2001 Roundup of European Automotive Electronics

Bosch Automotive Technology Sector
2001 Sales: €23.2 billion ($21.2 billion)
Change from 2000: up 3.1%

Products contributing most to Bosch’s growth in 2001 were direct diesel injection, A BS, ESP (electronic stability program) and navigation. The A utomotive Technology sector accounted for 68% of total Bosch Group sales in 2001, compared with 71% in 2000. Bosch plans to grow its non-automotive sectors to make the company less reliant on automotive sales. Sales for Bosch’s N orth A merican subsidiary, Robert Bosch Corp., declined 4.5% in 2001, to $4.2 billion.

In February 2002, chairman of the board of management, Hermann Scholl, said that the automotive industry had not yet hit the bottom; he does not expect much improvement in the automotive industry until the second half of 2002. Dr. Scholl expects only minor growth in Bosch’s automotive sales this year.

Continental Automotive Systems
2001 Sales: €3,986 million ($3,650 million)
Change from 2000: up 31.9%
2001 EBITA: up 8.4%, to €184.9 million ($169 million)

Continental Automotive Systems’ April 2001 acquisition of 60% of Temic from DaimlerChrysler contributed to a significant increase in sales. Excluding the consolidation of Temic, sales increased 13.2%. In April 2002, Continental bought the remaining 40% of Temic from DaimlerChrysler.

Within the Automotive Systems division, brake systems that use A BS, stability control systems or other types of electronics controls accounted for 45% of sales; foundation brakes accounted for

Microwave Components in Automotive Applications

Status of ACC, Radar Sensors, GPS, Multiband Antennas and Ultrawideband Sensors

We recently had a chance to interview Tom Rose, one of the world’s foremost experts on microwave components and the wireless communications market. Mr. Rose is a principal of BTR Solutions of York, Maine, a consulting firm that helps technology companies focus their resources on new market opportunities.

Prior to consulting Mr. Rose worked for M/A-COM, a Lowell, Massachusetts-based division of Tyco Electronics. During his last seven years at M/A-COM, he focused on developing the worldwide automotive market for microwave components including GPS (Global Positioning System) antennas, multiband antennas, radar sensors for A CC (adaptive cruise control) systems and short range sensors.

GPS Antennas

“Despite recent slow going in the telematics market, GPS onboard receivers and antennas are heading toward standard automotive equipment,” said Tom Rose. Used almost exclusively for location information in navigation and in-vehicle telematics applications, the global market for GPS automotive antennas in 2001 was about 5 million units, roughly $80 million. Prices average from $10 to $20 per unit, but in Japan, prices are breaking into the single digits. GPS antennas are presently the highest volume auto part sold by M/A-COM.

Telematics suppliers and carmakers are competing against the cellular phone industry for a reasonable share of the telematics and navigation markets. A key advantage for embedded systems over mobile (portable) hand-held phones is the vastly improved performance of the GPS antenna when it is mounted on a vehicle. “The handheld just can’t compete with a good antenna designed for the vehicle,” said Mr. Rose. Only about 1 inch by 1 inch by ½ inch, the antenna must be installed on the vehicle where it can ‘see’ as much of the sky as possible, and where the antenna can be combined with a good ground plane. On some G M vehicles, the GPS antenna is hidden in many different locations, including the windshield and the roof.

Multiband Antennas

A s more in-vehicle telematics applications are developed, additional antennas, beyond GPS, will be needed. Rather than making and installing two, three or four separate antennas, multiband antennas seem an obvious alternative, especially considering the need to keep the cost of telematics low. Multiband antennas are less expensive than connecting and mounting separate antennas, and they are less compromising of the vehicle’s exterior design.

The industry is developing multiband antennas as follows:

- Dual-band combines GPS at 1,575 MHz with U. S. cellular phone capability at 800 MHz.
- Tri-band adds PCS* capability at 1,900 MHz.
- Quad-band adds satellite radio reception at 2,300 MHz.
- * PCS (Personal Communications Services) refers to next-generation wireless communications in the 1,850 to 1,990 MHz band. Today cellular phone operators can use only a 5 MHz band, but PCS spectrum operators will be allowed to use a 15 MHz band.

In the United States, OnStar is by far the largest potential customer for multiband antennas and will soon be the first company to use dual- and tri-band antennas, both of which are close to launch phase. OnStar gets location information from GPS and uses an embedded wireless
Carmakers’ Electrical System Problems Diminish—Chrysler Moves Up To 3rd Place Tie

The Hansen Report annually reviews Consumer Reports’ Frequency of Repair data for electrical system problems, to see if quality is improving—and boy, is it ever.

To calculate our ranking, we weight data based on more than 500,000 new cars with U.S. sales by model, according to data from A utomotive N ews and the carmakers. Electrical system problems include switches, controls, lights, radio and sound system, horn, power accessories and wiring.

In 1992, the first year we analyzed the data, over 5% of light vehicles from the Big T hree had electrical system problems. (See The Hansen Report, May 1998, for a summary of data from 1992 to 1997.) Throughout the 1990s, Honda, Toyota, Mazda and Nissan had fewer electrical problems than the Big T hree and European carmakers, but as the table (right)

Researchers Hope Gas Stations May One Day Fuel Telematics Boom

While telematics services are advancing very slowly, there’s a rapid upturn in the use of wireless communications in a somewhat unlikely segment of the transportation industry, the service station.

Mobil’s SpeedPass has garnered use by roughly 5 million people at nearly 7,000 stations. Oil companies might be an unlikely place to look for the much-sought-after killer application for telematics, but the success of SpeedPass has sparked some R&D projects that aim to make service stations the hub for getting telematics information into the car. Some contend that car owners, who won’t pay a monthly subscription fee for services like OnStar, might be more than willing to splurge if service stations hit them with a compelling offer to download a movie, new MP3 tunes or map files with the latest construction information. Transaction speed will be important; the average gasoline stop is only around three to five minutes.

A telecommunications provider search for the right blend of services to attract automotive consumers, there’s a possibility that spot purchases at gas stations could play a role in helping telematics live up to its marketing hype. Some electronics company managers are bullish on the prospects. “This is going to happen at some time, it’s just a question of when,” said Doug Welk, system software manager at Delphi’s A dvanced Development Group in Kokomo, Indiana.

Other players, including the oil companies, are moving cautiously. Mobil has no plans to try to extend SpeedPass to handle maps or music. Neither BP A moco nor Shell Oil has firm plans to roll out these services in the near term. A General M otor s spokesman said its OnStar service provides directions for drivers, so there isn’t much need for drivers to download maps from service stations, and GM engineers don’t feel the demand for downloading MP3s or movies from service stations justifies much research. Even at Texas Instruments, which supplies SpeedPass RF chips, there isn’t a lot of hope that SpeedPass will be the technology of choice if and when drivers want to download music or movies. “The protocol was not made to handle large data files like maps,” said V.C. Kumar, strategy manager, wireless group at Texas Instruments R Fid Systems (Plano, Texas). “Can that be done with SpeedPass? Yes, but it will take more time with R Fid.”

Delphi’s Mr. Welk feels that, as with telematics and navigation systems, electronics suppliers have to push the technology forward so it will be ready if and when automakers decide to adopt it.

Mr. Welk said. “We’re in kind of a chicken-and-egg situation right now. The car companies want to have the services available before they move ahead, and the oil companies want to see cars equipped with telematics receivers before they start spending money,” M r. Welk said.

continued on page 8
mobile phone circuit to connect the vehicle with the call center. OnStar will use tri-band receivers to add PCS to its analog cellular reception.

Demand for quad-band antennas, which have moved past research into the development lab, will soon increase as OnStar adds XM Satellite Radio reception to its list of OnStar services. The first XM Radio-equipped Cadillacs were introduced last fall, and GM plans to offer XM Radio on over 20 models in 2003. Ford, DaimlerChrysler, BMW, Volkswagen and Nissan have agreed to install Sirius Satellite Radio’s A M/FM/SAT radios in their vehicles. Sirius’ programming is currently available in 18 states. Each satellite service promises up to 100 digital channels of music and talk programming.

Among the top developers of multi-band antennas are M/A-COM and RecepTec (Grand Blanc, Michigan, and Munich, Germany). RecepTec was started by a group of engineers who left Fuba Automotive in 1999, shortly after Fuba was acquired by Delphi. “Fuba is still a strong player in the antenna market, but it has not done as well as RecepTec in winning an early share of the telematics antenna market represented by OnStar and by Wingcast,” said Tom Rose.

Radar Sensors for ACC Systems

M/A-COM became a producer of forward-looking radar sensors by working with A.D.C. (Automotive Distance Control Systems, a joint venture of Temic and Leica) on behalf of Mercedes. Mercedes needed an experienced microwave component manufacturer that could handle automotive production volumes of radar sensors developed and licensed by Millitech, Deerfield, Massachusetts, a maker of millimeter-wave components and assemblies. A captive cruise control systems keep track of vehicles up to 150 meters ahead and automatically modulate vehicle speed to maintain a safe distance. Mercedes was the world’s first company to install a radar sensor in production vehicles, in June 1999 on the MY 2000 S Class platform, and since then, radar-based ACC has shown little evidence that it will progress much farther than the luxury car market represented by Jaguar’s priciest vehicle and by BMW. Though, says M.R. Rose of BTR Solutions, “Mercedes remains committed to the product. This year, ACC is available on the S, E, and C class vehicles, as well as the new SL.”

A big issue with ACC, as with almost all technology that comes out of the aerospace industry, is its high price. Forward-looking radar sensors are still too expensive. First-generation sensors, which came to market in 1999, were priced to the carmaker at nearly $1,000 each. Second-generation systems for today’s market are priced at less than half that. In several more years, says M.R. Rose, the sensor will come down to the $100 range. Besides M/A-COM, other radar sensor makers include Delphi systems, which supplies Jaguar; Hitachi, which supplies Nissan; and Bosch, which supplies BMW.

Safety Systems

Despite the high cost and lack of volume for radar cruise control systems, “I believe a much bigger market will come when carmakers use some of this technology to bring radar beyond cruise control to full-blown safety systems for collision avoidance and pre-crash sensing,” declared Tom Rose. “In the last seven years or so, I’ve seen a big change in carmakers. In the past, they were reluctant to tackle safety features that, if they failed, might lead to litigation. But today, carmakers are interested in pure safety systems.”

For example, said M.R. Rose, “Carmakers and their safety engineers are at their wits end dealing with a collision as it happens. Engineers have done excellent work modeling the frame of the vehicle and detecting forces so they can know from where the strike came and anticipate its severity. They’ve all come to the conclusion that having sensors that project outside the vehicle is the next step to dramatically improving safety.”

Safety engineers imagine a system of outward-looking sensors that see 360 degrees around the vehicle. Such sensors would be used, not only in collision warning systems, but also in pre-crash sensing systems to inform the airbags and seatbelt pretensioners so that they deploy in the best way possible to protect passengers once a crash occurs.

“There’s an enormous amount of R&D that is going into sensing technologies right now,” asserted M.R. Rose. “My belief is that the best sensor systems will combine radar sensors, which can measure distances and changes in distances very well, and video or optical sensors, which are best at identifying what is being seen.”

Ultrawideband Sensors

While seeing in 360 degrees has been a goal of safety engineers for years, M.R. Rose believes that such developments will accelerate when UWB (ultrawideband) radar sensors are ready for automotive production. UWB sensors are able to detect the location and movement of objects near a vehicle, enabling features such as near collision avoidance, improved airbag activation, and suspension systems that better respond to road conditions. UWB sensor development received a boost on February 14, 2002, when the U.S. adopted a Federal Communications Commission order that permits the marketing and operation of certain types of products that use UWB technology. According to the FCC order, “With appropriate technical standards, UWB devices can operate using spectrum occupied by existing radio services without causing interference, thereby permitting scarce spectrum resources to be used more efficiently.”

In the past, the FCC would not permit the use of ultrawideband devices because they transmit a wide range of frequencies, which could cause interference with other electronics devices. Such emanations come from radar sensors when they transmit short-duration pulses.

Forward-looking radar sensors operate at 77 GHz. That frequency was chosen so sensors could be small enough to fit behind a car’s grille; they can see well in front of the vehicle with highly focused antenna beams. To sense outward from the side of the vehicle, carmakers need sensors that can see in the near range, up to about 20 meters, and they need to be less expensive than today’s forward-looking sensors. For near-range sensing, developers have been working on radar sensors that operate in the 24 GHz band and use direction antennas. This technology is now permitted by the FCC, as long as the center frequency of the emission and the frequency at which the highest radiated emissions occur are greater than 24.075 GHz. Such UWB radar sensors are currently in the prototype testing stage.
Harman International

Address: 1101 Pennsylvania Ave., N.W.
Suite 1010, Washington, DC 20004;
Telephone 202-393-1101; fax 202-393-
3064; www.harman.com

Major Products: Loudspeakers, amplifiers,
tuners, DSPs, microphones, headphones,
DVD players, CD players and recorders,
navigation systems for cars, and video
products for the car and home

Automotive Markets: OEM and aftermarket

Automotive Brands: JBL, Infinity, Harman
Kardon, Becker, Lexicon, Mark Levinson,
AKG

FY 2001 Sales: $1,716.6 million

R&D: 5% of sales

Automotive OEM Customers:
DaimlerChrysler, with 20.5% of sales, is the
largest; others include BMW, Ferrari, Land
Rover, Lexus, Mitsubishi, Peugeot, Porsche,
Renault and Toyota.

Facilities: 72 facilities in 17 countries

Employees: At the end of June 30, 2001:
10,676, of which 3,671 were U.S. employ-
ees and 7,005 were international.

Background

Founded 50 years ago by Sidney
Harman, the company was sold when Dr.
Harman became secretary of commerce in
the 1970s. Dr. Harman repurchased the
company in 1980 and incorporated it as
Harco Industries Inc. The name was
changed to Harman International Indus-
tries Incorporated, and today it is listed on
the New York Stock Exchange under the
symbol HAR. At the end of 2001, Dr.
Harman, now executive chairman of the
board of directors, owned roughly 7.6% of
company shares, held in various family
trusts, in which he has sole voting power.

Dr. Harman is reported to be “not very
damn interested” in public relations but
very concerned for the welfare of his
workers. He believes companies should
make sure employees feel appreciated,
since if employees “have a serious emo-
tional connection to their company,” it
results in productivity improvement.

The company lists these leading-edge
infotainment system capabilities: GPS
(Global Positioning System), navigation,
telematics, integrated modular multimedia
displays, digital TV tuner/receivers,
human-machine interfaces, Internet ac-
cess technologies and MOST, a high-
speed, fiber-optic network standard for
multimedia networking in automotive
environments. The company holds ap-
proximately 408 United States and for-
eign patents and has approximately 362
patent applications pending around the
world.

Harman International group compa-
nies work in close cooperation to
codevelop and produce high-end audio
products that set industry benchmarks.
Generally, each Harman company special-
izes in and tries to be world-class in one
aspect of acoustics. Harman is aware that
brand recognition is worth a lot: Well-
known loudspeaker brands Infinity and
JBL compete directly with each other.
However, the company is able to manu-
facture both JBL and Infinity loudspeakers
in the same plants, taking advantage of
economies of scale to yield lower costs.

Since 1999, Harman International has
been organized into two end-user markets:
the Consumer Systems Group, responsible
for Harman products used in the home, in
vehicles and in computers, and the Profes-
sional Group, responsible for equipment
used by professionals in the broadcast,
cinema, concert hall and recording indus-
tries. Harman’s automotive business and
accounts for over half of the Consumer
Systems Group sales.

Automotive Sales Growth

Multimedia and infotainment systems
and components are factory-installed by

The Hansen Report on Automotive Electronics, Rye NH USA www.hansenreport.com
## The Company Profile Continued

<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
</tr>
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<tbody>
<tr>
<td>1981</td>
<td>Essex Loudspeaker Division of United Technologies, renamed Harman Motive and the company's entry into the automotive OEM market in the U.S.</td>
</tr>
<tr>
<td>1983</td>
<td>Infinity, a maker of high-end loudspeakers</td>
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<tr>
<td>1985</td>
<td>Harman Kardon</td>
</tr>
<tr>
<td>1989</td>
<td>ELAC (U.K.), a European OEM loudspeaker manufacturer, renamed Harman Motive, Ltd.</td>
</tr>
<tr>
<td>1993</td>
<td>AKG (Austria), a manufacturer of microphones</td>
</tr>
<tr>
<td>1993</td>
<td>Lexicon (U.S.), a manufacturer of digital audio signal processing equipment</td>
</tr>
<tr>
<td>1995</td>
<td>Becker GmbH (Germany), a maker of automotive head units and other electronics, which enabled Harman International to offer integrated audio systems; Becker was the principal audio head-unit supplier to Mercedes Benz, Becker was beginning to supply automotive audio systems to carmakers in Europe.</td>
</tr>
<tr>
<td>1996</td>
<td>Madrigal Audio Laboratories (U.S.), manufacturer of Mark Levinson</td>
</tr>
<tr>
<td>1997</td>
<td>Oxford, a manufacturer of automotive OEM loudspeakers for Chrysler with facilities in the United States and Mexico.</td>
</tr>
<tr>
<td>1997</td>
<td>Audio Electronic Systems (AES), a manufacturer of automotive OEM loudspeakers with facilities in Germany, Sweden and Hungary AES supplies loudspeakers to BMW, Mercedes, Volvo, Volkswagen and Fiat.</td>
</tr>
<tr>
<td>2002</td>
<td>ACC AG (Germany), a developer and provider of operating concepts, graphic user systems, and software for CarPC systems, including integrated driver information and communication systems</td>
</tr>
<tr>
<td>2002</td>
<td>Temic Speech Recognition and Processing (from DaimlerChrysler)</td>
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</table>

Harman considers itself the primary supplier of high-end automotive systems worldwide. Currently, more automotive sales come from abroad than from the United States. Total sales in FY 2001 increased 2.3% over FY 2000, with automotive business accounting for most of the growth. Growth came from increased shipments of K & G microphones to GM’s OnStar program, from audio system sales to Toyota and from radio and navigation sales to Mercedes-Benz, as well as in the European aftermarket. K & G microphones are accounted for in the Professional Group’s sales, which in FY 2001 were flat.

Recently announced multi-year deals with Mercedes-Benz for integrated infotainment/telematics systems and the deals to license Becker’s Traffic Pro navigation hardware and software to Pioneer and JVC, beginning in 2003, have led the company to project 25% earnings growth for its automotive business for each of the coming four or five years, according to the Washington Business Journal website.

## Automotive Strategy

In the home and in the vehicle, the company has used brand recognition to garner customers. In the early 1990s, Harman greatly expanded its automotive OEM business with its brand names Infinity, JBL and Harman Kardon. Although Harman had not yet acquired Becker, the German head-unit supplier to Mercedes-Benz, Becker was beginning to supply automotive audio systems to carmakers in Europe.

Traditionally, Harman’s automotive sales have comprised components sold separately to OEMs and the aftermarket, but the company is now more focused on developing sales of integrated systems to OEMs. In 1995, the acquisition of Becker leveraged Harman’s position with OEMs, allowing the company to begin marketing audio systems rather than just components. Acquisitions of key automotive component manufacturers have strengthened the company’s position with carmakers. In April 2002, Harman acquired Temic’s speech recognition and processing business from DaimlerChrysler. Acquisitions that advance technologies and further expand market share are expected to continue.

A key to selling more integrated infotainment/telematics systems has been the company’s involvement in helping to create the MOST standard. That involvement helped win recent contracts with Mercedes-Benz, Audi and BMW, and Harman Becker is now the primary supplier for integrated infotainment/telematics navigation systems to Mercedes-Benz, Audi, BMW, Porsche and Renault. The first U.S. introduction of a Harman integrated system appeared in early 2002 in BMW’s 7 Series. Harman has purchase commitments for integrated audio, video and navigation systems to be installed in MY 2002 and MY 2003 vehicles from Mercedes-Benz, Audi, BMW and Porsche.

A company goal is to dominate the market for all car infotainment systems that combine audio, video, navigation and telematics. As the DVD and digital television markets mature, the company believes increased customer traffic in those products will stimulate all audio system sales as consumers see the improvement that digital makes to audio quality. Over the next two years, Harman will introduce these new digital products for the car: multimedia, satellite and Internet communication devices, and new, high-resolution video products.

## New Contracts With Mercedes

In August 2001, Harman announced a new business deal that makes Harman Becker the sole supplier of navigation systems for all Mercedes-Benz vehicles. Harman will supply an integrated infotainment system for the E Class and continued on following page.
Harman International

OEM Customers by Harman Brand

Harman International Automotive

Infinity: DaimlerChrysler (the majority of Chrysler, Dodge and Jeep lines); Mitsubishi

Harman Becker (#1 in Europe’s OEM luxury car segment): BMW, Mercedes-Benz, Porsche

Infinity audio systems are integrated with Harman Becker head units and navigation systems in infotainment systems for upscale MY 2002 and MY 2003 vehicles by these OEMs: Audi, BMW, Mercedes-Benz, Porsche

Harman Kardon: BMW, Jaguar, Saab
JBL: Hyundai, Peugeot, Toyota
Mark Levinson: Lexus

The company also has non-branded loudspeaker agreements with: Audi, Fiat, Ford, Renault, Volvo and VW.

DVD navigation for the S Class. The contract is worth $850 million over three years, beginning in fiscal 2003.

In March 2002, Harman announced second contract with M ercedes for integrated infotainment/telematics systems for the S Class. First shipments under that contract will start in mid-2005. Dr. Sidney Harman noted in a press release: “This major new award represents over $200 million in annual incremental sales.”

Harman’s Integrated Infotainment/Telematics/Navigation System

This system will provide multimedia, DVD-based navigation, Internet access, radio and music reproduction, hands-free telephone and voice activation. It features:

- A MOST optical bus: MOST uses plastic fiber-optic technology to deliver high bandwidth, EM I robustness, large net throughput bit rates and synchronous data.
- M ultiplexed audio tuners from Harman Becker were designed to aid in uninterrupted reception.
- A K G microphones will facilitate hands-free operation.
- The system will use Harman Becker’s Traffic Pro navigation hardware and software.
- Bit-stream technology, first used in Harman Kardon products in the late 1980s, will be used in audio and data processing and storage in the new integrated infotainment/telematics navigation system. Two important Harman Kardon signature audio technologies are ultra-wide bandwidth systems and high-current amplifiers, technologies already employed in vehicles with Harman Kardon’s dual, independent power supplies for the front and rear channels, as well as convection, fan-less cooling for quiet operation.
- Harman expects that the voice-activation features in integrated systems will benefit from its recent acquisition of the Temic speech recognition and processing business.
- Harman Group company Lexicon’s Logic 7 surround-sound technology

Logic 7: Surround Sound

Harman will use Logic 7 surround processing in its new integrated infotainment/telematics systems for M ercedes-Benz, A ud i, BM W, Porsche and Renault. Earlier this year, BMW offered the seven-channel Logic 7 system in the 7 Series as an $1,800 option; BM W co-developed its system with Harman Kardon, using DSP (digital signal processing) technology from Lexicon. Logic 7 processing uses an ambience-extraction technology to create distinct surround sound from two-channel sources, like CDs. It creates seven channels of audio: two front (in the front doors), one center (atop the dash reflecting off the windshield), two middle (at the fronts of the side doors), and two rear (in the deck shelf), plus two subwoofers under the front seat.

In addition to Logic 7 technology, audio designers for the BM W used the cabin space to create great sound: The two subwoofers under the front seats use the air cavity of the car structure as the bass enclosure. Hollow cavities in the rocker panels help develop low bass. For more on surround sound, please refer to The Hansen Report, February 2002.

Beyond Surround Sound: Smart Loudspeakers

Harman not only designs loudspeakers in ways to make them more “room friendly,” but it is also finding ways to let the loudspeaker system interrogate the listening space and adjust itself for peculiarities in that particular space, according to Dr. Floyd Toole, vice president acoustical engineering for Harman International Industries. Dr. Toole was a senior research officer with the National Research Council of Canada’s Acoustics and Signal Processing Group for 25 years. He has conducted groundbreaking research using double-blind testing into why loudspeakers sound the way they do, how they are measured, and how listeners perceive what they hear. Dr. Toole has concluded: “When we did listening tests with even very simple experimental controls, we found that most people, most of the time, liked and disliked the same loudspeakers. People with close to normal hearing thresholds, who had some experience in critical listening, all agreed very closely in their preferences.”

Smart or active audio systems employ DSP technology to enhance loudspeakers. The result is high-quality sound even in less than optimal conditions. Loudspeakers, woofers and subwoofers are power amplified; DSP at the speakers allows automatic built-in parametric sound equalization that makes adjustments for a particular space. Integration of DSP and amplification in the loudspeaker system does a number of things: increases system reliability, enhances control functionality and allows rapid installation and set up. Plus, it is “a theoretical opportunity to deliver an audibly perfect translation of an electrical input into acoustic output,” according to a presentation at the Audio Engineering Society in January 2002, by Doug Button and Tim Shuttleworth of JBL Professional.

Active loudspeaker technology is currently commercially available in professional products for churches and concert halls, as well as in customized smart-loudspeaker systems, like JBL’s Synthesis system for the home, although these cost tens of thousands of dollars. Less expen-
sive home systems are in development. Smart loudspeakers are currently used in Lexus vehicles. In cooperation with Lexus engineers, the 7-channel Mark Levinson DSP audio system was developed by Madrigal Audio Laboratories (Connecticut), a Harman International subsidiary.

**Mark Levinson Audio in Lexus**

Mark Levinson designers began working with Lexus designers on an integrated sound system in the late 1990s. Road noise, electrical and electromagnetic noise, confined spaces and limited speaker placement options were significant engineering concerns.

However, Lexus engineers had already designed an exceptionally quiet cabin and the acoustics are further enhanced by using DSP to actively tailor sonic parameters. Different audio systems were created for each Lexus model, and digital equalization is used to optimize the performance of every system.

Mathematical algorithms were written to calculate exactly which parameters should be modified, when and by how much. These calculations are used to adjust the sound for the listener’s location relative to each loudspeaker, to account for the effects of nearby reflective surfaces and to compensate for the effects of road noise. In the last two years, the 11-speaker Mark Levinson audio system installed in the Lexus LS430 has received numerous auto audio accolades.

**Some Carmakers Look to Save Costs by Unbundling Components**

While branded premium audio systems such as Bose and Harman/Kardon, do command premium prices from carmakers, not all carmakers are interested in high-end, high-value-added integrated systems such as those in which Harman specializes. Some are more interested in cost-effective audio systems particularly for high-volume moderate- and low-priced vehicle production.

In a recent project, Chrysler moved from the realm of premium audio into the commodity realm by unbundling the components. As a result, Chrysler was able to lower the system cost “by tens of percent—age points.” The carmaker bid out the amplifier, radio control head and speakers separately and still got to use the Harman brand name. A Chrysler engineering manager noted: “It’s really a branding issue. Harman hated it, but they did cooperate, reluctantly. . . If you pick speakers and amps from various people, and mix and match them, what you get is a premium audio system where you pretty much brokered the pieces. . . An amp is an amp, and speakers are speakers. The sound does not change, regardless of the brand.”

He told us that all the carmaker has to do to get to use the brand name is buy some of the premium supplier’s parts, either an amp or some speakers. Chrysler has been equalizing and tuning the cabin sound in-house. “Now that DSP technology comes with a lot of radios or amplifiers, we can do a lot in the back seat ourselves with just a laptop computer.”

Chrysler and Harman are working on an integrated radio head unit and navigation device for a low-volume production vehicle that Chrysler will soon introduce in the European market. Until now, Chrysler has not used Harman radio control head products, although Chrysler has purchased speakers from Harman for some time. A Chrysler official familiar with Harman told us the carmaker is working with Harman for these reasons:

- Harman is one of the few companies that integrates the radio head unit with the navigation unit.
- Harman is one of the few that will allow the downloading of route information from a telematics service provider.
- Harman has much experience with Mercedes, and since DaimlerChrysler has already invested to develop the product, Chrysler would save.
- Harman understands MOST and has the ability to make the radio-navigation unit forward-compatible when Chrysler is ready to use MOST.

A cording to an engineering manager at GM, the last time GM North America dealt with Harman International was two or three years ago when GM invited Harman to demonstrate its audio capabilities. The sound from the Harman system was deemed unimpressive for the high price, and since Harman would not provide any technical data at that time, GM had no way to objectify the performance compared to competing systems. So GM went instead with Bose Corporation (Framingham, Massachusetts), but will probably invite Harman in again for another demonstration, as the carmaker is looking for a second source to Bose. Other potential second-source suppliers include Pioneer and Polk Audio, a less recognized brand with good sound at a lower price, according to a GM engineering manager.

GM feels surround sound is just too expensive to implement at this time. GM considers Denso, Aisin Seiki, Xanavi, Alpine, Siemens VDO and Panasonic as its potential navigation-system suppliers, but not Harman.

**AKG**

AKG automotive microphone sales are contributing to recent increases in Harman’s automotive sales in the United States; Harman expects AKG sales to increase worldwide as mandates for hands-free automotive systems increase. Microphones for OnStar and for OEM’s make up a significant part of A KG USA’s business.

For hands-free automotive applications, AKG digital microphones have directional characteristics, floating rubber suspension, a pre-amplifier, protection against RF from cellular phones and can be built into the cabin. They are also suitable for speech recognition systems. Joey Wolpert, vice president of OEM sales for A KG USA , told us: “The majority of microphones manufactured for automotive applications will continue to be analog. More expensive digital mikes, using directional and speech-enhancing algorithms, are finding their way into cabins that are particularly noisy, like convertibles and trucks.”

AKG also serves the music recording and broadcasting industry, as well as the mobile telephone industry, with earpiece and mouthpiece transducer capsules. The company has over 1,400 patents and claims its R&D laboratories are “the largest, best-equipped and most productive of their kind in the world.”

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26% of sales; electronics, 13%; brake actuation, 11%; air spring systems, 1%; and aftermarket business, 4%. Continental has a 44% share of the market for A/B5/ESP (electronic stability program) in Europe, and a 29% market share in North America. In the summer of 2001, G.M placed an order for Continental’s ILSA D (Integrated Starter Alternator Damper) for two G.M hybrid models, scheduled for MY 2004. Continental Automotive Systems, with 18,480 employees, accounted for 36% of Continental AG’s total sales in 2001. For 2002, Continental expects “a modest increase in sales and markedly improved income.”

Magneti Marelli

2001 Sales: €4,073 million ($3,729 million)
Change from 2000: down 8.5%

Effective July 1, 2001, parent company Fiat S.p.A. broke up the remaining businesses of Magneti Marelli into five companies: Magneti Marelli Sistemi Elettronici, Magneti Marelli Powertrain, Magneti Marelli Aftermarket, Magneti Marelli Services and Magneti Marelli Holding.

Magneti Marelli Sistemi Elettronici, which makes electronics modules, onboard computers, telematics and navigation platforms, was sold in April 2002 to Magneti Marelli Services and Magneti Marelli Holding, which makes electronics modules, onboard computers, telematics and navigation platforms, was sold in April 2002 to Mekfin, a holding company based in Padova, Italy. Mekfin will take full control of the Magneti Marelli electronics business through a newly established company, in which Fiat will invest €30 million ($27.5 million) for a 33% interest in the new company. Fiat will have a put option on its investment, exercisable after 2006. Fiat’s profit from the sale of the electronics business will be €70 million ($64 million). In 2001, revenue from the business sold to Mekfin was €570 million ($522 million). Not included in the sale is Magneti Marelli’s electronic engine control modules, which are part of Magneti Marelli Powertrain, also for sale.

Siemens VDO Automotive

2001 Sales: €5,702 million ($5,221 million)
Change from 2000: up 48.8%
EBITA (loss): (€261 million) or -€239 million, compared with a positive €89 million ($81 million) EBITA in 2000. 2001 sales include €1,686 million ($1,544 million) from VDO; the acquisition of VDO from Mannesman was completed in April 2001. Siemens VDO Automotive’s plans to focus on the products it believes have the highest growth potential—engine management, infotainment and passenger safety—and will sell off unprofitable businesses. Sixty percent of Siemens VDO Automotive’s products are automotive electronics. In July 2001, the company sold to A Loa Fujikura Ltd. four wiring harness plants, in Portugal, the Czech Republic, Belgium and Mexico, with a combined workforce of 5,600. The company intends to cut its workforce internationally and move some production to lower labor cost countries as part of its restructuring plan to improve profits, especially in the U.S.

Valeo

2001 Sales: €10,234 million ($9,370 million)
Change from 2000: up 12.2%

Operating Margin: 3.8% of sales, compared with 6.3% of sales in 2000. Valeo’s net loss in 2001 was €591 million ($541 million). Part of the company’s turnaround strategy resulted in a reduction in the number of Valeo suppliers by 900, and a reduction in the number of facilities worldwide, from 170 to 143. The company plans to reduce employment by 5,000 in 2002.

In North America, sales declined 14%. A Valeo subsidiary, Valeo Electrical Systems Inc., which manufactures wiper and air-flow system motors and components in Rochester, New York, filed for Chapter 11 bankruptcy. Despite Valeo’s bankruptcy filing as a strategy for renegotiating its contract with the IU E-CWA labor union. A fter contentious negotiations an agreement was reached that should allow restructuring to proceed. Valeo will exit the air-flow business and substantially reduce its workforce at the plant.

In March 2002, Valeo agreed to a manufacturing partnership with Jabil Circuit (St. Petersburg, Florida). Pending government regulatory approvals, Jabil will acquire Valeo’s electronics manufacturing operations in Meung-sur-Loire, France, and Wemding, Germany. Valeo will transfer production from its Switches and Detection Systems business in Texas and Juarez, Mexico, to Jabil’s plant in Chihuahua, Mexico. Jabil estimates annual revenue from the arrangement will be about $300 million. About 950 Valeo employees will become Jabil employees.

Gas Stations...

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A lot of the research addresses communication standards. Already, there’s a debate over which wireless technology is best suited for moving these large files from the gas company’s server to the car. Bluetooth and the 802.11 wireless Ethernet are in competition. Bluetooth has an edge over 802.11 because of its low cost and compact single-chip design, according to Bryce Johnstone, worldwide marketing director for TI’s short distance wireless group in Nice, France. Bluetooth is a 2.45 GHz technology that was built to let different types of computing gear share files. Bluetooth already has solid backing from automakers. Ford and Chrysler are both planning to use it as part of their telematics offerings, and some overseas companies have also expressed interest.

But Delphi is leading those who feel 802.11 is the best technology. 802.11’s transfer rate is faster, at 11 megabits per second vs. 726 kilobits per second for Bluetooth. That’s important if and when movies are being downloaded. “When you start talking about video, you’re getting into hundreds of gigabytes,” M.r. Velk said.

The range for 802.11 is 50-100 meters, but only the longest of three versions of Bluetooth handles that. The medium Bluetooth distance is 10-15 meters, with the basic version transmitting only 2-3 meters. Both Bluetooth and 802.11 are getting support from chip and computer makers, so the infrastructure will be well developed by the time the auto and oil industries decide to move forward.