Novel techniques that enable reagent free detection and analysis of single cells are of great interest for the development of biological and medical sciences, as well as point-of-care health service technologies. Highly sensitive and broadband RF sensors are promising candidates for such a technique. In this work, we present a highly sensitive and tunable RF sensor, which is based on interference processes and built with a 100-nm slotline structure. The highly concentrated RF fields, up to ~ $1.76\times10^{7}$ V/m, enable strong interactions between giant unilamellar vesicles (GUVs) and fields for high-sensitivity operations. We also provide two modeling approaches to extract cell dielectric properties from measured scattering parameters. GUVs of different molecular compositions are synthesized and analyzed with the RF sensor at ~ 2, ~ 2.5, and ~ 2.8 GHz with an initial $|S_{21}|_{min}$ of ~ -100 dB. Corresponding GUV dielectric properties are obtained. A one-dimensional scanning of single GUV is also demonstrated.