Installing dc-dc chargers - known problems

Collyn's office.

The recent trend to dc-dc alternator charging was inevitable, not least as it resolved so many previous problems in one go. It is the approach I recommend on my website and all recent published articles. I am also currently finalising the rewriting of two of my books - and both will recommend that this approach be taken regardless of the age of the vehicle. And explains why, and how it should be done.

Some owners, electrically competent or not, fit the units themselves, but most have them installed by auto electricians. Feedback from my book and magazine readers, however indicates that not all are 100% happy with the results. But rather than blaming the installation, they bad mouth the products.

The cause may a misunderstanding of manufacturers' (correct) statements that the units 'accept a range of input voltage' (typically as low as 9 volts to 18 volts). Not all installers however appear to realise the consequences of reduced input voltage.

This is possibly because battery makers, some auto electricians, and almost all DIY installers think in terms of amps (and amp-hours).

Energy matters!

What we are dealing with here now is available electrical energy, i.e. watts. And that is the product of amps and volts and, if over time, amp-hours time volts (watt-hours).

An alternator under load produces (say) 14.0 volts at a probable 70 amps. That is a maximum of 980 watts.

That 980 watts is the total electrical energy available for running the entire vehicle's electrical needs - including that left over for running fridges and charging auxiliary batteries.

That 'left over' energy is likely to be a maximum of about 35-37 amps at 14.0 volts (about 520 or so watts).

Prior to dc-dc charging any voltage drop between that alternator voltage and the battery limited the charging current accordingly. It did that because a far from uncommon 5% drop in voltage resulted (on full load) in not 14.0 volts, but often only 12.8 volts - and that in terms of available electrical energy is no longer 520 watts. It is about 475 watts. That 45 watt difference is lost forever - as heat energy along that cable.

Where that battery is in a caravan it is not uncommon for that voltage (under even light loading) to be little over 12 volts.

As auto electricians (but rarely their customers) will be aware, it's the internal resistance of the auxiliary battery, as well as the voltage across it at the time, which limits charging rate.

Internal resistance may thus limit a 70 Ah battery to accepting little more than 20 amps and, as cable voltage drop is proportional to the current flowing through it, the voltage drop will be less.

That still limits charging, but nothing like to the same extent as (say) charging a far from uncommon 450 Ah battery bank. The latter is more than capable of accepting that theoretically available 37.0 amps but cannot possibly do so because the available voltage is now far too low.

Heavy cable still required

In practice, the reduced charging voltage hugely restricted the ability to charge any but single auxiliary batteries. It is why users and installers are urged by battery charger makers (and writer/engineers like me) to use seriously heavy cable to limit that voltage drop.

Prior to dc-dc conversion, too light a cable thus precluded fully charging any auxiliary battery.

But, as astute readers have worked out, any energy lost as heat along that cable is no longer available its far end - no matter what is connected there.

Juggling volts and amps

A dc-dc charger acts much as does a torque converter in an automatic car. But instead of juggling horse-power and torque to optimise available power, it juggles volts and amps to optimise charging. Both expend energy in doing so, but the overall gain in operating efficiency makes that well worth while.

In effect, a dc-dc charger increases the voltage from that incoming to whatever is required for optimum charging. But, if that voltage is lower than the alternator voltage, because some energy is lost as heat (via voltage drop) along that cable, it can only compensate by drawing even more current down that cable. This further increases the voltage drop - and thus loses yet more energy. And that may not be available from the alternator.

Technical staff at companies like Redarc and Optima are not dummies. They know all this too. They thus make it very clear in their installation instructions that heavy input cable is still required.

But, to a lot of people, including one fears, some auto electricians, installation manuals seem only for newbies, softies and year one apprentices, all of whom thus have a statistically better chance of getting it right!

Energy lost

Meanwhile, DIY types in particular argue that as vendors say it can cope with 9.0 volts input, then even a close to 4.0 volt plus drop does not matter.

If so installed, that dc-dc charger will indeed be able to charge to some extent. But it will be massively limited as that voltage drop will cause close to a third of the available alternator output to be lost as heat. It may still thus charge a small auxiliary battery quite well, but cannot possibly do so with larger ones.

And that, to a fair extent is what

An elegant way of housing the readout. Pix: Redarc.

feedback from my book buyers and magazine article readers claim is now happening.

So whilst dc-dc chargers assist to optimise charging, there is no way they can recover energy lost as heat along too-light connecting cables. At least the minimum size cable specified must be used.

The products work even better connected by cable heavier than specified.

Auto-cable trap

Many DIY installers do know this. They realize that when the manual says that 4.0 sq mm or 6 sq mm cable (or whatever is required) that's what they seek to buy.

Redarcs's globally selling BMS series. Pix: Redarc.

They go to Bunnings or an auto parts store, and ask for 4 sq mm or 6 sq mm cable. But that's not what they are sold. What will be supplied is 4.0 mm or 6 mm auto cable.

Auto electricians know that this is typically 1.8-2.0 sq mm, and about 4.7 sq mm respectively. But the typical buyer does not know that. Let alone that this absurd rating tells you only the size hole you can just push it through!

Or they may ask for (say) '50 amp cable' - totally unaware that 'rating' is simply, and only, the maximum current that cable can carry before its insulation melts.

All of that too is totally obvious to the product makers, but it is not to the buyers of their products, nor most motoring or RV journalists. To my reasonable knowledge, my books and articles are the only ones that disclose it - and warn of the consequences, but as far from all read them, DIY installers may build in even greater voltage drop.

Collyn Rivers

The writer is an ex motor industry research engineer, who later switched careers to become a technical magazine editor and then writer and publisher.

His main books in the auto electrical our area are his very popular Motorhome Electrics, it covers caravans and camper trailers as well, and is updated each year.

Also being ordered extensively (even ahead of publication) is his all-new and expanded (2nd Edition) Solar That Really Works). This covers solar installation in depth.

Also new is as equally fully revised and expanded Camper Trailer Book - including a great deal on their design and construction.

Collyn's website is: www.caravanandmotorhomebooks.com.