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ADVANCED TOPICS IN OPTOELECTRONICS, MICROELECTRONICS AND NANOTECHNOLOGIES

A novel electronic switch for VHF/UHF low cost radars

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INTRODUCTION

Low cost radars for VHF/UHF can be signed by using standard portable transceivers, both to generate the RF signal for transmitting, and the local beat frequency for demodulating the signal scattered by the target.

In this work, we propose a diode electronic switch for such a low cost radar system based on a portable, ham radio transceiver operating at 145 MHZ and 433 MHz, respectively.

The circuit was characterized in terms of impedance match for rectangular, modulating waveforms of different frequencies and duty cycles, and eventually tested in a real radar configuration.

PROPOSED CONFIGURATION

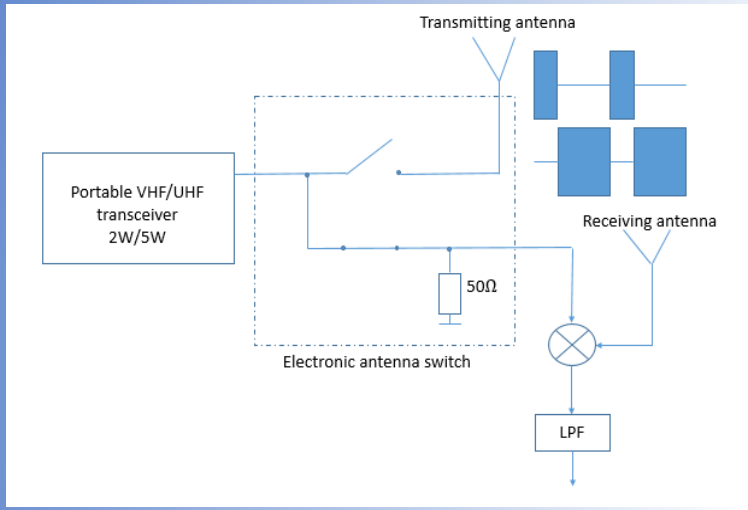


Fig. 1. Block diagram of radar system

- Let us consider a minimum target detection distance d_{min}=5m; the round-trip time to the target, t_0 can be found as:

$$t_0 = \frac{2d_{\min}}{c_0} = 0.03\ \mu s.$$

- The receiver bandwidth should therefore be:

$$B \sim \frac{1}{\tau} = 30\ \text{MHz}.$$

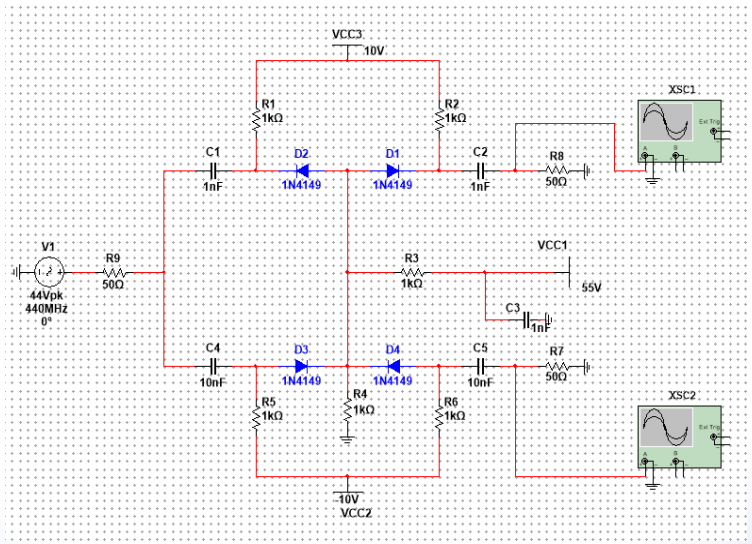


Fig. 2. Electric diagram of the antenna switch

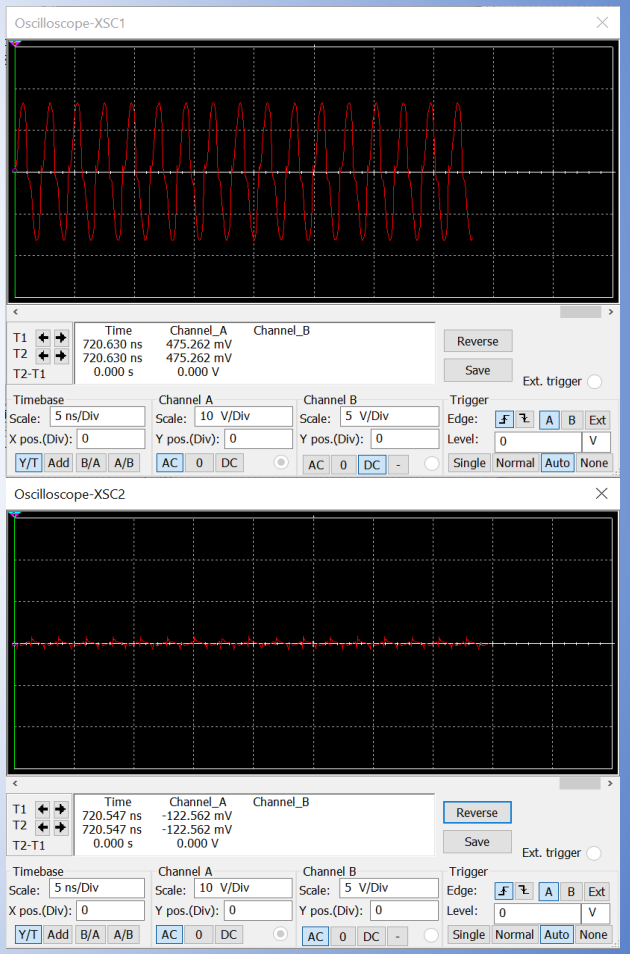
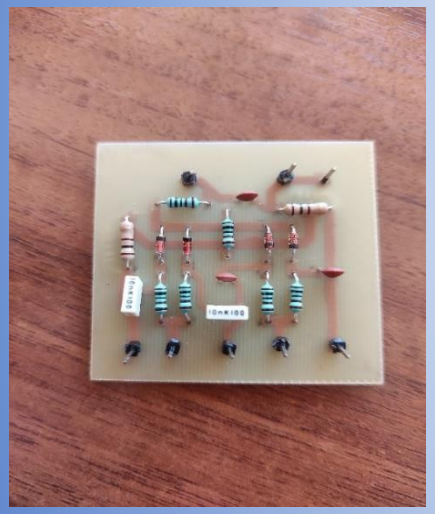
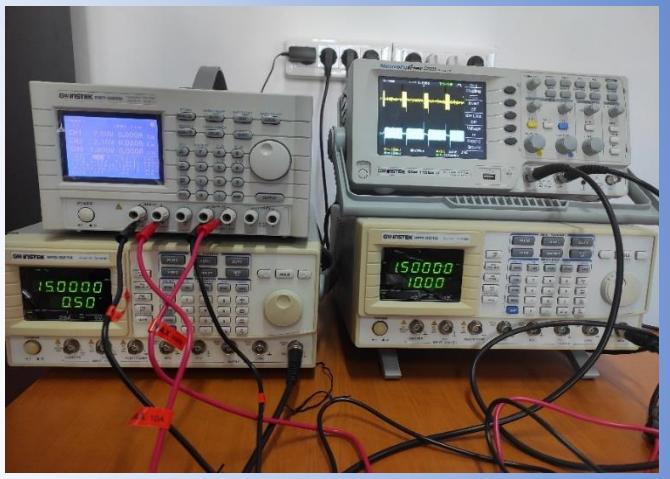


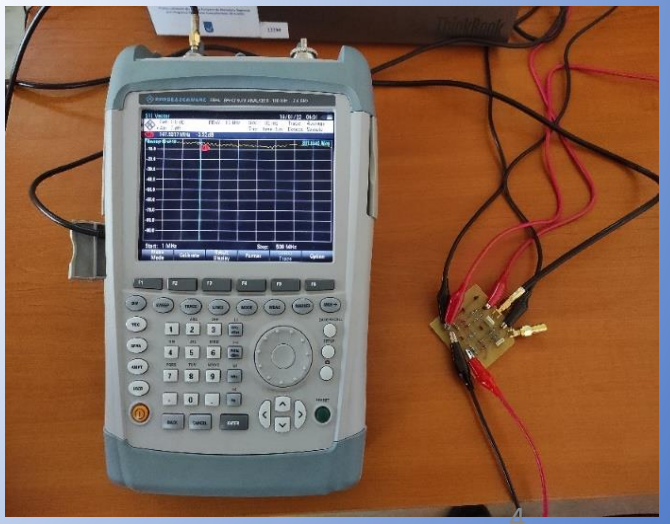
Fig. 3. Signals shown on the simulation oscilloscopes

EXPERIMENTAL VALIDATION RESULTS



- Figure 4 shows the PCB with all the electronic devices. The first test was performed for a carrier frequency as low as 15 MHz, in order to check the functionality (as seen in figure 5).
- Measurements on a vector network analyzer were further performed (Fig. 6), in order to investigate the dependence of the reflection coefficient at the switch input on the frequency of the switching signal, and on the duty cycle. The frequency on the vector network analyzer was swept between 1 MHz and 500 MHz.





- The variation of the voltage standing wave ratio (VSWR) as a function of switching frequency and duty cycle was depicted in figure 7, for both carrier frequencies of interest (145 MHz and 430 MHz).
- For the following part of the test, a portable, ham radio transceiver for 145 MHz and 430 MHz was used, and we observed the behavior of the switching circuit (Fig. 8).

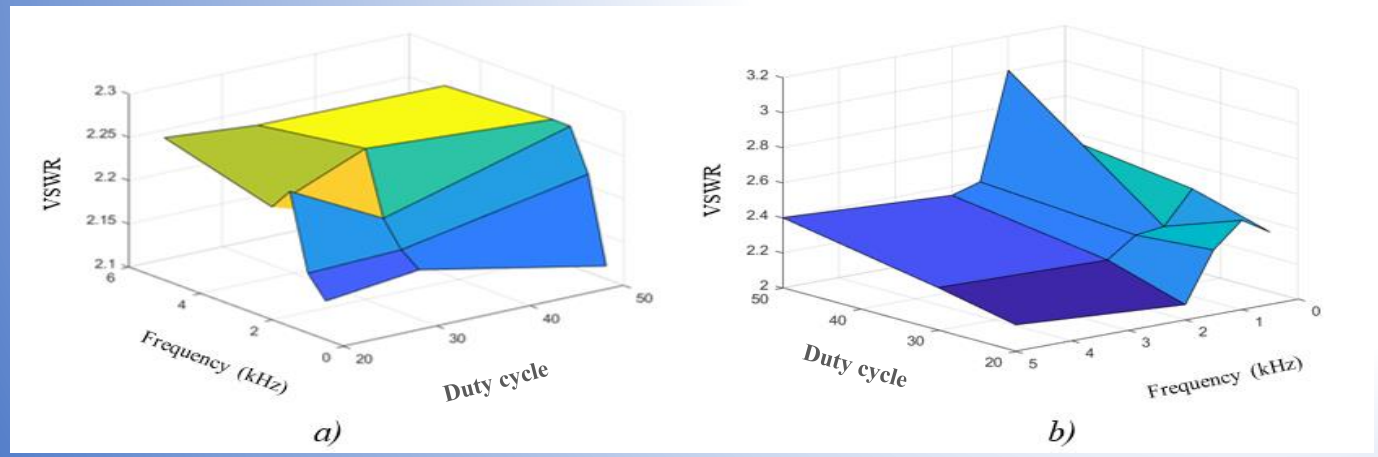


Fig. 7. Voltage standing wave ratio (VSWR) at the switch input: a) at 145MHz; b) at 430MHz

Fig. 8. Test on a portable transceiver: setup and switch output waveforms

- The switch was further tested in a radar configuration as presented in Figure 1. The transmitted and received signals are shown in Figure 9. The distance to the target placed at 5m away from the antenna system was measured accurately.

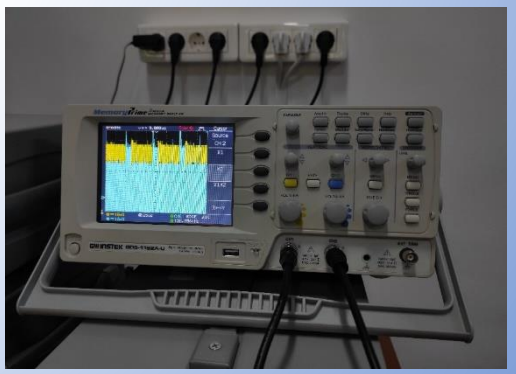
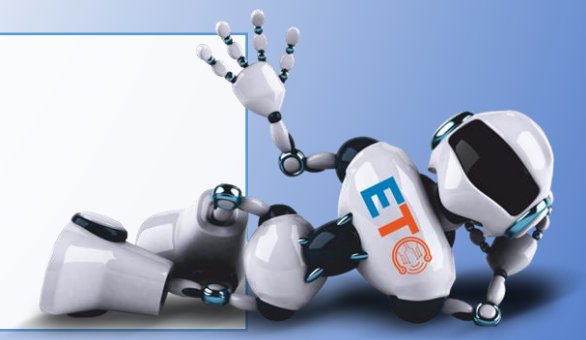


Fig. 9. Experimental results in a radar configuration

CONCLUSIONS

Before integrating it into the radar system, the switch was characterized in terms of impedance match and output phase for different modulating frequencies and duty cycles at two different carrier frequencies i.e., 145 MHz and 430 MHz.

It comes out that the proposed electronic switch configuration provides a good impedance match both at 145MHz and 430MHz (a VSWR below 2.5), and its phase contribution is negligible (0.4 degrees).

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