conoptics INC.

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Switching Systems

Synchronized switching systems ensure optimum performance

Conoptics provides a family of products specifically tailored for pulse selection or regenerative amplifier switching systems. Each system consists of an optical modulator, a modulator driver, and synchronization electronics. The low voltage design approach taken here reduces modulator drive levels by an order of magnitude compared to other methods. This feature makes switching rates to tens of MHz readily achievable and virtually eliminates EMI effects.

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Optical Modulators

Current technology involving mode locked lasers and regen systems deals primarily with the 500 to 2000nm spectral range, a region served by the 350(KD*P) and 360(LTA) series modulators. In general, the 350 series are employed in the majority of pulse selection and regen applications in this region. In the 1000 to 2000nm range the 360 series are employed.

Applications with mode locked lasers require that the modulator be capable of switching between the zero and half or quarter wave states completely during the 2L/C interpulse period, generally 10 to 13 nanoseconds. The 350/360 series devices have intrinsic switching times faster than needed and system performance is determined by the driver electronics. Construction details of the modulator's internal electrical transmission line (e.g. impedance) must vary according to the driver model chosen (See Tables I and II). This is not a concern unless modulator and driver are ordered separately.

All 360 devices are transverse field traveling wave structures with LTA (lithium tantalate) as the active medium. LTA has high optical transmission between 700 and 4000nm with lowest absorption in the center of the Ti:Sapphire operating region. Its high refractive index, low birefringence, and relatively low dielectric constant are compatible with high speed modulator design. Although it does exhibit a piezoelectric response, resonances are mild and rarely encountered with the electrical waveforms used in these applications.

350 Series modulators are similar in construction to the 360 Series but use KD*P (potassium dideuterium phosphate) as the active medium. For ultrafast application in the range 700 to 1000nm, despite their longer length, they exhibit only one-third to one-half the pulse broadening due to GVD as do half-wave voltage equivalent LTA devices. Furthermore, the higher intrinsic optical quality of KD*P, a solution grown rather than melt grown crystal, assures high pulse contrast at shorter wavelengths.

Modulator Drivers

Conoptics offers modulator drivers with various output formats. This data sheet describes variable gate drivers with repetition rates to 20MHz, that are digital only. We also offer analog drivers (please review data sheet 1092 for an explanation of these products). The 307 driver is primarily designed for use in regen systems, it offers high output voltage with fast switching times with a pulse width variable from 40 to 500nsec. The 25D is the most versatile driver, with a lower output requiring longer modulators, it offers a minimum pulse width of 18nsec, a maximum rep rate of 20MHz, and a maximum pulse width determined by your input signal. The Models 307 and 25D can also be employed as pulse shapers/choppers.

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All drivers listed include a variable DC bias voltage supply which allows precise positioning of the AC signal on the desired operating point of the modulator transfer characteristic and eliminates the need for quarter-wave plates.

Regen Switching Systems
Figures 1A and 1B are schematic illustrations of typical regen cavity configurations. Conoptics modulators and drivers permit the end user to inject a pulse into the cavity and then extract it after it has been amplified.

Figure 1A: Linear Geometry, involves double passing the pulse through the modulator. This configuration requires only a quarter-wave voltage to be applied to inject and extract the pulse. The optical isolator (M713/720) separates the input and output beam paths.

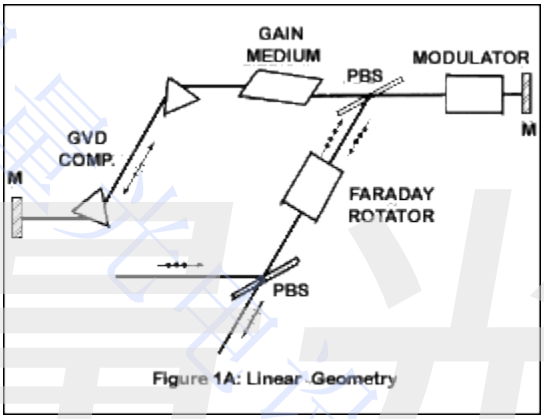

Figure 1A: Linear Geometry

Figure 1B: Ring Geometry, has only a single pass through the modulator and requires a half-wave voltage to be applied, and eliminates the need of the optical isolator.

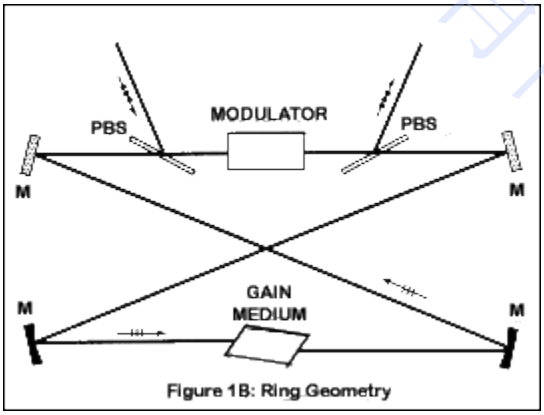

Figure 1B: Ring Geometry

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The temporial pump profile of the gain medium is considered to be CW if appreciable gain exists in the cavity for an appreciable time before the pulse to be amplified is injected and begins to increase immediately after the amplified pulse is extracted. Conoptics offers drivers for both CW pumped and non-CW pumped amplifiers.

Figure 2A shows the type of waveform which must be used with a CW pumped amplifier. Since gain exists before the event, the cavity must be kept open except during the period in which the pulse is circulating. The Model 25D driver and 307 are DC coupled and allow complete freedom in choosing the duration (circulating time) and reprate.

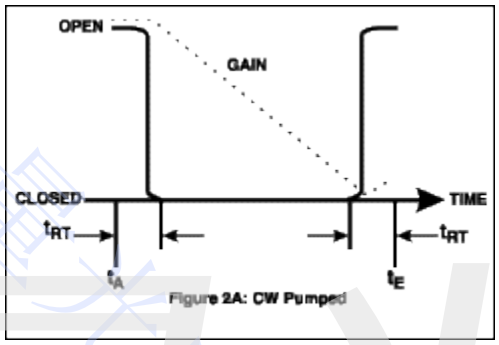

Figure 2B shows the waveform which can be used when the cavity gain is controllable in time. Since there is no gain before the event, there is no need to keep the cavity open, and a double waveform is permissible. Conoptics offers double pulse driver combinations on special order. Please contact the factory with your requirements.

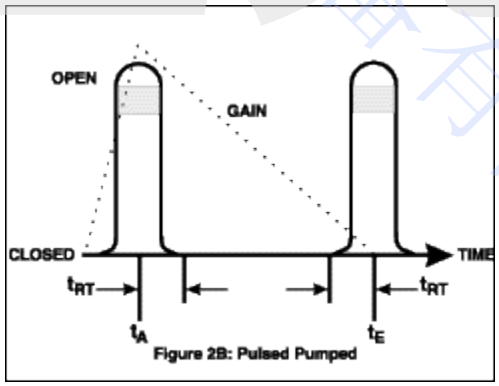

Figure 2: Driver Waveforms (not to scale)
t_A = arrival time of pulse to be injected.
t_E = time when circulating pulse is extracted.
t_{RT} = cavity round trip transit time.

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Models 305 and D305 Synchronous Countdowns

The Model 305 provides an economical and efficient means of synchronizing pulse selector gates to the laser frequency. It accepts either acousto-optic mode locker or photo-detector derived signals as the master clock input. Dual outputs are provided; a fixed, short duration analog output for driver Model 25D and a TTL output for Model 307. An internal, continuously variable 0-16 nanosecond delay is provided to control the relative phase of optical pulse train and electrical gates and eliminates the need for a variable optical delay.

In addition to performing the indispensable synchronization function, the Model 305 also includes an internal counter which allows pulses to be selected (within driver rep-rate limitations) at the laser C/2L frequency divided by a integer ranging from 2 to 1,000,000. This mode may be free running or externally triggered. An externally triggered single shot mode allows random pulse selection at any rate within the driver's capability.

The Model D305 has the same clock, countdown, and triggering features of the 305 but is intended for use in regenerative amplifier applications. It has a dual output format which consists of a variable width output for Model 25D and a two channel double pulse TTL output for Model 307 Driver. The duration of the variable width output and separation of the TTL outputs which correspond to the regen circulating time are controlled by an additional internal 70 to 500 nanosecond variable delay generator. External triggering allows precise and convenient synchronization of the regen switching system with both pump and source lasers.

The versatile output formats and external triggering features of the Models 305 and D305 encourage their use with data collection and diagnostic instrumentation. They are capable of synchronizing laser pulse selection and amplification with signals from external equipment not directly related to the laser switching process as well as providing trigger and pre-trigger signals synchronized with selected or amplified laser pulses.

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Table 1
Pulse Selection Systems

SYSTEM		DRIVER PARAMETERS		MODULATOR PARAMETERS			
DRIVER	MODULATOR	MINIMUM PULSE WIDTH NANOSEC	MAXIMUM REP RATE	MINIMUM WAVELENGTH	MAXIMUM WAVELENGTH FOR 100% DYNAMIC SWING	APERTURE mm	DYNAMIC SWING AT MAXIMUM OPERATING WAVELENGTH
25D	350-160	18 / variable	20MHz	350nm	700nm	2.7	80%@1000nm
25D	360-80	18 / variable	20MHz	600nm	1000nm	2.7	37%@2500nm
25D	360-120	18 / variable	20MHz	600nm	1350nm	2.7	56%@2500nm
25D	360-160	18 / variable	20MHz	600nm	2000nm	2.7	93%@2500nm
307A	350-50	18 / variable	50kHz	350nm	850nm	3.1	95%@1000nm
307A-1	350-50	18 / variable	5kHz	350nm	850nm	3.1	95%@1000nm
307A	360-40	18 / variable	50kHz	700nm	2000nm	2.7	95%@2000nm
307A-1	360-40	18 / variable	5kHz	700nm	2000nm	2.7	95%@2000nm

Please contact the factory for special configurations.
Typical static insertion loss is 6%

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Table 2
Regen Switching Systems

SYSTEM	RISE TIME NSEC	MAXIMUM REP RATE	APERTURE mm	MAXIMUM WAVELENGTH SINGLE PASS	MAXIMUM WAVELENGTH DOUBLE PASS	PULSE WIDTH
307 / 350-50	5	50kHz	3.1	880nm	1000nm	40 to 500 nsec
307 / 350-50 LA	5	50KHZ	5.7	450nm	900nm	40 to 500 nsec
25D / 350-105	8	20MHz	3.1	400nm	800nm	18 nsec to dc

Please contact the factory for special configurations.

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