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Traveling-Wave Photodetector has Sub-Nanosecond Response



Video Amplifier Unnel Diode Detector Video Output

The phenomenal growth of communications technology has led to the use of the optical and millimeter wavelength regions of the electromagnetic spectrum. A severe limitation encountered in the use of a laser in an optical communication systems is the lack of a suitable photodetector with a fast response time—in the nanosecond range (corresponding to a signal bandwidth of a gigahertz) or better.

Biasing the photodetector with microwave energy can increase the sensitivity by a factor of 10^3 over that of conventional dc bias methods. The mercury-doped germanium photodetector with the experimental instrumentation shown in the figure has led to further improvements through the use of a waveguide (nonresonant transmission line) which increases the absorption of the microwave energy within the photo-

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detector. There are no reflecting metallic elements in the path of the incident microwaves and the reflected microwaves are kept to a minimum to avoid a resonant condition. The dimensions of the waveguide and detector are chosen such that the propagation velocity of the microwaves is matched to the propagation velocity of the laser light.

In operation, the waveguide and photodetector are placed in a liquid helium dewar and cooled to 4° K. A CO₂ laser is the light source and a klystron (or Gunn diode) is the microwave energy source. The absorption of the laser light within the photodetector increases the conductivity, which in turn causes an increase in the absorption of the microwave energy. The increased microwave absorption is sensed by a crystal detector whose output is displayed on an oscilloscope. With proper calibration, the response time and signal bandwidth can be calculated. Measured response times of the described experimental arrangement are approximately 1 nanosecond.

Note:

Requests for further information may be directed to:

Technology Utilization Officer Goddard Space Flight Center Code 207.1 Greenbelt, Maryland 20771 Reference: B70-10641

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

Patent Courisel Mail Code 204 Goddard Space Flight Center Greenbelt, MD 20771

> Source: T. E. Walsh and C. Sun of RCA Corp. under contract to Goddard Space Flight Center (GSC-10831)