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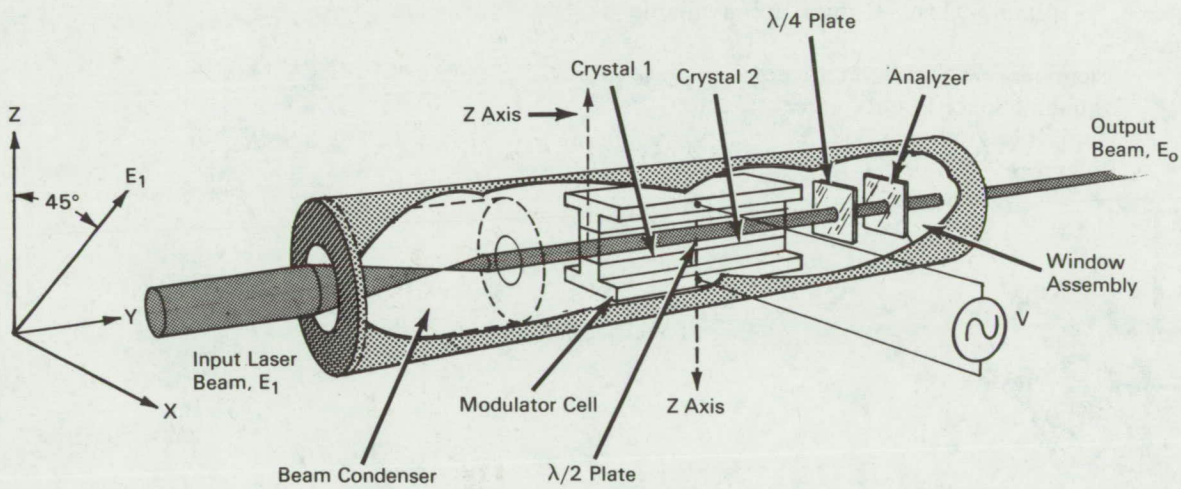
Brief 67-10289

NASA TECH BRIEF

Wideband, High Efficiency Optical Modulator Requires Less than 10 Watts Drive Power



The problem:

To develop an optical modulation system capable of operation over a 100 MHz video bandwidth with less than 10-watts modulator drive power. Prior art required up to 500 volts rms and 270 watts for operation over a 50 MHz video bandwidth. Optical modulation systems may serve importantly in future space wideband communication systems.

The solution:

An optical modulation system, consisting of an optical modulator and transistorized driver, that combines small cross-section potassium dideuterium phosphate crystals with laser beam-condensing optics.

How it's done:

The internal view shows construction details of the transverse lumped-element electro-optical modulator. A laser beam condenser is used at the modulator input to reduce and collimate the beam. The modulator cell employs equal length crystals on each side of a half-wave plate with their optic axes opposite in sense to balance the natural birefringence of the electro-optic element that is a function of temperature. When a voltage is applied across the cell, generating an E field along the optical (Z) axis of the crystals, a phase retardation is imparted to the X component of a light beam propagating along the Y axis. The result of the retardation imparted to the X component of the light beam is a conversion of linearly polarized input light to an elliptically polarized output. The analyzer in the output window converts the polarization modulated beam to intensity modulation. The quarter-wave plate biases the system to align the peak modulated polarization vector with the analyzer axis, thus eliminating the need for a dc bias component in the applied modulation voltage.

(continued overleaf)

Notes:

1. The CW modulation tests and the pulse response measurements show the feasibility of employing the modulator in either CW or PCM communications systems. The compact size and temperature independent performance of the high aspect ratio, potassium dideuterium phosphate modulator indicate feasibility for future use of similar designs in broadband space communication systems.
2. A space qualification design and test effort must be carried out before implementing the space modulation system with the low drive power modulator. The temperature independent performance must be verified in the vacuum of space.
3. Complete details are contained in: *Wideband High Efficiency Optical Modulator,* by W. J. Rattman, B. K. Yap, and W. E. Becknell, Final Report, 15 Feb. 1966 to 15 March 1967, Sylvania Electronic Systems, Waltham, Mass. Copies are available from:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B67-10289

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: W. J. Rattman, B. K. Yap, and W. E. Becknell
of Sylvania Electronic Systems
under contract to
Marshall Space Flight Center
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