

Integrating Semi-automatic Probe Stations with Keithley Parametric Test Systems

Introduction

This application note explains how to integrate a Micromanipulator 8860 Semi-automatic probing station with a Keithley Model 90 I-V Parametric tester and Metrics ICS software. An engineer will want to integrate the prober, measurement hardware and automation software together to enhance throughput and data analysis. This application note assumes the reader is familiar with the 8860 pcProbe II based prober, ICS and the Keithley Model 90 I-V tester.

Today's failure analysis, product test and device characterization engineers and technicians are constantly faced with the need to maintain efficiency, productivity and flexibility in the use of their laboratory equipment.

Complicating this task is the fact that equipment from multiple vendors is often present in the lab and the integration of various pieces of equipment is left up to the ingenuity and effort of the user.

Through the use of the pcProbe™ Windows™ based Prober Control System, Keithley Model 90 I-V Parametric Test Equipment and ICS-Metrics™ Graphical User Interface, the integration of prober and parametric tester is accomplished easily and cleanly.

pcProbe

The pcProbe™ Prober Control System is a graphical user control system for semi-automatic probing equipment. pcProbe provides remote interactive or programmable control of the prober wafer stage or device holder, probe platen, microscope positioning and focus.

Control is provided via a wafer map with "Point and Shoot" capability, via X, Y, Z positional inputs and via an interactive live video window with "click and drag" positioning

capability. Joystick control of all motorized components is also provided.

Touchdown sensing, auto focus, a condensation-free temperature environment and a shielded low current (fA) environment may be added to the pcProbe™ controlled prober to further enhance the efficiency of the prober and accessories.

Keithley Test System

The Keithley Model 90 I-V Test system is a flexible parametric test system offering multiple configurations in one integrated instrument.

The system features four industry-standard Model 236 SMUs or can be configured with an optional Model 237 High Voltage SMU and a Model 238 High Current SMU. Each instrument can source a voltage and measure current (or vice versa) with 10fA and 10uV measurement sensitivity at reading rates as fast as 1mS.

The system contains the Model 2361 Trigger Control Unit (TCU) which can synchronize the source and measure activity of each SMU without the need to specify any triggering configurations. Also included is the Model 213 Quad Voltage Source (QVS) four channels of voltage bias capability.

Each channel can apply ± 10 volts to device pins. Channels may be stacked to achieve dual ± 20 volt sources or a single ± 40 volt source.

ICS-Metrics Software

The ICS-Metrics™ Graphical User Interface Software is a Windows™ based setup and control program for parametric testers.

From the ICS-Metrics™ environment, device types may be selected, SMUs assigned and programmed, GPIB polling accomplished and prober interface established.

In addition to setup of the test equipment, ICS-Metrics™ provides powerful data reduction and graphical analysis features. Curve Fittings, Extrapolations and Smoothing may be accomplished with the ICS-Metrics™ control program.

Through the Windows™ Dynamic Data Exchange (DDE) facility, ICS-Metrics™ can also communicate with other Windows™ based programs, including Microsoft Excel™ and pcProbe™.



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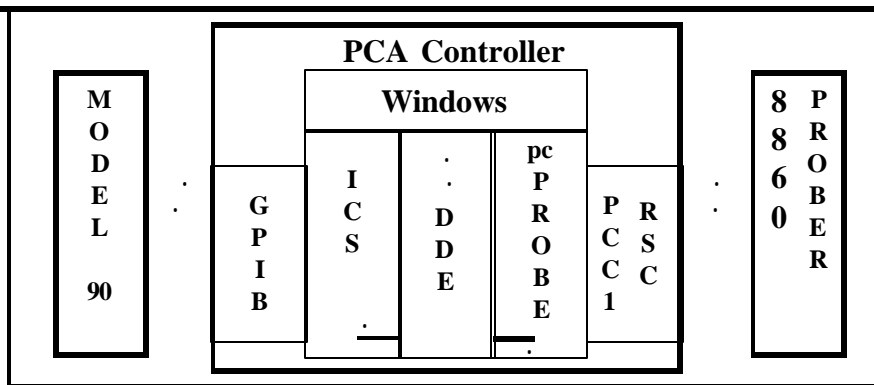
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Application

A schematic of an operational system is shown above. The pcProbe™ based probe stations feature an integral Pentium™ based CPU. pcProbe™ operates within the Windows™ environment on the CPU as does the ICS-Metrics™ control software. pcProbe™ contains an extensive library of DDE control commands through which control of the pcProbe program is accomplished by ICS-Metrics™. Links to the Keithley Model 90 and the probe station (and other programmable accessories) are accomplished through GPIB and dedicated interface cabling respectively.

Equipment Setup

1. The user starts in the pcProbe™ program. Device load, two-point alignment and reference positions are set. A wafer stepping program is then defined using the wafer map “point and shoot” and stored under an appropriate name. Probes or the probe card are positioned on contact points on the sample and touchdown verified visually or by using Touchdown Sensing™.
2. The user then switches to the ICS-Metrics™ program (via minimizing the pcProbe™ window or using the Control-Escape Windows™ key sequence).
3. Using ICS-Metrics™, the Model 90 tester is setup. The instrument is chosen and GPIB polling is accomplished. The user then selects a device type from the ICS-Metrics™ device library and assigns SMUs to each connection of the device. The SMUs are then programmed from the ICS-Metrics™ window.



4. The link to pcProbe™ is now established by using a pull-down menu (located in the ICS-Metrics™ window) and selecting the prober interface. If desired, a probing stepping program can be loaded directly from the ICS-Metrics™ menu which allows access to the pcProbe™ directory of created and stored programs.

Operation

With the link established, the user can operate both the prober and the parametric tester from the ICS-Metrics™ window. The user simply selects the ICS-Metrics™ measure icon. ICS-Metrics™ then automatically sends a step command via DDE to pcProbe™. The prober is activated, moves to the proper position and the probes are placed. The model 90 tester is then activated and the test or test sequence performed. Data is received by ICS-Metrics™ and stored for reduction and analysis.

The test session can then continue interactively by the user simply selecting the measure icon or through the execution of an auto sequence. pcProbe™ will move to the next programmed position, place the probes and the parametric test will be accomplished automatically.

If the user wishes to investigate results at a particular probe site in more detail, it is possible to switch to the pcProbe™ window and make use of its features. Interactive probing using the video window and directional controls may be

accomplished. When ready to resume the program, the user selects the “continue” icon, returns to ICS-Metrics™ and resumes the stepping and testing session.

Once test data has been generated, ICS-Metrics™ data reduction and graphical analysis tools may be invoked to analyze the test results. Finally, using the ICS-Metrics™ project storage feature and the pcProbe™ stepping program storage directory, the prober stepping program, test instrument setup and data reduction and analysis sequences may be stored for later retrieval and use for a similar device probing requirement.

Summary

The setup described provides an easy to use integration of the Micromanipulator Semi-automatic probe station and the Keithley Model 90 I-V test system.

In addition to providing tester control and data analysis from the Windows™ environment with the ICS-Metrics™ software, the accuracy and repeatability of the Micromanipulator Semi-automatic probe stations (i.e., the programmable manipulator has 0.05µm resolution and + 0.5 µm combined accuracy and repeatability error and the stage drive has 0.1µm resolution and + 1.5µm combined accuracy and repeatability error) and the high accuracy (0.03%), low noise (0.001%) and fast measurement speed of the Keithley Model 90 I-V test system are realized.