

TELECENTRIC ZOOM 100
10:1 OPTICAL SYSTEM

UNPRECEDENTED <0.1% DISTORTION
E-IRIS Models Guarantee 400,000 Zoom Cycles

**SETTING THE NEW STANDARD
IN METROLOGICAL ACCURACY**

In anticipation of the increasing precision requirements of metrology and quality assurance in the high-tech manufacturing and R&D realms, Thales Optem has developed a patented* 10:1 Zoom Optical System that delivers telecentric imaging with less than 0.1% distortion across the entire zoom range.

Simply stated, Thales Optem's Telecentric Zoom 100 (T-Zoom 100) delivers the imaging precision most needed for metrological accuracy. Its ingenious design virtually eliminates the distortion and parallax of an object regardless of its position in the field-of-view.



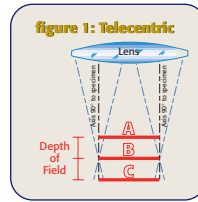
- **Unprecedented <0.1% Distortion**
- **Zero Vignetting**
- **E-Iris Version Guarantees 400,000 Cycles**

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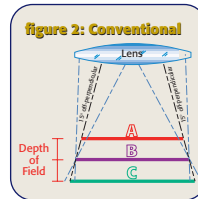
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The Physics of Telecentricity

A Telecentric cone of rays emanating from an object point remains perfectly perpendicular to the object plane across the entire field-of-view.



In contrast, a conventional lens has cones which are not perpendicular and thus produce parallax. Consider figures 1 and 2. In figure 1, all three locations (A, B & C) will measure the same size. However, in figure 2, A, B & C will all appear the same size to the camera, but in reality, are all different sizes.



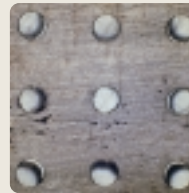
The Power of Precision

Telecentric Systems have a variety of quality-specific applications within the manufacturing and high-tech arenas. Specimens can be precisely and reliably measured over the entire field-of-view, resulting in higher throughput and ultimately more productive and accurate quality control.

Combine the extraordinary precision of the Telecentric Zoom 100 with zero vignetting, an expansive 10:1 zoom range, accessory lenses which allow magnifications from 0.1 to 10.3X, and you realize the embodiment of exacting metrological power and precision.

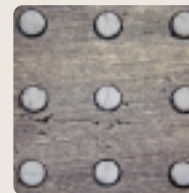
Conventional vs. Telecentric Imaging

Conventional Lens



The conventionally captured image (top) shows the side walls of the "off-axis" holes as well as occluded bottoms.

VS.



The T-Zoom 100 image (lower) shows all holes with consistent perspective regardless of position with the field-of-view (i.e., all holes present identically with fully visible bottoms.)

Telecentric Zoom 100

MODULAR FLEXIBILITY

Thales Optem's T-Zoom 100 has been modularly designed to provide you with maximum flexibility. Varying combinations of the Upper Zoom Modules and Lower Function Modules afford a broad array of optical, mechanical, illumination, camera, and physical configuration options.

Composition of a T-Zoom 100

Mount Coupler
The link between the camera and the dovetail end of the TV tube.

Tube
Establishes proper image size to eliminate vignetting for each specific camera format. Also positions the camera at the proper distance from the zoom (rear conjugate).

Upper Zoom Module
The very heart of the T-Zoom 100. Upper modules contain the core zoom function.

Lower Function Module
Provides for illumination options and holds the Objective Lens.

Objective Lens
Focuses the image of the object into the camera system at "infinity". Also provides for magnification and field-of-view flexibility.

UPPER ZOOM MODULE OPTIONS

There are four Upper Zoom Modules to choose from when specifying your T-Zoom 100 Optical System.

Manual Zoom Module



Provides basic hand-driven zoom function.

Manual Detented Zoom Module

Provides specific magnification stops throughout the zoom range without motorization. Detents are typically used in metrology applications where each position must be calibrated. T-Zoom 100 factory pre-set stops are: 0.75X; 1.0X; 2.0X; 3.0X; 4.0X; 5.0X; 6.0X; 7.0X; and 7.5X.

DC Motorized Zoom Module

Motorized options provide remote automated operation of your zoom system. DC motorized T-Zoom 100s provide smooth, continuous zoom throughout the entire 10:1 zoom range.



Electronic-Iris Stepper Motorized Zoom Module



The E-Iris version of the T-Zoom 100 provides repeatable magnifications similar to Stepper Motor versions. The unique Electronic Iris design replaces mechanical synchronization between the iris and zoom cam, thus significantly extending zoom-cycle life. Ideal for high-cycle motorized applications.

LOWER FUNCTION MODULE OPTIONS

There are three Lower Function Modules with which to outfit your Telecentric Zoom 100. They attach below the Upper Zoom Module by simply tightening three set screws.

Standard Function Module

The fundamental lower function module provides the capability of attaching objectives to a T-Zoom 100 without adding coaxial illumination functions.



Coaxial-Illumination Function Module (Polarizer, Analyzer and 1/4-Wave Plate Provisions)

Coaxial Module options provide a port for the injection of incident light, and are available with or without a built-in Analyzer for polarized light applications. A Polarizer and a 1/4 Wave Plate are recommended for optimal performance when using the Analyzer.



For an online archive of nominal component dimensions, downloadable schematics, and optical performance specifications, visit the Telecentric Zoom 100 Section of our web site.

CONNECTING TO YOUR CAMERA



TV Tubes are the essential link between the Upper Zoom Module and the video camera. They are required components of an operational T-Zoom 100. The T-Zoom 100 is specifically designed to maximize useable field-of-view by eliminating vignetting. Each of the three T-Zoom 100 TV Tubes establishes the optimal image size for its respective camera format. All T-Zoom 100 TV Tubes are focusable using a lockable thumb screw to ensure parfocality across the zoom range. They accept video cameras with a standard 1.00" x 32 C-mount.

0.75X Tube for 1/3" Cameras

The 0.75X TV Tube is designed to provide optimal imaging when used with a 1/3" camera. In addition, the small size of the 0.33" camera format allows the 1.0X and 1.38X TV Tubes to be used when the application calls for supplementary magnification at the camera.



1.0X Tube for 1/2" Cameras

The 1.0X TV Tube provides optimal imaging when used with a 1/2" format camera. If additional magnification is required at camera, the 1.38X TV Tube can be integrated. However, use of the 0.75X TV Tube will cause undesirable vignetting.



1.38X Tube for 2/3" Cameras

Intended for use with the largest of the compatible camera formats, the 1.38X is the only TV Tube capable of covering the 2/3" format cameras without any vignetting.



| CAT. NO. | DESCRIPTION | FORMAT COMPATIBILITY |
|----------|--------------------|----------------------|
| 30-58-02 |0.75X TV Tube |(1/3" camera) |
| 30-58-01 |1.0X TV Tube |(1/2" camera) |
| 30-58-03 |1.38X TV Tube |(2/3" camera) |

C-Mount Coupler

T-Zoom 100 TV Tubes feature a dovetail backend connection and therefore require the C-Mount Coupler to attach a camera to your system. A video camera can then be mounted to the standard 1.00" x 32 C-threads on the Coupler.



| CAT. NO. | DESCRIPTION |
|----------|----------------------|
| 33-02-00 |C-Mount Coupler |



ILLUMINATION OPTIONS

Dark Field (Ring) Illumination

Oblique dark field illumination (or ring illumination) is generally used on 3-dimensional objects to cast light rays at an angle onto the object, thus better defining its dimensions. Thales Optem offers the following oblique illuminators for your T-Zoom 100.

Horizontal Ring Light

Ideal for general purpose lighting applications in which the fiber optic cable exits the ring horizontally. Integrate the Horizontal Ring Light using the Ring Light Adapter (see System Diagram p.7)

Vertical Ring Light

This is the same as the Horizontal Ring Light except the fiber optic cable exits the ring at 30° off vertical, thus providing an overall savings on valuable space.

Coaxial Illumination

Coaxial illumination is most useful on highly reflective objects. Thales Optem's Coaxial Illuminators project cool, white light perpendicularly onto the specimen.

Fiber Optic Illuminator

The Fiber Optic Coaxial Illuminator produces intense illumination from a remote light source. The Illuminator accepts a 40" or 60" Fiber Optic Cable that can be inserted into a 115V/150W Lamphouse, or a 230V/150W Lamphouse.

Halogen Illuminator

The Halogen Illuminator provides an economical alternative to fiber optic options for coaxial systems. Use the 10W Halogen Lamp that is compatible with either the 6V Variable Transformer (120V), or the 6V Variable Transformer (220V).

Polarized Light

Coaxial Modules with built-in Analyzers are available to introduce polarized light to your system. Required for use with these Lower Modules are: A Polarizer (30-36-03) and a 1/4 Wave Plate (30-36-04). By rotating the Polarizer and 1/4 Wave Plate, the user can selectively extinguish specific beams of light.



MOTORIZING YOUR SYSTEM

The T-Zoom 100 can be specified as a DC-motorized zoom, or the Stepper-Motor Controlled E-Iris Zoom.



All Upper Zoom Modules may be selected with an integral DC or Stepper Motor system that is actuated with Thales Optem drivers.

E-Iris Stepper Motor Model

The T-Zoom 100 can be specified in motorized configurations that facilitate computerized control of the Zoom function. The Stepper Motor permits discrete movement in fine increments ("steps"). A Hall-Effect (magnetic) Homing Sensor is standard on the T-Zoom 100 Stepper Motor model, which provides a "zero" position for repeating location. This permits pre-programming of setups for multiple work pieces.



E-Iris Stepper Motor Controller

The Stepper Driver is designed to operate the Stepper Motors (zoom and iris) concurrently. Manual operation is available through the use of a "rocker" switch. RS232 operation is implemented through a serial port and a Windows GUI. Software is provided for use with Windows 9X, 2000, XP or NT.



Connections are made with DB-25 and DB-9 Pin Cables which are both included with the Stepper Driver. The DB-25 Pin Connector Cable plugs directly into the separate Junction Box which splices the individual six position RJ Modular connectors on the motor and sensor to the Cable. A Wall Transformer is required and must be ordered separately; 110V/60 Hz or 230V/50 Hz. *NOTE: In the case of the 230V Wall Transformer, you must select either a U.K. or Euro Power Cord.*

OEM E-Iris Stepper Motor Board

All connections are identical to the T-Zoom 100 E-Iris Stepper Motor set-up. The use of an OEM Board replaces the Stepper Driver box. The OEM Board has all connections onboard and is available with a code library for modification of functions.

NOTE: The DB-25 Pin, DB-9 Pin Cables, Junction Box and Wall Transformer are not supplied with the OEM Board. Windows 9X, 2000, XP and NT compatible software is available for downloading from Thales Optem's web site in the Telecentric Zoom 100 motorized section.



LabVIEW™ VI's

For system integrators working from the LabVIEW platform, Thales Optem now offers a VI library permitting seamless assimilation of our Stepper Motorized Zoom Systems.

DC Motor Models

A DC Motor Driver must be used to drive the DC motorized versions of the T-Zoom 100. DC Motors allow continuous movement throughout the zoom range.



Ports in the back of the Motor Driver accept the zoom motorized function. In addition, a Wall Transformer is required and must be ordered separately; 110V/60Hz or 230V/50Hz.

OBJECTIVE LENSES

Mandatory for operation of your Telecentric Zoom 100 System, Objective Lenses attach to the Lower Modules and are available in a variety of magnifications to further expand your imaging flexibility.



| CAT. NO. | DESCRIPTION |
|----------|---------------------------|
| 30-57-27 |0.18X Objective Lens |
| 30-57-28 |0.25X Objective Lens |
| 30-57-29 |0.33X Objective Lens |
| 30-57-30 |0.50X Objective Lens |
| 30-57-31 |1.0X Objective Lens |

For an online archive of nominal component dimensions, downloadable schematics, and optical performance specifications, visit the Telecentric Zoom 100 Section of our web site.

OBJECTIVE LENS

0.18X
30-57-27

84mm
WORKING
DISTANCE

| | | 0.75X TV TUBE <i>(optimized for 1/3" camera format)</i> | | 1.0X TV TUBE <i>(optimized for 1/2" camera format)</i> | | 1.38X TV TUBE <i>(optimized for 2/3" camera format)</i> | |
|------------------------------|------|--|-----------|---|-----------|--|-----------|
| | | Low | High | Low | High | Low | High |
| N.A. | | 0.0033 | 0.033 | 0.0033 | 0.033 | 0.0033 | 0.033 |
| MAG. | | 0.10 | 1.0 | 0.13 | 1.3 | 0.18 | 1.8 |
| D.O.F. | | 49.0 | 0.49 | 49.0 | 0.49 | 49.0 | 0.49 |
| F.O.V. (mm) camera format | 1/4" | 27.1 x 36.3 | 2.7 x 3.6 | 20.3 x 27.2 | 2.0 x 2.7 | 14.8 x 19.8 | 1.4 x 1.9 |
| | 1/3" | 35.8 x 47.7 | 3.5 x 4.7 | 26.8 x 35.8 | 2.6 x 3.5 | 19.5 x 26.0 | 1.9 x 2.6 |
| | 1/2" | — | — | 35.8 x 47.7 | 3.5 x 4.7 | 25.0 x 34.7 | 2.6 x 3.4 |
| | 2/3" | — | — | — | — | 35.8 x 47.7 | 3.5 x 4.7 |

0.25X
30-57-28

78mm
WORKING
DISTANCE

| | | 0.75X TV TUBE <i>(optimized for 1/3" camera format)</i> | | 1.0X TV TUBE <i>(optimized for 1/2" camera format)</i> | | 1.38X TV TUBE <i>(optimized for 2/3" camera format)</i> | |
|------------------------------|------|--|-----------|---|-----------|--|-----------|
| | | Low | High | Low | High | Low | High |
| N.A. | | 0.0047 | 0.047 | 0.0047 | 0.047 | 0.0047 | 0.047 |
| MAG. | | 0.14 | 1.4 | 0.19 | 1.9 | 0.26 | 2.6 |
| D.O.F. | | 25.0 | 0.25 | 25.0 | 0.25 | 25.0 | 0.25 |
| F.O.V. (mm) camera format | 1/4" | 19.4 x 25.9 | 1.9 x 2.6 | 14.5 x 19.4 | 1.4 x 1.9 | 10.5 x 14.1 | 1.0 x 1.4 |
| | 1/3" | 25.6 x 34.1 | 2.5 x 3.4 | 19.2 x 25.6 | 1.9 x 2.5 | 13.9 x 18.6 | 1.4 x 1.8 |
| | 1/2" | — | — | 25.6 x 34.1 | 2.5 x 3.4 | 18.6 x 24.8 | 1.8 x 2.4 |
| | 2/3" | — | — | — | — | 25.6 x 34.1 | 2.5 x 3.4 |

0.33X
30-57-29

79mm
WORKING
DISTANCE

| | | 0.75X TV TUBE <i>(optimized for 1/3" camera format)</i> | | 1.0X TV TUBE <i>(optimized for 1/2" camera format)</i> | | 1.38X TV TUBE <i>(optimized for 2/3" camera format)</i> | |
|------------------------------|------|--|-----------|---|-----------|--|------------|
| | | Low | High | Low | High | Low | High |
| N.A. | | 0.0062 | 0.062 | 0.0062 | 0.062 | 0.0062 | 0.062 |
| MAG. | | 0.19 | 1.9 | 0.25 | 2.5 | 0.34 | 3.4 |
| D.O.F. | | 14.1 | 0.14 | 14.1 | 0.14 | 14.1 | 0.14 |
| F.O.V. (mm) camera format | 1/4" | 14.5 x 19.4 | 1.4 x 1.9 | 10.9 x 14.6 | 1.0 x 1.4 | 7.9 x 10.6 | 0.79 x 1.0 |
| | 1/3" | 19.2 x 25.6 | 1.9 x 2.5 | 14.4 x 19.2 | 1.4 x 1.9 | 10.4 x 13.9 | 1.0 x 1.4 |
| | 1/2" | — | — | 19.2 x 25.6 | 1.9 x 2.5 | 13.9 x 18.6 | 1.4 x 1.8 |
| | 2/3" | — | — | — | — | 19.2 x 25.6 | 1.9 x 2.5 |

0.5X
30-57-30

163mm
WORKING
DISTANCE

| | | 0.75X TV TUBE <i>(optimized for 1/3" camera format)</i> | | 1.0X TV TUBE <i>(optimized for 1/2" camera format)</i> | | 1.38X TV TUBE <i>(optimized for 2/3" camera format)</i> | |
|------------------------------|------|--|------------|---|-------------|--|-------------|
| | | Low | High | Low | High | Low | High |
| N.A. | | 0.0094 | 0.094 | 0.0094 | 0.094 | 0.0094 | 0.094 |
| MAG. | | 0.28 | 2.8 | 0.38 | 3.8 | 0.52 | 5.2 |
| D.O.F. | | 6.2 | 0.062 | 6.2 | 0.062 | 6.2 | 0.062 |
| F.O.V. (mm) camera format | 1/4" | 9.7 x 12.9 | 0.97 x 1.3 | 7.2 x 9.7 | 0.72 x 0.97 | 5.2 x 7.0 | 0.52 x 0.70 |
| | 1/3" | 12.8 x 17.0 | 1.2 x 1.7 | 9.6 x 12.8 | 0.96 x 1.2 | 6.9 x 9.3 | 0.69 x 0.93 |
| | 1/2" | — | — | 12.8 x 17.0 | 1.2 x 1.7 | 9.3 x 12.4 | 0.93 x 1.2 |
| | 2/3" | — | — | — | — | 12.8 x 17.0 | 1.2 x 1.7 |

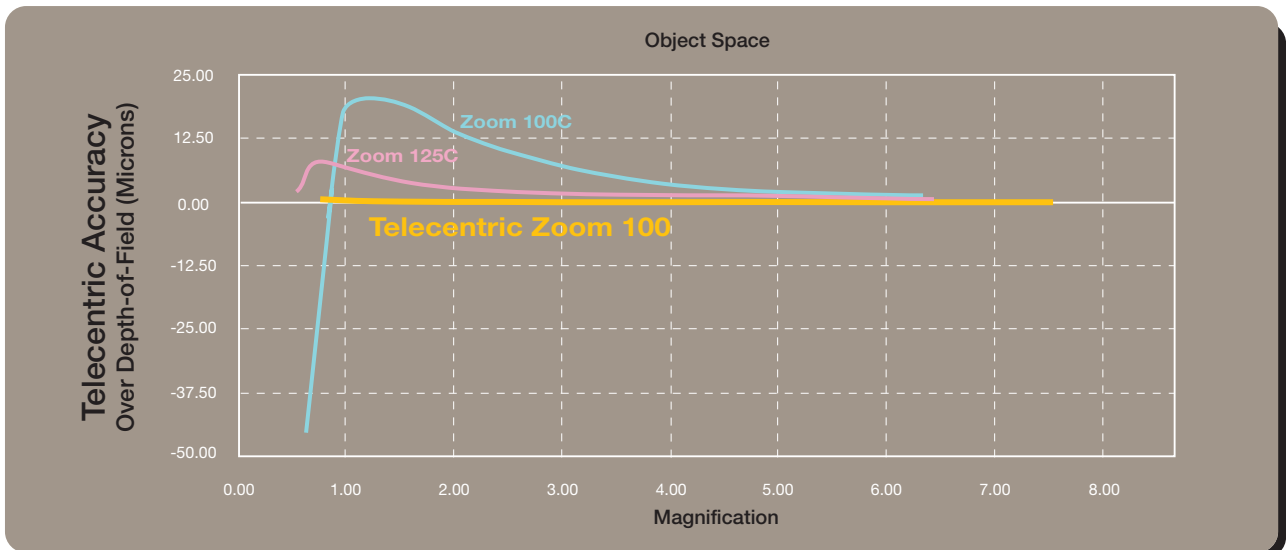
1.0X
30-57-31

75mm
WORKING
DISTANCE

| | | 0.75X TV TUBE <i>(optimized for 1/3" camera format)</i> | | 1.0X TV TUBE <i>(optimized for 1/2" camera format)</i> | | 1.38X TV TUBE <i>(optimized for 2/3" camera format)</i> | |
|------------------------------|------|--|-------------|---|-------------|--|-------------|
| | | Low | High | Low | High | Low | High |
| N.A. | | 0.019 | 0.19 | 0.019 | 0.19 | 0.019 | 0.19 |
| MAG. | | 0.56 | 5.6 | 0.75 | 7.5 | 1.03 | 10.3 |
| D.O.F. | | 1.5 | 0.015 | 1.5 | 0.015 | 1.5 | 0.015 |
| F.O.V. (mm) camera format | 1/4" | 4.8 x 6.4 | 0.48 x 0.64 | 3.6 x 4.8 | 0.36 x 0.48 | 2.6 x 3.5 | 0.26 x 0.35 |
| | 1/3" | 6.4 x 8.5 | 0.64 x 0.85 | 4.8 x 6.4 | 0.48 x 0.64 | 3.4 x 4.6 | 0.34 x 0.46 |
| | 1/2" | — | — | 6.4 x 8.5 | 0.64 x 0.85 | 4.6 x 6.2 | 0.46 x 0.62 |
| | 2/3" | — | — | — | — | 6.4 x 8.5 | 0.64 x 0.85 |

N.A. = Numerical Aperture MAG. = Magnification D.O.F. = Depth-of-Field F.O.V. = Field-of-View — = zoom range is limited due to vignetting

Telecentric Accuracy: Telecentric Zoom 100 vs. Zoom 100 and Zoom 125



Telecentric Zoom 100 System Diagram

Nominal Specifications

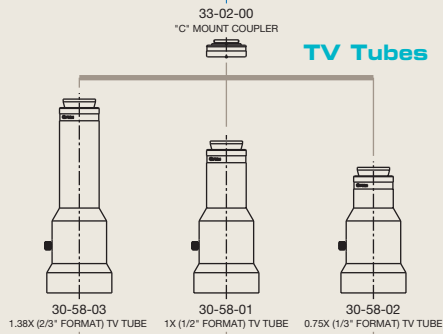
OPTICAL

| | |
|--------------------------------|-----------------|
| Mag./EFL/Mag. Power/Zoom | 0.75 - 7.50X |
| Resolution | 56-560 lp/mm |
| Depth-of-Field..... | 1.56-0.0156mm |
| Spectral Band | C, d, F |
| N.A./Pupil Dia. | 0.01875-0.18750 |
| Full F.O.V./Camera Size | 1/2" |
| Vignetting | >0% |
| Transmission | >80% |
| Telecentricity | <0.2 degrees |
| Distortion..... | <0.1% |

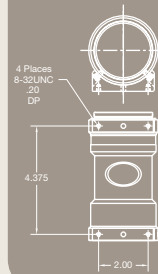
MECHANICAL

| | |
|----------------------------------|---------|
| Front Working Distance..... | 75.0mm |
| Back Working Distance..... | 128.5mm |
| Object to Image/oa. Length | 448.5mm |
| Maximum Diameter | 71.0mm |

CONNECT CAMERA TO TV TUBE



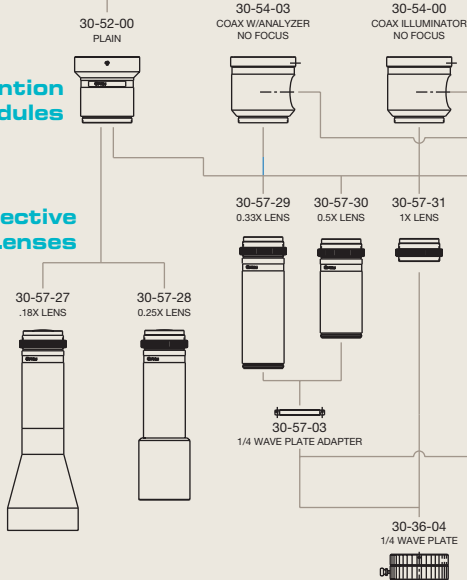
Flat Mounting



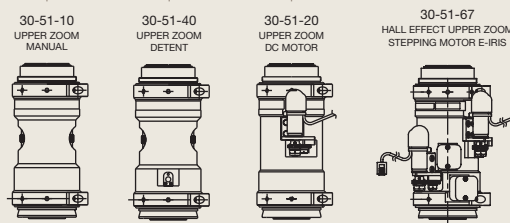
The T-Zoom 100 can be securely mounted to a flat surface by using the four pre-tapped holes in the saddles mounted to the Zoom body. The saddles can be moved around the body in 45° increments by using the existing holes in the body. Flat mounting the T-Zoom 100 maximizes stability. See diagram Left.

Function Modules

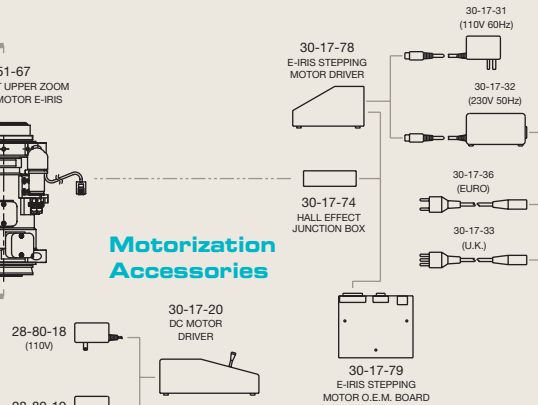
Objective Lenses



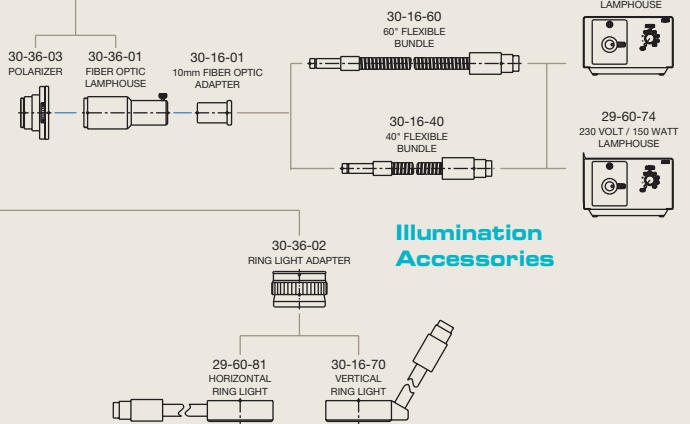
Zoom Modules



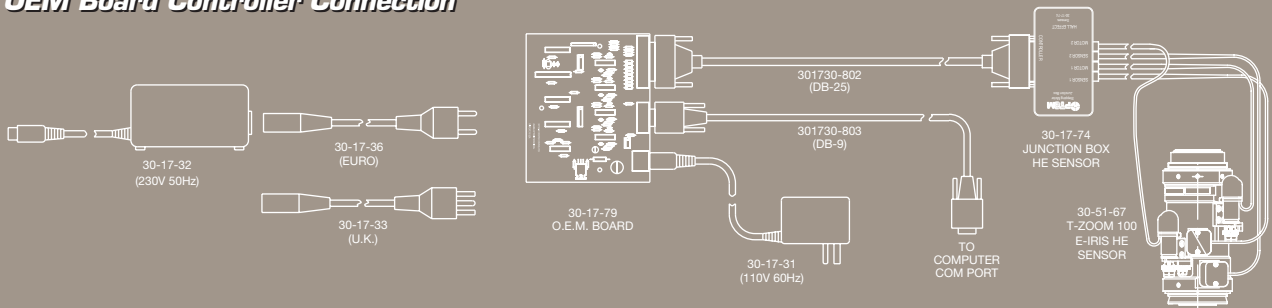
Motorization Accessories



Illumination Accessories



OEM Board Controller Connection



For an online archive of nominal component dimensions, downloadable schematics, and optical performance specifications, visit the Telecentric Zoom 100 Section of our web site.

TELECENTRIC ZOOM 100

Specifically designed to provide absolute minimal distortion, the Telecentric Zoom 100 delivers $<0.2^\circ$ telecentricity over the entire zoom range while eliminating vignetting. With an unprecedented N.A. of 0.1875 at 75mm W.D., it also delivers $<0.1\%$ manageable distortion.



10:1

ZOOM RATIO

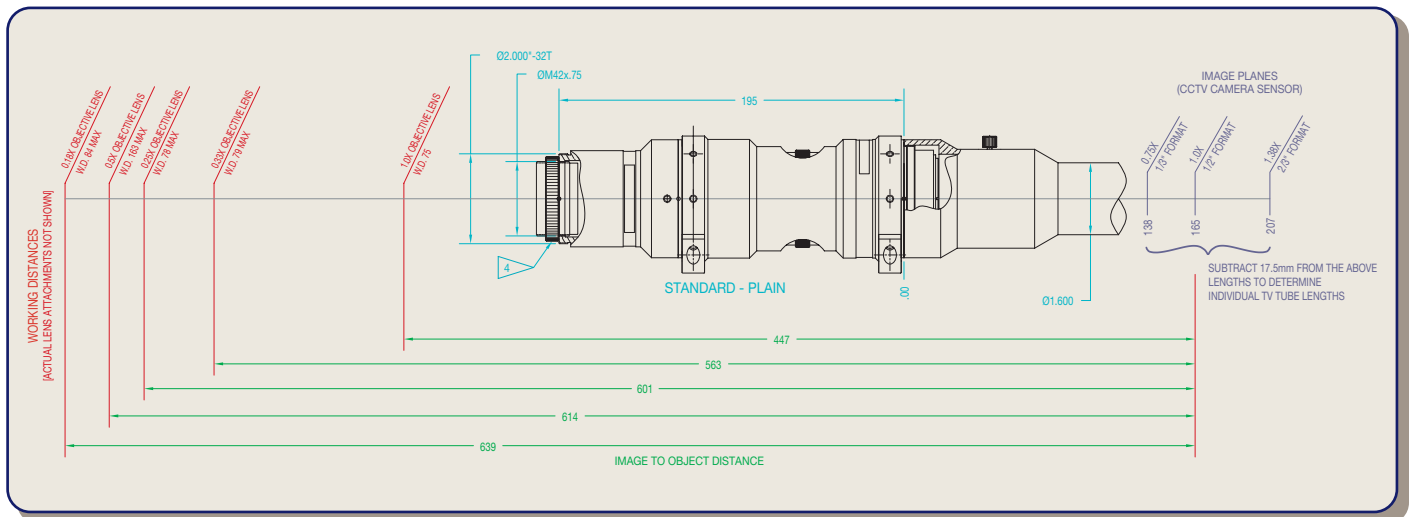
0.1875 Maximum N.A.

560 $\mu\text{p}/\text{mm}$
Maximum Resolution

0.64 x 0.85mm – 36 x 48mm
F.O.V. Range

75 – 163mm
Working Distance Range

Telecentric Zoom 100 Nominal Dimensions



THALES

Thales Optem Inc.

Zum Rennplatz 15, D-49401 Damme / Germany

Tel: (+49) 5491-2090 • Fax: (+49) 5491-2098 • www.thales-optem.de

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