AU4850 Pulsed IV/RF Characterization System

Featuring...

- 220 V, 30 A with 0.01% Current Resolution for RF designers
- S-parameter Option for Major Network Analyzers
- Pulsed Load-pull Option
- 1200 V, 100 A with Enhanced ON-resistance Accuracy for Power Electronic Users
- Stand-alone Pulser Head Option
Auriga’s 4th generation pulsed IV/RF characterization system delivers unparalleled performance, capturing measurements with incredible speed and accuracy.

Pulsed IV (current-voltage) measurements have emerged as the preferred method of capturing current-voltage characteristics of active devices such as field effect (FETs) and bipolar junction (BJTs) transistors. With the growing popularity of high-power devices, like GaN HEMTs, LDMOS, SiC, and graphene, current and voltage requirements are constantly being pushed higher and higher.

With these requirements in mind, Auriga Microwave has developed its next-generation Pulsed IV/RF Characterization System, the AU4850. The AU4850 is designed to meet the ever-changing requirements of the device modeling community. With its modular hardware design and powerful application programming interface (API), the AU4850 is poised to handle present and future pulsed IV requirements.

The design of this new, high-end pulsed IV system simplifies the measurement process for faster, easier and deeper insight of unique characteristics of the industry’s most advanced high-powered devices. Fast sampling time provides power electronics users break-through accuracy in dynamic on-resistance measurements for characterizing high-voltage applications.

The AU4850 is a full-featured characterization platform capable of measuring DC IV and pulsed IV curves, expandable to pulsed S-parameters and pulsed load-pull. With rise times as fast as 30 ns, measurements can be taken near the instant of activation to mitigate channel, self-heating and memory effects. With pulse widths as narrow as 70 ns, the AU4850 is ideally suited for isothermal testing of devices. Unlike less-capable solutions, the AU4850 can deliver up to 1200 V and 100 A—a must for designers working with high-power devices.

Key Features
- Auriga MEM™
- Up to 1200 V and 100 A pulser heads
- Pulse widths as narrow as 70 ns
- Low pulse droop
- Optional S-parameter capabilities
- Optional pulsed load-pull capabilities
- Optional stand-alone pulser head adapter

Application Areas
- Aerospace and defense
- Automotive and transportation
- Battery, energy and smart grid
- Communication
- Computer and peripherals
- Consumer appliances
- Displays and video products
- Industrial
- LED and general lighting
- Medical
- Motor control
- Power systems

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Introducing Auriga MEM

Auriga MEM™, Auriga’s newest pulsed IV function (patent pending), enhances current resolution to an industry-leading 0.01% of maximum current. Using Auriga’s advanced calibration algorithms and an external Keysight digital multimeter (DMM), Auriga MEM brings the DC measurement plane directly to the device under test.

Key Features

- Provides extraordinary current resolution of 0.01% of max current
- Provides temperature independent measurements, allowing for accurate measurements impervious to environmental temperature changes
- Maintains calibration integrity for a longer period of time

These key features enable the AU4850 to achieve the measurement accuracy and repeatability needed for tomorrow’s demanding devices.

DC IV and Pulsed IV Measurement System (see Optional RF Measurement System below)

The AU4850 Pulsed IV/RF Characterization System is supplied with two external and interchangeable pulser heads. Their interchangeability enables this system to provide a variety of pulsed voltage and current ranges to provide the greatest resolution in the dynamic range of interest. External heads allow the pulser circuitry to be located closer to the device under test (DUT), minimizing any signal degradation due to transmission line effects. External heads enable the AU4850 to reside approximately six feet away from the DUT. The AU4850 is supplied with four external power supplies. These supplies provide the quiescent and non-quiescent voltages for both the gate (or base) and drain (or collector) and allow for a greater range of measurement alternatives.

Measurement Functions

The DC measurement system is capable of performing the following measurements:

- DC IV curves
- Pulsed IV curves
- Drain to source breakdown voltage (BVds)
- Gate current (Ig)
- Transconductance (Gm)

System Components

- AU4850 system mainframe (rack mountable)
- Four external LXI power supplies
- Pulser head – drain (or collector) bias side
- Pulser head – gate (or base) bias side
- Two precision resistor calibration standard units
- AU4850 system software
- Keysight DMM
- Documentation
Accuracy. Repeatability. Power. All with One System.

A clean IV plane will excite modelers and RF designers while power electronic users will appreciate the never-before-seen low-current resolution.

IV curves measured on large power device showing 0.0017% test-to-test variation at increasing magnification.
## AU4850 Pulsed IV/RF Characterization System

### Voltage and Current Measurements

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>PHG1001</th>
<th>PHD1020</th>
<th>PHD1100</th>
<th>PHD1300</th>
<th>PHD2010</th>
<th>PHD2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Voltage</td>
<td>±20 V</td>
<td>220 V</td>
<td>220 V</td>
<td>220 V</td>
<td>600 V</td>
<td>600 V</td>
</tr>
<tr>
<td>Max Current Pulsed</td>
<td>100 mA</td>
<td>2 A</td>
<td>10 A</td>
<td>30 A</td>
<td>1 A</td>
<td>5 A</td>
</tr>
<tr>
<td>Max Current DC</td>
<td>100 mA</td>
<td>0.85 A</td>
<td>1.7 A</td>
<td>5.0 A</td>
<td>1.0 A</td>
<td>1.0 A</td>
</tr>
<tr>
<td>Typical Error</td>
<td>0.1%</td>
<td>0.1%</td>
<td>0.01%</td>
<td>0.01%</td>
<td>0.01%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Max Power</td>
<td>2 W</td>
<td>40 W</td>
<td>200 W</td>
<td>1000 W</td>
<td>200 W</td>
<td>1000 W</td>
</tr>
<tr>
<td>Min Pulse Width</td>
<td>200 ns</td>
<td>200 ns</td>
<td>750 ns</td>
<td>1000 ns</td>
<td>70 ns</td>
<td>70 ns</td>
</tr>
<tr>
<td>Max Pulse Width</td>
<td>See RF Performance by Pulser Head plots below</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max Pulse Repetition Frequency (PRF)</td>
<td>250 KHz @ 20 V</td>
<td>20 KHz @ 200 V</td>
<td>20 KHz @ 200 V</td>
<td>20 KHz @ 200 V</td>
<td>200 KHz @ 200 V</td>
<td>200 KHz @ 200 V</td>
</tr>
<tr>
<td>Min Output Rise/Fall</td>
<td>30 ns</td>
<td>30 ns</td>
<td>55 ns</td>
<td>60 ns</td>
<td>35 ns</td>
<td>35 ns</td>
</tr>
<tr>
<td>Test Port Connector</td>
<td>BNC (f)</td>
<td>BNC (f)</td>
<td>BNC (f)</td>
<td>BNC (f)</td>
<td>High-voltage BNC (f)</td>
<td>High-voltage BNC (f)</td>
</tr>
</tbody>
</table>

### Notes
1. System calibration based on precision resistors
2. Specifications may fluctuate based on customer DUT and fixturing
3. All pulser heads can operate at the input or output of the DUT

### RF Performance by Pulser Head

**PHD1020**: 1 Ω pulses up to 200 µs (left) and 1000 µs (right)
RF Performance by Pulser Head
(Continued)

PHD1020: 5 Ω pulses up to 200 µs (left) and 1000 µs (right)

PHD1100: 5 Ω pulses up to 200 µs (left) and 1000 µs (right)

PHD1100: 1 Ω pulses up to 200 µs (left) and 1000 µs (right)

PHD1100: 5 Ω pulses up to 200 µs (left) and 1000 µs (right)
RF Performance by Pulser Head (Continued)

PHD1300: 1 Ω pulses up to 200 µs (left) and 1000 µs (right)

PHD1300: 5 Ω pulses up to 200 µs

PHD2010: 1 Ω pulses up to 200 µs (left) and 500 µs (right)
RF Performance by Pulser Head
(Continued)

PHD2010: 5 Ω pulses up to 200 µs

PHD2050: 1 Ω pulses up to 200 µs (left) and 500 µs (right)

PHD2050: 5 Ω pulses up to 200 µs (left) and 500 µs (right)
RF Performance by Pulser Head (Continued)

Rise and fall time for PHD1020 (left) and PHD1100 (right)

Rise and fall time for PHD1300 (left) and PHD2010 (right)
Pulsed RF Option

Optional RF Measurement System

- Measurement control of 2-port small signal S-parameters utilizing an appropriate network analyzer. (See table below.)
- Setup and calibration is performed utilizing the VNA software
- Measurement timing and triggering of the VNA is controlled through the AU4850 to coordinate the pulsed DC and S-parameter measurements
- Pulsed IV measurements are stored in CITI and/or CSV formats; S-parameters are stored in s2p format files
- Synchronization of timing of the pulsed DC and pulsed RF (both RF modulation and RF acquisition) is handled by hardware timing triggers of the AU4850 controlling the VNA

RF Upgrade Components

- RF measurement software
- VNA trigger lines
- Ethernet to USB adapter
- Ethernet cable (15')
- Documentation
- Optional: two bias tees
  
  (Network analyzer is not included)

VNA Requirements

The AU4850 Pulsed IV/RF Characterization System is designed to operate with network analyzers with pulsed capabilities. The following table summarizes the minimum VNA options required depending on the pulsed RF application (Auriga’s Pulsed IV Support is available for assistance in VNA and configuration selection):

<table>
<thead>
<tr>
<th>VNA Manufacturer Models and Option Requirements for Pulsed RF Measurements</th>
<th>Wideband Detection</th>
<th>Narrowband Detection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keysight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PNA-X Model N5242A</td>
<td>No additional options required</td>
<td>Requires 008 and firmware ≥ ver. 8.0</td>
</tr>
<tr>
<td>PNA Models: E8362B/C, E8363B/C, E8364B/C, E8361A/C</td>
<td>No additional options required</td>
<td>Requires 008 and firmware ≥ ver. 8.0</td>
</tr>
<tr>
<td>Anritsu</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VectorStar</td>
<td>35 (Digitizer Board), 42 (PulseView Application)</td>
<td></td>
</tr>
<tr>
<td>Rohde &amp; Schwarz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZVA</td>
<td>No additional options required</td>
<td></td>
</tr>
</tbody>
</table>
Auriga-Focus Microwaves Pulsed Load-pull Option

To complete the full suite of pulsed measurements, Auriga has teamed with Focus Microwaves to provide a pulsed load-pull (PLP) option. Focus’ system brings industry-leading harmonic measurement capability, testing speed, and impedance tuning range. The Focus load-pull system interfaces seamlessly with the AU4850 and controls the pulsed behavior. All functionality from both systems is available to the user.

Focus pulsed load-pull software user interface

Auriga Stand-alone Pulser Head Adapter PHA1000

The PHA1000 pulser head adapter allows AU4850 pulser heads to be used as stand-alone DC pulsers (models PHD1100, PHD1300, PHD2010, and PHD2050). Performance of the pulser heads, when utilized with the PHA1000, is the same as when used with the AU4850 system. The adapter takes two DC voltages (quiescent and non-quiescent) and a TTL timing signal as inputs and produces a voltage pulse alternating between quiescent and non-quiescent. If one of the DC voltage inputs are shorted, the pulser will have 0 V output in that state. AU4850 pulser heads are sold separately.
Power Electronics Performance by Pulser Head

Plotting \( I_{dnq} \) while stepping quiescent point vs. \( V_{dnq} \) (left) and vs. \( V_{dq} \) (right)

ON-resistance vs. \( V_{dnq} \) at \( V_{dq} \) from 0-600 V on 0.1 \( \Omega \) SiC device
General Specifications

External DC Power Supplies:

For PHD1000 Series:
(1) Keysight N5751A DC Power supply 300 V, 2.5 A, 750 W
(1) Keysight N6700B MPS Mainframe (400 W max. total)
(1) Keysight N6746B DC Power module 100 V, 1.0 A, 100 W
(2) Keysight N6734B DC Power module 35 V, 1.5 A, 50 W

For PHD2000 Series:
(1) Keysight N5752A DC Power supply 600 V, 1.3 A, 780 W
(1) Keysight N6700B MPS Mainframe (400 W max. total)
(1) Keysight N6746B DC Power module 100 V, 1.0 A, 100 W
(2) Keysight N6734B DC Power module 35 V, 1.5 A, 50 W

Environmental:
Operating Temperature Range: 5˚C to 30˚C
Operating Humidity Range: 5% to 70% (non-condensing)
Storage Temperature Range: -20˚C to 50˚C
(<=80% RH, non-condensing)
Accuracy is specified at: Temperature: 23˚C ±5˚C
Humidity: 5% to 70% RH
Warm-up: At least 30 min.

Note: Temperature changes after calibration must be less than 3˚C when using network analyzer.

Dimensions:
System: 17.5” W x 3.5” (2U) H x 21.5” D
PHD1000 Series Pulser Heads: 3.75” W x 2.5” H x 7.0” D
PHD2000 Series Pulser Heads: 7.25” W x 3.2” H x 10.7” D

Pulsed IV Support:
For those under warranty:
- Access to measurement experts
- How-to guidance and advice
- Technical support
- Guaranteed response within one business day:
  PIV-support@aurigamicrowave.com

System Weight:
System: Approx. 24 lb
PHD1000 Series Pulser Heads: Approx. 7 lb
PHD2000 Series Pulser Heads: Approx. 8.5 lb

Storage:
480 GB SDD Hard drive
4 GB Memory

Operating System:
Windows 7 64-bit
Quad core processor (8 threads total)

Display:
24” External display

Ports:
(10) USB ports (2 front/8 rear)
(3) Ethernet
(2) HDMI
(1) Digital
(3) Audio