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THE STUDY OF MECHANICAL VIBRATIONS OF MULTILAYER PRINTED CIRCUIT BOARDS

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The present work is devoted to the processing and analysis of signals arising from mechanical vibrations of multilayer printed circuit boards. An original measuring stand was developed and manufactured that allows detecting forced vibrations of rectangular beams. The following characteristics were studied: waveforms of signals; Fourier spectra, phase portraits. An algorithm for analyzing vibration signals was developed. To implement this algorithm, we used the Mathcad 15 program and built-in functions for approximating, interpolating, and Fourier transforming signals. It was shown that the vibrational characteristics of printed circuit boards are influenced not only by the total mass of SMD components, but also by the surface mounting and metallization structure. With the increase in the number of SMD components, the quality factor of printed circuit boards increases. In the experimental spectra of oscillations, two harmonics are distinguished: a large peak corresponds to the frequency of the fundamental tone of the oscillations; small peaks refer to the second harmonic, which decays rapidly over time. With an increase in the number of SMD components, the amplitudes of both harmonics increase, which is associated with an increase in the stiffness of the samples. With an increase in the number of SMD components, the peaks of both harmonics shift toward lower frequencies. This is because the natural frequencies of the printed circuit boards are sensitive to the total mass of SMD components. Thus, printed circuit boards with a large number of SMD components are capable of storing a large amount of mechanical energy, which can adversely affect their performance in conditions of intense vibration.

Keywords: printed circuit board, damped oscillations, phase portrait, spectral characteristics, SMD components.

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