1.0 Objective

The product was subjected to the HALT (Highly Accelerated Life Test) process to uncover design and/or process weaknesses. During the test process, the product was subjected to progressively higher stress levels brought on by thermal dwells, vibration, rapid temperature transitions and combined environments.

2.0 Background

Throughout a HALT process, the intent is to subject the product to stimuli well beyond the expected field environments to determine the operating and destruct limits of the product. Failures that typically show up in the field over a period of time at much lower stress levels are quickly discovered while applying high stress conditions over a short period of time.

HALT is primarily a margin discovery process. In order to ruggedize the product, the root cause of each failure needs to be determined and the problems corrected until the fundamental limit of the technology for the product can be reached. This process will yield the widest possible margin between product capabilities and the environment in which it will operate, thus increasing the product's reliability, reducing the number of field returns and realizing long-term savings.

3.0 Executive Summary

HALT was performed using 2 units. During the test process, the goal was to find the operating and destruct limits for the product tested using thermal step stress, rapid thermal transitions, vibration step stress, and combined environment of temperature and multi-axis, 6 degree-of-freedom vibration. Once these limits were determined, the goal was to fix the weak links and stress even further to expand the limits as much as possible.

Serial #	Unit	Date	Thermal	Rapid	Vibration	Combined
96E2	TS-7250-V2	5/10/16	X	X	X	X
9ACE	TS-7250-V2	5/10/16	X	X	X	X

Description and calibration dates of test equipment available on request.

Thermal Step Stress

The product was subjected to cold thermal step stress beginning at +20°C, with the temperature decreasing in 10°C increments. Once the thermocouples located on the product reached the setpoint temperature, the product dwelled at that setpoint for 10 minutes. Upon completion of cold thermal step stress the product was returned to ambient and remained there until full functionality was verified.

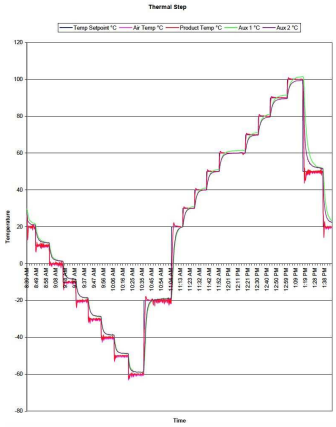
THERMAL STEP STRESS (COLD)

Unit	20	10	0	-10	-20	-30	-40	-50	-60
96E2	OK	OK	OK	OK	OK	OK	OK	OK	OK
9ACE	OK	OK	OK	OK	OK	OK	OK	OK	OK

Hot thermal step stress began at a setpoint temperature of 30°C with the temperature increasing in 10°C increments. Once the thermocouples located on the product reached the setpoint temperature, the product dwelled at that setpoint for 10 minutes.

THERMAL STEP STRESS (HOT)

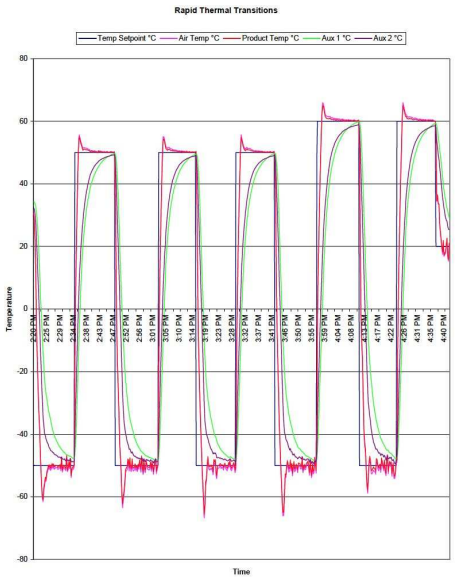
Unit	30	40	50	60	70	80	90	100	50
96E2	OK	OK	OK	OK	OK	OK	OK	OK	OK
9ACE	OK	OK	OK	OK	OK	OK	OK	OK	OK



Rapid Thermal Transition

The device under test was subjected to 5 temperature cycles (-50°C to +50°C) at an average thermal transition rate of 60°C per minute (air temperature). Dwell time at each setpoint was 10 minutes after equalization.

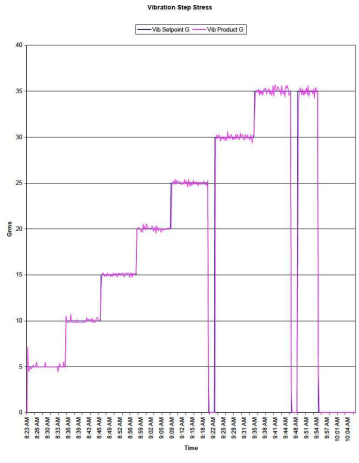
Unit	20	-50	50	-50	50	-50	50	-50	50	-50	60	20
96E2	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
96D8	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK



Vibration Stress Test

Vibration Step Stress was performed at ambient temperature (+25C). The device under test was subjected to vibration step stress beginning at a setpoint of 5 Grms with the vibration setpoint increasing in 5 Grms increments at 10 minute intervals (minimum of 10 minutes plus functional test time).

Unit	0	5	10	15	20	25	30		0
96E2	OK	OK	OK	OK	OK	OK	OK*		OK
9ACE	OK	OK	OK	OK	OK	OK	OK*		OK



Combined Environment

The product was subjected to 5 temperature cycles from (-50C to +50C) at an average thermal transition rate of 60C per minute combined with vibration. Vibration started at 6 Grms and was increased by 6 Grms on every cycle. Dwell time at each setpoint was 10 minutes after equalization.

Temp	20	-50	50	-50	50	-50	50	-50	50	-50	50	20
Grms	0	6	6	12	12	18	18	24	24	30	30	0
96E2	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
9ACE	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK