

# CASTECH®

## LASER COMPONENTS



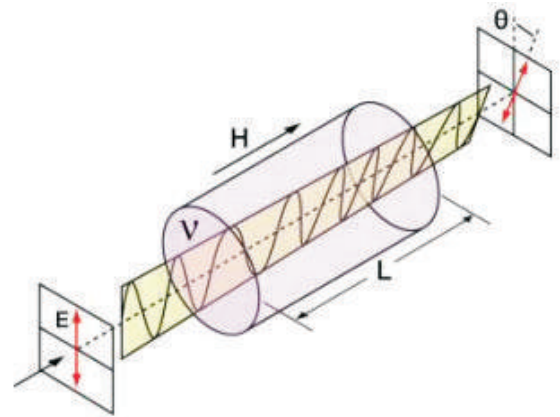
## Isolators and Faraday Rotators

### Introduction

The main component of the optical isolator is Faraday rotator. The magnetic field  $B$ , applied to the Faraday rotator causes a rotation in the polarization of the light due to the Faraday effect. The angle of rotation  $\theta$  is given by  $\theta = \nu BL$ , where  $\nu$  is the Verdet constant of the magneto-optic material, and  $L$  is the length of the magneto-optic material. Specifically for an optical isolator, the values are chosen to give a rotation of  $45^\circ$ .

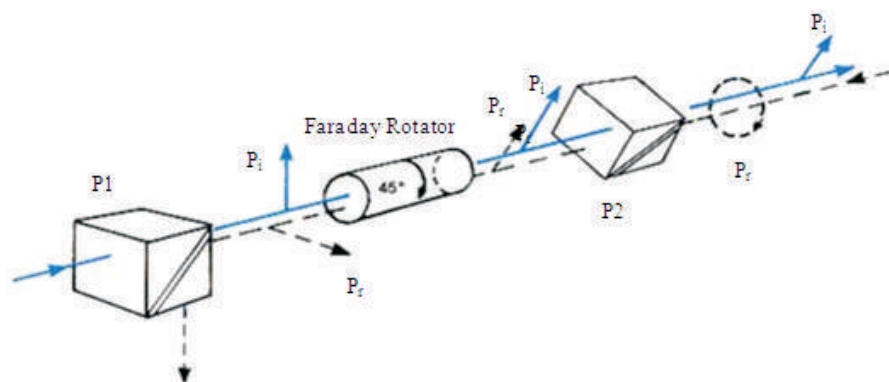
### Faraday Rotator

Faraday rotator is an important optical element in an isolator. The characteristics of a Faraday rotator include a high Verdet constant, low absorption coefficient, low non-linear refractive index and high damage threshold. The two most commonly used materials for the 700-1100 nm range are terbium doped borosilicate glass and terbium gallium garnet crystal (TGG). For infrared wavelength range, typically for the 1300-4000nm, yttrium iron garnet crystals are used (YIG).



Faraday rotator provides non-reciprocal rotation while maintaining linear polarization. That is, the polarization rotation due to the Faraday rotator is always in the same relative direction. So in the forward direction, the rotation is  $+45^\circ$ . In the reverse direction, the rotation is  $-45^\circ$ . This is due to the change in the relative magnetic field direction, positive one way, negative the other. This then adds to a total of  $90^\circ$  when the light travels in the forward direction and then the negative direction. This allows a higher isolation to be achieved.

### Optical Isolator

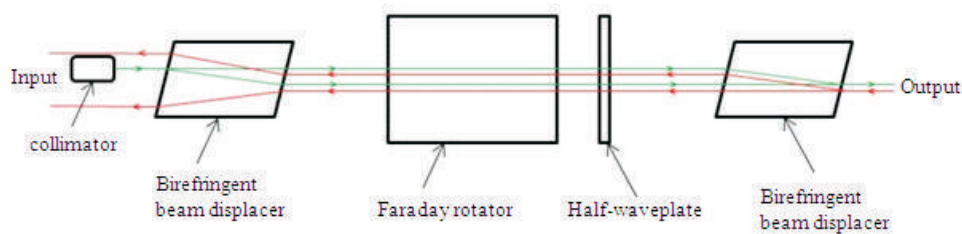


Optical isolator according to its physical principles can be divided into polarization dependent isolator and polarization independent isolator.

The polarization dependent isolator, or Faraday isolator, is made of three parts, an input polarizer (polarized vertically), a Faraday rotator, and an output polarizer, called an analyser (polarized at 45°).

Polarization dependent isolators are typically used in free space optical systems. This is because the polarization of the source is typically maintained by the system. In optical fibre systems, the polarization direction is typically dispersed in non polarization maintaining systems. Hence the angle of polarization will lead to a loss.

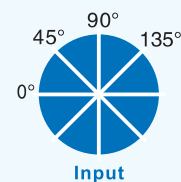
The polarization independent isolator is made of three parts, an input birefringent beam displacer, a Faraday rotator, a half-waveplate, and an output birefringent beam displacer.



Polarization independent isolators are typically used in fiber laser systems to maintain frequency stability, such as industrial processing areas etc.

### Input Polarization Reference

- All free space isolators non-reciprocally rotator the plane of polarized light in 45 degree.
- $\lambda/2$  waveplate is customized for arbitrary out polarizations if required.



## Advantages of our products

### High Transmission

The materials used in our products are with low absorption. Antireflective coatings are with low residual reflectivity on all entrance and exit surfaces. Transmission of isolator and Faraday rotator is achieved typically >90% and >98% respectively.

### High Isolation

CASTECH specially selected crystal materials with high verdet constant and extinction ratio to obtain an isolation typically > 30dB.

### Large Aperture

The aperture of CASTECH's Faraday rotators and isolators is alternative from 2 to 12mm.

### Mounting Flexibility

CASTECH's isolators and rotators can be mounted directly via threaded holes in the housing or freely customized.

## Typical Applications

- Eliminate instability in amplified laser systems
- Reduce Nd and Yb oscillations from ASE created by amplifiers
- Maintain frequency stability in fiber lasers, fiber amplifier etc.
- Industrial processing areas
- Optical fiber measuring equipment and optical coherence detection.

## Faraday Rotators

CASTECH's faraday rotators have high power handling up to 100W of average input power in 400-4500nm wavelength range. It could maintain the light's linear polarization, through rotating the plane of polarized light 45° in the forward direction and an additional 45° of non-reciprocal rotation in the reverse direction.



### Features

- ▶ High damage threshold and power handling
- ▶ Peak rotation is 45°±0.5°

### Applications

- ▶ Maintain the light's linear polarization
- ▶ Change the polarization direction of polarized light

### Specifications<sup>a,b</sup>

	VIS	NIR	IR
▶ Center Wavelength	405,532,561,632,650 780,808,850,980nm	1030,1064nm	1319,2000, 4500nm
▶ Operating Wavelength Range	≥ ± 10 nm	≥ ± 15 nm	≥ ± 10 nm
▶ Peak Transmission	>93%	>98%	>93%
▶ M <sup>2</sup> Degradation	<10%	<10%	<10%
▶ Clear Aperture	3,4 mm or Others	2,3,4,5,8,10,12 or Others	3,4mm or Others
▶ Optical Power(Average)	10,30,50W or Specify	10,30,50,100W or Specify	10,30,50W or Specify
▶ Damage Threshold	3.5J/cm <sup>2</sup> @ 10ns	10J/cm <sup>2</sup> @ 10ns	5J/cm <sup>2</sup> @ 10ns
▶ Storage Temperature Range	-20~70℃		
▶ Tunable Temperature Range	10~30℃		

<sup>a</sup>Product specifications are subject to change without notice;

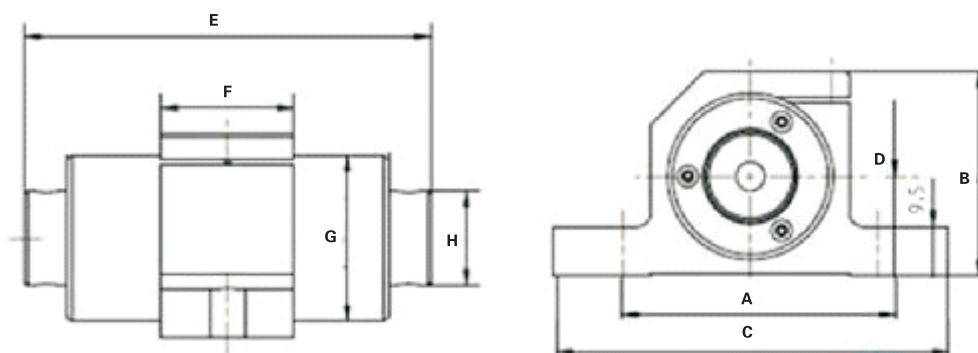
<sup>b</sup>Customized (Wavelength, Dimension, Power Handling , etc) are available;

Note: All products are RoHS compliant.

# Isolators and Faraday Rotators

## Dimensions(unit: mm)

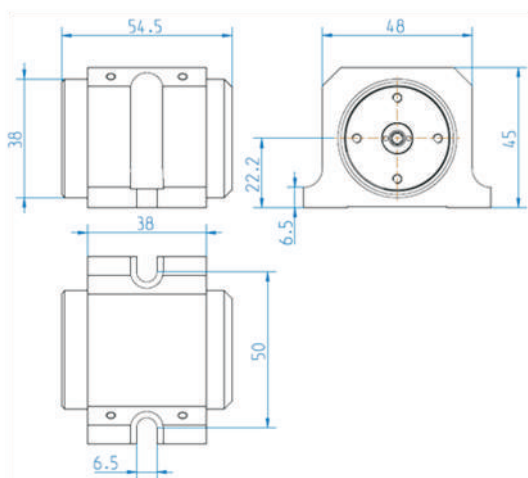
### VIS(common type):



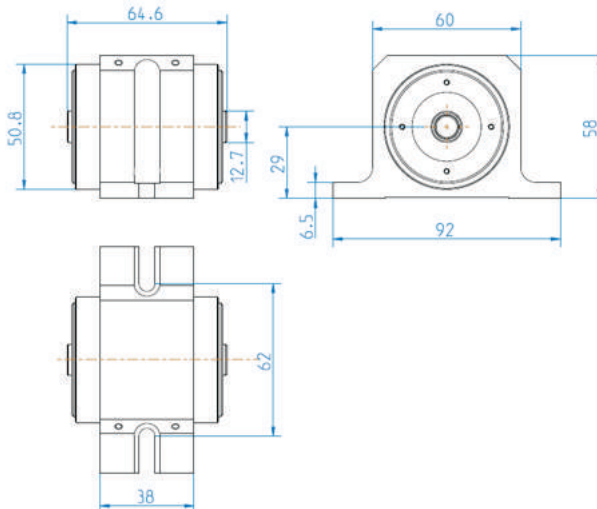
Wavelength	A	B	C	D	E	F	G	H
532nm	23	34.5	35	19	48	11	Φ 27	Φ 20
561nm	23	34.5	35	19	48	11	Φ 27	Φ 20
650nm	29	32.3	76.2	19	56.4	25.4	Φ 27	Φ 18
780nm	29	32.3	76.2	19	62.5	25.4	Φ 27	Φ 18
850nm	31.7	37.1	76.2	21.3	66.5	25.4	Φ 27	Φ 18
980nm	38.1	37.1	76.2	24.4	70.4	25.4	Φ 31.8	Φ 18

### NIR(common type):

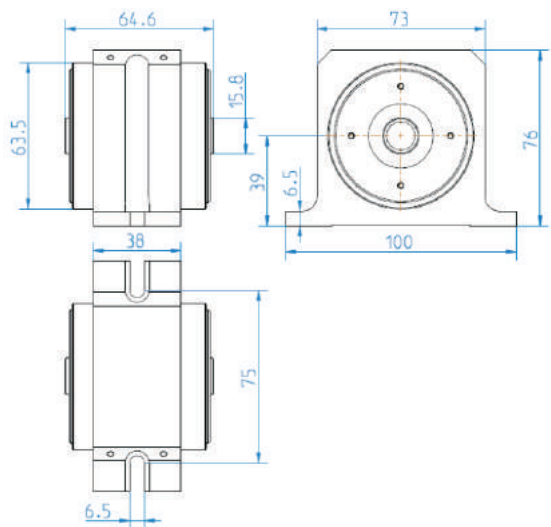
Aperture=2~5mm



Aperture=8/10mm

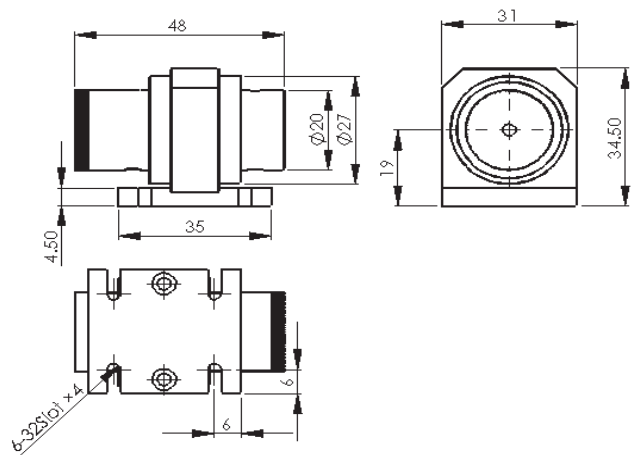


Aperture=12mm

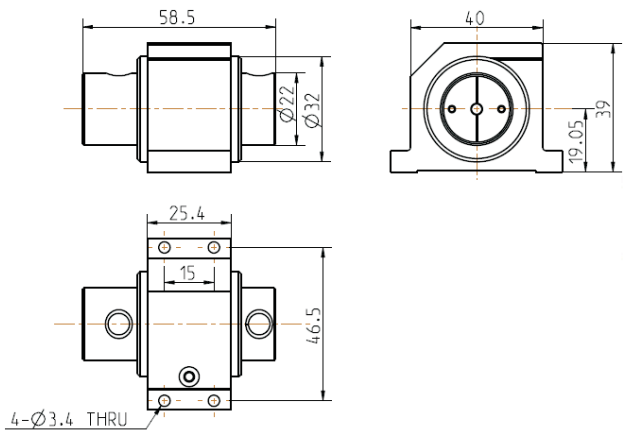


IR(common type):

Wavelength at 1319nm



Other wavelength



Model Number:

A	B	C	D	E
Device	Type	Power Handling(W)	Aperture Size(mm)	Wavelength(nm)
Rotators	Common Type	10 30 50 100	2	532-980
			3	1030
			4	1064
			5	1319
			8	2000
			10	4500
			12	
			others	

Example: Model Number **HPRO-FS-30-3-532** described 3mm aperture isolator centred at 532nm, handling power is 30W.



## Free Space Isolators

CASTECH's free space isolators could maintain the light's linear polarization, through rotating the plane of polarized light 45° in the forward direction and an additional 45° of non-reciprocal rotation in the reverse direction. CASTECH's free space isolator series include 2 types: polarization and polarization independent. Meanwhile, free space isolators include fixed wavelength isolators and wavelength adjustable isolators.



Features		Applications	
▶ High damage threshold and power handling		▶ Maintain the light's linear polarization	
▶ Peak isolation: range from 30dB to 45dB		▶ Avoid deleterious effects of back reflections in laser diodes	
▶ Free space input and output		▶ Eliminate instability in amplified laser systems caused by ASE	
▶ Orthogonal isolated beams		▶ Reduce Nd and Yb oscillations from ASE created by amplifiers	
▶ Isolators are available for optional $\lambda/2$ plate			
▶ All isolators contain escape ports			

Specifications <sup>a,b</sup>			
	VIS	NIR	IR
▶ Center Wavelength	405,532,561,632,650 780,808,850,980nm	1030,1064nm	1319,2000, 4500nm
▶ Operating Wavelength Range	$\geq \pm 10 \text{ nm}$	$\geq \pm 15 \text{ nm}$	$\geq \pm 10 \text{ nm}$
▶ Peak Transmission	>90%	>92%	>90%
▶ Peak Isolation	>35dB	>30dB	>35dB
▶ M <sup>2</sup> Degradation	<10%	<10%	<10%
▶ Clear Aperture	3,4 mm or Others	2,3,4,5,8,10,12 or Others	3,4mm or Others
▶ Optical Power(Average)	10,30,50W or Specify	10,30,50,100W or Specify	10,30,50W or Specify
▶ Damage Threshold	3.5J/cm <sup>2</sup> @ 10ns	10J/cm <sup>2</sup> @ 10ns	5J/cm <sup>2</sup> @ 10ns
▶ Storage Temperature Range	-20~70℃		
▶ Tunable Temperature Range	10~30℃		

<sup>a</sup>Product specifications are subject to change without notice;

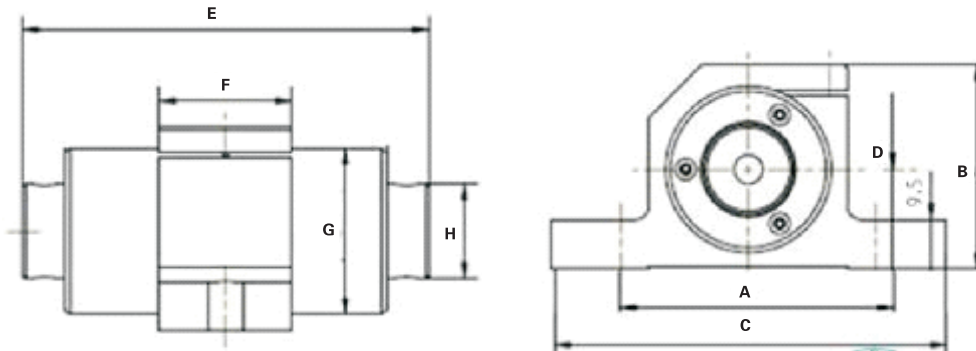
<sup>b</sup>Customized (Wavelength, Dimension, Power Handling, etc) are available;

Note: All products are RoHS compliant.



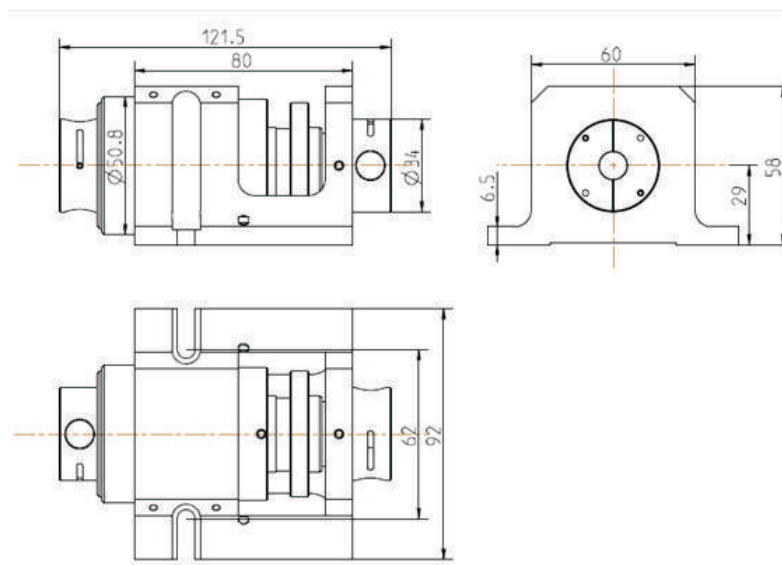
## Dimensions(unit: mm)

### VIS(common type):



Wavelength	A	B	C	D	E	F	G	H
532nm	23	34.5	35	19	48	11	Φ 27	Φ 20
561nm	23	34.5	35	19	48	11	Φ 27	Φ 20
650nm	29	32.3	76.2	19	56.4	25.4	Φ 27	Φ 18
780nm	29	32.3	76.2	19	62.5	25.4	Φ 27	Φ 18
850nm	31.7	37.1	76.2	21.3	66.5	25.4	Φ 27	Φ 18
980nm	38.1	37.1	76.2	24.4	70.4	25.4	Φ 31.8	Φ 18

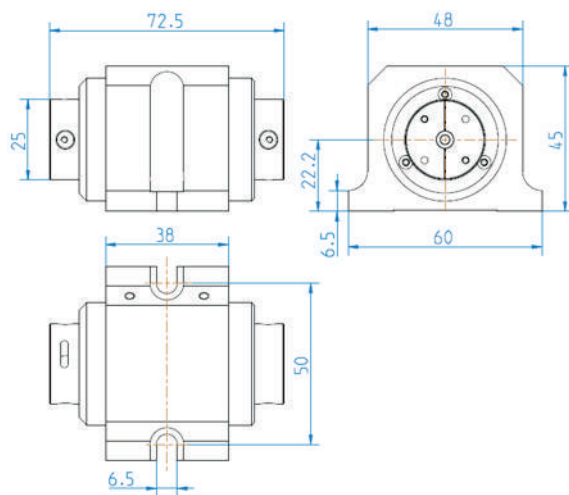
### VIS(adjustable broadband):



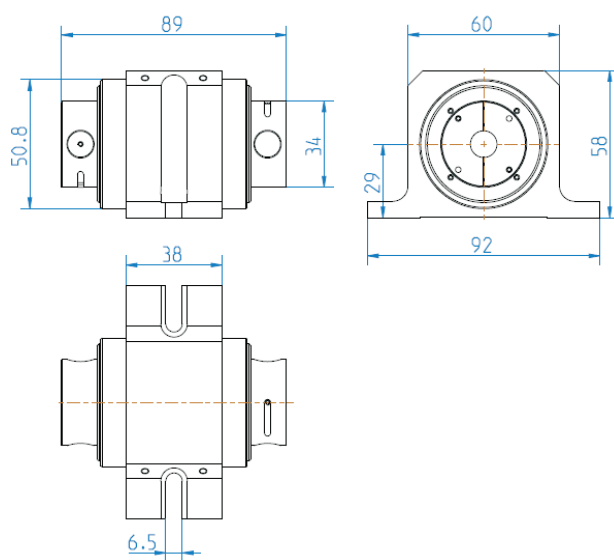
# Isolators and Faraday Rotators

## NIR(common type):

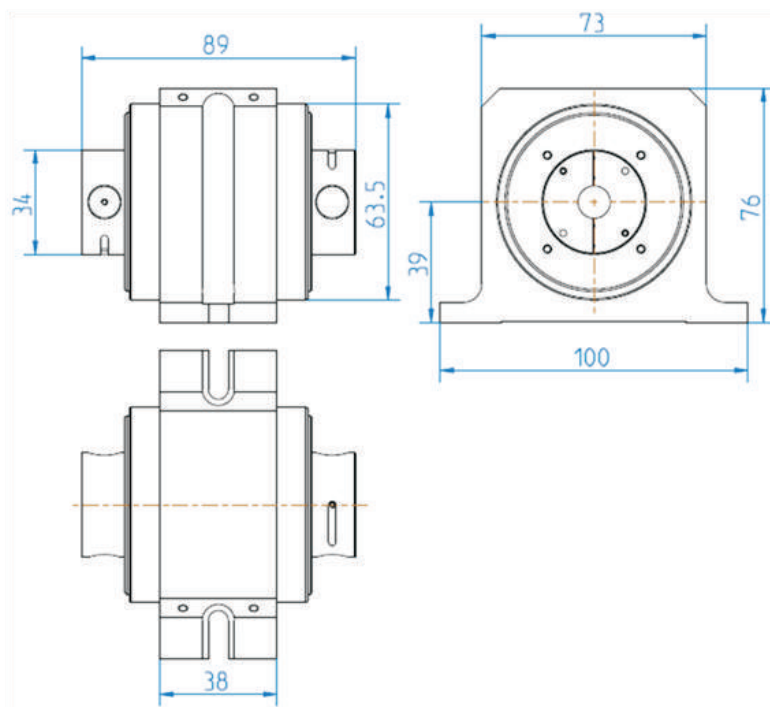
Aperture=2~5mm



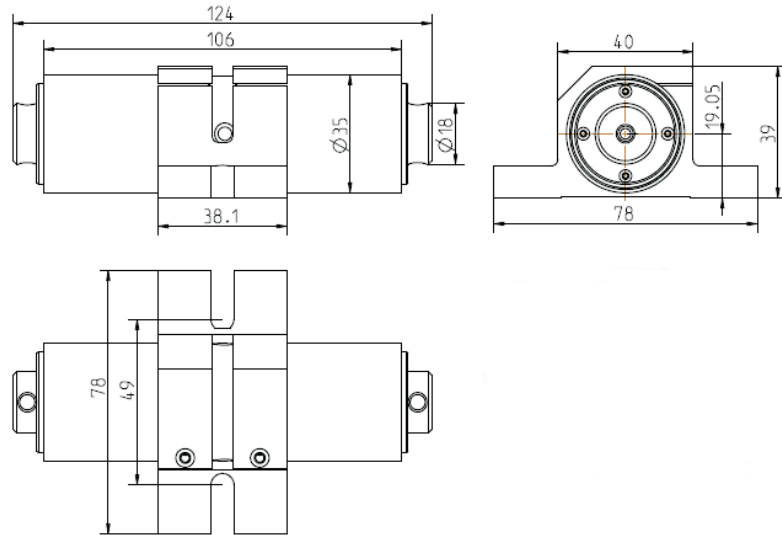
Aperture=8/10mm



Aperture=12mm

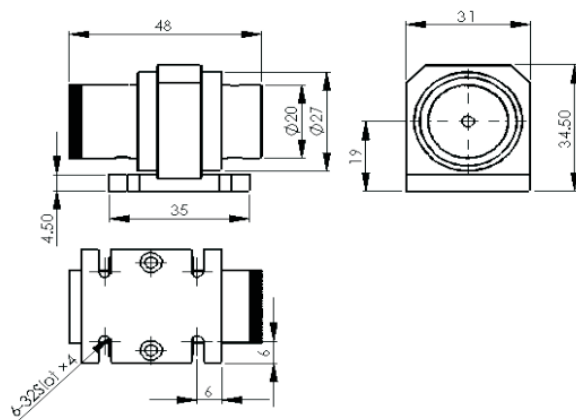


## NIR(dual stage type):

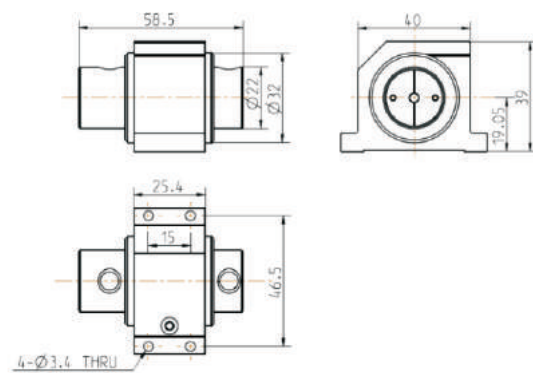


## IR

Wavelength at 1319nm

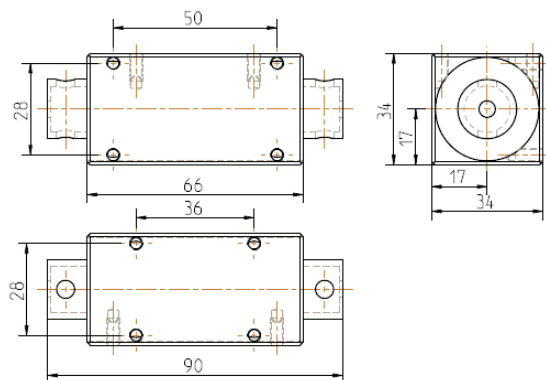


Other wavelength

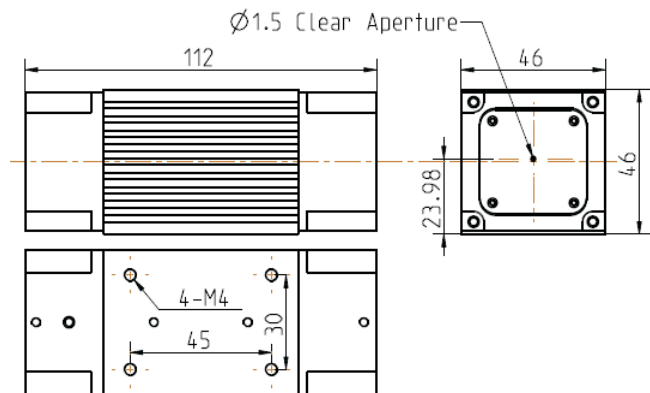


## Polarization Independent:

Default size:



Aperture=1.5mm



# Isolators and Faraday Rotators

## Model Number:

A	B	C	D	E
Device	Type	Power Handling(W)	Aperture Size(mm)	Wavelength(nm)
Isolator	Common Type		2	532-980
		10	3	1030
		30	4	1064
		50	5	1319
		100	8	2000
			10	
			12	
			others	4500

Example: Model Number **HPISO-FS-30-3-532** described 3mm aperture isolator centred at 532nm, handling power is 30W.

A	B	C	D	E
Device	Type	Power Handling(W)	Aperture Size(mm)	Wavelength(nm)
Isolator	Adjustable Broadband	30	6	550-750 others
		50	8	
		100	10	
			others	

Example: Model Number **HPISO-AB-100-5-550-750** described a 5mm aperture isolator which can be used over a specified tuning range of 550 to 750nm, handling power is 100W.

A	B	C	D	E
Device	Type	Power Handling(W)	Aperture Size(mm)	Wavelength(nm)
Isolator	Dual Stage	10	3	1030 1064
		30	4	
		50	5	
			others	

Example: Model Number **HPISO-DS-30-3-1064** described 3mm aperture isolator centred at 1064nm, handling power is 30W.

A	B	C	D	E
Device	Type	Power Handling(W)	Aperture Size(mm)	Wavelength(nm)
Isolator	Polarization Independent	5	1.5	980 1030 1064
		10	3	
		30	4	
		50	5	
			others	

Example: Model Number **HPISO-PI-30-3-1064** described polarization independent isolator handling power is 30W, which aperture is 3mm, centred at 1064nm.

Isolators &  
Faraday Rotators

Pockels Cells

Acousto-Optic  
Devices

Laser Optics  
Devices

Laser Seed  
Sources

# High Power In-Line Isolators

CASTECH's high power in-line isolators have center wavelength of 980/1030/1064nm, could maintain frequency stability in fiber lasers, fiber amplifiers, optical sensors. High power in-line isolators handling power are up to 100W.



Features	Applications
▶ Center wavelength at 980/1030/1064 nm	▶ Maintain frequency stability in fiber lasers, fiber amplifiers, optical sensors.
▶ Both side of isolators have fiber	▶ Used in optical fiber measuring equipments and optical coherence detection.
▶ Handling power up to 100W	▶ Changing direction of incoming signals
▶ The type of fiber is customized	

Specifications <sup>a,b</sup>			
	Polarization Independent	Common	Optical Circulator
▶ Center Wavelength	1064nm	980/1030/1064nm	1030/1064nm
▶ Operating Wavelength Range	≥ ± 10nm	≥ ± 10nm	≥ ± 10nm
▶ Peak Isolation	≥ 35dB	≥ 35dB	≥ 35dB
▶ Isolation in Band at 23℃	≥ 25dB	≥ 25dB	≥ 30dB
▶ Insertion Loss at 23℃	≤ 1.50dB	≤ 1.00dB	≤ 1.00dB
▶ Polarization Dependent Loss	≤ 0.15dB	≤ 0.15dB	≤ 0.15dB
▶ Return Loss (Input/Output)	≥ 50dB	≥ 50dB	≥ 50dB
▶ Fiber Type	HI 1060 Fiber/LMA Fiber/PM Fiber or Specify		
▶ Fiber Length	≥ 1.0m	/	/
▶ Optical Power(Average)	0.5, 2W or Specify	5,10,30,50,100W or Specify	3,5,10W or Specify
▶ Peak Pulse Power	/	20KW or Specify	10KW or Specify
▶ Operating Temperature	10-50℃		
▶ Storage Temperature	0-60℃		

<sup>a</sup>Product specifications are subject to change without notice;

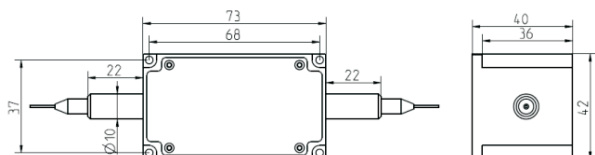
<sup>b</sup>Customized (Wavelength, Dimension, Power Handling , etc) are available;

Note: All products are RoHS compliant.

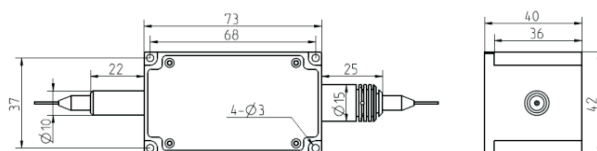
# Isolators and Faraday Rotators

## Dimensions(unit: mm)

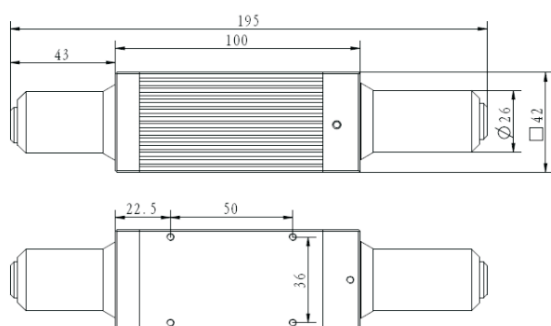
### 10W common:



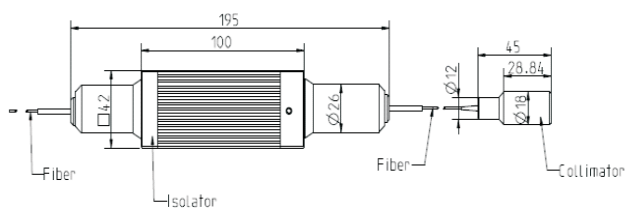
### 20-30W common:



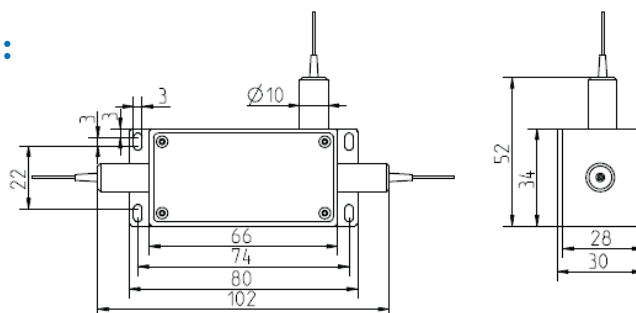
### 50-100W common:



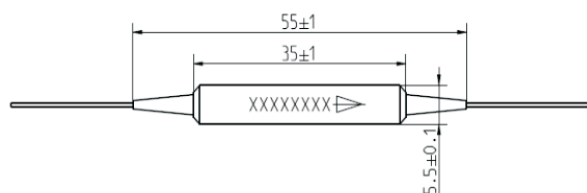
### 50-100W common (with collimator):



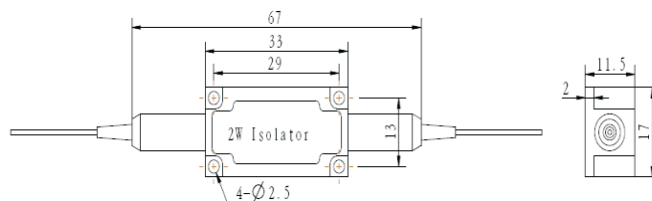
### Optical circulator:



### 0.5W polarization independent:



### 2W polarization independent:



## Model Number:

A	B	C	D	E	F	G
Device	Type	Power Handling(W)	Fiber Type	Wavelength (nm)	Pigtail Diameter	Fiber Length (m)
Isolator	Polarization Independent	0.5 2 Others	1:10/125SCF 2:20/130DCF 3:12/250DCF 4:20/250DCF 5:30/250DCF 6:HI1060 0:Others	1064 Others	L:900µm Loose Tube  B:3mm Loose Cable	1:1.0 0:Others

Example: Model number **HPISO-IL-2-1-1064-L-1** described in-line isolator handling power is 2W, which fiber type is 10/125SCF, centred at 1064nm, with fiber length 1m and pigtail diameter 900µm loose tube.

A	B	C	D	E	F	G
Device	Type	Power Handling(W)	Fiber Type	Wavelength (nm)	Pigtail Diameter	Fiber Length (m)
Isolator	Common	5 10 30 50 100	1:10/125SCF 2:20/130DCF 3:12/250DCF 4:20/250DCF 5:30/250DCF 6:HI1060 0:Others	980 1030 1064	L:900µm Loose Tube  B:3mm Loose Cable	1:1.0 0:Others

Example: Model number **HPISO-IL-30-1-1064-L-1** described in-line isolator handling power is 30W, which fiber type is 10/125SCF, centred at 1064nm, with fiber length 1m and pigtail diameter 900µm loose tube.

A	B	C	D	E	F	G
Device	Type	Power Handling(W)	Fiber Type	Wavelength (nm)	Pigtail Diameter	Fiber Length (m)
Circulator	Optical Circulator (three-port)	3 5 10	1:HI 1060 2:PM 980 0:Others	1030 1064	L:900µm Loose Tube  B:3mm Loose Cable	1:1.0 0:Others

Example: Model number **HPISO-CIR-5-1-1030-L-1** described optical circulator handling power is 5W, which fiber type is HI1060, centred at 1030nm, with fiber length 1m and pigtail diameter 900µm loose tube.



## Fiber To Free Space Isolators

CASTECH's high power fiber to free space isolators have center wavelength of 980/1030/1064nm, could maintain frequency stability in fiber lasers, fiber amplifiers, optical sensors. High power fiber to free space isolators' handling power up to 200W. CASTECH's fiber to free space isolators are with expanded beam output ,and non-expanded beam isolators are also available.



Features	Applications
▶ Center wavelength is 980/1030/1064nm	▶ Maintain frequency stability in fiber lasers, fiber amplifiers, optical sensors.
▶ Peak isolation $\geq 35\text{dB}$	▶ Used in optical fiber measuring equipments and optical coherence detection.
▶ Handling power up to 200W	▶ Widely used in industrial processing areas
▶ Fiber input and expanded beam output or not	
▶ The type of fiber is customized	

Specifications <sup>a,b</sup>				
	Single Stage	Dual Stage	With Laser Pointer	Non-Expanded Beam
▶ Center Wavelength	980/1030/1064nm	980/1030/1064nm	1064nm	980/1030/1064nm
▶ Operating Wavelength Range	$\geq \pm 10\text{nm}$	$\geq \pm 20\text{nm}$	$\geq \pm 10\text{nm}$	$\geq \pm 10\text{nm}$
▶ Peak Isolation	$\geq 35\text{dB}$	$\geq 45\text{dB}$	$\geq 35\text{dB}$	$\geq 35\text{dB}$
▶ Isolation in Band at 23℃	$\geq 25\text{dB}$	$\geq 35\text{dB}$	$\geq 25\text{dB}$	$\geq 25\text{dB}$
▶ Insertion Loss at 23℃	$\leq 0.4\text{dB}$	$\leq 0.6\text{dB}$	$\leq 0.5\text{dB}$	$\leq 0.4\text{dB}$
▶ Polarization Dependent Loss	$\leq 0.15\text{dB}$	$\leq 0.15\text{dB}$	$\leq 0.15\text{dB}$	/
▶ Return Loss (Input/Output)	$\geq 50\text{dB}$	$\geq 50\text{dB}$	$\geq 50\text{dB}$	$\geq 50\text{dB}$
▶ $M^2$ Degradation	$<10\%$	$<10\%$	$<10\%$	$<10\%$
▶ Fiber Type	LMA Fiber/PM Fiber or Specify			
▶ Operating Temperature	10~50℃			
▶ Storage Temperature	-10~60℃			
▶ Output Beam Diameter(1/e <sup>2</sup> )	6,7,8mm or Specify			0.5mm or Specify
▶ Optical Power(Average)	20,30,50,100,200W or Specify		10,20,30,50W or Specify	
▶ Peak Pulse Power	50KW or Specify		20KW or Specify	
▶ Laser Pointer	/		650nm, <5mW, >1m	/

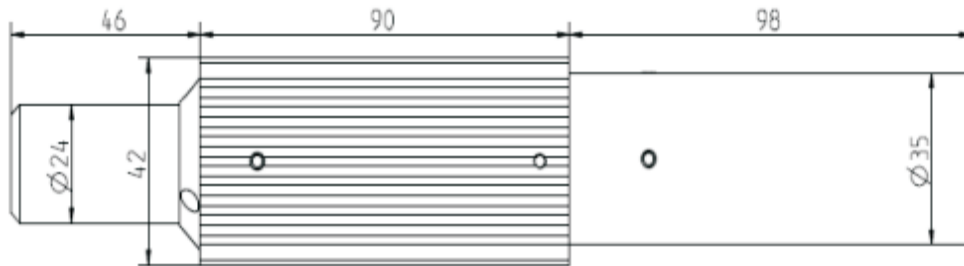
<sup>a</sup>Product specifications are subject to change without notice;

<sup>b</sup>Customized (Wavelength, Dimension, Power Handling , etc) are available;

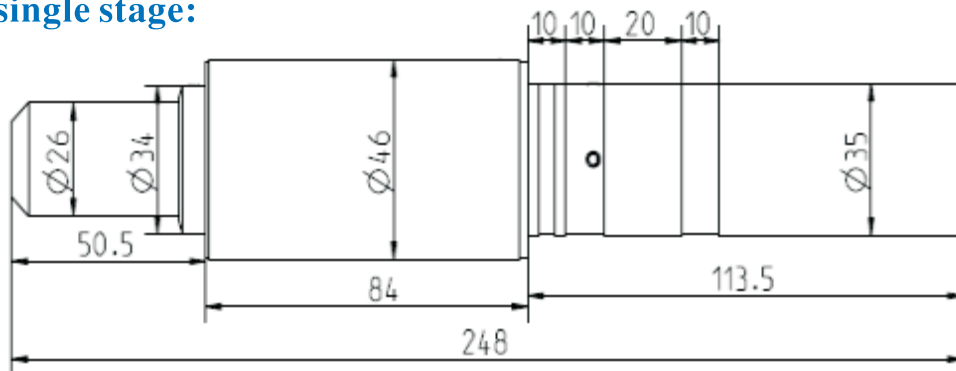
Note: All products are RoHS compliant.

## Dimensions(unit: mm)

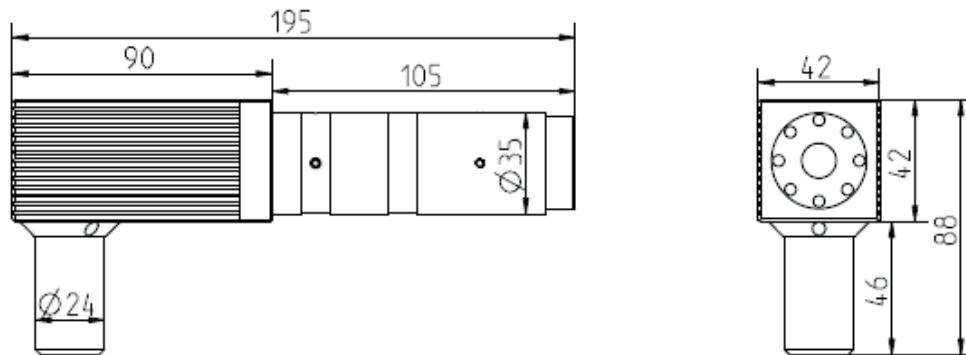
### Square single stage:



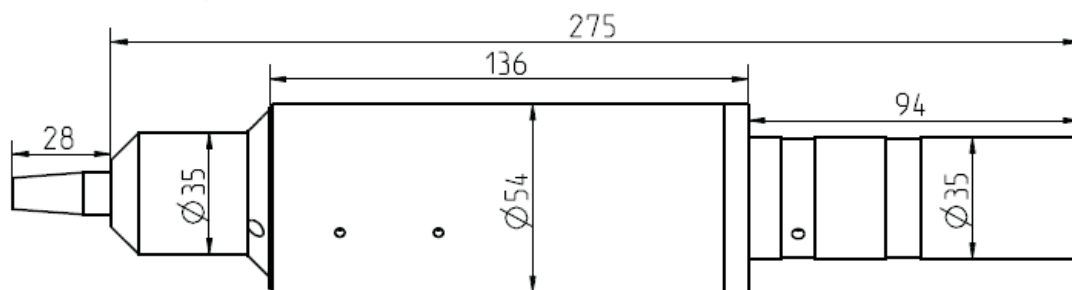
### Circular single stage:



### L-type single stage:

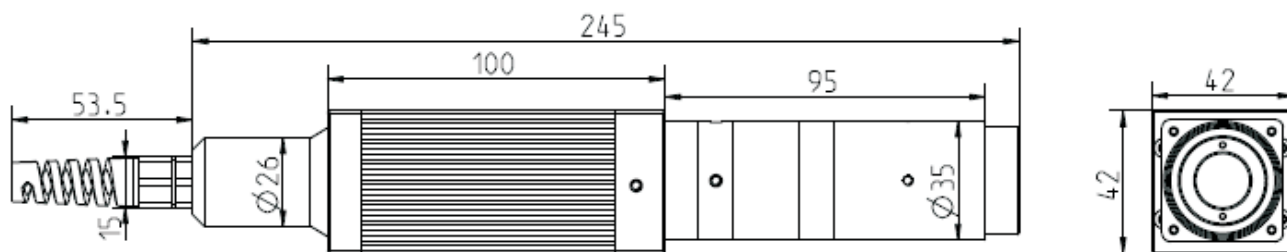


### 100/200W dual stage:

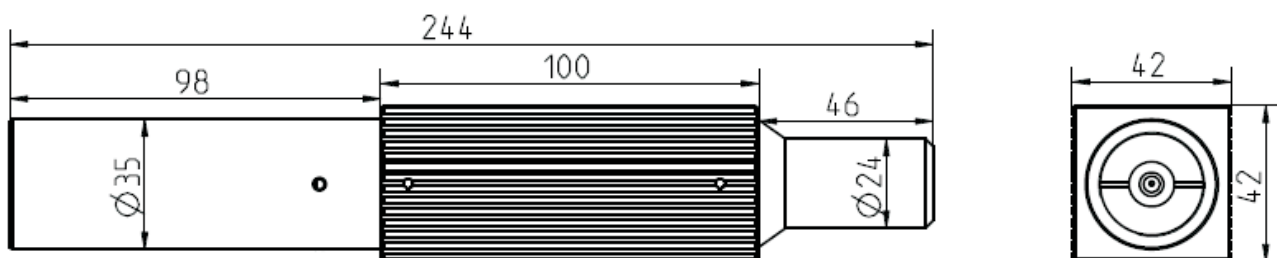


# Isolators and Faraday Rotators

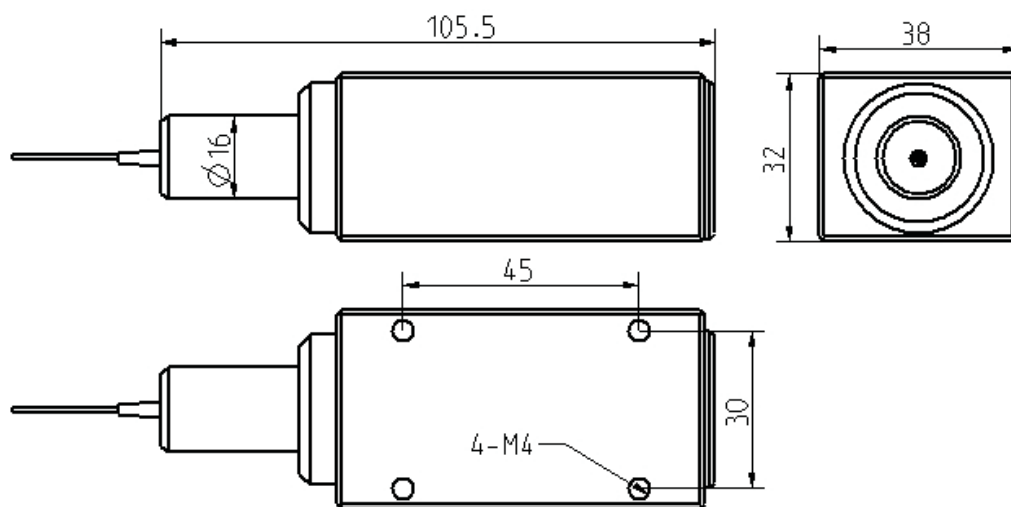
## 100/200W single stage:



## With laser pointer of expanded beam output:



## Non-expanded beam output :



## Model Number:

A	B	C	D	E	F	G
Device	Type	Power Handling(W)	Fiber Type	Wavelength (nm)	Pigtail Diameter	Output Beam Diameter (mm)
Isolator	Expanded Beam	30	1:10/125SCF	980 1030 1064	C:6mm Armoured Cable  E:8mm Armoured Cable	6
		50	2:20/130DCF			7
		100	3:12/250DCF			8
		200	4:20/250DCF			Others
			5:30/250DCF			
			0:Others			

Example: Model number **HPISO-EB-50-5-1064-E-6** described expanded beam isolator handling power is 50W, which fiber type is 30/250DCF, centred wavelength is 1064nm, with 8mm armoured cable and 6mm output beam diameter.

A	B	C	D	E	F	G
Device	Type	Power Handling(W)	Fiber Type	Wavelength (nm)	Pigtail Diameter	Output Beam Diameter (mm)
Isolator	With Laser Pointer	10	1:10/125SCF	1064	C:6mm Armoured Cable  E:8mm Armoured Cable	6
		20	2:20/130DCF			7
		30	3:12/250DCF			8
		50	4:20/250DCF			Others
			5:30/250DCF			
			0:Others			

Example: Model number **HPISO-WLP-50-2-1064-E-6** described expanded beam isolator with laser pointer handling power is 50W, which fiber type is 20/130DCF, centred wavelength is 1064nm, with 8mm armoured cable and 6mm output beam diameter.

A	B	C	D	E	F	G
Device	Type	Power Handling(W)	Fiber Type	Wavelength (nm)	Pigtail Diameter	Output Beam Diameter (mm)
Isolator	Non-Expanded Beam	10	1:10/125SCF	980 1030 1064	C:6mm Armoured Cable  E:8mm Armoured Cable	2:2.0
		20	2:20/130DCF			2.5:2.5
		30	3:12/250DCF			0:Others
		50	4:20/250DCF			
			5:30/250DCF			
			0:Others			

Example: Model number **HPISO-FF-20-2-1064-E-2** described high power fiber to free space isolator handling power is 20W, which fiber type is 20/130DCF, centred wavelength is 1064nm, with 8mm armoured cable and 2m fiber length.



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