High-Performance Hybrids Could Spark U.S. Market

While the first hybrid vehicles on the market—the Honda Insight and the original Toyota Prius—appealed mostly to a small group of environmentally-attuned early adopters, carmakers are expecting the increased power and performance of MY 2004 and 2005 hybrids will find a wider audience among U.S. consumers. Of course, any combination of reduced emissions, improved fuel economy and higher performance comes at a price—a very substantial price—from $4,000 to $9,000 to the consumer for the added electrical and electronic equipment, depending on the amount of power. And increasing performance will compromise low emissions and fuel economy improvements. With the second-generation Prius winning Motor Trend’s Car of the Year award for 2004, even power-hungry American consumers could be taking a second look at hybrids this year. Hironobu Ono, Toyota’s top electrical engineer and a managing officer, told us last fall that Toyota will advertise the new Prius as “more powerful, more fun to drive, because this vehicle has more torque than conventional gasoline engine [models].”

“The reality is that buyers value performance,” said Dave Hermance, executive engineer of environmental engineering for Toyota Technical Center U.S.A. Speaking at the SA E Hybrid Vehicles Symposium in San Diego, California, January 28-29, Mr. Hermance noted that the Lexus RX 400h (a hybrid version of the RX 330 SUV), which will be introduced this fall, will have at least 200 kW (268 hp) peak power from its 6-cylinder engine and electric motor combination and will provide V-8 SUV performance with compact-car fuel economy. The RX 400h will accelerate from zero to 60 mph in less than eight

Big Obstacles A head for Bluetooth

Bluetooth is pretty hot right now. A number of carmakers around the world are finally rolling out some new features based on the long-awaited standard wireless communications protocol invented by cell-phone maker Ericsson in 1994. But a host of technical and market obstacles are severely limiting production applications of Bluetooth to only the most basic functions. Unless these obstacles are overcome, carmakers will be unable to fully exploit Bluetooth’s ability to make wireless voice and data connections between vehicle systems, cell phones, PDA’s and laptops and to the outside world. If the automotive and the cell phone industries can’t soon overcome the obstacles to applying and profiting from Bluetooth, the auto industry could lose interest in this promising technology.

Bluetooth could be used for remote diagnostics, to make wireless software upgrades or to download map updates or driving directions. Bluetooth could even serve as a wireless audio bus in a vehicle. Essentially, Bluetooth would be a key enabler in telematics and infotainment systems, especially when the driver’s portable cell phone must be part of the picture.

Probably the biggest market driver worldwide for Bluetooth today comes from consumers who want hands-free operation of their cell phones while driving. With Bluetooth, drivers can safely use their phones by speaking into a vehicle-mounted microphone, and listening to the other side of the conversation through the vehicle’s audio system. The cell phone itself can stay put inside a briefcase or a coat pocket. In order to implement hands-free operation, a wireless communications node conforming to the Bluetooth Hands-Free Profile 1.0 must be installed in the cell phone and somewhere in the vehicle. HFP 1.0, written by the Car Working Group, one of many working groups within the Bluetooth Special Interest Group (SIG), was completed in April 2003. Following analysis and testing of the spec, it became apparent that implementations of HFP 1.0 could create ambiguities and interoperability problems in all but the most straightforward, simple

Issues Before Bluetooth Car Working Group

The Bluetooth Car Working Group is now working on Hands-Free Profile 2.0, which will not only extend HFP 1.0 but will also tackle some tough non-Bluetooth systems problems that have dogged telematics and infotainment engineers as they try to meld automotive electronics with consumer electronics—the cell phone in this case.

HFP 1.0 does not properly account for automakers’ desire to switch what the cell phone usually displays (signal and battery strength, roaming indication and status of the call) to the vehicle display.

HFP 1.0 doesn’t account for the proper handling of multiparty calls, where a call is put on hold while a second call is handled.

HFP 1.0 doesn’t provide phone book access for hands-free dialing.
2003 Roundup of European Auto Electronics Suppliers

Bosch Automotive Technology Sector

2003 Sales: €23.6 billion ($28.8 billion)
Change from 2002: up just 1.3%

The Automotive Technology sector, which accounted for 65% of the Bosch Group's total sales in 2003, employs about 146,000 people in 133 production sites worldwide. €2.2 billion ($2.7 billion) or 82% of Bosch's total R&D expenditure was automotive related in 2003. According to a Bosch press release, strength in the automotive sector came from growing installation rates for electronic stability systems and "a consistently booming business in diesel systems."

In June 2003, Dr. Bernd Bohr, member of the board of management, predicted diesel injection sales would reach 6 million units in 2003, compared with 5.2 million units in 2002.

Looking forward, Bosch has targeted drive train, chassis and driver assistance as the most important growth areas. Fuel efficient, low emission diesel direct injection systems will be further developed. In the area of chassis systems, Bosch sees room for more growth in ESP penetration, especially in the U.S. and Western European countries, but long term, Dr. Bohr believes "the future belongs to brake-by-wire." Bosch has 300 development engineers working on advanced driver assistance products including night vision, lane-keeping and an automatic "stop-and-go" enhancement for adaptive cruise control.

Brose Group

2003 Sales Estimate: €1.9 billion ($2.3 billion)
Change from 2002: up 7%

The privately held company makes window regulators, door systems, door latches and seat adjusters for more than 30 vehicle brands.

Continental AG


2003 Operating Income Estimate: €800 million ($977 million), 6.7% of sales.

Like Bosch, Continental is a big promoter of electronic stability systems. Worldwide sales volumes of Continental's ESP (electronic stability program) will top 3 million units in FY 2003, according to company estimates. Continental projects a 10% to 15% annual increase in sales of electronic brake systems and a 20% to 25% yearly increase in electronics sales.

Hella KG Hueck & Co.

(Fiscal year ended May 31, 2003).

FY 2003 Sales: €3.028 billion ($3.7 billion)
Change from FY 2002: up 2.9%

Regionally, Hella's FY 2003 sales in Germany grew 7.7% to €1.9 billion ($2.3 billion); Asia/Pacific/Australia sales increased 19.3% to €142 million ($173 million), while sales in America decreased 18.6%. As of May 31, 2003, Hella employed 22,811 people, 56% of them in Germany.

Hella produces a broad range of automotive lighting products including "bend lighting," which adapts to curves in the road. Hella claims 60% market share in xenon headlamps and its bi-xenon headlamps produce low and high beam light from one module. Future applications in development include a dynamic LED brake signal, which lights in three stages depending on the degree of deceleration. Hella is also developing LED-based interior lighting.

Siemens VDO Automotive

(Fiscal year ended September 30, 2003.)

FY 2003 Sales: €8,375 million ($10,233 million)
Change from FY 2002: down 2%

FY 2003 Profit (EBIT): €418 million ($511 million) or 5% of sales, compared with 0.8% of sales in FY 2002.

Siemens VDO attributes its growth in profit partly to increased sales of diesel injection and infotainment systems. Also contributing to profits were material cost reductions, streamlining R&D and production processes and trimming administrative costs.

The largest regional markets for Siemens VDO in 2003 were Western Europe, which accounted for 69% of sales, and the NAFTA countries, accounting for 19% of sales. The company aims to grow sales in the NAFTA region to 29% of total sales by 2008. In February 2004, Siemens VDO acquired Daimler-Chrysler's Huntsville Electronics business, which annually ships approximately $1 billion worth of electronic control units, instrument clusters and radios to Chrysler.

Valeo

2003 Consolidated Sales: €9,234 million ($11,282 million); 64% from E/E products
Change from 2002: down 6%; E/E product sales were down 8%.

2003 Net Income: €181 million ($221 million) or 2% of sales. Net income in 2002 was 1.4% of sales.

In 2003, €5,905 million ($7,215 million) including inter-company sales were from electrical and electronics products including lighting, electrical systems, wiper systems, motors and actuators, security systems, switches and detection systems, electronics and connective systems. With sales totaling €1.5 billion ($1.8 billion), engine cooling systems is Valeo's largest product line.

Sales in Europe accounted for 71% of total sales, compared with 67% of total sales in 2002. Valeo continues to look to Asia for growth. In October, the company signed a letter of intent to form an alliance with Japanese wiring manufacturer Furukawa Electric to jointly develop wiring systems business worldwide. In China, Valeo began construction of a technical center for advanced lighting system development. Sales in Asia grew 9% in 2003, following a 17% improvement in 2002.

ZF Friedrichshafen

2003 Sales Estimate: €9.3 billion ($11.4 billion)
Change from 2002: up slightly, about 1%

According to ZF, which does substantial business in the U.S., the relative weakness of the dollar against the euro kept sales growth minimal, despite high demand for its Car Chassis Technology division's products. The company reported strong sales of steering technology, automotive transmissions and chassis components.

Hansen Report on Automotive Electronics

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hands-free applications. Testing and evaluation of HFP 1.0 was performed by the Automotive Multimedia Interface Collaboration (AMiC), by Honda and other carmakers and by the Car Communications Application Promotion (CCAP). The CCAP group is comprised of Japanese carmakers and communications suppliers who came together to try and clarify the ambiguities found in the hands-free profile and come up with some application guidelines for carmakers.

**Car Working Group**

Finding solutions to these problems globally falls on the shoulders of the Motorola A C E S’ Tony M. Ansour and his Bluetooth Car Working Group, which has set a hugely challenging goal of concluding the Hands-Free Profile 2.0 specification within the year 2004. In addition to Motorola, key players driving the Car Working Group include Toshiba, Denso, Nissan and Toyota, all part of the CCAP, and BMS (Berner & Mattner Systemtechnik), a German software engineering house representing the interests of DaimlerChrysler, Audi and BMW. Though not yet part of the Car Working Group, Japan’s number-one cell phone company, NTT DoCoMo, a CCAP participant, has provided high quality expertise.

Notable by their absence and by their stature as the number-one and number-two carmakers in the world, former members General Motors and Ford are no longer participating in the Bluetooth Working Group. It should be pointed out that Bluetooth holds little interest to engineers at General Motors North America where OnStar, which includes a dedicated cell phone, is already embedded in 51 GM models, which covers two-thirds of the GM fleet, according to OnStar. OnStar’s embedded phone represents a serious alternative to the Bluetooth wireless approach.

While the challenges are difficult, some of the same technical issues that the Bluetooth Working Group is now addressing have already been addressed by CCAP, AMiC and by the MOST consortium. MOST is the standard high-speed multimedia entertainment network developed by the Germans. “We intend to leverage all of those ideas,” said Mr. Ansour. “[But] the real task is getting concurrence from all of the stakeholders.” Most important among them are the world’s carmakers, the cell phone handset makers and the cell phone system operators. In order for Bluetooth hands-free features to work, the hands-free car kit and the cell phone must conform to the same profile. “What we are trying to do within the working group is present with a coherent voice what the automakers want from the cell phone equipment makers,” said Mr. Ansour.

Whether or not cell phone makers and operators chose to market handsets that fit the latest hands-free profile is a business matter. “Bluetooth has been a technology looking for an application,” said John Jackson, Yankee Group Bluetooth market analyst. “It’s a chicken and egg scenario. The operators who spec and sell cellular phones question the efficacy of a short-range technology that does nothing for them—doesn’t make them any money. In fact, it costs them money because they have to pay extra for phones that are Bluetooth enabled.” A corollary to the Yankee Group, 14% of cell phones sold in North America in 2005 will be Bluetooth enabled, but not all of them will have the required Hands-Free Profile 2.0.

There has been some wishful thinking among Bluetooth advocates that wide scale automotive applications of Bluetooth will be brought to life in the States by government mandates. A corollary to Matt Sundeen of the National Conference of State Legislatures, so far only New York, New Jersey and Washington DC prohibit the use of handheld phones by drivers. And while seventeen states have introduced bills that would restrict the use of handheld phones, not all of those efforts will be successful. We have seen no evidence to suggest that the U.S. Congress will vote to create a federal hands-free mandate. Either way, Bluetooth isn’t essential to hands-free phone operation. A simple cellular phone docking station gets the job done.

Thus far, most Bluetooth production applications have appeared in vehicles made for the European market. According to the Yankee Group, 10% of cell phones sold in Europe came equipped with Bluetooth in 2003.

In the States, some Bluetooth hands-free features are presently available as a factory-installed option on the Chrysler Pacifica and the Acura TL. Toyota offers Bluetooth features on the 2004 Prius, the Lexus LX 470 and 430 and on the Land Cruiser. A Bluetooth hands-free system is available as a dealer option on all 2004 Lincoln ls. Bluetooth technology is available as an option on BMW 3 series, 5 series and X5 vehicles.
Johnson Controls Inc.

**Company Profile**

**Headquarters:** 5757 N. Green Bay Avenue, Milwaukee, Wisconsin 53201, USA

Telephone: 414-524-1200

www.johnsoncontrols.com

2003 Sales: $22,646 million, a 13% increase over 2002

2004 Sales Growth Estimate: 10% to 12% over the prior year

R&D: 4.1% of sales

Operating Margin: 5.1%

Net Margin: 3.0%

Working Capital: $18.6 million as of December 31, 2003

Shareholder’s Equity: $4,581.6 million as of December 31, 2003

Return on Average Equity in 2003: 18%

Employees: 118,000 at the end of FY 2003

Sales per Employee in 2003: $191,915

Automotive Group

Key Products: Mainly seating, plus other interior products, batteries and automotive electronics

2003 Sales: $17,070 million, a 14% increase over the prior year

2004 Sales: JCI expects a 10% to 15% increase over 2003.

2004 Automotive Electronics Sales: Roughly $1.8 billion

2003 Operating Margin: 5.1%

Top Automotive Customers: General Motors, Ford and DaimlerChrysler

Note: Johnson Controls’ fiscal year ends September 30.

**Background**

Johnson Controls was founded in 1885 as Johnson Electric Service Co. in Milwaukee, Wisconsin, to make temperature regulation systems for buildings. Renamed Johnson Controls Inc. in 1974, the company primarily operated in the building controls business until 1978 when it entered the automotive market with the acquisition of Globe-U nion Inc., an automotive battery manufacturer. JCI entered the automotive seating market in 1985 with the acquisition of Hoover Universal. Today the Automotive Group accounts for three-quarters of JCI sales.

The Controls Group, which in 2003 generated 25% of JCI revenue, installs nonresidential building control systems and provides technical facility management services covering comfort, energy and security management. JCI systems include temperature, ventilation and humidity control, fire, safety and security.

JCI’s mission is to continually exceed customers’ expectations. The company writes that it values integrity, that is, doing what it says it will do, customer satisfaction, its employees, improvement and innovation, safety and the environment. Honesty, dignity, fairness and respect are the company’s creed. Company objectives include growth by building on existing businesses and market leadership: “operating in markets where we are or have the opportunity to become the recognized leader,” according to company literature.

Johnson Controls employs a Six Sigma quality improvement program that influences not just manufacturing but also product design, customer service, purchasing and billing.

Technology plays an important role in JCI’s growth strategy. For new technology, JCI relies on in-house development as well as on strategic alliances. Remarkably, Johnson Controls’ sales have increased every year for 57 years; earnings have increased for 13 consecutive years. As a result, Johnson Controls has increased dividend payments for 28 consecutive years. Johnson Controls trades on the New York Stock Exchange under the symbol JCI. JCI has paid consecutive dividends since 1887.

Over the last few years JCI has been investing a greater percentage of its capital in the automotive business than that segment's share of sales would dictate. In fiscal 2003, when automotive sales accounted for 75.4% and controls accounted for 24.6% of total sales, JCI invested 94.6% of its total $628.3 million capital expenditures in the A automotive Group.

Citing one of the reasons why Johnson Controls is successful in the automotive industry where other companies fail to profit and grow, Jim Geschke, vice president and general manager of electronics integration, told us: “We are a very conservatively run company from a financial perspective. We tend not to get too leveraged. While that may limit the extent to which we can rapidly grow, it does tend to keep us out of trouble when times are lean.” Two closely watched financial ratios at JCI are return on assets, which was 5.2% for fiscal 2003, and debt-to-equity ratio, which was at 0.55 at fiscal year end September 30, 2003. Johnson Controls is targeting after tax ROIC (return on invested capital) at 15% to 16% for 2004. A of January 28, 2003, Johnson Controls carried an A/Stable rating from Standard and Poor's credit rating service. A n “A” indicates that the company has a strong capacity to meet its financial obligations. “Stable” means the rating is unlikely to change soon.

Highly matrixed, Johnson Controls is organized into numerous overlapping groups that have responsibility for development, product management, manufacturing, sales, customer business teams, purchasing and finance. “While in a matrix organization you run the risk of war- ring tribes emerging, at JCI we really work hard to make sure that never gets started,” explained Mr. Geschke. “We do that by embracing a culture of cooperation that is empowered by cross-functional work teams that get things done.”

Automotive Technology

JCI operates more than 1.5 million square feet in five technology centers in the United States, Germany, France and Japan. The tech centers employ more than 5,000 people in engineering, design, research and development, prototyping, product testing, sales, marketing and administration. Worldwide automotive technology center headquarters is located in Plymouth, Michigan.

Automotive Electronics

Based on fiscal year 2004 projections, including unconsolidated joint ventures, pass throughs and other items, Johnson Controls will ship roughly $1.8 billion worth of automotive electronics this year, according to the company. The roots of JCI’s automotive electronics capabilities go back to its 1996 acquisition of Prince Automotive of Holland, Michigan, for $1.35 billion. At the time of the acquisition, Prince, with $850 million in sales, supplied automotive interior components but also had a niche automotive electronics activity supplying HomeLink Universal Transceivers (garage door openers), electronic compasses and overhead-mounted trip computers. The HomeLink Wireless Control System, as it is now known, has since progressed beyond garage door opening to also include the control of gates, entry door locks, security systems, home lighting and other systems. JCI shipped about 5 million HomeLink units for 160 vehicle models worldwide in 2003.

That small Prince electronics operation has grown from within to encompass the Electronics Design and Development center with 200 employees, “pretty much continued on following page
all" of whom are involved with electronics development, according to Jim Geschke, who manages the center.

In October 2001, Johnson Controls took a significantly larger position in electronics with the acquisition of Sagem SA’s automotive electronics operation. In 2001 that business was shipping $522 million worth of body and engine controllers, multimedia products, instrument clusters and information displays, mainly to Peugeot and Renault. Johnson Controls paid $435 million for the Sagem activity, which for the first time gave JCI electronics manufacturing capacity in Europe. At the time of the acquisition the French business employed a total of about 2,600 people, including engineers and factory workers.

Today Sagem’s primary automotive electronics research and development center in Pontoise, France serves as a JCI electronics center of expertise, as does the Holland, Michigan engineering center. The Pontoise facility employs nearly 1,000 workers, 80% of whom are involved with technical matters.

The next step in JCI’s bid to further its electronics expertise came in July 2003 when the company announced the acquisition of Borg Instruments with its line of instrument clusters, reconfigurable and information displays, electronic parking assist system and a navigation system. With 2002 sales of €55 million ($70 million) and anticipated sales growth of nearly 8% annually through 2004, JCI paid a total of approximately €117.5 million ($150 million) for Borg, whose customers include BMW, DaimlerChrysler, PSA Peugeot Citroën, General Motors’ Opel, Volkswagen Group and Ford’s Premier Automotive Group. Based in Remchingen, Germany, near Frankfurt, Borg Instruments employed 400 people, including 120 research and development engineers. Presently about 150 people work at JCI’s technical center in Remchingen.

Before the acquisitions of Sagem and Borg Instruments, JCI’s principal interest in electronics was to add value to its interiors product lines. Interior suppliers of large assemblies or modules are in a good position to add value to the assemblies they develop and ship. Shipments of JCI modules and assemblies have included instrument clusters, compasses, overhead mounted information panels, climate control systems, universal garage door openers and rear-seat video entertainment systems. But now with the inclusion of the automotive electronics lines from Sagem and Borg Instruments, only 25%, or so, of the electronics JCI ships is part of an interior product shipment.

One leg of JCI’s electronics product strategy going forward involves integrating electronics with the four interior zones: seats, overhead panels, door panels and instrument panels. Expanding electronics is a key element in JCI’s growth strategy for interiors. The other part of Johnson Controls’ electronics strategy is devoted to body controllers, which came along with Sagem, and electrical energy management systems, which JCI says complement the company’s leadership in battery manufacturing. “We’ve gotten much more focused on electronics in and of itself,” said Mr. Geschke. “Our electronics business is no longer so tied to the market for interior modules.” Increasingly carmakers are consolidating numerous electronics control circuits from inside the passenger compartment into one main body computer, which controls interior and exterior lighting, directional signals, warning buzzers, windshield wipers, memory seats, door locks and power windows. JCI ships body control modules to Renault and PSA Peugeot Citroën and is targeting the body controller business for future growth.

Two of JCI’s competitors in the interiors business, Lear and Delphi, make wiring harnesses. While that capability gives them an opportunity to add value and gives them greater visibility when new interior module business opportunities come along, Johnson Controls has no intention of getting into the wiring business. “While wiring is a significant part of what we do, wiring is a commodity business and as multiplexing becomes more prevalent the wiring market will slow,” said M. R. Geschke. JCI will partner with outside suppliers for the wiring needed for interior modules.

**Batteries and Electrical Energy Management**

Johnson Controls expects strong demand for electrical energy management systems, an important new product area and one that complements the company’s number-one global market position in batteries. “Electrical energy management (EEM) is what you do to ensure that you don’t destroy the battery, and that you manage power systems effectively so you don’t have to over-specify the battery," explained Mr. Geschke. While the demand for such systems has barely shown itself, some fully-featured vehicles are facing the limits of what the 14-volt alternator can produce. EEM systems will eventually be needed in high volume as carmakers transition to 42-volt systems and hybrid vehicles. EEM systems would include dc-to-dc converters and controllers that operate integrated starter-alternators and traction motors. The company could also provide smart junction boxes that use solid state switches or other intelligence to control and regulate power throughout the vehicle.

JCI’s new PowerWatch battery management system is scheduled for a production launch in 2005. Going beyond simple...

electronics products lines. Not only do displays to be one of its most promising including reconfigurable and solid-state Instrument Clusters-Inspira, Vlies.Tec and Optima. bent-glass-mat lead acid battery solutions: controls already offers three different absor- and 42-volt applications, Johnson Con- vehicles. Potentially applicable to both 14- 42-volt alternator systems and hybrid ve- nickel-metal hydride and lithium-ion bat- teries. The Varta acquired battery maker Varta Automotive, motive, and in 2003 the company ac- quired battery maker Hoppecke Auto- motive, and in 2003 the company ac- quired battery maker Varta Automotive, both German companies. The Varta ac- quisition gave Johnson Controls the nickel-metal hydride and lithium-ion battery technology needed to develop future 42-volt alternator systems and hybrid ve- hicles. Potentially applicable to both 14- and 42-volt applications, Johnson Controls already offers three different absorbent-glass-mat lead acid battery solutions: Inspira, Vlies.Tec and Optima.

Instrument Clusters

JCI considers instrument clusters including reconfigurable and solid-state displays to be one of its most promising electronics products lines. Not only do instrument clusters fit well into JCI’s strategy to add value to the instrument panels and cockpit modules it sells, but JCI expects clusters to stand on their own. With the clusters and displays from Sagem and Borg Instruments, JCI is confident that it now has the capability to compete in clusters, with technology covering from the low to the high end of the price range. Using in-house design, engineering and validation facilities in Pontoise, France; Remchingen, Germany; Holland and Plymouth Michigan; and manufacturing facilities in Holland, Pontoise, St. Georgen, Germany and Grabatai, Brazil, JCI can comfortably serve instrument cluster customers in Europe and the Americas. A long with stepper-motor-driven gauges, JCI can also deliver liquid crystal, vacuum fluorescent and organic LED displays. While instrument clusters are often thought to be commodity products, Mr. Geschke believes that the company’s ability to use LED illumination will help distinguish JCI clusters from others. LEDs let designers create clusters that are lightweight and don’t protrude very far into the instrument panel as do conventional clusters with incandescent lighting. An- other advantage of cluster designs using LED lighting is that they don’t require bulb replacement—LEDs will last the life of the vehicle.

A toVision Rear Seat DVD

In April 2000 JCI began a joint develop- ment project with Philips Flat Display Systems (San Jose, California) to develop a rear-seat entertainment system that JCI could seamlessly integrate into interiors. A toVision can include a video cassette player, fixed or removable DVD player, LCD monitors and access for video games. So far JCI has booked 23 O.E.M. pro- grams involving A toVision. For example, A toVision DVD systems were first of- fered on Ford’s 2003 Lincoln Aviator, Explorer and Mercury Mountaineer models. A toVision systems have also been adopted by European automakers. In early 2003 A toVision was an option on the BMW X5, 5 and 7 series, Renault Vel Satis, Opel Zafira and Omega Caravan. A toVision will be an option on General Motors’ 2005 crossover sports vans where the product line is designed to fit into JCI’s Overhead Rail system, an innovative modular packaging scheme that provides docking for a variety of electronics and electrical products as well as a variety of storage compartments. A u toVision and Overhead Rail are also available on the 2004 Ford F-150 XLT, FX4 and Lariat.

Bluetooth Phone Link

Johnson Controls is one of the first companies in the world to provide Bluetooth capability for installation by carmakers. First installed on the Acura TL as HandsFreeLink, the Johnson Controls-developed feature turns any Bluetooth enabled cellular phone into a hands-free phone that connects without wires to the vehicle. Using the vehicle-mounted microphone, the phone can be dialed by voice. The conversation is also handled hands-free and can be heard on the vehicle’s audio system. Visual feedback of the call status is provided by a vehicle-mounted display. In a somewhat different configuration, Johnson Controls’ Bluetooth system is available as a factory-installed option on Chrysler’s 2004 Pacifica as U Connect.

Cockpit Modules

JCI delivers an interior system to General Motors for the Pontiac Grand Prix that integrates the instrument panel, steering column, steering wheel, electronics, wiring harness, brake pedal, airbags and climate control system. JCI also supplies the Grand Prix overhead system, floor console and door panels, as well as cockpit modules for the Buick Rendevous and Jeep Liberty.

Contract Manufacturing

Johnson Controls has had a long-term strategic relationship with jabil Circuit, a contract electronics manufacturer that makes roughly 30% of the electronics JCI sells. While the company intends to con- tinue manufacturing a significant percent- age of its products in-house to maintain electronics purchasing expertise, JCI is in the process of rationalizing its overall manufacturing footprint and could bring in a second contract electronics manufac- turer. ◆
addition to the Toyota and Lexus hybrids, the Honda, **Mercedes**, **Subaru** and **Mitsubishi** brought concept vehicles with hybrid powertrains. **Mercedes** showed a hybrid concept of its Vision Grand Sports Tourer, with a diesel-powered (67 hp) electric motor that combine for 317 hp and 634 ft-pounds of torque. Even though a hybrid will not be offered in the initial production version, due in about a year, **Mercedes** claims the Vision hybrid can achieve 60 mph in about 6.45 seconds with the combined powertrain.

The 2004 Honda Accord hybrid that will go into production later this year uses the Integrated Motor Assist (IMA) hybrid system concept from the Insight and Civic but will provide V-6 performance, according to H. Hideharu Takemoto, principal engineer at Honda R&D, said that Honda engineers did not reduce the engine size when they added the electric motor to the drivetrain. This will increase the available power and make it quite different from the Insight. (See table, right.)

Peter Savagian, **General Motors**' engineering director for hybrid powertrain systems, noted at the SAE symposium that industry combined light car and truck sales had an average power-to-weight ratio of 0.047 in 2000, according to EPA data. Using historical values, the Honda Insight and Toyota's 2002 Prius, both at 0.033 hp/lb, provide about the same level of performance as vehicles sold in the early 1980s. For comparison, the power-to-weight ratio of a 2004 Camry 4 cylinder is 0.05, and Ford's F-150 4.6L V-8 is 0.048 hp/lb.

Walt McManus, executive director at J.D. Power and Associates, said, "Americans do not have a lot of reasons to be concerned with the price of fuel and so they aren't." Based on the delayed introduction of some models, J.D. Power reduced its forecast for hybrid vehicle sales in 2006—from 500,000 to 350,000 units for the United States. Toyota's Hironobu No confirmed last fall that Toyota's target for hybrid vehicle sales remains the same as what they announced in 1997 when the first Prius was brought to market: 300,000 units worldwide per year by 2005, including all models, not just the Prius. In addition to the Lexus SUV, **Toyota** plans to introduce a hybrid highlander SUV in the States. These same models in Japan are sold as the Harrier and the Kluger V. **Toyota** also sells a MY 2004 hybrid Estima minivan and a hybrid Aiphard full-size van in Japan. **Toyota** executive have said they will sell 100,000 hybrids annually in the U.S. beginning in 2005: 50,000 Priuses, 30,000 Highlanders and 20,000 of the Lexus RX400h. In December, **Toyota** revised its forecast of 2004 Prius production to 47,000, based on better than expected U.S. sales. **Toyota** sold 24,627 Priuses in the U.S. in 2003, according to automotive N.ews.

**Electrical/Electronics Content**

A reporting to John Miller, formerly of Ford Motor Company and now principal of J-N-J Miller Design Services (Cedar, Michigan) and editor of the IEEE Power Electronics Society newsletter, “The present cost of hybridization for Toyota's THS-II system on the Prius is from $66/kW to $99/kW including the traction battery and dc-dc converter, and the cost of a spark ignited engine is about $30/kW to $35/kW.” In hybridization, the battery with a full battery management system (cell balancing, thermal management, state of charge and state of health monitoring and the dc converter) accounts for 40% to 47% of the cost. Strategy Analytics (Milton Keynes, U.K.) estimates the cost of an electric drivetrain module at $656. The higher voltage HEV's require sophisticated control ICs, IGBTs plus other electronic components. In comparison, the average price of a powertrain ECU for a multipoint indirect injection system in North America is $163.

The hardware for production hybrids is predominantly being sourced from Japan or Europe. Even **Ford** plans to use **Aisin**, **Sanyo**, **TDK** and **NSK** as suppliers when it introduces the hybrid Escape this summer. This will keep U.S. component suppliers out of the market unless they pursue hybrid opportunities in Japan and Europe.

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### Power-to-Weight Ratio of Selected Vehicles

The new hybrid Honda Accord achieves the same power-to-weight ratio as the standard 6-cylinder Accord.

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Engine (hp)</th>
<th>Motor (hp)</th>
<th>Total (hp)</th>
<th>Curb Weight (Lbs)</th>
<th>Power to Weight (x100)</th>
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<tbody>
<tr>
<td><strong>Hybrids</strong></td>
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<td><strong>EPA Data for Average P/W Extrapolated to 2004</strong></td>
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*Assuming only 13 hp added by electric motor and additional weight of 150 lbs.*