OPTIMIZATION OF SINGLE-PHASE MULTILEVEL INVERTER VOLTAGE QUALITY USING TIME DOMAIN PROBLEM FORMULATION

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Introduction. Single-phase multilevel inverter voltage quality for staircase (step) modulation, or fundamental switching, (Fig.1) is characterized by Normalized voltage ripple Mean Square (NMS) or more widely accepted Total Harmonic Distortion (THD) [1]. The goal is to find theoretically optimal switching angles and respective minimal NMS / THD values for arbitrary modulation indices and level counts.

Materials and methods. Optimal voltage quality problem is formulated in time domain as a constrained optimization one thus accounting for all switching harmonics. A solution is obtained using available numerical optimization software (e.g., GAMS, MATLAB).

Results and discussion. The outcome of this research is optimal switching angles (Fig.2) obtained by numerical solution of constrained optimization problem that deliver theoretically minimal NMS/ THD (Fig.3, 4) values for arbitrary modulation indices and different level counts.

Conclusions. The multilevel inverter optimal voltage quality problem is formulated in time domain in order to account for all switching harmonics. The numerical solutions establish theoretical voltage quality lower bounds for a single-phase multilevel inverter achieved for staircase modulation for entire voltage dynamic range and different voltage levels count.

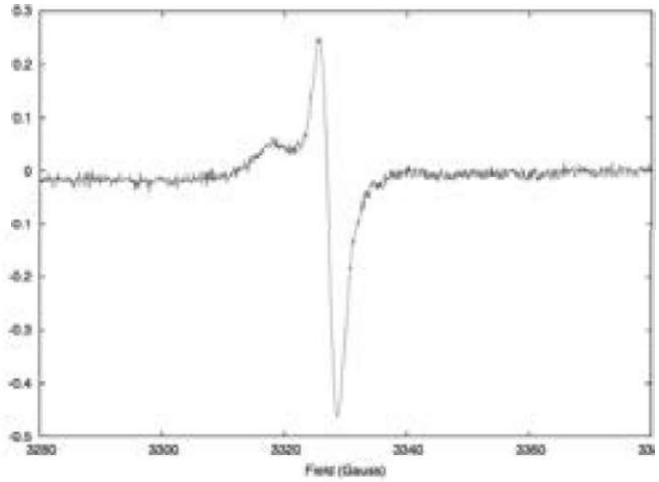

Figure 1. CW-EPR of the new 'reaction centre'

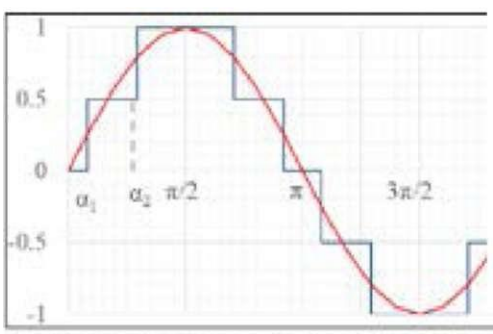

Fig. 1. An example of staircase modulation for a 5-level single-phase inverter.

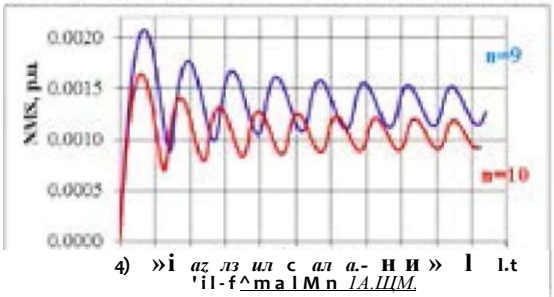

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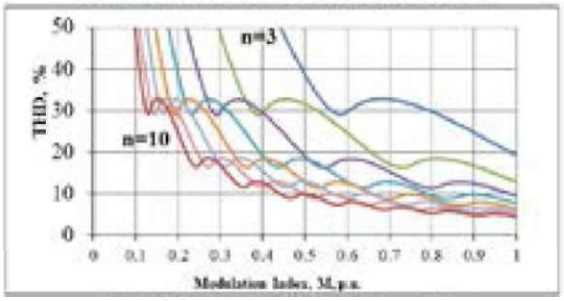
Fig. 2. Optimal switching angles for 10 inverter level count



Minimal voltage r l № * T * - J , *, . , №

References.

1. A. Ruderman, G. Mehlmann, and B. Reznikov, "PWM voltage quality bounds of a single-phase multilevel inverter," *Proc. Int. Conf. on Optim. of Electr. and Electron. Equip. (OPTIM),* May 2012, pp. 58-68.