



The Optical Engineering Experts®

LensCheck™

System and Accessories





Table of Contents

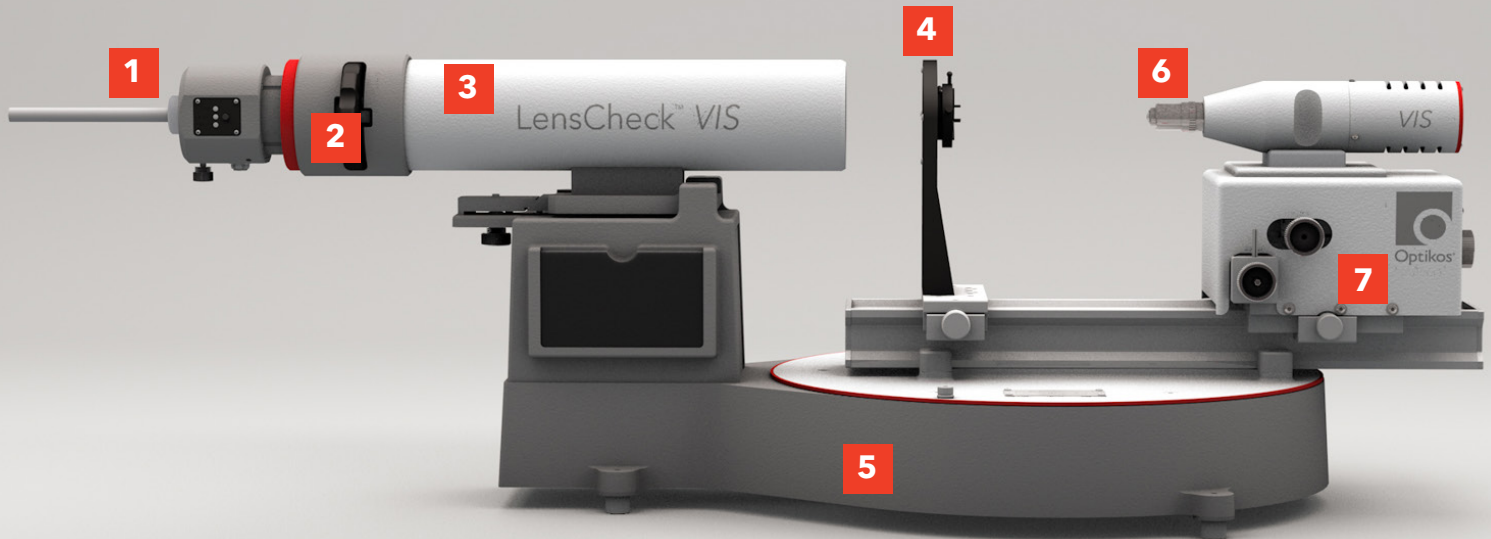
Specification Table	3
System Layout	4
General LensCheck Information	5
Stray Light Accessories	8
Finite Conjugates	9
Other Accessories	10
Collimators	11
Lens Mounts	12
Thermal Module	13

Parameter	VIS-NIR (Video)	SWIR (Video)	LWIR (Video)
Optical Setup	Infinite/Finite	Infinite	Infinite
Max. Off Axis Angle	±105 Deg.	±105 Deg.	±105 Deg.
Spectral Ranges	400-1000 nm	900-1700 nm	8-12 μm
Azimuth Range*	360 Deg.	360 Deg.	360 Deg.
Max. Image Height	±12.5 mm	±12.5 mm	±12.5 mm
Spatial Frequency Range	0-500 lp/mm	0-200 lp/mm	0-60 lp/mm
MTF Accuracy (Specification)	±2 MTF (±1 MTF Typical)	±3 MTF (±2 MTF Typical)	±3 MTF (±2 MTF Typical)
MTF Repeatability (Specification)	±1 MTF (±0.5 MTF Typical)	±2 MTF (±1 MTF Typical)	±2 MTF (±1 MTF Typical)
EFL Accuracy	±0.2%	±0.2%	±0.2%
Distortion Accuracy	±0.2%	±0.2%	±0.2%

*Requires rotary lens mount accessory.

Available Measurements:

- MTF – on/off axis
- EFL and F/#
- Back focal length
- Astigmatism
- Field Curvature
- Distortion
- Chief Ray Angle
- Ensquared/Encircled Energy
- Axial and Lateral Chromatic (APO Relay Lenses and Reflective Collimator Recommended)
- Transmission (optional) – Requires LC-TK Transmission Kit
- Relative Illumination (optional) – Requires LC-RI Relative Illumination Kit
- Veiling Glare Index (optional) – Requires LC-SLK Veiling Glare Index Kit
- Glare Spread Function (optional) – Requires LC-GSF Upgrade
- Line of Sight (optional) – Requires LC-RLM 360 Degree Rotary Lens Mount



1 Light Source

Provides high intensity illumination from 0.4 μ m to 1 μ m

2 Manual Target and Manual Filter Wheels

- 8 position manual target wheel – standard
 - Alignment target
 - Pinholes
 - USAF 1951 target
- 8 position manual filter wheel – standard
 - Photopic
 - 546nm bandpass
 - Infrared cutoff
 - RGB Set
 - (2) open spots
 - additional filters available upon request
- Automated shutter – standard

3 Collimator

Presents an object at infinity to the lens under test

- 355mm EFL refractive – standard
- Reflective collimator option available

4 Lens Mounts/Accessories

Holds the lens under test in the collimated beam

- Rotary lens mount option available
- Factory aligned lens mounting tower – standard
- 3 jaw chuck mount and C-mount plate for tower – standard
- 20+ mount options & adapter plates available
- Thermal Module Upgrade available

5 Rotary Platform

Rotates the lens under test and the visible image analyzer to present the collimated beam at different angles for far off-axis measurements

- $\pm 105^\circ$ full travel

6 Image Analyzer

Relays and magnifies the image from the lens under test onto a CMOS array to allow for analysis of the image with OpTest®7 software

- 40x 0.65NA achromatic standard
- Plain APO objectives available as options

7 Image Analyzer Mount

Moves the visible image analyzer along the Z axis (along the optical axis of the test setup) to set the image plane location, and along the X and Y axes to track the image for measurements made at off-axis field points

- Standard 25mm X stage
- Extended travel 100mm X stage upgrade available
- Standard rail (500mm)
- Extended rail (700mm)

LensCheck Systems measure and assess image quality for VIS/NIR, SWIR and LWIR lenses, and feature:

- Patented VideoMTF technology that enables real-time MTF measurements
- Flexible platform allows a wide range of measurements (e.g. MTF, EFL, distortion, etc.)
- VIS - industry leading measurement accuracy better than 2% (1% typical); and better than 1% repeatability (0.5% typical) - each validated with a 50mm f/4 Audit Lens
- LWIR - industry leading measurement accuracy better than 3% (2% typical) to 40lp/mm; and better than 2% repeatability (1% typical) - each validated with a 25mm f/1.5 Audit Lens
- Configurable automated measurement routines
- Easily switch between wavebands (VIS/NIR, SWIR, or LWIR)
- Installed in production and R&D facilities around the world



Applicable Lenses for Testing

Lens Specification	VIS	SWIR	LWIR
Entrance pupil diameter	Up to 50mm		
Focal length	≤ 100mm (with appropriate image analyzer objective lens)	5-50mm	5-50mm. (Extended range with collimator options possible)
f-number	f/20 - f/1 (with appropriate image analyzer objective); dependent on signal to noise consideration	f/20 - f/1	f/20 - f/1
Image format size	Up to 25mm full image diagonal. Optional upgrade to 100mm		
Max spatial frequency	Up to 500 lp/mm using standard relay (other relays available for higher spatial frequencies, customizable up to 1000lp/mm)	Up to 120 lp/mm using standard relay (other relays available for higher spatial frequencies)	Up to 60lp/mm

System Specifications

Specification	VIS	SWIR	LWIR
Physical size	15" (355mm) H; 30" (762mm) W; 48" (1219mm) L <i>*Does not include computer or peripherals.</i>		
Power requirements	100-240 VAC, 60/50 Hz, <15 amp		
Environmental	Optimal performance is achieved in a dark room		
Refractive collimator	355mm EFL, 50mm clear aperture	355mm EFL, 50mm clear aperture; shorter EFL collimators available upon request	355mm EFL, 50mm clear aperture; shorter EFL collimators available upon request
Motorized z-axis	25mm travel 0.1µm resolution		
Motorized x-axis	25mm travel with encoder (Ext. travel available) 0.05 µm resolution		
Manual y-axis	12.5mm travel		
Motorized rotary lens platform	±105° off-axis rotation; 0.0001° resolution glass scale encoder; 0.5m optical rail; self-centering lens mount		
Source module	Fiber optic light source: 400-2000nm. Electronic shutter enables automatic background correction.	Fiber optic light source: 400-2000nm. Electronic shutter enables automatic background corrections.	Broadband emitter: 7-15 µm. Electronic shutter enables automatic background corrections.
Target Set	8-position manual target and filter wheels; target set: various pinholes, USAF 1951, and alignment target	12-position high-speed motorized target wheel: slits, pinholes, crosshairs, and alignment target	12-position high-speed motorized target wheel: slits, pinholes, crosshairs, and alignment target
Filter Set	Photopic, 546nm bandpass, infrared cutoff, RGB set, and two open slots	0.9-1.7µm bandpass	8-12 µm bandpass
Image analyzer	CMOS GigE camera, 6MP or better, 4.5µm pixels, 12-bit video, 40X 0.65NA relay lens, 400-1000 µm sensitivity.	InGaAS video camera, 640x512, apochromatic 20X relay lens, spectral sensitivity 0.9-1.7 µm	Uncooled microbolometer 640 X 512 format; spectral sensitivity 7.5 - 15 µm; calibrated 7.5X 0.70NA relay lens, 14-bit video output



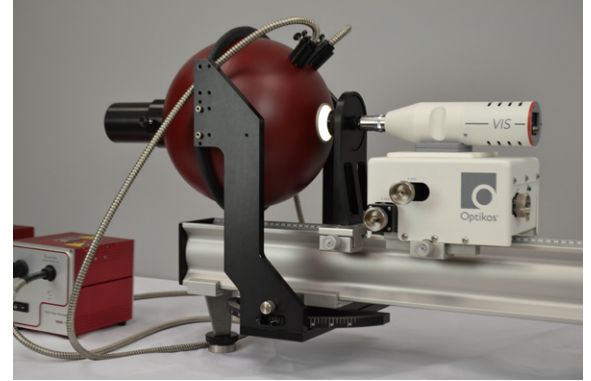
General LensCheck Information

Customized Testing for Your Applications

Options	VIS	SWIR	LWIR
Finite Conjugate Platform (available as an upgrade or a standalone unit)	X		
Small Format Finite Conjugate Platform (Available as standalone or upgrade)	X		
Adjustable Conjugate LensCheck	X		
Stray Light Kit – GSF (VIS Only), VGI (Available as standalone or upgrade)	X		
Achromatic Objectives	X		
Apochromatic Objectives	X	X	
Separate Transmission Kit/Relative Illumination Kit Upgrade	X	X	
Rotary Lens Mount - 360°	X	X	X
Line of Sight	X	X	X
Reflective Collimator	X	X	X
Audit Lenses	X	X	X
Lens Mounting Plates for Standard and Custom Lens Interfaces	X	X	X
Thermal Module	X		
LensCheck Enclosure	X		
Short EFL Collimator (150mm) for Lenses Where $2.5\text{mm} < \text{EFL} < 25\text{mm}$			X
Collimator EFL Reducer for Lenses with $\text{EFL} < 2.5\text{mm}$			X

Veiling Glare Index (VGI) Kits

- Black spot surrounded by a uniform, bright field
- VIS/NIR testing (400mm – 1000mm)
- Sphere rotates to present black spot off axis, up to ± 40 degree rotation
- Stray light measurements per ISO 9358
- Validated with reference lens down to 0.1%
- Sphere size options (based on focal length)
 - 6" sphere
 - 10" sphere
 - 20" sphere
- Available as upgrade to existing LensCheck or standalone system



GSF Upgrade

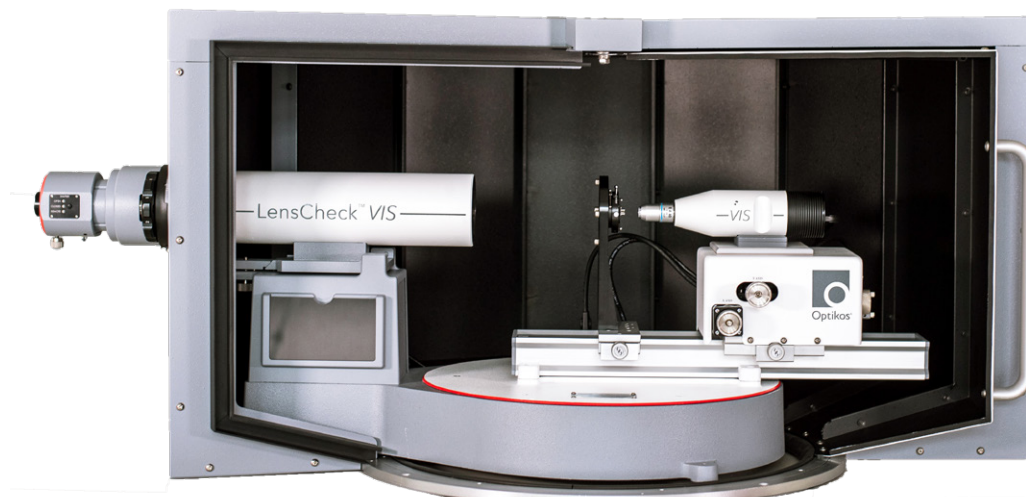
- Expands the capacity of the LensCheck VIS to measure Glare Spread Function (GSF) of the lens under test in accordance with ISO 9358
- Measurement module include the following hardware upgrades
 - 40X 0.65NA objective with precision pinhole field stop
 - Light guide adapter with diffuser and reduced exit aperture
- VIS/NIR testing (400mm – 1000mm)
- 10^{-6} or better dynamic range for broadband visible test spectrums
- Only available as an upgrade to a new or existing LensCheck VIS System

Enclosure

LensCheck VIS measurement accuracy and repeatability is optimized when the system is operating in a dark environment that eliminates all stray background illumination. This is especially critical for high dynamic range measurements such as the Glare Spread Function (GSF). The LensCheck enclosure was designed for this purpose as it replaces the need to provide a dedicated dark room for lens testing.

Features:

- Creates a dark environment around the lens under test to optimize measurement accuracy and repeatability
- Eliminates air current effects from HVAC in laboratories or fan filter units in cleanrooms
- Allows full access to the instrument while loading a lens and performing alignments
- Most compact form factor (open~ 41"L x 32"W x 22"H)



Standard Finite Conjugate Platform

The Standard Finite Conjugate Platform can be built into a standalone, finite conjugate only test bench, or can be added to an infinite conjugate LensCheck VIS as an upgrade. When used as an upgrade for a LensCheck, the Image Analyzer, Image Analyzer Mount and Lens Mount are removed from the LensCheck and installed on the Finite Conjugate Platform, and the LensCheck computer can run both test setups with a simple OpTest 7 software upgrade.

The Standard Finite Conjugate Platform includes:

- 20X and 60X object re-projection objectives
- Motorized X axis, manual Z axis for object
- 500mm mounting rail to accommodate a wide range of test setups
- Adjustable LensCheck tower mount with manual X,Y,X stages and C-mount lens mounting plate

Small Format Finite Conjugate Platform

The Small Format Finite Conjugate Platform is configured for measuring image quality parameters for lenses designed for close conjugate imaging (object distances less than 300mm). It can be configured either as a standalone test bench, or it can be added as an upgrade to a standard LensCheck system.

This platform is suitable for testing lenses used for the following applications:

- Medical imaging and other surgical applications
- Cell imaging systems
- Low-magnification microscopy
- Finite conjugate objectives (objective/tube lens pairs)
- Inspection or short TTL machine vision optics
- Macro lenses

The Small Format Finite Conjugate Platform includes:

- 20X and 60X object re-projection objectives
- Motorized X axis, manual Z axis for object
- 500mm mounting rail to accommodate a wide range of test setups
- Adjustable LensCheck tower mount with manual X,Y,X stages and C-mount lens mounting plate

Adjustable Conjugate Upgrade

The Adjustable Conjugate Upgrade can be added to a new or existing LensCheck to allow for infinite conjugate and finite conjugate testing of small lenses with one system. Unlike the other finite conjugate platforms that Optikos offers, the Adjustable Conjugate upgrade allows for testing with both positive and negative object conjugates (real and virtual objects for the UUT), with possible object distances ranging from -1m to infinity to +1.2m.

Finite Conjugate System Specifications			
	Standard Finite Platform	Small Format Finite Platform	Adjustable Finite Upgrade
Object Distance Range	0 to 1000mm	0 to 300mm	-1m to infinity to +1.2m
Maximum Object Size	±250mm	±125mm	±105°
Footprint	82" x 30"	32" x 14"	Same as standard LensCheck VIS

Objectives	<ul style="list-style-type: none"> • Uncalibrated 4X 0.10NA achromatic DIN objective (for ease in locating image) • Calibrated 10X 0.25NA achromatic DIN objective • Calibrated 20X 0.20NA achromatic DIN objective • Calibrated 60X 0.85NA achromatic DIN objective
Apochromatic Objectives	<ul style="list-style-type: none"> • Calibrated 20X 0.80NA plan apochromat objective and tube lens • Calibrated 40X 0.95NA plan apochromat objective and tube lens
Visible Audit Lens AL-050	<ul style="list-style-type: none"> • Diffraction-limited visible lens used for verification of system performance • 50mm EFL, f/4 • Factory aligned and mounted to rail carrier for quick setup
LWIR Audit Lens AL-080	<ul style="list-style-type: none"> • Diffraction-limited LWIR lens used for verification of system performance • 25mm EFL, f/1.5 • Factory aligned and mounted to a rail carrier for quick setup
Rotary Lens Mount	<ul style="list-style-type: none"> • High-speed motorized stage used to rotate the lens about the optical axis of the measurement system • 360 degrees of continuous travel • Tip-tilt adjustment ($\pm 1^\circ$) to align the lens or lens mount to the rotation axis • X and Y adjustment (± 1mm) to center the lens or lens mount to the rotation axis • Includes a dial indicator for aligning mechanical datums on the lens or lens mount • Compatible with standard LensCheck Rotary Platform rail • Includes adapter plate to interface with standard LensCheck Tower Mount adapter plates



Reflective Collimator Upgrade

- Off-axis parabolic mirror
 - 50mm clear aperture
 - 750mm focal length
 - $\lambda/10$ surface accuracy after mounting
 - Protected aluminum coating
- Replaces LensCheck refractive collimator
- Provides aberration-free collimated beam for improved chromatic aberration measurements
- Factory-aligned to 8-position target wheel
- Interferometric qualification data provided



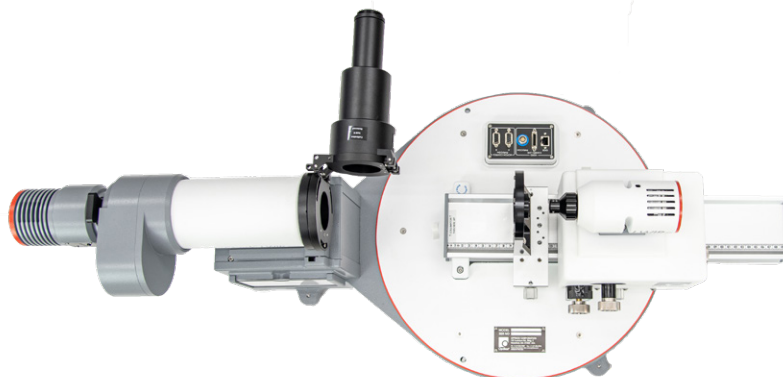
Reflective collimator

LWIR 150mm Refractive Collimator Upgrade

- 50mm clear aperture, 150mm focal length
- Replaces standard 355mm focal length refractive LWIR collimator
- For use with shorter focal length LWIR lenses
- 2.5-25mm UUT focal length

LWIR Collimator Focal Length Reducer Upgrade

- Attachment to LWIR 150mm Collimator that lowers the minimum values of the entrance pupil diameter and focal length ranges of the lens under test
 - EPD ranges from 0.5mm to 2.5mm
 - EFL ranges from 0.5mm to 2.5mm
- Features a saloon door so the reducer assembly can be opened to either side to use the 150mm collimator without reducer
 - Also serves as a safety feature if the lens under test crashes into the reducer
- Factory aligned + validated with small pupil audit lens



Standard LensCheck Lens Adapters

- LensCheck Tower Mount (Carrier and Lens Mount Tower) + C-Mount Plate (1 inch x 32 TPI) Included with LensCheck System

Additional Options Are:

- Blank Adapter Plate
- S-Mount - M12 x 0.5mm
- Self-Centering (Small Caliper) Lens Mount
- Canon EF-Mount
- D-mount 0.625"-32
- Leica M-Mount
- M13 Mount M13 X 1 mm
- M16 Mount M16 X 0.5mm
- M39 Mount M39 X 0.977mm
- M42 Mount M42 X 1mm
- Mitutoyo Mount M 26 X 0.706mm
- Nikon F-mount
- Nikon Mount M25 X 0.75mm
- Olympus OM-Mount
- Pentax K-Mount
- DIN Standard Mount 0.800" x 36 TPI (Formerly RMS)
- S Mount Lens Holder M12 X 0.5
- Sigma SA-Mount
- Thorlabs SM05 0.535"-40 TPI
- Thorlabs SM1 1.035"-40 TPI
- Thorlabs SM2 2.035"-40 TPI
- Thorlabs SM30 M30.5x0.5 TPI
- T-mount M42 X 0.75mm
- Zeiss Mount M27x0.75mm

***Is your lens mount not listed? Custom lens adapters are available on demand.*

Additional LensCheck Mounts

LensCheck Small Lens Mount

- Small opti-claw mount assembly with tip/tilt adjustment
- Compatible with existing LensCheck rail
- Appropriate for optics with diameters of 1.5 - 16 mm

LensCheck Medium Lens Mount

- Small opti-claw mount assembly with tip/tilt adjustment
- Compatible with existing LensCheck rail
- Appropriate for optics with diameters up to 50 mm

Thermal Module for LensCheck

The LensCheck™ Thermal Module is used as an accessory to LensCheck™ VIS Lens Testing Systems for testing lenses across a range of temperatures, typically from -40°C to 105°C . With two thermal chambers designed for small lenses with a maximum field of view* equal to $\pm 80^{\circ}$ (TC-1010/TC-1011), and $\pm 40^{\circ}$ (TC-1050), and the recent addition of the TC-1065 chamber for testing larger lenses, the LensCheck Thermal Module line of accessories adds to the range of automotive lenses that may now be characterized.

**Actual fields of view depend on the specific mounting features of each lens*

This modular system comprises the following:

- Thermal Chamber (multiple options available)
- Skyhook (suspends hoses)
- Control Manifold
- Julabo Presto Temperature Controller (multiple options available)

Types of measurements include:

- FFL Variation
- On- and Off-Axis Automated Measurements:
 - MTF
 - Through Focus MTF
 - Distortion
 - Field Curvature
 - EFL



LensCheck VIS with Thermal Chamber and Sky Hook (Temperature Controller and Manifold not shown)



The Optical Engineering Experts®

Anywhere Light Goes®

Optikos Corporation
107 Audubon Rd., Bldg. 3,
Wakefield, MA 01880 USA

phone: +1.617.354.7557
email: sales@optikos.com
web: optikos.com

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