

Bentham FCH-500/FCH-1000 Homogeniser

200 nm to 2.5 μm fibre-coupled square flat-top illumination with $U_2 \geq 98\%$

1 General Description

The Bentham FCH-500/FCH-1000 Homogeniser is a **microlens-array (MLA) based optical homogeniser** that converts fibre-coupled optical input into a large, square, spatially uniform illumination field at the sample plane.

Available with **60 mm \times 60 mm** and **120 mm \times 120 mm** projected fields, it is designed for applications requiring both high irradiance and high spatial uniformity. When paired with Bentham fibre-coupled monochromator and broadband-source systems (see *Recommended Systems* below), it provides uniform wavelength-tuneable illumination across a broad spectral range.

Typical applications include **detector characterisation, camera and image-sensor testing, solar-cell QE/EQE measurement, hyperspectral imager calibration** and related sample-plane illumination tasks.

2 Key Features

- Large-area square, flat-top illumination
- Whole-field spatial uniformity $U_2 \geq 98\%$, with large contiguous areas achieving $U_2 \geq 99\%$
- Broadband optical design for UV, visible and NIR operation (200 nm to 2500 nm)
- High optical throughput, typ. 50% at 550 nm
- Modular configuration:
 - choice of 60 mm \times 60 mm or 120 mm \times 120 mm projected field
 - choice of single-input or dual-input with motorised switching between fibre-coupled sources, USB or front-panel control
- Compatible with standard 0.22 NA fibre
- Configurable patch size, fibre connector, input count, source combination, mounting

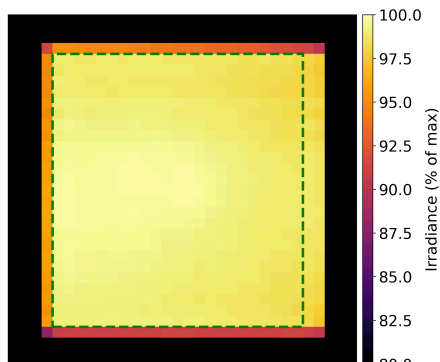


Figure 1: Measured map of typical 60 mm unit at 475 nm. $U_2 \geq 98\%$ area highlighted.

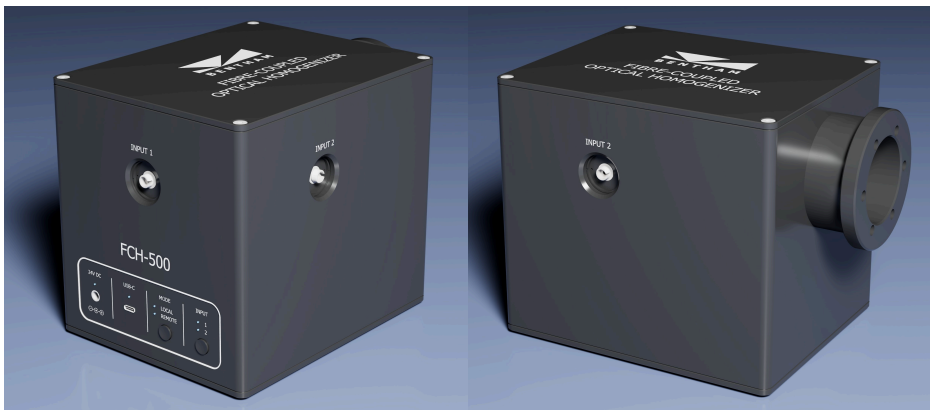


Table 1: Dual-input Fibre-Coupled Homogeniser

3 Options

The instrument is built from two modular opto-mechanical blocks, selected according to the required fibre input configuration and projected field size.

- an **input block** that accepts one or two fibre-coupled sources

Input Block	Ports	Selection
1	1	Passive, single fibre input
2	2	Motorised 2 fibre inputs, USB / front-panel control

- an **output block** that projects the homogenised square field to the working plane, shown in Figure 1.

Output Block	Projected Field	Working Distance
FCH-500	60 mm \times 60 mm	500 mm
FCH-1000	120 mm \times 120 mm	1000 mm

Ordering code example: FCH-500-1

4 Optical Specifications

Parameter	Value
Working distance	500 mm / 1000 mm
Projected field shape	Square
Spectral range	200 nm to 2500 nm
Typical throughput*	50%
Input fibre interface	SMA-905 / FC-PC
Recommended fibre core	200 μm to 800 μm

Uniformity area*	FCH-500	FCH-1000
Typical, $U_2 \geq 98\%$	3300 mm ²	13200 mm ²
Typical, $U_2 \geq 99\%$	1200 mm ²	4800 mm ²
Max., $U_2 \geq 99\%$	1800 mm ²	7200 mm ²

* Measured at 550 nm.

* Uniformity area is the largest contiguous measured area meeting the stated U_2 criterion. U_2 is the minimum

grid-cell irradiance divided by the maximum grid-cell irradiance within that area. Measured at the working distance using a 600 μm , 0.22 NA input fibre, with 2.4 mm grid spacing for FCH-500 and 5.0 mm for FCH-1000.

5 Recommended Systems

The FCH-500/FCH-1000 Homogeniser accepts standard fibre-coupled optical sources. It pairs especially well with Bentham fibre-coupled tuneable light sources, which are optimised for high whole-system throughput and provide high-irradiance, spatially uniform illumination at the sample plane.

Monochromator	Source(s)
FTMC100-LDS_0003	EQ-77X-QZ-S, EQX-850-RR-QZ-S
FTMC100-LDS_0004	EQ-99X-QZ-S
FTMC50-SCL	Supercontinuum lasers

In dual-input configurations, the two fibre inputs are typically connected to complementary source branches, for example a broadband LDLS branch and a laser or supercontinuum branch with speckle suppression. The user can switch between illumination regimes from the front panel or via USB without disturbing the optical setup.

Several example systems are detailed overleaf in Section 8.

6 Customisation

Custom configurations are available for specific wavelength ranges, patch sizes, working distances, fibre interfaces, source combinations and mounting requirements. Contact Bentham Instruments to discuss your application.

7 Applications

Applications include flat-field calibration of UV, visible, NIR and SWIR cameras; detector and photodiode-array responsivity mapping; hyperspectral and multispectral imager calibration; machine-vision camera calibration; and uniform illumination of mounted optical instruments.

The device can also support photovoltaic spectral-response and QE/EQE research, material and sample illumination, remote-sensing sensor checks and other applications requiring a large, stable, spatially uniform illumination field.

The passive single-input configuration, with no moving parts, is well suited to fixed machine-vision and process-inspection installations where stable, repeatable homogeneous illumination is required.

8 System Examples

Optical fibres present a compact, low-extendue target. Extended broadband sources therefore cannot be coupled efficiently into fibres without careful source and monochromator design.

To address this, Bentham offers specialised monochromator systems that interface directly with high-radiance broadband sources, including laser-driven xenon sources and supercontinuum lasers. A source-agnostic high-efficiency fibre-to-fibre monochromator is also available.

8.1 Supercontinuum Laser

The **FTMC50-SCL** is a monochromator-based tunable light source designed to harness the high radiance of supercontinuum laser sources and couple high-intensity monochromatic light into a free-space (Figure 2) or fibre exit port. A fibre-to-fibre speckle suppression device (**FLIPS**) is also available.

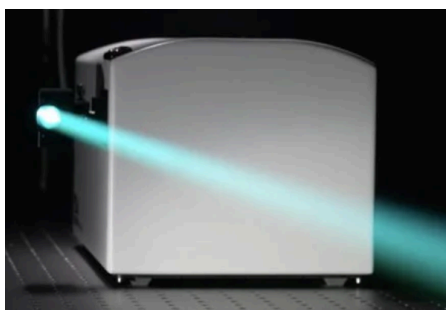


Figure 2: FTMC50-SCL supercontinuum-laser-coupled tunable light source, shown with free-space output optics. Fibre output optics suitable for use with the FCH-500/FCH-1000 Homogeniser are also available.

8.2 Laser Driven Light Source

The **FTMC100-LDS** (Figure 3) is a monochromator built specifically to harness the entire

optical output, up to 0.5 NA, of several models of laser-driven xenon light sources (LDLS). The high radiance of these sources, combined with the specialised monochromator, permits efficient coupling of intense monochromatic light into compact fibres.

The map shown in Figure 1 was created using one of these devices at 475 nm driving the FCH-500/FCH-1000 homogeniser, resulting in a high irradiance uniform light field.



Figure 3: Bentham FTMC100-LDS high-power fibre-coupled tuneable light source

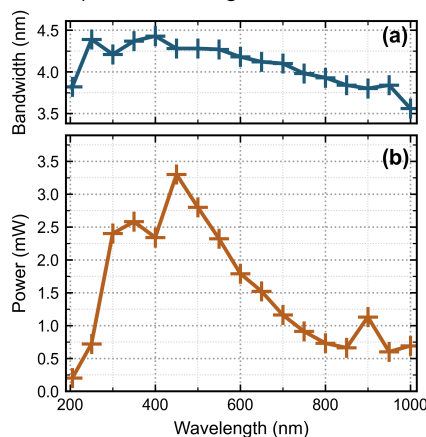


Figure 4: One possible configuration balance between bandwidth (a) and integrated output power (b) of FTMC100-LDS driven by EQ77. Other combinations bandwidth and power are available.

8.3 Fibre-coupled Monochromator

Bentham also offers the **FTMC50V**, a high-efficiency fibre-to-fibre monochromator (Figure 5) suitable for use with the FCH-500/FCH-1000 Homogeniser and with existing fibre-coupled light sources, including fibre-coupled LDLS sources such as the EQ-99X-FC. Its 0.22 NA input is matched to common multimode fibre delivery, helping to maximise fibre-to-fibre throughput.

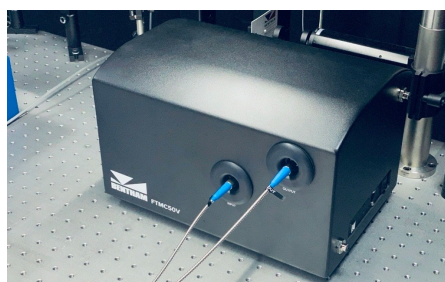


Figure 5: FTMC50V high efficiency fibre-to-fibre monochromator

8.4 Direct Fibre Source

The FCH-500/FCH-1000 Homogeniser can be used directly with standard fibre-coupled sources, including the Bentham WLS-3LED (Figure 6), lasers, LDLS sources, the TLS120Xe (Figure 7), and other broadband or monochromatic fibre outputs.



Figure 6: Bentham WLS-3LED high-power fibre-coupled LED light source

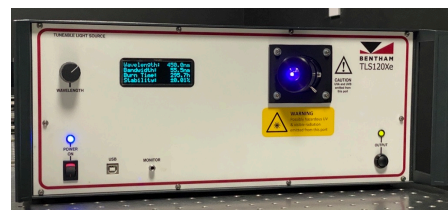


Figure 7: Bentham TLS120Xe high-power fibre-coupled tuneable light source

9 Summary

The Bentham FCH-500/FCH-1000 Homogeniser is a high-throughput, fibre-fed, flat-top field projector for generating 60 mm × 60 mm or 120 mm × 120 mm square uniform illumination fields. It is suitable for broadband or monochromatic fibre-coupled sources and is especially well matched to Bentham tuneable light-source systems.

About Bentham

Bentham Instruments has a 50-year history of manufacturing high quality products that can be found in laboratories across the world. This ubiquity is achieved through products that perform precisely, day in, day out, are durable and affordable.

Bespoke Systems

Many of the standard products in our extensive catalogue have started out as customer enquiries, resulting in products that fulfil real-world needs.

OEM applications

Bentham has a long history of successful OEM relationships with clients across the world, for whom Bentham-designed systems and components provide key spectroscopic capabilities and who can leverage Bentham's multidisciplinary expertise, capability, and flexibility.

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