Power Cycling Tester

This test procedure enables to define thermomechanical robustness of semiconductor devices and its electrical and thermal connections under cyclic stresses by switching on and off the power dissipation within the active semiconductor. Therefore the load current is periodically switched on and off leading to rapid temperature changes. Power cycling aims to reproduce stresses of power electronic applications, e.g. traction converters, and complements accelerating life tests at high temperatures. Power cycling can lead to failure mechanisms other than fast passive temperature cycles (two chamber or two bath methods). This test procedures leads to ageing and has to be considered as destructive.

1. Test equipment

The power cycling platform is modular in order to be adaptable to the specimen and required stress parameters. Load currents are provided by CD power sources according to table 1. These sources can be paralleled to achieve higher currents.

Table 1 DC power sources

Type	Number	Voltage [VDC]	Current [A]
Sorensen DCS8-350	4	8	350
HP 6681A	6	8	580
HP 6680A	2	5	875
Power Ten R66D	2	8	1600

Cooling of devices under test is provided by the laboratory cooling water circuit with a temperature of 8°C, by a circulator with a cooling power of 3 kW (heating 2 kW) or a recirculating chiller with a cooling force of 11 kW.

2. Power cycling platform

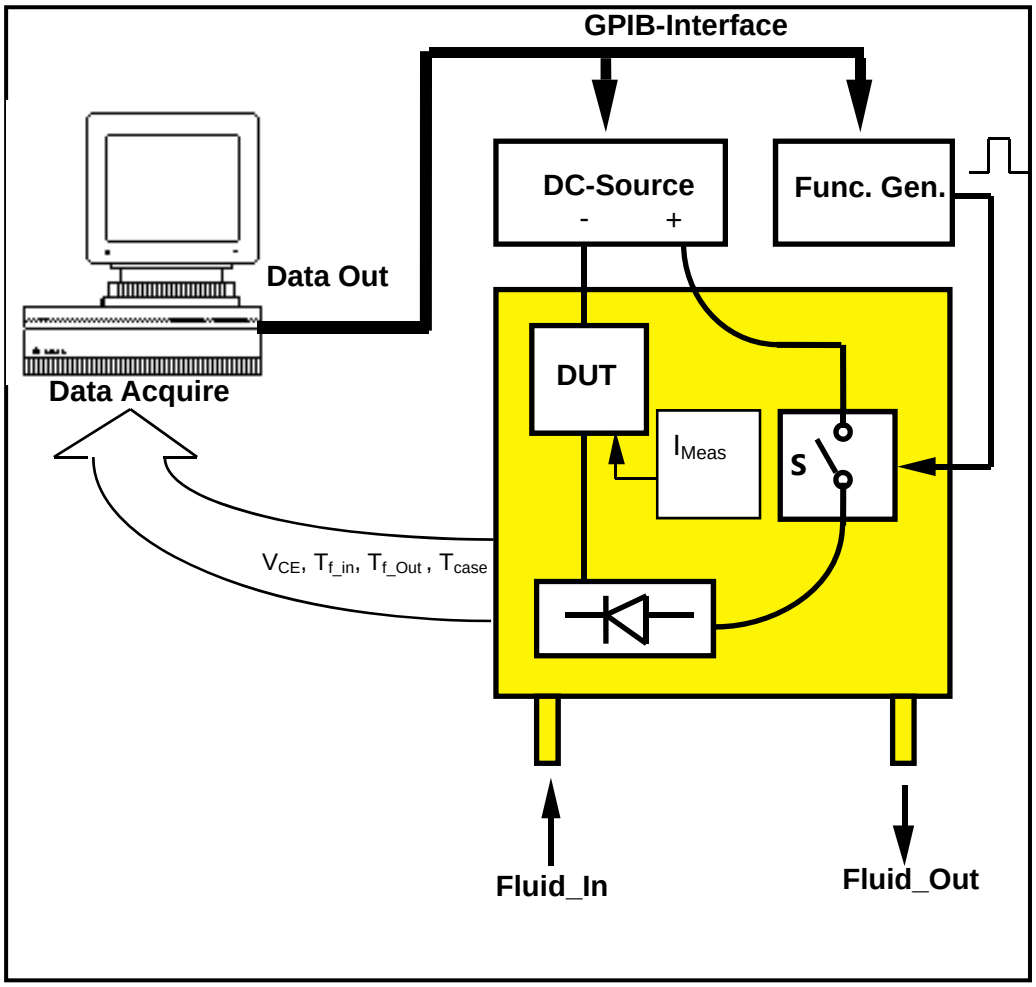

Fig. Basic setup of the power cycling platform

The device under test DUT is attached to water cooler.

The periodic switching of the load current can be done in two ways:

1. Switching of the DC source, i.e. a defined load current is switched on and off by the source.

2. The load current of the DC source is switched on and off by a separate switch S controlled by a function generator and a suitable driving unit.

With both methods the DUT itself is always in forward direction which allows to permanently inject a small measurement current I_{Meas} used for the determination of the semiconductor junction temperature. This requires that the voltage drop of the DUT as a function of I_{Meas} and temperature is measured in advance.

The data acquisition system records and stores voltages, currents and temperatures of the DUT and the test platform.

Comprehensive safety features allow permanent operation of the power cycling tester.

3. Standard

DIN EN 60749-34 Semiconductor devices - Mechanical and climatic test methods - Part 34: Power cycling (IEC 60749-34:2010); German version EN 60749-34:2010

4. Reference

Marcel Held, Peter Jacob, Giovanni Nicoletti, Paolo Scacco, Max H. Poech, Fast power cycling test for insulated gate bipolar transistor modules in traction application. International Journal of Electronics, Vol. 86, No. 10, pp 1193-1204, 1999.