

# OPERATION

## 1.0 Safety



**CAUTION:** Obey all safety procedures. See **Laser Safety starting on page 1.**



**CAUTION:** Wear eye protection. Obey safety precautions as though the system is capable of lasing at any time.

## 2.0 Precautions

Follow these guidelines to avoid laser damage.

- Store the laser in a dust-free environment. Keep the Laser Head covered when not in use. This protects the output window from dust and particulate.
- Avoid back reflections. Back reflections of even a small percentage of the output energy can damage optical components in the Laser Head.

Example: An uncoated convex lens or a glass disk calorimeter reflects about 4% of the incident energy. While the reflection may seem harmless, it can perturb the resonator operation and degrade the near-field beam intensity profile and damage laser optics. It may also affect the resonator holdoff, causing prelasing and catastrophic optical damage. In some cases, even anti-reflection coated glass optics reflect enough energy to damage laser optics. It is best to use only quality optics coated for the operating wavelength.



**CAUTION:** To avoid damaging the laser, minimize back reflections of the output beam. When reflections are unavoidable, direct them away from the optical axis of the system by canting the optics off-axis. Failure to do so can damage the laser and void the warranty.

## 3.0 Remote Interlock

The Interlock BNC connector provides an interface for an external safety shutdown switch. The Interlock can be connected to a lab door or other system outputs for safety purposes. When using the Interlock, only an isolated switch, such as a relay, should be used in order to avoid ground loops. If external safety switches are used, it is important that they are connected in series.

The Interlock connection must be completed in order to operate the laser. If an open circuit occurs, the ICE high voltage is disabled and the Q-touch screen shows a fault indication.

The system is shipped with the BNC shorting cap attached on this connector. Leave this connector in place if this function is not needed. See **Interlock on page 12.**

## 4.0 Emission Warning

The Emission Warning indicator illuminates when the shutter is open. See **Emission Warning on page 14.**

## 5.0 Manual Shutter



**CAUTION:** If the shutter is open, take precautions as though the laser is capable of lasing, regardless of any other status. See **Manual Shutter on page 14.**



**CAUTION:** Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

## 6.0 Operating Modes

The follow methods may be used to operate the laser:

1. Directly via the Q-touch interface.
2. Remotely via ethernet software similar to that of the touchscreen.

See **Ethernet Interface on page 51**.

The same software interface is used to control the system from the touchscreen or from software running remotely. The only difference is that commands are selected by touching icons on the screen or by using a mouse to click the icon.

## 7.0 The Control Software



**WARNING:** Follow all safety precautions. See **Laser Safety starting on page 1**. During laser operation, everyone present in the laser room must wear eye protection appropriate for the specific output wavelengths.



Figure 10 Q-touch

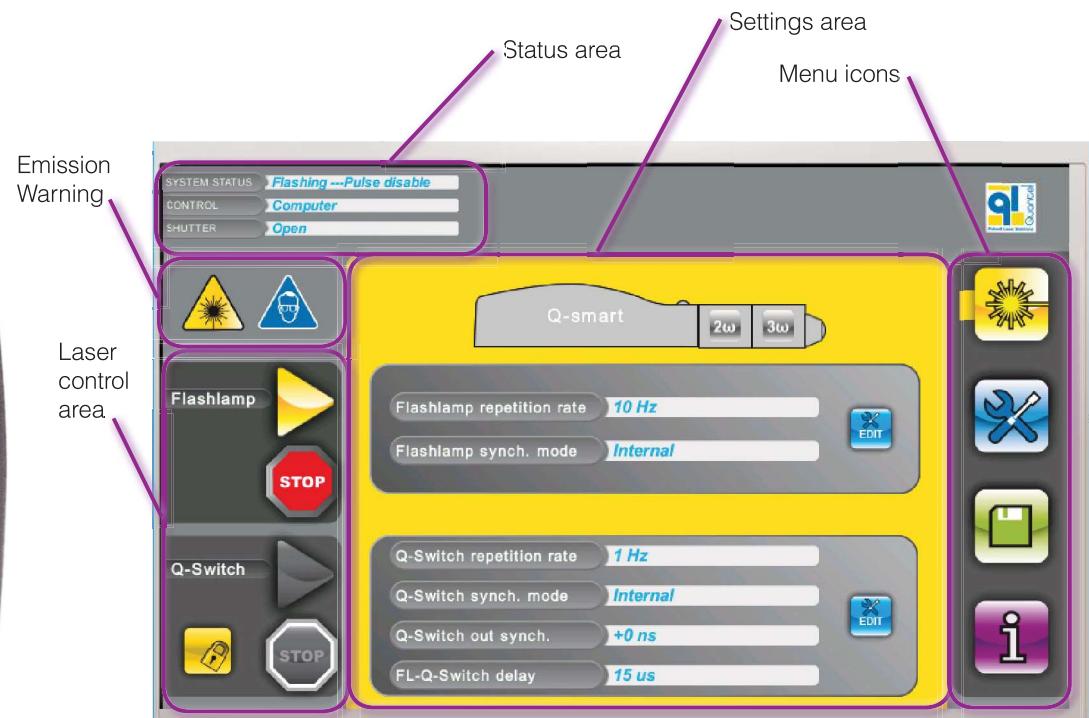


Figure 11 Software Screen

## 8.0 Emission Warning Area

The following buttons warn you of laser emission.



**Emission Warning:** Whenever the laser emission is ON, this warning icon flashes. Everyone in the area must be wearing proper eye protection and following all safety precautions.



**Safety Eyewear:** Whenever this icon is ON, everyone in the area must be wearing proper eye protection and following all safety precautions.



**CAUTION:** Follow safety precautions as though the system is capable of lasing at any time, whenever the laser is in the ready state.

## 9.0 Status Area

The status area shows the system state, control method and the shutter state.



**System Status:** Displays the laser status. The following messages appear in this area

**Laser interlock:** The remote interlock circuit is open.

**System warm up:** The laser is warming up during start up and is not ready for operation (about 15 minutes).

**Laser ready:** The warm up is complete and the laser is ready for Run mode. The flashlamp start icon changes to solid yellow.

**Flashing---Pulse disable:** The system is in Run mode, and the Flashlamp start icon is selected (high voltage enabled), the lamps begin flashing (if a trigger is present). The Q-Switch is not yet enabled, either due to an interlock issue or the required 8 second delay between flashlamp start and Q-Switching.

**Flashing---Pulse enable:** Eight seconds after the laser is stabilized in RUN mode, Q-Switching is enabled.

**Laser ON---auto (or Burst/scan):** Depending on the settings you have selected and if no HG modules are connected you may see this laser state.

**Laser ON---NLO warm up:** Either the HG crystals have not reached their set point temperatures or the number of shots for stable energy has not been reached. APM is not available, until the system reaches the set point temperature.

**Laser ON---NLO ready:** HG module crystals are warmed up and the required number of shots for stable energy has been reached.

**Laser ON---APM #1 running:** Automatic Phase Matching for 2w is running.

**Laser ON---APM #2 running:** Automatic Phase Matching for 3w or 4w is running.

**Laser ON---APM #3 running:** Automatic Phase Matching for 5w is running.

**Control:** **Computer, Q-touch, or TDL** is indicated, depending on which method is being used to control the system.

**Shutter:** The state of the shutter (**Open** or **Closed**) is shown.

## 10.0 Laser Control Area

The laser control area provides controls to start and stop the flashlamp and Q-Switching. The icons appear as follows:

### Flashlamp

Icon	Meaning
	Grey icon indicates that the flashlamp is not able to be activated because the system is still warming up.
	Solid yellow icon indicates that the flashlamp is ready to be started. Select this button to start the lamp flashing.
	Blinking yellow icon indicates that the lamp is flashing. The laser Emission Warning is flashing. Everyone in the area must be wearing proper eye protection and following all safety precautions.
	Stops the flashlamp and ceases laser emission. <b>Note:</b> To stop the laser at any time, do any of the following: <ul style="list-style-type: none"> <li>• Press the STOP icon</li> <li>• Turn OFF the Key Switch on the ICE front panel.</li> </ul>
	The flashlamp is not started and so cannot be stopped and therefore this selection is “grayed out”.

### Q-Switch

Icon	Meaning
	Not Ready Grey icon indicates that the system is not ready and the Q-Switch cannot be started. Until the system status shows as <b>Flashing---Pulse disable</b> , the Q-Switch is not able to be started.
	Ready/Start Solid yellow icon indicates the system is ready and the Q-Switch may be started. The laser Emission Warning is flashing. Everyone in the area must be wearing proper eye protection and following all safety precautions.  <b>Single shot mode:</b> Press this button once for a single shot  <b>Continuous mode:</b> Press this button continuously until it blinks. Then launch continuous mode and the laser is running at the selected rep rate
	Running (blinking) Blinking yellow icon indicates that the Q-Switching is running. The laser Emission Warning is flashing. Everyone in the area must be wearing proper eye protection and following all safety precautions.

### Q-Switch

Icon	Meaning
	Stop icon Stops the Q-Switch and ceases laser emission. <b>Note:</b> To stop the laser at any time, do any of the following: <ul style="list-style-type: none"> <li>• Press the STOP icon</li> <li>• Turn OFF the Key Switch on the ICE front panel.</li> </ul>
	Not started The Q-Switch is not started and so cannot be stopped and therefore this selection is “grayed out”.
	Locked The Q-Switch is “locked” and cannot be started manually.
	Locked The Q-Switch is “locked”. Touch the lock icon to change it to unlocked.
	Unlocked The Q-Switch is “unlocked” and can be used for single pulse or continuous operation. See <b>Single Shot Mode on page 40</b> .

## 11.0 Menu Icons

Use the menu icons to access the following screens:

Menu Icon	Function
Laser Operation 	Enters the screen to view laser parameters such as internal temperature, output power, diode current, diode temperature or crystal temperature. To change the values, use the Settings screen.
Settings 	Enters the screen to set laser parameter values.
Configuration 	Enters the screen to view or set network configurations for remote control of the system.
Information 	Enters the screen to view system information such as laser information, synch information, and fault status.

Indicates item is selected



## 12.0 The Laser Operation Screen

Item	Function
Flashlamp repetition rate	Displays the flashlamp operating frequency in Hz. When in the Flashlamp synch. mode is set to Internal, the ICE fires the flashlamp at this frequency; when set to External, the ICE compares the frequency of the external trigger with this setting. If the External trigger frequency is too low or too high for the factory settings, the flashlamp will be disabled.
Flashlamp synch. mode	Displays the flashlamp trigger mode in use. <b>Internal:</b> The flashlamp pulses at the frequency set for Flashlamp repetition rate. Example: Starting the flashlamp cause the flashlamp to fire at 10 Hz. <b>External:</b> The flashlamp fires when a valid signal is applied to the "Lamp Synch In" connector on the ICE front panel.
Q-Switch repetition rate	Displays the Q-Switch operating frequency in Hz.
Q-Switch synch. mode	Displays the Q-Switch trigger mode in use. <b>Internal:</b> The Q-Switch fires at the rate set based on the Q-Switch Settings repetition rate. See <b>Q-Switch Settings</b> on page 38 for details. <b>External:</b> The Q-Switch fires when a valid signal is applied to the "Q-Switch Synch In" connector on the ICE front panel.

Item	Function
Q-Switch out synch.	Displays the delay (in ns) between the Q-Switch pulse and the signal output to the Q-Switch Synch. Out BNC connector
FL-Q-Switch delay	Displays the delay (in ns) between the flashlamp pulse and the Q-Switch pulse

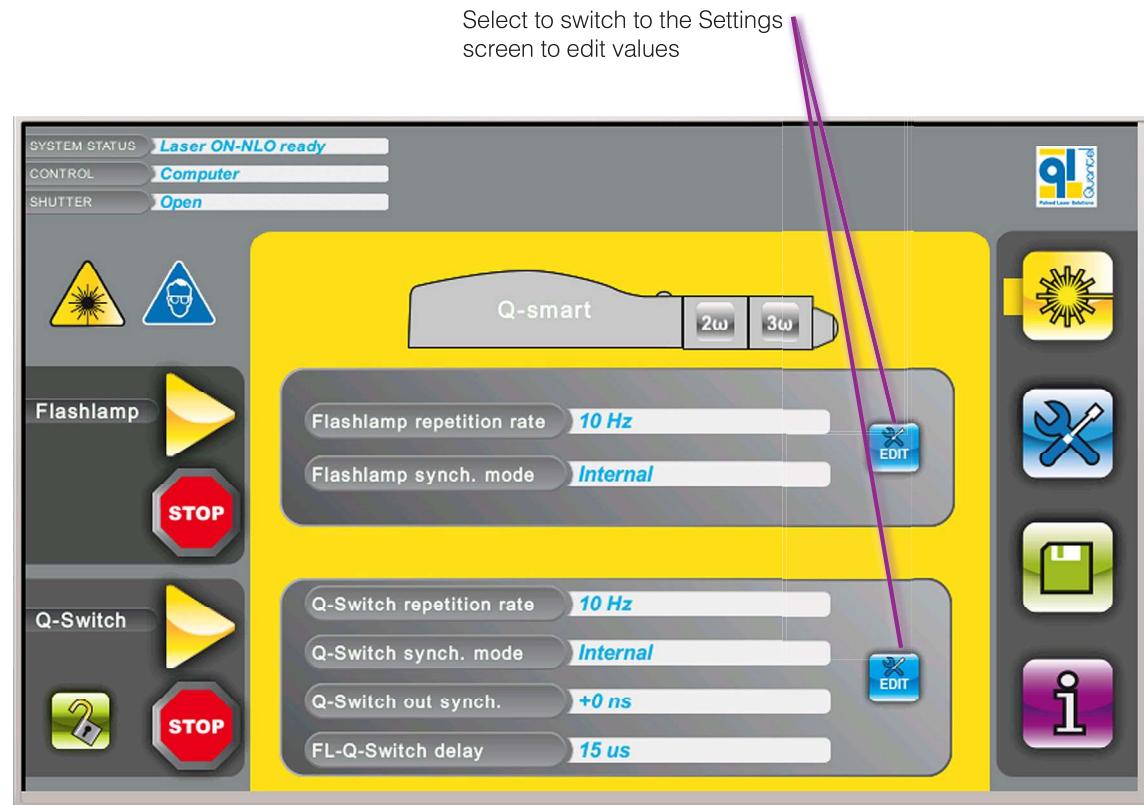


Figure 12 Example Laser Settings Screen

## 13.0 Laser Operation Modes



**CAUTION:** Everyone in the area must be wearing proper eye protection and following all safety precautions.

### Internal Flashlamp/Internal Q-Switching

In this mode, the ICE automatically generates the flashlamp pulses at the rate set for **Flashlamp repetition rate**. The Q-Switch pulses occur after the flashlamp pulse at a time specified by the value set for **FL-Q-Switch delay**. Adjusting this delay is one method of adjusting the optical energy of a laser pulse. No external signal generator is needed. Any signals to the external trigger Inputs are ignored. See Figure 13 for a timing diagram showing Internal/Internal mode.

To obtain continuous emission of laser pulses:

1. Set **Flashlamp synch. mode** to **Internal**. See **Flashlamp Settings on page 37** for details.
2. Set **Q-Switch synch. mode** to **Internal**.
3. Open the manual shutter on the Laser Head.
4. Touch the Flashlamp start icon. The icon begins blinking to show the flashlamp is running.
5. Touch the Q-Switch start icon. The icon begins blinking to show the Q-Switch is started. Laser emission begins and the Emission Warning icon appears on the screen. The Emission Warning LED on the Laser Head blinks. See additional details for **Q-Switch Settings on page 38**.



To cease laser emission:



1. Press the Q-Switch Stop icon or press the Flashlamp Stop icon. The Emission Warning icon on the Q-touch and the Emission Warning indicator on the Laser Head will stop flashing.
2. Close the shutter on the Laser Head.

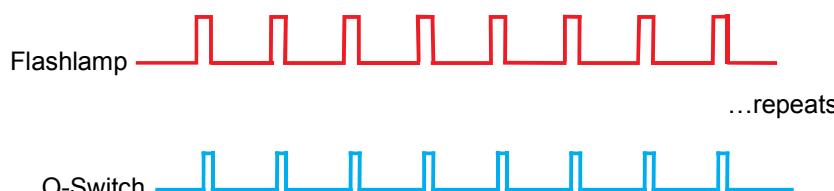


Figure 13 Internal/Internal Timing Diagram

### External Flashlamp/Internal Q-Switching

In this mode the flashlamp trigger is received from your external source. The flashlamp trigger frequency is limited by the ICE. If an external trigger event occurs before the minimum allowed period (1/PRFMAX), the trigger is ignored. Refer to the **External Trigger Signal Requirements on page 58** for details. The Q-Switch trigger and timing is internal and is controlled by the ICE. If an external Q-Switch trigger is present, it is ignored.

To use External Flashlamp/Internal Q-Switch mode:

1. Connect your flashlamp external trigger source to the Lamp Sync In BNC connector on the ICE front panel. See **BNC Connectors on page 12**.
2. From the Q-touch set **Flashlamp synch. mode** to **External**.
3. Set **Q-Switch synch. mode** to **Internal**.
4. Open the manual shutter on the Laser Head.
5. Touch the Flashlamp start icon. The icon begins blinking to show the flashlamp is running.
6. Touch the Q-Switch start icon. The icon begins blinking to show the Q-Switch is started. Laser emission begins and the Emission Warning icon appears on the screen. The Emission Warning LED on the Laser Head blinks.



To cease laser emission:



1. Press the Q-Switch Stop icon or press the Flashlamp Stop icon. The Emission Warning icon on the Q-touch and the Emission Warning indicator on the Laser Head will stop flashing.
2. Close the shutter on the Laser Head.

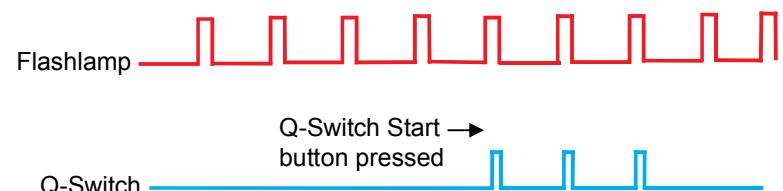


Figure 14 External Flashlamp/Internal Q-Switch Timing

## External Flashlamp/External Q-Switching

Both the flashlamp and Q-Switch triggers are received from an external signals provided by the user. The input signals control all frequency, timing, and delays. The flashlamp trigger frequency is limited by the ICE. If an external trigger event occurs before the minimum allowed period (1/PRFMAX), the trigger is ignored.

See the **Laser Data Sheet** provided with your laser to determine the necessary Q-Switch delays. Refer to the **External Trigger Signal Requirements on page 58** for signal requirement details.

To use External Flashlamp/IExternal Q-Switch mode:

1. Connect your flashlamp external trigger source to the Lamp Sync In BNC connector on the ICE front panel. Connect your Q-Switch external trigger source to the Q-Switch Sync In BNC connector on the ICE front panel. See **BNC Connectors on page 12**.
2. From the Q-touch, set **Flashlamp synch. mode** to **External**.
3. Set **Q-Switch synch. mode** to **External**.
4. Open the manual shutter on the Laser Head.
5. Touch the Flashlamp start icon. The icon begins blinking to show the flashlamp is running.
6. Touch the Q-Switch start icon. The icon begins blinking to show the Q-Switch is started. Laser emission begins and the Emission Warning icon appears on the screen. The Emission Warning LED on the Laser Head blinks.



To cease laser emission:

1. Press the Q-Switch Stop icon or press the Flashlamp Stop icon. The Emission Warning icon on the Q-touch and the Emission Warning indicator on the Laser Head will stop flashing.
2. Close the shutter on the Laser Head.

## 14.0 The Settings Screen

The Settings screen provides access to settings via selectable tabs for Flashlamp, Q-Switch, Harmonics, and Maintenance.

### Flashlamp Settings

View or set the following items:

Area	Item: Function
Flashlamp Parameters	<p><b>Repetition Rate:</b> Shows the flashlamp operating frequency in Hz. When set to Internal, the flashlamp fires at this frequency; when set to External, the ICE compares the frequency of the external trigger with this setting. If the External trigger frequency is too low or too high for the factory settings, the flashlamp will be disabled.</p> <p><b>Voltage:</b> Adjusts the flashlamp voltage.</p> <p><b>CAUTION:</b> Quantel advises against decreasing the energy of the flashlamp(s) to reduce the output energy.</p> <p><b>Pulse width:</b> Adjusts the flashlamp pulse width.</p>
Flashlamp counter	<p><b>Internal counter:</b> Shows the number of flashlamp fires since set at factory.</p> <p><b>User counter:</b> Shows the flashlamp fires since last reset by the user.</p> <p><b>Reset button:</b> Click to reset the user counter.</p>
Synchronization mode	<p>Use the slider to select between Internal and External flashlamp trigger modes.</p> <p><b>Internal:</b> The flashlamp pulses at the frequency set for Flashlamp repetition rate. Example: Starting the flashlamp cause the flashlamp to fire at 10 Hz.</p> <p><b>External:</b> The flashlamp fires when a valid signal is applied to the "Lamp Synch In" connector on the ICE front panel.</p>

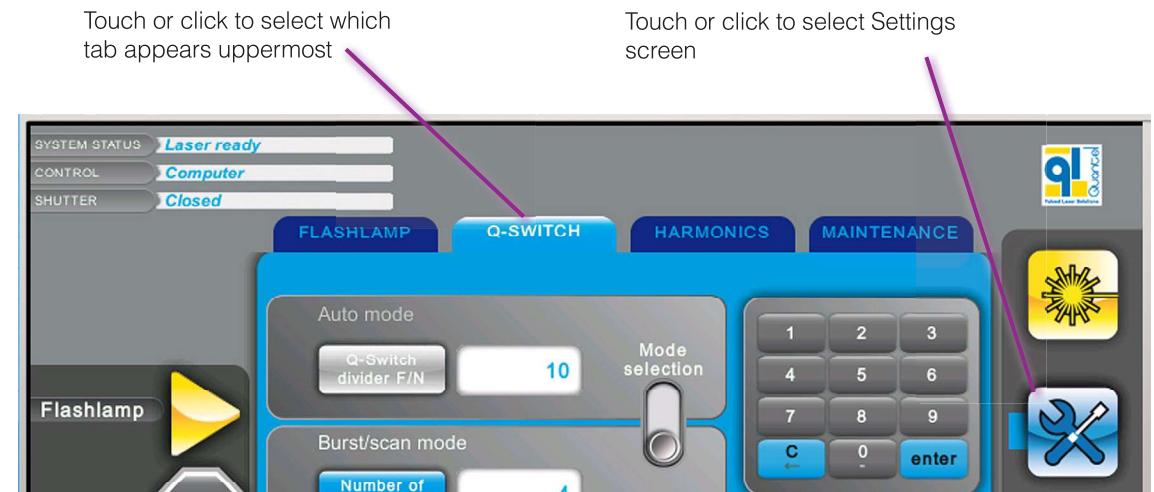


Figure 16 Example Operational Settings Screen

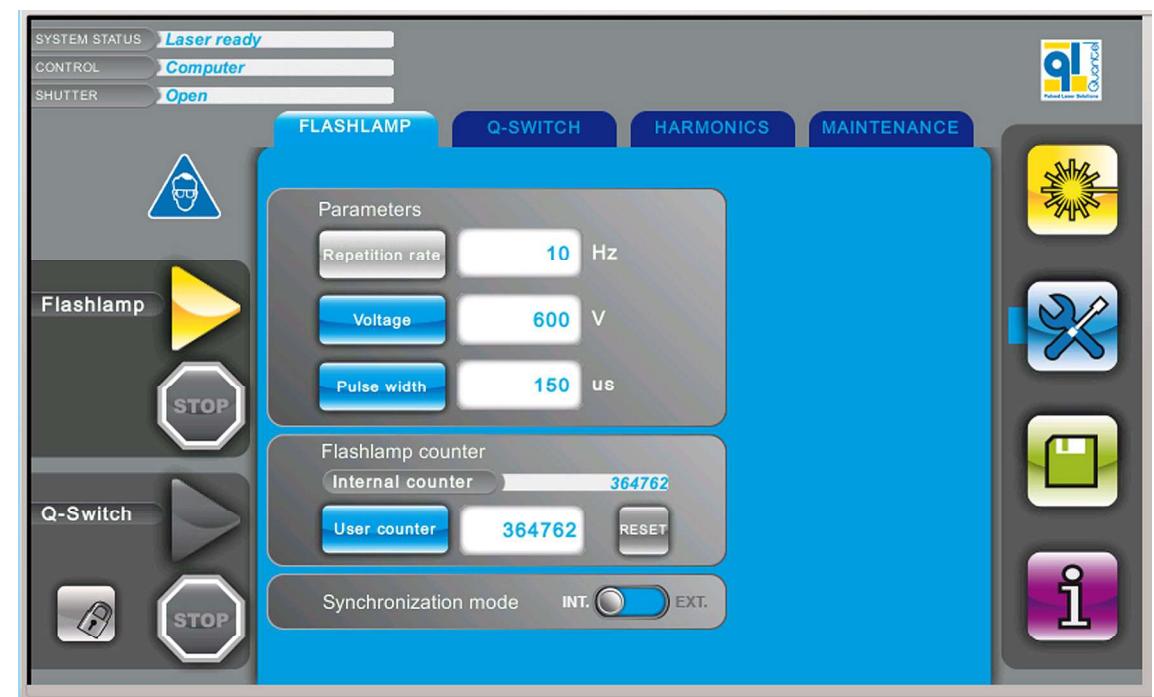


Figure 17 The Flashlamp Tab of the Operational Settings Screen

## Q-Switch Settings

The following items can be viewed or set via the Q-Switch tab of the Operational Settings screen:

Item	Function
<b>Automode</b>	
Q-Switch divider F/N	Allows you to change the ratio of flashlamp pulses to Q-Switch pulses. See details on page 39.
<b>Burst/scan mode</b>	
Number of scans	Enter a value for the number of times to repeat a group of active and passive Q-Switch pulses. After the total number of scans is complete, the Q-Switch is disabled. A value of 0 results in continuous repetition of the active and passive pulses.
Number of active shots	Enter the number of active Q-Switch pulses for each Scan group. This is the number of flashlamp pulses that have an associated Q-Switch pulse and therefore cause laser light to be emitted
Number of passive shots	Sets number of flashlamp pulses that have no Q-Switch pulse and therefore produce no laser emission
<b>Synchronization mode</b>	Int./Ext. This toggle makes it easy to change between Internal and External Q-Switching.

Item	Function
Delays	
Q-Switch out synchronization	Adjusts the delay (in $\mu$ s) between the Q-Switch pulse and the signal output to the Q-Switch Synch. Out BNC connector
FL-Q-Switch delay	Adjusts the delay (in $\mu$ s) between the flashlamp pulse and the Q-Switch pulse
Number pad	Provides touch screen number entry into the active item

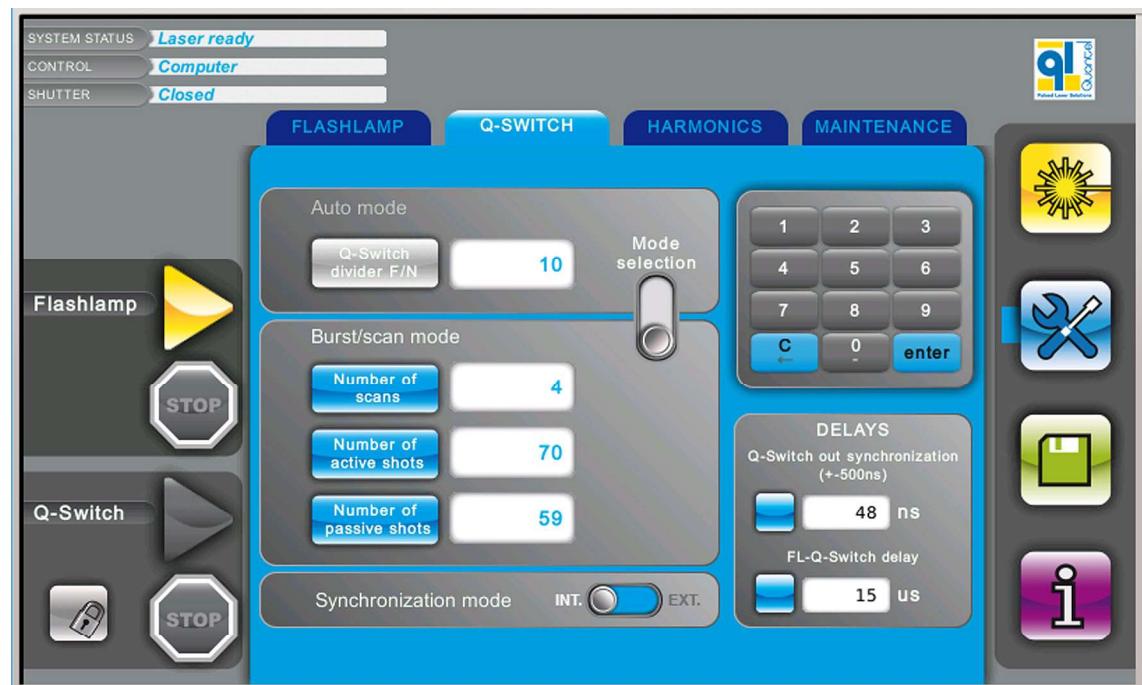


Figure 18 The Q-Switch Tab of the Operational Settings Screen

## 15.0 Burst/Scan Mode Operation

In this mode the flashlamp trigger is received internally or externally. The Q-Switch trigger and timing is internal and is controlled by the ICE. Parameters (number of scans, number of active shots, number of passive shots) are set to control the number of active Q-Switch pulses for each flashlamp pulse.

To use Burst/scan mode:

1. Set Q-Switch synchronization mode to **Internal**.
2. Set the number of scans, number of active shots, number of passive shots from the Q-Switch tab of the Operational Settings screen. System status will indicate Laser ON---Burst/scan mode.
-  3. Open the manual shutter on the Laser Head.
-  4. Touch the Flashlamp start icon. The icon begins blinking to show the flashlamp is started.
-  5. Touch the Q-Switch start icon. The icon begins blinking to show the Q-Switch is started. Laser emission begins and the Emission Warning icon appears on the screen. The Emission Warning LED on the Laser Head blinks.
-  6. Unlock the Q-Switch area on the Q-touch by pressing the lock button. The icon appears unlocked.

To cease laser emission:

1. Press the Q-Switch Stop icon. The Q-Switch returns to the locked state. The Emission Warning icon on the Q-touch and the Emission Warning indicator on the Laser Head will stop flashing.
2. Close the shutter on the Laser Head.

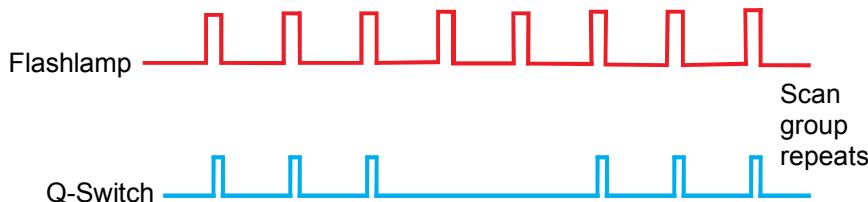


Figure 19 Example Timing Diagram for Burst/scan Mode (QS Pulses = 3)

## 16.0 Q-Switch Divider (Auto-Ratio)

This mode causes the Q-Switch to fire once for every specified number of flashlamp pulses. The Q-Switch Divider value is the number of flashlamp pulses to the number of active Q-Switch pulses. An example is shown in the timing diagram below, where the Auto-ratio value is set to three:

To use Q-Switch Divider:

1. From the Q-Switch tab, enter a value greater than 1 for Q-Switch Divider in the Automode area. A value of 1 would cause the Q-Switch to fire every time the flashlamp fires.

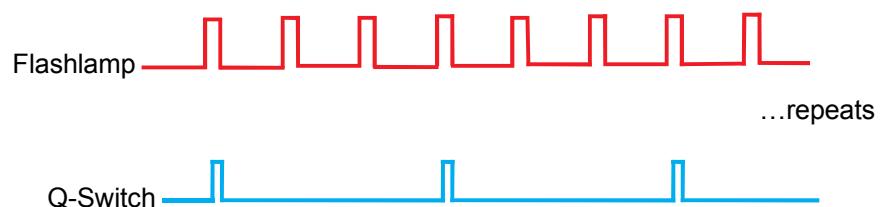


Figure 20 Q-Switch Divider Mode Timing (value set to 3)

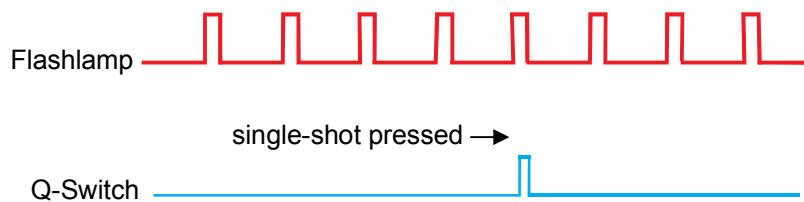
## 17.0 Single Shot Mode

Single-shot mode fires the Q-Switch one time, producing a single pulse of light from the laser. This mode is useful while aligning the experimental setup. See Figure 21 for an example timing diagram. For a single shot, the Q-Switch mode must be set to Internal.

To obtain a single-pulse emission from the laser:



1. Verify that the flashlamp is running.
2. Open the manual shutter on the Laser Head
3. Press the Q-Switch start button once. One laser pulse will be generated.
4. You may need to consider the Time out for the Lock button.



**Figure 21 Timing Diagram: Single-Shot Mode**

## 18.0 Continuous Pulse Mode

To use continuous pulse mode:

- 
1. Verify that the flashlamp is running.
  2. Open the manual shutter on the Laser Head.
  3. Press the Q-switch start button until the icon begins blinking
  4. Latch it to start pulsing.

## 19.0 Automatic Phase Matching (APM)

Harmonic generation within the system is very stable, in general. However, each crystal used in harmonic generation behaves slightly differently. When you add a harmonic generation module to change the system wavelength, you will need to fine tune the system using the APM function.

- APM is only available when internal trigger modes and nominal repetition rates are used.
- Before APM can be run, the crystals must be at thermal stability and a required number of shots must be reached.
- The APM process tracks optimum energy levels. When an optimal value is found, the phase-matching process stops automatically.

Though the phase-matching is automatic, it is not constantly monitoring the system. You need to launch it whenever:

- you install or remove an HG module.
- you move the system to a new location.
- you notice a decrease in system energy levels.

Use these steps to launch APM:

1. From the Operational Settings screen, select the **Harmonics tab**.
2. Select the icon of the HG module to adjust, for example: 2w or 3w.
3. Select **Start**. If APM is not available, Start will be "grayed-out". The APM process starts. The APM process may take up to 15 minutes, depending on how far the system is from optimum energy level.
4. Once APM is complete, a message appears where you can accept or cancel the new operation set point. If you select **OK**, APM is complete. If you select **Cancel**, the system returns to the previous setting and may take few minutes to restabilize.
5. You can also select **Escape** at any time to exit the APM process.
6. To reset the crystals to their factory settings, select **Default T° set point**.

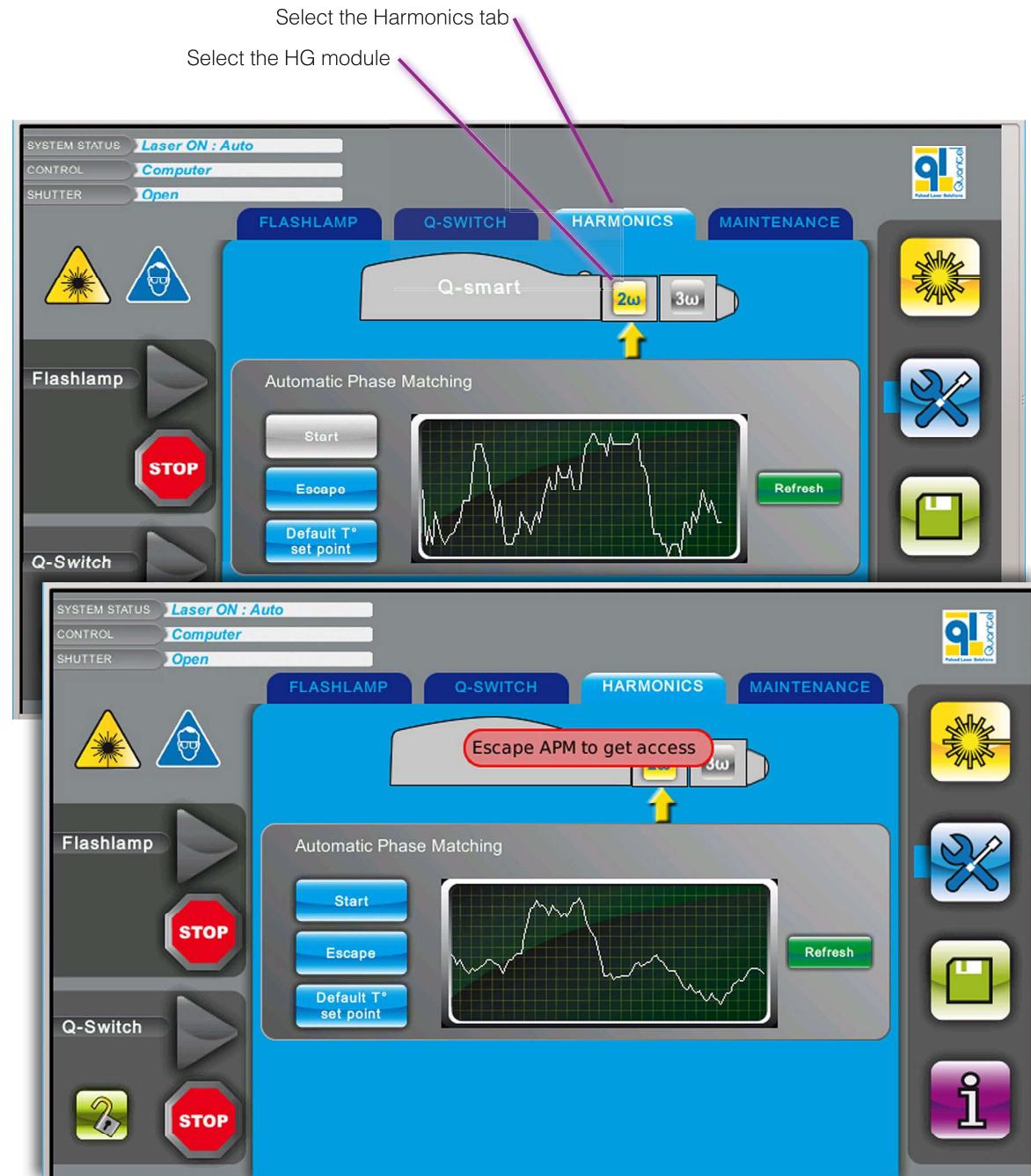


Figure 22 Automatic Phase Matching

## APM for $2\omega$ HG (SHG) Configurations

Use the following steps when adjusting for  $2\omega$  HG:

1. From the Operational Settings screen, select the **Harmonics tab**.
2. Select the  **$2\omega$**  HG icon.
3. Select **Start**. If APM is not available, Start will be “grayed-out”. The APM process starts.
4. The graph displays the photodiode signal during the APM process. Select **Refresh** to clear the data on the graph.  
During APM, the signal may reach transient values higher than the final optimal result. The APM process may take up to 15 minutes, depending on how far the system is from optimum energy level.
5. Once APM is complete, a message appears where you can accept or cancel the new operation set point. If you select **OK**, APM is complete. If you select **Cancel**, the system returns to the previous setting and may take few minutes to restabilize.
6. You can also select **Escape** at any time to exit the APM process.
7. To reset the crystals to their factory settings, select **Default T° set point**.

## APM for $3\omega$ HG (THG) Configurations

When running the APM for  $3\omega$ , the system will automatically optimize the required  $2\omega$  HG module first.

Use the following steps when adjusting for  $3\omega$  HG:

1. From the Operational Settings screen, select the **Harmonics tab**.
2. Select the  **$3\omega$**  HG icon.
3. Select **Start**. If APM is not available, Start will be “grayed-out”. The APM process starts.
4. The system status indicates which crystal the APM is analyzing. One of the following will display in the system status area:
  - APM#1 when applied on  **$2\omega$**  HG
  - APM#2 when applied on the  **$3\omega$**  HG
5. The graph displays the photodiode signal during the APM process. Select **Refresh** to clear the data on the graph.  
During APM, the signal may reach transient values higher than the final optimal result. The APM process may take up to 15 minutes, depending on how far the system is from optimum energy level.
6. Once APM is complete, a message appears where you can accept or cancel the new operation set point. If you select **OK**, APM is complete. If you select **Cancel**, the system returns to the previous setting and may take few minutes to restabilize.
7. You can also select **Escape** at any time to exit the APM process.
8. To reset the crystals to their factory settings, select **Default T° set point**.

## APM for $4\omega$ HG (FoHG) Configurations

When running the APM for  $4\omega$ , the system will automatically optimize the required  $2\omega$  HG module first.

Use the following steps when adjusting for  $4\omega$  HG:

1. From the Operational Settings screen, select the **Harmonics tab**.
2. Select the  **$4\omega$  HG icon**.
3. Select **Start**. If APM is not available, Start will be “grayed-out”. The APM process starts.
4. The system status indicates which crystal the APM is analyzing. One of the following will display in the system status area:
  - APM#1 when applied on  $2\omega$  HG
  - APM#2 when applied on the  $4\omega$  HG

5. The graph displays the photodiode signal during the APM process. Select **Refresh** to clear the data on the graph.

**Note:** During APM, the energy level will quickly drop to a few mJ, then it will reach an optimum level and then drop again. The system will finally stabilize to the optimum.

The APM process may take up to 15 minutes, depending on how far the system is from optimum energy level.

6. Once APM is complete, a message appears where you can accept or cancel the new operation set point. If you select **OK**, APM is complete. If you select **Cancel**, the system returns to the previous setting and may take few minutes to restabilize.
7. You can also select **Escape** at any time to exit the APM process.
8. To reset the crystals to their factory settings, select **Default T° set point**.

## APM for $5$ HG (FiHG) Configurations

### $(2\omega + 4\omega + 5\omega$ HG)

Before installing the  $5\omega$  HG, the  $4\omega$  HG must be optimized. Use the following steps to optimize the  $5\omega$  HG.

1. Follow the procedure “APM for  $4\omega$  HG (FoHG) Configurations” on page 43.
2. Once the APM for  $4\omega$  HG is complete, place a power meter at the output of the  $5\omega$  HG.
3. Remove the cover from the  $5\omega$  HG.
4. Unlock the locking screw located near the top of the  $5\omega$  HG module.
5. Ensure that everyone in the laser area is following all safety precautions and wearing appropriate eye protection.
6. Start the Q-Switch.
7. Tune the crystal in order to get the maximum energy level. Use a screwdriver to carefully adjust the tuning mechanism, which is a cam. The cam returns to its starting position at each turn.
8. Wait 30 seconds for the laser energy to stabilize. During this waiting period, the energy level will either increase or decrease.
9. Use a screwdriver to finely adjust the crystal tuning cam once again.
10. If you do not reach the expected energy, follow the procedure again “APM for  $4\omega$  HG (FoHG) Configurations” on page 43.
11. Relock the locking screw located near the top of the  $5\omega$  HG module.
12. Replace the module cover.



## 20.0 The Maintenance Tab

The Maintenance tab provides access to the following items  
 (See **Maintenance** on page 63 for more details):

Item	Function
DI Cartridge	Replacement date, next replacement date due, and DI cartridge part number.
Service center France and International	Service center email address
Service center USA and Canada	Service center email address for USA and Canada
Flashlamp counter	User set flashlamp counter and reset.
Screen Brightness	Adjusts the screen brightness as a percentage of the maximum brightness.

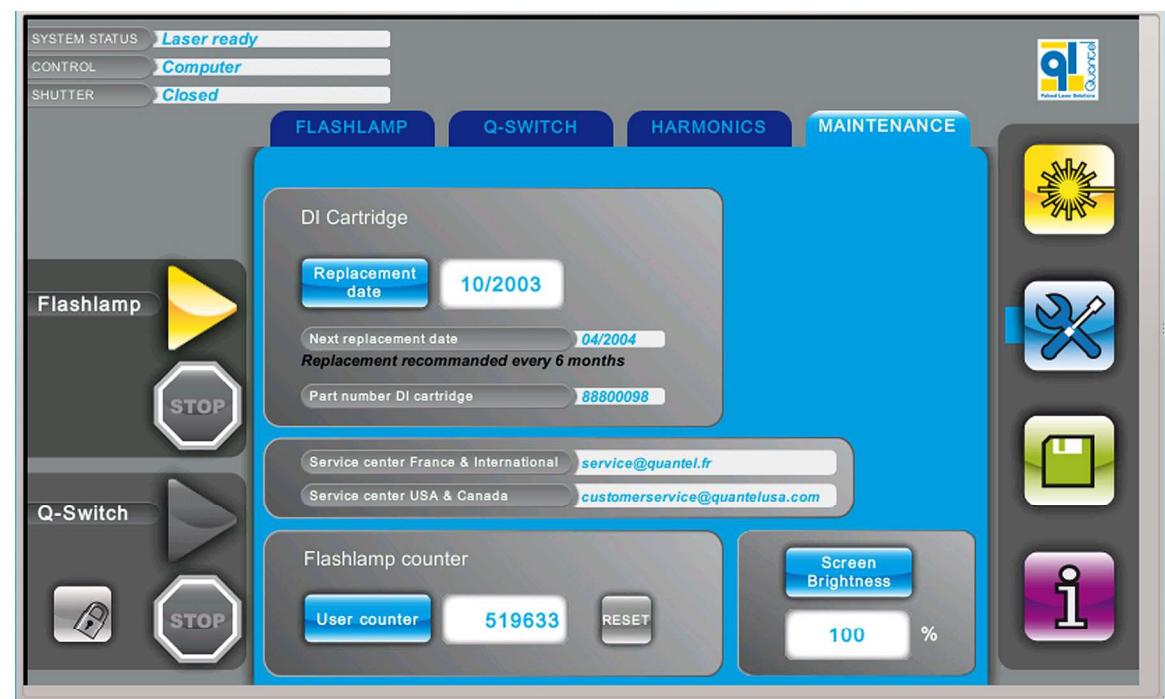


Figure 23 The Maintenance Tab

## 21.0 The Configuration Screen

The Configuration screen provides access to store and load stored settings, as well as select factory defaults. Laser parameters currently in use appear in the Operational settings area at the right of the screen.

You can store up to 4 configurations containing the following items:

- QS Divider
- FL Voltage (V)
- Number of active shots
- Number of scans
- Number of passive shots
- Q-Switch out sync (ns)
- FL-Q-Switch delay (μs)

To store a configuration:

1. Use the Q-touch Settings screen to establish the laser parameters. You cannot enter parameter values using the Configuration screen.
2. Select the button for the configuration number where you will store your current operation settings, for example: **Config.1**.
3. Select the **Save as** button. You will see the parameters listed for that button update to your parameters in use.

To load a configuration:

1. Select the button for the configuration number of the parameters to use, for example: **Config.1**
2. Select the **Load** button.
3. The Operational parameters area updates to show the parameters loaded from your configuration.

To load the factory default settings:

Select the **Factory settings** button.

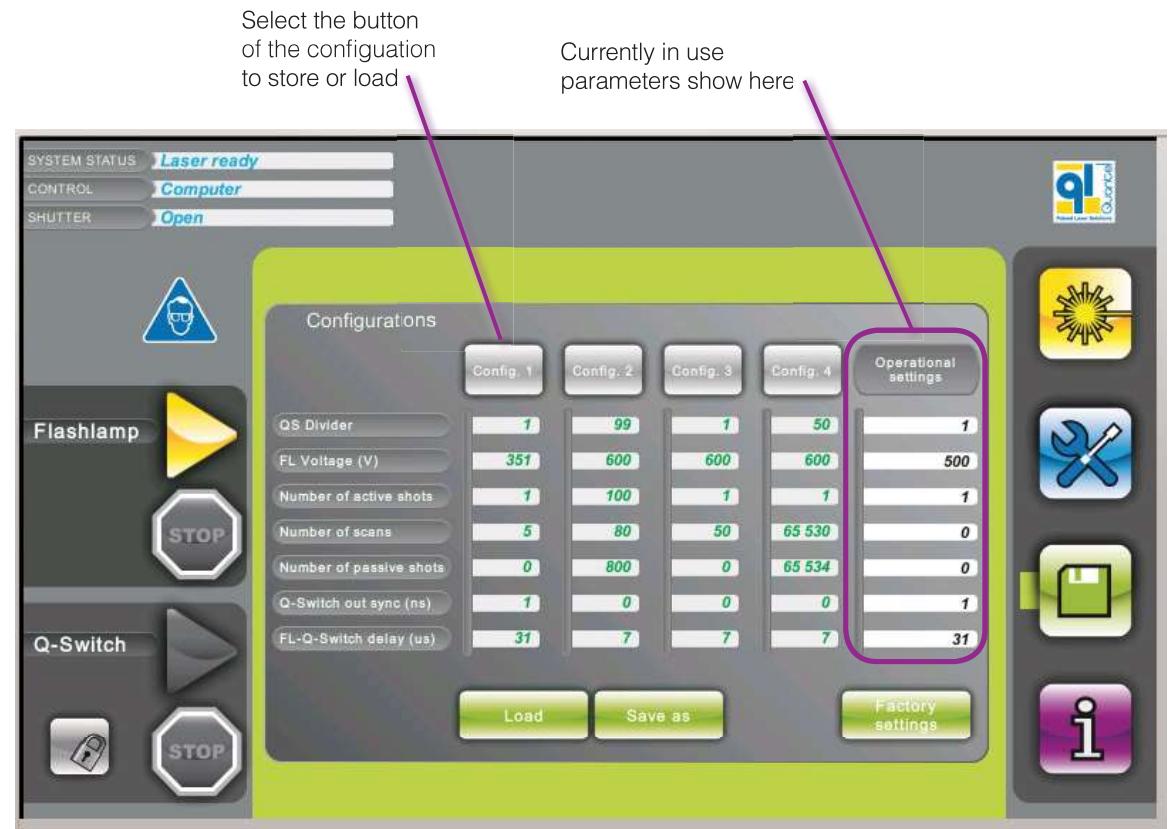


Figure 24 The Configuration Screen

## 22.0 The Information Screen

The Information screen provides access to laser information, synch information, and fault status.

### The Laser Information Tab

The Laser Information tab shows serial numbers and other helpful information about the laser system, as follows:

Item	Function
<b>Laser Information</b>	
Laser head serial #	Laser head serial number
Power supply serial #	Power supply serial number
I/O cable length	Cable length in meters
Firmware version	Firmware version number
<b>Flashlamp</b>	
FL shot counter	System flashlamp shot counter
FL part #:	Flashlamp part number
<b>DI Cartridge</b>	
Last replacement date	User entered date
Recommended replacement date	Calculated replacement date based on Quantel recommendations

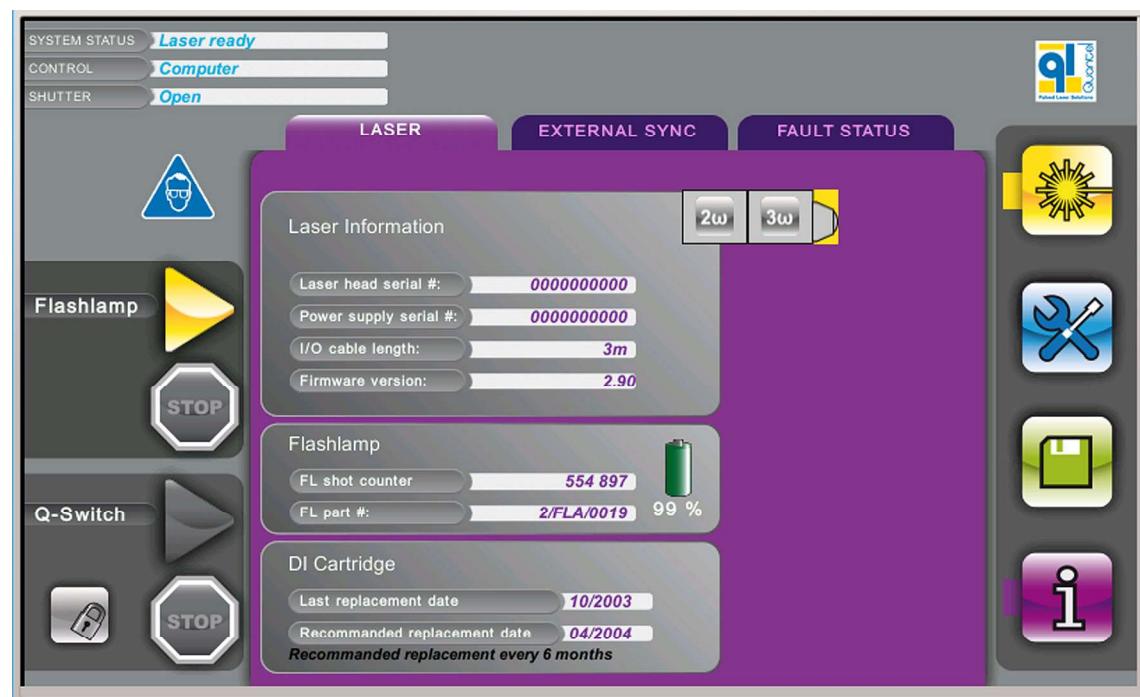


Figure 25 Example Information Screen, Laser Tab

## The External Synch Tab

The External Synch tab shows the timing diagram. See [Timing Diagrams on page 59](#) for a view of the same diagram.

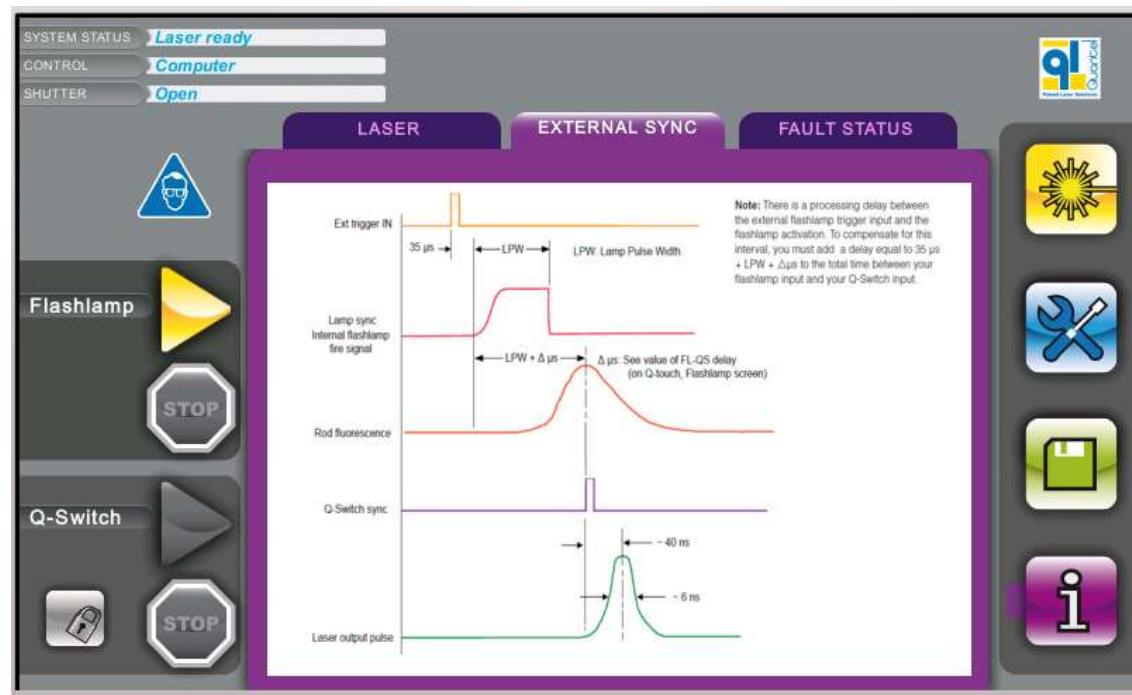


Figure 26 The External Synch Tab

## The Fault Status Tab

The system constantly monitors for potentially hazardous conditions. If any of these conditions exist, laser output ceases and the screen shows a message indicating the fault condition.

When no alarm conditions are present, the fault indicators show green. When alarm conditions are present the fault indicators show red.

## Clearing a Fault Condition

 A red indicator identifies the fault condition that caused system operation to cease. To clear a fault condition, first remedy the issue, then choose **Reset alarms**, located near the center of the Alarms screen. See **Resolving Interlock Fault Conditions on page 75** for details.



Figure 27 The Fault Status Tab

## 23.0 Example Start-Up Procedure



**WARNING:** The following steps result in laser light emission from the output aperture of the Laser Head. During laser operation, everyone present in the laser room must be wearing eye protection appropriate for the specific output wavelengths.



**Note:** Verify that you removed the protective cover from the aperture.

To start the laser system, follow this procedure:

1. Turn the AC power switch located on the ICE rear panel to ON ("1").
2. Turn the Key Switch located on the ICE front panel to ON ("1").
3. As the Key Switch is turned to ON, verify that the "Main Switch On" and the "Power ON" indicators on the ICE front panel. If not, check the Q-touch for fault messages. If necessary, see **Troubleshooting on page 74** to remedy the issue.
4. Use the Q-touch menus to select the desired operating mode. If using an External mode, connect the external signal generator to the appropriate "Lamp Synch In" and/or the "Q-Switch Synch In" BNC connector(s) on the ICE.
5. Open the manual shutter on the Laser Head.
6. Touch the Flashlamp start icon. The icon begins blinking to show the flashlamp is started.
  - In Internal mode, the flashlamp begins flashing at the frequency set for the Flashlamp Repetition Rate.
  - In External mode, the flashlamp will flash at the frequency determined by the external signal generator.
7. Touch the Q-Switch start icon. The icon begins blinking to show the Q-Switch is started. Laser emission begins and the Emission Warning icon appears on the screen. The Emission Warning LED on the Laser Head blinks. See additional instructions earlier in this section.



To cease laser emission:



1. Press the Q-Switch Stop icon or press the Flashlamp Stop icon. The Emission Warning icon on the Q-touch and the Emission Warning indicator on the Laser Head will stop flashing.
2. Close the shutter on the Laser Head.

## 24.0 Example Shutdown Procedure

To shut down the laser system, follow this procedure:



1. Press the Q-Switch Stop icon or press the Flashlamp Stop icon. The Emission Warning icon on the Q-touch and the Emission Warning indicator on the Laser Head will stop flashing.
2. Close the shutter on the Laser Head.
3. Verify the ICE front panel "Laser ON" indicator is off.
4. Turn the Key Switch located on the ICE front panel to OFF ("0").
5. Turn the AC power switch located on the ICE rear panel to OFF ("0").
6. Disconnect the power cord from the ICE AC Mains power if you will not be using the system for an extended period.

## 25.0 Decreasing Output Energy

Specifications are guaranteed at the maximum energy. Nevertheless the energy can be adjusted.

Operation at a decreased energy level is useful when starting an experimental setup or testing equipment. A simple way to decrease the laser output energy is to increase the delay between the flashlamp and Q-Switch to a value that is higher than optimal. You can do this using the Q-touch.



**CAUTION:** Quantel advises against decreasing the energy of the flashlamp(s) to reduce the output energy. Decreasing the energy of the flashlamp(s) will cause a change in beam characteristics. Divergence and position of the focal points may cause damage to the laser's internal optics.

To adjust the output energy using the Q-touch:

1. From the Operation Settings screen, select the **Q-Switch tab** or select the **Flashlamp tab**.
8. Enter a new value for the **FL-Q-Switch Delay**.

## 26.0 Increasing Output Energy



**WARNING:** Do not attempt to modify the pumping power by using the Q-touch to increase the flashlamp energy. This energy has been factory set for optimal laser performance.

Increase the flashlamp energy with the Q-touch only if the flashlamp efficiency decreases. Please contact **Quantel Customer Service** to determine the cause of the efficiency decrease.

## 27.0 Remote Operation

The Q-smart may be controlled by a remote computer using the Ethernet port located on the ICE front panel. The Ethernet connection allows you to manage the laser operation directly from your computer thru a standard RJ45 10Base-T and 100Base-TX Link (autonegotiation supported). The protocol used is the telnet com port control option defined by the RFC 2217. **Ethernet Interface on page 51** for details.