2020 Sofijan_2020_J._Phys.__Conf._Ser._1500_012004-Irwin Bizzy.

by Irwin Bizzy

Submission date: 24-Mar-2022 08:39PM (UTC+0700)
Submission ID: 1791787959
File name: 20_Sofijan_2020_J._Phys.__Conf._Ser._1500_012004-Irwin_Bizzy.pdf (1,019.02K)
Word count: 3728
Character count: 18102

Performance Evaluation Solar Charge Controller on Solar Power System Home-Based SPV Amorphous 80 Watt-peak.

Performance Evaluation Solar Charge Controller on Solar Power System Home-Based SPV Amorphous 80 Watt-peak.

Armin Sofijan[1], Zainuddin Nawawi[2], Bhakti Yudho Suprapto[3], Riman Sipahutar[4], Irwin Bizzy[5]
[1,2,3]Department of Electrical Engineering, Engineering Faculty, Sriwijaya University, Jalan Raya Palembang-Prabumulih Km 32 Indralaya Indonesia
[4,5]Department of Mechanical Engineering, Engineering Faculty, Sriwijaya University, Jalan Raya Palembang-Prabumulih Km 32 Indralaya Indonesia
Corresponding author's e-mail: a_sofijan@ft.unsri.ac.id

Abstract. The problem in renewable energy technology is the capacity stability, battery life and sustainability of energy supply. Similarly, it applies to solar power plant or Solar Home System (SHS). To deal with the required Solar Charge Controller (SCC), the form of electronic equipment that implements the Pulse Width Modulation (PWM) technology in the lead acid battery capacity 120 Ah to set battery charging function and current discharging from battery to load generated by solar Photovoltaic (SPV) Amorphous 80 Wp. Research has been done for systems that work well through the testing phase and data retrieval at the research laboratories. Performance SCC generates the largest current on the current panel 2.08 ampere, at 13.00 pm Use the load Head light of 10 W, 15 W, and 20 W. The load of 10 W generates a current of 0.850.92 A, at a load of 15 W generates a current of 1.23-1.26 A and on Load of 20 W generates a current of 1.77-1.79 A.

1. Introduction

Photovoltaic panels (PV panels) consist of several types, *namely* monocrystalline, polycrystalline, *and* Thin Film Solar Cell. These three types of PV panels have their own advantages and disadvantages. Moreover, the performance of the PV panel is also influenced by its own photovoltaic cell temperature when receiving solar radiation that comes to its cell surface. The higher the radiation that comes to the cell is less performance [1]. The main advantage of the PV panel compared to the energy derived from fossils can reduce global warming. Similarly, researchers [2] conducted a study on the performance of power generation systems from the PV panel. The results of the study include that polycrystalline provides maximum electrical output, minimum greenhouse gas- emissions, minimum costs for research locations in India that have different climatic conditions.

According to [3], [4] The PV panel is a new renewable energy alternative solution to replace the world's energy in the future. Meanwhile, [5] has researched various PV panel materials.[6], [7], has researched the latest PV panel materials, namely fourth generation PV panel material, mass flow and energy during production process and life cycle assessment of PV Panel technology. Ev[8] [8] Examine the current and voltage characteristics of the PV panel, namely Monocrystalline type, polycrystalline and amorphous silicon solar cells measured in the dark. The model of the equivalent two diodes is used to describe the electronic nature of solar cells related to its efficiency.

Meanwhile, this PV panel application is very popular, especially for a home solar power plant. Home Solar power is a standalone power plant and uses an off-grid system [9]. The off-grid system is a

generator consisting of SPV, battery, inverter, and AC load that operates independently not connected to other plants. A component in an off-grid system that plays an important role as a SPV-generated power storage container is a battery. Batteries can be durable or not damaged by an SCC is a battery protection device that does not occur overcharging and over-discharging[10]. Researchers [11] stated that solar panels are a supply of power systems whose development can be applied also to office power. The results showed the power of solar Panel can generate a power of 334 W, but the power supply to the office can only 290 W.

Solar Charge Controller (SCC) is a component that regulates the current voltage that is supplied to the battery that will be channeled to the load. Solar charge controllers can regulate the incoming voltage that is dialed into the battery so that the occurrence of over voltage or overcharge also avoids overdischarge to the load resulting in a rapidly damaged battery. Solar charge controller has a protection system which can keep from damage and also the financing of care is not too expensive [12].

For that, will be researched solar Charge Controller Solar Home System. There is an amorphous solar panel type with a capacity of 80 Wp and battery of 120 Ah. This research evaluated the SCC performance specification tool. The equipment of household in order to protect existing batteries. This research wears led lamp of 10 W, 15 W and 20 W in Energy Technology Laboratories, Electrical Engineering Department, Faculty of Engineering, Sriwijaya University Indralaya.

2. Literature Review

Planning a power plant must meet some criteria, especially the area to be built should be sufficient sunlight and the location is not covered by large trees. In general, solar power plants have system configurations:

- Power plant Off Grid/Stand alone, a power plant system that is not connected to other power plants or stands alone.
- Power plant on Grid, a power plant system connected to other plants or a system.
- Power plant, a power plant system integrated with one or several power plants with a different primary energy source, with integrated operating pattern.

SCC is a tool that serves to regulate the current DC that enters the battery so as not to overcharging or the lack of stability of the voltage that enters the battery. Solar charge controller as regulating voltage and inflows into the battery to keep the battery safe and durable. That, SCC is an important role in the charging of battery batteries as well as setting the voltage to the battery and load voltage. A system consisting of solar cells is made with portable construction, battery and SCC. Solar cells function to convert solar light energy into electricity through the process of photovoltaic effect. The electricity generated from the solar cells will be stored on battery batteries. The SCC functions as a battery charging controller so that the filling process can provide safe conditions against battery. The conceptualized system can be illustrated in Figure 1

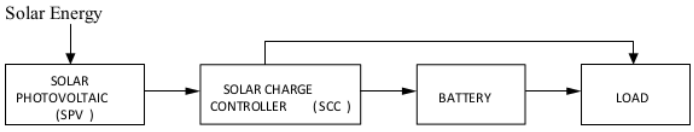

Figure 1. Diagram block of solar renewable energy system

The SCC also functions as a current monitoring, voltage panel PV and battery voltage. SCC, it consists of 1 input (2 terminals) connected to the solar cell output, 1 output (2 terminals) connected with

battery and 1 output (2 terminals) connected with load. Some types of SCC provide monitoring for the system of power performance to work properly:

- Switching Shunt Charge Controller (SSCC) is SCC that regulates the voltage and current array of maximum entry into the battery through the diode blocking. Next, allow the battery voltage to reach the set point charge termination. In this condition, the shunt transistor will live to improve the energy arrangement of the solar cell and stop the battery charging further.
- Single Stage Controller (SSC) is a type of SCC having a greater capacity in banding with switching shunt controllers. This type uses a relay or transistor to disconnect the current flowing when it occurs charging to the battery and avoids the current return from the battery to the solar cell.
- Diversion Controller (DC), in this type of controller, current flowing into the battery can be adjusted automatically by means of checking the battery voltage. When there is more current it will be switched to the load resistor and the current from the solar cell will flow when voltage of the battery lower.
- Pulse Width Modulation (PWM). PWM is a modulation technique that regulates the pulse width of the output. In microcontrollers, the source of the pulse made through the internal clock is then modulated with the waves generated from the wave generator. On this charge controller, the resulting pulse is set by using PWM via microcontroller so that it will be able to adjust to a rechargeable battery condition. This type one is the most effective way to achieve constant voltage battery charging by switching the solar system's controlling power device. When in PMW current regulation of SPV shrinks affecting battery condition and power requirement. The charge control uses the Arduino to regulate the battery voltage.
- Maximum Power Point Tracker (MPPT) is an electronic system that operates a Photovoltaic module (PV) in a way that allows the module to produce everything the power they can afford. MPPT is a fully electronic system that varies the electrical operating point of the module so that modules can convey the maximum available power. The additional power generated from the module was then made available to increase the battery charge current. Shrinks. This type of MPPT is very superior with maximum power characteristics to charge the battery generated by solar cell. This type can take and store the maximum power generated solar panels. MPPT has advantages over other types of solar cells that can be adjusted higher than the voltage of the battery. Another advantage of this type is that it can also depend on the solar temperature of the cell during operation and battery voltage level.

3. Research methods

The SCC set scheme can be seen in Figure 2. This research was conducted at energy technology Laboratory on campus of Sriwijaya university, Indralaya. Sunlight illuminating the Amorphous Solar Cell of 80 Wp(1) will be converted into DC electrical energy . This energy is streamed to the SCC which functions as regulatory of voltage and current. The voltage and current are read by the DC voltage sensor (2) and current module of ACD712 (3). After that, the current and voltage enter the gate on buck converter (4).

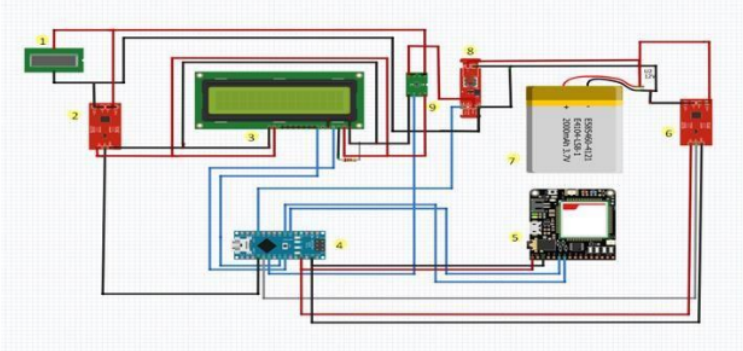

Figure 2. SCC Network Scheme

Mosfet will close and open the gate according to the PWM command. Next, the voltage will be lowered by switching as it passes the buck converter before going into the lead acid battery of 120 Ah (9). The DC voltage sensor (10) on the battery will read the voltage that enters the battery displayed on the LCD (8) by Arduino UNO R3 (5) and RTC module (Real Time Clock) DS1307 (6). Current and voltage data results are recorded in the SD Card module (7).

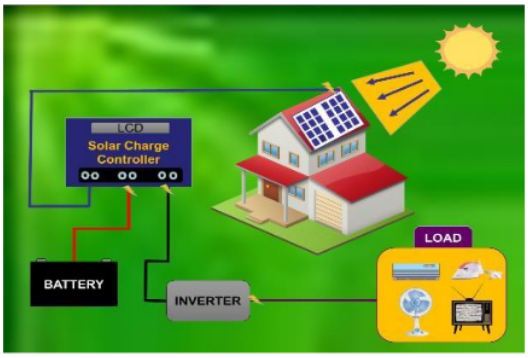

Figure 3. Solar power plant-off grid system *3.1.*

Over charge Testing

On the overcharge test, the battery condition is full then the SCC automatically switches the energy from the solar panels directly to the load without going through a battery called bypass. The test result data is shown in table 1.

Table 1. Overcharge.testing

Time	Input Voltage (V)	Battery Voltage (V)	Condition
10:00	22.06	13.17	Bulking
11:00	22.64	13.32	Bulking
12:00	23.54	13.75	Floating
13:00	23.67	13.87	Bypass

Figure 4. Full Battery Display

The LCD indicator on the solar charge controller shows a bypass mode indicating the current flowing to the load decreases directly.

3.2. Over discharge testing

An over discharge test is the battery condition has a voltage under the setting. This over discharge protection acts as a battery safety in a normal battery state. This test uses the battery lead acid 12V 120 Ah one piece. At the time of testing the voltage is below the 11.1 V then the protection will work. This over discharge protection is called low voltage disconnected. The result of this protection test works when the voltage is at 10.9 V, voltage previously set to 11.1 V. This happens because it still has not perfected the calibration between the voltage sensor and the measurement directly.

Figure 5. Low Voltage Disconnnected condition

3.3. Battery Charging Stage Testing

The stage of the charging of the solar charge controller towards the battery consists of 3 stages that is on where the solar charge controller gets the voltage and current from the solar panel, charging the bulking when the voltage below 13.53 V will function as battery charging in a fast way and floating charging is when the voltage above 13.53 V already approached the full battery level then this charging is done by slowing down the charging solar charge controller to keep the battery are not immediately full.

Table 2. Charging Stage Testing results

Time	Source voltage (V)	Battery voltage (V)	Charging voltage
08:00	21.36	12.83	Bulking
09.00	21.87	12.85	Bulking

10.00	22.00	13.43	Bulking
11.00	22.26	13.70	Floating
12.00	22.64	13.87	Bypass

Figure 6. Floating condition

Figure 7. Bulking condition

Data retrieval on this research is conducted in the affairs at energy technology laboratories Engineering Faculty Sriwijaya. University, the purpose of this data retrieval is to observe the current generated by the PV panel and its output to the load current produced by solar panels.
Pictures 8, 9, 10, 11, 12,13 indicate the current panel and the load current obtained from solar cells.

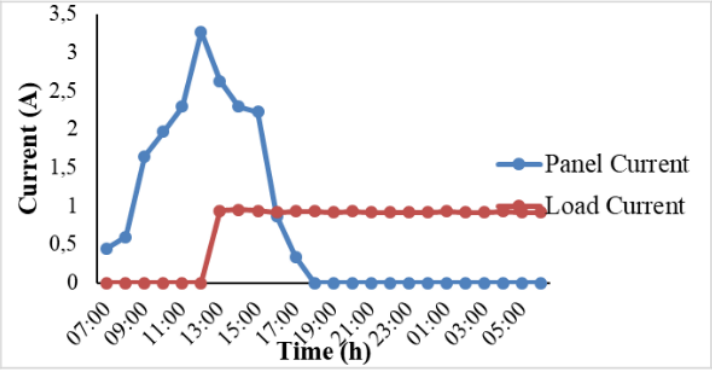

Figure 8. Current (A) and time (h) diagram on August 7, 2018

Based on the image observation result figure 8. It can be seen that the current resulting from the solar system at 07.00 o'clock produces a current of 0.38 A, the current starts to rise drastically at the time of 10.00 generating the current 1.63 A due to battery condition in the state of thirst With a battery voltage of 12.49 V, the current start up and solar charge controller enters the bulking mode. The amount of currents affected by the weather can be seen from the current graph of the panel at the time of 14.00, in the flow due to cloudy weather. For the burden of starting to be installed at 13.00 with the use of 10 W led, the load current is experiencing up and down 0.85 A to 0.83 A.

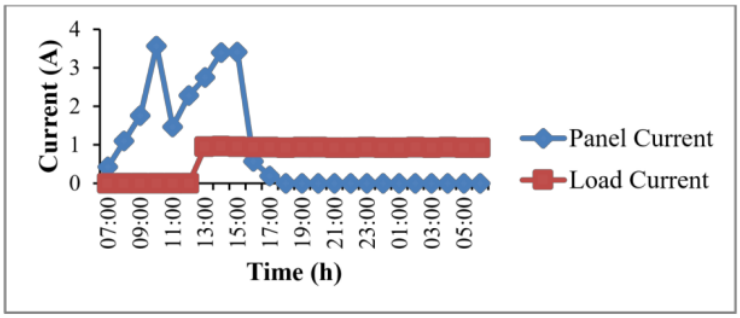

Figure 9. Current (A) and time (h) diagram on August 8, 2018.

Figure 9, on August 8, 2018. Image Based on figure the current supplied by the solar panel in bright conditions can be seen a continuous rising current starting at 09.00 to 12.00 .and peak at 12.00 , the current panel is peak and starts according continuously starting from 15.00 to 18.00.that can't produce any more currents due to cloudy weather. The burden starts to be inserted at 13.00 is a 10 W Led. Load current experience up down about 0.92 A up to 0.96 A and left lit until 06.00.

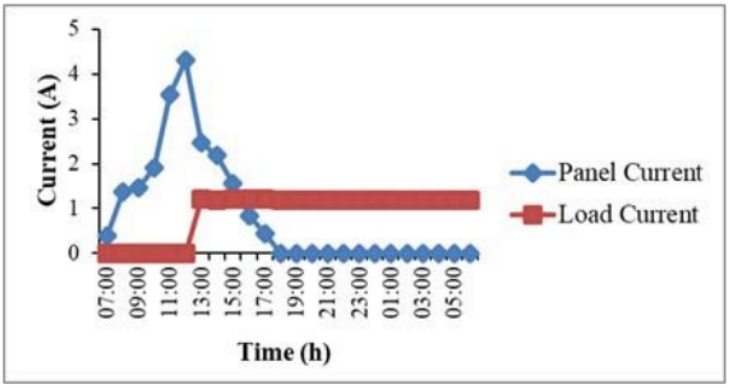

Figure 10. Current (A) and time (h) diagram on August 9, 2018.

Base on figure 10, August 9, 2018 is a continuation of the previous data retrieval. The weather at this time is sunny and the sun is covered by clouds. In the morning starts at 07.00 to 10.00 and can only produce a current panel of 0.76 A the largest current in 12.00 which is 1.77 A at the time of 13.00 the weather closed clouds so that affects the current and the resulting voltage is 1.26 A just ride Momentarily at 14.00 is 1.64 A and dropped back at 16.00 to 1.26 A. For loads we put a 15watt led at 13.00 to 6 load currents from 1.24 A to 1.25 A due to constant loads also.

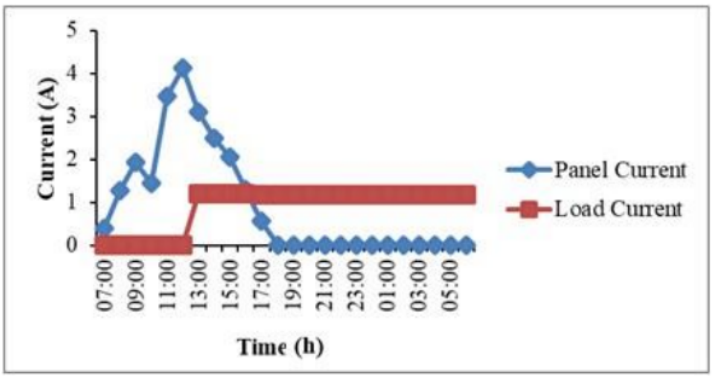

Figure 11. Current (A) and time (h) diagram on August 10, 2018.

Based on figure 11, August 10, 2018 sunny weather generates the maximum current at 12.00 to 16.00 in clear weather can provide a current of 1.83 A at 12 o'clock. At 13.00 the current decreased to 1.64 A because the battery charge has entered the voltage of 13.53 V which means solar charge controller works in a state of float. At 17.00, the current panel began to decline 0.44 A to 18.00 with the current 0.25 A. Load starts at 13.00 which is led 20 watts until 06.00, load currents surge in the early 1.79 A and start stable at 1.78 A and 1.77 A. living expenses up to 06.00.

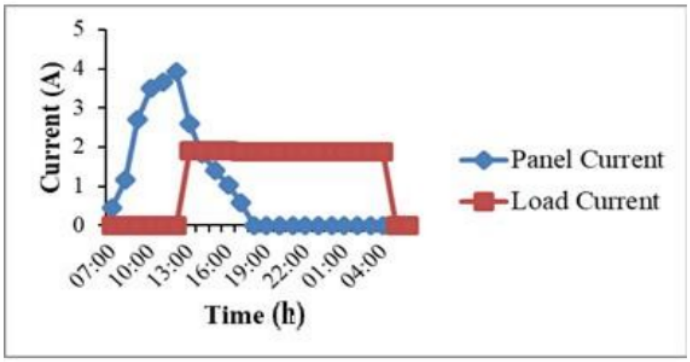

Figure 12. Current (A) and time (h) diagram on August 11, 2018.

Based on image figure 12, August 11, 2018 sunny weather generates a maximum current at 12.00 to 16.00 in the clear weather can provide a current of 1.83 A at 12.00. At 13.00 noon the current decreased to 1.64 A, because the battery charge has entered the voltage of 13.53 V which means solar charge

controller works in a state of float. At 17.00 the current panel began to decline 0.44A to 18.00 with the current 0.25 A. Load starts at 13.00 which is Led 20 W until 06.00. Load currents surge in the early 1.79 A and start stable at 1.78 A and 1.77 A. Living expenses up to 06.00 am.

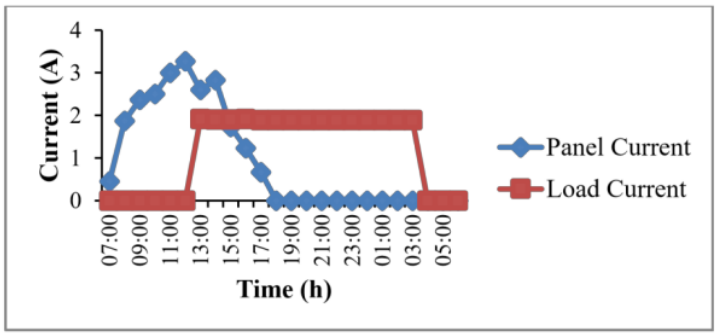

Figure 13. Current (A) and time (h) diagram on August 12, 2018

Based on figure 13, August 12, 2018.We accidentally charge the battery for 2 days without any load aiming to conduct an over charge test, apparently with this experiment succeeded to conduct the overcharge test. Current panel generated at 10.00 is 1.32 A with battery voltage 13.17V. At the time of 12.00 to 13.00 the battery current decreases compared to 10.00, the current decreases due to charging the battery has entered the voltage of 13.75V Solar charge controller works already according to the program. Further-more the current decreased at 14.00 until 18.00, because the weather was cloudy. At load tests we used 15watt led starting at 13.00 until 18.00. The resulting current is stable of 1.47 A and 1.46.A

4. Conclusion

The results showed that the current panel increased dramatically over 10.00 to 13.00 due to increased solar intensity but began to drop ov 13.00 17.00 due to decreased solar intensity.
SCC battery Charging by means of a quick charging mode (bulking) when the voltage is below 13.5 V and will be floating when the voltage equals 13.5V until 13.85V. In addition, when the voltage above 13.85V, battery charging process will be stopped and this condition will be called bypass.

References

[1] J. Adeeb, A. Farhan, and A. Al-Salaymeh, "Temperature Effect on Performance of Different Solar Cell Technologies," *J. Ecol. Eng.*, vol. 20, no. 5, pp. 249–254, 2019.
[2] A. F. Sherwani, M. Asjad, and A. Haleem, "Performance evaluation of solar photovoltaic electricity-generating systems: an Indian perspective," *Int. J. Sustain. Eng.*, vol. 12, no. 1, pp. 70–75, 2019.
[3] B. Parida, S. Iniyan, and R. Goic, "A review of solar photovoltaic technologies," *Renew. Sustain. Energy Rev.*, vol. 15, no. 3, pp. 1625–1636, 2011.
[4] S. Mughal, Y. R. Sood, and R. K. Jarial, "A Review on Solar Photovoltaic Technology and Future Trends," *J. Phys.*, no. April, pp. 227–235, 2018.
[5] A. Goetzberger, C. Hebling, and H.-W. Schock, "Photovoltaic materials, history, status and outlook," *Mater. Sci. Eng. R Reports*, vol. 40, no. 1, pp. 1–46, 2003.
[6] A. Luceño-s and A. Mar, "Materials for Photovoltaics : State of Art and Recent Developments," *Int. J. Mol. Sci.*, vol. 20, pp. 1–42, 2019.

[7] S. A.F., U. J.A., and Varun., "Life cycle assessment of solar PV based electricity generation systems: A review," *Renew. Sustain. Energy Rev.*, vol. 14, pp. 540–544, 2010.
[8] U. Stutenbaeumer and B. Mes, "Equivalent model of monocrystalline , polycrystalline and amorphous silicon solar cells," *Renew. Energy*, vol. 18, pp. 501–512, 1999.
[9] P. K. Dewangan and U. T. Nagdeve, "Inverter for Grid Connected PV System A Review," *Int. J. Adv. Res. Electr. Electron. Instrum. Eng.*, vol. 03, no. 10, pp. 12336–12340, 2014.
[10] J. Rodríguez, J. S. Lai, and F. Z. Peng, "Multilevel inverters: A survey of topologies, controls, and applications," *IEEE Trans. Ind. Electron.*, vol. 49, no. 4, pp. 724–738, 2002.
[11] S. B. Adejuyigbe, O. Ekiti, B. O. Bolaji, M. Olanipekun, and M. Adu, "Development of a Solar Photovoltaic Power System to Generate Electricity for Office Appliances," *Eng. J.*, no. January, pp. 30–39, 2013.
[12] C. A. Osaretin and F. O. Edeko, "Design and Implementation of a Solar Charge Controller with Variable Output," *J. Electr. Electron. Eng.*, vol. 12, pp. 40–50, 2015.

Acknowledgments
The author thanked fellow researchers, students, and staff of the Laboratory for Energy Technology Research Department of Electrical Engineering Faculty of Sriwijaya University.

2020 Sofijan_2020_J._Phys.__Conf._Ser._1500_012004-Irwin Bizzy.

ORIGINALITY REPORT

15%	9%	6%	14%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of Greenwich Student Paper	4%
2	repository.iainbengkulu.ac.id Internet Source	4%
3	Submitted to Lane Technical College Preparatory High School Student Paper	3%
4	ijsrd.com Internet Source	1%
5	ejournal.unsri.ac.id Internet Source	1%
6	Submitted to Sriwijaya University Student Paper	1%
7	eprints.ulm.ac.id Internet Source	1%
8	Ulrich Stutenbaeumer, Belayneh Mesfin. "Equivalent model of monocrystalline,	1%

polycrystalline and amorphous silicon solar cells", Renewable Energy, 1999
Publication

9	docplayer.net Internet Source	1 %

Exclude quotes	Off	Exclude matches	< 1%
Exclude bibliography	On		