Wismar, 2015-07-01

Test Report #413.097.3
Mechanical Strength Tests
on

Oxygen Sensors

Equipment under Test (EuT):

Description: Oxygen sensor for medical applications
Model: Oxygen Sensors OOM101, OOM102, OOM103, OOM107, OOM110, OOM201

Manufacturer: **EnviteC-Wismar GmbH**
Alter Holzhafen 18
D-23966 Wismar (Germany)

Test Laboratory: CEcert GmbH
Alter Holzhafen 19a
D 23966 Wismar, Germany

Purpose of test: Conformity qualification

Applied Standards: **ISO 80601-2-55:2011 sub-clause 201.15.3.5.101.2**

Classification met: **professional transportation of a patient outside a healthcare facility**

Detailed Test Specification:

Tests:	Test specification: [1]	Result:
Shock (Test Ea / Eb)	**300 m/s^2 / 11 ms half sine** **3** shocks in each perpendicular axis	**PASS**
Shock (Test Ea / Eb)	**1000 m/s^2 / 6 ms half sine** **3** shocks in each perpendicular axis	**PASS**
Broad band random (Test Fh)	**10 – 100 Hz: 5,0 m²/s³** **100 – 200 Hz: - 7dB/oct.** **200 – 2000 Hz: 1 m²/s³** Test time on each perpendicular axis: **30 min**	**PASS**
Free Fall (Test Ec / Ed)	**250 mm** **2** times from each attitude	**PASS**

Comment:
PASS - EuT meets the requirements **FAIL** - EuT does not meet the requirements **NA** - requirements are not applicable
1) For detailed specification and results see appended test report.

Evaluation :

The Equipment under Test (EuT) meets the mechanical strength requirements according to the specification and classification as listed above.

Period of test: 2014-11-18 - 2014-11-19

This test report with appendix consists of **31** pages.

1 General information

Product description:

Description:	Oxygen sensor for medical applications
Model:	Oxygen Sensors OOM101, OOM102, OOM103, OOM107, OOM110, OOM201
Manufacturer:	EnviteC-Wismar GmbH
Contact person:	--

Brief description/Introduction:

Product description:

The EnviteC Medical Oxygen electro-galvanic sensors are the oxygen-sensing component of an oxygen analyzer that measures oxygen concentration in breathing gas mixtures.

Test report rationale:

This test report amends the particular basic safety and essential performance evaluations according ISO 80601-2-55:2011 performed on the oxygen sensors, see test report 413.097.1, dated 2015-07-01. Particular mechanical strength test are recorded. The associated essential performance tests are retained in 413.097.1.

Participant in the tests: none

List of documents providing further information:

Item	Description	pages
Appendix 1	Additional Photo Documentation	31 - 31
Attachment 1	General Specifications – Medical Oxygen Sensors (Doc. No.: 001-33-00000011 / 07/2006)	6 pages

Due to big files and bulk of paperwork, the documents listed as Appendix # are included in this document only. Documents listed with Attachment # are kept separately. The documents assessed and listed as 'kept in file' can be supplied upon request. The manufacturer is responsible for this information to be provided.

Responsible for the technical content of the test report:

	Name:	Signature:
Tested by..... :	Sebastian Lupp	
Approved by..... :	Bernd Schmidt	

Note:
The CEcert GmbH assures the applicant that the tests are carried out within the scope of the tests outlined under point 2 and in accordance with the test specifications outlined under point 3. Any exceptions or deviations will be clearly indicated.
The results contained in this test report are relevant exclusively to the item(s) submitted for testing. The CEcert GmbH is not liable for any conclusions and generalizations which may be drawn from the test results and applied to further samples and examples of the type of device represented by the item submitted for testing.
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Report history log:

Ref.	Date of issue	Comment	Approved by
413.097.3 Rev.0	2015-07-01	first edition	Bernd Schmidt

2 Test Specification

2.1 General

The purpose of these tests is to certify the conformity of the Equipment under Test (EuT) with the applied standards.

2.2 Applied standards

ISO 80601-2-55:2011; see 2.5

2.3 Classification

Class: professional transportation of a patient outside a healthcare facility
Environments and application were mechanical shock with high energy content may occur, the EuT will be less careful handled while use and transport.

2.4 Exceptions and deviations from requirements

none

2.5 Tests performed

The following tests have been performed:

Chapter	Test	Basic standard for test procedure	Testing location
4.1.	**Clause 201.15.3.5.101.2 a) (Type 1)**	**IEC 60068-2-27:2008** Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	CEcert GmbH, Alter Holzhafen 19a, D-23966 Wismar
4.2.	**Clause 201.15.3.5.101.2 a) (Type 2)**	**IEC 60068-2-27:2008** Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	
4.3.	**Clause 201.15.3.5.101.2 b) (Broad-band random)**	**IEC 60068-2-64:2008** Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance	
4.4.	**Clause 201.15.3.5.101.2 c) (Free - Fall)**	**IEC 60068-2-31:2008** Environmental testing - Part 2-31: Tests - Test Ec: Rough handling shocks, primarily for equipment-type specimens	

2.6 Applied non-standard methods

none

2.7 Test sequence

If not otherwise stated in this report, test performed in sequence as listed under section 2.5 with the specimen listed in section 3.1

3 Specification of the Device/Equipment under Test (EuT)

3.1 Product configuration tested

Description:	Model:	Type No.: / Lot / S/N	Manufacturer:	Notes:
Equipment under Test:				
oxygen sensor	OOM101	01-00-0013, A118605	EnviteC-Wismar GmbH	
oxygen sensor	OOM102	01-00-0019, A134174	EnviteC-Wismar GmbH	
oxygen sensor	OOM103	01-00-0015, A101620	EnviteC-Wismar GmbH	
oxygen sensor	OOM107	01-00-0058, A104191	EnviteC-Wismar GmbH	
oxygen sensor	OOM110	01-00-0098, A109046	EnviteC-Wismar GmbH	
oxygen sensor	OOM201	01-00-0014, A197104	EnviteC-Wismar GmbH	
Components:				
--				
Accessories/peripherals (not part of conditioning):				
--				
Simulators: none				

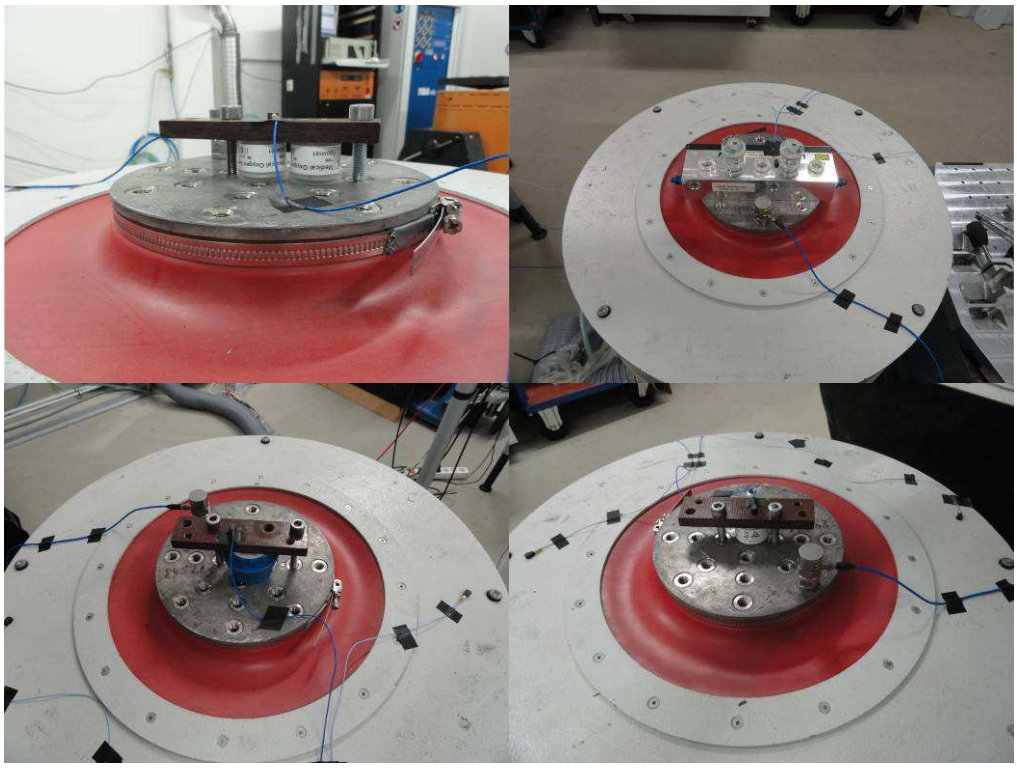
3.2 Cables and Lines

none

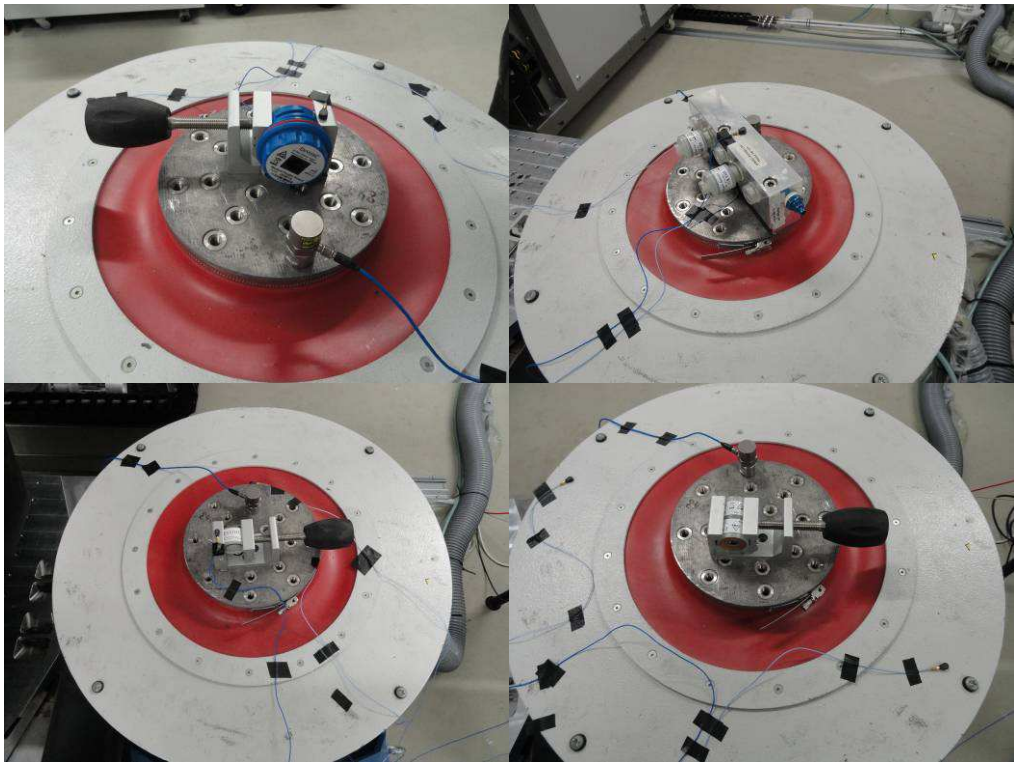
3.3 Design particulars

For details, see photographs in 3.4.

3.4 Notes and/or Sketches



Equipment under Test (EuT) and assigned test axis Y



Equipment under Test in direction of the x-axis and z-axis

Dimension of EuT:	OOM101, OOM201 - 22 mm x 29 diameter OOM102, OOM 103 - 42 mm x 28 diameter OOM107 - 21 mm x 32 diameter OOM110 -40 mm x 53 diameter
Mass of EuT:	OOM101, OOM103, OOM102 - 28 g; OOM107 - 43 g; OOM110 - 50 g

3.5 Operating Condition of the Specimen

The status of the test object during the tests represented its normal area of deployment.

Operation:	No operation during tests. (OFF)
Functional Test:	Functional test and essential performance evaluation before and after disturbance tests.
Power supply:	via functional test equipment

Climatic conditions during the tests:

Ambient temperature:	23 °C ± 3 °C
Relatively air humidity:	30 % - 55 %
Air pressure:	86 kPa - 106 kPa (860 mbar - 1060 mbar)

3.6 Mounting Conditions and absorbing means of EuT

The specimen was mounted on a rigid fixture as described in IEC 60068-2-47.

3.7 Acceptance criteria

The Equipment or System shall be able to provide the essential performance and remain safe after each test. Particular the following degradations shall not be allowed during and after test:

- component failures;
- loosening of components (internal/external) which can cause hazardous situation and unintended malfunctions;
- leakage of liquids

and shall not degraded below the following requirements after each environmental test procedure is completed (functional test and evaluation of essential performance):

- comply with the intended functions and rated data;
- no changes in intended function and programmable parameters;
- measured values before and after disturbance tests within accuracy, repeatability and linearity limits as described in technical specifications, see 1 general information ‘List of documents providing further information’)

Additional specifications (influencing functions): none

3.8 Sampling particulars

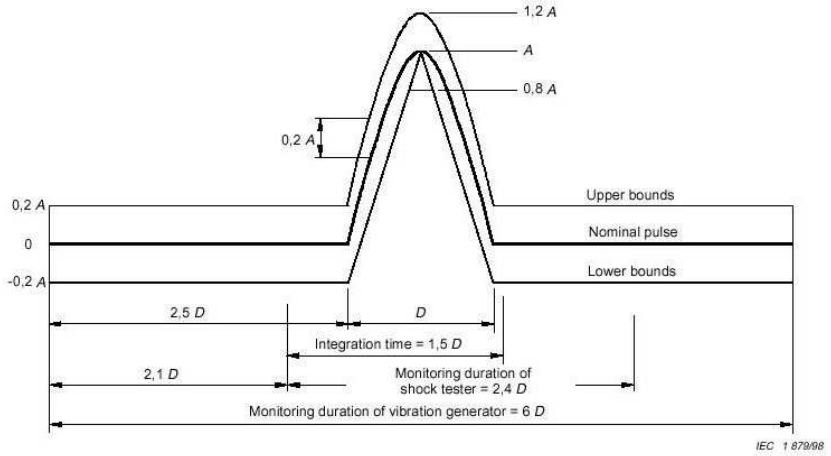
No sampling performed. The product was tested as delivered by the manufacturer.

4 Measurement and test results

4.1 Test Ea: Shock

Test set-up: IEC 60068-2-27 (not tested in its packing and transport case)

Test process:
The shocks applied to the EuT have the shape of a half sine pulse.
Reference point: shake table (fixing point)
(see picture in Appendix) – single point control
Measuring point: enclosure of EuT (see picture in Appendix)
Shock repetition: 1 / sec.
The cross axis motion at the measuring point at both axes perpendicular to the test axis does not exceed 30 % of the severity level.
The degree of severity of the test is characterized by the following parameters.



Initial measurement:
Functional test: **PASS**
Electrical and mechanical check: **PASS**
Visual inspection: **PASS**

Conditioning:

EuT	Test axis	Test condition / severity	Notes/observation	Compliance Pass/ Fail/ NA
OOM101	X – Axis (X+) and (X-)	A = **300 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **11 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
OOM102	X – Axis (X+) and (X-)	A = **300 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **11 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
OOM103	X – Axis (X+) and (X-)	A = **300 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **11 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
OOM107	X – Axis (X+) and (X-)	A = **300 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **11 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
OOM110	X – Axis (X+) and (X-)	A = **300 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **11 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
OOM201	X – Axis (X+) and (X-)	A = **300 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **11 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
While tests the EuT was powered off.				

Number of shocks:	3 shocks in each perpendicular axis (18 in total)	
Final measurement:	Functional test:	**PASS**
	Electrical and mechanical check:	**PASS**
	Visual inspection:	**PASS**

Test evaluation:

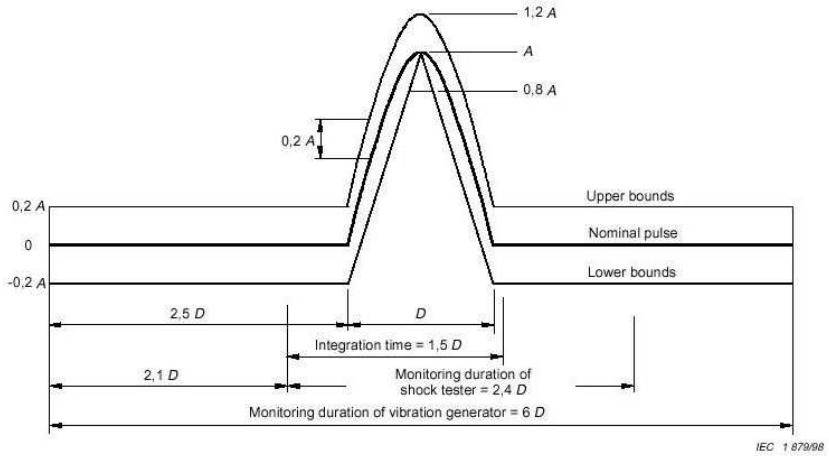
No relevant influencing functions of the equipment could be observed during the tests. No mechanical degradation, cracks in the exterior and no leakage of liquids could be observed. The sensors meet the essential performance requirements specified by the manufacturer, see Test Report 413.097.1 according ISO 80601-2-55:2011. The acceptance criteria specified in section 3.7 are met.

According to the above test set-up the equipment under test specified in chapter 3 meets the mechanical shock requirements.

4.2 Test Ea: Shock

Test set-up: IEC 60068-2-27 (not tested in its packing and transport case)

Test process:
The shocks applied to the EuT have the shape of a half sine pulse.
Reference point: shake table (fixing point)
(see picture in Appendix) – single point control
Measuring point: enclosure of EuT (see picture in Appendix)
Shock repetition: 1 / sec.
The cross axis motion at the measuring point at both axes perpendicular to the test axis does not exceed 30 % of the severity level.
The degree of severity of the test is characterised by the following parameters.



Initial measurement:

Functional test:		**PASS**
Electrical and mechanical check:		**PASS**
Visual inspection:		**PASS**

Conditioning:

EuT	Test axis	Test condition / severity	Notes/observation	Compliance Pass/ Fail/ NA
OOM101	X – Axis (X+) and (X-)	A = **1000 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **6 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
OOM102	X – Axis (X+) and (X-)	A = **1000 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **6 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
OOM103	X – Axis (X+) and (X-)	A = **1000 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **6 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
OOM107	X – Axis (X+) and (X-)	A = **1000 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **6 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
OOM110	X – Axis (X+) and (X-)	A = **1000 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **6 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
OOM201	X – Axis (X+) and (X-)	A = **1000 m/s²**	none	**PASS**
	Y – Axis (Y+) and (Y-)	D = **6 ms**	none	**PASS**
	Z – Axis (Z+) and (Z-)		none	**PASS**
While tests the EuT was powered off.				

Number of shocks: 3 shocks in each perpendicular axis (18 in total)

Final measurement:	Functional test:	**PASS**
	Electrical and mechanical check:	**PASS**
	Visual inspection:	**PASS**

Test evaluation:

No relevant influencing functions of the equipment could be observed during the tests. No mechanical degradation, cracks in the exterior and no leakage of liquids could be observed. The sensors meet the essential performance requirements specified by the manufacturer, see Test Report 413.097.1 according ISO 80601-2-55:2011. The acceptance criteria specified in section 3.7 are met.

According to the above test set-up the equipment under test specified in chapter 3 meets the mechanical shock requirements.

4.3 Test Fh: Vibration broad band random (digital control)

Test set-up: IEC 60068-2-64 (not tested in its packing and transport case)

Test process:
At broad-band random vibration test the excitement of test device is applied by a function of GAUSSian white noise with a restricted frequency band. The acceleration spectral density is constant in the nominal frequency range. At the margins this spectrum is falling down with determined slopes. Here the spectrum is controlled at the single control and reference point at the mounting plate of the generator. The random vibration is applied on the test device for a determined time. The degree of severity of the test is characterized by the following parameters.

Reference point:	shake table (fixing point) (see picture in Appendix) – single point control
Measuring point:	enclosure of EuT (see picture in Appendix)
Cross-axis motion:	The cross-axis motion at the measuring points in both axes perpendicular to the test axis is less than – 3dB of the specified ASD level. The total r.m.s value of this cross-axis motion does not exceed 50 % of the severity level.

Initial measurement:

Functional test:	**PASS**
Electrical and mechanical check:	**PASS**
Visual inspection:	**PASS**

Conditioning:

EuT	Severity level (ASD)	Test axis	Test condition / duration	Notes/observation	Compliance Pass/ Fail/ NA
OOM101	10 – 100 Hz / 5,0 $(m/s^2)^2/Hz$	X – Axis	30 min	none	**PASS**
	100 – 200 Hz / - 7dB/oct. $(m/s^2)^2/Hz$	Y – Axis	30 min	none	**PASS**
	200 – 2000 Hz / 1 $(m/s^2)^2/Hz$	Z – Axis	30 min	none	**PASS**
OOM102	10 – 100 Hz / 5,0 $(m/s^2)^2/Hz$	X – Axis	30 min	none	**PASS**
	100 – 200 Hz / - 7dB/oct. $(m/s^2)^2/Hz$	Y – Axis	30 min	none	**PASS**
	200 – 2000 Hz / 1 $(m/s^2)^2/Hz$	Z – Axis	30 min	none	**PASS**
OOM103	10 – 100 Hz / 5,0 $(m/s^2)^2/Hz$	X – Axis	30 min	none	**PASS**
	100 – 200 Hz / - 7dB/oct. $(m/s^2)^2/Hz$	Y – Axis	30 min	none	**PASS**
	200 – 2000 Hz / 1 $(m/s^2)^2/Hz$	Z – Axis	30 min	none	**PASS**
OOM107	10 – 100 Hz / 5,0 $(m/s^2)^2/Hz$	X – Axis	30 min	none	**PASS**
	100 – 200 Hz / - 7dB/oct. $(m/s^2)^2/Hz$	Y – Axis	30 min	none	**PASS**
	200 – 2000 Hz / 1 $(m/s^2)^2/Hz$	Z – Axis	30 min	none	**PASS**
OOM110	10 – 100 Hz / 5,0 $(m/s^2)^2/Hz$	X – Axis	30 min	none	**PASS**
	100 – 200 Hz / - 7dB/oct. $(m/s^2)^2/Hz$	Y – Axis	30 min	none	**PASS**
	200 – 2000 Hz / 1 $(m/s^2)^2/Hz$	Z – Axis	30 min	none	**PASS**
OOM201	10 – 100 Hz / 5,0 $(m/s^2)^2/Hz$	X – Axis	30 min	none	**PASS**
	100 – 200 Hz / - 7dB/oct. $(m/s^2)^2/Hz$	Y – Axis	30 min	none	**PASS**
	200 – 2000 Hz / 1 $(m/s^2)^2/Hz$	Z – Axis	30 min	none	**PASS**
While tests the EuT was powered off.					

Crest factor:	at least 2,5
Sample rate (f_{high}):	5425.3 Hz
Frequency resolution (B_e):	6.8 Hz
Statistical degree of freedom:	120 DoF
Shape of ASD level:	as described above

Final measurement:	Functional test:	**PASS**
	Electrical and mechanical check:	**PASS**
	Visual inspection:	**PASS**

Final response investigation:
Final vibration response investigation shows no significant mechanical failures and changes in the dynamic behavior versus initial response investigation (resonance peak level changes less than 10 %).

Test evaluation:

No relevant influencing functions of the equipment could be observed during the tests. No mechanical degradation, cracks in the exterior and no leakage of liquids could be observed. The sensors meet the essential performance requirements specified by the manufacturer, see Test Report 413.097.1 according ISO 80601-2-55:2011. The acceptance criteria specified in section 3.7 are met.

According to the above test set-up the equipment under test specified in chapter 3 meets the mechanical vibration (broad band random) requirements.

4.4 Test Ec: Free fall

Test set-up: IEC 60068-2-31 (not tested in its packing and transport case)

Test process:

Drop onto surface: The equipment is standing in its normal position of use and is tilted along the bottom edges as listed below. The angle/height of the opposite edge is identified in the table below.
Procedure 1 as described in IEC 60068-2-31: The EuT was released to allow free fall from the severity level by the examiner with a minimum of disruptance at the moment of release. The test surface was a smooth, hard, rigid surface of concrete. The high of fall was measured from the part of specimen nearest to the test surface.

Initial measurement:

Functional test:	**PASS**
Electrical and mechanical check:	**PASS**
Visual inspection:	**PASS**

Conditioning:

EuT	Severity level / High of fall	Test axis / attitude from which the EuT was dropped	Number of falls	Notes/observation	Compliance Pass/ Fail/ NA
OOM101	250 mm	(+X) – Axis	2 from each attitude	none	**PASS**
		(+Y) – Axis		none	**PASS**
		(+Z) – Axis		none	**PASS**
		(-X) – Axis		none	**PASS**
		(-Y) – Axis		none	**PASS**
		(-Z) – Axis		none	**PASS**
OOM102	250 mm	(+X) – Axis	2 from each attitude	none	**PASS**
		(+Y) – Axis		none	**PASS**
		(+Z) – Axis		none	**PASS**
		(-X) – Axis		none	**PASS**
		(-Y) – Axis		none	**PASS**
		(-Z) – Axis		none	**PASS**
OOM103	250 mm	(+X) – Axis	2 from each attitude	none	**PASS**
		(+Y) – Axis		none	**PASS**
		(+Z) – Axis		none	**PASS**
		(-X) – Axis		none	**PASS**
		(-Y) – Axis		none	**PASS**
		(-Z) – Axis		none	**PASS**
OOM107	250 mm	(+X) – Axis	2 from each attitude	none	**PASS**
		(+Y) – Axis		none	**PASS**
		(+Z) – Axis		none	**PASS**
		(-X) – Axis		none	**PASS**
		(-Y) – Axis		none	**PASS**
		(-Z) – Axis		none	**PASS**
OOM110	250 mm	(+X) – Axis	2 from each attitude	none	**PASS**
		(+Y) – Axis		none	**PASS**
		(+Z) – Axis		none	**PASS**
		(-X) – Axis		none	**PASS**
		(-Y) – Axis		none	**PASS**
		(-Z) – Axis		none	**PASS**
OOM201	250 mm	(+X) – Axis	2 from each attitude	none	**PASS**
		(+Y) – Axis		none	**PASS**
		(+Z) – Axis		none	**PASS**
		(-X) – Axis		none	**PASS**
		(-Y) – Axis		none	**PASS**
		(-Z) – Axis		none	**PASS**

During test was applied the specimen was off.

Final measurement:	Functional test:	**PASS**
	Electrical and mechanical check:	**PASS**
	Visual inspection:	**PASS**

Test evaluation:

No relevant influencing functions of the equipment could be observed during the tests. No mechanical degradation, cracks in the exterior and no leakage of liquids could be observed. The sensors meet the essential performance requirements specified by the manufacturer, see Test Report 413.097.1 according ISO 80601-2-55:2011. The acceptance criteria specified in section 3.7 are met.

According to the above test set-up the equipment under test specified in chapter 3 meets the free fall requirements in accordance with applied standard.

5 Uncertainty of the measuring system

Overall uncertainty (K=2): 5.1 %
(estimation/calculation performed in PA_Umwelt_Shock&Vibration_2)

6 Information about the Test Equipment

Test equipment:

Item	Description	Model/type	Manufacturer	Range used	Last Cal	Cal. due
051/02	Scale	LC620P-00V1	Sartorius	2mg-620g	2014,09	2015,09
061/12	Steel Measure	105-7930	Perschmann	0-1000mm	2012,10	2015,09
052/06	Timer	KW9161	eurochron	sec - minutes - hours	2014,08	2015,09
065/05	Data logger temp./humid. *)	SP-2000-20R	Veriteq	Auto	2014,04	2015,03
080/01	Vibration Controller	VR-8500	Vibration Research	Auto	2014,09	2015,09
080/04	ICP Accelerometer**)	353B31	PCB	1-5000Hz	2014,09	2015,09
080/08	ICP Accelerometer	352C22	PCB	5Hz-10kHz	2014,09	2015,09
080/09	ICP Accelerometer	352C22	PCB	5Hz-10kHz	2014,09	2015,09
080/10	ICP Accelerometer	352C22	PCB	5Hz-10kHz	2014,09	2015,09
*)	test ambient monitoring					
**)	reference accelerometer for single point control					

Auxiliary equipment:

Item	Description	Model/type	Manufacturer	Last Verification	Verification due
080/00	Shake Table and Degauss unit	TV 56280/LS	TIRA	2013,11	2015,10
080/05	Amplifier	A52318	TIRA	2013,11	2015,10

Test Data List:

Title **Page**

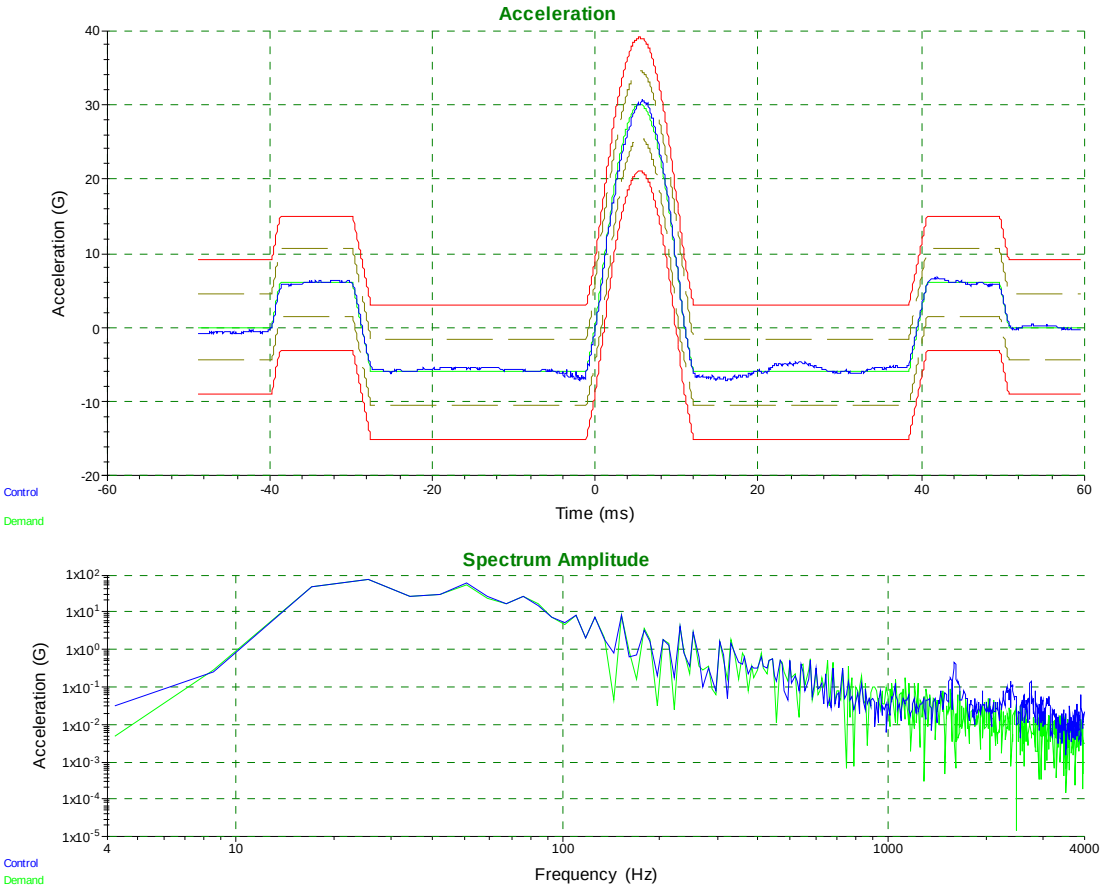
Following test data protocols are an example obtained for OOM103 testing and are representative for all sensors certified!

Test Data:

Appendix List:

Title **page**

Test Data Ea/Eb: Shock acceleration x-Axis + (300 m/s2 / 11 ms half sine)



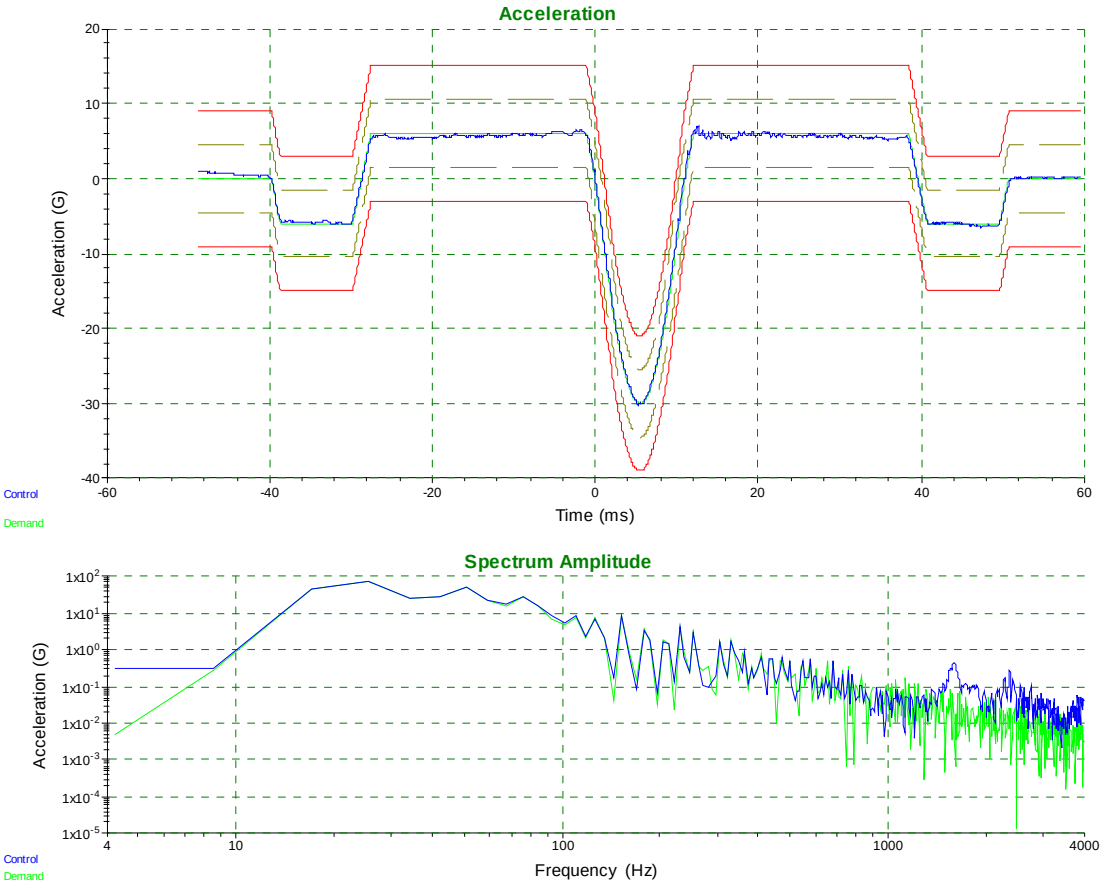
Current Measurements:

Control amplitude: 30.6 G
Output voltage: 2.267 Volts peak

Channel Measurements:

	Acceleration
353B31	31.01 G
352C22	28.59 G
352C22	3.119 G
352C22	2.308 G

Test Data Ea/Eb: Shock acceleration x-Axis - (300 m/s2 / 11 ms half sine)



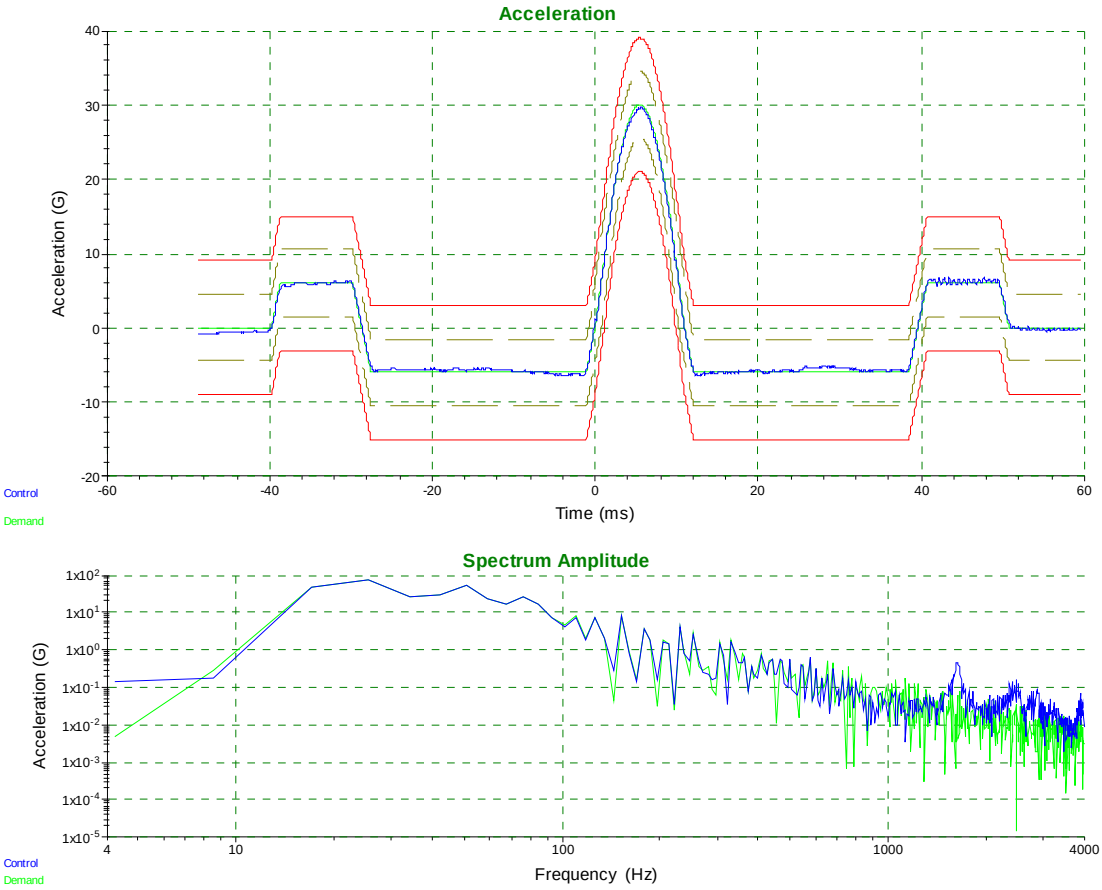
Current Measurements:

Control amplitude: 30.26 G
Output voltage: 2.274 Volts peak

Channel Measurements:

	Acceleration
353B31	30.68 G
352C22	28.76 G
352C22	3.09 G
352C22	2.86 G

Test Data Ea/Eb: Shock acceleration y-Axis + (300 m/s2 / 11 ms half sine)



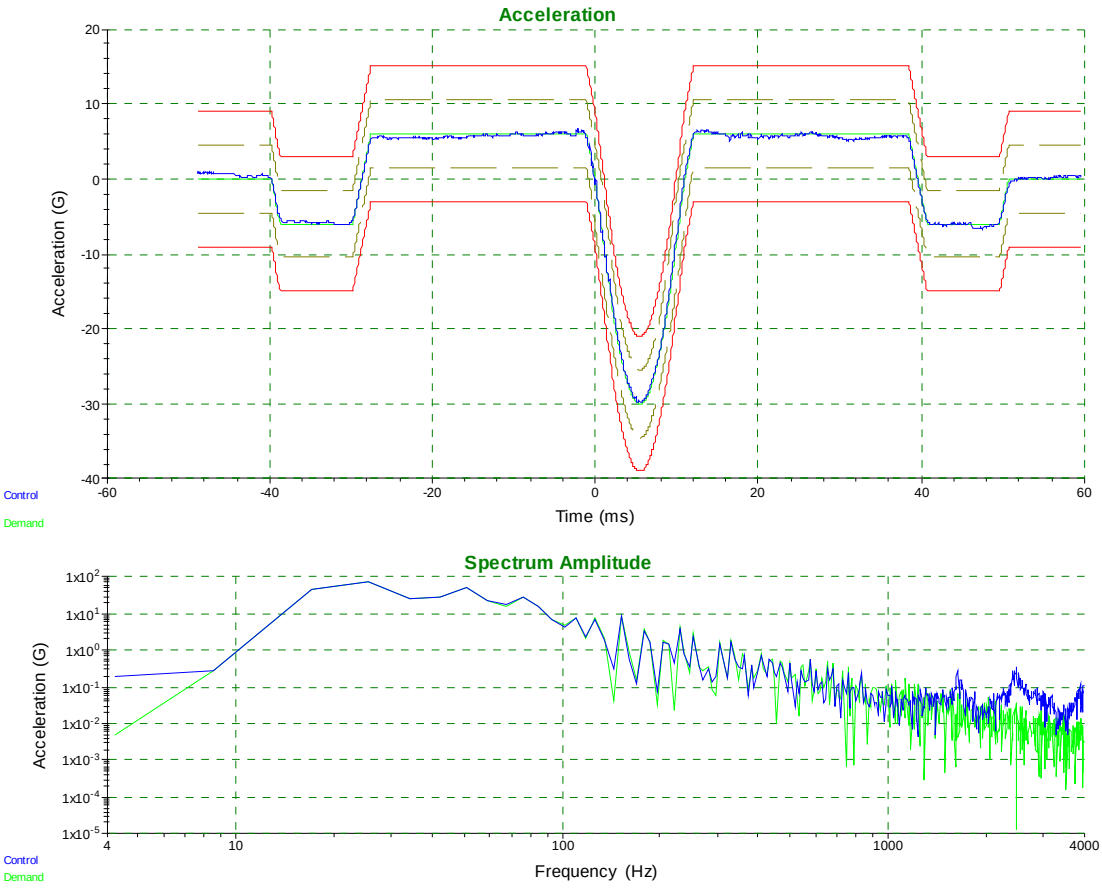
Current Measurements:

Control amplitude: 29.73 G
Output voltage: 2.27 Volts peak

Channel Measurements:

	Acceleration
353B31	30.14 G
352C22	28.49 G
352C22	1.784 G
352C22	3.751 G

Test Data Ea/Eb: Shock acceleration y-Axis - (300 m/s2 / 11 ms half sine)



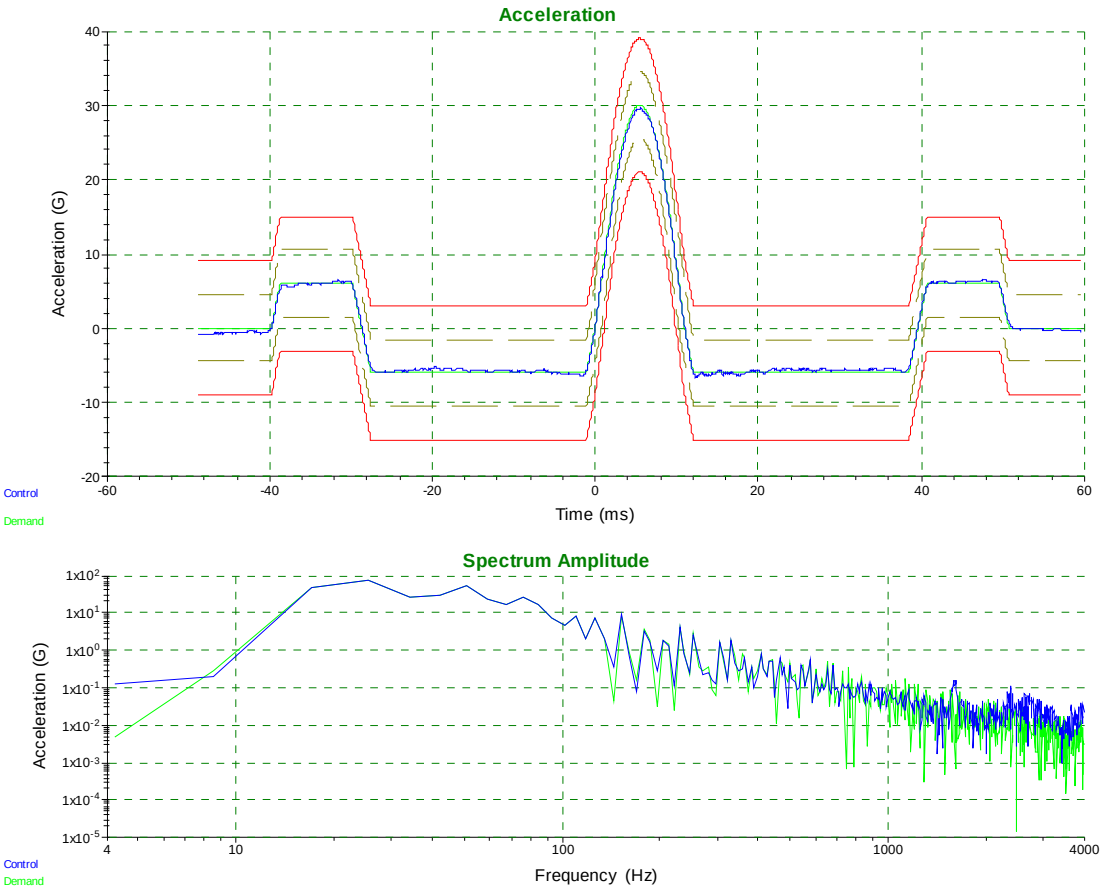
Current Measurements:

Control amplitude: 29.85 G
Output voltage: 2.287 Volts peak

Channel Measurements:

	Acceleration
353B31	30.25 G
352C22	28.35 G
352C22	2.617 G
352C22	4.863 G

Test Data Ea/Eb: Shock acceleration z-Axis + (300 m/s2 / 11 ms half sine)



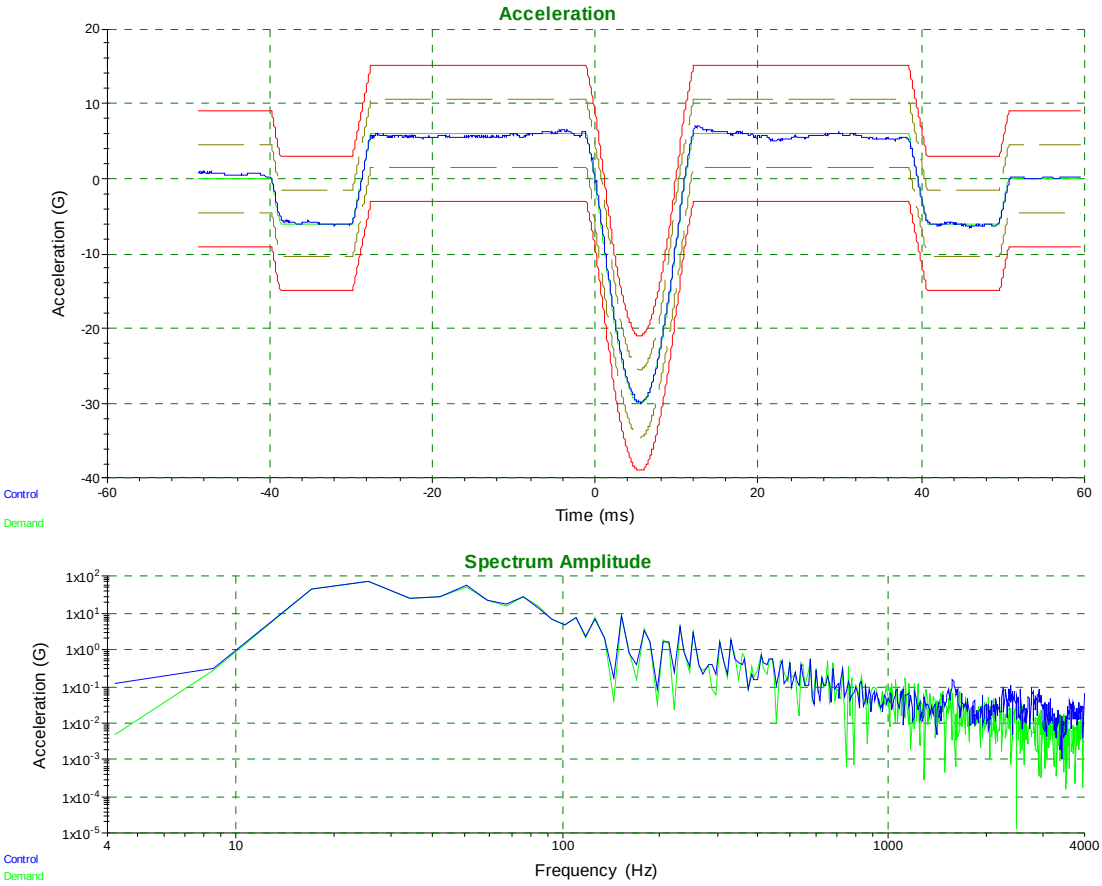
Current Measurements:

Control amplitude: 29.61 G
Output voltage: 2.256 Volts peak

Channel Measurements:

	Acceleration
353B31	30.02 G
352C22	28.48 G
352C22	2.892 G
352C22	3.199 G

Test Data Ea/Eb: Shock acceleration z-Axis - (300 m/s2 / 11 ms half sine)



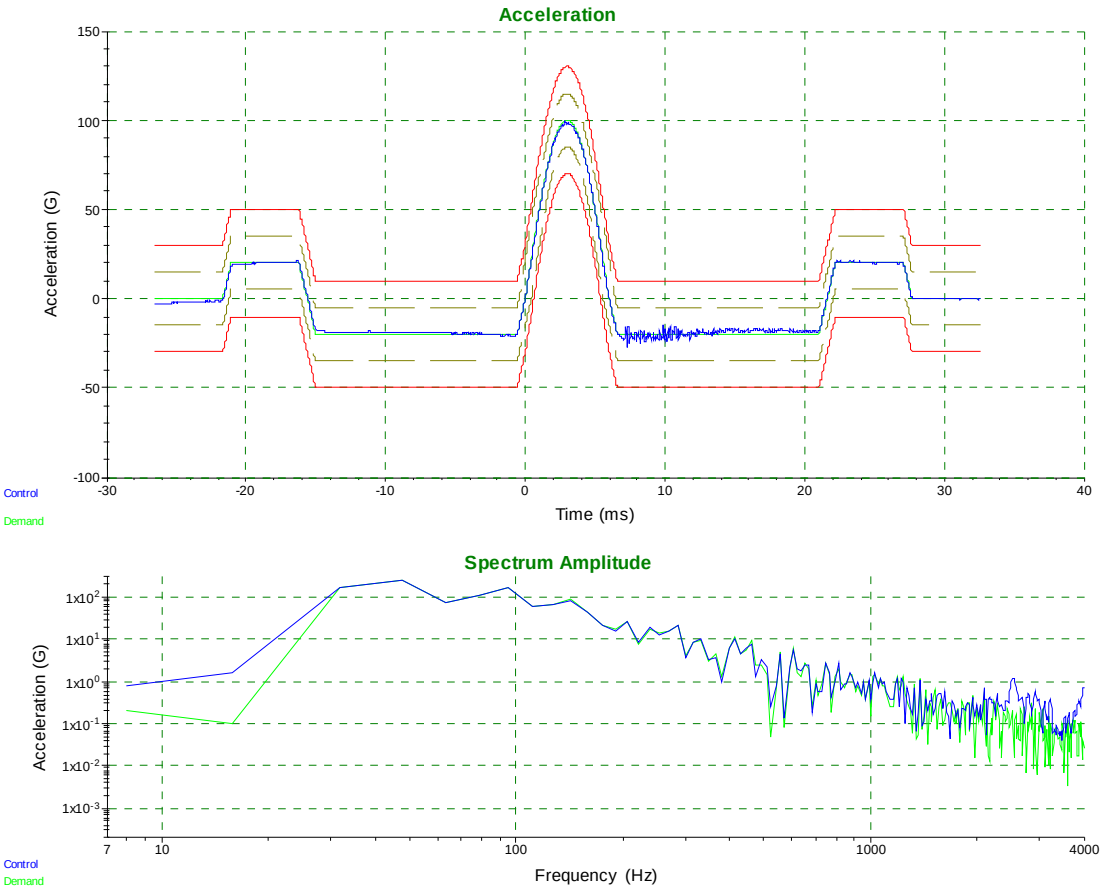
Current Measurements:

Control amplitude: 29.95 G
Output voltage: 2.26 Volts peak

Channel Measurements:

	Acceleration
353B31	30.35 G
352C22	28.72 G
352C22	2.858 G
352C22	2.624 G

Test Data Ea/Eb: Shock acceleration x-Axis + (1000 m/s2 / 6 ms half sine)



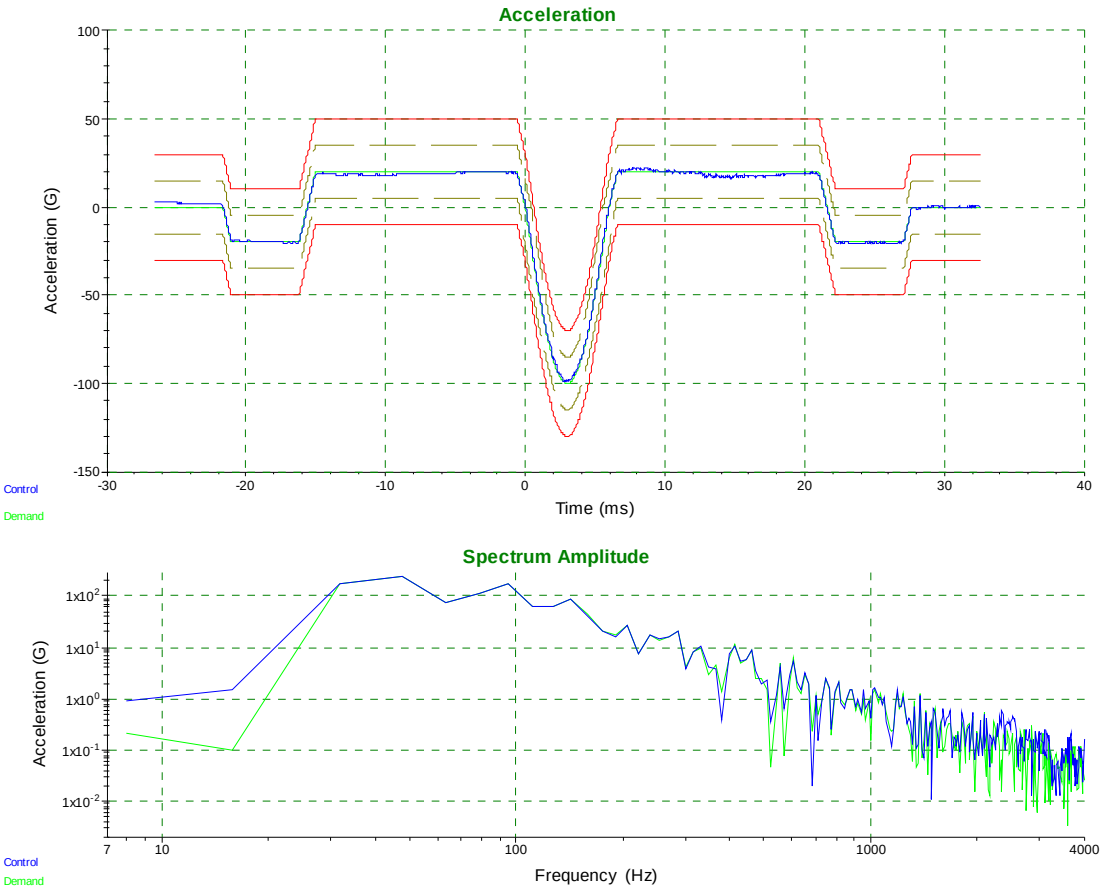
Current Measurements:

Control amplitude: 99.5 G
Output voltage: 4.417 Volts peak

Channel Measurements:

	Acceleration
353B31	100.9 G
352C22	94.66 G
352C22	10.19 G
352C22	7.688 G

Test Data Ea/Eb: Shock acceleration x-Axis - (1000 m/s2 / 6 ms half sine)



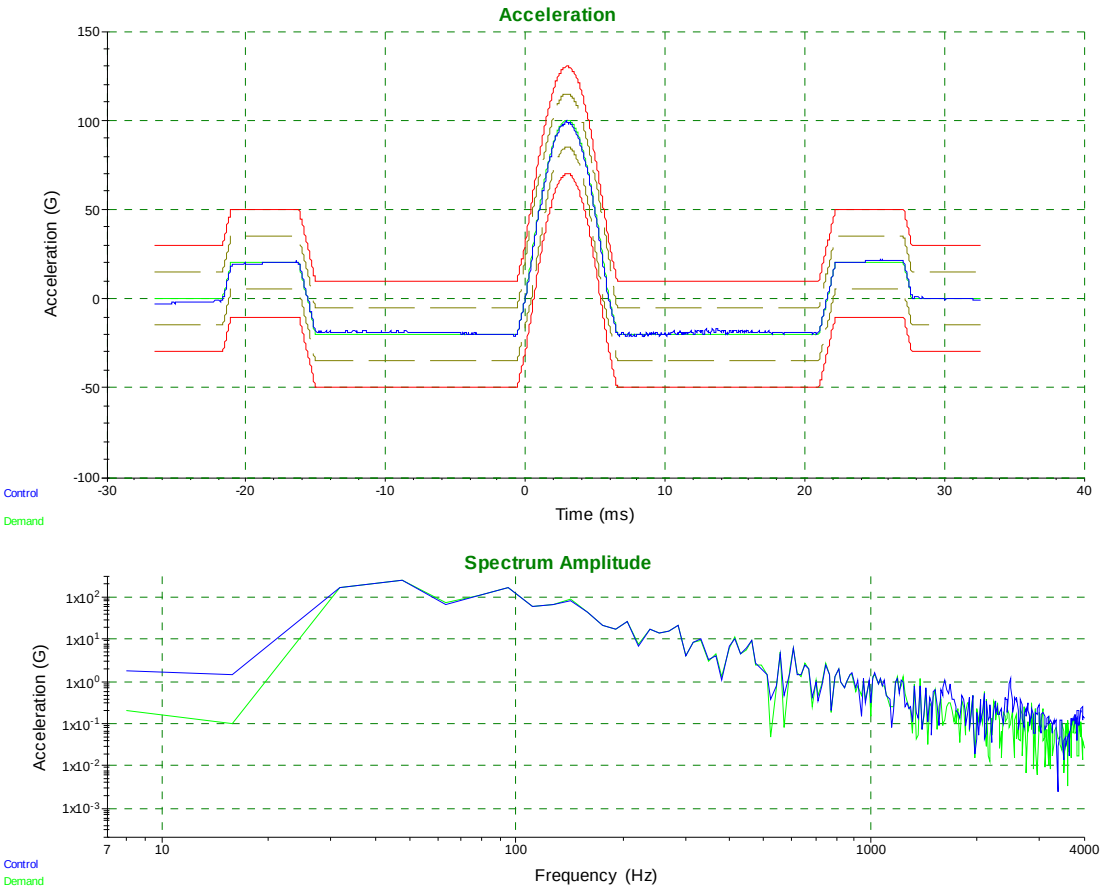
Current Measurements:

Control amplitude: 99.06 G
Output voltage: 4.346 Volts peak

Channel Measurements:

	Acceleration
353B31	100.3 G
352C22	96.72 G
352C22	6.987 G
352C22	5.197 G

Test Data Ea/Eb: Shock acceleration y-Axis + (1000 m/s2 / 6 ms half sine)



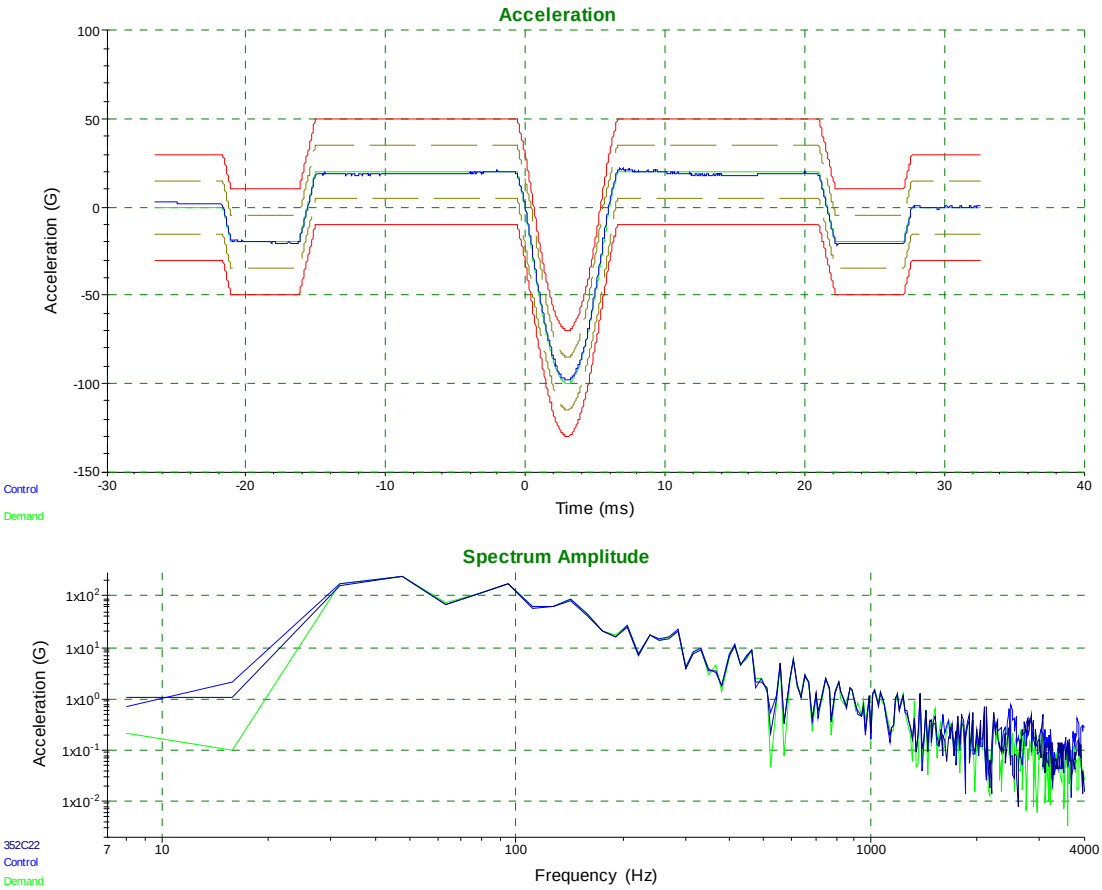
Current Measurements:

Control amplitude: 99.17 G
Output voltage: 4.472 Volts peak

Channel Measurements:

	Acceleration
353B31	100.6 G
352C22	95.56 G
352C22	6.023 G
352C22	10.47 G

Test Data Ea/Eb: Shock acceleration y-Axis - (1000 m/s2 / 6 ms half sine)



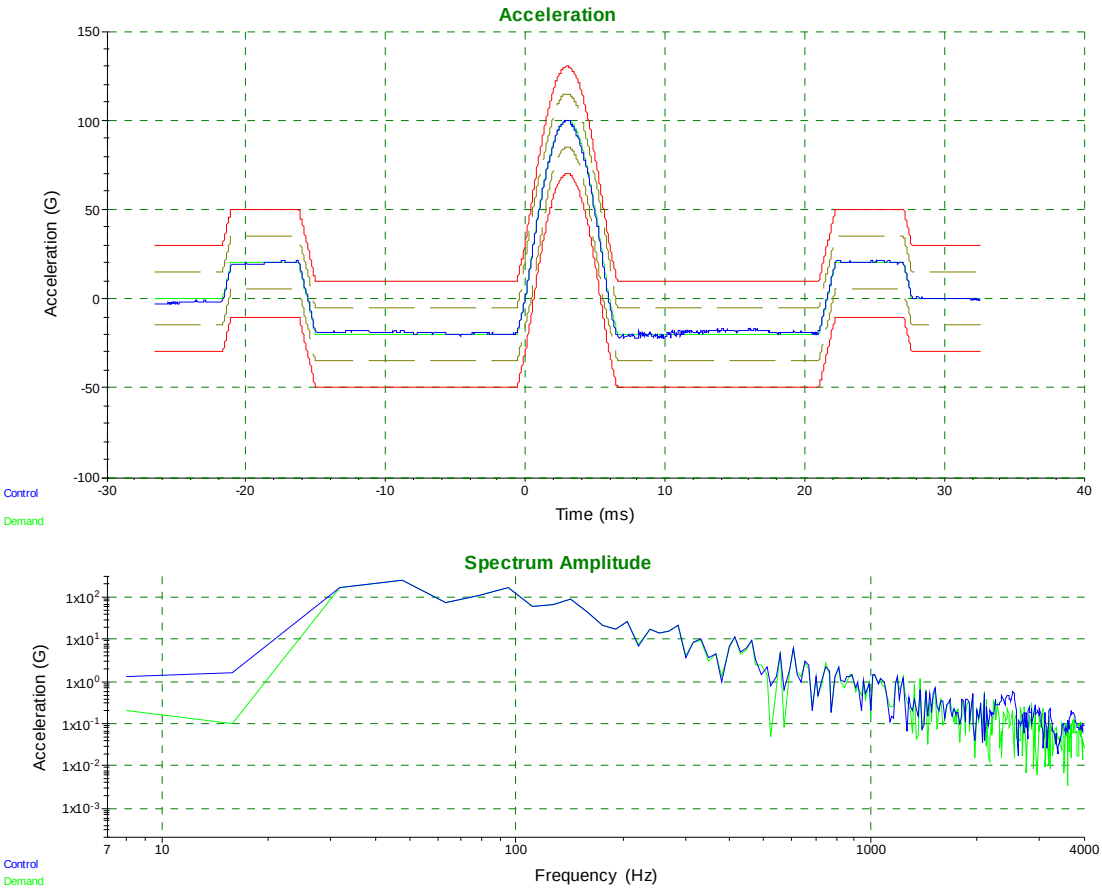
Current Measurements:

Control amplitude: 98.28 G
Output voltage: 4.39 Volts peak

Channel Measurements:

	Acceleration
353B31	99.47 G
352C22	95.95 G
352C22	6.079 G
352C22	5.877 G

Test Data Ea/Eb: Shock acceleration z-Axis + (1000 m/s2 / 6 ms half sine)



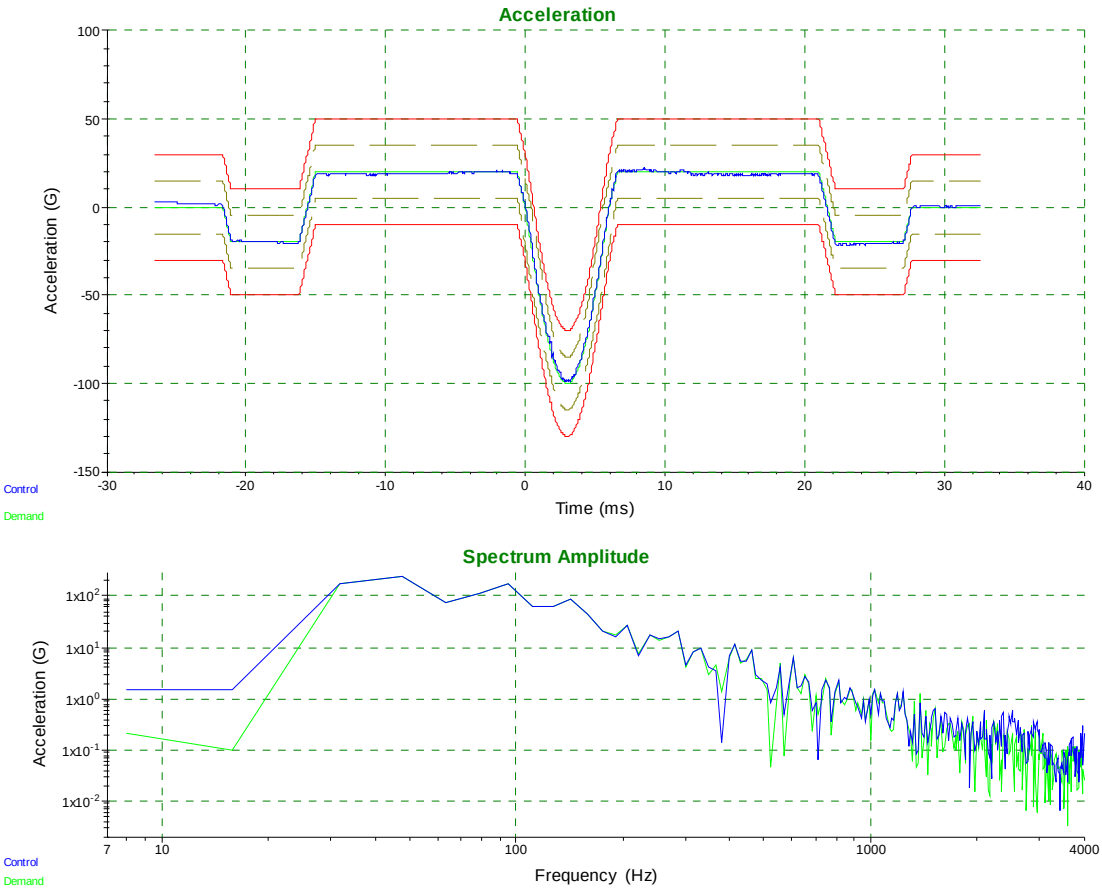
Current Measurements:

Control amplitude: 99.77 G
Output voltage: 4.451 Volts peak

Channel Measurements:

	Acceleration
353B31	101.2 G
352C22	95.33 G
352C22	7.611 G
352C22	3.445 G

Test Data Ea/Eb: Shock acceleration z-Axis - (1000 m/s2 / 6 ms half sine)



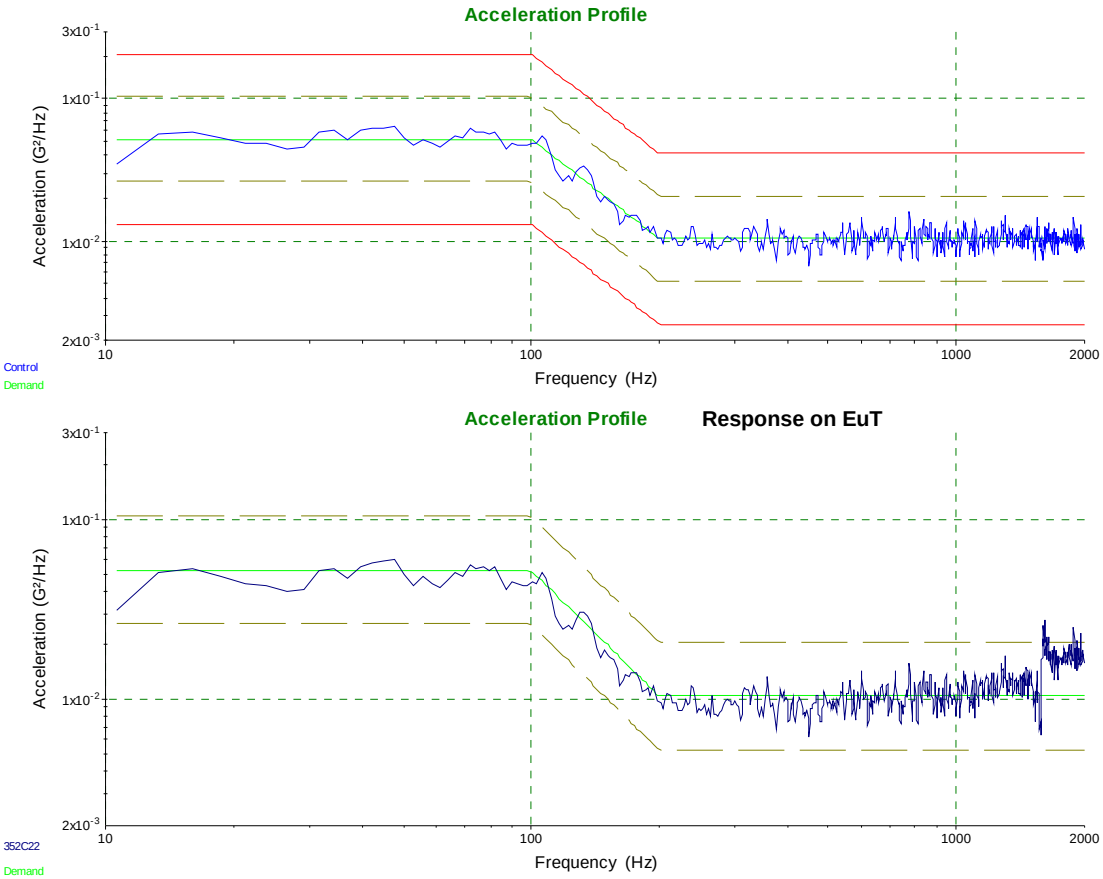
Current Measurements:

Control amplitude: 99.46 G
Output voltage: 4.361 Volts peak

Channel Measurements:

	Acceleration
353B31	100.6 G
352C22	96.96 G
352C22	7.096 G
352C22	7.44 G

Test Data Fh: Vibration, broad band random in direction of x-axis



Breakpoint table

Frequency	G²/Hz	dB/Octave
10 Hz	0.05199	0
100 Hz	0.05199	-6.99
200 Hz	0.0104	0
2000 Hz	0.0104	

Measurements:

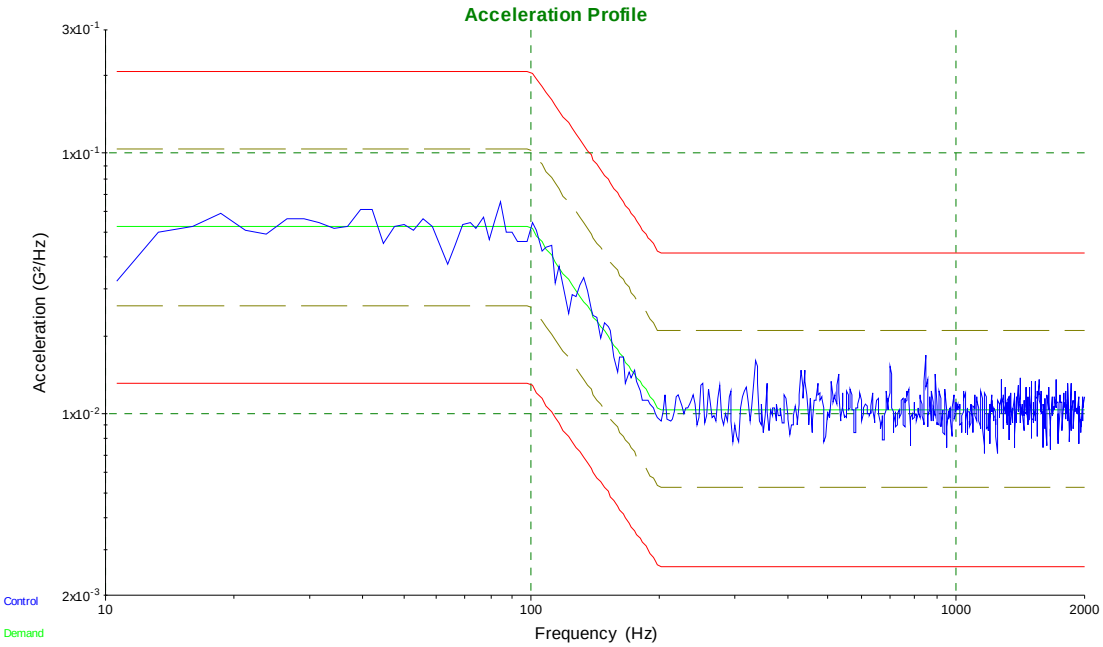
Demand: 5.08 G RMS	6.815 mm pk-pk
Control: 5.102 G RMS	7.66 mm pk-pk

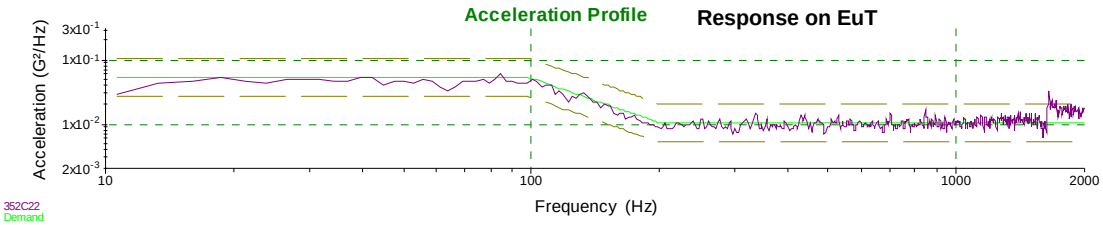
Channel Measurements:

Ch1: 5.095 G RMS	Ch1 in-band: 5.097 G RMS
Ch2: 5.363 G RMS	Ch2 in-band: 5.36 G RMS
Ch3: 0.2726 G RMS	Ch3 in-band: 0.2573 G RMS
Ch4: 0.3786 G RMS	Ch4 in-band: 0.37 G RMS
Drive voltage: 0.3199 Vrms	

System gain is 0.06269 Volts/G (Max system gain limit = 100)

Test Data Fh: Vibration, broad band random in direction of y-axis





Breakpoint table

Frequency	G²/Hz	dB/Octave
10 Hz	0.05199	0
100 Hz	0.05199	-6.99
200 Hz	0.0104	0
2000 Hz	0.0104	

Measurements:

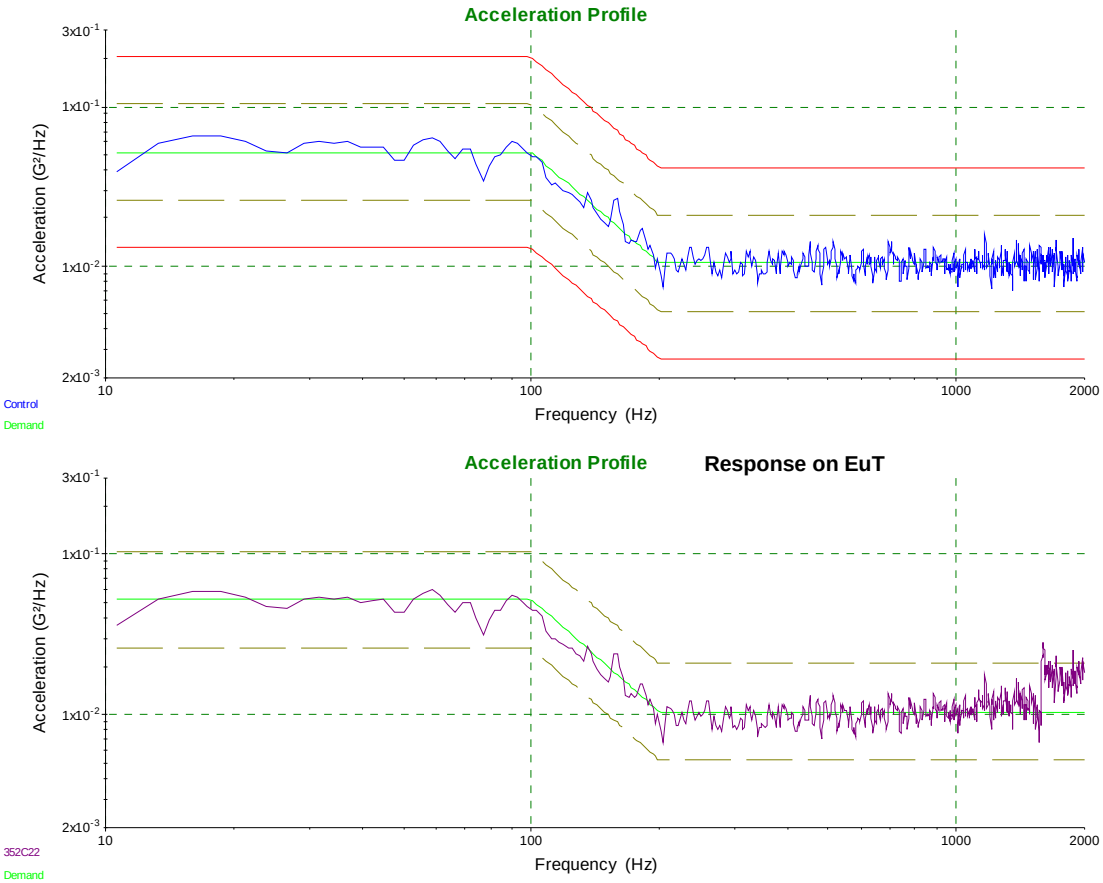
Demand: 5.08 G RMS	6.815 mm pk-pk
Control: 5.09 G RMS	7.4 mm pk-pk

Channel Measurements:

Ch1: 5.129 G RMS	Ch1 in-band: 5.084 G RMS
Ch2: 5.306 G RMS	Ch2 in-band: 5.261 G RMS
Ch3: 0.3872 G RMS	Ch3 in-band: 0.3841 G RMS
Ch4: 0.4382 G RMS	Ch4 in-band: 0.4196 G RMS
Drive voltage: 0.3221 Vrms	

System gain is 0.06328 Volts/G (Max system gain limit = 100)

Test Data Fh: Vibration, broad band random in direction of z-axis



Breakpoint table

Frequency	G²/Hz	dB/Octave
10 Hz	0.05199	0
100 Hz	0.05199	-6.99
200 Hz	0.0104	0
2000 Hz	0.0104	

Measurements:

Demand: 5.08 G RMS	6.815 mm pk-pk
Control: 5.11 G RMS	8.063 mm pk-pk

Channel Measurements:

Ch1: 5.09 G RMS	Ch1 in-band: 5.104 G RMS
Ch2: 5.341 G RMS	Ch2 in-band: 5.352 G RMS
Ch3: 0.2566 G RMS	Ch3 in-band: 0.2529 G RMS
Ch4: 0.3342 G RMS	Ch4 in-band: 0.3286 G RMS
Drive voltage: 0.3193 Vrms	

System gain is 0.06248 Volts/G (Max system gain limit = 100)

Appendix 1
Additional Photo Documentation:

Equipment under Test (Particulars)