

CURRENT EVENTS

Promoting the use of electric vehicles since 1967

November '97 Vol. 29 No. 10

VIPER DRIVER GREAT SPORT

Current Eliminator vs. Viper at NEDRA Event

BY JOHN WAYLAND, E-CAR

I am convinced more than ever, that the venue of 'spirited competition at the Christmas Tree', will help get people interested in EVs who would have never given them a second look, and in the long run it will help to reduce air pollution (once the tire smoke settles) by promoting EVs in a fun and positive light. A lady who worked the tower at Woodburn, perhaps said it best when she proclaimed, "This is the first drag race I've worked, where I can go home afterwards without my ears ringing from all the noise, and where I don't have a headache from breathing all the perfumes of the day....what a fantastic idea!"

I received the following gracious Email from my new friend, Jon Brobst, the owner of the Dodge Viper GTS who raced against my other good friend, Dennis Berube' with his 'Current Eliminator' electric junior dragster.

Show, Go, Blow, or Throw

(FROM JOHN BROBST TO JOHN WAYLAND)

Thanks again for the invite to the 'Voltage Vendors Venue at Woodburn'. I am ALWAYS ready to visit a track, where I will SHOW, GO, BLOW, or POKE A HOLE in the fence trying! (One of your EVs can relate !!)



Current-Powered Cannonball

I was stunned when the EV launched 4 lengths ahead, silently....I actually lifted a moment because I thought "I must not be hooking up?" His (Dennis Berube's) 60 ft. times were phenomenal...a full .45 second ahead !! He had me by 3 at 1/8, when I began to collect him. At the last 60 ft. trap, he was 1 ahead, but a puff of smoke told the tale of his exploded battery (now THERE is a new excuse for my ears!!) Without the blown battery, he would have beaten me by more than the .176 that separated our runs. I was quite pleased with my 12.273.

The TV-2 interviewer found me saying things like:

- "EVs are the future, since emissions are a worldwide problem."
- "EV draggers are car guys, too...the quest is the same: horsepower-to-weight ratios."

■ "We are ALL hunting for a few hundredths of a second"

■ I also said: "The evolutions of fossil burners (like the Prowler) will help the EVs due to expanded use of composites and aluminum."

Bench Racing

When the race was OVER, the bench racing excuses began:

■ "I am set up for a road course, with negative camber."

■ "I was on street tires."

■ "I weigh 3307 lb., he weighed 950."

■ "He was so quiet, he snuck up on me!"

And my favorite excuse:

■ "Whaddya expect....I only had TWELVE VOLTS !!!"

Beaten is beaten !

Thanks again, Jon Brobst/Viper GTS

Gracefully Viped Out

(From John Wayland)

continued on page 19

1 Viped Out - A personal story from the Oregon Electric drags. Good sport Jon Brobst brought his Viper V-10 to compete against Dennis Berube's "Current Eliminator". Even though the EV dragster blew a battery, Dennis won. Here's Brobst's account of how it feels to get "Viped out" electrically. (He was a really nice guy about it too)

4 AeroVironment's new PosiCharge TM fast-charge system combined with the Delphi Delco-powered Ford Ranger to give 150 miles per day on lead-acid batteries. 20 minutes and you're up and running again.

6 Alameda had its first EV Expo and these were some of the reactions from members of the general public who attended. This first Expo was "a foot in the door", next year's event is planned to be "in the grand ball-room", according to Expo organizers. Quotable note? "No vrooming"!

8 Bob Batson of EVA "motor-vates" CE's readers with an installment of his series that focuses on the heart of your EV - the electric motor.

11 A Furry Car? Well, that's the prototype of the Tiger EV hybrid, being developed in Hangar 20 as a joint project with your editor and several of the Calstart companies, including Kaylor and Phasor Corp.

12 What is that PowerPulse REALLY Doing? Well, here's some data fresh off the oscilloscope. Courtesy of EAA member Bob Wheeler and a friend of his at Ampex Corp.

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Winge-ing About Prices

An English EV friend of mine taught me a marvelous word when he was here on a visit. In Brit-speak, "to winge" (pronounced *windj*) means to whine, complain, bitch, moan, and generally make known one's dissatisfaction with something. To the person on the receiving end of the dissatisfaction, "winge" describes wonderfully the perpetrator and the action. "Winge" sounds like what it is; sort of an onomopaeic word. One gets the aural image of a continuous droning whine, sort of like a large, annoying and persistent mosquito.

So why this editorial excursion into Anglo vocabulary. "Winge" describes exactly what the Washington Post and other similarly minded folks (see boxed article) have been doing. The opposition has failed to get us on a number of counts, including safety, environmental concerns, technology and so forth, so now the complaint is about prices. The new EVs from the commercial sector, they say, are too expensive and no-one can possibly afford them.

This is a first-class winge and as such, deserves rebuttal. Not to say that the new EVs from Honda, Toyota, GM, etc. aren't pricy. \$45K ain't exactly low-income. But hey, folks, have you looked at the prices of new gas cars lately? Those sport-utes (ah, yes, her favorite target) that now compromise 40% of the US fleet, cost on average \$10K more than a comparable sedan. If the average price of a new car in the US is \$28K, then the average price of something like a Ford Explorer is \$38K. In comparison, the projected price for the GM EV1 is \$32K. In the two-seater performance car market (which the EV1 is designed to hit), \$40K, \$50K, \$60K and up is not uncommon. This is Porsche, Lotus, Ferrari, Bugatti country. I don't see the Washington Post indignantly complaining that the work-

ing class is hard-pressed to afford a \$200+K Bugatti. The fun-mobile market seems to be pretty healthy.

Returning to the much abused sport-utes, (OK Clare, quit filing your fangs) one can point out that they do not cost more to build than a standard sedan, wagon or hatchback, yet the car companies can tack on an additional \$10K and they still fly off the showroom floor. \$10K of pure profit is one good reason why these urban assault vehicles now constitute 54% of the new car market. Do we hear the press complaining about that? Nope!

If the up-front cost of new vehicles is sky-high, why do they still sell? Because people DON'T PAY the up-front cost. They finance or lease their cars. Some folks don't even know the true purchase price of their vehicle. All they look at is the monthly payment. The auto industry has managed to squirrel things around so that monthly payments, even on high-class wheels, are affordable. They may be back-breakers for some families, but with some struggle, people can do it. Low-cost auto loans and leases fuel the car industry — make no mistake about it.

The press also winges about the lease cost of the Honda, Toyota and GM Evs. It's in the \$400-\$500 per month bracket. When I spoke to someone at a show recently about EV leases, upon hearing these figures, she said, "That's not so bad — I pay more per month for my Ford Explorer"

I am not trying to justify the fact that the car companies are digging into the public's pocket as much as they can get away with. That, after all, is the nature of their game. However they are doing it across the board, not just with EVs.

It would be nice if the Big 7 had come out with a little workhorse EV in the \$15-20K range to accompany their higher end models. Something equivalent to a Civic, Escort, Geo or other econo-jellybean would be most welcome. One may soon see an "EV2" or "EV Plus a Smidgen" out of the Big

EV Prices Still A Major Obstacle

While production EVs are now available to the general public, major automakers agree that any mass market for EVs is still a long way off. The biggest obstacle facing the industry and potential EV buyers is price. Honda's new four-passenger EV Plus can travel about 50 miles on a single charge with conventional lead-acid batteries, or as much as 80 miles on the newer NiMH battery technology.

Unfortunately, batteries for the EV Plus cost \$54,000, while the company's most expensive gasoline-fueled model, the Passport EX four-wheel-drive sport-utility vehicle sells for a little more than \$29,000. Once the demand for EVs increases significantly, prices will naturally begin to decrease. However, while prices for advanced battery technologies such as NiMH remain high, consumer purchases are likely to remain low.

(WASHINGTON POST: 9/18)

Seven. It may come from Hyundai, Daihatsu or another Asian low-end high-volume vehicle producer. Or it might be home-grown here in the states or emerge from EV-progressive Europe. Perhaps it might even take shape here in Hangar 20.

Anyway, take comfort in the fact that the complainers are running out of things to winge about if they have to resort to grumbles about price.—CB

AeroVironment PosiCharge Jump- Starts EV Infrastructure.

DEARBORN, MI., 9/11/97 — Ford Motor Company today received an electric vehicle fast-charging system from California-based AeroVironment Inc. The PosiCharge™ advances the usable daily range of electric vehicles by charging a battery pack in a matter of minutes instead of hours. The new technology will initially be used for the Ranger Electric pickup, which will be in customers' hands by next year.

50 Miles to 150 Miles

The Ranger EV production model now has a real world range of 50 miles before requiring a 6-hour recharge. The PosiCharge™ system will recharge the battery 80% in less than 20 minutes, giving Ford's EV pickup truck a working range of well over 150 miles per day on existing affordable lead acid batteries.

Public charging infrastructure was difficult to establish when recharge times were six to eight hours. With the AeroVironment technology breakthrough, many locations are now viable recharge sites: restaurants, rest stops and shopping malls.

PosiCharge Will Aid EV Corridors

AeroVironment anticipates that utilities, government agencies and municipalities, as well as pioneering individuals, will utilize the PosiCharge™ system extensively to create "electric vehicle corridors," EV-friendly regions where EV drivers can get a quick recharge during their journeys.

PosiCharge™ uses the same technology as AeroVironment's successful ABC-150 Power Processing System, which helps electric vehicle manufacturers and battery producers world-wide to develop and test EV components and systems. "By using the ABC-150

With proper charging cycles and battery management, valve-regulated lead-acid batteries can recover an 80 percent charge in as little as 10 minutes, instead of six hours.

architecture," said AeroVironment Product Line Manager Edward Moore, "we increase the reliability of PosiCharge™.

The AeroVironment system utilizes the PosiCharge™ On-Vehicle Controller with Smartguard™ technology to avoid damaging the battery pack. AeroVironment has already demonstrated that fast-charging is a viable technology. With proper charging cycles and battery management, valve-regulated lead-acid batteries can recover an 80 percent charge in as little as 10 minutes, instead of six hours, without battery damage. The technology represents thousands of hours of testing on the ABC-150 System.

1,023 MPC Demo Run

In order to win a recent Southern California Air Quality Management District (SCAQMD) \$1.7 million commercialization contract, AeroVironment had to prove its Level III charging system capabilities. A prototype version, the PosiCharge™ High Power Conductive Charging System, was used in a world-record 24-hour endurance run. A new EV record was set at 1,020 miles in a single day, eclipsing a prior 24-hour EV record distance by 23 percent.

For the SCAQMD program, AeroVironment is developing and demonstrating two 60kW conductive systems and one 60kW inductive system to charge four S-10 electric-conversion pickup trucks and one General Motors EV S-10 OEM truck. The four-month demonstration starts in February 1998 at facilities operated by Southern California Edison and the Los Angeles Department of Water and Power.

In addition to the vehicle demonstration, the program will develop a fast-charging profile for Delphi-E Valve-Regulated Lead Acid (VRLA) batteries used in commercial Ford and GM EVs. The program will also do battery pack

testing for the United States Advanced Lead Acid Battery Consortium (USABC) in compliant DST and FUDS cycles using another AeroVironment product, the ABC-150 Power Processing Unit.

By utilizing these tests and the ABC-150, program engineers can evaluate the effectiveness of the charging process, event, charger performance and the positive impact of fast charging on battery pack life. The project is expected to complete on June 30, 1998.

Complies with SAE J-1772

The PosiCharge™ design incorporates the AVCON/Meltric industry standard connector and complies with SAE standard J-1772 for conductive charging equipment and J-2293 for communication and control. (For a detailed description of the standard, see Current Events, Oct 1998)

Industry First, Consumers Later

The first PosiCharge™ production deliveries will go to industrial customers, however a consumer version will be offered through a nationwide distribution network early next year.

Busses Too

"Fleet managers now have a single piece of equipment which can charge trucks and cars," said AeroVironment's Moore. "And the same product can charge buses, too."

Fast-Charging Pioneers - EV Racers

One should note that fast-charging using both high-power electronics and current dumps from stationary battery packs was initially been pioneered by EV racers. The first trackside battery-battery fast recharge was performed by Michael Hackleman and Eli Schless at the 1992 Phoenix APS Electric 500 (later the Phoenix Electrics.) Other fast-charge pit stops were performed by Team ElectroAutomotive in the Ron

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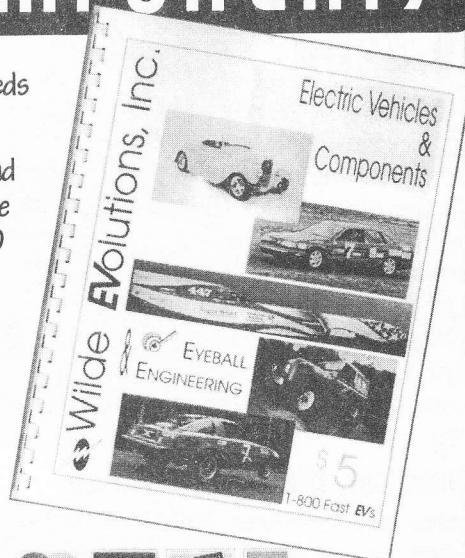
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Rasmussen Porsche #13 in 1993, Little Guy Racing in their Rabbit (1994), The Women's Electric Racing Team and EcoElectric (Porsche #13 and Rabbit #6, 1994, 1995), Sunbelt Battery (Karmann Ghia #84, 1996). AeroVironment itself participated in several fast-charge pit stops at recent APS Phoenix Electrics races when it ran a very successful EV Saturn. —CB

Sources: FORD TAKES DELIVERY OF FIRST EV FAST CHARGER; New AeroVironment System Addresses Range Obstacle, 9/11/97

AeroVironment Awarded Fast-Charging Contract, (BUSINESS WIRE)—7/3/1997

For more information on PosiCharge™
<http://www.AeroVironment.com/area-electric/prod-serv/posicharge.html>

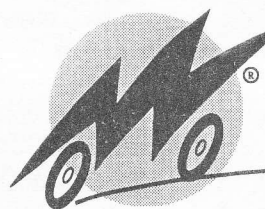
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Reactions from the Alameda EV Expo

A San Jose Mercury News reporter spoke to a number of "the 3,000 curious drivers who wandered into the Alameda EV Expo to examine the latest in EV technology." Reporter Renee Koury adds "They were amazed to find sports cars and family cars that looked like regular cars and an assortment of motorized bicycles, scooters and motorcycles." Here are some of the reactions:

Clean Car, Clean Conscience

"I was very impressed," said Bob Spoer of San Francisco, a high-tech recruiter, after he rode in GM's sporty red, two-seat EV1. "It was sort of like a leap into the future. The main advantage is, it's so quiet. And you're driving with a clean conscience."

Seeing Nothing But Yellow

Many drivers, while wincing at the prices for the cars, said they'd buy them to help clean up the air.

"When you're driving a truck all day long up and down the freeway, you look on the horizon and see nothing but yellow, and you start to feel so guilty," said Mike Connors of Alameda, a driver for an East Bay coffee company. "The warning signs of pollution are here. We have to listen."

Hearing the Wind

"They look like regular cars," marveled Tina Monaco-Glynn of Oakland, who drove a Toyota RAV-4 EV. "The amazing thing was, you could still hear the wind while you were driving. Too bad they're so expensive, or I might consider it. I like the cars, but it's so much money."

No Vrooming

Doree Miles of Alameda was equally stunned by the lack of vrooming. "You don't even know the car is on," she said after test-driving a General Motors EV-1



Zebra sports roadster stands next to Jefferson Programmed Power's "Spirit of Alameda" race car.

Photo credit: Roy Kaylor



The Alameda Expo Line-Up (left to right), Ford Ranger, GM-S-10, Pivco Citibee Charger Bike, GM EV1, Lectra Motorcycle, Bombardier NEV, Ranger #2, Toyota RAV-4 EV, Honda EV Plus, Zebra roadster, Alameda Bureau of Electricity pickup, Honda EV Plus #2.

Photo credit: Roy Kaylor



The classic conversion and the new purpose-built EV. Don Gillis' EAA Porsche 914 EV and friendly PIVCO Citibee provide a contrast at the EV Expo.

Photo credit: Roy Kaylor

"The warning signs of pollution are here. We have to listen."

electric sports car. "It's so quiet." You don't have the gas pedal revving the car up or the exhaust coming out."

Market-Ready? Yes!

"A lot of people don't believe they're really market-ready yet, and they are," said John Huetter, Project Hatchery Alameda Director for Calstart, a consortium of companies creating clean transportation.

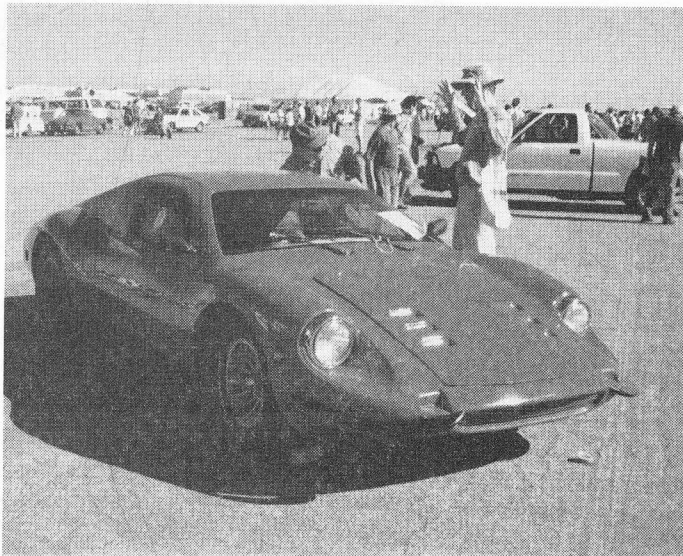
Transition Vehicles?

"I personally love them, but I'd like a transition period where there are cars with both gasoline and electricity," said Mike Connors' wife, Terri. "I'm still a little leery."

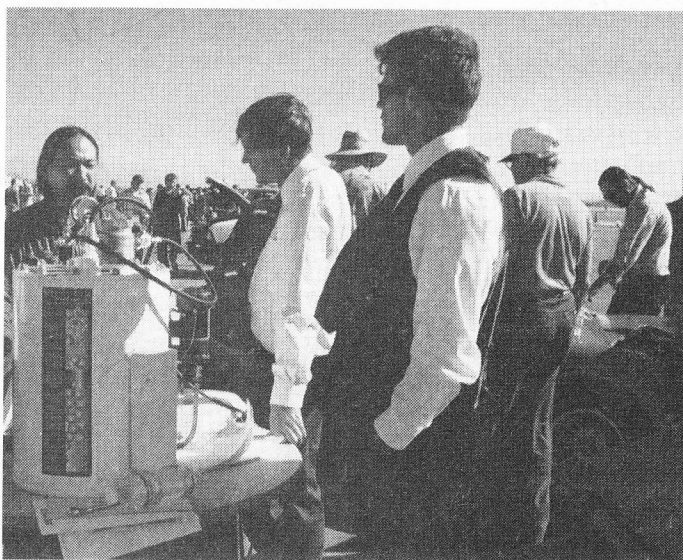
Well, keep in mind, Terri, that there are more electric outlets in the world than there are gasoline pumps. —CB

Source: San Jose Mercury News article by Renee Koury, Test drivers revved up by electric cars at Expo: Clean, quiet vehicles a hit, except for price, at Alameda showcase. 9/28/97

EAA and CE would like to extend our many thanks to the major auto manufacturers for bringing their EVs to the Stanford SVEAA, & CALSTART Alameda EV Expo EBAAA rallies. We look forward to working with you again.



It really runs on hydrogen? Well, Fuel cells, actually. The Kaylor-Kit Dino equipped with hydrogen fuel cells sparks amazement.



Powerball technology is an intriguing way of generating hydrogen for fuel cells. A plastic-encapsulated sodium hydride ball is mechanically split in the presence of water. Evolved hydrogen is collected and piped to fuel cells.



The Bombardier NEV put in an appearance.

EV Motors: Installation and Inspection Tips

BY BOB BATSON
ELECTRIC VEHICLES OF AMERICA, INC.

The purpose of the following article is to share our ideas and experience regarding the installation and periodic inspection of your electric motor. Although this experience is with dc series wound motors, the information should be applicable to most EV motors. Specific installation guidelines are not provided, but should come from your motor supplier, based on the motor and the adaptor plate/coupling design.

Initial Receipt and Inspection

When you first receive your motor, you may be pretty excited. This is the power plant that is going to drive your EV. It is a major investment, so take the time to inspect it closely and to test it.

You can visually inspect the motor to ensure that it was not harmed during transit. Check to ensure that none of the terminal studs are damaged, no cracks show in the casting, or there is no other physical damage caused by improper handling. If there is, notify your supplier immediately, so that the shipping company can return to inspect the motor.

If you want to perform an initial test to check the rotation, use a 12V battery supply and jumper cables. This will allow slow rotation of the motor and a means of quickly disconnecting the power. Conduct the test on the floor and restrain the motor from rolling. Do NOT test the motor with full voltage unless it is installed in the vehicle; otherwise, the torque can throw the motor across the room, possibly hurting someone.

If you do not plan to use the motor for a few months, be sure to operate it at low voltage in order to lubricate the bearings, and store it in a clean dry area.

Motor Installation

The motor installation is critical; therefore, it is essential that you check and double-check all dimensions and clearances before, during and after installa-

CALCULATION FOR MAXIMUM SPEED IN EACH GEAR

CALCULATION FOR MAXIMUM SPEED IN EACH GEAR

Tire Diameter-ft (D) _____ ft

Gear Ratio (GR:1)

Maximum Speed (MS) Equation is:

$$MS \text{ (MPH)} = (5000 \text{ Rpm} \times 60 \text{ min/hr} \times 3.14 \times D) / (GR \times 5280 \text{ ft/mile})$$

Complete the following table:

GEAR	GEAR RATIO	MAXIMUM SPEED (MPH)
1st	_____	_____
2nd	_____	_____
3rd	_____	_____
4th	_____	_____
5th	_____	_____

EXAMPLE (S-15)

MAXIMUM SPEED

Tire Diameter-ft (D) 25 3/4 inches = 2.15 ft

Gear Ratio (GR:1)

GEAR	GEAR RATIO	MAXIMUM SPEED (MPH)
1st	15.2	25
2nd	9.1	43
3rd	5.7	68
4th	3.8	103
5th	2.6	150

tion. The center of the output shaft of the motor must match the center of the input shaft of the transmission within a few thousandths of an inch. This tolerance depends on the specific vehicle and the method of connecting to the motor (clutch vs clutchless). Although this is critical, rarely has anyone had a problem.

The electric motor should be supported in the same manner that the internal combustion engine was mounted. Thousands of engineering hours have been spent by the automobile manufacturer in selecting and designing the engine mounts. Take advantage of their expertise—design your motor mount to attach to the existing engine mounts. The motor mount should support the motor weight between the motor mid-point and the outboard end. For rear wheel drive (RWD) vehicles, the motor mount consists of two clamps that hold

the motor and bolt to the existing engine mounts.

For front wheel drive (FWD) vehicles, we recommend the use of the front motor mount that attaches at the adaptor plate and bell housing and a rear plate that attaches to the brush end of the motor using the two tapped holes and the rear engine mount. This design allows the motor and transaxle to be supported in the same manner as the original design.

The need for a torque rod depends on the motor mounting and the specific vehicle. On FWD vehicles, the front motor mount to the radiator cross-member will act as a torque rod. For RWD vehicles, you can use a piece of flat bar (1 inch wide) between the adaptor plate and the frame. Some have questioned the use of the motor field bolts for removing torque. This is not acceptable and could damage the motor.

Protecting Your Motor

During vehicle construction, be sure to completely cover and protect the electric motor to prevent any metal chips, etc. from entering the motor and causing major damage. Typically we wrap the motor with a large trash bag using duct tape, then cover it with a second trash bag for additional protection.

It is also recommended that you install a fine mesh screen beneath the headband of the motor. The fine screen will prevent the entry of small stones, etc. that could damage the motor during operation. The fine mesh screen is taped to the inside of the head-band.

To prevent direct water spray etc. from entering your motor, you can also install a protective cover over the brush area by using any existing tapped holes in the commutator endhead. On the Advanced DC Motor FB1-4001 (9 inch diameter), we use a 13 inch diameter dishpan. We cut off the upper lip, so that the pan covers only the brush area. The 1-2 inch of clearance allows for sufficient air flow. Others have used the bottom of

a 5 gallon bucket which is a smaller diameter; however, we feel that this may restrict the air flow too much. Finally, this cover is painted black to match the motor and frame. It is cheap, easy, and provides additional protection.

Motor Overspeed Protection

DC motors can overspeed. For example, at 120V the FB1-4001 motor is most efficient between 4500 and 5300 rpm; therefore we recommend 5000 rpm as the maximum motor speed. Self destruction occurs at about 8000 rpm. The purchase of a tachometer drive system and an overspeed protection system will help you. However, there is also a less expensive way. And that is to determine the maximum speed in each gear. This can be done by rotating the rear wheel one revolution and counting the motor revolutions at the auxiliary or tail shaft. This identifies your final gear ratio for that gear.

The calculation (boxed sidebar on page 8) shows how to determine the maximum speed for each gear. This exer-

cise is critical because overspeeding the motor is not covered by its warranty. Therefore, perform the calculation and mark the maximum speed for each gear on the dash for all drivers to read. If you start to exceed the maximum speed, go to the next higher gear or use your brakes and slow down. We mention this because one team in the American Tour de Sol race climbed a hill in first gear to decrease motor current. Once they reached the top of the hill, they started to coast down going faster and faster. They never thought to slow down or shift gears. The inevitable happened!

Since motor overspeeding is due to mechanical forces, it can occur even when you are coasting in a low gear. No electrical energy is required.

Periodic Inspection

The biggest problem with EVs is that, after a while, the tendency is to treat them as a Zero Maintenance Vehicle as well as a Zero Emissions Vehicle. There is no oil to check, no coolant to change. Everything is operating fine.

continued on pg 10

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Bolton High School

EV Motors

continued from page 9

However, we recommend a monthly inspection, a quarterly inspection, and an annual rebuild.

Monthly Inspection

Pick the first day of the month or the first Saturday to carefully inspect the vehicle and perform routine maintenance (e.g. battery watering, etc.). The motor should be visually inspected and tested to ensure:

- All terminal connections are clean and tight.
- Air passages to cool the motor are not blocked.
- No unusual noise (bearings or misalignment) occurs when operated at a slow speed (1-2 mph).

Quarterly Inspection

Quarterly, you should perform a more thorough inspection of the motor:

Remove the headband and examine the brush and commutation area for even wear. The commutator surface should be a dark brownish color with the brush area being evenly polished. If the commutator appears rough, pitted, scored, or has signs of burning or heavy arcing, the motor should be removed for servicing. Using the motor to "hold" the vehicle on a hill at a traffic light will burn the commutator. Use your brakes, not your motor.

Brushes should be inspected for uneven wear and signs of overheating as indicated by discoloration on the brush assembly. If replacement is required, the complete brush set should be replaced using only the replacement brushes recommended by your motor supplier or manufacturer.

Inspect the brush springs for equal wear and even pressure.

Annual Rebuild

It may have taken many months to build your EV. If you designed your EV for maintainability, it can be disassembled, inspected, cleaned, and re-assembled in a single day. The purpose of the annual

In one of our customer surveys, it was determined that one component failure occurred in 15,000 miles.

rebuild is to determine if any component is showing signs of aging or uneven wear. During the rebuild, you may decide to make specific upgrades, such as the addition of a tachometer. Your EV represents a major investment that, with proper care, will maintain its value. We know because we sold one of our demonstration vehicles, a 1991 GMC S-15 truck for \$20,000 after using it for two years. Why? Because it was maintained and the best looking EV in New England.

Trouble Shooting

Periodically, something does go wrong with an EV. In one of our customer surveys, it was determined that one component failure occurred in 15,000 miles. This included all components (motors, controllers, contactors, DC/DC converters, etc.). Rarely does a motor have a problem if it has been sized properly for the application.

■ Motor problems are more related to overheating that may be due to:

■ A motor too small for the application. Every 1000 lb. of vehicle weight requires 4-6 hp continuous. Naturally, you need less horsepower on level terrain (e.g. Florida) and more horsepower on hilly terrain (e.g. New England). A motor that doesn't meet your needs is not a bargain.

■ Inadequate ventilation. Although the motor may be 90 percent efficient, the 10 percent inefficiency can generate a great quantity of heat. Simply multiply the voltage x the amperage x the inefficiency to obtain the amount of waste heat. This can equal 2000-4000 watts; which represents 20-40 100 watt light bulbs. Ventilation is required to remove that heat or damage will occur.

■ Direct drive (no gear reduction). If the motor is designed to operate most efficiently at 5000 rpm, what do you think is the impact of operating it at 900 rpm? Inefficiency and overheating.

It is easy to check your motor for operation. Simply connect a 6 V or 12V battery to the terminals as you did when you first received the motor. If the motor operates, the problem is elsewhere.

Your EV motor is a major investment. By properly installing the correct motor for your application and performing a periodic inspection, your investment will provide trouble-free service for many years.—BB

I want to thank Advanced DC Motors (Syracuse, NY) for contributions to the above article.

**Bob Batson, Electric Vehicles of America, Inc.
Maynard, Massachusetts**

Urban Assault Vehicle for Environmentally Conscious

ALAMEDA, CA 9/26/97

Kaylor Energy Products today announced the debut of the "Tiger" Electric Vehicle, a purpose-built, low-cost hybrid EV. Tiger has a custom frame, a fiberglass body and a raked-back windshield, which gives the car the appearance of a 4-wheel drive sport utility that has been modified for aerodynamic efficiency. Tiger uses the exciting new "China Wind" separately excited DC motor. The "sep-ex", as this technology is known, can give speed and torque performance nearly equivalent to an AC-type drivetrain at a fraction of the cost.

Low-Cost Hybrid EV

In addition, Tiger is a hybrid, using a state-of-the-art auxiliary power unit developed by Bruce Colley of Phazor Corporation. This APU eliminates the perceived "range problem" in pure Evs by providing an on-board means of continuously charging the batteries. Though experience has shown that the car will operate most of the time as a pure EV, the



A fuzzy car? Tiger gets stroked at Alameda EV Expo.

onboard hybrid unit will provide more flexibility in addition to driver reassurance. Tiger's APU uses a quiet catalytic converter-equipped, water-cooled Kawasaki 750 coupled with a lightweight but high-powered alternator.

Because Tiger uses suspension, transmission and steering components from VW Golf/Rabbit, flooded-cell lead-acid batteries and a low-cost DC motor technology, KEP expects it to sell for \$20,000 in full production, making it the "VW Bug" of EV hybrids. Tiger will also be available with the Kaylor Monster Motor, a 100+ peak hp DC series motor that is the largest and most powerful available for Evs.

Honestly Exposed Batteries

The first Tiger prototype is being built in the Calstart Hangar 20 and is the first EV hybrid fabricated on-site. To emphasize its image as a rugged survivor in the urban environment, Tiger will carry its batteries along the sides of the car and have them exposed for ease in servicing and to give the car a tough military look. For those who prefer less aggressive styling, battery covers will be available.

A Furry Car

Tiger combines sport-utility styling with friendly appeal. To enhance its "petability" factor, which makes Tiger different from more slick-looking Evs, the prototype is covered with synthetic tiger fur. The press and public is invited not only to touch the car but to stroke and pet it.

The Only Convertible with a True Rollbar

In line with its friendly image, Tiger emphasizes safety. Batteries are located low in the vehicle to enhance stability. In addition, Tiger will have a sturdy rollbar bolted directly to the frame. This will protect passengers in the unlikely event that the car does roll. Tiger is the only open or convertible car in the US that has this safety feature. Many sport utilities and pickup trucks have what appear to be rollbars, but these are really "light-bars", designed only for display and to support flood or fog-lights. They will not take the weight of the car in a rollover. Tiger's rollbar will support the car, protecting the passengers from head and crush injuries.

Tiger and Tigress

The car will be available in two versions; the aero-jeep Tiger and Tigress, a sport convertible designed to appeal to women. Both vehicles are based on the Herb Adam's "JackRabbit", a quality kit car based on the VW Rabbit/Golf.

Clare Bell, who is involved with the project, described the car as "an urban assault vehicle for the environmentally conscious."

Sources: Roy Kaylor - (510) 521-8887 or (408) 338-2200 or Clare Bell (510) 864-9293

SPECIFICATIONS

Two-seater sport utility

Curb weight - 1850 lb.

True rollbar capable of supporting the car's full weight.

Dimensions: L 64" x W 128" x H 48"

Range as an electric — 50 miles

Range with onboard APU and 10-gallon tank - 400+ miles

Battery- 16 flooded-cell lead-acids

Voltage (nominal) - 128 V on 8V batteries (16)

Laboratory Tests of the Kummerow Zinc-Air Batteries

By A. F. BURKE

INSTITUTE OF TRANSPORTATION
STUDIES UNIVERSITY OF CALIFORNIA, DAVIS

Kummerow of North America shipped twenty (20) Zinc Air cells to UC Davis for testing in the Electric Vehicle Power System Laboratory. It was decided to test the cells in groups of five. Each group of cells was filled with 30% by weight KOH as the electrolyte and then they were connected in series to form a 7V module. The module was assembled in a box with spacing between the cells to allow fan-driven air to pass over the air cathode of the cell. The 7V module was then connected to a battery tester to perform constant current and pulse current discharges.

Tests were performed using an Arbin BT2040 battery test system (six channels, 20V, 20A) and a Bitrode (50V, 400A) to control the discharges and acquire the data. One module was discharged at a constant current of 5A and a second module at 10 A. In each test, the discharge was terminated at a cut-off voltage of 4.5V (0.9 V/cell). The constant current discharge profile consisted of repeated cycles of one hour (60 minutes) at constant current and five minutes of rest.

This test profile permitted the tracking of the open-circuit voltage of the module during the discharge and the calculation of the module resistance at various states of charge. The Arbin system did not permit the measurement of individual cell voltages, but occasional manual readings of the cell voltages with a Fluke meter indicated that the cell voltages were quite uniform. The data from the tests were plotted and analyzed using an EXCEL spreadsheet.

A third group of cells was assembled into a 7V module for pulsed current testing to determine the high-power characteristics of the cells. The discharge profile for these tests was successive current pulses at increasingly higher currents. The test currents were 5A, 10A, 20A, 25A, 30A, 35A, 37.5A, and 40 A. The pulse profile for each current was 120 seconds at the specific current followed by a three minute rest before the initiation of the next higher current pulse. For these tests, the minimum voltage was set at 0.4V/cell.

During the initial tests in this series, it was found that one of the cells was significantly weaker than the others in the group. That cell was removed and the pulse test with currents up to 40A was performed using four cells in the module. The pulse current tests were performed using the Bitrode tester, which permitted the measurement of individual cell voltages.

These measurements indicated that the four cells were very uniform with only a small spread in their voltages at the various currents. The data were plotted and the resistance of the four-cell module calculated from the data using an EXCEL spreadsheet.

Constant Current Tests

The primary objectives of the constant current tests were to determine the Ah capacity and energy density (Wh/kg) of the cells. The resistance was also calculated from the periodic interruptions of the current during the constant current discharges. The constant current data are summarized in Table 1. The voltage Vs. time curves for the 5A and 10A discharges are shown in Figures 1 and 2. The resistance results are shown in Figures 3 and 4.

The Ah capacity of the cells was found to be 251.0 Ah at 5 A and 246.9 Ah at 10 A. The Wh capacity of the cells was found to be 1422 Wh at 5A and 1264 Wh at 10 A. For a module weight of 8.9 Kg (1.78kg/cell), the energy capacities correspond to 160 Wh/kg at the 5A rate and 142 Wh/kg at the 10 A rate. As shown in

Figures 3 and 4, the cell resistances determined from constant current tests varied only slightly with state-of-charge, but there was a significant difference in the resistance between 5A and 10A. The resistance at 5A was 0.22 Ohm and at 10A, it was 0.15 Ohm. This decrease in resistance was confirmed in the later pulse current tests.

Pulse Current Tests

The pulse Current test results are given in Figures 5-8. The current and voltage vs. time curves are shown in Figures 5 and 6. The curves and the sec-by-sec data indicate that the cells respond very fast to current change commands and that the voltage rises in less than a second to near its final value.

The Zinc-air cells show a slight increase in voltage as the current is maintained for 120 seconds, unlike other batteries that show a voltage sag with prolonged high currents. Like other battery types, the open circuit voltage of the Zn-air cells recovers slowly after the current pulse is removed.

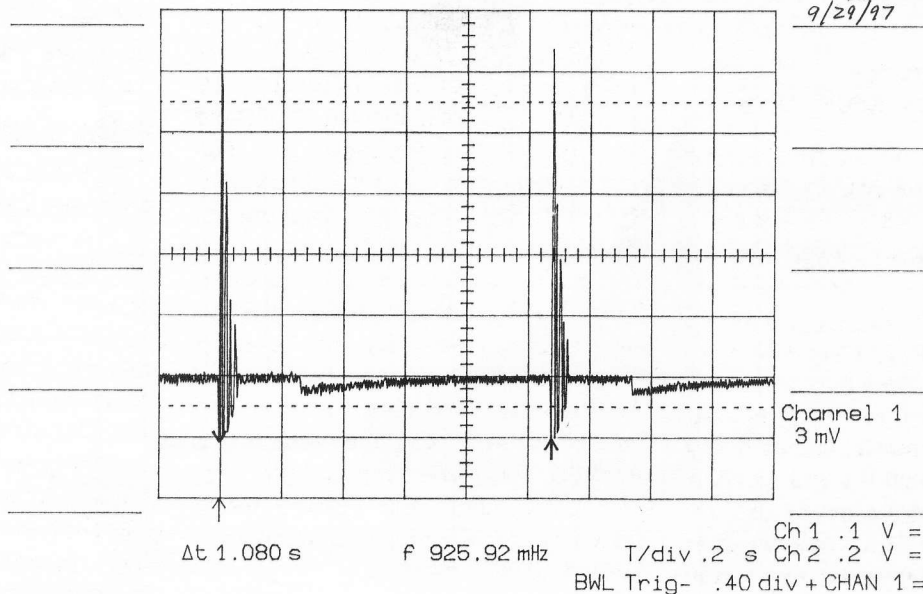
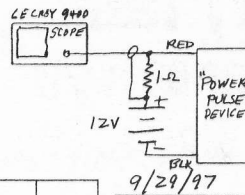
This recovery was essentially complete in the three minute rest period used in the present tests. The cell voltage decreased as the pulse current was increased due to the resistance of the cell. The voltage of the four-cell module decreased to about 2V for the 40A pulse.

The resistance of the module was calculated from the data. The results, given in Figure 7, show a decreasing resistance with current. The resistance appears to approach 0.1 Ohm (.025 Ohm/cell) at the high currents. The power ($V \cdot I$) from the module increases rapidly with current up to about 25A (75W) and then very slowly as the current is increased to 40 A (80 W).

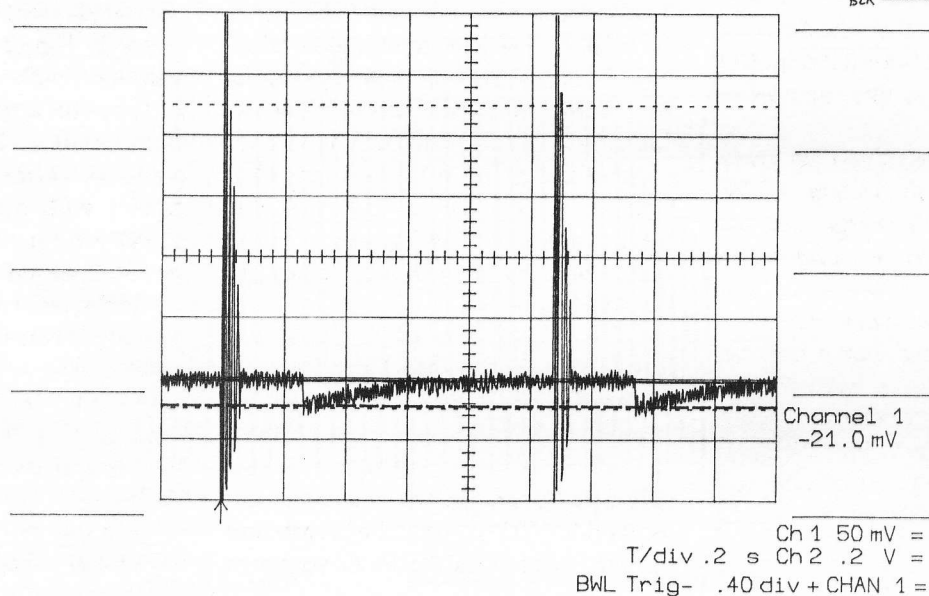
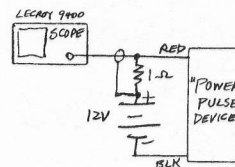
If the resistance was constant independent of current, the maximum power would occur at $V_{oc}/2$, which for these cells would be about .7V/cell or for a pulse of 25 A. A maximum power of 80 W corresponds to a power density of 11 W/kg.

During the pulse current tests, the individual voltages of the four cells was

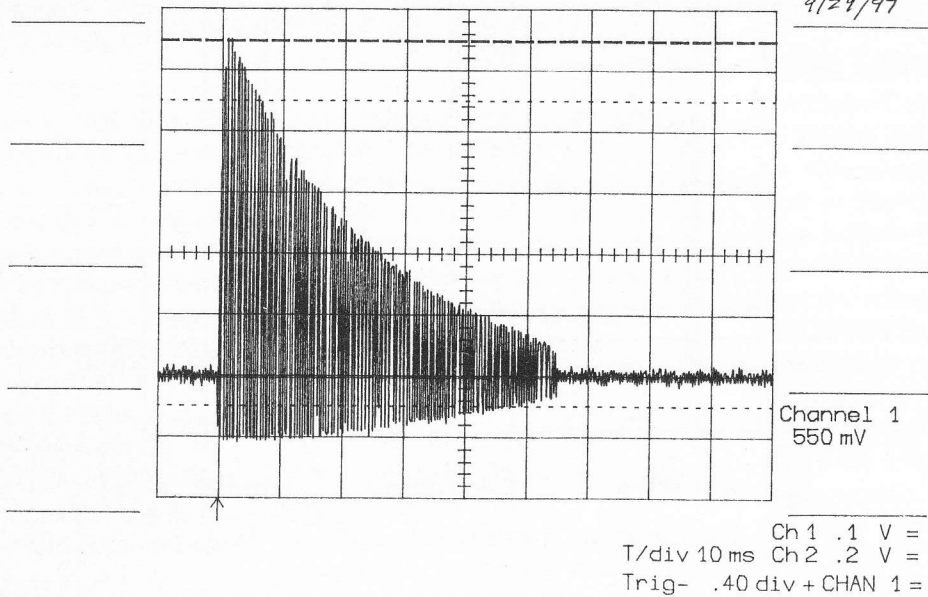
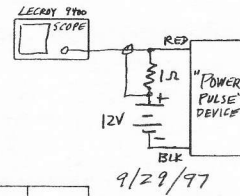
PACKET REP RATE : 1.08 Sec



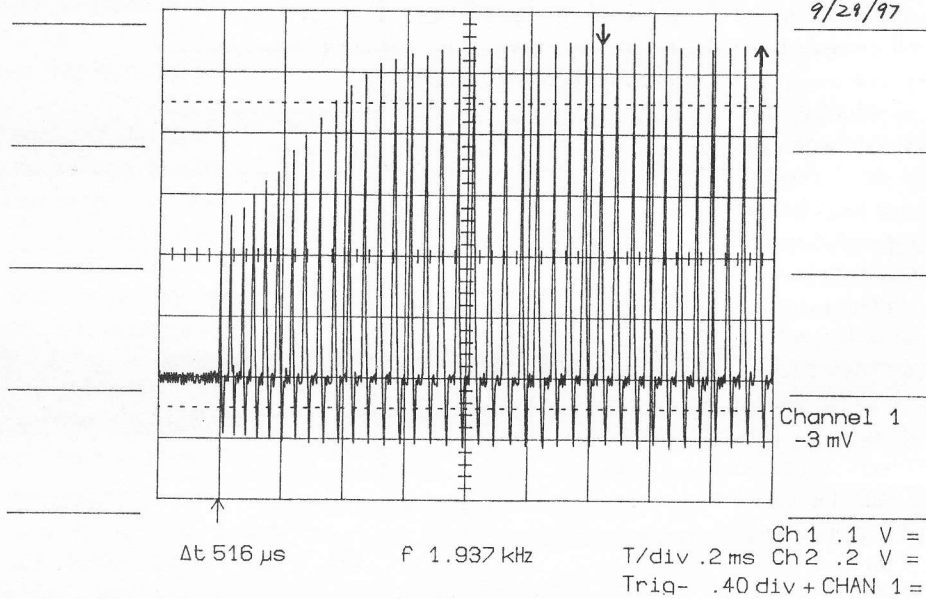
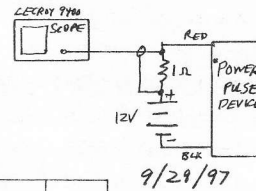
DC DEMAND BETWEEN PACKETS : 20 mA peak



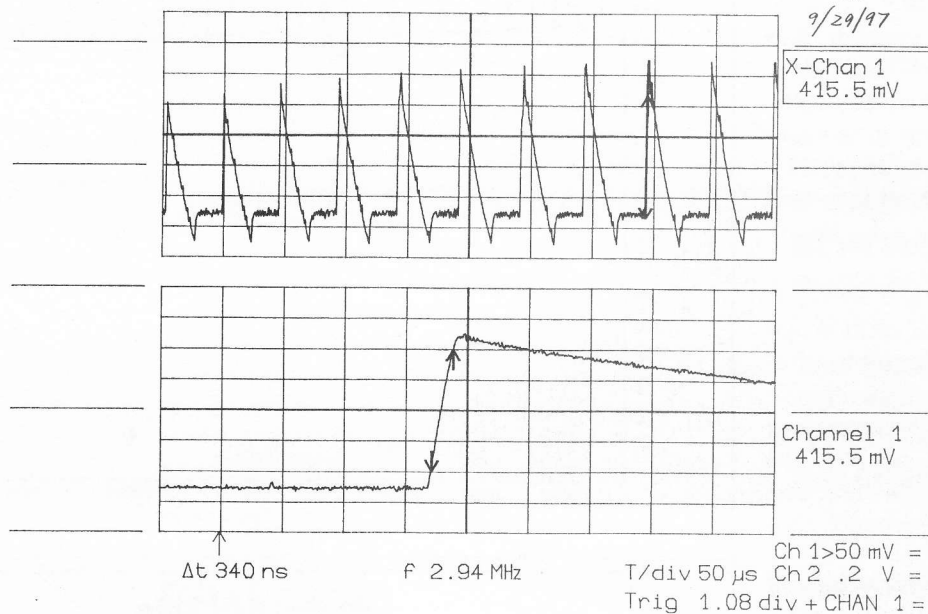
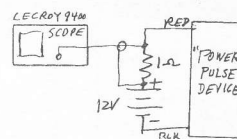
PACKET MAX AMPLITUDE : 0.55 A.
PACKET DURATION : 55 mSec



PULSE FREQUENCY : 19.37 kHz



PULSE RISE-TIME : 340 nSec.



measured. As shown in Figure 8, the variability between the cells was relatively small. As is the case for all batteries, the variability increased as the current of the pulse was increased. In general, the variability of the cells tested was quite satisfactory except when a cell was clearly defective, as in the case of the leaking cell in the five-cell module used in the initial pulse power tests.

Constant current discharge and pulse current tests were produced in the Electric Vehicle Power System Laboratory at the University of California, Davis on groups of Zinc-Air battery cells obtained from Kummerow of North America. The constant current tests indicated the Ah capacity and the energy density of the cells were 251 Ah and 160 Wh/kg. for 5A and 247 Ah and 142 Wh/kg for 10A discharges, respectively. The pulse current tests indicated that the resistance of the cells decreased with increasing current, approaching 0.025 Ohm at high currents (40A). The maximum power was 75-80 W, which

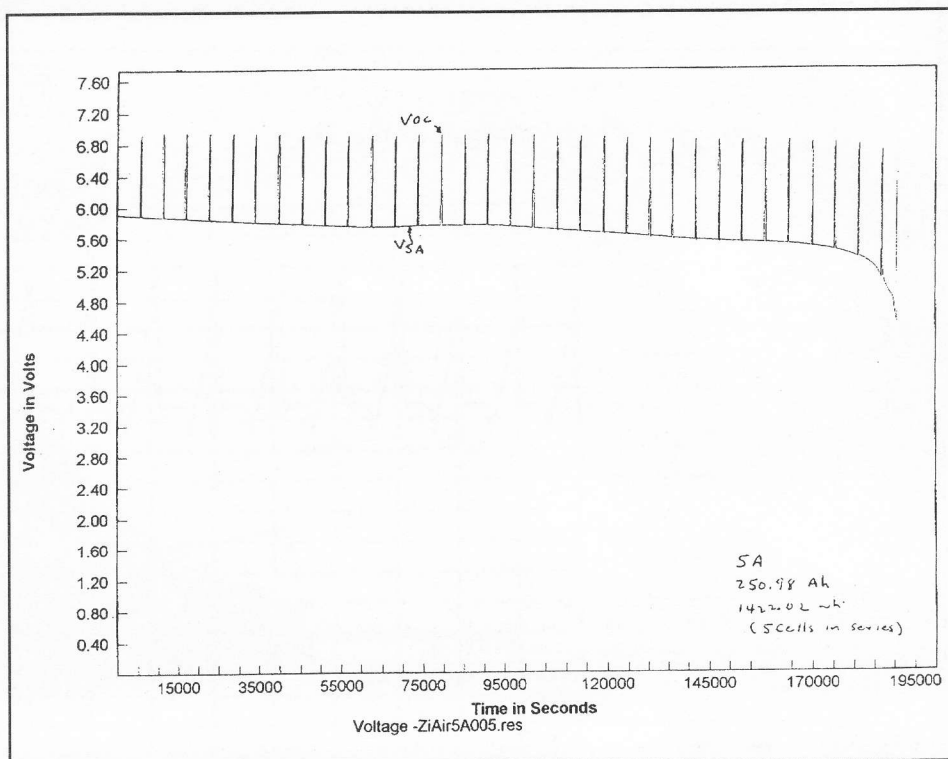
occurred at about 25 A. The power from these cells was essentially constant between 25A and 40 A. The peak power density of the cells was 11 W/kg. From the limited data available from Germany (some given verbally and others from a few curves of test data, it appears that the data obtained from the tests at UCDavis are consistent and verify similar data taken in Germany.—AB

What is That PowerPulse REALLY Doing?

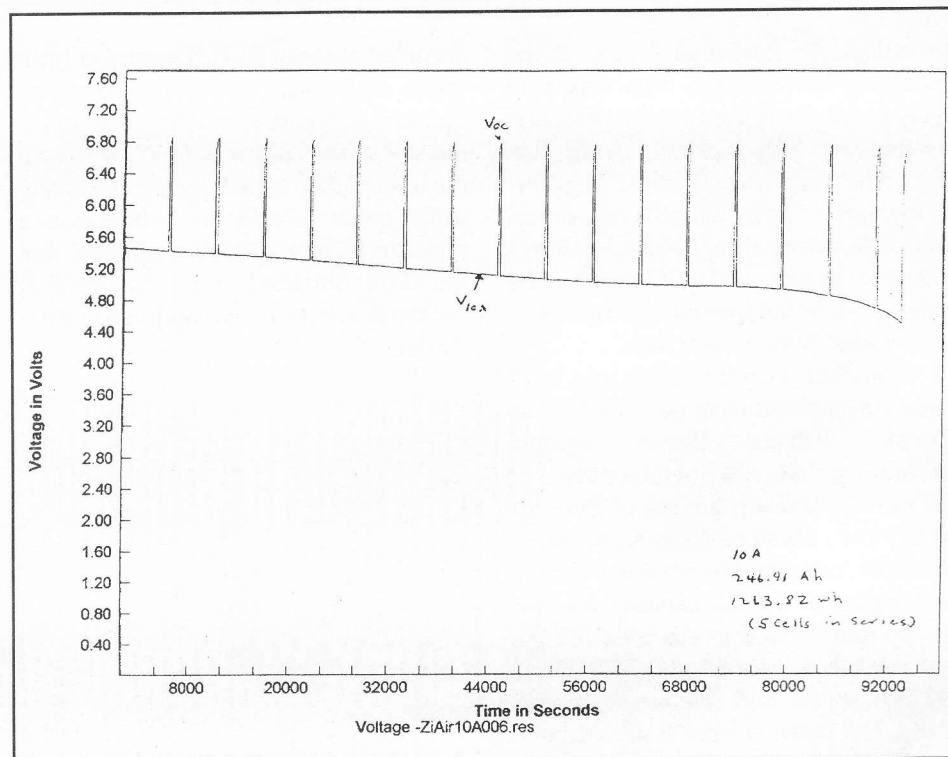
EA Silicon Valley member Bob Wheeler encouraged a friend of his, who has a Lecroy 9600 high-frequency storage scope, to investigate the signals coming out of a 12V PowerPulse unit. He did, and then sent the results to Bob Wheeler, who kindly forwarded copies on to CE.

The experimental set-up is shown at the right corner of the first oscilloscope trace. A 1 ohm ceramic (not wire-wound!) resistor simulated the impedance of the battery. Lower resistor values (.1 ohm) have similar results, but slowed pulse rise times due to the added inductance of their wire-wound construction.

For those ultra-techies who think of scope traces as fine art, enjoy! For those who just want more information on the de-sulfating PowerPulse, here you are. Incidentally, does anyone out there know what the inter-crystalline bond-breaking frequencies are for lead sulfate? It would be interesting to compare that data to the PowerPulse's 340 nanosecond rise time. — CB

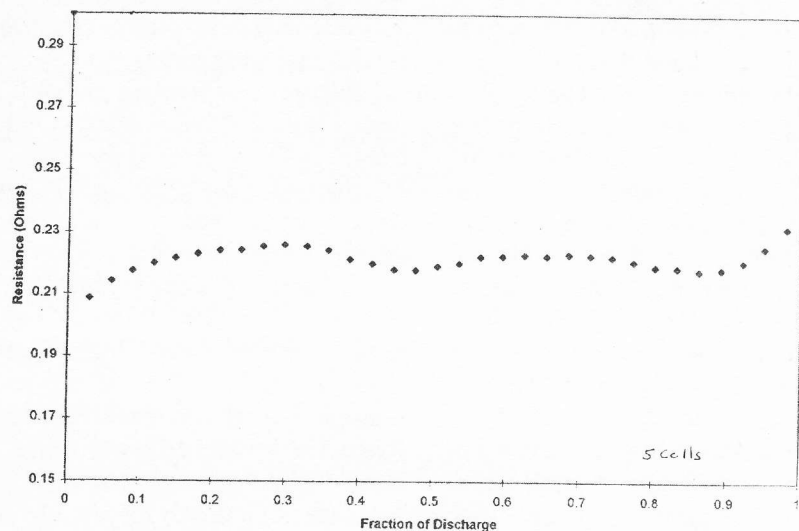


Packet Rep Rate



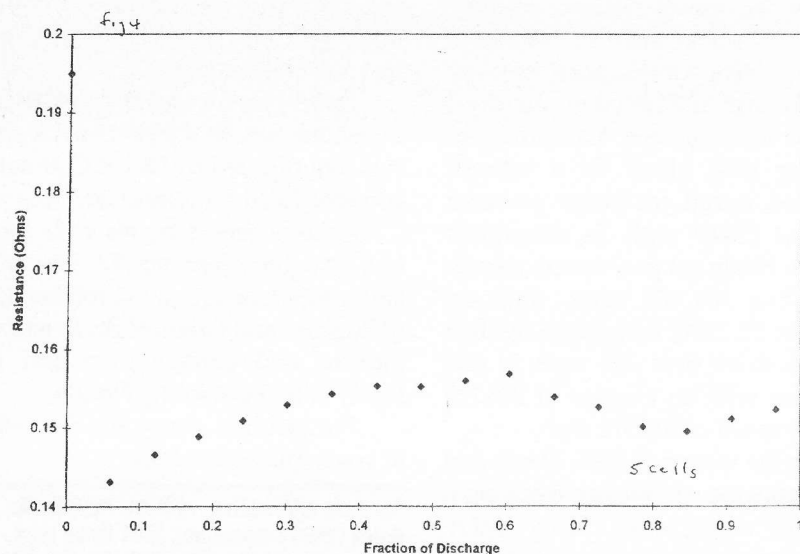
DC Demand Packet Max Amplitude

Resistance vs Fraction of Discharge (5 Amps)



Pulse Frequency

Resistance vs Fraction of Discharge (10 Amps)



Pulse Rise Time

BOARD OF DIRECTORS

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EV Landspeeder Lloyd Healy Dead at 40

Lloyd William Healy, the builder and driver of the world's fastest electric car, died September 19 at his home in Converse, TX. He was 40

Healy, who had been diagnosed with cancer of the pancreas and liver in August 1992, died of the disease after a long and courageous battle.

Ironically, it was the medical retirement which gave him time to pursue a lifelong interest in automobile racing, if only for five years. But in that brief period, Lloyd Healy set five national and seven world electric car speed records. He was the first person to go over 200 mph in an electric car. At the time of his death, he still held his world speed record of 206.512 mph, established at the Bonneville Salt Flat in Utah on Sept. 26, 1996.

Born and raised in Toronto, Ontario, Healy as a young man built and raced motocross bikes. He was also a gifted athlete, an all-star hockey goalie, baseball catcher and Olympic weightlifter. After his family moved to the United States, Mr. Healy enlisted in the US Air Force at age 17, where he served for 18 years. While participating in Senior Non-Commissioned Officer Academy in August 1992, he experienced pain while running, and was subsequently diagnosed with terminal cancer of the pancreas and liver. Once diagnosed, nearly 90 percent of pancreatic cancer victims die within a year. Healy was medically retired as a Master Sergeant in 1992.

In addition to conventional chemotherapy, Healy participated in an experimental cancer treatment at the Cancer Therapy Research Center of San Antonio, headed by Dr. Daniel Von Huff. The drug under the name Gemcitabine was developed by Eli Lilly, the

Indianapolis Indiana pharmaceutical company. Currently Gemcitabine is approved only for treatment against advanced metastatic pancreatic cancer. Of the one hundred people in the original test group, Healy lived the longest.

In November 1992, Healy purchased a gas-powered race car from Doc Jefferies, a Bonneville Salt Flats racing legend. The car, affectionately known as the Pink Lady for its color, was converted to battery power. In September 25, 1993, at the Bonneville, Healy set a world speed record for lightweight electric car at 101.325. For this car and other, Mr. Healy received generous and advanced technical assistance from staff of the Southwest Research Institute, and product and financial support from Quick Cable Corporation, Racine, WI. Realizing the limitations of a converted car, Healy and his team, now including Mike Meeks, an experienced racecar builder, designed and built a new electric battery powered car, the Spirit of San Antonio II

The Spirit of San Antonio II is 22 feet long, 26 inches high, 25.5 inches wide and weighs 820 lb. without batteries. The driver, dressed in a fire-proof racing suit, pilots the car from a reclined position, lying on his back in a similar manner to a luge pilot. Healy campaigned the car at Bonneville and at El Mirage, the dry lake track in Southern California. In November 1994, Healy set a national land speed record for battery powered vehicles at 154.67 mph. In subsequent races, Mr. Healy set new speed records by breaking his old ones, until on September 25, 1996, he became the first person to drive over 200 mph in an electric car, with an average of 204.123 and a top speed of 206.512 mph.

Over the winter of 1996, Healy and Meeks re-engineered the car, readying it for the 1997 racing series. Healy continued his extensive national speaking schedule. He spoke to cancer support groups, oncology professionals, children's and religious groups. But by the late spring of 1997, it was clear that the

cancer tumors had at last gained the upper hand. All speaking engagements were canceled. In August, Healy was too weak to travel to Bonneville, where Mike Meeks took Healy's place for the "Speed Week" qualifying trials.

Bill France, President of NASCAR, said Healy's "determination on all fronts, both in (his) pursuit of new records and (his) fight against cancer were inspirational." "I admired his determination," said Wally Parks, chairman and founder of NHRA Championship Drag Racing, "and the results it gained. 'Believing is what he stood for, and I know of now better example that it can work. George W. Bush, Governor of Texas, called Mr. Healy 'shining example to others' for his 'love of God, zest for life, and sheer determination.'"

"One of Lloyd's greatest accomplishments," said Mr. Shannon, President, Quick cable Corporation, "was his ability to put together a team. In an activity of complex as automobile racing, he could not have set world records merely working by himself; he set world records by first building a very effective team. Lloyd worked through his team and now that team with continue to work with the same enthusiasm, goals and deadlines as before."

Lloyd Healy's life story and electric car records are the subject of a documentary film directed by David Cottingham and scheduled for release later this year.

He is survived by his wife, Janine, two daughter, Jennifer, 22, Megan 12, and a son, John, 10, two brothers, Dana of England and Grant, of St., Petersburg, Florida; and parents John and June Healy of St. Petersburg, Florida.

For pictures, please see the website at www.quickcable.com.

For more information, contact: Mark Kukla, Quick Cable Corporation, 2501 Eaton Lane, Racine, WI. Phone 800-558-8667, Ext. 370 Fax 800-733-8611. Healy Motorsport, 901 Meadow Branch, Converse, TX 78109, Phone 210-659-6994

Guidelines for EAA Awards

BY GEORGE GLESS

1. Awards given are: the EAA Fellow Award and the Keith Crock Award.
2. Number of awards presented each year: normally 2-5 Fellow Awards are made while only one Keith Crock Award is given.
3. Nominations may be made by: any EAA member, group of EAA members, an EAA chapter, or chapter representatives.
4. Eligibility: the Keith Crock Award is given for technical excellence and may be made to an individual, a group, or a company or other organization. The technical accomplishment for which the award is given may be in the form of a vehicle, a component, a drive system, supporting infrastructure, etc. The Fellow Award is made to individuals for outstanding activities in areas relating to support of the EAA, advancing the cause of electric vehicles, or other activities of benefit to the EV industry.
5. Each award recipient receives a plaque, which is presented at an appropriate function.
6. Nominations may be submitted in any form that clearly outlines the nominee and other pertinent information, such as the nominee's address, the type of award, etc. Sufficient information, such as text, pictures, etc. should be included to support the nomination.
7. Nominations are to be submitted to the EAA Board of Directors (see the contact address and telephone/fax number listed below) for final action.

George Gless
Awards Committee Chair
EAA Board of Directors
2940 13 Street
Boulder, CO 80304
Tel/Fax: (303) 442-6566

Current Eliminator

CONTINUED FROM PAGE 1

What a great sport! Jon can be reached at his Email address at <AVIPERGUY@aol.com>, for those who wish to thank him personally. By the way, for those who referred to his gorgeous Viper (that he so willingly brought to our first EVent) as a gas guzzler, it is interesting to note that Jon actually chuckled at the comment and said he was not offended at all. However, Jon was quick to add that his V10 Viper yields 22 mpg on the open road.

Jon is very excited about high performance EVs, and has contacted a Chrysler-backed quarterly publication dedicated to news and racing bits about Vipers.

Contact John at E-Car, (503) 256-5064

As the current president of NEDRA, I wish to thank everyone for their support and attendance at our first, but certainly not the last, 'all electric' national drag race.

CE thanks Bob Rickard of Wilde Evolutions, Bruce Meland of Electrifying Times, John Wayland of E-Car and of course the great sport himself, John Brobst and his Viper GTS.

News in Brief is compiled by Ruth M. Shipley from information supplied by the Environmental Information Network. If reprinted, please credit CE and Ruth Shipley. News in Brief

California Homes Built EV-Ready

Some newly-constructed Southern California homes will be "EV ready" when they are complete because builders are adding the needed electric wiring to handle the energy demand of an EV. Comstock Homes, for example, is working with officials in the city of Carson, a Los Angeles suburb, to provide EV-ready homes in the builder's Monterey Pines gated residential development. The EV-ready housing package includes the wiring and outlets needed to accommodate an EV charger and is free to home buyers. Another construction company, Taylor Woodrow homes, is including the EV-ready garage as an option at a nominal cost to home buyers in a new 83-home gated community in Huntington Beach, CA. Contact: Comstock Homes, 310-952-0017; Taylor Woodrow Homes, 1-800-474-3222.

PosiCharge Available for Ford Ranger

Though Ford recently introduced its PosiCharge fast EV charger, a nationwide network of charging stations is still a long way away, according to experts in Detroit. The PosiCharge, developed by California-based AeroVironment Inc., is a device designed to significantly boost the usable daily range of EVs by charging a battery pack in a matter of minutes rather than hours. Ford said its new charging technology will be added to the Ranger Electric pickup trucks, allowing a nearly full recharge in as little as 20 minutes. While the charger looks about the same as a standard gasoline pump at a fill station, it has a large electric cable instead of a fuel hose. The cable includes a three-inch diameter connector that will be a universal type for all conductive charge electric connections.

(AGENCE FRANCE PRESSE: 9/13)

GM Remains Optimistic About EV1

General Motors still sees potential in its EV1 electric vehicle, though sales have been slow. Since being introduced to customers in Southern California and Arizona eight months ago, the automaker has placed only 225 EV1s and another 200 electric-powered S-10 pickup trucks. GM, however, remains optimistic about Evs. "If you measure the success of this car in terms of 10-day sales numbers, you're missing the point," said Robert Purcell, head of GM's EV operations. "Anyone's who's going to declare failure after just eight months has no idea what it takes to get new technology into the marketplace." The EV1 engineers are currently developing options to increase the vehicle's appeal such as an optional NiMH battery pack that doubles its range to 81 miles per charge.

(WASHINGTON TIMES: 9/12)

Unique Mobility Wins DOE Grant

Unique Mobility, Inc. recently received a Department of Energy (DOE) grant to develop the company's patented electric motor manufacturing process for hybrid electric vehicles. Unique's electric motor will be used to power a hybrid electric mid-sized passenger car. The manufacturing process requires conventional industry presses to compact a special resin-coated magnetic powdered iron into segments that are arranged to form an electric motor stator, which helps reduce losses in the motor. The process also cuts the number of parts in a motor, saves time and labor, and produces minimal scrap metal. Unique plans to build and evaluate two test motors — one using powdered iron and the other using standard laminations — for cost and performance.

(UNIQUE MOBILITY RELEASE: 9/10)

Automakers Plan Fuel Cell Vehicles

Though vehicles powered by fuel cells are quieter and 50 times more fuel efficient than vehicles with internal combustion engines, they are still large and expensive for the mass market. Still, automakers are racing to develop the environmentally-friendly systems for the next generation of vehicles.

Daimler-Benz claims it will produce Mercedes-Benz A-class vehicles powered by a methanol-type fuel cell by the middle of the next decade. Toyota has also unveiled a prototype powered by proprietary fuel cells operating on hydrogen generated from methanol. Chrysler has said it will produce a car powered by a single fuel cell by 1999, while Ford expects to produce a hydrogen-fueled integrated research prototype that could be ready for evaluation by 2000.

(FINANCIAL TIMES: 9/9)

Hyundai Unveils Atos EV

Hyundai Motor Company recently introduced its new EV, the Atos EV, at the Frankfurt Motor Show. The five-seater EV is a development vehicle that weighs only 2,585 pounds with its battery pack, which contains 24 NiMH batteries. The vehicle has a top speed of 80 mph and a range of over 120 miles in stop-and-go traffic. The Atos EV is equipped with the Hyundai Intelligent Diagnostic System (HIDS) that monitors the electrical subsystems and adjusts operation for maximum efficiency, as well as a battery management program and a regenerative braking system. Also featured is a "creeper" mode that enables the vehicle to use the minimum amount of power necessary to move in slow traffic. The batteries can be fully recharged onboard in seven hours with a 6.6 kilowatt conductive charger.

(HYUNDAI MOTOR RELEASE: 9/9)

Daimler-Benz Introduces Fuel Cell A Class

German automaker Daimler-Benz unveiled its fuel cell-powered version of the company's A class compact car at the Frankfurt International Auto Show. Daimler-Benz expects the car to do well in niche markets, maintaining that it is not yet ready to begin mass-producing the vehicle. The car, known as NECAR 3, is Daimler-Benz's fourth fuel cell vehicle to be developed in the past three years. The A class fuel cells would manufacture hydrogen from methanol, which the company says produces far less carbon dioxide than conventional internal combustion engines. A methanol reformer on the NECAR 3 allows for the elimination of bulky hydrogen tanks which helps cut down vehicle weight and makes the car more practical.

(REUTER: 9/9)

Fuel Cell FEVER to Undergo Testing

French-Italian-Swedish collaboration has resulted in a fuel cell-powered concept vehicle, the FEVER, which will soon begin road trials. The vehicle is a Renault station wagon equipped with a 30-kilowatt PEM system. FEVER, short for Fuel Cell Electric Vehicle for Efficiency and Range, was developed over the past three years and operates on liquid hydrogen and a NiMH battery, which helps with energy buffer storage and startup. The vehicle has a top speed of 75 mph, a range of 312 miles on one charge, on a road weight of 2,200 kilograms with two passengers. Project participants include top French engineering school Ecole des Mines, Italian firms Ansaldo Ricerche and De Nora s.p.a., France's Air Liquide and Sweden's Volvo Technology Development unit.

(HYDROGEN & FUEL CELL LETTER: SEPT. 1997)

Honda Develops Gasoline-Hybrid Engine

A gasoline-electric hybrid engine that reportedly is lighter, simpler to produce and uses slightly less gasoline than Toyota's hybrid electric vehicle (HEV) has been developed by Honda. Though all the major automakers are working on some type of HEV, none of them has mass produced the vehicles for market yet. Honda reported that its new hybrid engine will be able to get 70 mpg. Under Honda's Integrated Motor Assist (IMA) system, the gasoline engine runs as long as the car is running. The IMA assists the electric motor, while the gasoline motor generates electricity. The IMA system is unlike conventional hybrids, which switch back and forth between the engine and motor. Honda said the IMA is simpler and lighter and requires the same number of parts as a regular engine, which is critical for production costs.

(AP: 9/19) (CURRENT: VOL.2, ISSUE 7)

Reliant Developing Electric-Powered Robin

Staffordshire, UK-based Reliant recently announced that it is developing an electric version of the three-wheeled Robin car. The automaker expects to complete an advanced prototype this fall, with plans to market a battery-powered production version, possibly in southern California, by the end of next year. Reliant is currently working to produce a car with a top speed of 65 mph and a range of 70 miles on a charge. The Robin is two-thirds the weight of a comparable size four-wheel, steel-bodied car, and would require less battery bulk. Reliant said that it plans to sell the car for about 7,000 pounds sterling (a little more than \$11,000), which is the cost of the gasoline version.

(THE INDEPENDENT: 9/3)

ELECTRIC VEHICLES ONLINE TODAY Month-in-Review

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UL Evaluating Charging Systems

Underwriters Laboratories (UL), through a grant from the Electric Power Research Institute (EPRI), is conducting tests of charging systems to verify system safety. The tests are being conducted in three cities under different environmental conditions, with assistance from Southern California Edison. The three groups are collaborating with vehicle manufacturers and electric utility companies to evaluate the effect of climate on charging equipment, and to validate conductive charging equipment safety standards. This validation could lead to UL listing for the charging devices. The tests are being conducted on the Honda EV-PLUS, Ford Ranger EV, Toyota RAV-4 EV, and Chrysler's EPIC minivan vehicles using chargers manufactured by SCI Systems and Electric Vehicle Infrastructure, Inc.

(CURRENT: VOL.2, ISSUE 7)

For Sale

1981 Jet Electrica (Ford Escort). Refurbished, 4-spd, 96V/400A, Prestolite, new battery (16x USB 145), DC/DC, new paint. \$8,995. Call (650) 964-3974. (California)

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EV Racecar, SnoWhite. Bob Schneeveis' legendary 100 mph+, 9 second battery swap Phoenix racecar is seeking a new home. University, commercial or individual racing teams can own and race a part of EV history. SnoWhite was the first modern EV racer to break 100 mph on the oval track at Phoenix International Raceway. She's probably capable of 140 with the right tires. She's also a lot of fun in SCCA Solo 2 Autocross — she beats nearly everything out there and is a major attitude adjustment device. Bob is selling her because he wants to build an even better car and needs the \$ to do it. \$20K complete with Otmar Ebbenhoech "Godzilla" controller and all battery-swap equipment. Without Godzilla, the price is \$15K. Bob Schneeveis, 510-493-5806 eves and weekends. (Northern California)

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FW001	Flywheel Energy Storage	\$ 5.00
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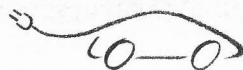
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CAP001	100% Cotton Cap, Forest Green with Yellow Ink	\$8.00
DC001	Decal - black and red, 3x9 inch, for Window	\$3.50
KC001	Key Chain with LED light and "30 Years 1967-1997"	\$2.50
MUG002	Thermal Mug	\$6.50
MUG003	Porcelain Mug	\$5.50
PS001	Polo Shirt w/ embroidered logo select shirt color & size: Teal Green, Forest Green or Navy (s,m,l,xl)	\$30.00
SS001	Auto Window Sun Shade with Logo	\$8.00
PN001	Ball point writing pen with EAA and 800 number	\$1.00
CS001	Current Solutions/Motor Show Video Tape (14 minute runtime)	\$15.00
WL001	Window Literature Holder (fits pages 8.5 x 11 inch)	\$25.00
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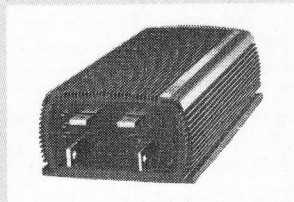
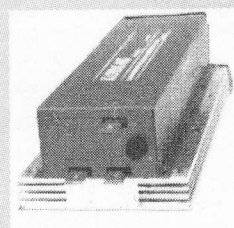
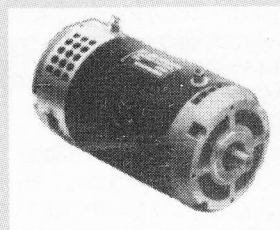
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