ISSN 0735-2727, Radioelectronics and Communications Systems, 2013, Vol. 56, No. 5, pp. 213–226. © Allerton Press, Inc., 2013.
Original Russian Text © A.F. Berezniak, A.S. Korotkov, 2013, published in Izv. Vyssh. Uchebn. Zaved., Radioelektron., 2013, Vol. 56, No. 5, pp. 3–20.

Solid-State Microwave Switches: Circuitry, Manufacturing Technologies and Development Trends. Review (Part 2)[1]

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Received in final form March 5, 2013

Abstract—This paper presents an overview of the process and design capabilities of state-of-the-art in the field of microwave solid state switches. The paper describes types of solid state switches, switch specifications, a review of technological advances in this area. The overview results indicate that AlGaN/GaN MMICs including solid state switches are realizable.

DOI: 10.3103/S0735272713050014

INTRODUCTION

In the second part of review [99] we generalize knowledge on solid-state microwave switches from the circuit design viewpoint with further comparison of different technological and circuit-level solutions pointing out the most promising techniques.

The second part of review contains Sections 4 and 5 and conclusion. In Section 4 we generalize circuit-level solutions and give examples of typical switch designs that have been developed during the last decade. Section 5 considers system-level solutions using solid-state microwave switches. Section and figure numbering continues the one introduced in the first part of review.

4. CIRCUITRY OF SOLID-STATE MICROWAVE SWITCHES

4.1. Switch Classification Based on Physical Operation Principle

Circuitry of solid-state microwave switches is based on a notion of a switching element represented by an equivalent resistor with controllable impedance. Microwave switches based on PIN diode are controlled by current, while the ones based on field-effect transistor (FET) are controlled by voltage.

Efforts of solid-state microwave switch manufacturers are concentrated on designing a controllable resistor with minimum impedance and minimum parallel parasite capacity which shunts the resistor. Based on the physical operation principles microwave switch designs are divided into two groups:

– reflection-type microwave switches;

– attenuation(absorption)-type microwave switches.

In the first case the controllable resistor is connected so that in the off state microwave energy travels back into the source. In the latter a switch in the off state absorbs microwave energy.

Let's introduce denotations for equivalent representation of a switching element of microwave switch that consists of controllable resistor and parasite capacity as depicted in Fig. 4.1. Parameter R_{min} corresponds to active resistance of open/on PIN diode or FET R_{on} (Fig. 4.1a), parameter R_{max} denotes active resistance of closed/off PIN diode or FET and C stands for parasite capacity of closed/off PIN diode or FET C_{off} (Fig. 4.1b).

[1] The paper presents research results obtained as part of Federal Target Program "Scientific and scientific-teaching staff of innovative Russia" for 2009–2013.