OLYMPUS

Microscope Components Guide

# Microscope Components for OEM Integration

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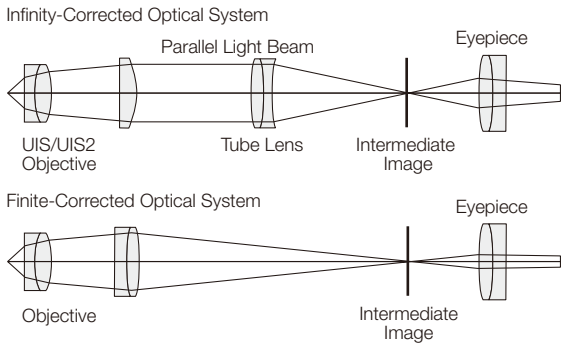
# Welcome to UIS2 Optics

## UIS2:
## Maximize the Advantage of Infinity-Corrected Optics

### *What are infinity-corrected optics?*

The UIS2 infinity-corrected optical system is designed so that light passes from the specimen through the objectives without forming an image along the way. Instead, light travels in the form of parallel rays to the tube lens, is focused by the tube lens, and forms an intermediate image. In finite-corrected optics, the intermediate image is formed by the objective without a tube lens.

**Figure 1. Infinity-Corrected and Finite-Corrected Optical System Principles**




### *Advantages of Infinity-corrected Optics*

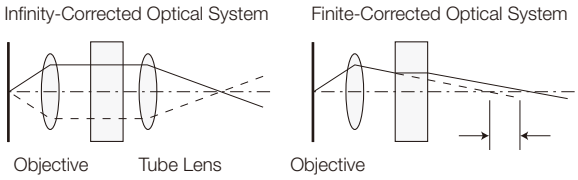
Infinity-corrected optics offer a number of advantages:

- There is no change in magnification, even when the distance between the objective and tube lens is altered.
- Because the total magnification remains constant, there is no image aberration — even when prisms or sliders are interposed between the objectives and the tube lens.

The advantages of UIS2 infinity-corrected optics are important when designing the ideal microscope optical system. With infinity-corrected optics, users can freely insert or remove intermediate attachments in the parallel rays of light between the objectives and tube lens, enabling the creation of user-specific or task-specific optical systems. To establish real flexibility with such a system, it is necessary to eliminate coma aberration. **

***In UIS2 objectives, the parfocal distance is designed at 45 mm and the focal length of the tube lens is 180 mm.*

**Figure 2. Advantages of Infinity-corrected Optical System**

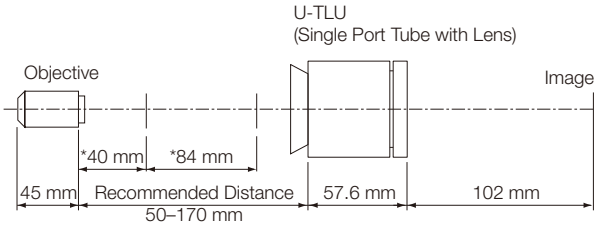



### *Basic Dimensions in the UIS2 Optical System*

The UIS2 optical system corrects aberration with a dedicated telan lens and eyepiece; coma aberration and flatness are not degraded even when the telan lens' exit pupil position is modified by changing the objective and telan distance. This makes it possible to use a distance of 50 mm to 170 mm from the objective mounting position to the single port tube with lens.

**See definition in the optical terminology section.*

**Figure 3. Basic Dimensions of UIS2 Optical System**




*Basic dimensions when our revolving nosepiece and illuminator are combined. When the position of the illuminator is changed, the illuminator's performance cannot be maintained.

## *Features of UIS2 Objectives*

UIS2 objective lenses are compatible (in both screw diameter and optical performance) with the UIS optical system and offer the following features as compared to conventional objectives.

**1. Wavefront Aberration Control**

Olympus UIS2 objectives push the boundaries of performance with wavefront aberration control, high numerical apertures (NA), and long working distances. Our objectives are designed to provide splendid performance by minimizing the aberrations that reduce resolution.

****See definition in the optical terminology section.*

**2. Objective Lenses with Splendid Image Parcentricity**

Semi Apochromatic UIS2 objectives have splendid parcentricity. When a user changes objectives by rotating the nosepiece, the center of the field of view does not change on the digital camera (50X magnification or higher in the MPLFLN and LMPLFLN series objectives).

**3. Improved Color Reproducibility**

UIS2 objectives realize true color reproduction without chromatic shifts using specially selected high-transmittance glass and advanced coating technology. These features provide high transmittance that is flat over a wide-band wavelength. Because the entire optical system, including the tube lens, is designed to reproduce a true color users know that they can obtain realistic images of the specimen even without using a digital microscope camera.

**4. Reduced Weight**

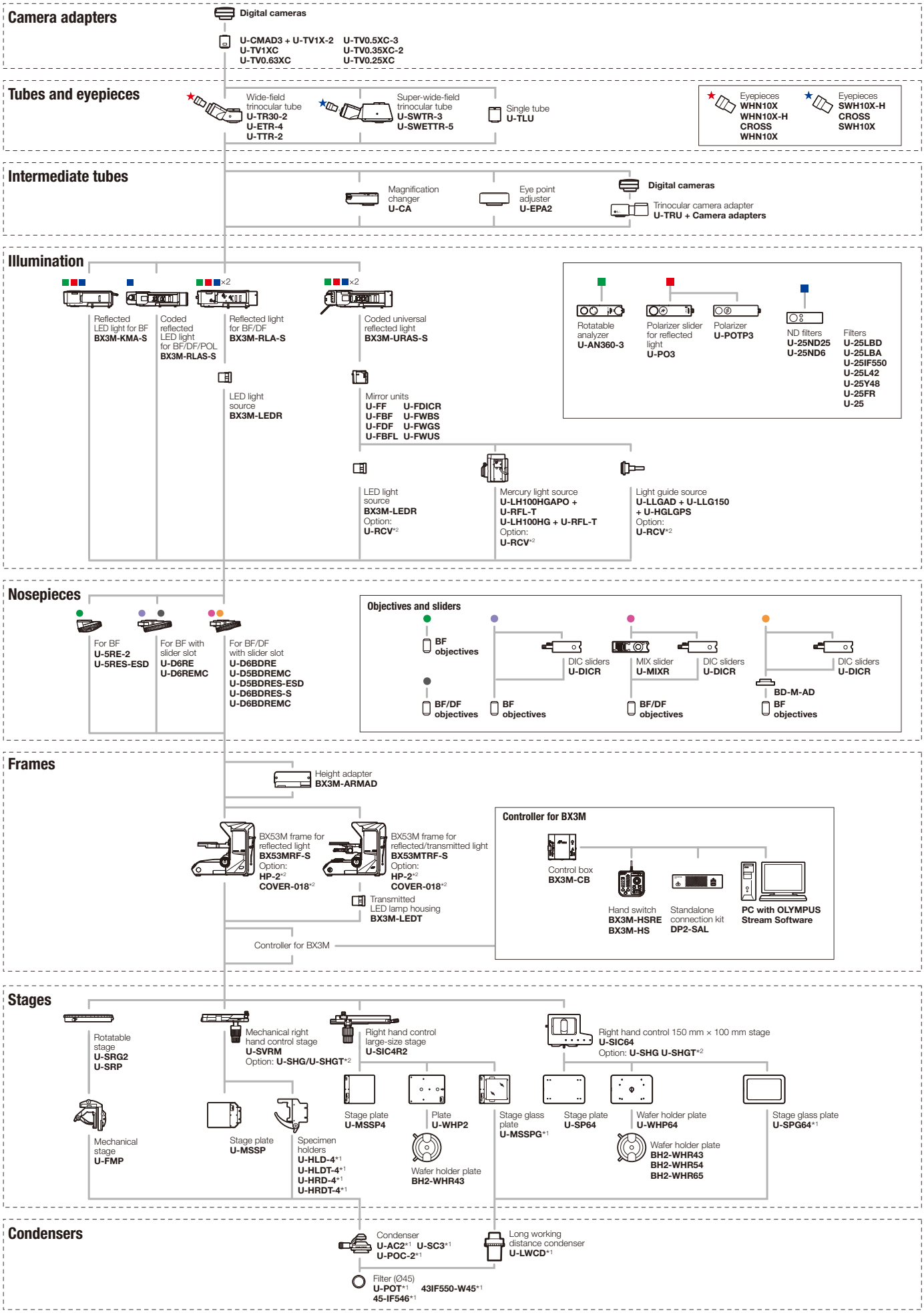
UIS2 objectives (MPLFLN and LMPLFLN series) feature an aluminum objective barrel cover, reducing their weight to approximately 2/3 that of conventional objectives. This lightens the load on devices when the objectives are moved up and down, suppressing vibrations by lowering the inertia generated when users switch objectives.

**5. Lead and Cadmium Free**

UIS2 objectives are made from lead- and cadmium-free eco-glass.

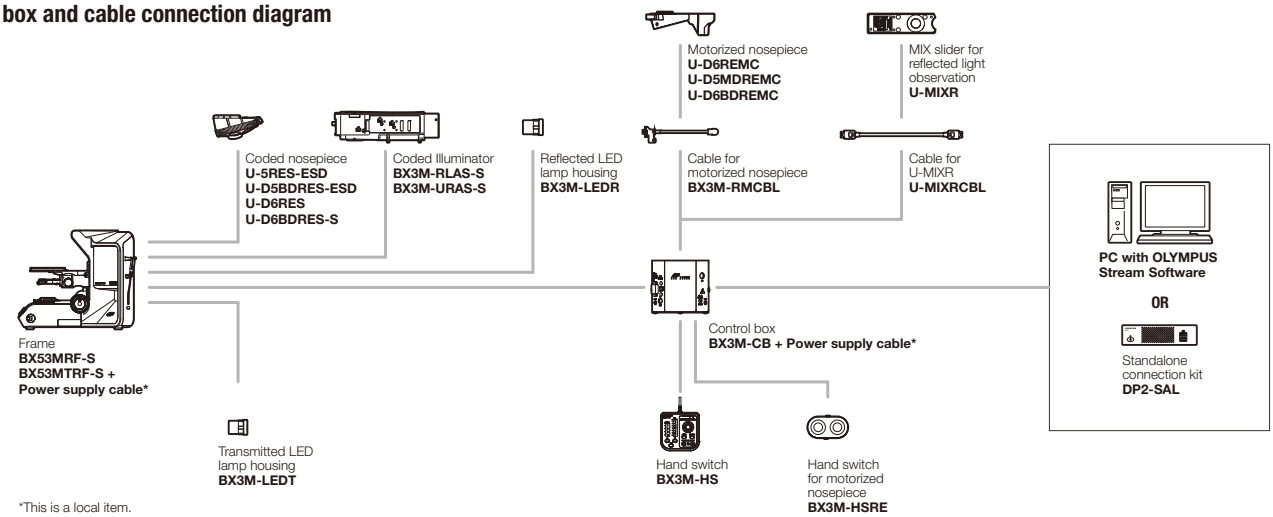
# System Diagram

## BX53M System Diagram (for Reflected and Combination Reflected/Transmitted Light



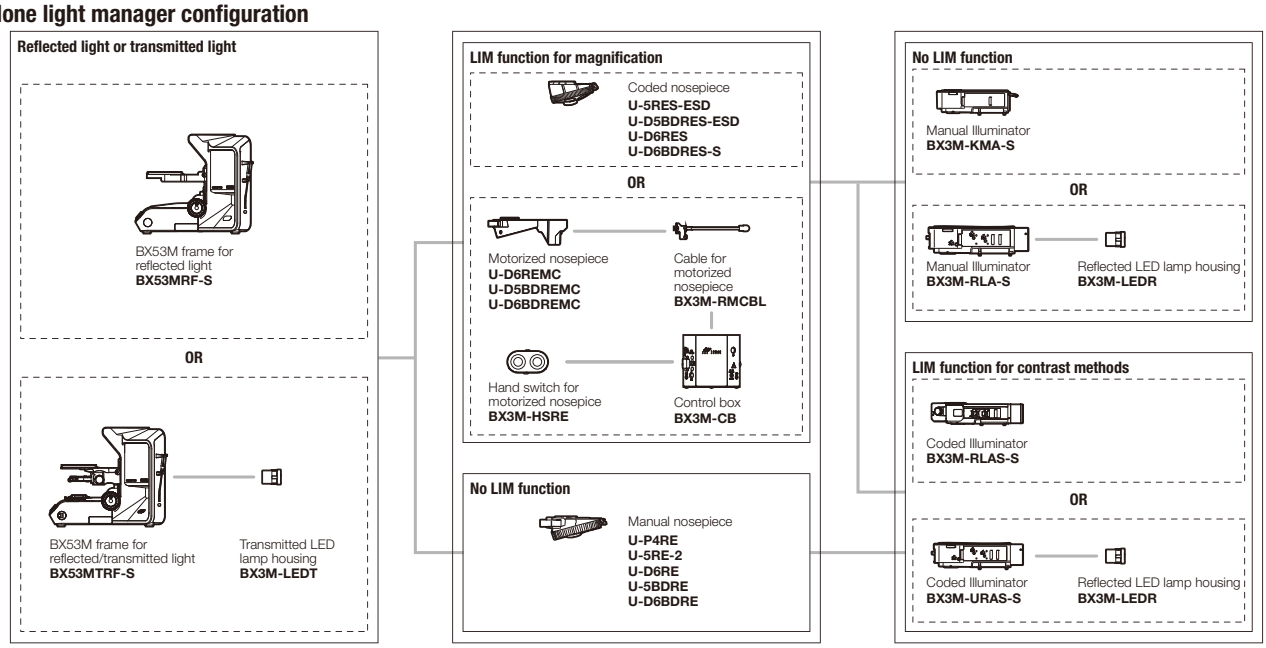

*For transmitted light combination only

## Control box and cable connection diagram

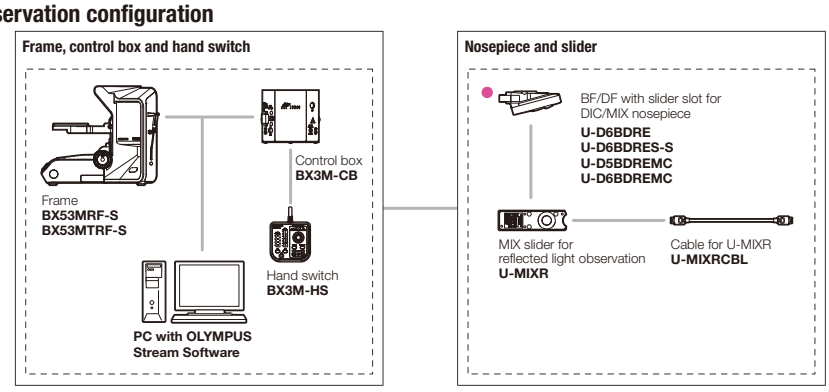



*This is a local item.

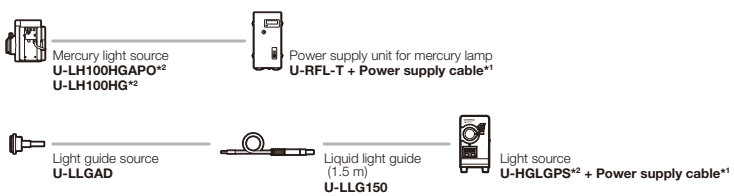
## Stand-alone light manager configuration




## MIX observation configuration




## Illumination and cable connection diagram




*1 This is a local item.
*2 Bulbs are required for these light sources.

# System Diagram

## BXFM System Diagram

### Camera adapters

Digital cameras

U-CMAD3 + U-TV1X-2
U-TV1XC
U-TV0.63XC
U-TV0.5XC-3
U-TV0.35XC-2
U-TV0.25XC

### Tubes and eyepieces

Wide-field trinocular tube
**U-TR30-2**
**U-ETR-4**
**U-TTR-2**

Super-wide-field trinocular tube
**U-SWTR-3**
**U-SWETTR-5**

Single tube
**U-TLU**

★ Eyepieces
**WHN10X**
**WHN10X-H**
**CROSS**
**WHN10X**

★ Eyepieces
**SWH10X-H**
**CROSS**
**SWH10X**

### Intermediate tubes

Magnification changer
**U-CA**

Eyepoint adjuster
**U-EPA2**

Digital cameras

Trinocular camera adapter
**U-TRU + Camera adapters**

### Illumination

Reflected LED light for BF
**BX3M-KMA-S**

Coded reflected LED light for BF/DF/POL
**BX3M-RLAS-S**

×2 Reflected light for BF/DF
**BX3M-RLA-S**

×2 Coded universal reflected light
**BX3M-URAS-S**

×2 Reflected light for BF
**U-KMAS**

LED light source
**BX3M-LEDR**

Mirror units
**U-FF** **U-FDICR**
**U-FBF** **U-FWBS**
**U-FDF** **U-FWGS**
**U-FBFL** **U-FWUS**

LED light source
**BX3M-LEDR**

Power supply for LED
**BX3M-PSLED**

LED light source
**BX3M-LEDR**
Option:
**U-RCV**[*2]

Power supply for LED
**BX3M-PSLED**

Mercury light source
**U-LH100HGAPO +**
**U-RFL-T**
**U-LH100HG +**
**U-RFL-T**
Option:
**U-RCV**[*2]

Light guide source
**U-LLGAD +**
**U-LLG150**
**+ U-HGLGPS**
Option:
**U-RCV**[*2]

Power supply for LED
**BX3M-PSLED**

Illuminator holder for BXFM
**BX3M-ILH**
Option: **BXFM-ILHSPU**[*2]

Illuminator holder BXFM
**BXFM-ILHS**

Rotatable analyzer
**U-AN360-3**

Polarizer slider for reflected light
**U-PO3**

Polarizer
**U-POTP3**

ND filters
**U-25ND25**
**U-25ND6**

Filters
**U-25LBD**
**U-25LBA**
**U-25IF550**
**U-25L42**
**U-25Y48**
**U-25FR**
**U-25**

### Nosepieces

For BF
**U-5RE-2**
**U-5RES-ESD**

For BF with slider slot
**U-D6RE**
**U-D6REMC**

For BF/DF with slider slot
**U-D6BDRE**
**U-D5BDREMC**
**U-D5BDRES-ESD**
**U-D6BDRES-S**
**U-D6BDREMC**

**Objectives and sliders**

**BF objectives**
**U-DICR**
**BF objectives**
**U-MIXR**
**BF/DF objectives**
**U-DICR**
**BF objectives**
**U-DICR**
**BD-M-AD**
**BF objectives**

### Frame

BXFM frame
**BXFM-F**

Controller for BXFM

Stand
**U-ST**[*1]
**SZ-STL**

**Controller for BXFM**

BXFM control box
**BX3M-CBFM**

Hand switch
**BX3M-HSRE**
**BX3M-HS**

Standalone connection kit
**DP2-SAL**

**PC with OLYMPUS Stream Software**

Control box for coded function
**U-CBS**

Standalone connection kit
**DP2-SAL**

**PC with OLYMPUS Stream Software**

*1 U-ST is not available with BX3M-ILH.
*2 Please select as necessary

### Control box and cable connection diagram

Coded nosepiece
**U-5RES-ESD**
**U-5BDRES-ESD**
**U-D6RES**
**U-D7RES**
**U-D6BDRES-S**

Coded Illuminator
**BX3M-RLAS-S**
**BX3M-URAS-S**

Motorized nosepiece
**U-D6REMC**
**U-D5BDREMC**
**U-D6BDREMC**

MIX slider for reflected light observation
**U-MIXR**

Extension cable for motorized nosepiece
**BX3M-RMECBL**

Extension cable for U-MIXR
**U-MIXRCBL/**
**U-MIXRECBL**

**PC with OLYMPUS Stream Software**

Control box for coded function
**U-CBS +**
**Power supply cable***

BXFM control box
**BX3M-CBFM + Power supply cable***

Standalone connection kit
**DP2-SAL**

Hand switch
**BX3M-HS**

Hand switch for motorized nosepiece
**BX3M-HSRE**

Note:
DP2-SAL is available only with either the coded system or the motorized system, but not with both.

*This is a local item.

### MIX observation configuration

**Frame, control box and hand switch**

BXFM control box
**BX3M-CBFM**

Hand switch
**BX3M-HS**

**Nosepiece and slider**

BF/DF with slider slot for DIC/MIX
**U-D5BDRE** **U-D5BDRES-ESD**
**U-P5BDRE** **U-D6BDRES-S**
**U-D6BDRE** **U-D6BDREMC**
**U-D6BDREMC**

MIX slider for reflected light observation
**U-MIXR**

Extension cable for U-MIXR
**U-MIXRMCBL**

### Illumination and cable connection diagram

Mercury light source
**U-LH100HGAPO**[*2]
**U-LH100HG**[*2]

Power supply unit for mercury lamp
**U-RFL-T + Power supply cable**[*1]

Light guide source
**U-LLGAD**

Liquid light guide (1.5 m)
**U-LLG150**

Light source
**U-HGLGPS**[*2] **+**
**Power supply cable**[*1]

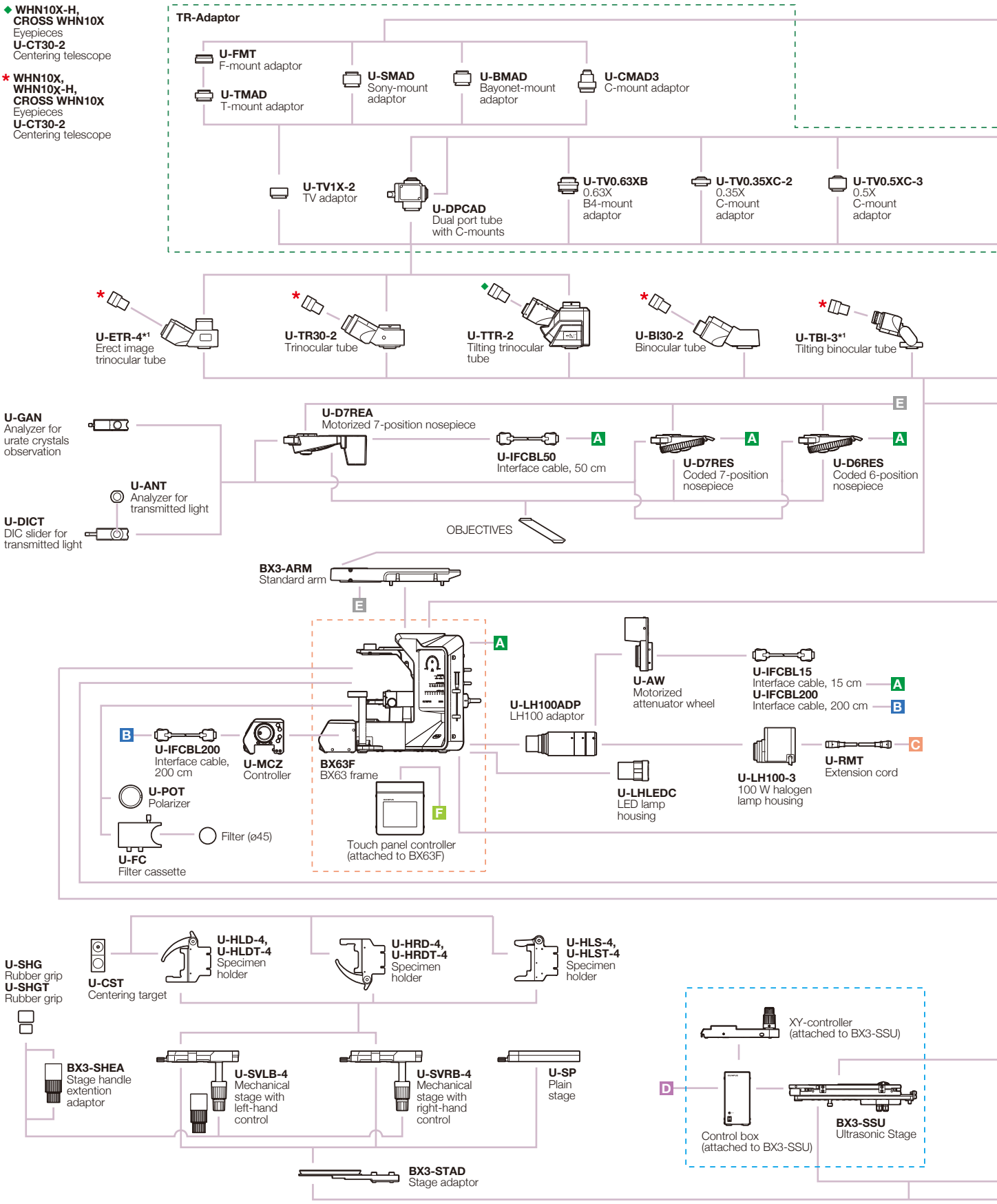
LED light source
**BX3M-LEDR**[*2]

Power supply for LED
**BX3M-PSLED + Power supply cable**[*1]

*1 This is a local item.
*2 Bulbs are required for these light sources.

# System Diagram

## BX63 System Diagram




*1 Slight vignetting may occur in combination with an additional intermediate attachment or fluorescence illuminator. *2 Require an additional intermediate attachment or fluorescence illuminator.

CAMERAS

**U-TV0.63XC**
0.63X C-mount adaptor

**U-TV1XC**
C-mount adaptor 1X (XY adjustment)

**U-TBI-3-CLI***1
Tilting binocular tube

**U-TTBI**
Ergonomic binocular tube

**U-TTLBI***2
Tilting, telescopic, lifting binocular tube

**U-KPA**
Intermediate attachment for simple polarizing observation

**U-ANT**
Analyzer for transmitted light

**U-CA**
Magnification changer

**U-EPA2**
Eyepoint adjuster

**U-EPAL-2**
Eyepoint adjuster

**U-LLGAD**
Liquid light guide adapter

**U-LLG150/ U-LLG300**
Liquid light guide (1.5 m/3 m)

**U-HGLGPS**
Light source

**BX3-RFAS**
Coded fluorescence illuminator

**U-LH100HGAPO**
100 W mercury apo lamp housing

**U-LHEAD**
Extension adaptor for lamp housing

**U-DULHA**
Double lamp housing adaptor

**U-LH100HG**
100 W mercury lamp housing

**U-RFL-T**
Power supply unit for mercury lamp

Mirror units

**U-AN-2**
Analyzer slider

**U-IFCBL15**
Interface cable, 15 cm

**U-IFCBL200**
Interface cable, 200 cm

**U-AW**
Motorized attenuator wheel

**BX3-RFAA**
Motorized fluorescence illuminator

**U-IFCBL15**
Interface cable, 15 cm

**C1394A**
Interface cable

**BX3-CBH**
Control box

PC (software)

**IX2-GCP**
Glass stage insert plate

**IX-CP50**
Insert plate

**IX-SCL**
Slide clip

**IX-SVL2***3
Cross stage with short left handle

**U-SC3**
Swing-out condenser

**U-AAC**
Achromatic/ Aplanatic condenser

**U-DCD**
Darkfield condenser, dry

**U-DCW**
Darkfield condenser, oil

**U-TLD**
Dry top lens

**U-UCD8-2**
8-position universal condenser

**BX3-UCD8A**
Motorized universal condenser

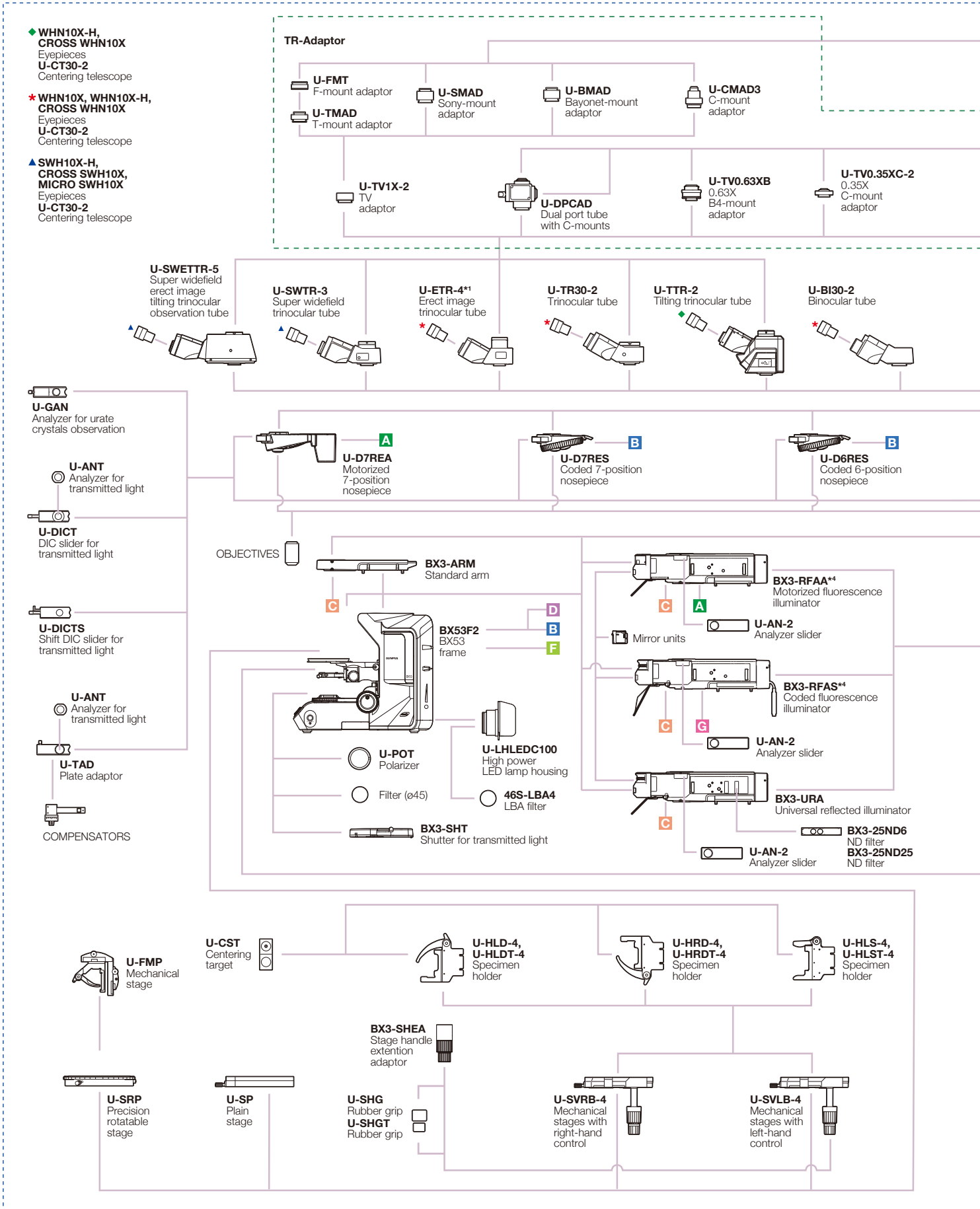
Optical elements

**U-IFCBL15**
Interface cable, 15 cm

***3** Cannot be used with BX3-UCD8A and U-UCD8-2

# System Diagram

## BX53 System Diagram




*1 Slight vignetting may occur in combination with an additional intermediate attachment or observation method. *2 Require an additional intermediate attachment or fluorescence illuminator.
*3 Cannot be used with U-TTLBI. *4 Compatible with FN 22. *5 Cannot be used with BX3-URA. *6 Stand is a standard equipment of the U-MDOSV, BX3-MDO18R, and U-MDO10R3.

CAMERAS

**U-TV0.5XC-3**
0.5X C-mount adaptor

**U-TV0.63XC**
0.63X C-mount adaptor

**U-TV1XC**
C-mount adaptor 1X (XY adjustment)

**U-TBI-3**[*1]
Tilting binocular tube

**U-TBI-CLI**[*1]
Tilting binocular tube

**U-TTBI**
Ergonomic binocular tube

**U-TTLBI**[*2]
Tilting, telescopic, lifting binocular tube

C

**U-D6RE**
Sextuple revolving nosepiece for DIC/simple POL

**U-5RE-2**
Quintuple revolving nosepiece

**U-KPA**
Intermediate attachment for simple polarizing observation

**U-ANT**
Analyzer for transmitted light

**U-CA**
Magnification changer

**U-DP**[*1*3]
Dual port

**U-DP1XC**
Dual port 1X

**U-EPA2**
Eyepoint adjuster

**U-EPAL-2**
Eyepoint adjuster

**U-TRU**[*1*3]
Trinocular intermediate unit

**U-TRUS**[*1]
Trinocular intermediate unit

**U-CPA**
Intermediate attachment for conoscopic andorthoscopic observation

**U-AN360P**
Rotatable analyzer

**U-OPA**
Intermediate attachment for orthoscopic observation

**U-DO3**
Dual observation attachment

**U-SDO3**
Side by side observation attachment

**BX3-MDOE**
Multi-observation extension

**U-MDOSV**[*6]
Multi-observation side viewer

**U-MDOB3**
Multi-observation body

**U-MDO10B3**
Multi-observation body for 10 persons

**U-MDO10R3**[*6]
Multi-observation body for 10 persons

**BX3-MDO18R**
Multi-observation body for 18 persons

**U-LLGAD**
Liquid light guide adaptor

**U-LLG150/ U-LLG300**
Liquid light guide (1.5 m/3 m)

**U-HGLGPS**
Light source

**U-LHEAD**[*5]
Extension adaptor for lamp housing

**U-DULHA**
Double lamp house adaptor

**U-LH100HGAPO**
100 W mercury apo lamp housing

**U-LH100HG**
100 W mercury lamp housing

**U-RFL-T**
Power supply unit for mercury lamp

**U-AW**
Motorized attenuator wheel

A

**U-LC**[*7]
Low magnification condenser

**U-AC2**
Abbe condenser

**U-SC3**
Swing-out condenser

**U-AAC**
Achromatic/ Aplanatic condenser

**U-PCD2**
Phase/darkfield condenser

Stand[*6]

**U-HSEXP**
Hand switch forexposure

Optical devices

**BX3-UCD8A**
Motorized universal condenser

**U-TLD**
Dry top lens

**U-DCD**
Darkfield condenser, dry

**U-DCW**
Darkfield condenser, oil

E
B
G

**U-CBS**
Control box for coded function

**CBSIFCBL200**
Interface cab le, 200cm

**U-HSCBM**
Hand switch for CBM

**DP2-SAL**
Standalone Connection Kit

**BX3M-HSRE**
Hand switch

F

**U-UCD8-2**
8-position universal condenser

B

**U-IFRES**
Interface for coded nosepiece

A

**U-IFCBL200**
Interface cable, 200 cm

**BX3-CBM**
Control box

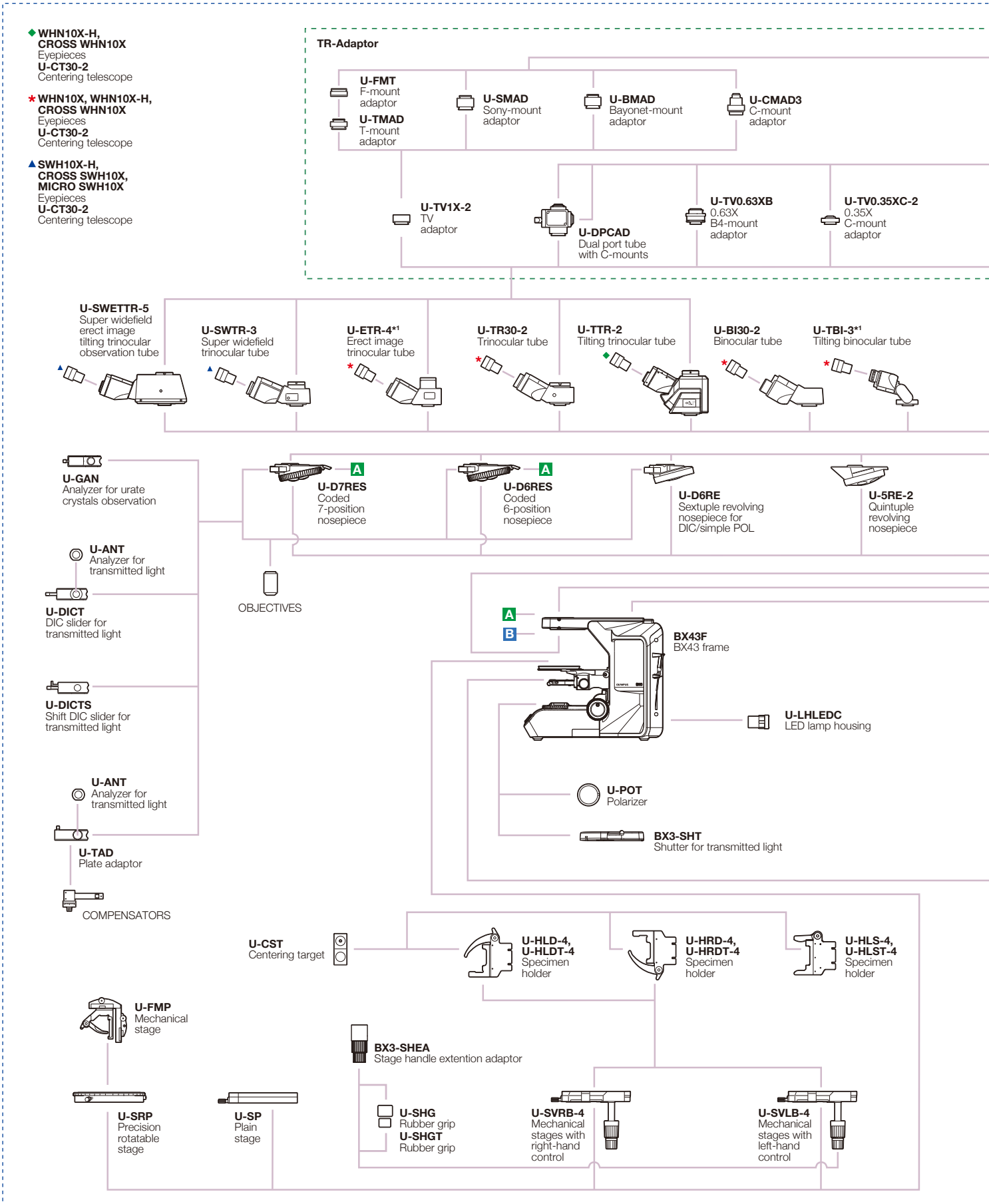
PC (Software)

D E

***7** An auxiliary lens is equipped.

# System Diagram

## BX43 System Diagram




***1** Slight vignetting may occur in combination with an additional intermediate attachment or observation method.
***2** Require an additional intermediate attachment or fluorescence illuminator. ***3** Cannot be used with U-TTLBI. ***4** Compatible with FN 22. ***5** An auxiliary lens is equipped.

CAMERAS

U-TV0.5XC-3
0.5X
C-mount
adaptor

U-TV0.63XC
0.63X
C-mount
adaptor

U-TV1XC
C-mount
adaptor 1X
(XY adjustment)

U-CA
Magnification changer

U-DP*1*3
Dual port

U-DP1XC
Dual port 1X

U-TBI-CLI*1
Tilting binocular tube

U-TTBI
Ergonomic
binocular tube

U-TTLBI*2
Tilting,
telescopic,
lifting binocular tube

U-TRU*1*3
Trinocular intermediate unit

U-TRUS*3
Trinocular intermediate unit

U-ANT
Analyzer for
transmitted light

U-KPA
Intermediate attachment for
simple polarizing observation

U-EPA2
Eyepoint adjuster

U-EPAL-2
Eyepoint adjuster

BX43-5RES
Coded
5-position
nosepiece
for BX43

U-LLGAD
Liquid light
guide
adaptor

U-LLG150/
U-LLG300
Liquid light
guide
(1.5 m/3 m)

U-HGLGPS
Light source

U-LH100HGAPO
100 W mercury
apo lamp
housing

U-LH100HG
100 W mercury
lamp housing

U-RFL-T
Power supply unit
for mercury lamp

U-CPA
Intermediate
attachment for
conoscopic and
orthoscopic
observation

U-AN360P
Rotatable
analyzer

U-OPA
Intermediate attachment for
orthoscopic observation

BX3-URA
Universal reflected illuminator

U-PO
Polarizer

BX3-6ND6
ND filter
BX3-25ND25
ND filter

Mirror units

U-AN-2
Analyzer slider

BX3-RFAS*4
Coded
fluorescence
illuminator

U-DULHA
Double
lamp house
adaptor

U-DO3
Dual observation attachment

U-SDO3
Side by side observation
attachment

U-LC*5
Low
magnification
condenser

U-AC2
Abbe
condenser

U-SC3
Swing-out
condenser

U-AAC
Achromatic/
Aplanatic
condenser

U-PCD2
Phase/darkfield
condenser

U-DCD
Darkfield
condenser,
dry

U-DCW
Darkfield
condenser,
oil

U-TLD
Dry top lens

Optical devices

U-UCD8-2
8-position
universal
condenser

U-IFRES
Interface for
coded
nosepiece

U-CBS
Control box for
coded function

U-HSEXP
Hand switch for
exposure

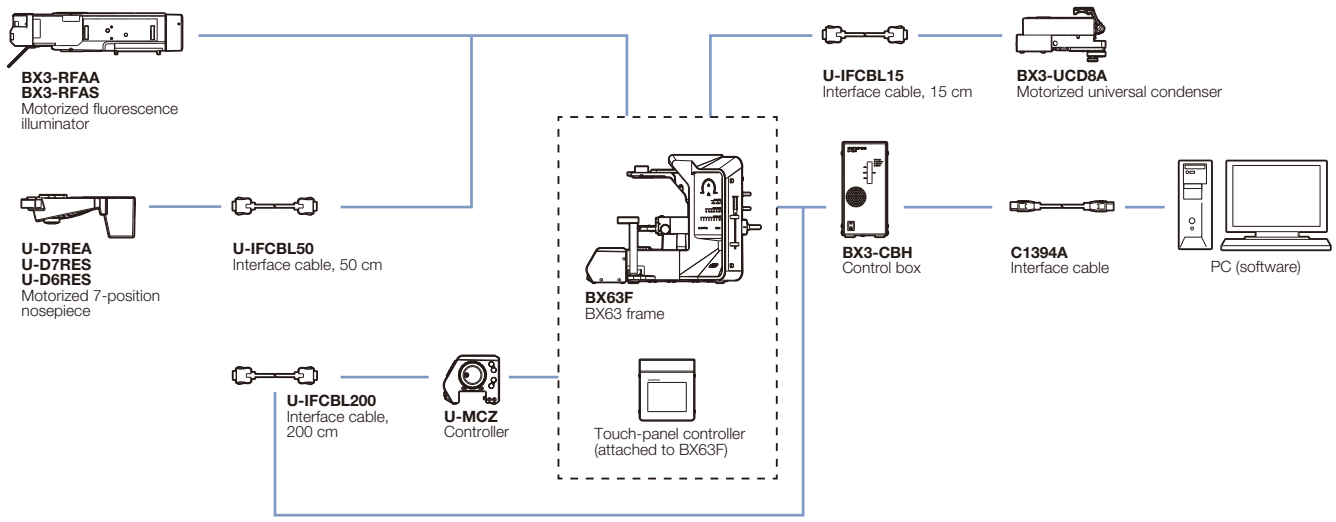
DP2-SAL
Standalone Connection Kit

PC (Software)

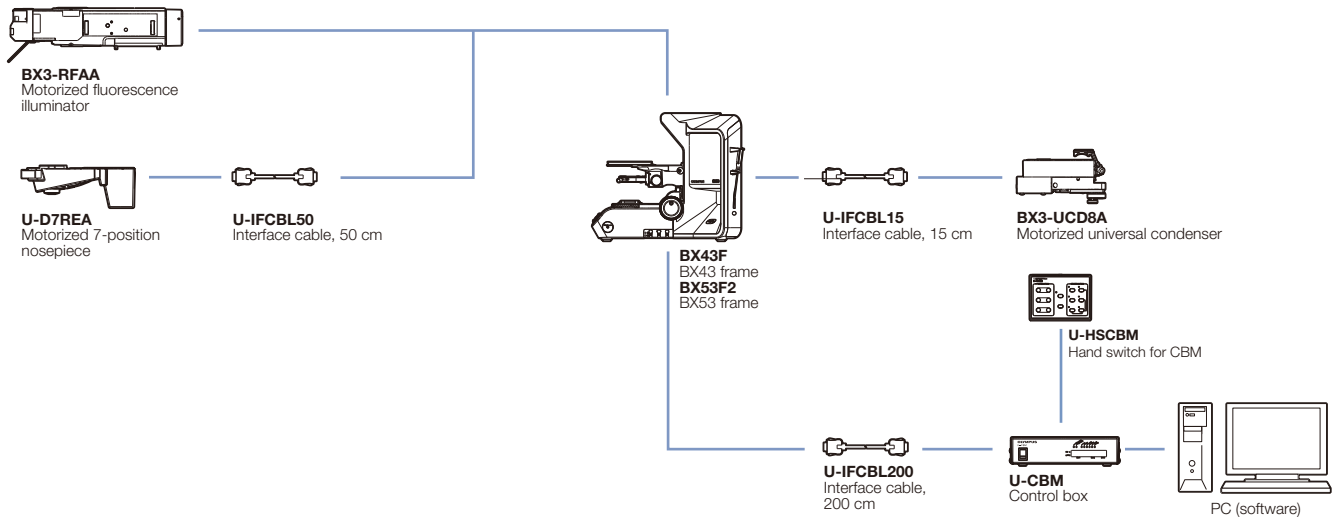
# System Diagram

## BX3 Series Basic Motorized System Diagram

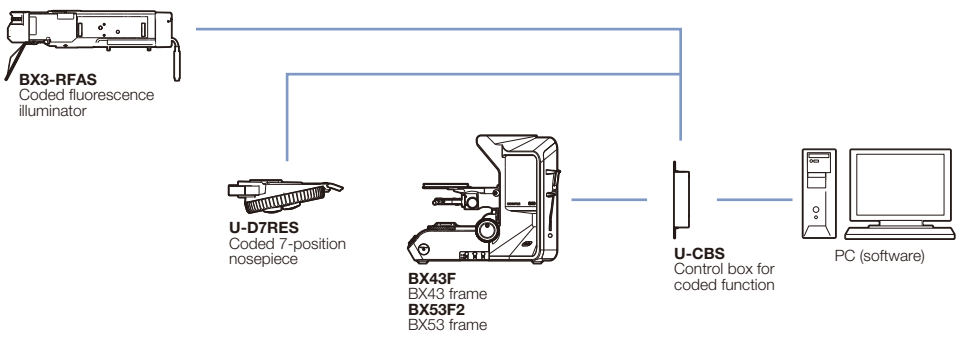
Full Motorized System Basic Configuration for BX3 series




Semi-Motorized System Basic Configuration for BX3 series




Coded System Basic Congratulation for BX3 series

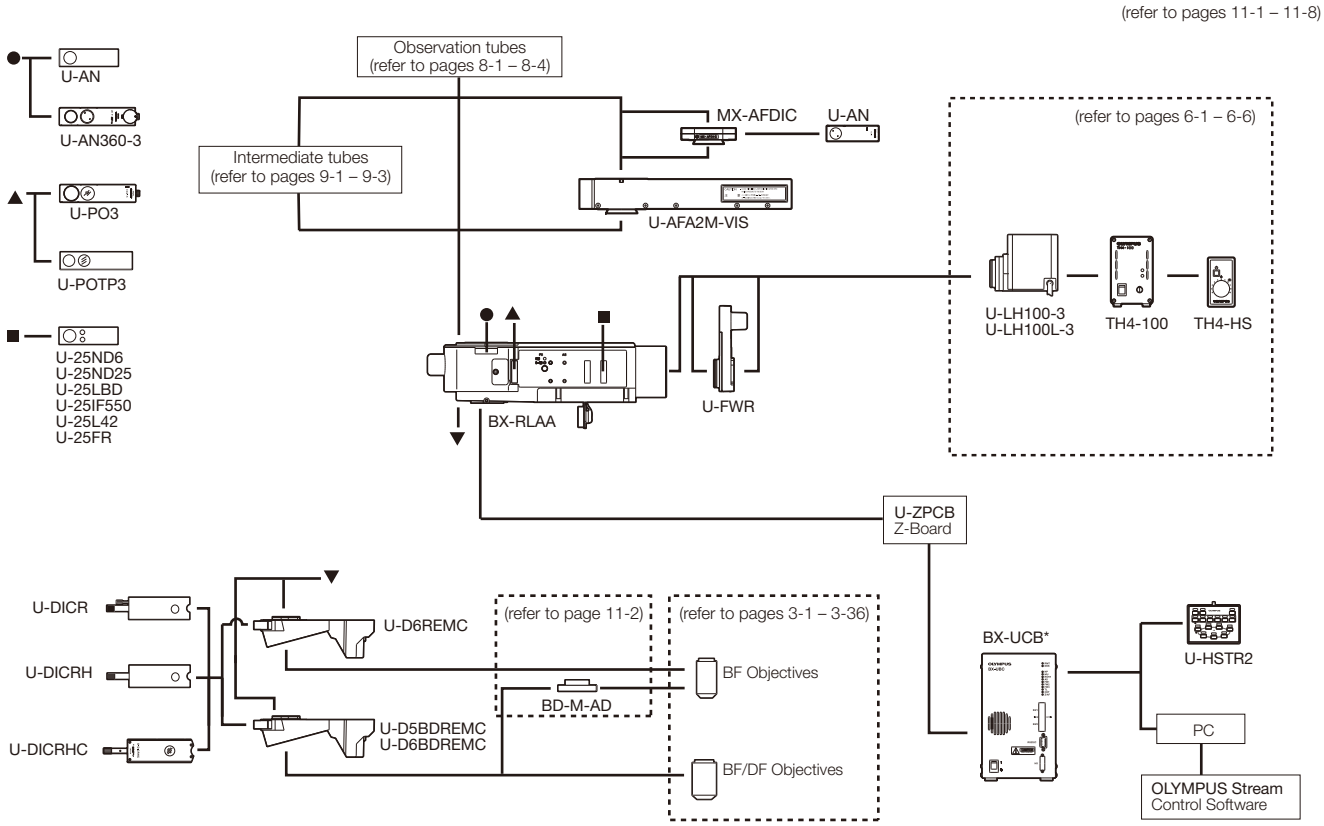



*Please refer to "Section 13 Motorized Unit" for each motorized unit in the detail.

**Please consult your nearest Olympus representative for details about motorized system configurations and combinations.

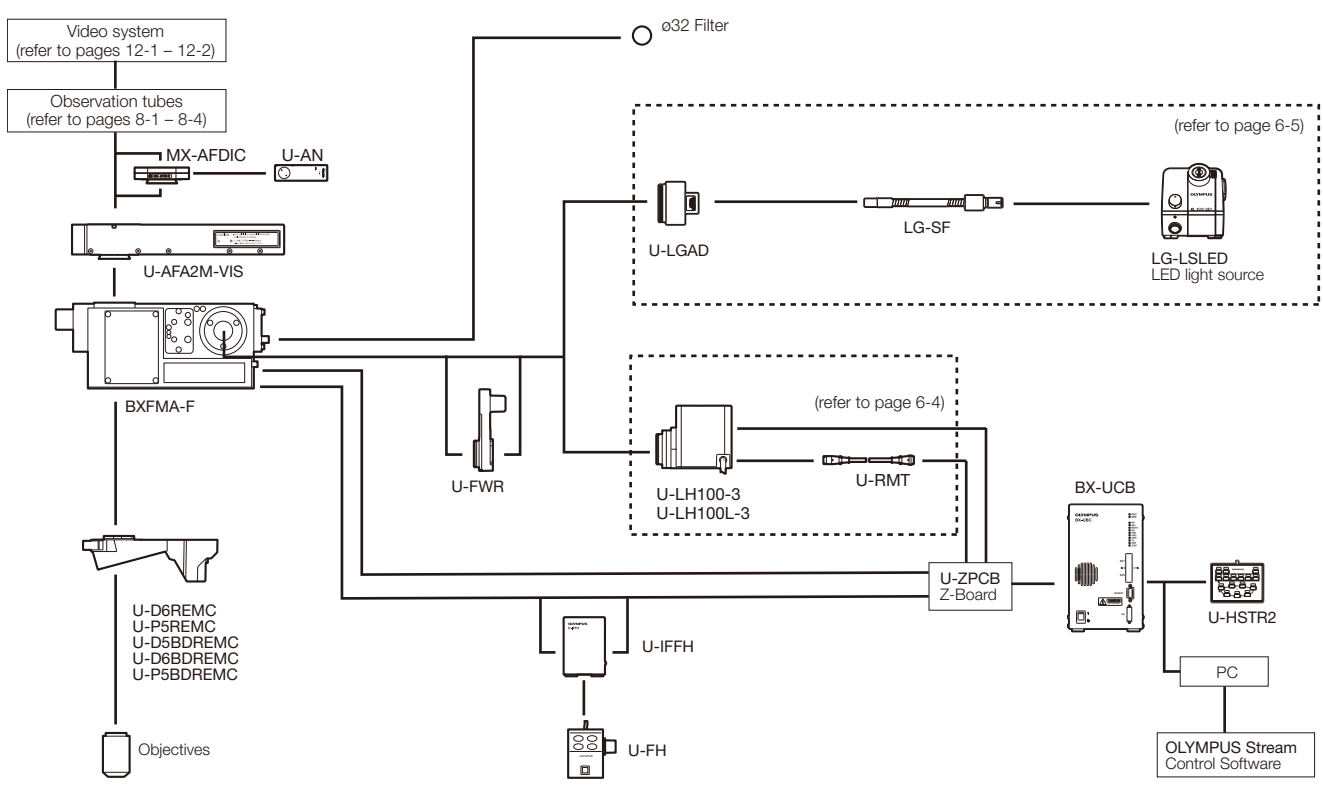
# System Diagram

## BX2 Series Motorized Unit System Diagram




*BX-REMCB is also available for BX-RLAA + motorized revolving nosepiece control (refer to page 13-3).
**These illuminators can only attach to the MX51 or BX61 frames.

## BXFM-A System Diagram



# UIS2 Objectives (for Industrial Applications)

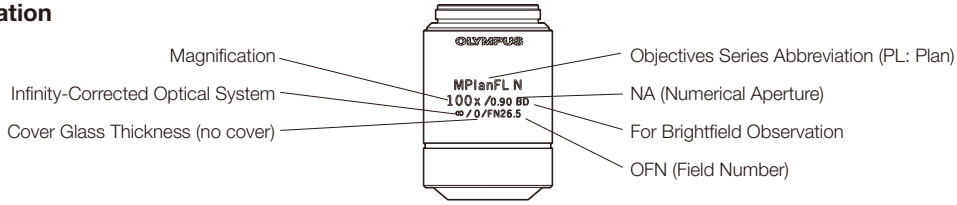
UIS2 World-leading optics

## Definition for Objective Abbreviations

**M PL(Plan) F L N - 1 0 0 B D**

- **M:** Metallurgical (no cover)
  - **LM:** Long Working Distance Metallurgical Use
  - **SLM:** Super Long Working Distance Metallurgical Use
  - **LC:** Observation Through Substrate
- **PL:** Plan: Corrects Field Curvature on the Periphery of the Image Plane
- **None:** Achromat/ Effectively corrects chromatic aberration at 486 nm and 656 nm wavelengths
  - **FLN:** SemiApochromat/ Corrects chromatic aberration that is in the middle of apochromat and achromat
  - **APON:** Apochromat/ Effectively corrects chromatic aberration in the entire visible range (435-656 nm)
- **Number:** Objective Magnification
- **None:** Brightfield
  - **BD:** Brightfield/Darkfield
  - **BDP:** Brightfield/Darkfield/ Polarizing
  - **IR:** Infrared
  - **LCD:** Obervation Through LCD Panels

## Objective Notation




## Objective Series List

| Series | Magnification | BF | DF | DIC*1 | POL | FL | OFN (Field Number) | Remarks |
|---|---|---|---|---|---|---|---|---|
| MPLAPON | 50/100 | ○ | | ○ U | ○ | | 26.5 | |
| MPLAPON O | 100 | ○ | | | ○ | ○ | 26.5 | |
| MPLFLN | 1.25/2.5 | ○ | | | | | 1.25X: 22/2.5X: 26.5 | We recommend using a polarizer and analyzer |
| | 5/10/20/40*2/50/100 | | ○ | | ○U | ○ | 26.5 | |
| LMPLFLN | 5/10/20/50/100 | ○ | | ○L | ○ | ○ | 26.5 | |
| MPLN | 5/10/20/50/100 | | ○ | | | | 22 | |
| LCPLFLN-LCD | 20/50/100 | ○ | | ○L | | | 26.5 | For LCD |
| SLMPLN | 20/50/100 | ○ | | | | | 26.5 | |
| LMPLN-IR | 5/10 | ○ | | | | | 22 | For near-IR observation |
| LCPLN-IR | 20/50/100 | ○ | | | | | 22 | For near-IR observation |
| MPLFLN-BD | 5/10/20/50/100/150 | ○ | ○ | ○U | ○ | ○*3 | 26.5 | |
| MPLFLN-BDP | 5/10/20/50/100 | ○ | ○ | ◎U | ◎ | ○*3 | 26.5 | |
| LMPLFLN-BD | 5/10/20/50/100 | ○ | ○ | ○L | ○ | ○ | 26.5 | |
| MPLN-BD | 5/10/20/50/100 | ○ | ○ | | | | 22 | |
| WLI100XMRTC | 100X | ○ | | | | | 22 | Mirau objective |

*1 DIC Prism U-DICR: UM/LM Position, U-DICRHC: LM Position Fixed, U-DICRH: UM Position Fixed. *2 40X: BF Only *3 5–20X: U Excitation Also Possible.
○: Responds; ◎: Optimally Responds; BF: Brightfield; DF: Darkfield; DIC: Differential Interference Contrast; POL: Polarized light; FL: Fluorescence

## Features of Each Objective Series

**● MPLAPON series: M Plan Apochromat — p. 3-2**
This series of Plan Apochromat objectives corrects chromatic aberrations at optimal levels. Olympus guarantees* the optical performance (correction for wavefront aberration) with a Strehl ratio** of 95% or better. These objectives can be used with Olympus' U-AFA2M active auto focus unit.

**● MPLAPON100XO2: M Plan Apochromat — p. 3-2**
This Plan Apochromat objective is designed for oil immersion*** and features a numerical aperture of 1.45. The objective provides excellent chromatic aberration correction and high resolving power.

**● MPLFLN series: M Plan Semi Apochromat — p. 3-3**
This series of Plan Semi Apochromat objectives delivers high-level correction for chromatic aberration. The eight objectives in this series offer magnifications ranging from 1.25X to 100X and a minimum working distance of 1 mm (except 40X). Since the exit pupil position of the 5X–100X objectives is standardized, the position of the DIC prism does not have to be switched when changing the magnification (40X is not applicable to DIC observation). For very low magnifications (1.25X, 2.5X), use the objectives with an analyzer, polarizer, and reflected light illuminator.

**● LMPLFLN series: Long Working Distance M Plan Semi Apochromat — p. 3-4**
This series of long working distance Plan Semi Apochromat objectives delivers high-level correction for chromatic aberration. Because of the long working distance, these objectives are suitable for observing larger samples. Since the exit pupil position of the 5X–100X objectives is standardized, the position of the DIC prism does not have to be switched when changing the magnification.

**● MPLN series: M Plan Achromat — p. 3-5**
Plan Achromat objectives provide excellent image flatness up to FN 22.

**● LCPLFLN-LCD series: LCD Long Working Distance M Plan Semi Apochromat — p. 3-6**
These objectives are designed for making observations through LCD panels and other samples that have a glass substrate. The correction collar provides aberration correction that can be matched to the thickness of the glass.

**● SLMPLN series: Super Long Working Distance M Plan Achromat — p. 3-7**
These are high-magnification Plan Achromat objectives with a super long working distance. Three magnifications, 20X, 50X, and 100X, are available. For 5X or 10X objectives, select from the LMPLFLN series.

**● LMPLN-IR series: IR Long Working Distance M Plan Achromat — p. 3-8**
This series is designed for near-infrared microscopy, which is typically used to view the internal structure of silicon wafers.

**● LCPLN-IR series: IR Long Working Distance M Plan Achromat — p. 3-9**
This series is designed for near-infrared microscopy, which is typically used to view the internal structure of silicon wafers. These objectives have a correction collar to correct for aberrations based on the thickness of the silicon or glass substrate.

**● MPLFLN-BD series: M Plan Semi Apochromat BD — p. 3-10**
This series of Plan Semi Apochromat objectives provides high-level correction for chromatic aberration with a minimum working distance of 1 mm. Since the exit pupil position of the 5X–150X objectives is standardized, the position of the DIC prism does not have to be switched when changing the magnification.

**● MPLFLN-BDP series: M Plan Semi Apochromat BDP — p. 3-11**
This series of Plan Semi Apochromat objectives provides high-level correction for chromatic aberrations with a minimum working distance of 1 mm. Since the exit pupil position of the 5X–100X objectives is standardized, the position of the DIC prism does not have to be switched when changing the magnification. This series is optimized for brightfield, darkfield, and polarized light observations and can be used with differential interference contrast.

**● LMPLFLN-BD series: Long Working Distance M Plan Semi Apochromat BD — p. 3-12**
This series of long working distance Plan Semi Apochromat objectives provides high-level correction for chromatic aberration and are suitable for observing samples with height or varying topography. Since the exit pupil position of the 5X–100X objectives is standardized, the position of the DIC prism does not have to be switched when changing the magnification.

**● MPLN-BD series: M Plan Achromat BD — p. 3-13**
This series of Plan Achromat objectives provides excellent image flatness up to FN 22.

**● WLI100XMRTC series: White Light Interferometry Objective — p. 3-14**
This objective is designed to be used with Mirau-style white light interferometers and tolerates high temperatures. The objective has a working distance of 0.7 mm and an optimized NA of 0.8 that provides improved light gathering.

**Measurement guarantee assessed with an Olympus interferometer for transmitted wavefront measurement under the following conditions: a temperature of 23 °C + 1 °C; measurements made within the 97% range of the pupil diameter.*

***Strehl ratio: Indicates in percent (%) the ratio of the proportion of light that an actual optical system can concentrate with respect to the proportion of light concentrated in the image plane (central intensity) by an ideal, aberration-free optical system, with the latter serving as 100%. A higher percentage indicates a higher quality optical system.*

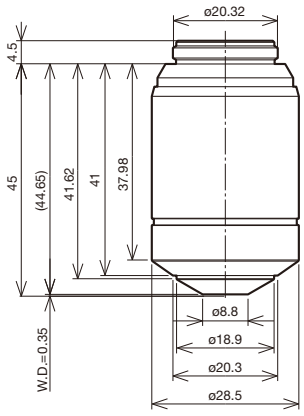
****Specified oil: IMMOIL-F30CC*

# M Plan Apochromat

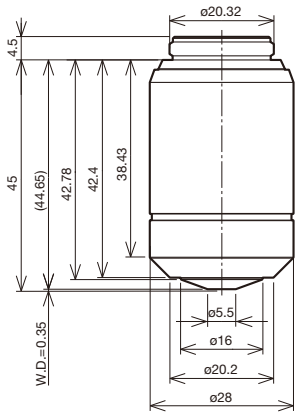
## MPLAPON series

This series of Plan Apochromat objectives corrects chromatic aberrations at optimal levels. Olympus guarantees* the optical performance (correction for wavefront aberration) with a Strehl ratio** of 95% or better. These objectives can be used with Olympus' U-AFA2M active auto focus unit.

### MPLAPON50X




### MPLAPON100X




** Measurement guarantee assessed with an Olympus interferometer for transmitted wavefront measurement under the following conditions: a temperature of 23 °C + 1 °C; measurements made within the 97% range of the pupil diameter.*

*** Strehl ratio: Indicates in percent (%) the ratio of the proportion of light that an actual optical system can concentrate with respect to the proportion of light concentrated in the image plane (central intensity) by an ideal, aberration-free optical system, with the latter serving as 100%. A higher percentage indicates a higher quality optical system.*

Unit: mm

| UIS2 Objectives | | | | | Widefield Eyepiece WHN10X FN 22 | | | Super Widefield Eyepiece SWH10X FN 26.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Objective (magnification) | NA | W.D. (mm) | Focal Distance f (mm) | Weight (g) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) |
| MPLAPON50X | 0.95 | 0.35 | 3.6 | 139 | 500 | 0.44 | 1 | 500 | 0.53 | 1 |
| MPLAPON100X | 0.95 | 0.35 | 1.8 | 125 | 1000 | 0.22 | 0.67 | 1000 | 0.27 | 0.67 |

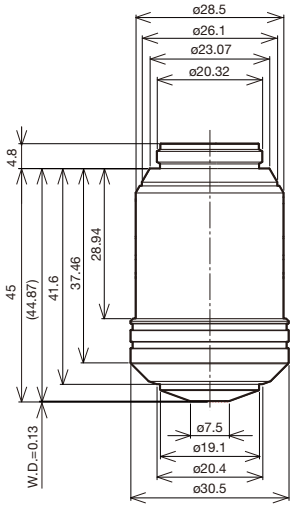
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)

# M Plan Apochromat

## MPLAPON100XO2

This Plan Apochromat objective is designed for oil immersion*** and features a numerical aperture of 1.45. The objective provides excellent chromatic aberration correction and high resolving power.

### MPLAPON100XO2




**** Specified Oil: IMMOIL-F30CC*

Unit: mm

| UIS2 Objectives | | | | | Widefield Eyepiece WHN10X FN 22 | | | Super Widefield Eyepiece SWH10X FN 26.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Objective (magnification) | NA | W.D. (mm) | Focal Distance f (mm) | Weight (g) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) |
| MPLAPON100XO | 1.45 | 0.13 | 1.8 | 163 | 1000 | 0.22 | 0.34 | 1000 | 0.27 | 0.34 |

Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)

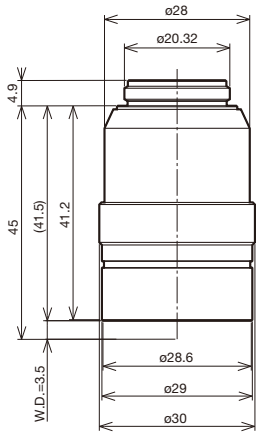
# M Plan Semi Apochromat

## MPLFLN series

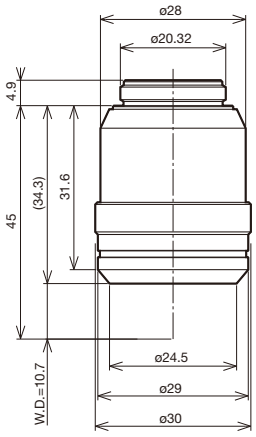
UIS2 World-leading optics

This series of Plan Semi Apochromat objectives delivers high-level correction for chromatic aberration. The eight objectives in this series offer magnifications ranging from 1.25X to 100X and a minimum working distance of 1 mm (except 40X). Since the exit pupil position of the 5X–100X objectives is standardized, the position of the DIC prism does not have to be switched when changing the magnification (40X is not applicable to DIC observation). For very low magnifications (1.25X, 2.5X), use the objectives with an analyzer, polarizer, and reflected light illuminator.

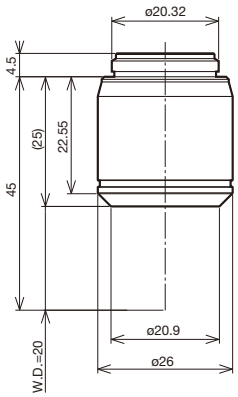
### MPLFLN1.25X



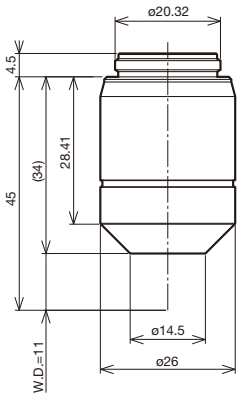

### MPLFLN2.5X



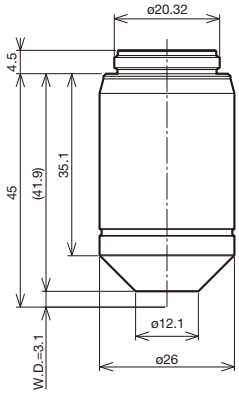

### MPLFLN5X



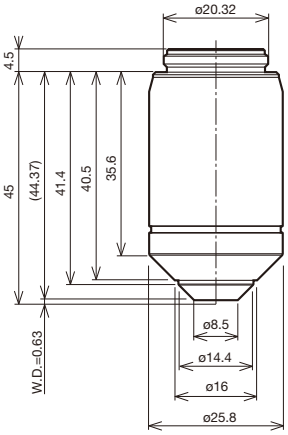

### MPLFLN10X



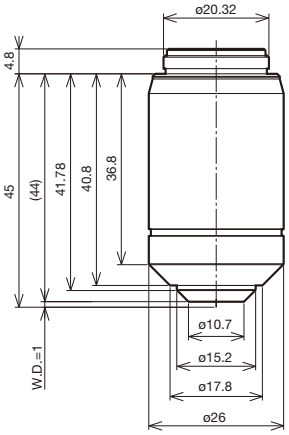

### MPLFLN20X



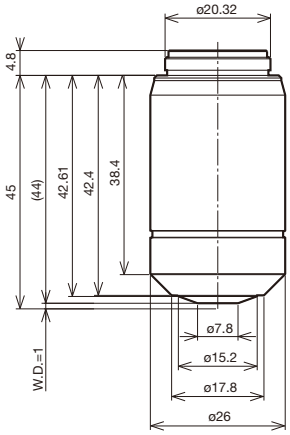

### MPLFLN40X




### MPLFLN50X




### MPLFLN100X




Unit: mm

| UIS2 Objectives | | | | | Widefield Eyepiece WHN10X FN 22 | | | Super Widefield Eyepiece SWH10X FN 26.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Objective (magnification) | NA | W.D. (mm) | Focal Distance f (mm) | Weight (g) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) |
| MPLFLN1.25X | 0.04 | 3.5 | 145 | 122 | 12.5 | 17.6 | 870 | — | — | — |
| MPLFLN2.5X | 0.08 | 10.7 | 72 | 106 | 25 | 8.8 | 220 | 25 | 10.6 | 220 |
| MPLFLN5X | 0.15 | 20 | 36 | 51.5 | 50 | 4.4 | 59 | 50 | 5.3 | 59 |
| MPLFLN10X | 0.3 | 11 | 18 | 68.1 | 100 | 2.2 | 15 | 100 | 2.7 | 15 |
| MPLFLN20X | 0.45 | 3.1 | 9 | 70.4 | 200 | 1.1 | 5.2 | 200 | 1.3 | 5.1 |
| MPLFLN40X | 0.75 | 0.63 | 4.5 | 120 | 400 | 0.55 | 1.66 | 400 | 0.66 | 1.66 |
| MPLFLN50X | 0.8 | 1 | 3.6 | 89.9 | 500 | 0.44 | 1.3 | 500 | 0.53 | 1.3 |
| MPLFLN100X | 0.9 | 1 | 1.8 | 90.9 | 1000 | 0.22 | 0.73 | 1000 | 0.27 | 0.73 |

Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)

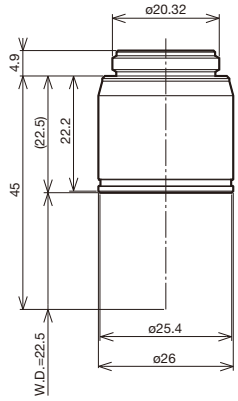
# Long Working Distance M Plan Semi Apochromat

## LMPLFLN series

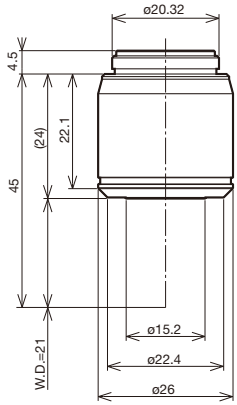
UIS2 World-leading optics

This series of long working distance Plan Semi Apochromat objectives delivers high-level correction for chromatic aberration. Because of the long working distance, these objectives are suitable for observing larger samples. Since the exit pupil position of the 5X–100X objectives is standardized, the position of the DIC prism does not have to be switched when changing the magnification.

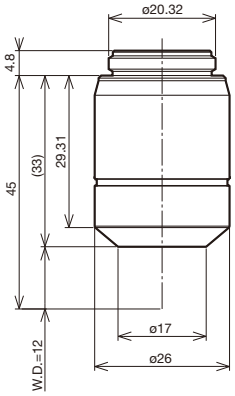
### LMPLFLN5X



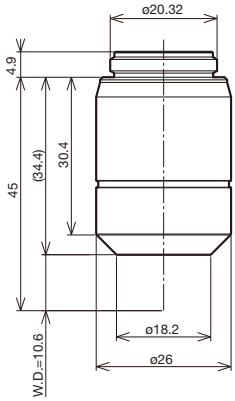

### LMPLFLN10X



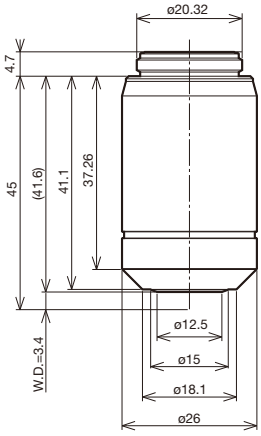

### LMPLFLN20X




### LMPLFLN50X




### LMPLFLN100X




Unit: mm

| UIS2 Objectives | | | | | Widefield Eyepiece WHN10X FN 22 | | | Super Widefield Eyepiece SWH10X FN 26.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Objective (magnification) | NA | W.D. (mm) | Focal Distance f (mm) | Weight (g) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) |
| LMPLFLN5X | 0.13 | 22.5 | 36 | 50 | 50 | 4.4 | 70 | 50 | 5.3 | 70 |
| LMPLFLN10X | 0.25 | 21 | 18 | 54 | 100 | 2.2 | 18 | 100 | 2.7 | 18 |
| LMPLFLN20X | 0.4 | 12 | 9 | 73 | 200 | 1.1 | 6.1 | 200 | 1.3 | 6.1 |
| LMPLFLN50X | 0.5 | 10.6 | 3.6 | 77 | 500 | 0.44 | 2.5 | 500 | 0.53 | 2.5 |
| LMPLFLN100X | 0.8 | 3.4 | 1.8 | 94 | 1000 | 0.22 | 0.87 | 1000 | 0.27 | 0.87 |

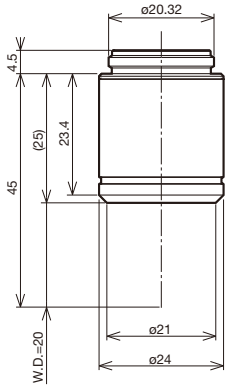
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)

# M Plan Achromat

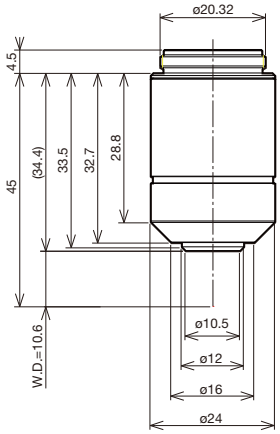
## MPLN series

Plan Achromat objectives provide excellent image flatness up to FN 22.

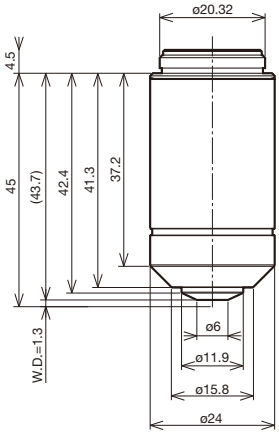
### MPLN5X



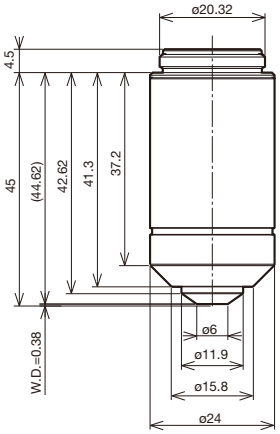

### MPLN10X



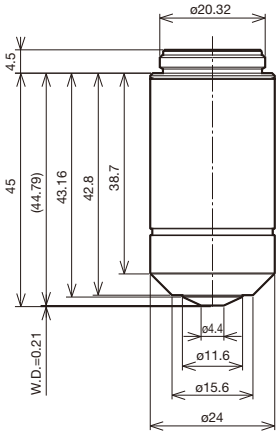

### MPLN20X




### MPLN50X




### MPLN100X




Unit: mm

| UIS2 Objectives | | | | | Widefield Eyepiece WHN10X FN 22 | | |
|---|---|---|---|---|---|---|---|
| Objective (magnification) | NA | W.D. (mm) | Focal Distance f (mm) | Weight (g) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) |
| MPLN5X | 0.1 | 20 | 36 | 64 | 50 | 4.4 | 98 |
| MPLN10X | 0.25 | 10.6 | 18 | 80 | 100 | 2.2 | 18 |
| MPLN20X | 0.4 | 1.3 | 9 | 111 | 200 | 1.1 | 6.1 |
| MPLN50X | 0.75 | 0.38 | 3.6 | 13 | 500 | 0.44 | 1.4 |
| MPLN100X | 0.9 | 0.21 | 1.8 | 116 | 1000 | 0.22 | 0.73 |

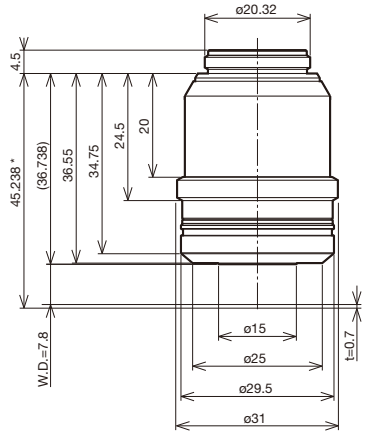
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)

# LCD Long Working Distance M Plan Semi Apochromat

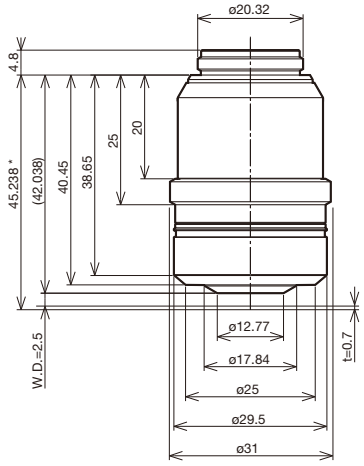
## LCPLFLN-LCD series

These objectives are designed for making observations through LCD panels and other samples that have a glass substrate. The correction collar provides aberration correction that can be matched to the thickness of the glass.

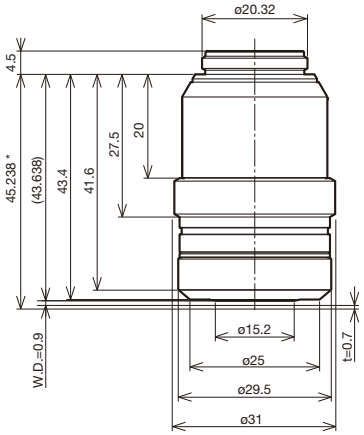
### LCPLFLN20XLCD




### LCPLFLN50XLCD




### LCPLFLN100XLCD




*Typical value when cover glass thickness is 0.7 mm.

Unit: mm

| Objective | LCPLFLN20XLCD | | | LCPLFLN50XLCD | | | LCPLFLN100XLCD | | |
|---|---|---|---|---|---|---|---|---|---|
| Corresponding Glass Thickness (mm) | 0–1.2 | | | 0–1.2 | | | 0–0.7 | | |
| Correction Collar Indication | 0 | 0.7 | 1.2 | 0 | 0.7 | 1.2 | 0 | 0.5 | 0.7 |
| W.D. (mm) | 8.3 | 7.8 | 7.4 | 3 | 2.5 | 2.2 | 1.2 | 0.98 | 0.9 |
| Correction System | Correction Collar | | | Correction Collar | | | Correction Collar | | |

| UIS2 Objectives | | | | | Widefield Eyepiece WHN10X FN 22 | | | Super Widefield Eyepiece SWH10X FN 26.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Objective (magnification) | NA | W.D.** (mm) | Focal Distance f (mm) | Weight (g) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) |
| LCPLFLN20XLCD | 0.45 | 7.8 | 9 | 146 | 200 | 1.1 | 5.2 | 200 | 1.3 | 5.2 |
| LCPLFLN50XLCD | 0.7 | 2.5 | 3.6 | 170 | 500 | 0.44 | 1.6 | 500 | 0.53 | 1.6 |
| LCPLFLN100XLCD | 0.85 | 0.9 | 1.8 | 185 | 1000 | 0.22 | 0.79 | 1000 | 0.27 | 0.79 |

Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
**Value when the correction collar indication is 0.7.

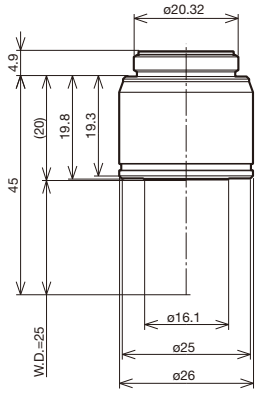
# Super Long Working Distance M Plan Achromat

## SLMPLN series

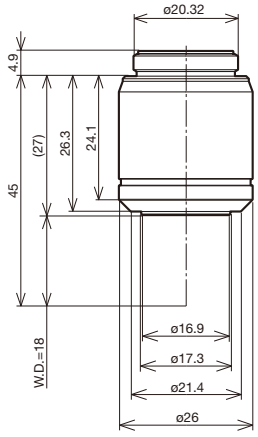
UIS2 World-leading optics

These are high-magnification Plan Achromat objectives with a super long working distance. Three magnifications, 20X, 50X, and 100X, are available. For 5X or 10X objectives, select from the LMPLFLN series.

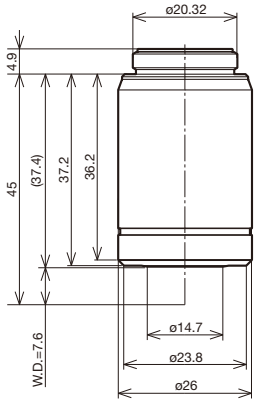
### SLMPLN20X




### SLMPLN50X




### SLMPLN100X




Unit: mm

| UIS2 Objectives | | | | | Widefield Eyepiece WHN10X FN 22 | | | Super Widefield Eyepiece SWH10X FN 26.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Objective (magnification) | NA | W.D. (mm) | Focal Distance f (mm) | Weight (g) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) |
| SLMPLN20X | 0.25 | 25 | 9 | 56 | 200 | 1.1 | 11.4 | 200 | 1.3 | 11.4 |
| SLMPLN50X | 0.35 | 18 | 3.6 | 74 | 500 | 0.44 | 4.2 | 500 | 0.53 | 4.2 |
| SLMPLN100X | 0.6 | 7.6 | 1.8 | 100 | 1000 | 0.22 | 1.3 | 1000 | 0.27 | 1.3 |

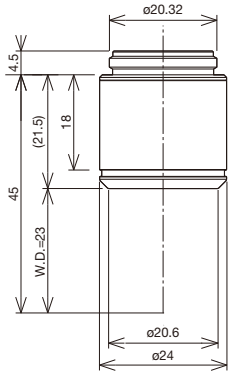
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)

# IR Long Working Distance M Plan Achromat

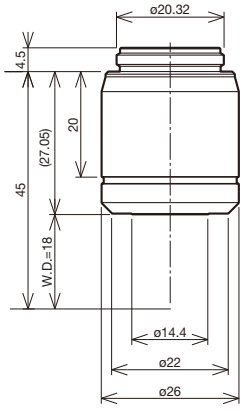
## LMPLN-IR series

This series is designed for near-infrared microscopy, which is typically used to view the internal structure of silicon wafers.

### LMPLN5XIR




### LMPLN10XIR




Unit: mm

| UIS2 Objectives | | | | |
|---|---|---|---|---|
| Objective (magnification) | NA | W.D. (mm) | Focal Distance f (mm) | Weight (g) |
| LMPLN5XIR | 0.1 | 23 | 36 | 55 |
| LMPLN10XIR | 0.3 | 18 | 18 | 78 |

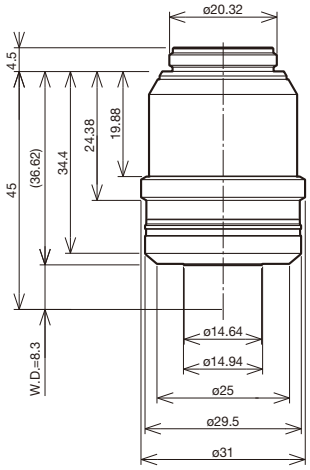
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)

# IR M Plan Achromat

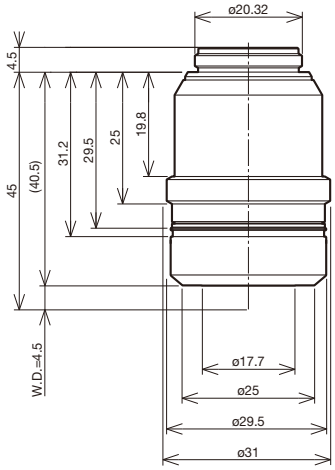
## LCPLN-IR series

This series is designed for near-infrared microscopy, which is typically used to view the internal structure of silicon wafers. These objectives have a correction collar to correct for aberrations based on the thickness of the silicon or glass substrate.

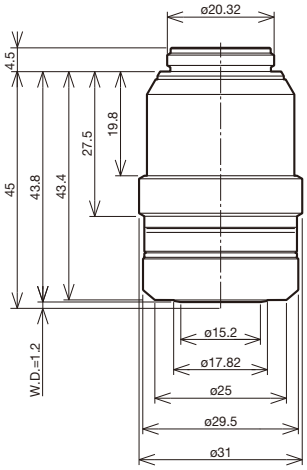
### LCPLN20XIR




### LCPLN50XIR




### LCPLN100XIR




Unit: mm

**Silicon thickness correction**

| Objective | LCPLN20XIR | | | LCPLN50XIR | | | LCPLN100XIR | | |
|---|---|---|---|---|---|---|---|---|---|
| Corresponding Silicon Thickness (mm) | 0–1.2 | | | 0–1.2 | | | 0–1.0 | | |
| Correction Collar Indication | 0 | 0.7 | 1.2 | 0 | 0.6 | 1.2 | 0 | 0.5 | 1 |
| W.D.* (mm) | 8.3 | 8.2 | 8 | 4.5 | 4.3 | 4.1 | 1.2 | 1.1 | 1 |
| Correction System | Correction Collar | | | Correction Collar | | | Correction Collar | | |

*Using a 1100 nm laser.

**Silicon thickness correction**

| Objective | LCPLN20XLCD | | | LCPLN50XLCD | | LCPLN100XLCD | |
|---|---|---|---|---|---|---|---|
| Corresponding Glass Thickness (mm) | 0–1.2 | | | 0–1.2 | | 0–0.7 | |
| Correction Collar Indication | 0 | 0.7 | 1.2 | 0 | 1.2 | 0 | 0.7 |
| W.D.* (mm) | 8.3 | 7.9 | 7.6 | 4.5 | 3.7 | 1.2 | 0.9 |
| Correction System | Correction Collar | | | Correction Collar | | Correction Collar | |

*Using a 1064 nm laser.

| UIS2 Objectives | | | | |
|---|---|---|---|---|
| Objective (magnification) | NA* | W.D.* (mm) | Focal Distance f (mm) | Weight (g) |
| LCPLN20XIR | 0.45 | 8.3 | 9 | 149 |
| LCPLN50XIR | 0.65 | 4.5 | 3.6 | 169 |
| LCPLN100XIR | 0.85 | 1.2 | 1.8 | 184 |

Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Value when the correction collar indication is 0.

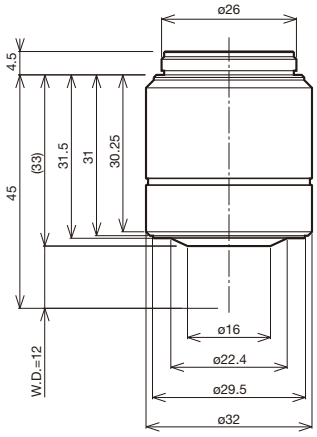
# M Plan Semi Apochromat BD

(BD: Brightfield/Darkfield)

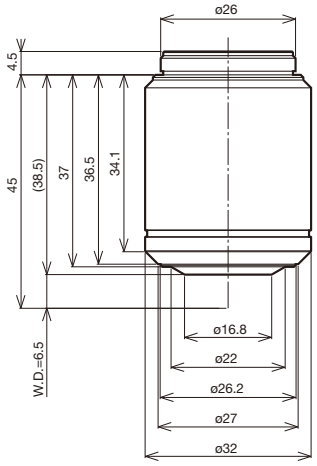
## MPLFLN-BD series

This series of Plan Semi Apochromat objectives provides high-level correction for chromatic aberration with a minimum working distance of 1 mm. Since the exit pupil position of the 5X–150X objectives is standardized, the position of the DIC prism does not have to be switched when changing the magnification.

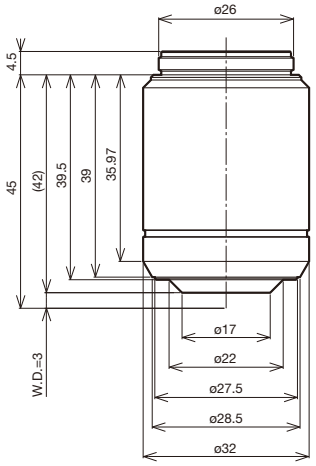
### MPLFLN5XBD



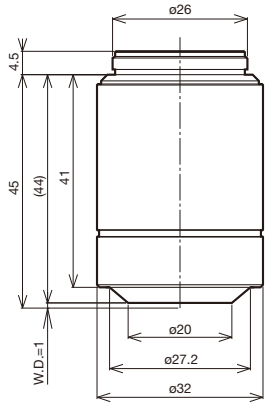

### MPLFLN10XBD



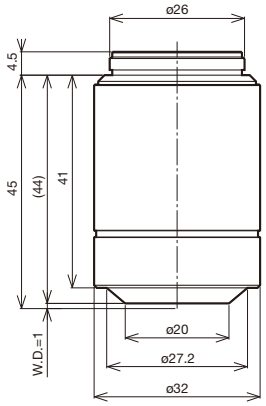

### MPLFLN20XBD



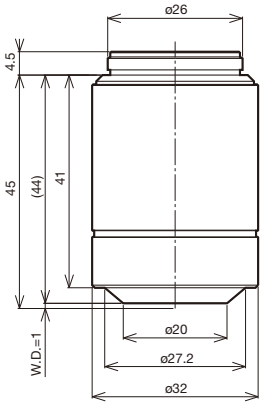

### MPLFLN50XBD




### MPLFLN100XBD




### MPLFLN150XBD




Unit: mm

| UIS2 Objectives | | | | | Widefield Eyepiece WHN10X FN 22 | | | Super Widefield Eyepiece SWH10X FN 26.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Objective (magnification) | NA | W.D. (mm) | Focal Distance f (mm) | Weight (g) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) |
| MPLFLN5XBD | 0.15 | 12 | 36 | 95.5 | 50 | 4.4 | 59 | 50 | 5.3 | 59 |
| MPLFLN10XBD | 0.3 | 6.5 | 18 | 82.8 | 100 | 2.2 | 15 | 100 | 2.7 | 15 |
| MPLFLN20XBD | 0.45 | 3 | 9 | 87.7 | 200 | 1.1 | 5.2 | 200 | 1.3 | 5.2 |
| MPLFLN50XBD | 0.8 | 1 | 3.6 | 99.8 | 500 | 0.44 | 1.3 | 500 | 0.53 | 1.3 |
| MPLFLN100XBD | 0.9 | 1 | 1.8 | 98.9 | 1000 | 0.22 | 0.73 | 1000 | 0.27 | 0.73 |
| MPLFLN150XBD | 0.9 | 1 | 1.2 | 104.8 | 1500 | 0.15 | 0.6 | 1500 | 0.18 | 0.6 |

Screw: W 26 mm × 0.706 mm (1 in. × 0.03 in.)

# M Plan Semi Apochromat BDP

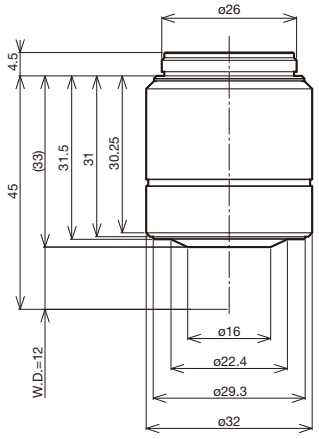
BDP: Brightfield/Darkfield/Polarized

## MPLFLN-BDP series

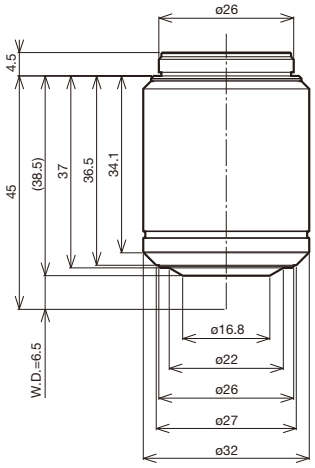
UIS2 World-leading optics

This series of Plan Semi Apochromat objectives provides high-level correction for chromatic aberrations with a minimum working distance of 1 mm. Since the exit pupil position of the 5X–100X objectives is standardized, the position of the DIC prism does not have to be switched when changing the magnification. This series is optimized for brightfield, darkfield, and polarized light observations and can be used with differential interference contrast.

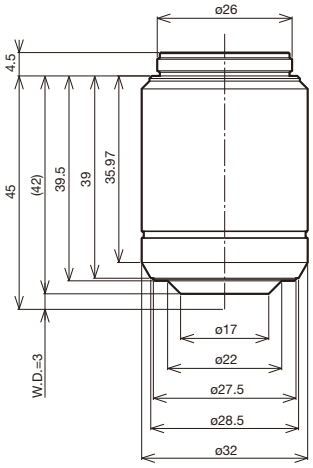
### MPLFLN5XBDP



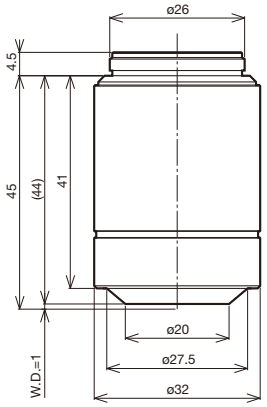

### MPLFLN10XBDP



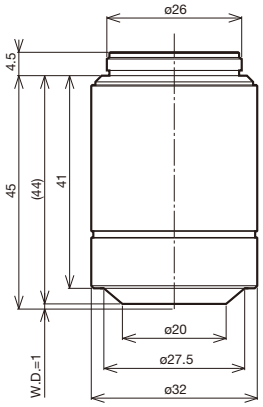

### MPLFLN20XBDP




### MPLFLN50XBDP




### MPLFLN100XBDP




Unit: mm

| UIS2 Objectives | | | | | Widefield Eyepiece WHN10X FN 22 | | | Super Widefield Eyepiece SWH10X FN 26.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Objective (magnification) | NA | W.D. (mm) | Focal Distance f (mm) | Weight (g) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) |
| MPLFLN5XBDP | 0.15 | 12 | 36 | 95.5 | 50 | 4.4 | 59 | 50 | 5.3 | 59 |
| MPLFLN10XBDP | 0.25 | 6.5 | 18 | 83.3 | 100 | 2.2 | 18 | 100 | 2.7 | 18 |
| MPLFLN20XBDP | 0.4 | 3 | 9 | 88.5 | 200 | 1.1 | 6.1 | 200 | 1.3 | 6.1 |
| MPLFLN50XBDP | 0.75 | 1 | 3.6 | 100.5 | 500 | 0.44 | 1.4 | 500 | 0.53 | 1.4 |
| MPLFLN100XBDP | 0.9 | 1 | 1.8 | 101.5 | 1000 | 0.22 | 0.73 | 1000 | 0.27 | 0.73 |

Screw: W 26 mm × 0.706 mm (1 in. × 0.03 in.)

# Long Working Distance M Plan Semi Apochromat BD

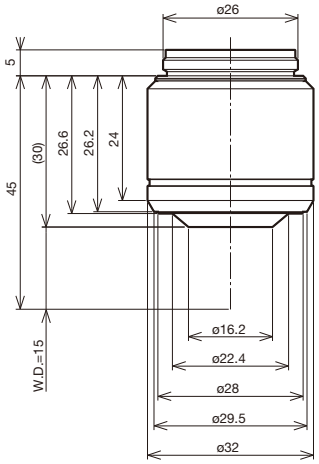
(BD: Brightfield/Darkfield)

## LMPLFLN-BD series

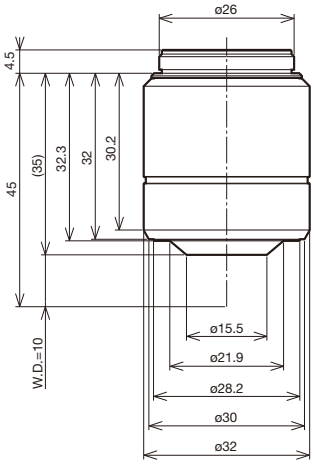
UIS2 World-leading optics

This series of long working distance Plan Semi Apochromat objectives provides high-level correction for chromatic aberration and are suitable for observing larger samples. Since the exit pupil position of the 5X–100X objectives is standardized, the position of the DIC prism does not have to be switched when changing the magnification.

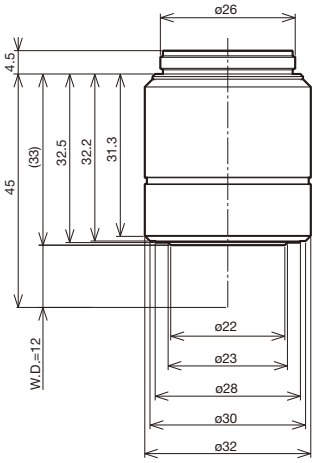
### LMPLFLN5XBD



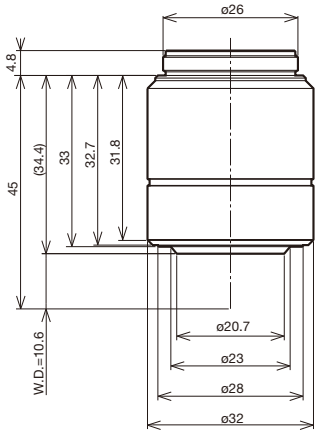

### LMPLFLN10XBD



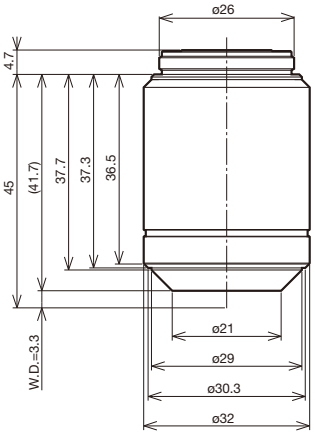

### LMPLFLN20XBD




### LMPLFLN50XBD




### LMPLFLN100XBD




Unit: mm

| UIS2 Objectives | | | | | Widefield Eyepiece WHN10X FN 22 | | | Super Widefield Eyepiece SWH10X FN 26.5 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Objective (magnification) | NA | W.D. (mm) | Focal Distance f (mm) | Weight (g) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) | Total Magnification | Practical Field of View (mm) | Depth of Focus (µm) |
| LMPLFLN5XBD | 0.13 | 15 | 36 | 81 | 50 | 4.4 | 70 | 50 | 5.3 | 70 |
| LMPLFLN10XBD | 0.25 | 10 | 18 | 84 | 100 | 2.2 | 18 | 100 | 2.7 | 18 |
| LMPLFLN20XBD | 0.4 | 12 | 9 | 86 | 200 | 1.1 | 6.1 | 200 | 1.3 | 6.1 |
| LMPLFLN50XBD | 0.5 | 10.6 | 3.6 | 85 | 500 | 0.44 | 2.5 | 500 | 0.53 | 2.5 |
| LMPLFLN100XBD | 0.8 | 3.3 | 1.8 | 102 | 1000 | 0.22 | 0.87 | 1000 | 0.27 | 0.87 |

Screw: W 26 mm × 0.706 mm (1 in. × 0.03 in.)

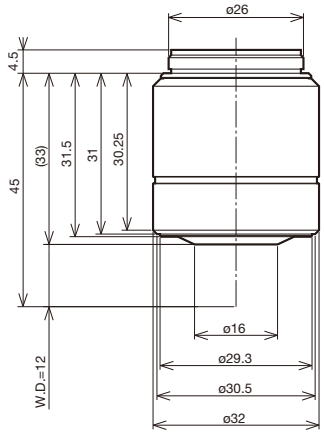
# M Plan Achromat BD

(BD: Brightfield/Darkfield)

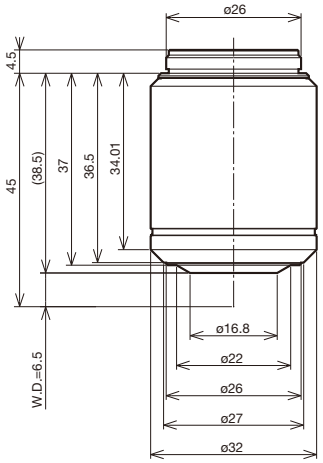
## MPLN-BD series

This series of Plan Achromat objectives provides excellent image flatness up to FN 22.

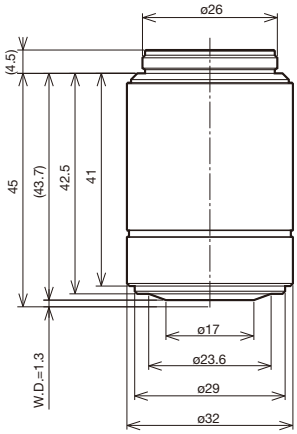
### MPLN5XBD



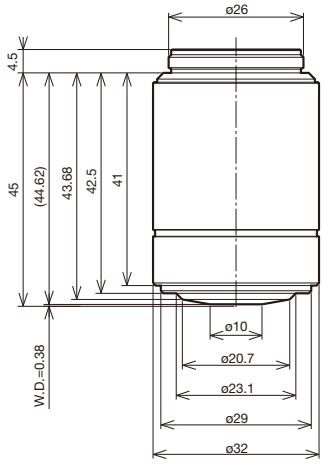

### MPLN10XBD



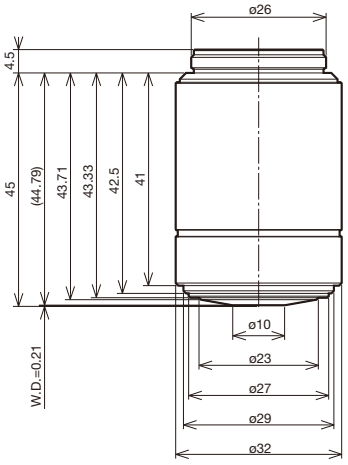

### MPLN20XBD




### MPLN50XBD




### MPLN100XBD




Unit: mm

| UIS2 Objectives | | | | | Widefield Eyepiece WHN10X FN 22 | | |
|---|---|---|---|---|---|---|---|
| Objective (magnification) | NA | W.D. (mm) | Focal Distance f (mm) | Weight (g) | Total Magnifications | Practical Field of View (mm) | Depth of Focus (µm) |
| MPLN5XBD | 0.1 | 12 | 36 | 137 | 50 | 4.4 | 98 |
| MPLN10XBD | 0.25 | 6.5 | 18 | 155 | 100 | 2.2 | 18 |
| MPLN20XBD | 0.4 | 1.3 | 9 | 162 | 200 | 1.1 | 6.1 |
| MPLN50XBD | 0.75 | 0.38 | 3.6 | 157 | 500 | 0.44 | 1.4 |
| MPLN100XBD | 0.9 | 0.21 | 1.8 | 160 | 1000 | 0.22 | 0.73 |

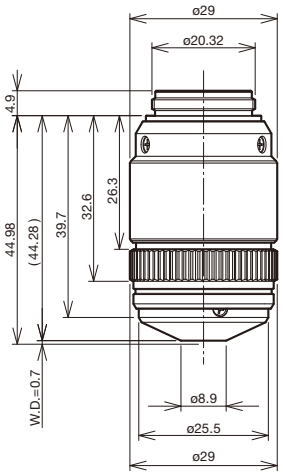
Screw: W 26 mm × 0.706 mm (1 in. × 0.03 in.)

# White Light Interferometry Objective

## WLI100XMRTC

This objective is designed to be used with Mirau-style white light interferometers and tolerates high temperatures. The objective has a working distance of 0.7 mm and an optimized NA of 0.8 that provides improved light gathering.

### WLI100XMRTC




unit: mm

| Objective (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| WLI100XMRTC | 0.8 | 0.7 | 0 | — | — | — | 22.0 |

Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)

# UIS2 Objectives (for Life Science Applications)

UIS2 World-leading optics

## Definition for Objective Abbreviations

**U PL (Plan) FL N 60X OI PH**

**U:** Universal objectives for fluorescence (U/BG) and DIC
**L:** Long working distance
**C:** Tissue culture observations through bottles and dishes
**M:** For no cover observation
***XL:** Extra large; parfocal length exceeds 45 mm (e.g. XLUMPLFL20XW 75 mm)

**PL (or PLN):** Plan: Corrects field curvature of the periphery on the image plane
**None:** Non-Plan

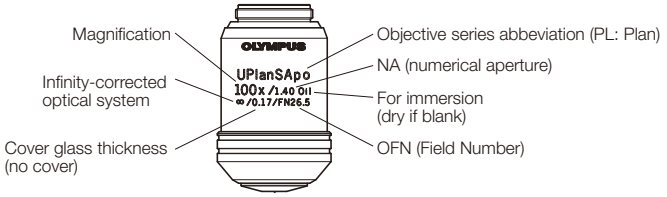
**ACHN:** Achromat/ Effectively corrects chromatic aberration at 486 nm and 656 nm wavelengths
**FLN:** SemiApochromat/ Corrects chromatic aberration that is in the middle of apochromat and achromat
**APON:** Apochromat/ Effectively corrects chromatic aberration in the entire visible range (435-656 nm)
**SAPO:** Super Apochromat/ Effectively corrects chromatic aberration in the visible to near infrared range (435-1000 nm)
**XAPO:** Extended Apochromat/ Effectively corrects chromatic aberration in the visible to infrared range (400 to 1000 nm)

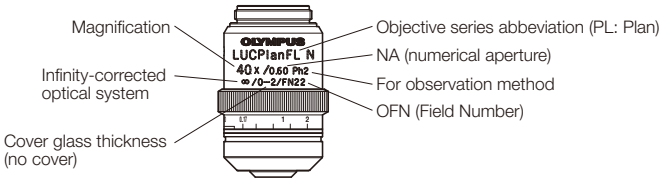
**Number:** Objective magnification

**None:** Dry
**O:** Oil immersion
**W:** Water immersion
**S:** Silicone immersion
**OI:** Oil immersion with iris

**None:** Brightfield
**P:** Polarizing
**PH:** Phase contrast
**PHP:** Pre-centered phase contrast
**RC:** Relief contrast
**CY:** Equiped with ND filter
**340 :** High-transmission at 340 nm wave length

## Objective Notation




## Objective series List

Objective series for standard biological samples

| Series | Magnification | BF | DF | DIC* | POL | FL | OFN (Field Number) | Remarks |
|---|---|---|---|---|---|---|---|---|
| UPLXAPO | 4X/10X/20X/40X/40XO/60XO/100XO | ○ | 10X/20X | ○ (except 4X) | ○ | ○ | 26.5 | |
| UPLSAPO | 4X/10X/20X/20XO/40X/60XO/60XW/100XO | ○ | 10X/20X/20XO | ○ (except 4X) | ○ | ○ | 26.5 | |
| PLAPON | 1.25X/2X | ○ | | | | | 26.5 | |
| UPLFLN | 4X/10X/20X/40X/40XO/60X/60XOI/100XO/100XOI | ○ | 10X/20X/40X/60XOI/100XOI | ○ (except 4X) | ○ | ○ | 26.5 | |
| PLFLN | 100X | ○ | | | | ○ | 26.5 | |
| PLN | 2X/4X/10X/20X/40X/50XOI/100XO | ○ | 10X/20X/40X/50XOI | 10X/20X/40X/50XOI | | ○ | 22 | |
| UPLFLN-PH | 4XPH/10XPH/20XPH/40XPH/60XOIPH/100XOPH | ○ | 10XPH/20XPH/40XPH/60XOIPH | | | ○ | 26.5 | |
| PLN-PH | 10XPH/20XPH/40XPH/100XOPH | ○ | ○ (excpet 100XOPH) | | | | 22 | |
| UPLFLN-P | 4XP/10XP/20XP/40XP/100XOP | ○ | 10XP/20XP/40XP | ○ (except 4XP) | ○ | ○ | 26.5 | |
| PLN-P/ACHN-P | 4XP/10XP/20XP/40XP/100XOP | ○ | 10XP/20XP/40XP | | ○ | ○ | 22 | |
| PLN-CY | 10XCY | ○ | | | | | 22 | |

*These objectives are suitable for standard biological samples embeded on a glass slide with a 0.17 mm cover slip and are mainly used with upright microscopes.

Objective series for cultured samples

| Series | Magnification | BF | DF | DIC | POL | FL | OFN (Field Number) | Remarks |
|---|---|---|---|---|---|---|---|---|
| LUCPLFLN | 20X/40X/60X | ○ | ○ | ○ | ○ | ○ | 22 | |
| LUCPLFLN-RC/ UCPLFLN-RC | 10XRC/20XRC/40XRC | ○ | ○ | | | ○ | 22 | |
| LUCPLFLN-PH/ UCPLFLN-PH | 10XPH/20XPH/40XPH/60XPH | ○ | ○ | | | ○ | 22 | |
| CPLN-PH/ LCACHN-PH | 10XPH/20XPH/40XPH | ○ | ○ | | | | 22 | |
| CPLN-RC/ LCACHN-RC | 10XRC/20XRC/40XRC | ○ | ○ | | | | 22 | |

These objectives are suitable for cultured tissue/cell observation in a dish, bottle, or micro plate and are mainly used with inverted microscopes.

Objective series for special applications

| Series | Magnification | BF | DF | DIC | POL | FL | OFN (Field Number) | Remarks |
|---|---|---|---|---|---|---|---|---|
| LUMPLFLN/ UMPLFLN | 10XW/20XW/40XW/60XW | ○ | 10XW/20XW | ○ | ○ | ○ | 26.5 | |
| XLUMPLFLN | 20XW | ○ | | ○ | | ○ | 22 | Perocal length 75 mm |
| APON 340 | 20XW/40XO/40XW | ○ | 20XW/40XW | ○ | ○ | ○ | 22 | |

## Features of Each Objective Series (please refer to the following pages for details on each objective.)


- UPLXAPO: Extended Apochromat — p. 3-16
- UPLSAPO: Universal Plan Super Apochromat — p. 3-17
- PLAPON: Plan Apochromat — p. 3-18
- UPLFLN: Universal Plan Semi Apochromat/Plan Semi Apochromat — p. 3-19
- PLN: Plan Achromat — p. 3-21
- UPLFLN-PH UPlanFl-P Universal Plan Semi Apochromat for Phase Contrast — p. 3-23
- PLN-PH: Plan Achromat for Phase Contrast — p. 3-24
- UPLFLN-P: UPlanFl-P Universal Plan Semi Apochromat for Polarizing. — p. 3-25
- PLN/ACHN-P: Achromat for Polarizing. — p. 3-26
- PLN-CY: Plan Achromat (ND) — p. 3-27
- LUCPLFLN, UCPLFLN: Long Working Distance Universal Plan Semi Apochromat — p. 3-28
- LUCPLFLN/UCPLFLN-RC: Long Working Distance Universal Plan Semi Apochromat for Relief Contrast — p. 3-29
- LUCPLFLN/UCPLFLN-PH: Long Working Distance Universal Plan Semi Apochromat for Phase Contrast — p. 3-30
- CPLN/LCACHN-PH: Culture Specimen Objectives for Phase Contrast — p. 3-31
- CPLN/LCACHN-RC: Culture Specimen Objectives for Relief Contrast — p. 3-32
- LUMPLFLN/UMPLFLN: No Cover Water Immersion for Fixed Stage Upright Microscope — p. 3-33
- XLUMPLFLN: No Cover Water Immersion for Fixed Stage Upright Microscope — p. 3-34
- APON 340: Universal Apochromat — p. 3-35

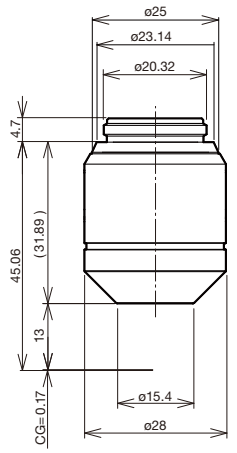
# Extended Apochromat Objectives

## UPLXAPO series

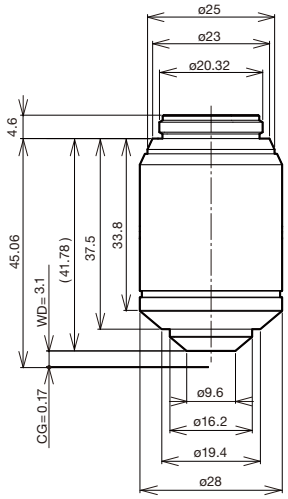
UIS2 World-leading optics

The UPLXAPO extended apochromat objectives have a high numerical aperture (NA), wide homogeneous image flatness, and an extended range of chromatic aberration compensation from 400 nm to 1000 nm. These features enable you to acquire high-resolution, bright images for a wide range of applications from brightfield/fluorescence microscopy to confocal /super resolution microscopy.

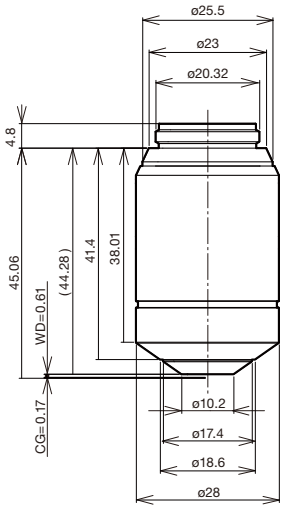
### UPLXAPO4X



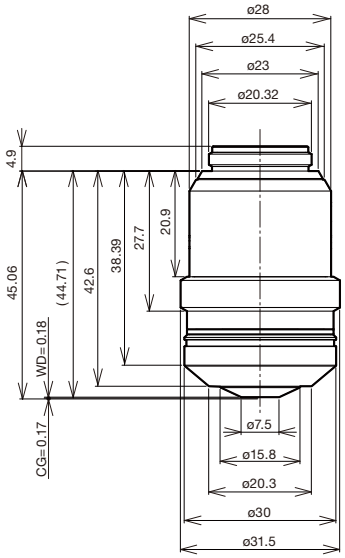

### UPLXAPO10X



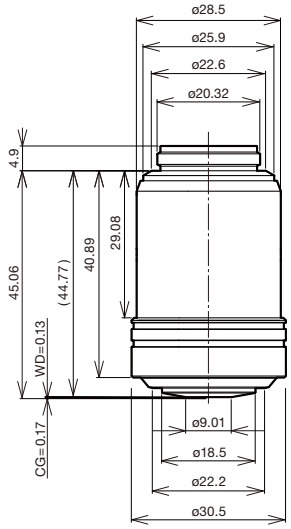

### UPLXAPO20X



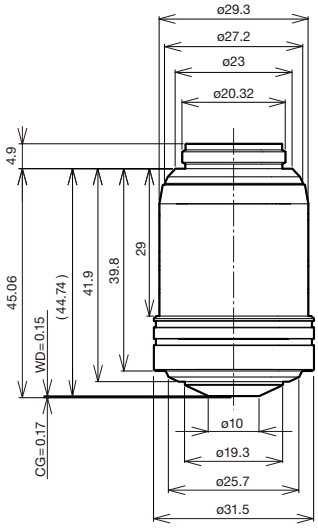

### UPLXAPO40X



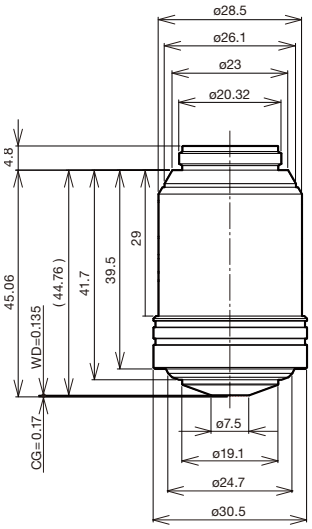

### UPLXAPO40XO




### UPLXAPO60XO




### UPLXAPO100XO




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| UPLXAPO4X | 0.16 | 13.0 | — | — | — | U/BG/IR | 26.5 |
| UPLXAPO10X | 0.40 | 3.1 | 0.17 | — | — | U/BG/IR | 26.5 |
| UPLSAPO20X | 0.8 | 0.6 | 0.17 | — | — | U/BG/IR | 26.5 |
| UPLXAPO40X | 0.95 | 0.18 | 0.11-0.23 | — | Yes | U/BG/IR | 26.5 |
| UPLXAPO40XO | 1.40 | 0.13 | 0.17 | Oil | Yes | U/BG/IR | 26.5 |
| UPLXAPO60XO | 1.42 | 0.15 | 0.17 | Oil | Yes | U/BG/IR | 26.5 |
| UPLXAPO100XO | 1.45 | 0.13 | 0.17 | Oil | Yes | U/BG/IR | 26.5 |

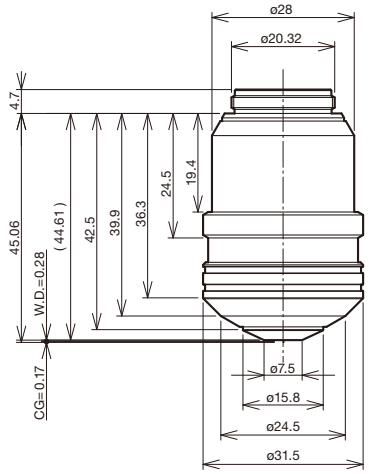
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.

# Universal Plan Super Apochromat

## UPLSAPO series

The UPLSAPO Super Apochromat objective fully compensate for both spherical and chromatic aberrations from the UV to the near-infrared region. This enables the acquisition of sharp, clear images without color shift in brightfield, Nomarski DIC, and fluorescence observations. For quality and performance, this objective series is a splendid solution for numerous digital imaging applications.

### UPLSAPO60XW




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| UPLSAPO60XW | 1.20 | 0.28 | 0.13-0.21 | Water | Yes | U/BG/IR | 26.5 |

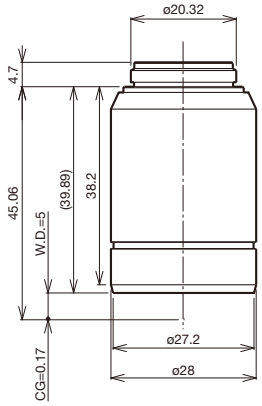
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.

# Plan Apochromat

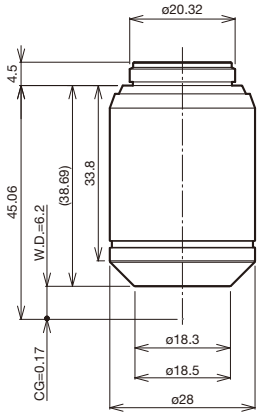
## PLAPON series

The PLAPON Apochromat objectives display flat images from violet to the near-infrared region of the spectrum. For quality and performance, this objective series is a splendid solution for numerous digital imaging applications.

### PLAPON1.25X




### PLAPON2X




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| PLAPON1.25X | 0.04 | 5.0 | — | — | — | (BG)(/IR) | 26.5 |
| PLAPON2X | 0.08 | 6.2 | — | — | — | (BG)(/IR) | 26.5 |

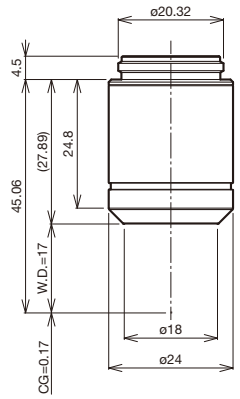
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.
***IR excitation might cause the objective to go slightly out of focus.

# Universal Plan Semi Apochromat/Plan Semi Apochromat

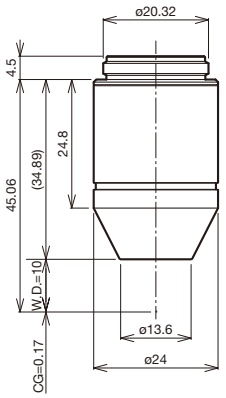
## UPLFLN, PLFLN series

The UPLFLN and PLFLN objectives display flat images from violet up to the near-infrared region of the spectrum. With their high signal-to-noise (S/N) ratio, high resolution, and splendid contrast, they are especially effective in brightfield and Nomarski DIC observations. For quality and performance, this objective series is a splendid solution for numerous digital imaging applications.

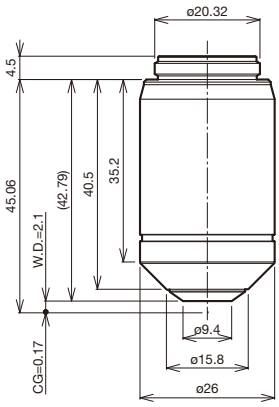
### UPLFLN4X



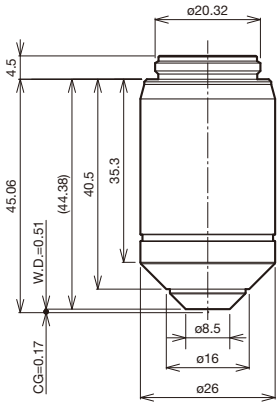

### UPLFLN10X2




### UPLFLN20X




### UPLFLN40X




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| UPLFLN4X | 0.13 | 17 | — | — | — | (U)(/BG)(/IR) | 26.5 |
| UPLFLN10X2 | 0.30 | 10 | — | — | — | U/BG/IR *** | 26.5 |
| UPLFLN20X | 0.50 | 2.1 | 0.17 | — | — | U/BG/IR *** | 26.5 |
| UPLFLN40X | 0.75 | 0.51 | 0.17 | — | Yes | U/BG/IR *** | 26.5 |

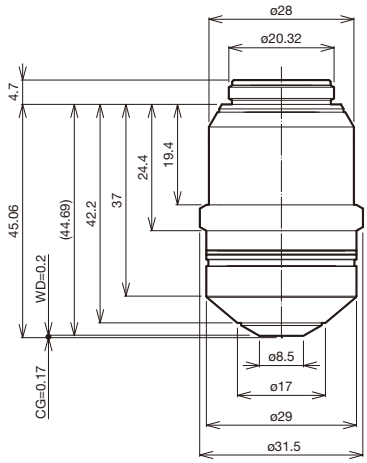
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.
***IR excitation might cause the objective to go slightly out of focus.

# Universal Plan Semi Apochromat/Plan Semi Apochromat

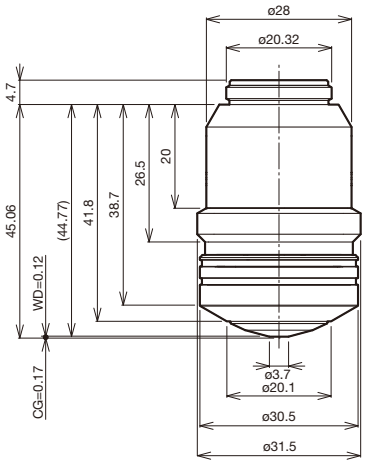
## UPLFLN, PLFLN series

The UPLFLN and PLFLN objectives display flat images from violet up to the near-infrared region of the spectrum. With their high S/N ratio, high resolution, and splendid contrast, they are especially effective in brightfield and Nomarski DIC observations. For quality and performance, this objective series is a splendid solution for numerous digital imaging applications.

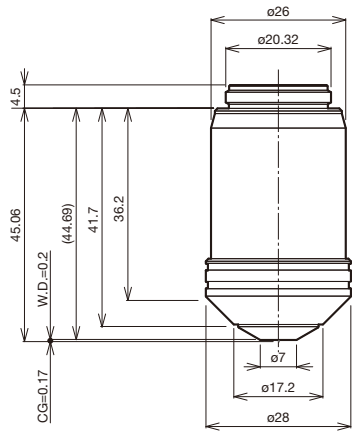
### UPLFLN60X



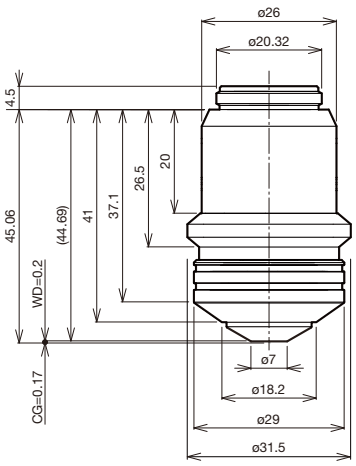

### UPLFLN60XOI



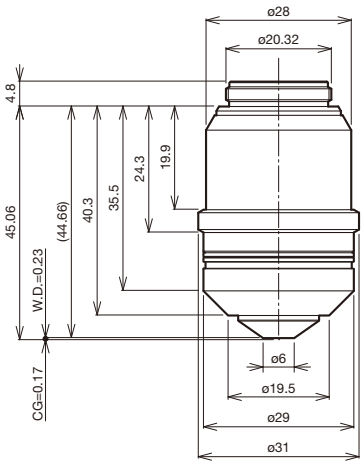

### UPLFLN100XO2




### UPLFLN100XOI2




### PLFLN100X




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| UPLFLN60X | 0.90 | 0.2 | 0.11–0.23 | — | Yes | U/BG/IR *** | 26.5 |
| UPLFLN60XOI | 1.25–0.65 | 0.12 | 0.17 | Oil | Yes | U/BG/IR *** | 26.5 |
| UPLFLN100XO2 | 1.30 | 0.2 | 0.17 | Oil | Yes | U/BG/IR *** | 26.5 |
| UPLFLN100XOI2 | 1.3–0.6 | 0.2 | 0.17 | Oil | Yes | U/BG/IR *** | 26.5 |
| PLFLN100X | 0.95 | 0.2 | 0.14–0.2 | — | Yes | BG | 26.5 |

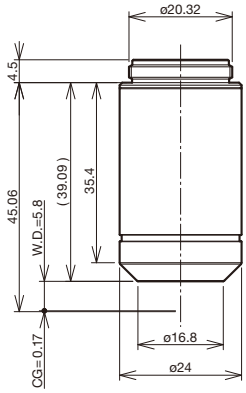
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.
***IR excitation might cause the objective to go slightly out of focus.

# Plan Achromat

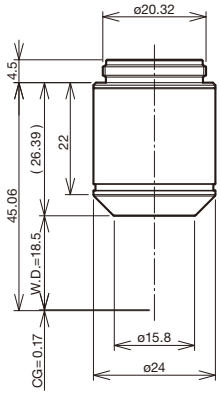
## PLN series

The PLN standard objectives provide excellent field flatness during fluorescence, darkfield, and brightfield observation in transmitted light. These objectives are well-suited to clinical laboratory and examination work.

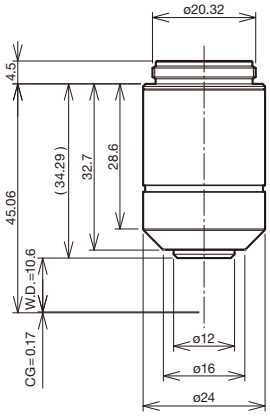
### PLN2X



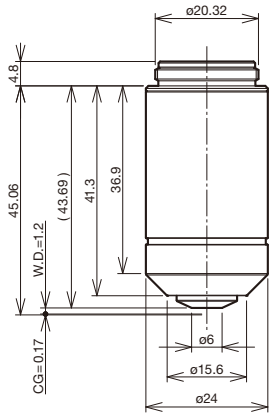

### PLN4X




### PLN10X




### PLN20X




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| PLN2X | 0.06 | 5.8 | — | — | — | (BG) | 22.0 |
| PLN4X | 0.10 | 18.5 | — | — | — | (BG) | 22.0 |
| PLN10X | 0.25 | 10.6 | — | — | — | (BG) | 22.0 |
| PLN20X | 0.40 | 1.2 | 0.17 | — | Yes | (BG) | 22.0 |

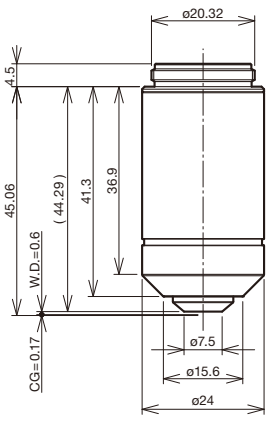
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.

# Plan Achromat

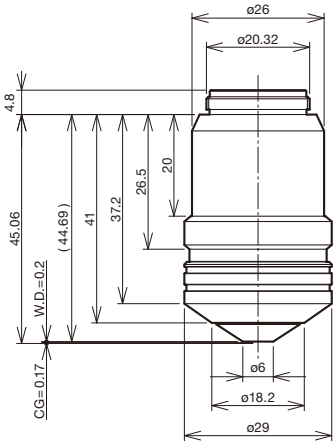
## PLN series

The PLN standard objectives provide excellent field flatness during fluorescence, darkfield, and brightfield observation in transmitted light. These objectives are well-suited to clinical laboratory and examination work.

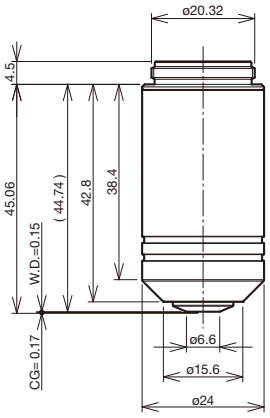
### PLN40X




### PLN50XOI




### PLN100XO




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| PLN40X | 0.65 | 0.6 | 0.17 | — | Yes | (BG) | 22.0 |
| PLN50XOI | 0.9–0.5 | 0.2 | — | Oil | Yes | (BG) | 22.0 |
| PLN100XO | 1.25 | 0.15 | — | Oil | Yes | (BG) | 22.0 |

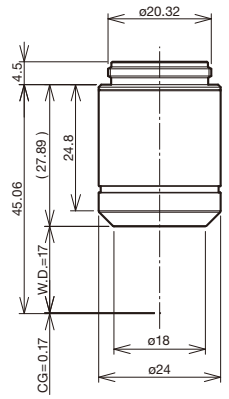
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.

# Universal Plan Semi Apochromat for Phase Contrast

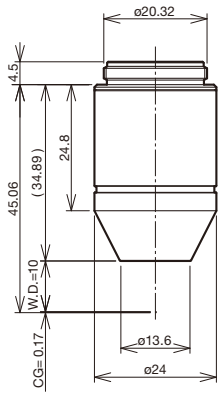
## UPLFLN-PH series

The UPLFLN-PH objectives are especially effective in phase contrast observations with their high S/N ratio, high resolution, and splendid contrast. These objectives display flat images from violet up to the near-infrared region of the spectrum.

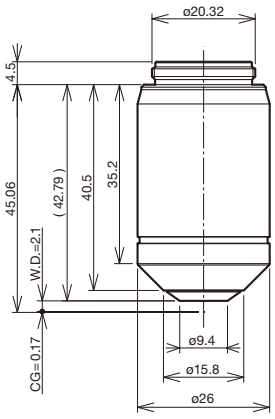
### UPLFLN4XPH



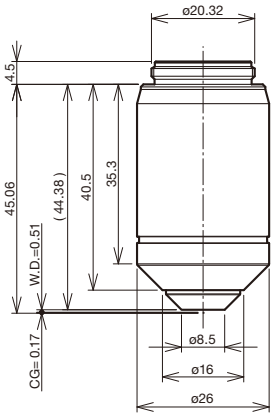

### UPLFLN10X2PH



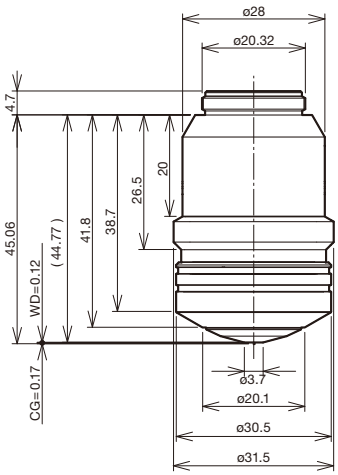

### UPLFLN20XPH



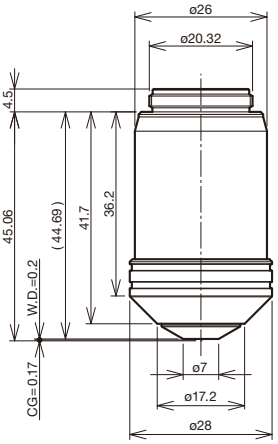

### UPLFLN40XPH




### UPLFLN60XOIPH




### UPLFLN100XO2PH




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| UPLFLN4XPH | 0.13 | 17 | — | — | — | U/BG/IR *** | 26.5 |
| UPLFLN10X2PH | 0.30 | 10 | — | — | — | U/BG/IR *** | 26.5 |
| UPLFLN20XPH | 0.50 | 2.1 | 0.17 | — | — | U/BG/IR *** | 26.5 |
| UPLFLN40XPH | 0.75 | 0.51 | 0.17 | — | Yes | U/BG/IR *** | 26.5 |
| UPLFLN60XOIPH | 1.25–0.65 | 0.12 | 0.17 | Oil | Yes | U/BG/IR *** | 26.5 |
| UPLFLN100XO2PH | 1.30 | 0.2 | 0.17 | Oil | Yes | U/BG/IR *** | 26.5 |

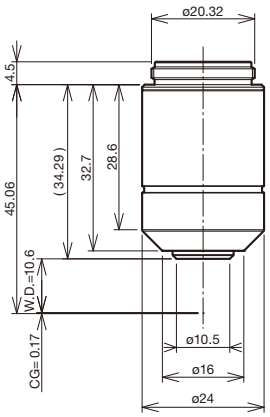
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.
***IR excitation might cause the objective to go slightly out of focus.

# Plan Achromat for Phase Contrast

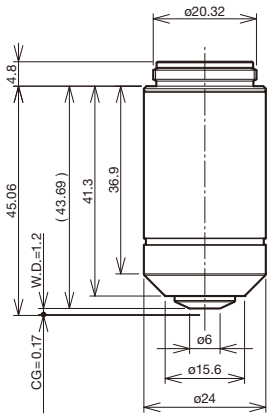
## PLN-PH series

The PLN-PH standard objectives provide excellent field flatness during phase contrast observation in transmitted light.

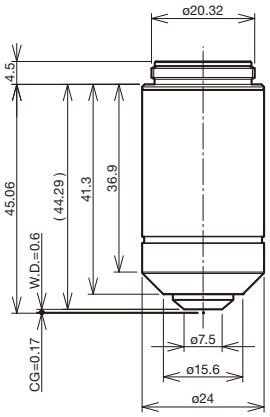
### PLN10XPH



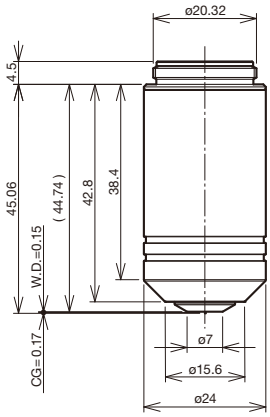

### PLN20XPH




### PLN40XPH




### PLN100XOPH




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| PLN10XPH | 0.25 | 10.6 | — | — | — | (BG) | 22.0 |
| PLN20XPH | 0.40 | 1.2 | 0.17 | — | Yes | (BG) | 22.0 |
| PLN40XPH | 0.65 | 0.6 | 0.17 | — | Yes | (BG) | 22.0 |
| PLN100XOPH | 1.25 | 0.15 | — | Oil | Yes | (BG) | 22.0 |

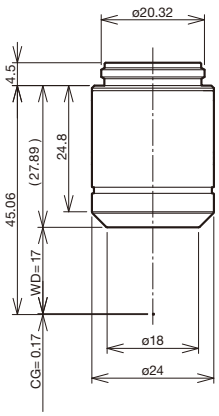
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.

# Universal Plan Semi Apochromat for Polarizing

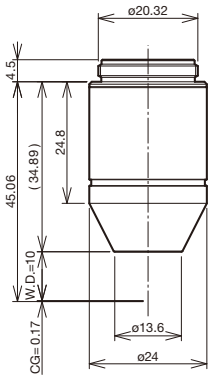
## UPLFLN-P series

The UPLFLN-P universal objectives display flat images from violet up to the near-infrared region of the spectrum. These objectives reduce internal strain to a minimum and are designed for polarizing, Nomarski DIC, brightfield, and fluorescence microscopy.

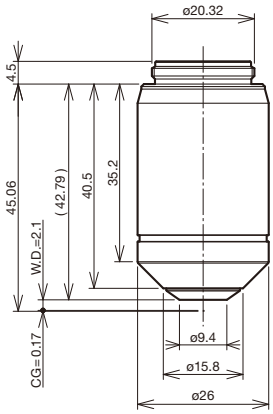
### UPLFLN4XP



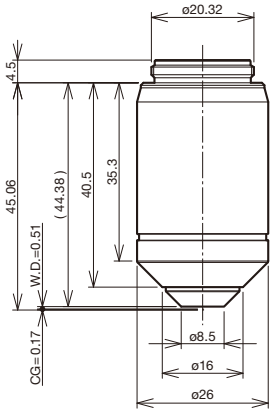

### UPLFLN10XP



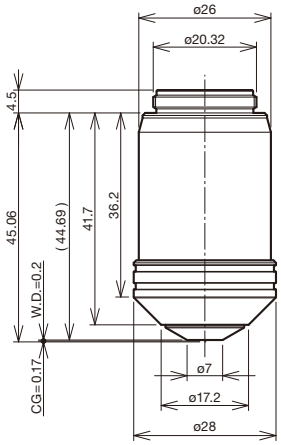

### UPLFLN20XP




### UPLFLN40XP




### UPLFLN100XOP




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| UPLFLN4XP | 0.13 | 17 | — | — | — | (U)(/BG) | 26.5 |
| UPLFLN10XP | 0.30 | 10 | — | — | — | U/BG | 26.5 |
| UPLFLN20XP | 0.50 | 2.1 | 0.17 | — | — | U/BG | 26.5 |
| UPLFLN40XP | 0.75 | 0.51 | 0.17 | — | Yes | U/BG | 26.5 |
| UPLFLN100XOP | 1.30 | 0.2 | 0.17 | Oil | Yes | U/BG | 26.5 |

Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. “( )” indicates that fluorescence might be slightly darker.

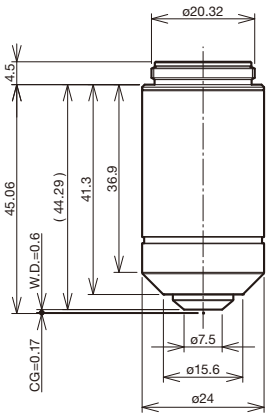
# Achromat for Polarizing

## PLN-P, ACHN-P series

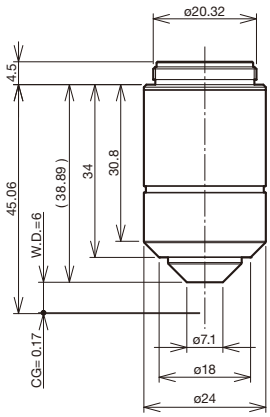
UIS2 World-leading optics

The PLN-P and ACHN-P are cost-efficient objectives designed for transmitted polarized light observations.

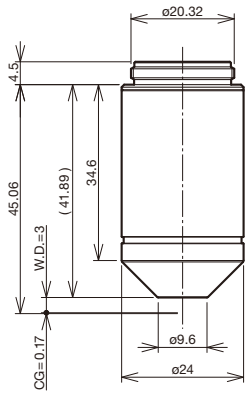
### PLN4XP



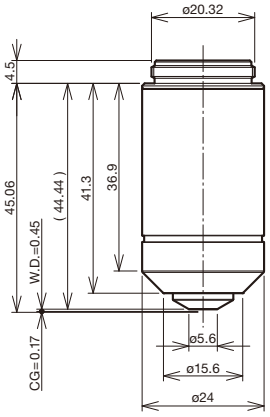

### ACHN10XP



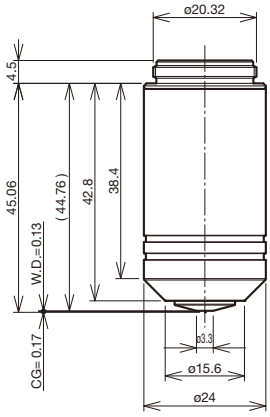

### ACHN20XP




### ACHN40XP




### ACHN100XOP




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| PLN4XP | 0.10 | 18.5 | — | — | — | (BG) | 22.0 |
| ACHN10XP | 0.25 | 6 | — | — | — | (BG) | 22.0 |
| ACHN20XP | 0.40 | 3 | 0.17 | — | — | (BG) | 22.0 |
| ACHN40XP | 0.65 | 0.45 | 0.17 | — | Yes | (BG) | 22.0 |
| ACHN100XOP | 1.25 | 0.13 | — | Oil | Yes | (BG) | 22.0 |

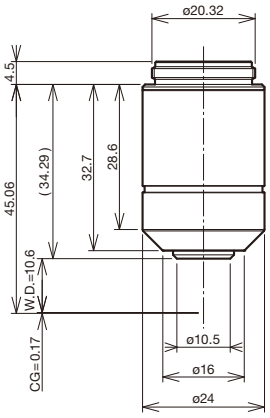
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.

# Plan Achromat (ND)

## PLN-CY series

The PLN-CY standard objective provide excellent field flatness. This objective, equipped with neutral density (ND) filters, provide the same level of brightness, even if the magnification is changed, thereby removing the need for brightness adjustment.

### PLN10XCY




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| PLN10XCY | 0.25 | 10.6 | — | — | — | (BG) | 22.0 |

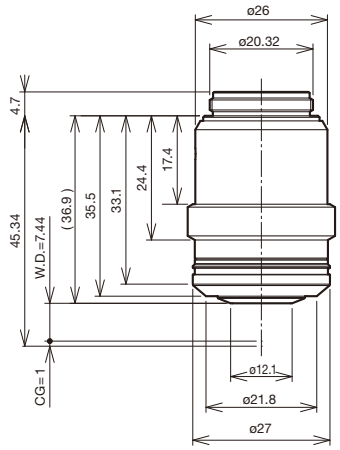
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.

# Long Working Distance Universal Plan Semi Apochromat

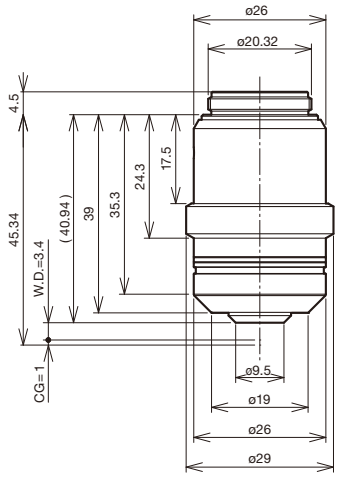
## LUCPLFLN series

The LUCPLFLN long working distance, universal objectives display flat images from violet up to the near-infrared region of the spectrum. These objectives are dedicated to tissue culture observations through bottles and dishes, offering high contrast and splendid resolution in brightfield, DIC, and fluorescence observations.

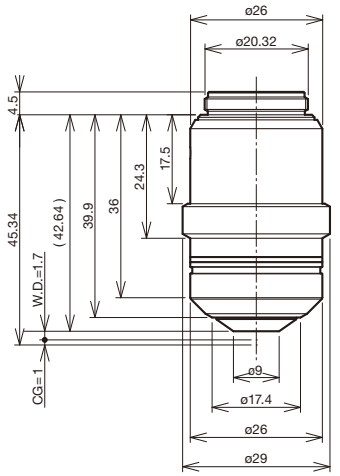
### LUCPLFLN20X




### LUCPLFLN40X




### LUCPLFLN60X




unit: mm

| Objectives (Magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| LUCPLFLN20X | 0.45 | 7.8–6.6 | 0–2 | — | — | U/BG/IR *** | 22.0 |
| LUCPLFLN40X | 0.60 | 4–2.7 | 0–2 | — | — | U/BG/IR *** | 22.0 |
| LUCPLFLN60X | 0.70 | 2.2–1.5 | 0.1–1.3 | — | — | U/BG/IR *** | 22.0 |

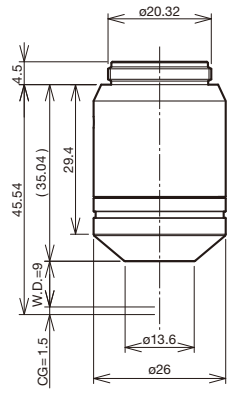
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV excitation, BG: Visible Excitation, IR : Near IR. "( )" indicates that fluorescence might be slightly darker.
***IR excitation might cause the objective to go slightly out of focus.

# Long Working Distance Universal Plan Semi Apochromat for Relief Contrast

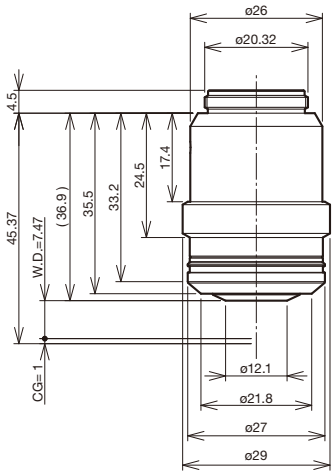
## CPLFLN-RC, LUCPLFLN-RC series

The CPLFLN-RC and LUCPLFLN-RC long working distance, universal objectives display flat images from violet up to the near-infrared region of the spectrum. These objectives are designed for the observation of living cells, including oocytes. Plastic vessels can be used with these objectives for relief contrast observations.

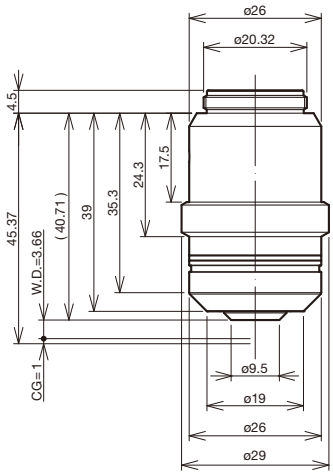
### CPLFLN10XRC




### LUCPLFLN20XRC




### LUCPLFLN40XRC




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| CPLFLN10XRC | 0.30 | 9 *** | — | — | — | BG | 22.0 |
| LUCPLFLN20XRC | 0.45 | 7.8–6.6 | 0–2 | — | — | U/BG/IR **** | 22.0 |
| LUCPLFLN40XRC | 0.60 | 4.2–3.0 | 0–2 | — | — | U/BG/IR **** | 22.0 |

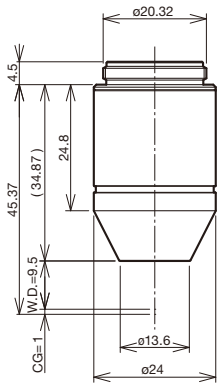
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.
***Defined by 1 mm bottom thickness of a plastic container and 0.5 mm bottom thickness of a glass heat plate (depends on the shape of container).
****IR excitation might cause the objective to go slightly out of focus.

# Long Working Distance Universal Plan Semi Apochromat for Phase Contrast

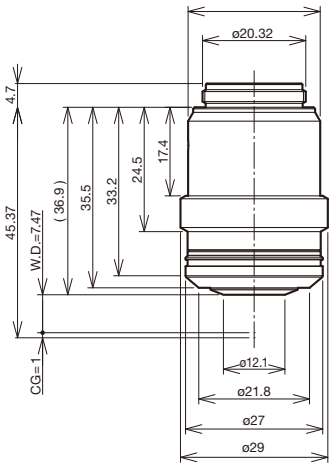
## CPLFLN-PH, LUCPLFLN-PH series

The CPLFLN-PH and LUCPLFLN-PH long working distance, universal objectives display flat images from violet up to the near-infrared region of the spectrum. These objectives are specifically designed for culture specimens and are optimized to produce splendid phase contrast images, regardless of the thickness and material of the culture vessel.

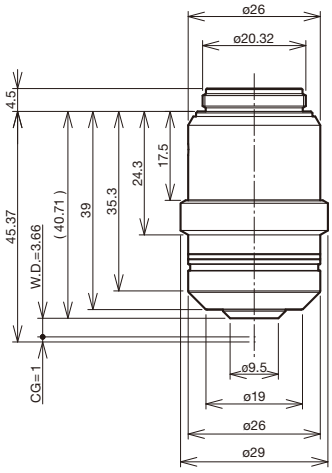
### CPLFLN10XPH



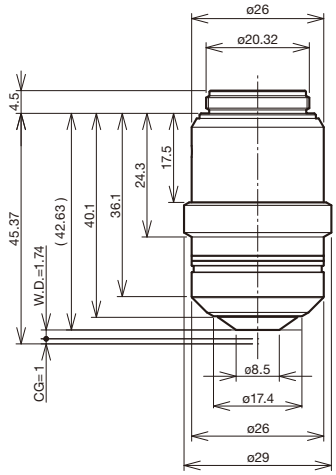

### LUCPLFLN20XPH




### LUCPLFLN40XPH




### LUCPLFLN60XPH




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| CPLFLN10XPH | 0.30 | 9.5 *** | 1 | — | — | BG | 22.0 |
| LUCPLFLN20XPH | 0.45 | 7.8–6.6 | 0–2 | — | — | U/BG/IR **** | 22.0 |
| LUCPLFLN40XPH | 0.60 | 4.2–3.0 | 0–2 | — | — | U/BG/IR **** | 22.0 |
| LUCPLFLN60XPH | 0.70 | 2.2–1.5 | 0.1–1.3 | — | — | U/BG/IR **** | 22.0 |

Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.
***Defined by 1 mm bottom thickness of a plastic container.
****IR excitation might cause the objective to go slightly out of focus.

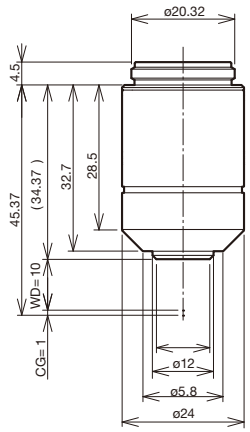
# Culture Specimen Objectives for Phase Contrast

## CPLN-PH, LCACHN-PH series

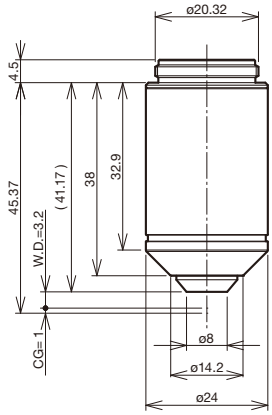
UIS2 World-leading optics

The CPLN-PH and LCACHN-PH standard objectives provide excellent field flatness during phase contrast observation in transmitted light.

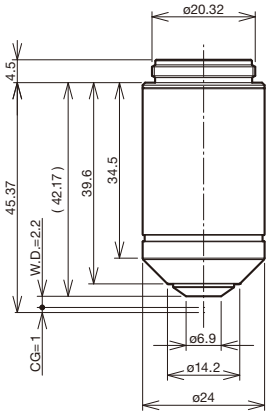
### CPLN10XPH




### LCACHN20XPH




### LCACHN40XPH




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| CPLN10XPH | 0.25 | 10 *** | — | — | — | BG | 22.0 |
| LCACHN20XPH | 0.40 | 3.2 *** | 1 | — | — | BG | 22.0 |
| LCACHN40XPH | 0.55 | 2.2 *** | 1 | — | — | BG | 22.0 |

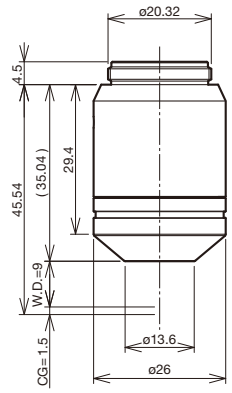
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.
***Defined by 1 mm bottom thickness of a plastic container.

# Culture Specimen Objectives for Relief Contrast

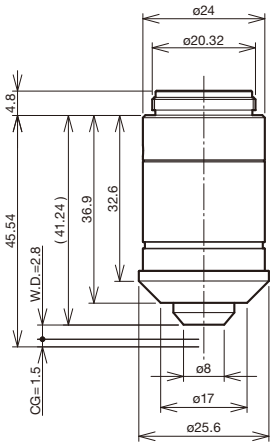
## CPLN-RC, LCACHN-RC series

The CPLN-RC and LCACHN-RC standard objectives provide excellent field flatness during relief contrast observation in transmitted light. These objectives are designed for the observation of living cells, including oocytes, in plastic vessels.

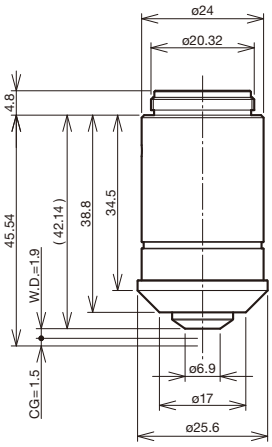
CPLN10XRC




LCACHN20XRC




LCACHN40XRC




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| CPLN10XRC | 0.25 | 9.7 *** | — | — | — | BG | 22.0 |
| LCACHN20XRC | 0.40 | 2.8 *** | 1.5 | — | — | BG | 22.0 |
| LCACHN40XRC | 0.55 | 1.9 *** | 1.5 | — | — | BG | 22.0 |

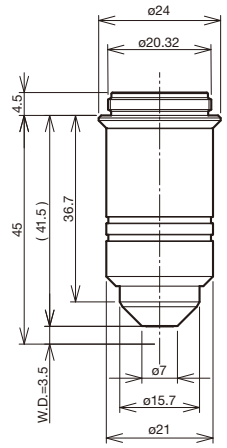
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.
***Defined by 1 mm bottom thickness of a plastic container and 0.5 mm bottom thickness of a glass heat plate (depends on the shape of container).

# No Cover Water Immersion for a Fixed Stage Upright Microscope

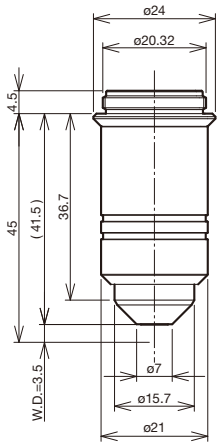
## UMPLFLN-W, LUMPLFLN-W series

The UMPLFLN, LUMPLFLN-W, and LUMFLN series of long working distance, water immersion objectives display flat images from high transmission factors up to the near-infrared region of the spectrum. These objectives achieve splendid DIC and fluorescence from the visible range to infrared and are ideal for fluorescence imaging of brain tissue, as well as other tissue and specimens.

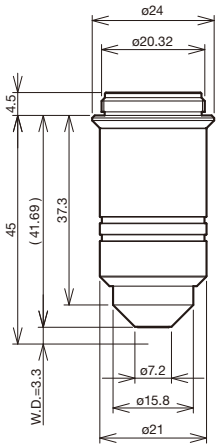
### UMPLFLN10XW



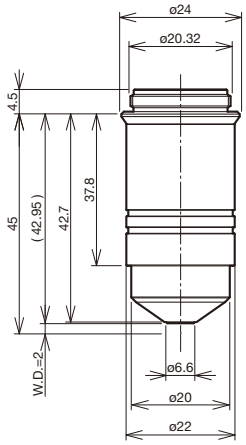

### UMPLFLN20XW




### LUMPLFLN40XW




### LUMPLFLN60XW




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| UMPLFLN10XW | 0.30 | 3.50 | 0 | Water | — | U/BG | 26.5 |
| UMPLFLN20XW | 0.50 | 3.50 | 0 | Water | — | U/BG | 26.5 |
| LUMPLFLN40XW | 0.8 | 3 | 0 | Water | — | U/BG | 26.5 |
| LUMPLFLN60XW | 1.00 | 2 | 0 | Water | — | U/BG | 26.5 |

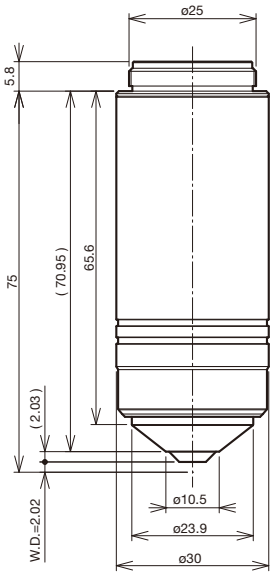
Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.

## No Cover Water Immersion for a Fixed Stage Upright Microscope

### XLUMPLFLN20XW

The XLUMPLFLN-W high NA, long working distance objectives display flat images from high transmission factors up to the near-infrared region of the spectrum. These objectives achieve splendid DIC and fluorescence from the visible range to infrared. These objectives enable the measurement of cell membrane electric potential since the design of the objectives provides easy access to patch clamp electrodes.

**XLUMPLFLN20XW *****




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| XLUMPLFLN20XW *** | 1.00 | 2 | 0 | Water | — | U/BG/IR **** | 22.0 |

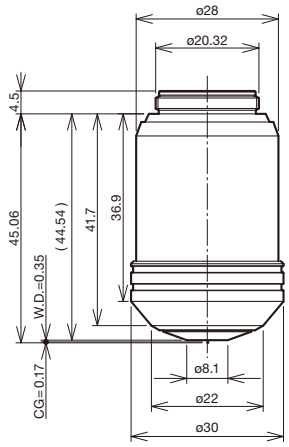
Screw: W 25 mm × 0.75 mm (1 in. × 0.03 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.
***Special dedicated nosepiece needed (WI-SNPXLU).
****IR excitation might cause the objective to go slightly out of focus.

# Universal Apochromat

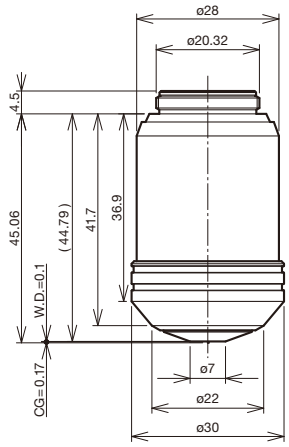
## UAPON 340 series

The UAPON340 objectives feature high transmission of 340 nm wavelength light, providing maximum performance in fluorescence microscopes using UV excitation.

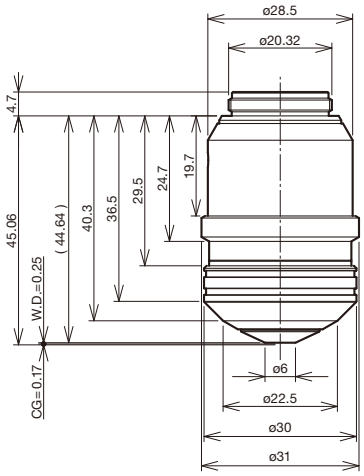
### UAPON20XW340




### UAPON40XO340-2




### UAPON40XW340




unit: mm

| Objectives (magnification) | NA | W.D. (mm) * | Cover Glass Thickness (mm) | Immersion | Spring | Fluorescence ** | FN |
|---|---|---|---|---|---|---|---|
| UAPON20XW340 | 0.70 | 0.35 | 0.17 | Water | Yes | U/BG | 22.0 |
| UAPON40XO340-2 | 1.35 | 0.1 | 0.17 | Oil | Yes | U/BG | 22.0 |
| UAPON40XW340 | 1.15 | 0.25 | 0.13-0.25 | Water | Yes | U/BG | 22.0 |

Screw: W 20.32 mm × 0.706 mm (0.8 in. × 1/36 in.)
*Defined with cover glass thickness shown as “CG” in the above drawings.
**U: UV Excitation, BG: Visible Excitation, IR: Near IR. "( )" indicates that fluorescence might be slightly darker.

# UIS2 Tube Lens Unit

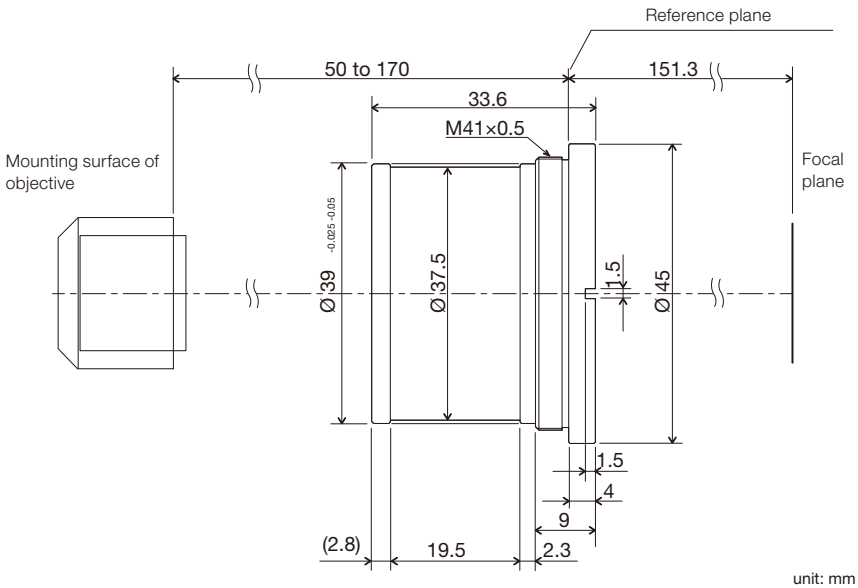
## SWTLU-C

Olympus' SWTLU-C compact, super-wide tube lens and super-wide UIS2 objectives meet that demand with homogenous, flat images with negligible aberration across a field of view up to 26.5 mm. Compact and lightweight, the SWTLU-C tube lens is easy to integrate into your optical system.
Mount the tube lens unit (SWTLU-C) using a standard M41 x 0.5 thread.

### Specifications

| | |
|---|---|
| **Product Name** | SWTLU-C |
| **Dimension** | $\phi$ 45 × 33.6 mm |
| **Weight** | 94 g |
| **Projection Area** | 26.5 mm *1) |
| **Focal length f** | 180 mm |
| **Magnification** | 1X *2) |
| **Focal Plane Position** | 151.3 mm from the reference plane |
| **Mounting Thread** | M41 x 0.5 mm |
| **Mounting Method** | Screw In |

*1) In combinations with FN26.5 Objectives
*2) In combination with UIS2 Objectives (designed for f180 mm tube lens)




unit: mm

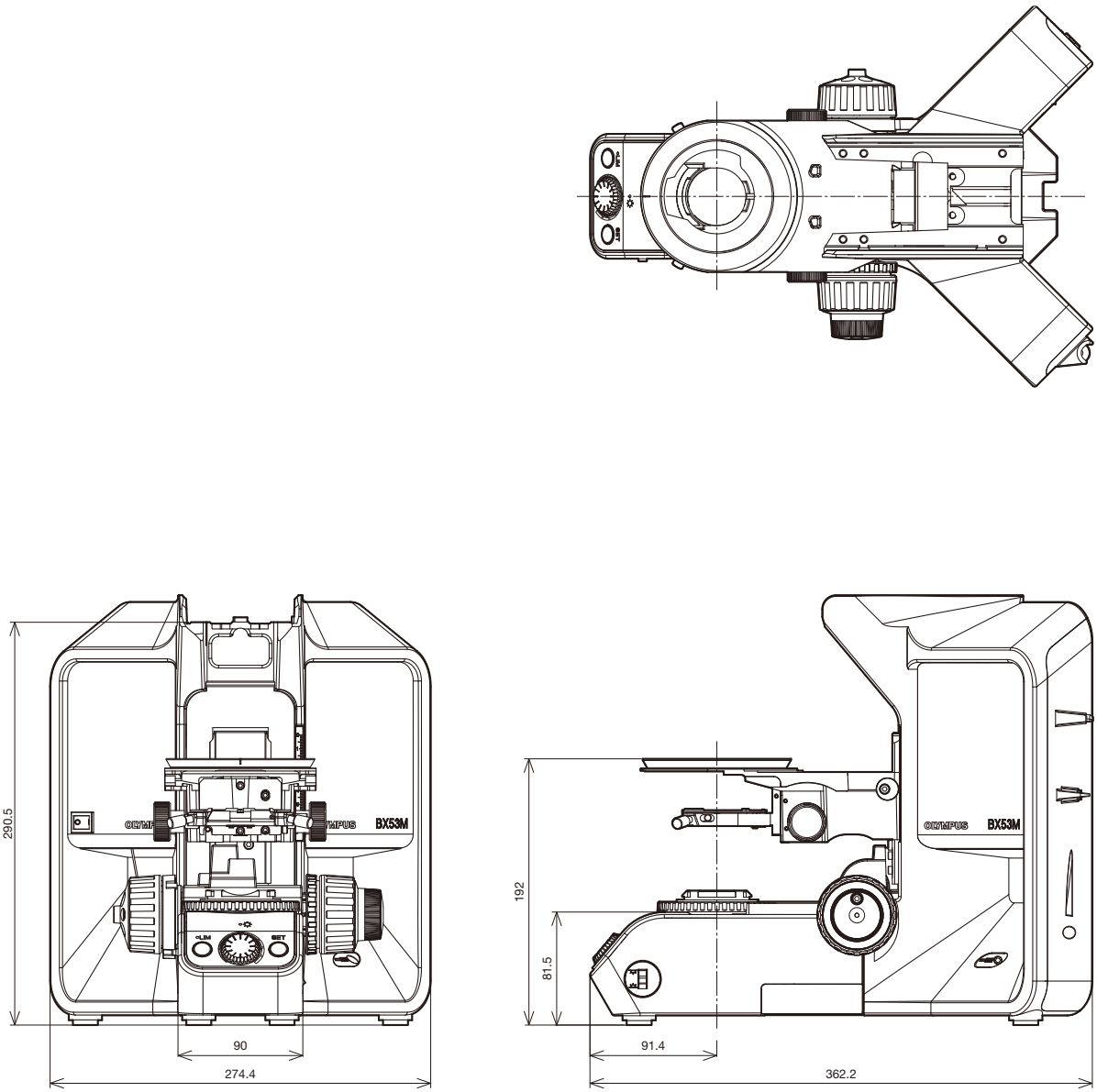
# Microscope Frame

## BX53M: Upright Transmitted and Reflected Light Microscope Frame

### BX53MTRF-S

Designed with modularity in mind, the BX3M series provide versatility for a wide variety of material science and industrial applications. The frames are outfitted with electro-static discharge (ESD) capability to help protect electronic samples.

**BX53MTRF-S**




Weight: 7.6 kg Unit: mm

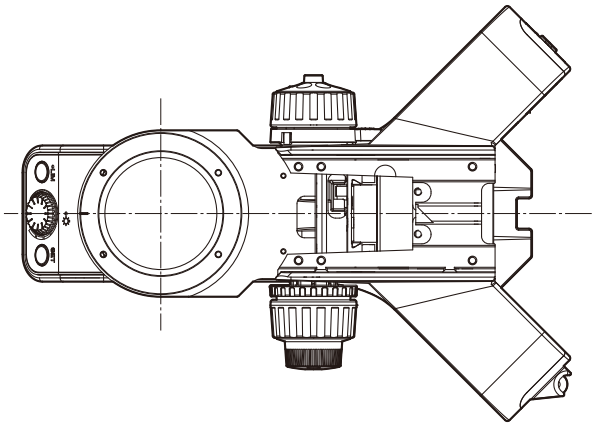
# Microscope Frame

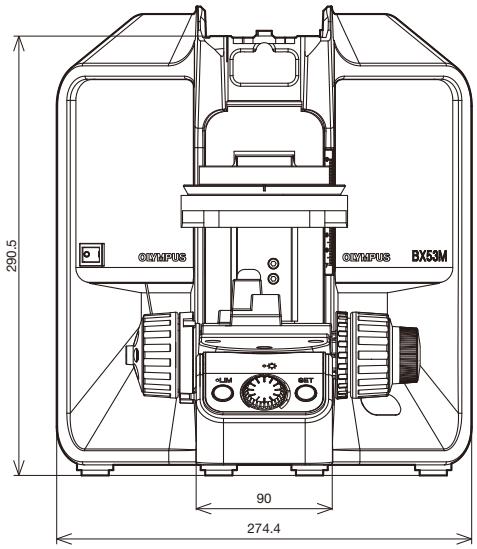
## BX53M: Upright Reflected Light Microscope Frame

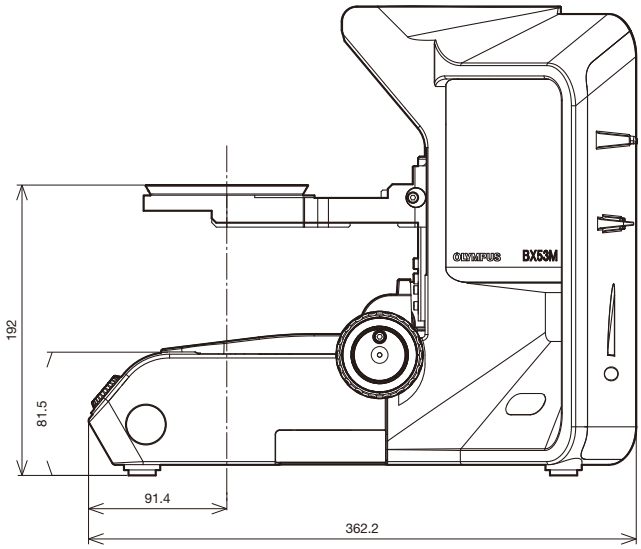
### BX53MRF-S

Designed with modularity in mind, the BX3M series provide versatility for a wide variety of material science and industrial applications. The frames are outfitted with ESD capability to help protect electronic samples.

**BX53MRF-S**






Weight: 7.4 kg Unit: mm

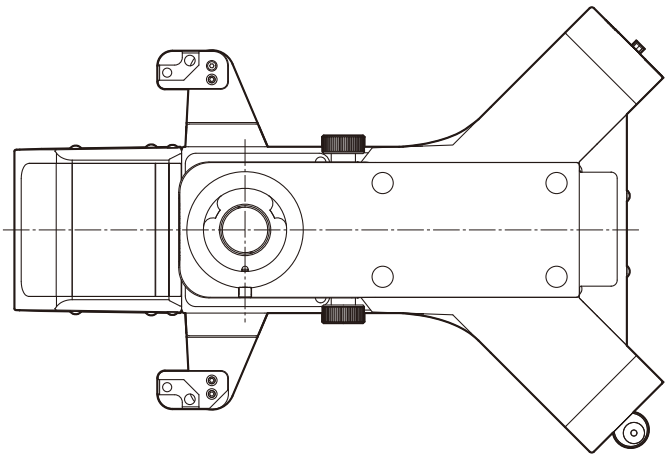
# Microscope Frame

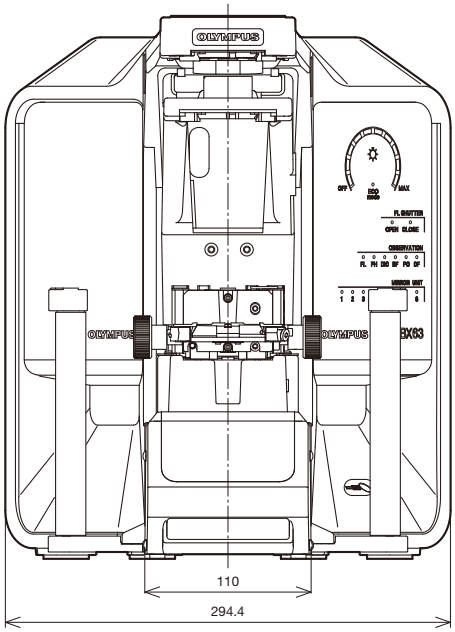
## BX3: Automated Transmitted Light Microscope Frame

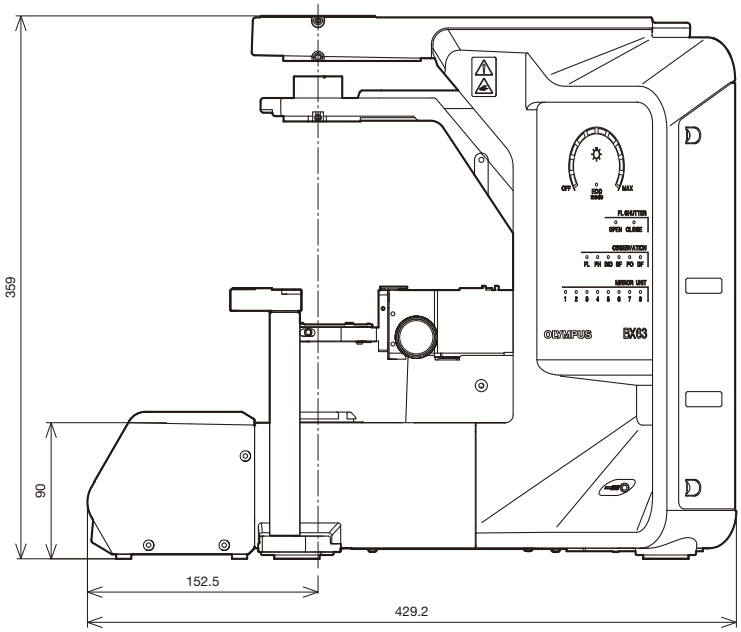
### BX63F

This fully motorized system enables automation of complex multidimensional experiments and features a precise motorized Z-drive and splendid stability thanks to the fixed stage design.

**BX63F**






Weight: 14.1 kg Unit: mm

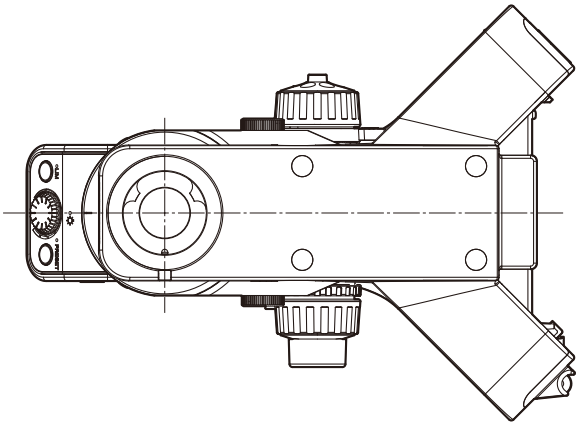
# Microscope Frame

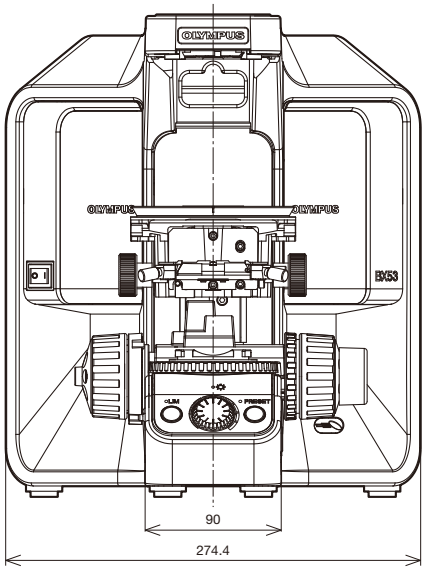
## BX3: Semi-Motorized Fluorescence Transmitted Light Microscope Frame

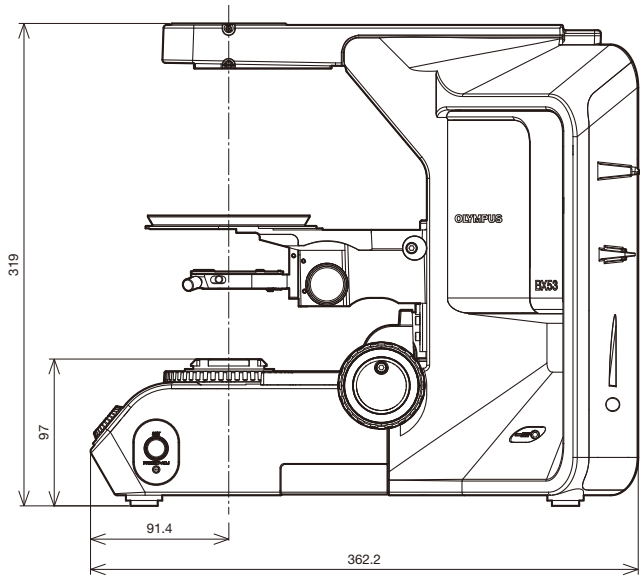
### BX53F2

The entire optical path of the BX53 is designed for optimal fluorescence imaging and uses UIS2 optical components that set a new standard in precision and clarity. The modular concept enables motorization of individual components.

**BX53F2**






Weight: 8.3 kg Unit: mm

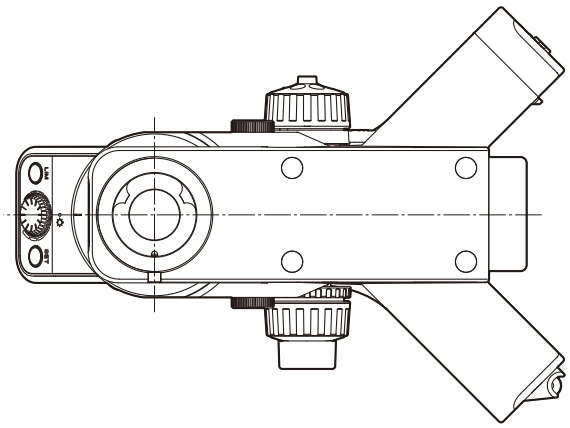
# Microscope Frame

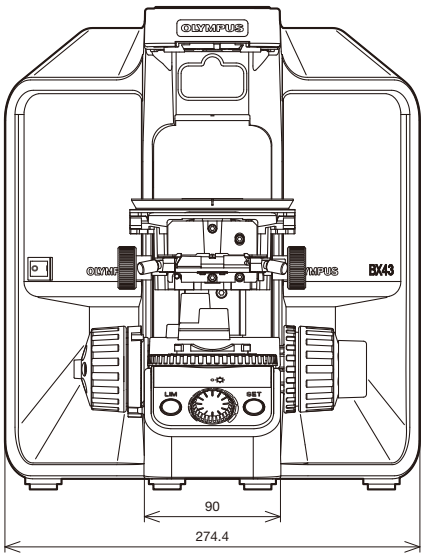
## BX3: Manual System Transmitted Light Microscope Frame

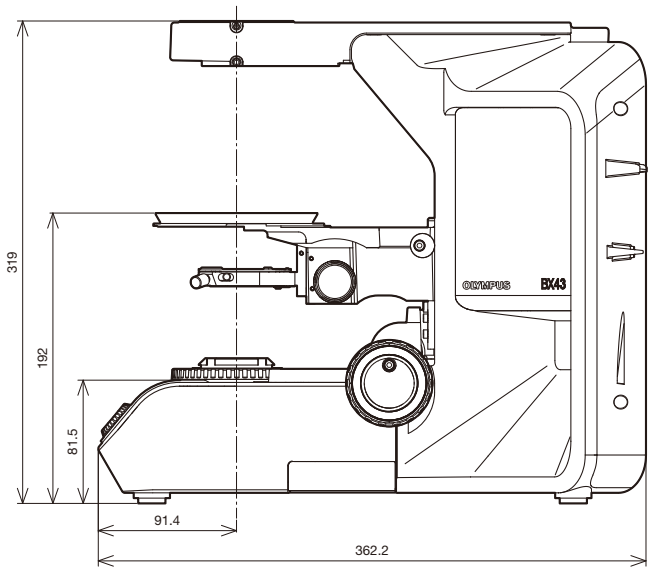
### BX43F

The BX43 microscope offers a wide range of features, splendid optical performance, and is the ideal platform for digital imaging. This flexible microscope offers various contrast methods and leading-edge optics combined with true-color LED illumination for true-to-life color rendering.

**BX43F**






Weight: 9.1 kg Unit: mm

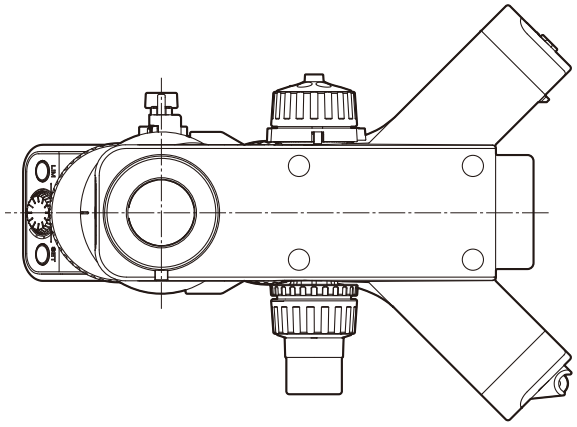
# Microscope Frame

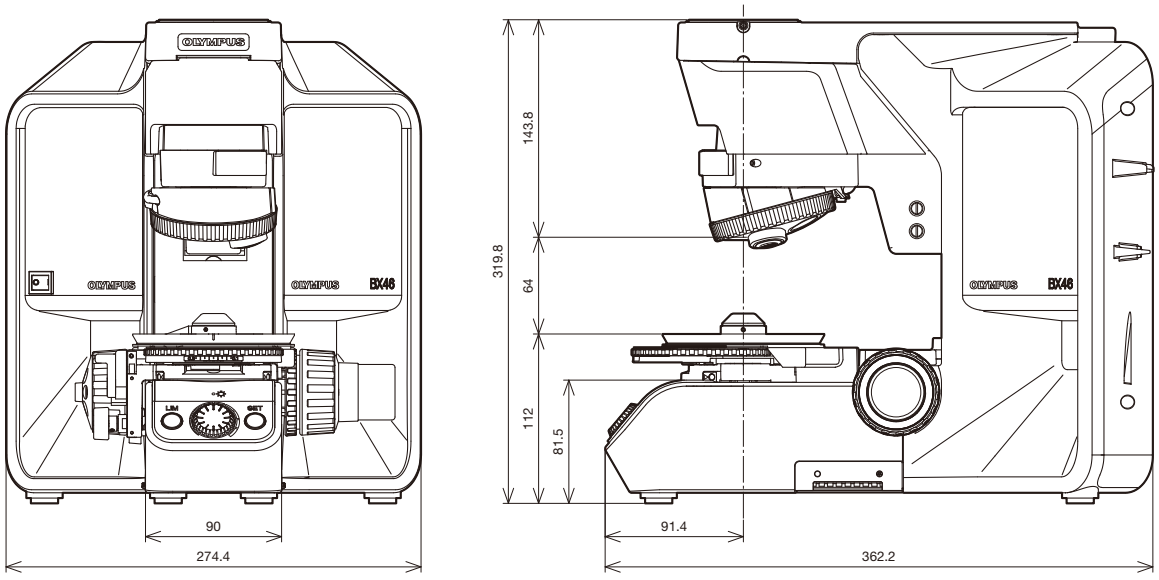
## BX3: Transmitted Light Ergonomic Microscope Frame

### BX46F

The BX46 features an ergonomic design with a low-position fixed stage and nosepiece focus that helps keep users comfortable while they're working.

**BX46F**





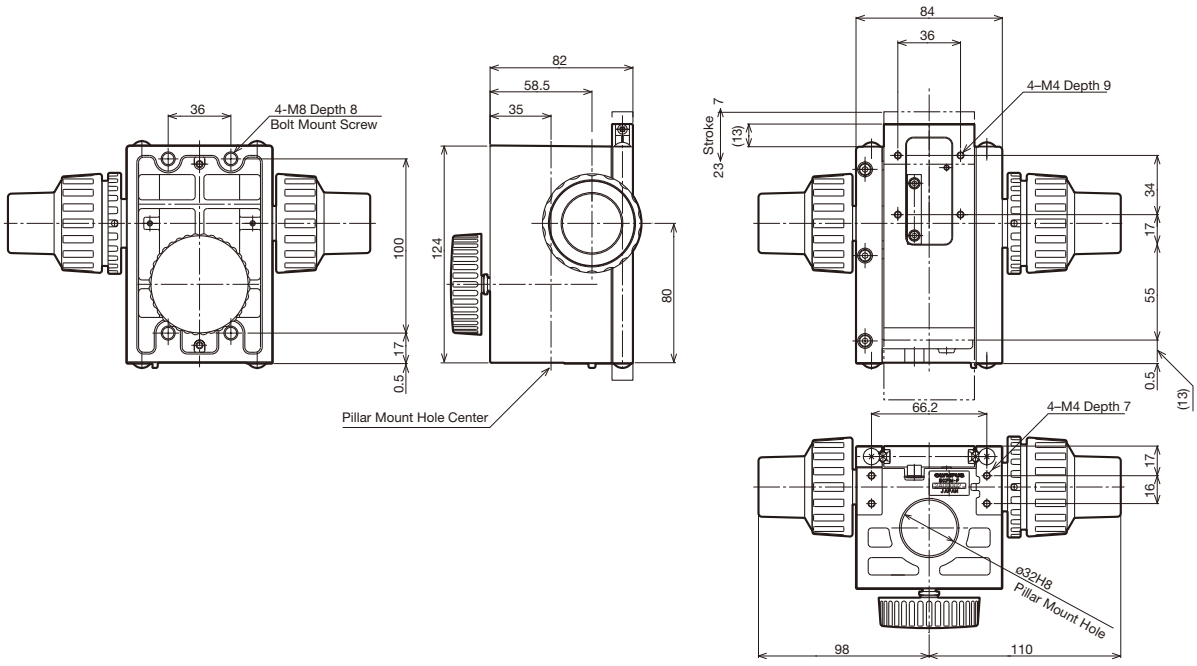

Weight: 9.8 kg Unit: mm

# Microscope System BXFM

## BXFM Frame

### BXFM-F

This popular microscope frame can be used with fiber illumination, a motorized nosepiece, and a telan lens unit. The frame can easily be integrated into other equipment, which can be attached by a rear bolt mounting screw or pillar mounting hole.



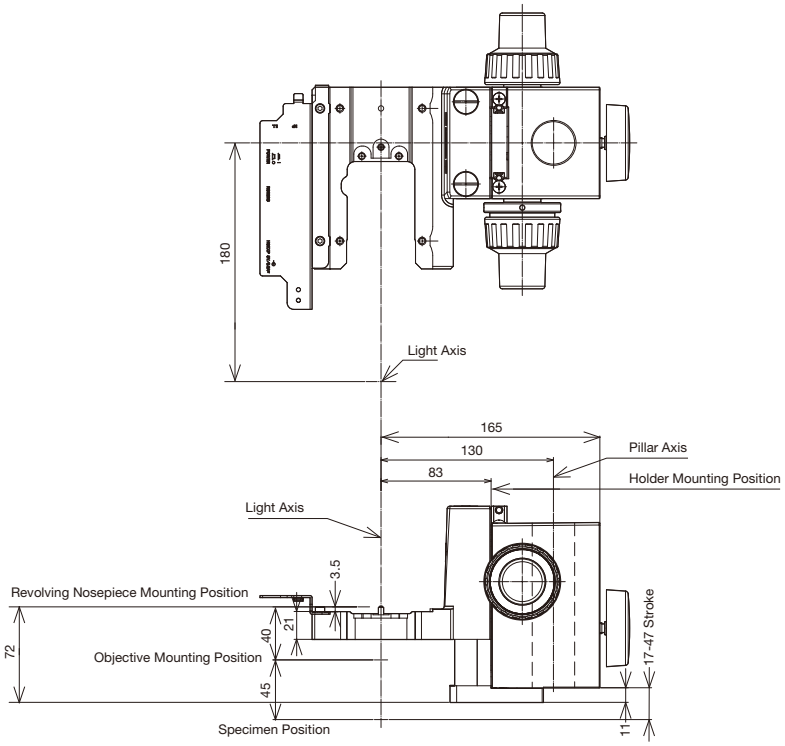

Weight: 1.9kg Unit: mm

# Microscope System BXFM

## BXFM System Configuration Example 1

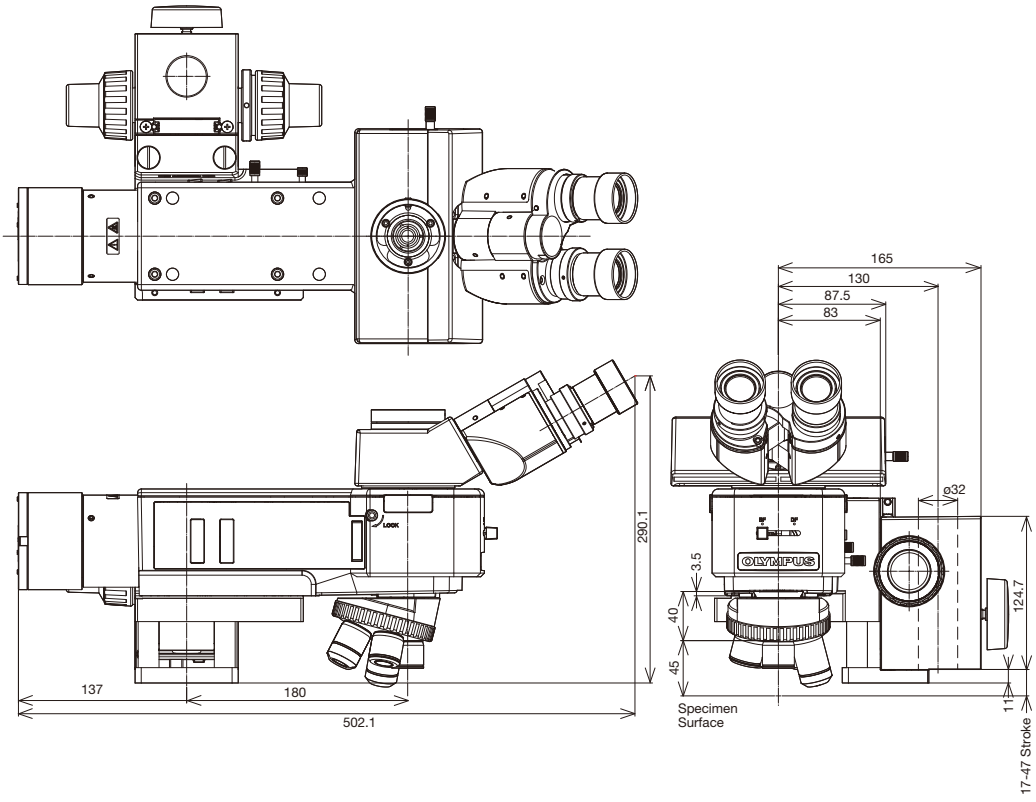
### BXFM-F + BXFM-ILH + BXFM-ILHSPU

This example accommodates reflected light brightfield/darkfield and fluorescence illuminators.




Weight: 3.2kg Unit: mm

BXFM Combination Sample
BXFM-F + BXFM-ILH + BXFM-ILHSPU + TR30-2 + BX-RLA2 + U-LH100L-3



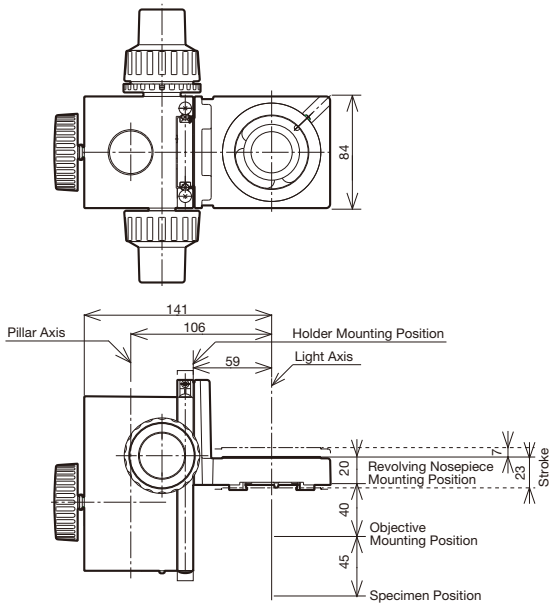

*For installation dimensions, refer to the BXFM-F diagram.

Weight: 8.2kg (excludes objectives) Unit: mm

## BXFM System Configuration Example 2

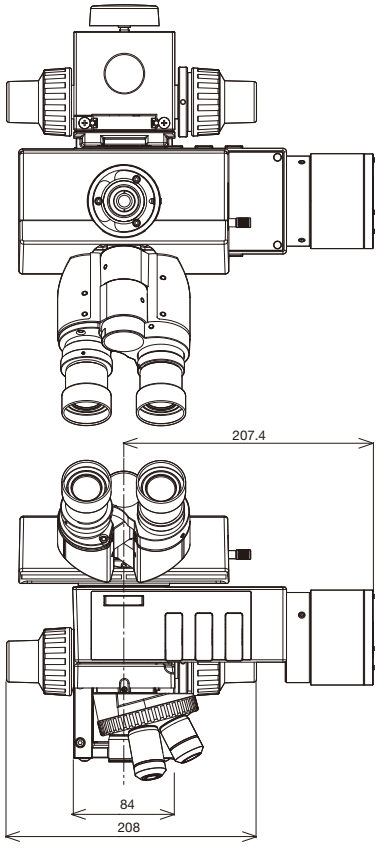
### BXFM-F + BXFM-ILHS

This system example contains a compact focusing unit that is suitable for being integrated into existing equipment.




Weight: 2.4kg Unit: mm

BXFM-S Combination Sample
BXFM-F + BXFM-ILHS + TR30-2 + U-KMAS + U-LH100L-3



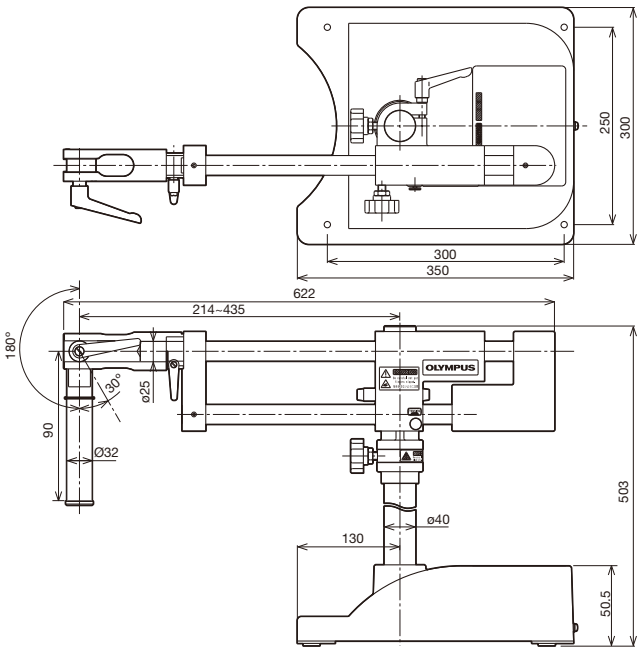

*For installation dimensions, refer to the BXFM-F diagram.

Weight: 5.5 kg (excludes objectives) Unit: mm

## Stands for the BXFM

A wide variety of stands are available to suit different applications and purposes.

### SZ2-STU2
Universal Stand Type 2

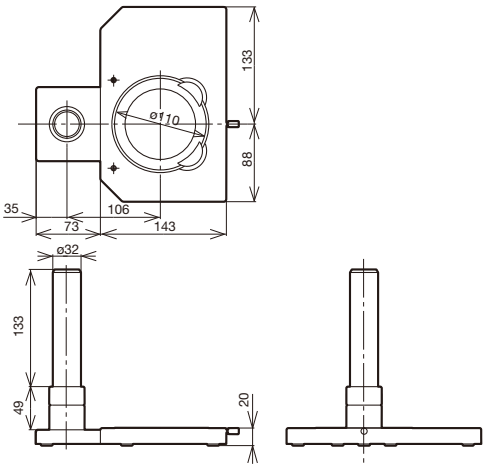



*The rotation angle of the horizontal arm can be restricted to 90 degrees with a stopper.

**Major Specifications**

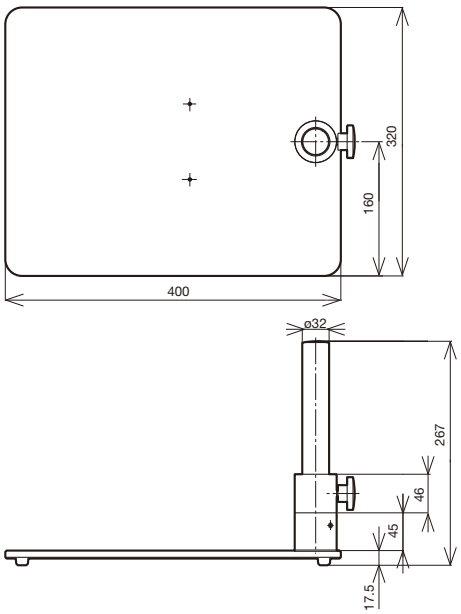
| | Item | Specifications |
|---|---|---|
| 1 | Diameter of Focusing Arm or Fixing Section of Tube | ø32 mm |
| 2 | Vertical Pole Diameter | ø40 mm |
| 3 | Diameter of Horizontal Poles | ø25 mm (both upper and lower poles) |
| 4 | Stroke | Horizontal: 234 mm<br>Vertical: 205 mm |
| 5 | Movement Range | Horizontal: 541 (435 + 106) mm max. (vertical pole — BXFM-S optical axis) |
| 6 | Maximum Specimen Weight | Forward: 10 kg (within 90-degree area)<br>Transverse Direction: 6 kg<br>Backward Direction: 7 kg (at maximum stroke) |
| 7 | Weight | 30 kg |

### U-ST
Compact Stand




Weight: 1.8 kg

### SZ-STL
Large Stand




Weight: 5 kg

Unit: mm

# Illumination Units

## Reflected Light Illuminators for the BX53M Microscope

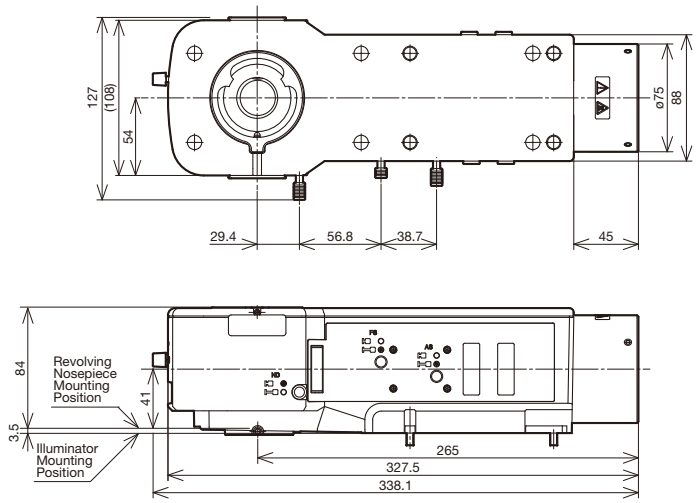
Manual illuminators for brightfield, darkfield, and fluorescence applications.

### BX3M-RLA-S

Reflected Light Illuminator for BF/DF for the BX53M Microscope

**Accessories**

| Unit Name | Description | Weight (g) |
|---|---|---|
| U-25LBD | Daylight Color Filter | 20 |
| U-25LBA | Halogen Color Filter | 20 |
| U-25IF550 | Green Filter | 20 |
| U-25L42 | UV-Cut Filter | 20 |
| U-25Y48 | Yellow Filter | 20 |
| U-25FR | Frost Filter | 20 |
| U-25 | Empty Filter (for use with user's ø25 mm filters) | <20 |
| U-25ND50 | ND Filter | 20 |
| U-25ND25 | ND Filter | 20 |
| U-25ND6 | ND Filter | 20 |



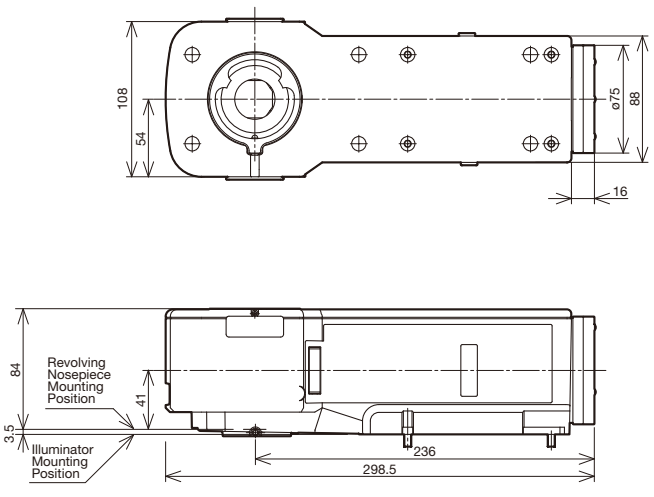

Weight: 3.0 kg

### BX3M-KMA-S

BF Reflected LED Light Illuminator for the BX53M Microscope

**Accessories**

| Unit Name | Description | Weight (g) |
|---|---|---|
| U-AN-2 | Fixed Analyzer | 50 |
| U-AN360-3 | Rotatable Analyzer | 79 |
| U-PO3 | Fixed Polarizer | 71 |
| U-POTP3 | Fixed Polarizer (use with U-DICRH) | 71 |
| U-25LBD | Daylight Color Filter | 20 |
| U-25LBA | Halogen Color Filter | 20 |
| U-25IF550 | Green Filter | 20 |
| U-25L42 | UV-Cut Filter | 20 |
| U-25Y48 | Yellow Filter | 20 |
| U-25FR | Frost Filter | 20 |
| U-25 | Empty Filter (for use with user's ø25 mm filters) | <20 |
| U-25ND50 | ND Filter | 20 |
| U-25ND25 | ND Filter | 20 |
| U-25ND6 | ND Filter | 20 |




Weight: 2.4 kg

Unit: mm

# Illumination Units

## Coded Reflected Light Illuminator for the BX53M Frame

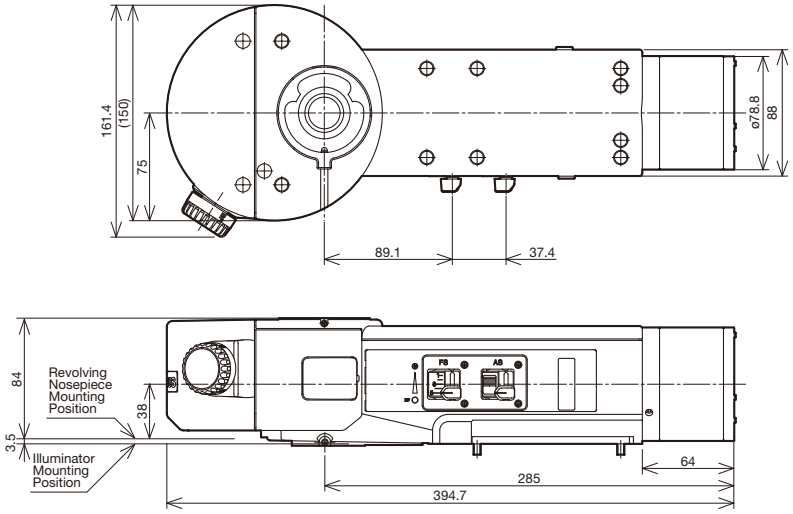
Coded illuminators require users to physically change the device's settings, but the microscope's software automatically recognizes these changes.

### BX3M-RLAS-S

Coded Reflected Light Illuminator for BF/DF for the BX53M Frame

**Accessories**

| Unit Name | Description | Weight (g) |
|---|---|---|
| U-AN-2 | Fixed Analyzer | 50 |
| U-AN360-3 | Rotatable Analyzer | 79 |
| U-PO3 | Fixed Polarizer | 71 |
| U-POTP3 | Fixed Polarizer (use with U-DICRH) | 71 |
| U-25LBD | Daylight Color Filter | 20 |
| U-25LBA | Halogen Color Filter | 20 |
| U-25IF550 | Green Filter | 20 |
| U-25L42 | UV-Cut Filter | 20 |
| U-25Y48 | Yellow Filter | 20 |
| U-25FR | Frost Filter | 20 |
| U-25 | Empty Filter (for use with user's ø25 mm filters) | <20 |
| U-25ND50 | ND Filter | 20 |
| U-25ND25 | ND Filter | 20 |
| U-25ND6 | ND Filter | 20 |



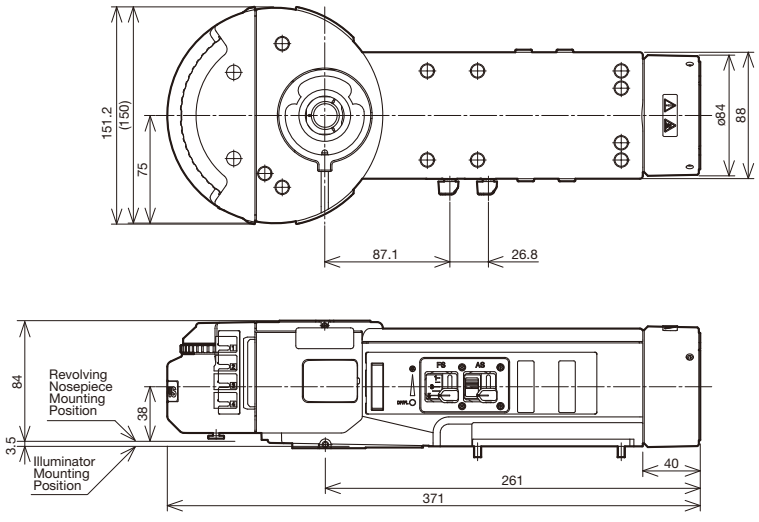

Weight: 3.6 kg

### BX3M-URAS-S

Coded Universal Reflected Illuminator for the BX53M Frame

**Accessories**

| Unit Name | Description | Weight (g) |
|---|---|---|
| U-AN-2 | Fixed Analyzer | 50 |
| U-AN360-3 | Rotatable Analyzer | 79 |
| U-PO3 | Fixed Polarizer | 71 |
| U-POTP3 | Fixed Polarizer (use with U-DICRH) | 71 |
| U-25LBD | Daylight Color Filter | 20 |
| U-25LBA | Halogen Color Filter | 20 |
| U-25IF550 | Green Filter | 20 |
| U-25L42 | UV-Cut Filter | 20 |
| U-25Y48 | Yellow Filter | 20 |
| U-25FR | Frost Filter | 20 |
| U-25 | Empty Filter (for use with user's ø25 mm filters) | <20 |
| U-25ND50 | ND Filter | 20 |
| U-25ND25 | ND Filter | 20 |
| U-25ND6 | ND Filter | 20 |




Weight: 3.2 kg

Unit: mm

# Illumination Units

## Reflected Illuminator for the BX3 Series

Manual illuminators for brightfield, darkfield, and fluorescence applications.

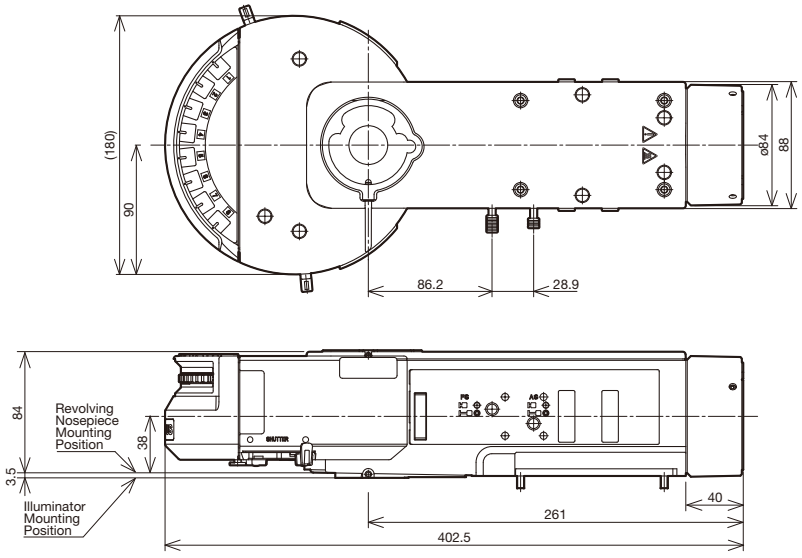
### BX3-URA

Universal Reflected Illuminator for the BX3 Series

A total of eight fluorescence mirror units can be attached for multi color fluorescence observations.

**Accessories**

| Unit Name | Description | Weight (g) |
|---|---|---|
| U-AN-2 | Fixed analyzer | 50 |
| U-AN360-3 | Rotatable analyzer | 79 |
| U-PO3 | Fixed polarizer | 71 |
| U-POTP3 | Fixed polarizer (use with U-DICRH) | 71 |
| U-25LBD | Daylight color filter | 20 |
| U-25LBA | Halogen color filter | 20 |
| U-25IF550 | Green filter | 20 |
| U-25L42 | UV-cut filter | 20 |
| U-25Y48 | Yellow filter | 20 |
| U-25FR | Frost filter | 20 |
| U-25 | Empty filter, for use with user's ø25 mm filters | <20 |
| U-25ND50 | ND filter | 20 |
| U-25ND25 | ND filter | 20 |
| U-25ND6 | ND filter | 20 |




Weight: 3.8 kg

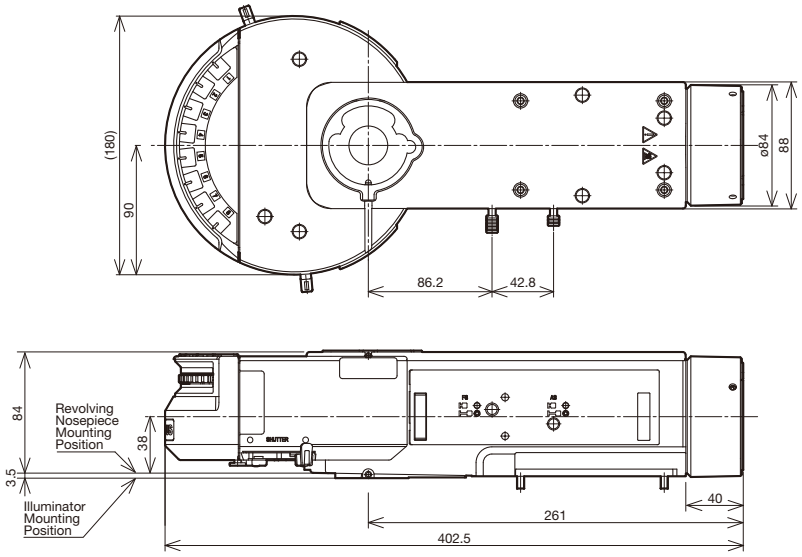
### BX3-RFAS

Coded Fluorescence Illuminator for the BX3 Series

The eight fluorescence mirror units feature coded functionality.

**Accessories**

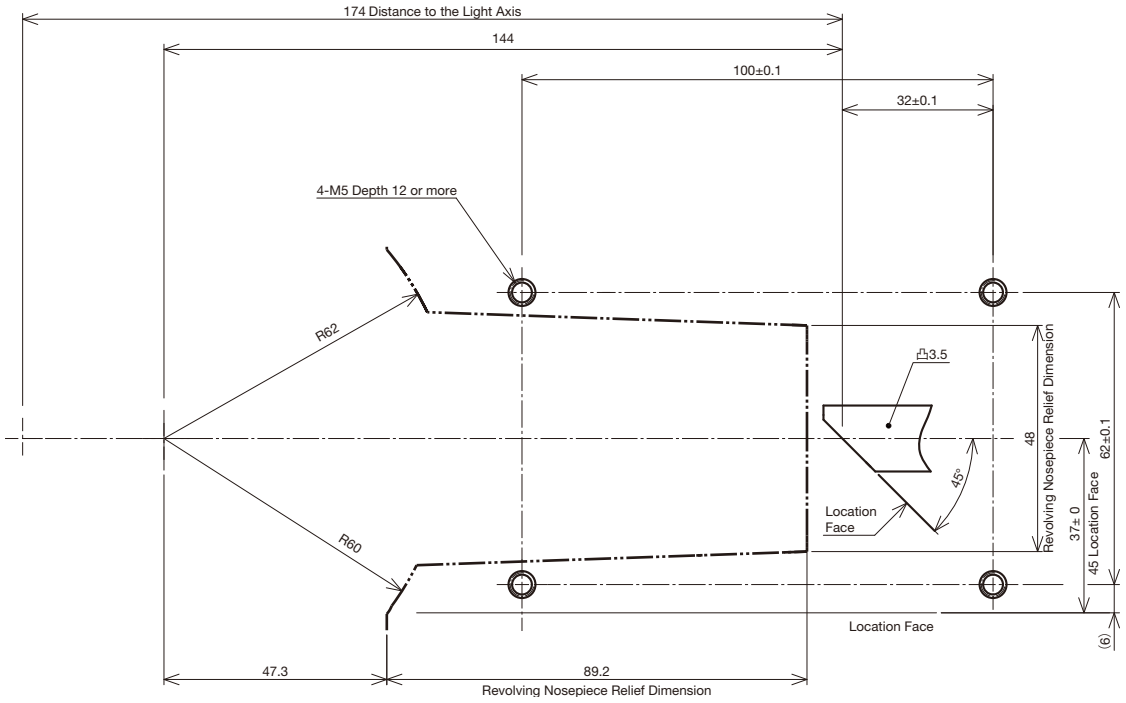
| Unit Name | Description | Weight (g) |
|---|---|---|
| U-AN-2 | Fixed analyzer | 50 |
| U-AN360-3 | Rotatable analyzer | 79 |
| U-PO3 | Fixed polarizer | 71 |
| U-POTP3 | Fixed polarizer (use with U-DICRH) | 71 |
| U-25LBD | Daylight color filter | 20 |
| U-25LBA | Halogen color filter | 20 |
| U-25IF550 | Green filter | 20 |
| U-25L42 | UV-cut filter | 20 |
| U-25Y48 | Yellow filter | 20 |
| U-25FR | Frost filter | 20 |
| U-25 | Empty filter, for use with user's ø25 mm filters | <20 |
| U-25ND50 | ND filter | 20 |
| U-25ND25 | ND filter | 20 |
| U-25ND6 | ND filter | 20 |




Weight: 3.9 kg

Unit: mm

## Mounting Dimensions of Illuminator (BX3M-RLA-S, BX3M-RLAS-S, BX3M-URAS-S, BX3M-KMA-S, BX3-RFAS, BX3-URA)




Fix illuminator using four M5 screws and projection for fastening.

Unit: mm

## Compact Reflected Light Illuminator for BF

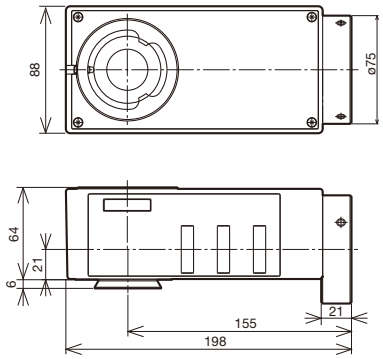
### U-KMAS

Very compact reflected light illuminator with reduced depth.

**U-KMAS**

**Accessories**

| Unit Name | Description | Weight (g) |
|---|---|---|
| U-25LBD | Daylight Color Filter | 20 |
| U-25IF550 | Green Filter | 20 |
| U-25ND6 | ND Filter | 20 |
| U-25ND25 | ND Filter | 20 |
| U-25FR | Frost Filter | 20 |
| U-25L42 | UV-Cut Filter | 20 |
| U-PO3 | Fixed Polarizer | 71 |
| U-POTP3 | Fixed Polarizer (use with U-DICRH) | 71 |
| U-AN360-3 | Rotatable Analyzer | 79 |
| U-AN | Analyzer Slider for Reflected Light | 50 |
| U-DICR | DIC Slider for Reflected Light | 130 |
| U-DICRH | DIC Slider for Reflected Light (Resolution Type) | 130 |
| U-DICRHC | DIC Slider for Reflected Light (Contrast Type) | 130 |




Weight: 1.2 kg

Unit: mm

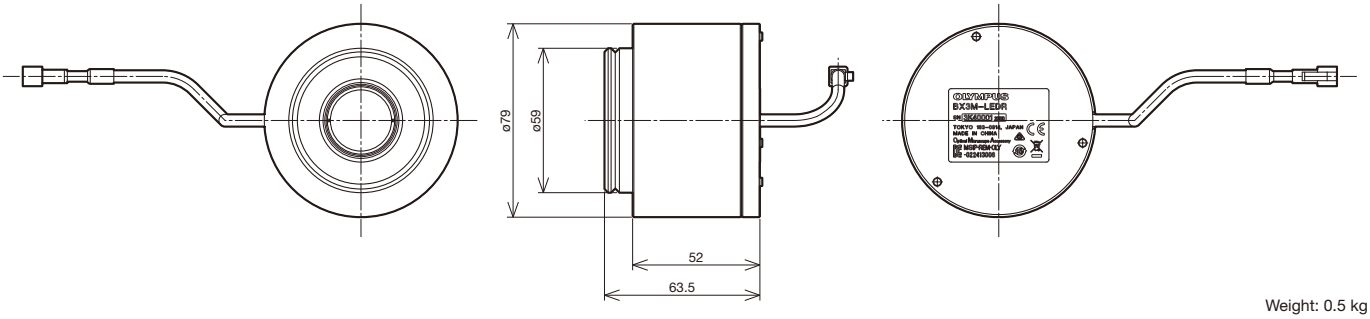
# Light Source Units

## LED Lamp Housing for the BX53M Microscope

The BX3M microscope utilizes a high-intensity white LED light source for both reflected and transmitted light. High-intensity light support various observation modes such as BF, DF, DIC, and polarizing.

### BX3M-LEDR

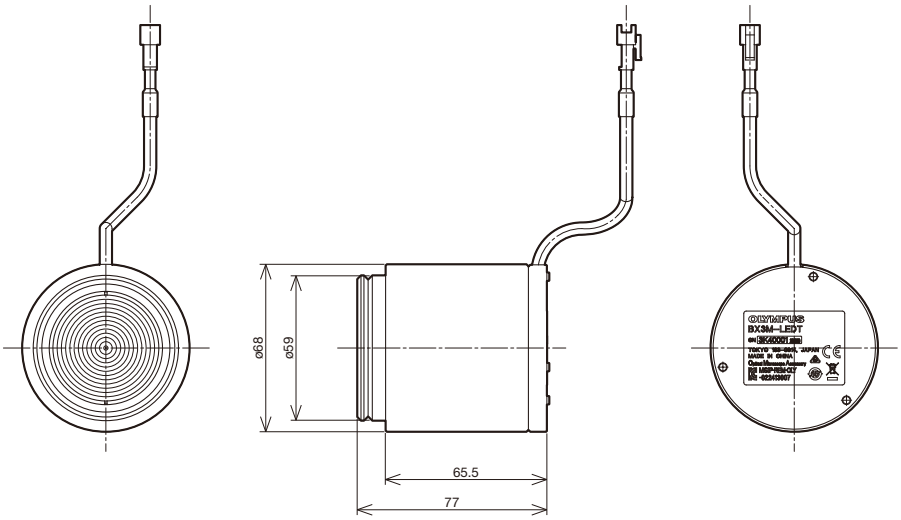
LED Lamp Housing for BX3M Reflected




Weight: 0.5 kg

### BX3M-LEDT

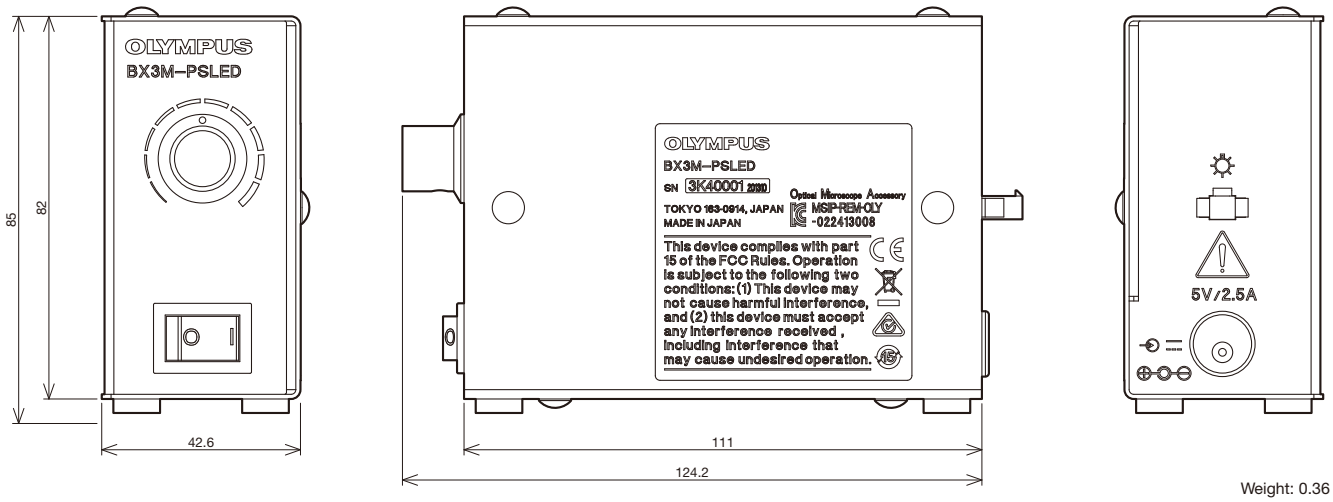
LED Lamp Housing for BX3M Transmitted




Weight: 0.5 kg

### BX3M-PSLED

Power Supply for LED Lamp House (required with the BXFM)




Weight: 0.36 kg

Unit: mm

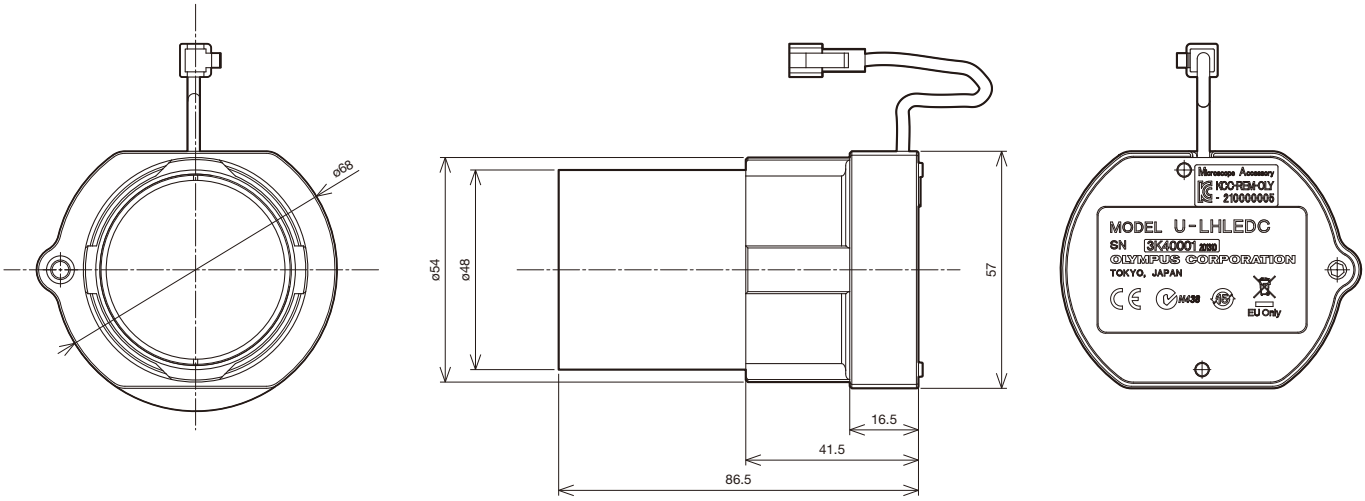
# Light Source Units

## LED Lamp Housing for the BX3 Series

The BX3M microscope utilizes a high-intensity white LED light source for both reflected and transmitted light. High-intensity light support various observation modes such as BF, DF, DIC, and polarizing.

### U-LHLEDC

LED Lamp Housing for BX3M Transmitted

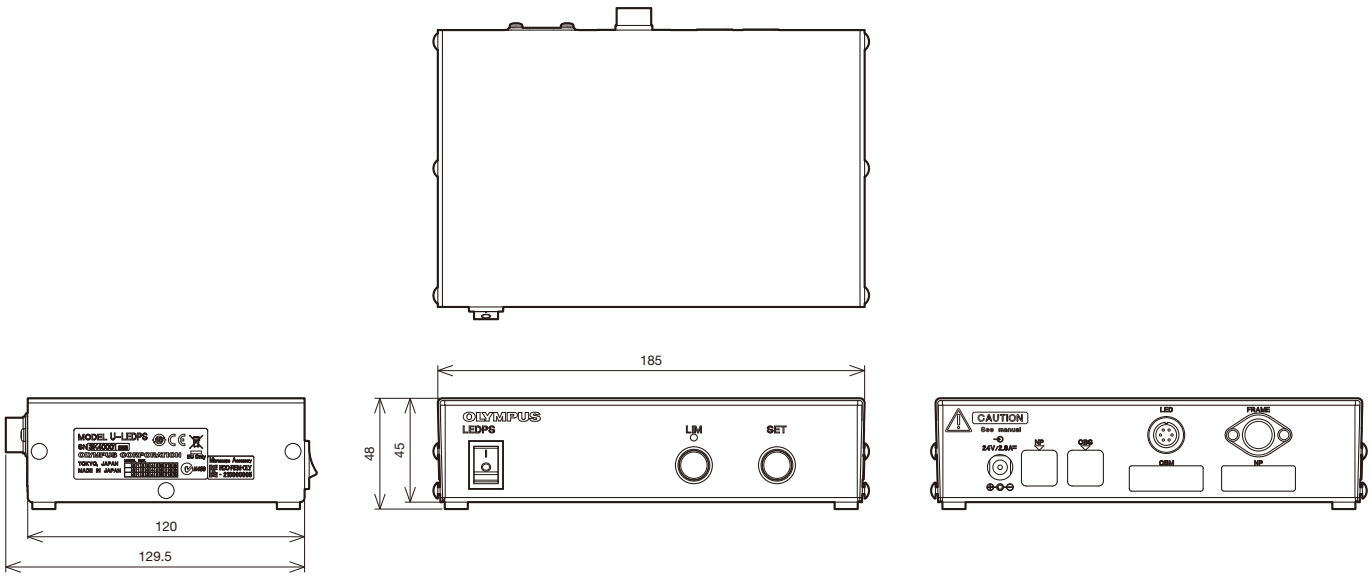



Weight: 0.5 kg

### U-LEDPS

External Power Supply for U-LHLEDC

The BX3 utilizes LED illumination that provides true color reproduction and an optimized color temperature, enabling consistent color reproduction for brightfield stains.




Weight: 0.78 kg

Unit: mm

# Light Source Units

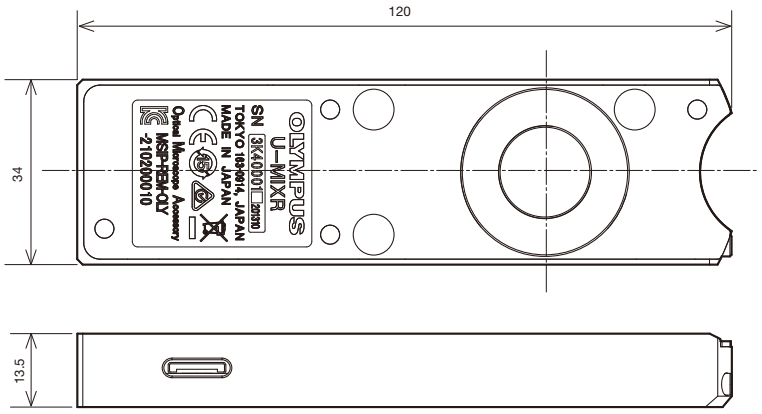
## MIX Slider for Reflected Illumination

### U-MIXR

The MIX slider provides illumination flexibility with a segmented LED source in the dark field path.
MIX observation technology combines bright field and dark field illumination methods. The LEDs in the MIX slider shine directional dark field on the sample, which is similar to traditional dark field, but with more flexibility. This combination of bright field and directional dark field is called MIX illumination, and is especially helpful to highlight defects and differentiate raised surfaces from depressions.

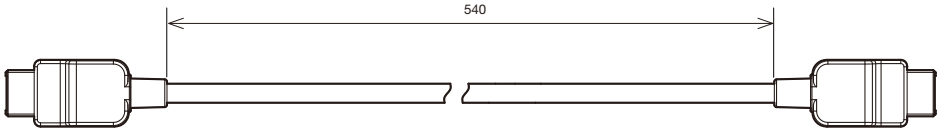
**MIX Slider Specifications**
U-MIXR

Illumination LED Light Source
Indicate Power ON/OFF, Cable connected/ unconnected
Dimension/weight 34mm×120mm×13.5mm 85g



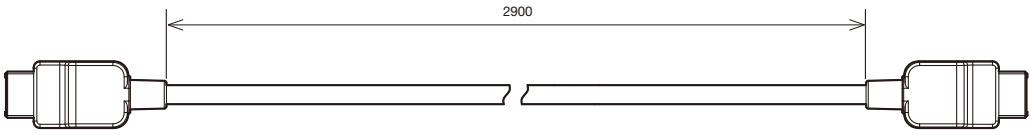

**MIX slider cable specifications**
U-MIXRCBL (for BX3M-CB)

Length 0.54m Weight 20g
Outer Dimension




**MIX slider cable specifications**
U-MIXRECBL (for BX3M-CBFM)

Length 2.9m Weight 95g
Outer Dimension



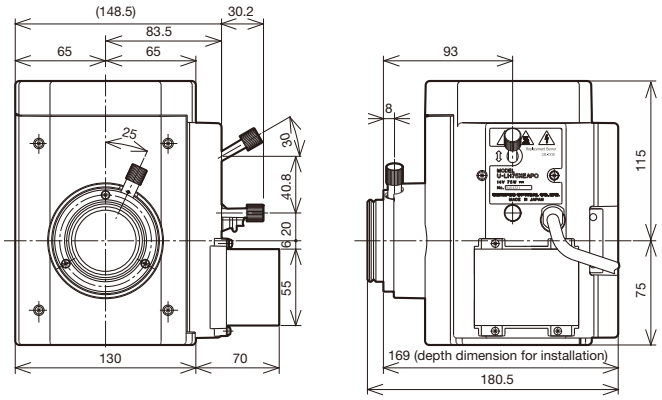

Unit: mm

# Light Source Units

## Lamp Housings

A variety of different lamp housings are available for use with different light sources, enabling users to choose the most appropriate housing for their application.
For customers who use these units in a production line, please consult your nearest Olympus representative to discuss your specific needs.

### U-LH75XEAPO
75 W Xenon Apo Lamp Housing

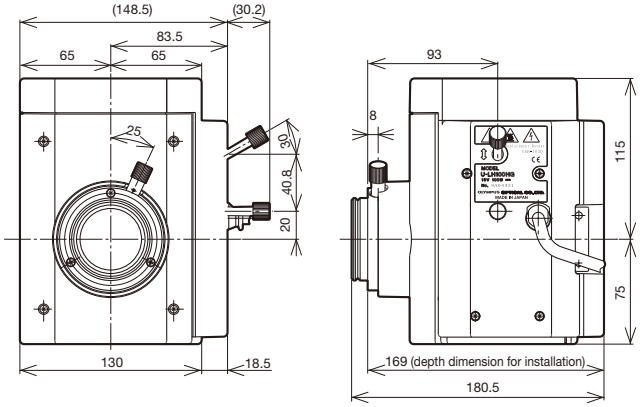



*Power supply unit (U-RX-T) and power cable (UYCP) are required for the 75 W xenon lamp housing. These items are sold separately.

Cable Length : 2,000 mm Accepted Lamp: USH-103OL Weight: 2.7 kg

### U-LH100HGAPO
100 W Mercury Apo Lamp Housing

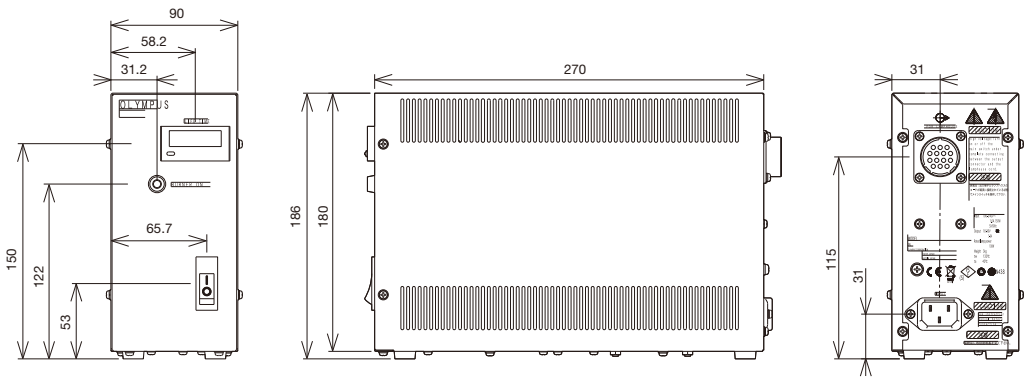
### U-LH100HG
100 W Mercury Lamp Housing




*Power supply unit (U-RFL-T) and power cable (UYCP) are required for the 100 W mercury lamp housings. These items are sold separately.

Cable Length : 2,000 mm Accepted Lamp: USH-103OL Weight: 2.7 kg

### U-RFL-T
Power Supply Unit for Mercury Lamp




Weight: Approximately 3 kg

Unit: mm

# Light Source Units

## Halogen Illumination

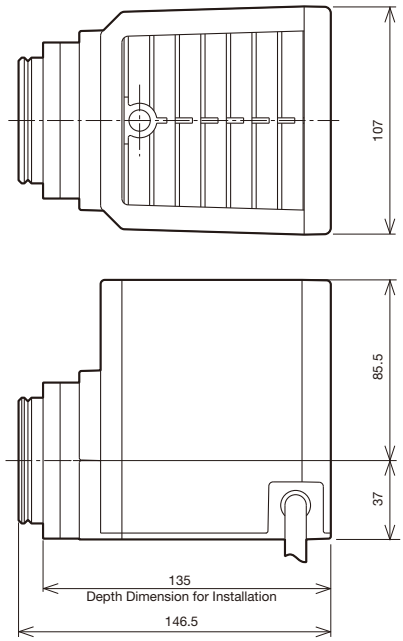
The external power supply for the 100 W halogen lamp (TH4-100/200) features an intensity adjustment knob and an on/off switch, both located close to the operator's hand for splendid comfort.

For customers who use these units in a production line, please consult your nearest Olympus representative to discuss your specific needs.

*Illumination devices for microscopes have suggested lifetimes. Periodic inspections are required. Please visit our website for details.*

### U-LH100-3/U-LH100IR/U-LH100L-3

100 W Halogen Lamp Housings




Cable Length U-LH100-3: 290 mm
U-LH100IR: 290 mm
U-LH100L-3: 800 mm

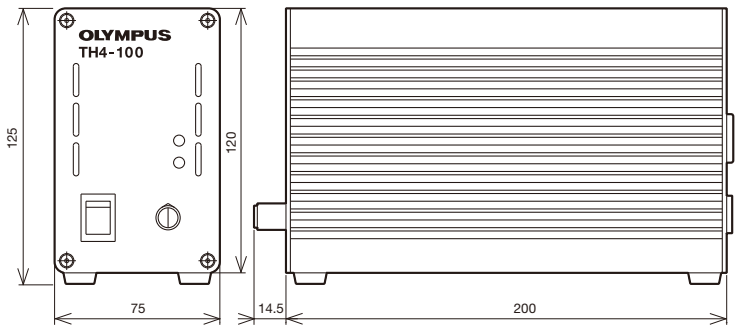
Accepted Lamp: 12V100WHAL (high-intensity lamp)
12V100WHAL-L (long-life lamp)

*External power supply (TH4-100 or TH4-200) and power cable (UYCP) are required for 100 W halogen lamp housings. These items are sold separately.

Weight: 880 g

### TH4-100/200

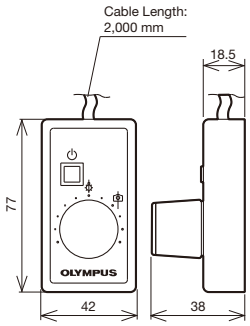
External Power Supply




Weight: 2.2 kg

### TH4-HS

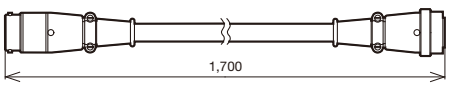
Hand Switch




Weight: 140 g

### U-RMT

Extension Cord




Weight: 200 g

Unit: mm

# Light Source Units

## Halogen Fiber Illumination Accessories

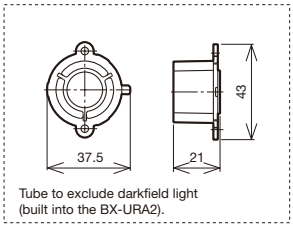
All Olympus reflected light illuminators can be used with fiber illumination.

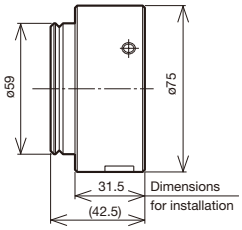
For customers who use these units in a production line, please consult your nearest Olympus representative to discuss your specific needs.

*Illumination devices for microscopes have suggested lifetimes. Periodic inspections are required. Please visit our website for details.*

### U-RCV

DF Converter for BX-URA2

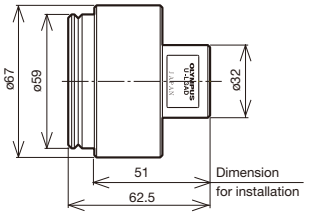



Weight: 315 g

### U-LGAD

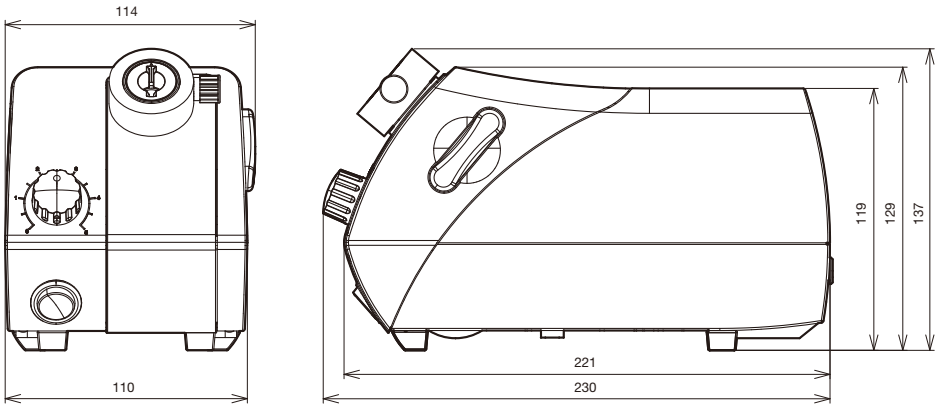
Fiber Adaptor for Reflected Light Observation




Light Guide Mount Hole ø12;  Weight: 390 g

### LG-LSLED

LED Light Source

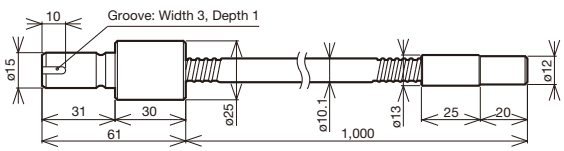



*The types of models in use varies by country.

Weight: 1.6 kg

### LG-SF

Light Guide




Weight: 210 g

Unit: mm

# Light Source Units

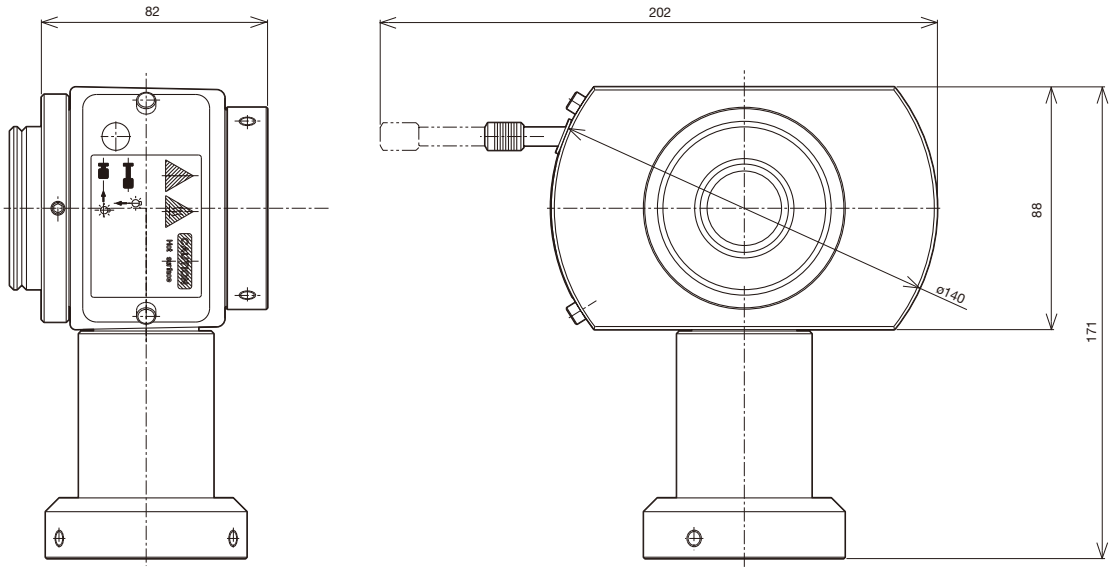
## Lamp Housing Accessory

Two lamp housings can be attached simultaneously.

For customers who use these units in a production line, please consult your nearest Olympus representative to discuss your specific needs.

**U-DULHA**

Double Lamp House Adaptor




Weight: 1.2 kg

Unit: mm

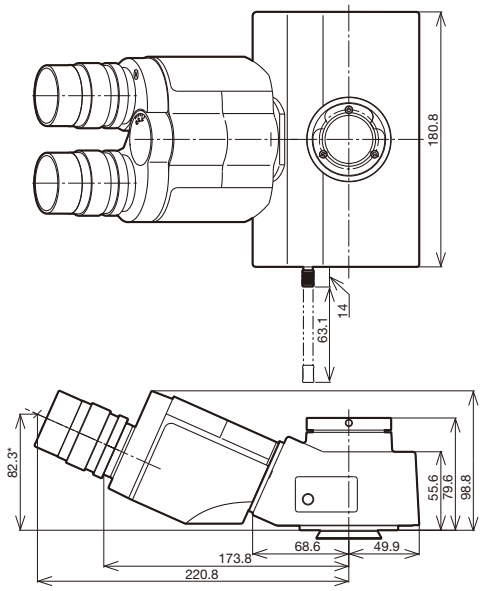
# Observation Tubes

## Super Widefield Trinocular Observation Tubes

Trinocular observation tubes with a super-wide field of view. These tubes are compatible with objectives up to FN 26.5.

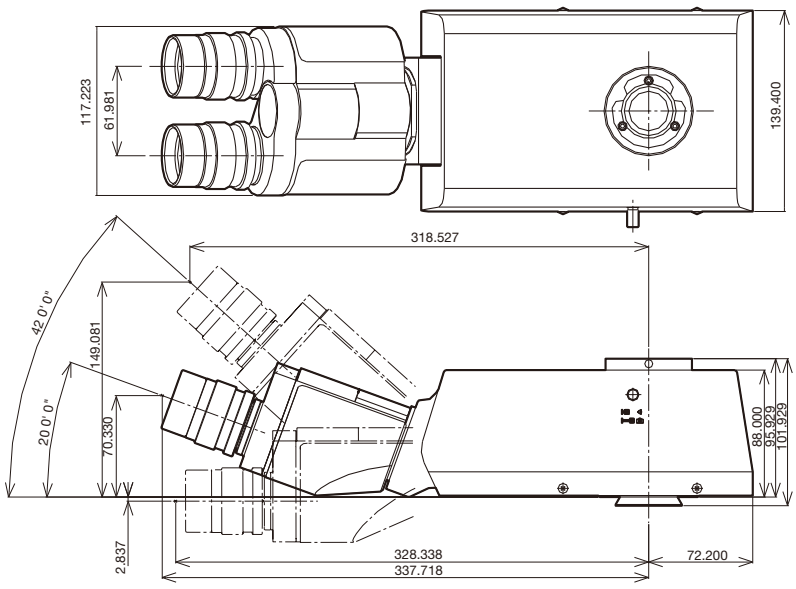
**U-SWTR-3**

Super Widefield Trinocular Tube




**MX-SWETTR**

Super Widefield Erect Image Tilting Trinocular Tube




Unit: mm

| Name | FN | Inclination Angle (degrees) | Interpupillary Distance (mm) | Light Path Selector (eyepiece/video port) | Observation Image | Weight (g) |
|---|---|---|---|---|---|---|
| U-SWTR-3 | 26.5 | 24 | 50–76 | 100/0, 20/80, 0/100 | Inverted | 2300 |
| MX-SWETTR | 26.5 | 0–42 | 50–76 | 100/0, 0/100 | Erect | 4200 |

*Length marked with an asterisk (*) may vary according to interpupillary distance. The distance for the figure shown is 62 mm.

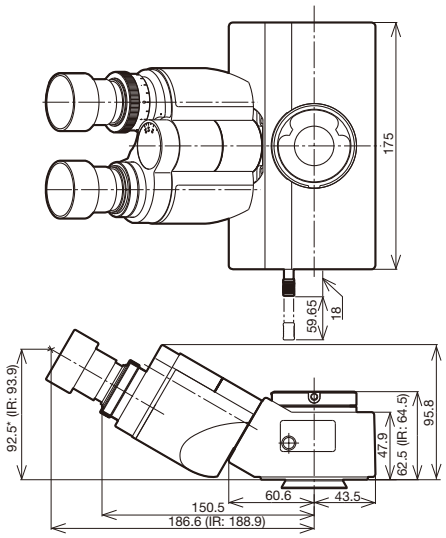
# Observation Tubes

## Widefield Trinocular Observation Tubes

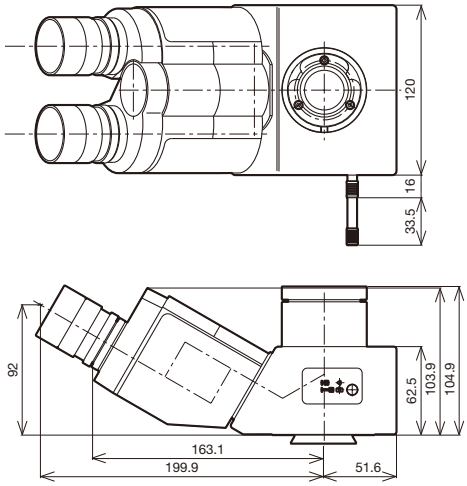
Trinocular observation tubes with wide field of view. These tubes are compatible with objectives up to FN 26.5.

**U-TR30-2**
Widefield Trinocular Tube

**U-TR30IR**
Widefield Trinocular Tube for IR




**U-ETR-4**
Widefield Erect Image Trinocular Tube




Unit: mm

| Name | FN | Inclination Angle (degrees) | Interpupillary Distance (mm) | Light Path Selector (eyepiece/video port) | Observation Image | Weight (g) |
|---|---|---|---|---|---|---|
| U-TR30-2 | 22 | 30 | 50–76 | 100/0, 20/80, 0/100 | Inverted | 1600 |
| U-TR30IR | 22 | 30 | 50–76 | 100/0, 0/100 | Inverted | 1600 |
| U-ETR-4 | 22 | 30 | 50–76 | 100/0, 0/100 | Erect | 1900 |

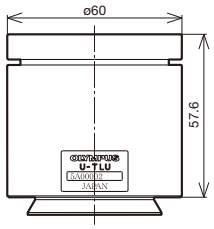
*Length marked with an asterisk (*) may vary according to interpupillary distance. The distance for the figure shown is 62 mm.

## Single Port Tube with Lens

When visual observation is not needed and only video observation is required, a single port tube with a built-in telan lens can be attached directly to the video port.

**U-TLU**
Single Port Tube with Lens

**U-TLUIR**
Single Port Tube with Lens for IR



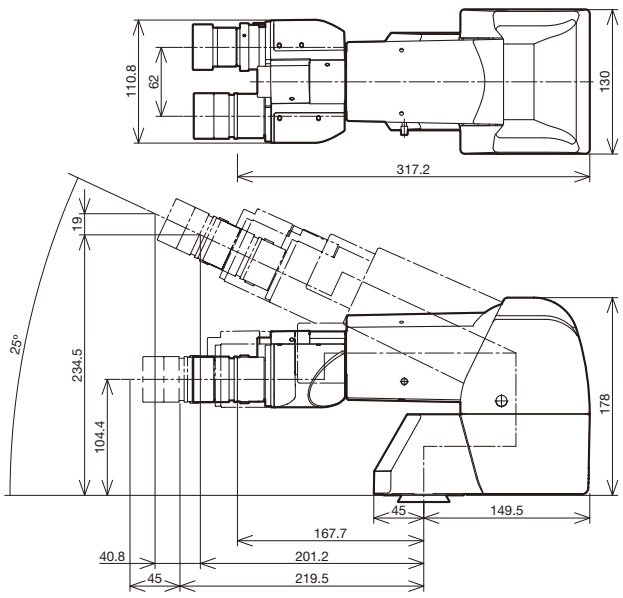

• For attachable video camera adaptors, refer to the video camera adaptors system diagram (pages 2-12 and 2-13).

Weight: 350 g Unit: mm

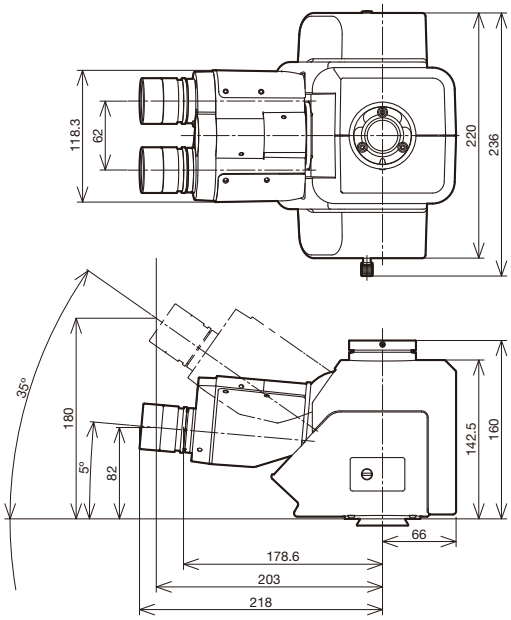
# Observation Tubes

## Tilting Binocular Tube

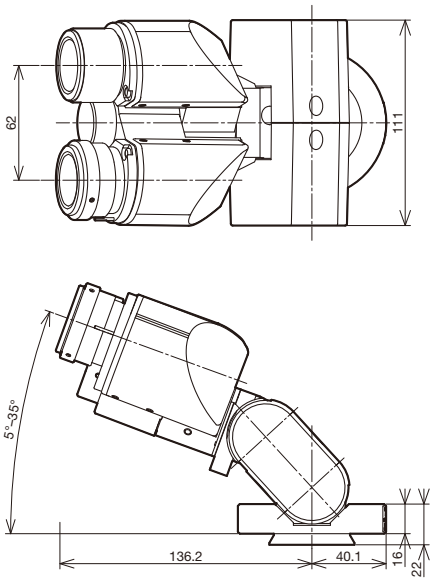
**U-TTBI**
Telescopic Tilting Binocular Tube




**U-TTR-2**
Tilting Trinocular Tube




**U-TBI-3**
Tilting Binocular Tube




Unit: mm

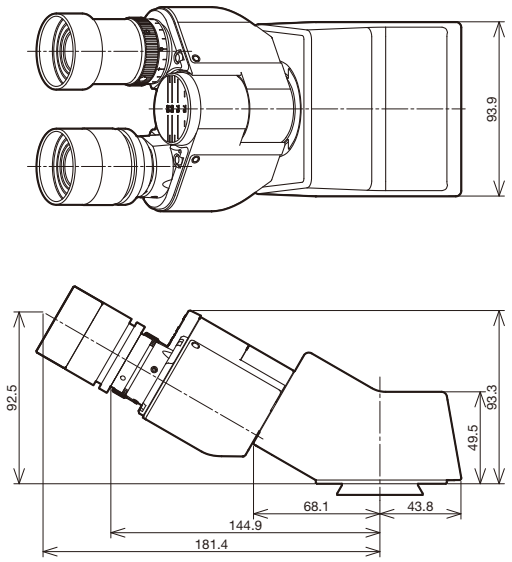
| Name | FN | Inclination Angle (degrees) | Interpupillary Distance (mm) | Light Path Selecter (eyepiece/video port) | Observation Image | Weight (g) |
|---|---|---|---|---|---|---|
| U-TTBI | 22 | 0–25 | 50–76 | NA | Inverted | 3800 |
| U-TTR-2 | 22 | 5–35 | 50–76 | 100/0, 0/100, 50/50 | Inverted | 3200 |
| U-TBI-3 | 22 | 5–35 | 50–76 | NA | Inverted | 1300 |

*When combined with the CX-RFA-2, the field number is reduced to 18.

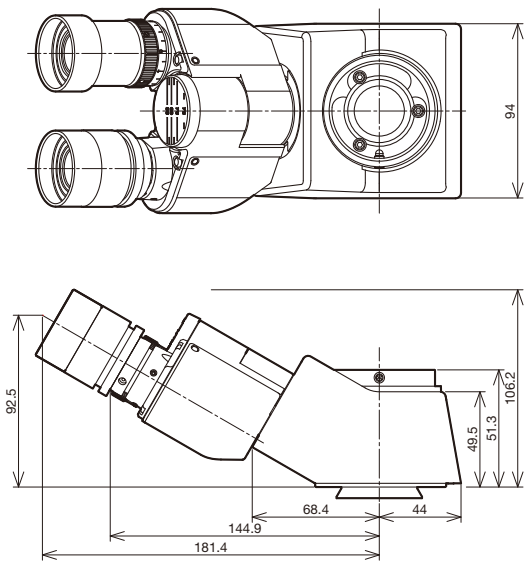
# Observation Tubes

## Binocular Tube

**U-CBI30-2**
Binocular Tube




**U-CTR30-2**
Trinocular Tube




Unit: mm

| Name | FN | Inclination Angle (degrees) | Interpupillary Distance (mm) | Light Path Selector (eyepiece/video port) | Observation Image | Weight (g) |
|---|---|---|---|---|---|---|
| U-CBI30-2 | 20, 18(*) | 30 | 48–75 | NA | Inverted | 800 |
| U-CTR30-2 | 20, 18(*) | 30 | 48–75 | NA | Inverted | 900 |

*When combined with the CX-RFA-2, the field number is reduced to 18.

# Condenser Units

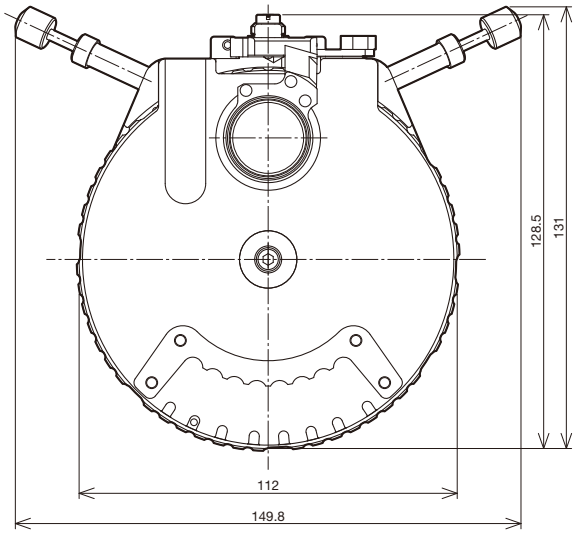
## Universal Condenser

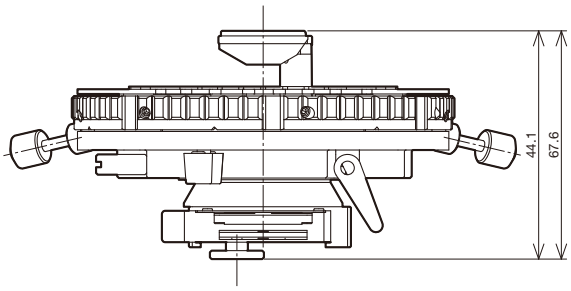
### U-UCD8-2

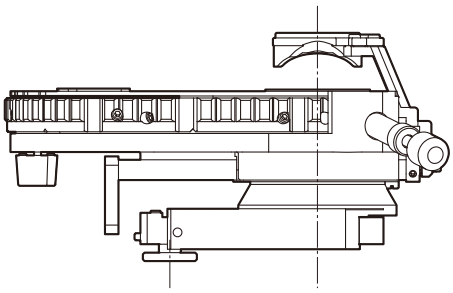
The universal condenser contains 8 optical element slots.

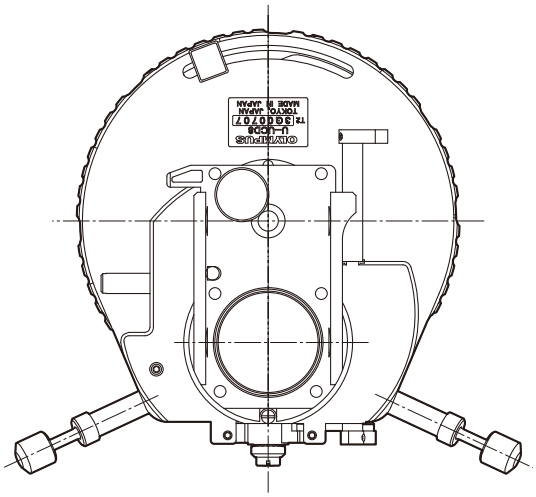
*Optical elements are required. Please consult your local Olympus representative for information about different optical element combinations.

U-UCD8-2





Weight: 700 g

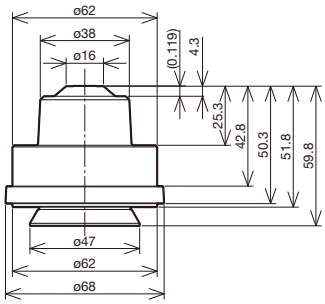
Unit: mm

# Condenser Units

## Condenser

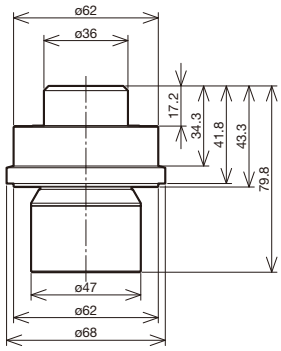
Condensers for different applications: brightfield, darkfield, and long working distance.

**U-AC2-7**
Abbe Condenser



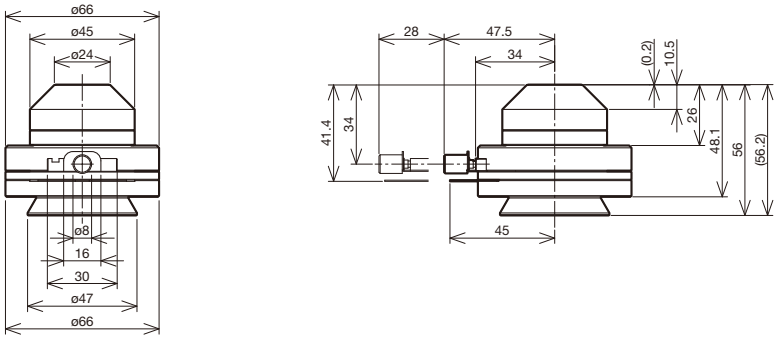

Weight: 174 g

**U-LWCD**
Long Working Distance Condenser




Weight: 380 g

**WI-OBCD**
Long Working Distance Oblique Condenser




Weight: 530 g

Unit: mm

# Intermediate Tubes and Accessories

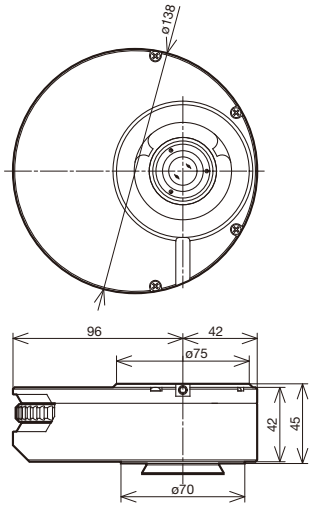
## Intermediate Tubes

Olympus makes various accessories to satisfy a wide variety of observation needs.

### U-CA

Magnification Changer

Provides 1X, 1.2X, 1.6X, and 2X intermediate magnifications.

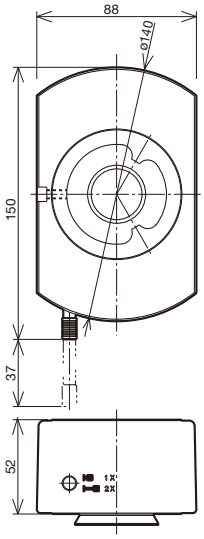



Weight: 1.3 kg

### U-ECA

Magnification Changer 2C

Provides 1X and 2X intermediate magnifications.

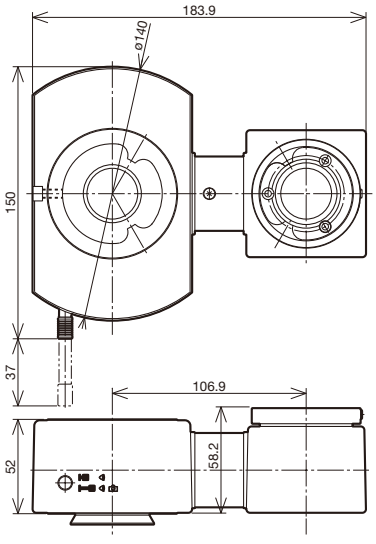



Weight: 1.3 kg

### U-TRU

Trinocular Intermediate Attachment

The intermediate attachment divides the light path,
enabling users to attach both digital and video cameras.




BI:PT=100:0/20:80

Weight: 1.3 kg

Unit: mm

# Intermediate Tubes and Accessories

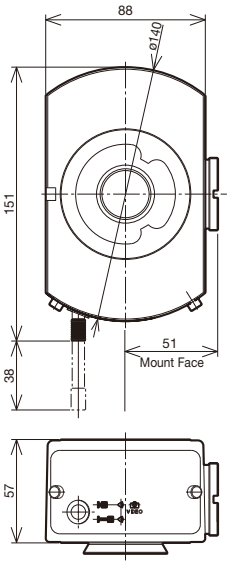
## Intermediate Tubes

Olympus makes various accessories to satisfy a wide variety of observation needs.

### U-DP

Dual Port

Use this intermediate tube to divide the light path.




Weight: 1 kg

*Light path selector via mirror unit*

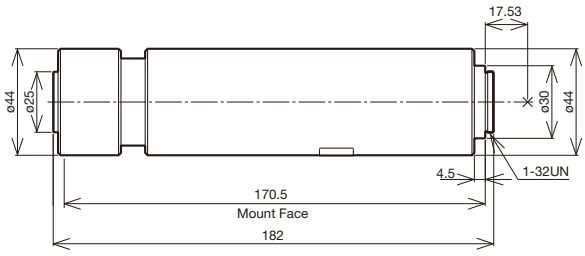
Transmitted Side Port: Side Port = 100:0

Transmitted Side Port: Side Port = 70:30 (with use of U-MBF3)

### U-DP1XC

Dual Port 1X

Combine this component with the U-DP to obtain a 1X image.

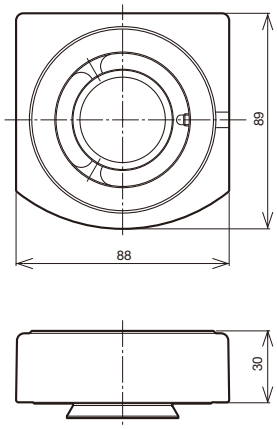



Weight: 500 g

### U-EPA2

Eyepoint Adjuster

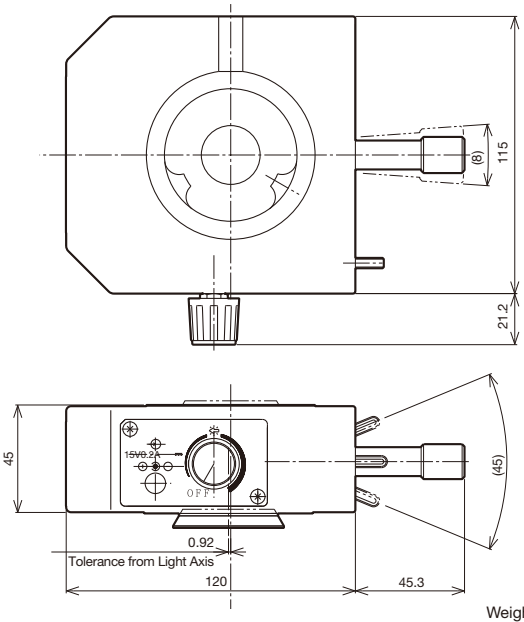
This component rases the eyepoint by 30 mm.




Weight: Approximately 500 g

### U-APT

Arrow Pointer




Weight: 1.2 kg

Unit: mm

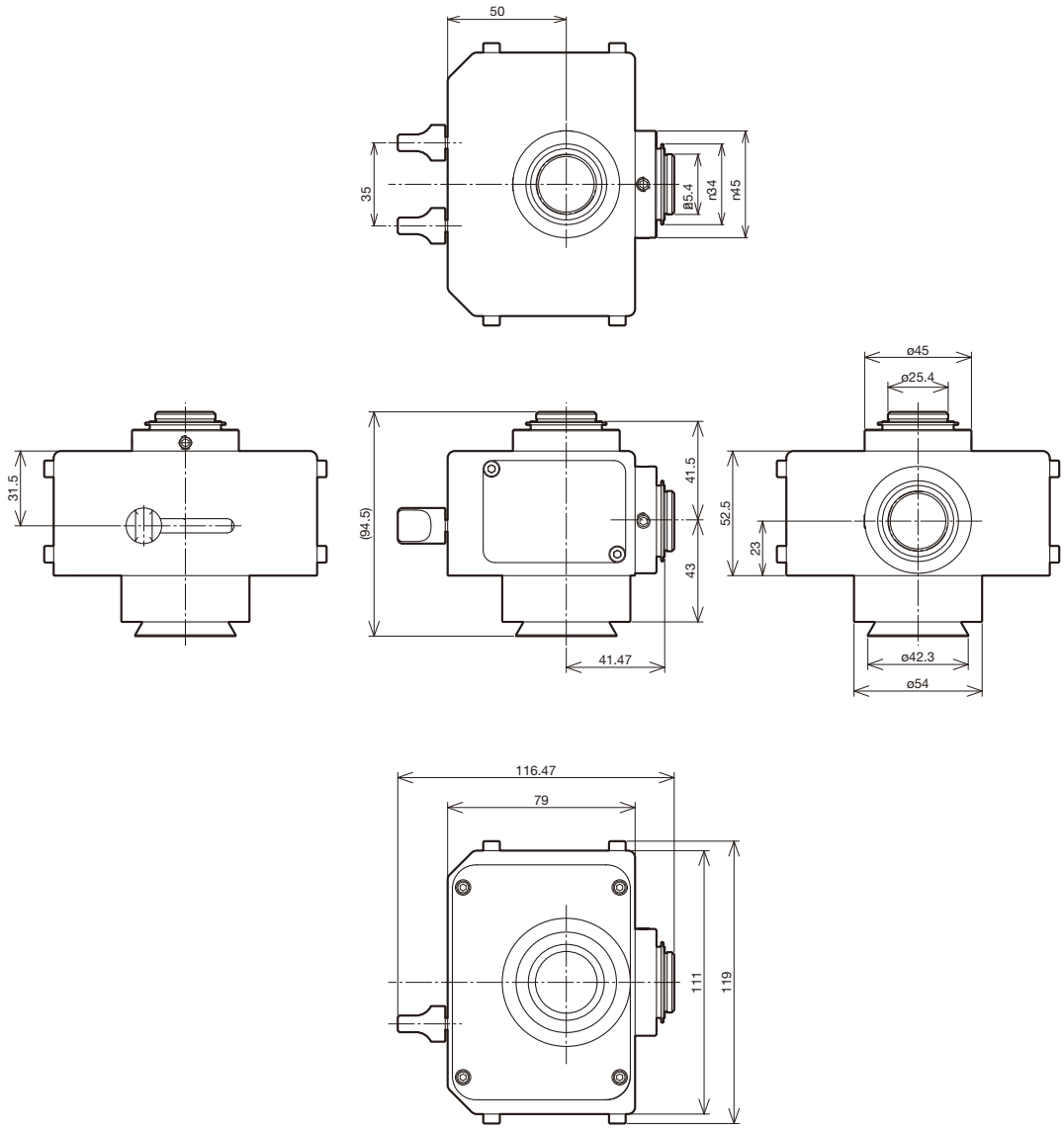
# Intermediate Tubes and Accessories

## Dual port tube with C-mounts

### U-DPCAD

The dual camera port enables the user to attach two cameras.

U-DPCAD



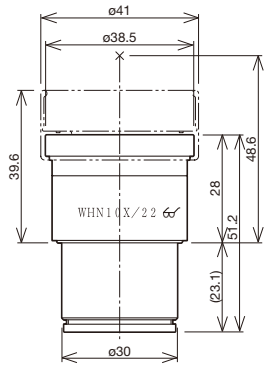

Weight: 0.9 kg Unit: mm

# Eyepieces

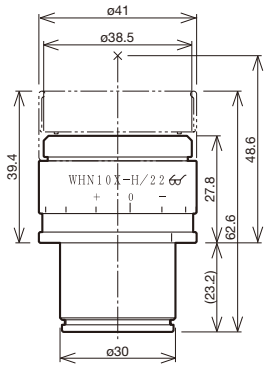
## Eyepieces

Eyepieces for the UIS2 optical system.

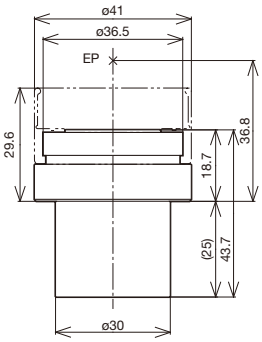
**WHN10X**
Widefield Eyepiece



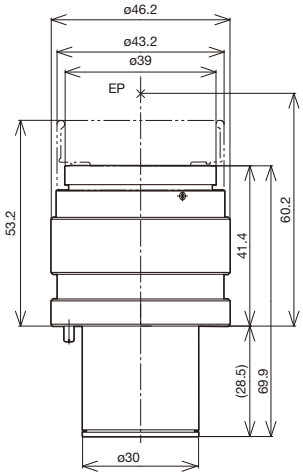

**WHN10X-H**
**CROSSWHN10X**
Widefield Eyepieces




**WH15X**
Widefield Eyepiece




**SWH10X-H**
**MICROSWH10X**
**CROSSSWH10X**
Super Widefield Eyepieces




unit: mm

| Name | FN | Diopter Adjustment Range (1/m) | Micrometer Diameter (mm) | Weight (g) | Remarks |
|---|---|---|---|---|---|
| WHN10X | 22 | — | 24 | 90 | |
| WHN10X-H | 22 | -8–+5 | 24 | 170 | With adjustable diopter |
| CROSSWHN10X | 22 | -8–+5 | — | 170 | With cross lines and adjustable diopter |
| WH15X | 14 | — | 24 | 90 | |
| SWH10X-H | 26.5 | -8–+2 | — | 210 | With adjustable diopter |
| MICROSWH10X | 26.5 | -8–+2 | — | 210 | With micrometer and adjustable diopter |
| CROSSSWH10X | 26.5 | -8–+2 | — | 210 | With cross lines and adjustable diopter |

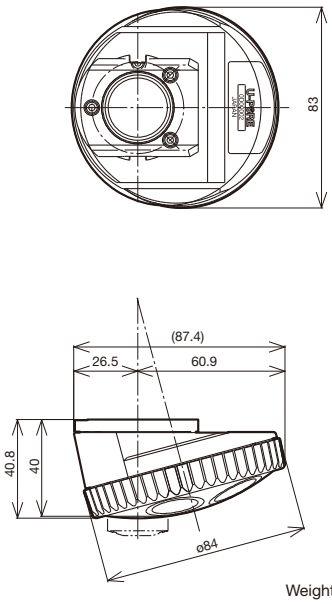
*EP=eyepoint

# Revolving Nosepieces

## Revolving Nosepieces for BF Objectives

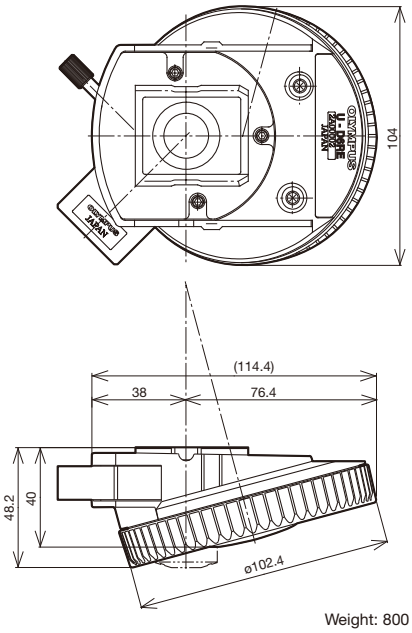
Users can choose from the 6 revolving nosepieces for BF objectives shown below. For motorized nosepieces, please refer to the motorized unit page.

### U-5RE-2
Quintuple Revolving Nosepiece



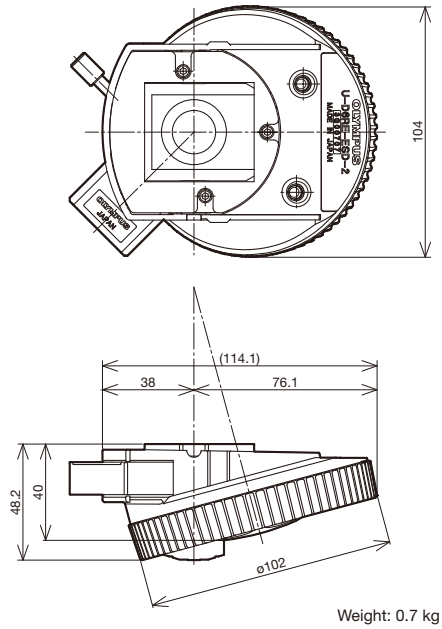

Weight: 520 g

### U-D6RE
Septuple Revolving Nosepiece with Slider Slot for DIC



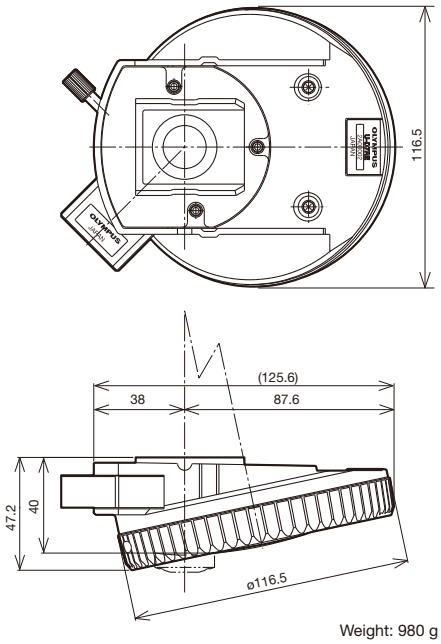

Weight: 800 g

### U-D6RE-ESD
ESD-Resistant Sextuple Revolving Nosepiece with Slider Slot for DIC



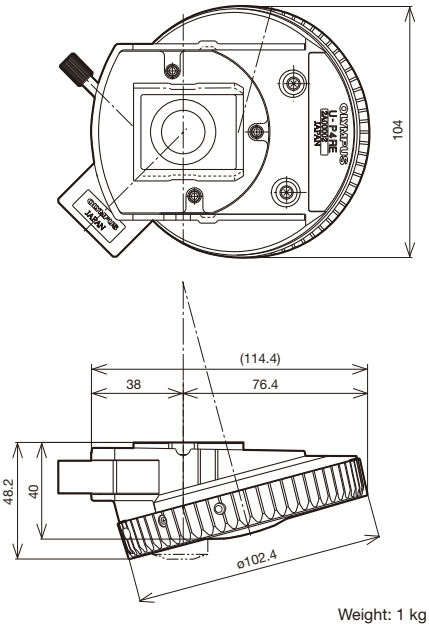

Weight: 0.7 kg

### U-D7RE
Sextuple Revolving Nosepiece with Slider Slot for DIC



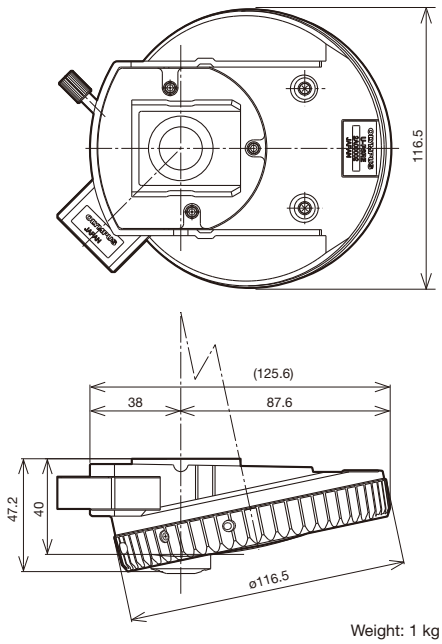

Weight: 980 g

### U-P4RE
Centerable Quadruple Revolving Nosepiece with Slider Slot for DIC




Weight: 1 kg

### U-P6RE
Centerable Sextuple Revolving Nosepiece with Slider Slot for DIC




Weight: 1 kg

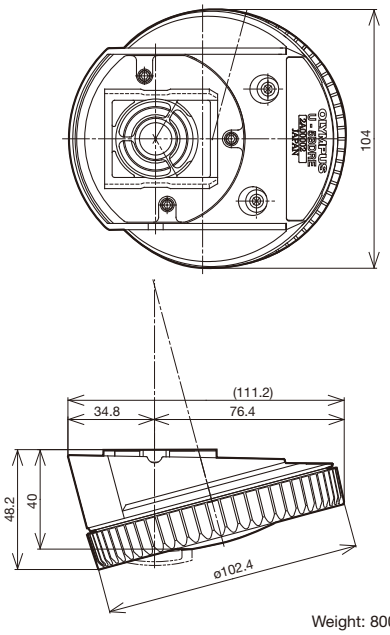
Insert the DIC dummy when not using the DIC slider. unit: mm

# Revolving Nosepieces

## Revolving Nosepieces for BF/DF Objectives

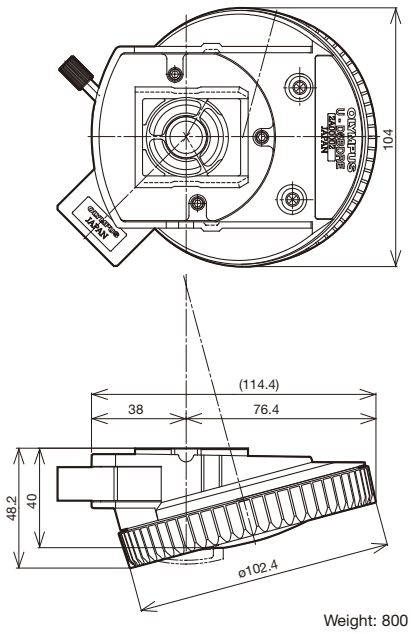
Users can choose from the following 3 types of revolving nosepieces for BF/DF objectives. To attach brightfield objectives, users must use the BF adaptor (BD-M-AD). For motorized nosepieces, please refer to the motorized unit page.

**U-5BDRE**
Quintuple Revolving Nosepiece for BF/DF




Weight: 800 g

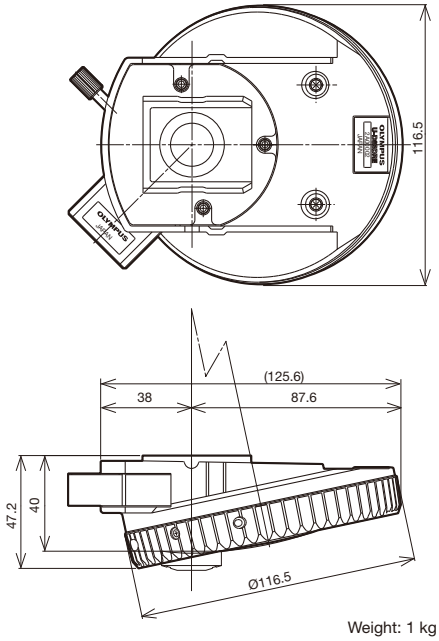
**U-D5BDRE**
Quintuple Revolving Nosepiece for BF/DF with Slider Slot for DIC




Weight: 800 g

**U-P5BDRE**
Centerable Quintuple Revolving Nosepiece with Slider Slot for DIC

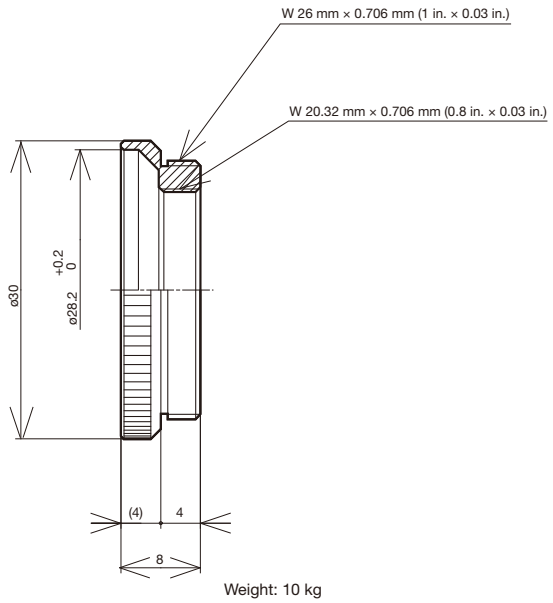
**U-D6BDRE**
Sextuple Revolving Nosepiece for BF/DF with Slider Slot for DIC




Weight: 1 kg

Insert the DIC dummy when not using the DIC slider.

**BD-M-AD**
Adaptor to Mount BF Objectives




Weight: 10 kg

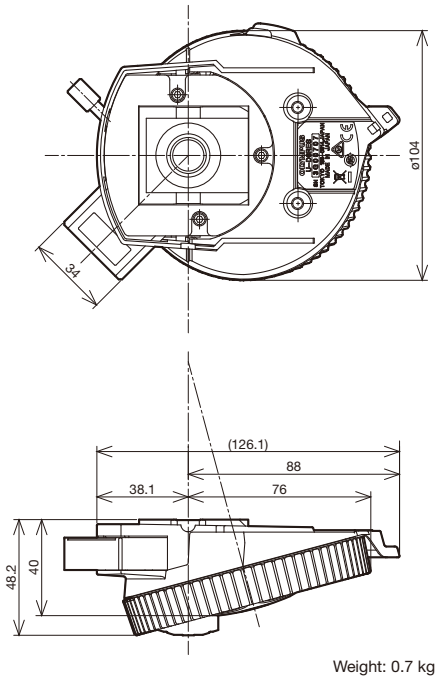
unit: mm

# Revolving Nosepieces

## Coded Sextuple Revolving Nosepiece

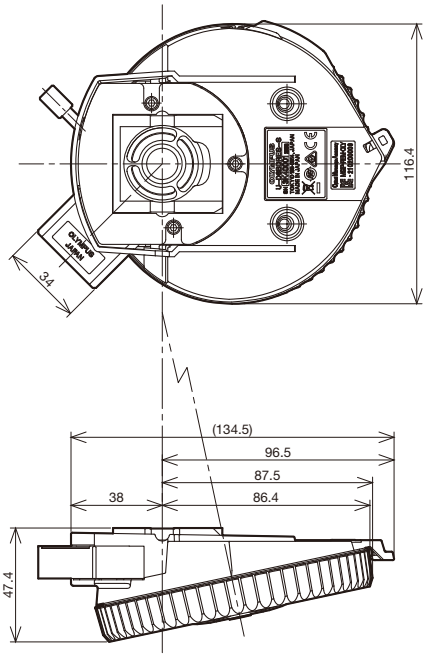
Coded nosepieces for BF, DF, and DIC applications.

**U-D6RES**
Coded Sextuple Revolving Nosepiece with Slider Slot for DIC



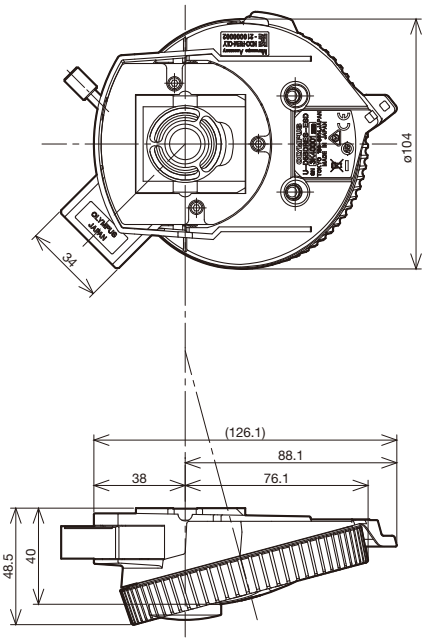

Weight: 0.7 kg

**U-D6BDRES-S**
Coded Sextuple BF/DF Revolving Nosepiece with Slider Slot for DIC



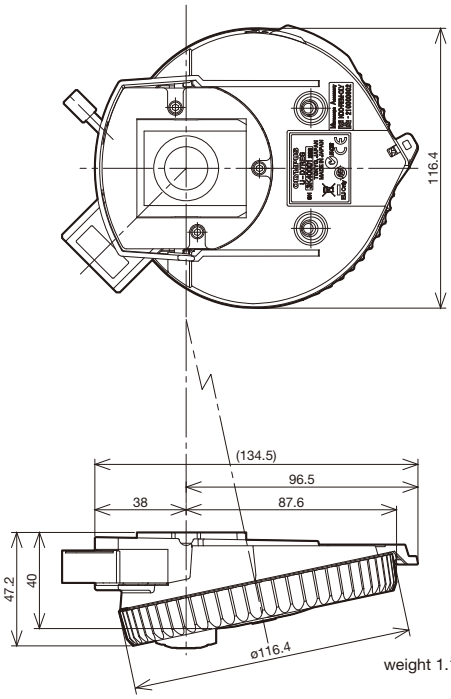

Weight: 0.9 kg

**U-D5BDRES-ESD**
ESD-Resistant Coded Quintuple BF/DF Revolving Nosepiece with Slider Slot for DIC




Weight: 0.75 kg

**U-D7RES**
Coded Septuple Nosepiece with Slider Slot for DIC




weight 1.1 kg

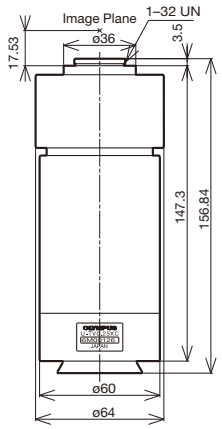
unit: mm

# Video Camera Adaptors

## C-Mount Video Camera Ports

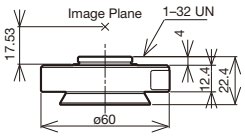
Enables users to directly attach a C-mount video camera. Five types are provided: 1X, 0.63X, 0.5X, 0.35X and 0.25X. All models feature a focus adjustment function.

**U-TV0.25XC**
C-Mount Video Port with 0.25X Lens



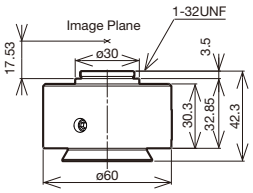

Weight: 1.2 kg

**U-TV0.35XC-2**
C-Mount Video Port with 0.35X Lens



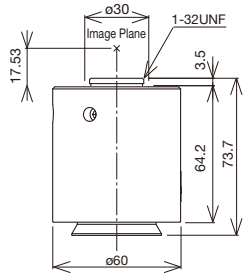

Weight: 100 g

**U-TV0.5XC-3**
C-Mount Video Port with 0.5X Lens



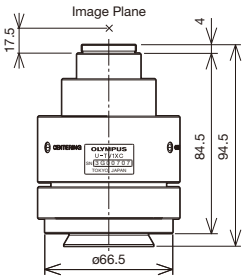

Weight: 200 g

**U-TV0.63XC**
C-Mount Video Port with 0.63X Lens

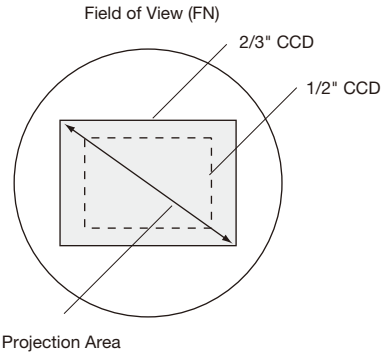



Weight: 430 g

**U-TV1XC**
C-Mount Video Port with 1X Lens




Weight: 300 g




| Video Camera Adaptor (projection lens) | Projection Magnification | Projection Area (FN) | | |
|---|---|---|---|---|
| | | 2/3" CCD | 1/2" CCD | 1/3" CCD |
| U-TV1X-2 | 1X | 11 | 8 | 6 |
| U-TV1XC | 1X | 11 | 8 | 6 |
| U-TV0.63XC | 0.63X | 17.5 | 12.7 | 9.5 |
| U-TV0.5XC-3 | 0.5X | 22 | 16 | 12 |
| U-TV0.35XC-2 | 0.35X | — | 22 | 17.1 |
| U-TV0.25XC | 0.25X | — | — | 24 |

$$\text{Practical Field of View (mm)} = \frac{\text{Projection Area (FN)}}{\text{Objective Magnification}}$$

Adjust the focus on the video camera adaptor to help keep the eyepiece image in focus when switching magnification.
Typically, the video camera adaptor is focused by switching to a low magnification after focusing at a high magnification.

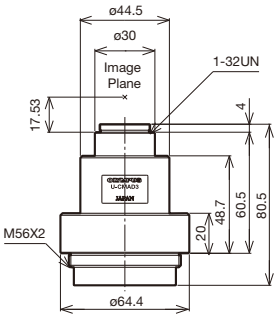
Unit: mm

# Video Camera Adaptors

## Video Camera Mount Adaptors

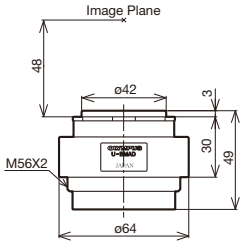
These video camera mount adaptors enable users to attach cameras with C, bayonet, Sony, and F-mounts. Use these adaptors with the U-TV1X-2. Focus by amount of screwing into U-TV1X-2.

**U-CMAD3**
C-Mount Adaptor



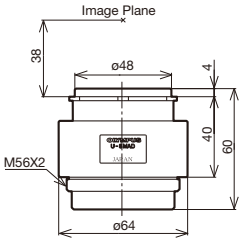

Weight: 165 g

**U-BMAD**
Bayonet Mount Adaptor



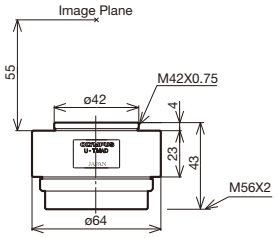

Weight: 80 g

**U-SMAD**
Sony Mount Adaptor



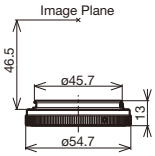

Weight: 90 g

**U-TMAD**
T-Mount Adaptor




Weight: 70 g

**U-FMT**
F/T-Mount Adaptor *



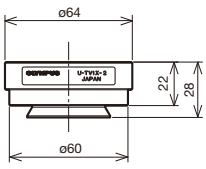

*This adaptor must be combined with U-TMAD.

Weight: 30 g

## Video Camera Port

This port can be attached directly to the trinocular observation tube as well as to the single port tube with lens.

**U-TV1X-2**
Video Port 1X




Weight: 80 g

Unit: mm

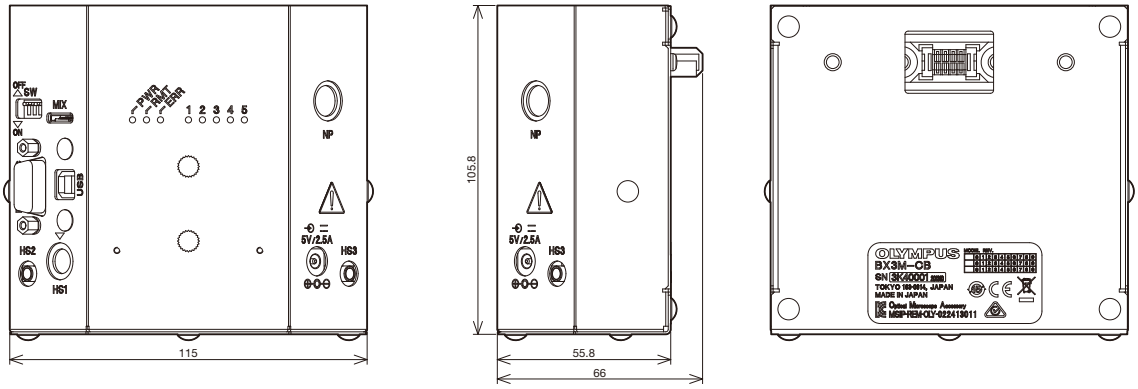
## Control Box for the BX53M/BXFM Microscope

### BX3M-CB

Control Box for the BXFM Microscope

The control box can be connected to a PC using an RS232 or USB2.0 cable (attached to the microscope frame).

*Please consult your local Olympus representative for detailed system configuration and combination information.



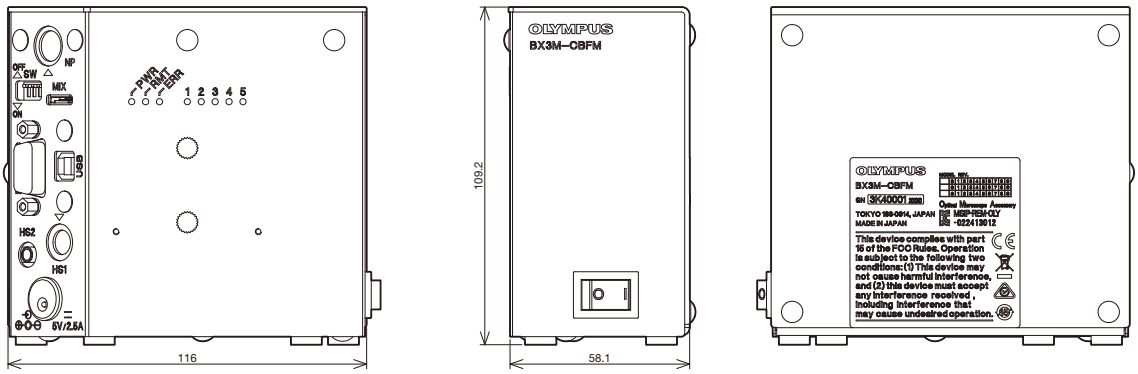

Weight: 0.49 kg

### BX3M-CBFM

Control Box for the BX53M Frame

The control box can be connected to a PC using an RS232 or USB2.0 cable (attached to the microscope frame).

*Please consult your local Olympus representative for detailed system configuration and combination information.

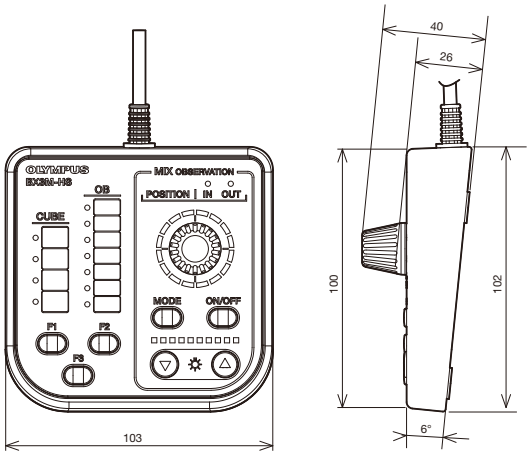



Weight: 0.67 kg

### BX3M-HS

Hand Switch

MIX observation control, indicator of coded hardware, programmable function button of software.

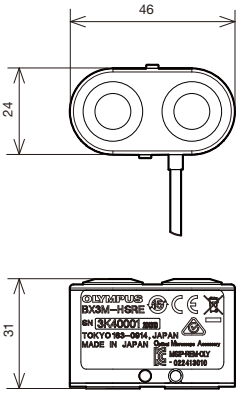



Weight: 200g

### BX3M-HSRE

Hand Switch

Motorized nosepiece rotation




Weight: 60g

Unit: mm

# Motorized Units

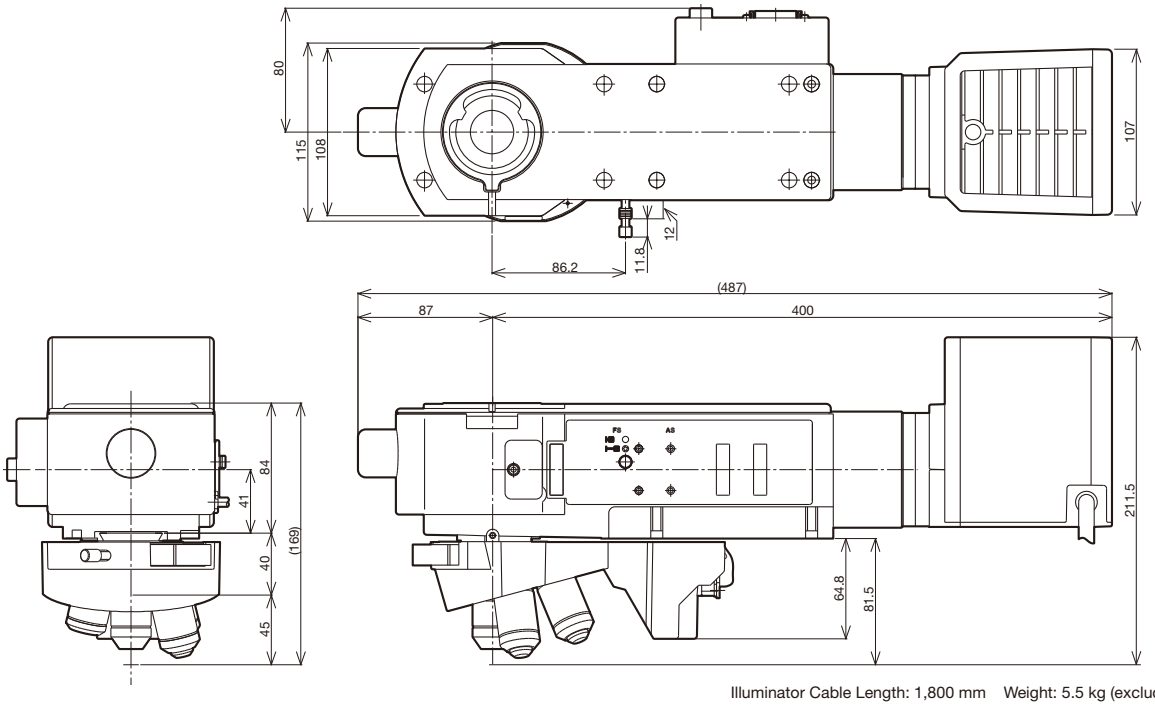
## Motorized Universal Reflected Illminator for the BX2 Series

These various motorized units are used to help automate equipment.

### BX-RLAA + U-D6REMC + U-LH100-3

Motorized BF/DF Reflected Light Illuminator + Motorized Nomarski DIC Sextuple Revolving Nosepiece + 100 W Halogen Lamp Housing

These components motorize the exchange of objectives, the selection of brightfield and darkfield observation, and the opening and closing of the aperture diaphragm. The BX-UCB control unit has an RS232C connector, enabling control via a PC. For instructions on how to attach an illuminator, please refer to the mounting directions for the BX-RLA2.



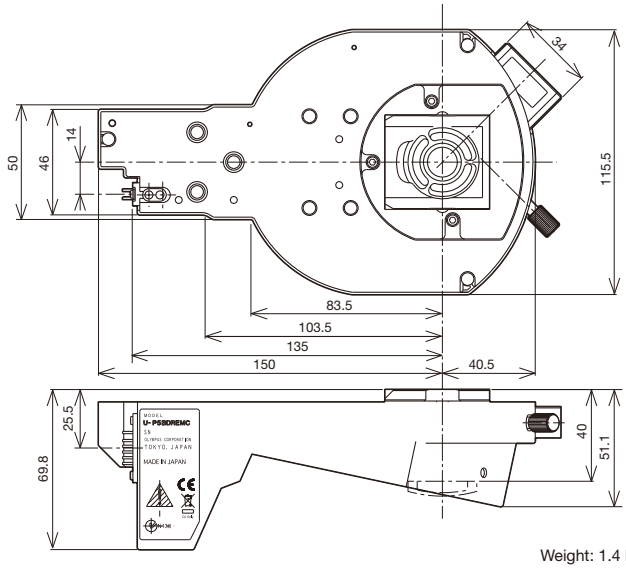

Illuminator Cable Length: 1,800 mm  Weight: 5.5 kg (excludes objectives)

Unit: mm

## Motorized Units

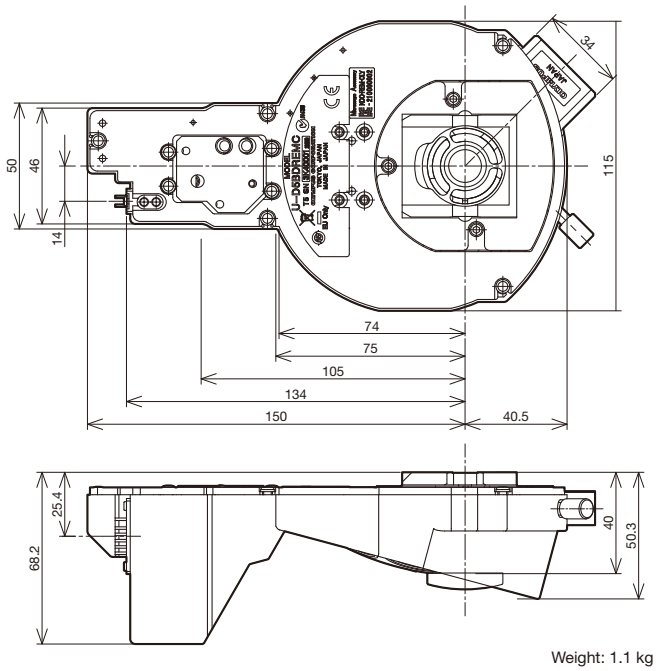
These various motorized units are used to help automate equipment.

**U-P5BDREMC**
Motorized Centerable Quintuple BD Revolving Nosepiece with Slider Slot for DIC
**U-D6BDREMC**
Motorized Sextuple BD Revolving Nosepiece with Slider Slot for DIC




Weight: 1.4 kg

**U-D5BDREMC**
Motorized Quintuple BD Revolving Nosepiece with Slider Slot for DIC
**U-D6REMC**
Motorized Sextuple Revolving Nosepiece with Slider Slot for DIC
**U-P5REMC**
Motorized Centerable Quintuple Revolving Nosepiece with Slider Slot for DIC




Weight: 1.1 kg

Unit: mm

# Motorized Units

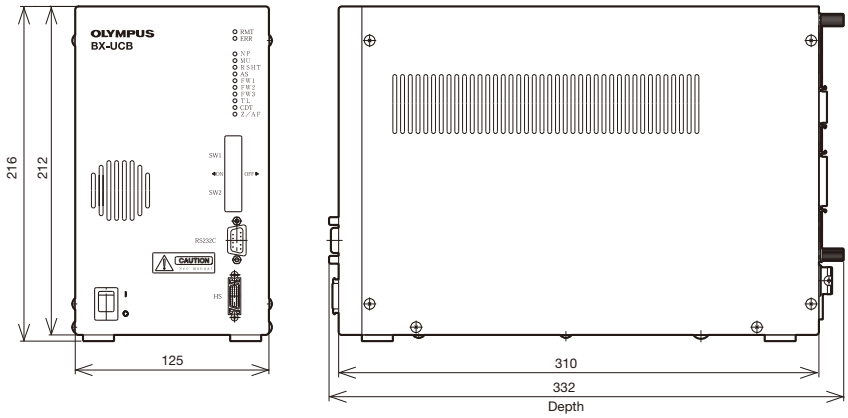
## Control Box for the BX2 Series

These various motorized units are used to help automate equipment.

### BX-UCB

Control Unit

Motorized units, including the motorized illuminator and auto focus unit, can be totally controlled from the BX-UCB.

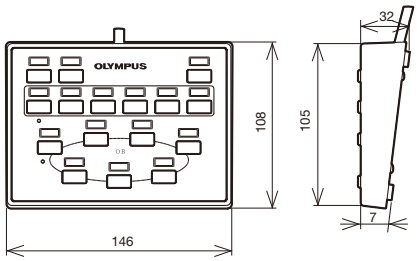



*Extension cord U-RMT (1,700 mm) should be used to connect the lamp housing (U-LH100-3) to the BX-UCB.

Weight: 1.0 kg

### U-HSTR2

Hand Switch




Cable Length 2,000 mm  Weight: 370 g

Unit: mm

# Motorized Units

## Motorized Units for the BX2 Series

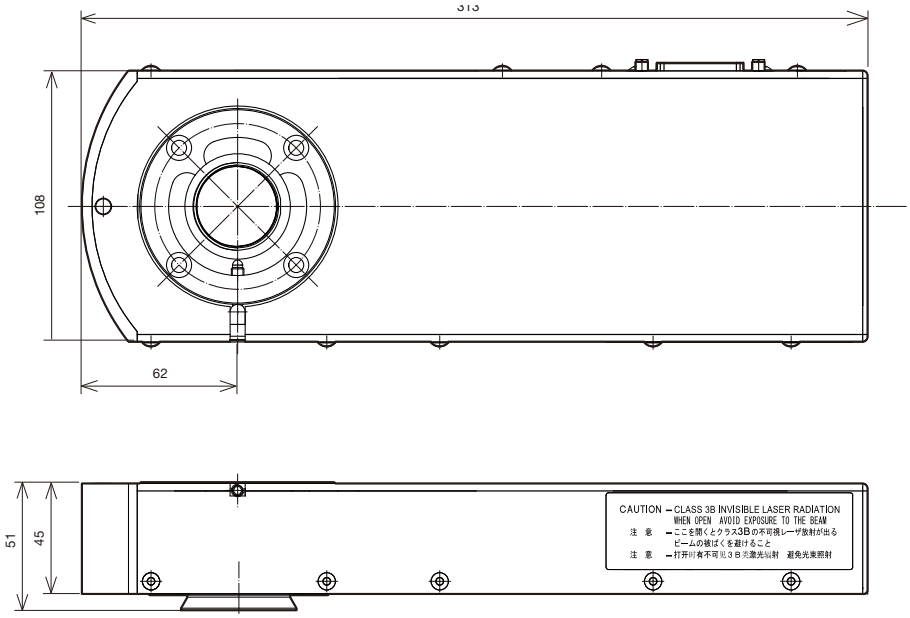
These various motorized units are used to help automate equipment.

### U-AFA2M-VIS

Active Auto Focus Unit

This unit features a 785 nm auto focus laser light source. The multiple-spot sensor enables fast, stable focusing on specimens with variable height differences.

*Class 1 laser product




*Consult your local Olympus dealer about the motorized focus.

Weight: 2.6 kg

Cable

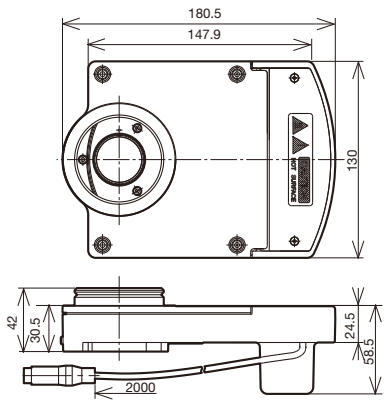
AFA2M-CBL2M Weight: 0.23 kg Length: 2 m

AFA2M-CBL3M Weight: 0.36 kg Length: 3 m

### U-FWR

Motorized Reflected Filter Wheel

With this filter wheel, quickly switch between 6 different filters.




Weight: 1.0 kg

Unit: mm

# Motorized Units

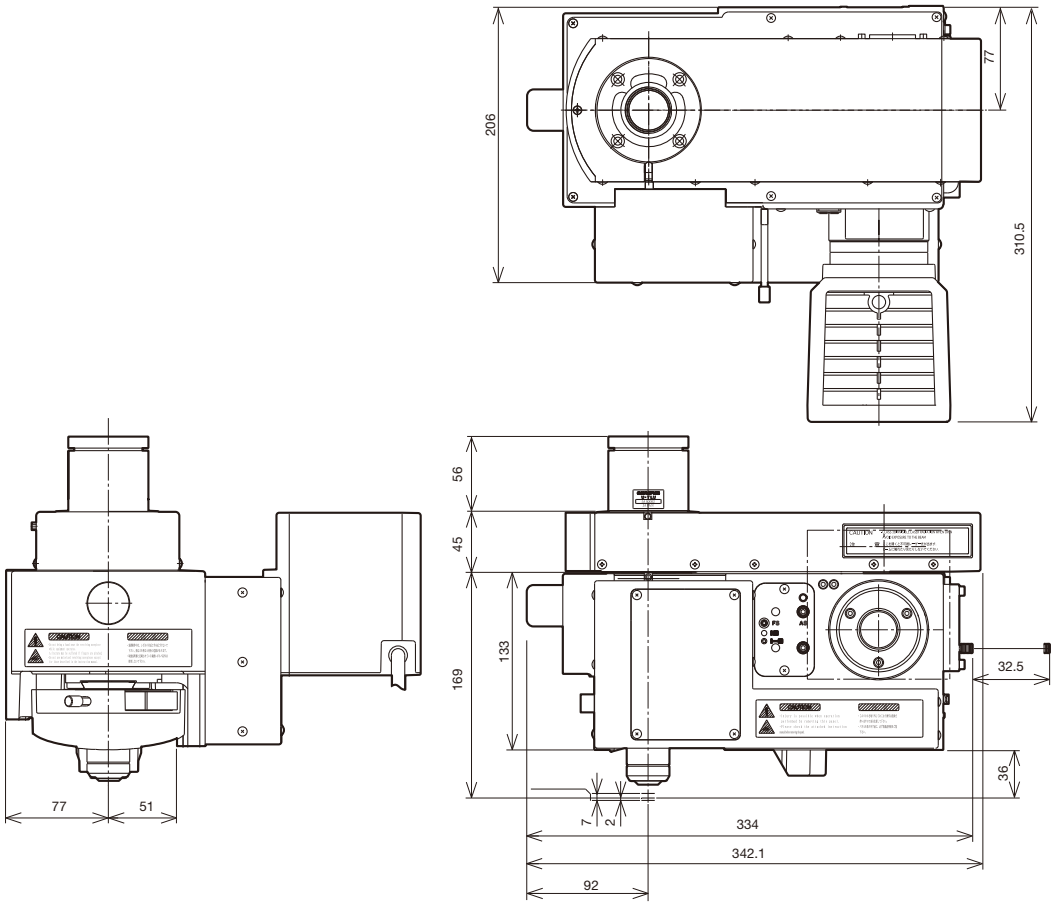
## Motorized Modular Microscope

With these components, users can integrate motorized microscope units into their equipment. Motorized operations, such as moving the nosepiece up and down, changing objectives, opening and closing the aperture diaphragm, and changing between brightfield and darkfield observation modes, are made possible using these components. Several of these operations can be totally controlled from an external unit by adding an auto focus (AF) unit.

### BXFMA-F

Motorized Illumination with Power Focus

This configuration combines the active auto focus unit (U-AFA2M-VIS), a single port tube with lens (U-TLU), a lamp housing, a motorized nosepiece, and objectives.

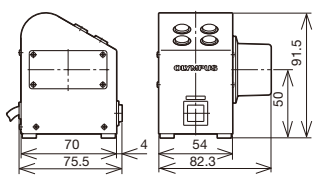



*Please consult your local Olympus representative for information about the mounting dimensions.

Weight: 13 kg (BXFMA-F frame 7.6 kg)

### U-FH

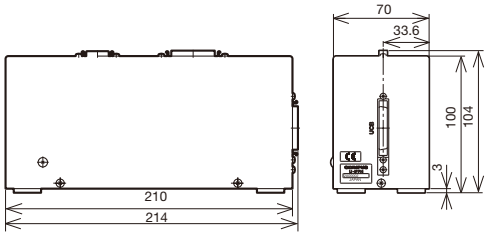
Focus Adjustment Knob Unit




Weight: 760 g

### U-IFFH

Focus Adjustment Knob Interface




Weight: 1450 g

Unit: mm

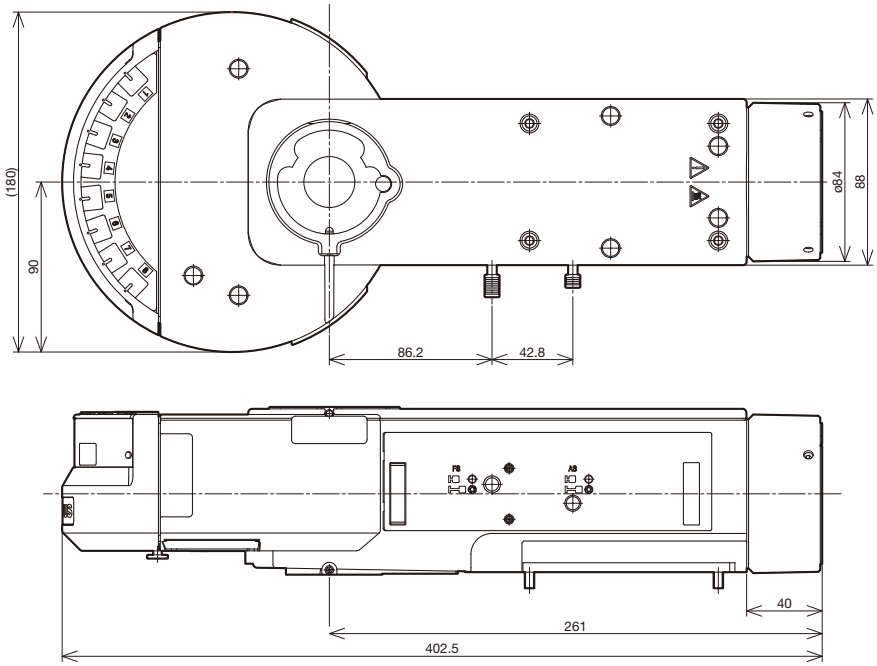
# Motorized Units

## Motorized Units for the BX3 Series

The flexibility of the motorized fluorescence illuminator accommodates multi color stained specimens. The 8-position mirror unit permits quick changeover of fluorescence colors.

### BX3-RFAA

Motorized Fluorescence Illuminator



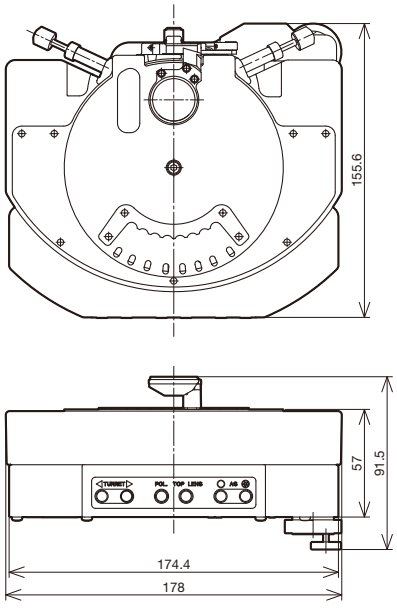

Weight: 4.2 kg

### BX3-UCD8A

Motorized Universal Condenser

The motorized universal condenser integrates a variety of optical elements to accommodate transmitted light techniques including brightfield, DIC, and phase contrast observation.

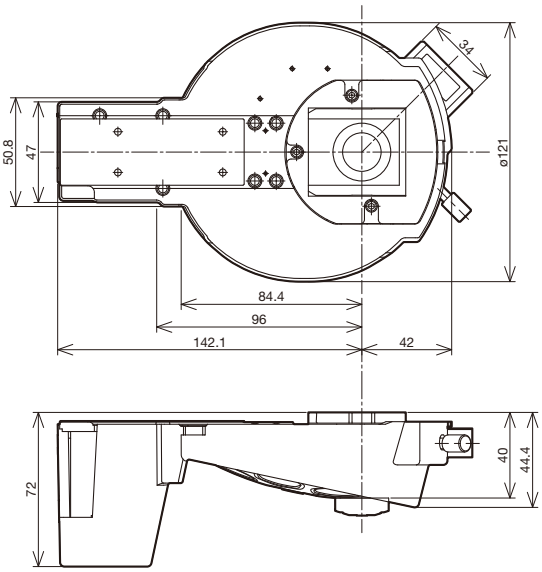
*Optical elements are required. Please consult your local Olympus representative about optical elements combinations.




Weight: 1.6 kg

### U-D7REA

Motorized Septuple Revolving Nosepiece with Slider Slot for DIC




Weight: 1.5 kg

Unit: mm

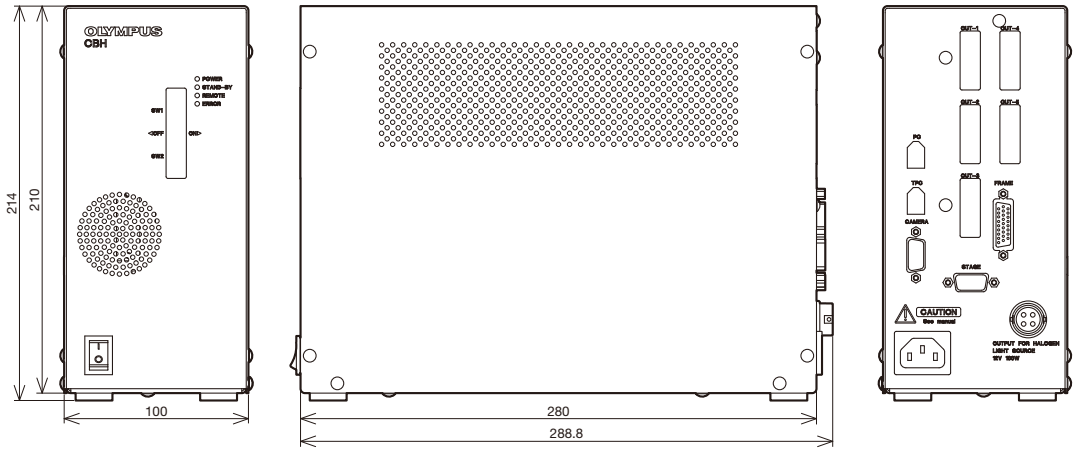
# Motorized Units

## Control Box for the BX3 Series

### BX3-CBH

Control Box for Fully-Motorized Function

The control box can be connected to a PC via the IEEE1394 cable.



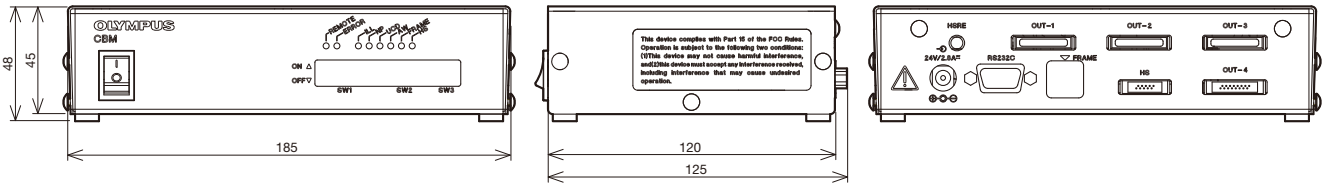

Weight: 4.2 kg

### U-CBM

Control Box M for Motorized Function

The control box can be connected to a PC via a RS232 cable.

*Please consult your local Olympus representative for a detailed system chart.



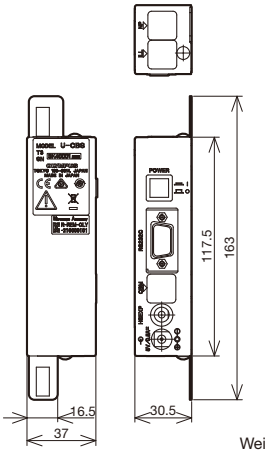

Weight: 0.82 kg

### U-CBS

Control Box for Coded Function

The control box can be connected to a PC via a RS232 cable (attached onto the microscope frame).

*Please consult your local Olympus representative for a detailed system chart.




Weight: 0.5 kg

Unit: mm

# Optical Terminology

## 1. FN and Practical Field of View

The field number (FN) is the size (in mm) of the eyepiece diaphragm, which defines the viewable area of a specimen. The diameter on the sample plane that can actually be viewed through the eyepiece is known as the practical field of view (FOV) and is determined by the following formula:

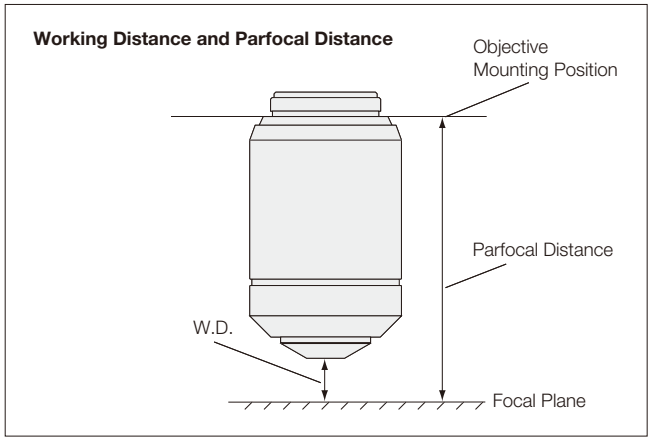
$$FOV = \frac{\text{Eyepiece FN}}{\text{Objective Magnification}} \text{ (mm)}$$

## 2. Working Distance

The working distance (W.D.) is the distance between the front edge of the objective and the specimen surface (or the surface of the cover glass when using a cover glass objective) when the specimen is in focus.

## 3. Parfocal Distance

The parfocal distance is the distance between the objective mounting plane and the specimen. In UIS2/UIS objectives, the parfocal distance is designed to be 45 mm.




For the parfocal distance of the LCPLFLN-LCD series objectives, refer to the appropriate objective page.

## 4. Relationship Between the Objective's Focal Length and Magnification

The magnification indicated for a UIS2/UIS objective is the value when the focal length of the tube lens is 180 mm.

$$M_{(ob)} = \frac{\text{Focal Length of Tube Lens}}{f}$$

$M_{(ob)}$: Objective magnification
f: Objective's focal length

## 5. Total Magnification

### 5.1 Observation Through Eyepiece (binocular observation)

$$M_{(bino)} = M_{(ob)} \times M_{(oc)}$$

$M_{(bino)}$: Total magnification for binocular observation
$M_{(ob)}$: Objective magnification
$M_{(oc)}$: Eyepiece magnification

### 5.2 Video Monitor Observation

●Total Magnification for Video Monitor

$$M_{(\text{video monitor})} = M_{(ob)} \times M_{(\text{video camera adaptor})} \times \text{Monitor Magnification}^*$$

$M_{(\text{video monitor})}$: Total Magnification on the Video Monitor
$M_{(ob)}$: Objective Magnification
$M_{(\text{video camera adaptor})}$: Projected magnification for video camera adaptor including photo eyepiece
*(refer to Figure 1)*

**Refer to Figure 3 for "monitor magnification"*

●Practical Field of View for Video Monitor Observation

$$\text{Practical Field of View for Video Monitor Observation} = \frac{\text{Image Device Size}^*}{M_{(ob)} \times M_{(\text{video camera adaptor})}}$$

$M_{(ob)}$: Objective Magnification
$M_{(\text{video camera adaptor})}$: Projected magnification for video camera adaptor including photo eyepiece
*(refer to Figure 1 for projected magnifications)*

**Refer to Figure 2 for image device size*

Figure 1 Video Camera Adaptor and Projection Magnifications

| Video Camera Adaptor (projection lens) | Projection Magnification |
|---|---|
| U-TV1X-1 + Video Camera Mount Adaptors | 1X |
| U-TV1XC | 1X |
| U-TV0.63XC | 0.63X |
| U-TV0.5XC-3 | 0.5X |
| U-TV0.35XC-2 | 0.35X |
| U-TV0.25XC | 0.25X |

Figure 2 Imaging Device Size

| Camera Format | Diagonal | Horizontal | Vertical |
|---|---|---|---|
| 1/3" | 6.0 mm | 4.8 mm | 3.6 mm |
| 1/2" | 8.0 mm | 6.4 mm | 4.8 mm |
| 2/3" | 11.0 mm | 8.8 mm | 6.6 mm |

The above table is for standard image device sizes.
Check your device size for precise calculation.

Figure 3 Imaging Device Size and Monitor Magnifications

| Camera Format | Monitor Size (diagonal) | | | | |
|---|---|---|---|---|---|
| | 10" | 15" | 17" | 19" | 21" |
| 1/3" | 42.3X | 63.5X | 72.0X | 80.4X | 88.9X |
| 1/2" | 31.8X | 47.6X | 54.0X | 60.3X | 66.7X |
| 2/3" | 23.1X | 34.6X | 39.3X | 43.9X | 48.5X |

*Example*
What is the total magnifications for a video monitor when a objective is 50X, a video camera adaptor U-TV0.5XC, a 2/3" video camera, and a 21" monitor are used ?

•Total magnification on the video monitor:
$m_{(ob)}$=50X, $M_{(video\ camera\ adaptor)}$ is 0.5X from Figure 1, and the monitor magnification is 48.5× from Figure 3.
$M_{(monitor\ observation)}=M_{(ob)}\times M_{(video\ camera\ adaptor)}\times$monitor magnification
=50×0.5×48.5=1213X

•Practical filed of view for video observation (horizontal side):
$M_{(ob)}$=50X, $M_{(video\ camera\ adaptor)}$ is 0.5X (from Figure 1), and the horizontal side of a 2/3" imaging device is 8.8 mm (from Figure 2)

$$\text{Practical Field of View for Video Observation} = \frac{\text{Image Device Size}}{M_{(ob)}\times M_{(video\ camera\ adaptor)}}$$

$$= \frac{8.8\ (mm)}{50 \times 0.5} = 352\ \mu m$$

## 6. NA

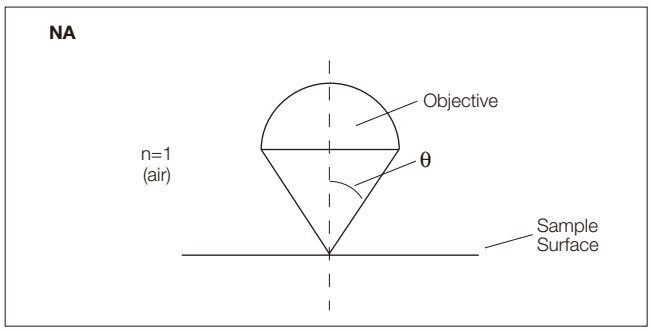
The numerical aperture is a key factor to the performance of an objective (resolving power, focal depth, and brightness). The NA is determined by the following formula:

$$NA = n \times \sin\theta$$

n=The refraction rate of the medium between the specimen and objective. (Air: n=1, oil: n=1.515)
θ: The angle made by the optical axis and refraction of the light farthest from the center of the lens.

The visual field brightness (B) of the microscope is determined by the following formula in relation to the objective magnification (M). The larger the NA and the lower the objective magnification, the brightness will increase by a factor of the second power.

$$B \propto \frac{NA^2}{M^2}$$




## 7. Resolving Power

The resolving power of an objective is measured by its ability to differentiate two lines or points in an object. The greater the resolving power, the smaller the minimum distance between two lines or points that can still be distinguished. The larger the NA, the higher the resolving power.

### Resolving Power Formula

The following formula is generally used for determing resolution.

$$\varepsilon = 0.61 \times \frac{\lambda}{NA}$$ (Reyleigh formula)

λ: Wavelength or radiation in use
(λ=0.55 μm is used for visible light.)
NA: Objective NA

*Example*
MPLFLN100X (NA=0.90), λ=0.55 μm

$$\varepsilon = 0.61 \times \frac{\lambda}{NA} = \frac{0.3355}{NA} = \frac{0.3355}{0.90} = 0.37\ \mu m$$

## 8. Focal Depth of Microscope

The focal depth refers to the depth of the specimen layer that is in sharp focus at the same time, even if the distance between the objective and the specimen plane is changed when observing and imaging the specimen plane using the microscope. Because human eyes are individually different in the ability to adjust their focus, each person's perception of the focal depth varies.
At present, the Berek formula is generally used because it gives a focal depth value that often coincides with the focal depth obtained through experiments.

### Focal Depth Formula

#### Visual Observation (Berek formula)

$$\pm DOF = \frac{\omega \times 250{,}000}{NA \times M} + \frac{\lambda}{2\,(NA)^2}\ (\mu m)$$

DOF: Depth of Focus

ω: Resolving Power of Eyes 0.0014
(when the optical angle is 0.5 degrees)
M: Total Magnification
(objective magnification x eyepiece magnification)

$$\rightarrow \pm DOF = \frac{350}{NA \times M} + \frac{0.275}{NA^2}\ (\lambda=0.55\ \mu m)$$

This indicates that the focal depth becomes smaller as the numerical aperture becomes larger.

Example
With MPLFLN100X (NA=0.90), WHN10X:

$$\pm DOF = \frac{350}{0.90 \times 1{,}000} + \frac{0.275}{0.81} = 0.39 + 0.34 = 0.73\ \mu m$$

#### Video Camera

In the case of a video camera, the focal depth will vary according to the number of pixels of the CCD, optical magnification, and numerical aperture. The above-mentioned formula is used as a rough guide only.

## 9. Aberrations

A difference between an ideal image and the actual image that passes through an optical system is called an “aberration.”

### 9.1 Requirements for Ideal Image Formation

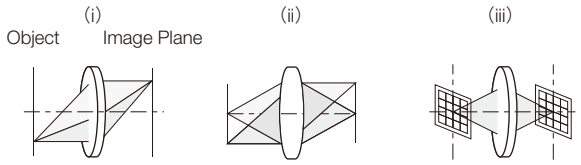
The following three requirements must be satisfied to form an image with no aberrations, or an ideal image.

(i) All the light rays coming from a single point and passing through an image formation optical system converge on a single point.

(ii) Image points, which correspond to object points on the same plane perpendicular to the optical axis, are present on the same plane.

(iii) The planar shape of an object and the planar shape of an image that are on the same plane perpendicular to the optical axis have a similar relation.

**Figure 9-1 Requirements for Ideal Image Formation**



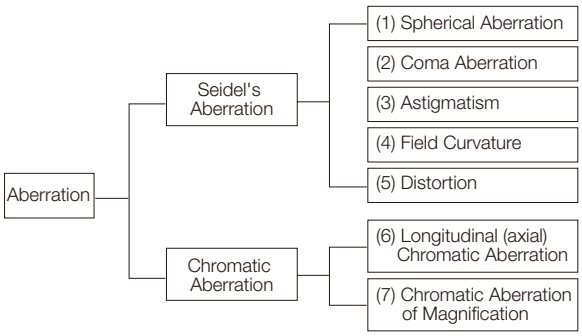

In an actual optical system, however, it is very difficult to strictly meet the requirements for ideal image formation, and this causes “aberrations” that interfere with image-forming performance.

### 9.2 Classification of Aberrations

Aberrations that interfere with image-forming performance are classified as shown below in Figure 9-2.

Seidel’s Aberration = “Expansion of a Point Image” + “Curvature of the Image Plane” + “Deformation”

**Figure 9-2 Classification of Aberrations**




Types (1) to (3) correspond to “expansion of a point image” that goes against requirement (i) for ideal image formation in Figure 9-1. Type (4) corresponds to “curvature of image plane” that goes against requirement (ii) in Figure 9-1.

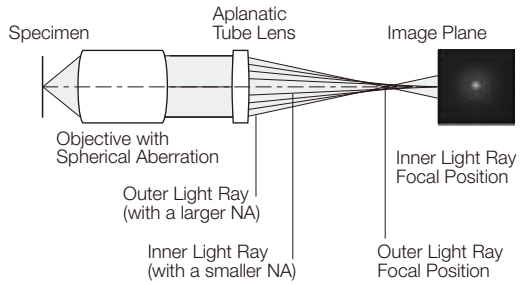
Type (5) corresponds to “deformation” that goes against requirement (iii) in Figure 9-1.

Types (6) and (7) correspond to the “color blur” of images caused by characteristics of glass materials used for the optical system. “Expansion of a point image” can also be expressed by “wavefront aberration” that regards the light as “waves” and takes into account the phase to include the influence of diffraction.

#### (1) Spherical Aberration

When light rays coming out of an axial object point enter a lens, the light rays with a larger numerical aperture (NA) are subjected to stronger refraction power and cross the optical axis in positions further away from the ideal image formation position. The aberration caused by different image forming positions due to the differences in NA of axial light rays is called “spherical aberration.” (“Spherical aberration” is proportional to NA to the third power.)

**Figure 9-3 Spherical Aberration**

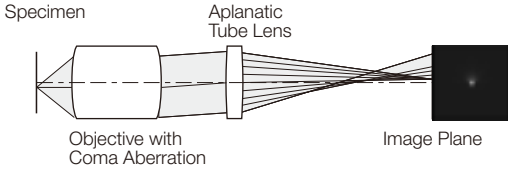



Typically, objectives with a larger NA have better resolution but worse spherical aberration. Our advanced design and manufacturing techniques have realized good optical performance even with a large numerical aperture.

#### (2) Coma Aberration

Even though spherical aberration is compensated to be very small, there are cases where light rays coming out of an off-axis object point are not condensed to a single point on the image plane but, instead, generate asymmetric blur that looks like a comet leaving traces. This is called coma aberration.

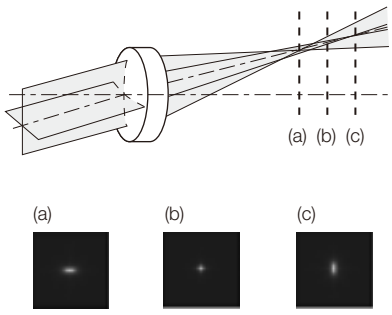
**Figure 9-4 Coma Aberration and Spot Shape on the Image Plane**



(3) Astigmatism

Even though a lens is compensated for spherical aberration and coma aberration, there are cases where an image of an off-axis object point is not focused to a single point but separated to a concentric line image and a radial line image. This is called “astigmatism.” When astigmatism is present, a point image blurs vertically and horizontally, before and after the focus position.

**Figure 9-5 Astigmatism and Change in Spot Shape in Different Focus Positions**




(4) Field Curvature

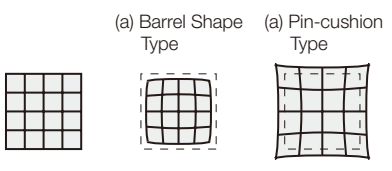
An image plane of an object on a plane perpendicular to an optical axis does not always become a plane perpendicular to the optical axis, but it generally becomes a curved plane. This symptom is called “field curvature.”

When field curvature is present, the image is more displaced as it becomes closer to the periphery of the visual field. Therefore, when the center of an image is brought into focus, blur occurs in the peripheral areas of the image. To bring the entire image, including the periphery, into clear focus, it is necessary to adequately compensate for this type of aberration.

(5) Distortion

When there is no similar relation between a planar shape on an object and a shape on the image plane, this is called “distortion.” When distortion is present, a square image appears in a shape of a barrel or pin-cushion as shown in Figure 9-6.

**Figure 9-6 Distortion**




The microscope optical system contains some distortion. When distortion is present, it can bring erroneous results of shape measurements. When a microscope is used for precision measurements, pay close attention to this aberration, for example, by providing it with an aberration compensation function.

(6) Chromatic Aberration

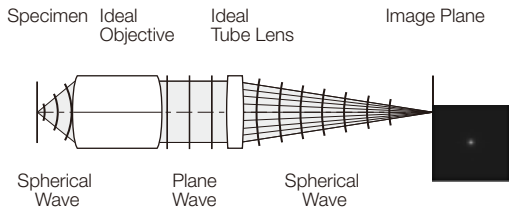
Glasses used for optical systems have different refractive indexes depending on the wavelength. This causes differences in focal length between wavelengths and generates displacement of image forming position. This phenomenon is called “chromatic aberration,” which is sometimes subdivided into axial displacement on the optical axis, called “axial chromatic aberration” (or lateral chromatic aberration) and displacement on the image plane, called “chromatic aberration of magnitude.”

Many special glass materials are used, e.g., for apochromats, to eliminate chromatic aberration in a wide range from violet light (g-rays with wavelength of 435 nm) to red light (c-rays with wavelength of 656 nm).

## 9.3 Wavefront Aberration

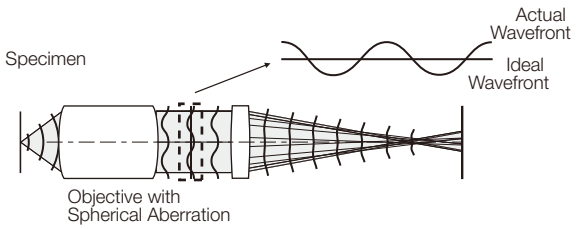
For a long time, aberrations have been used in “geometric optics,” which considers light as “light rays.” Microscope optical systems are often used to observe very small specimens at the wavelength level and sometimes adopt “wave optics,” which regards light as “waves” and handles the phase information, accounting for the influence of diffraction. In such a case, “wavefront aberration” is used for evaluation. As shown below, when requirements for ideal imaging are satisfied in a microscope optical system, the spherical wavefront (spherical waves) coming from a single point on an object (specimen) is converted to plane waves through an ideal objective. The plane waves are converted to spherical waves through an ideal tube lens and condensed to a single point. The wavefront of these waves is called the “ideal wavefront.”

**Figure 9-7 Ideal Microscope Optical System**




Based on the figure indicated for (1) spherical aberration, the behavior of the wavefront in an optical system that has an aberration is described below.

**Figure 9-8 Illustration of Wavefront Aberration**

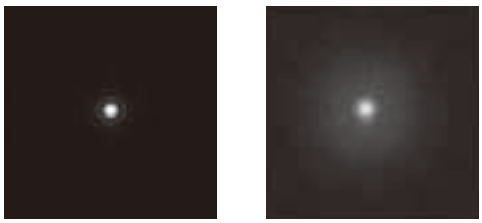



A difference (a degree of disagreement) between the ideal wavefront and the actual wavefront shown above is called “wavefront aberration.”

## 9.4 Strehl Ratio

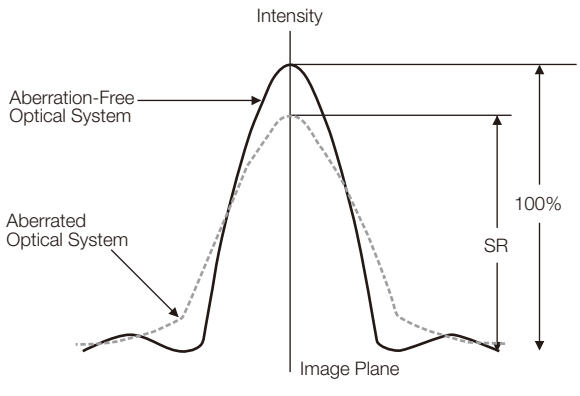
When a point light source is observed with an aberration-free optical system and an aberrated optical system, the former concentrates the focal point to a point at the image formation position. In contrast, the latter fails to produce a focal point, instead causing a spread in the intensity distribution of the point image (this is known as “point spread”). The specific appearance of such a point image (i.e. point spread) is shown in Figure 9-9.

**Figure 9-9 Appearance of Condensed Light in the Image Plane (point spread)**




With the proportion of light concentrated in the image plane (intensity of light concentrated in the Airy disk) by an aberration-free optical system serving as 100%, the proportion of light concentrated by an aberrated optical system is known as the Strehl ratio (SR). When graphed, the Strehl ratio reveals peaks in intensity as shown in Figure 9-10. The higher the SR, the closer an optical system is to being aberration-free.

**Figure 9-10 Strehl Ratio (SR)**




A Strehl ratio of 80% is typically called the diffraction limit, and lenses with a lower ratio lack the performance required to serve as an objective. A ratio of over 95% means that the lens’ performance in general observations is comparable to that of an aplanatic lens (which is corrected for spherical aberrations and coma).

*Note: A laser interferometer is used to assess optical performance, so assessment is done at a single wavelength. Unless otherwise noted, Strehl ratio measurements are at the e-line (544 nm).*

Memo

Memo

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