DATA SHEET

DS-10060

WBG HTOL/HTRB Reliability Test Model RS-100

- **Testing to Learn, not just to pass**
- **Capacity for qualification requirements**
- **Individual in-situ stressing/monitoring**
- **High current HTOL capable**
- **100V to 10kV HTRB**
- **IV and single data tests measurements**
- **Customizable stress/monitor capabilities**

Reedholm Systems recognizes the unique needs and challenges of stress, test, and measurement of wide band gap devices (WBG). The stress/measurement needs for these devices stretches the limits of conventional parametric measurement tools. Additionally, WBG materials challenges and applications are driving divergent needs from those of traditional Si, therefore Reedholm Systems tailors its measurement instrumentation and long-term reliability stress capabilities specifically for the GaN, SiC, GaN on Si, and other WBG devices & materials.

The RS-100 WBG Reliability system delivers two fundamental capabilities:

- The capacity to deliver statistically significant sample sizes needed for reliability testing. The base system offers 15 DUT per experiment stress condition and up to 6 simultaneous experiments for a capacity of 90 DUT, with expansions to 270 DUT and 18 simultaneous experiments.
- When paired with a fully integrated Reedholm parametric analyzer, it gives the ability to not just test to pass but test to learn. Each experiment operates independently of the others and switch in the parametric instrumentation for periodic user defined measurements tests and cycles.

The ability to provide customized stress for HTOL applications for the high voltage/high current needs of the target devices. Customization for frequency, voltage, current, dynamic operation or other features can be implemented.

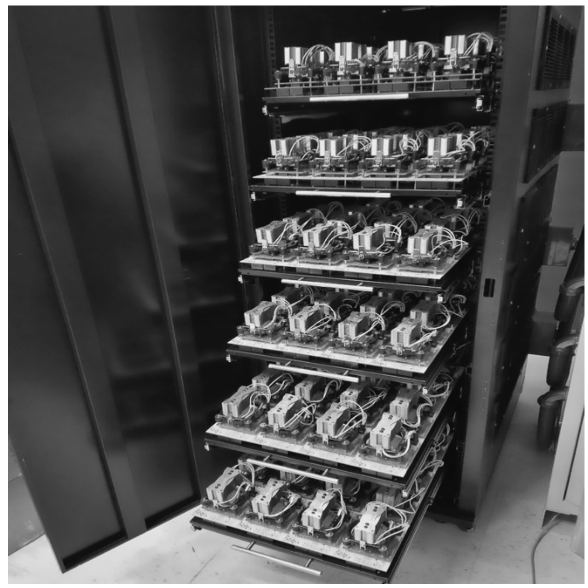

Figure 1 RS-100 DUT Racks

A key principal in the design and execution of these systems is their intent for customization to meet stress and test requirements. Reedholm Systems recognizes that the challenges of the devices and technologies being analyzed means that there is no one solution for all applications. Therefore, we have architected these systems to be readily customized for stress and measurement requirements defined by the customer.

This allows a tailored system for HTRB and HTOL where the specific stress requirements for each application are factored into the hardware and software.

Data collected during the stress cycle such as temperature, voltage, and current is recorded to a local datalog for reviewing changes in DUT behavior during an experiment. Periodic parametric data collected, either single value or I-V curve data, is saved to a database which can be queried at any point during the experiment to allow monitoring of experiment progress.

Monitoring & Control

The distributed stress control architecture allows the user to define control limits, test & measurement temperatures, and provide fully automated and continuous monitoring of each DUT during stress.

- Ability for dynamic HTOL
- Over-current failure isolation
- Constant current Ids with Vg control
- Integration of RF stress capabilities
- Constant current Ids with Vg control
- Continuous data logging

A significant advantage is the ability to interrupt stress on a failed device once a failure threshold has been achieved. A single DUT cannot bring down the voltage stress on other devices and continued destruction of a failed device is interrupted providing an opportunity to have more structures for failure analysis.

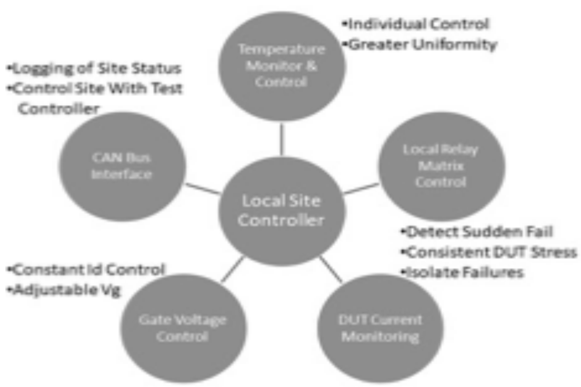

Figure 2 - Monitoring Features

Local Temperature Regulation

Variation in power dissipation between devices produces changes in junction temperature between devices within a given experiment. Thermal monitoring and control for each DUT gives the ability to independently regulate the temperature of each DUT, 200C is standard, with higher temps available.

Local, independent control of the temperature and stress interconnect relay matrix allows any combination of temperature, voltage, current, and measurement options when characterizing a device in-situ.

This design approach means that only the DUT is at the stress temperature allowing other stress and/or monitoring circuitry to be integrated into the DUT environment. This means local circuitry is not subjected to the extreme temperatures of long-term stress.

HV (1250V+) & High Current – Stress

Reedholm Systems offer stress capabilities currently at 0-100V, 0-600V, and 0-1250V with up to 50mA of current per device for blocking mode stress delivery (HTRB).

Different configuration of stress supplies and fixtures delivers higher current compliance per device at lower stress voltages to support higher current stress requirements (HTOL).

HTRB VOLTAGE	STANDARD	OPTION
100V	60mA/15 DUT	120mA
700V	40mA/15 DUT	80mA
1,000V	60mA/15 DUT	120mA
2,000V	30mA/15 DUT	60mA
4,000V	30mA/15 DUT	60mA
8,000V	30mA/15 DUT	60mA
10,000V	25mA/15 DUT	50mA
HTOL	**STANDARD**	**OPTION**
Vds	5V@4A/DUT	5V@30A/DUT*

* - High power capabilities for HTOL may be limited by DUT Carrier size, thermal solution design, and control requirements. Higher voltage compliance is also available if desired.

Figure 3 Currant Stress Requirements

Addressing HTOL (Static, Dynamic, and RF)

Because the system stress environment is maintained below 55°C, there is ability to integrate operational components around the DUT inside the stress chamber. This allows flexibility to address specific challenges for HTOL stress requirements for power devices:

- For DC/DC Conversion – Implement Buck/Boost design elements around the DUT with the ability to monitor, characterize, and control using the local controller and measure efficiency real-time.
- For Static HTOL – Provide closed-loop control to bias the gate while monitoring the DUT current to achieve a pre-defined constant current stress to the DUT from high current bias supplies.
- For RF Applications – Integrate customer-defined RF stress elements on the DUT Carrier within inches of the DUT for low-loss, low-noise delivery of RF stress to the DUT controlled by the local controller.

Parametric Measurement Capabilities

With systems integrated to the Reedholm Systems parametric analyzer, each board of 15 DUT has 4 parametric tester pins which can be connected to each DUT for periodic device characterization. The full suite of Reedholm Systems parametric test routines are available to define a test or sequence of tests to perform periodically on devices throughout the experiment duration. Measurements include single datapoint measurements, I-V sweep measurements, and custom test routines available from the Reedholm Systems hardware capabilities. The standard tests limits for the parametric analyzer are +/- 100V and 100mA per bias supply (4 supplies total) and 16-bit DMM accuracy.

	KEY BENEFITS & CAPABILITIES
STATIC Rds-ON	100V, 400mA Standard, Options for 10KV or 50A (pulsed)
DYNAMIC Rds-ON	100V, 400mA Standard, Options for 10KV or 50A (pulsed)
CURRENT COLLAPSE	Record and report results over time stress
SWITCHING SPEED (t-ON)	uS Speed parametric measurements
REVERSE RECOVERY (t-rr)	Precise timing resolution of measurements
GATE LEAKAGE (Ig)	nA Resolution measurement across wide V-range
I-V INFO (Vt, Gm, Ids)	Full parametric capabilities – sweep and discrete measurement
RF CHARACTERIZATION	Integrate customer defined instrumentation/tests

Load Board Architecture

Each load board includes three components:

- **DUT Carrier Board–**One of these boards per DUT site, the DUT board holds the DUT socket, thermal solution, and any local drive/monitoring components (i.e. RF parts or HTOL drive components)
- **Control Board–** One of these boards per DUT site, this board contains the local microcontroller that continuously monitors and controls all stress elements and connections to the DUT
- **Main Load Board**– This large PCB provides interfacing between the test controller and the DUT carrier boards and contains the stress supplies for HTOL and HTRB as well as local relay matrix for DUT connectivity.

Figure 4 - Reedholm Systems Load Boards

Design for Customization

Reedholm System recognizes that the market of WBG stress and measurement demands are not fully established and therefore there is not one ‘standard’ that applies to all requirements. The advantage of this “Architectural Design” approach allows for flexibility and customization. For example:

- **Support any New of Future Package Types**- Customization is provided with each order to allow for an array of packaged types to be used, this includes solutions for TO, SO, SMT, DIP and any other package type.
- **Expand Stress/Measurement Functional Capability**– Changes to Control Board firmware and associated circuitry allows implementation of different features for stressing or monitoring the devices during stress. This can include active components for HTOL, RF components for dynamic stress, additional bias supplies for devices, or additional current/voltage monitoring capabilities.
- **Higher Current Compliance Capabilities**– Expand the standard system current compliance with higher power, higher current supplies for high power stress requirements.

GUI Software Interface

All test and measurement requirements to define an experiment configuration are setup and selected using an intuitive GUI interface. Users setup the requirements for stress (stress type, temperature, voltage, current, dynamic test frequency, etc.) and measurement (periodic parametric test measurement frequency, parametric test items per measurement, and I-V sweep measurements).

The GUI interface shows the user an intuitive view of ongoing experiments, DUT status, and summary statistics to monitor ongoing experiments.

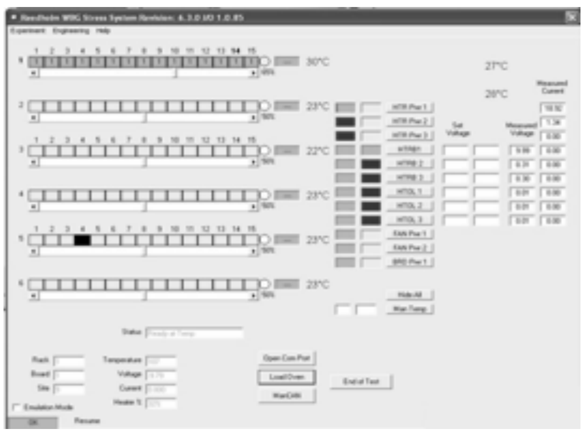

Figure 5 - WBG Experiment Status Screen

Maintaining the System

The modular design of the system lends itself to easy and rapid maintenance procedures. Control boards can be removed and replaced in the event of failure. DUT carrier boards likewise can be readily replaced in the event of failure or for package configuration changes.

By isolating the DUT interface on one 'daughter board' and the control logic on another, the remaining system elements have few possible points of failure – producing a highly reliable system.

System Layout Information

The system configuration includes a power cabinet which includes AC power distribution and control elements as well as the bulk AC-DC power supplies for providing DUT stress, temperature control, and logic supplies.

The stress chamber utilizes ventilated variable speed cross-flow air movement to regulate DUT cooling requirements and can optionally include recirculation if a chiller is integrated into the system.

All cabinets and access to dangerous voltages are contained and access is not allowed during system operation.

Power requirements to the system vary based on total system power consumption but varies from 208V/50A/1φ to 480V/40A/3φ.

High Voltage (10kV) & High Current (50A) - Measurement

The core Reedholm system is well suited for the gamut of parametric test requirements, delivering both power and precision. Reedholm is a pioneer in delivering turn-key systems for die sort and process monitoring. With WBG development products delivering blocking voltages in the 1000's of volts and devices regularly operating at several 10's of Amps of current, measurement instrumentation needs to not only meet but exceed these capabilities to deliver the ability to characterize beyond the product operational range.

Shown is an optional dedicated 10kV voltage source & pulsed 50A current source that can allow either measurement condition to be applied to devices to measure both standard and power devices with a single test system.

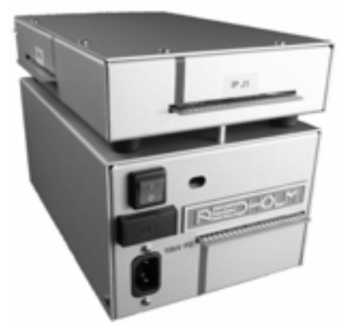

Figure 6 - 10kV/50A DC Power Parametric Analyzer

For more information about this instrumentation capability, see Reedholm Systems Datasheet DS10058.

Refer to the Reedholm DS1000 test system capabilities and features. Due to the custom layout and configuration of WBG systems for routing of tester connections to each DUT, specific performance can vary from one application to the next.