SPEC SHEET

OPAL-SD – Single-die testing

SEMI-AUTOMATED TEST STATION FOR INTEGRATED PHOTONICS

- Entry-level, flexible, cost-effective and upgradable. Ideal for testing photonics integrated circuits (PIC). Automated optical alignment; manual or motorized positioning of die and electrical probes; traceable and queriable results.

KEY FEATURES

- Characterization of a single singulated die
- Research-grade solution for PIC testing and characterization
- Flexible design with repositionable optical and electrical RF/DC heads
- Preparation, automated execution (alignment, instrument control) and data management (repository, analysis) with the included PILOT software suite
- Different optical head options, as needed: up to 6 motorized axes for surface and edge coupling with single fibers or fiber arrays
- Precise DC and RF probing positioners

APPLICATIONS

- Optical and electrical probing and testing of integrated photonics photonics (PIC) at the die, module or bar-level
- For R&D, low-volume design verification and test development
- Perfect for academia and R&D teams
- Opto-electronic testing of integrated photonics platforms: silicon photonics, indium phosphide, III-V, polymer, heterogeneous, etc.
- Application-agnostic: telecom & datacom transceivers, quantum, LIDAR, sensors, AI, etc.

EXFO

OPAL-SD PLATFORM

The OPAL single-die test station for integrated photonics is composed of a 4-axis manual stage and chuck, as the base system, motorized optical head(s) and manual electrical head(s), including a top-vision system. The station also comes with a side camera, a server-grade PC and a license for the PILOT software suite.

It offers fully automated optical probe navigation at the die-level, and manual electrical probing. When combined with the advanced optical measurements capabilities of EXFO's product line of optical instrumentation, this system provides an unmatched solution for optical spectrum analysis as well as electro-optic testing such as BER. Together with the PILOT software suite, the OPAL-SD station becomes a complete, flexible and scalable solution.

The OPAL single-die station is part of a larger family of test stations and can be used as a stepping stone to increase throughput capabilities. EXFO's multi-die and wafer stations share many of the OPAL-SD elements, particularly the probe heads, vision system and more importantly, the PILOT software—allowing flexible migration from single-die testing to wafer characterization. OPAL platforms come with an advanced automation software providing high-performance functionalities to control the motion and vision systems as well as any test instrumentation from EXFO or third-parties. The advanced features of the software on data analysis and AI modeling transform measurements of PIC into properly informed decisions and actions on the user's side.

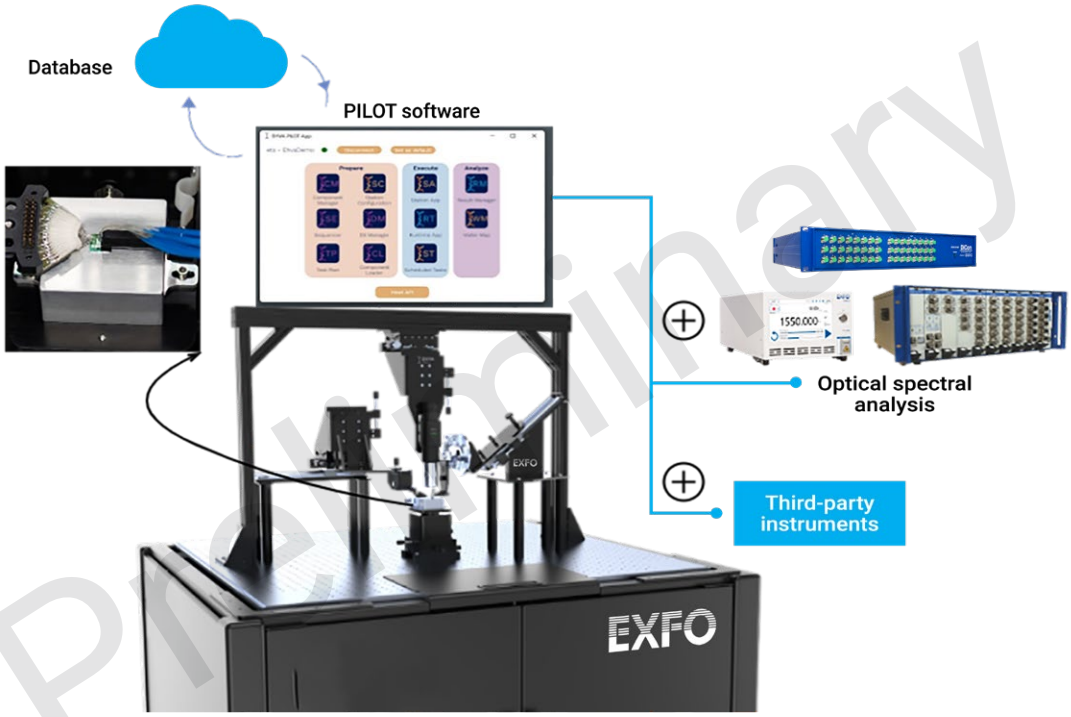


Figure 1. OPAL-SD platform as a characterization solution with PILOT software

PILOT AUTOMATION SOFTWARE

PILOT is a software platform that orchestrates the complete flow of PIC test and measurement: (i) test preparation, (ii) execution of fully automated navigation, alignment and measurements at a high-throughput and (iii) analysis and data management of the results.

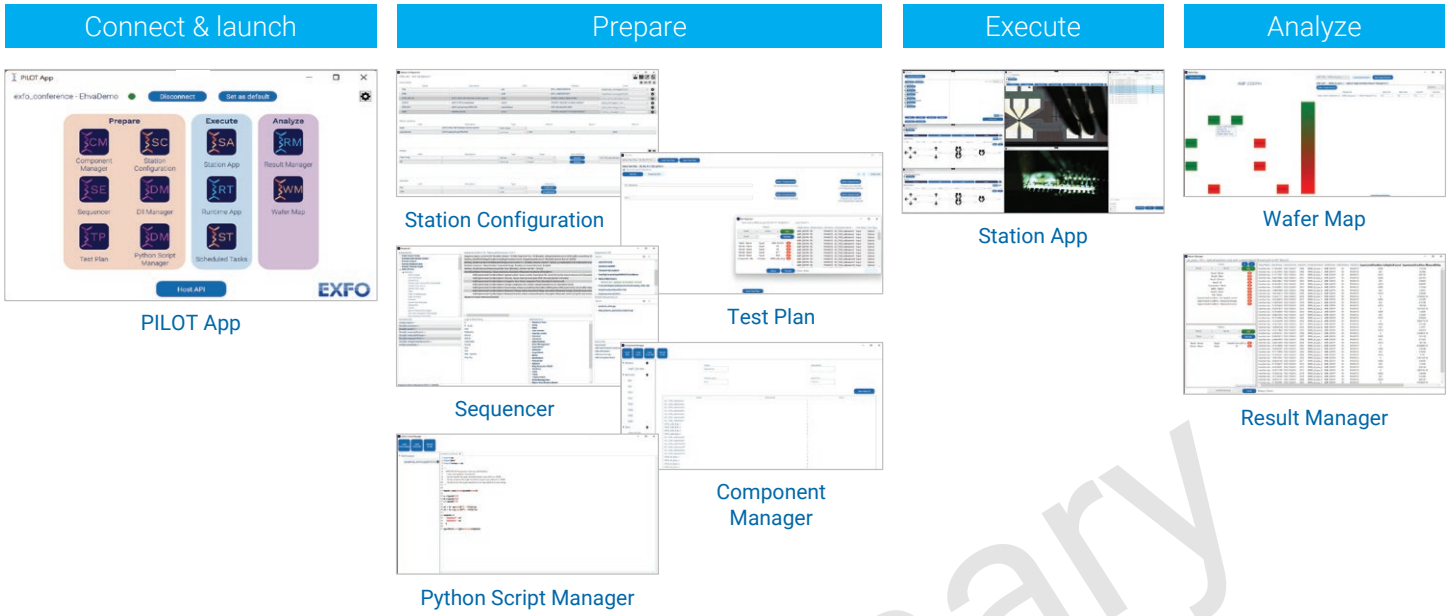


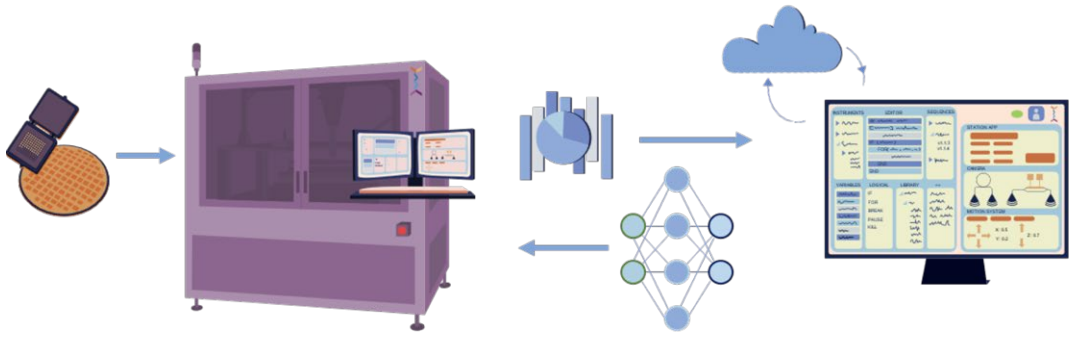
Figure 5. PILOT App: Prepare – Execute – Analyze with a single software suite.

POWERFUL AND SCALABLE

From software architecture to implementation, the software is designed for scalability in time and volume and helps to implement best practices. It streamlines automation of tasks (preparation, data analysis, reporting) and measurements (navigation, alignment, instrument control) to increase effectiveness. It is composed of multiple applications, each designed for its specific task, with de-coupled concepts and responsibilities.

BENEFITS

- EXFO aims to provide the user with insight and knowledge, enabling data-driven decision-making. The foundation lies in its powerful automated test stations and software suite, coupled with a structured database. These tools can be leveraged to gather massive amounts of high-quality data from the measurement of photonic integrated circuits.
- The control software is flexible and allows system interoperability. Customers can then create and customize their own control and test and use it as needed, seamlessly.
- Advanced automation software empowers users to define and maintain a logical structure among the circuit components, design parameters, simulation results, experimental results and conditions, computations results and sequences. This provides all support needed for absolute traceability and reliability and naturally creates a dataset that is a report-ready and AI-ready.



DATABASE BENEFITS

Underlying all applications, the software is linked to a database (cloud-based or on-premises), that acts as a data repository for all of the elements (results and experimental conditions, station configuration, test definition, component definition, drivers, Python scripts). It therefore enables multi-users, multi-site collaboration with a shared common workspace of the data. The database is relational, traceable and scalable to high-volume, making the system natively compatible and designed to support advanced data analysis, artificial intelligence, and business intelligence tools through built-in tools or by interoperability.

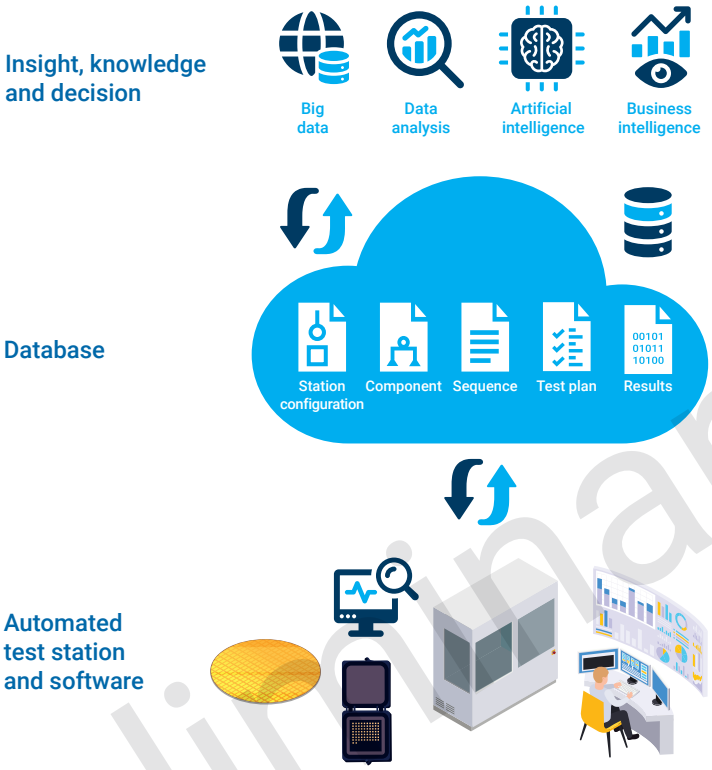
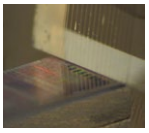
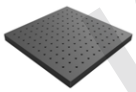


Figure 6. OPAL test stations and PILOT software automates PIC testing with powerful, scalable features, utilizing multiple applications linked to a collaborative database for advanced data analysis and AI.

OPAL-SD PLATFORM COMPONENTS

The OPAL-SD platform consists of a basic configuration to perform initial PIC testing and characterization. All the components can be purchased as single items at anytime, for upgradability.

	COMPONENTS		
BASIC STATION	**Chuck**		Provides excellent and smooth surface with switchable vacuum. An optional advanced chuck that also offers thermal capabilities and coaxial electrical connection is available.
	Manual 4-axis stage		Enables precise position adjustment of the chuck and die. Coarse aligment and ease of displacement from an electro-optic circuit to another when multiple electrical arms are present.
	Vision		3-axis manual translation stage for top vision system. Includes an entry-level top vision system for operation purposes. A high-quality vision system for stable, repeatable and high-resolution for machine vision purposes is offered as an option. The upgrade includes an in-line fiber illumination scheme and features a large numerical aperture.
			Magnetic toggleable, side-view with ultra-long working distance camera to provide easy and repeatable adjustement of optical/electrical probes.
	PILOT software		Full software suite for automation and control of test station, instruments and data. Allows users to define and maintain a logical structure among circuit components, design parameters, simulation results, experimental results and conditions, computations results and sequences. This provides all support needed for absolute traceability and reliability while naturally creating a dataset that is report-ready and AI-ready.
	Also included		Honeycomb optical breadboard, server-grade PC, controllers and cables.
PROBES [a]	**Electrical (PRE)**		4-axis manual electrical probe positioners. Fine alignment and long travel range. Probe holders compatible with most DC and RF probes.
	Optical (PRO-XX)		**P60:** Motorized 6-axis nanometer-precision piezo-based hexapod for precise and fast operation. Features a virtual pivot point capability, enabling seamless optimization of the injection angle. Can be used for both edge and surface coupling. Ideal for R&D applications.
			P30: Motorized 3-axis, direct drive aligner with unmatched repeatability, longevity and reliability. Can be used for both edge and surface coupling. Ideal for production.
			ECO series: Motorized 3, 4 or 6 axis, screw-driven aligner with high reliability. Please select other optical head options if high-repeatability edge-coupling is required. Ideal for entry-level R&D or production with surface coupling.

a. Optical fiber / array and probe RF not included.

BUILD YOUR STATION CONFIGURATION

The OPAL platform being a modular solution, it can fit customer needs through the setup of up to 4 heads simultaneously in any combination. Optical or electrical probes can be positioned around the device under test in any orientation: North, East, South and West. This flexibility enables customers to tailor and scale testing to their needs for optimal results. The table below shows some of the many possible application examples.

MEASUREMENT SETUP	EXAMPLES OF STATION CONFIGURATION
Optical surface coupling only. Best suited for entry-level solution.	 **Single-die base stage** Manual 4D translation stage with vacuum chuck +  **ECO series** 3-axis, screw-driven aligner +  **Top/side vision system**
Electro-optical, surface coupling and edge-coupling capable. Best suited for R&D.	 **Single-die base stage** Manual 4D translation stage with vacuum chuck +  **4-axis manual electrical probe positioner** +  **Optical probe PRO-P60** 6-axis nanometer-precision and piezo-based hexapod +  **Top/side vision system**
Electro-optical, surface coupling and edge-coupling capable. Best suited for industrial production.	 **Single-die base stage** Motorized 4D translation stage with vacuum chuck +  **Thermal chuck** Vacuum and temperature controlled chuck +  **4-axis motorized electrical probe positioner** +  **P40** 3-axis, direct drive aligner +  **Top/side vision system**

SPECIFICATIONS

As EXFO continuously improves its products, the delivered station may differ slightly from the one shown in the CADs and images used throughout this document.

SINGLE-DIE BASE STAGE, 4-AXIS MANUAL	
X, Y axis travel (mm)	27
Z axis travel (mm)	9
Rz axis travel (degrees)	20
X, Y axis displacement/revolution (mm)	0.3175
Z axis displacement/revolution (mm)	0.085
Rz axis displacement/revolution (degrees)	1.2
Chuck size (mm)	Typical: 50 × 50
Vacuum zones	Typical: 1
Optional: Thermal chuck temperatura range	Typical: 0 °C to 120 °C (32 °F to 248 °F). Contact EXFO for more options.
Optional: Thermal chuck temperature stability	Typical: 0.05 °C (32 °F)
Optional: Thermal chuck temperature resolution	0.01 °C (32 °F)

Optical head options

P60 – 6 MOTORIZED AXIS, PIEZO-HEXAPOD	
X axis travel (mm)	20
Y axis travel (mm)	11
Z axis travel (mm)	20
Rx axis travel (degrees)	23
Ry axis travel (degrees)	38
Rz axis travel (degrees)	26
X, Y, Z axis resolution (nm)	1
Rx, Ry, Rz axis resolution (arcsec)	0.04
X, Y, Z axis unidirectional repeatability (nm)	Typical: 50
Rx, Ry, Rz unidirectional repeatability (arcsec)	Typical: 1.5

P40 – 4 MOTORIZED AXIS, DIRECT-DRIVE	
X, Y, Z axis travel (mm)	25 (X, Y), 4.8 (Z)
X, Y, Z axis resolution (nm)	Typical: 10 (X, Y), 60 (Z)
X, Y, Z axis bidirectional repeatability (nm)	Typical: 70 (X, Y), 250 (Z)

ECO-30, 40, 60 – 3, 4 OR 6 MOTORIZED AXIS, SCREW-DRIVEN	
X, Y, Z axis travel (mm)	25 (X, Y), 12.5 (Z)
X, Y, Z axis resolution (nm)	200 (X, Y), 25 (Z)
X, Y, Z axis bidirectional repeatability (nm)	Typical: 125 (X, Y, Z)
X, Y, Z, axis accuracy (µm)	Typical: 4 (X, Y), 1.5 (Z)

ELECTRICAL HEAD, 4-AXIS MANUAL	
X, Y, Z axis travel (mm)	48
X, Y, Z axis displacement/revolution (mm)	0.3
X, Y, Z axis accuracy (µm)	Typical: 2
Tilt travel (degrees)	10
Tilt displacement/revolution (degrees)	Typical: 0.7
Rail system X axis travel (mm)	180
Z axis coarse step travel (mm)	Min: 6.35 Max: 56

TOP VISION SYSTEM	
Bridge system with 3-axis manual positioner	
X, Y, Z axis travel (mm)	48
Z axis coarse step travel (mm)	Min: 6.35 Max: 19
X, Y axis displacement/revolution (mm)	1.41
Z axis displacement/revolution (mm)	0.3175
Magnification (X)	Typical: 8
Numerical Aperture	Typical: 0.28
Depth of focus (µm)	3.5
Field of view (µm)	880
Working distance (mm)	Typical: 34
Resolution (MP)	Typical: 5.1
Frame rate (fps)	Typical: 34
Illumination type	In-line, fiber-based LED illuminator (option)
Type	Color 12-bit
Wavelength	Visible, visible and IR available (option)

SIDE VISION SYSTEM	
Magnification (X)	Typical: 3
Numerical aperture	Typical: 0.043
Field of view (mm)	Typical: 2.2
Working distance (mm)	Typical: 11
Resolution (MP)	Typical: 5.1
Frame rate (fps)	Typical: 34
Type	Color, 12-bit

MAIN SYSTEM	
Weight	Typical: 160 kg (352.7 lb)
Length (mm)	1219 mm (48 in)
Width (mm)	914 mm (36 in)
Base	High-quality honeycomb optical breadboard
Work-station computer	Intel i7 CPU, 32 GB RAM, 1 TB SSD, 2 Ethernet ports, multiple USB ports, Windows 11 Pro, mouse and keyboard included
Monitors	2 x 27-inch screens

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