Studies on Fabrication and Performance of Solar Modules for practical utilization in Bangladeshi Climate

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Abstract

This paper indicates the solar module assembling and utilization under Bangladeshi climate. Solar irrigation works have been conducted using these solar modules assembled in Bangladesh. After irrigation this solar modules have been used also for vegetables field under Bangladeshi climate. It is found that the efficiency and the Fill Factor(FF) of the solar module is 18.04% and 77.46 under the Bangladeshi climate. Finally it is concluded that the assembled solar module is feasible and viable for practical utilization in Bangladesh.

Keywords*: Fabrication, Solar module, Assembling, Utilization, Bangladeshi Climate.*

Introduction

Solar cell is the building block of the solar photovoltaic system. Solar cell is the smallest part of the solar module. After imported the solar cell solar module was assembled and fabricated in Bangladesh. The main components of the solar cell are the rectifier diode. These diodes are connected in series in a unit solar cell [1-10]. Then one or more unit cells make a solar module. Under the climatic conditions of Bangladesh the open circuit voltage, short circuit current, maximum power, useful current, useful voltage and maximum power point tracking, Fill Factor and conversion efficiency have been studied for solar module [11-21].

II. Methods and Materials

A solar water pump was used for irrigation and vegetative & fruits field. The change of the solar cell has been occurred before and after the use of solar cell [22-29].

II A Practical application of solar cell for irrigation and Vegetable field:

Fig.1 Apparatus for solar module assembling for practical utilization under Bangladeshi climatic condition.

It is shown in Fig.1 that the instruments for making a solar module. Polymer sheets are used for covering the unit cell firstly and then module[30-41]. This polymer sheets save the unit cell and module from the environment [42-50].

Fig.2 Solar module assembling for practical utilization under Bangladeshi climatic condition.

It is shown in Fig.2 that the instruments for making a finish product of the solar module. An electric heater is used for making the fished module. Polymer sheets are used for covering the unit cell firstly and then module. This polymer sheets save the unit cell and module from the environment [51-60].

Fig.3 Solar module uses at Bangladeshi climatic condition

It is shown in Fig.3 that the solar module as a finished product. This modules have been used for practical utilizations for irrigation and for vegetative and fruits field [61-69].

Fig.4 I-V characteristics measurement for solar module under Bangladeshi climatic condition

It is shown in Fig.4, the way of I-V
Characteristics by the help of the computer. The modules are outside the room and it was connected to the computer with data logger. The I-V characteristics curve have collected from sun rise to sunset.

II. B. Define different Parameters:

i) Open circuit voltage : The voltage without load is called Open circuit Voltage. Generally, it is denoted by V_{oc}.
ii) Short circuit current: The current without load is called short circuit current. Generally, it is denoted by I_{sc}.
iii) Fill Factor (FF):
It **is** defined as**,** FF = $(V_mI_m) / (V_{oc}I_{sc})$, where, V_m = Useful voltage, I_m = Useful current, V_{oc} = Open circuit Voltage, I_{sc} = short circuit current[51-62].
iv) Convesion efficiency (η_c):
It is defined as, Conversion efficiency, $\eta_c = (V_mI_m) / A_cI_b$, where, V_m = Useful voltage, I_m = Useful current, Ac = Collector area(m^2), I_b = Beam radiation (w/m^2).
II.C Description of solar cell, module, panel, array:
Solar Cell: It is the building block of a solar cell. In a solar cell some rectifier diodes are in parallel connection. The standard open circuit voltage of the solar cell is 0.5 volt. The short circuit current of a solar cell = 0.5 A. The standard temperature of a solar cell= 25^0C. The standard pressure = 1 atm pressure= 760 mm Hg pressure [70-73].
Solar module: One or more than two cells make a solar module. It can be connected in series or parallel by solar cells.
Solar Panel: One or more than two modules make a solar panel. In a panel solar module can be connected by the series or parallel combination.
Solar Array: One or more than two panels make a solar array. A SPV Array is made up of PV modules, which are environmentally-sealed collections of SPV Cells - the devices that convert sunlight to electricity. The most common SPV module that is 5-to-25 square feet in size and weighs about 3-4 lbs./ft^2. Often sets of four or more smaller modules are framed or attached together by struts in what is called a panel. This panel is typically around 20-35 square feet in area for ease of handling on a roof. This allows some assembly and wiring functions to be done on the ground if called for by the installation instructions[74].
Balance of system equipment (BOS): BOS includes mounting systems and wiring systems used to integrate the solar modules into the structural and electrical systems of the home. The wiring systems include disconnects for the dc and ac sides of the inverter, ground-fault protection, and over current protection for the solar modules [75]. Most systems include a combiner board of some kind since most modules require fusing for each module source circuit. Some inverters include this fusing and combining function within the inverter enclosure.

DC-AC inverter: This is the device that takes the dc power from the PV array and converts it into standard ac power used by the house appliances.
Metering: This includes meters to provide indication of system performance. Some meters can indicate home energy usage.
Other components: Utility switch (depending on local utility).

II D SPV Electrical System Types:
There are two general types of electrical designs for PV power systems for homes; systems that interact with the utility power grid and have no battery backup capability; and systems that interact and include battery backup as well [76-85].

II E Grid-Interactive Only (No Battery Backup):
This type of system only operates when the utility is available. Since utility outages are rare, this system will normally provide the greatest amount of bill savings to the customer per dollar of investment. However, in the event of an outage, the system is designed to shut down until utility power is restored [86-95].

II F Standard solar cell condition: The standard state condition of a solar cell is: The standard open circuit voltage of the solar cell is 0.5 volt. The short circuit current of a solar cell = 0.5 A. The standard temperature of a solar cell = 25^0C. The standard pressure = 1 atm pressure = 760 mm Hg pressure[96-110].

III. Results and Discussion with Graphical Analysis:

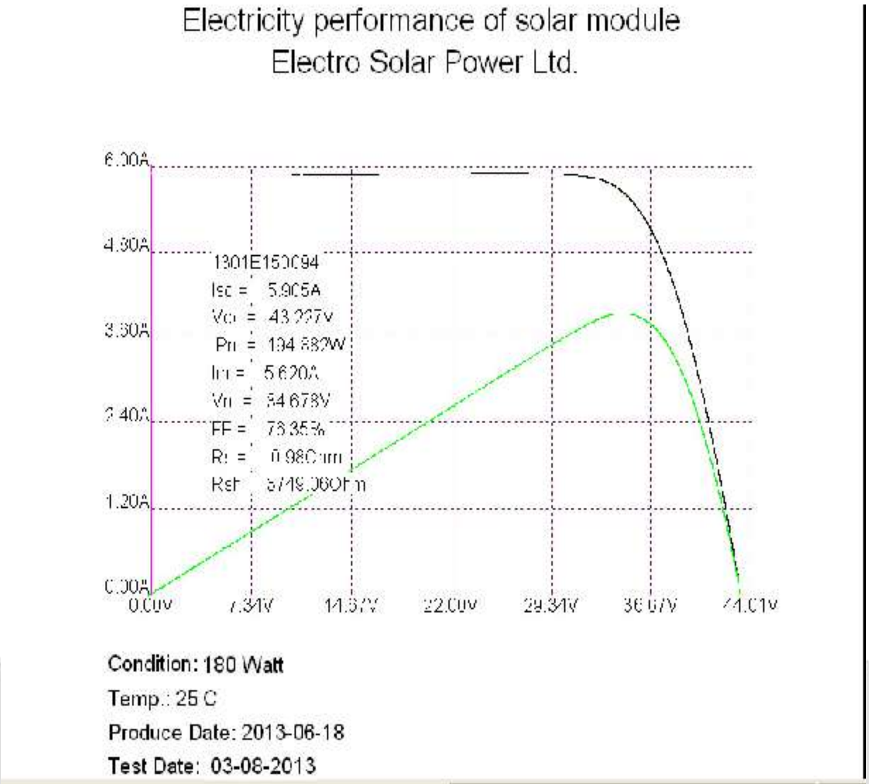

Fig.5 Ideal I-V curve for an ideal solar module-1

It is shown (Fig.5) the I-V curve after use of the solar module-1 it has been damaged by anyhow. The I-V curve (Fig.5) deviated the ideality due to damage of the solar cell. The Fill Factor (FF) = 75.30 %

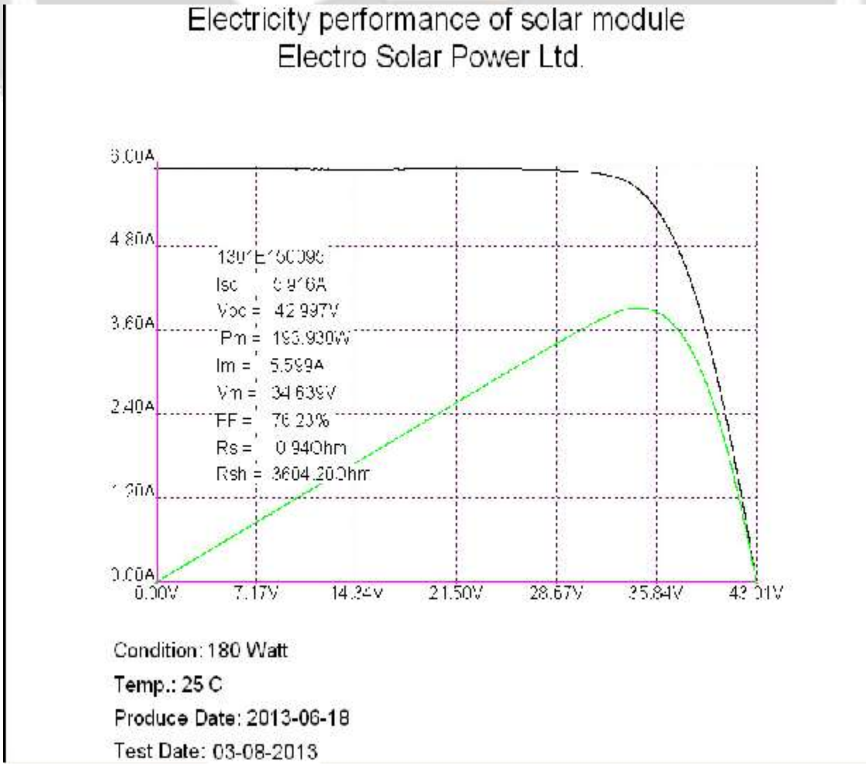

Fig.6 Ideal I-V curve for a non-ideal solar module-2

It is shown (Fig.6) the I-V curve after use of the solar module-2 it has been damaged by anyhow. The I-V curve (Fig.6) deviated the ideality due to damage of the solar cell. The Fill Factor (FF) = 74.23 %

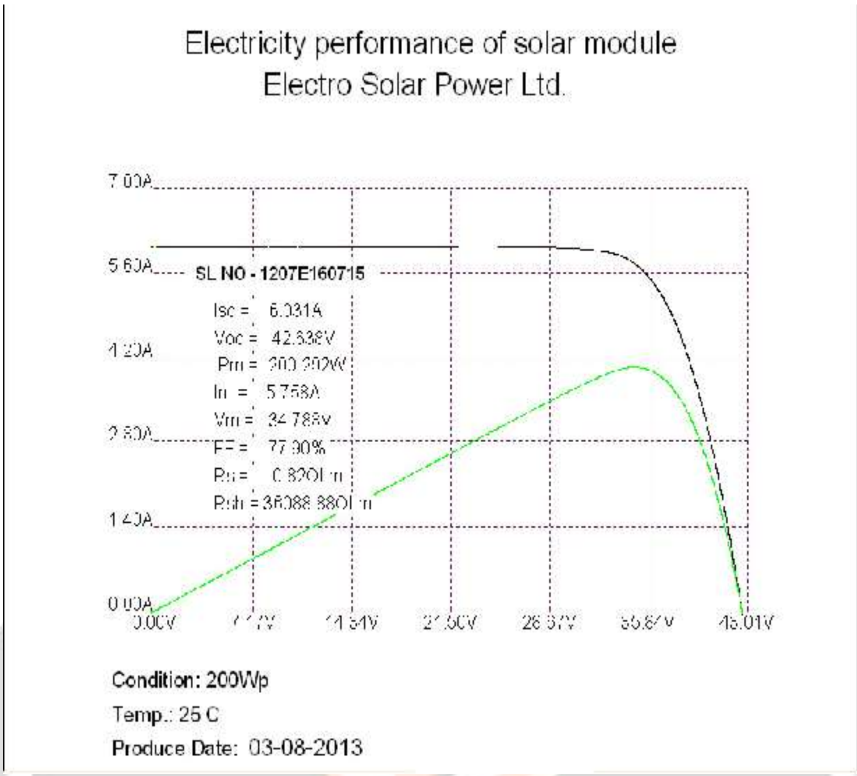

Fig.7 Ideal I-V curve for non-ideal solar module-3

It is shown (Fig.7) the I-V curve after use of the solar module-3 it has been damaged by anyhow. The I-V curve (Fig.7) deviated the ideality due to damage of the solar cell. The Fill Factor (FF) = 77.13 %

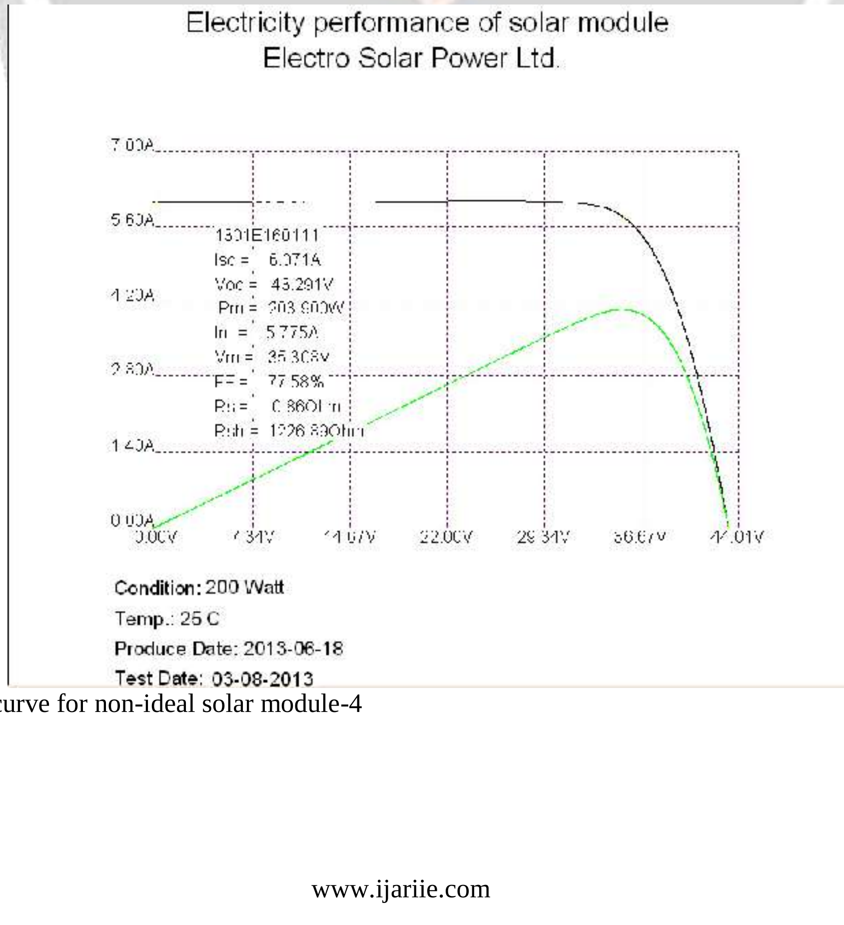

Fig.8 Ideal I-V curve for non-ideal solar module-4

It is shown (Fig.8) the I-V curve after use of the solar module-3 it has been damaged by anyhow. The I-V curve (Fig.8) deviated the ideality due to damage of the solar cell. The Fill Factor (FF) = 77.58 %

Finally, it is shown that where FF was higher, then the conversion efficiency also higher. Therefore it can be said that there is a correlation between FF and conversion efficiency (η_c) of a solar module [111-125].

IV. Conclusion

Solar photovoltaic electricity depends on solar radiation. Bangladesh is located in fine places where solar radiation falls nicely for solar Photovoltaic system[126-135]. It is concluded that SPV system can be utilized for all months of the whole year. So that SPV system is feasible and viable for the agricultural activities under Bangladeshi climate. But sometimes it is shown that due to shadow effect sola cell became damage and as result the conversion efficiency and the FF became lower than the ideal value. So that finally, it is concluded that the solar cell should be set up in a proper places where shadow effect is totally absent for getting better performances[136-141].

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