

Qioptiq Optem Zoom 70XL
7:1 Optical System



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Optem® Zoom 70XL 7:1 Micro-Inspection Zoom Lens System

The Optem Zoom 70XL is specifically designed to stand up to the grueling conditions of automated imaging. The “XL” stands for Xtended Life backed by superior engineering and only the highest-quality components and materials.

The Zoom 70XL Lens System features robust optomechanics to deliver defect-free performance out to 250,000 zoom cycles... guaranteed! The Zoom 70XL features a three-piece modular design in most configurations for maximum flexibility.

With a wide variety of function options and magnification accessories, Zoom 70XL can be configured to cover a wide range of micro-imaging applications.

Base Configuration (1X TV Tube with no Aux. Lens)	(@ Low Mag.)	(@ High Mag.)
Magnification Range	0.75X	5.25X
Numerical Aperture	0.024	0.080
Resolution	72 lp/mm	240 lp/mm
Depth-of-Field	0.98 mm	0.09 mm
Working Distance	89 mm	89 mm
FOV (1/3" Camera)	4.80 x 6.40 mm	0.69 x 0.92 mm
FOV (1/2" Camera)	6.40 x 8.53 mm	0.91 x 1.23 mm
FOV (2/3" Camera)	8.80 x 11.73 mm	1.26 x 1.69 mm
FOV (1" Camera)	12.80 x 17.07 mm	1.85 x 2.46 mm
Min. Configuration (0.375X TV Tube + 0.18X Aux. Lens)	(@ Low Mag.)	(@ High Mag.)
Working Distance	468 mm	468 mm
Magnification Range	0.051X	0.35X
Numerical Aperture	0.0043	0.015
Resolution	13 lp/mm	45 lp/mm
Depth-of-Field	31 mm	2.5 mm
Max. Configuration (2.0X TV Tube + 20X HR Obj.)	(@ Low Mag.)	(@ High Mag.)
Magnification Range	14X	100X
Numerical Aperture	0.24	0.60
Resolution	720 lp/mm	1800 lp/mm
Depth-of-Field	0.0098 mm	0.0016 mm
Working Distance	13 mm	13 mm



Specifying Your Optem Lens System

To specify your Optem Lens System identify the parameters of your application and select the modular components which deliver the optimum imaging solution.

STEP 1. Determine the Field-of-View (FOV) you require by choosing your intended camera format (1/3", 1/2", 2/3" etc.), and using the dimensions of that camera format to calculate the optical magnification required (see camera dimensions below):

$$\text{Optical Mag.} = \frac{\text{Camera dimension (mm)}}{\text{FOV desired (mm)}}$$

STEP 2. The Zoom 70XL **base configuration** consists of a Manual Zoom, a Basic Lower Function Module and a 1X TV Tube, which yields an optical magnification range of 0.75X - 5.25X.

Given your optical magnification requirement from STEP 1, determine if your needs fall into the **base configuration** range of 0.75X - 5.25X. If you require higher than 5.25X optical magnification, you can add an Auxiliary Lens with a magnification factor greater than 1X, AND/OR you can choose a TV Tube with a magnification factor greater than 1X (keeping in mind that Aux. Lenses affect the working distance of the system and TV Tubes do not).

Referring to the [Optical Performance Charts \(p. 6-9\)](#), you can select the best combination of Aux. Lens (if necessary) and TV Tube to best meet the parameters of your application.

STEP 3. Select the Upper Zoom Module: The upper module has the following options available: iris, detents and motorization (see [System Diagram p. 10-11](#)).

Select the Lower Function Module: Lower Function Modules integrate the features and functions desired in your lens system which include: coaxial illumination, internal focus and motorization (see [System Diagram p. 10-11](#)).

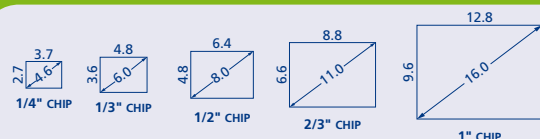
STEP 4. When completed, you will have identified the following four components required for your functional Zoom 70XL Lens System.

- 1) TV Tube
- 2) Upper Zoom Module
- 3) Lower Function Module
- 4) Auxiliary Lens (if needed)

Optem Lens Systems are specifically designed to deliver maximum versatility for your micro-inspection needs. If you do not see a standard configuration that meets your requirements, Qioptiq offers efficient and affordable custom modifications to meet special parameters.

Useful Formulas & Definitions

CAMERA CHIP DIMENSIONS (mm):



DEPTH-OF-FIELD (DOF):

The axial depth of the space on both sides of the object plane within which the object can be moved without objectionable loss of sharpness.

$$\text{DOF} = \lambda \div \text{NA}^2$$

λ = Wavelength of Light (Green Light = 0.000550mm or 550nm)

MAGNIFICATION:

The ratio of image size to actual object size.

$$\text{Optical Mag.} = \text{Camera Chip dim.} \div \text{Field-of-View (FOV)}$$
$$\text{Electronic Mag.} = \text{Monitor Diag.} \div \text{Camera Diag.}$$

NUMERICAL APERTURE (NA):

A measurement of the light collecting ability of the lens. A higher NA translates to a brighter image, better resolution, and shallower depth-of-field.

Zoom and Function Modules

Upper Zoom Modules

The specific Upper Zoom Module selected will determine the type of zoom operation for your Zoom 70XL System.



MANUAL ZOOM MODULE – Provides basic hand-driven 7:1 zoom function.

IRIS DIAPHRAGM MODULE – Provides manual 7:1 zoom with manual iris illumination control for increased depth-of-field and/or maintain consistent image brightness across your entire field.



DETENT MODULE – Obtain specific and repeatable magnification stops throughout the 7:1 zoom range without the complexity and cost of motorization. Detents are ideal for metrology applications where each position can be calibrated. Factory-set stops are located at 0.75X, 1.0X, 1.5X, 2.0X, 3.0X, 4.0X, and 5.0X



MOTORIZED ZOOM MODULE – Provides automated zoom function in either DC or Stepper Motorized versions. All Stepper Motorized Models come complete with homing and limit sensors.

Lower Function Modules

When configuring your Zoom 70XL Lens System, choose from the following Lower Modules to specify the lighting and focus functions of your systems:

- **BASIC MODULE**
- **INTERNAL FOCUS MODULE** (motor avail.)
- **COAXIAL ILLUMINATION MODULE**
- **INTERNAL FOCUS COAXIAL MODULE** (motor avail.)

If you require specialized optical performance, select from these special Lower Function Modules to boost magnification or provide flexible working distance.

03

OBJECTIVE MODULES - Integrate Infinity-Corrected Objectives utilizing one of four Objective Lower Function Modules. All are equipped with M26 x 36T threads to accept Optem and Mitutoyo Objectives. An RMS thread adapter is available for Nikon and Olympus Objectives (See p. 9 for Objectives performance).



VARIABLE WORKING DISTANCE AUXILIARY LENS -

Intended for applications requiring working distances between 127mm (5") and 432mm (17"). Covers magnification factors 0.288X at 127mm, and 0.109X at 432mm (See p. 9 for VWD factors).



RESOLUTION:

The ability to distinguish or separate fine detail. Expressed in line pairs per millimeter (lp/mm). Numerical Aperture (NA) is the controlling factor over resolution... the higher the NA, the brighter the image, and the better the resolution.

Visual Resolution (lp/mm) = $3000 \times NA$
 $1 \div lp/mm = \text{Approx. microns } (\mu) \text{ resolved}$

VIGNETTING:

The blockage of rays from off-axis object points by constraining apertures. Vignetting results in the darkening of the corners on your monitor.



Illumination Options



Illumination Options

The Zoom 70XL Lens System offers a variety of illumination options to meet a variety of imaging requirements.

You have two basic illumination options which can be integrated with your Zoom 70XL System... coaxial illumination or oblique ring light illumination.

Coaxial Illumination Options

Coaxial (or vertical) illumination is most useful on highly reflective objects. Optem's Coaxial Illuminators project cool, white light perpendicularly onto the specimen for exceptional contrast and field uniformity.

Select from one of several coaxial-equipped Lower Function Modules when specifying your Zoom 70XL lens system and integrate one of the three following options of coaxial illumination.

FIBER OPTIC COAXIAL ILLUMINATORS – Integrate coaxial illumination from your choice of either 110V or 220V Optem VSI Fiber Optic Illuminators using flexible 40- or 60-inch flexible fiber bundles.

LED COAXIAL ILLUMINATORS – Programmable 1-Watt LED Coaxial Illuminators offer reduced power requirements and heat generation with substantial service life gains.

LED Coaxial illuminators are available in straight and right-angle configurations to meet your specific space requirements, and feature

compact designs and simplified cable management. These can be driven by stand-alone, single-channel programmable controllers. Coaxial LEDs emit brilliant cool light in the visible spectrum and deliver virtually identical optical performance to our traditional Fiber Optic Coaxial Illuminator.

10W HALOGEN COAXIAL ILLUMINATORS –

When economy is high priority, Halogen light sources are available with a 6V Variable Transformer (110V / 220V) (see System Diagram p. 10-11).

POLARIZED LIGHT – When imaging highly reflective subjects, Polarizer Modules with built-in Analyzers are available to introduce polarization to both LED and Fiber Optic Coaxial Illumination paths.

Oblique Ring Light Options

Dark Field Illumination is generally used on 3-D objects to cast light rays at an angle onto an object, thus better defining its surface profile. Optem offers the following dark field illuminators for the Zoom 70XL System.

FIBER OPTIC RING LIGHTS – Ring light Illuminators are ideal to better define features of dimension-rich subjects. Driven with the same VSI Fiber Optic Illuminator as conventional coaxial systems. Qioptiq offers Ring lights specifically designed for a variety of configurations, including integration of objectives (see System Diagram p. 10-11).



Motorization & Configuration Accessories

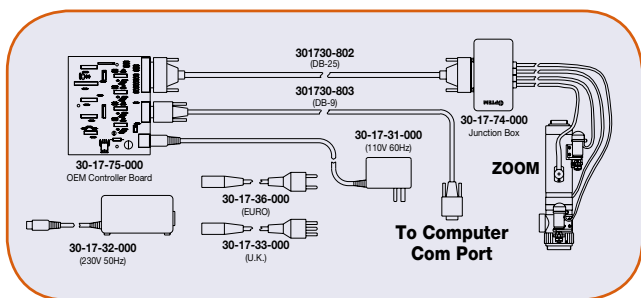


Motorizing Lens System

Optem Lens Systems can be specified with motorized zoom and/or focus functions.

STEPPER MOTOR – The stepper motors provide accurate repeatability of zoom magnification and/or focus using a Hall-effect sensor to set repeatable home position. A desktop rocker switch controller offers manual control and features an RS-232 port for automated computer control. Includes controller instructions with a list of RS-232 control commands, a Windows® control program, and startup LabVIEW control program.

An OEM controller board version is available for streamlined integration.



DC MOTOR – DC motors provide continuous control of zoom magnification and/or focus. A desktop joystick controller offers simultaneous control of both zoom and focus functions.



Configuration Accessories

In addition to modifying the physical configuration and orientation of your imaging path utilizing Right-Angle and U-bend TV Tubes (see System Diagram p. 10-11), you can extend the versatility of your Zoom 70XL Lens System with two new innovations in form and function.

MID-SYSTEM, RIGHT-ANGLE MODULE – This accessory allows the introduction of a 90° of your optical axis at the mid-body point of your Zoom 70XL Lens System. Users can now integrate any Zoom 70XL Lower Function Module below the right-angle turn, maintaining full working distance and affording greater configuration flexibility. NOTE: the Mid-System Right-Angle Module produces a mirror (reversed) image.



DUAL-MAGNIFICATION MODULE –

Simultaneously integrate two Zoom 70XL Zoom Modules with TV Tube, and/or Optem FMOS Fixed Tubes over a single subject. This permits real-time dual fixed and/or zoom imaging of your object of interest with your choice of magnifications, FOVs, camera formats and camera types. Integrate any of the full range of FMOS, Zoom 70XL and Zoom 125C Lower Function Modules below the Dual-Mag Module, or integrate vertical illumination through the compact Dual-Mag coaxial block.



Optical Performance - Oblique/Substage Illumination

	0.18X Aux Lens 29-20-09-000 (No Spacer) WD: 468 mm		0.25X Aux Lens 29-20-09-000 WD: 310 mm		0.5X Aux Lens 29-20-38-000 WD: 178 mm		0.75X Aux Lens 29-20-39-000 WD: 114 mm		Base Configuration No Aux Lens required WD: 89 mm		1.5X Aux Lens 29-20-40-000 WD: 52 mm		2.0X Aux Lens 29-20-41-000 WD: 32 mm	
	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.375X TV Tube	NA	0.0043	0.0015	0.020	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	Res (lp/mm)	13	45	60	36	120	54	180	72	240	108	360	144	480
	Mag	0.051	0.35	0.49	0.14	0.98	0.21	1.5	0.28	1.95	0.42	2.9	0.56	3.9
	DOF (mm)	31	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm)	71.1 x 94.8	10.3 x 13.7	51.2 x 68.3	7.38 x 9.8	25.6 x 34.1	3.69 x 4.92	17.1 x 22.8	2.46 x 3.28	12.8 x 17.1	1.85 x 2.46	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53
0.5X TV Tube	NA	0.0043	0.015	0.060	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	Res (lp/mm)	13	45	60	36	120	54	180	72	240	108	360	144	480
	Mag	0.068	0.47	0.65	0.19	1.3	0.28	2.0	0.38	2.6	0.56	3.9	0.75	5.2
	DOF (mm)	31	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm)	53.3 x 71.1	7.69 x 10.3	38.4 x 51.2	5.54 x 7.38	19.2 x 25.6	2.77 x 3.69	12.8 x 17.1	1.85 x 2.46	9.60 x 12.8	1.38 x 1.85	6.40 x 8.5	4.80 x 6.40	3.60 x 4.80
0.67X TV Tube	NA	0.0043	0.015	0.060	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	Res (lp/mm)	13	45	60	36	120	54	180	72	240	108	360	144	480
	Mag	0.090	0.62	0.13	0.87	2.6	0.38	2.6	0.50	3.5	0.75	5.2	1.0	6.9
	DOF (mm)	31	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm)	40.0 x 53.3	5.77 x 7.69	28.8 x 38.4	4.15 x 5.54	14.4 x 19.2	2.08 x 2.77	9.60 x 12.8	1.38 x 1.85	7.20 x 9.60	1.04 x 1.38	4.80 x 6.40	3.60 x 4.80	2.40 x 3.20
1.0X TV Tube	NA	0.0043	0.015	0.060	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	Res (lp/mm)	13	45	60	36	120	54	180	72	240	108	360	144	480
	Mag	0.14	0.94	1.3	0.38	2.6	0.56	3.9	0.75	5.2	1.1	7.8	1.5	10
	DOF (mm)	31	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm)	26.7 x 35.6	3.85 x 5.13	19.2 x 25.6	2.77 x 3.69	9.60 x 12.8	1.38 x 1.85	6.40 x 8.53	0.92 x 1.23	4.80 x 6.40	0.69 x 0.92	3.20 x 4.27	2.40 x 3.20	1.60 x 2.13
1.5X TV Tube	NA	0.0043	0.015	0.060	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	Res (lp/mm)	13	45	60	36	120	54	180	72	240	108	360	144	480
	Mag	0.20	1.4	2.0	0.56	3.9	0.84	5.9	1.1	7.8	1.7	12	2.3	16
	DOF (mm)	31	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm)	17.8 x 23.7	2.56 x 3.42	12.8 x 17.1	1.85 x 2.46	6.40 x 8.53	0.92 x 1.23	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62	2.13 x 2.84	1.60 x 2.13	0.92 x 1.23
2.0X TV Tube	NA	0.0043	0.015	0.060	0.012	0.040	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	Res (lp/mm)	13	45	60	36	120	54	180	72	240	108	360	144	480
	Mag	0.27	1.9	2.6	0.38	2.6	1.1	7.8	1.5	10	2.3	16	3.0	21
	DOF (mm)	31	16	1.4	3.9	0.35	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm)	13.3 x 17.8	1.92 x 2.56	9.60 x 12.8	1.38 x 1.85	4.80 x 6.40	0.69 x 0.92	3.20 x 4.27	0.46 x 0.62	2.40 x 3.20	0.35 x 0.46	1.60 x 2.13	1.20 x 1.60	0.92 x 1.23
Max FOV at Low Mag (Dia.):														
19 mm ø														
28 mm ø														
37 mm ø														
56 mm ø														
110 mm ø														
160 mm ø														
14 mm ø														

-- FOV Limited by vignetting at low mags. Approximate maximum illuminated FOV given as diameter above.

Optical Performance - Coaxial Illumination

NOTE: 0.18X, 0.25X and 0.5X Aux Lenses are not recommended for use with coaxial illumination		0.75X Aux Lens 29-20-39-000 WD: 114 mm		Base Configuration No Aux Lens Required WD: 89 mm		1.5X Aux Lens 29-20-40-000 WD: 52 mm		2.0X Aux Lens 29-20-41-000 WD: 32 mm	
		Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag
0.375X TV Tube	NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	Res (lp/mm)	54	180	72	240	108	360	144	480
	Mag	0.21	1.5	0.28	1.95	0.42	2.9	0.56	3.9
	DOF (mm)	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	--	--	12.8 x 17.1	1.85 x 2.46	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23
0.5X TV Tube	1/2"	--	--	--	--	11.4 x 15.2	1.64 x 2.19	8.53 x 11.4	1.23 x 1.64
	1/2"	--	--	--	--	15.6 x 20.9	2.26 x 3.01	11.7 x 15.6	1.69 x 2.26
	2/3"	--	--	--	--	0.036	0.12	0.048	0.16
	NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	Res (lp/mm)	54	180	72	240	108	360	144	480
0.67X TV Tube	Mag	0.28	2.0	0.38	2.6	0.56	3.9	0.75	5.2
	DOF (mm)	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	--	--	9.60 x 12.8	1.38 x 1.85	6.40 x 8.53	0.92 x 1.23	4.80 x 6.40	0.69 x 0.92
	1/2"	--	--	12.8 x 17.1	1.85 x 2.46	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23
	1/2"	--	--	--	--	11.7 x 15.6	1.69 x 2.26	8.80 x 11.7	1.27 x 1.69
1.0X TV Tube	2/3"	--	--	--	--	17.1 x 22.8	2.46 x 3.28	12.8 x 17.1	1.85 x 2.46
	1"	--	--	--	--	0.036	0.12	0.048	0.16
	NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	Res (lp/mm)	54	180	72	240	108	360	144	480
	Mag	0.38	2.6	0.50	3.5	0.75	5.2	1.0	6.9
1.5X TV Tube	DOF (mm)	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	9.60 x 12.8	1.38 x 1.85	7.20 x 9.60	1.04 x 1.38	4.80 x 6.40	0.69 x 0.92	3.60 x 4.80	0.52 x 0.69
	1/2"	--	--	9.60 x 12.8	1.38 x 1.85	6.40 x 8.53	0.92 x 1.23	4.80 x 6.40	0.69 x 0.92
	1/2"	--	--	13.2 x 17.6	1.90 x 2.54	8.80 x 11.7	1.27 x 1.69	6.60 x 8.80	0.95 x 1.27
	2/3"	--	--	12.8 x 17.1	1.85 x 2.46	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23
2.0X TV Tube	1"	--	--	--	--	0.036	0.12	0.048	0.16
	NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	Res (lp/mm)	54	180	72	240	108	360	144	480
	Mag	0.84	5.9	1.1	7.80	1.7	12	2.3	16
	DOF (mm)	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
2.0X TV Tube	FOV (mm) Cam Format	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62	2.13 x 2.84	0.31 x 0.41	1.60 x 2.13	0.23 x 0.31
	1/2"	5.69 x 7.59	0.82 x 1.09	4.27 x 5.69	0.62 x 0.82	2.84 x 3.79	0.41 x 0.55	2.13 x 2.84	0.31 x 0.41
	1/2"	7.82 x 10.4	1.13 x 1.50	5.87 x 7.82	0.85 x 1.13	3.91 x 5.21	0.56 x 0.75	2.93 x 3.91	0.42 x 0.56
	2/3"	11.4 x 15.2	1.64 x 2.19	8.53 x 11.4	1.23 x 1.64	5.69 x 7.59	0.82 x 1.09	4.27 x 5.69	0.62 x 0.82
	1"	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
2.0X TV Tube	NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	Res (lp/mm)	54	180	72	240	108	360	144	480
	Mag	1.1	7.8	1.5	10	2.3	16	3.0	21
	DOF (mm)	1.8	0.16	0.98	0.089	0.44	0.039	0.25	0.022
	FOV (mm) Cam Format	3.20 x 4.27	0.46 x 0.62	2.40 x 3.20	0.35 x 0.46	1.60 x 2.13	0.23 x 0.31	1.20 x 1.60	0.17 x 0.23
2.0X TV Tube	1/2"	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62	2.13 x 2.84	0.31 x 0.41	1.60 x 2.13	0.23 x 0.31
	1/2"	5.87 x 7.82	0.85 x 1.13	4.40 x 5.87	0.63 x 0.85	2.93 x 3.91	0.42 x 0.56	2.20 x 2.93	0.32 x 0.42
	2/3"	8.53 x 11.4	1.23 x 1.64	6.40 x 8.53	0.92 x 1.23	4.27 x 5.69	0.62 x 0.82	3.20 x 4.27	0.46 x 0.62
	1"	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
	NA	0.018	0.060	0.024	0.080	0.036	0.12	0.048	0.16
Max FOV at Low Mag (Dia.):		8.9 mm ø		12 mm ø		13 mm ø		10 mm ø	



Optical Performance
Variable Working Distance
Lower Module

Working Distance	Auxiliary Lens Mag.
5"	0.288
6"	0.253
7"	0.226
8"	0.202
9"	0.184
10"	0.169
11"	0.158
12"	0.147
13"	0.138
14"	0.130
15"	0.123
16"	0.116
17"	0.109

-- FOV limited by illumination at low mags. Approximate maximum illuminated FOV given as diameter above. -- Not recommended due to significant illumination losses throughout entire zoom range.

Long-Working Distance Objectives

Achieve significantly higher magnifications and increased resolution. Combine your Zoom 70XL with the expanded line of Optem LWD Infinity-Corrected Objectives.

08

When integrating objectives onto your Zoom 70XL Lens System, You will need to specify one of four Objective Lower Function Modules (see [System Diagram p. 10-11](#)).

Optem M-Plan APO, LWD Objectives

Eliminate chromatic aberration across exceptionally flat fields for the ultimate in high-magnification accuracy. Select from 2X, 5X, 10X, and 20X Long-Working Distance Objectives. These objectives are exact replacements for Mitutoyo 378 series objectives and are ideal for metrology applications.

LWD Infinity-Corrected M-Plan APO Objectives

- 2X M Plan APO, LWD 28-21-02-000
- 5X M Plan APO, LWD 28-21-05-000
- 10X M Plan APO, LWD 28-21-10-000
- 20X M Plan APO, LWD 28-21-11-000



Optem High-Resolution, LWD Objectives

Specifically designed to capture maximum resolution at the high-end magnifications of Optem Zoom Lenses, the 5X, 10X and 20X Optem HR Objectives are ideal for applications where distinguishing every finite detail is critical.

LWD Infinity-Corrected Hi Res Objectives

- 5X High-Resolution, LWD 28-20-44-000
- 10X High-Resolution, LWD 28-20-45-000
- 20X High-Resolution, LWD 28-20-46-000



Optical Performance - Objectives with coaxial Illumination

* Zoom 70X does not pass full NA of Optem 5X and 10X HR Objectives

NOTE: 0.375X TV Tube is not recommended for use with Optem Objectives	2x M Plan APO LWD Objective 28-21-1-02-000 WD: 34 mm		5X M Plan APO LWD Objective 28-21-05-000 WD: 34 mm		10X M Plan APO LWD Objective 28-21-1-10-000 WD: 34 mm		20X M Plan APO LWD Objective 28-21-1-1-000 WD: 20 mm		5X High-Res* LWD Objective 28-20-44-000 WD: 34 mm		10X High-Res* LWD Objective 28-20-45-000 WD: 19 mm		20X High-Res LWD Objective 28-20-46-000 WD: 13 mm		
	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	Low Mag	High Mag	
0.5X TV Tube	NA	0.024	0.055	0.14	0.12	0.30	0.24	0.42	0.060	0.19	0.12	0.39	0.24	0.60	
	Res (lp/mm)	72	165	420	360	900	720	1260	180	570	360	1170	720	1800	
	Mag	0.36	2.5	6.2	1.8	12	3.6	25	0.90	6.2	1.8	12	3.6	25	
	DOF (mm)	0.98	0.19	0.029	0.039	0.0063	0.010	0.0032	0.16	0.016	0.039	0.0037	0.0098	0.0016	
0.67X TV Tube	1/3*	10.0 x 13.3	1.44 x 1.92	4.00 x 5.33	2.00 x 2.67	0.29 x 0.38	1.00 x 1.33	0.14 x 0.19	4.00 x 5.33	0.58 x 0.77	2.00 x 2.67	0.29 x 0.38	1.00 x 1.33	0.14 x 0.19	
	1/2*	13.3 x 17.8	1.92 x 2.56	5.33 x 7.11	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	5.33 x 7.11	0.77 x 1.03	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	
	2/3*	--	--	7.33 x 9.78	1.06 x 1.41	0.53 x 0.71	--	--	--	--	--	--	1.83 x 2.44	0.26 x 0.35	
	FOV (mm)	0.024	0.055	0.060	0.14	0.12	0.30	0.24	0.42	0.060	0.19	0.12	0.39	0.24	
1.0 TV Tube	NA	72	165	420	360	900	720	1260	180	570	360	1170	720	1800	
	Res (lp/mm)	0.72	5.0	12	3.6	25	7.2	50	1.8	12	3.6	25	7.2	50	
	Mag	0.98	0.19	0.16	0.039	0.0063	0.010	0.0032	0.16	0.016	0.039	0.0037	0.0098	0.0016	
	DOF (mm)	5.00 x 6.67	0.72 x 0.96	2.00 x 2.67	1.00 x 1.33	0.14 x 0.19	0.50 x 0.67	0.072 x 0.096	2.00 x 2.67	0.29 x 0.38	1.00 x 1.33	0.14 x 0.19	0.50 x 0.67	0.072 x 0.096	
1.5X TV Tube	1/3*	6.67 x 8.89	0.96 x 1.28	2.67 x 3.56	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.096 x 0.13	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.10 x 0.13	
	1/2*	9.17 x 12.2	1.32 x 1.76	3.67 x 4.89	1.83 x 2.44	0.26 x 0.35	0.92 x 1.22	0.13 x 0.18	3.67 x 4.89	0.53 x 0.71	1.83 x 2.44	0.26 x 0.35	0.92 x 1.22	0.13 x 0.18	
	2/3*	13.3 x 17.8	1.92 x 2.56	5.33 x 7.11	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	5.33 x 7.11	0.77 x 1.03	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	
	FOV (mm)	0.024	0.055	0.060	0.14	0.12	0.30	0.24	0.42	0.060	0.19	0.12	0.39	0.24	
2.0X TV Tube	NA	72	165	420	360	900	720	1260	180	570	360	1170	720	1800	
	Res (lp/mm)	1.1	7.5	19	5.4	37	11	75	2.7	19	5.4	37	11	75	
	Mag	0.98	0.19	0.16	0.039	0.0063	0.010	0.0032	0.16	0.016	0.039	0.0037	0.0098	0.0016	
	DOF (mm)	3.33 x 4.44	0.48 x 0.64	1.33 x 1.78	0.67 x 0.89	0.10 x 0.13	0.33 x 0.44	0.048 x 0.064	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.096 x 0.13	0.33 x 0.44	0.048 x 0.064	
2.0X TV Tube	1/3*	4.44 x 5.93	0.64 x 0.85	1.78 x 2.37	0.26 x 0.34	0.089 x 0.119	0.13 x 0.17	0.064 x 0.085	1.78 x 2.37	0.26 x 0.34	0.89 x 1.19	0.13 x 0.17	0.44 x 0.59	0.064 x 0.085	
	1/2*	6.11 x 8.15	0.88 x 1.18	2.44 x 3.26	0.35 x 0.47	0.122 x 0.163	0.18 x 0.24	0.088 x 0.12	2.44 x 3.26	0.35 x 0.47	1.22 x 1.63	0.18 x 0.24	0.61 x 0.81	0.088 x 0.12	
	2/3*	8.89 x 11.9	1.28 x 1.71	3.56 x 4.74	1.78 x 2.37	0.26 x 0.34	0.89 x 1.19	0.13 x 0.17	3.56 x 4.74	0.51 x 0.68	1.78 x 2.37	0.26 x 0.34	0.89 x 1.19	0.13 x 0.17	
	FOV (mm)	0.024	0.055	0.14	0.12	0.30	0.24	0.42	0.060	0.19	0.12	0.39	0.24	0.60	
2.0X TV Tube	NA	72	165	420	360	900	720	1260	180	570	360	1170	720	1800	
	Res (lp/mm)	1.44	10	25	7.2	50	14	100	3.6	25	7.2	50	14	100	
	Mag	0.98	0.19	0.16	0.039	0.0063	0.010	0.0032	0.16	0.016	0.039	0.0037	0.0098	0.0016	
	DOF (mm)	2.50 x 3.33	0.36 x 0.48	1.00 x 1.33	0.50 x 0.67	0.072 x 0.096	0.25 x 0.33	0.036 x 0.048	1.00 x 1.33	0.144 x 0.19	0.50 x 0.67	0.072 x 0.096	0.25 x 0.33	0.036 x 0.048	
2.0X TV Tube	1/3*	3.33 x 4.44	0.48 x 0.64	1.33 x 1.78	0.67 x 0.89	0.096 x 0.13	0.33 x 0.44	0.048 x 0.064	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.096 x 0.13	0.33 x 0.44	0.048 x 0.064	
	1/2*	4.58 x 6.11	0.66 x 0.88	1.83 x 2.44	0.92 x 1.22	0.13 x 0.18	0.46 x 0.61	0.066 x 0.088	1.83 x 2.44	0.26 x 0.35	0.92 x 1.22	0.13 x 0.18	0.46 x 0.61	0.066 x 0.088	
	2/3*	6.67 x 8.89	0.96 x 1.28	2.67 x 3.56	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.096 x 0.13	2.67 x 3.56	0.38 x 0.51	1.33 x 1.78	0.19 x 0.26	0.67 x 0.89	0.096 x 0.13	
	FOV (mm)	--	--	8.00 x 10.7	1.15 x 1.54	--	--	--	--	--	--	--	--	--	
Max FOV at Low Mag (Dia.):		14 mm ø		6.1 mm ø		2.8 mm ø		1.1 mm ø		5.3 mm ø		2.0 mm ø		1.4 mm ø	

-- FOV Limited by illumination at low mags. Approximate maximum illuminated FOV given as diameter above.

-- Not recommended due to significant illumination losses throughout entire zoom range.

Zoom 70XL Lens System Diagram

29-50-10-000
UNIVERSAL CLAMP
(top view)



39-15-34-000
FLAT MOUNT
(for Motorized versions)



Tube Clamp Mounts



30-25-76-000
76mm O.D. TUBE CLAMP
(OLYMPUS, NIKON, LEICA)



30-25-82-000
82mm O.D. TUBE CLAMP
(UNITRON)



30-25-83-000
83mm O.D. TUBE CLAMP
(GENERIC)



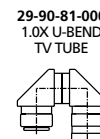
30-25-84-000
84mm O.D. TUBE CLAMP
(MEIJ)



Right-Angle TV Tubes

29-90-86-000 – 0.5X RA
29-90-87-000 – 0.67X RA
29-90-74-000 – 1.0X RA
29-90-88-000 – 1.5X RA
29-90-89-000 – 2.0X RA

NOTE: Right-Angle TV Tubes
yield a reversed image



U-Bend TV Tube

29-90-81-000
1.0X U-BEND
TV TUBE



29-90-26-000
0.5X MINI
TV TUBE



29-90-27-000
0.67X MINI
TV TUBE



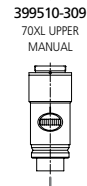
29-90-90-000
1.0X MINI
TV TUBE



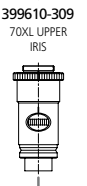
29-90-28-000
1.5X MINI
TV TUBE

Mini TV Tubes

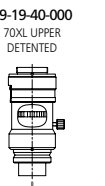
Upper Zoom Modules



399510-309
70XL UPPER
MANUAL



399610-309
70XL UPPER
IRIS



3919-40-000
70XL UPPER
DETENTED

Illumination

396010-810
SINGLE-CHANNEL
PROGRAMMABLE
LED CONTROLLER



39-60-10-000
STRAIGHT
1-WATT COAXIAL LED



39-60-20-000
RIGHT-ANGLE
1-WATT COAXIAL LED



27-60-07-000
110/6 VOLT VARIABLE
27-60-17-000
220/6 VOLT VARIABLE



29-60-09-000
10 WATT
HALOGEN LAMP



29-60-83-000
VSI 110 ILLUMINATOR
110 VOLT / 150 WATT
29-60-84-000
VSI 220 ILLUMINATOR
220VOLT / 150 WATT

30-16-40-000
40" FLEX
BUNDLE
30-16-60-000
60" FLEX
BUNDLE



33-04-00-000
LOW PROFILE, R.A.
COAXIAL LAMPHOUSE
(Replaces standard
bottom module lamphouse)



30-16-01-000
10MM ADAPTER



30-16-01-000
10MM ADAPTER



29-65-14-000
STANDARD
COAXIAL LAMPHOUSE



396010-810
SINGLE-CHANNEL
PROGRAMMABLE
LED CONTROLLER



39-60-10-000
STRAIGHT
1-WATT COAXIAL LED

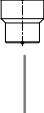


Lower Function Modules

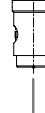
29-25-15-000
ZOOM 70XL VARIABLE
AUXILIARY LENS



299510-310
BASIC
MODULE



299591-310
INTERNAL FOCUS
MODULE



296515-310
COAX ILLUM.
MODULE



296591-310
COAX ILLUM. &
FOCUS MODULE



33-03-03-000
RING LIGHT ADAPTER



29-60-81-000
HORIZONTAL
RING LIGHT



29-60-31-000
MINI-ANNULAR
RING PROBE

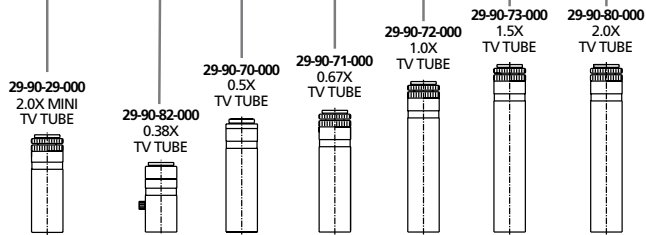


29-20-09-000
0.18X / 0.25X
CONVERTIBLE
AUX LENS
29-20-38-000
0.5X
AUX LENS
29-20-39-000
0.75X
AUX LENS
29-20-40-000
1.5X
AUX LENS

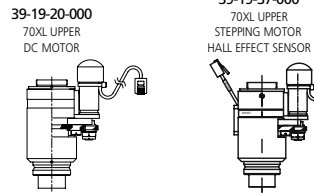


CAMERA

Standard TV Tubes

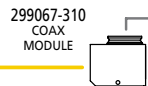
Non-Inverting
Right-Angle TV Tubes

29-90-92-000 - 0.5X NIRA
 29-90-93-000 - 0.67X NIRA
 29-90-94-000 - 1.0X NIRA
 29-90-95-000 - 1.5X NIRA
 29-90-96-000 - 2.0X NIRA



29-90-66-000
LONG WORKING
RIGHT-ANGLE
MODULE

NOTE: Long-Working
Right-Angle Module
yields a reversed image



Can also integrate FMOS
Upper Fixed Tubes. Refer
to Optem FMOS Brochure

29-90-67-000
DUAL MAGNIFICATION
MODULE

Motorization Control & Power Supply

DC MOTOR

28-80-18-000
110V TRANSFORMER

28-80-19-000
220V TRANSFORMER

30-17-20-000
DC MOTOR DRIVER

STEPPER MOTOR

30-17-70-000
STEPPING MOTOR
DRIVER

30-17-74-000
HALL EFFECT SENSOR
JUNCTION BOX

30-17-75-000
STEPPING MOTOR
O.E.M. BOARD

30-17-31-000
UNIV. TRANSFORMER
(100-240V, 50-60Hz)

30-17-37-000
(N. AMER CORD)

30-17-36-000
(EUR CORD)

30-17-33-000
(UK CORD)

Color Key

Optical Path —
 Illumination Path —
 Electrical —

299066-304
FMOS / ZOOM 70
LOWER MODULE
COUPLER

299066-306
ZOOM 125
LOWER MODULE
COUPLER

Integrates with Optem Zoom 125
Lower Function Modules. Refer to Zoom 125 Brochure

299066-302
M25x0.75
ADAPTER

299066-303
OPTEM / MITU.
OBJECTIVES
COUPLER

299066-305
NIKON / OLY
OBJECTIVES
COUPLER

296084-310
COAX ILLUM.
OBJ. DUAL FOCUS

296085-310
COAX ILLUM.
OBJECTIVE MODULE

299084-310
OBJECTIVE DUAL
FOCUS MODULE

299085-310
OBJECTIVE ADAPTER
MODULE

29-20-31-000
2X CONVERSION LENS

Auxiliary Lenses

29-20-41-000
2.0X
AUX LENS

30-17-01-000
0.5X R. A.
AUX LENS

30-17-02-000
0.75X R. A.
AUX LENS

29-90-59-000
RIGHT ANGLE
ADAPTER

NOTE: Yields a reversed image,
and reduces effective working
distance by 48mm



Optem® LWD Objectives
 28-20-44-000 - 5X HIGH-RES
 28-20-45-000 - 10X HIGH-RES
 28-20-46-000 - 20X HIGH-RES

Optem® LWD Objectives
 28-21-02-000 - 2X M PLAN APO
 28-21-05-000 - 5X M PLAN APO
 28-21-10-000 - 10X M PLAN APO
 28-21-11-000 - 20X M PLAN APO

29-20-32-000
RMS ADAPTER



30-16-50-000
OBJECTIVE RING LIGHT



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...and Manufacturing Advancement

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