

# PhaseCam<sup>®</sup> Model 6000 4D Technology

## High Performance Dynamic Twyman Green Interferometer

### Instantaneous Acquisition

The PhaseCam<sup>®</sup> 6000 is an extremely compact and lightweight dynamic laser interferometer for measurement of optics and optical systems. With an easy-to-position, fiber-coupled measurement head and motorized controls, the PhaseCam 6000 is ideal for measuring large, focal optical systems such as concave telescope mirrors and lens systems, as well as small-aperture, afocal components such as flat mirrors and collimators.

The PhaseCam 6000 incorporates Dynamic Interferometry<sup>®</sup> technology, using a single camera, high-speed optical phase sensor to make wavefront measurements in less than 30 microseconds—over 5000 times faster than a temporal phase shifting interferometer. Because acquisition time is so short, the PhaseCam can be used without vibration isolation or turbulence control, making it ideally suited for use *in situ* on production equipment, in clean rooms and in environmental test chambers.

### Complete Measurement System

The PhaseCam 6000 is a turnkey instrument that includes the interferometer, 4Sight<sup>™</sup> advanced wavefront analysis software, and a high-speed computer system. Samples with reflectivity from 1% to 100% can be measured with a simple adjustment. Choose a stabilized HeNe (632.8 nm), 1053 nm or 1064 nm laser source to measure optics at their functional wavelength.



PhaseCam Model 6000

### Industry Leading Analysis, Standard

4Sight wavefront analysis software features a user-friendly interface with unmatched simplicity, analysis features and graphical displays. The Measurement Screen aids alignment and execution of single, averaged, burst or continuous data acquisition. The Measurement Flow interface lets you visualize the entire measurement process, from raw acquisition through masking, reference subtraction, terms removal, etc. Zernike, Seidel, geometric and diffraction analyses are easy to perform. Comprehensive data sharing capabilities let you read, write, save and print from most file types, including MetroPro IDL<sup>®</sup>, MatLab<sup>®</sup>, Opticode<sup>®</sup>, Vision<sup>®</sup>, HDF5<sup>®</sup> and CodeV<sup>®</sup>. Generating phase movies to characterize deforming surfaces and moving parts is simple and straightforward.

### Accessory Optics

Numerous accessories and options are available, including a 5-axis mounting stage, low-reflectivity diverger lenses, beam expanders and a visible alignment laser to speed test setup.

## FEATURES

- Vibration Insensitive Dynamic Operation
- 30  $\mu$ sec Data Acquisition Time
- 1000 x 1000 Pixel Camera
- Outstanding Data Analysis and Visualization Software

## APPLICATIONS

- In Situ Process Control
- Large Telescope Optics
- Quality Verification of Optical Components
- Vacuum and Environmental Chamber Testing
- Focal Optical Systems
- Adaptive Optics and Moving Parts
- Optical Testing of Moving Parts

# PhaseCam®

## Specifications

### Configuration

Description	Vibration insensitive dynamic Twyman-Green interferometer
Acquisition Mode	Instantaneous Phase Shifting with pixelated phase sensor
Optical Path	Fiber-coupled head and laser source module; 5 m fiber length
Laser Source	Stabilized HeNe @ 632.8 nm; optional 1053 nm or 1064 nm
Maximum Cavity Length	>100 m
Beam Diameter	9 mm collimated FWHM
Polarization	Circular
Field of View	8.95 mm
Focus Range	±12.5 mm
Magnification	Fixed, 4X digital zoom
Fringe Contrast	User adjustable for reflectivity from 1–100%
Camera	1k x 1k pixels, 10-bit standard
Data Array	User selectable full, half, quarter data arrays

Computer System	High performance PC
Operating System	Windows® 7
System Software	4Sight™ Analysis Software
	Instantaneous Phase Shifting data acquisition
	Reference generation, subtraction, data averaging, masking
	2D and 3D surface maps
	Zernike / Seidel / Slope / Geometric / Fourier Analysis
	Fiducial aided data set mapping
	HDF4 / HDF5 data format standard, others supported
	Absolute sphere, prism & corner cube analysis
	Multiple sub-aperture analysis
	Upgrades free during warranty period

Physical Envelope	Measurement Head: < 18.0 x 16.2 x 9.1 cm (7.1 x 6.4 x 3.6 in) Laser Source: 48.3 x 20.3 x 11.9 cm (19 x 8.0 x 4.7 in)
-------------------	--

Weight	Measurement Head: < 4.5 kg (10.0 lbs) Laser Source: < 8.2 kg (18.0 lbs)
--------	--

Quiescent Head Dissipation	Interferometer 5 Watts; Laser Source 22 Watts
Power consumption	< 50 Watts at 120 V AC Measurement Head and Laser Source

Temperature Range	Operational: 16–27° C (60–80° F), non-condensing Storage: -1–38° C (30–100° F), non-condensing
-------------------	---

### Options

Beam Expanders	Optional 22.5 mm, 45 mm (others on request)
Divergers	Range of lenses from f/1 to f/32; low reflectivity diverging lenses
Stage	5-axis (X, Y, Z, tip and tilt)
Special Analysis	Modal (Vibration) Analysis
Alignment Laser	Visible 532 nm laser for faster alignment of test setups

### System Performance

Acquisition Rate	> 10 frames/sec display; 4 interferograms/frame (camera dependent) > 25 frames/sec max data acquisition with post processing
Minimum Exposure	30 µsec
Sample Reflectivity	1–100%
RMS Repeatability	< 0.001 wave*
RMS Precision	< 0.002 wave**

### Warranty

One Year, limited, on-site system installation and operator training

\* One sigma for RMS of 10 data sets of calibration mirror, each data set being an average of 16 measurements.

\*\* Average RMS of the pixel by pixel difference of 10 data sets between measured surface and the calibrated surface. Each data set is an average of 16 measurements. Calibrated surface is the average of all 160 measurements.

10.30.2015 ■ ©4D Technology Corporation

PhaseCam and Dynamic Interferometry are registered trademarks of 4D Technology Corporation. MetroPro IDL, MatLab, Opticode, Vision, HDF5, CodeV and Windows are registered trademarks of their respective owners.

All specifications subject to change without notice.

Patent 7,230,717. Other patents may apply.



PhaseCam 6000 with laser source, hand held controller and optional 5-axis mount

