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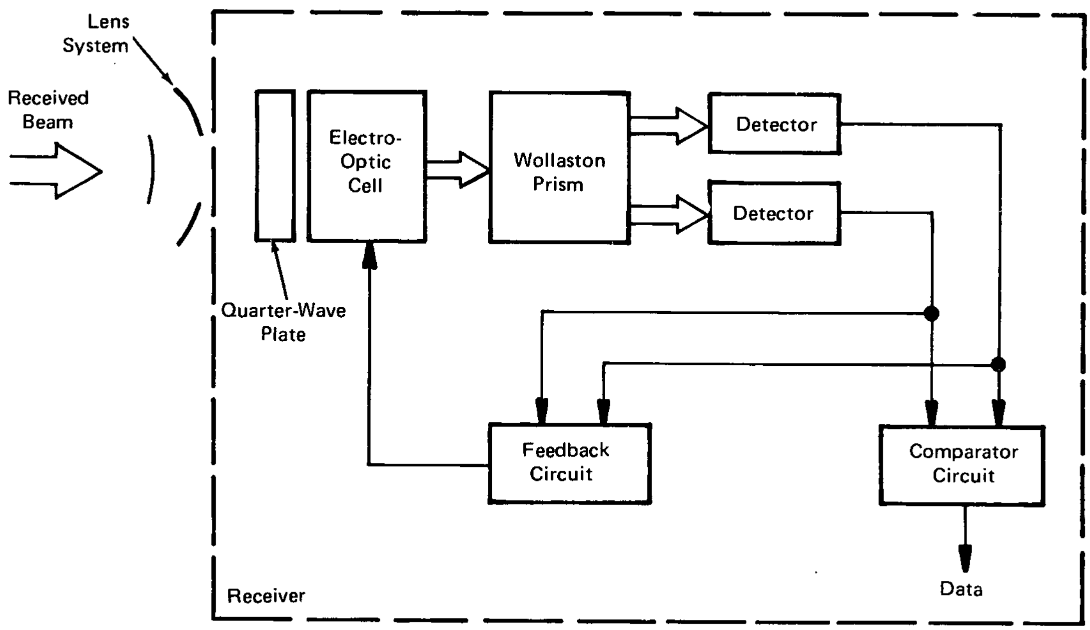
Dynamic Polarization Compensating System for Optical Communications Receiver



Optical Receiver Block Diagram

The problem:

In one laser communication technique, digital information is impressed on a light-beam carrier by the modulation of the light beam between two orthogonal polarizations. Modulation is impressed in accordance with a serial data stream. For example, a digital "one" corresponds to one polarization state, and a digital "zero" corresponds to a second polarization state orthogonal to the first. When this information is transmitted through the atmosphere, however, part of it becomes distorted. What happens is that the power of an intended polarization state, corresponding for example to a digital "one", is partially shifted into the other polarization state, corresponding to an unintended digital "zero". The power received in both polarization states results in crosstalk.

The solution:

A new system has been included in an optical receiver which automatically compensates for shifts in the polarization states.

How it's done:

The polarization compensating system, as shown in the receiver block diagram, is equipped with an electro-optic cell (Pockell cell or Kerr cell) located in the optical path of the input light beam. The cell includes a crystal for controlling the phase between the two polarization states. The cell axes are rotated 45° to the receiver axes defined by the vertical and horizontal polarization states. When an incoming light beam is distorted due to the polarization bias introduced by the atmosphere (or other media), the voltage across the cell

(continued overleaf)

automatically compensates for the polarization bias by introducing the proper amount of different phase retardation along the crystal axes.

After passing through the crystal, the light beam falls on a polarization-dependent beam splitter, a Wollaston prism, which splits the beam into two paths. Horizontally polarized light travels along one of the paths, and vertically polarized light travels along the other path. The two paths terminate at two optical detectors. Each detector is used for one polarization state. The electrical outputs of these two detectors are fed to a comparator and data recording equipment.

A feedback circuit is also connected to the detector outputs. It derives an ac signal proportional to the difference between the powers in the two orthogonal polarization states. This difference signal is rectified to make it unidirectional. The signal then is maximized by the cyclical dithering of the electro-optic crystal voltage and the coherent detecting of the resultant variation in the rectified signal. This produces an error signal which is coupled to the crystal electrodes through an integrator to form a polarization bias-correcting feedback loop.

When right circular and left circular orthopolarization states are transmitted instead of linear polarization states, a quarter-wave plate is used ahead of the Wollaston prism. The quarter-wave plate converts the orthogonal circular polarization states to orthogonal linear polarization states.

Note:

Requests for further information may be directed to:

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Reference: TSP74-10182

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

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