

Public Abstract

First Name:Armin

Middle Name:

Last Name:Karabegovic

Adviser's First Name:Robert

Adviser's Last Name:O'Connell

Co-Adviser's First Name:

Co-Adviser's Last Name:

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Department:Electrical Engineering

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Title:PHOTOSWITCH-BASED CLASS E MICROWAVE POWER AMPLIFIER

Currently radar systems have problems with power losses and efficiency. The main problem with low efficiency is that more power is used and more heat removal is needed, which directly translates to the weight and the volume of the system. The primary source of loss in radar systems is the final amplifier in the transmission-receive module. The goal in RF amplifier development is to make them more compact and lighter, and to have reduced power requirements. Currently, Class A amplifiers operating at RF frequencies have operational efficiencies around 10% at S-band and above, and Class AB amplifiers have operational efficiency of 30-40%. Class D amplifiers operating at 2-3 GHz have 50% DC-RF efficiency. Power efficiency around 63% for a Class E amplifier is possible at 10.6 GHz.

The Class E amplifier was studied because of its simplicity and excellent high frequency characteristics. In this project, photoswitches were used instead of transistors for the active device, because they have fast turn-on and turn-off times, low on-state resistance, and large off-state resistance. Simulations showed that using this approach one can design a Class E amplifier with anode efficiency of 80.1% or power added efficiency of 59.3% at 10 GHz.

Analysis of the photoswitch when used in a simple circuit was also performed in order to determine its switching characteristics. It was shown that it is possible to design a photoswitch with fast switching times and low on-state resistance, and that this same photoswitch will produce the best operating efficiency when used in the Class E amplifier.