4.1.3 Photosensors

4.1.3.1 Design

(1) Uses
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.

(2) 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 monitor, or some other similar fail-safe measure.

(3) 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 designed 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.

4.1.3.2 Mounting

(1) Cleaning accumulated dust from lens surfaces and checking for 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 recommends 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

4.1.4.1 Design

(1) 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.

(2) 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. This requires that 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 be fully taken into consideration at the design stage.

(3) Combustibility of package resin
The resin used in packages is V0 grade under UL-94 standards. Since this resin is not incombustible, 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.

4.1.4.2 Inspection, Testing and Evaluation

⚠WARNING 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.

(1) 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 a long time is not recommended.

4.1.4.3 Mounting

(1) 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.

4.1.4.4 Usage Environment

(1) Light disruption (e.g. sunlight or strobe flash)
Strong light (e.g. sunlight, a strobe flash or a search light) 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®)

4.1.5.1 Design

(1) 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.

(2) 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 will not touch the metal cover.

(3) 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.

(4) 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.

(5) Laying optical fiber cables
When laying optical fiber cables, bend them at 6 to 10 times the stipulated minimum bending radius.

4.1.5.2 Inspection, Testing and Evaluation

(1) 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 device's internal chip, 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.

4.1.5.3 Mounting

(1) Soldering
Since optical transmit/receive modules are optical components, do not use a soldering method affected by a 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 on the other components, clean the board and then solder the optical transmit/receive modules using a soldering iron.

4.1.5.4 Maintenance

(1) 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.

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