

> HK4R SERIES ENTERPRISE SATA SSD

Designed for read-intensive workloads, the enterprise HK4R SATA SSD series offers excellent performance, high reliability and low power consumption with high quality of service, especially for enterprise and file server use.

The HK4R family supports 6.0 Gbit/s interface and is available in large capacities up to 1.92TB. All 7.0mm height models are equipped with enterprise-grade features such as Power Loss Protection.

SSD



> KEY FEATURES

- Capacity up to 1.92TB
- 1 DWPD
- SATA 6.0 Gbit/s Interface
- Low Operation Power
- Power Loss Protection
- End to End data protection
- Hot-Plug/OS-Aware Hot Removal

> APPLICATIONS

- Web Servers
- File Server
- Media Streaming
- VOD
- Search Engine
- Warm Data Storage

> SPECIFICATIONS

Standard Models	2.5-inch (7.0mmH)
Connector Type	Standard SATA
Memory	TOSHIBA MLC NAND Flash Memory
Interface ¹⁾	ACS-3, SATA revision 3.2 1.5/3/6 Gbit/s
Capacity ¹⁾	120/240/480/960/1920 GB
Performance ^{1) 2) 3)}	Sequential Read: 524 MB/s{500 MiB/s} Sequential Write: 503 MB/s{480 MiB/s} Random Read: 75,000 IOPS Random Write: 14,000 IOPS
Supply Voltage	5.0 V ±5 %
Power Consumption	Active: 4.5 W typ. Idle: 1.2 W typ.
Temperature	Operating: 0 °C - 55 °C Non-operating: -40 °C - 70 °C
Shock	Operating / Non-operating: 9,800 m/s ² {1000 G} at 0.5 ms
Vibration	Operating: 21 m/s ² {2.17 Grms} at 100-800 Hz Non-operating: 159 m/s ² {16.3 Grms} at 20-2,000 Hz
Reliability	Mean Time to Failure (MTTF): 2,000,000 hours Product Life: Approximately 5 years
Size	100.45 mm(Length) x 69.85 mm(Width) x 7.0 mm(Height)
Weight	60 g Max
More Features	28-bit LBA mode commands and 48-bit LBA mode commands support Automatic retries and corrections for read errors NCQ (Native Command Queuing) function supported
Compliance	UL, cUL(CSA), TÜV, KC, FCC, BSMI, CE, RCM, ISED, VCCI

Refer to the notes on the next page.

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

- 1) Definition of capacity: Toshiba defines a megabyte (MB) as 1,000,000 bytes, a gigabyte (GB) as 1,000,000,000 bytes and a terabyte (TB) as 1,000,000,000,000 bytes. A computer operating system, however, reports storage capacity using powers of 2 for the definition of $1\text{GB} = 2^{30} = 1,073,741,824$ bytes and therefore shows less storage capacity. Available storage capacity (including examples of various media files) will vary based on file size, formatting, settings, software and operating system, such as Microsoft Operating System and/or pre-installed software applications, or media content. Actual formatted capacity may vary.
- 2) A kibibyte (KiB) means 2^{10} , or 1,024 bytes, a mebibyte (MiB) means 2^{20} , or 1,048,576 bytes, and a gibibyte (GiB) means 2^{30} , or 1,073,741,824 bytes.
- 3) Performances are measured when the SSD is on a steady state.

* MTTF (Mean Time to Failure) is not a guarantee or estimate of product life; it is a statistical value related to mean failure rates for a large number of products which may not accurately reflect actual operation. Actual operating life of the product may be different from the MTTF.

* DWPD: Drive Write Per Day. One full drive write per day means the drive can be written and re-written to full capacity once a day every day for five years, the stated product warranty period. Actual results may vary due to system configuration, usage and other factors.

* Read and write speed may vary depending on the host device, read and write conditions, and file size.

* IOPS: Input Output Per Second (or the number of I/O operations per second)

* PLP (Power Loss Protection): PLP supports to record data in buffer memory to NAND flash memory, utilizing back up power of solid capacitor in case of sudden supply shut down.

> ORDERING INFORMATION

<u>THN</u>	<u>SN</u>	<u>8</u>	<u>xxxx</u>	<u>C</u>	<u>S</u>	<u>E</u>
1	2	3	4	5	6	7

1. Model Name THN: Toshiba NAND drive
2. Model Type SN: SED not supported
3. Controller Type 8: Type 8
4. Capacity 120P/240P/480P/960P/1Q92: 120GB/240GB/480GB/960GB/1920GB with PLP
(1 GB = 1,000,000,000 bytes)
5. Form Factor C: 2.5-inch case (7.0 mm height)
6. Host I/F Type S: Standard SATA
7. NAND Type E: MLC

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

> PRODUCT LINE UP

Model Number	Formatted Capacity	PLP ¹⁾	SED ²⁾	Form Factor
THNSN8120PCSE	120 GB	Supported	Not supported	2.5-inch 7.0 mm case
THNSN8240PCSE	240 GB	Supported	Not supported	
THNSN8480PCSE	480 GB	Supported	Not supported	
THNSN8960PCSE	960 GB	Supported	Not supported	
THNSN81Q92CSE	1920 GB	Supported	Not supported	

1) PLP: Power Loss Protection

2) SED: Self Encrypting Drive based on TCG Enterprise SSC

> CAPACITY

Capacity	Total Number of User Addressable Sectors in LBA Mode	
	512 bytes sector	
120 GB	234,441,647	
240 GB	468,862,127	
480 GB	937,703,087	
960 GB	1,875,385,008	
1920 GB	3,750,748,848	

Note: 1 GB (Gigabyte) = 1,000,000,000 bytes

> PERFORMANCE

	THNSN81Q92CSE	THNSN8960PCSE	THNSN8480PCSE	THNSN8240PCSE	THNSN8120PCSE
Interface Speed	6 Gbit/s Max				
Sequential Read 64KiB, QD=32	524 MB/s {500 MiB/s}				
Sequential Write 64KiB, QD=32	503 MB/s {480 MiB/s}		283 MB/s {270 MiB/s}		126 MB/s {120 MiB/s}
Random Read 4KiB, QD=32	75,000 IOPS				
Random Write 4KiB, QD=32	14,000 IOPS		12,000 IOPS	10,000 IOPS	4,000 IOPS

Note: Performances are measured when the SSD is on a typical steady state.

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

> SUPPLY VOLTAGE

	2.5-inch Case(7.0 mmH)
Allowable voltage	5.0 V \pm 5 %
Allowable noise/ripple	250 mV p-p or less

Note: This drive has over current protection circuit. (Rated current: 3.15A)

> POWER CONSUMPTION

Operation (Ta ¹)=25°C)	2.5-inch Case(7.0 mmH)
Active	4.5 W typ.
Idle	1.2 W typ.

1) Ambient Temperature

ENVIRONMENTAL CONDITIONS

> TEMPERATURE

Condition	Range	Gradient
Operating (Ta) ¹	0 °C – 55 °C	20 °C/h Max
Non-operating (Ta) ¹	-40 °C – 70 °C	20 °C/h Max
Under Shipment (Ta) ^{1 2)}	-40 °C – 70 °C	20 °C/h Max

1) Ta: Ambient Temperature, Tc: Case or Components Temperature

2) Packaged in Toshiba's original shipping package

> HUMIDITY

Condition	Range
Operating	5 % – 95 % R.H. (No condensation)
Non-operating	5 % – 95 % R.H. (No condensation)
Under Shipment ¹⁾	5 % – 95 % R.H.

1) Packaged in Toshiba's original shipping package

> SHOCK

Condition	Range
Operating	9,800 m/s ² {1000 G} / 0.5 ms duration
Non-operating	
Under Shipment ¹⁾	

1) Apply shocks in each direction of the drive's three mutually perpendicular axes, one axis at a time. Packaged in Toshiba's original shipping package.

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

> VIBRATION

Condition	Range
Operating	21 m/s ² {2.17 Grms} (100 to 800 Hz)
Non-Operating	159 m/s ² {16.3 Grms} (20 to 2000 Hz)
Under Shipment	

COMPLIANCE

> SAFETY / EMI STANDARDS

Title	Description	Region
UL (Underwriters Laboratories)	UL 60950-1	USA
cUL(CSA) (Underwriters Laboratories of Canada (Canadian Standard Association))	CSA-C22.2 No.60950-1	Canada
TÜV (Technischer Überwachungs Verein)	EN 60950-1	Germany
KC	KN22, KN24	Korea
FCC	FCC part 15 Subpart B Class B	USA
BSMI (Bureau of Standards, Metrology and Inspection)	CNS13438(CISPR Pub. 22) Class B	Taiwan
CE	EN 55022, EN 55024	Europe
RCM	AS/NZS CISPR Pub. 22 Class B	Australia, New Zealand
ISED	ICES-003	Canada
VCCI	Class B	Japan

> RELIABILITY

Parameter	Value
Mean Time to Failure	2,000,000 hours
Product Life	Approximately 5 years

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

MECHANICAL SPECIFICATIONS

> 2.5-inch

Model	Weight	Width	Height	Length
THNSN8120PCSE	60 g Max	69.85 mm +/- 0.25 mm	7.0 mm + 0.2, -0.5 mm	100.45 mm Max
THNSN8240PCSE				
THNSN8480PCSE				
THNSN8960PCSE				
THNSN81Q92CSE				

The enclosure of this device complies with SFF-8201.

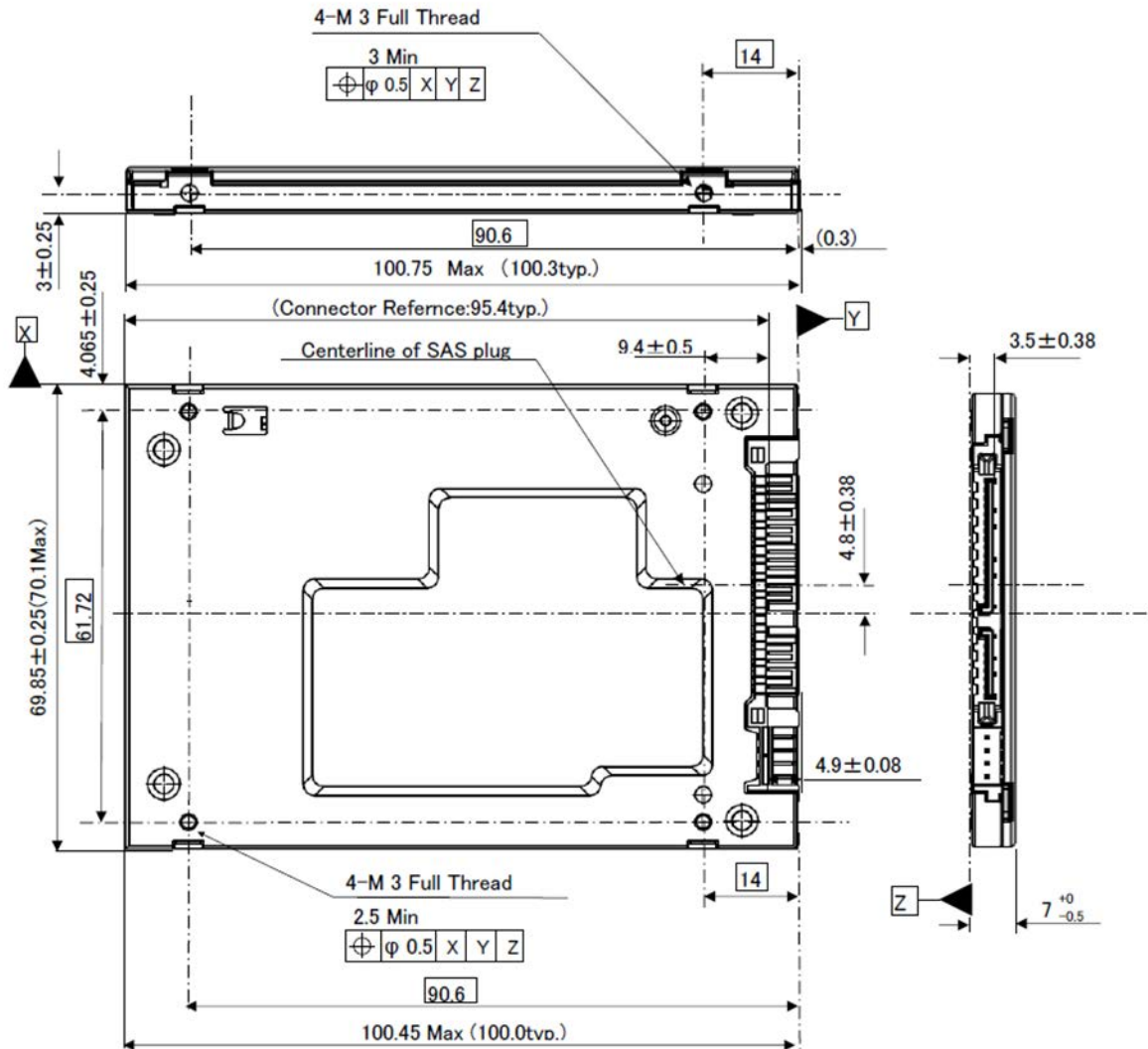


Figure 1: 2.5-inch Drive Dimension

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

INTERFACE CONNECTOR

> **2.5-inch SATA Interface Connector**

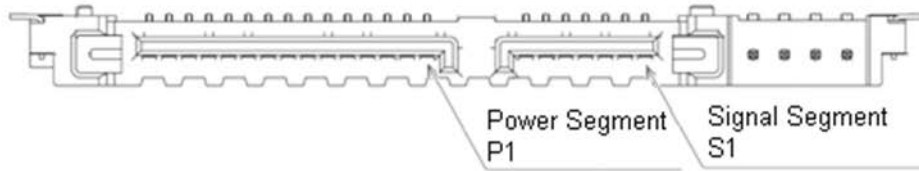


Figure 2: 2.5-inch SATA Interface connector

> **2.5-INCH DRIVE CONNECTER PIN ASSIGNMENT**

Segment	Pin Position	Name	Signal Description
Signal Segment	S1	GND	Ground
	S2	A+	Differential Pair A
	S3	A-	
	S4	GND	Ground
	S5	B-	Differential Pair B
	S6	B+	
	S7	GND	Ground
Signal segment "L"			
Central connector polarizer			
Power segment "L"			
Power Segment	P1	V33	3.3V power (Unused) ^{1) 2)}
	P2	V33	3.3V Power (Unused) ^{1) 2)}
	P3	V33	3.3V power pre-charge (Unused) ¹⁾
	P4	GND	Ground
	P5	GND	Ground
	P6	GND	Ground
	P7	V5	5 V power, pre-charge
	P8	V5	5 V power
	P9	V5	5 V power
	P10	GND	Ground
	P11	DAS/DSS	Drive Active Signal / Disable Staggered Spin-up ³⁾
	P12	GND	Ground
	P13	V12	12 V power, pre-charge (Unused)
	P14	V12	12 V power (Unused)
	P15	V12	12 V power (Unused)
Power segment key			

- 1) This drive uses 5V power. 12V and 3.3V power are not used. DE and DC ground (ground pins on interface) are connected electrically each other.
- 2) P1 and P2 are connected together.
- 3) DSS is not supported

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

> COMMAND TABLE

ATA Command Set

Op-Code		Command Name
00h		NOP
06h		DATA SET MANAGEMENT
10h		RECALIBRATE
20h		READ SECTOR(S)
21h		READ SECTOR(S) WITHOUT RETRY
24h		READ SECTOR(S) EXT
25h		READ DMA EXT
27h		READ NATIVE MAX ADDRESS EXT
29h		READ MULTIPLE EXT
2Fh		READ LOG EXT
30h		WRITE SECTOR(S)
31h		WRITE SECTOR(S) WITHOUT RETRY
34h		WRITE SECTOR(S) EXT
35h		WRITE DMA EXT
37h		SET MAX ADDRESS EXT
39h		WRITE MULTIPLE EXT
3Dh		WRITE DMA FUA EXT
3Fh		WRITE LOG EXT
40h		READ VERIFY SECTOR(S)
41h		READ VERIFY SECTOR(S) WITHOUT RETRY
42h		READ VERIFY SECTOR(S) EXT
45h		WRITE UNCORRECTABLE EXT
45h	55h	Create a pseudo-uncorrectable error with logging
45h	AAh	Create a flagged error without logging
47h		READ LOG DMA EXT
57h		WRITE LOG DMA EXT
60h		READ FPDMA QUEUED
61h		WRITE FPDMA QUEUED
70h		SEEK
90h		EXECUTE DEVICE DIAGNOSTIC
91h		INITIALIZE DEVICE PARAMETERS

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

Op-Code		Command Name
92h		DOWNLOAD MICROCODE
92h	03h	Download with offsets and save microcode for immediate and future use.
92h	07h	Download and save microcode for immediate and future use.
92h	0Eh	Download with offsets and save microcode for future use.
92h	0Fh	Activate downloaded microcode.
93h		DOWNLOAD MICROCODE DMA
93h	03h	Download with offsets and save microcode for immediate and future use.
93h	07h	Download and save microcode for immediate and future use.
93h	0Eh	Download with offsets and save microcode for future use.
93h	0Fh	Activate downloaded microcode
B0h		SMART
B0h	D0h	SMART READ DATA
B0h	D1h	SMART READ ATTRIBUTE THRESHOLDS
B0h	D2h	SMART ENABLE/DISABLE ATTRIBUTE AUTOSAVE
B0h	D3h	SMART SAVE ATTRIBUTE VALUES
B0h	D4h	SMART EXECUTE OFF-LINE IMMEDIATE
B0h	D5h	SMART READ LOG
B0h	D6h	SMART WRITE LOG
B0h	D8h	SMART ENABLE OPERATIONS
B0h	D9h	SMART DISABLE OPERATIONS
B0h	DAh	SMART RETURN STATUS
B0h	DBh	SMART ENABLE/DISABLE AUTOMATIC OFF-LINE
B1h		DEVICE CONFIGURATION OVERLAY
B1h	C0h	DEVICE CONFIGURATION RESTORE
B1h	C1h	DEVICE CONFIGURATION FREEZE LOCK
B1h	C2h	DEVICE CONFIGURATION IDENTIFY
B1h	C3h	DEVICE CONFIGURATION SET
B1h	C4h	DEVICE CONFIGURATION IDENTIFY DMA
B1h	C5h	DEVICE CONFIGURATION SET DMA
B4h		SANITIZE DEVICE
B4h	00h	SANITIZE STATUS EXT
B4h	12h	BLOCK ERASE EXT
B4h	20h	SANITIZE FREEZE LOCK EXT
C4h		READ MULTIPLE
C5h		WRITE MULTIPLE
C6h		SET MULTIPLE MODE
C8h		READ DMA
C9h		READ DMA WITHOUT RETRY

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

Op-Code		Command Name
CAh		WRITE DMA
CBh		WRITE DMA WITHOUT RETRY
CEh		WRITE MULTIPLE FUA EXT
E0h		STANDBY IMMEDIATE
E1h		IDLE IMMEDIATE
E2h		STANDBY
E3h		IDLE
E4h		READ BUFFER
E5h		CHECK POWER MODE
E6h		SLEEP
E7h		FLUSH CACHE
E8h		WRITE BUFFER
E9h		READ BUFFER DMA
EAh		FLUSH CACHE EXT
EBh		WRITE BUFFER DMA
ECh		IDENTIFY DEVICE
EFh		SET FEATURES
EFh	02h	Enable volatile write cache
EFh	03h	Set transfer mode
EFh	05h	Enable APM feature set
EFh	10h	Enable Serial ATA feature set
EFh	10h	02h Enable DMA Setup FIS Auto-Activate optimization
EFh	10h	03h Enable Device-initiated interface power state (DIPM) transitions
EFh	10h	06h Enable Software Settings Preservation(SSP)
EFh	10h	07h Enable Device Automatic Partial to Slumber transitions
EFh	10h	09h Enable Device Sleep
EFh	55h	Disable read look-ahead
EFh	66h	Disable reverting to power-on defaults
EFh	82h	Disable volatile write cache
EFh	85h	Disable APM feature set
EFh	90h	Disable Serial ATA feature set
EFh	90h	02h Disable DMA Setup FIS Auto-Activate optimization
EFh	90h	03h Disable Device-initiated interface power state (DIPM) transitions
EFh	90h	06h Disable Software Settings Preservation(SSP)
EFh	90h	07h Disable Device Automatic Partial to Slumber transitions
EFh	90h	09h Disable Device Sleep
EFh	AAh	Enable read look-ahead
EFh	CCh	Enable reverting to power-on defaults

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

Op-Code		Command Name
F1h		SECURITY SET PASSWORD
F2h		SECURITY UNLOCK
F3h		SECURITY ERASE PREPARE
F4h		SECURITY ERASE UNIT
F5h		SECURITY FREEZE LOCK
F6h		SECURITY DISABLE PASSWORD
F8h		READ NATIVE MAX ADDRESS
F9h		SET MAX ADDRESS
F9h	01h	SET MAX SET PASSWORD
F9h	02h	SET MAX LOCK
F9h	03h	SET MAX UNLOCK
F9h	04h	SET MAX FREEZE LOCK
F9h	05h	SET MAX SET PASSWORD DMA
F9h	06h	SET MAX UNLOCK DMA

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.

> RESTRICTIONS ON PRODUCT USE

- Toshiba Corporation, and its subsidiaries and affiliates (collectively "TOSHIBA"), reserve the right to make changes to the information in this document, and related hardware, software and systems (collectively "Product") without notice.
- This document and any information herein may not be reproduced without prior written permission from TOSHIBA. Even with TOSHIBA's written permission, reproduction is permissible only if reproduction is without alteration/omission.
- Though TOSHIBA works continually to improve Product's quality and reliability, Product can malfunction or fail. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of Product could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Before customers use the Product, create designs including the Product, or incorporate the Product into their own applications, customers must also refer to and comply with (a) the latest versions of all relevant TOSHIBA information, including without limitation, this document, the specifications, the data sheets and application notes for Product and the precautions and conditions set forth in the "TOSHIBA Semiconductor Reliability Handbook" and (b) the instructions for the application with which the Product will be used with or for. Customers are solely responsible for all aspects of their own product design or applications, including but not limited to (a) determining the appropriateness of the use of this Product in such design or applications; (b) evaluating and determining the applicability of any information contained in this document, or in charts, diagrams, programs, algorithms, sample application circuits, or any other referenced documents; and (c) validating all operating parameters for such designs and applications. **TOSHIBA ASSUMES NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS.**
- **PRODUCT IS NEITHER INTENDED NOR WARRANTED FOR USE IN EQUIPMENTS OR SYSTEMS THAT REQUIRE EXTRAORDINARILY HIGH LEVELS OF QUALITY AND/OR RELIABILITY, AND/OR A MALFUNCTION OR FAILURE OF WHICH MAY CAUSE LOSS OF HUMAN LIFE, BODILY INJURY, SERIOUS PROPERTY DAMAGE AND/OR SERIOUS PUBLIC IMPACT ("UNINTENDED USE").** Except for specific applications as expressly stated in this document, Unintended Use includes, without limitation, equipment used in nuclear facilities, equipment used in the aerospace industry, medical equipment, equipment used for automobiles, trains, ships and other transportation, traffic signaling equipment, equipment used to control combustions or explosions, safety devices, elevators and escalators, devices related to electric power, and equipment used in finance-related fields. **IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT.** For details, please contact your TOSHIBA sales representative.
- Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy Product, whether in whole or in part.
- Product shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.
- The information contained herein is presented only as guidance for Product use. No responsibility is assumed by TOSHIBA for any infringement of patents or any other intellectual property rights of third parties that may result from the use of Product. No license to any intellectual property right is granted by this document, whether express or implied, by estoppel or otherwise.
- **ABSENT A WRITTEN SIGNED AGREEMENT, EXCEPT AS PROVIDED IN THE RELEVANT TERMS AND CONDITIONS OF SALE FOR PRODUCT, AND TO THE MAXIMUM EXTENT ALLOWABLE BY LAW, TOSHIBA (1) ASSUMES NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (2) DISCLAIMS ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO SALE, USE OF PRODUCT, OR INFORMATION, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.**
- Do not use or otherwise make available Product or related software or technology for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). Product and related software and technology may be controlled under the applicable export laws and regulations including, without limitation, the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of Product or related software or technology are strictly prohibited except in compliance with all applicable export laws and regulations.
- Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. Please use Product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. **TOSHIBA ASSUMES NO LIABILITY FOR DAMAGES OR LOSSES OCCURRING AS A RESULT OF NONCOMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS.**

Products and specifications discussed herein are for reference purposes only and are subject to change without notice. All information discussed herein is provided on an "as is" basis, without warranties of any kind. Before creating and producing designs and using, customers must refer to and comply with the latest versions of the product specifications.