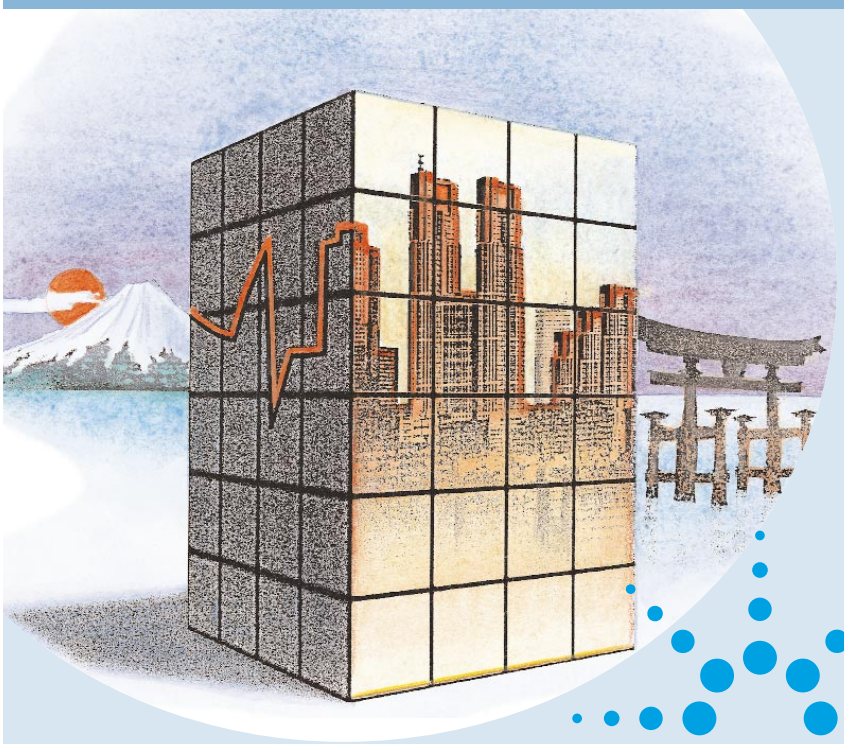
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IDEAS AND INFORMATION FOR TEST ENGINEERS AND MANAGERS





Asian Recovery: Good news for the industry

It seems the semiconductor industry has recovered from the Asian flu. Last year was a turnaround year for the industry, and analysts are predicting it will be the first year of a multi-year up-cycle. The rise in 1999 came partially from the continued growth of computers and telecommunications, fueled by the expansion of the Internet and Internet-related technologies, but also an Asian economic recovery.

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Agilent Technologies
Innovating the HP Way

An Asian perspective on the market

By Yih-Neng Lee



Yih-Neng Lee is general manager, semiconductor test–Asia, for Agilent Technologies

In the Chinese zodiac, the year 2000 ushers in the year of the Dragon. This mystical animal, according to folklore, would bring about prosperity, wealth and good health. Judging from the first few months of the year, it is beginning to look like this dragon is indeed living up to its reputation.

After negotiating safely past Y2K, almost every country in Asia affected by the financial crisis is hurrying into the year, boasting GDP growth, a sharp recovering exchange rate and rising stock markets. Nominal interest rates have tumbled, in many cases to below pre-crisis levels, and exports are booming from Singapore to Seoul. Electronics manufacturing is expanding rapidly, in large part because of the expanding U.S. markets, whose demands are fueled by some record-high rejoicings on Wall Street and phrases like the "New Economy."

Closer to heart, the worldwide semiconductor industry (including Asia) grew at a relentless pace, with the back end equipment B/B ratio standing at 1.39 in January. The pre-occupation today is to increase capacity, and Asian companies are right in the center of the worldwide investment frenzy. TSMC has raised its spending plans for 2000 from an original $2B to $5B, buying several high profile fabs in the process (WSMC). It now competes head-to-head with Intel on Capex as well as 300mm pilot production schedule. Assembly and test is another success story, with Taiwan's revenues in this area growing from $1.9B in 1994 to $3.6B in 1999. Anam/Amkor, ASE, and Siliconware are now some of the household names in the industry.

The strong underlying factor driving the Asian semiconductor miracle is undoubtedly the trend of outsourcing. With its humble beginning as a lower cost alternative to manufacturing, it has now matured to a level that it can even provide leading edge technology and processes to outpace the best. The business model is based on providing lower cost through more efficient utilization of capital, as well as bearing all the investment risks of manufacturing. With investments running into billions of dollars for a new 300mm fab, it's little wonder why such a model would flourish.

Despite all the hype of successes of the fabless model, this industry is still in its infancy. It currently represents about 12 percent of all worldwide manufacturing activities, and it is expected to grow to the 30 percent-plus level, especially when the next phase involving the IDMs kicks in. Motorola, NEC, STM, QUALCOMM, and Infineon are some of the big guys who are experimenting with the model actively.

Through our early involvement in this outsourcing model, coupled with our close working relationships and understanding of our customer business needs, I strongly believe that Agilent is well positioned to provide the products and services to further support growth in the industry. Agilent has put in place a worldwide organization consisting of teams in Asia and the U.S., covering fabs/test-houses and design houses.

We provide to our fabless/SCM customers the infrastructure to enable a manufacturer to effectively and efficiently move parts from design to fab to package/test to ship, worldwide. For our design house/IDM customers, we help manage cost of test over their product's life.

The next few years will be exciting for the semiconductor industry, especially for Asia. The stakes are going higher, but this is where the fun is.

DID YOU ? KNOW

How did 'qwerty' keyboards become standard?

Almost every alphabetic keyboard in the world has the letters in an arrangement called "qwerty," after the first six letters in the top row. There are several popular myths about the origin of today's standard keyboard arrangement. Some say it was deliberately designed to slow down typists. What is the truth?

When inventor C. L. Sholes built his first typewriters in 1868, he arranged the keys in alphabetical order. But the clumsy mechanical linkages inside the machine could tangle if certain pairs of keys were struck quickly.

The "qwerty" arrangement fixed the tangling problem by separating the internal links for frequently paired letters, making the machines more reliable. After a historic typing, "qwerty" became the standard way to arrange the keys.



The Asian recovery: Good news for the semiconductor industry

It seems the semiconductor industry has recovered from the Asian flu. Last year was a turnaround year for the semiconductor industry, and analysts are predicting it will be the first year of a multi-year up-cycle. The rise in 1999 came partially from the continued growth of computers and telecommunications, fueled by the expansion of the Internet and Internet-related technologies. An even bigger factor, however, was economic recovery—especially in Asia.

The Asia-Pacific region is home to two-thirds of the world's population. In several years, it's likely to become home to the majority of the world's semiconductor manufacturing equipment as well.

The growth in Asia is attributed to several factors, according to Jung Hun Suh, vice chairman of the Korea Semiconductor Industry (SEMI) Association.

This includes the:
- growth of the Internet business;
- growth of products for the Internet and digital customers.

A capital equipment boom

SEMI reported a January book-to-bill ratio for global semiconductor equipment of 1.38:1. $2.8 billion sold, 120 percent above 99 levels. Manufacturers have the Pacific Rim countries to thank, most notably Taiwan, for a good chunk of the increase.

"Taiwan and the other Asian countries, excluding Japan, have been very hot," said Risto Puhakka, vice president of operations for VLSI Research Inc., San Jose. The research firm predicts a 25 percent annual growth rate for semiconductor capital expenditures for 2000 and 2001, growth rates in Taiwan and Korea could approach 36 percent. VLSI Research estimates other Asian countries will experience a combined growth rate of approximately 42 percent and North America's rate will be around 20 percent.

Puhakka said there are no signs of a slow down or leveling off within the capital equipment market anytime soon. "All the data that's coming in doesn't show any sign of the market letting up," he said.

Along with a price recovery for memory, financial restructuring is leading Korea toward economic upturn.

Korea: highly aggressive

Until last year, however, the situation in the Asia Pacific region wasn't particularly rosy. Take Korea, for example, where the Asian financial crisis and the falling price of computer memory threatened the survival of many semiconductor manufacturers and their suppliers.

Along with a price recovery for memory, financial restructuring is leading Korea toward economic upturn, enabling device manufacturers to increase their investment in new capacity and new products in the region. Analysts at research firm SEMI predict that Korean capital spending on semiconductor equipment and fabs will grow at 30 percent in 2000, faster than the worldwide average of 26 percent.

The recovery also is evident in the aggressive moves of several Korean companies. Hyundai and LG Semicon merged last year to become the biggest memory producer worldwide. Samsung, another of the world's largest memory companies, invested in one fab line in 1999 and has plans to begin construction of an additional fab in the second half of 2000.

Continued on page 4



A recovery in Asia for the semiconductor industry

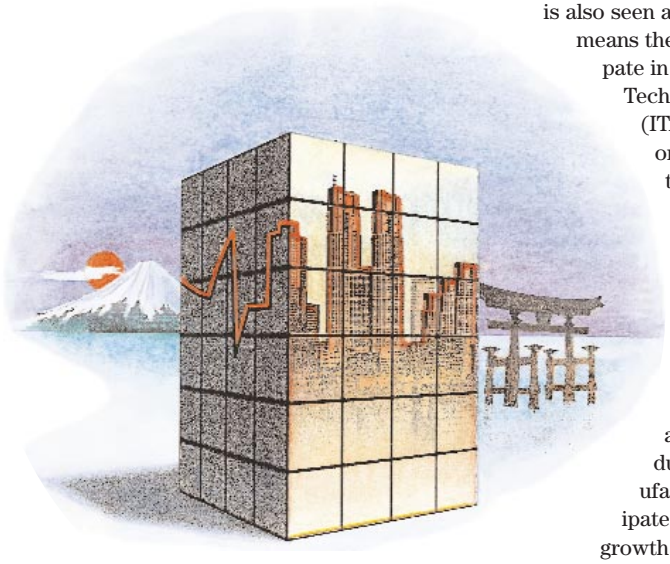
Continued from page 3

According to industry statistics, Samsung and Hyundai/LG Semicon ranked among the top 10 worldwide capital spenders in 1999, with Samsung coming in second only to Intel.

Taiwan: the hottest market

Korea's story is echoed in other parts of Asia, including Singapore and Taiwan—the epicenter of the burgeoning pure-play foundry industry. These foundries, which pride themselves on being nimble and quick, are gaining a higher profile as semiconductor-producing powerhouses. In addition to creating a world of opportunity for equipment manufacturers, the high concentration of Asian foundries, such as those in Taiwan's Hsinchu industrial park, simplifies business and enables equipment vendors to more efficiently support a large installation base within a small geographic area.

The shift to manufacturing devices based on 300-millimeter wafers is also expected to benefit these emerging foundry industries. Manufacturing devices from 300-mm wafers requires a huge capital investment in new equipment and fabs, which only the largest companies and foundries can afford. As a result, integrated device manufacturers like IBM, Sony and Texas Instruments are expected to turn to large foundries with 300-mm-ready equipment to balance their manufacturing requirements and, in some cases, avoid the up-front capital expenditures.



"Taiwan is the hottest market in the world right now for semiconductor equipment manufacturers," says Paul Davis, vice president of SEMI's International Operations. "It is a market that will likely continue to grow as foundries take advantage of the pending shift to 300-millimeter wafers to capture a larger percentage of integrated device manufacturers' capacity."

China: the sleeping tiger

Even the prospects for China are looking up. Sweeping privatization of many formerly government-owned IC manufacturing businesses and the easing of technology import restrictions are among the most important new factors spurring growth in this emerging market. China's entry into the World Trade Organization (WTO) is also seen as a positive move. It means the country will participate in the Information Technology Agreement (ITA), eliminating tariffs on a number of high technology products, including semiconductor manufacturing equipment. Analysts say China's membership in the WTO and the ITA would help establish a level playing field and allow semiconductor equipment manufacturers to fully participate in the expected growth of China's semiconductor industry.

Above and beyond privatization measures, Davis believes China is beginning to take a more enterprising approach to the market. "The Chinese government is making an important philosophical shift away from defining the country's industrial requirements and solutions to creating the necessary economic conditions for drawing outside industries into joint ventures and other forms of relationships," says Davis. "This is an important change that is required for China to become a powerful force in the semiconductor industry."

Japan: a mixed bag

The outlook for Japan continues to be mixed. Japan's share of the worldwide market for integrated circuits has dropped from 40 percent in the early 1990s down to approximately 20 percent today. And, while Japanese semiconductor manufacturers' stock prices have recovered somewhat, the country's gross domestic product declined once again last quarter. On a positive note, SEMI projects Japan's capital investment plans are increasing over what they have been in recent years.

"Japan has always been a major presence in the semiconductor industry, and will continue to be," notes Davis. "We're also seeing Japanese semiconductor companies becoming more nimble in responding to current market realities by establishing partnerships that leverage each others' strengths."

In spite of Japan's ups and downs, strong recovery continues in the rest of Asia, adding up to good news for equipment manufacturers. Half of Agilent Technologies' semiconductor test equipment sales, for example, are now in the Far East and business in Korea is mushrooming, with growth rates of nearly 40 percent. With business booming, it's no surprise that the semiconductor industry is keeping a close eye on Asia. ✦

Asia-Pacific enthusiasm for the Web is spreading

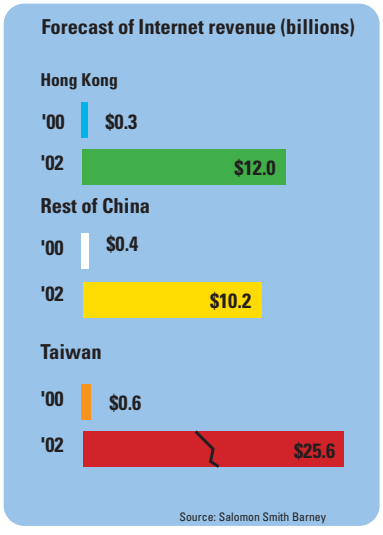
Markets are growing in Asia, and there is widespread enthusiasm for business on the web. As reported in *The New York Times,* there's great interest in dot.com stocks aimed at the Asian market, and to the surprise of some, Asia's leaders are realizing that they can't flourish in the new economy by doing business as usual.

"We have no choice but to adapt an Asian version of the American model of openness and entrepreneurialism, said Victor Fung, chairman of the Hong Kong Trade Development Council.

Even in China, the government backs building the infrastructure of a wired economy. "China needs the Internet more than any other country in the world," said Peter Yip, chief executive of China.com, a Hong-Kong company of which the Beijing government is part owner.

The Times concludes that there still is a lot of hype associated with Internet ventures in Asia, just as there is in the United States. And there are plenty of places in Indonesia, Malaysia and Thailand where basic development remains frozen and the web is a distant dream.

Still, as the region resumes its economic race, the idea that Asia is fundamentally different has lost its resonance. The information technology revolution is liberalizing an already liberal West; the more traditional East seems destined for the same.



Agilent receives test systems awards from Infineon and QUALCOMM

Agilent Technologies Inc. has received the much-coveted "Supplier of the Year" award for automated test equipment from Infineon Technologies, as well as the "Supplier of the Year" award from QUALCOMM.

The Infineon award is based on supplier evaluations in six categories: quality, technology, cost, logistics, marketing and management.

Infineon currently utilizes semiconductor test solutions from Agilent's SOC (System-on-a-Chip), memory, RFIC and semiconductor parametric test product groups.

"Having a supplier with solutions that meet our current and future semiconductor products test needs is critical to our business results," said Harald Eggers, senior vice president and general manager of Infineon. "The product support and delivery continues to be excellent—the transition from HP to Agilent has improved the quality of service that we receive."

QUALCOMM presented supplier of the year awards to five companies—including Agilent Technologies—that "demonstrated the highest combined delivery, quality and customer service for each business unit throughout 1999."



Sang-Weon Lee recently was appointed semiconductor test equipment general manager for Korea.



Awards were presented at the recent QUALCOMM Key Supplier Conference. Shown above (from left) are Steve Ball, district manager, Agilent Technologies; Bharat Kulkarni, worldwide QUALCOMM program manager for Agilent; Laura D'Angelo Fennell, subcontracts administrator QUALCOMM Inc.; and Randy Hierbaum, vice president and general manager, Agilent Technologies, semiconductor test, Americas sale region.

User's Group meeting set for May 21-25

The Agilent Technologies annual User's Group meeting, this year, entitled "Test-Fest," will be held in Monterey, CA from May 21 to 25.

The following are mini-portraits from two out of 35-plus presentations:

Title:
DDR SDRAM testing on Agilent 95000 HSM series

Author:
Dong-Weon Yi, Agilent Technologies Korea Ltd.

Abstract:
DDR SDRAM, Rambus DRAM's competitor, uses a double-data-rate architecture to achieve high-speed operation. As with standard SDRAMs, the pipelined, multibank architecture of DDR SDRAMs allows for concurrent operation, thereby providing high effective bandwidth by hiding row precharge and activation time. This presentation describes the solution for testing of DDR SDRAM on the Agilent 95000 HVM Series and suggests specific test approaches.

Title:
Measurements and modeling of noise in semiconductor devices.

Author:
Samuel Martin, Semiconductor Physics Research Department at Bell Laboratories, Lucent Technologies.

Abstract:
This paper addresses the main issues relevant for noise in VLSI technologies at various levels. Three classes of active devices are chosen for illustration: bipolar junction transistors (BJT), field effect transistors (FET) and two terminal junction devices (diode). The chip level noise is then presented in terms of the major contributions being amplifier noise, oscillator noise, timing jitter and interconnect noise. Finally, specific solutions are presented for wafer-level noise measurements and extraction of noise parameters suitable for device model development and circuit simulation.

STATS TDC to add the Agilent 83000 services

Agilent Technologies and ST Assembly Test Services (STATS), a leading subcontract semiconductor test and advanced packaging service provider, recently announced their cooperative efforts to add an Agilent 83000 (HP-83000) F330i series VLSI test platform to the STATS Test Development Center (TDC) in San Jose, CA.

"Installation of the Agilent 83000 allows STATS to provide locally dedicated test engineering services for complex ICs that require high data rate and high pin count test capabilities," said Steve Dielman, sales manager for Agilent.

John Ritchie, director of the San Jose STATS Test Development Center, said that the STATS TDC is dedicated to supporting its customers with the test program generation and component evaluation services that will ultimately shorten their product development cycle time.

DID YOU ? KNOW



How to fend off a shark

1. Hit back. If a shark is coming toward you or attacks you, use anything you have in your possession—a camera, probe, harpoon gun, your fist—to hit the shark's eyes or gills, which are the areas most sensitive to pain.

2. Make quick, sharp, repeated jabs in these areas. Sharks are predators and usually will only follow through on an attack if they have the advantage, so making the shark unsure of its advantage in any way possible will increase your chances of survival.

Contrary to popular opinion, the shark's nose is not the area to attack, unless you cannot reach the eyes or gills. Hitting the shark simply tells it that you are not defenseless.

Source: *The Worst-Case Scenario Survival Handbook*

News roundup from the Asia-Pacific region

Hongkong.com to become WAP-friendly

Newly listed Hongkong.com is on the acquisition trail, and has bought 30 percent of InfoisLive.com, a Hong Kong-based wireless application service provider, to jointly offer portal-enabled interactive mobile WAP (wireless application protocol) services to mobile users in Hong Kong and the surrounding region before mid-June.

Hongkong.com will gain access through InfoisLive to technology needed to provide advanced WAP services through different media, including WAP phones, personal digital assistants (PDAs) and WebTV. Potential applications include mobile ICQ and e-mail, entertainment services and electronic commerce.

Source: *Hong Kong Business Standard*

Japan PC market expanded in 1999; growth to continue

Japan's personal computer market expanded in 1999 and is likely to continue growing in 2000 because of a strong demand from both consumers and businesses, said Dataquest, a Gartner Group Inc. company.

PC shipments in Japan from approximately 30 companies grew 36 percent in 1999 to 10.54 million units, compared with an annualized 1.1 percent contraction in shipments in 1998, according to Dataquest.

NEC Corp. had the biggest market share in 1999, with 22 percent. Fujitsu Ltd. followed with 21.5 percent. IBM Japan Ltd. Had 9.9 percent; Toshiba Corp. controlled 7.4 percent, and Sony Corp. had 6.9 percent.

Source: *The Asian Wall Street Journal*

Encryption technology rules eased

China has eased tough new restrictions on encryption technology, announcing that a vast category of consumer software and equipment—including mobile phones and Microsoft Windows—would be exempt from the rules.

The government agency in charge of enforcing the rules sent a "clarification" to U.S. business organizations in early March which steps back from the hard position it had taken when the rules were adopted on Jan. 31. They required all businesses and individuals to register with the government any products containing encryption technology.

The restrictions now "only limit specialized hardware and software for which encryption and decoding operations are core functions," the State Encryption Management Commission wrote. "Other products, including wireless telephones, Windows software, browser software, etc. are not being included in the scope," it said.

Source: *Hong Kong Standard*

Consumer prices rise in China

For the first time in nearly two years, consumer prices in China rose in February—a sign that Beijing's moves to spur consumption may finally be bearing fruit.

The consumer price index, which China began using as its benchmark measure of inflation this year, rose 0.7 percent year-on-year in February due to higher prices for vegetables and services.

Some analysts, however, said it is too early to conclude the economy had finally turned the corner.

Source: *Hong Kong Standard*

DID YOU ? KNOW



What were the largest steam locomotives ever built?

The largest, heaviest, most powerful steam locomotives ever built were the giant 2-6-6-6 Allegheny engines, used by the Chesapeake & Ohio Railroad during the 1940s. These 600-ton behemoths could reach a maximum speed of 60 miles per hour (97 km/hr).

To supply the Allegheny steam engines with fuel and water, a new tender car had to be developed that could hold 25,000 gallons of water (95,000 liters) and 25 tons of coal.

The monster locomotives were used to pull trains of coal and timber across the Allegheny mountains, out of the New River Valley of West Virginia. When diesel engines replaced them in the 1950s, the local steam train industry collapsed, ruining the economies of several railroad-based towns.

More about the biggest steam engines: http://www.steamlocomotive.com/allegheny/

The scalable 93000 SOC series incorporates high-end analog

DID YOU ? KNOW



10 most popular items traded over the Internet

Here are the 10 most popular items traded over the Internet and their online auction sales in January and February:

• Baseball cards	$15.7 million
• Rolex watches	$14.2 million
• Pokémon cards	$6.2 million
• Beanie babies	$5.4 million
• Portable computers	$5.4 million
• Digital cameras	$4.1 million
• Barbie dolls	$3.6 million
• Sports memorabilia	$2.5 million
• Camcorders	$2.1 million
• World War II memorabilia	$1.8 million

As electronic-device geometries continue to shrink, manufacturers are increasing the capability on each device rather than reducing the size of the chips themselves. Complex devices, once primarily digital in character, have acquired considerable analog function.

The problem has become particularly acute with System-on-a-Chip (SOCs). Newer SOCs, however, include both high-speed digital and high pin counts along with their analog circuits. This demands a new solution. Hard disk-drive controllers, DTV, DVD, and digital-camera applications are examples that combine such high-level advanced design with small size.

To address these issues, Agilent has introduced a set of comprehensive analog capabilities for the 93000 series SOC test system. The analog measurement modules reside on a single board in the 93000's test head, whereas earlier test systems required as many as three boards to provide comparable function. The simplicity and compactness of the 93000 analog solution facilitates low-cost device testing. Because of the modular design, customers can begin by installing a digital-only system if it meets current requirements, knowing that they can add analog capabilities later without changing or expanding the tester footprint.

The 93000 SOC series' 1024-pin test head can carry as many as 32 analog-measurement modules, permitting multi-site testing to increase test capacity while reducing cost. In addition, the system includes relay circuits in each module for switching between analog and digital measurements on the same pin. With many systems, such switching requires relays in the DUT board. As a result, the 93000 DUT board is easier to design and maintain, as well as less expensive than earlier versions.

The system's digitizers provide a local sequencer and waveform memory for each resource, permitting more flexible waveform capture. A flexible input-relay multiplexer can cover several input channel connections and loopback. Compact module design ensures high signal fidelity.

The 93000 offers the lowest noise floor available for highly integrated high-speed devices. One reason is the isolation between analog and digital measurement modules. In addition, all test head components run off a high-voltage DC power supply, thereby avoiding AC noise. Water cooling of digital channels and analog modules improves specification stability by providing more efficient cooling. This method also avoids the use of fans in the test head that can produce electromagnetic noise.

The unmatched digital performance of the 93000 SOC system includes maximum test speeds of 250 or 500 MHz, maximum data rate of 1 Gbps, overall timing accuracy of +/-200 ps and edge-placement accuracy of +/-100 ps. Among the existing analog modules, the high-resolution digitizer offers a 2 Mbps sampling rate, with 16-bit resolution that can expand to 24-bit with averaging. The high-speed digitizer provides 4 Mbps sampling with 12-bit resolution. Customers can choose waveform-generator modules with 1 Mbps sampling at 18-bit resolution, 128 Mbps sampling at 12-bit resolution, or 2.6 Gbps sampling at 8-bit resolution. The dual high-speed sampler offers 1 Mbps sampling with a maximum input frequency of 1 GHz with 12-bit resolution. The time-interval analyzer can measure jitter, period, frequency, and related parameters.

With these expanded capabilities, the 93000 SOC Series test systems can easily meet today's volume production test needs on one single scalable platform.

The Agilent 93000 SOC Series.



Endwave is speeding production for broadband communication modules

Endwave Corp. (formerly TRW) has brought on line the world's first automated module test system capable of testing millimeter-wave monolithic integrated circuit (MMIC) broadband modules. Operating at frequencies of 50 to 75 GHz, these modules can be added to Agilent production test systems already in place that operate at the 2 to 45 GHz range.

Operating at frequencies of 50 to 75 GHz, these modules can be added to Agilent production test systems already in place that operate at the 2 to 45 GHz range.

By cutting test time 10-fold for modules operating at these frequencies, the automated test system from Agilent helps Endwave meet the growing demand for high-performance transmit/receive modules used in broadband wireless equipment.

The new test system, an Agilent Technologies 84000 Millimeter Wave series model E6520A, is capable of significantly improving time-to-market by providing a full measurement suite and reducing measurement time.

"The successful installation of Agilent's new, high-speed module test system helps solidify Endwave's position as a leader in the automated, high-volume production of MMIC modules," said Don Dodson, vice president and general manager of Endwave, Inc. "It allows us to not only fulfill the demand for these modules by broadband wireless equipment suppliers, but also produce MMIC modules cost-effectively for other high volume communications or automotive applications."

The high bandwidths afforded by millimeter wave frequencies make Endwave's MMIC modules an essential part of the equipment being used to implement broadband wireless communications services for a growing number of commercial, small-office and home office customers.

"The 84000 Millimeter Wave series E6520A solved the challenge of making multiple millimeter wave measurements with a single connection," said Steve Fossi, general manager for Agilent's RF Semiconductor Test Division. "The system includes the ability to provide multi-state device control with easy to use software. We're confident it will help Endwave achieve its high throughput millimeter wave module testing goals in a cost-effective manner, while providing the company with the flexibility to meet new test requirements in the future."

The Agilent 84000 Millimeter Wave series module test system allows Endwave to measure a variety of key module parameters including gain, gain suppression, efficiency, harmonic distortion, power, known spurious signals, S-parameters, supply current, voltages, noise figure, mixer conversion gain and Nth order inter-modulation, Fossi added.

DID YOU ? KNOW



How often does lightning strike??

Although thought to be an uncommon occurrence, lightning hits the earth about 100 times per second, resulting in more than eight million strikes per day. Scientists have estimated that at any given moment, there are nearly 2,000 thunderstorms occurring over the earth's surface.

The average lightning stroke is about six miles long. The flash appears wider than it actually is due to the glowing air surrounding it. Lightning's return stroke can reach 50,000 degrees Fahrenheit. The surface of the sun has been recorded at only about 11,000 degrees.

DID YOU ? KNOW



How to escape from a mountain lion

1. Do not run. The animal probably has already seen and smelled you, and running will cause it to pay more attention.
2. Try to make yourself look bigger by opening your coat wide. The mountain lion is less likely to attack a larger animal.
3. Do not crouch down. Hold your ground, wave your hands, and shout. Show it that you are not defenseless.
4. If you have small children with you, pick them up—do all you can to appear larger. (Children, who move quickly and have high-pitched voices, are at higher risk than adults.)
5. Back away slowly, or wait until the animal moves away. Report any lion sightings to authorities as soon as possible.

Source: *The Worst-Case Scenario Survival Handbook*

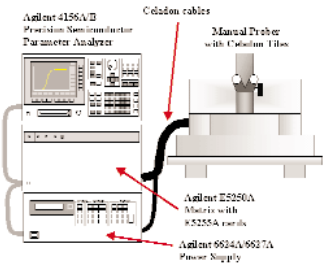
Cost-effective instrument-based hot-carrier injection test solution available

Semiconductor manufacturers face a number of new challenges in the 21st century. One such challenge is decreasing channel widths in MOSFET devices. While this has been an issue for some time, channel widths below 0.25m now mandate increased monitoring of hot-carrier injection (HCI) induced device degradation to ensure product reliability.

Unfortunately, most systems designed to monitor HCI are both expensive (between $120K–$200K) and difficult to operate. However, Agilent Technologies has developed an instrument-based HCI solution that is both inexpensive ($100K or less) and easy to use.

Using the 4156A/B Precision Semiconductor Parameter Analyzer as the system controller, Agilent Technologies' HCI solution runs on instrument BASIC (IBASIC) and does not require any programming knowledge to operate. Moreover, Agilent Technologies has worked with Celadon Systems, a manufacturer of multi-site high performance probe cards, to create a solution that can measure eight or more sites simultaneously on a wafer.

The figure shown below illustrates the components of the HCI solution:



This solution delivers many benefits:

- Simplicity—The entire system is controlled by the Agilent 4156A/B, eliminating the need for external PC or workstation control.
- Ease of use—No IBASIC programming is required.

Many of the test parameters can be changed by simply modifying the front-panel measurement (.MES) files called by the IBASIC program. In addition, most of the other program parameters can be changed interactively while running the program.

- Open source code—You are fully free to modify the IBASIC code to suit your individual needs.
- Low cost—A typical hot carrier test instrument solution costs $100K or less (including probes and cables).
- Compactness—The entire solution (including detailed instructions in Adobe PDF) fits on a floppy disk.

Using the HCI solution is very simple. Just place the floppy disk containing the IBASIC program and measurement set-up files into your 4156A/B, and then load the HCI program from the IBASIC menu. Push the "Run" button, and you are on your way! The user interface consists of a series of softkey menus and submenus that allow you to change program parameters and even halt the program to make individual device measurements. No IBASIC programming is necessary, and you can modify many of the test parameters by changing the measurement setup files used by the software. Test results are written to the floppy disk in an easily manipulated ASCII file format (with .txt extensions).

Please contact your local sales representative to learn more about how this innovative solution can solve your HCI test challenges. To learn more about Celadon Systems high-performance probe cards, visit the web site at www.celadonsystems.com.

Digital Testing Services to provide leading-edge Rambus interface testing

Agilent and Digital Testing Services (DTS) have teamed to provide at-speed test correlation for system-on-a-chip (SOC) integrated circuits that include the Rambus ASIC Cell (RAC).

DTS will provide characterization and production tests necessary for validating each function of SOC devices. The characterization process is often used to develop the first-generation production-test program and provide valuable test data for the device. Data correlation is important as the designer moves the device from the characterization test system to the single-pass production test system.

"Design correlation and production tests are extremely important for the volume manufacturing of high speed products," said Avo Kanadjian, vice president of worldwide marketing for Rambus Inc. "Customers will benefit from DTS's ability to provide at-speed RAC testing and Agilent's high-speed testers capable of handling volume quantities."

DTS has proven successful correlation between the 83000 Rambus series platform and the new 93000 SOC platform. DTS is equipped with an Agilent 83000 Rambus series VLSI test system, and also has taken delivery of multiple Agilent 93000 SOC series test systems.

"The Agilent 93000 offers 1Gbit/sec data rates," said Sassan Raissi, president of DTS. "Using this platform, we are able to manage high-volume, low-cost production in Asia through ASET and our facilities in Korea, Singapore and Taiwan."

Samsung purchases Gigabit data rate system

Samsung recently acquired an Agilent 95000 High-Speed Memory (HSM) series for production testing of 32 high-speed memory devices simultaneously on a single test head. The company added the new 32-site system for additional capacity.

The new system can test up to 32 Rambus DRAMs, Synchronous DRAMS, or DDR SDRAMs on a single test head. The 32-site Agilent 95000 lowers the cost of test for testing high speed memories such as RDRAMs compared to other test systems shipping today. The faster "read/write" times of the Rambus DRAM reduce test times so dramatically that it is less expensive to test 800 megabit-per-second data rate RDRAM on the Agilent 95000 than to test PC 133 Synchronous DRAM on lower-speed, lower price-per-site ATE testers.

"Agilent has been instrumental in the development, characterization and production test of Rambus DRAMS," said John Scruggs, senior vice president and general manager of Agilent's Automated Test Group. "We are particularly proud that Samsung, the largest memory manufacturer worldwide for the past several years, has chosen to work with us to test their leading edge memory products."

DID YOU ? KNOW

The most desolate place on earth?

The earth has many desolate places—vast deserts, icy mountains, the Poles—places people go to in order to prove that they can do it and, hopefully, return.

But none may be more desolate or dangerous than the Umm as Samim (in Arabic, Mother of Poisons), a vast, salt-encrusted flat located in eastern Oman. Situated between the scorched Hajar Mountains (whose little rainfall drains into it) and the Empty Quarter, Arabia's great sand desert (900 x 400 miles, the size of Texas), Umm as Samim is the quintessence of godforsakenness—a parched, empty, featureless surface beneath which hides a treacherous bog which in times past is reputed to have swallowed entire caravans.

For the adventurous, Land Rover Expeditions offers a "Dunes and Wadis of Oman" trip that features, among other things, a drive across the safer part of the Umm as Samim.



Utilization: a primary key to OEE

DID YOU ? KNOW

Why are cats' tongues so rough?

A cat's tongue is actually a very sophisticated cleaning device, in addition to its other functions. It is covered with tiny, hooklike, backward-pointing extensions called papillae, something like one half of a velcro connector.

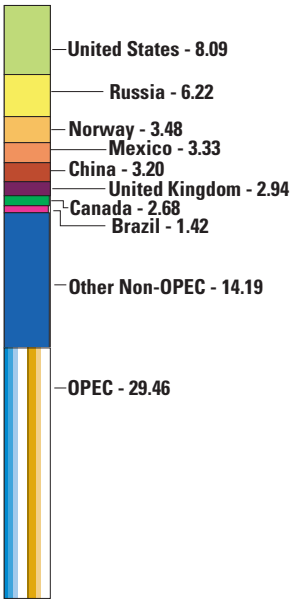


When it cleans its fur by licking with its tongue, a cat is pulling these hooks through the fur. As the hooks pass through, they pick up dirt and skin flakes, and more importantly, any fleas, flea eggs, or other skin parasites that might be present. The cat swallows these along with any loose hair, and they are killed by the strong acid in the cat's stomach.

The cat's tongue is also important for eating, of course. In nature, cats use their rough tongues as efficient tools for scraping the flesh from the bones of their animal prey.

DID YOU ? KNOW

A look at world oil production in millions of barrels



In its simplest terms, OEE (Overall Equipment Effectiveness) is a measure of overall test cell efficiency. When this formula is applied, it will help increase overall test utilization. A concept introduced by SEMATECH, OEE helps to optimize return on investment.

An improved OEE concept allows you to amortize your equipment costs over more devices, thus reducing cost of ownership (i.e., cost-of-test). Ultimately, this means that either profits increase, or at least stay stable as the average selling price of devices declines.

OEE is a measurable value that incorporates many different aspects of operation manufacturing equipment. The tracking and improvement of overall efficiency, however, is not always so easily implemented.

Reducing production costs

One key parameter to improving production costs is utilization. Agilent is studying just how much utilization affects OEE and the cost-of-test. Every percent of change in utilization results in an equivalent change in cost-of-test (per good part). This cost-per-part reduction is achieved by putting more devices through the test system per unit of time. Utilization is critical to the maintenance and reduction of production costs.

The SEMI E.10 standard is a good start to defining utilization. But E.10 leaves a great deal of room for interpretation. Consider, for example, the definition of productive time:

> A sample of 10 lots, processed through final test over a period of 31 hours was considered. Utilization is calculated from the same data set, using different resolutions for the productive time.

The following table shows the results of these utilization calculations. It illustrates that with the same data, and depending on how productive time is defined, utilization can vary by more than 20 percent, e.g., from 41 percent to 63 percent:

	Measured utilization	
Productive time	Index time not included	Index time included
All inserts	46%	63%
Good inserts only	41%	55%

The definition of productive time greatly influences the resulting utilization. Agilent's conversations with customers indicate that there are many definitions being used today.

Productive time

Although there are multiple definitions of productive time, Agilent believes that some are better than others. What is most important is selecting one, and then staying with it over time. The issue is consistency. Using a consistent definition of productive time or utilization will enable you to better measure, analyze, improve, and control your processes.

OEE is a great starting point, but it is not an ending point. You need to continue measuring utilization, turn that into process improvements, re-analyze and keep in mind that the entire back-end process needs to be reviewed. Improvements must span the entire manufacturing process.

More information on OEE will be available at SEMICON/West. ✦

OEE is described by SEMATECH technology transfer document # 95032745A-GEN.

Observations on the changes in the semiconductor industry

*William Davidow is chairman of the board of Rambus, Inc., and also a founder of the venture capital firm, Mohr, Davidow Ventures. He received his Ph.D. from Stanford University, and is the author of the book, "*The Virtual Corporation."

How would you describe the business climate as we enter the 21st century?

A: This is a time of the individual entrepreneur, of individual responsibility, and where there are fewer dependable institutions. It's a very competitive environment. More and more, businesses want to be in the "winner-take-all" situation, where being number one is the only thing. Indeed, there is a race for monopolistic positions, because that seems to be the perceived key to survival.

What do you foresee in terms of chip performance and functionality?

A: I don't think performance and functionally will go any place but up. These devices will just get bigger and bigger. You take the current chips and if you go to 0.1 micron technology, you will quadruple the number of devices—that's a lot of complexity to swallow.

What about Moore's law—will we still continue to double as he predicted?

Moore's law, which I think should be called Moore's observation, will not change for the foreseeable future. One of the consequences of Moore's law is that complexity is very cheap until it reaches the consumer, and then complexity doesn't simplify things, it consumes people's time.

How is this affecting our societal needs?

Our lives are becoming so porous that no one has any time to think any more. We are making people instantly available all the time. I am not sure there is a great deal of benefit to people in terms of economic or social return by having all of this instant access to them. What is the trade-off if you steal what little time people have left to think anymore? This instant availability has economic benefits, but there are penalties we also pay—in terms of thinking creatively and exploring new approaches. These are intangible, but they are there.

'The complexity of these devices is getting so high that the real impact will be whether people can figure out how to manufacture and design systems that will save people more time than they consume. There's a tremendous amount of complexity that doesn't buy the consumer many benefits.'

What do you see as the most critical technologies next five years?

We are investing in Internet infrastructure, business-to-business (B-2-B) ventures, and a lot of networking and telecommunications types of businesses.

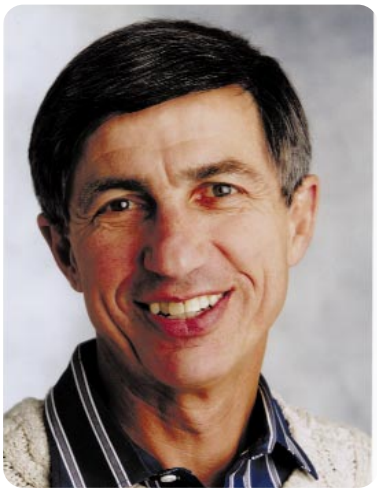
From a technical standpoint, what do you see as the most exciting development in the semiconductor industry?

A: I don't think it is any single thing. It seems we can now construct these very complex devices that operate at extremely high speeds that solve almost every problem.

What do you see as the application for these gigahertz processors that we're starting to see come on the scene?

If you look at something like Play Station 2, you see we are creating very realistic virtual environments. The computer is becoming a communications device, and it will enable

Continued on page 14



William Davidow

DID YOU ? KNOW

What was the best throwing weapon before bows?

Before the bow and arrow were invented about 15,000 years ago, a simpler weapon was used to throw long darts with great power and accuracy. The atlatl [at-LAT-ul] was invented at least 25,000 years ago, and is still used by Australian aborigines.

The atlatl is a stick about 60 centimeters long (24 inches), with a notched hook at one end. Into the notch is placed the end of a flexible, feathered "dart" that is at least 150 centimeters long (59 inches) and possibly longer. By flicking the atlatl quickly forward, the user is able to fling the dart toward the target with tremendous speed.

Recently, there has been a surge of interest in the atlatl. Its physics are surprisingly sophisticated, involving temporary storage of energy in the flexing of the dart as it is thrown. Enthusiasts are now designing ever-better atlatls using high-tech materials, and there are world-wide competitions.

The World Atlatl Society:
http://www.worldatlatl.org/

Continued from page 13

you to interact with either other people or other environments in much more real ways, whether it's a shopping experience or a teleconference or an interview. Therefore, to me the benefit is that it will continue to improve the quality of communications, and that will require more and more bandwidth.

As you look out at the semiconductor industry and the changes taking place, as in the fabless model, any thoughts about the semiconductor industry as a whole?

The whole semiconductor industry is going to continually be undergoing restructuring. There will be fewer and fewer opportunities to be effective IDMs. The industry will become more and more horizontal— people are going to have layers of intellectual properties they will be designing, while other people will be providing foundries. There is less and less chance that any particular IDM can understand enough about many different customer problems. It used to be easy to understand the customer problem when it was just a few gates. But today semiconductors are becoming systems, and the people who really understand how to design systems are not, in general, resident in many semiconductor companies. For the most part the applications are becoming niches, whether it's a set of circuits that go inside a camera, or a particular optical device. It's going to be increasingly a horizontal structure that will ensue.

Any worldwide changes that you would single out?

Sure. It used to be the U.S. was dominant, then it looked like Japan would be dominant, and now the U.S. is back in the lead. Japan lost a lot of its lead because the industry became very commoditized and they didn't possess enough intellectual property to define the circuits anymore. The Taiwanese have begun to rise in importance because they understood a lot of the PC applications better than other people. Now I am hearing the Taiwanese don't want to be in the memory business because the foundry business is so good for them. All these changes are going on, and all of us are being affected.

DID YOU ? KNOW



Why do the seasons lag two months behind the Sun?

The time when the Sun is brightest and the days are longest is the summer solstice, near June 21 in the northern hemisphere. Yet the hottest days of summer usually come in July or August, when the days are shorter and the Sun is lower in the sky. Winter's coldest days also lag the solstice by about two months. Why?

When the sunshine maximum comes in June, the landscape and atmosphere are still warming from the winter's chill. Although the Sun begins to lose strength after the solstice, there is still enough heat to continue warming the landscape until the balance shifts about two months later.

In the days after the winter solstice, although the Sun's heat is returning, it is still not warm enough to keep the landscape from cooling further, especially during the night. It is not until early March that the balance of solar heat and nighttime cooling shifts into a warming trend.

More about the changing seasons:
http://library.thinkquest.org/29033/begin/earth-sunmoon.htm
http://www.treasuretroves.com/astro/Season.html



SEMICON/Korea drew a great number of visitors this year. Here are a few scenes near the Agilent Technologies booth and at an Agilent customer reception.







Korean digital hardware manufacturers shipping to overseas customers first

In the era of globalization and digitalization, Korean electronics companies are pushing a marketing policy of "overseas first."

Samsung Electronics and LG Electronics are launching newly developed products overseas first and releasing them in Korea later to get a jump start on the global market early.

Before the digital era, Korea, which entered the electronics product sector late, used to see companies sell at home and then later turn to exports.

Korean companies, however, started to launch new digital products overseas soon after development—as the country entered the digital market at almost the same time with advanced countries and thus could effectively compete with their products.

Source: *The Korea Herald*

global calendar

MAY

Agilent Technologies User's Group Meeting
May 21–25
Monterey, California

JUNE

Wireless RF SOC Symposium
Santa Clara, California

JULY

SEMICON/West
July 12–14
San Jose, California

SEPTEMBER

SEMICON/Taiwan
September 13–15
Taiwan

OCTOBER

ITC
October 3–5

DECEMBER

SEMICON/Japan
December 6–8
Japan



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Data subject to change
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