The Dawn of a New Era in Parametric Test

Agilent Technologies
The 300 mm Challenge

Paradigm Shift

The transition to 300 mm wafers presents unique challenges that the semiconductor industry has previously not encountered. The factors causing this paradigm shift are:

- Loaded wafer carriers are too heavy for manual lifting.
- Wafers are too valuable to risk damage or destruction caused by human error.
- More stringent cleanliness requirements necessitate minimizing human contact.
- Capital equipment costs mandate 100 percent equipment utilization to ensure high overall equipment efficiency (OEE).

Meeting these challenges requires you to adopt a solution that supports industry standards for factory automation. This means your test system, prober, and FOUP loadport must be integrated as a single point of communication with the CIM host. However, you also want a solution that allows you to leverage as much as possible from your existing production environment.

Solution Requirements

When starting up a 300 mm wafer facility, you are faced with many requirements for your parametric test solution. You need a solution that allows you to get up and running quickly. You need a solution that supports all relevant industry standards. You need a solution with the flexibility to customize individual elements to meet your unique needs. And, finally, you need a solution provider with the experience and expertise in 300 mm parametric test to help you meet all of these challenges.

World Leader in Parametric Test Solutions

Judged by market share, Agilent Technologies is the world leader in parametric test. Agilent reached the milestone of installing its 2000th test system in the year 2000, and our installed base continues to grow. International Sematech, Selete, and IMEC have all selected Agilent 4070 Series systems as their standard for 300 mm parametric test.
Proven and Reliable Solution

Agilent 4070 Series test systems are reliable, well proven, and have been installed in the world’s first 300 mm production wafer fabs. Our 4070|300 solution and SECS/GEM integration expertise give us the ability to supply you with the right test at the right cost. We also can get the parametric test portion of your 300 mm wafer fab up and running quickly, allowing you to focus on other more critical issues.

Customizable

Different parametric test environments have different needs. Agilent recognizes this fact and has designed the 4070|300 solution with the flexibility to allow customization. You can customize the solution yourself, or Agilent can provide you with customization services that fully utilize the knowledge and experience of our worldwide team of expert application engineers.

Support for SEMI Standards

The 4070|300 solution supports all current relevant SEMI automation standards, and it will continue to support new standards as they are developed. Support for standards lowers your cost of test by reducing the time required to integrate the 4070|300 solution into your overall 300 mm factory environment.
Agilent SPECS-FA Provides Seamless SECS/GEM Integration

Agilent SPECS-FA for 300 mm Factory Automation

SPECS-FA is the factory automation version of Agilent’s popular SPECS (Semiconductor Process Evaluation Core Software) parametric test shell. SPECS-FA is optimized for automated factory environments and has a software interface that fully supports SEMI standards E5 (SECS II) and E30 (GEM). SPECS-FA has three operation modes: online remote (for full automation); online local (for local equipment control and communication between the host computer and the equipment); and offline (for local equipment control without communication between the host computer and the equipment). Algorithms created for SPECS will run on SPECS-FA without modification. SPECS and SPECS-FA also support algorithms written in either C/ANSI C or HP BASIC/UX.

Intelligent Adaptive Test

Agilent SPECS and SPECS-FA have adaptive test capabilities to lower your cost of test. They allow you to use different test plans to test multiple lots within one wafer cassette; they enable you to change the details of your test plan based on the results of previous tests; and they allow you to eliminate unnecessary measurements intelligently, thereby maximizing your throughput.
Ideal Design for Full Automation in Parametric Test

Fast and Flexible

The design of SPECS-FA greatly simplifies control of Agilent 4070 Series test systems and wafer probers in a factory automation environment. SPECS-FA can report the status of both the parametric test system and wafer prober in real time, so the host controller always knows the exact status of the test cell. This information allows you to have greater flexibility and improve your throughput. Furthermore, SPECS-FA supports the carrier management standard (E87), which is a requirement for full factory automation.
Solutions for Every Need

Protecting Your Investment

The upgrade capabilities of the 4070 Series ensure that your current parametric test investment is protected. You can upgrade a 4071A to either a 4072A or a 4073A, and you can upgrade a 4072A to a 4073A. Moreover, you can use all existing probe card and interface solutions with every model in the 4070 Series. As your requirements change, your 4070 Series test solution will be ready to meet new challenges.

Intelligent Software Environment

The Agilent SPECS test shell, which runs on both 4062UX and 4070 Series test systems, allows you to leverage algorithms developed on earlier hardware platforms for use on your current platforms. The intelligent interpretation feature of the 4070 Series software allows you to run any algorithm developed on any 4070 Series test system on any other 4070 Series test system. If an algorithm uses a feature not found on another test system, the software will automatically substitute the best equivalent function. This capability allows you to run the same SPECS test plan on all of your 4070 Series test systems without modification. You can also use algorithms developed in SPECS in the SPECS-FA 300 mm environment.
**Innovative Test System in a Test Head**

**Maximum Flexibility, Throughput, and Accuracy**

By placing the DC measurement resources in the test head, Agilent is able to maximize the throughput and accuracy of its 4070 Series test systems. The technological superiority of this design has been proven by the fact that the 4070 Series has achieved industry acceptance worldwide and is by far the dominant test platform for parametric test. Moreover, the 4070 Series achieves its high performance levels without the need for complicated and risky pre-amplification schemes. A dedicated and fully buffered FIFO optical interface moves commands and data between the test head and the system controller, eliminating nearly the entire overhead associated with electrically based designs. A large number of optional instruments are also integrated into the system test software, greatly reducing programming time.
Performance for Extreme Measurement Challenges

Measure Advanced Processes

The Agilent 4073A Ultra Advanced Parametric Test System offers the performance you need to meet your most difficult measurement requirements in both advanced laboratory and fabrication environments. With a current resolution of 1 fA, the 4073A provides you with the means to evaluate sub quarter-micron technologies. The 4073A’s 0.1 μV voltage resolution (using the 3458A) allows you to measure copper metal structures with ease. Finally, the 4073A’s 2 fA noise floor (observed data) ensures that you can obtain full measurement performance from your test system, ultra low-leakage probe card, and low-noise wafer prober.

Faster Throughput

Besides increased measurement performance, the 4073A also has improved measurement speed. The low-current spot measurement capability of the 4073A can be from 3 times up to 30 times faster than that of the already fast 4072A. Moreover, the 4073A uses intelligent measurement range control to speed up sweep measurements by 30 percent or more. The 4073A provides the throughput you want today as well as the throughput you will need in the future.
Unsurpassed Probe Card Technology

The Elegant Simplicity of Direct Docking

The direct docking scheme employed by the 4070 Series provides you with both increased performance and lower cost of test. The test head pins protrude beyond the test head surface for direct contact with the probe card, eliminating the need for a test system-to-probe card interface. Direct docking vastly improves low-current measurement capability over birdcage designs. The direct docking scheme also supports fully guarded Kelvin measurement. For maximum performance, the force and sense lines are terminated together on the probe card as close as possible to the DUT. Finally, the alignment scheme ensures that operators can quickly remove, replace, and realign a probe card.

High-Performance Capability

To enable the full measurement potential of the 4073A test system, Agilent has developed advanced probe card technologies. A superior probe card material greatly shortens settling times by removing the effects of dielectric absorption. In addition, our ultra low leakage probe card virtually eliminates noise and stray charging currents. Best of all, this solution is available worldwide through various probe card suppliers.

Common Design Reduces Cost

All 4070 Series probe card solutions work on all 4070 Series test systems. This interchangeability gives you greater flexibility in your manufacturing environment and reduces costs by allowing you to standardize on a common design. Whether you need a standard Kelvin probe card for the 4072A or ultra low leakage Kelvin probe card for the 4073A, Agilent has a solution to meet your needs.
High-Frequency Matrix for Flash Testing...

Integrated Flash Test

The increasing use of embedded flash memory on integrated circuit products means that a flash cell testing capability has become a virtual necessity for semiconductor parametric test systems. Thus, the 4072A and the 4073A each offer flash cell test capability as a standard feature.

Fast Write/Erase Endurance Testing

Both 4072A and 4073A test systems include a versatile 60 MHz (@ –3dB) high-frequency matrix, which ensures maximum flexibility for pulse signal routing. An integrated pulse switch enables you to create multilevel pulses, switch between connected and open states, and flip automatically between write and erase conditions without the need for controller intervention. This reduces write-to-erase transition time from several hundred milliseconds to a few milliseconds. As a result, a typical million-cycle write/erase endurance test takes only a few hours instead of a week or more. In addition, control of the Agilent 81110A and 8114A pulse generators is fully integrated into the 4070 Series system software.

Convenient GUI Control

The GUI-based Interactive Debug Panel (IDP) allows you to make interactive flash cell measurements and check the programmed output timing of each channel pulse via simulated waveforms in the waveform window. The FASTCode generator also allows you to automatically generate C/ANSI C or HP BASIC/UX code from your interactive flash measurement setups.
High-Frequency Matrix has Multiple Uses

The high-frequency matrix included in the 4072A and 4073A allows these test systems to be used for applications beyond flash memory test. This is because the matrix has the capability to function beyond its specified 60 MHz bandwidth and because it can transmit signals of 300 MHz or more (although, obviously, with attenuation). The capability offered by the high-frequency matrix opens the door for a host of other uses for the 4072A and 4073A, which are limited only by your ingenuity.

Ring Oscillator Evaluation

One popular application of the 4070 Series high-frequency matrix is the evaluation of ring oscillator circuits in both laboratory and production environments. Agilent offers a spectrum analyzer option with 4072A and 4073A test systems that gives you the ability to achieve accurate frequency measurements of hundreds of megahertz. This method provides a more easily automated and clear-cut frequency determination than you can achieve using either a frequency counter or oscilloscope.
Easy Algorithm Development

The Agilent FASTCode generator can automatically create C/ANSI C or HP BASIC/UX code to reduce test algorithm development time. You can use IDP to set up an interactive measurement, make the measurement, and then use the FASTCode generator to create equivalent test code. These auto-generated algorithms will work in SPECS, SPECS-FA, or your own test shell.

Reliable Test System Control

Agilent 4070 Series system software is robust and reliable. Powered by HP C-Class UNIX workstations, the test system software supports test algorithm development in either C/ANSI C or HP BASIC/UX. The Interactive Debug Panel (IDP) allows you to control your 4070 Series test system and make interactive measurements without programming.
A Powerful and Easy-To-Use Test Executive

Complete Solution

Agilent SPECS test shell software merges the intuitiveness of a graphical user interface with the organizational logic of a spreadsheet to create an extremely efficient test plan development environment. SPECS allows you to enter new data quickly and to reuse existing test plans easily. Test plan generation requires the creation of only four specifications: wafer, die, probe, and test. The structured architecture of SPECS ensures the long-term supportability of your test plans, which in turn protects your software investment.

Frameworks Improve Productivity

The SPECS framework enables you to customize and control overall test shell behavior, and it provides you with a convenient method of defining user interfaces, controlling wafer probers, and specifying test shell execution flow. The framework test plan language gives you a compact yet powerful command set for running tests, making decisions, and outputting data.

Intelligent Adaptive Test

Both SPECS and SPECS-FA, which is optimized for factory automation environments, have powerful adaptive test capabilities. These capabilities allow you to use different test plans to test multiple lots within one wafer cassette; enable you to change the details of your test plan based on the results of previous tests; and allow you to make intelligent decisions in order to eliminate unnecessary measurements, thereby maximizing your throughput. The end result is lower cost of test.
Total Wafer Level Reliability (WLR) Solutions

Agilent can supply you with WLR solutions for all phases of your product life cycle: development, qualification, and production. You can create a complete suite of WLR tests in a few minutes using predictive, demonstrated, quantitative (PDQ)-WLR software and the WLR framework in the Agilent SPECS test shell. All WLR algorithms are JEDEC compliant, and are available in both C/ANSI C and HP BASIC/UX. Moreover, the powerful PDQ-AT (analysis tool) software reduces the tedious task of data analysis to a few simple mouse clicks, and this software will run on either HP UX or Windows NT®.
**Agilent 4073A and 4072A Selection Guide**

<table>
<thead>
<tr>
<th><strong>Standard Resources</strong></th>
<th>Agilent 4073A Ultra Advanced Parametric Test System</th>
<th>Agilent 4072A Advanced Parametric Test System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Power SMU (Up to 8)</td>
<td>10 fA and 2 μV resolution 100 V and 100 mA maximum output</td>
<td>Same</td>
</tr>
<tr>
<td>High Power SMU (Up to 2)</td>
<td>10 fA and 2 μV resolution 200 V and 1 A maximum output</td>
<td>Same</td>
</tr>
<tr>
<td>High Resolution SMU (Up to 2)</td>
<td>1 fA and 2 μV resolution 100 V and 100 mA maximum output</td>
<td>Not available</td>
</tr>
<tr>
<td>Ground Unit</td>
<td>1.6 A @ 0 V</td>
<td>Same</td>
</tr>
</tbody>
</table>

**Optional Integrated Resources**

<table>
<thead>
<tr>
<th></th>
<th>Agilent 4073A Ultra Advanced Parametric Test System</th>
<th>Agilent 4072A Advanced Parametric Test System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agilent 3458A DVM</td>
<td>0.1 μV resolution</td>
<td>1 μV resolution</td>
</tr>
<tr>
<td>Agilent 4284A LCR Meter</td>
<td>1 fF to 10 nF measurement range 1 KHz, 10 KHz, 100 KHz, and 1 MHz frequencies Compensation includes probe card</td>
<td>Same</td>
</tr>
<tr>
<td>Agilent 81110A Pulse Generator</td>
<td>20 ns to 200 ms transition time ± 19 V output amplitude (19 V peak-to-peak)</td>
<td>Same</td>
</tr>
<tr>
<td>Agilent 8114A High Voltage Pulse Generator</td>
<td>65 ns fixed transition time – 49.9 V to 50 V amplitude (40 V peak-to-peak)</td>
<td>Same</td>
</tr>
<tr>
<td>Agilent E4411B Spectrum Analyzer</td>
<td>9 KHz to 1.5 GHz*</td>
<td>Same</td>
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*Instrument specification, not a guaranteed system specification

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<tr>
<th><strong>Switching Matrix</strong></th>
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<tr>
<td>(12 to 48 output pins)</td>
<td>2 active-guarded, shielded low-current paths (non-Kelvin) 6 full Kelvin active guarded paths 8 auxiliary input ports 48 extended path inputs 48 full Kelvin active guarded outputs Dedicated chuck connection Built-in diagnostics requiring no external fixture High-frequency switching matrix (3 x 48 or two 3 x 24) Pulse Switch</td>
<td>Same</td>
</tr>
</tbody>
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<tr>
<th><strong>Probe Card</strong></th>
<th>Agilent 4073A Ultra Advanced Parametric Test System</th>
<th>Agilent 4072A Advanced Parametric Test System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Kelvin probe card</td>
<td>Standard Kelvin probe card</td>
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- Germany (0) 18 05 24-63 34
- Greece 20 547-9999
- Ireland 016158393
- Italy 02 92 60 8333
- Luxembourg (0) 2 404-9340
- Netherlands (0) 20 547-9999
- Poland 20 547-9999
- Russia 20 547-9999
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- Switzerland (German) (0) 1 735-9300
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- Israel 20 547-9999

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Printed in USA October 23, 2003
5988-3842EN