

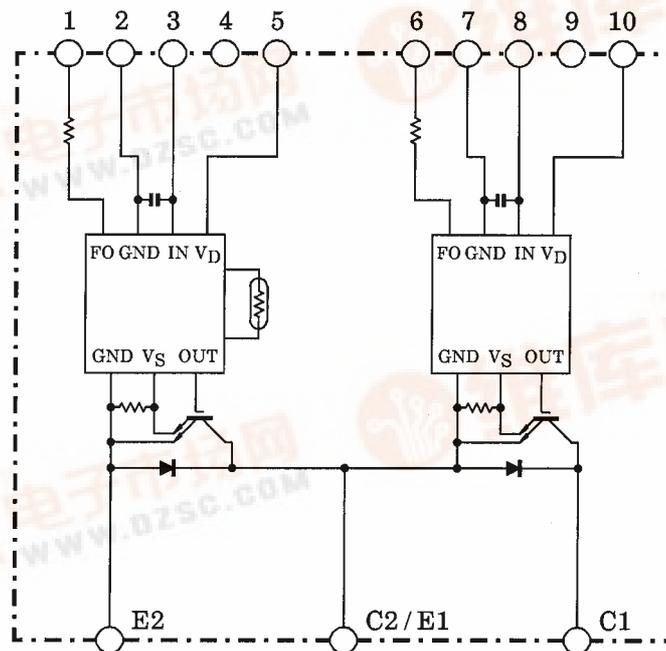
TOSHIBA Intelligent Power Module Silicon N Channel IGBT

# MIG400J101H

High Power Switching Applications  
Motor Control Applications

- Integrates inverter power circuits & control circuits (IGBT drive units, protection units for over-current, under-voltage & over temperature) in one package.
- The electrodes are isolated from case.
- High speed type IGBT :  $V_{CE(sat)} = 2.5V$  (max)  
 $t_{off} = 2.0\mu s$  (max)  
 $t_{rr} = 0.15\mu s$  (max)
- Package dimensions : TOSHIBA 2-121A1A
- Weight : 510g

## Equivalent Circuit



- |           |            |           |         |               |
|-----------|------------|-----------|---------|---------------|
| 1. FO (L) | 2. GND (L) | 3. IN (L) | 4. Open | 5. $V_D$ (L)  |
| 6. FO (H) | 7. GND (H) | 8. IN (H) | 9. Open | 10. $V_D$ (H) |



## Maximum Ratings (T<sub>j</sub> = 25°C)

| Stage    | Characteristic              | Condition                    | Symbol           | Ratings    | Unit |
|----------|-----------------------------|------------------------------|------------------|------------|------|
| Inverter | Supply voltage              | P-N power terminal           | V <sub>CC</sub>  | 450        | V    |
|          | Collector-emitter voltage   | —                            | V <sub>CES</sub> | 600        | V    |
|          | Collector current           | T <sub>c</sub> = 25°C, DC    | I <sub>C</sub>   | 400        | A    |
|          | Forward current             | T <sub>c</sub> = 25°C, DC    | I <sub>F</sub>   | 400        | A    |
|          | Collector power dissipation | T <sub>c</sub> = 25°C        | P <sub>C</sub>   | 1600       | W    |
|          | Junction temperature        | —                            | T <sub>j</sub>   | 150        | °C   |
| Control  | Control supply voltage      | V <sub>D</sub> -GND terminal | V <sub>D</sub>   | 20         | V    |
|          | Input voltage               | IN-GND terminal              | V <sub>IN</sub>  | 20         | V    |
|          | Fault output voltage        | FO-GND (L) terminal          | V <sub>FO</sub>  | 20         | V    |
|          | Fault output current        | FO sink current              | I <sub>FO</sub>  | 14         | mA   |
| Module   | Operating temperature       | —                            | T <sub>C</sub>   | -20 ~ +100 | °C   |
|          | Storage temperature range   | —                            | T <sub>stg</sub> | -40 ~ +125 | °C   |
|          | Isolation voltage           | AC 1 minute,                 | V <sub>ISO</sub> | 2500       | V    |
|          | Screw torque                | M6                           | —                | 3          | Nm   |

## Electrical Characteristics (T<sub>j</sub> = 25°C)

### a. Inverter Stage

| Characteristic                       | Symbol                | Test Condition   | Min                    | Typ. | Max  | Unit |    |
|--------------------------------------|-----------------------|--|------------------------|------|------|------|----|
| Collector cut-off current            | I <sub>CEX</sub>      | V <sub>CE</sub> = 600V   | T <sub>j</sub> = 25°C  | —    | —    | 2    | mA |
|                                      |                       |  | T <sub>j</sub> = 125°C | —    | —    | 40   |    |
| Collector-emitter saturation voltage | V <sub>CE (sat)</sub> | V <sub>D</sub> = 15V, I <sub>C</sub> = 400A<br>V <sub>IN</sub> = 3V → 0V   | T <sub>j</sub> = 25°C  | —    | 2.0  | 2.5  | V  |
|                                      |                       |  | T <sub>j</sub> = 125°C | —    | 2.0  | —    |    |
| Forward voltage                      | V <sub>F</sub>        | I <sub>F</sub> = 400A  | —                      | 2.1  | 2.7  | V    |    |
| Switching time                       | t <sub>on</sub>       | V <sub>CC</sub> = 300V, I <sub>C</sub> = 400A<br>V <sub>D</sub> = 15V, V <sub>IN</sub> = 3V ↔ 0V<br>Inductive load<br><br>(Note 1) | 1.4                    | 2.1  | 2.8  | μs   |    |
|                                      | t <sub>c (on)</sub>   |  | —                      | 1.2  | 1.8  |      |    |
|                                      | t <sub>rr</sub>       |  | —                      | 0.08 | 0.15 |      |    |
|                                      | t <sub>off</sub>      |  | —                      | 1.2  | 2.0  |      |    |
|                                      | t <sub>c (off)</sub>  |  | —                      | 0.3  | 0.6  |      |    |

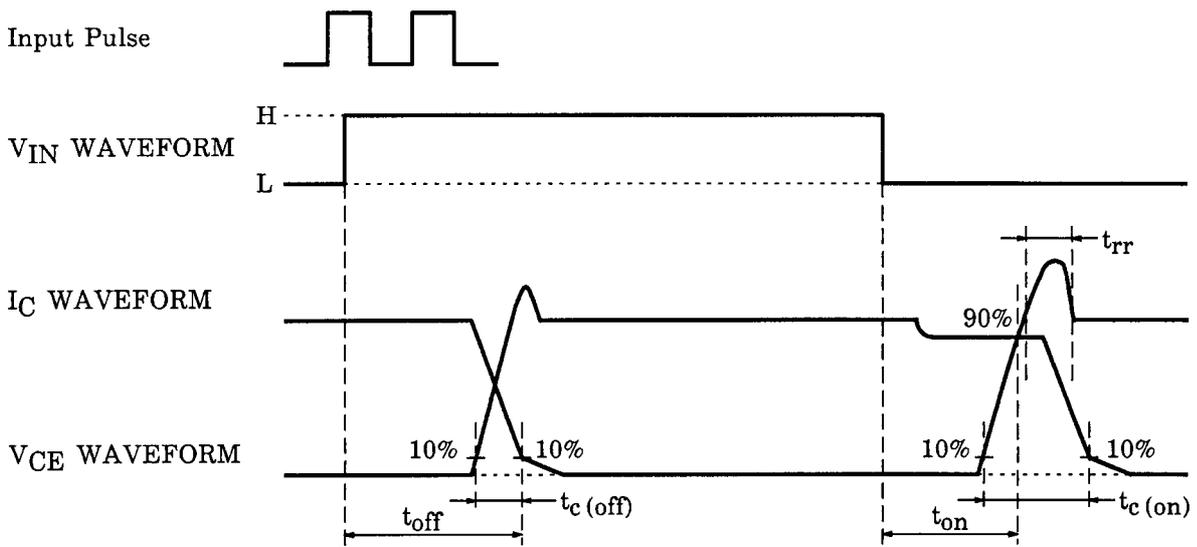
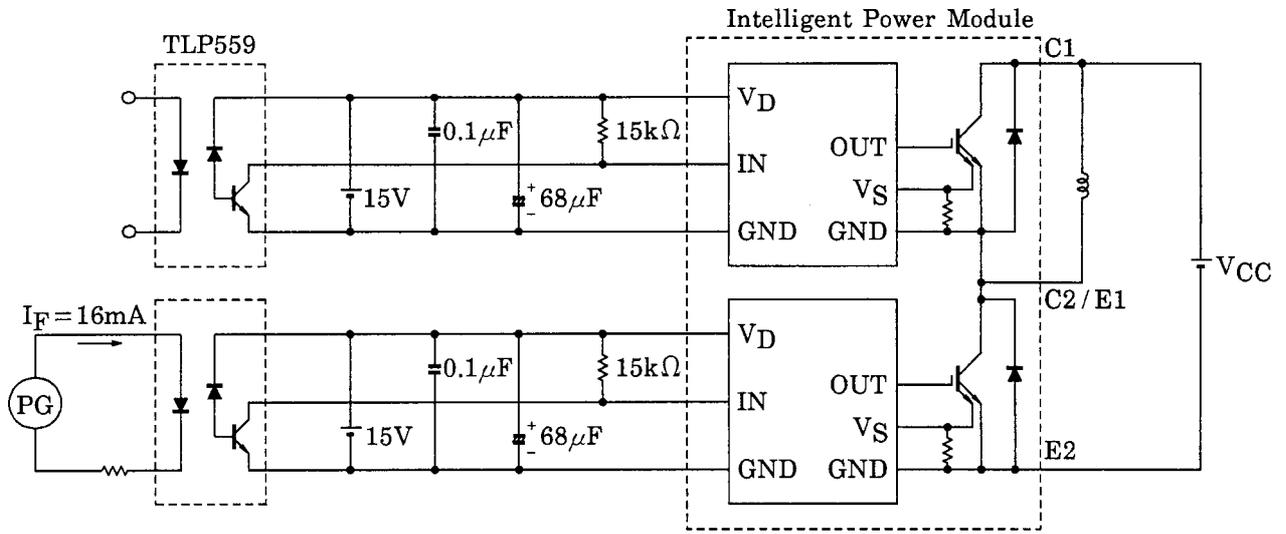
**b. Control Stage (T<sub>j</sub> = 25°C)**

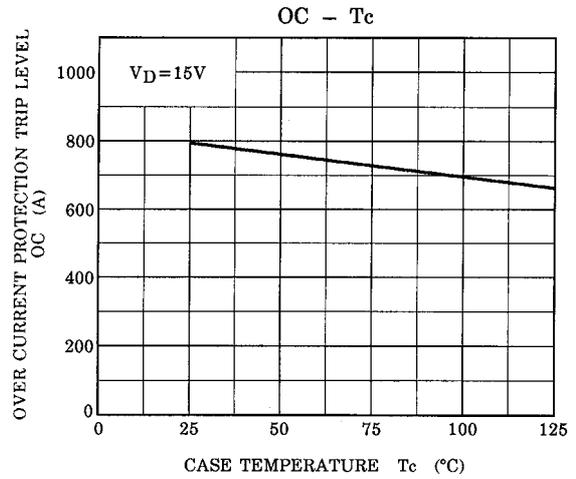
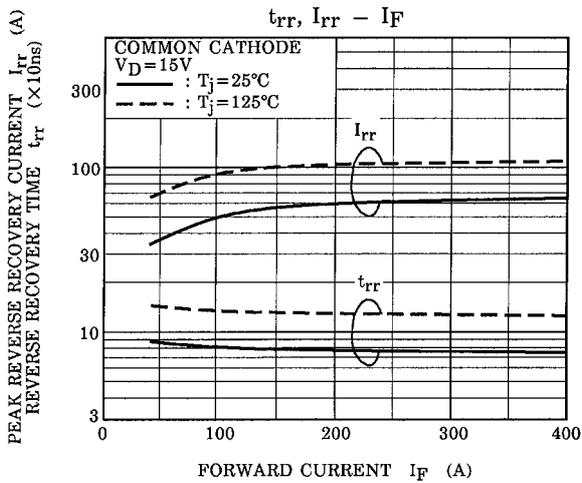
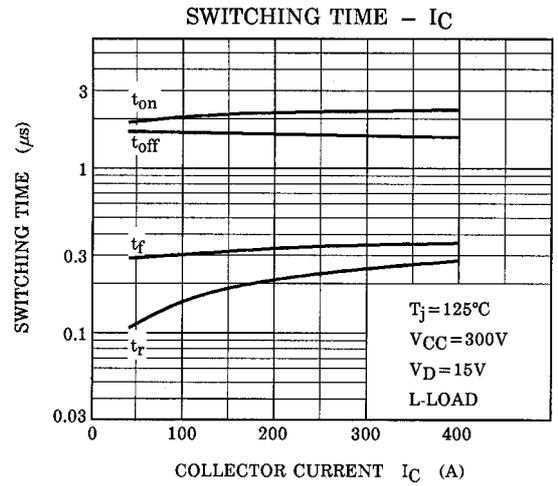
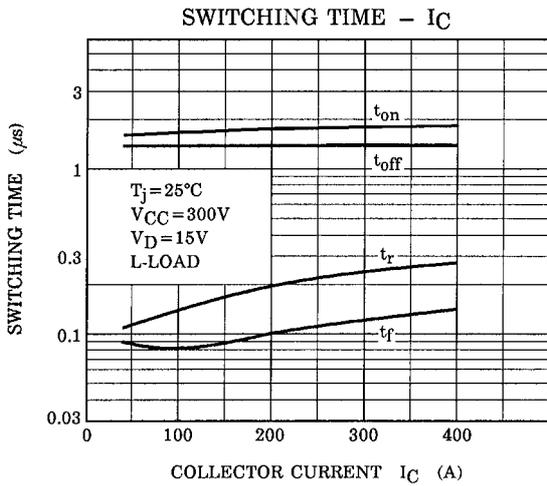
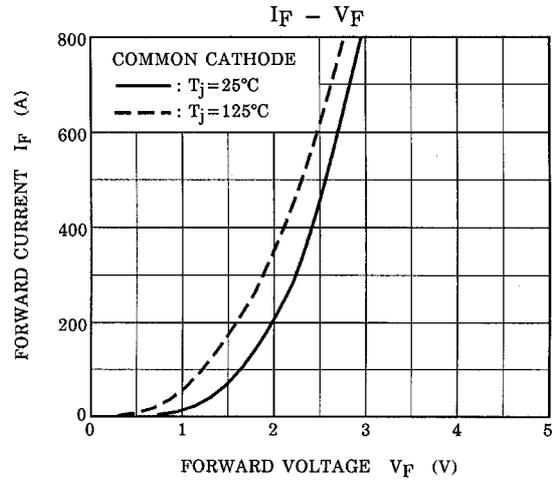
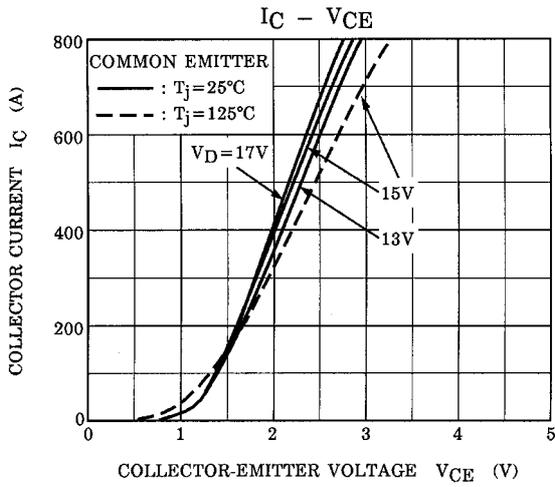
| Characteristic                          |             | Symbol                | Test Condition                               | Min  | Typ. | Max  | Unit |
|---|-------------|-----------------------|--|------|------|------|------|
| Control circuit current                 |             | I <sub>D</sub>        | V <sub>D</sub> = 15V                         | —    | 20   | 30   | mA   |
| Input on signal voltage                 |             | V <sub>IN (on)</sub>  | V <sub>D</sub> = 15V, I <sub>C</sub> = 400mA | 0.9  | 1.1  | 1.3  | V    |
| Fault output current                    | Protection  | I <sub>FO (on)</sub>  | V <sub>D</sub> = 15V                         | 8    | 10   | 12   | mA   |
|   | Normal      | I <sub>FO (off)</sub> |  | —    | —    | 1    |      |
| Over current protection trip level      |             | OC                    | V <sub>D</sub> = 15V, T <sub>j</sub> = 125°C | 560  | 640  | —    | A    |
| Short circuit protection trip level     |             | SC                    | V <sub>D</sub> = 15V, T <sub>j</sub> = 125°C | 840  | 960  | —    | A    |
| Over current cut-off time               |             | t <sub>off (OC)</sub> | V <sub>D</sub> = 15V                         | —    | 10   | —    | μs   |
| Over temperature protection             | Trip level  | OT                    | Case temperature                             | 111  | 118  | 125  | °C   |
|   | Reset level | OTr                   |  | 93   | 100  | 107  |      |
| Control supply under voltage protection | Trip level  | UV                    | —  | 11.3 | 12.0 | 12.7 | V    |
|   | Reset level | UVr                   |  | 11.8 | 12.5 | 13.2 |      |
| Fault output pulse width                |             | t <sub>FO</sub>       | V <sub>D</sub> = 15V                         | 1    | 2    | 3    | ms   |

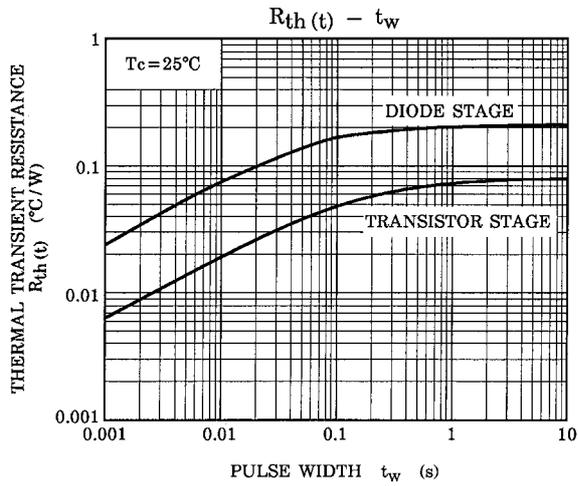
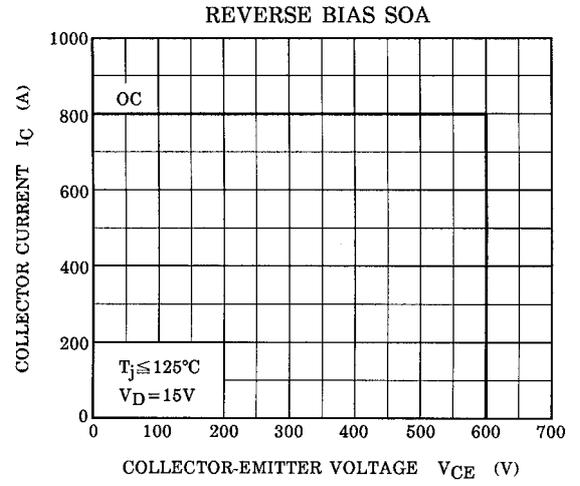
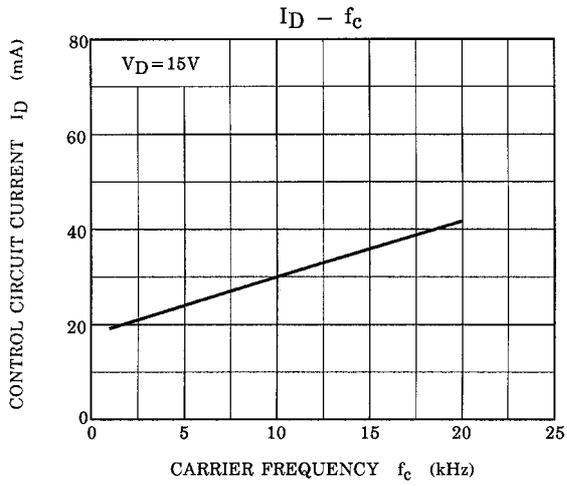
**c. Thermal Resistance (T<sub>j</sub> = 25°C)**

| Characteristic                      | Symbol                | Test Condition      | MIN | TYP. | MAX   | Unit   |
|-------------------------------------|-----------------------|---------------------|-----|------|-------|--------|
| Junction to case thermal resistance | R <sub>th (j-c)</sub> | IGBT                | —   | —    | 0.078 | °C / W |
|                                     |                       | FRD                 | —   | —    | 0.208 |        |
| Case to fin thermal resistance      | R <sub>th (c-f)</sub> | Compound is applied | —   | 0.05 | —     | °C / W |

Note 1: Switching time test circuit & timing chart

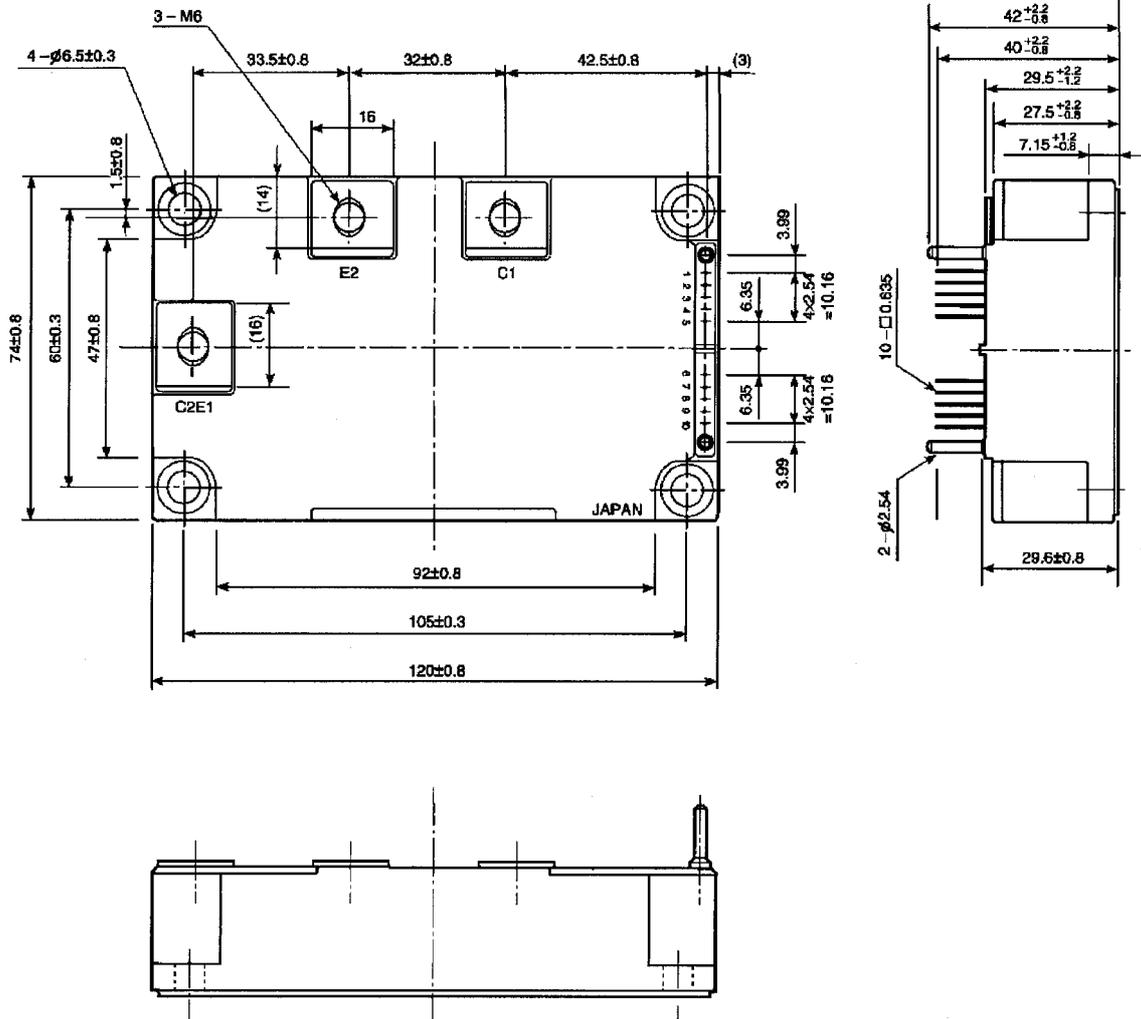






## Package Dimensions: TOSHIBA 2-121A1A

Unit: mm



- |           |            |           |         |                        |
|-----------|------------|-----------|---------|------------------------|
| 1. FO (L) | 2. GND (L) | 3. IN (L) | 4. Open | 5. V <sub>D</sub> (L)  |
| 6. FO (H) | 7. GND (H) | 8. IN (H) | 9. Open | 10. V <sub>D</sub> (H) |

**RESTRICTIONS ON PRODUCT USE**

000707EAA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.  
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.