HALT & HASS

LABORATORY

HALT TEST REPORT

CELLOTRACK, MULTISENSE

For

POINTER TELOCATION LTD.

11/12/2018

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DOCUMENT CONTROL

Document History

The following table records information regarding released editions of this document and briefly describes their file location, purpose, and changes made to them.

Edition Id	Release Date	Responsible Author	File Reference, Purpose and Description of Changes
01	11/12/2018	Dina Klebansky	**File Reference:** Z:\HALT LABORATORY main directory\REPORTS\Reports 2018\Pointer CELLOTRACK, MULTISENSE HALT REP181201.doc **Purpose:** **Changes:**

Document Approvals

This edition has been approved by:

	Name	Title	Signature	Date
Compiled	Dina Klebansky	Technical Writer		11/12/2018
Reviewed	Alon Berger	Test Engineer		11/12/2018
Approved	Carlos Guerrero	Environmental, HALT and HASS Labs Manager		11/12/2018

Distribution List

Organizational Unit	Title	Title	Title	Title

Open Issues

This part of the document control section is used to record and track open issues and/or unresolved questions. As the development of this document proceeds, these issues and questions should be resolved and then removed from the list.

No.	Subject/Section	Description
1.		
2.		

EXECUTIVE SUMMARY

The following table summarizes the product operation maximum limits as were observed during the HALT procedure conducted at QualiTech - HALT & HASS Laboratory.
POINTER TELOCATION LTD. performed the functional tests and the functional tests results are their sole responsibility. The stated results apply only to the specific UUT that undergone the testing.

Minimum Operation Limit Temperature	-30 °C
Maximum Operation Limit Temperature	70 °C
Maximum Operation Limit Vibration	24.0 gRMS
Maximum Operation Limit Cold Start	N/A
Results Analysis	In accordance with the test results & with QualiTech's HALT & HASS laboratory engineers, the next recommended step is **Proof of Screening (POS)** as specified in the recommendation section 7. The POS will define the optimal **HASS** profile.

The follow functional tests were monitored and reviewed during (real time) HALT tests:

1. Cellular Connectivity and connection to server
2. GPS availability
3. Bluetooth Connectivity
4. No Data corruption
5. No Resets
6. No power drop\Battery power disconnection

No issues found.

Statement of Compliance with test requirements:
QualiTech - HALT & HASS Lab. declare that the UUT CELLOTRACK, MULTISENSE was tested to comply with the methodology of the applicable HALT & HASS test specification.

Customer granted the permission to reproduce and distribute this report only in the full format with no change and no addition.

A2LA symbol in the front page is applicable only to the tests under the scope of QualiTech accreditations.
QualiTech has A2LA accreditation to ISO/IEC 17025:2005 for Certificate and test types as listed see the following link:
https://www.a2la.org/scopepdf/1633-02.pdf

TABLE OF CONTENTS

1. INTRODUCTION

1.1. PURPOSE

The purpose of this report is to determine the CELLOTRACK, MULTISENSE operation limits by performing a Highly Accelerated Life Test (HALT).

1.2. GLOSSARY

Abbreviation / Acronym / Term	**Explanation / Description**
iDDE	Integrated Document Development Environment
N/A	Not Applicable
TBD	To Be Defined
HALT	Highly Accelerated Life Test
HASS	Highly Accelerated Stress Screening
HLTR	Halt Test Report
POS	Proof of Screening
UUT	Unit Under Test

1.3. APPLICABLE DOCUMENTS

This section contains a list of resources (e.g., documents, files, tools) referenced by or related to this document.

A. iDDE/hltr Document Development Tool, Edition 2.01, ECI Telecom Ltd., Software Engineering Department.
B. ECI HALT Procedure #20-20-28.
C. ECI HASS Procedure #20-50-80.
D. QRS-600V Operation Instructions: 40-50-80.

2. UNIT UNDER TEST OVERVIEW

Test Date	04/12/2018
Customer Representative	Itamar Gohary
Customer	POINTER TELOCATION LTD.

Unit Name	Item Manufacturer	Part Number	Serial Number	Item Quantity
CELLOTRACK 10Y LTE C1 NA	POINTER TELOCATION LTD.	GC9773000-000	50000005 50000031	2
CELLOTRACK Power XT LTE C1	POINTER TELOCATION LTD.	GC9773013-000	20000013 10000032	2
CELLOTRACK XT LTE C1	POINTER TELOCATION LTD.	9773014-000	20000008 20000009	2
CELLOTRACK NANO 20 LTE C1 NA	POINTER TELOCATION LTD.	GC9771010-000	4004, 4008	2
MULTISENSE MULTISENSE-TH	POINTER TELOCATION LTD.	715-50100 715-50200	-	2 2

3. TEST INSTRUMENTATION

3.1. INSTRUMENTATION LIST

No.	Instrumentation Name	Calibration Due Date
1.	QRS 600V Stretch, S\N: 9801-016.	24/12/2018

3.2. TEST CHAMBER UNCERTAINTY VALUES

The following section presents the uncertainty values of the HALT chamber measurements sensors, related to the vibration and thermal temperature tests. The data is displayed for information only.

3.2.1. ACCELEROMETERS SENSORS DATA

The following table displays the 9801-016 chamber vibration controllers

Sensor S/N	Channel
10641	X1
10642	Y1
10643	Z1
10743	X2
10659	Y2
10744	Z2

3.2.2. VIBRATION TEST - CHAMBER UNCERTAINTY VALUES

The following table displays the 9801-016 chamber uncertainty values which are related to the vibration test.

Setup Vibration Level (g RMS)	Confidence Probability	Coverage Factor	Frequency Range (Hz)	Accuracy (g RMS)	Exp. Uncertainty (g RMS)
10	95%	2	20-2000	0.11	0.3
20				0.22	0.7

3.2.3. THERMAL TEMPERATURE TEST - CHAMBER UNCERTAINTY VALUES

The following table displays the 9801-016 chamber uncertainty values which are related to the thermal temperature test.

For ceiling height of **38''** the following table relate to the product temperature sensor.

Setup Temperature (°C)	Confidence Probability	Coverage Factor	Uncertainty Value (°C)	Accuracy (°C)
-60	95%	2	-0.7	6.12
20			-0.7	4.48
100			-1.7	4.6

3.3. LAB'S ENVIRONMENTAL CONDITIONS

Parameter Name	Parameter Value	Tolerance Value	Measure Unit
Temperature	25	± 10	Degree Celsius (°C).
Humidity	55	± 27	% R.H.
Mains Voltage	230	± 23	Volts
Mains Frequency	50	± 2	Hertz
Site Air Pressure	760	± 5	mmHg
	1012	± 5	millibar

4. TEST SETUP

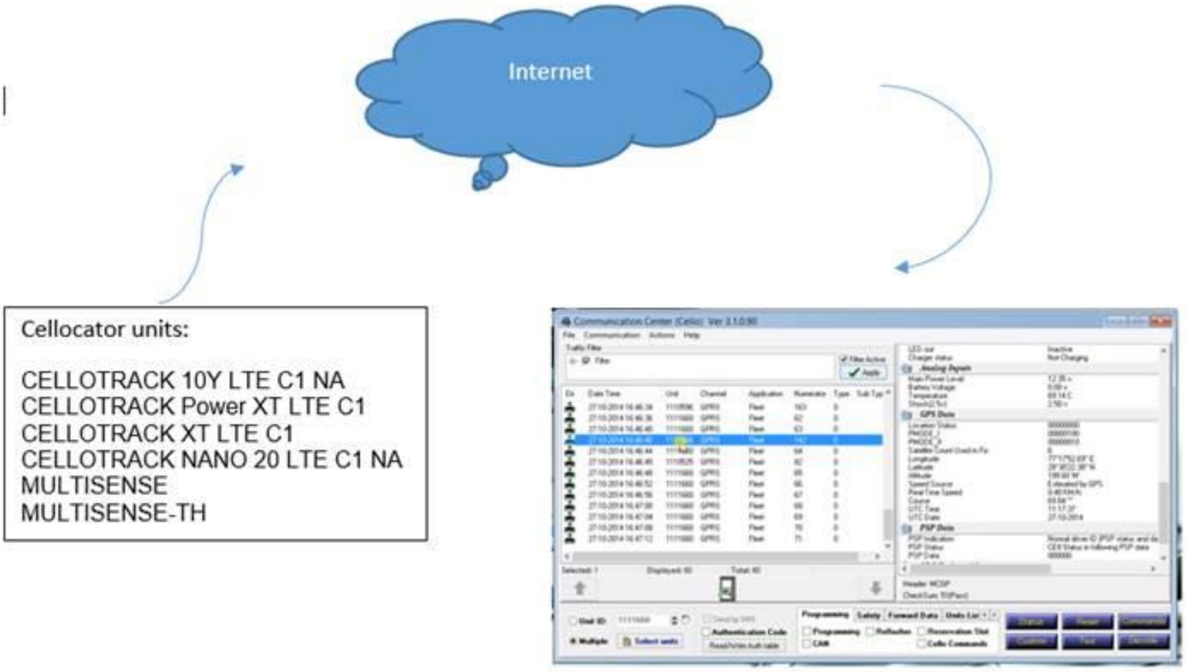


Figure 1-Cellocator Server

5. THE HALT PROCEDURE

5.1. ADDITION OR EXCLUSION FROM THE TEST METHOD

None.

5.2. HALT PROCEDURE STAGES

The table below describes in details the procedures potential steps parameter during HALT process.

Step No.	Test Name	From	To	Step Description	Period
1.	Low Temperature	0 °C	-30 °C or until stops functioning	Reduction of -10 °C intervals.	Dwell time: at least 10 minutes in each step.
2.	High Temperature	0 °C	+70 °C or until stops functioning	Increase of +10 °C intervals.	Dwell time: at least 10 minutes in each step.
3.	Vibration	5 gRMS	24 gRMS	20% increments between steps.	10 minutes at each load.
4.	Temperature Shock Cycling	Step 1 extreme point	Step 2 extreme point	Rate of up to 40 °C per minute.	
5.	Temperature Cycling and Vibration	Step 1 extreme point	Step 2 extreme point	Rate of up to 40 °C per minute and vibration level as identified in step 3.	
6.	Temperature Cycling and Vibration test at a lower intensity than step 5 (Detection test).	Step 1 extreme point + (+10) °C	Step 2 extreme point - (-10) °C	Rate of up to 40 °C per minute and vibration level half from the identified value in step 3. During this cycle, a functional test is performed to identify flaws. Dwell time: 10 minutes at each extreme point.	

6. HALT RESULTS

6.1. UUT PASS RESULTS (UNDER FULL LOAD)

The table provides the achieved (Pass) limits during HALT process.

Test Environment		Test Description	Test Result	Remarks
Temperature [°C]	**Vibration**			
Minimum temperature	None	-30 °C	O.K.	
Maximum temperature	None	+70 °C	O.K.	
20 °C (room temperature)	Maximum gRMS	+24.0 gRMS	O.K.	Manually Stopped
Temperature cycling	None	-30 °C to+70 °C	O.K.	
Temperature rate per min.		40 °C	O.K.	
Combined cycling	24.0 gRMS	-30 °C to+70 °C	O.K.	
Minimum temperature ramp	0.5 * maximum gRMS	-20 °C	O.K.	
Maximum temperature ramp	0.5 * maximum gRMS	60 °C	O.K.	

6.2. UUT FAIL RESULTS

The table below provides the (Fail) limits and observed reason during HALT process.

Test Environment		Failure Values	Failure Description	Failure Reason
Temperature [°C]	**Vibration**			
Minimum temperature	None	-35 °C	Not Applicable	Not Applicable
Maximum temperature	None	+75 °C	Not Applicable	Not Applicable
20 °C (room temperature)	Maximum gRMS	26.0	Not Applicable	Not Applicable

6.3. HALT VIBRATION RESULTS (AT ROOM TEMPERATURE)

According to the customer requirements, the test was performed without sensors

6.3.1. INPUT: 5.0 gRMS RESULT: O.K.

6.3.2. **INPUT: 6.0 gRMS RESULT: O.K.**

6.3.3. **INPUT: 7.2 gRMS RESULT: O.K.**

6.3.4. **INPUT: 8.6 gRMS RESULT: O.K.**

6.3.5. **INPUT: 10.4 gRMS RESULT: O.K.**

6.3.6. **INPUT: 12.4 gRMS RESULT: O.K.**

6.3.7. **INPUT: 15.0 gRMS RESULT: O.K.**

6.3.8. **INPUT: 18.0 gRMS RESULT: O.K.**

6.3.9. **INPUT: 21.4 gRMS RESULT: O.K.**

6.3.10. **INPUT: 24.0 gRMS RESULT: O.K.**

6.4. HALT TEMPERATURE RESULTS (WITHOUT VIBRATION)

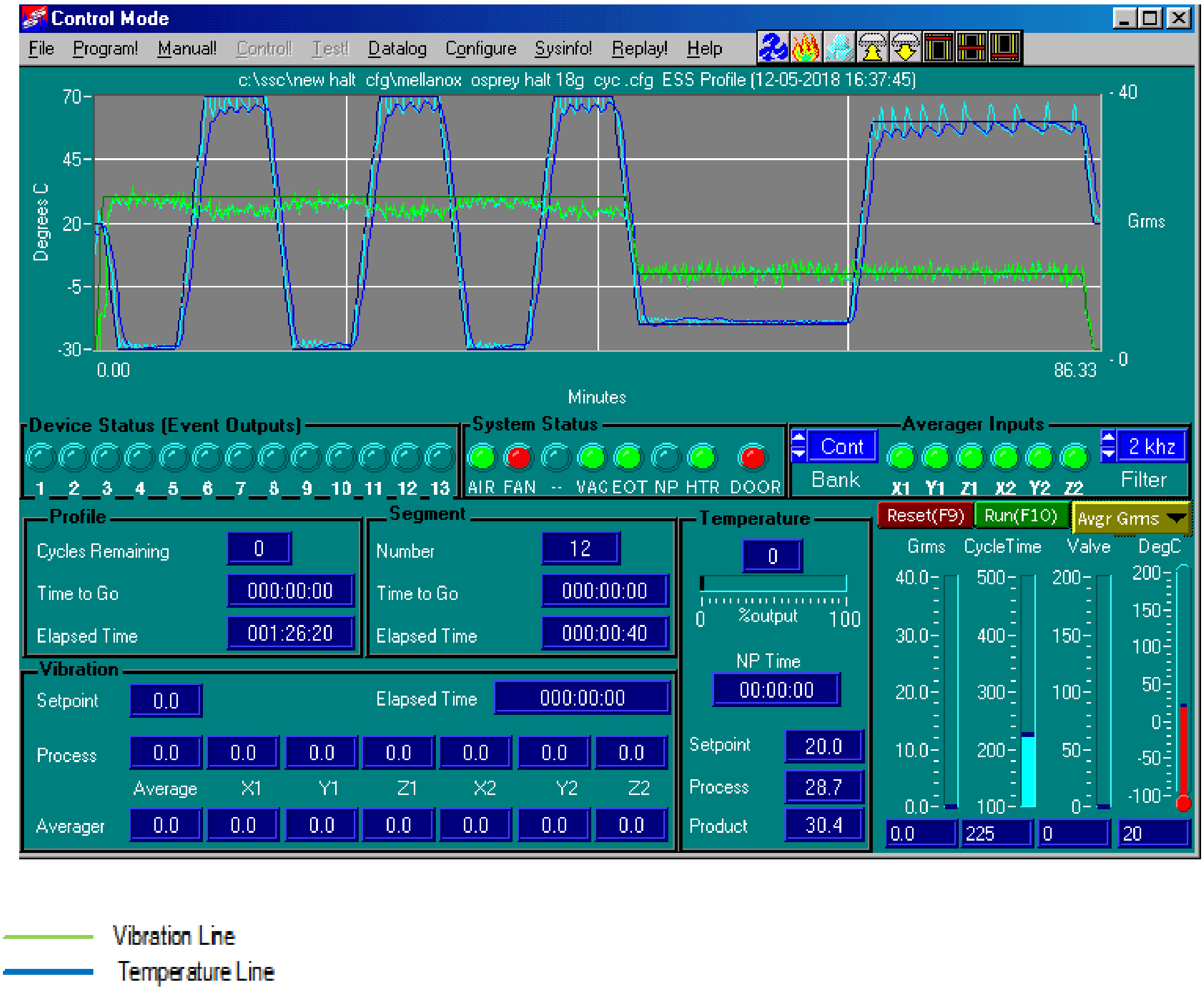
According to the customer requirements, the test was performed without sensors

No.	Ambient Temp.	Cold \Hot start	
1.	-40 °C		
2.	-35 °C		
3.	-30 °C		V
4.	-20 °C		V
5.	-10 °C		V
6.	0 °C	-	V
7.	+10 °C	-	
8.	+20 °C	-	
9.	+30 °C	-	V
10.	+40 °C	-	V
11.	+50 °C	-	V
12.	+60 °C	-	V
13.	+65 °C	-	
14.	+70°C	-	V
15.	+75 °C	-	
16.	+80°C	-	
17.	+85 °C	-	
18.	+90 °C	-	

6.4.1. TEMPERATURE MEASUREMENT ANALYSIS

Minimum Temperature	-30 °C
Maximum Temperature	+70°C

6.5. UUT - ANALYZER RESULTS

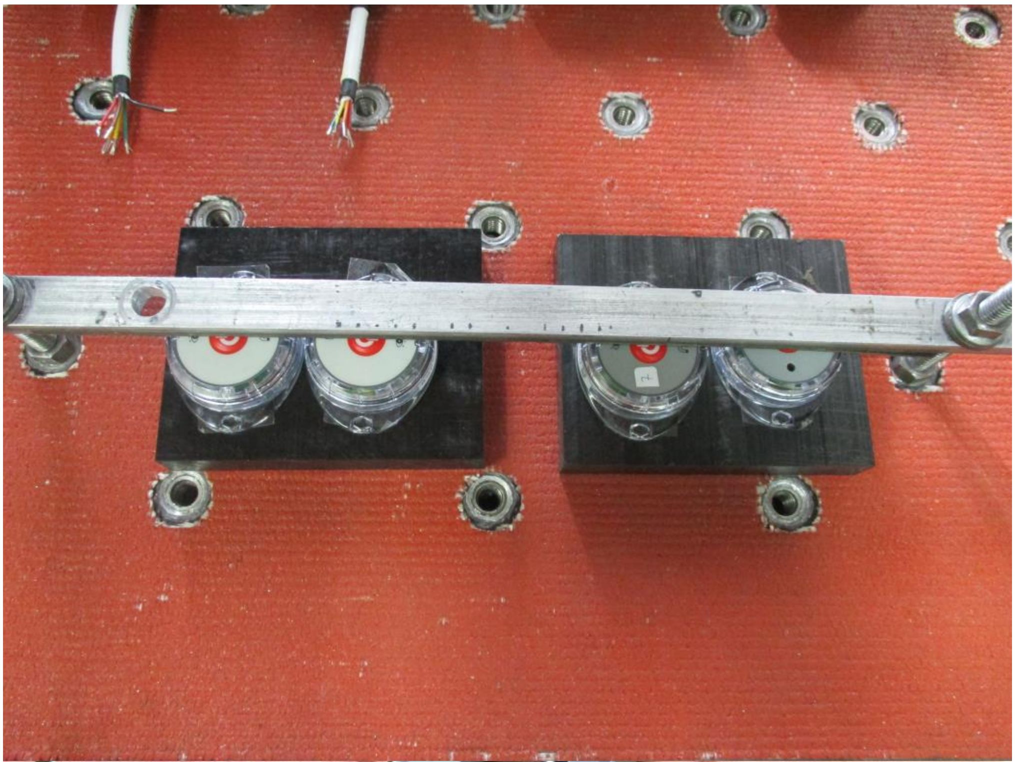


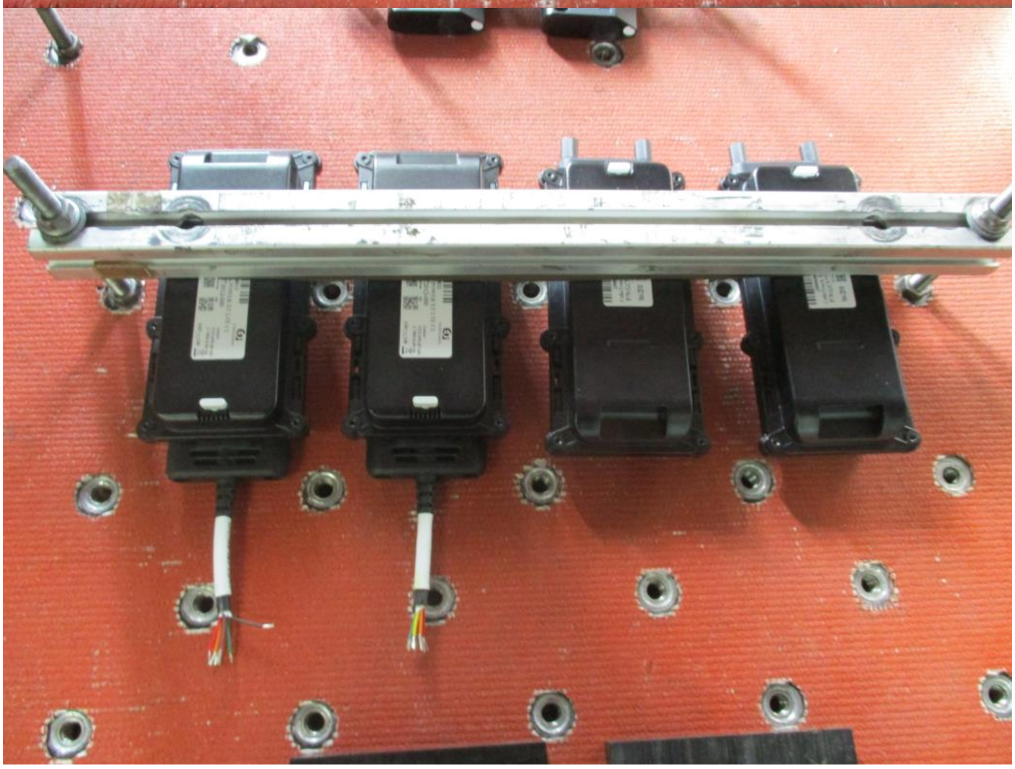
Combined Cycling Parameters:

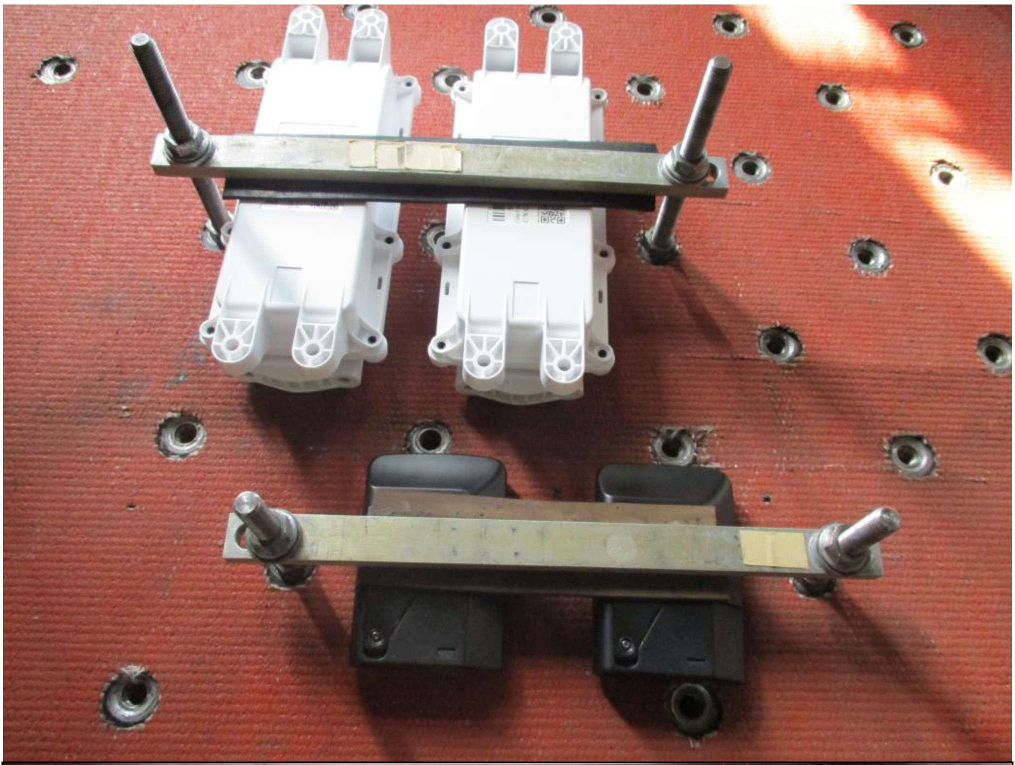
- Thermal cycle range – from -30 °C to +70 °C
- Thermal rate of change 40 °C/minute
- 3D Random vibration – high level 24.0 gRMS – low level 12.0 gRMS

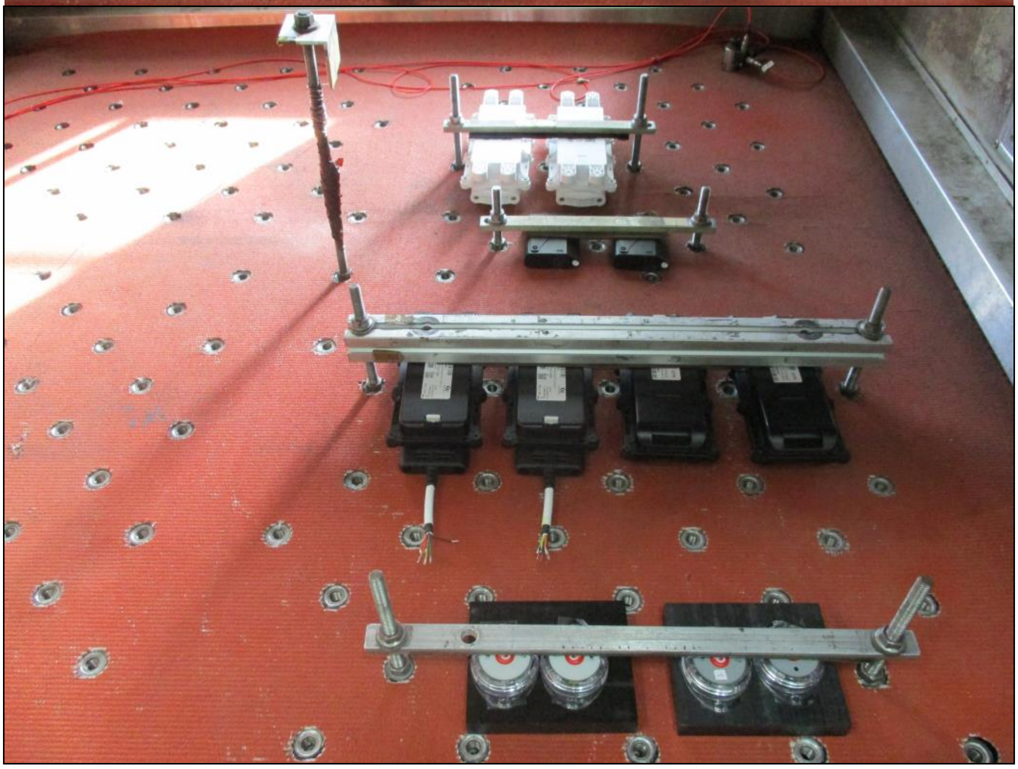
7. UUT PICTURES

7.1. UNITS LOCATED IN TEMPERATURE CHAMBER DURING HALT TEST









8. RECOMMENDATIONS

Based on the HALT test result analysis, the next recommended step is Proof of Screening (POS).
The following table displays the recommended parameters profile for the POS stage.
For further information regarding the POS main objectives, see Appendix B.

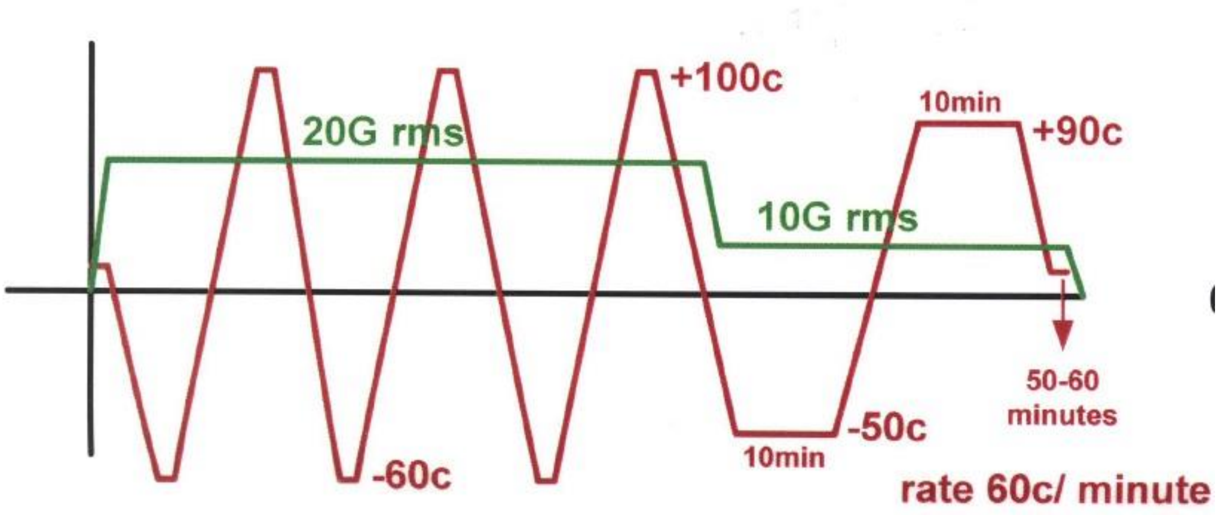
8.1. DRIVEN POS PROFILE

Minimum Operation Limit Temperature	-24 °C
Maximum Operation Limit Temperature	56 °C
Maximum Operation Limit Vibration	12.0 gRMS
Number of Cycles	25

8.2. GENERIC DRIVEN HASS PROFILE

Minimum Operation HASS Temperature	-24 °C
Maximum Operation HASS Temperature	56 °C
Maximum Operation HASS Vibration	12.0 gRMS
Number of HASS Cycles	1

Typical HASS Graph:



9. APPENDIX A: THE HALT METHODOLOGY

9.1. THE TEST METHOD

HALT is performed using a few sample units. The samples are tested in a Temperature Chamber and on a Quasi-Random Vibration System. The system produces high energy thermal cycling and broadband simultaneous tri-axial vibration for combined temperature and vibration operation.

The vibration energy to the shaker assembly is obtained from specially designed 16 pneumatic impulse-type vibrators, which creates a continuous broadband spectrum closely resembling a true random spectrum. High air temperature change rates are achieved using high power heaters and liquid nitrogen at its boiling point (-195 °C). The HALT is performed using QRS-600 (V by Screening System Inc. USA).

During the HALT process, the goal is to find the operating and destruction limits for the units under test using thermal and vibration step stresses, and combined environmental stresses such as rapid temperature cycling combined with vibration stress.

The tested unit can be a single electronic module (PWB) or as full sub-rack with several PCBs. In both cases it must be fixed to the shaker table by standard mounting jigs or special customized fixtures, such as clamps, aluminum frames bars and threaded rods.

During the HALT procedure the UUT in the test chamber is always in operational mode, electrically loaded, connected to external matching test control and monitoring equipment.

The unit's responses to the environmental stresses are tested - during the test - by using two kinds for monitoring and recording sensors:

1. **Accelerometers** - up to sixteen product response accelerometer. [gRMS.]

2. **Thermocouples** - up to twenty product response thermocouples. [°C]

During the tests the UUT in the QRS-600V chamber can be visually monitored through clear windows in the front and back doors.

9.2. HALT MAIN OBJECTIVE

Poor reliability, low MTBF, frequent field returns, high in-warranty cost, and customer dissatisfaction are often the result of design and/or process weaknesses, even if a product has successfully passed qualification tests and/or burn-in.

Due to the above reasons - the development prototype unit is subjected to the HALT process to uncover design and/or process weaknesses.

During the HALT process the product is subjected to progressively higher stress levels brought on by thermal dwells, vibration, rapid temperature transitions and combined environments.

Throughout the HALT process, the intent is to subject the product to these stimuli well beyond the expected field environments to determine the operating and destruction limits of the product.

The same failures, which typically show up in the field over time at much lower stress levels, show up quickly in these short-term high stress conditions. HALT is primarily a discovery process.

In order to improve the product's reliability and increase its MTBF, the root cause of each of the failures noted 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.

The operating and destruct limits discovered during HALT on these units could be used to develop an effective Highly Accelerated Stress Screen (HASS) for manufacturing which can quickly detect any process flaws or new weak links without taking significant life out of the product.

The HASS process can ensure that the reliability gains achieved through HALT will be maintained in future production.

10. APPENDIX B: POS MAIN OBJECTIVES

The HALT - HASS process contains three stages:

1. HALT - Highly Accelerated Life Test, performed at the product development stage.
2. POS - Proof of Screening, performed before starting mass production screening stage.
3. HASS - Highly Accelerated Stress Screening, performed as part of the mass production stage. The HASS goal is to check the product's manufacturing stability and the workmanship. The test is performed by using less savior stress than in the HALT process. The HASS profile is based on the HALT test results.

In order to achieve the maximum efficiency from the HASS test it is recommended to perform the POS stage, which insures the HASS defined profile.

The first batch of the POS process contains 4-12 units (depends on the unit's cost).
The product batch is subjected under a combined stress, based on the definitions to the HASS routine test.

The purpose of the POS process is to expose the product to stress levels that are beyond the expected level at the field environments. The combined stress is executed continually 25 times. During the process, the samples are under full load and are monitored by test equipment, in order to follow-up their performance degradation and stability. The POS stress profile can be re-defined ('fine-tuning') according to the consequent symptoms.

The batch products are tested during the POS process at visual and functional procedures.

An optimal POS is a process that finds defects during the first / second cycling, and after repairing the product units, they ' survive' another 24 cycling without failing.

An optimal POS process can guaranty one HASS cycling during the mass production test, which will cause maximum life damaging of 4%. The process is based on a linear fatigue stress assumption.

This process will increase yield percentage between product capabilities and the environment in which it will operate. As a result, the product's reliability increases; number of field returns is reduced and long-term saving is achieved.

END OF REPORT