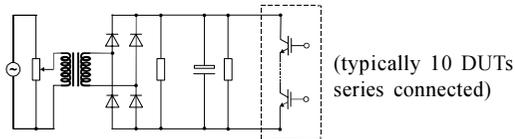


POWER CYCLE CAPABILITY OF SOLDER CONTACT DCB-MODULES

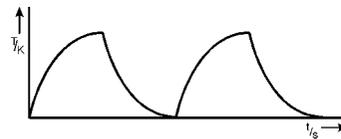
In contrast to semiconductor devices for information processing, power semiconductors may experience a high number of temperature cycles during their lifetime in field usage. Therefore it is a requirement that power device design be capable of withstanding several thousand load cycles and in some applications, like traction and forklift truck applications or elevator service, even millions of cycles. During load cycling, the internal construction of the device is subjected to high thermal and mechanical stresses and the internal electrical connections have to carry high current loads. Due to their unique design based on DCB alumina substrates, IXYS power modules can fulfill both of the following requirements: least thermal expansion mismatch between solder layers and minimum number of internal connectors and interfaces.

Power circuit designers need to estimate the life of components in their application. Tests to prove load cycle capability of power device design and manufacture are very expensive and time consuming, although in most cases accelerated test are performed. However, in addition to the temperature excursion of the die, cycle period has significant influence on the performance of solder contacts: Short power cycles (~ seconds) yield better results than long cycle periods (~ minutes).

Load cycle tests are conducted at IXYS on test devices mounted to heat sink and heating them up by applying their rated current specified at $T_{\text{Sink}} = 85^{\circ}\text{C}$. Forced air convection cools the heat sink back to $\sim 40^{\circ}\text{C}$ after the load current is turned off. Then the next cycle starts. Cycle period is in the order of minutes. Load cycle tests are done on a routine basis to monitor the reliability of parts in production as well as to qualify new parts before their release to production.

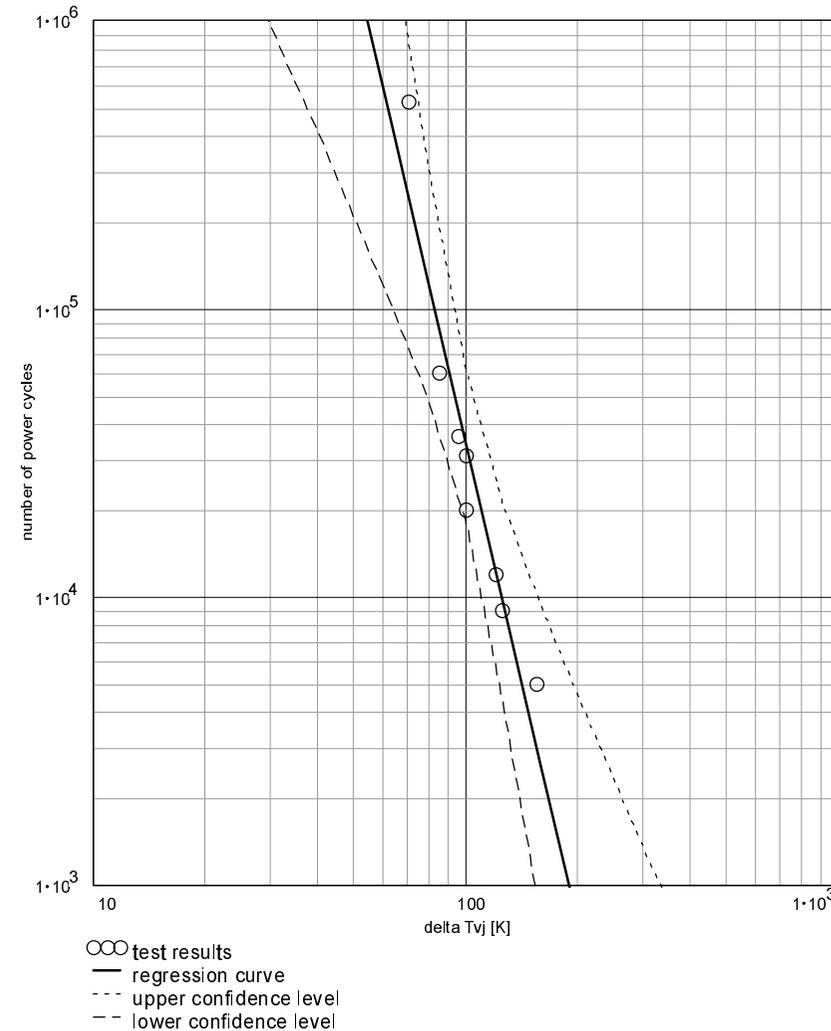


Schematic circuit for load cycling at IXYS



Typical temperature cycle

The following diagram shows the result of load cycling tests performed on IXYS power modules with DCB base plate with different temperature excursions. Vertical axis shows the number of cycles to failure (open circuit) versus temperature excursion of the die. The test results can be best fitted by a straight line.



- test results
- regression curve
- - - upper confidence level
- · - lower confidence level