Fast High Voltage Switch (Q-switch driver)
Model: RPQ..-..HV.

Frequently asked questions:

Handling and safety

What are the safety rules?
This device should only be operated by personnel trained and experienced in the field of high voltage switching. Opening any of the boxes or improper use of the device can lead to severe injury or death due to a high voltage shock. Before turning this device on, care must be taken that all high voltage leads are inaccessible to human contact. Also, the high voltage cable needs to be handled with care and small turn radii need to be avoided, as it is a fragile component.

Top

General

What is the availability of the product?
Typical availability is 4-6 weeks for low quantities. For quantities up to 10 the shipping time is 6-8 weeks. For higher quantities please call Inrad.

Does it come with a warranty?
Yes there is a 90-day replacement warranty for defective units from date of invoice.

Is the 9-pin sub-D test cable included?
Yes, but only with the optional 24V power supply unit.

Can this switch also be used as a REGEN driver?

The RPQ … switch series is intended for Q-switch operation. For regen applications, 2 drivers and 2 separate Pockels cells would be needed. A better choice for regen applications is the RPR… switch series, which is designed for use with regenerative amplifiers (regen) and is based on the same technology with very similar characteristics.

Top

• Mounting and mechanical

What is the finish of the switch box?
The switching box is gold plated to allow good thermal and electrical contact and to prevent any long-term corrosion.

How does the "easy" PC pin connection work, is the pin included?
The switch box comes with an integrated high voltage plug to allow an easy pin connection with the Pockels cell mount or laser housing. The pin is included with the product.

What is the purpose of the 4-40 threaded holes on the top and bottom of the switch box?
These threaded holes can be used for various mounting arrangements and to connect the ground of the Pockels cell crystal.

How long are the cables between the HV power supply and the switch box?
The standard length is around 1m in length. However, the cable can be customized to any length.

Top

• Electrical

What are the current requirements for the 24VDC power supply?
This depends on the Model. For the 10kHz RPQ models I ≥ 1A @ 24VDC; the 20kHz RPQ model needs I ≥ 1.5A @ 24VDC.

What happens if the specified repetition rate is exceeded?
The switching unit will turn off if the repetition rate exceeds the specified maximum repetition rate by about 5-10%. It will automatically turn back on when the repetition rate is in its allowed range again.

How can the high voltage be adjusted?
There are two ways to adjust the high voltage:

Manual:
Connect pin 3 to pin 4 on the 9-pin subminiature D-connector of the HV-power supply and adjust the high voltage with a screwdriver through the hole in the top of the HV-power supply.

Remote voltage control:
Provide an input voltage to pin 3 on the 9-pin subminiature D-connector of the HV-power supply, using pin 5 as the ground for the input voltage. The high voltage output will be 1kV per 1V input on pin 3 +-10%.

The high voltage can be monitored 1:100 on pin 9. The accuracy is +-5%.

What happens if the HV control input is too high?
The high voltage power supply will turn off if the remote input voltage exceeds the maximum high voltage rating for the particular model. It will turn back on as soon as the voltage is in the allowed range again.

How fast does the trigger input need to be?
The TTL-trigger input should have a rise time <10ns to allow low jitter. Therefore, a 50-Ohm termination is preferred. The switch however will work also with slower input rise times.

How much jitter does the switch have between trigger input and fast HV output?
The jitter is <200ps pulse-to-pulse and <50ps RMS.

What is the turn-on delay?
The turn-on delay between the trigger input and the HV-output is < 50ns.

How long can the connection to the Pockels cell be and what type of cable should be used?
The cable length between the switching box and the Pockels cell crystal should be kept as short as possible in order to maintain a fast switching speed. All rise time measurements were done with a 40 mm long cable. The cable length can be much longer than that, e.g. 10 cm; however, a thick cable cross-section should be maintained in order to minimize the inductive voltage loss. Also, the conducting part of the cable should be kept away from any ground by several millimeters to avoid parasitic capacitances, which reduce the switching speed.

Is the Pockels cell grounded?
Yes, one connection to the Pockels cell crystal is connected to ground through one of the #4-40 threaded features on the switch box or through some other good contact to the switch-box housing.
All incoming signal grounds, which includes the high voltage, the 24VDC, and the trigger input ground, are connected internally together to one common ground.

Is there a turn-on sequence for the driver?
No. The driver can be turned on in any sequence (HV first or trigger first). However all connections must be made before anything is turned on. Also human contact to any HV component must be avoided when the HV is turned on.

What happens if the capacitive load of the Pockels cell is > 6pF?
All switching specifications have been tested for loads up to 6pF. The switch will continue to work for larger capacitances, however it will become slower as the capacitance goes up.

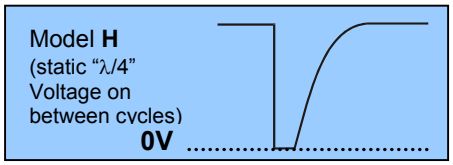
What if I need a slower switch?
In general, a resistor put in series on the HV side of the Pockels cell will slow down the switching speed. However, no specifications are made.

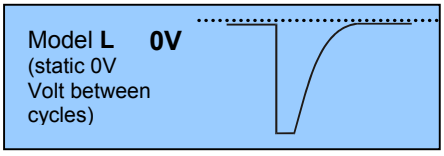
Is the switch protected against open and short circuit?
The switching unit has no problem with an open circuit and it even may survive a short circuit on the HV output for a short period of time. However, no warranty is given against shorting out the high voltage output! Please, use caution.

Top

- ## Optical

What are the characteristics of the "H" and "L" models and how to choose between them?



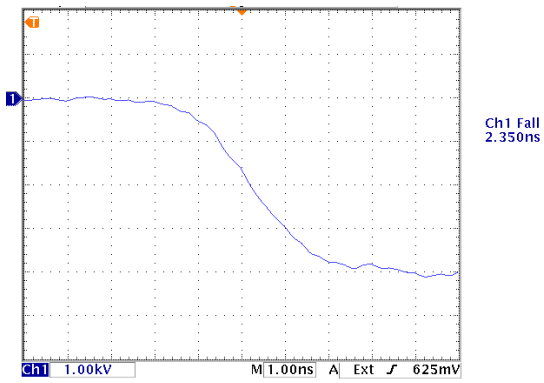


The "H" model keeps the Pockels cell under high voltage between cycles and then switches fast down to 0V. This allows the Pockels cell to be at λ/4 retardation between cycles and eliminates the need for an extra λ/4-plate inside the laser for typical q-switch operation. Concerns of this operation mode are that dirt particles are attracted to charged crystals and some Pockels cell crystals degrade when high voltage is left on for long periods of time.

The "L" model maintains 0V between cycles. Typical Q-switch configurations need an added λ/4-plate or a static λ/4 alignment of the Pockels cell itself.

What type of crystals can be driven by this switch?
In general this switch can drive any type of crystal. However, specific properties of different crystals need to be considered.

How fast will the optical raise time be?
In general, the 10%-90% optical rise time correlates with a 20%-80% electrical rise time. Since this switch has a typical electrical 10%-90% rise time of 2.5ns, the typical optical 10%-90% rise time is < 2ns.



How good is the optical contrast?
The optical contrast depends not only on the rise time of the switch but also on the presence of any slow shoulders before and after the fast switching. This family of HV-switches shows very little shoulder effects and, therefore, provides high optical contrast ratios.

Top

- **Thermal**

How much heat is produced depending on settings?
The switch box has the following heat output:

At 4kV operation:
5kHz → 7W
10kHz → 14W
20kHz → 28W

Lower operating voltages will result in reduced heat output.

What does "no active cooling" mean?
No active liquid, gas or Peltier cooling is required. However, the high repetition rate models need to be heat-sunk.
No cooling required?
The switch box can be operated up to a housing temperature of 75^0C. The 10kHz models will stay below that maximum temperature even without heat sinking at 25^0C air temperature. The 20kHz models would exceed that

temperature and therefore, need heat sinking. In general, it is a good idea to keep the switch box housing temperature as low as possible, since the switching rise time becomes slower at higher temperatures.

What is the allowed operating temperature?
The switch box temperature can go up to 75^0C and down to -10^0C. However, low temperatures can be tolerated only in dry or sealed environments where no condensation is present.

What does "thermal management of the components" mean?
It means that all high power components inside the switch box are thermally controlled and are operated well below their maximum temperature ratings. The switch box housing is thermally conductive all around, and heat sinking can be applied to any side.

Top

Please contact Inrad with any further questions at (201) 767-1910 or via Fax at (201) 767-9644.
Email: sales@inrad.com
Visit our web site: www.inrad.com