

Fig. 6. Waveforms of voltage $u_{p/2l}$ and current $i_{R/1l}$ of the supply line, at nominal load of the 2 kW rectifier.

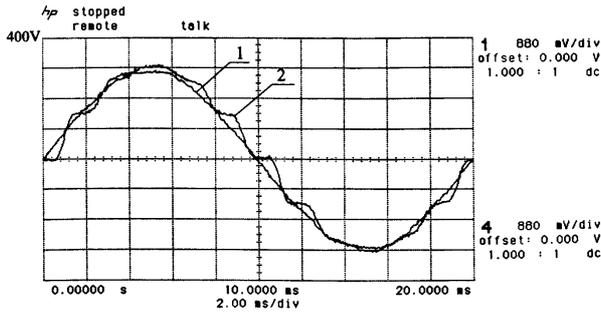


Fig. 7. Oscillograms of undistorted phase voltage u_{R-1} in the supply network, and voltage u_{GR0-2} at input terminals of the 3CRλ system at nominal converter load.

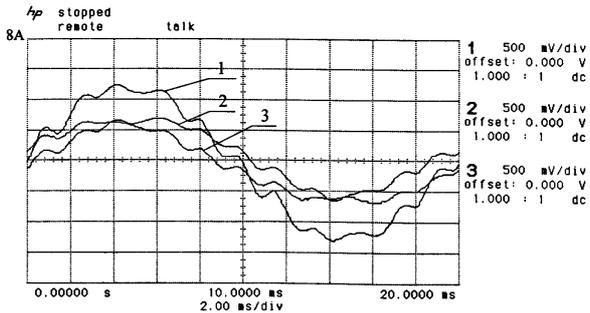


Fig. 8. Oscillograms of network current i_{R-1} and 3CRλ winding currents i_{1R-2} , i_{2R-3} at nominal converter load.

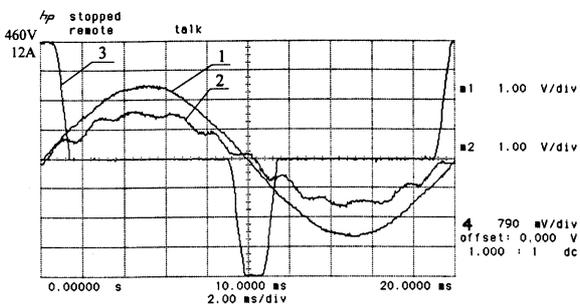


Fig. 9. Oscillograms of voltage u_{R-1} and current i_{R-2} in the supply line, and voltage $u_{K1RK2R-3}$ on main 3CRλ windings, at rated converter load.

The presented results of the simulation and experimental tests comply to a sufficient degree with the theoretical results.

5. Conclusion

The presented research work based on simulation and experimental tests proved a significant usefulness of multi-pulse rectifiers for supplying multilevel inverters. The paper presents the 12-pulse rectifier connected to the line by use of three-phase coupled reactors. The 12-pulse rectifier consists of two classic bridge rectifiers and the reactors are connected and work in a special variant 3CRλ described in cited contributions. The application of such a solution makes that the diodes conduction angle in rectifiers achieves 180°. Certainly increasing the inductance improves the shape of the supply current waveform but it leads to the increase of the commutation angle. For the inductance $L_s = 20$ mH and the assumed load of 2 kW, the THD_i value is below 8%. Although the experimental tests have been done on low power level but these works proved that multi-pulse rectifier gives a worthy performance and has some respectable properties.

References

- [1] J. Iwaszkiewicz, P. Bogusławski, A. Krahel, E. Łowiec, "Three-phase Voltage Outages Compensator with Cascaded Multilevel Converter", in Archives of Electrical Engineering, Vol. 61, No. 3, pp. 325-336.
- [2] J. Iwaszkiewicz, L. Wolski, M. Perez Donsión, "A Case Study Control on High Power Compensator of the Power Grid Irregularities for Industrial Appliances", in International Conference on Renewable Energy and Power Quality ICREPQ'13, Bilbao, 20-22 March 2013, Spain.
- [3] J. Iwaszkiewicz, A. Muc, "A three phase 3-level inverter with reduced THD factor", in International Conference on Renewable Energy and Power Quality ICREPQ'18, Salamanca, 21-23 March 2018, Spain.
- [4] IEEE Std 1159-2009 (Revision of IEEE Std 1159-1995) - IEEE Recommended Practice for Monitoring Electric Power Quality
- [5] P. Mysiak, R. Barlik, "An DC-output twelve-pulse converter in the low voltage power network supply conditions", in International Conference on Power Electronics and Motion Control, Warsaw University of Technology, Warsaw Poland, 1994.
- [6] P. Mysiak, "Multipulse Diode Converters - Frequency Doma in Analysis of Operation of the Applied Coupled Three-Phase Reactor", in 6th International Conference-Workshop, Compatibility And Power Electronics (CPE 2009), Badajoz, Spain, May 20-22, 2009.
- [7] P. Mysiak, "Eighteen-pulse diode rectifier with three-phase coupled reactors", in Archives of Electrical Engineering, Vol. L, No 1, Warsaw, 2001.
- [8] M. Depenbrock, C. Niermann, "A New 12-Pulse Rectifier Circuit with Line-Side Interphase Transformer and Nearly Sinusoidal Line Current", in Proc. of the 6th Conference on Power Electronics and Motion Control, Budapest, Hungary, Oct. 1-3, Vol. 2, 1990, pp. 374-378.
- [9] M. Depenbrock, C. Niermann, "A new 18-pulse rectifier circuit with line-side interphase transformer and nearly sinusoidal line currents", in Conf. IAS 1990.
- [10] M. Depenbrock, C. Niermann, "Netzfreundliche Gleichrichterschaltung mit netzseitiger Saugdrossel (TDS) - Teil II: Eigenschaften", in Etz Archiv Bd. 11 (1989) H.10, pp. 317-321.