



A Compact High-Efficiency RF Rectifier with Wide Power Range and Its Application in Wireless Power Transfer

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With the rapid development of smart grids, on-line monitoring systems of transmission and distribution lines are more necessary than ever before. However, it is a difficult problem to supply the power for the on-line monitoring devices. Wireless power transfer (WPT) is a promising technology for many potential applications [1-3], such as wireless sensors [4], space solar-power stations (SSPSs) [5], implantable medical devices (IMDs) [6], unmanned aerial vehicles (UAVs) [7] and RF energy harvesting (EH) [8]. Thus, WPT technology is regarded as an efficient method to realize power supply for devices in special environment, such as high-voltage environment. The popular WPT techniques include: magnetic-field coupled wireless power transfer (MC-WPT), electric-field coupled wireless power transfer (EC-WPT), microwave power transmission (MPT), laser power transfer (LPT) and ultrasonic power transmission (UPT).

In this paper, by employing MC-WPT and MPT technologies, the power transmission from high-tension lines to on-line monitoring devices is achieved. Moreover, as a key part of the WPT system, a 5.8GHz microwave rectifier with wide power range and high efficiency is proposed based on the nonlinear characteristics of diode wideband impedance matching method. The proposed rectifier consists of two sub circuits, operating at the high power region and the low power region, respectively. The transmission line in series with the diode has the effect of compensating the imaginary part of the diode impedance and suppressing higher harmonics, and the $\lambda/4$ transmission line is used to reverse the change of the diode impedance relative to the input power. From the rectification efficiency curve of the rectifier, it can be seen that the reflection coefficient is below -10 dB from 0 dBm to -30 dB. The rectification efficiency of the rectifier is 70% at the frequency of 5.8 GHz and the input power of 12.9 dBm, and the rectification efficiency is more than 60% from -0.5 dBm to 26 dBm. The proposed rectifier circuit has advantages of large power range, high efficiency, compact circuit size and low-cost.