

1164

Comprehensive Platform for Concurrent Intrinsic Reliability Test Applications

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Overview

The advanced 1164 reliability test system provides true parallel testing for a wide variety of semiconductor reliability applications at both package and wafer level. The 1164 leverages a unique and scalable architecture in which systems are comprised of modular components; these are configured with system capabilities and capacities to exactly match customer requirements, and allow for easy system expansion and adaptation. Application modules provide accurate source-measurement circuitry for a wide variety of reliability test applications and operating ranges. Application modules operate independently from one another and can be used in any combination within a system. The 1164's continuous monitoring system with high sampling rates provides excellent structure behavior detail for any system size or configuration.

Patented Notebook Ovens provide a stable and uniform thermal environment for package testing, in a small footprint to allow a large number of Notebook Ovens per system. Notebook Ovens operate independently from one another for maximum flexibility and test throughput. Proprietary DUT board technology results in reliable long-term high-temperature testing and low cost of ownership. Notebook Ovens also provide the interface point for wafer-level reliability testing.

Full-featured system software provides a flexible and powerful test environment. Statistical analysis software determines failure times based on various user-defined conditions, calculates acceleration model parameters, and predicts lifetimes with confidence intervals.



Features / Benefits

Flexibility

- Compact, configurable system provides full suite of test applications – EM, CVEM, LFPEM, SWEAT, ISOT, SM, BTS, TDDB, SILC, MTTDDB, HCI, and BTI. A single system may run any mix of these applications simultaneously.
- System performs package-level reliability (PLR) and/or wafer-level reliability (WLR)
- Independent Notebook Ovens provide many concurrent temperatures for PLR
- Full-featured software offers many experiment setup options

Throughput

- Notebook Ovens complete more PLR tests in less time, with independent start/stop times for each sample set
- Parallel measurement system completes tests faster
- Conductor software provides automated, unattended WLR testing

Performance

- Individual meters per DUT provide continuous monitoring and fast data sampling to characterize DUT behavior in detail and immediately capture breakdown
- Parallel measurement system minimizes device relaxation
- Precision SMUs provide accurate biases and measurements.

Reliability Test Applications

Test Algorithm	Devices Tested (Partial List)
EM (Constant Current Electromigration)	Interconnects (lines, vias, bumps, TSVs, pillars)
CVEM (Constant Voltage Electromigration)	Interconnects (lines, vias)
LFPEM (Low Frequency Pulse Electromigration)	Interconnects (lines, vias)
SWEAT (Standard Wafer-Level EM Accelerated Test)	Interconnects (lines, vias)
ISOT (Isothermal EM)	Interconnects (lines, vias)
SM (Stress Migration)	Interconnects (lines, vias, bumps, TSVs, pillars)
BTS (Bias Temperature Stress)	Dielectrics/barriers (ILDs, IMDs, MIMs, TSVs)
TDDB (Time Dependent Dielectric Breakdown)	CMOS transistor gate oxides (NMOS, PMOS)
SILC (Stress Induced Leakage Current)	CMOS transistor gate oxides (NMOS, PMOS)
MTTDDB (Multi Terminal TDDB)	CMOS transistor gate oxides (NMOS, PMOS)
HCI (Hot Carrier Injection)	CMOS/bipolar transistors (NMOS, PMOS, NPN, PNP)
BTI (Bias Temperature Instability) – NBTI (Negative BTI) and PBTI (Positive BTI)	CMOS transistors (PMOS, NMOS)

Operating Platform

Architecture	<ul style="list-style-type: none"> Modular system, one or more compact 4Paks per system <ul style="list-style-type: none"> Up to 16 4Paks in one system – mix and match various types Expand by adding 4Paks Four test slots per 4Pak – each slot contains: <ul style="list-style-type: none"> One independent application module – mix and match various types One independent Notebook Oven – multiple types available One DUT board for package-level reliability (PLR) –or– WLR Interface (with cables to probe card) for wafer-level reliability (WLR) System framework consisting of User Interface PC, Test Control Unit(TCU) and TCU PC, power distribution assembly (PDA), 4Pak communications, stacking, and accessories Simultaneously executes in a single system up to 64 autonomous experiments of different types, biases and temperatures
Package-Level Reliability (PLR)	<ul style="list-style-type: none"> 230°C, 250°C, 350°C, or 450°C maximum temperature (as determined by selected 4Pak / Oven and DUT Board types) DUT Boards for 300 or 600 mil DIPs, up to 28 pins Standard and custom DUT board designs – multiple types available
Wafer-Level Reliability (WLR)	Interfaces to one or more single site or parallel multi-site probe cards on probe stations with thermal chucks
Software	<ul style="list-style-type: none"> Windows 7 operating system Included: Zeus system software to set up and monitor experiments; store, export and graph measurement data Optional: Conductor software for WLR automation Optional: Statistical analysis software for modeling and lifetime prediction – multiple packages

Kit	Notes
User Interface and TCU Kit	<ul style="list-style-type: none"> Two PCs, LCD monitor, keyboard, mouse TCU cabinet, communications cables PDA and stacking hardware for up to four 4Paks Software, ESD-safe loading platform and accessories
User Interface and TCU Kit with Emergency Off (EMO) switch	<ul style="list-style-type: none"> Two PCs, LCD monitor, keyboard, mouse TCU Cabinet, communications cables PDA with EMO and stacking hardware for up to four 4Paks Software, ESD-safe loading platform and accessories
Stacking Base Kit	<ul style="list-style-type: none"> PDA and stacking hardware for up to four additional 4Paks
Stacking Base Kit with EMO	<ul style="list-style-type: none"> PDA with EMO and stacking hardware for up to four additional 4Paks

4Paks and Notebook Ovens

Each 4Pak includes four Notebook Oven temperature chambers; all Notebook Ovens within a 4Pak are identical (i.e., they have the same maximum temperature). Each 4Pak includes up to four application modules; some modules require different 4Pak power supplies, according to the compatibility matrix below.

4Pak Type	Max Notebook Oven Temp	Supported Application Module Types
250°C Standard	250°C	UHAEM, SEM+, MPEM+, STDDDB, HVTDDDB, EVTDDDB, AHCI, HVHCI
250°C High Current	250°C	UHAEM, SEM+, MPEM+, HATDDDB STDDDB, HVTDDDB, EVTDDDB, MTTDDDB
250°C High Current EM	250°C	UHAEM, SEM+, HIEM+, MPEM+, HATDDDB, STDDDB, HVTDDDB, EVTDDDB, MTTDDDB
350°C Standard	350°C	UHAEM, SEM+, MPEM+, STDDDB, HVTDDDB, EVTDDDB
350°C High Current	350°C	UHAEM, SEM+, MPEM+, HATDDDB STDDDB, HVTDDDB, EVTDDDB, MTTDDDB
350°C High Current EM	350°C	UHAEM, SEM+, HIEM+, MPEM+, HATDDDB, STDDDB, HVTDDDB, EVTDDDB, MTTDDDB
450°C Standard	450°C	UHAEM, SEM+, MPEM+, STDDDB, HVTDDDB, EVTDDDB
450°C High Current	450°C	UHAEM, SEM+, MPEM+, HATDDDB STDDDB, HVTDDDB, EVTDDDB, MTTDDDB
450°C High Current EM	450°C	UHAEM, SEM+, HIEM+, MPEM+, HATDDDB, STDDDB, HVTDDDB, EVTDDDB, MTTDDDB

Application Modules

System test capabilities, operating ranges, and DUT capacities can be configured by selecting a mix of application module types from the list below. Note compatibility with 4Pak types in preceding table.

Module Type	Test Algorithms	DUT Capacity per Module (Max per 1164 System)	Application Notes
5 mA 10 V Ultra High Accuracy EM (UHAEM)	EM, SM	16 (1,024)	For 32 nm and beyond (excellent accuracy for very low currents, high sampling rate)
200 mA 40 V Standard EM (SEM+)	EM, SWEAT, ISOT, SM	16 (1,024)	For general purpose EM
4 A 10 V High Current EM (HIEM+)	EM, SWEAT, ISOT, SM	12 (768)	For 3D IC (high accuracy Wheatstone Bridges for low resistance bumps and TSVs)
25 mA 10 V Multipurpose EM (MPEM+)	EM, CV EM, LFP EM, SWEAT, ISOT, SM	16 (1,024)	For constant voltage, constant current, and pulsed EM; also fast wafer level EM (SWEAT, ISOT)
40 V 350 mA High Accuracy TDDB (HATDDB)	BTS, TDDB, SILC	48 (3,072)	For thin oxides including HKMG and FinFET (high sampling rate for soft breakdown)
40 V 1 mA Standard TDDB (STDDB)	BTS, TDDB, SILC	64 (4,096)	For general purpose BTS and TDDB
150 V 10 mA High Voltage TDDB (HVTDDB)	BTS, TDDB, SILC	32 (2,048)	For higher-voltage processes
200 V 10 mA Extended Voltage TDDB (EVTDDB)	BTS, TDDB, SILC	32 (2,048)	For higher-voltage processes
12 V 50 mA Multi-Terminal TDDB (MTDDB)	MTDDB	24 (1,536)	For thin oxides including HKMG and FinFET (more detail than 2-terminal TDDB)
15 V 100 mA Advanced HCI (AHCI)	HCI, BTI	12 (768)	For general purpose HCI and conventional BTI, including HKMG and FinFET
150 V 100 mA High Voltage HCI (HVHCI)	HCI	6 (384)	For higher-voltage processes

PLR DUT Boards and WLR Interfaces

DUT boards come in two technologies (polyimide for lower-temperature testing and porcelain on steel for higher temperature testing) and support various package sizes according to the table below. Standard (catalog) pinouts are offered – custom pinouts are also available (consult factory).

DUT Board Style	Max Temp	Compatible 4Paks
Polyimide, for 300-/600-mil DIPs up to 28 pins	230°C	250°C 4Paks
Porcelain on steel, for 300-mil DIPs up to 20 pins	450°C	250°C, 350°C and 450°C 4Paks
Porcelain on steel, for 600-mil DIPs up to 24 pins	450°C	250°C, 350°C and 450°C 4Paks
Porcelain on steel, for 600-mil DIPs up to 28 pins	450°C	250°C, 350°C and 450°C 4Paks

➤ WLR Interfaces

WLR interfaces can be configured with multiple cable options to match various single site and multi-site probe cards, and support the same full-module capacity as PLR DUT boards. WLR interfaces are manufactured by Celadon Systems. Both PLR DUT boards and WLR interfaces must match application module types according to this table.

DUT Board or WLR Interface Type	Supported Module Types
EM	UHAEM, SEM+, MPEM+
HIEM	HIEM+
HATDDB	HATDDB
STDDB	STDDB
HVTDDB	HVTDDB, EVTDDDB
AHCI	AHCI
HVHCI	HVHCI

➤ Regulatory Compliance

CE, SEMI S2, ETL

➤ Available Options

Warranty*	Fifteen months from date of delivery or twelve months from date of installation
Service contracts	Single- and multi-year programs available to suit your needs

* See FormFactor's Terms and Conditions of Sale for more details.

➤ Ordering Information

Consult factory for more detailed specifications, additional options, suitability of configuration for intended usage, part numbers, pricing, and delivery.

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