Department of Semiconductor and Optoelectronic Devices

Optoelectronics laboratory

Exercise 6

Off-grid photovoltaic system

1 Theory

1. INTRODUCTION AND LAOBARATORY SETUP.

Small photovoltaic off-grid systems are typically a combination of auxiliary power supply system (UPS) with classical photovoltaic plant. Contrary to typical UPS systems Solar UPS are equipped with build-in energy source (solar cells) used for recharging batteries, which makes them more reliable in emergency applications. Autonomous PV systems may be also configured to cooperate with other auxiliary power supply like diesel generators, wind turbines, fuel cells or even utility grid.
For safe and efficient cooperation with optional cooperation with utility grid is supervised by algorithm, used for monitoring of grid resistance and voltage fluctuations. For laboratory purposes small off-grid system depicted in Fig 1 was built.

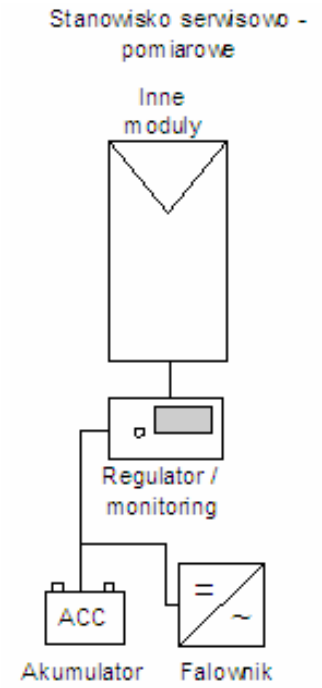

Fig 1Scheme of small off-grid PV system, used in Photovoltaic Laboratory .

2. SYSTEM ELEMENTS.

In off-grid systems electric energy is typically stored in gel-type battery. Proper battery should present sufficient capacity, long-term stability and low price. As an additional element charge controller is attached. It's main

role is to protect battery against overload and complete discharge as well as provide the system load with sufficient amount of energy. When standard AC equipment is supplied by small off-grid system DC/AC converter is additionally utilized.

In this case the battery is the most import ant part of the system, since the maintenance costs and efficient functioning of the whole installation is up to the battery performance. Solar installation battery should be able to work permanently in harsh environment conditions, including various ambient temperatures, deep discharge and irregular recharge cycles. Solar Power Stations are typically equipped with batteries adjusted by tape and capacity to the specific system application. Even though the higher purchase costs this type batteries are necessary for long-term system operation.
Mai functions of the charge regulator is the monitoring of the electric energy flow, however more advance regulators are also able to control battery temperature and capacity or monitor the dawn-dusk trigger in light systems. The operation of the regulator may not be disturbed by the instable energy supply and may not cause disturbances in supplied equipment as well. Thus all regulators are tested according to EMC rules.

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3. PARAMETERS OF LABORATORY SETUP:

PART	PARAMETRS
MODULE: SF-115 A, SOLARFABIRIC	**polisilicon; 115Wp (5%); 12V; 6,7A; weight 11,5 kg,**
Battery:8G8D-12	**Capacity C-20; 225 Ah, voltage: 12V, gel-type**
Charge controler: RSS-02 Steca	**Voltage: 12V, current 15A, load: battery, LED status indicator**
LOAD	**DC/AC converter 250W, bulb**

4. THE EXERCISE

4.1 Practical part

Measurements of charge controller input voltage and current should be done by the help of digital multimeter. Multimeter probes should be attached in track of **Module** input of charge cotroller (current - in serial mode, voltage – in parallel mode). Compare obtained results with LED indicator status.

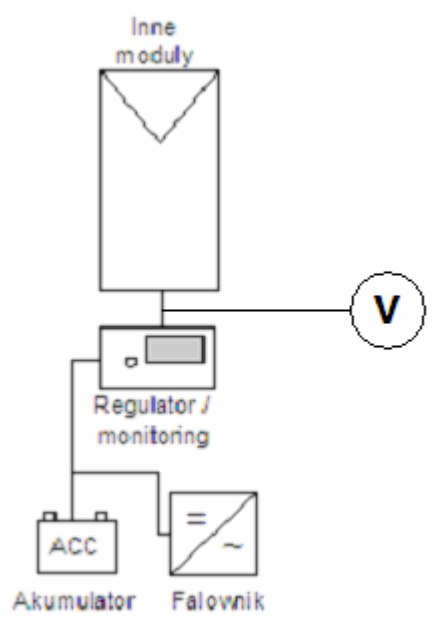

Fig 2 Measurements of PV module voltage/current

Measurements of charge controller output (**DC/AC converter in idle status**) voltage and current should be done by the help of digital multimeter. Multimeter probes should be attached in track of **Load** output of charge cotroller (current - in serial mode, voltage – in parallel mode). Note that battery should be attached during the whole course of this point of exercise!

Measurements of charge controller output (battery) voltage and current should be done by the help of digital multimeter. Multimeter probes should be attached in track of **Battery** output of charge cotroller (current - in serial mode, voltage – in parallel mode). After finishing of this point disconnect Battery (by the help of supervisor !) and measure disconnected battery voltage.

Measurements of charge controller output (**working DC/AC converter**) voltage and current should be done by the help of digital multimeter. Multimeter probes should be attached in track of Load output of charge cotroller (current - in serial mode, voltage – in parallel mode). DC/AC converter should be charged with electric bulb with regulated output power (as the supervisor). Measure charge controller output voltage and current for each level of bulb power (1/3 Pmax, 2/3 Pmax, Pmax). Use 3 different types of electric bulb (100W, 60W, LED). Note that battery should be attached during the whole course of exercise!

Each measurement should be performed 3 times and the average values should be presented in digital nad graphical form.

3 Report

In the report all results and conclusions should be presented. Obtained outcomes should be compared with equipment designers and current weather condition parameters.