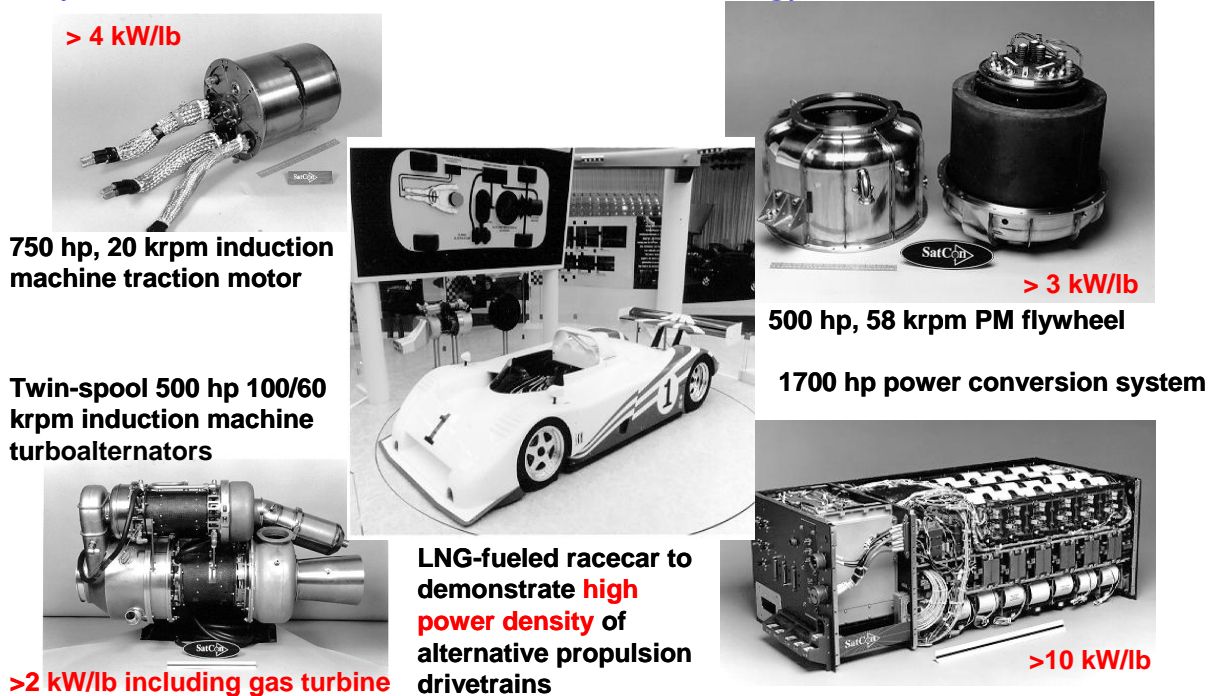


## Advanced vehicle drive train heritage

### Chrysler Le Mans Class Race Car Technology Demonstrator



Hybrid electric drivetrain, converters, flywheel energy storage. RCT Systems designed and built:

- Twin spool 250 HP turbine alternators: low speed spool - 60K rpm, high-speed spool – 100K rpm; weight of 190 pounds and power density of greater than 2 Kw/lb.
- 750 HP traction motor: 6-pole induction motor, 20K rpm, 145 pounds with a power density of greater than 4 Kw/lb.
- 4.25 Kw-hr composite flywheel energy storage with a maximum rotation speed of 58,300 rpm, 500 hp over full speed range, 130 pounds with power density of greater than 3 Kw/lb.
- 1700 hp power conversion and power management system with a power density of approximately 20Kw/lb

Over 40 patents were issued in relation to the Patriot drivetrain technology including:

5,463,294	Control Mechanism for Electric Vehicle
5,504,378	Direct Cooled Switching Module for Electric Vehicle Propulsion System
5,504,655	Electric Vehicle Power Distribution Module
5,517,063	Three Phase Power Bridge Assembly
5,519,269	Electric Induction Motor & Related Method of Cooling
5,552,976	Improved EM Filter Topology for Power Inverters
5,581,171	Electric Vehicle Battery Charger
5,682,074	Electric Vehicle Motor
5,831,409	Electric Vehicle Propulsion System Employing AC Induction Motor Control
5,892,279	Packaging for Electronic Power Devices and Applications

## Chrysler Epic Minivan – LRIP Model

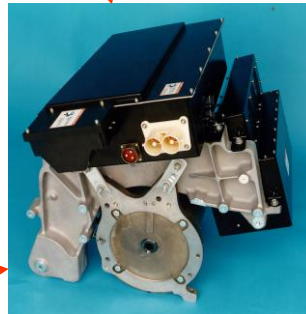


**Production battery electric vehicle**



**Widely acclaimed early entry into the EV market**

**120 HP (89.5kW)  
three-phase inverter**



**165 ft-lbs, 12 krpm  
induction motor**

**6kVA battery charger  
1.3kW DC/DC converter  
Oil and water pumps  
High voltage distribution**

**300 units produced with a developed  
production capacity of 5000 units/year**

Overall drivetrain systems integrator, responsible for integrating the electric drivetrain/battery charger/coolant pump/auxiliary power unit. Developed production capability for 5,000 systems per year. Delivered 350 integrated power trains to Chrysler for their 1999 model year EPIC. RCT Systems designed and built:

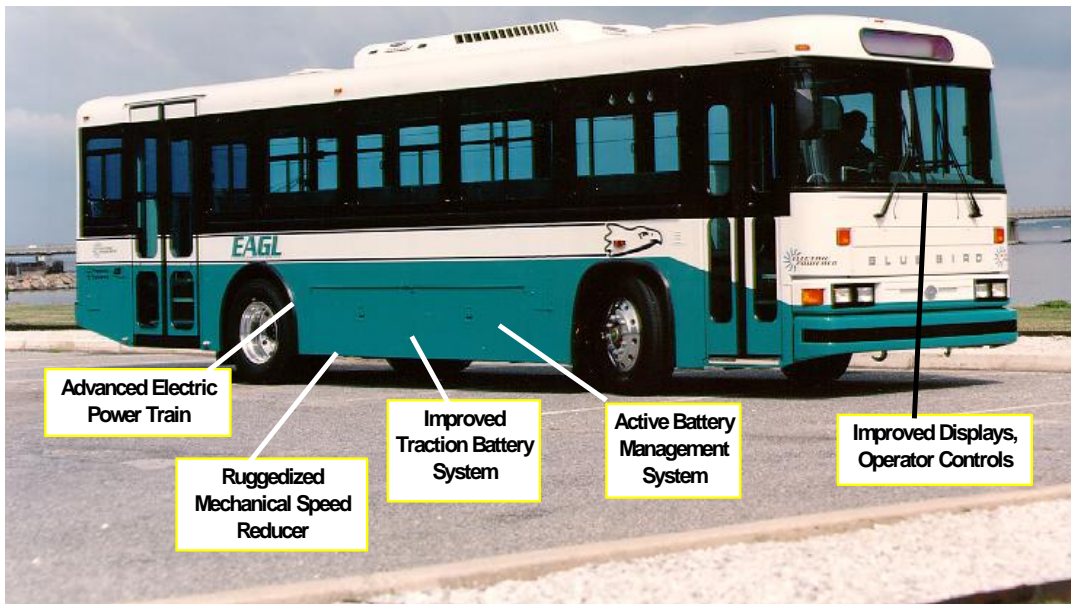
- 115 HP Motor Drive Inverter
- 12,000 RPM 160ft-lb torque, oil-cooled 120 HP induction motor
- 100 A, high voltage bus to 12VDC resonant DC/DC converter
- 6kW on-board battery charger
- High voltage coolant pump

More than 30 patents were issued in conjunction with EV and HEV minivan and bus applications:

5,168,204	Automatic Motor Torque and Flux Controller for Battery-Powered Vehicle Drive
5,182,508	Reconfigurable AC Induction Motor Drive for Battery-Powered Vehicle
5,469,124	Heat Dissipating Transformer Coil
5,481,194	Fault Detection Circuit for Sensing Leakage Currents Between Power Source and Chassis
5,504,378	Direct Cooled Switching Module for Electric Vehicle Propulsion System
5,504,655	Electric Vehicle Power Distribution Module
5,508,594	Electric Vehicle Chassis Controller
5,519,269	Electric Induction Motor & Related Method of Cooling
5,569,966	Electric Vehicle Propulsion System Power Bridge with Built-In Test
5,581,171	Electric Vehicle Battery Charger
5,594,636	Matrix Converted Circuit and Commutating Method
5,627,758	Vector Control Board for an Electric Vehicle Propulsion System Motor Controller
5,634,262	Method of Manufacturing Heat Dissipating Transformer Coil
5,736,831	Power Limiting Circuit for Electric Vehicle Battery Charger

5,831,409 Electric Vehicle Propulsion System Employing AC Induction Motor Control  
5,994,872 Apparatus for Charging Energy Storage Means from a Multiphase Power Source

## *Bluebird and other Bus Electric and Hybrid Electric Systems*



Developed EV & HEV drivetrain and battery charging systems for 34ft, 33,000 lb GVW buses. Delivered 50 systems for a number of transit and school bus applications. Developed the production capacity for 2,000 systems per year. RCT Systems designed and built:

- 230 hp motor drive inverter.
- 12,000 RPM, 245 ft-lb torque oil-cooled induction motor for traction.
- 200A, 12V auxiliary power converter.
- Relay box assembly for vehicle auxiliary power control
- “Luggage Box” assemblies that housed motor drive, and air-conditioner inverters.

In addition to the above, RCT Systems specified, tested, and integrated the speed-reduction chain-drive used in these bus systems. Users include:

- Five Seasons Transportation, Cedar Rapids Iowa – delivered 4 pure electric bus systems, and 5 hybrid bus systems through a consortium under a series of DOT grants. Buses from this program are still in use today. As part of this program, a system of four, 150 kW fast-chargers with pulse charging capability, along with a Battery Energy Storage System for peak shaving was developed and installed. RCT Systems still provides some support to these systems today.
- Several school bus system operators – including Antelope Valley Capistrano, and Napa Valley school districts in California, and others in Alabama, and New York city.



- China Yuan-Wong bus company – a total of 2 buses in China.
- Five buses for the 1996 Olympics in Atlanta, Georgia.
- Georgia Tech – one bus and a fast charger.

## *Dodge/Ford Pickup Trucks*

Electric drivetrain. Delivered a number of the 115 HP systems described above for two pickup applications: one with Troy Design & Manufacturing (TDM) using Ford Rangers (a total of 25 systems), and another using Dodge Dakotas for the Wright Patterson Air Force Base (a total of 5 systems).

## *Chrysler DCX Natrium Fuel Cell Vehicle*

**60kW and 80kW DC/DC Converters between variable fuel cell and propulsion busses**



**DCX Natrium Fuel Cell Demo Vehicle based on Chrysler Town and Country**



DC/DC Converter. RCT Systems designed and delivered two bi-directional buck/boost converters for the DCX Natrium vehicles. Converters were 60kW and 80kW, and converted between a 250-425VDC fuel cell bus and a 240-400VDC propulsion bus.