

PRODUCT GUIDE

# Fiber-Optic Devices TOSLINK™



# TOSLINK™ Optical Transmission Devices



External appearances of TOSLINK

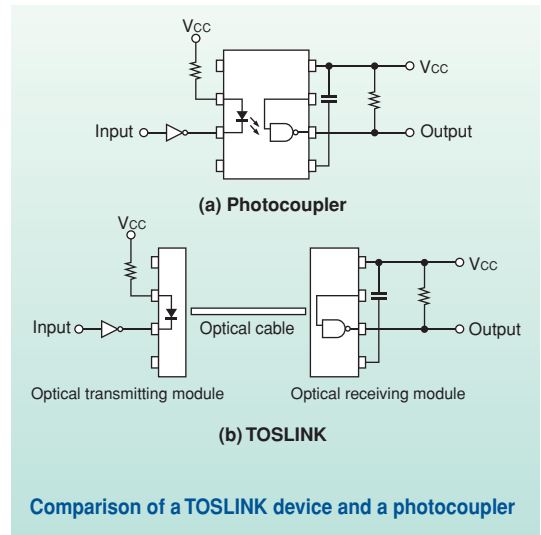
TOSLINK™ is a family of data transmission devices that use optical signals instead of electrical signals. Because TOSLINK uses an optical fiber cable as a transmission line, it provides the following benefits, compared to electrical transmission using a twisted-pair or coaxial cable:

## Comparison of TOSLINK devices and photocouplers

A photocoupler is a semiconductor that consists of a light-emitting device and a light-receiving device molded in one package. It is used to provide electrical isolation between input and output. In contrast, TOSLINK uses separate light-emitting and light-receiving units that are connected through a long optical cable.

Because an optical cable is used as a transmission line, it is possible to transmit signals over long distances while providing a galvanic isolation between the transmitting and receiving ends.

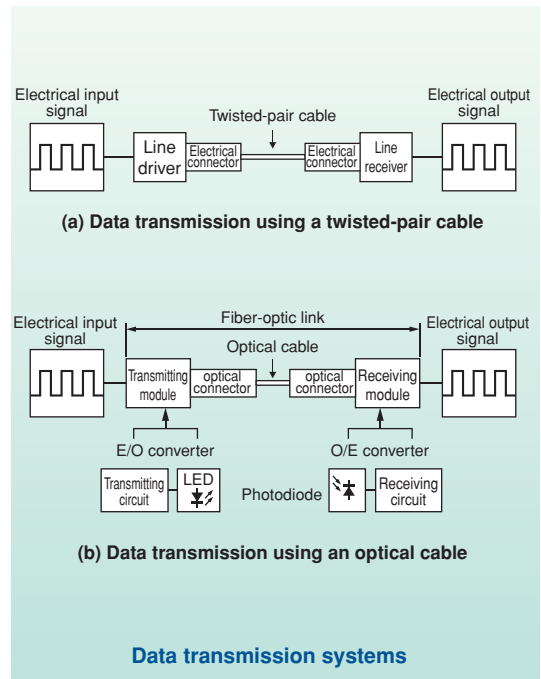
Thus, TOSLINK can be viewed, in a sense, as a long-distance photocoupler.



## Electrical and optical transmission systems

In an electrical data transmission system, a line driver is used to drive electrical signals through a long transmission line such as a twisted-pair cable. At the other end, a line receiver compensates for signal decay by amplifying the signals. A connector is required at each end of the cable. By contrast, in a TOSLINK-based system, a transmitting module converts electrical signals into optical signals, and a receiving module converts optical signals back to electrical signals. An optical fiber cable is used as a transmission line, and optical connectors link the transmitting and receiving modules to the cable.

The TOSLINK transmitting module incorporates a light-emitting diode and driver circuit. The TOSLINK receiving module incorporates a photodiode and waveform reshaping circuit. The interface is either TTL or PECL for both modules for easy connection with other peripheral ICs.



- The transmission line (i.e. the optical cable) is not susceptible to electromagnetic interference.
- The optical cable does not radiate any electromagnetic noise.
- The optical cable provides a complete galvanic isolation between equipments.

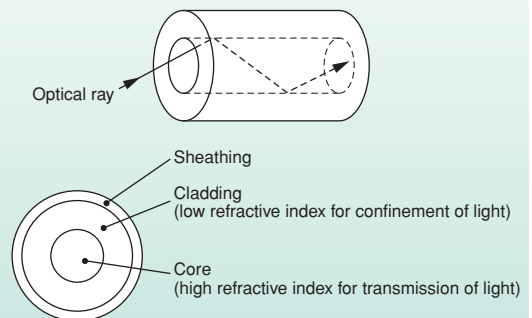
## Optical fiber

An optical fiber consists of a core surrounded by a cladding. An optical ray entering the fiber is reflected back at the boundary between the core and the cladding. In this manner, it travels along the length of the fiber.

There are three kinds of optical fiber:

- All-plastic fiber (APF)
- Plastic-clad silica fiber (PCF)
- Silica fiber

All-plastic fiber, having a plastic core and plastic cladding, is used for short-distance transmission. A plastic-clad silica fiber, which consists of a silica core and plastic cladding, is used for mid-distance transmission. Silica fiber consists of a pure silica core with silica cladding and is used for long-distance transmission. Each optical fiber has a lower transmission loss over a certain wavelength range and is used together with appropriate optical modules.

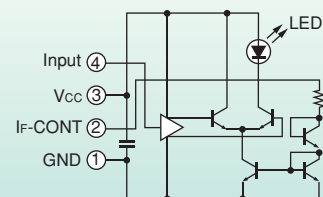


Structure of an optical fiber

## TOSLINK circuit configurations

### Optical transmission module

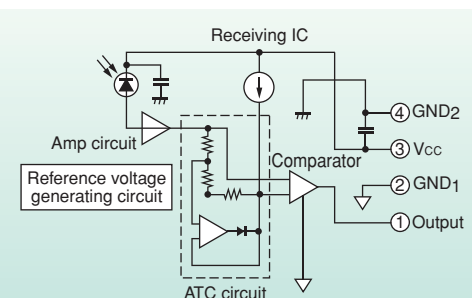
The LED is driven by a differential circuit to reduce current transients generated during the on-off switching of the LED so that the LED's switching does not affect peripheral ICs.



Transmitting module

### Optical receiving module

The receiving module employs an ATC (automatic threshold control) circuit to reshape the waveform. The ATC circuit controls the comparator reference voltage so that it is always automatically adjusted in accordance with the input optical power. This minimizes pulse width distortion, regardless of the length or bending of the optical fiber.

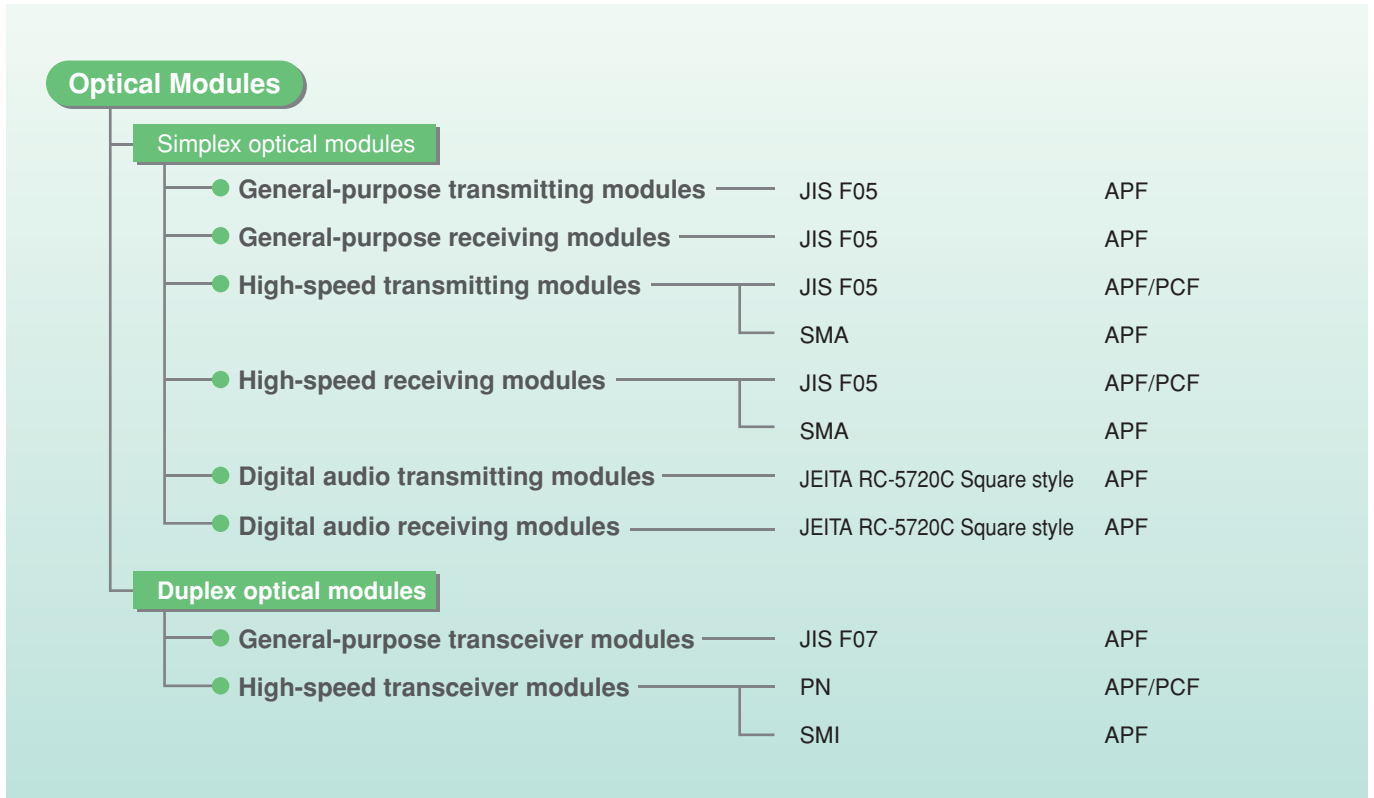


Receiving module

# TOSLINK™ Optical Transmission Devices

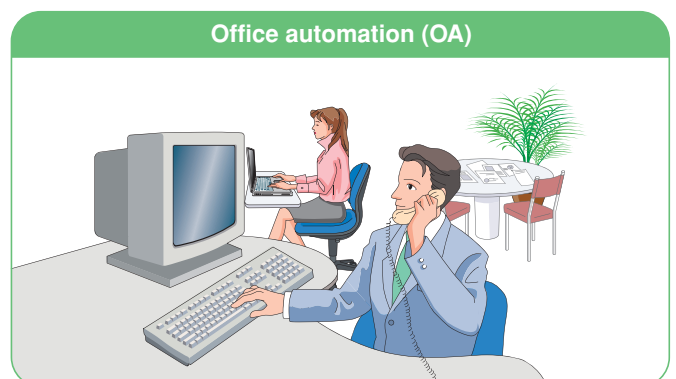
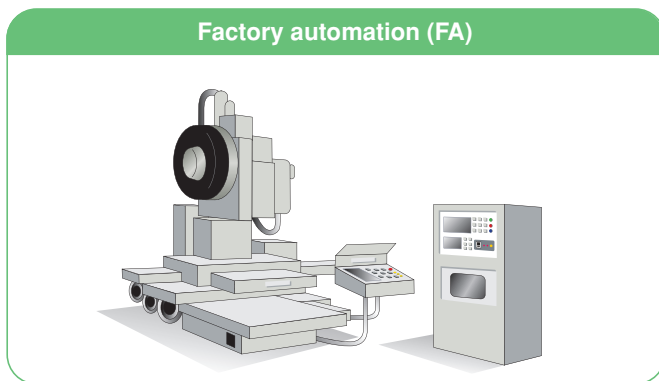
## TOSLINK categories

The Toshiba TOSLINK products are broadly categorized as follows.



## TOSLINK application examples

TOSLINK is used in a wide variety of applications, such as digital audio and factory automation.



# General-Purpose Optical Modules

## Upgrades of General-Purpose Optical Modules

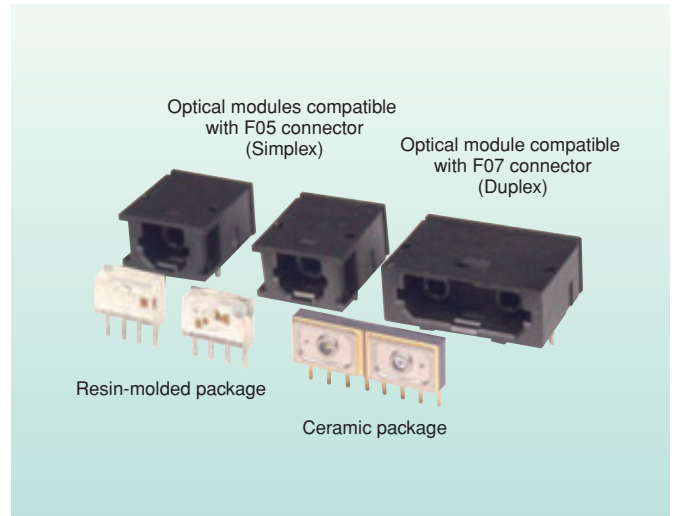
The TOSLINK 170, 180 and 190 Series are general-purpose optical modules well proven in the market. They have been upgraded, while maintaining their features and electro-optical characteristics.

### Features

- Resin mold and ceramic packages
- Simplex (JIS F05) and duplex (JIS F07)
- Available in versions suitable for various applications.

### Key specifications

- Data Rate: DC to 10 Mb/s(NRZ)
  - Transmission Distance:
    - APF-compatible modules: Up to 50 m
    - PCF-compatible modules: Up to 1000 m  - Power Supply:  $5 \pm 0.25$  V
  - Operating Temperature:  $-40$  to  $85^{\circ}\text{C}$
- Note: Key specifications differ from module to module. For details, see the appropriate technical datasheet.



## Compatibility of the General-Purpose Optical Modules

Package	Connector	LED	Transmitting Module		Receiving Module		Transceiving Module	
			Predecessor	Replacement	Predecessor	Replacement	Predecessor	Replacement
Resin mold	JIS F05/F07	Red	TOTX195(F)	TOTX1950(F)	TORX194(F)	TORX1950(F)	TODX295(F)	TODX2950(F)
			TOTX195A(F)		TODX295A(F)			
			TOTX197(F)		TODX297(F)			
			TOTX197A(F)	TODX297A(F)				
			TOTX170A(F)	TOTX1951(F)	TORX170(F)	TORX1951(F)	TODX270A(F)	TODX2951(F)
			TOTX171A(F)		TODX271A(F)			
			TOTX193(F)	TOTX1952(F)	TORX193(F)	TORX1952(F)	TODX293(F)	TODX2952(F)
			TOTX193A(F)		TODX293A(F)			
		Infrared	TOTX170(F)	TOTX1960(F)	TORX170(F)	TORX1950(F)	TODX270(F)	TODX2960(F)
			TOTX196B(F)		TODX270B(F)			
			TOTX194(F)	TORX194(F)	TODX294(F)			
			TOTX196(F)	TORX196(F)	TODX294B(F)			
					TODX296(F)			
					TODX296B(F)			
Ceramic	JIS F05/F07	Red	TOTX180A(F)	TOTX1850(F)	TORX180(F)	TORX1850(F) (Differs in pin assignment from TORX186)	TODX280A(F)	TODX2850(F)
		Infrared	TOTX180(F)	TOTX1860(F)	TORX180(F)		TODX280(F)	TODX2860(F) (Differs in pin assignment from TORX286)
					TORX186(F)	TODX286(F)		

The replacement modules have the same pin assignment as their respective predecessors, unless otherwise noted. However, replacement modules with different pin resistance may require an external capacitor. For details, see the appropriate technical datasheet.

# General-Purpose Optical Modules

## Connecting general-purpose optical modules

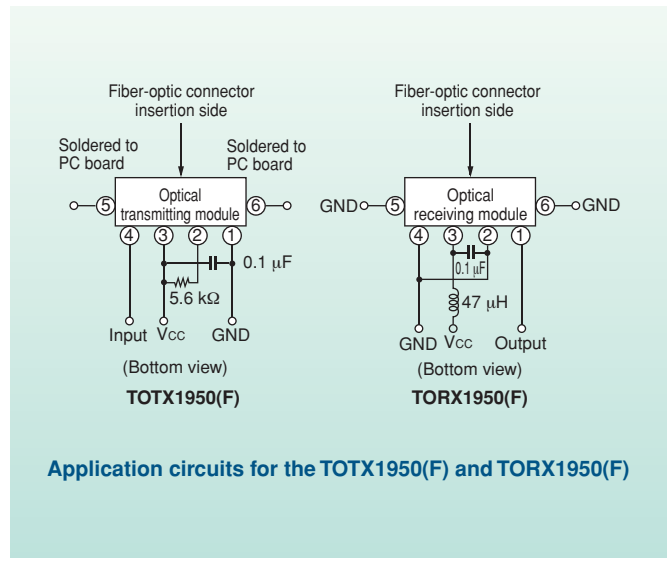
Application circuits for the TOTX1950(F) and TORX1950(F), a pair of transmitting and receiving modules, are shown in the figure on the right.

The TOTX1950(F) transmission module requires an external resistor to supply current to the LED. Additionally, it requires a capacitor as a noise filter.

The TORX1950(F) receiving module requires an inductor-capacitor noise filter on the Vcc line. The module case is made of conductive resin to provide a shielding effect against external noise. Pins #5 and #6 must be connected to the system ground.

There are also duplex modules in the general-purpose TOSLINK series; their application circuits are generally the same as for simplex modules.

All the general-purpose modules have a TTL interface for easy connection with peripheral digital ICs.

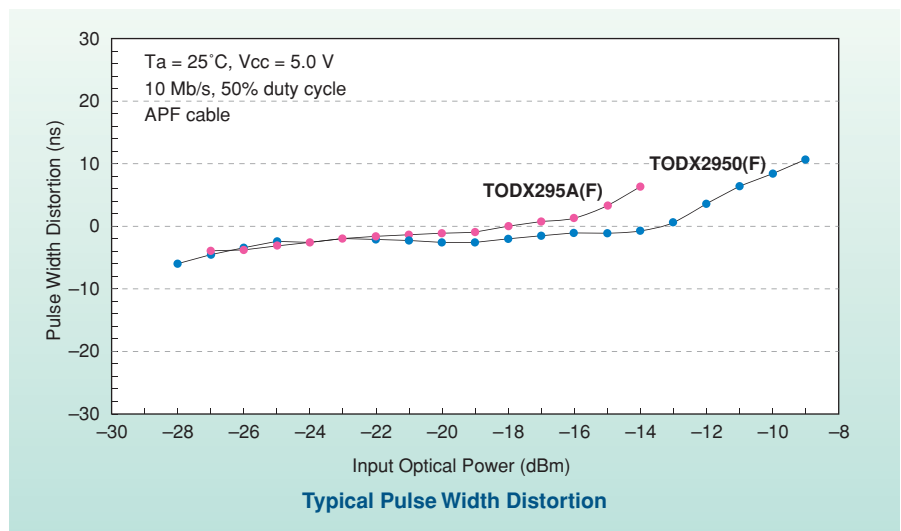


## Typical pulse width performance of general-purpose optical modules

Generally, the width of pulse trains generated by a receiving module varies with the input optical power. This is referred to as pulse width distortion.

The figure at right shows the pulse width distortion of a replacement and a predecessor module, the TODX2950(F) and TODX295A(F).

The replacement module provides a stable performance over a wider range of input optical power.

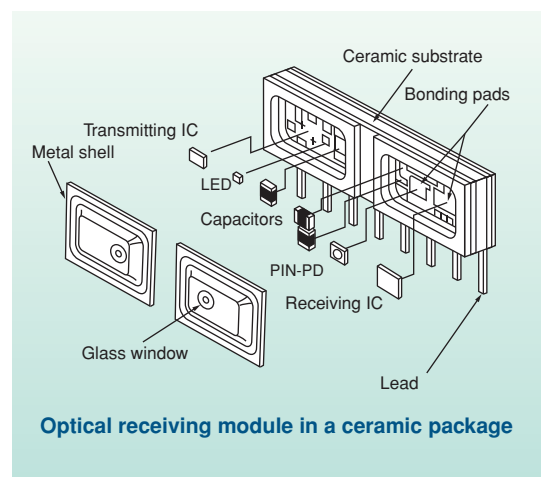


## General-purpose optical modules in ceramic packages

Toshiba offers several TOSLINK modules housed in ceramic packages that have higher reliability than plastic molded packages.

In ceramic packages, devices are mounted on a ceramic substrate and hermetically sealed in metal shells.

Ceramic packages provide superior moisture resistance and also reduce the stress put on the internal LED, leading to longer life.



# High-Speed Optical Modules

Toshiba offers high-speed optical modules compatible with JIS F05 and SMA connectors for simplex data transmission and those compatible with SMI (Small Multimedia Interface) and PN (Premises Network) connectors for duplex data communication.

JIS F05 and SMA connectors have been widely used in industrial applications in and outside Japan, respectively. SMI connectors are suitable for digital home appliances. While SMI connectors are about the same size as digital audio simplex connectors, they provide high-speed, full-duplex data transmission.

PN connectors are an improvement over JIS F07 connectors that have been widely used in industrial applications. TOSLINK is available in versions compatible with various connectors for high-speed optical communications.

## JIS F05 optical modules—TOTX1701(F) and TORX1701(F)

The TOTX1701(F) optical transmitting module and the TORX1701(F) optical receiving module support APF (all-plastic fiber) and PCF (plastic-clad silica fiber) cables.

They are compatible with JIS F05 connectors and well suited for a high-speed optical ring network.

### Key specifications

- Data rate: 20 to 125 Mb/s (NRZ code)
- Transmission distance: Up to 20 m of APF  
Up to 100m of GI-PCF
- Center wavelength: 650 nm
- Operating temperature: -10 to 70°C
- PECL interface
- Power supply: 3.3 V  $\pm$  0.3 V



## PN optical transceiver module—TODX2701(F)

The TODX2701(F) optical transceiver module supports APF (all-plastic fiber) and PCF (plastic-clad silica fiber) cables.

The TODX2701(F) is compatible with PN and JIS F07 connectors and well suited for Fast Ethernet (125 Mb/s) transmission.

### Key specifications

- Data rate: 20 to 125 Mb/s (NRZ)
- Transmission distance: Up to 20 m of APF  
Up to 100 m of GI-PCF
- Center wavelength: 650 nm
- Operating temperature: -10 to 70°C
- PECL interface
- Power supply: 3.3  $\pm$  0.3 V



# High-Speed Optical Modules

## SMI optical transceiver module—TODX2402(F)

The TODX2402(F) optical transceiver module is compatible with SMI connectors that have been proposed as an industry standard for digital home appliance applications.

The TODX2402(F) provides full-duplex 250 Mb/s transmission; thus it supports IEEE 1394b S100 (125 Mb/s), IEEE 1394b S200 (250 Mb/s) and Fast Ethernet (125 Mb/s).

### Key specifications

- Data rate: 20 to 250 Mb/s (NRZ)
- Transmission distance: up to 20 m at 250 Mb/s  
up to 50 m at 125 Mb/s
- Center wavelength: 650 nm
- Operating temperature: 0 to 60°C at 250 Mb/s  
–10 to 70°C at 125 Mb/s
- Built-in transmitting and receiving ICs
- PECL interface
- Power supply: 3.3 ± 0.3 V



## SMA optical transmitter and receiver modules—TOTX1400(F) and TORX1400(F)

The TOTX1400(F) optical transmitting module and the TORX1400(F) receiving module support APF (all-plastic fiber) cables.

The TOTX1400(F) and TORX1400(F) are compatible with SMA connectors and well suited for Fast Ethernet (125 Mb/s) transmission.

### Key specifications

- Data rate: 20 to 125 Mb/s (NRZ)
- Transmission distance: Up to 50 m of APF
- Center wavelength: 650 nm
- Operating temperature: –10 to 70°C
- PECL interface
- Power supply: 3.3 ± 0.3 V








# Digital Audio Optical Modules

The digital audio optical modules are capable of transferring digital audio interface signals. The interface level and optical connector configuration conform to the Digital Audio Interface (DAI) standards JEITA CP-1212 and RC-5720C respectively. These modules are therefore ideal for a wide variety of applications, ranging from audio visual equipment such as DVD players to sound applications for personal computer and computer entertainment systems.

## Product Lineup<sup>(1)</sup>

Digital audio optical modules are available with an optional shutter and in several choices of packages, supply voltages and data rates.

Package		Power Supply		Data Rate (Mb/s)
		5 V	3 V (3.3 V)	
	Transmitter	TOTX177A(F,T) TOTX177A(F,TJ)	TOTX147A(F,T) TOTX147A(F,TJ)	DC to 15
	Receiver	TORX177(F,T) TORX177(F,TJ)	TORX147(F,T) TORX147(F,TJ)	0.1 to 15
	Transmitter	TOTX177AL(F,T) TOTX177AL(F,TJ)	TOTX147AL(F,T) TOTX147AL(F,TJ)	DC to 15
	Receiver	TORX177L(F,T) TORX177L(F,TJ)	TORX147L(F,T) TORX147L(F,TJ)	0.1 to 15
	Transmitter	TOTX177APL(F,T) TOTX177APL(F,TJ)	TOTX147APL(F,T) TOTX147APL(F,TJ)	DC to 15
	Receiver	TORX177PL(F,T) TORX177PL(F,TJ)	TORX147PL(F,T) TORX147PL(F,TJ)	0.1 to 15

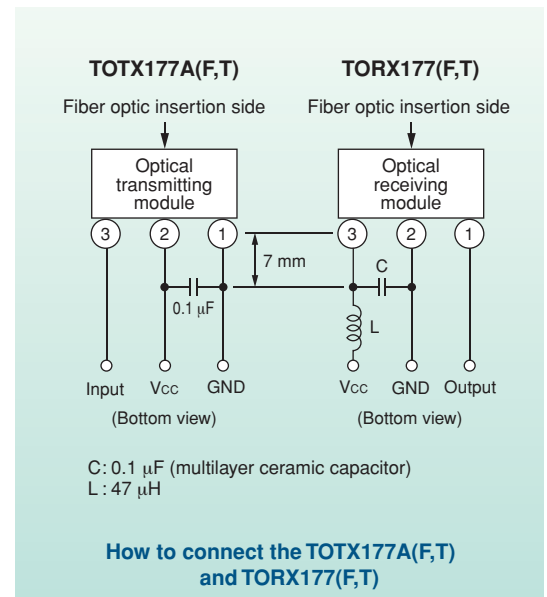
## Application circuit

The figure at right shows application circuit of the TOTX177A(F,T) and TORX177(F,T).

The TOTX177(F,T) transmitting module requires a bypass capacitor.

The TORX177(F,T) receiving modules requires an inductor and a capacitor for a noise filter.

Products in different packages, such as the TOTX177AL(F,T) and TORX177PL(F,T), can also be used in the same way.















Note: (1) Products listed in this table are manufactured by Toshiba Semiconductor Thailand Co., Ltd. For the availability of these products, contact the Toshiba distributors. Optical modules with the (F,T) suffix are manufactured by Toshiba Semiconductor Thailand Co., Ltd. The ordering codes for these optical modules have the (F,TJ) suffix in Japan. For details, contact the your local Toshiba distributor.

# Optical Module Product Lineup

## 1. Simplex Optical Modules

### 1-1. General-purpose optical modules





Transmitting Module	Receiving Module	Data Rate (NRZ, b/s)	Emission Wavelength (nm)	Transmission Distance (m) <sup>(1)</sup>	Pulse Width Distortion (ns) <sup>(1)</sup>	Power Supply (V)	Operating Temperature (°C)	Compatible Optical Connector	Compatible Optical Fiber (μm)
TOTX1950(F) <sup>(2)</sup> 	TORX1950(F) 	DC to 10 M	650	Up to 50	±30 (at 10 Mb/s) ±55 (at 6 Mb/s)	5 ± 0.25	-40 to 85	JIS F05	APF (980/1000) NA = 0.5
TOTX1951(F) 	TORX1950(F), TORX1951(F) 	DC to 6 M	650	Up to 40	±55 (at 6 Mb/s)	5 ± 0.25	-40 to 85	JIS F05	APF (980/1000) NA = 0.5
TOTX1952(F) 	TORX1952(F) 	DC to 10 M	660	Up to 10	±30 (at 10 Mb/s)	5 ± 0.25	-40 to 85	JIS F05	APF (980/1000) NA = 0.5
TOTX1960(F) 	TORX1950(F) 	DC to 10 M	770	Up to 1000	±30 (at 10 Mb/s) ±55 (at 6 Mb/s)	5 ± 0.25	-40 to 85	JIS F05	H-PCF (200/230)
TOTX1850(F) <sup>(2),(3)</sup> 	TORX1850(F) <sup>(3)</sup> 	DC to 10 M	650	Up to 50	±30 (at 10 Mb/s) ±55 (at 6 Mb/s)	5 ± 0.25	-40 to 85	JIS F05	APF (980/1000) NA = 0.5
TOTX1860(F) <sup>(3)</sup> 	TORX1850(F) <sup>(2)</sup> 	DC to 10 M	770	Up to 1000	±30 (at 10 Mb/s) ±55 (at 6 Mb/s)	5 ± 0.25	-40 to 85	JIS F05	H-PCF (200/230)

Notes: (1) Ta = 25°C, Vcc = 5

(2) An external resistor should be selected according to the transmission length, depending on the data rate.







(3) Ceramic-packaged product

### 1-2. High-Speed Optical Modules

Transmitting Module	Receiving Module	Data Rate (NRZ, b/s)	Emission Wavelength (nm)	Transmission Distance (m) <sup>(1)</sup>	Power Supply (V)	Operating Temperature (°C)	Compatible Optical Connector	Compatible Optical Fiber (μm)
TOTX1400(F) 	TORX1400(F) 	20 to 125 M	650	Up to 50	3.3 ± 0.3	-10 to 70	SMA	APF (980/1000) NA = 0.3
TOTX1701(F) 	TORX1701(F) 	20 to 125 M	650	Up to 20 (APF) Up to 100 (GI-PCF)	3.3 ± 0.3	-10 to 70	JIS F05	APF (980/1000) NA = 0.3 GI-PCF (200/230)

Notes:(1) Ta = 25°C, Vcc = 5 V

### 1-3. Digital Audio Transmitting Modules

Transmitting Module <sup>(4)</sup>	Data Rate (NRZ, b/s)	Emission Wavelength (nm)	Fiber Output Power (dBm) <sup>(1)</sup>	Pulse Width Distortion (ns) <sup>(1)</sup>	Power Supply (V)	Operating Temperature (°C)	Compatible Optical Connector	Compatible Optical Fiber (μm)
TOTX147A(F,T) <sup>(5)</sup> TOTX147A(F,TJ) <sup>(5)</sup> 	DC to 15 M	650	-21 to -15	±15	2.7 to 3.6	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5
TOTX147AL(F,T) <sup>(5)(6)</sup> TOTX147AL(F,TJ) <sup>(5)(6)</sup> 	DC to 15 M	650	-21 to -15	±15	2.7 to 3.6	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5
TOTX147APL(F,T) <sup>(6)(7)</sup> TOTX147APL(F,TJ) <sup>(6)(7)</sup> 	DC to 15 M	650	-21 to -15	±15	2.7 to 3.6	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5
TOTX177A(F,T) <sup>(5)</sup> TOTX177A(F,TJ) <sup>(5)</sup> 	DC to 15 M	650	-21 to -15	±15	5 ± 0.25	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5
TOTX177AL(F,T) <sup>(5)(6)</sup> TOTX177AL(F,TJ) <sup>(5)(6)</sup> 	DC to 15 M	650	-21 to -15	±15	5 ± 0.25	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5
TOTX177APL(F,T) <sup>(6)(7)</sup> TOTX177APL(F,TJ) <sup>(6)(7)</sup> 	DC to 15 M	650	-21 to -15	±15	5 ± 0.25	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5

Notes: (1) Ta = 25°C, Vcc = 5 V

(4) Products listed in this table are manufactured by Toshiba Semiconductor Thailand Co., Ltd. For the availability of these products, contact the Toshiba distributors.

Optical modules with the (F,T) suffix are manufactured by Toshiba Semiconductor Thailand Co., Ltd. The ordering codes for these optical modules have the (F,TJ) suffix in Japan. For details, contact the your local Toshiba distributor.

(5) Panel-mount type (6) Shutter-equipped (7) Mini-package type (fixed to printed circuit board)

### 1-4. Digital Audio Receiving Modules

Receiving Module <sup>(4)</sup>	Data Rate (NRZ, b/s)	Minimum Receivable Power (dBm) <sup>(1)</sup>	Pulse Width Distortion (ns) <sup>(1)</sup>	Power Supply (V)	Operating Temperature (°C)	Compatible Optical Connector	Compatible Optical Fiber (μm)
TORX147(F,T) <sup>(5)</sup> TORX147(F,TJ) <sup>(5)</sup> 	0.1 to 15 M	-24 Max	±15	2.7 to 3.6	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5
TORX147L(F,T) <sup>(5)(6)</sup> TORX147L(F,TJ) <sup>(5)(6)</sup> 	0.1 to 15 M	-24 Max	±15	2.7 to 3.6	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5
TORX147PL(F,T) <sup>(6)(7)</sup> TORX147PL(F,TJ) <sup>(6)(7)</sup> 	0.1 to 15 M	-24 Max	±15	2.7 to 3.6	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5
TORX177(F,T) <sup>(5)</sup> TORX177(F,TJ) <sup>(5)</sup> 	0.1 to 15 M	-24 Max	±15	5 ± 0.25	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5
TORX177L(F,T) <sup>(5)(6)</sup> TORX177L(F,TJ) <sup>(5)(6)</sup> 	0.1 to 15 M	-24 Max	±15	5 ± 0.25	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5
TORX177PL(F,T) <sup>(6)(7)</sup> TORX177PL(F,TJ) <sup>(6)(7)</sup> 	0.1 to 15 M	-24 Max	±15	5 ± 0.25	-20 to 70	JEITA RC-5720C Square	APF (980/1000) NA = 0.5

Notes: (1) Ta = 25°C, Vcc = 5 V

(4) Products listed in this table are manufactured by Toshiba Semiconductor Thailand Co., Ltd. For the availability of these products, contact the Toshiba distributors.







Optical modules with the (F,T) suffix are manufactured by Toshiba Semiconductor Thailand Co., Ltd. The ordering codes for these optical modules have the (F,TJ) suffix in Japan. For details, contact the your local Toshiba distributor.

(5) Panel-mount type (6) Shutter-equipped (7) Mini-package type (fixed to printed circuit board)

# Optical Module Product Lineup

## 2. Duplex Optical Modules

### 2-1. General-purpose optical modules



Transceiving Module	Data Rate (NRZ, b/s)	Emission Wavelength (nm)	Transmission Distance (m) <sup>(1)</sup>	Pulse Width Distortion (ns) <sup>(1)</sup>	Power Supply (V)	Operating Temperature (°C)	Compatible Optical Connector	Compatible Optical Fiber (μm)
TODX2950(F) <sup>(2)</sup> 	DC to 10 M	650	Up to 50	±30 (at 10 Mb/s) ±55 (at 6 Mb/s)	5 ± 0.25	-40 to 85	JIS F07	APF (980/1000) NA=0.5
TODX2951(F) 	DC to 6 M	650	Up to 40	±55 (at 6 Mb/s)	5 ± 0.25	-40 to 85	JIS F07	APF (980/1000) NA = 0.5
TODX2952(F) 	DC to 10 M	650	Up to 10	±30(at 10 Mb/s)	5 ± 0.25	-40 to 85	JIS F07	APF (980/1000) NA=0.5
TODX2960(F) 	DC to 10 M	770	Up to 1000	±30 (at 10 Mb/s) ±55 (at 6 Mb/s)	5 ± 0.25	-40 to 85	JIS F07	H-PCF (200/230)
TODX2850(F) <sup>(2)(3)</sup> 	DC to 10 M	650	Up to 50	±30 (at 10 Mb/s) ±55 (at 6 Mb/s)	5 ± 0.25	-40 to 85	JIS F07 (PN)	APF (980/1000) NA=0.5
TODX2860(F) <sup>(3)</sup> 	DC to 10 M	770	Up to 1000	±30 (at 10 Mb/s) ±55 (at 6 Mb/s)	5 ± 0.25	-40 to 85	JIS F07 (PN)	H-PCF (200/230)

Notes: (1) Ta = 25°C, Vcc = 5 V

(2) An external resistor should be selected according to the transmission length, depending on the data rate.

(3) Ceramic-packaged product

### 2-2. High-Speed Optical Modules

Transceiving Module	Data Rate (NRZ, b/s)	Emission Wavelength (nm)	Transmission Distance (m) <sup>(1)</sup>	Power Supply (V)	Operating Temperature (°C)	Compatible Optical Connector	Compatible Optical Fiber (μm)
TODX2402(F) 	20 to 250 M	650	Up to 50 (125 M) Up to 20 (250 M)	3.3 ± 0.3	-10 to 70 (125 M) 0 to 60 (250 M)	SMI	APF (980/1000) NA = 0.3
TODX2701(F) 	20 to 125 M	650	Up to 20 (APF) Up to 100 (GI-PCF)	3.3 ± 0.3	-10 to 70	JIS F07 (PN)	APF (980/1000) NA = 0.3 GI-PCF (200/230)

Notes: (1) Ta = 25°C, Vcc = 5 V

# Recommended Optical Fibers with Optical Connectors

## 1. APF

	Category	Product Number	Compatible Optical Connector	Compatible Optical Fiber	Optical Fibers with Optical Connectors			
					Asahi Kasei E-Materials	Mitsubishi Rayon	Toray Industries	HONDA TSUSHIN KOGYO
Simplex	General-purpose	TOTX1950(F) TOTX1951(F) TOTX1952(F) TORX1850(F) TORX1950(F) TORX1951(F) TORX1952(F) TORX1850(F)	JIS F05	APF (980/1000 μm) NA = 0.5	LUCT1-TC1000-***M LUCT1-TC1000-50K-***M LUCT3-TC1000-***M LUCT3-TC1000-50K-***M		TOCP100-***MBT TOCP100P-***MBT TOCP155-***MBT TOCP155P-***MBT	
	High-speed	TOTX1701(F) TORX1701(F)						
		TOTX1400(F) TORX1400(F)	SMA	APF (980/1000 μm) NA = 0.3		RFA3021M-***		
Digital audio	TOTX177A(F,T) TORX177(F,T) etc.	JEITA RC-5720B Square	APF (980/1000 μm) NA = 0.5		RFA4011-***			
Duplex	General-purpose	TODX2950(F) TODX2951(F) TODX2952(F) TODX2850(F)	JIS F07	APF (980/1000 μm) NA = 0.5	LUCT2-TC1000W-***M LUCT2-TC1000W-60K-***M LUCT4-TC1000W-***M LUCT4-TC1000W-60K-***M		TOCP200-***MBT TOCP200P-***MBT TOCP255-***MBT TOCP255P-***MBT	
	High-speed	TODX2701(F)	PN			RFA4212G-***		
		TODX2402(F)	SMI	APF (980/1000 μm) NA = 0.3		RFA4412M-***		LPG-Z0005P Series

## 2.PCF

	Category	Product Number	Compatible Optical Connector	Compatible Optical Fiber	Optical Fibers with Optical Connectors	
					Sumitomo Electric Industries	Oki Electric Cable
Simplex	General-purpose	TOTX1960(F) TOTX1860(F) TORX1950(F) TORX1850(F)	JIS F05	H-PCF (200/230 μm)	CF-2071 (HC-20/70) Series	OPC202HV Series
	High-speed	TOTX1701(F) TORX1701(F)	JIS F05	GI-PCF (200/230 μm)	CF-1071 (HG-20/80) Series	
Duplex	General-purpose	TODX2960(F) TODX2860(F)	JIS F07	H-PCF (200/230 μm)	CF-2071 (HC-20/70) Series	OPC202HV Series
	High-speed	TODX2701(F)	PN	GI-PCF (200/230 μm)	CF-2071 (HG-20/80) Series	

# Precautions for Using TOSLINK™

## 1. Absolute Maximum Rating

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The absolute maximum ratings are the limit values that must not be exceeded during device operation. Any one of them must not be exceeded. Otherwise, the device characteristics may become unrestorable or the device may be permanently damaged in the worst case.

## 2. Operating Ranges

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The operating range is the range of conditions necessary for the device to operate as specified in individual technical datasheets and databooks. Even if a device is operated within the absolute maximum ratings, functional operation of the device or the specifications related to electrical characteristics may not be guaranteed beyond the conditions indicated under "Operating Ranges."

Exposure to conditions in excess of these ranges may also affect device reliability. Thus, special precautions are necessary in designing electronic systems. For higher reliability, operating ranges should be derated for current, power and temperature.

## 3. LED Lifetime

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Over a long period of time, the performance of an optical module will gradually be degraded, mostly be due to the lowering of the fiber output power (Pf). This is caused by the degradation of the optical output of the LED used as the light source. Its cause may be a wafer crystallization defect or mold resin stress, but no detail has been elucidated yet.

The lifetime of an LED is greatly influenced by the operating and environmental conditions in which it is used, as well as by the lifetime characteristics specific to the device type. Thus, once the type of the LED and the operating conditions have been determined, it is recommended to evaluate the lifetime characteristics.

Depending on the environmental conditions, Toshiba recommends that maintenance be performed regularly, including the checking of optical output.

## 4. Soldering

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Optical modules use semiconductor devices but are essentially optical components. When soldering, ensure that flux does not adhere to the light-emitting or light-receiving surfaces.

Take the same care when cleaning off flux after soldering.

Some optical transceiver modules include a protective cap. This cap is intended to prevent accidental operation when the module is not in use. It is not dust- or waterproof. Because the optical module is an optical component, Toshiba does not recommend soldering methods or post-solder flux cleaning methods in case where flux could affect the module. Toshiba recommends first soldering without mounting the module, then cleaning the PCB. The module should then be hand-soldered and no subsequent cleaning should be performed.

If it is not possible to hand-solder the module, one way of avoiding the effects of flux is to use non-halogen (chlorine-free) flux, taking care not to leave chlorine or other residue, and omitting the post-solder cleaning. In such cases too, the reliability of the device must be checked. Be sure to check the reliability of the device.

## 5. Noise Resistance

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The case for the TOSLINK optical receiving and transceiver modules is made of conductive plastic. The case is designed to provide shielding against noise when the reinforcing pin at the front of the module is grounded. When the module is used, this pin should be connected to the signal ground.

Since the case for the optical receiving and transceiver modules has a resistance of several tens of ohms, ensure that the case does not touch the power line or any other circuits.

Generally, the use of optical transmission devices is considered to improve noise resistance.

While optical fibers are certainly not affected by noise, optical modules, particularly receiver modules, are comparatively easily affected by noise because they handle such minute current signals.

To improve noise resistance, the TOSLINK case is treated to make it conductive. However, since the signal output from the optical receiving module's photodiode is a minute current signal, in some environments simply shielding the case will not protect against noise. When using a TOSLINK device, conduct live tests to check noise resistance.

A simple noise filter is mandatory for the power lines for the TOSLINK optical receiving module and optical transceiver module.

However, in the case of significant power supply ripples, further filter reinforcement is also necessary. In addition, when the optical module is placed in a location susceptible to emission noise, Toshiba recommends covering the optical module and power supply filter with a metal cover to enhance the shielding.

## 6. Vibration and shock

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Resin-molded optical modules are plastic-sealed devices whose wires are fixed with resin. While this structure makes them comparatively resistant to vibration and shock, wire breakage has been observed in equipment in which the soldering and connections are exposed to vibration, shock or stress. Therefore, when using a plastic-molded optical module in equipment with high vibration levels, ensure that the structure is designed to withstand vibration, shock and stress.

Ceramic-package optical modules are ceramic-sealed, with a hollow interior. Since the wires in the module are not fixed, the module is susceptible to vibration and shock.

Therefore, when using a ceramic-package optical module in equipment which is subject to high levels of vibration and shock, ensure that the structure of the equipment is designed to withstand vibration, shock and stress.

## 7. Support Pins

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The support pins of an optical module must be soldered onto a printed circuit board.

## 8. Shielding and Board Traces

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To provide a shielding effect, the support pins of optical receiver and transceiver modules must be grounded.

Also, for optical receiver and transceiver modules are housed in a conductive resin case, care should be taken so that it will not touch any board trace or land.

## 9. Solvent

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When using solvent for flux removal, do not use a strongly acidic or alkaline solvent. Be careful not to pour solvent into the optical connector ports. If solvent has inadvertently been poured into them, clean it off using cotton-tipped swab.

## 10. Protective Cap

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When the optical module is not in use, cover it with the protective cap.

## 11. Incidence of a Photo Flash

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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

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Modules should be used with a supply voltage within the standard operating conditions. Ensure that the power supply does not exceed the rated absolute maximum voltage of 6 V even momentarily.

## 13. Input Voltage

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If a voltage exceeding the absolute maximum rating ( $V_{CC} + 0.5\text{ V}$ ) is applied to the transmitter input, the internal IC may be adversely affected or destroyed. If there is a possibility of excessive input voltage due to a surge, for example, add a protective circuit to the input.

## 14. Output

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Note that internal ICs can be damaged when the receiver output is low and the output is shorted to the power supply, or when output is high and is shorted to GND.

## 15. Soldering condition

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Solder at 260°C or less for no more than ten seconds.

## 16. Disposal Precautions

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TOSLINK devices and packaging materials must be disposed of by the user as industrial waste products in an environmentally appropriate way and in accordance with the law.

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