S530 / S530-HV Parametric Test Systems

Datasheet

Today's analog, wide bandgap (e.g. GaN, SiC), and power semiconductor technologies require parametric testing that maximizes measurement performance, addresses a wide product mix, and minimizes the cost of test. The KTE 7-based S530 platform offers high-speed, fully flexible configurations up to 1100 V that can easily evolve as new applications emerge and requirements change, while enabling the easiest, lowest cost migration path from legacy Keithley S600, S400, and other test platforms.

Key Features

- 200 V and 1100 V models from 12 to 64 Kelvin pins. Assign any test resource to any test pin. Test all parameters in a single probe touchdown
- High speed, high-accuracy DC Source / Measure capability, including Capacitance, Resistance, Pulse, and Frequency
- Testhead option enables direct docking to the Prober, and supports system calibration-to-the-pin, multi-vendor probe card re-use, and IATF-16949 requirements
- System-level ISO-17025 calibration via optional System Reference Unit (SRU)
- Runs on industry proven, Linux-based KTE software to ensure backward compatibility and correlation with legacy S400 / S600 systems
- KTE 7 software provides up to 15% faster test time vs. KTE 5.8
- Built-in transient over-voltage / over-current (TOVP/TOVC) protection prevents accidental damage to probe cards, needles, and instrumentation
- Commercial Off-The-Shelf (COTS) instrumentation-based design ensures lab-grade measurement performance and low downtime
- SECS/GEM Automation Option

Keithley Expertise

For over 40 years, Keithley has been providing solutions for automated semiconductor wafer test applications such as process control monitoring (PCM), device characterization, wafer acceptance / known good die testing (WAT/KGD), and reliability. Today's KTE (Keithley Test Environment) software offers industry-leading test plan flexibility, automation, and test date management capabilities, while our instrumentation provides best-in-class accuracy, resolution, and throughput. Together, these capabilities enable the Keithley S530 Series to maximize measurement performance while minimizing the COO (Cost of Ownership) profile.

Powerful Test Resources

The S530 (200 V) and S530-HV (1100 V) systems are configurable with up to eight SMU channels, a CVU (Capacitance-Voltage Unit), up to three PGUs (Pulse Generator Units), two high-resolution DMMs (Digital Multimeters), and a Spectrum Analyzer (for Ring Oscillator measurements). Connect any test resource to any pin during any test sequence without re-wiring or re-configuring the system. All test pins and signal pathways are full Kelvin (i.e. 4-wire remote sense) to the probe card to ensure measurement integrity.

The Industry's Widest Dynamic Range SMUs

All SMUs in the S530 are the Keithley 2636B, an industry-proven 200V / 1A / 20W SMU with femtoamp (fA) level resolution. The wide dynamic range of the 2636B eliminates the need to specify, select, and configure specific (and fixed) SMU / SMU channel pathways, thereby enabling greater flexibility today, and adaptability to meet tomorrow's requirements with minimum cost and complexity. These same SMUs are also used in the S530-HV, along with Keithley 2470 for up to 1100 V sourcing and measurement.

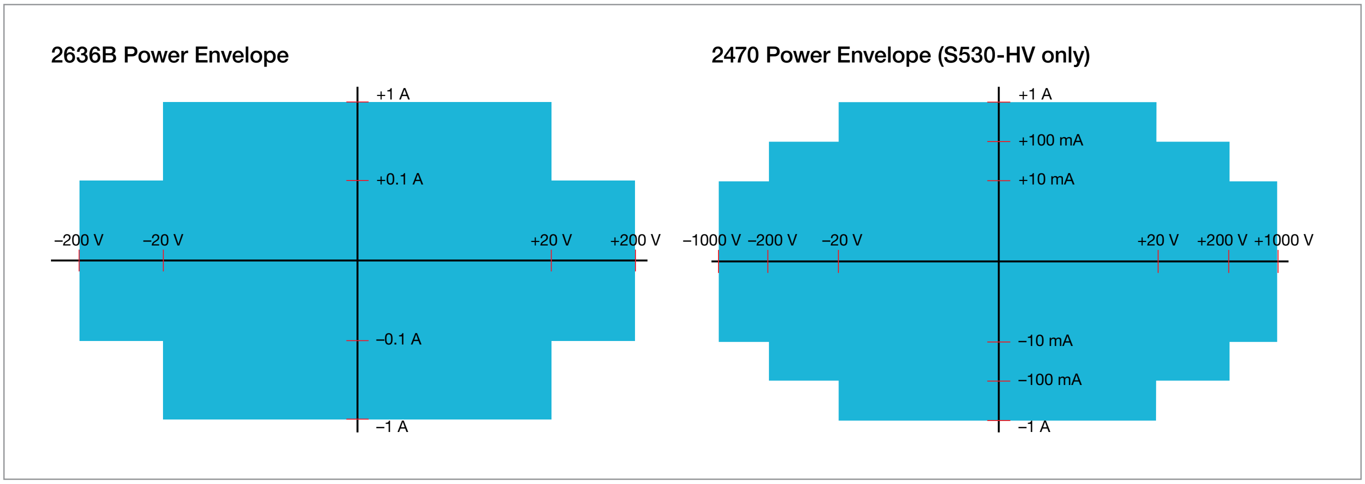


Figure 1: Sourcing and measurement ranges of the SMUs used in S530 and S530-HV systems

Test up to 1100 V on any pin with a single probe touchdown

In addition to sourcing and measuring up to 1100 V, the high voltage switch matrix inside the S530-HV enables the user to perform these measurements on any test pin at any time. This provides maximum flexibility to meet the pin-out requirements of a wide mix of test devices and structures, while eliminating the throughput delays and costs associated with two-pass testing or dedicated pin approaches. Up to two 2470 SMUs can be configured in a S530-HV system.

Testhead option enables calibration-to-the-pin and improved productivity

The S530 series with KTE 7 offers a Testhead option as an alternative to the traditional 9139B Probe Card Adapter (PCA), which is also an available option. The Testhead option provides direct docking of the S530 system to the prober, and enables ISO-17025 compliant system level calibration to the pin, while supporting the requirements of automotive quality standard IATF-16949. It also enables faster probe card changing in high-mix environments.

Movement of the optional Testhead is performed one of three ways: 1) by using the optional Reid-Ashman Manipulator, 2) by re-purposing an existing S600 InTest Manipulator using Keithey's optional Manipulator Retrofit Kit, or 3) a two-person lift.

To conserve valuable floor space, the primary movement of the Manipulator is in the vertical direction, while the manipulator arm enables the Testhead to pivot and rotate. This allows the system cabinet to remain fixed and close to the Prober while performing calibration or servicing the Testhead. Once installed on the prober, the Testhead is secured in place with a dual-cam locking mechanism.

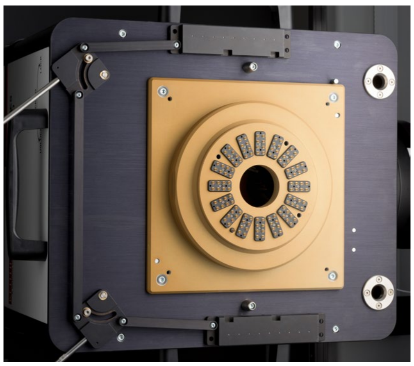
Figure 2: S530 with optional Testhead docked to Reid-Ashman Manipulator

Figure 3: Close-up view of Testhead option

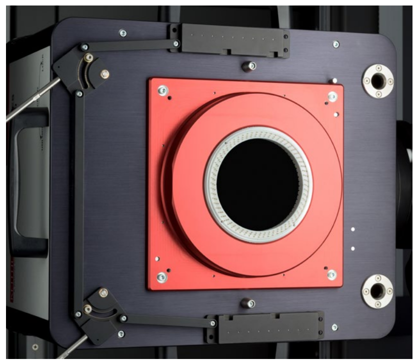
Multiple Probe Card interface options ease the migration from legacy parametric test systems

Over the years, many semiconductor fabs have assembled sizable libraries of probe cards to support testing numerous types of wafers, devices, and structures. When migrating to a new test platform, investing the money and time necessary to replace and requalify these probe cards with newer designs can often be an obstacle.

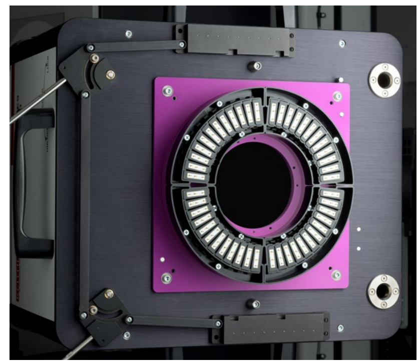
The S530 Series with KTE 7 solves this problem by offering a variety of ways to interface to an existing Prober and Probe Cards. Three probe card interface choices are available for the Testhead – The Keithley S600, Keithley S400/S530, and Keysight 4070/80. All three enable re-use of an existing probe card inventory to minimize migration costs and protect the original investment.



S600 Probe Card interface



S400 / S530 Probe Card Interface



4070/80 Probe Card interface

Figure 4: Bottom view of the Testhead showing optional probe card interface options

As an alternative to the optional Testhead, the S530 Series continues to support the optional 64-pin 9139B-PCA probe card interface, which offers 1100 V pin-to-pin isolation, and is compatible with legacy S400 installations.

The S530 Series also supports custom-designed or 3rd-party probe card interfaces via the basic 3m triax cabling option, which does not include a PCA or Testhead.

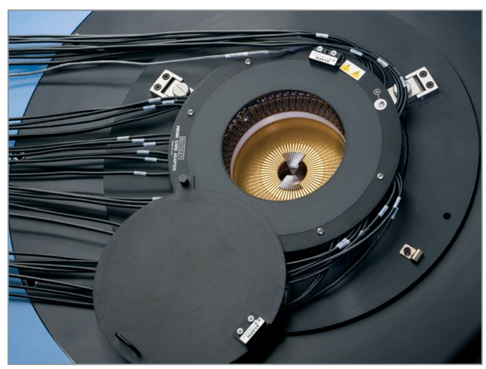


Figure 5: 9139B-PCA probe card interface option installed on a Prober

Optional System Reference Unit (SRU) supports ISO-17025 system-level calibration

The optional 5880-SRU provides an NMI traceable system-level calibration, enables an ISO-17025 accredited calibration, and meets the calibration requirements of IATF-16949.

Depending on the probe card interface option selected, the calibration plane will be either the Testhead pins, or the back of the switch matrix inside the system cabinet. All Testhead interface options support system calibration to the pin, as shown in **Figure 7**. The 9139B-PCA, custom-designed probe cards, and 3rd party probe card interface options support system calibration to the back of the switch matrix. The 5880-SRU is configured to match the probe card interface selected, as well as test system resources as shown in **Figure 6**.

During system calibration, the 5880-SRU System Reference Unit automatically switches all DC and AC reference standards, thus eliminating the need to manually connect, disconnect, and reconnect. This fully automated process greatly reduces system downtime and the resulting support costs when performing system calibration, resulting in a lower COO profile. A full system-level calibration can be performed within a typical 8-hour work shift. As an alternative to purchasing the 5880-SRU, calibration services are also available from the Tektronix/ Keithley global Service organization.

Figure 7: S530 system with Testhead, connected to 5880-SRU for system calibration to the pin.

The 5880-SRU is used for DC calibration of SMUs and DMMs.

The AC calibration option for the 5880-SRU is used for calibrating CVUs and PGUs.

Figure 6: 5880-SRU and accessories

Linux-based KTE 7 software enables compatibility with legacy systems while boosting throughput and productivity

Hosted an industrial PC with RAID drives and Linux OS, Keithley Test Environment (KTE) version 7 software provides a powerful, yet flexible, test development and execution environment that has been refined with over 40 years of production experience.

KTE 7 takes full advantage of Keithley's TSP/TSP-Link (Test Script Processor) intra-instrument triggering and communication technology to boost system throughput up to 15% compared to previous S530 Series systems running KTE 5.8. Even higher throughput gains, up to 50%, can be achieved compared to earlier versions of KTE.

KTE 7's high level of platform-to-platform compatibility not only shortens the learning curve when working with multiple systems, but also offers a smooth migration path when upgrading from legacy Keithley systems to today's S530 Series systems. Legacy measurement routines and test plans can be easily converted, re-used, or re-written to get up and running faster.

KTE 7 software includes all the key system software operations, including:

- Wafer description
- Test macro development
- Test plan development
- Limits setting
- Wafer or cassette level testing with automatic prober control
- Test data management
- Adaptive Test
- Support for the Keithley Recipe Manager (KRM) for conversion of legacy systems
- Support for User Access Points (UAPs) to modify the operational flow of the test sequence at key events like "load wafer," "start test," "end cassette," etc.

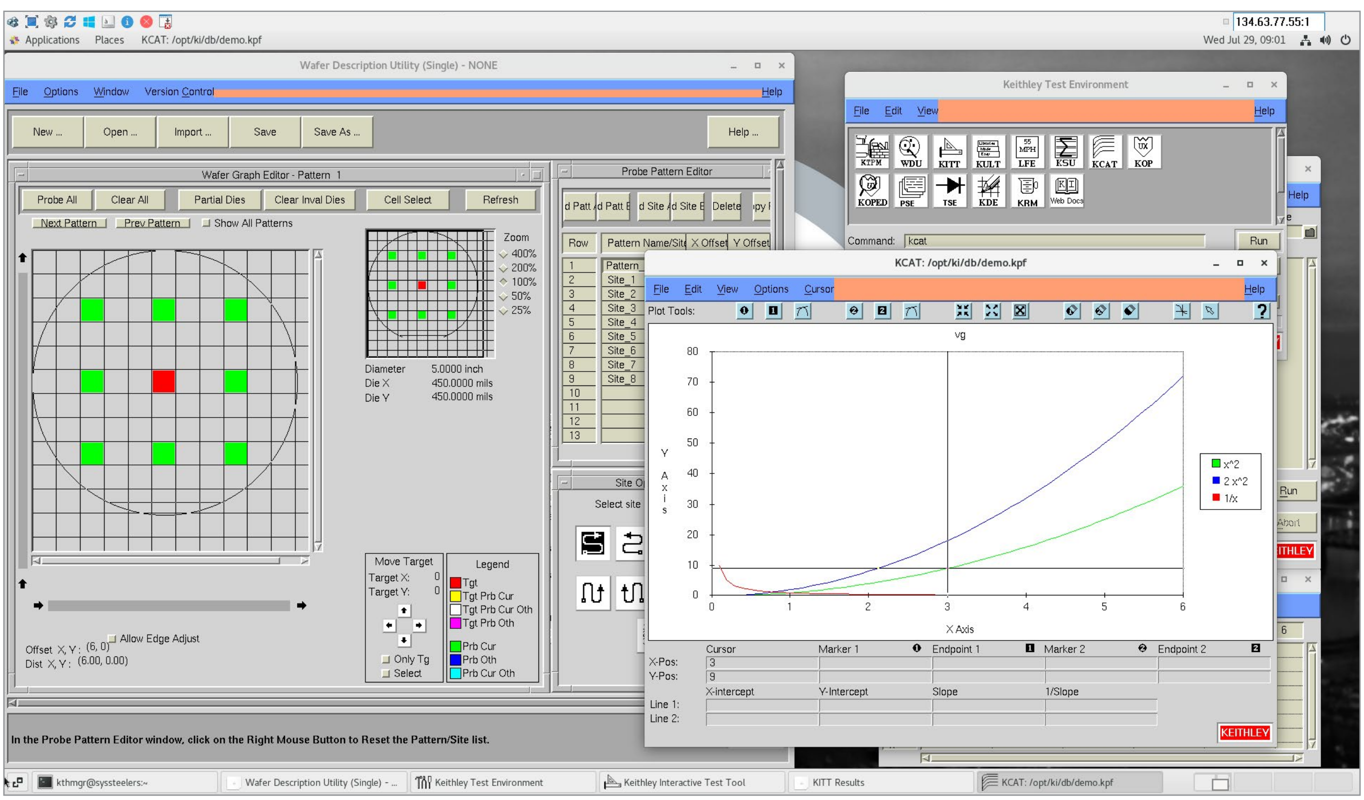


Figure 8: KTE 7 user interface.

Powerful Diagnostics Capability Speeds Troubleshooting to Maximize System Uptime

If unexpected test results occur on the production floor, it is critical to quickly determine if there is a problem in the test cell, or if it is device-under-test (DUT) related. The diagnostics software tool in KTE 7 contains a suite of user-selectable tests that verify correct functionality and performance of all instruments and connections within the S530 system. As shown in **Figure 9**, each diagnostic test detects one specific failure, which makes troubleshooting the system more efficient. To further improve efficiency and productivity, KTE 7 diagnostics enable any single test to be selected to run independently of any other tests, and the internal execution engine has been optimized to significantly reduce operational time.

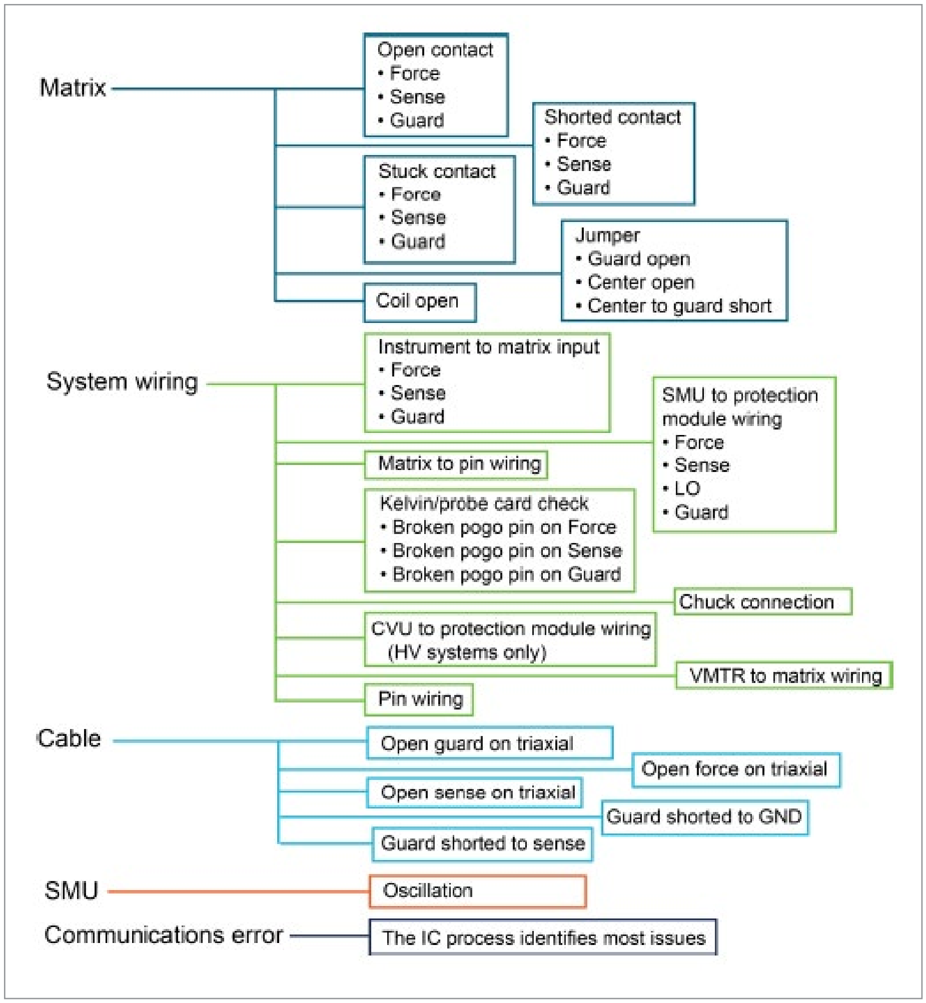


Figure 9: KTE 7 diagnostics testing architecture

A key element of diagnostics is the System Health Check function, which can be performed routinely or on-demand to ensure that the system is performing as expected. This feature quickly checks all instruments in the system for correct wiring and operation, and verifies that all relays in all matrix cards are functioning properly. The entire series of System Health Check tests take less than 15 minutes to complete, and provides real-time status updates.

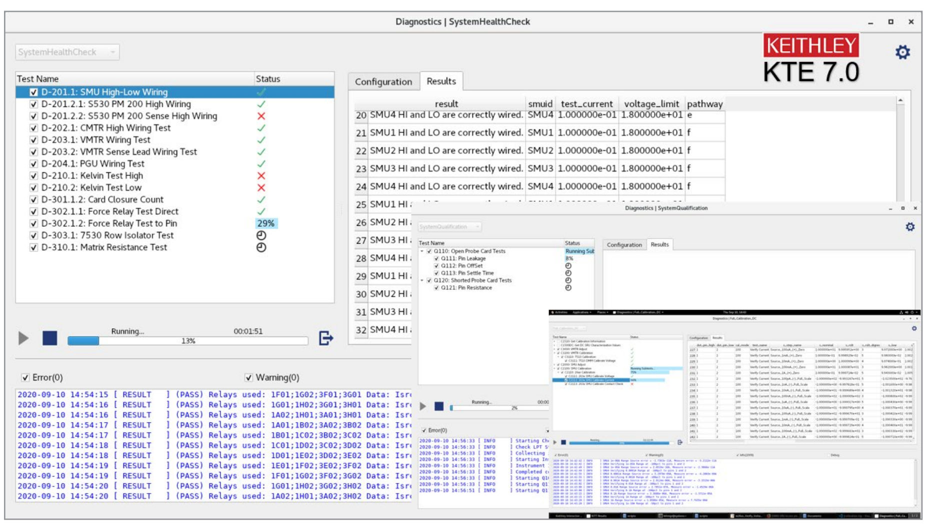


Figure 10: Diagnostics Health Check User Interface

Protection from damaging over-voltage and over-current conditions

When testing today's high-speed power semiconductors and technologies, transient over-voltage and/or over-current conditions can frequently occur, especially during breakdown tests. These extreme conditions can result in burned or melted probe card needles, destroyed devices, and/or damaged instrumentation within the system. Traditional methods of addressing these issues include designing and installing current limiting resistors on individual probe cards. While this time-consuming approach may address a specific failure mechanism that have happened in the past, it cannot anticipate future failures that can happen as devices and technologies continue to change. In addition, any additional series resistance cannot be effective in both limiting the current, and at the same time, ensuring required accuracy.

The S530 Series has built-in transient over-voltage and over-current (TOVP/TOVC) protection modules to address these issues. These protection modules eliminate high current glitch peaks, and prevent high voltages from reaching the device under test or the instrumentation.

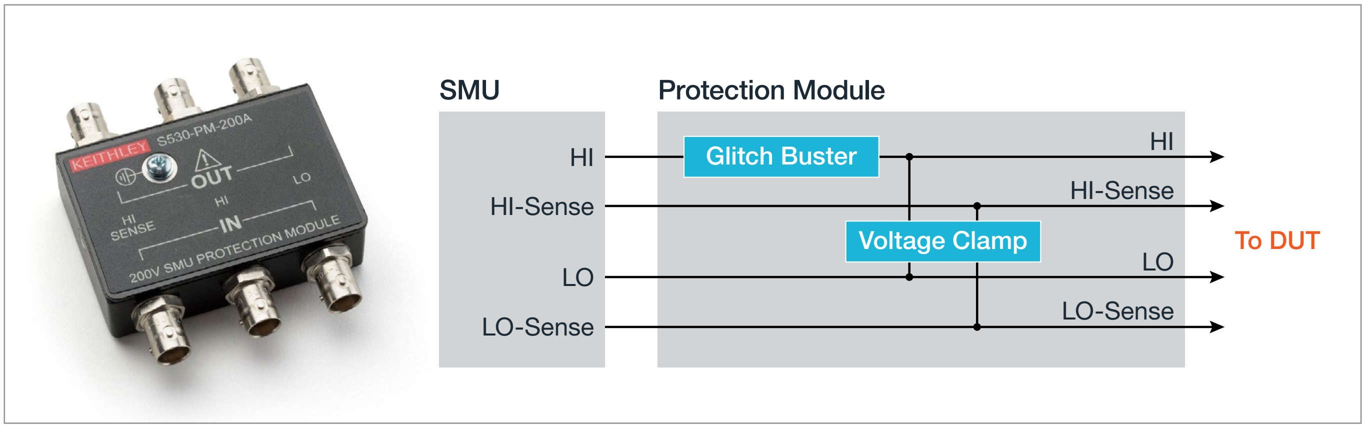


Figure 11: TOVP/TOVC Protection Module and block diagram

SECS/GEM Automation and 300 mm Prober Support

Keithley's SECS/GEM interface for KTE software fully supports SEMI automation standards E5 (SECS-II), E30 (GEM), E37 (HSMS), E39 (OSS), E40 (PMS), E87 (CMS), E90 (STS), and E94 (CJM). This optional software package is customized based on specific user requirements in 300 mm applications.

Prober support packages are available for most popular 300 mm and 200 mm Probers, and include docking hardware for the testhead, KTE 7 software drivers, and cabling for communication.

S530 Low-Current Parametric Test System

Current Source Specifications

Current Range	Maximum Voltage	SOURCE		
		Programming Resolution	Accuracy[A5,A7] % of reading + % of range	Typical Performance[A5,A7] % of reading + % of range
1 A	20 V	20 µA	0.05 % + 0.18 %	0.01 % + 0.03 %
100 mA	200 V	2 µA	0.03 % + 0.03 %	0.02 % + 0.005 %
10 mA	200 V	200 nA	0.04 % + 0.06 %	0.01 % + 0.01 %
1 mA	200 V	20 nA	0.03 % + 0.04 %	0.01 % + 0.005 %
100 µA	200 V	2 nA	0.03 % + 0.06 %	0.01 % + 0.01 %
10 µA	200 V	200 pA	0.03 % + 0.06 %	0.02 % + 0.005 %
1 µA	200 V	20 pA	0.03 % + 0.07 %	0.01 % + 0.02 %
100 nA	200 V	2 pA	0.2 % + 0.05 %	0.08 % + 0.02 %
10 nA	200 V	200 fA	0.35 % + 0.05 %	0.1 % + 0.02 %
1 nA	200 V	20 fA	0.35 % + 0.2 %	0.2 % + 0.03 %

Current Measure Specifications

Current Range	Maximum Voltage	MEASURE		
		Display Resolution	Accuracy[A5,A7] % of reading + % of range	Typical Performance[A7,A9] % of reading + % of range
1 A	20 V	1 µA	0.035 % + 0.15 %	0.01 % + 0.03 %
100 mA	200 V	100 nA	0.035 % + 0.02 %	0.03 % + 0.005 %
10 mA	200 V	10 nA	0.03 % + 0.03 %	0.02 % + 0.01 %
1 mA	200 V	1 nA	0.02 % + 0.02 %	0.02 % + 0.003 %
100 µA	200 V	100 pA	0.02 % + 0.025 %	0.01 % + 0.01 %
10 µA	200 V	10 pA	0.03 % + 0.015 %	0.02 % + 0.004 %
1 µA	200 V	1 pA	0.025 % + 0.04 %	0.01 % + 0.02 %
100 nA	200 V	100 fA	0.20 % + 0.04 %	0.07 % + 0.01 %
10 nA	200 V	10 fA	0.35 % + 0.03 %	0.1 % + 0.03 %
1 nA	200 V	1 fA	0.35 % + 0.2 %	0.2 % + 0.03 %
100 pA[A12]	200 V	0.1 fA	0.3 % + 0.65 %	0.25 % + 0.10 %

Voltage Source Specifications

Voltage Range	Maximum Current	SOURCE		
		Programming Resolution	Accuracy[A5] % of reading + % of range	Typical Performance[A9] % of reading + % of range
200 V	100 mA	5 mV	0.03 % + 0.04 %	0.011 % + 0.004 %
20 V	1 A	500 µV	0.025 % + 0.04 %	0.009 % + 0.005 %
2 V	1 A	50 µV	0.025 % + 0.04 %	0.002 % + 0.01 %
200 mV	1 A	5 µV	0.025 % + 0.25 %	0.006 % + 0.08 %

Voltage Measure Specifications

Voltage Range	Maximum Current	MEASURE		
		Display Resolution	Accuracy[A5] % of reading + % of range	Typical Performance[A9] % of reading + % of range
200 V	100 mA	1 mV	0.015 % + 0.025 %	0.01 % + 0.001 %
20 V	1 A	100 µV	0.015 % + 0.025 %	0.01 % + 0.001 %
2 V	1 A	10 µV	0.02 % + 0.018 %	0.01 % + 0.002 %
200 mV	1 A	1 µV	0.04 % + 0.15 %	0.04 % + 0.015 %

S530 Low-Current Parametric Test System (continued)

C-V Measurement Option (Typical[A9])

Capacitance	Frequency	Accuracy
10 pF	100 kHz	2.50 %
10 pF	1 mHz	3.50 %
100 pF	10 kHz	0.70 %
100 pF	100 kHz	0.30 %
100 pF	1 mHz	1.50 %
1 nF	10 kHz	0.70 %
1 nF	100 kHz	0.65 %

CMTR	Minimum AC	Maximum AC
4210-CVU	10 mV_{RMS}	100 mV_{RMS}
4215-CVU	10 mV_{RMS}	1 V_{RMS}[A11]

C-V Measurement Footnotes

1. After system offset compensation has been performed.
2. Unless otherwise noted, all measurements taken with 30 mVRMS and 300 mVRMS AC source.

High Resolution DMM Voltage Measurement Option

VOLTAGE			
Range	Resolution	Accuracy[A5] % of reading % of range	Typical performance[A8] % of reading % of range
1000 V	100 µV	0.0175 % + 0.007 %	0.006 % + 0.0001 %
100 V	10 µV	0.0110 % + 0.005 %	0.006 % + 0.0006 %
10 V	1 µV	0.0100 % + 0.002 %	0.003 % + 0.0009 %
1 V	100 nV	0.0050 % + 0.030 %	0.003 % + 0.0060 %
100 mV	10 nV	0.0025 % + 0.250 %	0.002 % + 0.0600 %

S530 Low-Current Parametric Test System (continued)

Pulse Option[1,2,3,4]

	Output Condition	10 V Range	40 V Range
V_{OUT}	50 Ω into 1 MΩ	–10 V to +10 V	–40 V to +40 V
Amplitude Accuracy	—	±(0.5% + 10 mV)	±(0.4% + 30 mV)
Resolution	50 Ω into 1 MΩ	<0.5 mV	<1.5 mV
Overshoot/ Preshoot/ Ringing	50 Ω into 1 MΩ, typical	±(3% + 60 mV)	±(3% + 90 mV)
Current into 50 Ω Load (at full scale)	—	±100 mA typical	±400 mA typical

Pulse Footnotes

1. Valid for S530 200 V systems equipped with 7530A matrix cards.
2. Unless stated otherwise, all specifications assume a 50 Ω termination.
3. Level specifications are valid after 50 ns typical settling time (after slewing) for the 10 V source range and after 500 ns typical settling time (after slewing) for the 40 V source range into a 50 Ω load.
4. With transition time of 20 ns (0% to 100%) for the 10 V source range and 100 ns (0% to 100%) for the 40 V source range.

Pulse Timing

	10 V Range Source Only	40 V Range Source Only
RMS Jitter (period, width), typical	0.1% + 200 ps	0.1% + 200 ps
Period Range	20 ns to 1 s	100 ns to 1s
Accuracy	±1%	±1%
Pulse Width Range	10 ns to (Period – 10 ns)	50 ns to (Period – 10 ns)
Accuracy	±(1% + 200 ps)	±(1% + 5 ns)

Frequency Measurement Option[1]

RF Input Frequency Range	9 kHz to 50 MHz
Frequency Reference Accuracy	±3 × 10–6
Input Level Range	–10 dBm to +10 dBm sinusoid
Impedance	50 Ω nominal
Maximum Input Level	40 V dc

Frequency Measurement Footnote

1. Instrument-level specifications.

S530 High-Voltage (1100 V) Parametric Test System – 2470 1100 V SMU

Current Source Specifications – High-Performance / High-Voltage Paths

Current Range	Maximum Voltage	SOURCE		
		Resolution	Accuracy[A5,A8]	Typical Performance[A8,A9]
1 A	21 V	50 µA	0.08 % + 1 mA	0.0034 % + 0.25 µA
100 mA	210 V	5 µA	0.055 % + 15 µA	0.0188 % + 3.2 µA
10 mA	1100 V	500 nA	0.025 % + 1.5 µA	0.0076 % + 0.5 µA
1 mA	1100 V	50 nA	0.035 % + 150 nA	0.0119 % + 36 nA
100 µA	1100 V	5 nA	0.04 % + 15 nA	0.0114 % + 5.2 nA
10 µA	1100 V	500 pA	0.045 % + 3 nA	0.0150 % + 0.4 nA
1 µA	1100 V	50 pA	0.025 % + 400 pA	0.0043 % + 165 pA
100 nA	1100 V	5 pA	0.06 % + 300 pA	0.0188 % + 92 pA
10 nA	1100 V	500 fA	0.2 % + 220 pA	0.0253 % + 52 pA

Current Measure Specifications – High-Performance / High-Voltage Paths

Current Range	Maximum Voltage	MEASURE		
		Resolution	Accuracy[A5,A8]	Typical Performance[A8,A9]
1 A	21 V	1 µA	0.08 % + 1 mA	0.0048 % + 0.2 mA
100 mA	210 V	100 nA	0.07 % + 5 µA	0.0182 % + 3.1 µA
10 mA	1100 V	10 nA	0.06 % + 1 µA	0.0074 % + 0.5 µA
1 mA	1100 V	1 nA	0.06 % + 50 nA	0.0107 % + 36 nA
100 µA	1100 V	100 pA	0.05 % + 12 nA	0.0109 % + 5.1 nA
10 µA	1100 V	10 pA	0.055 % + 2 nA	0.0128 % + 0.5 nA
1 µA	1100 V	1 pA	0.025 % + 350 pA	0.0042 % + 142 pA
100 nA	1100 V	100 fA	0.06 % + 350 pA	0.0240 % + 76 pA
10 nA	1100 V	10 fA	0.2 % + 350 pA	0.1112 % + 74 pA

Voltage Source Specifications – High-Performance / High-Voltage Paths

Voltage Range	Maximum Voltage	SOURCE		
		Resolution	Accuracy[A5]	Typical Performance[A9]
1000 V	10 mA	50 mV	0.02 % + 100 mV	0.0005 % + 5.0 mV
200 V	100 mA	5 mV	0.015 % + 24 mV	0.0066 % + 2.0 mV
20 V	1 A	500 µV	0.015 % + 2.4 mV	0.0075 % + 0.1 mV
2 V	1 A	50 µV	0.02 % + 300 µV	0.0034 % + 12 µV
200 mV	1 A	5 µV	0.02 % + 250 µV	0.0006 % + 14 µV

Voltage Measure Specifications – High-Performance / High-Voltage Paths

Voltage Range	Maximum Voltage	MEASURE		
		Resolution	Accuracy[A5]	Typical Performance[A9]
1000 V	10 mA	10 mV	0.02 % + 50 mV	0.0005 % + 9.5 mV
200 V	100 mA	100 µV	0.02 % + 16 mV	0.0056 % + 3.5 mV
20 V	1 A	10 µV	0.02 % + 1.6 mV	0.0057 % + 0.4 mV
2 V	1 A	1 µV	0.012 % + 300 µV	0.0019 % + 34 µV
200 mV	1 A	100 nV	0.012 % + 250 µV	0.0006 % + 12 µV

S530 High-Voltage (1100 V) Parametric Test System – 2636B 200 V SMU

Current Source Specifications – High-Performance / High-Voltage Paths

Current Range	Maximum Voltage	SOURCE		
		Resolution	Accuracy[A5,A8]	Typical Performance[A8,A9]
1 A	20 V	20 µA	0.05 % + 1.8 mA	0.0080 % + 0.3 mA
100 mA	200 V	2 µA	0.04 % + 35 µA	0.0174 % + 4 µA
10 mA	200 V	200 nA	0.04 % + 6 µA	0.0096 % + 1 µA
1 mA	200 V	20 nA	0.03 % + 400 nA	0.0131 % + 48 nA
100 µA	200 V	2 nA	0.03 % + 60 nA	0.0140 % + 8 nA
10 µA	200 V	200 pA	0.03 % + 6 nA	0.0082 % + 3 nA
1 µA	200 V	20 pA	0.03 % + 700 pA	0.0101 % + 97 pA
100 nA	200 V	2 pA	0.25 % + 50 pA	0.0727 % + 11 pA
10 nA	200 V	200 fA	0.45 % + 5.0 pA	0.1187 % + 2 pA
1 nA	200 V	20 fA	0.65 % + 2.5 pA	0.1858 % + 0.5 pA

Current Measure Specifications – High-Performance / High-Voltage Paths

Current Range	Maximum Voltage	MEASURE		
		Resolution	Accuracy[A5,A8]	Typical Performance[A8,A9]
1 A	20 V	1 µA	0.04 % + 1.5 mA	0.0124 % + 0.5 mA
100 mA	200 V	100 nA	0.045 % + 30 µA	0.0236 % + 5 µA
10 mA	200 V	10 nA	0.03 % + 3 µA	0.0139 % + 1.1 µA
1 mA	200 V	1 nA	0.025 % + 250 nA	0.0136 % + 46 nA
100 µA	200 V	100 pA	0.035 % + 25 nA	0.0105 % + 11 nA
10 µA	200 V	10 pA	0.03 % + 5.5 nA	0.0058 % + 2.5 nA
1 µA	200 V	1 pA	0.025 % + 400 pA	0.0073 % + 132 pA
100 nA	200 V	100 fA	0.25 % + 40 pA	0.0738 % + 10 pA
10 nA	200 V	10 fA	0.49 % + 4 pA	0.1514 % + 3 pA
1 nA	200 V	1 fA	0.55 % + 3.5 pA	0.3438 % + 0.3 pA
100 pA[A12]	200 V	100 AA	0.55 % + 1 pA	0.1935 % + 0.3 pA

Voltage Source Specifications – High-Performance / High-Voltage Paths

Voltage Range	Maximum Voltage	SOURCE		
		Resolution	Accuracy[A5]	Typical Performance[A9]
200 V	100 mA	5 mV	0.03 % + 80 mV	0.0082 % + 6 mV
20 V	1 A	500 µV	0.03 % + 8 mV	0.0080 % + 0.5 mV
2 V	1 A	50 µV	0.025 % + 800 µV	0.0071 % + 90 µV
200 mV	1 A	5 µV	0.025 % + 500 µV	0.0087 % + 48 µV

Voltage Measure Specifications

Voltage Range	Maximum Voltage	MEASURE		
		Resolution	Accuracy[A5]	Typical Performance[A9]
200 V	100 mA	100 µV	0.015 % + 60 mV	0.0096 % + 7 mV
20 V	1 A	10 µV	0.015 % + 5 mV	0.0085 % + 0.6 mV
2 V	1 A	1 µV	0.02 % + 360 µV	0.0060 % + 69 µV
200 mV	1 A	100 nV	0.04 % + 300 µV	0.0310 % + 43 µV

S530 High-Voltage (1100 V) Parametric Test System – 2636B 200 V SMU (continued)

C-V Measurement Specifications (Typical[A9])

Capacitance	Frequency	Accuracy
10 pF	100 kHz	4.00 %
10 pF	1 mHz	3.50 %
100 pF	10 kHz	1.20 %
100 pF	100 kHz	0.35 %
100 pF	1 mHz	3.50 %
1 nF	10 kHz	0.60 %
1 nF	100 kHz	0.50 %

CMTR	Minimum AC	Maximum AC
4210-CVU	10 mV_{RMS}	100 mV_{RMS}
4215-CVU	10 mV_{RMS}	1 V_{RMS}[A11]

C-V Measurement Footnotes

1. After system offset compensation has been performed.
2. Unless otherwise noted, all measurement taken with 30 mV_{RMS} and 300 mV_{RMS} AC source.

High-Resolution DMM Voltage Measurement Option

VOLTAGE			
Range	Resolution	Accuracy[A5] % of reading + % of range	Typical performance[A8] % of reading + % of range
1000 V	100 µV	0.021 % + 0.007 %	0.0044 % + 0.0003 %
100 V	10 µV	0.013 % + 0.005 %	0.0056 % + 0.0006 %
10 V	1 µV	0.01 % + 0.005 %	0.0034 % + 0.0008 %
1 V	100 nV	0.0015 % + 0.05 %	0.0014 % + 0.0056 %
100 mV	10 nV	0.0018 % + 0.4 %	0.0013 % + 0.0583 %

Specification Addendum

A. Specification Conditions

1. 23 °C ±5 °C, 1 year.
2. Relative humidity between 5 percent and 60 percent after 2-hour warmup.
3. KTE 7.0.5 system software with CentOS 7 operating system.
4. All specifications are based on 1-year calibration cycle for individual instruments.
5. Measurement readings are taken at 1 PLC (power line cycle) unless otherwise noted.
6. All pathways and measurements made with full Kelvin connections.
7. Typical system leakage performance with test-head option is 40 fA/V at 10 V through 7530/7530A cards (200 V system).
8. Typical system leakage performance with test-head option is 100 fA/V at 10 V through 7072-HVD cards (1100 V system) through the low-current pathways (rows A and B).
9. The typical values represent the mean plus one standard deviation, are not warranted, apply to 23 °C ±5 °C, < 60 percent relative humidity, and are provided solely as useful information.
10. The typical values represent the mean plus one standard deviation and calibration uncertainty, are not warranted, and are provided solely as useful information. Values are calculated by averaging ten averages of fifteen 1-NPLC readings.
11. Derate maximum AC drive from 1 V_{RMS} at 500 kHz to 700 mV_{RMS} at 1 MHz.
12. Measurement readings are verified by averaging fifteen 1-NPLC readings.

B. General IV Source Specifications

1. Maximum output power per source-measure unit (SMU): 20 W (fourquadrant source or sink operation).
2. Compliance resolution and accuracy are determined by the corresponding range used.
3. SMU 2636B maximum voltage (pin-to-ground) is 200 V. Maximum differential voltage (pin-to-pin) is 400 V.

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