go/semiconductor

Summer 2000
Volume 4
Number 1

IDEAS AND INFORMATION FOR TEST ENGINEERS AND MANAGERS





RESOURCE UTILIZATION: MORE PROFITS USING CURRENT EQUIPMENT

Resource utilization has the potential to dramatically increase profit margins. It can eliminate unnecessary capital expenditures—and increase throughput—with the resources you have in place today. The stakes couldn't be higher.

FEATURE STORY, see page 4

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Agilent Technologies
Innovating the HP Way

Why the European semiconductor market is doing so well in this 'system-on-a-chip' era

By Pascal Ronde



Pascal Ronde is general manager, Automated Test Group–Europe, for Agilent Technologies.

The European semiconductor industry has been doing very well, thank you! I am not talking only about the past few quarters when the global semiconductor market grew at a relentless pace. No, even in tougher times (e.g., 1996 to 1998), the European manufacturers did comparably better than others.

Some evidence? Well, in 1993 the top three European Integrated Design Manufacturers (IDMs) at that time—Philips, SGS Thomson and Siemens—ranked between 12 and 18 on the worldwide market. In 1999, all three of them (now Philips, ST Microelectronics and Infineon Technologies) were in the top 10—and growing faster than the crowd.

Why? Certainly the top three Europeans put a lot of energy to refocus their efforts on growing markets, to restructure themselves to be more efficient and customer-centric, to develop the value-added intellectual property, and to improve the relationship with their customers. Infineon spun off from Siemens and became a pure play semiconductor company, ST Microelectronics became public and changed its name to SGS Thomson, Philips Semiconductor went through drastic changes.

But what has been some of the strengths of the European semiconductor industry in the long run are its focus on value added, differentiated products, its superior know-how in mixed signal and analog design, as well as its broad technology. What some considered a disadvantage in the late '80s and early '90s ("They are spread too thin, they are not leading in any mainstream business like DRAM or microprocessers...") turned into a major advantage in the late '90s. Europe has been driving the technology train in wireless and digital consumer products, and many of the major developments in microelectronics have been initiated by Europeans: DECT, GSM, Bluetooth (standards for wireless communications), and MPEG, DVB, DAB (standards for digital consumer applications).

'Today, the European electronic industry produces 42 percent of the world's set-top boxes, 39 percent of the mobile phones, 56 percent of the smart cards and 32 percent of the navigation systems.'

Today, the European electronic industry produces 42 percent of the world's set-top boxes, 39 percent of the mobile phones, 56 percent of the smart cards and 32 percent of the navigation systems, just to name some of the high- volume growth drivers.

Is everything perfect? Cer-tainly not. Europe has a number of inherent hurdles: labor costs are higher compared to Asia; our cultural, linguistic and governmental multiplicity makes it harder to accomplish some things, compared to Japan or the U.S.

But with the move toward more integration, toward system-on-a-chip, the strengths of Europe are going to be reinforced. The times when the IC industry was labor intensive or even capital intensive will dissolve into a new era where the winners will be "IP intensive." Thanks to its tradition of cooperation, thanks to its broad technology, the European semiconductor industry has a bright future as we enter the 21st century.

Agilent is committed to participating in this success. We provide the added value services that help our European customers keep the pace that they have set for themselves: Grow faster than the worldwide industry.

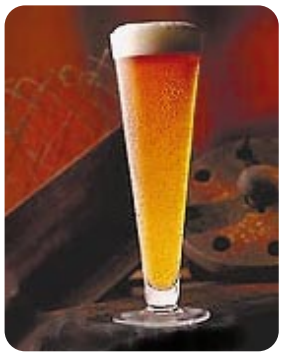
DID YOU ? KNOW

Why do brewers add hops to beer?

The sharp bite of beer is partly a result of flavor elements that come from the conelike female flower of the hop vine (Humulus lupulus), also known as the "spices" of beer. But hops do much more than add flavor to beer.

Brewers began adding hops to beer in the 14th century, when it was discovered that not only was the flavor better, but the beer also held its head better (the foam lasted longer) and it was less likely to go bad during the brewing process.

Female hops flowers contain glands that produce resins vital to the brewing process. They change the surface tension of the liquid, so the head is firmer, and they also interfere with the growth of undesirable bacteria. Many complex compounds in the hops also contribute to the distinctive flavor of beer.



Silicon Wave and the Bluetooth-enabled future

The Bluetooth wireless technology is set to revolutionize personal connectivity by providing freedom from wired connections. It is a standard encompassing a small form-factor, low-cost radio solution providing links between mobile computers, mobile phones and other portable and handheld devices, and connectivity to the Internet. As one of first companies to join the Bluetooth SIG, Silicon Wave has developed a highly integrated chip that combines all radio, modem and synthesizer functions. We spoke with Silicon Wave's Chairman and CEO, David L. Lyon, to gather his impressions about this emerging marketplace.

Q: What is your vision for success in the marketplace, especially for the portion of your business that designs ASICs based on Bluetooth?

A: We are big believers in Bluetooth. It's exciting because it will allow consumers to interconnect the hundreds of millions of PDAs, cell phones, printers, and other consumer devices out there very easily, without wires. But it will only get exciting if it's easy to use, inexpensive, very small, and draws little power. People will compare the cost of Bluetooth with the current method, and if the cost is too high, they will not make the switch.

Silicon Wave is realizing its vision by becoming the first company to successfully demonstrate and ship in volumes a fully integrated single chip that includes a radio, modem and synthesizer. It's challenging, because Bluetooth is the first of its kind, and so is our device. But with help from our partners like Agilent, we're meeting the size, power, and cost requirements for fully enabling the vision of the Bluetooth standard.

Q: Is there a particular segment of the Bluetooth marketplace that Silicon Wave will be focusing on?

A: We don't intend to eliminate possible Bluetooth markets or focus on a subsegment of the market. We have an architecture and road map for our products that lets us address an array of market segments, from laptops to cell phones to digital appliances like digital cameras. From the beginning, we partitioned our solution into segments—radio/modem/ synthesizer, baseband controller, baseband protocol stack software, plus applications on top—so customers can buy what they need. Some may need a complete Bluetooth solution, including a custom application, while others only need the radio/modem/synthesizer. Working with our partners, we can provide a turnkey solution for almost any market.

Q: Is compatibility a problem, particularly if you are trying to provide turnkey solutions?

A: Compatibility is always a problem, and we put a lot of emphasis in this area. We are intentionally doing our best to handle the pieces that are common for virtually any application, the radio/modem/synthesizer IC, baseband controller, and the protocol stack. We believe we have achieved the smallest size and overall lowest cost, and lowest power dissipation.

Q: Any guess on just how big the marketplace is and will be?

A: Market research companies are keeping a close eye on this market. By 2005, *InStat* expects there will be 700 million new Bluetooth endpoints in the market.

Q: Why did you bank your future on the Bluetooth standard?

A: A combination of emotion and business logic. In terms of emotion, several of us at Silicon Wave have had extensive experience developing wireless interconnections and Internet-enabled applications for cell phones. Our collective experience told us that Bluetooth was the way to achieve "go anywhere, be connected

Continued on page 14



David L. Lyon, chairman and CEO of Silicon Wave.

Market research companies are keeping a close eye on this growing market. By 2005, *InStat* expects there will be 700 million new Bluetooth endpoints in the market.

DID YOU ? KNOW

Useful conversion factors and units

1. Ratio of an igloo's circumference to its diameter?
2. 2000 pounds of Chinese soup
3. Speed of a tortoise breaking the sound barrier
4. 365.25 days of drinking low-calorie beer because it's less filling
5. Half of a large intestine
6. 1000 aches
7. Basic unit of laryngitis
8. Time between slipping on a peel and smacking the pavement
9. 453.6 graham crackers
10. One millionth of a mouthwash

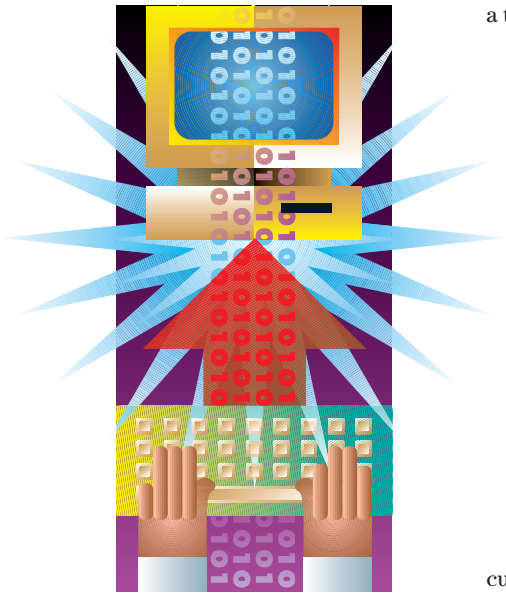
See answers, page 5

Resource utilization: Using your equipment more intelligently

The so-called New Economy may be changing the world, but a basic law of the Old Economy still applies and always will: There are still just two ways to improve profitability as a manufacturer. Increase revenues or decrease costs.

"Resource utilization" addresses the latter. It refers to the way in-house resources such as manufacturing equipment and tools are monitored, controlled and used. The stakes couldn't be higher. As a manufacturing discipline, resource utilization has the potential to dramatically increase profit margins by eliminating unnecessary capital expenditures and increasing throughput with the resources you have in place today. Do it right and you have a competitive edge. Do it poorly and you're throwing money away—potentially millions of dollars a year—which is bad form in any economy, new or old.

Agilent Technologies' Imaging Electronics Division (IED) has perfected the art and science of resource utilization. In fact, IED has harnessed its manufacturing process and test results data so effectively that IED managers can make highly informed decisions about their manufacturing operation—not with projections or guesswork, but with quantifiable numbers. They know precisely how the manufacturing floor is operating at any given moment. They know when there's an overall production problem or when specific test cells are performing below average. They know when additional resources are truly justified—and when they're not. They know how the performance of one test system compares to an identical test system elsewhere, or how one line performs from week-to-week or shift-to-shift.



'Resource utilization' is the way in-house resources such as manufacturing equipment and tools are monitored, controlled and used. The stakes couldn't be higher.

This information goes directly to the bottom line at IED. Unnecessary equipment purchases are avoided, new purchases are justified by actual workflow. Expensive equipment does not sit idle at IED—every resource is used to near-capacity. It's a true success story in resource utilization, one that may have major implications for manufacturing test in the near future.

Numbers game

What if you could increase production output by 30 percent without buying a single piece of new equipment, without increasing overhead in any way? IED did precisely that. It was a competitive necessity: as one of Agilent Technologies' integrated circuit (IC) manufacturing facilities, IED provides IC fab services to customers in highly demanding market segments. IED customers are cost-sensitive, schedule-driven and obsessed with quality; they expect their suppliers to be fast, flawless and competitively priced. IED is thriving in this difficult market, in part because it developed a practical way to view and control its entire manufacturing operation in aggregate, as a single entity comprised of multiple interconnected tools and equipment. It's the holy grail of manufacturing: IED actually uses the vast amounts of performance data it collects every day to cut costs, increase profitability, and become a more formidable competitor.

Extracting useful information

Every manufacturing environment collects data. Some are better than others at turning that data into usable information, and IED is one of the best. IED's "factory utilization monitoring system," known informally as FUMS, taps the huge flow of information that is available from test equipment on manufacturing floor. FUMS acts as a filter, extracting user-defined information from the IED database and presenting it to different users with different requirements:

Near-real-time status updates. Few line managers have access to the line they're managing. They operate blindly, using tracking reports or inventory controls to determine how a line is working. It's difficult, if not impossible, to know when lines are operating below capacity, when they need additional operators, or where to begin troubleshooting when production output drops. Line managers at IED, however, can see what's happening on the shop floor at any moment. FUMS tracks the operation of all production lines and provides a live display of all lines for the past 24 hours. The display is refreshed every few minutes to provide an updated 24-

hour snapshot. When IED managers arrive for work in the morning, they know immediately if there's a problem that requires attention.

Historical analysis. How long does it take to run a program on a given piece of equipment? What's the response time for a given system? What's the true utilization rate? How does output for a given system compare from shift-to-shift? Many production environments are forced to make educated guesses and fuzzy projections when determining the performance of their equipment. IED knows exactly how specific tools work over time. IED managers can create extremely accurate planning and capacity models because they know exactly what their systems can do.

Comparative analysis. How does a group of machines compare over time? Why does one line consistently outperform another line? IED's process managers can quickly create comparative models to get a clear understanding of their production environment. They know how to mix and match tools to optimize output. They know when the production process is working, when it's faltering, and where to focus their efforts for continuous process improvement.

The Power of Information

Having all three functions easily accessible is the difference at IED. It's what turns massive amounts of captured data into usable information that can be evaluated and acted upon. IED managers have direct access to the manufacturing line, and a fundamental understanding of how their operational space is working at any given moment.

Many of the same advantages that are found in FUMS may become commercially available in the future. Test utilization tools (see sidebar at right) are coming to market to provide key utilization metrics for test systems. With this kind of tool, test departments can have a "big picture" view of test cell utilization. Over time, even bigger picture views are possible, thus providing managers with the information they need to eliminate unnecessary capital expenses, cut costs and improve margins. Good news for any enterprise that hopes to thrive in the New Economy! ◆



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New test utilization measurement tool is being introduced at SEMICON /West July 12-14

What are the top four factors in reducing cost of test? Typically, IC manufacturers look at yield, test system price, test time, and utilization.

Though this concept is not new, manufacturers still often report only 40 percent utilization. Why is it so low? What is happening during the other 60 percent of the time?

Agilent's new test utilization measurement software is the first product designed to measure test cell utilization, thus characterize non-utilization issues. The result? Companies can now "see" test cell inefficiencies and focus on testing more parts. It accurately measures test system states and tracks transitions between states. It then analyzes those states and reports useful information, not data, to anyone who needs it. This may sound familiar, but it is unique. No system today has the 3 R's of utilization measurement:

Real Time—The software captures data and reports information in real-time. This means that everyone (operators, technicians, engineers, planners) can see screen outputs and proactively determine how to keep their test systems working.

Continued on page 14

DID YOU ? KNOW

Where are spider webs used as fishing nets?

Natives of New Guinea, a lush tropical island north of Australia, use the webs of giant Nephila orb spiders as fishing nets. The spiders that make these webs are among the largest arachnids in the world, able to trap and eat small birds. Their bite is very painful, but usually does not kill.

Fishermen in Polynesia use the webs of a closely related spider as fishing line. Their golden orb weaver fishing lines can haul in single catches big enough to feed several people.

The webs of Nephila spiders are beautiful marvels of natural design. Cast across human-size or larger gaps, they form a slightly tilted bull's eye, often with a vertical design made out of the remains of prey.



Useful English system conversions/units

See test, page 3

Answers:

1. Eskimo Pi
2. Won ton
3. Mach Turtle
4. Lite year
5. One semi-colon
6. One mega-hurtz
7. One hoarsepower
8. Bananosecond
9. One pound cake
10. One microscope

Customers rate Agilent high in top 10 survey

VLSI Research of San Jose, Calif. gave Agilent two top 10 awards— one is first-place for the BEST supplier of process diagnostic equipment; and the second is among the BEST top 10 for supplier of test and material handling equipment.

"The company is doubly honored this year," VLSI said in its news release. "It (Agilent) not only achieved the top ratings in five categories for suppliers of process diagnostic equipment, but it also has achieved the highest score for product performance among all 10 BEST suppliers. It also appears in the 10 BEST suppliers of test and material handling equipment segment."

VLSI said "the newly-formed Agilent Technologies achieved the number one position with an overall rating of 8.29" in the process diagnostic equipment category.

Agilent, formerly Hewlett-Packard, has retained this lead position for four years in a row.

"Customers praise Agilent with comments such as, 'Great equipment performance. . .(Agilent is) jointly developing equipment with customers to meet their needs,' " VLSI said.

This year six suppliers received enough customer responses to be eligible for the 10 BEST in this category.

In the test and material handling equipment category. Agilent received an "exceptional 1.01 point increase in its overall ratings," VLSI said.

VLSI received more than 5,200 ratings of individual companies from 2,168 returns. "Each of these 5,200-plus ratings were, in turn, made from the eight separate categories listed, comprising altogether about 41,600 individual ratings," VLSI stated. ◆

Asian growth rate outpacing others

The Asian region is forecast to grow more than 6 percent this year, eclipsing expected global expansion of 3.4 percent, a Hong Kong and Shanghai Banking Corp. (HSBC) report.

The global growth rate for 2000 would be an improvement over the average 2.9 percent recorded last year, the banking group said.

"Globally, stronger economic growth is forecast for all regions except Japan this year, with strongest growth expected in Asia, excluding Japan," said HSBC Asset Management global chief investment officer Bryce McDonnell.

Source: *The Korea Herald*

Agilent ships industry-first 32-site system

Samsung recently installed an Agilent 95000 high-speed memory series for production testing of 32 high-speed memory devices simultaneoulsy on a single head. This marks the first time the high-speed memory system has been shipped.

The new system can test up to 32 Rambus DRAMs, synchronous DRAMs, or DDR SDRAMs on a single test head. 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 it is to test PC 133 synchronous DRAM on lower-speed, lower price-per-site ATE testers.

Monterey TestFest 2000: What's in a name?

In July 1999, Hewlett-Packard announced the creation of a new company—Agilent Technologies, and with this came an array of opportunities. One was to rename the users' group meetings, since the traditional acronym, HUG (derived from Hewlett-Packard Users' Group) no longer was appropriate. "TestFest 2000" was chosen for this new company's new users' group meeting for this year.

"We changed the name from HUG to something that would reflect more of what we wanted to achieve—a festival of test—combining a festival-like atmosphere around a test conference that is family-friendly," said John Wise, Agilent's Americas field marketing manager for semiconductor test

The conference, held this year in Monterey, Calif., was filled with several activities, such as a golf tournament, a private behind-the-scenes tour of the Monterey Bay Aquarium, a beach party with pool, table tennis, volleyball, video games, a limbo contest, dancing to live music, and "technical content as good as ITC," as one attendee commented.

Awards were given to the best presentation in each track as determined by each respective audience. The award winners were:

VLSI test—"Physical Layer Networking Device Characterization"
Zoe Butler – Agilent
Albert Alcorn – PMC-Sierra

Mixed signal/communications test—"Challenges and futures…94000BT, a new tester for a new technology"
Edwin Lowery – Agilent

RF/wireless IC test—"Digital demodulation analysis on the 84000 RFIC test system"
Dan Rishavy – Agilent
Mike Seibel – Agilent

Memory test—"High-speed wafer-level internal probing direct Rambus memory on the Agilent 95000 HSM tester"
Frank Pavlik – IBM
Peter Fitzpatrick – Agilent

Parametric and process monitoring—"Automated gated diode measurements for process characterization"
Bill Verzi – Agilent

Automation and manufacturing optimization—"Cost of Test"
Janet McCracken – Agilent

Stay tuned for announcements of TestFest 2001: A Test Odyssey. If you would like more information or would like to participate in next year's conference, contact John Wise at Agilent's Santa Clara, Calif. site—408-553-7092 (john_wise@agilent.com). ◆





TestFest awardees for presentations included Janet McCracken of Agilent (top photo, right) who was presented the award by Agilent's Randy Hierbaum, general manager, semiconductor test—Americas, and (above, from left) Albert Alcorn of PMC-Sierra, Hierbaum, and Zoe Butler of Agilent.



The beach party at Monterey's TestFest: barbecued ribs, corn, music, and a limbo contest.

Compact testhead adds high-end features to low-cost RFIC test systems

DID YOU? KNOW

What kind of robot melts its way into solid ice?



A new kind of robot (but NOT like the one pictured above) is being built to explore a lake buried under four kilometers (2.5 miles) of Antarctic ice. Called a cryobot, it will slowly melt its way down into the ice until it emerges in the liquid water of Lake Vostok, near the South Pole.

When the cryobot reaches liquid water, it will attach itself to the underside of the ice, then release a smaller robot called a hydrobot. The hydrobot will swim around in the lake, taking measurements and reporting back to the cryobot.

Lake Vostok is one of the world's largest icebound bodies of water, about the size of North America's Lake Ontario. It has been locked under the ice for millions of years. Scientists hope to discover life in the lake, which may provide clues to the possibility of life in the icebound oceans of Jupiter's moon Europa.

A new compact testhead for the Agilent 84000 Series Models A20e, A20pa and A30mx low-cost, application-focused RFIC test systems provides all the advantages of hard docking and automatic calibration that are now found in the series' most versatile systems, the A60t and A120t. Combining the new testhead with an application-focused system yields an economical solution that lowers cost-of-test (COT) for high-volume manufacturers of power amplifiers, mixers, RF switches and LNAs.

For example, the pairing of an A20e power amplifier test system and the compact testhead offers eight-port testing and dual-site capability with a cost savings of 40 percent over the A120t. This combination also has the advantage of a 40 percent smaller footprint than the A120t.

The new hard docking solution uses Agilent switches to multiplex the two and three ports of the application-focused systems to eight and 12 ports, respectively. The testhead can be hard docked to automatic handlers, eliminating the dangling cables that result when using soft dock solutions. Also, Agilent's calibration boards can be used to speed and simplify multi-port calibration, reducing test costs.



Any A20e, A20pa or A30mx can be field retrofitted by Agilent for use with the new compact testhead.

Two versions

There are two versions of the compact testhead. The 2x8 multiplexer version is used with the two-port systems, the A20pa and A20e. The 3x12 multiplexer version is used with the A30mx, a three-port system.

Agilent 84000 RFIC Series

The 84000 Series is comprised of application-focused models (A20e, A20pa and A30mx) and two versatile models (A60t and A120t). The application-focused models are low-cost systems designed to test specific types of RFICs, such as power amplifiers, mixers, RF switches and LANs. The versatile models are flexible systems with mixed-signal capabilities for testing highly integrated RFICs such as transceivers and multi-function RFICs, as well as power amplifiers, mixers and LANs.

A total solution

With the 84000 Series systems, Agilent provides the following products and services to ensure a complete testing solution:

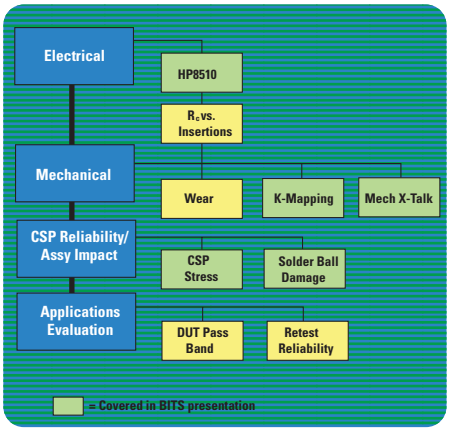
- Handler docking kits that include all the hardware needed to dock a handler to the system and a software driver to allow the system to control the handler.
- Fixturing components such as fixture boards, highly repeatable blindmates, octoblocks, RF cables and precision peripheral pins.
- Compliant, high-frequency YieldPro contactors, which have the lowest parasitics in the industry.
- RF applications engineers who will develop the entire application. ◆

Contactors (not contractors!) can be weak link for high performance CSP testing

Testing high performance ICs in chip scale packages (CSP) puts demands on more than the just the test system. Test engineers understand the need to characterize all of the "links" in the chain between both the test program and accurate, repeatable results on the production test floor. In the memory test arena today, Direct RDRAM is probably the best example of a demanding DUT that asks the test engineer to squeeze out every bit of uncertainty in the accuracy chain.

In addition to the test system itself, the load board, sockets and contactors are the key elements in the accuracy chain and, in high volume production test, contactors are potentially one of the weak links. Quantifying the accuracy effects of each of the elements in the signal path is something that Agilent has been engaged in since it began testing the very first devices at Rambus Inc. in 1991.

As users of the Agilent 95000 HSM Series test systems are preparing for the Direct RDRAM production ramp, Agilent R&D has been providing engineering support on a variety of topics, including contactors. One such effort was a study of the most suitable contactors for a production test environment.



ABSTRACT: Direct RDRAM and chip scale packages in the back end memory test environment are driving changes in socketing/contacting technology for massively parallel high-data rate memory test applications. We describe an electrical and mechanical evaluation program used to evaluate three-socket/contactor technologies' suitability for the RDRAM CSP at-speed final test. It describes the experimental methodology and modeling techniques applied to ascertain electrical suitability for fast data-rate applications via RF measurement and modeling. Mechanical measurements, including some novel techniques and FEA simulation are applied to determine contact behavior, uniformity, wear and suitability to accept normal CSP process variations.

In all cases thermal mechanical conditions of the in-test environment and handler equipment of choice were simulated to best match the production conditions. The results of the evaluation support the notion that most contacting technologies meet the CSP reliability and mechanical requirements in the application studied. ◆

Agilent wins 'Best Presentation'

A summary of the methodology was presented at the Burn-in and Test Sockets (BITS) Workshop (Mesa, AZ, Feb. 27-29) sponsored by the IEEE Test Technology Technical Council. Agilent's presentation, "Characterization of high performance contactors for production RDRAM chip-scale package test," earned the "Best Presentation" honors for Agilent's Ken Karklin, Francois Billaut and Gary Chew.

The BITS presentation is available in PDF format at http://www.bitsworkshop.org

DID YOU ? KNOW

What kind of fish steals scales from other fish?

Fish in the genus Perissodus eat mouthfuls of scales from the sides of other fish.These strange predators live in Africa's Lake Tanganyika, where they form part of one of the most diverse freshwater ecosystems on Earth.

Each Perissodus individual is left-biting or right-biting. Its mouth curves to the left or to the right, and it can only steal scales from one side of its prey. The number of left-biting and right-biting fish is roughly equal.

The scale-stealing Perissodus are cichlids, part of a family of fish that became isolated in Eastern African lakes millions of years ago. The family includes hundreds of specialized kinds of fish, with many different feeding and breeding habits. All of them evolved since the lakes were isolated.



DID YOU ? KNOW



When computers were big—very big!

"War circumstances had made it imperative to construct the Eniac out of conventional electronic circuits and elements with a minimum of redesign. This . . . led to an extremely large machine. Its 30 separate units, plus power supply and forced air cooling, weighed over 30 tons and occupied 1,800 sq. ft. Its 19,000 vacuum, tubes (16 different types), 1,500 relays and many thousands of resistors, capacitors and inductors consumed about 174 kilowatts of electrical power.

"In the late '40s, the main part of Eniac consisted of 42 panels arranged around three sides of a room. Each panel was about 9 feet high, 2 feet wide and 1 foot thick…

"The computer represented the largest collection of interconnected electronic circuitry then in existence…

"The blower system was not adequate to dissipate the heat into the warm, humid atmosphere…

"At 11:45 p.m. on 2 October, 1955, the power to Eniac was removed. The rapid progress of computer technology, spurred by the Eniac itself, had made the device obsolete."

— *Electronic Computers Within the Ordnance Corps,*" Karl Kempf, 1961

Ultra advanced test solution accelerates ramp and improves process yield

Agilent Technologies introduces the "Agilent 4073A Ultra Advanced Parametric Tester," the Agilent 4070 parametric tester family's new flagship product. The 4073A solution is ideally suited for advanced laboratories and fabrication lines focusing on next-generation semiconductor device development (including 300 mm fabs). It can also accelerate the ramp-up of new processes and improve the yield on existing processes.

Solutions for complex parametric test needs

Well-established market trends, like system-on-a-chip (SOC) integration and copper interconnect with low dielectric materials, have mandated improvements in parametric test. Today, parametric test systems must handle advanced parametric test as well as Flash memory cell evaluation, ring oscillator measurement, and sophisticated WLR tests. However, new trends such as deep sub micron and low power consumption are spurring requirements to be raised once again. DRAM cell evaluation now requires ultra low current measurement below 100fA. Resistance evaluations of advanced Cu interconnect and matching tests for new analog devices both need sub-1mV measurement capability. Of course, new processes cannot achieve quick ramp-up solely on the basis of precise measurement; high throughput is required as well.

To meet this need, the measurement speed of the 4073A is orders of magnitude faster for low-current and low-voltage measurement. Such performance was previously possible only with the addition of external instruments.

To meet this need, the measurement speed of the 4073A is orders of magnitude faster for low-current and low-voltage measurement. Such performance was previously possible only with the addition of external instruments. Thus, the capabilities of the 4073A help to ensure a quick turn-around-time for ultra advanced processes.



The Agilent 4073A Ultra Advanced Parametric Tester

Outstanding parametric test solution

The 4073A offers excellent performance with an ultra-low noise floor, fast low-current/low-voltage measurement settling times, and improved measurement precision and resolution. Agilent Technologies has worked hard to remove barriers to achieve this superior performance in production, through both collaboration with automatic wafer prober manufacturers as well as an innovative and cost-effective probe card design. The total noise floor of this system solution is well below 100fA. This total solution allows one to make both low level current and voltage measurements faster in production, and to tighten measurement guardbands. Therefore, it can lower the overall cost of test. (For more wafer prober and probe card information, please contact your local Agilent sales representative.)

Superior software

An efficient and complete parametric test solution requires exceptional software in addition to superior hardware. To meet these requirements, the Agilent 4073A has both a versatile system software environment as well as compatibility with the Agilent SPECS test shell.

The Agilent 4073A system software supports the intuitive Interactive Debug Panel (IDP) and the powerful Agilent Flexible Algorithm Semiconductor Test Code (FASTCode) generator. IDP provides a user-friendly graphical user interface (GUI) for making quick interactive measurements on the 4070 family of test systems. The Agilent FASTCode generator automatically creates equivalent HP BASIC/UX or C code from IDP measurement setups. IDP and the Agilent FASTCode generator can be utilized together to create quickly new test algorithms for use in process development or production.

The Agilent SPECS (Semiconductor Process Evaluation Core Software) test shell continues its role as the unifying environment for Agilent's total semiconductor parametric test solution. SPECS covers a wide spectrum of needs from interactive or automated test plan development to intelligent automated test. By standardizing on SPECS, you assure a common environment for you and your worldwide partners. Most important, the ability of SPECS to be used in a fully automated test environment can save both money and time, especially as you migrate from 200mm to 300mm wafer fabrication lines. ◆

Most important, the ability of SPECS to be used in a fully automated test environment can save both money and time, especially as you migrate from 200mm to 300mm wafer fabrication lines.

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DID YOU ? KNOW

The origins of ice cream

The exact origins of ice cream are not known, but it probably descended from chilled or frozen wines and fruit juices. It is known that the Roman emperor Nero Claudius Caesar (A.D. 54-68) would send runners into the mountains for snow, and then flavor it with honey, juices, and fruit pulp. During the end of the 13th century, Marco Polo returned from the Far East bringing back a frozen dessert that resembled sherbet. By the early 1600s it was said that King Charles I of England paid a hefty sum to a French chef so that the chef would produce "creme ice" only for the king, and would keep the recipe a strict secret. Upon the king's beheading in 1649, the chef sold his secret to a group of noblemen who had long coveted the secret of "creme ice."

Around 1670, Paris would see its first coffeehouse, the Café Procope, and finally the masses were able to sample the "iced creams." In any event, by the 1700s ice cream had become very popular. An anonymous book named L'Art de Faire des Glaces gave detailed instructions on how to prepare apricot, violet, rose, chocolate, and caramel ice creams.



Agilent's 93000 well suited for testing IF cores of mobile communications devices

The easy test setup and excellent performance of the high-speed Arbitrary Waveform Generator (AWG) make the 93000 a total fit for IF test requirements.

The figures of merit typically used as recommended minimum performance standards for base stations and mobile receivers operating under the IS-95A cellular specifications are:

- Receiver sensitivity and dynamic range
- Spurious immunity (including single-tone desensitation and intermodulation-spurious-response attenuation).

The sensitivity of the receiver is its ability to recover data when the input signal level is low. Spurious immunity measures the receiver's ability to demodulate desired information correctly in the presence of unwanted CW signals. The intermodulation spurious response attenuation test measures how well a receiver can demodulate a signal on the wanted channel in the presence of two much larger interfering tones.

There are several test challenges when making these measurements. Input signals vary widely. Therefore, a large dynamic range of signal strength is needed and a noise floor well below the weakest signal strength is required. A dynamic frequency range for sourcing and measuring multitone test signals is also necessary.

Agilent's High Speed Arbitrary Waveform Generator is equipped to handle these test challenges. The sinewave frequency can be programmed up to 32MHz with programmable attenuation from 0 to 63 dB. The mixed-signal tool makes multitone waveform generation easy. In addition, a low noise floor is inherent in the 93000 SOC tester design; –140 dBm per square root hertz in a frequency range of 0 to 100 kHz.

The High Speed AWG of the Agilent 93000 SOC Series meets all the requirements for testing IF cores of mobile telecommunication devices. Performance measurements of typical test setups show that the signal quality of the AWG more than sufficient in terms of noise and dynamic range.

The following plots show test setups for sensitivity tests under two conditions:
15.0 MHz < f_c < 17.5 MHz
5.5 MHz < f_c < 7.0MHz

Scalable 93000 SOC series to be shown at SEMICON/West

Agilent has introduced a set of comprehensive analog capabilities for the 93000 series SOC test system, which will be shown at SEMICON/West July 12-14 at Santa Clara, Calif.

This "A+" system has analog measurement modules which 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.

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.

High speed, high accuracy, low-noise floor: It is all available now on the one scalable platform, the 93000 SOC series.

DID YOU ? KNOW

How to survive when lost in the desert

1. Do not panic, especially if people know where you are and when you are scheduled to return. If you have a vehicle stay with it—do not wander!

2. If you are on foot, try to backtrack by retracing your steps. Always move downstream or down country. Travel along ridges instead of in washes or valleys, where it is harder for you to see and for rescuers to see you.

3. If you have completely lost your bearings, try to get to a high vista and look around.

4. Build smoky fires during daylight (tires work well) but keep a bright fire burning at night.

5. If a car or plane is passing, or if you see other people off in the distance, try to signal them.

6. To avoid heat prostation, rest frequently.

7. Try to find water. Look at the base of rock cliffs, in the gravel wash from mountain valleys, and in wet sand (dig down three to six feet to find seeping water).

8. Find cactus fruit and flowers. Split open the base of cactus stalks and chew on the pith, but don't swallow it.

Source: *The Worst-Case Scenario Survival Book*



The following plots below show test setups for sensitivity tests under two different conditions. The test signal consists of a two-tone signal where the carrier frequency has a far smaller amplitude than the jammer signal.

Signal 1
15.0 MHz< f_c<17.5 MHz, amp= -66 dBm
f_j= f_c+/-900 kHz, Amp=-25.8 dbm

Signal 2
5.0 MHz< f_c<7.0 MHz, amp=-72.8 dBm

f_j= f_c+/-60 kHz, amp=-21.8 dBm

The test setup for order intermodulation distortion consists of a three tone signal. The following measurements show two different test stimuli:

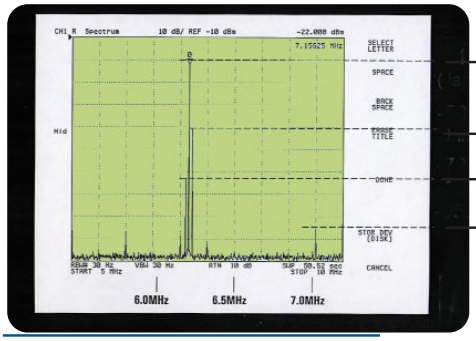
Signal 1
carrier 15.0 MHz< f_c<17.5 MHz, amp=-66.0 dBm
jammer1 f_j1 = f_c +/- 900 kHz, amp= -41.0 dBm
jammer2 f_j2 = f_c +/- 1.7 MHz, amp= -41.0 dBm

Signal 2
carrier 5.5 MHz < f_c < 7 MHz, amp= -72.8 dBm
jammer1 fj1 = f_c +/- 60kHz, amp= -41.0 dBm
jammer2 f_j2 = f_c +/- 120kHz, amp= -41.0 dBm

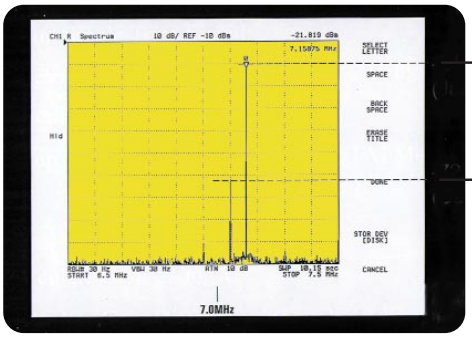
In summary, the easy test setup and excellent performance of the High Speed AWG make the 93000 totally fit for IF test requirements.

The AWG thus has a wide range in signal strength and frequency range and is capable of testing IF as well as baseband. The noise floor is very low, which is especially desirable when working with weak signals. ◆

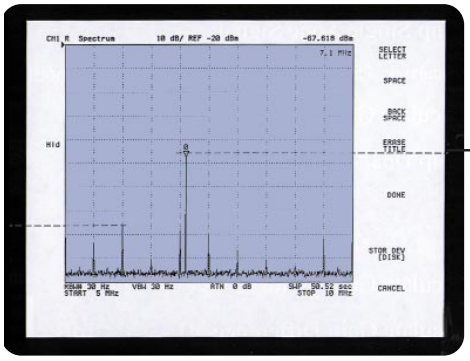
IMR3 (5)
- Mode 2



Single Tone Jammer Desense (5)
- Mode 2



Input sensitivity (3)
- Mode 2



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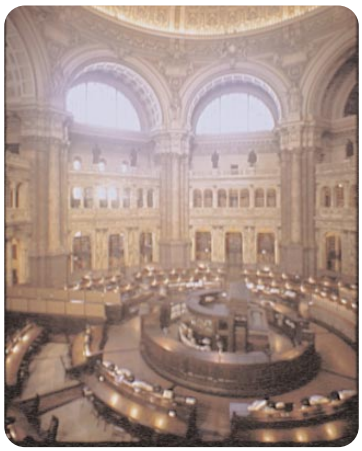
DID YOU ? KNOW

The Library of Congress

The Library of Congress is the largest library in the world, with nearly 119 million items on approximately 530 miles of bookshelves. The collections include some 18 million books, two million recordings, 12 million photographs, four million maps, and 53 million manuscripts. The Library's African and Middle Eastern Division alone holds some 600,000 volumes in the non-Roman script languages of the region.

The Library receives some 22,000 items each working day and adds approximately 10,000 items to the collections daily. Approximately half of the Library's book and serial collections are in languages other than English. Some 460 languages are represented in the collections.

Below: The main reading room of Library of Congress.



Lyon on Bluetooth

Continued from page 3

anywhere" functionality, while preserving the consumer's ability to buy best-in-class digital devices. With Bluetooth, people can continue to buy the lightest, most powerful devices, without compromises—then when they want them to talk together, they simply activate Bluetooth.

From a business standpoint, we penciled out the time-to-market and cost requirements and analyzed the business logic. We can trace our decision to focus on Bluetooth back to fall 1998.

Now, it's a matter of interoperability and execution, ensuring that Bluetooth-enabled appliances will all work together and delivering on our promises. Sometimes the excitement and hype around a technology can get ahead of the reality, and consumers can become disappointed. It is incumbent on the Bluetooth SIG and leading manufacturers like Silicon Wave not to let that happen.

Q: It's being said your devices should sell for about $5. What are the challenges of focusing on this high volume, low-cost consumer marketplace?

A: Five dollars sounds accurate in terms of the market expectation. We have publicly stated that in two year's time, we would be producing in volumes that would allow us to supply a single-chip Bluetooth peripheral IC at about $5. Of course, there will be an additional marginal cost for full system implementation. These numbers presume the level of integration is very tight. To get prices this low, there is a very smart partitioning between the computing engine in the consumer device and what is in the Bluetooth peripheral. The Silicon Wave Odyssey part will be what many consumer devices use externally. We are working closely with manufacturers, because there will be part of the Bluetooth application running on the computing engine which drives the cell phone or laptop or other digital appliance. ◆

Continued from page 5

Measurement utilization tool being introduced

Resolution—It captures each unique event for the ultimate accuracy. You no longer have to calculate or sample your system utilization. You know exactly what is happening on your production floor.

Responsive monitoring—It actively seeks process information. Test systems do not follow a simple diagram of test states; instead they face a chaotic sequence of states triggered by interruptions from handlers, probers, and operators. Agilent's utilization software handles interruptions and unexpected states by polling equipment to determine the true state of the equipment.

There are results. Utilization inconsistencies have been identified at EVERY installation to date... and within 24 hours of initial operation. In one instance, a simple software change reduced test + index time by more than 30 percent. In another, the actual test + index time was measured to be significantly longer than the calculated times.

Agilent's new test utilization measurement tool provides the information needed to ship more IC's every day. Given a 1 percent improvement in utilization, equipment can be working an additional 5 minutes per shift or 15 minutes per day. This 5-minute improvement means you can ship nearly 80,000 more parts per year per system if you assume a 3-second test time and 0.75 second index time. This can mean literally millions of dollars of additional revenue, and hundreds of thousands of dollars of unrealized profit for an IC manufacturer per year.

Visit the Agilent booth at Semicon West for more information. ◆

Agilent to exhibit at SEMICON/West 2000

One of the largest semiconductor trade shows in the world, SEMICON/West, will be held from July 12 to 14 at the San Jose Convention Center in San Jose, Calif.

Agilent's booth will include a number of product displays and demonstrations, including the following:

SOC test:
- 93000 SOC C200 (cost-effective)
- 93000 SOC P1000 (high-performance)
- Bluetooth solution (graphics only)

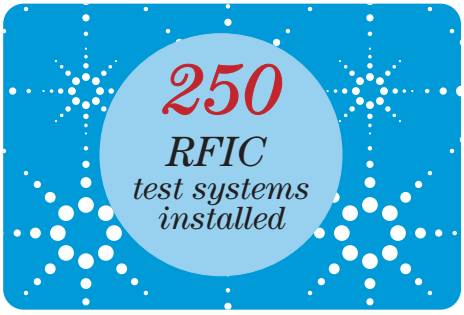


Memory test:
- 95000 high-speed memory
- Versatest V1000 NVM NAND

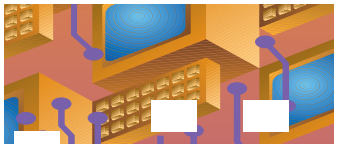
RFIC test:
- 84000 A20pa (cost-effective)

Semiconductor Parametric test:
- 4073A Parametric Tester (software demo)
- SEC/GEM
- 4156B precision semiconductor analyzer
- E5250A low leakage switch
- Cerprobe prober w/Celedon probe card

Strategic Services
- Secure Remote Access (93000 system)
- Test utilization measurement software (see article on page 5) ◆



The installation of the 250th RFIC test system will be celebrated at SEMICON/West with the distribution of a very large and very luscious chocolate bar.



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global calendar

JULY

SEMICON/West
July 12–14
San Jose, California

SEPTEMBER

Agilent Customer Event
September 6-8
Taiwan

SEMICON/Taiwan
September 13–15
Taiwan

OCTOBER

ITC
October 3–5

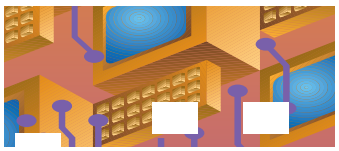
DECEMBER

SEMICON/Japan
December 6–8
Japan



- Agilent Semiconductor Test Factories
- Agilent Sales and Support Offices

More than 3,500 Agilent semiconductor test systems are installed worldwide.



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Agilent Technologies, U.S.A.
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Europe
tel. (31 20) 547.9999 (Amstelveen, The Netherlands)

Japan
tel. (81-426) 56.7832 (Tokyo)

Latin America
tel. (305) 267.4245 (Miami, FL, USA)

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go/manufacturing is published quarterly by Agilent Technologies. Address any correspondence to go/manufacturing, c/o Rick Gaan, Agilent Technologies, 5301 Stevens Creek Rd., PO Box 58059, MS 54/L32, Santa Clara CA, USA, 95052-8059.

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Data subject to change
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