

Life Science Readers

Omega Series

Ultra-Fast Full Spectrum Absorbance
in a Multifunctional Microplate Reader



The Omega series is BMG LABTECH's 5th generation of multifunctional life science microplate readers. They employ Tandem Technology (TT), which uses an ultra-fast UV/Vis spectrometer for absorbance and high performance filters for fluorescence. The Omega offers the most measurement modes of any multifunctional life science reader.



See pages 61-64 for description of icons



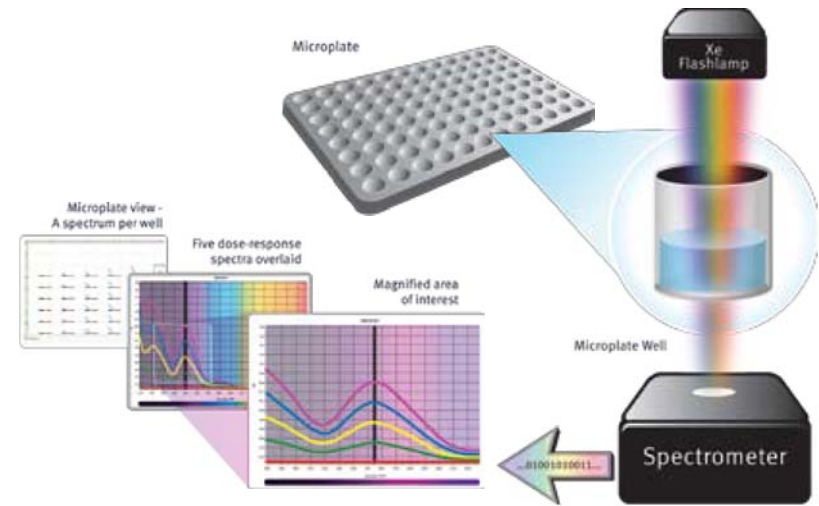
The Omega's Tandem Technology (TT) uses an ultra-fast UV/Vis spectrometer for flexibility in absorbance and high performance filters for detection in fluorescence. There are four readers in the Omega line:

SPECTROstar Omega offers ultra-fast full UV/Vis spectrum absorbance. It may be upgraded to the FLUOstar or POLARstar.

FLUOstar Omega offers seven different reading modes: Ultra-Fast Full Spectrum Absorbance (UV/Vis), Fluorescence Intensity (FI), Fluorescence Resonance Energy Transfer (FRET), Time-Resolved Fluorescence (TRF), Time-Resolved Fluorescence Resonance Energy Transfer (TR-FRET), High Performance Luminescence (Lum) and AlphaScreen® (AS).

POLARstar Omega offers eight different detection modes: the seven FLUOstar modes, plus Simultaneous Dual Emission (SDE) detection for Fluorescence Polarization (FP) assays. SDE can also be used to improve performance in FRET, BRET and TR-FRET assays.

LUMIstar Omega offers high performance luminescence detection. It may be upgraded to the FLUOstar or POLARstar.



It's a Spectrometer – No Scanning Required!
Full UV/Vis spectrum in <1 second per well.

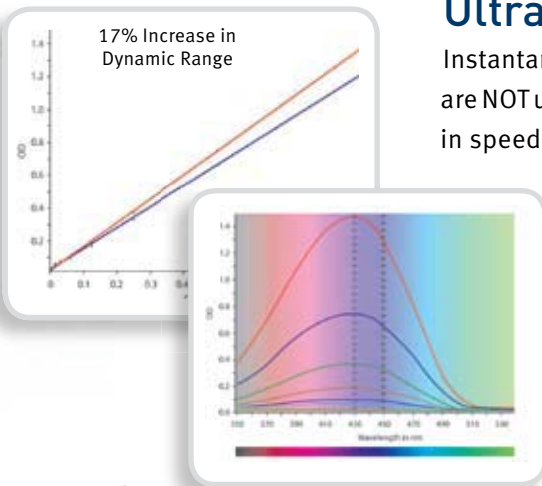
Ultra-Fast UV-Vis Spectrometer

Instantaneously capture all wavelengths at once in any range from 220 to 850 nm at resolutions as low as 1 nm. Monochromators are NOT used, so no scanning or calibration is required. Furthermore, monochromators cannot match a spectrometer's performance in speed or sensitivity. For more information on the spectrometer see page 57.

Improve Absorbance Applications with the Ultra-Fast UV/Vis Spectrometer

The Omega combines the flexibility and sensitivity of a classic spectrophotometer with the speed and sample capacity of a microplate reader. Its UV-Vis absorbance spectrometer allows the Omega to perform many applications that were not previously possible on a microplate reader:

- Easily quantify DNA and protein (260/280/320) with ONE read in <1 second/well
- Measure the optimal detection wavelength for an ELISA because ALL wavelengths are given (graphs to the left)
- Monitor enzymatic reactions without knowing the absorbance wavelength of the product or substrate
- Instantaneously detect global changes for co-factors such as NADH, NO or NADPH without switching filters
- Detect interferants in an assay or samples with a full spectral scan



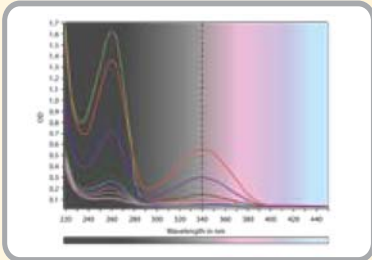
▲ ELISA assay correction - 17% increase in dynamic range when measured with the spectrometer vs. normal filter measurement at 450 nm.

Freedom to Perform All Life Science Applications...

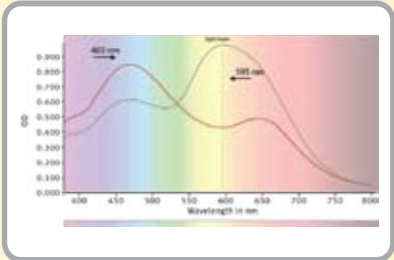
The Omega series performs all of the leading non-isotopic detection technologies using up to eight different



Ultra-Fast UV/Vis Absorbance – The Omega uses an ultra-fast spectrometer that instantaneously captures the UV/Vis absorbance spectrum of each well at speeds of less than 1 second per well (1, 2, 5 or 10 nm increments are possible).



UV/Vis absorbance measurements (220 – 450 nm) of varying concentrations of NAD+ and NADH.

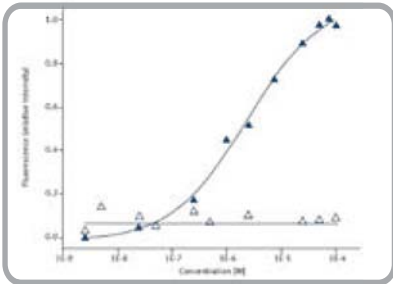


Bradford protein concentration assay.

Available on
FLUOstar / POLARstar / SPECTROstar



Fluorescence Intensity – A high intensity xenon flash lamp and carefully selected PMTs, coupled with high transmission band pass filters, provide a stable, low-noise signal platform for ultra sensitive fluorescence readings. The Omega can accurately read any fluorophore from 220-900 nm, including fluorescently tagged proteins, with low limits of detection.



Fluorescence intensities obtained with Tryptophan (280/350 nm) at varying concentrations.

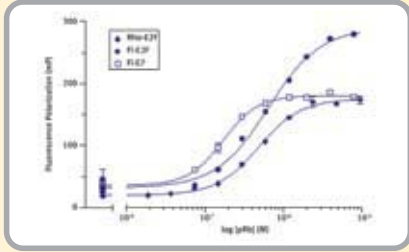
Available on
FLUOstar / POLARstar



Fluorescence Polarization – Low mP variation is obtained because a high intensity xenon flash lamp, carefully paired PMTs and high performance filters ensure low variability between measurement channels.



Simultaneous Dual Emission Detection – Reading two wavelengths at once decreases read times and increases accuracy.



Change in FP upon binding of fluorescein-E2F, rhodamine-E2F and fluorescein-E7 to the retinoblastoma tumor suppressor protein in 384-well format.

Available on
POLARstar



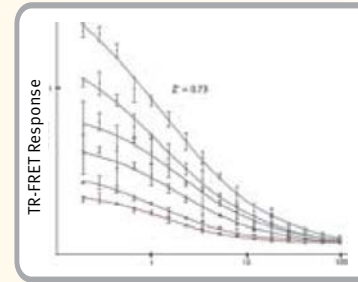
measurement modes – FI, FP, TRF, FRET, TR-FRET, UV/Vis Abs, Lum and AlphaScreen®. Here are a few examples:



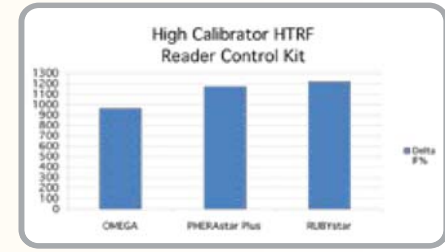
TRF and TR-FRET – Optional TRF reading head allows the Omega to obtain unmatched time-resolved fluorescence performance for a life science reader. The Omega can deliver HTS-like performance at a fraction of HTS prices.



Available on
FLUOstar / POLARstar



Adapta™ TR-FRET titration curve from Invitrogen™.



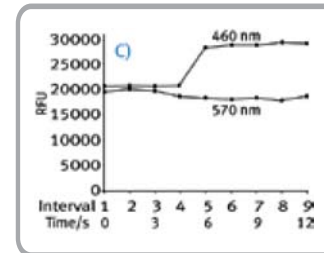
High calibrator HTRF® reader control kit from Cisbio.



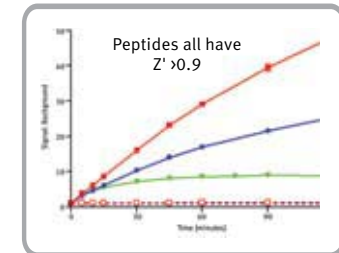
FRET/BRET – Fluorescence or Bioluminescence Resonance Energy Transfer is easy on the Omega using features such as SDE, optimized filters and precise reagent injection. No other mid-range reader has SDE, which allows for fast and precise FRET/BRET data.



Available on
FLUOstar / POLARstar



FRET based Voltage Sensitive Probes from Invitrogen™ measures ion channel activity.

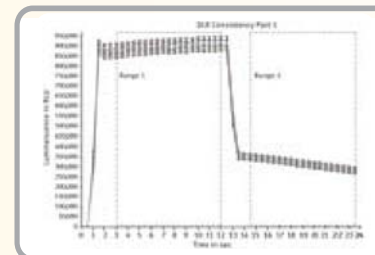


CyDye FRET protease assay from GE Healthcare, metalloproteinase time course of three peptides.

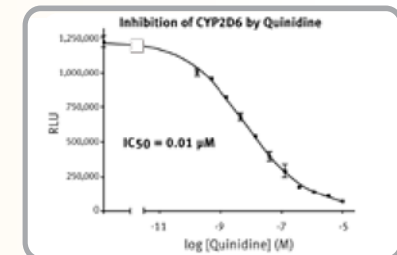


Luminescence – Dedicated measurement electronics elevate the luminescence capabilities of the Omega to match stand alone luminometers.

Available on
FLUOstar / POLARstar / LUMIstar



Dual Luciferase® reaction from Promega™ measuring the consistency for Firefly (Range 1, %C=2.3) and for Renilla (Range 2, %CV=2.5).



P450-Glo™ assay from Promega® measures the IC₅₀ calculation of CYP450-2D6 and its inhibitor quinidine.

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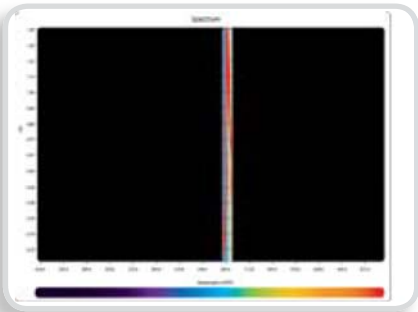
SPECTROstar Omega - Upgradable Ultra-Fast UV/Vis Absorbance Reader

The SPECTROstar is the world's first fully upgradable UV/Vis spectrometer-based microplate reader. The SPECTROstar has the ability to analyze absorbance assays with power never before seen in the laboratory.

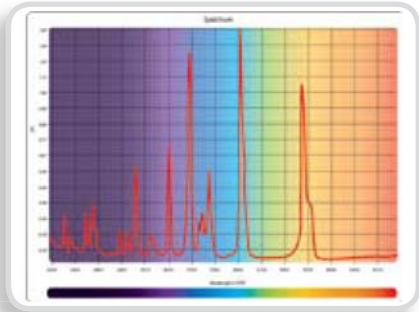
The SPECTROstar uses a proprietary ultra-fast UV/Vis spectrometer to capture the entire UV/Vis spectrum (220-850 nm) of each sample with a 1 nanometer resolution. No need to select wavelengths or guess that the optimal wavelength is selected. The entire UV/Vis spectrum of each well is given in approximately one second per well, or about one minute for a 96 well plate.



▲ The SPECTROstar Omega is a dedicated absorbance reader with an ultra-fast UV/Vis spectrometer and it is upgradable to a FLUOstar or POLARstar Omega.



▲ Traditional readers using monochromators or filters only capture a small part of the spectrum at a time.



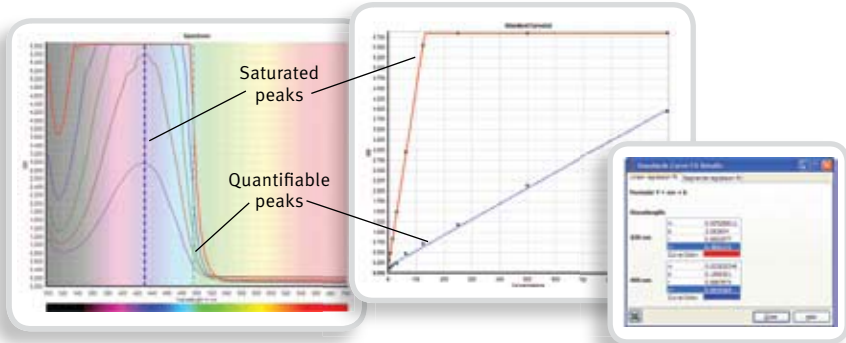
▲ The Omega's ultra-fast UV/Vis spectrometer captures all absorbance wavelengths all of the time.

Features on the SPECTROstar Omega include: ultra-fast UV/Vis spectrometer that can capture either a full spectrum (220nm to 850 nm) at 1, 2, 5, or 10 nanometer resolution in under one second per well, or up to eight discrete wavelengths at once. Obtain 96 full-spectrum reads in < 90 seconds or 96 single wavelength reads in < 25 seconds. Also includes incubation up to 45°C (optional 60°C), varied shaking options, two reagent injectors, well scanning and powerful MARS evaluation software. For more information see Features and Technologies pages 45-60.

Full Spectrum View

The ability to view a full spectrum without tedious scanning by a monochromator (which can take > 30 minutes per well) allows for compounds and assays to be investigated in new ways.

As an example, on the spectrum graph to the right, the 3 highest concentration points on the absorbance curve are saturated at wavelength 430 nm (>4 O.D.) and cannot be used in the linear regression fit. However, if a higher wavelength is used like 490 nm, all of the concentration points can be used for the standard curve. This can only be done with an Omega since the entire spectrum is available.



▲ An absorbance assay that is saturated at its peak wavelength (430 nm) can only use 3 data points for a linear regression fit (red line on middle graph). However the 490 nm measurement is not saturated and is quantifiable, thus giving more data points for a linear regression fit (blue line).



Automatic DNA Calculation

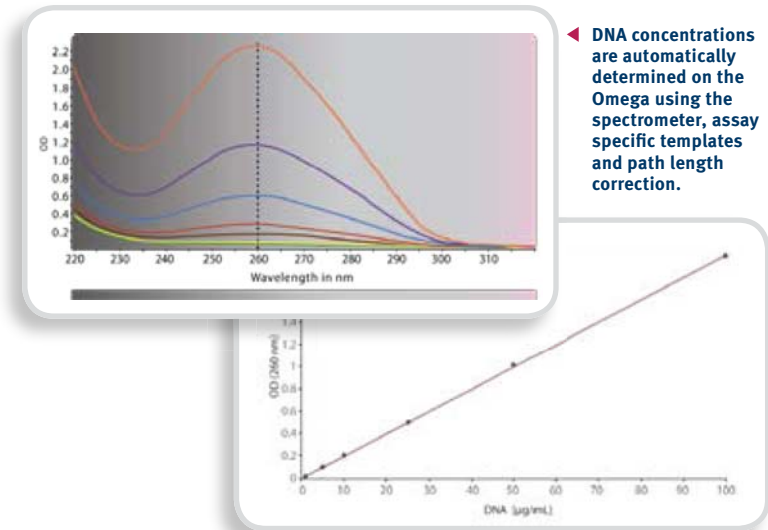
The SPECTROstar can read an entire UV/Vis spectrum, from 220nm to 850nm, or it can capture up to 8 discrete wavelengths in 1 second per well. Thus DNA measurements at 260nm and 280nm, with a 320 or 600 nm correction, can be obtained in a single read of each well of the microplate. Whether eight wavelengths or the entire spectra, the Omega can capture what is needed in about one second per well – no filters, no monochromators needed.

The graph to the right shows a DNA purity measurement. The MARS evaluation software automatically calculates the ratios, corrects for the reference, performs 1 cm path length correction using Beer's law and quantifies unknowns. For more information on MARS and path length correction see pages 51-53 and 55.

SPECTROstar Upgrades

A great feature of the SPECTROstar is its upgradeability. The SPECTROstar is the only UV/Vis absorbance reader on the market that is fully upgradable to the following technologies:

- Fluorescence Intensity
- Luminescence
- Time-resolved fluorescence (TRF) including TR-FRET
- Simultaneous Dual Emission for Fluorescence Polarization



The SPECTROstar shares the same BMG LABTECH technology platform as the FLUOstar and POLARstar Omegas. It is fully upgradable to all BMG LABTECH technologies and it can grow as needed to handle all life science applications.

Applications

The SPECTROstar can read any UV/Vis spectrophotometric assay that can be performed with a conventional cuvette spectrophotometer, including:

- | | | |
|-------------------------------------|-----------------------------------|--|
| • DNA, RNA and protein quantitation | • Drug dissolution profiles | • Permeability assays (PAMPA) |
| • Kinetic turbidimetric methods | • DNA/RNA purity | • Colorimetric assays |
| • ELISAs/EIAs | • Lipophilicity assays | • Food and industrial color determination |
| • Immunoassays | • Serum Albumin binding assays | • Solubility assays |
| • ADME-Toxicological assays | • High resolution filter scanning | • Enzyme kinetics (e.g., K_i , K_D , V_{max} , etc.) |

Life Science Readers



▲ The FLUOstar Omega is BMG LABTECH's most popular microplate reader.

FLUOstar Omega - Multifunctional Reader for the Life Science Laboratory

The FLUOstar Omega is the first multifunctional microplate reader with a true UV/Vis spectrometer for absorbance. Its innovative design and technology allow for great flexibility and sensitivity in all reading modes.

Additional features on all of the Omegas include: top and bottom reading, incubation up to 45°C (optional 60°C), varied shaking, two reagent injectors, well scanning, orbital averaging and powerful MARS evaluation software.

Multimode for Many Applications

Ultra-Fast Full Spectrum Absorbance

The UV/Vis spectrometer can perform absorbance assays that were not previously possible on a microplate reader. For more information on ultra-fast full spectrum absorbance see SPECTROstar Omega on page 26.

Fluorescence Intensity (Including FRET)

A high intensity xenon flash lamp, carefully selected PMTs, high transmission band pass filters, and low light blocking optics provide a low-noise, stable signal platform for ultra sensitive fluorescence readings. Fast filter switching and adjustable gain allow for FRET based assays to be performed with the FLUOstar.

High Performance Luminescence

All Flash and Glow luminescence assays are easily performed on the FLUOstar.

For more information see LUMIstar Omega page 29.

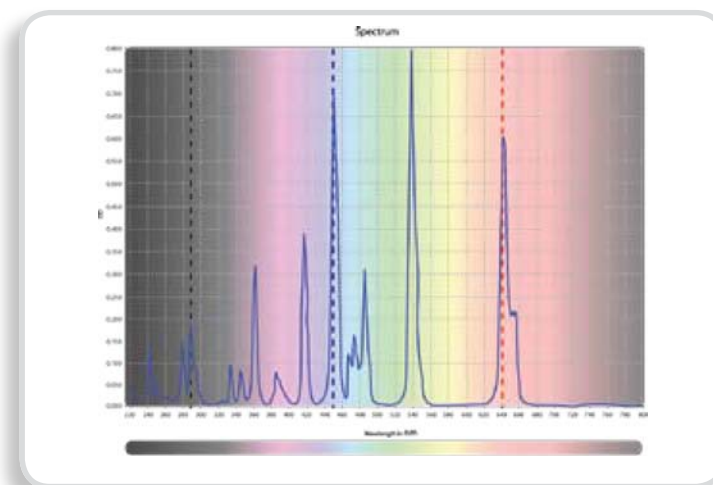
Time-Resolved Fluorescence (Including TR-FRET)

This detection mode can be achieved in two ways, *Standard TRF* and *Advanced Performance TRF*.

For more information see POLARstar Omega on page 28.

AlphaScreen®

BMG LABTECH engineers have designed a specialized measurement mode and optical system to provide the OMEGA readers with AlphaScreen® performance that rivals any HTS reader. For the first time, experience AlphaScreen® performance on a mid-range reader. Along with Advanced Performance TRF, AlphaScreen® is part of the Omega's optional Advanced Assay Technology.



▲ Full UV/Vis spectrum of holmium oxide as measured by the FLUOstar Omega's ultra-fast absorbance spectrometer.



POLARstar Omega – Advanced Multifunctional Reader with SDE

The POLARstar Omega is the most comprehensive reader in the Omega family. It has the same basic reading modes as the FLUOstar, but it also includes a second photomultiplier tube (PMT). This allows for Simultaneous Dual Emission (SDE) detection and fluorescence polarization (FP) measurements.

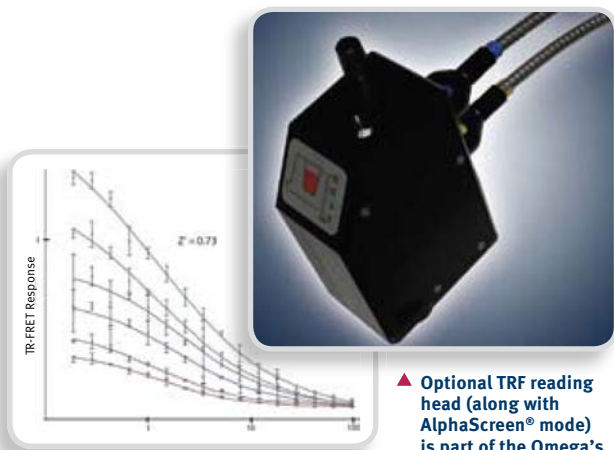
Additional features on all of the Omegas include: top and bottom reading, incubation up to 45°C (optional 60°C) varied shaking, two reagent injectors, well scanning, orbital averaging and powerful MARS evaluation software.

Multimode with Simultaneous Dual Emission (SDE) Detection

For assays that require detecting two emission wavelengths, SDE permits the Omega to attain faster and more accurate results when compared to plate readers without this capability. Assay measurements that use SDE detection result in faster read times, as well as better Z' values and %CVs. SDE reduces the inherent variability that results from comparing signals from two separate reads. For more information see Dual Emission on page 46.



▲ The POLARstar Omega with two PMTs has Simultaneous Dual Emission (SDE) detection for fast and accurate FP, FRET, BRET, and TR-FRET measurements.



▲ Advanced Performance TRF on the Omega using the Adapta™ TR-FRET assay from Invitrogen™.

▲ Optional TRF reading head (along with AlphaScreen® mode) is part of the Omega's Advanced Assay Technology.

Fluorescence Polarization

Carefully paired photomultiplier tubes, a high intensity xenon flash lamp and assay optimized fluorescence filters ensure low variability between measurement channels, thus giving low mP standard deviations. These features make the POLARstar Omega the best performing FP reader in its price range.

Time-Resolved Fluorescence Including TR-FRET (also available on the FLUOstar Omega)

Standard TRF uses assay optimized filters, along with a high intensity xenon flash lamp and adjustable gain to provide a high signal-to-noise ratio and a broad dynamic range for most lanthanide based experiments.

Advanced Performance TRF, along with AlphaScreen®, is part of the Omega's optional Advanced Assay Technology. It utilizes an optional TRF optical reading head that incorporates an assay specific dichroic mirror. Combined with the high intensity xenon flash lamp, assay optimized filters and adjustable gain, the Omega TRF reading head allows the Omega to outperform any microplate reader in the mid-range market.

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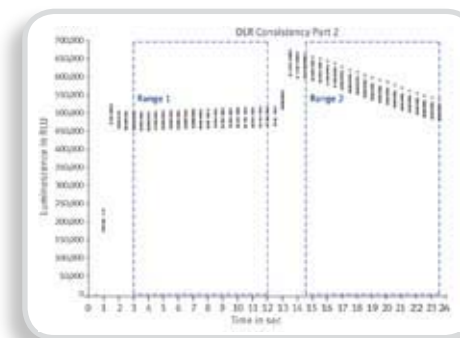
▲ The LUMIstar Omega is a dedicated luminescence detection reader and it is upgradable to a FLUOstar or POLARstar Omega.



LUMIstar Omega - Upgradable Luminescence Reader

The LUMIstar Omega is a dedicated high performance luminescence microplate reader that can be upgraded to a FLUOstar or POLARstar Omega.

Additional features on all of the Omegas include: top and bottom reading, incubation up to 45°C (optional 60°C), varied shaking, two reagent injectors, well scanning, orbital averaging and powerful MARS evaluation software.



▲ Dual Luciferase® reaction from Promega measuring Firefly (Range 1) and Renilla (Range 2).

High Performance Luminescence Detection

Dedicated measurement electronics, liquid light guides and adjustable gain make the LUMIstar Omega one of the best luminometers on the market. Couple this with the Omega's advanced features (slow and fast kinetics, onboard reagent injectors, variable shaking, and top and bottom reading) and the LUMIstar can easily perform all Flash and Glow luminescence assays.

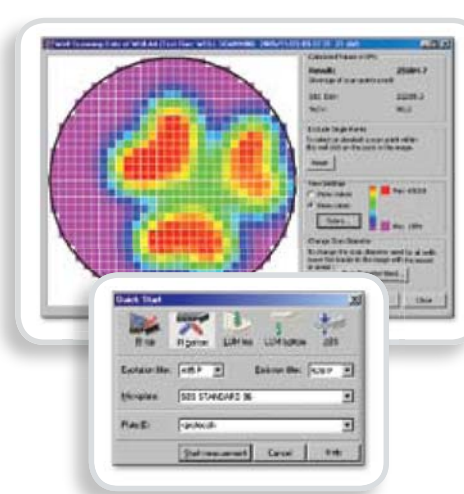
Additional Omega Features for Advanced Functionality and Flexibility

- Quick Start
- Top and bottom reading
- Incubation up to 60°C
- Various shaking modes
- Two onboard reagent injectors
- TRF reading head
- Slow and fast kinetics
- Orbital averaging
- Well scanning with advanced data handling
- Powerful evaluation software
- Stacker and robot compatible

For more information see Features and Technologies pages 44-60.



▲ Onboard reagent injectors.



▲ Well Scanning and quickstart features.



▲ Omega on a Stacker II.

Technical Specifications



Omega Series

Measurement Modes	Endpoint and kinetic measurements
	Sequential dual emission measurements
	Sequential dual excitation measurements
	Ratiometric measurements
	Well scanning
Light Source	High energy xenon flashlamp
Filters	Excitation and emission filter wheel for 8 filters each
Reagent Injection	Up to two built-in reagent injectors
	Injection at measurement position (6 to 384-well)
	Individual injection volumes for each well (35 ... 350 µL)
	Variable injection speed (100 ... 420 µL/s)
	Up to four injection events per well
	Reagent back flushing
Incubation	+ 5°C above ambient to 45°C (60°C optional)
	Temperature stability: 0.2°C
	Temperature gradient: < 0.5°C
Shaking	Linear, orbital and double orbital
Microplate Formats	From 6- to 1536-well plates
Reading Time	flying mode
	9 s (96-well format) 16 s (384-well format)
Dimensions	Width: 44 cm, depth: 48 cm, height: 31 cm
	Weight: 29 kg
Stacker II	Magazines for up to 50 plates
	Continuous loading feature
	Barcode reader

SPECTROstar Omega

Detection Mode	UV/Vis absorbance spectra
Absorbance Spectrometer	Spectral range: 220 to 850 nm
	Spectral resolution: down to 1 nm
	OD range: 0 to 3 OD
	Accuracy: < 1% at 2 OD
	Precision: < 0.5% at 1 OD and < 0.8% at 2 OD

POLARstar Omega

Detection Modes	UV/Vis absorbance spectra	
	Fluorescence intensity	
	Fluorescence polarization	
	Time-resolved fluorescence	
	Fluorescence resonance energy transfer	
	Time-resolved fluorescence resonance energy transfer	
	Luminescence (flash and glow)	
	AlphaScreen®	
	Detector	Two matched side window photomultiplier tubes
	Spectral Range	220 ... 900 nm
Absorbance Spectrometer	Spectral range: 220 to 850 nm	
	Spectral resolution: down to 1 nm	
	OD range: 0 to 3 OD	
	Accuracy: < 1% at 2 OD	
	Precision: < 0.5% at 1 OD and < 0.8% at 2 OD	
Sensitivity*	FI:	< 0.2 fmol/well sodium fluorescein
	FP:	< 5 mP for 1 nM fluorescein
	TRF:	< 30 amol/well europium
	LUM:	< 30 amol/well ATP

FLUOstar Omega

Detection Modes	UV/Vis absorbance spectra	
	Fluorescence intensity	
	Time-resolved fluorescence	
	Fluorescence resonance energy transfer	
	Time-resolved fluorescence resonance energy transfer	
	Luminescence (flash and glow)	
	AlphaScreen®	
	Detector	Side window photomultiplier tube
Spectral Range	220 ... 900 nm	
Absorbance Spectrometer	Spectral range: 220 to 850 nm	
	Spectral resolution: down to 1 nm	
	OD range: 0 to 3 OD	
	Accuracy: < 1% at 2 OD	
	Precision: < 0.5% at 1 OD and < 0.8% at 2 OD	
Sensitivity*	FI:	< 0.2 fmol/well sodium fluorescein
	TRF:	< 30 amol/well europium
	LUM:	< 30 amol/well ATP

LUMIstar Omega

Detection Modes	Luminescence (flash and glow)
Detector	Side window photomultiplier tube, second PMT optional
Sensitivity*	< 30 amol/well ATP
	0.2 amol/well recombinant Aequorin

*BMG LABTECH states conservative values for LOD/sensitivity. Measured results may be significantly better.
For more information on how BMG LABTECH calculates sensitivity see page 8.

Stacker II

Microplate Automation the Easy Way

The STACKER II is the perfect complement to any BMG LABTECH reader to increase throughput. A small footprint, perfect reader integration, quality engineering and rugged design make the STACKER II the best choice for medium to high-throughput screening operations.

BMG LABTECH's STACKER II plate handling system transforms any of its microplate reader into a laboratory automation system, which allows users to walk away and concentrate on running assays, not managing plates.

The STACKER II is compatible with all BMG LABTECH microplate readers and can be added at any time. The Stacker II is programmable through the reader control software, which ensures a seamless integration with all BMG LABTECH readers.

The STACKER II holds twin 50 plate magazines and is compatible with all SBS standard plates. The magazines are easily loaded and unloaded from the top without the need to remove the stacks from the reader. Easy access allows for the Stacker II to deliver plates indefinitely. On days when plate volume is low, the magazines can be removed and the reader used in single plate mode.

A microplate barcode reader can be installed on the STACKER II in three different positions depending on the location of the label. The barcode can be automatically entered into the test run information or ASCII data stream to ensure that data collection is accurate and organized.

The STACKER II is built with quality materials that can withstand the rigors of a working laboratory. The magazines are constructed from anodized aluminum that hold up under prolonged use. The magazines are chemical resistant and are easily removed for cleaning and maintenance. Powerful electromagnets minimize the number of moving parts needed for holding and releasing plates, and precision control software accurately delivers plates to the reader.

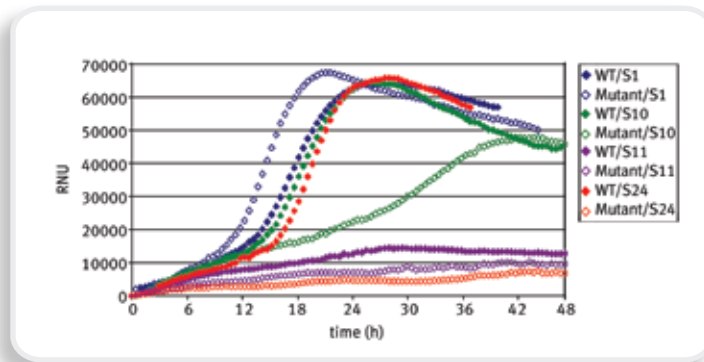
Multiple plate sensors are used on the Stacker II to minimize the possibility of a misloaded plate. If a plate does not load correctly, the STACKER II executes an emergency shut down to avoid damage to moving parts and to prevent the spillage of liquids. This feature allows users to clear the plate, reset the system and continue reading.



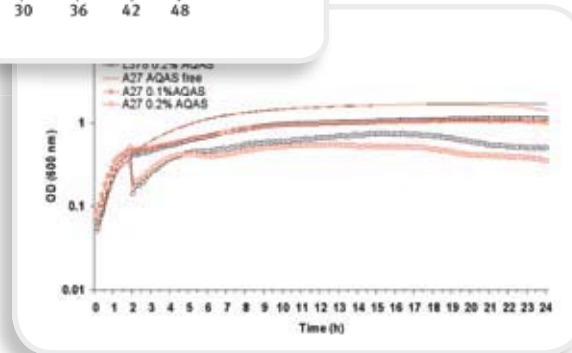
Gas Vent

Most BMG LABTECH microplate readers have the option of adding a gas vent to the system. This feature offers a tremendous advantage for assays where special or inert gas (e.g. CO₂, Ne, Ar, or He) is needed for gas sensitive samples. The gas vent system allows the user to either inject an atmosphere or to pull a vacuum into the reader. This is especially useful when working with volatile oxidizing solutions. No additional connections are necessary beyond the single connector in the rear of the unit. The system utilizes a “quick connect”, which allows users the ability to move their instrument or to easily change to different gas systems.

One of the most popular uses for the gas vent system is the study of bacterial and fungal growth on the NEPHELOstar, as well as on the OPTIMA and Omega series of readers. These assays are especially sensitive to oxygen and the growth rates can be affected by altering the percentage of oxygen in the air. The gas venting system allows the user to pipe in the exact air mixture that is required for their assay. Combined with onboard incubators, environmental conditions can be controlled by the user. The gas vent system is also available as an upgrade to existing BMG LABTECH readers.



▲ A gas vent on the NEPHELOstar pumps in CO₂ and it allows for the determination of growth curves for wild type and a deletion mutant of *C. glutamicum* as measured by LASER nephelometry.



▲ A gas vent on the FLUOstar Omega pumps in CO₂ allowing for the determination of bacterial growth kinetics using wild type and mutated strains of *Salmonella Typhimurium* as measured by absorbance at 600 nm.



▲ Gases are easily introduced into the microplate chamber using an optional gas vent with “quick connection”.

Features and Technologies

Incubation and Shaking

BMG LABTECH readers are equipped with both incubation and shaking. These features allow users to mix reagents and measure samples at elevated temperatures.

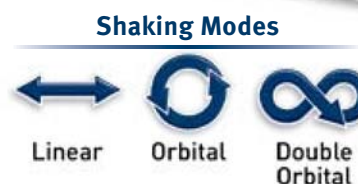
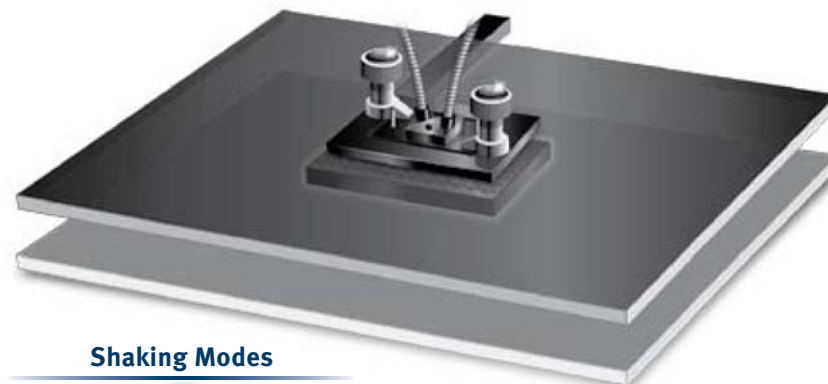
The incubator on the Omega series of readers controls the measurement chamber from near-ambient temperatures up to 60°C (45°C is standard). This capability enables the accurate measurement of enzyme assays, cellular responses, apoptosis and heat-shock responses. The high-temperature incubation allows users to monitor protein folding over time, carry out DNA melting-point analyses and determine the binding affinities of small molecules. Users can also increase temperature at regular time intervals so that temperature-sensitive reactions can be carried out entirely within the reader, with no measurement interruption.

BMG LABTECH's measurement chamber is heated over an area much greater than just the surface of a microtiter plate. This allows uniform heating from well-to-well and provides a more stable temperature-buffered area when microtiter plates are inserted or when reagents are added.

BMG LABTECH readers permit shaking that varies in intensity, duration, and the direction of motion. There are different shaking options depending upon whether round-bottom or flat-bottomed wells are being used, or whether particles or cells need re-suspension. The shaking radius is adjustable and users can vary displacement based upon well size or fluid volume.

The timing of mixing and shaking can be defined specifically by the user. Shaking can be programmed to occur before or after kinetic measurement intervals or only after an injection cycle has been completed. For assays that require high uniformity, shaking can take place immediately following injection in each well.

Incubation	+ 5°C above ambient to 45°C (60°C optional)
	Temperature stability: 0.2°C
	Temperature gradient: < 0.5°C
Shaking Modes	Linear, Orbital, Double Orbital
Shaking Diameter	1 - 7 mm
Shaking Speed	86 - 1000 rpm
Shaking Time	0 to ∞ seconds per cycle



▲ Top and bottom incubation plates are large enough to ensure even distribution of temperature over the entire microplate, and multiple shaking modes give users options for different assays.



Injectors

Many popular assays such as enzyme kinetics, calcium flux, dual luciferase and ORAC require the ability to monitor a signal before, during and after the addition of a reagent to a well. Some of these assays are very rapid and cause a change in signal instantly after reagent addition. In these cases, the signal can become unreadable in only a few seconds. Without the ability to inject and read simultaneously, the user can lose valuable information.

BMG LABTECH readers can be equipped with software controlled reagent injectors. The injectors are fully integrated into the reader platform and does not require a bulky add on unit or *ad hoc* engineering. BMG LABTECH was the first microplate reader company to equip readers with injectors, thereby establishing our expertise in this area.

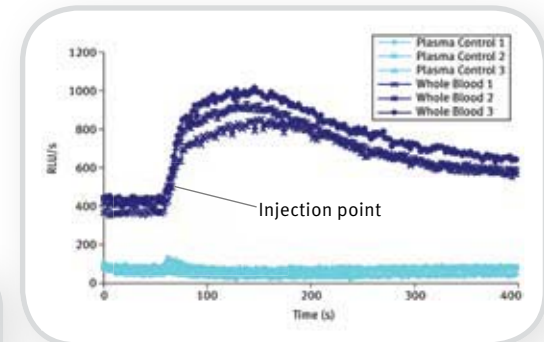
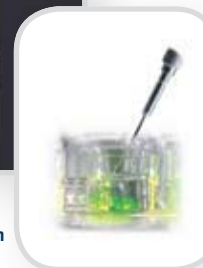
Our injectors enable delivery of a variety of reagents including buffers, substrates, agonists or enzymes into any plate format from 6-384 wells. The control software provides options to determine injection timing, injection speed, delivery volume and the ability to inject different volumes into any well. The control software also allows for multiple additions from the same injector into the same well. Most important however, is the ability of the injectors to deliver reagent simultaneously with measurement – up to 50 points per second, the fastest in the industry.

Simultaneous injection and reading ensure that users will experience no loss of data and will save valuable laboratory time. The reagent injectors are easily cleaned, chemically inert and can be configured with varying syringe types depending on the need of the customer. High volume syringes are available for large volume buffer delivery and low volume syringes are available for precious, expensive or temperature sensitive reagents.

Delivery Volume	5 µl to 350 µl per well
Delivery Increment	0.5 µl
Delivery Speed	100 µl to 420 µl/min
Number of pump actions per well	4
Variability	<1.0%
Simultaneous Injection and Read	Yes
Individual injection volumes per well	Yes
Reagent back flush	Yes
Fully programmable delivery times	Yes



▲ Onboard Reagent Injectors with simultaneous injection and read.



▲ Reagent injection of fMLP stimulates plasma and leukocytes in whole blood to produce free radicals, which are measured using the ABEL[®] luminescence assay.

Features and Technologies

MARS - Microplate Analysis Reduction Software

Data Evaluation Made Simple

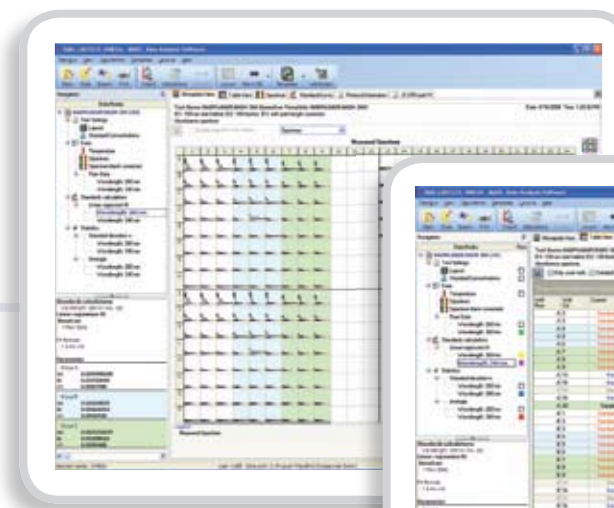
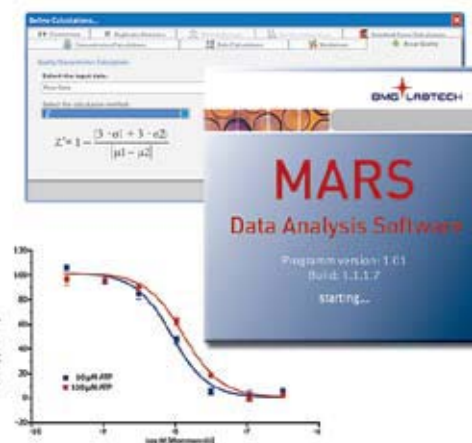
In 2007 BMG LABTECH released its new, powerful and intuitive MARS evaluation software. MARS is a proprietary software package that uses the powerful MATLAB® mathematics engine.

Key Features:

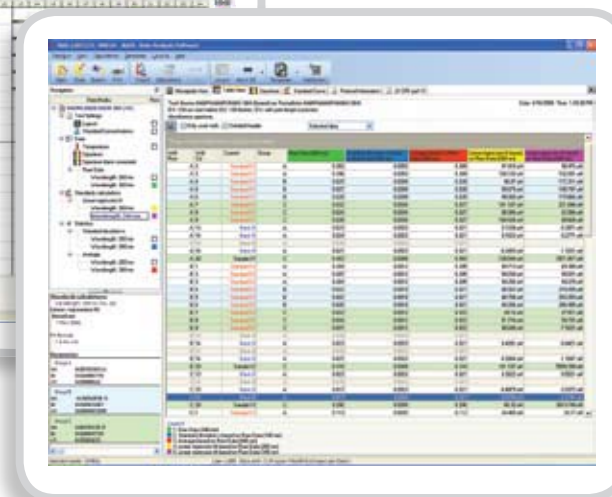
- Assay specific calculation templates
- Automatic background/baseline correction
- Automatic DNA/RNA concentration determination
- Delta F% calculation for HTRF®
- Excel and ASCII export
- Linear, 4-parameter, cubic-spline and segmental regression fits (to name a few)
- Michaelis-Menten kinetics and Lineweaver-Burk plot (Vmax, Km, et al.)
- Moving (boxcar) averages
- Multiple layout views
- Standard curve calculation wizard
- Signal-to-Noise and Signal-to-Blank calculations
- UV/Vis spectral view (OMEGA version only)
- Z' calculation
- Title 21 CFR Part 11 compliant

Viewing Data

There are two ways to view data within MARS: the Microplate View and the Table View. The Microplate View shows all of the wells of the microplate in either the numerical form or as a graphical representation if applicable (i.e. kinetic curves or absorbance spectra). The Table View creates separate categories for each column and sorts the data according to a chosen column. Both options allow users to view, print and export their data according to their preferences.



◀ The Microplate View shows results in a microplate format.



▶ The Table View allows data to be organized according to users' preferences.

Features and Technologies

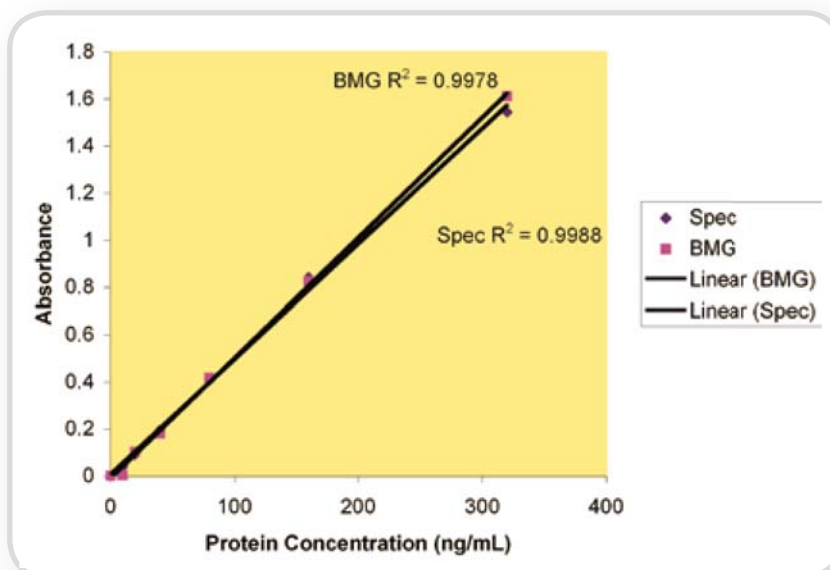
Path Length Correction

BMG LABTECH knows that users want to compare absorbance microplate results with data obtained from a 1 cm path length spectrophotometer in order to facilitate DNA quantitation, protein determination and other life science assays. All BMG LABTECH absorbance capable readers have a built-in 1 cm path length correction. This is accomplished with an internal fitting algorithm that requires no additional measurements to be made. Using this correction technique, 1cm data can be calculated from a 96-well microplate assay without any extra calculations or estimations.

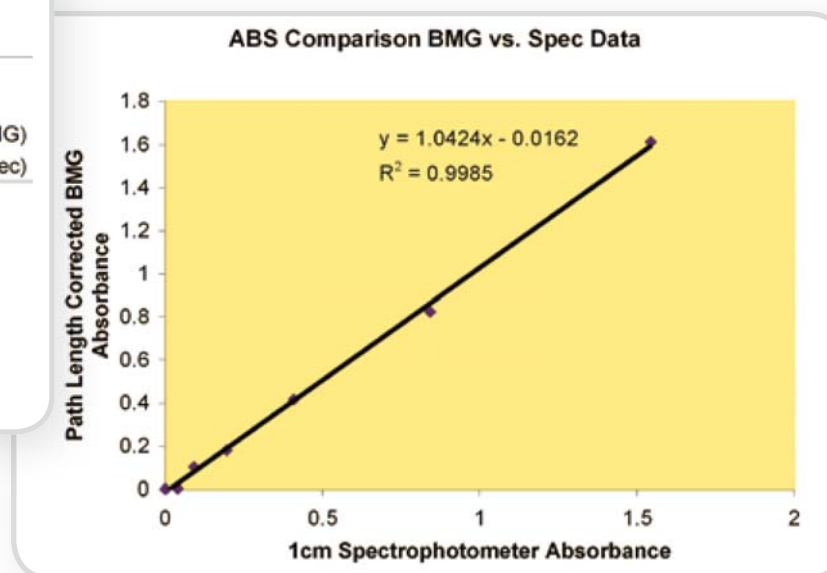
A linear regression comparison of microplate data and cuvette measurements produces an R^2 value > 0.99 . As required, the path length correction feature can be turned on or off via the software.

Absorbance Readings on a Cuvette Spectrophotometer and a BMG PHERAstar ^{Plus}

Concentration	Spec	BMG
0	0.001	0.001
10	0.04	0.005
20	0.092	0.103
40	0.196	0.181
80	0.409	0.417
160	0.843	0.825
320	1.544	1.612



The graph below compares the absorbance measurements on the graph to the right (and in the table above) that were taken with a 1 cm cuvette spectrophotometer and with a BMG LABTECH PHERAstar using path length correction.



Features and Technologies

Spectrometer

BMG LABTECH has always been an innovator in microplate reader technology. In 2007, BMG LABTECH introduced another innovation in microplate readers with a UV/Vis spectrometer option on the Omega series of microplate readers.

A spectrometer is an optical device incorporating gratings, mirrors and linear array detectors that allow the immediate measurement of light intensity throughout the complete UV and visible spectrum. Similar to a monochromator, but much faster and with better sensitivity and resolution, a spectrometer can capture the entire UV/Vis spectrum of a sample in under 1 second per well – no scanning needed.

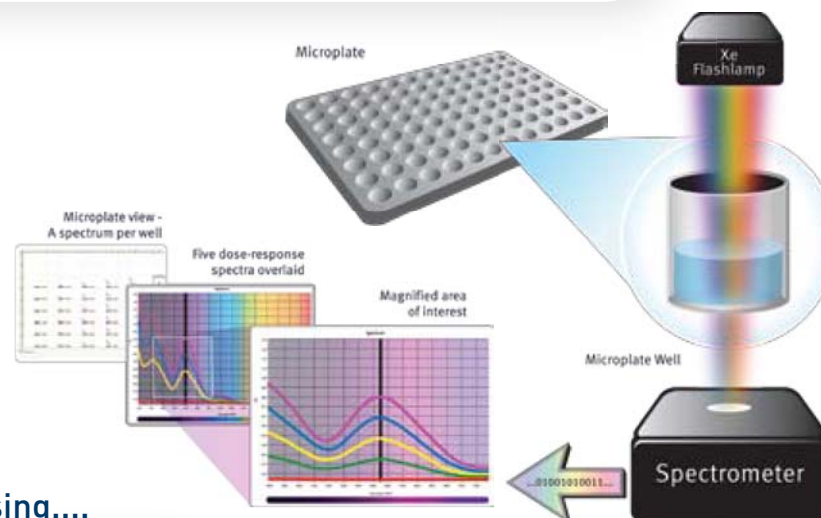
Never again worry about setting the wavelength, using the correct filter or missing the peak wavelength. The spectrometer captures absorbance data from wavelengths between 220 - 850 nm at a 1, 2, 5 or 10 nm resolution in under 1 second per well. If absorbance data is needed at more than one wavelength, it will always be there without determining the requirements beforehand.

The spectrometer permits absorbance experiments that were not previously possible. Due to the ultra-fast speed of spectral capture, time-course experiments can be monitored for wavelength shifts with 0.2 second resolution. Absorbance shifts can be monitored in real-time as an assay goes to completion. The spectrometer technology allows users to focus on developing assays and to expand capabilities without worrying about running instrumentation.

For more information on the Omega series of microplate readers see pages 21-30.

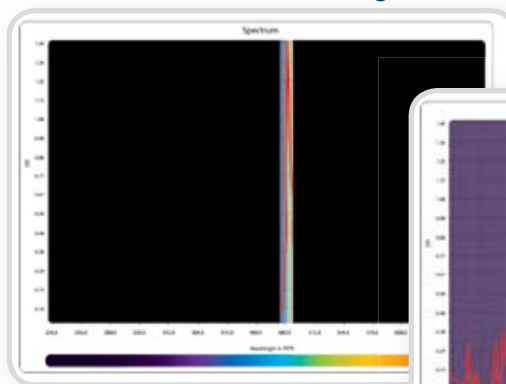
Ultra-Fast UV/Vis Absorbance Spectrometer

Spectral range: 220 to 850 nm or eight discrete wavelengths
Spectral resolution: 1, 2, 5, or 10 nm
Speed: 0.4 sec/well for 10 nm; 1.3 sec/well for 1 nm
OD range: 0 to 3 OD
Accuracy: < 1% at 2 OD

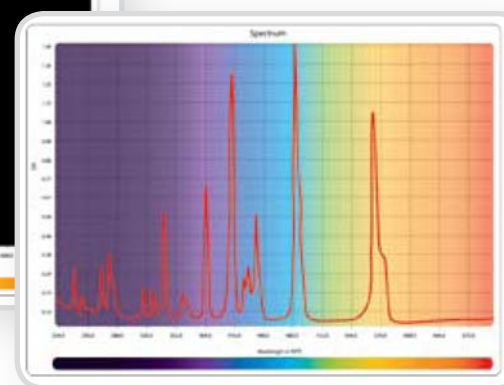


See what is missing....

It's a Spectrometer - No Scanning Required



▲ Absorbance reading from a traditional reader with a monochromator or filter (10 nm of a spectrum).



▲ Absorbance reading with the Omega spectrometer (whole spectrum from 220 - 850 nm).

TR-FRET

Time-Resolved Fluorescence Resonance Energy Transfer (TR-FRET) is employed in several different assay technologies (HTRF[®], LANCE[®], LanthaScreen[™], Transcreener[™], Adapta[™] and others). TR-FRET is a technique that measures the proximity of two fluorescently labeled molecules. It involves the excitation of a donor fluorescent group (a lanthanide) at one wavelength, which then transfers energy to an acceptor fluorophore, which emits light at another wavelength (see diagram). A TR-FRET response can be calculated by comparing the emissions of the donor and acceptor. The assay can be used to measure various aspects about the binding interaction of two molecules (e.g. IC_{50} , EC_{50}). Because time-resolved fluorescence lifetimes are longer relative to background fluorescence, very low limits of detection can be attained.

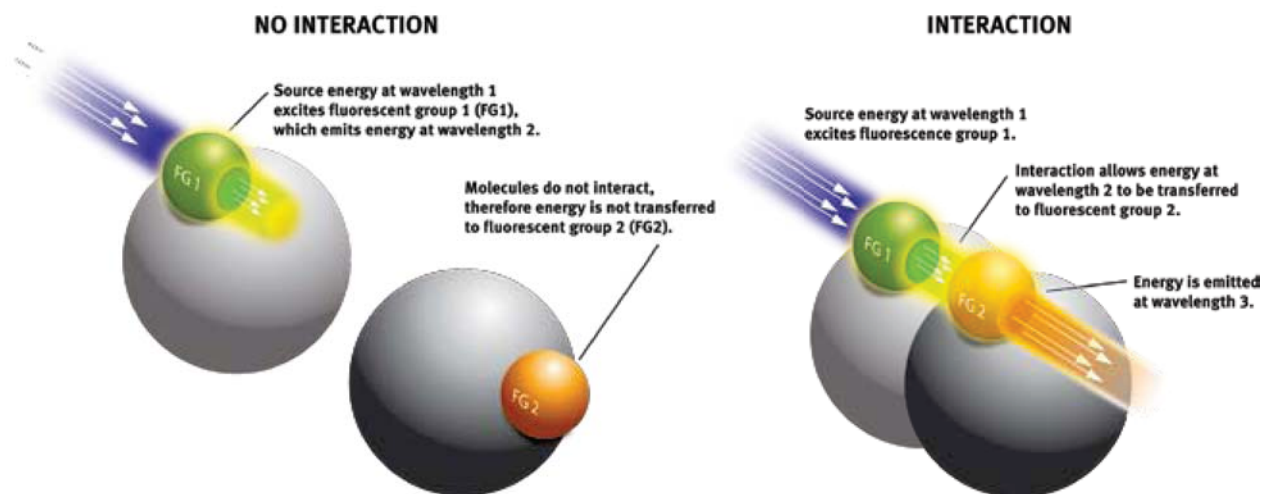
TR-FRET has is an important technique in HTS and drug discovery because it is a homogeneous assay (one step reaction done in one well of a microplate) that can be easily automated to screen thousands of compounds. A typical HTS TR-FRET assay involves the activation of a receptor, which is measured by a downstream event. The downstream event (i.e. cAMP formation, kinase activation, IP3 formation) is analyzed via TR-FRET.

In the case of Protein Kinase C (PKC), a fluorescently labeled substrate of PKC is added along with a fluorescently labeled antibody that interacts with the phosphorylated substrate. If the substrate is phosphorylated by PKC, via activation of the receptor, then the antibody interacts with the substrate and FRET occurs between the two fluorescent groups. This compound would then be considered a positive 'hit' for that receptor.

BMG LABTECH has two readers that specialize in TR-FRET measurements, the RUBYstar and the PHERAstar^{Plus}. These are the only readers available that are capable of monitoring the complete fluorescent decay curves from time-resolved fluorophores. The RUBYstar is a dedicated HTRF[®] plate reader that measures any plate size up to 384 wells, uses a pulsed nitrogen LASER and was designed specifically for HTRF[®] measurements. For more information on the RUBYstar see pages 11-14.

The PHERAstar^{Plus} is a multifunctional plate reader that can read in all detection modes (absorbance, luminescence, fluorescence, TR-FRET, FP and AlphaScreen[®]), in any plate format up to 1536 wells. The PHERAstar^{Plus} has a module-based optical system along with a TR-FRET specific detection system. BMG LABTECH has modules that have been optimized for various TR-FRET chemistries. For more information on the PHERAstar^{Plus} and optic modules see pages 1-10 and page 54.

BMG LABTECH also has an optional advanced TR-FRET measurement head for the Omega series of microplate readers. While the TR-FRET reading speed of the Omega cannot match the PHERAstar^{Plus}, the assay performance is on par with the PHERAstar^{Plus} and provides Omega users with an extremely sensitive system for non-HTS use. For more information on the Omega and TRF reading head see pages 21-30.



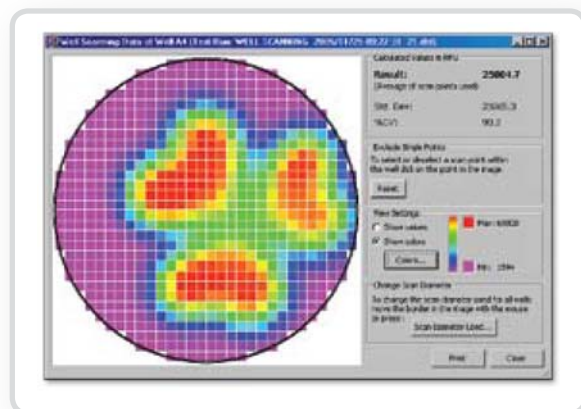
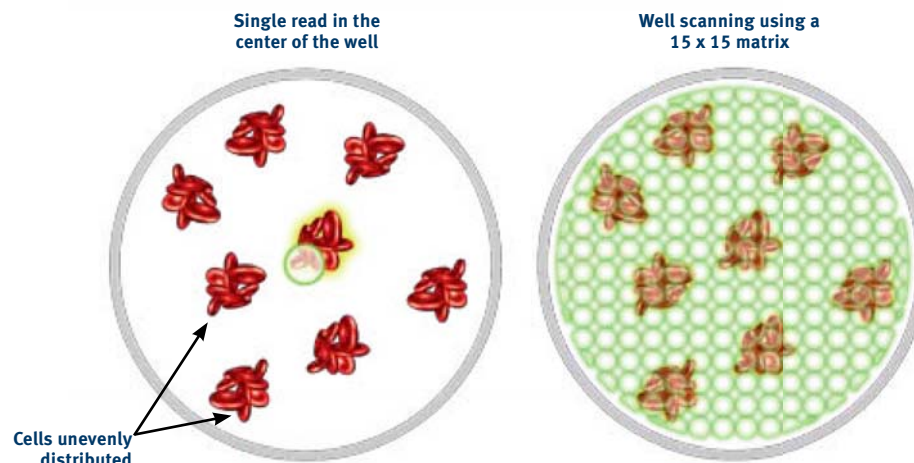
Features and Technologies

Well Scanning

For homogeneous assays, most readers take a single measurement in the center of each well. For cell-based assays or assays that are nonhomogeneous, a single center well reading may be insufficient. Cell clumping, pocket concentrations and/or particulates that fall out of solution can cause inconsistent readings from well to well and may not account for heterogeneities within a sample. In some cases a single center point reading may completely miss the material of interest in a large well format such as a six well plate. See representative diagram to the right.

To alleviate this problem, BMG LABTECH has introduced an advanced well scanning system. In well scanning mode, the reader takes multiple measurements in each well in a concentric circle or matrix format, with over 100 points per well in some circumstances. The user has full control over the number or measurements and how the data for each point is manipulated.

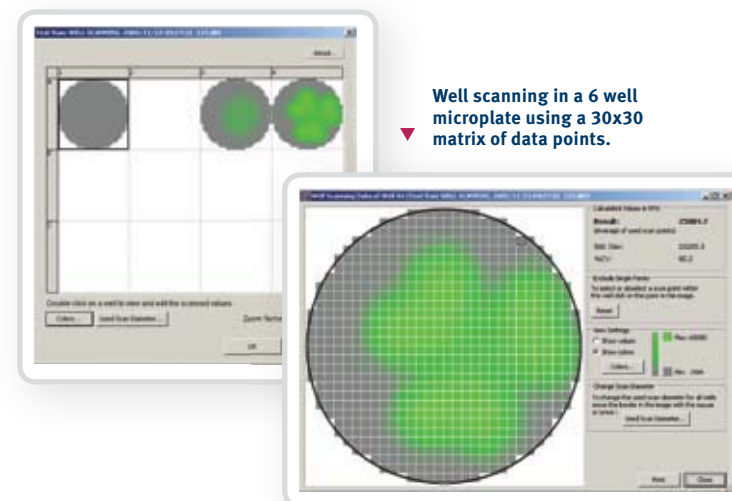
In its simplest form, the software allows for an average of multiple points within a well. Users are able to define a number of measurement points and the software acquires the data and averages the readings for the entire well, outputting a single mean value.



▲ Well scanning using a multicolor display to show different gradients of signal in one well.

In advanced well scanning mode, the software displays each point graphically and creates a well map for any well. Users can remove individual data points or entire sections of each map with a few mouse clicks. The graphical interface uses multiple color options to display data quickly, such as a two color high/low display or a colored heat map corresponding to intensity variations within the plate.

This simple yet powerful feature enables cell researchers to quantify results without the need to destroy live cells or damage cultures that have taken days or weeks to prepare. Because BMG LABTECH readers can combine incubation, shaking and gas pressure, cell lines can be kept healthy, alive and thoroughly analyzed.



▼ Well scanning in a 6 well microplate using a 30x30 matrix of data points.



Absorbance (ABS) – UV/Vis absorbance measurement is a standard technique that many ELISA assays utilize, as well as DNA and protein concentration determination.



AlphaScreen® (AS) – Amplified Luminescent Proximity Homogeneous Assay® is an HTS tool that uses donor and acceptor beads bioconjugated to molecules. When the beads are in close proximity, a cascade of chemical reactions is initiated by a strong light source with subsequent emission of light between 520-620 nm.



Bottom Reading (BR) – A reading position for fluorescence, luminescence, BRET and FRET measurements that employs clear bottomed microplates. This mode is used for cell based assays or when a lid/sealer is on top of a microplate.



Bioluminescence Resonance Energy Transfer (BRET) – BRET is a dual reporter luminescence detection assay that measures light emitted from two bioluminescent markers. By comparing the ratio of the light output of the two markers, the extent of biomolecular interaction can be determined.



Decay Curve Monitoring (DCM) – DCM is an exclusive feature on the PHERAstar^{Plus} and RUBYstar. These instruments can collect real-time, time-resolved fluorescence decay curves down to a 2 μ s resolution. This unique BMG LABTECH feature greatly helps with troubleshooting and assay development for all TR-FRET experiments.



Fluorescence Intensity (FI) – The most common analytical technique in microplate assays. A fluorophore is excited at one wavelength and the emission from the fluorophore is measured at a longer wavelength. Literally thousands of assays are available that are measured using fluorescence intensity.



Fluorescence Polarization (FP) – Technique that measures the rotation of a fluorescent molecule through the emission of light polarized in two planes. If the molecule is small and unbound, it rotates faster; when the molecule interacts and is larger, it rotates slower. FP is a homogeneous method of monitoring molecular interactions. Examples of available assays include Transcreener™ FP and Far Red PolarScreen™.



Fluorescence Resonance Energy Transfer (FRET) – FRET uses energy emitted from one fluorescent group attached to a protein (or ligand) to excite (or transferred to) another fluorescent group attached to target (or receptor). FRET can be used to measure molecular interactions, determine relative concentrations or monitor intracellular interactions. Examples of available assays include Invitrogen's® Voltage Sensor Probe and CFP/YFP protein interactions.



Incubation (Inc) – A built-in incubation chamber that keeps the microplate at a set temperature while reading microplates. A 45°C maximum temperature is standard on most BMG LABTECH readers and some have a 60°C option. For more information see page 49.



Injectors (Inj) – Reagent injectors can dispense liquids into the microplate wells. This feature can be used to start kinetic assays, such as enzymatic reactions, or to re-constitute a plate with a liquid buffer. Injections can occur at the point and time of measurement, allowing for simultaneous injection and reading. For more information see page 50.



Luminescence Detection (Lum) – Luminescence detection measures light emitted as a product of a chemical or biochemical reaction. Two common examples are Renilla and firefly luciferase. Because there is typically no luminescent background signal, luminescence assays can achieve very low limits of detection. Examples of commercially available assays include Caspase-Glo™, CYP450-Glo™ and Dual Luciferase® Reporter (DLR®).



Nephelometry (Neph) – A light scattering technique that measures forward scattered light in microplate wells. Forward scattered light can be used for highly accurate solubility determinations of compounds and determination of particle concentrations in a solution.



Pipettor – The pipettor is a unique feature found on the NOVOstar microplate reader, which allows for the transfer of reagents or compounds from one plate to another plate. It is ideal for cell-based assays that require fast kinetic reads upon the addition of a stimulus, such as calcium flux or ion channel measurements. For more information on the NOVOstar and pipettor see pages 37-43 and page 56.



Simultaneous Dual Emission (SDE) – SDE is a feature found on several BMG LABTECH readers. This feature allows the unit to measure two emission wavelengths, thus increasing the speed and accuracy of assays. For more information see page 46.



Spectrometer Absorbance (UV/Vis ABS) – BMG LABTECH is the only microplate reader company in the world that offers an ultra-fast full UV/Vis spectrometer in a multifunction microplate reader. Not to be confused with a monochromator, the spectrometer allows entire UV/Vis spectral scans from 220-850 nm, with 1 nm resolution, in approximately one second per well. For more information see page 57.



Time-Resolved Fluorescence (TRF) – TRF is an assay technique that uses lanthanides, which are rare Earth elements that have long fluorescence half-lives. The two most commonly used lanthanides are Europium and Terbium, which when excited around 337 nm emit light at longer wavelengths. The longer half-lives (microseconds vs. nanoseconds) allow for significant decrease in background fluorescence compared to more common fluorophores such as fluorescein. Because background fluorescence is very low in these assays, very low limits of detection can be attained.



Time-Resolved Fluorescence Resonance Energy Transfer (TR-FRET) – TR-FRET is a FRET technique using lanthanide donors that have long emission half-lives. A comparison measurement of the two emitted wavelengths over time is calculated for a TR-FRET response. Examples of commercially available assays include HTRF[®], Lance[®], LanthaScreen[™] and Transcreener[™]. For more information see page 58.

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Transcreener[™] is a trademark of BellBrook[®] Labs.

Element[®] is a registered trademark of Velocity11[®].

IMAP[®] is a registered trademark of Molecular Devices[®].

HTRF[®] is a registered trademark of Cisbio[®] International.

Asset[™] is a trademark of the The Automation Partnership.

Coltest[™] is a trademark of Immuno-Chemical Products Ltd.

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Customer Care / Service Information

Customer Care

At BMG LABTECH our mission is simple – to deliver the best microplate reader possible and to insure the best technical support possible.

BMG LABTECH customer care begins in Germany with the construction of our microplate readers from the highest quality components available. Our German Engineers test each instrument according to the strictest of standards before shipment. Customer care continues with direct support from the scientists and engineers at BMG LABTECH offices worldwide. All sales and technical support employees are highly trained professionals and experts in new product training, technical troubleshooting and assay support.

At BMG LABTECH we strive to provide our customers with unmatched service. If there is a need for technical support, we are only a phone call or an email away. During business hours, customers immediately speak to a live person who is happy to assist. There is no automated phone system or waiting in a queue, a live scientist or technician is always on call. If needed, BMG LABTECH offers both on-site and factory service.



U.S. Technical Service Contact Information
 Toll free number: 1-877-BMG-LABS (1-877-264-5227)
 Email: usatech@bmglabtech.com

Technical Support

BMG LABTECH does not charge for phone or email technical support and most issues are answered promptly. However, if the issue is not initially discernible, BMG LABTECH will work quickly to resolve it. Our field staff is highly knowledgeable and can perform most services that our in-house technical support personnel can perform. BMG LABTECH's technical support center is available during regular business hours.

Instrument Service

BMG LABTECH offers several different service plans to meet the needs of all research laboratories, including both on-site and factory service in the U.S.:

Repair Services

BMG LABTECH supports and services all products that we sell. If a reader's service contract is expired, our technicians will quote all work and get approval before beginning any repair. On-site service is also available on a per visit basis and may include travel costs, labor and part replacement.

Standard Service Contract

Every BMG reader purchased is covered under our standard one-year service plan. This service guarantees the repair of the unit by a qualified BMG LABTECH service personnel at our home office facility. This service plan covers all related costs of repair including parts, labor and shipping.

Preferred Service Contract

BMG LABTECH offers the Preferred Service package for those customers requiring on-site service. With this plan, a qualified service engineer will repair the unit on-site or BMG LABTECH will provide a loaner unit during the maintenance period. The goal of the Preferred Service plan is to minimize downtime and to get the unit repaired as quickly as possible.

Quality Control and Preventative Maintenance

A regularly maintained instrument ensures accurate results. BMG LABTECH offers a comprehensive Quality Control and Preventive Maintenance (QC/PM) package that can be performed on-site or at our office. This service realigns the reader, checks for potential future problems, and tests the reader in all modes. This procedure is recommended every 12 to 18 months, depending on usage.