

GROWING NEED FOR POWER CYCLING

The *Wyeast Technology 354A FET Cycling Control* is used to conduct Power Cycling, an important test for estimating long term reliability of power electronic products.

Power semiconductors are showing up in more products every day, providing new features and energy efficiency. One of the inherent challenges in any product design is to add features and efficiency while maintaining reliability over desired operating life. This is especially true when applying power electronics, given large thermal stresses on high power, large silicon area parts.

Large semiconductor devices wear out at end of life due to thermal cycling. As a part heats and cools, stresses develop due to differences in material thermal expansion coefficients. These stresses degrade package interface materials, leading to reduced performance as the part ages. Power cycle testing is used to evaluate the effect of this repetitive stress in a manageable time period by reducing the time between heat up and cool down of a given part.

CURRENT POWER CYCLING TEST SYSTEMS

Power Cycling is often a labor and engineering intensive process using in-house designed test systems.

Typically, Power Cycle testing is specified as a number of cycles and a given heat swing, such as: *45,000 cycles of a 100°C junction temperature swing.*

To set heating power levels, the thermal properties of the part, mounting interface, and the heat sink must be characterized. Good characterization of a single power MOSFET can be a difficult task. Mounting and heat sinking do not make this easier.

Unfortunately, thermal characteristics of both the part and the heat sink system are not constant throughout testing. Thermal interfaces may degrade as the test progresses, sometimes after an initial improvement.

A manufacturer concerned with maintaining a constant temperature swing has traditionally had to deal with a labor intensive, error prone process of multiple characterizations and power level adjustments over the course of a given test.

ENTER THE WYEAST TECHNOLOGY 354A

The *Wyeast Technology 354A* both simplifies power cycling and outperforms in-house designed cycling systems by simultaneously addressing the problems of interface change and initial performance differences of individual parts.

The *354A* seamlessly integrates cycling control and the measurement of junction temperatures on each part, over every cycle. With no interaction required, the *354A* and host controller record actual junction temperatures and electrical power levels measured during testing. *Heat Power is continuously adjusted by the host controller to closely hold temperature swings to a set value over the course of testing.* This is a major improvement over systems in which a user must stop the test for characterization and manual readjustment.

SOFTWARE

Host software accompanying the 354A makes it simple to perform accurate initial characterization (*K-factor* determination) for all parts before power cycling. Manual characterization of heat sink and mounting is not necessary because the 354A self-adjusts power levels based on measured junction temperatures. In effect, the 354A characterizes all thermal interfaces every cycle.

In default configuration, software stores all measured data in a relational database (RDBMS) on the host machine. The host software may also be configured to use other database systems which may be available on a network. All stored data is available, and integrated report generating capabilities make it easy to collect and transfer in formats compatible with spreadsheet and other software tools.

Full control of the 354A is possible over a secure link by any remote computer running host software. Tests may be stopped or started, reports may be run, and data can be monitored from a computer on the LAN or across the Internet.

EXAMPLE OF TESTING

A customer used the 354A to test the effects of power cycling on two different types of parts and a variety of mounting methods. Examining the results, the customer could determine the effects on both initial characteristics and thermal interface stability of multiple mounting methods.

The 354A adjusts the heat power used for every part individually, enabling easy comparison of parts with differing performance in the same test.

ADVANTAGES OF THE 354A CYCLING SYSTEM

The 354A out performs most conceivable in-house built setups for power cycling, reducing design efforts and labor costs while improving the quality of data gathered from testing.

Service life and long term reliability is impossible to directly measure at the beginning of a product design life cycle. A manufacturer designing efficient home appliances to last 20 years or industrial drives to serve for 10 cannot afford test durations on the order of these service lives before selling the first unit. This is a large concern because service life will be tested by the end market, and will have a significant effect on the profitability and reputation of any company who's name is on the label. Power cycling is an important way to evaluate long term aging effects of thermal stress in a manageable time period.

Host Software User Interface

