TLS120Xe User Manual

1. Overview

Figure 1: TLS120Xe unit

The TLS120Xe is a tuneable light source operating from 280 nm to 1100 nm, with a wavelength switching speed of <10ms for 100nm and a wavelength accuracy of ±0.1nm. It can be controlled via the front panel or via the USB interface. The unit contains a 75 W xenon light source with a precision regulated supply, a concave diffraction grating monochromator and optics to couple the monochromatic output to a light guide.

The diffraction grating is a 1200g/mm ruled, concave diffraction grating. This is mounted on to a stepping motor allowing switching between wavelengths. The use of an elliptical reflector results in a higher power output than would be otherwise while a 4 position filter wheel acts as a shutter and is used to suppress the presence of higher diffraction orders.

Note: *The gas contained within the lamp is held under high pressure. Always wear eye protection when the lamp is exposed and hand protection when changing the lamp. The lamp in the TLS120Xe can be operated horizontally or vertically with the anode above the cathode. Running the lamp with the cathode in the uppermost position will permanently damage the lamp and lead to failure within a few hours.*

Furthermore, the spectral output of the TLS120Xe has been measured at Bentham using a double monochromator over its working spectral range. The absolute power output has been determined by measuring the output using a detector with known spectral response.

2. Monochromator

The TLS120Xe contains a Czerny-Turner monochromator that diffracts the broad spectrum light and allows the users to select individual wavelengths to use. The principles of operation of the monochromator are discussed in the following section.

The Czerny-Turner configuration, as employed in Bentham monochromators, uses a diffraction grating. In order to control the location of diffracted light, the grating should be illuminated by collimated light. Incident light, diverging from an entrance slit is collimated by a first concave mirror. After diffraction from the grating, light is focussed to an exit slit by a second concave mirror. As a function of wavelength therefore, the grating is rotated to scan through a spectral range.

The efficiency of a grating is defined as the power of monochromatic light diffracted into a given order relative to that light incident. In order to increase the efficiency of a grating at a given wavelength, the angle of the grooves is designed such that the specular reflection from the grating surface lies in the same direction as that wavelength in question. This procedure is called blazing, the peak wavelength being the blaze wavelength.

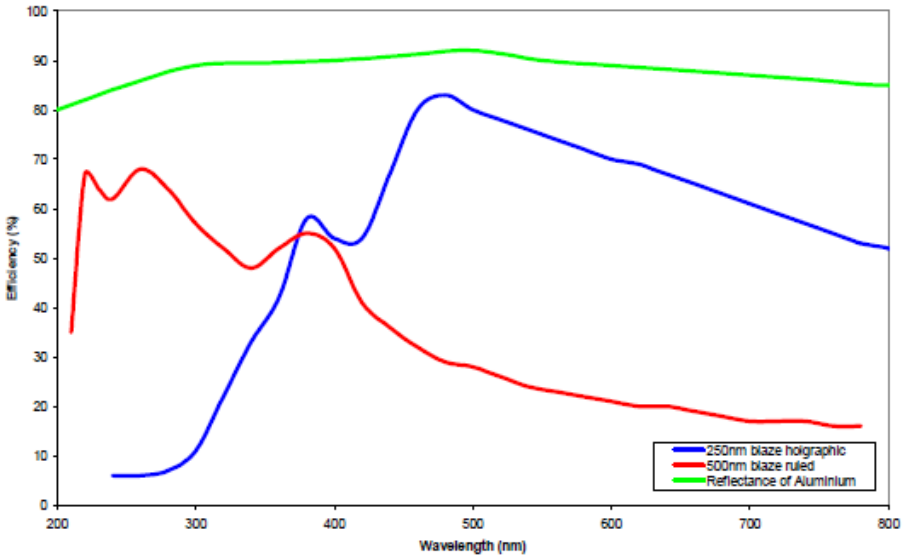

Figure 2: Typical efficiency of 1200 g/mm gratings, blazed at 250nm (blue) and 500nm (red)

The consideration of grating efficiency becomes more complicated when one considers polarised incident light, and in particular the case of TM polarised light in which case the electric field vector is perpendicular to the grooves, giving rise to anomalies, or abrupt changes in the grating efficiency curve.

To move the diffraction grating through a range of angles in a repeatable manner, stepping motors are employed. A stepper motor is a type of electric motor that moves in increments, or steps, rather than turning smoothly as a conventional motor does. The size of the increment is measured in degrees and can vary depending on the application. Typical increments are 0.9 or 1.8 degrees, with 400 or 200

increments thus representing a full circle. The speed of the motor is determined by the time delay between each incremental movement.

Inside the device, sets of coils produce magnetic fields that interact with the fields of permanent magnets. The coils are switched on and off in a specific sequence to cause the motor shaft to turn through the desired angle. The motor can operate in either direction. When a current is passed through the coils of a stepper motor, the rotor shaft turns to a certain position and then stays there unless or until different coils are energized. Unlike a conventional motor, the stepper motor resists external torque applied to the shaft once the shaft has come to rest with current applied. This resistance is called holding torque. Stepping motors, combined with gear systems or sine-bar mechanisms are used to provide high precision and highly repeatable monochromators.

3. Order Sorting Filter Wheel

As explained in the previous section, the governing diffraction equation admits solutions for integer multiples of the wavelength in consideration, thus diffraction orders. Most spectroradiometry is performed on the first order contribution, it is necessary to avoid measurement of higher order signals for correct measurements. An order sorting filter wheel is to be found on the inside of the monochromator exit port. The following filters are fitted:

Position	Filter	Insertion (nm)
1	Shutter	-
2	Open	0
3	OS400	400
4	OS700	700
5	-	-

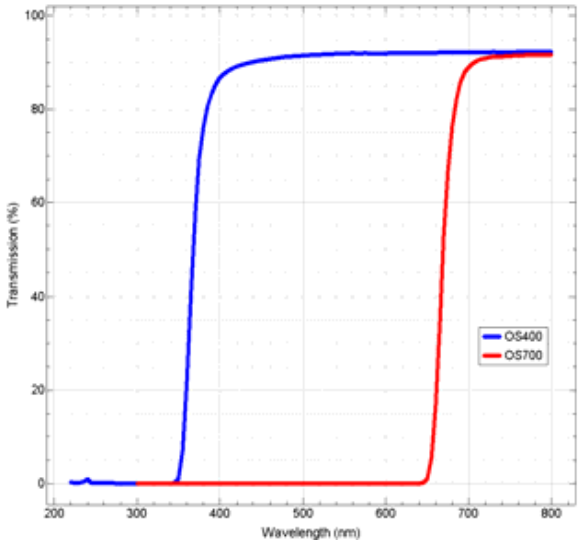

Figure 3: Top; table of filters fitted to the TLS120Xe and their positions in the filter wheel. Below; transmissions of the OS400 and OS700 filters

4. Bandwidth

The bandwidth is set by fixed width entrance and exit slits. Always use slits in equal width pairs. To change slits, disconnect the unit from the mains and remove the top cover by undoing the M4 screws at the rear corners. Pull out the slits with a pliers and replace as required noting correct orientation. The table below shows the various slit widths and bandwidths available with the TLS120Xe.

Grating Groove (l/mm)	1200
Reciprocal Dispersion (nm/mm)	2.70
Slit Width (mm)	**Bandwidth (nm)**
0.74	5
1.48	10
2.96	20
5.92	40

5. Operation of the TLS120Xe

NOTE: Users should ensure that the unit is powered from an earthed wall socket.

Upon powering on the TLS120Xe, users will be presented with the following splash screen showing the product ID, serial number and firmware version.

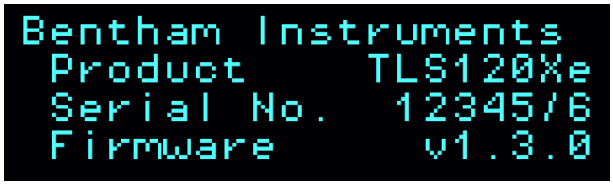

Figure 4: Splash screen at initial boot of TLS120Xe

Upon finishing the boot sequence and the xenon lamp striking the display will indicate the wavelength, calculated bandwidth (given the slits installed), the burn time of the lamp and its stability.

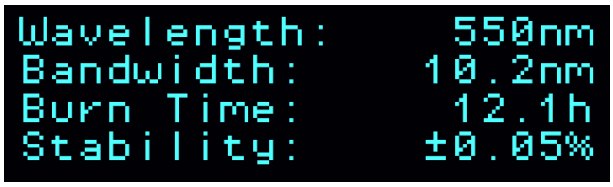

Figure 5: Display during normal operation

5.1 Manual Control

Before beginning the user should attach a fibre or liquid light guide to the output of the TLS120Xe. To manually control the TLS120Xe, firstly turn the power on the unit using the power switch, the lamp

will automatically turn on by default but this is user-configurable. The LED should turn from red to green to indicate that the lamp has ignited.

If the unit has not been set to ignite the lamp at start up, then pressing the output button will turn the lamp on.

The user can then use the wavelength knob to select the wavelength, with a 1nm resolution. Users can also use the iris situated on the optics tube.

Figure 6: TLS120Xe with fibre optic attached

5.2 Software Control

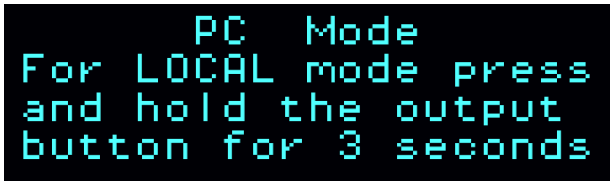

Figure 7: Display shown when initiating remote mode

Software control of the TLS120Xe can be conducted via an intuitive SCPI command interface. This allows the user to control the wavelength to a resolution of 0.1nm. Upon finishing the boot up sequence, the user can control the unit remotely. In the following example the TLS120Xe is set to remote mode, the target wavelength is set to 500nm, the target filter set to the appropriate filter for 500nm and the monochromator moved to the target wavelength:

:SYST:REM
:MONO 500
:MONO:FILT:WAVE 500
:MONO:MOVE

A much more detailed guide to remotely controlling the TLS120Xe can be found in the TLS120Xe Communications Manual found on the helpdesk.

6. Lamp Installation and Alignment

The xenon lamp should be changed if it has failed or if the power output has fallen below the recommended level of 87.5% of the initial output. This should be around 2000 hours. The lamp used in the TLS120Xe is the Ushio UXL-S75XE.

6.1 Removing the old lamp

Before removing the old lamp, read safety instructions supplied by the lamp manufacturer with the replacement lamp and ensure that you wear goggles and protective gloves. Avoid touching the lamp envelope. It is important not to strain the lamp so follow the instructions in order.

1. Switch off unit and remove power cord. If the unit has been running, wait at least 10 minutes for the lamp to cool
2. Remove the side panels by prying them off using the divots and then remove the top cover
3. Unplug the lamp shield safety switch, undo the screws holding the safety shield and then remove the lamp shield
4. The anode end of the lamp is the larger ferrule which is clamped into the brass block which has the red wire connected to it. The cathode end is the smaller ferrule which is connected to the bare flying lead by the small brass cylinder
5. Loosen screws on the wire connected to the tip of the lamp
6. Remove screw terminal attaching to the tip of the lamp
7. Loosen screws holding the base of the lamp
8. Withdraw the old lamp from the unit and place on one side

6.2 Inserting the new lamp

As before, you must fix the lamp in the correct order to avoid straining the envelope.

1. Take the new lamp out of its box. Remove the plastic safety cover from the new lamp and fit it to the old lamp. Place the old lamp in the packaging for disposal
2. Noting the cut out in the parabolic mirror and the seal protruding from the side of the xenon lamp, attach the screw terminal to the tip of the lamp (opposite end to the lamp seal) taking care that it sits flush with the lamp
3. Place the lamp into the receptacle aligning the lamp seal with the cut out in the parabolic mirror
4. Tighten the screws on the lamp base
5. Replace the lamp cover and secure in place with the screws
6. Plug in the safety shield switch and loosen the setscrew lock screws from the top of the TLS

7. Replace the top cover but leave the side panel off

6.3 Optimising the lamp position

To optimise the lamp position of the TLS120Xe users should:

1. Connect the fibre or liquid light guide to the monitor port of the TLS120Xe
2. Switch TLS120Xe on, as well as the lamp if the lamp doesn't automatically switch on
3. Hold the output button for 3 seconds to enter the optimisation mode
4. White light should be emitted and the sensor information is displayed. The user can use the wavelength knob to change the target wavelength

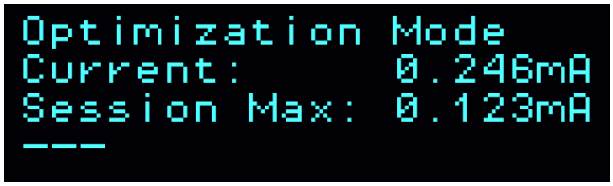

Figure 8: Front panel display during optimisation mode

5. Adjust the kinematic mount to maximise the signal. The 2 alignments are the height and the tilt of the bulb. These 2 are controlled in the following way. Both the height and tilt alignments should be done iteratively until no more signal can be gained.

   Height: At the top of the light source is a central screw held in place with a nut onto the central aluminium bar (red circle). This nut can be loosened so that an Allen key can be inserted in the top of the grub screw. As this grub screw is rotated the bulb will be moved vertically in the mount. The resultant value should be watched and the height of the bulb adjusted until this is a maximum value

   Tilt: There are three other grub screws present which screw directly into the brass block (blue circles). Each of these adjusts the tilt of the xenon bulb. Each of these should be adjusted so that a maximum resultant value is seen. It may be found that after all 3 have been adjusted, the first can be adjusted further to gain even more signal, therefore this process should be done iteratively until no more gain in signal can be achieved

6. When a maximum signal is achieved, switch unit off
7. Remove mains connector and top cover
8. Tighten set screw lock screws
9. Replace top and side covers and insert mains cable

7. Changing Slits

To change the slits inside the TLS120Xe, users need to:

1. Remove the side panels using the divots on the panel then remove the top panel
2. Pull existing slits out, noting the orientation

3. Put new slits in, ensuring they are correctly orientated. The slit plates should be towards the grating
4. Replace the top and side covers
5. Turn on the TLS120Xe and the lamp if not already on. The splash screen should show
6. Briefly press the output button while the lamp is striking. This should allow the user to enter slit setup mode

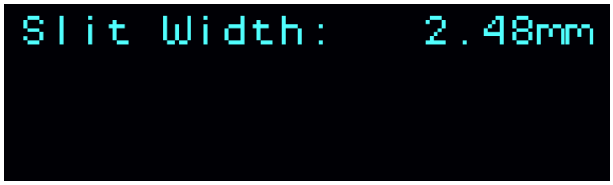

Figure 9: Front panel display during slit setup mode

7. Use the wavelength knob to set the slit width
8. Press the output button again to exit