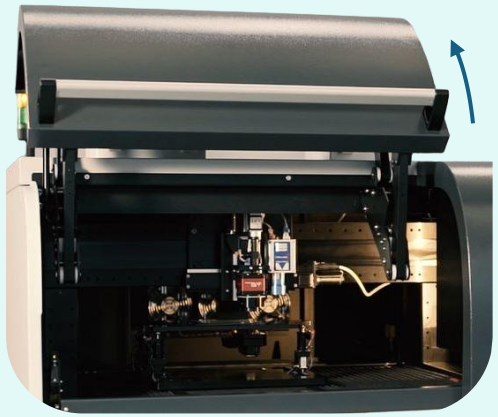
alfamation
an inTEST Company

WALOT™

WAfer Level Optics Tester
Platform Focus

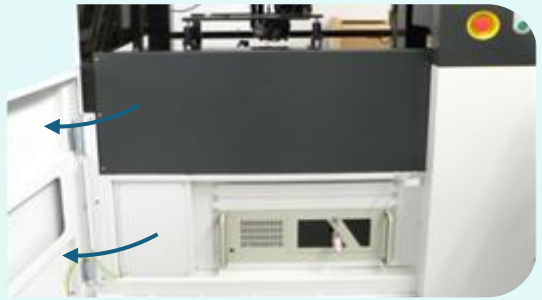
WALOT™ : the fully Automated Wafer-Level Test System Platform Structure

At Alfamation we offer a **fully automated test system** designed to combine **efficient automation** with the capability of handling a **wide range of functional tests**. The platform is equipped with a high performative and reliable **air-bearing wafer handling system** combined with a **flexible measurement setup architecture** which requires little to no maintenance. The platform is structured as showed below:



Based on a XY air-bearing wafer handling system, the application area is then configured to meet the test requirements of the specific components. The tester also comes equipped with a vision system used for fiducial recognition and DMC\Barcode\QR Code reading.

Configurable Application Area



Equipped with Industrial PC and configurable with other instruments based on specific test needs. (i.e. tuneable laser, optical attenuators, ...)

Instrument Rack

Monitors

Industrial Stack Light

Emergency and Start Button

Keyboard and Mouse

A pair of HEPA filter is positioned on the tester roof, while on a system of fans blowing both in and out creates the needed airflow.

Air Filtering

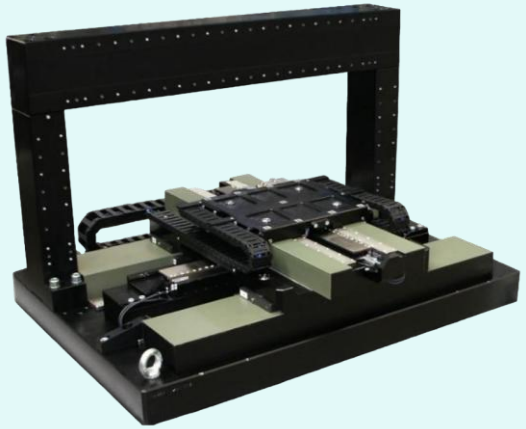
On the back panel are located the interfaces of the system with the rest of the facility.
They consist of the power supply interface, an ethernet port to connect the system to the LAN and a fast snap connector to provide compressed air.

System Interfaces

WALOT™ : Platform Structure
Configurable Application Area

The core of the application area is the wafer handling system. This setup is then equipped with a chuck and configured with a set of instruments which depends on the specific elements which needs to be tested.

XY Wafer Handling System

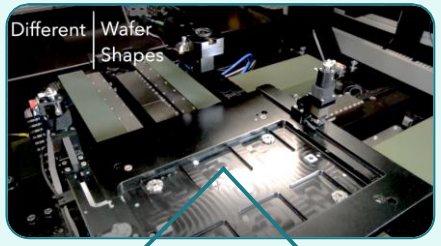


The systems uses aerostatic linear systems with **adjustable flat air bearings** and guideways overlaid by antiseizure material to avoid the risk of blocking the guideways in case of temporary and unexpected overloading. The **portal frame** is used for the application tooling and allows to **preserve the orthogonality of the system**.

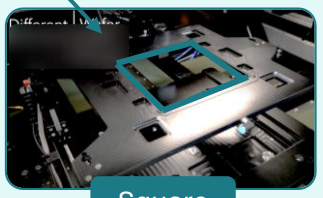
Feature	UM	X axis	Y Axis
Stroke	mm	400	
Maximum Speed	m/s	2	
Maximum Acceleration	m/s²	1.5	2
Position Repeatability	µm	±0.3	
Position Accuracy	µm/m	±5	
Orthogonality	arcsec	±30	

Chuck

The wafer handling system is than equipped with **pillars** and a **chuck** where the wafer can be loaded either **manually** or with a **wafer handler unit**. **The chuck design** can be **customized** to the specific **wafer layouts** and **test needs**. It is possible to measure wafers with diameters **up to 12”** and with **any shape**. Additional features like **automated wafer rotation, automated wafer warpage compensation or wafer retention systems** are all realized with the addition of elements **at chuck level**, so the **design of the chuck** really allows for **flexible and diverse implementations**.



Circle

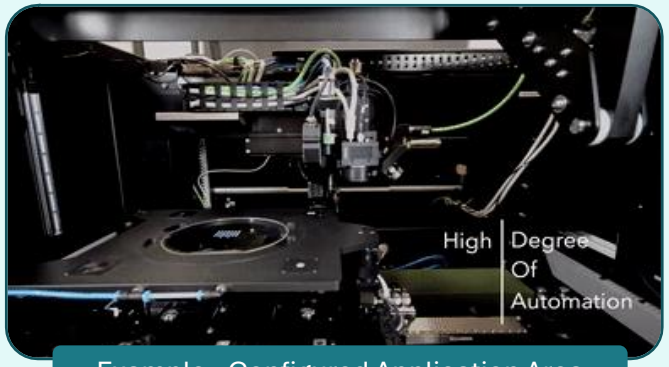


Square

Configurable Application

The portal frame is equipped with the instruments needed to carry out the test tasks. This configuration is dependent on the DUT, but it usually consists of two groups:

1. The **Upper-Group or Analysis Group** where analysis instrument like **industrial cameras, distance sensors, integrating sphere or steering mirrors** are mounted
2. The **Lower Group or Beam Shaper Group,** an **opto-mechanical system designed to produce on the DUT plane a light signal with specific characteristics** (i.e. **Intensity Profile**, **Spatial Correlation**, **Divergence**, **Spot Shape & Dimension**, **Wavelength**, ...).

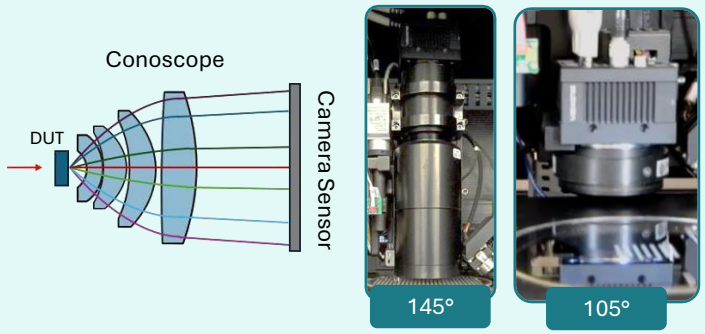


Example - Configured Application Area

WALOT™ : Application Area Configurations
Conoscopy Mode

One of the mode the tester can be configured into is the Conoscopy Mode. This setup allows to measure devices such as Diffractive Optical Elements (DOE) and Meta Optical Elements (MOE). These devices have often a large emission angle and thus require specialized optics to be tested.

Upper Group – Analysis Group



The Upper Group or Analysis Group is equipped with a **high-resolution camera** (50 MP) with a **large sensor** (diagonal 35 mm). A specialized optics called **conoscope** is mounted on the camera. This lens system has a **high acceptance angle** and produces an **angular map** of the light emitted by the device on the camera sensor. Alfamation offers **different conoscope designs** with **different fields of view** (from **105° to 145°**) and **different optical resolutions** (down to **0.3°**). The conoscope calibration and characterization is performed directly by Alfamation.

Lower Group – Beam Shaper Group

Alfamation provides different configuration of the Lower Group or Beam Shaper Group depending on the specification of the DUTs.

1. Usually, to test **DOEs,** a single **collimated beam** with a **well-defined spot size and shape** on the DUT plane is sufficient.
2. **MOEs** often combine the diffractive properties of a DOE with collimation, so in this case a **divergent beam with a specific numerical aperture** and **additional motorized linear stage to execute a focus scan** procedure are needed.
3. In the **final application**, these devices are usually combined with **VCSEL arrays**, so the beam shaper could be based off these devices too.

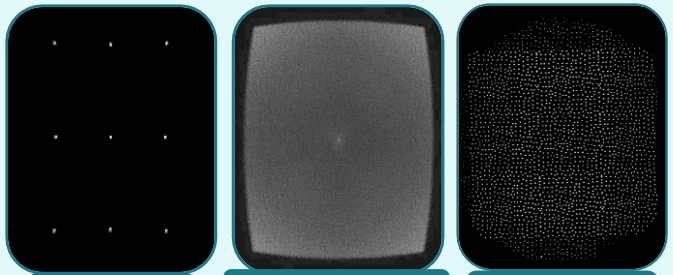
Example - Conoscope Images of different beam shapers

Collimated Beam Square Spot | VCSEL Array | Divergent Beam NA = 0.22

Performance

Test Metrics: Angular Distribution, Transmission Efficiency, Diffraction Efficiency, Uniformity
Speed: Up to **3000 UPH** (Units per hour)
Stability: Gage R&R < 10%

Example – Test Images on Conoscope

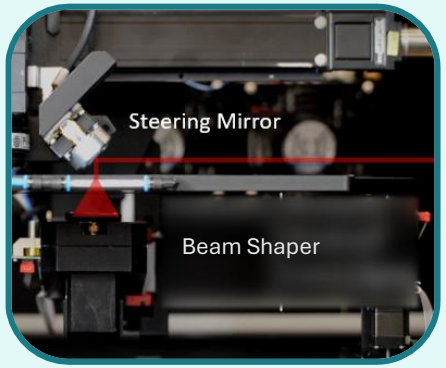


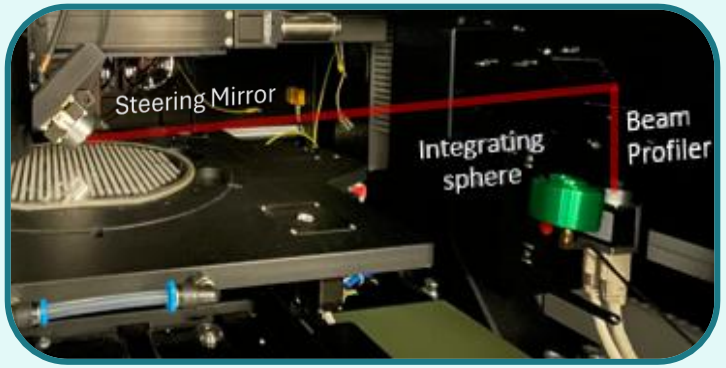
Dot Pattern Single Spot | Flood Illuminator | Dot Pattern VCSEL Array

WALOT™ : Application Area Configurations
Collimated Beam Profiling Mode

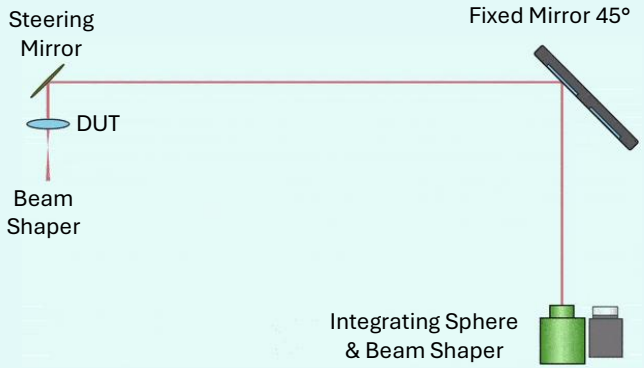
Another mode the tester can be configured into is the Collimated Beam Profiling Mode. This setup allows to measure collimation lenses such as the ones used combined with Diffractive Optical Elements (DOE). These devices usually require to test the collimation quality far from the DUT.

Upper Group – Analysis Group & Lower Group – Beam Shaper Group





The **Lower Group or Beam Shaper Group** is designed to illuminate the DUTs with a **divergent beam** with **tuneable numerical aperture**. It is completed by a **motorized linear stage** used to move the optical module and allowing to perform a **focus scan** on the devices. The **Upper Group or Analysis Group** is equipped with a **steering mirror**. Its function is to **deflect the beam towards the side instruments**, placed **far from the DUT** itself, at a **configurable distance**. This side instruments usually consist of a **beam profiler** and an **integrating sphere**, which are used to evaluate the collimation quality of the lenses. The steering mirror allows not only to switch the beam destination between the integrating sphere and the beam profiler, but it also allows to perform **off-axis measurements**, by compensating for the output angle of the collimation lenses.

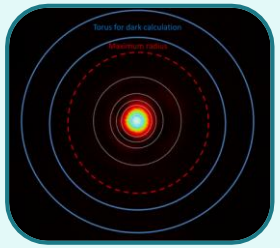


On Axis – Off Axis : Steering

Performance

Test Metrics: **Spot Size, Transmitted Power, Flange Focal Length, Effective Focal Length**
Speed: Up to **1500 UPH** (Units per hour)
Stability: **Gage R&R < 10%**

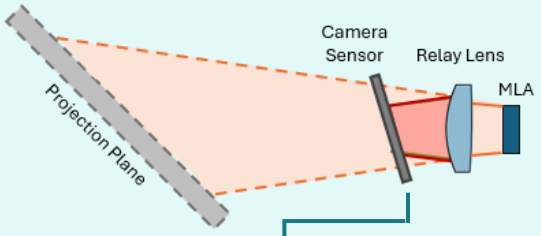
Example – Test Images on Beam Profiler



WALOT™ : Application Area Configurations
Light Pattern Projection Mode

The platform can be configured into the Light Pattern Projection Mode, allowing to test Micro Lens Arrays (MLAs), used for example for vehicle light projection. Due to the working distance and the dimension of the illuminated area of these devices, an optical relay system is used to keep the test environment compact.

Upper Group – Analysis Group



Projection on Camera Sensor

The Upper Group or Analysis Group is equipped with a **relay lens system**, which allows to project the DUT signal on a much closer and smaller target. This system is based on a **motorized wheel** which allows to switch between different lenses based on the test needs. The signal then gets to a **high-resolution camera** (50 MP) with a **large sensor** (diagonal 35 mm). The camera inclination and distance with respect the relay system are controlled through a **motorized system**. A proprietary **algorithm** is used to **transform** the image obtained on to the corresponding image on **the camera sensor** the **target projection plane**.

Lower Group – Beam Shaper Group

The Lower Group or Beam Shaper Group can be configured with multiple tools based on the specific device properties and test needs:

1. Usually, a system of **apertures swap** is used to **change the shape of the spot on the DUT plane**, based on the DUT dimension and orientation. It can be a **pneumatic switch** between a couple of different shapes, or a **motorized wheel** with multiple apertures.
2. These devices are usually tested in the **visible range**. **Fiber-coupled LED and optical couplers** are used to **switch between different wavelength** if needed.
3. The system can be designed to obtain **different intensity profiles on the DUT plane** (i.e. uniform, gaussian, ...)
4. The **divergence** of the signal can be **adjusted through a motorized tuning system**.

Square Spot – Uniform Intensity

Performance

Test Metrics: **Relative Brightness, Contrast\Gradient, Cross Talk\Ghost, Chromatic Aberration**
Speed: Up to **2800 UPH** (Units per hour)
Stability: **Gage R&R < 10%**

Example – Test Images

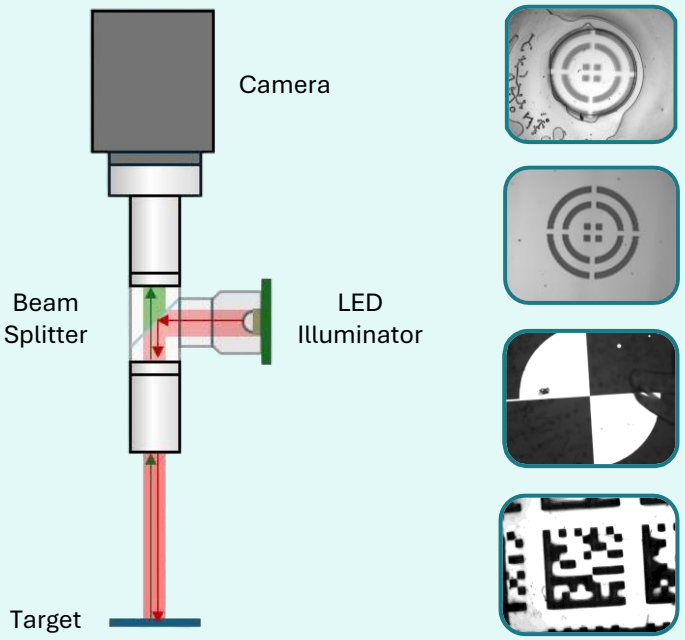
Pattern Image on Camera Sensor

Transformed Pattern Image on Projection Plane

WALOT™ : Features
Align on Fiducials and Position Management

The platform is equipped with a vision system which is for alignment purposes and eventually to read Barcodes\QR Codes\DMC and similar.

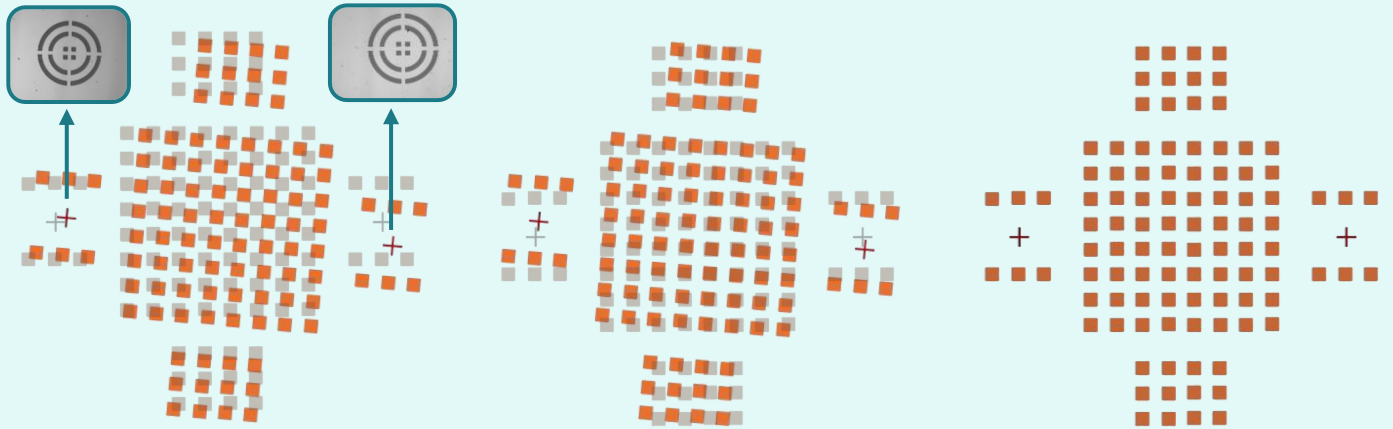
The vision system



The vision system employs a **COAX illumination system**. Usually, the illuminator is a red LED, but the choice of the wavelength might change according to the feature to be identified. The **field of view** of the system usually ranges from **5x4 to 7.5x6 mm**, with a **resolution** of **5-10 um**.

Align on Fiducials and Position Management

Once the wafer is loaded on the chuck, there is still room for **tolerance in its positioning**. That is why the system performs an **Align on Fiducials procedure** to compensate for this tolerances. The system can **automatically recognize the fiducials** though a pattern-match logic and new templates can be easily set by the users. By picking the positions of 2 fiducials it is possible to find out the residual translational offset and rotation offset with respect the nominal layout. The system will then apply a **roto-translational transformation** to all the positions in the layout and will **manage the movement on the DUTs autonomously**.



Offset + Rotation

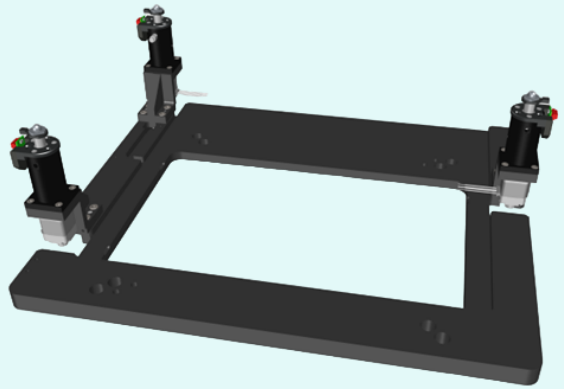
Rotation only

Corrected Layout

WALOT™ : Features
Wafer Warpage Compensation

Once manufactured, wafers usually show a **warpage**, which is **larger the thinnest and wider the wafer** is. The WALOT™ platform can be equipped with a **wafer compensation kit**, which allows to correct locally at each DUT the effect of the residual warpage.

Warpage Compensation Kit



Motorized Chuck Base

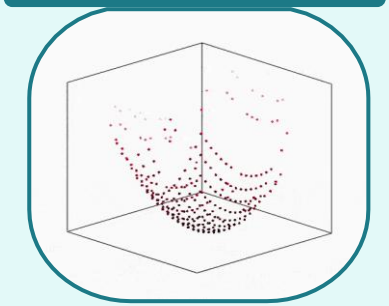
The wafer warpage compensation kit consists of **2 main additions**:

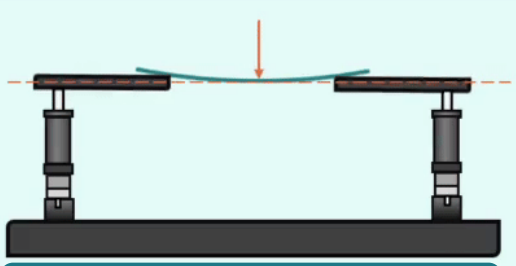
1. **Three linear actuators** replacing the fixed pillars where the chuck is placed. This **motorized chuck base** allows to **fully manipulate the wafer tilt**.
2. A **distance sensor used to characterize the wafer warpage**. The choice of the sensor depends on multiple factors ranging from the wafer material and coating to the trade-off of accuracy and costs.

Warpage Compensation Procedure

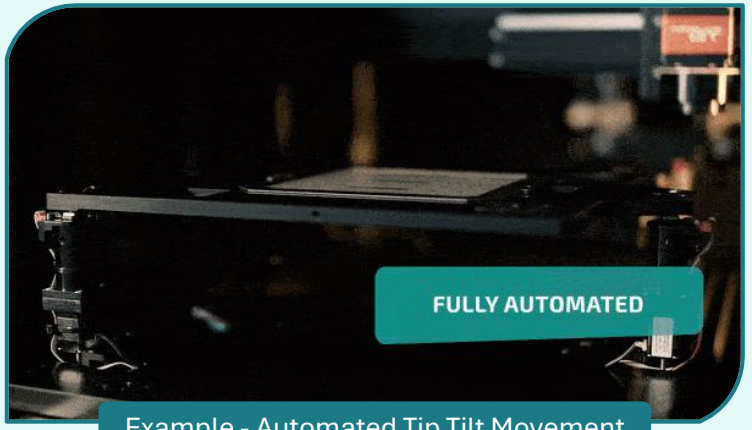
At the beginning of each run, the system performs a **scan of the wafer to characterize its warpage using a distance sensor**. The result is a layout of the wafer which maps the shape of its surface. Using an algorithm, the position of the three linear actuators of the motorized chuck base can be computed in order to **locally compensate for the wafer warpage at each DUT position**. The compensation is applied in such a way to locally **conserve the overall height of the sample**.

Warpage Characterization





Warpage Compensation – Sample Height Conservation



Example - Automated Tip Tilt Movement

WALOT™ : Features

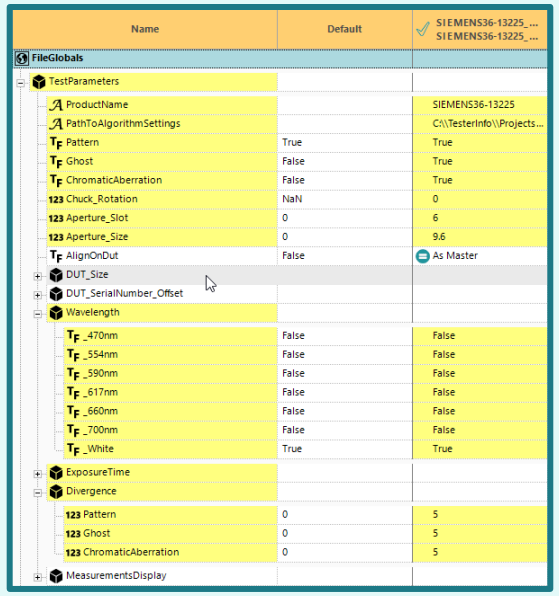
supernova™

Supernova™ is Alfamation' s test sequencer, based on NI TestStand. It provides full control over the test sequence, together with a user-friendly GUI and result management.

Configure the System

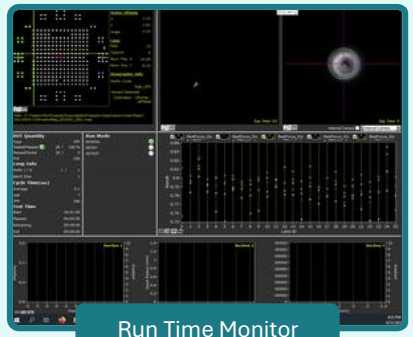
Supernova™ provides multiple tools to fully configure the test environment interface like **Multi-Language** and **Users privileges**. The system is divided in different environments, which allows for an intuitive and modular approach, making it possible to **adjust the test procedure to different kind of devices**. A **Service** environment is present, where debug, **calibration and maintenance** procedures are located. These semi-automatic procedure will **guide the operator step-by-step** with the support of images and examples. The **result management** is entirely integrated in the software, the results are logged on a local SQL database, but it also possible to log on remote location or to interface the system with MES.

Define different Test Variants

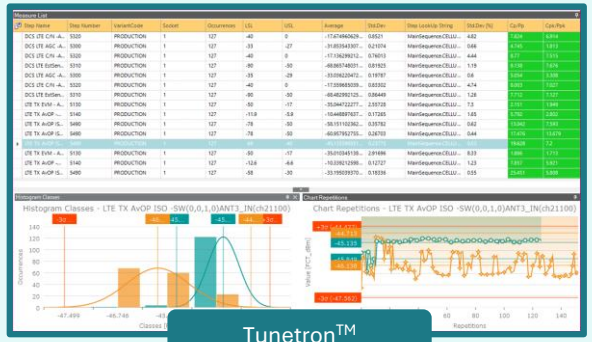


Supernova™ allows to define **different test variants** for different product needs. An intuitive Variants system is in place, allowing to **easily change key test parameters and steps**, giving the user the flexibility to test different devices on the same platform, without major retooling.

Run Tests and Analyse Results



Run Time Monitor



Tunetron™

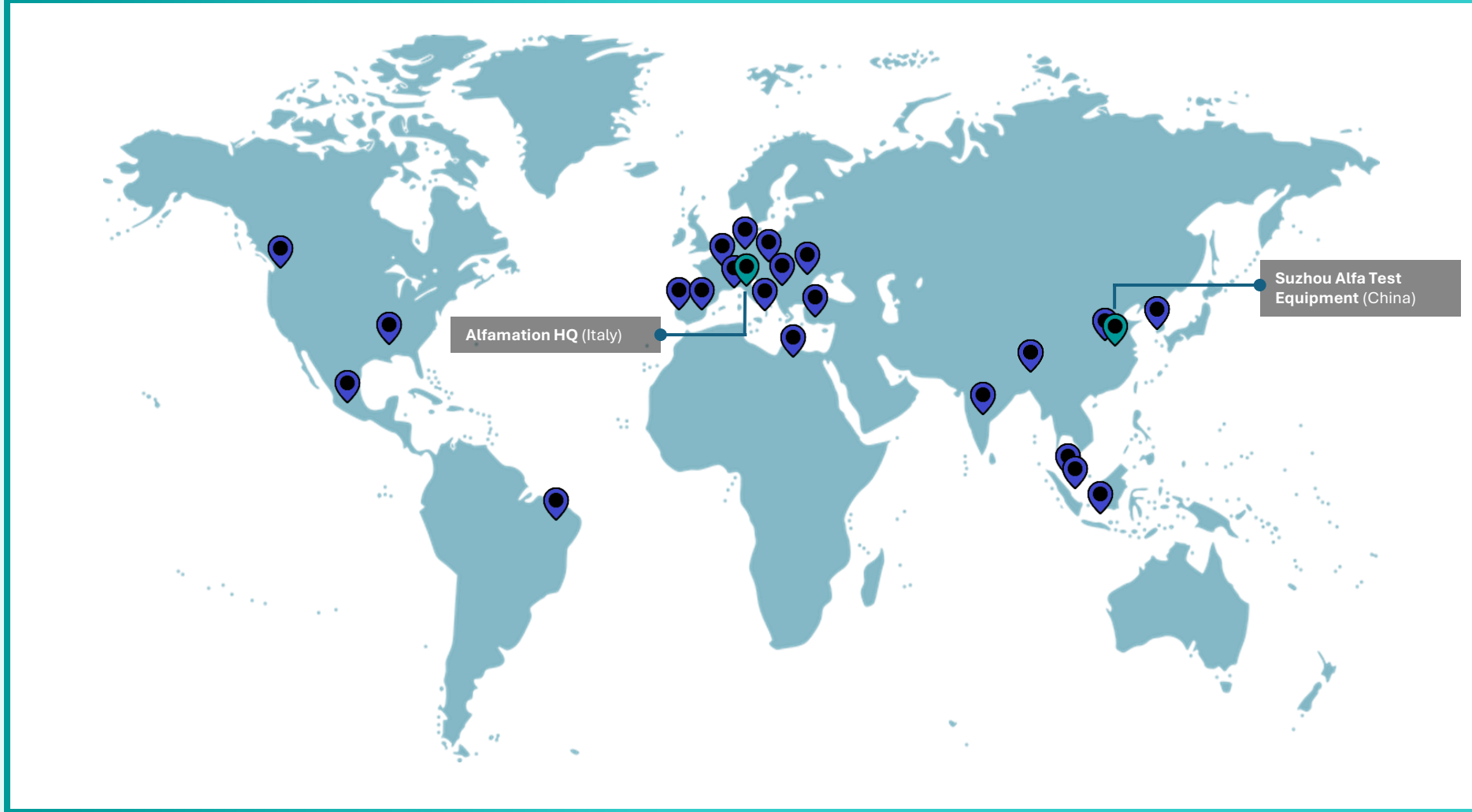
Supernova™ Test Run environment provides an intuitive interface for the user during the test run, showing results, graphs and images live. The results can be then easily analysed thanks to the **Tunetron™** add-on.

Since 2001 DNV ISO 9001 Certified
Since 2003 Certified Registered CSIA Member
Since 2014 Bureau Veritas ISO 9001 (Quality Management) Cert.
Since 2021 Bureau Veritas ISO 45001 (Occupational Health & Safety)
Since 2022 Bureau Veritas ISO 14001 (Environmental Mgmt.)
Since 2023 Bureau Veritas ISO 27001 (Cyber Security)

Install your System Worldwide

Alfamation has been installing test solutions worldwide for more than 30 years.

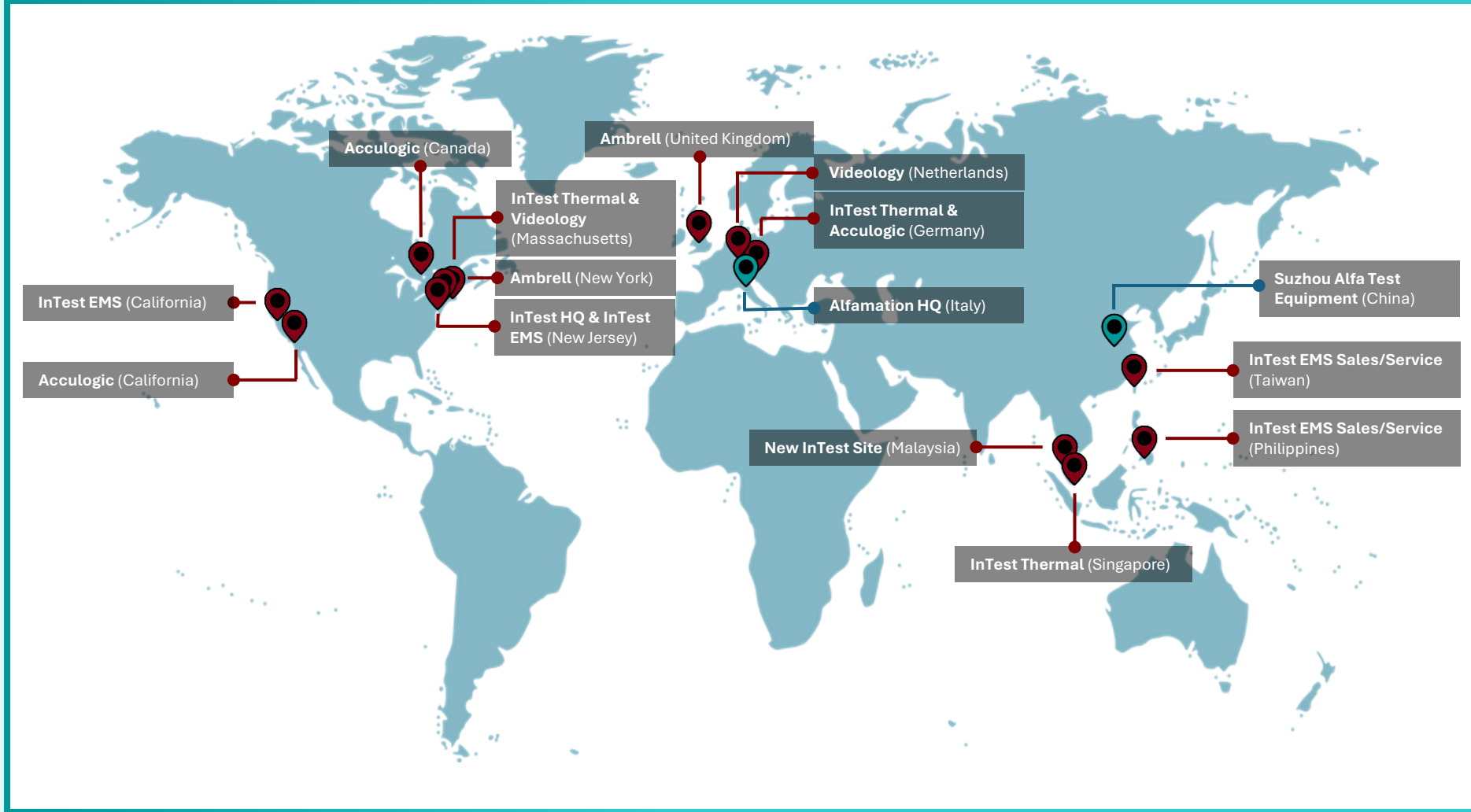
EMEA: France, Germany, Italy, Portugal, Poland, Czech R., Slovakia, Spain, Belgium, Hungary, Romania, Egypt
Americas: Brazil, Canada, Mexico, USA
Asia: China, HK, Indonesia, Malaysia, Singapore, Korea, Taiwan, Thailand



Get Support Everywhere

Alfamation has its HQ in Italy and can easily provide support around Europe. An additional office in Suzhou (China) provide service all over Asia.

As a part of InTest Corporation, Alfamation has also access to a network of support which ranges worldwide.



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