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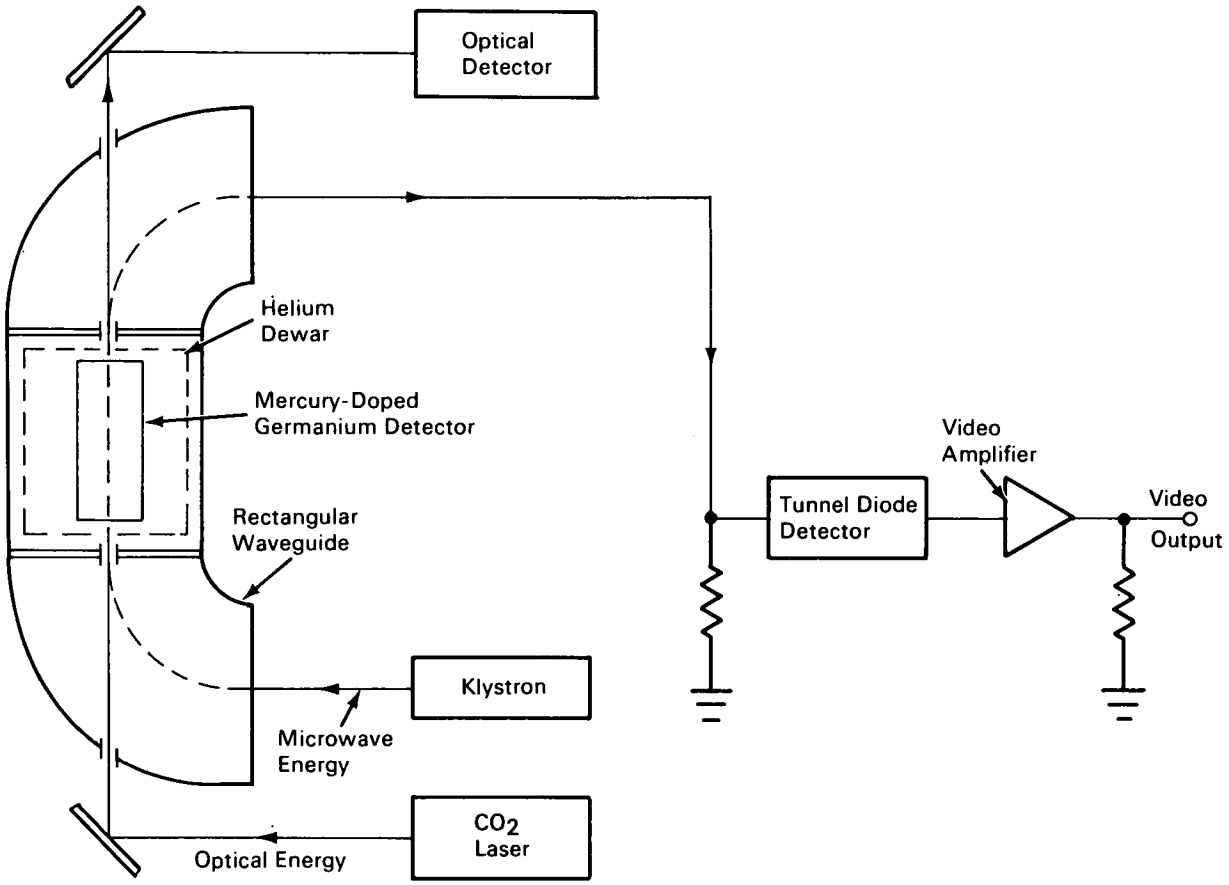
NASA TECH BRIEF

Traveling-Wave Photodetector has Sub-Nanosecond Response



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 (non-resonant transmission line) which increases the absorption of the microwave energy within the photo-

(continued overleaf)

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 CO_2 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:

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Patent status:

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

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