Research Paper
Volume : 4 | Issue : 7 | July 2015 • ISSN No 2277 - 8179

Simulation of symmetric and Non-Symmetric Gating Pulse for H-Bridge of Electronic Transformer

Engineering
KEYWORDS : Converter, symmetrical, firing of H-Bridge

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ABSTRACT

A transformer performs many functions such as voltage transformation, isolation, and noise decoupling, and it is an indispensable component in electric power distribution systems. However, at low frequencies, it is a bulky and expensive component. A fairly straight forward approach to accomplish size reduction in a transformer feeding a conventional rectifier, inverter, UPS, etc system is to introduce a high frequency transformer. Such ac-ac converters need switches with bi-directional voltage blocking and current carrying capability, which are commonly realized with pairs of gate turn-off devices such as MOSFET.This paper reports on generation of gate pulse for H-bridge on both side for electronic transformer and explain the advantage of symmetric modulation scheme over asymmetric modulation scheme.

I. Introduction

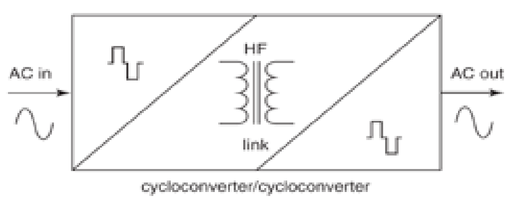

Fig. 1 *Electronic transformer using HF AC link*

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Line frequency transformers (50 and 60Hz) are heavy and bulky items in power conversion and distribution systems. Transformer size is inversely proportional to the frequency of operation and saturation flux density. Hence a reduction in volume and weight can be obtained by high-frequency operation of the magnetic core. Introduction of a high frequency link to realize a small-size electronic transformer has been widely discussed in the literature. Low cost and easy availability of ferrite core material has helped in the implementation of high-frequency link power transformation. The electronic transformer utilizes power electronic converters along with a high-frequency transformer to obtain overall size and cost advantages over a conventional transformer. One of the topologies of the electronic transformer is the high-frequency AC link. It has two cycloconverters with a high-frequency AC link in between, as shown in Fig. 1. The circuit uses the standard H-bridge, one on either side of the high-frequency transformer. A novel PWM scheme is proposed, which symmetrically delays and advances the phase of the left and right legs of the front-side converter with respect to the output side converter. The major payoff expected is size reduction and automatic voltage regulation.

This paper presents the standard H-bridge adapted to AC/AC power conversion. The circuit is illustrated in Fig. 2. When the above-mentioned control is applied i.e., HM(t) controlling converter 1 and HD(t) controlling converter 2, the unfiltered output voltage obtained is as shown in Fig. 4 along with the frequency spectrum. In Fig. 4, it is observed that with the above scheme the output voltage waveform is bipolar. Also since the transformer voltage does not have any zero voltage instants, i.e. no freewheeling sub-periods, some of the switching transitions in the converters are hard switching transitions. In this paper, an alternative control method is proposed wherein some of the switches achieve soft transitions.

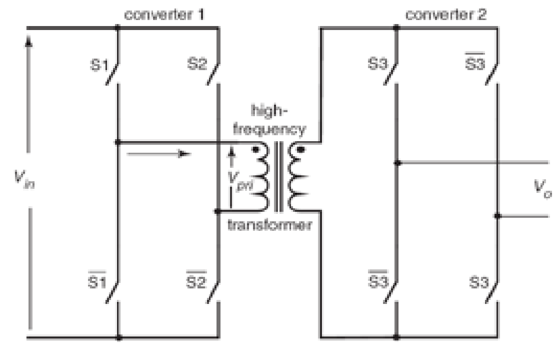
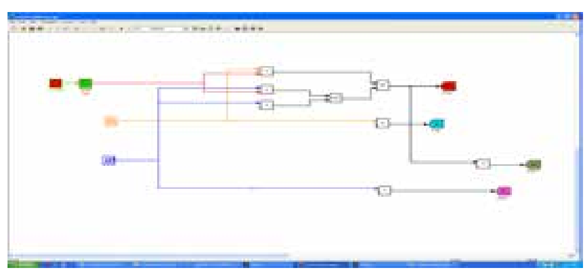


Fig. 3 *Topology of high-frequency AC link electronic transforme*

Fig. 2 Topology of high frequency AC link electronic transformer

II. SIMULATION RESULT

A. *Gating pulses for asymmetric modulation scheme for converter*



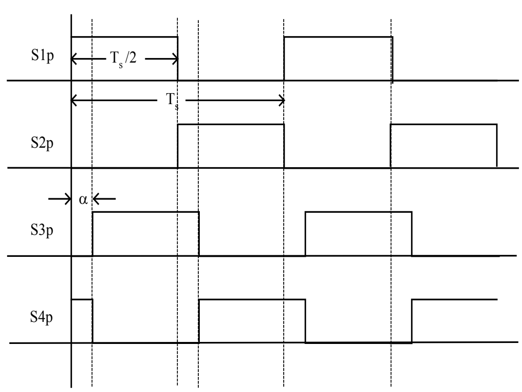


Figure 3: simulation circuit for asymmetric modulation

Figure: 4: Simulation results of asymmetric modulation scheme for converter

B. ***Gating pulses for symmetric modulation scheme for converter***

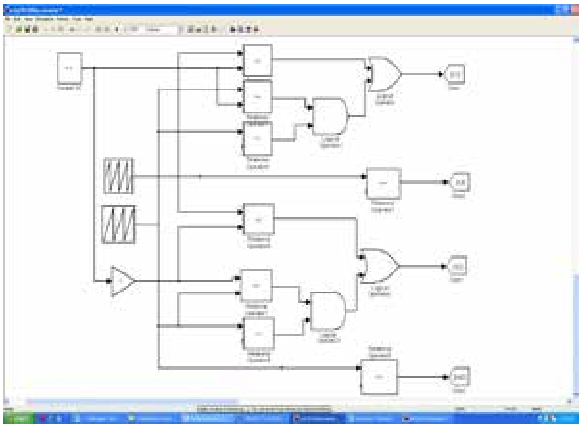


Fig. 5 Control signals for switches S1 to S4

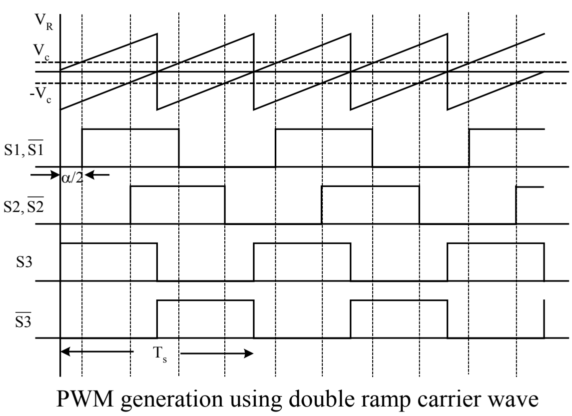
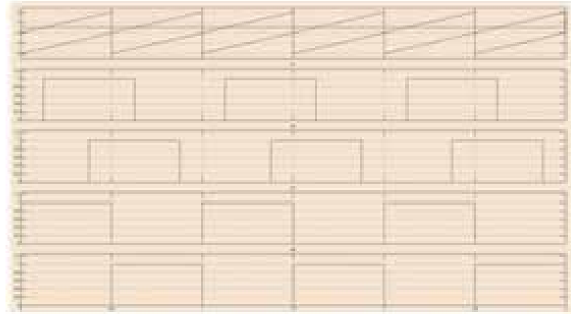
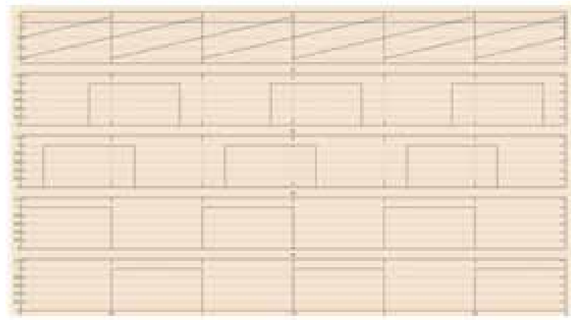


Figure : 6 PWM Generation using double ramp carrier wave



(a)) $\alpha = T_s/8$



(b) $\alpha = 3T_s/8$

Fig. 7 (i) double ramp, (ii) S1 (iii) S2 (iv) S3 (v) S4

vIII. Conclusions

A symmetric modulation scheme for control of electronic transformer is explained.

Advantages of symmetric modulation scheme:

- Converter1 has free-wheeling sub-periods
- Zero voltage transitions occur in converter2
- The rms value of the voltage across the transformer reduces.

REFERENCE

[1] McMurray, W.: 'Power converter circuits having a high-frequency ink', US Patent 35173000, 23 June 1970 | [2] Kang, M., Enjeti, P.N., and Pitel, I.J.: 'Analysis and design of electronic transformers for electric power distribution system', IEEE Trans. Power Electron., 1999, 14, (6), pp. 1133–1141 | [3] Harada, K., Sakamoto, H., and Shoyama, M.: 'Phase-controlled DCAC converter with high-frequency switching', IEEE Trans. Power Electron., 1988, 3, pp. 406–411 | [4] Hienemann, L., and Mauthe, G.: 'The universal power electronics based distribution transformer – an unified approach'. IEEE PESC2001, Conf. Rec. | [5] Kwon, B.H., Youm, J.H., and Choi, J.H.: 'Automatic voltage regulator with fast dynamic speed', IEE Proc. Electr. Power Appl., 1999, 146, (2), pp. 201–207 | [6] Hietpas, S.M., and Naden, M.: 'Automatic voltage regulator using an AC voltage-voltage converter', IEEE Trans. Ind. Appl., 2000, 36, pp. 3–38 | [7] Hariharan, K.: 'High frequency AC link electronic transformer'. MSc Thesis, Department of Electrical Engineering, Indian Institute of Science, April 2002 | [8] Enjeti, P.N., and Choi, S.: 'An approach to realize higher power AC controller'. Proc. IEEE APEC Conf., March 1993, pp. 323–327 | [9] Rajapandian, A., and Ramanarayanan, V.: 'A Constant Frequency Resonant Transition Converter', J. Indian Inst. Sci., 1996, pp. 363–3