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THORLABS

Part F810APC-842 - FEB 28, 2019

Item # F810APC-810 was discontinued on FEB 28, 2019. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

AIR-SPACED DOUBLET COLLIMATORS - FC/PC, FC/APC, & SMA

- Multi-Element Lens Design for Diffraction-Limited Performance
- Options for FC/PC, FC/APC, or SMA Connectors
- Collimated Beam Diameters Range from 6.4 to 8.0 mm
- Simplifies Fiber-Coupled Detection Systems

F810FC-780
780 nm, Focal Length: 36.01 mm

F810SMA-2000
2.0 µm, Focal Length: 37.52 mm

F810APC-543
543 nm, Focal Length: 34.74 mm

Hide Overview

OVERVIEW

Features

- Fiber Collimatiors with FC/PC (2.1 mm Wide Key), FC/APC (2.2 mm Wide Key), and SMA Connectors
- Factory-Aligned Collimation Package for Wavelengths from 543 nm to 2 µm
- Simplifies Free-Space Laser to Fiber Coupling
- Multi-Element Lens Design for Diffraction-Limited Performance
- Lens Material: N-SF6 or Equivalent
- Non-Magnetic Stainless Steel Housing

Click to Enlarge
F810FC-780 in an AD15F Adapter

Quick Links to Available Wavelengths
543 nm
635 nm
780 nm
842 nm
850 nm
1064 nm
1310 nm
1550 nm
2.0 µm

The F810 Series Fiber Collimation Packages are pre-aligned to collimate a laser beam propagating from the tip of an FC/PC, FC/APC, or SMA terminated fiber with diffraction-limited performance at the design wavelength. Since the F810 Series fiber collimators do not have any movable parts, they are compact and not susceptible to misalignment. Due to chromatic aberration, the effective focal length (EFL) of the doublet lens is wavelength dependent. As a result, these collimators will only perform optimally at the design wavelength. The doublet lens, which features an antirelection (AR) coating that minimizes surface reflections, is factory aligned for each design wavelength so that the lens is one focal length away from a fiber tip inserted into the collimator. Additionally, the receptacles for the FC/APC versions are angled so that light exiting the fiber enters the collimator perpendicular to the focal plane.

We recommend using the F810APC and F810FC collimation packages with our AR-coated single mode fiber optic patch cables. These cables feature an antireflective coating on one fiber end for increased transmission and improved return loss at the fiber-to-free-space interface. F810SMA fiber collimation packages are optimized for single mode fibers and are compatible with our SMA-terminated hybrid single mode fiber optic patch cables. Alternatively, our large selection of standard fiber patch cables can also be used.

Alternatives

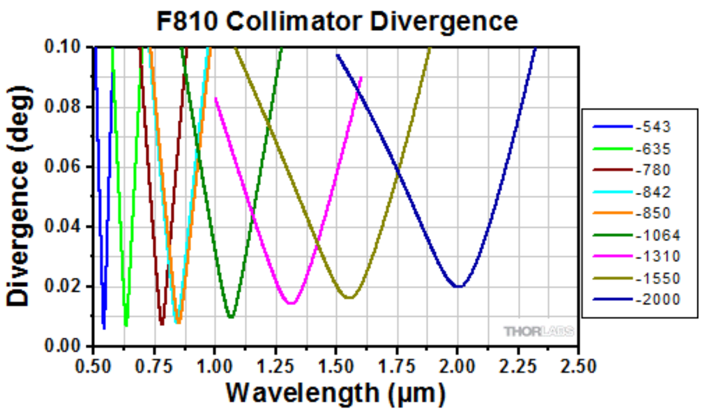
We can align collimation packages at custom wavelengths if a standard version is not suitable for your application. We also offer a line of adjustable collimation packages called FiberPorts that are well suited for a wide range of wavelengths and are ideal solutions for adjustable, compact fiber couplers. For other collimation and coupling options, please contact Tech Support.

Hide Divergence

DIVERGENCE

Theoretical Approximation of the Divergence

The divergence angle listed in the specifications tables below is the theoretical full-angle divergence when using the fiber collimator at its design wavelength with the listed fiber. Simulations of the theoretical divergence of the F810 collimators at wavelengths other than the design wavelengths are shown below. Similarly, the beam diameter as a function of propogation distance was simulated for each of our F810 collimators at the design wavelength, assuming input from the design fiber and a Gaussian intensity profile.



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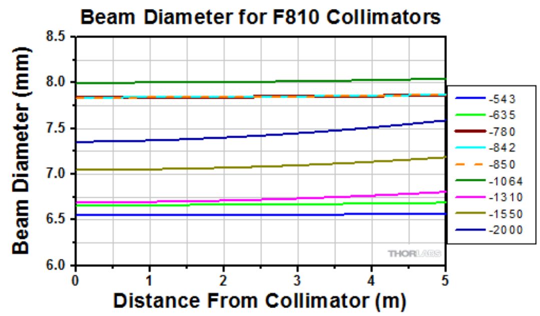

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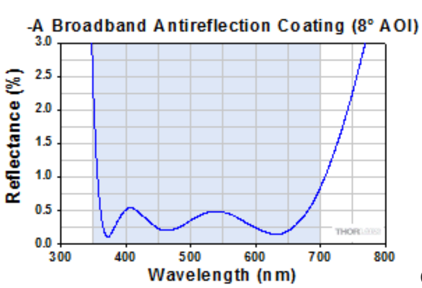
Hide AR Coatings

AR COATINGS

The graphs below show the reflectance with respect to wavelength of the AR coatings used on the lens surfaces in our F810 series collimators. The blue shaded region indicates the wavelength range specified for each coating. The table below details the AR coating designations with their corresponding wavelength ranges and average reflectance. Transmission for the N-SF6 lens material is also provided.

AR Coating Information					
Coating Designation	A	B	1064	C	D
Coating Range	350 - 700 nm	650 - 1050 nm	1054 - 1074	1050 - 1620 nm	1.8 - 2.4 µm
Reflectance	R_{avg} < 0.5%	R_{avg} < 0.5%	R_{avg} < 0.25%	R_{avg} < 0.5%	R_{avg} < 0.5%



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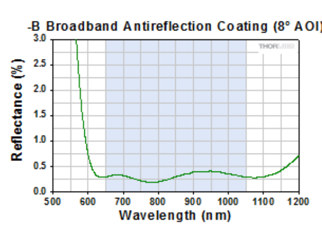

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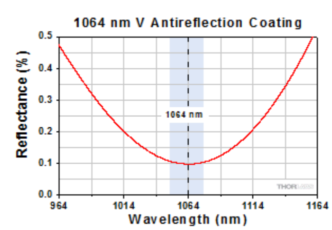

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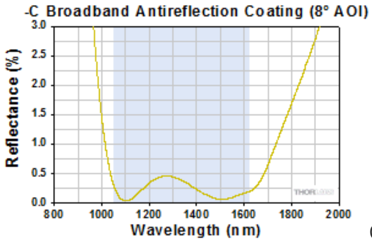

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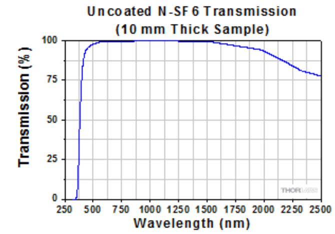

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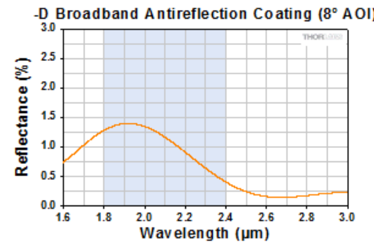

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Hide Calculations

CALCULATIONS

Theoretical Approximation of the Divergence Angle

The full-angle beam divergence listed in the specifications tables is the theoretically-calculated value associated with the fiber collimator. This divergence angle is easy to approximate theoretically using the formula below as long as the light emerging from the fiber has a Gaussian intensity profile. Consequently, the formula works well for single mode fibers, but it will underestimate the divergence angle for multimode (MM) fibers since the light emerging from a multimode fiber has a non-Gaussian intensity profile.

The Full Divergence Angle (in degrees) is given by

$$\theta \approx \left(\frac{[MFD]}{f}\right)\left(\frac{180}{\pi}\right)$$

where *MFD* is the mode field diameter and *f* is the focal length of the collimator. (Note: *MFD* and *f* must have the same units in this equation).

Example:

When the F220FC-A collimator (*f* ≈ 11.0 mm; not exact since the design wavelength is 543 nm) is used to collimate 515 nm light emerging from a 460HP fiber (*MFD* = 3.5 µm), the divergence angle is approximately given by

θ ≈ (0.0035 mm / 11.0 mm) x (180 / pi) = 0.018°.

When the beam divergence angle was measured for the F220FC-A collimator, a 460HP fiber was used with 543 nm light. The result was a divergence angle of 0.018°.

Theoretical Approximation of the Output Beam Diameter

The output beam diameter can be approximated from

$$d \approx 4\lambda\left(\frac{f}{\pi[MFD]}\right)$$

where λ is the wavelength of light being used, *MFD* is the mode field diameter, and *f* is the focal length of the collimator. (Note: *MFD* and *f* must have the same units in this equation).

Example:

When the F240FC-1550 collimator (*f* = 8.18 mm) is used with the P1-SMF28E-FC-1 patch cable (*MFD* = 10.4 µm) and 1550 nm light, the output beam diameter is

d ≈ (4)(0.00155 mm)[8.18 mm / (pi · 0.0104 mm)] = 1.55 mm.

Theoretical Approximation of the Maximum Waist Distance

The maximum waist distance, which is the furthest distance from the lens the waist can be located in order to maintain collimation, may be approximated by

$$z_{max} = f + \frac{2f^2\lambda}{\pi[MFD]^2}$$

where *f* is the focal length of the collimator, λ is the wavelength of light used, and *MFD* is the mode field diameter. (Note: *MFD* and *f* must have the same units in this equation).

Example:

When the F220FC-532 collimator (*f* = 10.9 mm) is used with the P1-460B-FC-1 patch cable (*MFD* ≈ 4.0 µm; calculated approximate value) and 532 nm light, then the maximum waist distance is approximately

z_{max} ≈ 10.9 mm + [2 · (10.9 mm)^2 · 0.000532 mm] / [pi · (0.004 mm)^2] = 2526 mm.

Hide Damage Thresholds

DAMAGE THRESHOLDS

Damage Threshold Data for Thorlabs' Air-Spaced Doublet Collimators

The specifications to the right are measured data for a selection of Thorlabs' air-spaced doublet collimators. Damage threshold specifications are constant for these collimators, regardless of the connector type.

Damage Threshold Specifications	
Item # Suffix	**Damage Threshold**
-543	7.5 J/cm^2 (532 nm, 10 ns, 10 Hz, Ø0.362 mm)
-1064	7.5 J/cm^2 (1064 nm, 10 ns, 10 Hz, Ø0.442 mm)

Laser Induced Damage Threshold Tutorial

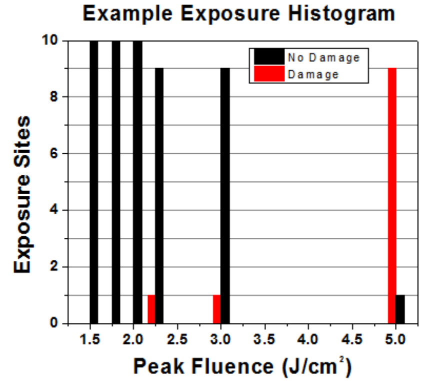
The following is a general overview of how laser induced damage thresholds are measured and how the values may be utilized in determining the appropriateness of an optic for a given application. When choosing optics, it is important to understand the Laser Induced Damage Threshold (LIDT) of the optics being used. The LIDT for an optic greatly depends on the type of laser you are using. Continuous wave (CW) lasers typically cause damage from thermal effects (absorption either in the coating or in the substrate). Pulsed lasers, on the other hand, often strip electrons from the lattice structure of an optic before causing thermal damage. Note that the guideline presented here assumes room temperature operation and optics in new condition (i.e., within scratch-dig spec, surface free of contamination, etc.). Because dust or other particles on the surface of an optic can cause damage at lower thresholds, we recommend keeping surfaces clean and free of debris. For more information on cleaning optics, please see our *Optics Cleaning* tutorial.

Testing Method

Thorlabs' LIDT testing is done in compliance with ISO/DIS 11254 and ISO 21254 specifications.

First, a low-power/energy beam is directed to the optic under test. The optic is exposed in 10 locations to this laser beam for 30 seconds (CW) or for a number of pulses (pulse repetition frequency specified). After exposure, the optic is examined by a microscope (~100X magnification) for any visible damage. The number of locations that are damaged at a particular power/energy level is recorded. Next, the power/energy is either increased or decreased and the optic is exposed at 10 new locations. This process is repeated until damage is observed. The damage threshold is then assigned to be the highest power/energy that the optic can withstand without causing damage. A histogram such as that below represents the testing of one BB1-E02 mirror.

The photograph above is a protected aluminum-coated mirror after LIDT testing. In this particular test, it handled 0.43 J/cm^2 (1064 nm, 10 ns pulse, 10 Hz, Ø1.000 mm) before damage.



Example Test Data			
Fluence	# of Tested Locations	Locations with Damage	Locations Without Damage
1.50 J/cm^2	10	0	10
1.75 J/cm^2	10	0	10
2.00 J/cm^2	10	0	10
2.25 J/cm^2	10	1	9
3.00 J/cm^2	10	1	9
5.00 J/cm^2	10	9	1

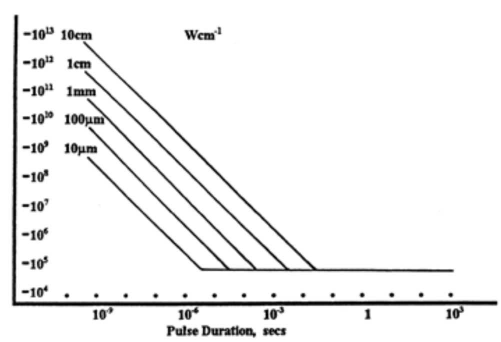
According to the test, the damage threshold of the mirror was 2.00 J/cm^2 (532 nm, 10 ns pulse, 10 Hz, Ø0.803 mm). Please keep in mind that these tests are performed on clean optics, as dirt and contamination can significantly lower the damage threshold of a component. While the test results are only representative of one coating run, Thorlabs specifies damage threshold values that account for coating variances.

Continuous Wave and Long-Pulse Lasers

When an optic is damaged by a continuous wave (CW) laser, it is usually due to the melting of the surface as a result of absorbing the laser's energy or damage to the optical coating (antireflection) [1]. Pulsed lasers with pulse lengths longer than 1 µs can be treated as CW lasers for LIDT discussions.

When pulse lengths are between 1 ns and 1 µs, laser-induced damage can occur either because of absorption or a dielectric breakdown (therefore, a user must check both CW and pulsed LIDT). Absorption is either due to an intrinsic property of the optic or due to surface irregularities; thus LIDT values are only valid for optics meeting or exceeding the surface quality specifications given by a manufacturer. While many optics can handle high power CW lasers, cemented (e.g., achromatic doublets) or highly absorptive (e.g., ND filters) optics tend to have lower CW damage thresholds. These lower thresholds are due to absorption or scattering in the cement or metal coating.

Pulsed lasers with high pulse repetition frequencies (PRF) may behave similarly to CW beams. Unfortunately, this is highly dependent on factors such as absorption and thermal diffusivity, so there is no reliable method for determining when a high PRF laser will damage an optic due to thermal effects. For beams with a high PRF both the average and peak powers must be compared to the equivalent CW power. Additionally, for highly transparent materials, there is little to no drop in the LIDT with increasing PRF.

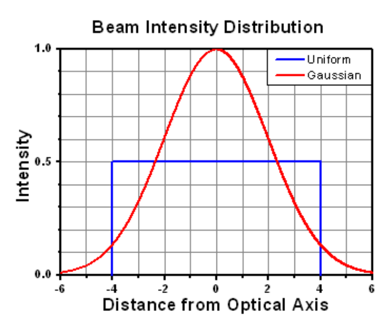


LIDT in linear power density vs. pulse length and spot size. For long pulses to CW, linear power density becomes a constant with spot size. This graph was obtained from [1].

In order to use the specified CW damage threshold of an optic, it is necessary to know the following:

1. Wavelength of your laser
2. Beam diameter of your beam (1/e^2)
3. Approximate intensity profile of your beam (e.g., Gaussian)
4. Linear power density of your beam (total power divided by 1/e^2 beam diameter)

Thorlabs expresses LIDT for CW lasers as a linear power density measured in W/cm. In this regime, the LIDT given as a linear power density can be applied to any beam diameter; one does not need to compute an adjusted LIDT to adjust for changes in spot size, as demonstrated by the graph to the right. Average linear power density can be calculated using the equation below.



$$\text{Linear Power Density} = \frac{\text{Power}}{\text{Beam Diameter}}$$

The calculation above assumes a uniform beam intensity profile. You must now consider hotspots in the beam or other non-uniform intensity profiles and roughly calculate a maximum power density. For reference, a Gaussian beam typically has a maximum power density that is twice that of the uniform beam (see lower right).

Now compare the maximum power density to that which is specified as the LIDT for the optic. If the optic was tested at a wavelength other than your operating wavelength, the damage threshold must be scaled appropriately. A good rule of thumb is that the damage threshold has a linear relationship with wavelength such that as you move to shorter wavelengths, the damage threshold decreases (i.e., a LIDT of 10 W/cm at 1310 nm scales to 5 W/cm at 655 nm):

$$Adjusted\ LIDT = LIDT\ Power\left(\frac{Your\ Wavelength}{LIDT\ Wavelength}\right)$$

While this rule of thumb provides a general trend, it is not a quantitative analysis of LIDT vs wavelength. In CW applications, for instance, damage scales more strongly with absorption in the coating and substrate, which does not necessarily scale well with wavelength. While the above procedure provides a good rule of thumb for LIDT values, please contact Tech Support if your wavelength is different from the specified LIDT wavelength. If your power density is less than the adjusted LIDT of the optic, then the optic should work for your application.

Please note that we have a buffer built in between the specified damage thresholds online and the tests which we have done, which accommodates variation between batches. Upon request, we can provide individual test information and a testing certificate. The damage analysis will be carried out on a similar optic (customer's optic will not be damaged). Testing may result in additional costs or lead times. Contact Tech Support for more information.

Pulsed Lasers

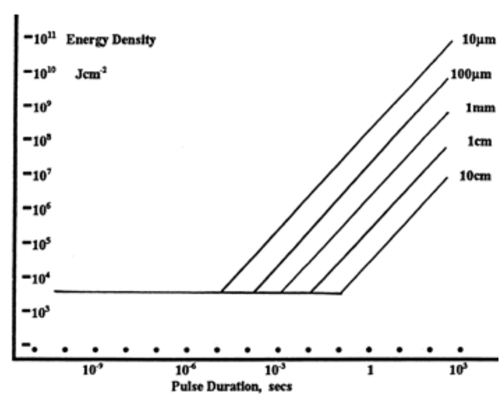
As previously stated, pulsed lasers typically induce a different type of damage to the optic than CW lasers. Pulsed lasers often do not heat the optic enough to damage it; instead, pulsed lasers produce strong electric fields capable of inducing dielectric breakdown in the material. Unfortunately, it can be very difficult to compare the LIDT specification of an optic to your laser. There are multiple regimes in which a pulsed laser can damage an optic and this is based on the laser's pulse length. The highlighted columns in the table below outline the relevant pulse lengths for our specified LIDT values.

Pulses shorter than 10^{-9} s cannot be compared to our specified LIDT values with much reliability. In this ultra-short-pulse regime various mechanics, such as multiphoton-avalanche ionization, take over as the predominate damage mechanism [2]. In contrast, pulses between 10^{-7} s and 10^{-4} s may cause damage to an optic either because of dielectric breakdown or thermal effects. This means that both CW and pulsed damage thresholds must be compared to the laser beam to determine whether the optic is suitable for your application.

Pulse Duration	$t < 10^{-9}$ s	$10^{-9} < t < 10^{-7}$ s	$10^{-7} < t < 10^{-4}$ s	$t > 10^{-4}$ s
Damage Mechanism	Avalanche Ionization	Dielectric Breakdown	Dielectric Breakdown or Thermal	Thermal
Relevant Damage Specification	No Comparison (See Above)	Pulsed	Pulsed and CW	CW

When comparing an LIDT specified for a pulsed laser to your laser, it is essential to know the following:

1. Wavelength of your laser
2. Energy density of your beam (total energy divided by $1/e^2$ area)
3. Pulse length of your laser
4. Pulse repetition frequency (prf) of your laser
5. Beam diameter of your laser ($1/e^2$)
6. Approximate intensity profile of your beam (e.g., Gaussian)



LIDT in energy density vs. pulse length and spot size. For short pulses, energy density becomes a constant with spot size. This graph was obtained from [1].

The energy density of your beam should be calculated in terms of J/cm^2. The graph to the right shows why expressing the LIDT as an energy density provides the best metric for short pulse sources. In this regime, the LIDT given as an energy density can be applied to any beam diameter; one does not need to compute an adjusted LIDT to adjust for changes in spot size. This calculation assumes a uniform beam intensity profile. You must now adjust this energy density to account for hotspots or other nonuniform intensity profiles and roughly calculate a maximum energy density. For reference a Gaussian beam typically has a maximum energy density that is twice that of the $1/e^2$ beam.

Now compare the maximum energy density to that which is specified as the LIDT for the optic. If the optic was tested at a wavelength other than your operating wavelength, the damage threshold must be scaled appropriately [3]. A good rule of thumb is that the damage threshold has an inverse square root relationship with wavelength such that as you move to shorter wavelengths, the damage threshold decreases (i.e., a LIDT of 1 J/cm^2 at 1064 nm scales to 0.7 J/cm^2 at 532 nm):

$$Adjusted\ LIDT = LIDT\ Energy \sqrt{\frac{Your\ Wavelength}{LIDT\ Wavelength}}$$

You now have a wavelength-adjusted energy density, which you will use in the following step.

Beam diameter is also important to know when comparing damage thresholds. While the LIDT, when expressed in units of J/cm², scales independently of spot size; large beam sizes are more likely to illuminate a larger number of defects which can lead to greater variances in the LIDT [4]. For data presented here, a <1 mm beam size was used to measure the LIDT. For beams sizes greater than 5 mm, the LIDT (J/cm2) will not scale independently of beam diameter due to the larger size beam exposing more defects.

The pulse length must now be compensated for. The longer the pulse duration, the more energy the optic can handle. For pulse widths between 1 - 100 ns, an approximation is as follows:

$$Adjusted\ LIDT = LIDT\ Energy \sqrt{\frac{Your\ Pulse\ Length}{LIDT\ Pulse\ Length}}$$

Use this formula to calculate the Adjusted LIDT for an optic based on your pulse length. If your maximum energy density is less than this adjusted LIDT maximum energy density, then the optic should be suitable for your application. Keep in mind that this calculation is only used for pulses between 10^{-9} s and 10^{-7} s. For pulses between 10^{-7} s and 10^{-4} s, the CW LIDT must also be checked before deeming the optic appropriate for your application.

Please note that we have a buffer built in between the specified damage thresholds online and the tests which we have done, which accommodates variation between batches. Upon request, we can provide individual test information and a testing certificate. Contact Tech Support for more information.

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[1] R. M. Wood, Optics and Laser Tech. **29**, 517 (1998).
[2] Roger M. Wood, *Laser-Induced Damage of Optical Materials* (Institute of Physics Publishing, Philadelphia, PA, 2003).
[3] C. W. Carr *et al*., Phys. Rev. Lett. **91**, 127402 (2003).
[4] N. Bloembergen, Appl. Opt. **12**, 661 (1973).

Hide Collimator Guide

COLLIMATOR GUIDE

Fiber Collimator Selection Guide

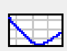
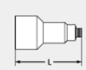
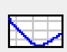
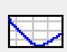
Click on the collimator type or photo to view more information about each type of collimator.

Type		Description
Fixed FC, APC, or SMA Fiber Collimators		These fiber collimation packages are pre-aligned to collimate light from an FC/PC-, FC/APC-, or SMA-terminated fiber. Each collimation package is factory aligned to provide diffraction-limited performance for wavelengths ranging from 405 nm to 4.55 µm. Although it is possible to use the collimator at detuned wavelengths, they will only perform optimally at the design wavelength due to chromatic aberration, which causes the effective focal length of the aspheric lens to have a wavelength dependence.
Air-Spaced Doublet, Large Beam Collimators		For large beam diameters (Ø6.6 - Ø8.5 mm), Thorlabs offers FC/PC, SMA, and FC/APC air-spaced doublet collimators. These collimation packages are pre-aligned at the factory to collimate a laser beam propagating from the tip of an FC or SMA-terminated fiber and provide diffraction-limited performance at the design wavelength.
Adjustable Fiber Collimators		These collimators are designed to connect onto the end of an FC/PC or FC/APC connector and contain an AR-coated aspheric lens. The distance between the aspheric lens and the tip of the FC-terminated fiber can be adjusted to compensate for focal length changes or to recollimate the beam at the wavelength and distance of interest.
Zoom Fiber Collimators		These collimators provide a variable focal length between 6 and 18 mm, while maintaining the collimation of the beam. As a result, the size of the beam can be changed without altering the collimation. This universal device saves time previously spent searching for the best suited fixed fiber collimator and has a very broad range of applications. They are offered with FC/PC, FC/APC, or SMA905 connectors with three different antireflection wavelength ranges to choose from.
		Thorlabs' Large-Beam Fiber Collimators are designed with an effective focal length (EFL) of 40 mm or 80 mm over three different wavelength ranges and are available with FC/PC or FC/APC connectors. A four-

Large Beam Fiber Collimators		element, air-spaced lens design produces a superior beam quality (M^2 close to 1) and less wavefront error when compared to aspheric lens collimators. As a result, these collimators are very flexible; they can be used as free-space collimator or coupler. They may also be used over a long distance in pairs, which allows the free-space beam to be manipulated prior to entering the second collimator and may be useful in long-distance communications applications.
FiberPorts		These compact, ultra-stable FiberPort micropositioners provide an easy-to-use, stable platform for coupling light into and out of FC/PC, FC/APC, or SMA terminated optical fibers. It can be used with single mode, multimode, or PM fibers and can be mounted onto a post, stage, platform, or laser. The built-in aspheric or achromatic lens is available with three different AR coatings and has five degrees of alignment adjustment (3 translational and 2 pitch). The compact size and long-term alignment stability make the FiberPort an ideal solution for fiber coupling, collimation, or incorporation into OEM systems.
Triplet Collimators		Thorlabs' High Quality Triplet Fiber Collimation packages use air-spaced triplet lenses that offer superior beam quality performance when compared to aspheric lens collimators. The benefits of the low-aberration triplet design include an M^2 term closer to 1 (Gaussian), less divergence, and less wavefront error.
Reflective Collimators		Thorlabs' metallic-coated Reflective Collimators are based on a 90° off-axis parabolic mirror. Mirrors, unlike lenses, have a focal length that remains constant over a broad wavelength range. Due to this intrinsic property, a parabolic mirror collimator does not need to be adjusted to accommodate various wavelengths of light, making them ideal for use with polychromatic light. Our reflective collimators are ideal for single-mode fiber.
Pigtailed Collimators		Our pigtailed collimators come with one meter of either single mode or multimode fiber, have the fiber and AR-coated aspheric lens rigidly potted inside the stainless steel housing, and are collimated at one of six wavelengths: 532, 830, 1030, 1064, 1310, or 1550 nm. Although it is possible to use the collimator at any wavelength within the coating range, the coupling loss will increase as the wavelength is detuned from the design wavelength.
GRIN Fiber Collimators		Thorlabs offers gradient index (GRIN) fiber collimators that are aligned at a variety of wavelengths from 630 to 1550 nm and have either FC terminated, APC terminated, or unterminated fibers. Our GRIN collimators feature a Ø1.8 mm clear aperture, are AR-coated to ensure low back reflection into the fiber, and are coupled to standard single mode or graded-index multimode fibers.
GRIN Lenses		These graded-index (GRIN) lenses are AR coated for applications at 630, 830, 1060, 1300, or 1560 nm that require light to propagate through one fiber, then through a free-space optical system, and finally back into another fiber. They are also useful for coupling light from laser diodes into fibers, coupling the output of a fiber into a detector, or collimating laser light. Our GRIN lenses are designed to be used with our Pigtailed Glass Ferrules and GRIN/Ferrule sleeves.

Hide 543 nm Air-Spaced Doublet Collimator Packages

543 nm Air-Spaced Doublet Collimator Packages

Item #	Alignment Wavelength[a]	Lens AR Coating[b]	Waist Diameter[c]	Waist Distance[d]	Full-Angle Divergence[e]	Theoretical Divergence	NA	Focal Length at Alignment Wavelength	Damage Threshold[f]	L	Drawing[g]	Connector Type
F810APC-543	543 nm	350 - 700 nm	6.4 mm	34.81 mm	0.006°		0.26	34.74 mm	7.5 J/cm^2	45.2 mm (1.78")	 Click for Details	FC/APC
F810FC-543	543 nm	350 - 700 nm	6.4 mm	34.81 mm	0.006°		0.26	34.74 mm	7.5 J/cm^2	45.0 mm (1.77")		FC/PC
F810SMA-543	543 nm	350 - 700 nm	6.4 mm	34.81 mm	0.006°		0.26	34.74 mm	7.5 J/cm^2	47.3 mm (1.86")		SMA

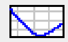
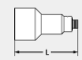
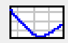
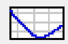
- For optimal collimation, these packages should be used at the alignment wavelength. For some applications, they may also be used at other wavelengths within the AR coating Range. Please contact Tech Support for packages that are aligned at other wavelengths.
- For data on Thorlabs' standard AR coatings, refer to the *AR Coatings* tab above.
- Theoretical $1/e^2$ Diameter at 1 Focal Length from Lens; Calculated at Alignment Wavelength with 460HP Fiber
- Measured from the Front of the Collimator Housing
- Theoretical $1/e^2$ Divergence Angle; Calculated at Alignment Wavelength with 460HP Fiber
- Measured at 532 nm, 10 ns, 10 Hz, Ø0.362 mm
- These collimators are compatible with the AD15F and AD15NT Ø15.0 mm mounting adapters.

Part Number	Description	Price	Availability
F810APC-543	543 nm FC/APC Collimation Package, NA = 0.26, f = 34.74 mm	$262.65	Today

F810FC-543	**543 nm FC/PC Collimation Package, NA = 0.26, f = 34.74 mm**	**$231.13**	**Today**
F810SMA-543	**543 nm SMA Collimation Package, NA = 0.26, f = 34.74 mm**	**$231.13**	**Today**

Hide 635 nm Air-Spaced Doublet Collimator Packages

635 nm Air-Spaced Doublet Collimator Packages

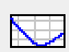
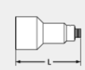
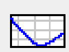
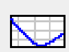
Item #	Alignment Wavelength[a]	Lens AR Coating[b]	Waist Diameter[c]	Waist Distance[d]	Full-Angle Divergence[e]	Theoretical Divergence	NA	Focal Length at Alignment Wavelength	Damage Threshold	L	Drawing[f]	Connector Type
F810APC-635	635 nm	350 - 700 nm	6.7 mm	35.16 mm	0.007°		0.25	35.41 mm	-	45.8 mm (1.80")	 Click for Details	FC/APC
F810FC-635	635 nm	350 - 700 nm	6.7 mm	35.16 mm	0.007°		0.25	35.41 mm	-	45.6 mm (1.80")		FC/PC
F810SMA-635	635 nm	350 - 700 nm	6.7 mm	35.16 mm	0.007°		0.25	35.41 mm	-	48.0 mm (1.89")		SMA

- For optimal collimation these packages should be used at the alignment wavelength. For some applications, they may also be used at other wavelengths within the AR coating range. Please contact Tech Support for packages that are aligned at other wavelengths.
- For data on Thorlabs' standard AR coatings, refer to the *AR Coatings* tab above.
- Theoretical $1/e^2$ Diameter at 1 Focal Length from Lens; Calculated at Alignment Wavelength with SM600 Fiber
- Measured from the Front of the Collimator Housing
- Theoretical $1/e^2$ Divergence Angle; Calculated at Alignment Wavelength with SM600 Fiber
- These collimators are compatible with the AD15F and AD15NT Ø15 mm mounting adapters.

Part Number	Description	Price	Availability
F810APC-635	**635 nm FC/APC Collimation Package, NA = 0.25, f = 35.41 mm**	**$262.65**	**Today**
F810FC-635	**635 nm FC/PC Collimation Package, NA = 0.25, f = 35.41 mm**	**$231.13**	**Today**
F810SMA-635	**635 nm SMA Collimation Package, NA = 0.25, f = 35.41 mm**	**$231.13**	**Today**

Hide 780 nm Air-Spaced Doublet Collimator Packages

780 nm Air-Spaced Doublet Collimator Packages

Item #	Alignment Wavelength[a]	Lens AR Coating[b]	Waist Diameter[c]	Waist Distance[d]	Full-Angle Divergence[e]	Theoretical Divergence	NA	Focal Length at Alignment Wavelength	Damage Threshold	L	Diagram[f]	Connector Type
F810APC-780	780 nm	650 - 1050 nm	7.5 mm	36.10 mm	0.008°		0.25	36.01 mm	-	41.4 mm (1.63")	 Click for Details	FC/APC
F810FC-780	780 nm	650 - 1050 nm	7.5 mm	36.10 mm	0.008°		0.25	36.01 mm	-	46.0 mm (1.81")		FC/PC
F810SMA-780	780 nm	650 - 1050 nm	7.5 mm	36.10 mm	0.008°		0.25	36.01 mm	-	48.6 mm (1.92")		SMA

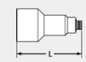
- For optimal collimation, these packages should be used at the alignment wavelength. For some applications, they may also be used at other wavelengths within the AR coating Range. Please contact Tech Support for packages that are aligned at other wavelengths.
- For data on Thorlabs' standard AR coatings, refer to the *AR Coatings* tab above.
- Theoretical $1/e^2$ Diameter at 1 Focal Length from Lens; Calculated at Alignment Wavelength with 780HP Fiber
- Measured from the Front of the Collimator Housing
- Theoretical $1/e^2$ Divergence Angle; Calculated at Alignment Wavelength with 780HP Fiber
- These collimators are compatible with the AD15F and AD15NT Ø15.0 mm mounting adapters.

Part Number	Description	Price	Availability
F810APC-780	**780 nm FC/APC Collimation Package, NA = 0.25, f = 36.01 mm**	**$262.65**	**Today**

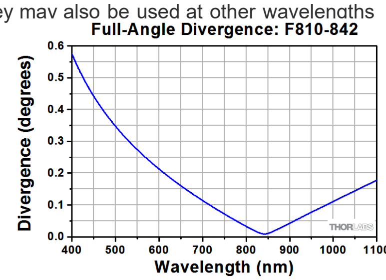
F810FC-780	**780 nm FC/PC Collimation Package, NA =0.25, f = 36.01 mm**	**$231.13**	**Today**
F810SMA-780	**780 nm SMA Collimation Package, NA = 0.25, f = 36.01 mm**	**$231.13**	**Today**

Hide 842 nm Air-Spaced Doublet Collimator Packages

842 nm Air-Spaced Doublet Collimator Packages

Item #	Alignment Wavelength[a]	Lens AR Coating[b]	Waist Diameter[c]	Waist Distance[d]	Full-Angle Divergence[e]	Theoretical Divergence	NA	Focal Length at Alignment Wavelength	Damage Threshold	L	Diagram[f]	Connector Type
F810APC-842	842 nm	650 - 1050 nm	7.8 mm	35.92 mm	0.008°		0.25	36.18 mm	-	41.4 mm (1.63")	 Click for Details	FC/APC

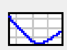
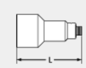
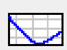
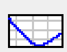
- For optimal collimation, these packages should be used at the alignment wavelength. For some applications, they may also be used at other wavelengths within the AR coating Range. Please contact Tech Support for packages that are aligned at other wavelengths.
- For data on Thorlabs' standard AR coatings, refer to the *AR Coatings* tab above.
- Theoretical $1/e^2$ Diameter at 1 Focal Length from Lens; Calculated at Alignment Wavelength with 780HP Fiber
- Measured from the Front of the Collimator Housing
- Theoretical $1/e^2$ Divergence Angle; Calculated at Alignment Wavelength with 780HP Fiber
- These collimators are compatible with the AD15F and AD15NT Ø15.0 mm mounting adapters.



Part Number	Description	Price	Availability
F810APC-842	**842 nm FC/APC Collimation Package, NA = 0.25, f = 36.18 mm**	**$262.65**	**Lead Time**

Hide 850 nm Air-Spaced Doublet Collimator Packages

850 nm Air-Spaced Doublet Collimator Packages

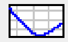
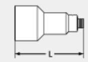
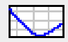
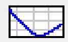
Item #	Alignment Wavelength[a]	Lens AR Coating[b]	Waist Diameter[c]	Waist Distance[d]	Full-Angle Divergence[e]	Theoretical Divergence	NA	Focal Length at Alignment Wavelength	Damage Threshold	L	Diagram[f]	Connector Type
F810APC-850	850 nm	650 - 1050 nm	7.8 mm	36.18 mm	0.008°		0.25	36.20 mm	-	46.6 mm (1.83")	 Click for Details	FC/APC
F810FC-850	850 nm	650 - 1050 nm	7.8 mm	36.18 mm	0.008°		0.25	36.20 mm	-	46.4 mm (1.82")		FC/PC
F810SMA-850	850 nm	650 - 1050 nm	7.8 mm	36.18 mm	0.008°		0.25	36.20 mm	-	48.6 mm (1.91")		SMA

- For optimal collimation, these packages should be used at the alignment wavelength. For some applications, they may also be used at other wavelengths within the AR coating Range. Please contact Tech Support for packages that are aligned at other wavelengths.
- For data on Thorlabs' standard AR coatings, refer to the *AR Coatings* tab above.
- Theoretical $1/e^2$ Diameter at 1 Focal Length from Lens; Calculated at Alignment Wavelength with 780HP Fiber
- Measured from the Front of the Collimator Housing
- Theoretical $1/e^2$ Divergence Angle; Calculated at Alignment Wavelength with 780HP Fiber
- These collimators are compatible with the AD15F and AD15NT Ø15.0 mm mounting adapters.

Part Number	Description	Price	Availability
F810APC-850	**NEW! Fiber Collimation Package, 850 nm, f = 36.20, FC/APC**	**$262.65**	**Today**
F810FC-850	**NEW! Fiber Collimation Package, 850 nm, f = 36.20, FC/PC**	**$231.13**	**Today**
F810SMA-850	**NEW! Fiber Collimation Package, 850 nm, f = 36.20, SMA**	**$231.13**	**Today**

Hide 1064 nm Air-Spaced Doublet Collimator Packages

1064 nm Air-Spaced Doublet Collimator Packages

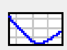
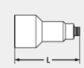
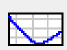
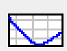
Item #	Alignment Wavelength[a]	Lens AR Coating[b]	Waist Diameter[c]	Waist Distance[d]	Full-Angle Divergence[e]	Theoretical Divergence	NA	Focal Length at Alignment Wavelength	Damage Threshold[f]	L	Diagram[g]	Connector Type
F810APC-1064	1064 nm	1050 - 1074 nm	8.0 mm	36.66 mm	0.010°		0.25	36.60 mm	7.5 J/cm^2	46.1 mm (1.81")	 Click for Details	FC/APC
F810FC-1064	1064 nm	1050 - 1074 nm	8.0 mm	36.66 mm	0.010°		0.25	36.60 mm	7.5 J/cm^2	46.2 mm (1.82")		FC/PC
F810SMA-1064	1064 nm	1050 - 1074 nm	8.0 mm	36.66 mm	0.010°		0.25	36.60 mm	7.5 J/cm^2	49.0 mm (1.93")		SMA

- For optimal collimation, these packages should be used at the alignment wavelength. For some applications, they may also be used at other wavelengths within the AR coating Range. Please contact Tech Support for packages that are aligned at other wavelengths.
- For data on Thorlabs' standard AR coatings, refer to the *AR Coatings* tab above.
- Theoretical $1/e^2$ Diameter at 1 Focal Length from Lens; Calculated at Alignment Wavelength with SM980-5.8-125 Fiber
- Measured from the Front of the Collimator Housing
- Theoretical $1/e^2$ Divergence Angle; Calculated at Alignment Wavelength with SM980-5.8-125 Fiber
- Measured at 1064 nm, 10 ns, 10 Hz, Ø0.442 mm
- These collimators are compatible with the AD15F and AD15NT Ø15.0 mm mounting adapters.

Part Number	Description	Price	Availability
F810APC-1064	Customer Inspired! 1064 nm FC/APC Collimation Package, NA = 0.25, f = 36.60 mm	$262.65	Today
F810FC-1064	1064 nm FC/PC Collimation Package, NA = 0.25, f = 36.60 mm	$231.13	Today
F810SMA-1064	1064 nm SMA Collimation Package, NA = 0.25, f = 36.60 mm	$231.13	Today

Hide 1310 nm Air-Spaced Doublet Collimator Packages

1310 nm Air-Spaced Doublet Collimator Packages

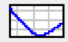
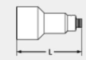
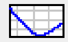
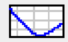
Item #	Alignment Wavelength[a]	Lens AR Coating[b]	Waist Diameter[c]	Waist Distance[d]	Full-Angle Divergence[e]	Theoretical Divergence	NA	Focal Length at Alignment Wavelength	Damage Threshold	L	Diagram[f]	Connector Type
F810APC-1310	1310 nm	1050 - 1620 nm	6.7 mm	36.96 mm	0.014°		0.24	36.90 mm	-	47.2 mm (1.86")	 Click for Details	FC/APC
F810FC-1310	1310 nm	1050 - 1620 nm	6.7 mm	36.96 mm	0.014°		0.24	36.90 mm	-	46.9 mm (1.84")		FC/PC
F810SMA-1310	1310 nm	1050 - 1620 nm	6.7 mm	36.96 mm	0.014°		0.24	36.90 mm	-	49.6 mm (1.95")		SMA

- For optimal collimation, these packages should be used at the alignment wavelength. For some applications, they may also be used at other wavelengths within the AR coating Range. Please contact Tech Support for packages that are aligned at other wavelengths.
- For data on Thorlabs' standard AR coatings, refer to the *AR Coatings* tab above.
- Theoretical $1/e^2$ Diameter at 1 Focal Length from Lens; Calculated at Alignment Wavelength with SMF-28e Fiber
- Measured from the Front of the Collimator Housing
- Theoretical $1/e^2$ Divergence Angle; Calculated at Alignment Wavelength with SMF-28e Fiber
- These collimators are compatible with the AD15F and AD15NT Ø15.0 mm mounting adapters.

Part Number	Description	Price	Availability
F810APC-1310	1310 nm FC/APC Collimation Package, NA = 0.24, f = 36.90 mm	$262.65	Today
F810FC-1310	1310 nm FC/PC Collimation Package, NA = 0.24, f = 36.90 mm	$231.13	Today
F810SMA-1310	1310 nm SMA Collimation Package, NA = 0.24, f = 36.90 mm	$231.13	Today

Hide 1550 nm Air-Spaced Doublet Collimator Packages

1550 nm Air-Spaced Doublet Collimator Packages

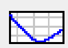
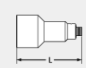
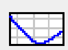
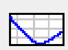
Item #	Alignment Wavelength[a]	Lens AR Coating[b]	Waist Diameter[c]	Waist Distance[d]	Full-Angle Divergence[e]	Theoretical Divergence	NA	Focal Length at Alignment Wavelength	Damage Threshold	L	Diagram[f]	Connector Type
F810APC-1550	1550 nm	1050 - 1620 nm	7.0 mm	37.20 mm	0.016°		0.24	37.13 mm	-	46.9 mm (1.85")	 Click for Details	FC/APC
F810FC-1550	1550 nm	1050 - 1620 nm	7.0 mm	37.20 mm	0.016°		0.24	37.13 mm	-	46.9 mm (1.85")		FC/PC
F810SMA-1550	1550 nm	1050 - 1620 nm	7.0 mm	37.20 mm	0.016°		0.24	37.13 mm	-	49.8 mm (1.96")		SMA

- For optimal collimation, these packages should be used at the alignment wavelength. For some applications, they may also be used at other wavelengths within the AR coating Range. Please contact Tech Support for packages that are aligned at other wavelengths.
- For data on Thorlabs' standard AR coatings, refer to the *AR Coatings* tab above.
- Theoretical $1/e^2$ Diameter at 1 Focal Length from Lens; Calculated at Alignment Wavelength with SMF-28e Fiber
- Measured from the Front of the Collimator Housing
- Theoretical $1/e^2$ Divergence Angle; Calculated at Alignment Wavelength with SMF-28e Fiber
- These collimators are compatible with the AD15F and AD15NT Ø15.0 mm mounting adapters.

Part Number	Description	Price	Availability
F810APC-1550	**1550 nm FC/APC Collimation Package, NA = 0.24, f = 37.13 mm**	**$262.65**	**Today**
F810FC-1550	**1550 nm FC/PC Collimation Package, NA = 0.24, f = 37.13 mm**	**$231.13**	**Today**
F810SMA-1550	**1550 nm SMA Collimation Package, NA = 0.24, f = 37.13 mm**	**$231.13**	**Today**

Hide 2.0 µm Air-Spaced Doublet Collimator Packages

2.0 µm Air-Spaced Doublet Collimator Packages

Item #	Alignment Wavelength[a]	Lens AR Coating[b]	Waist Diameter[c]	Waist Distance[d]	Full-Angle Divergence[e]	Theoretical Divergence	NA	Focal Length at Alignment Wavelength	Damage Threshold	L	Diagram[f]	Connector Type
F810APC-2000	2.0 µm	1.8 - 2.4 µm	7.3 mm	37.45 mm	0.02°		0.24	37.52 mm	-	47.1 mm (1.86")	 Click for Details	FC/APC
F810FC-2000	2.0 µm	1.8 - 2.4 µm	7.3 mm	37.45 mm	0.02°		0.24	37.52 mm	-	47.5 mm (1.87")		FC/PC
F810SMA-2000	2.0 µm	1.8 - 2.4 µm	7.3 mm	37.45 mm	0.02°		0.24	37.52 mm	-	50.3 mm (1.98")		SMA

- For optimal collimation, these packages should be used at the alignment wavelength. For some applications, they may also be used at other wavelengths within the AR coating Range. Please contact Tech Support for packages that are aligned at other wavelengths.
- For data on Thorlabs' standard AR coatings, refer to the *AR Coatings* tab above.
- Theoretical $1/e^2$ Diameter at 1 Focal Length from Lens; Calculated at Alignment Wavelength with SM2000 Fiber
- Measured from the Front of the Collimator Housing
- Theoretical $1/e^2$ Divergence Angle; Calculated at Alignment Wavelength with SM2000 Fiber
- These collimators are compatible with the AD15F and AD15NT Ø15.0 mm mounting adapters.

Part Number	Description	Price	Availability
F810APC-2000	**2.0 µm FC/APC Collimation Package, NA = 0.24, f = 37.52 mm**	**$262.65**	**Today**
F810FC-2000	**2.0 µm FC/PC Collimation Package, NA = 0.24, f = 37.52 mm**	**$231.13**	**Today**
F810SMA-2000	**2.0 µm SMA Collimation Package, NA = 0.24, f = 37.52 mm**	**$231.13**	**Today**