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This Week's Citation Classic

Kaminow I P & Turner E H. Electro-optic light modulators. *Proc. IEEE* **54**:1374-90, 1966 and *Appl. Optics* **5**:1612-28, 1966. [Crawford Hill Laboratory, Bell Telephone Labs., Inc., Holmdel, NJ]

Applications of the electro-optic effect to the modulation of light are reviewed. All available data on electro-optic crystals are tabulated. The design and operating principles of modulators suitable for use with lasers are presented in a tutorial fashion. [The *SCI*® indicates that this paper has been cited over 135 times in Proc. *IEEE* **and over 70 times in** *Appl. Optics* **since 1966.]**

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"Research on topics related to the laser, which was first demonstrated in 1960, had made great progress by 1965. Karl Willenbrock, who was editor of the *IEEE Proceedings,* had the novel idea that a Special Joint Issue of the *Proceedings* and *Applied Optics* would be a timely means for disseminating the accumulated experience. Don Herriott and I were asked to be guest editors, and we invited appropriate workers to provide tutorial review articles. Because no up-to-date book was available, many of these reviews were widely read and referenced.

"The review of electro-optic modulators was done by Ed Turner and myself. It contains basic design criteria and complete tabulation of electro-optic materials parameters. I believe that both the tutorial and the handbook aspects of the article have contributed to its long-term utility.

"My interest in light modulation began when the laser was first announced. I had been working on microwave ferrite devices for a few years and was ready for a change. Microwave researchers saw the laser as a conventional oscillator of very high frequency. Since the bandwidth of a microwave device is typically a fixed (say 5%) fraction of its carrier frequency, laser systems seemed to offer the potential of very large bandwidths. With my microwave experience in radar antennas and ferrite devices, I thought high frequency light modulators would be a good way to get on the laser bandwagon —especially as most other people were concentrating on the laser itself.

"Coincidentally, Ed Turner, a coworker and friend, had attempted to make a lumped microwave light modulator using the electro-optic effect in ammonium dihydrogen phosphate (ADP) in 1952, long before the advent of the laser. In a talk in November 1960, Nico Bloembergen discussed a lumped microwave modulator similar to Turner's unpublished device but using potassium dihydrogen phosphate (KDP). In December 1960 I put a drawing for a traveling-wave, 10 GHz, KDP modulator into the shop. This device, which took advantage of an idea provided by Rudi Kompfner, operated successfully in March 1961 using an incandescent source. Both Ed Turner and I have continued to work on the electro-optic effect modulation since those early days."