



Screening temperature cycles on FEASTMP modules

The HALT test performed on samples from production-grade FEASTMP modules confirmed their very good quality. However, individual samples from relatively large production runs might be affected by defects that could induce early failure in the field (infant mortality). In order to identify these

'fragile' modules before deployment in the field, a screening procedure based on thermal cycles has been setup and is systematically applied to all production modules before their acceptance testing.

Choice of the temperature cycles

The screening procedure has to be simple enough to be practicable on the large number of modules projected for LHC upgrades (more than 20,000), and it should not require an increase of the cost of the modules. The choice of using thermal cycles is in this sense a common practice. A sequence of ramps in temperature, whose speed is limited by the available thermal chamber, is applied to the samples, while the temperature range is chosen from the experience of the HALT test. It is important to consider that the stress should be sufficient to activate the defects that could impact the infant mortality, but it should not over-stress the samples to the point that their reliability or durability is affected.

The HALT test of the FEASTMP modules has shown that the modules can work in the whole range of temperature used for the test: -100 to +200°C. However, it also evidenced that above 160°C some of the soldering pastes used in the assembly get soft, giving origin to failure if high temperature and strong vibration are

simultaneously applied. A screening test for the modules has hence to stay well away from the 160°C temperature not to weaken the soldering of the components.

Considering the above aspects, the thermal cycles has been chosen as follows for the FEASTMP modules:

- minimum ramp temperature: -40°C
- maximum ramp temperature: +130°C
- temperature ramp speed: 5°C/minute.

To verify that a sequence of cycles does not influence the reliability of good modules, 60 FEASTMP samples from a production run were first fully characterized, then exposed unbiased to a total of 60 cycles. Every 10 cycles some electrical properties were measured, while full characterization was performed every 30 cycles. This revealed no change in performance of any of the 60 modules.

Screening test adopted for the production

On the basis of the above, the final screening method that is applied to all production batches of the FEASTMP modules, and that will be applied also to the production batches of other versions of the FEAST modules (FEASTMP_CLP, FEASTMN) is the following:

1. Upon reception of each production batch from the assembly house, all samples are exposed to a sequence of 20 thermal cycles between -40 and +130°C (rate 5°C/minute), unbiased

2. All samples are then measured with the routing production testing setup for acceptance. Only modules that successfully pass the acceptance criteria are distributed to users for deployment in the field.

Revision history

Revision	Date	Description
1.0	March 2015	First release of the document.