MIDAS

SEMICONDUCTOR EQUIPMENT ASSESSMENT

Results Bulletin MIDAS

Advanced reliability qualification and monitoring equipment assessment

There is no other system on the market that has a comparable flexibility to MIDAS II and this aspect is important for a global manufacturer.

EQUIPMENT EVALUATION SITES

AMI SEMICONDUCTOR

PHILIPS

EQUIPMENT SUPPLIER

Reltech LIMITED

Equipment Description

The targeted applications for the Reltech Flexitray MIDAS 5000 series reliability test equipment (Fig. 1) include a wide range of IC technologies from high power to low-voltage, high current deep sub-micron CMOS, Analog and mixed function technologies within a single life test equipment. The equipment provides high-speed, low-voltage switching capabilities with long signal depth on many channels as is important for sub micron telecom and audio consumer applications. It also provides low-speed, high current, high voltage signal switching capabilities for automotive and high power industrial applications.

Modular in concept and using distributed processing and PCB modules for each of the key functional elements, it enables variations to be made on a one-off basis without incurring excessive NRE expenses thus providing cost effective and advanced automated testing.

Features that impact Cost Of Ownership, include:

- *Modularity*
- *Flexibility*
- *High board capacity*
- *Multiple temperature zones*
- *Energy cost saving*
- *Use of other manufacturers burn-in boards*
- *Digital/analog/mixed signal/memory capability within a single equipment*
- *Use with existing ATE programmes via rapid software conversion to MIDAS format.*

The Flexitray© MIDAS© system concept

Today's semiconductor manufacturers need to get reliability data much faster and at a lower cost. The trend towards System-On-Chip design, decreasing sizes in CMOS technology and related lower voltage levels as well as higher frequencies has created the need for advanced burn-in methods. Typical SOC designs often include microcontroller cores, interface cores and non-volatile memories such as EEPROM, Flash and other embedded features. To cope with this demand the MIDAS system has evolved to MIDAS II during this project and has been further developed to provide broad functionality with multiple temperature, power and signal zones with the ability to test differing device technologies simultaneously.

Enhancement for Memory Testing

As a result of the project, the new MIDAS II system now has an added capability for memory testing, the modular concept allowing memory test modules to be added. 176 bi-directional vector lines enable testing of SRAM, DRAM and EEPROM devices. Importantly, FLASH memory is included, particularly for testing System-on-Chip (SOC) devices with embedded FLASH memory. A key development with MIDAS II is the capability to do test during Burn-in (TDBI), DUT (Device Under Test) monitoring during life test is also possible. (See Fig. 2)

Cost Effectiveness

The modularity, software and flexibility of the MIDAS Flexitray system together with the high board capacity bring a number of benefits to the user that impact Cost of Ownership (CoO). This has been analysed in the project. Some examples are given below.

Multiple temperature zones (up to six). If used for dual temperature applications with different activation energies, junction temperatures, device types or package styles, only one MIDAS system is required, thus saving ~ $520K, factory space and related running costs. Also, if only one temperature zone is active the user can save energy of 2.5 MWh for a 1000-hour period.

Simultaneous testing. Many different device types can be tested simultaneously, again saving on the cost of further systems and impacting time to market of product.

Reconfigurability. Each MIDAS driver card can be easily configured using add-on modules. For each module that is upgraded it saves the cost of a new driver board.

Example: 64 channel module = $650, new driver card = $6,500 giving a saving ($5,850 x 12) of $70,200.

Protecting existing investments

- Existing burn-in boards can be retained by using MIDAS conversion frames
- Existing ATE Software can be used. For example, for 20 programmes in the first year it provides a net saving of $11,700 using Programme Conversion Software (purchase accounted for in the calculation).

Addition of Analog capability. Adding mixed signal device testing on 77 DUTs to an existing MIDAS system configured for digital stimulation costs $81,250. A net cost saving of $438,750 compared to the purchase of a new system.

Fig. 1: Midas 5000

Fig. 2: Individual DUT tray

MIDAS placements at AMIS and Philips

Main application areas for AMIS are for high power high voltage and analogue switching whilst Philips applications are for high speed, low voltage with long test pattern depths, so the user partners ensured a complete evaluation for Digital, Analogue, and Power for applications such as telecom, ASICS, automotive, mixed function, power devices and subsequently memory content.

Evaluation of MIDAS at AMIS

The Flexitray© MIDAS© system concept and modules assessed at AMIS focused on automotive and telecom integrated circuits, requiring mixed signals, especially during high temperature life test and its usability and cost-effectiveness.

Whilst the automotive product required high voltage (mixed-signal), the telecom product put higher demands on the digital capability of the equipment. Telecom products required wider and deeper vector patterns (e.g. JTAG scan chain). Following initial assessments AMIS gave recommendations for enhancements and revised final target specifications that resulted in the new MIDAS driver cards (MIDAS II). The equipment performed effectively indicating its potential to address the diverse set of product requirements.

Evaluation of MIDAS at Philips

Philips Semiconductors utilized the Reltech pre-screen station, a useful "off-line" equipment feature, to assess the signal generation of the analogue audio and digital driver boards, with focus on low voltage and high frequency, at room temperature.

This included the stability and reproducibility of the digital signals at different voltages for the vector and the sub vector channels and extensive evaluation of the parametric performance. The analogue signal generator was also checked and tested. Suggestions were made to further enhance MIDAS hardware/software performance that Reltech subsequently implemented.

The overall assessment of the MIDAS II test system brought excellent results that were considered effective by the users.

The MIDAS II system has provided a solution for testing the reliability aspects of next generation chips. The high frequencies in combination with low Voh voltage levels answer the needs for emerging device evaluation (see Fig. 3 and 4).

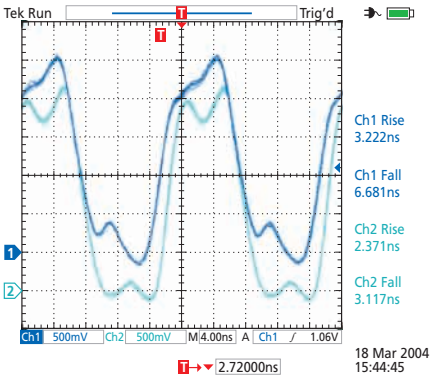

Fig. 3: Main clock at 100 MHz, Voh = 3.3 V

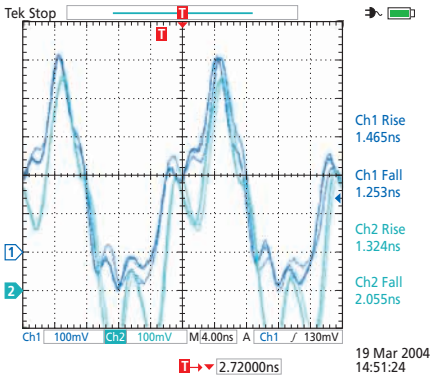

Fig. 4: Main clock at 100 MHz, Voh = 0.5 V

Improved Results in MIDAS II

Power Supply Range extended	0.5V to 20V
Clock Frequency increased	100MHz
Number of Vector Channels increased	176 (bi directional)
Vector Depth increased	2MB
Maximum Vector Frequency increased	25MHz
Sub Vector Frequency increased	50MHz
More waveforms	Sine, triangular, saw tooth, square now possible
O/p voltage low frequency	0-60V up to 20KHz now software controlled
O/p Voltage high frequency	0-60V up to 20MHz now software controlled
Mass current at 10KHz increased	10A
DC Offset	20V
Minimum Load	2 Ohms

Benefits to the user

The MIDAS system brings a number of benefits to the user including:

- Ability to perform testing of a wide range of device technologies from one system. This gives a large cost saving factor – "one system does all".
- Quick re-configuration to suit a new technology – decreasing time to market.
- Use of existing burn-in hardware – protecting existing investment.
- Energy saving – use of only one temperature zone during low volume applications brings energy and cost saving and reduces running cost.
- Easy upgrade path for future device technology. Possibility to add new modules – e.g. increased pattern depth, memory, pattern width, reduced Voh levels, Memory testing.
- MIDAS – ATE conversion software. Existing ATE programs are converted to MIDAS format.
- Increased uptime – ease of changing functional modules in case of failure – no system down time.
- Ease of new test program debug by use of the remote development station. Saving time, greater convenience with no need to shut system down or change temperature.

As an example of the modularity, a system has been provided to life test CMOS devices containing a micro video screen on its top surface. The modularity of the MIDAS system enabled an optical current measuring function to be added. Also the MIDAS driver hardware and software were installed within a temperature and humidity environment. Special backplanes only were required for this application.

AMIS also did an evaluation of the equipment usability. The calculated uptime over a one-year period is approximately 96%, but due to the modularity of the system the uptime is effectively 100%. Reltech has designed its own MIDAS II power supplies, giving a Mean Time Between Failure (MTBF) of approx. 4000 hours. Mean time to repair (MTTR) for a power supply was initially 8 hours but is now faster with the new design. The throughput is very good with 16 product types testable over a 7-week period.

AMIS' comment "There is no other system on the market that has a comparable flexibility and this is important for a global company."

Further information on Project MIDAS
A project partially funded by the EC IST programme

www.sea.rl.ac.uk

SEMICONDUCTOR EQUIPMENT ASSESSMENT

SEA DISSEMINATION OFFICE
Central Microstructure Facility
Rutherford Appleton Laboratory
Didcot OX11 0QX, UK
Tel: **+44 1235 445946**
Fax: **+44 1235 446283**
email: **sea@rl.ac.uk**
Web: **www.sea.rl.ac.uk**

EVALUATION SITE
Paul Colson
AMI Semiconductor Belgium BVBA
Westerring 15
B-9700 Oudenaarde
Belgium
Tel: **+32 55 33 23 41**
Fax: **+32 55 33 25 47**
email: **paul_colson@amis.com**
www.amis.com

EQUIPMENT SUPPLIER
Mark Ashley
Reltech Limited
Cam Mills, Lower Cam, Dursley
Gloucestershire GL11 5PW
UK
Tel: **+44 1453 541 200**
Fax: **+44 1453 545 810**
email: **m.ashley@reltech.co.uk**
www.reltech.co.uk

EUROPEAN COMMISSION CONTACT
Michel Hordies
European Commission
DG INFSO C1 (Nanoelectronics and Photonics)
BU29 5/32
1049 Brussels
Belgium
Tel: **+32 2 296 5718**
Fax: **+32 2 296 1692**
email: **michel.hordies@cec.eu.int**

Issued November 2004