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S530 Parametric Test System

KTE Software Manual

S530-921-01 Rev. C / September 2015

S530-921-01C

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Safety precautions

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with nonhazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the user documentation for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product warranty may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the user documentation. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, perform safe installations, and repair products. Only properly trained service personnel may perform installation and service procedures.

Keithley Instruments products are designed for use with electrical signals that are measurement, control, and data I/O connections, with low transient overvoltages, and must not be directly connected to mains voltage or to voltage sources with high transient overvoltages. Measurement Category II (as referenced in IEC 60664) connections require protection for high transient overvoltages often associated with local AC mains connections. Certain Keithley measuring instruments may be connected to mains. These instruments will be marked as category II or higher.

Unless explicitly allowed in the specifications, operating manual, and instrument labels, do not connect any instrument to mains.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30 V RMS, 42.4 V peak, or 60 VDC are present. A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 V, no conductive part of the circuit may be exposed.

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance-limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, ensure that the line cord is connected to a properly-grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

For safety, instruments and accessories must be used in accordance with the operating instructions. If the instruments or accessories are used in a manner not specified in the operating instructions, the protection provided by the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with the same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as protective earth (safety ground) connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If a ⏚ screw is present, connect it to protective earth (safety ground) using the wire recommended in the user documentation.

The symbol on an instrument means caution, risk of danger. The user must refer to the operating instructions located in the user documentation in all cases where the symbol is marked on the instrument.

The ⚡ symbol on an instrument means caution, risk of electric shock. Use standard safety precautions to avoid personal contact with these voltages.

The symbol on an instrument shows that the surface may be hot. Avoid personal contact to prevent burns.

The symbol indicates a connection terminal to the equipment frame.

If this Hg symbol is on a product, it indicates that mercury is present in the display lamp. Please note that the lamp must be properly disposed of according to federal, state, and local laws.

The **WARNING** heading in the user documentation explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in the user documentation explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits — including the power transformer, test leads, and input jacks — must be purchased from Keithley Instruments. Standard fuses with applicable national safety approvals may be used if the rating and type are the same. Other components that are not safety-related may be purchased from other suppliers as long as they are equivalent to the original component (note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product). If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water-based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., a data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

Safety precaution revision as of January 2013.

Table of Contents

Section 1

Introduction

In this section:

Introduction

This manual details the operation and use of the KTE software for the S530 Parametric Test System. It explains the different software tools used in creating and executing test programs and how system files are controlled and handled.

Contact information

If you have any questions after you review the information in this documentation, please contact your local Keithley Instruments office, sales partner, or distributor. You can also call Keithley Instruments corporate headquarters (toll-free inside the U.S. and Canada only) at 1-800-935-5595, or from outside the U.S. at +1-440-248-0400. For worldwide contact numbers, visit the Keithley website (*http://www.keithley.com*).

Manual contents

- **Section 1, Introduction** (on page 1-1): Gives an overview of the manual and an overview of the entire Keithley Test Environment (KTE) software system.
- **Section 2, Creating test plans** (on page 2-1): Discusses the tools used to create test plan files.
- **Section 3, Test execution** (on page 3-1): Discusses the tools that control the selection and execution of cassette plans.
- **Section 4, Data analysis** (on page 4-1): Describes the tools used to gather and analyze results data provided by an executed test program.
- **Section 5, System administration** (on page 5-1): Details the setup of the KTE software, file management, system configuration, and ethernet specifications.
- **Appendix A, Keithley Data Files Library** (on page A-1): Describes the set of routines used to organize and save parametric test data into ASCII data files.
- **Appendix B, Keithley User Interface Library**: (on page B-1) Describes the different subroutines that support the creation of sophisticated operator interface dialogs for test programs.
- **Appendix C, KTE Tool file structure examples**: (on page C-1) Provides file structure examples for all of the files created using the KTE software.
- **Appendix D, Data pool** (on page D-1): Describes the data pool which is used to hold global data while the Keithley Test Execution Engine (KTXE) is running.
- **Appendix E, User access points** (on page E-1): Provides descriptions and examples on how to use User Access Points.

Other documentation

Although this manual provides some detailed information about the KTE software system, it does not repeat information contained in other manuals. For information pertaining to the KTE software that is not in this manual, refer to the following documentation.

- **Linear Parametric Test Library (LPTLib) Manual:** A library of command subroutines that provide direct program control of the instrumentation and matrix.
- **Parametric Test Library (PARLib) Manual:** PARLib is a parameter extraction and data analysis software system. The PARLib subroutines are used to analyze data associated with S530 parametric tests.
- **Prober Library Manual:** A library of subroutines used to control a variety of manual and automatic wafer probers.

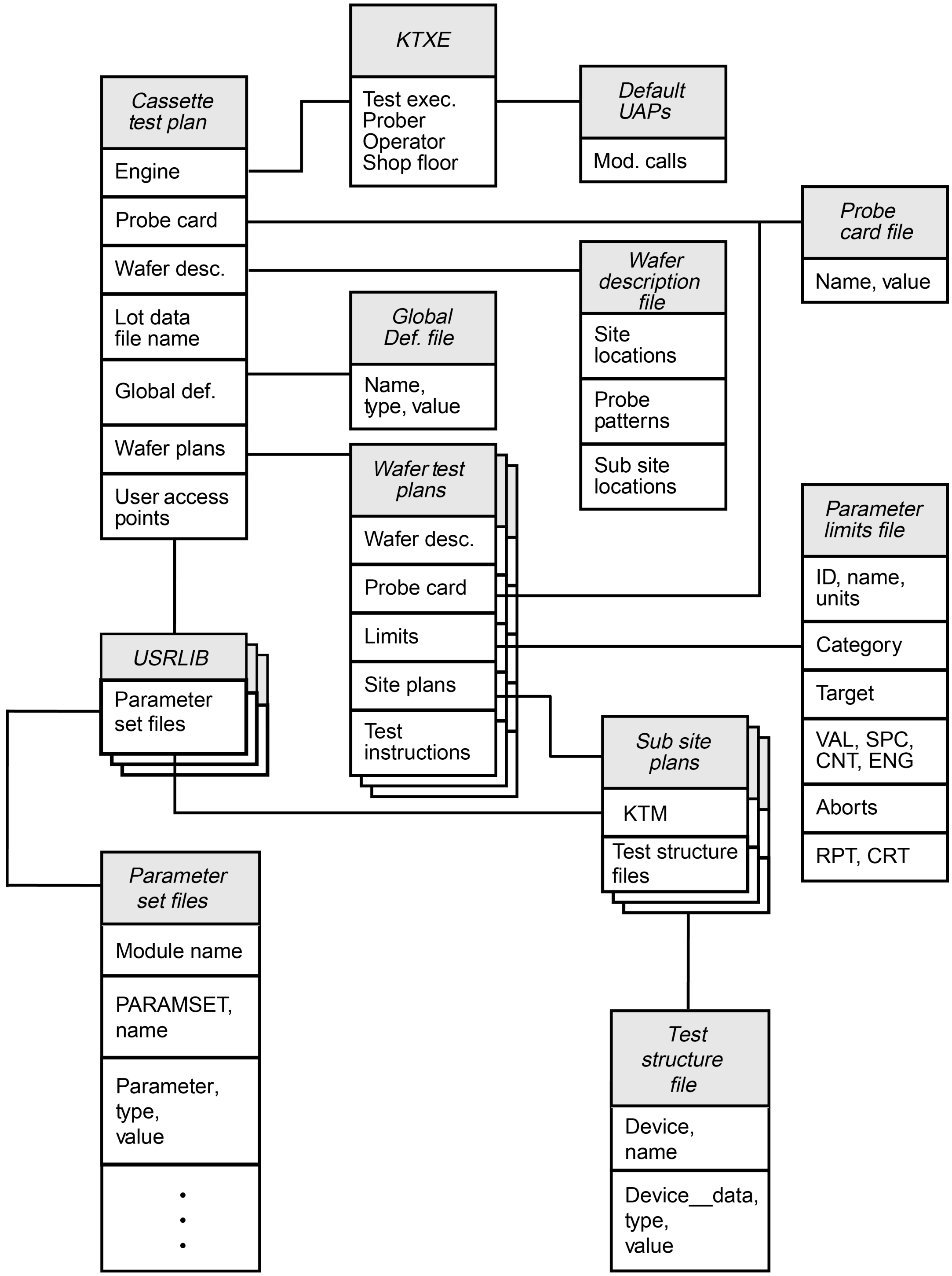
System software

This version of the software differs from earlier versions of the KTE software tools. Earlier versions (V2.X) of the KTE software created compiled, uneditable, executable files. This version of the software creates a much more flexible, editable test plan. The benefits derived from this version include:

- Test plans that can be edited to suit your needs.
- User Access Points (UAPs) that allow you to extend the functionality of the test execution engine.
- Test execution that is data driven. This means that test plan execution is derived from data files read by the test execution engine.

The following figure shows a diagram of how KTE is used to create and execute a cassette plan.

Figure 1: Data file hierarchy



The data elements for a test plan are created in much the same way as the executable files in earlier versions of KTE:

- The Wafer Description Utility (WDU) is used to describe the wafer and specify the test sites and subsites.
- The Limits File Editor (LFE) is used to specify the test result limits.
- The Keithley User Library Tool (KULT) is used to create user libraries that are accessible in the Keithley Interactive Test Tool (KITT).
- KITT is used to create the test macro that will be run on the selected wafer.

The improvements that have come as a result of this version include:

- Adding the Keithley Data Editor (KDE), which gives you access to all probe card files (`.pcf`), global data files (`.gdf`) and predefined identifiers (PDI) from one centralized location.
- Adding the Test Structure File Editor (TSE), which allows you to create a set of test parameters for each different device that is to be tested.
- Adding the Parameter Set Editor (PSE), which allows you to edit and add parameter set data for a specific routine.
- Changes to the KITT Parameter Entry Window that allow you to provide more detailed parameter data.
- The ability to create probe card files (`.pcf`) that specify pad name to tester pin assignments.
- The ability to create global data files (`.gdf`) that assign values to test data variables and can be accessed by multiple test plans.
- The ability to create wafer plans (`.wpf`) that specify the wafer description, site and subsite plans, the test macros that will be applied to the wafer, and the limits file that will control the wafer testing depending on the test results.
- The ability to create cassette test plans (`.cpf`) that tie all of the test data together into a coherent executable test plan.
- Adding the ability to use math expressions in test macros and conditional execution of test modules.

All of the data files created using KTE play important roles in creating a coherent test plan. The following figure shows a diagram of the data in each file and the placement of each file when a test plan is created.

During test plan creation, it is possible to specify the probe card file and the wafer description file in more than one place. If this occurs, the file specified in the Cassette Test Plan takes precedence over the file specified in the Wafer Test Plan.

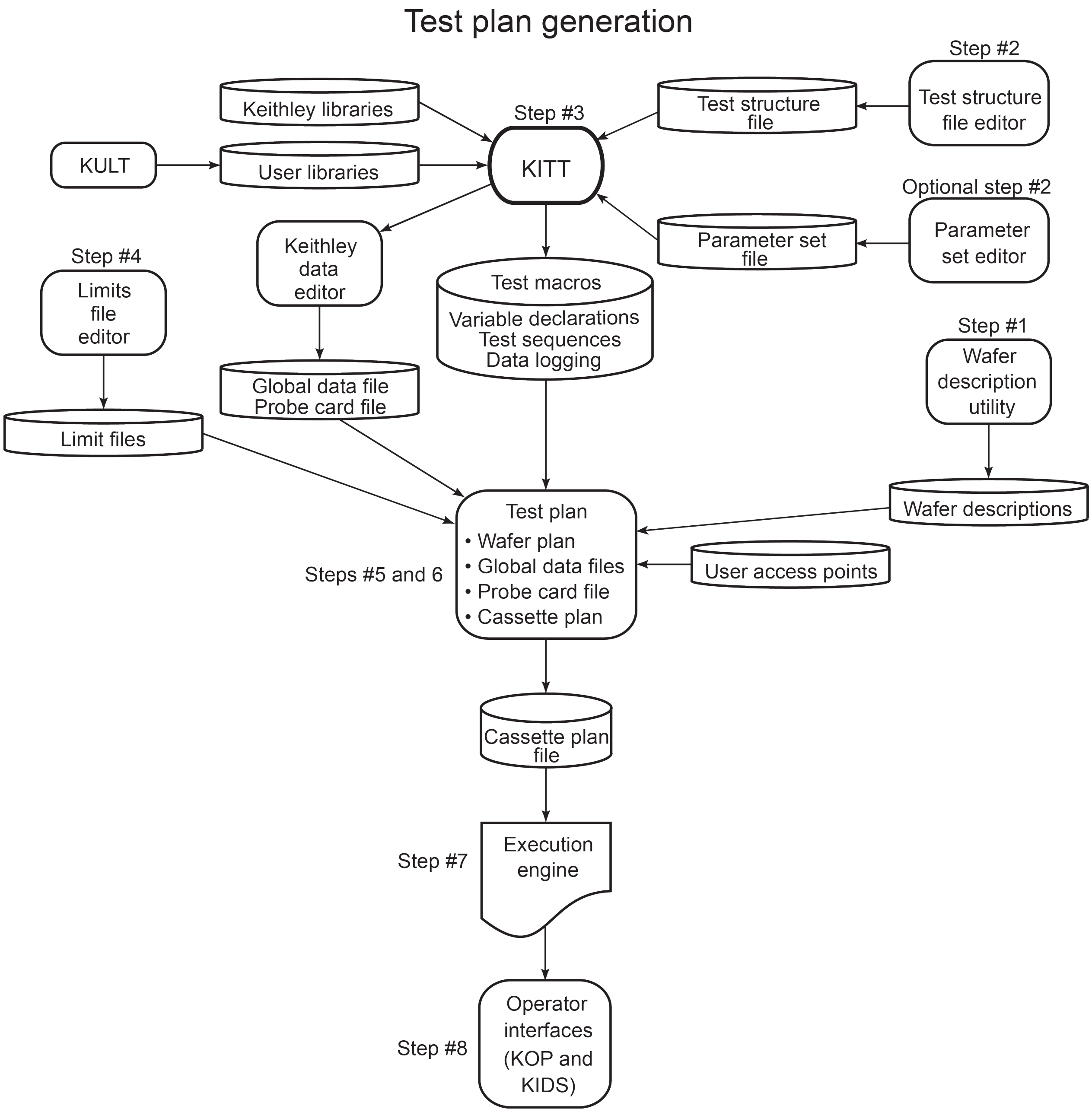
The Test Execution Engine (KTXE) accesses the Cassette Test Plan, which specifies the:

- Execution engine
- Probe card file
- Wafer description file
- Lot data filename
- Global data file
- Wafer test plans

The cassette plan then accesses this data. If the probe card file and wafer description file have already been specified by the cassette plan, they are ignored if specified in the wafer plan file.

Production-quality test plans are created using the Keithley Test Plan Manager (KTPM). KTPM allows you to create sophisticated test plans without having to edit, compile, and link C language source files. Instead, you create your test plans by selecting from prebuilt program elements and allow KTPM to bind them together to produce the final cassette plan. The following figure shows the test plan creation process.

Figure 2: Test plan generation block diagram



The software that is used by the system is the Keithley Test Equipment (KTE) Software platform. With the KTE software tools you can create and execute the test programs that are performed by the parametric test system. The KTE software tools include:

Wafer Description Utility (WDU): Captures information to describe the size of a wafer, its orientation, sites, and subsites.

Test Structure File Editor (TSE): Used to create test structure files that contain device-specific parameters.

Keithley Interactive Test Tool (KITT): Used to create test macros (including the data used), and interactively debug the macros on the tester.

Keithley Data Editor (KDE): Used to create and modify global data files and probe card files.

Parameter Set Editor (PSE): Used to edit and add parameters for a library module routine.

Keithley User Library Tool (KULT): Used to create test modules and user libraries that can be used in KITT and as user access points (UAPs) to control the testing process.

Limits File Editor (LFE): Used to capture information describing the criteria for judging the measured parameters identified in KITT.

Keithley Test Plan Manager (KTPM): Used to create wafer test plans, cassette plans, and cassette plan documentation.

Keithley Operator Interface Editor (KOPED): Used to create the operator's cassette plan selection tree that is presented to the operator in KOP.

Keithley Operator Interface (KOP): Used by the operator to select and execute a cassette plan.

Keithley Test Execution Engine (KTXE): Executes the cassette plans created using KTPM. The KTXE used is specified in the cassette plan.

KTE Integrated Display Service (KIDS): Used for recipe selection, execution, display status, and the 300mm automation option (if installed).

Keithley Summary Utility (KSU): Used to view the results and compare them against the parameter limits entered in the Limits File Editor.

Keithley Curve Analysis Tool (KCAT): Used to create a graphical representation of array results data generated from a test run using KITT.

For more information about the KTE software tools, refer to Creating test plans (on page 2-1).

Section 2

Creating test plans

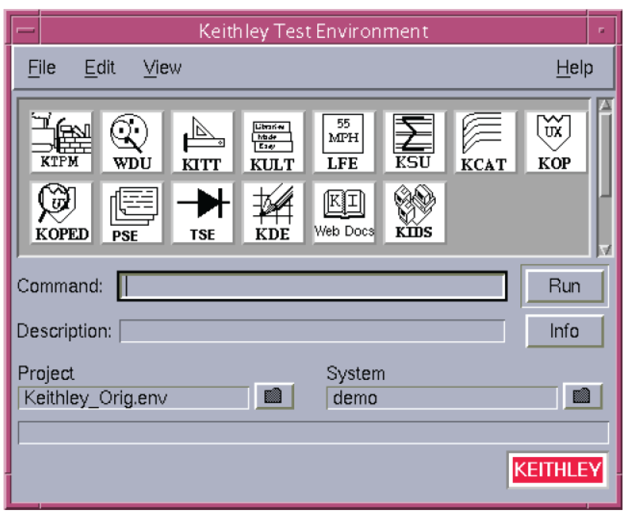
In this section:

Introduction

This section describes the tools required to create the files used when building a test plan, including:

- Wafer Description Utility (on page 2-3): Using the Wafer Description Utility (WDU) to create a wafer description file that describes the wafer used during the testing process.
- Test Structure File Editor (on page 2-21): Using the Test Structure File Editor (TSE) to create parameters for a specified device located at a specific wafer subsite.
- Keithley Interactive Test Tool (on page 2-25): Using the Keithley Interactive Test Tool (KITT) to create a test macro containing the tester commands.
- Parameter Set Editor (on page 2-38): Using the Parameter Set Editor (PSE) to modify parameter set data assigned to a library module.
- Keithley User Library Tool (on page 2-41): Using the Keithley User Library Tool (KULT) to create a user library that contains test modules that can be used when creating a test macro.
- Limits File Editor (on page 2-58): Using the Limits File Editor (LFE) to create a limits file containing parameter limits that are compared to the results acquired during testing.
- Keithley Test Plan Manager (on page 2-62): Using the Keithley Test Plan Manager (KTPM) to create a cassette plan file (`.cpf`) that can be executed by the Keithley Test Execution Engine (KTXE).
- Keithley Tool Pallet: Using the Keithley Tool Pallet (KTP) in a point-and-click interface for the Keithley Test Environment (KTE). The tool palettes for the S530 system, shown in the following figure, contain an icon for each of the test plan development and utility functions. Refer to System administration (on page 5-1) for further details about Keithley Tool Pallet.

Figure 3: Keithley tool palette



Wafer Description Utility (WDU)

The Wafer Description Utility (WDU) captures the size and location information that describes where the test structures that will be probed are when this wafer description file is used. This information is entered through seven different windows within the WDU:

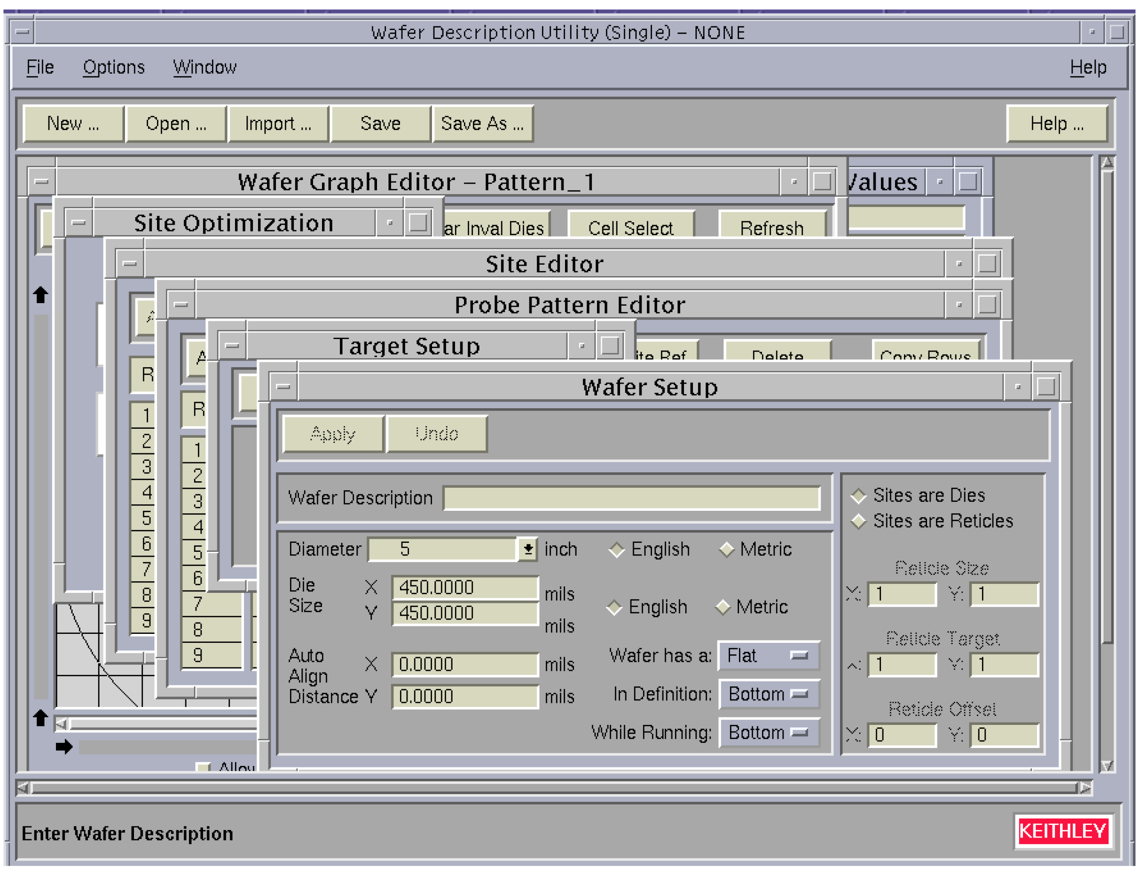
- Wafer Setup
- Target Setup
- Probe Pattern Editor
- Site Editor
- Site Optimization
- Wafer Graph Editor
- User Defined Values

The resulting file is saved in an easy-to-read ASCII format.

WDU main window

The Wafer Description Utility (WDU) main window appears when WDU is initiated. A description of the main window components follows.

Figure 4: WDU main window



Title bar: The title bar displays the filename of the current wafer description file, and the read-write status of the file.

Menu bar: The menu bar contains selections used to modify the information in the main window work area.

Control buttons: The control buttons (New, Open, Import, Save, Save As, and Help) give you control over the information in the main window work area.

Main window work area: The main window work area contains all the windows used to enter the data for each wafer description file.

WDU File menu

Selecting **File** produces the menu shown in the following figure.

Figure 5: WDU File menu

New: Initializes a new `.wdf` file as either single or multiple project.

Open: Opens an existing `.wdf` file.

Import: Imports or converts a file to a `.wdf` file. The import script must be specified in the `wdu.ini` file. See the Wafer Description Utility (WDU) online help for more details.

Save: Writes the current `.wdf` to the path and filename shown in the title bar.

Save As: Writes the current `.wdf` file to a user-specified path and filename.

Delete: Opens a window allowing you to delete a file.

Print: Allows you to print data from the Site Editor, Wafer Graph Editor, Target Setup, Wafer Setup, Probe Pattern Editor, and Site Optimization screens.

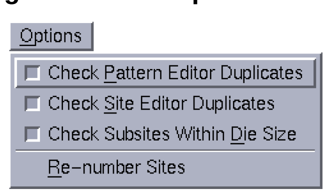
Print Setup: Lets you set up the printed page parameters.

Exit: Exits the WDU.

WDU Options menu

Selecting **Options** from the menu bar produces the menu in the figure below.

Figure 6: WDU Options menu



Check Pattern Editor Duplicates: Checks for duplicate probe pattern IDs, cross-checks the site IDs in the Probe Pattern Editor against those in the Site Editor, and checks for duplicate site locations within a pattern, all when saving the file.

Check Site Pattern Duplicates: Checks for duplicate subsite IDs and for duplicate site IDs when saving the file.

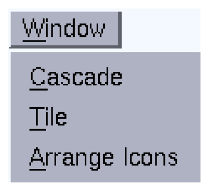
Check Subsites Within Die Size: Verifies that all subsite coordinates are within the die size when saving the file. The Wafer Description Utility (WDU) uses the absolute values of subsite coordinates in its comparison against the die size.

Re-number Sites: Renumbers site IDs. Any existing site IDs are replaced with the default names, `Site_N`, where *N* is an increasing number. This allows you to reorder site names and numbers. You are prompted before any action is taken.

WDU Window menu

Selecting **Window** from the menu bar produces the menu in the following figure.

Figure 7: WDU Window menu



Cascade: Arranges all windows so the title bars of each can be seen in the main window.

Tile: Arranges all the windows so they are viewed in the main window work area.

Arrange Icons: Arranges the icons for all the closed windows along the bottom of the main window work area.

WDU Help menu

Selecting **Help** produces a menu that accesses the following items:

WDU Documentation: Provides help for the Wafer Description Utility (WDU).

About: Displays the installed WDU version number.

Control buttons

Clicking a control button performs one of the following procedures:

New: Allows the selection of Single or Multi-project mode, and initializes the Wafer Description Utility (WDU) for the entry of a new `.wdf` file.

Open: Opens an existing `.wdf` file.

Import: Imports or converts a file to a `.wdf` file. Import script must be specified in the `wdu.ini` file. See the WDU online help for more details.

Save: Writes the current `.wdf` file to the path and filename shown in the title bar.

Save As: Writes the current `.wdf` file to a user-specified path and filename.

Help: Provides online help information about the WDU.

Main window work area

The main window work area is directly below the control buttons. This area contains all of the windows used to enter data for each wafer description file:

Wafer Setup: Lets you enter data describing the wafer (For example, wafer size and notch location).

Target Setup: Lets you position the wafer target and change the wafer orientation.

Probe Pattern Editor: Lets you add or remove wafer locations from probe patterns (group of site locations on the wafer).

Site Editor: Lets you add or remove subsites from within sites.

Site Optimization: Lets you select the site probing order.

Wafer Graph Editor: Graphically shows die locations that are selected (single project only) and allows cursor selection of additional die locations.

NOTE

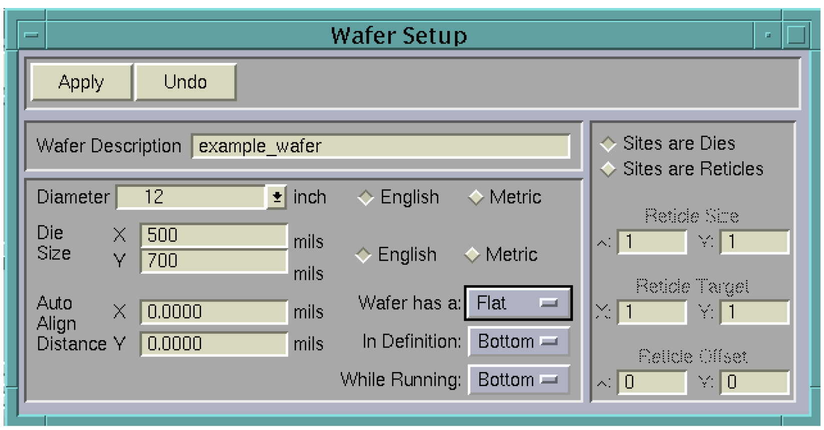
The center mouse button can be used to select any of these windows when the cursor is in the main window work area.

The functions of each window are discussed in detail in the subsections that follow.

Wafer Setup window

The Wafer Setup window, shown in the following figure, is used to enter all of the wafer size, die size, site definition, and autoalign distance data.

Figure 8: Wafer Setup window



Control buttons

Apply: Applies the wafer setup information to all other windows.

Undo: Resets the field values to the values present at the time of the previous Apply.

Wafer setup data fields

Wafer Description: Lets you enter a short description of the `.wdf` file.

Diameter: Lets you set the diameter of the wafer (inches or millimeters) from a default list of sizes stored in the `wdu.ini` file by clicking the down arrow and making the desired selection.

Die Size: Lets you enter the X and Y die size (mils or millimeters). These fields are not used for multiproject wafers.

Auto Align Distance: Lets you enter the X,Y position for a prober move that could be used to position the wafer for manual adjustments. User Access Point (UAP) code must be written and referenced in the cassette plan to use this data at run time.

English-Metric selector buttons

The top set of buttons lets you select English (inches) or Metric (millimeters) as the measurement setting for the wafer diameter. The bottom set of buttons lets you select English (mils) or Metric (millimeters) as the measurement setting for the rest of the wafer data.

Wafer orientation buttons

Pop-up windows are activated when positioning the cursor on the following selection rectangles and holding the left mouse button down.

Button preceded by "Wafer has a" (flat or notch button): Select flat or notch.

Orientation buttons: Specify the flat or notch position to be on the left, right, bottom, or top of the wafer in the following two categories:

- **"In Definition" (Bottom, Top, Left, or Right button):** Specifies the normal flat or notch orientation.
- **"While Running" (Bottom, Top, Left, or Right button):** Specifies the orientation to which the flat or notch may be rotated when in the prober (for example, to probe the "streets" in a particular direction).

Site definition area

Sites are Dies button: Specifies that each site is an individual die, in contrast to a group of dies, as defined by a reticle. Accordingly, the reticle dimension and coordinate fields in the site definition area are disabled.

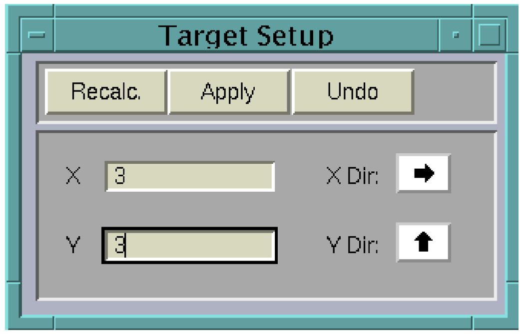
Sites are Reticles button: Specifies that each site is a group of dies, as defined by a reticle. The sets of fields described below specify the size and coordinates of the reticle.

- **Reticle Size field:** When Sites are Reticles is selected, Reticle Size specifies the X,Y dimensions of a reticle in terms of the number of sites in each direction. For example, if X: is 4 and Y: is 4, the reticle is 4 sites wide and 4 sites deep and contains 16 dies.
- **Reticle Target field:** When Sites are Reticles is selected, defines the relative X,Y coordinates of the reticle’s target die in terms of the number of sites in each direction. For example, if Reticle Target coordinates are 2,2 and Reticle Offset coordinates are 0,0 (see below), the target die is located in the second column from the left and the second row from the bottom.
- **Reticle Offset field:** When Sites are Reticles is selected, Reticle Offset defines the relative X,Y location on the reticle from which internal coordinates are measured. For example, if Reticle Offset is 0, 0, the internal coordinates are measured from origin of the reticle (lower left corner).

Target Setup window

The Target Setup window shown in the following figure, sets the X,Y coordinates of the target site (die or reticle) and the direction for increases in the X,Y coordinate values.

Figure 9: Target Setup window



Control buttons

Recalc.: Saves target information and adjusts the coordinate values of all specified sites so that the relative position of the target site is maintained.

Apply: Saves target information only. Sites specified will shift relative to the new target.

Undo: Resets the field values to the values present at the time of the previous Apply.

X and Y data fields

These fields let you specify the target X and Y coordinate values in site (die or reticle) units for single project wafers, or in mils and millimeters for multiproject wafers (multiproject wafers have more than one repeating reticle pattern).

X dir and Y dir arrow buttons

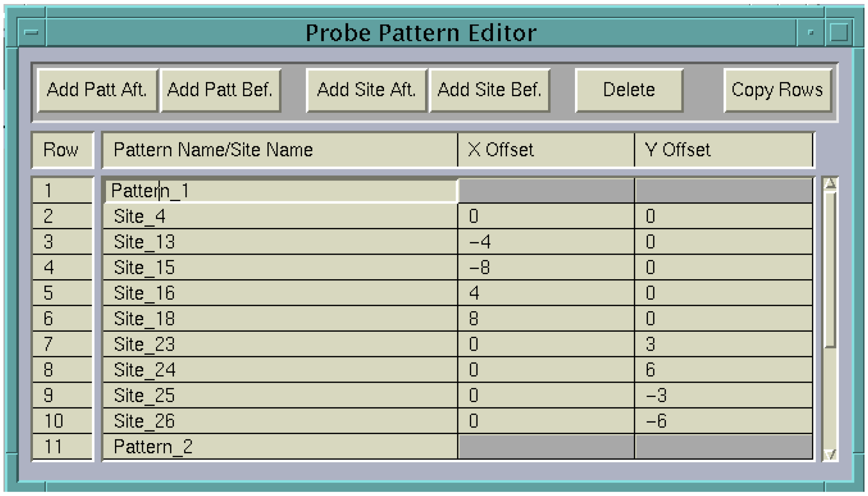
These buttons let you set the direction in which the X and Y position values increase.

Probe Pattern Editor window

The Probe Pattern Editor window, shown in the following figure, is used to specify site probe patterns during testing. These site probe patterns are paired with tests in the Keithley Test Plan Manager (KTPM) tool's Wafer Plan Editor window. This allows a simple method for specifying different tests at different sites.

All the tests for a specific site from multiple patterns are combined by the execution engine so that each site is visited by the test probe one time only. Default site names are given to each site in a pattern. You can change this default name by clicking the site name and entering a different name for the site.

Figure 10: Probe Pattern Editor window



Right-clicking the mouse button in the Pattern Name field brings up a menu that lets you move quickly through the different patterns you have created. The commands that are accessed through this menu are:

Goto Next Pattern: Jumps to the next pattern in the list.

Goto Previous Pattern: Jumps to the previous pattern on the list.

Find Pattern: Opens a dialog box that lets you enter the name of the pattern you want to change.

Find Site: Opens a dialog box that lets you enter the name of the site you want to change.

Find Site Location: Opens a dialog box that lets you enter the coordinates of the site location you want to change.

Reset Pattern/Site List: Removes all patterns and sites from the Pattern Editor window.

Control buttons

The control buttons along the top of the Probe Pattern Editor window function for both single and multiproject files:

Add Patt Aft.: Adds a pattern name field to the pattern listing after the currently selected field.

Add Patt Bef.: Adds a pattern name field to the pattern listing before the currently selected field.

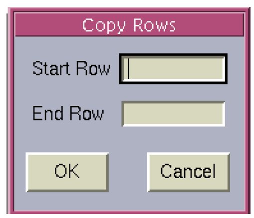
Add Site Aft.: Adds a site name field to the site listing after the currently selected field. Site names are not necessary for single project wafers because all sites are identical.

Add Site Bef.: Adds a site name field to the site listing before the currently selected field. Site names are not necessary for single project wafers because all sites are identical.

Delete: Deletes the currently selected field.

Copy Rows: Copies the rows indicated in the Copy Rows window, shown in the following figure, after the row where the cursor is currently positioned.

Figure 11: Copy Rows window



Pattern Name/Site Name data field

The information in this field depends on the project type selected with the New button. A pattern name must be entered before any sites can be added. The default name `Pattern_1` is entered by the Wafer Description Utility (WDU) when a new `.wdf` file is started.

Single project: Site names are not necessary, but can be entered for a single project wafer, because all the dies on the wafer are the same. A `.wdf` file can contain many probe patterns.

Multiproject: Each site within a pattern must be given a name because a multiproject pattern is not restricted to a single, repeating reticle frame. Many probe patterns are also supported in a multiproject wafer file.

X and Y offset fields

The information in these fields differ depending on the project type selected.

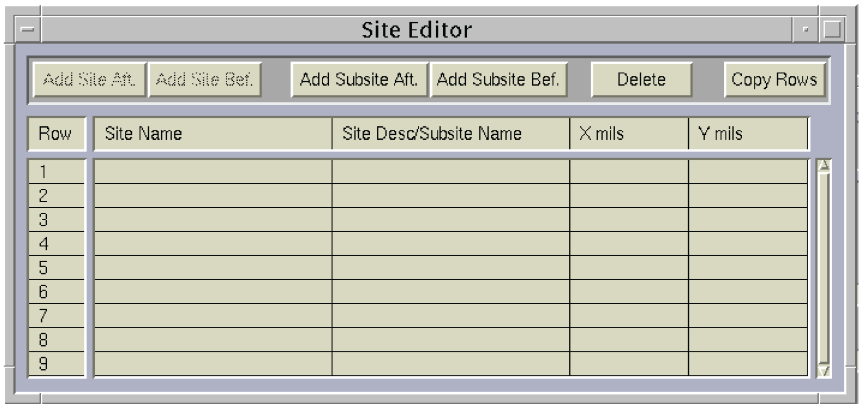
Single project: The X,Y offset values are based on site (die or reticle) coordinates. You specify the coordinate values through the Target Setup window.

Multi-project: The X,Y values provided are position information in millimeters or mils. These values are absolute position information. The wafer alignment can be used to put the wafer in the correct initial position.

Site Editor window

The Site Editor window, shown in the following figure, is used to specify the different sites and their subsites. The information required depends on the project type selected.

Figure 12: Site Editor window

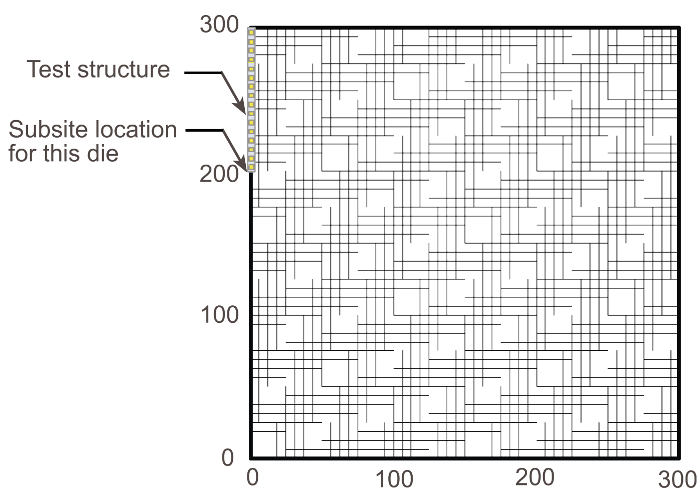


Single-project wafers have only one site type; no site information is necessary – only subsite information. Multiproject wafers can have more than one site type. Therefore, both the site's description and subsite locations must be provided.

To specify subsite X,Y coordinates:

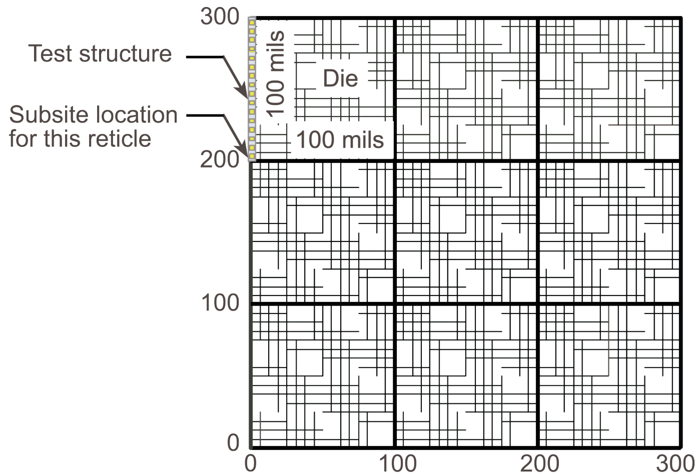
- For a site that is defined as a die, specify subsite coordinates relative to the dimensional origin of the die (typically the lower left corner of the die). See the following figure.

Figure 13: Subsite coordinates 0,200 for a site that is defined as a single 300 mil x 300 mil die



- For a site that is defined as a reticle, specify subsite coordinates relative to the dimensional origin of the reticle (typically the lower left corner of the reticle), even though the subsite may be a test structure on one of the dies that compose the reticle. See the following figure.

Figure 14: Subsite coordinates 0,200 for a site defined as a reticle with nine 100 mil x 100 mil



Right-clicking the mouse button in the Site Name field brings up a menu that lets you move quickly through the different patterns you have created. The commands that are accessed through this menu are:

Find Site: Opens a dialog box that lets you enter the name of the site you want to change.

Find Subsite: Opens a dialog box that lets you enter the name of the subsite you want to change.

Find Subsite Location: Opens a dialog box that lets you enter the coordinates of the subsite location you want to change.

Reset Site/Subsite List: Removes all sites and subsites from the Editor window.

Open .tsf: Opens the corresponding test structure file in the Test Structure Editor (TSE). If the file does not exist, you are prompted to create the file or cancel.

Control buttons

The control buttons along the top of the Site Editor window function as follows:

Add Site Aft.: Used for multiproject wafers to provide site information after the currently selected field for a site name listed in the Probe Pattern Editor.

Add Site Bef.: Used for multiproject wafers to provide site information before the currently selected field for a site name listed in the Probe Pattern Editor.

Add Subsite Aft.: Adds a subsite after the currently selected field.

Add Subsite Bef.: Adds a subsite before the currently selected field.

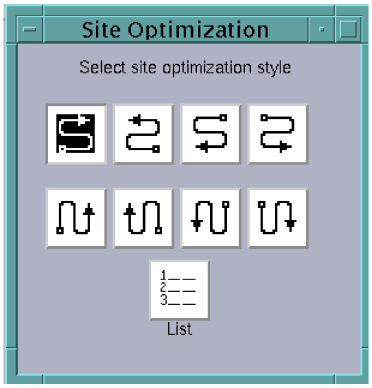
Delete: Deletes the currently selected field.

Copy Rows: Copies the rows indicated in the Copy Rows window after the row where the cursor is currently positioned.

Site Optimization window

The Site Optimization window, shown in the following figure, is used to specify the order in which each of the test sites on the wafer is tested.

Figure 15: Site Optimization window



You may choose from eight different patterns and the List selection. When a pattern is selected, the tester starts at the site closest to the chosen location and then proceeds to all selected sites on the wafer, following the selected serpentine pattern. When the List selection is chosen, the system tests each of the sites in the order they are listed in the Probe Pattern Editor window.

Wafer Graph Editor window

The Wafer Graph Editor window, shown in the following figures, works with single-project `.wdf` files only. This window displays a single probe pattern at a time or all probe patterns contained in a `.wdf` file (see the Show All Patterns button above the wafer display). The left mouse button can be used to select additional site locations to be included in a probe pattern.

Figure 16: Wafer Graph Editor when "Sites are Dies" is selected in

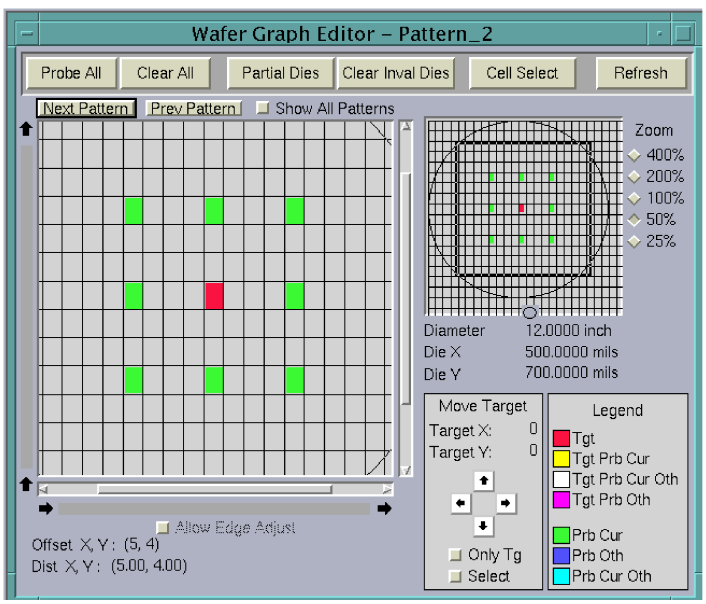
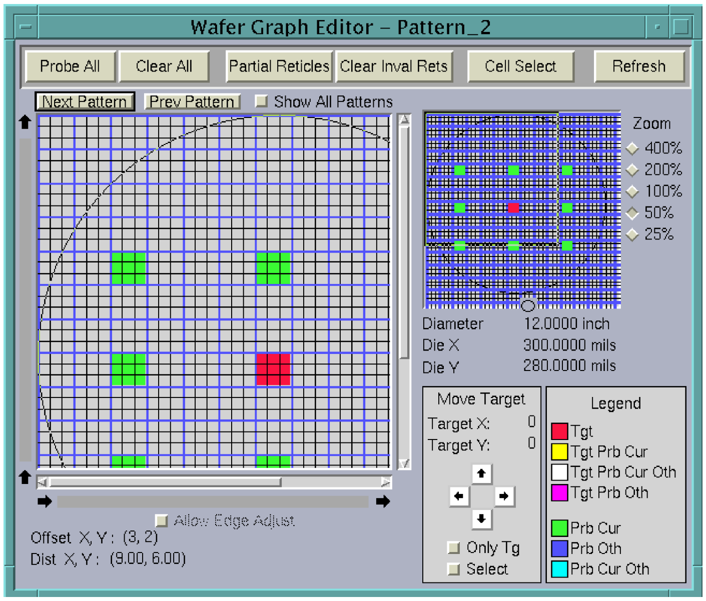


Figure 17: Wafer Graph Editor when Sites are Reticles selected in Wafer Setup Window



Note that in the previous figure, the graphical site display at left shows both the full reticles and the individual dies within each reticle.

Large control buttons

Probe All: Selects all possible sites on the wafer.

Clear All: Clears all selected sites on the wafer.

Complete Dies/Partial Dies: Visible only when Sites are Dies is selected in the Wafer Setup window; selects whether partial dies or only complete dies can be selected for testing.

- **Partial Dies:** You can select dies that do not fall completely within the usable wafer space.
- **Complete Dies:** You cannot select dies that do not fall completely within the usable wafer space (for example, a Probe All action will then select only dies that are fully within the usable wafer space). If any previously selected dies straddle usable wafer boundaries, those dies are deselected when you click Refresh or Clear Inval Dies.

Complete Rets/Partial Rets: Visible only when Sites are Reticles is selected in the Wafer Setup window; selects whether partial reticles or only complete reticles can be selected for testing.

- **Partial Reticles:** You can select reticles that do not fall completely within the usable wafer space.
- **Complete Reticles:** You cannot select reticles that do not fall completely within the usable wafer space (for example, a Probe All action selects only reticles that are fully within the usable wafer space). If any previously selected reticles straddle usable wafer boundaries, those reticles are deselected when you click Refresh or Clear Inval Rets.

Clear Inval Dies: Visible only when Sites are Dies is selected in the Wafer Setup window; when Complete Dies has been previously selected, clears all the dies selected for testing that do not fall completely within the usable wafer space.

Clear Inval Rets: Visible only when Sites are Reticles is selected in the Wafer Setup window; when Complete Rets has been previously selected, clears all the reticles selected for testing that do not fall completely within the usable wafer space.

Cell Select/Row Select/Col Select: Lets you select test sites by individual site, entire row, or entire column. Clicking the button scrolls through the selections.

Refresh: Refreshes the Wafer Graph Editor window with all changes or updates made to the data from all the other windows.

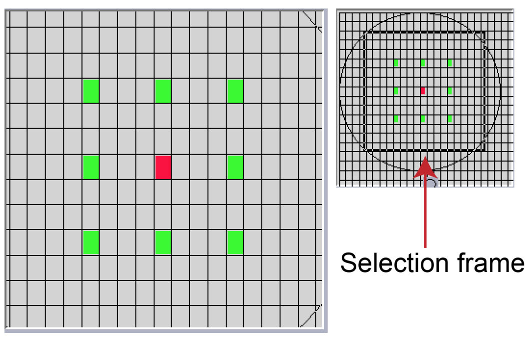
Graphical editing features

The wafer Graph Editor Window has the following graphical editing features.

Graphical site displays

In the following figure, the specific sites represented in the large pattern at left correspond to the sites inside the selection frame of the small pattern at right. The size of the selection frame is determined by the Zoom settings, as discussed in Zoom settings (on page 2-14). The selection rectangle can be moved with the mouse to any location on the wafer. Using a combination of Zoom settings and selection rectangle positions, the sites on any part of the wafer can be viewed and edited at different magnifications.

Figure 18: Graphical site displays

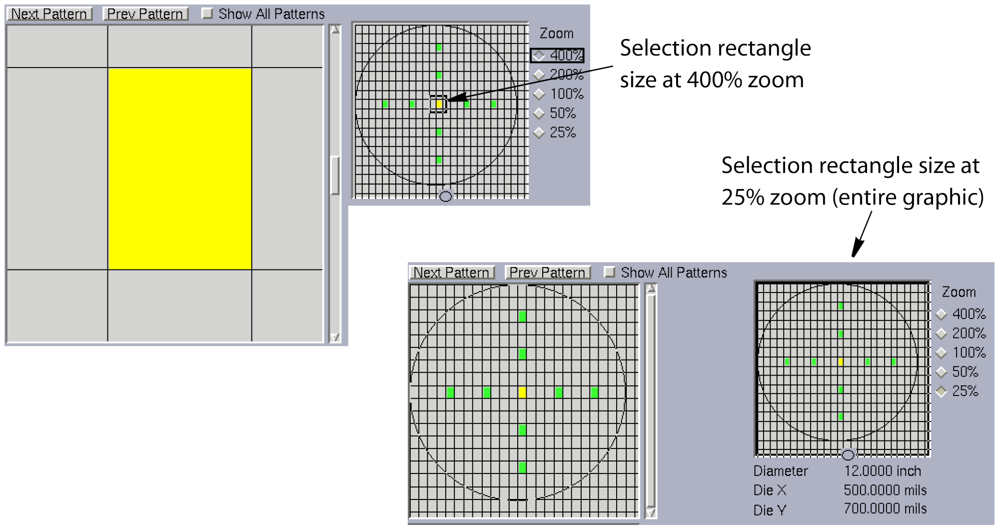


Target sites in the large pattern on the left can be directly selected or deselected by clicking. Target sites can be manipulated by the arrows and selections at the lower right of the Wafer Graph Editor. Refer to Move target arrow buttons and location display (on page 2-19).

Zoom settings

The Zoom settings at the far right control the size of the selection frame and the magnification of the sites displayed in the large graphical pattern. See the following figure.

Figure 19: Using Zooms



Controls located above the graphical site displays

- **Next Pattern:** Selects the next pattern in the Probe Pattern Editor's sequential list of patterns to be the current pattern.
- **Prev Pattern:** Selects the preceding pattern in the Probe Pattern Editor's sequential list of patterns to be the current pattern.
- **Show All Patterns:** Selects simultaneous display of all probe patterns in the `.wdf` file. The following figures illustrate the Wafer Graph Editor when Show All Patterns is selected.

Figure 20: Effects of selecting Show All Patterns for a Sites are Dies .wdf

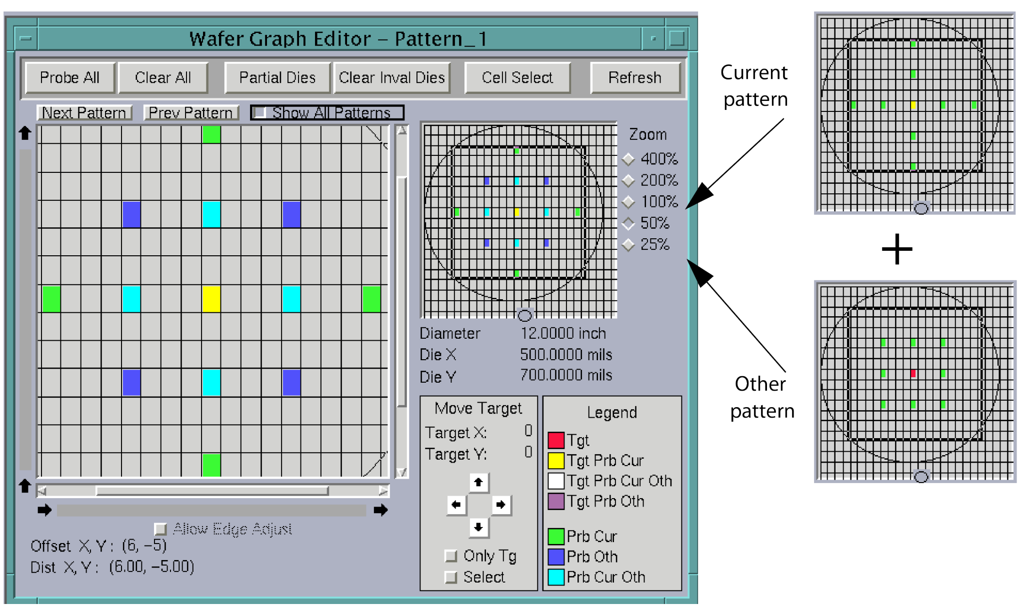
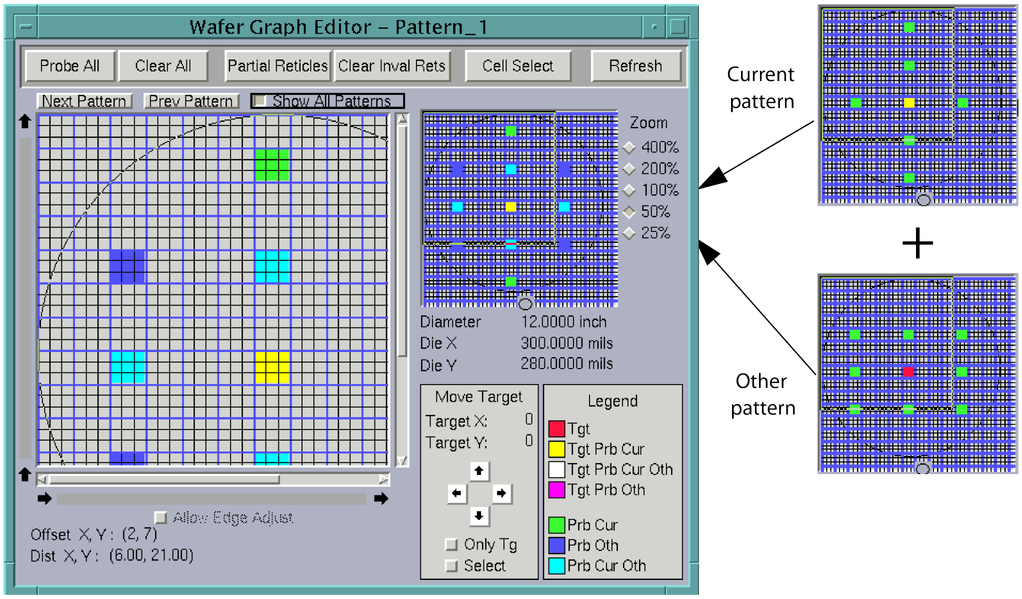


Figure 21: Effects of selecting Show All Patterns for a Sites are Reticles .wdf



Note that color codes distinguish the sites in the current probe pattern from the sites in other probe patterns. The color codes in previous figures show that the other (noncurrent) probe pattern in this example has a rectangular configuration, as defined by the blue-colored and cyan-colored sites. The cyan-colored sites are locations where current-pattern sites overlap other-pattern sites. The next subsection describes the color codes in detail.

Legend

The site colors in the graphical site displays are coded as shown in the legend. This subsection explains the meaning of each color, as follows:

- **Tgt (red):** Target-only site (not tested).
- **Tgt Prb Cur (yellow):** Target site that is tested in the current probe pattern.
- **Tgt Prob Cur Oth (white):** Target site that is tested in the current probe pattern, overlapping at least one other target site that is tested in another probe pattern (applicable only when Show All Patterns is selected). See the following figures.

Figure 22: Legend

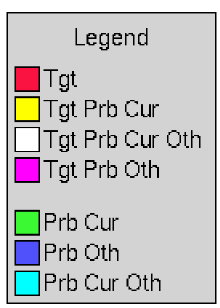


Figure 23: Scenario that results in Tgt Prob Cur Oth (white) color-coded target site

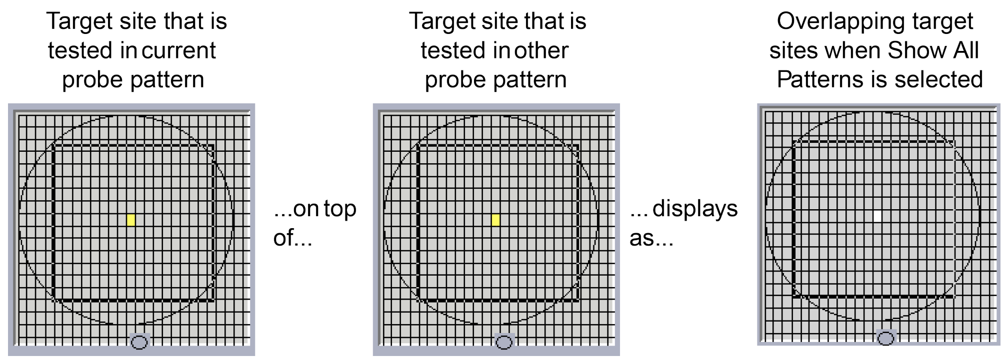
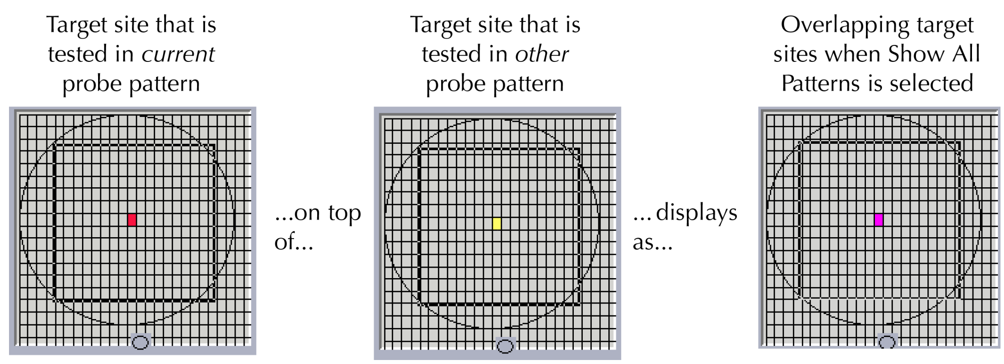


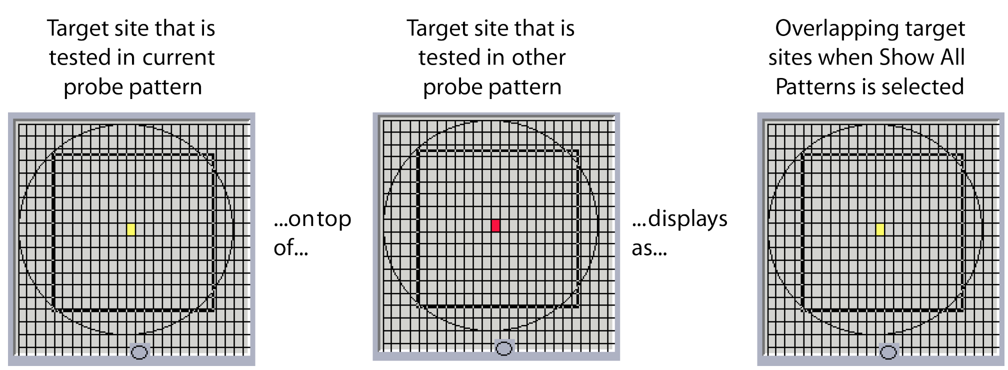
Figure 24: Scenario that results in Tgt Prob Oth (magenta) color-coded target site



- **Tgt Prob Oth (magenta):** Target-only site (not tested) in the current probe pattern, overlapping at least one other target site that is tested in another probe pattern (applicable only when Show All Patterns is selected). See the following figure.

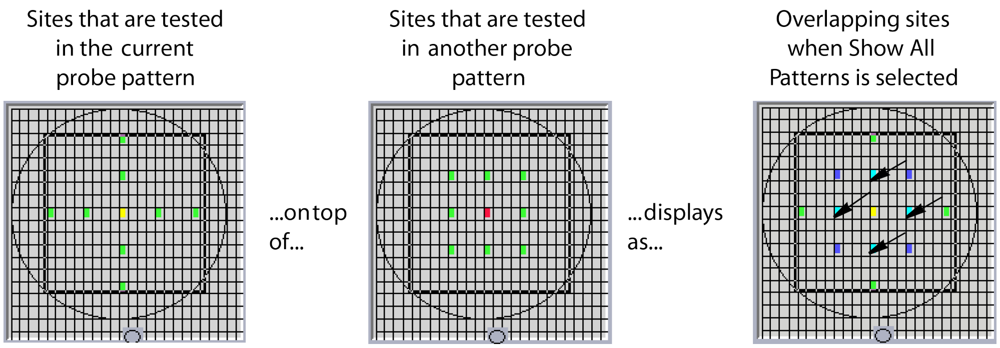
> **NOTE**
>
> When a tested target site in the current probe pattern overlaps an untested target site or sites in another probe pattern, the target site color is yellow. See the following figure.

Figure 25: S530 scenario that results in Tgt Prob Oth magenta color-coded target site



- **Prb Cur (green):** Probed (nontarget) site that is tested in the current probe pattern.
- **Prb Oth (blue):** Probed (nontarget) site that is tested in another probe pattern. Applicable only when Show All Patterns is selected.
- **Prb Cur Oth (cyan):** Probed (nontarget) site that is tested in the current probe pattern, overlapping one or more probed sites that are tested in another probe pattern. Applicable only when Show All Patterns is selected. See the following figure.

Figure 26: Example of overlapping probed sites in current and non-current probe patterns



Controls located below the graphical site displays

- **Allow edge adjust:** This allows the relative positioning of the die grid on the wafer to be shifted up to one die size in both the X and Y directions. Shifting the wafer outline does not affect any of the information used for the test process. It is intended for display purposes only and is not used by the system during wafer testing.
- **Offset X,Y and Dist X,Y:** These fields show the current position of the cursor arrow relative to the target site. Offset is in site (die or reticle) size units and Dist. is in mils or millimeters.

Move target arrow buttons and location display

The Target X and Target Y values display the target site X,Y location. The arrow buttons let you change this location in one of the following ways.

Move the target site by clicking the arrows:

1. Select the **Only Tgt** button, which allows only the target site to move.
2. Click an arrow button to move the target site one position in a given direction.

Move the target site by selecting a destination:

1. Select both the **Only Tgt** and **Select** buttons.
2. Select a new target site location by clicking it on the graphical display. Only the target site moves to the new location.

Move all selected sites by clicking the arrows:

1. Select the **Select** button.
2. Click the arrow buttons to move both the target site and the prober sites together to a new position.

Wafer information area

This area, located below the small graphical site display, contains the following information for the current `.wdf` file:

- Wafer diameter
- Die X and Y dimensions

Site name/subsite name data fields

Site names are not necessary for a single project wafer because all the sites on the wafer are the same.

A site name must be entered for a multiproject wafer before any subsites can be added. A site description can be added to each site name.

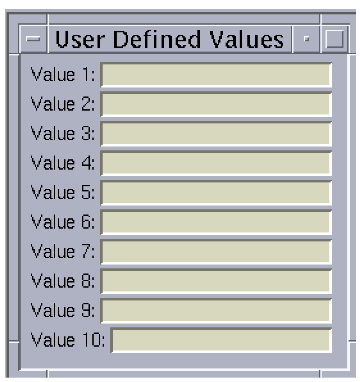
X and Y offset fields

These fields list the subsite X and Y offsets within each site. The values are in mils or millimeters, depending on the units selected in the Wafer Setup window.

User-Defined Values window

The User-Defined Values window contains the fields shown in the following figures.

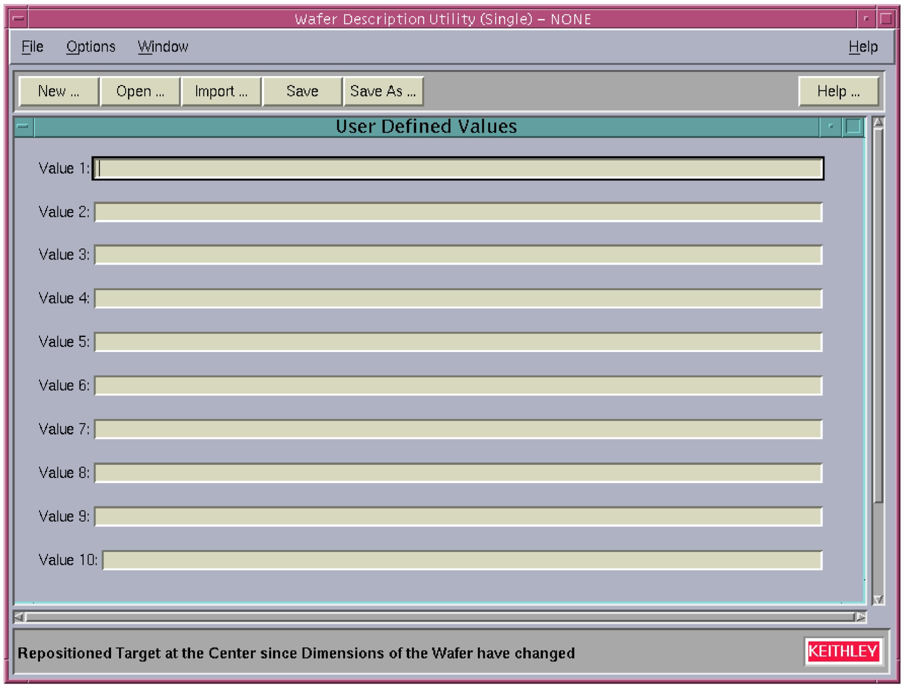
Figure 27: User Defined Values window, as it first appears



NOTE

If this window is not visible among the layers of Wafer Description Utility (WDU) windows, bring it forward by clicking the middle mouse button and selecting **User Defined Values** from the menu that appears.

Figure 28: User Defined Values window, expanded



In these fields, optionally enter information that you would like to be available to the Keithley Test Execution Engine (KTXE). For example, enter parameters for the user access point (UAP) code that you write. The information must meet the following requirements:

- **Data type:** Character (char) string without the quotation marks
- **Maximum string length:** 128 characters

The WDFRec pointer in the data pool contains these user-defined values. This pointer can be used in UAP routines after KTXE loads the wafer description file.

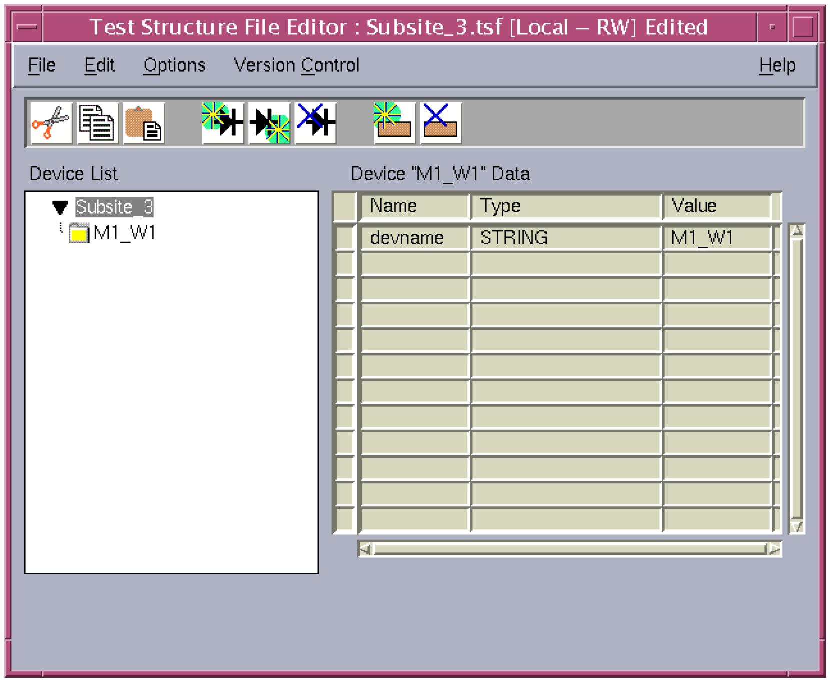
Test Structure File Editor (TSE)

The Test Structure File Editor (TSE) allows you to create parameters for a specific device located at a wafer subsite previously created using the Wafer Description Utility (WDU). The device parameters can then be plugged in with the test macro parameter data to create a more precise test that takes into account the specifications of the device.

TSE main window

The following figure shows the Test Structure File Editor (TSE) main window that appears on screen when the TSE is first activated. A brief description of each feature follows.

Figure 29: Test structure file editor main window



Title bar

The title bar lists the name of the currently open test structure file and the read-write status of the file.

TSE File menu

New: Clears the editor screen of all data.

Open: Opens a currently existing test structure file.

Launch Template File: Opens a new instance of the Test Structure File Editor (TSE) and loads the `template.tsf` file. This allows you to select devices from the template and copy or paste them into another instance of TSE to quickly add devices.

Save: Saves any changes made to the current test structure file.

Save As: Requests a filename before saving the current test structure file.

Exit: Exits TSE.

TSE Edit menu

Cut: Removes highlighted text, which can be restored to a new location using the Paste function.

Copy: Copies highlighted text, which can be placed in a new location using the Paste function.

Paste: Places cut or copied text in a new location.

Insert Device: Adds a device to the Device List.

Delete Device: Removes a device from the Device List.

Add Info After: Adds device information after the currently selected data.

Delete Info: Deletes the currently selected data.

Each of the items in the Edit menu also has a corresponding button on the toolbar, which is located directly below the menu bar.

TSE Options menu

ID/Comment String: Opens a text box that allows you to enter additional information about the device.

TSE Help menu

TSE Documentation: Displays current Test Structure File Editor (TSE) help documentation.

About: Displays the software revision level.

Device list

The Device List is located on the left side of the main window. It provides a list of all of the device parameters that are available for the current subsite. Clicking one of the devices listed opens that device's parameters into the Device Data window.

Device data window

The Device Data window is located on the left side of the main window. This window is a table that lists all of the parameters that apply to the device selected in the Device List. The parameters in this window can be modified by clicking any of the cells.

Copying device data

Device data can be cut, copied, and pasted within the same instance of the Test Structure File Editor (TSE), or between separate instances.

To cut or copy device data:

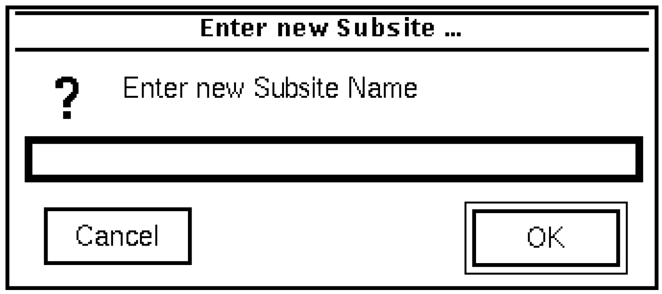
1. Select the device data and click the right mouse button. A Device Actions pop-up menu is displayed.
2. Select **Cut** or **Copy** to place the device data on the clipboard. **Cut** removes the device data from the current location and places it on the clipboard. **Copy** leaves the device data in its current location and only places a copy of it on the clipboard.
3. Select a new location in either the same instance of TSE, or in another instance, and right-click again. The Device Actions pop-up menu is displayed.
4. Select **Paste Before** or **Paste After** and the device data is inserted in the selected location.

Creating a test structure file

To create a test structure file:

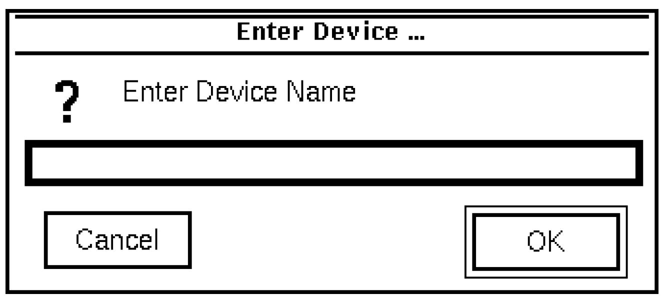
1. Select **New** from the File menu. A text box, shown in the following figure, opens asking you for the Subsite name. Enter the name of a subsite that is currently in use in a wafer description file (`.wdf`) and click **OK**.

Figure 30: Subsite name test box



2. A device name text box opens. Enter the name of the device and click **OK**. To add additional devices to the current list, click the last device in the Device List and select the **Add Device After** icon or the menu item from the Edit menu. Repeat this process until you have added all of the devices required.

Figure 31: Device name text box



3. To enter device data, select the device from the Device List, then select the **Add Info After** icon or menu item. The first row already contains the default parameter name, `new_name`. Enter the parameter name to be used.
4. In the Type column, click the cell to activate the pop-up menu.
5. Click the arrow to the right of the cell to open the menu and select the proper parameter type. The parameter type, IDENTIFIER, references predefined probe-card or global-identifier data.

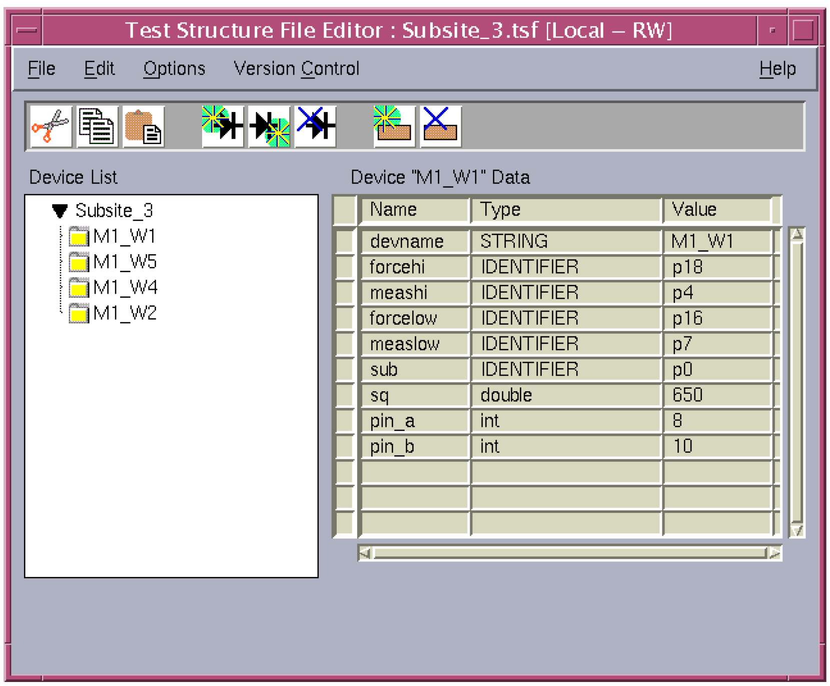
NOTE

IDENTIFIER values must start with a non-numeric character, and can only contain letters, numerals, and underscores.

6. In the Value column, enter the actual value for the parameter.
7. Once all of the device data for the subsite has been entered, select **Save** from the File menu.

   The test structure file (`.tsf`) is now complete, as shown in the following figure, and can be accessed by the Keithley Interactive Test Tool (KITT) Parameter Entry window if that subsite is selected in the KITT subsite box.

Figure 32: Completed test structure file



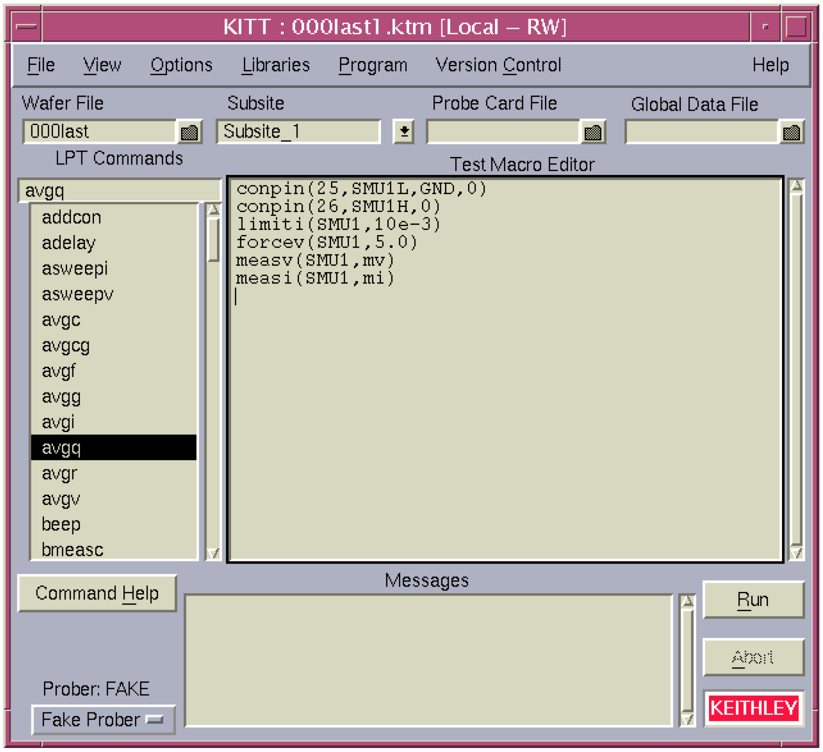
Keithley Interactive Test Tool (KITT)

The Keithley Interactive Test Tool (KITT) provides a software environment that gives you immediate access to standard test libraries. KITT provides language-independent calls to create test macros and allows interactive, immediate execution of test macros and prober calls. KITT is useful to diagnose instrument, prober, and device measurement problems and create test macros.

KITT main window

The following figure shows the Keithley Interactive Test Tool (KITT) main window that appears on the screen when KITT is first activated. A brief description of each feature follows.

Figure 33: KITT main window



Title bar

The title bar lists the name of the currently open test macro file and the read-write status of the file.

KITT File menu

The File menu items let you:

- Start a new Keithley Test Module (KTM).
- Open test macro files into the Test Macro Editor window.
- Include an existing test macro.
- Save test macro files shown in the Test Macro Editor window.
- Delete macro files.
- Print test macro files.
- Exit Keithley Interactive Test Tool (KITT).

KITT View menu

The View menu contains:

- **Command Help:** Opens or closes the Command Help window. This can also be done from the Help button in the parameter entry window or Keithley Interactive Test Tool (KITT) main window.
- **Parameter Entry:** Opens or closes the KITT Parameter Entry window for the presently selected test command.
- **Results:** Opens or closes the KITT Results window.
- **Keithley Data Editor:** Opens the Keithley Data Editor.
- **Results Settings:** Opens the Results Settings window where the plot, log, and user parameters can be set for the present macro.
- **Test Macro Description:** Lets you attach notes to the present test macro.

KITT Options menu

The Options menu controls:

- Whether the tester hardware is online or offline.
- If autoplotting is on and if Keithley Curve Analysis Tool (KCAT) will be used to plot the results, with the plot value set to X or Y.
- Whether or not results are grouped by result name in the Keithley Interactive Test Tool (KITT) results window.
- Determines whether just the filename or the entire path will be saved in the `.ktm` file. If the entire path is to be saved, it is recommended that the environment variables be used. This will make subsequent file retrieval easier.
- Whether the wafer and subsite data is saved with the `.ktm` file.
- Whether the probe card file is saved with the `.ktm` file.
- Whether the global data file is saved with the `.ktm` file.
- Whether or not to create a `kitt.ini` file to save the current status of the Options menu.
- Whether the execution time for the test macro and of test modules will be shown in the Messages window.
- Whether or not Probe Card values and Global Data values are resolved in the Parameter entry window.
- Whether or not Strict Parameter Resolution is enforced.
- Prober error and transaction logging, and viewing the error or transaction logs.
- The user-defined level of the error log.
- Whether or not the results are overwritten in the KITT results window when a test macro is run.
- Whether all of the results are shown in the KITT results window, or only those selected to be viewed in the Results Settings window.

KITT Libraries menu

The Libraries menu lets you select the following command libraries:

- Prober
- LPTLib
- User Libraries

KITT Program menu

The Program menu items let you:

- Run or loop program test macros.
- Generate C programming language code.
- Debug C programming language code before running the macro (practice task).
- Clear messages previously written in the Messages window.
- Remove error identifier strings from text in the Test Macro Editor window.

KITT Help menu

Help menu items display Keithley Interactive Test Tool (KITT) help documentation and software revision level.

Test data fields

These fields include:

- **Wafer File:** The wafer description file to be used during testing.
- **Subsite:** The wafer subsite the test macro is to be run on.
- **Probe Card File:** The probe card file used when the current test macro is run.
- **Global Data File**: The global data file used when the current test macro is run.

Right-clicking any of the data fields displays a pop-up menu. The menu allows you to open the data file in the appropriate tool for editing. For example, right-clicking the Wafer File field will allow you to open the wafer file in the Wafer Definition Utility (WDU).

This information is written into the macro file (`.ktm`) so future work in the Keithley Interactive Test Tool (KITT) can be continued without reentering these selections. However, the wafer files, probe card files, and global data files used in production runs by the execution engine are specified in the wafer plan and cassette plan editors. The execution engine uses the subsite information stored in the test macro (`.ktm`) to determine what subsite the macro is to run on.

Commands scroll box

The commands scroll box displays and allows selection of the various commands for the selected library. To display information about the selected command, click the **Command Help** button. A pop-up window will display pertinent information about the selected command including parameters that it uses.

Test macro editor window

The Test Macro Editor window is the primary work area for generating your test macros. Commands can be moved from the Parameter Entry window to the Test Macro Editor window using the OK and Apply buttons. Control buttons associated with the Test Macro Editor window are:

- **Run:** Runs the entire test macro listed in the Test Macro Editor window, or just the highlighted lines.
- **Abort:** Aborts the test macro presently being executed.

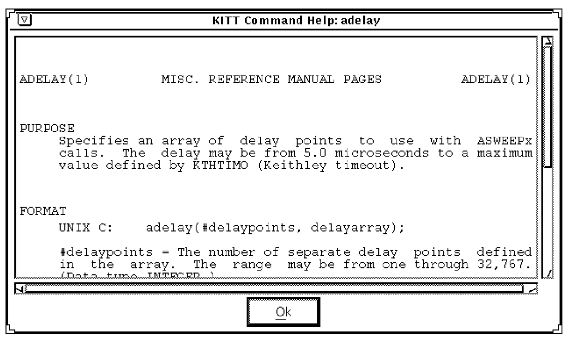
Messages window

The Messages window displays event and error messages that occur during Keithley Interactive Test Tool (KITT) operation. You can clear the Messages window by selecting the Clear Messages menu item in the Program menu.

Command help

The Command Help button will display help information for the test command currently selected in the Command help window, as shown in the following figure.

Figure 34: Command help window



Prober

The Prober displays the name of the currently configured prober driver. You can toggle between Fake and Real Prober by clicking the Prober selection box. The commands supported by the currently configured prober driver will be displayed in the Commands box when Prober Library is selected under the Libraries menu.

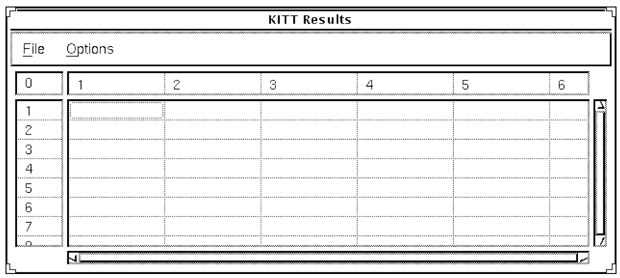
KITT Results window

The following figure shows the Keithley Interactive Test Tool (KITT) Results window. Results data from the test macros are displayed in a spreadsheet format. Each column displays one result when the test macro is run. The column heading identifies the result name. Each row is a separate execution of the macro.

KITT Results window menu items include:

- **File:** Lets you open, save, and print results data and clear the results data window.
- **Options:** Lets you select the delimiter to be used to separate individual data elements in the output file. This ASCII-delimited format allows data to be read into most spreadsheet and data analysis tools.

Figure 35: KITT results window



KITT math, array and logic expression support

Keithley Interactive Test Tool (KITT) supports the following functions.

Math

Refer to your C language reference manual for more information on proper syntax use.

Definition

Keithley Interactive Test Tool (KITT) supports the following math operators and functions:

- Addition ‘+’
- Subtraction ‘-’
- Multiplication ‘*’
- Division ‘/’
- Parentheses ‘(‘ and ‘)’

  The parentheses ‘(’ and ‘)’ operators may be used to define precedence of the math operations

- int abs(int val);

  abs() returns the absolute value of its int operand
- double fabs(double x);

  fabs(x) returns the absolute value of x
- double exp(double x);

  exp(x) computes the exponential function e**x
- double log(double x);

  log(x) computes the natural logarithm of x
- double log10(double x);

  log10(x) computes the base-10 logarithm of x.
- double pow(double x, double y);

  pow(x, y) computes x raised to the power y

The operators and functions may be used as part of a calculation to define a parameter value to a test. The operators and functions may act on data associated with identifiers from the following data sources:

- Predefined identifiers within a test macro file (`.ktm`)
- Global data from a global data file (`.gdf`)
- Probe card data from a probe card file (`.pcf`)
- Device data from a test structure file (`.tsf`)
- Literal values (for example, 1.23e-4)

The operators and functions above can also be used with the equal sign (=) assignment operator. This operator can assign a new value to previously defined identifiers or create a results identifier. If this result value is not previously defined, the result will be type DOUBLE.

Parameter values are resolved as each macro line is executed.

Restrictions

- Operators are not valid with parameter set identifiers.
- Parameters with operators will not be saved in parameter sets.
- Variable must not be named with a digit and an `E` or `e` as the last two characters.

  For example:

  The variable name `foo2e` is invalid.

  The variable name `Foo2` is valid.

  This restriction is due to the expression `Foo2e - 5` being confused with the number `2e-5`.
- A runtime error occurs if a divide by `0` is attempted. The macro execution only terminates at that point.

Examples

- Math in parameters

```
Test(param1, (R1/(ss_dev1_width * ss_dev1_length), output_result)
```

- Assignment operator

```
Area = ss_dev1_width * ss_dev1_length
AnotherResult = ((result_array[0] * 3.14)/some_identifier)
```

The results `Area` and `AnotherResult` will be type DOUBLE if not previously defined.

- The compiler requires the use of decimal points to signify floating point notation.

  For example:

```
1/8 = 0
1.0/8.0 = 0.125
```

Array support

Arrays must be defined before their use. Definition can occur as:

- Predefined identifiers within a test macro file (`.ktm`)
- Global data from a global data file (`.gdf`)

A complete array or a single element can be an input or an output parameter. If a complete array is passed into or out of a test, the array index is not specified. If a single array element is passed into or out of a test, the array index is defined by using brackets `[` and `]`. An expression can be used to define the array index.

To use a variable as an array index, the variable must be type INT. This is necessary for the Practice Task and Save As C features to function correctly.

Restrictions

There are some minor restrictions on result array assignment notation. No nested array notation and no complex math expressions are allowed as index expressions. The following list of examples should help explain.

Supported:

```
gdfArray[1] = function()
pdiArray[x + 2] = function()
resultArray[3] = 4.53
```

Not supported:

```
AnyArray[(x + 2 ) * 3] = function()
AnyArray[anotherArray[3] + 1] = function()
```

Examples

Examples of how arrays can be used in the Keithley Interactive Test Tool (KITT) are described in the following topics.

Array elements as outputs

The array `result_array` is defined previously as array data. The `result_array[]` parameters are output parameters. The complete `result_array` parameter is passed into the `Fit_function`. The `number_of_elements_in_array` parameter indicates to the function how many array elements to use.

```
Test(ss_dev1_pad1, ss_dev1_pad2, input_item, result_array[0])
Test(ss_dev2_pad1, ss_dev2_pad2, input_item, result_array[1])
Test(ss_dev3_pad1, ss_dev3_pad2, input_item, result_array[2])
Test(ss_dev4_pad1, ss_dev4_pad2, input_item, result_array[3])
Fit_function(result_array, number_of_elements_in_array, result_value)
```

Also, arrays may contain function return values.

```
Result_array[1] = Test(param1)
```

Array elements as inputs

The array `input_array` is defined previously as array data or as a result output from a function. In the following example `resulta`, `resultb`, and `resultc` are output parameters.

```
TestB(ss_dev1_pad1, ss_dev1_pad2, input_array[0], resulta)
TestB(ss_dev1_pad1, ss_dev1_pad2, input_array[1], resultb)
TestB(ss_dev1_pad1, ss_dev1_pad2, input_array[2], resultc)
```

Also,

```
Test(param1, input_array[(identifier*2)], result_array[identifier])
```

Array as Output

In the following example, `result_array` is an output parameter and `number_of_elements_in_array` is input parameter.

```
TestSweep(param1, param2, result_array, number_of_elements_in_array)
```

This is already supported in version 3.2 and later.

Array as Input

In the following example, `result_array` and `number_of_elements_in_array` are input parameters.

```
Fit_function(result_array, number_of_elements_in_array, result_value)
```

This is already supported in version 3.2 and later.

If-then-else and logical expressions

The Keithley Interactive Test Tool (KITT) supports the if-then-else statement with the following Boolean operators for int, float, and double data types:

- < less than
- <= less than or equal to
- > greater than
- >= greater than or equal to
- == equal to
- != not equal to

The following Boolean operators are supported for int data types:

- && logical AND
- || logical OR
- ! logical NOT

Each of the Boolean operators generate a 0 or 1 response. If a result is created and assigned using a Boolean operator, the result type is treated as a double if the result has not been previously defined otherwise.

Restrictions

- When using the `if` statement, the open and close braces must be used and they must be on separate lines.

Example:

```
if (a > b)
{
      value = 4
}
else
{
      value = 0
}
```

- Nesting is supported up to 32 levels.

Using generated identifiers in a test macro

Generated identifier are of three types:

- Test Structure Data Identifier
- Parameter Set Data Identifier
- Generated Result Identifier

Test Structure Data Identifiers

Test Structure Data Identifiers take the form `device_parameter`.

The device part of the identifier is set in the Keithley Interactive Test Tool (KITT) Parameter Entry window by selecting the device to use at a subsite.

The parameter part of the identifier is associated with the name of the parameter.

These Test Structure Data Identifiers are only generated for parameters that have the same name as an item in the selected device's test structure file. The test structure file used is based on the subsite name set in the KITT main window.

Parameter Set Data Identifiers

Parameter Set Data Identifiers take the form `module_paramset_parameter`.

The `module` part of the identifier is the name of the test module.

The `paramset` part of the identifier is the name given to the parameter set.

The `parameter` part of the identifier is associated with the name of the parameter.

Selecting a parameter set in the Keithley Interactive Test Tool (KITT) Parameter Entry window places the parameter set data identifiers in all symbolic value fields that have a matching parameter. If a parameter's symbolic value field contains test structure data and a parameter set contains a matching parameter, the parameter set data identifier will replace the test structure data identifier in the field.

Generated Result Identifiers

Generated Result Identifiers take the form `subsite_device_parameter`.

The `subsite` part of the identifier is the subsite name set in the Keithley Interactive Test Tool (KITT) main window.

The `device` part of the identifier is the device selected in the KITT Parameter Entry Window.

The `parameter` part of the identifier is the output parameter name.

Custom Identifier Separators

The generated identifier separator may be changed from the default _ to any single letter a through z or A through Z. This is set in the `kitt.ini` file.

KTE data usage

The following topics describe Keithley Test Environment (KTE) data usage.

Data pool

- A data storage area generated during Keithley Test Execution Engine (KTXE) and Keithley Interactive Test Tool (KITT) execution.
- Run-time storage of probe card file (`.pcf`) data, global data file (`.gdf`) data, global predefined date identifier (PDI) data, KTXE control data, and data generated with `dpAdd` functions. Each run starts with a clean data pool.

Data precedence

The Keithley Test Execution Engine (KTXE) and Keithley Interactive Test Tool (KITT) resolve parameters from the data sources in the following order:

- Local predefined data identifiers (PDI)
- Test structure data
- Parameter set data
- Probe card file data
- Global data file data
- Global PDI
- Generated results

Data sources

The following data sources are used in the Keithley Test Environment (KTE).

Local predefined identifiers

- A local predefined identifier (PDI) is a value local to a Keithley test module (KTM).
- A local PDI is highest in the data precedence. A local PDI value is used before the data pool.
- Useful for local constants and defining data types of intermediate variables.

Test structure data

- Loaded into internal test structure memory.
- Used to define test structure and device-specific data.
- Changing test structure data effects all test modules that use the data as a parameter.
- Use to define pad-to-structure mapping. Example: Drain = pad3.
- Use to define test structure characteristics. Example: Length = 100.

Parameter set data

- Loaded into internal parameter set memory.
- Used as templates for standard test parameters.
- Changing a parameter set permits modification of all Keithley test modules (KTMs) that use the parameter set.

Probe card file data

- Probe card file (PCF) data is loaded into the data pool during the wafer loading phase of the Keithley Test Execution Engine (KTXE).
- Because the PDF file data is loaded for each new wafer plan, items from previous PCF files may be in the data pool.
- Keithley Interactive Test Tool (KITT) loads the PCF file at the start of each run.
- Use to define tester pin-to-pad mapping. Example: Test pin 8 = pad3.

Global data file data

- Global data file (GDF) data is loaded into the data pool during the cassette plan loading phase of the Keithley Test Execution Engine (KTXE).
- The GDF files are loaded in the order of definition. If two GDF files load items of the same name, the value in the last file is used.
- The Keithley Interactive Test Tool (KITT) loads the GDF file at the start of each run.
- Useful for passing data between Keithley test modules (KTMs).
- Useful for passing global test parameters into tests.
- KTXE supports loading of multiple global data files.
- Can be used to change execution behavior of KTXE.
- User access points (UAPs) can access this data.

Global predefined identifiers

- A global predefined data identifier (PDI) value is available to the defining Keithley test module (KTM). After KTM execution, they are placed into the data pool. Any KTM executed following the defining KTM or re-execution of the defining KTM gets the value of the global PDI from the data pool.
- A global PDI is lowest in the data precedence.
- Useful for passing data between KTMs (global data is more flexible).

Generated results

- Output variables generated by the Keithley Test Execution Engine (KTXE) or the Keithley Interactive Test Tool (KITT).

Keithley Test Execution Engine control data

- The Keithley Test Execution Engine (KTXE) places items in the data pool at run time. This data is used internally by KTXE and may be altered to change KTXE execution behavior.
- See Data pool (on page D-1) for a list of these items.
- During Keithley Interactive Test Tool (KITT) execution, no KTXE control data exists.

Passing data between Keithley test modules

Data is passed between Keithley test modules (KTMs) through the data pool. KTMs may place data into the data pool by outputting the results to a global data file (GDF) defined name or a global predefined identifier (PDI), or using a dpAdd function in a user library. Data pool items accessed by a KTM must exist before executing a macro line. If not, a run-time error occurs and the KTM currently executing terminates.

Example:

Two KTMs each generate one result that is used by a third KTM. Two values are placed in the global data file that is loaded in the data pool.

Global data file: `passedresults.gdf`

```
slope_5x20, DOUBLE_P, 0
slope_5x10, DOUBLE_P, 0
```

KTM: `x20.ktm`

```
nvth5x20 = vth_ext(p10,p11,p13,p24,0.1,0.0,2.0,1e-6,100, slope_5x20)
```

KTM: `x10.ktm`

```
nvth5x10 = vth_ext(p9,p11,p13,p24,0.1,0.0,2.0,1e-6,100, lope_5x10)
```

KTM: `calc.ktm`

```
deltaw(slope_5x20, 20, slope_5x10, 10, result)
```

Use of ibupu functions in the Keithley Interactive Test Tool

In the Keithley User Library Tool (KULT) user library routines, the `ibupu()` functions are called using the following syntax:

```
ibupu(unit, IBUPU_CLEAR, slot)
ibupu(unit, IBUPU_DEFINE, slot, tad, lad, sad, rmd, eod, wmd)
ibupu(unit, IBUPU_FINISH)
ibupu(unit, IBUPU_LOCAL, slot)
ibupu(unit, IBUPU_READ, slot, *read_buff, count)
ibupu(unit, IBUPU_SRPOLL, slot)
ibupu(unit, IBUPU_SRQWAIT, slot, timeout)
ibupu(unit, IBUPU_TRIGGER, slot)
ibupu(unit, IBUPU_WRITE, slot, *write_buff, length)
```

When using these functions from the Keithley Interactive Test Tool (KITT), use the following syntax:

```
ibupu_clear(unit, slot)
ibupu_define(unit, slot, tad, lad, sad, rmd, eod, wmd)
ibupu_finish(unit)
ibupu_local(unit, slot)
ibupu_read(unit, slot, *read_buff, count)
ibupu_remote(unit, slot)
ibupu_srpoll(unit, slot)
ibupu_srqwait(unit, slot, timeout)
ibupu_trigger(unit, slot)
ibupu_write(unit, slot, *write_buff, length)
```

Parameter Set Editor

The Parameter Set Editor (PSE) allows you to add, remove, or edit parameter set data assigned to a library module. The PSE does not modify the default data created in the Keithley User Library Tool (KULT), but allows you to create additional parameter sets that can be used when creating a test macro.

New parameter sets can be created by pressing the **Save** button on the Keithley Interactive Test Tool (KITT) parameter entry screen. If the Parameter Set Editor is active when this save occurs, the Parameter Set Editor is not refreshed with the new data until the specified module name is reopened. Clicking the folder icon for the module refreshes the display.

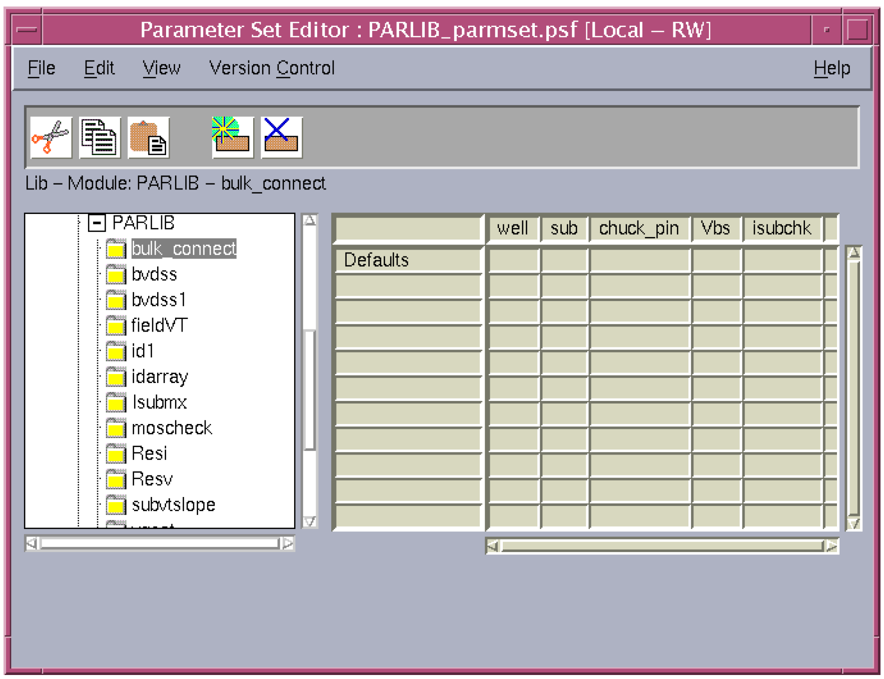
PSE main window

There are two main areas of the Parameter Set Editor (PSE), shown in the following figure.

The Library Browser: Allows you to navigate through a directory tree of available user libraries and modules to select the parameter data you want.

The Parameter Data list box: Lists all of the available parameter data for a module that is selected from the library browser.

Figure 36: PSE main window



Title bar

The title bar lists the name of the currently open parameter set file and the read-write status of the file.

PSE File menu

The Parameter Set Editor (PSE) File menu contains the following items:

- **Save**: Saves any changes made to the parameter set data.
- **Exit**: Closes the PSE.

PSE Edit menu

The Parameter Set Editor (PSE) Edit menu contains the following items:

- **Cut**: Removes highlighted text, which can be restored to a new location using the Paste function.
- **Copy**: Copies highlighted text, which can be placed in a new location using the Paste function.
- **Paste**: Places cut or copied text in a new location.
- **Add New Set After**: Adds a new set of parameters after the currently selected set.
- **Delete Parameter Set:** Deletes the current parameter set.

Each of the items in the Edit menu also has a corresponding button on the toolbar, which is located directly below the menu bar.

PSE View menu

- **Parameter Sets**: Toggles the Parameter Set Editor between showing the entire main window and just the Library Browser.

PSE Help menu

- **PSE Documentation**: Displays current Parameter Set Editor (PSE) help documentation.
- **About**: Displays the software revision level.

Library browser

To navigate through the available libraries, click the plus (**+**) icons to expand the library tree and the minus (**-**) icons to collapse the library tree. A folder icon indicates a user library module that could contain parameter set data. If parameter set data exists for a module, clicking the folder icon opens the parameter data contained in the selected module in the Parameter Data list box.

If the directory tree is longer than the viewable window, a vertical scroll bar appears that can be used to scroll the library or module list into view. Holding the left mouse button down and dragging on an empty section of the directory tree background also allows you to move the view area.

Parameter data list box

NOTE

The default data for a parameter cannot be modified from the Parameter Set Editor; it can only be changed using Keithley User Library Tool (KULT).

The first row of the parameter set edit panel lists the column heading for the library module: Parameter set name and parameter names.

The first column displays the parameter set name. If the library has defaults set for any parameters, the parameter set name `Defaults` will displayed in the first column with the values in the appropriate field. Parameter set names may contain any alpha-numeric character or an underscore character. The name of the parameter set is made available in the Parameter Set Selection box in the Keithley Interactive Test Tool (KITT) Parameter Entry window.

The second and greater columns display the parameter values or identifiers. Valid values must be appropriate for the data type of the parameter. Identifiers must be resolvable by KITT and the Keithley Test Execution Engine (KTXE).

This field displays a message about the item that has focus. For parameter set parameters, the following items are presented: Parameter data type and value range.

To edit data in one of the cells, click the cell and enter the new value. To remove a parameter set data value, clear the contents of the cell, or select **Cut** from the Edit menu.

To add a new parameter set, click the row above where you wish the new parameter set to be. Select **Add New Set After** from the Edit menu. A new parameter set is created. Enter the name of the new parameter set in the first column. Enter the rest of the parameter set data as needed.

To delete an entire parameter set, click the parameter set name cell and select the **Delete Parameter Set** button. You are asked to confirm the deletion. Please note that the Cut option does not function for entire parameter sets.

To refresh the library listing to view new or remove deleted libraries and modules, minimize and then maximize the root directory labeled Libraries in the library browser area.

If a module is deleted from a library, all parameter set data is purged from the data structures. You must save this parameter set to completely remove the data from future use.

Keithley User Library Tool (KULT)

The Keithley User Library Tool (KULT) is a tool used to create and manage user modules and libraries. It performs a different function than the other Keithley Test Environment (KTE) tools. The other tools are used to capture data to describe the wafer, tests, parameter limits, wafer test plans, cassette test plans and operator test selections. KULT is used to make code additions and organize the code into modules and libraries. In KULT, you can edit and compile C language code.

KULT is used to extend the testing capabilities of a standard software distribution. A structured graphical user interface is provided to facilitate the code and data entry. The module calling structure, code, parameters, description, and include files are all entered separately. This structured entry allows the user extensions to be functionally integrated with the KTE test plan development and production testing tools. This means that proprietary test algorithms, shop floor control procedures, and other unique site requirements can be added without vendor-supplied software upgrades. Also, KULT-created user library extensions are compatible with future software upgrades.

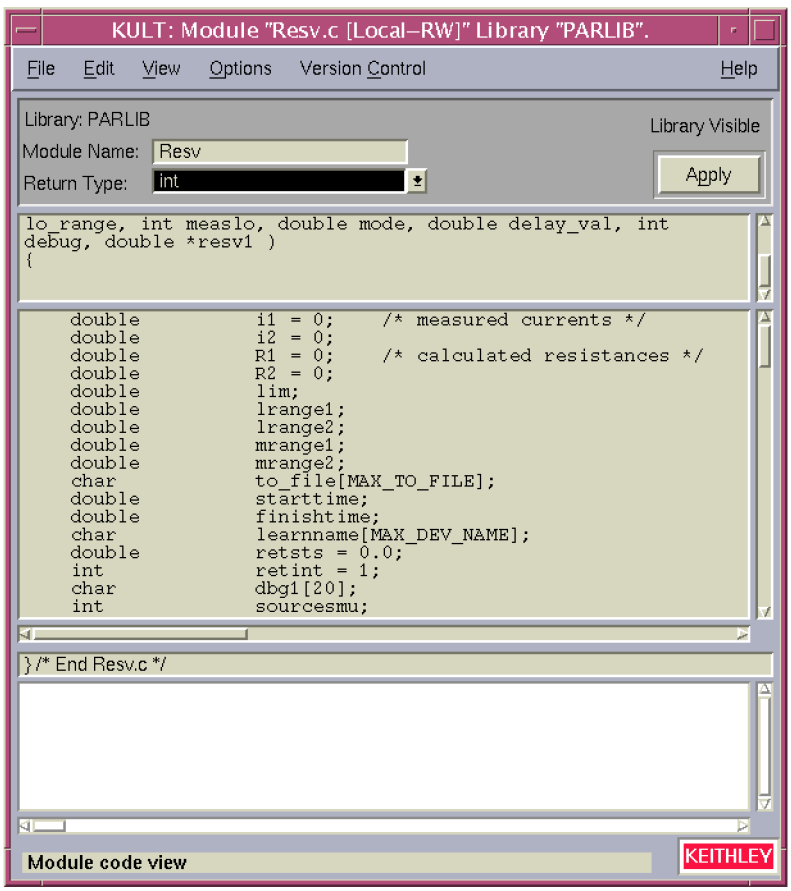
KULT libraries are created to allow for easy and quick extensions to the capabilities of the parameter test routines (PAR), prober drivers, and the production test execution engine (KTXE). Once a user library is developed, it is available for test macro development in the Keithley Interactive Test Tool (KITT). Or, the module can be included in KTXE for execution at the user access point (UAP) specified in the cassette plan.

KULT libraries are dynamically loaded when used by KITT and KTXE. All the file control benefits of libraries are realized (single master copy, reuse, and control). Site-specific test modules can be created once and then called by many different product test plans. A new user library can call the system libraries and other user libraries.

KULT main window

The Keithley User Library Tool (KULT) main window is shown in the following figure. The library name, module name, module call, and code are presented to the user in this window. Other windows are used to present the module's arguments and description.

Figure 37: KULT main window



Title bar

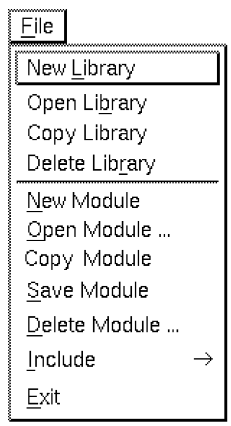
The title bar lists the name of the currently open library module and the read-write status of the file.

KULT File menu

The File menu shown in the following figure contains the following items:

- **New Library**: Produces the new library name dialog box and initializes the new library.
- **Open Library**: Lists available user libraries.
- **Copy Library**: Permits creating a copy of an existing library.
- **Delete Library**: Deletes the selected library and all of its contents.
- **New Module**: Produces the module name dialog box and initializes the new module.
- **Open Module**: Lists available modules.
- **Copy Module**: Permits copying the current module into an existing library.
- **Save Module**: Saves changes made to a module.
- **Delete Module**: Deletes the selected module from a library. Note that you must rebuild the library to ensure the module has been deleted.
- **Include**: Inserts other modules into the module body area. This function lets you alter an existing module or create a new module.
- **Exit**: Exits the Keithley User Library Tool (KULT).

Figure 38: KULT file menu



KULT Edit menu

The Edit menu shown in the following figure contains file editing functions.

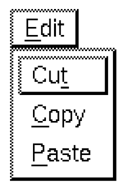
The edit options are:

- **Cut**: Removes highlighted text, which can be restored to a new location using the Paste function.
- **Copy**: Copies highlighted text, which can be placed in a new location using the Paste function.
- **Paste**: Places cut or copied text in a new location.

NOTE

When cutting, copying, and pasting between the main window and the Description window, use the Cut or Copy commands from the window that contains the text, and use the Paste command from the window where the text is being placed.

Figure 39: KULT edit menu



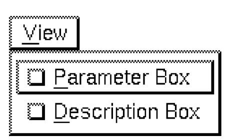
The Main Body Area, Description Window, and Include Files window all support the following menu items from the menu that appears when the middle mouse button is pressed:

- **Cut**: Same as Cut in the Edit menu.
- **Copy**: Same as Copy in the Edit menu.
- **Paste**: Same as Paste in the Edit menu.
- **Select All**: Highlights all text in selected window for cutting or copying.
- **Search**: Opens a dialog box that lets you specify a text string to search for.
- **User Paste Strings**: Reveals Add User Paste Strings, which lets you enter a text string that you want to paste into the selected window.

KULT View menu

The View menu lets you display or conceal the parameter box or the description box. See the following figure for the View menu options.

Figure 40: KULT view menu

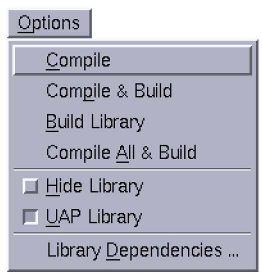


KULT Options menu

The Options menu shown in the following figure contains the following functions:

- **Compile:** Compiles source files into object files and checks for errors in the module.
- **Compile and Build**: Performs both the Compile and Build Library functions.
- **Build Library:** Creates a user library and establishes help files for the module.
- **Compile All and Build:** Performs the Compile and Build Library operations for all modules that are part of the current library.
- **Hide Library:** Toggles the availability of the presently open library to a test macro, in the Keithley Interactive Test Tool (KITT), between visible and hidden.
- **UAP Library:** Toggles the availability of the presently open library for use at a user access point (UAP).
- **Library Dependencies**: Allows you to specify other user libraries to link to.

Figure 41: KULT options menu



KULT Help menu

The Help menu contains online help information about the Keithley User Library Tool (KULT).

Module identification area

The module identification area is located directly below the menu bar and defines the active library and module. The components of this area are:

- **Library Name:** Defines the active library.
- **Module Name:** Defines the active module.
- **Return Type:** Defines the format of the module's output. The standard variable types used in the Keithley User Library Tool (KULT) are:
  - **double:** Double precision data
  - **float:** Single precision, floating point data
  - **int:** Integer data
  - **long:** 32-bit integer data
  - **void:** No data returned
- **Apply**: Updates the module name and return type of the present library.
- **Library Hidden, Library Visible, Library UAP/Hidden, or Library UAP/Visible (one of these is displayed):** Indicates whether the presently open library is hidden or visible to test macros in the Keithley Interactive Test Tool (KITT) and available to user access points (UAPs) in Keithley Test Plan Manager (KTPM). For details, refer to Changing library attributes (on page 2-53).

Include area

The include area is located directly below the module identification area and displays header files and constants specified in the parameter box. The include area only displays information and cannot be accessed.

Module body area

The module body area is located below the include area and displays code of the active module for developing and editing purposes. Scroll bars located to the right and below the module body area let you move through the code.

Error and warning message area

This area contains any error and warning messages generated by the C language compiler. Selecting (double-clicking) a compile error listed in this window moves the cursor to the line that caused the error in the module body area. This facilitates error corrections. If no errors are generated during a compile, the following message is displayed: `No error/warnings reported, compilation/build was successful.`

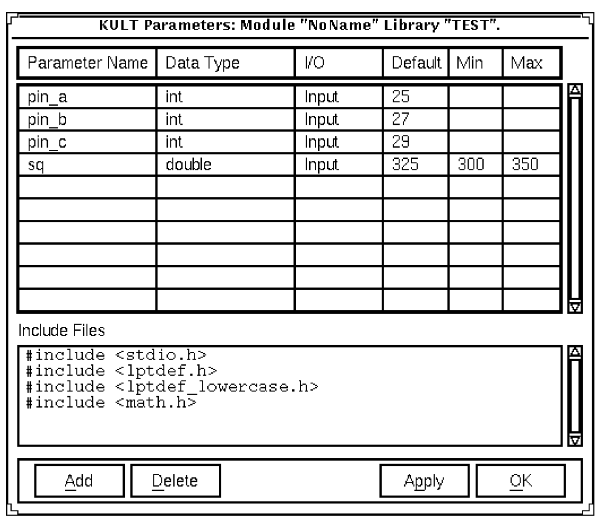
Parameter window

The Parameter window shown in the following figure is located at the top right side of the Keithley User Library Tool (KULT) screen and defines the variables specified in the module.

The Parameter window components are:

- Parameter definition area
- Include files area
- Control button area

Figure 42: Parameter window



Parameter definition area

The parameter definition area is the primary function of the Parameter window. The parameter definition area defines the Parameter Name, Data Type, and I/O field for all data included in the module call.

Parameter Name

The Parameter Name identifies the specified parameter.

Data Type

The Data Type specifies the parameter type. Clicking the arrow to the right of the Data Type field activates a pop-up menu listing the available data types, which are:

- **char:** Character data
- **char*:** Pointer to character data
- **float:** Single-precision, floating-point data
- **float*:** Pointer to single-precision, floating-point data
- **double:** Double-precision data
- **pointer:** Double-precision, floating-point data
- **int:** Integer data
- **int*:** Pointer to integer data
- **long:** 32-bit integer data
- **long*:** Pointer to 32-bit integer data
- **F_ARRAY_T:** Float array type
- **I_ARRAY_T:** Integer array type
- **D_ARRAY_T:** Double-precision array type

I/O field

The I/O field defines whether the parameter is an input or output type. Clicking the arrow to the right of the I/O field activates a pop-up menu that shows the input and output selections.

Default, min, and max fields

The following fields are used to specify default, minimum, and maximum parameters:

- **Default field:** For an input parameter, sets the default value for the specified parameter; for an output parameter, the default identifier name is set.
- **Min field:** Sets the suggested minimum value for the specified parameter, if applicable.
- **Max field:** Sets the suggested maximum value for the specified parameter, if applicable.

Include files area

The include files area is located at the bottom of the parameter box and lists the header files used within the module. This area can be used to add include files and #defines to the present module.

Control button area

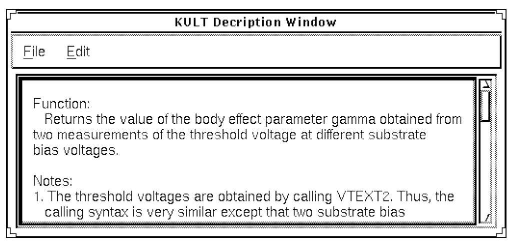
The control button area is aligned vertically along the right side of the parameter box and contains the following functions:

- **Add:** Adds a parameter template to the parameter definition area after the present parameter template.
- **Delete:** Removes a parameter template from the parameter definition area.
- **OK:** Updates the parameter list and header files of the module. The parameters and header files appear in the main window, and the Parameter window becomes hidden.
- **Apply:** Updates the constants and header files of the module. The parameter list and header files appear in the main window.

Description window

The Description window, shown in the following figure, is located at the bottom of the Keithley User Library Tool (KULT) screen. Information entered in this window is for module documentation and Keithley Interactive Test Tool (KITT) user library help. For more information about KITT, refer to Keithley Interactive Test Tool (on page 2-25).

Figure 43: Description window

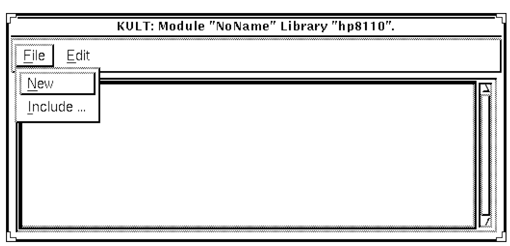


File menu

The File menu shown in the following figure has the following options:

- **New:** Clears the description area of text.
- **Include:** Lets you include an existing file in the description. Selecting Include produces the include dialog box. Use this box to locate the file you wish to include.

Figure 44: Description window file menu



Edit menu

The Edit menu, shown in the following figure, contains the following selections:

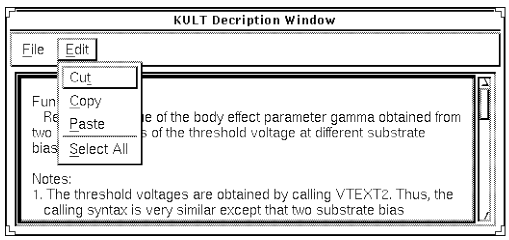
- **Cut:** Removes highlighted text, which can be restored to a different location using the Paste function.
- **Copy:** Copies highlighted text, which can be placed in a different location using the Paste function.
- **Paste:** Places cut or copied text at the cursor location.
- **Select All:** Lets you highlight all of the information entered in the description area for the purpose of cutting, copying, and pasting to a different location.

NOTE

When cutting, copying, and pasting between the main window and the Description window, remember to use the Cut or Copy command from the window that contains the text, and the Paste command from the window where the text is being placed.

You can also use the Edit commands that are accessed by clicking the middle mouse button, as described earlier in this section.

Figure 45: Description window edit menu



Description area

The description area is located below the menu bar and provides the area to enter help information.

NOTE

Do not place a period in the first column of any line in the description area. Any text after the period in the description area will not be available from the Keithley Interactive Test Tool (KITT) Command Help.

Command line interface

The Keithley User Library Tool (KULT) command-line interface lets you load, build, or delete libraries and add or delete modules from the command line. The format for command line instruction is:

```
kult subcommand [options] [filename...]
```

The subcommands are listed in the following table.

Command	Syntax	Description
new_lib	kult new_lib -l<*library_name*>	Start KULT and immediately load a new library from the command line.
bld_lib	kult bld_lib -l<*library_name*>	Start creating a new library immediately after starting KULT from the command line.
del_lib	kult del_lib -l<*library_name*>	Delete a library from the command line.
add_mod	kult add_mod-l<*library_name*> -d<*directory_name*> <*module*>	Add a module immediately after starting KULT from the command line. The -d option is needed when the modules you want to add are not in the present directory.
del_mod	kult del_mod -l<*library_name*> <*module*>	Delete a module from the command line.
compile_mod	kult compile_mod -l<*library_name*> <*module*>	Compile a module into the library *library_name*. The module must already exist.
update_mod	kult update_mod -l<*library_name*> <*module*>	Generates the prototype file, wrapper files, and help file for a module in the library *library_name*, then compiles the module. The module must already exist.

The options include:

- -l<*library_name*>
- -d<*directory_name*>
- -hide
- -nohide
- -uap
- -nouap
- -dep [*library_name*].....[*library_name*]

Example

The following is an example of how to use the command line to create a new library, add an existing module to the library, and then build the new library. This need can occur when you want to add a usrlib module from another facility or project to the current project.

NOTE

The new module name must be unique from any other module name in other user libraries.

In this example, you will be creating the new library, `mylib2`, and adding the module, `res3`. Both the old library and the new library are contained in the `/home/kthmgr` directory.

```
kult new_lib -lmylib2
kult add_mod -lmylib2 -d/home/kthmgr res3
kult bld_lib -lmylib2
```

If you want to add the module to an existing library, omit the kult `new_lib -lmylib2` step above. This assumes that the user library `mylib2` already exists and does not already contain a module named `res3`.

Copying user libraries with kult_copy_lib

The `kult_copy_lib` utility can be used to copy all or listed user library source files (`.c`) from the current or specified directory to a new user library in the current `KI_KULT_PATH`.

Usage:

```
kult_copy_lib -llibrary [-ddirectory [files]]
```

Where:

`library` = New user library name

`directory` = Directory path that contains the `.c` user library files

`files` = One or more files from the directory to include (default is `*.c`)

Example:

```
> ls *.c
   module1.c module2.c
   > kult_copy_lib -lmy_lib
   Library "my_lib" was created!
   module module1 added to library my_lib
   module module2 added to library my_lib
   Library my_lib built.
   done.
```

or

```
> ls ~/libfiles/*.c
   file1.c file2.c file3.c
   > kult_copy_lib -lmy_lib2 -d~/libfiles file1.c file3.c
   Library "my_lib2" was created!
   module file1 added to library my_lib2
   module file3 added to library my_lib2
   Library my_lib2 built.
   done.
```

Migrating user libraries with migrate_usrlib

The `migrate_usrlib` utility provides an easy method of copying usrlibs from previous Keithley Test Environment (KTE) installation packages to the current KTE installation package when the current package is installed in an alternate directory. It can be used to copy any usrlib from any project of any previously installed package into the current `KI_KULT_PATH` directory.

The `migrate_usrlib` utility first looks for previously installed packages, then prompts you to select the one where the source usrlib is located. If the `-p` option is used, it then displays a list of projects associated with the package, and prompts you to select one. If `-p` is not used, or if no projects (other than the default) are associated with the selected package, the script assumes that the default project contains the source usrlib. It then displays a list of usrlibs in the selected package or project, and prompts you to select one (or all) to copy. It proceeds to call `kult_copy_lib` to copy the selected usrlibs into the `KI_KULT_PATH` directory, and then exits.

Usage:

```
migrate_usrlib [-p]
```

Migrating from S400 test plans to S530

The S530 Keithley Test Environment (KTE) software is mostly compatible with existing S400 KTE test plans. However, due to operating system and instrumentation differences, some minor changes are necessary for your measurement routines. This section identifies some of the most common items.

1. S530 KTE software executes in the CentOS Linux® environment and uses the GCC Compiler. The GCC Compiler may generate more warnings than the Sun Solaris Workshop compiler tools. Adding `#include <stdlib.h>` and `#include <string.h>` lines to your Keithley User Test Library (KULT) modules may be enough to resolve the warnings. Please note that these are compiler warnings only. The modules will still execute, but it is always a good practice to have your usrlib module code compile without warnings.

NOTE

If you are using the Recipe Manager/Version Control feature of KTE, you must have your usrlib modules compile without warnings.

2. The S530 uses SMUs, not VIMS. As a result, any references to VIMS need to be changed to SMU.
3. The S530 LPTLib library returns data as "double" instead of "float." Your usrlib modules may need to be modified to support double data types instead of float.
4. The S530 system has all of the source-measure unit (SMU) low terminals connected to each other. As a result, you cannot stack two or more SMUs together to increase the voltage. Your usrlib modules may need to be modified to remove the use of this stacking capability.
5. The polarity value of current measurements for the S530 SMUs is reversed from the S400 VIMS. As a result, any usage of the `trigX` commands will need to be changed. The current measurement polarity of the S530 SMUs and S600 SMUs are the same, so no change is necessary.
6. Any OS-specific user access point (UAP) code and user scripts may need to be ported to Linux® from Solaris. Most UAP routines will need to be recompiled in the new S530 KTE environment.

Locking a module

Each time a module is opened in the Keithley User Library Tool (KULT), a lock file is created at `$KI_KULT_PATH/"libname"/lock` that prevents other users from modifying the module while it is open. The module may be accessed and used, but no changes can be made to the module without changing the name of the file.

When an attempt is made to access a module that is already open, a dialog box is displayed stating that the module selected is locked and the present user's name and PID.

After clicking the **OK** button, the module opens normally. If any changes are made to the module while it is locked by another user, this edited module must be given a new name. This new name cannot be a name that is already being used, or KULT will not allow the module to be saved.

WARNING

If a library is deleted while another user is working on a module from that library, the module will still be deleted without warning, even though it is locked, and the user will be prompted that the file no longer exists when a Save is attempted. The user should then save the file to a new module.

NOTE

It is a good practice to periodically check the home directory of the lock files and clean up any files that no longer require locks.

When a module is opened, a lock file is created at `$KI_KULT_PATH/"libname"/lock` in the following manner:

- The lockfile is named *X* - *Y* `.lck`, where *X* is the library name and *Y* is the module name.
- The following information is contained in the lockfile:
  PID:****The processor ID
  USER:**** User name
  HOST:**** Host computer name
  TIME:**** Time lock was created
  LIB:**** Library name
  MOD:**** Module name
  FILE:**** Path/Lockfilename

Changing library attributes

You can change library attributes; the following topics describe how.

Hiding libraries from Keithley Interactive Test Tool macros

A library that you create may contain modules that will not work if called by Keithley Interactive Test Tool (KITT) macros (for example, modules that are designed only to be called by other modules in other user libraries). The Hide Library menu item and the hide command-line option allow you to make a library unavailable to macros by hiding the library from KITT.

Application example

The following example assumes user library `LibB` contains low-level modules that only modules in user library `LibA` can call. By setting the dependency of `LibA` on `LibB` and then hiding `LibB`, only the modules in `LibA` will be able to call the modules in the hidden `LibB`.

Procedures

To hide a user library from the Keithley Interactive Test Tool (KITT), use either of the following methods.

To hide a user library using the KULT window:

1. Open the library in KULT.
2. From the **Options** menu, select the **Hide Library** toggle. The Library Visible or Library UAP/Visible indication located in the upper right of the KULT main window changes to Library Hidden or Library UAP/Hidden.
3. In the **Options** menu, select **Build Library** to rebuild the library as a hidden library.

Or:

Using the command line, enter the following:

```
kult bld_lib -l<library_name> -hide
```

To make a user library visible in KITT, use either of the following methods.

To make a user library visible using the KULT window:

1. Open the library in KULT.
2. From the **Options** menu, deselect the **Hide Library** toggle. The Library Hidden or Library UAP/Hidden indication located in the upper right of the KULT main window changes to Library Visible or Library UAP/Visible.
3. In the **Options** menu, select **Build Library** to rebuild the library as a library that is hidden from KITT.

Or:

Using the command line, enter the following:

```
kult bld_lib -l<library_name> -nohide
```

The following table summarizes Hide Library use combined with UAP Library use (discussed in the topics that follow).

Figure 46: Effect of library options on library availability to macros and UAPs

Combination of options that is set at the command line or in the Options menu		Library state		Indication that displays above the Apply button
bld_lib command options[2]	Options menu selections[2]	Available to test macros and visible in KITT	Available at UAPs and in KTPM[3]	
-nohide[1] -uap[1]	Hide Library UAP Library	●	●	Library UAP/Visible Apply
-nohide[1] -nouap	Hide Library UAP Library	●	No	Library Visible Apply
-hide -uap[1]	Hide Library UAP Library	No	●	Library UAP/Hidden Apply
-hide -nouap	Hide Library UAP Library	No	No	Library Hidden Apply

Setting library availability at UAPs

Some libraries that you create may contain modules that do not work in user access points (UAPs). The UAP Library toggle, when deselected, and the `- nouap` command-line option make these libraries unavailable at UAPs and in the Keithley Test Plan Manager (KTPM). Refer to the procedures below and the previous table.

To make a user library unavailable at UAPs and in KTPM, use either of the following methods.

To make a user library unavailable us the KULT window:

1. Open the library in KULT.
2. From the **Options** menu, deselect the **UAP Library** toggle (UAP Library is selected by default). The Library UAP/Visible or Library UAP/Hidden indication located in the upper right of the KULT main window changes to Library Visible or Library Hidden.
3. In the Options menu, select "Build Library" to rebuild the library.

Using the command line, enter the following:

```
kult bld_lib -l<library_name> -nouap
```

To make a user library available at UAPs and in KTPM, use either of the following methods.

To make a user library available using the KULT window:

1. Open the library in KULT.
2. From the **Options** menu, select the **UAP Library** toggle. The Library Visible or Library Hidden indication located in the upper right of the KULT main window changes to Library UAP/Visible or Library UAP/Hidden.
3. In the **Options** menu, select **Build Library** to rebuild the library.

Using the command line, enter the following:

```
kult bld_lib -l<library_name> -uap
```

KTE library locking

The following topics describe Keithley Test Environment (KTE) library locking.

Run-time library locking

You can lock a run-time library using the following procedure.

LIBRARY reader locks for KTXE, KSOX, and KITT

LIBRARY reader locks for Keithley Test Execution Engine (KTXE), Keithley Sequential Executor (KSOX), and Keithley Interactive Test Tool (KITT). These locks are set when a process opens the library for use. These locks reside in the LIBRARY lock directory (`$KI_KULT_PATH/lock`). The lock file is named:

```
libName.pid.hostname
```

Where:

`libName` = The name of the library
`pid` = The pid of the process that is using the library
`hostname` = The hostname of the machine using the library

The following programs and tools use the library reader locks:

Keithley Sequential Executor (KSOX)

When you attempt to open a usrlib, check for the existence of a build lock. If a build lock exists for this library, skip the `dlopen` call. No reader lock is created because the `dlopen` was not called. Delete the reader lock when a library is closed.

Keithley Interactive Test Tool (KITT)

KITT only opens the usrlib when it needs references for syntax checking or for loading the command list.

KITT uses the KSOX utilities to create and delete the reader locks. The same rule applies if a build lock exists while attempting to open a library; the open will fail.

KTXE

KTXE will use KSOX utilities to create and delete the reader locks. The same rule applies if a build lock exists while attempting to open a library; the open will fail.

Edit-time library locking

You can lock an edit-time library using the following procedure.

LIBRARY write lock for the Keithley User Library Tool

This lock is created and exists only while the Keithley User Library Tool (KULT) is building the library. This lock resides in the LIBRARY lock directory (`$KI_KULT_PATH/lock`). The lock file is named:

`libName`

Where:

`libName` = The name of the library

KULT checks for the presence of any reader locks before attempting a build library operation. If a read lock exists, a warning message is displayed and the library build does not occur.

KULT creates a write lock before the build operation starts. This write lock is removed when the build operation has completed.

KULT uses the existing module lock scheme.

KULT uses the existing module lock scheme to prevent multiple edits of the same module. The location of these lock files changed from the old lock directory, `$KIHOME/lock`, to a new location:

`$KI_KULT_PATH/libName/lock`

Where:

`libName` = The name of the library.

Troubleshooting

Occasionally, an error occurs and lock files are not deleted or removed by the appropriate application. The following are some situations that can cause problems:

- **Using the debugger and not running the program to completion.** Using the debugger to test a program and aborting the session before the program can complete normally leaves reader locks present in the `$KI_KULT_PATH/lock` directory.
- **Using the `kill -9` command.** If a process is stopped using the `kill -9` command, reader locks are not removed automatically from the `$KI_KULT_PATH/lock` directory.

Deleting the lock files resolves the above problems.

Limits File Editor

The Limits File Editor (LFE) creates and edits limits files (`.klf`). Spreadsheet and Dialog views are provided for data manipulation. The Dialog view is restricted to a single parameter at a time. The following information is included in the file for every test parameter:

Character fields: ID, Name, Units, Category

Choice fields: Report, Critical, Abort Action, Abort Limit, and Enabled

Data fields: Target, four limit pairs (Valid, Spec, Ctrl, and Engr), Class, and three user data fields (User 1, User 2, and User 3).

LFE data is used both during test execution and after test execution. Abort flags can be set to interrupt testing if preliminary test results on a few parameters include gross errors. In such cases, testing can be delayed for operator intervention, corrective action, and retry. User access point (UAP) code can use LFE data to perform simple or complex run-time actions.

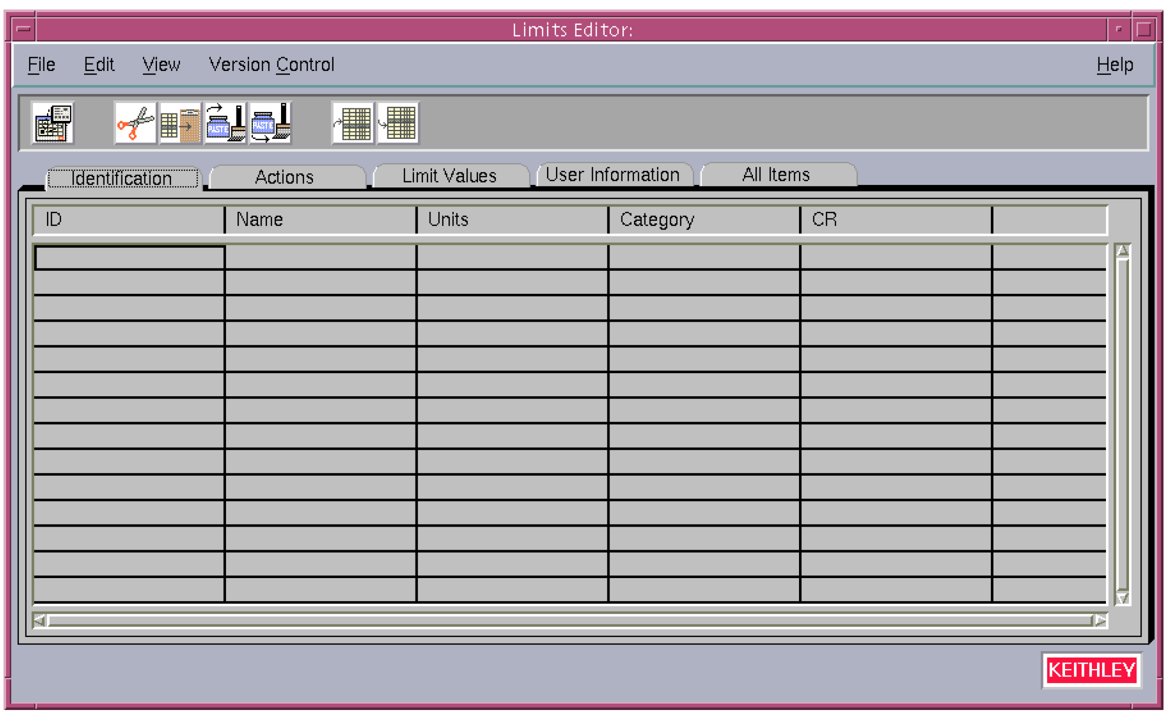
LFE data is also used by the Keithley Summary Utility (KSU) and the Lot Summary program to create reports. These reports show the acquired data compared against the Valid, Spec, Ctrl, and Engr limit pairs. The limits file used during production testing is specified in the Wafer Plan.

LFE main window

The Limits File Editor (LFE) main window, shown in the following figure, is the primary interface of LFE.

LFE is a full-screen graphical application with a spreadsheet format. The main window contains four pull-down menus, seven push buttons that correspond to menu selections, and a data entry area organized by five tabs.

Figure 47: LFE main window



Title bar

The title bar lists the name of the currently open limits file and the read-write status of the file.

The pull-down menus contain the following functions:

- Select and save parameter limits files
- Exit the Limits File Editor (LFE)
- Manipulate data in a limits file
- View limits file information in a different format
- Access help

The following paragraphs contain a brief overview of each menu.

LFE File menu

You can use the File menu to do the following tasks:

- Reinitialize the main window (new)
- Load or save limits files
- Delete limit files
- Generate limits from Keithley Test Macros (KTM) files
- Set a limit as the default limit
- Save column settings
- Exit the Limits File Editor (LFE)

LFE Edit menu

You can use the Edit menu to manipulate limits by cutting, copying, pasting, and inserting. You can also do a search for specific data (character strings) or sort the data by the selected data field.

LFE View menu

You can use the View menu to access the Limits Editor Dialog window and enter a comment line that will be stored with the file.

LFE Help menu

You can use the Help menu to acquire online help information about the Limits File Editor (LFE) and the release version of the LFE being run.

Push-buttons

Seven push-buttons located beneath the menu bar provide shortcuts to menu selections.

Limits data entry area

The limits data associated with each parameter is arranged along one row. Multiple rows contain the same limits data for multiple parameters. The information is organized by tabs, allowing you to quickly find and modify the desired fields:

- **Identification:** Contains the ID, Name, Units, Category, and Critical fields.
- **Actions:** Contains the ID, Name, Enabled, Class, Report, Abort Action, and Abort Limit fields.
- **Limit Values:** Contains the ID, Name, Target, Valid (H/L), Spec (H/L), Control (H/L), and Engineering (H/L) fields.
- **User Information:** Contains the ID, Name, User 1, User 2, and User 3 fields.
- **All Items:** Contains all the fields.

ID

The ID uniquely identifies each test parameter. This entry must be a legal C language name. The string may contain a maximum of 128 characters. This field is required.

Name

The name field provides for a descriptive name that describes the parameter more clearly than the ID. The data in this field is used by the Keithley Summary Utility (KSU). This field may contain non-alphanumeric characters (including spaces) and need not be a legal C language name. The only constraint is that it must not include commas. The string can contain a maximum of 40 characters.

Units

The Units field defines the units for the limit's test results. This field may contain non-alphanumeric characters (including spaces) and need not be a legal C language name. The only constraint is that it must not include commas. The string can contain a maximum of 10 characters. Examples of entries for this field are `volts` or `amps`.

Category

The Category field allows you to specify what group the results data will belong to when all of the results data is sorted into database groups. Each category must be a single-word string. One parameter can belong to several categories if all the categories are listed (comma- or white space-delimited). This field can contain a maximum of 20 characters.

RP

RP (Report) determines whether or not the limit is included in the lot summary report compiled in the Keithley Summary Utility (KSU). The entry for this field is `Y` for yes and `N` for no.

CR

CR (Critical) allows parameters to be tagged as not critical (`N`) or as critical with one of nine different critical flags (`1`, `2`, `3`, `4`, `5`, `6`, `7`, `8`, `9`).

Target

The Target field identifies the ideal result expected for the specified result ID. The entry for this field is a numeric value.

Abort Action

The Abort Action field identifies the sequencer execution engine level to proceed to if the measured result fails the abort limit check. This field toggles between the following values: Subsite, Site, Wafer, Lot, or None.

Abort Limit

The Abort Limit field specifies the limits to use for the Abort Action results comparison in the execution engine. If an abort flag is triggered by the measured value, the sequencer loops to the sequencer level specified by the Abort Action field. This field toggles between the following values: Valid, Spec, Ctrl, or Engr.

Valid, Spec, Ctrl, and Engr high and low parameters

Each limit has up to four different high and low limits that can be set. These limits can be used during test program execution to establish testing abort criteria. These limits are used to sort parameter test results in the Keithley Summary Utility (KSU) lot summary report. These ranges can be set to any user-specified parameters and are expressed in scientific notation. Following are four typical applications for the parameters.

- **Valid:** This limit pair can be used to check for faults within the testing system. Numbers outside of this range indicate that the data being produced by the system is invalid, usually due to an equipment malfunction.
- **Spec:** This limit pair be used to check for manufacturing standards. Numbers outside of this range indicate that the device being tested does not meet manufacturing specifications.
- **Ctrl:** This limit pair can be used to check process control limits.
- **Engr:** This limit pair can be used by engineers to ensure the components meet design standards.

Enabled

The Enabled field is used only with the Adaptive Test option software. This field determines whether this parameter is included in the test. The entry for this field is `Y` for yes and `N` for no.

Class

The Class field can be used with the enabled flag or as user data. This field can contain a maximum of 255 characters.

User fields

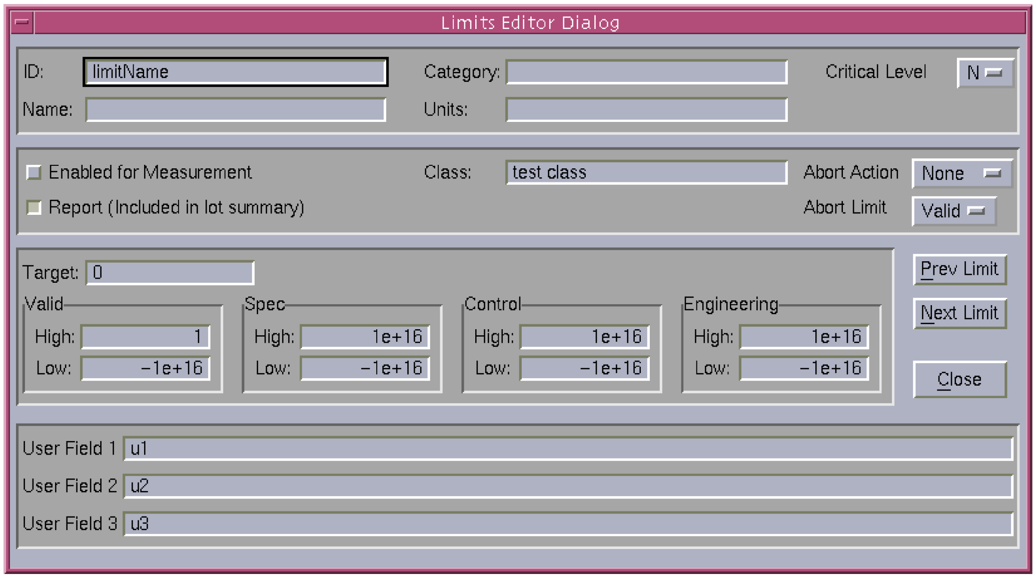
The User fields can contain a maximum of 255 characters of information. There are three user data fields:

- User Field 1
- User Field 2
- User Field 3

Limits Editor Dialog window

The Limits Editor Dialog window displays all of the elements for a parameter, one parameter at a time, as shown in the following figure. A single parameter in the spreadsheet format is one row. The parameter that appears in this window is the parameter that is highlighted in the main window.

Figure 48: Limits editor dialog window



This window also tracks the movement of the cursor in the Limits File Editor (LFE) main window. As changes are made in the main window, the information in the Limits Editor Dialog window is automatically updated.

There are two check boxes in this window for the Report (RP) and Enabled columns in the main window. Checking these boxes is the same as entering Y in the corresponding box in the main window. There are choice boxes for the Critical (CR), Abort Action, and Abort Limit fields, allowing you to select one of the available options for each field.

Keithley Test Plan Manager (KTPM)

The following paragraphs contain basic information about the Keithley Test Plan Manager (KTPM). Brief descriptions of the Wafer Plan Builder, the Cassette Plan Builder, and the Test Documentation Tool are included.

KTPM is a graphical user interface used by the test engineer to create a cassette plan file (`.cpf`) that can be executed using the Keithley Test Execution Engine (KTXE). The information that is entered into the `.cpf` file determines the parameters of the test process that will be executed.

Wafer plan builder

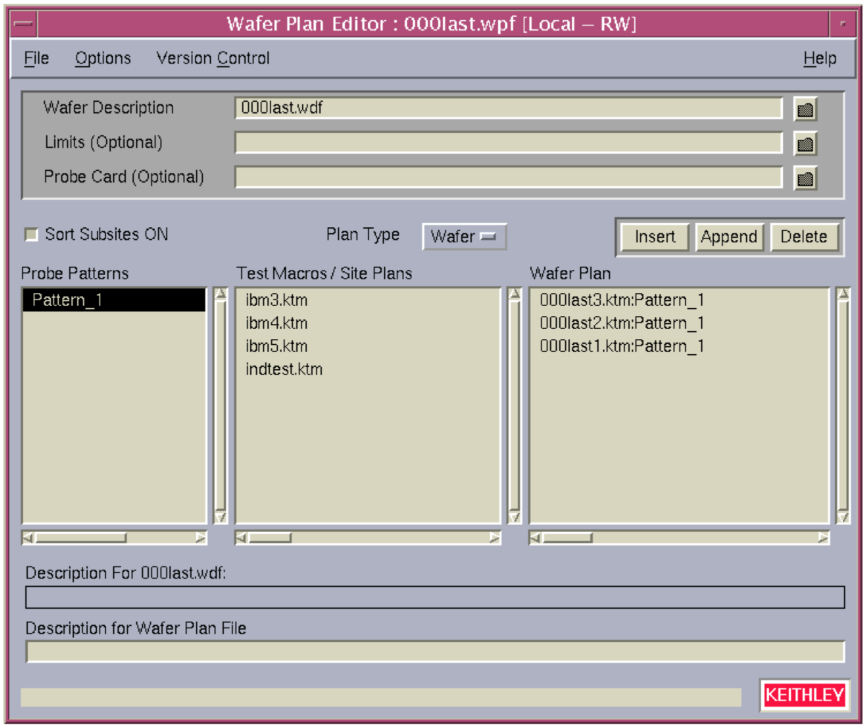
The Wafer Plan Builder is used to create a wafer testing plan. The most important function performed in the wafer plan builder is the binding of tests to wafer probe patterns. This can be simplified for many wafer plans by using the feature of grouping test macros into site plans.

Wafer plan builder main window

The wafer plan builder window shown in the following figure contains the following areas:

- **Main menu bar:** Contains the File, Options, and Help menus.
- **Wafer description file selection field:** Used to select the wafer description file.
- **Limits file selection field:** Used to select the limits file.
- **Probe card file selection field:** Used to select the probe card file.
- **Sort Subsites button:** Used to modify the subsite probing sequence.
- **Plan type selection button:** Used to select between building a wafer plan or a site plan.
- **Probe Patterns/Site Plan list:** Gives a listing of all of the probe patterns or site plans available.
- **Test Macros/Site Plans list:** Gives a listing of all the valid test macros and site plans for the wafer description file specified.
- **Site plan/Wafer plan builder field:** For site plans, this field contains the macros in the site plan. For wafer plans, this field contains the macros and site plans bound to the probe pattern.
- **Insert buttons:** Used to place selected files before or after a file in the builder field, or to delete a file from the builder field.
- **New site plan button (available only when the plan type button is set to Site Plan):** Opens a dialog box that allows you to enter the name and description of a new site plan.
- **Wafer plan file description field:** Lets you enter a description of the wafer plan file.
- **Wafer description file description field:** Displays the description of the selected `.wdf` file. This field cannot be edited.

Figure 49: Wafer plan builder



Title bar

The title bar lists the name of the currently open wafer plan file and the read-write status of the file.

Wafer plan builder File menu

The File menu contains the following selections:

- **New:** Clears the Wafer Plan Builder main screen to prepare for creating a new wafer plan file.
- **Open:** Opens an existing wafer plan file.
- **Save:** Saves the currently displayed wafer plan file under the current name.
- **Save As:** Saves the currently displayed wafer plan file under a new or pre-existing user-specified name.
- **Delete:** Opens a window allowing you to delete a wafer plan file.
- **Exit:** Exits the wafer plan builder.

Wafer plan builder Options menu

The Options menu contains the toggle Save Default Path. This toggle enables or disables the storing of the filenames within the `.wpf` file. The default environment variables are assumed and used for file locations. If this toggle is disabled and the user selects a file that is not in the default location, the path is saved with the filename. If the toggle is enabled, the path is always saved in the `.wpf` file.

Wafer plan builder Help menu

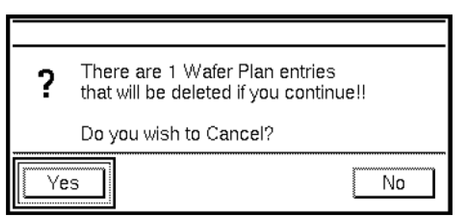
The Help menu provides online help and release version information about the wafer plan builder. The Documentation option allows access to the online Keithley Test Plan Manager (KTPM) manual. The About option displays the software revision information.

Wafer description file selection field

The wafer description file selection field lets you select the `.wdf` file that will be used during test execution. This is an optional field overrides the `.wdf` file specified in any wafer plan file used. Right-clicking the filename in this field displays a pop-up dialog box allowing you to open the wafer description file for editing.

If a test macro site plan has been entered into the wafer plan and the `.wdf` folder button is selected, the warning box shown in the following figure is displayed, telling you that there are wafer plan entries that will be deleted if you continue selecting a new `.wdf` file. Select **Yes** to cancel the procedure or **No** to continue.

Figure 50: Wafer plan entry warning box



Limits file selection field

Clicking the limits file selection field folder icon lets you select the `.klf` file that will be used during wafer plan execution. Right-clicking the filename in this field displays a pop-up dialog box allowing you to open the limits file for editing.

Probe card file selection field

The probe card file selection field lets you select the `.pcf` file that will be used during test execution. This is an optional field that overrides the `.pcf` file specified in any wafer plan file used. Right-clicking the filename in this field displays a pop-up dialog box allowing you to open the probe card file for editing.

Plan type selection button

Click and hold on this button to choose between building a Wafer Plan and building a Site Plan.

Sort subsites button

When this button is selected, the subsites are sorted for testing by their increasing X-axis and Y-axis values. When this button is not selected, the subsites are tested in the order they appear on the subsite list.

Probe patterns and site plans list

When the plan type selection button is set to Wafer Plan, this area contains a list of all the probe patterns available from the wafer description file selected. When Site Plan is selected, this area lists all of the site plans available for use when building the wafer plan. Site plans are saved within each `.wpf` file only; there is no master list of site plans accumulated across `.wpf` files.

Test macros and site plans list

When the plan type selection button is set to Wafer Plan, this area contains a list of all the test macros and site plans available. When Site Plan is selected, this area lists all of the test macros available for use when building a site plan.

Site plan and wafer plan builder field

This field is used to build the wafer plan or site plan. By clicking the different files in the Probe Pattern/Site Plan list and the Test Macros/Site Plan list, and then clicking the Insert Bef. or Insert Aft. buttons, you can add the highlighted files to the site plan or wafer plan you are building. When macros or site plans are bound to probe patterns, those macros or site plans are removed from the list of available macros and site plans. Each macro or site plan can be bound to only one probe pattern.

Insert buttons

Used to move the files from the Probe Pattern/Site Plan list and the Test Macros/Site Plan list into the Site Plan/Wafer Plan Builder field. The functions of each of these buttons is:

- **Insert button**: Inserts the highlighted files from the Probe Pattern/Site Plan list and the Test Macros/Site Plan list before the highlighted file in the Site Plan/Wafer Plan Builder field.
- **Append button**: Inserts the highlighted files from the Probe Pattern/Site Plan list and the Test Macros/Site Plan list after the highlighted file in the Site Plan/Wafer Plan Builder field.
- **Delete button**: Removes the file highlighted in the Site Plan/Wafer Plan Builder field.

New site plan button

This button appears when the plan type selection button is set to Site Plan. Clicking this button opens a dialog box that lets you enter the name and description of a new site plan. Once a site plan description is entered and a site plan is formed, it cannot be viewed or edited in the wafer plan editor, and will only appear in the `.wpf` file whenever the site plan is used in that `.wpf`. This new site plan appears in the Site Plan list when the plan type selector button is set to Site Plan, and in the Test Macros/Site Plans list when the Plan Type selector button is set to Wafer Plan.

Wafer plan file description field

This field lets you enter a description of the wafer plan file, which can be edited and saved.

Wafer description file description field

Displays the description of the selected `.wdf` file. This field cannot be edited.

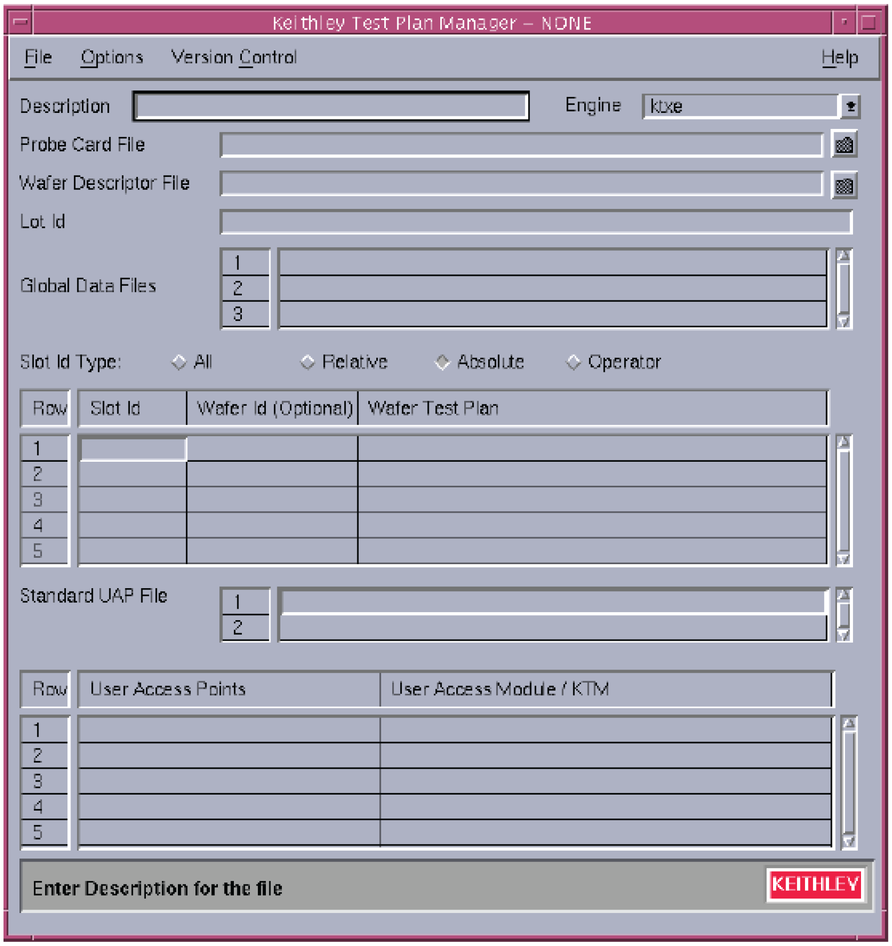
Cassette plan builder

The cassette plan builder, shown in the following figure contains the following areas:

- **Main menu bar:** Contains the File, Options, and Help menus.
- **File description field**: Enter a description of the cassette plan file.
- **Execution engine selection field:** Select a specific execution engine.
- **Probe card file selection field:** Select the probe card file to be used for all wafers in the cassette.
- **Wafer description file selection field:** Select the wafer description file to be used for all wafers in the cassette.

- **Lot ID data field:** Enter the ID of the lot that is to be tested.
- **Global data file selection field:** Enter the files containing all the global data definitions.
- **Wafer test plan area:** Identify the Wafer Test Plan to be used for each wafer during testing.
- **Standard UAP file field:** Identify the files containing any standard user routines to be added to the execution engine. If multiple files are identified they are executed in the order entered.
- **UAP Module/KTM area:** Identify any additional modules or Keithley Test Modules (KTMs) to be added to the execution engine at the specified user access point (UAP).

Figure 51: Cassette plan builder



Title bar

The title bar lists the name of the currently open cassette plan file and the read-write status of the file.

Cassette plan builder File menu

The File menu contains the following selections:

- **New:** Clears the cassette plan builder main screen to create a new cassette plan file.
- **Open:** Opens an existing cassette plan file.
- **Save:** Saves the currently displayed cassette plan file under the current name.
- **Save As:** Saves the currently displayed cassette plan file under a new or pre-existing user-specified name.
- **Delete:** Opens a window allowing you to delete a cassette plan file.
- **Exit:** Exits Keithley Test Plan Manager (KTPM).

Cassette plan builder Options menu

The Options menu contains the following selections:

- **Wafer Plan Editor:** Opens the wafer plan editor window, allowing you to create or modify a wafer plan.
- **Test Documentation Tool:** Opens the Test Documentation Tool, allowing you to view the cassette plan as it will be executed by the selected execution engine.
- **Save Default Path:** This toggle enables or disables the storing of the various filenames within the `.cpf` file. The default environment variables are assumed and used for file locations. If this toggle is disabled and you select a file that is not in the default location, the path is saved with the filename. If the toggle is enabled, the path is always saved in the `.cpf` file.

Cassette plan builder Help menu

The Help menu provides online help and release version information about Keithley Test Plan Manager (KTPM). The Documentation option allows access to the online KTPM manual. The About option displays the software revision information.

File Description field

The file Description field is used to enter a short description about the cassette plan file.

Execution Engine selection field

The execution Engine selection field lets you select the execution engine that will run the cassette plan.

Probe card file selection field

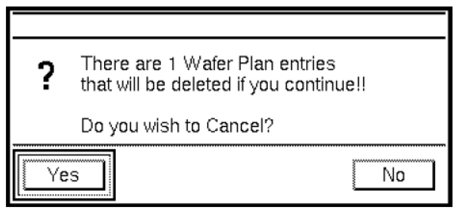
The probe card file selection field lets you select the `.pcf` file that will be used during test execution. This is an optional field that overrides the `.pcf` file specified in any wafer plan file used. Right-clicking the filename in this field displays a pop-up dialog box allowing you to open the probe card file for editing.

Wafer description file selection field

The wafer description file selection field lets you select the `.wdf` file that will be used during test execution. This is an optional field overrides the `.wdf` file specified in any wafer plan file used. Right-clicking the filename in this field displays a pop-up dialog box allowing you to open the wafer description file for editing.

If a test macro site plan has been entered into the wafer plan and the `.wdf` folder button is selected, the warning box shown in the following figure is displayed, telling you that there are wafer plan entries that will be deleted if you continue selecting a new `.wdf` file. Select **Yes** to cancel the procedure or **No** to continue.

Figure 52: Wafer plan entry warning box



Lot ID data field

This is an optional field that lets you identify the lot that will be tested. This data is used as the default if none is specified at run time by the operator or shop floor control system.

Global data file selection field

The global data file selection field is an optional field that lets you specify any `.gdf` files that will used to define data during plan execution. The full path name of the file should be given.

Slot ID type selection buttons

These buttons apply to the Slot ID column in the wafer test plan. Four different selections are possible:

- **All:** All wafers within a cassette will be tested with the same wafer plan.
- **Relative:** Each wafer should be identified by its slot position relative to the other wafers in the cassette.
- **Absolute:** The wafer should be identified by its actual slot position in the cassette.
- **Operator:** Allows the operator to select which wafers to test.

Wafer test plan field

The wafer test plan field lets you specify the wafer test plan for a specific wafer. This area lets you specify the slot that contains the wafer, the wafer ID (optional), and the path and filename of the wafer test plan.

Standard user access point file field

The Standard UAP file field is optional and lets you specify files that contain module and Keithley Test Module (KTM) routines to be used at user access points (UAPs) in the execution engine.

User access point module and Keithley test module area

The UAP Module/KTM area lets you specify the module or `.ktm` file that will be executed at the user access point (UAP) listed. Available UAPs are shown by clicking the right mouse button in this field and selecting Add New UAP After or Insert New UAP. A list arrow is displayed that lets you select from all the UAPs available to the selected execution engine. Each engine will have a different list of available UAPs. The UAP list and descriptions are stored in the `ktpm.ini` file.

Test documentation tool

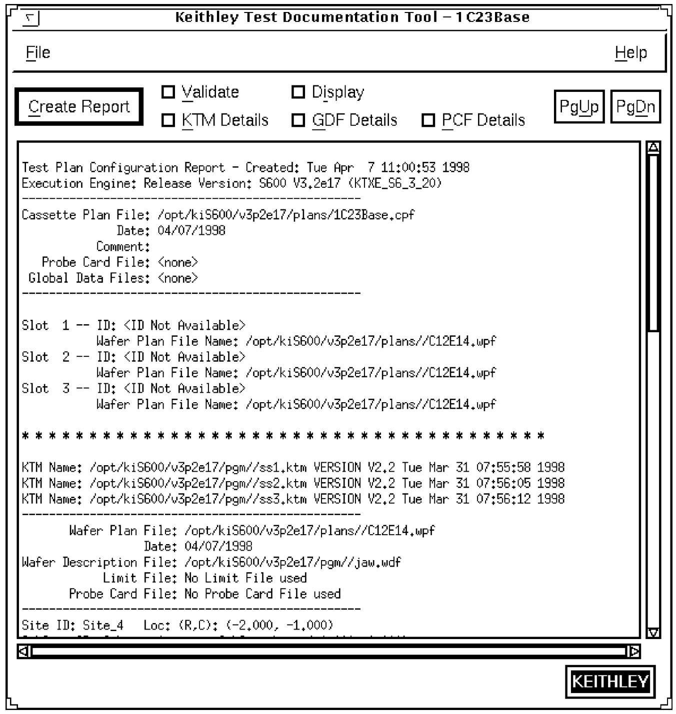
The test documentation tool is used to view the test that will be performed by the cassette plan file specified in the Keithley Test Plan Manager (KTPM). The tool provides a report that shows each user access point (UAP) and `.ktm` file that is executed, in the order of execution for all wafers, sites, and subsites.

Main window

The test documentation tool main window, shown in the following figure, contains the following areas:

- **Main menu bar:** Contains the File and Help menus.
- **Create report button:** Regenerates the report with any new options specified.
- **KTM details toggle:** Enables or disables the display of Keithley Test Module (KTM) details.
- **GDF details toggle:** Enables or disables the display of Global Data File details
- **PCF details toggle:** Enables or disables the display of Probe Card File details.
- **Validate toggle:** Enables or disables additional cassette plan validation steps.
- **Display toggle:** Enables or disables displaying the test plan sequence report.
- **PgUp/PgDn buttons:** Lets you scroll through the report page-by-page rather than line-by-line.
- **Report field:** Shows the report created by the Test Documentation Tool.

Figure 53: Test documentation tool



File menu

The File menu contains the following selections:

- **Save As:** Saves the information to a new file.
- **Print:** Provides a complete printout of the report.
- **Exit:** Exits the Test Documentation Tool.

Help menu

The Help menu provides online help and release version information about the Test Documentation Tool. The Documentation option allows access to the online Keithley Test Documentation Tool (KTDT) manual. The About option displays the software revision information.

Create report button

When this button is clicked, the report is created with either the Keithley test module (KTM), global data file (GDF), and probe card file (PCF) Details enabled or disabled.

Keithley test module Details toggle

This toggle button is used to enable or disable the display of all Keithley test module (KTM) details. These details consist of the actual test commands within the KTM. Enabling this option could cause the report to be very large. This option provides a way to create a detailed printout for archiving purposes.

Global data file Details toggle

This toggle button is used to enable or disable the display of the global data file (GDF) details. These details consist of the actual global data names and values. Enabling this option could cause the report to be very large. This option provides a way to create a detailed printout for archiving purposes.

Probe card file Details toggle

This toggle button is used to enable or disable the display of the probe card file (PCF) details. These details consist of the actual pin names and assignments. Enabling this option could cause the report to be very large. This option provides a way to create a detailed printout for archiving purposes.

Validate toggle

This toggle button is used to enable or disable additional cassette plan validation steps. These additional steps include checking the path names and file locations of all the files associated with the selected cassette plan. Any errors that are identified are logged to the `$KI_KTXE_CPF/cassPlanName.cpf.err` file. These errors are also shown in the documentation window.

Display toggle

This toggle button is used to enable or disable displaying the test plan sequence report after the report has been created. A printout of the report can be created even if the report is not displayed on screen.

PgUp and PgDn buttons

These buttons allow you to scroll through the report page by page. To move through the report at smaller intervals, use the scroll bar along the right side of the report field.

Report field

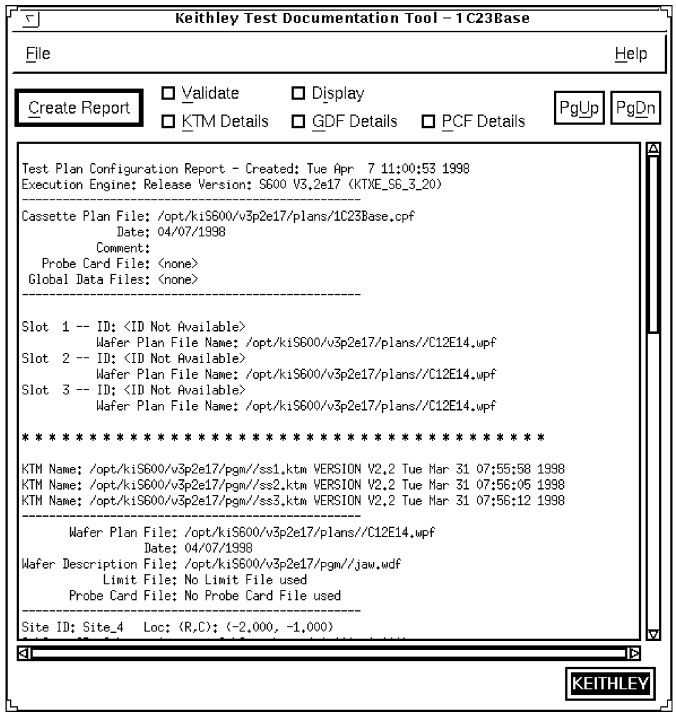
This field is where the entire test report can be viewed. If a wafer plan file has been specified for multiple slots, only the full details of the first occurrence of the wafer plan file is shown.

Using the Test Documentation Tool

Once you have completed building your cassette plan file, you can preview the actual test plan using the Test Documentation Tool.

Select **Test Documentation Tool** from the **Options** menu. The Test Documentation Tool is displayed, as shown in the following figure.

Figure 54: Test documentation tool



Enable or disable the appropriate options for your report and press the **Create Report** button. The system creates and displays the execution report in the display window. From this window you can review your cassette plan to ensure that the test plan will perform the desired tests in the proper sequence.

For all wafers, sites, and subsites, you can also examine each of the test macros by clicking the Keithley Test Manager (KTM) **Details** toggle button and then the **Create Report** button. You can also print out a copy of the entire test plan by selecting **Print** from the **File** menu. This will give you a printed copy of the test plan that can be stored in your archives. The **Save As** option from the **File** menu enables you to save an electronic copy of the report for archival.

Generating documentation during testing

It is possible to generate documentation during Keithley Test Execution Engine (KTXE) execution with the addition of a command-line switch to KTXE. The switch used is `-doc DOC_ON`. After KTXE completes execution, a file is placed in the `$KITMP` directory with the same base name as the cassette plan with the extension `.cpf.kxd`. The utility CreateExecDoc should then be executed to produce a report. The report is written to the `$KITMP` directory with the cassette plan base name `.cpf.kxd.txt`. For more information on CreateExecDoc, enter `CreateExecDoc -help`.

Usage:

```
ktxe -cpf cassette_plan -doc DOC_ON
   CreateExecDoc -cpf cassette_plan
```

Example:

```
> ktxe -cpf myplan.cpf -doc DOC_ON
   > CreateExecDoc -cpf myplan.cpf
   > ls myplan.*
   myplan.cpf myplan.cpf.kxd myplan.cpf.kxd.txt
```

Adaptive testing

Adaptive testing is an optional component of the Keithley Test Environment (KTE) that enables the test plan to change for each wafer being tested. There are two main components of adaptive testing: Zone-based testing and result-based testing. Zone-based testing creates random site test patterns, and result-based testing changes the sites or tests to be used based on the results of previous site tests. Both of these methods are described below.

Zone-based testing

Zone-based testing is a test method where the sites to be tested are generated at run time. The sites to be tested are selected randomly from predefined zones, or patterns, contained in the wafer definition file. For information about creating patterns in the wafer definition file, refer to Wafer Description Utility (on page 2-3).

Zone-based test modes

Zone-based testing can be initiated using two different methods. The first method, described below, is a command line switch for use with the Keithley Test Execution Engine (KTXE). The second method, described under Global data variables (on page 2-77), is with the use of the KTXE_RP_test_mode variable. There are four modes available when using zone-based testing. Testing modes are selected from the command line by specifying the -u "*X*" argument when executing KTXE, where "*X*" is the test mode desired. For example:

```
ktxe -cpf MyPlan.cpf -u "A" -w TestZones.wdf
```

The four test modes are as follows:

- **N – Normal Test:** When normal testing is selected, no patterns are generated at run time. This is the default behavior of KTXE. If the -u command line argument is not specified when executing KTXE, this mode is used.
- **R – Runtime:** This test mode generates random patterns based on the initial wafer description file and the frequency of sites on each wafer. The frequency of sites per wafer is defined in global data by KTXE_RP_max_freq. The initial wafer pattern defines zones for testing. Each zone is defined by a pattern. Each pattern is associated with a wafer plan file generated at run time from an initial wafer plan file.
- **A – Additional Sites:** Retests wafers based on a previously generated wafer description file. The previous wafer description filename is LotID_retest.wdf. The wafers are retested using (pattern number + 1) of the original so that different sites are tested.
- **S – Runtime with Skip:** This test mode generates a random pattern for all wafers that have a wafer plan that matches the name found in the data pool string KTXE_RP_random_wpf. This mode must be used with absolute or relative wafer slot ID types.

KTXE_RP user library

Zone-based testing is accomplished with the use of calls to the user library KTXE_RP at various user access points (UAPs). The following routines are included in the KTXE_RP user library:

- **KTXE_RP_CleanUpWDF:** This function renames the randomly generated WDF file to lot_XXX_wdfname. This preserves the WDF file used in the test for a future adaptive retest. This routine is used if a lot execution is suspended. This function should be called at UAP_LOT_END.
- **KTXE_RP_CreateRandomWDF:** This function creates a wafer file based on the maximum frequency and number of wafers. The name of the wafer description file is saved in the cpf_info structure. This function uses the rand_pat utility to generate random patterns. For information on the rand_pat utility, refer to KTE support utilities (on page 2-87). This function should be called at UAP_WRITE_LOT_INFO.
- **KTXE_RP_CreateWPF:** This function creates a new wafer plan file to use the appropriate probe pattern name. The new wafer plan file is created by duplicating the base file and modifying the probe pattern name. This function should be called at UAP_WAFER_PREPARE.
- **KTXE_RP_GetUsrArgs:** This function checks the command-line arguments used to invoke the Keithley Test Execution Engine (KTXE) to determine the test mode. This overrides the global data entry, KTXE_RP_test_mode, if used. This function should be called at UAP_PROG_ARGS.
- **KTXE_RP_RemoveWPF:** This function deletes wafer patterns that were generated at run time. This function should be called at UAP_WAFER_END.

Required user access point files

A user access point (UAP) file, `adapt_zone.uap`, has been provided to illustrate the usage of these library commands. This UAP file must be specified in the Keithley Test Program Manager (KTPM) to enable zone-based testing.

As an alternative to specifying this UAP file in every cassette plan file, this UAP file can be specified to affect all cassette plans executed. This is accomplished by setting the environment variable `$KI_KTXE_SYSTEM_AP` to point to the desired UAP file. Care should be taken in using the UAPs. Execution order is important. Refer to User access points (on page E-1) for more information on UAPs and Environment variables (on page 5-7) for more information on environment variables.

Global data variables

There are three global data values that affect the behavior of zone based testing. These variables are normally defined in a global data file attached to the cassette plan file through Keithley Test Plan Manager (KTPM). These variables are as follows:

- `KTXE_RP_max_freq`: This variable defines the number of sites to be tested per wafer when using zone-based testing.
- `KTXE_RP_random_wpf`: This variable is only used by the Runtime Test with Skip method of zone-based testing. When using this test method, random wafer patterns will be generated for all wafers having a wafer pattern name matching the value of this variable.
- `KTXE_RP_test_mode`: This global data variable allows for all tests executed by the Keithley Test Execution Engine (KTXE) to be conducted using one of the zone-based testing modes. This has the same effect as using the four options for the command line argument `-u`. If you use `KTXE_RP_test_mode` to define the test mode, remove any `KTXE_RP_GetUserArgs` from the user access point (UAP) list. `KTXE_RP_GetUserArgs` will override this global data variable.

The following are the four valid values for `KTXE_RP_test_mode`.

Value	Command line equivalent	Test mode
0	N	Normal test
1	R	Run time
2	A	Additional sites
4	S	Run time with skip

Sample GDF files are provided illustrating the use of these global data values. For each Test Mode, a global data file with a name of the form `adapt_KTXE_RP_`*`n`*`.gdf` is included; where *n* is the test mode number.

Result-based testing

Result-based testing is a test method where the tester changes the sites and tests used in response to the test results received on previous sites. Result-based testing can be used to throw out bad wafers when a certain amount of failing data is received, minimizing the collection of bad data. It can also be used to reduce test time on good wafers by scaling back testing if all results are good. During data collection, results can be evaluated and additional tests run immediately when failing data is encountered. This can remove the need to re-probe the wafer.

Keithley Test Environment (KTE) uses six global variables in conjunction with the limits file to determine whether a site or wafer is good or bad. The limits file determines which parameters are monitored to determine failed sites. The global data variables determine how many tests can fail before a site fails, and how many sites can fail before the wafer fails. Complete descriptions of these global data variables are provided later in this section.

Result-based test modes

There are four test modes available for use with result based testing. These four modes operate as follows:

- **Alternate Sites on Current Wafer:** When testing on the current site fails, an additional alternate site is tested when the current site is completed. The alternate sites are pre-defined in the Wafer Description Utility (WDU) using alternate test patterns, and have a one-to-one relationship with the normal sites. Normal testing resumes on the next site.
- **More Sites on Current Wafer:** When testing on any site fails, additional predefined sites are tested. There is a one-to-many relationship between the normal sites and the alternate sites. Normal testing does not resume on the next wafer, the additional sites will still be tested. The additional sites will continue for the remainder of the lot on all wafers with the same wafer plan, if no new wafer plan is encountered.
- **More Tests on Current Wafer:** When testing on a site fails, additional tests are used on the next site (current wafer only). On the next wafer, the original testing occurs (no additional tests will be performed). The additional testing occurs on the current wafer but not the next wafer because the function `KTXE_AT_wafer_begin` (at `UAP_WAFER_BEGIN`) sets the flag `KTXE_AT_alternate_site_test_mode` to `0`.
- **More Tests on Next Wafer:** When testing on a site fails, a new wafer plan will be executed on the next wafer, and all following wafer plans using the same name. This is done with a new wafer file.

Global data variables

There are six global data values that affect the behavior of result based testing. These variables are normally defined in a global data file attached to the cassette plan file through the Keithley Test Plan Manager (KTPM). These variables are as follows:

- `ktxe_at_ed_active`: This variable must be enabled (by setting to 1) to enable result based testing. When this global data item is enabled, tests using parameters marked as disabled in the Limits File Editor will not be performed. This variable is only used with the More Tests on Current Wafer test mode.
- `KTXE_AT_critical_param_failure_limit`: This variable defines how many critical parameters on a site must fail before the site itself fails. This variable is used with all result-based testing modes. To fail a site on any parameter failure, set the variable to 0. To permit two failures, set the variable to 2; the third failure will fail the site.
- `KTXE_AT_critical_site_failure_limit`: This variable defines how many sites on a wafer must fail before the wafer itself fails. If the wafer fails, testing on the wafer is aborted. This variable is used with all result based testing modes. To fail a wafer on any site failure, set the variable to 0. To permit two wafer failures, set the variable to 2; the third failure will fail the wafer. Note that critical site failures are only counted for the original sites.

- KTXE_AT_limit_code: This variable defines which specific limit is used for a critical parameter. The following values are used to determine which limit is used:

Value	Limit used
1	Valid
2	Spec
3	Control
4	Engineering

- KTXE_AT_alternate_test_class: This variable defines the class of extra tests to be enabled when a site fails. The class corresponds to the value of the Class field assigned in the Limits File Editor (LFE) to the extra tests that will be performed. The default value for this variable is extra_tests. This variable is only used with the More Tests on Current Wafer testing mode. For more information on LFE, refer to Limits File Editor (on page 2-58).
- KTXE_AT_alternate_wafer_plan: This variable defines the alternate wafer plan to be used when the next wafer will be tested with a new wafer plan. This variable is only used with the More Tests on Next Wafer testing mode.

There are three demo global data values that are used with KTXE_AT_generate_val to generate demo data. For more information, refer to the description of KTXE_AT_generate_val later in this section. These variables are as follows:

- demo_type: This variable is a number (0 to 12) which defines result failures based on site location on wafer.
- demo_high_lim: This variable defines the upper bound of passing results.
- demo_low_lim: This variable defines the lower bound of passing results.

Preparing result-based tests

Implementing result-based testing requires several additional steps beyond creating normal tests. Depending on the testing mode used, modifications will need to be made to the wafer definition file, wafer plan file, and limits file. Additional user access point (UAP) files and global data files (GDF) also need to be specified.

For information about using the Limits File Editor, refer to Limits File Editor (on page 2-58). For information on using the Wafer Description Utility, refer to The Wafer Description Utility (on page 2-3).

The following paragraphs describe the requirements for each of the modes of result-based testing.

General procedure for result-based testing

The following is a general procedure for setting up an existing cassette plan to use result-based testing. This procedure assumes that a cassette plan file has already been created using the tests to be included.

1. Start the Keithley Test Plan Manager (KTPM) and open the cassette plan file (CPF) file that will be adapted to use result-based testing.
2. Add the required user access point (UAP) file that corresponds to the desired test mode. The specific files required are listed in the description of the individual test modes.
3. If using the Alternate Sites Current Wafer or More Sites Current Wafer testing mode, modify the wafer definition file (WDF) file to include the alternate site pattern.
4. If using the More Tests Next Wafer testing mode, create a new wafer plan file to use as the alternate wafer plan.
5. Specify the required global data file (GDF) that corresponds to the test mode you want. The specific files required are listed in the description of the individual test modes. Set the global data variables as required by the testing mode you want.
6. Set up the limits file using the limits file editor (LFE). Define the critical parameters and test classes if required by the selected testing mode.
7. Save the cassette plan file.

When the cassette plan file is executed, the result-based testing mode will be enabled.

Alternate sites on current wafer

When using this test mode, the test results on each site are evaluated before moving to the next site. If the number of failed critical parameters on a site exceeds the value specified in `KTXE_AT_critical_param_failure_limit`, then the site fails. When a site is determined to have failed, the corresponding alternate site is tested.

The first step in implementing this test mode is to define the critical parameters using the limit file editor (LFE). This is done by specifying a value in the CR field for each parameter to be evaluated for result based testing. Valid values for the CR field are `N` and `1` through `9`. For the purposes of result-based testing, all values other than `N` are treated as critical parameters.

After specifying the critical parameters, alternate test sites need to be specified. Alternate test sites are created by creating a new pattern and adding an `_ALT` to the pattern name. The alternate pattern must have the same number of sites as the original pattern.

After specifying the alternate sites, the appropriate global data values need to be specified. The global data item `KTXE_AT_critical_param_failure_limit` must be set to the number of critical tests to fail on a site before the site itself is considered to have failed.

After all the component files have been set up, the test is set up as normal with the Keithley Test Plan Manager (KTPM). The only exception is that the appropriate global data files (GDF) and user access point (UAP) files must be added to the test plan. For this test mode, the GDF and UAP files to be added are `adapt_alternate_site.gdf` and `adapt_alternate_site.uap`.

More sites on current wafer

When using this test mode, the test results on each site are evaluated before moving to the next wafer. If the number of failed critical parameters on a site exceeds the value specified in `KTXE_AT_critical_param_failure_limit`, then the site fails. When any site fails, all of the alternate sites are tested.

The first step in implementing this test mode is to define the critical parameters using the limits file editor (LFE). This is done by specifying a value in the CR field for each parameter to be evaluated for result-based testing. Valid values for the CR field are `N` and `1` through `9`. For the purposes of result-based testing, all values other than `N` are treated as critical limits.

After specifying the critical parameters, alternate test sites need to be specified. Alternate test sites are created by creating a new pattern and adding an `_ALT` to the pattern name. The alternate pattern can have more sites than the normal pattern.

After specifying the alternate sites, the appropriate global data values need to be specified. The global data item `KTXE_AT_critical_param_failure_limit` must be set to the number of critical tests to fail on a site before the site itself is considered to have failed.

After all the component files have been set up, the test is set up as normal with the Keithley Test Plan Manager (KTPM). The only exception is that the appropriate global data files (GDF) and user access point (UAP) files must be added to the test plan. For this test mode, the GDF and UAP files to be added are `adapt_more_sites_cur_wafer.gdf` and `adapt_more_sites_cur_wafer.uap`.

More tests on current wafer

When using this test mode, the test results on each site are evaluated before moving to the next site. If the number of failed critical parameters on a site exceeds the value specified in `KTXE_AT_critical_param_failure_limit`, then the site fails. When a site is determined to have failed, additional tests are immediately run on the site. The additional tests will continue to be run on all sites for all wafers in the lot if no new wafer plan is encountered.

The first step in implementing this test mode is to define the critical parameters using the limits file editor (LFE). This is done by specifying a value in the CR field for each parameter to be evaluated for result-based testing. Valid values for the CR field are `N` and `1` through `9`. For the purposes of result-based testing, all values other than `N` are treated as critical limits.

In addition to specifying the critical parameters, the additional tests must also be specified. These are specified by setting the eClass of the parameter to the value defined in the global data item `KTXE_AT_alternate_test_class`. The eClass is set to `extra_tests` by default. Tests associated with this class will not be performed until a site fails.

After specifying the additional tests, the appropriate global data values need to be specified. The global data item `ktxe_at_ed_active` must be enabled. The global data item `KTXE_AT_critical_param_failure_limit` must be set to the number of critical tests to fail on a site before the site itself is considered to have failed. The global data item `KTXE_AT_alternate_test_class` must be set to the class used in the Class field in the LFE.

After all the component files have been set up, the test is set up as normal with the Keithley Test Plan Manager (KTPM). The only exception is that the appropriate global data files (GDF) and user access point (UAP) files must be added to the test plan. For this test mode, the GDF and UAP files to be added are `adapt_more_tests_cur_wafer.gdf` and `adapt_more_tests_cur_wafer.uap`.

More tests on next wafer

When using this test mode, the test results on each site are evaluated before moving to the next wafer. If the number of failed critical parameters on a site exceeds the value specified in `KTXE_AT_critical_param_failure_limit`, then the site fails. When a site is determined to have failed, testing on all future wafers in the lot with the same wafer plan name will use an alternate wafer plan.

The first step in implementing this test mode is to define the critical parameters using the limits file editor (LFE). This is done by specifying a value in the CR field for each parameter to be evaluated for result-based testing. Valid values for the CR field are `N` and `1` through `9`. For the purposes of result-based testing, all values other than `N` are treated as critical limits.

After specifying the critical parameters, the appropriate global data values need to be specified. The global data item `KTXE_AT_critical_param_failure_limit` must be set to the number of critical parameters to fail on a site before the site itself is considered to have failed. The global data item `KTXE_AT_alternate_wafer_plan` must be set to the name of the alternate wafer plan to be used if a site fails.

After all the component files have been set up, the test is set up as normal with the Keithley Test Plan Manager (KTPM). The only exception is that the appropriate global data files (GDF) and user access point (UAP) files must be added to the test plan. For this test mode, the GDF and UAP files to be added are `adapt_more_tests_next_wafer.gdf` and `adapt_more_tests_next_wafer.uap`.

KTXE_AT user library

Result-based testing is accomplished with the use of calls to the user library KTXE_AT at various user access points (UAPs). The following routines are included in the KTXE_AT user library.

KTXE_AT_alternate_site_site_end()

This function is used to determine, at completion of site testing, if an alternate site should be tested.

Usage

```
KTXE_AT_alternate_site_site_end()
```

Details

Use at `UAP_SITE_END`.

KTXE_AT_alternate_site_test_end()

This function is used to determine if any test results failed during the testing of a Keithley test module (KTM).

Usage

```
KTXE_AT_alternate_site_test_end()
```

Details

Use this function at `UAP_TEST_END`.

KTXE_AT_AlterWWP()

This function is used to alter the working wafer plan (WWP) list to add all Keithley test modules (KTMs) that have failed on the current site to be executed at an alternate site.

Usage

```
int KTXE_AT_AlterWWP(long *current_wwp_list,float altx, alty)
```

Details

This function is used internally.

KTXE_AT_CheckResWithLimits()

This routine should be called from another routine or from a user access point (UAP) to check the value of a result with the limits specified in a limit list or a limit sublist.

Usage

```
int KTXE_AT_CheckResWithLimits(char *Result_Name, double Result_Value, int
    Limit_Code, char *Limit_List)
```

Result_Name	Character string specifying the name of the result; the name should exist in the limit list
Result_Value	Double value of the result
Limit_Code	An integer value between 1 and 4; the result is checked against Valid, Spec, Ctrl or Engr limit based on the code • 1 = Check against Valid limit • 2 = Check against Spec limit • 3 = Check against Ctrl limits • 4 = Check against Engr limits
Limit_List	The name of the limit list to use for looking up the result; you can pass the default `limit_list` or pass in a limit sublist name for this parameter
Return value	If the result is within the limits `TRUE` is returned; if the result is not within the limits, `FALSE` is returned

Details

This function is used internally.

This routine can be run at any UAP if the result and the limit list exist in the data pool at that UAP. This routine can also be called from other routines (for example, `KI_SubsiteTest`).

This routine returns a `TRUE` or a `FALSE`. The return value should be checked after this routine is called and action should be taken based on the returned value.

To see the errors generated by this macro when running in the Keithley Test Execution (KTXE), set the `KI_KTXE_ERROR_LOG` environment variable.

KTXE_AT_cleanup_site()

This function is used to reset counts and clean up data structures.

Usage

```
KTXE_AT_cleanup_site()
```

Details

This function is used internally.

KTXE_AT_debug_print()

This function is used to print the internal flags and counters used in `KTXE_AT`.

Usage

```
KTXE_AT_debug_print()
```

Details

Use this function at `UAP_SITE_END`.

KTXE_AT_demo_data_func()

This function generates demo data.

Usage

```
double KTXE_AT_demo_data_func(double x)
```

Details

This function is called internally by `KTXE_AT_generate_val`.

KTXE_AT_enable_kdf()

This function enables Keithley data file (KDF) logging, if previously disabled.

Usage

```
KTXE_AT_enable_kdf()
```

Details

Use this function at `UAP_TEST_DATA_LOG`.

KTXE_AT_FindAltSite()

This function is used to find the alternate site coordinates for the current site.

Usage

```
KTXE_AT_FindAltSite()
```

Details

This function is used internally.

KTXE_AT_generate_val()

This demo data generation function returns a value for each variable tested based on *highV* and *lowV*, which are upper and lower bounds, and a specified *demo_type*.

Usage

```
double KTXE_AT_generate_val(int demo_type, double highV, double lowV)
```

demo_type	The demo type (int); a number from 0 to 12 that defines result failures based on site location on the wafer • 0 = Random high/low fail • 1 = Inside fails high • 2 = Outside fails high • 3 = Top fails high • 4 = Bottom fails high • 5 = Right fails high • 6 = Left fails high • 7 = Inside fails low • 8 = Outside fails low • 9 = Top fails low • 10 = Bottom fails low • 11 = Right fails low • 12 = Left fails low
highV	demo_high_lim = Upper bound of passing results (double)
lowV	demo_low_lim = Lower bound of passing results (double)
Result	The test result (double)

Details

Call this function from a Keithley test module (KTM) as follows:

```
result = KTXE_AT_generate_val(demo_type, demo_high_lim, demo_low_lim)
```

Define demo_type, demo_high_lim, and demo_low_lim as global data for ease of use.

KTXE_AT_LogResultList()

This function is used to log saved result lists to a Keithley data file (KDF).

Usage

```
KTXE_AT_LogResultList(char *result_list_name)
```

Details

The function is used internally.

KTXE_AT_more_sites_cur_wafer_site_end()

This function is used to determine, at completion of site testing, if more sites should be tested on the current wafer.

Usage

```
KTXE_AT_more_sites_cur_wafer_site_end()
```

Details

Use this function at `UAP_SITE_END`.

KTXE_AT_more_tests_curr_wafer_site_end()

This function is used to determine, at completion of site testing, if more tests should be executed on the current wafer.

Usage

```
KTXE_AT_more_sites_cur_wafer_site_end()
```

Details

Use this function at `UAP_SITE_END`.

KTXE_AT_more_tests_curr_wafer_wafer_begin()

This function is used to add results in the alternate test class to the list of results that are disabled during initial execution.

Usage

```
KTXE_AT_more_tests_cur_wafer_wafer_begin()
```

Details

Use this function at `UAP_WAFER_BEGIN`.

KTXE_AT_more_tests_next_wafer_site_end()

This function is used to change wafer plan to be used for the next wafer that has the same wafer plan name as the current wafer plan.

Usage

```
KTXE_AT_more_tests_next_wafer_site_end()
```

Details

Use this function at `UAP_SITE_END`.

KTXE_AT_wafer_begin()

Library initialization module.

Usage

```
KTXE_AT_wafer_begin()
```

Details

Use this function at `UAP_WAFER_BEGIN`.

Installation of adaptive testing user libraries

To install the adaptive test user library for zone-based testing, enter the following at the command line:

```
> cd $KIHOME/src/KTXE_RP
> kult_copy_lib –lKTXE_RP
```

To install the adaptive test user library for result-based testing, enter the following at the command line:

```
> cd $KIHOME/src/KTXE_AT
> kult_copy_lib –lKTXE_AT
```

Installation of demonstration files

Keithley has provided a collection of demonstration files for zone and result-based testing. To install these files, execute the script `KTXE_RP_demo_install` for zone-based files and `KTXE_AT_demo_install` for result-based files. These scripts will copy the files for these demos to the current projects directories.

To install files for zone-based demo, enter the following at the command line:

```
> cd $KIHOME/src/KTXE_RP
> KTXE_RP_demo_install
```

To install files for result-based demo, enter the following at the command line:

```
> cd $KIHOME/src/KTXE_AT
> KTXE_AT_demo_install
```

The installed demo files for adaptive testing start with `adapt_`.

KTE support utilities

Random pattern generation

The random pattern generation (`rand_pat`) utility provides the ability to read in a `.wdf` file containing zones (patterns) and create a new `.wdf` file containing randomly generated patterns covering the given zones. This function may be used as a stand-alone utility.

Syntax of command:

```
rand_pat infile [-s sites/wafer] [-w wafers/cassette] [-o outfile]
```

Where:

`infile` = Input `.wdf` file with define zones (patterns)

`[sites/wafer]` = Number of sites per wafer

`[wafers/cassette]` = Number of wafers per cassette

`[outfile]` = Output `.wdf` file

Each time the routine is called, a new random seed is generated based on the date and time returned by the system. This guarantees full randomness over the set of all possible combinations of sites and sectors. The output file will contain patterns named `pattern_n`, where `n` is the number of the pattern. For example, if the output file contains two patterns, the patterns would be named `pattern_1` and `pattern_2`.

Note that if neither the `-s` or `-w` option is used, the routine will set the number of sites per wafer equal to the number of zones, and then generate a natural set of patterns without any retesting. If the number of wafers is a multiple of the number of zones, and each zone has the same number of sites, then even coverage is uniformly achieved.

At this point, the utility allows you to specify a number of sites per wafer different from the number of patterns. It also allows you to generate a number of patterns different from the natural number. If fewer patterns are specified, there may be untested sites; if more are specified, then there will be redundant coverage. Note that if more than the natural set is generated, the random seed is reinitialized, and all following patterns will again be truly random.

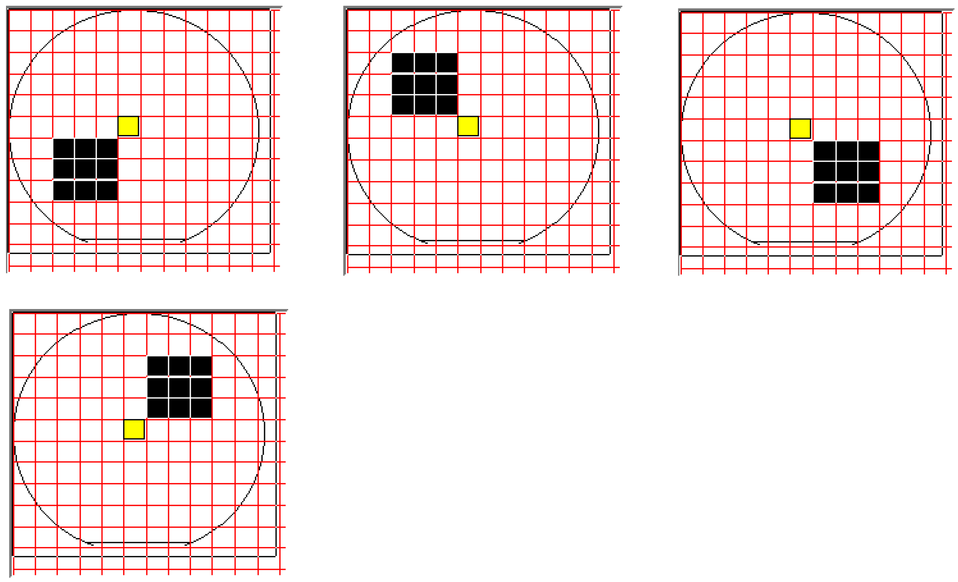
Example:

Upon executing

```
> rand_pat mywdf.wdf -o randwdf.wdf
```

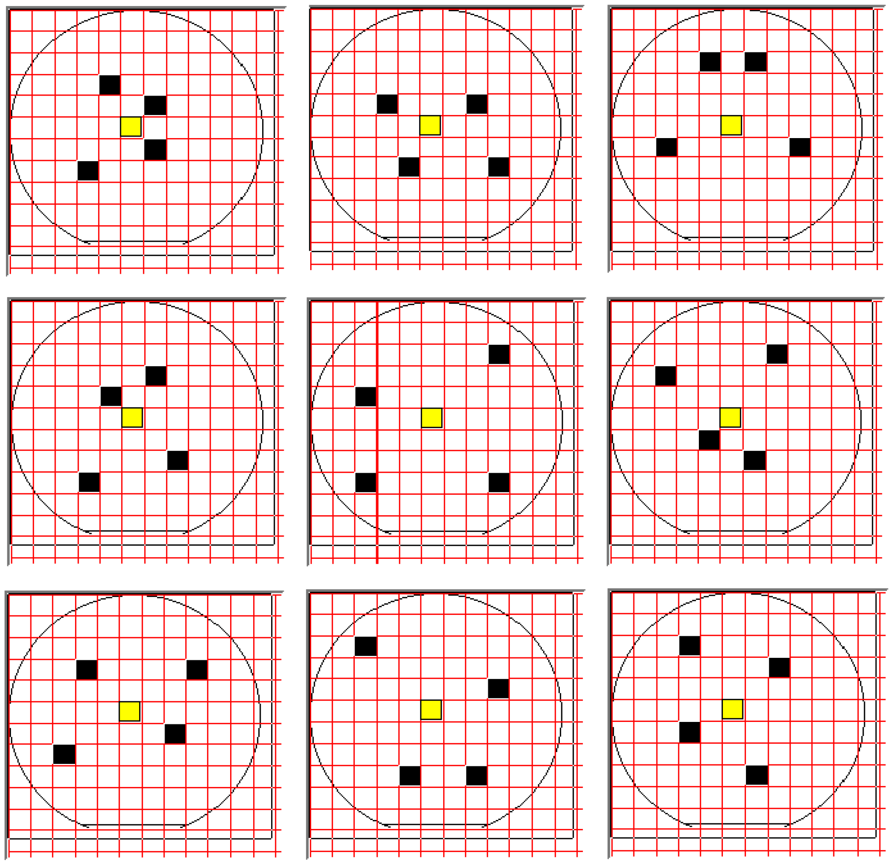
Where the input file zones have the following form:

Figure 55: Random pattern utility input file zones



The output patterns look like:

Figure 56: Random pattern utility output patterns



File filtering

All Keithley Test Environment (KTE) tools use a standard window to open and save files. Directories are displayed with a folder icon before the name, and read-only files are identified by a lock icon before the filename. A Choose Filter drop-down menu allows for the selection of predefined filter patterns. Files may be filtered by entering a new pattern in the Filter field and clicking the **Filter** button.

The predefined filter list provides a simple way to filter files by picking from a list of custom filters. These filters are listed by a simple name for easy recognition. The filter list can be customized using a plain text editor. The filter list is located in the file `$KIHOME/filters.ini` file. The format of the file is as follows:

```
[filter nice name]filterPattern
```

Where `[filter nice name]` is the name that will appear in the window drop-down listing. `filterPattern` is a simple expression filter used for pattern matching. The filter pattern supports only two wildcard characters: ? to indicate any single character, and `*` to indicate any substring of characters. The filter name must be enclosed by the brackets.

For example:

```
[Project 1 Files]project_1_*
```

This filter would be displayed in the open and save windows as Project 1 Files, and would display all filenames that started with the characters `project_1_`.

Comments may be added to the `filters.ini` file by preceding them with the # character. The comment will not appear in the Choose Filter drop down box. The period character (`.`) may not be used as part of the filter pattern.

Section 3

Test execution

In this section:

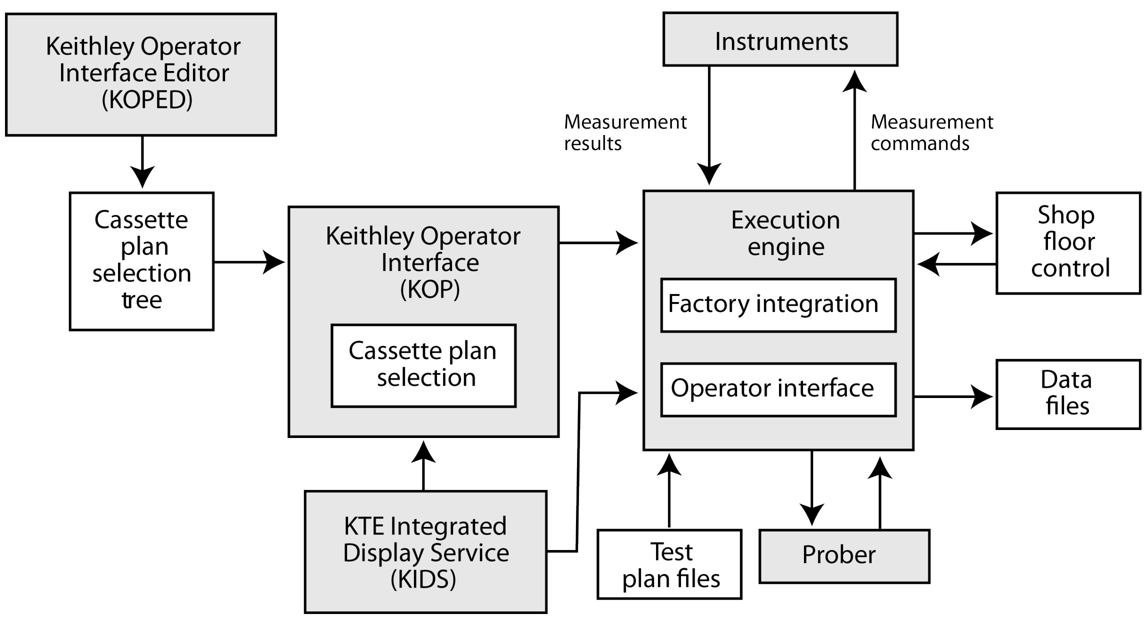
Introduction

You can execute a cassette plan in one the following ways:

- Using Keithley Integrated Display Service (KIDS)
- Using Keithley Operation Interface Editor (KOPED) and Keithley Operator Interface (KOP)
- Directly accessing the Keithley Test Execution Engine (KTXE)

The following figure shows a diagram of the test execution process.

Figure 57: Test plan execution flow diagram



This section describes the tools required to execute a completed test plan. In this section, the following will be discussed:

- **Keithley Operator Interface Editor (KOPED)**: How to create a series of test processes that can be activated from the Keithley Operator Interface (KOP).
- **Keithley Test Execution Engine (KTXE)**: How to use KTXE to execute the test plans created using the Keithley Test Plan Manager (KTPM).
- **KTE Integrated Display Service (KIDS)**: How to use KIDS for recipe selection, execution, and display status.

Keithley Operator Interface Editor (KOPED)

This section includes basic information for using Keithley Operator Interface Editor (KOPED). Brief descriptions of KOPED's main window and menus are also included.

KOPED is a graphical user interface used by the test engineer to create a test initialization file. The information entered into the initialization file determines the operator choices available when the Keithley Operator Interface (KOP) is run. There are three levels in the selection tree available to be set up: Level 1, Level 2, and Level 3. These can be set to any string you want.

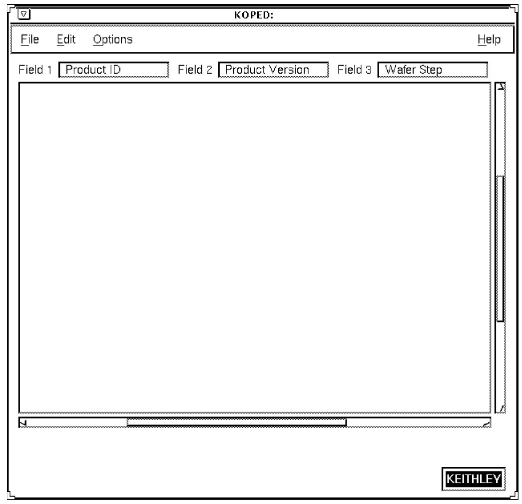
KOPED main window

The Keithley Operator Interface Editor (KOPED) main window, shown in the following figure, contains the following areas:

- **Main menu bar**: Contains the File, Edit, Options, and Help menus.
- **Data Entry Level 1**: Used to enter the label for column one in the Keithley Operator Interface (KOP).
- **Data Entry Level 2**: Used to enter the label for column two in KOP.
- **Data Entry Level 3**: Used to enter the label for column three in KOP.
- **Window work area**: Shows a flow tree for all of the possible test routines that can be accessed through KOP.
- **Engineering data entry Level**: Used to enter the name that appears in the highlighted box in the tree in KOPED.
- **Plan or Program (with path)**: Used to enter the cassette plan filename or executable program name and directory path.

The Engineering and Operator Levels do not appear until a Level 1 is created or an existing `.ini` file is loaded. The Plan field will appear when an entry in Level 3 is created.

Figure 58: KOPED main window



KOPED File menu

The Keithley Operator Interface Editor (KOPED) File menu contains the following selections:

- **New**: Clears the KOPED main window to create a new initialization file.
- **Open**: Opens an existing initialization file.
- **Save As**: Saves the present initialization file using a new filename.
- **Save**: Saves the present initialization file using the present filename.
- **Exit**: Exits KOPED.

KOPED Edit menu

The Keithley Operator Interface Editor (KOPED) Edit menu contains the following selections:

- **Window label**: Lets you enter the window label for the operator interface (when KOP is run).
- **Delimiter**: Lets you enter the delimiter of the initialization file.
- **Add Level 1**: Lets you add a new top-level field to the main window work area.

KOPED Options menu

The Keithley Operator Interface Editor (KOPED) Options menu lets you enable or disable Test Plan Validation. If enabled, the operator will be able to use the Verify button on the Keithley Operator Interface (KOP) screen to validate the information in a cassette plan before execution. If disabled, the Verify button on the KOP screen will be disabled, preventing the operator from cassette plan validation.

KOPED Help menu

The Keithley Operator Interface Editor (KOPED) Help menu provides online help and KOPED version information. The Documentation option allows access to online Help. The About option displays the release version.

Pop-up menus

With the exception of the Level 1 pop-up menu, the pop-up menus are accessed by placing the cursor in the boxes, and pressing and holding the right mouse button. Selections are made by pulling the cursor down to the desired selection and releasing the mouse button.

The New Level 1 pop-up menu is accessed by pressing and holding the right mouse button anywhere in the window area of the Keithley Operator Interface Editor (KOPED). The pop-up menus include:

- **New Level 1 pop-up menu**: Lets you Add or Paste Level 1 data.
- **Edit Level 1 pop-up menu**: Lets you Cut or Copy data, and Add or Paste Level 2 data.
- **Edit Level 2 pop-up menu**: Lets you Cut or Copy data, and Add or Paste Level 3 data.
- **Edit Level 3 pop-up menu**: Lets you Cut or Copy data.

Keithley Test Execution Engine (KTXE)

This section includes basic information about the Keithley Test Execution Engine (KTXE). A brief description of the KTXE main window is included.

KTXE is a graphical user interface used by the test engineer to execute a cassette plan file (`.cpf`) that can be created using the Keithley Test Program Manager (KTPM).

It is possible to define an alternate localization file. Refer to Keithley Test Environment (KTE) Keithley UI (KUI) localization in Keithley User Interface Library (on page B-1).

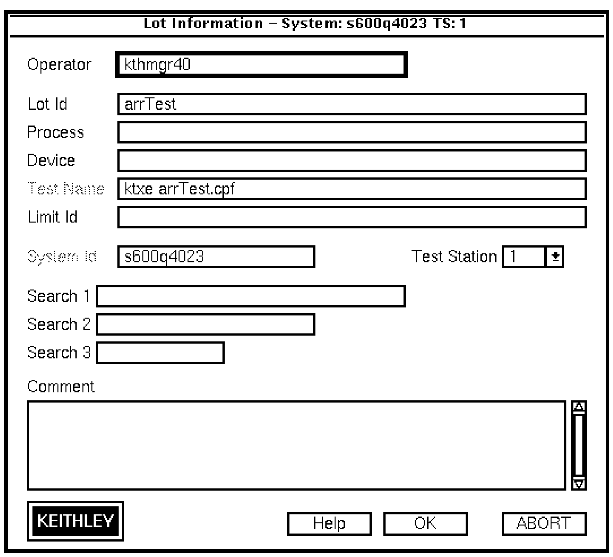
The KTXE interface can be viewed in any language. Refer to KTE KUI localization (on page B-19).

KTXE main window

The Keithley Test Execution Engine (KTXE) main window shown in the following figure contains the following areas:

- **Operator data field:** This field is used to enter the ID of the operator running the test.
- **Lot Id data field:** This field is used to identify the test path and filename. This data is entered when the cassette plan file is specified when KTXE is started.
- **Process data field:** This field is used by the operator to enter information about the test process.
- **Device data field:** This field is used by the operator to enter any necessary information about the device.
- **Test Name data field:** This field is used to identify the test name. This data is entered when the cassette plan file is specified when KTXE is started.
- **Limit Id data field:** This field is used by the operator to enter the limit file that will be used during testing.
- **System Id data field:** This field is used to identify the system that is running the test.
- **Test Station field**: This field is used to select the test station that the test will be run on.
- **Search key data fields:** The search keys are used to further identify the test process when test results are being searched for in the Keithley Summary Utility (KSU).
- **Comments field:** This field is used to enter any comments about the test being run.
- **Control buttons:** Used to start the test process, abort the test process, and to receive online help for KTXE.

Figure 59: Lot dialog window

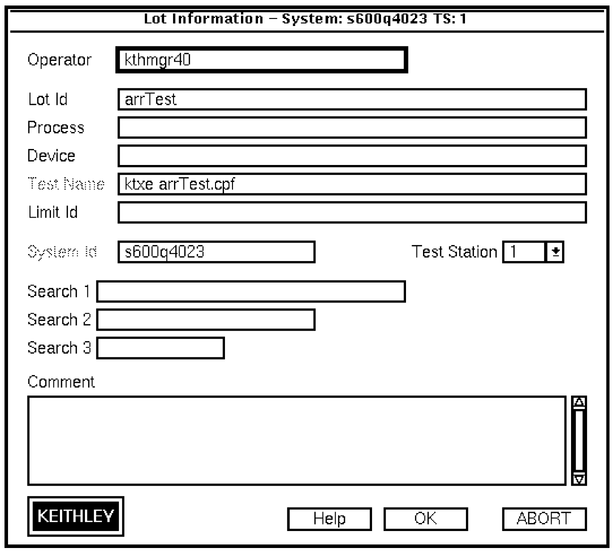


Test execution from KTXE

It is also possible to execute your cassette plan by directly accessing the Keithley Test Execution Engine (KTXE).

1. Start KTXE from the command line by entering the following: `ktxe -cpf fname.cpf` where `fname.cpf` is the name of the cassette plan.
2. Verify all the test execution data that appears in the Lot Dialog window, as shown in the following figure.

Figure 60: Lot dialog window



3. Click **OK** to begin the testing process.

Command-line options for KTXE

The following is a listing of all the command-line options that can be entered when starting the Keithley Test Execution Engine (KTXE).

Switch	Type	Description
`-c`	text (command-line arguments are concatenated to the switch argument until the next switch occurs)	Lot information comment field; this switch can be used to add comment text to the lot header.
`-cass`	n (numeric)	Select cassette n: 1 through 4; this switch is used to select a specific cassette for a prober with multiple cassettes.
`-cpf`	fname (valid filename and path)	Cassette plan filename; this switch is required if the `-krf` switch is not used, and it specifies the name of the cassette plan to execute.
`-d`	text (command-line arguments are concatenated to the switch argument until the next switch occurs)	Lot information device field; this switch can be used to specify the device field of the lot header.
`-doc`	"options" (must be enclosed in quotation marks)	Documentation tool information; this switch is used to disable portions of the execution to allow test documentation information to be collected. These switches can also be used to customize KTXE execution. • `NO_LOT`: Disable default lot reporting .kdf • `NO_KUI`: Disable the user interface • `NO_PROBER`: Disable Prober activity • `NO_KTM`: Disable Keithley test module (KTM) execution • `NO_UAP`: Disable user access point (UAP) execution • `DOC_ON`: Enable Test Plan Document data generation; this will cause KTXE to create a data file containing execution information. This data file is named `casPlanName.cpf.kxd` and is placed in the directory specified by the `$KITMP` environment variable. • `DOC_ONLY`: Configure for Test Plan Document generation only Several of the above `-doc` options can be used together. For example, to disable the default `.kdf` logging and default prober activity, use the following command-line switch for KTXE: `-doc "NO_LOT,NO_PROBER"`
`-e`	n [fname] (numeric) (valid filename and path)	Error reporting mode n: 0 through 3 • `0`: None • `1`: Display messages • 2: Log messages • 3: Display and log message

Switch	Type	Description
-ev	n [fname] (numeric) (valid filename and path)	Event reporting mode n: 0 through 3 • 0: None • 1: Display messages • 2: Log messages • 3: Display and log message The -e and -ev switches enable the error and event logging. The error and event reporting capability of KTXE can be used to determine possible problems with macros and test plans.
-h		Display command line options (shown here)
-i	id (valid filename, no paths or extensions)	Lot information lot id field; the lot id determines the name of the .kdf lot file; the actual .kdf lot filename is $KI_KTXE_KDF/lot_id.kdf
-k	n text (numeric) (command-line arguments are concatenated to the switch argument until the next switch occurs)	Lot search key n: 1 to 3 field; this switch allows the search key fields in the.kdf lot file to be filled with the specified text; use a separate -k for each field
-krf	fname (valid filename and path)	Uses the specified recipe name; see the Keithley Recipe Manager documentation for more information
-l	id (valid filename, no paths or extensions)	Lot information limit id field; this switch will specify the limits file to use for processing test data; the limits file specified by this switch will override any limits files specified in wafer plan files
-o	text (command-line arguments are concatenated to the switch argument until the next switch occurs)	Lot information operator field; this switch allows the operator field in the.kdf lot file to be filled with the specified text
-p	text (command-line arguments are concatenated to the switch argument until the next switch occurs)	Lot information process field; this switch allows the process field in the.kdf lot file to be filled with the specified text
-r	"options" (must be enclosed in quotation marks)	Lot summary report options; this switch allows the sum_report_options data pool entry to be filled with the text string specified; calling the KTXEAddIn:KTXESummaryReport() function at UAP_LOT_END allows the LotSummary program to be executed with the specified options
-s	text (command-line arguments are concatenated to the switch argument until the next switch occurs)	Lot information system field; this switch allows the system field in the .kdf lot file to be filled with the specified text

Switch	Type	Description
`-u`	text (command-line arguments are concatenated to the switch argument until the next switch occurs)	User argument; this switch can be used for additional user command-line arguments
`-w`	fname (valid filename and path)	Wafer description filename; this switch will specify the wafer description file to use for processing test data; the wafer description file specified by this switch will override any wafer description file specified in the cassette plan or wafer plan file
`-x`	n (numeric)	Debug flag n: 0 to 32767; this switch can be used for user command-line arguments

The execution process

Once test execution has begun, the execution engine begins working its way through the cassette plan you specified. The Keithley Test Execution Engine (KTXE) uses the engine you selected for your cassette plan as the format for how KTXE will proceed when accessing and executing the data files specified in the cassette plan file. The following figure shows a flow diagram of how the execution engine proceeds through all of the test data.

Figure 61: Test execution engine

Cassette Level	Wafer Level	KTM Level
process the command line arguments load cassette plan UAP_PROG_ARGS get lot id UAP_CASSETTE_LOAD UAP_LOT_INFO display lot dialog screen initialize prober for this cassette UAP_PROBER_INIT prompt operator to load cassette UAP_WAFER_MISMATCH proper pipeline and cassette plan verified UAP_ACCESS_WDF_INFO access WDU before call to PrInit UAP_POST_PROBER_INIT change prober setup based on WDU file UAP_WRITE_LOT_INFO write lot structure into kdf file UAP_POST_LOT_INFO load wafer UAP_WAFERLOAD_STATUS UAP_PROFILE_WAFER provides time for hot chuck to warm up wafer before profiling. UAP_ALIGN_ERROR UAP_POST_INITIAL_WAFER_LOAD perform AutoZ after first wafer load **Wafer Level** UAP_WAFER_END write end of wafer to lot file load next wafer UAP_ALIGN_ERROR write end of lot to lot file UAP_LOT_END UAP_ENGINE_EXIT	UAP_WAFER_PREPARE load the wafer plan load the probe card file load the limits file load wafer description file prepare the complete wafer plan load all the ktms UAP_VALIDATE_OCR write wafer header to lot file UAP_WAFER_BEGIN **KTM Level**	move probe chuck to the test site UAP_SITE_CHANGE write site data to lot file move probe chuck to the test subsite UAP_SUBSITE_CHANGE UAP_TEST_BEGIN execute the ktm UAP_TEST_END write results to lot file UAP_TEST_DATA_LOG check limits file/results for abort UAP_HANDLE_ABORT UAP_SUBSITE_END UAP_SITE_END
UAP_ABORT_EXIT_HDLR UAP_PRB_ERR_HDLR UAP_STATUS_CHANGE	The UAPs to the left are executed at the time the event happens.	

The execution engine begins at the cassette level, gathering cassette information and collecting lot and prober information. The engine then moves on to the wafer level. Here, the engine loads all the data specified in the wafer plan. When all the wafer information is loaded, the engine moves on to the Keithley test module (KTM) level where the test execution process begins. The engine finds each specified site and subsite, and then performs the specified test at each selected position. The execution engine continues this process until either it has exhausted all the information specified within the cassette plan or logged test data has signaled an abort.

The execution engine will order probing and testing based on the following:

- If the Optimize Site Processing button in the Wafer Definition Utility (WDU) is selected, the execution engine will process sites based on Y and X coordinate positioning. If the Optimize Site Processing button is not selected, the site order will be as specified in the Probe Pattern Editor in the WDU (first occurrence, first probed). In both cases, each site will be probed only one time, as the execution engine merges all tests across probe patterns.
- Tests will occur in the order they are specified in the Wafer Plan Editor (Keithley Test Plan Manager, KTPM). Subsites will be probed in the order they are specified in the Site Editor (WDU).

The following is an in-depth description of what happens at each user access point (UAP) during test execution. Each UAP is listed, followed by a description of the actions that UAP causes to occur.

KTXE INITIATED

- Initialize engine variables.
- Set data pool value "ManualProberType" to `FALSE`; use global data to set otherwise.
- Process the command-line arguments.
- Initialize error logging.
- Determine Documentation Tool command-line options and configure the execution engine appropriately. First store the default values into the Data pool. The `GetDocumentationConfig` routine will adjust the values if necessary.
- Load the cassette plan.
- Load global data files only if there are files to load.
- Refresh the "ManualProberType" variable from Global Data Load.

UAP_PROG_ARGS

- Get LOT ID. Check command line first, then the cassette plan.
- Check for Suspended Lot information.

UAP_CASSETTE_LOAD

- Check for empty slot list. Exit if empty.
- Collect any additional lot related information at this user access point (UAP) before displaying lot dialog screen to operator.

UAP_LOT_INFO

- Display Lot dialog screen and gather information from the operator.
- Display status dialog on the screen.
- Starting Tester Control.
- Add the LOT ID to the data pool.
- The product filename should be set at this user access point (UAP) if used.

UAP_PROBER_INIT

- If the "`KI_PRB_AUDIT_LOG`" environment variable is set, then:
  `EnableTransactionLogging();` /* prober transactions */
- Load the product file. If it is non-null:
  `if (product_file[0] != "\0")`
- `KTXELoadProductFile(product_file);`

NOTE

Check options after product file load because product file could enable or disable options.

- Check Prober Options.
- Prompt operator to load Cassette onto Prober.
- Determine the slot mode: all (ALL), index (nn), or relative (Rnn).
- Check only first slot.
  `wafer->boat = 1;` /* assume cassette 1 only */

  `FindWafersToProbe -`

  Determine which wafers are to be probed and set the prober's slot status accordingly.

- Get a Cassette Mapping from the prober regardless of the slot mode.
- Error if "Cassette not loaded", if there are "unmapped wafers", or if "No Unprobed wafers found", try again.
- Determine the slot mode: all (ALL), index (nn), relative (Rnn)
- Check only first slot in the slot list.
- If "ALL" mode "where All Mode means test ALL WAFERS"

  Build a slot list using all available wafers in cassette.

- If "Relative" Mode

  find the nth slot with a wafer in cassette.

NOTE

If no more wafers are found unprobed, no errors are generated. PrLoad Cassette complete will handle the completion. Any non-relative slots will be skipped.

- If "indexed slot" mode:

  set slot status IF a wafer is really there.

- Send new cassette slot status to prober.

UAP_WAFER_MISMATCH

- END FindWafersToProbe
- Load the Wafer Description File so the prober can be initialized.

Hierarchy of loading:

1 - Command-line arg.

2 - Cassette Plan.

3 - Wafer Description File of *FIRST* Wafer Plan.

UAP_ACCESS_WDF_INFO

- This UAP allows access to the .wdf file before the call to PrInit.
- Initialize the Prober (PrInit).

UAP_POST_PROBER_INIT

- Any extra changes to the LOT header should be made at this user access point (UAP).

UAP_WRITE_LOT_INFO

- Write LOT structure into `.kdf` file.
- Register exit handler for `.kdf` (EndWafer).

UAP_POST_LOT_INFO

- This UAP may be used to add tag data to the lot file before the first wafer is tested.
- Do we skip the first wafer?
  Reload from data pool in case a UAP modified the value.
  This data pool value can be set for probers that need the first wafer manually loaded.

  (P8 and others)
- If not skip_first_wafer_load
  Load Wafer

UAP_WAFERLOAD_STATUS

- if (TRUE == ManualProberType)
- Prompt operator to "Load/Unload Wafer from chuck".

UAP_PROFILE_WAFER

- This UAP may be used to provide time for the hot chuck to warm up the wafer before profiling.
- Profile first WAFER.
- Align first WAFER.

UAP_POST_INITIAL_WAFER_LOAD

- Perform AutoZ after the first wafer load.

NOTE

AutoZ is a function of the SofTouch optional licensed feature for the Keithley Test Environment (KTE). For more information on SofTouch, refer to the Prober and Prober Drivers Manual.

- Loop through slots defined in the cassette plan.
  Wafer Loop

UAP_ALIGN_ERROR

- Error recovery after wafer alignment.

UAP_WAFER_PREPARE

- Get wafer plan name from the slot list entry.
- Keep count of wafers defined in cassette wafers_tested++.
- Determine if the previous wafer plan is the same as the current wafer plan.
- If the previous wafer had the same wpf, do not reload the working wafer plan (WWP), test enable all tests in WWP since there may have been a previous abort.
- if (previous_wafer_has_same_wpf == FALSE)
  Load the wafer plan for the wafer.
  Load the probe card file.
  Load the Limits filename.
  Update the `limit_list` data pool pointer.
  Load Wafer Description File.
  Prepare a complete wafer plan for execution.
  Load all the Keithley test modules (KTMs) in wafer patterns.
  Keep track using the data pool of the KTM list.
- Place the address of the wwp into the data pool.
  `dpAddPointer( "wwp_list", LONG_P, wwp_list );`
- Read wafer ID from prober.

UAP_VALIDATE_OCR

- Start of the wafer tests (`start_wafer_test`:).
- Reset the `KI_ktxe_retest_wafer` data pool flag.
- Write wafer header to the LOT file.

UAP_WAFER_BEGIN

- Execute a wafer plan.
- Add `result_list`, `failed_result_list` and abort level to data pool for use at `UAP_HANDLE_ABORT`.
- Get site and subsite pointers from the data pool.
- Get a working copy of `wwp_list` and place into data pool as "`current_wwp_list`".
- LOOP: (Execute only tests that are enabled in wafer plan)
- Reset "`KI_ktxe_redo_macro`" data pool flag.
- Reset "`ktxe_disable_kdf`" data pool flag to initial value.
- Move probe chuck to the test site if x or y values changed.

UAP_SITE_CHANGE

- Write Site data to LOT file.
- Move probe chuck to the test subsite if changed.
- Raise the chuck to make contact with pins.

UAP_SUBSITE_CHANGE

- Save copy of this subsite as the prev or last subsite.

UAP_TEST_BEGIN

- Execute the Keithley test module (KTM).
- Update the `result_list` DataPool value with new results.

UAP_TEST_END

- Write results to LOT file.

UAP_TEST_DATA_LOG

- If (`KI_ktxe_skip_limits_check = = 0`), check limits file results for abort conditions.
- Disable tests based on abort flags. if subsite or site aborts, disable tests in the working wafer plan (WWP).

UAP_HANDLE_ABORT

- if WAFERABORT we will leave execution loop.
- if LOTABORT we will leave execution loop.
- if (ktxe_abort_logging)
  log Abort Reason
- If "KI_ktxe_redo_macro" data pool flag is not set then

UAP_SUBSITE_END

At end of subsite processing, this access point is called.

UAP_SITE_END

- increment to next test.
- Update "current_wwp_list" data pool value with new entry.
- END LOOP: (Execute only tests that are enabled in wafer plan)
- Do a Prober PrRelReturn to clean up for the next wafer.
- Call EndSite to close up KDF file.
  End of execute a wafer plan.

UAP_WAFER_END

- Handle wafer and lot abort as needed.
- Write end of wafer to LOT file.
- Check if we want to redo this wafer using the `KI_ktxe_retest_wafer` data pool flag.
  if so

  go to `start_wafer_test`

  else

  load next wafer

UAP_PROFILE_WAFER

- This user access point (UAP) may be used to provide time for the hot chuck to warm up the wafer before profiling.
- Profile next WAFER.
- Align next WAFER.

UAP_WAFERLOAD_STATUS

- If (TRUE == ManualProberType.
- Prompt operator to "Load/Unload Wafer from chuck."

UAP_ALIGN_ERROR

- If cassette is complete...
  Clean up the working wafer plan (WWP) list
  else
  Advance to next slot in slot list.
- If no more slots, or next slot uses different Wafer Plan:
  Clean up the WWP list
  Set flag saying different WPF for next slot
  else
  Next wafer exists and uses same wafer plan so Enable Tests in WWP.
  End of Wafer Loop.
- Write end of lot to LOT file.

UAP_LOT_END

- Release the tester via tstdsl()
- Set data pool flag for no error...normal exit mode...

UAP_ENGINE_EXIT

- Pause the status dialog so the operator can inspect the display.
- Clean up internal memory structures.
- Release user interface support.
- Set flag so the AbortExitHandler routine will skip execution
  NormalExit = TRUE ;
  exit(KI_OK);

NOTE

The following UAPs (UAP_ABORT_EXIT_HDLR, UAP_PRB_ERR_HDLR, and UAP_STATUS_CHANGE) are executed at the time the event occurs.

UAP_ABORT_EXIT_HDLR

- At UAP_ABORT_EXIT_HDLR, KUI functions may not be used to display information. An external program may be used to check Keithley Test Execution Engine (KTXE) exit status and prompt with a GUI if necessary.

```
void KTXEAbortExitHdlrStub()
{
  We only want to do this if we abort...
}
```

NOTE

Here is the list of the `atexit()` functions that we use and their order of placement onto the stack. The execution order is the reverse.

Install order:

- AbortExitHdlr
- tstdsl
- Endlot

Execution order:

- Endlot
- tstdsl
- AbortExitHdlr routines

Because the abort exit handler routine is the last to execute, if the user wishes to do prober or LPTLib calls, they will have to perform a tstsel call first and then a tstdsl call to release.

Also, note that we are executing this abort exit routine because the KTXE process is being terminated. Certain system items may not be stable at this time. For this reason, KUI calls are illegal at this user access point (UAP).

UAP_PRB_ERR_HDLR

- If a prober error occurs, this user access point (UAP) is used to call user created recovery code.

UAP_STATUS_CHANGE

- This user access point (UAP) is called when the operator presses the Pause or Continue buttons on the Status Dialog Window, causing an execution state change. This UAP can be used to notify a shop-floor control system that the tester has been paused

User library files required for KTXE execution

During Keithley Test Execution Engine (KTXE) execution, not all user library files are required to be on a tester. If a file server is used to store and develop user libraries, it may be convenient to only copy the files needed for executing tests.

The following user library files are required by KTXE in the `KI_KULT_PATH` directory at execution time:

- `libaaaa.so`
- `libkittaaaa.so`
- `aaaa_proto.h`
- `aaaa_paramset.psf` (if parameter sets are used from this library)

Where "`aaaa`" is the name of the user library.

If the `KI_KULT_PATH` is not mapped to the default location, the following Keithley provided files must be in the `KI_KULT_PATH` directory.

Prober user library:

- `libprbxxxx.so`

Where "`xxxx`" is the prober driver type in use. Example: "`xxxx`" equals "`EG40`" for the Electroglas 4090 prober.

Keithley provided user library:

- `libuuuu.so`
- `libkittuuuu.so`
- `uuuu_proto.h`

Where "`uuuu`" is any Keithley user access point (UAP) user library. Example: "`uuuu`" equals "`KTXEAddIn`" for `libKTXEAddIn.so`, `libkittKTXEAddIn.so`, and `KTXEAddIn_proto.h`.

The KTXE ErrorHandler function

The Keithley Test Execution Engine ErrorHandle function will output additional information to you. A data pool item, `ktxe_error_gui`, can be set by you and will have the following effect:

- If `ktxe_error_gui` is set to `1`: The operator will be prompted with a choice of continuing with the error or aborting the test program.
- If `ktxe_error_gui` is set to `2`: The operator will be notified that the test program will abort. The operator can only select OK.
- If `ktxe_error_gui` is set to any other value or not defined at all, the error will be logged to the KTXE error log.

In addition, if KUI (`ktxe_disable_kui` controls, if the GUI is used) is disabled, output to the operator will be disabled.

In general, this functionality will be available in conjunction with selected errors that the operator may be able to correct or control.

Error and event logging

With the Keithley Test Execution Engine (KTXE), it is possible to create a log containing a report of the events and errors that occur during test execution. There are two ways to set the path for the event logs:

- Specify the log path at the command line when starting KTXE.
- Set the environment variables so they contain the log path.

> **NOTE**
>
> If the "`-e`" (error) and "`-ev`" (event) command line options are specified, the filename specified with these options override the filename set by the environment variables.

To set the log path at the command line when KTXE is started, enter:

```
ktxe -cpf cassettePlan -e 2 /mydir/file.log -ev 2 /mydir/file.log
```

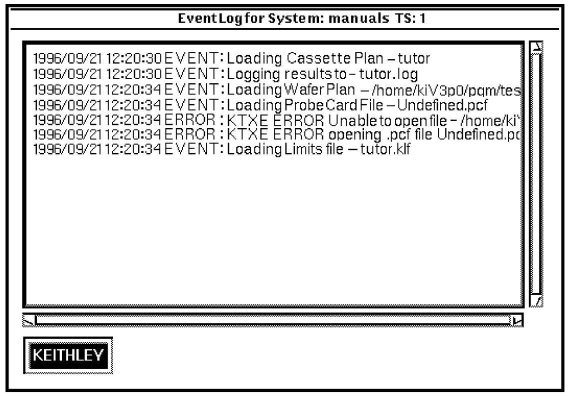
This enters the events (`-ev`) and errors (`-e`) into the logfile `file.log`.

To accomplish the same event and error logging with the environment variables, enter:

```
prompt> setenv KI_KTXE_EVENT_LOG   /mydir/file.log
prompt> setenv KI_PRB_AUDIT_LOG    /mydir/file.log
prompt> setenv KI_KTXE_ERROR_LOG   /mydir/file.log
prompt> setenv KI_LPT_DEBUG_LOG    /mydir/file.log
```

An example of an event log is shown in the following figure.

Figure 62: Event log window



Lot suspend and resume

When the Abort button is pressed on the Status Dialog window, the operator can abort immediately, suspend, or cancel. If suspend is selected, the Keithley Test Execution Engine (KTXE) will stop execution at completion of the current macro. Data files are created to keep track of current execution status, so if the engine is started with the same cassette plan again, the operator is asked if they would like to resume the suspended lot.

WARNING

The `.kdf` file will contain multiple entries for the wafer/site that execution was suspended on.

Example:
Assume that each wafer has 5 sites, 4 subsites per site, one macro per subsite.

Assume execution was suspended on wafer 2, site 4, subsite 2. Then the lot execution was resumed to completion.

The Keithley data file (KDF) file will contain data for wafer 1, wafer 2 up to site 4, and parameters including data for subsite 2. Then, there will be another entry for wafer 2, site 4 and parameters for subsite 3 and 4, then site 5, and the rest of the lot data.

Rules:
The execution status files are named `casPlanName_QMO.sav` and `casPlanName_QMO.wwp`, located in `$KI_KTXE_CPF`. This means that you cannot suspend LOT1 using `casPlanName` and then run and suspend LOT2 using `casPlanName`. The data for LOT1 suspension will be lost. You must resume a test before suspending another test using the same cassette plan.

Multicassette Multilot Testing Utility

The multicassette multilot Keithley Test Execution Engine (KTXE) launcher (`multi_cassette`) utility will collect the standard lot dialog information for one to four cassettes to be tested.

For each lot the wafer ids for each wafer may be entered. After all data is available, the cassettes will be tested without further information from the operator. Cassette plans that are launched by the `multi_cassette` program require the user access point (UAP) module `KTXEExtSetWaferId` from the KTXEAddIn library to be placed at the `UAP_WRITE_LOT_INFO`.

Also, to disable the standard operator dialog boxes used during testing, the following items should be placed in a global data file (`.gdf`) included in the cassette plan:

```
ktxe_disable_load_cassette_msg,INT,1
display_lotdlg,INT_P,0
ktxe_disable_plan_complete_msg,INT,1
```

Sources for the `multi_cassette` program are included in the `$KIHOME/src` directory if customization is required.

To rebuild the `multi_cassette` program enter:

```
> compile_ktxe.sh multi_cassette.c
```

Wafer id usage in KTXE

The Keithley Test Execution Engine (KTXE) will query the prober, lookup in the cassette plan, or generate a wafer id during execution.

If the prober has a wafer id reader, the id is returned to the `prober_wafer_id` data pool value if non-null. Or, if the cassette plan contains, or the operator entered, a wafer id, the wafer id is returned to the `prober_wafer_id` data pool value. Or, a wafer id is generated in the form "`Wafer_nn`", where "`nn`" is the cassette slot number.

At `UAP_VALIDATE_OCR` the data pool value `prober_wafer_id` can be checked or altered. See Data pool (on page D-1) for more data pool usage information.

Abort flags

The Keithley Test Execution Engine (KTXE) has the ability to check the results generated from the execution of a test macro against the specified limits file. If a certain result is out of the acceptable limits range, KTXE takes the appropriate abort action as specified in the limits file. The following is a more detailed description of how limits checking and abort conditions are handled by KTXE.

Limits checking

After the Keithley Test Execution Engine (KTXE) executes a test macro at a subsite, it checks all the results against the limits specified in the limits file. For each result, the acceptable range is determined using the specified abort limit for that result. A linked list of all the failed results is created. If a result is outside the acceptable limit, it is added to the failed results linked list. Also, the highest level of the abort action is determined out of all the failed results, and that abort action is put into the data pool. At the user access point `UAP_HANDLE_ABORT`, which is encountered after the execution of each of the test macros, you have access to the failed results list and the abort action flag.

At the user access point `UAP_HANDLE_ABORT`, you can extract useful information regarding the failed results and determine the highest level of abort (for example, LOT, WAFER, SITE or SUBSITE) caused by the failed results. There are five different abort levels. The following is the list starting from highest to lowest.

NOTE

Although there are five abort levels, only the first four listed have failed results. Therefore, you may have action taken based on the abort level using `UAP_HANDLE_ABORT` for the first four levels (not NOABORT).

- **LOTABORT:** Testing on the lot is aborted due to the failed result.
- **WAFERABORT:** Testing on the current wafer is aborted due to the failed result.
- **SITEABORT:** Testing on the current site is aborted due to the failed result.
- **SUBSITEABORT:** Testing on the current subsite is aborted due to the failed result.
- **NOABORT:** There were no failed results; therefore, no abort action was taken.

If you want to take some action based on the abort level, you can do it at the `UAP_HANDLE_ABORT`. For example, if you want to take different actions at different levels of abort, you can write the following code in a Keithley User Library Tool (KULT) module and run the module at the `UAP_HANDLE_ABORT`.

In the include files section in the KULT parameter window, append:

```
    #include "COM_usrlib.h"
    #include "ktxe_types.h"
In the KULT main window, type code similar to the following:
{
    int abort;
    /* get the abort flag from the data pool */
    abort = *(int *) dpGetPointer("abort_level", INT_P);
    /* take action based on the abort flag */
    switch(abort)
            {
            case LOTABORT:
                    {
                    /* User Lot abort code */
                    break;
                    }
            case WAFERABORT:
                    {
                    /* User Wafer abort code */
                    break;
                    }
            case SITEABORT:
                    {
                    /* User Site abort code */
                    break;
                    }
            case SUBSITEABORT:
                    {
                    /* User Subsite abort code */
                    break;
                    }
            default:
                    {
                    /* default code */
                    }
            }
}
```

Failed results linked list

The failed results are logged to the event log by default. You can enable event logging by using the -ev flag at the command line when starting the Keithley Test Execution Engine (KTXE). The logging of the failed results in the event log will be of the following format:

```
"ABORT REASON id = ... limit high = ... low = ... value = ..."
```

If the failed results information in the event log is not sufficient, you also have access to the failed results linked list at UAP_HANDLE_ABORT. The structure for a node of the linked list (defined in ktxe_types.h) is:

```
typedef struct _failed_result_list
{
char   id[PARAM_ID_LENGTH];  /* failed result name */
float  high;                 /* high limit */
float  low;                  /* low limit */
char   abortflag[LIMIT_ABORTSTR_LENGTH];
/* abort level - LOT, WAFER, etc. */
   char   abortfield[LIMIT_ABORTSTR_LENGTH];
/* abort limit - Spec, Ctrl, etc. */
   float  value; /* failed result value */
   struct _failed_result_list *next;
/* pointer to the next failed result */
}
failed_result_list_t;
```

The following is an example Keithley User Library Tool (KULT) module that you can create and run at UAP_HANDLE_ABORT. The code below traverses through the failed results linked list to find out if a specific result failed and takes the appropriate action in such a situation.

In the include files section in the KULT parameter window, append:

```
#include "COM_usrlib.h"
#include "ktxe_types.h"
```

In the KULT main window, type code similar to the following:

```
{
 failed_result_list_t *failed_result_ptr;
 /* get the pointer to the beginning of the list from the
   data pool */
 failed_result_ptr = (failed_result_list_t*)
dpGetPointer("failed_result_list",  LONG_P);
 /* Traverse through the linked list to find the required result name */
 while(failed_result_ptr != NULL)
 {
   if(!strcmp(failed_result_ptr->id, "MyResult"))
   {
   /* found the required result in the linked list */
 /* Take the appropriate actions -- USER CODE*/
   break;
  }
  failed_result_ptr = failed_result_ptr->next;
   /* Required result not found yet, go to the next node of the linked list */
 }
 if(failed_result_ptr == NULL)
 {
  /* "MyResult" was not in the failed result list */
  /* Take any default action if required -- USER CODE */
 }
}
```

The following are notes about the abort action flag and the failed results linked list:

- The user access point UAP_HANDLE_ABORT is encountered after the execution of every test (for example, a Keithley test module). Therefore, the abort flag and the failed results list are created for each test.
- Both the abort action flag and the failed results list are available only at UAP_HANDLE_ABORT. They are put into the data pool after UAP_TEST_DATA_LOG and are removed from the data pool after UAP_HANDLE_ABORT. If you want to preserve the values of the abort flag or the failed results list, you must create your own working copy at UAP_HANDLE_ABORT.
- The abort action flag represents the highest level of abort action in the list of failed results. For example, if you have a list of five failed results and four of them have an abort level of SUBSITE and one has an abort level of WAFER, the abort flag will be set to WAFERABORT.
- If there were no failed results generated from the execution of a test, the failed_result_list in the data pool will be NULL.

Refer to the Limits File Editor (LFE) documentation for more information on creating the limits files and setting the abort actions and abort limits for results.

KTXE results and their structures

The result structures and results are available after an execution of a Keithley test module (KTM) by the Keithley Test Execution Engine (KTXE). The result structures are:

- **result_list_t:** results from KTMs
- **failed_result_list_t:** failed results from a KTM

The result variables are:

- **result_list:** results from KTMs
- **failed_result_list:** failed results from a KTM

After execution of a KTM, the `result_list` contains a list of all results. These results in the `result_list` are available at `UAP_TEST_END` and `UAP_TEST_DATA_LOG`. The `result_list` is also available at `UAP_HANDLE_ABORT` if a result failed to pass the check against the limits.

The `failed_result_list` contains only the results that failed. These results failed to pass the check against the limits. The `failed_result_list` is available at `UAP_HANDLE_ABORT`. The structures listed below are located in `ktxe_types.h` with definitions in `ktxe_defs.h`.

result_list

```
typedef struct _result_list
{
   char   id[PARAM_ID_LENGTH];
   float  value;
   int    log;   /* True or False Flag to determine if the result is logged*/
   int    user;  /* True or False Flag for User Data
   Logging */
   struct _result_list  *next;
}
result_list_t;
```

failed_result_list

```
typedef struct _failed_result_list
{
   char   id[PARAM_ID_LENGTH];
   float  high;
   float  low;
   char   abortflag[LIMIT_ABORTSTR_LENGTH];
   char   abortfield(LIMIT_ABORTSTR_LENGTH];
   float  value;
   struct _failed_result_list     *next;
}
failed_result_list_t;
```

Section 4

Data analysis

In this section:

Introduction

This section describes the tools required to analyze results data once testing has been completed:

- **Data output formats:** The different formats that the results can be reviewed in.
- **Keithley Summary Utility (KSU):** How to use the features within KSU to analyze your results data.
- **Keithley Curve Analysis Tool (KCAT):** How to use KCAT to analyze your results data.

Data output formats

There are two different ways to view test results from within the Keithley Test Environment (KTE) software system:

- **Keithley Summary Utility (KSU)**: This tool is used to review results data in a tabular format.
- **Keithley Curve Analysis Tool (KCAT)**: This tool can be used to plot results data that is generated from a test run within KITT in a graph format.

Each of these programs uses different parameters to produce results data output.

Also included is a conversion utility to export data from the Keithley data file (`.kdf`) format:

- KDFtoKCS File Conversion Utility

Preview

This section describes in detail the Keithley Summary Utility (KSU) interface including menu options, controls, and report formats. KSU takes measurement data from a Keithley data file (`.kdf`) and applies limits from a Keithley limits file (`.klf`) to create a report with summary statistics.

Keithley Summary Utility (KSU)

The Keithley Summary Utility (KSU) takes parameter information and measured data from a Keithley data file (`.kdf`) and applies limits from a Keithley limits file (`.klf`) to create a report with summary statistics.

The KSU utility provides you with the capability to:

- **Generate two types of reports:** A standard report and a raw report. Reports can include raw reporting of all measurements recorded and a summarized report that includes means, standard deviations, and ranges.
- **Export data:** In delimited format to most databases and spreadsheets.
- **Search:** Use the browser utility to search for lots based on a series of search criteria.

All of these features are provided in an easy-to-use graphical user interface.

Summary reports

Keithley Summary Utility (KSU) provides two report forms, standard and raw. The standard report provides a table of tests indexed with a series of data from each test to include mean, minimum, and maximum. The report is preceded by a report header similar to the one shown in the following figure. The report header displays information about the lot, process, and device. The header lines are displayed on each report page.

Figure 63: Sample standard report header

```
                               Lot Summary Report KDF V1.0                                   Page:  1
Lot      : 149616                                    Operator   : witzke
Process  :                                           Starttime  : 15-Feb-97 16:14
Device   :                                           System     : 400ux
Testname: testengine                                 Teststation: 1
Limits File:LimFile3                                 Wafer File:
? = outside valid limits
* = outside selected limits
# = critical result is outside selected limits
Wafers: 1
Sites : 3
```

The raw report includes the same header file displayed in the standard report form. It displays the test data in columns and indexes the data by site, which lets you compare test results between the multiple sites. At the end of each column is the data contained in a standard report.

Both the standard and raw reports let you create an export version of the summary file with delimited fields. You can specify any single character field delimiter, enabling the file to be exported to a spreadsheet or database for additional analysis.

If a test is aborted, all data gathered up to and including the last test performed is recorded in the `.kdf` file. This means that the summary reflects the abort data, and out-of-range values are flagged to show that they meet the criteria required to abort, as specified in the limits file.

Standard report

The standard report form shown in the following figure consists of the report header field, included in all but export report forms, followed by the lot data.

Figure 64: Standard report

```
                                        Lot Summary Report KDF V1.0                                                          Page:  1
Lot      : example                                          Operator    : witzke
Process  : Test                                             Starttime   : 18-Apr-1997 07:42
Device   : new                                              System      : sawsun
Testname: ktxe                                              Teststation: 1
Limits File:                                                Wafer File:
? = outside valid limits
* = outside selected limits
# = critical result is outside selected limits
Wafers: 1
Sites : 1
```

Name	Units	Mean	SDEV	Min	Max	%SDEV	SpecL	SpecH	%Spec	CNT	%Vld
sice		1.55e-10	0.00e+00	1.55e-10	1.55e-10	0.0	-1.00e+15	1.00e+15	50.0*	1	50.0*
sbeta		0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.0	-1.00e+15	1.00e+15	0.0*	0	0.0*
sbmax		-5.00e+14	7.07e+14	-1.00e+15	1.11e+09	141.4	-1.00e+15	1.00e+15	100.0	2	100.0
sicmax		8.44e-20	1.19e-19	1.40e-45	1.69e-19	141.4	-1.00e+15	1.00e+15	100.0	2	100.0
tee_test_fg		2.00e+00	1.00e+00	1.00e+00	3.00e+00	50.0	-1.00e+15	1.00e+15	100.0	3	100.0

The header is placed at the top of each page of the summary report. An empty field in the header indicates the corresponding field in the data file was empty at the time of the search. The data is listed with test names as row labels on the left, and test information in columns across the top. The test information consists of the mean, minimum, and maximum for the sites based on the test performed.

Following the header is a series of column field labels. These fields contain data derived from the `.kdf` file. Some fields such as %Spec and %Vld include an asterisk next to the data points. This asterisk indicates the data is out of range and alerts you to potentially bad data points. The following paragraphs describe the fields that are the column indexes for the standard report shown in the previous figure.

If a result is outside user-specified limits (specification limits by default) and the critical flag in the Limits File Editor was set to true, a # is displayed on the report, and the result is not used in any calculations.

Name

This is the parameter name to which the data corresponds. The Name field is the row index of the summary report.

Units

This is the data units specified in the limits file. This field is blank if no limits file is specified.

SpecL and SpecH

Specification constraints from the limits file. These values let you quickly identify data points that are out of range. If no limits file is specified, they default to -1.00e+15 and 1.00e+15, respectively.

Mean

The mean for each parameter is calculated from the data of all test sites. It is the arithmetic mean of all the results for the wafer and the specified parameter.

Min and Max

Minimum and maximum for the data points of the parameter.

SDEV

This is the standard deviation from the mean of the data points of the parameter.

%SDEV

The standard deviation expressed as a percentage plus or minus from the mean.

CNT

The number of data points used in calculations.

%Vld

The percentage of data points that are within the valid range specified in the limits file. This is 100 % if no limits file was specified.

%Spec

The percentage of data points that are within SpecL and SpecH.

Raw report

The raw report is an expanded version of the standard report. The additional data found in the raw report consists of the actual data points derived from the `.kdf` file.

The raw report uses the same header file as the standard report. In a raw report, the parameters are listed in columns instead of rows. The information found in a standard report is listed in the bottom rows of each raw report page.

This information is calculated in the same manner as a standard report. In rows above the standard report data are the wafer and site names for each data point. A specific data point for a test is found as follows:

1. Find the appropriate wafer and site in the rows along the left side of the summary report.
2. Read across the row until the appropriate parameter or test is found. This value is the desired data point.
3. The relative information for the other data points in the parameter or test can be found by reading down the column until the mean, minimum, and maximum are found.

The following figure is a raw report generated from the same `.kdf` file as the standard report shown in the previous figure.

Figure 65: Raw report

```
                                              Lot Summary Report KDF V1.0                                                    Page:  1
Lot      : xxx                                                  Operator    : kthmgr
Process  :                                                      Starttime   : 22-Nov-94 22:38
Device   :                                                      System      :
Testname: trial4                                                Teststation: 1
Limits File: xxx                                                Wafer File:
? = outside valid limits
* = outside selected limits
# = critical result is outside selected limits


         ntranopens  ngateshort  ptranopens  pgateshort  ncontin     pcontin     ngoxileak   pgoxileak   n50x045ifr  n50x045irv
   Spec  -1.000e+15  -1.000e+15  -1.000e+15  -1.000e+15  -1.000e+15  -1.000e+15  -1.000e+15  -1.000e+15  -1.000e+15  -1.000e+15
Wafer     1.000e+15   1.000e+15   1.000e+15   1.000e+15   1.000e+15   1.000e+15   1.000e+15   1.000e+15   1.000e+15   1.000e+15
 Site
------------------------------------------------------------------------------------------------------------------------------
WaferID: 1;   Split: ;   Boat: 1;   Slot: 1
 1        1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.930e-12   1.036e-13   2.552e-02   2.566e-02
 2        1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.794e-12  -9.205e-15   2.380e-02   2.390e-02
 3        1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   2.028e-12  -8.285e-14   2.877e-02   2.888e-02
 4        1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   7.885e-13  -5.524e-13   2.368e-02   2.378e-02
 5        1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   6.354e-13  -2.595e-13   2.507e-02   2.523e-02
 6        1.000e+02   0.000e+00   1.000e+02   0.000e+00   0.000e+00   0.000e+00  -1.097e-07   1.000e+21?  1.200e+22?  1.200e+22?
 7        0.000e+00   1.200e+22?  1.000e+02   1.000e+02   0.000e+00   0.000e+00   1.199e-12   1.671e-14   1.200e+22?  1.200e+22?
 8        1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   7.506e-13  -1.501e-14   2.655e-02   2.675e-02
------------------------------------------------------------------------------------------------------------------------------
Count         8           7           8           8           8           8           8           7           6           6
Mean      8.750e+01   8.571e+01   1.000e+02   8.750e+01   7.500e+01   7.500e+01  -1.371e-08  -1.141e-13   2.557e-02   2.570e-02
STDEV     3.536e+01   3.780e+01   0.000e+00   3.536e+01   4.629e+01   4.629e+01   3.879e-08   2.234e-13   1.904e-03   1.915e-03
%STDEV    4.041e+01   4.410e+01   0.000e+00   4.041e+01   6.172e+01   6.172e+01   2.829e+02   1.958e+02   7.448e+00   7.451e+00
MIN       0.000e+00   0.000e+00   1.000e+02   0.000e+00   0.000e+00   0.000e+00  -1.097e-07  -5.524e-13   2.368e-02   2.378e-02
MAX       1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   1.000e+02   2.028e-12   1.036e-13   2.877e-02   2.888e-02
```

KSU description

The Keithley Summary Utility (KSU) graphical user interface lets you choose one of several lots to use in summary report creation. This section provides detailed information and procedures for using the KSU graphical user interface and KSU tools.

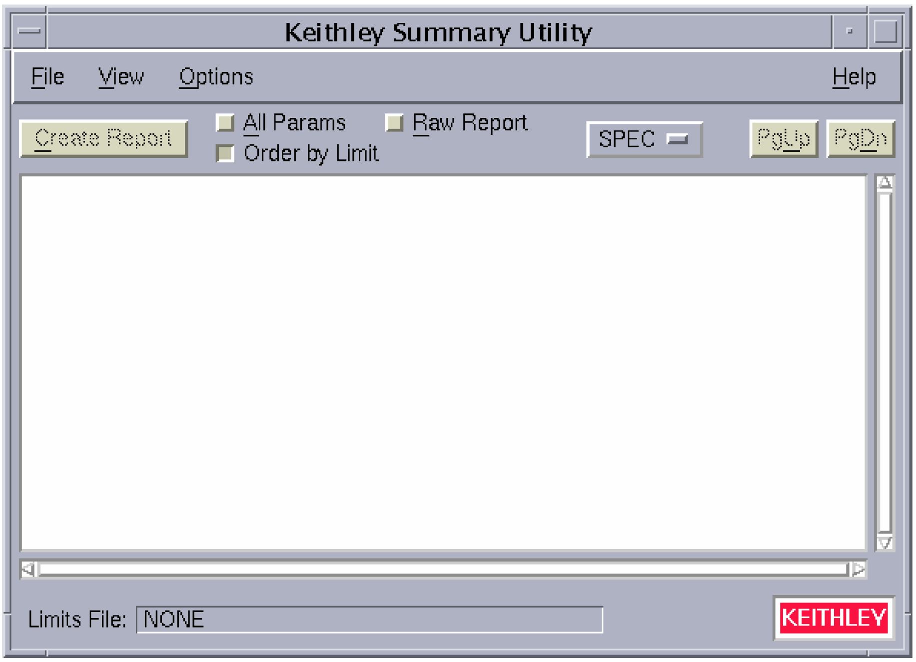
Starting KSU

The Keithley Summary Tool (KSU) can be started from the KSU icon or the command line. Some examples are:

- Double-click the KSU icon or the executable file.
- Click the KSU icon or the executable file and select **Run**.
- Enter the executable file at a command line prompt, and press **Enter**.

After activating KSU, the KSU main window, shown in the following figure is displayed.

Figure 66: KSU main window



KSU main window

The Keithley Summary Utility (KSU) main window menu bar contains the following selections:

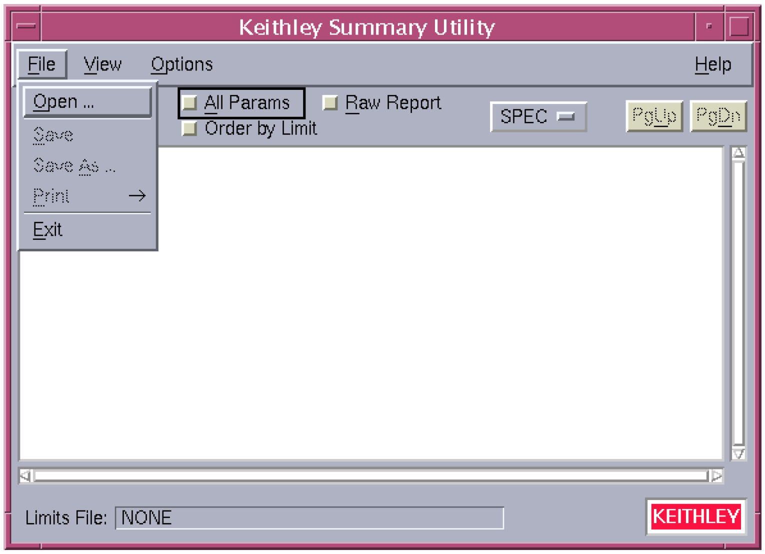
- File menu
- View menu
- Options menu
- Help menu

File menu

Selecting **File** produces the menu shown in the following figure. The menu items are:

- **Open:** Produces the Keithley Summary Utility (KSU) Lot Browser window.
- **Save:** Saves the presently displayed summary file using the present name.
- **Save As:** Saves the presently displayed summary file using a new name.
- **Print:** Produces the print cascade menu, allowing you to choose print options.
- **Exit:** Exits KSU.

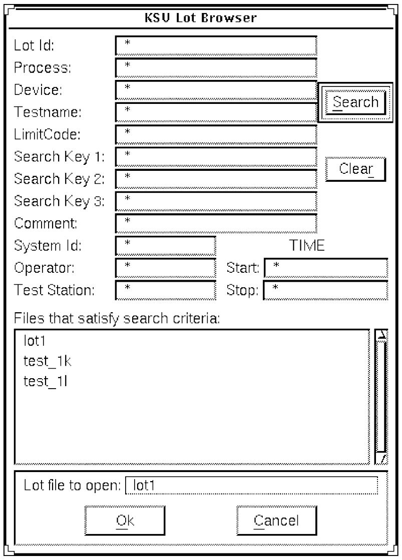
Figure 67: KSU file menu



KSU lot browser window

The Lot Browser window, shown in the following figure, is displayed when you select **Open** from the **File** menu.

Figure 68: KSU lot browser window



The lot browser allows data entry in all of the provided fields. These fields are defined in the `.kdf` file, and only those defined are available to the lot browser search fields. Undefined fields appear blank.

The lot browser search fields support the asterisk (`*`) and question mark (`?`) standard wildcard characters. The asterisk (`*`) is used as a default character in any search field left blank. When the browser is first opened, it performs a search using the standard wildcards. The following table contains a list of valid search criteria and a list of lots displayed. In the example, the possible lots are test 1, test 1-1, test 2, testing, testit, and best1.

Sample search criteria

Search criteria	Lots displayed
*	test1, test1-1, test2, testing, testit, best1
test*	test1, test1-1, test2, testing, testit
test?	test1, test2
test1*	test1, test1-1
?est1	best1, test1
test??	testit

The lot browser's main function is to search the `.kdf` file and produce reports based on that search. The user function controls are located on the panel below the window that displays the available lot files.

Lot browser controls

The lot browser functions are controlled with following screen buttons:

- **Search**: Initiates a new lot file search based on the present search criteria. A search is initiated the first time in a session you access through the Lot Browser window from the Open selection of the File menu. Each time the Lot Browser window is accessed after that, you must press this button to initiate a search.
- **Clear**: Clears all search criteria and returns each field to the `*` default.
- **OK**: Closes the Keithley Summary Utility (KSU) Lot Browser window and causes the selected lot file to transfer to the KSU main window for report generation.
- **Cancel**: Exits the KSU Lot Browser window and returns to the KSU main window.

The Search results are displayed in the Files that satisfy search criteria list box. To select a lot for search and report generation, click the lot and click the **OK** button, or double-click the lot.

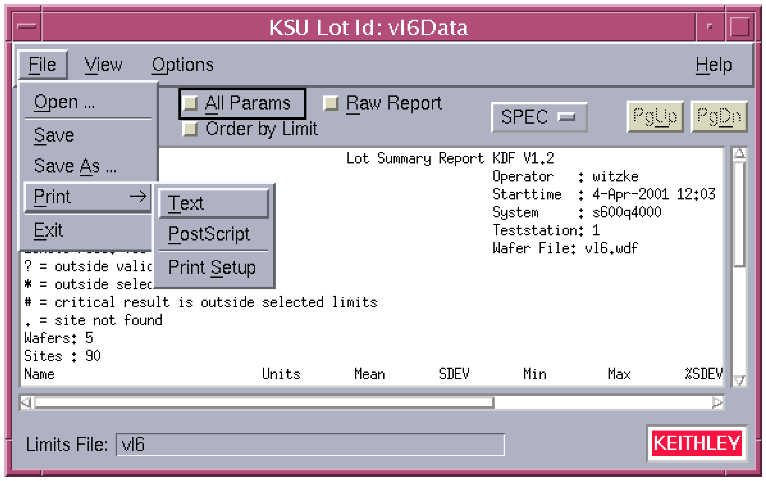
The Lot Browser window closes and the selected lot is transferred to the KSU window for processing. Selecting the **Cancel** button removes the Lot Browser window from the screen and returns control to the KSU main window.

Print menu

When the **Print** option in the **File** menu is selected, the menu shown in the following figure is displayed with the following options:

- **Text**: Prints to non-postscript printers according to formatting data in the print setup.
- **PostScript**: Prints to postscript printers according to formatting data in the print setup.
- **Print Setup**: Sets up the page format for printing.

Figure 69: KSU print menu

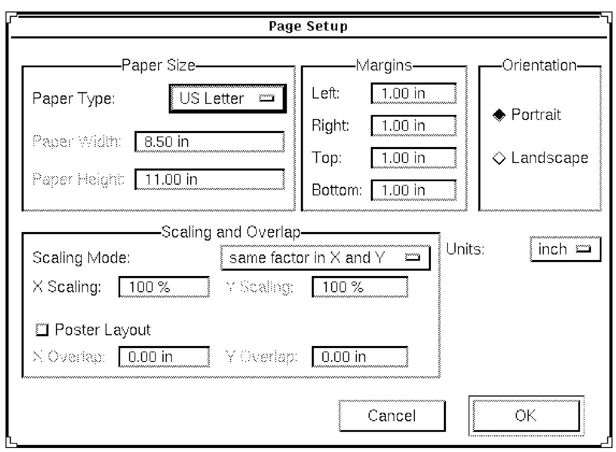


Print Setup

Use the Print Setup selection to set up the page format:

1. Select Print Setup from the Print menu. The Page Setup window shown in the following figure is displayed.

Figure 70: Page setup window



2. Select the page options:

- Paper Type
- Paper Width
- Paper Height

NOTE

The width and height of the paper can only be changed if a paper type of **Other** is selected.

- Margins
- Orientation (portrait or landscape)

NOTE

Landscape prints sideways on a printer. Make sure your printer will support this option before printing.

- Scaling and Overlap. Scaling Mode selections include:
  - **Same factor in X and Y:** The X and Y axes are changed by the same percentage.
  - **Separate X and Y factors:** The X and Y axes are changed independently.
  - **Fit to page:** The X and Y axes are changed accordingly to fit the paper size selected.
  - **Fill one page (unequal):** The data is sized to fill one page, and the X and Y axes will be unequal.
  - **Fit page width:** The data is sized to fit the width of the paper size selected.
  - **Fit page length:** The data is sized to fit the length of the paper size selected.

  If the data area is too large to fit the width and height of the paper, select **Poster Layout**. The X and Y overlap determines how much data is repeated on each sheet so the sheets can be pasted together.
- Units (inch, mm, or point)

3. Click **OK** to accept the page setup or **Cancel** to abort the printer setup operation.

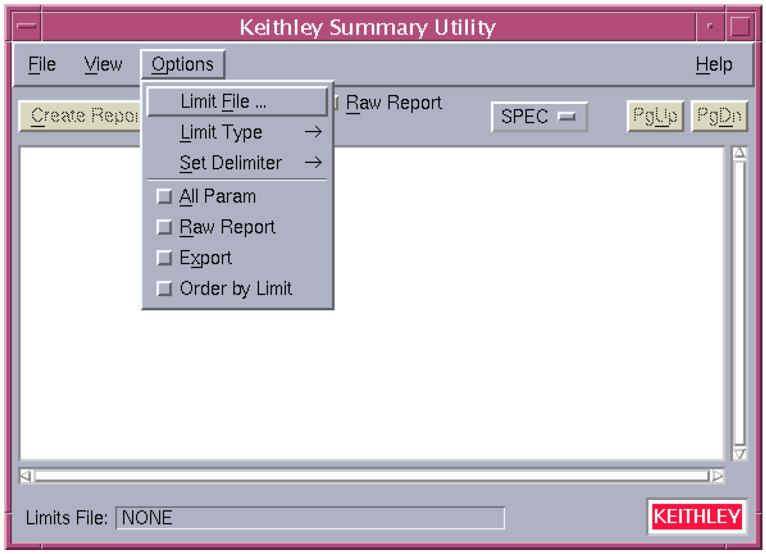
View menu

Selecting **View** lets you select the display format of the Keithley Summary Utility window.

Options menu

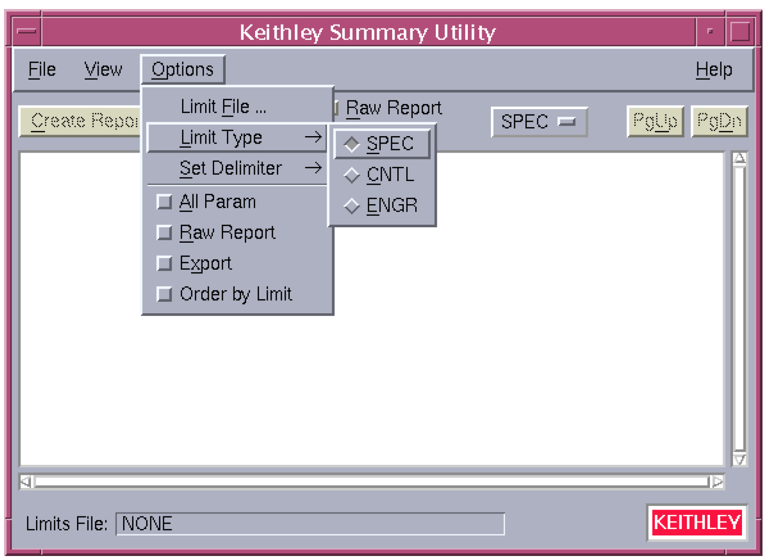
The Options menu shown in the following figure contains the following selections:

Figure 71: KSU options menu



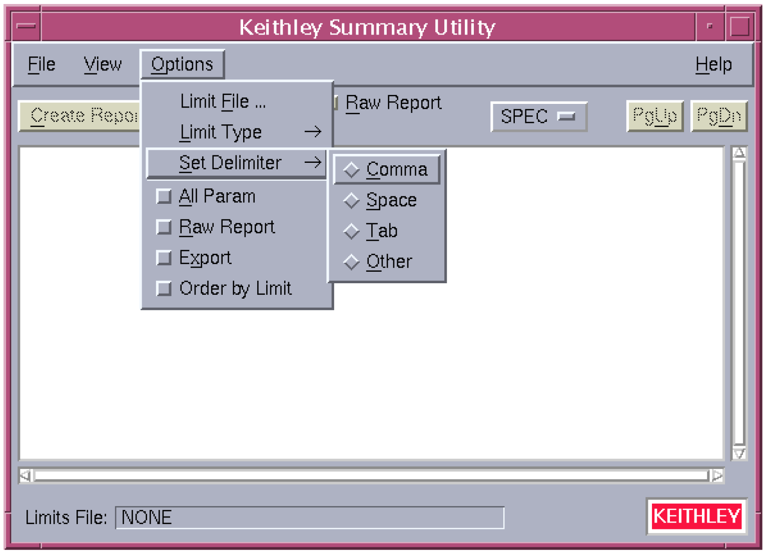
- **Limit File:** Select a limit file to apply to the Keithley Summary Utility (KSU).
- **Limit Type:** Choose specific limits from the chosen limits file (see the following figure).

Figure 72: Limit type menu



- **Set Delimiter:** Choose a delimiter to apply when the KSU file is exported using the Export option.

Figure 73: Set delimiter menu



- **All Param:** Include all available parameters in the KSU report.
- **Raw Report:** Access all information contained in the selected lot file.
- **Export:** Export the KSU report with the delimiter chosen using the Set Delimiter option.
- **Order by Limit:** Create report results in the order specified in the limits file.

Help menu

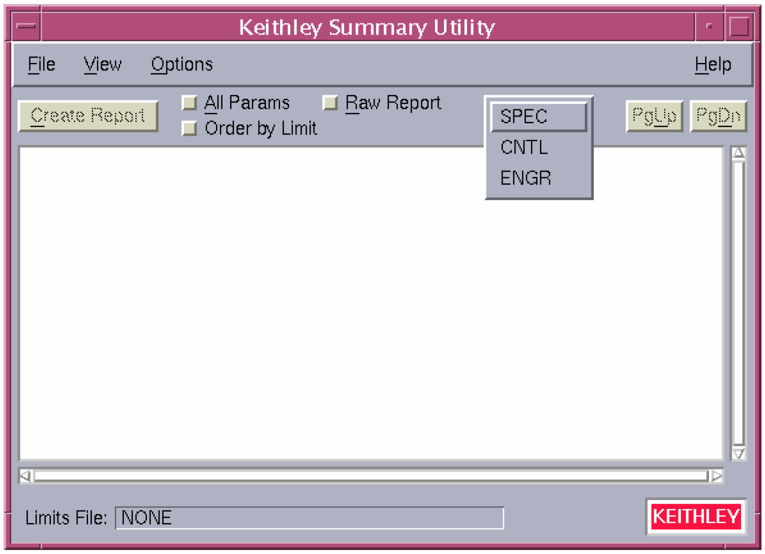
The Help menu item contains the following selections:

- **KSU Documentation:** Provides help information on selected topics about the Keithley Summary Utility (KSU).
- **About:** Displays the installed KSU version number.

Other KSU main window controls

The Keithley Summary Utility (KSU) main window contains the following control selections.

Figure 74: Control selections



- **Create Report:** Initiate KSU report generation using the selected parameters.
- **All Params:** Include all available data file information in the KSU report.
- **Order by Limit:** Direct KSU to produce its report in the same manner as the `-e` command-line switch.
- **Raw Report:** Direct KSU to produce its report in the same manner as the `-r` command-line switch.
- **SPEC, CNTL, ENGR:** Choose which parameter set to apply to KSU report generation.
- **PgUp and PgDn:** Scroll through the displayed report one page at a time.
- **Scroll Bars:** Position the displayed file within the limits of a single displayed screen using the scroll bars on right side and bottom of the window.
- **Limits File:** Display the presently selected limits file.

Command-line options for KSU

The following list contains the command-line options that can be entered when starting the Keithley Summary Utility (KSU).

`-a` Report on all parameters, even if they are not in the limits file.

`-c` Disable the graphical user interface (GUI) (use the lotsummary interface).

`-e` Order results as specified in the limits file.

`-f<filename>` Specify the limits file to use. Default is limits file within lot.

`-d<char>` Set the delimiter. Default is a space, except for the Export version, which is a comma.

`-h` Display the help information.

`-l<char>` Specify which limits to use in addition to the valid limits where <*char*> is s = spec (default), c = control, *e* = engineering.

`-n` Do not print report header.

`-o<filename>` Set the output filename. Default is `<lotname>.sum`.

`-p` Send the output to a printer. Default is no print.

`-r` Generate a raw report. Default is Lot Level Summary Report.

`-s` Send the output to the screen. Default is no screen.

`-x` Generate an export version of the report. Default is no export.

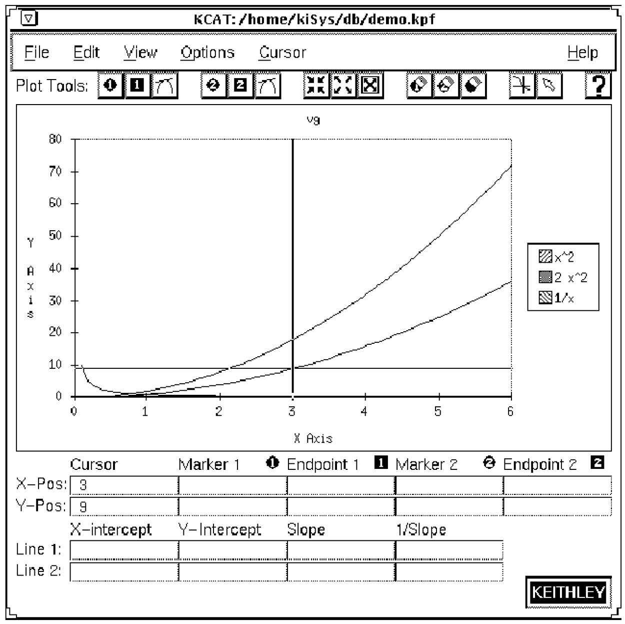
Keithley Curve Analysis Tool (KCAT)

This section describes the windows and features associated with the Keithley Curve Analysis Tool (KCAT). For complete details on using the KCAT graphical interface, refer to the KCAT tutorial. The main function of KCAT is to graph results data and calculate slopes, intercepts, and tangents on the resulting curves.

KCAT main window

The following figure shows the Keithley Curve Analysis Tool (KCAT) main window, which is the primary interface to the graphing capabilities of KCAT. When KCAT is executed, the main window is displayed in the upper left quadrant of the screen.

Figure 75: KCAT main window



The main window has the following sections:

- Menu bar
- Tool bar
- Graph area
- Data fields

Menu bar

The menu bar contains the following menus:

File: Load, save, or print Keithley plot files, and exit the Keithley Curve Analysis Tool (KCAT).

Edit: Customize the X and Y axis labels.

View: Display the full KCAT main window, show the KCAT Data window, and the KCAT Scaling window.

Options: Select color or monochrome graphing, line or scatter graph, and the marker type.

Cursor: Customize how the cursor interacts with the graphing area.

Help: Displays KCAT documentation and the KCAT software revision level.

Tool bar

The tool bar contains plotting tools that let you:

- Place and clear markers and endpoints on the graph.
- Draw tangents.
- Zoom in, zoom out, and autoscale the viewing area of the graph.
- Change the interaction of the cursor with the graph.
- Access online help documentation.

Graph area

The graph area contains the following:

- The plotted graph.
- The graph label.
- The graph legend.
- The X and Y axis labels.

Data fields

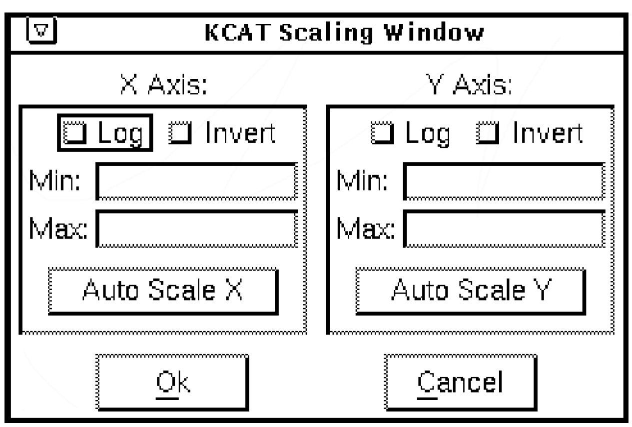
The data fields display information about the graph. The status line gives a description of the present menu or tool being used.

Scaling window

The Scaling window, shown in the following figure, lets you manipulate the graph by turning selecting the following options or scaling the range of the axes.

- **Log:** Change either the X axis data or the Y axis data to the logarithmic equivalent.
- **Invert:** Invert either the X axis data or the Y axis data.

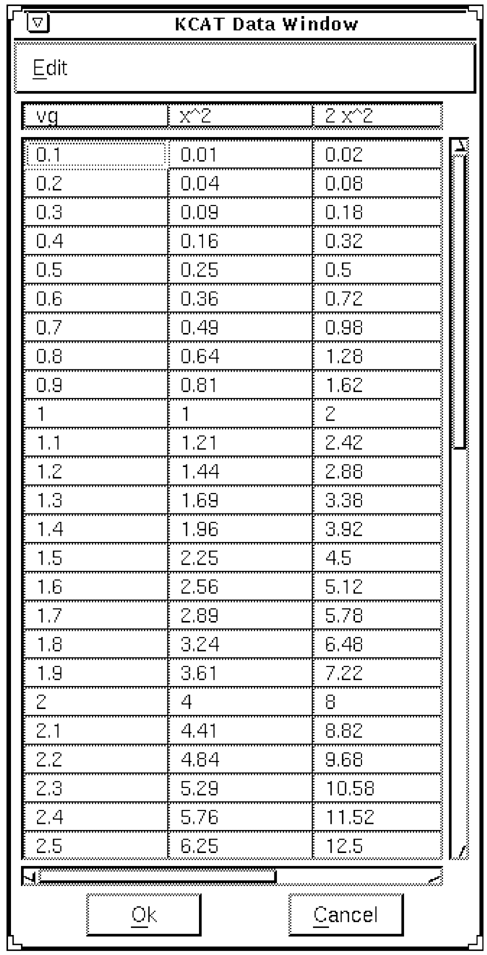
Figure 76: Scaling window



Data window

The Data window contains a listing of all the data points associated with the present graph.

Figure 77: Data window



vg	x^2	2 x^2
0.1	0.01	0.02
0.2	0.04	0.08
0.3	0.09	0.18
0.4	0.16	0.32
0.5	0.25	0.5
0.6	0.36	0.72
0.7	0.49	0.98
0.8	0.64	1.28
0.9	0.81	1.62
1	1	2
1.1	1.21	2.42
1.2	1.44	2.88
1.3	1.69	3.38
1.4	1.96	3.92
1.5	2.25	4.5
1.6	2.56	5.12
1.7	2.89	5.78
1.8	3.24	6.48
1.9	3.61	7.22
2	4	8
2.1	4.41	8.82
2.2	4.84	9.68
2.3	5.29	10.58
2.4	5.76	11.52
2.5	6.25	12.5

Pop-up tools menu

The pop-up tools menu contains a listing of all of the tools in the tool bar. It is accessed by pressing the center mouse button when the cursor is anywhere over the graph area.

KDFtoKCS File Conversion Utility

This utility reads a specified Keithley Data File (.kdf) and writes an equivalent Cornerstone format file (.kcs). Both are ASCII comma-delimited data files. This utility is useful if you want to use a spreadsheet or other Cornerstone-compatible document reader to interpret and edit data.

Syntax of command:

```
KDFtoKCS [-c category][-f substitution_string][-h]
     [-l limit_file][-o outfile][-p] kdf
```

Where:

- category = The limits category of interest
- substitution_string = An optional string to be substituted into the .kcs file wherever the data value is invalid
- limit_file = The name of an appropriate Keithley Limits File (.klf)
- outfile = The name of the intended output .kcs file
- kdf = The name of the .kdf to be converted

The program first accesses the Keithley Limits File (as specified in the .kdf file or by using the -l command-line option) to write the header row to the .kcs file. There are several ways to manipulate this header row, which lists the names and units of the data parameters (see the command-line options list below). The header row has the following format:

```
Wafer,Site,Col,Row,Param1.name Param1.units,Param2.name
     Param2.units,…,ParamN.name ParamN.units
```

The program then proceeds to write each data row containing the site-specific data defined in the header row. The data rows have the following format:

```
WaferID,SiteID,ColNum,RowNum,Param1.val,Param2.val,…,ParamN.val
```

When finished, the output .kcs file is located in a folder specified by the environment variable $KIDB and has the name of the lot as defined in the .kdf file (or, alternately, the name supplied using the -o option).

The command-line options are as follows:

- -conly = The parameters of the specified category are listed. Only one category may be specified with this option, and it must match at least one category of the parameter exactly, or else the parameter will be discarded.

NOTE

Any given parameter may have several categories if they are comma or whitespace-delimited within the category field of their entry in the .klf file.

- `-fthe` = Program substitutes the string argument for data values that do not lie within the valid limits (or omits these values if no substitution string is supplied).
- `-hdisplays` = A help file on the screen.
- `-lsets` = The limits file name.
- `-osets` = The output `.kcs` file name.
- `-puses` = The parameters as they appear in the `.klf` file (default is to get the parameters from the first site entry in the `.kdf` file).

Example

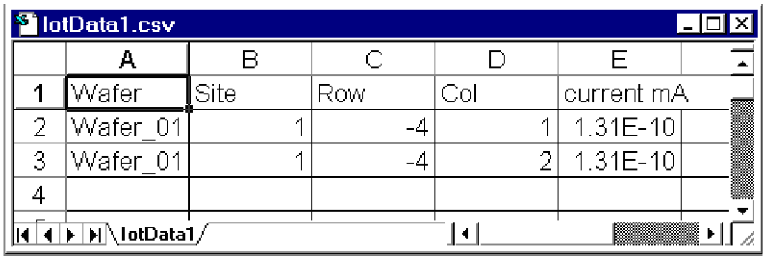
Given the following `.kdf` and `.klf` files:

4 lotData1.kdf	**detailLimit.klf**
TYP,KDF V1.0 LOT,lotData1 TST,ktxe SYS,Q22 TSN,1 OPR,operator1 LMT,detailLimit STT,01-Jan-1999 13:26 <EOH> Wafer_01,,1,1 1,-4,1 icur,1.3124e-10 <EOS> Wafer_01,,1,1 1,-4,2 icur,1.3126e-10 <EOS> <EOW>	#Keithley Parameter Limits File Version,1.0 File,/TestArea/detailLimit.klf Date,01/01/1999 Comment,KLF <EOH> ID,icur NAM,current UNT,mA RPT,1 CRT,0 TAR,0.0000e+00 AF,0 AL,0 VAL,1.3100e-10,1.3125e-10 SPC,-2.0000e-10,2.0000e-10 CNT,-2.0000e-10,2.0000e-10 ENG,-2.0000e-10,2.0000e-10 <EOL>

5 lotData1.kcs
Wafer,Site,Row,Col,current mA Wafer_01,1,-4,1,1.3124e-10 Wafer_01,1,-4,2,1.3126e-10

When this file is viewed in a spreadsheet program such as Microsoft® Excel®, it appears like this:

Figure 78: Lotdata1.kcs in a spreadsheet



lotData1.csv

	A	B	C	D	E
1	Wafer	Site	Row	Col	current mA
2	Wafer_01	1	-4	1	1.31E-10
3	Wafer_01	1	-4	2	1.31E-10
4					

lotData1

NOTE

The extension was changed from `.kcs` to `.csv` so that Excel can recognize the format.

Section 5

System administration

In this section:

Introduction

This section discusses setting up and using the Keithley Test Environment (KTE) software for use with the KTE system:

- **Workstation applications:** The Keithley Tool Palette, configuring the system software, file management, and customizing the workstation for the KTE system.
- **Integrating the system into the network:** Integrating the KTE into the current system and logging test data.

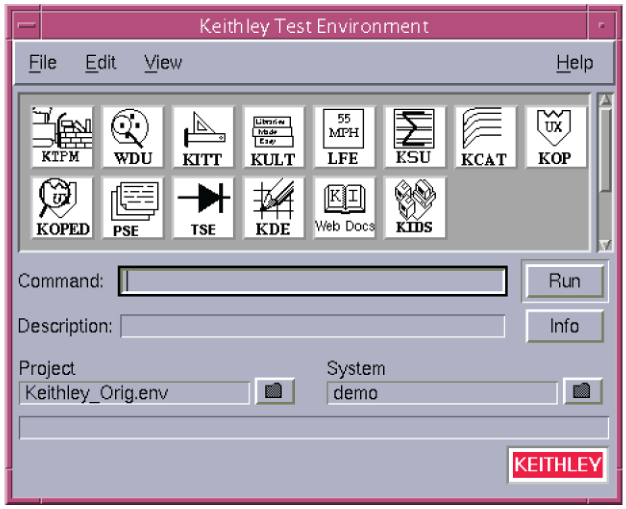
Workstation applications

The following topics describe the workstation applications.

Keithley tool palette

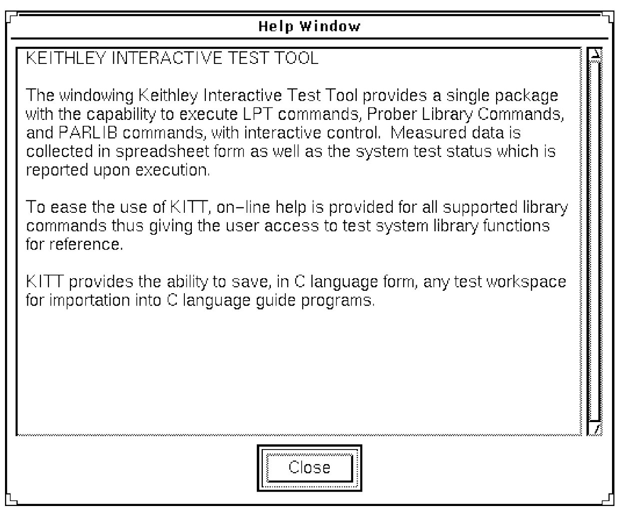
The tool palette provides a point-and-click interface into the Keithley Test Environment (KTE) development environment. The tool palette for the S530 system, shown in the following figure, contains an icon for each of the test plan development and utility functions.

Figure 79: Keithley tool palette



After clicking an icon, the command related to that icon is displayed in the Command field and a brief description of the selected tool is displayed in the Description field. You can access more information about the selected command by clicking the Info button located in the lower right corner of the tool palette. This opens the Help window shown in the following figure.

Figure 80: Tool window



To start the currently selected tool, click the **Run** button in the lower right corner of the tool palette or double-click the icon of the software tool you want to initiate. The status of the program selected is displayed directly below the Description field.

Menu bar

The menu bar is located across the top of the tool palette and provides access to the following system-related functions.

File menu

- **Exit:** Closes the Keithley tool palette.

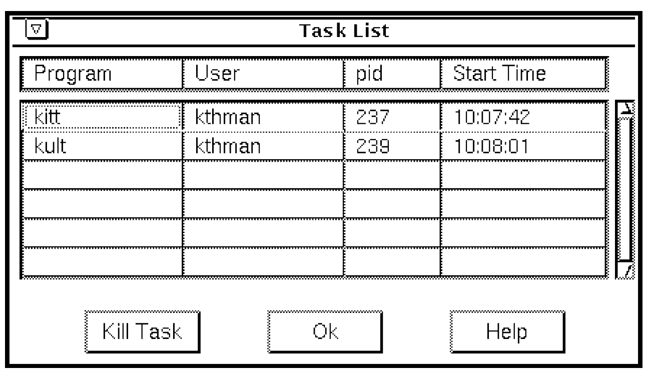
Edit menu

- **Edit tool.tpi:** Allows you to modify the tool palette. The `tool.tpi` file controls the icons displayed by each of the View menu selections.
- **Reload tool.tpi:** Reinitializes the program using the modified `tool.tpi` file. The `tool.tpi` file must be reloaded after any changes have been made for modifications to take effect.

View menu

- **Keithley tools:** Displays Keithley Development Tools icons.
- **Tester Tools:** Displays the Tester Tools icons.
- **Linux® tools:** Displays the System Tools icons.
- **Linux administration:** Displays the Administrator Tools icons.
- **User programs:** Displays the User programs icons.
- **All:** Displays all of the icons listed above.
- **Task list:** Displays a dialog box containing presently running programs, as shown in the following figure, and lets you stop individual program execution.

Figure 81: Task list window



- **Icon only view:** Removes everything from the tool palette except the icons and opens the task list. The right mouse button accesses a dialog box that lets you toggle between the icon-only view and the full view of the tool palette.

Help menu

- **KTP documentation:** Lists version information about the Keithley Test Environment (KTE) software.
- **About:** Opens the help window related to the software tool selected (the same as clicking the Info button).

Project field

The project field lets you select a specific project environment that describes the location of the Keithley Test Environment (KTE) directory tree to use during testing.

System field

The system field lets you specify the test system to which your workstation should connect.

System configuration: kth.ini file

The Keithley Test Environment (KTE) system uses a system-wide initialization file called `kth.ini` to configure some of the software components. The format for each entry within the `kth.ini` file is:

```
<COMPONENT>
item = value
```

The definition for each of these parameters is:

- `<COMPONENT>` = One of the KTE software subsystems.
- `item` = The customizable parameter for the subsystem.
- `value` = The value associated with the item.

When started, Keithley application programs search the following locations for the `kth.ini` file:

- The current working directory.
- The login directory.
- The master version in `$KIHOME`.

The following is an example of a `kth.ini` file:

```
<KDF>
#Datapath=$KIDB
Error_Log=/$KIHOME/log/kdf_error.log
<SUM>
Lprint=lpr
LinesPerPage=55
ParamsPerLine=10
<GPIB232CT-UNIT#1>
BAUD=9600
TIMEOUT=10
TTYDEV=/dev/ttya
```

Any parameters defined by the `kth.ini` file can be changed by editing the file with an ASCII editor. The new values are used the next time the program executes.

When you make changes that you do not want other users to be affected by, copy the `kth.ini` file from `$KIHOME` to your present or login directory and edit it there. For example, assume you want to modify the Summary Report Generator `<SUM>` to print five parameters per line, rather than its default setting of 10 per line. Do the following:

1. Copy the `kth.ini` file to your working directory:

   ```
   prompt> cp $KIHOME/kth.ini
   ```
2. Edit the file with text edit or any other ASCII editor.
3. Modify the `<SUM>` parameter `ParamsPerLine` as needed. Do not use spaces around the = sign.

NOTE

If you make an invalid change, for example `ParamsPerLine=-10`, the software ignores the setting and uses a reasonable default value when it executes.

4. Generate your summary report. The Summary Report Generator uses the new value of `ParamsPerLine` if you execute it from the working directory.

To make this change universal, replace the file in `$KIHOME` with the new version.

kptm.ini file

The `ktpm.ini` file allows you to set the user access points (UAPs) that are associated with each engine used in the Keithley Test Program Manager (KTPM). The `ktpm.ini` file, shown below, is located in the `$KI_KTXE_CPF` directory.

When an engine is selected, the UAPs associated with that engine are accessible to the UAP Module/KTM area in KTPM. Only the UAPs listed with the selected engine can appear in this area. Each selection in this field has an associated list of UAPs that become active when the engine version is selected.

```
# Start of File */
<Engine_List>
Engine1 = ktxe,$KIBIN,Initial KI Execution Engine for V5.x
<ktxe>
# process user's ktxe command line arguments
UAP1 = UAP_PROG_ARGS
# start processing the cassette plan
UAP2 = UAP_CASSETTE_LOAD
# start setting up the lot file
UAP3 = UAP_LOT_INFO
# start of prober initialization
UAP4 = UAP_PROBER_INIT
# mismatch detected between cassette plan and prober
UAP5 = UAP_WAFER_MISMATCH
# allow access to wdf before call to PrInit
UAP6 = UAP_ACCESS_WDF_INFO
# called to send init commands to prober
UAP7 = UAP_POST_PROBER_INIT
# before writing lot information
UAP8 = UAP_WRITE_LOT_INFO
# write usertag data after LOT header
UAP9 = UAP_POST_LOT_INFO
# after a wafer load and the wafer is rejected
UAP10 = UAP_WAFERLOAD_STATUS
# error recovery after wafer alignment
UAP11 = UAP_ALIGN_ERROR
# perform AutoZ after first wafer load
UAP12 = UAP_POST_INITIAL_WAFER_LOAD
# start processing next wafer plan
UAP13 = UAP_WAFER_PREPARE
# after OCR and before wafer ID is logged to data file
UAP14 = UAP_VALIDATE_OCR
# start executing wafer plan
UAP15 = UAP_WAFER_BEGIN
# start of next site processing
UAP16 = UAP_SITE_CHANGE
# start of next subsite processing
UAP17 = UAP_SUBSITE_CHANGE
# start of next ktm processing
UAP18 = UAP_TEST_BEGIN
# end of processing a ktm
UAP19 = UAP_TEST_END
# after test data has been logged
UAP20 = UAP_TEST_DATA_LOG
# processing an abort condition
UAP21 = UAP_HANDLE_ABORT
# end of current sub-site processing
UAP22 = UAP_SUBSITE_END
# end of current site processing
UAP23 = UAP_SITE_END
# end of processing a wafer plan
UAP24 = UAP_WAFER_END
# end of processing the cassette plan file
UAP25 = UAP_LOT_END
# before leaving the execution engine
UAP26 = UAP_ENGINE_EXIT
```

```
# called as an atexit function
UAP27 = UAP_ABORT_EXIT_HDLR
# called if prober err and function exists
UAP28 = UAP_PRB_ERR_HDLR
# called when pause/cont is pressed on StatDlg
UAP29 = UAP_STATUS_CHANGE
# before profiling a wafer
UAP30 = UAP_PROFILE_WAFER
# Place probers that support PrSetSlotStatus here in this list.
# The YES is mandatory!!!
<AbsProbers>
EG40=YES
EG2X=YES
TSK9=YES
P8=YES
# This is used for working off-line. Comment this out if you want.
FAKE=YES
/*End of File */
```

The ktpm.ini file searches through the different directories for the data associated with each UAP in the following order:

```
$KI_KTXE_CPF
$KIHOME
$HOME
```

To modify the `ktpm.ini` file, use textedit or any other ASCII text editor program.

Environment variables

The following list contains the environment variables used by the Keithley Test Environment (KTE) tools and execution engines. Environment variables can be set to determine the default location of data files. Environment variables also provide a mechanism to manipulate different sets of data with the same tools. Set the environment variables to the locations you want and start the tool.

Scripts can be developed that set these variables to point to different areas of the file system. For example, a script, `SetProduction`, could be used to set the environment variables to point to the production data file system. Another script, `SetDevelopment`, could be used to set the environment variables to point to a development data file system.

NOTE

If the environment variables are changed after the tool has started execution, you must exit the tool and restart for any changes to take effect.

NOTE

The Wafer Plan Editor (WPE) is part of the Keithley Test Plan Manager (KTPM). There are references to both KTPM and WPE. They are combined into one tool.

KTPM (path is stored with .wpf, .pcf, and .gdf)

- Cassette: Uses `$KI_KTXE_CPF`
- Global: Uses `$KI_KTXE_GDF`
- ktm: Uses `$KI_KTXE_KTM`
- wafer plan: Uses `$KI_KTXE_WPF`
- Prober Card: Uses `$KI_KTXE_PCF`
- Wafer Desc: Uses `$KI_KTXE_WDF`
- UAP: Uses `$KI_KTXE_UAP`
- SYSTEMAP File: Uses `$KI_KTXE_SYSTEM_AP`

WPE (part of KTPM)

- Open: Uses `$KI_KTXE_WPF`
- Wafer Desc: `Uses $KI_KTXE_WDF`
- Limits: Uses `$KI_KTXE_KLF`
- Probe Card: Uses `$KI_KTXE_PCF`

Keithley Interactive Test Tool (KITT)

- Open: Uses `$KI_KTXE_KTM`
- Wafer Desc: Uses `$KI_KTXE_WDF`
- Global Data: Uses `$KI_KTXE_GDF`
- Probe Card: Uses `$KI_KTXE_PCF`
- Test Structure: Uses `$KI_KTXE_TSF`
- Parameter Set: Uses `$KI_KTXE_PSF`
- Practice Task: Uses `$KIPGM`

Logic File Editor (LFE)

- Open: `$KI_KTXE_KLF`
- Read ID: `Uses $KI_KTXE_KTM`

Wafer Description Utility (WDU)

- Open: Uses `$KI_KTXE_WDF`

Test Structure File Editor (TSE)

- Open: `$KI_KTXE_TSF`

Keithley Curve Analysis Tool (KCAT)

- Open: `$KI_KTXE_KDF`

Parameter Set Editor (PSE)

- Open: $KI_KTXE_PSF

Keithley Operator Interface Editor (KOPED)

- Open: Uses $KIDAT

Keithley Summary Utility (KSU)

- Open: $KI_KTXE_KDF

Keithley Operator Interface (KOP)

- .ini file load: Uses $KIDAT

The Keithley startup and login files define the environment variables shown in the following tables. It is good programming practice to use these variables whenever possible. This allows you to move the location of the Keithley directory tree without affecting your programs and scripts.

Keithley directory environment variables

Variable	Definition	Meaning
KIHOME	Installation dir (/opt/ki)	KI HOME directory
KIBIN	${KIHOME}/bin	KI binaries directory
KIDAT	${KIHOME}/dat	KI data directory
KIDB	${KIHOME}/db	KI data base
KILIB	${KIHOME}/lib	KI libraries directory
KILOG	${KIHOME}/log	KI log files directory
KITMP	${KIHOME}/tmp	KI temporary directory
KIINCLUDE	${KIHOME}/include	KI include directory
KI_LOCK_LOC	${KIHOME}/lock	KI_lock_file directory
KIPGM	${KIHOME}/pgm	.ktm and .wdf directory

Open interface environment variables

Variable	Definition	Meaning
ND_HOME	${KIHOME}openint	Open interface home directory.
ND_PATH	${ND_HOME}/lib:$KIDAT	Open interface search file path.
ND_LIB	${ND_HOME}/shr	Open interface library subdirectory.
OIT_LOOK	MOTIF	Open interface graphical user interface (GUI) theme.
OIT_PATH	${OIT_HOME}/lib:$KIDAT	
OIT_LIB	${OIT_HOME}/shr	
OIT_HOME	${KIHOME}/openint	

System environment variables

Variable	Definition	Meaning
KI_SYSTEM	System name string	
KI_PRB_CONFIG	${KIDAT}/prbconfig_xxxx.dat	Prober configuration for system
KI_CONFIGURATION	${KIDAT}/acconfig_QMO.ini	Configuration file for system
KI_KUI_CLASSIC	Default state Undefined. Set to 1 to use old-style Keithley User Interface (KUI) windows	Provides a way to use existing KUI.
KI_ENABLE_2010_DISPLAY	Set to 1 to activate the front-panel display of the optional Model 2010 Digital Multimeter (DMM)	
KI_ENABLE_2410_DISPLAY	Set to 1 to activate the front-panel display of the high-voltage Model 2410 source-measure unit (SMU)	
KI_DEFAULT_LIM_MODE	Set to KI_INDICATOR to use the KI_INDICATOR value (7.0e22) instead of the measured value	
KI_NO_GPIB	Set to KI_NO_GPIB to disable prober GPIB communications	Use to disable prober GPIB communications if the GPIB adapter is missing or defective. Can be set in the $KIHOME/.ki_setup file (if the FAKE prober is specified).
KI_ONLY_GND_CHUCK	Set to 1 to automatically connect the CHUCK to GND if CHUCK is unused	Note that the KI_GND_UNUSED environment variable must also be set to get this behavior.
KI_GND_UNUSED	Set to 1 to automatically connect unused pins (including CHUCK) to GND	
KI_MATRIX_PRINT	Set to 1 to enable debug messages from the matrix driver to be displayed	
KI_KELVIN_CHECK	Set to ON to enable or OFF to disable Kelvin check	Undefined means disabled.

Diagnostics environment variables

Variable	Definition	Meaning
KI_PLATFORM	S530	Platform type.
KI_DIAGTOOLS_CONFIG	${KIHOME}/dat	Configuration file.
KI_DIAGTOOLS_LOG	${KIHOME}/log	Log output file.

User library tool environment variables

Variable	Definition	Meaning
KI_KULT_PATH	${KIHOME}/usrlib	Location of user libraries.

Test plan manager environment variables

Variable	Definition	Meaning
KI_KTXE_CPF	${KIHOME}/plans	Location of cassette plan files.
KI_KTXE_GDF	${KIHOME}/plans	Location of global data files.
KI_KTXE_KDF	${KIHOME}/db	Location of data files.
KI_KTXE_KLF	${KIHOME}/db	Location of limit files.
KI_KTXE_PCF	${KIHOME}/plans	Location of probe card files.
KI_KTXE_PLANS	${KIHOME}/plans	Plans directory.
KI_KTXE_UAP	${KIHOME}/plans	Location of user access points (UAPs).
KI_KTXE_WDF	${KIHOME}/pgm	Location of wafer description files.
KI_KTXE_WPF	${KIHOME}/plans	Location of wafer plan files.
KI_KTXE_KTM	${KIHOME}/pgm	Location of test macros.
KI_KTXE_TSF	${KIHOME}/plans	Location of test structure files.
KI_KTXE_PSF	$KI_KULT_PATH	Location of parameter set files.
KI_LOCALIZE_CFG	Defined by user (optional)	KTXE/KUI localization file.

Log file environment variables

Variable	Definition	Meaning
KI_KTXE_ERROR_LOG	Defined by user	Keithley Test Execution Engine (KTXE) error log file location.
KI_KTXE_EVENT_LOG	Defined by user	KTXE event log file location.
KI_KTXE_DEBUG_LOG	KTXE debug log file location	
KI_PRB_AUDIT_LOG	Defined by user	Prober transaction log file location.
KI_IC_AUDIT_LOG	Undefined	Determines where any IC error messages will be stored.
KI_TRACE_LEVEL	Undefined	Can be set to TRACE, DEBUG, or ERROR. This determines what level of log messages are displayed by the IC process. Default level is DEBUG.
KI_DISABLE_TRACE	Undefined	Disables any IC log messages from being displayed. Note that if the KI_IC_AUDIT_LOG variable is defined, error level messages are logged.
KI_KISA_DEBUG	Set to 1 to enable debug messages from the kisa process.	
KI_KISA_SHOW_LOG	Set to 1 to enable print-type logging in addition to file logging for the kisa process.	
KI_KTXE_STARTUP_MSGS	Set to 1 to enable KTXE process startup messages.	
KI_ALWAYS_SHOW_DIAGS	Set to 1 to enable version control operation debug messages.	
KI_HIDE_UNSUPPORTED_MSGS	Set to 1 to disable the "UNSUPPORTED LPT COMMAND" messages.	

Log file environment variables

Classification of errors:

- **Prober Errors**: Recover if possible. Notify, user abortable, logable.
- **LPT Errors**: No recovery. Logable, abort on fatal errors. See exithandlers.
- **Data Logging Errors**: Notify and abort, logable.
- **Engine Data Errors:** Non-fatal: Notify and continue, logable. Fatal: Notify and abort, logable.

If these environment variables are defined, the respective log messages are placed in the file specified.

NOTE

If the `-e` and `-ev` command-line options for the execution engine have a file name specified, this file name overrides the environment variables.

- `KI_KTXE_ERROR_LOG`**:** Determines the path and filename of the Keithley Test Execution Engine (KTXE) error log file.
- `KI_PRB_AUDIT_LOG`**:** Determines the path and filename of the transaction log file.
- `KI_LPT_ERRORLOG`**:** Determines the path and filename of the Linear Parametric Test Library (LPTLib) error log file.
- `KI_PRB_ERROR_LOG`**:** Determines the path and filename of the prober error log file.
- `KI_PRB_ERRM`**:** Determines the path and filename of the prober error message file.

Example

To log KTXE events and errors, prober errors, and LPTLib errors to same file:

```
prompt>   setenv KI_KTXE_ERROR_LOG /mydir/file.log
prompt>   setenv KI_PRB_AUDIT_LOG /mydir/file.log
prompt>   setenv KI_LPT_ERRORLOG /mydir/file.log
prompt>   setenv KI_PRB_ERROR_LOG /mydir/file.log
prompt>   setenv KI_PRB_ERRM /mydir/file.log
```

Or, start the execution engine as:

```
prompt>   ktxe -cpf cassettePlan -e 2 /mydir/file.log -ev 2 /mydir/file.log
```

This logs KTXE errors to `/mydir/file.log`.

File management

The system disk on the Keithley Test Environment (KTE) system contains the standard operating system partitions /, /user, and /home. All of the KTE software is located under the /opt/ki path. The following is a list of all of the directories located under the /opt/ki/ path:

- bin: Keithley executable files and shell scripts.
- dat: Keithley and GUI data files.
- db: Data files.
- doc: KTE Tools online help
- include: Keithley C language header files
- install: Installation tools
- lib: Keithley static and shared libraries
- lock: Keithley lock files; to protect against multiple access writes
- log: System log files
- openint: Open interface files
- pgm: Test macro and wafer description files
- plans: Test plan files
- skel: Default login scripts
- src: Source files for some system files
- tmp: System temporary scratch directory
- unsupported: Unsupported utilities
- usrlib: Keithley User Library Tool (KULT) user libraries

Keithley Component Manager (KCM) utility description

Use the Keithley Component Manager (KCM) utility to package and transfer test plans from one location to another. This utility selects all files required by the test plan and places them into a *.tar file. Specify the -u switch to include all usrlibs in addition to the required files.

Usage

```
kcm -e efile [-u] [-o <fname>]
   kcm -i ifile [-u] [-f]
```

- `-e | -i`: Export or import files (mutually exclusive).
- `ifile`: Name of file to be imported. The file must be generated by the Keithley Component Manager (KCM) utility. Paths are supported.
- `efile`: Name of file to be exported. Non-usrlib files must include file extension. Paths are ignored.
- `-u`: Optional parameter to include dependent usrlibs. Unless specified, usrlibs are not included in the `efile` or installed from the `ifile`. If the file specified is a usrlib, the `-u` switch has no effect. Only the usrlib specified is bundled.
- `-f`: Optional parameter to force overwriting local files and usrlibs without asking for confirmation.
- `-o <fname>`: Optional export parameter to specify output filename. Default output filename is `efile.tar`.

Samples

Using `kcm -e sample.cpf -u` creates a package that contains all Keithley Test Environment (KTE) files necessary to execute the `sample.cpf` cassette plan.

Using `kcm -i sample.cpf -u` installs this package into the current environment.

Project environments

The `.ki_setup` file has been modified to dynamically adjust your environment variables on a project-level basis. This allows you to set up different areas to store, run, and load your product specific files, or separate production and development code.

You can use the `make_project` script to create a new tree containing the following directories:

- `db`
- `pgm`
- `plans`
- `usrlib`

The script prompts for each of these possibilities and creates the directories as necessary. In the case of the usrlib directory, the original `KIHOME/usrlib` directory is copied to the new location.

The following example creates a new project named `dev1Area`, and the tree root of the project is placed in `/kte/ProjectTree`.

```
Prompt> make_project
Usage: make_project tree projname
Prompt> make_project /kte/ProjectTree dev1Area
   Creating Project
   Would you like to create a new db directory? y
   Would you like to create a new usrlib directory? n
   Would you like to create a new plans directory? y
   Would you like to create a new pgm directory? y
   Creating /ki/dat/dev1Area.env
   Creating /ki/dat/dev1Area.set
   Finished Creating Project
Prompt>
```

The creation of a project places a new file, `projectname.env`, in the `KIDAT` directory. The example above create the file `dev1Area.env`, which is shown below:

```
setenv KIPROJ /kte/ProjectTree/dev1Area
setenv KI_PROJ_DB /kte/ProjectTree/dev1Area/db
setenv KI_PROJ_USRLIB /ki/usrlib
setenv KI_PROJ_PLANS /kte/ProjectTree/dev1Area/plans
setenv KI_PROJ_PGM /kte/ProjectTree/dev1Area/pgm
setenv KI_PROJ_NAME dev1Area.env
```

There are two ways to reset your environment for a different project.

Invoke `select_project`, which will scan the `KIDAT` directory for all possible `.env` files, present an enumerated list, and ask which one you want. You can cancel by entering `0`, or reload the original variables by entering `111`.

```
Prompt> select_project
```

Your choices are:

- Project 1 is `DemoProject.env`
- Project 2 is `Keithley_Orig.env`
- Project 3 is `current.env`
- Project 4 is `dev1Area.env`

```
Enter your selection or 0 to cancel;
       111 to load KI Original
   >>---> 0
Prompt>
```

The process used by the `select_project` script sets the following environment variables:

- `KIPROJ`: Points to the base path of the project tree.
- `KI_PROJ_DB`: Points to path of directory where Keithley Data Files (KDF) and Keithley Logic Files (KLF) are stored.
- `KI_PROJ_USRLIB`: Points to the usrlib directory where Keithley User Library Tool (KULT) libraries are stored.
- `KI_PROJ_PLANS`: Points to directory where `.cpf`, `.wpf`, `.gdf`, and `.pcf` files are stored.
- `KI_PROJ_PGM`: Points to directory where wafer definition files (WDF) and Keithley Test Module (KTM) files are stored.
- `KI_PROJ_NAME`: Project name.

The .ki_setup file uses these base variables to configure the remaining Keithley Test Environment (KTE) environment variables.

A graphical user interface (GUI) window is provided in the Keithley Operator Utility (KOP) and Keithley Test Plan (KTP). By changing the project within these tools, all applications started by these tools use the project environment specified.

When you start a new shell or log in, the last project environment saved in $HOME/current.env is loaded. If this file does not exist, the system looks for the existence of $KIDAT/current.env. If that does not exist, the system takes the Keithley defaults using the tree off of $KIHOME.

The make_project and select_project scripts are located in the $KIBIN directory. They are C-Shell scripts and can be modified to add additional environment variables and capabilities. For example, you can add other project specific environment variables for use in project specific KULT functions, as shown below:

Add the following to the $KIDAT/development_project.env file:

```
setenv MY_ENV_STRING ">>> development shell"
```

Add the following to the KIDAT/production_project.env file:

```
setenv MY_ENV_STRING ">>> production shell"
```

Now a KULT function can use this environment variable and determine the project and adjust behavior based upon this information. For example:

```
printf("This is the %s\n",getenv("MY_ENV_STRING"));
```

Select tester

The following topics describe how to select the tester.

Setup information

A $KIDAT/kitester.dat file contains a list of the QMO numbers of the testers to which the workstation is permitted to connect. To allow connection to additional testers, modify the $KIDAT/kitester.dat file to include the QMO numbers. You must also create a $KIDAT/acconfig_QMO#.ini file for each QMO listed in the $KIDAT/kitester.dat file.

The select_tester script creates a .ki_define_config file in the user's home directory. This file is then sourced if select_tester is executed interactively. If select_tester is called noninteractively, the you must source ~/.ki_define_config so that the Keithley Test Environment (KTE) is configured correctly.

select_tester script

The `select_tester` routine enables the operator to specify to which tester the KTE toolset will connect. A `$KIDAT/kitester.dat` file contains a list of the QMO numbers of the testers the workstation is permitted to connect with. This file is accessed by the `select_tester` script and the list of available testers is shown. The operator can then choose the tester from the list, or accept the currently selected tester if shown (sample display).

This script can be executed interactively or integrated into a `.cshrc` file for automatic tester selection at login.

Interactive execution:

```
prompt> source select_tester
```

or

```
prompt> select
```

No parameters are permitted. Tester selections are interactive. `select` is an alias for source `${KIBIN}/select_tester`.

Noninteractive execution:

```
prompt> select_tester 2
```

A parameter is permitted to specify tester, but the `~/.ki_define_config` execution will have no effect.

To use from the `.cshrc` file, include after source `~/.kth_startup`.

Example:

```
source ~/.kth_startup
select_tester 2
source ~/.ki_define_config
```

Sample display

The following example display shows `select_tester` being executed with the operator choosing the current tester, QMO 4001.

```
prompt>source select_tester
-------------------------------------------
Keithley S530 System Selection Utility:
-------------------------------------------
Number    QMO    System Name
----------       --------     -------------------------
   -->      1    - 4001 Tester1Nice Name
            2    - 4002 Tester2Nice Name
            3    - 4003 Tester3Nice Name
           99    - Debug Tester
            0    - Exit
    Enter Number: [1]
Configuring Environment for QMO:4001 - Tester1Nice Name
   prompt>
-----------------------------------------------------------------------------
```

Selecting tester 99, the debug tester, will use the fake prober. You do not control an actual tester or prober.

The `select_tester` script creates a `.ki_define_config` file your home directory. This file is then sourced (if in interactive mode) to initialize the proper environment variables based upon the tester selected.

.ki_define_config

The `select_tester` script creates a `.ki_define_config` file your home directory. This file is then sourced (if in interactive mode) to initialize the proper environment variables based upon the tester selected.

S530 environment variables

The following environment variables are defined by `select_tester` that allow the Keithley Test Environment (KTE) toolset to communicate with the proper tester:

```
setenv KI_CONFIGURATION ${KIDAT}acconfig_$QMO.ini
setenv KI_PRB_CONFIG ${KIDAT}prbcnfg_$QMO.dat
setenv KI_SYSTEM $SystemName
```

Where:

`$QMO` = The QMO of the tester selected by the `select_tester` script.

`$SystemName` = The `SystemName` value found in the `$KIDAT/acconfig_QMO#.ini` file.

ki_setup_$QMO

Additional tester-specific setup can occur using a `$KIHOME/ki_setup_$QMO` file. This file, if it exists for a particular QMO number, is also sourced so that additional environment variables or other customizations can be initialized.

kitester.dat

The following sample `kitester.dat` file allows the workstation to connect to testers with QMO numbers 4002, 4003, and 4010.

```
#
# QMO numbers of testers accessible by this workstation account
# Modify this file as necessary to allow/disallow access to testers
# Only the QMO number is necessary.
#
# There MUST be a acconfig_nnnn.ini file for each QMO number listed!!!
#
# example:
#4001
4002
4003
4010
```

System customization

The following topics discuss system customization.

Logging in to the workstation

The Keithley Test Environment (KTE) system ships with four default user accounts installed:

- **System Administrator:** This account is for the person responsible for overall operation of the system and workstation. The system manager typically performs system backups, generates new accounts for users, installs software upgrades, and maintains the Linux® environment.
- **Test System Manager:** This account is for the person responsible for maintaining files on the system. In many environments, the System Administrator and Test System Manager roles are assigned to the same person.
- **Test Engineer/Programmer:** This account is for the engineers writing parametric test plans. This account has the access privileges required to create, modify, and run test plans.
- **Test Station Operator:** This account is for anyone responsible for operating a wafer prober, running test plans, or other application programs.

These four accounts are summarized in the following table.

Type of account	Log-in name	Password	Log-in directory
System Administration	`root`	`keithley`	`/`
Test System Management	`kthmgr`	`kthmgr`	`/export/home/kthmgr`
Test Program Development	`kthprg`	`kthprg`	`/export/home/kthprg`
Operators Login	`kthopr`	`kthopr`	`/export/home/kthopr`

You can customize your system to change the level of access for each type of account by modifying the log-in directory to limit or expand access as required. You can also change the access password for each account.

Configuring the tool.tpi file

The `tool.tpi` file is the main configuration for the Keithley Tool Palette (KTP) and contains the names of all of the other files needed to access the tools available from the KTP.

The `tool.tpi` file has four major categories to be defined:

- Keithley-Tools
- Unix-Tools
- Unix Administration
- User Programs

These categories correspond to the icon sets available in the KTP. All four categories use the same configuration scheme.

The first line of each category within the `tool.tpi` file is defined by the category name enclosed by less than (<) and greater than (>) symbols. The following paragraphs describe the contents for one entry within a category:

```
ICON#=iconfile,scriptfile,infofile,terminal,warning
```

Where:

- `#` = The number of the icon in the KTP. Icons are numbered sequentially, starting at 1.
- `iconfile` = The bitmap icon filename.
- `scriptfile` is the file containing the command to be executed. An example is provided below:

```
<KTP>
COMMAND=(the full pathname of the program to start)
DESCRIBE=(a line description of the program)
```

- `infofile` = The file you create that contains help text for the program. The help file is read as an ASCII file and can be created with any text editor.
- `terminal` = The flag that specifies whether the program needs to be started in its own terminal window. Programs that do not require terminal windows are those that have their own graphical user interface, such as the Keithley Interactive Test Tool (KITT). The valid entries for this input are `Y` for yes and `N` for no.
- `warning` = The flag that specifies whether you should be warned before executing the program. The valid entries for this input are `Y` for yes and `N` for no.

All of the required script files (file type `.src`) must reside in the `$KIDAT/` directory.

When you put all of this together, you get an entry in your `tools.ini` file that looks like this:

```
<KEITHLEY-TOOLS>
ICON1=kitt.ico,kitt.src,kitt.inf,N,N
```

You can modify the programs that are activated from one of the major categories by adding the correct definition for your additional tool. Ensure that the required files are located in the proper directories.

Here is an example of the `tool.tpi` file:

```
<Keithley-Tools>
ICON1=config.ico,config.scr,config.inf,Y,N
ICON2=diags.ico,diags.scr,diags.inf,Y,Y
ICON3=ksu.ico,ksu.inf,N,N
ICON4=download.ico,download.scr,download.inf,Y,Y
ICON5=kitt.ico,kitt.src,kitt.inf,N,N
ICON6=limitx.ico,limitx.scr,limitx.inf,N,N
ICON7=ktpm.ico,ktpm.scr,ktpm.inf,N,N
ICON8=wdu.ico,wdu.scr,wdu.inf,N,N
ICON9=kop.ico,kop.scr,kop.inf,N,N
ICON10=koped.ico,koped.scr,koped.inf,N,N
ICON11=kult.ico,kult.scr,kult.inf,N,N
ICON12=kcat.ico,kcat.scr,kcat.inf,N,N

<Unix-Tools>
ICON1=terminal.ci,terminal.scr,terminal.inf,N,N
ICON2=textedit.ico,textedit.scr,textedit.inbf,N,N
ICON4=calendar.ico,calendar.scr,calendar.inf,N,N
ICON5=clock.ico,clock.scr,clock.inf,N,N
ICON6=mail.ico,mail.scr,mail.inf,N,N

<Unix Administration>
ICON1=xman.ico,xman.scr,xman.inf,N,N

<User Programs>
ICON1=user.ico,user.scr,user.inf,N,N
```

Here is an example of the script file for KITT:

```
<KTP>
COMMAND=kitt
DESCRIBE=StartstheKeithleyInterativeTestTool.
```

System integration

To simplify integrating the Keithley Test Environment (KTE) system into your testing environment, Keithley has developed a series of test libraries that contain commands used during test plan generation, commonly used test procedures, system prober commands, commands used to control and monitor testing, and commands used to handle and store test data. The following paragraphs discuss these different libraries and provide information on test data handling.

Linear Parametric Test Library

The Linear Parametric Test Library (LPTLib) is a high-speed data acquisition and instrument control software system. It is the lowest level of command interface to the systems instrumentation. This library contains commands to program the system instrumentation for parametric testing. Access to this library is available through the Keithley Interactive Test Tool (KITT) and the Keithley User Library Tool (KULT). For more information about the commands, refer to the Linear Parametric Test Library (LPTLib) User's Manual.

Parametric Test Library

The S530 Test Subroutine Library (PARLib) is a collection of standard parametric tests. They can be included in test macros created in the Keithley Interactive Test Tool (KITT) and the Keithley User Library Tool (KULT). These common test procedures have been simplified to avoid repetitious entry of test calls. You only need to fill in the pertinent data for each call. For more information about the PARLib commands, see the Parametric Test Library (PARLib) User's Manual.

Keithley Data Files library

The Keithley Data Files (KDF) library is a series of routines to organize and save parametric test data into simple ASCII data files. KDF is discussed further in Keithley Data Files Library (on page A-1).

Keithley User Interface library

The Keithley User Interface (KUI) library contains a series of subroutines that support the creation of user interface dialogs for your test programs. Using KUI, you can control and monitor test activities during the test process. For more information about the KUI subroutines, refer to Keithley User Interface Library (on page B-1).

Appendix A

Keithley Data Files Library

In this appendix:

Test data logging

The following paragraphs describe control and handling of the test data.

Keithley Data Files (KDF) library

The Keithley Data Files (KDF) library is a set of routines to organize and save parametric test data into simple ASCII data files. The following paragraphs discuss the `.kdf` file and how to control the output of this data once it has been stored.

KDF does not make use of any special environment variables. It does use the Keithley initialization file, `kth.ini`, to define the directory used to store and retrieve data files. By default, all data files are created in the `$KIHOME/db` directory. You can modify this by changing the `kth.ini` file.

All programs that contain KDF library commands must include the `kdf.h` header file, located in the `$KIINCLUDE` directory. This file declares the functions and allows the ANSI-C compiler to validate calling arguments. The proper way to declare a KDF function is:

```
#include "kdf.h"
```

File structure

A Keithley Data File (KDF) is stored as a tagged ASCII file. The lot level header information varies in length and is terminated by the <EOH> symbol. It is followed by one or more wafer blocks, each of which is terminated with the <EOW> symbol. Each wafer block is made up of one or more site blocks, each of which contains the result data for a single site. A site block within a wafer block is terminated by the <EOS> symbol. Refer to the example in the following table.

KDF output description file

Data file record	Description of data
`TYP,KDFV1.0`	Identifies the file as a valid V1.0KDF Data File
`LOT,test1`	Lot ID="test1.kdf"
`PRC,CMOS`	Process="CMOS"
`DEV,TNG-121`	Device="TNG-121"
`TST,Test1`	Test name="Test1"
`TSN,1`	Test Station Number=1
`LMT,limits`	Limits Filename="limits.klf"
`<EOH>`	<End of Header>
`1,,0,0`	Wafer Id = 1
`1,0,0`	Site Id = 1
`1,1.0000e+00`	Tag=1, Value=1.0
`2,3.0000e+00`	Tag=2, Value=3.0
`<EOS>`	<End of sight data>
`<EOW>`	<End of Wafer data>

The lot level header is a variable length structure. Each record in the header section is tagged with the identifiers in the following table.

Optional lot-header parameters

Lot header parameters	KDF tag	Length	Description
`id`	`LOT`	51	50 character lot identification (used for lot name)
`process`	`PRC`	51	50 character process name
`device`	`DEV`	51	50 character device name
`testname`	`TST`	256	255 character test name
`system`	`SYS`	21	20 character system identification
`teststation`	`TSN`	integer	Test station number (1 to 4)
`operator`	`OPR`	31	30 character operator name
`starttime`	`STT`	21	20 character test start time
`stoptime`	`SPT`	21	20 character test completion time
`sk1`	`SK1`	31	30 character User Search Key #1
`sk2`	`SK2`	21	20 character User Search Key #2
`sk3`	`SK3`	11	10 character User Search Key #3
`limitcode`	`LMT`	81	80 character limits filename
`comment`	`COM`	257	256 character user-definable comment

Data logging interfaces

Refer to Data logging routines (on page A-13) for information on the different interfaces used to perform data logging.

Keithley data file storage limits

A summary report of the test results is provided by the Keithley Summary Utility (KSU). This report combines the test results from the `.kdf` file and the assigned limits located in the `.klf` file. When combined into a report, you can see which results met or exceeded the desired limits.

Using limits files

All Parametric Test Results (PTRs) are logged into storage with either the `LogPtr` or `PutParam` commands. Each command logs the result data with an associated result tag.

A limits file associates result tags with result names, units of measurement, and result limits. Use the Keithley Limits File Editor to create new limit files or edit existing ones. Limits files are created with a `.klf` extension, Keithley limit file, and must be located in the same directory as the `.kdf` data files.

Normally there is a single limits file for each of your test programs, but you may decide to create a single master limits file that is shared by all your test programs.

The limits file is only used by the Summary Report Generator. It contains the information required to properly label the individual results and to determine whether the results pass or fail the different validation limits. If the Summary Report Generator is run without a limits file, all validation limits default to ±1E16.

Limits file structure

A limits file is an ASCII file organized into records. Each record consists of 18 attributes that identify and process each measured test result. The following list describes each attribute:

- `ID`, limit record ID tag
- `NAM`, limit record name
- `UNT`, limit record units
- `CAT`, category description
- `RPT`, report option: 1 = use in Summary Report, 0 = ignore
- `CRT`, critical level
- `TAR`, target value of parameter
- `AF`, abort flag setting

- AL, limit abort flag is to be compared to
- VAL, low and high VALID limits
- SPC, low and high SPECIFICATION limits
- CNT, low and high CONTROL limits
- ENG, low and high ENGINEERING limits
- ena, enabled flag (only for adaptive test): 1 = test, 0 = ignore
- cla, class data field
- usr1, user data field
- usr2, user data field
- **usr3**, user data field
- <EOL>, marks end of limit record

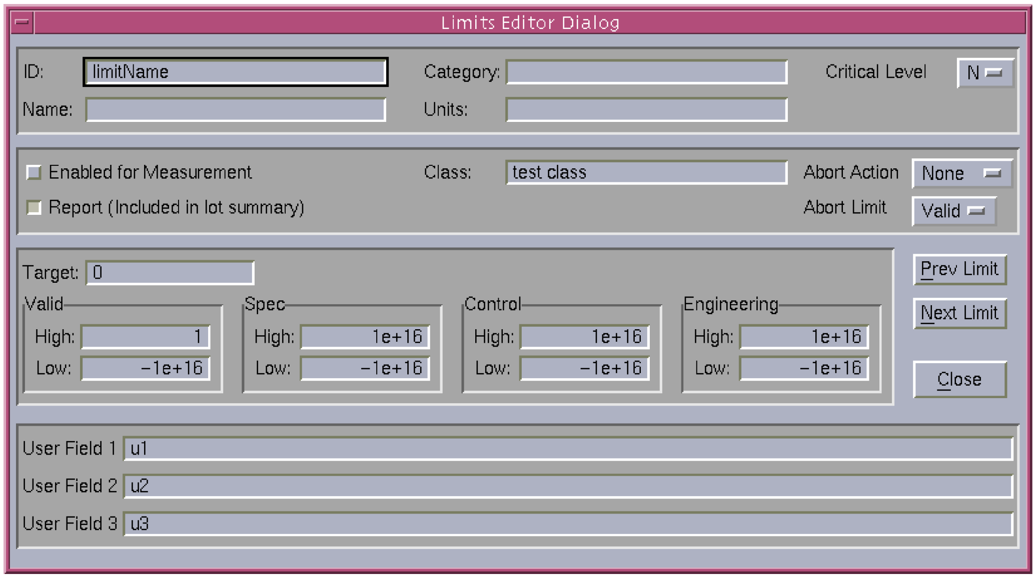
When a limits file is loaded into memory, the cla, usr1, usr2, and usr3 fields contain a NULL pointer, not an empty string, if the data is not defined in the limits file. The NAM, UNT, and CAT fields contain an empty string if the data is not defined in the limits file.

These attributes are repeated for each result ID in the limits file. The following limits file contains the file header and two separate result ID records:

```
Version,1.0
File,/home/kiSys/db/tutor.klf
Date,07/21/1996
Comment,KLF
<EOH>
ID,moda_n13x1_vtati
NAM,moda_n13x1_vtati
UNT,volts
CAT,test
RPT,1
CRT,1
TAR,1.32
AF,N
AL,VAL
VAL,-1.0000e+16, 1.0000
SPC,-1.0000e+16, 1.0000e+16
CNT,-1.0000e+16, 1.0000e+16
ENG,-1.0000e+16, 1.0000e+16
ENA,1
CLA,main
USR1,user 1
USR2,user 2
USR3,user 3
<EOL>
ID,i_res
NAM,ires test
UNT,ohms
CAT,test
RPT,1
CRT,0
TAR,1.000000
AF,SS
AL,SPC
VAL,-1.0000e+20, 1.0000e+21
SPC,-1.0000e+16, 1.0000e+16
CNT,-1.0000e+16, 1.0000e+16
ENG,-1.0000e+16, 1.0000e+16
ENA,1
CLA,main
USR1,user 1
USR2,user 2
USR3,user 3
<EOL>
```

Each result ID record within a limits file can be viewed individually. By selecting **Dialog** from the **View** menu, you can view and modify the currently selected limit in the Limits Editor Dialog window, shown in the following figure.

Figure 82: Limits editor dialog window



Programming examples

The following topics contain programming examples.

Logging data using KDF

The following sample program demonstrates how to log data to a `.kdf` file. It loops through two simulated wafers, each with three sites, and logs two parameters per site. The programs use both of the available data logging interfaces to create the same output file. The final output files are named and displayed after the source code listing.

```
#include <stdio.h>
#include <stdlib.h>
#include "kdf.h"
void main(void)
{
LOT*testlot;
WAFER*testwafer;
SITE*testsite;
PARAM*testparam;
int waferloop,siteloop;
int status;
int total_wafers=2;
int sites_per_wafer=3;
floatvalue;
charwafer_id[4];
charsite_id[4];

/**************** S T A R T  O F  C O D E *****************/
/* Initialize kdf data structures */
testlot = CreateNewLot ();
testwafer = CreateNewWafer();
testsite = CreateNewSite ();
testparam = CreateNewParam();

/* Initialize some of the lot header items */
strcpy (testlot->id, "test1");       /* lot name */
strcpy (testlot->process, "CMOS");   /* process name */
strcpy (testlot->device, "TNG-121"); /* device name */
strcpy (testlot->testname, "Test1"); /* test name */
strcpy (testlot->limitcode, "limits");     /* limits filename */
testlot->teststation=1; /* test station 1 */

/* Actually create the lot file */
status = PutLot(testlot, CREATELOT);
if (status < 0) exit(status);
printf("\n\nStart Test #1\n");

/* Start Testing: Loop through all wafers & sites */
tstsel(1);
for (waferloop = 1;waferloop <= total_wafers;waferloop++)
{
   sprintf(testwafer->id,"%i",waferloop);
   status = PutWafer(testlot,testwafer);
   if (status < 0) exit(status);
   printf("Logging Wafer %i\n", waferloop);

   for (siteloop = 1; siteloop <= sites_per_wafer; siteloop++)
   {
         sprintf(testsite->id,"%i",siteloop);
         status = PutSite(testlot,testwafer,testsite);
         if (status < 0) exit(status);
         printf("\tLogging Site %i\n", siteloop);

         /* calculate the beta*/
         strcpy(testparam->id, "1");
         testparam->value = beta1(1,4,7,-1, 0.5e-3, 2.0, ‘N’);
```

```
          status = PutParam(testlot,testwafer,testsite, testparam);
          if (status < 0) exit(status);

          /* test the capacitance when the bias voltage is 1.0 */
          strcpy(testparam->id, "2");
          testparam->value = cap(3,5,7,1.0);
          status = PutParam(testlot,testwafer,testsite, testparam);
          if (status < 0) exit(status);

          /* Site complete */
          EndSite();

          /* Insert prober code here to move to next site */
}

/* Wafer complete */
EndWafer();
   /* Insert prober code here to move to next site */
}

/* Lot complete. Close data file */
EndLot();

/* Initialize kdf data structures */

status = LogLot("test2", 0, "CMOS", "TNG-121", "Test1", "", "",
"Limits", "", CREATELOT);
if (status <0) printf("Error in LogLot, status %i\n",status);

/* Start Testing: Loop through all wafers & sites */
tstsel(1);
printf("\n\nStart Test #2\n");
for (waferloop = 1;waferloop <= total_wafers;waferloop++)
{

   sprintf(wafer_id,"%i",waferloop);
   status = LogWaf(wafer_id,0);
   if (status <0) printf("Error in LogWaf, status %i\n",status);
   printf("Logging Wafer %i\n", waferloop);

   for (siteloop = 1; siteloop <= sites_per_wafer; siteloop++)
   {
          sprintf(site_id,"%i",siteloop);
          status = LogSit(site_id, 0);
          if (status <0) printf("Error in LogSit, status %i\n",status);
          printf("\tLogging Site %i\n", siteloop);

          /* calculate the beta*/
          value = beta1(1, 4, 7, -1, 0.5e-3, 2.0, ‘N’);
          status = LogPtr(1, value);
          if (status <0) printf("Error in LogPtr, status %i\n",status);
          /* test the capacitance when the bias voltage is 1.0 */
          value = cap(3,5,7,1.0);
          status = LogPtr(2, value);
          if (status <0) printf("Error in LogPtr, status %i\n",status);

          /* Site complete */
```

```
          EndSite();

          /* Insert prober code here to move to next site */
    }

    /* Wafer complete */
    EndWafer();

    /* Insert prober code here to move to next site */
}

/* Lot complete. Close data file */
EndLot();
}
```

The two data files created by this example are shown in the following table.

PUTxxx and LotLog/LogWat/LogSit data files

File created by Putxxx Interface	File created by LogLot/LogWaf/ LogSit Interface	File created by Putxxx Interface	File created by LogLot/LogWaf/ LogSit Interface
TYP,KDFV1.0 LOT,test1 PRC,CMOS DEV,TNG-121 TST,Test1 TSN,1 LMT,limits <EOH> 1,,0,0 1,0,0 1,1.0000e+00 2,3.0000e+00 <EOS> 2,0,0 1,1.0000e+00 2,3.0000e+00 <EOS>	TYP,KDF V1.0 LOT,test2 PRC,CMOS DEV,TNG-121 TST,Test1 TSN,1 LMT,limits <EOH> 1,,0,0 1,0,0 1,1.0000e+00 2,3.0000e+00 <EOS> 2,0,0 1,1.0000e+00 2,3.0000e+00 <EOS>	3,0,0 1,1.0000E+00 2,3.0000E+00 <EOS> <EOW> 2,,0,0 1,0,0 1,1.0000e+00 2,3.0000e+00 <EOS> 2,0,0 1,1.0000e+00 2,3.0000e+00 <EOS> 3,0,0 1,1.0000e+00 2,3.0000e+00 <EOS> <EOW>	3,0,0 1,1.0000E+00 2,3.0000E+00 <EOS> <EOW> 2,,0,0 1,0,0 1,1.0000e+00 2,3.0000e+00 <EOS> 2,0,0 1,1.0000e+00 2,3.0000e+00 <EOS> 3,0,0 1,1.0000e+00 2,3.0000e+00 <EOS> <EOW>

The resulting summary report is shown below:

```
   Lot Summary Report KDF V1.0
Lot : test1       Operator     :
Process   : CMOS Starttime     :
Device    :TNG-121     System :
Testname  : Test1      Teststation   : 1 Limits File: limits
#Wafers   :      2
#Sites    :      6
```

Name units	SpecL	SpecH	Mean	Min	Max	SDEV	%SDEV	CNT	%Vld	%Spec
1	-1.00e+15	1.00e+15	1.00e+00	1.00e+00	0.00e+00	0.00e+00	0.0	6	100.0	100.0
2	-1.00e+15	1.00e+15	3.00e+00	3.00e+00	3.00e+00	0.00e+00	0.0	6	100.0	100.0

Data retrieval using KDF

The following sample program demonstrates how to read data from a `.kdf` file. The program attempts to read all of the data from `test1.kdf` (created in the previous example) and display the results on the screen.

```
#include <stdio.h>
#include <stdlib.h>
#include "kdferr.h"
#include "kdf.h"

void main(void)
{
LOT *searchlot,*gotlot;
WAFER     *searchwafer,*gotwafer;
SITE      *searchsite,*gotsite;
PARAM     *searchparam,*gotparam;

int waferloop,siteloop;
int status;

/************ START DATA RETRIEVAL *****************/
searchlot = CreateNewLot();
gotlot = CreateNewLot();

/* Retrieve all the data from lot test1.kdf */
strcpy(searchlot->id, "test1");
GetLot(searchlot, gotlot);

/* Get all the wafers in the lot */
searchwafer = CreateNewWafer();
gotwafer = CreateNewWafer();
strcpy(searchwafer->id, "*");
GetWafer(gotlot, searchwafer, gotwafer);

while (gotwafer != NULL)
{
   printf("\tWafer %s\n", gotwafer->id);
   searchsite = CreateNewSite();
   gotsite = CreateNewSite();
   /* Get all the sites in this wafer */
   strcpy(searchsite->id, "*");
   GetSite(gotlot, gotwafer, searchsite, gotsite);

   while (gotsite != NULL)
   {
          printf("\t\tSite %s\n", gotsite->id);
          searchparam = CreateNewParam();
          gotparam = CreateNewParam();
          /* Get all the parameters in this site */
          strcpy(searchparam->id, "*");
          GetParam(gotlot, gotwafer, gotsite, searchparam, gotparam);

          while (gotparam != NULL)
          {
```

```
                printf("\t\t\tId, Value = %s, %e\n", gotparam->id, gotparam-
   >value);
                gotparam = FindNextParam(gotparam);
          }

          gotsite = FindNextSite(gotsite);
   }
   gotwafer = FindNextWafer(gotwafer);
}
/************* CLEANING UP MEMORY ****************/

RemoveParam(searchparam);
RemoveSite (searchsite);
RemoveWafer(searchwafer);
RemoveLot (searchlot);
RemoveLot (gotlot);

while (gotwafer != NULL)
gotwafer = RemoveWafer(gotwafer);

while (gotsite != NULL)
gotsite = RemoveSite(gotsite);

while (gotparam != NULL)
gotparam = RemoveParam(gotparam);
}
```

The resulting output is:

```
Wafer 1
   Site 1
          Id, Value = 1, 1.000000e+00
          Id, Value = 2, 3.000000e+00
   Site 2
          Id, Value = 1, 1.000000e+00
          Id, Value = 2, 3.000000e+00
   Site 3
          Id, Value = 1, 1.000000e+00
          Id, Value = 2, 3.000000e+00
Wafer 2
   Site 1
          Id, Value = 1, 1.000000e+00
          Id, Value = 2, 3.000000e+00
   Site 2
          Id, Value = 1, 1.000000e+00
          Id, Value = 2, 3.000000e+00
   Site 3
          Id, Value = 1, 1.000000e+00
          Id, Value = 2, 3.000000e+00
```

Data logging routines

Descriptions of the data logging routines are in the following topics.

PutLot

This routine will log the header information to the DB or FF. Lotadd is used to either append (Lotadd = APPENDLOT), create new (Lotadd = CREATELOT), or to replace an existing lot (Lotadd = CREATELOT). Opens a file, writes to it, and then closes it.

Usage

```
Status = PutLot(*LotStruct, Lotadd)
```

LOT *LotStruct	The lot where data is logged
int Lotadd	Can be set to either CREATELOT or APPENDLOT; determines what will happen if a lot file already exists

Details

You cannot use the * or the ? characters in the Lot structure fields because they are the wildcard characters. Use of these characters will result in an error.

The Lot ID will be used as the lot filename, with the .kdf extension added.

PutLot logs all the data up to and including the <EOH> marker.

If a lot file already exists, it will be renamed from a .kdf extension to a .kd% extension.

Example

```
strcpy (testlot->id, "test1");
strcpy (testlot->testname, "Voltage 1");
GetStartTime(testlot->starttime);

/* Start the logging of the new lot "test1". The lot has 3 wafers and 10
sites to be logged.
*/
status = PutLot(testlot, CREATELOT);
if (status < 0)
return(status);
```

Full code can be found in sample program 1.

PutWafer

This routine will log the information in the Wafer Structure to the DB or FF for a specific instance of a lot. Opens a file, writes to it, and then closes it. Must be followed at some point by `EndWafer`.

Usage

`Status = PutWafer(*LotStruct, *WafStruct)`

`LOT *LotStruct`	The lot where data is logged
`WAFER *WafStruct`	The wafer to log to the lot

Details

After a call to `PutWafer`, you must make a call to `EndWafer` before calling `PutWafer` again.

You cannot use the `*` or the `?` characters in the wafer structure fields because they are the wildcard characters. Use of these characters will result in an error.

Example

```
for (waferloop = 1;waferloop <= 3;waferloop++)
{
sprintf(testwafer->id,"%i",waferloop);
status = PutWafer(testlot,testwafer);
if (status < 0)
return(status);
```

Full code can be found in sample program 1.

PutSite

This routine will log the information contained in the Site Structure to the DB or FF for a specific instance of a lot and wafer. Opens a file, writes to it, and then leaves it open for parameter data. Must be followed at some point by an `EndSite`.

Usage

`status = PutSite(*LotStruct, *WafStruct, *SiteStruct)`

`LOT *LotStruct`	The lot where data is logged
`WAFER *WafStruct`	The wafer to log to the lot
`SITE *SiteStruct`	The site to log to the lot

Details

After a call to `PutSite`, you must make a call to `EndSite` before calling `PutSite` again.

You cannot use the `*` or the `?` characters in the site structure fields because they are the wildcard characters. Use of these characters will result in an error.

Example

```
for (siteloop = 1; siteloop <= 10; siteloop++)
{
sprintf(testsite->id,"%i",siteloop);
status = PutSite(testlot,testwafer,testsite);
if (status < 0)
return(status);
```

Full code can be found in sample program 1.

PutParam

This routine will log the information contained in the Param Structure to the DB or FF for a specific instance of a lot, wafer, and site. Writes to the already open file.

Usage

`Status = PutParam(*LotStruct, *WafStruct, *SiteStruct,*ParamStruct)`

`LOT *LotStruct`	The lot where data is logged
`WAFER *WafStruct`	The wafer to log to the lot
`SITE *SiteStruct`	The site to log to the lot
`PARAM *ParamStruct`	The parameter to log to the lot

Details

You cannot use the `*` or the ? characters in the Param structure fields because they are the wildcard characters. Use of these characters will result in an error.

`EndSite` should be called after the last parameter for the current site is logged.

Example

```
strcpy(testparam->id, "beta1");
/* calculate the beta*/
testparam->value = beta1(1, 4, 7, -1, 0.5e-3, 2.0, 'N');
status = PutParam(testlot,testwafer,testsite,testparam);
if (status < 0)
return(status);
```

Full code can be found in sample program 1.

PutParamList

This routine will log a list of `param` Structures to the `DB` or `FF` for a specific instance of a lot, wafer, and site. The next pointer set to NULL will signify the end of the list to be logged.

Usage

```
Status = PutParamList(*LotStruct, *WafStruct, *SiteStruct, *Param)
```

`LOT *LotStruct`	The lot where data is logged
`WAFER *WafStruct`	The wafer to log to the lot
`SITE *SiteStruct`	The site to log to the lot
`PARAM *ParamStruct`	The linked list of parameters to log to the lot

Details

`PutParamList` makes a series of calls to `PutParam` as it traverses the linked list, so it has the same rules as `PutParam`.

After calling `PutParamList`, remember to free up the memory from the list (use a while loop with `RemoveParam`).

Example

```
testparam=CreateNewParam();
strcpy(testparam->id, "Volts 1e-2");
/* voltagetest is an example test routine that would return a voltage */
testparam->value = voltagetest(1e-2);

new=CreateNewParam();

strcpy(new->id, "Volts 1e-1");
/* voltagetest is an example test routine that would return a voltage */
testparam->value = voltagetest(1e-1);
/* Add current into the list following testparam */
AddNewParam(testparam,new);
testparam = FindNextParam(testparam);
new = CreateNewParam();

strcpy(new->id, "Volts 1");
/* voltagetest is an example test routine that would return a voltage */
testparam->value = voltagetest(1);
/* Add current into the list following testparam */
AddNewParam(testparam,new);

/* Go to the first param in the list to get ready for PutParamList */
testparam=FindFirstParam(testparam);
PutParamList(testlot,testwafer,testsite,testparam);
```

Full code can be found in sample program 2.

EndLot

This routine ends the logging of the current lot. It must be called before another lot can be logged.

Usage

```
status = EndLot()
```

Details

`EndLot` must be called before `PutLot` can be called again, otherwise an error is generated.

The end of the lot is signified by the end of the lot file.

EndWafer

This routine ends the logging of the current wafer. It must be called after a call to `PutWafer`.

Usage

```
status = EndWafer()
```

Details

`EndWafer` must be called before `PutWafer` can be called again, otherwise an error is generated.

`EndWafer` writes the `<EOW>` marker to the file.

EndSite

This routine ends the logging of the current site. It must be called after a call to `PutSite`.

Usage

```
status = EndSite()
```

Details

`EndSite` must be called before `PutSite` can be called again, otherwise an error is generated.

`EndSite` writes the `<EOS>` marker to the file.

GetLot

This routine returns a NULL terminated list of lots, starting with `LotStructGot`, that match the criteria specified in `LotStructWanted`. The `LotStructGot` pointer should already point to a structure when the routine is called (for example, `LotStructGot = CreateNewLot`). Wildcards are supported in the wanted structure. Wildcards cannot be entered in the integer fields (a value of zero in an integer position is the same as `*`).

Usage

```
Status = GetLot(*LotStructWanted,*LotStructGot)
```

`LOT *LotStructWanted`	Lot structure containing the information on the lot to be retrieved. It can be very general (using wildcards) or very specific
`LOT *LotStructGot`	Lot structure to which the found data is returned. It must be an allocated structure when it is sent to `GetLot`

Details

NOTE

The Lot ID is the only required field.

Using wildcards may cause a noticeable decrease in performance in a directory with many files.

If the status returned is greater than or equal to zero, then it is the number of lots found. If it is less than zero, it is an error code.

Example

```
gotlot = CreateNewLot();

strcpy(testlot->id, "test1");
/* Retrieve all the data that was just logged */
GetLot(testlot, gotlot);
```

Full code can be found in sample program 1.

GetWafer

This routine returns a NULL terminated list of wafers, starting with `WaferStructGot`, that match the criteria specified in `WafStructWanted` for the specific (single) `LotStruct`. Wildcards are supported in the wanted structure. The `WafStructGot` pointer should already point to a structure when the routine is called (for example, `WafStructGot = CreateNewWafer`). Wildcards are not supported for the integer fields (a value of zero in an integer position is the same as `*`). If an empty (NULL) wanted structure is passed in, the routine will return all wafers in the specified lot.

Usage

```
Status = GetWafer(*LotStruct, *WafStructWanted,*WaferStructGot)
```

`LOT *LotStruct`	The specific lot in which the wafer should be found
`WAFER *WaferStructWanted`	Wafer structure containing the information on the wafer to be retrieved. It can be very general (using wildcards) or very specific
`WAFER *WaferStructGot`	Wafer structure to which the found data is returned. It must be an allocated structure when it is sent to `GetWafer`

Details

If the status returned is greater than or equal to zero, then it is the number of wafers found. If it is less than zero, it is an error code. The wanted structure must contain a valid string or wildcard for the `"id"` and `"split"` string items. A null string in either of these string items will not return a match.

Example

```
gotwafer = CreateNewWafer();

/* Get all the wafers in the lot */
strcpy(testwafer->id, "*");
GetWafer(gotlot, testwafer, gotwafer);
```

Full code can be found in sample program 1.

GetSite

This routine returns a NULL terminated list of sites, starting with `*SiteStructGot`, that match the criteria specified in `SiteStructWanted` for the specific (single) `LotStruct` and `WafStruct`. The `SiteStructGot` pointer should already point to a structure when the routine is called (for example, `SiteStructGot = CreateNewSite`). Wildcards are supported in the wanted structure. Wildcards are not supported for the integer fields (a value of zero in an integer position is the same as `*`).

Usage

```
Status = GetSite(*LotStruct, *WafStruct, *SiteStructWanted, *SiteStructGot)
```

`LOT *LotStruct`	The specific lot in which the wafer should be found
`WAFER *WaferStruct`	The specific wafer in which the site should be found
`SITE *SiteStructWanted`	Site structure containing the information on the site to be retrieved. It can be very general (using wildcards) or very specific
`SITE *SiteStructGot`	Site structure to which the found data is returned. It must be an allocated structure when it is sent to GetSite

Details

If the status returned is greater than or equal to zero, then it is the number of sites found. If it is less than zero, it is an error code.

Example

```
gotsite = CreateNewSite();

/* Get all the sites in this wafer */
strcpy(testsite->id, "*");
GetSite(gotlot, gotwafer, testsite, gotsite);
```

Full code can be found in sample program 1.

GetParam

This routine returns a NULL terminated list of parameters, starting with the `*ParamStructGot`, that match the criteria specified in `ParamStructWanted` for the specific (single) `LotStruct`, `WafStruct`, and `SiteStruct`. The `ParamStructGot` pointer should already point to a structure when the routine is called (for example, `ParamStructGot = CreateNewParam`). Wildcards are supported in the wanted structure. Wildcards are not supported for the integer fields (a value of zero in an integer position is the same as `*`).

Usage

```
Status = GetParam(*LotStruct, *WafStruct, *SiteStruct, *ParamStructWanted,
   *ParamStructGot)
```

`LOT *LotStruct`	The specific lot in which the wafer should be found
`WAFER *WaferStruct`	The specific wafer in which the site should be found
`SITE *SiteStruct`	The specific site in which the param should be found.
`PARAM *ParamStructWanted`	Parameter structure containing information on the parameter to be retrieved; it can be very general (using wildcards) or very specific
`PARAM *ParamStructGot`	Parameter structure to which the found data is returned. It must be an allocated structure when it is sent to `GetParam`

Details

If the status returned is greater than or equal to zero, then it is the number of parameters found. If it is less than zero, it is an error code.

Example

```
gotparam = CreateNewParam();

/* Get all the parameters in this site */
strcpy(testparam->id, "*");
GetParam(gotlot, gotwafer, gotsite, testparam, gotparam);
```

Full code can be found in sample program 1.

GetParamList

This routine returns a NULL terminated list of parameters to `*ParamStruct` that are included in the `*ParamStructList` list. Wildcards are supported at the parameter level.

Usage

```
Status = GetParamList(*LotStruct,  *WafStruct, *SiteStruct, *ParamStructList,
    *ParamStruct)
```

`LOT *LotStruct`	The specific lot in which the wafer should be found
`WAFER *WaferStruct`	The specific wafer in which the site should be found
`SITE *SiteStruct`	The specific site in which the param should be found
`PARAM *ParamStructList`	List of parameter structures to be retrieved. Each parameter in the list can be very general (using wildcards) or very specific
`PARAM *ParamStruct`	Head of the list of parameter structures to which the found data is returned. It must be an allocated structure when it is sent to `GetParamList`

Details

If the status returned is greater than or equal to zero, then it is the number of parameters found. If it is less than zero, it is an error code.

GetLotData

This routine returns a tree structure of all the wafers, sites, and parameters in `LotWanted`. The returned list begins with the next field of the lot structure sent to the function.

Usage

```
Status = GetLotData (*LotWanted)
```

`LOT *LotWanted`	Put the specific lot data that you want to find in this structure and the found lot will be returned in the `LotWanted->next` field

Details

The data is returned in `LotWanted->next`. Then the data follows a tree structure from there.

`LotWanted->wafers` points to the first wafer in the lot.

`LotWanted->wafers->sites` points to the first site in the first wafer.

`LotWanted->wafers->sites->params` points to the first parameter in the first site of the first wafer.

Wildcards are not supported.

Example

```
gotlot = CreateNewLot();

strcpy(gotlot->id, "test1");
/* Retrieve all the data that was just logged */
GetLotData(gotlot);
```

Full code can be found in sample program 1.

MatchParam2Limit

This routine takes the list of parameters and matches them to the corresponding limit codes. Each parameter points to its corresponding limit code and each limit points back to the parameter. If no match is found for a parameter, the pointer is set to NULL.

Usage

```
Status = MatchParam2Limit(*ParamList, *LimitList)
```

`PARAM *ParamList`	List of parameters
`LIMIT *LimitList`	List of limits to match to the above parameters

FileExist

Checks for the existence of a file in the current data directory (where the lot files are being stored). Returns TRUE (`1`) if the file is in the directory, FALSE (`0`) if the file is not in the directory.

Usage

```
Status = FileExist(filename)
```

`char filename[]`	Name of the file to find

Details

The current data directory is determined by the value in the `kth.ini` file after `"Datapath="`.

LotExist

Checks for the existence of a lot file in the current data directory. Returns TRUE (1) if the lot is in the directory, FALSE (0) if the lot is not in the directory.

Usage

```
Status = LotExist(*LotStruct)
```

LOT *LotStruct	The lot structure containing the information to be found

Details

The current data directory is determined by the value in the kth.ini file after "Datapath=".

GetStartTime

Returns a time and date string in the format "DD-MM-YYYY hh:mm" where DD=day, MM=month, YYYY=year, hh=hour, and mm=minutes.

Usage

```
GetStartTime(timestring)
```

char timestring[]	String to which the current time is returned; must be at least 20 characters

DeleteLot

This routine will delete all lot associated data for the specified lot structure. All Lots in the NULL terminated linked list will be deleted. The DeleteLot routine is responsible for ensuring referential integrity.

Usage

```
Status = DeleteLot(*LotStruct)
```

LOT *LotStruct	The lot or linked list of lots to be deleted

Details

Wildcard deletes are not allowed.

When a lot is deleted, the lot is renamed from the .kdf extension to a .kd% extension.

DeleteWafer

This routine will delete all wafer information for the specified lot and wafer. All wafers for the NULL terminated linked list wafers will be deleted. Wildcards are not allowed in either structure.

Usage

`Status = DeleteWafer(*LotStruct, *WafStruct)`

`LOT *LotStruct`	The lot that contains the wafer to be deleted
`WAFER *WafStruct`	The wafer or linked list of wafers to be deleted.

Details

Wildcard deletes are not allowed.

When a wafer is deleted, the lot is renamed from the `.kdf` extension to a `.kd%` extension.

DeleteSite

This routine will delete all site information for the specified lot, wafer, and site. All sites for the NULL terminated linked list of sites will be deleted. Wildcards are not allowed in any of the structures.

Usage

`Status = DeleteSite(*LotStruct, *WafStruct, *SiteStruct)`

`LOT *LotStruct`	The lot that contains the wafer to be deleted
`WAFER *WafStruct`	The wafer that contains the site to be deleted
`SITE *SiteStruct`	The site or linked list of sites to be deleted

Details

Wildcard deletes are not allowed.

When a site is deleted, the lot is renamed from the `.kdf` extension to a `.kd%` extension.

DeleteParam

This routine will delete the parameter information for the specified lot, wafer, site, and parameter. All parameters for the NULL terminated linked list of parameters will be deleted. Wildcards are not allowed in any of the structures.

Usage

```
Status = DeleteParam(*LotStruct, *WafStruct, *SiteStruct, *ParamStruct)
```

`LOT *LotStruct`	The lot that contains the wafer to be deleted
`WAFER *WafStruct`	The wafer that contains the site to be deleted
`SITE *SiteStruct`	The site that contains the parameter to be deleted
`PARAM *ParamStruct`	The parameter or linked list of parameters to be deleted

Details

Wildcard deletes are not allowed.

When a parameter is deleted, the lot is renamed from the `.kdf` extension to a `.kd%` extension.

DeleteLimitCode

This routine is used to delete entire sets of limits defined by a limit code. All limits specified in the NULL terminated list of limit codes will be deleted.

Usage

```
Status = DeleteLimitCode(*LimitcodeStruct)
```

`LIMITCODE *LimitcodeStruct`	The limit code or linked list of limit codes to be deleted

Details

Wildcard deletes are not allowed.

Limit code information is used to generate the limits filename.

When a limit code is deleted, the lot is renamed from the `.klf` extension to a `.kl%` extension.

DeleteLimit

This routine is used to delete limit records from the DB. All limits specified in the NULL terminated list of limits will be deleted.

Usage

```
Status = DeleteLimit(*LimitcodeStruct, *LimitStruct)
```

`LIMITCODE *LimitcodeStruct`	The limit code containing the limit to be deleted
`LIMIT *LimitStruct`	The limit or linked list of limits to be deleted

Update comment routines

The following topics describe the update comment routines.

GetComment

This routine will fetch the comment from the `.kdf` file for a specific lot occurrence.

Usage

```
Status = GetComment(*LotStruct, comment)
```

`LOT *LotStruct`	The lot to retrieve the comment from
`char comment[]`	The string where the comment is returned

PutComment

This routine will overwrite the comment in the `.kdf` file for a specific lot occurrence.

Usage

```
Status = PutComment(*LotStruct, comment[])
```

`LOT *LotStruct`	The lot where the comment is to be changed
`char comment[]`	The string sent to be logged as the new comment

Update limits routines

The following topics describe the update limits routines.

GetLimitCode

This routine will fetch a list of limit codes that match the criteria specified in the wanted structure.

Usage

```
Status = GetLimitCode(*LimitcodeStructwanted, *LimitcodeStructlist)
```

`LIMITCODE *LimitcodeStructwanted`	The limit code information to search for in the logging directory
`LIMITCODE *LimitcodeStructlist`	The returned list of limit codes that were found in the search

Details

Limit code information is used to generate the limits filename.

Wildcards can be used in the `*LimitcodeStructwanted` structure.

The return value is the number of limit codes found or an error value if it is less than zero.

GetLimit

This routine will fetch a NULL terminated linked list of limit structures with the specified limit code and limit information. The head of the linked list of limits is returned in both the `*LimitStruct` and in the `LimitcodeStruct->limits` fields.

Usage

```
Status = GetLimit(*LimitcodeStruct, *LimitStruct)
```

`LIMITCODE *LimitcodeStructwanted`	The limit code to retrieve the limits from
`LIMIT *LimitStruct`	The returned list of limits that were found in the limit code

Details

Limit code information is used to generate the limits filename.

The return value is the number of limits found or an error value if it is less than zero.

PutLimit

This routine will write a list of limits to the `DB` or `FF` for the limit code specified. If the limit code already exists, the new limits will overwrite and append.

Usage

```
Status = PutLimit(*LimitcodeStruct, *LimitStruct)
```

`LIMITCODE *LimitcodeStructwanted`	The limit code to log the limits to
`LIMIT *LimitStruct`	The list of limits to log to the limit code

Details

If the limit code already exists, it will be renamed from a `.klf` extension to a `.kl%` extension.

Structure handling routines

There is a version of each of the structure handling routines for every structure (`LOT`, `WAFER`, `SITE`, `PARAM`, and `LIMITCODE`).

AddNew[STRUCTURE]

This routine adds `new` to the list following `current`. There is a version of each of the structure handling routines for every structure (LOT, WAFER, SITE, PARAM, and LIMITCODE).

Usage

```
AddNewLimitCode(*current, *new)
AddNewLot(*current, *new)
AddNewWafer(*current, *new)
AddNewSite(*current, *new)
AddNewParam(*current, *new)
```

`LIMITCODE *current`	Pointer to the current limit code
`LOT *current`	Pointer to the current lot
`WAFER *current`	Pointer to the current wafer
`SITE *current`	Pointer to the current site
`PARAM *current`	Pointer to the current parameter
`LIMITCODE *new`	The new limit code to be added
`LOT *new`	The new lot to be added
`WAFER *new`	The new wafer to be added
`SITE *new`	The new site to be added
`PARAM *new`	The new param to be added

Example

```
LIMITCODE *current, *new;
AddNewLimitCode(current, new);
```

CreateNew[STRUCTURE]

This routine allocates the memory for and returns a pointer to the new LIMIT CODE, LOT, WAFER, SITE, or PARAM.

Usage

```
LimitCodePtr = CreateNewLmtCode()
LotPtr = CreateNewLot()
WaferPtr = CreateNewWafer()
SitePtr = CreateNewSite()
ParamPtr = CreateNewParam()
```

`LIMITCODE *LimitCodePtr`	Pointer to a limit code structure
`LOT *LotPtr`	Pointer to a lot structure
`WAFER *WaferPtr`	Pointer to a wafer structure
`SITE *SitePtr`	Pointer to a site structure
`PARAM *ParamPtr`	Pointer to a parameter structure

Details

This routine must be called before performing operations with `LimitCodePtr`, `LotPtr`, `WaferPtr`, `SitePtr`, or `ParamPtr`.

Example

```
LIMITCODE *LimitCodePtr;
LimitCodePtr = CreateNewLmtCode();
```

FindFirst[STRUCTURE]

This routine returns the first LIMIT CODE, LOT, WAFER, SITE, or PARAM that `current` points to in the list. NULL is returned if `current` is NULL.

Usage

```
LimitCodePtr = FindFirstLmtCode(*current)
LotPtr = FindFirstLot(*current)
WaferPtr = FindFirstWafer(*current)
SitePtr = FindFirstSite(*current)
ParamPtr = FindFirstParam(*current)
```

`LIMITCODE *LimitCodePtr`	Pointer to a limit code structure
`LOT *LotPtr`	Pointer to a lot structure
`WAFER *WaferPtr`	Pointer to a wafer structure
`SITE *SitePtr`	Pointer to a site structure
`PARAM *ParamPtr`	Pointer to a parameter structure
`LIMITCODE *current`	Pointer to the current limit code
`LOT *current`	Pointer to the current lot
`WAFER *current`	Pointer to the current wafer
`SITE *current`	Pointer to the current site
`PARAM *current`	Pointer to the current parameter

Example

```
LIMIT *LimitCodePtr, *current;
LimitCodePtr = FindFirstLmtCode(current);
```

FindLast[STRUCTURE]

This routine returns the last LIMIT CODE, LOT, WAFER, SITE, or PARAM that `current` points to in the list. It returns NULL if `current` is NULL.

Usage

```
LimitCodePtr = FindLastLimitCode(*current)
LotPtr = FindLastLot(*current)
WaferPtr = FindLastWafer(*current)
SitePtr = FindLastSite(*current)
ParamPtr = FindLastParam(*current)
```

`LIMITCODE *LimitCodePtr`	Pointer to a limit code structure
`LOT *LotPtr`	Pointer to a lot structure
`WAFER *WaferPtr`	Pointer to a wafer structure
`SITE *SitePtr`	Pointer to a site structure
`PARAM *ParamPtr`	Pointer to a parameter structure
`LIMITCODE *current`	Pointer to the current limit code
`LOT *current`	Pointer to the current lot
`WAFER *current`	Pointer to the current wafer
`SITE *current`	Pointer to the current site
`PARAM *current`	Pointer to the current parameter

Example

```
LIMITCODE *LimitCodePtr, *current;
LimitCodePtr = FindLastLimitCode(current);
```

FindNext[STRUCTURE]

This routine finds the next LIMIT CODE, LOT, WAFER, SITE, or PARAM after the position that `current` points to in the list. NULL is returned if `current` is at the end of the list.

Usage

```
LimitCodePtr = FindNextLimitCode(*current)
LotPtr = FindNextLot(*current)
WaferPtr = FindNextWafer(*current)
Site = FindNextSite(*current)
Param = FindNextParam(*current)
```

`LIMITCODE *LimitCodePtr`	Pointer to a limit code structure
`LOT *LotPtr`	Pointer to a lot structure
`WAFER *WaferPtr`	Pointer to a wafer structure
`SITE *SitePtr`	Pointer to a site structure
`PARAM *ParamPtr`	Pointer to a param structure
`LIMITCODE *current`	Pointer to the current limit code
`LOT *current`	Pointer to the current lot
`WAFER *current`	Pointer to the current wafer
`SITE *current`	Pointer to the current site
`PARAM *current`	Pointer to the current parameter

Example

```
LIMITCODE *LimitCodePtr, *current;
LimitCodePtr = FindNextLimitCode(current);
```

FindPrev[STRUCTURE]

This routine finds the previous LIMIT CODE, LOT, WAFER, SITE, or PARAM before the position `current` points to in the list. NULL is returned if `current` is at the beginning of the list.

Usage

```
LimitCodePtr = FindPrevLimitCode(*current)
LotPtr = FindPrevLot(*current)
WaferPtr = FindPrevWafer(*current)
Site = FindPrevSite(*current)
Param = FindPrevParam(*current)
```

`LIMITCODE *LimitCodePtr`	Pointer to a limit code structure
`LOT *LotPtr`	Pointer to a lot structure
`WAFER *WaferPtr`	Pointer to a wafer structure
`SITE *SitePtr`	Pointer to a site structure
`PARAM *ParamPtr`	Pointer to a param structure
`LIMITCODE *current`	Pointer to the current limit code
`LOT *current`	Pointer to the current lot
`WAFER *current`	Pointer to the current wafer
`SITE *current`	Pointer to the current site
`PARAM *current`	Pointer to the current parameter

Example

```
LIMITCODE *LimitCodePtr, *current;
LimitCodePtr = FindPrevLimitCode(current);
```

InsertNew[STRUCTURE]

This routine adds `new` into the LIMIT CODE LOT, WAFER, SITE, or PARAM list before `current`.

Usage

```
InsertNewLmtCode(*current, *new)
InsertNewLot(*current, *new)
InsertNewWafer(*current, *new)
InsertNewSite(*current, *new)
InsertNewParam(*current, *new)
```

`LIMITCODE *current`	Pointer to the current limit code
`LOT *current`	Pointer to the current lot
`WAFER *current`	Pointer to the current wafer
`SITE *current`	Pointer to the current site
`PARAM *current`	Pointer to the current param
`LIMITCODE *new`	The new limit code to be inserted
`LOT *new`	The new lot to be inserted
`WAFER *new`	The new wafer to be inserted
`SITE *new`	The new site to be inserted
`PARAM *new`	The new parameter to be inserted

Example

```
LIMITCODE *current, *new;
InsertNewLmtCode(current,new);
```

Remove[STRUCTURE]

This routine removes the LIMIT CODE, LOT, WAFER, SITE, or PARAM pointed to by `current` and returns a pointer to the next limit code, lot, wafer, site, or parameter in the list. If the next pointer is NULL, the previous limit code, lot, wafer, site, or parameter is returned. If the previous limit code, lot, wafer, site, or parameter is also NULL, then NULL is returned.

Usage

```
LimitCodePtr = RemoveLimitCode(*current)
LotPtr = RemoveLot(*current)
WaferPtr = RemoveWafer(*current)
SitePtr = RemoveSite(*current)
ParamPtr = RemoveParam(*current)
```

`LIMITCODE *LimitCodePtr`	Pointer to a limit code structure
`LOT *LotPtr`	Pointer to a lot structure
`WAFER *WaferPtr`	Pointer to a wafer structure
`SITE *SitePtr`	Pointer to a site structure
`PARAM *ParamPtr`	Pointer to a parameter structure
`LIMITCODE *current`	Pointer to the current limit code
`LOT *current`	Pointer to the current lot
`WAFER *current`	Pointer to the current wafer
`SITE *current`	Pointer to the current site
`PARAM *current`	Pointer to the current parameter

Example

```
LIMITCODE *LimitCodePtr, *current;
LimitCodePtr = RemoveLimitCode(current);
```

LimitExist

This routine tests for the existence of a limit file in the current `Limit File` data directory based on the limit code "`limitin`." TRUE (`1`) is returned if the limit files exist, and FALSE (`0`) is returned otherwise. This routine is only for the `LIMITCODE` structure.

Usage

```
Status = LimitExist(*limitin)
```

`int Status`	The result value of the call
`LIMITCODE *limitin`	The limit code to search for

Example

```
int Status;
LIMITCODE *limitin;
Status = LimitExist (limitin);
```

Keithley Data File user tag data

The Keithley Data File (KDF) library is being modified to support user-defined data. This information is contained within the `.kdf` file with the following format:

```
<TAG>"tagName",tag value string
```

- The `<TAG>` field is required.
- The `"tagName"` field can contain any characters except the double-quote character. The max length of the `tagName` is `PARAM_ID_LENGTH` (128) characters.
- The comma is required and separates the `tagName` field from the tag value string field.
- The `"tag value string"` has a max length of 512 characters and cannot contain the new-line character.

The following routines have been added to the KDF library:

- `PutTag`
- `GetTag`
- `PrintTagList`
- `ClearTagList`

The application programming interface (API) descriptions are as follows:

`int PutTag(char *tagName, char *valueString) ;`

Return values:

- `0` = Success
- `<0` = Error (error codes can be found in the kdferr.h header file)
- `BAD_CALL_ORDER (-14)` = Called before `PutLot()` called
- `ERR_WRITE_FILE (-21)` = Error from fprintf call to write data
- `ERR_OPEN_FILE (-20)` = Error from fopen call
- `ERR_CLOSE_FILE (-22)` = Error from fclose call
- `ILLEGAL_TAG (-25)` = Illegal character in tag name
- `TAG_STR_LEN_ERR (-26)` = Tag string length too long
- `TAG_NAM_LEN_ERR (-27)` = Tag name too long

`PutTag` will write a user tag into the KDF file using `tagName` and `valueString`.

- `tagName` can contain any printable ASCII character except the double-quote character. Maximum length is `PARAM_ID_LENGTH`, or 128 characters. `tagName` must be null-terminated.
- `valueString` has a maximum length of 512 characters and can contain any printable ASCII. The `valueString` cannot contain the new-line character. `valueString` must be null-terminated.

Example:

```
status = PutTag( "myWaferTag", "wafer tested using Base algorithm" ) ;
```

The above code will cause the following data to be written into the `.kdf` file at the current location:

```
<TAG>"myWaferTag",wafer tested using Base algorithm
int GetTag( LOT *wantedLot,
            WAFER *wantedWafer,
            SITE *wantedSite,
            char *tagName,
            tagList **got ) ;
            typedef struct _tagList
                          {
                  char *tagName ;
                  char *tagString ;
                  _tagList *next ;
            } tagList ;
```

`GetTag` returns a null-terminated list of tag data whose head is the `got` parameter. This list is malloced and needs to be freed by the calling routine.

- `wantedLot` is the specific lot in which the `tagName` should be found.
- `wantedWafer` is the specific wafer in which to start searching for tags. If `wantedWafer` is `NULL`, all tags for all wafers will be returned in the list. If `wantedWafer` is a specific wafer, just tags associated with the wafer will be returned. Wafer tags are tags located between the Wafer header line and the <`EOW`> marker.
- `wantedSite` is the specific site in which to start searching for tags. If `wantedSite` is `NULL`, all tags for all sites on the wafer will be returned in the list. If `wantedSite` is a specific site, just tags associated with the site will be returned. Site tags are tags located between the site header line and the <`EOS`> marker.
- `tagName` is the name of the desired tag. If `tagName` is `NULL`, all tags will be returned in the list or just the tags named `tagName` will be returned. Wildcard characters are supported in the `tagName` field.

```
void PrintTagList( tagList *head ) ;
```

`PrintTagList` is a debug routine that can be used to display the list of tags pointed to by the `head` parameter. The tags are written to `stdout`.

```
void ClearTagList( tagList **head ) ;
```

`ClearTagList` is a routine that will free the `tagList` created by a call to `GetTag`.

Example

The following code sequence will return a list of all user tags for all wafers and sites in the specified lot file. The list is pointed to by the `gotTagList` variable. Please note that the tag list is malloced by the `GetTag` routine and must be freed by the user. The `ClearTagList()` routine can be used for this operation.

```
tagList *gotTagList = NULL ;

GetTag( lot, NULL, NULL, NULL, &gotTagList ) ;
PrintTagList( gotTagList ) ;
ClearTagList( &gotTagList ) ; /* free list created by GetTag */
```

Example of use within a cassette plan

You need to add additional data for the lot and wafer. Using the PutTag routine at UAP_WAFER_PREPARE will allow you to add information after the lot header. UAP_WAFER_BEGIN can be used to add information after the wafer header section of the .kdf file.

If the following commands are called up at UAP_WAFER_PREPARE:

```
PutTag( "LotType", "CMOS" ) ;
PutTag( "LotPlant", "Cleveland" ) ;
```

And the following is called at UAP_WAFER_BEGIN:

```
PutTag( "WaferPlanUsed", "WPFbase" ) ;
```

The resulting .kdf file will be:

```
TYP,KDF V1.1
LOT,lotName
TST,ktxe sample
SYS,s530q4000
TSN,1
OPR,williamson
STT,2-Nov-1999 13:23
WDF,sample.wdf
<EOH>
<TAG>"LotType",CMOS
<TAG>"LotPlant",Cleveland
Wafer_01,,1,1
<TAG>"WaferPlanUsed",WPFbase
Site_1,1,1
Param1, 5.0000e+00
<EOS>
<EOW>
```

User access points

The following is a list of user access points (UAP) within the Keithley Test Execution Engine (KTXE) and when the Keithley Data Files (KDF) logging routines are executed. The `PutTag` routine can be called any time after the `PutLot()` routine is called.

```
UAP_PROG_ARGS
UAP_CASSETTE_LOAD
UAP_LOT_INFO
UAP_PROBER_INIT
UAP_WAFER_MISMATCH
UAP_ACCESS_WDF_INFO
UAP_POST_PROBER_INIT
UAP_WRITE_LOT_INFO
   PutLot()
UAP_POST_LOT_INFO
UAP_ALIGN_ERROR
UAP_POST_INITIAL_WAFER_LOAD

/* Start of Wafer Loop */
UAP_WAFER_PREPARE
UAP_VALIDATE_OCR
   PutWafer()
UAP_WAFER_BEGIN
UAP_SITE_CHANGE
   EndSite()
   PutSite()
UAP_SUBSITE_CHANGE
UAP_TEST_BEGIN
UAP_TEST_END
   PutParam()
UAP_TEST_DATA_LOG
UAP_HANDLE_ABORT
UAP_SUBSITE_END
UAP_SITE_END

   EndSite()
UAP_WAFER_END
   EndWafer()

UAP_ALIGN_ERROR

/* End of Wafer Loop */

   EndLot()
UAP_LOT_END
UAP_ENGINE_EXIT

UAP_ABORT_EXIT_HDLR
```

Structure definitions

For structure definitions of LOT, WAFER, SUBSITE, SITE PARAM, LIMITCODE, and LIMIT, refer to the include file in $KIINCLUDE/kdf.h.

Sample programs

The following topics contain sample programs.

Logging one PARAM at a time, data retrieval through Get routines

```
#include <stdio.h>
#include <stdlib.h>
#include "kdferr.h"
#include "kdf.h"

void main(void)
{
LOT *testlot,    *gotlot;
WAFER     *testwafer,  *gotwafer;
SITE      *testsite,   *gotsite;
PARAM     *testparam,  *gotparam;

int waferloop,siteloop;

int status;

testlot   = CreateNewLot  ();
testwafer = CreateNewWafer();
testsite  = CreateNewSite ();
testparam = CreateNewParam();

strcpy (testlot->id, "test1");
strcpy (testlot->testname, "Voltage 1");
GetStartTime(testlot->starttime);

/* Start the logging of the new lot "test1". The lot has 3 wafers and 10
sites to be logged.
*/
status = PutLot(testlot, CREATELOT);
if (status < 0)
return(status);

for (waferloop = 1;waferloop <= 3;waferloop++)
{
sprintf(testwafer->id,"%i",waferloop);
status = PutWafer(testlot,testwafer);
if (status < 0)
return(status);
```

```
for (siteloop = 1; siteloop <= 10; siteloop++)
{
sprintf(testsite->id,"%i",siteloop);
status = PutSite(testlot,testwafer,testsite);
if (status < 0)
return(status);

strcpy(testparam->id, "beta1");
/* calculate the beta*/
testparam->value = beta1(1, 4, 7, -1, 0.5e-3, 2.0, ’N’);
status = PutParam(testlot,testwafer,testsite,testparam);
if (status < 0)
return(status);

strcpy(testparam->id, "cap 1.0");
/* test the capacitance when the bias voltage is 1.0 (Parlib routine)*/
testparam->value = cap(3,5,7,1.0);
status = PutParam(testlot,testwafer,testsite,testparam);
if (status < 0)
return(status);

EndSite();
/* Prompt user to move to the next site */
printf("Please move the prober to the next site and hit a key\n");
getchar();
}

EndWafer();
/*Prompt user to move to the next wafer */
printf("Please move the prober to the next wafer and hit a key\n")
getchar();
}
EndLot();
GetStartTime(testlot->stoptime);

/* Append the stoptime into the header. (Does not change any of the data that
was already logged.)
*/
status = PutLot(testlot,APPENDLOT);
if (status < 0)
return(status);

/************           END OF DATA LOGGING  *****************/
/************           START DATA RETRIEVAL *****************/

gotlot = CreateNewLot();

strcpy(testlot->id, "test1");
/* Retrieve all the data that was just logged */
GetLot(testlot, gotlot);

gotwafer = CreateNewWafer();

/* Get all the wafers in the lot */
strcpy(testwafer->id, "*");
GetWafer(gotlot, testwafer, gotwafer);
```

```
while (gotwafer != NULL)
{
gotsite = CreateNewSite();

/* Get all the sites in this wafer */
strcpy(testsite->id, "*");
GetSite(gotlot, gotwafer, testsite, gotsite);

while (gotsite != NULL)
{
gotparam = CreateNewParam();

/* Get all the parameters in this site */
strcpy(testparam->id, "*");
GetParam(gotlot, gotwafer, gotsite, testparam, gotparam);

/* If the first parameter result is greater than 1, remove that site from the lot
   */
if (gotparam->value > 1)
DeleteSite(gotlot,gotwafer,gotsite)

gotsite = FindNextSite(gotsite);
}
gotwafer = FindNextWafer(gotwafer);
}

/***********          CLEANING UP MEMORY   ****************/
RemoveParam(testparam);
RemoveSite (testsite);
RemoveWafer(testwafer);
RemoveLot  (testlot);

RemoveLot  (gotlot);
while (gotwafer)
gotwafer = RemoveWafer(gotwafer);
while (gotsite)
gotsite = RemoveSite(gotsite);
while (gotparam)
gotparam = RemoveParam(gotparam);
}
```

Logging a linked list of PARAMs, data retrieval using GetLotData

```
#include <stdio.h>
#include <stdlib.h>
#include "kdferr.h"
#include "kdf.h"

void main(void)
{
LOT *testlot,    *gotlot;
WAFER     *testwafer,  *gotwafer;
SITE      *testsite,   *gotsite;
PARAM     *testparam,  *gotparam;
PARAM *new;
int waferloop,siteloop;
int status;

testlot   = CreateNewLot  ();
testwafer = CreateNewWafer();
testsite  = CreateNewSite ();

strcpy (testlot->id, "test1");
strcpy (testlot->testname, "Voltage 1");
GetStartTime(testlot->starttime);

/* Start the logging of the new lot "test1". The lot has 3 wafers and 10
sites to be logged.
*/
status = PutLot(testlot, CREATELOT);
if (status < 0)
return(status);

for (waferloop = 1;waferloop <= 3;waferloop++)
{
sprintf(testwafer->id,"%i",waferloop);
status = PutWafer(testlot,testwafer);
if (status < 0)
return(status);

for (siteloop = 1; siteloop <= 10; siteloop++)
{
sprintf(testsite->id,"%i",siteloop);
status = PutSite(testlot,testwafer,testsite);
if (status < 0)
return(status);

testparam=CreateNewParam();
strcpy(testparam->id, "Volts 1e-2");
/* voltagetest is an example test routine that would return a voltage */
testparam->value = voltagetest(1e-2);

new=CreateNewParam();

strcpy(new->id, "Volts 1e-1");
   /* voltagetest is an example test routine that would return a voltage */
testparam->value = voltagetest(1e-1);
```

```
/* Add current into the list following testparam */
AddNewParam(testparam,new);
testparam = FindNextParam(testparam);
new = CreateNewParam();

strcpy(new->id, "Volts 1");
/* voltagetest is an example test routine that would return a voltage */
testparam->value = voltagetest(1);
/* Add current into the list following testparam */
AddNewParam(testparam,new);

/* Go to the first param in the list to get ready for PutParamList */
testparam=FindFirstParam(testparam);
PutParamList(testlot,testwafer,testsite,testparam);

EndSite();
/* Some routine to get the next site ready for testing */
move_next_site();
}

EndWafer();
/* Some routine to get the next wafer ready for testing */
move_next_wafer();
}
EndLot();
GetStartTime(testlot->stoptime);

/* Append the stoptime into the header. (Does not change any of the data that was
   already logged.)
*/
status = PutLot(testlot,APPENDLOT);
   /************       END OF DATA LOGGING  *****************/
/************          CLEANING UP MEMORY   *****************/
while(testparam != NULL)
RemoveParam(testparam);
RemoveSite (testsite);
RemoveWafer(testwafer);
RemoveLot  (testlot);
/************          START DATA RETRIEVAL *****************/

gotlot = CreateNewLot();

strcpy(gotlot->id, "test1");
/* Retrieve all the data that was just logged */
GetLotData(gotlot);

gotwafer = gotlot->wafers;

while (gotwafer != NULL)
{
gotsite = gotwafer->sites;

while (gotsite != NULL)
{
gotparam = gotsite->params;

/* If the result was greater than 1, remove that site from the lot */
```

```
if (gotparam->value > 1)
DeleteSite(gotlot,gotwafer,gotsite)

gotsite = FindNextSite(gotsite);
}
gotwafer = FindNextWafer(gotwafer);
}
}
```

Appendix B

Keithley User Interface Library

In this appendix:

Introduction

The Keithley User Interface (KUI) Library contains functions that provide the program developer with a basic set of user interfaces for operator data entry and program status monitoring program specifically for test programs.

The location of the library and files depends on the specific platform and product. Refer to the specific platform's manual for location of the library.

An `include` file named `kui_proto.h` is provided for the library. The following line should be placed in every test program or file that will be linked with the KUI library:

```
#include "kui_proto.h"
```

Starting with Keithley Test Environment (KTE) software version 5.1.0 and later, the following KUI window routines are displayed on the Dialog tab on the Keithley Integrated Display Service (KIDS) interface. If this behavior is not desired, set the `KI_KUI_CLASSIC` environment variable to `1` to cause KUI routines to use the old-style windows.

If the KIDS interface is not running or connections are not being accepted by KIDS, KUI defaults to the Classic windowing mode.

Note that the WfrIdDlg window is not supported by the KIDS interface. The Classic windows (Keithley Operator Interface (KOP)) is used for WfrIdDlg routines.

User interface constants

Constants corresponding to values returned by the dialogs indicate how the dialog was exited. The returned value is then used to determine further program execution.

DLG_ABORT

DLG_EXIT

DLG_NO

DLG_OK

DLG_SKIP

DLG_YES

Constants that can be used to determine the look and feel of the user interface dialogs. They are intended for use with the `InitUI` command.

DLG_LOOK_MOTIF

DLG_LOOK_MSW

DLG_LOOK_OPENLOOK

DLG_LOOK_PM

DLG_LOOK_PM2

Constants are provided for those dialogs which allow selecting which of the dialog's fields can be edited by the user by passing a field edit enable array as a part of a dialog's command call.

FIELD_ENABLED

FIELD_DISABLED

Constants intended for use with the pause, continue, and abort flag (`pca_flag`) used by the Status dialog. Refer to the StatusDlg (on page B-10) command.

KI_ABORT

KI_CONTINUE

KI_PAUSE

Constant that specifies the number of fields within the Lot Information Dialog (`LotDlg`). Used to declare the `lot_dlg_flds` array with the proper dimension.

NUM_LOT_FIELDS

Constant that indicates the highest value allowed for dialog look selection. Refer to the GetProgramArg (on page B-4) GUI look command-line argument switch and the InitUINew (on page B-6) command.

MAX_DLG_LOOK

Enums corresponding to fields in the Lot Information Dialog (`LotDlg`). Intended for use as indexes into the `lot_dlg_flds` array in order to select `FIELD_ENABLED` or `FIELD_DISABLED`. Refer to LotDlg (on page B-7).

`EXIT_LOT_DLG`

`OPERATOR`

`LOT_ID`

`PROCESS`

`DEVICE`

`TEST_NAME`

`SYSTEM_ID`

`TEST_STATION`

`SEARCH_KEY1`

`SEARCH_KEY2`

`SEARCH_KEY3`

`LIMIT_FILE`

`LOT_COMMENT`

User interface library variables

`lot_dlg_fields[]`

Array that assigns an element to each field in the Lot Information Dialog (`LotDlg`). The value for the element determines whether the field can be edited by the operator when the lot information dialog is displayed. It is declared within the `LotDlg` source file and defined as an external int array in the header file to make it accessible to the user program. Refer to LotDlg (on page B-7).

`pca_flag`

Variable that flags the execution state of the test plan as controlled by the Status Dialog. There is a routine that can be used to query the state of the `pca_flag`.

`int Get_pca_flag;`

If the Keithley Test Execution Engine (KTXE) is running with the Keithley User Interface (KUI) disabled, using the `Get_pca_flag()` routine will allow your user access point (UAP) code to detect that a tester fatal event has occurred and can force the engine to exit. The KTXE `UpdateStatusAbort` call within the execution engine checks this flag automatically. Your UAP code can also check the flag to detect state changes earlier.

User interface library commands

The following topics describe the Keithley User Interface (KUI) Library commands.

GetProgramArgs - Get Program Command Line Arguments

This command gets program command-line arguments.

Usage

```
void GetProgramArgs(int argc, char *argv[], int *debug, int *err_report_mode, char
   **err_log_fname, int *gui_look, LOT **lot, char **sum_report_options, char
   **kwf_fname, char *user_arg)
```

Details

The `GetProgramArgs` command allows values for specific test program global variables to be passed in using the command line.

The `GetProgramArgs` command parses the command-line arguments to match switches assigned to the test program variables. When a match is found, the `GetProgramArgs` command will then try to parse in its argument, converting and bounding it per the variable type, as required.

If an error occurs in interpreting the command-line arguments, the `GetProgramArgs` command will print an error message explaining the reason and the allowable command-line arguments to `stderr`, and exit the test program.

The allowable command-line arguments can be displayed by typing `-h` at the command line following the test program's name.

Valid switches are:

`-c` Text lot information comment field

`-d` Text lot information device field

`-e` *`n`* `[`*`fname`*`]` Error reporting mode

Where n = `0` to `3`

`0` - None

`1` - Display Error Messages

`2` - Log Error Messages

`3` - Display and Log Error Messages

`[`*`fname`*`]` - Error log file path and name

`-g` *`n`* GUI look and feel operation

Where *n* = `0` to `4`

`0` - Motif

`1` - OpenLook

`2` - Microsoft Windows

`-h` Display command line options

`-i` ID lot information lot id field

`-k` *`n`* `text` Lot search key

Where *n* = `1` to 3 fields

`-l id` Lot information limit ID

`-o text` Lot information operator field

`-p text` Lot information process field

`-r "options"` Lot summary report options

`-s text` Lot information system field

`-t` *`n`* Test station

Where *n* = `1` to 4

`-w` *`fname`* Wafer description filename

`-u text` User argument

`-x` *`n`* Debug flag

Where *n* = `-32767` to `32768`

`fname` - Valid filename and path

`options` - Options must be enclosed in quotes

`text` - Command-line arguments will be concatenated to the switch argument until the next

switch (dash-letter) occurs

Example

```
/* KI_Strncpy guarantees the member will be xxx_LENGTH & null terminated */
KI_Strncpy(lot->limitcode, "tutorial_limits", LIMITCODE_LENGTH);
KI_Strncpy(lot->id, "tutorial_lot", LOT_ID_LENGTH);
lot->teststation = 1;
GetStartTime(lot->starttime);

if(getenv("USER")!=NULL)
KI_Strncpy(lot->operator, getenv("USER"), LOT_OPERATOR_LENGTH);

if(getenv("HOST")!=NULL)
KI_Strncpy(lot->system, getenv("HOST"), LOT_SYSTEM_LENGTH);

/*>> set default Keithley wafer (description) file name */
kwf_fname = "sample.wdf";

/*>> default lot summary report options */
sum_report_options = "-s";

/*>> set/override program run time values and flags w/ command line args */
GetProgramArgs(argc, argv, &debug, &err_report_mode, &err_log_fname, &gui_look,
    &lot, &sum_report_options, &kwf_fname, user_arg);
```

This example illustrates how test program global variables can be set with default values within the program and optionally overridden from the command line.

InitUINew - Initialize User Interface Library

This command initializes the Keithley User Interface (KUI) Library so that so that dialogs can be displayed and become operable. It must be called before any dialogs are called. In addition, it also allows specifying the look and feel of the displayed dialogs as provided in the `DLG_LOOK_XXXX` constants. It also starts the control thread of execution.

Usage

```
InitUINew(int look, void *Main () );
```

Details

The KUI system is now threaded for better response to operator input. As a result, the control thread process name is specified in the `InitUINew` command. The `look` program variable is defined in `kui_proto.h`. It is used with the `GetProgramArgs` command to set the look using the test program command line.

InputMsgDlg — Input Message Dialog

The `InputMsgDlg` command displays a modal dialog window containing the passed message string and provides the user with a text edit widget to enter information into the program.

Usage

```
int InputMsgDlg( char *msgstr, char *inputstr)
```

Details

The program remains in the dialog until the user presses one of the buttons. The text edit widget text is then placed in the `inputstr` buffer. The dialog then returns either `DLG_OK` or `DLG_EXIT` per the OK or CANCEL buttons. The input string pointer cannot contain a null value. It should point to some allocated memory space to place the entered string. If you do not want to use the string, pass `0` as the argument.

LotDlg - Lot Information Dialog

This command displays a modal dialog window in order to collect lot information from the operator. It has as arguments a pointer to a lot structure, a field enable array, and a bound for the maximum test station, that can be selected.

Usage

```
LotDlg(LOT *lot, char lot_dlg_fields[NUM_LOT_FIELDS], int max_teststation)
```

Details

Default entries for the lot dialog fields can be passed through this structure prior to calling `LotDlg` as follows:

(`KI_Strncpy` guarantees the member will be `xxx_LENGTH` and null terminated)

```
LOT *lot;
KI_Strncpy(lot->limitcode,"tutorial_limits", LIMITCODE_LENGTH);
KI_Strncpy(lot->id, "tutorial_lot", LOT_ID_LENGTH);
lot->teststation = 1;
```

The `lot_dlg_fields` array is an array passed to the lot information dialog to indicate the fields that can be altered by the user. The `lot_fields` enum corresponds to indexes within that array and should be used with `FIELD_ENABLED` and `FIELD_DISABLED` constants to set array elements before calling `LotDlg` as follows:

```
lot_dlg_fields[SYSTEM_ID] = FIELD_DISABLED;
lot_dlg_fields[TEST_NAME] = FIELD_DISABLED;
LotDlg(lot, lot_dlg_fields, max_teststation);
```

All fields are enabled by default.

The `LotDlg` command returns either `DLG_OK` or `DLG_ABORT` per the OK and ABORT buttons. If exited with OK, the dialog fields are updated and returned in the lot structure. The return value can then be used to determine further program execution.

> **NOTE**
>
> `InitUI` must be called before `LotDlg`.

OkCancelAbortMsgDlg — Ok Cancel Abort Message Dialog

This command displays a modal dialog window containing the passed message string and requires the user acknowledge it by pushing either OK or CANCEL before the program can continue.

Usage

```
int OkCancelAbortMsgDlg(char *msgstr)
```

Details

The message should be phrased to state the test program can be aborted by pressing CANCEL. If OK is pressed, the dialog returns `DLG_OK`. If CANCEL is pressed, the user is then prompted through another modal dialog to verify aborting the test program. The dialog will then return either `DLG_ABORT` if OK was pressed, or `DLG_NO` if CANCEL was pressed in the verification dialog.

OkCancelMsgDlg — Ok Cancel Message Dialog

This command displays a modal dialog window containing the passed message string and requires the user acknowledge it by pushing either OK or CANCEL before the program can continue.

Usage

```
int OkCancelMsgDlg( char *msgstr )
```

Details

Returns either `DLG_OK` or `DLG_EXIT`.

OkMsgDlg — Ok Message Dialog

This command displays a modal dialog window containing the passed message string and requires the user acknowledge it by pushing OK before the program can continue.

Usage

```
void OkMsgDlg(char *msgstr)
```

Details

The `OkMsgDlg` command does not return a value. It is used to pause the test program and require the operator to acknowledge the message before the program can continue.

QuitUI — Quit User Interface

This command removes any remaining displayed dialogs and performs clean-up actions required for using the dialogs in the User Interface library.

Usage

```
int QuitUI()
```

Details

The `QuitUI` command should be called prior to program exit.

ScrollMsgDlg — Scrollable Message Dialog

This command sets a label of a dialog window.

Usage

```
void ScrollMsgDlg(char *label)
```

Details

Messages accumulate and can be scrolled through in the visible area until it is cleared or the `QuitUI` command is called. The `ScrollMsgDlg` command is called with a label to display at the top of the dialog window.

Refer to UpdateModelessDlgs - Update Modeless dialogs (on page B-11) and UpdateStatusDlg — Update Status Dialog (on page B-12) for issues regarding the responsiveness of the `ScrollMsgDlg` command.

ScrollMsgDlgClr — Scrollable Message Dialog Clear

This command is used to clear all messages from the scrolling message dialog.

Usage

```
void ScrollMsgDlgClr()
```

Details

The scrolling message dialog will remain displayed and the first message sent will be placed at the top of the scrolling area.

ScrollMsgDlgMsg — Scrollable Message Dialog Message

This command is used to post a message to the scrolling message dialog.

Usage

```
void ScrollMsgDlgMsg(char *msgstr)
```

Details

The passed string should make use of `\n` as needed. If the `ScrollMsgDlg` command was not called previous to the `ScrollMsgDlgMsg` command, it will be called from within it, and the dialog label set as "Test Program Messages." The buffer size is limited by the `maxScrollLines` variable, which defaults to ~500 lines. When this buffer size is exceeded, the oldest 2/3 of the buffer is thrown away and the buffer will continue to grow. The maximum value can be adjusted using the data pool. Refer to the Data pool documentation for an example.

StatusDlg - Status Dialog

This command provides a modeless dialog window which will remain displayed from when `StatusDlg` is first called until `QuitUI` releases the user interface on program exit. Besides providing display fields for key test program variables, it also provides a single text display line on which a program-specific status message can be displayed as well as a level of program execution control through the PAUSE, CONTINUE and ABORT buttons.

Usage

```
void StatusDlg(LOT **lot, WAFER **wafer, SITE **site, SUBSITE **subsite, int
   *total_wafers, int *wafers_tested, int *total_sites, int *sites_tested,
   kui_support_t **KUI_Support, kui_user_t **KUI_User);
```

Details

The `StatusDlg` command was designed in conjunction with guide test program data. In order to minimize the argument list required for `UpdateStatusDlg`, `StatusDlg` establishes pointers to the test program variables from which the dialog fields will obtain their display information for the remainder of the test program. The status dialog treats all these variables as read-only. The lot, wafer, site, and subsite pointers point to structures with members corresponding to status dialog display fields. Since the addresses passed for these structures also point to the present structure in their respective linked list, the status dialog automatically tracks and displays the correct information. The status dialog is called as follows:

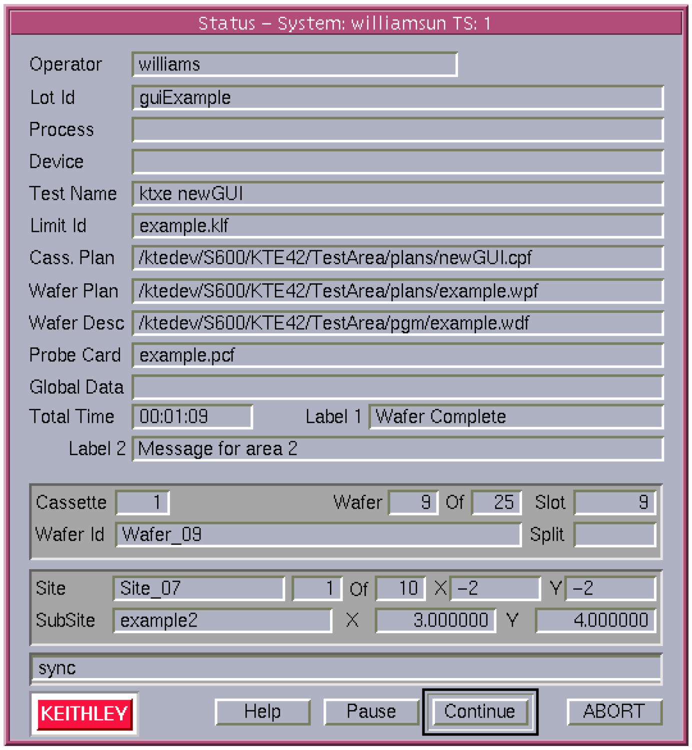
```
StatusDlg(&lot, &wafer, &site, &subsite,
   &total_wafers, &wafers_tested,
   &total_sites, &sites_tested,
   &KUI_Support, &KUI_User );
```

The status dialog contains a Total Time field. This field displays a running timer indicating elapsed time for test plan execution. Two user fields are also available for custom use.

There is a pointer to the `KUI_User` structure in the data pool. Populating this structure will enable or disable the user fields. These fields must be initialized at `UAP_LOT_INFO` or earlier for proper operation. Once the fields are initialized, changing the values and calling the `KTXEUpdateStatusAbort()` command will cause an immediate update. If the user fields are left uninitialized, they will not be present on the Status dialog window.

The following figure shows a sample status dialog window.

Figure 83: Status dialog window



UpdateModelessDlgs — Update Modeless Dialogs

This command is used to update and display the scroll message dialog when their contents change.

Usage

```
void UpdateModelessDlgs()
```

UpdateStatusDlg — Update Status Dialog

This command is provided to update and display the status dialog fields when their contents change in the test program, as well as pass a status message appropriate for that point in the program.

Usage

```
int UpdateStatusDlg(char *user_msg)
```

Details

Although the status dialog remains displayed throughout the test program, even while other dialogs are displayed, the fields are only updated and buttons checked when `UpdateStatusDlg` is called as in the following example:

```
UpdateStatusDlg("Loading Wafer ... ");
```

When `UpdateStatusDlg` is called, it first checks for differences between the test program variables and their display fields, updating them if necessary. The status message is then placed in its field. The PAUSE, CONTINUE, and ABORT buttons are then checked.

The pause-continue-abort `pca_flag` reflects the state of program execution (by default, it is set to `KI_CONTINUE`). When the status dialog buttons are checked by `UpdateStatusDlg`, if a button is pressed, it will set the flag appropriately.

Just before the `UpdateStatusDlg` command returns, it checks the `pca_flag`. If paused, the test program will remain within the `UpdateStatusDlg` call until either CONTINUE or ABORT is pressed. The `pca_flag` will be set appropriately and allow the function to return with either `DLG_OK` or `DLG_ABORT`, respectively. The return value can be used to determine further program execution.

The responsiveness of updating the status dialog and the PAUSE, CONTINUE, and ABORT buttons is directly a result of where and how often `UpdateStatusDlg` appears in the test program. For example, if a number of tests that require significant time appear in the test program, it may be necessary to intersperse `UpdateStatusDlg` between them.

NOTE

The `InitUI` command must be called before the `StatusDlg` command. The `UpdateStatusDlg` command may appear in the test program before the `StatusDlg` command, but will be ignored as the status dialog pointers and the window itself have not been established.

VarMsgDlg — Variable Message Dialog

This command creates a window with a scrolling text region and multiple push buttons. In addition, each push button has a user-defined label.

Usage

```
int VarMsgDlg(*VarMsgDlgDataPtr) ;
```

Details

This routine is passed a structure containing configuration data for the window. The structure definition is shown below:

```
typedef struct _VarMsgDlgData
{
int no_buttons;
int no_lines;
char **button_labels;
char *win_label;
char *ted_string;
}
VarMsgDlgDataRec, *VarMsgDlgDataPtr;
```

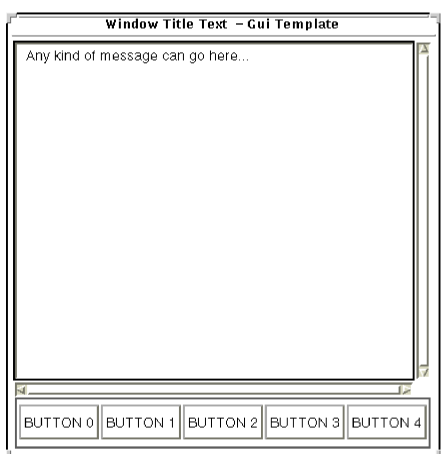
- **no_buttons:** The number of pushbuttons displayed. There is no limit to the number of buttons, but screen space and size will impose a practical limit.
- **no_lines:** How many lines of text will be displayed in the scrolling region.
- **button_labels:** An array of text for labels.
- **win_label:** The text used for the title bar on the window.
- **ted_string:** The message to be displayed in the scrolling window.

This command will return the index number of the button that was pressed by the user. The first button is index 0.

There is an example program located in the distribution showing sample Keithley User Interface (KUI) Library calls and their uses. This file is located in `$KIHOME/src/gui_template.c`.

The following figure shows an example of a dialog window created using this routine.

Figure 84: Variable message window



WfrIdsDlg — Multiple Wafer Information Dialog

NOTE

This window is not supported in the KTE Integrated Display Service (KIDS) graphical user interface (GUI). The standard Keithley User Interface (KUI) Classic window will be used.

This command displays a modal dialog window in order to collect information from the operator for multiple wafers to be tested by the test program. It facilitates automated testing as the wafer id will not have to be prompted as each wafer is tested.

Usage

```
int WfrIdsDlg(WAFER **wafer_ptr, int max_cassette, int *total_ptr)
```

Details

The `WfrldsDlg` command has as arguments a pointer to a wafer structure pointer, a bound for the highest cassette that can be selected, and a pointer to the variable that will contain the total number of wafers to be tested.

The multiple wafer information dialog allows you to enter from `1` to `max_cassette` lists of wafer IDs and split entries corresponding to 25 slots on each cassette. While the dialog is displayed, you can switch between cassettes and can enter IDs in any order. A split entry can only be made if the slot has a corresponding ID entry.

The `WfrIdsDlg` command is passed a pointer to the test program's present WAFER structure pointer. A pointer to the pointer is required to allow the `WfrIdsDlg` command to modify the test program's present WAFER structure pointer that is passed in and return a different pointer value.

For example, the wafer structure pointer may point to NULL when the `WfrIdsDlg` command is called, but points to an allocated wafer structure in the wafer linked list upon return.

As you enter wafer information, the `WfrIdsDlg` command will allocate elements and maintain a linked list of wafer structures. When you exit the multiple wafer information dialog, the entered wafers will be in cassette-slot order in the linked list. The test program variable pointed to will contain the number of wafers in the linked list.

The `WfrIdsDlg` command returns either `DLG_OK or DLG_ABORT` per the OK and ABORT buttons. The return value can then be used to determine further program execution.

In most cases, the pointer to the wafer structure pointer will point to NULL when the dialog is called as the number of wafers, their position and IDs will most likely be determined at program run time. The default entries for the ID and Split fields will be empty. However, the ability to pass in a pointer to an established linked list of wafers is reserved for possible future development. It is intended for possible use to accommodate situations where wafer IDs might remain the same from test run to test run, such as program development, where generic wafer IDs are suitable, or for validation or editing of IDs obtained through some other means such as optical character recognition or bar coding.

For this reason, the linked list of wafers passed to the dialog will reflect changes even if the dialog is exited with ABORT as no tracking of which wafers were passed in will be maintained by the dialog.

The multiple wafer information dialog is called as in the following example:

```
WfrIdsDlg(&wafer, max_cassette, &total_wafers);
```

NOTE

The `InitUI` command must be called before the `WfrIdsDlg` command.

WfrIdDlg — Single Wafer Information Dialog

NOTE

This window is not supported in the KTE Integrated Display Service (KIDS) graphical user interface (GUI). The standard Keithley User Interface (KUI) Classic window will be used.

This command displays a modal dialog window in order to collect information from the operator for single wafers to be tested by the test program. It is intended primarily for situations where an operator is prompted to enter information on a wafer by wafer basis, such as when manual wafer loading occurs. It has as arguments a pointer to a wafer structure pointer, and a bound for the highest cassette which can be selected.

Usage

```
int WfrIdDlg(WAFER **wafer_ptr, int max_cassette)
```

Details

The single wafer information dialog allows you to enter the cassette number bounded from `1` to `max_cassette`, the slot from `1` to `25`, the wafer ID and split information. A split entry can only be made if the slot has an ID entry.

A pointer to a WAFER structure pointer is passed to the `WfrIdDlg` command. A pointer to the pointer is used only to maintain similar arguments and reduce confusion with the multiple wafer information dialog `WfrIdsDlg` command, which requires a pointer to a pointer. The passed pointer value will not be modified by the `WfrIdDlg` command.

Unlike the multiple wafer information dialog, `WfrIdsDlg`, the single wafer information dialog will not allocate a wafer structure if needed within the dialog call and expects to be passed a pointer to one.

Since it is passed a pointer to an allocated wafer structure, the dialog fields can be initialized based on the values of the members of the passed structure.

If you exit the dialog with OK, the structure members are updated with the dialog field entries and the `WfrIdDlg` returns `DLG_OK`. If ABORT is used to exit the dialog, the structure members are not updated and `DLG_ABORT` is returned. The return value can then be used to determine further program execution.

The single wafer information dialog is called as in the following example, which allocates a wafer structure and initializes the fields based on the present entry in the wafer linked list, and adds it to the existing wafer linked list if the dialog is exited with OK:

```
next_wafer = CreateNewWafer();
KI_Strncpy(next_wafer->split, wafer->split, WAFER_SPLIT_LENGTH);
next_wafer->boat = wafer->boat;
next_wafer->slot = wafer->slot;

if(next_wafer->slot < MAX_SLOT)
next_wafer->slot++;
switch( WfrIdDlg( &next_wafer, max_cassette) )
{
case DLG_ABORT:
EXIT_PRGM
case DLG_OK:
AddNewWafer( wafer, next_wafer );
wafer = next_wafer;
wafers_tested++;
total_wafers++;
```

NOTE

The `InitUI` command must be called before the `WfrIdDlg` command.

YesNoAbortMsgDlg — Yes No Abort Message Dialog

This command displays a modal dialog window containing the passed message string and requires the user acknowledge it by pushing either YES, NO, or ABORT before the program can continue.

Usage

```
int YesNoAbortMsgDlg(char *msgstr)
```

Details

The message should be phrased to state the test program can be aborted by pressing ABORT. If YES is pressed, the dialog returns `DLG_YES`. If NO is pressed, the dialog returns `DLG_NO`. If ABORT is pressed, you are then prompted through another modal dialog to verify aborting the test program. The dialog will then return either `DLG_ABORT` if OK was pressed, or `DLG_NO` if CANCEL was pressed in the verification dialog.

YesNoCancelMsgDlg — Yes No Cancel Message Dialog

This command displays a modal dialog window containing the passed message string and requires the user acknowledge it by pushing either YES, NO, or CANCEL before the program can continue.

Usage

```
int YesNoCancelMsgDlg(char *msgstr)
```

Details

Returns either `DLG_YES`, `DLG_NO`, or `DLG_EXIT`.

ContSkipAbortDlg — Continue Skip Abort Message Dialog

This command displays a message in a dialog box with the Continue, Skip, and Abort choices.

Usage

```
int ContSkipAbortDlg (char *msg)
```

Details

Continue returns `DLG_YES`, Skip returns `DLG_SKIP`, and Abort returns `DLG_ABORT`.

LBoxDlg — List Box Message Dialog

NOTE

This window is not supported in the KTE Integrated Display Service (KIDS) graphical user interface (GUI). The standard Keithley User Interface (KUI) Classic window will be used.

This command opens a window containing a list of items and allows selection of one or more of these items.

Usage

```
int LBoxDlg(char *text_label, char *windowTitle, LBOXDLG_ListPtr **listPtr, int
    MultipleSelectionEnabled) ;
```

Details

`text_label` = Text label over list of items

`windowTitle` = Title text for window frame

`listPtr` = Pointer to a linked list of `LBOXDLG_ListPtr` items

```
typedef struct _lboxDlg
{
    char *label ;
    int selected ;
    struct _lboxDlg *next ;
} LBOXDLG_ListPtr ;
```

`MultipleSelectionEnabled` = Single or Multiple Selection flag. Possible values: `LBOXDLG_SINGLE_SELECT` or `LBOXDLG_MULTI_SELECT`.

Return values:

`DLG_OK` = OK button pressed

`DLG_EXIT` = Cancel button pressed

`DLG_ABORT` = Abort button pressed

In addition, the `listPtr` list of items has been modified to reflect any selection changes. These changes only take effect if the OK button is pressed. Pressing the CANCEL or ABORT buttons leaves the list in its original state.

Example

```
int retVal, i ;
LBOXDLG_ListPtr *lboxList, *new, *last ;
/* Create a list of items to display
 */
new = ( LBOXDLG_ListPtr *)malloc( sizeof( LBOXDLG_ListPtr ) ) ;
new->label = strdup( "Item 1" ) ;
new->selected = 1 ;
new->next = NULL ;
last = lboxList = new ;
for ( i = 2 ; i < 10 ; i++ )
{
   char label[ 64 ] ;
   sprintf( label, "Item %d", i ) ;
   new = ( LBOXDLG_ListPtr *)malloc( sizeof( LBOXDLG_ListPtr ) ) ;
   new->label = strdup( label ) ;
   new->selected = 0 ;
   new->next = NULL ;

   last->next = new ;
   last = new ;
}
/* Show list and get selection.  ( Single select mode )
 */
retVal = LBoxDlg( "Test lbox text",
       "Lbox Title",
       &lboxList,
       LBOXDLG_SINGLE_SELECT ) ;
/* free the list.  Display the data while we are here
 */
while( lboxList != NULL )
{
   LBOXDLG_ListPtr *tmp ;
   if ( 1 == lboxList->selected )
      printf( "%s was selected!\n", lboxList->label ) ;

   free( lboxList->label ) ;
   tmp = lboxList->next ;
   free( lboxList ) ;
   lboxList = tmp ;
}
```

KTE KUI localization

The `KI_LOCALIZE_CFG` environment variable is used to define an alternate localization file. Simply set `KI_LOCALIZE_CFG` to a file of the form below, and localization will automatically take place within The Keithley User Interface (KUI). Only the elements that you want to modify need to be included in this file.

Note that all defaults are included in this example. Format for the lines of the file requires:

```
name,"value"
```

Note that other comments may come after the second unescaped quotation mark on each line, and that blank lines and those starting with a pound sign (#) will be ignored.

NOTE

This feature is only used for the `KUI_CLASSIC` graphical user interface (GUI) windows. These values will have no effect in the KTE Integrated Display Service (KIDS) GUI display. The `guiLabels.xml` and `ktxe_error_msgs.xml` files are used to define the label values and messages for the KIDS display. This path name for these files is determined by the `pathToXMLfiles` setting in the `kth.ini` file.

Example:

```
#Keithley Localization File
Version,1.0
File,/opt/ki/dat/example.loc
Date,
Id,
Comment,
<EOH>
KI_LOTINFO_LBL,"Lot Information - " # Lot Info Title
KI_OPR_LBL,"Operator"
KI_LOT_LBL,"Lot Id"
KI_PROCESS_LBL,"Process"
KI_DEVICE_LBL,"Device"
KI_TESTNAME_LBL,"Test Name"
KI_LIMIT_LBL,"Limit Id"
KI_SYS_LBL,"System Id"
KI_TESTSTN_LBL,"Test Station"
KI_SK1_LBL,"Search 1"
KI_SK2_LBL,"Search 2"
KI_SK3_LBL,"Search 3"
KI_COMMENT_LBL,"Comment"
KI_STATUS_LBL,"Status - " # Status Dlg Title
KI_CPFNAME_LBL,"Cass. Plan"
KI_WPFNAME_LBL,"Wafer Plan"
KI_PCFNAME_LBL,"Probe Card"
KI_GDFNAME_LBL,"Global Data"
KI_WDFNAME_LBL,"Wafer Desc"
KI_TIME_LBL,"Total Time"
KI_WAFID_LBL,"Wafer Id"
KI_CURWAF_LBL,"Wafer"
KI_OF_LBL,"Of"
KI_SLOT_LBL,"Slot"
KI_SPLIT_LBL,"Split"
KI_CASS_LBL,"Cassette"
KI_X_LBL,"X"
KI_Y_LBL,"Y"
KI_COL_LBL,"X"
KI_SSID_LBL,"SubSite"
KI_ROW_LBL,"Y"
KI_SID_LBL,"Site"
KI_OF_LBL,"Of"
KI_WFRIDSDLG_LBL,"Wafer Information - " # Wafer Ids Dlg title
KI_WFRIDDLG_LBL,"Wafer Information - " # Wafer ID Dlg Title
KI_CBCASS_LBL,"Cassette"
KI_CBSLOT_LBL,"Slot"
KI_WFRIDCOL_LBL,"ID"
KI_WFRSPLITCOL_LBL,"SPLIT"
KI_OKBUT_LBL,"OK"
KI_ABORTBUT_LBL,"ABORT"
KI_HELPBUT_LBL,"Help"
KI_YESBUT_LBL,"Yes"
KI_NOBUT_LBL,"No"
KI_SKIPBUT_LBL,"Skip"
KI_CANCELBUT_LBL,"Cancel"
KI_CONTTBUT_LBL,"Continue"
```

```
KI_ERROR_LBL,"Error Log for "
KI_EVENT_LBL,"Event Log for "

#
#-------------------------------------------------------------------------------
# The following are text for System Message Dialog windows
#-------------------------------------------------------------------------------
#
KI_SUSPEND_ABORT_MSG,"Abort KTXE?"
KI_ABORT_EXE_MSG,"Are you sure you want to ABORT execution?\n"
KI_SUSPEND_UNLOAD_MSG,"You MUST unload all wafers MANUALLY!"

KI_LOT_EXISTS_USE_MSG,"Lot Data already exists and may be in use!\n\nDo you want to
   append data to the lot?\n\nPress YES to append to the existing lot data.\nPress
   NO to DELETE the old lot data\nand create a NEW lot data file.\nPress ABORT to
   stop execution."

KI_LOT_EXISTS_MSG,"Lot Data already exists!\n\nDo you want to append data to the
   lot?\n\nPress YES to append to the existing lot data.\nPress NO to DELETE the
   old lot data\nand create a NEW lot data file.\nPress ABORT to stop execution."

KI_OK_CANCEL_MSG,"Press OK to Continue\nCancel to ABORT"
KI_LOAD_CASS_MSG,"Load Wafer Cassette(s).\n\nWhen ready press OK to continue or
   CANCEL to ABORT test program"

KI_LOAD_WAFER_MSG,"Load/Unload Wafer from chuck"
KI_FRONT_LOAD_MSG,"Manually Load/Profile/Align Wafer.\n\nMove chuck to target die"
KI_FRONT_UNLOAD_MSG,"Manually UnLoad Wafer"

KI_NO_MAP_MSG,"Could not map any cassettes."

#
#-------------------------------------------------------------------------------
# The following values have sprintf arguments embedded within. The arguments
# MUST EXIST in any changes that you make
#-------------------------------------------------------------------------------
#
KI_PROBER_ERROR_MSG,"PROBER ERROR %i has occurred.\nPlease clear the error.\nPress
   'Continue' for current wafer\nPress 'Skip' to skip current wafer\nPress 'Abort'
   to ABORT the test program."

KI_KDF_ERROR_MSG,"KTXE ERROR, %s returned status = %d\nYou can attempt to correct
   the problem\nand retry or abort the test program\n\nDo you wish to retry
   %s?\n\nPress OK to RETRY the operation\nPress CANCEL to ABORT\n"

KI_RESUME_MSG,"Resume lot id: %s ??"

KI_CASS_NOT_LOADED_MSG,"Cassette %d Not loaded"

KI_CASS_UNMAP_MSG,"Unmapped wafers found in cassette %d.  Please wait for mapping
   to complete"

<EOLOC>
```

Appendix C

KTE Tool file structure examples

In this appendix:

Data file extensions

The following topics contain examples of the data files that are created by the different tools in the Keithley Test Environment (KTE) software. The extensions for each of the data files are:

- `.wdf`: The Wafer Description File created by the Wafer Description Utility (WDU).
- `.tsf`: The Test Structure File created by the Test Structure Editor (TSE).
- `.ktm`: The Keithley Test Macro created by the Keithley Interactive Test Tool (KITT).
- `.pcf`: The Probe Card File created by KITT.
- `.gdf`: The Global Data File created by KITT.
- `.psf`: The Parameter Set File created by the Parameter Set Editor (PSE).
- `.klf`: The Keithley Limits File created by the Limits File Editor (LFE).
- `.wpf`: The Wafer Plan File created by the Wafer Plan Editor in the Keithley Test Program Manager (KTPM).
- `.cpf`: The Cassette Plan File created by the Cassette Plan Editor in KTPM.
- `.krf`: The Keithley Recipe File created by the Keithley Recipe Manager (KRM) Tool.
- `.kdf`: The Keithley Data File created by an executed test, to be used by the Keithley Summary Utility (KSU).
- `.uap`: The user access point (UAP) file used by KTPM and the Keithley Test Execution Engine (KTXE).
- `.kpf`: The Keithley Plot File created by KITT, to be used by the Keithley Curve Analysis Tool (KCAT).
- `.c`: The Keithley User Library Tool (KULT) module file. Used and created by KULT.

Wafer description file format

Filename

`wafer_description_file.wdf`

Format

```
#Keithley Wafer Description File
Version,n.n
File,file_path_and_name.wdf
Date,mm/dd/yyyy
Comment,comment string
Project,project_type
DiameterUnits,english_or_metric
Diameter,diameter_measurement
Units,english_or_metric
DieSizeX,x.x
DieSizeY,y.y
Orientation,notch_or_flat,position
WaferOffset,x,y
Axis,axis
Origin,x,y
Target,x.x,y.y
AutoAlignLocation,x.x,y.y
Optimize,optimization_style
RevID,$Revision: n.n $
<EOH>
Pattern,pattern_name
site_or_project_name,x,y
site_or_project_name,x,y
Pattern,pattern_name
site_or_project_name,x,y
site_or_project_name,x,y
<EOSITES>
Site,project_name,probe_description
subsite_name,x.x,y.y
subsite_name,x.x,y.y
<EOSUBSITES>
```

Header

This section contains general information about the file.

- `Version`: Contains the current version number.
- `File`: Contains the path and filename (with `.wdf` extension) of the Wafer Plan Definition File.
- `Date`: Contains the date the file was last edited, in Y2K-compliant form.
- `Comment`: May contain any relevant text, up to 256 characters.
- `Project`: Contains the project type (either `Single` or *`Multiple`*).
- `DiameterUnits`: Contains the diameter measurement system (either `English` or `Metric`).
- `Diameter`: Contains the diameter measurement in inches or millimeters, selected from a list of choices as specified in `wdu.ini`.

- `Units`: Contains the die size measurement system (either `English` or `Metric`). This is separate from the diameter units, which means that the wafer diameter can be specified in English units while the rest of the size and position information can be specified in Metric units, and vice-versa.
- `DieSizeX`: Contains the x measurement of the die size in mils or microns. If this is a multiple-project wafer, this field must be 0; site x-y values will be specified in mils or mm instead of die offsets.
- `DieSizeY`: Contains the y measurement of the die size in mils or microns. If this is a multiple-project wafer, this field must be 0; site x-y values will be specified in mils or mm instead of die offsets.
- `Orientation`: Contains the orientation marker (either `Notch` or `Flat`) and the position of the marker (either `Top`, `Bottom`, `Right`, or `Left`).
- `WaferOffset`: Contains two pixels used by the Wafer Description Utility (WDU) only. The wafer offset is for graphics use only; however, it is very important to be able to align the grid on the wafer to match the grid as presented by lithography tools. The maximum X and Y offset values are equal to the die size.
- `Axis`: Contains the proper axis number (`1` to `4`). The different numbers stand for the following orientations:
  - `1` = X, right; Y, up
  - 2 = X, left; Y, up
  - 3 = X, left; Y, down
  - 4 = X, right; Y, down
- `Target`: Contains the target die coordinates for alignment. For multiple projects, this field contains the target offset coordinates for the first probed site.
- `AutoAlignLocation`: Contains the offset coordinates (using the orientation of the `Axis`, above) from the notch or flat, to the alignment die. This is an optional line used to help position the wafer on the prober so the operator must only validate the position and, if necessary, do some fine adjustments. This would be unused for fully automated probers as the alignment information would be in the product files. This value is saved, but not used in the current Keithley Test Execution Engine (KTXE); however, a user access point (UAP) is provided at the point where the alignment of the first wafer should be done.
- `Optimize`: Contains the optimization style as a serpentine pattern number (`1` to `8`). If the wafer is to be probed as listed, `0` should be used in this field.
- `RevID, $Revision: n.n $`: Field for Version Control option, where `n.n` is the revision number for the option.

The header section terminates with the `<EOH>` tag.

Sites

This section contains pattern names with sites. The first line in each pattern defines the pattern name.

- `Pattern`: contains the pattern name. This one-word string must be a valid C-identifier: It must start with a nonnumeric character, and must contain only letters (a through `z`, `A` through `Z`), digits (`0` to `9`), and the underscore character (_).

This line is followed by any number of sites or projects to be associated with the pattern. Each line contains these fields:

- The site name (for single-project wafers) or the project name (for multiple-project wafers) that is to be associated with the pattern.
- The x coordinate.
- The y coordinate.

This section terminates with the `<EOSITES>` tag.

Subsites

This section specifies subsites. Multiple-project wafers can have several such entries, while single-project wafers should have only one. The first line of each entry contains these fields:

- The keyword `Site`.
- The project name. For single-project wafers, this is the string `Single`. For multiple-project wafers, this can be any valid C-identifier as described above, up to 32 characters.
- The project description. For single-project wafers, this should also be the string `"Single"`. For multiple-project wafers, this can be any relevant text.

This line is followed by a list of subsites, one per line, each containing these fields:

- The subsite name. This can be any valid C-style string as described above.
- The x coordinate of the subsite.
- The y coordinate of the subsite.

This section terminates with the `<EOSUBSITES>` tag.

General Notes

Lines that begin with a # are ignored.

If a file is multiple-project, that means that multiple site types are possible. A site name must be entered for each site to be probed. A list of subsites will be entered for each site type (each site type has a unique site name). Tests will still be bound to subsites. All sites within a probe pattern must contain the same subsites, although they may be in different locations.

There is no graphical representation of multiple-project wafers currently in WDU. The pattern, site, and subsite information is entered directly into the appropriate tables.

Wafer Description Files are generated by WDU, and can be found in the `$KI_KTXE_WDF` directory.

Test structure file format

Filename

`subsite_name.tsf`

Format

```
#Keithley Test Structure File
Version,n.n
File,file_path_and_name.tsf
Date,mm/dd/yyyy
Id,id_string
Comment,comment_string
RevID,$Revision: n.n $
<EOH>
devname,STRING,device_name
device_data_name,datatype,value
device_data_name,datatype,value
<EODEV>
devname,STRING,device_name
device_data_name,datatype,value
device_data_name,datatype,value
<EODEV>
<EOTSF>
```

Header

This section contains general information about the file.

- `Version`: Contains the current version number.
- `File`: Contains the path and file name (with `.tsf` extension) of the Test Structure File. The file name must match a subsite name referenced in the Keithley Test Macro (`.ktm`) and the Wafer Description File (`.wdf`).
- `Date`: Contains the date the file was last edited, in Y2K-compliant form.
- `Id`: May contain any relevant text, up to 255 characters.
- `Comment`: May contain any relevant text, up to 255 characters.

The header section terminates with the `<EOH>` tag.

Devices

These sections define the devices of the test structure. Each line contains these fields:

- The data name. This string need not be a valid C-identifier; it may contain nonalphanumeric characters, including spaces. The only constraint is that it may not include commas.
- The data type. All data types defined in `kiox_def.h` are supported. In addition, a special data type, `IDENTIFIER`, may be used to reference a predefined probe card or global identifier.
- The data value. This must be of the type specified in the second field. If it is a `STRING`, the only constraint is that it may not contain commas.

The first line of each section must have `devname` in the first field, `STRING` in the second field, and the device name itself in the third field. This device name must be unique within the test structure (but may be used in other Test Structure Files). Each device section terminates with the `<EODEV>` tag.

General Notes

The Test Structure File terminates with the <EOTSF> tag. Lines that begin with a # are ignored.

Test Structure File is generated by Test Script Editor (TSE) and can be found in the $KI_KTXE_TSF directory.

Keithley test macro (.ktm)

```
/*>> KITT MODULE GENERATION VERSION Vn.n date_and_time */
RevID,$Revision: n.n $ /*n.n is the revision number.*/
/*>> KTM TEST MODULE DESCRIPTION FOR macro_name */
/*
description of the macro
*/
/*>> KTM WAFER & SUBSITE NAME
   wafer_description_file_name
         subsite_name
END KTM WAFER & SUBSITE NAME*/
/*>> KTM PROBE CARD FILE NAME
   probe_card_file__name
   END KTM PROBE CARD FILE NAME*/
/*>> KTM GLOBAL DATA FILE NAME
   global_data_file_path_and_name.gdf
   END KTM GLOBAL DATA FILE NAME*/
/*>> KTM CONSTANT & GENERAL PURPOSE VARIABLES */
/*>> KTM TEST MODULE VARIABLES FOR macro_name */
   datatype variable_name; /* for module_name */
         datatype variable_name; /* for module_name */
   /* Global Pre-Defined Identifiers */
         datatype constant_name = value; /* Constant Declaration */
         datatype constant_name = value; /* Constant Declaration */
   /* Local Pre-Defined Identifiers */
         datatype constant_name = value; /* Constant Declaration */
         datatype constant_name = value; /* Constant Declaration */
/*>> KTM TEST MODULE CONSTANTS SETTINGS
   constant_name, datatype,constant_type,value,
   constant_name, datatype,constant_type,value,
   END CONSTANTS SETTINGS*/
/*>> KTM TEST MODULE PLOT AND LOG ***DO NOT MODIFY***
   variable_name,plot_code,log_code,number,user_code
         variable_name,plot_code,log_code,number,user_code
         END PLOT AND LOG SETTINGS*/
/*>> KTM TEST MODULE BEGIN USRLIB INFORMATION
   user_library_name,user_library_name,
         KTM TEST MODULE END USRLIB INFORMATION*/
/*>> KTM TEST MODULE TEST SEQUENCE FOR macro_name */
   module(param1,param2);
         variable=module(param1,param2);
```

Header

This section contains general information about the file. The entries in this section are marked by the following banners:

- `KITT MODULE GENERATION VERSION`: This banner contains the version number and the date and time the macro was last edited. The date and time take the form `day mon dd tt:tt:tt yyyy` (example: `Mon Jan 01 01:00:00 2000`).
- `KITT TEST MODULE DESCRIPTION`: Contains a description of the macro, which can be any relevant text. The macro name is included in the banner.
- `KTM WAFER & SUBSITE NAME`: Contains the name of the associated Wafer Description File (without `.wdf` extension). This may include a path if necessary; if no path is specified, then the file is presumed to be located in the `$KI_KTXE_WDF` directory.
- `KTM PROBE CARD FILENAME`: Contains the name of the associated Probe Card File (without `.pcf` extension). This may include a path if necessary; if no path is specified, then the file is presumed to be located in the `$KI_KTXE_PCF` directory. This banner and entry are optional, and may be omitted if no `.pcf` is associated with the macro.
- `KTM GLOBAL DATA FILENAME`: Contains the name of the associated Global Data File (without `.gdf` extension). This may include a path if necessary; if no path is specified, then the file is presumed to be located in the `$KI_KTXE_GDF` directory. This banner and entry are optional, and may be omitted if no `.gdf` is associated with the macro.

Declarations

This section declares the variables necessary to run the macro, and specifies some important settings. The entries in this section are marked by the following banners:

- `KTM CONSTANT & GENERAL PURPOSE VARIABLES`: Is a reserved section.
- `KTM TEST MODULE VARIABLES`: Contains the declarations for the variables necessary to run the macro. The first, untitled segment of this section declares the variables first used in the body of the macro; each declaration is followed by a comment describing which module uses the variable. The second segment, titled `Global Pre-Defined Identifiers`, declares and initializes the global constants specified under the Pre-Defined Identifiers tab in the Keithley Data Editor. Similarly, the third section, titled `Local Pre-Defined Identifiers`, declares and initializes the local constants specified under the Pre-Defined Identifiers tab in the Keithley Data Editor. The macro name is included in the banner.
- `KTM TEST MODULE CONSTANTS SETTINGS`: Contains a list of constants and their properties. Each line contains these fields:
  - The constant name. This string should be a local or global identifier specified under the `KTM TEST MODULE VARIABLES` banner.
  - The datatype. This can be any type specified in `kiox_def.h`, but it should correspond to the C-type the constant was declared as above.
  - The constant type. This can be either `GLOBAL` or `LOCAL`.
  - The value associated with the constant name.

- KTM TEST MODULE PLOT AND LOG: Contains Keithley Interactive Test Tool (KITT) configuration information for each of the test module variables (but not for the constants). Each line in this entry contains these fields:
  - The variable name. This string should be an identifier specified under the KTM TEST MODULE VARIABLES banner.
  - The variable plot code. This can be either PLOT_X if Keithley Curve Analysis Tool (KCAT) should use the results of this variable as x values, PLOT_Y if you want KCAT to use the values of this variable as y values, or PLOT_OFF if KCAT should ignore the variable.
  - The variable log code. This can be either LOG_ON if you want the variable results to be written to a log file, or LOG_OFF if the results should not be logged.
  - A number.
  - The variable user code. This can be either USER_ON if you want to see the results of this variable presented in a scrolling window while the test is running, or USER_OFF if the results should remain hidden.

Body

This section details the macro routine. Each line is composed of a module call using appropriate parameters. If the module returns a value, then a variable may be used to capture this return value in the form of `variable = module(param1,param2);`. Each line ends with a semicolon.

General Notes

A .ktx extension on a Test Macro File means that KITT has tagged the file as containing errors.

Test Macro Files are generated by KITT and can be found in the $KI_KTXE_KTM directory.

Probe card file format

Filename

probecard_file.pcf

Format

```
#Keithley Probe Card Definition File
Version,n.n
File,file_path_and_name.pcf
Date,mm/dd/yyyy
Id,id_string
Comment,comment_string
RevID,$Revision: n.n $
<EOH>
pin_name,datatype,pin_number
pin_name,datatype,pin_number
<EOPINS>
```

Header

This section contains general information about the file.

- `Version`: Contains the current version number.
- `File`: Contains the path and filename (with `.pcf` extension) of the Probe Card File.
- `Date`: Contains the date the file was last edited, in Y2K-compliant form.
- `Id`: May contain any relevant text, up to 255 characters.
- `Comment`: May contain any relevant text, up to 255 characters.

The header section terminates with the <`EOH`> tag.

Pins

This section maps alphanumeric symbols to actual pin numbers. Each line contains these fields:

- The pin name. This one-word string must start with a nonnumeric character, and must contain only letters (a through `z`, `A` through `Z`), digits (`0` to `9`), and the underscore character (_).
- The data type of the pin. Currently, this is always `INT`, but this field is included here to allow for future support of other data types (example: `Pinlist`).
- The actual pin number.

This section terminates with the <`EOPINS`> tag.

General Notes

Any line that begins with a `#` is ignored.

Probe Card Files are generated by the Keithley Data Editor in KITT and can be found in the `$KI_KTXE_PCF` directory.

Global data file format

Filename

`global_data_file.gdf`

Format

```
#Keithley Global Data Definition File
Version,n.n
File,file_path_and_name.gdf
Date,mm/dd/yyyy
Id,id_string
Comment,comment string
RevID,$Revision: n.n $
<EOH>
data_name,datatype,value
data_name,datatype,value
<EOGDF>
```

Header

This section contains general information about the file.

- Version: Contains the current version number.
- File: Contains the path and filename (with .gdf extension) of the Global Data File.
- Date: Contains the date the file was last edited, in Y2K-compliant form.
- Id: May contain any relevant text.
- Comment: May contain any relevant text.

The header section terminates with the <EOH> tag.

Data Definitions

This section defines specific variables. Each line contains these fields:

- The data name. This one-word string must start with a nonnumeric character, and must contain only letters (a through z, A through Z), digits (0 to 9), and the underscore character (_).
- The data type. All data types defined in kiox_def.h are supported.
- The data value. This must be of the type specified in the second field.

This section terminates with the <EOGDF> tag.

General Notes

Any line that begins with a # is ignored.

Global Data Files are generated by the Keithley Data Editor in KITT and can be found in the $KI_KTXE_GDF directory.

Parameter set file format

Filename

`Userlibrary_paramset.psf`

Format

```
#Keithley Parameter Set File
Version,n.n
File,file_path_and_name.psf
Date,mm/dd/yyyy
Id,id_string
Comment,comment string
RevId,$Revision: n.n $
<EOH>
MODULE,module_name
PARAMSET,parameter_set_name
module_paramset_parameter,datatype,value
module_paramset_parameter,datatype,value
<EOPS>
PARAMSET,parameter_set_name
module_paramset_parameter,datatype,value
module_paramset_parameter,datatype,value
<EOPS>
<EOMODULE>
<EOLIB>
```

Header

This section contains general information about the file.

- `Version`: Contains the current version number.
- `File`: Contains the path and filename (with `.psf` extension) of the Parameter Set File. The filename should have the form *`userlibrary`*`_parmset.psf`, where *`userlibrary`* is the name of the user library the Parameter Set File is associated with.
- `Date`: Contains the date the file was last edited, in Y2K-compliant form.
- `Id`: May contain any relevant text.
- `Comment`: May contain any relevant text.

The header terminates with the <`EOH`> tag.

Modules

This section defines a module by listing all the parameter sets associated with it. One line is needed before getting into the parameter sets:

- `MODULE`: Contains the module name. This one-word string must start with a nonnumeric character, and must contain only letters (a through `z`, A through `Z`), digits (`0` to `9`), and the underscore character (_).

This line is followed by any number of Parameter Sets (see information following). This section terminates with the <`EOMODULE`> tag.

Parameter Sets

These sections define parameter sets. The first line in each section is the PARAMSET line:

- PARAMSET: Contains the name of the parameter set. This one-word string follows the same rules as the module name, above.

This is followed by a list of parameter definitions, one per line. Each line contains these fields:

- The parameter name. This follows the standard naming rules outlined above.
- The data type. All data types defined in kiox_def.h are supported.
- The data value. This must be of the type specified in the second field.

Each Parameter Set terminates with the <EOPS> tag.

General Notes

The Parameter Set File terminates with the <EOLIB> tag. Lines that begin with a # are ignored.

Parameter Set Files are generated by the Parameter Set Editor (PSE) and can be found in the $KI_KTXE_PSF directory.

Parameter limits file format

Filename

limits_file.klf

Format

```
#Keithley Parameter Limits File
Version,n.n
File,file_path_and_name.klf
Date,mm/dd/yyyy
Comment,comment_string
RevID,$Revision: n.n $
<EOH>
ID,parameter_id
NAM,parameter_name
UNT,parameter_units
CAT,parameter_category
RPT,y_or_n
CRT,critical_flag
TAR, target_value
AF,abort_destination
AL,abort_action
VAL,val_low, val_high
SPC,spc_low, spc_high
CNT,cnt_low, cnt_high
ENG,eng_low, eng_high
ena,enabled flag
cla,class data
usr1,user data field 1
usr2,user data field 2
usr3,user data field 3
<EOL>
```

Header

This section contains general information about the file.

- `Version`: Contains the current version number.
- `File`: Contains the path and filename (with `.klf` extension) of the Parameter Limits File.
- `Date`: Contains the date the file was last edited, in Y2K-compliant form.
- `Id`: May contain any relevant text.
- `Comment:` May contain any relevant text, up to 246 characters. The default comment created by the Limits File Editor (LFE) is `KLF`.

The header section terminates with the `<EOH>` tag.

Limits

These section provides important data about each parameter, including four sets of production limits.

- `ID`: Contains the unique ID of the parameter. This string must be a valid C-identifier. This string may contain a total of 40 characters.
- `NAM`: Contains the name of the parameter. This string need not be a valid C-identifier; it may contain nonalphanumeric characters, including spaces. The only constraint is that it must not include commas. This string may contain a total of 40 characters.
- `UNT`: Contains the units of the parameter. This string need not be a valid C-identifier; it may contain nonalphanumeric characters, including spaces. The only constraint is that it must not include commas. This string may contain a total of 10 characters.
- `CAT`: Contains the category of the parameter. Each category must be a single-word string, but one parameter can belong to several categories, as long as all the categories are listed (comma or whitespace-delimited) on this line, and do not total more than 20 characters.
- `RPT`: Contains either a `Y` for yes or an `N` for no, depending on whether or not the limit is to be included in the lot summary report compiled by the Keithley Summary Utility (KSU).
- `CRT`: Contains `0` (zero) if the parameter is noncritical and any single digit number from `1` to `9` if the parameter is critical; thus, nine different categories of critical parameters can be designated.
- `TAR`: Contains the target value specification for the parameter. Code can use this value to calculate, on a percent under-over basis, the limits for runtime or report comparisons.
- `AF`: Contains the abort action code. If the Keithley Test Execution Engine (KTXE) runs into an abort condition (see `AL`, below), it will go to the next {subsite (`SS`), site (`S`), wafer (`W`), or lot (`L`)} depending upon the code in this field.
- `AL`: Contains one of the limits (`VAL`, `SPC`, `CNT`, `ENG`) to be used for qualifying the parameter value. KTXE will abort if it comes across a data value that fails to satisfy the limit conditions specified in this field.
- `VAL`: Contains the validity limits, typically used to check for faults within the testing system. A low limit and a high limit can be specified.
- `SPC`: Contains the manufacturing standard's limits. A low limit and a high limit can be specified.
- `CTR`: Contains the process control limits. A low limit and a high limit can be specified.
- `ENG`: Contains the engineering limits, typically used by engineers to make sure components meet design standards. A low limit and high limit can be specified.

- `ena`: Contains either a `Y` for yes or an `N` for no, depending on whether or not the parameter is to be included in the adaptive test. Used only with the Adaptive Test option software.
- `cla`: Contains class data. Can be used with the enable flag or as user data.
- `usr1`: Contains user data. Can contain up to 255 characters of information.
- **usr2**: Contains user data. Can contain up to 255 characters of information.
- `usr3`: Contains user data. Can contain up to 255 characters of information.
- Each parameter's limits section terminates with the `<EOL>` tag.

General Notes

Lines that begin with a # are ignored.

Parameter Limits Files are generated by the Limits File Editor (LFE) and can be found in the `$KI_KTXE_KLF` directory.

Wafer test plan file format

Filename

`wafer_plan_file.wpf`

Format

```
#Keithley Wafer Plan Definition File
Version,n.n
File,file_name.wpf
Date,mm/dd/yyyy
Comment,comment string
Wafer,wafer_file_name.wdf
Limits,limits_file_name.klf
Probe,probe_file_name.pcf
SS_SORT,yes_or_no
RevID,$Revision: n.n $
<EOH>
Siteplan,siteplan_name,description of siteplan
macro_file_name.ktm
macro_file_name.ktm
Siteplan,siteplan_name,description of siteplan
macro_file_name.ktm
macro_file_name.ktm
<EOSP>
siteplan_name,probe_pattern
siteplan_name,probe_pattern
macro_file_name.ktm,probe_pattern
macro_file_name.ktm,probe_pattern
<EOW>
```

Header

This section contains general information about the file.

- Version: Contains the current version number.
- File: Contains the filename (with .wpf extension) of the Wafer Plan Definition File. This may be preceded by the path to the file, but if no path is specified the file is assumed to reside in the $KI_KTXE_WPF directory.
- Date: Contains the date the file was last edited, in Y2K-compliant form.
- Comment: May contain any relevant text, up to 255 characters.
- Wafer: Contains the name (with .wdf extension) of the appropriate Wafer Description File. This may be preceded by the path to the file, but if no path is specified the file is assumed to reside in the $KI_KTXE_WDF directory. This line allows pin mappings to be set for each wafer. This line is ignored if the Cassette Plan File specifies a Wafer Description File.
- Limits: Contains the name of the appropriate Parameter Limits File (with .klf extension). This may be preceded by the path to the file, but if the path is not specified the file is assumed to reside in the $KI_KTXE_KLF directory. This line is optional.
- Probe: Contains the name (with .pcf extension) of the appropriate Probe Card File. This may be preceded by the path to the file, but if no path is specified the file is assumed to reside in the $KI_KTXE_PCF directory. This line allows the probed locations to be set for each wafer. This line is ignored if the Cassette Plan File specifies a Probe Card File. This line is optional.
- SS_SORT: Contains either YES or NO, depending on whether the subsites should be sorted.

The header section terminates with the <EOH> tag.

Site plans

This section defines site plans. Each site plan entry contains these fields:

1. The keyword Siteplan.
2. The site plan name. This one-word string must start with a nonnumeric character, and must contain only letters (a through z, A through Z), digits (0 to 9), and the underscore character (_).
3. A description of the site plan.

This line is followed by a list of Test Macro File names (with .ktm extension) to be included in the site plan, one per a line. Each of these may be preceded by the path to the file, but if no path is specified the file is assumed to reside in the $KI_KTXE_KTM directory. This section terminates with the <EOSP> tag.

Probe patterns

This section associates probe patterns with site plans. Each line has these fields:

1. The name of the object to associate with the probe pattern. This can be either the name of a site plan (as defined above) or a name and optional path of a Test Macro File (with .ktm extension) not already associated with a site plan.
2. The name of a probe pattern.

This section terminates with the <EOW> tag.

General notes

Lines that begin with a # are ignored.

The Execution Engine reads the wafer plans specified in the Cassette Plan File. The Wafer Plan File contains abort condition checks from the `.klf`, pin mapping from the `.pcf`, and the macro-to-probe-pattern mapping information. The probe pattern and subsite position information for this Wafer Plan File is contained in the `.wdf`.

Wafer Plan Files are generated by the Wafer Plan Editor in Keithley Test Program Manager (KTPM), and can be found in the `$KI_KTXE_WPF` directory.

Cassette test plan file format

Filename

`cassette_plan_file.cpf`

Format

```
#Keithley Cassette Plan Definition File
Version,n.n
File,file_name.cpf
Date,mm/dd/yyyy
Comment,comment string
Data,lot_id
Engine,execution_engine
Probe,probe_card_file_name.pcf
Wafer,wafer_card_file_name.wdf
Global,global_data_file_name.gdf
UAPdefaults,uap_defaults_file_name.uap
RevID,$Revision: n.n $
<EOH>
slot_id,wafer_id,wafer_plan_name.wpf
slot_id,wafer_id,wafer_plan_name.wpf
<EOS>
uap_name,library_name,uam
uap_name,library_name,uam
<EOUAP>
```

Header

This section contains general information about the file.

- `Version`: Contains the current version number.
- `File`: Contains the filename (with `.cpf` extension) of the Cassette Plan File. This may be preceded by the path to the file, but if no path is specified then the file is assumed to reside in the `$KI_KTXE_CPF` directory.
- `Date`: Contains the date the file was last edited, in Y2K-compliant form.
- `Comment`: May contain any relevant text, up to 256 characters.
- `Data`: Contains the lot ID. If no output filename is specified at runtime, then the program will create a file named *`lot_id`*`.kdf` (where *`lot_id`* is specified here) in the `$KI_KTXE_KDF` directory and use that as the output file.

- `Engine`: Contains the name of the execution engine to be used. There can be more than one test execution engine; however, most customer sites should require only one. For example, there could be a production engine and a development engine; however, user access modules (UAMs) could be used to distinguish these different modes of operation...switches are available to change what a single Keithley Test Execution Engine (KTXE) will do for a specific run.
- `Probe`: Contains the name of the appropriate Probe Card File (with `.pcf` extension). This may be preceded by the path to the file, but if no path is specified then the file is assumed to reside in the `$KI_KTXE_PCF` directory. This line is optional; if the `.pcf` is specified here it will override any `.pcf` files specified in any wafer plan files.
- `Wafer`: Contains the name of the appropriate Wafer Description File (with `.wdf` extension). This may be preceded by the path to the file, but if no path is specified then the file is assumed to reside in the `$KI_KTXE_WDF` directory. This line is optional; if the `.wdf` is specified here it will override any `.wdf` filename specified in the `.wpf`.
- `Global`: Contains the name of the appropriate Global Data File (with `.gdf` extension). This may be preceded by the path to the file, but if no path is specified then the file is assumed to reside in the `$KI_KTXE_GDF` directory. This line is optional. Global data can be specified in a `.gdf` file. This information will be created with the Keithley Data Editor (KDE) and read in by the KTXE. The data precedence is set to:
  - PDI - local scope
  - PCF data
  - GDF data
  - PDI - global scope

  Multiple `.gdf` files can be selected for a single `.cpf`.
- `UAPdefaults`: Contains the name of the appropriate User Access Points Defaults File (with `.uap` extension). This may be preceded by the path to the file, but if no path is specified then the file is assumed to reside in the `$KI_KTXE_UAP` directory. This line is optional. This mechanism will allow multiple UAMs to be grouped into a single file of type `.uap`. This file can be created with any text editor. Each line in the file must conform to the syntax as specified in the user access point (UAP) section of the `.cpf` file.

The header section terminates with the `<EOH>` tag.

Slots

This section associates slots with Wafer Plan Files. Each line contains these fields:

- The slot ID. There are several options here. If the ID is absolute, then this field should only contain the slot number. If the ID is relative, than this field should contain the character `R` immediately followed by the slot number. All the slots can be referenced at one time here by using the keyword `ALL`. Finally, if the keyword `OPR` is used here, then the operator will be prompted to specify the slot during the test execution.
- The wafer ID. This one-word string may contain up to 32 characters, must start with a nonnumeric character, and must contain only letters (a through `z`, `A` through `Z`), digits (`0` to `9`), and the underscore character (_). If the first field reads `ALL` or `OPR`, this field should be left blank.
- The filename of the appropriate Wafer Plan File (with `.wpf` extension). This may be preceded by the path to the file, but if no path is specified then the file is assumed to reside in the `$KI_KTXE_WPF` directory.

It must be noted that having multiple wafer plans will have an impact on the Keithley Summary Utility (KSU). Summaries could be per wafer plan (for example, there could be different parameters or different limits). If the same wafer plan will be used for all the wafers in a cassette then only one line is needed. This line must have the keyword `All` in the first field, a blank second field, and the path and filename of the designated Wafer Plan File. Absolute and relative slot references cannot be used in the same file (the prober must be able to load the wafers in order). This section terminates with the <EOS> tag.

User access points

This section modifies the Execution Engine at designated user access points (UAPs). Each line contains these fields:

1. The UAP name. This is the string that identifies the UAP. The `ktpm.ini` file contains lists of the UAPs that are included in each of the available test execution engines.
2. The library name.
3. The user access module (UAM). This can be either a module in the user library specified in the second field, an expression of the form *return_value=module_name(param1,param2)* using said module, or the name of a Test Macro File (with `.ktm` extension). If it is the latter, the second field should be left empty.

This section allows you to extend (customize) KTXE by creating code to be inserted at designated spots (UAPs) by KTXE. You can specify the modules (UAMs) to be included at any UAPs by modifying this section. This section terminates with the <EOUAP> tag.

General Notes

Lines that begin with a # are ignored.

Cassette Plan Files are created by the Cassette Plan Editor in Keithley Test Plan Manager (KTPM) and can be found in the `$KI_KTXE_CPF` directory.

The Keithley Data File (KDF) library is being modified to support user-defined data. This information is contained within the KDF file with the following format:

```
<TAG>"tagName",tag value string
```

- The <TAG> field is required.
- The `"tagName"` field can contain any characters except the double-quote character. The maximum length of the `tagName` is `PARAM_ID_LENGTH` (128) characters.
- The comma is required and separates the `tagName` field from the tag value string field.
- The `tag value string` has a maximum length of 512 characters and cannot contain the new-line character.

Keithley data file format

Filename

`data_file.kdf`

Format

```
TYP,file_typ
LOT,lot_name
PRC,process_name
DEV,device_name
TST,test_name
SYS,system_name
TSN,test_station_id_string
OPR,operator_name_string
STT,dd,mmm,yyyy, tt:tt
SK1,usr_data_1
SK2,usr_data_2
SK3,usr_data_3
LMT,limit_file_name
WDF,wafer_description_file_name
COM,comment_string
<EOH>
wafer_id,wafer_split,wafer_boat,wafer_slot
site_id,row,column
param_id,value
param_id,value
<EOS>
site_id,row,column
param_id,value
param_id,value
<EOS>
<EOW>
wafer_id,wafer_split,wafer_boat,wafer_slot
site_id,row,column
param_id,value
param_id,value
<EOS>
site_id,row,column
param_id,value
param_id,value
<EOS>
<EOW>
```

Header

This section contains general information about the file.

- TYP: Contains the type of the file; typically reads KDF V*n.n*, where *n.n* is the version number.
- LOT: Contains the name of the lot. This string may contain up to 50 characters.
- PRC: Contains the process name. This string may contain up to 50 characters.
- DEV: Contains the device name. This string may contain up to 50 characters.
- TST: Contains the test name. This string may contain up to 255 characters.
- SYS: Contains the system name. This string may contain up to 20 characters.
- TSN: Contains the test station ID integer (1 to 4).
- OPR: Contains the operator name. This string may contain up to 30 characters.
- STT: Contains the date and time the file was created, in Y2K-compliant form.
- SK1: Contains a user search key. This string may contain up to 30 characters.
- SK2: Contains a user search key. This string may contain up to 20 characters.
- SK3: Contains a user search key. This string may contain up to 10 characters.
- LMT: Contains the Parameter Limits File name. This string may contain up to 80 characters.
- WDF: Contains the Wafer Description File name. This string may contain up to 80 characters.
- COM**:** May contain any relevant text, up to 256 characters.

The header terminates with the <EOH> tag.

Wafers

These sections lists all the sites within a given wafer. One line is needed before getting into the site sections, and that line contains these fields:

- The wafer ID. This one-word string must be a valid C-style identifier; it must start with a nonnumeric character, and must contain only letters (a through z, A through Z), digits (0 to 9), and the underscore character (_).
- The wafer split. This optional one-word string must be a valid C-style identifier as described above.
- The wafer boat. This optional one-word string must be a valid C-style identifier as described above.
- The wafer slot. This one-word string must be a valid C-style identifier as described above.

This line is followed by any number of sites (see below). Each wafer section terminates with the <EOW> tag.

Sites

These sections report the data for each site. The first line in each section contains these fields:

- The site ID. This one-word string must be a valid C-style identifier as described above.
- The site row number.
- The site column number.

This line is followed by a list of all the measurements that were taken for that site, one per line. Each line contains these fields:

- The parameter ID. This is the C-style identifier string that matches a parameter ID in the Parameter Limits File.
- The numeric value of the measurement.

Each site section terminates with the `<EOS>` tag.

General Notes

Lines that begin with a # are ignored.

Data files are generated by test executions, and can be found in the `$KI_KTXE_KDF` directory.

User access point file format

Filename

`user_access_point_file.uap`

Format

```
#Keithley UAP File
Version,n.n
File,file_path_and_name.uap
Date,mm/dd/yyyy
Id,id_string
Comment,comment_string
RevID,$Revision: n.n $
<EOH>
uap_name,user_library_name,routine_name_or_expression
uap_name,user_library_name,routine_name_or_expression
<EOUAP>
```

Header

This section contains general information about the file.

- `Version`: Contains the current version number.
- `File`: Contains the path and filename (with `.uap` extension) of the UAP File.
- `Date`: Contains the date the file was last edited, in Y2K-compliant form.
- `Id`: May contain any relevant text.
- `Comment`: May contain any relevant text.

The header section terminates with the `<EOH>` tag.

User access points

This section defines the user access points (UAPs). Each line contains these fields:

- The UAP name.
- The user library name of the module you want to use at this UAP.
- A routine name or an expression using the routine name. If an expression is used, it must be of the form `return_value = routine_name(param1,param2)`.

This section terminates with the `<EOUAP>` tag.

General Notes

Any line that begins with a # is ignored.

Keithley plot file format

Filename

`plot_file.kpf`

Format

```
#<KTE>Keithley Results File
#<VERSION>n.n
#<DELIMITER>,
parameter1_id,parameter2_id,parameter3_id,
site1_parameter1_data,site1_parameter2_data,site1_parameter3_data,
site2_parameter1_data,site2_parameter2_data,site2_parameter2_data,
```

Header

This section contains general information about the file.

- `VERSION`: Contains the current version number.
- `DELIMITER`: Contains a single character (usually `,`) to serve as a delimiter while listing the data points.

Every line in this section begins with a `#`.

Parameters

This section is just one line long. It lists the variables specified in in the Keithley Interactive Test Tool (KITT), separated by the delimiter specified in the header. The delimiter also ends the line.

Data

This section lists the actual data values for each parameter above. Each line represents one site worth of data values. The values are simply written out in the same order as the parameter section, separated by the delimiter specified in the header. The delimiter also ends the line.

General Notes

Plot files are generated by the Results Window in KITT, and can be found in the `$KI_KTXE_KDF` directory.

KULT module file format

Filename

`kult_module_file_name.c`

Format

```
/* USRLIB MODULE INFORMATION
   MODULE NAME: kult_module_name
   MODULE RETURN TYPE: datatype
   NUMBER OF PARAMS: n
   ARGUMENTS:
   param, datatype, input_or_output, default, min , max
   param, datatype, input_or_output, default, min, max
#include <header_file_name.h>
#include <header_file_name.h>
END USRLIB MODULE INFORMATION
*/
   /* USRLIB MODULE HELP DESCRIPTION
   END USRLIB MODULE HELP DESCRIPTION */
/* USRLIB MODULE VERSION CONTROL */
static char const vcid[] ="$Id: kult_module_name.c,v 1.2 2000/09/27 14:09:43 user
   Exp $";
/* USRLIB MODULE PARAMETER LIST */
   #include <header_file_name.h>
   #include <header_file_name.h>
   datatype kult_module_name( datatype param, datatype param )
{
         /* USRLIB MODULE CODE */
   code_body
   /* USRLIB MODULE END */
}
/*End kult_module_name.c */
```

INCLUDES:

Header

This section contains general information about the file. There are two banners in this header. The first banner reads `USRLIB MODULE INFORMATION`, and contains the following entries:

- `MODULE NAME`: Contains the name of the module (incidentally, the Keithley User Library Tool (KULT) module file name itself should be the name of the module with `.c` extension.)
- `MODULE RETURN TYPE`: Contains the datatype of the module's return value. This is restricted to the following types: `char`, `float`, `double`, `int`, `long`, and `void`.
- `NUMBER OF PARAMS`: Contains the number of parameters the module takes.

- ARGUMENTS: Details information about each of the parameters, one per line. Each line contains these fields:
  - The name of the parameter. This one-word string should be a valid C-style identifier; it must start with a nonnumeric character, and must contain only letters (a through z, A through Z), digits (0 to 9), and the underscore character (_).
  - The datatype of the parameter. This can be any of (or a pointer to any of) the following types: char, double, float, int, long. Three array types are also available: F_ARRAY_T (for floats), D_ARRAY_T (for doubles), and I_ARRAY_T (for ints). If an array type is used, then the next line must be the entry for the number of elements in this array, and should have the form ArrSizeForarray_param, int, Input, default, min, max, where *array_param* is the name of the array.
  - Either Input or Output, depending on the purpose of the parameter.
  - The default value of the parameter. This field is optional, but if it is used then the type should match the datatype in the second field. If the type in the second field is an array, then this field should be left empty.
  - The minimum value of the parameter. This field is optional, but if it is used then the type should match the datatype in the second field. If the type in the second field is an array, then this field should be left empty.
  - The maximum value of the parameter. This field is optional, but if it is used then the type should match the datatype in the second field. If the type in the second field is an array, then this field should be left empty.
- INCLUDES: Lists all of the header files that are to be included in the module, in the standard C compiler-directive format.

The next banner reads USRLIB MODULE HELP DESCRIPTION, which may be followed by any number of lines of text commentary about the module.

Include directives

This section actually instructs the compiler to include the header files listed in the header section. After the banner USRLIB MODULE PARAMETER LIST, the include files should be listed exactly the way they appear in the header section.

Code body

This section contains the actual code used by the compiler. The function header (not to be confused with the header section as detailed above) should include all of the parameters listed in the header section. If an array is declared in the header section, then the parameter should be listed in the function header as a pointer to the type of array declared (double, float, or int). The function header is followed by a pair of curly brackets; between them is all of the code necessary to execute the module.

General Notes

Every KULT Module File is a C-language document, but not every C-language document is a KULT Module File. To be a KULT Module File, the C-language document must conform to the format explained above.

Test Macro Files are generated by KULT and can be found in the $KI_KULT_PATH/usrlib directory, where usrlib is the name of the module's user library.

Appendix D

Data pool

In this appendix:

Data pool

The data pool is used to hold global data while the Keithley Test Execution Engine (KTXE) is running. When KTXE is started, the variables declared in the global data files and probe card file are copied into the data pool. The data pool is accessible at any point during test execution. This allows you to access global variables in test macros generated in the Keithley Interactive Test Tool (KITT) and also pass data pool items as parameters to modules generated from the Keithley User Library Tool (KULT) that are run at user access points (UAPs).

For example, you could be using global data in your Keithley Test Module (KTM). When KTXE executes a test macro and encounters a variable, it checks for the variable in the following order:

1. KTXE checks the variable against the list of Pre-Defined Identifiers (PDIs) of local scope. If the variable is found, it is passed on to the test macro.
2. If the variable is not found in the local PDIs, the data pool is then searched and the variable is passed on to the test macro.

The data pool is also used to look up variables for parameters that are passed to KULT-generated modules when they are run at the UAPs. When you select UAPs in Keithley Test Program Manager (KTPM) and start the user access module selector to choose the KULT module, you will have to enter the values for each of the parameters of the module. For the values of the parameters, you can type in absolute values or specify a variable that is in the data pool. When KTXE processes the UAPs, it checks to see if the parameter being passed to the module is an absolute or a variable value. If a variable is being passed, the value of the variable is looked up in the data pool.

Since the data pool holds global data, the variables in the data pool are updated as they are changed. For example, if KTXE executes a test macro that contains instructions that modify the value of a variable in the data pool (for example, a data pool variable is used as a return value variable), the data pool is updated as soon as the value of the variable is changed. This allows the results generated from the execution of one macro to be used in another macro or at a UAP.

KTXE puts the items listed in the following table into the data pool.

Data pool items

Name	Type	Initial value	First available	Last usable
KI_ktxe_redo_macro	**INT**	**0**	**UAP_SITE_CHANGE**	**UAP_SITE_END**
Flag that allows a macro to be re-executed. Set this at or before UAP_TEST_END or UAP_TEST_DATA_LOG to retest. Any non-zero value means retest. This flag is reset automatically to zero once it is set. Multiple retests will require the flag to be set each time.				

Name	Type	Initial value	First available	Last usable
KI_ktxe_retest_wafer	**INT**	**0**	**UAP_WAFER_BEGIN**	**UAP_WAFER_END**
Flag that allows a wafer to be retested. Set this at or before UAP_WAFER_END to retest. Any non-zero value means retest. This flag is reset automatically to zero once it is set. Multiple retests will require the flag to be set each time.				

Name	Type	Initial value	First available	Last usable
KI_ktxe_skip_limits_check	**INT**	**0**	**UAP_TEST_DATA_LOG**	**UAP_TEST_DATA_LOG**
If set to 1, causes KTXE to skip the default limit/results checking for abort conditions. The user can use their own custom checking routine at UAP_TEST_END, or UAP_TEST_DATA_LOG. If custom routines are used, this flag MUST BE SET at or before UAP_TEST_DATA_LOG, else the default limit check routine could/would reset the abort flag(s).				

Name	Type	Initial value	First available	Last usable
KUI_User	**LONG_P**	**&KUI_User**	**UAP_PROG_ARGS**	**UAP_LOT_INFO**

Pointer to the KUI_User structure. This allows access to two user-defined fields on the KTXE Status Dialog window. The KUI_User structure is initialized to NULL by default, causing the user fields to be invisible. Initializing the "label_1" or "label_2" fields at or before UAP_LOT_INFO, will enable the user fields and make them visible on the Status Window.

Example:

```
#include "kui_proto.h"
#include "COM_usrlib.h"

kui_user_t *user ;
long *tmp ;

tmp = ( long *)dpGetPointer( "KUI_User", LONG_P ) ;
if ( tmp == NULL )
  return ;

user = ( kui_user_t *)*tmp ; /* <---- VERY IMPORTANT to de-reference tmp */

/* Initialize field 1 */
strcpy( user->label_1, "First Label " ) ;
strcpy( user->data_1, "Data for first field" ) ;

/* Initialize field 2 */
strcpy( user->label_2, "Second Label " ) ;
strcpy( user->data_2, "Data for second field" ) ;

KTXEUpdateStatusAbort( "Forcing update of display..." ) ;
```

Name	Type	Initial value	First available	Last usable
ManualProberType	**INT**	**0**	**UAP_PROG_ARGS**	**UAP_PROBER_INIT**

Flag to tell KTXE that we have a CM61-type prober that will allow a PrLoad command. You must set this value via a Global Data file or at UAP_PROG_ARGS in order for this to take effect.

Name	Type	Initial value	First available	Last usable
ManualWaferLoad	**INT**	**0**	**UAP_PROG_ARGS**	**UAP_PROBER_INIT**

Flag to tell KTXE that we have a prober that allows front-access loading of single wafers. You must set this value via a Global Data file or at UAP_PROG_ARGS in order for this to take effect.

Example: You have an EG4080 prober and want to load a single wafer via the front access tray. Set the ManualWaferLoad flag to 1 in a global data file referenced by your cassette plan and run KTXE with said cassette plan. You will be prompted to manually load/profile/align the wafer and press OK. The wafer will be tested normally. You will then be prompted to manually unload the wafer.

Name	Type	Initial value	First available	Last usable
UAP_abort_level	**INT**	**uap_abort_level**	**after a UAP is executed**	**after a UAP is executed**

Return value of a UAP routine if assigned in KTPM. Can be used to cause KTXE to abort after a UAP is executed. If the UAP returns the value KI_ABORT, KTXE will exit.

Example

A UAP description within a cassette plan file as:

UAP_TEST_END,myLib,UAP_abort_level=MyUAProutine()

will cause KTXE to exit if MyUAProutine returns KI_ABORT.

Name	Type	Initial value	First available	Last usable
abort_code	**INT**	**-1**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**
abort_code_description	**CHAR_P**	**&abort_code_description**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**
These two values are used by the UAP_ABORT_EXIT_HDLR routines. They can be set to user-defined values for abort handing.				

Name	Type	Initial value	First available	Last usable
abort_level	**INT_P**	**&abort_level;**	**UAP_SITE_CHANGE**	**UAP_ENGINE_EXIT**

Value that determines the abort level of a limit.
Example:

```
int *abort_level ;
enum abort_level_t abort_code ;
/* something happens to require the abort_code to be set to one
 * of the following:
 */
abort_code = NOABORT ;
abort_code = SUBSITEABORT ;
abort_code = SITEABORT ;
abort_code = WAFERABORT ;
abort_code = LOTABORT ;
/* Check abort code and react accordingly
* set the abort level flag for the proper skip action
* (the execution engine will handle the abort just as if a limit/result
* pair had caused an abort...)
*/
abort_level = ( int *)dpGetPointer( "abort_level", INT_P ) ;
*abort_level = abort_code ;
if ( NOABORT == abort_code )
 return ;
/* we are here so this means we need to skip something...
 * Skip the  "normal" limit/result list abort checking so we don't
 * reset the abort code that we just set up!!
 */
dpAddData( "KI_ktxe_skip_limits_check", INT, 1 ) ;
```

Name	Type	Initial value	First available	Last usable
cl_kwf_fname	**CHAR_P**	**cl_kwf_fname**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**
Wafer description filename entered from "-w" command-line switch.				

Name	Type	Initial value	First available	Last usable
confirm_oper_wafers	**INT**	**0**		
If this value is set to 1 and the operator selects an empty slot for OPERATOR MODE, an error message will be displayed. This value is set to off by default.				

Name	Type	Initial value	First available	Last usable
cpf_info	**LONG_P**	**cpf_info**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**

Pointer to the cassette plan info structure.

```
typedef struct
{
       char version[MAXVERSIZE];
       char cpfname[MAXFILENAMESIZE];
       char ascdatetime[MAXDATESTRSIZE];
       char comment[MAXCOMMENTSTRSIZE];
       char uapdefaults[MAXENGNAMESTRSIZE];
       char engine[MAXENGNAMESTRSIZE];
       char pcffname[MAXFILENAMESIZE];
       gdffname_list_t *gdffname_list;
       char kdffname[MAXFILENAMESIZE];
       char wdffname[MAXFILENAMESIZE];
       slot_list_t *slot_list;
       uap_list_t *uap_list;
}
cpf_info_t;
```

Name	Type	Initial value	First available	Last usable
current_slot_list	**LONG_P**	**& current_slot_list**	**UAP_LOT_INFO**	**UAP_ENGINE_EXIT**

Pointer to the current_slot_list element. Updated each wafer.

Example:

```
long *tmp ;
slot_list_t *slot ;
/* Get the current slot list pointer..
 */
tmp = ( long *)dpGetPointer( "current_slot_list", LONG_P )  ;
slot = ( slot_list_t *) *tmp ;
```

Structure definition:

```
typedef struct _slot_list
{
       char        slot[SLOTNAMESIZE];
       char        wafer_id[MAXWAFERID];
       char        split_id[MAXWAFERID];
       char        wpfname[MAXFILENAMESIZE];
       char        plan_wpfname[MAXFILENAMESIZE];
       struct _slot_list *next;
}
slot_list_t ;
```

Name	Type	Initial value	First available	Last usable
current_wwp_list	**LONG_P**	**current_wwp_list**	**UAP_SITE_CHANGE**	**UAP_SITE_END**

Pointer to the current node of the working wafer plan (WWP) list. Updated each Macro.
Structure definition: See type definition for wwp_list_t in $KIHOME/include/ktxe_types.h.

Name	Type	Initial value	First available	Last usable
cur_wwp_list_ptr	**LONG_P**	**&current_wwp_list**	**UAP_SITE_CHANGE**	**UAP_SITE_END**

This is a pointer to the current_wwp_list pointer value. This allows execution flow adjustment by manipulation of the current_wwp_list pointer value.

Example:

```
wwp_list_t *wwp ;
long *foo ;
foo = ( long *)dpGetPointer( "cur_wwp_list_ptr", LONG_P ) ;
wwp = ( wwp_list_t *) *foo  ;
/* Skip until Site_3 node
*/
if( wwp->next != NULL )
{
       while ( wwp->next != NULL )
       {
              if ( strcmp( wwp->next->siteid, "Site_3" ) == 0 )
                     break ;
              else
                     wwp = wwp->next  ;
       }
}
/* adjust the current_wwp_list value
 */
*foo = (long) wwp ;
```

Name	Type	Initial value	First available	Last usable
display_lotdlg	**INT_P**	**&display_lotdlg**	**UAP_PROG_ARGS**	**UAP_LOT_INFO**

Flag to enable/disable Lot Dialog display. Defaults to 1, or enabled. MUST be updated at or before UAP_LOT_INFO.

Example:

```
int *logDlg ;
/* disable the display of the Lot Dialog screen
 */
lotDlg = ( int *)dpGetPointer( "display_lotdlg", INT_P ) ;
*lotDlg = 0 ;
```

Name	Type	Initial value	First available	Last usable
failed_result_list	**LONG_P**	**failed_result_list**	**UAP_HANDLE_ABORT**	**UAP_HANDLE_ABORT**

Pointer to a results list containing results that failed the limits checking. Use this for any custom abort handling requirements.

Name	Type	Initial value	First available	Last usable
ktm_list	**LONG_P**	**ktm_list_head**	**UAP_VALIDATE_OCR**	**UAP_WAFER_END**

Pointer to the list of all KTMs used in a wafer plan. This is updated each wafer before UAP_WAFER_BEGIN.

Structure definition:

```
typedef struct _ktm_list
{
       char ktmfname[MAXFILENAMESIZE];
       char wafpatname[MAXWAFPATNAMESIZE];
       struct _ktm_list *next;
}
ktm_list_t;
```

Name	Type	Initial value	First available	Last usable
ktxe_abort_logging	**INT_P**	**&ktxe_abort_logging**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**
Flag to enable logging of the limits abort.				

Name	Type	Initial value	First available	Last usable
ktxe_cpf_mode	**INT**	**cassette plan probe mode**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**
Flag that indicates the probe mode of the cassette plan. This value is set when the Cassette plan is loaded. This flag can be useful for Prober error recovery sequencing. ALL_MODE = 1 OPR_MODE = 2 ABS_MODE = 3 REL_MODE = 4				

Name	Type	Initial value	First available	Last usable
ktxe_debug	**INT_P**	**&ktxe_debug**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**
Debug flags from "-x" command-line switch.				

Name	Type	Initial value	First available	Last usable
ktxe_disable_exec_log	**INT**	**undefined**		
Flag that prevents the execution log from being placed into KDF file. Define flag (set to 1) at or before UAP_WRITE_LOT_INFO. This data pool switch is only effective while KTXE is executing a recipe. Refer to the Recipe Manager documentation for additional information about the execution log.				

Name	Type	Initial value	First available	Last usable
ktxe_disable_kdf	**INT**	**FALSE**	**UAP_PROG_ARGS**	**UAP_WAFER_END**
Flag for disabling standard kdf data logging.				

Name	Type	Initial value	First available	Last usable
ktxe_disable_ktm	**INT**	**FALSE**	**UAP_PROG_ARGS**	**UAP_LOT_END**
Flag for disabling macro test execution.				

Name	Type	Initial value	First available	Last usable
ktxe_disable_kui	**INT**	**FALSE**	**UAP_PROG_ARGS**	**UAP_LOT_END**
Flag for disabling user interface for KTXE.				

Name	Type	Initial value	First available	Last usable
ktxe_disable_load_cassette_msg	**INT**	**FALSE**	**UAP_PROG_ARGS**	**UAP_PROBER_INIT**
Flag for disabling "Load Cassette" message dialog.				

Name	Type	Initial value	First available	Last usable
ktxe_disable_plan_complete_msg	**INT**	**FALSE**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**
Flag for disabling the "KTXE Plan Complete" message.				

Name	Type	Initial value	First available	Last usable
ktxe_disable_prober	**INT**	**FALSE**	**UAP_PROG_ARGS**	**UAP_WAFER_END**
Flag for disabling default KTXE prober routines.				

Name	Type	Initial value	First available	Last usable
ktxe_disable_statdlg	**INT**	**0**	**UAP_PROG_ARGS**	**UAP_LOT_INFO**
Flag for disabling KTXE status dialog window. Set this flag to 1 to disable the KTXE status dialog window or add to a global data file used by the recipe or cassette plan.				

Name	Type	Initial value	First available	Last usable
ktxe_disable_uap	**INT**	**FALSE**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**
Flag for disabling execution of UAP routines.				

Name	Type	Initial value	First available	Last usable
ktxe_enable_cl_log	**INT**	**FALSE**	**UAP_PROG_ARGS**	**UAP_POST_LOT_INFO**
Flag for enabling/disabling logging of command line arguments. Set this flag to 1 to log KTXE command-line arguments to the KDF file. Set this flag to 0 to prevent logging. Defaults: Cassette plan mode: 0 (prevents logging); Recipe mode: 1 (allows logging). A global data file or a UAP routine can be used to alter the state of this variable.				

Name	Type	Initial value	First available	Last usable
ktxe_disable_exec_log	**INT**	**FALSE**	**UAP_PROG_ARGS**	**UAP_POST_LOT_INFO**
Flag for disabling logging of list of files. Set this flag to 1 to prevent list of files used by a recipe from being logged into the KDF file.				

Name	Type	Initial value	First available	Last usable
ktxe_enable_doc	**INT**	**FALSE**	**UAP_PROG_ARGS**	**UAP_PROG_ARGS**
Flag for enabling test execution documentation data collection.				

Name	Type	Initial value	First available	Last usable
ktxe_error_gui	**INT**	**0**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**
Flag for defining the behavior of KTXE when an error occurs. Default, (ktxe_error_gui undefined or set to other than 1 or 2), errors are written to the error log. If ktxe_error_gui == 1; error msg will be displayed and the user has the option to continue or quit. If ktxe_error_gui == 2; error msg will be displayed and the user can only quit.				

Name	Type	Initial value	First available	Last usable
ktxe_fill_opr_dlg	**INT**	**0**	**UAP_PROG_ARGS**	**UAP_PROBER_INIT**
Flag for enabling/disabling the initialization of the Wafer ID dialog window. If this flag is set to 1, the Wafer ID dialog window will be filled with the wafers available from the PrCassetteMap call. If this flag is set to 0, the Wafer ID dialog window will be empty. Default state is 0.				

Name	Type	Initial value	First available	Last usable
ktxe_min_SS_touch	**INT**	**ktxe_min_SS_touch**	**UAP_PROG_ARGS**	**UAP_WAFER_PREPARE**
Flag that enables/disables subsite touchdown minimalization to occur. Default state is 1, enabled. This flag is ONLY effective when the ktxe_sort_subsite_ktms flag is disabled. If the wafer plan file specified multiple macros at a subsite, and the macros are not listed together, this flag will determine if the probes will touch-down multiple times at the same subsite, or only once. Must be updated at or before UAP_WAFER_PREPARE.				

Name	Type	Initial value	First available	Last usable
ktxe_missingSS_ok	**INT**	**0**		
Set to non-zero to suppress the "missing Subsite error" messages. This will allow the KTDT Validation step to pass without error.				

Name	Type	Initial value	First available	Last usable
ktxe_reload_wafer_plan	**INT**			**UAP_WAFER_END**
Wafer plan reloading may be forced by defining this data pool item. If a working wafer plan (WWP) list has been modified, it will be necessary to define this item to force the next WWP list to be reset to the original. This item must be added at or before each UAP_WAFER_END. This item is removed at the end of each wafer loop.				

Name	Type	Initial value	First available	Last usable
ktxe_report_no_klf	**INT**	**1**	**UAP_PROG_ARGS**	**UAP_WAFER_PREPARE**
This flag defaults to value 1 and if set to 0 will cause KTXE to suppress the generation of a "Missing Limits File" error message.				

Name	Type	Initial value	First available	Last usable
ktxe_report_no_pcf	**INT**	**1**	**UAP_PROG_ARGS**	**UAP_WAFER_PREPARE**
This flag defaults to value 1 and if set to 0 will cause KTXE to suppress the generation of a "Missing Probe Card File" error message.				

Name	Type	Initial value	First available	Last usable
ktxe_sort_subsite_ktms	**INT**	**ktxe_sort_subsite_ktms**	**UAP_PROG_ARGS**	**UAP_WAFER_PREPARE**
Flag that enables/disable subsite sorting to occur. Default state is 1, enabled. Disabling this flag will cause macros to be executed in the order specified by the wafer plan file. Must be updated at or before UAP_WAFER_PREPARE.				

Name	Type	Initial value	First available	Last usable
last_prober_call	**CHAR_P**	**last_prober_call**		
Pointer to the last prober function which encountered an error. This item is updated in KTXESUP/KTXEProberErrorMessage which is used by the Execution Engine. This data pool value can be used at UAP_PRB_ERR_HDLR.				

Name	Type	Initial value	First available	Last usable
last_prober_error	**INT_P**	**last_prober_error**		
Pointer to the last prober which encountered an error. This item is updated in KTXESUP/KTXEProberErrorMessage which is used by the Execution Engine. This data pool value can be used at UAP_PRB_ERR_HDLR.				

Name	Type	Initial value	First available	Last usable
last_subsite	**LONG_P**	**last_subsite**		
Pointer to the last subsite structure. Updated after subsite change. This is used to assist in getting subsite timing information. Refer to KTXEAddIn:KTXEShowSubsiteTime module for details.				

Name	Type	Initial value	First available	Last usable
limit_list	**LONG_P**	**limit_list**	**UAP_VALIDATE_OCR**	**UAP_WAFER_END**
Pointer to the limits list returned by GetLimit. Updated each wafer, if the Wafer Plan file has a limits file specified.				

Name	Type	Initial value	First available	Last usable
limithashtab	**LONG_P**	**&limithashtab[0]**	**UAP_WAFER_BEGIN**	**UAP_WAFER_END**

Pointer to the hash table used for fast lookups of limit values.
Example:

```
LIMIT **limithashtab;
LIMIT *limit_list;

limithashtab = (LIMIT**)dpGetPointer( "limithashtab"’ LONG_P);
limit_list = (LIMIT *)limithashtab[ hash( result_id, HASHSIZE ) ];
while(limit_list != NULL)
{
    if (strcomp( result_id, limit_list->id ) == 0 )
        break ; /* we have the limit we are looking for... */

    limit_list = limit_list->nexth ;
}
```

Name	Type	Initial value	First available	Last usable
lot	**LONG_P**	**lot**	**UAP_PROBER_INIT**	**UAP_ENGINE_EXIT**
Pointer to lot structure.				

Name	Type	Initial value	First available	Last usable
lotadd	**INT_P**	**&lotadd**	**UAP_PROBER_INIT**	**UAP_WRITE_LOT_INFO**

Flag that determines if PutLot will append data to an exist lot file, or create a new lot file. Values are APPENDLOT or CREATELOT. Must be set before or at UAP_WRITE_LOT_INFO.
Example:

```
int *lotAdd ;
/* set up for append to lot data
 */
lotAdd = ( int *)dpGetPointer( "lotadd", INT_P ) ;
*lotAdd =  APPENDLOT ;
```

Name	Type	Initial value	First available	Last usable
lotid	**CHAR_P**	**lot->id**	**UAP_PROBER_INIT**	**UAP_ENGINE_EXIT**

Lot id string.

Name	Type	Initial value	First available	Last usable
maxErrEvtLines	**INT_P**	**maxErrEvtLines**	**UAP_PROG_ARGS**	**UAP_PROG_ARGS**

Pointer to the maxErrEvtLines variable used to determine the maximum buffer size of the Error/Event Message Dialog window. Value is lines to display. Change this value at UAP_PROG_ARGS.
Example:

```
int *maxLines ;
/* get pointer from data pool
 */
maxLines = ( int *)dpGetPointer( "maxErrEvtLines", INT_P ) ;
*maxLines =  newMaxLinesValue ;
```

Name	Type	Initial value	First available	Last usable
maxScrollLines	**INT_P**	**maxScrollLines**	**UAP_PROG_ARGS**	**UAP_PROG_ARGS**

Pointer to the maxScrollLines variable used to determine the maximum buffer size of the Scrolling Msg dialog window. Value is lines to display. Change this value at UAP_PROG_ARGS.
Example:

```
int *maxLines ;
/* get pointer from data pool
 */
maxLines = ( int *)dpGetPointer( "maxScrollLines", INT_P ) ;
*maxLines =  newMaxLinesValue ;
```

Name	Type	Initial value	First available	Last usable
next_wwp_list	**LONG_P**	**&previous_wwp_list**	**UAP_SITE_CHANGE**	**UAP_SITE_END**

Pointer to the next WWP list node that is scheduled to be executed. This is updated each time a macro is executed.
Structure definition: See wwp_list_t in ktxe_types.h. definition.

Name	Type	Initial value	First available	Last usable
next_wwp_list_ptr	**LONG_P**	**&previous_wwp_list**	**UAP_SITE_CHANGE**	**UAP_SITE_END**

This is a pointer to the next_wwp_list pointer value. This can be adjusted to alter execution flow if desired.

Name	Type	Initial value	First available	Last usable
previous_wwp_list	**LONG_P**	**&previous_wwp_list**	**UAP_SITE_CHANGE**	**UAP_SITE_END**
Pointer to the previous WWP list node that was actually executed. This is updated each time a macro is executed. See type definition for wwp_list_t in $KIHOME/include/ktxe_types.h.				

Name	Type	Initial value	First available	Last usable
prev_wwp_list_ptr	**LONG_P**	**&previous_wwp_list**	**UAP_SITE_CHANGE**	**UAP_SITE_END**
This is a pointer to the previous_wwp_list pointer value. This can be adjusted to alter execution flow if desired.				

Name	Type	Initial value	First available	Last usable
prober_wafer_id	**CHAR_P**	**&prober_wafer_id**	**UAP_VALIDATE_OCR**	**UAP_WAFER_END**

Pointer to the wafer id as read from the prober OCR, if supported. If prober does not support OCR, wafer id is determined by value in cassette plan, or default value of Wafer_xx, where xx is the slot number.
Example:

```
char *stringPtr ;

stringPtr = ( char *)dpGetPointer( "prober_wafer_id", CHAR_P ) ;
printf( "old id: <%s>\n", stringPtr ) ;

/* Make sure you do not over-run the array!!
 * Currently prober_wafer_id is sized 256 characters
 */
strcpy( stringPtr, "A different wafer id" ) ;
```

Name	Type	Initial value	First available	Last usable
product_file	**CHAR_P**	**&product_file**	**UAP_PROG_ARGS**	**UAP_PROBER_INIT**
Prober Product file string. Must be updated at or before UAP_PROBER_INIT.				

Name	Type	Initial value	First available	Last usable
result_list	**LONG_P**	**NULL**	**UAP_TEST_END**	**UAP_HANDLE_ABORT**
Pointer to the results list created by a KTM.				

Name	Type	Initial value	First available	Last usable
site	**LONG_P**	**site**	**UAP_SITE_CHANGE**	**UAP_SITE_END**
Pointer to the site structure. Updated before UAP_SITE_CHANGE.				

Name	Type	Initial value	First available	Last usable
sites_tested	**INT_P**	**&sites_tested**	**UAP_SITE_CHANGE**	**UAP_ENGINE_EXIT**
Pointer to number of sites tested. Updated before UAP_SITE_CHANGE.				

Name	Type	Initial value	First available	Last usable
skip_first_wafer_load	**INT**	**skip_first_wafer_load**	**UAP_PROG_ARGS**	**UAP_POST_LOT_INFO**
Flag to skip the first KTXE PrLoad, PrProfile, and PrAlign calls. Must be updated at or before UAP_WRITE_LOT_INFO. Use the kult routine KTXEAddIn:KTXEOperatorLoadAlign routine at UAP_WRITE_LOT_INFO. This flag is used for P8 and other probers that need the first wafer loaded manually.				

Name	Type	Initial value	First available	Last usable
skip_next_wafer_load	**INT**	**skip_next_wafer_load**	**UAP_PRB_ERR_HDLR**	**UAP_WAFER_END**
Flag to skip the next KTXE PrLoad, PrProfile, and PrAlign calls. Must be updated at UAP_PRB_ERR_HDLR. Use the kult routine KTXEAddIn:KTXESkipNextWaferLoad routine at UAP_PRB_ERR_HDLR. This flag is used for any prober that the operator can, during testing, cycle to the next wafer manually.				

Name	Type	Initial value	First available	Last usable
subsite	**LONG_P**	**subsite**	**UAP_SUBSITE_CHANGE**	**UAP_SUBSITE_END**
Pointer to the subsite structure. Updated at subsite change.				

Name	Type	Initial value	First available	Last usable
sum_report_options	**CHAR_P**	**sum_report_options**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**
Summary report options from KTXE "-s" command-line switch.				

Name	Type	Initial value	First available	Last usable
total_sites	**INT_P**	**&total_sites**	**UAP_WAFER_BEGIN**	**UAP_ENGINE_EXIT**
Pointer to total number of sites to be tested. Updated before UAP_WAFER_BEGIN.				

Name	Type	Initial value	First available	Last usable
total_wafers	**INT_P**	**&total_wafers**	**UAP_POST_PROBER_INIT**	**UAP_POST_ENGINE_EXIT**
Pointer to total wafers to be tested value. Updated after UAP_PROBER_INIT.				

Name	Type	Initial value	First available	Last usable
user_arg	**CHAR_P**	**user_arg**	**UAP_PROG_ARGS**	**UAP_ENGINE_EXIT**
User argument entered from "-u" command-line switch.				

Name	Type	Initial value	First available	Last usable
wafer	**LONG_P**	**wafer**	**UAP_VALIDATE_OCR**	**UAP_WAFER_END**
Pointer to the wafer structure. Updated at wafer change.				

Name	Type	Initial value	First available	Last usable
wafers_tested	**INT_P**	**&wafers_tested**	**UAP_WAFER_BEGIN**	**UAP_WAFER_END**
Pointer to number of wafers tested. Updated before UAP_WAFER_BEGIN.				

Name	Type	Initial value	First available	Last usable
wdfptr	**LONG_P**	**wdfptr**	**UAP_POST_PROBER_INT**	**UAP_POST_ENGINE_EXIT**
Pointer to the wdfptr, or wafer description structure. Updated before UAP_POST_PROBER_INIT.				

Name	Type	Initial value	First available	Last usable
wpf_info	**LONG_P**	**wpf_info**	**UAP_VALIDATE_OCR**	**UAP_ENGINE_EXIT**
Pointer to the wafer plan structure. Used by the Analysis Software.				

Name	Type	Initial value	First available	Last usable
wwp_list	**LONG_P**	**wwp_list**	**UAP_WAFER_BEGIN**	**last UAP_SITE_END**
Pointer to the working wafer plan list (WWP list). Updated each wafer, each test, each abort. See type definition for wwp_list_t in $KIHOME/include/ktxe_types.h.				

Advanced data pool use

You can manipulate the data pool in the Keithley User Library Tool (KULT) modules using the data pool functions. You must be careful about using these functions because the improper use may cause fatal errors. The list of functions that follow allow you to add, modify, remove, and print data pool information.

To use the data pool functions in KULT, you must include the `COM_usrlib.h` header file. Type `#include "COM_usrlib.h"` in the Include Files section of the KULT Parameters window.

Most of the data pool functions will require you to pass the data type of the variable that you want to manipulate. You must pass in one of the following data types:

- `INT`, `INT_P`: Integer, Integer Pointer
- `FLOAT`, `FLOAT_P`: Float, Float Pointer
- `LONG`, `LONG_P`: Long, Long Pointer
- `DOUBLE`, `DOUBLE_P`: Double, Double Pointer
- `CHAR`: Character
- `CHAR_P`: String of Characters
- `INT_ARRAY`: Array of Integers
- `FLOAT_ARRAY`: Array of Floats
- `DOUBLE_ARRAY`: Array of Doubles

The following is a list of data pool functions with the descriptions below.

Adding items to the data pool:

```
int dpAddData(char *name, int type, ...);
int dpAddPointer(char *name, int type, void *valuep);
int dpAddArray(char *name, int type, void *valuep, int elements);
```

Getting items from the data pool:

```
void      *dpGetDataPtr(char *name, int type);
void      *dpGetPointer(char *name, int type);
void      *dpGetArrayElement(char *arrname, int type, int element);
```

Removing items from the data pool:

```
void      dpRemoveData(char *name, int type);
```

Printing items in the data pool:

```
void      dpPrintData(char *name, int type);
void      dpPrintAllData(void);
```

Data pool function descriptions

The following topics describe the data pool functions.

dpAddData

This function is used to add new non-pointer type data to the data pool. If data of the same name already exists in the data pool, the type and the value is overwritten with the new data.

Usage

`int dpAddData(char *name, int type, ...);`

name	Input	Character string containing the name of the data
type	Input	Non-pointer type of data (`INT`, `FLOAT`, `LONG`, `DOUBLE`, `CHAR`)
value	Input	Absolute data value; the value is interpreted internally based on the *type* parameter
Return value	Output	Returns one of the following statuses: • `OK_dpAdd`: The add was successful • `FAILED_dpAdd`: There was a problem allocating memory for the data node; the add was unsuccessful

Examples

```
status = dpAddData("MyIntData", INT, 10);
```

```
status = dpAddData("MyFloatData", FLOAT, 10.11);
```

dpAddPointer

This function is used to add pointer-type data to the data pool. If data of the same name already exists in the data pool, the type and the value is overwritten with the new data.

Usage

```
int dpAddPointer(char *name, int type, void *valuep);
```

name	Input	Character string containing the name of the data
type	Input	Pointer type of data (`INT_P`, `FLOAT_P`, `LONG_P`, `DOUBLE_P`, `CHAR_P`)
valuep	Input	Value pointer; see Details
Return value	Output	Returns one of the following statuses: • `OK_dpAdd`: The add was successful • `FAILED_dpAdd`: There was a problem allocating memory for the data node. The add was unsuccessful

Details

When using a dpAddPointer call, the data value being added to the data pool must be either static or malloc'd. Do not use automatic pointers.

Example

```
status = dpAddPointer("MyPointerData", FLOAT_P, floatptr);
```

dpAddArray

This function is used to add arrays to the data pool. If data of the same name already exists in the data pool, the type and the value is overwritten with the new data.

Usage

```
int dpAddArray(char *name, int type, void *valuep, int elements);
```

name	Input	Character string containing the name of the data
type	Input	Array type of data (`INT_ARRAY`, `FLOAT_ARRAY`, `DOUBLE_ARRAY`)
valuep	Input	Pointer to the first element of the array
elements		Number of elements in the array
Return value	Output	Returns one of the following statuses: • `OK_dpAdd`: The add was successful • `FAILED_dpAdd`: There was a problem allocating memory for the data node; the add was unsuccessful

Example

```
status = dpAddArray("MyArrayData", INT_ARRAY, arrayptr, 10);
```

*dpGetDataPtr

This function is used to get a pointer to a value of non-pointer type data (i.e., INT, FLOAT, DOUBLE, LONG, CHAR) in the data pool. This function returns a void pointer. It is the user's responsibility to typecast the value to the appropriate data type.

Usage

`void *dpGetDataPtr(char *name, int type);`

name	Input	Character string containing the name of the data to be extracted from the data pool
type	Input	The data type of the variable
Return value	Output	• If the data of a specified name and type is found in the data pool, a void pointer to the value is returned; it is the user's responsibility to typecast the data to the appropriate data type (for example, `int *`, `float *`, `double *`, `long *`, `char *`) • If the data is not found in the data pool, `NULL` is returned

Example

```
valueptr  =  (int *)dpGetDataPtr("MyInt Data", INT);
```

*dpGetPointer

This function is used to get the pointer value of pointer type data (for example, `INT_P`, `FLOAT_P`, `DOUBLE_P`, `LONG_P`, `CHAR_P`) in the data pool. This function returns a void pointer. It is the user's responsibility to typecast the value to the appropriate type.

Usage

`void *dpGetDataPtr(char *name, int type)`

name	Input	Character string containing the name of the data to be extracted from the data pool
type	Input	The data type of the variable
Return value	Output	• If the data of a specified name and type is found in the data pool, a void pointer to the value is returned; it is the user's responsibility to typecast the data to the appropriate data type (for example, `int *`, `float *`, `double *`, `long *`, `char *`) • If the data is not found in the data pool, `NULL` is returned

Example

```
valueptr  =  (float *)dpGetPointer("MyPointer Data", FLOAT_P);
```

*dpGetArrayElement

This function is used to get a specific element of an array from the data pool.

Usage

```
*dpGetArrayElement(char *arrname, int type, int element)
```

arrname	Input	Character string containing the name of the array
type	Input	The data type of the variable (for example, `INT_ARRAY`, `FLOAT_ARRAY`, `DOUBLE_ARRAY`)
element		Integer value specifying the index of the array
Return value	Output	Returns a pointer to the specific element in the array. • If the specified array name is found in the data pool, a void pointer to the specified element in the array is returned; it is the user's responsibility to typecast the data to the appropriate type `NULL` is returned in one of the following situations: • If the array name is not found in the data pool • If the data requested is not of an array type (for example, `INT_ARRAY`, `FLOAT_ARRAY`, `DOUBLE_ARRAY`) • If the element requested is less than 0 or larger than the number of elements in the array

Example

```
valueptr  =  (int *)dpGetArrayElement("MyArray Data", INT_ARRAY, 7);
```

dpRemoveData

This function is used to remove specific data from the data pool. It will free up the allocated memory for the node in the data pool and the memory for the value of any of the non-pointer type data (for example, `INT`, `FLOAT`, `LONG`, `DOUBLE`, `CHAR`). The user is responsible for reallocating memory for all of the pointer type data and the arrays.

CAUTION

Do not remove any variables put into the data pool by KTXE.
This may cause fatal errors.

Usage

```
void dpRemoveData(char *name, int type);
```

name	Input	Character string containing the name of the data to be removed from the data pool
type	Input	The data type of the variable

Details

This function does not return anything.

Examples

```
dpRemoveData("MyArrayData", INT_ARRAY);
```

```
dpRemoveData("MyPointerData", FLOAT_P);
```

dpPrintData

This function allows the user to print a variable and its value in the data pool by passing the name and type of data.

> **NOTE**
>
> All the `dpPrint` routines print to the location specified in the `KI_KTXE_DEBUG_LOG` environment variable. To print to the screen, set this environment variable to "`/dev/tty`".

Usage

```
void *dpGetDataPtr(char *name, int type);
```

name	Input	Character string containing the name of the data to be printed
type	Input	The data type of the variable

Details

This function does not return anything.

Example

```
dpPrintData("MyIntData", INT);
```

dpPrintAllData

This function allows you to print all the data in the data pool.

NOTE

All the `dpPrint` routines print to the location specified in the `KI_KTXE_DEBUG_LOG` environment variable. To print to the screen, set this environment variable to "`/dev/tty`".

Usage

```
void dpPrintAllData(void)
```

Details

No parameters are required for this function.

This function does not return anything.

Examples

```
dpPrintAllData();
```

Recommendations, hints, and examples

The following are some recommendations and hints about using the data pool:

- Try to avoid using the `dpAdd...` and the `dpRemove...` routines. Remember that when you define a variable in the global data file, it is automatically added to the data pool.
- When using the `dpAdd...` functions, make sure the variable of that name does not already exist in the data pool. If a variable of the same name is already in the data pool, it will be overwritten by the new value you passed in with the `dpAdd` functions.
- When you use the `dpPrint...` functions, make sure the environment variable `KI_KTXE_DEBUG_LOG` is set to the appropriate file location where you want the information logged.
- Do not use the `dpAdd...` or `dpRemove...` functions on any of the variables that the Keithley Test Execution Engine (KTXE) puts into the data pool. This may cause fatal errors.

Example

`dpAddData`/`dpGetDataPtr` example:

```
{
   /* create/initialize value in data pool
    */
   int value ;

   value = 4 ;
   dpAddData( "nameOfElement", INT, value ) ;
}
{
   /* get value from data pool
    */
   int value ;

   value = *(( int *)dpGetDataPointer( "nameOfElement", INT )) ;

   /* value would now equal 4
}
```

`dpAddPointer`/`dpGetPointer` examples:

```
    /* create/initialize value in data pool
     */
    double *dblPtr ;

    /* NOTE: This malloc needs to occur only once. DO NOT call
     * this inside of a loop.
     */
    dblPtr = ( double *) malloc( sizeof( double ) ) ;
    *dblPtr = 5.6 ;

    dpAddPointer( "myPtrName", DOUBLE_P, dblPtr ) ;
}
{
    /* Get value from data pool
     */
    double *dblPtr ;
    double dbl ;

    dlbPtr = ( double *)dpGetPointer( "myPtrName", DOUBLE_P ) ;
    dbl = *dlbPtr ;
    /* dbl = 5.6 now */

    /* Modify value. NOTE that we do not have to "refresh" the
     * data pool. Since this is a pointer data pool value
     */
    *dblPtr = 7.8 ;
}
{
    /* Read modified data pool value
     */

    double *dblPtr ;
    double dbl ;

    dlbPtr = ( double *)dpGetPointer( "myPtrName", DOUBLE_P ) ;
    dbl = *dlbPtr ;
    /* dbl = 7.8 now */
}

    /* CHAR_P usage:
     */
{
    char *stringVar ;

    /* Create and initialize data pool entry
     */
    stringVar = ( char *)malloc( 128 ) ;

    /* Make sure you do not over-run the array size!!
     */
    strcpy( stringVar, "Message goes here" ) ;

    dpAddPointer( "myString", CHAR_P, stringVar ) ;
}
```

```
{
   char *stringPtr ;

   stringPtr = ( char *)dpGetPointer( "myString", CHAR_P ) ;
   /* stringPtr contains "Message goes here" */

   /* Make sure you do not over-run the array size!!
    */
   strcpy( stringPtr, "A different message" ) ;
}
{
   char *stringPtr ;

   stringPtr = ( char *)dpGetPointer( "myString", CHAR_P ) ;
   /* stringPtr contains "A different message" */
}
```

User access points

In this appendix:

User access points (UAPs)

User access points (UAPs) are supported to let you extend the features and functions of a Keithley provided test execution engine. This is done by writing, compiling, and building user libraries. No Keithley provided code needs to be rebuilt. Multiple test execution engines are supported; however, it is expected that necessary execution engine extensions can be accommodated within predetermined UAPs.

UAPs are defined for all execution engines in the system `ktpm.ini` file. An example follows:

```
/* Start of File */
<Engine_List>
Engine1 = ktxe,$KIBIN,Initial KI Execution Engine for V5.x
<ktxe>
UAP1 = UAP_PROG_ARGS,process user’s ktxe command line arguments
UAP2 = UAP_CASSETTE_LOAD,start processing the cassette plan
UAP3 = UAP_LOT_INFO,start setting up the lot file
UAP4 = UAP_PROBER_INIT,start of prober initialization
UAP5 = UAP_WAFER_MISMATCH,mismatch detected between cassette plan and prober
UAP6 = UAP_ACCESS_WDF_INFO,allow access to wdf before call to PrInit
UAP7 = UAP_POST_PROBER_INIT,called to send init commands to prober
UAP8 = UAP_WRITE_LOT_INFO,before writing lot information
UAP9 = UAP_POST_LOT_INFO,write usertag data after LOT header
UAP10 = UAP_WAFERLOAD_STATUS,after a wafer load and the wafer is rejected
UAP11 = UAP_ALIGN_ERROR,error recovery after wafer alignment
UAP12 = UAP_POST_INITIAL_WAFER_LOAD,perform AutoZ after first wafer load
UAP13 = UAP_WAFER_PREPARE,start processing next wafer plan
UAP14 = UAP_VALIDATE_OCR,after OCR and before wafer ID is logged to data file
UAP15 = UAP_WAFER_BEGIN,start executing wafer plan
UAP16 = UAP_SITE_CHANGE,start of next site processing
UAP17 = UAP_SUBSITE_CHANGE,start of next subsite processing
UAP18 = UAP_TEST_BEGIN,start of next ktm processing
UAP19 = UAP_TEST_END,end of processing a ktm
UAP20 = UAP_TEST_DATA_LOG,after test data has been logged
UAP21 = UAP_HANDLE_ABORT,processing an abort condition
UAP22 = UAP_SUBSITE_END,end of current sub-site processing
UAP23 = UAP_SITE_END,end of current site processing
UAP24 = UAP_WAFER_END,end of processing a wafer plan
UAP25 = UAP_LOT_END,end of processing the cassette plan file
UAP26 = UAP_ENGINE_EXIT,before leaving the execution engine
UAP27 = UAP_ABORT_EXIT_HDLR,called as an atexit function
UAP28 = UAP_PRB_ERR_HDLR,called if prober err and function exists
UAP29 = UAP_STATUS_CHANGE,called when pause/cont is pressed on StatDlg
UAP30 = UAP_PROFILE_WAFER,before profiling a wafer
# Place probers that support PrSetSlotStatus here in this list.
# The YES is mandatory!!!
<AbsProbers>
EG40=YES
EG2X=YES
TSK9=YES
P8=YES
# This is used for working off-line. Comment this out if desired
FAKE=YES
/*End of File */
```

User access point usage

User access points (UAPs) can access data items stored or referenced through the data pool. See paragraph on data pool items for more information.

The following is an explanation of what data is accessed or passed at each UAP:

- `UAP_PROG_ARGS`: At this access point, program arguments passed on the command line are available.
- `UAP_CASSETTE_LOAD`: Cassette plan processing begins at this point.
- `UAP_LOT_INFO`: This access point is located before the call to `lotdlg`; if additional information needs to be added to the Lot Information dialog before the operator sees it, here is a good spot.
- `UAP_PROBER_INIT`: The prober will be communicated with for the first time after this access point. If product files on the prober are used, call `KTXEGetproductFile` to set the product filename.
- `UAP_WAFER_MISMATCH`: This UAP is positioned such that it may be used to detect the following situation: In the event of a failure that orphans wafers in the pipeline. The pipeline is defined as: Quick Loader, Pre-Aligner and Chuck. At the `UAP_WAFER_MISMATCH UAP` the wafer positions can be queried (not all probers allow this action; please refer to the Keithley-specific prober manual), and a determination can be made either to continue testing or abort the test. This will potentially save loading and unloading time consumed during wafer recovery.
- `UAP_ACCESS_WDF_INFO`: This UAP will allow the user to access wafer data file (WDF) information prior to prober initialization.
- `UAP_POST_PROBER_INIT`: At this access point, any additional prober initialization commands may be sent.
- `UAP_WRITE_LOT_INFO`: At this access point, any additions to the lot file header may be made before the lot file header is written.
- `UAP_POST_LOT_INFO`: This UAP may be used to add tag data to the lot file before the first wafer is tested.
- `UAP_WAFERLOAD_STATUS`: This UAP may be used to notify a shop-floor control system that the wafer load was completed but the wafer was rejected.
- `UAP_ALIGN_ERROR`**:** This UAP is positioned after the wafer is commanded to auto-align (not all probers allow this action, please refer to the Keithley-specific prober manual). In the event that the alignment fails, this UAP will allow corrective action to take place.
- `UAP_POST_INITIAL_WAFER_LOAD`: At this access point, `AutoZ` is performed after the first wafer load. Note that `AutoZ` is a function of the SofTouch optional licensed feature for the Keithley Test Environment (KTE). For more information on SofTouch, refer to the Prober and Prober Drivers Manual.
- `UAP_WAFER_PREPARE`**:** This is the first access point in the wafer loop. The wafer plan files have not loaded for this wafer at this time. Also, the working wafer plan has not been prepared.
- `UAP_VALIDATE_OCR`: At this access point, the wafer ID read from the prober can be verified or altered. This is the last UAP point before the wafer ID is written to the Keithley Data File (`.kdf`) file.

- `UAP_WAFER_BEGIN`: At this point, the working wafer plan has been prepared, the limits file is loaded into the limits structure, and the probe card file has been loaded. The wafer id has also been read from the prober or generated by the execution engine, and the wafer information has been written to the `.kdf` data file.
- `UAP_SITE_CHANGE`: At each site change, this access point is called.
- `UAP_SUBSITE_CHANGE`: At each subsite change, this access point is called.
- `UAP_TEST_BEGIN`: This UAP is executed immediately before a Keithley Test Module (KTM) is executed.
- `UAP_TEST_END`: This UAP is executed immediately after a KTM is executed.
- `UAP_TEST_DATA_LOG`: At this UAP, test results from the most recent KTM may be logged to another location. Use the "result list" data pool item.
- `UAP_HANDLE_ABORT`**:** This access point is active if any result generated an abort action. It uses the `failed_result_list` structure to determine which result aborted.
- `UAP_SUBSITE_END`: At end of subsite processing, this access point is called.
- `UAP_SITE_END`: At end of site processing, this access point is called.
- `UAP_WAFER_END`: At the end of the working wafer plan execution, this access point is available. The wafer has not been unloaded. Also, the KDF data file has not been marked as the end of the wafer.
- `UAP_LOT_END`: Testing of the lot is now complete, and the KDF data file is closed. For a lot summary report, the `KTXESummaryReport` routine may be used here.
- `UAP_ENGINE_EXIT`**:** This is the last access point before the execution engine completes execution.
- `UAP_ABORT_EXIT_HDLR`: This UAP is called when the execution engine is aborted prior to a test plan completion. The SOLARIS `atexit` function is used to schedule this routine. The Keithley User Interface (KUI) functions may not be used to display information. Use an external program for graphical user interface (GUI) prompts.
- `UAP_PRB_ERR_HDLR`: If a prober error occurs, this UAP is used to call user created recovery code.
- `UAP_STATUS_CHANGE`: This UAP is called when the operator presses the Pause or Continue buttons on the Status Dialog Window, causing an execution state change. This UAP point can be used to notify a shop-floor control system that the tester has been paused.

Types of user access points

There are two different types of user access points (UAPs):

- **User library modules:** Created by the Keithley User Library Tool (KULT)
- **Keithley Test Module (.ktm) files:** Created by the Keithley Interactive Test Tool (KITT)

User library modules

The format for user library modules created by the Keithley User Library Tool (KULT) is:

```
UAP_aaaa,user_library_name,module_name(argl,arg2)
```

- Input arguments come from the data pool
- Output arguments are written to the data pool

Example:

```
UAP_LOT_END,,status = KTXESummaryReport(lot, sum_report_options)
```

Where:

- `lot`: A pointer to a structure (long *) input
- `sum_report_options`: A char string (char *) input
- `status`: The returned value

The parameters `lot` and `sum_report_options` must be in the data pool before this module is accessed. The status return values is created in the data pool if it does not exist or it is updated if it does exist.

User libraries must be the directory tree defined by the environment variable `KI_KULT_PATH` (typically, this is `/opt/ki/usrlib`).

Keithley Test Module files

The formats for .ktm files created by the Keithley Interactive Test Tool (KITT) are:

`UAP_aaaa,,ktm_name` (note default path is KI_KTXE_KTM directory)

`UAP_aaaa,,/path/ktm_name` (full path used)

`UAP_aaaa,,$env_var/ktm_name` (environment variable used; `.ktm` file extension is optional)

Examples:

```
UAP_WAFER_BEGIN, ,measure_air.ktm
```

```
UAP_WAFER_BEGIN, ,/mydirectory/for/uap/ktms/measure_air.ktm
```

```
UAP_WAFER_BEGIN,,$MYUAPKTMS/measure_air.ktm
```

UAP locations

User access points (UAPs) are defined in three different locations:

- Within a UAP file pointed to `$KI_KTXE_SYSTEM_AP`
- Within a standard UAP file
- Within a cassette plan

The UAPs are executed in the order listed above.

Usage of LPTLib functions at UAPs

Linear Parametric Test Library (LPTLib) commands cannot be used at the following user access points (UAPs):

- `UAP_PROG_ARGS`
- `UAP_CASSETTE_LOAD`
- `UAP_LOT_INFO`
- `UAP_ENGINE_EXIT`

LPTLib commands may not be used within user library functions or Keithley Test Modules (KTMs) called at these UAPs.

Distributed user libraries

The following libraries and routines are available for use as reference routines for user access point (UAP) code development.

- **KITTAddIn**: Legacy routines that allow the user to insert or extract data elements into or from arrays. Keithley Test Environment (KTE) version 4.2.2 and later supports array notation within Keithley Interactive Test Tool (KITT) macros, making these routines obsolete.
- **KITTSupport**: `PutUserDataLoggingKTXE` routine to allow the display of run-time results.
- **KI_DEBUG**: Debug routines to allow display of datapool and KTE prober structure contents. Also a routine is provided that creates a global data file (`.gdf`) file from the current contents of the data pool. This `.gdf` file can be used by KITT to aid in debugging macros.
- **KI_UAPLIB**: Contains routines that create and use a subset of the limits list. These routines can be used to validate results against the limits list. These routines can be modified to perform any custom processing of results that exceed a limit value. In this library, some Keithley User Interface (KUI) functions are included.
- **KTXEAddIn**: Routines that demonstrate access to data pool values to control Keithley Test Execution Engine (KTXE) execution flow. The `KTXEOperatorLoadAlign` routine, for example, can be used to prompt the operator to load the first wafer manually for P8-type probers.

Please note that these routines are part of the KTE distribution and are subject to change in future releases. It is recommended that you copy and rename the routine you want in your own libraries for use within KITT and KTXE.

Test macro debugging

Since the data pool is only available while executing the Keithley Test Execution Engine (KTXE – Keithley Interactive Test Tool (KITT) does not generate a global data pool), debugging your Keithley Test Module (KTM) in KITT is very difficult. `DBG_gdfCreate` helps solve this problem by creating a snapshot of the current global data pool while executing KTXE.

By executing the `DBG_gdfCreate` macro at a user access point (UAP) just prior to the point your DTM is experiencing problems, it is possible to capture the contents of the global data pool into a `.gdf` file. This `.gdf` file can then be loaded into KITT along with your KTM to simulate the conditions of your KTM running in KTXE.

Following is a technical description of DBG_gdfCreate ...

```
(void)DBG_gdfCreate(char *gdffile)
```

DBG_gdfCreate is a KITT macro debugging routine that generates a valid Global Data File (.gdf) based on the current contents of the global data pool. This Global Data File will be stored in the location defined by the argument gdffile.

DBG_gdfCreate may be executed at any user access point to generate a snapshot of the current global data pool contents. This .gdf file may then be used in KITT as a means of debugging macros relying on data generated by KTXE at run time.

NOTE

The KI_KTXE_DEBUG_LOG environment variable must be set to a valid filename prior to calling DBG_gdfCreate. An example of this would be setenv KI_KTXE_DEBUG_LOG /tmp/log. KI_KTXE_DEBUG_LOG must not be set to /dev/tty or /dev/null if this log file is used as temporary storage for the data pool data during the creation of the .gdf file.

This function can be found in the KI_DEBUG KULT library.

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