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Wave propagation along a rectangular metallic wave-guide
longitudinally loaded with a metamaterial slab

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Abstract

Wave propagation along a rectangular metallic wave-guide loaded with a longitudinal metamaterial slab adjacent to air, has been studied. The dispersion relations have been obtained and the $\beta - \omega$ diagrams have been drawn for various width ratios of the metamaterial to air regions. For real propagation coefficients, in the $0 < \beta < k_0$ range, the group velocity could be negative, very low or constant, depending on the frequency range and on the width ratios of the two regions. In some cases it has been found that the propagation coefficient is complex although the media are lossless: there is no net energy flow through any cross-section of the guide so that the energy present is only stored, reactive, energy and this seems to be due to strong coupling processes occurring in the device.