用高速信号スイッチング

## 3 概要

TS3DDR4000 は 12 ビット幅バス・スイッチングが可能な 1:2 または 2:1 の高速 DDR2/DDR3/DDR4 スイッチです。A ポートの全ビットを同時に B または C ポートに切り換えることができます。TS3DDR4000 は DDR2、DDR3、DDR4 メモリ・バスのシステムで動作するように設計されており、独自のアーキテクチャにより広い帯域幅 (シングル・エンド -3dB 帯域幅 5.6GHz)、低周波数での小さな挿入損失、非常に短い伝播遅延を実現しています。

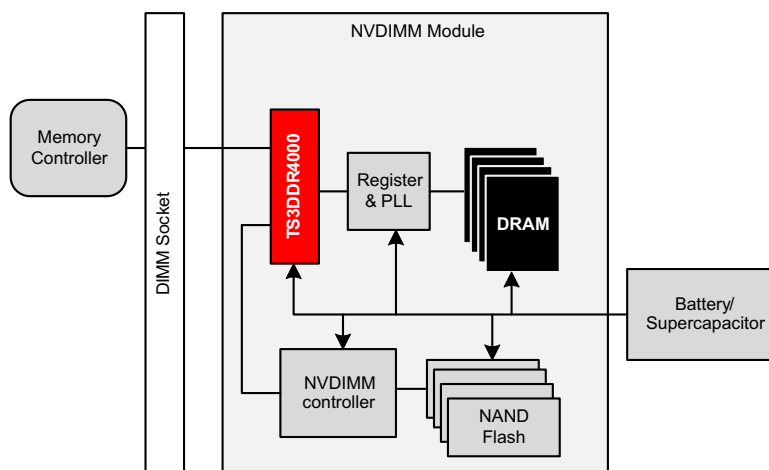
TS3DDR4000 は 1.8V ロジック互換で、すべてのスイッチが双方向であるため、設計を柔軟に行えます。また、TS3DDR4000 には低消費電力モードがあり、このモードではすべてのチャンネルが高インピーダンスとなってデバイスの消費電力が最小限に抑えられます。

### 製品情報<sup>(1)</sup>

型番	パッケージ	本体サイズ(公称)
TS3DDR4000	NFBGA (48)	8.00mmx3.00mm

(1) 利用可能なすべてのパッケージについては、このデータシートの末尾にある注文情報を参照してください。

### アプリケーション図



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## 4 改訂履歴

### Revision B (May 2017) から Revision C に変更

**Page**

•	Changed the <i>Pin Configuration</i> image .....	3
•	Changed $V_{IH}$ From: SEL1m and SEL2 To: SEL0 and SEL1 with a MIN value of 1 V in the <i>Recommended Operating Conditions</i> .....	4
•	Changed SEL1 To: SEL0 and SLE2 To: SEL1 in <a href="#">図 18</a> .....	11
•	Changed text "Standard layout technique for 0.5 mm pitch BGA package" To: "Standard layout technique for 0.65 mm pitch BGA package..." in the <i>Layout Guidelines</i> .....	15

### Revision A (March 2015) から Revision B に変更

**Page**

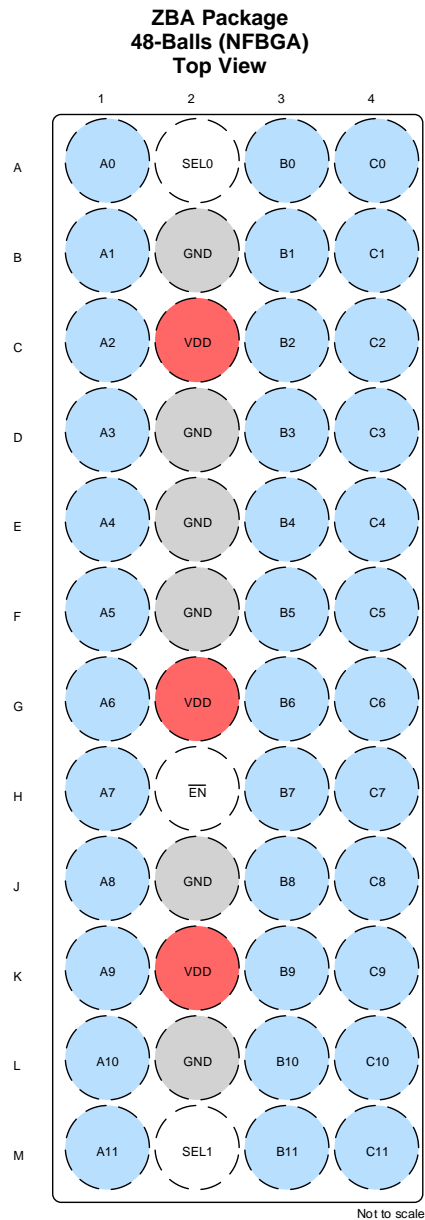
•	Changed $V_{DD}$ Max value From: 5.5 V to To: 4.8 V in the <i>Absolute Maximum Ratings</i> .....	4
•	Added the Note to the <i>Application and Implementation</i> section .....	13

### 2014年11月発行のものから更新

**Page**

•	ドキュメントをフルバージョンに更新 .....	1
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## 5 Pin Configuration and Functions



### Pin Functions

PINS		TYPE	DESCRIPTION
NAME	NO.		
VDD	C2, G2, K2	Power	Power supply
GND	B2, D2, E2, F2, J2, L2	Ground	Ground
A0-A11	A1-M1	I/O	Port A, signal 0-11
B0-B11	A3-M3	I/O	Port B, signal 0-11
C0-C11	A4-M4	I/O	Port C, signal 0-11
SEL0	A2	I	Select control 0
SEL1	M2	I	Select control 1
EN	H2	I	Enable

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) <sup>(1)</sup>

		MIN	MAX	UNIT
V <sub>DD</sub>	Voltage range on V <sub>DD</sub>	-0.3	4.8	V
V <sub>IN</sub>	Control input voltage range: SEL0, SEL1, and /EN	-0.3	5.5	V
V <sub>IO</sub>	Analog voltage range: A0-A11, B0-B11, and C0-C11	-0.3	3.6	V
T <sub>A</sub>	Operating ambient temperature range	-40	85	°C
T <sub>stg</sub>	Storage temperature range	-65	125	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

### 6.2 ESD Ratings

		VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Charge device model (CDM) <sup>(1)</sup>	±1000 V
		Human body model (HBM) on all pins <sup>(2)</sup>	±3000 V

(1) Tested in accordance with JEDEC Standard 22, Test Method C101

(2) Tested in accordance with JEDEC Standard 22, Test Method A114

### 6.3 Recommended Operating Conditions

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

		MIN	MAX	UNIT
V <sub>DD</sub>	Voltage range on V <sub>DD</sub>	2.375	3.6	V
V <sub>IO</sub>	Analog voltage range: A0-A11, B0-B11, and C0-C11	0	3.3	V
V <sub>IH</sub>	High-level control input voltage threshold ( $\overline{\text{EN}}$ )	1.4	V <sub>DD</sub>	V
	High-level control input voltage threshold (SEL0 and SEL1)	1	V <sub>DD</sub>	V
V <sub>IL</sub>	Low-level control input voltage threshold ( $\overline{\text{EN}}$ , SEL0 and SEL1)	0	0.5	V
T <sub>A</sub>	Operating ambient temperature range	-40	85	°C

### 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		TS3DDR4000	UNIT
		BGA (48)	
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	92.6	°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	33.4	
R <sub>θJB</sub>	Junction-to-board thermal resistance	56.2	
ψ <sub>JT</sub>	Junction-to-top characterization parameter	1.3	
ψ <sub>JB</sub>	Junction-to-board characterization parameter	54.9	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report .

## 6.5 Static Electrical Characteristics

Unless otherwise noted the specification applies over the  $V_{DD}$  range and operation junction temp of  $-40^{\circ}\text{C} \leq T_J \leq 85^{\circ}\text{C}$ . Typical values are for  $V_{DD} = 3.3\text{ V}$  and  $T_J = 25^{\circ}\text{C}$ .

PARAMETER		TEST CONDITION		MIN	TYP	MAX	UNIT
$R_{ON}$	On-state resistance	Port A to B	$V_{DD} = 2.375\text{ V}$ , $V_{I/O} = 1.2\text{ V}$ , $I_{I/O} = 10\text{ mA}$	–	8.3	11.2	$\Omega$
		Port A to C		–	8.3	11.2	$\Omega$
$R_{ON}$ (FLAT)	On-state resistance flatness for all I/Os	Port A to B	$V_{DD} = 2.375\text{ V}$ , $V_{I/O} = 1.2\text{ V}$ , $I_{I/O} = 10\text{ mA}$	–	0.6	–	$\Omega$
		Port A to C		–	0.6	–	$\Omega$
$\Delta R_{ON}$	On-state resistance match between channels	Port A to B	$V_{DD} = 2.375\text{ V}$ , $V_{I/O} = 1.2\text{ V}$ , $I_{I/O} = 10\text{ mA}$	–	0.2	1.0	$\Omega$
		Port A to C		–	0.2	1.0	$\Omega$
$I_{IH}$	Control input high leakage current	EN	$V_{DD} = 3.6\text{ V}$ , $V_{I/EN} = 1.4\text{ V}$	–	–	$\pm 1$	$\mu\text{A}$
			$V_{DD} = 2.375\text{ V}$ , $V_{I/EN} = 3.3\text{ V}$	–	–	$\pm 1$	$\mu\text{A}$
		SEL1	$V_{DD} = 3.6\text{ V}$ , $V_{SEL1} = 1.4\text{ V}$	–	–	$\pm 1$	$\mu\text{A}$
			$V_{DD} = 2.375\text{ V}$ , $V_{SEL1} = 3.3\text{ V}$	–	–	$\pm 1$	$\mu\text{A}$
		SEL2	$V_{DD} = 3.6\text{ V}$ , $V_{SEL2} = 1.4\text{ V}$	–	–	$\pm 1$	$\mu\text{A}$
			$V_{DD} = 2.375\text{ V}$ , $V_{SEL2} = 3.3\text{ V}$	–	–	$\pm 1$	$\mu\text{A}$
$I_{IL}$	Control input low leakage current	EN	$V_{DD} = 3.6\text{ V}$ , $V_{I/EN} = 0\text{ V}$	–	–	$\pm 0.5$	$\mu\text{A}$
		SEL1	$V_{DD} = 3.6\text{ V}$ , $V_{SEL1} = 0\text{ V}$	–	–	$\pm 0.5$	$\mu\text{A}$
		SEL2	$V_{DD} = 3.6\text{ V}$ , $V_{SEL2} = 0\text{ V}$	–	–	$\pm 0.5$	$\mu\text{A}$
$I_{OFF}$	Leakage under power off condition for all I/Os	EN	$V_{DD} = 0\text{ V}$ , $V_{I/EN} = 0\text{ V}$ , $V_{I/O} = 0\text{ V to } 3.3\text{ V}$	–	–	$\pm 5$	$\mu\text{A}$
			$V_{DD} = 0\text{ V}$ , $V_{I/EN} = 3.6\text{ V}$ , $V_{I/O} = 0\text{ V to } 3.3\text{ V}$	–	–	$\pm 5$	$\mu\text{A}$
		SEL1	$V_{DD} = 0\text{ V}$ , $V_{SEL1} = 0\text{ V}$ , $V_{I/O} = 0\text{ V to } 3.3\text{ V}$	–	–	$\pm 5$	$\mu\text{A}$
			$V_{DD} = 0\text{ V}$ , $V_{SEL1} = 3.6\text{ V}$ , $V_{I/O} = 0\text{ V to } 3.3\text{ V}$	–	–	$\pm 5$	$\mu\text{A}$
		SEL2	$V_{DD} = 0\text{ V}$ , $V_{SEL2} = 0\text{ V}$ , $V_{I/O} = 0\text{ V to } 3.3\text{ V}$	–	–	$\pm 5$	$\mu\text{A}$
			$V_{DD} = 0\text{ V}$ , $V_{SEL2} = 3.6\text{ V}$ , $V_{I/O} = 0\text{ V to } 3.3\text{ V}$	–	–	$\pm 5$	$\mu\text{A}$
$I_{DD}$	$V_{DD}$ supply current		$V_{DD} = 3.6\text{ V}$ , $I_{I/O} = 0\text{ A}$ , $I_{EN} = 0\text{ V}$ , $V_{SEL1} = V_{SEL2} = 0\text{ V}$	–	28	35	$\mu\text{A}$
			$V_{DD} = 3.6\text{ V}$ , $I_{I/O} = 0\text{ A}$ , $I_{EN} = 0\text{ V}$ , $V_{SEL1} = V_{SEL2} = 1.8\text{ V}$	–	40	48	$\mu\text{A}$
			$V_{DD} = 3.6\text{ V}$ , $I_{I/O} = 0\text{ A}$ , $I_{EN} = 0\text{ V}$ , $V_{SEL1} = 0\text{ V}$ , $V_{SEL2} = 1.8\text{ V}$	–	40	44	$\mu\text{A}$
			$V_{DD} = 3.6\text{ V}$ , $I_{I/O} = 0\text{ A}$ , $I_{EN} = 0\text{ V}$ , $V_{SEL1} = 1.8\text{ V}$ , $V_{SEL2} = 0\text{ V}$	–	40	44	$\mu\text{A}$
$I_{DD, PD}$	$V_{DD}$ supply current in power-down mode		$V_{DD} = 3.6\text{ V}$ , $I_{I/O} = 0\text{ A}$ , $I_{EN} = 1.8\text{ V}$	–	2	5	$\mu\text{A}$

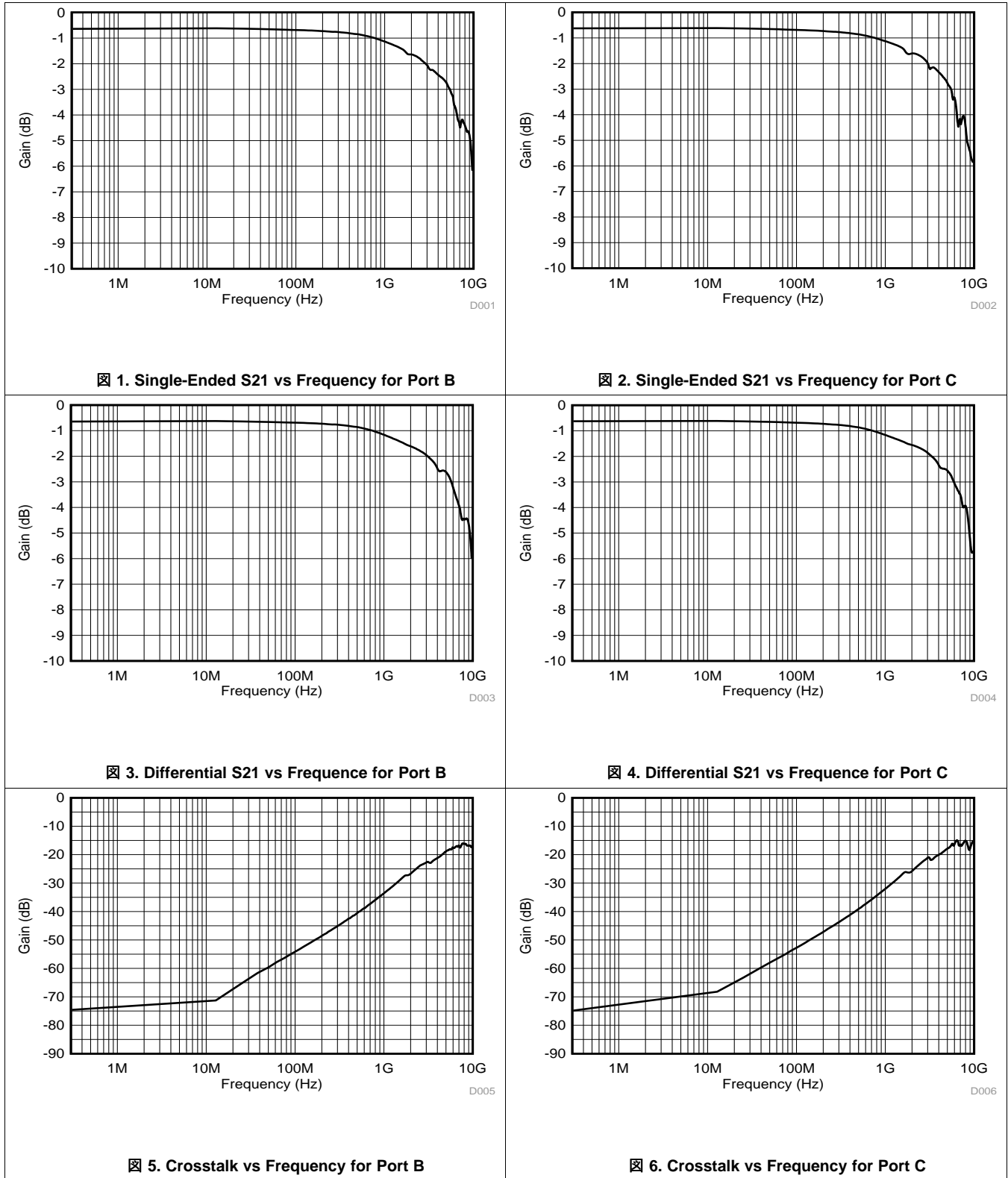
## 6.6 Dynamic Electrical Characteristics

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

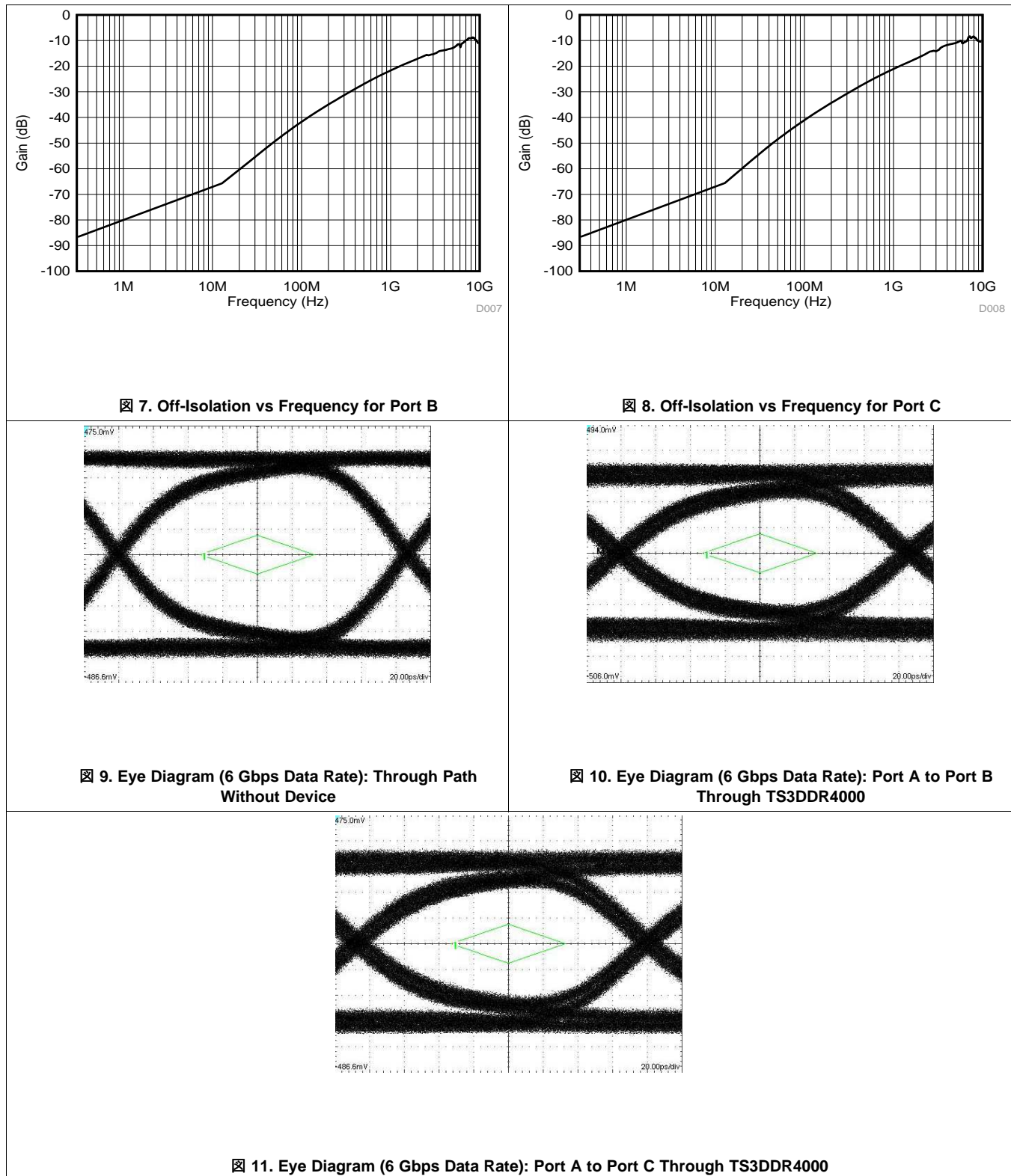
PARAMETER		TEST CONDITION		MIN	TYP	MAX	UNIT
$t_{ON}$	Switch turn-on time	EN to B	$V_{DD} = 2.375\text{ V}$ , $R_L = 50\ \Omega$ , $V_{An} = 3.3\text{ V}$ , $V_{/EN} = 1.8\text{ V} \rightarrow 0\text{ V}$ , $V_{SEL1} = V_{SEL2} = 0\text{ V}$ (See <a href="#">12</a> )	–	65	140	$\mu\text{s}$
		EN to C	$V_{DD} = 2.375\text{ V}$ , $R_L = 50\ \Omega$ , $V_{An} = 3.3\text{ V}$ , $V_{/EN} = 1.8\text{ V} \rightarrow 0\text{ V}$ , $V_{SEL1} = V_{SEL2} = 1.8\text{ V}$ (See <a href="#">12</a> )	–	65	140	$\mu\text{s}$
$t_{SWITCH}$	Switching time between channels for all I/Os	SEL to B	$V_{DD} = 2.375\text{ V}$ , $V_{/EN} = 0\text{ V}$ , $R_L = 50\ \Omega$ , $V_{An} = 3.3\text{ V}$ , (See <a href="#">13</a> )	–	65	–	ns
		SEL to C	$V_{DD} = 2.375\text{ V}$ , $V_{/EN} = 0\text{ V}$ , $R_L = 50\ \Omega$ , $V_{An} = 3.3\text{ V}$ , (See <a href="#">13</a> )	–	50	–	ns
$t_{PD}$	Propagation delay	Port A to B	$V_{DD} = 2.375\text{ V}$ , (See <a href="#">14</a> )	–	85	–	ps
		Port A to C	$V_{DD} = 2.375\text{ V}$ , (See <a href="#">14</a> )	–	85	–	ps
$t_{SKEW}^{(1)}$	Single-ended skew between channels	B0 to B11	$V_{DD} = 2.375\text{ V}$ , from any output to any other output	–	3	8	ps
		C0 to C11		–	3	6	ps
$C_{IN}$	Control input capacitance	EN	$f = 1\text{ MHz}$ , $V_{IN} = 0\text{ V}$	–	6	–	pF
		SEL1	$f = 1\text{ MHz}$ , $V_{IN} = 0\text{ V}$	–	6	–	pF
		SEL2	$f = 1\text{ MHz}$ , $V_{IN} = 0\text{ V}$	–	6	–	pF
$C_{OFF}$	Switch off capacitance	Port A to B	$f = 1067\text{ MHz}$ , $V_{/IO} = 0\text{ V}$ , $V_{SEL1} = V_{SEL2} = 1.8\text{ V}$	–	0.5	–	pF
		Port A to C	$f = 1067\text{ MHz}$ , $V_{/IO} = 0\text{ V}$ , $V_{SEL1} = V_{SEL2} = 0\text{ V}$	–	0.5	–	pF
$C_{ON}$	Switch on capacitance	Port A to B	$f = 1067\text{ MHz}$ , $V_{/IO} = 1.2\text{ V}$ , $V_{SEL1} = V_{SEL2} = 0\text{ V}$	–	1.0	–	pF
		Port A to C	$f = 1067\text{ MHz}$ , $V_{/IO} = 1.2\text{ V}$ , $V_{SEL1} = V_{SEL2} = 1.8\text{ V}$	–	1.0	–	pF
$X_{TALK}$	Crosstalk between channels	B0 to B11	$f = 1067\text{ MHz}$ , $V_{SEL1} = V_{SEL2} = 0\text{ V}$ , $R_L = 50\ \Omega$	–	-34	–	dB
		C0 to C11	$f = 1067\text{ MHz}$ , $V_{SEL1} = V_{SEL2} = 1.8\text{ V}$ , $R_L = 50\ \Omega$	–	-31	–	dB
$O_{ISO}$	Off-isolation	Port A to B	$f = 1067\text{ MHz}$ , $V_{SEL1} = V_{SEL2} = 1.8\text{ V}$ , $R_L = 50\ \Omega$	–	-21	–	dB
		Port A to C	$f = 1067\text{ MHz}$ , $V_{SEL1} = V_{SEL2} = 0\text{ V}$ , $R_L = 50\ \Omega$	–	-21	–	dB
$I_L$	Insertion loss (channel on)	Port A to B	$f = \text{DC}$ , $R_L = 50\ \Omega$	–	-0.75	-1	dB
		Port A to C	$f = \text{DC}$ , $R_L = 50\ \Omega$	–	-0.75	-1	dB
$BW_{SE}$	-3 dB bandwidth (Single-ended)	Port A to B	$R_L = 50\ \Omega$	–	5.6	–	GHz
		Port A to C		–	5.6	–	
$BW_{DIFF}$	-3 dB bandwidth (Differential)	Port A to B	$R_L = 100\ \Omega$	–	6	–	GHz
		Port A to C		–	6	–	

(1) Verified by design.

### 6.7 Typical Characteristics

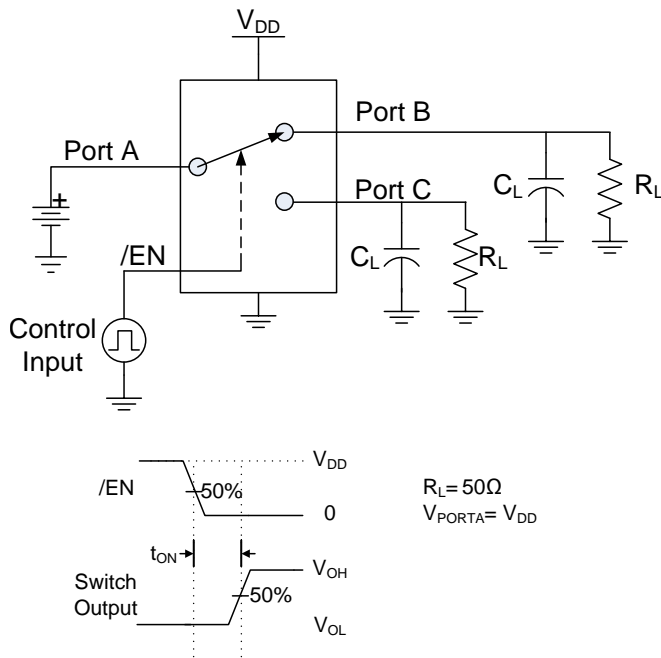


**Typical Characteristics (continued)**

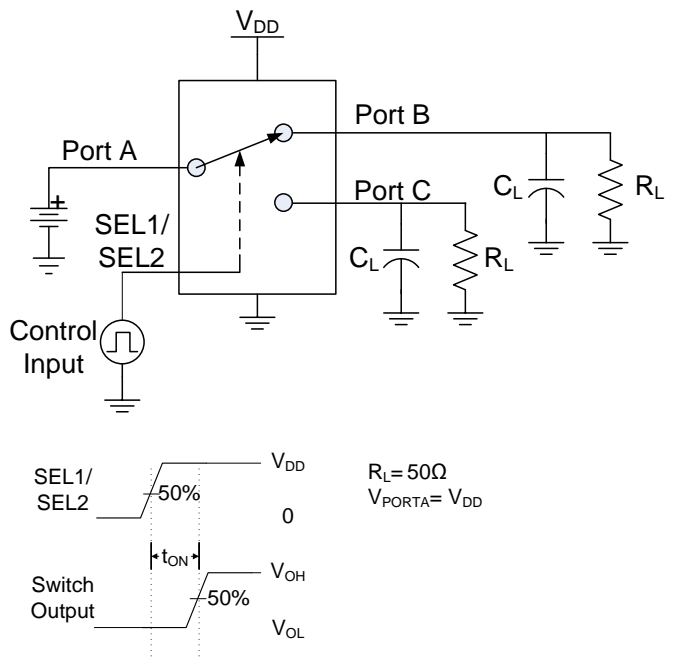




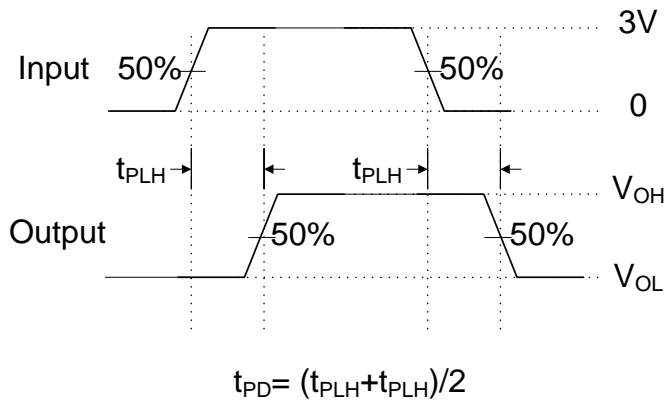
## 7 Parameter Measurement Information



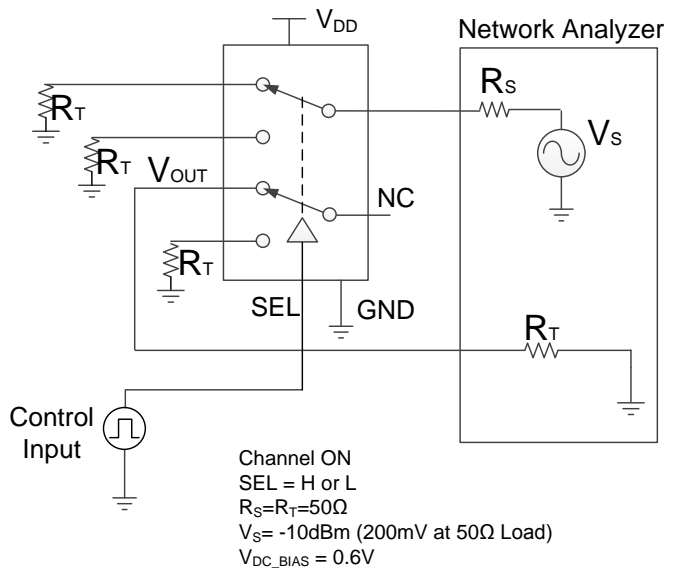
12. Switch Turn-on Time ( $t_{ON}$ ) Measurement



13. Switch Switching Time ( $t_{SWITCH}$ ) Measurement

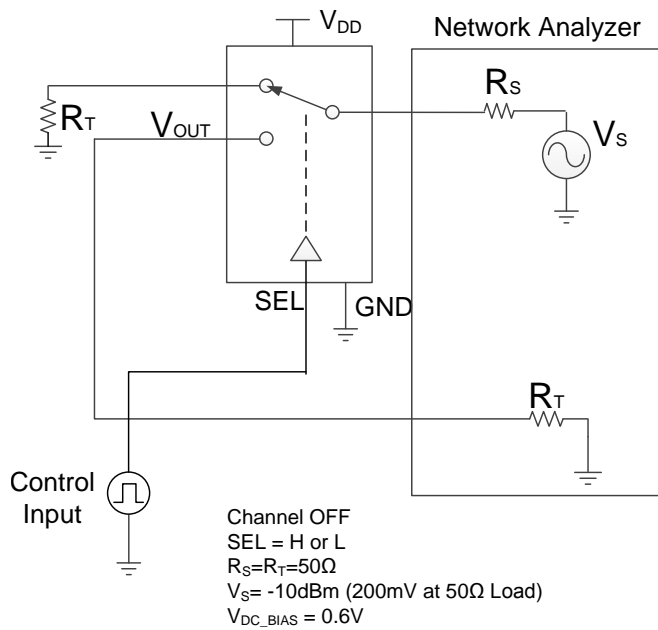


14. Propagation Delay ( $t_{PD}$ ) Measurement

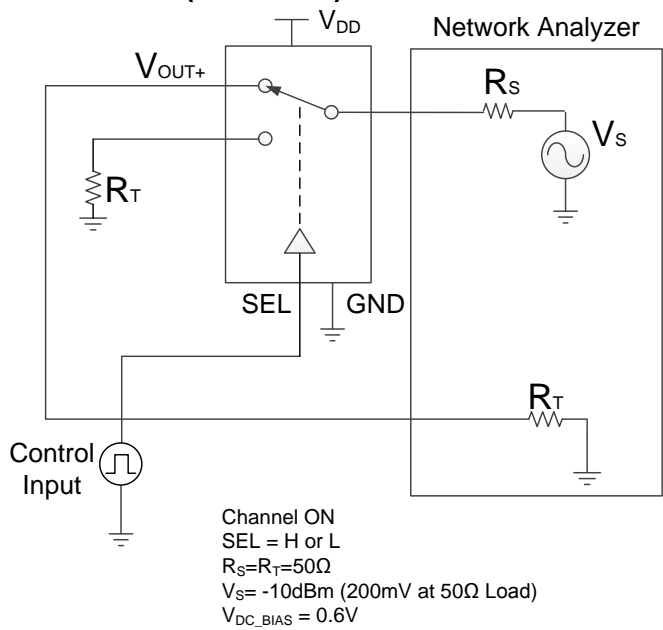


15. Crosstalk Measurement

**Parameter Measurement Information (continued)**



⊗ 16. Off Isolation Measurement



⊗ 17. Bandwidth Measurement

## 8 Detailed Description

### 8.1 Overview

The TS3DDR4000 is 1:2 or 2:1 high speed DDR2/DDR3/DDR4 switch that offers 12-bit wide bus switching. The A port can be routed to the B or C port for all bits simultaneously. Designed for operation in DDR2, DDR3 and DDR4 memory bus systems that support POD\_12, SSTL\_12, SSTL\_135, SSTL\_15, or SSTL\_18 signaling, the TS3DDR4000 uses a proprietary architecture that delivers high bandwidth (differential -3dB bandwidth of up to 6 GHz), and very low propagation delay and skew across all channels. The TS3DDR4000 is 1.8 V logic compatible, and all switches are bi-directional for added design flexibility. The TS3DDR4000 also offers a low-power mode, in which all channels become high-Z and the device operates with minimal power.

### 8.2 Functional Block Diagram

The following diagram (Figure 18) represents the switch function block diagram of the TS3DDR4000. Port A (A0-A11) can be routed to either port B (B0-B11) or port C (C0-C11) by configuring the SEL0 and SEL1 pins. The EN pin can be toggled high to put the device into the low-power mode with minimal power consumption.

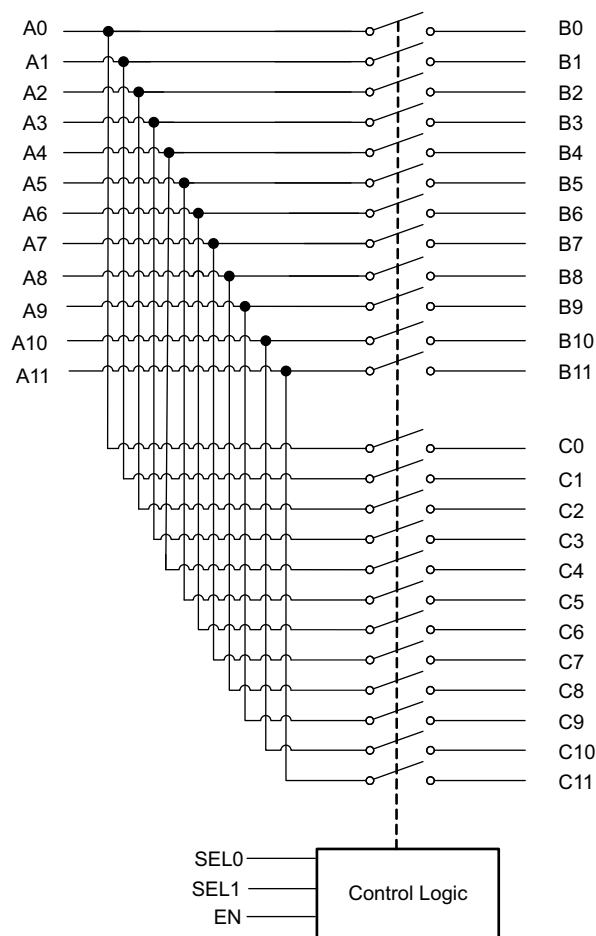


Figure 18. TS3DDR4000 Switch Function Block Diagram

### 8.3 Feature Description

- $I_{OFF}$  Protection: When no power is provided to the device ( $V_{CC} = 0\text{ V}$ ), the TS3DDR4000 prevents any I/O signals from back-powering the device. The leakage current is tightly controlled under such condition (refer to the  $I_{OFF}$  in the [Specifications](#) section) so it does not cause any system issues.
- Low-power mode: The  $\overline{EN}$  pin can be driven high to make the TS3DDR4000 enter the low-power mode. When in low power mode, all channels are isolated and the device consumes less than 5  $\mu\text{A}$  of current.

### 8.4 Device Functional Modes

When  $\overline{EN}$  pin is driven high, the TS3DDR4000 enters into the power-down mode, in which all channels are isolated and the device consumes less than 5  $\mu\text{A}$  of current. When EN pin is driven low, the A port is routed to either B port or C port depending on the configuration of SEL0 and SEL1 signals. The B and C port can also be partially turned on when SEL0 and SEL1 are not both high or both low. Refer to [表 1](#) for the control logic details.

**表 1. Logic Control Table**

CONTROL PINS			FUNCTION
$\overline{EN}$	SEL0	SEL1	
H	X	X	Power –down mode. All channels off (isolated)
L	L	L	Port A to port B ON Port A to port C OFF (isolated)
L	L	H	A [0,1,4,5,8,9] ↔ B [0,1,4,5,8,9] A [2,3,6,7,10,11] ↔ C [2,3,6,7,10,11] All other channels OFF (isolated)
L	H	L	A [2,3,6,7,10,11] ↔ B [2,3,6,7,10,11] A [0,1,4,5,8,9] ↔ C [0,1,4,5,8,9] All other channels OFF (isolated)
L	H	H	Port A to port B OFF (isolated) Port A to port C ON

## 9 Application and Implementation

### 注

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 9.1 Application Information

The TS3DDR4000 is a high-speed switch targeted for DDR memory applications that require 1:2 or 2:1 switching. The following sections describe two application scenarios that are widely used. In addition to memory applications, the TS3DDR4000 can also be used for generic high-speed switching that requires high bandwidth and minimal signal degradation.

### 9.2 Typical Application

#### 9.2.1 Non-Volatile Dual In-line Memory Module (NVDIMM) application

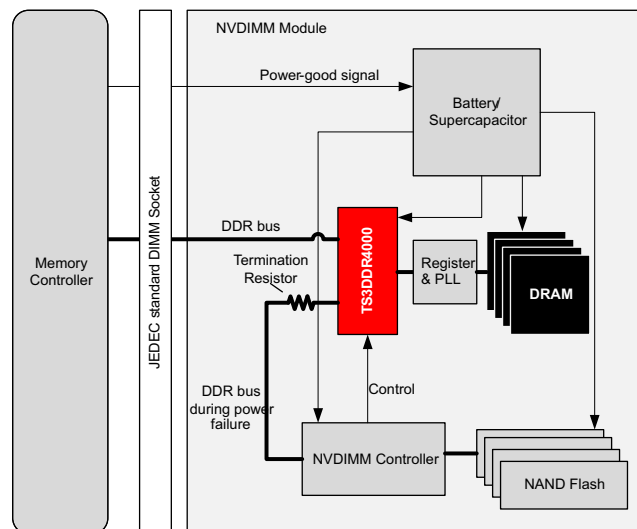


图 19. TS3DDR4000 Used In NVDIMM Application

##### 9.2.1.1 Design Requirements

The TS3DDR4000 can be used in the NVDIMM application to provide server systems reliable data backups when the system encounters power-failure conditions. 图 19 depicts a typical NVDIMM design utilizing the TS3DDR4000.

In normal system operation, the TS3DDR4000 routes the DDR signals between the system and the DRAM for normal data access. When the system encounters power failure, the charge stored in the battery or the super capacitor is used to power the NVDIMM controller, which configures the TS3DDR4000 to save the data from DRAM into the NAND Flash. The NAND Flash is non-volatile in nature, so the data stored internally stays intact even when the power goes away eventually. When the system power comes back on, the NVDIMM controller can re-route the data from the NAND Flash through the TS3DDR4000 back into the DRAM and can subsequently re-start the normal system operation.

## Typical Application (continued)

### 9.2.1.2 Detailed Design Procedure

The battery or the super capacitor needs to be designed to have enough capacity to maintain the power long enough for the backup procedure to be completed. At a backup speed of 128 MB/sec, it takes about 10 seconds per 1 GB to either backup or restore the data. Typically a super capacitor is preferred for its longer life of operation. The super capacitor is usually a separate module and is connected to the NVDIMM via a cable.

NVDIMMs require support from the system motherboard. When plugged in, the BIOS must recognize the NVDIMMs. Manufacturers who control the BIOS and MRC (memory reference code) can make the necessary code changes to implement NVDIMMs into their servers.

### 9.2.2 Load Isolation Application

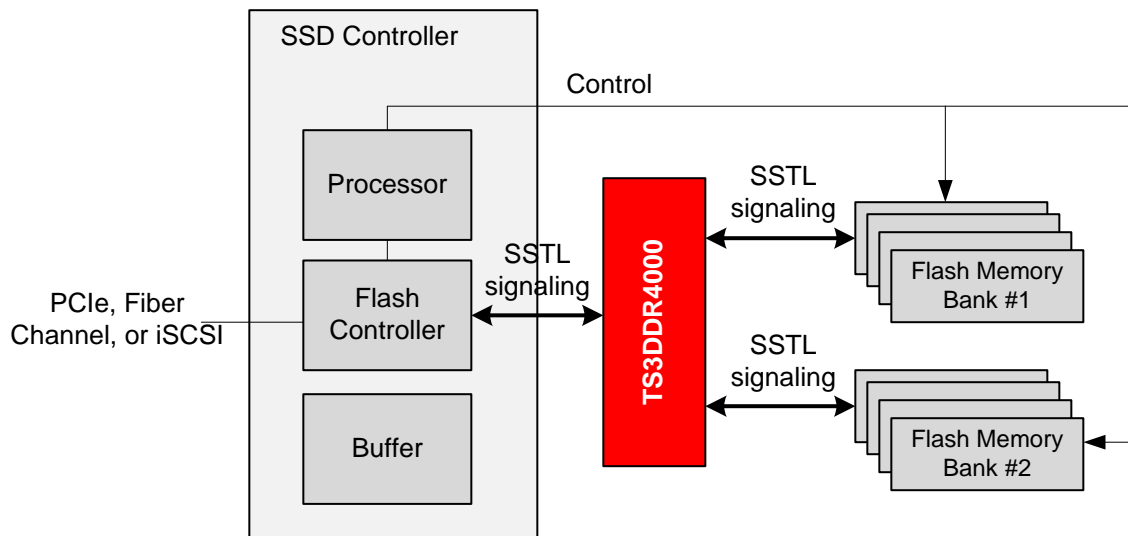


Figure 20. TS3DDR4000 Used In Load Isolation Application

#### 9.2.2.1 Design Requirements

In recent years, the size of Solid-State-Drives (SSDs) has increased rapidly, making it necessary to increase the number of flash memory devices in each drive. The flash memory devices sometimes share the same control and data channel to communicate with the controller. This causes increased loading to each communication channel as the number of flash memory devices increases. To meet the performance requirement of an SSD, the ability to isolate the loading becomes necessary.

#### 9.2.2.2 Detailed Design Procedure

As depicted in Figure 20, the TS3DDR4000 can be used for load isolation purpose. Flash memory bank #1 and #2 can share the same communication channel to the flash controller without increasing the loading to each other. While the TS3DDR4000 is enabled for one channel, the other channel is fully isolated. The off-isolation specification is about  $-21$  dB at 1067 MHz, as described in the [Specifications](#) section.

## 10 Power Supply Recommendations

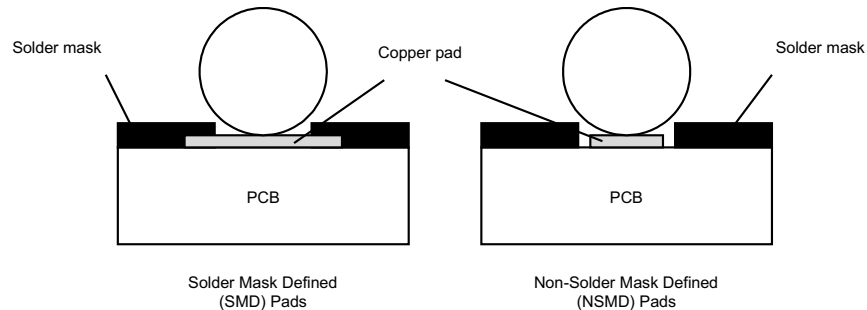
$V_{DD}$  should be in the range of 2.375 V to 3.6 V. A 0.1  $\mu$ F or higher decoupling capacitors placed as close to the BGA pad as possible is recommended. There are no power sequence requirements for the TS3DDR4000.

## 11 Layout

### 11.1 Layout Guidelines

Standard layout technique for 0.65 mm pitch BGA package shall be employed. The following commonly-used printed-circuit-board (PCB) layout guidelines are recommended:

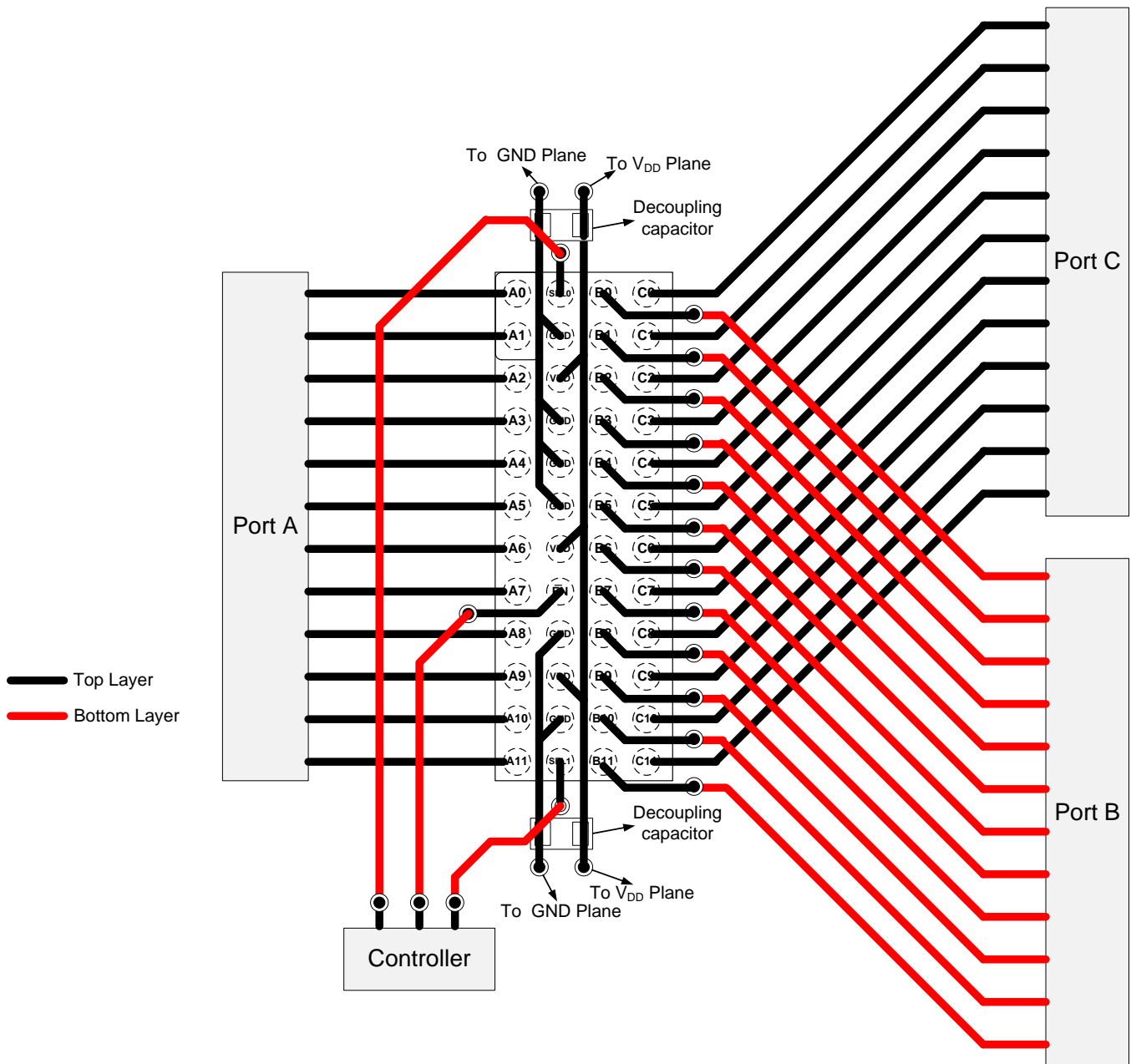
- Use Non-Solder-Mask-Defined (NSMD), rather than Solder-Mask-Defined (SMD) pads for the BGA solder balls to adhere if possible. For most applications, the NSMD pads provide more flexibility, fewer stress.



#### ☒ 21. Solder-Mask-Defined (SMD) and Non-Solder-Mask-Defined (NSMD) Pads

- One trace can generally be routed between two solder pads of a 0.65 mm pitch BGA. This allows the outer two rows of solder pads to be routed on the same top/bottom layer. The TS3DDR4000 has 4 rows, and thus no VIAs is generally required to route all the inner balls out.
- Generally high-speed signal layout guidelines:
  - To minimize the effects of crosstalk on adjacent traces, keep the traces at least two times the trace width apart.
  - Separate high-speed signals from low-speed signals and digital from analog signals.
  - Avoid right-angle bends in a trace and try to route them at least with two 45° corners.
  - The high-speed differential signal traces should be routed parallel to each other as much as possible. The traces are recommended to be symmetrical.
  - A solid ground plane should be placed next to the high-speed signal layer. This also provides an excellent low-inductance path for the return current flow.

## 11.2 Layout Example



22. TS3DDR4000 Layout Example



## 12 デバイスおよびドキュメントのサポート

### 12.1 ドキュメントの更新通知を受け取る方法

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### 12.2 コミュニティ・リソース

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](http://e2e.ti.com), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

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### 12.5 Glossary

**SLYZ022** — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 13 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。

**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
TS3DDR4000ZBAR	ACTIVE	NFBGA	ZBA	48	3000	RoHS & Green	SNAGCU	Level-3-260C-168 HR	-40 to 85	DDR4000	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.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

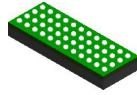
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TS3DDR4000ZBAR	NFBGA	ZBA	48	3000	330.0	16.4	3.4	8.4	1.3	8.0	16.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TS3DDR4000ZBAR	NFBGA	ZBA	48	3000	336.6	336.6	31.8

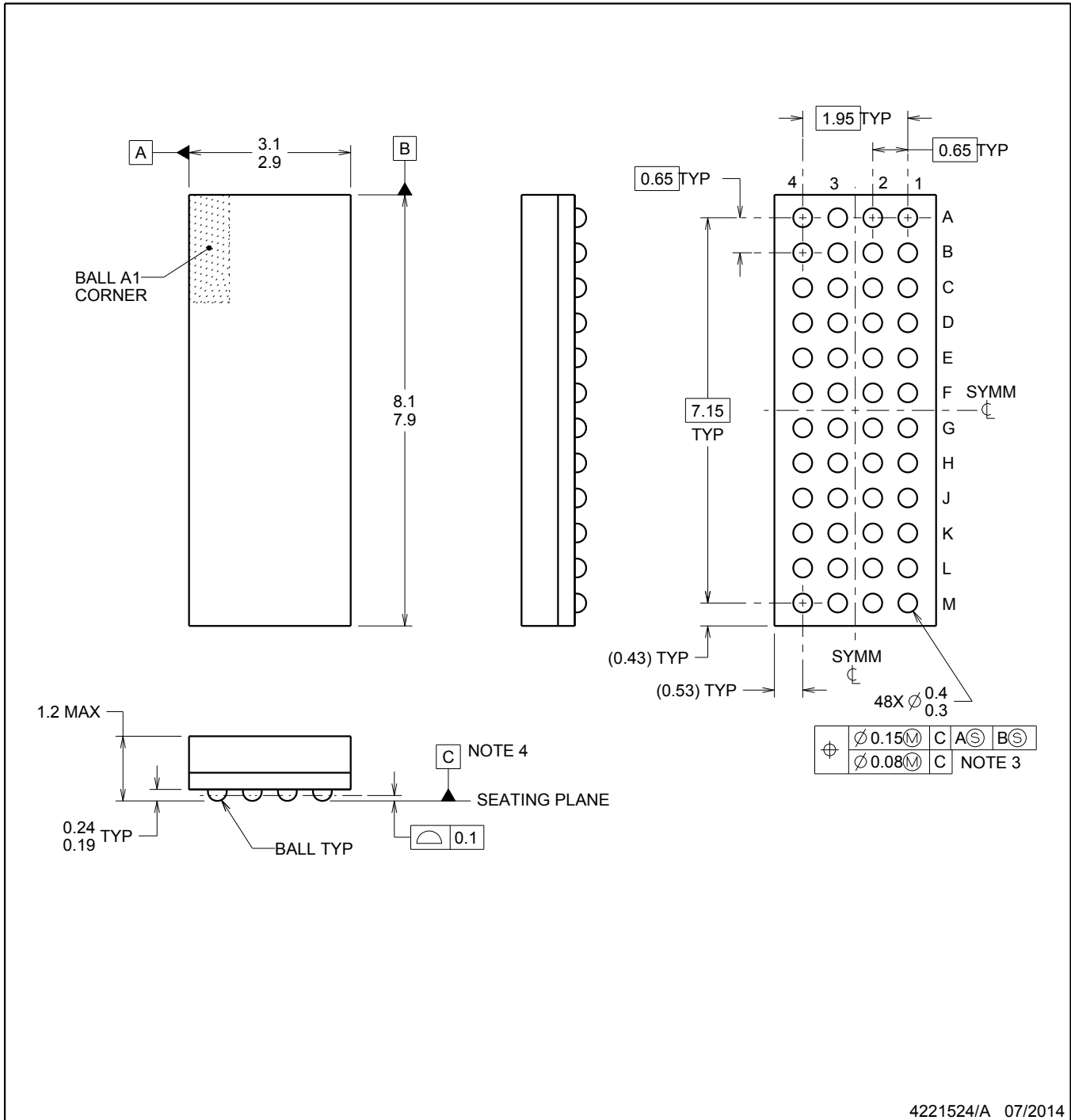
# ZBA0048A



# PACKAGE OUTLINE

## NFBGA - 1.2 mm max height

BALL GRID ARRAY



4221524/A 07/2014

### NOTES:

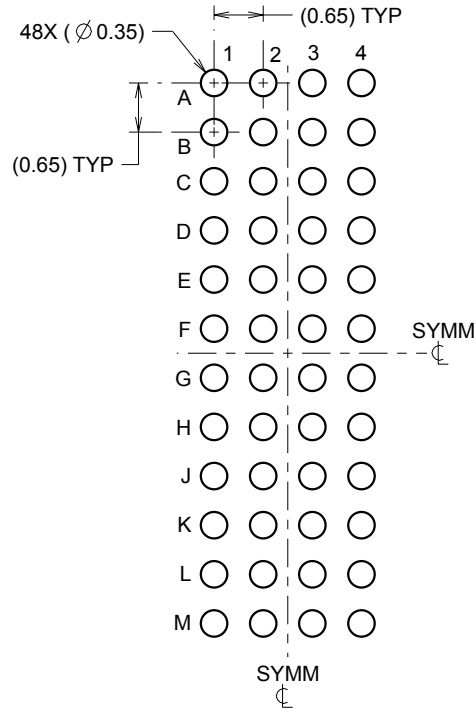
- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- Dimension is measured at the maximum solder ball diameter, parallel to primary datum C.
- Primary datum C and seating plane are defined by the spherical crowns of the solder balls.

# EXAMPLE BOARD LAYOUT

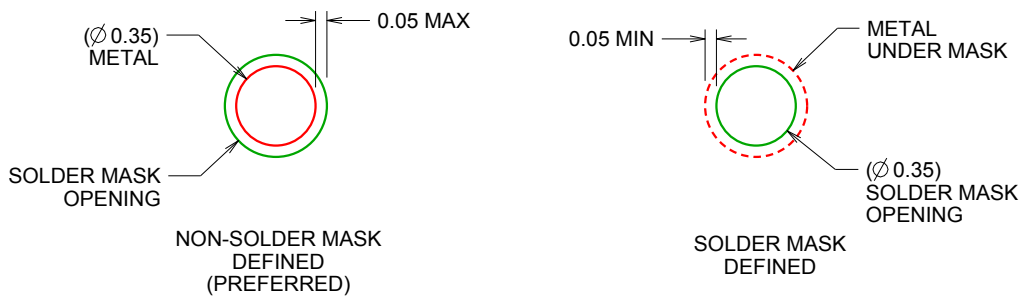
ZBA0048A

NFBGA - 1.2 mm max height

BALL GRID ARRAY



LAND PATTERN EXAMPLE  
SCALE:10X



SOLDER MASK DETAILS  
NOT TO SCALE

4221524/A 07/2014

NOTES: (continued)

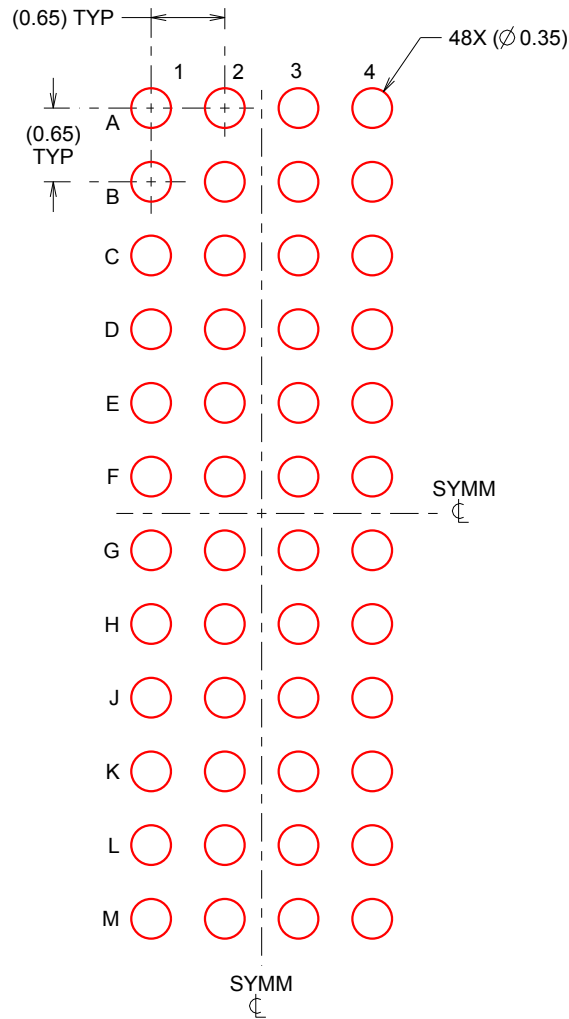
- Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments Literature number SPRAA99 ([www.ti.com/lit/spraa99](http://www.ti.com/lit/spraa99)).

# EXAMPLE STENCIL DESIGN

ZBA0048A

NFBGA - 1.2 mm max height

BALL GRID ARRAY



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:15X

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NOTES: (continued)

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

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