High-Tech *Solar System*

New Heliotrope controller boosts panel performance

■ BILL MOELLER

Like its new HPV22B counterpart, Heliotrope's new HPV30 controller incorporates an on/off switch, so the solar panels can be turned off. The HVP30 is specifically designed for motorhomes, and includes a separate circuit for keeping engine battery topped off. AM Solar panels were mounted in prone position for the test, replicating coach use.

PHOTOS: BILL MOELLER

Given the increasing popularity of dry camping among outdoor enthusiasts, the need for proper battery recharging is critical to an outing's success. Granted, you can recharge your house batteries by running the AC generator or the coach engine, but running a fossil-fueled engine for hours on end flies in the face of many of the reasons you veered off the beaten path to begin with.

There is another option: sunlight.

Integrated systems capable of absorbing sunlight and converting it into energy have been available for RV use for years. Much like any other high-tech industry, however, advancements continue to push a system's capabilities. Some time ago ("Silent Power," May 2004) we reviewed Heliotrope's HPV22 controller and found it to be a pretty good unit, particularly when paired with the AM100 panels.

To keep tabs on every aspect of the testing procedure, all requisite controls and monitors were mounted nearby, including a regulator, amp-hour meter, the HPV30 controller, an outdoor thermometer and an insolation meter.

To gauge the effectiveness of the charging system, two deep-cell batteries were wired in parallel; to completely discharge them during the tests, a quartz lamp was used, running off a 300-watt inverter.

The original HPV22 featured Maximum Power Point Tracking (MPPT), which uses unused power from the solar panels as a means of boosting the amperage output of the panels by as much as 35 to 45 percent. The method of charging used, a two-stage constant current/constant voltage system, allowed the amperage to flow at whatever level the panels were capable of producing until a certain battery voltage was reached (14.4 volts); then, that voltage is held constant — allowing the amperage to slowly taper off until the batteries are completely charged.

This has been shown to be the best and fastest form of battery charging available with today's technology — but Heliotrope's new HPV22B controller (MSRP $295) adds several new features that significantly increases the system's usability.

The first change is an ON/OFF switch that eliminates the need to install a separate switch in the positive lead from the panels to turn them on or off. Solar energy is passive, but there are still times when you do not wish to have the panels operating — especially when you want your fully-charged batteries to rest after they have been recently charged.

Another notable improvement is an additional switch, marked DRY CAMP/SHORE POWER. When set to the DRY CAMP position, the controller functions normally, allowing full charging of the batteries from the panels. When set

Heliotrope HPV30

Xantrex Link 10				HPV30 Solar Monitor				Daystar Meter Remote	Scientific Weather		Charging Boost	
Time	Amp/ Hours	Batt. Volts	Amps	Batt Volts	Array Amps	Charge Amps	Stage	Insol.*	Temp.	Humidity	Boost Amps	% Boost
8:30	-43.0 Ahs	12.65 V	0.4 A	12.6 V	0.5 A	0.4 A	Bulk	050 w/m	50.7˚F	84%	0	0
9:30	-40.6 Ahs	13.00 V	5.0 A	13.0 V	3.5 A	5.0 A	Bulk	237 w/m	58.3˚F	71%	1.5 A	42.80%
10:30	-34.9 Ahs	13.05 V	7.1 A	13.1 V	5.0 A	7.0 A	Bulk	449 w/m	65.1˚F	51%	2.0 A	40.00%
11:30	-28.1 Ahs	13.25 V	8.3 A	13.3 V	6.0 A	8.2 A	Bulk	575 w/m	68.0˚F	50%	2.2 A	36.60%
12:30	-21.2 Ahs	13.5 V	8.7 A	13.5 V	6.4 A	8.7 A	Bulk	636 w/m	69.6˚F	49%	2.3 A	35.90%
1:48	-11.5 Ahs	14.3 V	8.0 A	14.4 V	6.4 A	8.1 A	Taper	627 w/m	74.1˚F	45%	1.7 A	26.50%
2:30	7.8 Ahs	14.4 V	4.4 A	14.4 V	3.0 A	4.5 A	Taper	566 w/m	76.3˚F	41%	1.5 A	50.00%
3:30	-6.2 Ahs	13.25 V	0.1 A	13.3 V	0.3 A	0.0 A	Float	424 w/m	77.9˚F	35%	0	0

**Note: Insolation readings based on 1,000 watts per square meter.*
Sky was clear all day.
The 1:48 reading was taken just as the changeover occurred between bulk and taper, thus the differences in the readings.

to SHORE POWER, however, an additional circuit is engaged and the voltage is allowed to drop to a "float" mode and held to 13.2 volts. If a small load (or loads) come on line, the controller allows the amperage required to handle the load to pass as long as the float voltage is maintained.

Heavier loads, however, can sometimes trip most controllers to return to the bulk-stage voltage — and if batteries are subjected to the 14.4 voltage for too long after they have been fully charged, they can become over-charged and the plates can dry out. The HPV22B eliminates this possibility. I installed one of these new units in my rig, and it controls my two-BP85 watt and one-AM100 watt panels. Recently, while driving down Interstate 5 in California (with fully charged batteries), I left the switch set to the SHORE POWER setting; periodic monitoring showed that the controller was holding my batteries to a constant 13.2 volts with no amperage output — yet when I turned several lights on, as well as the water pump, the controller delivered the amps necessary to handle the loads. Pretty good for a solar panel controller.

A step up is Heliotrope's new Model HPV30 — the first controller especially designed for motorhomes, since it has a separate circuit for keeping the engine battery topped off. Most owners of motorhomes are not aware that there can be a constant phantom load on the engine battery. This load comes from many circuits involved with the vehicle's dashboard instruments, LEDs, clocks, radios, as well as loads coming from the transmission computer and, if you have a diesel, its computer, as well.

These loads are never turned off, and these circuits can drain your battery if the rig isn't used for an extended period of time. That's one of the reasons it is advisable to start and run your engine often. Remember that if you have a one-amp load over 24 hours, this means your battery is 24 ampere-hours down.

The HPV30 controller (MSRP $395) recognizes that the house and engine batteries will drop in varying degrees during the night. When the panels are turned on, if the house batteries are below 12.8 volts the entire charge will go to those batteries. As soon as they reach 13.2 volts, then 3 to 5 amperes will be diverted to the engine battery (if its voltage is below 13.2 volts). As soon as its voltage reaches 13.2 volts, its amperage is allowed to taper off — and the rest of the amperage will again go to the house batteries. The controller does this whenever the panels are operating, and will keep the engine battery fully charged day after day.

The controller offers the full range of multistage charging: the bulk stage; the absorption or acceptance stage (Heliotrope prefers to call it what it really is — a tapering-off stage) and the float stage. The set points are 14.4 volts where the controller switches from bulk to taper stage,

Peak Performance

The Insolation Meter we used for this test measures the light falling on the panels, and its standard is 1,000 watts per square meter. The reading on the meter is a percentage of 1,000 watts; a reading of .485, for example, would be 48.5 percent of 1,000 watts. We did the math, using the charging rate of 8.0 amps and an insolation reading of .485, and found the two panels were delivering the amperage under this amount of sunlight brightness as would two panels of 144 watts each.

Eight amps divided by 485 watts gives a figure of 16.49; multiplying this by the peak power voltage of the average panel of 17.5 volts gives 288.75 watts. Since we have two panels, this would mean each panel was delivering the amperage of a panel of 144 watts. This excellent performance was because of the high rate of MPPT allowed by the combination of the HPV30 regulator and the extra high voltage of the AM100 panels.

and 13.2 volts from taper to float stage. All of the set points are fully user-adjustable, so if you have special battery requirements you can make adjustments.

The user can also select between two-stage and three-stage charging by setting a dip switch on the circuit board in the main controller. The change from the taper to float stage is also controlled by a timer. Often, light conditions are such that the controller will remain in the taper stage; to prevent this from happening, a timer will automatically switch to the float stage after two hours have passed.

Another nice feature of this controller is a built-in limit switch of 15 volts. Voltage above this can burn out 12-volt light bulbs, damage refrigerator circuit boards and other electronic equipment. The controller is also rated to handle 30 amps, and even if there are spikes of boost amperage above this limit, fuses will not blow; the controller simply will not allow an output of more than 30 amperes.

The HPV30 controller is also different in that the electronics are located in a large metal enclosure that can be placed close to the batteries, or in an equipment bay in the motorhome. A small panel is connected to the controller using a telephone-type cable, and can be placed anywhere in the coach where it is easy to reach and read.

This remote has a series of green LEDs to show you what stage of charge the controller is in: bulk, taper and float. A slider switch selects from house-battery voltage to charge amperage, and then the engine voltage. A small momentary switch is located to the right of the LCD screen; when pushed, the LCD reads the array amperage. The difference between the two amperages when the charge amperage is the higher value is the amount of "boost" the panels are delivering.

The controller's most important feature is the battery voltage sense line. This is a separate, non-load carrying line that is used just for measuring the battery voltage. (Most instrumentation measures voltage through other lines, which can have the actual voltage of the battery distorted by even the charging process, and the instruments read the charge voltage, not the actual battery voltage.) During our tests, the remote meter showed the exact moment when the battery voltage reached 14.4 volts, the set point where the charge cycle changed from constant amperage to constant voltage.

Heliotrope also has tweaked the MPPT circuitry to achieve and maintain the maximum amount of boost possible from the AM100 panels. Although the controller will work very well with any brand or wattage of panels, it was specifically designed to work with the AM100 units. I was amazed at the consistency of the boost with this combination. In previous tests with other panels and controllers, we found that the boost could be an occasional thing; tests with the HPV30 showed a consistent 30- to 45-percent boost for most of the day. On one cold morning, a cloud shift temporarily gave us an incredible boost of 71.4 percent.

The AM100 44-cell panels are built specifically for AM Solar. They have an extra eight cells beyond traditional 36-cell panels, which give them a peak power voltage of 21.5 volts. This extra voltage means the panels deliver more charging amperage earlier in the morning than will other panels, and the extra voltage is the reason for the good boost capability the controller and panels deliver.

On the accompanying chart is a column labeled "Insolation" — this data was from a meter that measures the intensity of the sun, and is based on the maximum light brightness of 1,000 watts per square meter, the test standard for all solar panel performance. You will notice that in our tests we never had a reading of 1,000, and most of our readings were in a range of 200 to 650 — since our panels were laid out flat, just as they would be on the roof of an RV, we never reached 1,000 or even came close to it. We were only using a little more than 50 percent of the panels' potential.

As noted by the chart, the two AM100 panels were still able to give good charging capability for two wet-cell batteries with a total of 210 amp-hours (AHs). We discharged the batteries to 43.0 AHs and 29.4 AHs on two separate days, by using a quartz light run off of a 300-watt inverter. (There was a slight discrepancy between our amp/hour meter and the total number of charging amps on the monitor panel, so the amp/hour meter must only be considered as an approximate value.) On the day of our test, the panels delivered 41.9 amps — or an average of 5.23 amps over eight hours. The boost was a total of 11.2 amps over six hours, with an average of 1.8 amps. The average percent of boost was 45.7 percent for the same time period.

A second day of testing reflected a charge amperage total of 27.5A, and the average was 4.58 amps during the six-hour day. On this day, we had the surprising boost of 71.4 percent — it only lasted for a few minutes, but it did deliver. Granted, we had extremely clear skies for the tests; I would consider this to be an exceptional two days of solar charging within the limits of the tests, using only two panels and two batteries. If anything, however, it allowed for fully testing a combination of panels and controller that demonstrated outstanding performance. ∎

For More Information

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