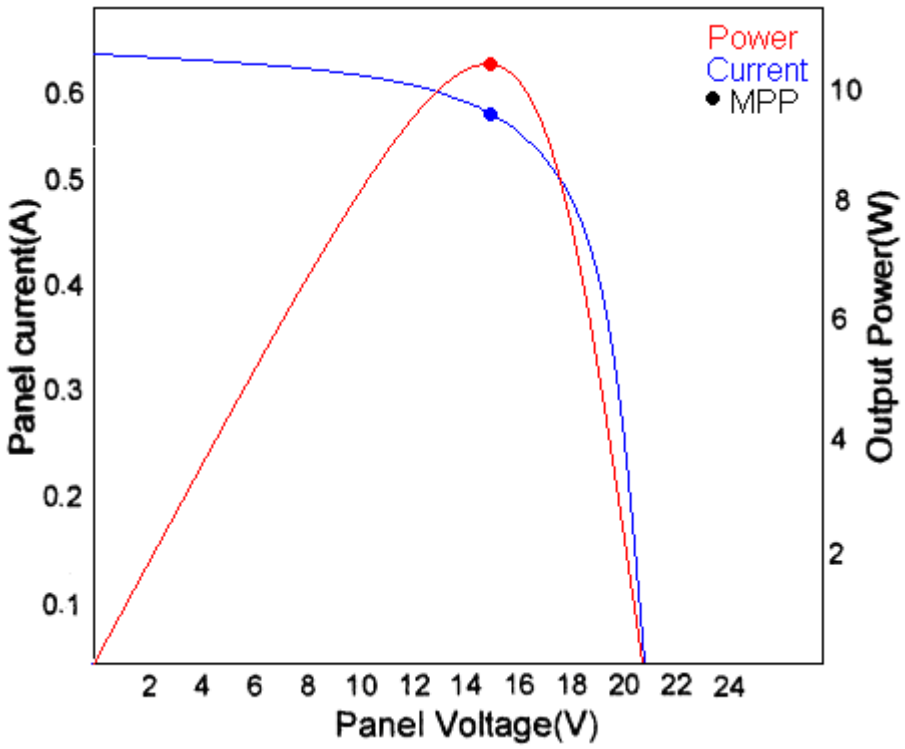
AUTOMAX

Solar Maximum Power Point Tracker

Introduction

The power output of a solar panel varies significantly with varying load conditions given constant illumination on the panel's surface. Under full sunlight, a 10 watt panel can output 10 watts given ideal load conditions, or it can output less than 1 watt, given non ideal load conditions.

The ideal load for a specific solar panel depends solely on the solar panels MPP (maximum power point). The MPP is a point on the I/V curve where output power is at maximum. Below is a I/V curve with the MPP clearly labelled with a dot. As you can see, the output power varies greatly with varying output voltage.



When I talk of the 'Ideal load', what I mean is; a load that will not pull or push the solar panels voltage below or above the MPP voltage.

Now, the problem is, when we connect the panel directly to a motor to drive, the load is hardly ever ideal. Why?? Ok, when your motor is stalled, or under heavy load (e.g. at the start-up gate), the voltage across the motor terminals is very low (it acts like a low Ω resistor), typically around 0.2-2 volts for a standard solar car motor. As the car speeds up, the voltage will increase (motor voltage is proportional to its speed), and eventually reach the MPP voltage. During a typical solar car race, a well geared car will sit at or around the MPP for only 10 – 20% of the race. So, it's only seeing maximum power for only around 10 – 20% of the time.

Now, how can we solve this problem?? How can we deliver maximum power to the motor, throughout the full lap?? Ok. This is what the MPPT does. It holds the solar panels output voltage at its MPP voltage regardless of the load conditions. We can

have 2 volts across the motor terminals, while having 15 volts across the solar panels terminals. Huh?? What happen to the rest of the voltage?? Ok... Its smart. It converts all the excess voltage into current. So we can have more amps going to motor, resulting in increased Torque, and thus, better accelation.

I don't get it?!! Ok, here's an example:

We have a 10watt solar panel with a MPP at 15.5 volts, and a short circuit current of 0.7 amps. During the beginning of our race our motor voltage will be low (voltage is proportional to speed remember). Let's say our motor voltage will be 3 volts. At 3 volts, the panel will produce around 0.68 amps, so our power going to the motor is 0.68amps x 3volts = 2.04 watts. Damn, we are losing like 8 watts. However, if we use a solar enhancer our panel voltage is always 15.5 volts and panel current is around 0.65 amps (10watts). So when we have 3volts across the motor, our motor current will be 10watts/3volts = 3.33 amps. WOW, we have 5 times the current, which means 5 times more torque at that motor speed (resulting in better acceleration). As our motor voltage increases, the current decreases, maintaining a output power of P_{max} watts (minus the MPPT losses which are very low).

Automax vs. Others

Because all solar panels have a different MPP, and because the MPP fluctuates with different light intensities and temperatures, you need to always tune your maximiser to get maximum performance.

With a normal maximiser, to tune your maximiser you'll need to connect it to load, and trim a potentiometer, or press a setup button, until you see maximum voltage across the load. When you see the maximum possible voltage across the load, it means your solar panel is set at its MPP. This method of tuning can be tricky, takes a lot of time, and sometimes, if you stuff up the tuning, it can lead to a huge power loss.

The Automax, however, does not require tuning or setting up. It has an inbuilt computer which continuously reads the input power, and tracks for the maximum power point all on its own.

Specs

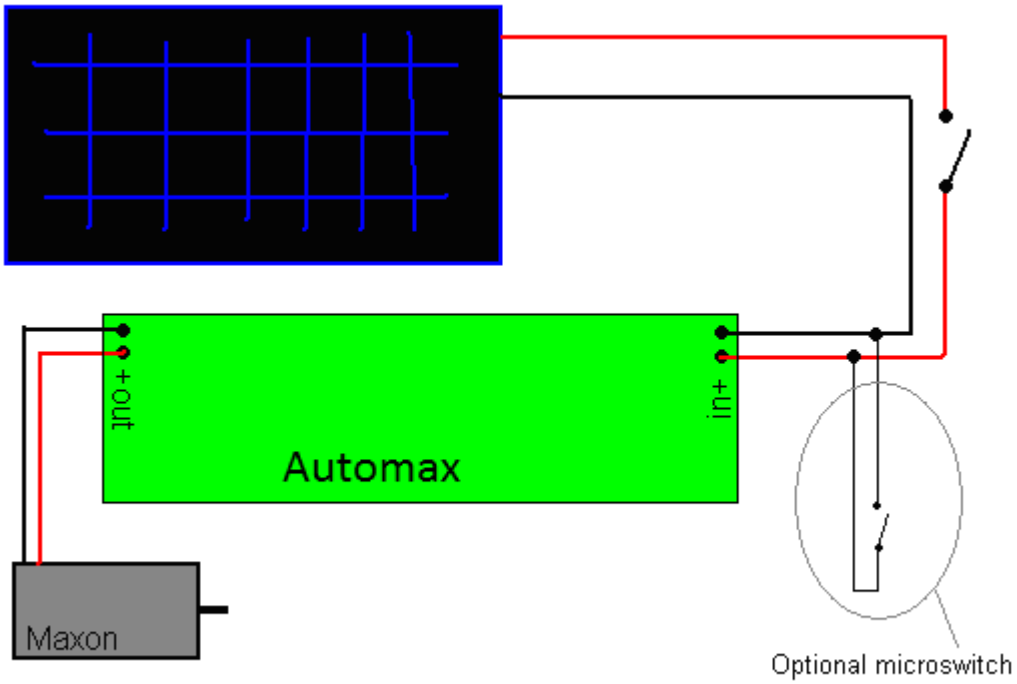
- Tracking response: 3Volts/S, 0.1V resolution
- Maximum efficiency: 98%
- Input voltage: 10 – 29volts (Voc)
- Input Current: 30ma – 1.05A (Isc)
- Output Voltage: depends on load
- Power: 0.5 – 18 watts

Setting it up

Connection and setup for direct motor drive

The rear of the Automax's PCB is labelled with **in** and **out**, with the positive terminal clearly labelled with a **+** sign. The **in** connects to your solar panel, and the **out** connects to your motor. Make sure you have the solar panel and motor polarities the right way.

Below is a connection diagram to make things simpler. ☺



>> If you want Back-EMF braking, just connect the switch in parallel with the panel (to short it) instead of in series.

>> Also, to prevent wheel spin at the start gate, you can have a micro-switch, connected to short the panel. Have separate wires connecting it so that way your actual power wires are short as possible. This will ensure minimal voltage drop.

The Automax has onboard **Dean's Micro** Plugs. These make the connections really simple and prevent stuff-ups later on. All you need to do is solder the motor, and solar panel wires onto the plugs and your set. You should receive a set of Dean's Micro plugs with your Automax, however, if you need them, they are readily available at your local hobby shop.

Setting the MPP

The Automax is a fully Autotracking Solar power MPPT, and does not require the user to set the actual maximum power point. On startup, the Automax will read your solar panels open circuit voltage, and use 0.8 x V(oc) as a reference point to start tracking. If your solar panels maximum power point shifts for whatever reason (shading or

heating), the Automax will detect the shift, and always ensure your load is absorbing maximum power.

LED status:

Blinking slowly: Normal operation – Tracking;
Blinking Fast: Normal operation – Tracking;
Never on: Load voltage is above your Solar Panels MPP voltage.

The Automax has reversed input protection, and input-output protection up to 1amp.

Notes:

Questions or Problems:

Got any problems, questions or suggestions???
Come have a chat at www.solarfreaks.com
Or send me an email: admin@solarfreaks.com

-Tony Bazouni.