Nano’s Extremely Cost-Optimized Electronics

Tata Motors Wants More E/E Suppliers

Imagine taking on the assignment to develop and source the electrical and electronics parts for a safe, family car that meets Euro VI emissions requirements and sells for $2,500—a complete car for no more than the price of some embedded infotainment systems.

As many people know by now, India’s number-two passenger carmaker, Tata Motors, brought the Nano to market this past March. By April 25, 2009, more than 203,000 people had put up the full purchase price to buy the vehicle. From July 2009 through the end of 2010, Tata will ship N anos to 100,000 customers chosen at random from the preregistered buyers.

The first N anos are being manufactured in Pantnagar at the rate of 50,000 per year. A new, dedicated factory in Sanand, Gujarat, with annualized capacity of 350,000 cars, will begin production in the first quarter of 2010.

I recently spoke with Tata’s top electrical engineers about the innovations that led to the remarkable Nano. “We have achieved what was widely perceived as an impossible goal. Full credit should go to the carmakers about the innovations that led to the remarkable Nano. “We have achieved what was widely perceived as an impossible goal. Full credit should go to the engineering services provider Ricardo, and technical advisor to NHTSA. Using vehicle-level simulations, Ricardo estimated the potential impact of the leading fuel economy technologies for all light vehicles from subcompacts to full-size trucks.

New U.S. 35.5 MPG Rule Puts Electrification Front and Center

What New Fuel Economy Goals Mean to the Auto Electronics Industry

If you make components for advanced gasoline engines or for hybrid or electric vehicles, your market in the U.S. received a big boost from the U.S. government’s decision last month to raise Corporate Average Fuel Economy (CAFE) requirements for light vehicles to 35.5 miles per gallon by 2016—a 40% increase over the current standard. A corollary to the U.S. Environmental Protection Agency’s attempt to make consumers’ new vehicle costs by $1,300 on average, and automotive electronics suppliers will get a significant chunk of those incremental funds.

“If you assume that carmakers will choose systems that give them the greatest efficiency gains for the least cost, then electrification of the vehicle will definitely prevail,” said Sandra Stojkovski, director of the vehicle fuel economy systems engineering practice at the engineering services provider Ricardo, and technical advisor to NHTSA. Using vehicle-level simulations, Ricardo estimated the potential impact of the leading fuel economy technologies for all light vehicles from subcompacts to full-size trucks.

A corollary to M’s Stojkovski, to reach the new CAFE targets carmakers will apply all types of hybridization, especially start-stop, which she expects to eventually see in all vehicle segments with the exception of full-sized light trucks. Besides electrification, we will see more dual-clutch transmissions and many more turbocharged, gasoline direct injection engines that have been downsized. V6s will serve applications once served by V8s and 4-cylinder engines will replace V6s.

Even with the 40% increase in CAFE to 35.5 mpg, the U.S. requirement falls well below the standard for vehicles in Japan and Europe. By 2015 European cars will be required to achieve the equivalent of 48.9 mpg; the Japanese, 46.9 mpg. But Americans drive much heavier vehicles than Europeans and Japanese drive, so carmakers may well find meeting the U.S. standard as challenging as meeting the more stringent requirements in Europe and Japan. “We are going to be stretching our suppliers, as well as our own engineering capabilities, in many different ways to meet these challenges,” said General Motors’ Kent Helfrich, director of powertrain software development.

If U.S. consumers continue to demand large vehicles with the same performance and towing capacity as today’s trucks and SUVs, the EPA’s $1,300 added cost estimate will need revising. According to M’s Stojkovski, consumers can expect to pay anywhere from $5,000 to $12,000 more for that type of vehicle that gets 35.5 mpg.

However, many in the industry are confident that the prevailing U.S. market culture of bigger is better will begin to change. “The new standard will
The Nano comes factory-equipped with just four electronic control units, each with one microcontroller. The engine ECU is supplied by Bosch; the instrument cluster and immobilizer ECUs are from Delphi. In models with heat and air conditioning, the HVAC controller is supplied by Behr-Hella Thermocool.

The immobilizer, which keeps the engine from being started without a key, will be required on all new vehicles in India starting in October of this year, according to Tata. Similar to immobilizers used elsewhere in the world, it uses an encrypted mechanism between the key and the immobilizer and between the immobilizer and the engine control system.

Very stingy with fuel, the Nano’s two-cylinder, 623cc, 24.6 kW, multiport fuel injection gasoline engine gets 23.6 km/liter (55.5 miles/gallon). As such it has a very small carbon footprint, emitting just 101 grams of CO2/km. While some BS-II compliant Namos will be available in some Indian cities, most Namos are BS-III compliant and are BS-IV ready. (BS II, BS III and BS IV are “substantially aligned with the European norms Euro II, Euro III and Euro IV,” according to a Tata publication.)

“The engine management system is also highly cost-optimized, as far as the hardware peripherals go, and there are few sensors: throttle position, crank, lambda, vehicle speed, TMAP [inlet temperature and manifold pressure] and engine coolant temperature,” said M. R. Robson. “But the microcontroller at its core is actually a latest-generation 32-bit micro.” That was needed to handle the software complexity associated with pretty sophisticated spark and fuel control; the ECU is designed to meet Euro IV. “By employing a very powerful microprocessor, we were able to dramatically reduce the catalyst loading. That cost savings outweighs the extra cost of the microprocessor. By biasing our efforts toward better control of the engine, we’ve been able to go with a smaller catalyst, one with less precious metal,” M. R. Robson explained.

The Nano comes with no radio, though aftermarket radios have been developed to Tata’s specifications. Most Nano customers are expected to purchase a radio separately.

While Standard versions of Nano don’t come with heating or air conditioning, the CX and LX versions do. The CX also comes with booster-assisted brakes. The CX and LX both have everything in the CX plus central locking, front power windows, fog lamps, electronic trip meter and a mobile charger port. In Mumbai the CX is priced at $2,849; the LX lists for $3,402.

Each of the three Nano models has a different, individually optimized wiring harness. The harnesses carry no unused parts for features that aren’t installed on the model for which it was designed. The main wiring harness has only 230 circuits, compared with roughly 1,500 on an SUV.

While the Nano does have seat belts and exceeds India’s current safety requirements, there are no electronics-assisted safety functions such as ABS or electronic stability control. Tata plans to equip the Nano to meet emissions and safety requirements for sale in the European and U.S. markets in 2011.

Chassis and Infotainment System Suppliers Wanted

Tata has two electrical engineering operations: one in Pune, India, with 150 people, and the other in Coventry, England, with 30 people. Tata Motors also now owns the Jaguar and Land Rover brands, but those engineering organizations are separate.

Randeep Singh, responsible for EE systems on passenger car applications in India, runs the Pune operation. He and M. R. Robson in Coventry are responsible for the electrical and electronics systems not only for the A-segment Nano, but also for Tata’s four B-, C- and D-segment models. More models are on the way.

“A Tata Motors expands at what seems like an exponential rate, we find that we need more high-quality suppliers onboard to meet our increasing volumes,” said M. R. Robson.

“We are looking for suppliers who are serious about the Indian market and are willing to set up product development and manufacturing facilities in India. ... We don’t want to rely on North American, European and Japanese suppliers who are trying to do everything at a distance. The systems must be well integrated with the rest of the vehicle, so from the beginning we need to have our guest engineers working alongside Tata Motors engineers on next-generation products.” Tata produced 201,926 passenger vehicles in the fiscal year that ended March 31, 2009, and the company has plans to significantly increase production.

Two of Tata Motors’ most pressing needs are in the chassis and infotainment system domains, where it sees weaknesses in the Indian supply base. “We have opportunities for suppliers of everything from foundation brakes and ABS to advanced stability control and lane keeping systems,” said M. R. Robson. “Those systems are on our immediate roadmap.”

Tata Motors is also interested in developing infotainment systems that can seamlessly integrate the driver’s portable device with the vehicle. “In developing markets where consumers have very limited disposable income, people are going to be very reluctant to have multiple devices that do the same job. If someone has already invested in the latest generation Nokia phone with navigation capability, we are not going to ask them to throw it away when they buy a Tata Motors vehicle,” Mr. Robson noted. ☝️
Pioneer, Omron Sales Down; Mobis Up 10.4%

Pioneer Car Electronics Business

FY 2009 ended March 31, 2009

FY 2009 Operating Revenue: ¥291.7 billion ($3.07 billion)
Change from FY 2008: down 22%
FY 2009 Operating Loss: ¥12.3 billion ($129.4 million), compared with a profit of ¥26.1 billion ($275 million) in FY 2008

FY 2010 Outlook for Operating Revenue: ¥250.0 billion ($2.6 billion), a decline of 14.3%

FY 2010 Outlook for Operating Loss: ¥9.0 billion ($94.7 million)

Pioneer Car Electronics sales reflect lower volumes in both car audio and navigation, especially aftermarket navigation sales in North America, Japan and Europe. OEM navigation sales declined in North America but grew in Japan and China. Car audio sales were down in both the aftermarket and OEM segments. Overall, OEM sales accounted for 41% of Car Electronics sales for the year, compared with 39% in fiscal 2008.

Faced with its sixth consecutive and largest-ever corporate net loss, falling share price and downgraded credit ratings, Pioneer Electronics announced its Medium Term Management Plan on April 28, 2009. A major restructuring, the plan includes positioning Car Electronics as a core business, expanding its automotive product line and growing business with automotive OEMs. Increased navigation business with OEMs in growth markets, specifically China, is part of the strategy.

Pioneer plans to launch affordable aftermarket navigation and car audio systems in emerging markets. In Japan, the company wants to stimulate demand for its products by establishing a telematics business. With these and other measures, Pioneer hopes to return to profitability in fiscal 2011.

Pioneer is getting out of the plasma TV business entirely by the end of FY 2010, and plans to transfer its optical disc business to a joint venture with Sharp Corp. to better compete in the Blu-ray market. In Car Electronics, Pioneer plans to grow sales through alliances including a joint development plan with Mitsubishi Electric for car navigation hardware and software, and a joint venture with Shanghai Automotive Industry Corp. (SAIC) for car navigation, multimedia and telematics services.

On the same day that the Medium Term Management Plan was announced, Pioneer released details of Honda’s planned investment in Pioneer, which will make Honda its second-largest shareholder, with 6.5% equity. Sharp Corporation is the largest. Honda will invest ¥2.5 billion ($26 million) in Pioneer shares, and Pioneer says it will direct the funds to Car Electronics research and development, especially for car navigation, during fiscal year 2010. Aaccording to the company it still needs to raise ¥40 billion ($421 million) to implement its medium term plans.

Omron Automotive Electronics Components (AEC)

FY 2009 ended March 31, 2009

FY 2009 Net Sales: ¥82.1 billion ($864 million)
Change from FY 2008: down 23.6%
FY 2009 Operating Loss: ¥6.38 billion ($67.1 million), compared with an operating profit of ¥1.408 billion ($14.8 million) in FY 2008

FY 2010 Outlook: Omron expects it will take at least another year for the automotive industry to rebound and is forecasting further declining sales in the segment. AEC sales are expected to fall 26.9% to ¥60 billion ($631.4 million).

The AEC business accounted for 13.1% of Omron’s sales in the year ending March 31, 2009. Omron cites weak global demand for cars, especially in North America, as the main contributor to AEC’s falling sales. Seventy percent of AEC sales are overseas; 30% are domestic Japan. In FY 2010, the company hopes to minimize the effect of lower vehicle volumes by focusing on what it sees as growth segments: keyless and passive entry systems and components for hybrid and electric vehicles.

Hyundai Mobis

2008 Sales: KRW 9,373.4 billion ($7.4 billion)
Change from 2007: up 10.4%
2008 Net Profit: KRW 1,090 billion ($860 million), or 11.6% of sales; net margin in 2007 was 9.1%

A s the primary supplier to Hyundai and Kia, Mobis attributes its sales growth in modules, which account for 66% of sales, to new Hyundai model launches and strong global sales of Hyundai vehicles. Hyundai’s unit sales rose 6.8% over the prior year. Mobis noted that the growing number of Hyundai and Kia vehicles on the road, including in emerging markets, spurs continuing demand for its aftermarket parts, which accounted for 43.6% of sales in 2008. Nearly all OEM sales are to Hyundai and Kia.

In May 2009, Hyundai Mobis reached an agreement to acquire Hyundai Autonet for approximately KRW 690 billion ($544 million). Hyundai Autonet shareholders will receive one Mobis share for 23.8 shares of Autonet. The transaction is expected to be completed on June 25, 2009. Hyundai Autonet, spun off from Hyundai Electronics in 2000, produces a broad range of automotive electronics as well as multimedia and infotainment products. Autonet sales in 2008 were KRW 1,138.5 billion ($898 million).

Industry News

Platinum Equity Agrees to Buy Delphi

On June 1, 2009, Delphi announced a plan to emerge from bankruptcy through the sale of its operations to Parnassus Holdings, a subsidiary of Beverly Hills, California-based Platinum Equity, for $3.6 billion. Delphi had $18.1 billion worth of sales in 2008. General Motors committed to financing $2.5 billion needed by Platinum Equity for the buyout from its U.S. government bailout funds. The judge overseeing Delphi's bankruptcy proceedings intervened, however, ordering an auction of Delphi’s assets, open to other bidders.

A part of the Platinum Equity deal, GM agreed to buy back from Delphi its global steering business and four plants in Michigan, Indiana and New York. GM will provide Delphi with $250 million in debtor in possession financing and will assume liability for Delphi’s U.S. hourly Pension Plan. GM filed for bankruptcy on June 1, 2009.

Platinum announced on April 30 that it would acquire the automotive wiring and electrical distribution systems Turn to Roundup, page 8
Background: A History of Market Leadership

Founded in 1974, Gentex is as focused a company as you'll find in the auto industry. Ninety-six percent of sales in 2008 were to automotive customers for electrochromic automatic-dimming mirrors or electronics features that can be attached to or integrated with those mirrors. The company sells its auto-dimming mirrors to all of the world's major carmakers with the exception of Renault. A II of Gentex's products are based on light sensing and control, and no other company in the world can match its expertise in auto-dimming technology. With an 83% share, Gentex dominates the market for auto-dimming mirrors.

From the time it began producing motorized glare control mirrors in 1982 until the end of 2008, Gentex has shipped 125 million auto-dimming mirrors; 14.4 million shipped in 2008. About 19% of all light vehicles produced in 2008 had an interior auto-dimming mirror; about 6% had at least one exterior auto-dimming mirror.

In 1987 Gentex was the world's first company to develop an electrochromic mirror and went on to control as much as 90% of the market. Its only competition in the early days came from Donnelly Corp., which was acquired by Magna International in 2002, and from Tokai Rika, a parts maker 31% owned by Toyota. By 2004 Donnelly's share of the market had grown to 21%, largely at the expense of Gentex, whose share declined to 77%. It would have been reasonable to expect that Gentex's share would continue to decline, but it hasn't. By 2008 it was back up to 83%, and Magna's had declined to 14%. We asked Connie Hamblin, vice president of investor relations and corporate communications, how Gentex continues to shut out its competitors.

"It's a combination of quality and delivery and the fact that we offer a lot more electronics features integrated into the mirror than our competitors do," said Ms. Hamblin. "Gentex is essentially an electronics company; we're also very good at doing electrochromatics. Electronics is not a core competence at Magna Mirrors, our primary competitor. Electrochromic mirrors are a very small part of their business. We have what is believed to be the best technology available, and we've won almost every product quality award you can win from every major automaker," she added.

Gentex's mirrors are constructed with a layer of electrochromic gel sandwiched between two pieces of glass, a control circuit board and two sensors. Both glass layers are treated with a conductive coating. The forward-looking sensor recognizes low
All Manufacturing in Michigan

Gentex operates five manufacturing facilities, all located in Zeeland, Michigan. Four plants handle automotive products, the other makes non-automotive fire protection products. Manufacturing entirely in Michigan is extremely rare, especially in the automotive industry, where cost pressures are so great that suppliers are almost always forced to move manufacturing operations to low labor cost regions of the world.

Building capacity at the Zeeland facilities is currently sufficient to manufacture approximately 20 million interior and nine million exterior mirrors. Production line capacity is increased each model year as needed. Gentex believes its ability to continually upgrade and automate manufacturing processes strengthens its competitive advantage.

“Every time we plan for a new manufacturing facility we go through an evaluation process to determine what makes the ambient light levels. The rear-facing sensor detects glare from headlamps approaching from the rear and sends voltage to the mirror’s gel in proportion to the amount of glare. The mirror dims until the glare is no longer detected. If the vehicle is equipped with exterior as well as interior dimming mirrors, the interior mirror controls the dimming of both.

Future Growth Drivers

When the bottom dropped out of the automotive market, especially in North America, Gentex would have been more financially challenged had it not diversified its customer base during the past decade. “In 1999 approximately two-thirds of our unit shipments went to the Detroit Three,” said Ms. Hamblin. “In 2008 just 24% of unit shipments went to them. Daimler, General Motors and Toyota each accounted for 14% of 2008 sales.”

Between 2003 and 2008, Gentex’s sales grew annually at just 5.9% per year; down significantly from its 16.1% annual rate of growth during the prior five-year period. Those days of double-digit growth will be back again, says Mr. Dykman, once the present economic turmoil ends and the automotive industry returns to normal production volumes. “We know that because the penetration of our products continues to grow with all of our customers,” he said.

According to Gentex, social and demographic trends are working in its favor.
Gentex

Interior Auto-Dimming Mirrors
Gentex manufactures a number of different types of auto-dimming mirrors, most with added electronics features. Below are some of Gentex’s most popular auto-dimming models.

- **Base auto-dimming mirror**: Automatically dims to eliminate glare of rearward approaching vehicles.
- **Compass/temperature mirror**: Adds compass and external temperature readout.
- **Map lamp mirror**: Uses LEDs.
- **OnStar mirror**: Adds three-button interface for OnStar functions.
- **Environmentally “green” mirror**: Lead free and uses Gentex’s Active Light Sensor in place of cadmium sulfide sensor to meet end-of-life vehicle requirements.
- **HomeLink mirror**: Adds J1 garage-door opener.
- **Tire pressure monitor mirror**: Monitors and audibly alerts when pressure is low.
- **9” mirror**: For smaller vehicles.
- **12” mirror**: For trucks, SUVs and large cars.
- **SmartBeam mirror**: Uses a CMOS camera chip to control high beams.
- **Microphone mirror**: Adds voice-recognition microphone.
- **Rear camera monitor**: Adds LCD backup monitor.

Exterior Auto-Dimming Mirrors
These mirrors dim in tandem with the vehicle’s interior auto-dimming mirror.

- **Flat technology**: One-to-one image ratio.
- **Convex technology**: Curved to provide expanded field of view.
- **Thin/flat technology**: Lighter and less prone to vibration.
- **Aspheric technology**: Eliminates blind spot.
- **LED turn signal**: Adds turn signal.

With more vehicles on the road every year, and an aging population looking to make nighttime driving easier and safer, a company that has no close competitors and a core product that solves the problem of glare can reasonably expect its market penetration to continue growing.

Gentex has long recognized the importance of the in-vehicle real estate it controls and has used the mirror as a platform for higher value integrated electronics features such as telematics and hands-free phone interface, remote keyless entry receiver, map lights, display for tire pressure, passenger airbag status, compass, temperature, trip functions and more. Among the most promising add-on features in terms of future sales are SmartBeam intelligent high beam headlamp control and Rear Camera Display.

SmartBeam
Packaged as part of the auto-dimming mirror assembly, Gentex’s SmartBeam headlamp control system automatically switches the high beams on and off according to traffic conditions. Under development since the mid-1990s and in production since 2004, Gentex has shipped more than one million SmartBeam systems—295,000 in 2008—to customers in the U.S. and Europe. SmartBeam mirrors add about $65 to the price of a basic auto-dimming mirror. In 2008 the average selling price across the entire mix of Gentex mirrors sold to OEMs was approximately $42.

SmartBeam is optionally available on 24 vehicle models, with more introductions planned for later this year. Where available, the take rate on the SmartBeam option is about 25% to 30%. Current customers include Cadillac, BMW, Chrysler, Audi, Opel/Vauxhall and Toyota.

A major advantage of SmartBeam compared to other offerings is its low cost. Gentex developed and assembles its own CMOS camera and lens. It has to because it couldn’t find a camera company willing to custom manufacture a low-resolution, automotive grade camera—one that essentially serves as a sophisticated light sensor—in the relatively low volumes Gentex required when the product was first launched. Suppliers only offered more expensive, higher-resolution multi-function cameras available off the shelf. “We were almost forced to make it in house,” said Ms. Hamblin. Sensitive to the wavelength of both headlamps and taillights, the camera chip has the ability to disregard street lights, because they are powered by alternating current, and light reflected from road signs, because they are stationary.

A nother advantage of SmartBeam is that because it is packaged within the interior mirror, carmakers avoid the expense of integrating headlight control into a variety of different models.

Gentex has recently been awarded a future vehicle program for the latest version of SmartBeam, which not only automates the process of turning the high beams on and off, but also can continuously control variable low-beam headlights that extend and contract the low-beam pattern.

In the future SmartBeam will also be used to control constant-on high-beam systems that take advantage of next-generation headlamp actuation hardware. Such systems will direct maximum forward lighting on the roadway while blocking out any light directed on oncoming and preceding vehicles.

Rear Camera Display
A nother promising new product category for Gentex is auto-dimming mirrors with an integrated LCD camera monitor. All vehicles have blind zones where it is difficult to see what’s in the rearward path, especially problematic with SUVs and large trucks. Gentex solves the problem with a display that’s built into the interior mirror that monitors a rear-facing camera. (Gentex does not supply the camera.) Drivers can simultaneously view the monitored and reflected scenes when the vehicle is in reverse, and the mirror looks normal when the vehicle is not in reverse.

Gentex shipped 65,000 Rear Camera Display (RCD) mirrors in 2007, and 270,000 in 2008. RCDs add more than $75 to the price of an auto-dimming mirror. Gentex has announced RCD...
requirements of the law. That law requires that automakers expand the field of view behind the vehicle to reduce death and injury resulting from backing incidents, particularly those involving small children and disabled persons. Such a standard could be met with additional mirrors, cameras or sensors. Once the rules are clarified, the phase-in period for carmakers to reach 100% compliance is four years, or approximately by 2015.

More Camera Applications Possible

Gentex’s development and manufacturing experience with the camera technology used in SmartBeam mirrors could someday be applied to other automotive camera applications, even those that don’t involve the mirror. That kind of R&D investment would be a big departure from Gentex’s automotive product strategy that has been focused on dimming mirrors and on electronics that can be integrated with the mirror. “We have a lot of research and development going on in a number of different areas in the vehicle, including cameras and all the different automotive applications for cameras,” Ms. Hamblin said.

While Gentex doesn’t rule out the possibility of someday moving off-mirror, it is far more likely that any new camera-based features it might introduce, for example lane departure warning, sign recognition, pedestrian and obstacle detection, would be rearview mirror-based. The cost advantages of using the existing electronics in the mirror, potentially sharing micro-processing capability, plus the location of the mirror at the driver’s eye level, with a clear view to the front and rear and protected from the elements, have thus far made it the logical place for Gentex to put cameras or other sensors. Optimizing costs allows Gentex to bring new products to market in high volumes, affordable for the widest possible range of vehicles.

Other Markets

With automotive stocks suffering, if there is one thing that Ms. Hamblin wishes investors knew about Gentex it would be “that we are a technology company that happens to be shipping a lot of product to the auto industry. We have potential to grow both inside and outside the auto industry.”

Gentex has been working since the 1980s to extend its electrochromic-dimming technology to other applications such as windows in buildings. Those efforts have finally begun to pay off. Working with its tier-one customer PPG Aerospace, Gentex has booked orders amounting to roughly $50 million of sales over five years for dimmable aircraft windows for Boeing’s 787 Dreamliner series. For each plane, Gentex will supply 100 dimmable-window subassemblies and the electronics to control them. Gentex and PPG Aerospace also booked a deal to supply dimmable windows for a smaller plane, this one from Beechcraft, with 15 windows. Shipments for both the Dreamliner and the Beechcraft planes are to begin in 2009. Deals involving other planes are also in the works.

The Company Profile Continued

Gentex’s Core Competencies

Electronics
Hardware/software development
Testing equipment design/build
Automated board assembly
Calibration testing and documentation
Added-value electronics features, automotive microphones, LED lighting, electronic image, etc.

Microelectronics
Semiconductor design, assembly and testing

Chemistry
Molecular design
Materials research
Research laboratory
Computer simulation and modeling
Chemical analysis and production

Glass Processing
Glass cutting
Glass forming and bending
Glass coating

Automated Assembly
Product and tool design
Systems development
Component and product testing
Environmental testing laboratories
Component manufacturing
Work cell assembly

Mechanical Engineering
Product design
Vibration analysis
Environmental/vibration testing
Optical design/development

installations on 27 models from Ford, GM, Toyota, Mazda, Suzuki and Hyundai/Kia. Three different display sizes are currently available: 2.4, 3.3 and 3.5 inches, measured diagonally.

The hardest part about integrating an LCD with the mirror is making the display bright enough to be seen through both the glass and the auto-dimming gel. Gentex does it by backlighting the display with multiple LEDs and special optics.

RCD mirror sales are likely to receive a big boost from the U.S. Kids Transportation Safety Act, signed into law in February 2008. The National Highway Traffic Safety Administration began rulemaking for the legislation in March 2009 and has three years to determine which technologies carmakers must use to meet the

Auto-Dimming Interior Mirror Penetration Rates, 2008

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>North America</td>
<td>40-45%</td>
</tr>
<tr>
<td>North American Transp.</td>
<td>20-25%</td>
</tr>
<tr>
<td>Western Europe</td>
<td>20-25%</td>
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<tr>
<td>Asia Pacific/South America</td>
<td>Nearly 10%</td>
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Gentex estimates that auto-dimming mirrors will penetrate roughly 45% of the world’s light vehicle production within the next 10 to 12 years, resulting in a $3 billion potential market.

Gentex Stock History

Gentex stock is traded on the NASDAQ Global Select Market. The company has declared a cash dividend of $0.43, $0.40 and $0.37 for the years 2008, 2007 and 2006, respectively.
Fuel Economy...

probably encourage many U.S. consumers to drive smaller, lighter vehicles,” said Ray Cornyn, director of automotive MCUs in Freescale’s Microcontroller Solutions Group.

Start-Stop Will Penetrate U.S. Fleet

According to Johannes-Joerg Rueger, a senior engineering vice president at Bosch, start-stop, which shuts the engine down when the vehicle is stopped and instantly restarts it upon acceleration, will have a high penetration of the U.S. fleet. “There is no reason why start-stop should not be available in the United States. It’s low hanging fruit that improves fuel economy and reduces CO2 by up to 5%.”

Engineers at Ford agree: “Start-stop will definitely be playing a role here in the States at Ford in the mid-term, after 2013,” said Dan Kapp, director of powertrain research and advanced engineering at Ford. “One of the enablers for start-stop that will make it less expensive is Ford’s EcoBoost engine, which combines twin turbochargers with gasoline direct injection. You can start that engine much more quickly, which means you could probably do it with an enhanced starter as opposed to a belt machine or an integrated starter generator. That’s the approach we are pursuing in Europe, and we will bring it here.”

Recently, GM announced that due to poor sales, it was discontinuing production of its mild hybrids with belt alternator start-stop.

Start-stop is moving much more quickly into the European fleet where fuel is significantly more expensive, so the payback is quicker. Vehicles fitted with manual transmissions, which make start-stop easier to add, are more prevalent in Europe.

“Start-stop is a bit more challenging with automatics,” explained M r. Kapp. “With manual transmission, the start-stop function is enabled when the car is in neutral; we would not expect our customers who drive automatics to move the gear shift lever to neutral when they come to a stop. The other factor with automatics is we need to keep the transmission pressure up when you shut off the engine, so that means adding an electric pump to the system,” he said.

Between now and 2012 or so, the bulk of Ford’s fuel efficiency gains will not come from start-stop and other electrification measures; it will come from currently available technologies. Ford will equip 90% of its nameplates with the EcoBoost engine. In 2013, EcoBoost will be installed in 1.3 million Ford vehicles worldwide, including 750,000 in North America.

In the near term, M r. Kapp noted, Ford will equip 100% of its portfolio in the U.S. with six-speed transmissions. “Dual clutch will be a subset of that, oriented more toward smaller, low-torque models.” Improved battery management is also a focus, as is electric-power steering. EPS will be applied to 80% to 90% of Ford vehicles.

While Ford’s near-term measures are making turbocharger manufacturers like Honeywell happy, they are not necessarily a boon to the makers of electrical equipment and electronics. The benefit will only come as start-stop and other electrification measures find high volume. “Our engine controls get more complex, but not necessarily in terms of microprocessing power or the number of sensors and actuators,” pointed out M r. Kapp. “We are now measuring air pressure to control boost and we utilize NOX sensing, but those are things that are already out there today.”

The real boost in the market for electrical and electronics parts will come as carmakers move to high volume production of full hybrid and electric vehicles. “Hybrids are great for increasing semiconductor content in the vehicle,” said Freescale’s M r. Cornyn. “For example, when you go to a hybrid powertrain, you add at least three microcontrollers, for controlling the electric motor, the inverter and for battery management.”

There are orders of magnitude more software in a hybrid vehicle than in a conventional gasoline powered vehicle, said GM’s M r. Helfrich. “We have over a million blocks in our software model. You are balancing the engine, the transmission, electric motors, batteries, the power management system—you are essentially tracking the generation and utilization of the energy. It is a big, messy problem.”

Karina Morley, who is global vice president of control electronics at Ricardo, sees a big boost in electronics content coming as carmakers begin producing hybrid and plug-in hybrid vehicles. “Not only are you adding the electric traction motor plus a lot of control hardware and software, but you are also modifying most of the subsystems in the vehicle to work in the electric mode, whether it’s air conditioning, braking or steering. All those things have to work when the car is shut off at a stoplight, so everything gets electrified.”

Roundup...

business of Alcoa’s Electrical and Electronic Solutions division. Included in the sale are operations in 13 countries employing roughly 17,500 people.

Intel Buys Wind River

The world’s largest semiconductor maker, Intel Corp., is buying embedded software developer Wind River Systems for $884 million. Wind River and Intel have been working together with BMW on a Linux-based, open source automotive infotainment platform, now under the framework of the GENIVI alliance.

Visteon Chapter 11

Visteon filed for bankruptcy protection on May 28, 2009. Ford has agreed to provide $125 million in DIP financing, subject to financing commitments from other Visteon customers as well.

Ford and H yundai are Visteon’s two largest customers. In 2008 Ford accounted for 34% of Visteon’s sales. H yundai/Kia accounted for 22%.

Hitachi Automotive Systems

In May 2009, Hitachi announced plans to spin off its Automotive Systems Group into a separate, wholly-owned subsidiary company to be named Hitachi Automotive Systems Ltd., effective July 1, 2009. The new company will focus on hybrid vehicle components including lithium-ion batteries, inverters and small motors, as well as on direct injection engine systems and variable valve actuation systems, braking, steering and suspension. Unconsolidated sales for the fiscal year ending March 31, 2010 (annualized) are expected to be approximately ¥280 billion ($2.9 billion).