CADAL CRAFT

HOW TO SIZE AN INVERTER/CHARGER

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I was asked once if a 2kW inverter charger was the right size for a 54 foot boat. This inspired me to write the following - I hope it is useful and clear enough to understand. Obviously there are other factors which can come into play which are not mentioned here, but I think I cover the main points.

Question: - Is a 2kW inverter big enough for my boat?

Answer:

The power output requirement of an inverter/charger is determined by these factors

[1] The instantaneous peak load you wish to take from it.
[2] Expected continuous high load.
[3] The size of the battery bank.
[4] Power factor of devices connected to the unit
[5] Ambient air temperature.

Things which the size of an inverter/charger is not determined by

[1] Interest rates
[2] Belief or otherwise in the existence of God
[3] Boat length

... amongst many many others!

Humour aside there are the following considerations:

Considerations:

[1] Instantaneous peak loads (many air-conditioners have this) you may see in product descriptions as startup loads. These may last from much less than a second up to around 5-8 seconds depending on a device. Victron inverter/chargers can deliver double their rated capacity for such startup loads but no more.

There can be unexpected problems - I remember one famous brand of giant fridge a customer put on a boat which had a continuous power requirement of only around 200W. But the load the compressor took every time it kicked in, which is several times an hour, was in excess of 2000W - ten times higher. It burnt out an 800kVA inverter very quickly.

[2] Dishwashers, washing machines, toasters, kettles, coffee machines: all of these items have continuous high loads in the range 2kW-3kW. If you are putting these aboard your boat you may need a much larger inverter/charger than you think.

[3] You must make sure, if at all possible, that the charger part of your inverter/charger has an output in the range 0.1C to 0.25C.

C in this equation is your battery capacity in Amp Hours.

Lets take an example , say you have a 300AH, 24V battery bank. This means your charge capability should be in the range 0.1x300 to 0.25x300 which is 30A to 75A 24V output.

If you select inverter/charger(s) which have too high an output to stay in this range we can program it/them to be lower output (well as long as they are Victron ones). If you select one with charge output which does not ever get as high as 0.1C, you are in danger of frying your batteries: the voltage may never drop down to storage levels as the float current of your batteries may be too high for the algorithm in the charger to recognise it as a float current, and thus reduce output voltage, but instead the charger proceeds to output a charge voltage of 13.8V or higher shortening the battery life.

[4] When an inverter is producing power it's actual peak continuous output is strongly affected by ambient air temperature. to take a 2kVA example: at 25C you might get 2kVA, but at 40C you might only get 1.6KVA. All inverter/chargers that I know of have a similar de-rating due to high ambient air temperatures. It may prove sensible to provide some air-conditioning to your inverter/charger, or at the very least high throughput (and perhaps forced) air ventilation.

[5] The actual peak continuous power that an inverter/charger can deliver is also determined by the type of device you are running. Some items have a Power Factor of 1 - ie 2kVA=2kW, other devices you might find a power factor of 0.8, ie 2kVA=1.6kW. Or even lower power factors. I seem to remember that some dive compressors have a power factor of only about 0.7 for example. This may mean apparently oversizing the inverter/charger. For AC devices VxA does not always mean W...

Sizing Example:

I have been designing a canal boat which is now in build. I am wondering if I should put in either

2x2kVA, 2x3kVA, 1x5kVA or 1 x 8kVA inverter/chargers.

Paralleling them means a higher expense, but some level of redundancy at a lower power output if one of them dies.

I intend to run washing machines/kettles/toasters on this boat so a 2kVA output inverter/charger is too small, and a single 3kVA could have trouble on a hot day.

The design then evolved to eliminate gas cooking completely (which means our vents on board can be a lot smaller as there are no CO producing devices on board, which also means less air interchange is required, which means a lot less heating required).

This means running an electric hob and oven. You can get electric hobs which automatically limit the power they put out so they cannot overwhelm a standard 13A socket - which can take 3kVA continuous. Ovens typically run at around 2kVA which implies a 5kVA unit or twin 3kVA units.

But I know that we want to be able to run a hob, and oven and a microwave simultaneously which means able to run 2x3kVa (hob and cooker) + 1 kVa (microwave) at the same time. Might be nice to have the telly on as well - so we need to plan for peak continuous loads of 7-8kVA which means the 8kVA unit is needed. The 8kVA unit from has a charger running at 200A at 24V, which means a minimum battery capacity of 800A at 24V which is approx 20kWh battery bank. In fact we are running this boat at 48V and have a 30kVA battery bank so we can use all of the capacity of the charger when we plug it in.

Your boat, your calculations of course!.