The effect of solar cells distribution on the Performance of solar panel

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Abstract:

Three different distribution modules of silicon solar cells in a panel are used in this study . Each module consists of five identical circular silicon solar cells of radius (5cm) and then the total panel areas are identical. The five solar cells are arranged in the panel in different shapes: circular, triangular and rectangular .The efficiency for these three panel distribution are measured indoor and outdoor. The results show that the efficiency is a function of the cells distribution.

Key word: Solar cell, cell distribution, panel efficiency.

Introduction:

Large solar panel can be synthesized by individual solar cells. The panel consists of a group of cells combined to produce a large sensitive area. The strong advantage multiple cells configuration is that they provide an alternative to the difficulties of fabricating very large high quality solar and low cost cells[1,2]. The distribution of the cells in panel can provide excellent performance using symmetric solar cell distribution.

The second array advantage in geometrical one. Array can be arranged into configuration that significant more compact than equivalent diameter panels. The third advantage is that the different configuration of solar cell gives different performance and the intensity of the panel is the summation of the intensity of the individual cells and it depends on the diameter of the cells and the distance between their centers. This total intensity is shown in the following relation, [3]

$$I(\rho) = I(\rho)\sum_{n,m=1}^{N} e^{ik(Dn-Dm)(\frac{ik\rho(Xn-Xm)}{R})}$$

Where I_1 (p) represent the individual cell intensity,
K wave number
m , n are integer
N is the total cell number in a panel
D diameter of the cell
X the distance between the cell centers
R aim point range

Materials and Methods:

As shown in fig (1-a ,b, c) three modules of panel consisted of five identical silicon solar cells of radius (5cm) connected in series through aluminum strips . Total area of the panel is (1349 cm) and active area of silicon solar cells is (392.699cm). Xenon lamp is used as artificial source of light supplied by Pasan company (flasher test-rev 181\89)it gives intensity of one-sun (1000w\m). (Current-Voltage) characteristic of the panels are drown using a special program with computer(Hp-hewlett , Packard 85b).

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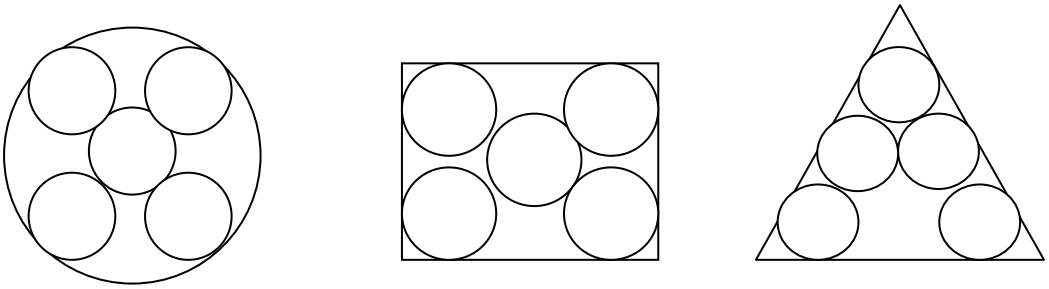


a-Circular distribution **b- Rectangular** **c-Triangular**

Fig.(1): Three different solar cell distributions in a panel

Also another indoor measurement done in laboratory using projector from Philips Company and measurement were made at a suitable distance from the projector, where light beams could be regarded as parallel and cover all the area of the cells (see figure ,2),

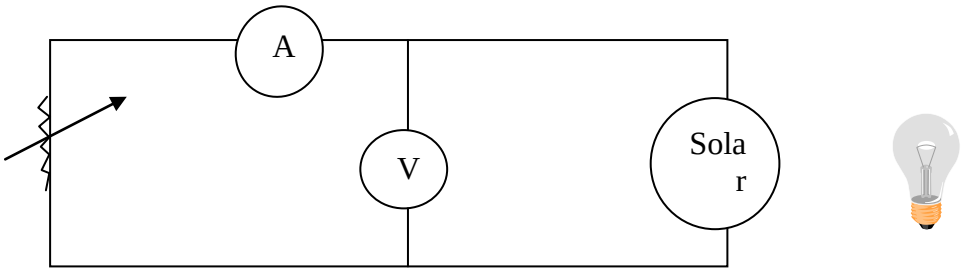


Fig. (2): I-V characteristic circuit diagram

Outdoor measurement also done the intensity of the sun radiation is (537w\m^2) measured by using solar intensity meter (118 from instruments HAENNI MESSGERATE). Current and voltage are measured using (7045) digital multi-meter supplied by electron Plan Company. The temperature of solar cell was measured by digital thermometer model (2754-p.t 100)

Discussion:

Indoor and outdoor efficiency were measured. For indoor, the first way was by using Xenon lamp, figure (3-a,b,c), indicate that the efficiency are 10.55% for the circular shape ,while it is 10.26% and 9.78% for rectangular and triangular cell distribution shape in a panel respectively .

The second way was by using projector. Figure (4) shows the efficiency are 8.4% ,7.323 and 5.03% for circular, rectangular and triangular cell distribution respectively .

For outdoor the panel exposed directly. Figure (5-a,b,c) shows the efficiency are 14.915% ,13.65 and 12.6% for circular, rectangular and triangular cell distribution respectively. These differences in results are caused since the distance between cells centers are depend on the shape of the cell distribution in a panel[4,5].

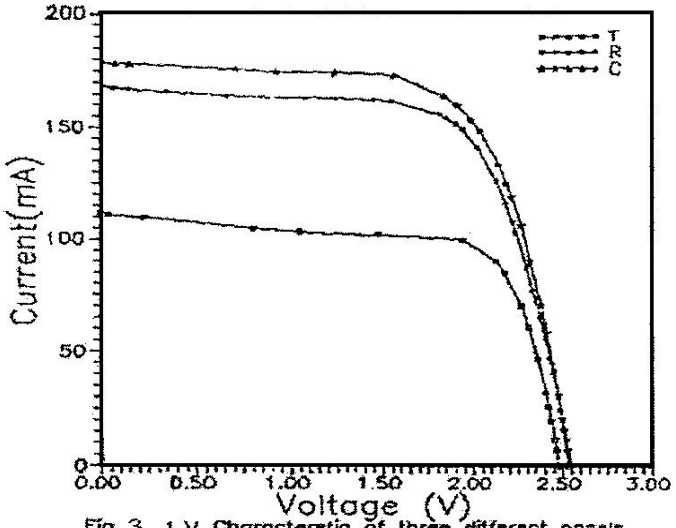
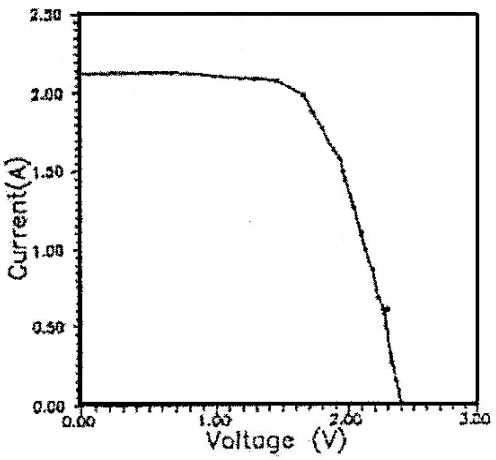


Fig. 3 I-V Characteristic of three different panels measured in libratory .



Fig(4-a)I-V Characteristic of circular panel under the sun .

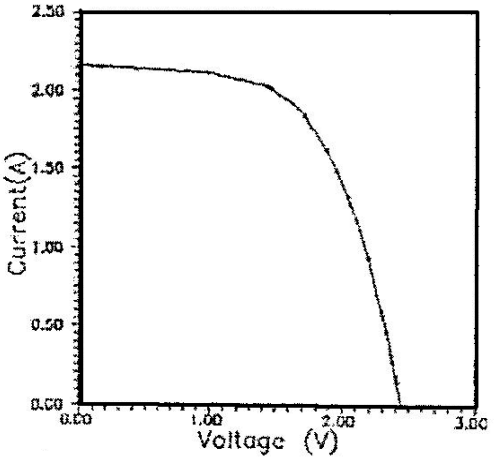


Fig (4-b) I-V Characteristic of rectangular panel under the sun .

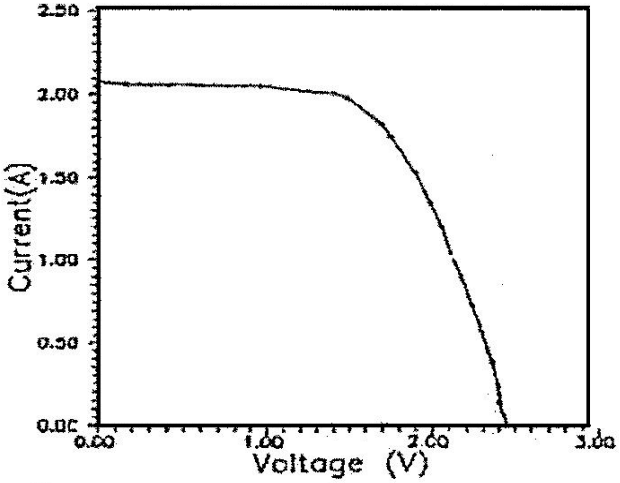


Fig. 4-C I-V Characteristic of triangular panel under the sun.

References:

1- Songyuan Dai, Kongjia Wang,Jian Weng,and Yifeng Yui, 2005, "Design of DSC panel with efficient more than 5%",Solar energy materials and solar cells, 85(3),: 447-455.

2- Reynolds G.O,and Develies .B., 1989,"The new physical optics ,Fourier optics" Applied optics, 28(8):1444.

3- Songyuan Dai, Jian Weng,and Yifeng Yui,2008," The Design and outdoor application of DSC solar cells", J. of photochemistry and photobiology A; Chemistry ,164(1-3),: 203-207.

4-Townsend, S.S and Palma G.E., 1986, "Performance and phasing of multi synthestic apertures",SPIE 643:208-219.

5- Baumgartner F.P,and Sutterlitti, J.,2006, "Indoor and outdoor characterization of a-Si p-i-n modules", 21th European photovoltaic solar energy conference , Germany.

تاثير توزيع الخلايا الشمسيه على اداء اللوح الشمسي

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الخلاصة:

درست في هذا البحث ثلاث اشكال من توزيعات الخلايا الشمسيه السيلكونيه في اللوح الشمسي يتالف كل تورزيع من خمس خلاياسيلكونيه متشابهه نصف قطر الواحدة منها (5سم) وبذلك تكون المساحه الكليه للماده الحساسه متساوية. رتبت الخلايا الشمسيه الخمسه في اللوح الواحد باشكال مختلفه هي الدائرية والمثلثة والستطيلة، ثم تم قياس كفائة هذه التوزيعات مختبريا وحقليا وقد اوضحت النتائج ان الكفاءة هي دالة لشكل توزيع الخلايا في اللوح الشمسي.