Development inverter FET together with Solar Panels

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ABSTRACT
In this paper we study the system of “solar photovoltaic - inverter - load” with microprocessor control to convert energy derived from solar photovoltaic, to AC power frequency. Proposes to develop transistor inverter to convert solar energy into electricity solar cells power frequency of single-phase and three-phase voltage. System when converting the DC voltage obtained from solar photovoltaic, an AC voltage, providing high quality, energy saving and low cost of conversion.

INTRODUCTION

In 1956 Uhlir and Turner first described the formation of porous silicon layers on silicon[1]. The efficiency was much higher than in bulk Si caused a flurry research [2]. Thus, this material has become popular among scholars and includes variety of applications. Canham, and others [3] have suggested that the bulk Si can be made micro porous (pore width ≤ 20 nm) and mesa porous (pore size of 20-500 nm) or macro porous (pore size > 500 nm), depending on etching conditions photo electrochemical etching using distillation character semiconductor / liquid compound; backlight increases the etching rate of n -Si[4]. Thönissen et al [5] have shown that irradiation of the sample Si during or after the etching process, as is known , has a free parameter etching, which can be used to change the P-Si layer morphology. For fixed parameters, can be attributed to the first result that the thickness is a linear function of the wavelengthpower of light used. Macro poros layer formedin N-type silicon wafer under illumination due to the fact that the nano-porous layer after several micrometersis formed, the light is not completely deep layersand hence macro porous layerformed in the dark. [6, 7, 8, 9, 10].

With the worsening of the world’s energy shortage and environmental pollution problems, protecting the energy and the environment becomes the major problems for human beings. Thus the development and application of clean renewable energy, such as solar, wind, fuel cell, tides and geothermal heat etc., are getting more and more attention. Among them, solar power will be dominant because of its availability and reliability. As predicted by [11], the solar will provide the electricity up to 64% of the total energy by the end of this century.

Photovoltaic (PV) power generation has become one of the main ways to use solar energy. And the renewable energy source based distributed generation (DG) system are normally interfaced to the grid through power electronic converters or inverters [12].

Thus developing a photovoltaic grid-connected inverter system is important for the mitigation of energy and environmental issues. Photovoltaic (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. The basic PV cell model is presented [13].

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Because photovoltaic devices generate direct current electricity with its unique IV characteristics, power electronics are required to help convert its maximum power for different applications. The typical applications include PV power plants, residential PV, building integrated PV (BIPV) and PV lighting. For PV power plants, one or several centralized inverter up to 1 MW is required to convert the DC power to AC power. For residential PV, a string type inverter between 1 kW and 10 kW or many micro-inverters are required to converter the power. The residential PV application utilizes either a standalone system or a grid-tied system. Stand-alone system is always used for some remote area. In this system, the outputs of power converters or inverters connect to the local load instead of connecting to the grid. Batteries are required to store the energy for night consumption [14]. In grid-tied system, the outputs of power converters or inverters connect to the grid directly. BIPV means that PV materials are used to replace conventional building materials in parts of the building envelope such as the roof, skylight, or facades [15]. In this application, a converter is required for each panel for energy conversion [16]. And in lighting application, a converter is normally required for each panel to charge a battery for powering lamps at night [17].

Methodology:
At present modern society pays great attention to renewable energy sources (RES), in particular, the conversion of solar energy, since these sources are an alternative to existing sources of energy and solve a number of environmental problems.

Kazakhstan is one of the last places in the world for the use of renewable energy sources. The share of electricity produced from renewable energy sources does not exceed 1% of the total electricity generated. This leads to the fact that the problem of the development of renewable energy sources is becoming increasingly important.

With increasing power increases the cost of all the equipment, so the conversion of solar energy systems to be energy efficient and have a high value of efficiency, weight and size have a small size and cost. Conversion of solar energy system should be constructed so that when converting the DC voltage obtained from solar photovoltaic, an AC voltage, providing high quality, energy saving and low cost of conversion. Therefore, the actual problem is the creation of energy-efficient converters of solar energy to AC power frequency and good quality.

The aim is to develop a system of “solar photovoltaic - inverter - load” with microprocessor control to convert energy derived from solar panel to AC power frequency.

Energy conversion in solar cells based on the photoelectric effect, which occurs in inhomogeneous semiconductor structures when exposed to sunlight.

Heterogeneity structure FEP can be obtained by doping the same semiconductor various impurities (creating p-n junctions), or by connecting the various semiconductors with unequal band gap - the energy of electron detachment from the atom (the creation of heterojunctions), or due to changes in the chemical composition of the semiconductor, resulting in the appearance of the gradient width band gap (the creation of graded-gap structures). There are also various combinations of these methods.

Conversion efficiency depends on the electrical characteristics of an inhomogeneous semiconductor structures, as well as the optical properties of solar cells, among which the most important role is played by the photoconductivity. It is due to the internal phenomena in semiconductors irradiated by sunlight.

Major irreversible losses of energy in the solar cells are connected with:
• reflection of solar radiation from the surface of the transducer,
• passage of the radiation through the FEP without being absorbed in it,
• scattering by thermal vibrations of the lattice of the excess energy of photons
• formed by recombination of photo-pairs on surfaces and in the amount of solar cells,
• the internal resistance of the inverter,
• and some other physical processes.

Theoretical analysis:
On the development of E.M. Romash and others [18], proposes to develop transistor inverter to convert solar energy into electricity solar cells power frequency of single-phase and three-phase voltage. These converters are protected by patents in the Committee on Intellectual Property Rights of the Ministry of Justice of the Republic of Kazakhstan.

Were 1-Wide pulse modulator, 2- voltage regulator, 3,4-field-effect transistor, 5-capacitor, 6-diode bridge, 7-the transformer, 8-circuit input voltage switch, 9-the body

The apparatus consists of the following element. Wide pulse modulator- controller controls the width of pulses 1, connected through a voltage regulator 2 and the capacitor 5, for filtering and limiting the input voltage, followed by connection of the FETs 3, 4 and bolted to the passive cooling, to prevent heat, and the parallel connection of the secondary winding of the transformer 7, the primary winding is connected directly with a diode bridge 6, connecting to the circuit input voltage switch 8. c, followed by the location in the body 9. [19]
Fig.1: Inverter FET.

The method of calculation and selection of batteries for storing solar energy. Rechargeable batteries can be connected both in series and in parallel. When connecting the voltage levels are summed, while simultaneously connecting the currents add up. The general form of a compound of the batteries has a stepped shape.

Each battery can be regarded as an element of a certain matrix. When step connection will be used in series and parallel-connected batteries, which consist of the following matrices corresponding to the number of stages.

$$A_n = A_1 + A_2 + A_3 + \ldots + A_n$$

Were $A_1$, $A_2$, $A_3$……$A_n$ – matrices corresponding to each stage.

Total battery voltage at each stage of power:

$$U_m = U_0 \sum_{i=1}^{m} b_i$$

где $U_0$ – the base voltage of the battery;

$\sum_{i=1}^{m} b_i$ – the number of series-connected batteries in the system storage.

Capacity of one battery is defined as:

$$C = I \times t$$

где $t$ – battery time.

Then the current one battery is:

$$I = \frac{C}{t}$$

Total current speed of the storage system is determined by the following formula:

$$I_{\text{sum}} = \frac{N_i}{t} \sum_{i=1}^{N_i} n_i$$

где $C$ – basic capacity of the battery;

$N_i$ – the number of parallel-connected batteries in the i-th stage.

The total capacity of all batteries in the system storage is:

$$P_{\text{sum}} = U_0 \times I_{\text{sum}}$$

$$P_{\text{sum}} = U_0 \frac{N_i}{t} \sum_{i=1}^{N_i} n_i$$
The required total number of batteries involved in the system storage is determined by the following expression:

\[ N = \sum_{i=1}^{k} n_{i} = \frac{P_{\text{in}}}{C_{i}U_{i}} \]  

(12)

Conclusions:

By the developed technique of rational use of solar photovoltaic were calculated for the three-phase conversion system at different inversion schemes. According to the calculations, it was found that the three-phase conversion system can save from 18.5% to 35.19% of expensive solar photovoltaic.

1- Output speed voltage curve; 2-ideal sinusoidal curve

Fig. 2: Output voltage models.

The use of multi-stage converters that allow you to save the amount of solar photovoltaic by 38.8% with a single-phase, three-phase system and transformation - from 18.5% to 35.19% and reduce the weight and size dimensions of the system conversion. Developed and described the new control algorithms multi-stage single-phase and three phase transistor inverters provide the most efficient operation of transistors and output allow to obtain a sinusoidal voltage curve.

REFERENCES


