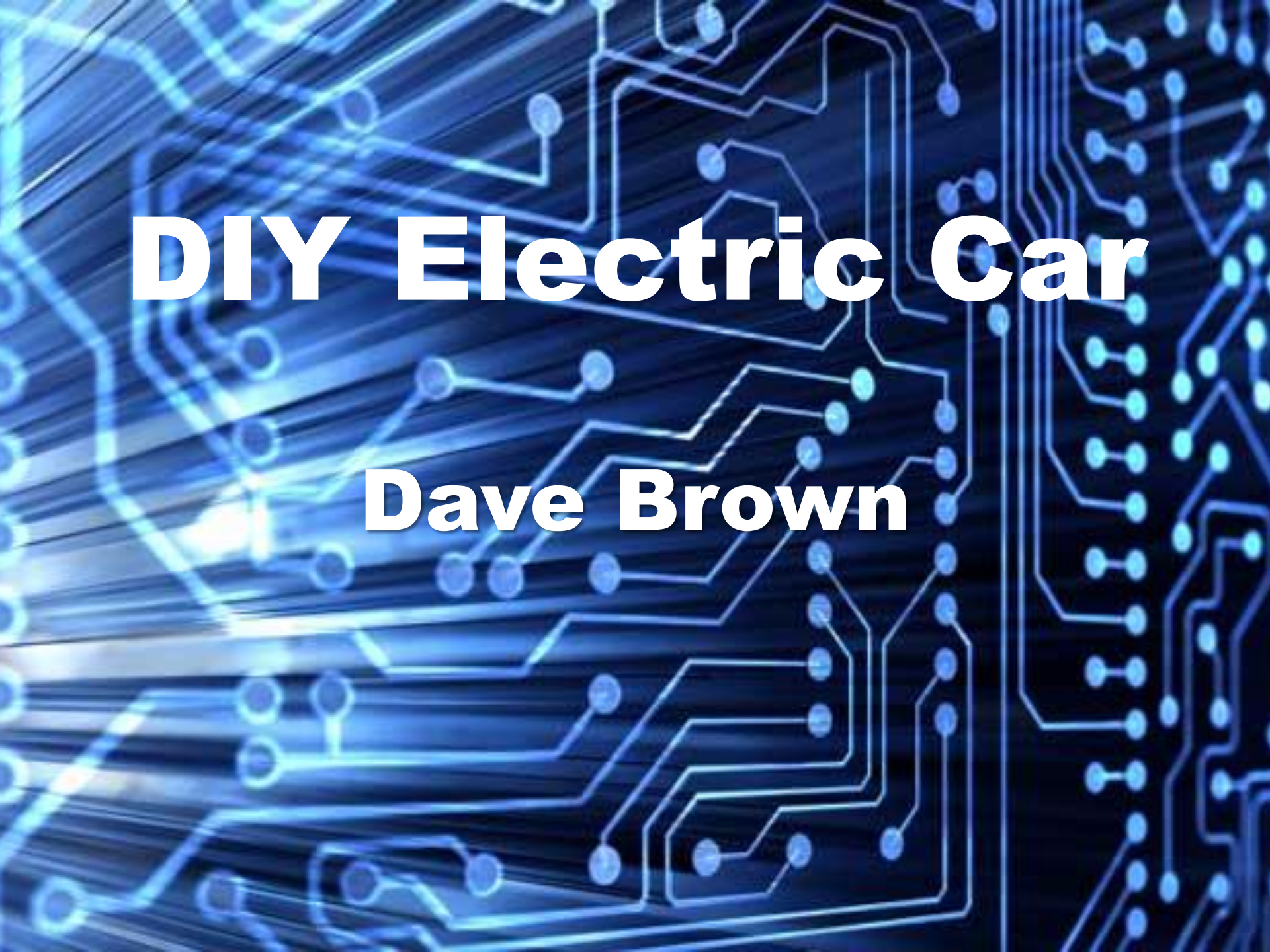
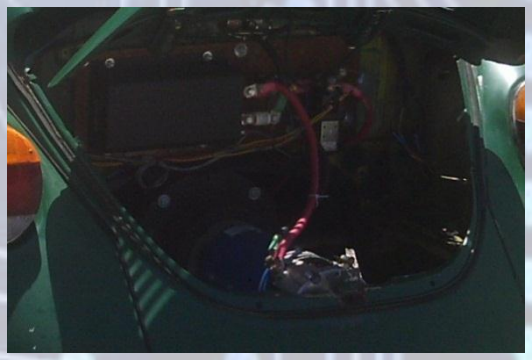

DIY Electric Car
Dave Brown

Resume

- FIRST Robotics
- Solar Power Station
- Solar Water Heater
- Bike Plow
- E-Bike
- Workbench 1.0
- Rain Barrels
- Bike Generator
- Voltswagon
- TV Stand
- Murphy Bed
- Workbench 2.0
- Solar Death Ray

Voltswagon



Vehicle:	1974 Volkswagen Beetle
Voltage:	120 Volts DC
Range:	16-26 Miles (25-42 KM)
Speed:	70 MPH (112 KPH)
Motor:	6.7" D&D ES-31B Series DC
Controller:	Curtis 1221C
Batteries:	10 DC-29, 12V Lead-Acid
Cost:	$6000

Road Map

- History
- Acronym Hell
- Pros & Cons
- Use Cases
- EV Diagram
- Conversion Kits
- Open Source Hardware & Software
- Tools
- Conversion

Car Wars (1835 - 1920)

- EVs predate ICE autos by 50 years
- First to break 100 km/h (60 mph) barrier in 1989
- EVs outsold ICE autos 10 to 1

The ICE Strikes Back (1910 - 2012)

- Cheap oil
- Electricity still limited and expensive
- Growing rural population
- 1914 Ford chooses gas-powered autos for motorized assembly line
- 1930 Electric tram networks bought out and dismantled by GM and Big Oil

The Insurgence (1970 - 2003)

- 1970’s Air pollution concerns and OPEC embargo prompt manufacture of thousands of EVs
- 1990s EVs produced in response to California Air Resources Board (CARB) mandates
- 2003 CARB mandate repealed; EVs reposessed and crushed

Return of the EV (1970 - 2012)

- Tesla Roadster
- Nissan Leaf

Acronym Hell

- A – Amps
- AH – Amp Hours
- V – Volts
- w – Watts
- wH – Watt Hours
- wH/M – wH per Mile

- BEV – Battery Electric Vehicle
- NEV – Neighborhood EV
- PHEV - Plug-in Hybrid EV
- E-REV – Extended Range EV
- R-EEV – Range Extended EV

Pros

- More efficient (70-90% vs 15-30%)
- Less Complex
- Less Maintenance
- Energy Independence
- Sustainability
- National Security
- Environmental

Cons

- Batteries
  - Upfront costs ($35-200/mile of range)
  - Lower energy density
    - Weight
    - Range
  - Charge time

Misconceptions

- EVs are slow
- The grid can’t take it
- Same pollution, moved to the plant
- More resources/pollution
- Lithium is too scarce

Use Cases

- NEV
- Commuter
- Business
- Racer

NEV

- Golf Carts
- Security/Maintenance
- Grocery Getter
- Inexpensive
- Reduced regulations

Commuter

- ~80% of US commutes are under 40 miles
- Typical cost <= $0.02 / mile
- No power used sitting in traffic

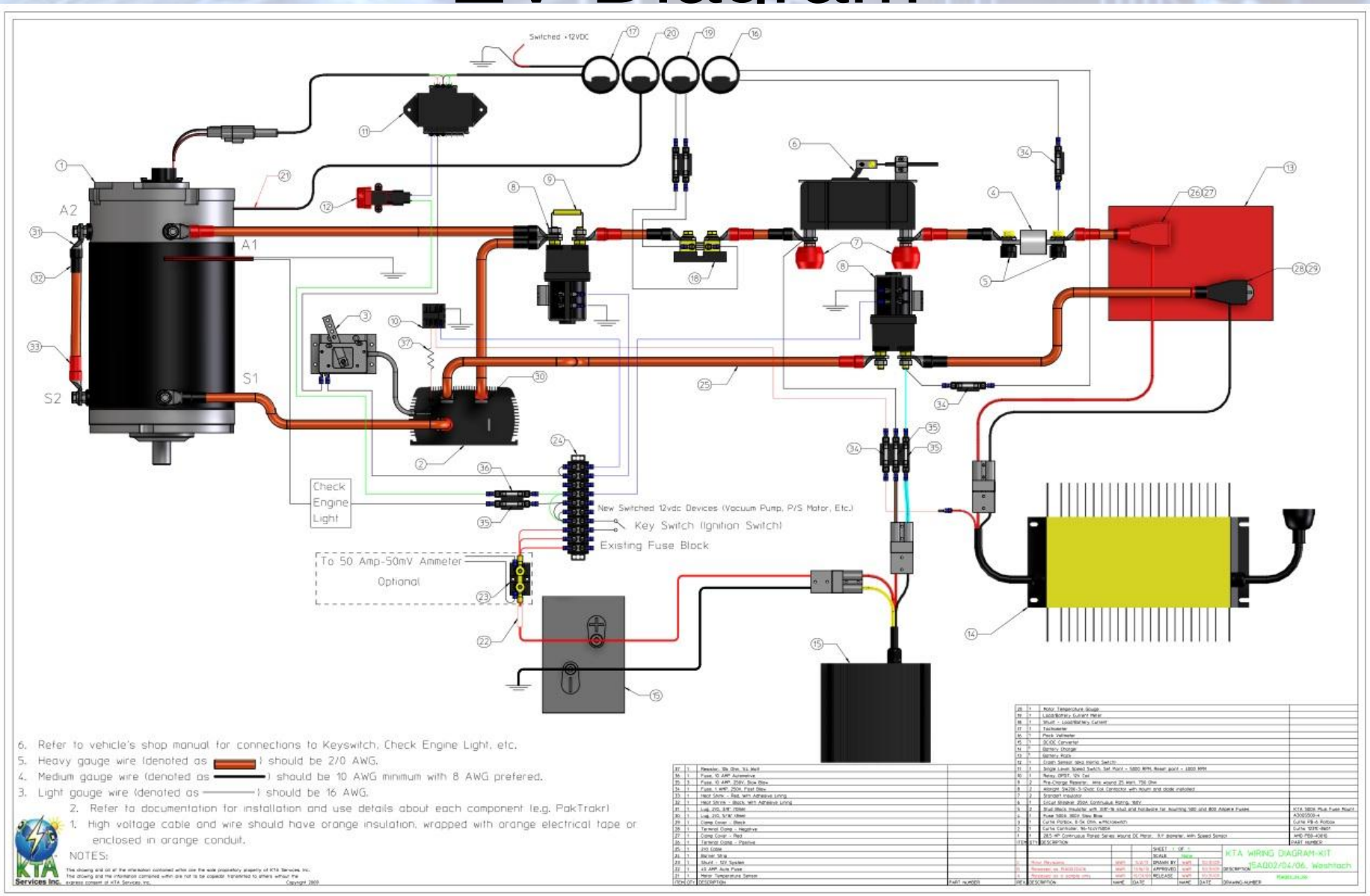
Business

- Predictable routes
- High mileage yields quick ROI
- Low maintenence

Race Car

- Peak torque from 0 RPM
- Wider power band requires less shifting

EV Diagram


Switched +12VDC
A2
A1
S1
S2
Check Engine Light
New Switched 12vdc Devices (Vacuum Pump, P/S Motor, Etc.)
Key Switch (Ignition Switch)
Existing Fuse Block
To 50 Amp-50mV Ammeter
Optional
6. Refer to vehicle's shop manual for connections to Keyswitch, Check Engine Light, etc.
5. Heavy gauge wire (denoted as) should be 2/0 AWG.
4. Medium gauge wire (denoted as) should be 10 AWG minimum with 8 AWG prefered.
3. Light gauge wire (denoted as) should be 16 AWG.
2. Refer to documentation for installation and use details about each component (e.g. PakTrakr)
1. High voltage cable and wire should have orange insulation, wrapped with orange electrical tape or enclosed in orange conduit.
NOTES:
KTA WIRING DIAGRAM-KIT
SA002/04/06, Washtech
KTA Services Inc.

Conversion Kits

Parts List

Essentials

- Donor
- Batteries & Charger
- Motor & Controller
- Shaft Coupler, Adapter Plate
- 12V Charger/DC-DC converter
- Battery/Motor cables & connectors
- Contactor(s) , Fuse(s)
- Voltmeter, Ammeter, Shunt
- Throttle signal

Conditionals

- Battery Management /Monitoring System (BMS)
- Brake/Suspension Upgrades
- SOC Gauge/monitor
- Precharge circuits

Recommended

- Circuit Breaker/Emergency disconnect
- Temperature sensor(s)
- Tachometer
- Inertia switch
- 12V AUX Battery
- Motor/controller cooling
- Battery Box(es) / Insulation
- AH Counter

Optionals

- AC
- Clutch
- Heater
- Low Rolling Resistance Tires
- Power Steering
- Solar Panel(s)

Tools List

Essentials

- Shop manual for donor vehicle
- 2+ ton trolley jack (high clearance preferred)
- 2+ ton adjustable jack stands
- Creeper
- Sockets, Wrenches, Screwdrivers, Pliers
- Angle Grinder
- Handheld drill
- Digital Volt Meter (DVM)
- Wire strippers and crimpers
- Cable cutters and crimper
- Shop light
- Rotary tool
- Measuring Tapes

Carry-On

- Digital Volt Meter (DVM)
- Jumper cable
- Commonly used Sockets, Screwdrivers

Recommended

- Electrical Tape
- Engine hoist or transmission jack
- Clamp On Ammeter
- Drill press
- Air compressor
- Rhino Ramps
- Welding Equipment
- Safety goggles or glasses
- Latex (or similar) gloves
- Soldering Iron
- Zip Ties
- Vise

Optional

- Workbench
- Box cutter, Jigsaw, Cut-off saw, Hacksaw
- Hammer, Pry Bar
- Heat gun or torch

Open Source

- Controller
- Charger
- Instrumentation
- Misc

Open ReVolt projects

> The Cougar **EV Series 500 DC Motor Controller PCB & Mosfet Power PCB** several versions are avalible on wiki.

> The Cougar **EV Series 1000 DC Motor Controller, Mosfet Power PCB, and Mosfet Driver PCB** are avalible on wiki.

> The preliminary **EV SR Motor Controller PCB** is on wiki, development is on going.

> The preliminary **EV AC Motor Controller PCB** is on wiki, development is on going.

>The preliminary **EV DC LCD Instrumentation PCB** - *Is now on wiki !!!*

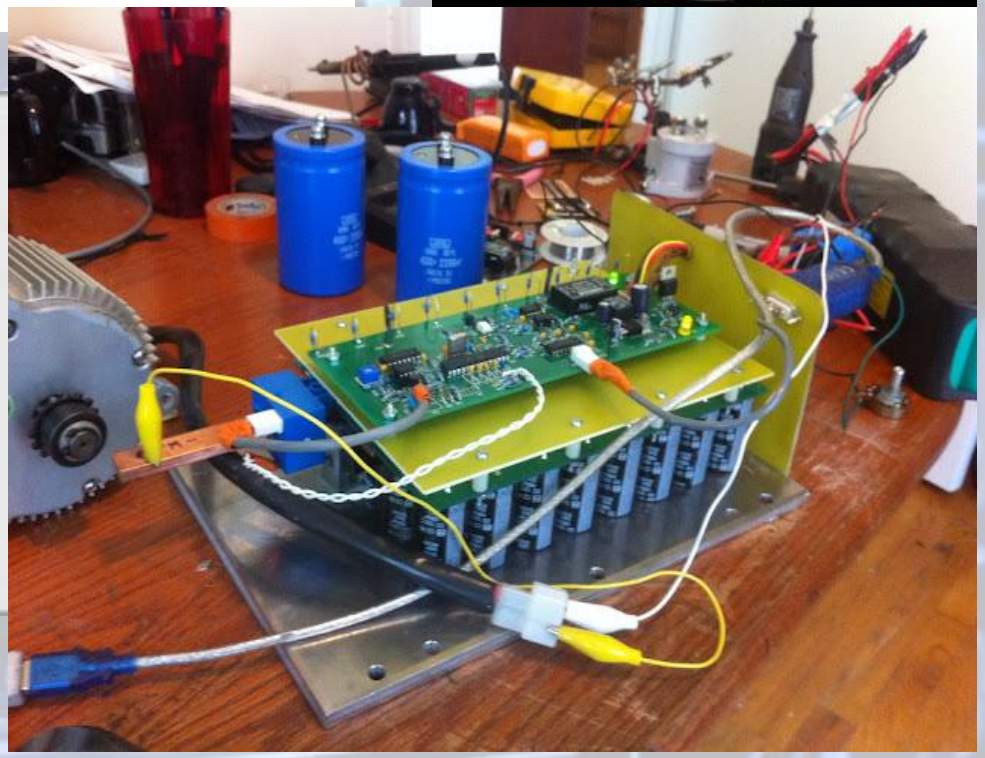
>The preliminary **EV 6Kw DC Charger Controller PCB** - *Was added to the wiki !!!*

>The preliminary **EV BMS Controller PCB** - *Was added to the wiki !!!*

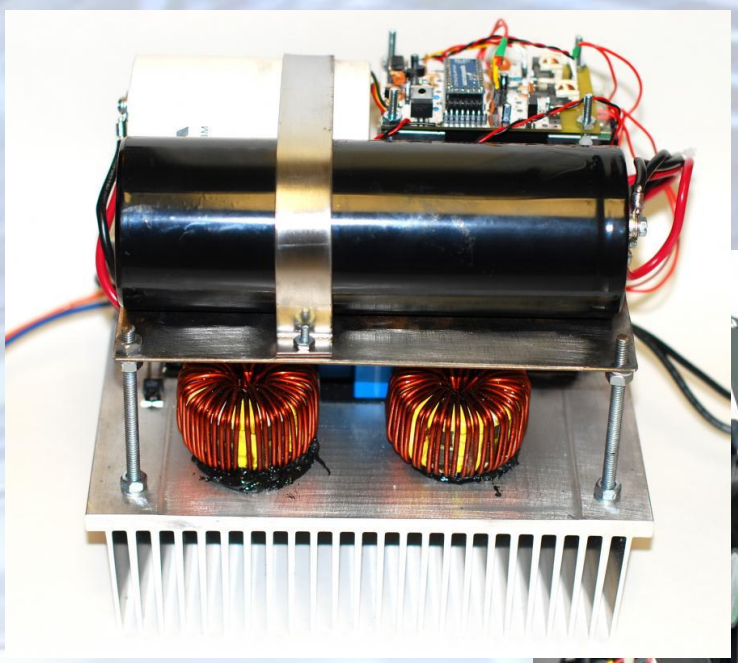
*** Planned Future Open ReVolt projects ***

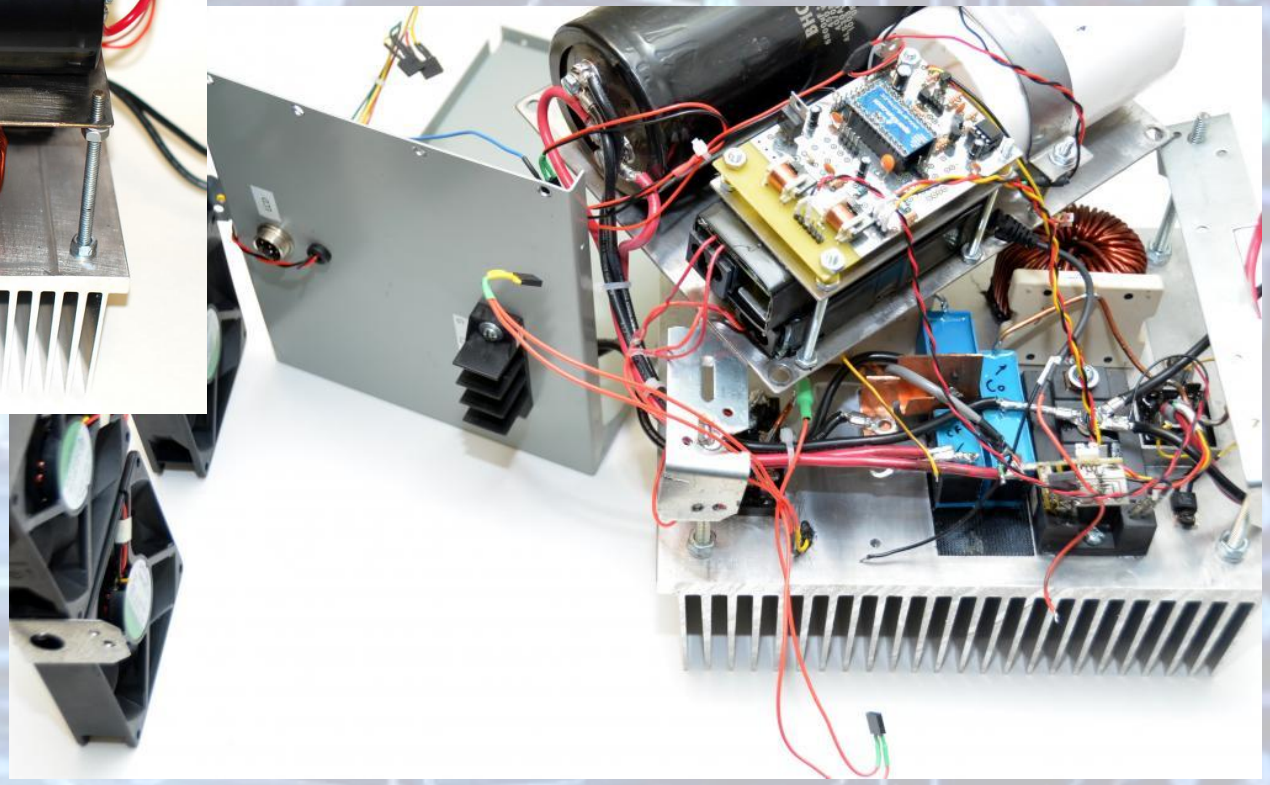
>The **EV IGBT Driver PCB** - *BG2A/VLA500 Interface - Coming Soon !!!*

> The Uprising **EV Series DC Motor Controller, and IGBT Driver PCB** *Coming Soon !!!*



EMW 10kW 60A Open Source Charger





EV Dashboard

Conversion

- Build Requirements
- Explore the Possibilities
- Find a Donor
- De-ICE
- Eliminate Waste
- Motor
- Controller
- Charger
- Batteries
- Accessories
- Hit the road!
- Keep on Hacking

Build Requirements

- Identify motivations
- Maximize your utility
- How far?
- How fast?
- Budget?
- Skills?
- Reality check

Explore the Possibilities EV Album

EV ALBUM | SEARCH | YOUR EV | EV RESOURCES | CONTACT

THE ELECTRIC VEHICLE PHOTO ALBUM

CURRENT TOTAL 3725 VEHICLES

Doug Johnson's
1997 Ford Ranger XLT
Updated: 06/22/2012

John W Mitchell's
1997 Saturn SC
Updated: 06/23/2012

Martin Winlow's
2008 Vectrix VX-1
Updated: 06/18/2012

Bill Bates's
2001 Nevco Gizmo
Updated: 07/07/2012

thingstodo's
1991 Chevrolet S-10
Updated: 06/16/2012

Pranav Bheda's
1972 Volkswagen Super Beetle
Updated: 06/15/2012

Jarkko Santala's
1987 Kawasaki GPX750R
Updated: 07/08/2012

Bruce Westlake's
2011 Th!nk City
Updated: 06/12/2012

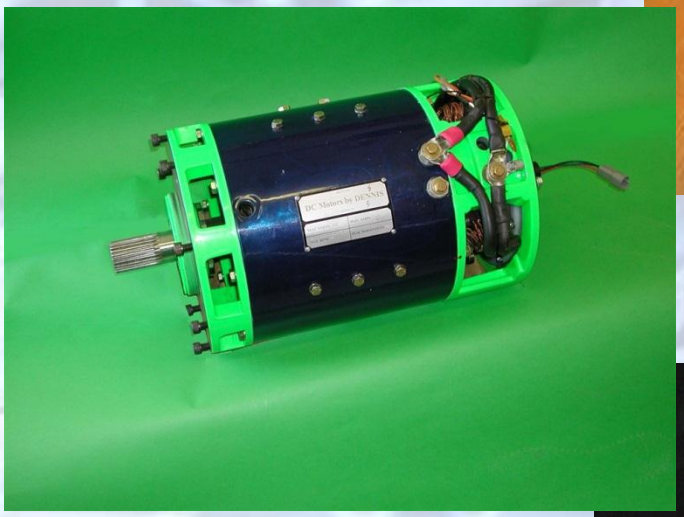
De-ICE

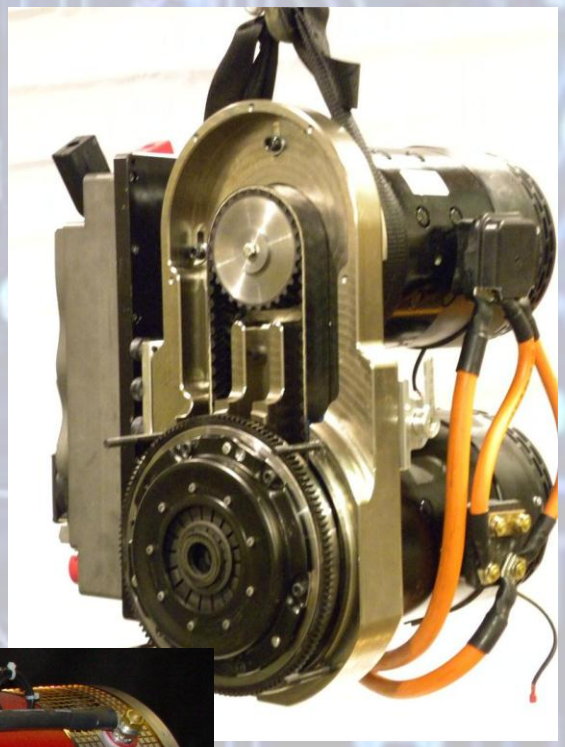
- Remove the engine
  - Find buyer first!
  - Jack up 2-3 feet for bottom removal
  - Engine hoist for top removal
- Drain and remove gas tank, radiator, starter, alternator, and other obsolete stuff

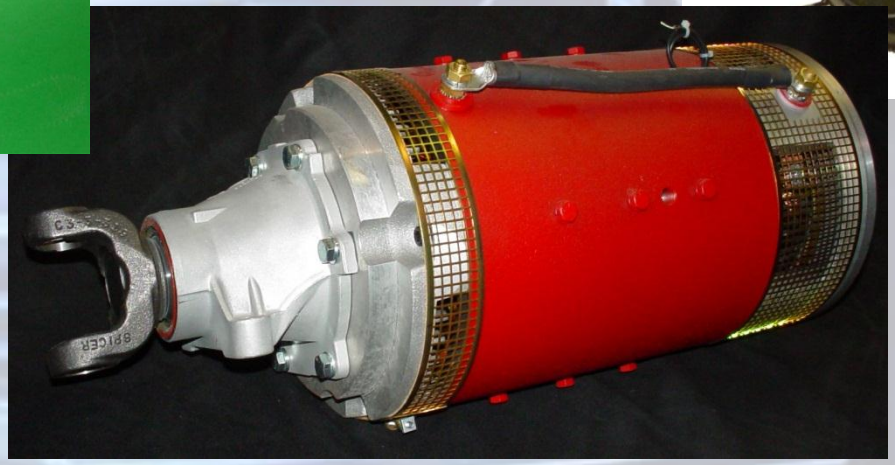
Eliminate Waste

- Less weight and less power draw = more range
- May be able to remove or replace non-essentials
  - Swap Fix-A-Flat for spare tire
  - Convert power steering and brakes to manual

Motor



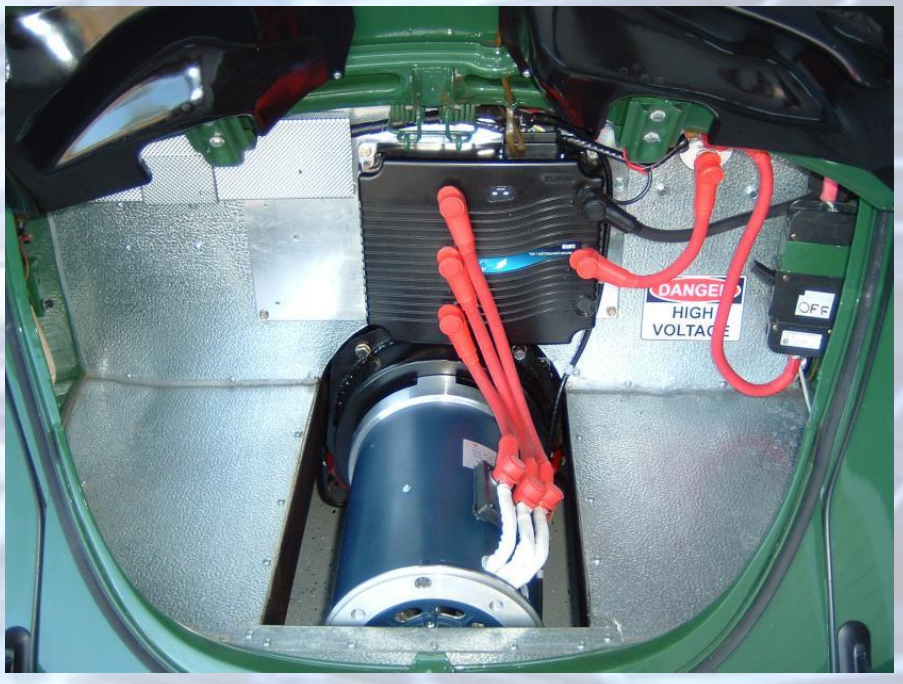


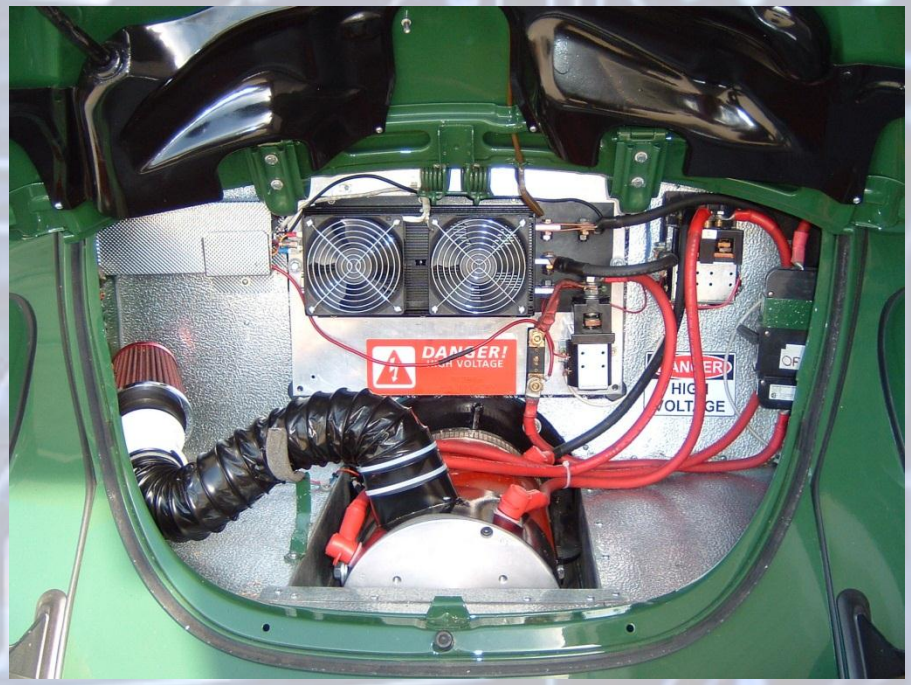


AC vs DC

- Regenerative braking
- Runs cooler
- Even less maintenance

- Cheaper





Controller

Precharge Resistor

- Small, but vital
- Prevents current surge

Charger

Batteries


Energizer
GC2
GOLF CART


APP70161227
A123
SYSTEMS
300333-001


3xE - electric cars

Lead vs Lithium (LiFePo4)

- Lower upfront cost
- Less sensitive
- No balancing necessary
- Easier to determine State of Charge (SOC)

- Light-weight
- Long cycle life
- High power output
- Less maintenance
- Flat discharge curve
- Better cold weather performance

To BMS, or not…

- Active or passive monitoring
- Some chemistries require BMS to maintain balance
- Expensive and complicated
- Potential Fire Hazard

Balancing

- No two cells are identical
- Cells must be balanced to prevent damage
- Balancing matches cells at either top or bottom
- If overcharged, cell is damaged
- If overdischarged, cell can be pushed to reversal and destroyed

Accessories

- Accessories may run off auxiliary driveshaft, or be powered separately

Keep it Legal

- Each state\country is different
- Some require inspections
- Some have strict requirements
- Some do not allow many conversions
- Some don’t know what an EV is

Hit the road!

Sounds Great, But…

- Perpetual Motion
- Hydrogen
- Supercapacitors
- Hub Motors
- DIY Hybrid
- Solar

Keep on Hacking

WARNING: EV Conversions are a very addictive/obsessive hobby. The only way to ‘finish’ a conversion is to start another.

Motor:	$1200
Controller:	$1000
Batteries:	$800
Charger:	$600
Adapter/Coupler:	$500
Misc:	$800

No longer being OPECXXON’s Bitch: Priceless