

CLARIOstar® Plus

High performance Microplate Reader with
Enhanced Dynamic Range




BMG LABTECH
The Microplate Reader Company



Monochromator. Perfected.

The new addition to your lab

The new CLARIOstar *Plus* is a high-performance microplate reader that fits the current and future needs of your laboratory, whether in academia, a core facility, biotech or pharma.

This multi-mode reader builds upon the success of the CLARIOstar and introduces new features including the **Enhanced Dynamic Range** technology that will help simplify your workflow in the lab.

The instrument is upgradable and can be equipped with all the leading non-isotopic detection technologies:

- UV/vis absorbance
- Fluorescence intensity, including FRET
- Luminescence (flash and glow), including BRET
- Fluorescence polarization/anisotropy
- Time-resolved fluorescence, including TR-FRET
- AlphaScreen® / AlphaLISA® / AlphaPlex™

Ideal for the following applications

Assay development	Reporter gene analysis
Real-time cell-based assays	Enzymatic reactions
Signalling	Drug discovery
Protein-protein interaction	Metabolism
Fast kinetics	DNA/RNA quantification
Cell/bacterial growth	Aggregation studies

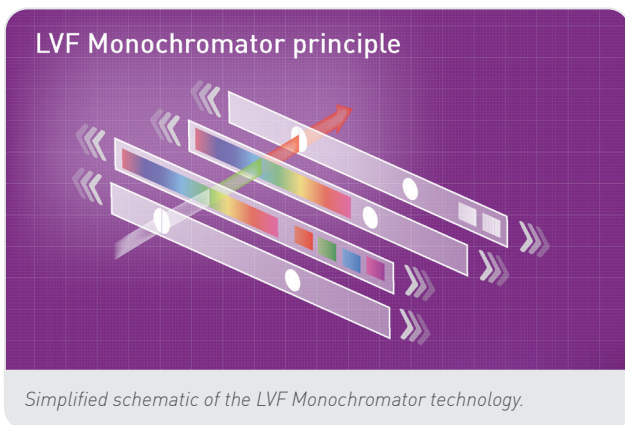
Equipped with our patented LVF Monochromators™, it combines at no compromise the sensitivity of filters with the flexibility of monochromators.

The following detection technologies guarantee the best performance in any assay:

- **LVF Monochromators** for the best flexibility and sensitivity in fluorescence intensity (incl. FRET), and flash/glow luminescence (incl. BRET)
- **Filters** for the greatest sensitivity in all fluorescence- and luminescence-based detection modes
- **Spectrometer** for the fastest UV/vis absorbance spectra

Game-changing technology

Our monochromators are based on Linear Variable Filters (LVF), special filters that vary spectral properties over their length, transmitting or blocking specific wavelengths at different positions. LVFs eliminate the need for concave gratings employed in conventional monochromators to separate and mechanically select coloured light. An LVF Monochromator consists of two aligned LVF slides that separate light into distinct wavelengths and continuously adjustable bandwidths. The CLARIOstar *Plus* is equipped with two LVF Monochromators, one for excitation and one for emission. A unique Linear Variable Dichroic mirror separates excitation and emission light.



Sensitivity and flexibility

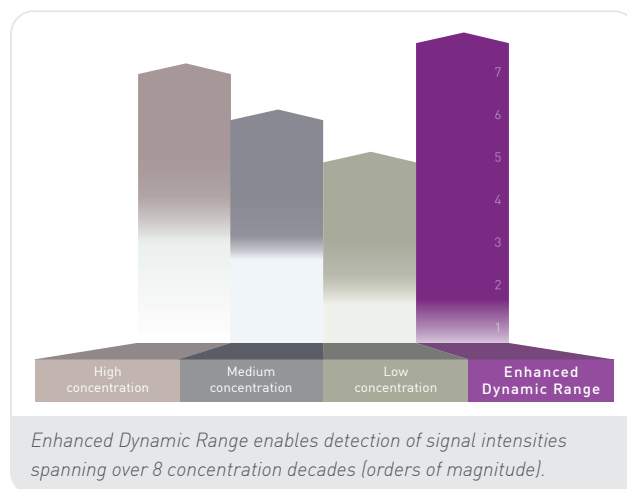
Several features of the CLARIOstar^{Plus} and the patented LVF Monochromator ensure significantly higher sensitivity and flexibility compared to conventional grating-based monochromator readers.

- **Filter-like performance:** LVF Monochromators benefit from a higher light transmission than conventional ones, as LVF slides have the same light transmitting properties as optical filters. Better light transmission results in higher sensitivity and less variability.
- **Linear Variable Dichroic mirror:** this unique feature is automatically tuned to provide the best characteristics to efficiently separate the excitation from the emission light, significantly reducing background noise.
- **Less noise:** the innovative design of our LVF Monochromators avoids the stray light that occurs with conventional monochromators, hence decreasing the background signal and significantly increasing performance.
- **Uniquely adjustable bandwidths from 8 to 100 nm** ensure better performance. Larger bandwidths yield more light for excitation and emission, and hence increase sensitivity.
- **Combine filters and monochromators** in one measurement. Thanks to its optic design, you can excite with a filter and scan the emission spectrum, or vice versa.

Simplify your assay setup

New technology on the CLARIOstar^{Plus} makes detection optimization simpler than it has ever been.

Thanks to the **Enhanced Dynamic Range (EDR)** technology and rapid, full-plate autofocus, every sample on your plate is automatically measured with the ideal settings without any action prior to the start of measurement. New users will be able to easily get started, while experienced users will get better data, more quickly.



You cannot always predict the signal intensity of your experimental samples. Different samples may display a large variability of signal intensities, from dim to very bright, spanning over multiple orders of magnitude. Especially in enzymatic or cell-based kinetic analysis, the signal variation can highly diverge over time. Applying the largest possible dynamic range is highly beneficial as it provides more sensitivity, flexibility, and more accurate results across your plate as both very high and very low signals can be acquired within the same run. EDR technology grants a dynamic range spanning over 8 concentration decades in a single measurement. It can be applied to any wavelength in fluorescence intensity and luminescence, both with filters and LVF Monochromators.

EDR significantly simplifies measurement setup and provides an easier solution for assay development. It ensures reliable detection of samples at a large range of concentrations and signal intensities with no manual intervention.

Moreover, this feature saves you time and money as it eliminates the need for repeated detection runs to acquire

highly divergent samples at different gain settings. It also allows to compare data acquired with the same assay kit or protocol but at different times to each other.

Focus on your samples

Identifying the well height at which the sample signal is at its highest and focus the detection optics on it is highly beneficial. The CLARIOstar^{Plus} incorporates a rapid, full-plate auto-focus, giving excellent sensitivity for both top and bottom reading in all plate formats up to 1536 wells. Combined with EDR, auto-focus makes detection easier and improves data quality. Using the best settings for each well results in a better assay window, lower standard deviations among replicates, and reduced blank measurements.

Flexibility in detection

The reader comes equipped with a standard low-noise PMT detector for fluorescence and luminescence modes. Users who need the very best performance in far-red fluorescent detection can benefit from a red-sensitive PMT. The use of a dedicated detector for luminescence and AlphaScreen provides the option to measure with the most sensitive PMT for your detection mode without compromise.

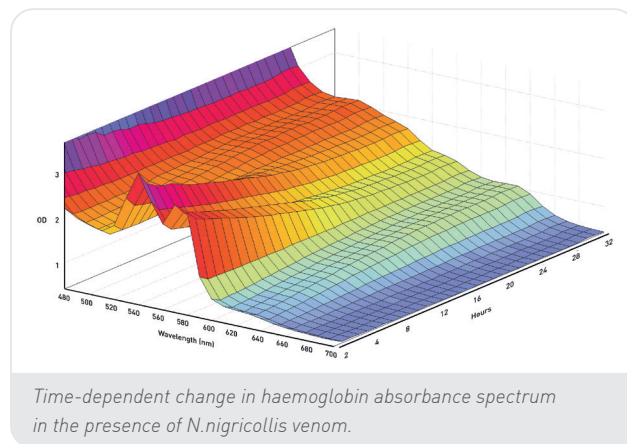
Dynamic luminescence detection

Luminescence assays such as flash, glow, dual glow, and BRET are some of the most commonly measured assays on a plate reader. On the CLARIOstar^{Plus}, both LVF Monochromators and filters can be used for luminescence detection. LVF Monochromators can acquire spectral scans of luminophores, and with adjustable bandwidths up to 100 nm, are sensitive enough to read dual-colour luminescence including BRET, without the need of filters.

Ultra-fast UV/vis absorbance spectra

Why would you measure only a single wavelength if you could acquire a full spectrum in the same time? Full-spectrum detection improves many absorbance assays as it can highlight shifting peaks or the presence of contaminants. Our spectrometer can capture a full 220 to 1000 nm absorbance spectrum at 1 to 10 nm

selectable resolutions in less than 1 second per well. Alternatively, up to eight discrete wavelengths can be captured in a single measurement at the same speed.



Advanced detection modes

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

- **Fluorescence polarization:** the CLARIOstar^{Plus} is the best fluorescence polarization plate reader on the market. Its unique optical design and instant polarizer switching provide the smallest mP standard deviation in any assay.
- **High-end TR-FRET/HTRF® performance:** certified to measure HTRF® assays in both black or white plates, the reader guarantees no compromises in any HTRF assay. The ability to measure HTRF in black plates is only prerogative of the most sensitive readers.
- **AlphaScreen®/AlphaLISA®/AlphaPlex™:** a dedicated excitation laser and specialized detection optics ensure the best assay window, speed, and sensitivity.

Cell-based assays

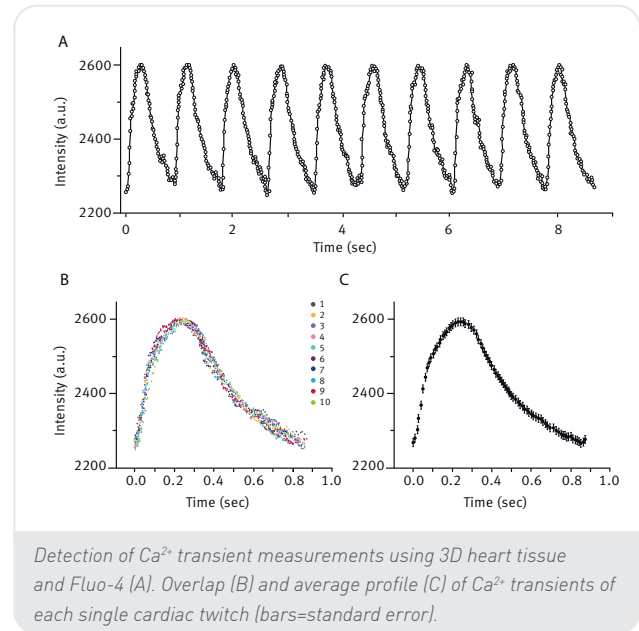
When running either end-point or real-time kinetic assays with living cells, several factors can beneficially affect the quality of your results:

- **Gas regulation and incubation** provide the ideal environmental conditions for living cells. The Atmospheric Control Unit (ACU) is able to independently regulate the concentration of O₂ and CO₂ into the reader, while the incubators provide the ideal temperature.



- **Gas ramps** are used in hypoxic and ischemia/reperfusion assays, as well as for metabolic and redox experiments. This unique feature of the CLARIOstar *Plus* allows O₂ to be rapidly reduced from ambient to hypoxic and return to ambient whilst maintaining a constant CO₂ concentration.
- **High-performance bottom reading** significantly improves data quality in adherent cell-based assays. Detection of adherent cells usually benefits from measuring from below the well. On this plate reader you can easily switch from top to bottom detection with a simple mouse click and no hardware displacements.
- **Well surface scan** is the perfect tool to get robust data from non-homogeneously distributed adherent cell samples. Matrix scan takes up to 900 data points/well and creates a map for each sample. Alternatively, orbital or spiral averaging calculate an average of multiple data points measured on a specific orbit.
- **Reagent injection** can be used to add a stimulus or inhibitor, and to initiate kinetic and enzymatic reactions while detecting in real time the sample's reaction. On our built-in injectors, delivery volumes are adjustable for each well, allowing users to automatically produce dilution schemes and gradients across the microplate. An extremely low dead volume and back flush capability ensure precious reagents are used sparingly and can be recovered.

- **High frequency sampling** acquires with ease extremely fast changing signals and kinetics like calcium flux or fast biological reactions. Thanks to a sampling rate of 100 measurements/second or 1 data point every 0.01 second, no data point will be lost.



Automation and integration

To simplify automation and reduce costs, all our readers have similar x-y dimensions and plate in/out locations. For medium level throughput, the reader can be equipped with two integrated microplate barcode readers capable of reading the east and south side of the plate. Additionally, our Stacker is the ideal solution for labs that wish to have a small-footprint automated plate feeder. It provides loading, unloading, restacking, and a continuous load feature for up to 50 plates. For higher throughput, the CLARIOstar *Plus* can be easily automated with all of the leading robotic platforms.

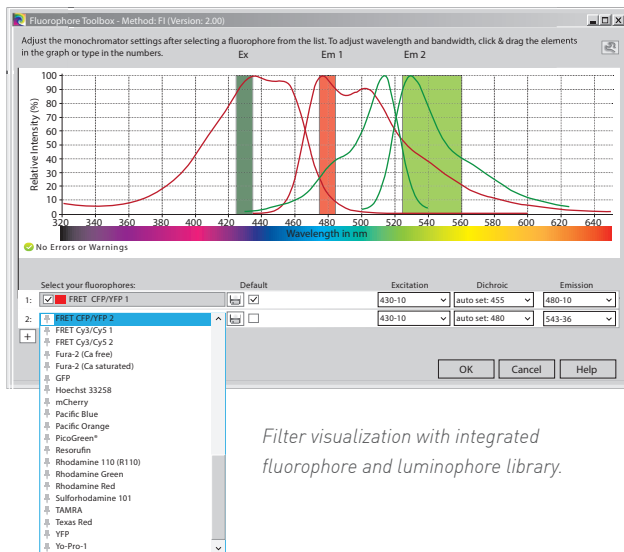


Control and MARS data analysis software

BMG LABTECH's Control Software runs the microplate reader, while data are analysed 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.

The Control Software allows users to easily define instrument parameters and protocols.

To simplify and improve assay setup, a library of spectra for the most common fluorophores and luminophores is integrated into the filter visualization tool. Users can measure assays with the recommended settings, or simply "drag & drop" new settings for wavelengths and bandwidths.



Filter visualization with integrated fluorophore and luminophore library.

The MARS data analysis software allows users to quickly view and analyse data. MARS is able to perform a variety of simple and diverse mathematical calculations.

Features include:

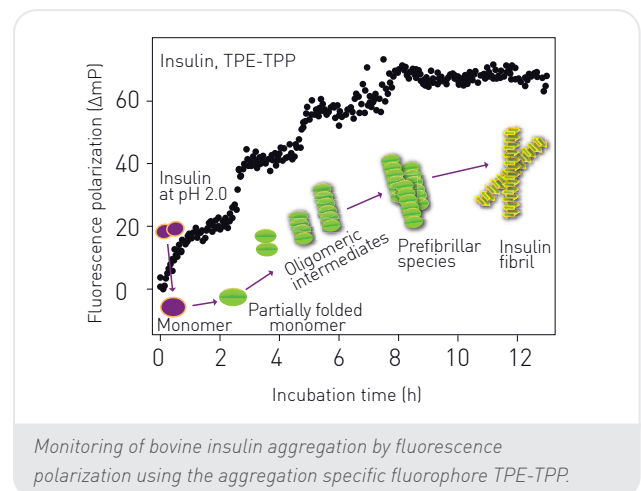
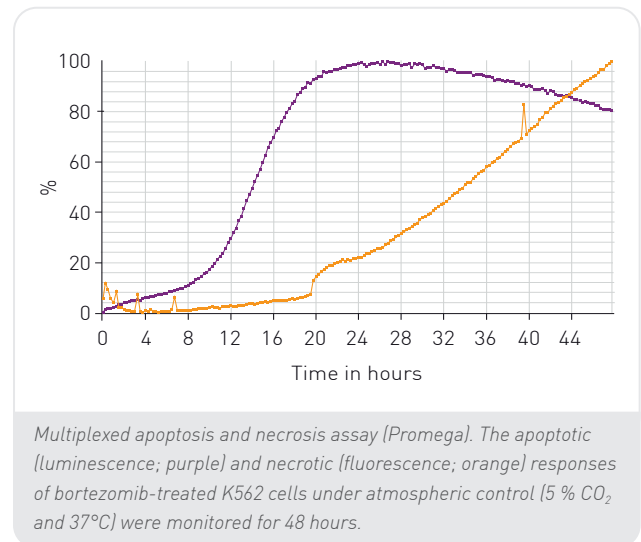
- Averaging, blanking, %CVs, and other statistics
- Standard curve fits, e.g. linear and segmental regression, 4- and 5-parameter, exponential
- Enzyme kinetics like V_{max} or K_m from Michaelis-Menten, Lineweaver-Burk, or Scatchard Plots
- Predefined templates automatically perform assay-specific calculations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

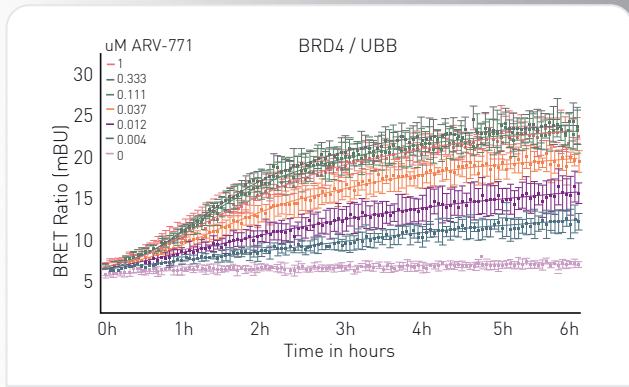
Applications center

A perfectly engineered instrument is only part of the solution, it needs to effectively perform all of the leading applications. With the CLARIOstar ^{Plus}, we offer 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 examples:





NanoBRET™ ubiquitination assay: endogenously tagged HiBiT-BRD4 cells co-expressing HaloTag®-Ubiquitin show rapid and dose-dependent ubiquitination upon treatment with ARV-771 PROTAC.

We continuously work with all of the leading reagent companies to optimize settings for their assays.



Visit the our 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 30 years of expertise and innovations. Over 4,000 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^{Plus} and all other BMG LABTECH microplate reading solutions.

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Binding studies
Transcreener[®]
 FRET assays **HTRF**[®]
 DNA/RNA quantifications
 AlphaPlex™ technology **Ca²⁺ assays**
DLR[™] AlphaTechnology
 Protease activity Kinase activity
 LanthaScreen[®] SNP Genotyping
 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
LANCE[®] **DELFLIA**[®]
 Solubility tests
 ATP and ADP detection
 Gene expression **ELISA**
 Reporter gene assays



The CLARIOstar Plus can include all or any combination of features listed below at purchase. Upgrading with additional features is possible at any time. Please contact your local representative for more details or a quote.



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Made in Germany

Detection modes	UV/vis absorbance spectra Fluorescence intensity (incl. FRET) Luminescence (flash and glow) - incl. BRET Fluorescence polarization Time-resolved fluorescence TR-FRET AlphaScreen®/AlphaLISA®/AlphaPlex™	
Measurement modes	Top and bottom reading Endpoint and kinetic Sequential multi-excitation Sequential multi-emission Spectral scanning [fluorescence, luminescence, absorbance] Ratiometric measurements Well scanning	
Microplate formats	6- to 1536-well plates, user-definable LVis Plate with 16 low volume microspots [2 µL]	
Microplate carrier	Robot compatible	
Light sources	High energy xenon flash lamp Dedicated laser for AlphaScreen®/AlphaLISA®/AlphaPlex™	
Detectors	Low-noise photomultiplier tube Red-sensitive photomultiplier tube CCD spectrometer	
Wavelength selection	Dual Linear Variable Filter (LVF) Monochromators™ Linear Variable Dichroic Mirror: separates excitation and emission LVF Monochromators Optical filters: excitation and emission slides hold up to 4 filters each LVF Monochromators + optical filters: use one for excitation and the other for emission UV/vis absorbance spectrometer: full spectra or 8 discrete wavelengths in < 1 sec/well	
Optical filters	Excitation and emission slides for up to 4 filters each	
Optical path	Top and bottom: free-air optical light path guided by motor-driven mirrors and dichroics	
Z-Adjustment	Automatic focal height adjustment [0.1 mm resolution]	
Spectral range	Filters	FI, FP, TRF: 240 - 740 nm or 240 - 900 nm [red-shifted PMT] LUM: 240 - 740 nm
	LVF Monochromators™	FI: 320 - 740 nm or 320 - 840 nm [red-shifted PMT] LUM: 320 - 740 nm
	Linear Variable Dichroic	340 - 740 nm or 340 - 760 nm [red-shifted PMT]
	Spectrometer	ABS: 220 - 1000 nm
	Sensitivity	FI filters (top) < 0.15 pM [< 3 amol/well fluorescein, 384sv, 20 µL] FI filters (bottom) < 1.0 pM [< 50 amol/well fluorescein, 384g, 50 µL] FI monochromator (top) < 0.35 pM [< 7 amol/well fluorescein, 384sv, 20 µL] FI monochromator (bottom) < 3.0 pM [< 150 amol/well fluorescein, 384g, 50 µL] FI dynamic range 8 decades in a single measurement FP < 0.5 mP SD at 1 nM fluorescein [384sv, 20 µL] HTRF® (black and white microplates) Reader Control Kit [Eu] after 18h [384sv, 20 µL] Delta F > 880 % [High Calibrator] Delta F > 30 % [Low Calibrator] TRF < 20 fM europium, 384, 80 µL LUM < 0.4 pM [< 8 amol/well ATP, 384sv, 20 µL] LUM dynamic range 8 decades in a single measurement AlphaScreen® with laser < 5 pM [< 100 amol/well P-Tyr-100, 384sv, 20 µL] ABS with spectrometer Full spectrum captured in < 1 s / well Selectable spectral resolution: 1, 2, 5, and 10 nm OD range: 0 - 4 OD Accuracy: < 1% at 2 OD Precision: < 0.5% at 1 OD and < 0.8% at 2 OD
Read times	Flying mode (1 flash)	8 s [96], 15 s [384], 28 s [1536]
	10 flashes	19 s [96], 57 s [384], 3 min 4 s [1536]
Reagent injection	Up to 2 built-in reagent injectors Individual injection volumes for each well: 3 to 500 µL (optionally up to 2 mL) Variable injection speed up to 420 µL/s Reagent back flushing	
Shaking	Linear, orbital, and double-orbital with user-definable time and speed	
Integrated barcode reader	Up to two integrated barcode readers	
Incubation	+3°C above ambient up to 45°C or 65°C The upper heating plate of the incubation chamber operates at 0.5 °C more than the lower plate. This prevents condensation build-up on the lid or sealer.	
Software	Multi-user Reader Control and MARS data analysis software included FDA 21 CFR Part 11 compliant Integrated fluorophore library	
Dimensions	Width: 45 cm, depth: 51 cm, height: 40 cm; weight: 32 kg	
	Optional accessories	
Stacker	Plate handler for up to 50 microplates - continuous loading feature	
THERMOstar	Microplate incubator and shaker	
Atmospheric Control Unit (ACU)	Actively regulates O ₂ and CO ₂ - 0.1-20% Gas ramping function	
LVis Plate	Microplate designed to measure 16 low volume [2 µL] samples and standard cuvettes. Incorporating NIST-traceable filters and holmium oxide standards for instrument performance test. Sensitivity: < 2 ng/µL dsDNA	
Filters	Optimized for dyes, fluorophores and specific assays Filters for all applications from UV to NIR Customized filters available upon request	
Upgrades	Upgrades to include options such as additional detection modes, reagent injectors, extended temperature control, etc. are available. Please contact your local representative for more information.	

US Patent Number 9,733,124.

Limit of detection (sensitivity) was calculated according to the IUPAC standard: $3 \times (SD_{blank}) / \text{slope}$

Specifications are subject to change without notice.

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