TOKIN

OPTICAL DEVICES

# Optical devices

Vol.3

# CONTENTS

# Optical Isolators

## Outline

These compact optical isolators use TOKIN-made rare earth bismuth garnet crystals as Faraday rotators.

## Applications

- Light sources for optical fiber communications
- Light sources for optical fiber amplifiers

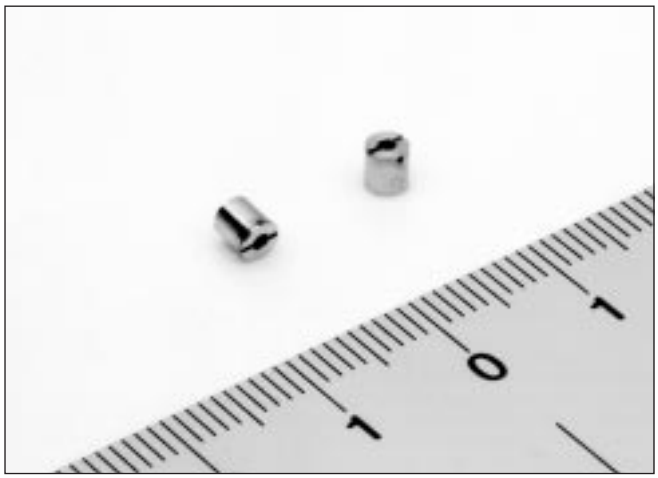
## Features

- Employ high-quality rare earth bismuth garnet crystals.
- Compact yet high performance.
- Bonded with solder and YAG laser welding to secure high reliability (PS, PSW and PW series).

* As an optical isolator for excimer laser, 0.98 (m is available aside from 1.48 (m. Pigtail type isolators and micro-miniature isolators for laser downsizing are available to satisfy individual customer requirements.

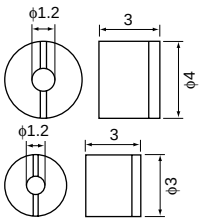
# Polarization Dependent Type

## Free Space Type 1.31$\mu$m/1.48$\mu$m/1.55$\mu$m/1.6$\mu$m/2.0$\mu$m

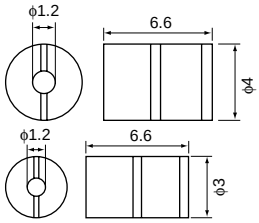


### Shapes and Dimensions

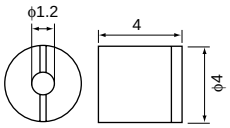
• PS series



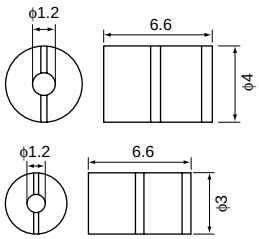

• PSW series




• D200-PS-4M




• PW series




[mm]

### Specifications

● PS series

| Code | Center wavelength ($\mu$m) | Aperture diameter (mm) | Isolation (dB) | Insertion loss (dB) | Outer dimension (mm) |
|---|---|---|---|---|---|
| D131-PS-4M | 1.31 | $\phi$1.2 | ≥35 | ≤0.3 | $\phi$4 |
| D148-PS-4M | 1.48 | | | | |
| D155-PS-4M | 1.55 | | | | |
| D131-PS-3M | 1.31 | | | | $\phi$3 |
| D148-PS-3M | 1.48 | | | | |
| D155-PS-3M | 1.55 | | | | |
| D162-PS-4M | 1.625 | | | ≤0.5 | $\phi$4 |
| D200-PS-4M | 2.00 | | | | |

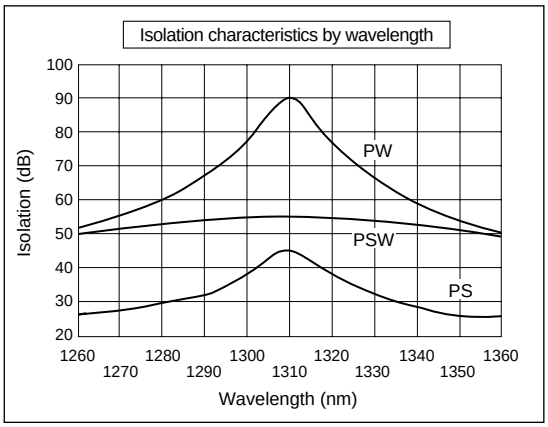
● PSW series

| Code | Center wavelength ($\mu$m) | Aperture diameter (mm) | Isolation (dB) | Insertion loss (dB) | Outer dimension (mm) |
|---|---|---|---|---|---|
| D131-PSW-4M | 1.31 | $\phi$1.2 | ≥50 | ≤0.7 | $\phi$4 |
| D148-PSW-4M | 1.48 | | | | |
| D155-PSW-4M | 1.55 | | | | |
| D131-PSW-3M | 1.31 | | | | $\phi$3 |
| D148-PSW-3M | 1.48 | | | | |
| D155-PSW-3M | 1.55 | | | | |

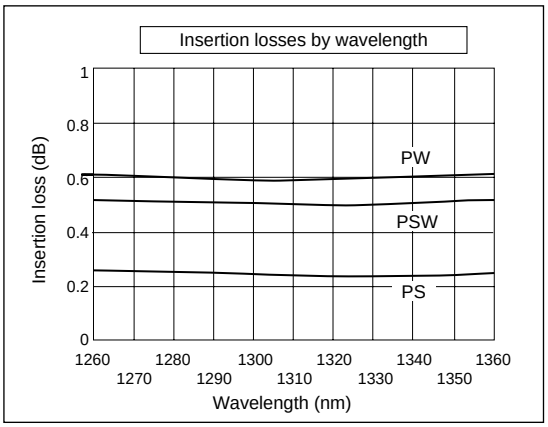
● PW series

| Code | Center wavelength ($\mu$m) | Aperture diameter (mm) | Isolation (dB) | Insertion loss (dB) | Outer dimension (mm) |
|---|---|---|---|---|---|
| D131-PW-4M | 1.31 | $\phi$1.2 | ≥60 | ≤0.7 | $\phi$4 |
| D148-PW-4M | 1.48 | | | | |
| D155-PW-4M | 1.55 | | | | |
| D131-PW-3M | 1.31 | | | | $\phi$3 |
| D148-PW-3M | 1.48 | | | | |
| D155-PW-3M | 1.55 | | | | |

● 1.31 μm




● 1.31 μm

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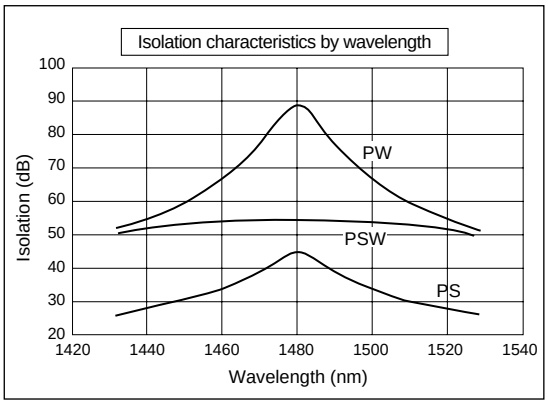
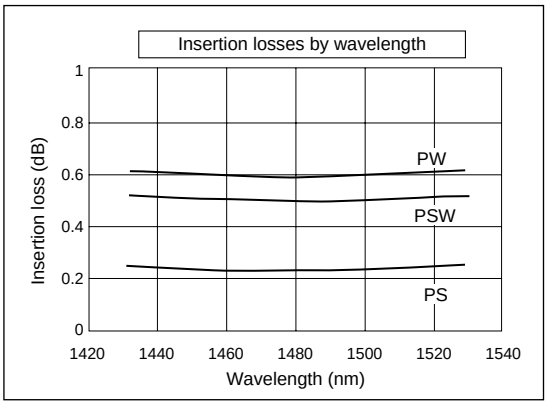
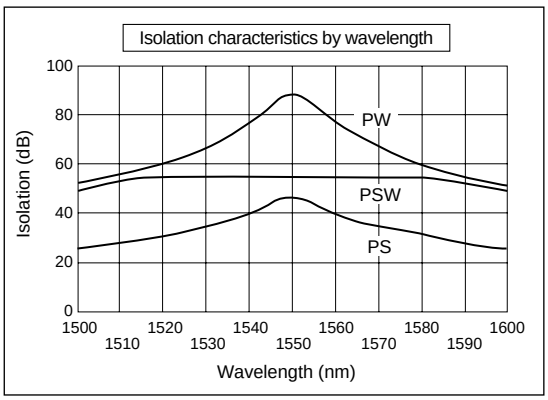


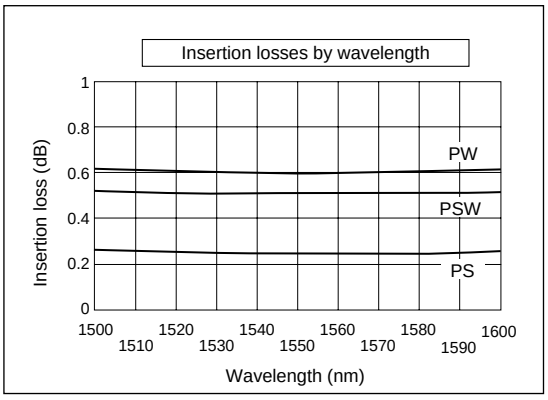

● 1.48 μm



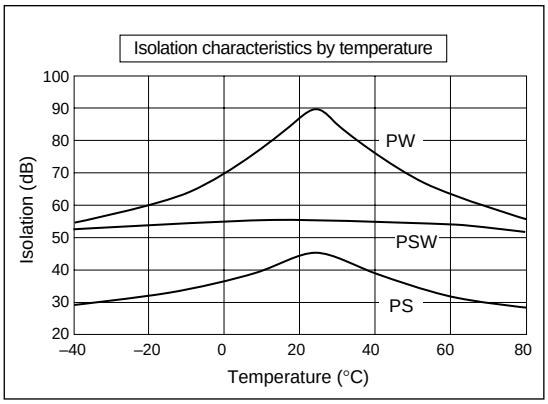

● 1.55 μm



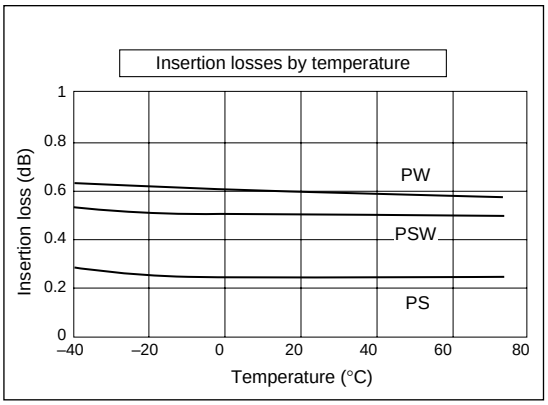

● 1.55 μm



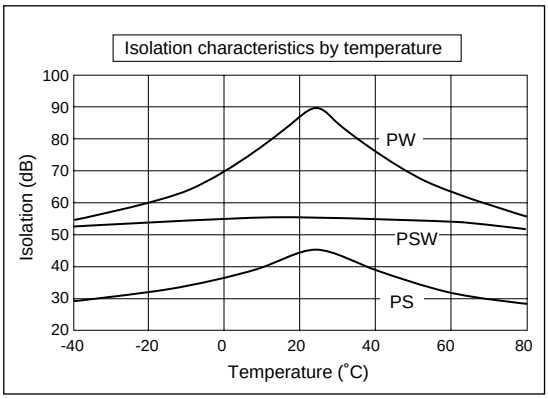

● 1.31 μm



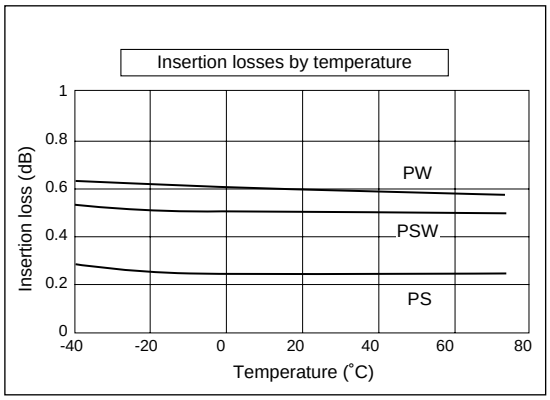

● 1.31 μm



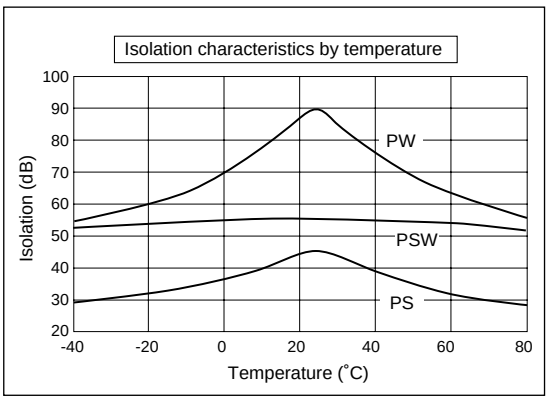
● 1.48 μm



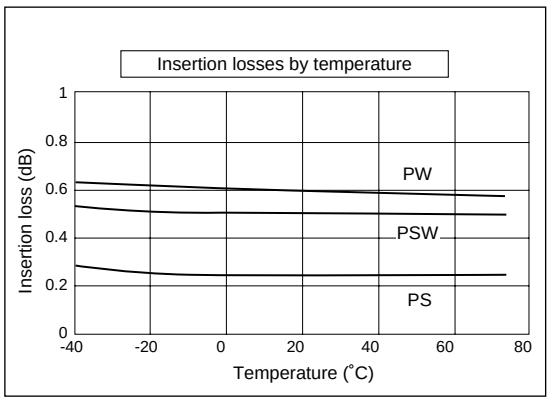

● 1.48 μm




● 1.55 μm




● 1.55 μm

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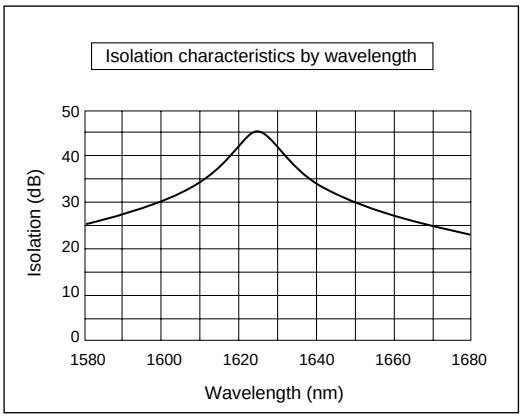
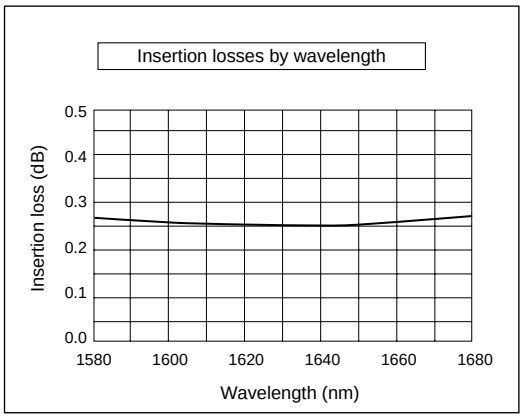
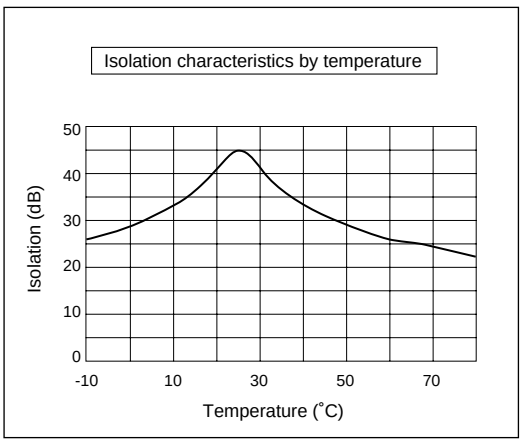
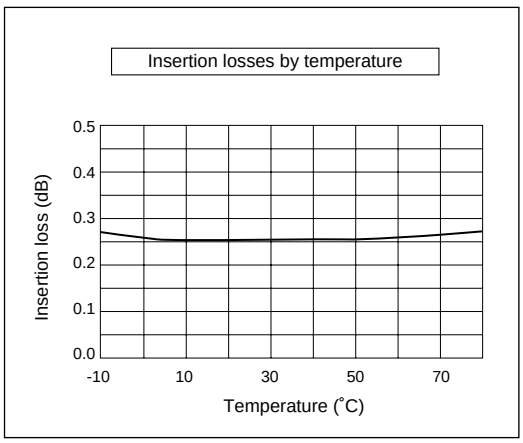


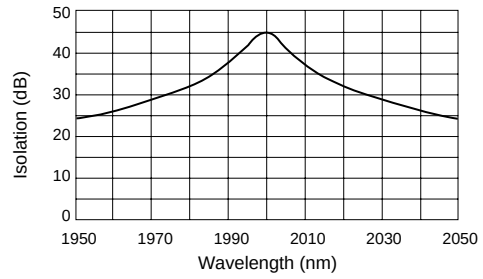



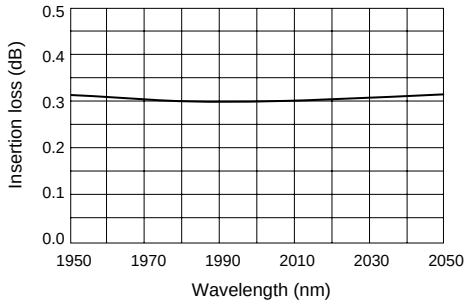



● 2.00 μm

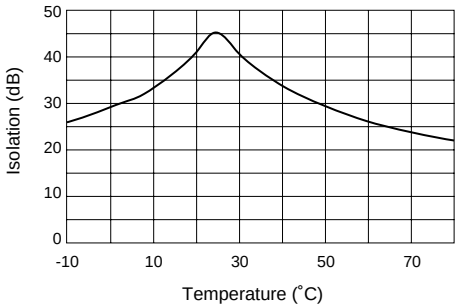
Isolation characteristics by wavelength



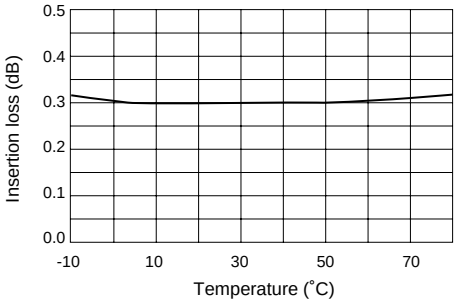

Insertion losses by wavelength



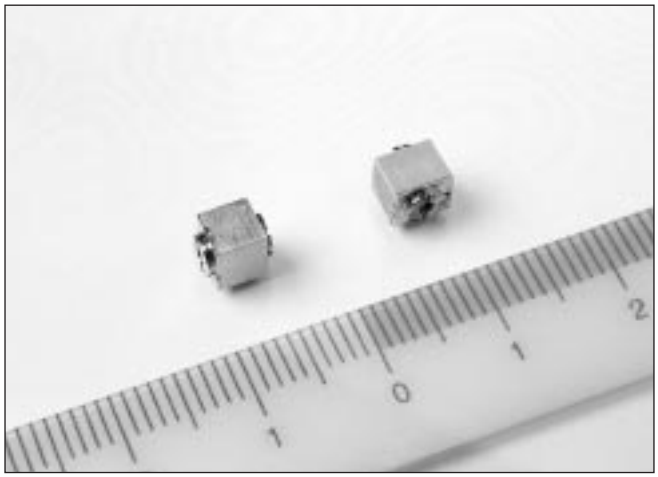

Isolation characteristics by temperature



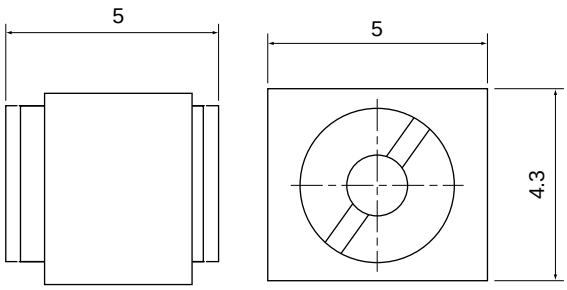

Insertion losses by temperature



# 0.98$\mu$m Free Shace Type



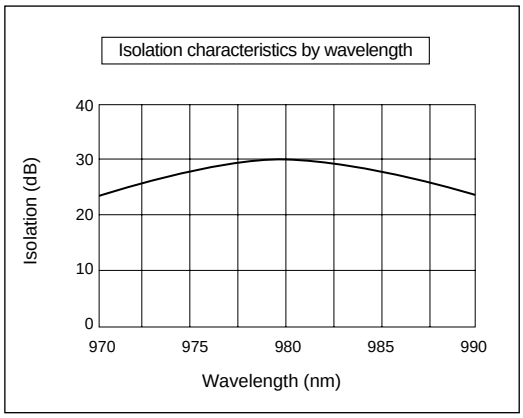
## Shapes and Dimensions

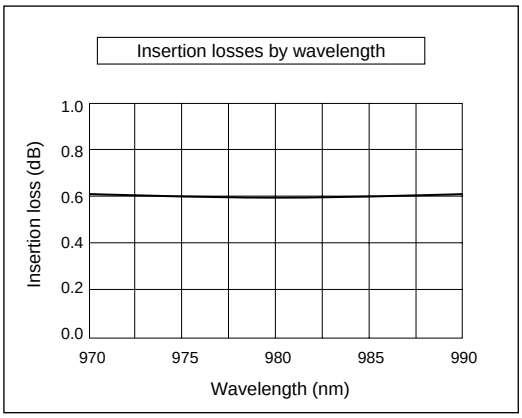


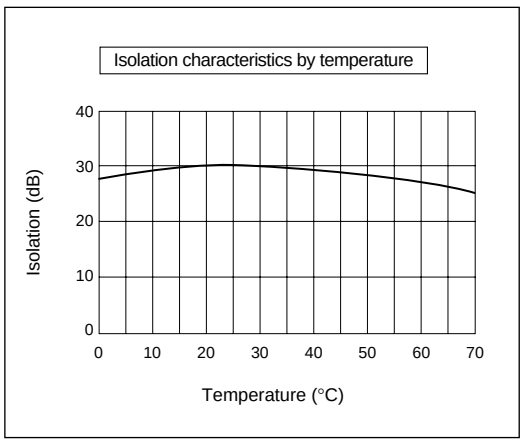

[mm]

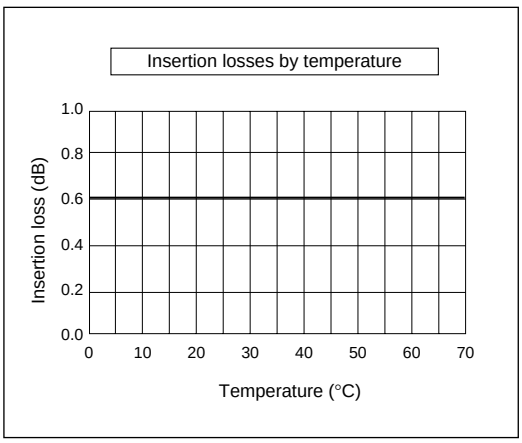
## Specifications

| Code | Center wavelength ($\mu$m) | Aperture diameter (mm) | Isolation (dB) | Insertion loss (dB) | Dimension (mm) |
|---|---|---|---|---|---|
| D98-PS-5M | 0.98 | $\phi$ 1 | ≥25 | ≤1.0 | 4.3 × 5 × 5 |

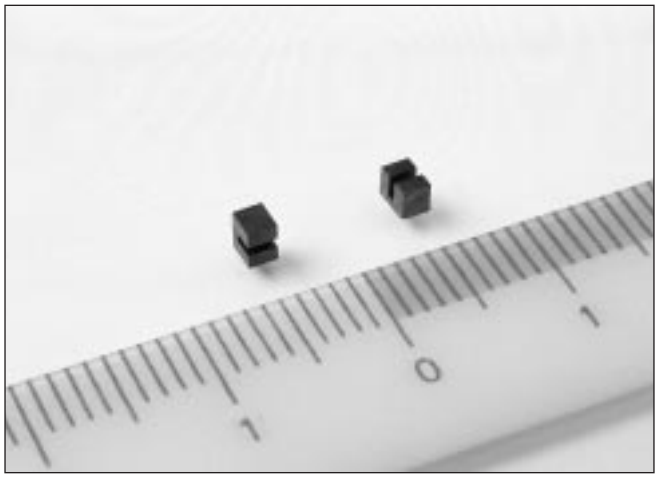


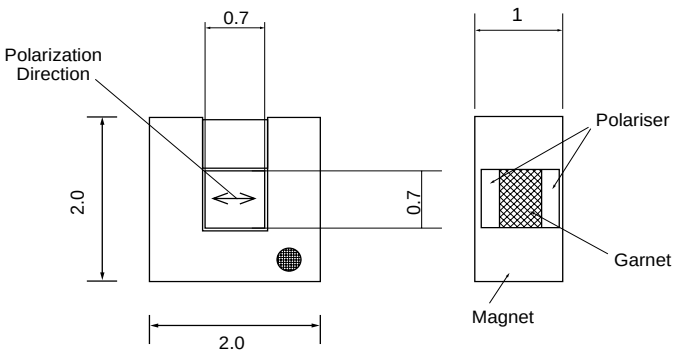



# Miniature Type 1.31μm/1.55μm



## Shapes and Dimensions

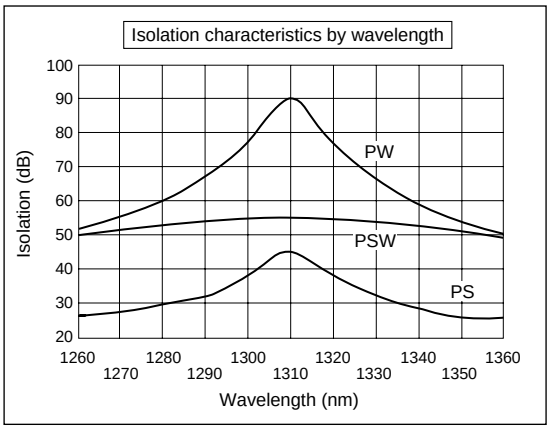



[mm]

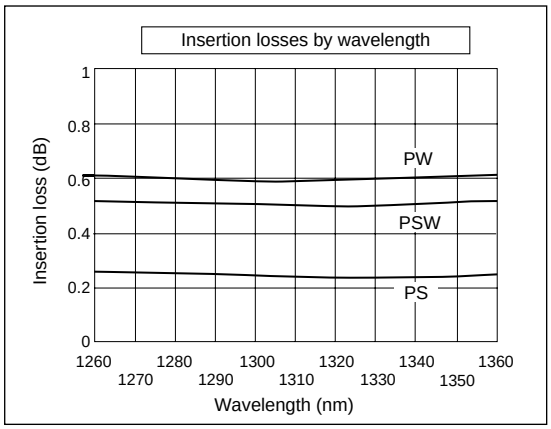
## Specifications

| Code | Center wavelength (μm) | Aperture diameter (mm) | Isolation (dB) | Insertion loss (dB) | Outer dimension (mm) |
|---|---|---|---|---|---|
| D131-PS-3E | 1.31 | 0.7×0.7 | ≥30 | ≤0.3 | 2×2×1 |
| D155-PW-3E | 1.55 | | | | |

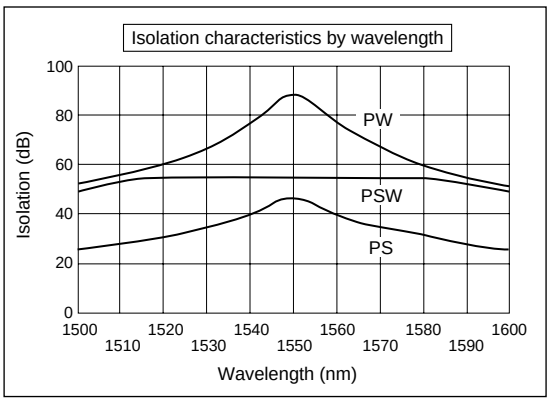
● 1.31 μm



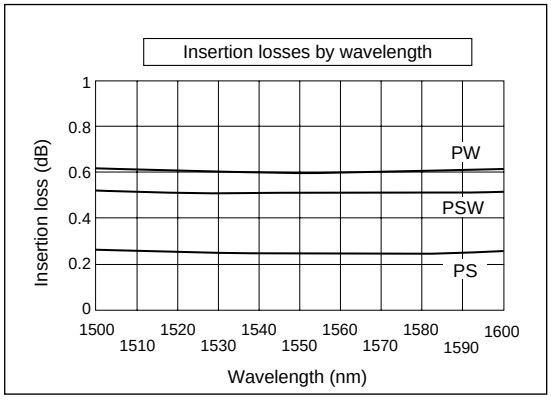

● 1.31 μm



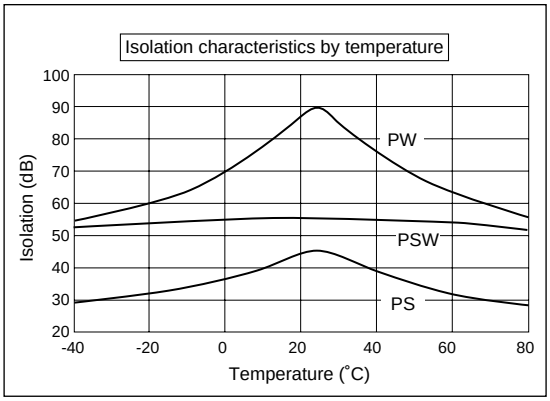

● 1.55 μm



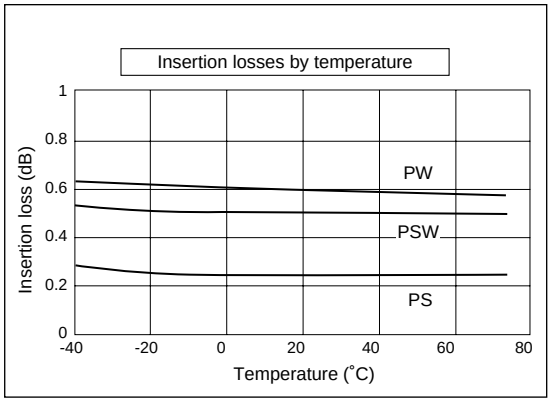

● 1.55 μm



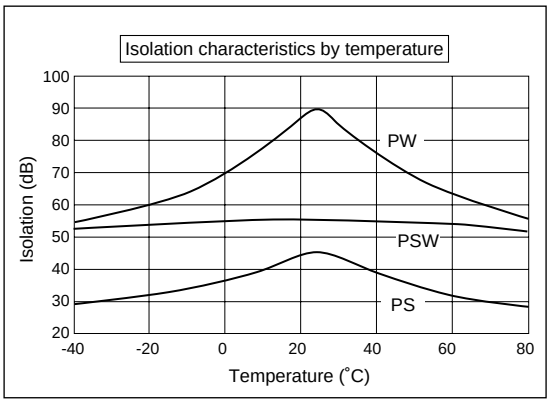
● 1.31 μm



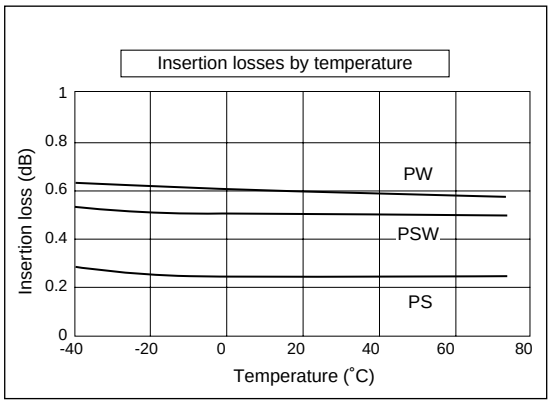

● 1.31 μm



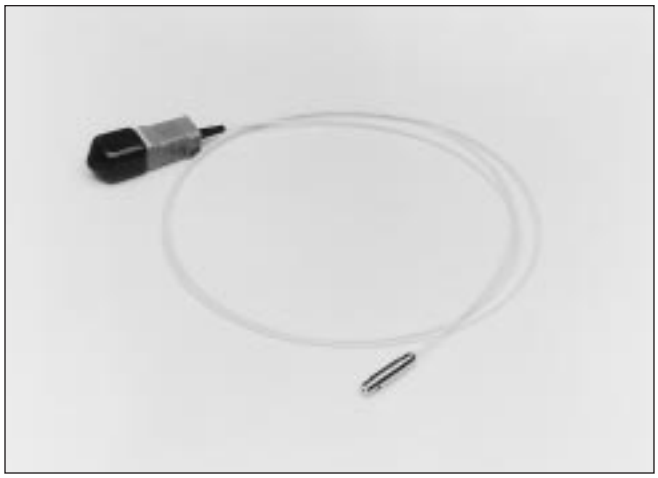

● 1.55 μm




● 1.55 μm



# Pig-tail Type 1.31$\mu$m/1.55$\mu$m



## Shapes and Dimensions

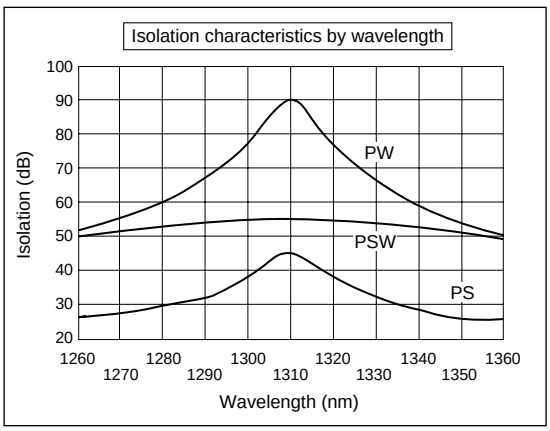

[mm]

## Specifications

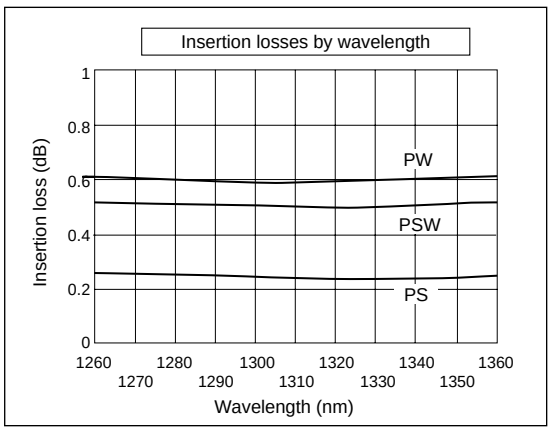
| Code | Center wavelength ($\mu$m) | Aperture diameter (mm) | Isolation (dB) | Insertion loss (dB) | Outer dimension (mm) |
|---|---|---|---|---|---|
| D131-PS-3E | 1.31 | $\phi$ 0.65 | ≥30 | ≤0.9* | $\phi$ 2.5 |
| D155-PW-3E | 1.55 | | | | |

*Includes connector losses.

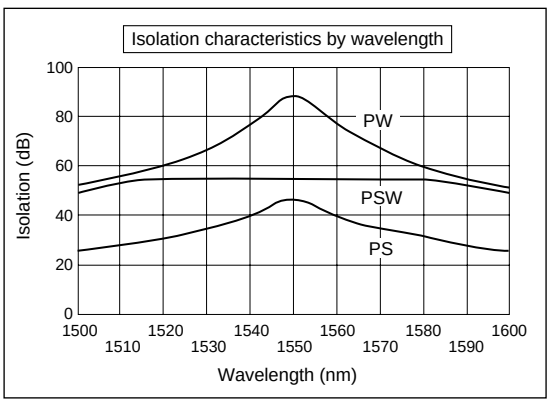
● 1.31 μm



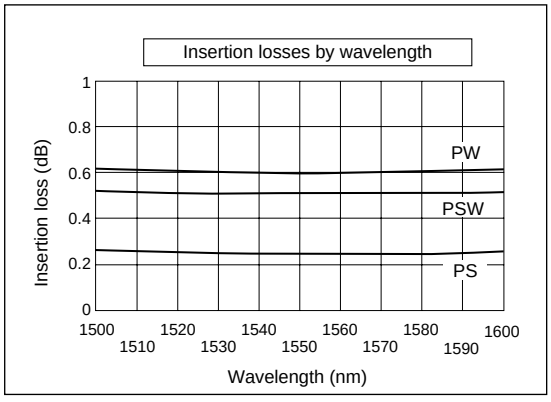

● 1.31 μm



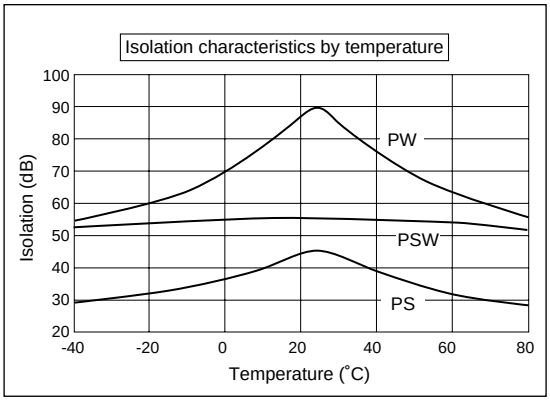

● 1.55 μm



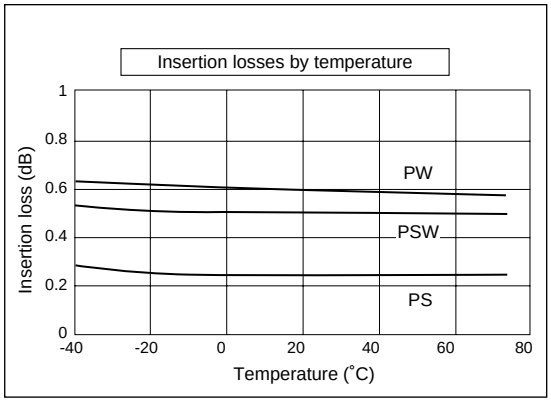

● 1.55 μm



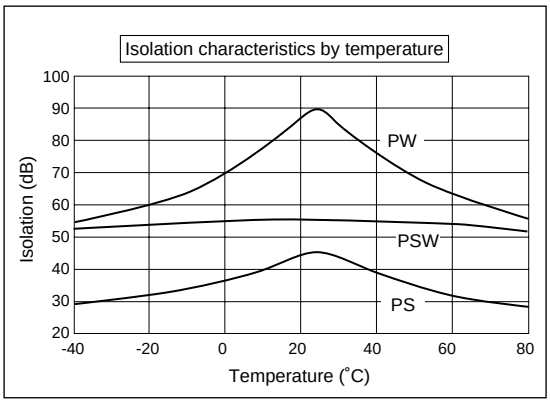
● 1.31 μm



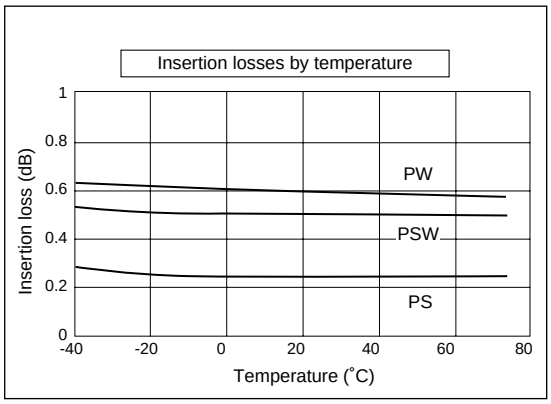

● 1.31 μm




● 1.55 μm




● 1.55 μm



# Polarizatior Independent Type

## In-Line Type

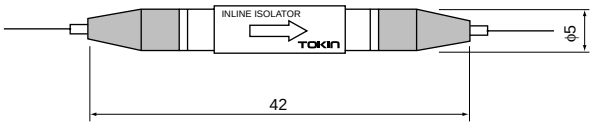
### Outline

These compact optical isolators use TOKIN-made rare earth bismuth garnet crystals as Faraday rotators. Applicable to the widening of band (C band, L band or wide band) resulting from wavelength division multiplexing.

### Applications

- Light sources for optical fiber communications
- Light sources for optical fiber amplifiers

### Shapes and Dimensions




[mm]

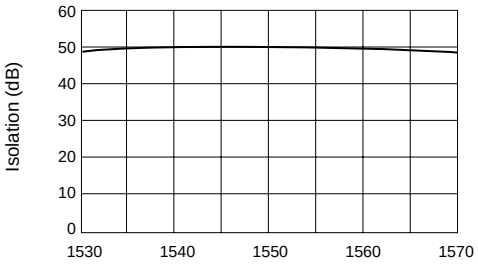
### Specifications

| Code | Center wavelength ($\mu$m) | Isolation (dB) | Insertion loss (dB) | PDL (dB) | Return loss (dB) | PMD (PS) | Outer dimension (mm) |
|---|---|---|---|---|---|---|---|
| I155-PW-5EF-C | 1.545 | ≥50 | ≤0.5 (Typical 0.4) | ≤0.1 (Typical 0.3) | ≥55 | ≤0.05 | $\phi$ 5 |
| I155-PW-5EF-L | 1.588 | | ≤0.6 (Typical 0.5) | | | | |
| I155-PW-5EF-A | 1.535 | | | | | | |

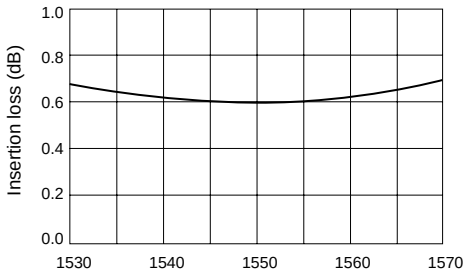
*at center wave I ength and 23˚C

I155-PW-5EF-C

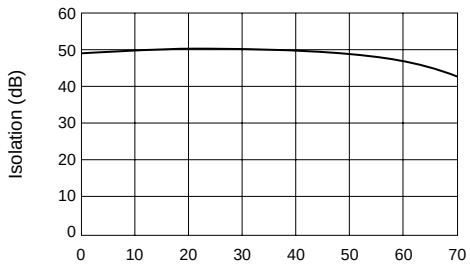
Isolation characteristics by wavelength



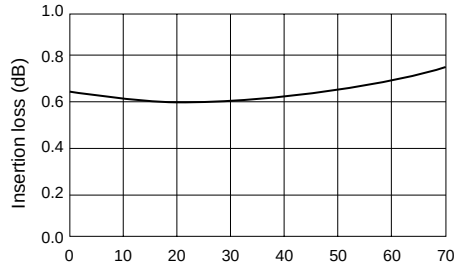

Insertion losses by wavelength



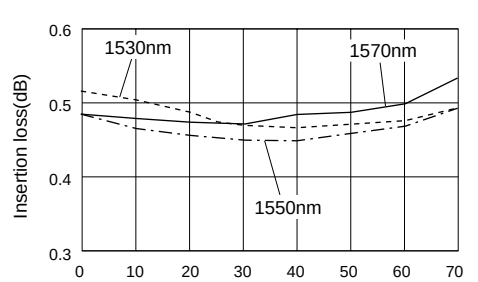

Isolation characteristics by temperature



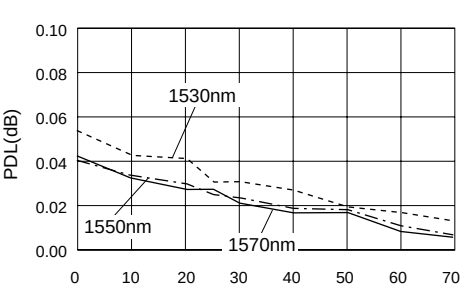

Insertion losses by temperature



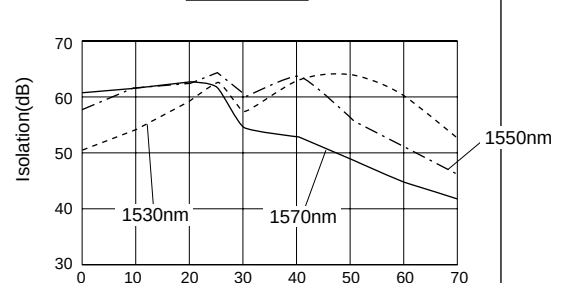

Insertion loss



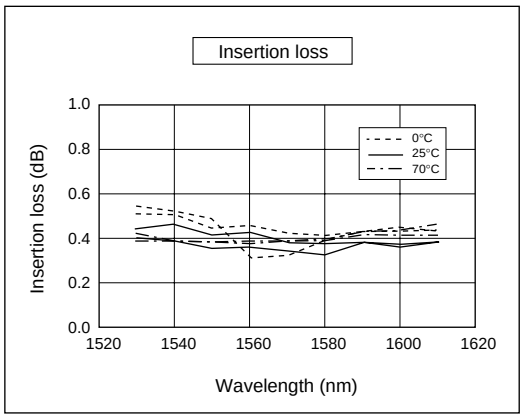

PDL

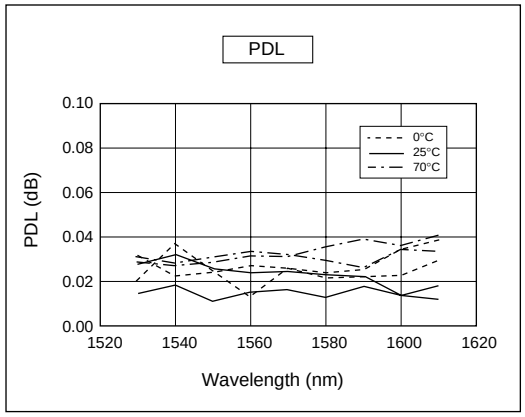


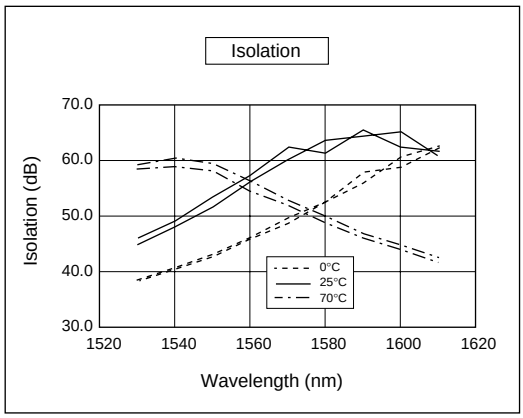

Isolation



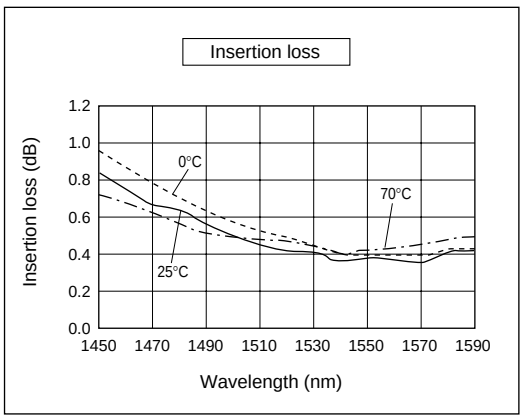
I155-PW-5EF-L

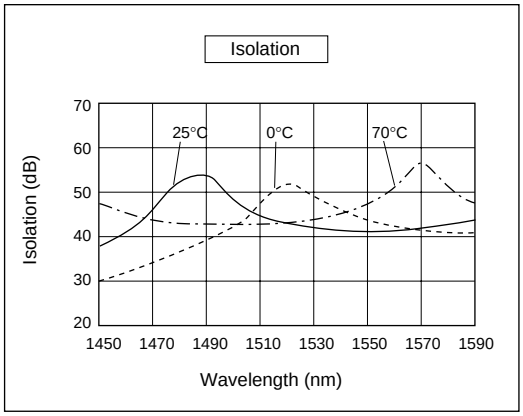


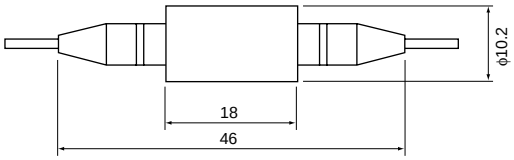

I155-PW-5EF-A



# 0.98μm In-Line Type

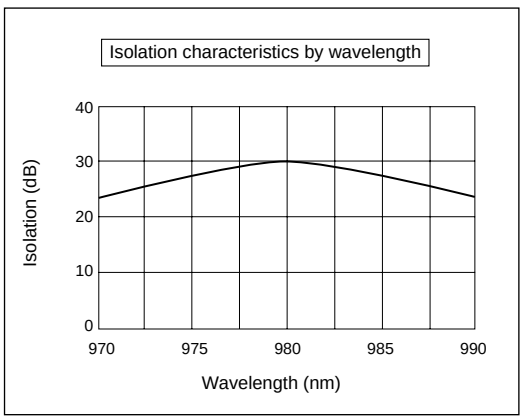
## Shapes and Dimensions

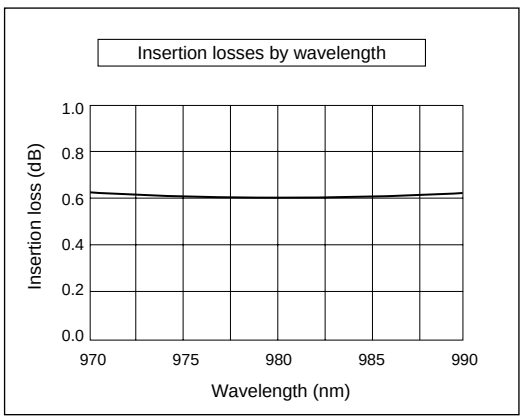


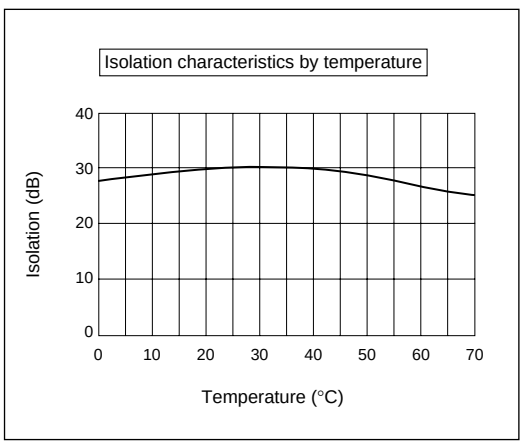

[mm]

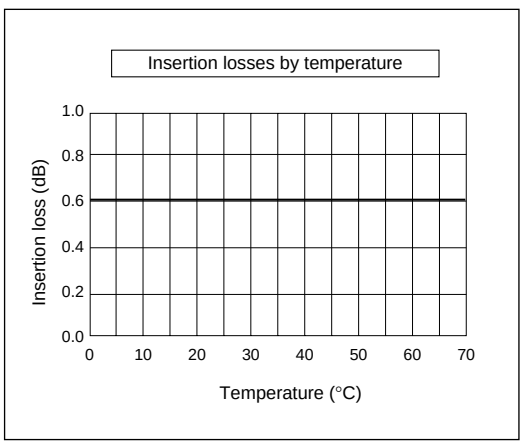
## Specifications

| Code | Center wavelength (μm) | Isolation (dB) | Insertion loss (dB) | Return loss (dB) |
|---|---|---|---|---|
| I98-PS-10EF | 0.98 | ≥20 (typical 26) | ≤0.8 (typical 0.6) | ≥50 |
| I98-PW-10EF | 0.98 | ≥35 (typical 40) | ≤1.2 (typical 0.8) | ≥50 |



# Optical Isolators for Visible and Near Infrared Rays

## Outline

TOKIN is the first in the world to make practicable optical isolators in which dilute-magnetic semiconductors are used as Faraday rotators.

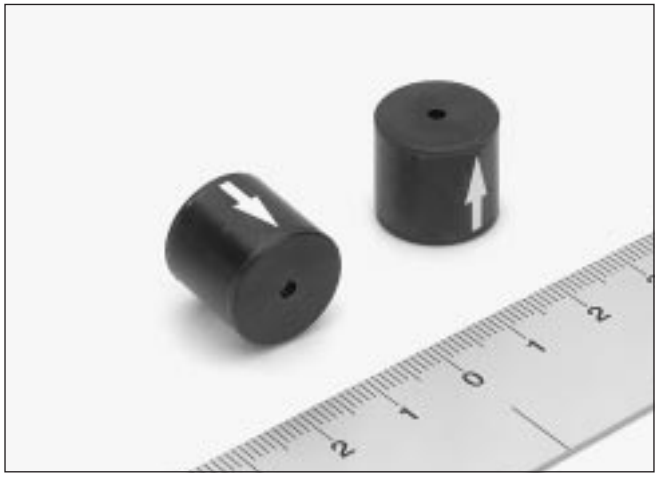
## Features

- Employ high-quality dilute-magnetic semiconductors
- These isolators can isolate light in a wide range from visible rays (bandwidth: 0.6–0.8 μm) to near infrared rays (bandwidth: 0.8 to 1.06 μm).
- Ultra-compact design (for 0.98 μm).

## Applications

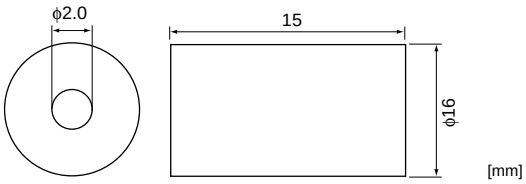
- Light sources for optical fiber communications
- Stabilized light sources for optical measurement
- Light sources for optical fiber amplifiers

# Free Space Type (Wavelength: 0.6~0.8$\mu$m)



## Shapes and Dimensions

● D65-SS-16E/D85-SP-16E

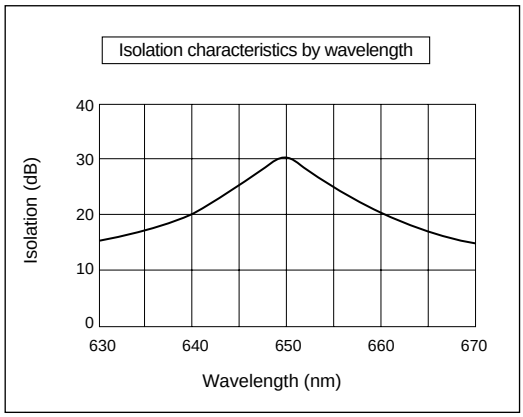


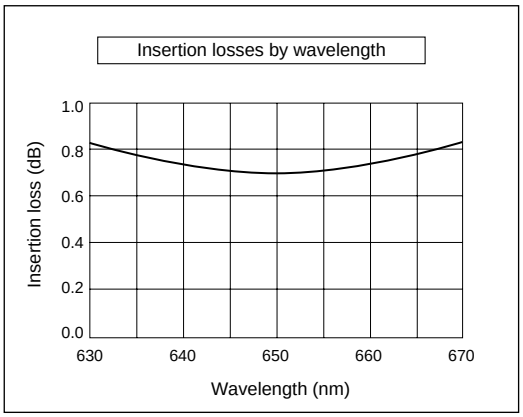

## Specifications

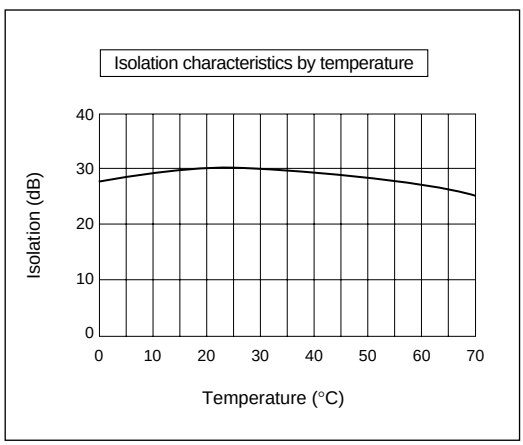
| Code | Center wavelength ($\mu$m) | Aperture diameter (mm) | Isolation (dB) | Insertion loss (dB) | Outer diameter (mm) |
|---|---|---|---|---|---|
| D65-SS-16E | 0.65 | $\phi$ 2.0 | ≥25 | ≤1.0 | $\phi$ 16 |
| D85-SP-16E | 0.85 | $\phi$ 2.0 | ≥25 | ≤1.0 | $\phi$ 16 |

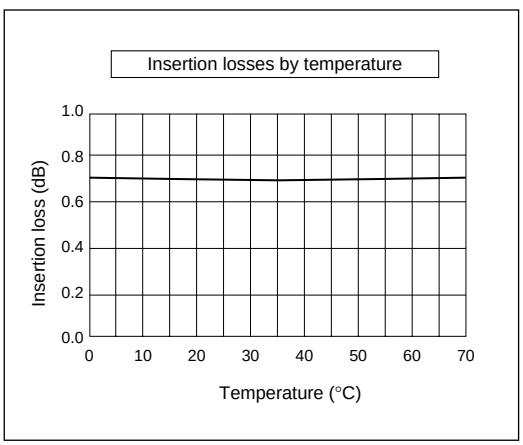
*Ask about the availability of models that isolate other wavelengths.

●0.65μm

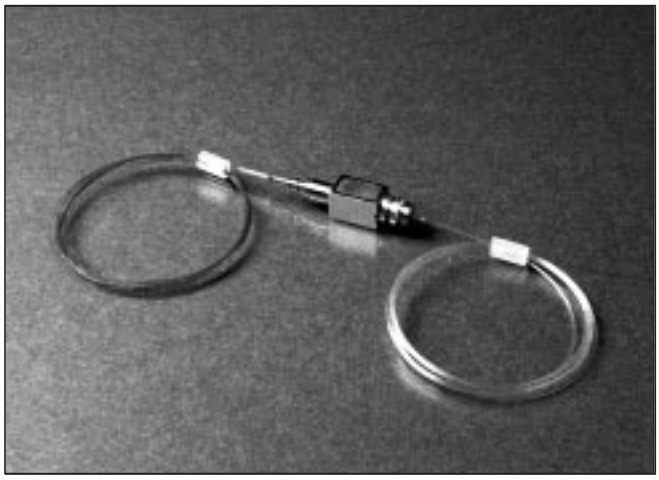


# Optical Circulators



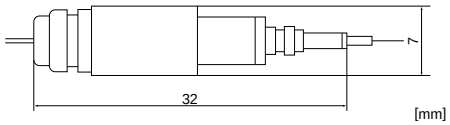
## Features

- Low loss and high isolation
- High-reliability
- Compact (low profile) design

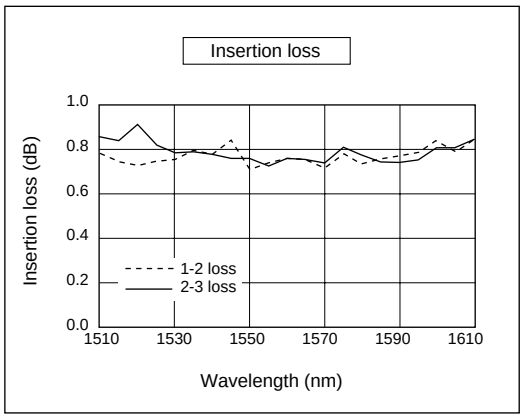
## Specifications

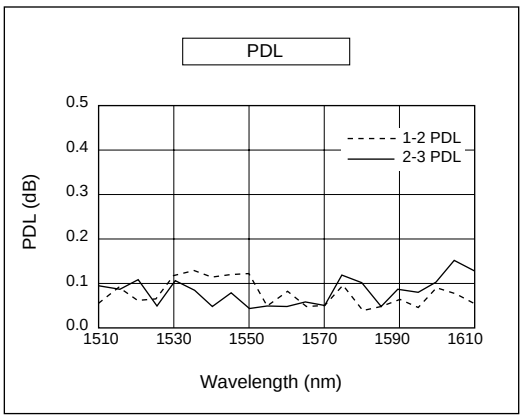
| Code | Center wavelength ($\mu$m) | Isolation (dB) | Insertion loss (dB) | PDL (dB) | Return loss (dB) |
|---|---|---|---|---|---|
| CLI-155-C | 1.55 | $P_2 \rightarrow P_1 \geq 40$ | $P_1 \rightarrow P_2 \leq 0.9$ | $P_1 \rightarrow P_2 \leq 0.15$ | ≧40 |
| | | $P_3 \rightarrow P_2 \geq 40$ | $P_2 \rightarrow P_3 \leq 0.9$ | $P_2 \rightarrow P_3 \leq 0.15$ | |

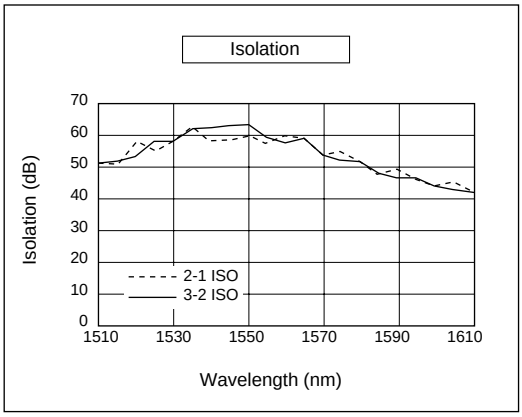
## Shapes and Dimensions




(Planned dimensions)



# Optical Electric Field Sensors

## Outline

These new-type electric field sensors use optical waveguide sensor heads to convert changes in the strength of electric fields directly into changes in optical strength so as to detect signals.

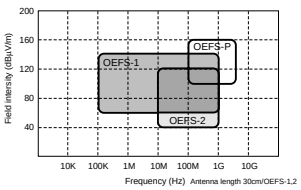
## Features

- Minimal use of metal parts (expect for metal rods) causes no disturbance in the electric field
- Small Sensor
  *OEFS-1, OEFS-2
- Small Sensor with antenna inside
  *OEFS-PT : Transmission type
  *OEFS-PR : Reflection type
- Non-inductive : No influence to electric field
- Wide-band/High speed response
- Available to measure with one extension-fiber code
  *OEFS-PR

## Applications

- Measuring EMC electric field strength and wave forms of radiation noises.
- Measuring electric field strength distribution in electric appliances.

## Characteristics Chart of the Sensor



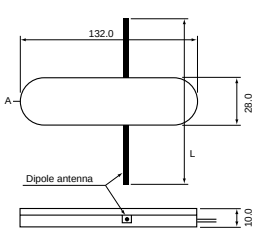

## Specifications

| Item / Model | | Specifications | | | |
|---|---|---|---|---|---|
| | | OEFS-1 | OEFS-2 | OEFS-PT NEW | OEFS-PR NEW |
| Sensitivity | (dBmV/m) | 70~120 (BW 1kHz) | 40~120 (BW 1kHz) | 90~140 (BW 1kHz) | 90~140 (BW 1kHz) |
| Frequency | (Hz) | 300K~1G | 20M~1G | 100M~2.5G | 100M~2.5G |
| Response | (ns) | 1 | 1 | 1 | 1 |
| Output voltage (Electric Field) | (dBmv) | ≥30 (100 dBμV/m) | ≥70 (100 dBμV/m) | ≥30 (100 dBμV/m) | ≥30 (100 dBμV/m) |
| Light source | | LD | LD : YAG | LD | LD |

## Shapes and Dimensions

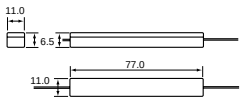
Sensor

● OEFS-1, OEFS-2 Type

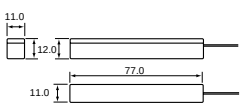



(mm)

● OEFS-PT




● OEFS-PR




(mm)

# Optical Remote Antenna

## Features

- No need to provide power supply for the receiving station in a duplex TV relay station.
- Not damaged by lightning.
- Significant reduction in maintenance work for receiving stations.

## Applications

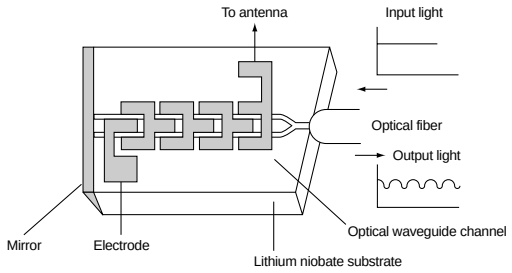
- Radio-wave transmission systems in FM, VHF and UHF bands.

## Outline

Optical remote antenna have been commercialized through joint development with NHK. These receivers modulate and transmit non-modulated light sent from a transmitting station to a duplex TV relay station, using radio waves being received. These are epoch-making radio-wave receiver-transmitters where highly sensitive optical modulators are used.

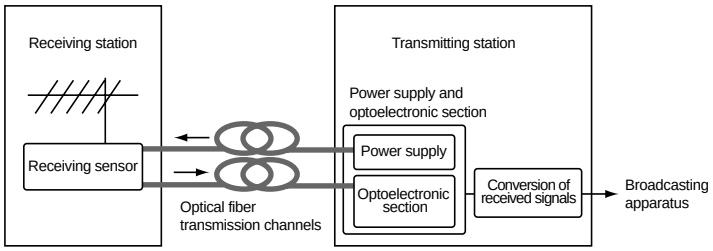
Optical fibers are used as transmission lines. This eliminates the necessity of providing power supplies for the receiving stations, and electrically isolates the transmitting stations from the receiving stations, bringing a substantial benefit in preventing the occurrence of damage due to lightning. Use of passive circuits only in the receiving station improves reliability and serviceability.

Receiving sensor




For the receiver, a totally brand-new and originally developed optical modulator is used. The optical modulator, whose design is based on an optical waveguide Lithium niobate crystals and boasts high sensitivity and broad bandwidth, directly converts received signals into optical signals.
In addition, the introduction of a special electrode structure and a resonance circuit realizes high sensitivity.

Example: Optical remote antenna




## Example of Standard Specifications (Radio Waves)

| Item | | Standard specifications |
|---|---|---|
| Transmission frequency | | Specify one or two channels from among channels 1–12, or channels 13 –62. |
| Transmission distance | | 2,000m (maximum) |
| Fibers used | | Single mode |
| Optical wavelength | | Bandwidth : 1.3mm |
| Light source and optoelectronic section | | |
| | Light source | LD-excited YAG laser |
| | Rated level of output optical signals | ≤23dBm |
| | Optical connector | FC-PC connector |
| | RF output level | 60dBmV±20 (variable by 10dB) |
| | RF output impedance | 50Ω TNC-J |
| | CN ratio VHF band | Over 50dB<br>(Receiver RF input level: 60dBμV, Measurement frequency band: 6MHz) |
| | CN ratio UHF band | Over 50dB<br>(Receiver RF input level: 65dBμV, Measurement frequency band: 6MHz) |
| | DP | ±3° |
| | DG | ≤3% |
| | Supervisory signal detection | Make contact |
| | Operating temperature range | Operational temperature range where performance is guaranteed<br>–10~+45°C (Working temperature range) |
| | Power supply | AC 100V, 50/60Hz, 130W (room temperature) |
| | Dimensions | Body: 149(H)×480(W)×350(D)mm<br>Fan unit: 49(H)×480(W)×350(D)mm (Full projections excluded) |
| | Weight | Body: approx. 10kg, Fan unit: approx. 2kg |
| Receiving sensor | | |
| | Optical connector | FC-PC connector |
| | RF input level | 60±20dBμV |
| | RF input impedance | 50Ω (N-J connector) |
| | Dimensions | 49 (H) x 480 (W) x 250 (D) mm (Full projection excluded) |
| | Weight | Approx. 4kg |

# Precautions

- The names of the products and the specifications in this catalog are subject to change without notice for the sake of improvement. The manufacturer also reserves the right to discontinue any of these products. At the time of delivery, please ask for specification sheets to check the contents before use.
- Descriptions in this catalog regarding product characteristics and quality are based solely on discrete components. When using these components, be sure to check the specifications with the component in question mounted onto the products.
- The manufacturer's warranty will not cover any disadvantage or damage caused by improper use of the products that deviates from the characteristics, specifications, or conditions for use described in this catalog.
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