Titanium Fiber Collimator series 60FC

for collimating radiation exiting an optical fiber or as an incoupler

FEATURES

The fiber collimator is designed for collimating radiation exiting from an optical fiber cable or used in reverse as a fiber coupler (fiber port) for coupling a beam into an optical fiber cable.

- Made from amagnetic titanium
- Focal lengths up to 20 mm
- Choice of aspheres, monochromats, achromats and apochromats
- Various AR coatings for UV - IR
- Choice of fiber receptacles: FC PC or FC APC (standard), ST, LSA or mini AVIM®
- Compact Ø 12 mm housing
- Front connector accepts attachment optics

DESCRIPTION

The fiber collimators series 60FC made from amagnetic titanium are designed for collimating radiation exiting optical fiber cables with high pointing stability. They can also be used in reverse-mode as fiber incouplers. They are suitable for single-mode and polarization-maintaining fiber cables leading to collimated beams with a Gaussian intensity profile. Please note that for multimode collimation the intensity profile is not Gaussian and depends on specific fiber and radiation properties.

An optics for each application
A large variety of collimating optics allows that the optimum focal length and the best lens type for a single wavelength (asphere, monochromat) or a wavelength range (achromat or apochromat) can be selected for each application. All lenses are AR-coated. For an ideal Gaussian beam and standard fibers you can reach coupling efficiencies up to 80%.

Adjustment of focus
The distance between fiber end-face and collimating optics is adjusted by means of an eccentric key. The lens does not rotate when adjusting the focus. The final focus setting is locked by means of two radially arranged clamping screws. Additionally attachment optics can be mounted to the front of the collimator.

Optimum lens performance
The angled polish of connectors of type APC is considered by a pre-angled mechanical coupling axis that compensates the beam deflection and you can use the lens centrically. This minimizes aberrations simply resulting from a non-ideal beam path through the lens.

Connector Type
The fiber collimator can be equipped with FC PC (wide key*), FC APC (wide key*), ST, LSA (compatible with fiber connectors type DIN, AVIO and AVIM) or mini AVIM® (compatible with mini AVIM® and midi AVIM®) receptacles. SMA-905 (F-SMA) type receptacles are available for 0°-polish e.g. for SMA-905 High Power connectors. In case of FC or LSA with a spring loaded ferrule the fiber coupler has an additional grub screw to increase pointing stability.*Even though the fiber collimator has a wide key receptacle it still can be used with both narrow key and wide key fibers. More information can be found here.

Amagnetic titanium
The fiber collimators are made from amagnetic titanium. The relative permeability of titanium is near 1 (μ_r=1.00005) making it almost transparent to magnetic fields. The linear coefficient of thermal expansion is close to that of the optics so that a thermal stability over a larger temperature range can be expected.

Mounting
The collimator can be placed into a standard mirror mount using the corresponding adapters.

- Lens Types
  Differences between aspheres, achromats and apochromats
- Fiber Connector Options
  FC PC, FC APC etc.
- Pre-angled coupling axis
  Reasons for a pre-angled coupling axis
- Grub screw for fiber ferrule
  Why you should tighten the grub screw for the fiber ferrule.
- Single-mode and PM fiber Coupling (6)
  Selection of focal length, estimated coupling efficiency

Single-mode and PM fiber Coupling
Selection of focal length, estimated coupling efficiency

- Selection of coupling focal length for an elliptical beam
  Selection of focal length and effective coupling diameter
- Coupling efficiency
  Sources of loss when fiber-coupling
- Industry-grade fiber coupling
  Industry-grade fiber coupling for different well-esablished laser systems
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  How measured fiber parameters help to choose the best coupling and collimation optics.
- Article - Perfectly Coupled
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- Collimating single-mode fibers (6)
  Collimated beam diameter, beam divergence, pilot beam
  - Collimated beam diameter of a singlemode fiber
    Selection of focal length or determination of the resulting beam diameter
  - Practical collimation
    Practical collimation tips for single-mode, polarization-maintaining and multimode fibers
  - Beam divergence
    Beam divergence of a collimated beam exiting a single-mode fiber
  - Pilot beam
    Approximate constant beam diameter across a certain working range
  - Article - Fiber Coupling to Polarization-Maintaining Fibers and Collimation
    How measured fiber parameters help to choose the best coupling and collimation optics.
  - Article - Specialized fiber collimators
    Cooling and trapping atoms using specially developed fiber collimators
- Producing spots (3)
  When can you produce a spot by simply refocusing the fiber collimator and when is a micro focus optics necessary?
  - Refocusing the collimator to produce a focus spot
    Beam divergence of a collimated beam exiting a single-mode fiber
  - Producing spots by using a fiber collimator and a micro focus optics
    Calculation of spot diameter for single-mode fibers
  - Rayleigh range
    What is the depth of focus of my spot?
- Multimode fiber coupling and collimation (5)
  Selection of focal length

Multimode fiber coupling
Selection of focal length

- Collimating multimode fibers
  Collimated beam diameter and divergence
- Practical collimation
  Practical collimation tips for single-mode, polarization-maintaining and multimode fibers
- Producing spots by refocussing multimode fiber collimators
  Calculation of spot diameter
- Coupling an Extended Source Into a Multimode Fiber
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- Mounting options for Ø 12mm Fiber Collimators (Series 60FC and 60FC-SF)
  Mounting options for Fiber Collimators series 60FC and 60FC-SF
- Article - Fiber Coupling to Polarization-Maintaining Fibers and Collimation
  How measured fiber parameters help to choose the best coupling and collimation optics.
- Connecting single-mode and PM fibers to a fiber coupler
  How to correctly insert a fiber into the receptacle of a fiber coupler

FAQ

Adjustment

How much can I change the focus setting?

For couplers and collimators with a focal length < 12 mm you can change the focus setting ± 0.5 mm. For couplers and collimators with a focal length ≥ 12 mm you can change the focus setting ± 1.0 mm.

What is the difference between the eccentric keys type 60EX-4 and 60EX-5?

Both eccentric keys are used for the fiber collimators series 60FC and the laser beam couplers series 60SMF/60SMS.The difference between the two eccentric keys is their stroke:

The eccentric key type 60EX-5 has a larger stroke compared to the key type 60EX-4. The 60EX-5 is used for couplers with focal length ≥ 12 mm. The 60EX-4 is used for focal lenghts < 12 mm.

In some (very, rare) cases it might be necessary to use the eccentric key type 60EX-5 even for couplers with focal lengths shorter than 12 mm:

- When the coupler is used with a fiber connector that has an end cap,

- the coupler is collimated for an extremely long wavelength,

- the coupler is collimated for an extremely short wavelength,

- or the coupler is focussed to a finite distance in order to generate a small spot .

How do I collimate a coupler with an end cap fiber cable?

Collimating with an end cap fiber cable is no different than with a standard fiber cable. However, the focus position might vary a little (<200 µm) when swapping a standard fiber cable for a fiber cable with end cap.

The eccentric key 60EX-4 is used to adjust the focus position. In some cases the stroke is not large enough. Please use the eccentric key 60EX-5 with a larger stroke instead.

I do not have a collimating telescope to collimate. Can you give me practical advice?

Of coarse, a collimating telescope is the best way to collimate. But there are other methods depending on the type of fiber (single-mode and PM vs. multimode) you can use. Please refer to our practical collimating tips here.

My collimator is shipped "prealigned". What does this mean?

Schäfter+ Kirchhoff ships all collimators prealigned and collimated for either a specific wavelength defined by the customer or a typical wavelength. The collimation is performed using professional collimating telescopes.

Please note: The fibers used in the standard adjustment procedure are all equipped with an end cap when aligning for wavelengths ≤ 520 nm. The adjustment wavelength is given on the label for each collimator/coupler. If a fiber with end cap was used it is marked by "EC".

I am unsure how to correctly adjust my coupler/collimator. Where do I find details about the adjustment procedure?
Please refer to the manual in the Downloads section for a detailed adjustment procedure.

Mounting

How do I mount the fiber coupler?
There are various options to mount the fiber coupler. Please click here for more information.

Fiber Receptacle

FC PC and FC APC

What type of receptacle does my collimator with receptacle type FC have? Narrow key or wide key?
All our fiber collimators and couplers with a receptacle type FC have a so calles wide key receptacle (2.14 mm).

These are suitable for connecting fibers with connector type FC (wide key) but also with thos of type narrow key! You can find the details in the FAQs below.

How do I attach a fiber cable?

To prevent damage to the sensitive fiber end-face, always insert the fiber connector`s ferrule at an angle, with the connector key properly aligned to the receptacle notch.
When the ferrule tip is safely located in the inner cylinder of the receptacle, align the connector to the receptacle axis and carefully introduce the connector into the fiber coupler.
Then, orient the connector key in a way that it is pressed gently onto the right-hand side of the receptacle notch ("right-hand orientation rule").
Gently screw on the connector cap nut onto the receptacle until it is finger-tight.
Gently tighten the fiber grub screw to reduce the free play of the ferrule in the receptacle.

What is the "right-hand orientation rule"?
When the ferrule tip is safely located in the inner cylinder of the receptacle, align the connector to the receptacle axis and carefully introduce the connector into the fiber coupler.

Then, orient the connector key in a way that it is pressed gently onto the right-hand side of the receptacle notch.

The tightened grub screw and the "right-hand orientation rule" for the connector, ensure a high reproducibility in mode field position and angle, which is especially important for attaching and reattaching polarization-maintaining fibers reproducibly.

Can I attach a narrow key fiber cable to a fiber coupler with a wide key receptacle?
Yes, you can- without any problem. Simply adhere to the "right-hand orientation rule".

Generally, with any FC PC or FC APC type connector there is a freeplay when inserting the fiber into the fiber coupler. The free play in between the connector ferrule and receptacle is only a few microns, but necessary for inserting the ferrule without force. There is a difference between the receptable and key width for wide key (2.14 mm) and narrow key (2.0 mm) fibers. If you follow the so-called "right-hand orientation rule" you can reproducibly attach and reattach even PM fibers with narrow key receptacle to fiber couplers with wide key receptacle without difficulty.

"Right-hand orientation rule":

When the ferrule tip is safely located in the inner cylinder of the receptacle, align the connector to the receptacle axis and carefully introduce the connector into the fiber coupler. Then, orient the connector key in a way that it is pressed gently onto the right-hand side of the receptacle notch. The tightened grub screw and the "right-hand orientation rule" for the connector, ensure a high reproducibility in mode field position and angle, which is especially important for attaching and reattaching polarization-maintaining fibers reproducibly.

Fiber Collimators with receptacle type SMA

Why do we not offer fiber couplers without TILT alignment and a receptacle type F-SMA with an angled polish?
The fiber connectors of type SMA do not have a spring-loaded ferrule (such as FC type connectors do).

The receptacles do not have a limit stop.
Since the length of the ferrule is not defined precisely, the emitting point in the fiber coupler is not properly defined.

In case of a 0°-polish this is not a problem since you can adjust for this by adjusting the axial lens position.

However, in case of an SMA fiber connector with an angled polish, the emitting point additionally moves laterally with ferrule length.

In order to compensate for this lateral displacement, a TILT alignment is absoluetely necessary.

Troubleshooting

I can‘t collimate the radiation out of a coupler. Why?

Have you loosened the grub screws?
The clamp screws have to be loosened before changing the focus setting, Please refer to the adjustment instructions of the individual couplers for more details.

Have you checked, if the fiber is correctly placed within the fiber receptacle of the coupler?

The fiber connector might not be placed correctly within the receptacle of the coupler/collimator. In particular, please check the small grub screw holding the connector's ferrule (e.g. for FC PC and FC APC type couplers). It might be in the way. Please refer to the adjustment instructions of the individual couplers/collimators for more details.

Have you tried another eccentric key?

Please check, if the eccentric key is damaged or broken.

Please also check, if you are using the appropriate eccentric key. The eccentric key type 60EX-5 has a larger stroke compared to the key type 60EX-4. The 60EX-5 is used for couplers/collimators with focal length ≥ 12 mm. The 60EX-4 is used for focal lenghts < 12 mm.

In some very rare cases (e.g.shorter wavelengths and end cap fibers) the stroke of the original eccentric key may be too small for the coupler in your applictation. (See FAQ "Difference between 60EX-4 and 60EX-5"). Try using the 60EX-5 in this case.

Have you checked the eccentric key for damage?

The eccentric key might be damaged or broken. If that is the case, try another eccentric key of the same type and (or) contact Schäfter+Kirchhoff for replacement.

Are you using a fiber with an end cap?

Collimating/coupling with an end cap fiber cable is no different than with a standard fiber cable. However, the focus position might vary a little (<200 µm) when swapping a standard fiber cable for a fiber cable with end cap.

The eccentric key 60EX-4 is used to adjust the focus position. In some cases the stroke is not large enough.

This includes working with very small wavelegths or very large wavelengths. Please try using the eccentric key 60EX-5 with a larger stroke instead.

It says my coupler/collimator was "precollimated" but the collimation setting seems to not be alright. What might be the problem?

Are you using the same wavelength as the adjustment wavelength?

Schäfter+ Kirchhoff ships all collimators/couplers prealigned and collimated/preadjusted for either a specific wavelength defined by the customer or a typical wavelength. The prealigned is performed using professional collimating telescopes.

The adjustment wavelength is given on the label for each collimator/coupler. If you are using another wavelength you need to change the focus setting. Please refer to the manual for more details.

Are you using the same fiber type as in the adjustment procedure?
The fibers used in the standard adjustment procedure are all equipped with an end cap when aligning for wavelengths ≤ 520 nm. The adjustment wavelength is given on the label for each collimator/coupler. If a fiber with end cap was used it is marked by "EC".

If you are not using a fiber with an end cap but the preadjustment at Schäfter+Kirchhoff was done using an end cap ("EC") or you are using a fiber with an end cap and the preadjustment at Schäfter+Kirchhoff was done without, you might need to change the focus setting. Please refer to the manual for more details.

DOWNLOADS

Adjustment_60FC.pdf (Manual)

Article_FibercouplingNAe2.pdf (Technote)

This downloads section only includes general downloads for the complete series.
Please access the individual product pages (using the product configurator, the product list, order options or the search button if you have a complete order code). Here you will find specific downloads including technical drawings or stepfiles.

ACCESSORIES

ADJUSTMENT TOOLS FIBER OPTICS	
ATTACHMENT OPTICS SERIES 5	to attach in the front of collimators with system mount Ø 8 mm
MICRO FOCUS OPTICS SERIES 5M	for transforming a collimated beam into a micro focus spot
IRIS DIAPHRAGMS 5BL	for collimators with Ø 12 mm
POLARIZATION FILTERS 5PF	for attaching to 60FC Fiber Collimators
RETARDATION OPTICS 5WP	Retardation optics for fiber collimators with Ø 12 mm

RELATED PRODUCTS

FIBER COLLIMATOR SERIES 60FC	for collimating radiation exiting an optical fiber or as an incoupler
ADAPTERS FOR 60FC	for Ø 12 mm to diameter Ø 25 mm, Ø 1" or with system mount Ø 19.5 mm
LASER BEAM COUPLERS SERIES 60SMS	for coupling into single-mode and polarization-maintaining fiber cables
FIBER COLLIMATOR SERIES 60FC-SF	Fiber Collimator/Fiber Coupler with super-fine thread
FIBER COLLIMATOR SERIES 60FC-T	for collimating large beam diameters and with additional TILT adjustment
FIBER COLLIMATOR SERIES 60FC-LSA	with LSA type receptacle for collimating radiation exiting an optical fiber or as an incoupler
FIBER COLLIMATOR SERIES 60FC-MAV	with mini AVIM type receptacle for collimating radiation exiting an optical fiber or as an incoupler

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