SGS Germany GmbH

Test Report No.: K4390001

Order No.: K439	**Pages:** 29	**Munich,** Jan 25, 2016

Client:	Bosco S.r.l.
Equipment Under Test:	Lectronic Cabinet completed with weight dummies
Manufacturer:	Bosco S.r.l.
Task:	Earthquake test with acceleration-time history waveform VERTEQII
Test Specification(s): [covered by accreditation]	Telcordia Technologies Generic Requirements **GR 63 CORE , Issue 4,** April 2012 NEBS Requirements : Physical Protection Section(s) 4.4 , 5.4 , Earthquake Zone 2
Result:	Test was performed according to Telcordia GR-63-CORE Zone 2

The results relate only to the items tested as described in this test report.

approved by:	**Date**	**Signature**
Stiglmaier Lab Manager Environmental Simulation	Jan 28, 2016	

This document was signed electronically.

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1 Summary

The report contains the results from the environmental tests “Earthquake” of the Bosco equipment:

Lectronic Cabinet H2100+100 plint W800xD800
with seismic easy kit

with regard to

Telcordia Technologies Generic Requirements
GR 63 CORE , Issue 4, April 2012, Zone 2
NEBS Requirements: Physical Protection
Section(s) 4.4, 5.4, Earthquake

Requirement	**Criteria met (yes/no)**	**Remark**
R 4-83 Earthquake: Structural / Mechanical Damage	Yes	Test performed without cable load
R 4-84 Earthquake: Deflection Criterion (3 in.)	Yes	Test performed without cable load
R 4-85 Earthquake: Natural frequency > 2 Hz	Yes	
O 4-86 Earthquake: Natural frequency > 6 Hz	No	
O 4-89 Earthquake: Framework and Anchor Criteria	Yes	The framework is a screwed construction
R 4-90 Earthquake: Framework and Anchor Criteria	Yes	
O 4-91 Earthquake: Framework and Anchor Criteria	-	Not performed. O 4-91 is covered by Test acc. R 4-84
R 4-92 Earthquake: Framework and Anchor Criteria	-	The anchors are unknown and therefore omitted from the test configuration *
O 4-93 Earthquake: Framework and Anchor Criteria	-	The anchors are unknown and therefore omitted from the test configuration *
O 4-94 Earthquake: Framework and Anchor Criteria	-	The anchors are unknown and therefore omitted from the test configuration *

2 References

2.1 Specifications

Telcordia Technologies Generic Requirements
GR 63 CORE, Issue 4 (2002), April 2012
NEBS Requirements: Physical Protection
Section(s) 4.4, 5.4, Earthquake

3 General Information

3.1 Identification of Client

Bosco S.r.l.
Via Trento, 5
22070 Fenegro(CO)
Francesco Bosco

3.2 Test Laboratory

SGS Germany GmbH
Department Environmental Simulation
Hofmannstraße 51
81379 München

3.3 Time Schedule

Delivery of EUT: Dec 18, 2015
Start of test: Dec 21, 2015
End of test: Dec 23, 2015

3.4 Participants

Name	**Function**	**Phone**	**E-Mail**
Johnny Wilde	Accredited testing	+49 89 787475-329	johnny.wilde@sgs.com
Werner Tanz	Accredited testing, Editor	+49 89 787475-314	werner.tanz@sgs.com

4 Equipment Under Test

Lectronic Cabinet H2100+100 plint W800xD800
with seismic easy kit

4.1 Configuration of EUT

Cabinet:	Width 800mm, length 800mm, height 2200mm
Doors:	Frontal door
Panel side:	Left, right and back
Total inside load:	174kg

Pic. 1 Equipment under Test

Pic. 2 Equipment under Test

5 Test Equipment

5.1 Test Facility

The measurements were carried out by
SGS Germany GmbH,
Department Environmental Simulation,
Hofmannstraße 50, 81379 München, Germany.

5.2 Measuring Equipment

Resonance search

ID. No.	Equipment	Manufacturer	Status	Last Cal.	Next Cal.
S0795	Frequency Counter	Newport	ind		
S0854	Frequency Display	Newport	ind		
S1419	80A Vibration Exciter VIB9000	RMS	cnn		
S5452	Vib Control V2.12.25	m+p	cnn		
S5560	Vibration Control and Analysis system (VIB9000)	VXI Technology	cal	Feb 12, 2015	Feb 2016
S6267	Lenovo Think Centre Tower PC (VIB9000)	Lenovo	ind		
S5850	Accelerometer	PCB	cal	Mar 31, 2014	Mar 2016
S6188	Accelerometer	PCB	cal	Feb 25, 2015	Feb 2017
S6308	Accelerometer	PCB	cal	Apr 29, 2014	Apr 2016

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary

Earthquake

ID. No.	Equipment	Manufacturer	Status	Last Cal.	Next Cal.
S0353	Earthquake Test System	MTS	cnn		
S0896	Control System for Earthquake		cnn		
S5298	Charge Amplifier	Bruel & Kjaer	cal	Apr 02, 2014	Apr 2016
S5299	Force Sensor	PCB Piezotronics	cal	Oct 24, 2014	Oct 2016
S5317	Accelerometer	Sensotec	cal	Aug 19, 2015	Aug 2017
S5324	Force Sensor	PCB Piezotronics	cal	Apr 02, 2015	Apr 2017
S5396	Accelerometer	Sensotec	cal	Aug 19, 2015	Aug 2017
S5398	Accelerometer	Endevco	cal	May 07, 2015	May 2016
S5453	Software Version 3.3A	MTS	cnn		
S5482	Power Supply	TET Electronic	ind		
S5544	Position Transducer	National Oilwell	ind		
S5841	3 CH DC Signal Conditioner	PCB	cal	May 07, 2014	May 2016
S5843	Accelerometer	Honeywell	cal	Aug 19, 2015	Aug 2017
S5844	Accelerometer	Honeywell	cal	Aug 19, 2015	Aug 2017

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary

6 Test Specifications and Results

The test results in the report refer exclusively to the test object described in section 4 and the test period in section 3.3.

6.1 Requirements Specification

6.1.1 Earthquake Criteria

R 4-83 All equipment shall be constructed to sustain the waveform testing of *GR-63-CORE Section 5.4.1 "Earthquake test Methods"* without permanent structural or mechanical damage

R 4-84 Frame level equipment shall be constructed so that during the waveform testing of *GR-63-CORE Section 5.4.1. "Earthquake Test Methods",* the maximum single-amplitude deflection at the top of the framework, relative to the base, does not exceed 75 mm.

R 4-85 Frame level equipment shall have a natural mechanical frequency greater than 2.0 Hz as determined by the swept sine survey of *GR-63-CORE Section 5.4.1. "Earthquake Test Methods."*

O 4-86 Frame level equipment should have a natural mechanical frequency greater than 6.0 Hz as determined by the swept sine survey of *GR-63-CORE Section 5.4.1. "Earthquake Test Methods."*

6.1.2 Framework and Anchor Criteria

O4-89 Framework should be of welded construction.

R4-90 Framework shall be constructed for base mounting to the floor without auxiliary support or bracing from the building walls or ceilings.

O4-91 For framework used in earthquake risk zones, the static pull testing procedures of *GR-63-CORE Section 5.4.1.4*, "Static Test Procedure", should be followed, meeting these objectives:

- The maximum single amplitude deflection at the top of the framework should not exceed 75 mm (3 in).
- The top of the framework should return to its original position, within 6 mm (0.24 In) when the load is removed.
- The framework should sustain no permanent structural damage during static framework testing.
- The static pull objective does not to be performed on
  Equipment intended to be provided without framework
  Equipment provided with framework that has previously been tested and found to conform to this objective, or
  Framework (loaded or unloaded) that has been synthesized waveform tested *per GR-63-CORE Section 5.4.1.5, "Waveform Test Procedure",*

R4-92 Concrete expansion anchors used to base mount framework to the floor shall meet the following requirements:

- Maximum embedment depth of 90 mm (3.5 in)
- Maximum bolt diameter of 13 mm (0.5 in).

O4-93 Concrete expansion anchors used to base mount the framework to the floor should be suitable for earthquake (dynamic) applications, as specified by the manufacturer.

O4-94 Concrete expansion anchors should use steel construction to minimize creep.

6.2 Test Specification

The tests were performed in accordance to GR – 63 – CORE, Section 5.4: Earthquake.

Remarks:
1. The Earthquake test was performed with acceleration-time history waveform VERTEQII.
2. The EUT was mounted during the tests on a 40mm aluminium adapter plate. The plinth is secured to the aluminium plate using four M12 screws and washers.
3. The EUT was completed with weight dummies, therefore no function are possible
4. The mounting on the floor and anchors are unknown and therefore omitted from the test configuration.
5. The resonance sweep was performed on an electro-dynamic shaker. Due to its performance, the applied acceleration was 0,13 g (instead of 0,2g).
6. Test performed without cable load.

Table 6.2.1 - Earthquake Test conditions

Environmental parameter	Test Severity		Duration	Method
Earthquake time-history	RRS	see Table 6.2.2	30 s	Time-history VERTEQII
	frequency range	1 – 50 Hz		
	axes	3		
	damping ratio	2 %		

Table 6.2.2 - Earthquake Required Response Spectrum for Zone 2 according to Telcordia Technologies GR-63-CORE Section 5.4.1

Coordinate Point	Frequency (Hz)	Values for Upper Floor Acceleration (g)
1	0.3	0.2
2	0.6	2.0
11	5.0	2.0
12	15.0	0.6
13	50.0	0.6

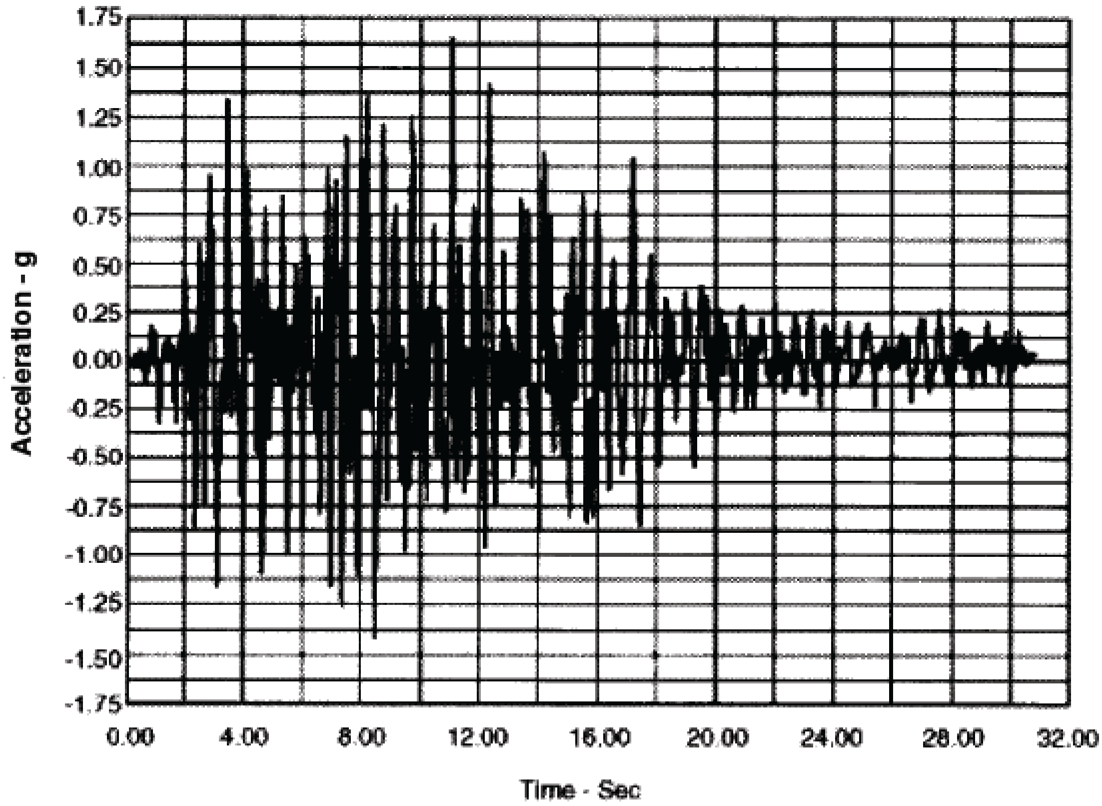


Figure 6.1: Earthquake Synthesized Waveform   VERTEQ II (example Zone4)

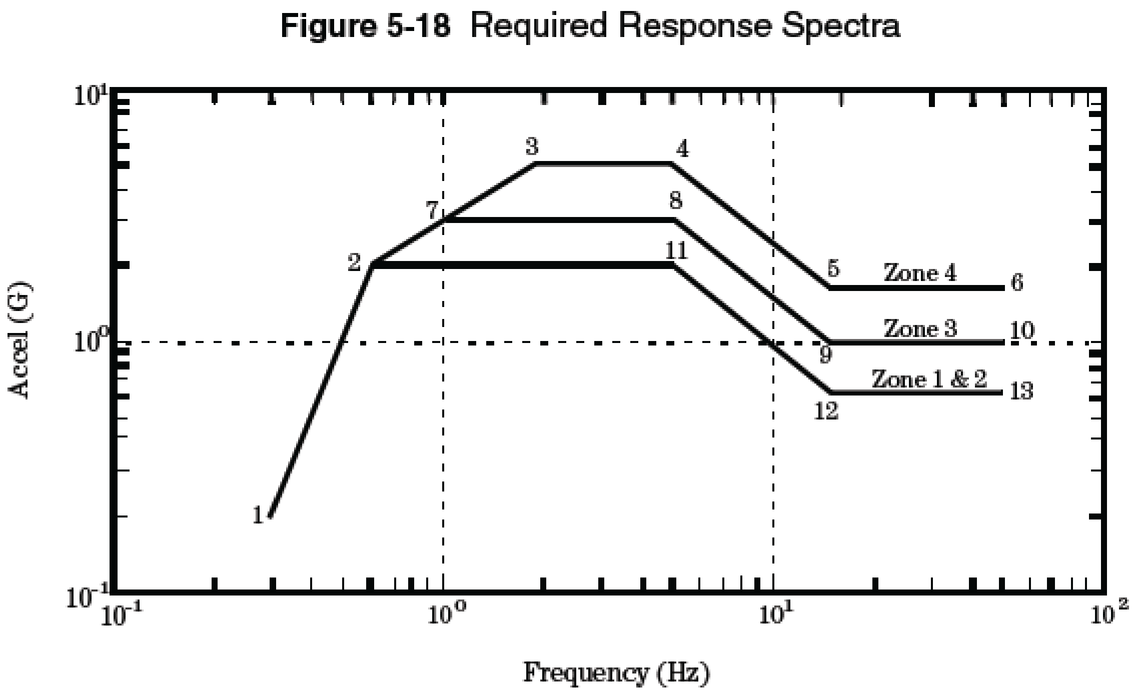


Figure 6.2: Earthquake Required Response Spectrum

6.3 Test Performance

For the tests the EUT were mounted on a 40 mm aluminium plate. The plinth of the EUT is secured to the aluminium plate using eight M12 screws and washers.
No function at the EUT is possible, because the cabinet was only completed with weight dummies.

For the time-history testing on the seismic table, the buildup “EUT – aluminium plate” remained unchanged.

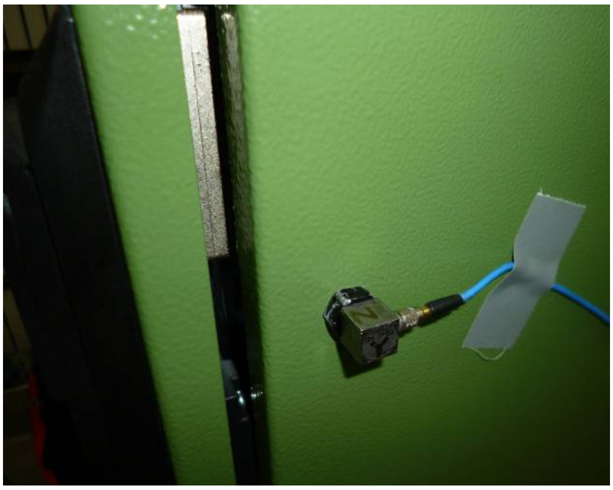
6.3.1 Vibration Response Investigation

Before execution of the main earthquake tests a vibration response investigation (resonance search) was performed on the electro dynamic vibration system VIB 9000 in 3 mutually perpendicular axes with the following parameters:

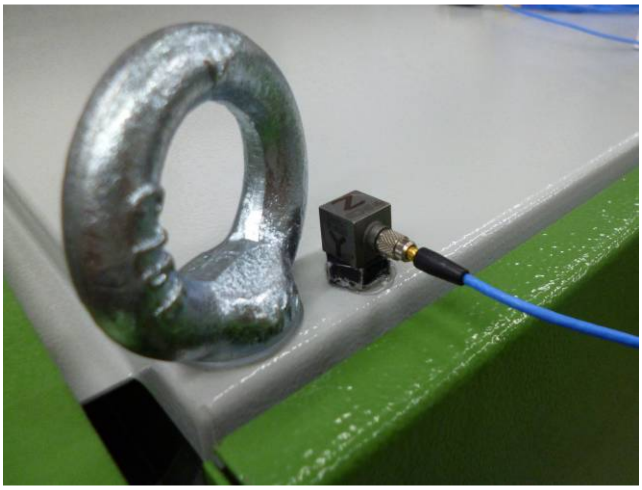
Frequency Range:	1.25 to 50 Hz
Acceleration:	1.3 m/s^2

Two accelerometers were attached to the middle and top of the cabinet.
Diagrams are shown in section 6.4.1.

The tests were performed in normal use attitude.

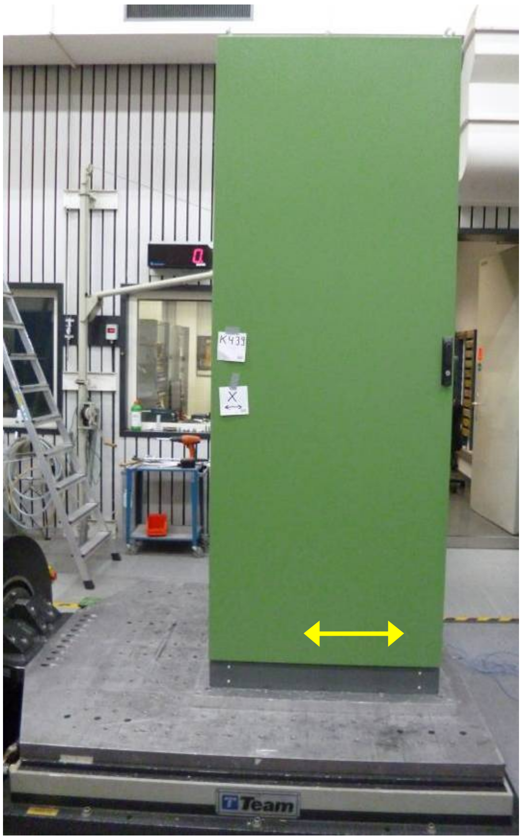


Pic. 3 Measuring point middle



Pic. 4 Measuring point top

Pic. 5 Mounting of EUT for Z-axis test



Pic. 6 Mounting of EUT for X-axis test

Pic. 7 Mounting of EUT for Y-axis test

6.3.2 Time-History

The EUT was mounted on the seismic table over a 40mm aluminium plate. The plinth of the EUT is secured to the aluminium plate using eight M12 screws and washers. No cable load was mounted at the top of the cabinet.

Two single-axis accelerometers are positioned at the middle and on top of the EUT to record the acceleration.

A LVDT for displacement measurement was attached to the top of the EUT.

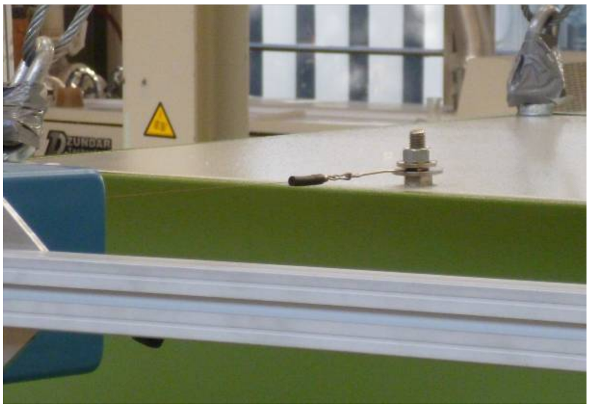
A video taken from tests in all three axes is part of the documentation.

The test was performed in 3 mutually perpendicular axes.

horizontal longitudinal front to back = Y-axis
horizontal lateral side to side = X-axis
vertical = Z-axis

Diagrams are shown in section 6.4.2 + 6.4.3

Pic. 8 Measuring point for time history at earthquake table



Pic. 9 Measuring Equipment for displacement

Pic. 10 Measuring point middle of EUT (horizontal)

Pic. 11 Measuring point top of EUT (horizontal)

Pic. 12 Mounting of EUT for Z-axis test

Pic. 13 Mounting of EUT for X-axis test

Pic. 14 Mounting of EUT for Y -axis test

6.4 Test Results

6.4.1 Vibration Response Investigation

The measured resonance frequencies are:

Table 6.3: Results - Resonance Frequencies

Axis	Frequency [Hz]
X	7.4
Y	8,9
Z	29

6.4.1.1 Vibration Response Investigation X-axis

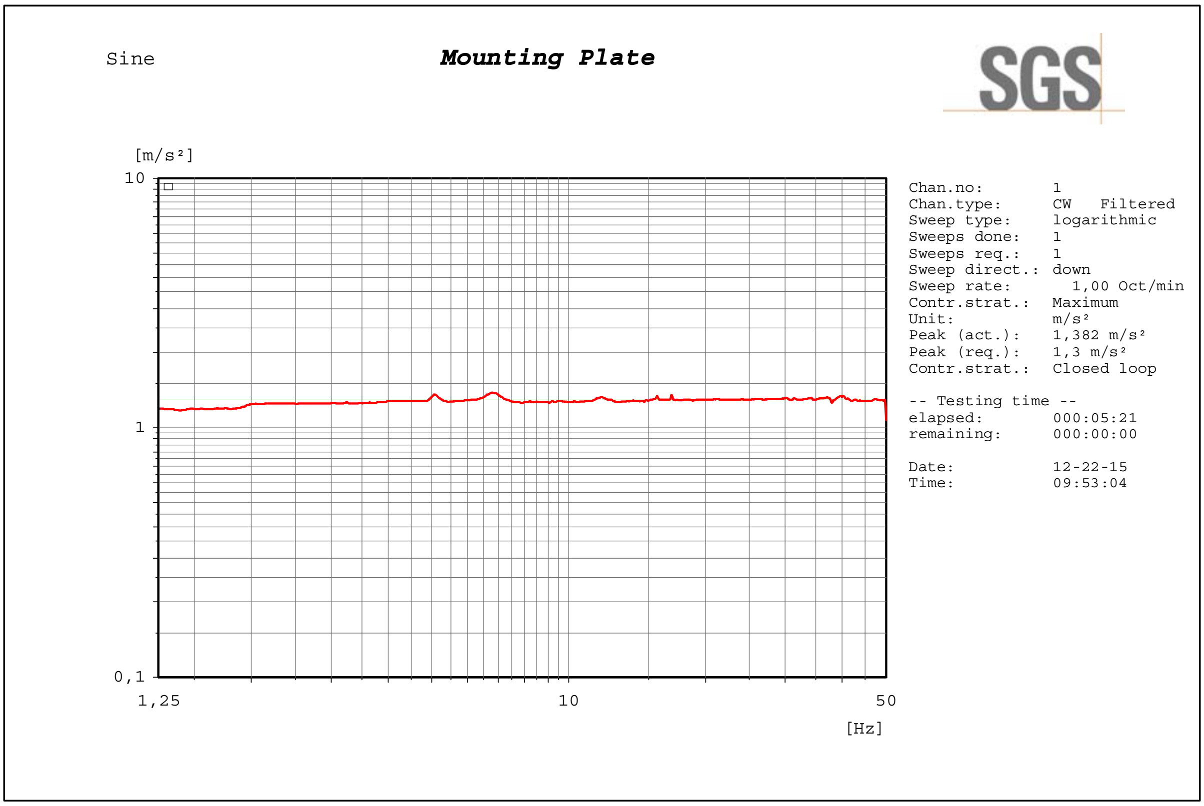


Figure 6.3: Res. Search: acceleration at Vibration Table, X-Axis

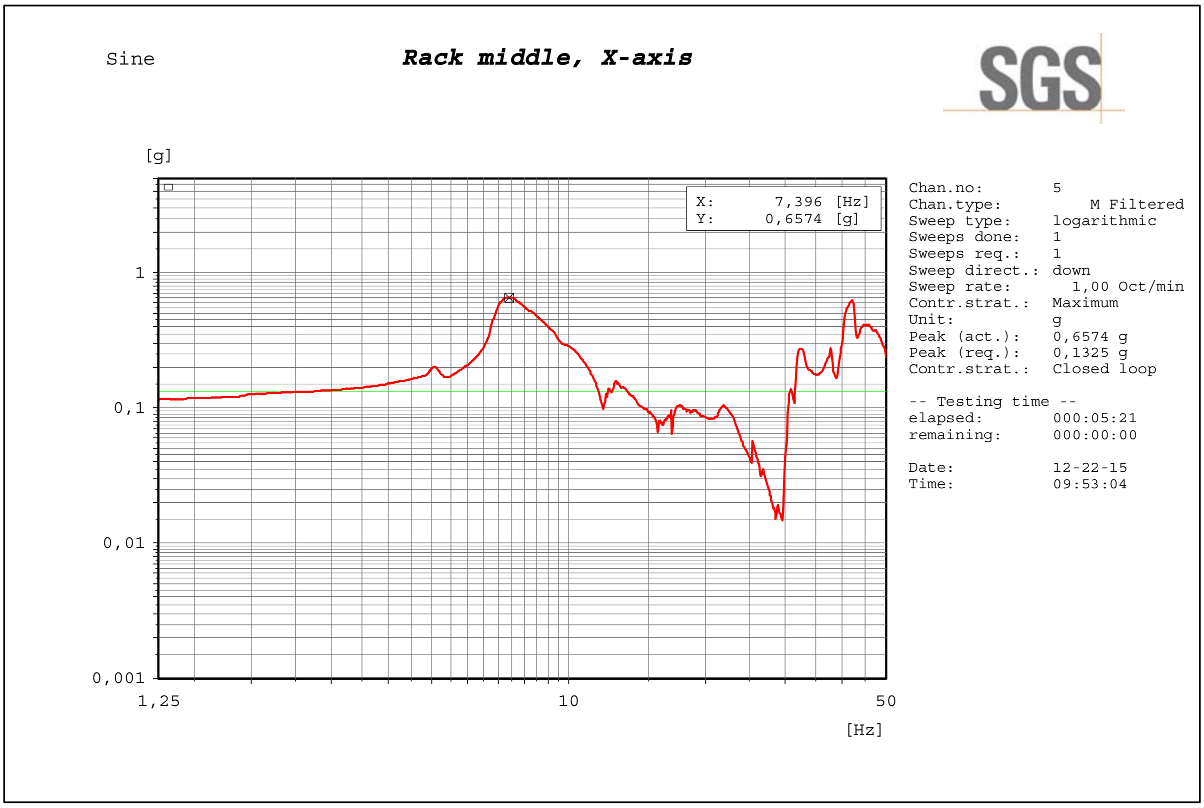


Figure 6.4: Res. search: excitation in x-dir.; middle of the rack

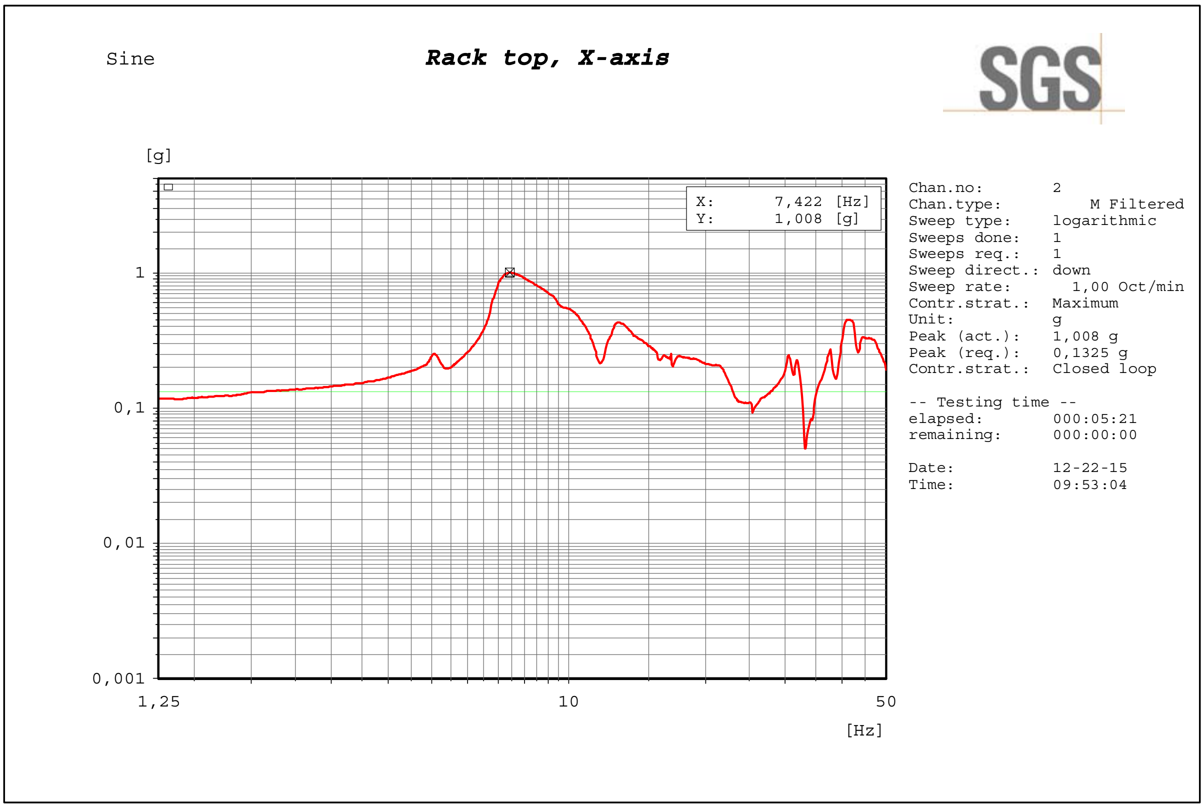


Figure 6.5: Res. search: excitation in x-dir.; top of the rack

6.4.1.2 Vibration Response Investigation Y-axis

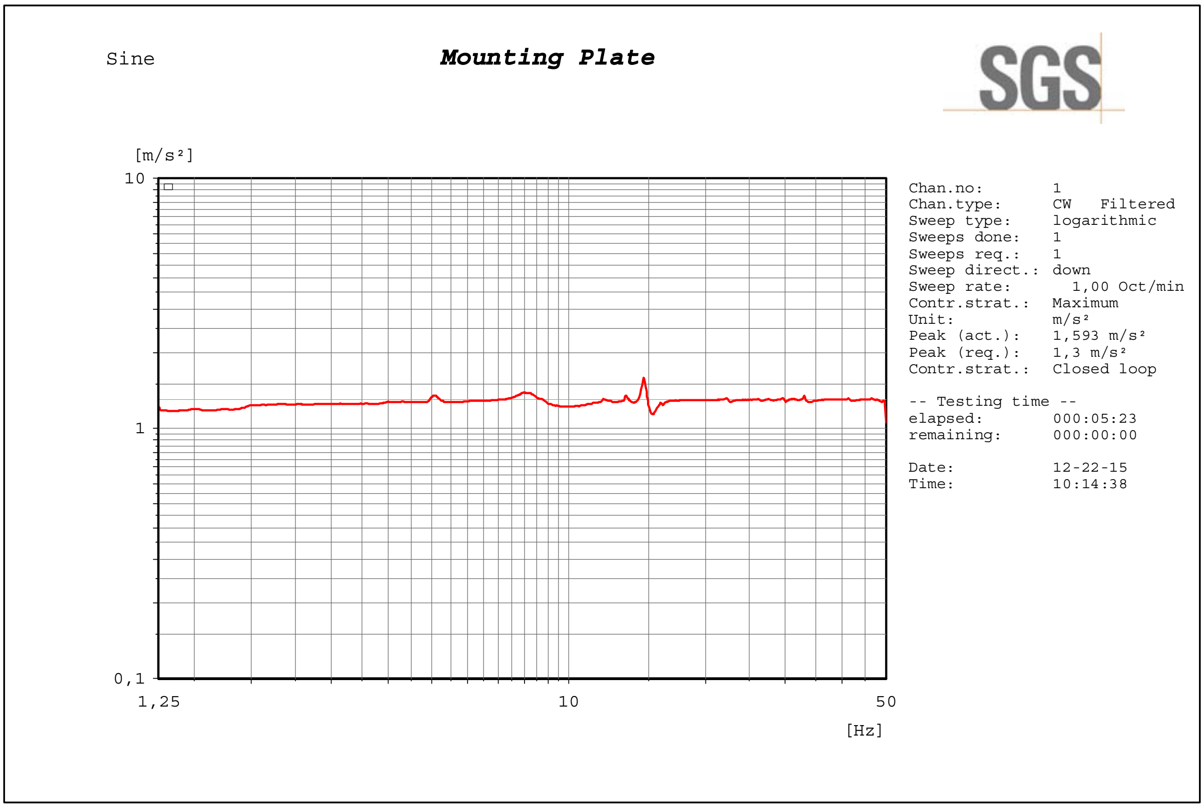


Figure 6.6: Res. Search: acceleration at Vibration Table, Y-Axis

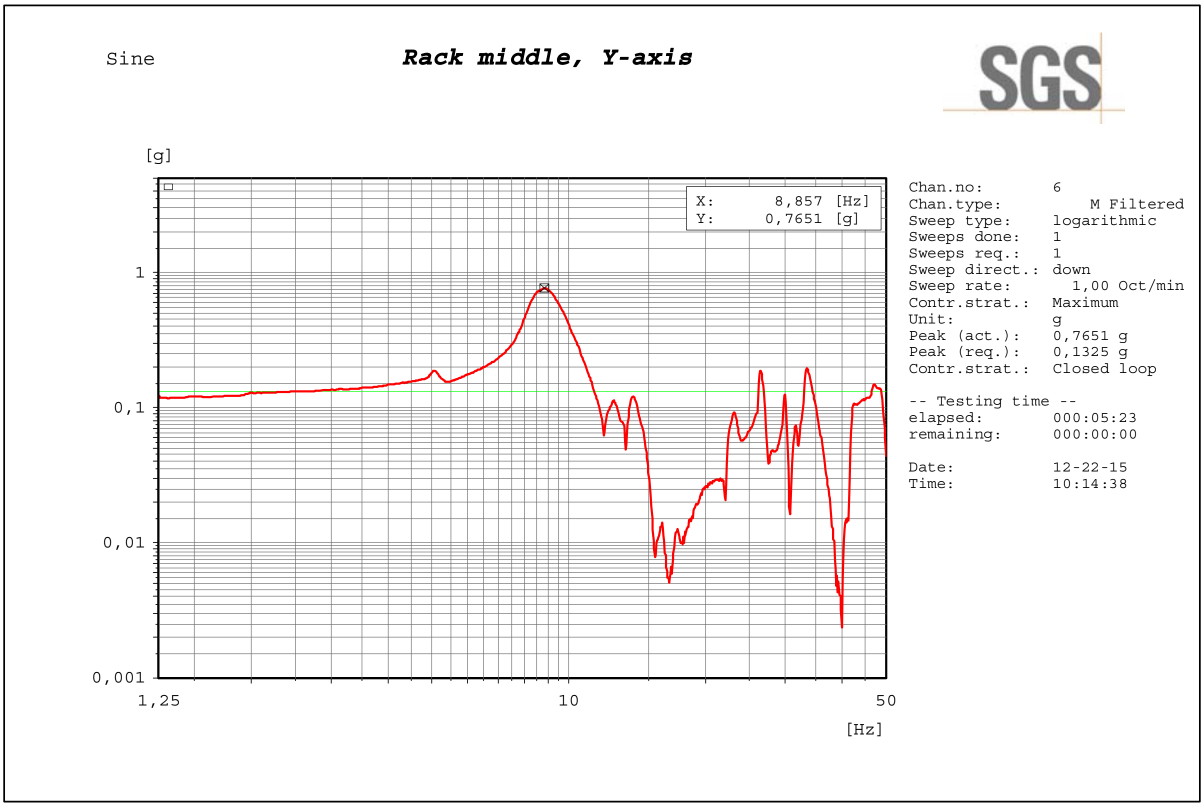


Figure 6.7: Res. search: excitation in y-dir.; middle of the rack

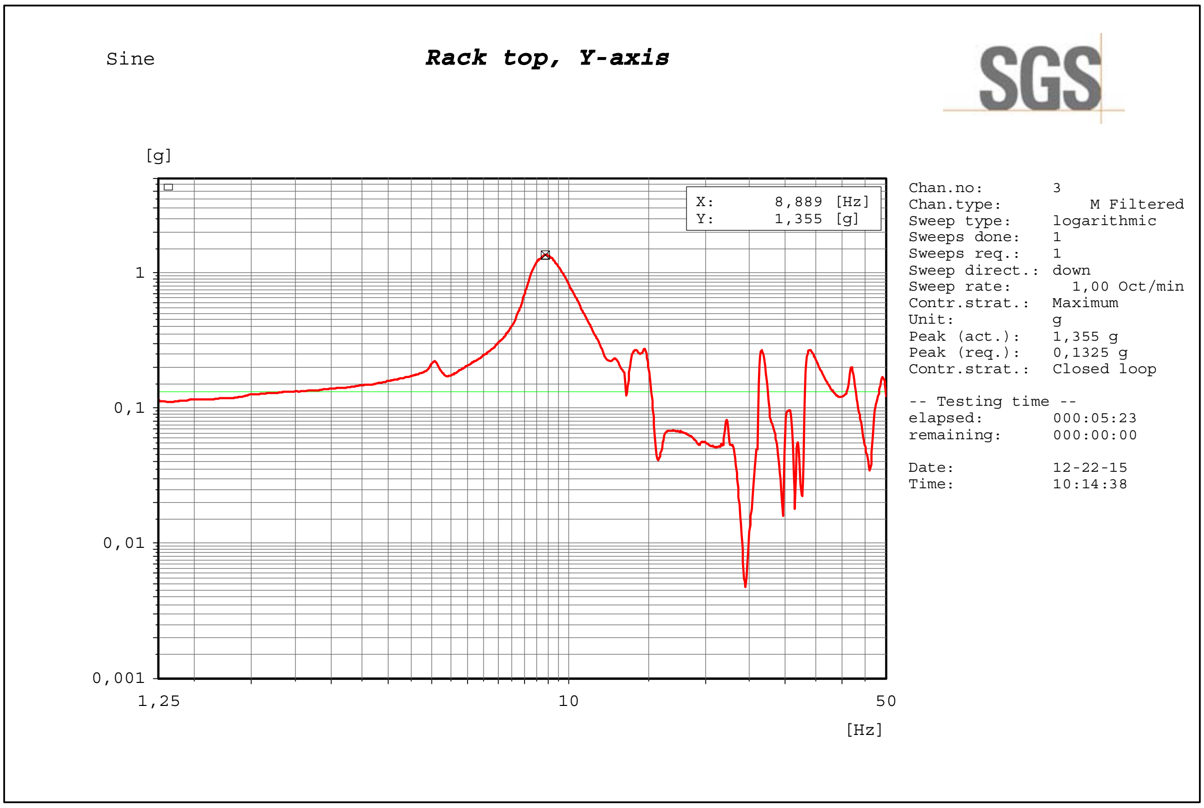


Figure 6.8: Res. search: excitation in y-dir.; top of the rack

6.4.1.3 Vibration Response Investigation Z-axis

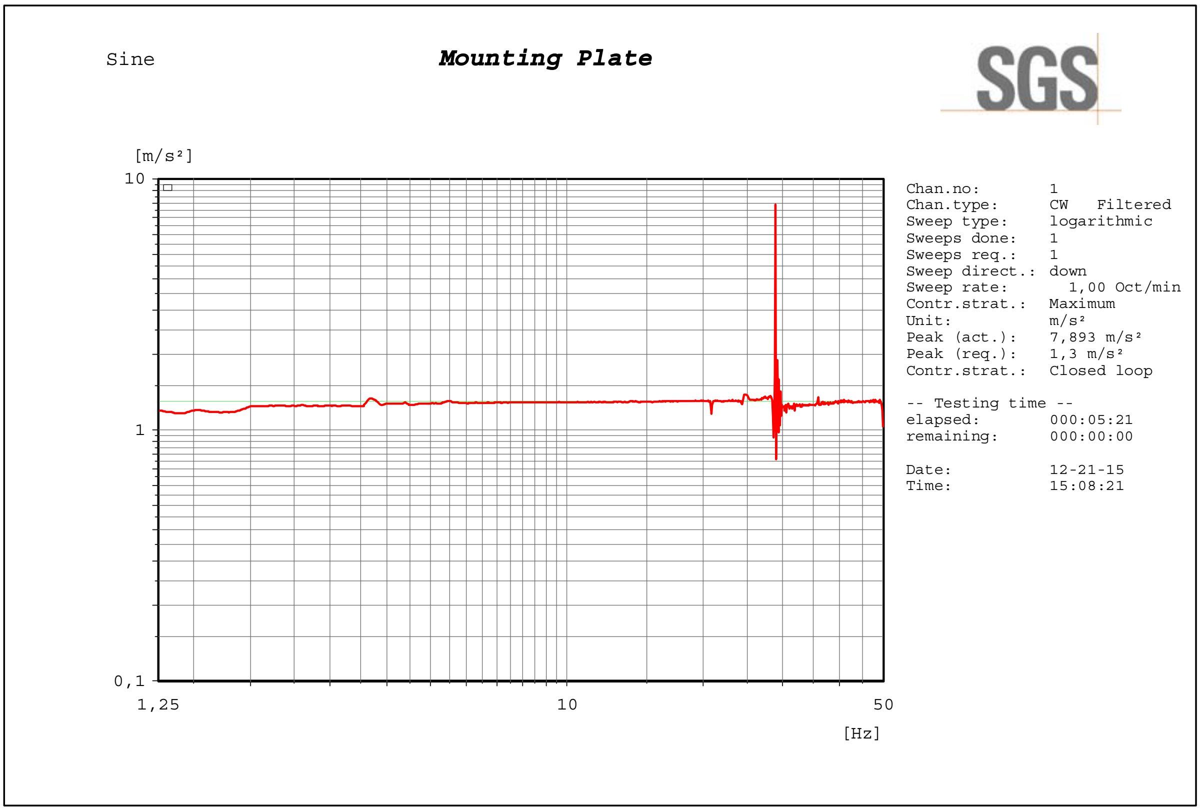


Figure 6.9: Res. Search: acceleration at Vibration Table, Z-Axis

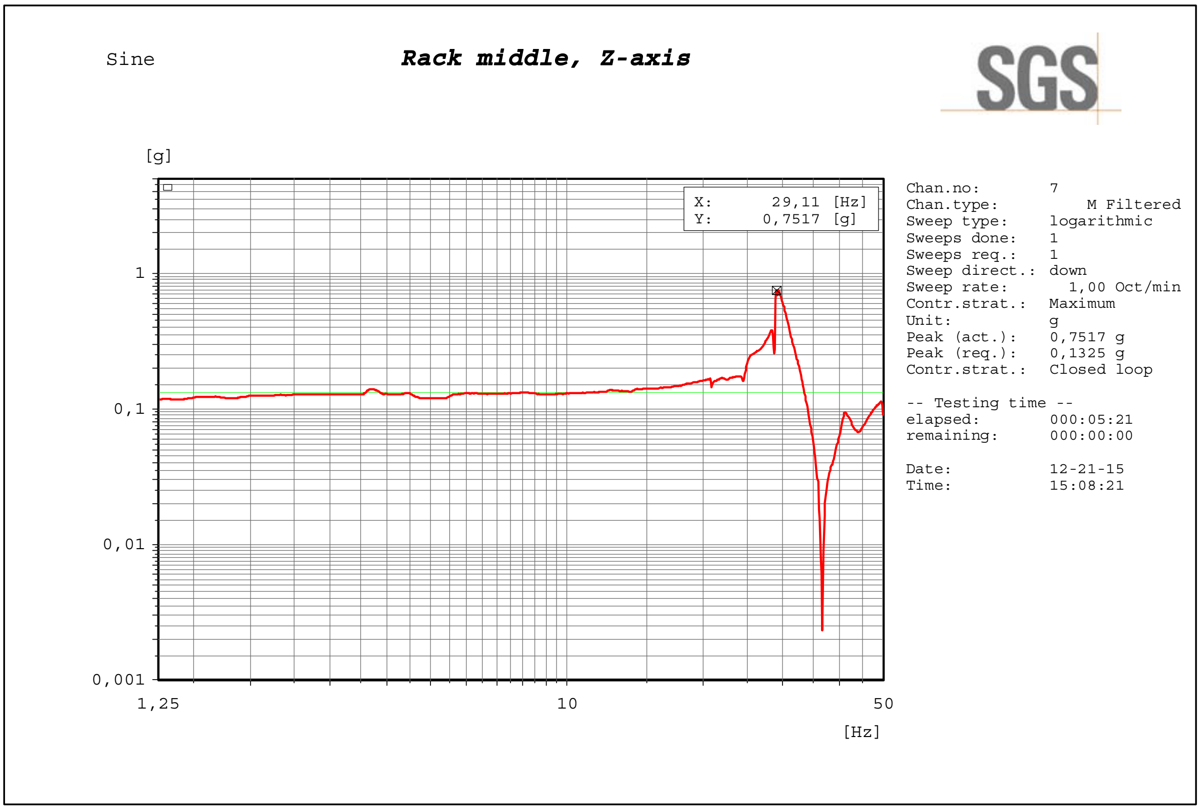


Figure 6.10: Res. search: excitation in z-dir.; middle of the rack

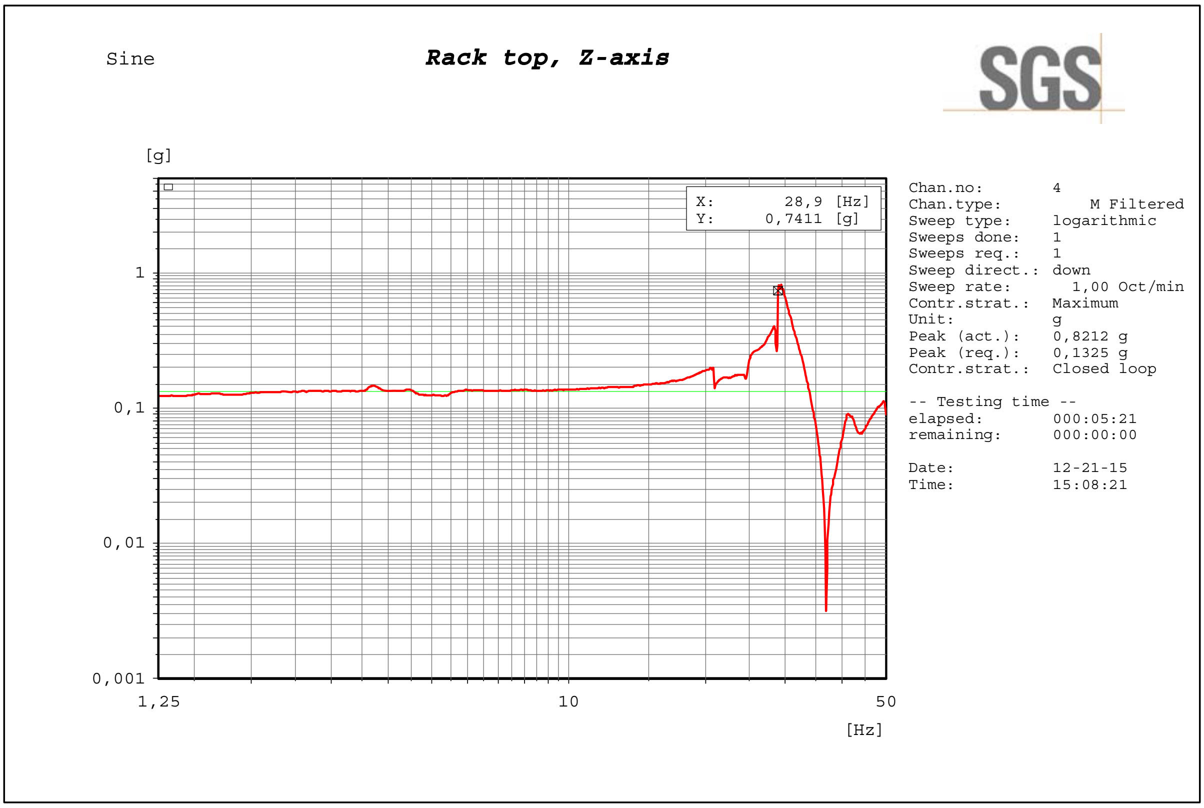


Figure 6.11: Res. search: excitation in z-dir.; top of the rack

6.4.2 Results Earthquake Test

In detail:

- R4-68 : No structural damages occurred
- R4-69 : The deflection on top was:
  X-axis: 12 mm
  Y-axis: 5,5 mm
  Z-axis: no LVDT-measurement was performed
- R4-70, O4-71: The lowest natural gross frequency was 7.4 Hz
- R4-72, O4-73: The EUT was completed with weight dummies, therefore no function are possible
- R4-74: Framework is not a welded construction.
- O4-75: Framework is constructed for base mounting.
- O4-76: Static pull test not performed, because Framework is synthesized waveform tested.
- R4-77: O4-78: O4-79 The anchors are unknown and therefore omitted from the test configuration.

Results Earthquake TRS vs. RRS and Acceleration at EUT

The shaker table's analysed acceleration, known as Test Response Spectrum (TRS, red line), must meet or exceed the Required Response Spectrum (RRS, blue line) for the Earthquake Risk Zone 2 in the range from 1.0 to 35 Hz.

The following diagrams show the recorded plots for each axis.

X-axis (horizontal)

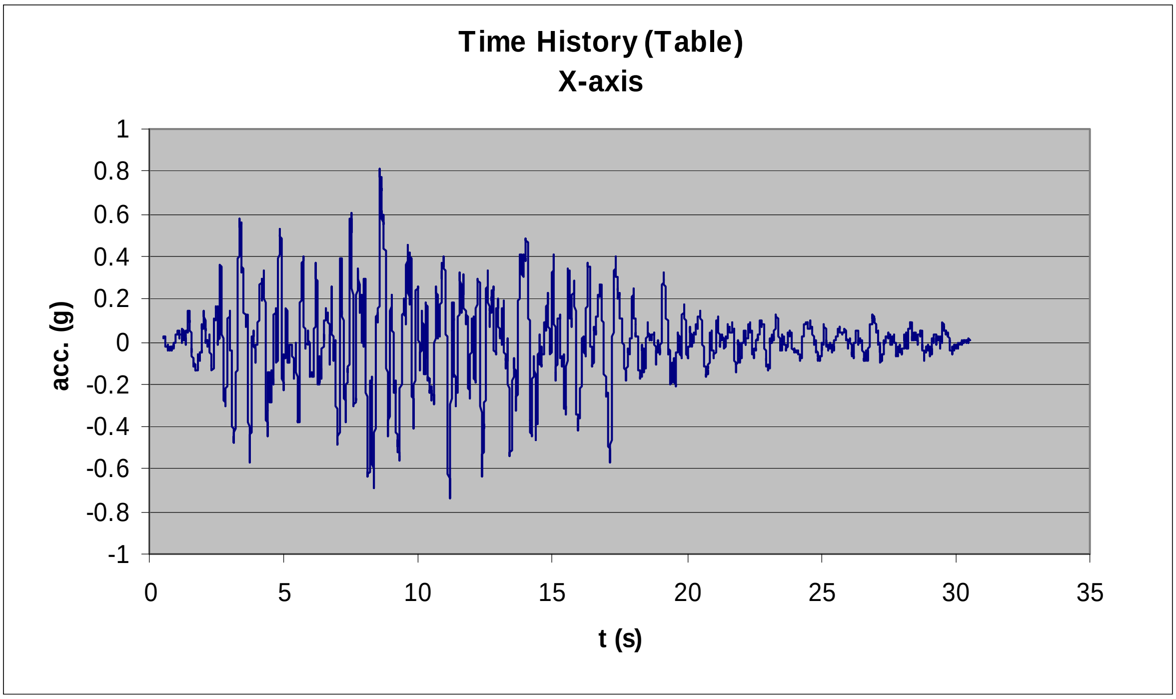


Figure 6.12: Acceleration at Earthquake Table (X-Axis)

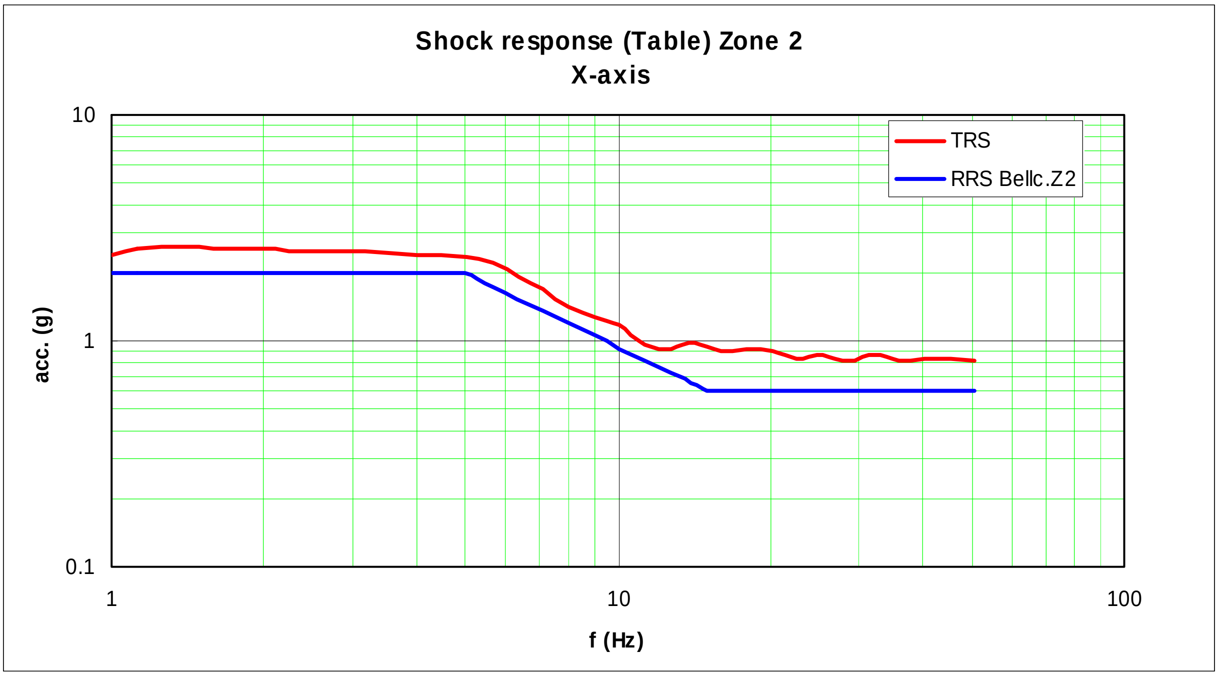


Figure 6.13: Test Response Spectrum – Earthquake table (X-Axis)

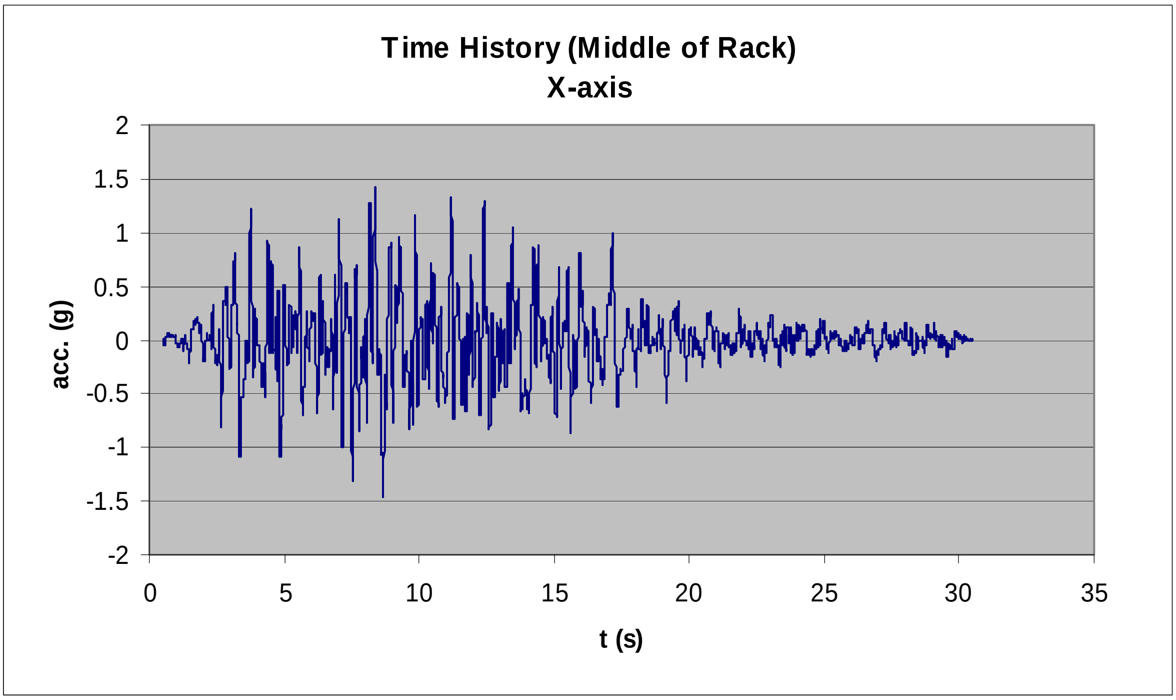


Figure 6.14: Acceleration at middle of Cabinet (X-Axis)

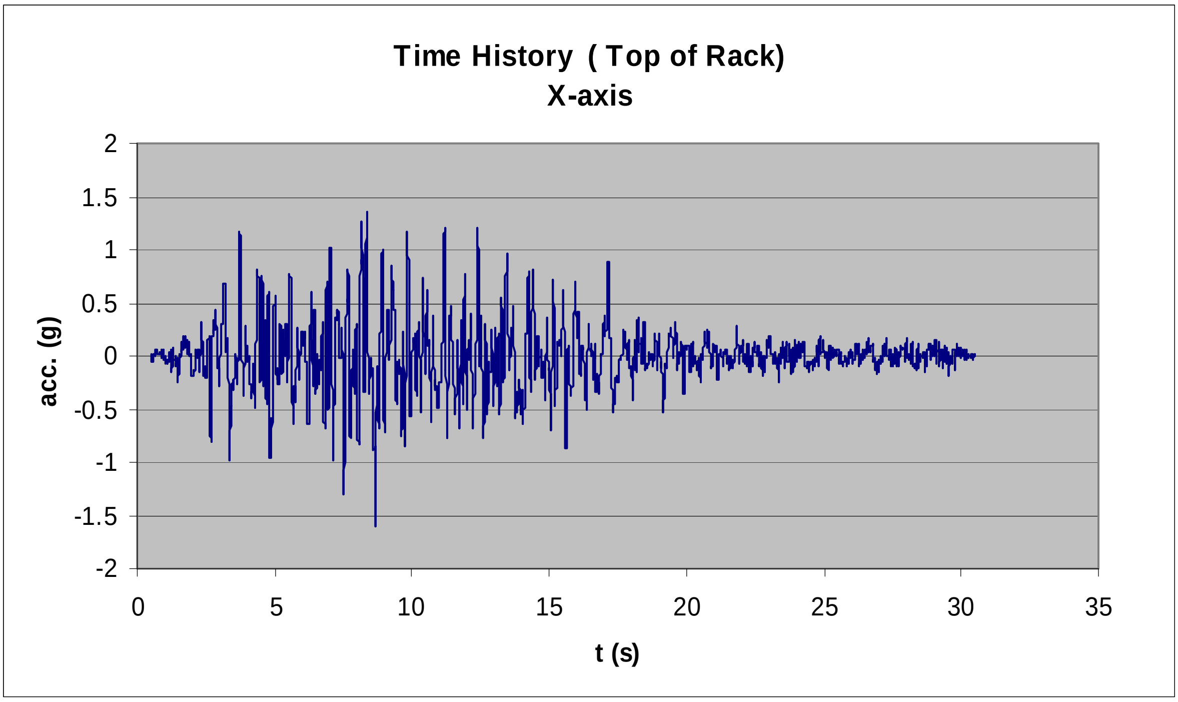


Figure 6.15: Acceleration at Top of Cabinet (X-Axis)

Y-axis (horizontal)

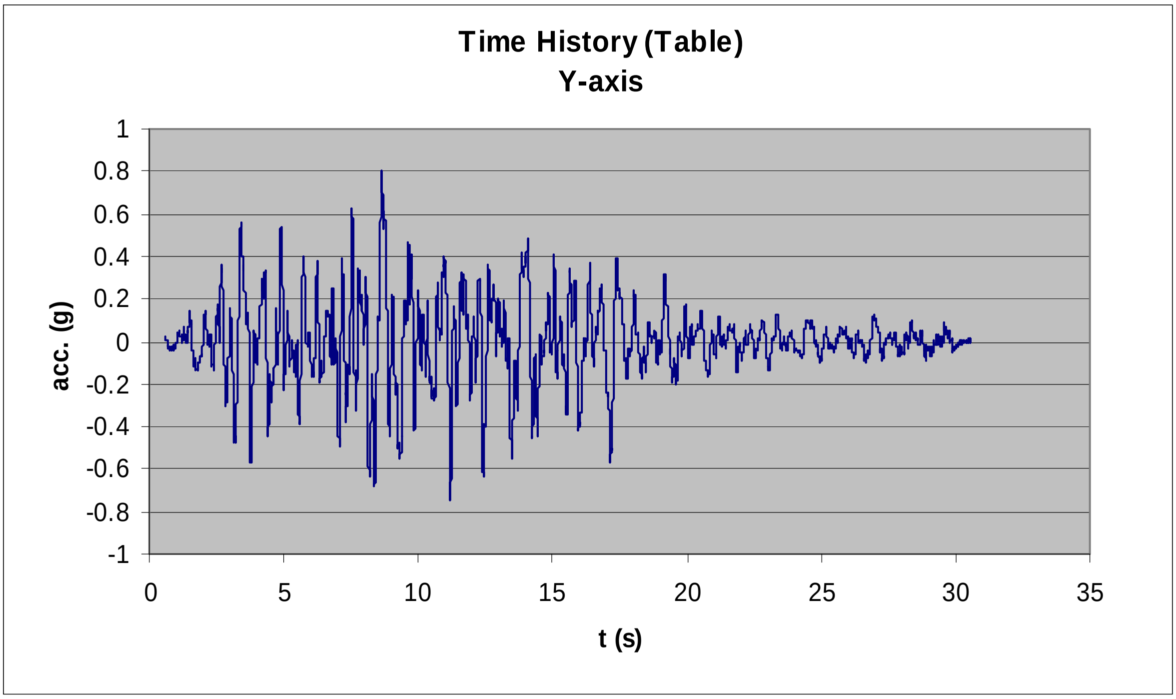


Figure 6.16: Acceleration at Earthquake Table (Y-Axis)

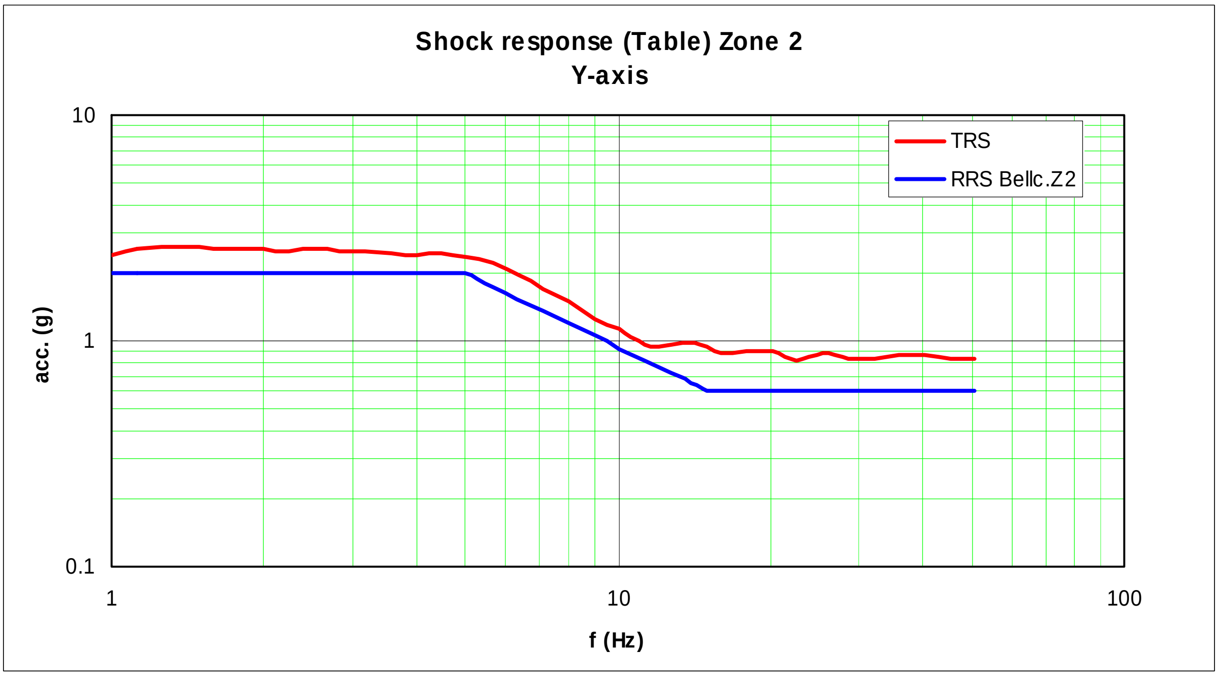


Figure 6.17: Test Response Spectrum – Earthquake table (Y-Axis)

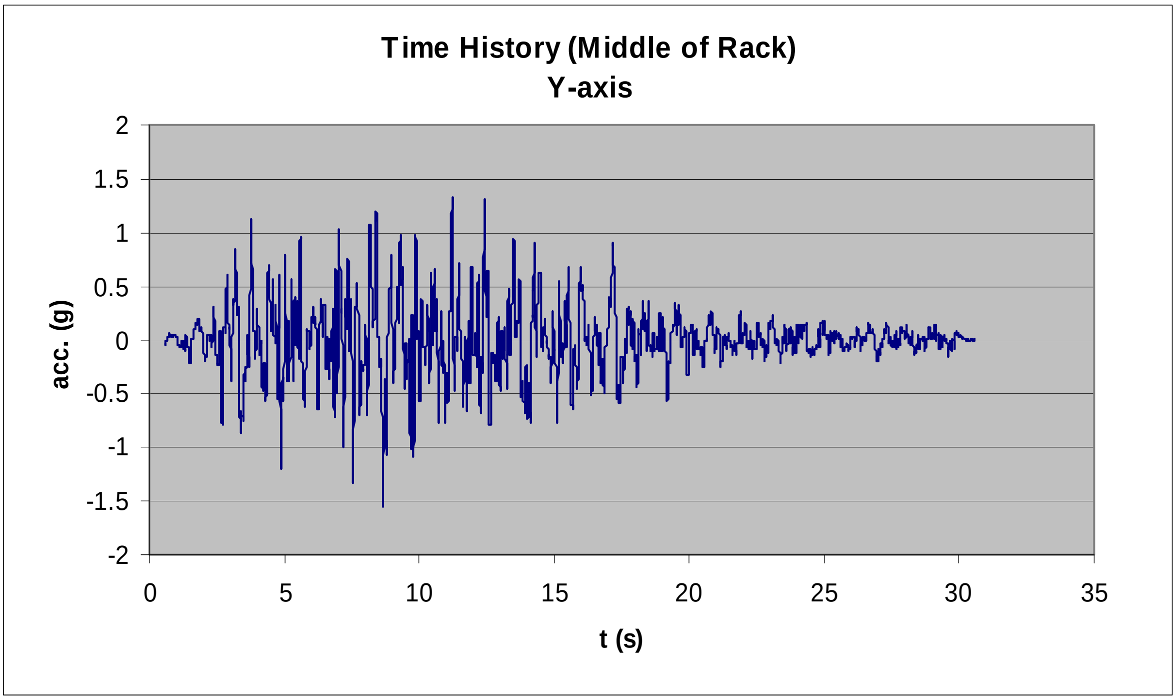


Figure 6.18: Acceleration at middle of Cabinet (Y-Axis)

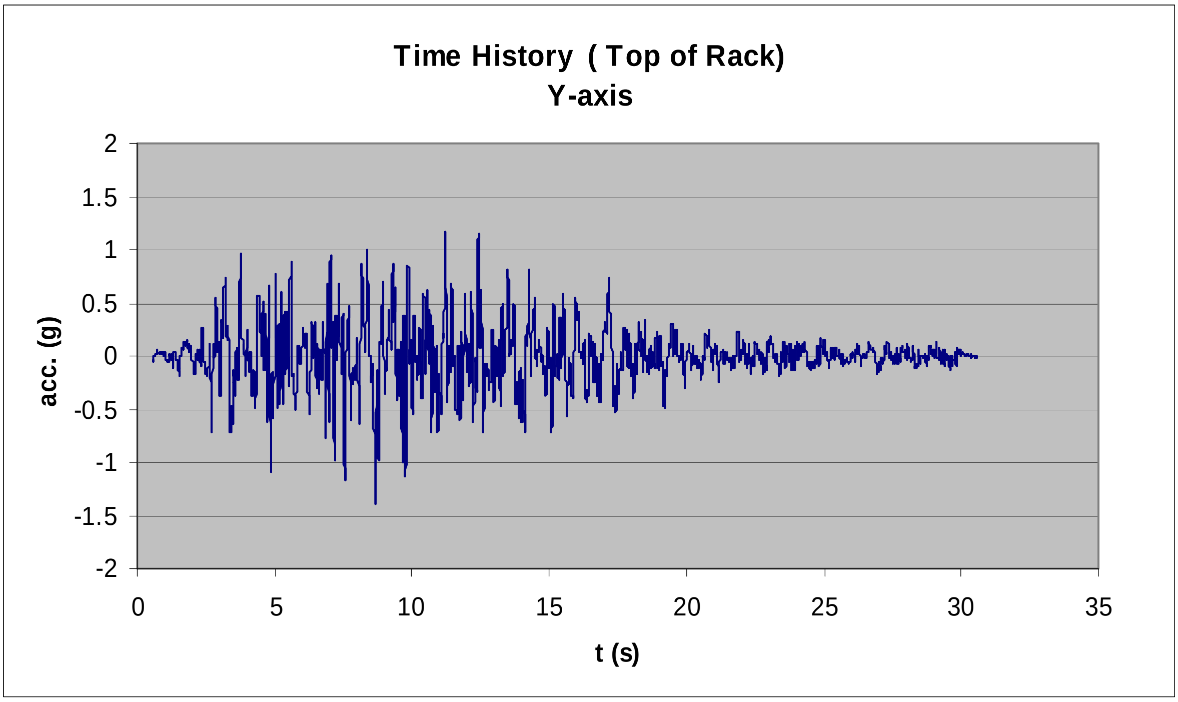


Figure 6.19: Acceleration at Top of Cabinet (Y-Axis)

Z-axis (vertical)

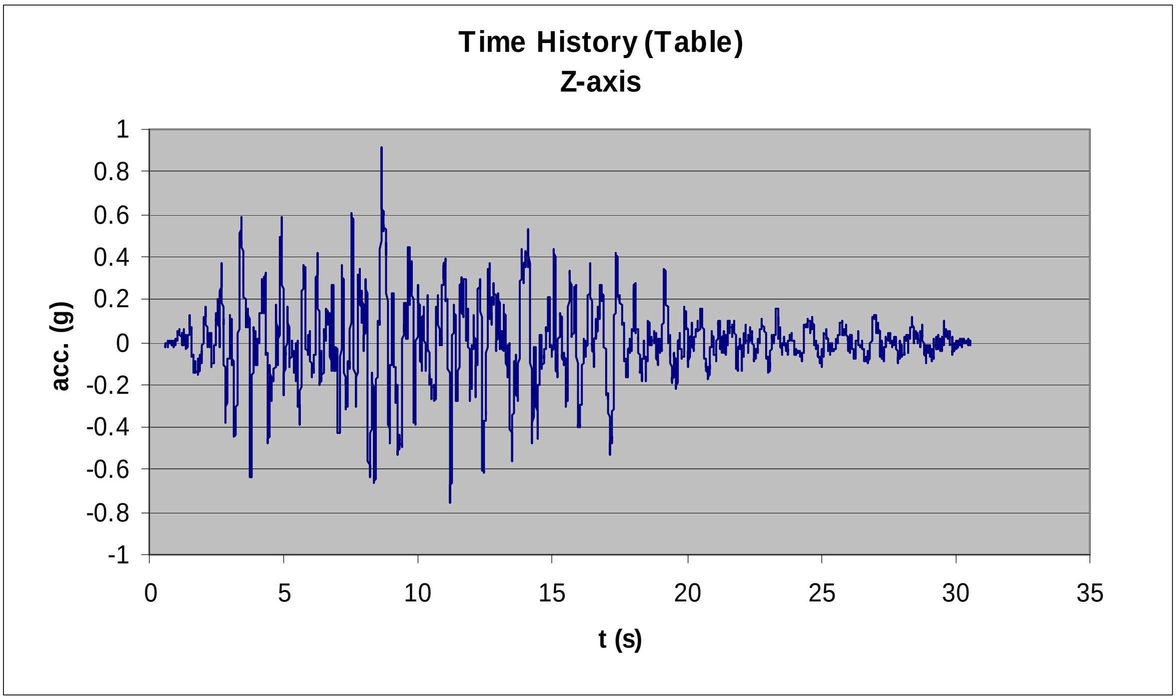


Figure 6.20: Acceleration at Earthquake Table (Z-Axis)

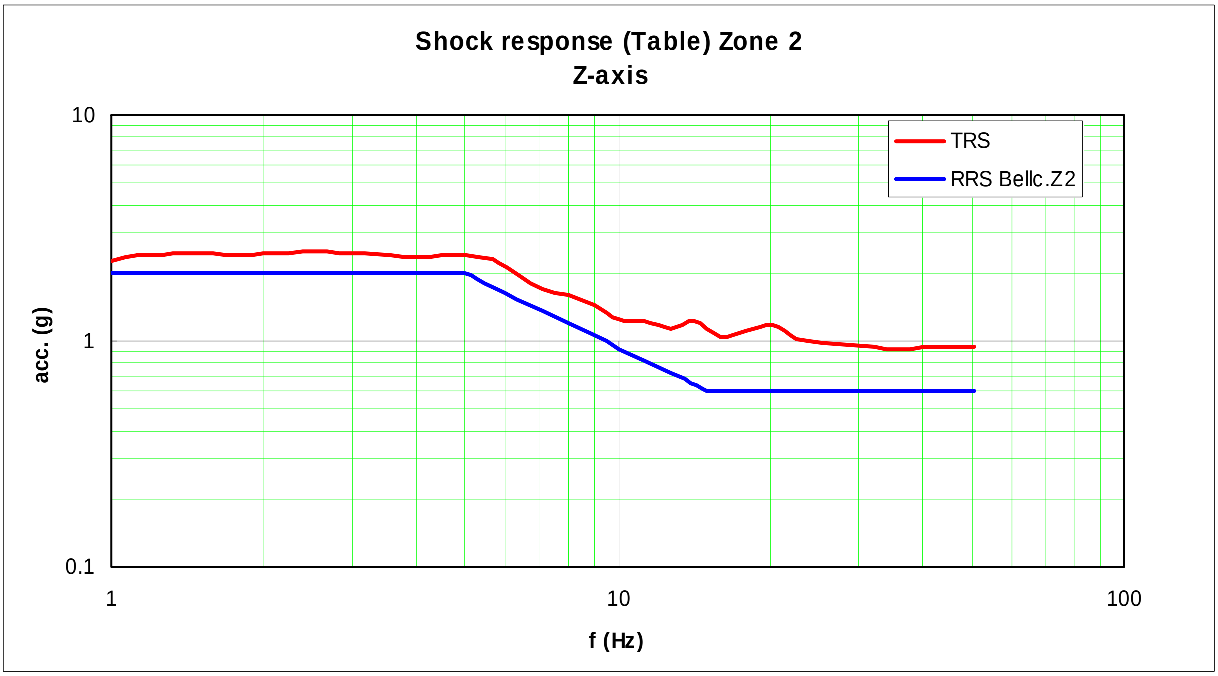


Figure 6.21: Test Response Spectrum – Earthquake table (Z-Axis)

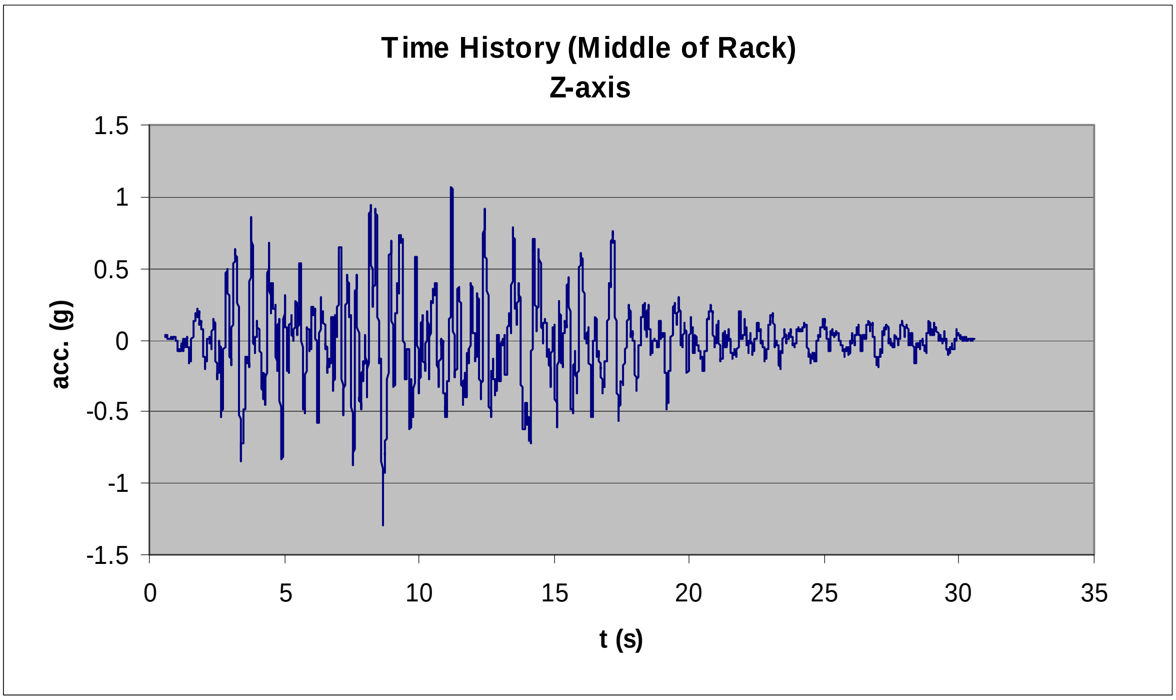


Figure 6.22: Acceleration at middle of Cabinet (Z-Axis)

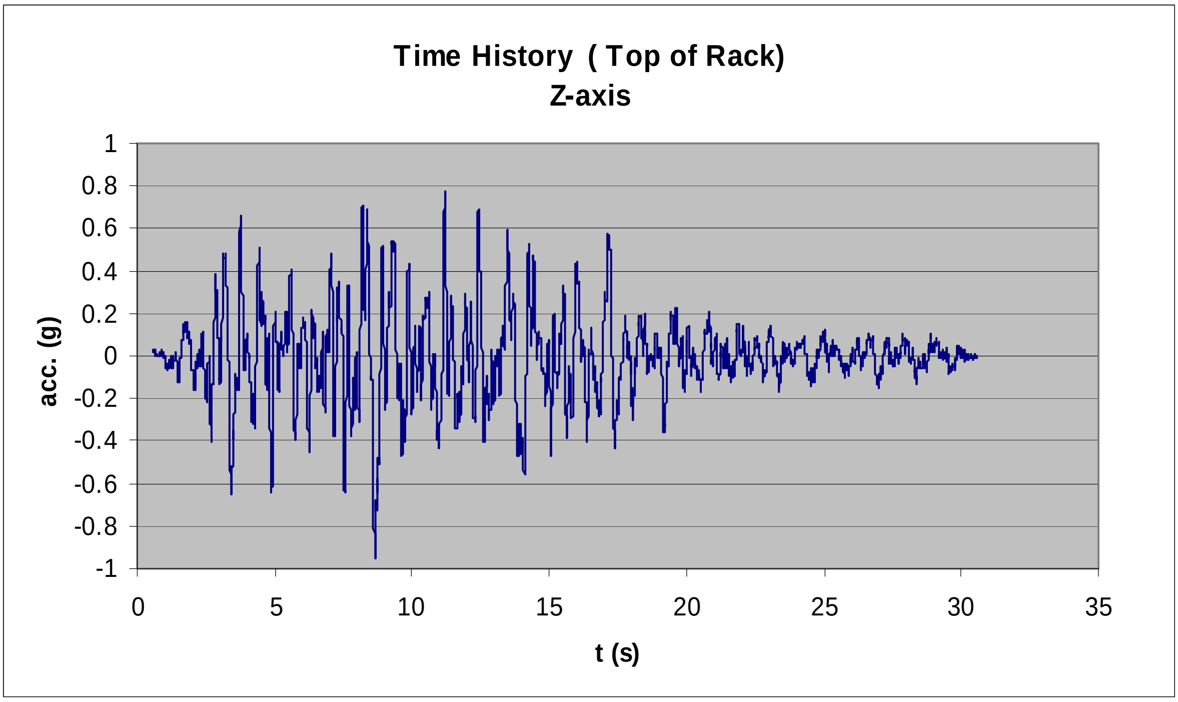


Figure 6.23: Acceleration at Top of Cabinet (Z-Axis)

6.4.3 Results of Displacement measurement

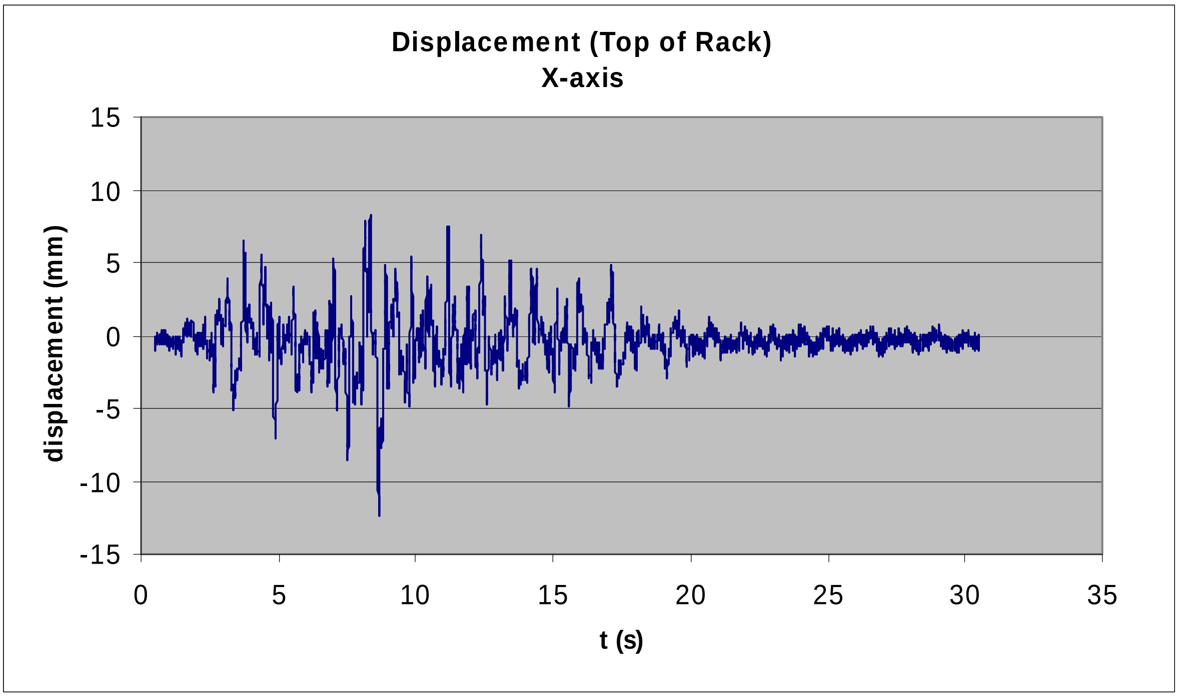


Figure 6.24: illustrates the displacement at top of EUT X-axis

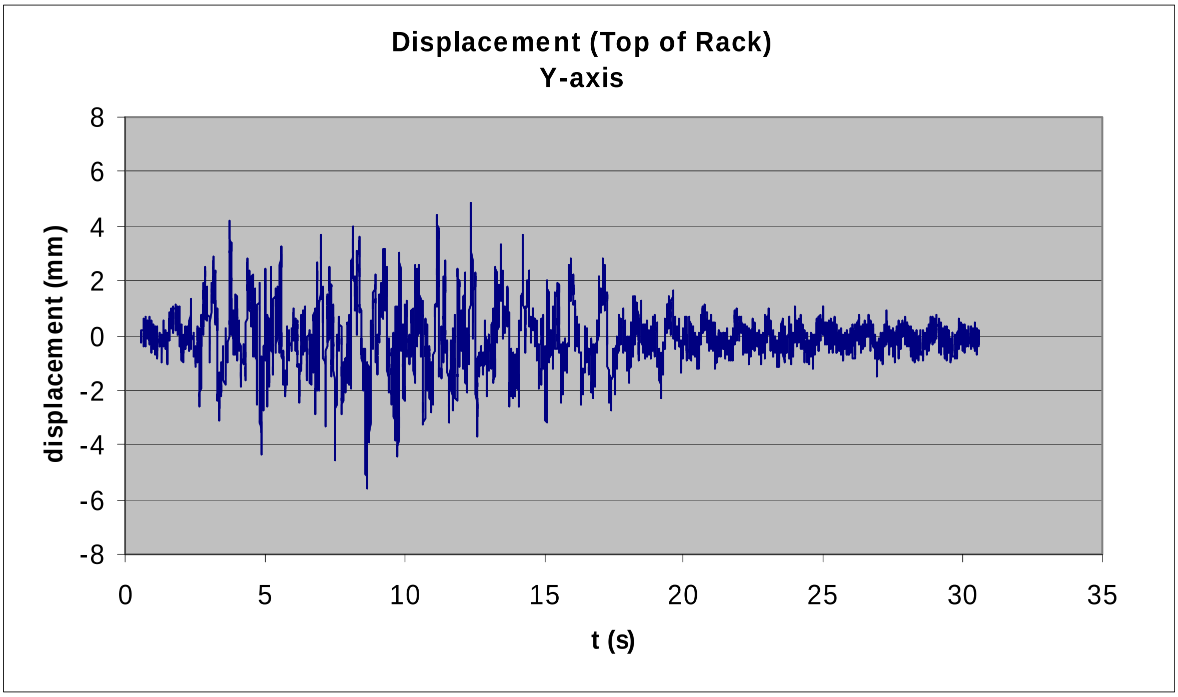


Figure 6.25: illustrates the displacement at top of EUT Y-axis

In **vibration direction vertical (Z-axis)** no displacement was measured.