In this paper, a class of high-data-rate battery-free yet active miniature radio-frequency identification tag without any external components (except antenna) operating at millimeter (mm)-wave frequencies is proposed and demonstrated. This fully embedded tag consists of a recently proposed CMOS-based zero-intermediate-frequency self-oscillating mixer, a high power conversion efficiency mm-wave-to-dc rectifier, and an ultralow-power voltage regulator on a single chip, integrated with ceramic-based antennas. Interconnection between the CMOS die and the antenna is realized using a wire-bonding technique, which is compensated and optimized to match the antenna input impedance and also to minimize the wire-bond associated losses at mm frequencies. The 10×10 mm^2 tag wirelessly harvests its energy from an incoming signal at 24 GHz, receives, and recovers the data sent by reader on an amplitude modulation (AM)-modulated 40-GHz carrier, and transmits its data back to the reader on a 40-GHz carrier, using AM modulation as well. The tag exhibits a bit rate of about 500 kb/s during the reader-to-tag communication and 10 Mb/s during the tag-to-reader communication, solely relying on the rectified energy for powering its operation. To the best of our knowledge, such an mm-wave identification tag at mm-wave frequencies has never been reported in the literature.