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Symmetric Stripline Duplexer

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Abstract—The compact duplexer using the symmetric stripline and containing the fifth-order comb filters in transmit channel *TX* (2300–2370 MHz) and receive channel *RX* (2510–2580 MHz) is constructed, and the characteristics of obtained duplexer are measured. This duplexer is built using dielectric material Al_2O_3 (Alumina, polikor) with high thermal conductivity that makes it possible to use the operating power of 10 W at small dimensions 57×11.8×4 mm. The losses in bandpass of *TX* and *RX* filters did not exceed 3 dB during the filter attenuation at adjacent channel frequencies of no less than 60 dB. It is shown that the selection of the width of metallized strip at the base of quarter-wave resonators makes it possible to change the duplexer width for attaining the required value. The circuit of coupling of resonators with loads used in this design made it possible to obtain a sufficiently high level of isolation from each other for *RX* and *TX* channels of duplexer. This level does not exceed 60 dB. The finite thickness of internal conductors of stripline amounting to 16 μm is taken into account while building the duplexer that results in good agreement between the simulation and measurement results.

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INTRODUCTION

Duplexers based on ceramic materials are an integral part of mobile communication systems, including the cellular telephony. They perform the separation of signals in receive and transmit channels [1, 2], where the receive and transmit channels are designated as *RX* and *TX*, respectively. *RX* and *TX* channels can use the high-pass and low-pass filters. It is also known that duplexer can employ a combination of bandpass and band-elimination filters. Two comb bandpass filters are most often combined in a duplexer. Small dimensions of duplexers are ensured by using the comb structure of *RX* and *TX* filters and also ceramics with high dielectric permittivity ε_r. Duplexers are produced in large quantities by high-tech companies, such as Murata (Japan) [3] and CTS Corporation (USA) [4].

Duplexers are known to have different designs. Duplexers built on coaxial dielectric resonators [3] and in a monoblock design with a series of resonance holes [4, 5] have become widespread. The use of microstrip bandpass filters on substrates with high value of ε_r [6] makes it possible to create compact microstrip duplexers [7], the dimensions of which are comparable with the sizes of duplexers on coaxial dielectric resonators. The most recent duplexers among the known microstrip ones [8, 9] using half-wave resonators in the loop form do not allow us to attain a high level of decoupling between the channels. The multilayer ceramic duplexers produced by LTCC (low temperature cofired ceramics) technology are in common use [10].

Designs of symmetric transmission striplines possess some advantages as compared to microstrip ones: they are shielded, while their resonators have a higher unloaded Q-factor [11]. For the sake of brevity, these designs shall be called stripline ones. They are simpler in manufacture as compared to multilayer designs. Nevertheless, the stripline duplexers are scarcely considered in the known literature sources.

Paper [12] presents the results of computer simulation of thin (1 mm) stripline duplexer, however the process of constructing this device and the experimentally measured characteristics is not considered. The noted low interest is probably related to the point established in [13] about the absence of coupling between the non-offset stripline $\lambda/4$ resonators oriented in one direction. This point was cited in the authoritative edition on the up-to-date filters [14] that played a negative role. The stripline comb structure with $\lambda/4$ resonators was referred to the category of all-locking circuit and defined as unpromising.

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