Programmable Logic Controller

Solution Proposal by Toshiba
Toshiba Electronic Devices & Storage Corporation provides comprehensive device solutions to customers developing new products by applying its thorough understanding of the systems acquired through the analysis of basic product designs.
Block Diagram
Programmable Logic Controller – Digital input module section detail

Digital Input Module Circuit

Input Channel : n

Back Plane
DC 5V
Logic
DC-DC
ASIC
Photocoupler
TVS
Digital Input Module

Criteria for device selection
- A TVS for internal protection is required at the signal input.
- Inter-module communication with backplane connection is possible by user-designed ASIC

Proposal from Toshiba
- **Prevent circuit malfunctions by absorbing electrostatic discharge (ESD) from external terminals**
  TVS diodes
- **High light output, high gain, high speed photocoupler**
  Transistor output photocoupler
  High-speed IC output photocoupler
- **Small, thin, low voltage, small surface mounting**
  One-gate CMOS logic

※ Click on the blue circled numbers above to view detailed descriptions.
Programmable Logic Controller - Digital output module section detail

Digital output module circuit

Back Plane
DC 5V
Control

DC-DC

Digital Output Module

Logic
ASIC
Photo coupler
MOSFET/Transistor Array

Output Channel : n

※ Click on the blue circled numbers above to view detailed descriptions.

Criteria for device selection
- The external signal (output) line needs to be isolated from the main unit.
- Inter-module communication with backplane connection is possible by user-designed ASIC

Proposal from Toshiba
- High light output, high gain, high speed photocoupler
  Transistor output photocoupler
  High-speed IC output photocoupler
- Small, thin, low voltage, small surface mounting
  One-gate CMOS logic
- Low power dissipation sets possible by means of low ON resistance
  U-MOS series MOSFET (trench-type)
- High withstand voltage, high current using DMOS FET output
  Transistor array
Programmable Logic Controller – MCU module section detail

**MCU Module Circuit**
Using full custom ASIC

- **Back Plane**
  - DC
  - Control

- **MCU Module**
  - Logic
  - DC-DC
  - ASIC
  - RS-485
  - Ethernet
  - USB
  - SD

**MCU Module Circuit**
Using MCU and ASIC

- **Back Plane**
  - DC
  - Control

- **MCU Module**
  - Logic
  - DC-DC
  - MCU
  - ASIC
  - RS-485
  - Ethernet
  - USB
  - SD

Criteria for device selection
- The full custom ASIC can achieve sequence operation at high speed.
- Inter-module communication with backplane connection is possible by user-designed ASIC

Proposal from Toshiba
- Small, thin, low voltage, small surface mounting
  One-gate CMOS logic

※ Click on the blue circled numbers above to view detailed descriptions.

Ethernet is a registered trademark of Fuji Xerox Corporation.
SD is a trademark of SD Association.
Programmable Logic Controller – Power supply module section detail

Power Supply Module

Criteria for device selection
- A low loss MOSFET suited for switching is required for efficient AC-DC power supply.
- Isolation is required between the primary and secondary of the AC-DC power supply.

Proposal from Toshiba
- Low power dissipation sets possible by means of low ON resistance
  π-MOSV series MOSFET (planar-type)
- Photocoupler with excellent environmental resistance
  Transistor output photocoupler

※ Click on the blue circled numbers above to view detailed descriptions.
Recommended Devices
As described above, in the design of PLC, “High reliability, environmentally friendly”, “Set power consumption reduction” and “Board miniaturization” are important factors. Toshiba’s proposals are based on these three solution perspectives.
Device solutions to address customer needs

<table>
<thead>
<tr>
<th></th>
<th>Advanced functions • Stable operation</th>
<th>High Efficiency • Low loss</th>
<th>Small packaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TVS diode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Transistor output photocoupler (AC input)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>High speed IC output photocoupler (AC input)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>One gate CMOS logic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Small signal MOSFET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Transistor Array</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>π-MOS(\text{VIII}) series MOSFET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Transistor-output photocoupler (DC input)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TVS diode

DF2B7ASL/DF2B7AFS/DF2B7ACT/DF2B7AE/DF2B7AFU

Value provided

Protects devices and prevents circuit malfunctions by absorbing ESD entering from external terminals

1. Increase ESD pulse absorption
   Compared to our earlier products, ESD absorption is improved (operating resistance reduced by 50%). High signal quality and protection assured by means of low operating resistance and low capacitance.

2. Suppress ESD energy by means of low clamp voltage
   Using original technology, provides full protection of connected circuit components.

3. High density mounting
   Wide selection of packages available (single ~ multi flow-through).

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>DF2B7ASL</th>
<th>DF2B7AFS</th>
<th>DF2B7ACT</th>
<th>DF2B7AE</th>
<th>DF2B7AFU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>SL2</td>
<td>fSC</td>
<td>CST2</td>
<td>ESC</td>
<td>USC</td>
</tr>
<tr>
<td>( V_{RWM} \text{ (Max)} ) [V]</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>( C_r \text{ (Typ.)} ) [pF]</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
</tr>
<tr>
<td>( R_{DYN} \text{ (Typ.)} ) [Ω]</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>( V_c \text{ (Typ.)} ) [V] @( I_{DP} = 1 \text{ A} )</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

Note: This device is for ESD protection only and cannot be used for other purposes such as, but not limited to, constant voltage source circuits.
Transistor output photocoupler (AC input)

TLP292/TLP292-4

Value provided

High conversion efficiency even for low input current ($I_F = 0.5$ mA)

1 Guaranteed conversion efficiency at low input current ($I_F = 0.5$ mA)

By adopting a high output LED, high conversion efficiency is achieved even under low input current conditions of $I_F = 0.5$ mA. In addition to $I_F = 5$ mA, conversion efficiency at $I_F = 0.5$ mA is guaranteed, allowing easy design.

2 Operation guaranteed up to 125°C

The operating temperature range is guaranteed from -55 °C to 125 °C to ensure operation under severe environments such as inverter devices, robots, machine tools, and high-output power supplies.

---

Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TLP292</th>
<th>TLP292-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>SO4 (4pin)</td>
<td>SO16</td>
</tr>
<tr>
<td>$BV_{(Min)} [\text{Vrms}]$</td>
<td>3750</td>
<td>3750</td>
</tr>
<tr>
<td>$T_{\text{op}} [\text{°C}]$</td>
<td>-55 to 125</td>
<td>-55 to 125</td>
</tr>
</tbody>
</table>
High speed IC output photocoupler (AC input)  
TLP2395/TLP2398

A photocoupler that combines a high-power infrared LED (bi-directional input) with a high-gain, high-speed integrated circuit light-receiving IC chip.

1. **Direct connection to both sink/source logic signals**

AC input is supported by adding a reverse parallel LED on the LED side of the photocoupler. Output can support both sink and source logic signals without adding a bridge circuit.

2. **Guaranteed operation up to 125 °C ambient temperature**

Can operate in extreme ambient temperature environments such as inverter devices, robots, machine tools, and high output power supplies.

3. **Wide supply voltage 3～20V**

Operation with a supply voltage from 3.0 V is possible, as well as in mixed 3.3 V / 5.0 V systems, enabling the use of shared, common components.

---

### Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TLP2395</th>
<th>TLP2398</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>SO6 (Spin)</td>
<td>SO6 (Spin)</td>
</tr>
<tr>
<td>BV_{s} (Min) [V_{rms}]</td>
<td>3750</td>
<td>3750</td>
</tr>
<tr>
<td>T_{op} (°C)</td>
<td>-40 to 125</td>
<td>-40 to 125</td>
</tr>
<tr>
<td>Output type</td>
<td>Buffer logic</td>
<td>Inverter logic</td>
</tr>
</tbody>
</table>

---

UL certification UL1577, File No.E67349  
cUL certified CSA Component Acceptance Service No.5A. File No.E67349  
VDE certified EN60747-5-5, EN60065, EN60950-1 (Note1)  
EN62368-1 (applied) (Note1)  
(Note): To select a VDE certified device, specify the “Option (V4)”.

---

© 2019 Toshiba Electronic Devices & Storage Corporation
One gate CMOS logic TC7WZ series
TC7WZ07FK/TC7WZ00FK

Line-up using small, common packages with low voltage operation offers good ease-of-use

1. Low power and high speed
   High speed operation is achieved with the low power of CMOS.

2. Compatible with low voltage systems
   The operating voltage range of 1.65V to 5.5V can be used with low voltage systems.

3. Power down protection function
   The output terminal has a 5.5V power-down protection function to protect the device when the power is off.

Line-up

<table>
<thead>
<tr>
<th>Part number</th>
<th>TC7WZ07FK</th>
<th>TC7WZ00FK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>US8</td>
<td>US8</td>
</tr>
<tr>
<td>$V_{CC}$ [V]</td>
<td>1.65 to 5.5</td>
<td>1.65 to 5.5</td>
</tr>
<tr>
<td>$t_{PD}$/$t_{PD}$ (Typ.) [ns]@$V_{CC} = 5$ V</td>
<td>2.3</td>
<td>2.4</td>
</tr>
<tr>
<td>$T_{op}$ (Max) [$^\circ$C]</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>Function</td>
<td>Non-Inverter (Open Drain)</td>
<td>2-Input NAND</td>
</tr>
</tbody>
</table>

© 2019 Toshiba Electronic Devices & Storage Corporation
Suitable for power management switches, contributing to miniaturization.

1. **High temperature compatible**

A channel temperature up to 175 °C and ambient from -55 to 175 °C are supported, designed for extreme environments such as inverters, robots, machine tools, and high-output power supplies.

2. **Low ON resistance**

By reducing the ON-resistance between the source and drain, heat generation and power consumption can be reduced, in keeping with the trend of declining system power consumption.

3. **Miniature package**

In addition to the industry standard SOT-23F package, a smaller UFM package is also available maintaining the same level of power consumption, contributing to overall set miniaturization.

### Line up

<table>
<thead>
<tr>
<th>Part number</th>
<th>SSM3K341R</th>
<th>SSM3K341TU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>SOT-23F</td>
<td>UFM</td>
</tr>
<tr>
<td>Polarity</td>
<td>N-ch</td>
<td>N-ch</td>
</tr>
<tr>
<td>$R_{DS(on)}$ (Typ.) [Ω] @$V_{GS} = 10$ V</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>$I_{D}$ (Max) [A]</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>$V_{DS}$ (Max) [V]</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>$V_{GS}$ (Max) [V]</td>
<td>±20</td>
<td>±20</td>
</tr>
</tbody>
</table>

---

© 2019 Toshiba Electronic Devices & Storage Corporation
High withstand voltage and current output using DMOS FET output

1. High withstand voltage & high current

Adoption of the BiCD, which is a high-withstand voltage monolithic process, an FET output is possible with an absolute maximum voltage of 50V and selectable current rating types of 0.3A, 0.5A and 1.5A.

2. Wide line-up

Selections include input type (buffer, inverter), output type (sink, source), number of channels (4 to 8). A total of 55 products are available, including DIP packages and built-in D-FF products.

3. Low loss

Low loss is achieved by the low Ron of the output circuit. Power loss is reduced by approximately 40% compared to conventional products. (Conditions: $T_a = 25$ °C, $I_{OUT} = 200mA$)

<table>
<thead>
<tr>
<th>Part number</th>
<th>TBD6203AFNG</th>
<th>TBD6273AFNG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Sink output transistor array</td>
<td>Source output transistor array</td>
</tr>
<tr>
<td>Outputs</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Ratings</td>
<td>50 V</td>
<td>50 V</td>
</tr>
<tr>
<td></td>
<td>500 mA (Max)</td>
<td>-500 mA (Max)</td>
</tr>
<tr>
<td>Output On resistance</td>
<td>2.0 Ω (Typ.)</td>
<td>1.6 Ω (Typ.)</td>
</tr>
<tr>
<td>Clamp diode</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Package</td>
<td>SSOP18</td>
<td>SSOP18</td>
</tr>
</tbody>
</table>

DMOS FET: Double-Diffused MOSFET

Return to Block Diagram TOP
Suitable for switching regulators, which are easy to handle and contributes to miniaturization.

1. **Low ON resistance**
   By reducing the ON-resistance between the source and drain, heat generation and power dissipation is reduced.

2. **Low leakage current**
   Drain leakage current $ID_{SS} = 10 \mu A$ (max) (at $V_{DS} = 640 \text{ V}$)

3. **Enhancement type**
   Easy to operate enhancement type FET where no collector current flows when no gate voltage is applied.

---

**Line up**

<table>
<thead>
<tr>
<th>Part number</th>
<th>TK10A80E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>TO-220SIS</td>
</tr>
<tr>
<td>$V_{DSS}$ [V]</td>
<td>800</td>
</tr>
<tr>
<td>$I_D$ [A]</td>
<td>10</td>
</tr>
<tr>
<td>$P_D$ [W]</td>
<td>50</td>
</tr>
<tr>
<td>$C_{iss}$ [pF]</td>
<td>2000</td>
</tr>
<tr>
<td>$R_{DSS}$(Max) [Ω]</td>
<td>0.7</td>
</tr>
<tr>
<td>Polarity</td>
<td>N-ch</td>
</tr>
</tbody>
</table>

◆Return to Block Diagram TOP
**Transistor output photocoupler (DC input)**

**TLP383**

**Value provided**

**Reduced board area and maintenance-free operation thanks to improved reliability**

1. **High isolation voltage in a small thin package**

A high isolation optocoupler with a phototransistor optically coupled to an infrared light emitting, diode with a guaranteed breakdown voltage of 5000 Vrms. Due to the small and thin DIP package, high density board mounting is possible.

2. **Guaranteed operation up to an ambient temperature of 125 °C**

Designed to operate in harsh environments, for applications such as inverters, robots, machine tools, and high output power supplies.

**Functional performance**

- **High isolation and noise immunity**

**Line up**

<table>
<thead>
<tr>
<th>Part number</th>
<th>TLP383</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>SO6L (4pin)</td>
</tr>
<tr>
<td>BV_s (Min) [Vrms]</td>
<td>5000</td>
</tr>
<tr>
<td>T_opr [°C]</td>
<td>-55 to 125</td>
</tr>
</tbody>
</table>

**Industrial equipment**

- Inverters
- Servo amps
- Robots
- FA
- High power supplies
- Security
- Semiconductor testers
- PLC

© 2019 Toshiba Electronic Devices & Storage Corporation
If you are interested in these products and have questions or comments about any of them, please do not hesitate to contact us below:

Contact address: https://toshiba.semicon-storage.com/ap-en/contact.html
These terms of use are made between Toshiba Electronic Devices and Storage Corporation ("We") and customers who use documents and data that are consulted to design electronics applications on which our semiconductor devices are mounted ("this Reference Design"). Customers shall comply with these terms of use. Please note that it is assumed that customers agree to any and all of the terms of use if customers download this Reference Design. We may, at our sole and exclusive discretion, change, alter, modify, add, and/or remove any part of these terms of use at any time without any prior notice. We may terminate these terms of use at any time and for any reason. Upon termination of these terms of use, customers shall destroy this Reference Design. In the event of any breach thereof by customers, customers shall destroy this Reference Design, and furnish us a written confirmation to prove such destruction.

1. Restrictions on usage
1. This Reference Design is provided solely as reference data for designing electronics applications. Customers shall not use this Reference Design for any other purpose, including without limitation, verification of reliability.
2. This Reference Design is for customer's own use and not for sale, lease or other transfer.
3. Customers shall not use this Reference Design for evaluation in high or low temperature, high humidity, or high electromagnetic environments.
4. This Reference Design shall not be used for or be incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.

2. Limitations
1. We reserve the right to make changes to this Reference Design without notice.
2. This Reference Design should be treated as a reference only. We are not responsible for any incorrect or incomplete data and information.
3. Semiconductor devices can malfunction or fail. When designing electronics applications by referring to this Reference Design, 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 semiconductor devices could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Customers must also refer to and comply with the latest versions of all relevant our information, including without limitation, specifications, data sheets and application notes for semiconductor devices, as well as the precautions and conditions set forth in the “Semiconductor Reliability Handbook”.
4. When designing electronics applications by referring to this Reference Design, customers must evaluate the whole system adequately. Customers are solely responsible for all aspects of their own product design or applications. WE ASSUME NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS.
5. No responsibility is assumed by us for any infringement of patents or any other intellectual property rights of third parties that may result from the use of this Reference Design. No license to any intellectual property right is granted by this terms of use, whether express or implied, by estoppel or otherwise.
6. THIS REFERENCE DESIGN IS PROVIDED "AS IS". We (a) ASSUME 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 (b) DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO THIS REFERENCE DESIGN, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.

3. Export Control
Customers shall not use or otherwise make available this Reference Design 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 (weapons of mass destruction). This Reference Design 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 this Reference Design are strictly prohibited except in compliance with all applicable export laws and regulations.

4. Governing Laws
These terms of use shall be governed and construed by the laws of Japan.
RESTRICTIONS ON PRODUCT USE

- Toshiba Electronic Devices & Storage 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 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.

- GaAs (Gallium Arsenide) is used in Product. GaAs is harmful to humans if consumed or absorbed, whether in the form of dust or vapor. Handle with care and do not break, cut, crush, grind, dissolve chemically or otherwise expose GaAs in Product.

- 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.

© 2019 Toshiba Electronic Devices & Storage Corporation