

OPTICAL BLOCKS

Optical Components for Optical Measurement

OVERVIEW

Optical blocks are freely combinable modular units designed to facilitate optical connections that are usually difficult for low-light-level measurements. Hamamatsu provides various types of optical blocks that allow installation of optical components such as filters, mirrors, and lenses.

Each optical block can be placed precisely and is easy to attach/detach yet excellent in light shielding.

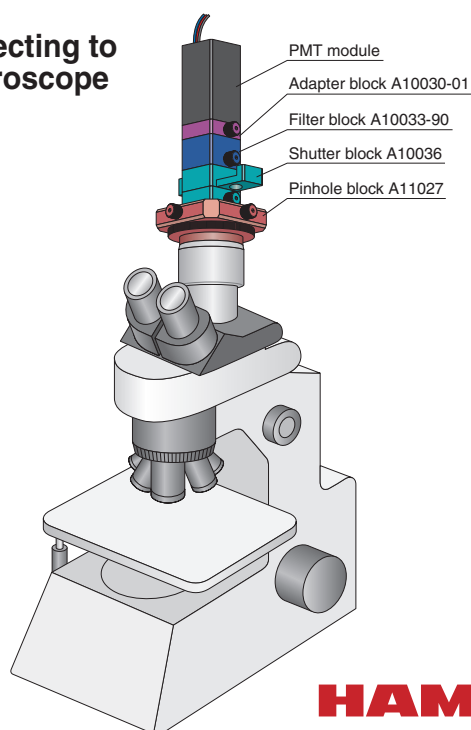
When used in combination with a Hamamatsu photomultiplier tube module, optical blocks allow low-light-level measurements even in an ordinary room environment.

FEATURES

- Easy to attach / detach
- No alignment required
- Excellent light-shielding effect
- Makes low-light-level measurement easy
- Easy connect to microscopes

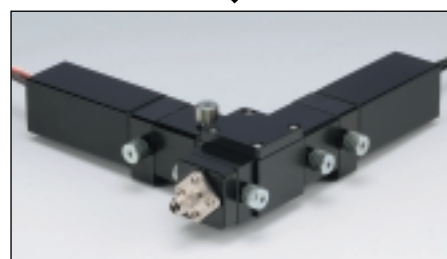
USING EXAMPLE


















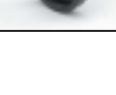
- Connecting to a microscope





| | |
|-------------------------------------------|------------------------------------------------|
| Mechanics Holder Stage | Light shield Darkroom environment |
| Optics Filter Mirror Lens | Detector PMT Photodiode Camera |

↓ Integration



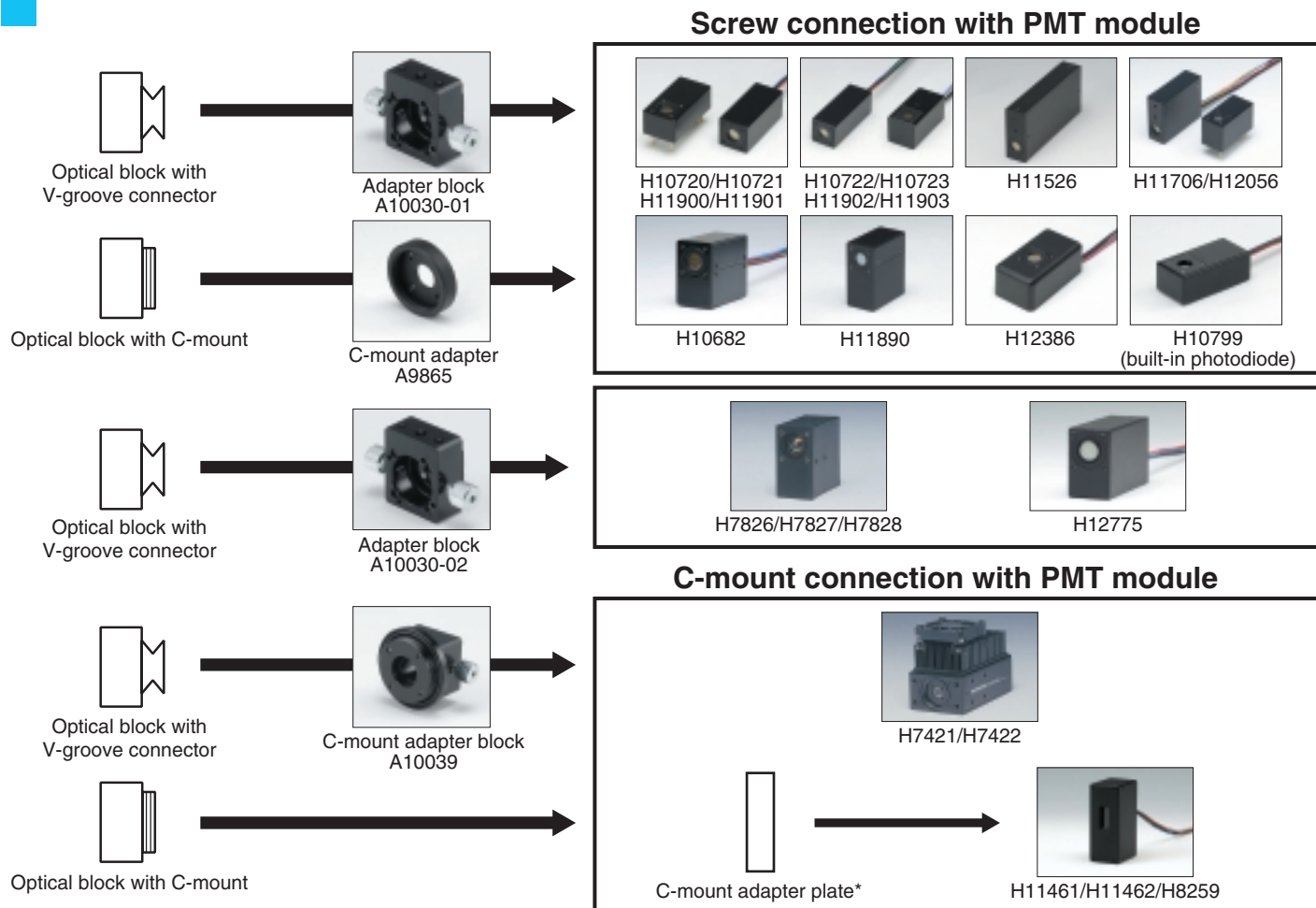
| Photo | Product name / Type No. | Over view | Page |
|-------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
|  | Adapter block A10030 series | The A10030 series is an adapter block for connecting a PMT module to a V-groove type optical block. | 4 |
|  | C-mount adapter block A10039 | This block connects a device having C-mount to V-groove type optical blocks. The connection angle for the device and block is adjustable. | 4 |
|  | Fiber adapter block A10037 series | Optical fiber cables with FC or SMA connectors can be connected to the blocks in the A10037 series. The lens assembled in the block collimates the light spread from the optical fiber. | 5 |
|  | Beam expander block A10031 | This optical block widens the diameter of a collimated beam of light to 2.5 times its original size or reduces the diameter to 1/2.5 times its original size. | 5 |
|  | Joint block A10038 series | The A10038 series is a joint block for connecting one optical block to another. The joint is available in two types: MM (male-male) type and FF (female-female) type. | 6 |
|  | Cuvette block A11971 | This block is a small dark box specifically designed for cuvettes with an optical path length of 10 mm, and allows easy measurement of samples in combination with various optical blocks. | 6 |
|  | Shutter block A10036 | The A10036 is a manual shutter block with a plate that is opened and closed by sliding it left and right. Light is sufficiently blocked so there will be no problem even at photon counting levels. | 7 |
|  | ND filter block A10032 series | A neutral density (ND) filter is included in this optical block to attenuate light levels. The ND filter is available in two types transmittance: 10 % type and 1 % type. | 7 |
|  | Interchangeable filter block A10033-90 | The A10033-90 is a holder block for assembling a commercially available 15 mm diameter filter. | 8 |
|  | Interchangeable dichroic block A10034-90 | This is a V-groove type holder block that allows installation of a commercially available dichroic mirror with a 45-degree incident angle. | 9 |
|  | Beam splitter block A10035 | This optical block uses a cubic type half-mirror. Incident light is split into reflected and transmitted beams at a ratio of 1 to 1. | 10 |
|  | Beam splitter block A10035-90 | The A10035-90 is a holder block designed to hold a 15 mm cubic type beam splitter. | 10 |
|  | Pinhole block A11027 | This is a holder block that can hold a commercially available, mount type pinhole. Light passing through the pinhole is collimated by the lens installed in the block and is output. | 11 |
|  | Stage block A10858 | This is a dark box equipped with 2 micrometers for positionings. It allows light measurements even under room lighting by externally connecting various types of optical blocks. | 12, 13 |
|  | Beam aligner block A10760 | This optical block is for using an infinity-corrected objective lens to guide laser light into an optical fiber with an attached FC connector or to collimate and transmit the beam from a fiber-optic cable. | 14 |
|  | Tube lens block A10859 series | This block contains a focusing lens with a focal distance of 100 mm and is used for an infinity-corrected objective lens. Aberration is reduced due to the use of an achromatic lens. | 15 |
|  | C-mount interchangeable filter block A11213 series | The A11213 series is a C-mount connection block for installing a commercially available 25 mm diameter filter or lens. This block allows angle adjustment and so is useful as a spacer or adapter that connects between C-mounts. | 16 |
|  | C-mount adapter A9865 | This adapter is for connecting a PMT module to a optical block and an equipment with C-mount. | 16 |

| Photo | Product name / Type No. | Over View | Page |
|-----------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
|  | C-mount interchangeable dichroic block A11214 | The A11214 is a C-mount connection block for installing a dichroic mirror for use at a 45° angle of incidence. | 17 |
|  | Polarizer block A11026 | This is a holder block designed for a polarizer. Polarizing filters and waveplates are polarizing elements whose polarization characteristics change depending on direction and angle. | 18 |

CONNECTION EXAMPLES

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COMPATIBLE PMT MODULE



* In preparation for use with optical blocks, a C-mount adapter plate must be attached to the PMT module. Please notify us of your need for this adapter when ordering.

BLOCK CHARACTERISTICS

●Adapter block A10030 series



NOTE: Avoid frequently attaching and detaching from PMT module.

COMPATIBLE PMT MODULES

| | |
|-----------|------------------------------------|
| A10030-01 | H10720/H10721/H10722/H10723/H11900 |
| | H11901/H11902/H11903/H11526/H11706 |
| | H12056/H10682/H11890/H12386 |
| | H10799 (built-in photodiode) |
| A10030-02 | H7826/H7827/H7828/H12775 |

The A10030 series is an adapter block for connecting a PMT module to each block. The A10030 series adapter blocks have M4 and M3 screw holes for securing to an optical bench or optical stage.

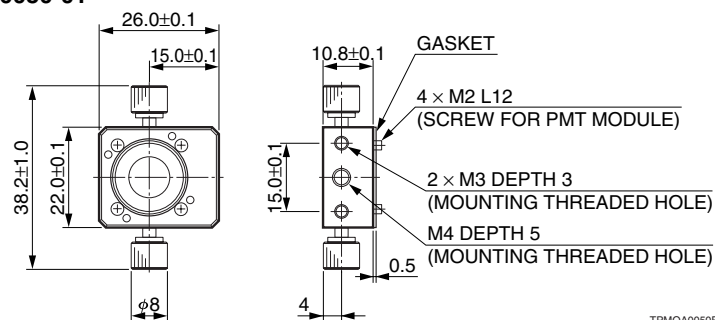
SPECIFICATIONS

| Type No. | Effective beam size | Weight |
|-----------|---------------------|--------------|
| A10030-01 | $\phi 8$ mm | Approx. 18 g |
| A10030-02 | $\phi 12$ mm* | |

* When connected to other optical blocks, their effective optical path diameters take precedence.

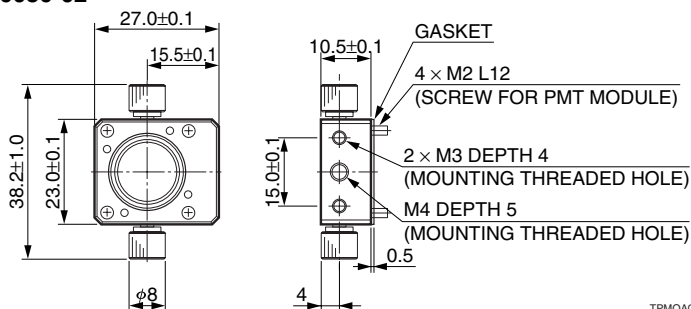
Dimensional outlines (Unit: mm)

A10030-01



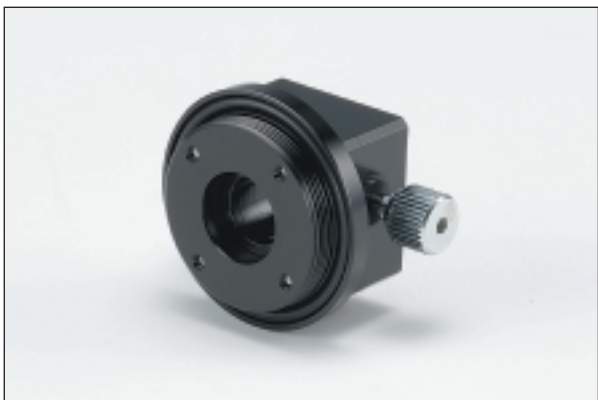
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A10030-02



TPMOA0085EB

●C-mount adapter block A10039



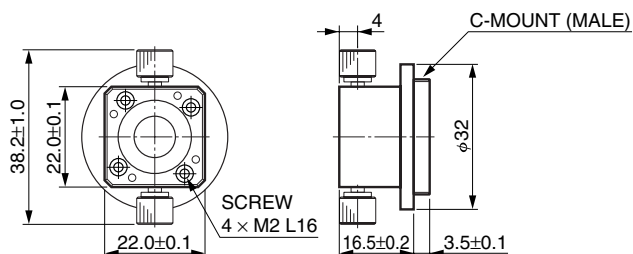
The A10039 connects a V-groove type optical block to a C-mount type optical block or a device with a C-mount. The A10039 also allows adjusting the connection angle.

SPECIFICATIONS

| Type No. | Effective beam size | Weight |
|----------|---------------------|--------------|
| A10039 | $\phi 8$ mm | Approx. 27 g |

* Supplied: C-mount double female thread ring.

Dimensional outlines (Unit: mm)



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How to connect a C-mount adapter block



1. Loosen the four screws on the adapter block and make sure the C-mount ring is separated about 1 mm from the adapter block body.

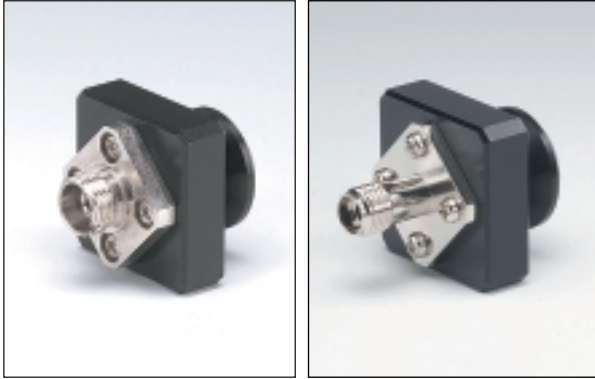


2. Insert the C-mount ring into the C-mount of the PMT module and turn the adapter block body clockwise until it stops.



3. Turn the adapter block body counterclockwise so that it is positioned at the desired angle and then tighten the four screws.

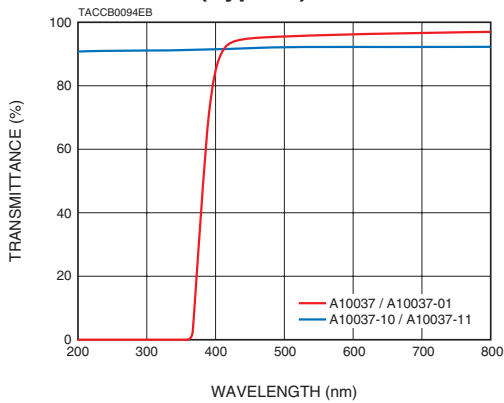
●Fiber adapter block A10037 series



▲A10037

▲A10037-01

Transmittance (Typical)



Optical fiber cables with FC or SMA connectors can be connected to the blocks in the A10037 series.

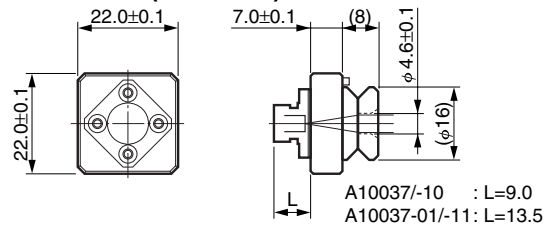
The lens assembled in the block collimates the light spread from the optical fiber.

The A10037/A10037-01 is suitable for use in the visible region (400 nm to 700 nm) and the A10037-10/A10037-11 for use in the UV region (200 nm to 400 nm).

SPECIFICATIONS

| Type No. | Recommended wavelength | Connector | Focal length | Weight |
|-----------|------------------------|-----------|--------------|--------------|
| A10037 | Visible | FC | 10 mm | Approx. 17 g |
| A10037-01 | | SMA | | |
| A10037-10 | UV | FC | 10 mm | Approx. 17 g |
| A10037-11 | | SMA | | |

Dimensional outlines (Unit: mm)



When fiber core diameter is 100 μm and NA is 0.2

| Distance from fiber output end | Beam diameter |
|--------------------------------|---------------|
| 100 mm | Max. 4.9 mm |
| 150 mm | Max. 5.4 mm |

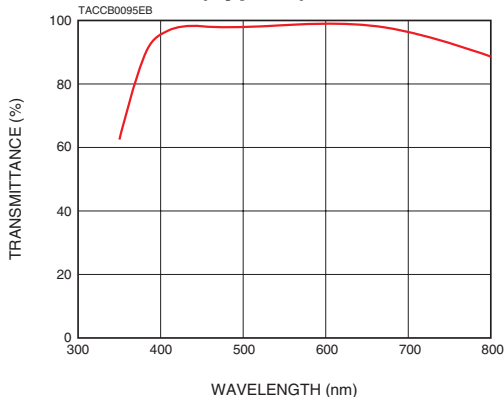
* In the case of the SMA connector type, the beam diameter depends on the position of the connected fiber cable end. The above values are measured when the fiber cable end is at the same position as the FC connector type.

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●Beam expander block A10031



Transmittance (Typical)



This block widens the diameter of a collimated beam of light to 2.5 times its original size or reduces the diameter to 1/2.5 times its original size. This block has a C-mount thread for connecting to another device.

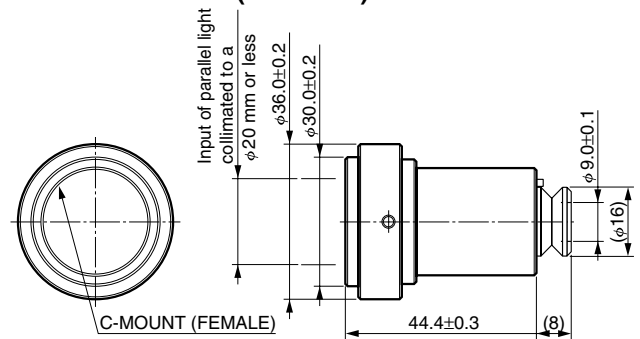
SPECIFICATIONS

| Type No. | Effective beam size | Weight |
|----------|---------------------|--------------|
| A10031 | φ8 mm | Approx. 43 g |

* Supplied: C-mount double male thread ring.

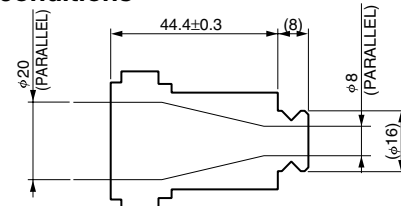
** Designed for wavelength from 400 nm to 700 nm.

Dimensional outlines (Unit: mm)



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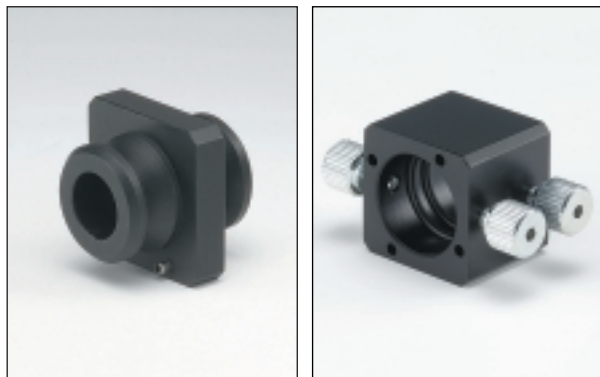
Incident light conditions



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BLOCK CHARACTERISTICS

●Joint block A10038 series



▲A10038-01

▲A10038-02

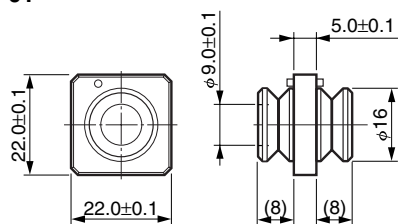
The A10038 series is a joint block for connecting one optical block to another. The joint is available in two types: MM (male-male) type and FF (female-female) type. Interposing the MM block (A10038-01) and/or FF block (A10038-02) between optical blocks allows various connections.

SPECIFICATIONS

| Type No. | Effective beam size | Weight |
|-----------|---------------------|--------------|
| A10038-01 | φ 8 mm | Approx. 10 g |
| A10038-02 | φ 8 mm | Approx. 25 g |

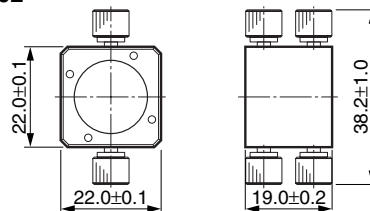
Dimensional outlines (Unit: mm)

A10038-01



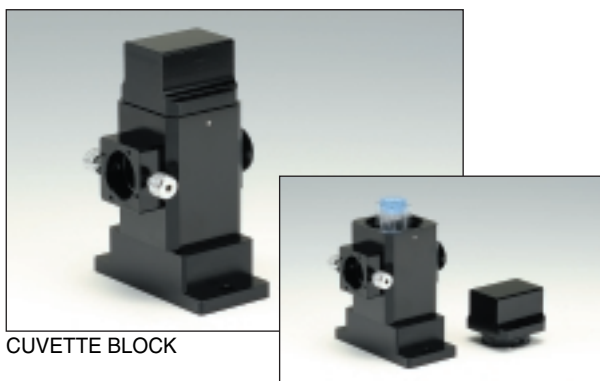
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A10038-02



TACCA0285EA

●Cuvette block A11971



CUVETTE BLOCK

CUVETTE BLOCK + CUVETTE
NOTE: Cuvette is sold separately.

The A11971 cuvette block is a small dark box specifically designed for cuvettes with an optical path length of 10 mm. It allows easy measurement of samples in combination with other optical blocks. The base can be removed as needed.

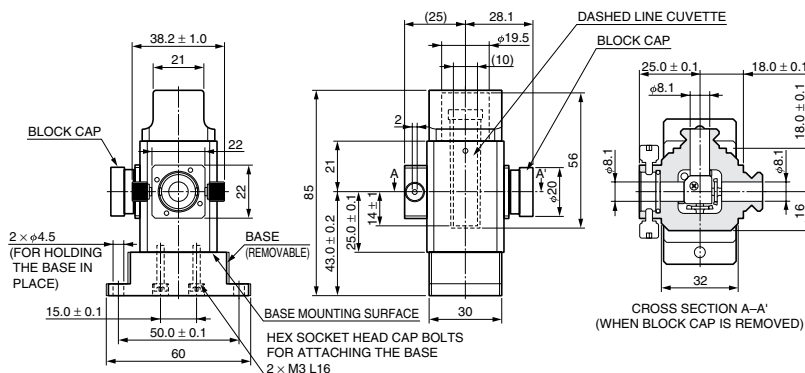
NOTE: This cuvette block is very compact. If it falls over, the sample may leak from the cuvette, so we recommend securing the body of the block and / or using a capped cuvette.

SPECIFICATIONS

| Type No. | Effective beam size | Applicable cuvette size | | Weight |
|----------|---------------------|-------------------------|-------------------------------|------------------------------------|
| | | Optical path length | Dimensional outline | |
| A11971 | φ 8 mm | 10 mm | 12.5 mm × 12.5 mm × 56 mm (H) | Approx. 206 g (including the base) |

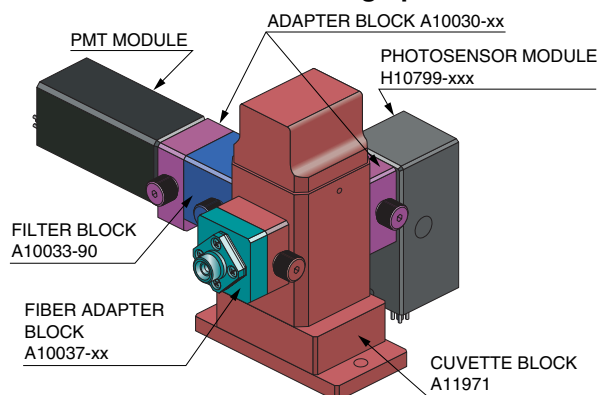
* Supplied: Block cap 2 pcs and Hex wrench S2.5

Dimensional outlines (Unit: mm)

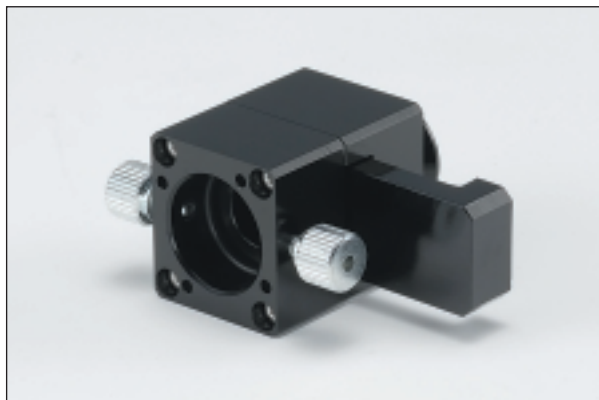


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Connection example: Absorbance and side fluorescence detection using optical fiber



●Shutter block A10036



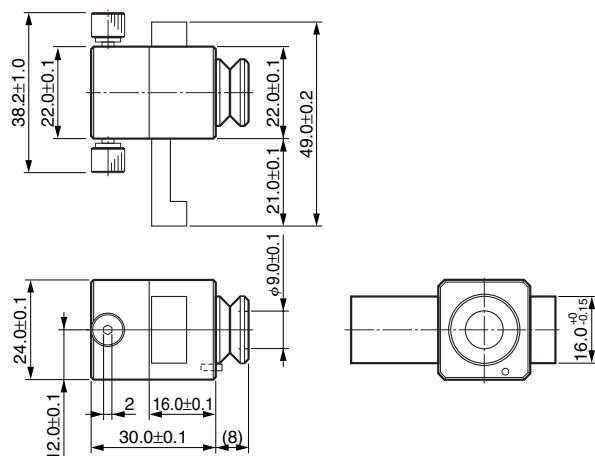
NOTE: If you feel the shutter does not open and close smoothly, we recommend applying small amount of an optical grease to the plate.

The A10036 is a manual shutter block with a plate that is opened and closed by sliding it left and right. Light is sufficiently blocked so there will be no problem even at photon counting levels.

SPECIFICATIONS

| Type No. | Effective beam size | Weight |
|----------|---------------------|--------------|
| A10036 | $\phi 8$ mm | Approx. 48 g |

Dimensional outlines (Unit: mm)



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●ND filter block A10032 series



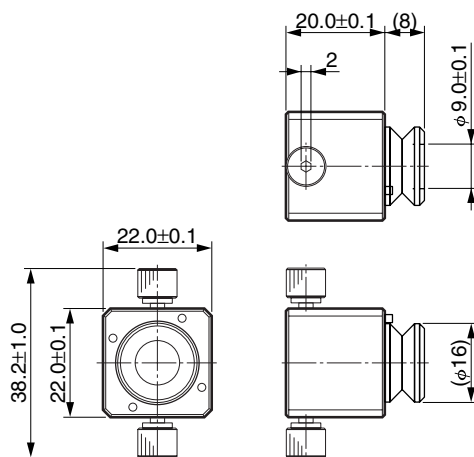
A neutral density (ND) filter is included in this optical block to attenuate light levels.

SPECIFICATIONS

| Type No. | Built-in filter | Transmittance | Effective beam size | Weight |
|-----------|-----------------|---------------|---------------------|--------------|
| A10032-10 | ND filter | 10 % | $\phi 8$ mm | Approx. 25 g |
| A10032-11 | | 1 % | | |

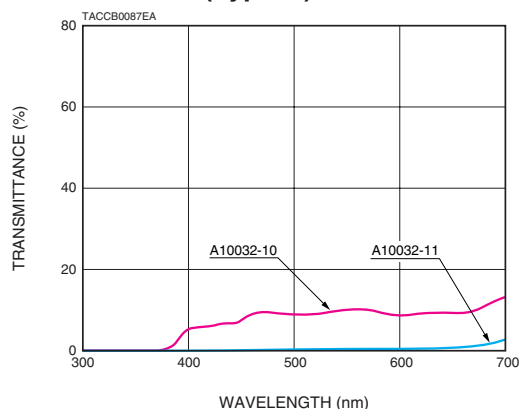
* Light transmittance is the average transmittance at wavelengths from 400 nm to 700 nm.

Dimensional outlines (Unit: mm)



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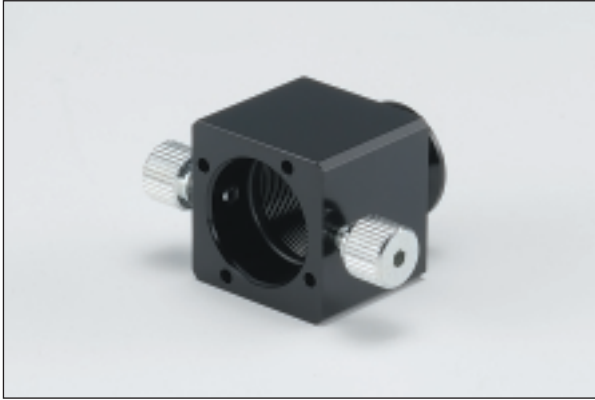
Transmittance (Typical)



* Transmittance characteristics are typical values and may differ depending on the production lot.

BLOCK CHARACTERISTICS

●Interchangeable filter block A10033-90



The A10033-90 is a holder block that allows you to insert an optical filter. The filter is held by the spacer ring and the retaining ring, and can be easily exchanged by using the accessory tool.

The A11213 C-mount interchangeable filter block series (P. 16) is also available. Filters with 25 mm diameters can be installed in these blocks.

SPECIFICATIONS

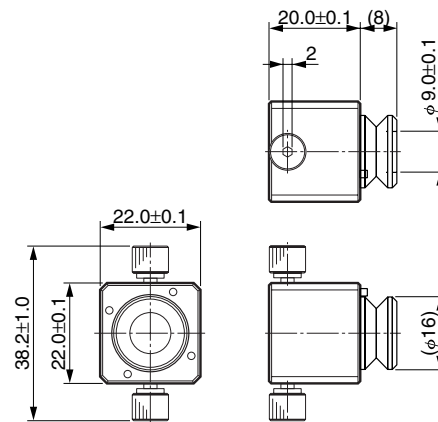
| Type No. | Effective beam size | Compatible filter size | Weight |
|-----------|---------------------|--------------------------------------------------------------------------------------------------|-----------------|
| A10033-90 | φ8 mm | Size: φ12.7 mm (1/2 inch) to φ15 mm (Max.) (recommended: φ15 mm) Thickness: 1.5 mm to 5 mm | Approx. 24 g |

* Supplied: Screw ring tool

NOTE: •Filters for this block must be purchased separately.

- Do not install optical filters in the wrong direction because they have the front side and back side for an light beam. Always insert the O-ring for blocking light after installing an optical filter.
- When installing an optical filter, be careful to keep it clean and to avoid getting fingerprints on it.

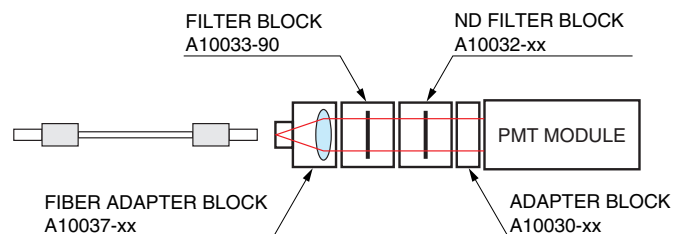
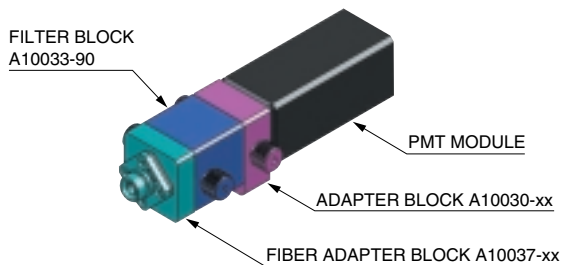
Dimensional outlines (Unit: mm)



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Connection example: Fiber-optic single wavelength detection

The lens inside the A10037 fiber adapter block collimates the beam of the light signal emitted from the optical fiber. The A10033-90 filter block contains an optical filter that only allows a specific wavelength to pass. When dimming the beam, use ND filter block A10032.



TPMOC0211EB

BLOCK CHARACTERISTICS

●Interchangeable dichroic block A10034-90



The A10034-90 is a V-groove type holder block that allows installation of a dichroic mirror with a 45-degree incident angle, such as a commercially available sized dichroic mirror frequently used for microscopes.

Hamamatsu also provides the A11214 C-mount interchangeable dichroic block. (p.17)

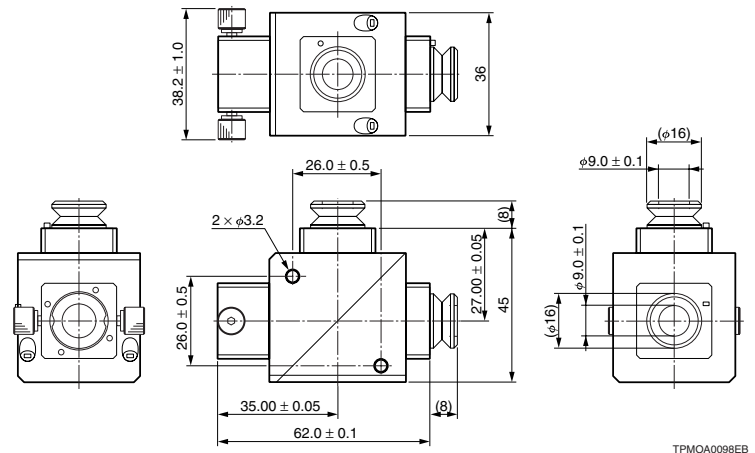
SPECIFICATIONS

| Type No. | Effective beam size | Compatible dichroic mirror | Weight |
|-----------|---------------------|--------------------------------------------------------------------------------------------------|---------------|
| A10034-90 | φ 8 mm | W × H: 25 mm to 26 mm (W) × 35 mm to 38 mm (H) Thickness: 0.9 mm to 1.1 mm (recommended 1 mm) | Approx. 139 g |

* Supplied: Hex wrench S2.0

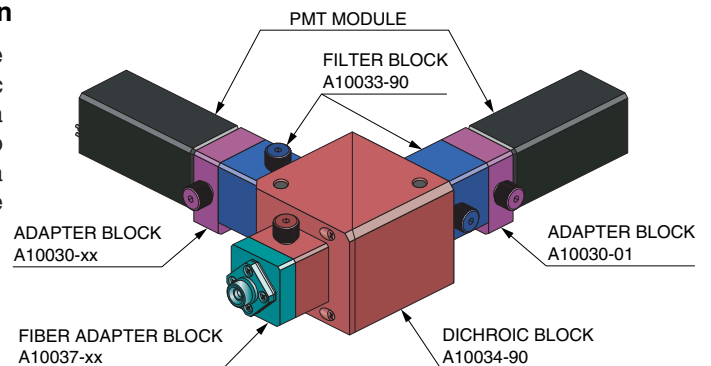
- NOTE:**
- Dichroic mirror for this block must be purchased separately.
 - Commercially available dichroic mirrors usually have markings to distinguish their front and back sides. Be careful to install dichroic mirrors in the A10034-90 in the correct direction.
 - When installing a dichroic mirror, be careful to keep it clean and to avoid getting fingerprints on it.

Dimensional outlines (Unit: mm)



Connection example: Fiber-optic dual wavelength detection

The lens inside the A10037 series fiber adapter block collimates the beam of the light signal emitted from the optical fiber. The dichroic mirror installed in the A10034-90 dichroic block reflects light below a certain wavelength and allows all light above that wavelength to pass. Finally, each of the two A10033-90 filter blocks extracts a specific wavelength so that the signal levels of the two separate wavelengths can be measured.



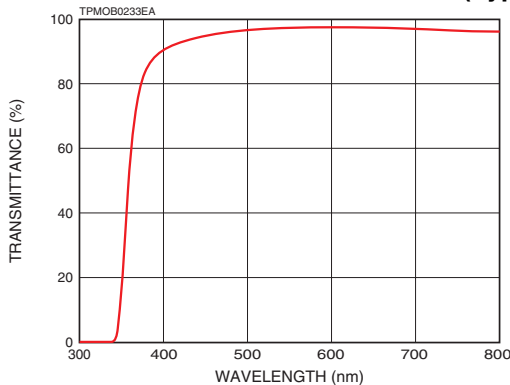
●Pinhole block A11027



NOTE:

- The collimate status changes depending on the pinhole diameter and the wavelength. (The assumed wavelength is between 400 nm and 700 nm.)
- The pinhole is not included. Use a pinhole that is installed in a mount.
- Be careful to install the pinhole so that it faces in the correct direction.
- When installing a pinhole, be careful to keep it clean and to avoid getting fingerprints on it.

Transmittance for the collimation lens (Typical)



The A11027 is a holder block for mounting a pinhole. The screws can be used to adjust the pinhole's position in the XY directions. The built-in lens collimates the light that passes through the pinhole and converges the light on a photodetector.

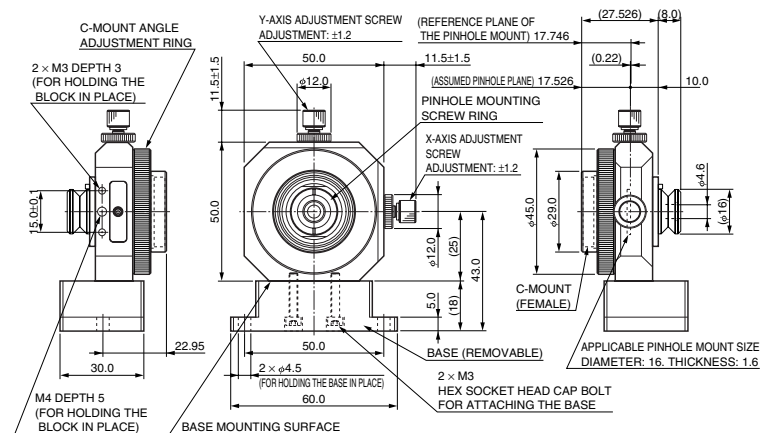
There is a base attached to the holder block through the M3 screw holes in the bottom of the block. If necessary, this base can be removed and re-attached to the side of the block.

SPECIFICATIONS

| Type No. | Applicable pinhole mount size | XY axis range of motion | Adjustment screw pitch | Focal length | Weight |
|----------|----------------------------------------------------|-------------------------|------------------------|--------------|------------------------------------|
| A11027 | Size: $\phi 16$ mm Thickness: 1.58 mm to 1.6 mm | ± 1.2 mm | 0.25 mm | 15 mm | Approx. 180 g (including the base) |

* Supplied: Screw ring tool and hex wrench S2.5

Dimensional outlines (Unit: mm)



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Extended example of microscope

Connecting the A11027 pinhole block to the C-mount port of a microscope configures a confocal optical system. Light passing through the pinhole is collimated by the lens in the block and is efficiently guided to the PMT module.

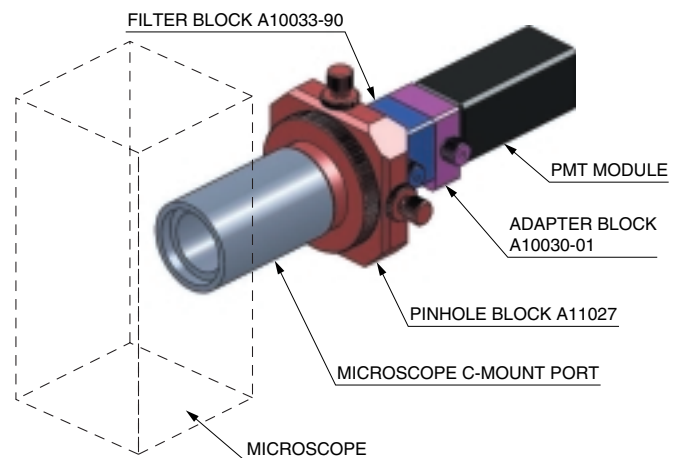
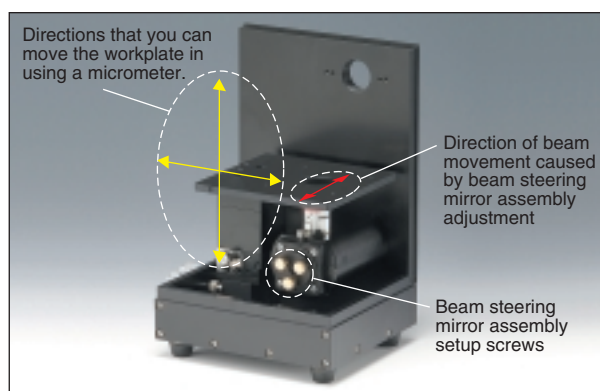
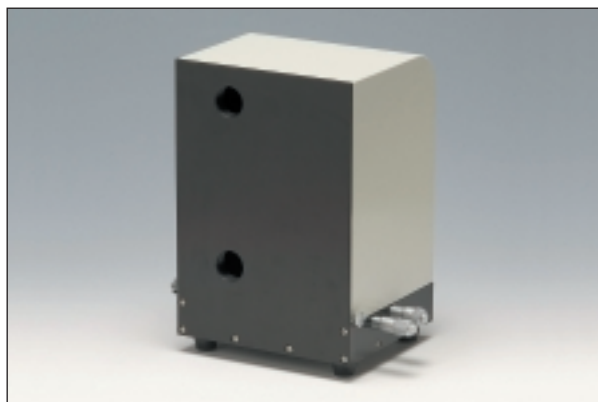
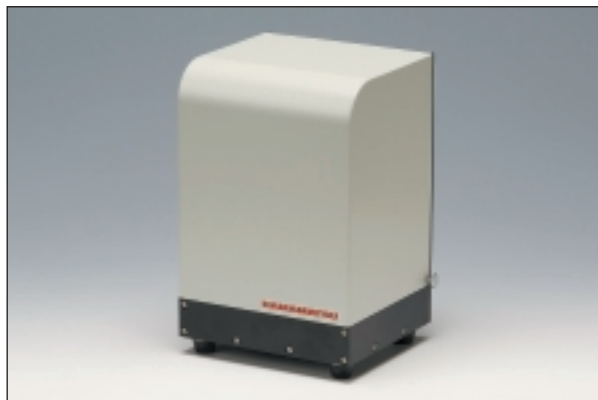


Figure 1

●Stage block A10858



The stage block is for using an infinity-corrected objective lens in object image generation and fluorescence detection. It has two C-mount ports on the top and bottom of its rear panel. You can use other optical blocks to connect the stage block to a PMT module or ICCD camera (p. 26). Because you can use the stage block cover to keep the measured area in darkness, the stage block is useful even when detecting faint light. Furthermore, if you remove the cover and illuminate the sample appropriately using an illuminator, you can generate images by using the stage block with the A10859-01 tube lens block, CCD cameras, and other devices.

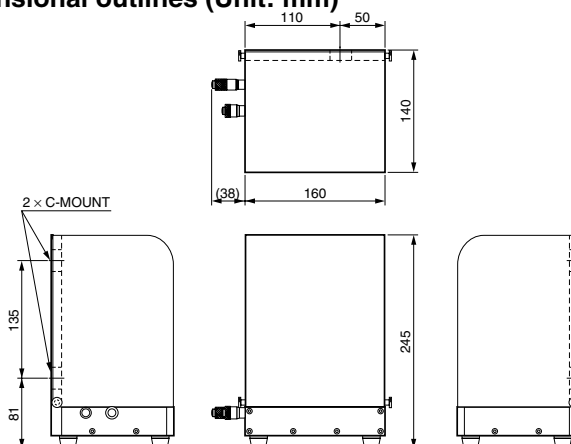
SPECIFICATIONS

| Type No. | Travels | | Port | Compatible objective lens | Weight |
|----------|---------|--------|------------|-----------------------------------------------------------------------------------|-----------------|
| | X-Axis | Z-Axis | | | |
| A10858 | ±6.5 mm | ±3 mm | 2; C-mount | Infinity-corrected objective lens M20.32 × P0.706 Parfocal distance*: 45 mm | Approx. 4 kg |

* For information about the parfocal distance, see p.14.

Supplied: Hex wrench S2.5

Dimensional outlines (Unit: mm)



TPMO40049ER

Workplate and beam movement

From outside of the stage block, you can use a micrometer to move the workplate horizontally along the X-axis or vertically along the Z-axis. You can also use the three setup screws in the beam steering mirror assembly to change the internal mirror angle and adjust the horizontal Y-axis.

Accessories

Stage block rack A11058

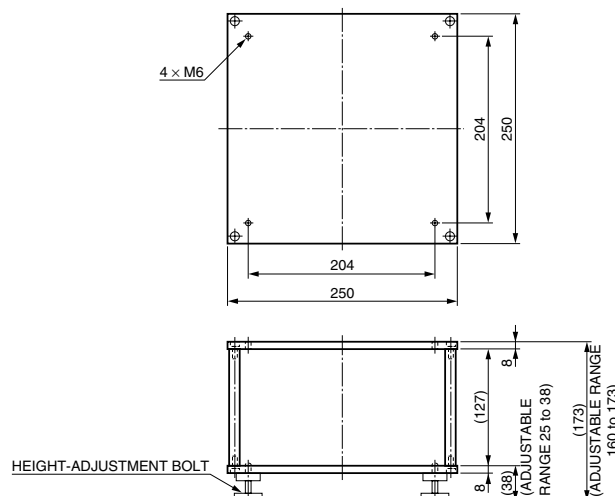


Sizes of the included spacers

| Spacer 1 | 90 mm × 90 mm, Thickness: 10 mm | 2 |
|----------|---------------------------------|---|
| Spacer 2 | 60 mm × 60 mm, Thickness: 18 mm | 1 |
| Spacer 3 | 60 mm × 60 mm, Thickness: 25 mm | 1 |

The spacer sizes have been designed according to their uses.

Dimensional outlines (Unit: mm)



TPMQA0066FR

Part names and features

M6 mounting hole

M6-thread mounting hole. You can use a mounting post or an angle mount for illumination.



* Please purchase illuminators from a company that manufactures them.

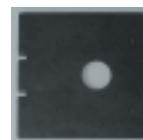
C-mount port

There are two C-mount ports at the top and bottom of the stage block. You can connect the stage block to other optical blocks through blocks such as the A11213 C-mount interchangeable filter block.

Supplied: C-mount cap

Workplate

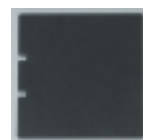
The stage block comes with three different workplates:



A workplate with a 36 mm diameter hole. With this workplate, you can put the sample on a slide and observe its reflected-light or transmitted-light image or measure its fluorescence.



This workplate is specially designed for use with the A10657-01 microwell slide (sold separately).



A workplate that you can place an object on to observe its reflected-light image in an upright configuration or to excite it from above and measure its fluorescence.

Supplied: Hex socket head cap bolt
M3 L8: 4 pcs

Micrometer

The micrometer enables you to perform precise horizontal (X-axis) and vertical (Z-axis) alignment and to accurately reproduce prior positionings.

Spacer



A 20 mm spacer is installed between the workplate and the XZ axis stage. Removing this spacer will give you 20 mm of extra space, which is useful when observing relatively tall objects in an upright configuration.

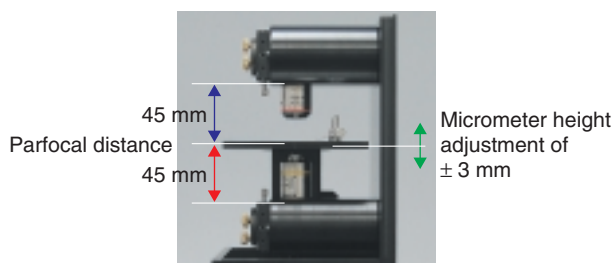


You can move the workplate along the X and Y axes by attaching an X-axis stage (SURUGA SEIKI B11-40C) in place of the spacer.*

* Please direct inquiries about the X-axis stage to SURUGA SEIKI.

Objective lens adapter

This is a mount for an objective lens. You can mount and remove the objective lens mount using the left and right screws. You can place the objective lens mount at the top of the stage mount for upright configurations, and at the bottom for inverted configurations. The A10858 comes with one objective lens mount.



NOTE: An additional objective lens mount (sold separately) is attached in the above example. Stage clips are not included.

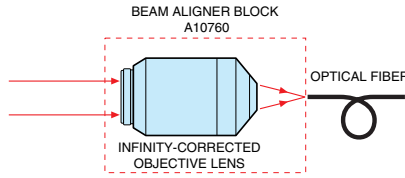
BLOCK CHARACTERISTICS

●Beam aligner block A10760

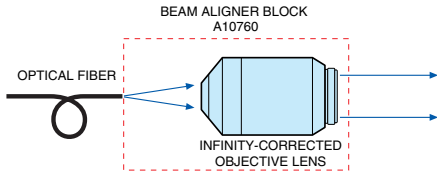


NOTE: Objective lens and fiber-optic cable are not included.

USING EXAMPLE 1: FOCUSING

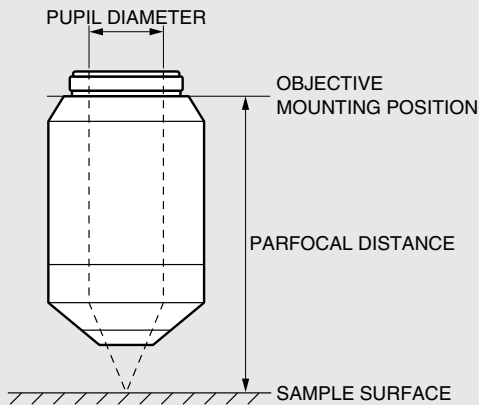


USING EXAMPLE 2: COLLIMATOR



Technical guide

Pupil diameter and parfocal distance



Pupil diameter

The diameter of the beam that is emitted from the pupil of an objective lens with a focal length f and a numerical aperture NA is given by:

$$\text{Pupil diameter} = 2 \times f \times NA$$

Parfocal distance

The parfocal distance is the distance from the objective mounting position of the objective lens to the sample at which the sample is in-focus. The A10760 is designed to be used with an objective lens whose parfocal distance is 45 mm.

This block is for using an infinity-corrected objective lens to guide laser light into an optical fiber with an attached FC connector or to collimate and transmit the beam from a fiber-optic cable.

The block has two micrometers for positioning the optical fiber along the X and Y axes and an additional micrometer at the bottom for fine adjustments along the Z axis.

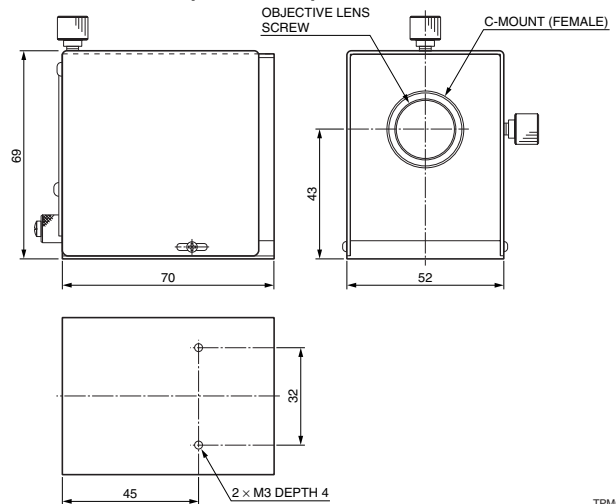
This block has a cover around the objective lens and an additional cover for the entire block that further increases its light shielding capability. There are two M3 screw holes in the bottom of the block for holding.

SPECIFICATIONS

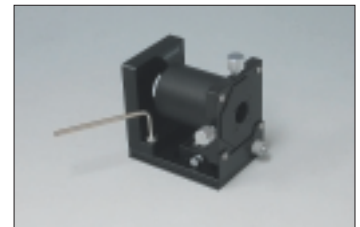
| Type No. | Travels | | Optical fiber connector | Compatible objective lens | Weight |
|----------|---------|--------|-------------------------|----------------------------------------------------------------------------------|------------------|
| | XY-axis | Z-axis | | | |
| A10760 | ±1 mm | ±3 mm | FC | Infinity-corrected objective lens M20.32 × P0.706 Parfocal distance: 45 mm | Approx. 420 g |

* Use an infinity-corrected lens as the objective lens.
Supplied: Hex wrench S3.0

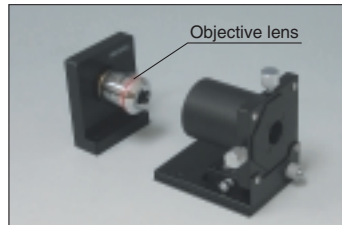
Dimensional outlines (Unit: mm)



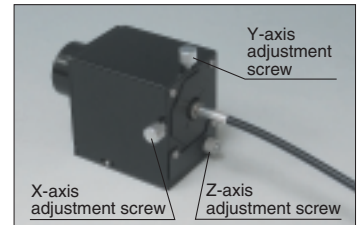
1. Remove the two cover screws using a Phillips-head screwdriver, and then remove the cover.



2. Use the hexagonal wrench that comes with the block to remove the two plate screws, and then remove the plate.



3. Attach an objective lens to the plate's objective lens screw hole (M20.32 P0.706).



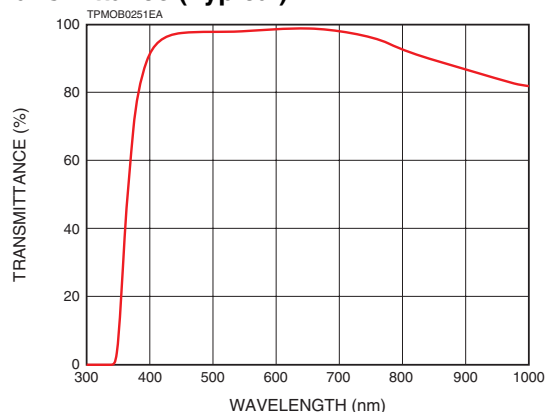
4. Reassemble the block by performing steps 1 and 2 in reverse, and then connect the block to other devices.
You can align the optical fiber by using the X-, Y-, and Z-axis adjustment screws. Only turn the Z-axis adjustment screw after you have loosened the screws in step 1.

●Tube lens block A10859 series



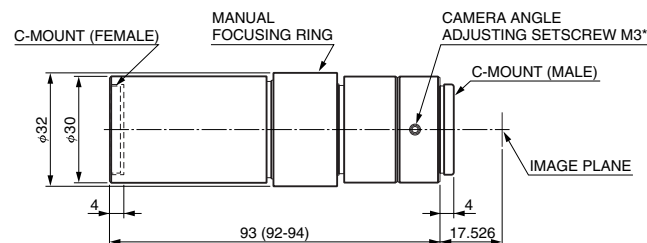
▲A10859

Transmittance (Typical)



Dimensional outlines (Unit: mm)

A10859



TPMOA0052EB



▲A10859-01

These are video lens blocks for use with the infinity-corrected objective lenses. It has a tube lens with a focal length of 100 mm to form an image. One side has a male C-mount thread, and the other side has a female C-mount thread. You can attach a device such as an ICCD or CCD camera to the side with the male thread.

You can use a C-mount double male thread ring to connect the side with the female thread to the A10858 stage block.

The tube lens block reduces aberration through the use of an achromatic lens.

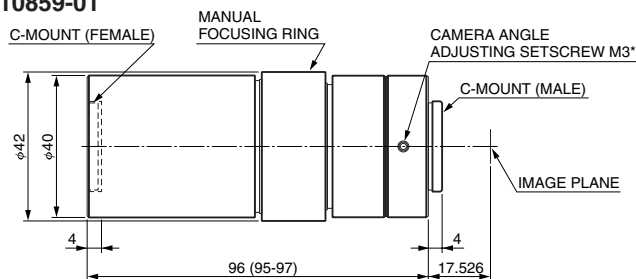
SPECIFICATIONS

| Type No. | Focal length | Effective beam size | Recommended sensor size | Weight |
|-----------|--------------|---------------------|-------------------------|---------------|
| A10859 | 100 mm | φ15 mm | 1/3 inches or less | Approx. 130 g |
| A10859-01 | | φ24 mm | 1/2 inches or less | Approx. 205 g |

* Supplied: C-mount double male thread ring and hex wrench S1.5

* Designed for wavelength from 400 nm to 700 nm.

A10859-01



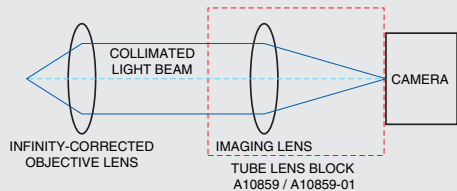
* You can adjust the camera tilt by loosening this screw and turning the tube lens block.

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Technical guide

Imaging lens

The light from the sample is collimated by the infinity-corrected objective lens before it enters the imaging lens. The imaging lens focuses the image on the focal point.



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Magnification

You can calculate the magnification from the imaging lens focal length (100 mm) and the focal length of the microscope's objective lens.

$$\text{Magnification (M)} = \frac{\text{Imaging lens focal length}}{\text{Objective lens focal length}} = \frac{100}{\text{Objective lens focal length}}$$

Example: When the objective lens focal length is 45 mm, the magnification is approximately 2.2 times.

Distance between the imaging lens and the objective lens

Even though the beam of light that passes from the infinity-corrected objective lens to the imaging lens is collimated, the distance between the lenses must still be kept below a certain limit. This limit (L) can be calculated from the specifications of the objective and imaging lenses and the effective area of the sensor.

$$L \text{ (mm)} = \frac{f_2(\phi_2 - \phi_1)}{\phi}$$

$$\phi_1 = 2 \times f_1 \times \text{NA}$$

$$d = \frac{\phi}{M}$$

where ϕ_1 is the objective lens's exit pupil diameter (mm), f_1 is the focal length (mm), NA is the numeric aperture, ϕ_2 is the imaging lens effective diameter, f_2 is the focal length (mm), ϕ is the effective sensor area, and d is the observation area.

To avoid vignetting when using the A10859 with objective lens ($f_1 = 18$ mm, NA = 0.25) and a 1/3-inch video camera ($\phi = 6$ mm), keep the distance from the objective lens to the A10859 below 100 mm. At this distance, placing a dichroic mirror between the objective lens and the A10859 will not have much of an effect on the overall optical characteristics.

BLOCK CHARACTERISTICS

●C-Mount interchangeable filter block A11213 series



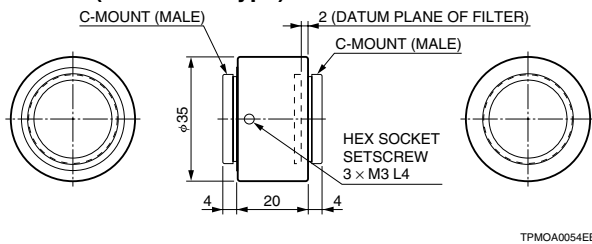
▲Left: A11213, Right: A11213-01

NOTE: • Filters and lenses for this block must be purchased separately.

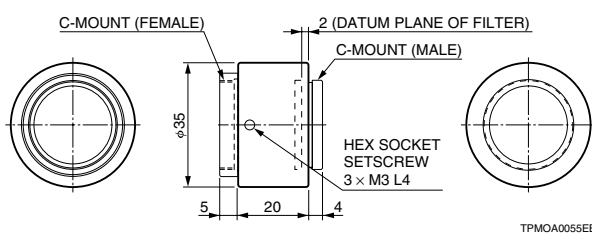
- When you install a filter that is designed to receive a beam of light from a specific side, make sure that you install the filter in the correct direction.
- When installing an optical filter or other device, be careful to keep it clean and to avoid getting fingerprints on it.

Dimensional outlines (Unit: mm)

A11213 (Male–Male type)



A11213-01 (Male–Female Type)



●C-mount adapter A9865



COMPATIBLE PMT MODULES

H10720/H10721/H10722/H10723/H11900/H11901/H11902
H11903/H11526/H11706/H12056/H10682/H11890/H12386
H10799 (built-in photodiode)

These C-mount threaded optical blocks are for installing commercial optical filters and lenses with 25 mm diameters. You can use it with the A11214 C-mount interchangeable dichroic block to measure fluorescence or perform other tasks.

Because this block enables angle adjustment, it is also useful as a spacer between C-mounts and as a connection adapter.

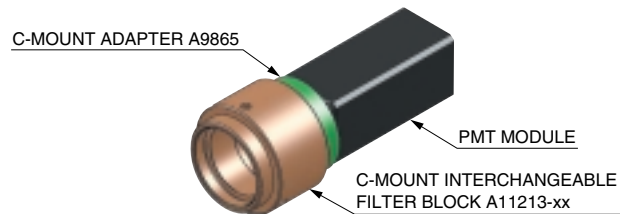
SPECIFICATIONS

| Type No. | Effective beam size | Compatible filter size | Weight |
|-----------|---------------------|---------------------------------------------------------|--------------|
| A11213 | φ20 mm | Size: φ24 mm to φ26 mm (φ25 mm to φ25.4 mm recommended) | Approx. 29 g |
| A11213-01 | | Thickness: 5 mm (Max.) (2 mm to 5 mm recommended) | Approx. 30 g |

* Supplied: Hex wrench S1.5

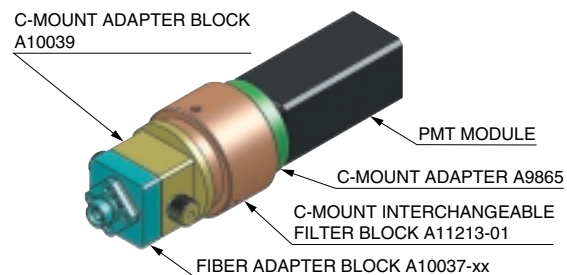
Connection example: Single wavelength detection

Only light at a specific wavelength passes through the optical filter assembled in the block and is detected by the PMT module.



Connection example: Fiber-optic single wavelength detection

Light emitted and spread from the optical fiber cable is collimated by the lens in the A10037 series fiber adapter block and is efficiently guided to the PMT module.

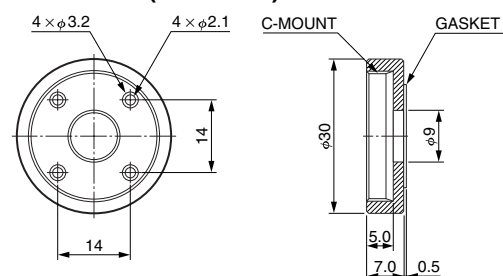


This adapter is for connecting a PMT module to a optical block or an equipment with C-mount.

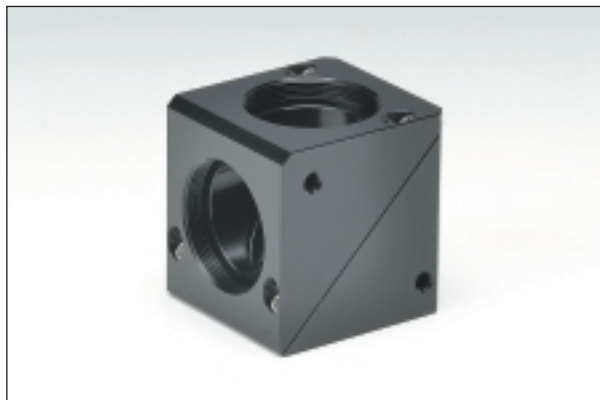
SPECIFICATIONS

| Type No. | Effective beam size | Weight |
|----------|---------------------|-------------|
| A9865 | φ8 mm | Approx. 7 g |

Dimensional outlines (Unit: mm)



●C-mount interchangeable dichroic block A11214



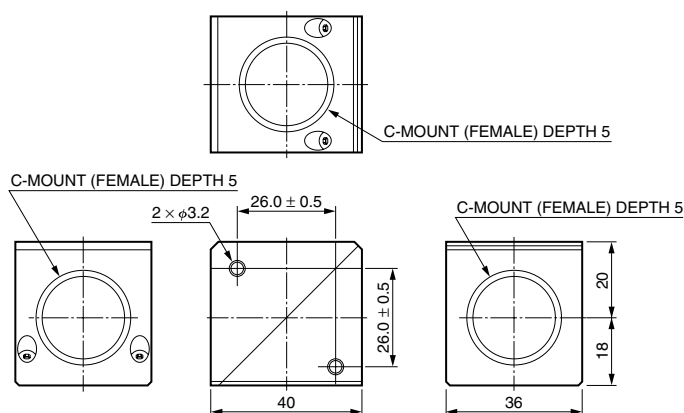
This C-mount threaded optical block is for installing a dichroic mirror for use at a 45° angle of incidence. You can use typical dichroic mirrors that are commercially available for use with microscopes.

SPECIFICATIONS

| Type No. | Effective beam size | Compatible dichroic mirror size | Weight |
|----------|---------------------|-------------------------------------------------------------------------------------------|-----------------|
| A11214 | φ20 mm | 25 mm to 26 mm (W) × 35 mm to 38 mm (H) Thickness: 0.9 mm to 1.1 mm (1 mm recommended) | Approx. 84 g |

* Supplied: Hex wrench S2.0

Dimensional outlines (Unit: mm)



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NOTE: • Dichroic mirrors for this block must be purchased separately.

• Commercially available dichroic mirrors usually have markings to distinguish their front and back sides. Be careful to install dichroic mirrors in the A11214 in the correct direction.

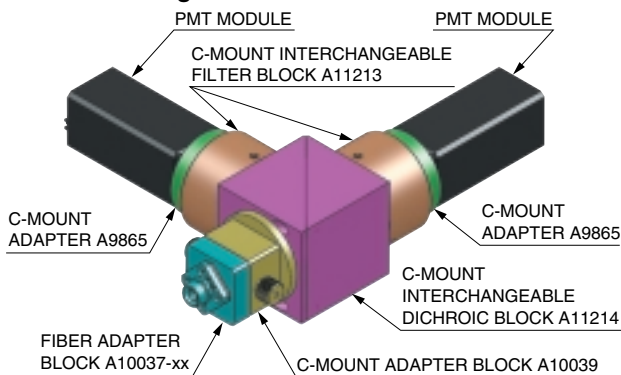
• When installing a dichroic mirror, be careful to keep it clean and to avoid getting fingerprints on it.

Connection example:

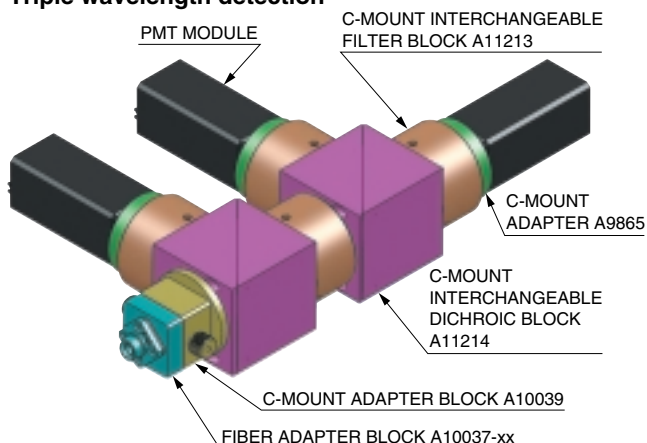
Fiber-optic dual / triple wavelength detection

The dichroic mirror assembled in the block reflects light at wavelengths shorter than a specific wavelength and transmits longer wavelength light. Furthermore, only light at a specific wavelength passes through the optical filter and is then detected by the PMT module.

Dual wavelength detection

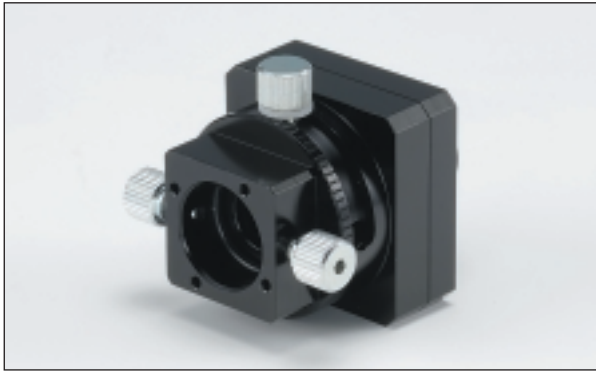


Triple wavelength detection



BLOCK CHARACTERISTICS

●Polarizer block A11026



NOTE: • The polarizing filter or waveplate is not included.
(Products by companies such as Edmund Optics Inc. and SIGMA KOKI CO., LTD. can be used.)
• When installing a polarizing element, be careful to keep it clean and to avoid getting fingerprints on it.

Polarizing filters and waveplates are polarizing elements whose polarization characteristics change depending on direction and angle. The A11026 is a simple, coarse-movement holder block that can be used to adjust the direction and angle.

SPECIFICATIONS

| Type No. | Effective beam size | Applicable polarizing element size | Adjustable range | Angle scale | Weight |
|----------|---------------------|-------------------------------------------------------|------------------|-------------------|--------------|
| A11026 | φ8 mm | Diameter: 25 mm to 25.4 mm Thickness: 1 mm to 8 mm | 90° ① | 5° ② Intervals | Approx. 55 g |

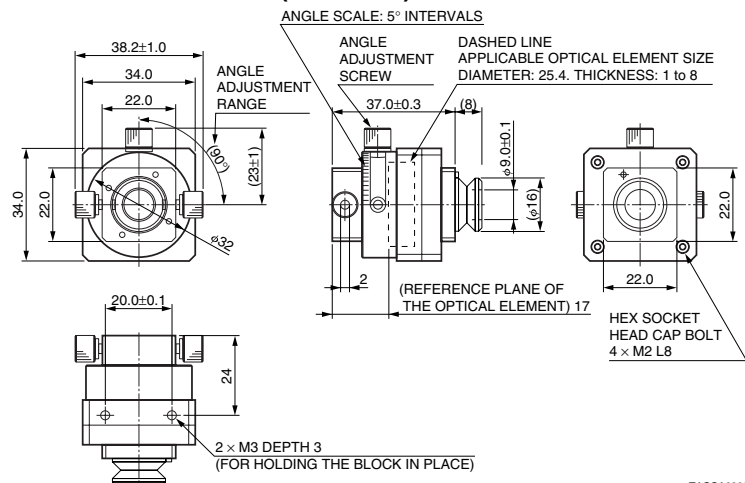
① Can be rotated 90° or more by changing the angle adjustment screw position.

② Scale indicates adjustment intervals and does not indicate adjustable pitch.

Can be fixed at any desired angle within the adjustable range of 90°.

* Supplied: Hex wrench S1.5

Dimensional outlines (Unit: mm)

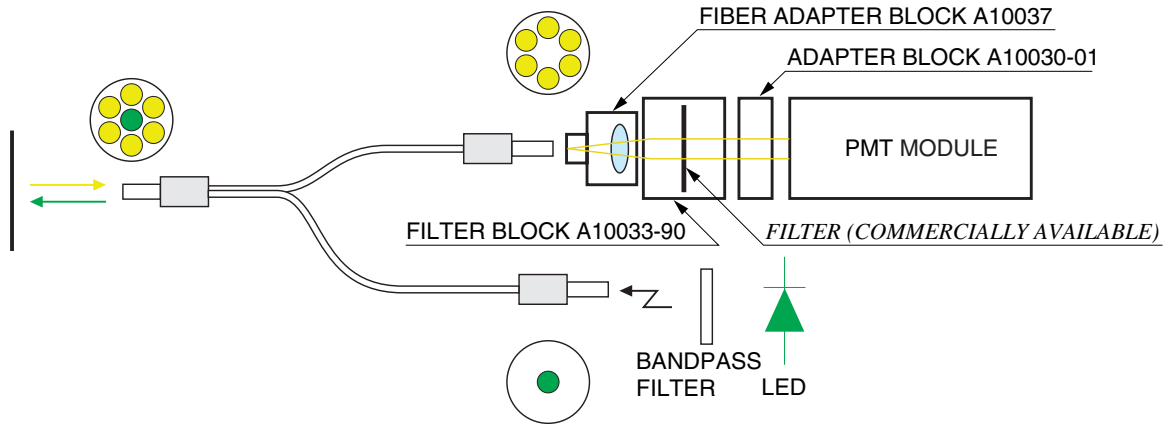


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CONNECTION EXAMPLES

●Connection example using bifurcated optical fiber

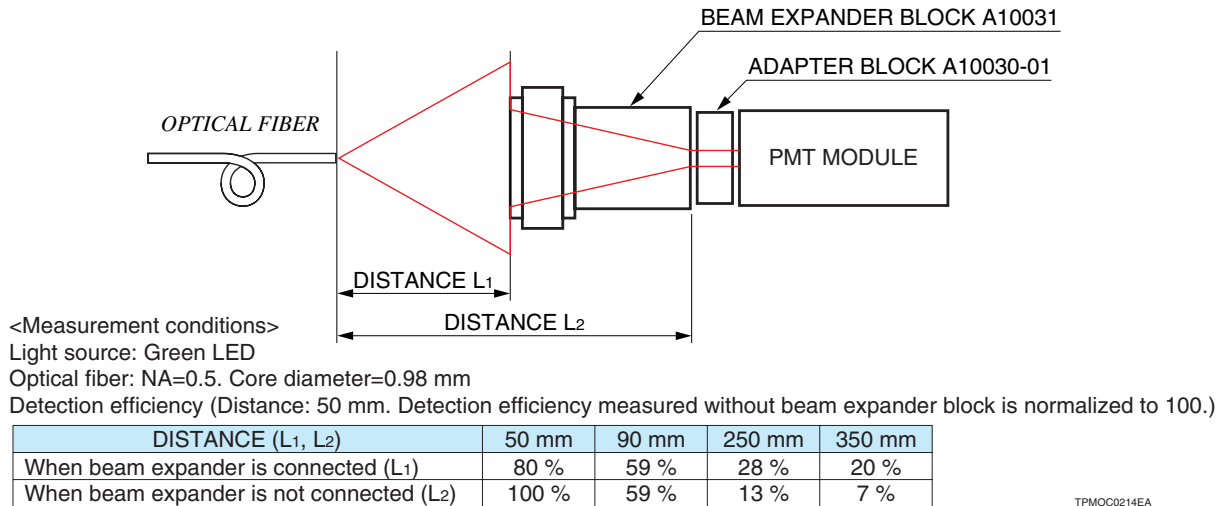
Light from a light source is injected into one arm of the bifurcated optical fiber to irradiate a sample or measurement surface. Fluorescence emitted from the sample or light reflected from the measurement surface is collected by the same optical fiber and then detected by the PMT module through the other arm of the bifurcated optical fiber.



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●Connection example using the beam expander block

The A10031 beam expander block is designed to reduce a 20-mm beam of collimated light to a diameter of 8 mm, the size of the PMT module's photocathode; however, the expander block's use is not just limited to collimated light, it can also be used to converge divergent light. For example, if you use the beam expander block to receive the divergent light from an optical fiber, the signal level will be higher than if you had just used a PMT module.

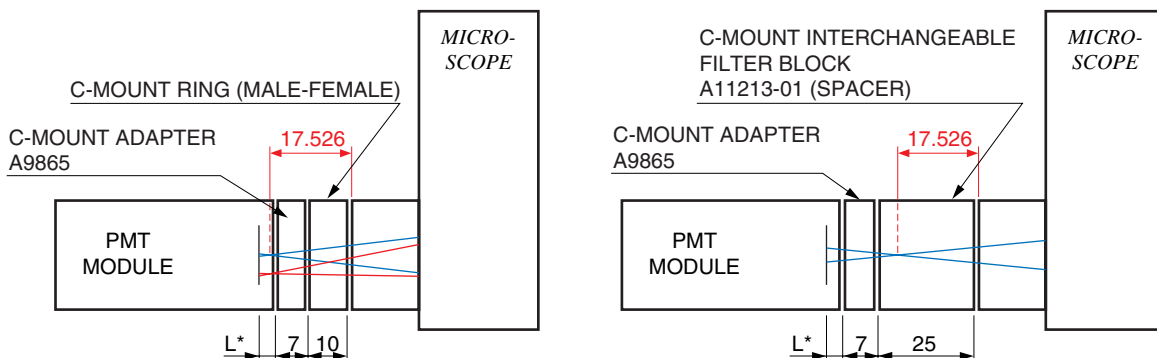


TPMOC0214EA

●Connecting to a microscope

The microscope port is designed so that the image is focused at 17.526 mm from the C-mount attachment location. When you connect a C-mount adapter to a commercially sold 10-mm C-mount ring (male to female), the approximate location of the image point is at the PMT module's photocathode (as shown in the figure on the left).

If the light converges to a diameter of 1 mm or less at the image point, do not match the location of the image point to the location of the PMT module's photocathode; instead, expose the photocathode to a defocused light beam with a diameter of 1 mm or more.



* L is the distance from the attached end of the PMT module to the photocathode.

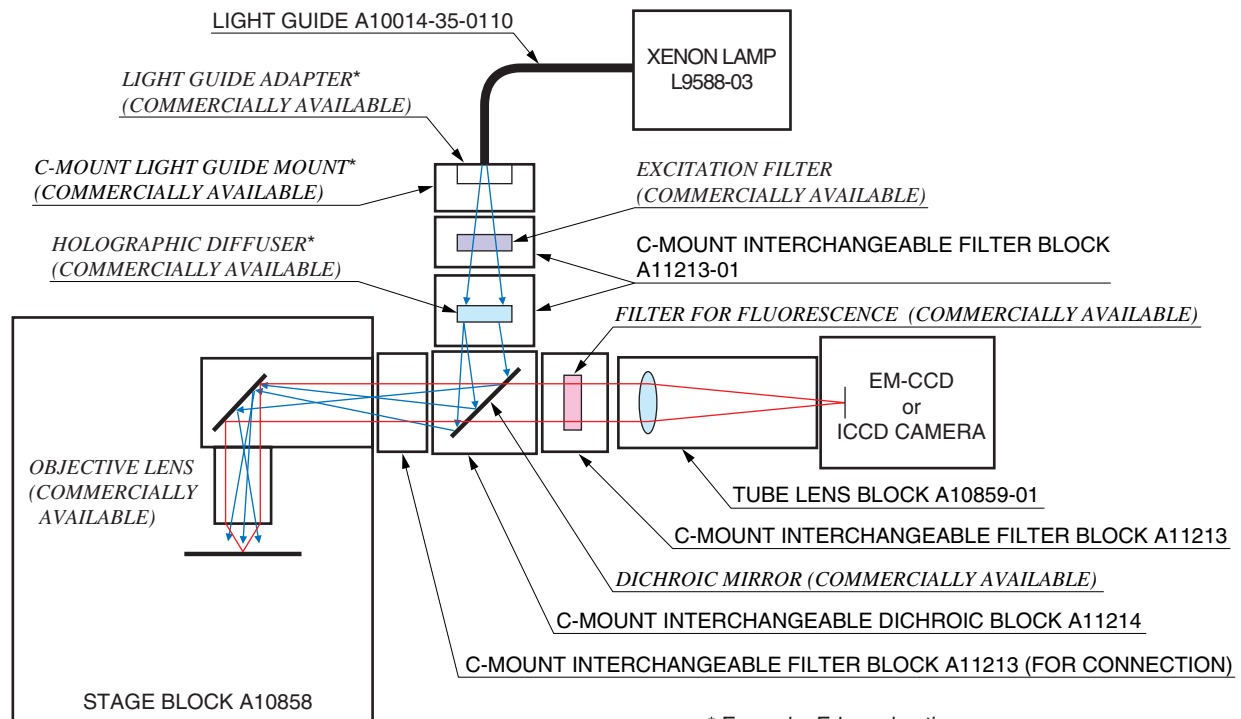
TPMOC0216EB

● Imaging System Connection Example

Coaxial Incident Illumination Method

Illuminate the sample with a fiber bundle connected to a xenon arc lamp. You can attach the fiber bundle easily by using a commercially available C-mount light guide mount. To excite the sample, put an excitation filter that matches its fluorescent dye into the A11213-01 C-mount interchangeable filter block. If the light from the fiber bundle is not diffused enough, you can illuminate the sample evenly by inserting a holographic or other type of diffuser.

The dichroic mirror reflects the excitation light. Then, the objective lens of the A10858 stage block focuses the light onto the sample, which is excited by the light. The fluorescence emitted from the sample passes through the dichroic mirror and the fluorescence filter and is focused onto the imaging camera by the lens inside the A10859-01 tube lens block.

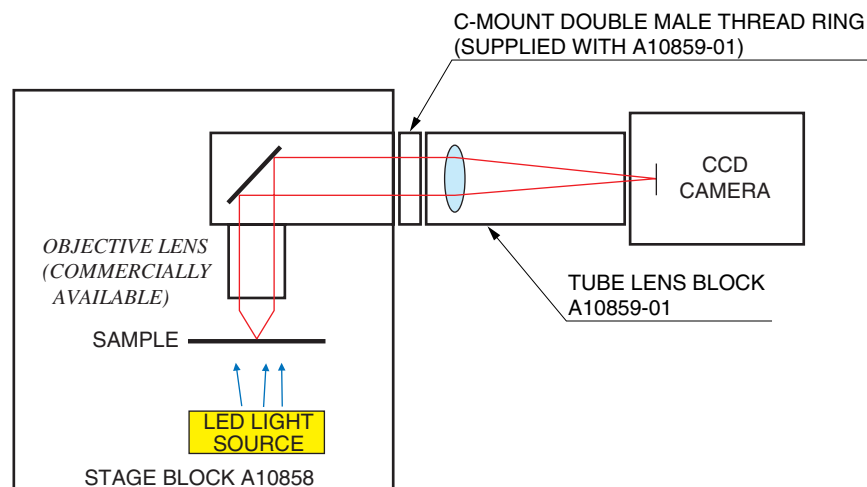


- * Example: Edmund optics
- C-thread light guide mounting adapter
 - Fiber optic light guide adapter SX-6
 - Holographic diffuser: $\phi 25$ mm type

TPMOC0218EC

Transmitted Illumination Method

This is an imaging example that uses transmitted illumination. The image of the sample is focused onto an imaging camera, such as a CCD camera, by an infinity-corrected objective lens and the A10859-01 tube lens block. A convenient way to illuminate the sample is to use a commercially available LED illuminator.

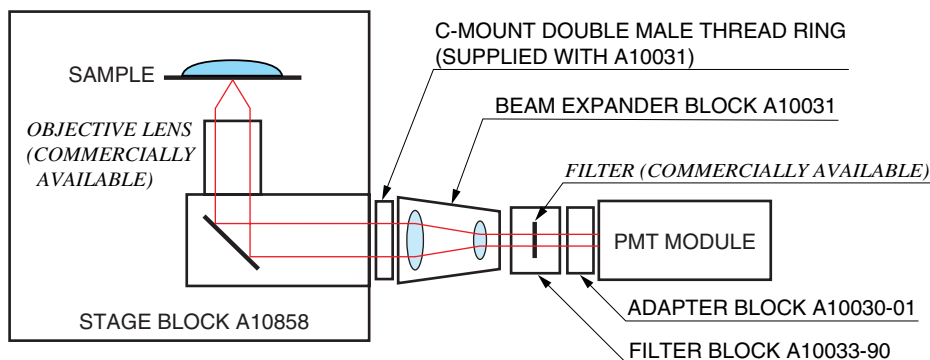


TPMOC0219JA

CONNECTION EXAMPLES

●Emission detection

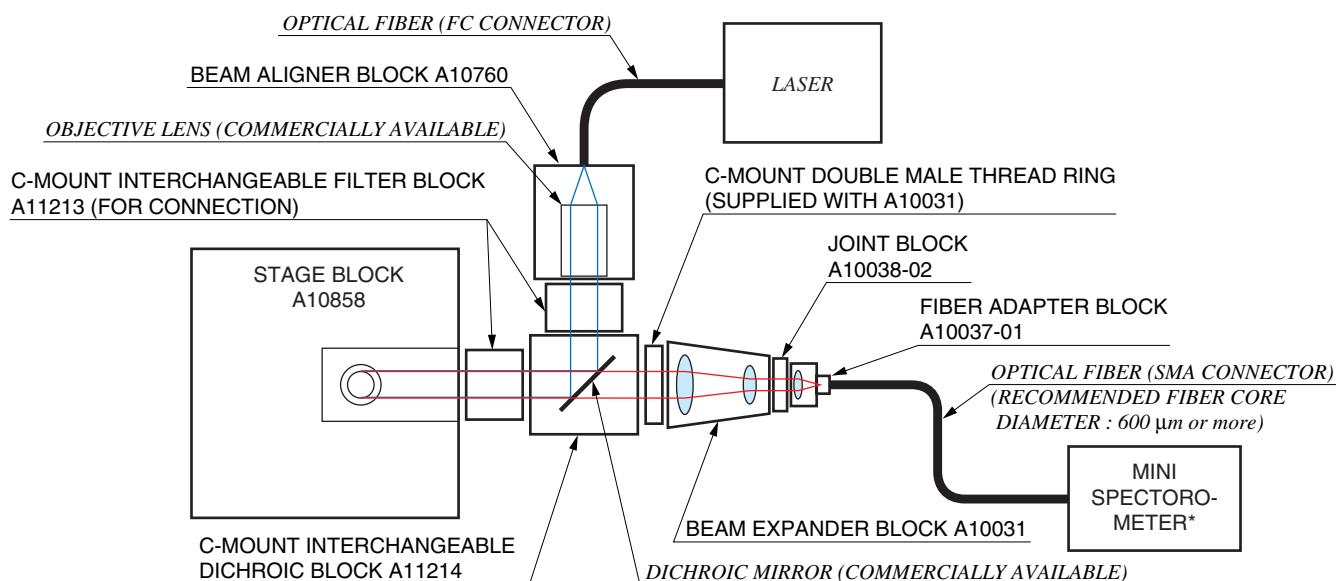
Collimated light such as chemiluminescence and bioluminescence captured by an infinity-corrected lens is reduced to 1/2.5 by using the A10031 beam expander and is guided to the PMT module with an effective diameter of 8 mm. A filter block is added when detecting light at a specific wavelength.



TPMOC0255EB

●Example of connection to a mini-spectrometer

The laser beam emitted from the optical fiber is collimated by the infinity-corrected objective lens inside the A10760 beam aligner block. The dichroic mirror inside the A11214 C-mount interchangeable dichroic block reflects the collimated laser, which then passes through the objective lens in the A10858 stage block and illuminates the sample. The fluorescence from the excited sample is converged by the objective lens and then passes through the dichroic mirror inside the A11214. The fluorescence is then converged further by the A10031 beam expander block. The lens inside the fiber adapter block converges the light into the optical fiber and guides it to the mini-spectrometer, where it is measured. If you want to remove the excitation light, place the A10033 filter block between the beam expander block and the A10037-01 fiber adapter block. The fiber adapter block does not have focusing capabilities, so we recommend that you connect the fiber adapter block and the mini-spectrometer with an optical fiber whose core diameter is at least 600 μm .



* There is a separate catalog for mini-spectrometers. Please refer to that catalog for more information.

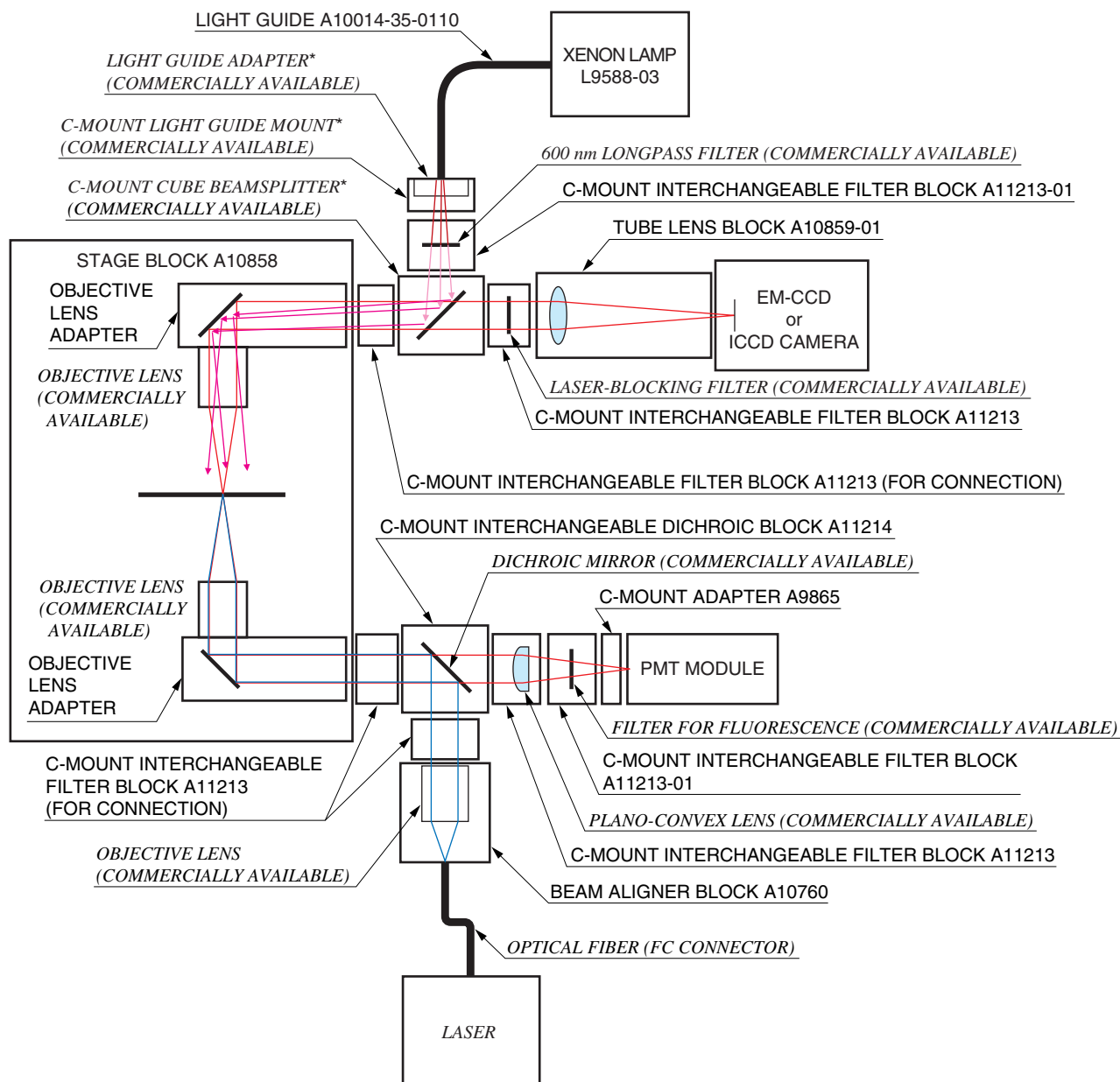
TPMOC0221EB

● Simultaneous measurement with a PMT module and an imaging camera

The following is an example of simultaneous measurement in which the two objective lens adapters are attached to the A10858 stage block. The lower (inverted) part excites the sample using laser light and measures the fluorescence of the sample using the PMT module. The upper (upright) part illuminates the observation area using a xenon arc lamp and uses an imaging camera to observe the observation area and the fluorescence signal.

A plano-convex lens and a fluorescence filter are installed in front of the PMT module to isolate the fluorescence. The plano-convex lens converges the beam of light. If this causes a problem in the fluorescence filter's wavelength shift, place the filter in front of the plano-convex lens.

So that there is no interference with the PMT module's measurement, use a wavelength for the imaging camera's illumination that is different from both the excitation wavelength and the fluorescence wavelength. For example, if you use a 488 nm laser, use a DM505 dichroic mirror for the PMT module and a 530/40 bandpass filter for the emission filter. On the imaging camera side, use a 600 nm longpass filter for illumination and put a laser-blocking filter in front of the camera.



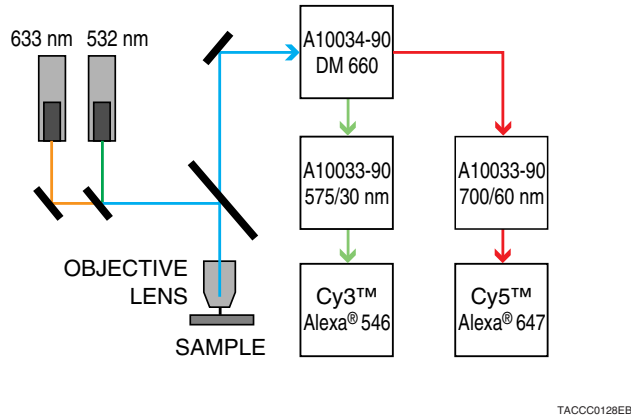
- * Example: Edmund optics
- C-thread light guide mounting adapter
 - Fiber optic light guide adapter
 - C-Mounted cube beamsplitter

NOTE: The A10858 stage block comes with one objective lens adapter.
To perform simultaneous measurement as shown above, you will need to purchase an additional objective lens adapter.

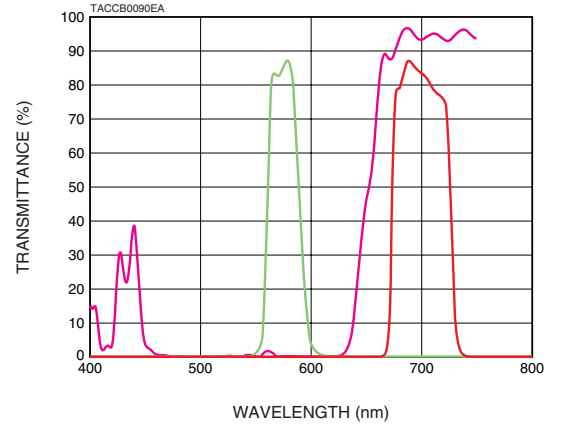
CONNECTION EXAMPLES

●Fluorescence dye and connection examples

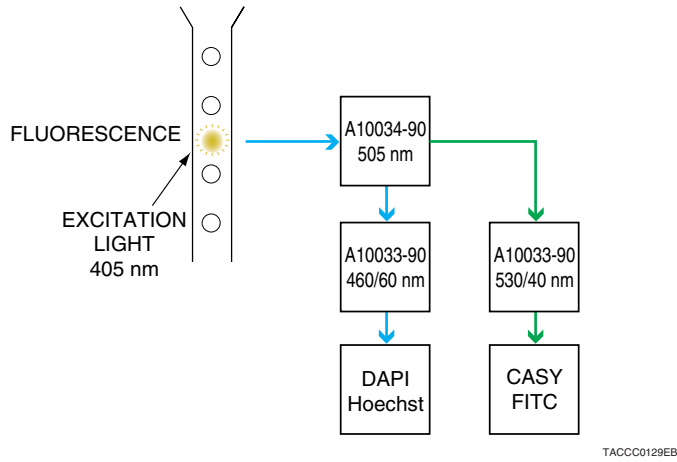
①



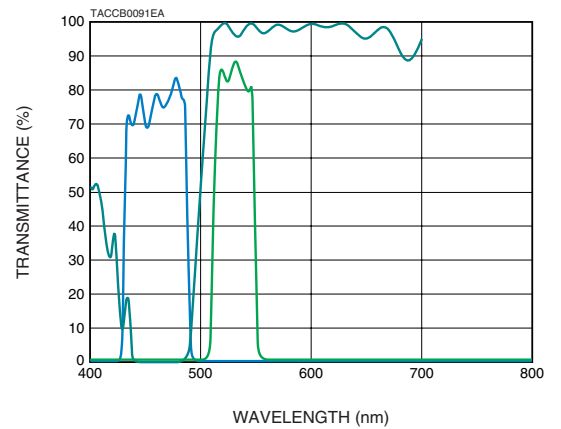
●Transmittance



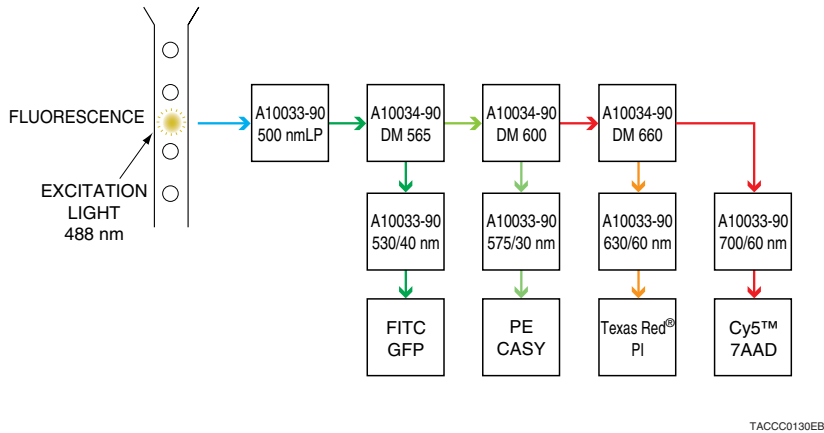
②



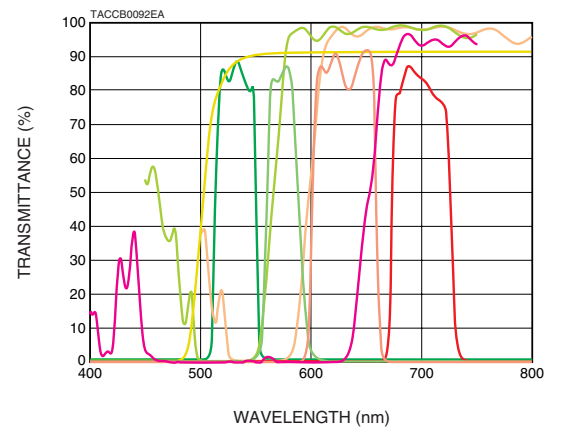
●Transmittance



③



●Transmittance



RELATED PRODUCTS

●Stabilized light sources for PMT L11494 series



The majority of these devices are LED light sources that have been developed for visual-sensitive compensation of PMTs and PMT modules.

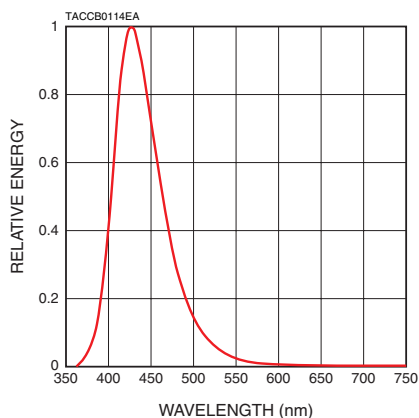
Because the amount of light generated by the LED is monitored and controlled by a photodiode, these devices always generate stable light of approximately 1 pW.

SPECIFICATIONS

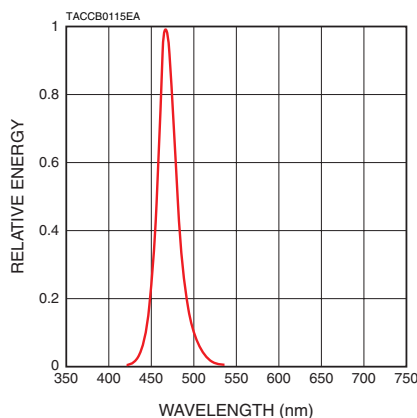
| Parameter | L11494-430 | L11494-470 | L11494-525 | L11494-660 | Unit |
|------------------------------------|------------|------------|------------|------------|------|
| Peak wavelength of generated light | 428 | 465 | 522 | 660 | nm |
| FWHM | 65 | 26 | 35 | 30 | nm |

Wavelength distribution of generated light (Typical)

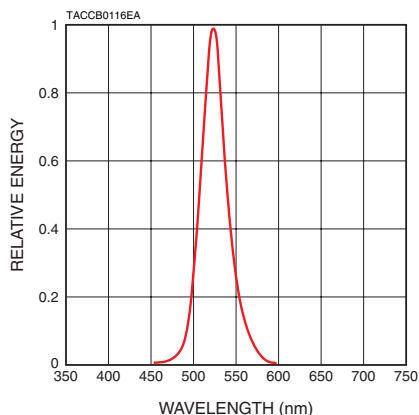
●L11494-430



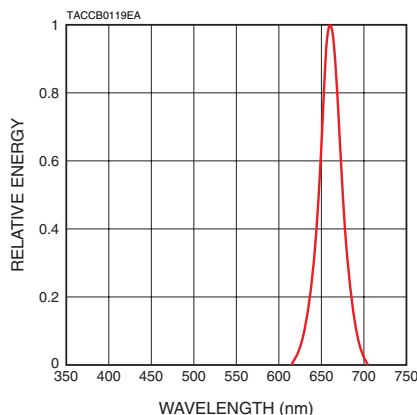
●L11494-470



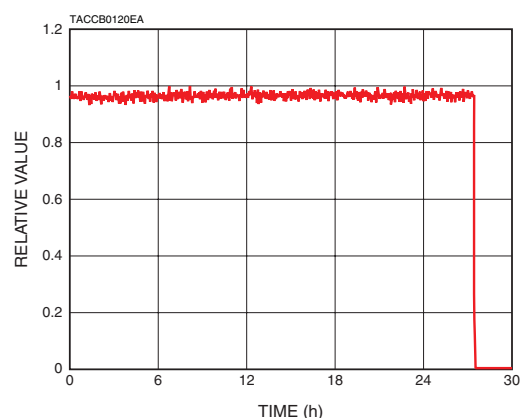
●L11494-525



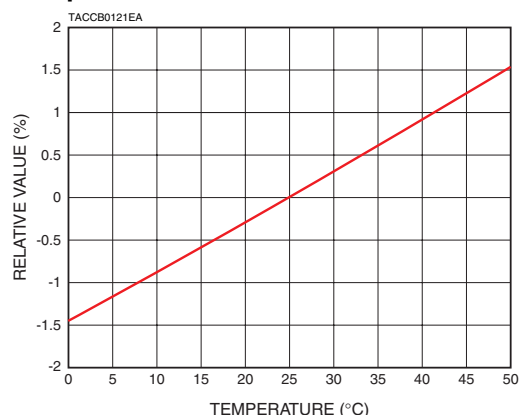
●L11494-660



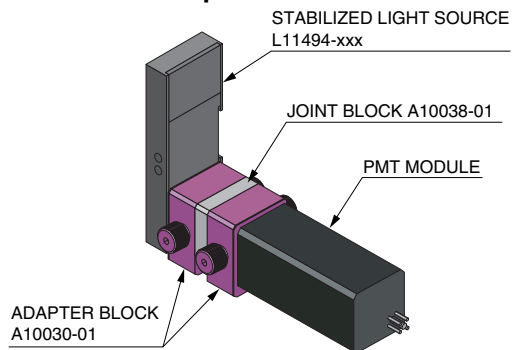
Life characteristic



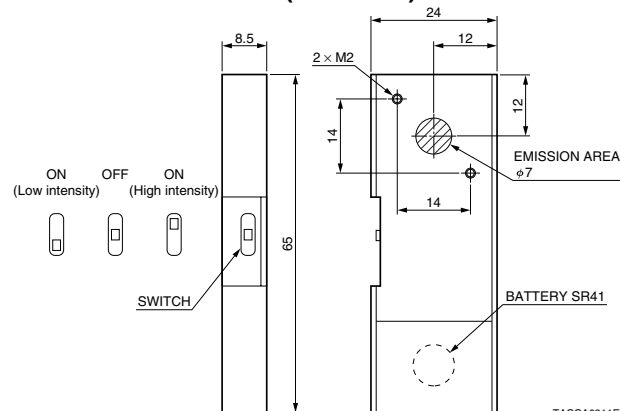
Temperature characteristic



Connection example



Dimensional outlines (Unit: mm)



* There is a separate catalog for stabilized light sources. Please refer to that catalog for more information.

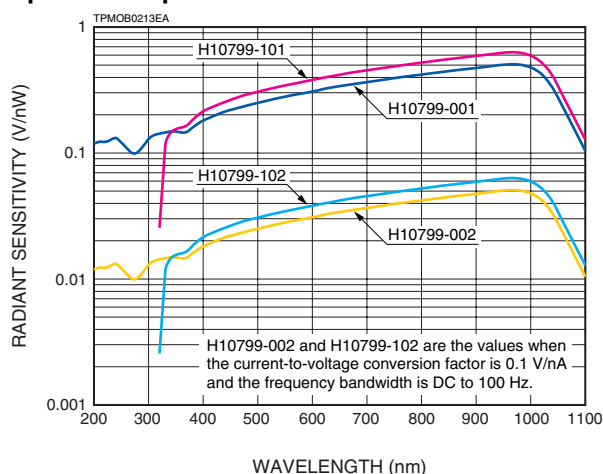
RELATED PRODUCTS

●Photosensor modules H10799 series



* Using example: P.6

Spectral response



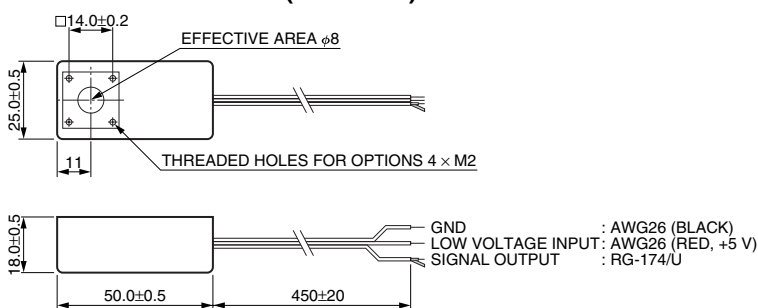
The H10799 series is cable output modules with S1337-1010 series photodiodes and current-to-voltage conversion amplifiers. You can connect it easily to optical blocks and use it as a photodetector.

SPECIFICATIONS

| Parameter | H10799 series | | | |
|------------------------------------------------------------|---------------------------------------|--------------|-------------------------|--------------|
| Suffix | -001 | -101 | -002 | -102 |
| Spectral response range | 190 nm / 320 nm to 1100 nm (See fig.) | | | |
| Input voltage | +5 V | | | |
| Max. input voltage | +5.5 V | | | |
| Max. output signal voltage | +4.5 V | | | |
| Current-to-voltage conversion factor / Frequency bandwidth | 1 V/nA / DC to 10 Hz | | 0.1 V/nA / DC to 100 Hz | |
| 0.01 V/nA / DC to 1 kHz (Switchable) | | | | |
| Effective area | ϕ8 mm | | | |
| Operating ambient temperature* | +5 °C to +50 °C | | | |
| Storage temperature* | -20 °C to +50 °C | | | |
| Internal photodiodes | S1337-1010BQ | S1337-1010BR | S1337-1010BQ | S1337-1010BR |

* No condensation

Dimensional outlines (Unit: mm)



TPMOA0048EB

●ICCD camera units C10054 series



* Using example: P.20, P21, P23

The C10054 series boast high speed and high sensitivity thanks to their built-in image intensifiers and high-speed electronic shutters (min. 5 ns).

SPECIFICATIONS

| Type No. | Spectral response (nm) | Minimum photocathode illuminance (lx) | Limiting resolution (TV lines) |
|-----------|------------------------|---------------------------------------|--------------------------------|
| C10054-x1 | 280 to 720 | 1×10^{-6} | 470 |
| C10054-x2 | | 4×10^{-7} | 450 |
| C10054-x3 | 185 to 900 | 4×10^{-5} | 480 |
| C10054-x4 | | 4×10^{-7} | 420 |
| C10054-x5 | 370 to 920 | 1×10^{-6} | 470 |
| C10054-x6 | | 4×10^{-7} | 450 |

* Image intensifier: an imaging device with high light-intensification capabilities and high-speed gate operation (shutter operation).

* There are separate catalogs for image intensifiers and ICCD cameras. Please refer to those catalogs for more information.

* The product names, software and company names mentioned herein may be the trademarks of their respective owners.

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