How to [and not to] Build an Electric Motorcycle

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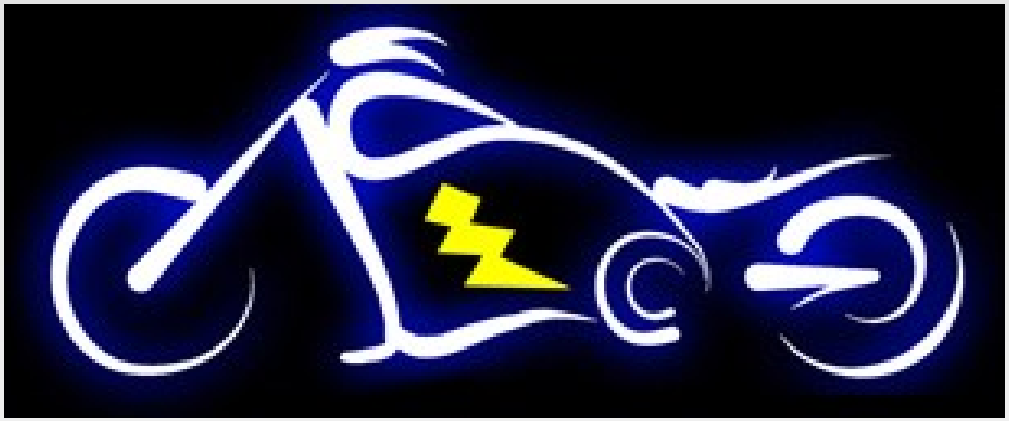
Why Build an EV?

- Gas is Costly
- Electricity is win
- EcoTard
- Coolness factor
- Even more for motorcycles



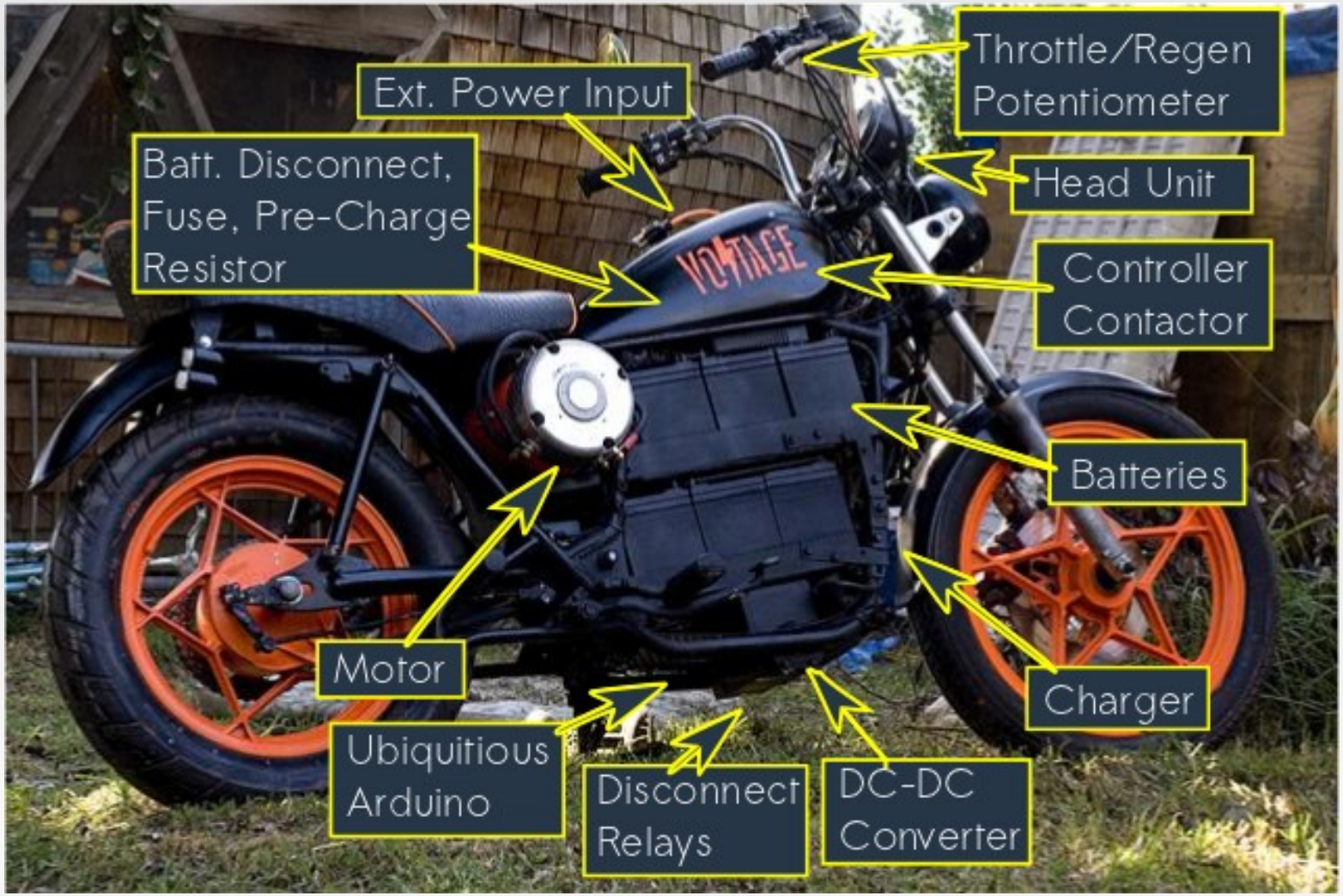
My Conversion

- 1980 Suzuki GS450
- Sepex motor
- 72-80v, 450A Controller
- 12v (6x) 35Ah SLA batteries
- 7A, 4 stage 'smart' SLA chargers (6x)

What to expect

- Fun and Rewarding
- Budget dependent
- Less range and top end
- Comparable acceleration
- Long term cost savings

On to the Good Stuff!
System Overview



Traction Motor

- BLDC/PMAC
- AC Induction
- Series wound
- SepEx
- Hub motor

Controller

- Specific to motor type
- Features!
  - CAN bus
  - USB programmable
  - 'Programmable' IO
  - 'ignition' key switch
  - Contactor Control
  - Throttle
  - Regen Control
  - LV supply

Contactor

- BIG mechanical relay
- Disconnect batteries when not in use
- Reversing
- NOT necessarily HV safe...
  - Precharge resistor
- Traditional disconnect not a bad idea

Throttle

- Magura twist grip
- Potentiometer in convienent form factor
- 2nd 'clutch' type for regen
- Other form factors available

Batteries: jargon

- SoC - State of Charge
- DoD – Depth of Discharge
- BMS – Battery Management System
- Energy Density
- Specific Energy
- C (rate) - Capacity
- Peukert effect
- SLA – Sealed Lead Acid
- NiMH/NiCd (not so important)
- Li-ion, LiPoly, LiFe, LiPo, LiFePO4, LiCoO2, LiNiMnCoO2, LiCo nano

Batteries: packs

Batteries: Charge and Balance

- Off the shelf charger/balancer
  - Active/Passive
- Individual chargers
- Match charger and Chemistry
- Charge Rate
- On/off board

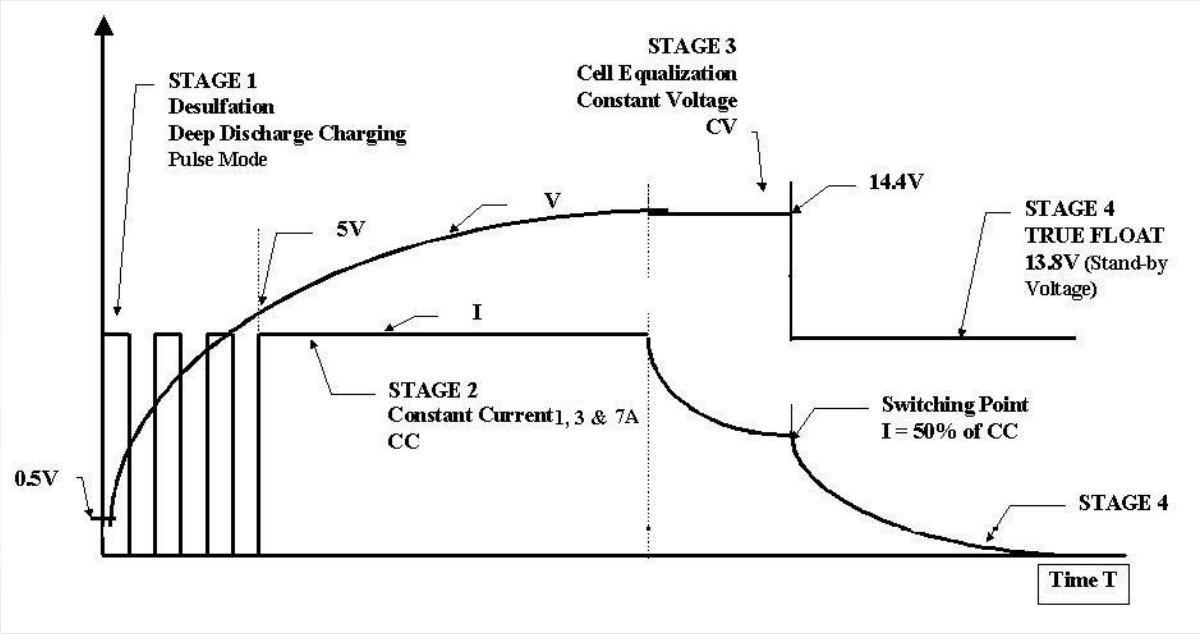


Image from ACI chargers

Batteries: Connectivity

- Fuse + Disconnect
- Mind Temp+Vibration
- Protective circuitry
- Inductive Paddle
- Direct contact
- Mains

Other Electronics

- 72->12v DC-DC converter
- Arduino indicator ctrl
- SoC Estimator
- Head Unit
  - CAN Batt/Controller data
  - PlugShare+GPS
  - Speedo
  - Security

Lessons Learned (aka FAIL)

- Chain clearance
- Battery Bottleneck
- Contactor Pitting
- [not so] smart chargers
- Shaft key
- Design for modification

End. Questions?

links

- http://www.elmoto.net/
- http://cafeelectric.com/
- http://www.acichargers.com/
- http://www.electricmotorsport.com/
- http://www.sevcon.com/
- http://batteryuniversity.com/