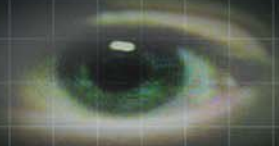
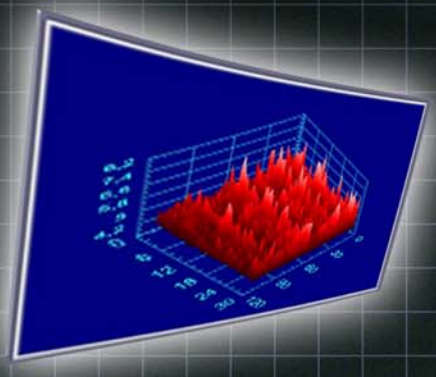
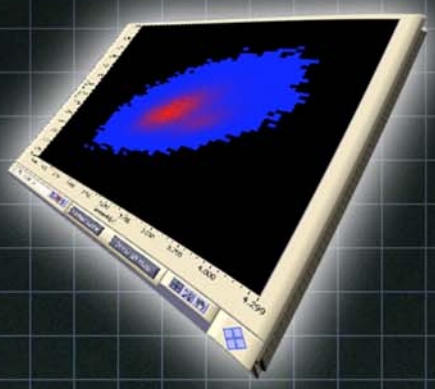
A NEW DAY IS COMING...
FOR NVM TESTING

RIFLE SE

THE EYE INSIDE YOUR DIE







ACTIVE TECHNOLOGIES

RIFLE SE

Based on the great success of the Rifle test equipment about the greatest European memory manufacturers (Infineon Flash, ST, Saifun, IMEC) the new high performance Rifle-SE system has been developed for the testing of single cell, stand alone or embedded avant-garde non volatile memories (NAND/NOR standard flash, multi-level, dual bit, PCM).

Rifle-SE has a completely new architecture that improves both digital and analog performances by a 10x factor and adds new important features to expand its application area considerably diminishing the measurement times.

The Rife-SE has an improved user interface, completely graphic, where complex analysis can be carried out and displayed with just few mouse clicks.

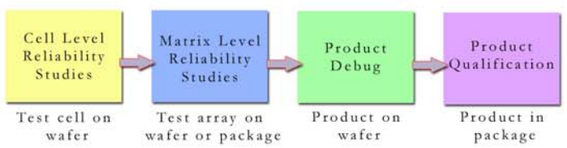
Application areas

Rifle-SE has been developed for deep investigation of the behaviour and reliability of non-volatile memory cells and arrays.

Its easy-to-use and easy-to-program interface, together with its dedicated high performance hardware circuits, enables its application in a wide range of operations, both during technology and product development and during the life-time of the memory devices.

The following diagram shows the various development phases where Rifle-SE is currently applied:

Technology and Product Development



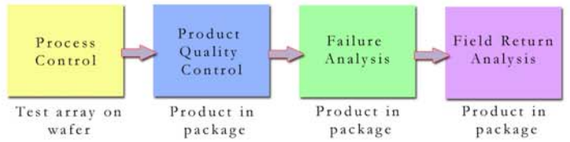
Cell Level Reliability Studies:
- Cell level measurements and characterization (IV, Vt);
- Single cell cycling;
- Algorithm trials (pulse waveforms, lengths, ...).

Matrix Level Reliability Studies:
- Matrix level measurements and characterization (distributions, maps, subset identifications);
- Full or partial matrix cycling;
- Algorithm trials (program and erase, simulating P/E controller).

Product Debug:
- Functional verification (matrix + interface);
- Product characterization (distributions, maps, subset identifications);
- Full or partial matrix cycling using embedded controller.

Product Qualification:
- Failure analysis;
- Interactive investigations.

Manufacturing and Product Life-Time

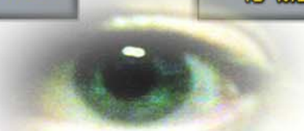


Process Control:
- Functional and reliability analysis on test structures;
- Matrix level measurements and characterization (distributions, maps, subset identifications);
- Full or partial matrix cycling.

Product Quality Control:
- Functional and reliability analysis on products;
- Product characterization (distributions, maps, subset identifications);
- Full or partial matrix cycling using embedded controller.

Failure Analysis:
- Understanding failures coming from the testing or from Quality Control;
- Interactive investigations.

Field Return Analysis:
- Understanding failures coming from field applications;
- Interactive investigations.



System architecture

The Rifle-SE core has a modular architecture made of programmable units that can be programmed by the user PC through a high bandwidth connection between the Rifle-SE and the PC or it can be programmed by an embedded dedicated RISC processor located inside the Rifle-SE system itself. This architecture allows to share the tasks between the PC and the embedded processor in order to optimize the system resources without loosing programming flexibility.

The Rifle-SE core is implemented by a 90-nm high performance FPGA and can be expanded by hardware IPs, allowing advanced specific customizations, or through a dedicated 1.2Gbps serial expansion bus.

Some of the main core units are:

The Digital Sequencer unit drives/stores the digital signals of the Device Under Test (DUT). The unit works at 400Mhz allowing a 2.5ns time resolution.

The PMU unit can force voltage/measure current or force current/measure voltage on the DUT data pins. The unit has 8 parallel independent channels with 70Mhz sampling rate (14.3 ns resolution time) and current measurement precision <1% at full speed (70Mhz). Also the current/voltage transitory can be measured like in an oscilloscope view.

The PW0 unit can force voltage/measure current or force current/measure voltage on any pin of the DUT through a low parasitic switch matrix. The PW0 unit has a 80Mhz sampling rate and current measurement precision <1% at full speed (80Mhz). The current/voltage transitory can be measured like in an oscilloscope view.

The AWG unit has up to 32 independent fully arbitrary waveform generators, operating at up to 100Mhz (10ns time resolution) with 9ns rise time and voltage resolution down to 1mV.

The Serial link unit is a dedicated 1.2Gbps serial bus for system expansions. Through this high speed connection, new programmable units can be added to the Rifle-SE core to extend its analog and digital resources without adding bandwidth bottlenecks.

Thanks to its high performance analog and digital resources, Rifle-SE can accurately evaluate the performance of any kind of non volatile memory device in very short times.

Connectivity

The Rifle-SE system is connected to the DUT by means of a Device Interface Board (DIB). The DIB can contact packaged devices or wafer dies through coaxial cables. The Rifle-SE system provides an IEEE488 connection and a complete software support to work with any kind of prober.

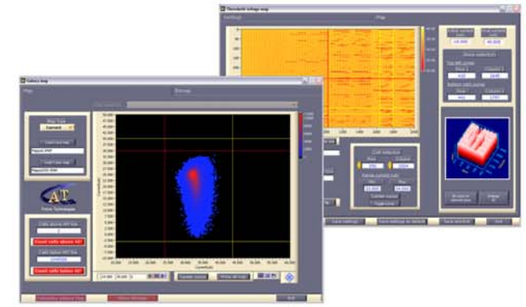
DIB can be a simple passive board or an advanced active board which can extend the system capabilities through the 1.2Gbps serial expansion bus.

Some examples of active DIB applications are:
- Dedicated switch matrix with high channel-to-channel insulation for single cell analysis;
- Leakage current measurements;
- Multi-channel fast current measurements for transient analysis.

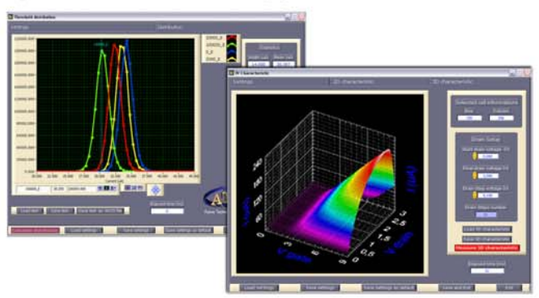
User interface

The Rifle-SE has a very intuitive and fully graphical user interface where any kind of measurement (program/erase, 2D and 3D Vt/current maps, Vt/current distributions, stresses, 2D and 3D I/V characteristics,...) can be configured and executed. The results, after being processed, can be analyzed by integrated graphical analysis tools.

The software is highly parametrized and structured to fit to different application areas and different device architectures.



The high performance hardware features are easily and efficiently supported by high-level graphical tools for editing the analogue and digital stimulus to be applied to the DUT.



Test flows can be edited by using standard C++ code, taking advantage of the powerful Microsoft .NET debugging features, or with LabVIEW block diagrams where the execution sequence is defined by easily placing icons (taken from a toolbar) representing the desired operation and connecting them together.

SPECIFICATIONS

- Multimaster architecture with integrated RISC processor
- 132 MByte/s transfer rate DMA channel
- Vector generator:
  - -32 bit @ 400 Mhz (2.5 ns edge placement resolution)
  - -Modular architecture to extend the number of channels
  - -Sequencer + RAM vector architecture for long and complex sequence generation
- Data bus:
  - -8/16/32 bit programmable
  - -400 Mhz update/sample rate(2.5 ns time resolution)
  - -Address/Data multiplexed
- Address generator:
  - -32 bit @ 200 Mhz
  - -4x4 stage pipeline structure for very complex address pattern generation
- Clock generator:
  - -Programmable period and duty cycle
  - -1.25 ns edge placement resolution
  - -400 Mhz max clock frequency
- Event detector and timer:
  - -Advance triggering capabilities: edge & level, edge or level, edge before/after level
  - -48 bit timer/counter @ 5 ns time resolution with 16 bit programmable prescaler
- 1.2 Gbps serial expansion bus
- Up to 32 waveform generators:
  - -12/14 bit resolution @ 100 Msps (10 ns time resolution)
  - -±12 V output voltage swing (9 ns rise time) or -9+36V high voltage option (36ns rise time)
- PMU current measurement units:
  - -8 parallel channels
  - -12 bit resolution @ 70 Mhz (14.3 ns time resolution) per channel
  - -Force current/measure voltage, force voltage/measure current
  - -Oscilloscope like transient measurements
- PW0 current measurement unit:
  - -12 bit resolution @ 80 Mhz (12.5 ns time resolution)
  - -Force current/measure voltage, force voltage/measure current
  - -Oscilloscope like transient measurement
- I/O optional expansion:
  - -Up to 256 I/O
  - -128 bit data bus with PMU connection
  - -Force current/measure voltage, force voltage/measure current on every pin
  - -Bank programmable I/O voltage

ABOUT ACTIVE TECHNOLOGIES

Active Technologies is an Italian start-up founded in 2002 by a staff of engineers expert in semiconductor characterization and test equipment design. Active Technologies supplies Automated Test Equipment (ATE) and general purpose electronic instrumentation to European and Middle East semiconductor company leaders

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