

4.1.6 Visible Semiconductor Lasers

4.1.6.1 Design



WARNING 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.

(1) 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.

(2) Power supplies and external noise

Before a device is operated, check that the device's 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 recommends carrying out noise simulation and implementing appropriate protective measures based on the results.

(3) 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 standards 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.

4.1.6.2 Inspection, Testing and Evaluation



CAUTION 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 IEC60825-1.

4.1.6.3 Mounting

- (1) 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).

- (2) Device packages are hermetically sealed. Applying excessive stress to the lead-to-case junctions and glass surfaces will cause the hermetic seal to degrade.
- (3) Be careful not to scratch or stain the window glass. The device's radiant power may decrease or the farfield 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.
- (4) Avoid cleaning devices. Not only does cleaning reduce the adhesive strength of the window glass, but it also causes the device's radiant power to decrease or the farfield 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 prevent 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.

4.2.2.1 Unused Pins

If a device is used with its unused pins left open, device operation may become unstable or the device may operate erratically. Connect unused signal pins to the power supply voltages used for signals. Apply a negative gate voltage of 10 V or more to the gate terminals of IGBTs, to make them resistant to breakdown voltages and voltage fluctuations.

4.2.2.2 Latch-up

Some types of IGBT do not have sufficient tolerance against load shorting or overcurrent, resulting in a fault condition called “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.

4.2.3.1 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.