BALMAR® WWW.BALMAR.NET DC CHARGING SOLUTIONS

Case Study

Silent Running – A Case for 48V Systems

July 2020

Introduction

Balmar's 96-Series 48V alternators provide impressive power generation in a compact package. Their typical use is as a secondary alternator to quickly charge a high-capacity battery bank. It is an ideal charging source to replace a small genset when charging high-performance batteries such as AGM TPPL, Carbon Foam and $LiFePO_4$. With careful system design and application, the result can be extended use without running an engine or generator.

Benefits

The primary benefit of a 48V system over 12V is improved efficiency of both power generation and power inversion. There is a compelling argument in favor of a 48V system when designing systems with large electrical loads. On boats and RVs, this typically involves loads like air conditioning and induction cooking.

Case Study – Running air conditioning without a generator

Every season, Marine and RV service professionals receive requests from customers asking to run air conditioning or electric cooking from batteries. They want to keep the cabin cool overnight without the noise of a generator. They also want to remove the safety issue that propane fuel introduces. The answer in most cases has been that the charging and energy storage system required is too big, too costly or too complex, often all three. However, what is difficult to achieve at 12V is often achievable at 48V. There are many installations where the only practical 12V-only solution is the addition of an AC genset.

A dedicated 48V system for this purpose is comprised of three major components:

1. A 48V battery bank, either of high-performance AGM or LiFePO4 batteries
2. A 48V alternator and external regulator: (http://www.balmar.net/96-series-48v-alternators/)
3. A 48V Inverter/Charger.

48V Advantages:

1. Power Take-Off: A 48V alternator uses less horsepower to generate the same wattage as a 12V or 24V alternator. At a sustained 90A output (4400 watt) output, the engine power takeoff is just over 9 HP. This is 1-2HP more efficient than a 12V alternator producing the same power. See Exhibit I to review the Balmar 96-Series output and PTO curves.
2. Total Power: A 48V alternator is able to produce significantly more sustained power than the highest output 12V alternators available - regardless of case size.
3. Inverter Efficiency: The typical 12V inverter is 90-93% efficient. 48V inverters are typically 95-96% efficient, and some even achieve 97% efficiency.
4. Inverter Size: 48V inverters are much smaller than their 12V counterparts.

5. Wire Size: DC from a 48V Inverter/Charger to the batteries is 4x smaller in cross section than a 12V system. This also adds the possibility of further increasing efficiency with slightly oversized cabling resulting in a lower resistance and voltage drop.

Consider the following use case. A vessel wants to run the air conditioning overnight, roughly over an eight hour period. The A/C will be running ½ of the time, so 4 hours total run time. The Installation also has some other loads such as refrigeration running overnight. AC Unit: 16k BTU, drawing 10.4A @115V + 2A for water pump.

12V System:
AC Unit draws 99A + 19A for pump (DC Amperage) = 118A. Inefficiencies (inverter, voltage losses) add 9% = 128.6A * 4 hours run time = 514.5Ah. Additional night time use of 25Ah. TOTAL battery draw = 539.5Ah overnight.

48V System:
AC unit draws 25A + 4.8A for pump (DC Amperage) = 29.8A. Inefficiencies (inverter, voltage losses) add 4% = 31A * 4 hours run time =124Ah. Additional night time use of 6.25Ah. TOTAL battery draw = 130.25Ah overnight.

Now let's put that power back into the batteries. Assume we are using a $LiFePO_4$ battery system. For the sake of simplicity, we are going to ignore any inefficiencies in charging, which are quite low when using a $LiFePO_4$ battery bank.

12V System:
Limiting ourselves to a single alternator, and excluding extra-large case sizes, the highest output small-mid case 12V Balmar alternator is the AT-Series producing 220A. Running the alternator at 3500 RPM provides 187A when hot. To replace the 539.5Ah removed, it will take approximately 2.9 hours of running time, not considering charging and battery efficiency losses.

48V System:
With the 96-48-100-K8 alternator, running hot at 3500 alternator RPM results in a 75A output. 131.5Ah/75 = 1.73 hours to recharge. That is over 60% faster charging!

But what if we don't exclude extra-large case size alternators? The highest output Balmar 12V alternator is the 98-Series 98-12-310 producing 310A. The US Coast Guard uses three of these alternators (24V version) on their 47 foot surf rescue boats. It is a big, heavy alternator that is typically not suitable for installation on smaller diesel engines. At 3500 RPM, it is generating 228A when hot. Even using this "monster alternator", it would take 2.3 hours to recharge the batteries!

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Summary

Simply put, a 48V system is more efficient at generating the power, and also when paired with a 48V battery bank is more efficient when consuming the power. It can negate the need for a small genset, with the associated installation costs, maintenance costs, space constraints and acoustic headaches.

Balmar's 48V 96-Series alternators include two power offerings, a 60A version (PN 96-48-60-K6) producing up to 2.9kW and 100A version (PN 96-48-100-K8) producing up to 4.8kW. For additional information, please download a datasheet from the following link:

http://www.balmar.net/wp-content/uploads/2020/03/PDS-96-48-100-K8.pdf

Disclaimer: Overall system performance and efficiency is a complex interplay of all components and connections working together. This is a not a promise of specific performance. It is intended to illustrate what may be possible given a careful system design and installation along with responsible usage.

Balmar Technical Support is available from 8:30 am – 7:30 pm EST Monday through Friday. Please call on us at +1-360-435-6100 x3 should you have any questions about Balmar products.