AMCAD SAS

High-Voltage Pulse IV System

AM3242

I - High Power transistor

Transistors are semiconductors that serve as the fundamental building blocks of all digital components. Amplifying and controlling a given voltage level is its main function. Over the years, a variety of transistor kinds have appeared, each with unique uses and with different technologies (Si, SiC, GaN, MOSFET, HEMT,...). One of these is the power transistor, it can handle high voltages and currents.

A transistor is widely used for switching operations, such as opening or closing a direct current (DC) circuit. In most cases, transistor switches are required to switch low DC ON/OFF.

A power transistor is an electronic component composed of semiconductor materials, with three terminals. Its design focuses on managing high current/voltage levels. When voltage or current is applied to one set of terminals, the device regulates the other sets. This functionality proves especially beneficial for high-power electronic equipment such as lamps, solenoids, relays, and motors.

Here are other advantages of a power transistor:

- High electric current density
- High voltage gain
- Large bandwidth gain
- Low forward voltage

Power transistor switches are ideal for high-power, current, or voltage applications: switched-mode power supplies, relays, DC/AC and DC/DC converters, power amplifiers, power control circuits.

Power electronics play a vital role in modern electrical engineering by enabling efficient energy conversion and management. This technology is essential for integrating renewable energy sources like solar and wind into the power grid, enhancing the performance of electric vehicles, and improving the efficiency of industrial processes. The continuous advancements in power electronics are key to developing more sustainable and efficient energy systems across various sectors, including renewable electric mobility, energy generation, and industrial automation.

II - Application case: C3M0021120D

Silicon Carbide (SiC) Power MOSFET N-Channel Enhancement Mode

- High blocking voltage with low On-resistance
- High speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery

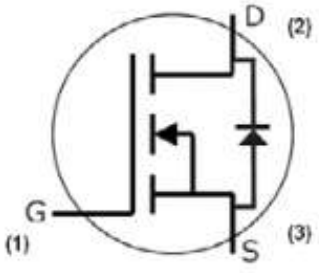
Typical applications: solar inverters, EV motor drive, high voltage DC/DC converters, switched mode power supplies, load switch.

Benefits:

- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

Key parameters:

- Drain-Source Voltage (Vds) up to 1200V
- Gate-Source Voltage (Vgs) from -4V to 15V
- Drain Current: 81A (DC) / 200A (Pulsed)



III - Pulsed Measurements

In semiconductor testing, accurately characterizing high-power transistors is essential for optimizing performance and reliability. Engineers working with high-voltage components need precise and stable measurement solutions to evaluate current, voltage, and transient responses without compromising the integrity of their devices.

In particular with transistor, self-heating effect impacts significantly its performances. To minimize this drawback, one solution is to reduce the on-time of the transistor.
Thus, pulsed measurement technique is totally indicated to achieve reliable and repeatable results. It consists of generating short voltage pulses instead of continuous DC voltage.

AM3242 is a Source and Measurement Unit (SMU): this system is able to generate and measure voltage and current pulses.
With a source/measurement range up to 150A and a voltage capability extending to 1500V, it delivers accurate and repeatable results in both static and dynamic conditions.
It supports low voltage and high current applications, with an optimized pulser safe operating area. Additionally, the transistor body diode measurement capability has been updated to support down to -50V and -150A, ensuring comprehensive device characterization.

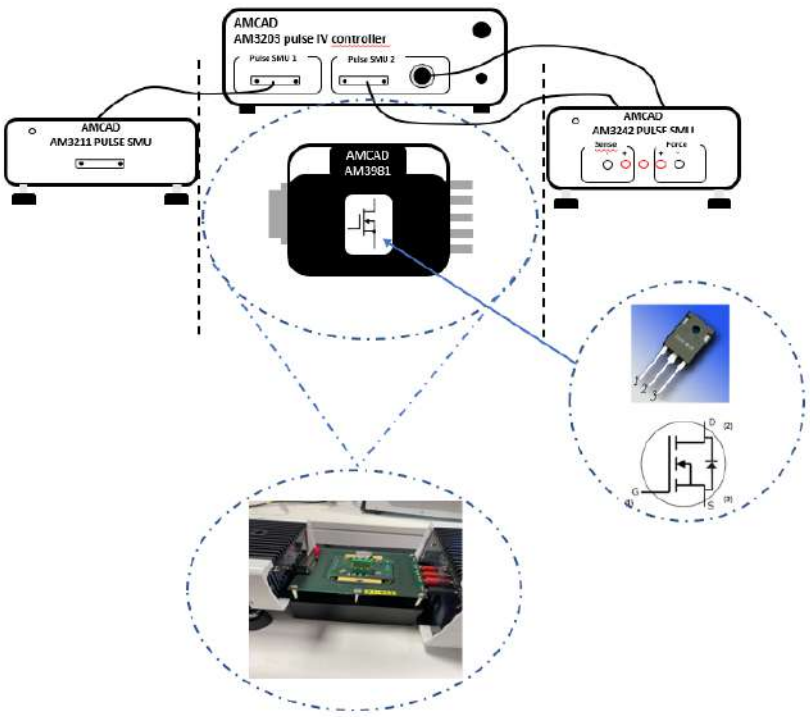
Typical measurements:

- High-Voltage transistor characterization, I-V measurements
- Static and dynamic Rds(On) measurements
- Transistor body diode measurements

Key parameters:

- Voltage range: -50V to 1500V
- Current range: -150A to 150A
- Minimum resolution: 26mV (@1500V range) and 2,8mA (@150A range)

AM3242 probe compatible with AM3200 systems
Completely integrated with IVCAD Suite (Dassault Systèmes software) to become a turnkey solution to characterize a transistor.

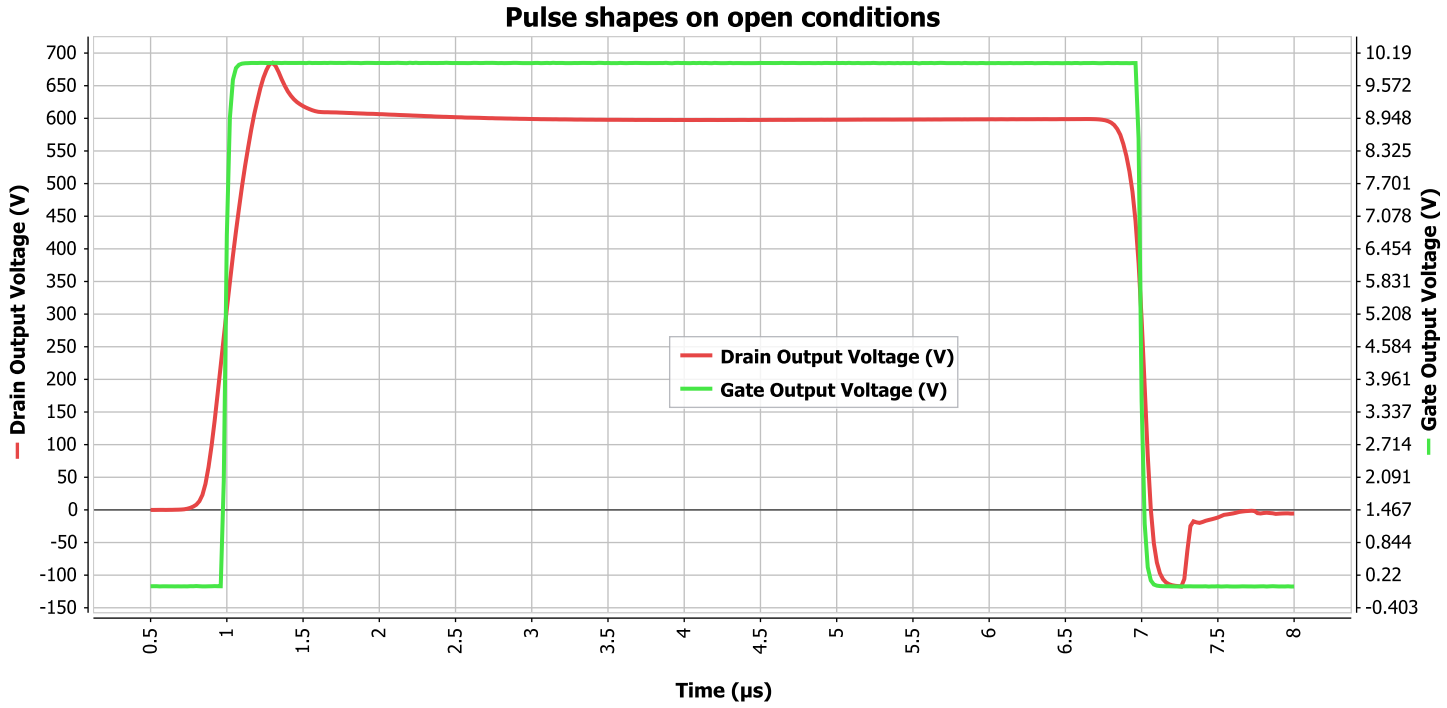


- Control unit 3203
- Probe 3211
- Probe 3242
- Test fixture AM3981
- Transistor Wolfspeed C3M0021120D

IV - Results

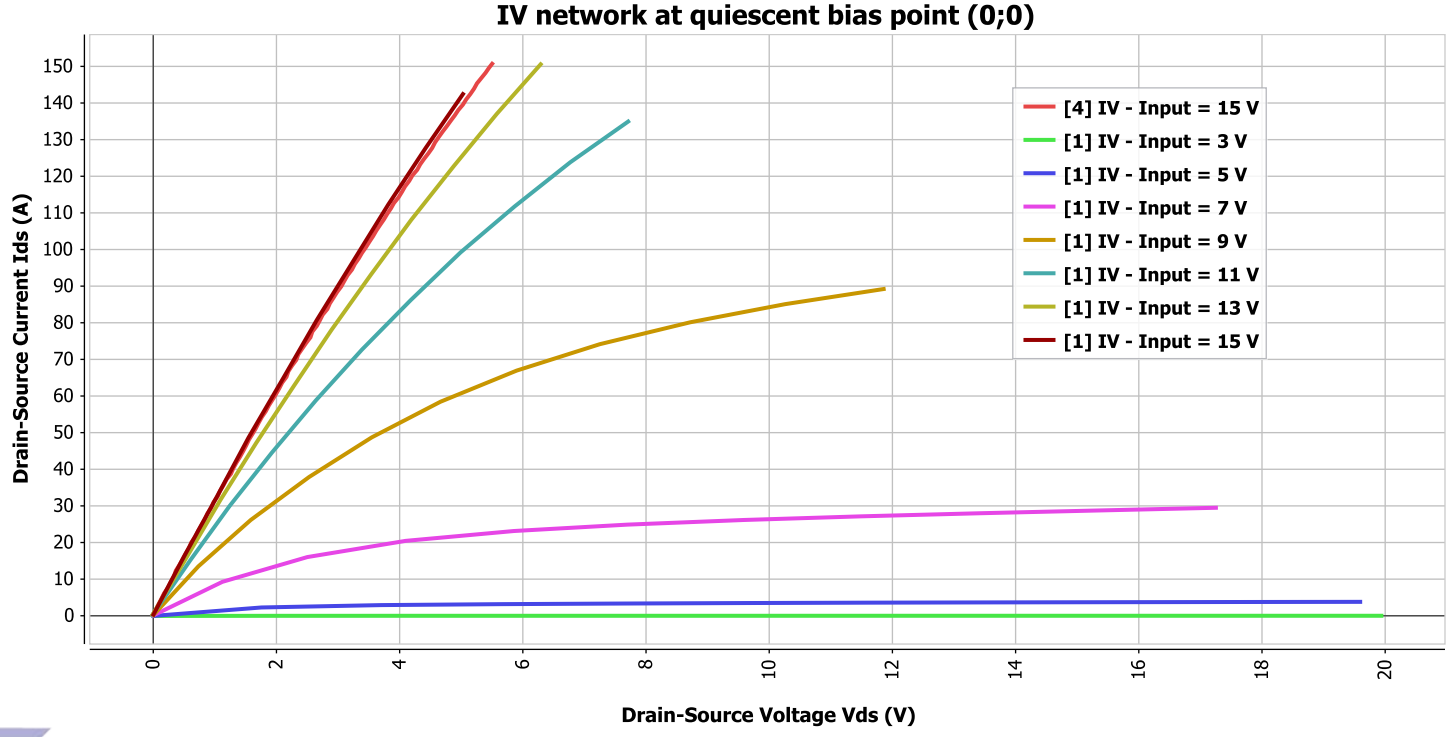
a - Pulse shape

The tests were conducted with a pulse width of 6µs on both the gate and drain probes, with an applied voltage of 10V on the 3211 and 600V on the 3242 (closely matching various customer applications).

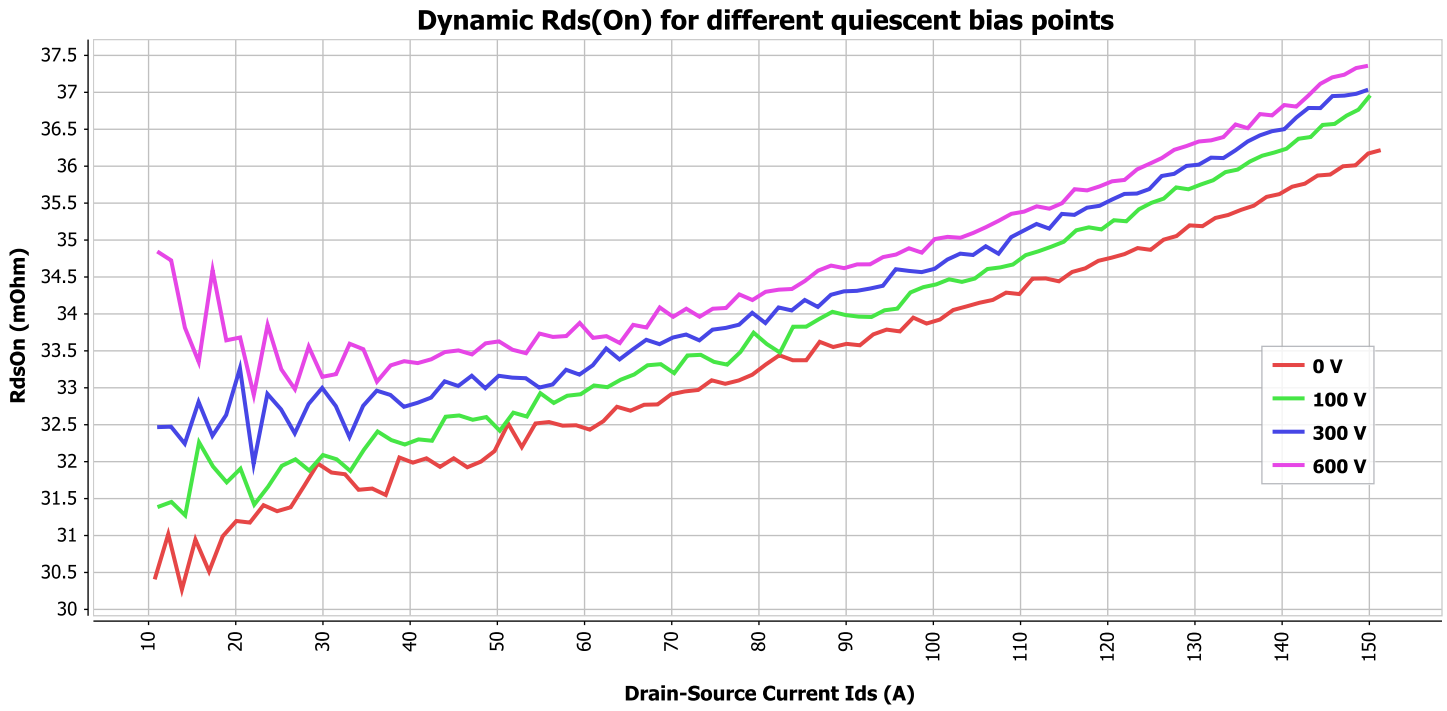


b - IV Network

This test involves measuring a high-voltage transistor (Cree C3M0021120D) using the 3242 high-voltage probe.
The test conditions for the pulsed IV network measurement are a pulse width of 1µs and a period of 2ms. Its usage closely simulates a final customer application.



c - Dynamic On-Resistance



d - Body Diode Characteristics