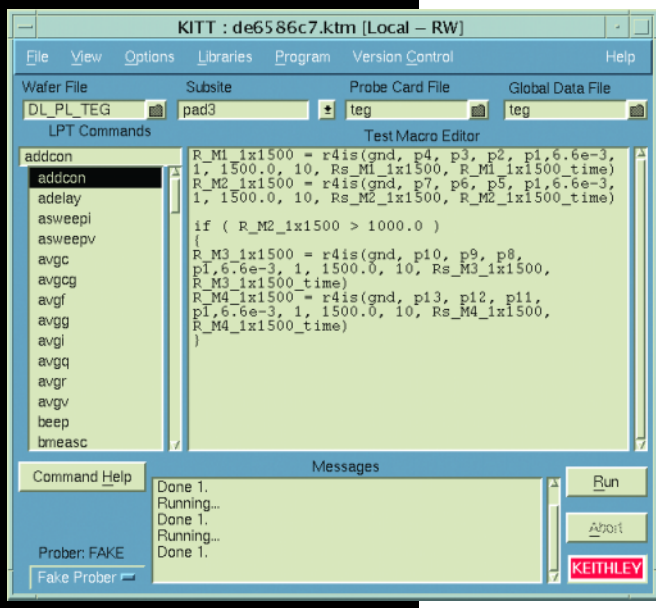
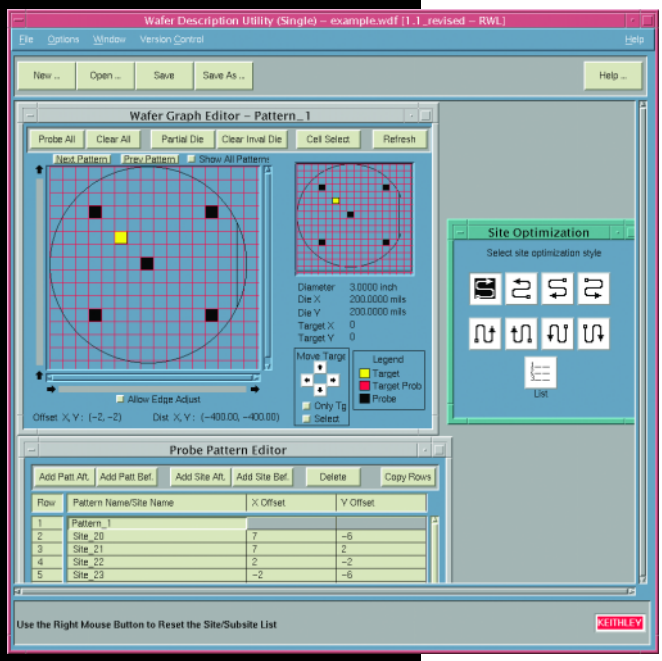
KTE

Keithley Test Environment

Version 5





Advanced Software Interface for Keithley APT Systems

Keithley's most advanced APT software solution provides a powerful test development and execution environment. KTE (Keithley Test Environment) software is compatible with S600 Series testers, S400, and the PC-based S900NT tester. Key program elements are also shared with the 4200-SCS system. This platform-to-platform compatibility not only shortens the user learning curve when working with multiple systems, but also offers a smooth migration path to protect the fab's test software investment when upgrading to higher performance systems.

Fast, Flexible Test Plan Development

The Graphical User Interface (GUI) in KTE guides test engineers through the development of a test plan. The user can create individual electrical tests at the subsite level by drawing on libraries of tests, then defining parameters and connections. To provide the ultimate in electrical test flexibility, KTE also lets users create User Libraries (custom parametric tests) using standard C. A C code generation utility simplifies this process by hiding most of the C code overhead and details.

KTE allows flexible sampling plans across individual wafers and lots. Key production control monitor tests can be performed at many wafer locations, while time-consuming tests can be assigned to a smaller set of locations. The tests to be run at each site are incorporated into a set of nested loops defined by the Keithley Test Execution Engine (KTXE). When KTXE is instructed to test a lot, it processes each wafer test plan in the cassette test plan. Within these loops, User Access Points (UAPs) simplify the customization of the test execution engine without the need for re-compiling or linking. UAPs can be used to perform tasks such as transferring data to other computers when a wafer's testing is completed or for special error-recovery tasks.

Customizable, High Speed Production Testing

Each wafer fab has its own unique production environment with its own special requirements. To meet this challenge, KTE Version 5 joins the flexibility of a custom product with the reliability and support of a proven, standardized product. Fast, automated test execution is combined with test sampling plans that allow the most efficient use of each probe touchdown, assuring maximum wafer throughput. The simple operator interface screen helps the user select a test plan quickly and accurately and indicates the live test status. User Access Points allow running custom software modules within the testing environment, so it's easy to add custom operator prompts, fab equipment coordination, customized data analysis and data logging to fit each fab's unique process. An optional SECS-II/GEM interface is available for use in standardized fab integration.

KTE Tool Set

Interactive Test Tool

The Keithley Interactive Test Tool (KITT) combines many test routine development features in a single, flexible environment. Users can create, debug, and test new algorithms interactively, as well as make direct calls to a variety of module libraries, all without writing code. These libraries include the LPTLIB parametric test library for instrument control, the PARLIB parametric test subroutine library, the PROLIB prober control library, as well as user-generated test libraries. KITT can also include math expressions, conditional tests, and array operations as part of a test macro to allow run-time optimization of the test sequence. The test structure editor allows the user to define devices, device pins, device geometry information, and other device characteristics. Finally, the parameter set editor allows the user to group common tests into sets that can be used repeatedly.

Powerful test development environment for APT systems

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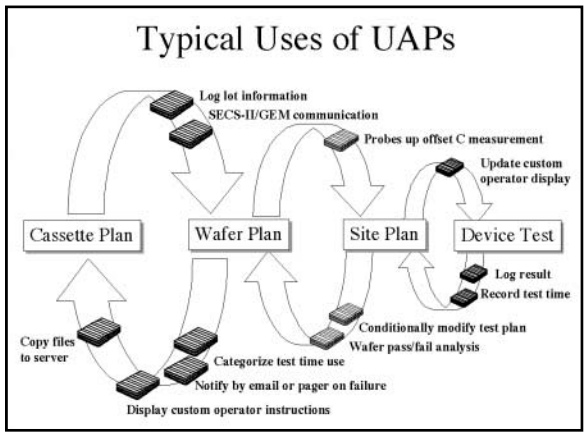
Wafer Description Utility

The included Wafer Description Utility (WDU) has a graphical user interface for specifying wafer size, die size, coordinate system, initial probe points, and first die points. Users can specify the actual probing points on a wafer map or use a numerical input screen. Users can zoom in on a specified section of the wafer map for precise probe die selection.

Test Program Manager

The Keithley Test Program Manager (KTPM) builds wafer and cassette level test plans. The software is flexible enough to allow individual plans to be created for separate wafers within a cassette plan. Test program execution can be customized through user access points to include functions such as interfacing with a CIM system. The test documentation tool allows the user to generate a listing of tests that will be executed on different sites within the test plan.



	Tool	Benefits
Test Development	Wafer Description Utility (WDU)	• Quick, easy, and intuitive selection of probe sites. • Flexible grouping of tests into sampling plans.
	Interactive Test Development Tool	• Device tests assembled in minutes. • No programming skills required. • Interactive development with instantaneous results. • Math operators +, –, *, /, abs, fabs, exp, log, log 10, pow. • Conditional tests <, <=, >, >=, ==, !=, &&, ||, !. • Test macros independent of pin assignments. • No need to rewrite test macros because different pin numbers are to be used. • Quick trial and modification.
	User Library Tool	• Limitless test algorithm flexibility. • Easy customizations. • No need to know the details of C code program construction.
	Test Structure Editor	• Enter all device-specific information only once. • Allows quick modification for technology changes such as process shrinks.
	Parameter Set Editor	• Capture test setup information into a reusable set. • Simplifies repetitive testing of similar devices. • Allows quick modifications to a test plan—a single change can be applied to multiple instances of the same test.
	Test Plan Manager	• Limitless cassette test plan possibilities. • Limitless site, wafer, and cassette sampling plan possibilities. • Programmable callback support via UAPs allows easy customization to support custom user prompts, fab communication, data logging, alarming, adaptive test, etc.
Test Execution	Test Execution Engine (KTXE)	• Data driven paradigm permits flexibility and rapid test plan optimization. • Permits fast, automated testing. • Custom fab integration supported. • Simple integration with shop floor control system.
	Operator Interface	• Simple tester operation. • Access limited to prescribed test plans. • Operator always knows status of current test.
	SECS/GEM Support	• Seamless fab coordination. • Total fab-wide integration.
	Diagnostics/ Calibration	• Accurate results guaranteed. • Repeatable results.
Test Result Analysis	Results Summary Utility	• Quick, convenient analysis of test results. • Results easily imported into third-party database or analysis software.
	Curve Analysis Tool	• Accurate device characterization. • Visualization of sweeps. • Automatic calculation of slopes.
	Test Documentation Tool	• Automatic test plan documentation. • Convenient test coverage checking.

In addition to the functionality provided in the basic KTE software environment, Keithley offers a number of optional layered software packages, designed to allow fabs to expand their testers' operation and capabilities quickly and economically:

AdapTest Software Option

Keithley Recipe Manager Option

Probe Card Manager Option

Copper Analysis Library Option

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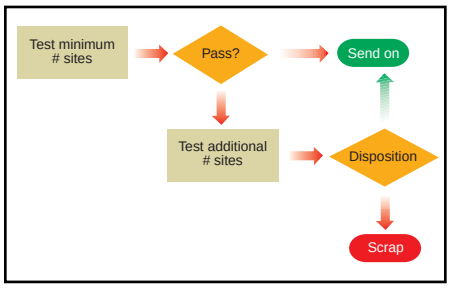
KTE Software Options

Now, fabs can choose from four different layered software options to enhance the productivity of their Keithley parametric test systems. These options packages are designed to allow fabs to expand their testers' operation and capabilities quickly and economically. All of these options require the use of current versions of the Keithley Test Environment.

AdapTest Software Option

- Layered option for S600 and S400UX Series testers
- Supports both results-based and zone-based adaptive testing
- Includes probe height adjustment and automated probe tip cleaning support
- Compatible with S400 and S600 testers running KTE v4.2.2 or later



The AdapTest software bundle is designed to enhance test throughput, product yields, process control, and process diagnostics, particularly for 300mm fabs running copper processes. It adds intelligence to the parametric test data gathering process, automatically changing test plans site-to-site and wafer-to-wafer based on that data. This layered option includes software tools that support adaptive testing, SofTouch probe height adjustment, and automated probe tip cleaning. Two methods of adaptive testing are supported. Results-based adaptive testing is fully implemented from the instrument level up to the wafer cassette level. It allows the tester to be programmed to increase or decrease the number of tests, sites tested, and wafers tested, based on the results of previous measurements. Preset zone-based testing generates random site test patterns for each cassette at runtime to detect within-wafer non-uniformity at increased wafer throughput on 300mm wafers.

Keithley's SofTouch solution automates detecting valid probe-to-pad contact on copper and aluminum pads, minimizing overdrive while verifying good electrical contact. The Probe Tip Cleaning Option allows programming the tester to initiate a cleaning cycle after a user-defined number of touchdowns, based on quality criteria when used with Probe Card Manager, or after a probe contact failure is detected with SofTouch. Together, these options ensure that tester- or prober-related effects are eliminated before adaptive testing reconfigures the test sequence.

Keithley Recipe Manager Option

- Speeds generation of valid test plans
- Version control tools prevent unintentional or undocumented code changes
- Allows easy bundled distribution of approved recipes and associated files to all testers
- Compatible with S400 and S600 Series testers running KTE v4.2.0 or later

The Keithley Recipe Manager Option (KRM) is a production-worthy package that enables test program developers to generate valid test plans quickly by allowing them to modify existing test plans easily for reuse. By providing the version control tools needed to prevent unintentional, undesired, or undocumented code changes, it also ensures that only approved test sequences are released to production.

KRM is ideal for synchronizing multi-tool, multi-fab, or joint venture production efforts because it allows easy bundled distribution of approved recipes and associated files to all testers, regardless of location. If a lot's functional test results are suspect or there are excessive field failures, KRM's traceability tools make it easy to determine whether the proper test recipe was used.

When the operator clicks the "Execute Recipe" button, the selected recipe is loaded from the production directory and the Keithley Test Execution Engine (KTXE) runs automatically, generating test results. The client/server architecture of multiple testers connected to a single system server or host ensures each tester is running the same released test plan from the recipe server. When a recipe and/or support file is revised and approved, it is automatically integrated into all the testers' production directories at the start of the next lot to be tested.

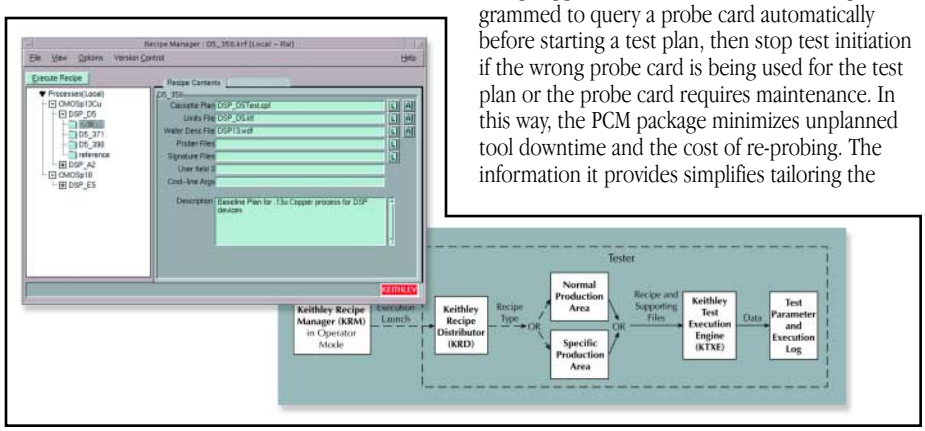
Probe Card Manager Option

- Automates probe card inventory management and maintenance scheduling
- Supports new and existing probe cards and testers
- Compatible with S600 Series Testers running KTE v4.2.0 or later

The Probe Card Manager (PCM) hardware/software package automates the management of probe card inventories. The PCM option can be specified for new cards and testers or retrofit on existing ones.

An EEPROM device attached to each probe card lets the tester identify individual cards and count probe touch-downs. It's simple to track each card independently because all ID information and touchdown counts are stored on this on-board chip. One counter tracks touchdowns during the current maintenance cycle; a second one records the card's lifetime touchdown count. The Probe Card Manager software running on the tester queries and updates the probe card information and saves it on the EEPROM. This information travels with the card when it is time to swap it out for a different type or remove it for cleaning, realignment, or other preventive maintenance.

Using supplied software, the tester can be programmed to query a probe card automatically before starting a test plan, then stop test initiation if the wrong probe card is being used for the test plan or the probe card requires maintenance. In this way, the PCM package minimizes unplanned tool downtime and the cost of re-probing. The information it provides simplifies tailoring the



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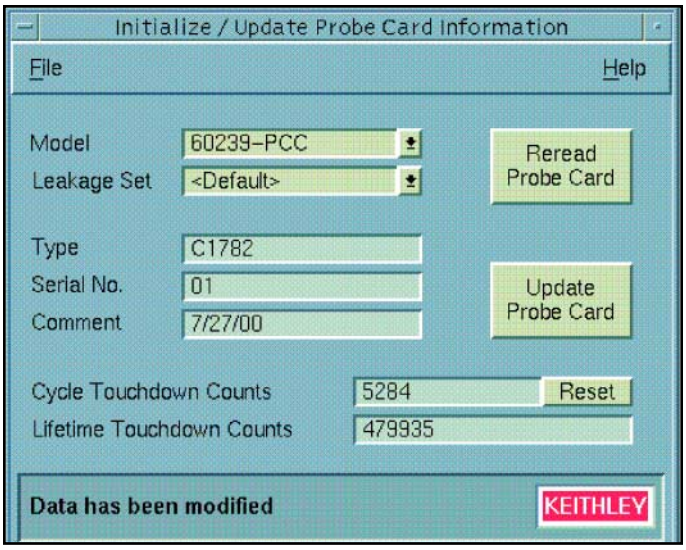

card's preventative maintenance schedule to the type of process or test plan. It also eliminates the cost of pulling the card out of service prematurely.

An offline probe card manager product is also available to allow equipment-engineering groups or off-site contractors to initialize, track, and re-initialize data on a PCM-enabled probe card in the probe card maintenance lab when no tester is available.

Copper Analysis Library Option

- Includes nine new copper test algorithms (patent pending) that can be easily incorporated into parametric test sequences
- Documentation provides recommendations for copper test structures
- Includes probe height adjustment and automated probe tip cleaning support
- Compatible with S600 Series Testers running KTE v4.2.2 or later

The Copper Analysis Library is a layered software option designed for use with the Keithley S600 Series testers running KTE, Version 4.2.2 or later. The library includes new copper test algorithms for:

- Measuring the breakdown voltage of a metal line sidewall oxide
- Copper line width measurement
- Calculating the resistance of a four-terminal metal line
- Four-terminal Van der Pauw measurement for metal sheet resistivity
- Corrosion induced metal leakage current measurement
- Sidewall leakage measurements
- Vertical resistance measurement for copper lines deposited with the dual damascene process
- Metal line sidewall capacitance extraction
- Testing the mechanical strength of a sidewall oxide exposed to thermal expansion stress from a Joule heated metal line
- Low-κ dielectric absorption

The option also includes recommendations for copper test structures to be used with these algorithms. The Copper Analysis Library provides a means of obtaining valuable information about a copper process readily. For example, the test algorithms allow users to determine the thickness variation in a barrier metal/copper line and detect sidewall defects using electrical techniques. They also enable users to test for current leakage due to photoelectric corrosion and determine if bad data is being caused by probe tip contamination.

This option also includes Keithley's SofTouch solution to automate validation of probe-to-pad contact on copper pads, minimizing overdrive while verifying good electrical contact. The Probe Tip Cleaning Option allows programming the tester to initiate a cleaning cycle after a user-defined number of touchdowns, based on quality criteria when used with Probe Card Manager, or after a probe contact failure detected with SofTouch.

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