# An Auto-electricians Guide to Installing Solar - an ongoing series

**Collyn's office**

Many, (possibly most) RVs have minimal factory installed electrical systems that are primarily designed to suit the rental market and the generally similar private owner casual weekend use.

These systems are increasingly being based on ac/dc converters that typically provide 13.60-13.65 volts dc feed at up to 20-35 amps from the mains 230 volt ac supply. To quote one major supplier: 'The [products], designed for operation in RVs provide 'a dc power system, with optional battery back up'.

Rarely understood by many buyers, that 'battery back up' is intended for limited and occasional use. In US-built RVs it is often described as an 'emergency supply' (Americans presumably regarding the lack of their 110 volts supply as an 'emergency').

Some converters accept input from an alternator or solar but they do not control that input voltage or current..

As the typical circuit shows, the input and output circuit is a few centimetres of wire plus a diode (to prevent possible reverse flow) that introduces a typical 0.5 volt drop and thus all but negating the input's use for alternator charging or solar charging via that unit.

Also rarely understood is that the battery charging facility is minimal. In most, the battery is floated across the 13.60-13.65 volts output via a sensor that typically limits float current to 0.8-1.5 amps.

An override usually enables charging at higher current if the battery drops below a certain level of charge (typically 10.5 volts), but at a fixed 13.6 or so volts – not nearly sufficient for deep and reasonably rapid charging.

This is made fairly clear in the converter maker's specification: one such advises that a deeply discharged 120 Ah battery connected to its product is likely 'to take require 10 hours to attain 80% charge, and a further ten hours to fully charge.' Another states: 'in our testing a 125 Ah battery was fully discharged to 10.5 volts and then connected to [one of our] Converter/Charger set to our standard output voltage of 13.6 volts. The battery reached full charge in 70 hours.'

But not RV buyer in 100 is likely to see these specification, let alone realise the implications of that '70 hours'.

A few converters incorporate some form of multi-phase charging, but usually at via fixed voltages for bulk, absorption and floating – not the constant current required for effective initial bulk cycle (typically 80% of the entire charge time).

These systems work well and reliably for their intended usage - with charging limited to preclude battery damage. No criticism can reasonably be made if the RV is used as intended.

The inherent limitations of converter systems however are not necessarily understood, let alone made known to buyers, by RV vendors.

They cause any amount of woe for those do not realise they require a system that is virtually the opposite (in that 230 volt charging is the back-up - not the primary source of power).

Converter-based systems do not meet the needs of those who wish to camp for more than 24 hours away from 230 volt power; nor can they realistically be modified to do so.

Before attempting to do any work on any RV it is *essential* to establish if it has a converter system of this type (at least 60% of all locally made RVs have), and if so, how it is being used.

Most such will (just) cope with a single overnight stay if the vehicle has LED lights and appliances originally installed – and is driven for at least five hours the following day, and/or recharged overnight from a 230 volt supply. But limited charging capability is likely to preclude a *second* night away from 230 volt power.

### A Probable Second Issue

The widespread use of these converters presents a further and major problem: that of massive voltage drop.

Because these converters provide 13.65 volts output, the associated cabling typically recommended by converter makers is much lighter than that required operation at battery voltage. An actual table, published, by one major supplier is shown above.

| Current | $mm^2$ | AWG |
|---|---|---|
| 0-10 amps | 1.0 | 18 |
| 10-20 amps | 3.0 | 14 |
| 20-30 amps | 5.5 | 10 |

Typical converter maker recommended cable sizes. Apart from the vital omission of length, if followed (as they often are), these sizes will result in huge voltage drops if the system runs at typical battery voltage.

As can be seen, it makes no mention of conductor length. It is not known how many Australian RV makers follow the converter makers' recommendations, but, if used at battery voltage, the result is totally unacceptable voltage drops of 0.75-1.0 volt.

All that can realistically be done with any such system, if it is to be used away from 230 volt mains power, is to change the lighting to LEDs, and suggest the (often included) inverter-run microwave oven be used only in caravan parks.

Increasing battery capacity is pointless as apart from the huge voltage drop, the charging is inadequate for any purpose than the maker intended.

Making these systems suitable for 'free camping' usage inevitably involves replacing that existing cabling, excepting that for lighting as long as LED globes are used – (these draw so little current that the existing cabling will be fine – and if not - LEDs are not that voltage sensitive anyway).

Apart from cable runs of a metre or so, the cabling may well need to be four or more times the original size.

The voltage drop is L X I X 0.0164 divided by the cable size in sq mm. L = conductor length, I = current in amps.

(Some people use 0.017 instead of the marginally more accurate (ISO standard) of 0.0164. It upsets purists, but 0.017 is easier to remember and makes next to no odds anyway!).

The converter cannot be modified. It needs replacing either by separate units, or preferably a BMS (Battery Management System) that includes the totally recommended dc-dc alternator charging, solar regulation, and often a 15-25 amp mains voltage charger, plus energy monitoring in one unit.

The hard part is not doing the work, but in breaking the news to the customer that there is no realistic choice. It is case of changing virtually the entire system. Or using it only in the way its maker had intended - and for which it works well.

Here is what major US RV electrical equipment supplier (Ample Power Co) says: "If you want to live unplugged from the AC power pole, the RV converter has to be removed. Call your local recycler and have them recover the copper wire in the transformer. There's no fix that can be done".

Not *all* RV are built this way, but commercial reality is that most are made with the assumption that 230 volts will be available almost all the time, except whilst driving.

Some, usually small production RVs, have proper chargers (or, and increasingly) BMS systems and are able to cope with two days away from 230 volts, but very few indeed have enough solar capacity, and only rarely have adequately sized cabling.

No RV system that uses solar as a major energy source should have more than 0.2 volt drop across any circuit (excepting for LED lighting). The starting point is to ensure that it is so.

If the owner does not accept that, try to explain why that is bad for both parties: that unless the work is done thoroughly, the system cannot possibly work as hoped for – so it's bad for the owner.

I suggest also advising that attempting to 'repair' that, which is not so much a fault, but an intended design characteristic, is not feasible - and to attempt to 'improve it' is bad for your reputation. Maybe give him your business card and tell him to come back when he is convinced.

Consider this: one auto electrical company (in Brisbane) that has specialised in this for many years, has customers travelling from as far away as Tasmania to have the work done properly.

I will write a simple explanation of why this issue is costly to fix – that hopefully your clients will understand. I will place it on my website shortly.

It will be called '*Converter Issues*' and will posted in the Articles section of my main website: www.caravanandmotorhomebooks.com.

Feel free to reprint it and give it to your customers (by all means add your business details – but please retain ours!)

It will also be published (in a longer form) in the March issue of the CMCA's 33,000 plus copies *The Wanderer* magazine.

None of the above is in any way intended as a criticism of converter systems. The problems discussed arise only if they are used for a purpose for which they were not originally intended.

## Learning More Right Now

For those seeking to know more right now, please see our Auto-electricians' Offer for the (August 2012) released 3rd Edition of *Solar That Really Works*.

That offer – of providing *Solar That Really Works* at a special reduced price has proved so popular that it is extended until further notice.

Following several requests, we also provide a special price for TAFE Institutes seeking to buy in bulk, and also for any company wishing to stock and resell the book to customers. Please call us regarding this on 02 9997 1052. Or email collynr@bigpond.com.

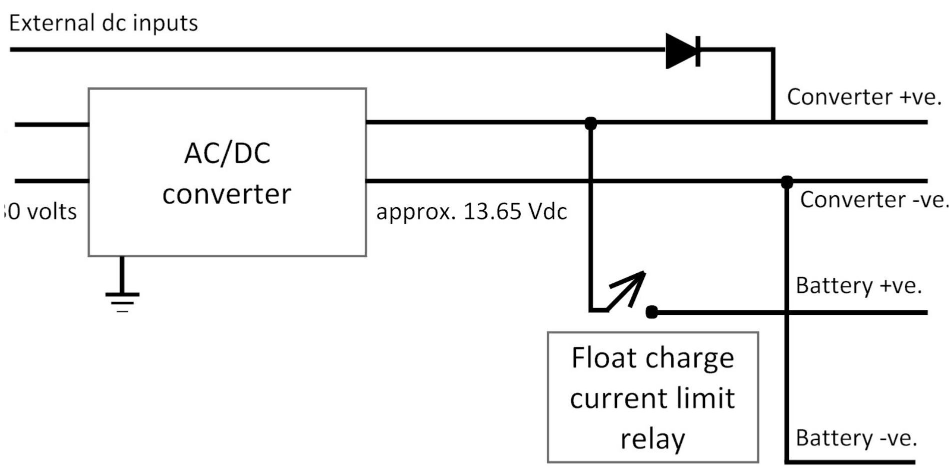
As some auto electrical companies are buying a copy for *each* of their staff, we provide an additional 10% discount for three or more. (We also extend this to buyers who may wish to group to place a single such order).

A similar offer will apply also to our new *Caravan & Motorhome Electrics* – available at much the same time you receive this issue of this journal.

The content of this current series will later be rewritten, expanded, and produced in print and eBook format.

For previous parts- see aaen.com.au






*A typical converter. Most are a basic 230 volt- 12 volt transformer with a full-wave bridge rectifier, but a few later ones are the more efficient switch mode converters. There is usually a low battery cut-off switch that (in some) is voltage adjustable. A few include multi-voltage charging, but still at fixed lowish voltages. Drawing: © www.caravanandmotorhomebooks.com*