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MODELS TWAM & TWAP HIGH SPEED MODULATORS DATA SHEET 720a

PRODUCT DESCRIPTION

The models 10 and 11 are high speed modulators of traveling wave type for modulating ampllitude (TWAM) or modulating phase (TWAP). They are useful for high frequency modulation, enabling vast amounts of information to be impressed on the laser beam. The Model 10 has a bandwidth from D.C. to 500 MHz and the Model 11 has a bandwidth from D.C. to 1000 MHz.

FEATURES

? Wide Bandwidth, D.C. - 1 GHz
? Traveling Wave Design
? 50 ohm Impedance
? Wide Spectral Range
? Low 70 V Half Wave Voltage
? High 48 mrad/V Phase Sensitivity

APPLICATIONS

? High Speed Recording or Imagery
? Photodiode Response Characterization
? FM Spectroscopy
? Pulse Forming or Shaping
? Laser Line Width Broadening

The modulators consist of Lithium Tantalate crystals with high electro-optic constant. Two crystals optically in series and electrically in parallel form a 50 ohm transmission line. The electro-optic constant is $r_{33} = 30.4 \times 10^{-12}$ m/volt and V ?? for transverse modulation is 2.8 KV at 632.8nm for unit aspect ratio. This crystal has a hardness of 6 and is grown at high temperatures in a Czochralski furnace . This non-hygroscopic and mechanically strong crystal makes the modulator rugged. This enables the modulator to withstand thermal shock and mechanical vibration as compared to the series 20 or 28 ADP type modulators (see Data Sheet 719). The electric field of the transmission line is parallel to the Z axis of the crystal and transverse to direction of optical propagation. The TWAM series modulator utilizes two matched crystals oriented in such a manner that thermally induced birefringence of one crystal is cancelled by the other. In order for this to occur, the second crystal is rotated by 90^0 with respect to the first crystal. This changes the ordinary ray in the first crystal into an extraordinary ray and vice versa, thereby eliminating any thermal birefringence, and reducing the modulator thermal noise. The modulator can be used over the entire transmission range of 500nm to 3500nm because of the absence of a half-wave plate as shown in Figure 1.

The dimensions of the transmission line are designed to match the microwave phase velocity with the optical velocity within a quarter wavelength along the modulating signal during its transit. Due to imperfect velocity matching, the electrical wave will slip behind the optical wave. The frequency at which the emerging beam is a quarter wave ahead of the electrical wave, is called the 3dB bandwidth. A computer aided design keeps the transmission line of 50 ohms impedance.

A phase modulator (TWAP) also utilizes two matched crystals. However, the crystals are not rotated by 90^o with respect to each other because in phase modulation, the plane polarized input beam is polarized in the plane defined by Z and Y axis and only the extraordinary ray passes through both crystals. This is the feature which distinguishes the construction of a TWAM and TWAP model.

The modulator consists of Lithium Tantalate crystals arranged to form a dielectrically loaded coaxial 50 ohm transmission line with a voltage standing wave ratio (VSWR) of less than 2:1 throughout the useful band. This feature ensure ensures proper matching with most readily available amplifiers. The modulator provides a large bandwidth from D.C. to 1000 MHz ? 3dB (Model 11). Depth of modulation of 30% is readily achieved with as little as 5 watts R.F. drive power. Model 3101 and 3500 drivers are avilable for this modulation. Auto Bias Control (Model 33C) will be available in the near future. Manual bias feature can be provided. The 1mm aperture is large enough for most laser applications. Although the modulator is designed for operation with HeNe laser (632.8nm), it can be used at any wavelength within the spectral range from 500nm to 3500nm. However, the driver voltage required increases linearly as the wavelength is increased.

The crystals are assembled in a rugged, anodized aluminum housing. The crystals are anti-reflection (AR) coated at the appropriate wavelength. This eliminates the need for index matching fluid. External optical windows are also not necessary because of the stable nature of the material. The modulator can be operated in any position, since it is not filled with fluid. Two SMA connectors are used, one for the input signal and the other for termination with 50 ohm RF load. The modulator is rugged in construction and cost-effective in performance.

The modulator can handle RF power up to 10 watts and CW optical power up to 1 watt, at 1064nm. The modulator may be operated at shorter wavelengths at slightly lower optical powers, please inquire. Economy, low drive power, capacity to handle large information density and many other unique features are incorporated in the design. For details of the Traveling Wave type modulator, please refer to Quantum Technology's paper published in Applied Optics, Vol. 20, no. 5, March 1981, p. 867.

Figure 2 shows the typical detected optical response for TWAM 11. Typical RF performance for TWAM 10 and 11 are shown in Fig. 3 thru Fig. 8. Note that the TWAM 10 bandwidth spans up to 700 MHz typical.

Quantum Technology, Inc. (QTI) has an R & D department which can design custom modulators with unique features. QTI is the only manufacturer in the world with an inhouse capability of growing ADP type crystals, fabricating modulators, and designing and manufacturing Electro-Optical systems with bandwidths from D.C. to 10 MHz, 25 MHz, 50 MHz and 100 MHz. The Models 10 and 11 complement these E-O systems at the RF frequencies up to 1000 MHz. Please inquire for these or any custom requirements

you may have. Our catalogue can be viewed on the Internet. Please send us E-Mail or FAX inquiry regarding any of your requirements.