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RESEARCH AND DEVELOPMENT OF ACS OF SOLAR CELLS TRACKING THE SUN USING STEPPER MOTORS AND SOLAR POSITION SENSORS

The analysis of studies has shown that in order to create an energy-efficient APCS of electric power generation in autonomous photovoltaic power units (APU) of 3-5 kW capacity, it is necessary to develop structural and functional schemes of the tracking system with a two-coordinate electromechanical actuator with a SM and a two-coordinate sensor of the Sun's position. The solar tracking system should provide multi-mode, self-diagnostics, communication and control with an external operator in emergency modes. At the same time, the tracking control system should ensure the specified accuracy of the SB tracking of the Sun while minimizing the electrical energy consumed by the two-coordinate electromechanical actuator with a rod for the SB tracking of the Sun [1].

When developing the functional and structural scheme of the tracking control system for autonomous photovoltaic power units (APU), the following shall be used:

– modern photovoltaic panels (SB) with high technical and economic performance;

– a specialized tracking controller that ensures the functioning of the mechanism of continuous-discrete tracking of the autonomous photovoltaic power units (APU) to the Sun with a given accuracy, realizing asymmetric positioning mode and control of peripheral devices with diagnostics of the whole system;

– battery charge controller with realization of the maximum power extraction mode with SB;

– a two-coordinate photoelectric sensor of the Sun's position with high sensitivity to ensure high tracking accuracy of the autonomous photovoltaic power units (APU);

– SM to provide the specified motion in both coordinates;

– power drivers of the drive having the ability to control the current amplitude, regulate the movement step, realize the micro-step mode, current and voltage protection;

– maintenance-free batteries with a high number of charge-discharge cycles without loss of capacity, with a capacity value designed for a given consumer;

– converter for communication of the tracking controller with the external computer, having optical isolation;

– single-phase inverter with sinusoidal output for powering consumers;

– worm gearboxes combined with spur gearboxes to provide the necessary torque to rotate the frame with the SB and to hold the frame under wind load when the motor is switched off;

– limit switches, providing limitation of frame movement on two coordinates and possibility of frame transfer to horizontal position;

– GPRS - communication module for remote control of autonomous photovoltaic power units (APU) in case of extreme conditions [2].

Taking into account the above, the functional scheme of the autonomous photovoltaic power units (APU) power generation automated control system was developed, shown in Figure 1. The following designations are adopted in the functional scheme: SB - solar batteries (consisting of several photovoltaic panels); STC - solar tracking controller; MCD1, MCD2 - stepper motor control drivers; S1, S2 - sensors of the Sun position by azimuth and angle of place; LS1–LS5 - limit switches; M1, M2 - stepper motors; R1-R4 - reducers; CCB - battery charge controller; I - inverter; B1, B2 - batteries, converter (type I-7561) - computer communication device with controller via RS485 channel; GPRS - communication unit with GPRS channel.

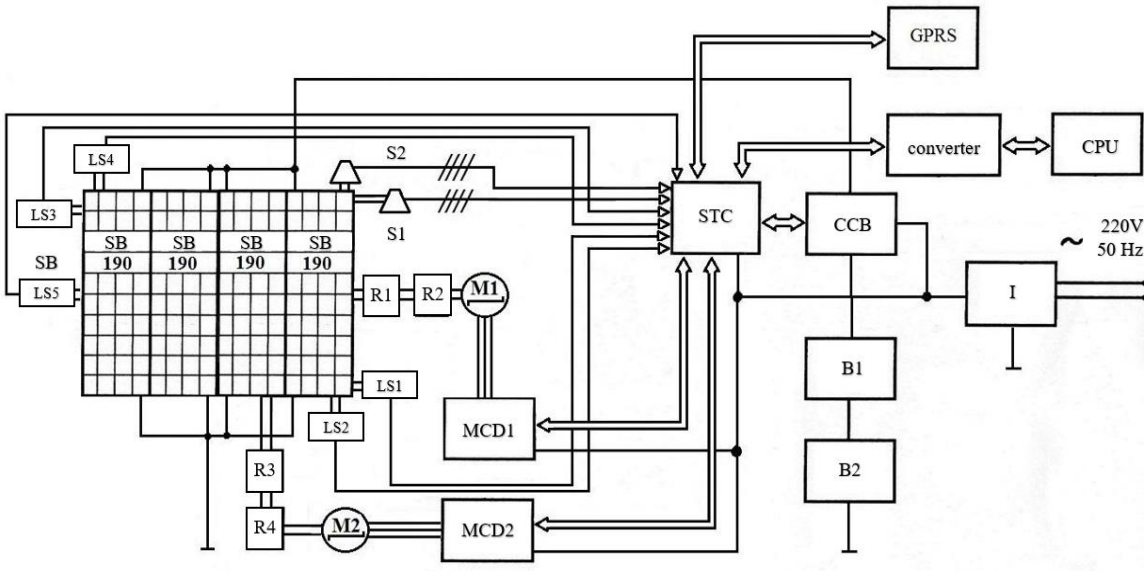

Figure 1 - Functional scheme of the APCS power generation control system

The use of data and commands received and transmitted via GPRS module in the control of autonomous photovoltaic power units (APU) provides realization of man-machine system. This realizes control over the state of the autonomous photovoltaic power units (APU) system by means of diagnostics of the whole system and sending a message to the operator (company servicing the autonomous

photovoltaic power units (APU)) in case of a malfunction in the autonomous photovoltaic power units (APU) system.

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ДОСЛІДЖЕННЯ ТА РОЗРОБКА СИСТЕМИ АВТОМАТИЧНОГО КЕРУВАННЯ ПОЛОЖЕННЯМ СОНЯЧНИХ ПАНЕЛЕЙ, ЩО СЛІДКУЄ ЗА СОНЦЕ НА ОСНОВІ КРОКОВИХ ДВИГУНІВ ТА ДАТЧИКІВ ПОЛОЖЕННЯ СОНЦЯ

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