



## The Q-Switch as a High-Speed Shutter

### Normal Q-Switch Operation

Q-switching is a technique in a CW Nd:YAG laser used to generate high *instantaneous* power levels many times greater than the laser's continuous beam power generating capacity. The Q-switch acts as a high-speed shutter within the laser optical resonator to control beam emission.

With the Q-switch in its "blocking" condition, lasing action is not possible. However, the arc lamp continues to "pump" optical energy into the YAG rod which stores this energy much as a capacitor stores electrical energy.

When the blocking effect is suddenly removed, lasing action is permitted, and all of the optical energy that has been stored in the YAG rod will be emitted in the form of a very short pulse of laser light. Duration of the pulse is typically in the range of 100-400 ns, but will depend on the design and operating conditions of the laser. Because the energy pulse is released in such an extraordinarily short period of time, the *instantaneous* or *peak* power developed by the pulse can be 2000 times the continuous beam power capability of the laser. For example, an Nd:YAG laser that is rated at 50 Watts CW power may be able to generate Q-switched pulses of 100 kW peak power.

The ability of the YAG laser to produce such high peak power pulses can be utilized in a wide variety of industrial micro-machining applications: scribing, trimming, cutting, and drilling. Q-switched pulses may be produced at frequencies as high as 40 kHz for some laser models.

### High-Speed "Gating" of the CW Beam

A unique feature of the Lee Laser Q-switching system permits high-speed, precision "gating" of the CW beam ON and OFF. In this situation, the laser emits a pulse of considerably *longer duration* than a typical Q-switched pulse, but lacks the high peak power content. This is useful for *heating applications* such as laser soldering where there exists no requirement for high peak pulse power, but rather a need to deliver an **exact quantity of beam energy** to a workpiece or target.

To do this, Series 800 Q-switching systems combine special optical designs and electronic circuitry to suppress peak pulse power generation, yet still retain fast response times.

<u>Beam Mode</u>	<u>Response Time</u>	<u>Rise/Fall Time</u>
ON	400 $\mu$ s	200 $\mu$ s
OFF	10 $\mu$ s	5 $\mu$ s

The user need only supply a positive voltage square-wave signal for whatever duration of beam ON time is desired. The EXT. VARIABLE BNC connector on the rear panel of the Q-switch driver is provided for this purpose.