

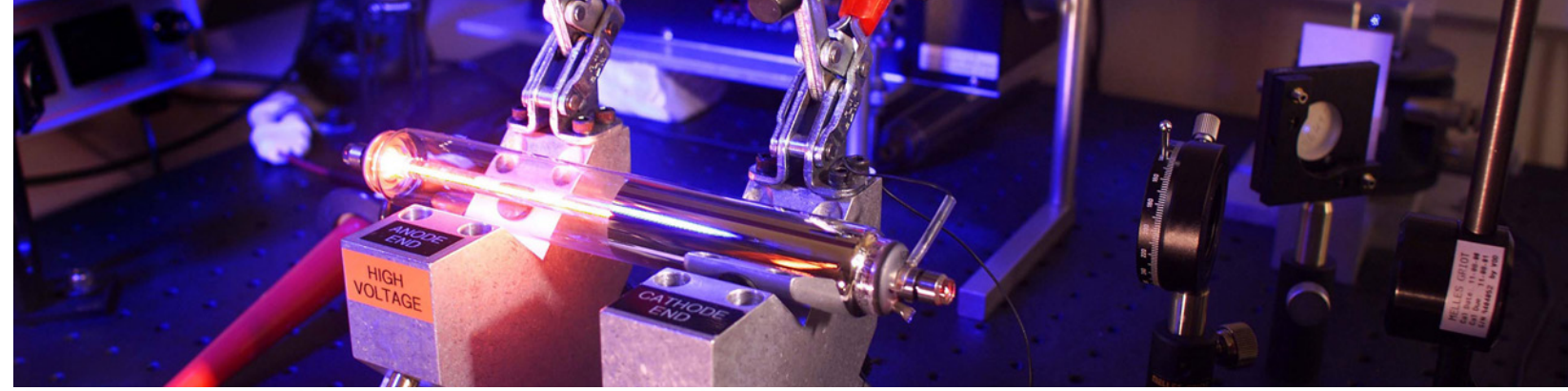
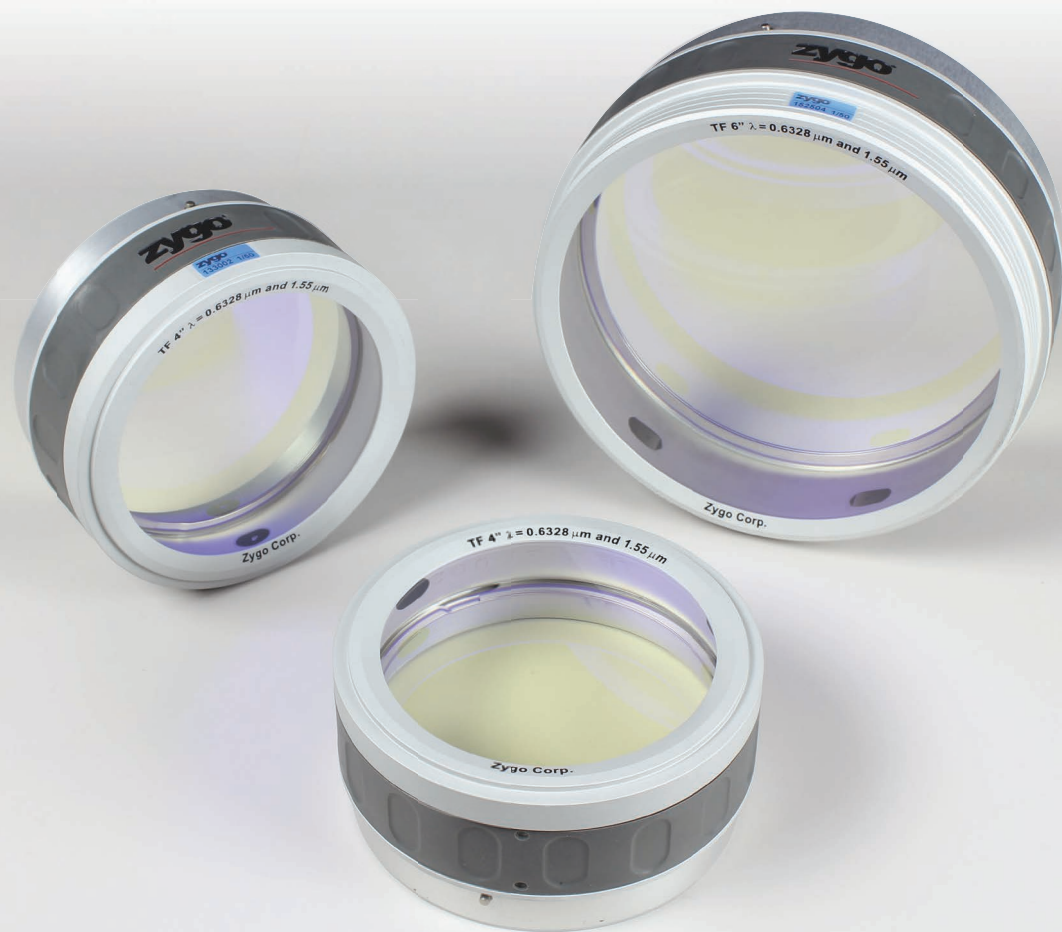


# Laser Interferometers

*The industry standard for reliability, flexibility and repeatability in precision metrology applications*



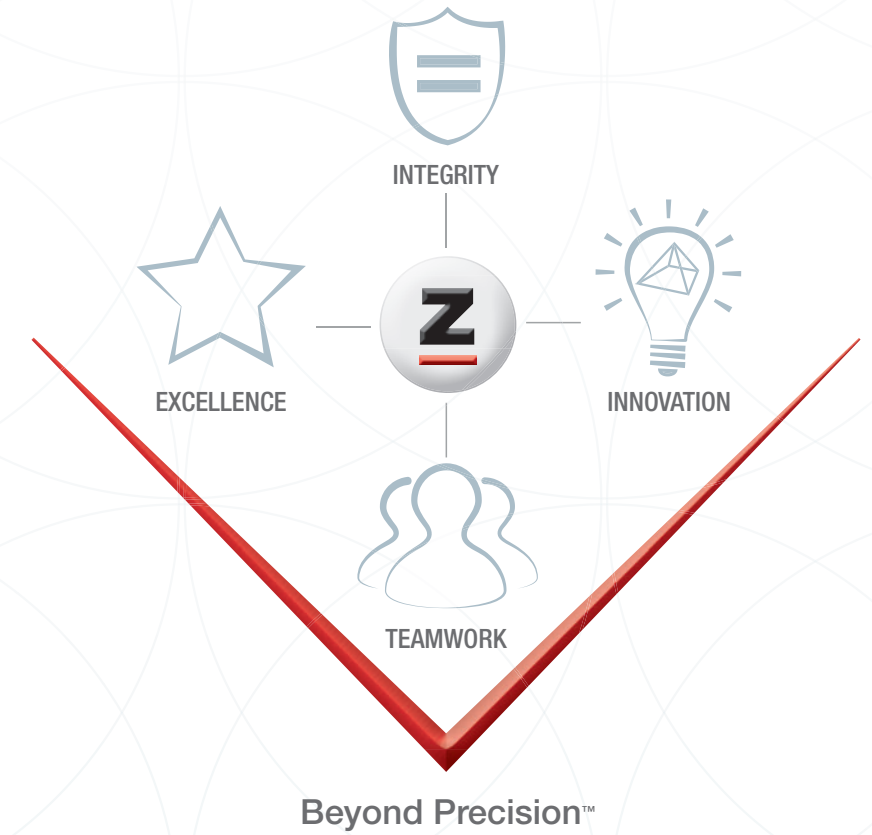
ZYGO® is respected globally as an innovator and for providing best-in-class technologies, services, and solutions with a focus on surface metrology, position sensing, and optical components and assemblies. In a world where meeting and achieving precise tolerances are critical to the success of advanced applications, ZYGO is your dedicated strategic partner.



ZYGO has been at the cutting edge of ultra-precision manufacturing for 50 years.

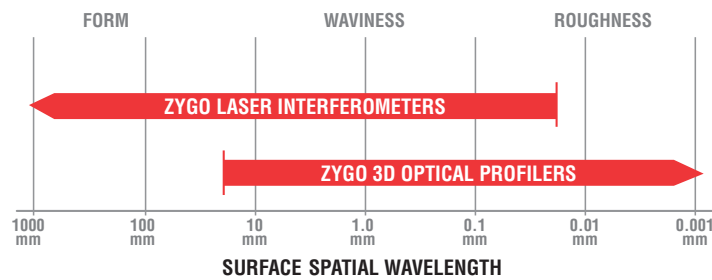
ZYGO's global, industry-wide reputation for excellence is a result of a dedicated team, and an unwavering focus on timely, cost-effective, and exceptional high-quality outcomes for the most critical specification.

We continuously innovate, achieving cutting-edge solutions through a combination of passion, experience, tenacity, and the desire to succeed. ZYGO's four core values sit at the heart of all we do. In every way ZYGO goes Beyond Precision™.



ZYGO's laser interferometers and 3D optical profilers measure the **broadest range of surface spatial wavelengths** in the industry today.

Through experience, ZYGO has elevated the application of optical metrology to an enabling technology for our customers. It is non-destructive and fast, with high resolution and low noise, and the versatility to address applications from R&D laboratories to industrial production and dynamic high-vibration environments – qualifying the most stringent tolerances in optical surface form, wavefront error, thickness variation, and other critical requirements.



# Metrology Workstation 400

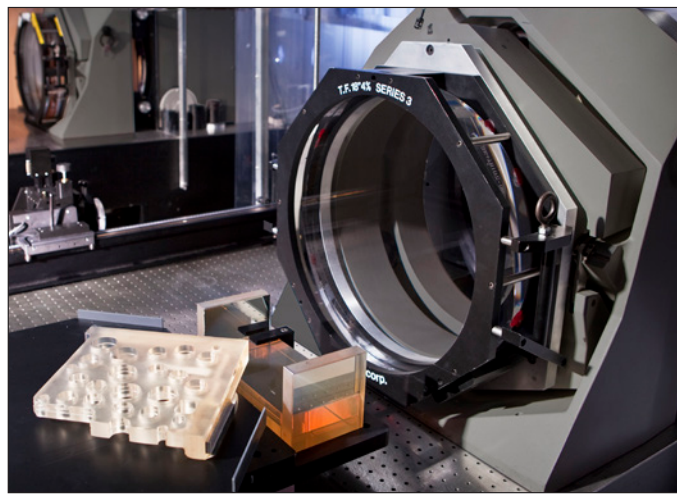
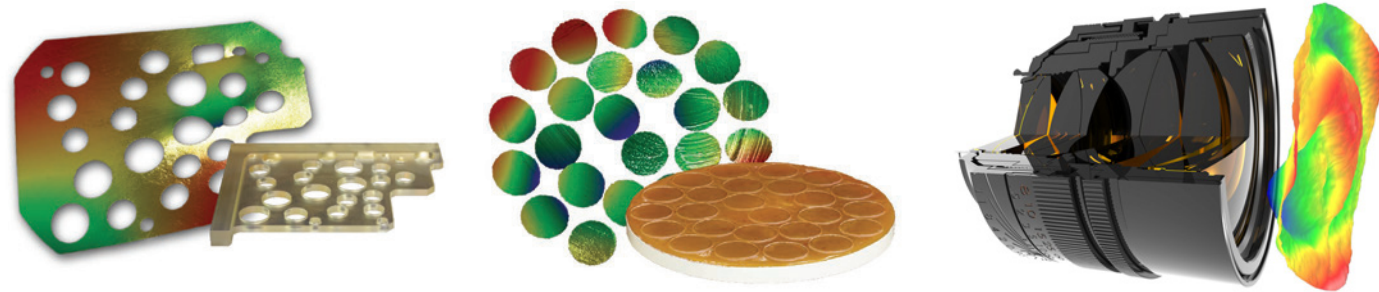


Our laser interferometers move beyond the quality lab.

## Confidence in Metrology

*“Our team at Nikon Optical Modules and Products are in favor of the capability of ZYGO interferometers to precisely measure surface form and refractive index uniformity of our high-quality optical materials and components. With ZYGO and our expertise, we maintain credibility with our customers, qualify our products to meet their requirements and deliver the best possible quality to the industry.”*

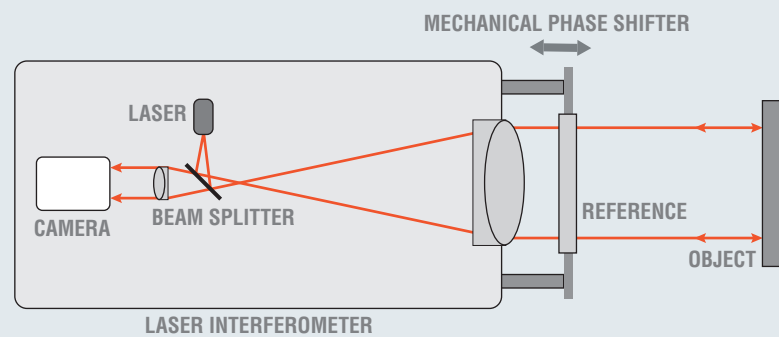
— Ms. Akiko Yoshida, NIKON CORPORATION



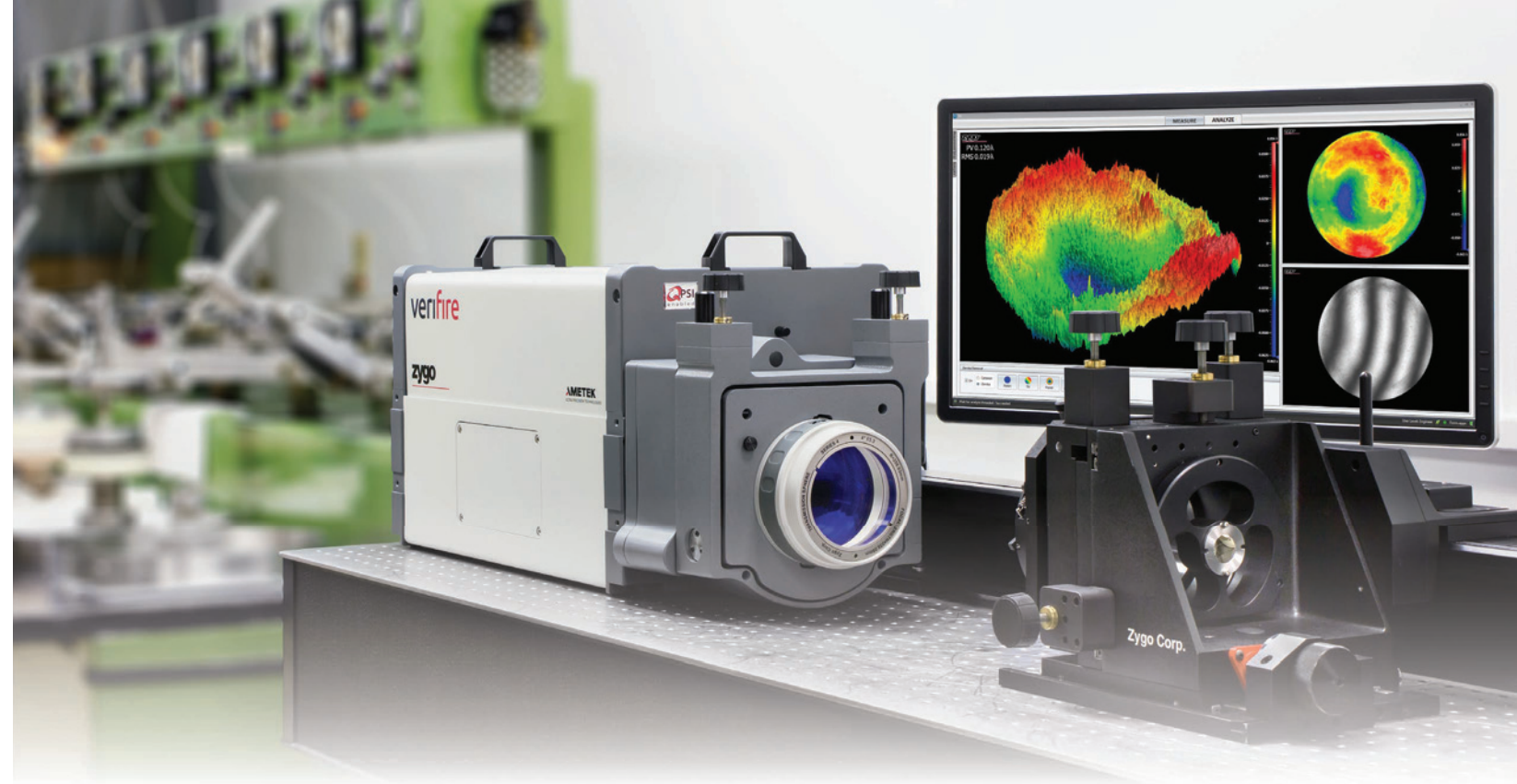
ZYGO Laser Fizeau interferometers provide sub-nanometer measurement precision with non-contact sensing, fast and precise measurements over a large aperture of optical surfaces and system wavefronts.

Our broad range of interferometer products are used in industries including semiconductor, consumer electronics, defense, aerospace, medical, research, and much more.

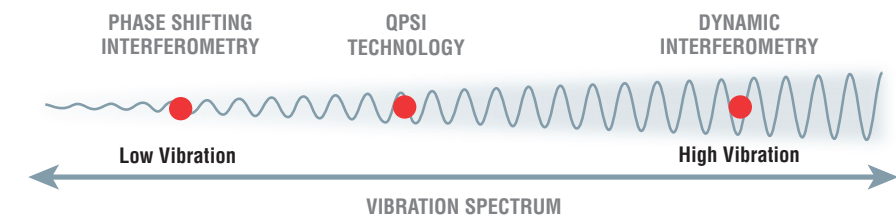
HOW IT WORKS



A laser source is expanded and collimated, then split between a reference beam and a test beam. The surface of interest is aligned to reflect the test beam into the instrument where it interferes with the reference beam – hence the name “interferometer”. The interference of the test beam and the reference beam create light and dark fringes, which can be analyzed to characterize the optic under test.

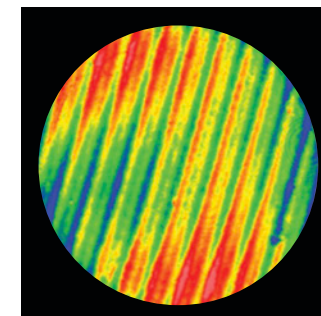


ZYGO innovation in action — **acquisition technology** enables reliable data in harsh environments.

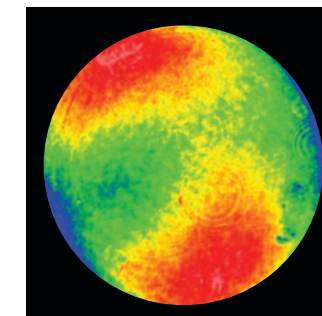


QPSI TECHNOLOGY

Enables measurement in production-level vibrations, providing reliable data for an efficient workflow. Patented on-axis acquisition method does not require calibration.



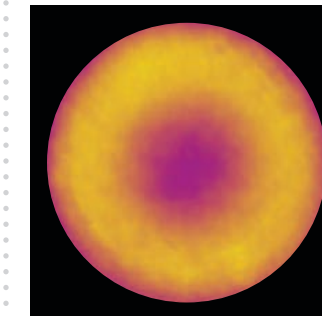
Vibration-induced “ripple-effect”



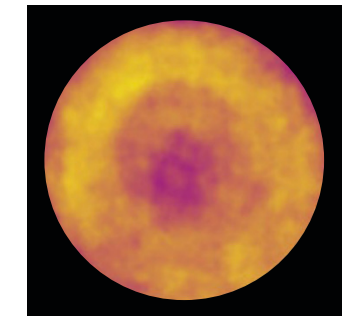
Same data with ZYGO's QPSI

DYNAPHASE™ DYNAMIC ACQUISITION

Enables the highest precision measurements in extreme vibration and air turbulent environments, and excellent correlation to temporal phase shifting interferometry (PSI).



Temporal PSI measurement of <1/20th wave cavity



DynaPhase measurement of same <1/20th wave cavity, enabled by patented carrier fringe and calibration methods

At the heart of every ZYGO laser interferometer is the **laser source**.

**Powerful**

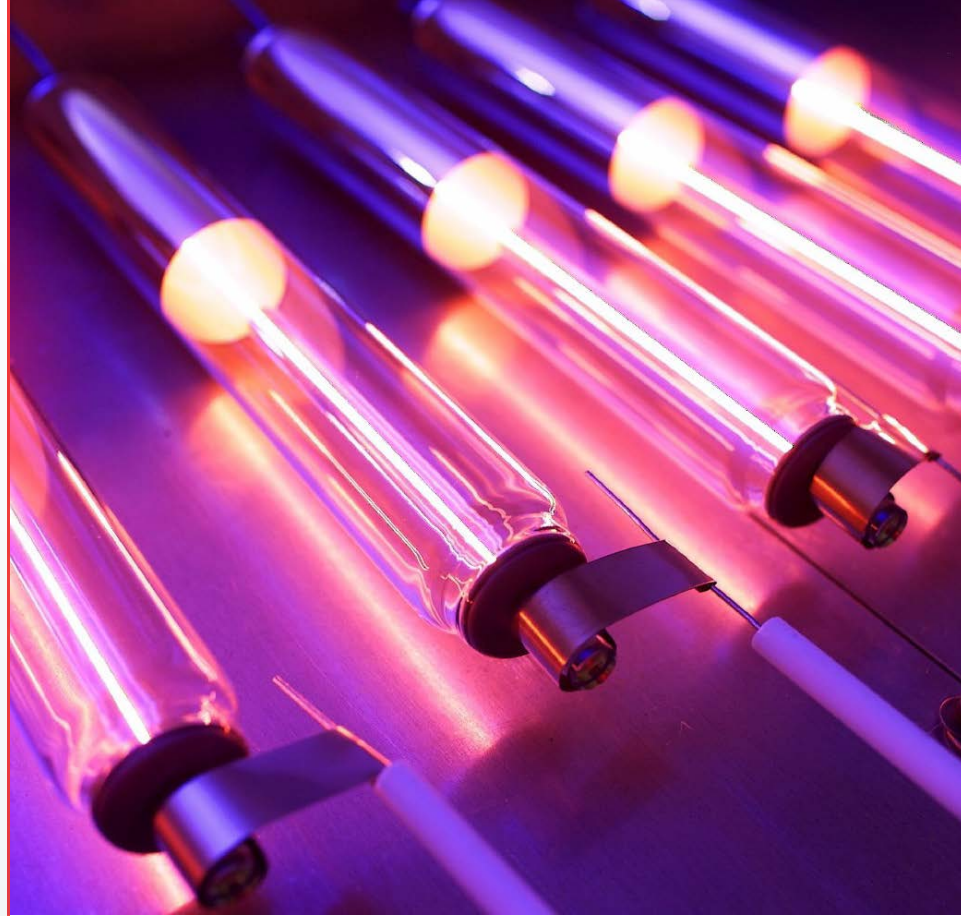
- The highest laser power available enables DynaPhase to acquire data at its fastest camera shutter rate to freeze vibration.

**Reliable**

- 99% of our lasers exceed their 60,000 hr life expectancy – triple the lifetime of typical HeNe laser sources – and are backed by a 3-year warranty.

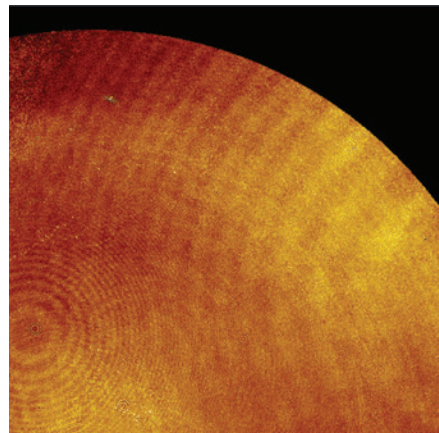
**Stable**

- Frequency stabilized to 0.0001 nm. No other HeNe laser available on the market meets this specification – reducing uncertainty in critical applications.

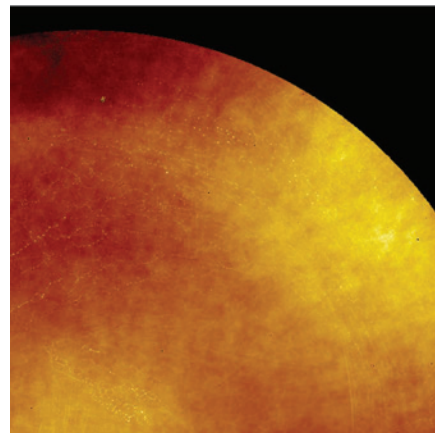


Each ZYGO laser tube is manufactured, tested and certified to exacting standards in our U.S. production headquarters — the only interferometer manufacturer in the world to do so. We designed and manufacture our own laser to ensure the best possible performance and life expectancy for our products. For our customers this means performance for challenging applications like dynamic environments, and lower cost of ownership with reduced downtime and replacement cycles.

Coherent Artifact Reduction Source (CARS)  
 Ring-source mode reduces spatial noise due to bullseye artifacts, laser speckle and coherent noise by a factor of up to 10X.

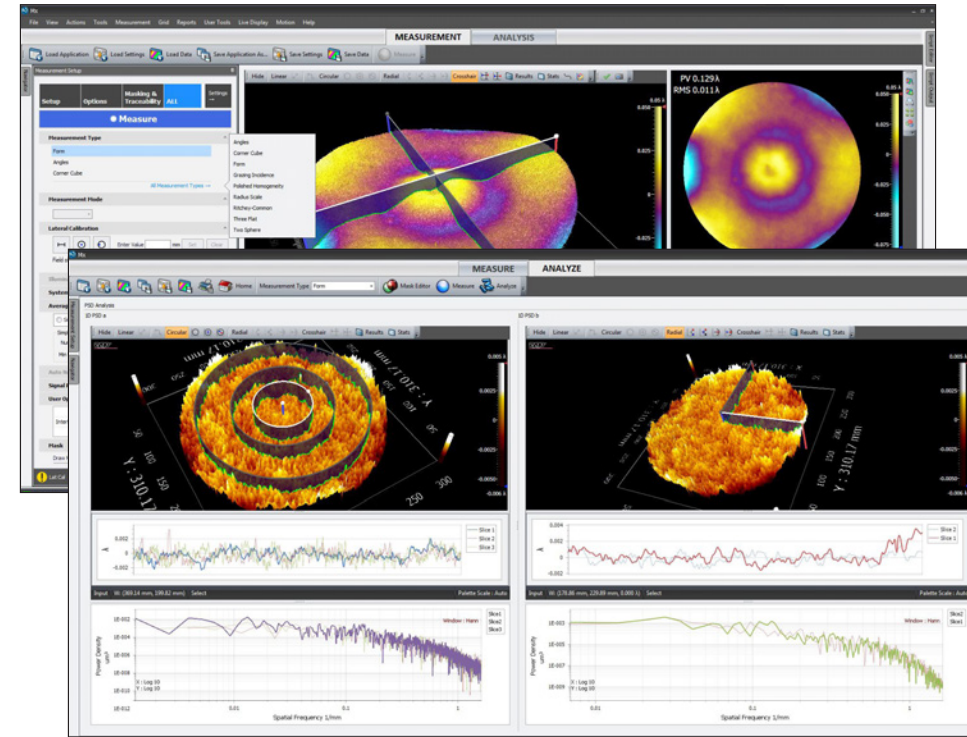


Phase data with bullseye due to dust and artifacts using Point Source



Same data with dust and artifacts using CARS

**MX SOFTWARE**



Mx™ software provides users with a **powerful set of tools** that sets it apart from standard data analysis and system control software.

- Robust measurements
- Interactive 3D plots
- Flexible analysis
- Intuitive user interface
- Built-in SPC analysis

ZYGO's Mx instrument control and analysis software offers a wide range of operational features and a comprehensive data analysis suite including Zernike, slopes, PSD/MTF/PSF, prism angle, corner cube, and many more. With built-in SPC, pass/fail indication, data reporting, and run charts, production-quality analysis is simple. Interactive and detailed data plots show full area data in 2D or 3D. Using a simple workflow-based concept, users easily navigate the metrology experience from setup through analysis and reporting.



**ZYGO Laser**

HeNe laser source made to exacting standards for long life and high power.



**QPSI**

Vibration rejection for noise-free data enabled by proprietary technology.



**Optical Zoom**

True optical magnification improves spatial response.



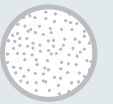
**DynaPhase**

Instantaneous measurements freeze vibration for precise measurements in any environment.



**High ITF**

Rigorous optical design supports high-spatial sampling for MSF and high slope metrology.



**CARS**

Source mode option reduces noise and speckle by up to 10X.



**MST**

Simultaneous Multiple Surface Test for parallel windows, thin glass and homogeneity.



ZYGO offers a complete line of **laser interferometers** enabling quick in-process checks and precise final metrology for the widest range of optical testing applications.

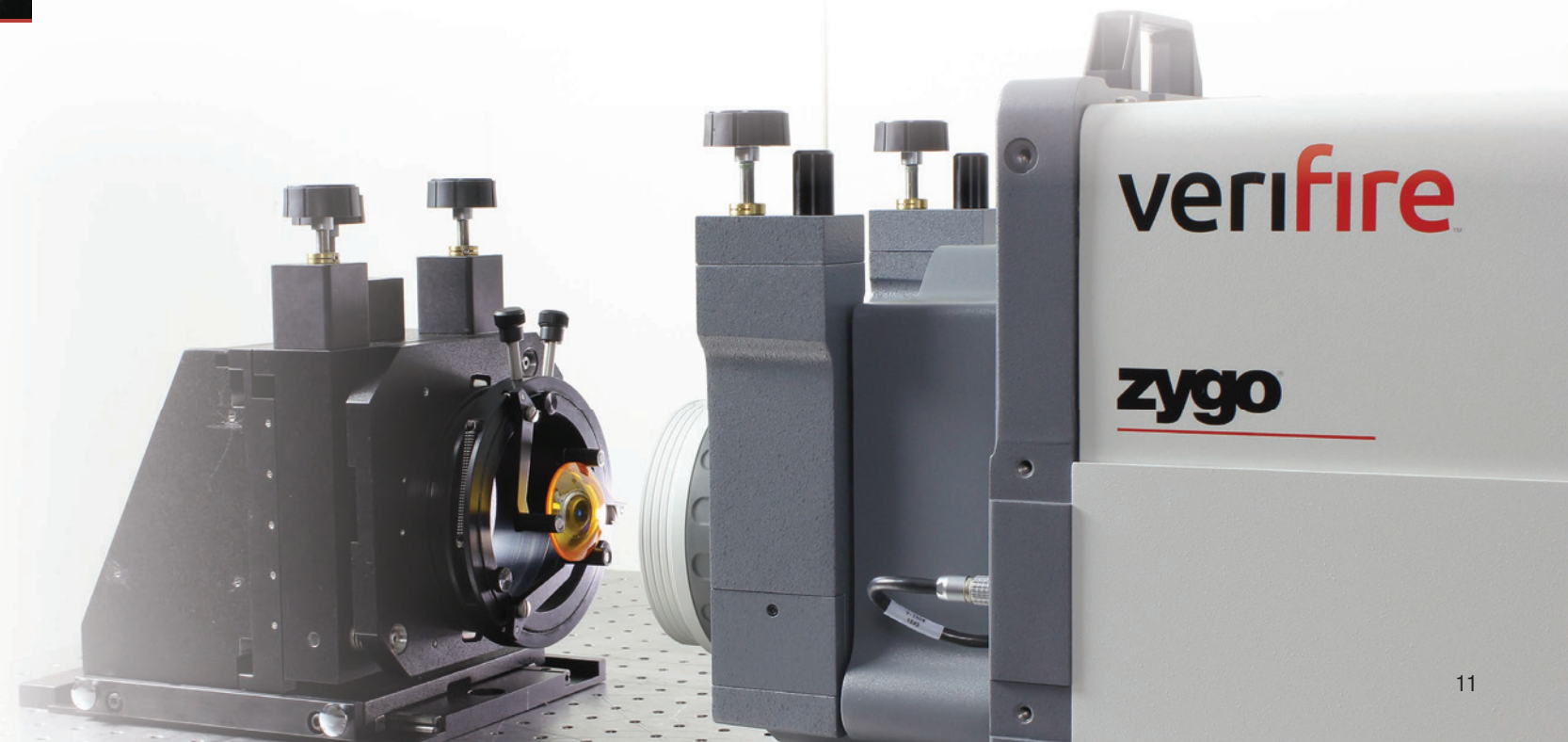
- Lenses, windows, mirrors
- Prisms, beamsplitters, corner cubes
- Camera lenses, laser optics, sub-assemblies
- Wafers, gratings, reticles, display glass
- Optical glass, crystals, IR materials
- Optical surface figure
- Wavefront quality
- Radius of curvature
- Optical material homogeneity
- Wedge, prism angle, corner cube
- Total thickness variation (TTV)



The Verifire interferometer is the workhorse of the optical shop, enabling everything from quick in-process checks to precise final metrology, on the shop floor to the quietest metrology laboratory. Packed with technology like QPSI, ZYGO's proprietary laser source, continuous optical magnification, and the latest Mx acquisition and analysis software, the latest generation of Verifire interferometers are reliable and easy to use for confident measurements, every time.



**Confidence in every measurement**





ZYGO.  
The **go-to metrology expert** when there is no room for error.

The most demanding optics applications require the highest performance interferometry available.

High-energy laser, semiconductor and lithography, remote sensing and free-space telecommunications are among the most demanding applications in the optics industry today.

ZYGO is the trusted source for the highest-resolution and precision interferometry available to support these and many other applications.

Backed by our proprietary ITF validation method, every ZYGO Verifire HD and HDX model ensures **performance where it matters most.**

The Instrument Transfer Function (ITF) describes the lateral resolving power of an interferometer and captures both optical design and camera sampling density in a single critical resolution parameter.

ZYGO Verifire HD and Verifire HDX models deliver the highest ITF performance available in a commercial interferometer and are ideally suited for mid-spatial frequency characterization of optical surfaces — a key measurand that requires extreme performance.

VERIFIRE HD	VERIFIRE HDX
<b>High sampling density supporting high ITF</b>	
2.3k x 2.3k sensor	3.4k x 3.4k sensor
<b>Fast sampling at full resolution minimizes noise sensitivity</b>	
205 Hz	96 Hz
<b>ITF defines critical lateral resolving power</b>	
> 0.7 @ 8.2 cyc/mm	> 0.7 @ 5.4 cyc/mm





The deployment of large optical systems has exploded to support critical applications like remote sensing and the cutting edge of space exploration.

Vibration and air turbulence are a reality for testing of these state-of-the-art optical systems. Large optics and long path lengths are often required and benefit from precision metrology that can handle almost any environment.

With three acquisition modes, Dynafiz® enables **accurate metrology in the harshest** environments.

With power and flexibility to address metrology environments from high vibration and air turbulence to the research lab, the Dynafiz is packed with features and technology that make it the most capable optical testing instrument in the world.

- Highly light-efficient
- Extreme vibration tolerance
- Optical zoom
- Three acquisition modes

DynaPhase instantaneous acquisition freezes vibration with no tradeoff in precision with ZYGO's patented calibration for removing systematic errors in dynamic measurements.

LivePhase™ acquisition provides live data at video-speed, including real-time Zernike feedback, for active alignment of an optical system or capturing dynamic events.



ZYGO Laser



Optical Zoom



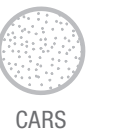
DynaPhase



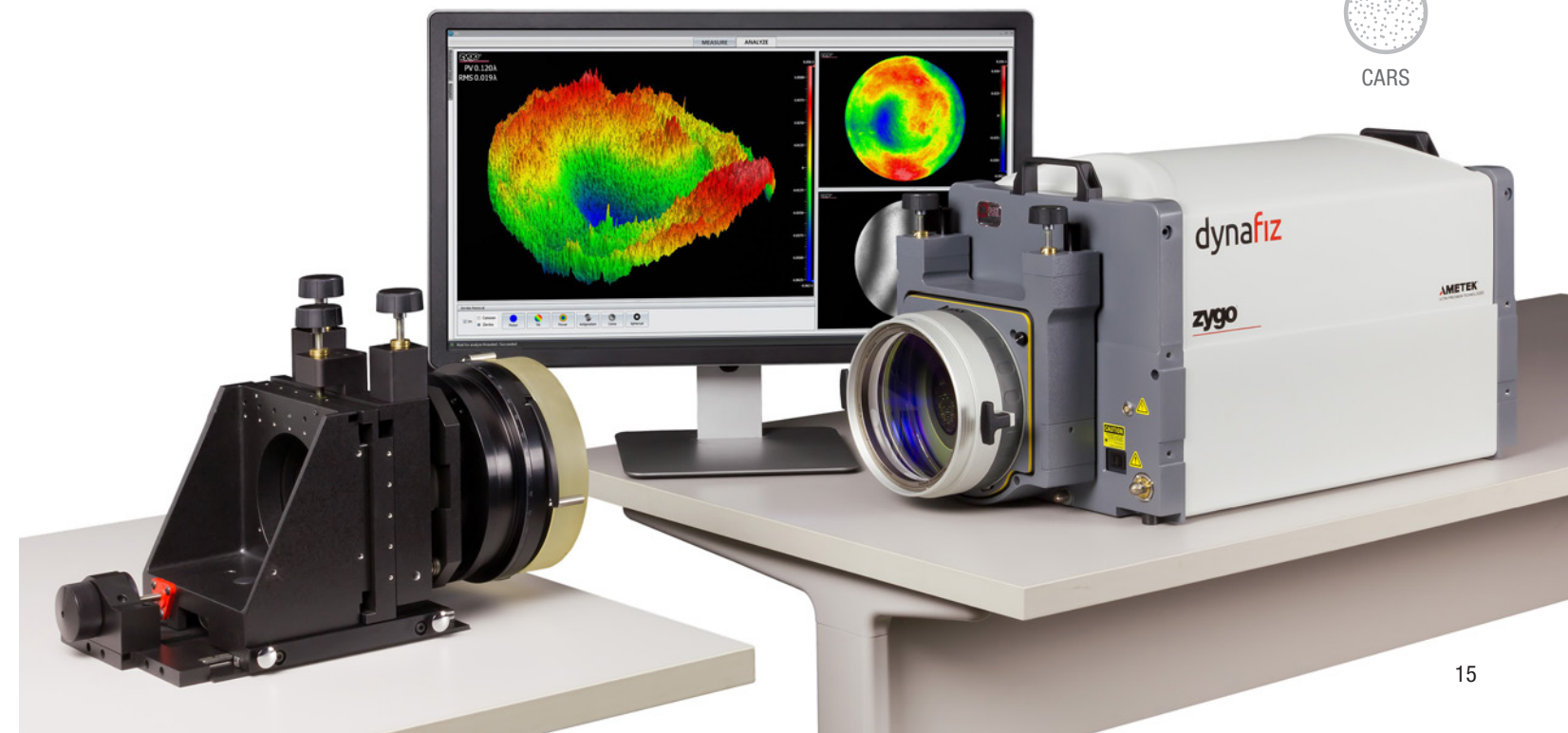
QPSI



High ITF



CARS



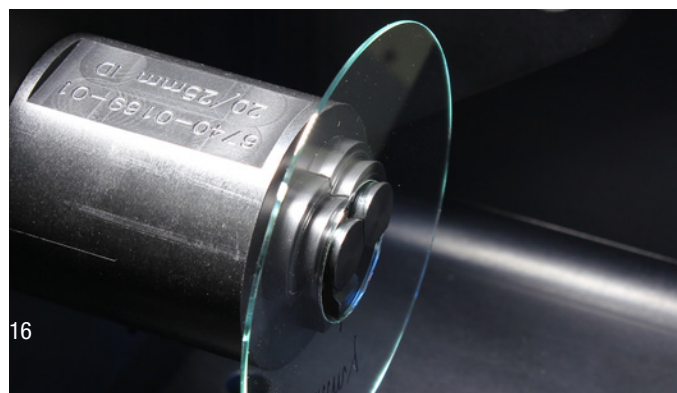
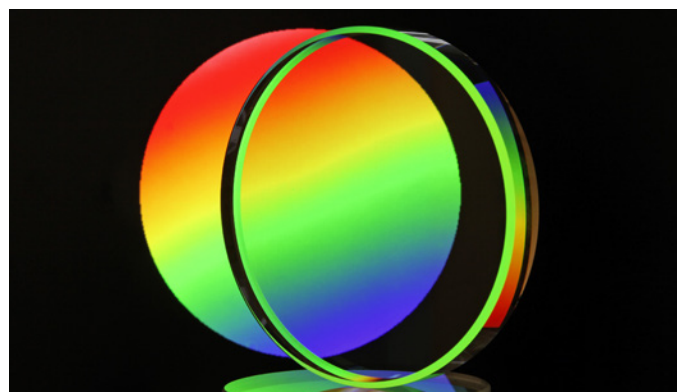




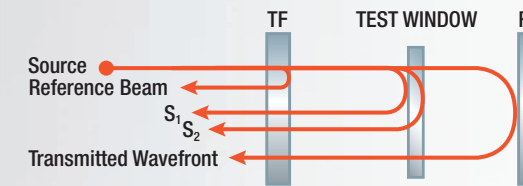
ZYGO innovative technology for **exacting measurements of parallel surfaces** meet tomorrow's challenges today.

Next generation consumer electronics products and features are leveraging the cutting edge in optical component manufacture and metrology.

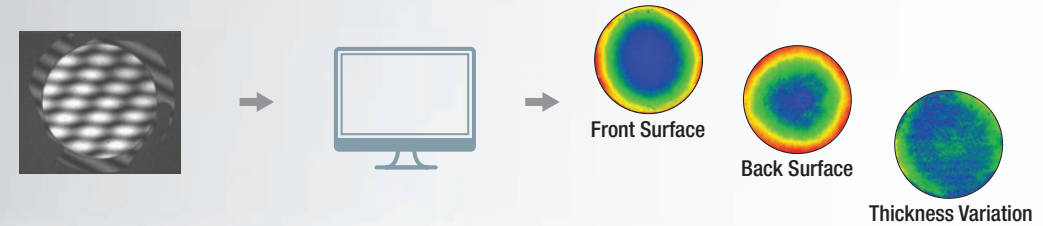
Technology is unlocked by precision windows, substrates and waveguides enabling consumer and business tech from next-generation display devices to data storage disc drives supporting ubiquitous mass storage capacity in the cloud.



HOW IT WORKS



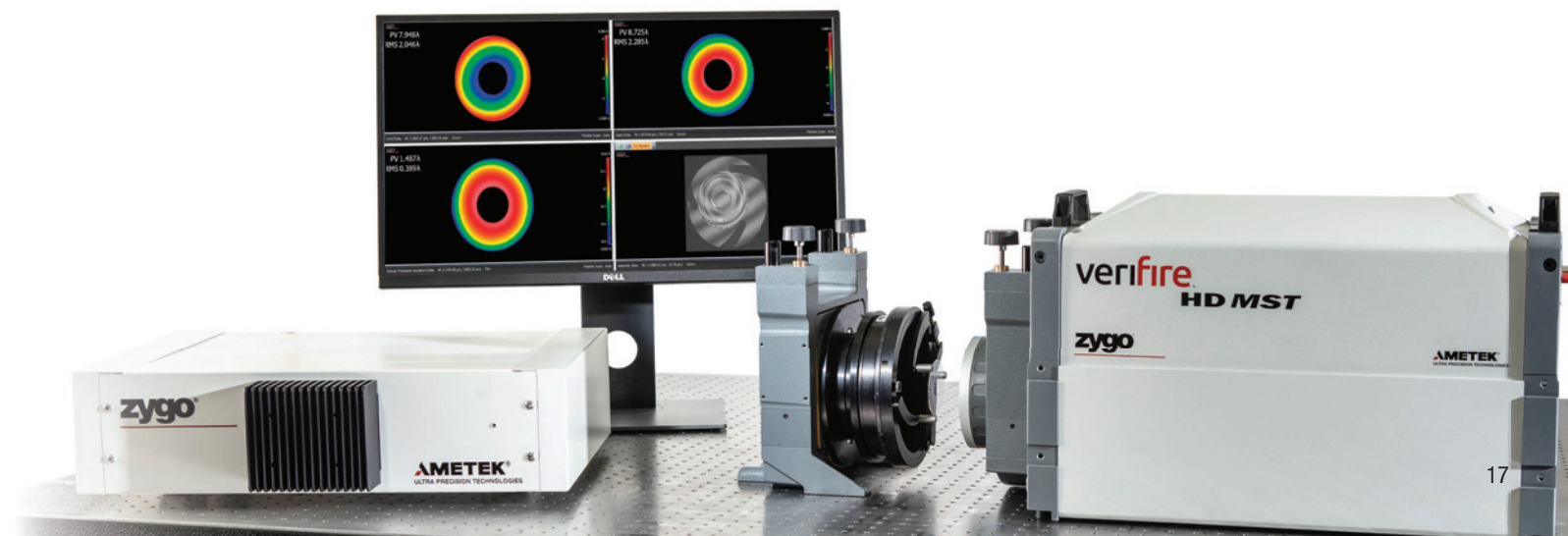
Patented MST acquisition captures complex fringe patterns through wavelength modulation, and unique software extracts signals from individual surfaces, wavefront, and homogeneity — all from a single measurement.



Verifire MST is the only commercial interferometer system that can measure **multiple surfaces simultaneously.**

- Parallel windows as thin as 0.4 mm
- Thin wafer and display glass
- Optical glass homogeneity
- Surface form
- Total Thickness Variation (TTV)
- Wedge
- Direct back-surface measurement

ZYGO Multiple Surface Test interferometers represent a technology that is unmatched in the industry — measure multiple surfaces simultaneously, enabling fast and precise feedback for challenging metrology applications.



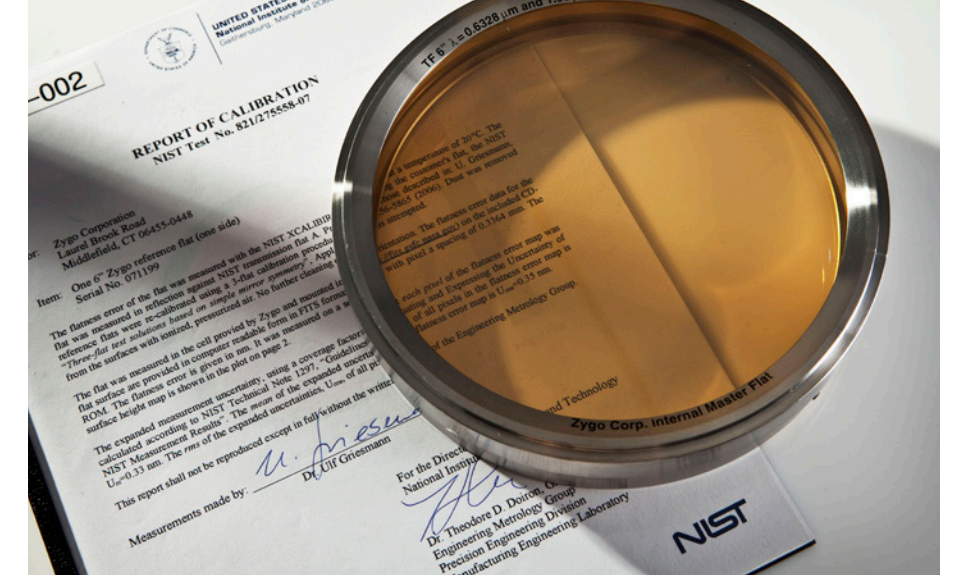


The benefits to our customers include **one-stop for all metrology needs** with guaranteed performance.

	VERIFIRE	DYNAFIZ	VERIFIRE HD	VERIFIRE HDX
Application	General purpose, form metrology	Enhanced resolution and imaging, best dynamic performance	High resolution and imaging, "research grade" performance	Extreme resolution for mid-spatial frequency characterization
Camera Resolution	1.2k	1.2k	2.3k	3.4k x 3.4k @ 96 Hz
ITF	Form metrology only	▲ >0.7 @ 3.3 cyc/mm (1X zoom)	▲▲ >0.7 @ 5.5 cyc/mm	▲▲▲ >0.7 @ 8.2 cyc/mm
Laser Source	▲▲▲▲ ZYGO HeNe, 633 nm	▲▲▲▲ ZYGO HeNe, 633 nm	▲▲▲▲ ZYGO HeNe, 633 nm	▲▲▲▲ ZYGO HeNe, 633 nm
Optical System	▲ Incoherent	▲▲▲ Coherent	▲▲▲ Coherent	▲▲▲ Coherent
Optical Zoom	1X – 5X Continuous Encoded Optical Zoom	1X Fixed 1X / 1.7 X / 3X motorized Zoom Turret (Option)	1X Fixed	1X Fixed
Acquisition Modes	PSI, QPSI, DynaPhase (Option)	PSI, QPSI, DynaPhase	PSI, QPSI, DynaPhase (Option)	PSI, QPSI, DynaPhase (Option)
Dynamic Performance	▲	▲▲▲	▲▲	▲▲
Dynamic Features	▲▲	▲▲▲	▲▲	▲▲▲
Artifact Reduction	None	CARS (Option)	CARS (Option)	CARS (Option)
MST Source	None	MST+	HD-MST	HDX-MST

▲ Good    ▲▲ Better    ▲▲▲ Best

**ACCESSORIES**



We are a truly **vertically integrated** and experienced metrology resource.



ZYGO offers a wide variety of optical and mechanical accessories to expand or enhance the capabilities of your interferometer system. Transmission and reference flats and spheres, mounts, holders, and radius of curvature options provide the building blocks necessary for you to create optimum measurement setup to meet your metrology requirements, without the need for custom fabrication.

ZYGO has invested heavily in our differentiated capability to calibrate the reference surface of nearly every optical reference accessory.

Full Area Calibration is a low-uncertainty data map of the small residual error left in the precision surface, generated by ZYGO proprietary techniques, and enables the user to remove the reference optic error to push reference precision to 1/100th wave or better.

Full Area Calibration is included standard with UltraFlat™ and UltraSphere™ reference optics, optional for other models.



**ZYGO INFRARED SYSTEM METROLOGY**

At-wavelength metrology...  
for demanding **infrared imaging**  
applications.



Optical imaging applications are broad and varied. Testing at a system's design wavelength is critical for development, final alignment and qualification.

**INFRARED DEFENSE APPLICATIONS**

- Intelligence, surveillance and reconnaissance imaging systems
- High-energy laser missile defense
- Air/land/sea targeting and tactical imaging
- Warrior systems

**INFRARED COMMERCIAL AND INDUSTRIAL APPLICATIONS**

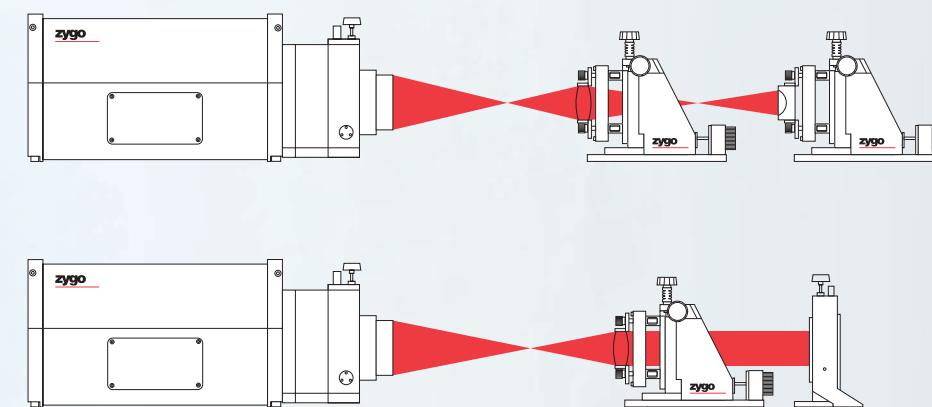
- Free-space communication
- Lidar and remote sensing for autonomous driving
- EUV source laser systems



ZYGO infrared interferometers and accessories offer the performance and reliability at the unique operating wavelength of some of the most critical defense, commercial and industrial IR optical systems.



- Wide range of operating wavelengths in NIR, SWIR, MWIR and LWIR
- At-wavelength QFAS alignment view eases setup of infrared test systems and components
- Vibration insensitive and vibration tolerant acquisition modes
- Multiple Surface Test capable at NIR and SWIR operating wavelengths
- Range of wavelength specific accessories available



Transmitted wavefront testing with interferometry simulates the operation of an optical component or imaging system by using a reference wavefront input, and a test beam that transmits through the optic or system under test.



### Uncompromised solutions

*“The upper plate of the first Fabry Perot Etalon for the “Visible Tunable Filter (VTF)” instrument developed by KIS. With a total diameter of 300mm (250 mm CA) it will be the largest air spaced Etalon ever built. VTF is a key component of the Daniel K. Inouye Solar Telescope on the island of Maui (Hawaii), enabling study of our nearest star.”*

— Dr. Laurent Pinard, LMA

Courtesy: LMA & KIS for VTF project

ZYGO’s large aperture interferometers are **the preferred reference** for many of the world’s most challenging projects.

As a company with deep roots in innovation, ZYGO is proud to support many areas of research. Our large aperture interferometer systems enable production of optics used in a range of scientific and industrial research applications.

Our large aperture interferometers have been proven in the lab and production settings with over 40 years of design experience and proprietary manufacturing and calibration methods that enable the highest possible performance for standard apertures up to 800 mm.

Available in a wide range of sizes and configurations.

- 12", 18", 24" and 32" horizontal
- Dual channel access to 4" leg and expanded leg
- Large optical accessories with surface quality up to 1/25th wave PV
- Available in a range of wavelengths from visible to SWIR

Verifire XL downward-looking 12-inch interferometer for simplified part handling and alignment for plano surface metrology.



DynaPhase



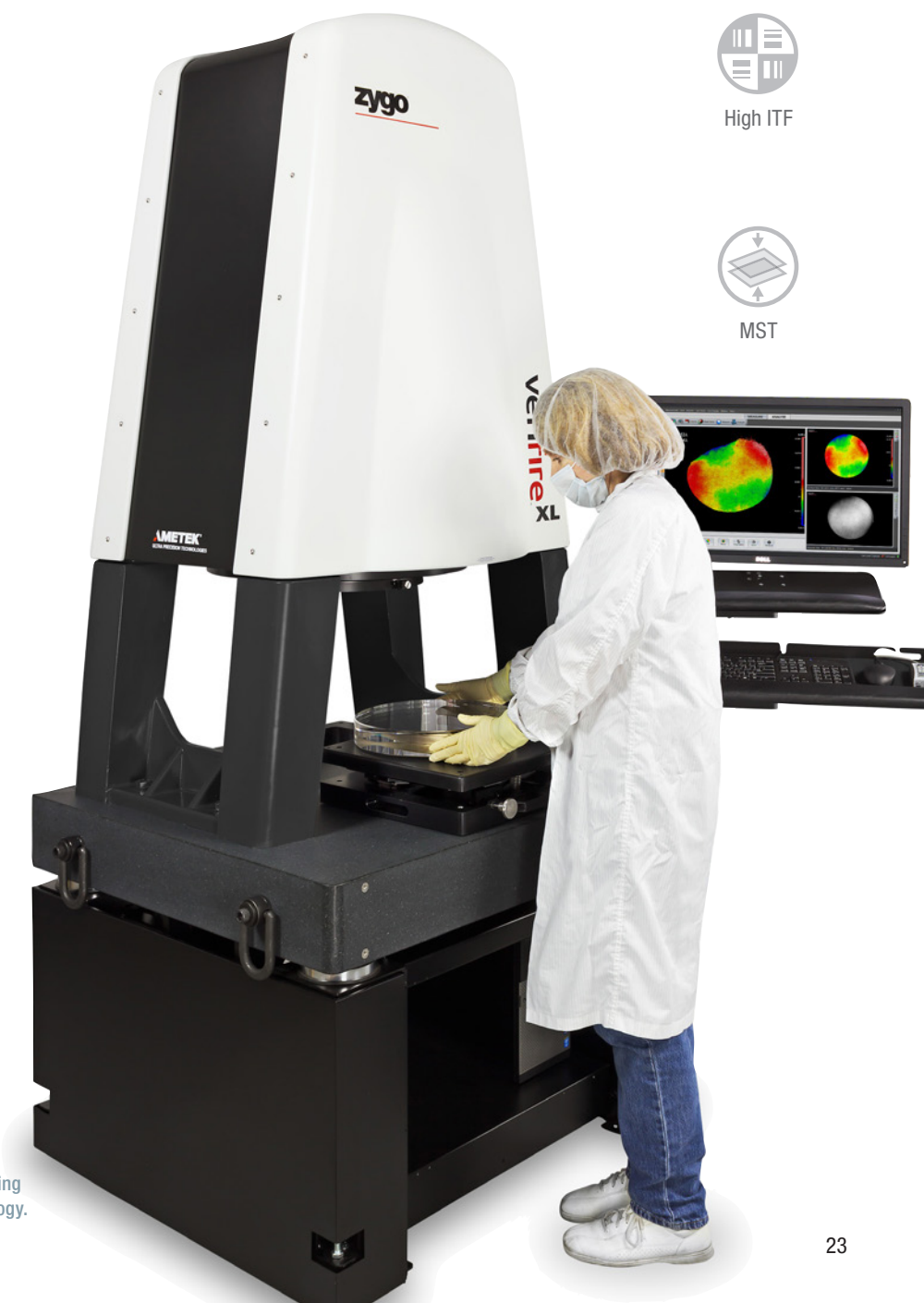
QPSI



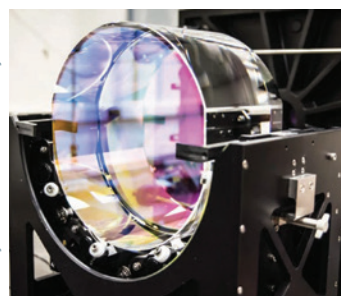
High ITF



MST



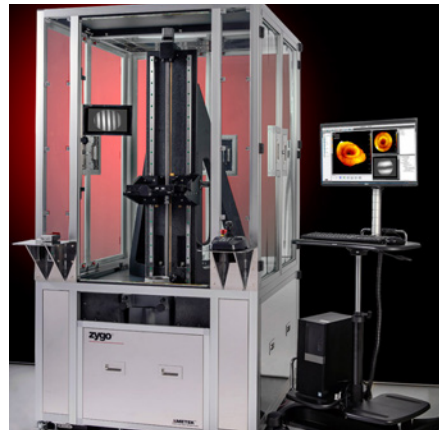
Courtesy Caltech/MIT/LIGO Laboratory



Advanced LIGO gravitational wave detection test masses, production supported by ZYGO large aperture metrology and Extreme Precision Optics division.



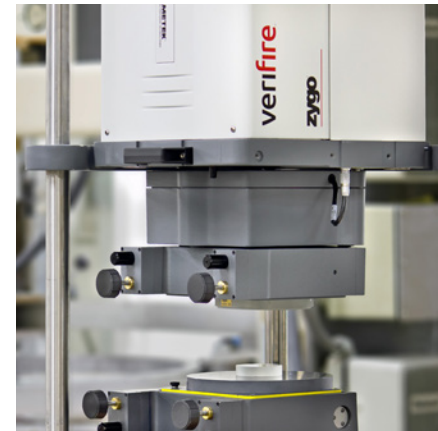
Wafer metrology to qualify critical thickness parameters of wafer substrates for semiconductor and consumer electronics components.



The Verifire VTS system is a stand-alone upward-looking interferometer workstation designed for stable and robust surface form and radius of curvature metrology of spherical optics. This fully-integrated turnkey system features a motorized Z-axis stage with one meter of encoded travel, which simplifies part positioning and enables automated radius of curvature measurements.



The MetroCell is an ultra-capable vertical downward-looking interferometer workstation with 5-axis motorized and programmable staging for part alignment including 800 mm of Z-stage travel, and integrated passive vibration isolation system. With a 2-axis DMI on the Z-stage, the MetroCell is the most precise spherical radius of curvature measurement platform available, capable of measurement uncertainty < 0.001% of radius value.



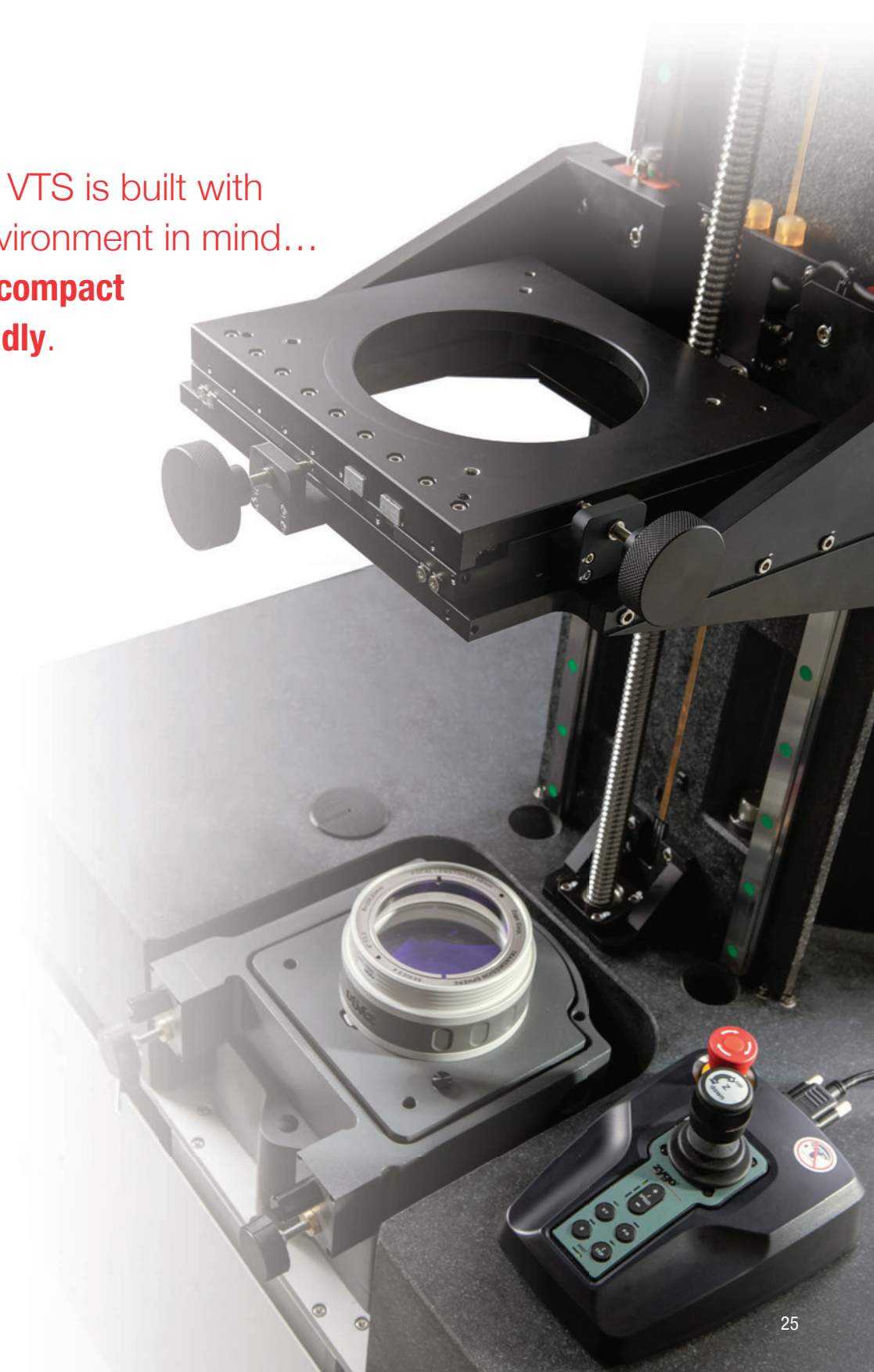
Vertical workstation kits enable the flexibility of a vertically-oriented interferometer in a no-frills cost-effective package. Check out the ZYGO Laser Interferometer accessory guide for more information on the configurations and options available.

Efficient production optics manufacturing leverages vertical configuration metrology for quick in process checks and reliable final metrology. ZYGO's range of interferometer workstations enable fast and efficient surface form and radius of curvature metrology of spherical optics and are configurable to suit your optics shop

	VTS	MetroCell	Vertical Kit
Radius precision	0.05%	0.001%	0.05%
Orientation	Upward	Downward	Upward or Downward
Test part stage	Z – Motorized XY – Manual	XYZPR – Motorized	Configurable
Vibration isolation	Integrated passive vibration isolation	Integrated passive vibration isolation	Vibration isolation table optional

The ZYGO Verifire VTS is built with the production environment in mind... **vibration isolation, compact footprint, user-friendly.**

- Robust design, built for production environments
- Turnkey system with compact footprint
- Integrated passive vibration isolation system
- Flexible configurations — Verifire, Verifire HD, Dynafiz
- MX™ software with radius of curvature encoder feedback
- Programmable and automation ready
- Optional safety enclosure with light curtain interlock



**Proven OEM and custom metrology solutions —**  
What you need, when you need it.



We bring decades of experience to optical metrology design and implementation.

ZYGO leverages our custom optics production capability for truly vertically integrated development of complete solutions tailored for unique and custom requirements.

We can modify our standard systems, design and build special fixturing, and customize software applications, just for you.

Give us a call to review your next precision metrology requirement.

**ZYGO®**

Where metrology enables advances in innovation, process development, and manufacturing efficiency.

We listen to you, and are ready to partner with you to push the boundaries and achieve excellence.

Passion. Confidence. Experience. **Beyond Precision.**



**21 locations**

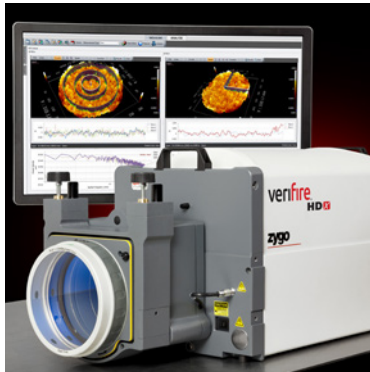
**50+ years**

**750+ patents**

**Countless innovations**



## The ZYGO® Family of World-Class Precision Metrology and Optics



### LASER INTERFEROMETERS

The industry-standard for reliability, flexibility and repeatability in precision metrology applications.



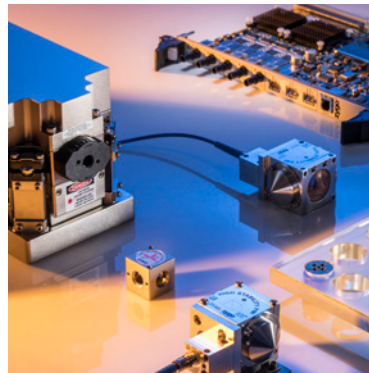
### 3D OPTICAL PROFILERS

Robust, non-contact metrology solutions for exacting applications.



### PRECISION OPTICAL COMPONENTS & SYSTEMS

Innovative, high-precision optical components & integrated system design, prototyping, and volume assembly.



### NANO POSITION SENSORS

Reliable and repeatable position measurements from the leader in optical-based metrology.

**zygo**

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**AMETEK**  
ULTRA PRECISION TECHNOLOGIES