FIBER OPTIC TRANSCEIVING MODULE

# TODX2960A(F)

GENERAL PURPOSE OPTICAL TRANSCEIVING MODULE

- For JIS F07 type optical connector
- CMOS level interface
- +5V single power supply
- LED is driven by differential circuit.
- 770nm LED

Not Recommended for New Design

## 1. Absolute Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Storage Temperature | $T_{stg}$ | −40 to 95 | °C |
| Operating Temperature | $T_{opr}$ | −40 to 85 | °C |
| Supply Voltage | $V_{CC}$ | −0.5 to 6 | V |
| Input Voltage | $V_{IN}$ | −0.5 to $V_{CC}$ + 0.5 | V |
| High Level Output Current | $I_{OH}$ | −20 | mA |
| Low Level Output Current | $I_{OL}$ | 20 | mA |
| Soldering Temperature | $T_{sol}$ | 260 (Note 1) | °C |

Note 1: Soldering time ≤ 10 s (More than 1 mm apart from the package).

Using continuously heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/ “Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

## 2. Operating Ranges

| Characteristics | Symbol | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | 4.75 | 5.0 | 5.25 | V |
| High Level Input Voltage | $V_{IH}$ | 3.5 | — | $V_{CC}$ | V |
| Low Level Input Voltage | $V_{IL}$ | 0 | — | 1.5 | V |
| High Level Output Current | $I_{OH}$ | — | — | −2.0 | mA |
| Low Level Output Current | $I_{OL}$ | — | — | 2.0 | mA |

Start of commercial production
2016-01

## 3. Electrical and Optical Characteristics (Ta = 25°C, Vcc = 5 V)

| Characteristics | Symbol | Test Condition | | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Data Rate | — | NRZ Code (Note 2) | | DC | — | 10 | Mb/s |
| Transmission Distance | — | DC to10 Mb/s Using TODX2960A(F) | H-PCF (Note 3) | 0.2 | — | 1000 | m |
| | | | H-PCF (Note 4) | 0.2 | — | 700 | m |
| | | DC to 6 Mb/s Using TODX2960A(F) | H-PCF (Note 3) | 0.2 | — | 1000 | m |
| | | | H-PCF (Note 4) | 0.2 | — | 800 | m |
| Pulse Width Distortion (Note 3)(Note 4)(Note 5) | Δtw | Using H-PCF and TODX2960A(F) Pulse width 100ns Pulse cycle 200ns, $C_L$=10pF | | −30 | — | 30 | ns |
| | | Using H-PCF and TODX2960A(F) Pulse width 165ns Pulse cycle 330ns, $C_L$=10pF | | −55 | — | 55 | ns |
| Fiber Output Power (Note 6) | $P_f$ | R = 3.3kΩ | | −20 | — | −14 | dBm |
| Center Emission Wavelength | $\lambda_C$ | — | | — | 770 | — | nm |
| Current Consumption | $I_{CC}$ | R = 3.3kΩ | | — | 26 | 50 | mA |
| Maximum Receivable Power (Note 3)(Note 4)(Note 7) | $P_{MAX}$ | Using H-PCF and TODX2960A(F) DC to 10 Mb/s | | −14 | — | — | dBm |
| Minimum Receivable Power (Note 3)(Note 4)(Note 7) | $P_{MIN}$ | Using H-PCF and TODX2960A(F) DC to 10 Mb/s | | — | — | −29 | dBm |
| | | Using H-PCF and TODX2960A(F) DC to 6 Mb/s | | — | — | −30 | dBm |
| High Level Input Voltage | $V_{IH}$ | — | | 3.5 | — | — | V |
| Low Level Input Voltage | $V_{IL}$ | — | | — | — | 1.5 | V |
| High Level Input Current | $I_{IH}$ | $V_{CC}$ = 5.25V, $V_I$ = 2.7V | | — | — | 20 | μA |
| Low Level Input Current | $I_{IL}$ | $V_{CC}$ = 5.25V, $V_I$ = 0.4V | | — | — | −0.4 | mA |
| High Level Output Voltage | $V_{OH}$ | $V_{CC}$ = 4.75V | | 4.1 | 4.5 | — | V |
| Low Level Output Voltage | $V_{OL}$ | $V_{CC}$ = 4.75V | | — | 0.1 | 0.4 | V |

Note 2: LED is on when input signal is high level, it is off when low level.
High level output when optical flux is received. Low level output when it is not received.
The duty factor must be kept 25 to 75%.

Note 3: H-PCF (200μm core / 230μm cladding) .F07 type optical connector with polished surface.

Note 4: H-PCF (200μm core / 230μm cladding). F07 type optical connector with non-polished surface (cut by fiber cutter).

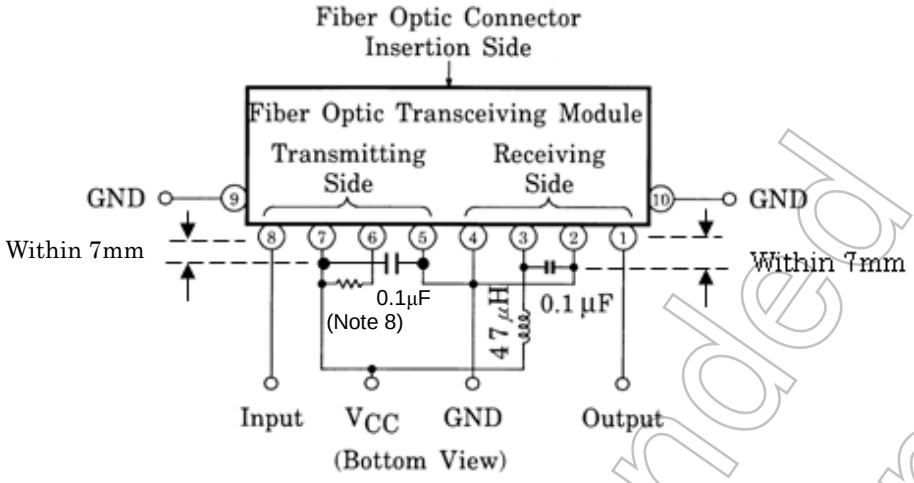
Note 5: Between input of TODX2960A(F) and output of TODX2960A(F).

Note 6: Measure with a standard optical fiber with fiber optic connectors. Valued by peak.

Note 7: BER ≤ $10^{-9}$, Valued by peak.

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## 4. Application Circuit




Note 8: Select a resistor value as follows (with TODX2960A(F))

(1) DC to 10 Mb/s (with TODX2960A(F))

| Fiber Optic Connector Type Name | Transmission Distance (m) | Resistor (kΩ) |
|---|---|---|
| F07 type Optical Connector with H-PCF(200/230μm). Polished Surface. | 0.2 to 1000 | 3.3 |
| F07 type Optical onnector with H-PCF(200/230μm). non-Polished Surface. (cut by fiber cutter) | 0.2 to 700 | 3.3 |

(2) DC to 6 Mb/s (with TODX2960A(F))

| Fiber Optic Connector Type Name | Transmission Distance (m) | Resistor (kΩ) |
|---|---|---|
| F07 type Optical Connector with H-PCF(200/230μm). Polished Surface. | 0.2 to 1000 | 3.3 |
| F07 type Optical onnector with H-PCF(200/230μm). non-Polished Surface. (cut by fiber cutter) | 0.2 to 800 | 3.3 |

## 5. Applicable Optical Fiber with Fiber Optic Connectors

Plastic Cladding Silica Fiber (200μm core / 230μm cladding),
F07 type Optical Connector with polished surface, or non-polished surface(cut by fiber cutter)

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## 6. Precautions during use

(1) Absolute maximum rating

The absolute maximum ratings are the limit values which must not be exceeded during operation of device. None of these rating value must not be exceeded. If the absolute maximum rating value is exceeded, the characteristics of devices may never be restored properly. In extreme cases, the device may be permanently damages.

(2) Operating Range

The operating range is the range of conditions necessary for the device to operate as specified in individual technical datasheets and databooks. Care must be exercised in the design of the equipment.
If a device is used under conditions that do not exceed absolute maximum ratings but exceed the operating range, the specifications related to device operation and electrical characteristics may not be met, resulting in a decrease in reliability.
If greater reliability is required, derate the device's operating ranges for voltage, current, power and temperature before use.

(3) Lifetime of light emitters

If an optical module is used for a long period of time, degeneration in the characteristics will mostly be due to a lowering of the fiber output power (Pf). This is caused by the degradation of the optical output of the LEDs used as the light source. The cause of degradation of the optical output of the LEDs may be defects in wafer crystallization or mold resin stress. The detailed causes are, however, not clear.
The lifetime of light emitters is greatly influenced by the operating conditions and the environment in which it is used as well as by the lifetime characteristics unique to the device type. Thus, when a light emitting device and its operating conditions determined, Toshiba recommend that lifetime characteristics be checked.
Depending on the environment conditions, Toshiba recommend that maintenance such as regular checks of the amount of optical output in accordance with the condition of operating environment.

(4) Soldering

Optical modules are comprised of internal semiconductor devices. However, in principle, optical modules are optical components. During soldering, ensure that flux does not contact with the emitting surface or the detecting surface. Also ensure that proper flux removal is conducted after soldering.
Some optical modules come with a protective cap. The protective cap is used to avoid malfunction when the optical module is not in use. Note that it is not dust or waterproof.
As mentioned before, optical modules are optical components. Thus, in principle, soldering where there may be flux residue and flux removal after soldering is not recommended. Toshiba recommend that soldering be performed without the optical module mounted on the board. Then, after the board has been cleaned, the optical module should be soldered on to the board manually.
If the optical module cannot be soldered manually, use non−halogen (chlorine−free) flux and make sure, without cleaning, there is no residue such as chlorine. This is one of the ways to eliminate the effects of flux. In such a cases, be sure to check the devices' reliability.

(5) Noise resistance

It is believed that the use of optical transfer devices improve noise resistance. In theory, optical fiber is not affected by noise at all. However, receiving modules which handle signals whose level is extremely small, are susceptible to noise.
TOSLINK improve noise resistance to use a conductive case. However, the current signal output by the optical receiving modules' photodiode is extremely small. Thus, in some environments, shielding the case may not achieve sufficient noise resistance.
First systems which incorporate TOSLINK, Toshiba recommend testing using the actual device to check its noise resistance.
Use a simple noise filter on TOSLINK fiber optic transceiving module's power line. If the ripple in the power supply used is significant, reinforce the filter.
The optical module is to be used in an area which is susceptible to radiated noise, increase the shielding by covering the optical module and the power line filter with a metallic cover.

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(6) Vibration and shock
This module is plastic sealed and has its wire fixed by resin. This structure is relatively resistant to vibration and shock. In actual equipment, there are sometime cases in which vibration, shock, or stress is applied to soldered parts or connected parts, resulting in lines cut. A care must be taken in the design of equipment which will be subject to high levels of vibration.

(7) Fixing fiber optical transceiving module
Solder the fixed pin (pins 9 and 10) of fiber optic transceiving module TODX2960A(F) to the printed circuit board to fix the module to the board.

(8) Shielding and wiring pattern of fiber optic transceiving modules
To shield, connect the fixed pins (pins 9 and 10) of fiber optic transceiving module TODX2960A(F) to the GND.
Where the fiber optic transceiving module uses conductive resin, be careful that the case does not touch wiring (including land).
To improve noise resistance, shield the optical module and the power line filter using a metallic cover.

(9) Solvent
When using solvent for flux removal, do not use a high acid or high alkali solvent. Be careful not to pour solvent in to the optical connector ports. If solvent is inadvertently poured in to them, clean it off using cotton tips.

(10) Protective cap
When the TODX2960A(F) is not in use, attach the protective cap.

(11) Incidence of a photo flash
If strong light such as a photo flash is incident on an optical module, a transmission error may occur.
Be careful, to avoid such situations.

(12) Supply voltage
Use the supply voltage within the operating ranges ($V_{CC}$ = 5 ± 0.25 V). Make sure that supply voltage does not exceed the absolute maximum rating value of 6 V, even for an instant.

(13) Input voltage
If a voltage exceeding the absolute maximum rating value ($V_{CC}$ + 0.5 V) is applied to the transmitter input, the internal IC may suffer damage. If there is a possibility that excessive voltage due to surges may be added to the input terminal, insert a protective circuit.

(14) Output
If the receiver output is at low and is connected to the power supply, or if the output is high and is connected to GND, the internal IC may be destroyed.

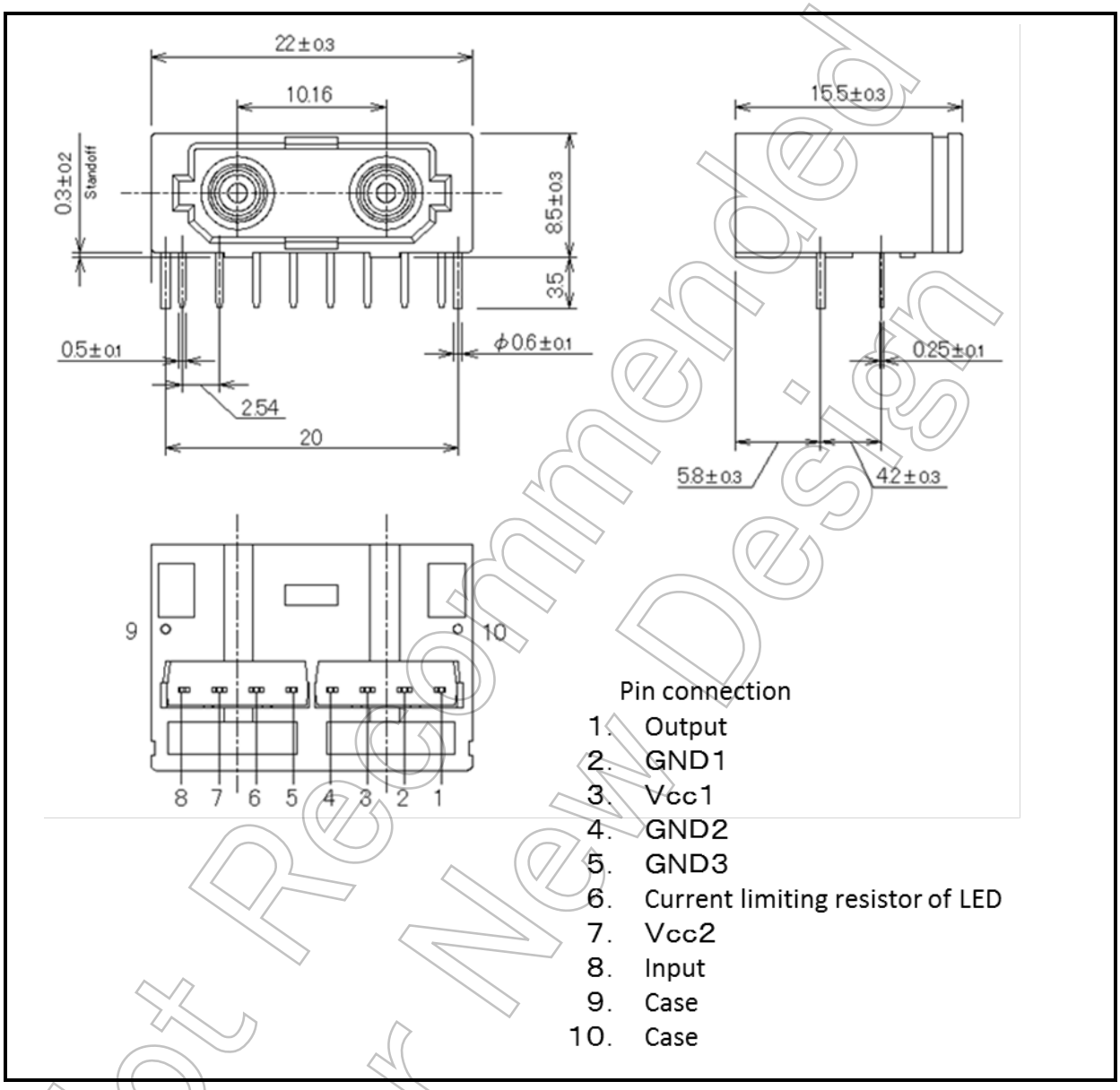
(15) Soldering condition
Solder at 260°C or less for no more than ten seconds.

(16) Precautions when disposing of devices and packing materials.
When disposing devices and packing materials, follow the procedures stipulated by local regulations in order to protect the environment against contamination.

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## 7. Package Outline drawing

Unit: mm




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