

Modular UV-Vis Spectroscopy: A Ground-breaking Approach to Diverse Application Needs

Agilent Cary 3500 UV-Vis spectrophotometer series
and Agilent UV Workstation software



Introduction

The concept of modularity in analytical chemistry instrumentation refers to a system design that allows various modules to be interconnected based on application needs. Modularity provides users with flexibility, efficiency, and scalability, and is especially useful in laboratories with evolving analytical or research needs. Agilent has implemented this beneficial design-approach to UV-Vis spectrophotometers.

The Agilent Cary 3500 UV-Vis spectrophotometer series shares a common UV-Vis engine that produces monochromatic light, which is then measured by the various UV-Vis sample measurement modules. The modules couple with the engine to provide measurement functionality for target applications, maximizing the adaptability and overall performance of the system.

As shown in Figure 1, the following modules can be connected to the common engine:

- The Cary 3500 Compact UV-Vis module for single sample measurements.
- The Cary 3500 Multicell UV-Vis module, which provides measurement solutions for cuvette-based applications.
- The Cary 3500 Flexible UV-Vis module, which provides measurements for liquid and solid samples and supports a range of accessories.

Agilent Cary 3500 UV-Vis spectrophotometers series



B



Cary 3500 Compact UV-Vis spectrophotometer*

The Cary Compact UV-Vis is designed for measuring a single sample and reference. It is available in either an ambient or temperature-controlled configuration.



Cary 3500 Multicell UV-Vis spectrophotometer**

The Cary 3500 Multicell UV-Vis is designed for measuring up to seven samples and a reference (or other combinations in the eight cell positions). It is available in either an ambient, temperature-controlled, or multiple-temperature-zone configuration.



Cary 3500 Flexible UV-Vis spectrophotometer

The Cary 3500 Flexible UV-Vis is designed for measuring a single sample and reference. It has a large sample compartment, in which liquid and solid samples can be measured.

*Compact ambient and temperature-controlled

** Multicell ambient, temperature-controlled or multiple-temperature-zone configuration

Figure 1. The Agilent Cary 3500 UV-Vis engine (A) and the three modules in the Cary 3500 UV-Vis spectrophotometer series (B).

Benefits of a modular-designed UV-Vis system

- **Scalability:** To future-proof against evolving industry or laboratory needs, modular instrument designs allow for enhanced scalability of the laboratory's analytical capabilities. Laboratories can expand the scope of UV-Vis applications by adding additional modules as required. This operation is easy to achieve with the smart modular design of the Cary 3500 UV-Vis.
- **Flexibility:** The modular design of the Cary 3500 allows the instrument to be optimized to suit specific applications or be adapted to evolving requirements or advancements in a field of study. Each module represents state-of-the-art analytical instrumentation. The Cary 3500 UV-Vis modules can be swapped quickly and reproducibly, enabling laboratories to analyze different types of samples efficiently.
- **Cost efficiency:** Laboratories can save costs by buying an instrument that shares a common engine and only buying the modules needed for their specific sample-types or study-objectives. All Cary 3500 UV-Vis configurations benefit from the powerful and advanced Xenon (Xe) flash lamp, which includes a 10-year replacement warranty.
- **Application-specific optimization:** Each module within the Cary 3500 spectrophotometer family is designed and optimized to deliver the best performance for specific applications. The modular design contributes to consistent and reliable instrument performance, leading to increased confidence in analytical data.

How does modularity work with the Cary 3500?

The Cary 3500 UV-Vis spectrophotometer series shares a common UV-Vis engine (Figure 2A). The modules (Figure 2B) are connected to the engine by engaging with the kinematic mounts located on the engine and secured using the module securing lever. This mechanical design ensures consistent light output, analytical accuracy, and stability, as the optics are aligned automatically.

Modules can be exchanged easily within a couple of seconds, maintaining high levels of productivity. Figure 2B shows the back view of the Cary 3500 Multicell UV-Vis module.

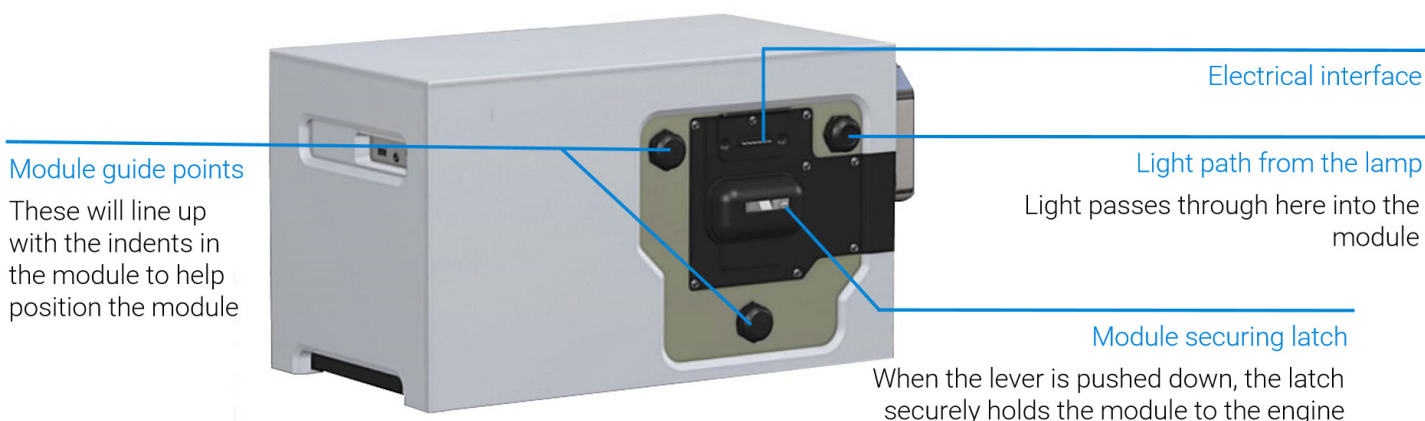
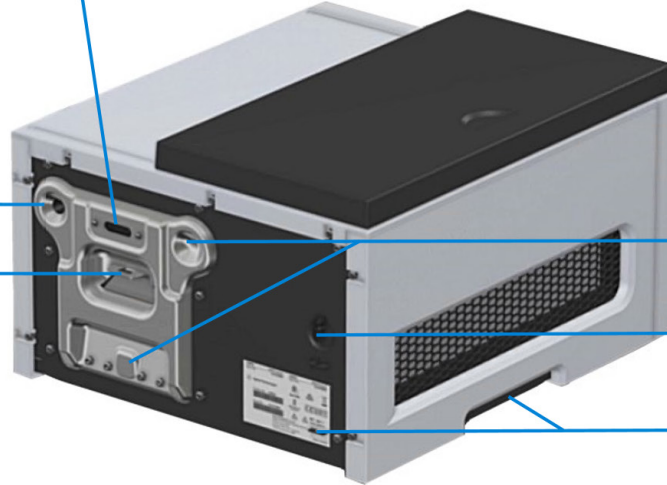


Figure 2A. Front view of the engine.

Electrical interface
Information is sent between the module and engine

Lightbeam entry port

Module securing latch



Module positioning indents

Purge inlet
Peltier modules only

Module label

The serial number is located here and on the left side (not shown) of the module

Figure 2B. Back view of the module.

Automatic calibration routine and self-tests

When an engine is connected to a module for the first time, a calibration is required to ensure the instrument's operational status and its ability to provide accurate and reliable measurements.

The **Agilent Cary UV Workstation software** that is used to control the Cary 3500 UV-Vis spectrophotometer series is integral to ensuring the operational reliability of the system. When a module is connected to an engine for the first time, the Cary UV Workstation guides the user to calibrate the system. Thereafter, the latest valid calibration for that engine and module combination will automatically be loaded by the software. The robust optical and mechanical design of the Cary 3500 UV-Vis spectrophotometer series helps in achieving this level of reliability.

To further ensure that the instrument is operational and providing accurate results, automated self-tests within the Cary UV Workstation software should be performed after calibration. These tests are designed to check all critical instrument components and provide the analyst with a high degree of confidence in the performance of the instrument.

After completion of the calibration and self-test routines, the results are saved into the Cary UV Workstation secured database. Clicking the result card will produce a report, which can be printed or saved for archival purposes. Examples of the calibration and self-test reports for the Cary 3500 Compact UV-Vis are shown in Figure 3.

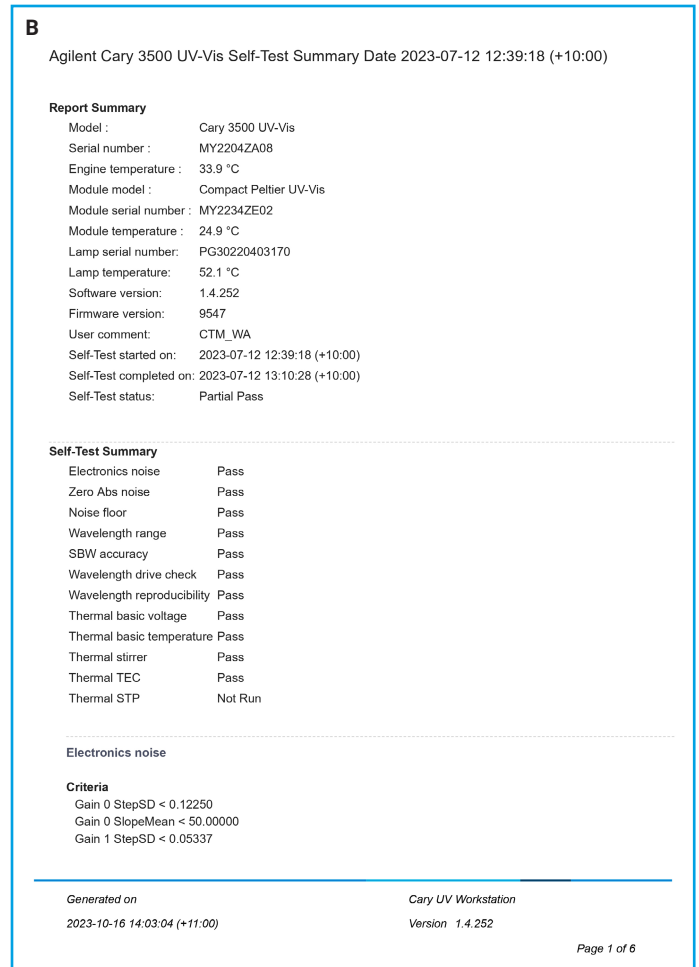


Figure 3. Calibration routine detailed report (A) and self-test detailed report (B).

Reconnecting a previously calibrated engine/module pair does not invalidate the calibration. The Cary Workstation software automatically retrieves and loads the previously performed calibration for the engine and module combination.

The Cary 3500 UV-Vis spectrophotometer calibration tests are categorized into engine and module-based tests. Only module-based tests vary with each module connection, while engine-based tests remain unchanged. The retrieval of module calibration upon reconnecting to a module demonstrates the flexibility and ease of configuring the Cary 3500 UV-Vis spectrophotometer series according to application needs.

Intuitive and secure software tailored for modular-design

The Cary UV Workstation software automatically identifies the Cary 3500 UV-Vis spectrophotometer configuration, i.e., the module that the engine is connected to. When opening a new batch or method, the software selects which module is being used and ensures that only a predefined method for the specific module will be run.

All Cary 3500 UV-Vis spectrophotometers are compatible with the optional Agilent OpenLab software suite. OpenLab software provides technical controls to securely acquire and store data in laboratories that must comply with FDA 21 CFR Part 11, EU Annex 11, GAMP5, ISO/IEC 17025, EPA 40 CFR Part 160, and similar regulations in other countries. These controls include access control and secure storage in a local or central database, electronic signature workflows, and an advanced audit trail review.

All the smart modular design benefits of the Cary 3500 series are available when the UV-Vis is configured with OpenLab software.

Improving laboratory sustainability

The Cary 3500 UV-Vis spectrophotometer series received My Green Lab's Accountability, Consistency, Transparency (ACT) label after an independent audit of its environmental impact throughout the product life cycle (Figure 4). The design of the Cary 3500 is optimized for productivity while reducing energy consumption, minimizing maintenance requirements, and reducing hazardous waste. All these factors combine to lower the cost-of-analysis and cost-of-ownership, making the system more economical and resource efficient.



Figure 4. My Green Lab's Accountability, Consistency, Transparency (ACT) label.

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Conclusion

The modular design of the Agilent Cary 3500 UV-Vis spectrophotometer series offers laboratories a number of benefits such as scalability, flexibility, and cost efficiency, as well as high analytical performance.

Depending on the sample type and analytical objectives, users can use three different modules with one engine. The intuitive Agilent Cary UV Workstation software automatically identifies which module has been connected to the engine, and automatically retrieves calibration logs for the module/engine pair.

The smart, modular design and sophisticated software remove the burden of performing optical alignment procedures and the time and effort to recalibrate the instrument each time a module is changed. Swapping modules is quick, simple, and easy, allowing users to address specific applications needs with tailored UV-Vis solutions.

Further information

[Cary 3500 Flexible UV-Vis Spectrophotometer](#)

[Cary 3500 Multicell UV-Vis Spectrophotometer](#)

[Cary 3500 Compact UV-Vis Spectrophotometer](#)

[Cary UV Workstation software](#)

[Data Integrity Options for GMP Facilities for the Agilent Cary 3500 UV-Vis Spectrophotometer Series](#)

[UV-Vis Spectroscopy and Spectrophotometer FAQs](#)