

## Electro-Optic Beam Deflectors



Conoptics series of electro-optic beam deflectors utilize a quadrupole electric field in an electro-optic material to produce a linear refractive index gradient proportional to the applied signal voltage. Choice of the proper material and crystallographic orientation eliminates piezoelectric ringing normally associated with other deflectors. There are no moving parts and they do not fatigue with prolonged use.

## Electro-Optic Laser Beam Deflectors



The angular deflection of E-O Deflectors is small but has rapid random access response and is extremely precise. Major applications include facet to facet error correction in laser data and image recorders which use spinning mirrors and the generation and stabilization of auxiliary tracks in optical disk mastering machines. Unlike acousto-optic deflectors, the intrinsic random access response of an electro-optic deflector is the optical rather than acoustic transit time. In practice, however, E-O Deflectors appear as capacitive loads and the response is driver limited. The precision with which a laser beam can be located, for all intents and purposes, is equivalent to the precision with which a voltage level can be applied to the device. Since operation is based on an index gradient, variations due to ambient temperature changes are reduced to second order effects. Similarly, unlike acousto-optic deflectors in which the deflection angle is proportional to the optical wavelength, the deflection angle of an electro-optic deflector is a function of the index dispersion and is relatively constant over the wavelength range of operation.

Other advantages of an E-O Deflector over an acousto-optic device include the fact that the entire beam is deflected. The transmission efficiency is limited only by the Fresnel reflections, absorption, and scattering losses in the cell and is not a function of the deflection mechanism.

Furthermore, E-O Deflectors are "straight through" devices, that is, the beam is deflected about the un-deflected zero applied signal position. This is in contrast to acousto-optic devices which have a large angular offset to the center of the deflection range and require that RF be maintained on the cell when the beam is in the quiescent position.

### **POLYTEC GmbH**

Büro Berlin Schwarzschildstraße 1 D - 12489 Berlin GERMANY  
Tel: +49 (30) 63 92 51 40 Fax: +49 (30) 63 92 51 41

wl@polytec.de  
www.polytec.de

The deflection angle,  $\theta$  of an E-O Deflector is given by:

$$\theta = K \frac{LV}{a^2}$$

Where K is a constant determined by the electro-optic material used, V is the applied voltage, L is the active length of the device, and a is the departure diameter. Translating deflection angle to the number of resolvable spots:

$$N = \frac{\pi}{4} \frac{KL}{\lambda} \frac{V}{a}$$

Where a diffraction limited Gaussian beam of a diameter and wavelength  $\lambda$  is assumed and beam clipping losses are ignored. Since  $V/a$  is limited by the internal breakdown voltage (approx. 1000v/mm for fluid filled units), once an electro-optic material and operating wavelength have been chosen, the active length is the only parameter remaining to increase the number of resolvable spots. Note that the equation given above is highly idealized and that "V" and "a" deserve considerable consideration because they determine the difficulty of electronics design and crystal fabrication.

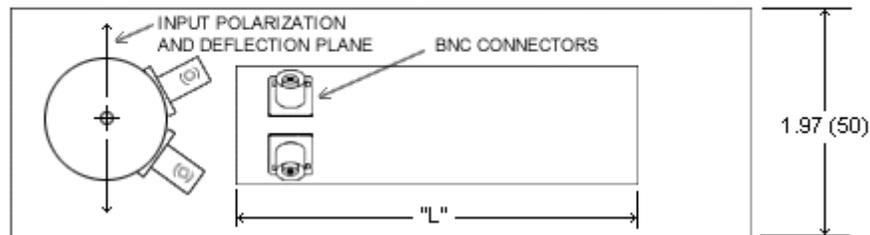
Conoptics offers several standard electronics drivers which may be use with our E-O Deflectors. The Model 301 allows switching with an 80 nanosecond access time between any two preselected levels within the range of  $\pm 200$  volts of zero. The Model 302 is a DC coupled analog driver and has random access time of 2.5 microseconds over a range of  $\pm 400$  volts. Many operational requirements, however, are more easily satisfied by modifications and special versions of the 310A and drivers. The most common changes are larger aperture diameters, operation in the UV and IR, and higher output voltage drivers with special waveforms. Construction of X-Y systems by coupling two deflectors with an intermediate polarization rotator is also common. Addition of a sensor and feedback loop driver allows the construction of a beam pointing stabilizer.

### E-O Deflector

<u>SPECIFICATION</u>	<u>M310A</u>	<u>M311A</u>	<u>M312</u>	<u>M312-2</u>
Deflection Efficiency micro-radians/volt	1.5	3.0	0.6	1.2
Usable Aperture, mm	2.5	2.5	2.7	2.7
Capacitance, pf *	100	185	50	100
Spectral Range **	400 → 750	400 → 750	400 → 1100	400 → 1100
Length, "L" (mm)	4.65 (118)	8.62 (219)	2.77 (71)	4.9 (125)

\* Available as 2 Port version - 50 and 100 ohms

\*\* UV and DUV options available



## Deflection System

### Model 308 High Voltage Digital Driver + Model 302 with Model 312-5 Five Crystal Deflector



*Four Crystals for Digital; One for Analog*

#### Specifications

Digital		
1)	Deflection	+/- 1.5 milliradians (symmetric)
2)	Rise/Fall Times	<60 nsec
3)	Maximum Pulse Width	<100 microsec
4)	Cable length Driver/Deflector	<40 cm
5)	Rep Rate	<1 kHz
6)	No DC Centering	
7)	Droop	<< 5%
8)	Amplitude Control	Internal 0 to 1 Kv
Analog		
1)	Deflection	+/- 0.3 milliradians
2)	Bandwidth	DC to 250 kHz
3)	DC Centering	< +/- 90 microradians
4)	Driver	Model 302 (See Data Sheet)

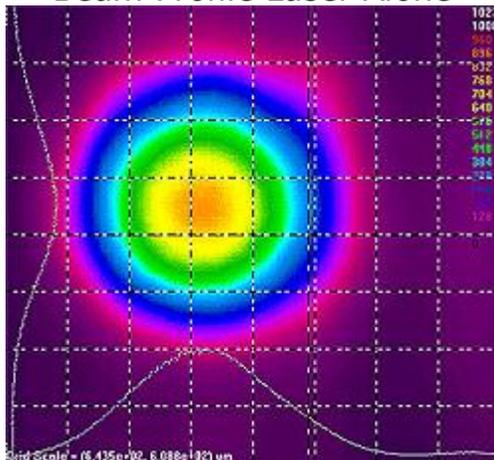
## Model 317 Dual Deflection System



*System Consists of a model 311A  
"Partitioned" Deflector and 2 Drivers*

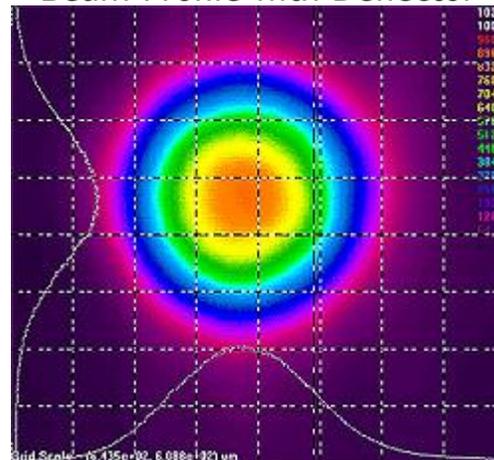
### Beam Profiles

Beam Profile Laser Alone



[Click for larger View](#)

Beam Profile with Deflector



[Click for larger View](#)

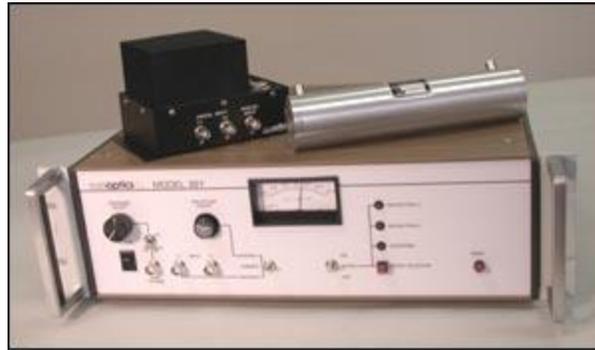
Deflector Specifications		
1)	Dimensions	50mm Diameter x 20 mm long
2)	Transmission	>90% 351//458
3)	Aperture	<2..5 mm
4)	Sensitivity	<2.63 microradians/volt (3 crystals)
		<0.875 microradians per volt (1 crystal)

M2100 Driver		
1)	Connected to 3 Crystal Port	0 to +/- 0.5 mrad
2)	Access Time	<35 nsec
3)	Bandwidth	<10kHz to 12 MHz
4)	Input	<0 dbm (626mv P-P) signal must have net DC = zero waveform (50% duty cycle)
5)	Dimensions	122 x 38.1 x 49.9 cm
6)	Maximum Pulse Width (2% droop)	200 nsec
7)	Static DC Bias Range	0 to 550v
8)	Electrical Input Power	1.6 KW

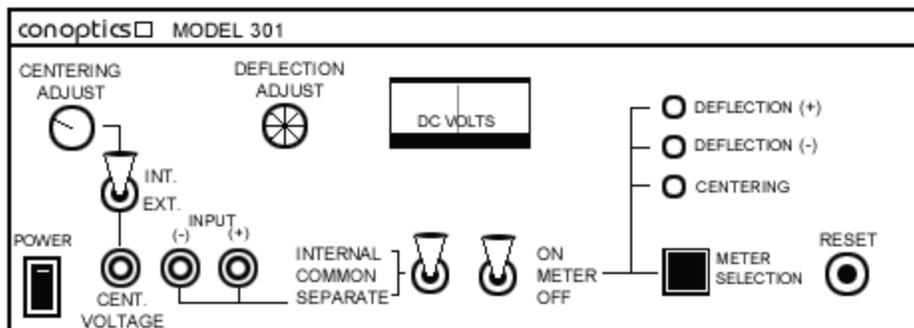
Model 302 Driver		
1)	Connected to Single Crystal Port	0 to +/- 0.3 mrad;DC to 200 KHz
2)	Access Time	<1 microsecond
3)	Input Requirement	<2 Volts P-P
4)	Input Impedance	<50 Ohms
5)	Output Voltage	750 Volts P-P
6)	-3 db Bandwidth	200 KHz
7)	Driver Cabinet	6.5" W x 4.125" L x 4..15" H
8)	Power Suply Cabinet	19" Rack x 5.25" H

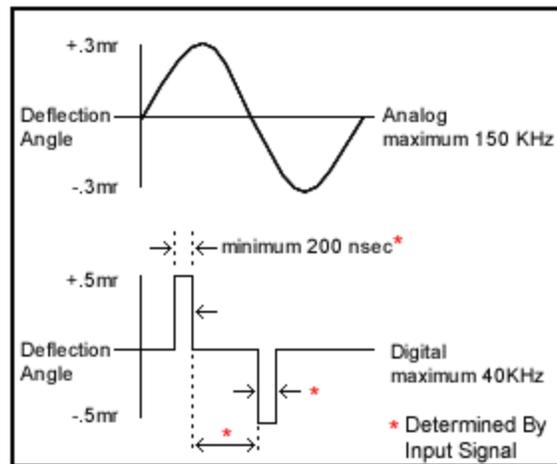
Model 301

### Model 301



*The system consists of a special version of the Model 311A Beam Deflector and a dual driver. This has been used for generation of auxiliary tracks in optical mastering equipment. The system accepts two inputs to generate analog and digital deflection.*





The system meets the following specs:	
1) Digital Deflection (3 Crystals)	
a. Input	TTL
b. Rep Rate	40 kHz Max
c. Deflection Angle	> +/- 0.5 mrad
d. Access Time	80 nsec
e. Deflection Angle	Adjustable (See Drawing)
2) Analog Deflection (1 Crystal)	
a. Input	+/- 2.0 v, P-P/1K
b. Deflection Frequency	DC - 150 kHz
c. Deflection Angle	> +/- 0.3 mrad
3) Cable Length	
60 cm (Deflector /Driver)	
3M (Driver/Control Cabinet)	
4) Transmission > 80%	