# COMPARATIVE ANALYSIS OF SOLAR CHARGE CONTROLLER PERFORMANCE BETWEEN MPPT AND PWM ON SOLAR PANELS

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ABSTRACT

*Solar power plants require other supporting equipment besides solar panels, including SCC (Solar Charger Controller) for solar panel charger media to batteries. While the battery itself as a store of electrical energy generated by solar panels. Therefore, other supporting equipment is very important in the application of solar power generation systems.*
*In the charger system or battery charging on solar panels, an SCC solar charger controller is needed as the charger media. In the solar charger controller there are two types between MPPT (Maximum Power Point Tracker) and PWM (Pulse Width Modulation). This study aims to analyze the performance comparison between SCC which is good for solar panels in battery charging. Apart from the comparison tool, the simulation tool used in this study is which one is superior between MPPT and PWM. The way of comparison is to compare the current and voltage results obtained from the SCC input and output between MPPT and PWM to find out which one is superior.*
*The results of the comparison with simulation produce current input from MPPT between 10, 15, 20, 25 A while PWM input current is between 10, 15, 20, 15A. The results of the MPPT current output are between 12, 18, 21, 25A, while the PWM output current is between 8, 18, 21, 25A. For the MPPT input voltage results are between 29, 25, 36, 41V, while the PWM is between 26, 29, 36, 41V, while the output MPPT voltage is between 14, 14, 15, 15V, while the PWM is in the range of 14, 14, 15, 15V.*

**Keywords**: *Solar Charger Controller, MPPT, PWM, Matlab Simulink*

## 1. INTRODUCTION

Solar energy is the most important renewable energy source which offers many advantages such as without the need for fuel oil, does not produce pollution, low maintenance costs and is environmentally friendly by converting sunlight into electrical energy.

In utilizing solar energy from solar panels before it can be used as electrical energy, a Solar Charger Controller (SCC) is needed. The function of the SCC is to protect and automate the voltage on battery charging so that the voltage does not exceed the limit which can cause the cells in the battery to be damaged.

In the SCC itself, there are two types of SCC variations that are often encountered, namely MPPT (Maximum Power Point Tracker) and PWM (Pulse Width Modulation). The two SCC have the same function, namely as a charging controller from the solar panels to the battery.

Several studies on Solar Charger Controller (SCC) have been carried out [1][2][3], but these studies only use one type of SCC variation between MPPT (Maximum Power Point Tracker) and PWM (Pulse Width Modulation), in the research he did.

In this study, a comparison and analysis will be carried out to compare the Solar Charger Controller (SCC) between MPPT (Maximum Power Point Tracker) and PWM (Pulse Width Modulation), using matlab (simulink). The input and output generated by the solar power plant using a solar panel to the Solar Charger Controller (SCC)-based battery.

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## 2. RESEARCH METHODS

In designing a software system, the comparison of SCC (solar charger controller) between MPPT (Maximum Power Point Tracker) and PWM (Pulse Width Modulation) using matlab (simulink) software, comparison of SCC between MPPT and PWM consists of three parts, inputs, controllers, and outputs. The input using a solar panel, then to the solar charger controller are MPPT or PWM, and the output from the charger controller from MPPT or PWM become the input for battery charger. This method aims to determine the current and voltage of the solar charger controller between MPPT and PWM. Figure 1 shows the simulink circuit for a system with MPPT control. Figure 2 shows the simulink circuit for a system with PWM control.

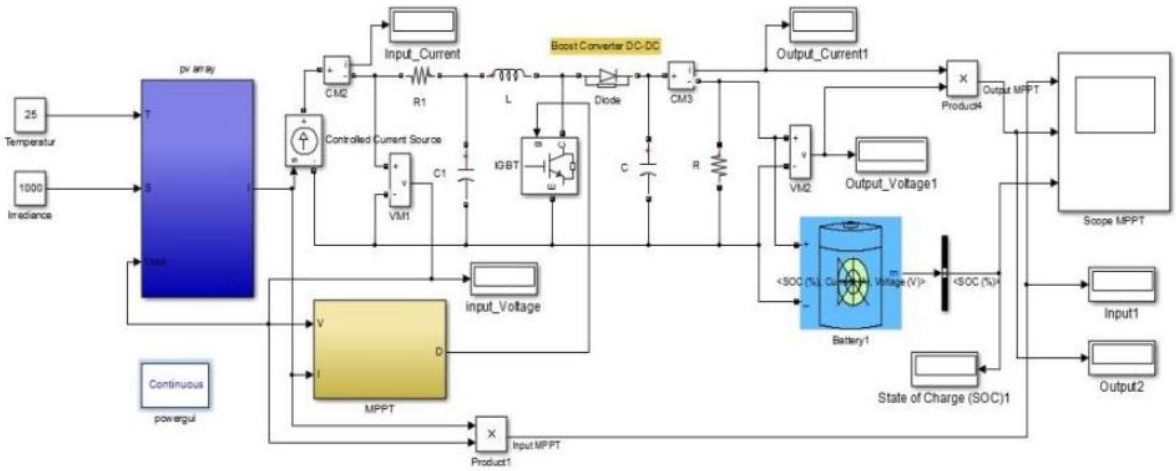


*Figure 1. Simulink Circuit for Systems with MPPT Control*

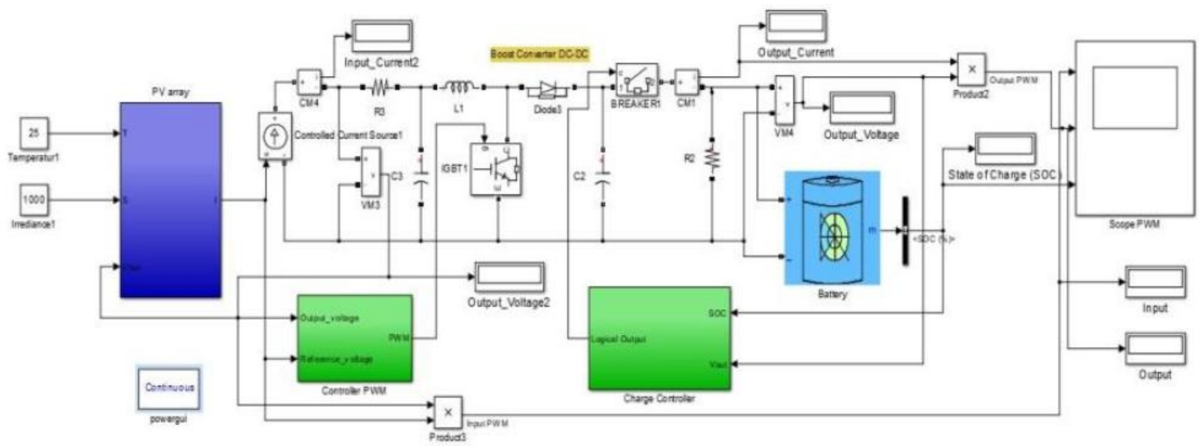


*Figure 2. Simulink Circuit for Systems with PWM Control*

## 3. RESULTS AND DISCUSSION

In the charging simulation using Matlab Simulink, the comparison of SCC (soler charger controller) between MPPT (Maximum Power Point Tracker) and PWM (Pulse Width Modulation) produces a comparison graph that includes input, output, current, and voltage.

From the Figure 3 until Figure 6 can be concluded that the input current value of temperature and irradiance is stable, except for the 1000W/m² irradiance with a temperature of 35°C, the PWM charger controller experiences a decrease in current, it show in Figure 6.

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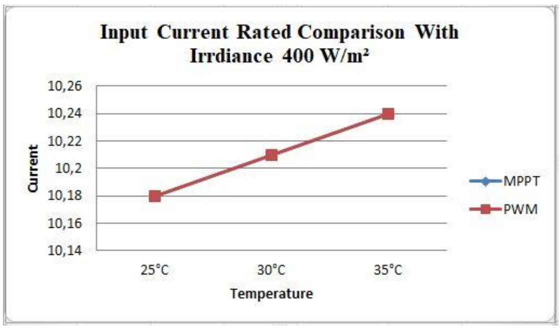


*Figure 3. Graph of Input Current With an Irradiance of 400 W/m².*

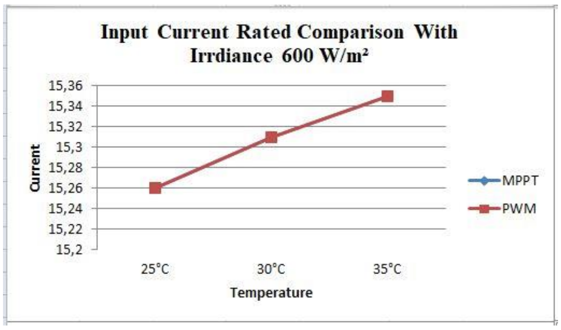


*Figure 4. Graph of Input Current With an Irradiance of 600 W/m².*

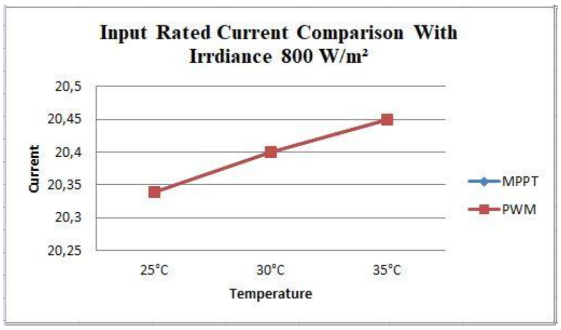


*Figure 5. Graph of Input Current With Irradiance 800 W/m².*

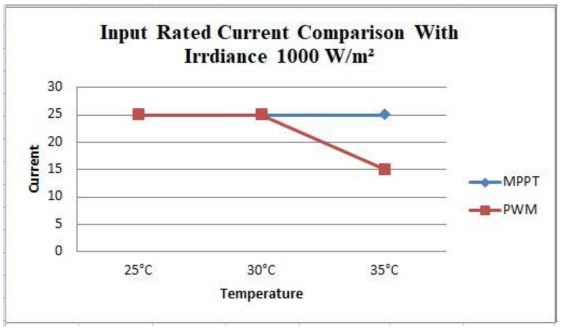


*Figure 6. Graph of Input Current with an Irradiance of 1000 W/m².*

In Figure 8, the current output of PWM charger controller is higher at 25°C than MPPT but while at 30°C MPPT is higher, and at 35°C both are in the same value, that is the condition in the 600 W/m$^2$ irradiance.

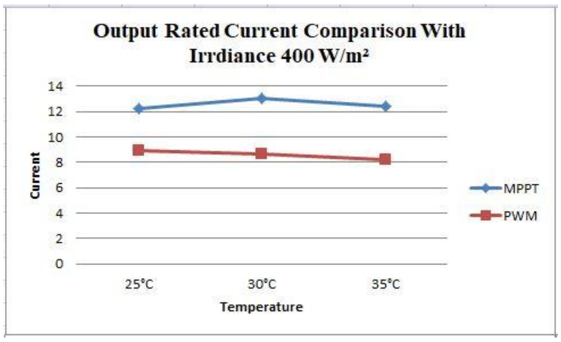


*Figure 7. Graph of Comparison of Output with an Irradiance of 400 W/m².*

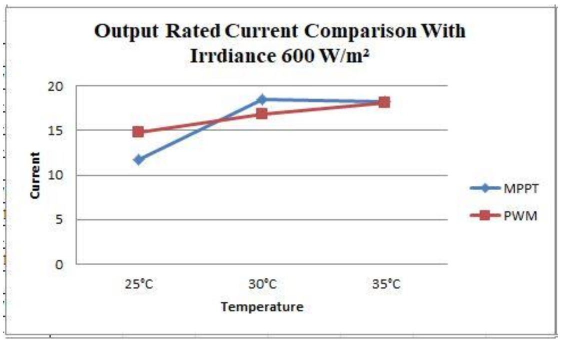


*Figure 8. Graph of Comparison of Output with an Irradiance of 600 W/m².*

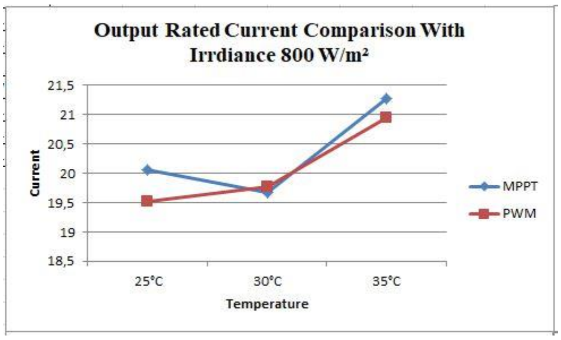


*Figure 9. Comparison of Output Graph with 800 W/m² Irradiance.*

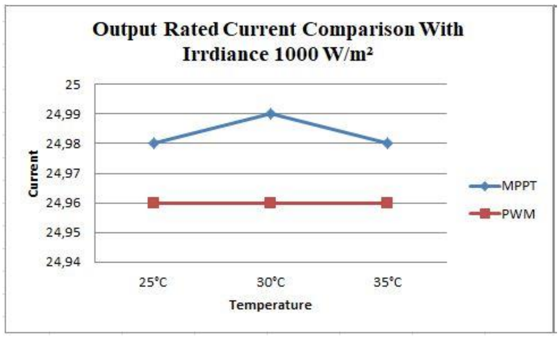


*Figure 10. Graph of Comparison of Output with Irradiance of 1000 W/m².*

In the 800 W/m$^2$ irradiance the current output at MPPT is superior to PWM although it decreases when the temperature is 30°C, it show in Figure 9. From the Figure 7 until Figure 10 show the current output from the MPPT and PWM charger controller, it be concluded that the current output at low to high temperature MPPT is better than PWM even though the range is a little.

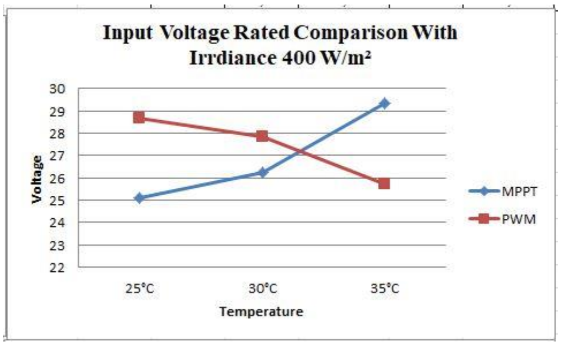


*Figure 11. Graph of Input Voltage With an Irradiance of 400 W/m².*

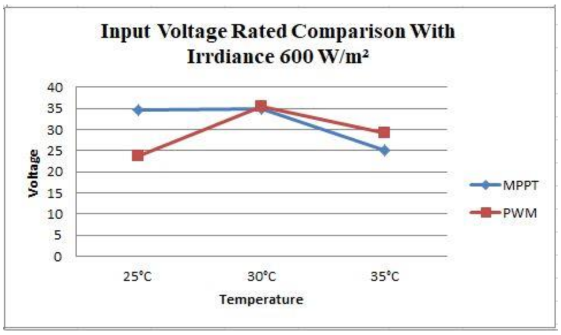


*Figure 12. Graph of Input Voltage With an Irradiance of 600 W/m².*

In Figure 11, In the input voltage with irradiance 400 show the PWM charger controller is decrease in the 35$^0$C while MPPT is increase. At this irradiance MPPT is better at low temperatures while at high temperature.

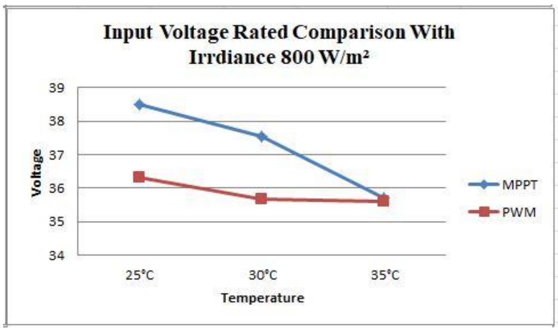


*Figure 13. Graph of Input Voltage With 800 W/m² Irradiance.*

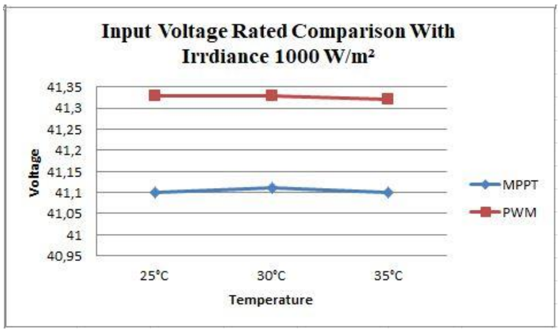


*Figure 14. Graph of Input Voltage with an Irradiance of 1000 W/m².*

At low temperatures MPPT is better, while at high temperatures both have the same voltage value. At low to high temperatures PWM control is better than MPPT. From the Figure 11 to Figure 14 and discussion above, it can be concluded that the input voltage between MPPT and PWM both experiences an increase and a decrease in voltage, but at 1000 W/m$^2$ irradiance PWM is better than MPPT.

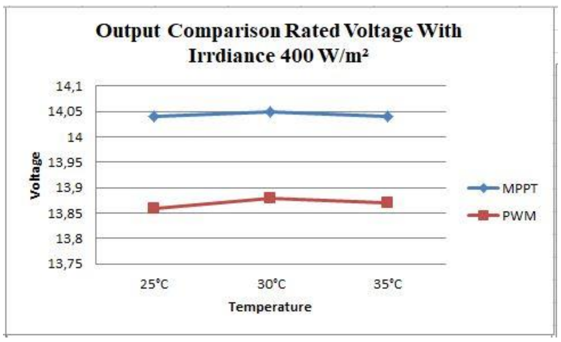


*Figure 15. Graph of Output Voltage With an Irradiance of 400 W/m².*

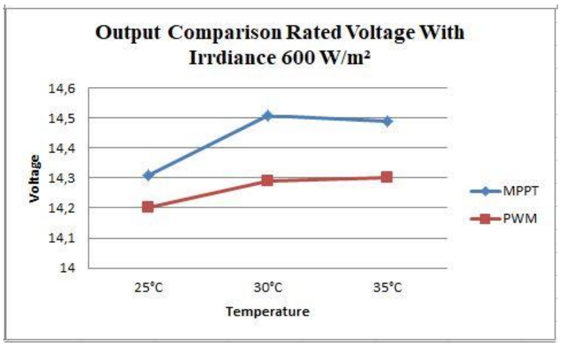


*Figure 16. Graph of Output Voltage With an Irradiance of 600 W/m².*

From Figure 15 untul Figure 18, show the output voltage at MPPT and PWM. It can be concluded that the MPPT output voltage has increased in voltage, and is superior to PWM.

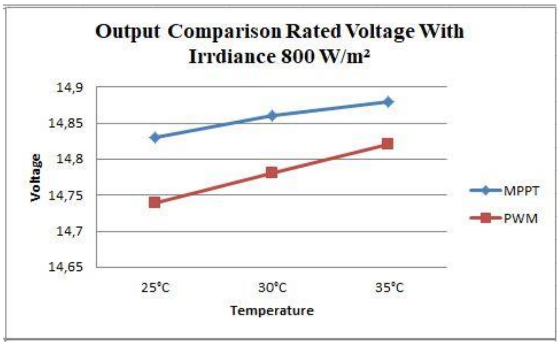


*Figure 17. Graph of Output Voltage With Irradiance 800 W/m².*

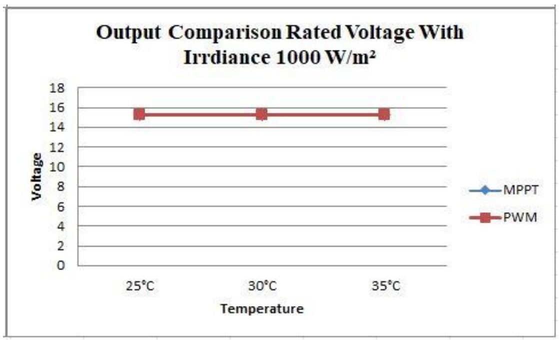


*Figure 18. Graph of Output Voltage With an Irradiance of 1000 W/m².*

From the graph above, it can be concluded that the MPPT voltage output also experiences an increase in voltage and is superior even though the PWM also experiences an increase in voltage. From the graph above, the output voltage between the MPPT charger controller and PWM, both can be said to be stable. From all the graphs and discussion above, it can be concluded that the output voltage of the MPPT charger controller is superior to PWM except when the irradiance is high, both are stable.

## 4. CONCLUSION

This study compares the SCC (solar charger controller) MPPT (Maximum Power Point Tracker) and PWM (Pulse Width Modulation) using Simulink/Matlab. The MPPT is better than PWM in the current input, which MPPT more stable than PWM, both of them are increase and a decrease in voltage, but when the irradiance is high, the PWM is superior to the MPPT

## REFERENCES

[1] Bayu Azmi, Jefri Abner, Prasepvianto, Hendrik Seputra," Review Perbandingan Teknik Maximum Power Point Tracker (Mppt) Untuk Sistem Pengisian Daya Menggunakan Sel Surya".

[2] Bassam Y. Al-Hanahi , Burak Akın, (September 2017), "MPPT Controlled Battery Charger Design and Simulation".

[3] Amirullah, Agus Kiswantono, (7 November 2016), "Power Quality Enhancement Of Integration Photovoltaic Generator To Grid Under Variable Solar Irradiance Level Using Mppt-Fuzzy".

[4] Puji Slamet, Subekti Yuliananda, Santoso, (April 2019), "Simulasi Desain Kontrol MPPT Sistem Photovoltaic (MPPT Control Design Simulation Photovoltaic Systems) ".

[5] Ario Amri Ihsan , Waluyo , Siti Saodah, "Perancangan dan Realisasi Solar Charge Controller Maximum Power Point Tracker dengan Topologi Buck Converter untuk Charger Handphone".

[6] Tulika Majaw , Reeny Deka , Shristi Roy , Bikramjit Goswami, "Solar Charge Controllers using MPPT and PWM: A Review".

[7] Dimas Juniyanto, Tatyantoro Andrasto, Suryono, "Optimalisasi Stand-Alone Photovoltaic System dengan Implementasi Algoritma P&O-Fuzzy MPPT".

[8] Julkifri M Sihombing, "Pengendali PWM Pada Buck Converter Dengan PID Control".

[9] Febin Midiatmoko , Yanu Shalahuddin , Mochtar Yahya, (Januari 2021), "PV Solar Tracker Berbasis Matlab / Simulink Untuk Optimasi Daya".

[10] Gusti Ngurah Agung Mahardika , Wayan Arta Wijaya, Wayan Rinas, (Juni 2016), " Rancang Bangun Baterai Charge Control Untuk Sistem Pengangkat Air Berbasis Arduino Uno Memanfaatkan Sumber PLTS".

[11] Aditya Yudha Perdana, (2020), "Analisis Efisiensi Solar Charger Controller Tipe PWM Dan MPPT Dengan Metode Simulasi".

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p.1197 - 1202