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Planar Lightwave Circuit based Arrayed Waveguide Grating for RF Arbitrary Wavefrom Generation

For the degree of Master of Science in Electrical and Computer Engineering

Is approved by the final examining committee:

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PLANAR LIGHTWAVE CIRECUIT BASED ARAYED WAVEGUIDE GRATING FOR RADIO FREQUENCY ARBITRARY WAVEFORM GENERATION

A Thesis

Submitted to the Faculty

of

Purdue University

by

Karlene A. Karrfalt

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of

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This thesis is dedicated to my parents, my sister, Sara, and Winky who gave me love, support and encouragement through it all.

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ABSTRACT

Karrfalt, Karlene A. M.S.E.C.E., Purdue University, December 2010. Planar Light Wave Circuit Based Arrayed Waveguide Grating for Radio Frequency Arbitrary Waveform Generation. Major Professor: Andrew M. Weiner.

Planar light wave circuits (PLCs) present many exciting opportunities in optical communications. PLCs are typically small, low loss optical devices which can be easily mass produced with today's semiconductor fabrication technology. PLCs are used as coupler/splitters for fiber-to-home connections as well as arrayed waveguide gratings for wavelength division multiplexing. This thesis explores a PLC-based arrayed waveguide grating (AWG) for use as a pulse shaping apparatus in a RF arbitrary waveform generation experiment. The PLC used was fabricated by NTT Electronics Inc. It consists of two arrayed waveguide gratings and an array of Mach-Zehnder switches and phase shifters. This device has 128 independently controlled channels with a spacing of 40GHz. Several RF arbitrary waveforms were produced using this PLC-based AWG. The waveforms demonstrate the ability of this technique to control the amplitude and frequency of the RF waveform on a cycle-by-cycle basis. The performance of the device is limited however due to manufacturing errors that result in unwanted spectral features in the unshaped optical spectrum. These unwanted features limit how accurately these waveforms can be produced.