

**TRANSPORTATION AND SEISMIC TESTS
ON YESPAN ELECTRICAL PANEL**

MODEL: S TYPE

TEST REPORT

ON BEHALF OF: YESPAN ELEKTRIK SAN. VE TIC. LTD. ŞTI.

RAT-MTL-ELE20-022-R00

Document of 61 pages

Written:	Mauro Amadei		07/05/2020
Verified and approved:	Michele Civera		08/05/2020

REVISIONS TRACK

Date	Version	Description of changes	Reference
May 2020	00	First issue	

The present report can not be partially reproduced without written approval by P&P LMC Srl.

The results are referred only to the tested items.

The Quality System of P&P LMC is in compliance with the ISO 9001:2015 standard for the following activities: Qualification of industrial products; Physical, mechanical and chemical testing of construction materials; Chemical analysis of environmental matrix, industrial hygiene, emissions to atmosphere; Calibration service of mechanical, electromechanical and electronic measurement devices (CSQ Certificate No. 9175.ILMC – IQNet Certificate No. IT – 20582).

P&P LMC laboratory is qualified by RINA to perform tests with “Sollecitazioni statiche e dinamiche sulle opere d’arte ferroviarie, modalità costruttive e di verifica strutturale (Static and dynamic stresses on railway products, construction methods and structural verification)” and tests (3 – 17 – 20) listed in Annex XI of D.L. 191/2010 and it is in compliance with the UNI EN 17025 standard (Qualification Certificate No. 05/2007 Rev. 3).

CONTENTS

REVISIONS TRACK	2
1. GENERAL DATA.....	4
1.1. CUSTOMER.....	4
1.2. UNIT UNDER TEST	4
1.3. MANUFACTURER	5
1.4. REFERENCE DOCUMENTS	5
1.4.1. <i>Contract documents</i>	5
1.4.2. <i>Technical documents and standards</i>	5
1.5. TEST OBJECTIVE.....	5
1.6. TESTING LABORATORY	6
1.7. TEST DATE	6
1.8. RESPONSIBILITIES	6
1.9. WITNESSES	6
2. TESTING PROCEDURES	6
2.1. GENERAL REMARKS	6
2.2. MOUNTING TECHNIQUES.....	6
2.3. CONTROL AND MEASURING POSITIONS.....	7
2.4. TRANSPORTATION TESTS	7
2.4.1. <i>Vehicle vibration - Truck profile</i>	7
2.5. SEISMIC TESTS	8
2.5.1. <i>Resonance frequency search</i>	8
2.5.2. <i>Earthquake test</i>	8
3. MEASURING, EXCITATION AND DATA PROCESSING EQUIPMENT	9
3.1. EXCITATION EQUIPMENT.....	9
3.2. MEASURING EQUIPMENT.....	10
3.3. DATA ACQUISITION AND PROCESSING INSTRUMENTATION	10
4. TEST RESULTS	11
4.1. TRANSPORTATION TESTS	11
4.1.1. <i>Tests in Z direction</i>	11
4.2. SEISMIC TESTS	11
4.2.1. <i>Tests in X direction</i>	11
4.2.2. <i>Tests in Y direction</i>	12
4.2.3. <i>Tests in Z direction</i>	12
4.3. GENERAL REMARKS	13
LIST OF FIGURES	14
PHOTO DOCUMENTATION	14



1. GENERAL DATA

1.1. Customer

YESPAN Elektrik San. ve Tic. Ltd. Şti.
Aydın Org. San. Bölgesi 2. Cad. No:41
Umurlu - Aydın
TURKEY

1.2. Unit under test

The tests were performed on YESPAN electrical panel with the following characteristics:

<p>Model / Type: <i>S Type</i></p>	 <p>SERIAL NO : 20200411 PRODUCTION DATE : APRIL 2020 TYPE : S DIMENSIONS (WxHxD): 800x2200+100x800 PROTECTION CLASS : IP54</p> <p>MADE IN TURKEY</p> <p>YESPAN ELEKTRİK SAN. ve TİC. LTD. ŞTİ. Umurlu Mah. Aydın Organize Sanayi Bölgesi 2.Cad. No: 41 Tel/Fax: +90 256 211 56 56 / +90 256 211 16 80 info@yespansan.com</p>
<p>Total weight on the swing frame: <i>120 kg</i></p>	

1.3. Manufacturer

YESPAN Elektrik San. ve Tic. Ltd. Şti.

1.4. Reference documents

1.4.1. Contract documents

- a. Offer P&P LMC No. OFF-MTL-ELE19-100-R00, dated December 11th, 2019.
- b. Order YESPAN: acceptance of OFF-MTL-ELE19-100-R00, dated March 5th, 2020.

1.4.2. Technical documents and standards

1. Telcordia Technologies Generic Requirements GR-63-CORE NEBS Requirements: Physical Protection, Issue 3, March 2006;
2. IEC 60068-3-3:1991 Environmental testing - Part 3-3: Guidance - Seismic test methods for equipments;
3. IEC 60068-2-6 Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal);
4. IEC 60068-2-27 Environmental testing - Part 2-27: Tests - Ea and guidance: Shock;
5. IEC 60068-2-57 Environmental testing - Part 2-57: Tests - Test Ff: Vibration - Time-history method;
6. IEEE Std 693-2005 IEEE Recommended Practice for Seismic Design of Substations;
7. ASTM D4169-16 Standard Practice for Performance Testing of Shipping Containers and Systems;
8. ISO 2041 Vibration and Shock – Vocabulary.

1.5. Test objective

The purpose of the transportation tests was to demonstrate that the packaged unit behaves in compliance with the requirements stated in doc. [7] according to the *Truck Profile* of “Schedule E - Vehicle Vibration”.

The purpose of the seismic tests was to demonstrate that the unit behave in compliance with the requirements stated in doc.[1] referring to a seismic risk classified in as *Zone 4* on the Telcordia Earthquake Zone Map. The following table correlates the earthquake risk zone with the expected Richter Magnitude, Modified Marcalli Index, and the expected ground and building accelerations.

Earthquake Risk Zone	Richter Magnitude	Modified Marcalli Index (MMI)	Low Frequency Ground Acceleration (g's)	Low Frequency Upper Building Floor Acceleration (g's)
0	< 4.3	V	< 0.05	< 0.2
1	4.3 - 5.7	V - VII	0.05 - 0.1	0.2 - 0.3
2	5.7 - 6.3	VII - VIII	0.1 - 0.2	0.3 - 0.4
3	6.3 - 7.0	VIII - IX	0.2 - 0.4	0.4 - 0.6
4	7.0 - 8.3	IX - XII	0.4 - 0.8	0.6 - 1.0

1.6. Testing laboratory

P&P LMC S.r.l.
via Pastrengo, 9
24068 Seriate (BG)
ITALY

1.7. Test date

April 29th - 30th, 2020 and May 4th - 5th, 2020.

1.8. Responsibilities

M. Civera; test responsible – M. Amadei; test engineer.

1.9. Witnesses

No witnesses.

2. TESTING PROCEDURES

2.1. General remarks

To perform the tests, three reference directions have been considered for the unit: X (front - rear), Y (side - side) and Z (vertical).

The transportation tests consisted in:

- *vehicle vibration: Truck profile (low, medium and high level)*, on the unit placed in its intended shipping position (Z direction)

The sequence of the seismic tests has been:

- *initial resonance frequency search*, performed in three directions (X, Y, Z);
- *earthquake test*, performed in three directions (X, Y, Z);
- *final resonance frequency search*, performed in three directions (X, Y, Z).

All the applied vibrations were monodirectional.

Tests in Z direction were performed on a vertical shaking table moved by an electro-dynamic shaker. For the other excitation directions, a horizontal shaking table was used. Excitation directions are shown in the photographs.

All the performed tests are listed in the tables of pages 19 - 22. Tests were numbered following the chronological sequence.

2.2. Mounting techniques

For transportation tests the packaged unit was put on the shaking table in the state in which it is normally transported, with fixing belts (see photos).

For seismic tests the unit was mounted in its intended operating configuration. The unit was fixed to the shaking table with No. 4 M14 screws, with a tightening torque of 80 Nm.

2.3. Control and measuring positions

During all the tests, for the motion control, the signal of a monoaxial accelerometer (CP1) in the excitation direction was used. Moreover, for the seismic test, two triaxial accelerometers (MP1 and MP2) were placed on the unit for the vibration measurement (see photos).

In the following table are summarized model and serial number of the transducers mounted in the control and measuring positions during the tests.

<i>Point ID</i>	<i>Accelerometer</i>		<i>Tests</i>
	<i>Model</i>	<i>Serial Number</i>	
CP1 (X,Y,Z) Control position located on shaking table	PCB 353B03 (monoaxial)	210161	All tests
MP1 (X,Y,Z) Measuring position located on the top of the panel	DYTRAN 3023A6 (triaxial)	982901 (X)	Seismic tests
		982902 (Y)	
		982903 (Z)	
MP2 (X,Y,Z) Measuring position located at middle height of the panel	DYTRAN 3023A6 (triaxial)	983002 (X)	Seismic tests
		983003 (Y)	
		983001 (Z)	

2.4. Transportation tests

2.4.1. Vehicle vibration - Truck profile

The unit was subjected to random vibrations with P.S.D. (Power Spectral Density) defined in the following table.

TRANSPORTATION TEST	<i>Random vibration parameters</i>						
	<i>Frequency range:</i>	1 – 200 Hz					
	<i>PSD levels:</i>	<i>High Level</i>		<i>Medium Level</i>		<i>Low Level</i>	
		[Hz]	[g ² /Hz]	[Hz]	[g ² /Hz]	[Hz]	[g ² /Hz]
	1	0.00072	1	0.00072	1	0.0004	
	3	0.030	3	0.018	3	0.010	
	4	0.030	4	0.018	4	0.010	
	6	0.0012	6	0.00072	6	0.00040	
	12	0.0012	12	0.00072	12	0.00040	
	16	0.0060	16	0.0036	16	0.0020	
	25	0.0060	25	0.0036	25	0.0020	
	30	0.0012	30	0.00072	30	0.00040	

(continue)

	<i>High Level</i>		<i>Medium Level</i>		<i>Low Level</i>	
	[Hz]	[g ² /Hz]	[Hz]	[g ² /Hz]	[Hz]	[g ² /Hz]
	40	0.0060	40	0.0036	40	0.0020
	80	0.0060	80	0.0036	80	0.0020
	100	0.00060	100	0.00036	100	0.00020
	200	0.000030	200	0.000018	200	0.000010
<i>R.m.s.:</i>	0.70 g		0.54 g		0.40 g	
<i>Duration:</i>	5 minutes		15 minutes		40 minutes	
<i>Direction:</i>	Z					

The three test levels were repeated three times, for a total duration of the transportation tests of 180 minutes.

2.5. Seismic tests

2.5.1. Resonance frequency search

The aim of these tests was to find the resonance frequencies of the unit.

In X, Y and Z direction, the unit was subjected to sine sweep, with the dynamic characteristics defined in the following table.

RESONANCE FREQUENCY SEARCH	<i>Sine vibration parameters</i>	
	<i>Frequency range:</i>	1 – 50 Hz
	<i>Level:</i>	1 – 2,23 Hz 10 mm (peak displacement)
		2,23 – 50 Hz 0,2 g (peak acceleration)
	<i>Sweep rate:</i>	1 oct/min
	<i>Duration:</i>	1 sweep
	<i>Direction:</i>	X, Y, Z

Signals from measuring accelerometers were processed to obtain the absolute response functions of the control channel and the frequency transfer functions of the measuring channels on the panel.

2.5.2. Earthquake test

In X, Y and Z direction, the earthquake was performed with reference to the Required Response Spectrum (RRS) reported in doc. [1] for Zone 4 risk area, with the dynamic characteristics defined in the following table.

EARTHQUAKE TEST	Earthquake parameters (Zone 4)		
	<i>Frequency range:</i>	0,3 – 50 Hz	
	<i>RRS level:</i>	0,3 Hz	0,2 g
		0,6 Hz	2,0 g
		2 Hz	5,0 g
		5 Hz	5,0 g
		15 Hz	1,6 g
		50 Hz	1,6 g
	<i>Damping:</i>	2 % (Q = 25)	
	<i>Duration:</i>	30 seconds / axis	
<i>Number of events:</i>	1 / axis		
<i>Direction:</i>	X, Y, Z		

The filtered time history was applied to the unit after acceptance of Customer’s technicians, based on duration, amplitude, shape and degree of envelope of the Required Response Spectrum.

3. MEASURING, EXCITATION AND DATA PROCESSING EQUIPMENT

3.1. Excitation equipment

Vibration tests in vertical direction were carried out using an electrodynamic shaker manufactured by ELIN, type MZV 210 W 20 S/N 713255, with the following characteristics:

- maximum sinusoidal dynamic force: 100 kN;
- moving element weight: 100 kg;
- frequency range: 0 ÷ 2000 Hz;
- max. displacement (peak to peak): 50,8 mm;
- max. acceleration: 100 g.

Vibration tests in horizontal directions were carried out using a magnesium slip table (operated by the previously described ELIN shaker) with the following characteristics:

- maximum sinusoidal dynamic force: 100 kN;
- moving element weight: 300 kg;
- frequency range: 0 ÷ 2000 Hz;
- max. displacement (peak to peak): 50,8 mm;
- max. acceleration: 33,3 g

3.2. Measuring equipment

Accelerometers employed during all the tests were PCB 353B03, monoaxial accelerometer, and DYTRAN 3023A6, triaxial accelerometers, with incorporated amplifiers.

The main characteristics of the accelerometers are listed below:

PCB 353B03:

- Nominal sensitivity:	10 mV/g;
- Transverse sensitivity (max):	< 5%;
- Frequency range:	1 ÷ 7000 Hz;
- Max. acceleration:	+/- 500 g;
- Resolution:	0,01g;
- Weight:	0,105 N

DYTRAN 3023A6:

- Nominal sensitivity:	5 mV/g
- Transverse sensitivity (max):	< 5%
- Frequency range axis 1 & 2:	1,5 ÷ 5000 Hz
- Frequency range axis 3:	1,5 ÷ 10000 Hz
- Max. acceleration:	+/- 1000 g
- Resolution:	0,010g
- Weight:	0,04 N

The frequency response of the whole measuring chain is flat, in the frequency range from 3 to 3000 Hz, with an accuracy of $\pm 5\%$.

Serial number of the employed accelerometer is listed in the above reported table. The instrumentation is submitted to a calibration program in accordance with internal procedures.

3.3. Data acquisition and processing instrumentation

During all the tests the shaker was controlled by a computer based system (the digital system LMS International) which is composed by an acquisition panel of 16 channels and by a PC. This control system generates the motion with the requested characteristics and feeds-back the shaker motion using the signal coming from the accelerometer chosen for the control.

Analogue signals coming from the accelerometers were amplified and conveyed to an analogue/digital converter, which sent the data to the disk storage of the aforementioned minicomputer for subsequent processing.

The block scheme of the excitation, acquisition and processing equipment is shown at page 18.

4. TEST RESULTS

4.1. Transportation tests

4.1.1. Tests in Z direction

Repetition No. 1

Figures at pages 23 - 25 show the PSD relevant to the control accelerometer obtained during the vehicle vibrations tests, for the Truck profile at low, medium and high level.

Repetition No. 2

Figures at pages 26 - 28 show the PSD relevant to the control accelerometer obtained during the vehicle vibrations tests, for the Truck profile at low, medium and high level.

Repetition No. 3

Figures at pages 29 - 31 show the PSD relevant to the control accelerometer obtained during the vehicle vibrations tests, for the Truck profile at low, medium and high level.

4.2. Seismic tests

The seismic tests were performed by applying an artificial time history obtained starting from the Required Response Spectrum as reported in doc. [1], with a 200 Hz sampling frequency. In order to fit the required displacement with the maximum allowable displacement of the test equipment, the drive signal was filtered with a high-pass filter at 4 Hz: the filtering was imposed on the basis of the results of the resonance frequency search performed in all the three excitation directions, showing that the cut-off frequency was lower of the lowest natural frequency of the unit before the earthquake test. In this case the Test Response Spectrum of the obtained shaking table acceleration (TRS CP1) is dominating the Required Response Spectrum (Telcordia RRS - Zone 4) of the reference doc. [1] in the frequency range from 4 to 50 Hz and the test can be accepted because the specimen was correctly excited around its natural frequencies. For every direction a comparison is given of the Required Response Spectrum with the Test Response Spectrum at a damping value of 2% analyzed with 12 points per octave. In any case the test was run in order to get a peak acceleration of the excitation time history greater than the Zero Period Acceleration of the specified Required Response Spectrum.

4.2.1. Tests in X direction

Initial resonance frequency search

Figures at pages 42 - 44 show the absolute response function relevant to the control accelerometer (AvgCtrl) and the frequency transfer functions relevant to the measuring accelerometers (MP1 and MP2) placed on the unit, recorded during the initial resonance frequency search performed before the earthquake test.

Earthquake test

Figures at page 45 show the acceleration time history relevant to the control accelerometer (CP1) and the relative displacement time history of the top of the unit, obtained during the earthquake simulation.

Figures at pages 46 - 47 show the acceleration time histories relevant to the measuring accelerometers (MP1 and MP2), obtained during the earthquake simulation.

Figure at page 48 show the Test Response Spectrum (TRS - solid line) compared with Telcordia Zone 4 Required Response Spectrum (RRS - dashed line), obtained during the earthquake simulation.

Final resonance frequency search

Figures at pages 49 - 51 show the absolute response function relevant to the control accelerometer (AvgCtrl) and the frequency transfer functions relevant to the measuring accelerometers (MP1 and MP2) placed on the unit, recorded during the initial resonance frequency search performed after the earthquake test.

4.2.2. Tests in Y direction

Initial resonance frequency search

Figures at pages 52 - 54 show the absolute response function relevant to the control accelerometer (AvgCtrl) and the frequency transfer functions relevant to the measuring accelerometers (MP1 and MP2) placed on the unit, recorded during the initial resonance frequency search performed before the earthquake test.

Earthquake test

Figures at page 55 show the acceleration time history relevant to the control accelerometer (CP1) and the relative displacement time history of the top of the unit, obtained during the earthquake simulation.

Figures at pages 56 - 57 show the acceleration time histories relevant to the measuring accelerometers (MP1 and MP2), obtained during the earthquake simulation.

Figure at page 58 show the Test Response Spectrum (TRS - solid line) compared with Telcordia Zone 4 Required Response Spectrum (RRS - dashed line), obtained during the earthquake simulation.

Final resonance frequency search

Figures at pages 59 - 61 show the absolute response function relevant to the control accelerometer (AvgCtrl) and the frequency transfer functions relevant to the measuring accelerometers (MP1 and MP2) placed on the unit, recorded during the initial resonance frequency search performed after the earthquake test.

4.2.3. Tests in Z direction

Initial resonance frequency search

Figures at pages 32 - 34 show the absolute response function relevant to the control accelerometer (AvgCtrl) and the frequency transfer functions relevant to the measuring accelerometers (MP1 and MP2) placed on the unit, recorded during the initial resonance frequency search performed before the earthquake test.

Earthquake test

Figures at page 35 show the acceleration time history relevant to the control accelerometer (CP1) and the relative displacement time history of the top of the unit, obtained during the earthquake simulation.

Figures at pages 36 - 37 show the acceleration time histories relevant to the measuring accelerometers (MP1 and MP2), obtained during the earthquake simulation.

Figure at page 38 show the Test Response Spectrum (TRS - solid line) compared with Telcordia Zone 4 Required Response Spectrum (RRS - dashed line), obtained during the earthquake simulation.

Final resonance frequency search

Figures at pages 39 - 41 show the absolute response function relevant to the control accelerometer (AvgCtrl) and the frequency transfer functions relevant to the measuring accelerometers (MP1 and MP2) placed on the unit, recorded during the initial resonance frequency search performed after the earthquake test.

4.3. General remarks

At the end of the tests, at a visual inspection, no mechanical failure was detected on the unit.

Considering the requirement stated in doc [7], the packaged unit supported the Vehicle Vibration Test forecasted for Truck Profile.

Considering the requirement stated in doc [1], the unit supported the Earthquake Test forecasted for Risk Zone 4.

The results of further checks on the unit are of CUSTOMER's responsibility.

LIST OF FIGURES

- Page 18:* Block diagram of the excitation and measuring equipment.
Pages 19 ÷ 22: List of the performed tests.
Pages 23 ÷ 61: Tests recordings during the seismic tests.

PHOTO DOCUMENTATION

- Photo 1:* Test configuration for transportation test in Z direction.
Photo 2: Test configuration for seismic test in X direction.
Photo 3: Test configuration for seismic test in Y direction.
Photo 4: Test configuration for seismic test in Z direction.
Photo 5: Measuring accelerometers MP1 and MP2.

Photo 1: Test configuration for transportation test in Z direction

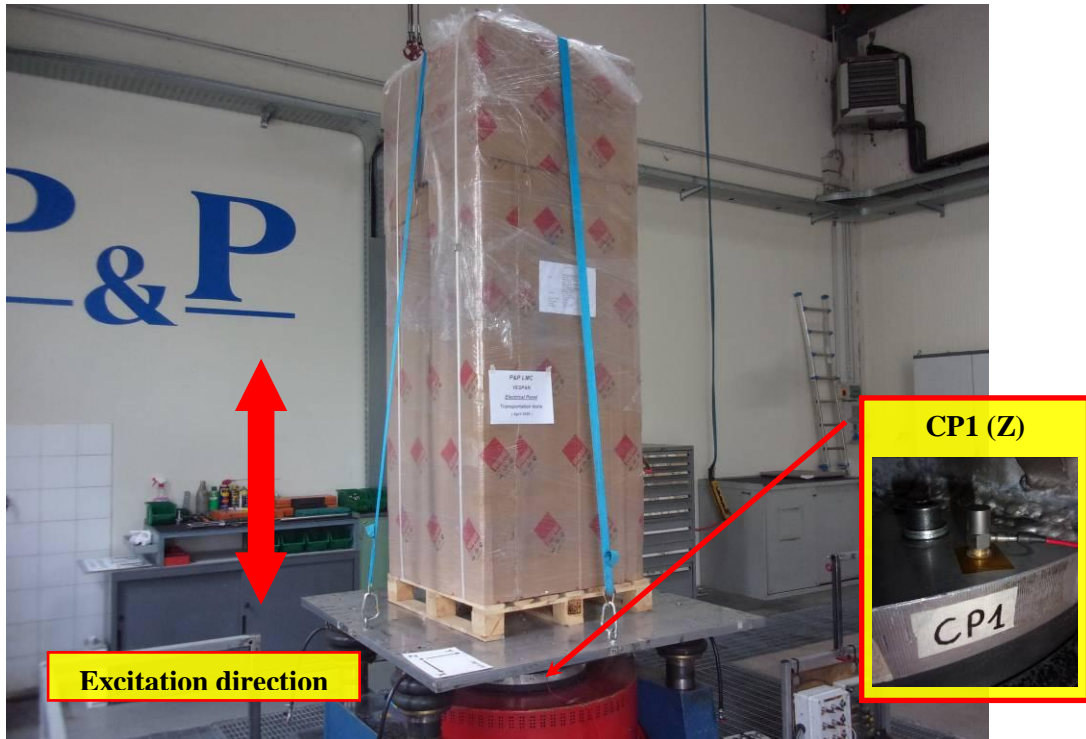


Photo 2: Test configuration for seismic test in X direction



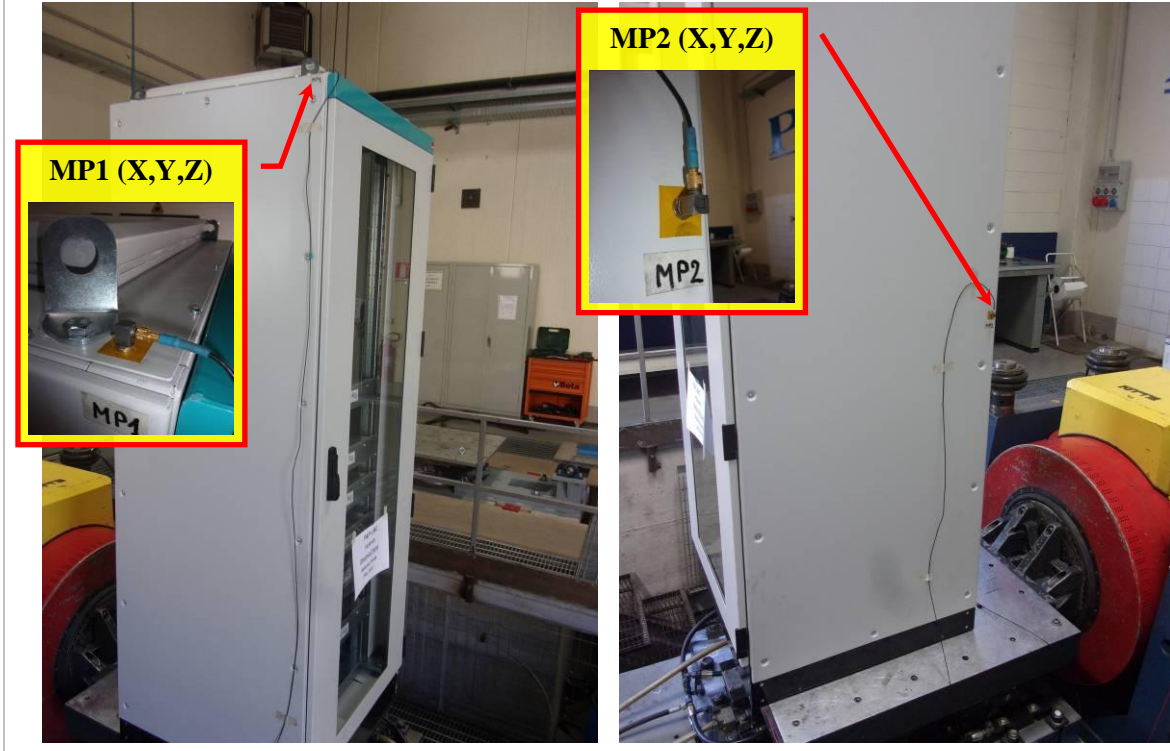
Photo 3: Test configuration for seismic test in Y direction



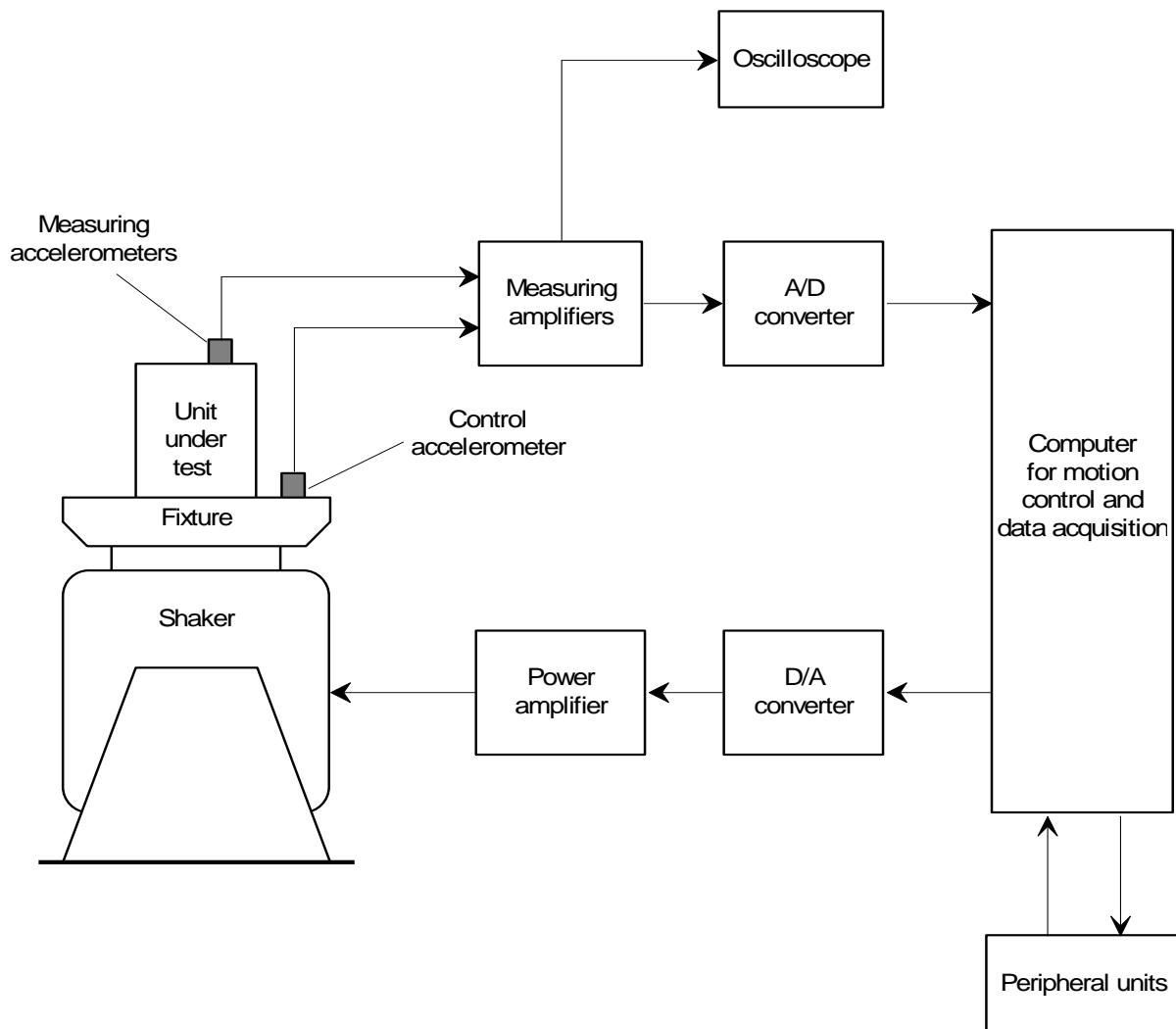
Photo 4: Test configuration for seismic test in Z direction



Photo 4: Measuring accelerometers MP1 and MP2



BLOCK DIAGRAM RELEVANT TO THE DYNAMIC TESTS



LIST OF THE PERFORMED TESTS

<i>Test No.</i>	<i>Test Type</i>	<i>Axis</i>	<i>Test parameters</i>	<i>Duration [h:min:sec]</i>	<i>Pages</i>
1	TRANSPORTATION TESTS: Low level	Z	<u>Frequency range:</u> 1 Hz - 200 Hz <u>Excitation levels:</u> 1 Hz @ 0.0004 g ² /Hz 3 Hz @ 0.010 g ² /Hz 4 Hz @ 0.010 g ² /Hz 6 Hz @ 0.00040 g ² /Hz 12 Hz @ 0.00040 g ² /Hz 16 Hz @ 0.0020 g ² /Hz 25 Hz @ 0.0020 g ² /Hz 30 Hz @ 0.00040 g ² /Hz 40 Hz @ 0.0020 g ² /Hz 80 Hz @ 0.0020 g ² /Hz 100 Hz @ 0.00020 g ² /Hz 200 Hz @ 0.000010 g ² /Hz <u>RMS acceleration:</u> 0.40 g	0:40:00	23
2	TRANSPORTATION TESTS: Medium level	Z	<u>Frequency range:</u> 1 Hz - 200 Hz <u>PSD levels:</u> 1 Hz @ 0.00072 g ² /Hz 3 Hz @ 0.018 g ² /Hz 4 Hz @ 0.018 g ² /Hz 6 Hz @ 0.00072 g ² /Hz 12 Hz @ 0.00072 g ² /Hz 16 Hz @ 0.0036 g ² /Hz 25 Hz @ 0.0036 g ² /Hz 30 Hz @ 0.00072 g ² /Hz 40 Hz @ 0.0036 g ² /Hz 80 Hz @ 0.0036 g ² /Hz 100 Hz @ 0.00036 g ² /Hz 200 Hz @ 0.000018 g ² /Hz <u>RMS acceleration:</u> 0.54 g	0:15:00	24
3	TRANSPORTATION TESTS: High level	Z	<u>Frequency range:</u> 1 Hz - 200 Hz <u>PSD levels:</u> 1 Hz @ 0.00072 g ² /Hz 3 Hz @ 0.030 g ² /Hz 4 Hz @ 0.030 g ² /Hz 6 Hz @ 0.0012 g ² /Hz 12 Hz @ 0.0012 g ² /Hz 16 Hz @ 0.0060 g ² /Hz 25 Hz @ 0.0060 g ² /Hz 30 Hz @ 0.0012 g ² /Hz 40 Hz @ 0.0060 g ² /Hz 80 Hz @ 0.0060 g ² /Hz 100 Hz @ 0.00060 g ² /Hz 200 Hz @ 0.000030 g ² /Hz <u>RMS acceleration:</u> 0.70 g	0:05:00	25

Test No.	Test Type	Axis	Test parameters	Duration [h:min:sec]	Pages
4	TRANSPORTATION TESTS: Low level	Z	<u>Frequency range:</u> 1 Hz - 200 Hz <u>Excitation levels:</u> 1 Hz @ 0.0004 g ² /Hz 3 Hz @ 0.010 g ² /Hz 4 Hz @ 0.010 g ² /Hz 6 Hz @ 0.00040 g ² /Hz 12 Hz @ 0.00040 g ² /Hz 16 Hz @ 0.0020 g ² /Hz 25 Hz @ 0.0020 g ² /Hz 30 Hz @ 0.00040 g ² /Hz 40 Hz @ 0.0020 g ² /Hz 80 Hz @ 0.0020 g ² /Hz 100 Hz @ 0.00020 g ² /Hz 200 Hz @ 0.000010 g ² /Hz <u>RMS acceleration:</u> 0.40 g	0:40:00	26
5	TRANSPORTATION TESTS: Medium level	Z	<u>Frequency range:</u> 1 Hz - 200 Hz <u>PSD levels:</u> 1 Hz @ 0.00072 g ² /Hz 3 Hz @ 0.018 g ² /Hz 4 Hz @ 0.018 g ² /Hz 6 Hz @ 0.00072 g ² /Hz 12 Hz @ 0.00072 g ² /Hz 16 Hz @ 0.0036 g ² /Hz 25 Hz @ 0.0036 g ² /Hz 30 Hz @ 0.00072 g ² /Hz 40 Hz @ 0.0036 g ² /Hz 80 Hz @ 0.0036 g ² /Hz 100 Hz @ 0.00036 g ² /Hz 200 Hz @ 0.000018 g ² /Hz <u>RMS acceleration:</u> 0.54 g	0:15:00	27
6	TRANSPORTATION TESTS: High level	Z	<u>Frequency range:</u> 1 Hz - 200 Hz <u>PSD levels:</u> 1 Hz @ 0.00072 g ² /Hz 3 Hz @ 0.030 g ² /Hz 4 Hz @ 0.030 g ² /Hz 6 Hz @ 0.0012 g ² /Hz 12 Hz @ 0.0012 g ² /Hz 16 Hz @ 0.0060 g ² /Hz 25 Hz @ 0.0060 g ² /Hz 30 Hz @ 0.0012 g ² /Hz 40 Hz @ 0.0060 g ² /Hz 80 Hz @ 0.0060 g ² /Hz 100 Hz @ 0.00060 g ² /Hz 200 Hz @ 0.000030 g ² /Hz <u>RMS acceleration:</u> 0.70 g	0:05:00	28

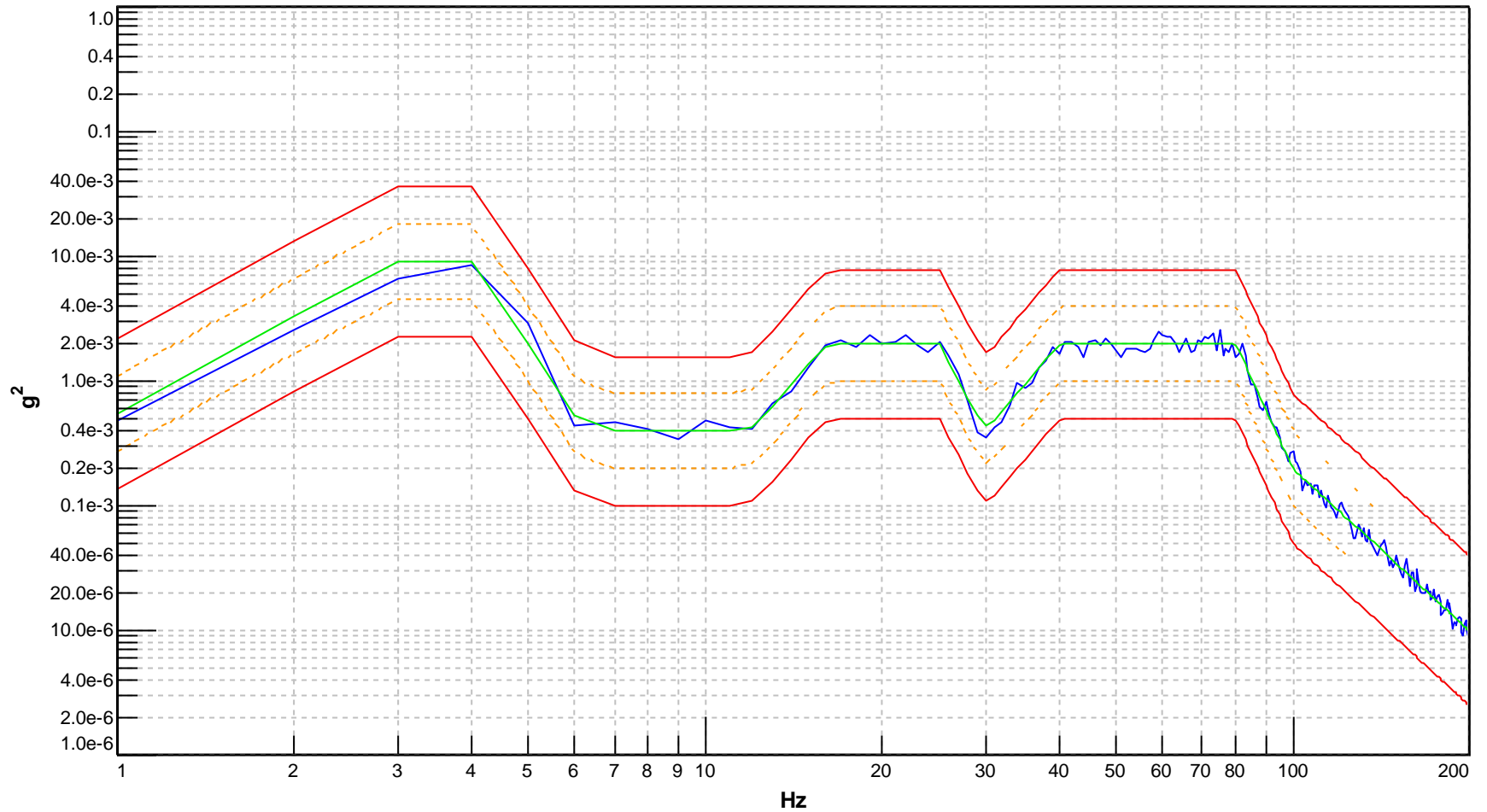
Test No.	Test Type	Axis	Test parameters	Duration [h:min:sec]	Pages
7	TRANSPORTATION TESTS: Low level	Z	<u>Frequency range:</u> 1 Hz - 200 Hz <u>Excitation levels:</u> 1 Hz @ 0.0004 g ² /Hz 3 Hz @ 0.010 g ² /Hz 4 Hz @ 0.010 g ² /Hz 6 Hz @ 0.00040 g ² /Hz 12 Hz @ 0.00040 g ² /Hz 16 Hz @ 0.0020 g ² /Hz 25 Hz @ 0.0020 g ² /Hz 30 Hz @ 0.00040 g ² /Hz 40 Hz @ 0.0020 g ² /Hz 80 Hz @ 0.0020 g ² /Hz 100 Hz @ 0.00020 g ² /Hz 200 Hz @ 0.000010 g ² /Hz <u>RMS acceleration:</u> 0.40 g	0:40:00	29
8	TRANSPORTATION TESTS: Medium level	Z	<u>Frequency range:</u> 1 Hz - 200 Hz <u>PSD levels:</u> 1 Hz @ 0.00072 g ² /Hz 3 Hz @ 0.018 g ² /Hz 4 Hz @ 0.018 g ² /Hz 6 Hz @ 0.00072 g ² /Hz 12 Hz @ 0.00072 g ² /Hz 16 Hz @ 0.0036 g ² /Hz 25 Hz @ 0.0036 g ² /Hz 30 Hz @ 0.00072 g ² /Hz 40 Hz @ 0.0036 g ² /Hz 80 Hz @ 0.0036 g ² /Hz 100 Hz @ 0.00036 g ² /Hz 200 Hz @ 0.000018 g ² /Hz <u>RMS acceleration:</u> 0.54 g	0:15:00	30
9	TRANSPORTATION TESTS: High level	Z	<u>Frequency range:</u> 1 Hz - 200 Hz <u>PSD levels:</u> 1 Hz @ 0.00072 g ² /Hz 3 Hz @ 0.030 g ² /Hz 4 Hz @ 0.030 g ² /Hz 6 Hz @ 0.0012 g ² /Hz 12 Hz @ 0.0012 g ² /Hz 16 Hz @ 0.0060 g ² /Hz 25 Hz @ 0.0060 g ² /Hz 30 Hz @ 0.0012 g ² /Hz 40 Hz @ 0.0060 g ² /Hz 80 Hz @ 0.0060 g ² /Hz 100 Hz @ 0.00060 g ² /Hz 200 Hz @ 0.000030 g ² /Hz <u>RMS acceleration:</u> 0.70 g	0:05:00	31

Test No.	Test Type	Axis	Test parameters	Duration [h:min:sec]	Pages
10	SEISMIC TESTS: initial resonance frequency search	Z	<u>Frequency range:</u> 1 Hz - 50 Hz <u>Excitation levels:</u> 1 - 2.23 Hz @ 10 mm 2.23 - 200 Hz @ 0.2 g <u>Sweep rate:</u> 1 oct/min	0:05:39	32 - 34
11	SEISMIC TESTS: earthquake simulation	Z	<u>Frequency range:</u> 0.3 Hz - 50 Hz <u>RRS:</u> 0.3 Hz @ 0.2 g 0.6 Hz @ 2 g 2 Hz @ 5 g 5 Hz @ 5 g 15 Hz @ 1.6 g 50 Hz @ 1.6 g <u>ZPA:</u> 1.6 g <u>Damping:</u> 2%	0:00:30	35 - 38
12	SEISMIC TESTS: final resonance frequency search	Z	<u>Frequency range:</u> 1 Hz - 50 Hz <u>Excitation levels:</u> 1 - 2.23 Hz @ 10 mm 2.23 - 200 Hz @ 0.2 g <u>Sweep rate:</u> 1 oct/min	0:05:39	39 - 41
13	SEISMIC TESTS: initial resonance frequency search	X	<u>Frequency range:</u> 1 Hz - 50 Hz <u>Excitation levels:</u> 1 - 2.23 Hz @ 10 mm 2.23 - 200 Hz @ 0.2 g <u>Sweep rate:</u> 1 oct/min	0:05:39	42 - 44
14	SEISMIC TESTS: earthquake simulation	X	<u>Frequency range:</u> 0.3 Hz - 50 Hz <u>RRS:</u> 0.3 Hz @ 0.2 g 0.6 Hz @ 2 g 2 Hz @ 5 g 5 Hz @ 5 g 15 Hz @ 1.6 g 50 Hz @ 1.6 g <u>ZPA:</u> 1.6 g <u>Damping:</u> 2%	0:00:30	45 - 48
15	SEISMIC TESTS: final resonance frequency search	X	<u>Frequency range:</u> 1 Hz - 50 Hz <u>Excitation levels:</u> 1 - 2.23 Hz @ 10 mm 2.23 - 200 Hz @ 0.2 g <u>Sweep rate:</u> 1 oct/min	0:05:39	49 - 51
16	SEISMIC TESTS: initial resonance frequency search	Y	<u>Frequency range:</u> 1 Hz - 50 Hz <u>Excitation levels:</u> 1 - 2.23 Hz @ 10 mm 2.23 - 200 Hz @ 0.2 g <u>Sweep rate:</u> 1 oct/min	0:05:39	52 - 54
17	SEISMIC TESTS: earthquake simulation	Y	<u>Frequency range:</u> 0.3 Hz - 50 Hz <u>RRS:</u> 0.3 Hz @ 0.2 g 0.6 Hz @ 2 g 2 Hz @ 5 g 5 Hz @ 5 g 15 Hz @ 1.6 g 50 Hz @ 1.6 g <u>ZPA:</u> 1.6 g <u>Damping:</u> 2%	0:00:30	55 - 58
18	SEISMIC TESTS: final resonance frequency search	Y	<u>Frequency range:</u> 1 Hz - 50 Hz <u>Excitation levels:</u> 1 - 2.23 Hz @ 10 mm 2.23 - 200 Hz @ 0.2 g <u>Sweep rate:</u> 1 oct/min	0:05:39	59 - 61

Project: MTL-20-016
Section: Z axis
Run: Random_1
Date: Wed Apr 29 2020 16:13:31
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average

TRUCK profile: Low level

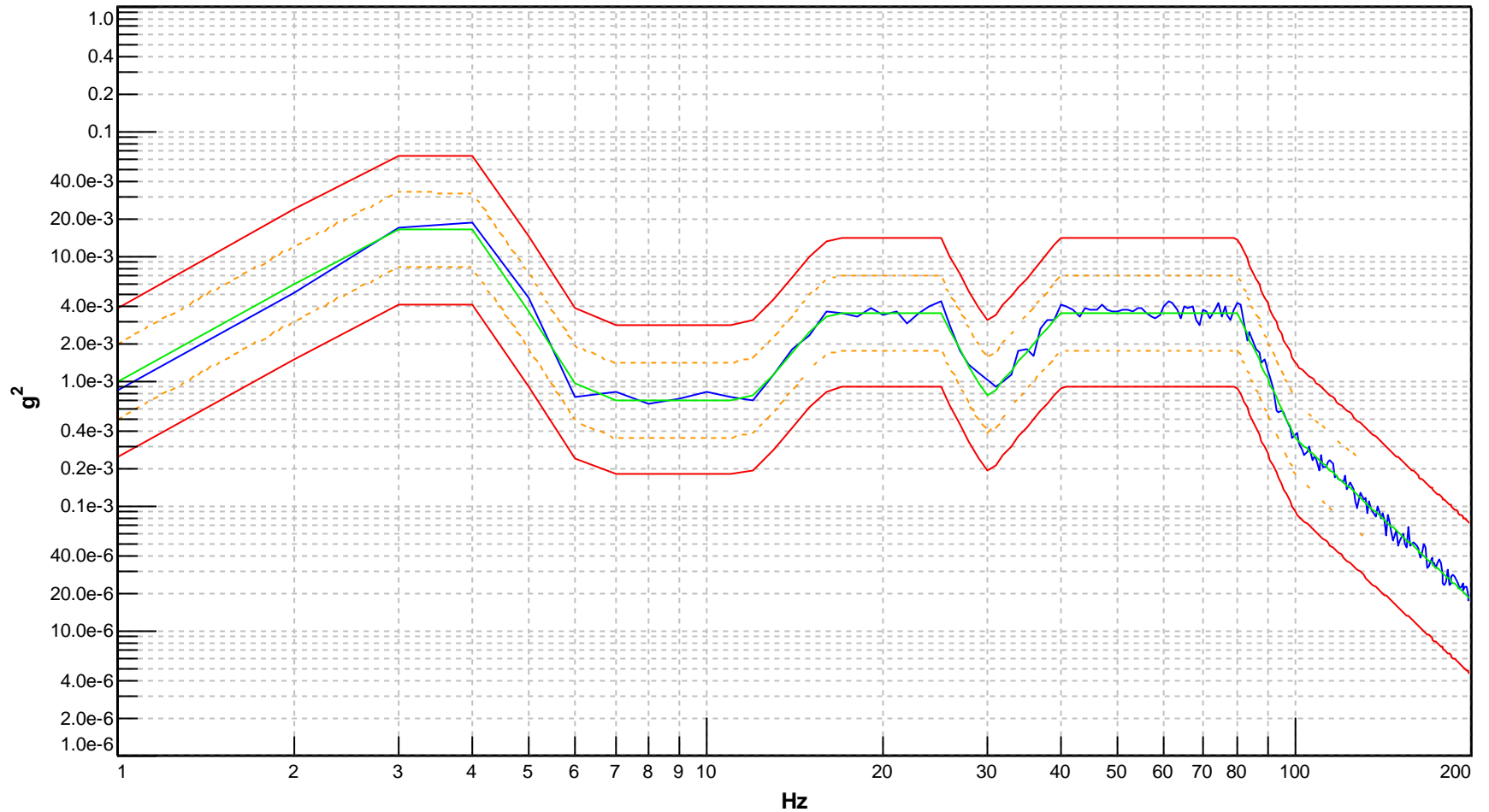
PSD AvgCtrl	RMS: 0.40 g
PSD Low Abort	RMS: 0.20 g
PSD Low Alarm	RMS: 0.29 g
PSD Reference	RMS: 0.40 g
PSD UpAbort	RMS: 0.81 g
PSD UpAlarm	RMS: 0.57 g



Project: MTL-20-016
Section: Z axis
Run: Random_2
Date: Wed Apr 29 2020 16:57:30
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average

TRUCK profile: Medium level

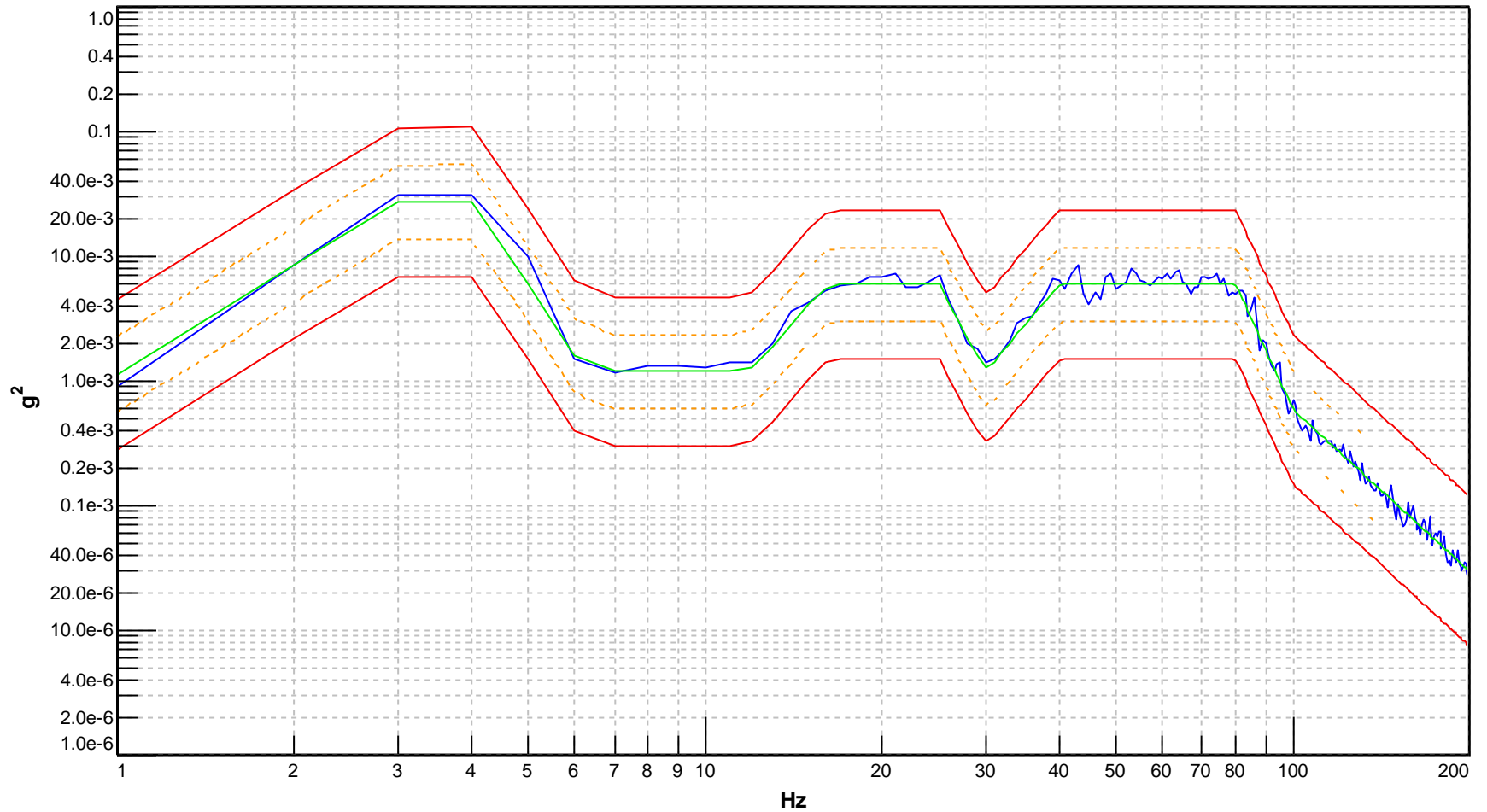
PSD AvgCtrl	RMS: 0.55 g
PSD Low Abort	RMS: 0.27 g
PSD Low Alarm	RMS: 0.38 g
PSD Reference	RMS: 0.54 g
PSD UpAbort	RMS: 1.08 g
PSD UpAlarm	RMS: 0.77 g



Project: MTL-20-016
Section: Z axis
Run: Random_3
Date: Wed Apr 29 2020 17:17:03
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average

TRUCK profile: High level

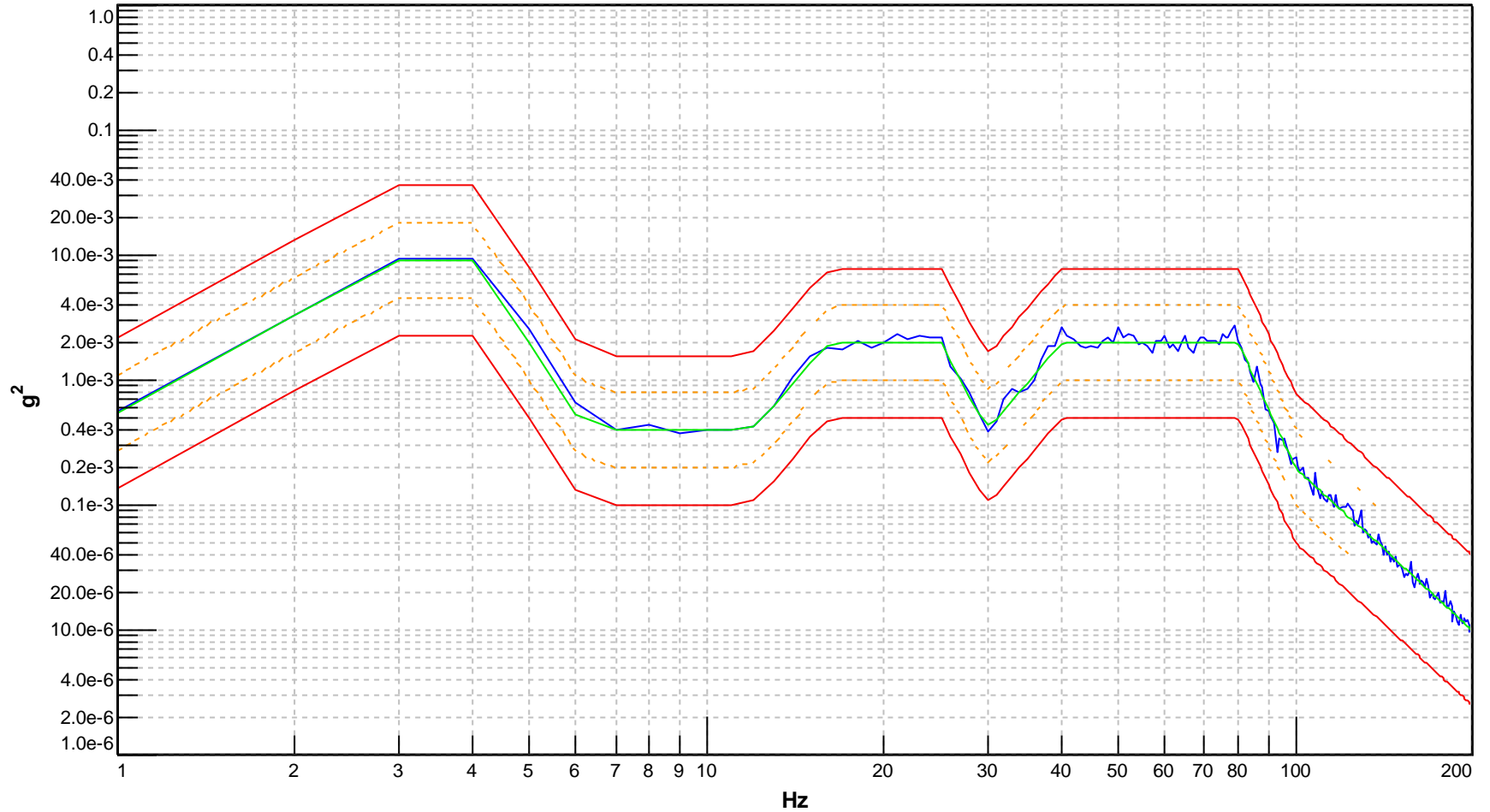
PSD AvgCtrl	RMS: 0.73 g
PSD Low Abort	RMS: 0.35 g
PSD Low Alarm	RMS: 0.49 g
PSD Reference	RMS: 0.70 g
PSD UpAbort	RMS: 1.39 g
PSD UpAlarm	RMS: 0.99 g



Project: MTL-20-016
Section: Z axis
Run: Random_4
Date: Wed Apr 29 2020 17:27:48
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average

TRUCK profile: Low level

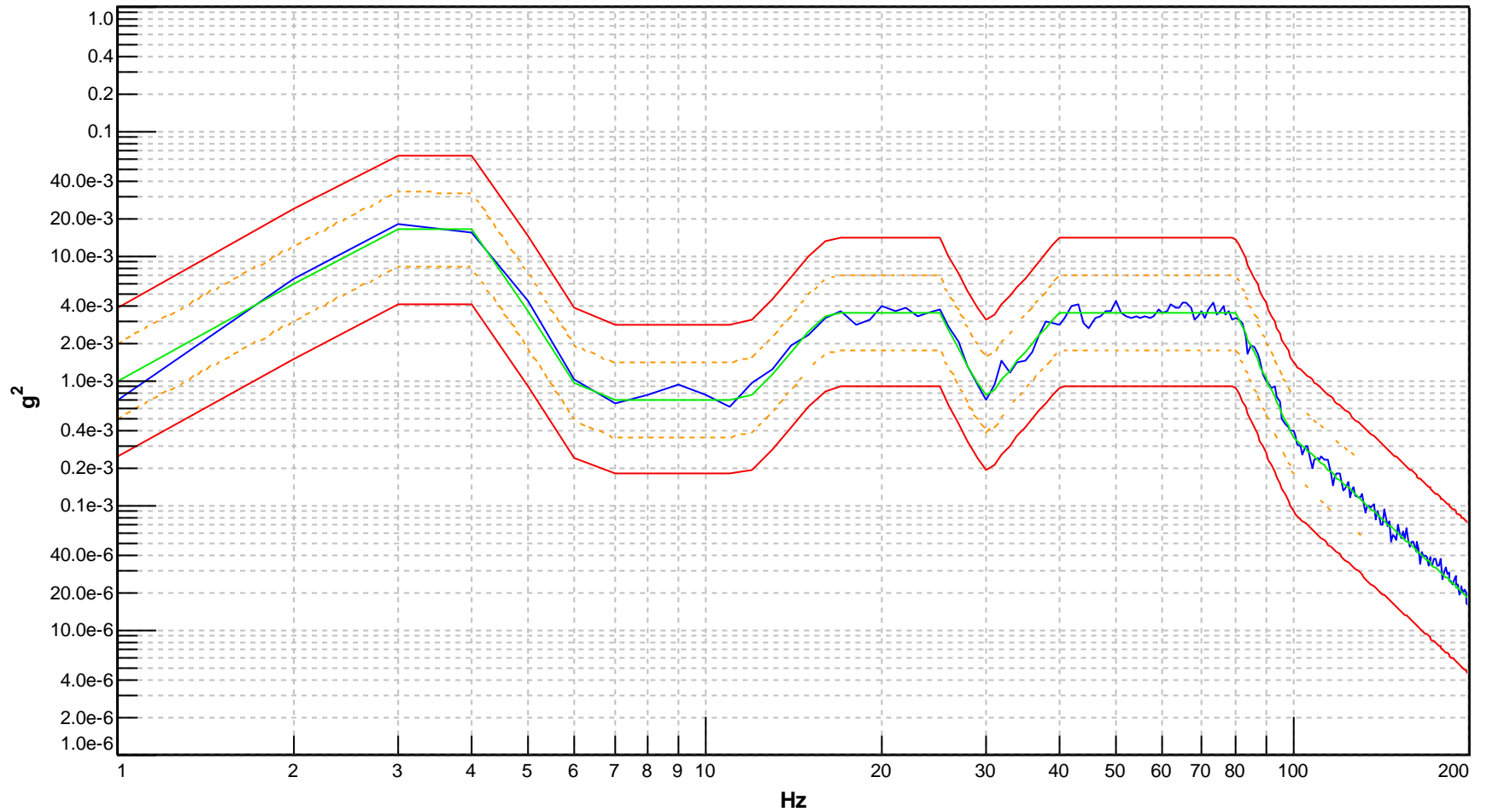
PSD AvgCtrl	RMS: 0.41 g
PSD Low Abort	RMS: 0.20 g
PSD Low Alarm	RMS: 0.29 g
PSD Reference	RMS: 0.40 g
PSD UpAbort	RMS: 0.81 g
PSD UpAlarm	RMS: 0.57 g



Project: MTL-20-016
Section: Z axis
Run: Random_5
Date: Wed Apr 29 2020 18:21:35
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average

TRUCK profile: Medium level

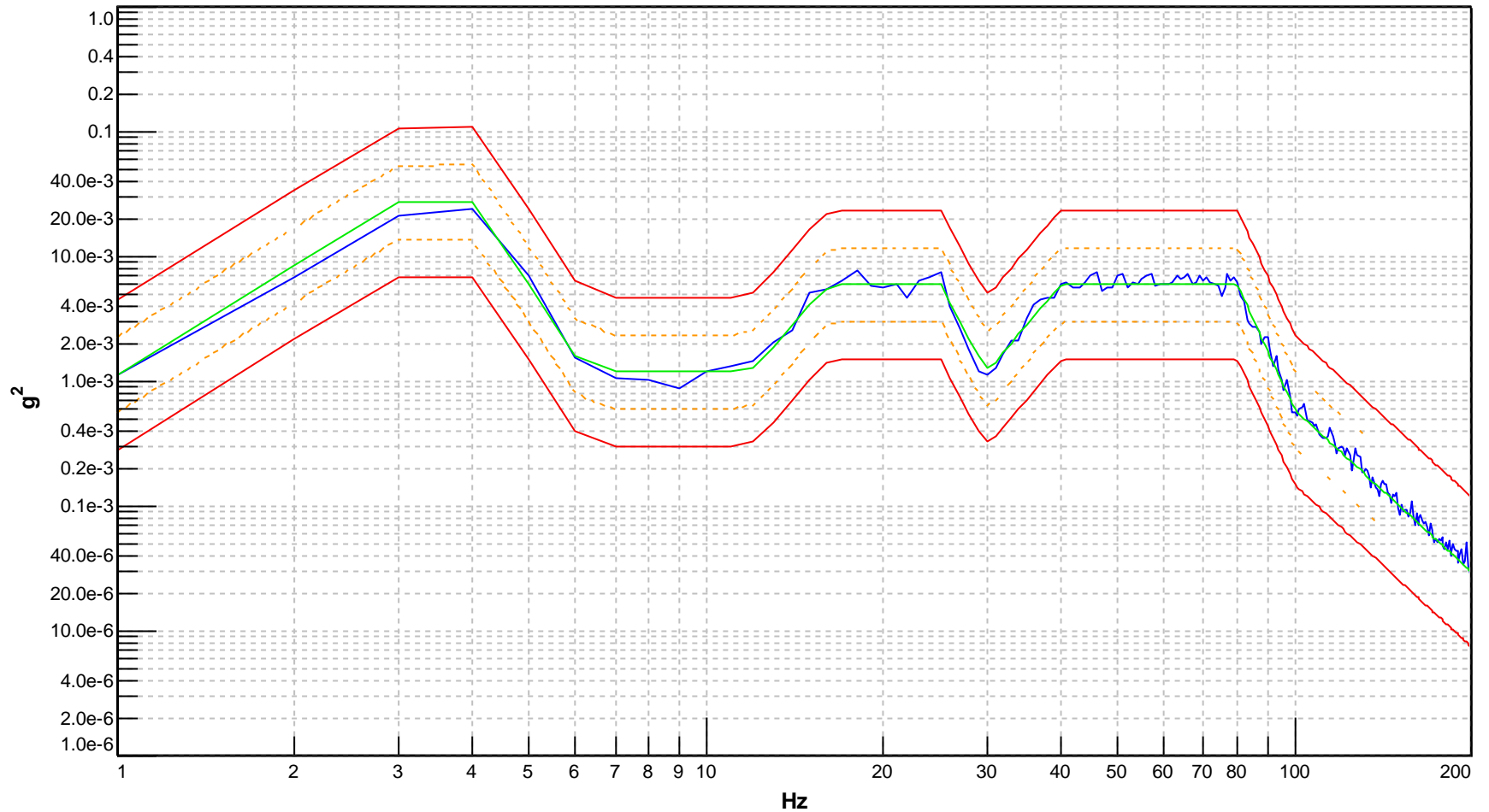
PSD AvgCtrl	RMS: 0.54 g
PSD Low Abort	RMS: 0.27 g
PSD Low Alarm	RMS: 0.38 g
PSD Reference	RMS: 0.54 g
PSD UpAbort	RMS: 1.08 g
PSD UpAlarm	RMS: 0.77 g



Project: MTL-20-016
Section: Z axis
Run: Random_6
Date: Wed Apr 29 2020 18:38:34
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average

TRUCK profile: High level

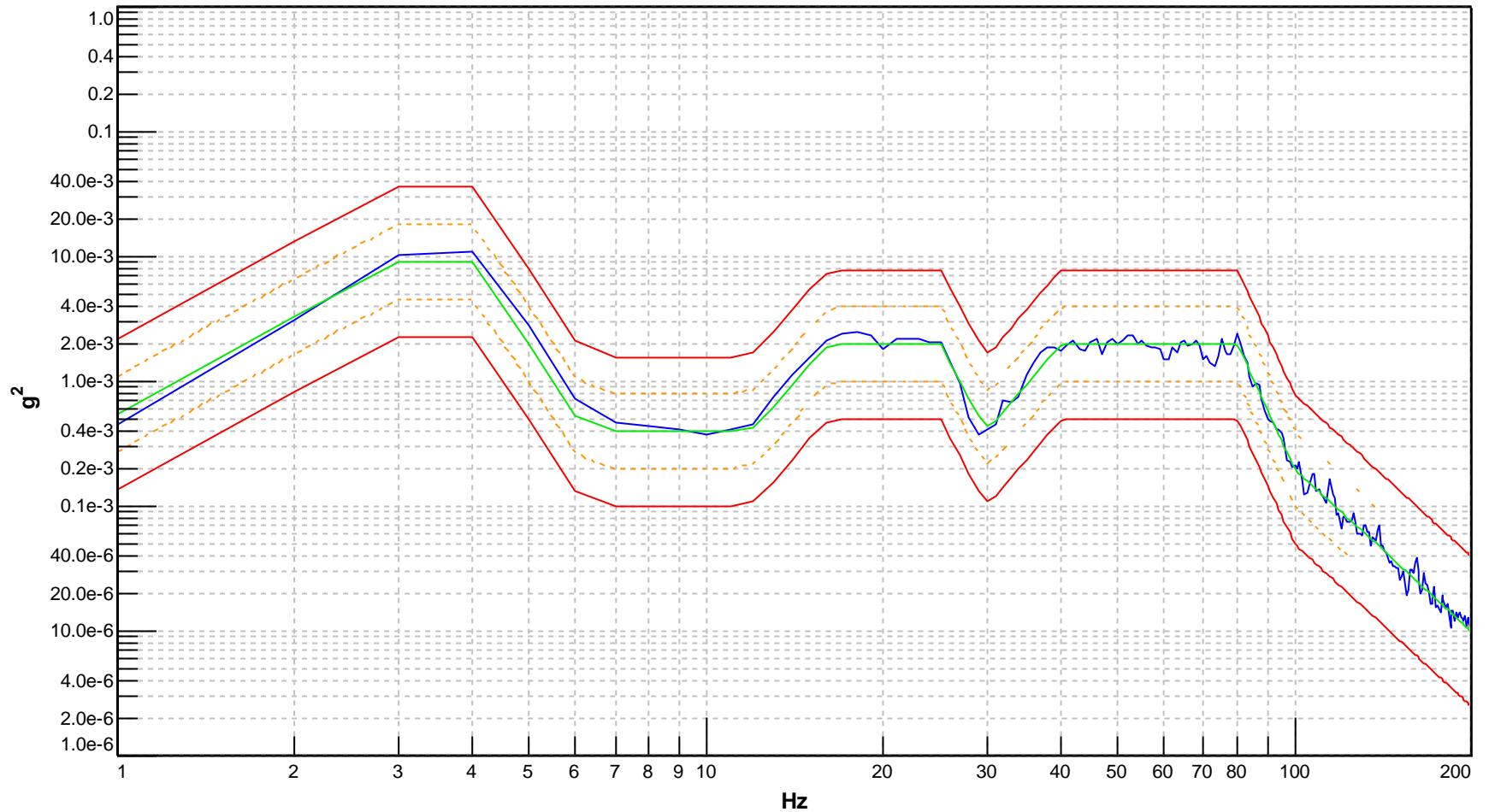
PSD AvgCtrl	RMS: 0.71 g
PSD Low Abort	RMS: 0.35 g
PSD Low Alarm	RMS: 0.49 g
PSD Reference	RMS: 0.70 g
PSD UpAbort	RMS: 1.39 g
PSD UpAlarm	RMS: 0.99 g



Project: MTL-20-016
Section: Z axis
Run: Random_7
Date: Thu Apr 30 2020 13:13:32
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average

TRUCK profile: Low level

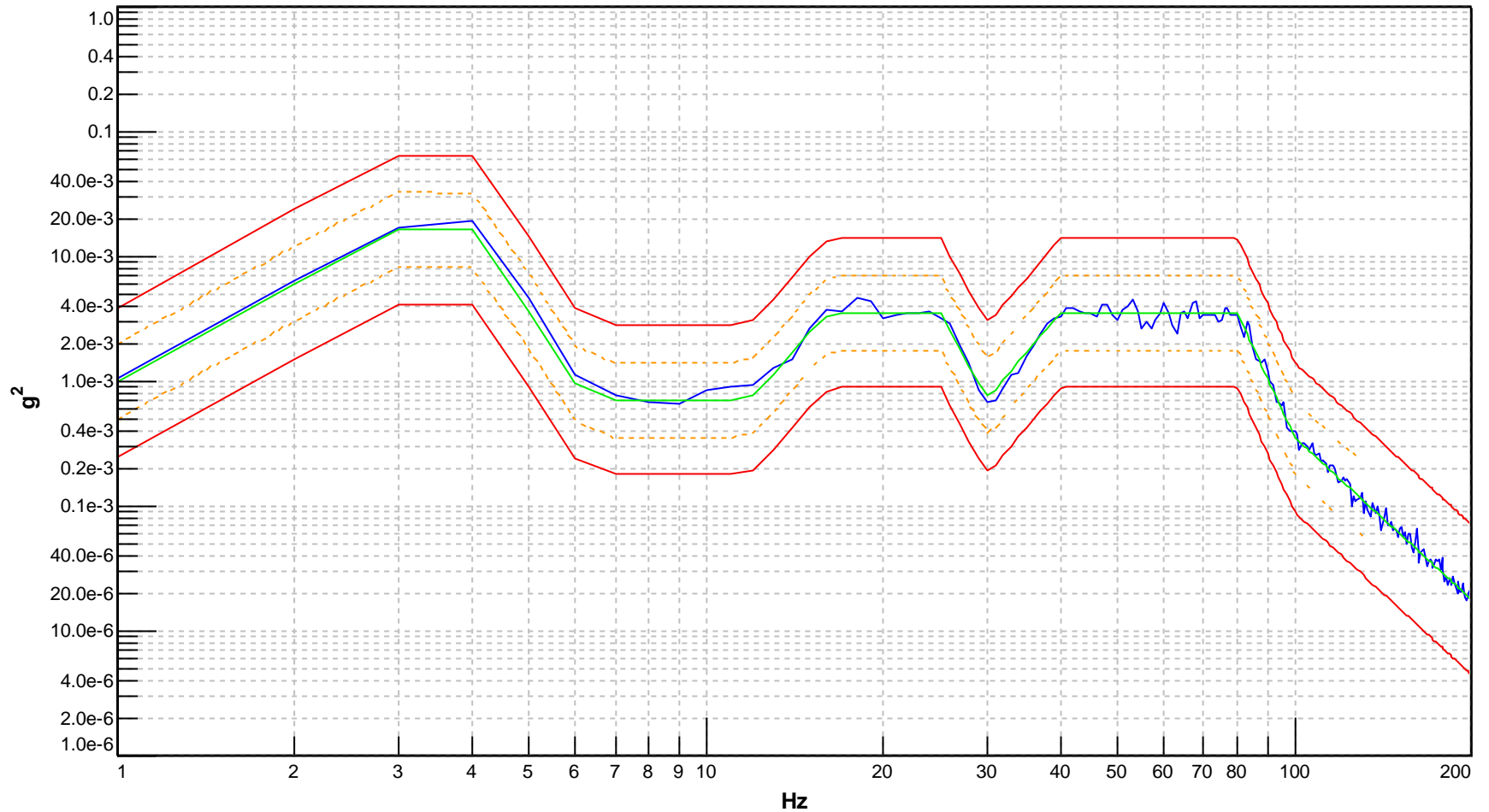
PSD AvgCtrl	RMS: 0.41 g
PSD Low Abort	RMS: 0.20 g
PSD Low Alarm	RMS: 0.29 g
PSD Reference	RMS: 0.40 g
PSD UpAbort	RMS: 0.81 g
PSD UpAlarm	RMS: 0.57 g



Project: MTL-20-016
Section: Z axis
Run: Random_8
Date: Thu Apr 30 2020 13:59:44
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average

TRUCK profile: Medium level

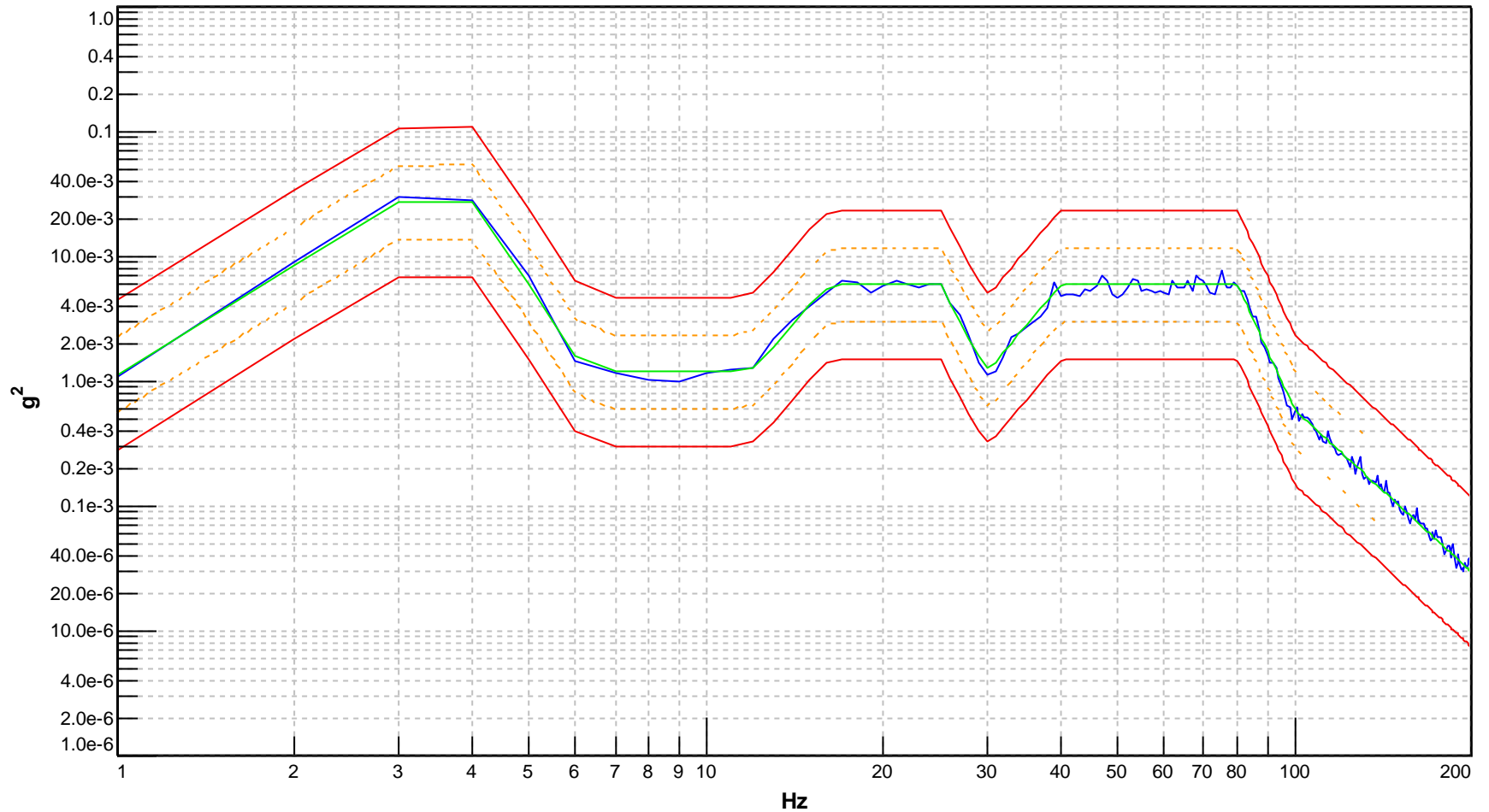
PSD AvgCtrl	RMS: 0.55 g
PSD Low Abort	RMS: 0.27 g
PSD Low Alarm	RMS: 0.38 g
PSD Reference	RMS: 0.54 g
PSD UpAbort	RMS: 1.08 g
PSD UpAlarm	RMS: 0.77 g



Project: MTL-20-016
Section: Z axis
Run: Random_9
Date: Thu Apr 30 2020 14:20:18
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average

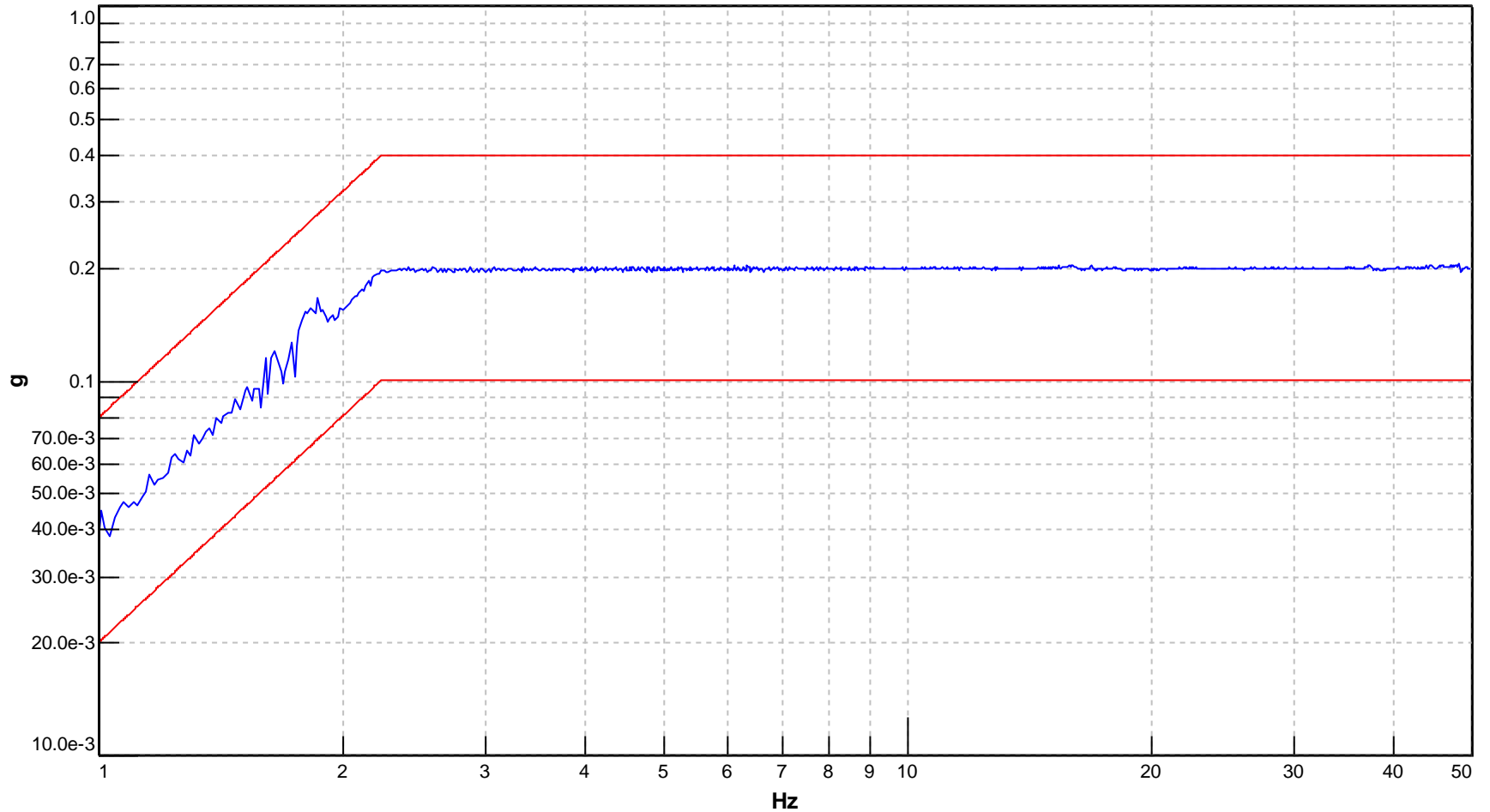
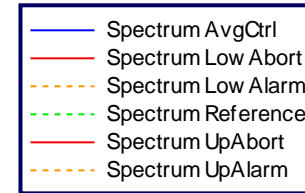
TRUCK profile: High level

PSD AvgCtrl	RMS: 0.70 g
PSD Low Abort	RMS: 0.35 g
PSD Low Alarm	RMS: 0.49 g
PSD Reference	RMS: 0.70 g
PSD UpAbort	RMS: 1.39 g
PSD UpAlarm	RMS: 0.99 g



Project: MTL-20-016
Section: Z axis
Run: Sine_1
Date: Mon May 04 2020 10:24:12
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average
Sweep rate: 1 Oct/min

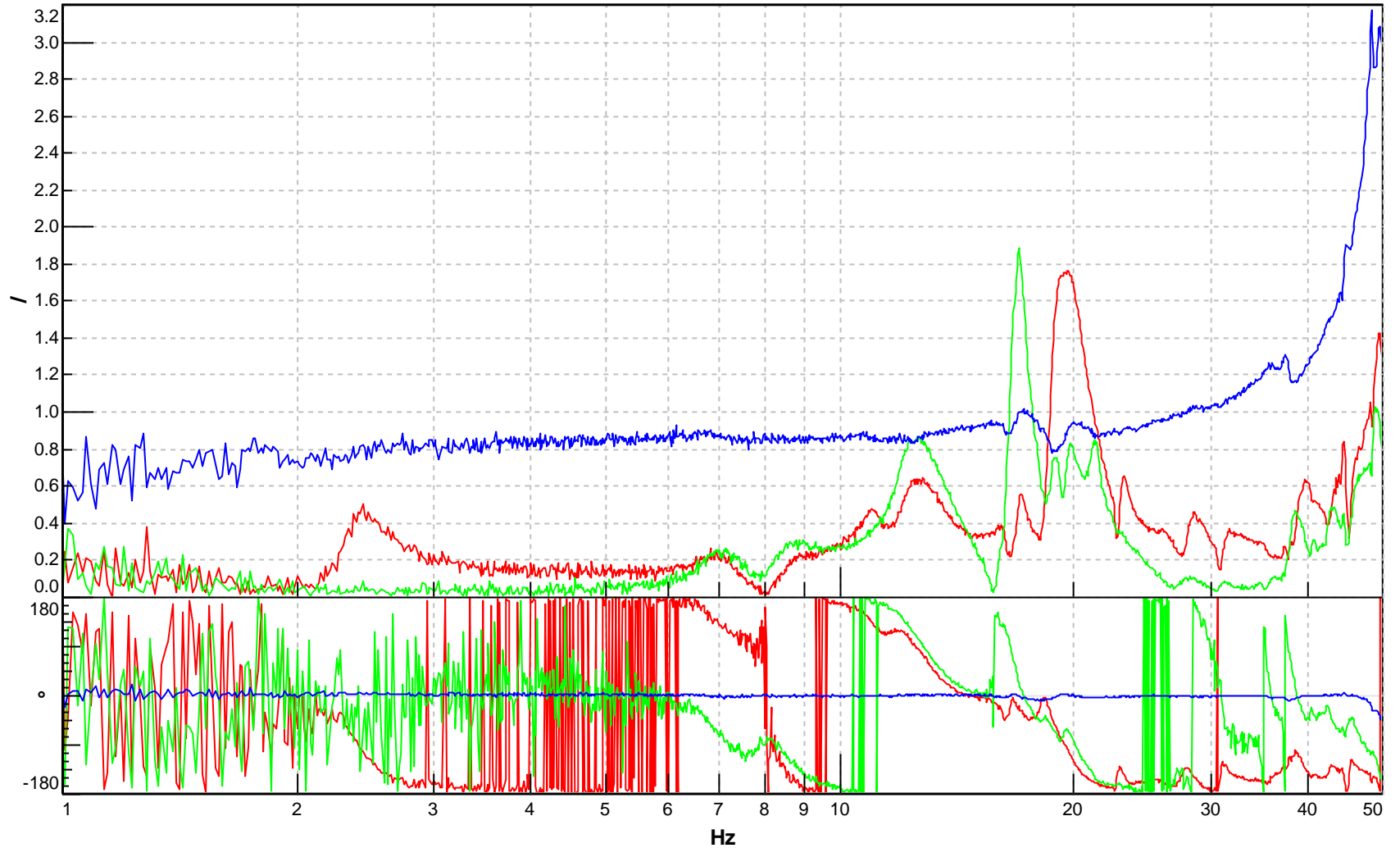
Resonance frequency search



Project: MTL-20-016
Section: Z axis
Run: Sine_1
Date: Mon May 04 2020 10:24:12
Point id: MP1
Reference point id: CP1
Sweep rate: 1 Oct/min

Resonance frequency search

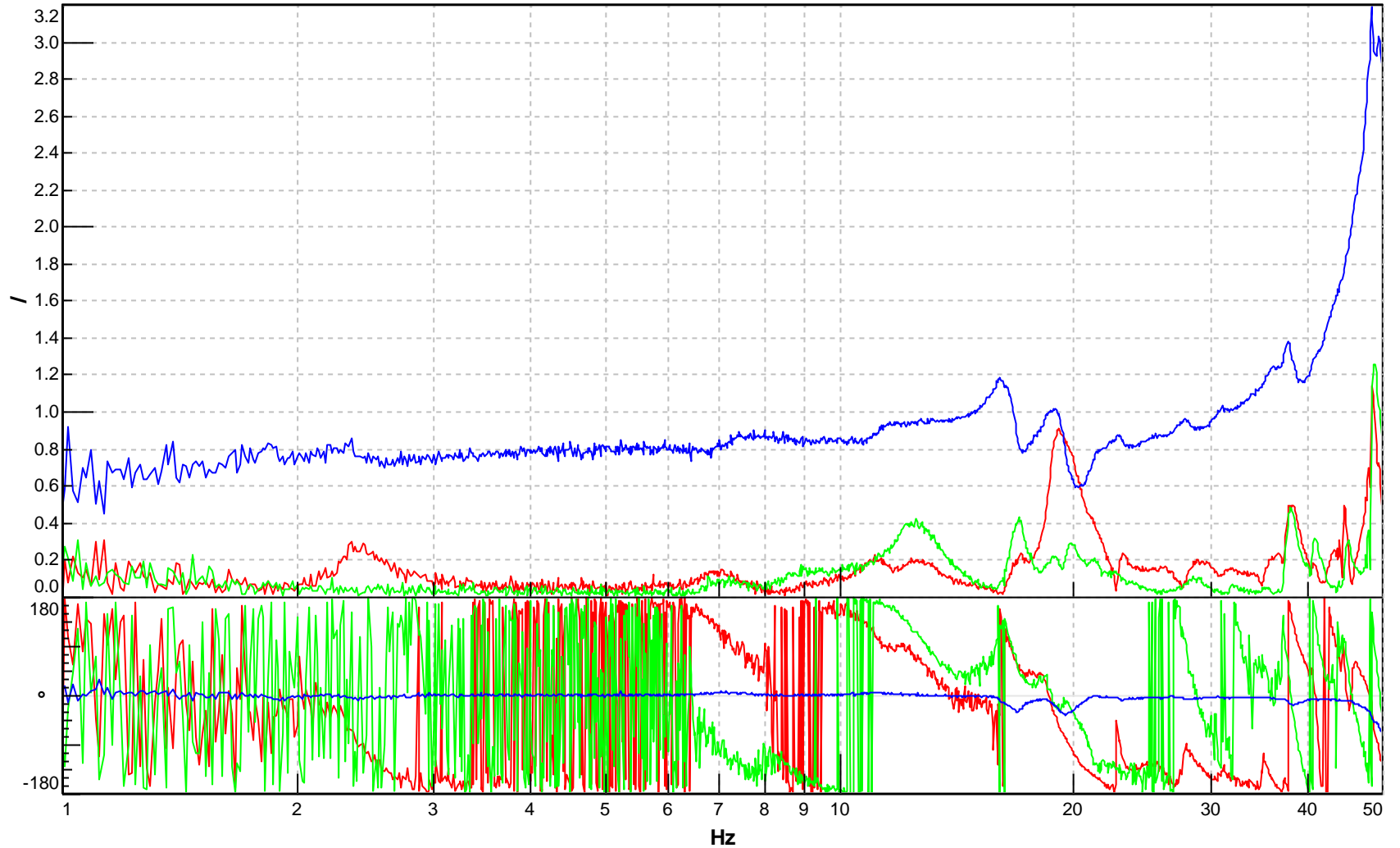
- FRF (Harmonic) MP1:+X/CP1:+Z
- FRF (Harmonic) MP1:+Y/CP1:+Z
- FRF (Harmonic) MP1:+Z/CP1:+Z



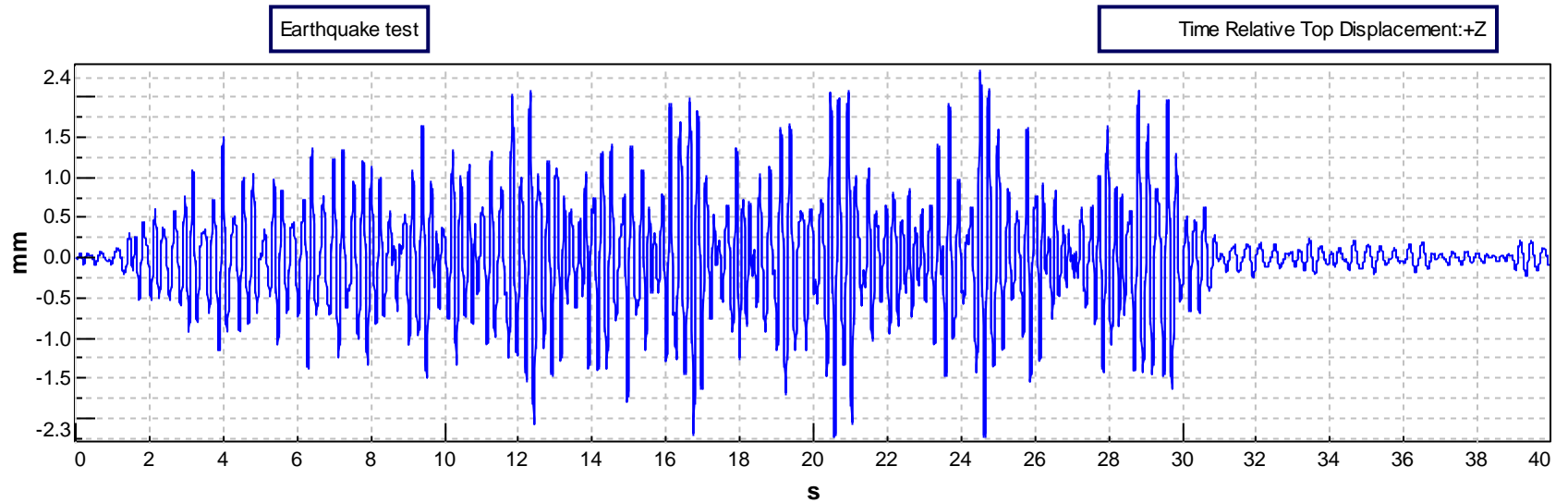
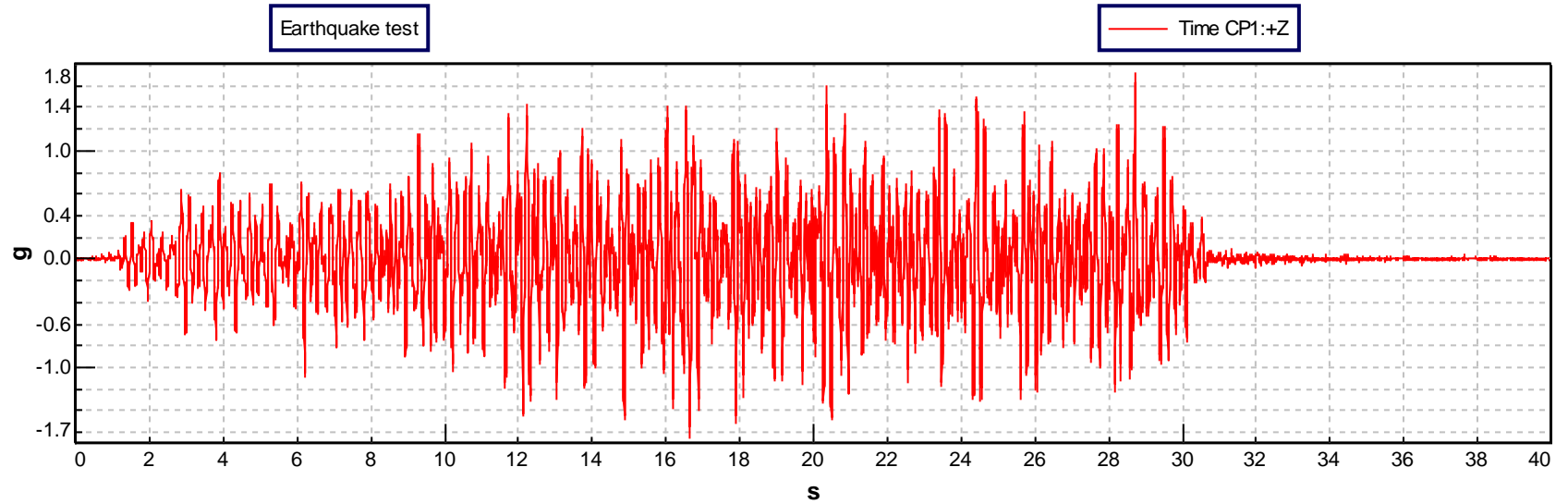
Project: MTL-20-016
Section: Z axis
Run: Sine_1
Date: Mon May 04 2020 10:24:12
Point id: MP2
Reference point id: CP1
Sweep rate: 1 Oct/min

Resonance frequency search

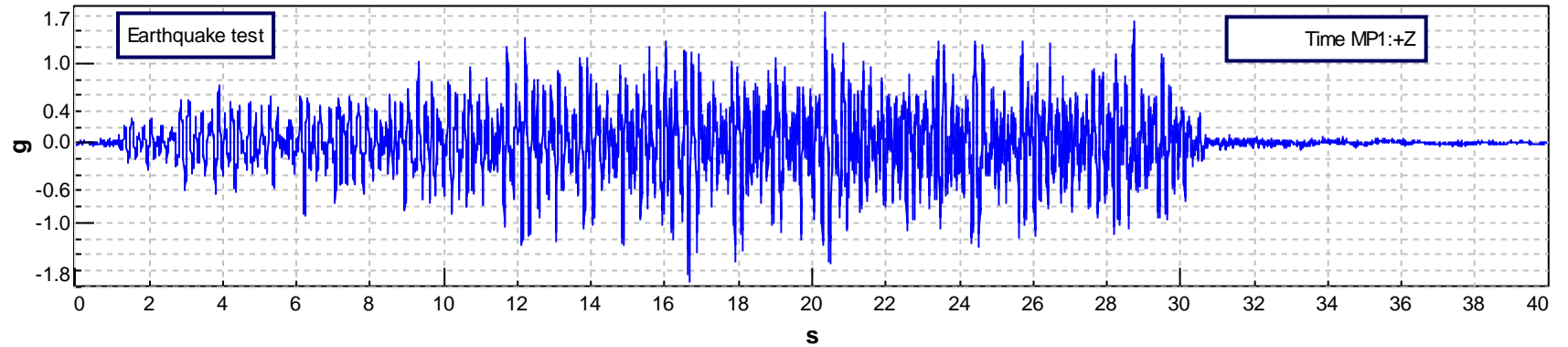
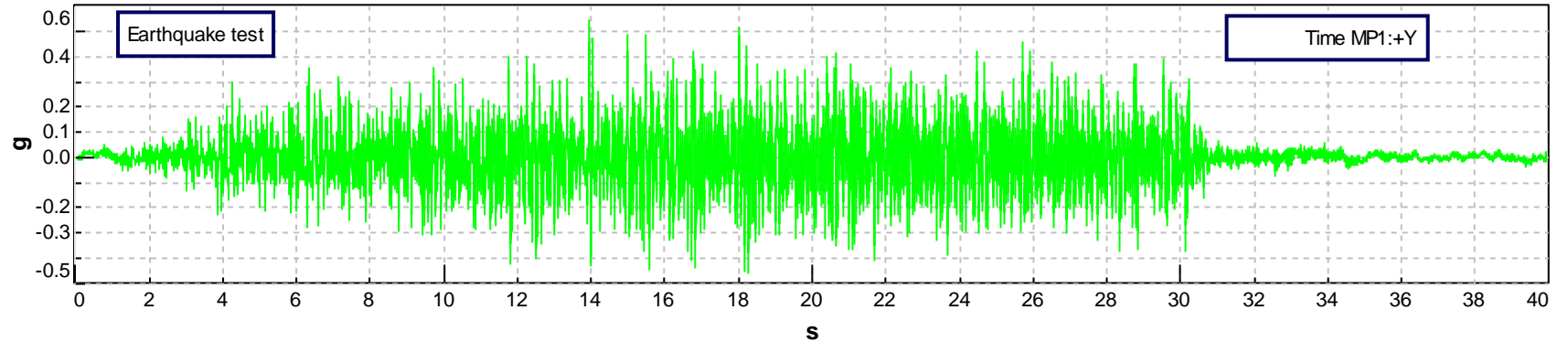
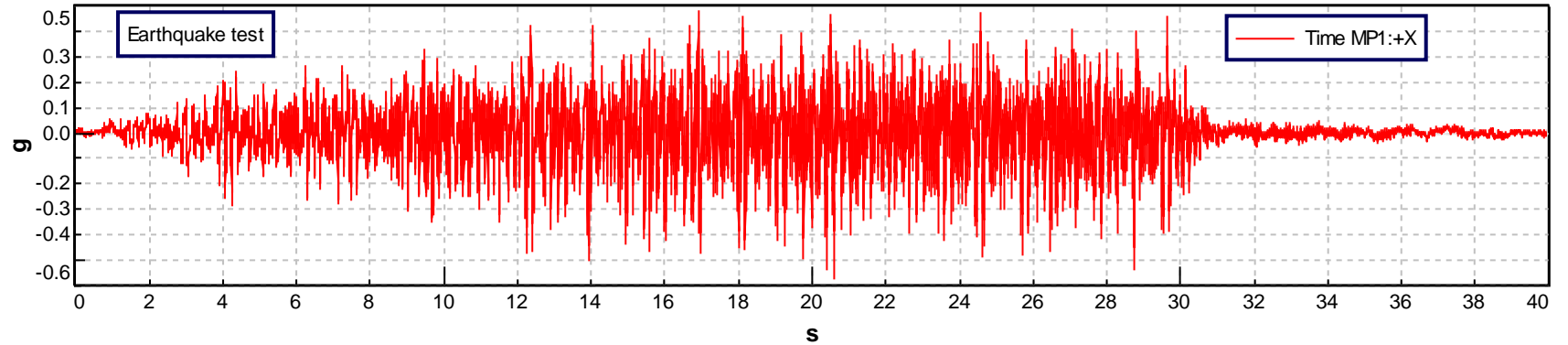
- FRF (Harmonic) MP2:+X/CP1:+Z
- FRF (Harmonic) MP2:+Y/CP1:+Z
- FRF (Harmonic) MP2:+Z/CP1:+Z



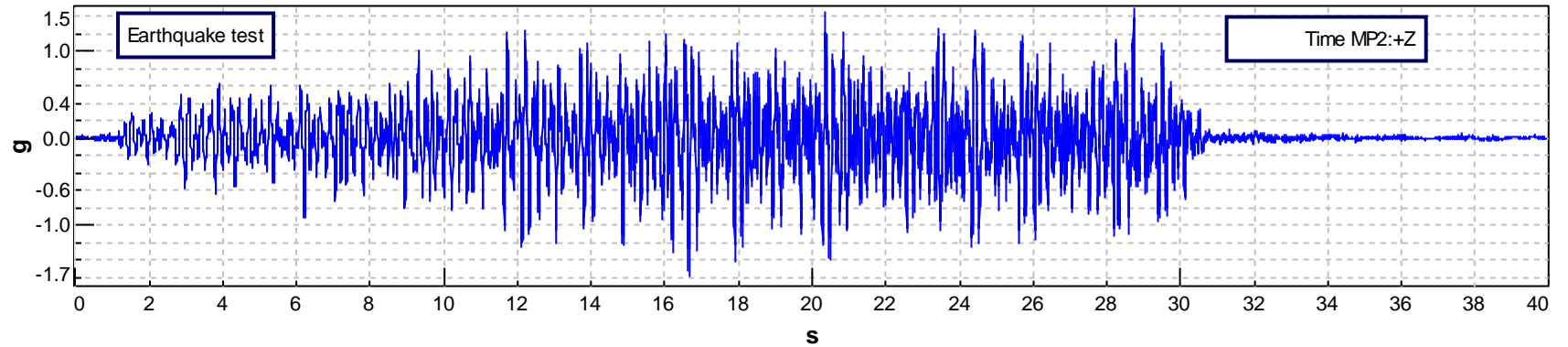
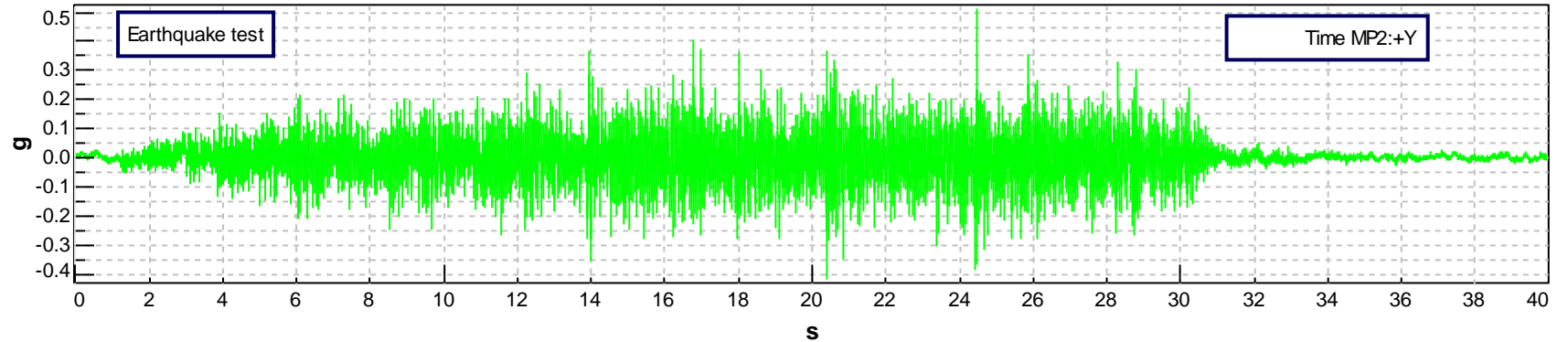
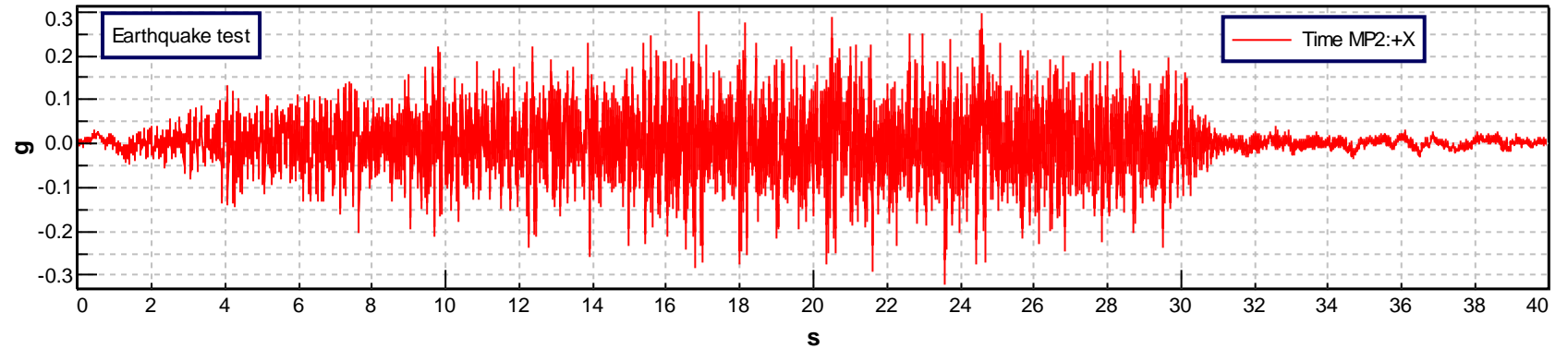
Project: MTL-20-016
Section: Z axis
Run: Shock_1
Date: Mon May 04 2020 10:31:30



Project: MTL-20-016
Section: Z axis
Run: Shock_1
Date: Mon May 04 2020 10:31:30



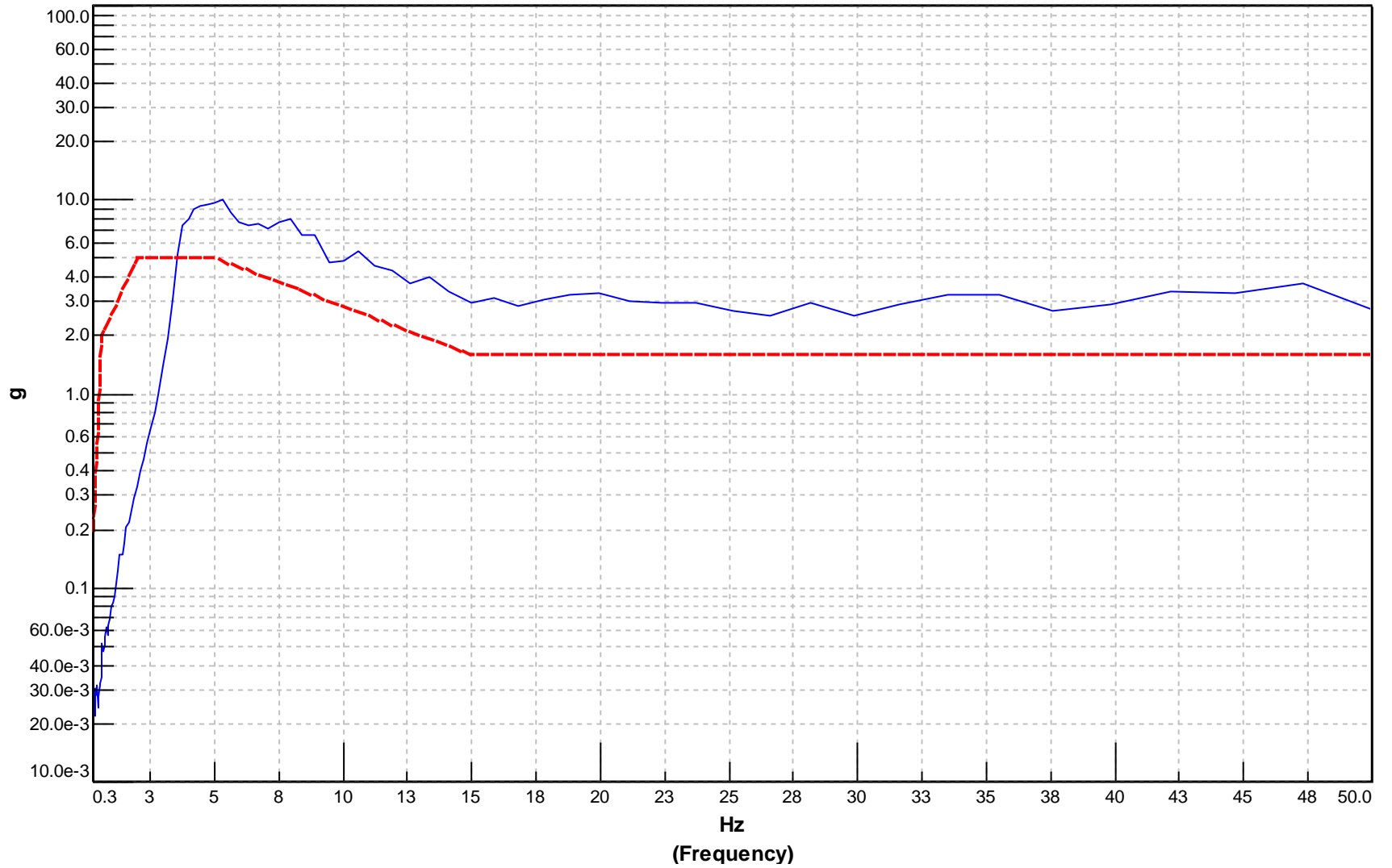
Project: MTL-20-016
Section: Z axis
Run: Shock_1
Date: Mon May 04 2020 10:31:30



Project: MTL-20-016
Section: Z axis
Run: Shock_1
Date: Mon May 04 2020 10:31:30

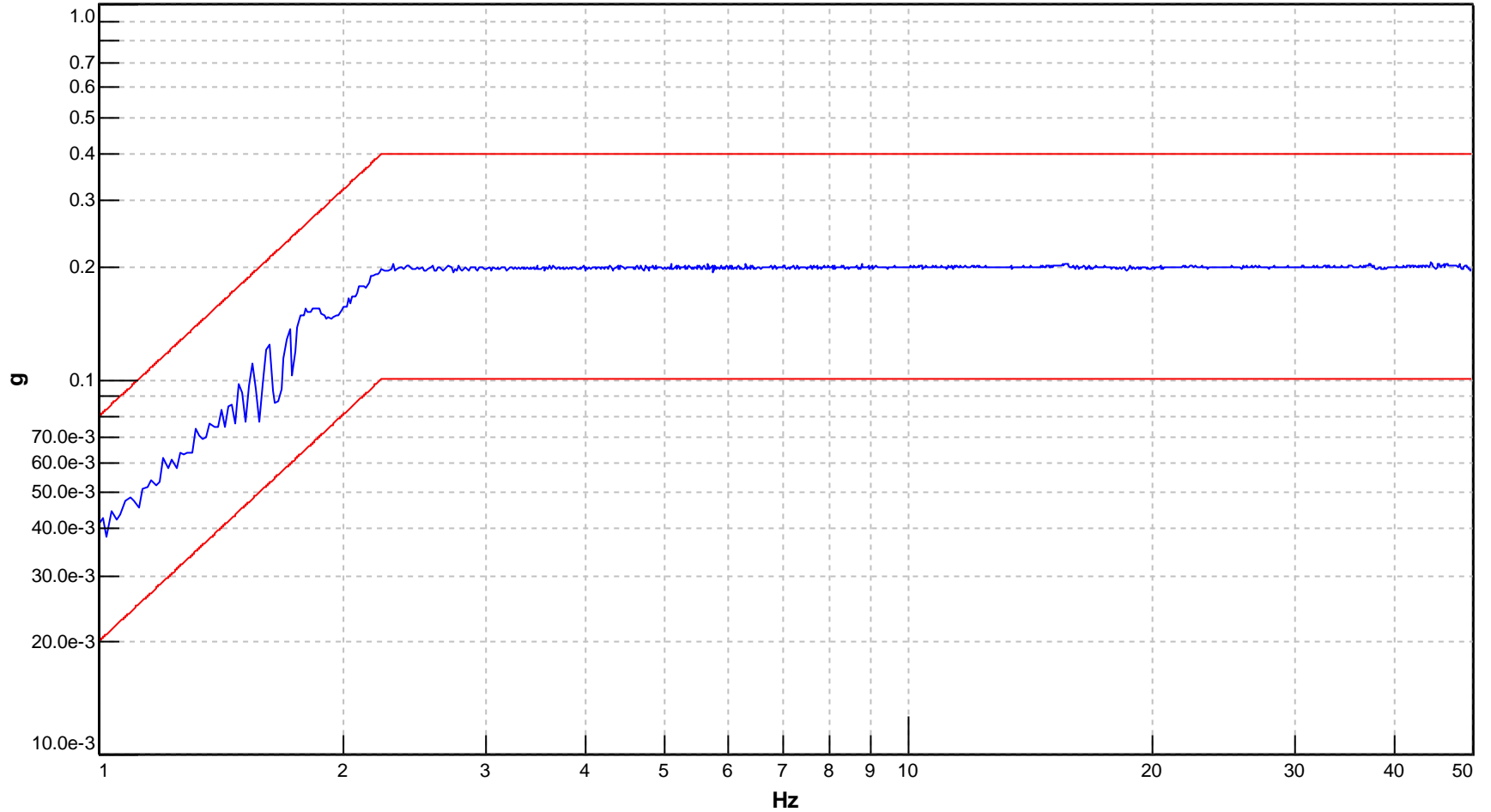
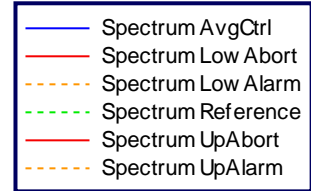
Earthquake test

— TRS CP1:+Z
- - - Telcordia RRS - Zone 4



Project: MTL-20-016
Section: Z axis
Run: Sine_2
Date: Mon May 04 2020 10:56:12
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average
Sweep rate: 1 Oct/min

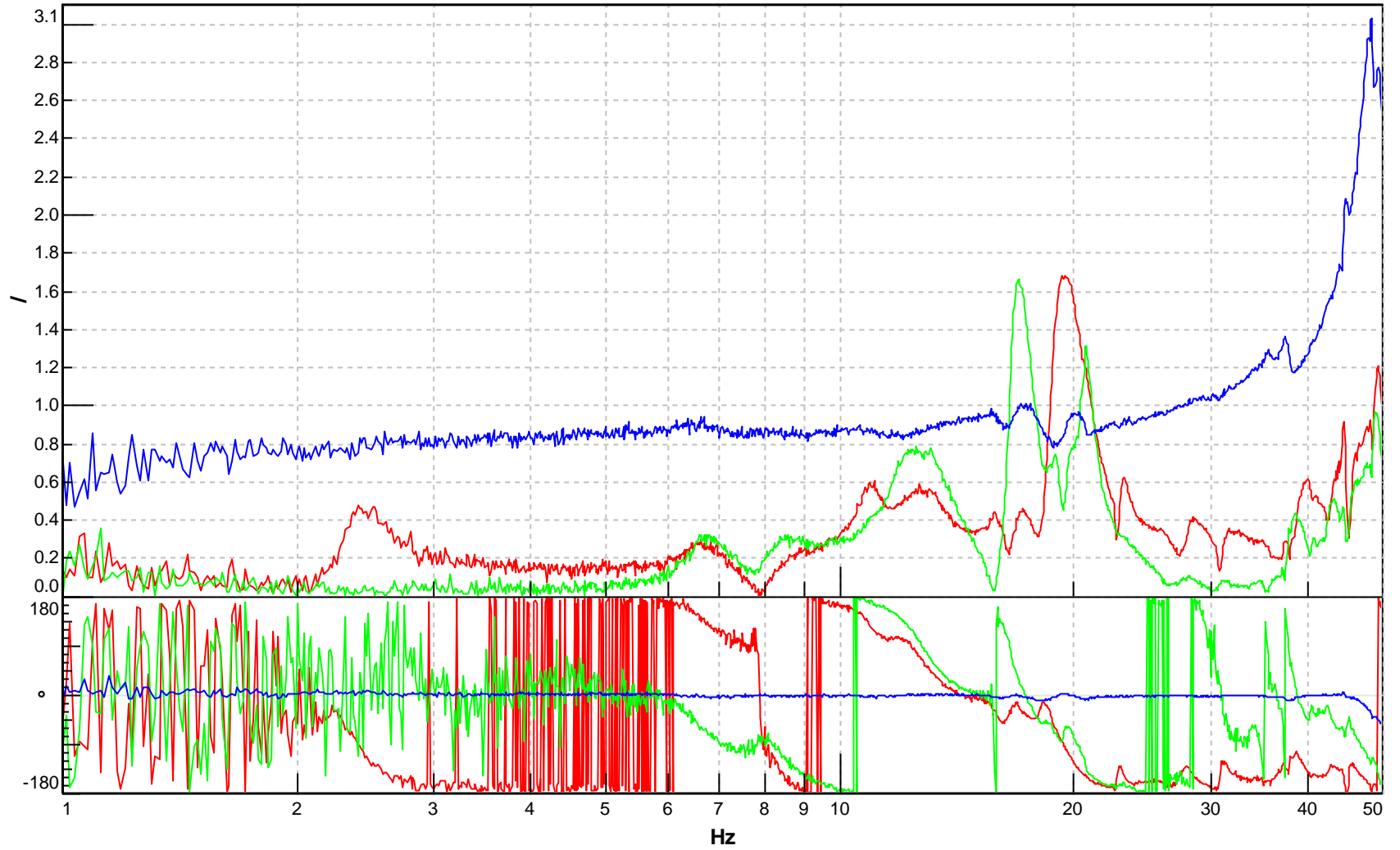
Resonance frequency search



Project: MTL-20-016
Section: Z axis
Run: Sine_2
Date: Mon May 04 2020 10:56:12
Point id: MP1
Reference point id: CP1
Sweep rate: 1 Oct/min

Resonance frequency search

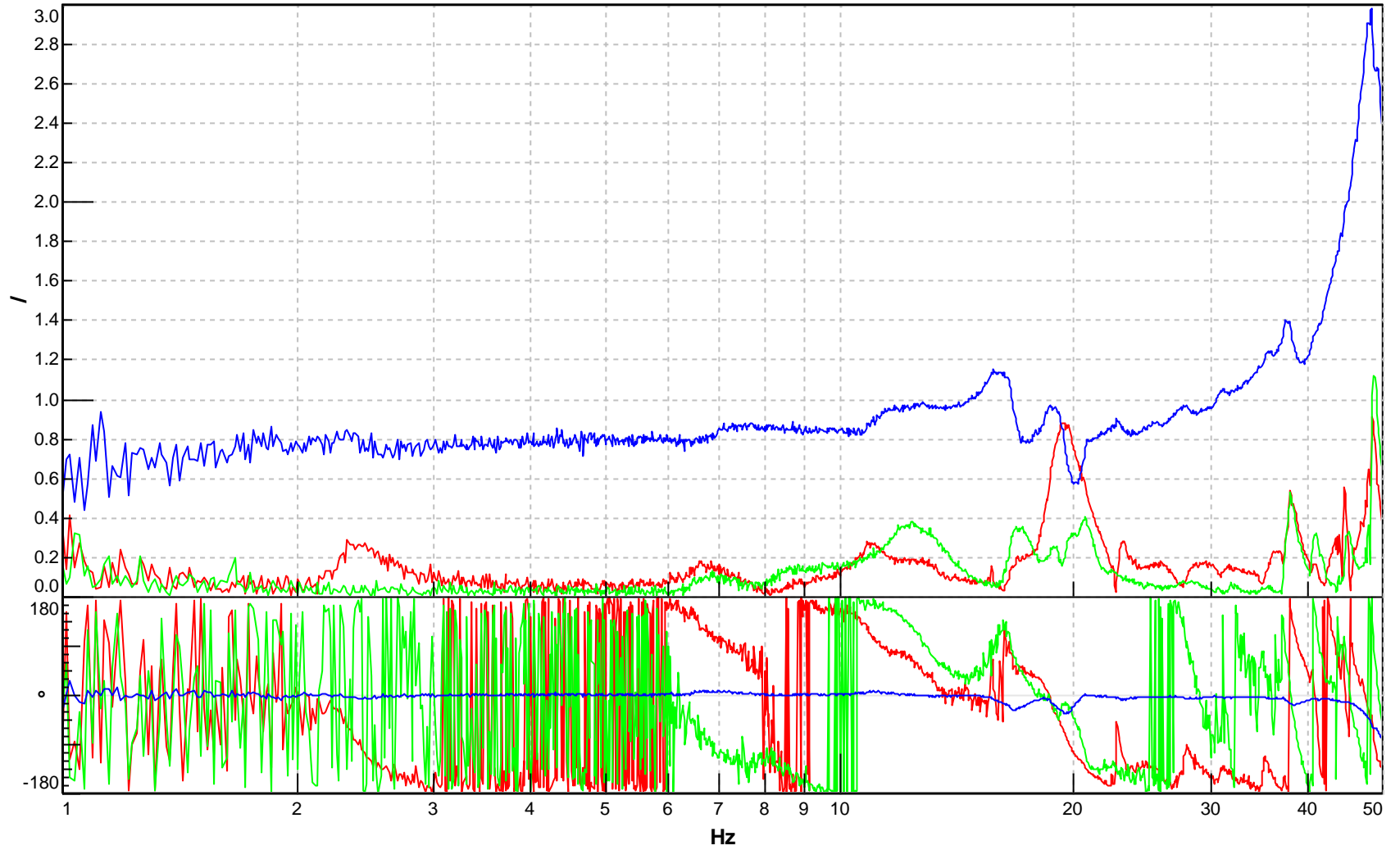
- FRF (Harmonic) MP1:+X/CP1:+Z
- FRF (Harmonic) MP1:+Y/CP1:+Z
- FRF (Harmonic) MP1:+Z/CP1:+Z



Project: MTL-20-016
Section: Z axis
Run: Sine_2
Date: Mon May 04 2020 10:56:12
Point id: MP2
Reference point id: CP1
Sweep rate: 1 Oct/min

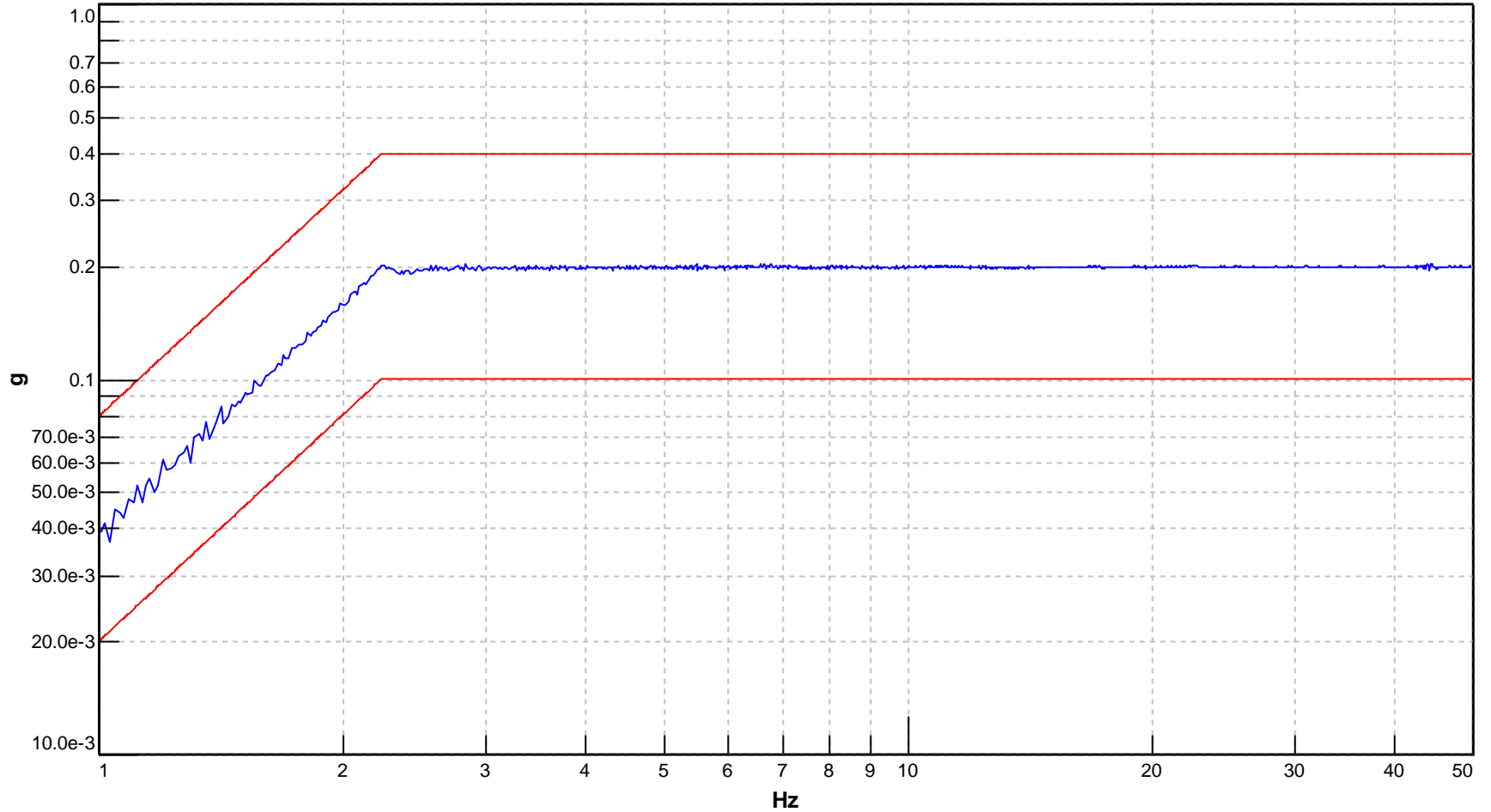
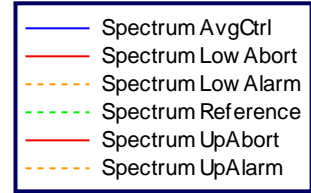
Resonance frequency search

- FRF (Harmonic) MP2:+X/CP1:+Z
- FRF (Harmonic) MP2:+Y/CP1:+Z
- FRF (Harmonic) MP2:+Z/CP1:+Z



Project: MTL-20-016
Section: X axis
Run: Sine_1
Date: Mon May 04 2020 12:05:03
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average
Sweep rate: 1 Oct/min

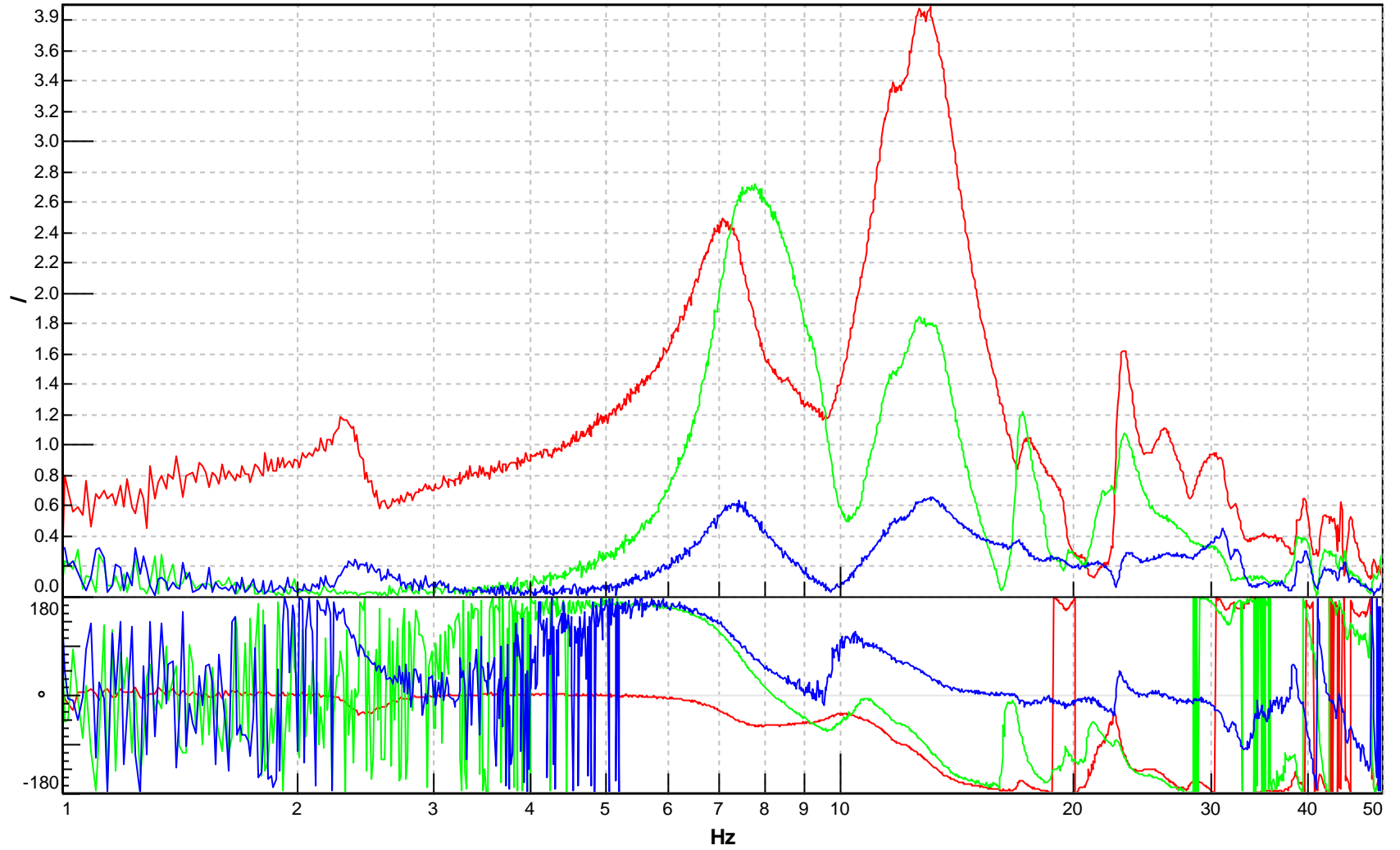
Resonance frequency search



Project: MTL-20-016
Section: X axis
Run: Sine_1
Date: Mon May 04 2020 12:05:03
Point id: MP1
Reference point id: CP1
Sweep rate: 1 Oct/min

Resonance frequency search

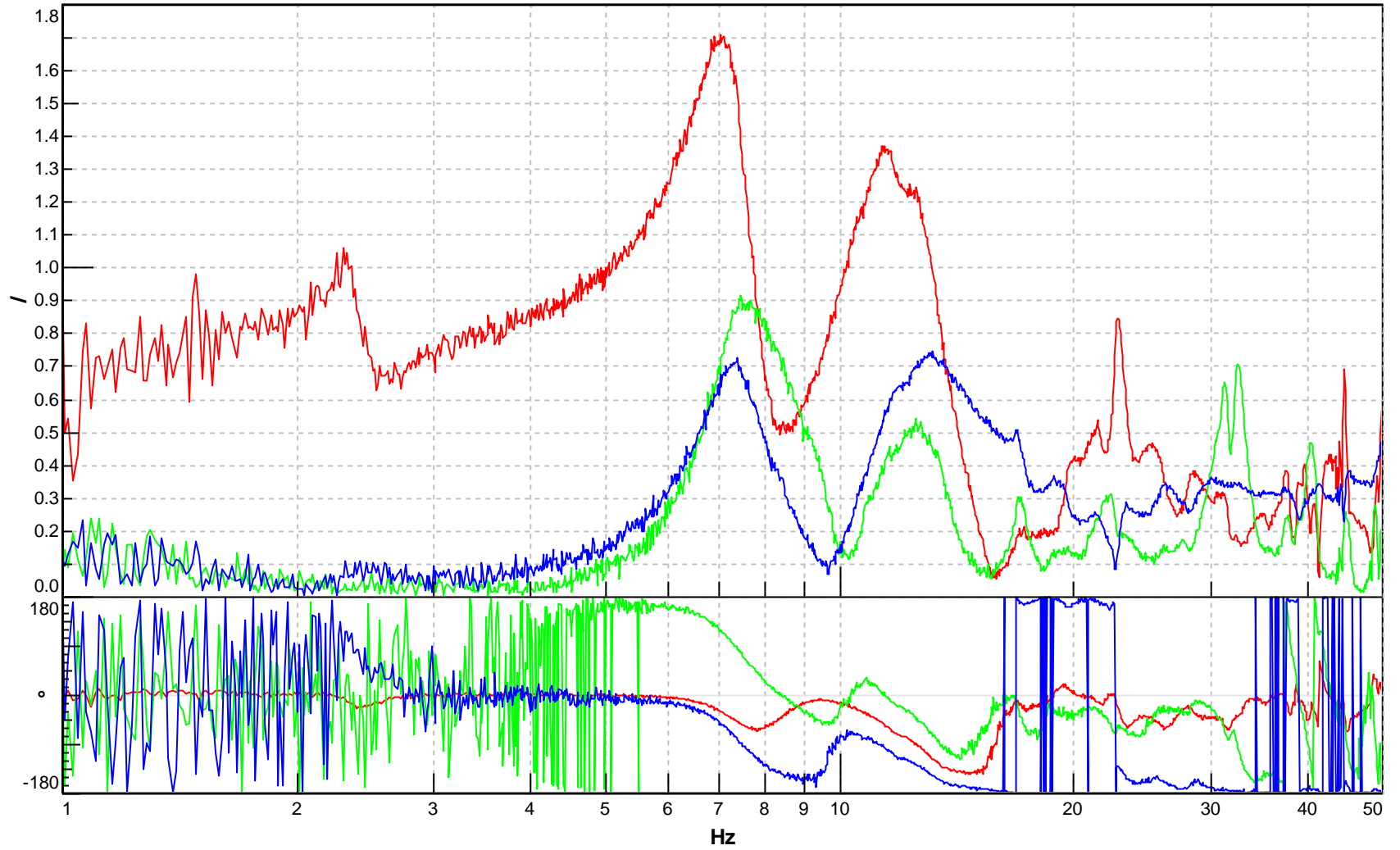
- FRF (Harmonic) MP1:+X/CP1:+X
- FRF (Harmonic) MP1:+Y/CP1:+X
- FRF (Harmonic) MP1:+Z/CP1:+X



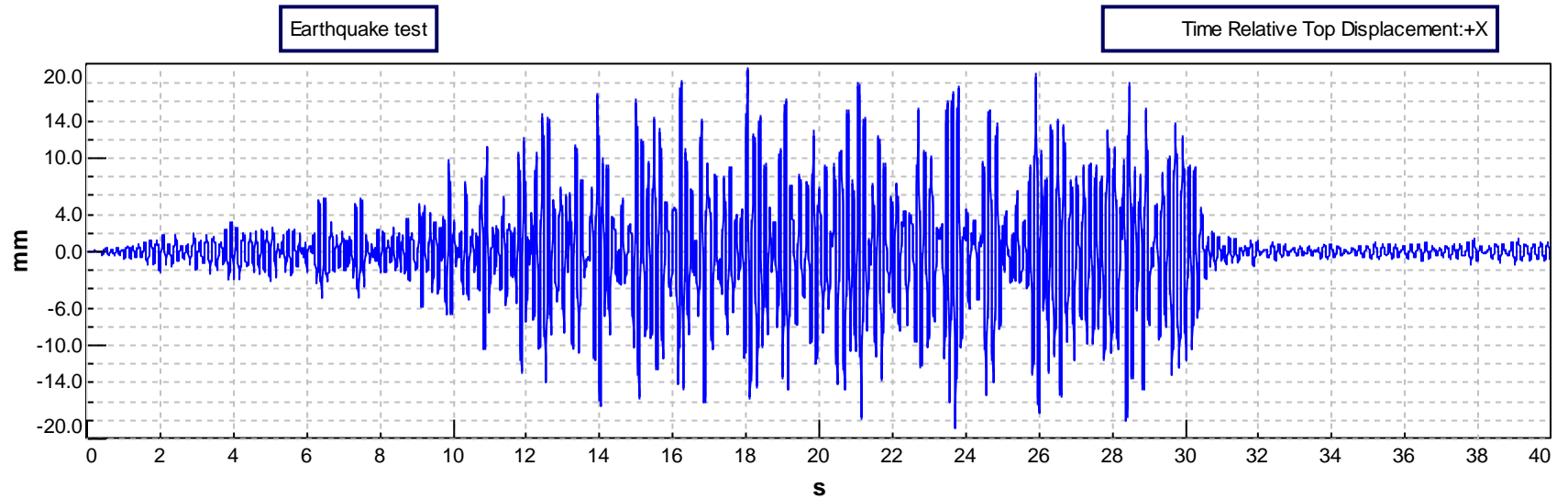
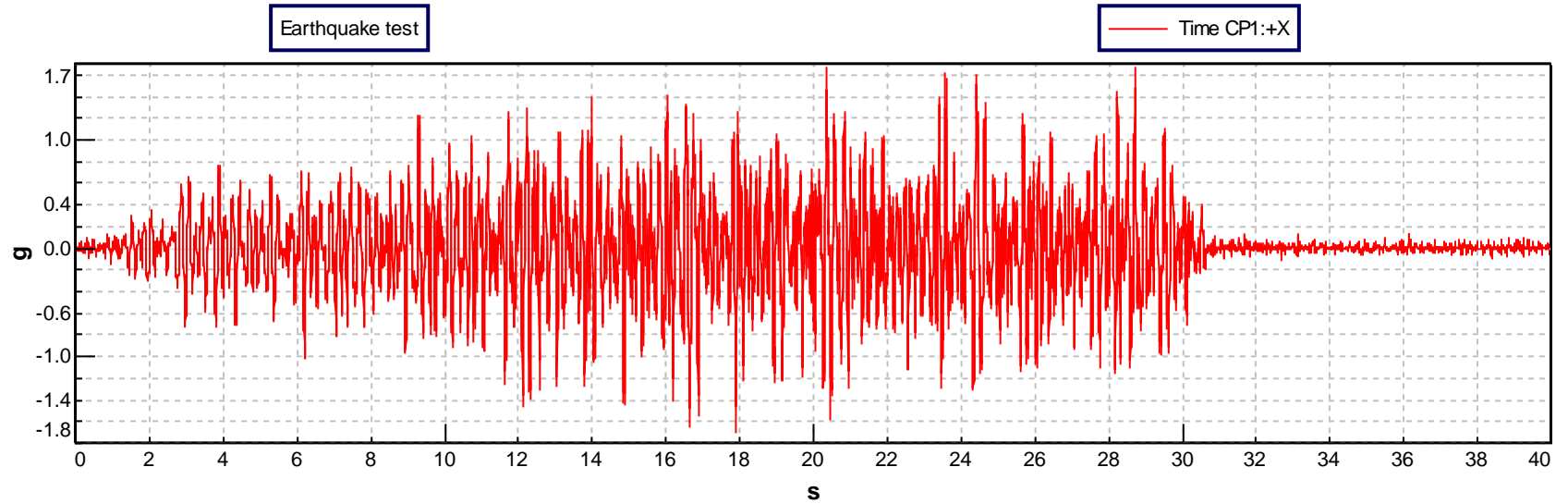
Project: MTL-20-016
Section: X axis
Run: Sine_1
Date: Mon May 04 2020 12:05:03
Point id: MP2
Reference point id: CP1
Sweep rate: 1 Oct/min

Resonance frequency search

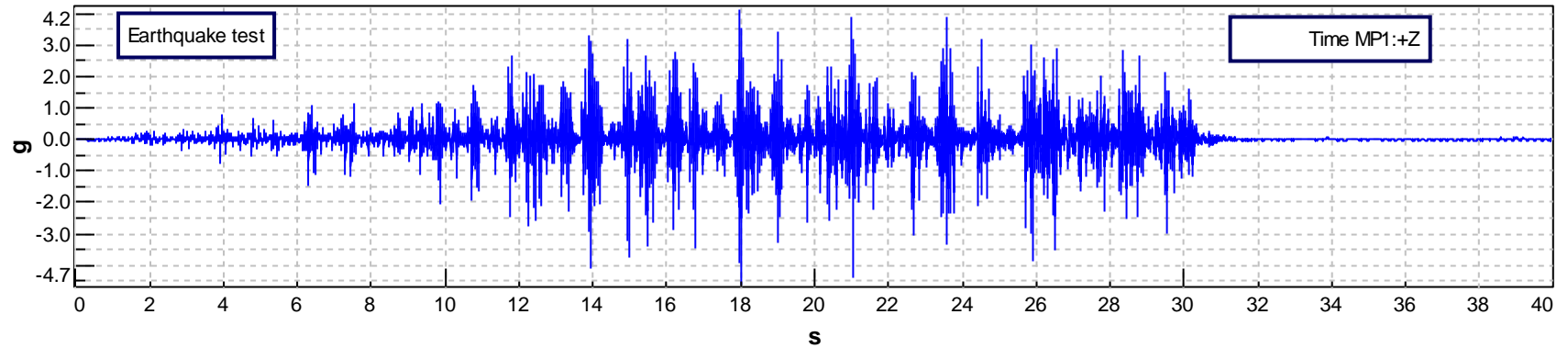
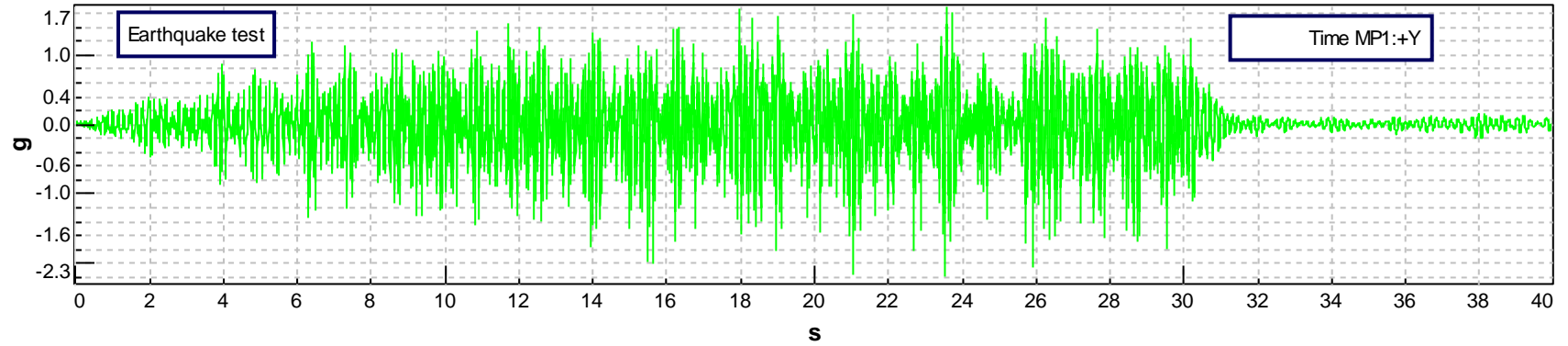
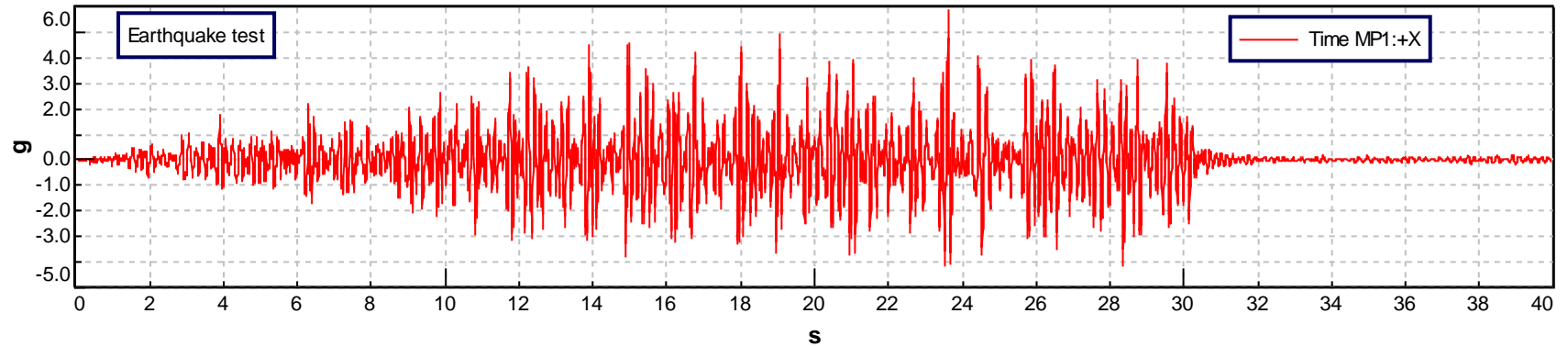
- FRF (Harmonic) MP2:+X/CP1:+X
- FRF (Harmonic) MP2:+Y/CP1:+X
- FRF (Harmonic) MP2:+Z/CP1:+X



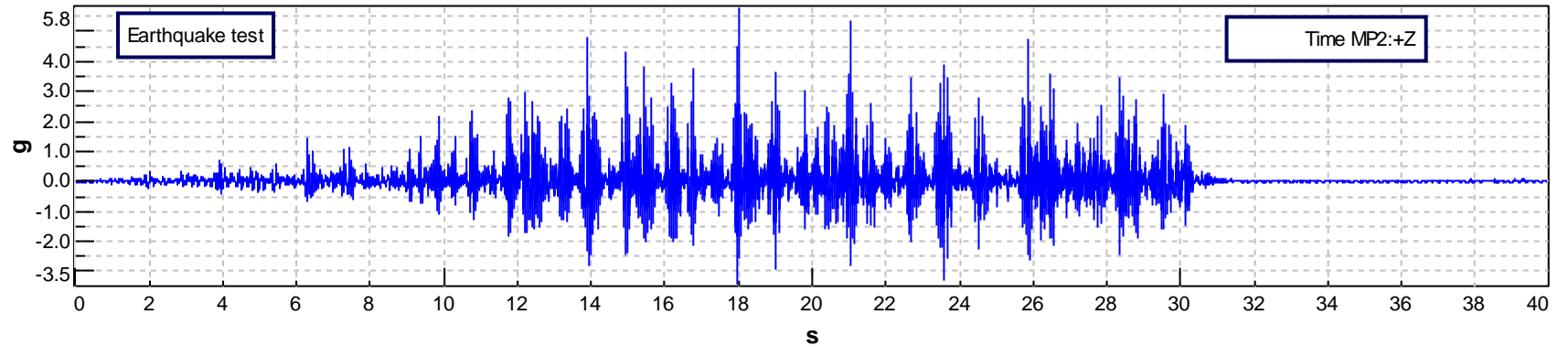
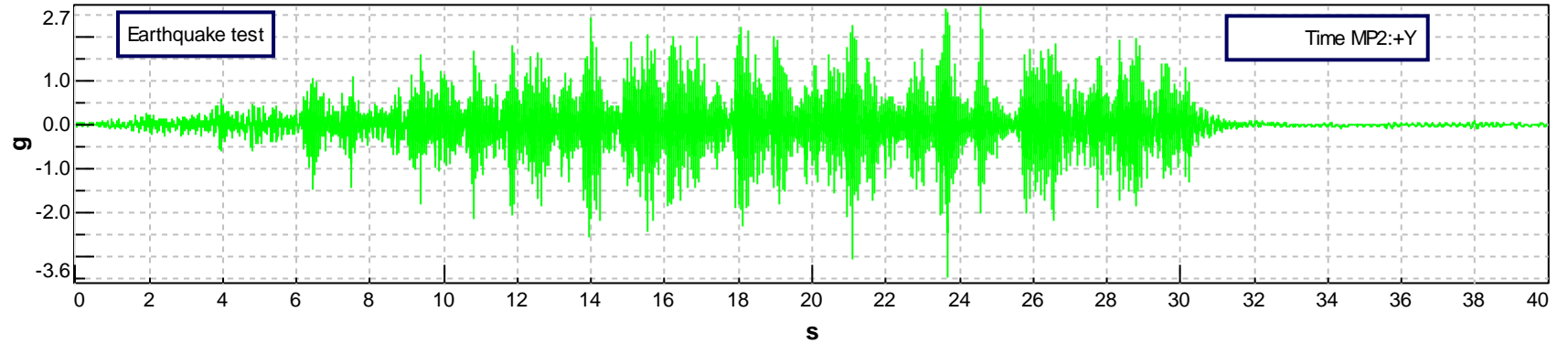
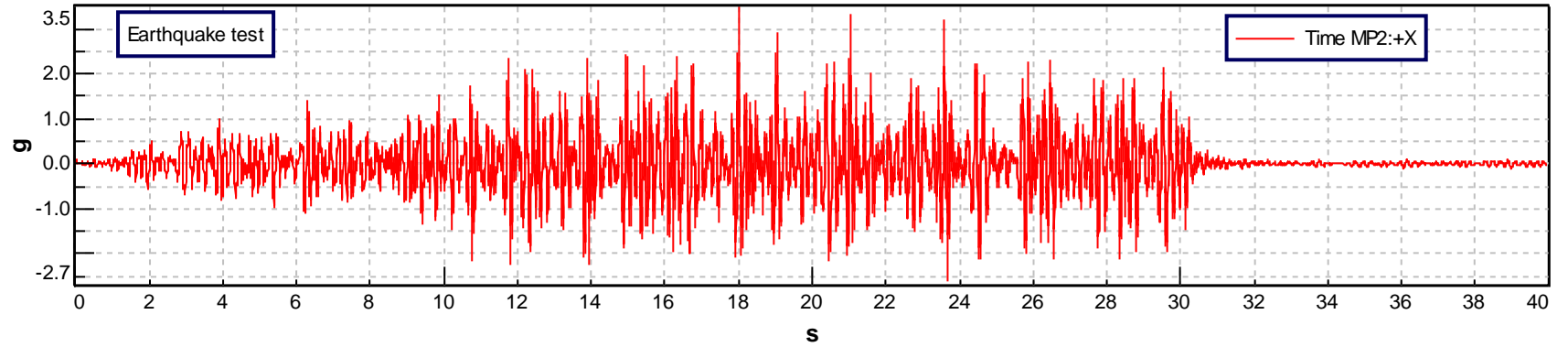
Project: MTL-20-016
Section: X axis
Run: Shock_1
Date: Mon May 04 2020 12:10:45



Project: MTL-20-016
Section: X axis
Run: Shock_1
Date: Mon May 04 2020 12:10:45



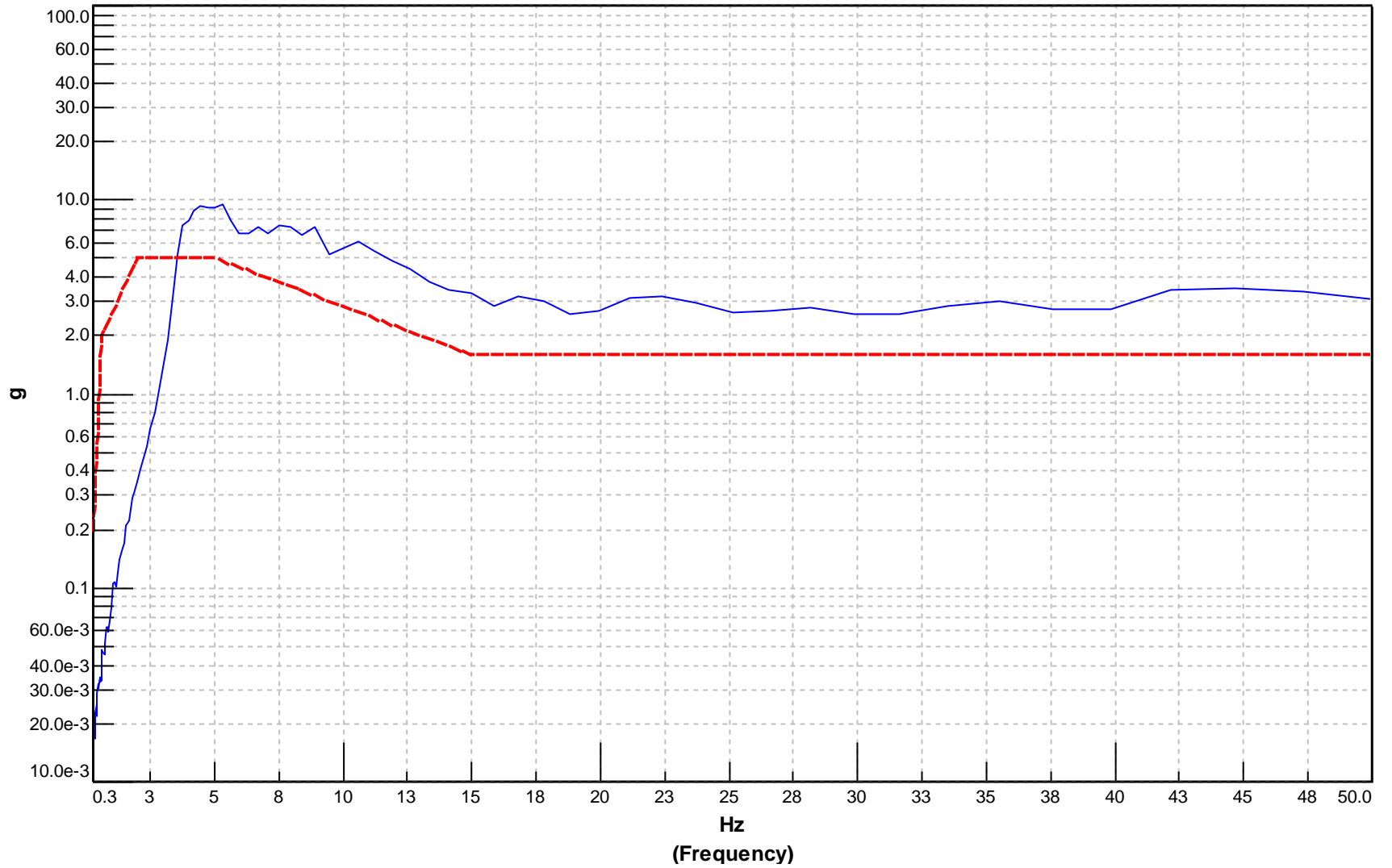
Project: MTL-20-016
Section: X axis
Run: Shock_1
Date: Mon May 04 2020 12:10:45



Project: MTL-20-016
Section: X axis
Run: Shock_1
Date: Mon May 04 2020 12:10:45

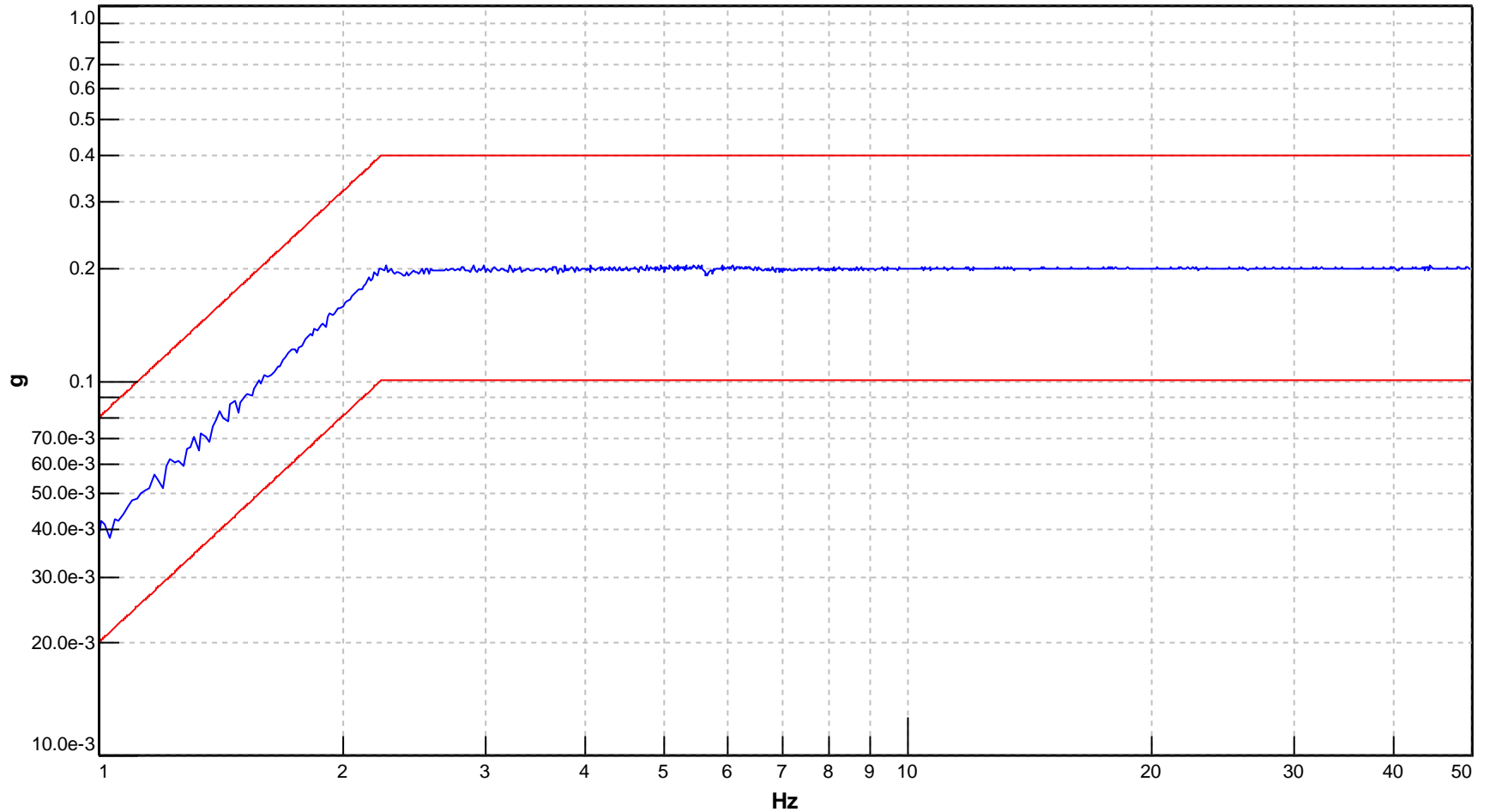
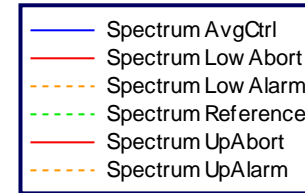
Earthquake test

— TRS CP1:+X
- - - Telcordia RRS - Zone 4



Project: MTL-20-016
Section: X axis
Run: Sine_2
Date: Mon May 04 2020 12:23:52
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average
Sweep rate: 1 Oct/min

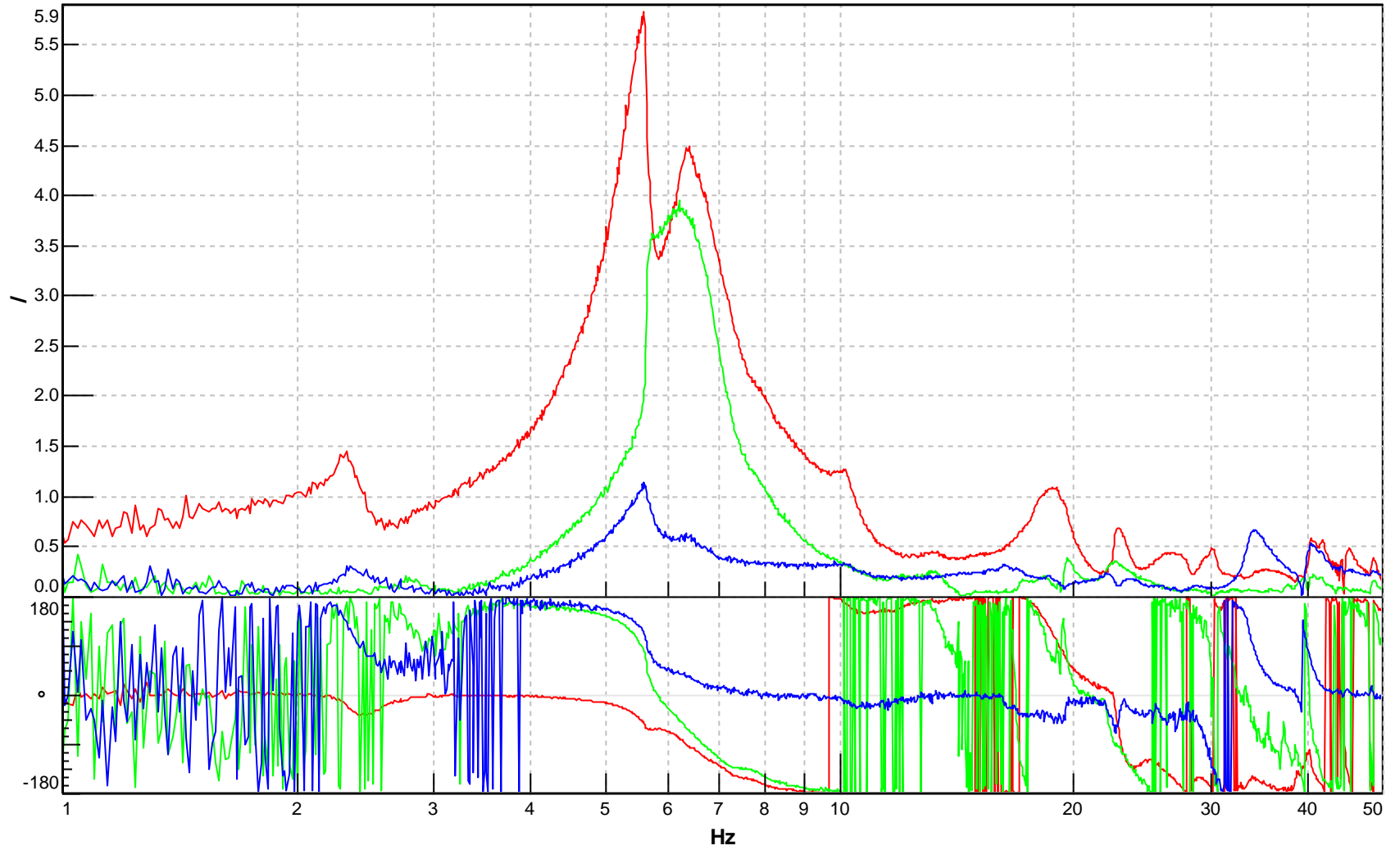
Resonance frequency search



Project: MTL-20-016
Section: X axis
Run: Sine_2
Date: Mon May 04 2020 12:23:52
Point id: MP1
Reference point id: CP1
Sweep rate: 1 Oct/min

Resonance frequency search

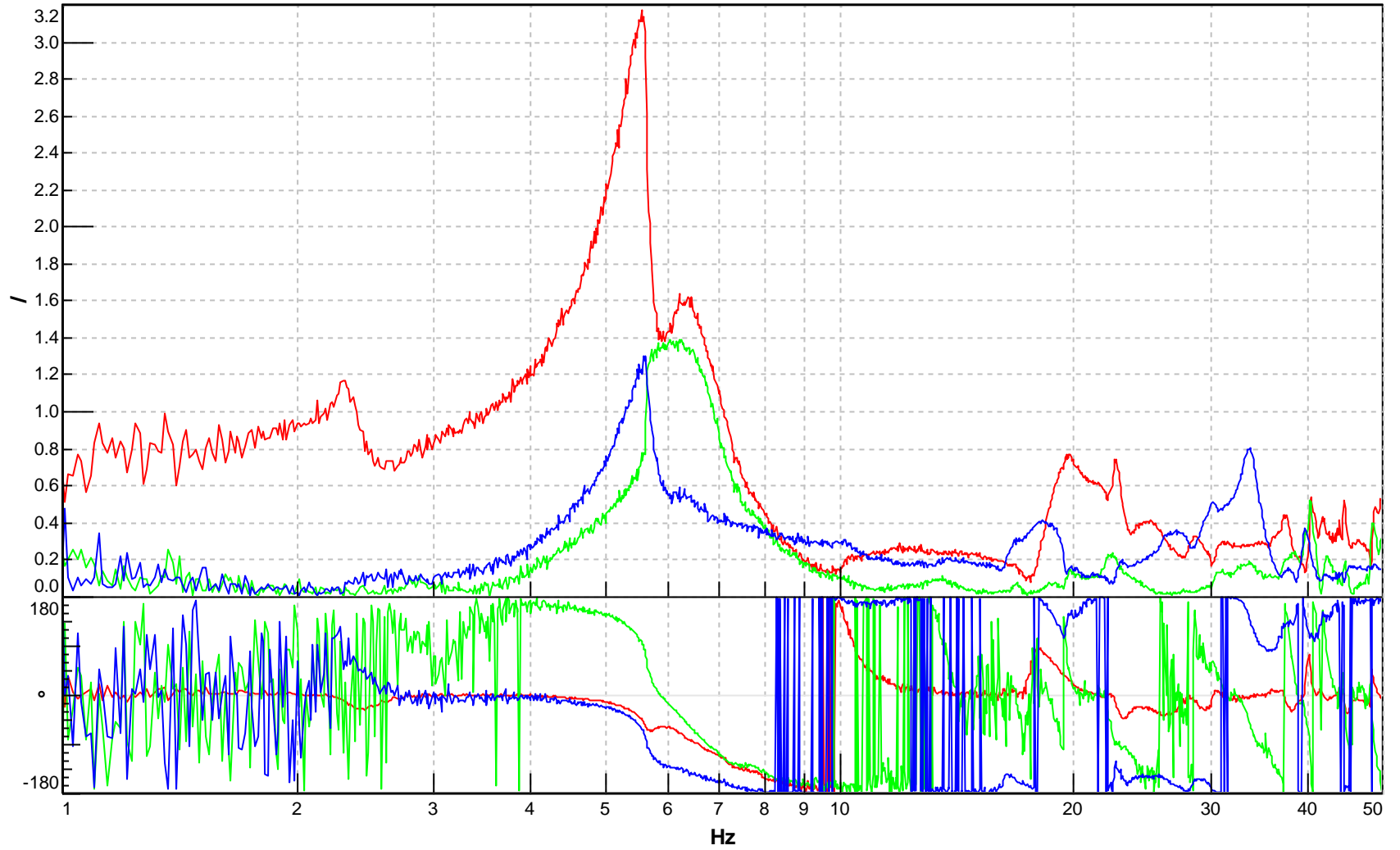
- FRF (Harmonic) MP1:+X/CP1:+X
- FRF (Harmonic) MP1:+Y/CP1:+X
- FRF (Harmonic) MP1:+Z/CP1:+X



Project: MTL-20-016
Section: X axis
Run: Sine_2
Date: Mon May 04 2020 12:23:52
Point id: MP2
Reference point id: CP1
Sweep rate: 1 Oct/min

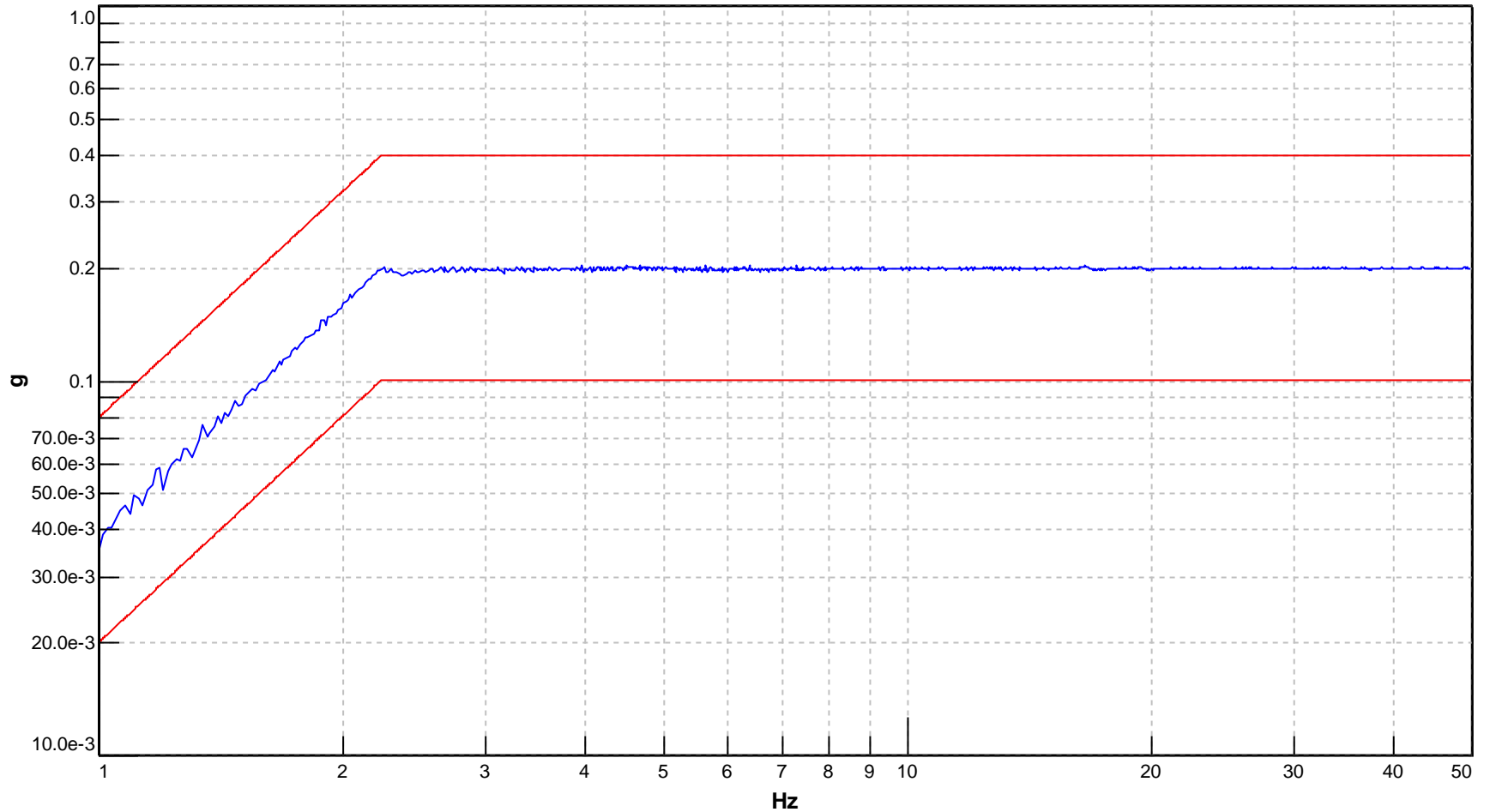
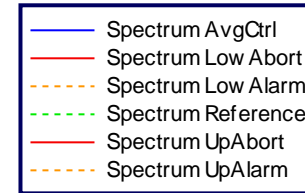
Resonance frequency search

- FRF (Harmonic) MP2:+X/CP1:+X
- FRF (Harmonic) MP2:+Y/CP1:+X
- FRF (Harmonic) MP2:+Z/CP1:+X



Project: MTL-20-016
Section: Y axis
Run: Sine_1
Date: Tue May 05 2020 09:28:05
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average
Sweep rate: 1 Oct/min

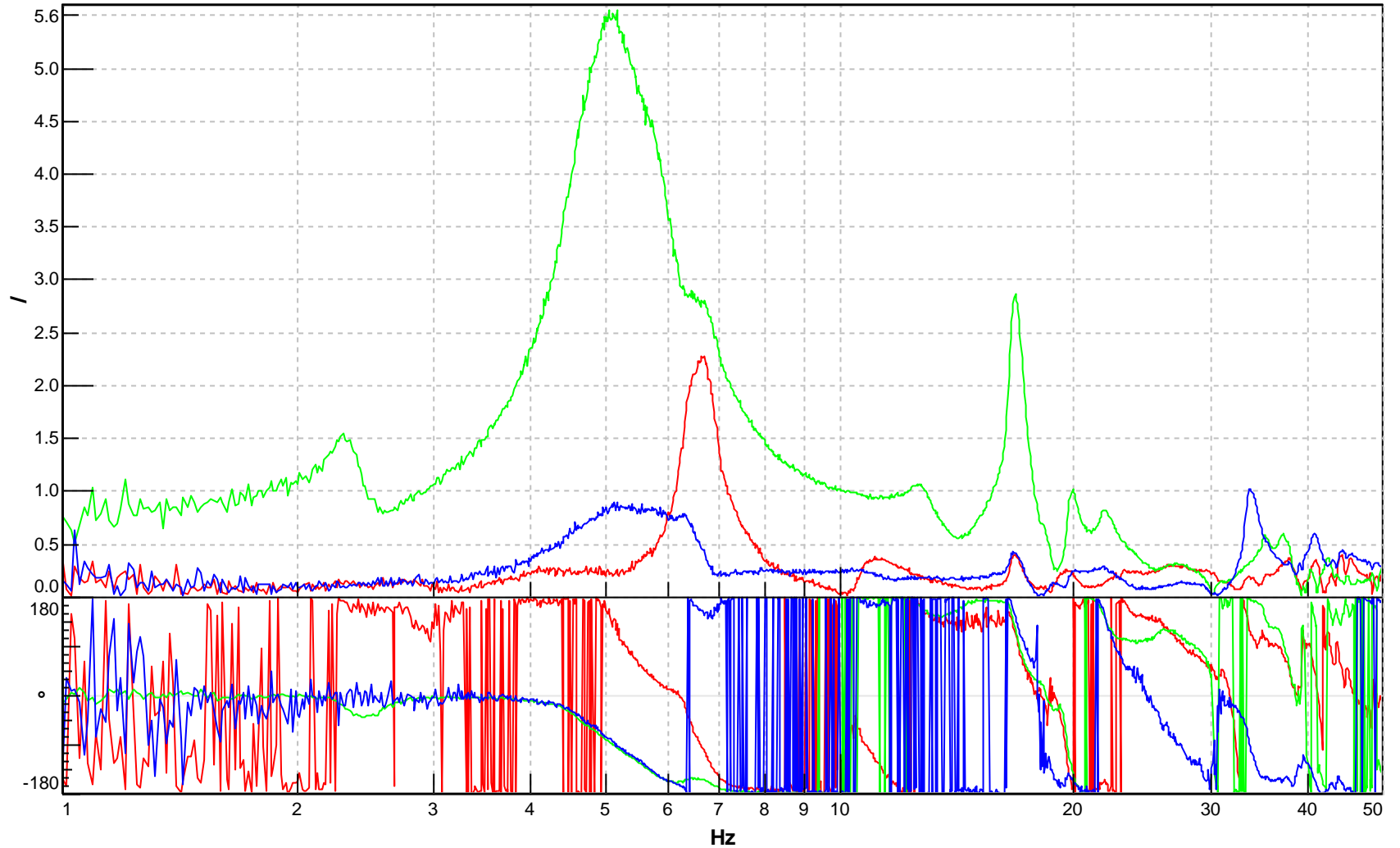
Resonance frequency search



Project: MTL-20-016
Section: Y axis
Run: Sine_1
Date: Tue May 05 2020 09:28:05
Point id: MP1
Reference point id: CP1
Sweep rate: 1 Oct/min

Resonance frequency search

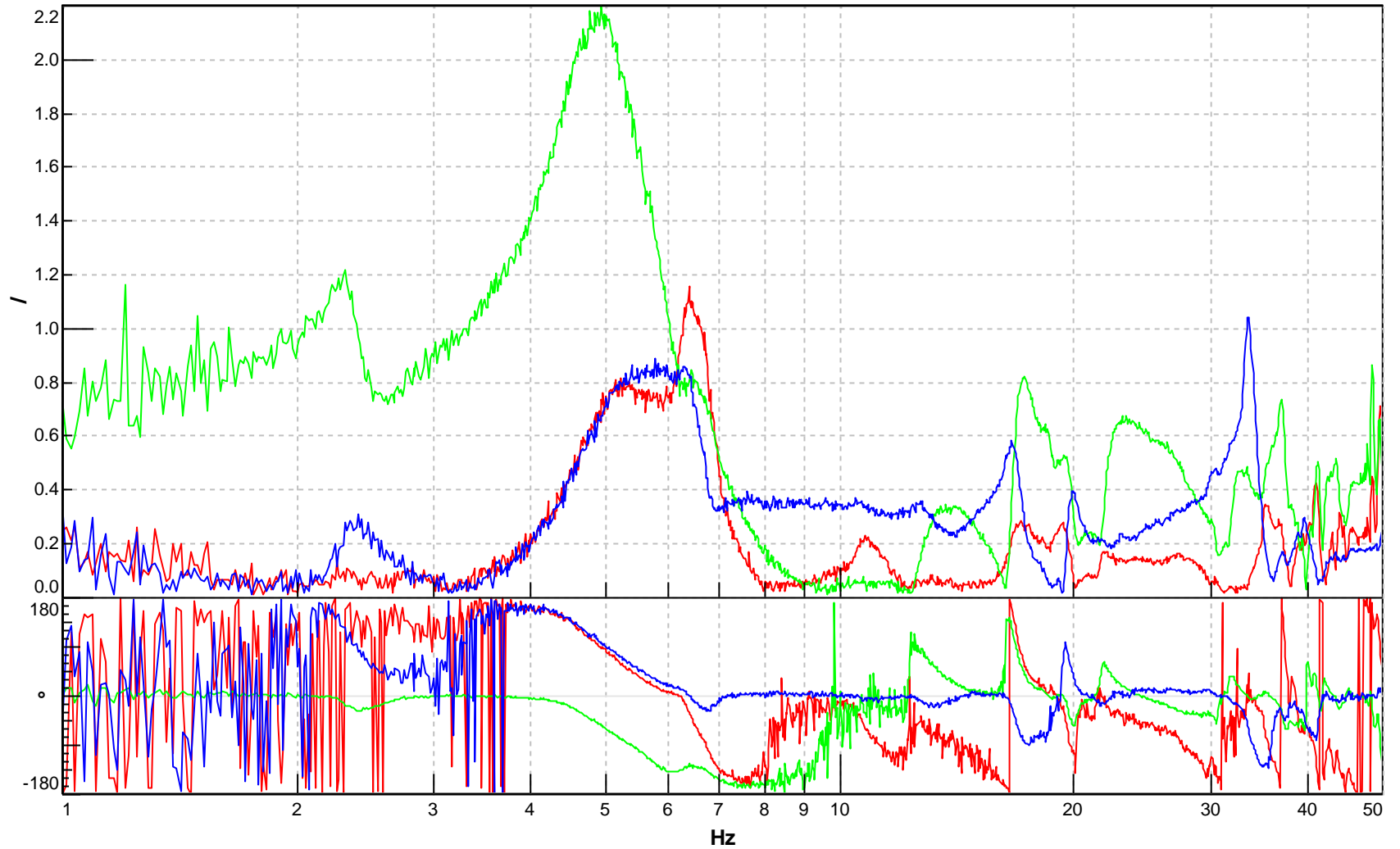
- FRF (Harmonic) MP1:+X/CP1:+Y
- FRF (Harmonic) MP1:+Y/CP1:+Y
- FRF (Harmonic) MP1:+Z/CP1:+Y



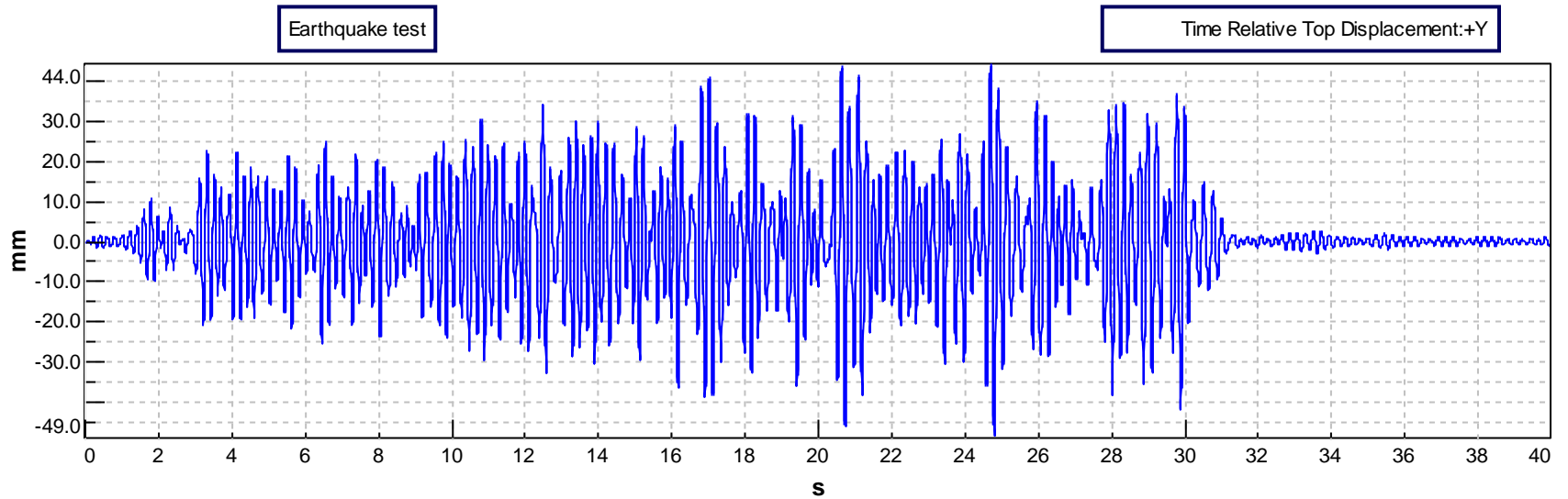
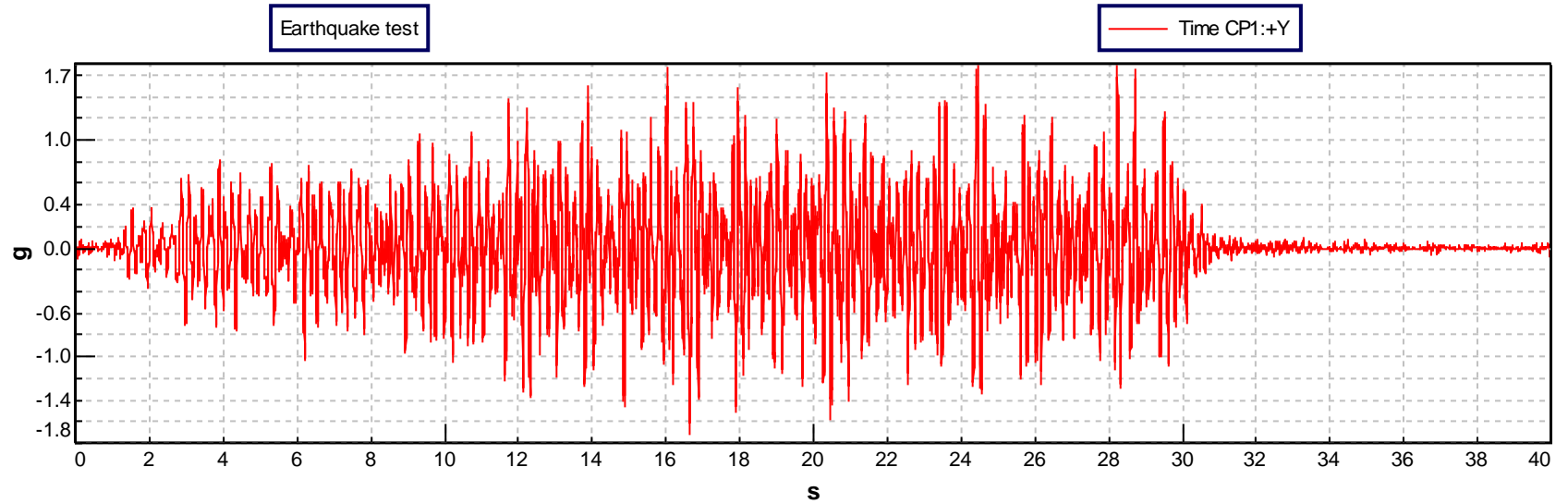
Project: MTL-20-016
Section: Y axis
Run: Sine_1
Date: Tue May 05 2020 09:28:05
Point id: MP2
Reference point id: CP1
Sweep rate: 1 Oct/min

Resonance frequency search

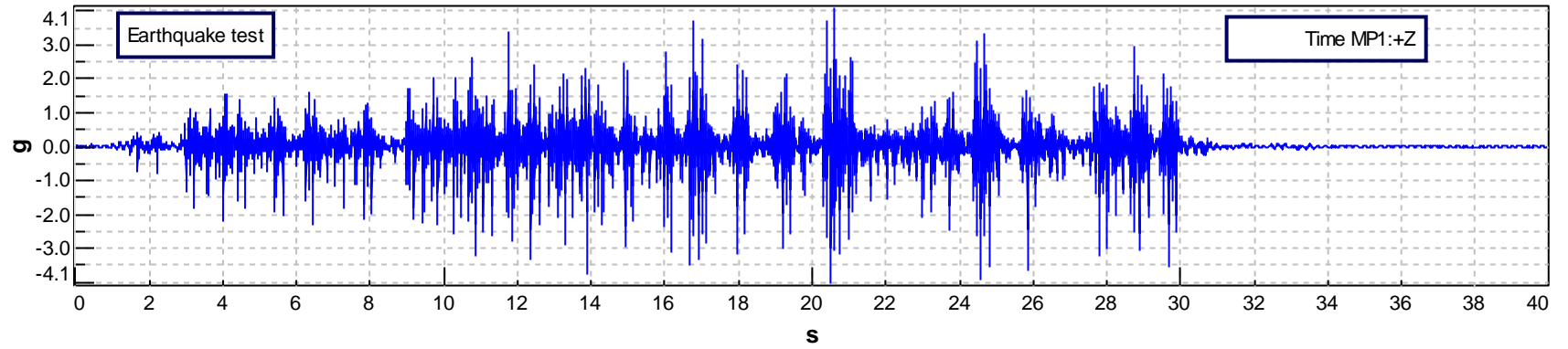
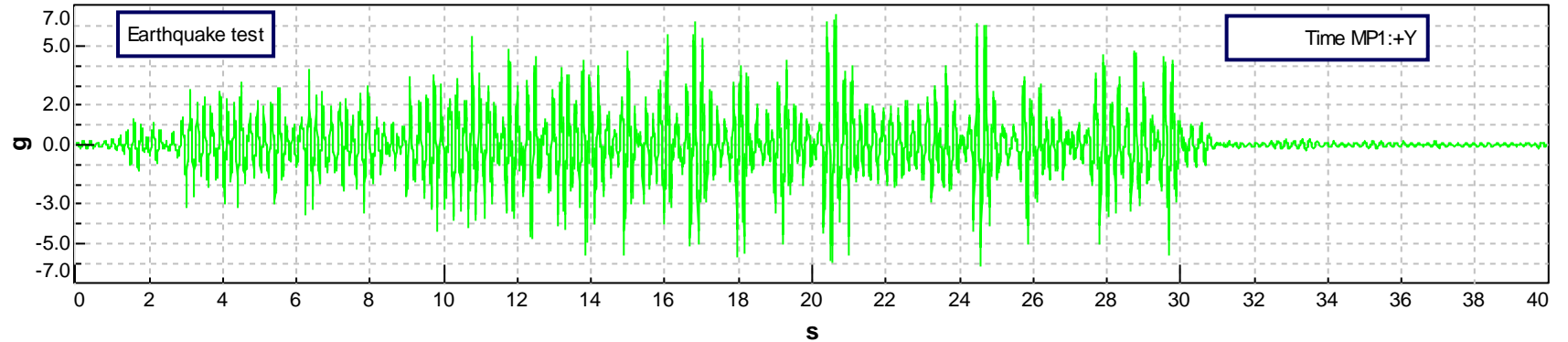
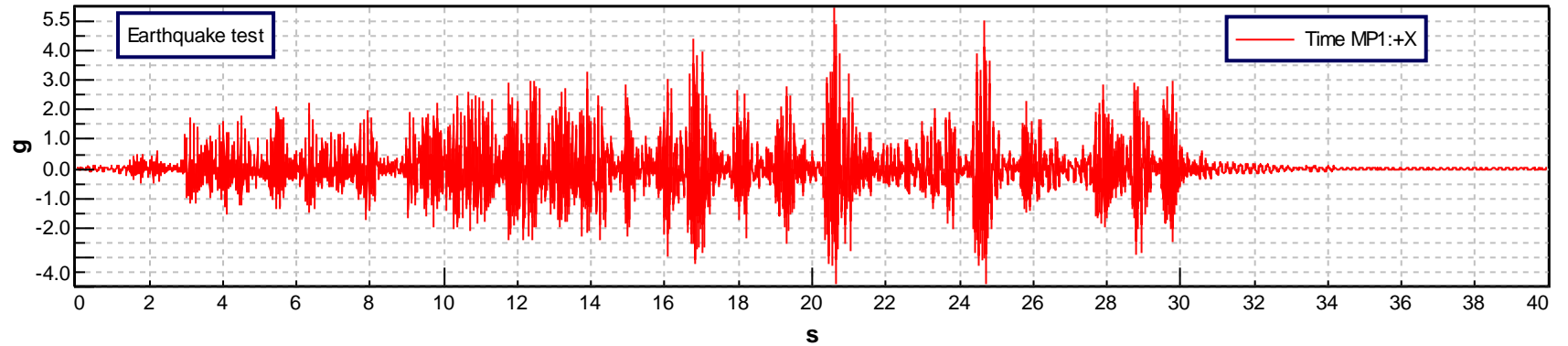
- FRF (Harmonic) MP2:+X/CP1:+Y
- FRF (Harmonic) MP2:+Y/CP1:+Y
- FRF (Harmonic) MP2:+Z/CP1:+Y



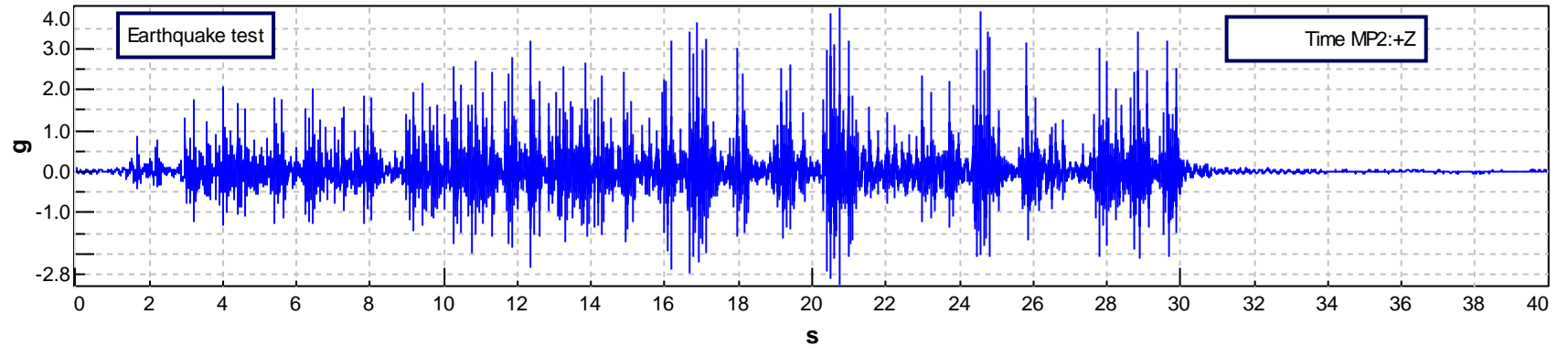
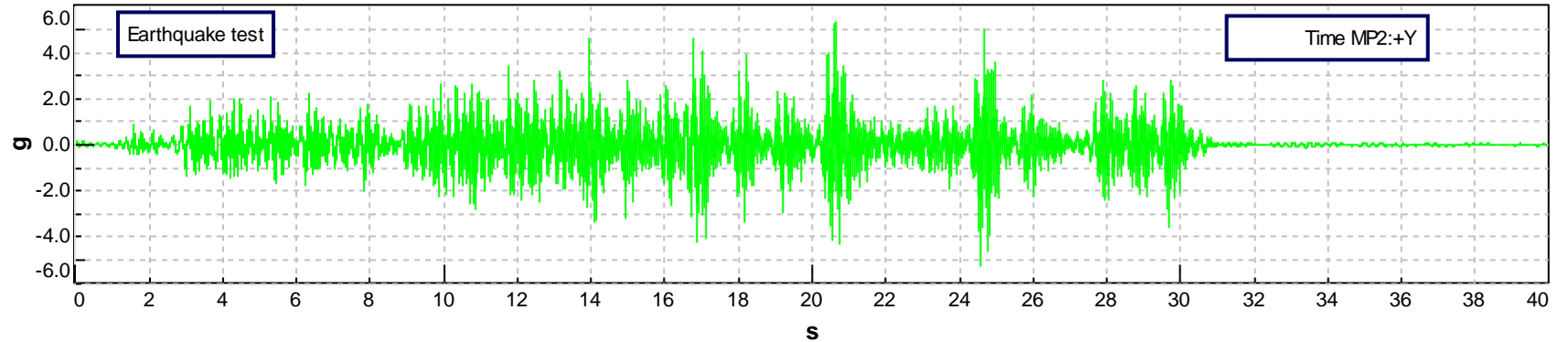
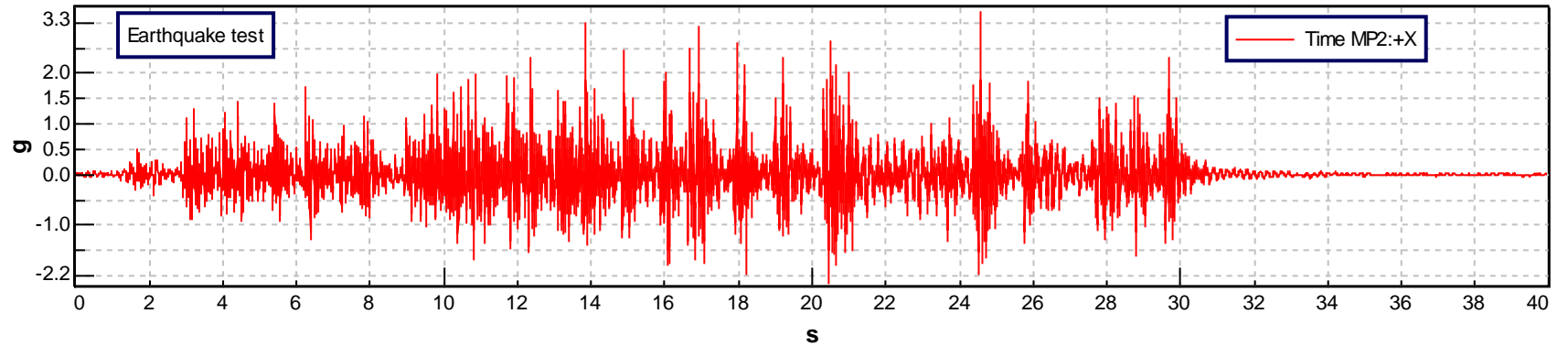
Project: MTL-20-016
Section: Y axis
Run: Shock_1
Date: Tue May 05 2020 09:35:26



Project: MTL-20-016
Section: Y axis
Run: Shock_1
Date: Tue May 05 2020 09:35:26



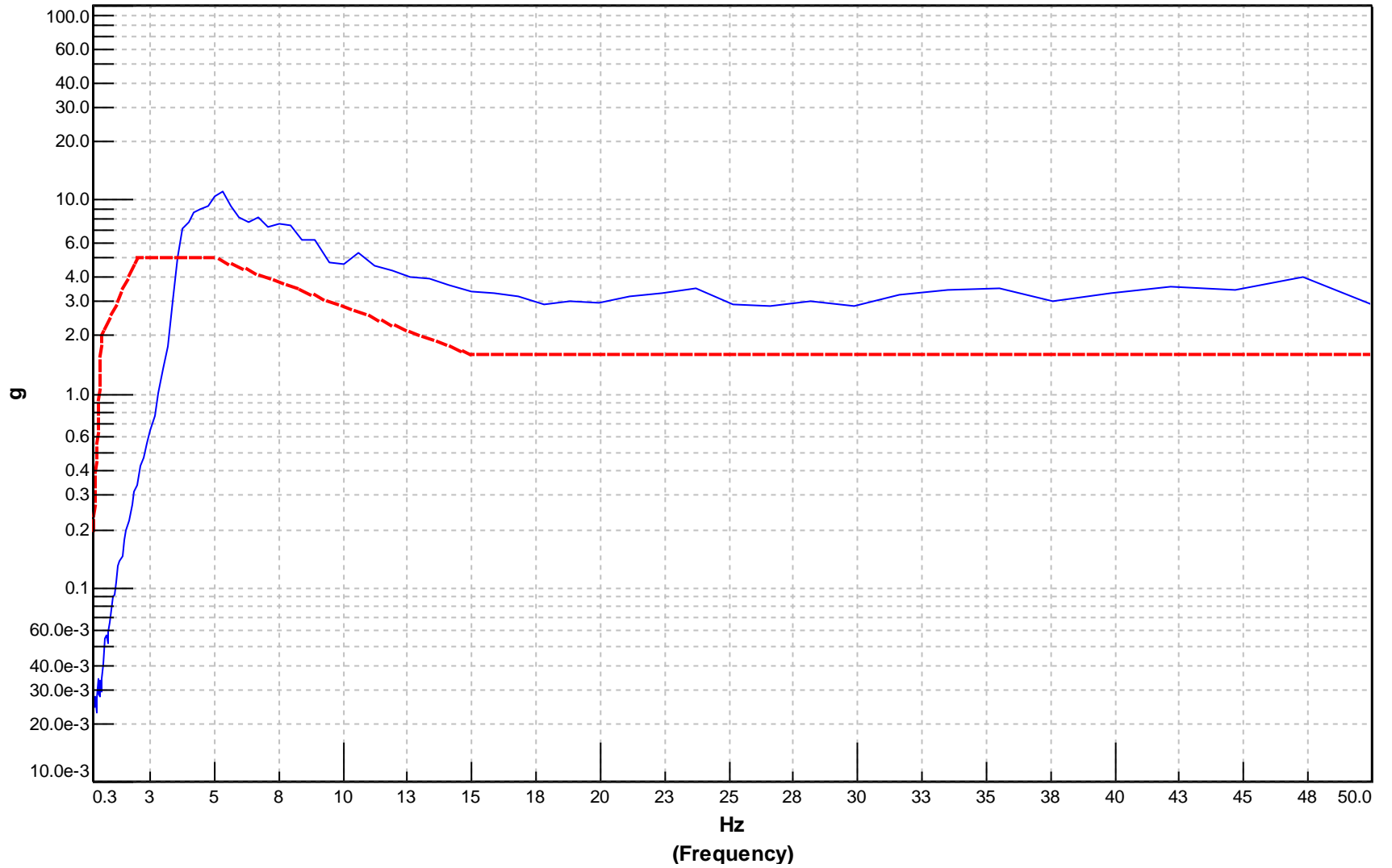
Project: MTL-20-016
Section: Y axis
Run: Shock_1
Date: Tue May 05 2020 09:35:26



Project: MTL-20-016
Section: Y axis
Run: Shock_1
Date: Tue May 05 2020 09:35:26

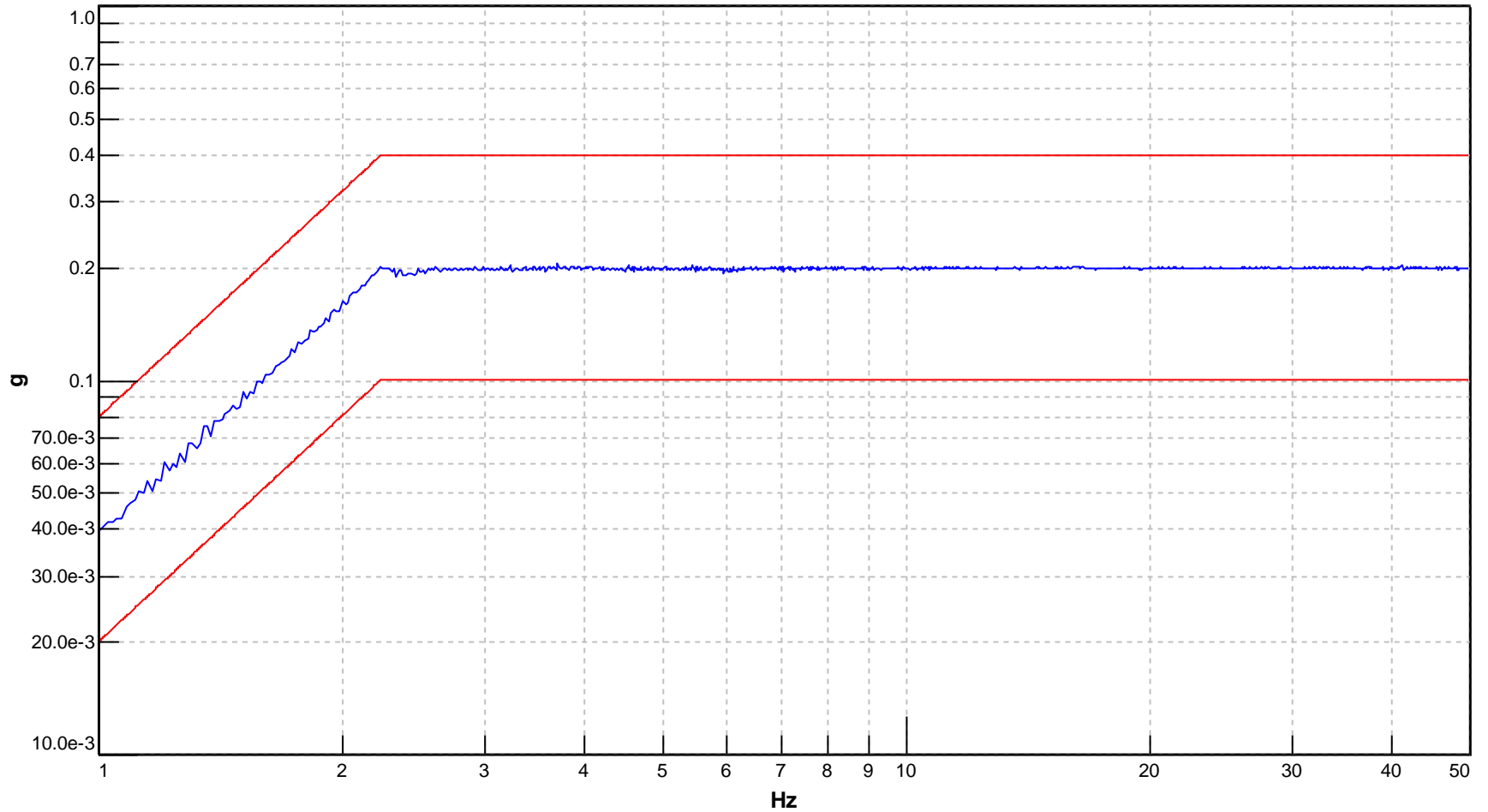
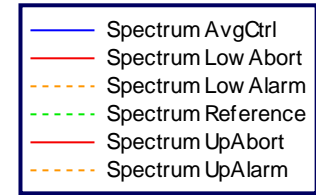
Earthquake test

— TRS CP1:+Y
- - - Telcordia RRS - Zone 4



Project: MTL-20-016
Section: Y axis
Run: Sine_2
Date: Tue May 05 2020 10:03:33
Point id: AvgCtrl
No. control channels: 1
Control strategy: Average
Sweep rate: 1 Oct/min

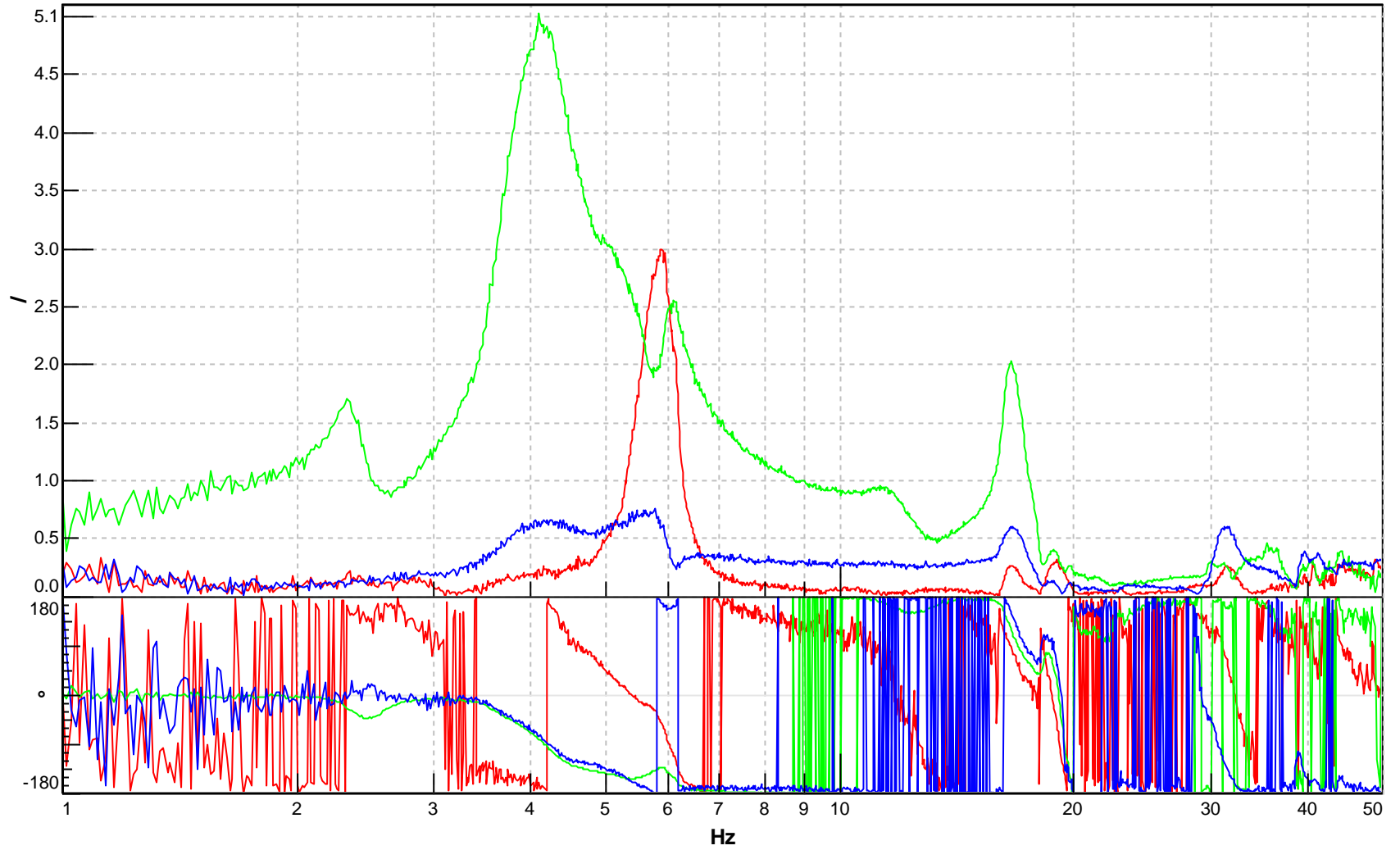
Resonance frequency search



Project: MTL-20-016
Section: Y axis
Run: Sine_2
Date: Tue May 05 2020 10:03:33
Point id: MP1
Reference point id: CP1
Sweep rate: 1 Oct/min

Resonance frequency search

- FRF (Harmonic) MP1:+X/CP1:+Y
- FRF (Harmonic) MP1:+Y/CP1:+Y
- FRF (Harmonic) MP1:+Z/CP1:+Y



Project: MTL-20-016
Section: Y axis
Run: Sine_2
Date: Tue May 05 2020 10:03:33
Point id: MP2
Reference point id: CP1
Sweep rate: 1 Oct/min

Resonance frequency search

- FRF (Harmonic) MP2:+X/CP1:+Y
- FRF (Harmonic) MP2:+Y/CP1:+Y
- FRF (Harmonic) MP2:+Z/CP1:+Y

