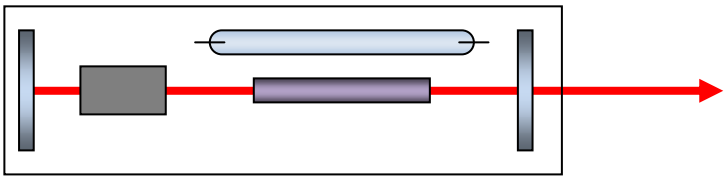
Litron Pulsed Laser Control Software

Litron Lasers Ltd
V2.02

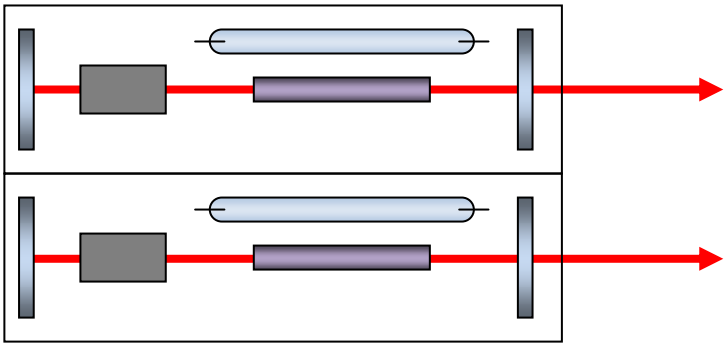
System Overview

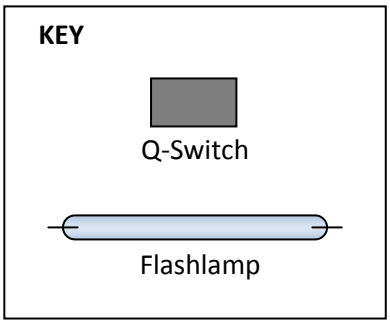
The Litron Control Software can be used to control a standard Litron Pulsed Laser System with up to 2 flashlamps and 2 Q-Switches. The three common configurations are shown below.

Oscillator

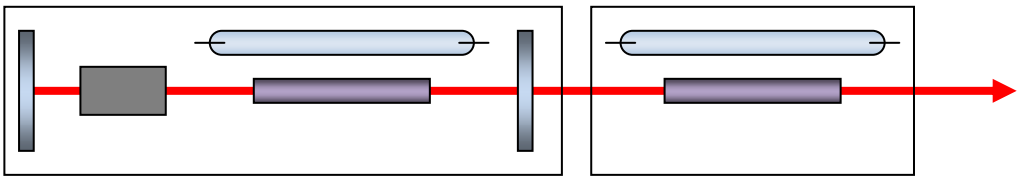


Twin Oscillator





Oscillator – Amplifier



Each Oscillator has a flashlamp which is triggered to fire a pulse of energy into the laser rod. This pulse is typically a few hundred microseconds in length. When enabled, the q-switch can be triggered after the flashlamp to let the laser pulse out of the laser cavity. The timing of these triggers is discussed later.

The energy output from the laser is adjusted by either altering the energy supplied to the flashlamp, or by altering the timing between the flashlamp and q-switch triggers.

On some systems it is possible to alter the repetition rate of the output pulses within a given range.

A mechanical shutter is fitted to each oscillator to allow the control of laser output.

System Operation

Interlocks

The system is hardware protected against certain failure modes. If a failure is detected, the laser is shut down into a safe mode and the error condition is reported. The interlocks are described below :

Laser Head	The cover on the laser head is not fitted.
PSU Cover	The cover on the laser power supply is not fitted.
PSU Temperature	The power supply is too hot.
Water Temperature	The internal cooling water is too hot.
Water Level	There is not enough internal cooling water.
Water Flow	There is not enough internal cooling water flow
Shutter Out Of Position	The beam shutter has not reached its commanded position in time.
Charger 1	The power module for flashlamp 1 has a fault.
Charger 2	The power module for flashlamp 2 has a fault.
Simmer 1	Flashlamp 1 will not ignite.
Simmer 2	Flashlamp 2 will not ignite.
External	The hardware link on the back of the power supply is open circuit.

When any interlock causes the system to shut down, the state of all interlocks at the time of failure is latched. This is to catch transitory / momentary failures and aid diagnostics. The system will continue to report this latched interlock state until it receives a command to restart the system. It will then update all the interlocks to their live state, report this state and attempt to restart the system (if the new interlock state allows).

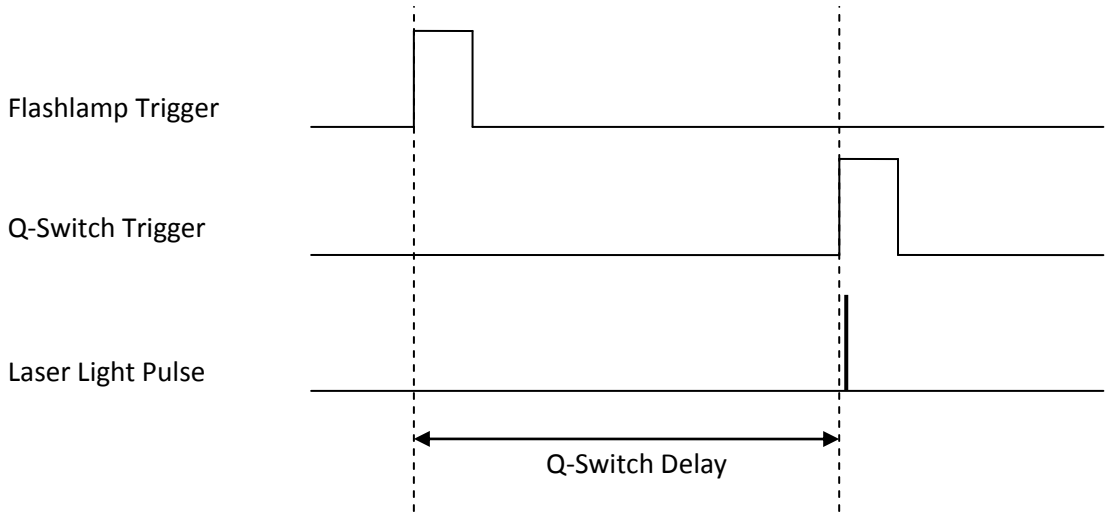
System Timing

Depending on the system configuration there may be up to 4 trigger pulses which must be accurately timed with respect to each other. When the system is using its own internal trigger generators, there are various system delays which can be adjusted for correct operation.

Q-Switch Delay

It is important for each Oscillator to fire its Q-Switch a specific time after its flashlamp. This is known as the Q-Switch Delay. The optimum value can be found in the laser test sheets (in the laser manual). This value is different for each laser. On dual oscillator systems, it is normal for the q-switch delays for the two heads to be slightly different.

The laser light pulse will be synchronised to the Q-Switch trigger.

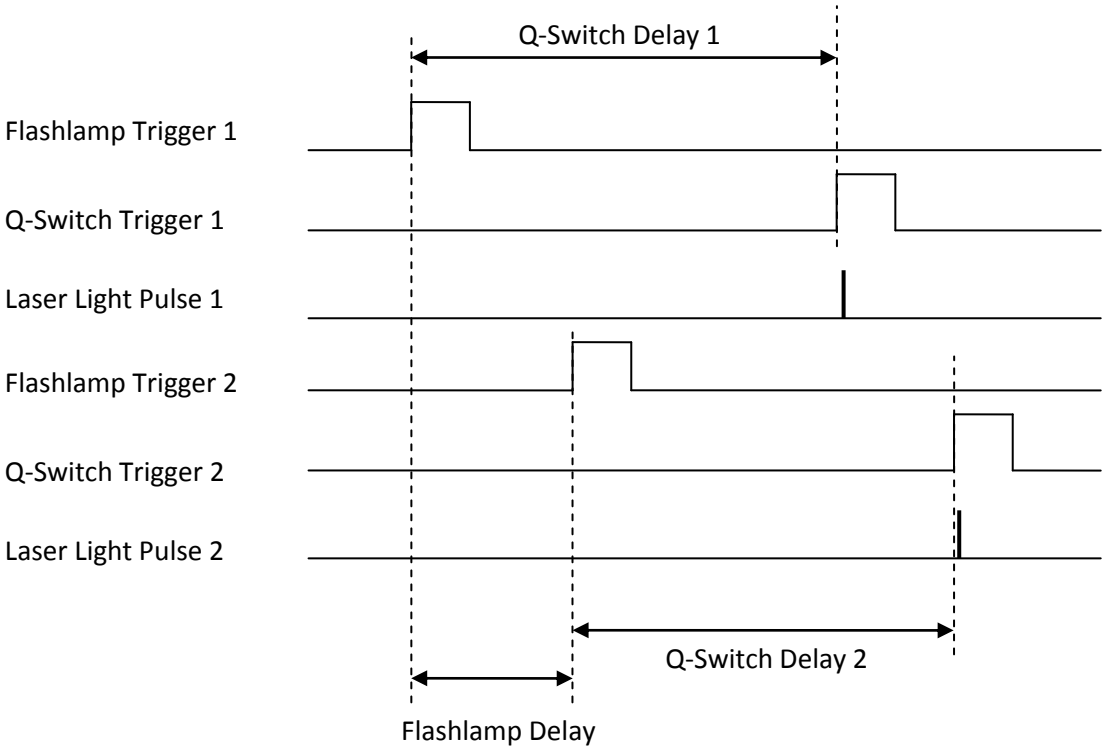


Flashlamp Delay

The Flashlamp Delay is used to adjust the delay between the flashlamp triggers on dual flashlamp systems (Twin Oscillator or Oscillator-Amplifier systems).

On an Oscillator-Amplifier System, the flashlamp delay should be set to zero unless told otherwise in the laser manual.

On a twin oscillator system, the Flashlamp Delay is used to apply a known time interval between the two laser pulses.



The flashlamp delay may be positive or negative enabling the lasers to fire in any order. A positive delay will cause Laser 1 to fire before Laser 2. A negative delay results in Laser 2 firing first.

The laser pulse separation time between Laser 1 and Laser 2 can be calculated as:

Flashlamp Delay + (Q-Switch Delay 1 – Q-Switch Delay 2)

Repetition Rate

The rep rate is the frequency at which the laser fires. It is defined in Hz and most lasers can operate within a defined range of frequencies. This range will be found in the laser manual.

System Parameters

Laser Energy Adjustment

The laser output energy is usually controlled by adjusting the voltage applied to the flashlamps. This is referred to as the Laser Drive value and is set to a value between 0 – 100. The graph of Laser Drive vs. Laser Output Energy is not linear. A table in the test sheets (found in the laser manual) will give a selection of points along this graph for a specific laser.

Enable Signals

The internal trigger generators used to generate the flashlamp and q-switch trigger signals can be enabled / disabled independently as required.

Trigger Sources

Triggers for lamps and q-switches can either be generated internally, or fed in from an external source.

Flashlamp Shot Counters

There are two shot counters for each flashlamp.

The Current Shot Counter is resettable. It should be used to keep track of the shot count of the current flashlamp to assist with a preventative maintenance schedule. It should be reset whenever a new flashlamp is fitted.

The Total Shot Counter is not resettable and shows the number of shots fired by the system since new.

The shot counters count flashlamp pulses rather than laser output pulses.

Rep Rate Divide

On some systems it is preferable to keep the flashlamps running at a fixed repetition rate. It is possible to decrease the effective rep rate by only firing the q-switch every second or third shot etc. This results in generating laser output pulses at ½, ⅓, ¼ etc of the base rep rate.

Burst Mode

When the lamp triggers are generated internally, it is possible to fire the flashlamps in bursts rather than continuously.

"G" Systems

There is a group of lasers which must be controlled in a slightly different way. These are identified by the letter "G" in the laser model number.

These systems perform best at a single fixed Repetition Rate and a single fixed Flashlamp Drive level.

It is possible to operate theses systems at ½, ⅓, ¼ etc of the base repetition rate using the **Rep Rate Divide** function described earlier.

Because the Flashlamp Drive cannot be adjusted, a different technique is required to adjust the laser energy output. To decrease the laser output energy, increase the Q-Switch delay. A table of Q-switch Delay vs. Laser Output Energy will be found in the laser manual.

Warning : On systems which have removable harmonic generator crystals, the range of acceptable Q-Switch Delays may change depending on whether the crystal is fitted or not. If this is the case it will be stated clearly on the laser test sheets. Do not operate the laser outside the recommended Q-Switch delay values for the current crystal configuration.

Control Interface

Installation

The Control Software is supplied on CD. It will run on any PC running Windows XP or later.

To install, simply run the Setup file.

If an existing copy of the software is already installed on the PC, this must be removed first using the Windows Control Panel.

Serial Port

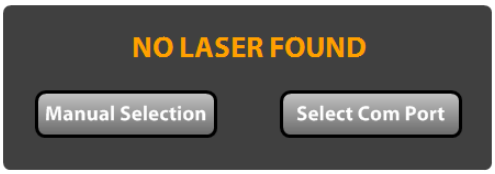
The Laser system is controlled via an RS232 Serial Port. The software will detect any serial ports available to the PC. These may be internal, or USB-Serial Converters.

The first time the software is run, the software will show you all the Serial Ports it has found.

Press the button relating to the Port connected to the laser.

The software will then try to communicate with the laser through that port.

If the laser is not found, the software will ask you to select another port.



Alternatively, you can choose you laser type manually, although without communication the software will only run in Demo Mode.

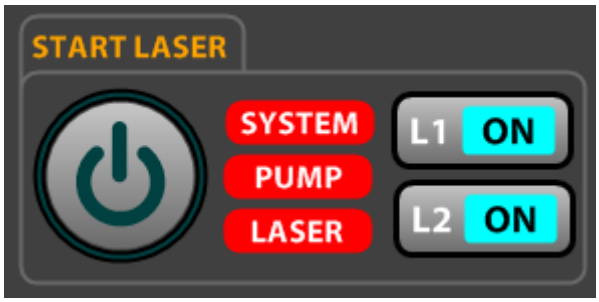
If the software has run successfully in the past, it will automatically try to find the laser on the last port it used and selection will not be needed.

Main Control Screen

The software will detect the configuration of your laser and present you with the correct control screen for your system. The layout of the screen will vary depending on the laser type, but most of the controls are common to all lasers.

Start Laser

The laser is started by pressing the circular Power button.



This will take the laser through a start sequence which may last up to 20 seconds.

The Power button will flash during the start up sequence. It will change to steady blue once the laser successfully starts.

Pressing the Power button again will turn the laser off.

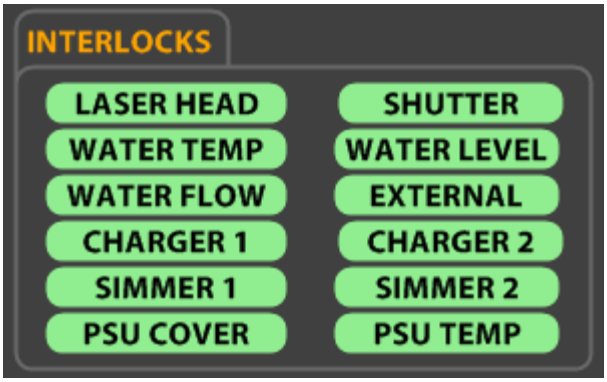
The L1 / L2 buttons allow the user to disable lamps in a multi-lamp system. These controls are usually used to power up only one laser head of a two headed system.

Interlocks

The laser is protected by a collection of interlocks.

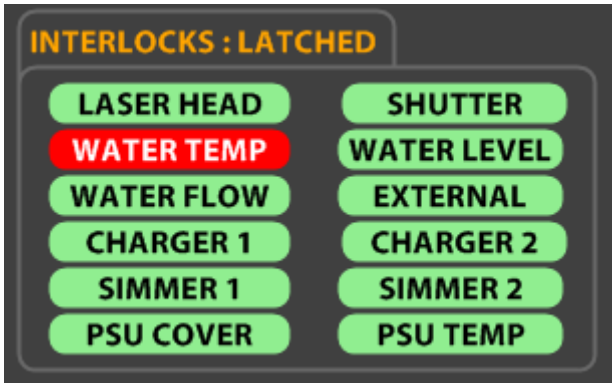
During normal operation these should all be in a “Good” condition shown by green.

It is normal for the **Simmer** and **Water Flow** interlocks to be red before the system is started. They should turn green during the start-up sequence.



If the laser won’t start, it may be due to an interlock fault. Check the interlock indicators to ensure they are green.

If an interlock fault occurs whilst the laser is running, the laser takes a snapshot of the interlocks and shows the interlock state at the moment of failure.



This is indicated by the ‘**INTERLOCKS : LATCHED’** title. This helps diagnose laser faults.

The ‘**INTERLOCKS : LATCHED’** message informs the user that the indicators are not showing live information.

To exit the latched state, press the **Close Shutter** button or the **Power** button (if you want to try to restart the laser).

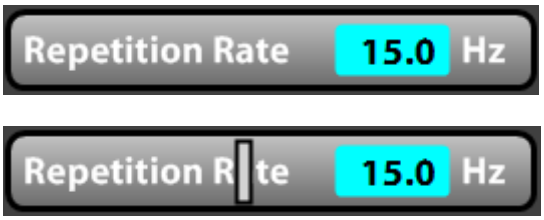
Shutter

The laser has an internal safety shutter which prevents the laser emitting light whilst closed.

Use the Open and Close buttons to control laser output once the laser is running.

Slider Controls

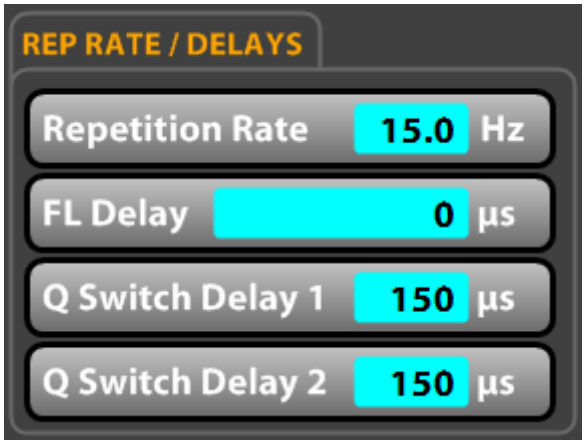
Controls with values on a blue background can be adjusted by clicking in the blue area. The user then types a new number and presses the ENTER / RETURN key. The edit can be aborted by pressing ESC instead.



Some controls can also be adjusted by moving the mouse to the left of the blue area. A slider will appear which can be dragged left and right to change the value. Releasing the mouse button enters the new value.

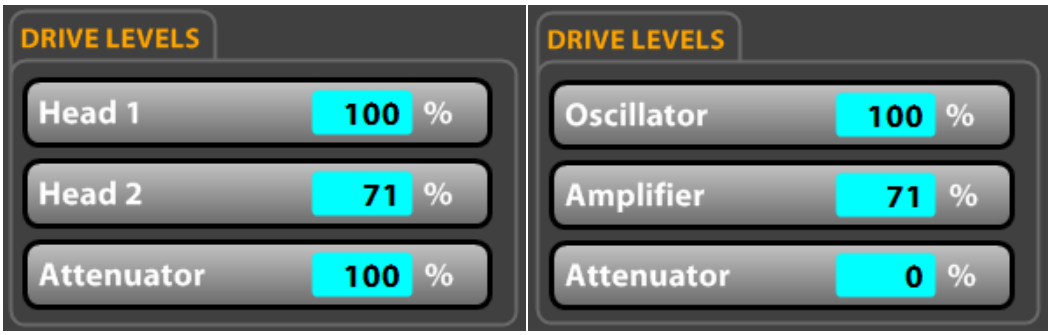
Repetition Rate & Delays

These values adjust the System Timings as described in the earlier section of this document.



Drive Levels

These controls adjust the energy output of the laser. The values do not relate linearly to laser output, so setting a value to 50% will not halve the output energy of the laser.



On most systems the drive level will adjust the lamp voltage. On ‘G’ systems the drive level adjusts the q-switch delay.

Not all systems are fitted with an attenuator.

As a general rule use the attenuator to adjust the laser output if your system has one.

If no attenuator is fitted, use the Amplifier Drive to adjust the laser output.

If your system has no amplifier, adjust laser output using the Oscillator Drive level.

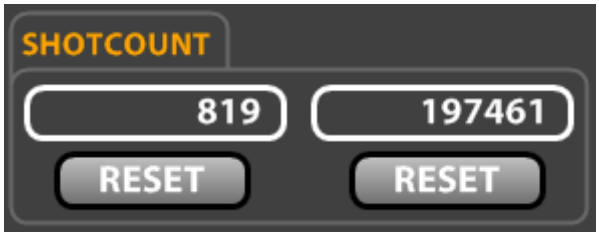
Refer to the Laser Manual which has test sheets showing the laser output at various drive levels for your specific system.

Shotcount

The laser keeps a record of how many times the flashlamps have fired.

This can help determine when the lamps should be changed.

When the lamps are changed, use the Reset Button to set the counter back to zero.



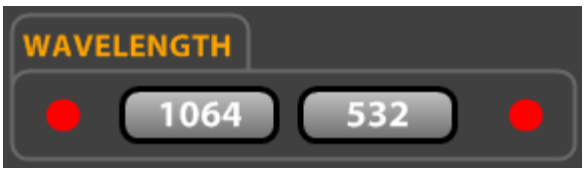
The CTRL key must be held down whist the RESET button is pressed. (to prevent accidental resets).

Wavelength Selection

Some systems are fitted with an automatic wavelength selector.

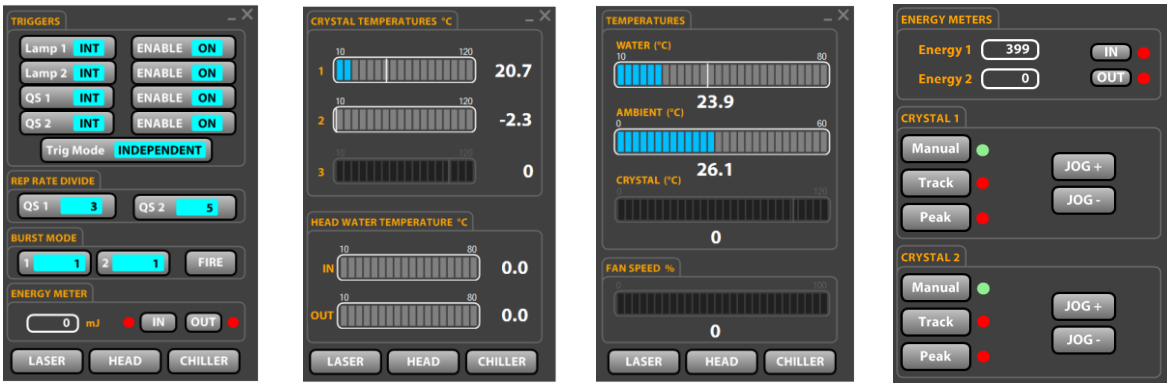
Pressing the relevant button selects the corresponding wavelength.

A green indicator shows which wavelength is currently selected.



Extended Control Panel

The More and Less buttons expand and collapse an extra control panel.



This panel can be used to display extra laser parameters, or monitor the head or cooler.

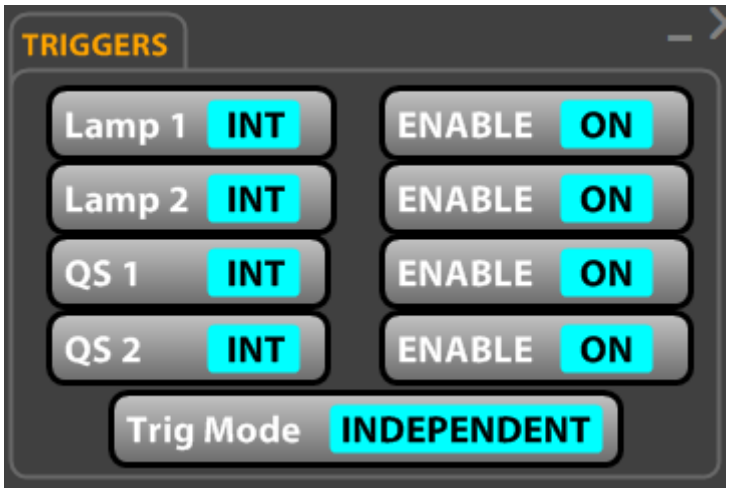
Use the buttons at the bottom of the panel to select its function. The monitoring available varies from system to system so some buttons may be unavailable.

Trigger Control

The flashlamps and q-switches can be triggered by either internal trigger generators, or by user supplied triggers.

The trigger source for each component can be toggled between Internal (INT) and external (EXT) by pressing the relevant button.

The internal trigger sources can also be toggled on and off by pressing the relevant Enable Button.



The Trig Mode is used when one lamp is fired by an external trigger and the second lamp is set to internal.

If the Trig mode is set to INDEPENDENT, the internally triggered flashlamp will free-run at the defined repetition rate, unsynchronised to the externally triggered lamp.

If Trig Mode is LINKED, the internally triggered lamp will fire at a fixed time after the externally triggered lamp. This time is defined by the Flashlamp Delay. The flashlamp delay must be positive if flashlamp 2 is the internally triggered lamp. The flashlamp delay must be negative if flashlamp 1 is the internally triggered lamp.

If a flashlamp is set to external trigger and the corresponding q-switch trigger is set to internal, the q-switch will fire synchronised to the external flashlamp trigger but delayed by the relevant q-switch delay value.

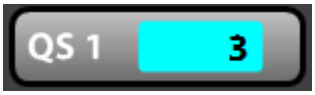
Rep Rate Divide

The Rep Rate Divide function is used mostly on 'G' type systems. The flashlamps will fire at their optimum frequency (defined by the Repetition Rate value), but the laser only emits pulses every 2nd, 3rd or 4th shot etc. A value of 1 is allowed and will emit laser pulses on every shot.

Pressing the control will toggle it between enabled and disabled:

Disabled :

Enabled :



Burst Mode

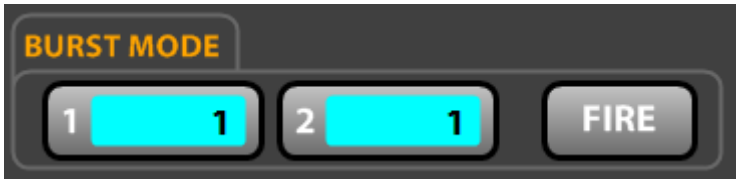
The laser can be instructed to fire a single burst of shots at the defined rep rate.

This mode can be enabled / disabled by pressing the relevant control.

The number of shots in the burst is user defined.

Pressing the Fire button will start the laser burst.

Changing the value will also initiate a single laser burst, so close the shutter if this is not desired.



If the Rep Rate Divide mode is enabled, the flashlamps will fire continuously and the q-switch is fired to emit the burst of pulses.

Energy Meters

Some systems have internal energy meters to allow remote monitoring / tuning of the harmonic crystals.

The energy meters will not always be calibrated.

On some systems, a movable mirror is used to divert the beam into the energy meter. The IN and OUT buttons will operate this mirror. The green marker will show the current position of the mirror. The laser shutter cannot be opened unless the mirror is in one state or the other.

Remote Crystal Tuning

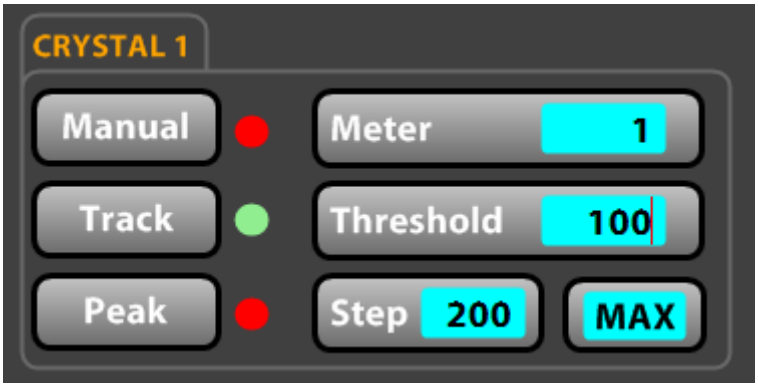
There are three possible modes used to remotely tune a harmonic crystal. These modes are selected using the MANUAL, TRACK and PEAK buttons.

When a remote crystal tuning housing has been fitted it may be jogged using the JOG+ and JOG- buttons on the MANUAL screen.

If the system has a remote crystal tuning housing and an internal energy meter, it is possible to use the PEAK or TRACK modes.

These modes are only available if the laser is ON and flashing.

Track Mode



Track mode is useful on system where the optimum angle of the harmonic crystal changes over time due to absorption or other effects.

The system will continuously make small changes to the angle of the crystal trying to achieve a better conversion.

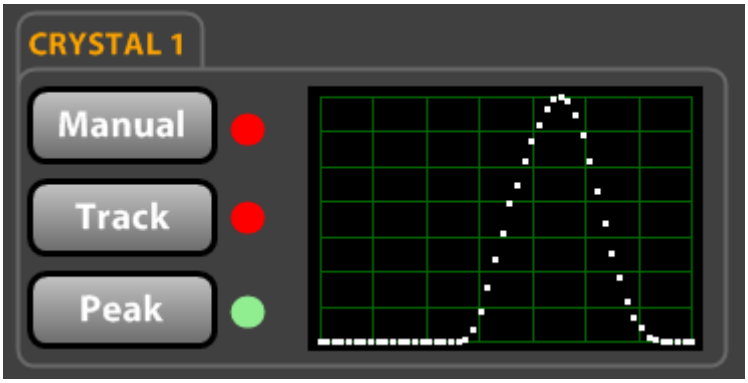
If the system has more than one energy meter fitted, the METER parameter defines which e-meter should be monitored during the tracking process.

The THRESHOLD parameter is used to remove false readings from the e-meter. Any energy reading less than the threshold value will be ignored.

The crystal will be moved by the angle defined in STEPS between energy readings. A small STEP value will cause the tracking function to fail as the energy difference between the two crystal positions is less than the natural peak to peak energy variation seen on the e-meter. A large STEP value will cause excessive fluctuations in energy output whilst the track mode is active. It is common for TRACK mode to be used when the shutter is first opened and the crystals achieve equilibrium. Once equilibrium is reached, the system can then be switched back to MANUAL mode to improve energy stability.

Some systems are set up to monitor conversion efficiency by directly monitoring the output wavelength intensity. These systems track by looking for a peak in energy output. These systems should use MAX mode. Other systems monitor the residual input wavelength to a crystal and look for the drop in energy associated with good conversion efficiency. These systems should use MIN mode.

Peak Mode



Peak mode will scan the crystal through a predefined angle looking for the best angle.

The Peak routine will start as soon as the PEAK button is pressed. If the system has a movable e-meter mirror, this will be moved into place automatically.

As the scan proceeds, a graph of energy(y) versus crystal angle will be displayed.

At the end of the scan, the crystal will be placed at the angle which gave the best conversion. It may take a few seconds for the crystal to move to the optimal position. If the system has a moveable mirror, it will be left in following the peak routine.

The METER, THRESHOLD and MAX parameters from the TRACK mode panel are also used in the peak routine. If MIN mode is used, the PEAK routine will look for the dip in energy curve rather than the spike.

Once the peak routine has finished, the system will drop back to MANUAL mode, but leave the graph on display.

To cancel a scan, change to a different mode by pressing MANUAL or TRACK.