

LEYSOP LTD



Leysop Ltd. Catalog

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- High Voltage Pockels Cell Q-Switch Driver
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LEYSOP LTD



At LEYSOP they supply a range of electro-optic modulators and drivers, Faraday rotators, optical polarisers, depolarisers and attenuators. As the only UK manufacturer of electro-optic modulators and deflectors, they are particularly proud of their optical workshop skills, development techniques, and also of their staff who have been involved in the design and fabrication of optical components for more than twenty years. These skills have been directed mainly to the manufacture of optical components used in laser systems which are to be found in this catalog.

If you have any questions or queries regarding the products or specifications available in this catalog then please don't hesitate to contact us here at M Square. info@mxmco.com

Electro Optic Phase Modulators

Resonant Phase Modulator:



PM50-100 (50 MHz to 100 MHz versions available)

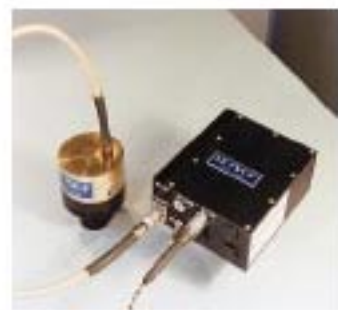
By making the electro-optic crystal part of a tuned circuit, relatively low drive voltages can be used to achieve up to π radians of phase modulation. For the range 50 MHz to 100 MHz the enhancement of the voltage which is able to be applied across the crystal as a result is typically around 10 times that of the 50 ohm input drive.

For the tuned circuit arrangements the drive power required from the source is usually less than one watt.

These phase modulators can currently only be supplied without a drive source.

Optical wavelength range	600 - 1300 nm (Lithium Tantalate)
Crystal Configuration	Brewster cut or ar/ar normal incidence rod
Aperture	2mm
RF Drive power	2 watt maximum for π radians
Tuning range of optical head	$\pm 15\%$ of centre frequency
Voltage gain from tuned circuit	≈ 10
Input impedance of head	$\approx 50 \Omega$
Note: These are typical specifications taken from a phase modulator operating at 70 MHz.	

Travelling Wave Broad-Band Phase Modulator



PM1000 (up to 1GHz available)

For frequencies higher than ~ 100 MHz, we have found that the enhancement in voltage available from using a resonant circuit is soon lessened to the extent that it is not so effective. We then find that a more conventional modulator is beneficial, however we use a pseudo-travelling wave arrangement to provide a 50 ohm characteristic impedance and also some matching of the optical and electrical phase velocity to maximize the bandwidth. Using this arrangement we have made phase modulators with useful response to ~ 1 GHz. The reasonable availability of moderately high powered (50W) r.f. amplifiers up to this frequency makes it possible to provide a voltage swing of around 140V peak to peak across the crystal which is sufficient to provide a sufficient degree of modulation depth for most applications. The device is supplied without driver or load (the r.f. signal must be terminated in a suitably specified r.f. load)

Optical Wavelength range	600 - 1300 nm (Lithium Tantalate) 200 - 600 nm (ADP)
Aperture	1.5mm typical
Characteristic design impedance	≈ 50W
Drive Power	Up to 50 watts

Low Voltage Electro-Optic Light Modulators

EM 200A

This is a low voltage ADP transverse modulator designed to operate at all wavelengths in the visible and is entirely free from piezo-electric resonances. This modulator has a high degree of temperature stability, but where long term d.c. amplitude is required it should be operated in a constant temperature environment. The modulation frequency is not limited by the device characteristics other than by its electrical capacitance and therefore depends on the drive circuit used. Wide band ar-coatings are used on all components.

Type: EM 200A, EM
200K & EM 200L



EM 200K

This is a low voltage transverse KD*P electro-optic modulator designed to give maximum thermal stability beyond that obtained by the ADP type. Its transmission range is extended into the infra-red and its extinction ration is also better than that obtained from its ADP counterpart. It does however display piezo-electric characteristics.

EM 200L

This is a low voltage transverse electro-optic modulator using high damage threshold lithium niobate. It has similar characteristics to the EM 200K with an optical range extended further into the infra-red.

Model No.	EM 200A	EM 200K	EM 200L
Crystal Type	ADP	KD*P	LiNbO ₃
Aperture	2.2mm	2.2mm	2.2mm
Crystal Length	4 x 20mm	2 x 40mm	2 x 20mm
Half Wave Voltage at 633nm	220V	220V	220V
Crystal Orientation	45°y-cut	45°z-cut	z-cut
Wavelength Range	0.3 - 1.0µm	0.2 - 1.2µm	0.5 - 4.0µm
Windows	BK7	BK7	Quartz
Max. Continuous Applied Voltage	250	250	400
Extinction ratio	³ 100:1	³ 200:1	³ 200:1
Capacitance	60pf	40pf	60pf
Cell Diameter	40mm	40mm	40mm
Cell Length	110mm	110mm	110mm
Optical Transmission	> 85%	> 90%	> 90%
Connectors	—BNC—		

Electro-Optic Deflector Q-Switch

Electro-Optic Deflector Q-Switch



The electro-optic deflector makes an ideal Q-switch for compact, low average power systems. Polarisers are not required and the optical loss can be kept to below 1%. The ability to deflect in a few nanoseconds allows short Q-switch pulses to be produced and high repetition rates obtained. The 1 mm aperture deflector has been successfully used to Q-switch a micro-chip laser at 20kHz while producing 1.5 ns pulse lengths. Leysop can supply the deflector with a miniaturised 1kV driver operating between 0 - 20 kHz. The Q-switch is not liquid filled and does not require accurate alignment.

Deflector Specification

Aperture	1mm	2mm	3mm
Deflector length	11mm	20mm	25mm
Deflection angle for 1kV drive	5mrad	3mrad	1.5mrad
Optical loss ar/ar at 1.06mm	< 1%	< 1%	< 1%
Dimensions (mm, excluding connections)	25 x 25 x 11	20 x 20 x 31	20 x 20 x 31
Connector	SMA	SMA	SMA
Capacitance	50pF	50pF	50pF
Switching Speed	Driver limited	Driver limited	Driver limited

Solid State 20kHz Driver Specification

Power Input	+9V or +12V @ 0.7A D.C.
Output	+900V pulse
Nominal Pulse Length	20 - 100ns, internally adjustable
Rise Time into 50pF Capacitor	£10ns
Trigger Input	2 - 5V with 10ns rise time into 50 W
Repetition Rate	0 - 20kHz
Dimensions	60 x 60 x 110mm
Connectors: Output & Trig. in	SMA
Cable length between Pulser and Deflector	500mm max.

Faraday Optical Isolators

FOI 5/57 & FOI 5/771

The Faraday Effect is weak, even in TGG and so a strong magnetic field is required. It is also wavelength sensitive as the verdet constant (which provides a sort of figure of merit) is strongly wavelength dependent. At increasing wavelengths, it is required to use especially strong magnetic fields in order to achieve a 45° rotation angle. There are therefore two basic designs of isolators in our range. For the shorter wavelengths we provide our FOI 5/57 design. This uses a simple arrangement of the permanent magnets and as a result, is slightly smaller than the longer wavelength model (FOI 5/711) where a special arrangement is used to increase the magnetic field strength to the very high levels required to obtain 45° rotation at ~1µm. The 5/57 isolators are wavelength tunable by a screw thread adjustment which adjusts the degree of insertion of the TGG rod into the magnet assembly. This operation requires removal of the input polarizer to allow access to the rod (the polarizer is simple to re-fit in position). Because the FOI 5/711 unit uses an opposing magnet arrangement, it is adjusted instead by increasing or reducing the separation of the opposed magnets. This changes the field strength in the central region where the TGG rod is fixed. The whole housing is adjusted for this process (one section screws into the other) and we again suggest that in most cases the removal of the polarizer is sensible. In general, the FOI 5/57 model may be tuned over a wavelength range of about 100-150nm, whilst the FOI 5/711 model has a more restricted tuning range of about 5% either side of the factory set wavelength.

FOI 5/57 & FOI 5/771



Type	FOI 5/57	FOI 5/711
Aperture (mm)	5	5
Wavelength (nm)	500 - 900	900 - 1100
Isolation (dB)	³ 30	³ 30
Insertion Loss (dB)	£ 0.5	£ 0.5
Tunable	Three Ranges 500 - 750, 750 - 850 and 800-900	±5° rotation about fixed wavelength
Dimensions (mm)		
Excluding Polarisers	60 dia x 58 long	75 dia x 75 long
With Polarisers	60 dia x 100 long	75 dia x 120 long

In addition to the above 5mm aperture units, we are also able to supply 8mm aperture alternatives (e.g. FOI 8/57 and FOI 8/711) on request.

Ultra-Wide Tuning Range Faraday Isolator

In response to customer demands for isolators with increasingly broad tuning ranges (it was much easier for us manufacturers before all these new sources became available!) we have introduced a new design of isolator. This is based on our FOI5/57 design but uses a slightly longer than normal TGG rod and greater strength magnet assembly to increase the maximum wavelength of operation and more importantly a new more convenient wavelength tuning assembly. The tuning mechanism is extremely smooth and allows very precise adjustment of the tuning to maximize isolation over the extra-ordinarily wide wavelength range of 650-1,100nm, all in one device.



250 Series High Voltage Video Amplifier

250 Series High Voltage Video Amplifier



This is a linear Class A output video amplifier with a maximum differential output of 275V over the range d.c. to 7MHz. The two outputs can also be set to $\pm 250\text{V}$ dc relative to each other using a bias control. This facility allows an electro-optic amplitude modulator to be set to any desired light output intensity level for any input signal level. This output bias does not introduce any limit to the signal output range.

The amplifier has been designed to drive electro-optic modulators from the EM200 range where the load is purely capacitive and does not exceed 100pf. The output is short circuit proof.

Signal output voltage range	275Vdc - 6MHz bandwidth
Amplifier Square Wave Rise & Fall Time using 100pf load	< 65 ns (10% - 90%)
Bias Voltage Range	+250V to -250V
Input Voltage for Full Output	$\pm 1\text{Vdc}$ or 2Vpp , ac
Input Impedance	50 W nominal
Cabinet Size (mm)	Height 220, Width 530, Length 340
Mains Voltage	110/200/240ac 50-60Hz
Temperature Range	0° - 40°C ambient

5000 Series High Voltage Linear Differential Amplifier

5000 Series High Voltage Linear Differential Amplifier



This 5000V series linear amplifier has been designed to drive large aperture electro optic modulators. It consists of two 0.4 - 3.0 kV linear amplifiers that together produce a differential output that can be connected to either side of the modulator. This produces an optical phase change equivalent to the output from a single sided 5000V unit.

The amplifier has a bandwidth of 14KHz and a rise time of less than 5 μs .

It incorporates a 1 - 10KHz internal oscillator giving sinusoidal, triangular and square waveforms. For square wave modulation applications the positive and negative excursions of the square wave output can be precisely controlled. This differential drive technique increases the lifetime of the modulator by maintaining a zero mean voltage across its terminals.

Output Voltage Range	400 - 3000V (each side)
Full amplitude Frequency Response	14 KHz
Small Signal Frequency Response (10% Full Amplitude)	100KHz
Rise and Fall Time	5µsec
Signal-Noise Ratio	50dB
Input Voltage	-2.5V to + 2.5V
Input Impedance	1000W
Cabinet Size (mm)	220 (height), 530 (width), 340 (length)
Mains Voltage	110/200/240ac 50-60Hz

High Voltage Pockels Cell Q-Switch Driver



Applications

Q-switching	Q-switching Opening Times	< 3 ns
Pulse Slicing	Optical Switching Time	< 3 ns
Pulse Picking Using	Cable length (50 ohm, 100 pF/m)	2 m - 4 m
4 - Terminal EO Modulator	Cable Delay	5 ns / m
	Pulse Width	10 ns - 20 ns
	Optical Risetime	< 3 ns
	Optical Falltime	< 3 ns

Step Pulse Generator	HVP 50/80
Output Pulse	
Voltage Range	1 - 8 kV
Maximum Output current	200 A
Electrical Faltime	< 3 ns
Recovery Time	100 μ s exponential
Output Impedance	50 W
Maximum on time at maximum current	200 ns
Maximum Repetition rate	100Hz
Minimum Pulse Width	10 ns
External Trigger Input	
Amplitude	-3 V to +3 V
Polarity of Leading Edge	Positive or Negative
Input Impedance	50 ohm
Minimum Internal Delay	40 ns
Sync Output	
Amplitude	$\sqrt{3}$ V into 50 ohms
Jitter wrt High Voltage Pulse	100 ps
Internal Rate Generator	
Repetition Rate	0.1 Hz - 100 Hz
Pulse Terminating Load (designed to correctly terminate a 50 ohm coaxial cable)	
AC Impedance	50 ohms nominal
Cabinet	
Volume (W x D x H)	330 x 330 x 100 mm
Weight	4 kg
Environmental Temperature	
Range	0°C - 40°C
Supply	
Mains Voltage @ 50 or 60 Hz	120 or 240 V \pm 10%
Power	50W
Enable Input	
Removal of a short circuit will prevent operation	

100kHz RTP Pockels cell Q-switch Driver



The relatively low voltage requirements of the transverse field RTP Pockels cell allow us to switch the high voltage at high repetition rates with acceptable power consumption at the driver.

We have developed the driver with the application of continuously pumped sources in mind (rather than flash-lamp pumped for example). For this reason we have not incorporated any facility for varying the delay from the input trigger pulse and the Q-switch output pulse. We have however provided full protection facilities based on internal current limiting to ensure that the demands on the internal HT power supply do not exceed its capability. There is also an internal rate generator for those applications where synchronization to external events is not required and free running use is acceptable.

Parameter	Value				
Repetition Rate	0 to 100kHz in five decade steps by internal or external generator				
Output Voltage	+200 to +2,000V adjustable with visual display				
Output Pulse	The standard system generates a positive going step function above zero. The generator can also be supplied giving a negative going step from the set HT level down to zero for quarter wave switching				
External Trigger In	+3.0 to 10.0V min. 10ns f.w.h.m. into 50W				
Synchronization Output	TTL approx. 30ns after trigger				
Overload Protection	(1) Repetition rates above 100kHz (2) HT Current above 25mA (3) Output stage fault overload Protection occurs by automatic removal of the HT supply which can be re-instated by the reset switch				
Power Input	Universal 90 - 265V a.c. 47 - 440Hz via fused IEC inlet				
Dimensions	150(h) x 250(w) x 330(d) (mm) Mass: 6kg				
Step Voltage at End of an Open Circuit 50W Line					
50W co-axial cable length	Rise-Time	Flat Top	Fall Time	Maximum Frequency at 2kV	Maximum Voltage at 100kHz
	125mm	5ns	175ns	400ns	80kHz
250mm	5ns	160ns	500ns	66kHz	1,500V
500mm	<7ns	150ns	700ns	50kHz	1,300V
1,000mm	<8ns	120ns	1,000ns	40kHz	800V