Microscope Components for Reflected Light Applications
Select a Nikon microscope unit for your manufacturing equipment and other systems that require high precision.

The development, manufacture, and evaluation of products require sub-micron precision, as symbolized by semiconductor manufacturing technology. Nikon's microscope units support such high precision and can be integrated with a variety of equipment.

This catalog presents technical data on using Nikon's microscope units.

Select a microscope unit to integrate with Nikon equipment – as symbolized by semiconductor manufacturing technology.
Modular Focusing Unit IM-4

Accommodates an epi-illuminator and motorized nosepiece or a maximum load of 10kg by adding a balancer. Accommodates the LV-UEPI-N or LV-EPILED universal illuminator as well as a motorized nosepiece.

- Attachment of the LV-UEPI-N Universal Epi-Illuminator enables the use of brightfield, darkfield and Nomarski DIC techniques.
- The built-in balancer ensures smoother vertical motion, even when the arm is heavily loaded.
- The standard maximum load is 4kg, which is expandable to 10kg by adding a balancer.
- The distance from the optical axis to the mounting surface is 141mm.
- A coarse motion stroke of 5.2mm per revolution improves the equipment’s load handling capability and increases durability.

Fixing Unit (Option)

Used to attach the Modular Focusing Unit IM-4 to a ø24.5mm post.

Fixing Unit MXA20681/240g

Note: For adding a balancer, consult your Nikon representative.
LV-IM IM Modules

This focusing module is suitable for incorporation into systems. It enables the mounting of a universal illuminator (LV-UEPI-N/LV-UEPI2/LV-UEPI2A or LV-EPILED) and a motorized nosepiece.

LV-IMA IM Module A (Motorized)
- Selectable mounting surface (back or bottom).
- 20mm vertical stroke.
- Dramatically improved rigidity enables the mounting of the LV-UEPI2A motorized universal illuminator, etc.
- External control is possible via the LV-ECON E Controller.
- The standard maximum permissible weight is 3-6kg, which is expandable to 9kg by adding a balancer.

LV-IMA IM Module A (Motorized)

LV-IM Module (Manual)
- Selectable mounting surface (back or bottom).
- 30mm vertical stroke.
- Dramatically improved rigidity enables the mounting of the LV-UEPI2A motorized universal illuminator, etc.
- The standard maximum permissible weight is 4-7kg, which is expandable to 10kg by adding a balancer.

LV-IM Module (Manual)

LV-FM FM Modules

This focusing module is suitable for incorporation into systems. It enables the mounting of a universal illuminator (LV-UEPI-N/LV-UEPI2/LV-UEPI2A or LV-EPILED) and a motorized nosepiece.

LV-FMA FM Module A (Motorized)
- Only the bottom mounting surface is supported.
- 30mm vertical stroke.
- Enables an enhanced system with motorized up/down mechanism when combined with the LVDIA-N DIA Base N.
- External control is possible via the LV-ECON E Controller.
- The standard maximum permissible weight is 3-6kg, which is expandable to 9kg by adding a balancer.

LV-FMA FM Module A (Motorized)
LVDIA-N DIA Base N

This base unit is for the ECLIPSE LV series of modular microscopes. The attachment of an optional power source enables the incorporation of a transmission illuminator.

LV-ARM Basic Arm

This arm unit is for the ECLIPSE LV series of modular microscopes.

LV-ECON E Controller

This controller enables external control of various units from a PC and other devices.

• Enables external control of motorized universal reflection illuminators and various light sources, universal motorized revolvers, and motorized focusing modules from a PC or other devices.
• Communication with PC possible via USB.
• Max. 11° inclination when using tilt (unit's feet).
CFSiC–CFIc objectives for brightfield use; Nomarski DIC is also possible with the TU type.

Dramatically extended working distances facilitate observations of samples having irregular surfaces. Working distances have been extended significantly.

Ultra-long working distances. Particularly useful when observing the bottom of a depression in the sample. Working distances have been extended significantly.
### CFI TU Plan Fluor BD

Perfect for brightfield, darkfield, and Nomarski DIC observations.

#### Code No.
- MUE42900
- MUE42500
- MUE42050
- MUE61200

#### Objectives (Magnifications)
- CFI TU Plan Fluor BD 10x
- CFI TU Plan Fluor BD 50x
- CFI TU Plan Fluor BD 100x

#### Specifications
- **Code No.**: MUE42900
- **M.D. (mm)**: ø36
- **NA**: 0.15
- **Diameter**: 10x
- **Focus**: 0.75
- **Weight (g)**: 4.45
- **Actual Field**: 1.24
- **Depth of Field**: 0.37

#### Code No.
- MUE42500
- MUE42050
- MUE61200

#### Objectives (Magnifications)
- CFI TU Plan Fluor BD 50x
- CFI TU Plan Fluor BD 100x

#### Specifications
- **Code No.**: MUE42500
- **M.D. (mm)**: ø36
- **NA**: 0.45
- **Diameter**: 10x
- **Focus**: 0.75
- **Weight (g)**: 4.45
- **Actual Field**: 0.45
- **Depth of Field**: 0.37

#### Code No.
- MUE61200

#### Objectives (Magnifications)
- CFI TU Plan Fluor BD 100x

#### Specifications
- **Code No.**: MUE61200
- **M.D. (mm)**: ø36
- **NA**: 1.0
- **Diameter**: 0.34
- **Focus**: 0.75
- **Weight (g)**: 4.45
- **Actual Field**: 0.45
- **Depth of Field**: 0.37

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### CFI TU Plan BD ELWD

Long Working Distance Objectives for Brightfield/Darkfield/Nomarski DIC Use

#### Extended working distances facilitate observations of samples having irregular surfaces.

#### Code No.
- MUE42900
- MUE42500
- MUE42050
- MUE61200

#### Specifications
- **Code No.**: MUE42900
- **M.D. (mm)**: ø36
- **NA**: 0.15
- **Diameter**: 10x
- **Focus**: 0.75
- **Weight (g)**: 4.45
- **Actual Field**: 1.24
- **Depth of Field**: 0.37

#### Code No.
- MUE42500
- MUE42050
- MUE61200

#### Objectives (Magnifications)
- CFI TU Plan BD ELWD 20x
- CFI TU Plan BD ELWD 50x
- CFI TU Plan BD ELWD 100x

#### Specifications
- **Code No.**: MUE42500
- **M.D. (mm)**: ø36
- **NA**: 0.45
- **Diameter**: 10x
- **Focus**: 0.75
- **Weight (g)**: 4.45
- **Actual Field**: 0.45
- **Depth of Field**: 0.37

#### Code No.
- MUE61200

#### Objectives (Magnifications)
- CFI TU Plan BD ELWD 100x

#### Specifications
- **Code No.**: MUE61200
- **M.D. (mm)**: ø36
- **NA**: 1.0
- **Diameter**: 0.34
- **Focus**: 0.75
- **Weight (g)**: 4.45
- **Actual Field**: 0.45
- **Depth of Field**: 0.37

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### CFI TU Plan Apo EPI/CFI TU Plan Apo BD/CFI LU Plan Apo EPI/CFI LU Plan Apo BD

High-Resolution Objectives for Brightfield or for Darkfield/Brightfield

Apochromat-type objectives virtually eliminate chromatic aberration and feature excellent resolution. Nomarski DIC is also possible with the TU/LU type.

#### Code No.
- MUC50151

#### Objectives (Magnifications)
- CFI TU Plan Apo EPI 10x
- CFI TU Plan Apo EPI 50x
- CFI TU Plan Apo EPI 150x
- CFI TU Plan Apo BD 50x
- CFI TU Plan Apo BD 100x

#### Specifications
- **Code No.**: MUC50151
- **M.D. (mm)**: ø36
- **NA**: 0.15
- **Diameter**: 0.34
- **Focus**: 0.75
- **Weight (g)**: 4.45
- **Actual Field**: 0.45
- **Depth of Field**: 0.37

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*This product has been discontinued, and only available from stock.*
The CFI L Plan EPI CR series employs a correction system to cope with the thinner coverglass for FDP and the increased integration and mounting density of devices.

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Weight (g)</th>
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<tbody>
<tr>
<td>LV-UEPI2</td>
<td>2,400g</td>
</tr>
<tr>
<td>LV-UEPI2A</td>
<td>2,570g</td>
</tr>
</tbody>
</table>

**LV-UEPI2**
- Equipped with advanced optics suitable for a wide variety of observation methods, ranging from brightfield, darkfield, simple polarizing, and DIC, to epi-fluorescence.
- Includes a feature for automatically maintaining optimal illumination conditions for the field and aperture diaphragms, shutter, and UV cut filters, thereby reducing tedious microscope operations to an absolute minimum.

**LV-UEPI2A**
- Accurate reproduction of illumination conditions thanks to the motorization of the illumination changeover turret and aperture diaphragm and control of the illumination vaneage.
- Automatic optimization of the aperture diaphragm according to the objective lens and illumination technique. Can also be changed manually depending on the sample and purpose.
- Control possible from the microscope or a PC when combined with LV100DA-U.
- External control also possible from a PC when combined with the LV-ECON E Controller.

**Universal Epi-Illuminator LV-UEPI-N**
This universal illuminator supports the CFI60-2 / CFI60 optical system.

- Enables brightfield, darkfield, simple polarizing, and DIC observation.
- Automatic opening of field and aperture diaphragms when observation is switched from brightfield to darkfield.
- Return of field and aperture diaphragms to their original position when observation is switched back from darkfield to brightfield.

**LU Nosepiece Adapter M32-25**
Adapter for attaching an Epi Plan objective to a brightfield nosepiece or universal nosepiece.

Universal Epi-Illuminator LV-UEPI2/LV-UEPI2A
- Motorized Universal Epi-Illuminator LV-UEPI2A/RBE60310

**Field diaphragm**
- Centerable and synchronized with B/D changeover

**Aperture diaphragm**
- Centerable and synchronized with motorized brightfield/darkfield changeover

**Illumination**
- 12V/50W high-intensity halogen lamp illuminator

**Filters**
- Supports insertion of four ø25mm filters (NCB11, ND10, ND4, ND16), two Fluorescence filter cubes, a polarizer/analyzer, and an excitation light balancer. Also supports ESD.

**Weight**
- 2,400g
- 2,570g

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</tr>
<tr>
<td>LV-UEPI2A</td>
<td>2,570g</td>
</tr>
</tbody>
</table>

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**Diagram:**

- Configured with LV-LH50PC Precentered Lamphouse
- Universal Epi-Illuminator LV-UEPI2/RBE60300
- Motorized Universal Epi-Illuminator LV-UEPI2A/RBE60310

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**Diagram:**

- Configured with LV-LH50PC Precentered Lamphouse
- Universal Epi-Illuminator LV-UEPI2/RBE60300
- Motorized Universal Epi-Illuminator LV-UEPI2A/RBE60310

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**Diagram:**

- Configured with LV-LH50PC Precentered Lamphouse
- Universal Epi-Illuminator LV-UEPI2/RBE60300
- Motorized Universal Epi-Illuminator LV-UEPI2A/RBE60310
TI-PS100W/A Power Supply

This transformer is for the LV-UEPI-N, LV-UEPI2, and LV-UEPI2A universal reflection illuminators.

LV-EPILED White LED Illuminator

This LED illuminator supports the CFiuc-2 / CFiuc optical system.
- Lightweight, compact white LED illuminator developed specially for brightfield observation.
- Operated via an attached power source controller.
- Can also be externally controlled via the LV-ECON E controller.
- Includes ND4 and ND16 filters.
- Standard cable length: 2.8m

Revolving Nosepieces

Eight types of nosepieces – either manual or motorized – are available to choose from.
### CF IC Objectives

#### Widefield CF eyepieces

<table>
<thead>
<tr>
<th>Code No.</th>
<th>CF IC Objectives</th>
<th>NA</th>
<th>W.D. (mm)</th>
<th>Focal length (mm)</th>
<th>Working Distance (mm)</th>
<th>Diameter (ømm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUL04201</td>
<td>CF IC EPI Plan ELWD 10×A</td>
<td>0.25</td>
<td>15.7</td>
<td>150×</td>
<td>0.25</td>
<td>1.80</td>
</tr>
<tr>
<td>MUL04201</td>
<td>CF IC EPI Plan ELWD 50×A</td>
<td>0.25</td>
<td>7.7</td>
<td>500×</td>
<td>0.4</td>
<td>1.49</td>
</tr>
<tr>
<td>MUL04201</td>
<td>CF IC EPI Plan ELWD 100×A</td>
<td>0.25</td>
<td>3.25</td>
<td>1000×</td>
<td>0.8</td>
<td>1.43</td>
</tr>
</tbody>
</table>

#### CF IC EPI Plan ELWD Long Working Distance Objectives for Brightfield Use

Extended working distances facilitate observations of samples with irregular surfaces.

#### CF IC EPI Plan SLWD Ultra-long Working Distance Objectives for Brightfield Use

Ultra-long working distances. Particularly useful when observing the bottom of a depression in the sample.
**CF IC EPI Plan Apo**  High-Resolution Brightfield Objectives

Apochromat-type objectives for brightfield use virtually eliminate chromatic aberration and feature excellent resolution.

- **CF IC EPI Plan Apo 100×A**
  - Focal length: 5.00
  - NA: 0.95
  - Working distance: 0.20

- **CF IC EPI Plan Apo 50×A**
  - Focal length: 5.00
  - NA: 0.95
  - Working distance: 0.32

**Double Beam Interference Objectives**

Double beam interference objectives that have large numerical aperture, long working distance and high optical performance.

- **CF IC EPI Plan D1 10xvA**
  - Focal length: 5.00
  - NA: 0.95
  - Working distance: 0.20

- **CF IC EPI Plan D1 50xA**
  - Focal length: 5.00
  - NA: 0.95
  - Working distance: 0.20

**CF IC LCD Plan CR**  for LCD Inspection

These objectives, developed specially for LCD inspection, enable the observation of a clear image under the coverglass.

- **CF IC LCD Plan CR 20x**
  - Focal length: 5.00
  - NA: 0.95
  - Working distance: 0.20

- **CF IC LCD Plan CR 50x**
  - Focal length: 5.00
  - NA: 0.95
  - Working distance: 0.32

**Ultra-Widefield CFI eyepieces**

- **CFI UW10×**
  - Focal length: 5.00
  - NA: 0.95
  - Working distance: 0.20

- **CFI UW 10×**
  - Focal length: 5.00
  - NA: 0.95
  - Working distance: 0.32

**C-OA 15mm Adapter**

An adapter for attaching CF & IC objectives to the C-OA Sextuple Nosepiece (page 17) that supports the CFI optical system.

**Code No.**

**Objective**

<table>
<thead>
<tr>
<th>Code No.</th>
<th>CF-IC Observer (Magnifications)</th>
<th>NA</th>
<th>F.D. (mm)</th>
<th>Working distance (mm)</th>
<th>Depth of focus (μm)</th>
<th>Total magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUT10051</td>
<td>CF IC EPI Plan Apo 100×A</td>
<td>0.95</td>
<td>0.20</td>
<td>4.50</td>
<td>0.3</td>
<td>170</td>
</tr>
<tr>
<td>MUT10101</td>
<td>CF IC EPI Plan Apo 50×A</td>
<td>0.95</td>
<td>0.20</td>
<td>2.00</td>
<td>0.3</td>
<td>170</td>
</tr>
<tr>
<td>MUT10153</td>
<td>CF IC EPI Plan Apo 150×B</td>
<td>0.95</td>
<td>0.20</td>
<td>1.33</td>
<td>0.3</td>
<td>160</td>
</tr>
</tbody>
</table>

- *The product has been discontinued, and only available from stock.*
CM-Series Compact Reflected Microscopes

Ultra-compact reflected microscopes designed for integration into production lines to provide on-monitor observations.

- Ultra-compact and lightweight.
- C-mount video cameras having 1/4 to 1-inch CCDS are attachable as standard. ENG-mount video cameras can also be mounted via optional ENG-mount adapters.
- The Koehler Illumination Optical System offers a uniformly bright viewfield.
- Tread holes ideally located on the surface of the microscope facilitate attachment of auxiliary equipment.

*1 Use an objective for measuring microscopes on the CM-5A and a CF IC EPI Plan lens on other A series units. In addition, use an EPI Plan lens from the CFI series on L series units.

*2 The ENG-mount for CM is a made-to-order product. When ordering, please inform us of the flange focal distance of the camera that will be used.

CM-10A/CM-10L
- Basic model with a tube lens focal length of f/200mm (1x).
- Features a tube shorter than the CM-10, by setting the tube lens focal length at f/100mm (0.5x).
- Compact model based on the CM-10 that features a short tube length.
-具备短管路设计，适合集成到生产线中提供在线观察。

CM-20A/CM-20L
- Enables simultaneous observation at different imaging magnifications (1x~5x). For CFI-2/FI-2 EPI Plan.

CM-30A/CM-30L
- Compact model based on the CM-10 that features a short tube length.

CM-70L
- Basic model with a tube lens focal length of f/200mm (1x).
- Features a tube shorter than the CM-10, by setting the tube lens focal length at f/100mm (0.5x).

Objective magnification × 0.5

Compatible objectives *A series: CF IC EPI Plan objectives / L series: CFI EPI Plan objectives

Illumination optical system
- Koehler illumination (high-quality telecentric illumination)

Attachment surfaces
- 4

Dimensions (mm): Width x Depth x Height
- 40 x 40 x 204.5mm - 440g
- 40 x 40 x 120.5mm - 280g
- 40 x 72 x 107.3mm - 400g
- 40 x 117 x 138.1mm - 690g

* On the above-mentioned A series and L series, use CF ICEP Plan and CFI-2/FI-2 EPI Plan Objectives, respectively.

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**CM-10A/CM-10L**

**CM-20A/CM-20L**

**CM-30A/CM-30L**

**CM-70L**

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*Use a objective for measuring microscopes on the CM-5A and a CF IC EPI Plan lens on other A series units. In addition, use an EPI Plan lens from the CFI-2/FI-2 series on L series units. 

*2 The ENG-mount for CM is a made-to-order product. When ordering, please inform us of the flange focal distance of the camera that will be used.
2nd Objective Lens Units

Used to focus parallel light beams coming through CFI60-2 / CFI60 objectives and CF&IC objectives onto the image plane.

Built-in Type 2nd Objective Lens Unit

- Compatible with CFI60-2, CFI60 and CF&IC infinity objectives.
- Focal length: f/200mm.
- To obtain the optimal objective performance, keep the distance between the lens unit and the objective’s shoulder within 100-200mm as shown in the diagram at right.

TV-Use 2nd Objective Lens Unit 0.5x/ TV Relay Unit 1x

- Image plane magnification: 0.5x; Focal length: f/100mm.
- Image plane magnification: 1x; Focal length: f/200mm.
- With a field number of 11mm, this lens unit can be used with CCD cameras smaller than 2/3-inch types.
- Distance between the lens unit and the objective’s shoulder: 60-160mm (110mm optimum).
Filters

A color balance compensation filter and neutral density filter are available.

ND Filters
This filter is used to adjust the light for illuminators such as illumination light and spectral properties (color balance).

* The numbers (xx) in NDxx signify the light reduction. For example, 4 means a 1/4 reduction and 16 and 1/16 reduction.

Effective for increasing the contrast of monochrome photographs and black-and-white TV images.

Neutral Density Filters

- GIF Filter: Allows only a green spectrum near the 546nm wavelength to pass through.
- NCB11 Filter: This compensation filter maximizes the color reproduction of daylight-type TV images.

These lens tubes can be combined with illuminators such as the LV-UEPI, LV-UEPI2, LV-UEPI2A and LV-EPILED. The trinocular eyepiece tube supports both ultrawide and wide fields of view with a change of the eyepiece lens.

Eyepecice Tubes/Double Port/Straight Tubes

These lens tubes can be combined with illuminators such as the LV-UEPI, LV-UEPI2, LV-UEPI2A and LV-EPILED. The trinocular eyepiece tube supports both ultrawide and wide fields of view with a change of the eyepiece lens.

GIF Filter

Unit: mm

a25mm Filter Slider

Double Port

Installed between the ep-illuminator and the trinocular tube, the double port enables simultaneous attachment of CCTV and 35mm cameras.

Straight Tubes

These attachments are used to change the format of the straight tube of a trinocular tube.

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Item Code</th>
<th>Weight (g)</th>
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<tbody>
<tr>
<td>MB066250</td>
<td>LV-TP Trinocular Tube E50</td>
<td>1800 Siedentopf</td>
</tr>
<tr>
<td>MB066100</td>
<td>LV-TT Tilting Trinocular Tube</td>
<td>2290 Siedentopf</td>
</tr>
<tr>
<td>MB065100</td>
<td>C-TE Trinocular Tube F</td>
<td>1000 Siedentopf</td>
</tr>
<tr>
<td>MB065110</td>
<td>C-E Trinocular Tube T</td>
<td>3290 Siedentopf</td>
</tr>
<tr>
<td>MB065200</td>
<td>C-TE2 Ergonomic Trinocular Tube</td>
<td>3130 Siedentopf</td>
</tr>
<tr>
<td>MB065210</td>
<td>C-TB Binocular Tube</td>
<td>900 Siedentopf</td>
</tr>
</tbody>
</table>

Unit: mm (E.P.: Eyepoint)

Straight Tubes

- Y-T TV Tube MBB73550/300g
- Y-T Photo Adapter MBBS3515/100g
- LV-TV Tube Adapter MBB96805/100g
- Y-100 TV Tube Adapter MBB93105/100g

These attachments are used to change the format of the straight tube of a trinocular tube.

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Unit: mm (E.P.: Eyepoint)

Front surface of tube is the infinity corrected optix: 30mm. Equipment magnification 1x. Diameter of the circular dovetail mount to the body: 8mm.

- MB066250 | C-TEP2 DSC Port For Ergonomic | 150g |
- MB066250 | C-TEP2 DSC Port For Ergonomic | 150g |
- MB066250 | C-TEP2 DSC Port For Ergonomic | 150g |
- MB066250 | C-TEP2 DSC Port For Ergonomic | 150g |
- MB066250 | C-TEP2 DSC Port For Ergonomic | 150g |

Unit: mm (E.P.: Eyepoint)

Eyepiece Tubes/Double Port/Straight Tubes

These lenses can be combined with illuminators such as the LV-UEPI, LV-UEPI2, LV-UEPI2A and LV-EPILED. The trinocular eyepiece tube supports both ultrawide and wide fields of view with a change of the eyepiece lens.

GIF Filter

Unit: mm

a25mm Filter Slider

Double Port

Installed between the ep-illuminator and the trinocular tube, the double port enables simultaneous attachment of CCTV and 35mm cameras.

Straight Tubes

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- MB066250 | C-TEP2 DSC Port For Ergonomic | 150g |
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- MB066250 | C-TEP2 DSC Port For Ergonomic | 150g |
- MB066250 | C-TEP2 DSC Port For Ergonomic | 150g |
- MB066250 | C-TEP2 DSC Port For Ergonomic | 150g |

Unit: mm (E.P.: Eyepoint)
Eyepieces  
These eyepieces have a 30mm sleeve diameter and maximize the performance of objective lenses.

Eyepieces  
These eyepieces have a 23.2mm sleeve diameter and maximize the performance of objective lenses.
CCTV Camera Adapters

Both C-mount and ENG-mount types are available.

Note: The Relay Lens 1×l

CCTV Camera Adapters
MQD12013/200g
MQD12012/200g
MQD12011/100g
MQD12023/180g
MQD12013/200g
MQD12021/830g
MQD12040/300g
MQD42040/620g
MQD42070/155g
MQD42055/300g
MQD42060/650g
MQD42000/180g
MQD41041/500g
MQD41061/500g
MQD41040/250g
MQD41035/250g
MQD41030/200g

ENG-mount TV Adapter
C-mount TV Adapter
1/3 Relay Lens
1/2 Relay Lens
C-mount Adapter
C-0.7x
C-0.65x
C-0.55x
C-0.45x

Relay Lens 1x
0.55×
0.45×
0.6×
0.9×

Adapters for 1/3-inch (0.35×), 1/2-inch (0.45×), and 2/3-inch (0.6×) CCD cameras are available.

* ENG Mount for Zooming Lens have been discontinued, and only available from stock.

Conjunction with 0.9-2.25× TV zoom lenses.

Note: The ENG-mount TV Adapter and C-Mount TV Adapter are used in conjunction with the Relay Lens 1x.

Glossary

- **Working Distance (W.D.) and Parfocal Distance**
  - Working distance is the distance between the top lens of the objective and the surface of the specimen (or the cover glass) when the specimen is focused. The distance between the objective's shoulder and the specimen (or the cover glass) when the specimen is focused is referred to as parfocal distance. Nikon's CF infinity objectives have a parfocal distance of 45mm, while its CFw-2 / CFw objectives feature a parfocal distance of 60mm.

- **Numerical aperture (NA)**
  - Numerical aperture is generally indicated by the equation below.
    
    \[ NA = n \times \sin \theta \]

  - Where, \( NA = \) Numerical aperture of objective
  - \( n = \) Refractivity of the substance existing between the specimen and the objective (\( n=1 \) for air)
  - \( \theta = \) Angle that is formed by the optical axis and the light ray that passes to the extreme periphery of the objective lens.

  - Numerical aperture is the most important factor in judging the objective's resolving power, brightness, and depth of focus.

- **Resolving Power**
  - The closest proximity of two objects that can be seen as two distinct regions of the image. Resolving power is generally indicated by the equation below, where the larger the NA the greater the resolving power.

  \[ \text{Resolving Power} = 0.61 \times \frac{\lambda}{2 \times (NA)^2} \]

  - Where, \( \lambda = \) Light source's wavelength (generally 0.55μm)
  - \( NA = \) Numerical aperture of objective

- **Depth of Focus** (When observing with eyepieces)
  - The range in front of and behind the target plane of the specimen, within which the observed structure can be sharply focused. The accommodation power of the human eye varies from person to person, so does depth of focus. Depth of focus is indicated by the equation below.

  \[ \text{Depth of focus} = \frac{n \times \lambda}{2 \times (NA)^2} + \frac{n}{7 \times NA \times M} \times 1000 \]

  - Where, \( n = \) Refractivity of the substance existing between the specimen and the objective. (\( n=1 \) for air)
  - \( \lambda = \) Light source's wavelength (generally 0.55μm)
  - \( M = \) Total magnification

- **Pupil Diameter**

  The pupil diameter of the objective lens is expressed by the following equation:

  \[ \text{Pupil diameter} = 2 \times f \times NA \]

  - \( f = \) Focal distance of objective lens
  - \( NA = \) Numerical aperture of objective

  Refer to this catalog for the values of \( f \) and \( NA \) for each objective lens. In addition, more information on pupils is available on the Nikon Corporation Instruments Company / Nikon Corporation website at: [http://www.nikon.com/industrial-metrology](http://www.nikon.com/industrial-metrology)

- **Total Magnification**

  When viewed through eyepieces

  Eyepiece observation magnification (M) = objective's magnification × eyepieces magnification

  When viewed on monitors

  Monitor observation magnification = objective's magnification × TV adapter magnification × monitor magnification

  Monitor magnification varies depending on the imaging device size of the TV camera used and the monitor size. For information, see the table below.

**Imaging device size**

<table>
<thead>
<tr>
<th>Type</th>
<th>Diagonal length</th>
<th>Longer side</th>
<th>Shorter side</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/3-inch</td>
<td>6.0mm</td>
<td>10.0mm</td>
<td>3.0mm</td>
</tr>
<tr>
<td>1/2-inch</td>
<td>8.0mm</td>
<td>13.0mm</td>
<td>5.0mm</td>
</tr>
<tr>
<td>2/3-inch</td>
<td>11.0mm</td>
<td>17.0mm</td>
<td>6.0mm</td>
</tr>
</tbody>
</table>

**Monitor Size**

<table>
<thead>
<tr>
<th>Monitor Size</th>
<th>Imaging device size</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-inch</td>
<td>38.6</td>
</tr>
<tr>
<td>14-inch</td>
<td>58.0</td>
</tr>
<tr>
<td>20-inch</td>
<td>80.2</td>
</tr>
</tbody>
</table>

**Working Distance**

<table>
<thead>
<tr>
<th>Objective Lens</th>
<th>30.8×</th>
<th>43.7×</th>
<th>56.7×</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Distance</td>
<td>30.8mm</td>
<td>43.7mm</td>
<td>56.7mm</td>
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</tbody>
</table>

**Objective Lens**

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<th>Objective Lens</th>
<th>30.8×</th>
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<td>30.8mm</td>
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</tbody>
</table>

**Image plane**

<table>
<thead>
<tr>
<th>Image plane</th>
<th>ø32</th>
<th>ø44</th>
<th>ø53</th>
</tr>
</thead>
</table>

**C-mount thread**

<table>
<thead>
<tr>
<th>C-mount thread</th>
<th>27.3</th>
<th>54.3</th>
</tr>
</thead>
</table>

**Glossary**

- **Image plane**
- **C-mount thread**
- **Working Distance**
- **Parfocal Distance**
- **Numerical aperture**
- **Resolving Power**
- **Depth of Focus**
- **Pupil Diameter**
- **Total Magnification**

**Table**

<table>
<thead>
<tr>
<th>Objective Lens</th>
<th>Image plane</th>
<th>ø25.4</th>
<th>ø30.2</th>
</tr>
</thead>
</table>

**Diagram**

- **ENG-mount TV Adapter**
- **C-mount TV Adapter**
- **1/3 Relay Lens**
- **1/2 Relay Lens**
- **C-mount Adapter**
- **C-0.7x**
- **C-0.65x**
- **C-0.55x**
- **C-0.45x**

**Legend**

- **ENG-mount TV Adapter**
- **C-mount TV Adapter**
- **1/3 Relay Lens**
- **1/2 Relay Lens**
- **C-mount Adapter**
- **C-0.7x**
- **C-0.65x**
- **C-0.55x**
- **C-0.45x**

**Note:** The Relay Lens 1x

<ref>MQD12013/200g</ref>

<ref>MQD12012/200g</ref>

<ref>MQD12011/100g</ref>

<ref>MQD12023/180g</ref>

<ref>MQD12040/300g</ref>

<ref>MQD42040/620g</ref>

<ref>MQD42070/155g</ref>

<ref>MQD42055/300g</ref>

<ref>MQD42000/180g</ref>

<ref>MQD41041/500g</ref>

<ref>MQD41061/500g</ref>

<ref>MQD41040/250g</ref>

<ref>MQD41035/250g</ref>

<ref>MQD41030/200g</ref>

**Diagram**

- **ENG-mount TV Adapter**
- **C-mount TV Adapter**
- **1/3 Relay Lens**
- **1/2 Relay Lens**
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- **C-0.7x**
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**Legend**

- **ENG-mount TV Adapter**
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