12v Battery Charger

Our goal for this project is to build a engine driven battery charger for the off-grid home. A off-grid home is built around a battery bank, with a variety of ways to charge them. We use a combination of solar panels, wind turbines, and engine driven battery charger, the focus of this project. The battery bank then feeds a Inverter that provides “normal” 120vac house current. See the List of Materials in Appendix 4.

Sizing the engine to the Alternator:

You can calculate the HP required for a 100 Amp alternator as follows. Assume 100 Amps at a full charge setpoint of 14 Volts. 
\[ V \times A = \text{Watts} = 1440 \] where \( V \) = Voltage; and \( A \) = Amps. 
There are 746Watts per HP and dividing 1440 by 746 yields 1.93. 
Doubling this for alternator inefficiency and engine aging yields 4 HP. Now add 1 HP for the belt. The final result is 5 HP. Remember that this is 5 HP at the RPM chosen. Engine manufacturers usually specify HP at the very peak possible. Such a rating is not a good indication of usable HP in a reliable setting. Derate engine specifications accordingly.

We started with a 6.5 hp horizontal shaft engine and a 60amp “P” type alternator (GM 10SI). These can be found used in a variety of machines used for gardening and kids go-karts. A vertical shaft engine could also be used. We add a alternator bracket, a pulley, and a belt. We took the engine and the alternator to the
We used 4 bolts for the legs, with 2 flat washers, one lock washer, and nut for each of the leg bolts. Another 4 bolts, with lock washers for bolting the alternator bracket to the crankshaft face, and two bolts for the alternator, one with 2 flat washers, a lock washer and a nut, the other with a flat washer and a lock washer (the case is threaded, no nut).

We picked a tossed aside shelf from an old department store to screw together furniture project as a base for this project.

Take a sheet of paper and place it on the bottom of the engine. Poke a pencil through the mountings holes on the bottom of the engine to create your mounting hole template. Then place the paper on the board, and drill the mounting holes.
Now bolt the engine to the board, with the bolt heads and a flat washer on the bottom of the board, and flat washer, lock washer, and nut on the engine legs. We used round head bolts, but next time I’d use hex head to keep the bolts from turning when tightening.

Next, we take the alternator bracket, and bolt it to the engine, using 4 bolts with lock washers. Then slide the pulley onto the shaft, with the key inserted, and slightly tighten the Allen screw. The pulley will be adjusted once the alternator is installed.

Now bolt in the alternator with the two alternator bolts. Install the belt, and adjust the tension, and tighten down the alternator.
Depending on your alternator, you may have to install a 10 ohm 10 watt resistor between the number 1 terminal on the alternator and an ignition source to properly excite the alternator.

For enhanced charging, install a externally regulated “P” type alternator, and use a 3 stage charge regulator. See Appendix 1.

Install an ammeter like a Trimetric from Bogart Engineering between the battery and all loads and charging devices to monitor the amount of electricity generated or used. See Appendix 2.

For a battery, we used a Type 27 Deep cycle from Walmart. This is a 12vdc quasi deep cycle that will work for this project. A Optima Yellow Top would a better option.

We then connect a 400 - 700 watt inverter (you can use a larger one if needed) to provide the 120vac house current.
Connect a solar panel (or array of solar panels) with a charge controller to the battery, to reduce engine run times. We recommend a Harbor Freight 45 watt kit(s) for this project and Sunguard 4 amp charge controller(s) (Do not use the HF included controller). The 400 watt wind turbine with 60 watt PhotoVoltaic array and inverter would be ideal (http://www.green-trust.org/products).

A propane conversion kit can be added to eliminate gasoline usage, reduce the risk of Carbon monoxide poisoning, and clean up emissions and increase convenience. A grill bottle or regular house sized propane system works fine. See Appendix 3.

Solar and propane conversion eBooks are available at http://www.green-trust.org/ebooks/

For help sizing a system based on your expected loads, see http://www.green-trust.org/2003/pvsizing/default.htm
Appendix 1:

Smart Charging

The Ample Power Smart Charger will maintain a bank of house batteries with 3 stage charging and temperature compensation, as well as maintain the starting battery as an isolated device.
Appendix 2:

Bogart Engineering Trimetric Battery Monitor

Magnified view of 5 SCREW TERMINAL STRIP located on circuit board:

**M- terminal must be connected to + with short wire (except as noted on page 3 of instructions. For unusual cases... **

IMPORTANT NOTE: The two wires G1, G2 must be connected to each other ONLY right at the shunt terminal at the small screw (Kelvin connection) for accurate current measurements. Don’t connect them together at the meter and run one wire to the shunt. Otherwise meter will show residual “amps” when it should be showing zero.) Also, good connections must be maintained for accuracy.

**NOTE: The SIG wire must be connected to the small screw (Kelvin connection) on the shunt, not the larger bolt which connects to the battery. Otherwise “amps” measurements will be inaccurate.**

FOR SAFETY: Place a 2 amp (fast blow) fuse in series with the + wire near the battery, as shown. That way, if there is ever a short between this wire and the other wires, you won’t melt down the wires, you will only blow the fuse.

SHUNT TO METER CABLE: Can be up to 150 ft. long if cable has #18 or larger wires, or 50 ft using #22 wires. Twisted pair wire should not be necessary. However, if it is used, we recommend wiring it as shown in the diagram. Use one twisted pair for the G1 and + wires, and another twisted pair for the G2 and SIG wires (as shown). For long cable runs, the M- terminal can be connected separately as described on page 3. For unusual cases...

**KELVIN CONNECTIONS:** These are the two smaller screws on the shunt which should be used for current sensing wires only. For measurement accuracy, never connect wires containing high currents to these connections.

**SYSTEM GROUND:** (if used) Be sure the negative lead from your solar charge controller is NOT connected here — but to the other side of the shunt! Otherwise the Trimetric will not measure your solar sheets.

**12 OR 24 VOLT BATTERY SYSTEM:**

**SHUNT:** 50 MV/500 AMP OR 100 MV/100 AMP

**TO CHARGING SYSTEM (SOLAR PANELS including controller, CHARGER, ETC.) AND ALL LOADS (INVERTER, ETC.)**

**SHUNT NOTE:** Use either a 500 amp shunt or 100 MV/100 AMP shunt. Shunt must be connected to minus side of battery. To read correct current and amp-hours, Trimetric battery monitor must be programmed for correct shunt type being used, as described in instructions.
Appendix 3:

Propane / Natural Gas (Methane) / Gasoline Tri-fuel Operation (Type C Kit)
Appendix 4:

List of Materials


One type C Propane conversion kit - http://uscarb.com/a-c_kits.htm

One Pulley / Bracket kit w/ ext. reg. alternator - http://www.theepicenter.com/tow02077.html

Assortment of bolts, nuts and washers from hardware store - metric if using the HF engine.

4 (engine mounts)
4 (bracket to engine)
2 (Alt to bracket)


Battery - Anything from a Walmart Type 27 Deep cycle to a Optima Yellow Top (preferred)

400 watt wind turbine w/ 60 watt Solar PV and inverter - http://www.green-trust.org/products/

Living on 12vdc / Wiring for 12vdc recommended - http://www.green-trust.org/products/


All these components, and a fully designed system can be obtained from:

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http://www.green-trust.org