



PhotoSyn[™]

High Power LED Photoreactor for Continuous Flow Chemistry





PhotoSyn™ LED Photoreactor

Variable, high power LED lamp unit for flow photochemistry



(Note: PhotoSyn shown fitted to Uniqsis Cold Coil MkII)

- High intensity, circular LED arrays direct light towards the reactor core
- Available in a variety of LED wavelength configurations
- Compatible with Cold Coil II[™] and Polar Bear *Plus* Flow[™] reactor modules
- Variable output programmable power supply
- Class leading safety features (interlocks, zero light leakage)

The Uniqsis PhotoSyn[™] is a high power LED lamp unit for continuous flow photochemistry applications.

The unit contains a set of hemispherical LED arrays composed of several hundred high quality individual diodes that maximise photon flux by concentrating the light inwards towards a central coil reactor. Chromed coil reactors are available to maximise reflective

Standard units are available with the following configurations in total power outputs up to a maximum of 700W:

- 365nm (UVA) + 455nm (blue)
- All blue (455nm)
- 455nm (blue) + 555nm (green) + white
- Customised LED arrays (e.g. 420nm, 385nm)

The high power LED arrays are water-cooled and incorporate thermal cut-outs which prevent damage associated with over-heating.

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To avoid the possibility of exposure to high intensity and/or UV light sources, the unit is constructed such that there is no extraneous light leakage in operation. Safety interlocks immediately switch off the LEDs should any attempt be made to remove the lamp enclosure from the reactor. module

The PhotoSyn[™] LED light unit is supplied with a matching high voltage power supply that 'recognises' the configuration of the lamp unit connected and modulates the current output accordingly to protect and maximise the lifetime of the LEDs. The same power supply may therefore be connected to any lamp unit.

Where available, different wavelengths, or combinations of wavelengths, can be selected using the keypad and the output can be varied from 10 to 100%.

The power supply displays the temperatures and current consumption of each LED array and has both

serial (RS232) and ethernet sockets (TCP/IP) to enable external comms connectivity.

The PhotoSyn[™] may be fitted to either the Uniqsis Cold Coil Mk II standalone coil/chip reactor module (as shown above), or the Polar Bear *Plus* Flow.

In the latter case ,it is necessary to fit an adaptor ring which both prevents the lamp unit being removed whilst powered and prevents the possibility of inadvertent exposure to high intensity light.



PhotoSyn^m is compatible with all existing Uniqsis PFA Coil Reactors constructed from either 1/16" or 1/8" OD PFA tubing.

Chromed coil reactors are also available that maximise reflected light inside the lamp unit.



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Using the PhotoSyn[™] Light Unit with the Uniqsis Cold Coil[™]

The Cold Coil Mk II is a standalone coil reactor module that is compatible with all Uniqsis coil reactors. It has a proprietary clamping mechanism that ensures coil reactors can be securely clamped in place to ensure optimal heat transfer, but easily removed and interchanged when required.

The Cold Coil has no internal electrical components and is designed to be connected to a suitable recirculating heater/ chiller.

Subject to the power of the recirculator, the temperature of the reactor may be accurately set between -80°C and 150°C.

As shown in the sequence above, assembly of the photoreactor is straightforward.

The Cold Cold II is the perfect partner for the PhotoSyn and, as shown above, these units can be seamlessly combined without the need for any adaptor plates. Moreover, the coil reactor may be quickly removed and changed.

For safety, interlock switches ensure that the LEDs are powered only when the PhotoSyn engages with the baseplate of the Cold Coil. No leakage of light occurs when the unit is in place.

When fitted with the optional Cold Coil Chip Holder (UQ1053-001), small Uniqsis Glass Static Mixer blocks may also be utilised.

Temperature control of the reactor module can be achieved by connection to either a suitable water supply (this may be the same as that used to cool the backplates of the LED arrays) or, optimally, an independent recirculating heater/chiller.

A nitrogen purge fitted to the Cold Coil II minimises condensation inside the unit.







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Using the PhotoSyn[™] Lamp unit with the Polar Bear *Plus* Flow[™]

The Polar Bear *Plus* Flow is a compact cryostatic reactor module for continuous flow applications. It is compatible with all Unqsis coil reactors. When the optional Chip Adaptor Plate (UQ1053-001) is fitted (as shown below) small Uniqsis Glass Static Mixer blocks (e.g. UQ5102) can also be accommodated.

The Polar Bear *Plus* Flow is a self-contained plug-andplay module requiring only an electricity supply to accurately control the reactor temperature from 150°C to subambient. Note: the minimum temperature attainable is determined by the throughput and the intensity of the PhotoSyn lamp unit.

Step 1: Fit the Polar Bear Plus Flow Adaptor Ring (UQ1080) and secure in place using the two red locking clamps, as shown opposite.



Step 2: Fit a suitable coil reactor (e.g. UQ2508-C) and route the tubing through the black foam inserts that prevent light escaping from the hood.

Note: It is recommended that the inlet and outlet tubes are 'sleeved' to prevent prevent light transmission along the tubing itself.

Step 3: Fit the temperature probe and lower the PhotoSyn LED lamp unit into place.

Note: The lamp unit will not disable the interlock safety switches unless the red locking clamps are rotated such that they lock the adaptor plate in position.

Step 4: Connect and switch on power supply, select wavelength (if available), switch on LEDs and select intensity.





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PhotoSyn[™] Application Note:

Organic photocatalysis for the radical couplings of boronic acid derivatives in flow

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Chem. Commun., 2018, 54, 5606.

An acridium-based organic photocatalyst is reported to be an efficient replacement for iridium-based photocatalysts to oxidise boronic acid derivatives by a single electron process. This was exemplified by the synthesis of four active pharmaceutical ingredients (APIs). A straightforward scale up approach using continuous flow photoreactors is also reported affording gram an hour throughput. The Uniqsis **Flow-UV**[™] inline spectrometer was utilised to conveniently monitor steady state.



METHOD:

A 500 mL conical-shaped flask equipped with a magnetic stir bar was charged with cyclohexyl boronic acid (3.84 g, 30 mmol, 1.0 equiv.), **Mes-Acr-4** (384 mg, 0.6 mmol, 2 mol%) and DMAP (732 mg, 6.0 mmol, 20 mol%) as Lewis base catalyst.

The flask was then sealed with a rubber septum and evacuated/backfilled with argon three times. Methyl vinyl ketone (6.0 mL, 120 mmol, 4.0 equiv.) was then added followed by 300 mL of a degassed acetone/methanol (1:1) mixture to lead a clear yellow transparent 0.1 M solution.

The clear solution was then pumped at 1.66 mL/min through the Uniqsis PhotoSynTM (52 mL, PFA; 3.25mm OD x 2.4mm ID) held at 30°C. followed by acetone:methanol (1:1) solvent to flush the reactor. The reaction plug monitored by UV-vis detection (Uniqsis Flow-UVTM), the totality of the plug was collected and then concentrated *in vacuo* and immobilised on ISOLUTE® HM-N. This immobilised crude was extracted on a pad of silica gel with 5% Et₂O in PE (3 L) to yield the pure product **5** (3.72 g, 24.1 mmol) as a colourless oil in 81% yield.

Part No.	Description
UQ1074	PhotoSyn [™] Blue HP LED photoreactor, Blue; 220/110V, 50/60Hz
UQ1075	PhotoSyn [™] UVA HP LED photoreactor UVA/Blue; 220/110V, 50/60Hz
UQ1076	PhotoSyn [™] Tricolour HP LED photoreactor Blue/Green/White: 220/110V, 50/60Hz
UQ1050-Mk II	Cold Coil [™] standalone coil reactor module (requires separate recirculating chiller)
UQ1080	Polar Bear Plus Flow Adaptor Ring for PhotoSyn™
UQ2509-C	Coil Reactor, chromed, PFA, 20ml, 1.57mm OD x 1.00mm ID
UQ2508-C	Coil Reactor, chromed, PFA, 52ml, 3.25mm OD x 2.41mm ID
UQ2507-C	Coil Reactor, chromed, PFA, 5.0ml, 1.57mm OD x 1.00mm ID

