CHOOSING AN AC DRIVE FOR YOUR EV.

by Dickson Beattie, November 2008.

INTRODUCTION.

When choosing between AC and DC drive for your EV, be aware that AC is by far the less trodden path for your home conversion. There are not many people you could consult or many AC electric cars in Australia you can test drive. That said, the rewards are worthwhile. You can expect a great performing, smooth drive, with regenerative braking as a standard feature and a controller that is fully computer interactive and programmable - great for all tech heads and computer geeks with deep pockets!!!

MOTORS.

Three phase AC motors and controllers are common place in industry.
There are only two types of AC motors you can choose from induction and synchronous.

The synchronous motor gets its name from the fact it will run at exactly the speed of the frequency of the voltage that is supplied to it (i.e. speed is synchronised with frequency). The synchronous can use magnets in the stator and makes a great generator, however is not often used for EVs, this type of motor is used to drive the TGVs (very fast trains) in Europe.

The induction motor is very common in EVs. It is so named because both the stator and rotor are made up of wound coils that use an induced magnetic field to create movement. The induction motor was invented by Nikola Tesla in 1892, the man whom the modern day all electric sports car was named after.

CONTROLLERS.

This is where your decision must be made. You will want to chose the controller which has all the smarts inside and take the induction motor that is matched to it.

An AC controller must be used to make the AC motor run. It also controls speed of motor and is an inverter, inverting a DC supply into the AC voltage (also called VSD variable speed drive or VFD variable frequency drive). Basically the controller inverts the DC to AC by using 6 transistors to send 3 out of phase positive pulses and 3 out of phase negative pulses to the motor giving a stepped wave form. AC controllers and motors are matched together - the controller is designed specifically for the motor and therefore can get maximum power and efficiency from that motor unlike in DC the controllers are used for various motors.

Not to be biased but my EV driving experience has been driving an Azure motor and controller in my Hyundai Getz....using Azure as an example:
The AZURE DYNAMICS range of AC controllers and motors:

- AC 24 motor/ DMOC 445 controller. Designed for cars up to 2 tonnes... 40kw peak (54 hp).
- AC 55 motor/ DMOC 445 controller. Designed for cars 2-5 tonnes...
- AC 90 motor/ DMOC 645 controller. Designed for trucks...

All controllers are computer programmable, have in built over and under voltage protection.
Analogue outputs include- speed, safety interlock, forward/reverse, regenerative braking on/off, brake lights (on whilst regen braking), reverse lights, power/economy modes. kits include wiring harnesses, forward/reverse selector, accelerator POT, power setting and regen braking switches.

PERFORMANCE.

My Hyundai Getz performance:
Petrol- 1040kg kurb weight (pre conversion).
Fully Electric- 1215kg kurb weight.
0-60km/h....6 seconds.
Top speed....120km/h.
Range....120kms.
1st gear....up to 60-70km/h.
2nd gear....up to 120km/h.

COST.

Total cost of my conversion was $28,000...(using Lithium Ion batteries at a cost of $9,000)
Controller around $4,500.
Induction motor around $3,500.

ADVANTAGES.

Of course the biggest advantage of AC is having regenerative braking (i.e. recapturing kinetic energy whilst the car is slowing down). 'Regening' can add up to 30% to the range of your car and also saving wear on your brake pads.

- More advantages of AC systems-higher voltages/lower currents are used therefore less demanding on batteries also allowing smaller conductors to be used.
- Programmability (computer interactive).
- Some controllers can also be used as the charger for the batteries.
- Electric reverse is easily done by controller -just swapping 2 phases.
- Much better performance up hills.
- No brushes to replace.
- Constant torque over a larger rev range (i.e. less or no gear changes).

DISADVANTAGES.

The disadvantages of AC controllers are shown in comparison with DC controllers.

Advantages of DC controllers:

- Lower cost,
- Simplicity,
- Controller is physically smaller and are able to take high over current spikes for a short time (i.e. for short bursts of acceleration (good for drag racing).
- Regen is still possible with DC.

CONCLUSION.

In conclusion I believe DC is the domain of the home converter and will always be popular with them for the cost efficiency and simplicity reasons. However I think AC is the future for production EVs, the complex power electronics is becoming much cheaper and the gains in power and programmability of a AC system will attract the car manufacturers as we have seen AC was used in the General Motors EV1, Ford Ranger EV, Toyota RAV4 EV and today in the Toyota Prius, AC Propulsion and the Tesla....

Other manufacturers of motors/controllers-

- Siemens,
- Curtis,
- Danfoss..

Suppliers of controllers-

- Blade Electric Vehicles (Azure),
- Electric Power Solutions (Australia).
- EVPower (AC & DC motors and controllers)...

For further information, the World Wide Web is full of it!!!!!