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THE MULTILEVEL INVERTER ON IGBT TRANSISTORS FOR TRANSFORMATION OF SOLAR ENERGY TO THE ELECTRIC POWER

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Keywords: Inverter, transistor, IGBT, Matlab, converter.

Abstract. In this article the multilevel inverter on IGBT transistors for transformation of energy of the sun to the electric power is investigated. At the exit of the multilevel inverter it is possible to receive tension close to a sinusoidal form. The analysis of the received output curves of tension on a sinusoidal is carried out. Main objective of this inverter is transformation of solar energy to the electric power of industrial frequency. Results of computer modeling and a pilot study are given.

Introduction. Development of renewables is one of the major factors stimulating growth of the market of power electronics, demanding continuous increase of efficiency of transformation and reliability [1]. The scope of power electronics covers now practically all spheres of activity of the person, fuel a power complex, the industry, transport, communication, life, etc. Use of devices of power electronics is the biggest and important area the modern electric drive [2].

Wind power installations (WPI) and the solar energetic stations (SES) are considered as the most perspective sources of alternative energy today. In all cases connection of the SES inverter to a network is carried out at satisfaction of the demanded value of coefficient of harmonicas [1].

The set of inverters of common industrial and special execution is known. The problem of inverting of the electric power is solved by mainly so-called static converters now, the most effective among which on efficiency and mass-dimensional indicators are semiconductor transistor converters. The inverter thus has to possess rather high power rates (specific power, efficiency, power factor, etc.) and quality of the developed electric power (tension curve form sinusoidal, stability of frequency and tension [3].

The imitating model of the multilevel inverter was collected in the program MATLAB R2010a environment. Analyses for eight, thirteen and twenty six levels were carried out. In figure 1, the imitating model of the eight-level inverter on IGBT transistors is shown.

The multilevel inverter works at IGBT transistors as follows. The known bridge scheme of the inverter 1 consists of transistors Ti1, Ti2, Ti3 and Ti4 and through n of transistor keys of KKn consisting of n of Tn and n transistors of Dn diodes is connected to n to En power supplies and forms at the exit squared tension, both in positive, and in a negative half-cycle.

To form the following positive half-cycle of tension the first specified algorithm repeats. Here it should be noted that it is possible to form unlimited number of levels at the inverter exit.

N of consistently connected solar elements (SE) and m in parallel connected by SE to current equal to I are necessary for transformation of solar energy to tension of alternating current with the operating value U. Thus some solar platform which develops a certain power P = Ui. According to a method of calculation of economy of solar elements and formation of multilevel tension at the exit of the inverter turns out power P = 8,11 kW of a solar platform tension of alternating current with the operating value U = 220 V was calculated (with amplitude Um value = 312 V). For this purpose n = 26 consistently connected solar elements and m = 26 in parallel of the connected solar elements with current in I = is necessary for 1 A.Pri it the economy of solar batteries depending on number of level of tension turns out.

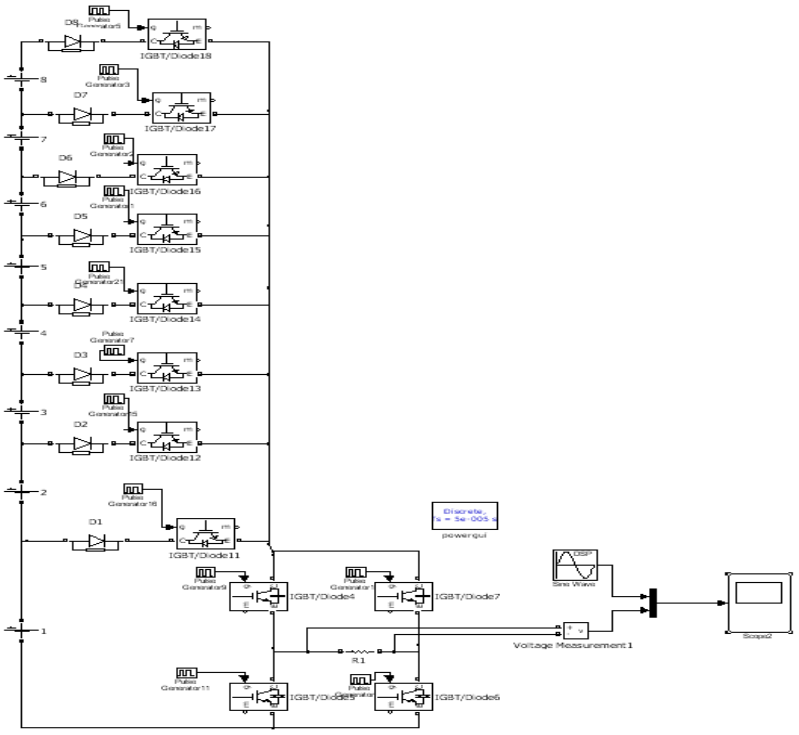

Figure 1 – Simulation model of the eight levels of inverters

For example, at 8 - the level of voltage of 28,2% and at 13 – the level of voltage of 30,5%, and at 26 – the level of voltage of 31,7%. Apparently from calculation, economy of expensive solar batteries essential if to consider that the cost of solar batteries makes the most part in system of transformation of energy "solar batteries – the switchboard – the inverter – loading".

Results of modeling confirmed the principle of work of system. As solar batteries sources of a direct current were used. Results of computer modeling of the output inverter are given in figures 2 at 8 levels of tension.

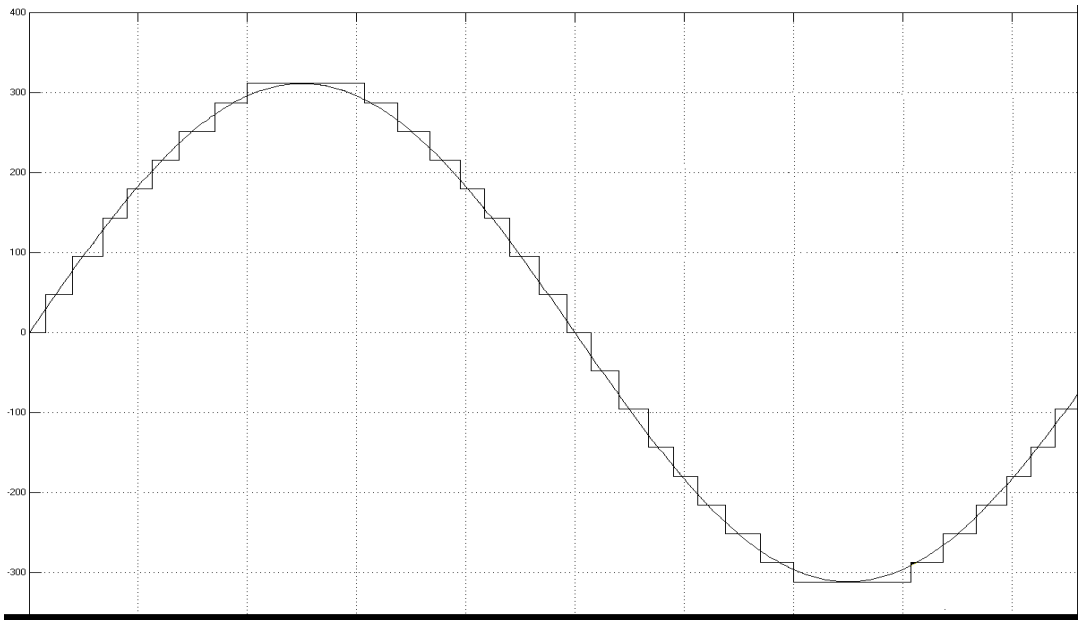

Figure 2 – Result of computer modeling the output 8-level tension of the inverter in the electric power of industrial frequency

One of parameters of quality of the electric power at the exit of the inverter is the coefficient of distortion of tension (THD), and the less its value, the output tension of the inverter closely to a sinusoid.

Apparently from schedules of tension, the number of levels of tension, the multilevel tension at the exit of the inverter closely to a sinusoid is higher. i.e. coefficient of distortion of tension (THD) not considerable. However thus the number of switching and according to loss in the switchboard increases and the scheme of management becomes complicated. The most optimum option is 13 – the-level tension at which it is possible not to use the power filter practically. As shows calculations, for the industrial frequency of 50 Hz power filters at increase of power to ten kilowatts have the essential mass-dimensional sizes (1).

Experimental research works are given. As power the key of switching is chosen the IGBT transistor (5).

The developed multilevel inverter looks as follows (figure 3).

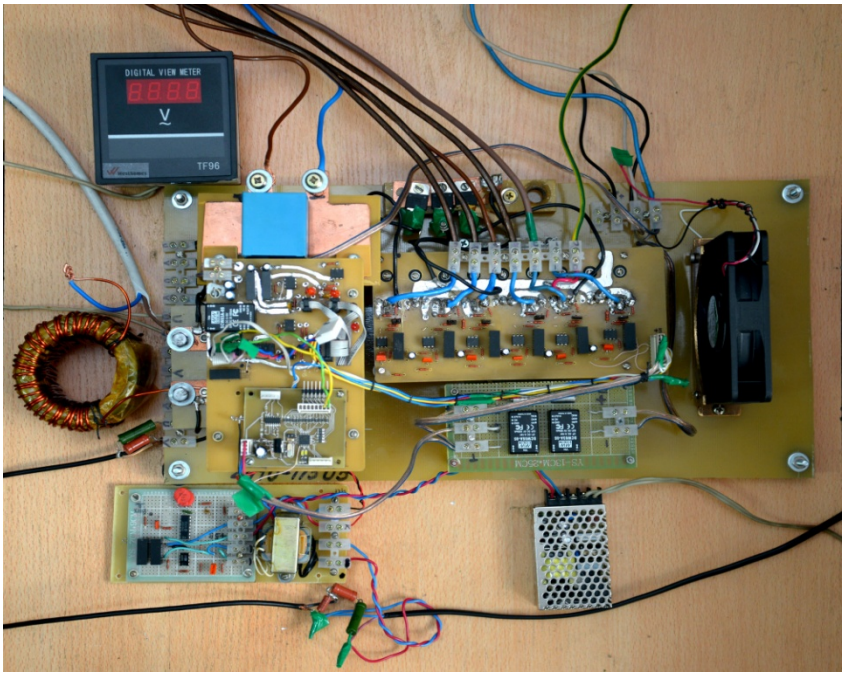

Figure 3 – Appearance of the six-level inverter on IGBT transistors

The received curve of tension was removed on an oscilloscope and given in figure 4.

In drawing - 4 the oscilloscope of output tension of the inverter (from above) and tension of an industrial network is submitted (from below). Apparently from the oscilloscope of output tension of the inverter, tension it is close to a sinusoid.

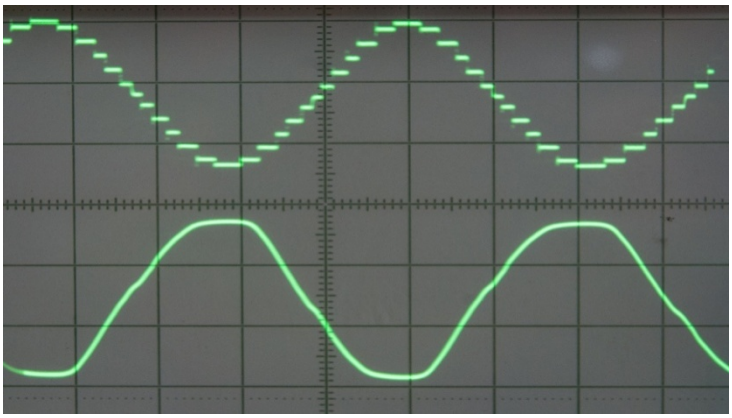

Figure 4 – Oscilloscope of output tension of the inverter (from above) and tension of an industrial network (from below)

Apparently from the oscilloscope the form of a curve of output tension of the inverter is-level, but close to sinusoidal. In addition, there is an opportunity to smooth gradualness of tension by means of filters. Further on the basis of results of modeling and the made pilot study when transforming energy of solar elements development and research of the three-phase multilevel inverter is planned.

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IGBT ТРАНЗИСТОРЛЫ КӨПДЕҢГЕЙЛІ ИНВЕРТОР АРҚЫЛЫ КҮН БАТАРЕЯСЫНАН АЛЫНҒАН ЭНЕРГИЯНЫ ЭЛЕКТР ЭНЕРГИЯҒА ТҮРЛЕНДІРУ

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Тірек сөздер: инвертор, транзистор, IGBT, күн элементі, Матлаб, түрлендіргіш.

Аннотация. Ғылыми мақалада күн батареясынан алынған энергияны электр энергиясына түрлендіретін көпдеңгейлі IGBT транзисторлы инвертор зерттелген. Көпдеңгейлі инвертордың шығысында синусоидаға жақын кернеу қисығын алуға болады Модельдеу нәтижесінде алынған шығыс кернеулерінің синусоидаға жақындығы талданды. Жалпы негізгі өзекті мәселе күн батареяларынан алынатын энергияны сапалы өндірістік жиілікпен, синусоидаға шамалас кернеу қисығын алатын көпдеңгейлі инверторды зерттеу және жетілдіру. Жұмыста компьютерлік модельдеу және эксперименттік талдау нәтижелері көрсетілді.

МНОГОУРОВЫЙ ИНВЕРТОР НА IGBT ТРАНЗИСТОРАХ ДЛЯ ПРЕОБРАЗОВАНИЯ ЭНЕРГИИ СОЛНЕЧНЫХ БАТАРЕЙ

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Ключевые слова: инвертор, транзистор, IGBT, солнечный элемент, Матлаб, преобразователь.

Аннотация. В данной статье исследован многоуровневый инвертор на IGBT транзисторах для преобразования энергии солнца в электроэнергию. На выходе многоуровневого инвертора можно получить напряжение, близкое к синусоидальной форме. Проведен анализ полученных выходных кривых напряжения на синусоидальность. Основная задача данного инвертора преобразование солнечной энергии в электроэнергию промышленной частоты. Приведены результаты компьютерного моделирования и экспериментального исследования.

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