Agilent PDQ-WLR™ Test and Analysis Software Environment

Product Note

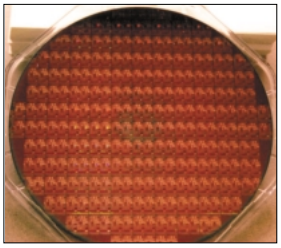
Agilent PDQ-WLR & AT Software

Total PDQ-WLR Solution

The shortened production lifetimes of modern semiconductor processes have increased the importance of wafer level reliability (WLR) data. Today, wafer fabs must use WLR data from the production line to ensure the reliability of their devices. In addition, reduced reliability qualification cycle times are needed to speed new IC processes to market. Used properly, WLR can provide high quality reliability data in a few minutes that was previously obtained through weeks of reliability test done on packaged test structures. This significantly shortens the development cycle time and results in faster time to market with less cost.

Agilent's PDQ (Predictive, Demonstrated, Quantitative) WLR software environment consists of Agilent PDQ-WLR test software, a WLR framework, Agilent SPECS (Semiconductor Process Evaluation Core Software) test shell, and Agilent PDQ-AT (analysis tool) software. The user interface is GUI (graphical user interface) based. This makes it easy to use for WLR testing, analysis, and quick decision-making. You can use it to detect problem production lots and to make process development decisions. For example, the software has proven effective in developing state-of-the-art Cu/low-k dielectric processes.

Accurate physics-based test algorithms and sophisticated characterization and analysis capabilities make PDQ-WLR uniquely suitable for all phases of IC evolution: production, development and qualification.



PDQ-WLR speeds-to-market the latest Cu/ low-k dielectric processes.

Features

- **Total WLR solution Support Production, Development and Qualification**
- **Easy to use and analyze**
- **JEDEC standards compliant**
- **Save time and money**
- **Not just WLR data, but WLR answers**
- **Analyze the measured data on Windows NT or HP-UX**

Agilent PDQ-WLR Software with WLR Framework in the Agilent SPECS Test Shell

Agilent PDQ-WLR test software provides an easy-to-use test environment in conjunction with the WLR test framework in the Agilent SPECS test shell. You can perform basic WLR tests (Standard EM, HCI and GOI) with minimal programming effort once your Agilent parametric test system, prober, and the Agilent SPECS test shell are customized to your test environment. Agilent SPECS also provides an easy-to-use yet sophisticated test development environment to meet the needs of advanced users, including production SPC (statistical process control) applications.

Agilent PDQ-WLR test software contains more than 30 sophisticated WLR test algorithms, and tests for all of the major reliability failure mechanisms. This includes electromigration (including contacts, vias, and void detection), oxide breakdown, hot carrier degradation, plasma damage, mobile ions as well as characterization of interface states and trapped charge.

You can develop a customized test plan with a few mouse clicks by selecting the necessary test algorithms from the algorithm list that resides in the Agilent SPECS GUI based test development window.

Agilent PDQ-WLR test software, when used in conjunction with the PDQ-Fab™ WLR test structures, yields the most repeatable and predictive wafer level reliability data.

Agilent SPECS provides an integrated parametric test environment. This includes the control and interface of the wafer prober, probe card, Agilent parametric tester, WLR test sequence, and GUI user interface.

You can use Agilent PDQ-WLR test software in the Agilent BASIC/UX environment HP Agilent SPECS; however, this does not give you the benefits of the Agilent SPECS test development environment.

PDQ-WLR test software supports integrated production and development environment reducing cost of ownership. The PDQ-WLR framework with WLR test menu and test execution provide easy-to-use test platform. High accuracy and fast WLR routines actively control critical acceleration for predictive reliability tests.

Agilent PDQ-WLR test software has a well-documented, built-in relational database. This permits turnkey analysis by Agilent PDQ-AT for quick answers. If desired, the database can also be turned off or the data can be read into other databases.

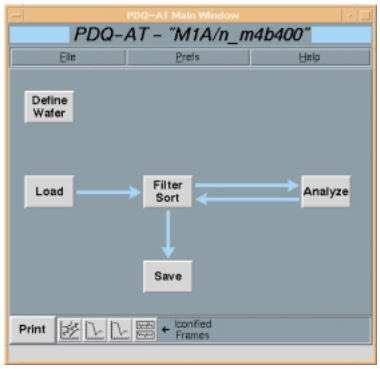
Agilent PDQ-AT™ Software

Agilent PDQ-AT is post-test statistical and physical analysis software. It aids in the analysis of production, development, or qualification test data taken by the Agilent PDQ-WLR test software.

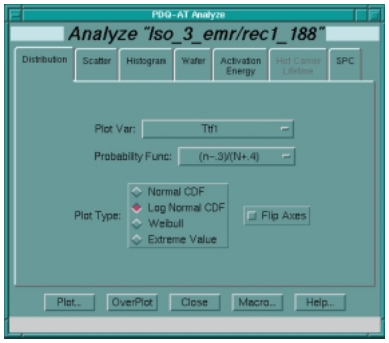
With a GUI interface and PDQ-WLR database links, access to the source of unusual or defective data is literally a mouse click away.

Click on the defective data and the source of this data (e.g. lot, wafer, site, date, operator, etc.) is displayed. If the I-V curve used to generate the data point is stored, one more mouse click will reveal this information. These features make the PDQ-AT post-measurement analysis capability sophisticated and easy-to-use.

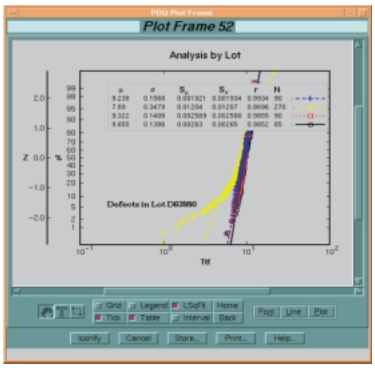
Agilent PDQ-AT provides standard statistical analysis graphical tools such as Log-Normal Cumulative



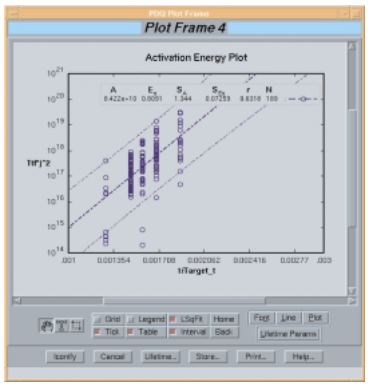
PDQ-AT's easy-to-use interface makes it simple to find the answers you need.



Sophisticated analysis is easily accessed.



Quickly and easily compare multiple lots, wafers, or batches.



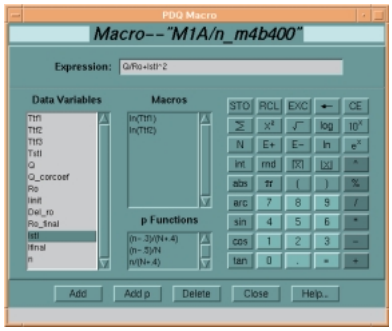
EM activation energy extraction.

Distribution Function (CDF) plots with Least Squares Fit (LSF). Since the operation is simple and GUI-based, complicated statistical analysis required for WLR can be done without much knowledge about the statistical theory. For example, the fit can be graphically changed to fit the main or defective population. Then, clicking on outlying data quickly identifies its source.

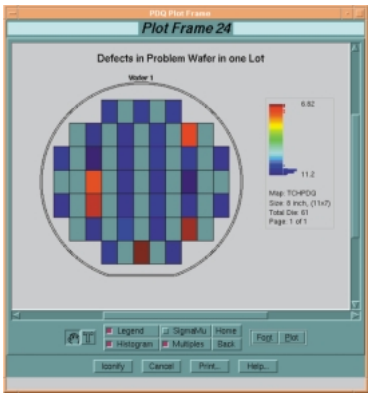
In addition to the statistical analysis tools, Agilent PDQ-AT provides physical reliability analysis capability. Physical reliability parameters are easily determined for the following:

- Hot-Carrier Degradation Lifetime extraction (Ib, 1/Vd and Ig model)
- Electromigration activation energy and lifetime extraction.

In addition, a unique and easy-



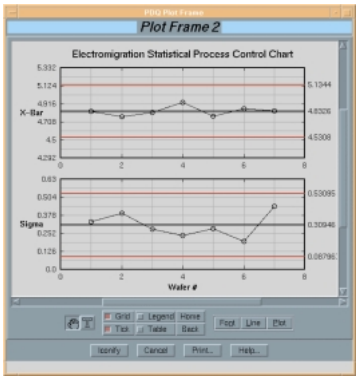
Custom analysis easily performed on any variable(s) with graphical calculator. Macro's speed repetitive analysis.



Wafer map shows detailed multiple site.

to-use graphical calculator provides advanced users with the capability to perform mathematical operations on any set of data variables. Frequently used functions can be stored and accessed as macros in the calculator window. This gives the user significant freedom in defining new acceleration techniques and extracting the parameters. Direct extraction to and import of spreadsheet data further enhances the customization.

Agilent PDQ-AT also supports trend chart for Statistical Process Control (SPC) in a production environment.



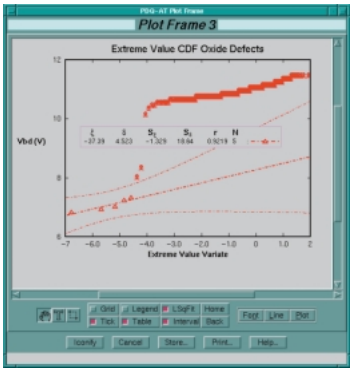
Production monitoring and analysis for fast and accurate decision-making.

Agilent PDQ-AT provides complete data manipulation capability including data merge (from different lots, tests, process, etc.); Data filter for filtering of useful/defect/bad data from the group; Data sorting and Data extraction with a simple graphical operation.

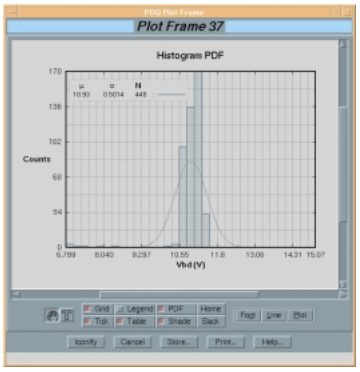
Agilent PDQ-AT Functionality List

The following functionality is provided:

- Data Sort, Limit, Extract
- Graphical Data calculator with scientific functions
- X-Y plots on any variable or calculated variable with Least Squares Fit (LSF) of graphically specified range of data
- Log-Normal Cumulative Distribution Function (CDF) plots with LSF on any range of data.
- Normal CDF plots
- Weibull distribution.
- Extreme Value distribution. A plot with LSF on selected range and confidence bound is shown.

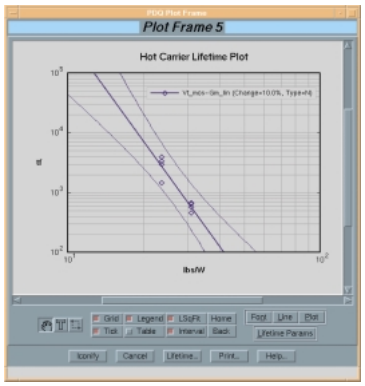


- Histogram plot. Overlay with normal probability density function (PDF) is shown.



- Full-color single or lot report wafer maps.

- EM activation energy analysis with lifetime-prediction plot. Hot carrier lifetime analysis. Prediction plots with full data linkage is shown.



- Confidence bounds (upper, lower, both) for all plots with LSF on any visually specified range.
- Statistical Process Control (SPC) trend charts
- CSV and X-graph for raw measurement data display
- Presentation-quality graphics: GIF, TIF and EPS for PDQ-AT EMF for PDQ-AT/Win

Agilent PDQ-WLR Software Test Algorithm/FunctionalityList

- EM: Isothermal, SWEAT, BEM, TCR, TVP (thermal resistance)
- GOI: V-ramp, J-ramp, V-TDDB, J-TDDB
- HCI: Constant V stress, detailed device characterization, lifetime extraction
- Charge-pumping: Interface traps/oxide trapped charges
- Capacitance-voltage: High-frequency and quasi-static
- Mobile ions: Self-heated and TVS
- Database generation and management

System Requirement and Supported Hardware

Agilent E3185B, E3186A, E3187A

- System Controller: Agilent9000 Series 700 Model 745/132L and 745I
- Operating System: HP-UX 10.20, HP BASIC/UX 8.02
- Agilent Parametric test system: Agilent 4073A, 4072A, 4071A, 4062UX
- Agilent SPECS test shell: Version 2.4 or greater

Agilent E3186B PDQ-AT/Win

- CPU: Pentium II 350MHz or faster
- Memory: >128MB RAM
- Diskspace: 7MB
- Disk drive: CD-ROM Drive
- OS: Windows NT 4.0 (Service Pack 3 or later)
- Display: XGA display (recommended)

Ordering Information

E3185B	PDQ-WLR software media (CD-ROM)/manual
E3185L	PDQ-WLR software License-to-use (LTU)
E3186A	PDQ-AT software media (CD-ROM)/manual
E3186L	PDQ-AT software License-to-use (LTU)
E3186B	PDQ-AT/Win software media (CD-ROM)/manual
E3186BL	PDQ-AT/Win software License-to-use (LTU)
E3187A	Bundled product of PDQ-WLR & AT with SPECS

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