

Pockels Cells(Q-Switches)

Introduction

Electro-optic Pockels cells are used in applications that require fast switching of the polarization direction of a beam of light. These uses include Q-switching of laser cavities, coupling light into and out from regenerative amplifiers, and, when used in conjunction with a pair of polarizers, light intensity modulation. Pockels cells are characterized by fast response, since the Pockels Effect is largely an electronic effect that produces a linear change in refractive index when an electric field is applied, and they are much faster in response than devices based on acoustic changes in a material, for example. Although INRAD Pockels cells can be used for phase modulation, during which sidebands are imprinted onto the frequency of the transmitted light at multiples of the drive frequency of the Pockels cell, these cells are not as efficient as devices that use an optimal crystal orientation and electric field direction and are designed specifically as phase modulators. Because of the desire for the light beam to experience no birefringence in the absence of an electric field, the light beam propagates along the optic axis of a uniaxial crystal for all standard INRAD Pockels cells.

Crystal Types

Selection of the best crystalline material to use as the Pockels cell medium is determined by the wavelength of operation and the specific performance requirements such as damage threshold, average power handling ability, contrast ratio, extinction ratio, and repetition rate.

- **KD*P Pockels Cells**

KD*P is routinely used for Q-switching applications from the uv out to about 1.1 μm where absorption limits its use in active cavities, although it can be useful at longer wavelengths when a few percent of absorption can be tolerated.

- **LiNbO3 Pockels Cells**

LiNbO3 is used at 1.064 μm and longer wavelengths. As a Pockels cell with an electric field applied transverse to the direction of light propagation, it can be configured to operate at a lower voltage than KD*P at 1.064 μm by selecting the thickness and length of the crystal. LiNbO3 is useful at infrared wavelengths as long as 4.0 μm although the half wave voltage becomes quite high. INRAD offers a damped LiNbO3 Pockels cell that dramatically decreases piezoelectric ringing and allows the Pockels cell to be used at higher repetition rates.

- **BBO Pockels Cells**

BBO can be useful at wavelengths from the uv out to about 2 μm . The crystal handles high average powers better than either KD*P or LiNbO3, although it has a relatively small electro-optic coefficient. Hence, for BBO Pockels cells, voltages typically are high. Longer crystals reduce the voltage requirement. Thinner crystals, for which the clear aperture is smaller, also require less voltage for a given application.

Inrad Pockels Cell Specifications							
Model Number	Aperture (mm)	Wavelength Range (nm)	Transmission (%T) @ specific λ	Capacitance (pF)	Quarterwave Voltage @1064 nm	Extinction Ratio @1064 nm	Damage Threshold (MW/cm ²)
PKC21	9.5, 12, 15, 20, 25	.30 - 1.32 μm	FC > 96 %	8, 9, 10,14, 17	3.3 kV	> 1000:1 For \leq 15mm aperture	FC> 500 SG> 800
		.25 - 1.32 μm	SG> 99 %				
PKC02	9,15,20	.30 - 1.32	FC > 95 %	14, 22, 28	1.65 kV	> 1000:1	> 500

		μm				For $\leq 15\text{mm}$ aperture	
PKC23	10	.30 - 1.32 μm	FC > 96 %	6	3.3 kV	> 1000:1	> 500
PKC24	9	.30 - 1.32 μm	SG > 99 %	8	3.3 kV	> 1000:1	> 800
PLC01	8.5	1.0 - 3.8 μm	> 98 %	20	1.65 kV	> 600:1	> 300
PLC01/D	8.5	1.0 - 3.8 μm	> 98 %	20	1.65 kV	> 600:1	> 300
PBC05	2.5, 3.5	.22 - 2.1 μm	> 98 %	3	4.8 kV, 3.6 kV	> 1000:1	> 500
PBC06	3.5, 4.5	.22 - 2.1 μm	> 97 %	5	3.6 kV, 2.4 kV	> 500:1	> 500

Accessories

Pockels Cell Drivers

Gimbal Mounts

INRAD M/N 815-430 and M/N 815-540 Gimbal mounts can be used to hold and adjust INRAD Pockels cells. The table below indicates the appropriate gimbal mount for each Pockels cell.

Gimbal Mounts for INRAD Pockels Cells	
Pockels Cell M/N	Gimbal Mount
PKC21-XX09	815-430 / 1.375
PBC05	815-430 / 1.00
PBC06	815-430 / 1.25
PKC02-XX09, PKC02-XX15, and PKC02-XX20	815-540
PLC01 and PLC01/D	815-540

Ordering Information

Please consult with an INRAD sales engineer before ordering a Pockels cell.

The model number of an INRAD Pockels cell is coded in the following format.

1 2 3 4 5 - 6 7 8 9 / xxxx nm / D

1 - P for all Pockels cells

2 - either K for KD*P, L for LiNbO₃, or B for BBO

3 - either C for capacitive or M for impedance matched

45 - a two digit model number

67 - either DC for a dry cell, SG for a sol gel coating, FC for a fluid filled cell with FC-43

89 - a two digit number indicative of the aperture of the cell in mm units

/xxxx - the wavelength of use

/D - a designation for a LiNbO₃ cell that indicates a piezoelectrically-damped unit

Examples:

Part Number Description

PKC21-SG09/1064nm

KD*P capacitive-type Pockels cell with a 9.5 mm aperture and AR coated for 1064 nm. The crystal faces are AR coated with a sol gel coating for 1064 nm and the windows have a dielectric AR coating at 1064 nm on both sides.

PKC02-FC09/1064nm

KD*P capacitive-type dual crystal Pockels cell with a 9 mm aperture and AR coated for 1064 nm. The cell is fluid filled with an index matching fluid and the windows have a dielectric AR coating at 1064 nm on the outside surfaces.

PLC01-DC08/1318nm/D

LiNbO3 capacitive-type Pockels cell with a 8 mm aperture and AR coated for 1318 nm. The crystal and windows have a dielectric AR coating at 1318 nm. The unit is piezoelectrically damped.

KD*P Pockels Cells, Dual Crystal			
Description	Notes	Aperture	Model
KD*P Dual Crystal Pockels Cell, with AR coated windows, filled with FC-43 fluid.	Windows are not wedged	9 mm	PKC02-FC09
		15 mm	PKC02-FC15
KD*P Dual Crystal Pockels Cell, with AR coated windows, with sol-gel coated crystal.	Windows are not wedged	9 mm	PKC02-SG09
		15 mm	PKC02-SG15
		20 mm	PKC02-SG20

KD*P Pockels Cells, Single Crystal			
Description	Notes	Aperture	Model
KD*P Pockels Cell, with AR coated windows, filled with FC-43 fluid.	Windows are wedged; customer must select between net 0° or 1° wedge for the device	9.5 mm	PKC21-FC09
		12 mm	PKC21-FC12
		15 mm	PKC21-FC15
KD*P Pockels Cell, with AR coated windows, with sol-gel coated crystal.	Windows are wedged; please, select between net 0° or 1° wedge for the device	9.5 mm	PKC21-SG09
		12 mm	PKC21-SG12
		15 mm	PKC21-SG15
		20 mm	PKC21-SG20
		25 mm	PKC21-SG25
		35 mm	PKC21-SG35
		50 mm	PKC21-SG50

KD*P Pockels Cells, Color Single Crystal			
Description	Notes	Aperture	Model
KD*P Pockels Cell, with AR coated windows, filled with FC-43 fluid.	Windows are not wedged	9 mm	PKC23-FC09
KD*P Pockels Cell, with AR coated windows, with sol-gel coated crystal.		9 mm	PKC23-SG09
KD*P Pockels Cell, with AR coated windows, with sol-gel coated crystal.	Windows are wedged; please, select between net 0° or 1° wedge for the device	9 mm	PKC24-SG09

LiNbO₃ Pockels Cells			
Description	Notes	Aperture	Model
LiNbO ₃ Pockels Cell, with crystal and windows AR coated for 1064 nm, dry cell.	Windows are not wedged	8.5 mm	PLC01-DC08/1064
LiNbO ₃ Pockels Cell, with crystal and windows AR coated for 1064 nm, dry cell, damped.		8.5 mm	PLC01-DC08/1064/D
LiNbO ₃ Pockels Cell, with crystal and windows AR coated for 1320 nm, dry cell.		8.5 mm	PLC01-DC08/1320
LiNbO ₃ Pockels Cell, with crystal and windows AR coated for 2100 nm, dry cell.		8.5 mm	PLC01-DC08/2100
LiNbO ₃ Pockels Cell, with crystal and windows AR coated for 1064 nm, dry cell.		10.5 mm	PLC01-DC10.5/1064

BBO Pockels Cells		
Description	Aperture	Model
BBO Pockels Cell, with AR coated windows, dry cell, for 248 nm operation.	5 x 16 mm	PBC03-DC516/248
BBO Pockels Cell, with AR coated windows, dry cell, for IR nm operation.	7.5 x 10 mm	PBC04-DC710/1064
BBO Pockels Cell, with AR coated windows, dry cell.	2.5 mm	PBC05-DC03/1064
	3.5 mm	PBC05-DC04/1064
BBO Pockels Cell, dual crystal, with AR coated windows, dry cell.	3.5 mm	PBC06-DC04/1064
	5.5 mm	PBC06-DC06/1064
Note: Custom wavelengths are available.		