Multi-Band Frequency-Selective Surfaces With Independent Band Tuning

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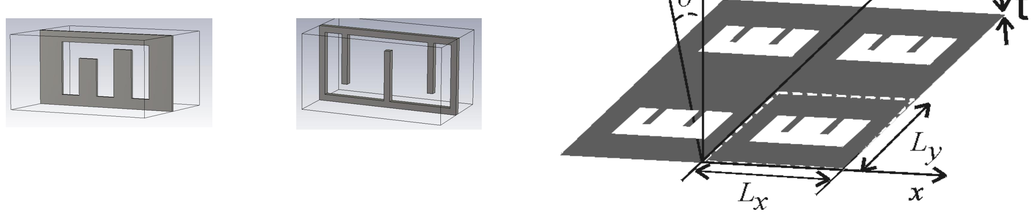
I. Objectives

- To design a frequency selective surface (FSS) enabling narrow-band pseudo-elliptic transmission of incident TE-polarized wave in a single-band or multi-band operating regime.
- To design a FSS enabling mixed-type frequency response, namely closely-spaced transmission of incident TE-polarized and its reflection simultaneously.
- To design a FSS providing independent control of passbands and stopbands.
- Such FSSs have found applications in a variety of applications such as wireless communications, radar systems, and satellite communications.

II. Proposed FSS design



- Proposed FSS is a thin metal perforated screen whose elementary cell contains a rectangular aperture with a set of pins implemented in its broad walls.
- Depending on the aperture geometry, namely dimensions of the pins, their location in the aperture cross-section and number of pins, different types of frequency responses are provided by a free-standing perforated screen for incident TE-polarized wave.
- Different operating regimes are generated by involving the higher modes of aperture into electromagnetic interaction. Operating regime type depends strongly on the number of modes involved into electromagnetic interactions.

III. Two-pin based designs

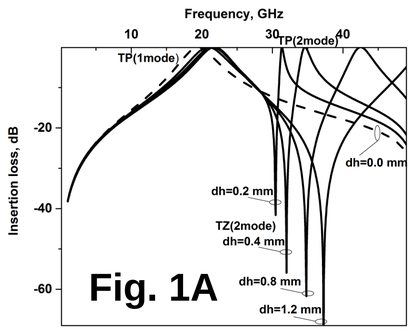


Fig. 1A

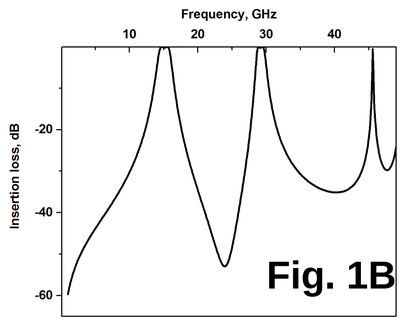


Fig. 1B

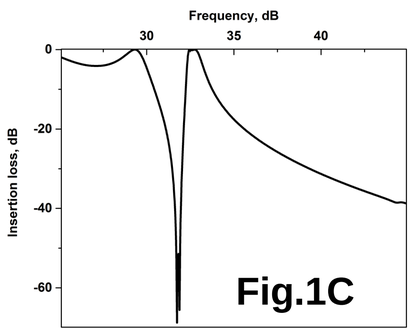


Fig.1C

- Single standing two-pit FSS provides transmission response if pins are equal (dashed line in Fig. 1A).
- It provides generation of additional pair of a transmission pole (TP) and a transmission zero (TZ) if pins are unequal. Frequency separation between TP and TZ is controlled by changing a difference in pins' heights mainly.
- Involving the second (1st higher) mode into electromagnetic interaction is a physical reason of such a response.
- Two-band transmission response (Fig. 1B) or a singlet-type response (Fig. 1C) are achieved by cascading a pair of proposed FSS.

IV. Tri-pin based designs

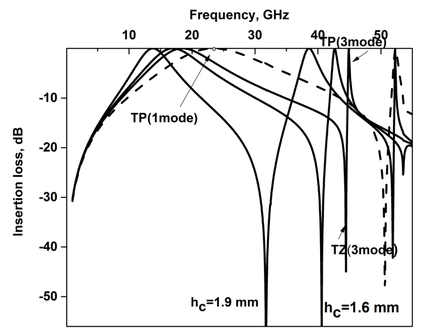


Fig. 2A

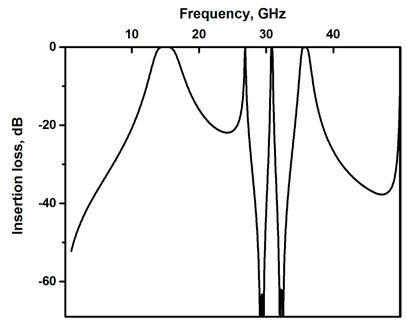


Fig. 2B

- Single standing tri-pin FSS enables two-band transmission response as well (Fig. 2A).
- Even symmetric FSS with equal pins enables generation of quasi-elliptic response Fig. C).
- Generation of additional pair of a transmission pole (TP) and a transmission zero (TZ) is caused by involving the 3rd (2nd higher) mode into electromagnetic interaction.
- FSS with broken symmetry enables tri-band transmission response achieved by additional involving the 2rd mode. Fig.B shows a response of doubled tri-band tri-pin based FSS. Depending on the input task, the response can be interpreted in different manner, namely as two-stopband one.
- Fig D shows plots of frequencies of the resonances and their Q-factor vs the angle Θ of incident wave.

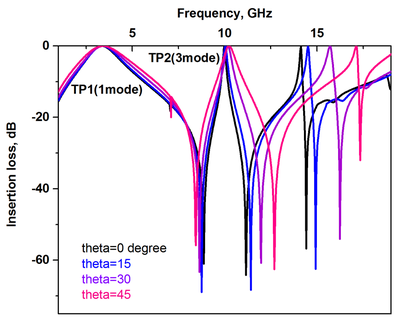


Fig. C

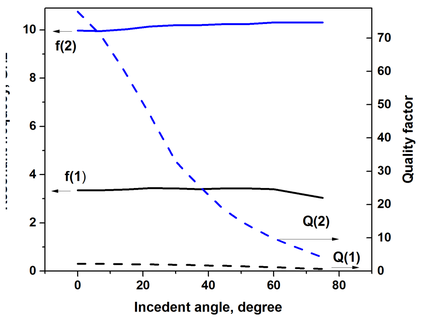


Fig. D

V. Multi-pin based designs

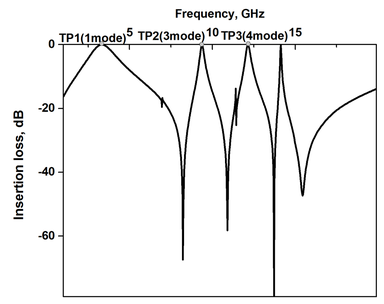


Fig. A

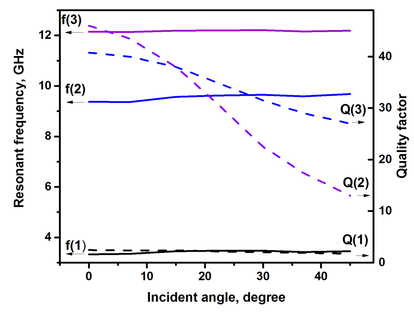


Fig. B

Typical multi-band response provided by a multi-pin section (Fig. A) . Fig. B shows plots of frequencies of the resonances and their Q-factor vs the angle Θ of incident wave

Acknowledgement

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