Asynt
By chemists, for chemists

PhotoChip™ User Manual

High power LED Photoreactor for Continuous Flow Chemistry

www.asynt.com
enquiries@asynt.com
+44 (0)1638 781709

CONTENTS.

www.asynt.com
enquiries@asynt.com
+44 (0)1638 781709

1. SAFETY:

1.1 General Safety Considerations

PLEASE READ THE USER MANUAL BEFORE USING THIS INSTRUMENT

The Asynt PhotoChip is designed to work under ambient temperature conditions in a properly ventilated environment only. The high intensity LEDS must be connected to a flowing cold-water supply (or similar) to dissipate the heat generated at the back plates of the high-powered LED arrays.
Failure to do so will INVALIDATE the product warranty.
The unit is fitted with safety interlock switches which immediately disable the LEDs should any attempt be made to remove the light hood from its reactor base when operating.
The PhotoChip has been designed to prevent light leakage when in operation and therefore does not need to be used within a light-tight or tinted glass enclosure.

The PhotoChip should only be operated by technically competent users wearing suitable personal protective equipment.

CAUTION! Risk of electric shock and death. The power supply casework and the LED lamp units within the light hood should NOT be opened under any circumstances. This is a high voltage product which uses 180V DC; sufficient to cause cardiac arrest. Any maintenance issues MUST be referred to Asynt Ltd in the first instance.

CAUTION! High intensity light source. The PhotoChip is fitted with high intensity LEDs and NO attempt should be made to look at the light source when in operation.

CAUTION! High intensity UV light. The PhotoChip is fitted with high intensity UV LEDs. Any attempt to view high intensity UV LEDs in operation, even for short exposure periods, can lead to skin and tissue damage which may be irreversible.

www.asynt.com
enquiries@asynt.com
+44 (0)1638 781709

2. INTRODUCTION

The Asynt PhotoChip has been designed to provide scientists with a high-power LED light source for continuous flow applications. The PhotoChip standalone temperature-controlled photoflow reactor module enables the use with Asynt Glass Static Mixer blocks (GSMs) - sometimes referred to as 'chips' or the Asynt Tube-in-plate Reactors. Based upon the Asynt Cold Chip GSM reactor module, it is compatible with both COMPACT and LARGE format Asynt Glass Static Mixer blocks and, with channel volumes up to 20ml, is designed for use as a flow-mixing reactor.

The large-format LED array is populated with high-power LEDs that are available in a wide range of wavelengths (365nm, 385nm, 405nm, 420nm, 455nm and 525nm). Versions are available that are compatible with both the variable intensity digital Borealis power supply unit or the more compact basic Scholar PSU. The former Digital is 180W whilst the Scholar is 150W.

Fig. PhotoChip X-ray View

A spacer with internal cooling channels fitted with an indicator window separates the LED lamp from the Cold Chip in order to accommodate the threaded tubing connections on the GSM or Tube-in-plate reactors.

Fig. PhotoChip with Spacer View

Liquid-cooling of the LED array can be achieved either by connection in series with the recirculator or separately by connecting to a cold water supply. For reactions close to room temperature, a cold water supply can be connected in series to both components obviating the need for the recirculator. PhotoChip LED lamp modules are designed to be housed on the PhotoChip "spacer". The "spacer" has a locating lug to ensure that they are always installed in the same way. Once the locating lug are engaged, the interlock is deactivated. An internal temperature sensor is fitted to the coil reactor, close to the reactor tubing. This connects to the rear of the power supply and provides a direct readout of the *reactor* temperature on the control display.

The temperature of the Cold Coil – and thereby that of the GSM or Tube-in-plate reactor – is controlled by connection to a suitable external recirculator. The PhotoChip LED lamp unit can be cooled independently by connection to a cold-water supply or alternatively, if the desired reactor temperature is within the range 15₀ – 40₀C, by connection in series with the Cold Coil.

www.asynt.com
enquiries@asynt.com
+44 (0)1638 781709

The ability to control the reactor temperature independently from the temperature of the LED lamp unit means that the reactor temperature limits are dictated by the power of the recirculator.

Whereas, the Huber Piccolo (solid state) heat exchanger is a compact affordable and convenient choice for temperatures in the range 10o – 70oC, a MiniStat or MiniChiller would be required for lower reaction temperatures.

Since the reactor temperature is controlled by a recirculator, ideally using an external temperature probe inserted through the base of the Cold Chip, then any recirculator can in fact be used with the PhotoChip photoreactor system.

Note: The reactor temperature displayed on the power supply control screen is the observed temperature i.e. the power supply does not control the reactor temperature.

Fig. Huber Piccolo Peltier Heat Exchanger

www.asynt.com
enquiries@asynt.com
+44 (0)1638 781709

3. ASSEMBLING THE PHOTOCHIP PHOTOREACTOR SYSTEM:

1. Place the Cold Chip in a suitable area. Then place a suitable reactor into the Cold Chip Base, either a GSM or Tube-in-plate. 6
2. Then place the “spacer” onto the Cold Chip Base. Note: The coolant hose connections are orientated towards the “back” of the PhotoChip.
3. Connect the tubing and thread it through the foam insert to the back of the spacer.

Fig. PhotoChip Assembly

4. The high-power rating of the PhotoChip LED lamp modules requires liquid cooling to prevent the LEDs from overheating. The temperature of the Cold Coil – and thereby that of the coil reactor – is controlled by connection to a suitable external recirculatory or water supply. The PhotoChip LED lamp unit can be cooled independently by connection to a cold-water supply or alternatively, if the desired reactor temperature is within the range 15o – 40oC, by connection in series with the Cold Chip. The ability to control the reactor temperature independently from the temperature of the LED lamp unit means the reactor temperature limits are dictated by the power of the recirculator.

Fig. PhotoChip Hose Connections

5. Although not essential, an external process probe may be used to control the recirculatory. This should be inserted through the hole in the back of the Cold Chip
6. Connect the PhotoChip LED Lamp unit multi-pin connector to the Borealis power supply (twist the connector plug until the pins align with the socket in the back of the power supply, then push in and twist the outer retaining ring to lock the connector in place).
7. If using the Digital PSU and required connect the temperature sensor (yellow plug) to the rear of the Borealis power supply. 7
8. Connect the GSM or Tube-in-plate reactor inlet /outlet to a suitable pump/reagent delivery system and back pressure regulator, if required. Asynt recommend the use of the following pumps:

Part No.	Description
UQ1022T	Binary Pump Module™ (BPM), PTFE flow path, 2 x 10ml/min, Pmax=40bar
UQ1062	HPLC Pump 4.1S (CPG20EB50) with pressure transducer, 0.05-10 ml/min
UQ-1068	Dosing Pump, PTFE, diaphragm, 0.05-30ml/min
UQ-1069	Dosing Pump, PTFE, diaphragm, 0.05-30ml/min, RS232

9. Connect the power supply to the mains (110V or 220V AC; 50/60Hz) and switch the mains supply 'on'.
10. Remember to start the coolant supply to the light hood flowing before powering 'On' the PhotoChip LED lamp. Check for any leaks! The power supply has a mains ON/OFF rocker switch located to the rear of the unit.

4. OPERATING THE PHOTOCHIP LED LAMP

PhotoChip LED lamps are available in either 150W or 180W versions. The former have 96x individual high-power LEDs and are compatible with the Borealis Scholar variable analogue power supply unit (PSU). 180W versions have 120x LEDs and are only compatible with the larger Borealis Digital PSU.

The lamps are not interchangeable and have connecting plugs that are compatible only with the correct PSU. Both power supplies are constant current devices.

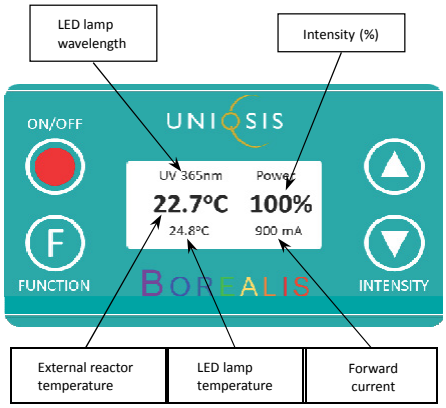
Fig. 96x LED PhotoChip LED lamp

Fig. 120x LED PhotoChip HP Borealis LED lamp

4.1 DIGITAL PSU FOR 180W PHOTOCHIP HP LED LAMPS

The LED display on the control panel of the power supply shows the following information:

a. The wavelength of the selected LED lamp.
b. The coil reactor temperature. 8
c. The power level selected (INTENSITY)
d. The current being supplied to the PhotoChip LED lamp module (mA).
e. LED lamp temperature (back-plate).



Note: in addition, operating information and error descriptions are inserted as text. The display will change colour to red if the interlock is disengaged.

1. The 'FUNCTION' button can be used to view and/or change the IP address of the module. Alternatively, set the IP address to 0.0.0.0 to switch to DHCP.
2. Press the RED on/off button to switch the LED array 'ON' or 'OFF'. The LED array will be powered at 10% intensity by default.
3. Press the <↑> or <↓> arrows to adjust the power level.

The GSM or Tube-in-plate reactor temperature is measured by a thermocouple embedded in the Cold Chip Base. This should be plugged into the rear of the PSU. The forward current is adjusted automatically to maintain constant output current.

There are ethernet (RJ45), Serial (RS232) and USB ports fitted to the back of the power supply that can be used for remote control or system integration (command protocols are available from Uniqsis on request

Fig. 180W Borealis LED lamp with DIGITAL PSU

4.2 SCHOLAR VARIO PSU FOR 150W PHOTOCHIP LED LAMPS

The 150W Scholar Vario PSU is more compact than the 180W digital PSU. Intensity can be varied manually in 20% increments using a rotary control knob. The Scholar Vario PSU is designed for standalone use and does not have external communication ports. It is simpler and more cost-effective than the larger digital PSU. It is fitted with over-current protection.

Fig. 120W Borealis LED lamp with SCHOLAR PSU

Depending upon the wavelength and intensity setting of the PhotoChip light unit, in practice the reactor temperature is typically 5o-8oC higher than the internal setpoint temperature of the recirculator. The LED (back junction) temperature will be approximately 5o-10oC higher than the reactor temperature.

5. ERROR CONDITIONS & SAFETY FEATURES

5.1 DIGITAL PSU

1. ‘Missing Thermocouple’ Thermocouple is either missing or faulty (open circuit).
2. ‘Performing Internal Test’ When the Borealis digital power supply is switched ‘on’, an internal safety test is performed to check the operation of the relays that control the power supply to the two LED arrays.
3. ‘Safety Test Passed’ A message will appear briefly at the bottom of the screen if this is completed successfully.
4. ‘Interlock’ RED screen. If an attempt is made to remove the LED lamp from the reactor when operating, or the lamp unit is not located correctly inside the coil reactor, the interlock microswitches will immediately disable the power supply to the LEDs to prevent light leakage. Only 0.5-1.0 mm of movement is sufficient to trigger this safety response.
5. If the LED lamp is replaced within 1 second, then the lamps will remain ‘off’ for 5 seconds but then restart at the last defined power level.
6. If the LED lamp is removed for more than approx 5 seconds, then the display screen will turn red and an error message will be displayed. This will then reset after 5 seconds but the lamps will remain ‘off’ until the <ON/OFF> button is depressed. The lamps will then be powered at the last defined power level.
7. If insufficient cooling is applied to the LED arrays and their temperature exceeds 50oC, the LEDS will automatically be switched ‘off’ by the power supply and cannot

be restarted until the PCB temperatures have fallen below the permitted maximum level. An error message will be displayed, accordingly.

8. Large fluctuations or unstable forward current readings may indicate a fault with the PhotoChip LED lamp unit

5.2 SCHOLAR VARIO PSU

1. If an attempt is made to remove the LED lamp from the reactor when operating, or the lamp unit is not located correctly on the PhotoChip Spacer, the interlock microswitches will immediately disable the power supply to the LEDs to prevent light leakage. Only 0.5-1.0 mm of movement is sufficient to trigger this safety response.
2. If the LEDs become too, a thermal cutout in the Borealis LED lamp will cut power to the LEDs until the lamp unit has cooled to below approximately 35$_{o}$C.

Please Note: The green LED on the front of the PSU indicates that the PSU is powered and not that the LEDs are necessarily illuminated.

6. SPECIFICATIONS

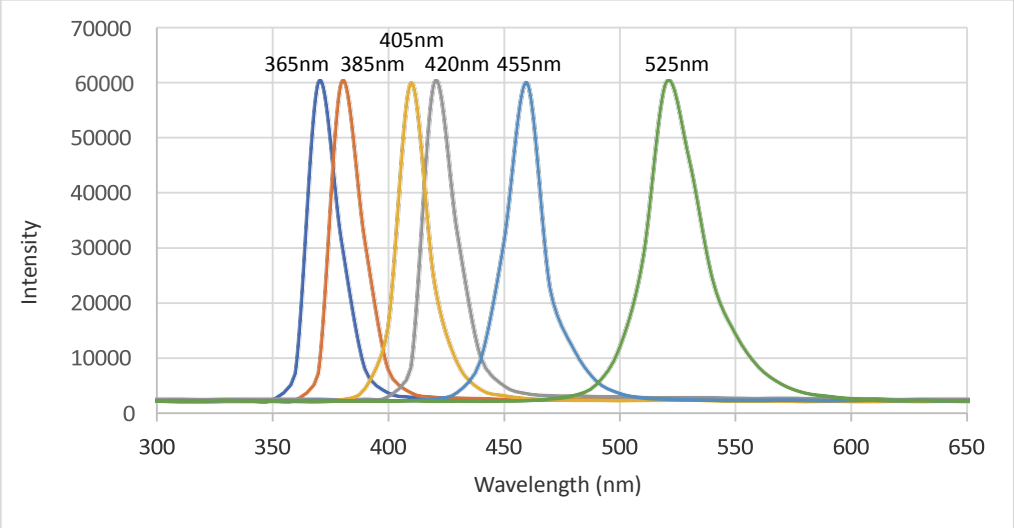
Part No.	Description
UQ8230	PHOTOCHIP GSM, base unit including spacer (excluding LED lamp and PSU)
PhotoChip 150W LED arrays	
UQ8226	BOREALIS$_{TM}$ SCHOLAR Vario Power Supply Unit, 150W; 110/230V
UQ8231	PhotoChip LED lamp unit, 365nm, 150W
UQ8232	PhotoChip LED lamp unit, 385nm, 150W
UQ8233	PhotoChip LED lamp unit, 405nm, 150W
UQ8234	PhotoChip LED lamp unit, 420nm, 150W
UQ8235	PhotoChip LED lamp unit, 455nm, 150W
UQ8236	PhotoChip LED lamp unit, 525nm, 150W
UQ8237	External Temperature Sensor with handheld display
PhotoChip 180W LED arrays	
UQ8206	BOREALIS™ Digital Power Supply, 300W; 230/110V
UQ8231HP	PhotoChip HP LED lamp unit, 365nm, 180W
UQ8232HP	PhotoChip HP LED lamp unit, 385nm, 180W
UQ8233HP	PhotoChip HP LED lamp unit, 405nm, 180W
UQ8234HP	PhotoChip HP LED lamp unit, 420nm, 180W
UQ8235HP	PhotoChip HP LED lamp unit, 455nm, 180W
UQ8236HP	PhotoChip HP LED lamp unit, 525nm, 180W

6.1 Power Supply

Width x Depth x Height	190 mm x 460 mm x 140 mm
Weight	7.3 kg

6.2 Borealis LED Lamp Assembly

Width x Depth x Height	180 mm x 180 mm x 150 mm
Weight	6.5 kg



6.3 Borealis Power Supply Specification

100-240V, 50-60Hz, <2.0A

Mains supply voltage fluctuations are not to exceed ±10% of the nominal supply voltage.

6.4 Electrical Supply

The device is intended for use with AC power networks of 110–230 VAC and 50-60Hz.

Check that the supply voltage marked on the serial number label, and the type of mains plug, are correct for your mains supply outlet, which must have a ground connector.

6.5 Conditions of Use

Operating environment:	Indoor use only
Pollution degree:	2
Installation category:	II
Temperature	5 to 40$_{o}$C
Maximum relative humidity	80 % r.h. in room temperatures up to 31°C decreasing linearly to 50 % r.h. at 40 °C
Altitude	Up to 6,500 feet (2,000 m) above sea level
Operating Environment:	Indoor use only

The unit should be protected from exposure to direct sunlight.

7. WARRANTY

The PhotoChip photoreactor is covered by a warranty for 12 months from the date of delivery. **The warranty does not include:**

Accidental or willful damage
Fair wear and tear
Damage caused by incompatible solvents or substrates
Damage specifically caused inadequate cooling of the LEDs
Blockages caused by precipitation in the reactor tubing
Blockages attributable to build up of residue in the cooling channels associated with a contaminated coolant liquid or water supply
Use outside of the parameters of the conditions of use (see conditions of use e.g. allowing LEDs to overheat)

Warranty includes:

Protection against faulty materials or workmanship
Shipment costs if unit is required to return to base for repair

All warranty claims shall be invalid if any unauthorized changes are made to the unit or any attempt is made to open the power supply or LED lamp array casework.

8. CLEANING & CARE

Risk of electrical shock or short circuit if cleaning solutions enter the inside of the Borealis power supply. Do not over-moisten the cleaning cloth. All external surfaces of the instrument can be cleaned using a cloth moistened either with a dilute aqueous soap solution or isopropanol.

Corrosive reagents and solvents should not be left in contact with any painted or anodized external surfaces for extended periods of time.

9. SERVICE & SUPPORT

For service and support please call Asynt:

Asynt Ltd.
29 Hall Barn Road
Industrial Estate,
Isleham,
Cambridgeshire CB7
5RJ
United Kingdom
T: +44 (0)1638 781709
E: enquiries@asynt.com
W: www.asynt.com