Nemko

COMLAB
Accredited Testing and Certification
EMC, Radio and Telecommunications

www.nemko.com

Test report no. : 93193/12

Item tested : Tron SART20

Type of equipment : Search And Rescue Transponder 9GHz

Client : Jotron AS

NORWEGIAN ACCREDITATION
TEST 033

Nemko AS is granted accreditation by Norwegian Accreditation
under registration number TEST 033

IEC 1097-1 Radar Transponder – Maritime search and rescue (SART) – Operation and performance requirements, methods of testing and required results
(First edition, 1992-07)

IEC 60945 Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required results
(Third edition, 1996-11; Fourth edition, 2004-08)

11th March 2008

Authorized by : .....
Geir Antonsen
Technical Verificator

CONTENTS

1 GENERAL INFORMATION

1.1 Testhouse Info

Name :	Nemko A/S
Address :	Nemko Comlab Gåsevikveien 8, Box 96 N-2027 Kjeller, NORWAY
Telephone :	+47 64 84 57 00
Fax :	+47 64 84 57 05
E-mail:	comlab@nemko.com
Number of Pages:	25

1.2 Client Information

Name :	Jotron AS
Address :	P.O Box 54, Østbyveien 1, NO-3280 Tjodalyng, Norway
Telephone :	+47 33 13 97 00
Fax :	+47 33 12 67 80

Contact:

Name :	Eirik Storjordet
Telephone :	+47 33 13 97 14
E-mail :	eirik.storjordet@jotron.com

1.3 Manufacturer (if other than client)

Name :	/
Address :	/
Telephone :	/
Fax :	/
E-mail :	/

2 Test Information

2.1 Tested Item

Name :	Tron SART20
Model/version :	
Serial number :	0015, 007
Hardware identity and/or version:	
Software identity and/or version :	
Frequency Range :	9200 – 9500 MHz
Type of Power Supply :	Internal primary battery (2 x 3,6 V Lithium)
Desktop Charger :	NA

Description of Tested Device(s)

The tested EUT is transponder for marine search and rescue (SART) operating at 9 GHz.

2.2 Test Environment

2.2.1 Normal test condition

Temperature: 21,2 – 25,2 °C

Relative humidity: 13,4 – 48,1 %

Atmospheric pressure: 961,3 – 1028,3 hPa

Normal test voltage: NA

All testing has been carried out with the supplied batteries.

The values are the limit registered during the test period.

2.3 Test Period

Item received date: 2007-09-19

Test period : from 2007-09-19 to 2008-03-02

2.4 Standards and Regulations

IEC 1097-1 Radar Transponder – Maritime search and rescue (SART) –
Operation and performance requirements, methods of testing and required results.
(First edition, 1992-07)

IEC 60945 Maritime navigation and radiocommunication equipment and systems –
General requirements – Methods of testing and required results.
(Third edition, 1996-11; Fourth edition, 2004)

2.5 Test Engineer(s)

Jan G Eriksen, Egil Hauger, Thanh Tran, Jon Fredrik Moe (compass safe distance), Jarle Skogland (vibration test)

2.6 Additional information

2.6.1 Test Methods

Described in the relevant standards.

2.6.2 Test Equipment

List of used test equipment, see clause 5.

THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

TESTED BY : _____ **DATE: 5th March 2008**

Jan G Eriksen, Test Engineer

3 TEST REPORT SUMMARY

3.1 Abbreviations

P Passed, the equipment fulfils the requirement
F Failed, the equipment does not fulfil the requirement
I Inconclusive, the test does not give a conclusive verdict
NA Not applicable, the requirement is not applicable
NT Not tested, the test is not performed even though the requirement is relevant
DBM Declared by manufacturer to comply with requirements

3.2 List of measurements

Measurement	**Standard** IEC 1097-1	IEC 60945	**Result (Pass/Fail)**
Operating instructions	4.1		P
Expiry date (battery replacement date)	4.2		P
Easy activation	6.2.1		P
Inadvertent activation	6.2.4		P
Visible and/or audible indication of operation	6.2.3		P
Manual activation	6.2.4		P
Stand-by indication	6.2.5		P
Battery capacity	6.3		P
Drop on hard surface	6.2.6	8.6.1	P
Drop into water	6.2.7	8.6.2	P
Water tightness and thermal shock	6.2.8		P
Float capability	6.2.9		P
Buoyant lanyard	6.2.10		P
Unaffected by seawater or oil	6.2.11	8.11	DBM
Resistance to prolonged exposure to sunlight	6.2.12	8.10	DBM
Corrosion		8.12	DBM
Yellow/orange colour	6.2.13		P
Smooth external construction	6.2.14		P
Dry heat cycle	6.4.1	8.2	P
Low temperature cycle	6.4.2	8.4	P
Damp heat		8.3	P
Thermal shock		8.5	P
Vibration		8.7	P
Compass safe distance		11.2	P
Protection against accidental access to dangerous voltages		12.1	NA (battery 7.2 V)
Electromagnetic radio frequency radiation		12.2	NA (EUT complies with IEC 1097-1)
Emission from visual display		12.3	NA
X-radiation		12.4	NA

3.3 Conclusion

The tested equipment complies with the requirements of relevant standards.

3.4 OTHER COMMENTS

General:

EUT (Equipment Under Test):

The EUT was in normal operating mode. A pulsed RF signal at 9350 MHz was transmitted to the EUT and the response signal from the EUT was monitored.

For all tests except drop on hard surface and vibration the EUT had serial number 0015.
For drop on hard surface and vibration the EUT had serial number 007.

List of ports:

Signal port:	Internal antenna
Power ports:	Internal battery

Performance criteria

Operate as intended during test.
Operate as intended after the tests.
No unintentional transmission.

4 RESULTS

4.1 Labelling

4.1.1 Operating instructions

This requirement has been observed according to IEC 1097-1 clause 4.1.
The EUT is equipped with operational instructions. The instructions describe the functionality of the visible and audible indicators during operation and in the event of a intercepted radar signal triggering the device.

4.1.2 Expiry date (battery replacement date)

This requirement has been observed according to IEC 1097 clause 4.2
The EUT is with a labelling giving the year and month of battery expiry.

4.2 Performance requirements

4.2.1 Easy activation

This requirement has been tested according to IEC 1097-1 clause 6.2.1

The EUT is activated by pulling the red tab/ring marked “Pull” and the on/off switch automatically goes to the “On” position.

4.2.2 Inadvertent activation

This requirement has been tested according to IEC 1097-1 clause 6.2.4.

The red tab marked “Pull” is secured by a thin wire and a seal.

4.2.3 Visible and/or audible indication of operation

This requirement has been tested according to IEC 1097-1 clause 6.2.3.

When the EUT is activated a red diode illuminates for about half a second and there is an audible signal (beep) for half a second. Afterwards the diode lights up for half a second approximately every five seconds.

When the EUT is interrogated by a radar signal the diode gives a short blink every two seconds and an audible signal is continuously heard.

4.2.4 Manual activation

This requirement has been tested according to IEC 1097-1 clause 6.2.4.

The EUT can be tested without damaging the sealing. The EUT will then give visible and audible signal for approximately one second.

4.2.5 Stand-by indication

This requirement has been tested according to IEC 1097-1 clause 6.2.5.

A red light emitting diode flashes for about half a second every five seconds.

4.3 Battery capacity

This requirement has been tested according to IEC 1097-1 clause 6.3.

The lower voltage of operation was determined to be 5,8 V. This level was found by decreasing the input voltage to the EUT and at the same time performing a functional test (monitoring the frequency sweep characteristics).

The average current to operate the EUT has been measured to 15,51 mA (standby) and 61,13 mA (active).

The batteries have then been tested with a current drain corresponding to stand-by mode for 96 hours and then followed by active mode for 8 hours – in total 104 hours. During the last 15 minutes of this test the battery voltage has been monitored.

This test have been carried out with batteries at nominal (+22 ºC) and at extreme temperatures (-20 ºC and +55 ºC).

During the last 15 minutes of the test the battery voltage was monitored to:
6,498 V at -20 ºC
7,021 V at +22 ºC
7,155 V at +55 ºC

A small modification was made after the initial battery test. This led to an increase in the current with approx 4%. Therefore the battery test was performed once more on the low temperature which is the most critical for battery test. The figure above for -20 ºC is valid for the modified version of the SART.

The EUT (battery) complies with the requirements.

4.4 Environmental requirements

4.4.1 Water tightness and thermal shock

This requirement has been tested according to IEC 1097-1 clause 6.2.8 and to IEC 60945 clause 8.5.

IEC 1097-1 clause 6.2.8: The EUT was stored at 1) +45 ºC and 2) -30 ºC relative to the temperature of the water in the pressure vessel (between 10 ºC and 20 ºC) and the EUT was then immersed in the water with a pressure of 100 kPa for one hour. During the test the pressure vessel had a temperature of 19,4 ºC to 19,8 ºC and the storage temperature was therefore +65,0 ºC and -11,0 ºC.
At completion of immersion the EUT was tested for leakage and a functional test was carried out.

The EUT complies with the test requirements.

IEC 60945 clause 8.5: The EUT was stored at +70 ºC for one hour. Then it was immersed into water (+25 ºC) at a depth of 100 mm for one hour. At the end of the test the performance of the EUT was checked.

The EUT complies with the test requirements.

4.4.2 Drop on hard surface

This requirement has been tested according to IEC 60945 clause 8.6.1.

The EUT has been dropped from one meter height on a hard surface with all faces of the EUT.

A small mechanical modification was performed to pass the test.

The EUT complies with the test requirements.

4.4.3 Drop into water

This requirement has been tested according to IEC 60945 clause 8.6.2.

The manufacturer has performed this test under supervision of "Det norske Veritas" – DnV. A separate test report authorized by DnV representative is available. Annex 1 to this report.

4.4.4 Vibration

This requirement has been tested according to IEC 60945 clause 8.7.2.

The EUT was subject to the following excitations.

1) Sweep from 2 to 5 to 13,2 Hz with an excursion of 1 mm,
   with maximum acceleration of 7 m/s^2 at 13,2 Hz.
2) Above 13,2 Hz and up to 100 Hz with a constant maximum acceleration of 7 m/s^2

Then endurance test for two hours at:
- frequency where a resonance is found, or if resonance is not found
- 30 Hz with acceleration of 7 m/s^2.

Both tests were done in all three directions.

The test was performed at Nemko AS, Gaustadalleen 30, Oslo. The test was performed with the SART placed in the mounting bracket which was screwed on to the vibration table.

See clause 6.3 in this report for plots and clause 8 for pictures of the vibration tests.

The EUT complies with the test requirements.

4.4.5 Float capability

This requirement has been observed according to IEC 1097-1 clause 6.2.9.

The EUT floats in an almost horizontal position.

The EUT complies with the requirements.

4.4.6 Buoyant lanyard

This requirement has been observed according to IEC 1097-1 clause 6.2.10.

The EUT has a buoyant lanyard of yellow colour which is 10,5 meters long.

The EUT complies with the requirements.

4.4.7 Unaffected by seawater or oil

This requirement has been considered according to IEC 1097-1 clause 6.2.11 and IEC 60945 8.11.

Enclosed is a statement from the manufacturer declaring that the materials used in the EUT are unlikely to be affected by seawater or oil.

4.4.8 Resistance to prolonged exposure to sunlight

This requirement has been considered according to IEC 1097-1 clause 6.2.11 and IEC 60945 8.10.

Enclosed is a statement from the manufacturer declaring that the materials used in the EUT are unlikely to be affected by exposure to sunlight.

4.4.9 Corrosion
This requirement has been considered according to IEC 1097-1 clause 6.2.12 and IEC 60945 8.12.

Enclosed is a statement from the manufacturer declaring that the materials used in the EUT are unlikely to be affected by corrosion.

4.4.10 Yellow/orange colour
This requirement has been observed according to IEC 1097-1 clause 6.2.13

The EUT has a bright yellow/orange colour.

The EUT complies with the requirements.

4.4.11 Smooth external construction
This requirement has been observed according to IEC 1097-1 clause 6.2.14
The EUT has a smooth external construction which inhibits damage to the user or to a floating raft.

The EUT complies with the test requirements.

4.4.12 Dry heat cycle
This requirement has been tested according to IEC 1097-1 clause 6.4.1 and IEC 60945 clause 8.2.

The EUT was in a climate chamber at normal temperature (+22 ºC). Then the temperature was increased to and maintained at +65 ºC for 10 hours. On conclusion of this period the temperature was reduced to +55 ºC within 30 minutes. The EUT was then switched on and a functional test was performed within 2 hours.

The EUT complies with the test requirements.

4.4.13 Low temperature cycle
This requirement has been tested according to IEC 1097-1 clause 6.4.2 and IEC 60945 clause 8.4.

The EUT was in a climate chamber at normal temperature (+22 ºC). Then the temperature was reduced to and maintained at -30 ºC for 10 hours. On conclusion of this period the temperature was increased to -20 ºC within 30 minutes. The EUT was then switched on and a functional test was performed within 2 hours.

The EUT complies with the test requirements.

4.4.14 Damp heat
This requirement has been tested according to IEC 60945 clause 8.3.

The EUT was placed in a climate chamber at normal temperature and humidity (+22 ºC and approx. 35 % humidity). Over a period of 3 hours the temperature was raised till 40 ºC and the humidity to 93 %. This level was maintained for 10 hours, the EUT was activated and a performance check was done every 15 minutes during two hours.

The EUT complies with the test requirements.

4.4.15 Antenna height
This requirement has been tested according to IEC 1097-1 clause 6.5.

The EUT floats in an almost horizontal position. In order to comply with the requirement in IEC 1097-1 clause 3.5 the EUT must be installed on a pole or hanging from the inner ceiling of the survival craft.

4.4.16 Electrical - Compass safe distance

Test Description

Method
EN 60945 (2002), Section 11.2
EN ISO 694 (2001)
Ships and marine technology. Positioning of magnetic compasses in ships.

Procedure
Compass safe distance is the distance between the nearest point of the EuT and the subject compass, where an unacceptable compass deviation occur
For a standard compass, the horizontal magnetic flux shall be less than 0.942 mGauss (compass deviation of 5.4°/H).
For a steering/standby/emergency compass, the horizontal magnetic flux shall be less than 3.142 mGauss (compass deviation of 5.4°/H).

The compass safe distance is measured with a DC milligaussmeter. The EuT is first rotated to determine the worst case direction. Secondly the EuT is moved towards/away from the measurement probe until the required field is measured. The distance is then measured.

Measurements are made at 3 EuT conditions:
1) Non-energized (in the magnetic condition received from customer)
2) Non-energized after magnetisation in a 1 Gauss (80A/m) DC field, with a superimposed stabilising 50Hz AC field of 18 Gauss (1430A/m) *
3) Energized and in normal operating condition

* Test 2) may be omitted if the application of a strong magnetic field may damage the EuT

Instruments used during measurement
Instrument list: Milligauss Meter: Alphalab DCMM (N-4046) (10/08)

Comments
The tested item had serial number 0010.

Conformity
Verdict: 60 cm
Test engineer: Jon Fredrik Mo

Detailed Test Log

Condition	Standard Compass	Other Compass	Direction
Non-energized	50 cm	- cm	Standing
Non-energized after magnetisation	50 cm	- cm	Standing
Energized and operating	60 cm	- cm	Standing

Conclusion

Overall Compass Safe Distance is considered to be = 60 cm

5 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries such as cables are identified (numbered) by the Test Laboratory.

No	Instrument/Ancillary	Type	Manufacturer	Ref. No.
1	Spectrum analyzer	FSEK30	R&S	LR 1337
2	Spectrum analyzer	FSU26	R&S	LR 1504
3	Spectrum analyzer	R3271	Advantest	LR 1188
4	RF-generator	SMP04	R&S	LR 1336
5	RF-generator	7200	Gigatronics	LR 1188
6	AF-generator	SPN	R&S	LR 1018
7	Oscilloscope	2440	Tektronix	LR 1009
8				
9				
10	Divide by 64 device		Jotron make	Jotron property
11	Directional coupler		Narda	Jotron property
12	Rectifying diode		Narda	Jotron property
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6 MEASUREMENT PLOTS

6.1 Sweep characteristics low temperature

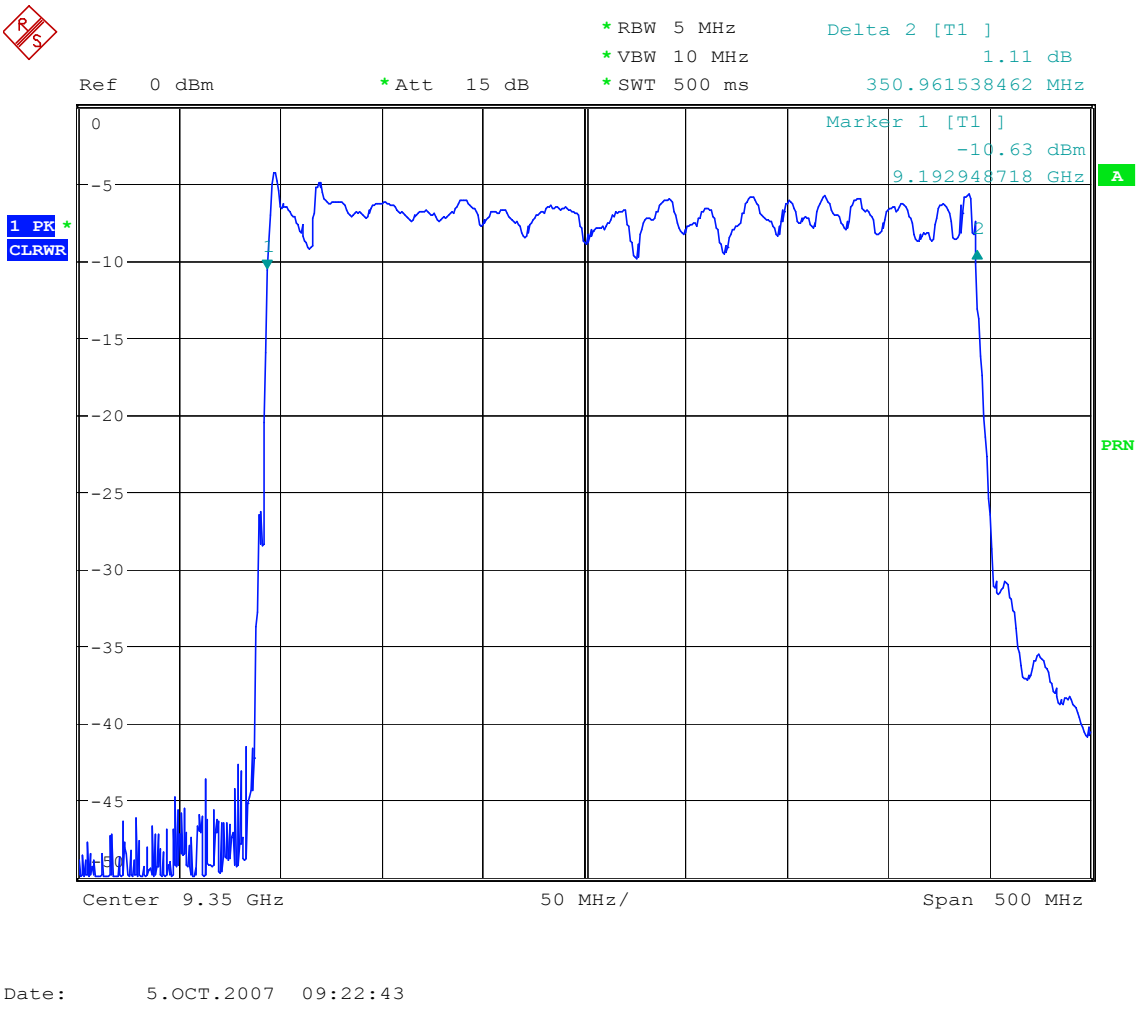

Figure 1: Shows the frequency spectrum of the EUT during functional test at -20 ºC.

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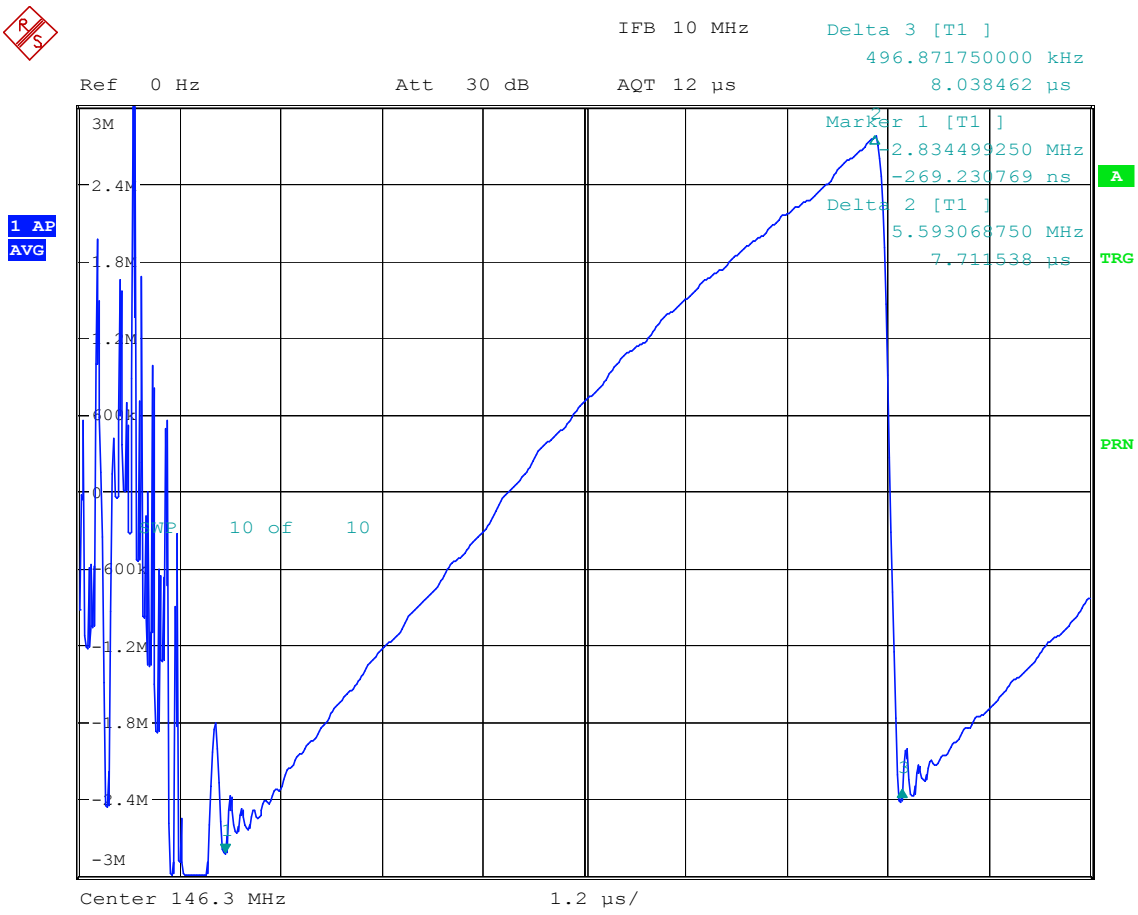


Figure 2: Shows first sweep (from 12 consecutive) from EUT during functional test at -20 ºC

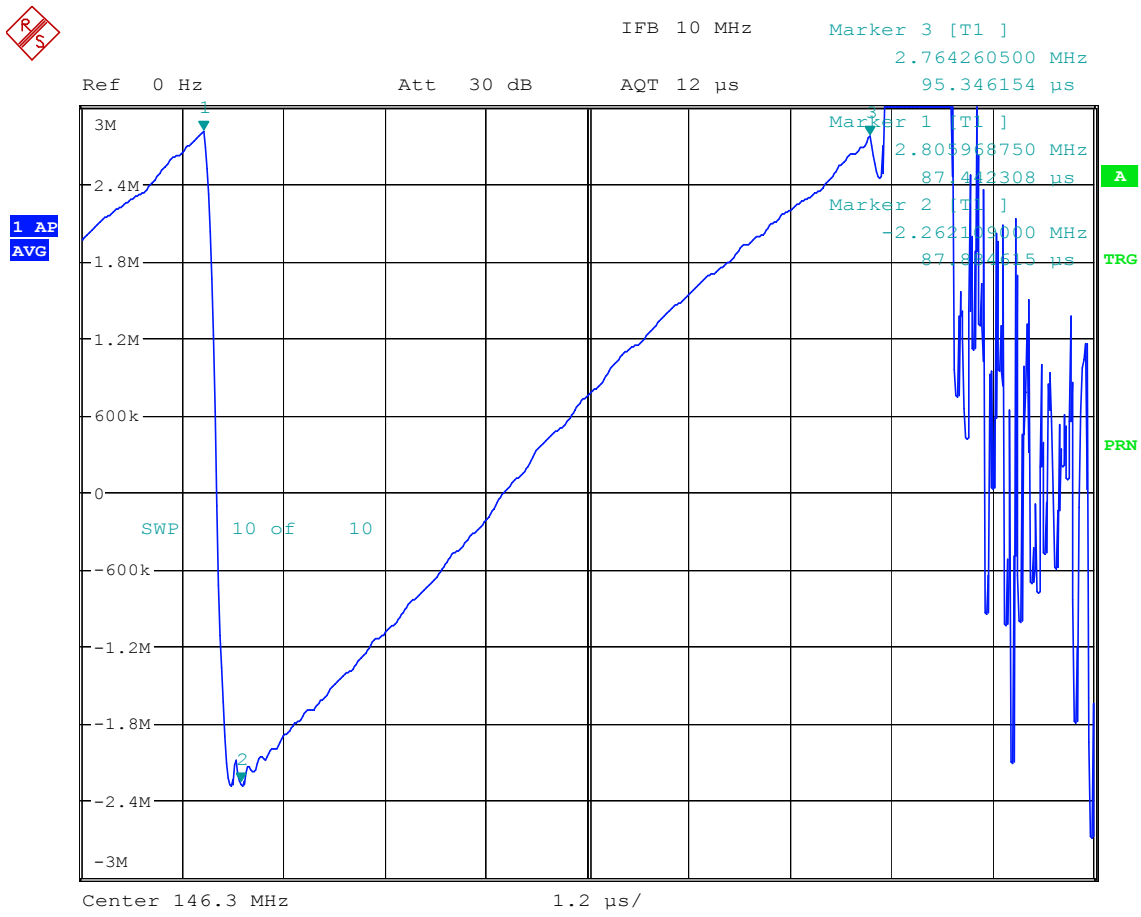


Figure 3: shows last sweep (from 12 consecutive) from EUT during functional test at -20 ºC

6.2 Sweep characteristics high temperature

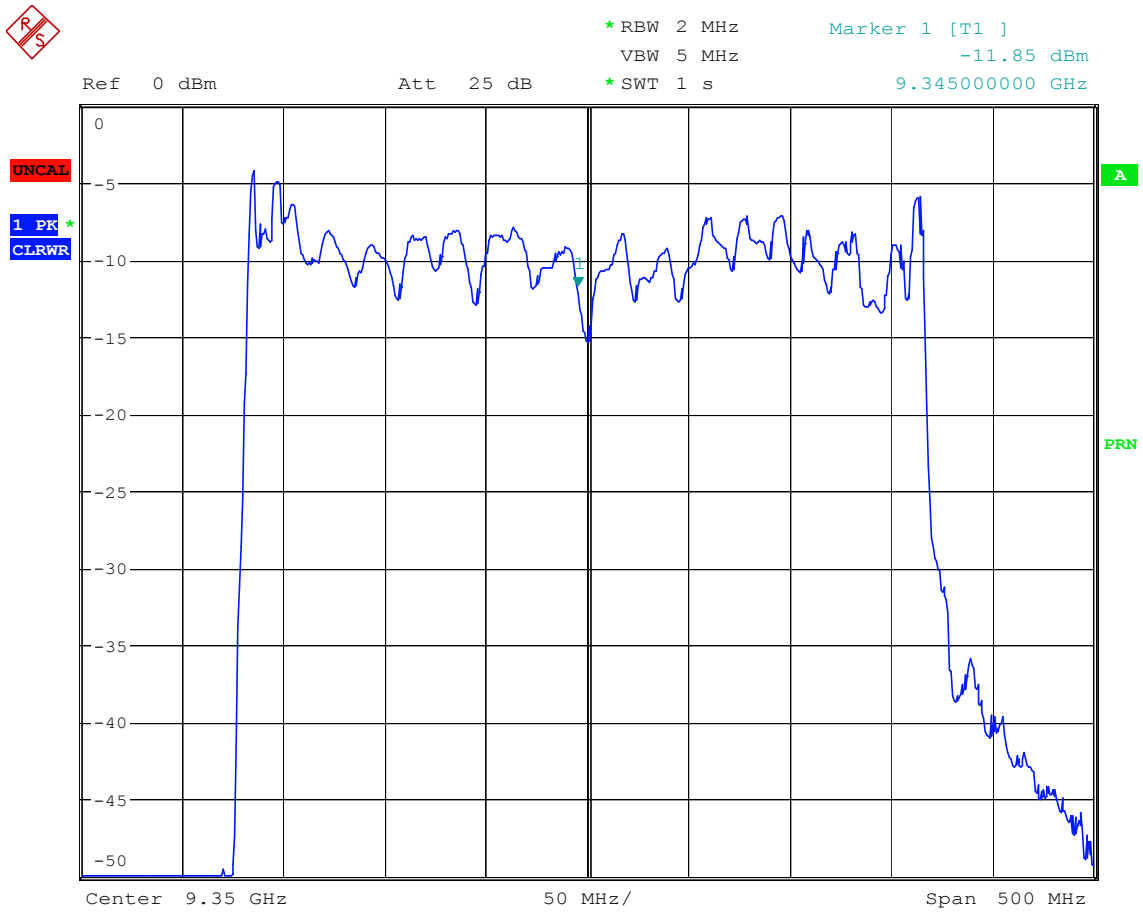


Figure 4: Shows frequency spectrum of the EUT during functional test at +55 ºC.

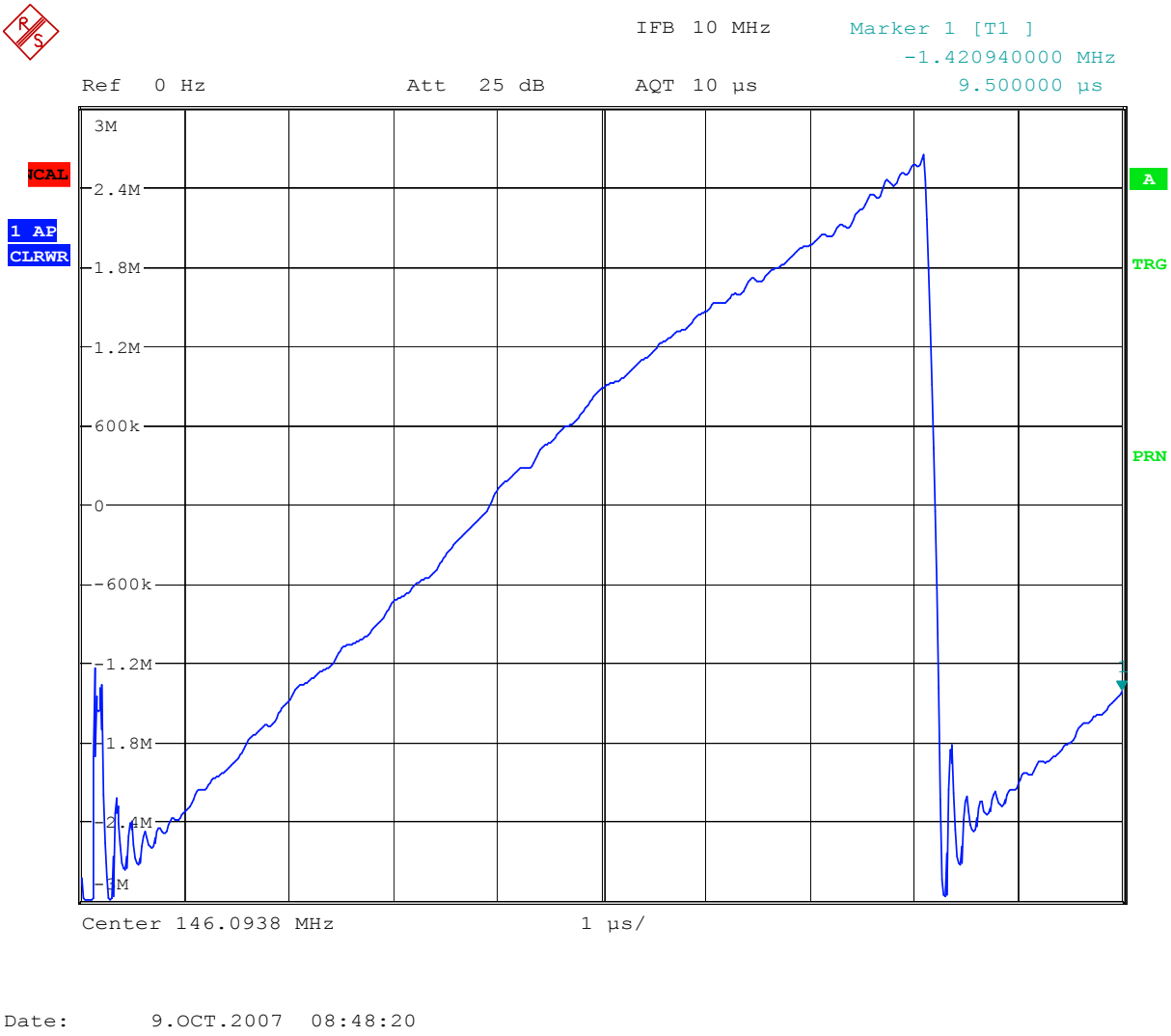


Figure 5: Shows the first of 12 consecutive sweeps from EUT during functional test at +55 ºC

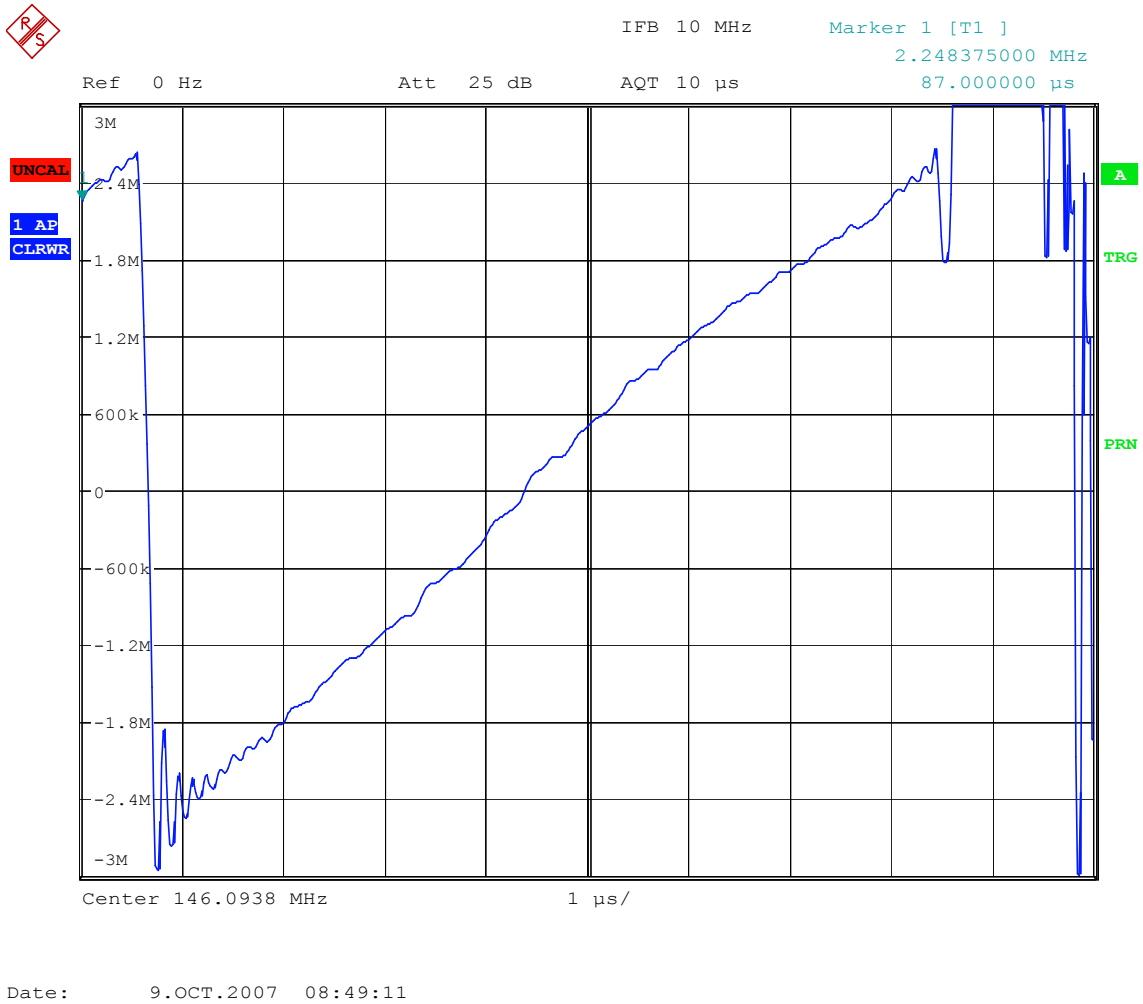


Figure 6: Shows last of 12 consecutive sweeps from EUT during functional test at +55 ºC

6.3 Vibration test

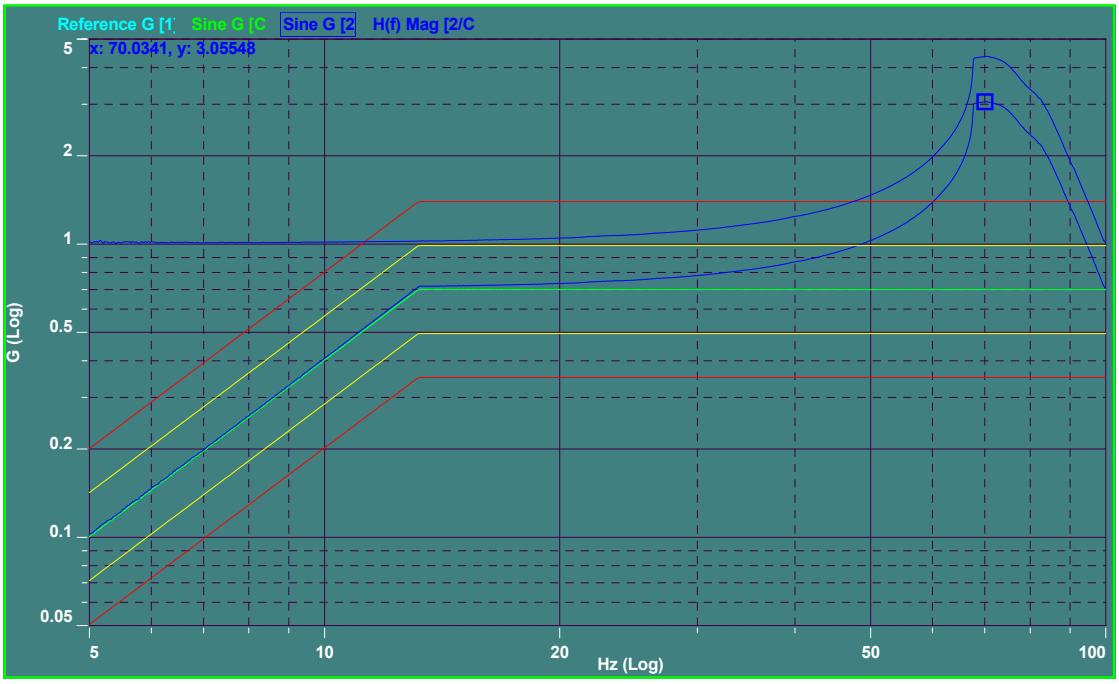


Figure 7: Shows vibration sweep response from, 5 to 100 Hz in x axis.

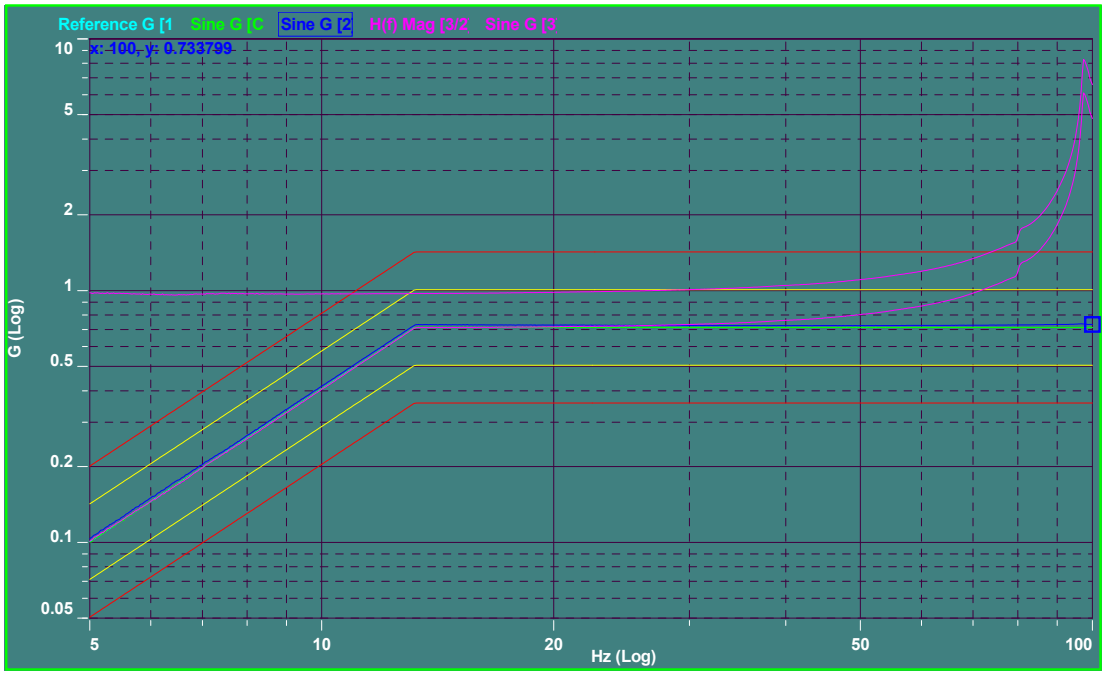


Figure 8: Shows vibration sweep response from, 5 to 100 Hz in y axis.

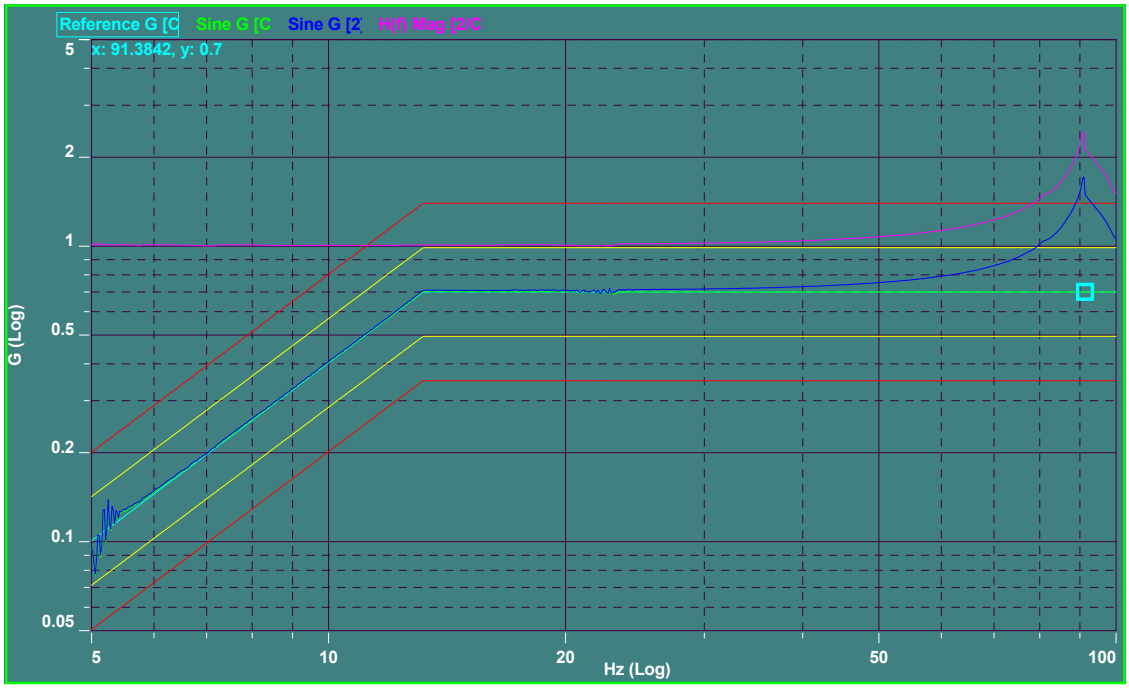


Figure 9: Shows vibration sweep response from, 5 to 100 Hz in z axis.

7 TEST SETUPS

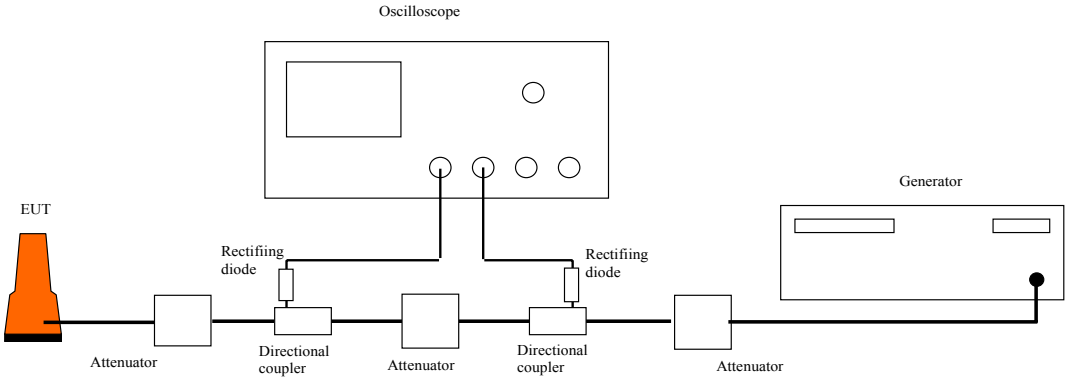


Figure 8: Shows the principal setup during timing performance measurements

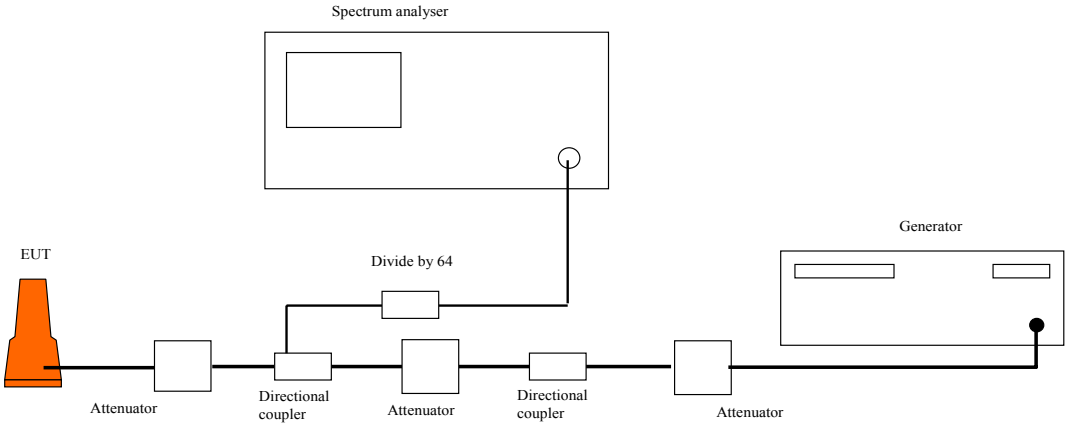
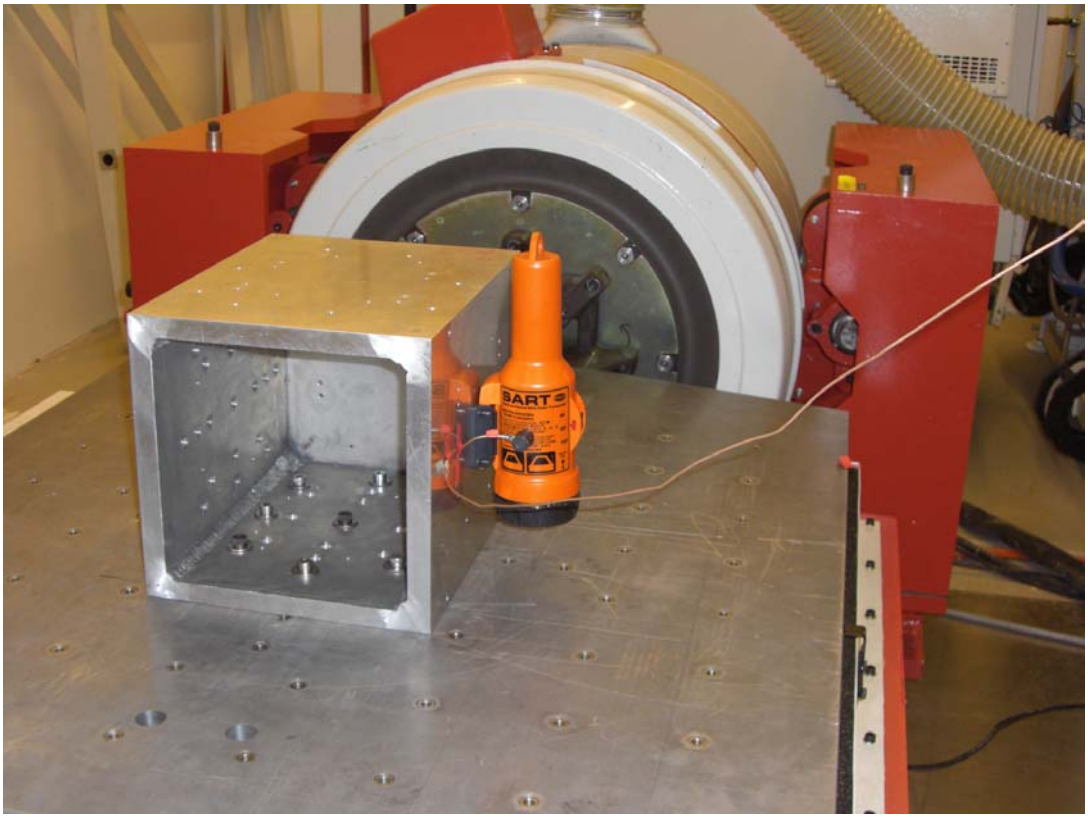


Figure 8: Shows the principal setup during sweep characteristics measurements

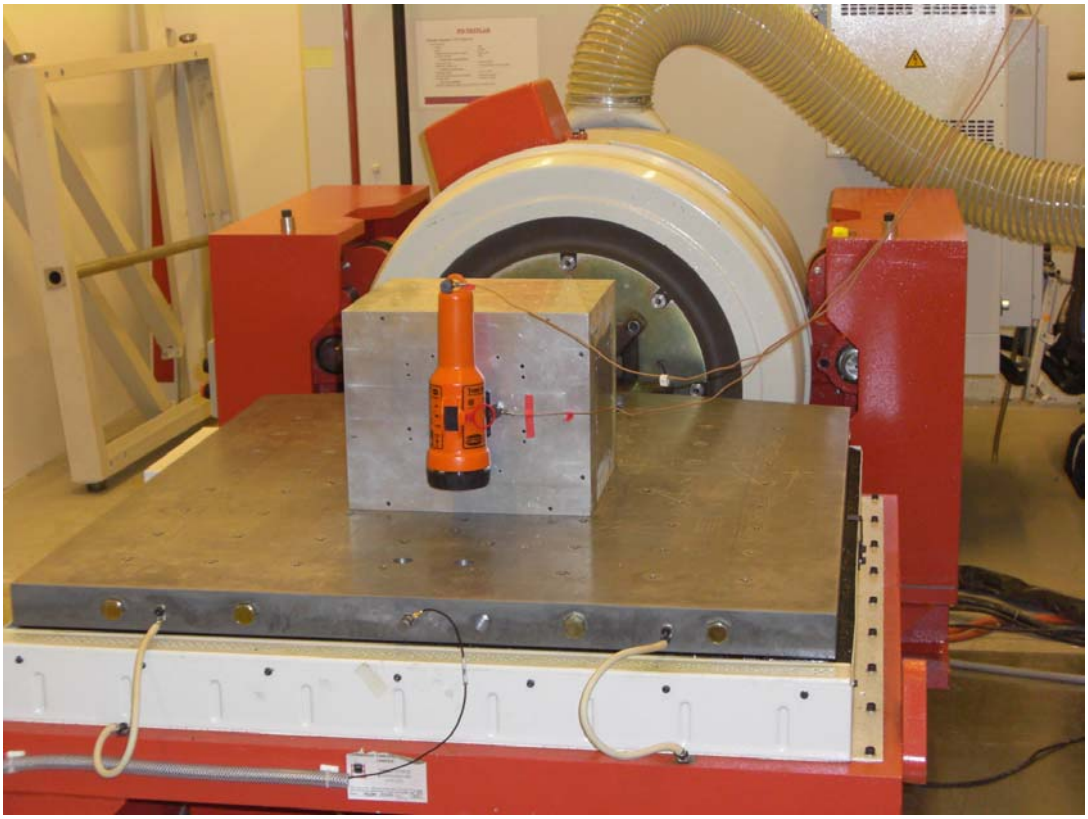
8 PICTURES

Picture 1: Shows the EUT with the mounting bracket

Picture 2: Shows drop test at Jotron premises



Picture 3: Shows the EUT during vibration in x axis



Picture 4: Shows the EUT during vibration in y axis

Picture 5: Shows the EUT during vibration in z axis

Document title:

Jotron test report

Document reference:

Jotron test report.doc

A	12.09.07	Test report	E. Storjordet	GH	ES
Rev	*Issue Date*	*Reason for Issue*	*Made by*	*Checked by*	*Approved by*

Project no: SART_MK2_200502	*Contract no:*	*Customer Doc.no:*
Jotron File Name: M:\03_Development\Project_Design\SART_MK2_200502\Admin\Approval\Jotron tests\Jotron test report drop SART20.DOC		*Jotron File no:*

LIST OF CONTENTS

1. GENERAL

1.1 Background

An agreement was made between (DNV) Det Norske Veritas and (JE) Jotron AS that JE could perform drop-test in Sandefjord harbor under supervision of DNV.

This test report also includes documentation related to the same standards.

1.2 Overview

IEC 61097-1ed.2	Executed test
3.2.f (3.2.6 ed.1)	X

1.3 Drop Into Water test

1.3.1 Test specifications and sequence

IEC 61097-1 ed.2 Section 3.2.f (3.2.6 ed.1)

"The SART shall be capable of withstanding without damage drops from a height of 20 m into the water"

1.3.2 Equipment under test

Name : Tron SART20
Ser. Nr: 001

1.3.3 Test site

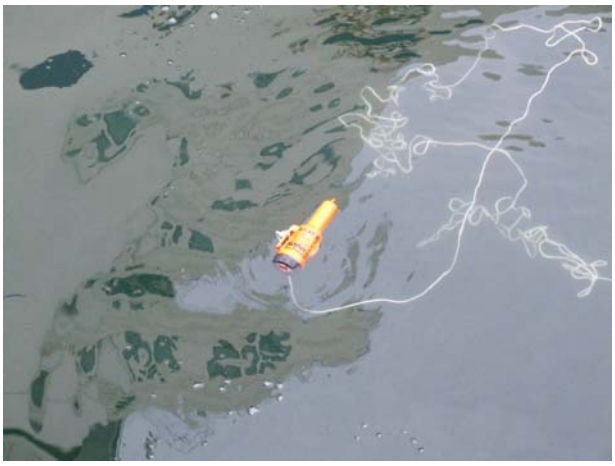
Sandefjord harbor.

1.3.4 Test Equipment

Crane 30 meter.

1.3.5 Description of the drop into water test

The EUT was functionally tested, and then fastened to the crane rope using a trigger mechanism with a separate trigger rope.
Because of the demands of drop heights in the English sector of the North Sea, we decided to perform all drops from 30 meter height.
At the height of 30 meter above sea level, the EUT was dropped into the water. After the drop a functionally test was performed at the EUT and it was inspected for damage.
This was repeated 3 times.



2. WITNESSED TEST

Nr.	Test	Result (Pass/Fail)	Date	Witness
1	To confirm that the Tron SART20 stands drop test according to IEC 61097-1 ed.2 Section 3.2.f (3.2.6 ed.1)		12.09.07	

Authorized by:

Eirik Storjordet
Certification Manager
Jotron AS

Knut Ragnar Nielsen
Surveyor
DNV avd. Sandefjord