56 Sparta Avenue • Newton, New Jersey 07860
(973) 300-3000 Sales • (973) 300-3600 Fax
www.thorlabs.com

THORLABS

# CFC-8X-C - FEB 11, 2020

Item # CFC-8X-C was discontinued on FEB 11, 2020. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

## ADJUSTABLE ASPHERIC FC COLLIMATORS

- **Collimate Light**
- **FC/PC and FC/APC Compatible Versions**
- **Diffraction-Limited Performance when used with FC/PC Patch Cables**

**CFC-5X-A**
f = 4.6 mm

**CFC-2X-B**
f = 2 mm

**CFC-8X-A**
f = 7.5 mm

**CFC-11X-C**
f = 11 mm

The AD9.5F Adapter Makes These Collimators SM1 Compatible

OVERVIEW

## Features

- Collimate Light
- Four Focal Length Options: 2.0 mm, 4.6 mm, 7.5 mm, and 11.0 mm
- Three AR-Coated Aspheric Lens Options
  - 350 - 700 nm
  - 650 - 1050 nm (600 - 1050 nm for CFC-2X-B)
  - 1050 - 1620 nm (1050 - 1700 nm for CFC-2X-C)
- Diffraction-Limited Performance if used with FC/PC Patch Cables
- Non-Magnetic Stainless Steel Housing

| Webpage Feature |
| --- |
| These links open a window that contains additional information about the aspheric lens incorporated into each of these adjustable collimators. Here, you'll find sketches, aspheric coefficients, lens specifications, glass transmission and coefficients data, and links to the complete product drawings and catalog page documents. |

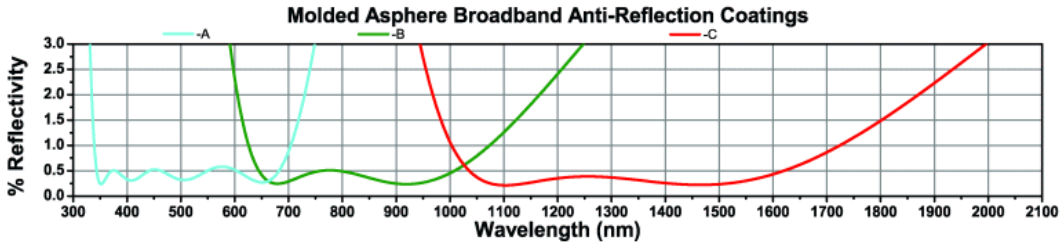
Thorlabs' Adjustable Focus FC Collimators, which consist of a spring-loaded, AR-coated aspheric lens mounted inside a stainless steel cell, are designed to collimate light exiting a fiber. For fiber-to-fiber coupling, we recommend using our FiberPorts or a fiber launch nanopositioning stage. The adjustable collimators featured here are available with an FC/PC receptacle. Rotation of the outer barrel of the collimator leads to translation of the housed aspheric lens along the optical axis, making it possible to adjust the distance between the lens and the tip of the fiber. The range for this distance is listed in the tables below as "Fiber-to-Lens Distance". Once the desired position is reached, the adjustment can be locked into place using two 0-80 setscrews and the included 0.7 mm hex key.

These collimators are comprised of four different focal length options (2.0 mm, 4.6 mm, 7.5 mm, or 11.0 mm), each of which is available with one of three antireflection coatings deposited on the aspheric lens surfaces. Please see the tables below for more information. All focal length lenses except for 11 mm provide dual FC/PC and FC/APC compatibility. In all cases, the fiber tip of the APC versions has the standard 8° wedge, leading to a 4° beam deviation from the mechanical axis of the housing. Each collimator can be made compatible with our SM1 (1.035"-40) threading by mounting it in an AD9.5F collimator mounting adapter.

Please note that for the 2.0 mm, 4.6 mm, and 7.5 mm focal length versions, which accept both FC/PC and FC/APC connectors, the light will not travel through the center of the aspheric lens if an FC/APC connector is used. For wavefront-sensitive applications that suffer from off-axis performance characteristics of aspheres, consider using a FiberPort; with 6 degrees of freedom, the optic location can be adjusted to ensure the beam travels through the optical axis of the lens.

Also please note that the Numerical Aperture (NA) specified in the *Lens Details* section of the tables below is that of the aspheric lens incorporated into the collimator, not the entire collimator assembly.

We recommend using adjustable collimators 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. These cables are available with an AR-coated FC/PC or FC/APC connector. Alternatively, our large selection of standard fiber patch cables can also be used.



CALCULATION

## 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 an MM 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 CFC-2X-A collimator is used with a single mode fiber patch cable such as our former item P1-460A-FC-2 such that *MFD* = 3.3 µm and *f* ≈ 2.0 mm, the divergence angle is

θ ≈ (0.0033 mm / 2.0 mm)*(180/3.1416) ≈ 0.095° or 1.66 mrad.

## 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.

Example:

When the CFC-5X-C collimator (f = 4.6 mm) is used with the P1-SMF28E-FC-1 patch cable (MFD = 10.5 µm) and 1550 nm light, the output beam diameter is

(4)(1550 nm)[4.6 mm / (π · 10.5 µm)] = 0.87 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.

Example:

When the CFC-2X-A collimator is used with a single mode fiber patch cable such as our former item P1-460A-FC-2 such that *MFD* = 3.3 µm, *f* ≈ 2.0 mm, and λ = 488 nm, then the maximum waist distance is

(2 mm) + (2 (2 mm)$^2$ (488 nm) / (3.1416) (3.3 µm)$^2$) = 116 mm.

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 (Ø5.3 - Ø8.5 mm), Thorlabs offers FC/APC, FC/PC, and SMA 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. |
| 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. |
| Achromatic Collimators for Multimode Fiber |  | Thorlabs' High-NA Achromatic Collimators pair a meniscus lens with an achromatic doublet for high performance across the visible spectrum with low spherical aberration. Designed for use with high-NA multimode fiber, these collimators are ideal for Optogenetics and Fiber Photometry applications. |
| 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. |
| 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 five 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. |
| 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. |
| Large Beam Fiber Collimators |  | Thorlabs' Large-Beam Fiber Collimators are designed with an effective focal length (EFL) of 40 mm or 80 mm, have optical elements broadband AR coated for one of three wavelength ranges, and are available with FC/PC, FC/APC, or SMA905 connectors. A four-element, air-spaced lens design produces 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 collimators or couplers. 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. |
| 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. |
| Single Mode Pigtailed Collimators |  | Our single mode pigtailed collimators come with one meter of fiber, consist of an AR-coated aspheric lens pre-aligned with respect to a fiber, and are collimated at one of eight wavelengths: 532 nm, 633 nm, 780 nm, 850 nm, 1030 nm, 1064 nm, 1310 nm, 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. |
| Polarization Maintaining Pigtailed Collimators |  | Our polarization maintaining pigtailed collimators come with one meter of fiber, consist of an AR-coated aspheric lens pre-aligned with respect to a fiber, and are collimated at one of six wavelengths: 532 nm, 830 nm, 1030 nm, 1064 nm, 1310 nm, or 1550 nm. Custom wavelengths and connectors are available as well. A line is engraved along the outside of the housing that is parallel to the slow axis. As such, it can be used as a reference when polarized light is launched accordingly. 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. |

| Type | | Description |
|---|---|---|
| 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. |

## Adjustable Aspheric Collimators (f = 2.0 mm)

| Item # | f (mm) | Input MFD[a] | Output Waist Dia. | Max Waist Distance[b] | Diver-gence[c] | Compatible Connectors | Fiber-to-Lens Distance[d] | AR Coating | Lens Details |
|---|---|---|---|---|---|---|---|---|---|
| CFC-2X-A | 2.0 | 3.3 µm | 0.38 mm[e] | 116 mm | 0.095° | FC/PC, FC/APC | 0.4 - 3.0 mm | 350 - 700 nm | |
| CFC-2X-B | 2.0 | 4.3 µm | 0.38 mm[f] | 89 mm | 0.123° | FC/PC, FC/APC | 0.4 - 3.0 mm | 600 - 1050 nm | |
| CFC-2X-C | 2.0 | 10.4 µm | 0.38 mm[g] | 38 mm | 0.298° | FC/PC, FC/APC | 0.4 - 3.0 mm | 1050 - 1700 nm | |

- Mode Field Diameter used to calculate the minimum divergence angle from the tip of the fiber (See the *Calculation* tab).
- Maximum beam waist distance, as measured from the lens, to maintain collimation.
- Theoretical full-angle beam divergence.
- Distance between the fiber tip and the lens.
- Based on our P1-460B-FC Series of FC/PC or P3-460B-FC Series of FC/APC Patch Cables
- Based on P1-630A-FC Series of FC/PC or P3-630A-FC Series of FC/APC Patch Cables
- Based on P1-SMF28E-FC Series of FC/PC or P3-SMF28E-FC Series of FC/APC Patch Cables

| Part Number | Description | Price | Availability |
|---|---|---|---|
| **CFC-2X-A** | **Customer Inspired! Adj. FC/PC and FC/APC Collimator, f = 2.0 mm, ARC: 350-700 nm** | **$260.79** | **Today** |
| **CFC-2X-B** | **Customer Inspired! Adj. FC/PC and FC/APC Collimator, f = 2.0 mm, ARC: 600-1050 nm** | **$260.79** | **Today** |
| **CFC-2X-C** | **Customer Inspired! Adj. FC/PC and FC/APC Collimator, f = 2.0 mm, ARC: 1050-1700 nm** | **$260.79** | **Today** |

## Adjustable Aspheric Collimators (f = 4.6 mm)

| Item # | f (mm) | Input MFD[a] | Output Waist Dia. | Max Waist Dist.[b] | Diver-gence[c] | Compatible Connectors | Fiber-to-Lens Distance[d] | AR Coating | Lens Details |
|---|---|---|---|---|---|---|---|---|---|
| CFC-5X-A | 4.6 | 3.3 µm | 0.87 mm[e] | 608 mm | 0.041° | FC/PC, FC/APC | 2.4 - 4.9 mm | 350 - 700 nm | |
| CFC-5X-B | 4.6 | 4.3 µm | 0.86 mm[f] | 466 mm | 0.054° | FC/PC, FC/APC | 2.4 - 4.9 mm | 650 - 1050 nm | |
| CFC-5X-C | 4.6 | 10.4 µm | 0.87 mm[g] | 198 mm | 0.130° | FC/PC, FC/APC | 2.4 - 4.9 mm | 1050 - 1620 nm | |

- Mode Field Diameter used to calculate the minimum divergence angle from the tip of the fiber (See the *Calculation* tab).
- Maximum beam waist distance, as measured from the lens, to maintain collimation.
- Theoretical Full-Angle Beam Divergence
- Distance between the fiber tip and the lens.
- Based on our P1-460B-FC Series of FC/PC or P3-460B-FC Series of FC/APC Patch Cables
- Based on P1-630A-FC Series of FC/PC or P3-630A-FC Series of FC/APC Patch Cables
- Based on P1-SMF28E-FC Series of FC/PC or P3-SMF28E-FC Series of FC/APC Patch Cables

| Part Number | Description | Price | Availability |
|---|---|---|---|
| **CFC-5X-A** | **Customer Inspired! Adj. FC/PC and FC/APC Collimator, f = 4.6 mm, ARC: 350-700 nm** | **$260.79** | **Today** |
| **CFC-5X-B** | **Customer Inspired! Adj. FC/PC and FC/APC Collimator, f = 4.6 mm, ARC: 650-1050 nm** | **$260.79** | **Today** |
| **CFC-5X-C** | **Customer Inspired! Adj. FC/PC and FC/APC Collimator, f = 4.6 mm, ARC: 1050-1620 nm** | **$260.79** | **Lead Time** |

## Adjustable Aspheric Collimators (f = 7.5 mm)

| Item # | f (mm) | Input MFD[a] | Output Waist Dia. | Max Waist Dist.[b] | Diver-gence[c] | Compatible Connectors | Fiber-to-Lens Distance[d] | AR Coating | Lens Details |
|---|---|---|---|---|---|---|---|---|---|
| CFC-8X-A | 7.5 | 3.3 µm | 1.4 mm[e] | 1612 mm | 0.025° | FC/PC, FC/APC | 4.2 - 6.8 mm | 350 - 700 nm | |
| CFC-8X-B | 7.5 | 4.3 µm | 1.4 mm[f] | 1233 mm | 0.033° | FC/PC, FC/APC | 4.2 - 6.8 mm | 650 - 1050 nm | |
| CFC-8X-C | 7.5 | 10.4 µm | 1.4 mm[g] | 521 mm | 0.079° | FC/PC, FC/APC | 4.2 - 6.8 mm | 1050 - 1620 nm | |

- Mode Field Diameter used to calculate the minimum divergence angle from the tip of the fiber (See the *Calculation* tab).
- Maximum beam waist distance, as measured from the lens, to maintain collimation.
- Theoretical full-angle beam divergence.
- Distance between the fiber tip and the lens.
- Based on our P1-460B-FC Series of FC/PC or P3-460B-FC Series of FC/APC Patch Cables
- Based on P1-630A-FC Series of FC/PC or P3-630A-FC Series of FC/APC Patch Cables
- Based on P1-SMF28E-FC Series of FC/PC or P3-SMF28E-FC Series of FC/APC Patch Cables

| Part Number | Description | Price | Availability |
|---|---|---|---|
| **CFC-8X-A** | **Customer Inspired! Adj. FC/PC and FC/APC Collimator, f = 7.5 mm, ARC: 350-700 nm** | **$260.79** | **Lead Time** |
| **CFC-8X-B** | **Customer Inspired! Adj. FC/PC and FC/APC Collimator, f = 7.5 mm, ARC: 650-1050 nm** | **$260.79** | **Today** |
| **CFC-8X-C** | **Customer Inspired! Adj. FC/PC and FC/APC Collimator, f = 7.5 mm, ARC: 1050-1620 nm** | **$260.79** | **Lead Time** |

## Adjustable Aspheric Collimators (f = 11 mm)

| Item # | f (mm) | Input MFD[a] (µm) | Output Waist Dia. | Max Waist Dist.[b] | Diver-gence[c] | Compatible Connectors | Fiber-to-Lens Distance[d] | AR Coating | Lens Details |
|---|---|---|---|---|---|---|---|---|---|
| CFC-11X-A | 11.0 | 3.3 | 2.1 mm[e] | 3.5 m | 0.017° | FC/PC | 8.3 - 10.9 mm | 350 - 700 nm | |
| CFC-11X-B | 11.0 | 4.3 | 2.1 mm[f] | 2.6 m | 0.022° | FC/PC | 8.3 - 10.9 mm | 650 - 1050 nm | |
| CFC-11X-C | 11.0 | 10.4 | 2.1 mm[g] | 1.1 m | 0.054° | FC/PC | 8.3 - 10.9 mm | 1050 - 1620 nm | |

- Mode Field Diameter used to calculate the minimum divergence angle from the tip of the fiber (See the *Calculation* tab).
- Maximum beam waist distance, as measured from the lens, to maintain collimation.
- Theoretical full-angle beam divergence.
- Distance between the fiber tip and the lens.
- Based on our P1-460B-FC Series of FC/PC Patch Cables
- Based on P1-630A-FC Series of FC/PC Patch Cables
- Based on P1-SMF28E-FC Series of FC/PC Patch Cables

| Part Number | Description | Price | Availability |
|---|---|---|---|
| **CFC-11X-A** | **Customer Inspired! Adjustable FC/PC Collimator, f = 11.0 mm, ARC: 350-700 nm** | **$279.18** | **Lead Time** |
| **CFC-11X-B** | **Customer Inspired! Adjustable FC/PC Collimator, f = 11.0 mm, ARC: 650-1050 nm** | **$279.18** | **Today** |
| **CFC-11X-C** | **Customer Inspired! Adjustable FC/PC Collimator, f = 11.0 mm, ARC: 1050-1620 nm** | **$279.18** | **Lead Time** |

Visit the *Adjustable Aspheric FC Collimators* page for pricing and availability information:
https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=4353