SUPPLEMENTING WITH SOLAR

As long as owners avoid energy-gobbling fridges, solar can supply 4WD and camper trailers' electrical needs. Workable alternatives include three-way units running on gas whilst camping, conventional 40-litre chest-opening fridges, or larger eutectic units.

It is *possible* to run conventional 60- to 80-litre fridges and even fridge/freezers from solar, but it needs a lot of solar capacity, particularly up north. With still-low solar efficiency, and 80-130 Ah/day plus draw of such fridges, it makes sense to supplement solar with a generator - or use only the latter.

How Much Energy Input

With 12-volt systems, modules produce 65%-70% of that seemingly claimed. A further 0.5% cent is lost for every degree above 5°C. (See p.30 for full explanation.)

In temperate climates a typical 120-watt module produces 85-90 watts and 80-85 watts at 35°C. For true output in amps, divide *claimed* wattage by 16-17 (ie. not 12).

At mid-2005 most 12-volt solar modules produce about 110 watts (9.1 amps) per square metre, weigh about 10 kg per 100 watts and cost $8-$10 per generated watt.

Amorphous modules (eg., Uni-Solar) are not affected by heat, but are twice the size.

Fig.9.1: Two solar modules comfortably run 40-litre fridge.

How Much Input

The solar industry uses 'Peak Sun Hours' (PSH) to quantify solar irradiation. A PSH can be seen as the contents of a barrel full of sunlight of known brightness. That barrel may fill in 45 minutes in Marble Bar, or 6 hours in a Hobart winter. When full, that's one 1 PSH.

The PSH maps (p.29) show average irradiation. Multiplying PSH, for area and time of year, by *actual* output of a solar module gives Wh/day and Ah/day respectively. The maps show mid-summer and mid-winter. The change is more or less linear in between.

Two by 120-watt modules should provide a minimum of 475 Wh/day (37.5 Ah/day) and a conservative maximum of 1000 Wh/day (83 Ah/day) at midwinter and midsummer respectively in most parts of Australia except the lower south in mid-winter. Those modules will run a 50-60 litre fridge, two or three halogen or compact fluros, and a TV.

What 12-volt modules *really* produce (at 25° C)

Nominal watts	Actual watts (amps)
32	21.7 (1.89)
64	43 (3.76)
80	54 (4.70)
100	68 (5.9)
120	81 (7.0)

Table 10a: Typical real-life module outputs, see also p.30.

Module Mounting

Solar modules work from sunlight, not heat. Cloud cover will cut input by half or so, rain even more. It's rare to have none.

The highest input is often on bright days with broken white cloud. Then, the sun is reflected back and thence down again to reinforce the direct rays.

The highest average input is with modules facing the sun. Mounting them close to flat loses 20%-30%. Rather than attempting to track the sun, add a bit more solar capacity to compensate. In this book such allowance has been made by adjusting the PSH figure.

The solar mounting used by Trak Shack and shown in Fig.1.14) is simple and effective but

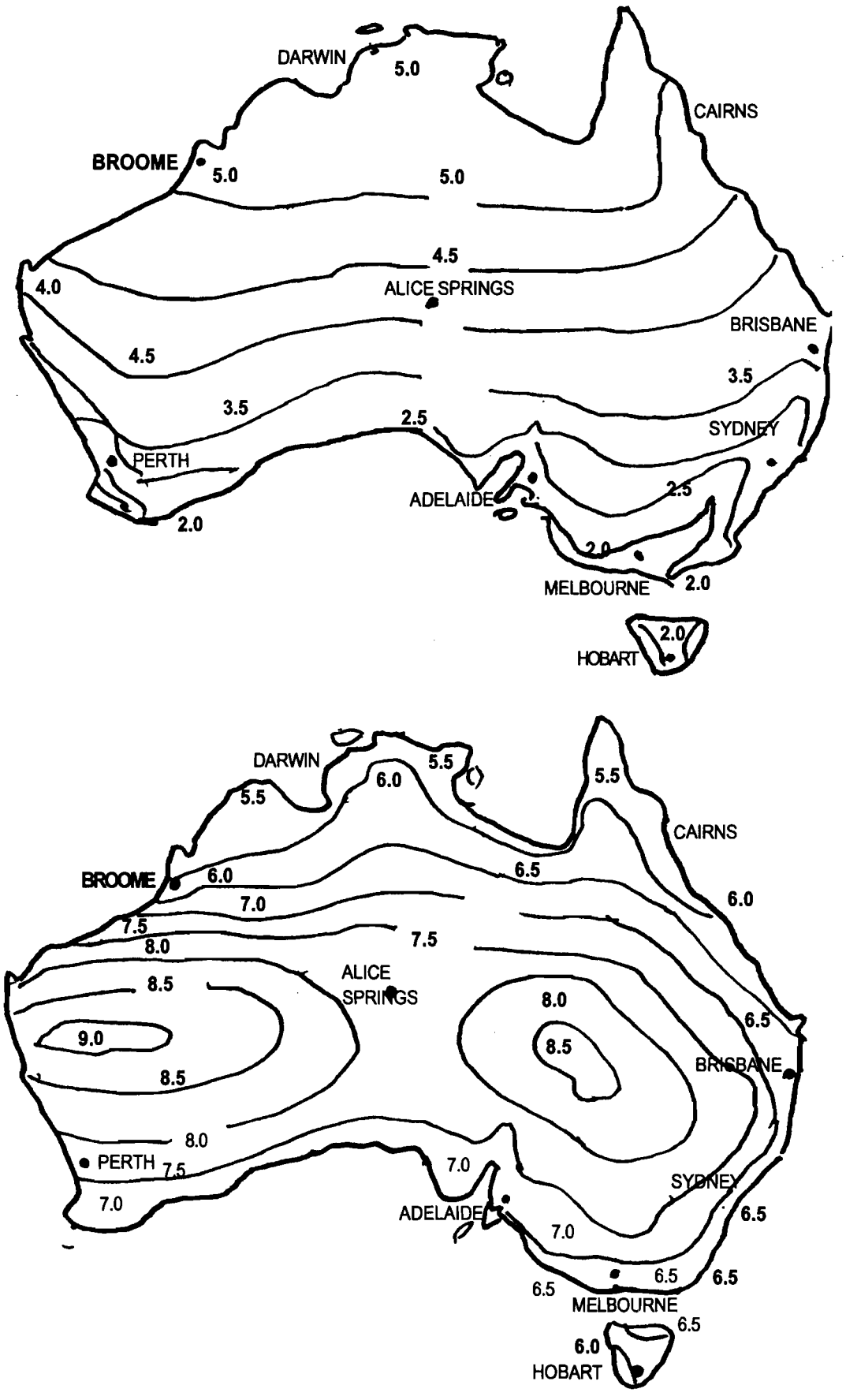

Fig. 9.2: Peak Sun Hour contours (top) July, (bottom) January. Multiplying true module output by the relevant number of Peak Sun Hours results in the module output for one day. There is no need to correct for changes as the sun moves across the sky. These (redrawn) maps are based on Australian Bureau of Meteorology data.

is heavy and necessitates the trailer being in the sun, although the modules provide shade.

Mounting modules on the roof of the towing vehicle enables the vehicle to be left in the sun, with the trailer in the shade.

My own preference is to have one or two modules on the towing vehicle and one on the trailer; the voltage regulator and one auxiliary battery also to be in the trailer, and a second battery in the towing vehicle.

Solar Regulators

Solar regulators control the output from solar modules. They ensure batteries charge quickly and deeply but are not overcharged, even if permanently connected. Some people do without a regulator but the risk of damaging batteries and equipment is very high, except

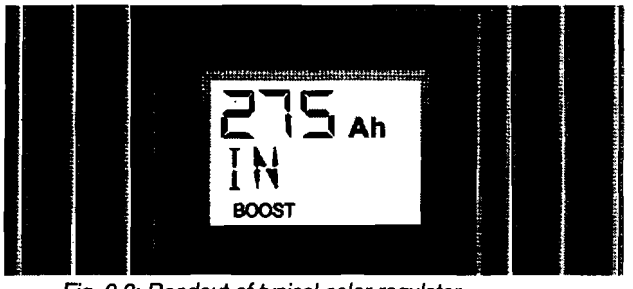

Fig. 9.3: Readout of typical solar regulator.

where < 5 watt modules are used to float-charge batteries of at least 100 Ah.

Budget regulators ($50-$100) are primarily voltage-sensitive on/off switches. As a battery gets close to full charge, they switch off. Then battery voltage falls and they switch on again - sometimes cycling many times a minute. They are cheap, reliable and more or less effective - but lack energy monitoring.

The more up-market regulators provide more efficient charging and have many monitoring functions. It is worth spending the extra money for these functions. Unless you have prior experience of solar you are unlikely to realise how necessary they are.

Functions may include: battery voltage; voltage across the solar modules; energy coming in now; energy being used now; total incoming energy so far today; total energy used since midnight; remaining charge (as a percentage of battery capacity); details of the present charging cycle and all or any of the above for the past 30 days.Some turn things on/off automatically at preset times.

Regulators from about $275 upward have programs for conventional deep-cycle batteries, gel cells, AGMs, and often sealed calcium batteries. Regulators will need setting for time, battery voltage and battery capacity. This is not hard once the manual has been read a few times. Teenagers are good at doing this - but not at explaining how. Alternatively, ask the vendor how easy it is. When being told it's simple - demand to be shown how.

Now You See it - Now You Don't

A 12-volt module that produces 120 watts should, *by definition* output 10 amps. But it doesn't, it produces about 7.1 amps. And 7.1 amps at 12-volts is 85 watts - not 120 watts.

To determine output, the vendors measure volts and amps separately. They then plot whatever combination gives peak watts - regardless of whether the voltage at which that is measured is 'usable'.

Most modules produce maximum power around 17.1 volts, and as that times 7.1 amps is 119.7 watts a module that does this is rated at 120-watts.

With a 17.1-volt system (which is as rare as a sardine singing Tosca), that module *will* produce what is claimed - on a really cold day with a bright sun. But into a typical 12-volt system it will produce 20%-25% less.

Figure 9.4 is an actual example. Here, Vpmax (voltage at which maximum watts are generated) is 16.9 volts. Ipmax (current at which maximum watts are generated) is 7.1 amps (ie 119.99 watts).

The second column shows typical output: stated *by the maker* to be 87 watts - and that's <u>still</u> at 15.1 volts!

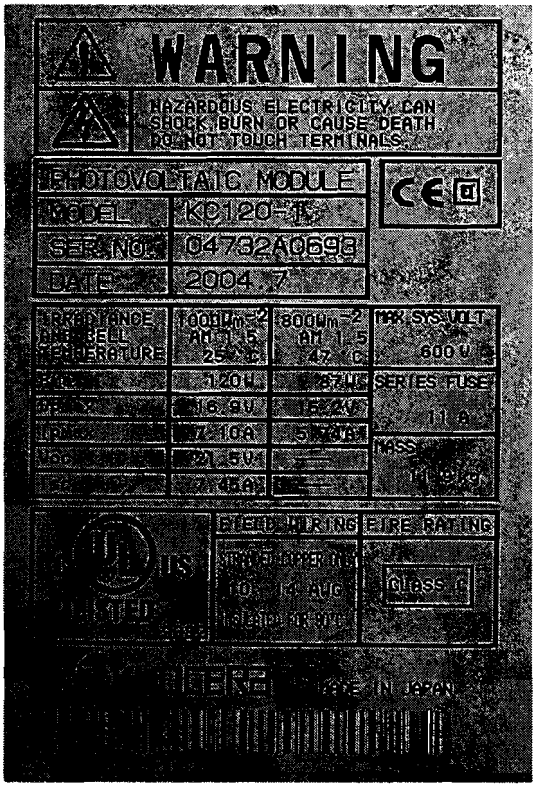

Fig.9.4: Data from an actual 120-watt module.