FLEXIBLE 2-GRAM RECTENNA WITH 50% CONVERSION EFFICIENCY AT VERY LOW INCIDENT POWER DENSITIES

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This paper presents a 900MHz flexible folded dipole rectenna with 2.7 dB RF-to-DC conversion loss and mass of only 2 grams. It employs a Schottky diode, a capacitor, and printed coplanar circuit elements. Rectification efficiency is improved by harmonic terminations resulting in class-F waveform shaping achieving an estimated efficiency of 53% efficiency AT 8uW/cm^2 incident power density. The rectenna is printed on 0.13mm PET with a commercial printing process depositing 1-μm-thick conductive traces.

The impedance at the harmonics is set with a shorted coplanar stripline (CPS) stub of length. The impedance presented to the diode, Z(f), is the antenna impedance in parallel with that of this harmonic shaping structure. At even harmonics, the feed structure is a short, while at odd harmonics, the antenna must have high impedance. The harmonic matching circuit also serves as the DC collection circuit: the shorted quarter-wavelength stubs are an RF choke and a DC short. The capacitor (C = 33pF), helps reduce the
impedance at the even harmonics. The compact meandered feed lines are integrated with a relatively standard coplanar dipole antenna, with a gap at the top to block DC. Adjusting the inset rectangle dimensions s and m varies Z(f_0) across a broad range of inductive values, allowing for tuning for the nonlinearity of the diode impedance. The flexible substrate is 0.13-millimeter thick polyethylene terephthalate (PET) with relative permittivity of 3. A commercial inkjet prints Methode 9101 conductive silver ink traces, with a nominal bulk conductivity of 15MS/m and 2μm thickness. The chips are bonded to the substrate with silver epoxy.

The rectification efficiency can also be expressed as a conversion loss, L=10log(P_{RF}/P_{DC}). For an incident power density of 80mW/m^2=8uW/cm^2 corresponds to slightly less than 1mW power input and 0.5mW output. We estimate the rectenna achieves conversion loss of L = 2.7dB.