# CLARIOstar®

High performance **Microplate Reader** with
**advanced LVF Monochromators**™

**BMG LABTECH**

*The Microplate Reader Company*

# CLARIOstar®

## The most sensitive monochromator-based microplate reader

### Triple technology

The CLARIOstar is a multi-mode, high-performance microplate reader with a revolutionary new type of dual monochromator technology. The advanced LVF Monochromators™, along with filters and a spectrometer, can be used for a variety of applications in the different detection modes.

The following three detection technologies guarantee that the CLARIOstar does not compromise on sensitivity or flexibility:

- **LVF Monochromators** offer the best flexibility
- **Spectrometer** provides the fastest spectra
- **Filters** ensure the greatest sensitivity

### Modular, upgradable microplate reader

The CLARIOstar is a modular, upgradable microplate reader that can fit the current and future needs of all laboratories and core facilities. It performs all of the leading non-isotopic detection technologies, including:

- UV/Vis Absorbance
- Fluorescence Intensity, including FRET
- Fluorescence Polarization/Anisotropy
- Time-Resolved Fluorescence, including TR-FRET
- AlphaScreen® / AlphaLISA® / AlphaPlex™
- Luminescence (flash and glow), including BRET



*A linear variable long pass filter slide (shown) is one of many specialized components that make up the CLARIOstar's sophisticated LVF Monochromator system.*

## LVF Monochromator™ technology

With the CLARIOstar, BMG LABTECH introduces a revolutionary new type of dual monochromator technology for fluorescence and luminescence measurements. The LVF Monochromators are based on Linear Variable Filters, which have variable coatings along their lengths that can reject or pass certain wavelengths of light. A linear variable filter consists of two slides, a linear variable long pass and a linear variable short pass, that when properly aligned separate light into distinct wavelengths and continuously adjustable bandwidths.
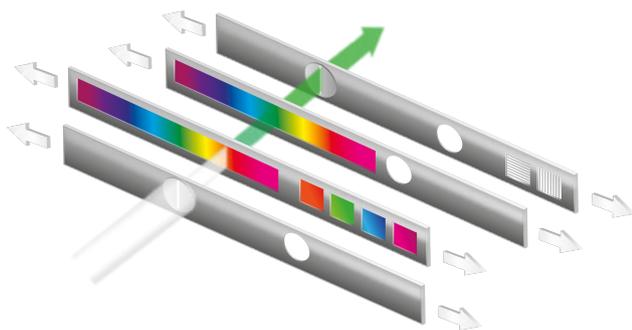


*Simplified schematic of the CLARIOstar's LVF Monochromator.*

The CLARIOstar contains two LVF Monochromators, one for excitation and one for emission. In addition, a Linear Variable Dichroic mirror (340 - 740 nm) separates the two LVF Monochromators.

## Greater sensitivity

Since LVF Monochromators separate light differently than conventional monochromators, they provide significantly higher sensitivity for several reasons:

- **No stray light**
  The LVF Monochromator design avoids stray light that occurs with conventional monochromators. Avoiding stray light decreases the background signal and significantly increases sensitivity.

- **More light with adjustable bandwidths up to 100 nm**
  The LVF Monochromators have unique continuously adjustable bandwidths from 8 to 100 nm. Larger bandwidths allow more light for excitation and emission, which means greater sensitivity.

- **Less background signal with a Linear Variable Dichroic**
  The Linear Variable Dichroic mirror separates the excitation from the emission light. This greatly reduces the background signal.

## Greater flexibility

Top and bottom reading for fluorescence and luminescence assays can be done with monochromators or filters. The CLARIOstar's inline optical system can also combine a monochromator with a filter. For instance, an excitation filter can be used with the emission LVF Monochromator. This gives the CLARIOstar unsurpassed flexibility for your research.

## Superior spectral scanning

Spectral scanning is possible in both fluorescence and luminescence modes with the LVF Monochromators. Whether developing an assay with a new fluorophore or modifying an assay with an existing one, it is important to verify the optimal peaks and bandwidths for excitation and emission with spectral scanning in order to obtain the best results.

## Dynamic luminescence detection

Luminescence assays such as flash, glow, dual glow, and BRET are some of the most commonly measured assays on a microplate reader. With the CLARIOstar's high performance luminescence mode and nine log dynamic range, there is no compromise in luminescence assay performance.

Additionally, the LVF Monochromator or filters can be used for luminescence measurements. The LVF Monochromator with adjustable bandwidths up to 100 nm is sensitive enough to read dual color luminescence signals at concentrations not possible with conventional monochromators.

## Exceptional performance in FP, TR-FRET, and AlphaScreen®

For fluorescence polarization (FP), time-resolved fluorescence (TRF and TR-FRET), and AlphaScreen® / AlphaLISA® assays, the CLARIOstar uses specialized components that guarantee exceptional performance without compromise in these assays.

☐ **Fluorescence Polarization**

The unique optical design and instant polarizer switching on the CLARIOstar provides the smallest mP standard deviation in fluorescence polarization assays, making the CLARIOstar the world's best FP reader.

☐ **TR-FRET including HTRF®**

The CLARIOstar has been certified to measure HTRF® assays in black and white microplates. The ability to use black microplates, which most readers cannot use, guarantees that the CLARIOstar never compromises on any HTRF® assay.

☐ **AlphaScreen® / AlphaLISA® / AlphaPlex™**

A dedicated laser and specialized optics ensure the best performance for Alpha Technology on the CLARIOstar with respect to speed, assay window, and sensitivity.
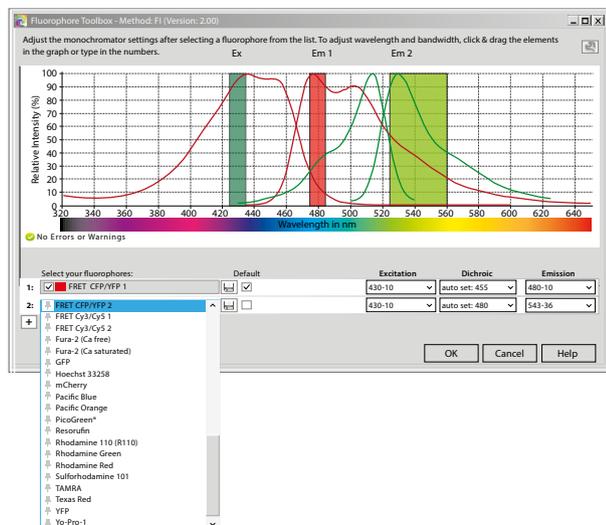


*Filter visualization tool with integrated fluorophore and lumiphore library.*

## Integrated fluorophore library

To greatly simplify and improve assay setup, a library of spectra for the most common fluorophores and lumiphores is integrated into the CLARIOstar's filter visualization tool. Users can measure assays with the recommended settings, or simply "Drag & Drop" new settings for wavelengths and bandwidths.

## Ultra-fast UV/Vis absorbance spectra

For ultra-fast, full spectrum absorbance measurements, the CLARIOstar employs a spectrometer. This technology can capture a full UV / Vis absorbance spectrum (220 to 1000 nm) at selectable resolutions (1 to 10 nm) in less than 1 second per well. Fast, full spectrum absorbance will improve all colorimetric assays. Furthermore, users can capture up to eight discrete wavelengths simultaneously in a single measurement with no wavelength switching.
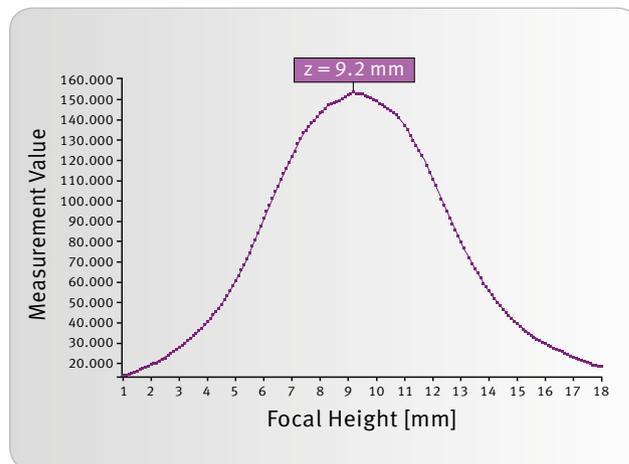


*Automated focal height adjustment ensures the best signal-to-noise ratio in all detection modes, all plate formats, and all volumes.*

## Focal height adjustment

The CLARIOstar incorporates automated focal height adjustment for both top and bottom reading at a resolution of 0.1 mm. The optical system directs the excitation light to a small focal point in the center of the well, giving excellent sensitivity in all plate formats up to 1536 wells.

This feature eliminates the influence of microplate formats, sample volumes, surface tension, and evaporation. The automated focal height adjustment ensures the best signal-to-noise ratio for every plate, every volume, and every application.

## Cell-based assays

The CLARIOstar has several key features that improve cell-based applications, including:

- ☐ **Advanced cell layer scanning** allows multiple points to be measured in each well. The software displays each scan point graphically creating a map for each well. This is the perfect feature for adherent cells that are not distributed evenly in the well.
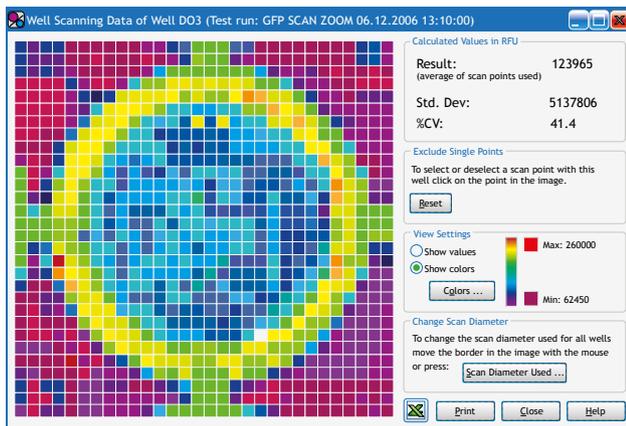


*Well scanning using a 30 x 30 matrix with 900 points/well resolution.*

- ☐ **Direct optic bottom reading** is an innovative design using lenses and mirrors to direct light to the microplate bottom, thereby eliminating the use of inefficient fiber optics. This feature significantly improves fluorescent protein detection in cell-based assays.

- ☐ **On-board reagent injectors** deliver precise volumes to stimulate cell-based assays or to initiate kinetic and enzymatic reactions. Delivery volumes are adjustable for each well, allowing users to automatically produce dilution schemes and gradients across the microplate.

- ☐ **The Atmospheric Control Unit (ACU)** is a module for independent control of both $O_2$ and $CO_2$ within the microplate chamber. The ACU is able to regulate $O_2$ from 0.1 - 20 % and $CO_2$ from 0.1 - 20 %.

  Applications include:
  Hypoxia · Migration and Invasion Studies · Proliferation and Cell Viability · Intracellular pH · Bacterial Growth Studies · Angiogenesis · Viral Uptake · Ischemia/Reperfusion, and more.



*ACU perfectly regulates both $O_2$ and $CO_2$ for all cell-based assays.*

| Specifications for Atmospheric Control Unit | |
|---|---|
| **$O_2$ Control** | Range: 0.1 – 20 %<br>Control: ± 0.1 %<br>Sensor: Low drift, long lifetime |
| **$CO_2$ Control** | Range: 0.1 – 20 %<br>Control: ± 0.1 %<br>Sensor: Low drift, long lifetime |

## Microplate Stacker and automation

For medium level throughput, BMG LABTECH offers a Stacker that can be used with the CLARIOstar. The Stacker is an ideal solution for mid-throughput labs that wish to have the small footprint of an automated plate feeder. It provides loading, unloading, restacking, and a continuous load feature for up to 50 microplates.

For higher throughput, the CLARIOstar's small footprint and integrated software allow it to be easily automated with all of the leading robotic platforms.

## Control and MARS data analysis software

BMG LABTECH's well-established Control Software runs the CLARIOstar microplate reader, while data are analyzed with the MARS Data Analysis Software. Both softwares are fully compliant with FDA regulation 21 CFR Part 11 and can be used on multiple PC systems at no extra cost.



*Colour-code visualization of HDAC proof-of-concept screening results achieved by setting limits in the MARS software.*

The Control Software allows users to easily define instrument parameters and protocols. With the new upgradable fluorophore library of spectra, users can easily and precisely optimize the CLARIOstar for the fluorophore or lumiphore in their assay.

MARS Data Analysis Software allows users to quickly view and analyze data. MARS is able to perform a variety of simple and diverse mathematical calculations. Features include:

- Averaging, blanking, %CVs, and other statistics
- Standard curve fits, e.g. linear and segmental regression, 4- and 5-parameter, exponential
- Enzyme kinetics like $V_{max}$ or $K_m$ from Michaelis-Menten, Lineweaver-Burk, or Scatchard Plots
- Predefined templates automatically perform assay-specific calculations
- Equation generator for unique calculations
- S:N, S:B, and Z' factor calculations

## Applications center

A perfectly engineered instrument is only part of the solution, it needs to effectively perform all of the leading applications. With the CLARIOstar, BMG LABTECH offers a sensitive and flexible instrument that supports all existing and future applications, including:

- DNA, RNA, and protein quantification
- Cell based assays
- Enzyme activity and kinetic assays
- Genotyping
- Reporter gene assays
- Protein-protein interactions
- Molecular binding assays
- And much more ...

Here are a few example applications:
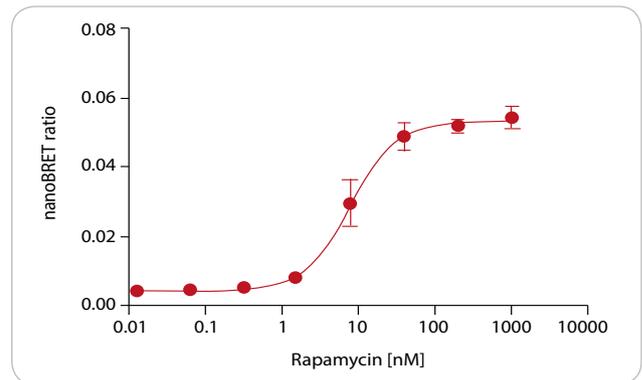


*Rapamycin-induced protein dimerization assay between FKBP and FRB monitored by nanoBRET*
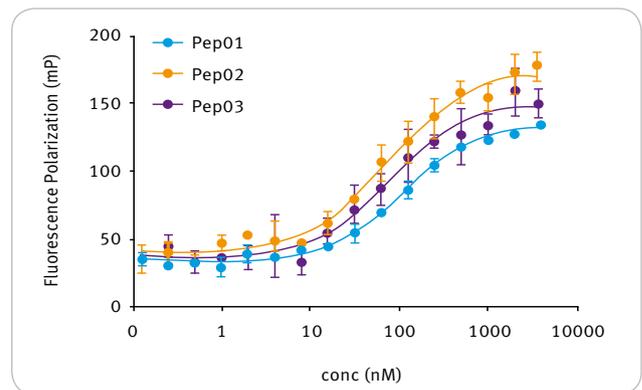


*Direct binding assay for LC1 and H3-derived peptides. In blue (pep01) H3 tail, 21 aa, methyl-Lys. In orange (pep02) H3 tail, 21 aa, K4M. In purple (pep03) SNAIL short peptide, 12 aa. Different amplitudes in the curves might be due to different protein-ligand conformations in solution.*
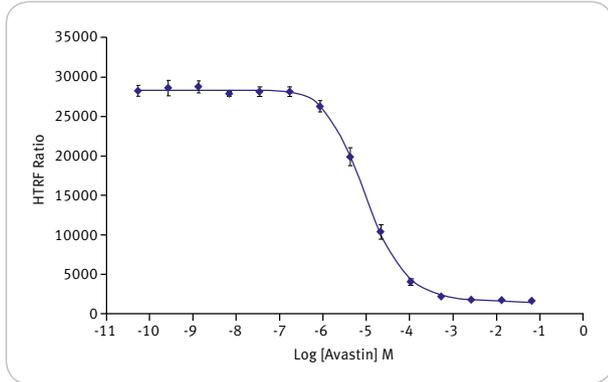
*CD 64 variant of Cisbio's CD 16a HTRF cellular assay.*

BMG LABTECH continuously works with all of the leading reagent companies to optimize settings for their assays.



Visit BMG LABTECH's Applications Center online to find references to all applications, listed as:

- □ Application notes
- □ Application focus
- □ Peer-reviewed papers

Our comprehensive searchable applications database reflects more than 25 years of expertise and innovations. Over 4000 published entries of peer-reviewed articles, and application notes demonstrate the flexibility and versatility of our readers, and their use in chemical and biological sciences.

## Support and training

BMG LABTECH operates globally through an extensive network of subsidiaries and trained distributors. Customers can rely on Ph.D. level support and assistance with regard to software, assay development, or general enquiries related to the CLARIOstar and all other BMG LABTECH microplate reading solutions.

Transcreener®
FRET assays
Binding studies
DNA/RNA quantifications
AlphaPlex™ technology    HTRF®
DLR™    AlphaTechnology
Protease activity    Kinase activity    SNP Genotyping
LanthaScreen®
Apoptosis    ORAC
HTS    Enzyme activity
Immunoprecipitation    Dual luciferase assays
Protein quantifications    BRET assays
Enzyme kinetics    ROS detection
Cell Viability    PCR product quantifications
NADH / NADPH assays    DELFIA®
LANCE®    Solubility tests
ATP and ADP detection
Gene expression    ELISA
Reporter gene assays

# CLARIOstar® - Technical specifications

**BMG LABTECH**

Due to the modularity of the CLARIOstar, all or a combination of the features can be installed at purchase. Most features can be upgraded at a later date. Please contact your local representative for more details or a quote.

| | | | |
|---|---|---|---|
| **Detection modes** | Fluorescence Intensity - including FRET<br>Luminescence (flash and glow) - including BRET<br>UV/Vis Absorbance<br>Fluorescence Polarization / Anisotropy<br>Time-Resolved Fluorescence - including TR-FRET<br>AlphaScreen® / AlphaLISA® / AlphaPlex™ | | |
| **Measurement modes** | Top and Bottom reading<br>Endpoint and Kinetic measurements<br>Spectral Scanning (Fluorescence, Luminescence and Absorbance)<br>Well Scanning | | |
| **Microplate formats** | 6- to 1536-well plates, LVis Plate with 16 microspots (2 µL) | | |
| **Light sources** | High energy xenon flash lamp<br>Dedicated laser for AlphaScreen® / AlphaLISA® / AlphaPlex™ | | |
| **Detectors** | Low noise Photomultiplier Tube (PMT)<br>UV/Vis Absorbance Spectrometer | | |
| **Dual LVF Monochromator™** | Fluorescence, Luminescence: Top and Bottom<br>Fluorescence Excitation / Emission Spectral Scanning<br>Luminescence Emission Spectral Scanning<br>Spectral Range: 320 - 850 nm (selectable increments from 0.1 to 10 nm)<br>Software Selectable Bandwidths: 8 - 100 nm | | |
| **Linear Variable Dichroic Mirror** | Spectral Range: 340 - 740 nm (selectable increments of 0.1 nm) | | |
| **UV/Vis absorbance spectrometer** | Spectral Scanning or up to 8 discrete wavelengths in less than 1 sec / well<br>Spectral Range: 220 - 1000 nm (selectable increments from 1 to 10 nm)<br>Bandwidth: 3 nm | | |
| **Optical filters** | Top and Bottom for all detection modes, except absorbance<br>Up to 4 excitation filters, 4 emission filters, and 3 dichroic mirrors<br>Spectral Range: 240 - 900 nm | | |
| **Sensitivity*** | FI<br>LVF Monochromator | Top:      < 0.35 pM fluorescein, 384sv, 20 µL (< 7 amol/well)<br>Bottom: < 3.0 pM fluorescein, 384, 50 µL (< 150 amol/well) | |
| | FI<br>Filters | Top:      < 0.15 pM fluorescein, 384sv, 20 µL (< 3 amol/well)<br>Bottom: < 1.0 pM fluorescein, 384, 50 µL (< 50 amol/well) | |
| | FP | < 0.5 mP SD at 1 nM fluorescein, 384sv, 20 µL | |
| | TRF | < 20 fM europium, 384, 80 µL | |
| | HTRF® | HTRF® certified for black and white microplates<br>Reader Control Kit (Eu) after 18h incubation, 384sv, 20 µL<br>> 880 % Delta F for High Calibrator<br>>   30 % Delta F for Low Calibrator<br><  2.0 % CV for Standard 0 | |
| | LUM | < 0.4 pM ATP, 384sv, 20 µL (< 8 amol/well)<br>Dynamic Range: 9 decades | |
| | AlphaScreen® | < 100 amol/well P-Tyr100 (384sv, 20 µL) | |
| | ABS with Spectrometer | Accuracy: < 1% at 2 OD<br>Precision: < 0.5% at 1 OD and < 0.8% at 2 OD<br>Dynamic Range: 0 - 4 OD | |
| **Read times** | 1 flash:      8 s (96)     15 s (384)     28 s (1536)<br>10 flashes:  19s (96)     57 s (384)     184 s (1536) | | |
| **Reagent injection** | Up to 2 built-in reagent injectors with reagent back flushing<br>Individual injection volumes for each well 3 to 500 µL (optional up to 2 mL)<br>Variable injection speed up to 420 µL/s | | |
| **Shaking** | Linear, orbital, and double-orbital with user-definable time and speed | | |
| **Incubation** | +3°C above ambient to 45°C (65°C optional) | | |
| **Software** | Integrated fluorophore library<br>Multi-user software package including Reader Control and<br>MARS Data Analysis Software, FDA 21 CFR Part 11 compliant | | |
| **Dimensions** | Width: 45 cm, depth: 51 cm, height: 40 cm; weight: 32 kg | | |
| | **Accessories** | | |
| **ACU** | Actively regulates $O_2$ and $CO_2$: 0.1 - 20% | | |
| **LVis Plate** | Measure 16 low-volume samples (2 µL) and QC standards | | |
| **Stacker** | Magazines for up to 50 plates - continuous loading feature | | |

**www.bmglabtech.com**

Made in Germany

BMG LABTECH's LVF Monochromator includes technology covered under US Patent 6,700,690, for which BMG LABTECH has an exclusive license for the microplate reader market.
*Limit of detection (sensitivity) was calculated according to the IUPAC standard: $3 \times (SD_{blank}) / slope$
Specifications are subject to change without notice.