



# Building an EV

## TOPIC #3

*What kind of batteries do I use?*

<http://www.evalbum.com>

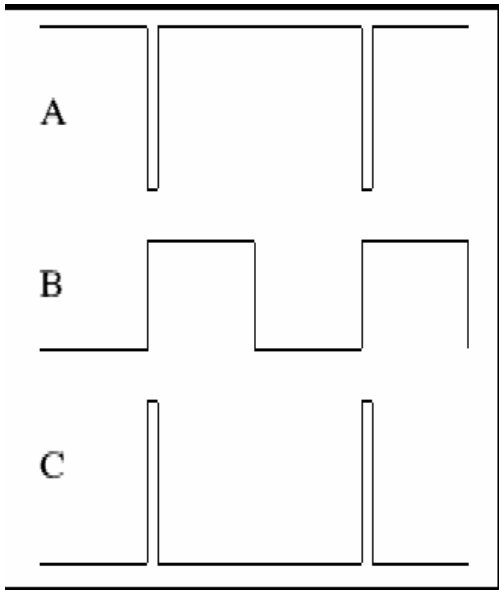
<http://www.diyelectriccar.com>

# Topics

- What is the best car to convert?
- What kind of motor should I use?
- What kind of batteries do I use?
- *What are controllers?*
- *Where can I buy the parts?*
- *Are there any books on how to do a conversion?*
- How far can I go on a charge?
- How fast will it go?
- How much will it cost?
- How to make battery cables?
- How do I charge the batteries?
- How to add power brakes and power steering?
- How to add safety?
- How to add air conditioning?
- How about solar panels?
- Is there anyway to make it recharge itself while driving?
- How about adding a generator?
- How about EV kits?

# *What are controllers?*

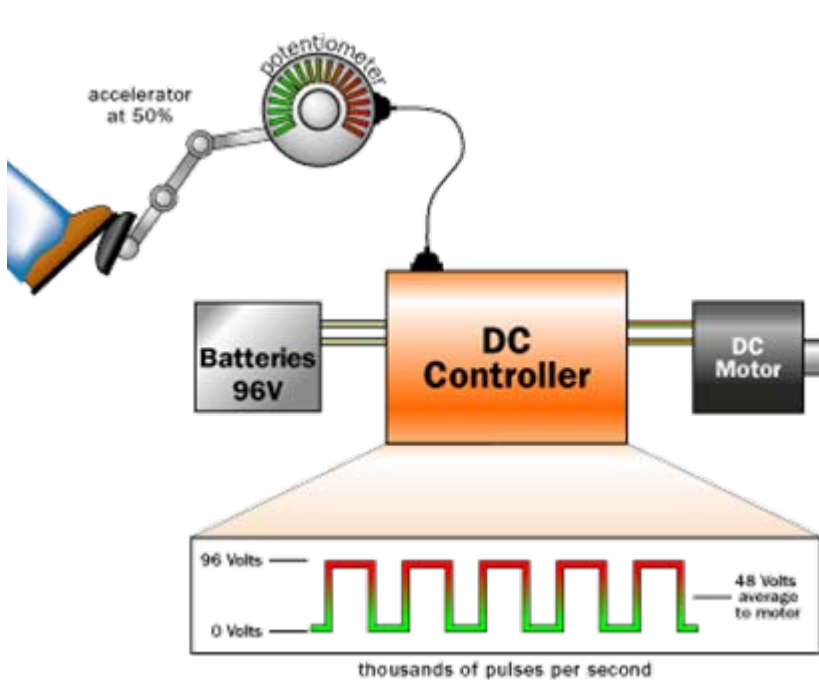
- The types of controllers covered are for DC series-wound motors and AC motors. The major manufacturers this year are Alltrax, Cafe Electric and Curtis for DC systems. Major manufacturers for AC drives is AC Propulsion with many up and coming competitors.



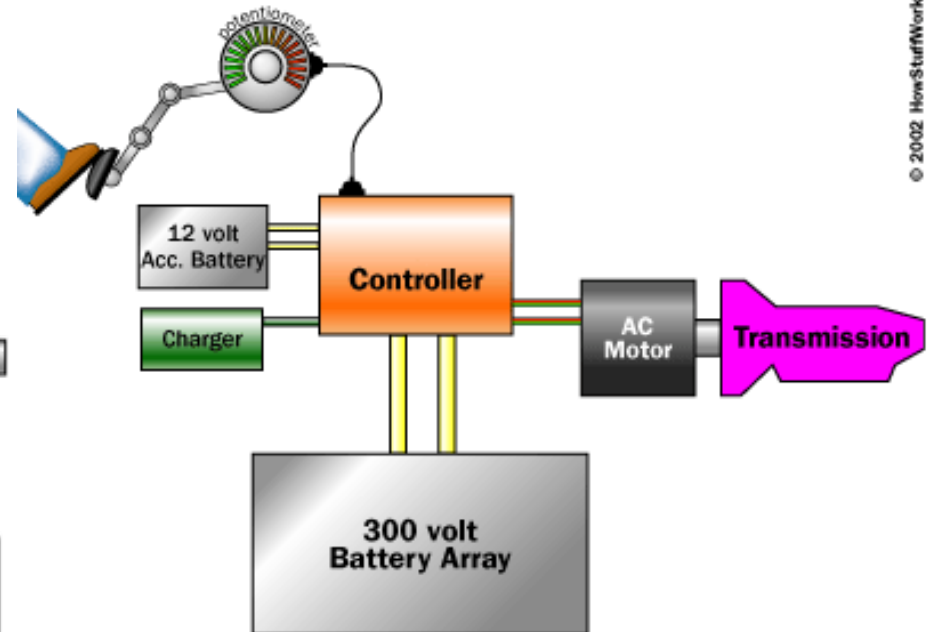
On a DC Controller varying width pulses of electricity are sent to the motor depending on throttle position. In the image A would be near full power, B would be a modest power level and C would be a low power level.

On AC Controllers the frequency of the AC sine wave vary with the motors speed.

# What are controllers?



- LOW VOLTAGE  
HIGH CURRENT



- HIGH VOLTAGE  
LOW CURRENT

# What are DC controllers?

## DC Controllers

- Zilla Z1K-HV (\$2675)



- Alltrax (\$636)



- Curtis Model 1231 (\$1,675)



- LogiSystems (\$1589.88)



- Kelly 144V 650A (\$1595)



# *What are DC controllers?*

- Zilla – Regarded as the Best
- Available in either 1000A or 2000A
- Available in 156, 300 or 336 volt models
- Water Cooled
- ~\$2,000 - \$5,000
- Hold Numerous World Speed Records for EV's



Currently Unavailable; however, the owner of the company, Otmar, is looking at several companies to license production of the controller so they should be available again soon. You can get on a waiting list at [www.cafeelectric.com](http://www.cafeelectric.com)

# Zilla Continued

- Silent Operation
- Hairball Vehicle Interface
  - Handles Precharging
  - Closes Contactor
  - Rev Limiting Option and Drives Dash Tachometer
  - Hall Effect or Potentiometer Pedal Options
  - Series Parallel Auto Switching for High Power Dual Motor Setups
  - Even More Options Available



Makes Vehicle Integration Simple.

# What Are DC Controllers?

- Cutris
- Many Sizes Available from 24V-144V 500A.
- Simple to Hook Up
- Needs Heatsink and Fan
- \$1,675 for 500A 144V
- Can't be used on anything larger than a 9" motor





# ***What are DC controllers?***

- Kelly Controllers - \$1,395 for 144V 650A
- Option for Regenerative Braking
- Note: I Have No Personal Experience with these Controllers. They are made in China and there have been several reports on the EV List of these controllers failing; however, the company have been good on warranty replacements.
- <http://www.kellycontroller.com/>



# ***What are DC controllers?***

- Logisystems Controllers
- 72V – 156V, 550A – 1000A
- 156V 550A ~\$1345
- Heatsink Built In
- No Personal Experience with these, but I have not heard anything bad as of yet.

Logisystems used to rebuild and beef up Curtis Controllers.

- Available at  
[www.evsource.com](http://www.evsource.com)



# Possible Alternatives

- Altrax Controller – Built by company who built the Raptor Controllers
- 72V 450A ~\$635
- Suitable for a city speed EV
- A city speed EV would be a great first project to get your feet wet and would cost significantly less than a full highway speed car



# What are AC controllers?

## AC Controllers

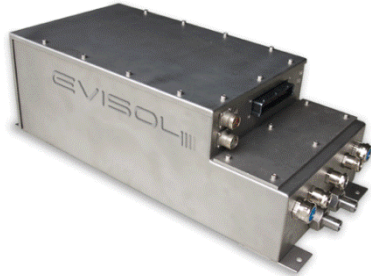
- AC Propulsion (\$20K + motor)



- MES-DEA (\$5600+motor)



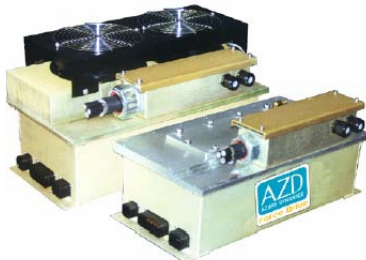
- Evisol (\$10,500 + motor)



- Enova Systems (\$20K + motor)



- Azure (\$3,500)



- BRUSA (\$1595)



# What are AC controllers?

## AC Controllers

- AC Propulsion (\$20K + motor)



## OPERATING PERFORMANCE

- Voltage 350 V nominal  
240 V min, 450 V max
- Current 580 A dc max (drive)  
200 A dc max (regeneration)
- Torque 225 Nm max, 0-5,000 rpm  
(drive)  
115 Nm max (regeneration)
- Power 150 kW max 6,000-12,000 rpm  
50 kW continuous
- EFFICIENCY
- Drive: 91% peak  
86% road load (30 kW, 8500 rpm)
- Charge: >90% (240 V line, 10 kW)

# What are AC controllers?

## AC Controllers

- Evisol (\$10,500 + motor)



## OPERATING PERFORMANCE

- • Type: Evisol EVI-200
- Nominal Voltage: 750 VDC
- Maximum Voltage: 900 VDC
- Maximum Output Current: 350 Arms
- Continuous Output Current: 300 Arms @ 4kHz switching frequency
- Maximum DC Input Current: 350 A
- Switching Frequency: 2-8 kHz
- Powerstage: Semikron Skiip 3 Integrated IGBT Module
- Phases: 3
- Cooling: Water/Glycol
- Weight: 24 kg

# What are AC controllers?

## AC Controllers

- Azure (\$3,500)



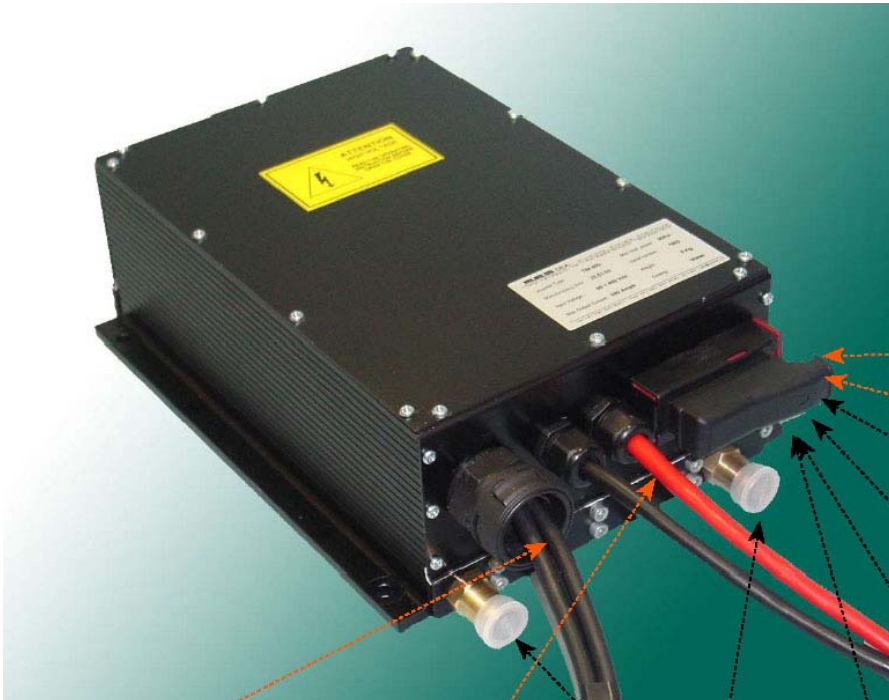
## OPERATING PERFORMANCE

- 156VDC/312VDC
- Maximum DC Current A DC 268/165
- Maximum Motor Phase Current Apk - AC 400/250
- Peak Efficiency % 85 87
- Peak Shaft Power kW 35 47
- Minimum Recommended Nominal Battery Voltage VDC 144/288
- Maximum Recommended Nominal Battery Voltage VDC 240/336

# What are AC controllers?

## AC Controllers

- BRUSA (\$1595)



## OPERATING PERFORMANCE

Peak power:	30/50/100/200 kW
Max input voltage	400 V
Input voltage range, nom*:	80...400 VDC
Input (battery) current max:	550 A (TIM900)
PWM Switching frequency	3...9 kHz
Output current max (RMS/peak)	500/700 A (TIM900)
Size and weight	<a href="#">Metric units</a> <a href="#">Standard units</a>
Efficiency	n/a
Main contactors option	n/a
DC-DC converter option	No DC-DC converter
Protection	IP-54



# What are AC controllers?

## AC Controllers

- MES-DEA (\$5600+motor)

### OPERATING PERFORMANCE

Peak power:	53 kW	106 kW	212 kW
Max input voltage	480 V / 960 VDC	480 V / 960 VDC	480 V / 960 VDC
Input voltage range, nom*:	514 model: 120...480 VDC 518 model: 240...960 VDC	524 model: 120...480 VDC 528 model: 240...960 VDC	544 model: 120...480 VDC 548 model: 240...960 VDC
Input (battery) current max:	132 A / 66 A	264 A / 132 A	528 A / 264 A
PWM Switching frequency	24 / 16 kHz	24 / 16 kHz	24 / 16 kHz
Output current max (RMS/peak)	514: 112/150 A 518: 56/75 A	524: 225/300 A 528: 112/150 A	544: 450/600 A 548: 225/300 A
Size and weight	255 x 240 x 88 mm 6.5kg (with coolant)	360 x 240 x 88 mm 9.5kg (with coolant)	580 x 240 x 88 mm 15kg (with coolant)
Efficiency	97%	97%	97%
Main contactors option	n/a	n/a	n/a
DC-DC converter option	No DC-DC converter	No DC-DC converter	No DC-DC converter
Protection	IP-65	IP-65	IP-65



# *Consider the Alternative*

- Curtis 1238 – Relatively New
- 84V rated (people run it at 96V)  
550A
- Motor and Controller \$4,300
- Would make a city speed and possibly highway capable vehicle (would be barely highway capable)
- <http://www.electricmotorsport.com>



# *Where can I buy the parts?*

- Canadian Electric Vehicles Ltd.
- Electric Vehicles of America, Inc.
- Electro Automotive
- EVs North West
- EVParts: formerly Wilde EVolutions
- EV Proud: Chrome "Electric" logos
- EV Source: Zilla controllers and Manzinta Micro chargers
- KTA Services Inc. Nice folks.
- Largo Scooters: Stealth Hub ebike conversion kits
- Metric Mind: Siemens AC drive motors and controllers
- Nu-Kar Electric Vehicles: Citicar and Comutacar Parts
- SD Scooters: Electric scooter parts

# *Are there any books on how to do a conversion?*

- "Convert It"

by Mike Brown (**\$24.95**)



- "Build Your Own Electric Vehicle"

by Bob Brant (\$62.92)



# Sources:

- <http://www.evalbum.com/build.html>
- <http://www.diyelectriccar.com/forums/showthread.php?t=669>