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Applications of Differential CDMA Schemes and Control Technology for Distribution Substations

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Abstract

This paper presents an approach to achieve monitoring and control of distribution systems in a distribution substation using power-line communication (PLC) combined with Hadamard code. Four different techniques, i.e., binary phase shift keying (BPSK), quadrature phase shift keying (QPSK), 16-quadrature amplitude modulator (QAM) and 64-QAM in code division multiple access (CDMA), are employed. With spreading-spectrum modulation and demodulation in the studied PLC system, the proposed approach can achieve reliable high-speed information transmission through power lines. With Hadamard code, the signals corresponding to different relays are orthogonal to each other and the interference among them can be reduced. The proposed approach has the advantages of high-speed detection, bi-direction communication, reading and backup data, control and turn-off functions, displaying the real-time system information, etc. When 100 kHz is used as the carrier frequency for 256 relays under power-line noise below 14 dB, the simulation results show that the bit error rate (BER) is less than 10^{-5}. The proposed scheme can be applied to the smart-grid distribution substation of the studied distribution systems.

Keywords: power-line communication, binary phase shift keying, quadrature phase shift keying, quadrature amplitude modulator, code division multiple access, bit error rate, orthogonal frequency division multiplexing

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