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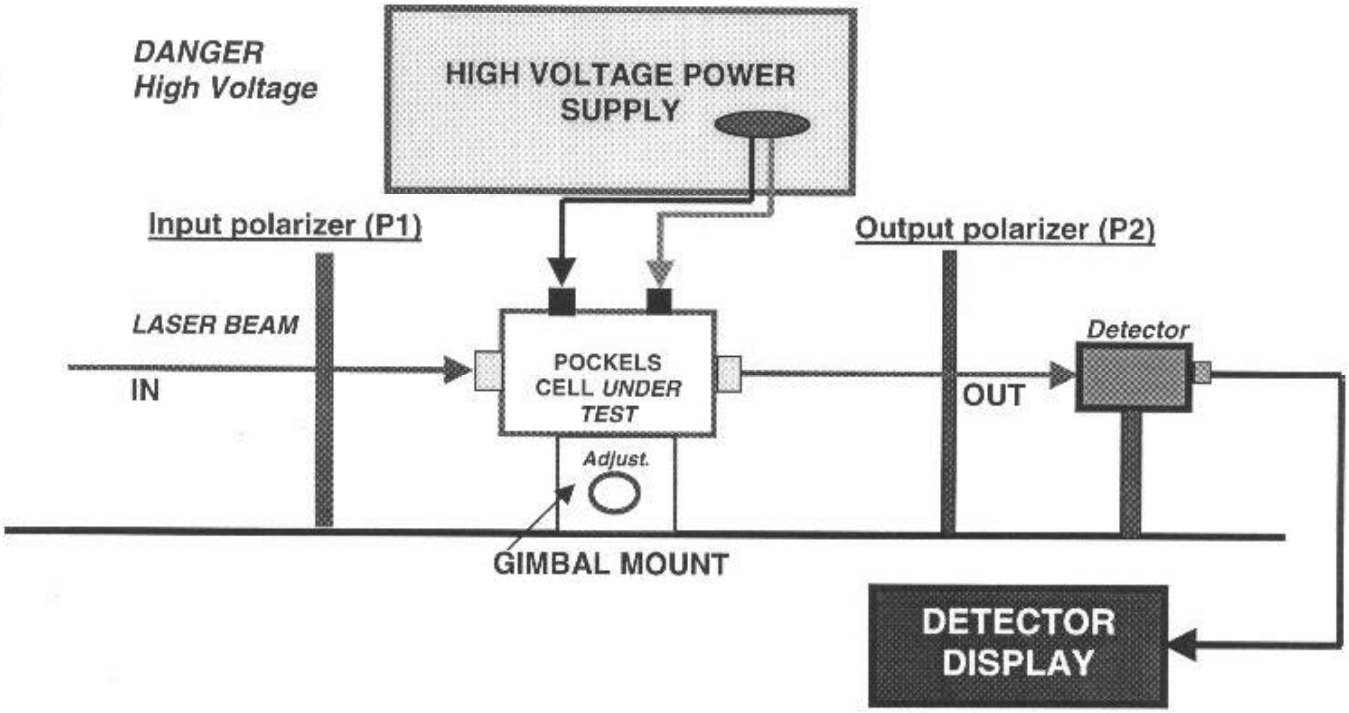
POCKELS CELL TESTING

GENERAL

This manual contains general testing of Pockels cells produced by Quantum Technology. It is a useful guide for alignment within a system as well as, a QC aid for incoming inspection, and basic failure analysis.

APARATUS

OPTICAL BENCH OR RAIL
TWO POLARIZERS (see text)
ONE TEST LASER - Preferred HeNe @ 633nm ~1mW CW
ONE DETECTOR for use within wavelength of test laser
ONE DISPLAY – for detector, either a meter or oscilloscope
ONE ROLL OF TRANSLUCENT TAPE – like Scotch invisible tape
ONE NEGATIVE LENS – Approximately -25mm
GIMBALL MOUNT TO ADJUST POCKELS CELL while under test
POCKELS CELL – *to be tested*
POCKELS CELL'S TEST DATA SHEET – *supplied with the Pockels cell*
WRITING MATERIAL
WHITE PIECE OF CARDBOARD OR PAPER



GENERAL SETUP FOR POCKELS CELL TESTING

Figure 1

INPUT/OUTPUT POLARIZERS – for this test they can be sheet polarizers if the test laser is in the visible range between 633nm (HeNe) and ~ 532nm. A CW power level of between 0.5mw~1mW is recommended. For reference, all tests in this procedure used 633nm-wavelength laser.

GIMBAL MOUNT – for YAW and PITCH adjustment of the Pockels cell. Rotational motion is not necessary, if the terminal are carefully placed in the "up" position as shown in the above drawing.

DETECTOR and DETECTOR DISPLAY – these devices are to be capable of indicating the intensity level of the source laser without saturating. A photodetector and oscilloscope or a low-level power meter can be used for this purpose.

HIGH VOLTAGE POWER SUPPLY – the range of this supply is up to 9KV depending of the Pockels cell under test. *This voltage is dangerous can be lethal.* Experienced personnel should only perform these tests. In some cases the Pockels cell driver can be used as the high voltage source, see the instruction manual for the particular unit used.

POCKELS CELL UNDER TEST – The Pockels cell under test can be one of the three basic models produced by Quantum Technology. The QC-series is KD*P, the QS-series is BBO, and the LN-series is lithium niobate. See table below for *approximate* halfwave voltages for 633nm. Consult the Pockels cell data sheet for the test voltage used for the particular cell.

QC- series (KD*P)	***QS- series (BBO)***	***LN – series (Lithium Niobate)***
~ 4 KV	**~ 8.1 KV**	**~ 1.4 KV**
Aperture: 6mm	*Aperture: 6mm*	*Aperture: 6mm*

VOLTAGE COMPARISON TABLE

NOTES:

1) **The larger the Pockels cell aperture – the greater the voltage**
2) **Dual crystal Pockels cells for QC and QS series require half the voltage shown in the above table.**

TESTING THE POCKELS CELL @ 633nm– OUTSIDE OF A LASER SYSTEM

These tests are usually performed for either a) inspection of a new or repaired Pockels cell, or b) determination of the proper operation of a Pockels cell. If the Pockels cell is in a laser system, please refer to that portion of the manual for proper setup.

Remove any protective end caps from the cell, and carefully visually inspect that the cell is clean and clear by looking through it. Double check the serial number against the data sheet provided to aid in setup the testing parameters.

Use two suitable polarizers, which are crossed polarized to each other. Let P1 be in the same polarization as the input laser beam. Use vertical polarization for the input laser beam. P1 can be eliminated if the test laser has a polarization ratio greater than 100:1.

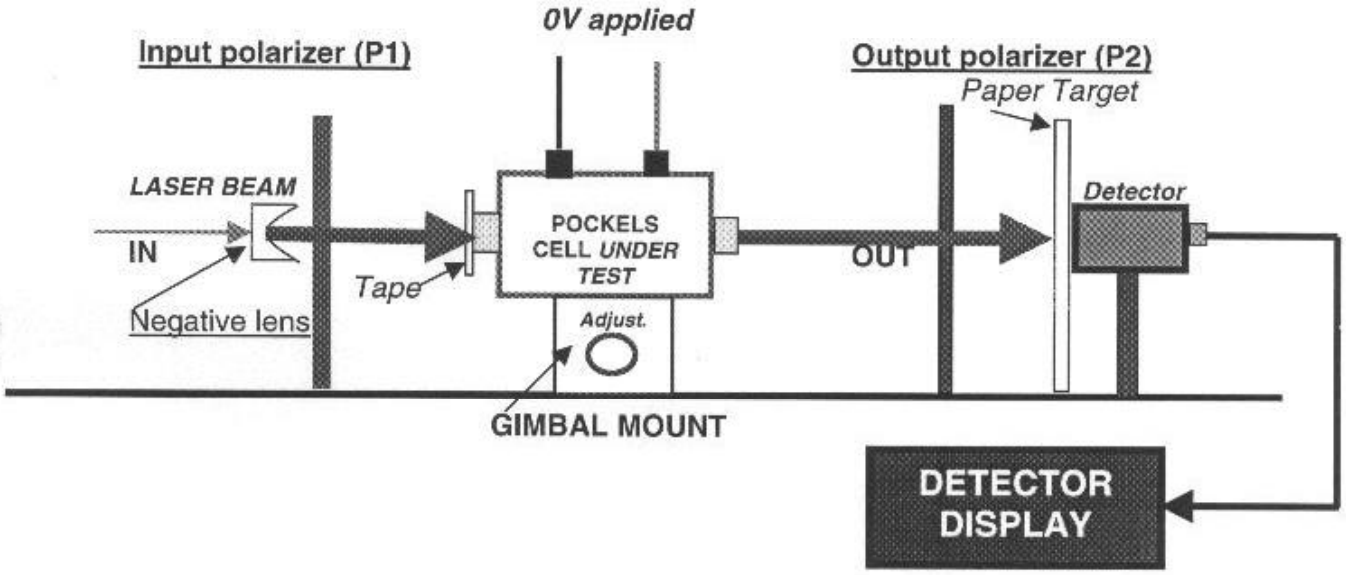
Set up the optical system as shown in figure 1.

Make sure the high voltage power supply is OFF and discharged before connection to the Pockels cell.

This manual references a HeNe laser at 1 mW for these tests, and recommends this method. The detector and display must be able to clearly show the minimum and maximum changes in laser beam intensity. A photodiode (biased) and an oscilloscope works very well. A low light power meter for 633nm is acceptable also.

Align the optical system such that the laser beam goes through the center of the Pockels cell (bore sighted) and falls directly on the active portion of the detector. with P2 removed. Note – be assured that P2, if not a sheet polarizing filter, does not displace the beam appreciably on the detector. If it does, compensate for the deviation when necessary. When P2 is replaced, (make sure it is crossed to the input polarization), observe the detector display.

Place a piece of translucent material such as "invisible" Scotch tape or lens tissue before P1. It is also recommended that a negative lens be placed also before P1 (with the tape) to expand the beam for easy observation. Place a white cardboard or paper sheet (paper target) in from of the detector for visual observation of the pattern referred to as the "Maltese cross".



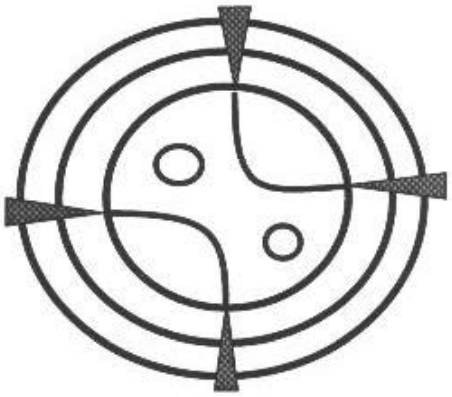
Ideal displayed cross

The paper target should show a projection as sketched here. The concentric circles should be as "round" as possible. The intersection of the cross must also be coincident with the laser beam that was bore sighted initially.

At this point the high voltage will be brought up to a value as shown in the data sheet sent with the Pockels cell. Increase the voltage slowly, and never exceed

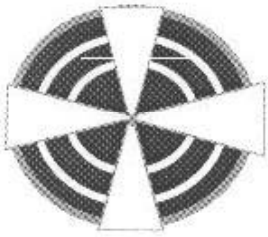
by 20% the value shown on the data sheet. While observing the paper target, increase the voltage until the cross opens, as shown in sketch.

This represents the pattern on the target paper at the halfwave voltage. The center opening should be clear.



Ideal sketch of Pockels cell pattern

Record the halfwave voltage at this point, but do not exceed ~ 15% of the data sheet voltage.
To obtain a better value for the halfwave voltage is to rotate P2 by 90-degrees, so that it in the same polarization plane as P1. At the halfwave voltage, a negative or inverse Maltese cross will be displayed. Remove the paper target and obtain a peak or maximum value on the display from the detector pickup. It should be less than 10% of that voltage value as recorded on the data sheet. Disconnect the Pockels cell from the High Voltage power supply, *after* the supply has been shutdown and discharged.



The inverted or negative image with P1 and P2 aligned to the polarization of the test laser. Compare to previous cross.

Ideal displayed negative or inverted cross

TRANSMISSION LOSS

It is recommended that this test be performed at the wavelength at which the Pockels cell is top be used, because other wavelengths will produce errors because of the AR coatings. Use a power level between 1mW and 10mW.

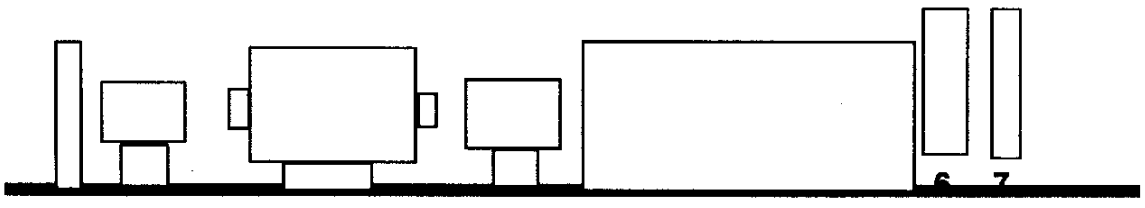
In this test, a laser power meter is required. Set the power to the proper conditions.

With the cell removed, measure the laser output power.

Without any polarizers, P1 and P2, and with the cell disconnected from the High Voltage Power Supply measure the output and record the power level from the display with the beam going through the center of the Pockels cell. Be careful to align the cell to the beam, so that it is bore sighted through the center of the cell. Measure the power, and calculate the loss. It should be 4~5% less.

NOTE: The previous test - TESTING THE POCKELS CELL @ 633nm– OUTSIDE OF A LASER SYSTEM – can be run at the actual wavelength, but keep the power low in CW mode. Sometimes this is not practical.

SETUP OF A POCKELS CELL OPRATING A QUARTERWAVE VOLTAGE UTILIZING A QUARTERWAVE PLATE IN A LASER CAVITY



Basic generic setup of a laser cavity

(For reference – there are many other configurations depending on application)

Where:

1 – Rear Mirror (Usually 1005 @ λ
2 – Quarterwave plate
3 – Pockels cell
4 – Polarizer (if necessary)
5 – Laser Head
6 – Shutter/Spatial filter
7 – Front mirror/output coupler

In this configuration the Pockels cell is operated in the quarterwave voltage (~ ½ of the halfwave voltage), and with no voltage applied to the cell until Q-switching is required. The Pockels cell used should have all ready been accepted as a working unit.

To setup the Pockels cell in an actual cavity, use a HeNe laser carefully aligned to the laser rod with all optical elements in place. Sometimes, it is easier to add one element at a time and adjust accordingly as other pieces are secured to the optical rail. Make certain that the laser system is OFF!

Defuse the HeNe laser (tape) and place target paper at the front mirror towards the laser head. Remove the shutter and spatial filter. Be assured that the "Maltese cross" is centered on the bore sighted He-Ne. With all elements replaced, the laser is ready for testing.

In simple terms, to obtain a GIANT pulse (Q-switched laser) two factors must be adjusted. The voltage on the Pockels cell which controls the polarization rotation, and the delay of the Q-switch trigger. The delay sets up the point at which the Pockels cell receives a signal allow to rotate the polarized light of the laser to create the GIANT pulse.

With the flash lamp ON, the population inversion takes place in the laser medium. However, the rear mirror is block because of the quarterwave plate. Since no voltage is across the Pockels cell the polarized light goes through the cell unaltered. The light gets rotated by the quarterwave plate, reflects off the rear mirror, returns again through the quarterwave plate, being rotated an again. When it reaches the polarizer it is orthogonal (90-degrees) or crossed to it, and the polarized light does not pass. Therefore, no lasing action. When a high voltage is applied to the Pockels cell at the quarterwave voltage, the light, which was unaltered before, now rotated by a quarterwave. Then passing through the quarterwave plate, it is rotated a complete halfwave, and is reflect back by the rear mirror. Entering the quarterwave plate and Pockels cell it is rotated again by halfwave. Now it passes through the polarizer, and lasing begins. Since the cavity was blocked, the lasing medium has built up greatly, and the sudden discharge of photons produce the GIANT pulse.