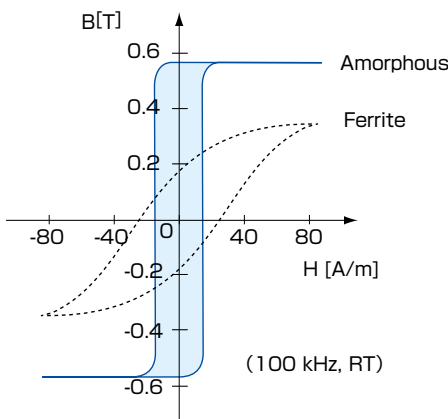
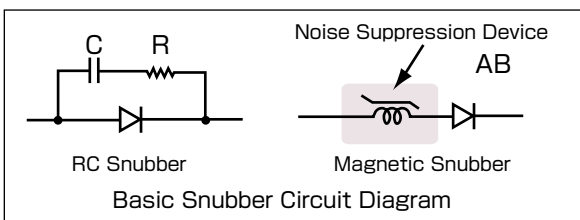


1. Noise Suppression Devices AMOBEADS™

An amorphous noise suppression device is unique and completely different from conventional noise filters. Conventional noise prevention products focus on somehow minimizing the noise after it's been created, by typically trying to absorb the noise, and so their effectiveness in noise reduction is directly influenced by frequency of the circuit. Amorphous noise suppressing devices, on the other hand, focus on the source of the electronic circuit noise is the rapid change of current or voltage, and the effectiveness of the amorphous cores in eliminating this noise is independent of frequency.

An amorphous noise suppression device is a product that takes full advantage of the unique magnetic characteristics of the cobalt based amorphous alloy. Toshiba Materials offers two noise suppression devices, "AMOBEADS™" and "SPIKE KILLERS™". AMOBEADS™ deliver excellent noise suppression results and are convenient to use by simply being slipped over the leads of the semiconductor device. "AMOBEADS™" are also available with a lead thru and in a surface mount configuration. "SPIKE KILLERS™", which are larger in size than "AMOBEADS™", most often are wire wound and are effective in eliminating or minimizing higher noise levels.

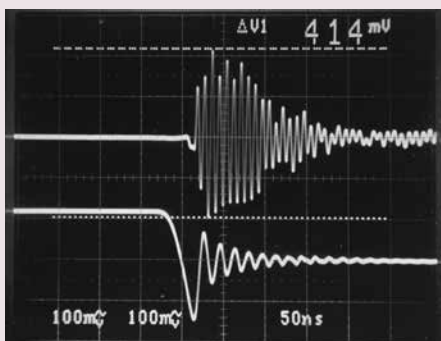


B-H Curve (typical)

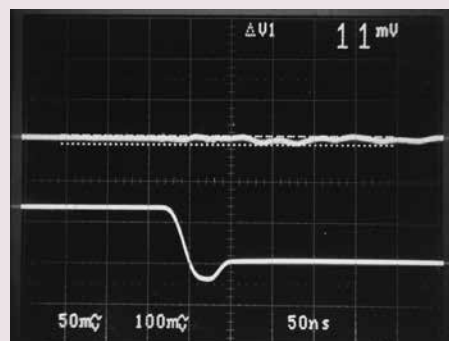


Example for Noise Suppressing Effect (Chopper Converter)

With an excellent saturable characteristic, "AMOBEADS™" suppress the reverse recovery current of the diode and decrease the noise that is occurring. When the current for diode reverses and tries to go into the recovery condition, the "AMOBEADS™" displays a large inductance and oppose the generation of the recovery current. In this instance, a soft recovery is possible for core material with a smaller coercive force.



Without Countermeasure



With AMOBEADS™
(AB4×2×8W)

Standard Specifications

AMOBEBADS™

W series

| Type No. | Finished Dimensions [mm] | | | Core Size [mm]*1 | | | Total Flux*2 $\phi c[\mu Wb]$ min | AL value*3 L[μH] min | Insulating Cover | Packing Unit |
|------------|--------------------------|-----------|----------|------------------|-------|------|--------------------------------------|--------------------------------|------------------|--------------------|
| | O.D. max | I. D. min | H.T. max | O.D. | I. D. | H.T. | | | | |
| AB3X2X3W | 4.0 | 1.5 | 4.5 | 3.0 | 2.0 | 3.0 | 0.9 | 3.0 | PBT case Blue | 2,000 [pcs/box] |
| AB3X2X4.5W | 4.0 | 1.5 | 6.0 | 3.0 | 2.0 | 4.5 | 1.3 | 5.0 | | |
| AB4X2X4.5W | 5.0 | 1.5 | 6.0 | 4.0 | 2.0 | 4.5 | 2.7 | 9.0 | | |
| AB4X2X6W | 5.0 | 1.5 | 7.5 | 4.0 | 2.0 | 6.0 | 3.6 | 12.0 | | |
| AB4X2X8W | 5.0 | 1.5 | 9.5 | 4.0 | 2.0 | 8.0 | 4.8 | 16.0 | | |

DY series (low price) (Recommend for big demand, 10,000pcs/lot)

| Type No. | Finished Dimensions [mm] | | Total Flux*7 $\phi c[\mu Wb]$ | Insulating Cover | Packing Unit [pcs/bag] |
|-------------|--------------------------|---------|----------------------------------|------------------|---------------------------|
| | O.D. | H.T. | | | |
| AB2.8X4.5DY | 4.0±0.2 | 5.7±0.3 | 0.9min | PBT Black | 10,000 |
| AB3X2X3DY | 4.0±0.2 | 4.2±0.3 | 0.9min | PBT Black | 10,000 |
| AB3X2X4.5DY | 4.0±0.2 | 5.7±0.3 | 1.3min | PBT Gray | 10,000 |
| AB4X2X6DY | 5.0+0.2/-0.3 | 7.2±0.3 | 3.6min | PBT Black | 5,000 |
| AB5X4X3DY | 5.95±0.2 | 4.2±0.3 | 0.45min | PBT Black | 5,000 |



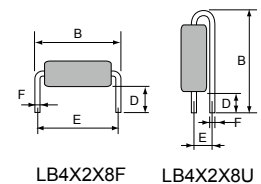
W series DY series

※Inner diameter can pass through a 1.2X0.7mm lead.
However, inner diameter of AB5x4x3DY can pass through a 2.5x0.7 mm lead.

AMOBEBADS™ with lead

Bulk type

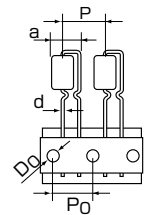
| Type No. | Finished Dimensions [mm] | | | | Current [A] | Total flux $\phi c[\mu Wb]$ | AL Value L[μH] | Insulating Cover | Packing Unit |
|----------|--------------------------|---------|----------|--------------------|----------------|--------------------------------|--------------------------|-------------------|--------------------|
| | B | D | E | F | | | | | |
| LB4X2X8F | 16.0max | 4.2±0.5 | 14.0±1.0 | $\phi 1.25\pm 0.1$ | (8.0) | 4.8 min | 16.0 min | PBT case Black | 1,000 [pcs/box] |
| LB4X2X8U | 20.0max | 4.0±0.5 | 5.0±1.0 | $\phi 1.25\pm 0.1$ | | | | | |



LB4X2X8F LB4X2X8U

Radial taping

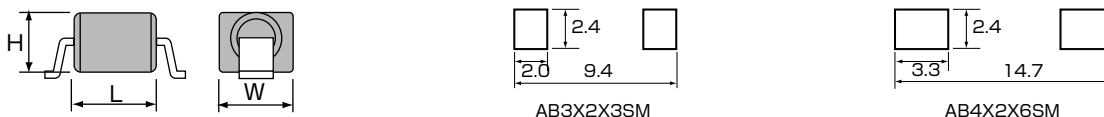
| Type No. | P [mm] | Po [mm] | Do [mm] | a [mm] | d [mm] | Current*4 I [A] | Total Flux*7 $\phi c[\mu Wb]$ | Packing Unit |
|------------|--------|---------|------------|--------|------------|--------------------|----------------------------------|--------------------|
| LB2.8X4.5U | 12.7 | 12.7 | $\phi 4.0$ | 9.0max | $\phi 0.8$ | (5) | 0.9min | 3,000 [pcs/box] |



SMD Type AMOBEBADS™

| Type No. | Finished Dimensions [mm] | | | Lead width x thickness | I _o *4 [A] | Total Flux*2 $\phi c[\mu Wb]$ | AL value*3 L[μH] | Insulating Cover | Packing Unit [pcs/reel] |
|-----------|--------------------------|---------|---------|------------------------|--------------------------|----------------------------------|----------------------------|------------------|----------------------------|
| | width | length | height | | | | | | |
| AB3X2X3SM | 5.0±0.3 | 5.0±0.3 | 4.0±0.3 | (1.8x0.35) | (6.0) | 0.9 min | 3.0 | LCP case | 2,000 |
| AB4X2X6SM | 6.0±0.3 | 8.0±0.3 | 5.0±0.3 | (1.8x0.52) | (9.0) | 3.6 min | 12.0 | Black | 1,000 |

Recommended Land Pattern (mm)

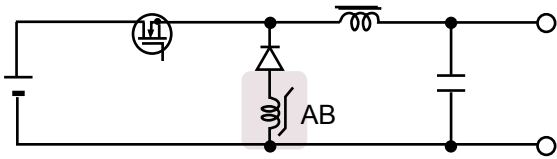


- *1 Reference Value *2 Minimum Guarantee on Measuring Condition : 50kHz, 80A/m(sine wave), R.T.
- *3 Measuring Condition:50kHz, 1V, 1 turn, R.T.
- *4 Typical Value, using a cross section of lead
- *5 Measuring Condition:100kHz, 80A/m(sine wave), R.T. *6 Tolerance ±0.2 [mm]
- *7 Converted from Inductance Value L₁ at 1kHz, 100mA(sine wave), R.T.
 $\phi c[\mu Wb]=0.282 \times L_1[\mu H]$

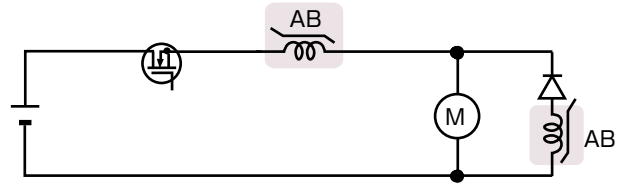
☆"AMOBEBADS™" sample kits are available. Please ask sales department.
☆"AMOBEBADS™" and "SPIKE KILLER™" : Registered trademarks of TOSHIBA MATERIALS Co., Ltd.
☆"AMOBEBADS™" and "SPIKE KILLER™" : Registered in U.S.A., France, Germany, U.K., Japan.

Examples of Applied Circuits and their Characteristics

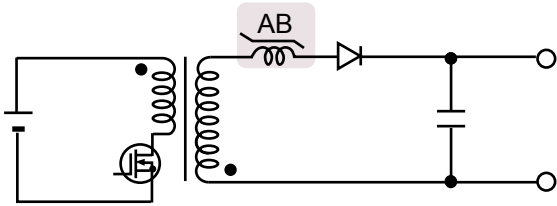
Application of Amorphous Noise Suppression Devices



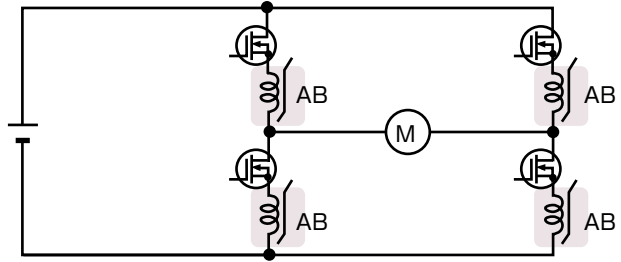
Chopper Converter



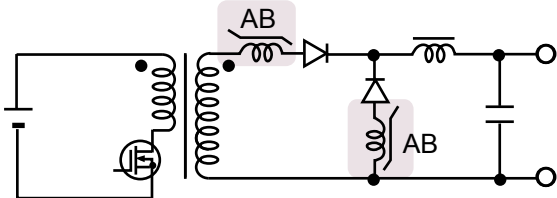
Control Circuit for Motor



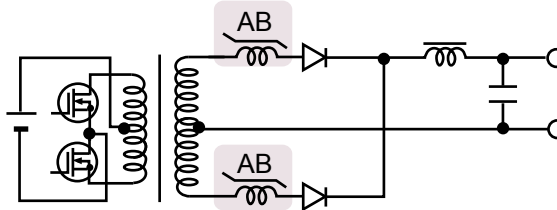
Flyback Converter



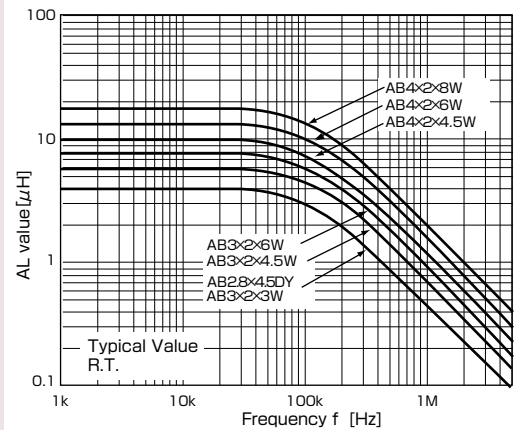
Motor Driving Circuit



Forward Converter

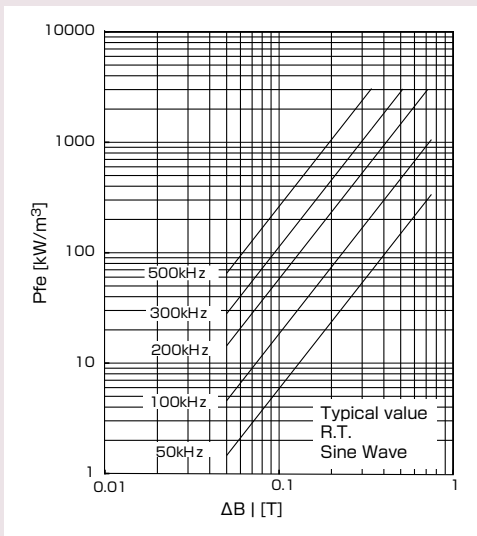


Push-pull Converter

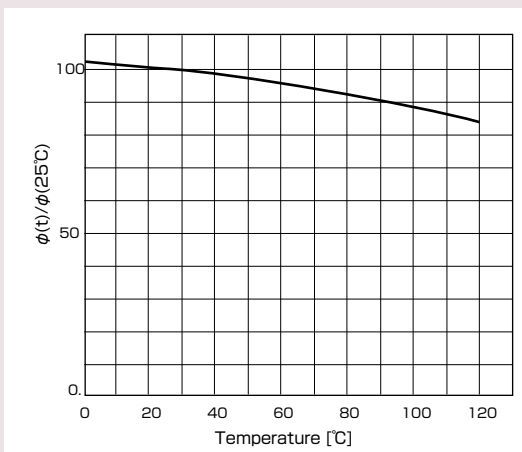


Frequency Characteristics of Inductance

Characteristics (Typical value)

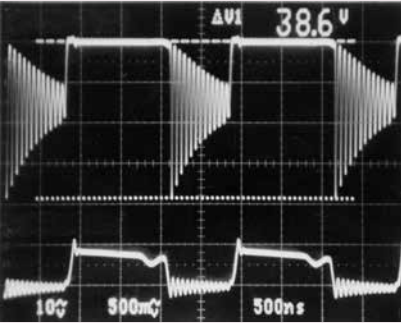
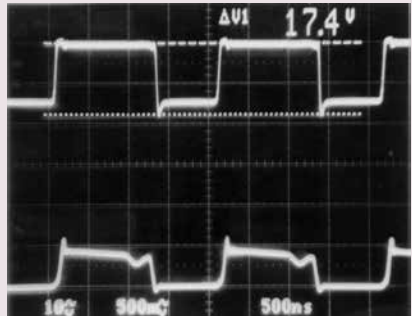

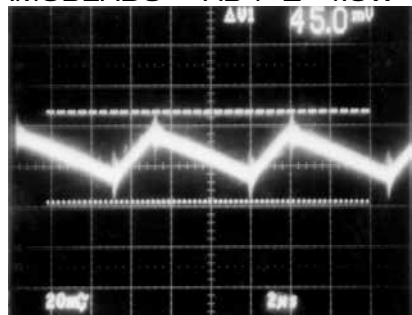
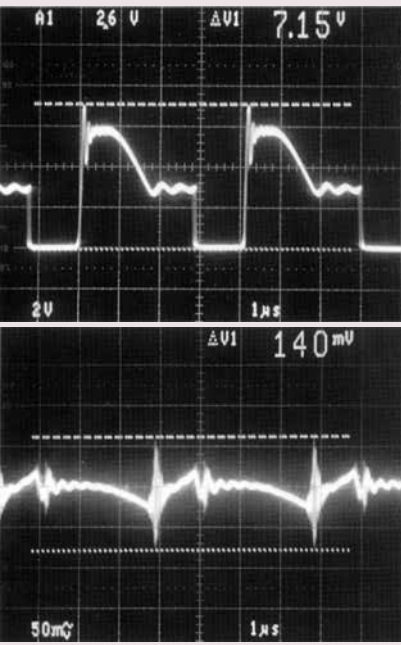
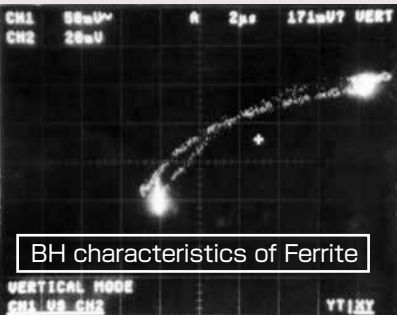
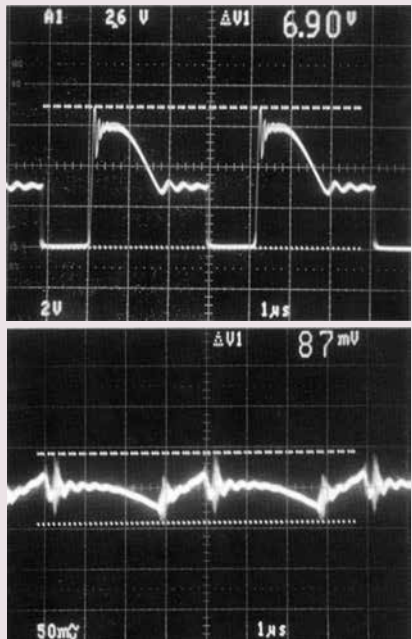
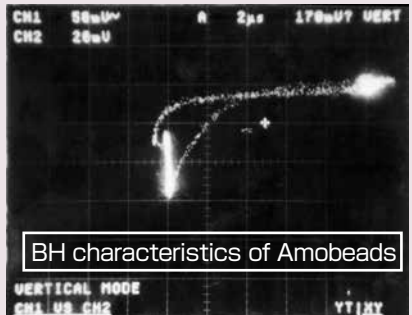


Coreloss Characteristic [AMOBEDS™]



Flux(ϕ) Decline Ratio vs. Temperature

Effects of Noise Suppression by AMOBEADS™

| | | |
|---|---|---|
| <p>Spike Voltage Suppression</p> <p>Spike voltage can be reduced and ringing phenomena can also be prevented by AMOBEADS. Also Schottky barrier diode (SBD) can be protected from over voltage.</p> <p>Frequency:500kHz Output Voltage - Current :5V-20A</p> | <p>Without Countermeasure</p>  <p>Diode Voltage V_d 10V/div</p> <p>Diode Current I_d 5A/div</p> | <p>AMOBEADS™ "AB4×2×4.5W"</p>  |
| <p>Output Noise Reduction</p> <p>When the ferrite is replaced by AMOBEADS at the secondary output diode (FRD) of the forward converter circuit, the output noise can be tremendously reduced, not only the noise peak level but also the amplitude range.</p> <p>Frequency:150kHz Output Voltage - Current :15V-10A</p> | <p>RC Snubber +Ferrite Beads</p>  <p>Output Noise V_n 20mV/div</p> | <p>AMOBEADS™ "AB4×2×4.5W"</p>  |
| <p>Primary Surge Voltage</p> <p>When the ferrite is replaced by AMOBEADS at the secondary output diode (SBD) of the forward converter circuit, the output noise and harmful influence to the primary stage can be reduced. These effects are based on the inclination of the actual BH curves between amorphous and ferrite materials.</p> <p>Frequency:250kHz Output Voltage - Current :5V-15A</p> <p>Output Noise</p> <p>Actual BH Curve</p> | <p>Ferrite Beads 4×2×4</p>  <p>MOS-FET Drain-Source Voltage V_{ds} 200V/div</p> <p>Output Noise V_n 50mV/div</p>  <p>BH characteristics of Ferrite</p> | <p>AMOBEADS™ "AB4×2×4.5W"</p>  <p>MOS-FET Drain-Source Voltage V_{ds} 200V/div</p> <p>Output Noise V_n 50mV/div</p>  <p>BH characteristics of Amobeads</p> |

RESTRICTIONS ON PRODUCT USE

Toshiba Corporation and its subsidiaries and affiliates are collectively referred to as "TOSHIBA".
Hardware, software and systems described in this document are collectively referred to as "Product".

- 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 may be subject to characteristic changes, damage, or malfunction due to changes in the environment, such as temperature or atmosphere. 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 characteristic change, damage and malfunction of Product could cause loss of human life, bodily injury or damage to property. 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, and the data sheets 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, 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, lifesaving and/or life supporting 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, and devices related to power plant. IF YOU USE PRODUCT FOR UNINTENDED USE, TOSHIBA ASSUMES NO LIABILITY FOR PRODUCT. For details, please contact your TOSHIBA sales representative or contact us via our website.
- Do not disassemble, 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 (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.
- Some of Product have Pb, Sb2O3 (lead, antimony trioxide). The powders and vapors in these Products are harmful to the human body. Please prevent exposure to these Products when destroying, processing, or chemically treating them.
- 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.

TOSHIBA MATERIALS CO., LTD. **Overseas Sales & Marketing Department**

1-1, Shibaura 1-Chome, Minato-ku, Tokyo 105-8001, Japan

Tel: +81-3-3457-4874 Fax: +81-3-5444-9235

<http://www.toshiba-tmat.co.jp/tmat/eng/>

■ **Toshiba America Electronic Components, Inc.** <Advanced Materials Division>

290 Donald Lynch Boulevard, Suite 201, Marlborough, MA 01752, U.S.A.

Tel: +1-508-303-5041

Fax: +1-508-481-8890

■ **Toshiba Electronics Asia (Hong Kong), Ltd.**

Level 11, Tower 2, Grand Century Place, No.193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong

Tel: +852-2375-6111

Fax: +852-2375-0969

■ **Toshiba Electronics Asia (Singapore) Pte. Ltd.**

20 Pasir Panjang Road, #13-27/28 Mapletree Business City, Singapore 117439

Tel: +65-6278-5252

Fax: +65-6271-5155

■ **Toshiba Electronics (China) Co., Ltd.**

5th Floor, Wheelock Square 1717 West Nanjing Road, Jingan District, Shanghai, China 200040

Shenzhen Office

28/F, Excellence Times Square Building, 4068 Yi Tian Road, Fu Tian District, Shenzhen, China 518048

TEL: +86-755-2399-6897

FAX: +86-755-2399-5573