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UHF Sensors for On-line Partial Discharge Detection on Power Transformer: Hilbert fractal, Moore Fractal and Peano fractal

Abstract

Partial discharge (PD) is the causes of the fault to occur in high voltage equipment due to the breakdown of the insulation system happen on equipment, even old equipment or new equipment. The PD in transformer oil is one of the significant causes of insulation failure and a breakdown. Hence, a sensor is needed to continuously monitor and detect the PD at an early stage on the power transformer. An antenna is one of the sensors that can be used to detect PD based on ultra-high frequency (UHF) method. However, the size of the antenna is the main problem to be installed in the transformer tank. Thus, three types of antenna which are Moore, Hilbert and Peano fractal with the dimension of 10 X 10 cm is designed to operate in UHF range 0.3 GHz to 3 GHz to be able to detect the frequency of partial discharge signal generated by electromagnetic waves. The performance of the proposed antennas in terms of return loss, Voltage Standing Wave Ratio (VSWR) and radiation pattern are analysed and compared for PD detection on the power transformer. Based on the result, the fourth-order of Hilbert fractal antenna was found to be the best antenna for PD detection in power transformer at working frequency range from 0.72 GHz to 2.77 GHz. This antenna also has low threshold of return loss at-36.2 dB for the resonant frequency at 1.67 GHz and the value of VSWR is near to one which is 1.03. Lastly, the radiation pattern of this antenna is almost in hemisphere shape and the gain variation of all frequencies are nearly stable compared to the other types of antenna.

Keywords

Fractal antenna; Hilbert Fractal antenna; Partial Discharge; UHF sensor