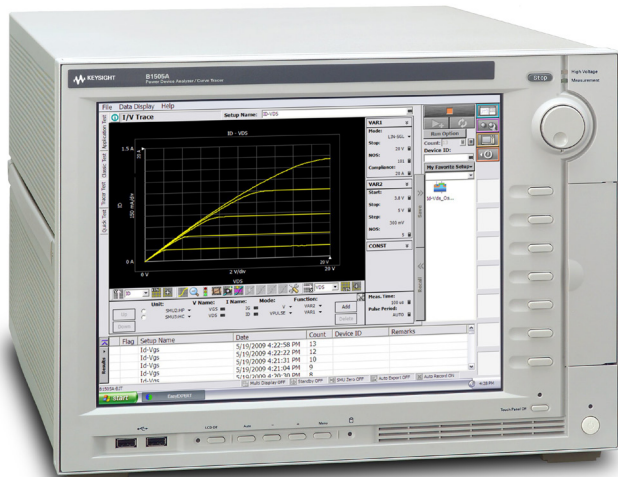


Keysight Technologies

GaN Current Collapse Effect Evaluation Using the B1505A

Keysight B1505A Power Device Analyzer/Curve Tracer accelerates your Gallium Nitride (GaN) power device development



Key features of the B1505A GaN current collapse measurement solution

Dynamic on-resistance measurement across a wide range of time intervals:

- 20 μ s switching time from OFF-state to ON-state
- High speed sampling (2 μ s sampling rate)
- Measurement of long term variations (long measurement mode)

Wide voltage/current range with precise measurement:

- 3000 V OFF-state voltage stressing
- 20 A ON-state drain current
- Capture current measurements with 6 digit resolution

Increased productivity of GaN device evaluation:

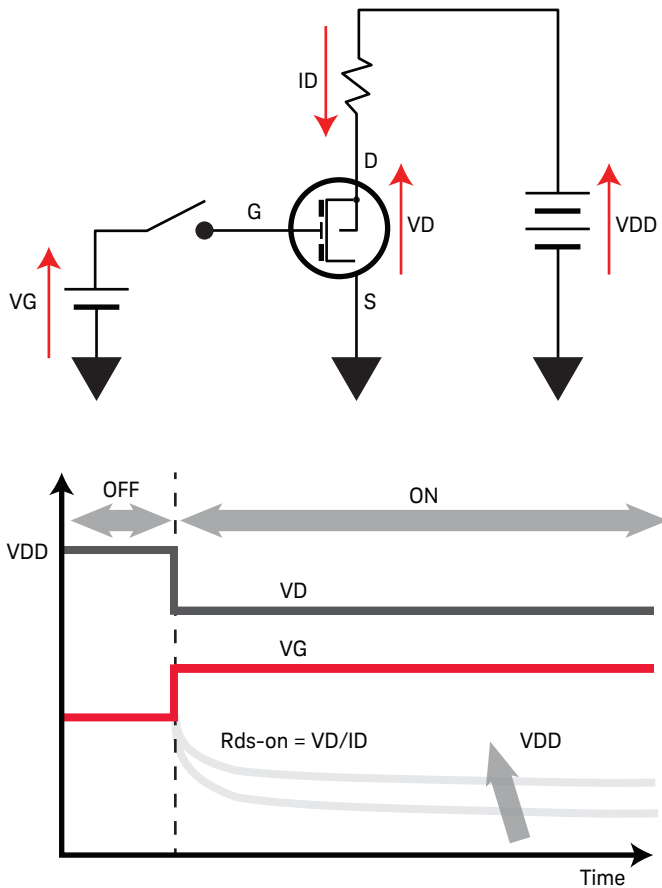
- Supports both packaged and on-wafer device testing
- Pre-installed application tests for fast startup of GaN current collapse measurements

A fully integrated, off-the-shelf GaN current collapse solution

In GaN devices the current collapse effect, which is believed to be caused by electron trapping and de-trapping, appears as a transient and recoverable reduction in drain current after the application of high voltage. Since the current collapse effect limits the performance and reliability of GaN devices, it is an area of research that is receiving intense interest. Unfortunately, obtaining a detailed understanding of the current collapse effect has been difficult to date since no available equipment incorporated all of capabilities listed below. This document outlines how the Keysight Technologies, Inc. B1505A with the N1267A High Voltage Source Monitor Unit / High Current Source Monitor Unit Fast Switch can be used to solve GaN current collapse measurement challenges.

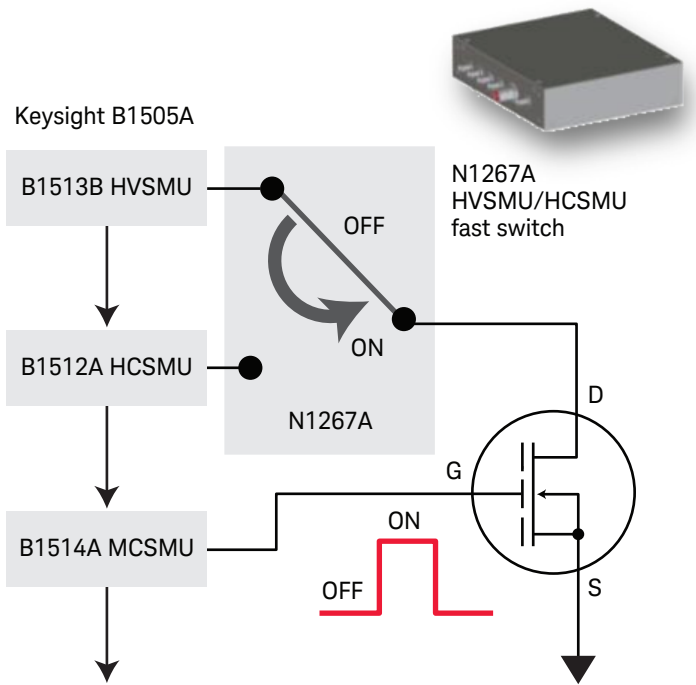
Key requirements for GaN current collapse measurement

- Several hundred volts need to be applied in the OFF-state.
- Transient currents of many Amps have to be measured immediately after the removal of high-voltage stress.
- Both fast response and slow response have to be measured.

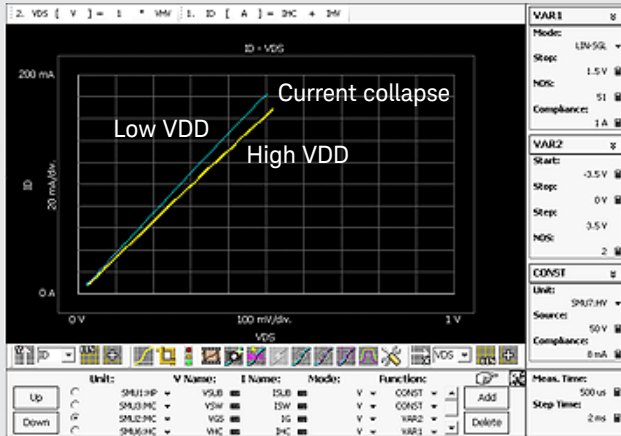


B1505A GaN current collapse measurement solution setup

- The B1513B HVSMU is used to apply high-voltage bias in the OFF-state.
- The B1512A HCSMU is used to measure current and apply voltage in the ON-state.
- The N1267A HVSMU/HCSMU fast switch enables fast switching between the HCSMU and the HVSMU modules.
- The HVSMU and the HCSMU modules act in synchronization with the device switching from off to on.



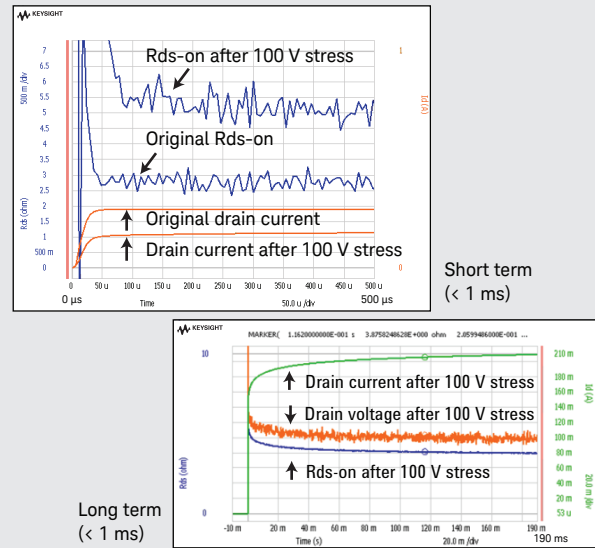
Example 1: GaN current collapse measurement using Tracer Test mode



Using the B1505A's Tracer Test mode overlay feature, we can easily obtain a graphical display of the current collapse effect.

The graph shows an example of the current collapse effect. The observed drain current after applying a 50 V drain voltage stress (High VDD) is less than after applying a 3 V drain voltage stress (Low VDD). Using the measurement repeat function, dynamic recovery of the drain current can be observed by reducing the VDD from 50 V back down to 3 V.

Example 2: Dynamic On-Resistance measurement using Application Test mode



Using application tests supplied with the B1505A, it is easy to perform dynamic on-resistance measurements for both short and long time periods without having to do any programming. The left graph shows an example of short-term (< 1 ms) time-based on-resistance measurement taken from 20 μs to 500 μs using a 2 μs sampling rate. We can clearly see the difference between when 3 V of stress is applied to the device in its OFF state versus when 100 V of stress is applied to the device in its OFF state. The right graph shows an example of a long-term (> 1 ms) time-based on-resistance measurement taken from 200 μs to 190 ms using a 200 μs sampling rate. A logarithmic time sampling mode is also available to monitor longer transient recoveries.

B1505A GaN current collapse measurement solution

Key features of the B1505A GaN current collapse measurement solution

- Max stress voltage at OFF-state: 3000 V
- Max drain current at ON-state: 20 A (pulse), 1 A (DC)
- OFF/ON switching time: Minimum 20 μs
- Stress time: Variable 10 ms~655.35 s (can be extended further via programming)
- On-state measurement duration
 - Fast measurement mode
 - 20 A range: Max 1 ms
 - 1 A range: Max 24 ms
 - Resolution: 2 μs~12 μs (minimum 6 μs~ for voltage measurement)
 - Measurement points: Max 4000 points
 - Long measurement mode
 - Resolution: 200 μs~65.535 s
 - Measurement points: Max 100,001 points
- Measurable devices: FET, diode

B1505A key features

- Wide voltage/current range: 10 kV/1500 A
- Accurate sub-pA level current measurement at high voltage bias
- μΩ resistance measurement capability at 100's of Amps
- High power pulsed measurement capability down to 10 μs
- Capacitance measurement at up to 3000 V of DC bias
- Temperature measurement capability

Please visit our YouTube channel to view video demos;
www.youtube.com/user/keysightParaPwrAnalyz

www.keysight.com/find/b1505A

