High Speed Photodetectors: Modeling Issues

Yasser M. El-Batawy[(1)], M. Jamal Deen[(2)]

McMaster University, ECE Dept., Hamilton, ON, L8S 4K1, Canada.
E-mails: elbataym@mcmaster.ca[(1)] and jamal@mcmaster.ca[(2)]
Tel. 905-525-9140 Ext. 27758[(1)] & 27137[(2)]
Fax. (905) 523-4407

Abstract

High Speed Photodetectors are one of the essential requirements for high speed optical communication systems as they are so important for the optoelectronic integrated circuit (OEIC) photoreceivers. In this paper, we discuss the circuit modeling of different kinds of high speed photodetectors. This study concentrates on modeling of resonant cavity enhanced photodetectors (RCE-PDs) and waveguide photodetectors (WGPDs) as these photodetectors are considered leading candidates to overcome the bandwidth-efficiency trade-off presented in conventional photodetectors. In this work, both PIN-PDs and separated absorption graded charge multiplication-avalanche photodetectors (SAGCM-APDs) are studied for both of RCE and WG structures.

These high speed photodetectors are modeled as lumped circuit element so that they can be simulated in any circuit simulator and hence a circuit analysis of the whole photoreceiver including the preamplifier is possible. This circuit model depends on the physical model and frequency response of the photodetectors and hence depends on the dimensions, the material parameters and on the multiplication gain in the case of the avalanche photodetectors. All the parasitics are considered in this model since they can significantly affect the performance of the photodetector.

The results obtained from the circuit model that is presented in this work are compared with published experimental results and good agreements have been obtained showing the validity of this circuit model.