

Study of metal-contact RF-MEMS switch/relay from DC to GHz

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This study describes the development of an RF-MEMS switch/relay with a metal contact that can operate from DC to the GHz frequency by means of MEMS technology. A number of reports on RF-MEMS switches and/or micro relays have been published to date but no commercial device has been produced yet. The key factor is that the technical challenges of reliability have not been solved.

The thesis consists of 6 Chapters.

Chapter 1 gives the background, purpose and overview of this study. Chapter 2 summarizes both the present situation and research problems with switching devices using RF-MEMS technology, and the basic theory in the design of RF switches. Chapter 3 describes the adoption of a high-frequency structure designed by a co-planer waveguide with ground and its application to a high-frequency analysis and actual device verification by FEM. The manufacturing process with wafer-level packaging is demonstrated, the basic characteristics surpassing the current semiconductor switch from DC to GHz. Chapter 4 shows that the novel wafer-level packaging, providing the signal line of the vertical feed through glass substrates, further improved the high-frequency characteristics and that the package maintained the excellent high-frequency performance at more than 10 GHz. Chapter 5 evaluates the method and failure mode concerning the reliability of the metal contact, considering solution methodology and actual operational reliability. Regarding actual operational reliability, a number of devices realized more than 2 billion contact operations during testing. Chapter 6 summarizes and concludes.