4. Precautions and Usage Considerations Specific to Each Product Group

This section describes matters specific to each product group which need to be taken into consideration when using devices. If the same item is described in Sections 3 and 4, the description in Section 4 takes precedence.

4.1 Optical Semiconductor Devices

Handling precautions common to all optical semiconductor devices are described in Section 4.1.1. Handling precautions for devices classified by product group are described in Sections 4.1.2 to 4.1.6. When using this brochure, please be sure to read the precautions common to all devices in Section 4.1.1 and those specific to the types of device used in your design.

4.1.1 Precautions common to all optical semiconductor devices

4.1.2 Visible LEDs (LED lamps, LED displays, LED matrix modules)

4.1.3 Photosensors (infrared LEDs, photodetectors, photointerrupters, photoreflective sensors)

4.1.4 Photocouplers

4.1.5 Fiber-optic devices (TOSLINK®)

4.1.6 Visible semiconductor lasers

4.1.1 Precautions common to all optical semiconductor devices

(1) Moisture-proof packing

The method for removing moisture from the moisture-proof packing of optical semiconductor devices differs from that used for the packing of other types of semiconductor device due to differences in their respective package resin characteristics. For more information regarding moisture removal, refer to the relevant individual datasheets and databooks.

(2) Design

- Derating
  The life characteristics of optical semiconductor devices are closely associated with the operating temperature, case temperature and operating humidity environment. This requires that in addition to ordinary derating, the relationship between the fluctuation and degradation rates for each of the device's primary characteristics (e.g. luminous intensity, radiant power and current conversion efficiency) and the operating and environment conditions be fully taken into consideration at the design stage.

- Fail-safe implementation
  If there is a possibility that failure in optical semiconductor devices, degradation of characteristics (e.g. luminous intensity, radiant power, current conversion efficiency or laser light output power) or functional abnormality will impair the safe operation of the system, design a fail-safe measure in accordance with the system's intended use.

(3) Inspection, testing and evaluation

When inspecting devices, be sure to observe the specifications laid down in the individual datasheets and databooks for the devices used. In particular, the reverse voltage/reverse current characteristics differ between different types of light-emitting material, so if current is forced to flow in the reverse polarity, the rate of failure in device characteristics may be high.

(4) Safety standards

The resin used in packages where light transmissivity is an important characteristic does not meet the combustion resistance requirements set forth in the various established safety standards. Because resin is not self-extinguishing, it not only generates poisonous gases but can also catch fire itself. The possibility of risk to devices and their packaging material must be taken into account when the ambient environment in which mounting will be performed is specified.

(5) Disposal precautions

For details of the precautions which must be taken when disposing of a particular device, refer to the relevant databook for the device concerned.

4.1.2 Visible LEDs

(1) Impact and vibration

- Matrix modules
  If an excessive impact is applied to the packing, the relative positions of the display and the drive substrate may shift. In such cases it will not be possible to mount the device on the board properly.

(2) Design

- Correct use
  LED lamps are designed for display purposes. Using an LED lamp as a light source for a photosensor is prohibited. If a light source for a photosensor is required, choose a device designed specifically for that purpose.

- Heat radiation
  For display systems configured using an array of visible LED devices, ensure that sufficient heat radiation measures are incorporated. Partial unbalanced heat generation must be taken into consideration, as this may reduce the luminous intensity of LED devices due to their temperature dependency. A reduction in luminous intensity will impair the device's display quality. Moreover, it may give rise to differences in the luminous intensity degradation characteristics between devices.

- Eyesight protection
  The safety of visible LEDs as regards the eyesight of users prescribed in IEC825-1 applies to finished products, not to individual LED lamps. When the operating conditions for LEDs and their external optical systems are specified, the safety of finished products as well as individual LED lamps with respect to human eyesight should be taken into account.

- Chemical resistance
  In the case of products in plastic packages in particular, unless the right chemical for washing and wiping is selected, the plastic properties can change and optical characteristics and reliability can be adversely affected. That is, when an inappropriate chemical is used, chemical changes in the plastic can alter the optical characteristics of the device, cause cracks in the plastic used in the package, and adversely affect the reliability of the device. Therefore, when selecting a new chemical, first perform tests or contact a Toshiba sales office.

- Lifetime

  The lifetime of light-emitting devices is greatly affected by the operating conditions and operating environment as well as by the particular lifetime characteristics of the device. Therefore, when a light-emitting device is to be selected and the operating conditions set, it is recommended that the lifetime condition be checked first.
  If it is necessary to control the light output fluctuation rate, Toshiba suggest constructing a system which operates using a control circuit based on a light output monitor, or a system which can adjust the light output using an alarm display or similar device.

- Usage restrictions

  With GaAlAs LEDs a light-absorption layer forms on the LED surface when the power is applied, reducing the light output. Since this tendency is particularly pronounced in high-temperature, high-humidity environments, when using these devices in this type of environment, be sure to perform adequate testing and checking beforehand.

(3) Mounting

- Mounting LED lamps with radial taping

  The leads of LEDs are made of relatively hard materials. Thus the life of blades which are subjected to lead clinching and lead cutting could be significantly shortened if, for example, an automatic mounter fails to coordinate properly the timing between lead clinching and lead cutting for each lead. Adequate coordination and maintenance are required so as not to reduce the lifetime of the blades.

- Stress on package-encapsulating resin

  When an automatic mounter is used, it is recommended that devices which have stoppers on their lead roots be used. If there is no stopper on the leads, the tensile stress applied during lead clinching may cause excessive stress to the package's encapsulating resin, degrading the reliability of the package.

- Diameter of lead-insertion holes on PCBs

  The diameter of lead-insertion holes on PCBs should not exceed the values recommended by the manufacturer of the automatic mounter which is being used. Setting the appropriate hole diameter will reduce stress on the package's encapsulating resin during lead clinching and prevent solder holes from forming.

4.1.3 Photosensors

(1) Design

- Correct use

  Using a visible LED lamp as a light source for a photosensor is prohibited. If a light source for a photosensor is required, choose a device designed specifically for that purpose.

- Reliability design

  The degradation of radiant power in LED devices is closely associated with the device's operating conditions, its package temperature and the level of humidity of the environment in which it is operated. If the degradation of radiant power could seriously degrade system safety, design a safety measure, such as a closed-loop control for the radiant intensity using a radiant-intensity monitor, or some other similar fail-safe measure.

- Dust and oil

  If dust accumulates on, or oil sticks to the lens surfaces of a device, the device's optical characteristics will be affected, making it impossible to obtain the desired radiant power or photodetection sensitivity. Also, this dust or oil may generate an adverse chemical reaction with the device, in a similar manner to corrosive gas.

(2) Mounting

- Lens cleaning and level shift
  To prevent system malfunction due to the degradation of characteristics caused by accumulated dust on the lens surfaces of light-emitting and photodetecting parts, Toshiba recommend that dust be periodically cleaned off. After cleaning, check to see that the photosensor operates normally and that no misalignment, such as a level shift, has occurred.

4.1.4 Photocouplers

(1) Design

- Dust and oil
  Dust accumulating on, or oil sticking to devices causes a reduction in the device's dielectric strength between the input and the output. Also, this dust or oil may generate an adverse chemical reaction with the device, in a similar manner to corrosive gas. If a reduction in the input-to-output dielectric strength of a device or an increase in the leakage current through its package could seriously degrade the system's functionality, countermeasures such as resin impregnation must be considered at the design stage.

- Observing the guaranteed operation range
  The life characteristics of a light-emitting device are closely associated with the device's operating current and package temperature. Hence, in addition to ordinary derating, the relationship between the fluctuation rate of the device's coupling characteristics (e.g. current conversion efficiency and trigger LED current) and the operating current and operating temperature must be fully taken into consideration at the design stage.

- Combustibility of package resin
  The resin used in packages is V0 grade under UL-94 standards. Since this resin is combustible, it may emit smoke or ignite if it is scorched or burned.
  Therefore, do not use devices packaged in this material near articles that may burn, generate heat or catch fire.

(2) Inspection, testing and evaluation

When testing the dielectric strength of a photocoupler, use testing equipment which can shut off the supply voltage to the photocoupler. If you detect a leakage current of more than 100 μA, use the testing equipment to shut off the photocoupler's supply voltage; otherwise a large short-circuit current will flow continuously, and the device may break down or burst into flames, resulting in fire or injury.

- Dielectric strength of a device between input and output

  (a) Control standards and application limits
  A device's input-to-output insulation performance is stipulated and tested in conformity with the criteria laid down in the American UL and German VDE component standards. The stipulated insulation performance for devices states that the performance retention time is 1 minute. Therefore, use of these devices in applications designed to provide continuous high-voltage insulation for extended periods of time is not recommended.

(3) Mounting

- Resin impregnation

  (a) Before applying resin impregnation, check that it will not affect the device.

(b) Before applying resin inpregnation, clean off dirt and impurities and dehumidify the device adequately. To ascertain the correct treatment method for resin impregnation, consult the resin manufacturer, informing them of the voltages which are applied between the device's input and output.

(4) Usage environment

- Light disruption (e.g. sunlight or strobe flash)
  Strong light (e.g. sunlight, a strobe flash or a searchlight) impinging upon a photocoupler-based system may cause it to operate erratically. Therefore, shield the device from light in a suitable manner, according to the system's intended use.

4.1.5 Fiber-optic devices (TOSLINK®)

(1) Design

- External noise
  To improve the noise resistance of an optical receive module (simplex type) or optical transmit/receive module (duplex type) when mounting it on a circuit board, connect the module's package-fixing reinforcing pins to SIGNAL-GND. At the same time make sure that the module's package will not touch the power supply lines or any other circuits.

- When using an optical transmit or receive module or an optical transmit/receive module in a location that is prone to noise, test the device's noise resistance under actual operating conditions in advance and take the following corrective measures as necessary:

  (a) If power supply ripples are large, increase the performance capability of the noise filter connected to the power supply line.

  (b) Protect the optical transmit or receive module or optical transmit/receive module and the power supply filter with covers to enhance the shielding capability. At the same time make sure that the module's case does not touch the metal cover.

- Dust and oil
  Devices are not dust-proof. When using a device in a location that is prone to dust or in a location where oil may be splashed, incorporate some kind of dust-proofing cover into the design which will protect everything: the optical transmit/receive module, the connected optical fibers and all fiber-optic connectors.

- Vibration
  When mounting optical modules in equipment which will be subject to vibration, resonance or mechanical shock, incorporate a structural measure into the design to alleviate the effects of these external phenomena. In particular, if a system incorporating optical fibers (and fiber-optic connectors) is subjected to vibration or mechanical shock, the optical module's package-fixing reinforcing pins may be sheared by inertial stress. Extreme care must be taken in this kind of situation.
  Optical modules in ceramic packages are hollow and therefore require even more protection from vibration, resonance and mechanical shock than resin-molded devices.

- Laying optical fiber cables
  When laying optical fiber cables, bend them at six to 10 times the stipulated minimum bending radius.

(2) Inspection, testing and evaluation

- Optical receive module output pins
  Do not connect the output pins directly to the power supply or GND. Otherwise a large current may flow into the IC, causing it to break down.
  If the output pins need to be pulled up or down, connect a resistor between the pin and the power supply or ground. For an explanation of how to choose the resistance value, refer to the relevant individual datasheets and databooks for the devices concerned.

(3) Mounting

- Soldering
  Since optical transmit/receive modules are optical components, do not use a soldering method which will be adversely affected by flux to mount them on the board. Cleaning of these devices is not recommended either. For this reason, when optical transmit/receive modules are to be mounted along with other circuit components on a printed circuit board, solder the other components, clean the board and then solder the optical transmit/receive modules using a soldering iron.

(4) Maintenance

- Protective caps
  When an optical module is not in use, attach a protective cap to the socket of each optical connector. Light (including external light) impinging on an optical module which is not in use (in particular an optical receive module) may adversely affect other circuits.

- Toshiba recommend that you stipulate in your system maintenance documentation that the system's combined fiber-optical output power be periodically checked.

4.1.6 Visible semiconductor lasers

(1) Design

When incorporating a visible semiconductor laser into a design, use the device's internal photodetector or a separate photodetector to stabilize the laser's radiant power so as to ensure that laser beams exceeding the laser's rated radiant power cannot be emitted.
If this stabilizing mechanism does not work and the rated radiant power is exceeded, the device may break down or the excessively powerful laser beams may cause injury.

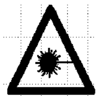
- Heat radiation
  Large amounts of heat emanate from the PN junctions of semiconductor lasers, necessitating a certain level of heat radiation. Normally semiconductor lasers are constructed in such a way that the heat generated is efficiently conducted to the flange section of the package. Therefore, the requisite external heat sink in your design must be in full contact with the flange section.

- Power supplies and external noise
  Before a device is operated, check that the device's absolute maximum ratings are not exceeded due to spike currents generated when the power is turned on or off. If chattering or overshoot is observed, incorporate a filter (e.g. an RC circuit) or a soft start circuit into your design to eliminate this type of noise.
  Moreover, if the input/output signal lines of the radiant power control component are long, the radiant power ratings may be exceeded due to induced noise or surges from external sources, causing the device to break down. For this reason, Toshiba recommend carrying out noise simulation and implementing appropriate protective measures based on the results.

- Laser beams
  The laser beams emitted from a device are extremely dangerous if they impinge directly upon human eyes. This is highly likely to impair vision, and in the worst case, may cause blindness. Therefore, when designing equipment that incorporates laser devices, include proper handling and safety precautions according to IEC standard IEC60825-1 in the user's manuals and in the instructions for workers who will be involved in inspection, testing and adjustment of the equipment.

(2) Inspection, testing and evaluation

⚠ DANGER



When a visible semiconductor laser is operating, do not look directly into the laser beam or look through the optical system.
This is highly likely to impair vision, and in the worst case, may cause blindness.
If it is necessary to examine the laser apparatus, for example, to inspect its optical characteristics, always wear the appropriate type of laser protective glasses according to IEC standard IEC825-1.

(3) Mounting

- When fitting a device to a heat sink, secure it by its flange. Do not fit a device in such a way that the device's cap will be nipped by the heat sink, as this will cause the window glass to break. When fixing a device's flange to the heat sink with screws, use a fastening torque of approximately 0.8 N·m and evenly tighten all the screws in stages (i.e. do not fully tighten one screw while the rest are still only loosely tightened).

- Device packages are hermetically sealed. Applying excessive stress to the lead-to-case junctions and glass surfaces will cause the hermetic seal to degrade.

- Be careful not to scratch or stain the window glass. The device's radiant power may decrease or the far-field pattern may become deformed. Avoid wiping the glass surface with cotton swabs etc. to remove accumulated dirt as this could cause damage to the glass.

- Avoid cleaning devices. Not only does cleaning reduce the adhesive strength of the window glass, it also causes the device's radiant power to decrease or the far-field pattern to become deformed due to impurities adhering to the window glass.

4.2 Power Devices

4.2.1 Vibration and impact

Use caution when handling devices and packing. Dropping devices or packing, or subjecting them to impact, may cause devices to break down. Be especially careful not to subject devices and packing to mechanical vibration or shock.
Some modules contain direct bond copper (DBC) ceramic boards. In addition, some high-power device packages are made of ceramics. High-power devices are heavy; if they are dropped, the ceramic may be damaged (i.e. it may crack).

4.2.2 Design

① Do not use devices under conditions in which their absolute maximum ratings (e.g. current, voltage or safe operating area) will be exceeded.
If used under these conditions, a device may break down, causing a large short-circuit current to flow, which may in turn cause it to catch fire or explode, resulting in fire or injury.

② Use a unit which can detect short-circuit currents and which will shut off the power supply if a short-circuit occurs. If the power supply is not shut off, a large short-circuit current will flow continuously, which may in turn cause the device to catch fire or explode, resulting in fire or injury.

③ When designing a case for enclosing your system, consider how best to protect the user from shrapnel in the event of the device catching fire or exploding.
Flying shrapnel can cause injury.

④ Make sure that all metal casings in your design are grounded to earth. Even in modules where a device's electrodes and metal casing are insulated, capacitance in the module may cause the electrostatic potential in the casing to rise. Dielectric breakdown may cause a high voltage to be applied to the casing, causing electric shock and injury to anyone touching it.

⑤ When designing the heat radiation and safety features of a system incorporating high-speed rectifiers, remember to take the device's forward and reverse losses into account.
The leakage current in these devices is greater than that in ordinary rectifiers; as a result, if a high-speed rectifier is used in an extreme environment (e.g. at high temperature or high voltage), its reverse loss may increase, causing thermal runaway to occur. This may in turn cause the device to explode and scatter shrapnel, resulting in injury to the user.

⑥ A design should ensure that, except when the main circuit of the device is active, reverse bias is applied to the device gate while electricity is conducted to control circuits, so that the main circuit will become inactive. Malfunction of the device may cause serious accidents or injuries.

(1) Unused pins

If a device which consists of multiple circuits is used with its unused pins left open, the device may operate erratically due to unstable inputs, or may break down due to a sudden increase in electric current. Apply a negative voltage as specified to the unused pins to ensure that they remain inactive. For details refer to the relevant datasheet and databook for the device.

(2) Latch-up

Some types of IGBT do not have sufficient tolerance against load shorting or overcurrent, resulting in a fault condition known as latch-up. When choosing an IGBT, check its intended use.

4.2.3 Inspection, testing and evaluation

⚠DANGER

① Never touch a power device while it is powered on. Also, after turning off a power device, do not touch it until it has thoroughly discharged all remaining electrical charge.
Touching a power device while it is powered on or still charged could cause a severe electric shock, resulting in death or serious injury.

② When conducting any kind of evaluation, inspection or testing, be sure to connect the testing equipment's electrodes or probes to the device under test before powering it on. When you have finished, discharge any electrical charge remaining in the device.
Connecting the electrodes or probes of testing equipment to a device while it is powered on may result in electric shock, causing injury.

⚠WARNING

① When conducting any kind of evaluation, inspection or testing, always use protective safety tools such as a cover for the device.
A device may explode, catch fire or generate sparking between an electrode and ground, resulting in injury to the user.

② Make sure that all metal casings in your design are grounded to earth. Even in modules where a device's electrodes and metal casing are insulated, capacitance in the module may cause the electrostatic potential in the casing to rise. Dielectric breakdown may cause a high voltage to be applied to the casing, causing electric shock and injury to anyone touching it.

⚠CAUTION

When conducting any kind of evaluation, inspection or testing, either wear protective gloves or wait until the device has cooled properly before handling it.
Devices become hot when they are operated. Even after the power has been turned off, the device will retain residual heat which may cause a burn to anyone touching it.

(1) Inspection

For protection against static charges, the gate and emitter terminals of IGBT modules are protected with conductive copper tape. Do not use them as shorted gate and emitter terminals for test purposes.

4.2.4 Mounting

Power devices are housed in various types of package, such as modules, lead-insertion packages, surface-mount packages and flat-type packages. The signal pins and the method of attaching the package to a heat sink (e.g. screwing, soldering or direct bond) are different for each type of package. For the screwing and direct bond heat sink attachment methods, there is a recommended tightening torque; in this case all the screws must be tightened evenly (i.e. one screw should not be fully tightened while the rest are still only loosely tightened). Similarly, soldering should be performed with caution so that no thermal stress is applied to the device. To ensure that device reliability will not be impaired, devices must be fitted so that they remain within stipulated torque and stress limits. For details of these limits, refer to the relevant individual datasheets and databooks for the devices used.

4.3 Microcontrollers

4.3.1 Design

(1) Using resonators which are not specifically recommended for use

Resonators recommended for use with Toshiba products in microcontroller oscillator applications are listed in Toshiba databooks along with information about oscillation conditions. If you use a resonator not included in this list, please consult Toshiba or the resonator manufacturer concerning the suitability of the device for your application.

(2) Undefined functions

In some microcontrollers certain instruction code values do not constitute valid processor instructions. Also, it is possible that the values of bits in registers will become undefined. Take care in your applications not to use invalid instructions or to let register bit values become undefined.

4.4 ASIC Products

4.4.1 Design

(1) Verifying power dissipation

When conducting design verification, it is necessary to consider any temperature increase due to power dissipation by the device itself. It is important to estimate the power dissipation under actual device operating conditions with the device mounted on the printed circuit board.

(2) Failure detection rate

Toshiba use customer-approved test data in their production tests. In order to conduct an exacting and reliable production test, Toshiba require test data with a high failure detection rate.

4.5 Bipolar ICs

4.5.1 ICs for use in automobiles

(1) Design

⚠CAUTION

① If your design includes an inductive load such as a motor coil, incorporate diodes into your design to prevent negative current from flowing in. Otherwise the device may malfunction or break down due to rush currents or counter electromotive force generated when the device is powered on and off. For information on how to connect the diodes, refer to the relevant individual datasheets for automobile ICs. Breakdown of the devices may result in injury.

② Ensure that the power supply to any device which incorporates protective functions is stable. If the power supply is unstable, the device may operate erratically, preventing the protective functions from working correctly. If protective functions fail, the device may break down, causing the device to explode and resulting in injury to the user.

- Heat radiation
  System power supply and driver ICs generate heat. When using these devices, refer to the technical databooks entitled Bipolar ICs for Use in Automobiles and General-Purpose Bipolar IC Databook, and incorporate sufficient heat radiation for the devices used into your design, so

that the heat generated will not exceed the stipulated junction temperature (Tj) at which the ICs' internal heat-isolating protective circuits are activated.

- Power supply fuses
  These ICs contain various protective circuits to prevent them from breaking down due to faulty wiring or when pulses of noise are input to the power supply. However, should the IC break down, a large current may continue to flow. To prevent this, use a fuse of the appropriate capacity for the power supply.
  For information about the various types of protective circuit incorporated into the ICs, refer to the individual datasheets for the devices used.

- Power supply
  Do not abruptly increase or decrease the power supply to a device.

(2) Mounting

- Heat sinks
  Depending on the type of package used (e.g. an HSIP7-P-2.54), a device's characteristics may be degraded if the package is attached to a heat sink using screws. In such cases please consult Toshiba or a Toshiba distributor.

4.5.2 Communication equipment ICs

(1) Design

When using these devices in power amps or system power supplies, be aware that since the effective current capacity of the output pins is 100 mA or higher, a device's DC output current may increase if there is any problem caused by an external component (in particular, leak current from a feedback resistor or a negative feedback capacitor). In some cases this will cause the product to generate heat or to catch fire. Take this into account when designing your product and choosing which components to use. For more detailed information, please refer to the individual datasheets or databooks.

(2) Mounting

Trends toward lightweight and compact design in mobile communications have resulted in the device-mounting board becoming vulnerable to distortion or deformation due to a lack of strength. This causes the devices to be imperfectly connected when mounted on the board. Therefore, carefully examine the board design and mounting methods to ensure that device pins are firmly connected to the board.

4.5.3 Audio/Video equipment ICs

These devices are designed for use in consumer electronics, typically in television and audio equipment. When using these devices in low-frequency audio amps, system power supply ICs, driver ICs or power ICs, pay attention to the following points:

(1) Design

- Circuit design
  Large leakage current in input or negative feedback capacitors causes the DC output voltage of power ICs to increase. In this case, if the speaker's DC input withstand voltage is low, the speaker may emit smoke or catch fire.
  This must be fully taken into account when selecting the types of capacitor and speaker to use, especially in the case of power ICs of the BTL (bridge-tied load) connection type, in which the DC output voltage is input directly to the speaker.

- Heat radiation
  Power ICs, system power supply ICs and driver ICs generate heat. When using these devices, and incorporate sufficient heat radiation for the devices used into your design, so that the heat generated will not exceed the stipulated junction temperature (Tj = 150°C) at which the ICs' internal thermal shutdown protective circuits are activated. For more detailed information, refer to the individual product datasheets and to the general audio/car audio LSI databooks. Also, take into account the operating temperature ranges and characteristics of the peripheral components used with power ICs.

- Power supply fuses
  These ICs contain various protective circuits to prevent them from breaking down due to faulty wiring or noise pulses on the power supply input. However, should the IC break down, a large current may continue to flow. To prevent this, use a fuse of the appropriate capacity for the power supply.

4.5.4 ICs for motors

(1) Design

- When designing a circuit incorporating a motor, be sure to incorporate a diode to act as a current-limiting resistance and to absorb any counter electromotive force so that the starting current or counter electromotive force does not cause any malfunction or breakdown in the IC. For detailed information concerning this type of design, refer to the relevant individual datasheets or databooks for ICs for motors.

- Circuits which are used to protect ICs from excessive current do not always work. If an IC is used outside its absolute maximum ratings, the IC may break down before the protective circuit is activated.

- Be sure to use a stable power supply for the IC. If the power supply is unstable, the internal circuits of the IC may function erratically, possibly causing the IC to break down.

(2) Heat radiation

- When using a driver IC, be sure to incorporate heat radiation so that the junction temperature (Tj) will never exceed 150°C. Since ICs generate considerable heat, ICs may break down if adequate heat radiation is not provided.

- Circuits which are used to protect devices from excessive heat do not always work. If an IC is used outside its absolute maximum ratings, it may break down before the protective circuit is activated.

- When attaching a heat sink to the driver IC, avoid excessive mechanical stress. Also note that some ICs inhibit the action of silicone rubber.

- When incorporating heat radiation or attaching heat sinks, refer to the relevant individual datasheets or databooks for ICs for motors.

(3) Power supply fuses

In order to prevent excessive current from flowing continuously when the IC breaks down, use a power supply fuse of an appropriate capacity. An IC may break down when used outside its absolute maximum ratings, or when wires or loads induce unusual pulse noise. The fuse capacity must be carefully determined in order to minimize any negative effect in the case of an IC breakdown and the resulting large current flow.

4.6 CCD Image Sensors

4.6.1 Storage

After removing the devices from their packing boxes, do not stack them directly on top of one another.

4.6.2 Mounting

(1) Dust or dirt sticking to the window glass surface can cause black flaws to appear on the image. Therefore, before using these devices clean the window glass surface. (For example, use a soft cloth or paper soaked in a small amount of organic solvent, such as alcohol, to wipe off dust and dirt.)

(2) Toshiba recommend the use of an IC inserter or similar appropriate tool to attach the devices to the printed circuit board. Also, it is recommended that the devices be attached without lead forming.