# Controller tests and results

**To coax more energy out of my existing solar panel setup I needed a new MPPT regulator to replace my Sunsaver 20A PWM device.**

I was curious to find whether I would actually get the additional 10% or so extra power that manufacturers claim, and also whether the cheap units I'd found were any good.

I set up the tests to compare the Sunsaver and the MPPT types side by side in as near identical conditions as possible. In the event I ended up with only two regulators to compare, the Sunsaver and the Victron, but the results were still illuminating.

The tests were run over three days in August with *Aderyn Glas* tied to the quayside in Gouvia Marina on Corfu. The sky was consistently clear and blue, allowing a comparison of devices to be made over the period. Solar noon was 13:45 for each of the days and a test was timed to run one side or other of noon, so if one device was tested for an hour before noon the other device was tested for an hour after to give as similar sky conditions as possible.

Throughout the tests the panels were held horizontal with neither azimuth or elevation adjustments. Care was taken to ensure there was no shading as the Earth rotated.

I had wanted to compare the measured results with the theoretical ones from the online JRC calculator but this turned out to be impossible and, due to failure and unsuitability of the other two units I'd acquired, I had to be content with testing the MPPT Victron using the PWM Sunsaver as a baseline.

The greatest problem was trying to achieve a consistent load, and the battery had to be driven down to the same starting voltage for each test by burning lights and other high-current devices. However, this process would not guarantee the same starting conditions since the batteries would show some natural recovery after such a drain. Input and output voltage and current (relative to the regulator under test) was recorded at five-minute intervals. Each test lasted one hour, but there was a clear settling period at the start of each test which was ignored in the final data analysis – over a long term this would have little effect on the energy produced.

A distinct difficulty was apparent recording the PWM Sunsaver voltages since even under high-throughput conditions the PWM feature was, surprisingly, still operating. This meant that the input voltage was held at $V_{OC}$ for a period equivalent to the PWM off-pulse, and this tended to skew the result.

The panel $V_{OC}$ was 19.69V, so 80% of $V_{OC}$ was 15.75V – the notional MPP. The air temperature was 30°C and the battery voltage 11.6V. Apart from battery charging, the only other load was the notebook data recorder which consumed a steady 2A. Although it made no difference to a horizontal panel installation, for the record the stern of the boat was oriented to 025° true.

ABOVE All ready for testing. Nearest is the Sunsaver 20, then MPPT30 and Victron 75/15. The data logger recorded power on the input of the regulator. BELOW The leads from the solar panel were fed through an ammeter to the unit under test. The voltage on both input and output was taken with a digital multimeter and the output current with a second digital multimeter. Readings were taken every five minutes

## Also-rans in the MPPT regulator market

**I had a look at the MPPT30 Solar Controller which, at roughly £30, seemed an attractive buy. When it arrived I took the cover off and soon realised that whatever it was, it was unlikely to give an efficient conversion of energy since it didn't have the substantial inductive components that a 20A DC-DC converter would have.**

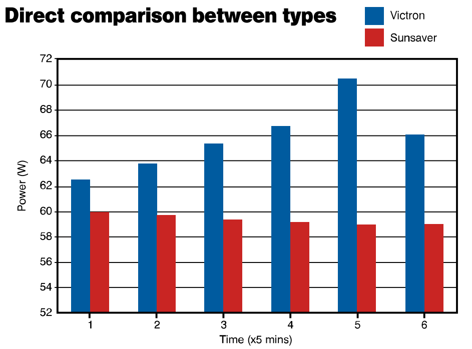
**In short, whereas the Victron is a weighty beast the MPPT30 Solar Controller is not. I verified that it had a microprocessor (without a processor, tracking is impossible), but I was disappointed with the quality of the internal components and assembly standard.**

**Nevertheless I decided to include it in the tests, having ensured I had some over-voltage protection in case it failed. In the event it lasted about 30 seconds before indicating a fault condition.**

**Despite everything I could think of I couldn't clear the condition and get a set of data from the device.**


The MPPT30 Solar Controller on the left is available all over the internet but is best left there, in my opinion. I didn't even test the CMTP02 Solar Charge Controller on the right. It may be a useful regulator – internally it seemed better constructed than the MPPT30 – but the small size, lack of DC-DC converter components and lack of a microprocessor clearly indicated it was not an MPPT type

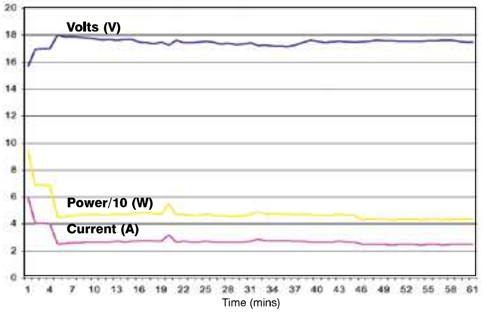
### Direct comparison between types



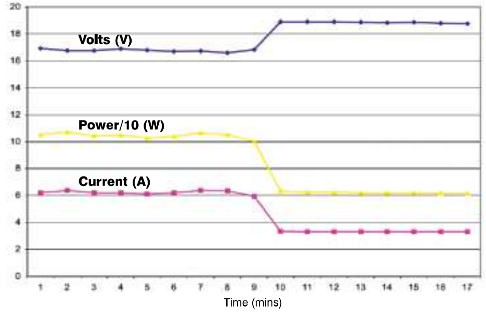

A direct comparison between the Sunsaver PWM and Victron MPPT regulators. Power at the output of the regulator

| TIME | VICTRON | SUNSAVER | DIFFERENCE | PERCENT |
|---|---|---|---|---|
| 35 | 62.59 | 59.96 | 2.62 | 4.37 |
| 40 | 63.89 | 59.78 | 4.11 | 6.87 |
| 45 | 65.33 | 59.36 | 5.97 | 10.05 |
| 50 | 66.79 | 59.22 | 7.57 | 12.78 |
| 55 | 70.52 | 59.04 | 11.48 | 19.44 |
| 60 | 66.03 | 59.04 | 6.99 | 11.85 |
| | | | | |
| Average | 65.86 | 59.40 | | 10.87 |
| Sum | 395.14 | 356.40 | | 10.87 |

The tabulated power results show the advantage the MPPT type has of being able to actively seek the best power point solution compared to the steady state output of the PWM device. The average margin of about 11% is probably misleading when taken over such a short period, and may actually have improved if the test had continued




The input power curve for the Victron run over a one-hour period. The sustained high voltage results in the energy accumulated over this period of 47Wh




This is a good example of the MPPT regulator doing its job. As shade hits the panels it seeks a new maximum power solution, achieved by winding the voltage up to 19V (input parameters from the data logger)

## Conclusions and recommendations

1 The JRC website calculator is a good starting point for discovering the likely energy you can capture in your chosen location, and will help you decide what your solar panel installation should look like. Use real-sky data, which includes the average cloud cover for your chosen location and time.

2 Only first-generation silicon panel technology, either mono- or polycrystalline, has sufficient power to area ratio (W/m²) to provide the energy we need in the space we have available on a boat.

3 To maximise the energy, the single most important factor is to mount the panels on a tilting mount in a position that cannot be shaded by the mast, sails, flags, ropes etc. The tilting mount can give up to a third more energy over the course of a summer day compared to a horizontal mount, and twice as much in winter.

4 Do a hard-nosed assessment of your energy requirements and be pessimistic about the energy you can get from your installation. Over-estimate the requirement and under-estimate the supply – at some point you will use all the energy you are getting.

5 Unfortunately I was not able to compare measured results with the theoretical results from the JRC calculator. This was probably due to difficulties in controlling the load. Theory predicted about 150W and the most I saw was 70W. However, comparative testing was possible and clearly showed a margin for the MPPT-type regulator of better than 10%.

6 A PWM-type regulator such as the Sunsaver 20 is fine for most situations, and in conditions of bright sunlight and high-current throughput is only about 10% lower in performance than the MPPT type.

7 However, to get the absolute maximum from your installation, especially in the more marginal dawn, dusk, cloudy and wintry conditions, consider an MPPT controller. In those conditions, it's claimed an MPPT type can deliver perhaps 30% more power than the PWM type.

■ **My thanks to Johannes Boonstra at Victron Energy for answering queries and clarifying some points for me.**