REVISED REPORT

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NORTH KENT 1

Surface and Subsurface Vibration Monitoring Report, Test Piles T5 and T42

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Executive Summary

This report summarizes the results of a test pile vibration monitoring program for the North Kent 1 project (NK1) completed as part of Section H1 of the Renewable Energy Approval (REA) document issued by the Ontario Ministry of the Environment and Climate Change (MOECC). The work was carried out in accordance with a vibration monitoring program prepared by Golder Associates Ltd. (Golder) dated March 3, 2017, subsequently approved by MOECC on March 6, 2017 for Pattern Development (Pattern) and Samsung Renewable Energy Inc. (Samsung). The intent of the work was to evaluate the surface and subsurface magnitudes, propagation and attenuation characteristics of ground vibrations associated with driving of test piles. This report focuses on:

- maximum vibration amplitudes near the pile driving source;
- patterns of vibration attenuation in soil and rock as compared to published methods of vibration attenuation prediction or analysis;
- magnitudes of vibrations at distant domestic water wells; and
- comparison of the site-specific data to published and regulatory vibration monitoring thresholds.

Vibrations of various magnitudes were detected by monitoring instruments during many different activities on the test pile T5 and T42 sites and during various activities at nearby domestic water wells. The resulting data has permitted an evaluation of distance-vibration attenuation behaviour for this site. The data further indicate that the character of vibrations at monitored water wells, as measured by the sensitive instrumentation, were not of concern as compared to those induced by common day-to-day activities. As compared to typical vibration magnitudes associated with other causes or published acceptable vibration thresholds for different activities and conditions, and as compared to background quiet[1] periods and deliberate actions to simulate day-to-day activities near the well location, vibrations at the residential well locations, were significantly below regulatory values for human perception and other published thresholds related to residential uses. It is our opinion that pile driving will not expose distant groundwater wells (e.g., more than 550 m) to vibrations in excess of those that the wells commonly experience otherwise.

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[1] For the purposes of this report “quite” periods are defined as absent of construction activities, deliberate or clearly defined activities but inclusive of background vibrations, nearby road traffic and environmental influences (e.g., wind/air pressures).

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1.0 INTRODUCTION

This report summarizes the results of a test pile vibration monitoring program for the North Kent Wind 1 project (NK1) as part of Section H1 of the Renewable Energy Approval (REA) document issued by the Ontario Ministry of the Environment and Climate Change (MOECC). The work was carried out in accordance with a vibration monitoring program prepared by Golder Associates Ltd. (Golder) dated March 3, 2017, subsequently approved by MOECC on March 6, 2017 for Pattern Development (Pattern) and Samsung Renewable Energy Inc. (Samsung). The intent of the work was to evaluate the surface and subsurface propagation and attenuation characteristics of ground vibrations associated with driving of two test piles. Two test pile sites, T5 and T42, and the related vibration monitoring, are discussed in this report. Test pile driving and vibration monitoring, was completed at site T42 first followed by site T5. This chronological rather than numerical order is used throughout this report.

This report on vibration monitoring associated with the Turbine T42 and T5 site test pile locations focuses on:

- measured vibration amplitudes adjacent to the test pile driving source;
- vibrations amplitudes at the ground surface and in the subsurface soil and rock at known distances from the test pile driving source;
- magnitudes of vibrations at distant domestic water wells; and
- patterns of vibration attenuation in soil and rock as compared to published methods of vibration attenuation prediction or analysis; and
- a comparison of these vibrations to regulatory and published thresholds.

This report summarizes:

- a description of the source of vibrations (test pile driving);
- the subsurface conditions at the NK1 and T42 and T5 test pile sites;
- test pile monitoring work plan along with rationale for borehole depths, monitoring locations, vibration sensor selection and data processing equipment;
- field activities during test pile driving program;
- a summary of the monitoring data gathered during test pile driving and at other key times; and
- interpretations of the data.

Where applicable, this report also references “Information to be Submitted for Approval of Stationary Sources of Sound (NPC-233)” and the two relevant references cited in NPC-233 “Procedures (NPC-103)” and “Impulse Vibration in Residential Buildings, (NPC-207)” as published by MOECC. The MOECC NPC-233, NPC-103 and NPC-207 documents have been referenced for guidance related to background information and data provided in vibration monitoring reports and the thresholds for human perception of vibrations as a means for comparison purposes.

2.0 PROJECT DESCRIPTION

The NK1 project is planned to include 34 to 36 wind turbines producing 100 MW of electrical power constructed over a 12-month period within the Municipality of Chatham-Kent. The turbines are planned within an area generally between Wallaceburg and Chatham, Ontario, bound by Bear Line on the west, Centre Side Road on the east, Oldfield Line on the north and Darrell Line and Pine Line on the south. In the project region, the site topography is relatively flat and the primary land use is agricultural.

Two of the turbine sites, numbers T42 and T5, were selected for installation of a single foundation test pile at each site to refine the preliminary design of turbine foundations for the NK1 project. Work at the T42 test pile site was completed first and included a surface, subsurface and domestic water well vibration monitoring. The general location, site layout and subsurface instrumentation for the Turbine T42 area are illustrated on Figures 1 and 2. Work at the T5 site included surface and domestic water well vibration monitoring at the locations illustrated on Figure 3. In general, the topography surrounding the T42 and T5 sites is relatively flat, with a topographic relief generally less than about 2 m. Buildings in the vicinity, considered potential receptors under NPC-233, consist of rural residences and farm buildings, typical of southwestern Ontario and the nearest residences are more than 550 m from the T42 and T5 test pile sites.

Each of the turbines is planned to be supported by a circular mass concrete foundation, measuring about 18.5 m across that will be supported by 20 to 26 pipe piles driven into the ground. The final number of driven piles had yet to be determined at the time of this report pending the outcome of field testing. At the time this report was prepared, the preliminary foundation design was based on the centre of the future piles being a radial distance of 8.675 m from the centre of the foundation and typically ranging in length from about 20 to 30 m depending on location.

Test pile driving was undertaken between March 29 and 31, 2017 at the T42 site and on May 3 and 4, 2017 at the T5 site. The test pile program consisted of driving one pile at each of sites T42 and T5 where the pile was driven to the depth of pile refusal to penetration to measure resistance to downward loads. The test piles will not form part of the foundation in the future and will be abandoned within the footprint of the future foundation.

The test piles, selected to be consistent with the future foundation piles, were about 410 millimetre (mm) outside diameter, driven with a closed end and filled with structural concrete after driving. The closed end was formed with an approximately 430 mm diameter, 50 to 60 mm thick plate welded to the tip of the pile.

With respect to the information required by NPC-233, the test pile driving that forms the source of the vibrations was completed using a Berminghammer B-32 diesel hammer with a rated energy of 110 kJ with an operational hammer rate of 35 to 56 blows per minute. Specifications related to this pile driving hammer are provided in Appendix A. The pile driving hammer and pile were suspended on a mobile crane mounted on a tracked/crawler carrier. Pile driving occurred during daytime and normal construction operational hours.

Ground surface and subsurface vibration monitoring was undertaken at the T42 site and ground surface monitoring was undertaken at the T5 site. Details regarding the test pile vibration monitoring are presented in subsequent sections of this report. As part of the monitoring plan, three pairs of boreholes were drilled at the T42 site to allow installation of subsurface instruments and these borehole locations are illustrated on Figure 1 along with the location of the T42 site borehole completed by AMEC (2016a) and locations of the monitored domestic water wells. A profile of the subsurface conditions and subsurface instruments is shown on Figure 2. Figure 3 illustrates the location of the surface and domestic water well monitoring locations for the T5 test pile site.

3.0 GROUND VIBRATIONS – BACKGROUND

Ground vibrations are caused by many every-day and construction activities. Every-day sources include normal road traffic and wind forces on structures and trees. Seismic activity (earthquakes) are another natural source of large ground motion. Sources related to human activities include stationary and mobile machinery of all different sizes where the machinery is in contact with the ground and construction operations such as soil compaction and pile driving among others. Much like ripples caused by dropping a stone in a pond, ground vibrations propagate radially in all directions from the source. As the ripples propagate away from the source, the amplitude (height of the wave) and frequency (e.g., time between wave peaks or troughs)[2] decrease and the rate at which the amplitude and frequency decrease is related to the physical character of the material (e.g., density, etc.) through which the wave propagates. Vibrations are usually described in terms of time and displacement, such as velocity or acceleration. For example, the distance a particle of ground (or water) moves up and down (displacement) as the wave propagates through the medium will be measured in units of length (e.g., metres (m)). This same particle will travel that distance in a given time and the distance divided by time is the average particle velocity. This same particle will also, however, accelerate from rest, to a maximum (peak) velocity before it then decelerates and reverses direction in the pattern of wave oscillation. Wave velocity can also be used to express the speed at which a wave crest (or trough or any other part of the wave) travels through the medium (ground, water, steel, etc.) away from the source. Velocity of a particle moving up and down (or side to side) from trough to crest and back again in an oscillating wave, however, should not be confused with the possible or characteristic velocity that a moving vibration wave crest can pass through the medium.

For simple, harmonic motion (e.g., uniform waves), the mathematics relating acceleration, displacement, velocity and time can be summarized as[3]:

$$V = \frac{d}{dt}D = \int A dt$$

$$A = \frac{d}{dt}V = \frac{d^2}{dt^2}D$$

and, for a simple sine wave function, at peak values when the trigonometric function is equal to 1, these equations reduce to:

$$D_o = \frac{V_o}{2\pi f} = \frac{A_o}{(2\pi f)^2}$$

$$V_o = 2\pi f D_o = \frac{A_o}{2\pi f}$$

$$A_o = (2\pi f)^2 D_o = 2\pi f V_o$$

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[2] measured in cycles per second or Hertz, Hz

[3] See, for example, Fundamentals of Physics, 3rd Edition, by D. Halliday and R. Resnick, 1988 or USBM RI 8507 (see references at conclusion of text).

where:

A and A_o = acceleration and peak acceleration, respectively;

D and D_o = displacement and peak displacement, respectively;

V and V_o = velocity and peak velocity, respectively;

f = frequency;

Complex and transient vibrations, such as those created by construction, cannot be approximated by the basic equations noted above in isolation and usually computer-aided waveform[4] analysis programs and reasonable approximations or simplifications are made. When characterizing ground vibrations as related to human perception and damage criteria, the most common parameters are frequency along with fractions of gravitational acceleration (*g*, with a value 1 *g* = 9.81 m/second^2), peak particle velocity (ppv)[5] or RMS velocity[5]. Within this report, acceleration and peak particle velocity are used along with frequency to characterize the measured ground vibrations. Methods of evaluating the complex vibrations are also described in subsequent sections of this report.

4.0 SUBSURFACE CONDITIONS AT NK1 T42 AND T5 TEST SITES

Available information relating to the subsurface conditions of the project site is summarized as background and context for the vibration monitoring and for consistency with the intent of NPC-233. Details of the subsurface conditions are described in AMEC (2016a, 2016b) and Golder (2016). A copy of the records of boreholes T42 and T5 completed by AMEC (2016a) are included in Appendix B of this report for reference. Additional data gathered by Golder at the T42 site are included in Appendices C and D.

In summary, the NK1 project site lies in the St. Clair Clay Plains Physiographic region of Southwestern Ontario (Chapman and Putnam 1984). The T42 and T5 sites are typical of the NK1 stratigraphy overall, being characterised by relatively shallow surficial deposits of layered sand, silt and, in some areas, silty clay underlain by a regionally-extensive and thick silty clay deposit. Beneath the silty clay, a basal glacial till unit is commonly found. This glacial till unit is of variable grain size distribution. Bedrock of the Kettle Point Formation is found beneath the glacial till, where present, at depths ranging from about 12 to 28 m below ground surface. The major geologic units, and the conditions found at the specific T42 and T5 sites, are described from the ground surface down as follows:

- Topsoil is commonly encountered near the surface and, in many areas, represents tilled and worked farmlands. About 0.4 m of topsoil was encountered by AMEC (2016a) at both the T42 and T5 sites.

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[4] velocity or acceleration wave patterns as related to time

[5] Peak particle velocity is the maximum oscillation speed of a particular particle (of ground in this case) as it driven by a passing displacement wave. Typically, peak particle velocity is measured in three mutually perpendicular directions and maximum vector resultant is used to describe the vibration intensity. Peak particle velocity is the most common parameter used for defining threshold vibration amplitudes associated with construction and blasting. Other systems measure, report and limit vibrations based on the root mean square (RMS) velocity. The RMS velocity is the square root of the average of individual velocity measurements squared, typically calculated over a time interval of one second. The RMS amplitude is always less than the peak particle velocity and the two can be related through a "crest factor" that is defined as the peak particle velocity divided by the RMS velocity. The US Federal Transit Administration guidance on noise and ground-borne vibration notes that the crest factor is "…always greater than 1.71, although a crest factor of 8 or more is not unusual for impulsive signals." Sometimes, vibrations are also reported in terms of decibels (VdB) calculated as 20 times the logarithm (base 10) of RMS velocity divided by a reference velocity. Accepted reference vibration velocities are 1x10^{-6} inches/second in the U.S. and 1x10^{-8} m/s or 5x10^{-8} m/s elsewhere (FTA 2006).

- In some areas, below the topsoil, deposits of sand and silt exist ranging in total thickness between nil and 8.2 m with an average of 1.7 m, based on the boreholes completed for this project (AMEC 2016a). At the T42 test pile site, a 1.0 m thick layer of silty clay was found beneath the topsoil, and a 0.7 m thick layer of fine sand existed below the topsoil and upper layer of silty clay. At the T5 site, these same layers were about 1.0 m and 0.7 m thick, respectively.
- Below the sand and silt, where present, the majority of the soils consist of a regionally extensive deposit of very soft to firm silty clay, ranging in thickness at the planned turbine sites from about 10 to 20 m with an average of 13.2 m (AMEC 2016a). At the T42 and T5 sites, the clay extended to depths of approximately 18 m and 14.6 m below ground surface, respectively.
- At various turbine, sites sand and gravel soils with varying proportions of silt and clay, either representing ice-contact outwash or basal glacial till soils, were commonly found between the overlying thick silty clay deposits and the underlying bedrock. These soils represent the local aquifer and are as much as 10.4 m thick with an average of about 2.2 m (AMEC 2016a). Glacial till, consisting of a broadly-graded heterogeneous mix of granular and fine grained particles was encountered at the T42 and T5 sites. The AMEC borehole samples were described as “Sand and Gravel Till, trace silt, trace clay, grey, compact, rock fragments, saturated, very dense”. Glacial till was encountered by AMEC at the T42 site between depths of about 17.7 m and 19.9 m below the ground surface. The boreholes drilled by Golder encountered the glacial till at depths of about 17.7 to 17.8 m below ground surface. Grain size distribution testing completed by Golder for samples of the glacial till indicated that, at the Golder borehole locations, the glacial till was more fine-grained than at the AMEC T42 borehole location, likely indicative of the natural variability in till composition (AMEC 2016b). At the T5 site, the glacial till was described by AMEC as “Sand and Gravel Till, trace silt, trace clay, grey, loose” and this deposit was encountered at a depth of 14.6 m below the ground surface and was 2.2 m thick.
- Fine-grained shale bedrock of the Kettle Point Formation was encountered beneath the glacial till at the T42 site at depths of between about 18.9 and 19.9 m below ground surface based on the AMEC (2016a) and Golder data. Bedrock was encountered at a depth of 16.8 m below ground surface at the T5 site (AMEC 2016a).

4.1.1 Silty Clay

The near-surface soils in the area are mapped largely as being of glaciolactustrine or glaciomarine origin (Chapman and Putnam 1984, Barnett et al. 1991). These soils possess a distinctively till-like structure with a small fraction of sand and gravel sized particles distributed randomly throughout. For the purposes of this report, only those dense or hard soils that exist between the bedrock and overlying softer or looser sediments are referred to as “glacial till” or “till”. The silty clay soils in the geographic region are generally composed of “rock flour” of silt- and clay-size particles with activity[6] typically less than about 0.6 and Atterberg limits plasticity indices ranging from 11 to 24 per cent based on 5 tests AMEC (2016a). The near-surface silty clay soils are typified by a stiff, brown and fissured “crust” where these soils are not overlain by saturated silt and sand. Below the “crust”, if and where

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[6] Plasticity index (PI) divided by percent <0.002 mm clay.

present, the silty clay is saturated, grey and of relatively low strength. The undrained shear strength of this soil (S_u) typically ranges from about 15 to 35 kilopascals (kPa) with an average of about 21 kPa.

4.1.2 Granular and Basal Till Deposits

Granular soils (silt, sand and gravel) and basal till soils that overlie the bedrock in the area are the result of glacial action along the bedrock surface during advances and retreats of continental ice sheets. Compositionally, the till is formed of a wide variety of mineral types including fragments of hard igneous and metamorphic rocks as well as sedimentary rocks including fragments of the regional Kettle Point shale bedrock. Particle size distribution and permeability (hydraulic conductivity) of these soils varies significantly, depending on the amount of silt and clay-size particles within the soil mass. Grain size distribution tests completed on samples obtained by Golder from the T42 site (see Appendix D) indicated that this glacial till consists of about 60 to 72 per cent silt and clay-size particles at the location of the Golder boreholes. Standard Penetration Test (SPT) N values[7] ranged from about 10 to 103 blows per 0.3 m of sampler penetration (10th to 90th percentile values, respectively) with an average value of about 50 blows per 0.3 m of sampler penetration (thus categorised as compact to very dense or hard to very hard). Based on the AMEC (2016a) data, the glacial till soils are not as dense at the T5 site as at the T42 site.

4.1.3 Bedrock

The Upper Devonian Kettle Point Formation is the upper-most bedrock formation in the NK1 project area and Chatham-Kent Region. The Kettle Point Shale Formation is a black, siliclastic, organic-rich shale and siltstone with minor green-grey, organic-poor shale and siltstone interbeds. In general, the Kettle Point Formation is of relatively high strength compared to other shale formations in southern Ontario. During subsurface exploration at the NK1 turbine sites, standard penetration testing could not drive the samplers into the rock and augers could not penetrate the rock. Laboratory testing for the NK1 project included four unconfined compressive strength (UCS) tests on core samples and the results ranged from about 49 megapascals (MPa) to 72 MPa. Rock quality designation (RQD) data reported by AMEC (2016a) ranged between a minimum of 20 per cent to 99 per cent, with an average of about 76 per cent. This same RQD data indicated that there was only a 10 per cent chance that the RQD value would be below 50 per cent for any given core run (i.e., 10th percentile value).

4.1.4 Regional Hydrogeology

About 90 per cent of the water supply wells in nearby Lambton County, also situated over the Kettle Point Formation, obtain water from the sand and gravel near the top of the bedrock" (Kent et al. 1986), commonly referred to as the "interface" or "contact" aquifer, while others in the Chatham-Kent area penetrate into the bedrock (Singer et al. 2003) depending on the local hydraulic conductivity of the soils immediately overlying the bedrock and the underlying upper few metres of bedrock.

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[7] American Society for Testing and Materials standard ASTM D1586.

5.0 MONITORING WORK PLAN

The test pile vibration monitoring work plan summarized below, supplemented by monitoring at the T5 site, was designed to address vibration monitoring during initial construction of a test pile at the T42 turbine site. The need for, scope, frequency and duration of vibration monitoring during the later construction and long-term operational phases of the facility will be determined subsequent to this report.

The test pile vibration monitoring program at the T42 site, as implemented, generally consisted of the following major elements:

1) subsurface vibration sensors installed within three pairs of boreholes at depths
    a. within the bedrock near the bedrock and overlying glacial till interface; and
    b. at the approximate mid-depth of the soft to firm clay soils;

    where the borehole pairs were located at distances of 10, 30 and 50 m from the test pile.
2) ground surface vibration monitoring within the construction site
    a. very close to the test pile (about 3 m distant); and
    b. close to each of the borehole pairs; and
3) vibration sensors installed on two domestic water well casings at neighbouring properties.

For the T5 site, the vibration monitoring program consisted of the following elements:

1) Ground surface vibration monitoring within the construction site
    a. very close to the test pile (about 3 m distant); and
    b. at distances of 10, 30 and 50 m from the test pile; and
2) vibration sensors installed on two domestic water well casings at neighbouring properties.

These elements are discussed in greater detail below.

5.1 Subsurface Vibration Monitoring, T42 Site

As part of the monitoring plan, three pairs of boreholes were drilled to allow installation of subsurface instruments as illustrated on Figures 1 and 2. The borehole completed by AMEC is also illustrated on Figures 1 and 2. The intent of the borehole layout was to obtain surface and subsurface vibration measurements at different distances from the turbine location. Distances to borehole monitoring sensors were chosen to be 10, 30 and 50 m from the driven test pile. These distances were chosen to capture three points within the region of most significant changes in vibration magnitudes expected at this site based on typical vibration attenuation characteristics. Using well-known distance and vibration amplitude attenuation relationships as a guide (e.g., CALTRANS, 2004) the anticipated magnitudes of vibrations at different distances from piling are summarized in Table 1, expressed as a percentage of the magnitudes at the source (pile). Shaded cells in Table 1 illustrate the selected off-set distances from the test pile to surface and subsurface monitoring locations. Instrument installation depths are illustrated on

Figure 2 and identified on the borehole records included in Appendix C. Additional details regarding equipment and installation depths are provided in Section 5.4 below.

Table 1: Estimated vibration magnitudes and distances from pile driving

Distance from Source/Pile (m)	Approximate Percentage of Peak Magnitude at Source (%)	
	In Soil	In Rock
0	100.0	100.0
3	22.0	34.0
10	4.0	10.0
30	1.0	4.0
50	0.5	2.0
70	0.3	1.5
80	0.2	1.3
100	0.2	1.0
150	0.1	0.7
300	<0.5	<0.5
500	<0.1	<0.3

Between March 14 and 18, 2017, boreholes were drilled in pairs, consisting of one deep borehole cored into bedrock for one set of sensors (boreholes BH-101, BH-102 and BH-103) and an adjacent borehole for installing sensors at the approximate mid-depth of the soft to firm clay soils (boreholes BH-101A, BH-102A and BH-103A). Borehole pairs were selected to facilitate installation for the following reasons:

- Vibration monitoring sensors needed to be firmly coupled to the ground (rock or soil) using cement grout fully around and above the sensors.
- Filling the entire volume of a single borehole with cement grout and two sets of sensors at the different depths would have created a hard inclusion and coupled the sensors together through the hardened column of grout. If the sensors installed in rock and those installed at the mid-depth of the soil profile were coupled together the resulting data would be compromised given the very different vibration attenuation characteristics of soil and rock.
- The boreholes had to be a minimum of 125 mm inside diameter to permit appropriate installation of the sensors.

Drilling of the boreholes was completed using conventional geotechnical exploration equipment mounted on a Terramac rubber track crawler system (see Photographs in Appendix E) operated by a specialist drilling and licensed water-well contractor under the direction of a Golder technician. Drilling was completed using a combination of hollow stem augers for the top 5 to 7 m, with the remaining depth drilled using mud-rotary drilling tools and soil and rock coring using PQ-size wireline drilling equipment. For each borehole, a protective steel casing was set and grouted in place over the top 4 to 5 m with a portion of this pipe above ground to house cables and provide a visible identification of the sensor locations.

An automatic Standard Penetration Test (ASTM D1586) hammer system and thin-walled tube methods were used for occasional soil sampling at selected depths and locations within the boreholes. The PQ soil coring system was used through the glacial till and into the rock. Conventional field vane shear tests were carried out in one borehole in general accordance with ASTM D2573. All of the samples obtained during the investigation were transported to our laboratory for further examination and testing. As part of the subsurface explorations and testing, one sample of the glacial till soils obtained with the PQ coring system was subjected to laboratory mechanical and hydrometer grain size distribution testing. The soil stratigraphy encountered in the boreholes and the results of the field and laboratory testing are shown on the Record of Borehole and laboratory test sheets included in Appendices C and D, respectively, and Figure 2.

To address competing schedule constraints related to accelerometer availability, driller availability, the test pile driving and grout curing times, all boreholes were drilled prior to installing the subsurface instruments between March 14 and 18, 2017. After completing coring in the deep holes and drilling to the planned depths in the shallow boreholes, the holes were flushed of cuttings and drilling mud was left to fill the hole. Prior to installing the vibration sensors, the borehole was checked again for depth continuity. One borehole, BH-101A, was found to have experienced caving of the near surface granular soils and was abandoned by filling with bentonite. A second hole was drilled, off-set approximately 2 m from the first hole (see Figure 1). In all boreholes, approximately 20 to 30 litres of cement grout was injected into the bottom of the boreholes using a tremie pipe. Drilling mud displaced from the borehole was collected in the drilling circulation tank at the surface. The vibration sensors were then lowered into place, sinking these into the grout for full encapsulation and bonding of the sensor systems to the surrounding ground. Subsequently, the boreholes were backfilled above the cement grout with bentonite chips that, after hydrating and swelling, would exhibit a strength and consistency similar to that of the surrounding soft natural clay soils. Sensor installation depths are indicated on the Record of Borehole sheets included in Appendix C. Installation of the sensors and grouting were completed during March 20 through 22, 2017.

Groundwater levels were observed in the boreholes during drilling as feasible given the different drilling systems used for this work, some of which required use of potable water for drilling and thus masked observations of local groundwater levels. Encountered groundwater levels are shown on the Record of Borehole sheets included in Appendix C. Upon completion of drilling, sampling, instrument installation, grouting and backfilling with bentonite the completed boreholes complied with Ontario Regulation 903 (as amended) with respect to plugging of drilled holes and wells.

5.2 Surface Monitoring, T42 and T5 Sites

Surface vibration monitoring points at the T42 and T5 sites are illustrated on Figures 1 and 3. The monitoring positions at the T5 site were selected to be consistent with the surface subsurface monitoring points at the T42 site with an additional location near (within 3 m) of the pile driving. The point close to the pile was selected to better capture relatively large amplitude vibrations near the source for better definition of vibration attenuation behaviour. At the borehole pairs at the T42 site, the surface points were located between the borehole casings to provide surface data at a position consistent with the subsurface monitoring systems.

5.3 Domestic Water Wells

The monitoring work plan called for monitoring at or near a domestic water well or at a location close to the property line nearest a well. Water well locations for which permission was granted for monitoring, are illustrated on Figures 1 and 3 and are summarized in Table 2, below. In accordance with the approved work plan, vibration measurements were not made at the bottom of the well or with the sensors submersed under water since such work would require removing the pump and/or piping and disrupting the water supply or otherwise influencing the internal character of the well and water. Vibration monitoring was also to be conducted without altering or damaging the well casing. Photographs of the well casings are included in Appendix E.

Table 2: Summary of Domestic Water Wells

Municipal Address	Available Well Details	Distance from Test Pile (m)
25209 Baldoon Road (Well #1, T42)	Well close to south side of house, near junction between older home and addition. Well depth extended to 37.5 m and serviced 25 years ago.	1,102
25345 Baldoon Road (Well #2, T42)	Well in farm field. Total depth about 21.3 m with bedrock encountered at 18.9 m and a stabilized water level at about 3.87 m below ground surface. Water is removed from well using a vacuum system with a pipe installed about 7 m down into the well. Six other well attempts were made on this property in 1974 before encountering water.	1,283
8522 Bush Line (Well #3, T5)	Well located in driveway area south of house. Well depth reported to be 18.7 m below ground surface. Well is reported to be equipped with piston pump but the location of the pump was not confirmed.	911
26347 St. Clair Road (Well #4, T5)	Well enclosed within small well house, located south of house. Pump within well house was not connected and not powered at the time of monitoring.	1,033

5.4 Vibration Sensor and Data Logging Systems

Vibration sensors were selected based on the need to collect vibration data over a wide range of amplitudes and relatively low frequencies and to provide a suitable degree of instrumentation redundancy in the event of field problems. Based on the CALTRANS (2004) methodology, driving of piles at a hammer rate of 35 to 56 blows per minute was expected to generate vibration amplitudes in both the soil and rock in the range of 1 to 150 mm/s (ppv) or 0.01 to 1 times the gravitational acceleration constant (*g*) with dominant pile and ground response vibration frequencies in the range of 5 to 70 Hertz (Hz) in the near vicinity of the driven pile (i.e., within 3 to 30 m). However, it was also recognized that at longer distances from the test pile, vibration amplitudes could be one to two orders of magnitude smaller than those associated with pile driving near the test pile location.

As well as planning for appropriate sensitivity and frequency response characteristics, the sensors selected for subsurface use also had to be of physical dimensions that were compatible with installation in conventional borehole diameters in soil and rock (ranging from about 100 to 125 mm). Based on these considerations, the following sensors were selected for use in the approved work plan:

1) The PCB356B18 triaxial accelerometers were selected for measuring underground vibrations in three orthogonal directions. These sensors are rated as having a sensitivity of 1000 millivolts (mV) per 1 *g.* The manufacturer states that these sensors are capable of a broad band resolution to 0.25 milli-*g* ($2.5\times10^{-4}g$) in the range of 0.5 to 100 Hz. Triaxial sensors were specifically selected to allow computation of peak particle velocity in three orthogonal directions and vector sums as a basis for comparing measured vibration amplitudes to published research related to construction-induced damage or disturbance criteria.

2) Meggit 731A uniaxial accelerometers were selected for measuring very small underground vibration amplitudes at longer distances from the turbine. These sensors are rated as having a sensitivity of 10,000 mV/g with a broad band resolution (signal detection above noise level) of about 1 μg (1×10^{-6} g). These sensors only measure vibrations in one direction (in this case, the vertical direction as relative to the sensor base and mounting orientation).

3) For measuring vibrations at the ground surface and at the domestic water wells with portable systems, uniaxial PCB393A03 accelerometers were selected for measuring small vibration magnitudes. These sensors are rated as having sensitivity of 1,000 mV/g with a broad band resolution of about 1×10^{-5} *g* between frequencies of 1 and 10,000 Hz.

4) Ground surface vibration amplitudes near the pile driving were anticipated to be above the rated limit of the PCB393A03 sensors. Therefore, conventional triaxial geophone (velocity measurement system) construction vibration monitoring systems were used for this purpose. For monitoring at the T42 test pile site, the Instantel Minimate system was selected for the 3 and 10 m distant positions which has a rated resolution up to 254 mm/s peak particle velocity with an accuracy of 0.5 mm/s over a frequency range of 2 to 250 Hz. These systems are commonly used for monitoring pile driving and other construction-related vibrations, are robust for difficult field environments and could measure the high-amplitude vibrations very close to the pile driving. These systems rely on triggering impulses and provide output in the common peak particle velocity parameter in three orthogonal directions. For ground surface monitoring at the T5 site, two additional Instantel Minimates were used with the one located at the farthest distance from the test pile (50 m) equipped with a low-level geophone with a maximum amplitude rating of 25.4 mm/s.

5) A pre-programmed Crystal Instruments Spider20 data logger connected to a PCB393A03 accelerometer was obtained for this purpose. The data logger was provided and programmed by the supplier according to requirements defined by Golder specifically to meet the needs of this project and collect continuous vibration data when operating.

Copies of manufacturer specifications and manufacturer calibrations for the instruments used for this phase of vibration monitoring are included in Appendix F. Prior to field deployment, these sensors were checked in Golder's offices once upon arrival and a second time after the sensors were connected with all cables, power sources and data collection systems. Checking of vibration responses was accomplished using a Modal Shop trusted sources TMS9110D and TMS9100D. Accelerometer mounting systems used for adapting to field conditions at the well sites are addressed in Appendix G.

Subsurface field deployment of the sensors in boreholes filled with water or drilling fluids required protection of the systems from the down-hole environment and to provide a mechanism for controlling the depth and orientation of the sensors within the boreholes. Therefore, a housing was designed and constructed as follows:

- 285 to 310 mm long, 89 mm diameter, Schedule 40 ABS pipe housing with the PCB 356B18 triaxial accelerometers mounted by bolting to the inside of the pipe where, because of the physical construction of the accelerometer, the:
  - positive y axis was oriented horizontally toward the test pile – “longitudinal” direction;
  - positive x axis was oriented vertically downward; and
  - z axis was horizontal and perpendicular to the y axis – “transverse” direction;
- 300 mm long, 76 mm diameter, round steel stock for adding base weight for sinking through cement grout and as base for mounting Meggit 731A uniaxial accelerometers (mounted with positive vertical axis upward);
- the pipe was bolted to the steel stock such that the two accelerometers were physically and rigidly coupled to the housing within 100 mm vertical distance separating the individual accelerometers or about 134 mm to 156 mm separating the mounting positions within the housing;
- sand to fill interior around mounted sensors;
- protective end cap with hole for passing sensor wires through; and
- twin steel cables for lowering and orienting the sensor and housing package, with the cables mounted at 180 degree positions at the housing top to facilitate orientation of the triaxial accelerometer directions.

While the connections and instrument housings were water-tight and sealed, prior to installing the accelerometers in the housing, each sensor and cable connection was coated with an epoxy sealant and spray-on plastic to assist with protecting the electrical connections. Photographs of the sensors and housings at various stages of the assembly are illustrated in Appendix E. Prior to subsurface deployment, output from the combined sensors and housings was compared with output from an independent and field-checked accelerometer where all sensors and housing were clamped to the same source of vibrations (drilling rig) as another confirmation of input-output reliability (see photographs in Appendix E).

Surface deployment of the Instantel Minimates was carried out in accordance with the manufacturer’s instructions where the geophone was coupled to the ground using the provided pins and sand bags were placed over top of the sensors to minimize influences of air compression waves and provide better ground coupling. The data recording trigger thresholds for the Minimate systems at the T42 test pile site, located at 3 and 10 m distant from the test pile, were initially set at a value of 4 mm/s (ppv) during the first day of monitoring and was later set during this same day to 1 mm/s (ppv) to capture more vibration waveform data prior to and as the pile encountered hard driving conditions. While longer periods of recording can be achieved, internal data memory is limited and continuous recording for long periods of time with low trigger thresholds can be problematic. At the T5 test pile site, the low-level geophone system located at 50 m from the test pile was set to trigger recording at 0.25 mm/s particle velocity.

Surface deployment of the PCB393A03 accelerometers was carried out using steel pins driven into the ground with a threaded sensor coupling at the pin top. The small excavations for these sensors were covered with a small, lightweight, plywood square without contacting the sensor or its wires to minimize external influences (weather), to minimize the potential for materials falling into the small pit or on the sensors, and for site safety (see photograph of small excavation in Appendix E).

The field configuration of the sensors and data logging systems are summarized in the table below. Because of the remote location, all power for the subsurface monitoring systems was provided by a small gasoline-powered alternating current generator.

Table 3: Summary of Sensor Identification, Depth and Signal Paths, T42 Site

Sensor Identification	Signal Conditioner	Data Logger	Data Storage
Pile Driving Sensor (3 m)			
SS3 (Minimate)	Self-Contained Unit		
Borehole Pair 101 (10 m from pile)			
101SS (Minimate)	Self-Contained Unit		
	PCB 481A02 and 482A22	Campbell CR5000	Dell Notebook Computer and External Memory Backup
Subsurface Shallow			
101SU (7.144 m)			
101STx (7.004 m)			
101STy (7.004 m)			
101STz (7.004 m)			
Subsurface Deep			
101DU (20.693 m)			
101DTx (20.550 m)			
101DTy (20.550 m)			
101DTz (20.550 m)			
Borehole Pair 102 (30 m from pile)			
101SS (PCB393A03)			
Subsurface Shallow			
102SU (7.591 m)			
102STx (7.455 m)			
102STy (7.455 m)			
102STz (7.455 m)			
Subsurface Deep			
102DU (20.723 m)			
102DTx (20.589 m)			
102DTy (20.589 m)			
102DTz (20.589 m)			

Sensor Identification	**Signal Conditioner**	**Data Logger**	**Data Storage**
Borehole Pair 103 (50 m from pile)		National Instruments CDAQ 9188	Dell Notebook Computer and External Memory Backup
103SS (393A)			
Subsurface Shallow			
103SU (7.692 m)			
Subsurface Deep			
103DU (20.843 m)			
103DTx (20.687 m)			
103DTy (20.687 m)			
103DTz (20.687 m)			
Well #1 25209 Baldoon Road (1,102 m)	Rion DA-21, Battery Powered		
Well #2 25345 Baldoon Road (1,283 m)	Crystal Instruments Spider20, Battery Powered		

Note: 1) depth shown in parentheses measured from ground surface to mounting bolt on accelerometer

Table 4: Summary of Sensor Identification and Signal Paths, T5 Site

Sensor Identification	**Signal Conditioner**	**Data Logger**	**Data Storage**
Pile Driving Sensor (3 m from pile)			
SS3 (Minimate)	Self-Contained Unit		
Ground Surface Sensor (10 m from pile)			
SS10 (Minimate)	Self-Contained Unit		
Ground Surface Sensor (30 m from pile)			
SS30 (Minimate)	Self-Contained Unit		
Ground Surface Sensor (50 m from pile)			
SS50 (Minimate with low-level Geophone)	Self-Contained Unit		
Well #3 8522 Bush Line (911 m)	Rion DA-21, Battery Powered		
Well #4 26347 St. Clair Road (1,033 m)	National Instruments CDAQ 9188, Dell Notebook Computer and External Memory Backup		

6.0 FIELD VIBRATION MONITORING ACTIVITIES

6.1 Background Vibration Measurements

6.1.1 T42 Test Pile Site and Associated Domestic Water Wells

Once the vibration sensors were installed in the boreholes, data was gathered from the subsurface sensors on March 20 and 23, 2017. Site activities during these two days are summarized in Table 5, below. On March 20, 2017 the monitoring activities were limited to system checks to confirm that the first sensors installed were responding to voltage signals once in the borehole. On March 23rd, 2017 data was collected as one measurement of background conditions and to further test the entire system. This background data was obtained within 24 hours after installing the instruments and, since the grout may not have sufficiently cured at this time, additional background data was gathered on other dates when no construction vehicles were operating and test pile driving was not taking place. Activities on subsequent dates are described under Section 6.2.

Table 5: Summary of Site Activities during Initial Vibration Monitoring System Tests and Measurements, T42 Site

Time	Activity
March 20	
16:00	Drilling rig idling at BH103, tracks on ground, no sampling
18:21	Drilling rig idling at BH102, tracks on timber mats, no sampling, hammer tap on casing BH102
18:24	Drilling rig idling at BH102, tracks on timber mats, no sampling
March 23	
11:52	Excavator moving on timber mats, passing sensor locations
12:08 to 13:00	Vac truck operating on timber mats to remove spoils from bin
12:43	Kicked casing at 102A with sensor clamped to casing
13:20 to 14:18	Quiet[8] site
13:53	Car on road
14:21	Vacuum truck backing along timber mats
14:22	Vacuum truck operating on timber mats to remove spoils from bin
15:20	Vacuum truck left site
15:20 to 15:30	Quiet site

Following permission to enter private properties, background vibration readings were obtained at each of the domestic water supply well locations associated with the T42 test pile site (Wells #1 and #2) on March 28, 2017. Background readings were obtained with a PCB393A03 sensor since it was the more sensitive of the devices available and the self-contained Rion data logger was most suited to this application.

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[8] For the purposes of this report “quite” periods are defined as absent of construction activities, deliberate or clearly defined activities but inclusive of background vibrations, nearby road traffic and environmental influences (e.g., wind/air pressures).

Table 6: Summary of Site Activities during Background Monitoring at Wells #1 and #2

Time	Activity
March 28, 2017	
8:50	On site at Well #1 and attached accelerometer to well casing
10:20	Monitoring system active
10:20 – 10:25	Quiet period, no activities
10:26	Golder staff member jumped up and down 3 times at 0.9 m from well
10:27	Golder staff member jumped up and down 3 times at 1.8 m from well
10:28	Golder staff member jumped up and down 3 times at 2.7 m from well
10:29	Golder staff member walked toward well
10:29 – 10:30	Transport truck drove past on Baldoon Road
10:30	5 light finger taps on well casing lid
10:31:45 – 10:32	Cell phone on well lid ringing in vibrating mode
10:31	Walking away from well
10:34:30	Climbed steps, knocked on door and descended steps
10:35	Walked toward well and retrieved cell phone
10:37	Started van in driveway at Baldoon Road
10:37 – 10:38	Drove van in driveway to end of drive, drove back and parked 3.3 m from well, shut off engine
10:41	Opened and slammed van door
10:42	Opened and slammed van door again
10:43	Started van
10:41	Cars passing on Baldoon Road
10:45 – 10:50	Quiet site except for individuals speaking at about 3 m from well
10:50	Stopped monitoring and removed system
10:50 – 11:00	Relocated to Well #2 and mounted accelerometer
11:07	Monitoring system active
11:21	Golder staff member jumped up and down 3 times at 1 m from well
11:22	Golder staff member jumped up and down 3 times at 2 m from well
11:23	Golder staff member jumped up and down 3 times at 3 m from well
11:24	5 light finger taps on well casing lid
11:22 – 11:50	Walking toward and away from well
11:25 – 11:30	Quiet site
11:29	Backhoe on road passing site (approximately 50 m away)
11:31	Cell phone on well lid ringing in vibrating mode
11:32	Removed cell phone, accelerometer and left site

6.1.2 T5 Test Pile Site and Associated Domestic Water Wells

Following permission to enter private properties, background vibration readings were obtained at domestic water supply well locations associated with the T5 test pile site on May 3, 2017 prior to test pile driving. Additional background readings were obtained prior to pile driving on May 4, 2017. All background readings were obtained using the same accelerometer and data logger systems as for monitoring during test pile driving. Monitoring and other activities at the Well #3 and Well #4 locations during times when pile driving was and was not occurring are all summarized in Table 9 and Table 10, below.

6.2 Pile Driving Vibration Monitoring

6.2.1 T42 Test Pile Site and Associated Domestic Water Wells

Vibration monitoring was carried out prior to, during and after pile driving on March 29 and 31, 2017. Heavy rains and wind precluded pile driving and monitoring on March 30, 2017. Pile driving activities are summarized in Table 7, below.

Table 7: Summary of Site Activities during Vibration Monitoring at Test Pile Site T42

Time	Activity
March 29, 2017 (See Table 8, below for activities at domestic water wells during pile driving)	
9:35 to 10:16	Minimate set up and unit clocks set. Recheck 102SS and 103SS (surface accelerometers) with controlled source.
10:47	Surface monitoring systems active
11:20	Subsurface monitoring systems active at 103/103A
11:24	Subsurface monitoring systems active at 101/101A, 102/102A
12:47	Contractor starts lifting pile
12:55	Pile hammered twice to set
12:56	Pile driving starts
13:00	Pile tip at 4.0 m
13:02 to 13:22	Channel 14 of data logging system temporarily lost connection (accelerometer 102STX)
13:03	Pile tip at 10.75 m
13:05	Pile driving stops and lifting bracket cut from pile
13:14	Pile driving starts
13:15	Pile driving stops for welding of next pile section
13:17	Crane backs along timber mats toward BH102
13:23	Fuel truck travels along timber mats past BH103 towards BH102
13:24	Welding generator started
13:27	Grinding of pile starts
13:33	Grinding of pile stops
13:33	Worker hammering on pile weld

Time	Activity
13:34	Welding stopped
13:38	Fuel truck leaves
13:53	Heavy hammering on pile with sledge
13:55	Lifting second pile section
13:59	Heavy hammering on pile with sledge
14:43	Welding completed
14:49	Pile driving starts
14:50	Pile driving slower progress (inferred harder material)
14:51	Pile driving stops
14:56	Pile hammered 10 times followed by pause
15:01	Pile hammered 10 times followed by pause
15:06	Pile hammered 10 times
16:08	Work concluded for day, monitoring systems shut down
17:21 to 17:28	Surface monitoring accelerometers rechecked using controlled source
March 31, 2017 (See Table 8, below, for activities at domestic water wells during pile driving)	
9:48	Rechecked surface monitoring accelerometers with controlled source
12:20	All monitoring systems active
12:20 – 13:24	Welding, occasional hammering on steel platform
12:53	Pile hammered 17 times
12:55	Pile driving stops
13:05	Pile hammered 3 times
13:08	3.6 kg sledge hammer hit pile 10 times
13:13	3.6 kg sledge hammer hit pile 10 times
13:15	Crane shut down (quiet)
13:24	Monitoring system shut down

At the T42 site, during the top few metres of pile driving, the number of hammer blows required to drive the pile approximately 0.25 m ranged from 1 to 17, with an average of about 7 blows. Between the tip depths of 2 and 3 m, the number of hammer blows per 0.25 m of penetration dropped to a typical value of about 3. Below 4 m, only 2 to 3 hammer blows were required to drive the pile a full metre into the ground. Driving resistance then increased again near a depth of about 17 m to about 2 to 4 blows per 0.25 m of penetration, increasing to about 10 until the tip depth of 19 m was achieved. After 20 blows was required for 0.25 m of penetration, the pile driving was halted on March 29, 2017 at a tip depth of 18.92 m. On March 31, 2017 pile driving was restarted to complete pile driving energy measurements. Monitoring of the last increments of pile driving on March 31, 2017 was completed by EXP using the dynamic Pile Driving Analyzer (PDA). The final pile depth was recorded as only progressing an additional 2 mm during the last phase of driving (19 blows of the hammer). Based on the EXP data, the pile hammer delivered approximately 66 kJ to the pile top at a hammering rate of about 35 blows per minute. The pile penetrated to a depth consistent with the top of bedrock in Golder borehole BH101 and within the glacial till, about 1 m above bedrock as identified in the AMEC (2016) borehole T42. Given the separation distances between these two boreholes, the pile could have reached refusal conditions on the top of bedrock or within the bottom 1 m of the glacial till unit immediately overlying the bedrock.

Table 8: Summary of Activities at Domestic Wells Vibration Monitoring, Wells #1 and #2

Time	Activity
March 29, 2017	
12:05	Monitoring system active at Well #1, water pump running, water sampling in progress (by others)
12:10	Departed Well #1 (25209 Baldoon Road)
12:24	Monitoring system active at Well #2 (25345 Baldoon Road)
12:27, 12:27:30	Car, car
12:29	2 Golder vehicles leave Well #2 (Fry)
12:32	Golder vehicle parked on shoulder near Well #1
12:32:30	Water pump off, vehicle turned around in driveway at Well #1
12:33, 12:33, 12:34	Light truck, light truck, light truck passed
12:52	Check on Well #1 (approached on foot)
12:59	Heard pile driving sounds
13:14	SUV
13:22, 13:23	Approached Well #2 by car, then by foot
13:29	Light truck left Well #2 (owner)
13:26	Golder vehicle left Well #2
13:29	Golder vehicle entered Well #1 driveway and turned around
13:38, 13:43, 13:45	Car, SUV, light truck
13:59	Heard pile driving sounds
14:34, 14:39, 14:40	Light truck, light truck, SUV
14:41	School bus
14:44	Approached Well #1 on foot to check status
14:48, 14:50	SUV, car
14:50	Heard pile driving sounds
14:51, 14:57, 15:10 15:12, 15:14, 15:20	SUV, car, light truck, car, light truck, 2 cars passed in opposite directions
15:21	Vehicle arrives at Well #1
15:22	Golder vehicle arrives at Well #1
15:23	Start of water sampling at Well #1 (by others)
15:30	Car

Time	Activity
15:33	Completed water sampling at Well #1 (by others)
15:35	Approach Well #1 on foot
15:38	Stop recording at Well #1
15:40 to 15:41	Recheck accelerometer with controlled source
14:48	Approached Well #2 by car
15:50	Approached Well #2 by foot
15:51	Stop recording at Well #2
15:52 to 15:53	Recheck accelerometer with controlled source
March 31, 2017	
11:38	Arrived at Well #1, completed accelerometer recheck with controlled source
11:44	Start recording at Well #1
11:46	Plastic wind and water shield over Well #1 accelerometer to protect from heavy rain
11:47	3 vehicles leave Well #1
11:50	Arrived at Well #2, completed accelerometer recheck with controlled source
11:57	Start recording at Well #2
11:58	Plastic bag used as wind and water shield over Well #2 accelerometer to protect from heavy rain
12:03	3 vehicles leave Well #2
12:03	2 light trucks
12:04	Golder vehicle turns in Well #1 driveway to reposition
12:07	Approached Well #1 on foot to check status
12:33	Pickup passed
12:44, 12:51, 13:00 13:32	SUV, SUV, SUV, car
13:32	3 vehicles arrive at Well #1
13:34	Approached Well #1 on foot to check status
13:34 to 13:53	Start of water sampling Well #1[9] (by othes), outside garden tap and kitchen tap being sampled, water remained flowing until end of time period (13:53)
13:53	Transport truck
13:55	Stop recording Well #1
13:58 to 13:59	Recheck of Well #1 accelerometer with controlled source
14:04	3 vehicles approach Well #2
14:05	Car
14:04 to 14:16	Vehicle at Well #2
14:16	Approached Well #2 on foot, removed plastic bag shield, removed accelerometer

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[9] Field times among AECOM and Golder notes differ due to personal watches not being synchronized

Time	Activity
14:17	Stop recording Well #2
14:22 to 14:24	Recheck Well #2 accelerometer with controlled source

6.2.2 T5 Test Pile Site and Associated Domestic Water Wells

Vibration monitoring was carried out prior to, during and after pile driving on May 3 and 4, 2017. Activities on these dates are summarized in Table 9, below.

Table 9: Summary of Site Activities during Vibration Monitoring at Test Pile, Site T5

Time	Activity
May 3, 2017 (See Table 10 for activities at domestic water wells prior to and during pile driving)	
8:22	Arrived to set up Minimate systems, set unit clocks
9:30	Surface monitoring systems ready for activating
9:30	Pile crane preparation
17:08	Minimate systems active
17:49	Crane crawls toward test pile
18:04	Hoisting pile
18:14	Pile driving starts
18:39	Pile reached refusal
18:44	10 pile hammer blows
18:46	10 hammer blows
18:51	10 hammer blows
18:52	Pile driving stops
18:53	Crane off pile
19:02 – 19:08	Minimate systems shut off and removed from site
May 4, 2017 (See Table 10 for activities at domestic water wells prior to and during pile driving)	
14:33 – 14:36	All monitoring systems active at T5 site
14:40	Pile Dynamic Analyzer (PDA) being connected
14:54	Crane moving to pile
15:10	Hammer set on pile
15:14	Pile driving, 16 blows for PDA test
15:19	Hammer off pile
15:29	5 hits with sledge hammer on pile
15:31 – 15:34	Monitoring systems at T5 shut off
16:08	All monitoring equipment removed from T5 site

At the T5 site, during the top few metres of pile driving, the number of hammer blows required to drive the pile approximately 0.25 m ranged from 0 to 5. Between the tip depths of 3 and 4 m, the number of hammer blows per 0.25 m of penetration dropped to a typical value of about 1. Below 4 m, only 2 to 4 hammer blows were required to drive the pile a full metre into the ground. Driving resistance then increased again near a depth of about 15 m to about 2 blows per 0.25 m of penetration until the tip depth of 16.5 m was achieved. After 89 blows with little additional penetration, pile driving was halted on May 3, 2017 at a tip depth of 16.5 m. On May 4, 2017 pile driving was restarted to complete pile driving energy measurements. Monitoring of the last increments of pile driving on May 4, 2017 was completed by EXP using the dynamic Pile Driving Analyzer (PDA). The final pile depth was recorded as only progressing an additional 2 mm during the last phase of driving. The pile penetrated to within 0.3 m of the top of bedrock as identified in the AMEC (2016a) borehole T5.

Table 10: Summary of Site Activities at Domestic Wells during Vibration Monitoring, Wells #3 and #4

Time	Activity
May 3, 2017 (See Table , above	
11:03 – 11:38	On site at Well #3, checked accelerometers with controlled source and attached accelerometers to well casing
11:38	Monitoring system active, placed protective bag over system
11:39 – 11:45	Air compressor running in garage, running water to flush system for sampling (by others)
11:45 – 11:49	Water samples being taken
11:51	Removed protective bag from system, personnel walking near well and accelerometers
11:56 – 12:00	6 vehicles left Well #3 site
12:26	One vehicle returned to Well #3 to cover with plastic garbage can for protection against predicted heavy rain
12:29	Departed Well #3
12:33 – 12:59	Relocated to Well #4, checked accelerometers with controlled source and attached accelerometers to well casing
13:35	Monitoring system active at Well #4
13:45	Closed and locked well house door
13:52	2 vehicles left Well #4
17:30	Returned to Well #4, monitoring system still running, grass had been cut around well house, vehicle left at well site
17:35	Returned to Well #3, Rion batteries had stopped functioning, replaced batteries, system active, heavy farm vehicles/equipment had been moved and parked near well
17:35 onward	Relatively constant flow of car and truck traffic along Highway 40 near Well #4
17:37, 17:48, 17:50	SUV, truck and car passing by Well #3 on Bush Line
17:50	Grass being cut on Well #3 property
17:51	Car turned into Well #3 driveway
18:18	Heard pile driving sounds

Time	Activity
18:25, 18:26, 18:28, 18:29, 18:36, 18:41, 18:41, 19:02	2 cars, car, SUV, car, car, truck, car and car pass by Well #3 site on Bush Line at respective times noted.
19:05 – 19:07	Returned to Well #4, monitoring systems stopped, data logger removed, accelerometers left in place on well casing, well house locked
19:34	Returned to Well #3
19:35	Golder staff member jumped up and down 3 times at 3 m from well
19:37	Golder staff member jumped up and down 3 times at 2 m from well
19:39	Golder staff member jumped up and down 3 times at 1 m from well
19:40	Monitoring systems stopped, accelerometers removed and checked with controlled source
May 4, 2017	
12:17 – 12:35	On site at Well #3, checked accelerometers with controlled source and attached accelerometers to well casing
12:39 – 13:21	Relocated to Well #4 and reconnected data logger to accelerometers left in place on well casing, system active
13:10	Vehicle arrived at Well #4
14:38	Checked Well #4
14:50	Observed relatively constant car and truck traffic on Highway 40
14:50	Relocated to Well #3, monitoring system active
14:50, 14:51, 14:52, 14:54, 14:56, 15:01, 15:14, 15:21, 15:25	SUV, large transport truck (Highway 40), light truck, school bus, light truck, car, heavy trucks (Highway 40), SUV, SUV passing Well #3 site on Bush Line at respective times noted.
15:06	Light truck left Well #3 site
15:21	Heard pile driving sounds
15:29	Sledge hammering on pile
15:32	3 vehicles arrive at Well #3
15:48	Remove accelerometers at Well #3 and check with controlled source
16:12 – 17:13	Return to Well #4, remove accelerometers and check with controlled source

7.0 DATA SUMMARY

Data summarized in this report reflects examination of data files for background and peak vibration measurement parameters (e.g., particle velocity) at specific time intervals associated with the activities identified above. Individual data reports from Instantel Minimate systems for the time periods after which recording was triggered are included in Appendix H. The large volume of data collected by the accelerometers, however, is not conducive to such reporting and is therefore summarized in this report using a format commonly employed in vibration monitoring reports (e.g., Appendix H) along with modifications as described below to address the lower range of frequencies and amplitudes measured by the sensitive instruments used for this project.

General notes regarding data collection are provided below as context for the overall data summary:

- Data was not captured appropriately by the Spider20 data logging equipment at Well #2 during the T42 test pile monitoring program and, therefore, no data was available for analysis. However, this was the more distant of the two wells associated with the T42 site. Data was captured for the closer Well #1 associated with the T42 site and both Wells #3 and #4 associated with the T5 test pile site.
- During test pile driving at the T42 site, the closest uniaxial accelerometer mounted in the bedrock (101DU) was overloaded (internal amplifier voltage saturation) on multiple pile strikes to the point where the data from these events could not be used. The uniaxial accelerometer was not overloaded to the point of damage based on all other vibration data, the manufacturer’s specifications and technical notes and since this accelerometer performed successfully after the overload events. These events occurred during the last 30 pile strikes on March 31, 2017 and several strikes during the PDA testing on March 31, 2017.
- The triaxial accelerometer installed within the bedrock at borehole BH-103 (103DTX, 103DTY, 103DTZ) experienced electrical signal interference on March 29, 2017, expected to have been the result of supply voltage and connections that was only observable after data processing. Based on examination of data from March 23, 29, and 31, 2017 and comparisons to data from other accelerometers, data from this triaxial accelerometer collected on March 29, 2017 was not used while data from March 31, 2017 was considered suitable.
- Based on examination of all data collection events, the low-level geophone used for the Instantel Minimate located 50 m from the T5 test pile did not capture data appropriately on May 4, 2017, though data from the previous day, during times when pile driving was not occurring, when pile driving through soil and when pile driving with the tip on hard glacial till or bedrock was of high quality and clearly identified the effects of pile driving.

7.1 Data Evaluation Methods

Data gathered by the Instantel Minimates was processed using the Blastmate software. While the geophones measure velocity, the determination of the frequency of a complex vibration waveform requires mathematical approximations or simplifications. The Instantel system uses the “zero crossing” approach to calculate vibration frequencies that correspond approximately to the peak particle velocities of a given waveform. In this approach, the time for one half of a complete cycle is measured as the time between two successive points at which the vibration wave crosses the zero amplitude time axis. This zero crossing frequency calculation is somewhat limited because it assumes a single predominant frequency at the peak particle velocity as might be expected with a simple sine wave pattern. With complex vibrations, the peak can be the result of multiple superposed frequency components. This limitation, however, is recognised in monitoring of construction-related vibrations as an acceptable means for practically addressing the complex waveform analysis and reporting. Geophone data is provided in Appendix H.

Data generated by the accelerometers required processing for the following reasons:

- high-precision, low-noise accelerometers were chosen for much of the monitoring since, for the physical size, frequency and amplitude ranges necessary for this work, available accelerometers were more sensitive than most geophone systems;
- background vibrations and other vibration noise (e.g., generated by nearby road traffic, other equipment operating at the ground surface, environmental influences, etc.) and system electronic noise (e.g., voltage variability of power generators, signals outside of rated frequency ranges, etc.) must be considered apart from the primary frequency source (pile driving) to arrive at appropriate measurements of related particle velocities;
- pile driving using an impact hammer produces discrete, transient, or discontinuous, complex waveforms (i.e., not continuous, repeating sinusoidal waves); and
- acceleration data must be mathematically integrated to obtain corresponding velocity data.

Data reduction and analysis was carried out using the MATLAB[10] Version 2017A software along with the Signal Processing Toolbox. Acceleration time histories for each accelerometer were used to relate specific activities to instrument responses.

Figure 4 illustrates acceleration time history data from various accelerometers during different phases of pile driving. An approximately 2 minute period of data is shown for accelerometer 101DU (10 m from pile, in bedrock) during the approximately 2 minute period of pile driving on March 29, 2017 between 14:49 and 14:51, prior to the last three groups of 10 hammer blows. This time history clearly illustrates accelerometer responses to pile driving actions during this period including reactions to initial upstrokes (diesel firing), ram strikes and hammer rebounds. Figure 4 also shows a detailed view of the acceleration time history during the second to last full hammer strike at accelerometer locations 101DU, 102DU, 103 DU (at 10, 30 and 50 m within the bedrock) and at Well #1 on March 31, 2017. On this figure, the additional detail shown for accelerometer 103DU is associated with the increased sampling rate. Figure 4 also clearly illustrates diminishing acceleration responses with increasing distance from the test pile. Further, for the more detailed time interval shown for the multiple accelerometers, the data show a very small phase or time lag as the distance between the test pile and accelerometers increases, as the vibration wave front travels through the bedrock.

A Fast-Fourier Transform (FFT) algorithm was used to convert data from the time domain into the frequency domain with the FFT data subsequently integrated to velocity. Based on examination of background measurements obtained at the T42 test pile site on March 23, 2017 and at the Well #1 site on March 28, 2017, when no other activities were occurring, the data clearly indicated background noise and the influence of transforming the time domain acceleration data into the frequency domain at and below about 5 to 10 Hz. Figure 5 illustrates unfiltered data obtained from one accelerometer (103DTX) for 75 one-second periods at the site during

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[10] MATLAB 2017a (2017). MATLAB, 1 Apple Hill Drive, Natick, MA 01760-2098; https://www.mathworks.com/products/matlab.html

which pile driving was not occurring (March 23, 2017) after FFT processing and integration to velocity. These one-second durations were individually selected to coincide with the directly observable start of individual pile driving impulses within the acceleration time histories. A known characteristic of the FFT process is that for transient or non-continuous signals sampled in finite time intervals (seconds, minutes, hours, etc.), the underlying mathematics for defining time-continuous (infinite) periodic cycles result in a phenomenon termed “leakage” where signal energy spreads to other frequencies within the signal spectra. In this case, the leakage and FFT process influences the character of low frequency signals as presented in FFT graphs. Therefore, subsequent to FFT and velocity integration for each pile striking event (7 strikes when driving through the top few metres of soil, and 94 strikes from the time at which difficult pile driving began), the values of each peak within the velocity spectrum for each pile strike event were chosen using the “findpeaks” function in MATLAB. This function identifies the local peaks of input signal vectors where a local peak is defined as a data point that is either larger than its two neighboring points or is equal to infinity and signal endpoints are excluded. This approach limited the potential influence of various filtering algorithms and signal power suppression that might otherwise be used to address FFT spectra noise and leakage while at the same time addressing the FFT results that appear in the low frequency range below 5 Hz. Verification of Parseval’s theorem was also completed to ensure that the recorded energy in the time domain was the same as the energy in the frequency domain. Data obtained from the well locations was also processed similarly where specific events and time intervals when test pile driving was on-going and during other deliberate or day-to-day activities were occurring. For data processing at the well sites, in some cases, longer periods of the acceleration time histories were aggregated for subsequent FFT and velocity evaluation because of the long periods during which pile driving was not occurring yet the wells were subject to other background conditions (i.e., property-specific traffic, road traffic and deliberate site-specific comparison actions).

The data processing and reduction process described above is illustrated by the examples shown in Figure 5. The data shown in Figure 5 were collected at the location most subject to influence from background noise because of the small amplitude accelerations measured 50 m from test pile driving. Similar FFT results were observed with all accelerometers for times when pile driving was not in progress. Clearly identifiable pile strike events and ground responses were examined individually (see examples shown on Figure 4). Figure 5 also illustrates integrated FFT velocity data from 18 pile strike events (when driving the pile on till/rock) readily discernable from the acceleration time history. Subsequent to FFT and velocity integration for each pile striking event (7 strikes when driving through soil, and 94 strikes from the time at which difficult pile driving began through to refusal and PDA testing), the values of each peak within the velocity spectrum for each pile strike event were identified. Then, the maximum of each of these peaks was selected from all accelerometer FFT data for individual pile strike events, resulting in more than 2,000 maximum particle velocity and corresponding frequency data pairs to characterise ground vibrations when driving the test pile through soil and rock. Additional examples of data analyses are included in Appendix I illustrating acceleration time histories, FFT and resulting velocity spectra.

7.2 Data Summary

Subsurface measurements obtained at the T42 test pile site on March 23, 2017 prior to any test pile driving indicated background vibrations of about 0.003 mm/s when no construction vehicles were operating on site, weather conditions were optimal and in the absence of nearby traffic. At the well sites, measurements obtained when the test piles were not being driven indicated a range of background vibrations from other causes including traffic, environmental conditions and other activities on the well sites, exclusive of activities specifically undertaken to deliberately induce vibrations, typically ranged from about 0.010 to 0.035 mm/s.

Figures 6A, 6B, 7A and 7B illustrate peak particle velocities measured by the Instantel Minimate systems within the T42 site during the periods of pile driving on March 29 and 31, 2017. These figures compare all data collected to typical reporting scales and thresholds (e.g., BlastMate software as used by Instantel as in Appendix H). Figures 6A through 7B also expand the measurement scales by two orders of magnitude lower in amplitude to address the range of measurements from vibration data summarized in subsequent graphs.

All data collected during all pile driving events from the close-proximity Instantel Minimate device at 3 m from the T42 test pile is illustrated on Figure 6A. Figure 6B shows only the data collected when the pile was nearing and at its termination depth in the glacial till or on bedrock (from March 29 and 31, 2017). Similarly, for the Minimate geophone system located 10 m from the test pile, data collected from this instrument during all pile driving events is illustrated on Figure 7A. Figure 7B shows only the data collected when the pile was near or at its termination depth on till or bedrock (from March 29 and 31, 2017).

Particle velocities and frequencies measured by the surface and subsurface accelerometers at the borehole pairs at the T42 test pile site are illustrated in Figures 8 to 10 as follows:

- Borehole pair BH101/101A, located 10 m from test pile T42:
    - Figure 8A – surface and subsurface vibrations in soil (mid-depth accelerometers) during pile driving through the top 2 m of soil;
    - Figure 8B – subsurface vibrations in rock during pile driving through the top 2 m of soil;
    - Figure 8C – surface and subsurface vibrations in soil (mid-depth accelerometers) during hard pile driving at the till/rock pile termination depth;
    - Figure 8D – subsurface vibrations in rock during hard pile driving at the till/rock pile termination depth.
- Borehole pair BH102/102A, located 30 m from test pile T42:
    - Figure 9A – surface and subsurface vibrations in soil (mid-depth accelerometers) during pile driving through the top 2 m of soil;
    - Figure 9B – subsurface vibrations in rock during pile driving through the top 2 m of soil;
    - Figure 9C – surface and subsurface vibrations in soil (mid-depth accelerometers) during hard pile driving at the till/rock pile termination depth;
    - Figure 9D – subsurface vibrations in rock during hard pile driving at the till/rock pile termination depth.
- Borehole pair BH103/103A, located 50 m from test pile T42:
    - Figure 10A – surface and subsurface vibrations in soil (mid-depth accelerometers) during pile driving through the top 2 m of soil;
    - Figure 10B – subsurface vibrations in rock during pile driving through the top 2 m of soil;

- Figure 10C – surface and subsurface vibrations in soil (mid-depth accelerometers) during hard pile driving at the till/rock pile termination depth;
- Figure 10D – subsurface vibrations in rock during hard pile driving at the till/rock pile termination depth.

Figures 10B and 10D include an inset graph to illustrate data magnitudes below the lower bound of the velocity axis as illustrated on Figures 6A through 10A and 10C.

Figures 11A through 14B summarize data from the Instantel Minimates obtained during pile driving at the T5 site. As above, Figures 11A, 12A, 13A and 14A illustrate all measurements at each of the monitoring locations at 3, 10, 30 and 50 m from the test pile whereas Figures 11B, 12B, 13B and 14B illustrate measurements only when the pile was being driven on the till/rock. Data illustrated for the low-level geophone, located 50 m from the test pile at site T5, is illustrated using histograms since, for the long-duration monitoring event, the low-level geophone software as implemented generates output only showing the triaxial peak particle velocity measurements without corresponding zero-cross frequencies for the recording period.

Table 11: Summary of Particle Velocities during Pile Driving through Top 2 m at T42 Site

Location	Distance from Test Pile (m)	Particle Velocity (mm/s)		
		Vertical	Transverse	Longitudinal
Close Proximity	3	38.1	7.2	31.7
BH-101/101A	10(12)[11]			
Surface		7.2	3.3	10.4
Soil Mid-Depth		0.36	0.51	0.21
Rock		0.13	0.04	0.04
BH-102/102A	30			
Surface		0.21	N/A	N/A
Soil Mid-Depth		0.27	0.15	0.20
Rock		0.03	0.04	0.02
BH-103/103A	50			
Surface		0.18	N/A[12]	N/A
Soil Mid-Depth		0.15	N/A	N/A
Rock		0.04	0.00	0.06

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[11] Sensors 101SU, 101STX, 101STY and 101STZ were installed in the shallow borehole off-set 2 m further distant from the test pile as described in the report text.

[12] N/A indicates “Not Applicable” since vibrations in the noted directions were not instrumented or measured. See Section 5 for additional details.

Table 12: Summary of Particle Velocities during Pile Driving at Till/Rock at T42 Site

Location	Distance from Test Pile (m)	Particle Velocity (mm/s)		
		Vertical	Transverse	Longitudinal
Close Proximity	3	11.0	7.2	14.7
BH-101/101A	10(12)[13]			
Surface		2.9	2.2	3.2
Soil Mid-Depth		6.38	13.28	12.90
Rock		13.24	8.76	7.33
BH-102/102A	30			
Surface		0.85	N/A	N/A
Soil Mid-Depth		8.65	4.98	7.84
Rock		5.12	0.45	2.54
BH-103/103A	50			
Surface		0.12	N/A	N/A
Soil Mid-Depth		0.10	N/A	N/A
Rock		0.01	0.00	0.01

Table 13: Summary of Particle Velocities during Pile Driving through Soil at T5 Site

Location	Distance from Test Pile (m)	Particle Velocity (mm/s)		
		Vertical	Transverse	Longitudinal
Surface	3	23.8	12.3	20.1
Surface	10	2.5	5.7	10.0
Surface	30	0.8	0.6	0.9
Surface	50	1.4	0.5	1.6

Table 14: Summary of Particle Velocities at Ground Surface during Pile Driving at Till/Rock at T5 Site

Location	Distance from Test Pile (m)	Particle Velocity (mm/s)		
		Vertical	Transverse	Longitudinal
Surface	3	11.3	12.3	11.1
Surface	10	2.5	2.9	5.1
Surface	30	0.8	0.6	0.9
Surface	50	0.7	0.4	0.7

Data collected at Well #1 is summarized in Table 15, below, for time periods on March 28, 29 and 31, 2017 when pile driving was not occurring (“quiet”) and when pile driving was occurring on March 29 and 31, 2017. During the

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[13] Sensors 101SU, 101STX, 101STY and 101STZ were installed in the shallow borehole off-set 2 m further distant from the test pile as described in the report text.

"quite" periods, the only other activities occurring within the near vicinity of the accelerometer at Well #1 consisted of traffic on Baldoon Road, people walking carefully near the accelerometer data logger to check on its status and environmental influences (e.g., wind/air pressures). On March 28, as indicated in Table 15, deliberate activities were also undertaken to examine their effect on the readings and to provide a basis for data comparison. These activities included jumping near the well, finger tapping on the well lid, driving a vehicle in the driveway, opening and closing vehicle doors and placing a vibrating cell phone on the well lid among others. These data collected on March 28, 29 and 31, 2017 during quiet periods is virtually identical to data during pile driving. Data collected at Wells #3 and #4 is also summarized in Table 15, below, for time periods on May 3 and 4, 2017 when pile driving was not occurring ("quiet") and when pile driving was occurring on these same dates. During the times when pile driving was not occurring, other activities occurred on the Well #3 and #4 properties including movement of farm equipment, lawn mowing with ride-on equipment, operating well pumps, traffic on St. Clair Road and Bush Line, typical light vehicles entering and exiting the sites and foot traffic in the vicinity. Well #3 was the monitored well closest to a test pile site. The accelerometers at this well captured pile driving induced accelerations during part of the pile driving period when the data was not otherwise obscured by the influence of other activities on the well site, background vibration noise and signal noise. Appendix I includes graphical summaries of data evaluation for this relevant time period along with examples of other conditions when test pile T5 was not being driven. These data illustrate the relative and inconsequential magnitudes of pile driving-induced vibrations as compared to the influences of common conditions otherwise.

Table 15: Summary of Particle Velocities at Domestic Water Wells

Particle Velocity[14] (mm/s)	**Relevant Activity**
March 28, 2017, Well #1	
0.01	Quiet period, no activities
0.018 (0.0182)	Golder employee jumped 3 times at 0.9 m from well (see Appendix I)
0.018 (0.0178)	Golder employee jumped 3 times at 1.8 m from well (see Appendix I)
0.018 (0.0178)	Golder employee jumped 3 times at 2.7 m from well (see Appendix I)
0.012	Golder employee walked toward well (a composite set of footfalls)
0.002	Golder employee walked toward well (see Appendix I)
0.083	Cell phone on well lid ringing in vibrating mode (see Appendix I)
0.016	Driving vehicle up and down driveway (see Appendix I)
0.018	Climbed steps, knocked on door and descended steps (see Appendix I)
March 29, 2017, Well #1	
0.037	No pile driving
0.031	Pile driving time period
March 31, 2017, Well #1	
0.025	No pile driving
0.017	Pile driving time period

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[14] Values indicated in table are maximum measured values for vertical, longitudinal and transverse directions. Values have been rounded to 3 decimal places except where shown in parentheses to provide additional detail.

Particle Velocity[14] (mm/s)	**Relevant Activity**
May 3, 2017, Well #3	
0.003 to 0.005	No pile driving
0.009 to 0.014	No pile driving
0.003	Pile driving time period (see Appendix I)
0.013	Golder staff member jumped up and down 3 times at 1 m from well (see Appendix I)
May 4, 2017, Well #3	
0.003 to 0.074	No pile driving, other activities appear to have occurred on site based on acceleration time history data
0.028 to 0.031	Pile driving time period
May 4, 2017, Well #4	
0.008 to 0.021	No pile driving
0.006 to 0.014	Pile driving time period

8.0 DATA INTERPRETATION

Ground surface and subsurface vibrations were measured at the T42 site. Ground surface vibrations were monitored at the T5 site. Vibrations of domestic water wells were successfully measured at three well locations with one of these near the T42 site and two near the T5 site. These domestic water wells were located at distances ranging from about 911 to about 1.1 km from the test pile sites.

Ground surface vibrations measured at the T42 and T5 sites were similar when driving the closed-end pipe piles through the first few metres of soil and when driving the piles within the glacial till or on the bedrock surface. When driving through the first few metres of soil, vibrations at the T42 site were greater than those at the T5 site. For example, the maximum vertical vibration amplitude measured at 3 m distant from the pile at the T42 and T5 sites were about 38 mm/s (Table 11) and about 24 mm/s (Table 13), respectively. The difference in ground surface vibration amplitudes can be attributed to the softer or looser soil conditions within the top few metres of soil at the T5 site as compared to the T42 site. The soil conditions at the T5 site required less energy for pipe pile penetration and, therefore, the ground surface vibration magnitudes were smaller than at the T42 site when driving through the top few metres of soil. Based on Golder's review of the borehole records as completed by AMEC, the ground surface vibration amplitudes summarized within Tables 11 and 13 for pile driving through the top few metres of soil are expected to be typical throughout most of the NK1 project site. In some NK1 project areas, the near-surface soils are expected to be stiffer or denser than at the T42 and T5 sites. At such locations, ground surface vibrations when driving through the top few metres of soil might be larger than those experienced at the T42 and T5 sites. While differences in ground surface vibration measurements are expected when driving through the first few metres of soil, these differences in vibration magnitude have little effect on the bedrock at the turbine site as illustrated by a comparison of Tables 11 and 12 for the vibration magnitudes in bedrock when the pile was being driven in the soil.

Data from the T42 site demonstrate that driving of the closed-end pipe piles on or near the bedrock surface represented the worst conditions with respect to vibrations of any substantive magnitudes measured within the bedrock. Maximum ground surface vibrations, near the test pile, when driving the closed-end pipe piles near or on the bedrock surface were not substantively different at the two test sites with measurements of about 11 to 15 mm/s at the T42 site and about 11 to 12 mm/s at the T5 site. Differences between ground surface vibration magnitudes measured at the ground surface when pile driving at or near the bedrock surface at the T42 and T5 sites were not substantive and are expected to be representative of conditions throughout the NK1 project area. The similarity in ground surface vibration data from these two sites illustrate the effects of the overlying soil mass on ground surface vibrations when the piles experienced refusal to further penetration and were subject to the largest pile driving energies during the test pile installation. For the remaining pile driving, ground surface vibrations are expected to be similar to those measured at both the T5 and T42 sites when driving the piles on or near the bedrock surface.

The site-specific data is also compared to earlier estimates (Golder 2016) based on published research and engineering practices (e.g., CALTRANS 2004). Maximum velocities, regardless of direction, measured at the ground surface by the Minimates and accelerometers during all pile driving activities at test pile sites T42 and T5 sites are illustrated on Figure 15. Maximum values for velocities, regardless of direction, measured by the accelerometers installed in the rock during intervals of pile driving in the glacial till/on rock are also illustrated on Figure 15. The site-specific data clearly illustrates the attenuation of particle velocity with increasing distance from the test pile.

As noted above, all data from the monitoring of Wells #1, #3 and #4 indicate that the peak particle velocity was less than 0.035 mm/s during pile driving. At times when pile driving was not occurring, the maximum particle velocity was nearly double this value as related to other activities on and near the monitored wells. As compared to typical vibration magnitudes associated with other causes or vibration thresholds for different conditions, as illustrated in Table 16 and Table 17, below, the vibrations generated by pile driving are expected to be significantly below the threshold of human perception for transient vibrations at domestic water supply wells located several hundred metres or more from pile driving. The data further indicate that the character of vibrations at Wells #1, #3 and #4 as measured by the sensitive instrumentation were similar to or less than those induced by common day-to-day activities (e.g., traffic, walking nearby, farming equipment and light vehicles) and by walking or jumping near the well casing.

Table 16: Examples of the effects, thresholds or conditions associated with small magnitude ground vibrations[15]

PPV (mm/s)	Effect or Condition
2 – 30	Pile driving in soft ground at 1 to 3 m from hammer using vibratory and impact hammers
23	Close-proximity nail driving in residential structure
2.5 – 12	Equates to normal daily family activity within residential structure
3 – 9	Vibration limits for pumps ranging from 10 hp to 3000 hp
7.6	Equivalent to jumping on floor of residential structure
6	Transient vibrations distinctly perceptible
5	Steady-state vibrations annoying
2.5	Truck traffic on bumpy road at 16 m
2.3	Large bulldozer at 7.6 m
1.9	Loaded trucks at 7.6 m
1	Steady-state vibrations readily perceptible
1	Transient vibrations barely perceptible
0.8	Steady-state threshold for workshop
0.8	Equivalent to walking on floor of residential structure
0.8	Small bulldozer at 7.6 m
0.76	Vehicle traffic at 16 m
0.15 – 0.5	Steady-state vibrations threshold of perception
0.4	Steady-state threshold for office
0.3	Steady-state vibrations slightly perceptible
0.2	Steady-state threshold for residence
0.1	Steady-state threshold for hospital operating room
0.025	Quiet background

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[15] See references at conclusion of report text for cited vibration magnitudes, their causes and other thresholds.

Table 17: Vibration Limits for Human Perception as Defined in Tables NPC-207-2 and NPC-207-3

Applicable Clause	Observation Period	Limit on the Average Peak Vibration Velocity (mm/s)	
		Daytime	Nighttime
Vibration Limits for Frequent Impulses			
4(4)(b)	≤20 minutes	0.3	0.3
4(4)(c)(i)	20 < period ≤ 60 minutes	0.6	0.3
4(4)(c)(ii)	60 < period ≤ 120 minutes	1.0	0.3
Vibration Limits for Infrequent Impulses			
4(4)(c)(iii)	120 minutes	10.0	0.3

Water quality testing was completed by AECOM (2017a and 2017b) on three occasions at Wells #1 and #2, identified by AECOM as wells PW1 and PW2, respectively and Well #3 (noted as MW2 by AECOM). These water quality testing events were identified by AECOM as “baseline”, “pre-pile” and “post-pile” events. As related to the T42 test pile, AECOM concluded that all indicator parameter concentrations were within an acceptable range compared to baseline and pre-test conditions, with the exception of turbidity at Well #2 (PW-2). Elevated colour and turbidity values at this well were concluded to have potentially been the result of changes in well use and/or climatic conditions affecting water quality that could have occurred since the time of baseline sampling completed more than 2 months prior to the test pile and not the test pile driving. AECOM noted that Well #2 (PW-2) was a further distance to the test pile location as compared to Well #1 (PW-1) where turbidity and other water quality parameter concentrations were considered by AECOM to be stable. Related to the T5 test pile monitoring, evaluations of water quality data completed by AECOM concluded that water quality indicator parameters were within acceptable ranges as compared to baseline and pre-pile conditions, with the exception of colour and turbidity. AECOM concluded that elevated colour values could be a result of changes in well use and/or climatic conditions affecting water quality considering that the baseline and pre-test pile values show a larger percent difference compared to the pre-pile and post-pile results. Further, the turbidity concentrations at MW1 were found by AECOM to exceed the referenced water quality standards at the time of all sampling events (baseline, pre-pile and post-pile), while concentrations at MW2 (Well #3) remained below the water quality standards at the time of all sampling events. Elevated post-pile turbidity concentrations at MW1 were judged to have potentially been result of poor well construction and weather conditions and not related to the test pile driving. Because of well construction details, the well identified as MW1 by AECOM was not suitable for monitoring vibrations. The conclusion of AECOM that the test pile driving did not adversely affect water quality at the monitored wells is consistent with analysis and interpretation of the monitoring data that vibrations at the well locations were inconsequential.

9.0 CONCLUSIONS

Surface and subsurface vibration monitoring was completed at the NK1 turbine T42 and T5 sites prior to and during installation of test piles. Vibration data was collected at multiple distances from test pile T42 at the ground surface, within the soft silty clay soils (at about mid-depth) and within the bedrock near the glacial till/bedrock interface. Ground surface vibration measurements were also obtained at the T5 test pile site at multiple distances from the pile. Vibrations of various magnitudes were detected by all monitoring instruments. The resulting data has permitted an evaluation of distance-vibration attenuation behaviour for this site and vibrations at residential well locations. As compared to typical vibration magnitudes associated with other causes or published acceptable vibration thresholds for different activities and conditions, and as compared to background vibrations and deliberate actions to simulate day-to-day activities near the well locations, vibrations at the residential well locations during pile driving were below regulatory values for human perception of transient vibrations, other published thresholds related to residential uses and below commonly occurring background levels. It is our opinion that pile driving will not expose distant groundwater wells (e.g., more than 550 m) to vibrations in excess of those that the wells commonly experience otherwise. The conclusion of AECOM that the test pile driving did not adversely affect water quality at the monitored wells is consistent with analysis and interpretation of the monitoring data that vibrations at the well locations were inconsequential.

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REFERENCES

AECOM 2017a. Memorandum: Turbine 5 Well Water Quality Pile-Driving Impact Assessment. May 17, 2017

AECOM 2017b. Memorandum: Turbine 42 Well Water Quality Pile-Driving Impact Assessment. May 17, 2017

Agilent Technologies (2000). The Fundamentals of Signal Analysis, Application Note 243.

AMEC 2016a. Geotechnical Investigation Report, Proposed North Kent Wind 1 Project, Municipality of Chatham-Kent, Ontario. AMEC Foster Wheeler Reference No. SWW167102.

AMEC 2016b. Supplementary Laboratory Testing data, North Kent Wind 1, Geotechnical Investigation Project.

CALTRANS. 2004. Transportation- and construction-induced vibration guidance manual. Prepared by Jones & Stokes for California Department of Transportation, Noise, Vibration, and Hazardous Waste Management Office, Sacramento, CA.

EXP Services Inc. (2017). Dynamic Testing of Piles, North Kent Wind Farm Project, Wind Turbine, T42, Municipality of Chatham-Kent, ON. Project Number BRM-00603996-A0, dated April 17, 2017.

Golder (2016). North Kent Wind Energy Project, Evaluation of Potential Turbine Foundation Influences on Water Supply Wells from Alleged Geological, Geotechnical, Hydrogeological and Radiological Conditions," September, 2016, Golder Project No. Report Number: 1662594-R01.

ISO 2631-2 (2003). Evaluation of human exposure to whole-body vibration - Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz). International Organization for Standardization, Geneva, Switzerland.

OSMRE (1986). Blasting Performance Standards, 30 Code of Federal Regulations, Sec. 816.61 Use of explosives: General requirements. Office of Surface Mining, Reclamation and Enforcement

USBM RI 8507 (1985). Report of Investigations 8507, Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting. D. E. Siskind, M. S. Stagg, J. W. Kopp and C. H. Dowding. United States Bureau of Mines.

Wiss, J.F. (1981). Construction vibrations: state-of-the-art. Journal of Geotechnical Engineering, ASCE 107(GT2):167–181.

H.R. Masoumi, S. Francois, and G. Degrande (2007). Free Field Vibrations Due To Pile Driving Using a Hybrid Frequency-Time Domain Approach, 18th Engineering Mechanics Division Conference (EMD2007).

List of References Used for Table 16

ANSI/HI 2009. Standard 9.6.4., Centrifugal and Vertical Pumps - Vibration Measurements and Allowable Values, Corrected Version (2010). Hydraulic Institute. In Europump, European Association of Pump Manufacturers, Pump Vibration Standards Guidelines, 2013.

API 2011. Standard 610, Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries, Eleventh Edition. American Petroleum Institute (API). In Europump, European Association of Pump Manufacturers, Pump Vibration Standards Guidelines, 2013.

CALTRANS. 2004. Transportation- and construction-induced vibration guidance manual. Prepared by Jones & Stokes for California Department of Transportation, Noise, Vibration, and Hazardous Waste Management Office, Sacramento, CA.

Deckner, F. 2013. Ground vibrations due to pile and sheet pile driving – influencing factors, predictions and measurements. Thesis, KTH, Royal Institute of Technology, Stockholm, Sweden.

Dowding, C.H. 1996. Construction vibrations. Prentice-Hall. Englewood Cliffs, NJ.

ISO 2014. Standard 10816 ISO series (6 parts), Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts. International Standards Organization, Geneva, Switzerland. In Europump, European Association of Pump Manufacturers, Pump Vibration Standards Guidelines, 2013.

Reiher, H. and F. J. Meister. 1931. The effects of vibration on people. Forshung auf dem Gebeite der Ingenieurwesens 2(2) in CALTRANS (2004).

Siskind, D. 2000. Vibrations from Blasting. International Society of Explosives Engineers, Cleveland, 68 – 69, 109.

Stagg, M. S. and Engler, A.J. 1980. Measurement of blast-induced ground vibrations and seismograph calibration. (Report of Investigations 8506.) Washington, DC: U.S. Bureau of Mines.

Whiffen, A. C. 1971. A survey of traffic-induced vibrations. (Report LR419.) Crowthorne, Berkshire, England: United Kingdom Department of Environment, Road Research Laboratory. Available at https://trb.org/.

Wiss, J.F. 1981. Construction vibrations: State-of-the-Art. Journal of the Geotechnical Engineering Division, ASCE, 107(2), 167 – 181.

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Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder’s express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder’s report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client’s expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

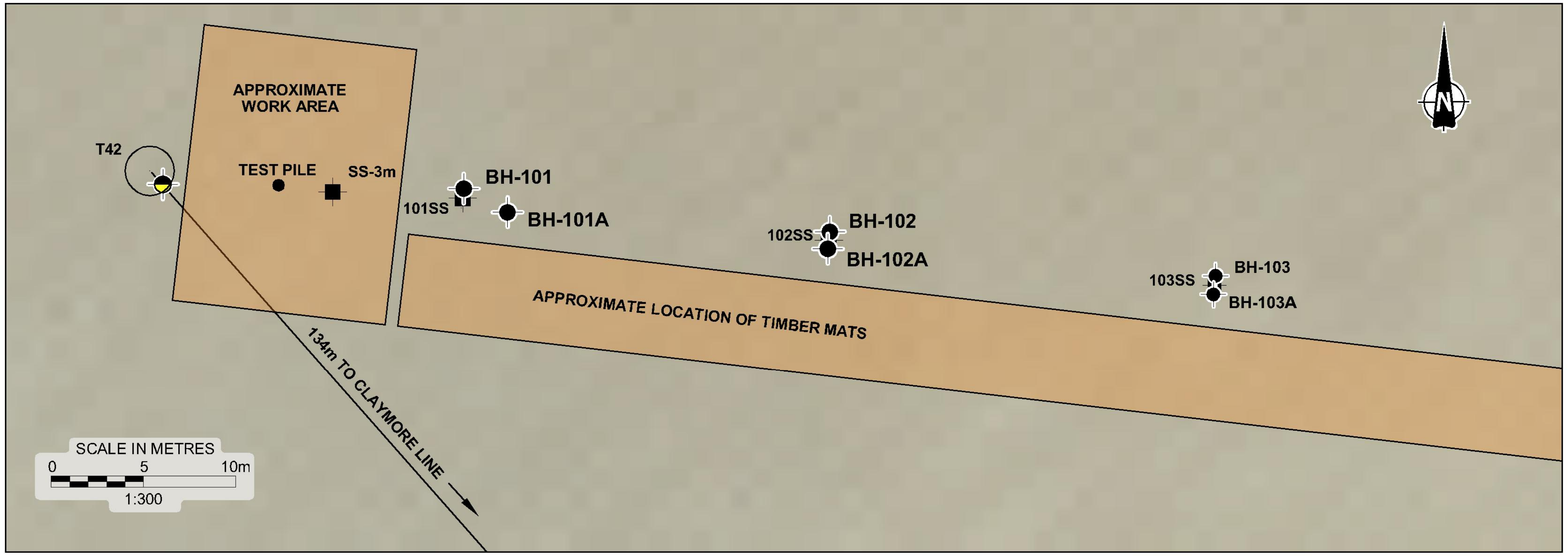
Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder’s report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder’s report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder’s report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder’s report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder’s responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

SITE PLAN



INSET A

LEGEND

●	BOREHOLE
■	SURFACE VIBRATION SENSOR
◐	BOREHOLE (AMEC)
●	WATER WELL

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

NORTH KENT 1
SURFACE AND SUBSURFACE VIBRATION MONITORING
TEST PILES T5 AND T42

TITLE

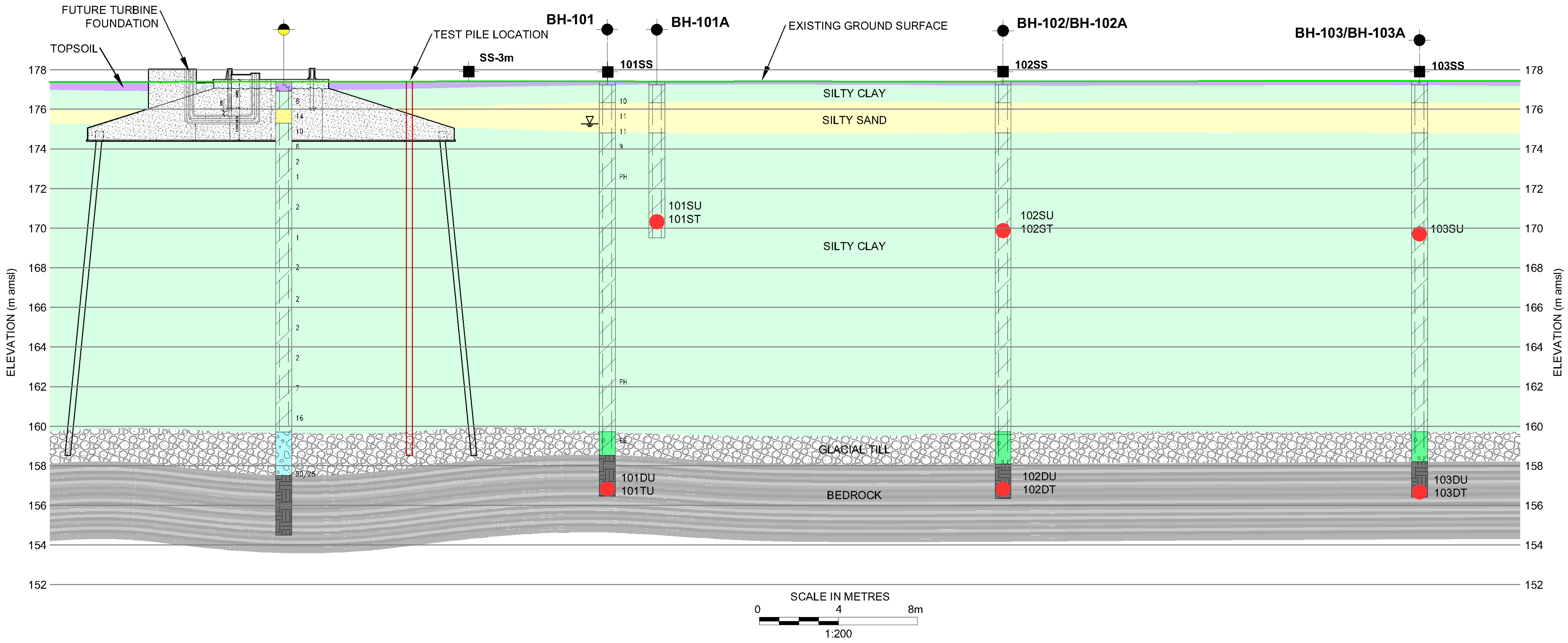
SITE AND INSTRUMENT LOCATION PLAN, T42

Golder Associates

PROJECT No. 1668031
FILE No. 1668031-2000-R01001
SCALE AS SHOWN
REV.
CADD DCH May 12/17
CHECK

FIGURE 1

Drawing file: 1668031-2000-R01001.dwg May 12, 2017 - 2:49pm



LEGEND

● BOREHOLE

■ SURFACE VIBRATION SENSOR

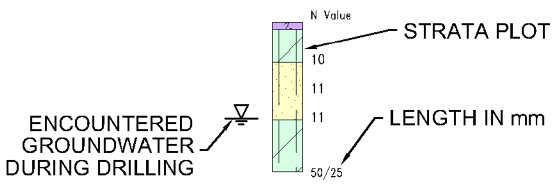
🔴 SUBSURFCE VIBRATION SENSOR

● BOREHOLE (AMEC)

SIMPLIFIED STRATIGRAPHY

▨ TOPSOIL	▨ SILTY CLAY
▨ SAND	▨ SILTY CLAY TILL
▨ SILTY SAND	▨ SILTY SAND & GRAVEL
▨ SAND & GRAVEL	▨ BEDROCK

INSTALLATION DETAILS



FOR DETAILS REFER TO RECORD OF BOREHOLES

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO;
"FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002; AND
AutoCAD FILE "T42.dwg", RES-GROUP, RECEIVED MARCH 14 - 2017.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT
NORTH KENT 1
SURFACE AND SUBSURFACE VIBRATION MONITORING
TEST PILES T5 AND T42

TITLE
SUBSURFACE PROFILE, T42

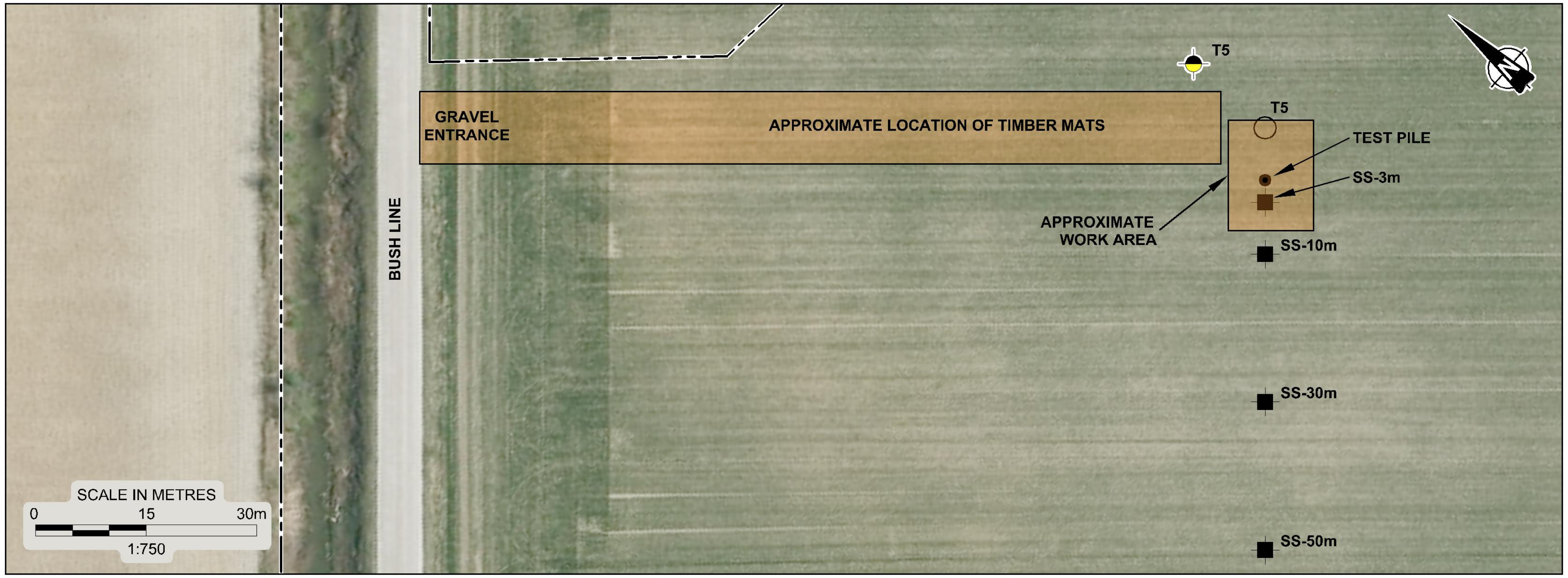
Golder Associates

PROJECT No.	1668031	FILE No.	1668031-2000-R01001
		SCALE	AS SHOWN
CADD	DCH	May 15/17	REV.
CHECK			

FIGURE 2

Drawing file: 1668031-2000-R01001.dwg May 15, 2017 - 10:35am

SITE PLAN



INSET B

LEGEND

■ SURFACE VIBRATION SENSOR

◓ BOREHOLE (AMEC)

● WATER WELL

REFERENCE

DRAWING BASED ON 2010 AERIAL IMAGERY PROVIDED BY THE MUNICIPALITY OF CHATHAM-KENT, INCLUDES MATERIAL c 2015 OF THE QUEEN'S PRINTER FOR ONTARIO; AND "FOUNDATION PLAN", ENTUITIVE, PROJECT No. C017-0190, DWG No. S002.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

NORTH KENT 1
SURFACE AND SUBSURFACE VIBRATION MONITORING
TEST PILES T5 AND T42

TITLE

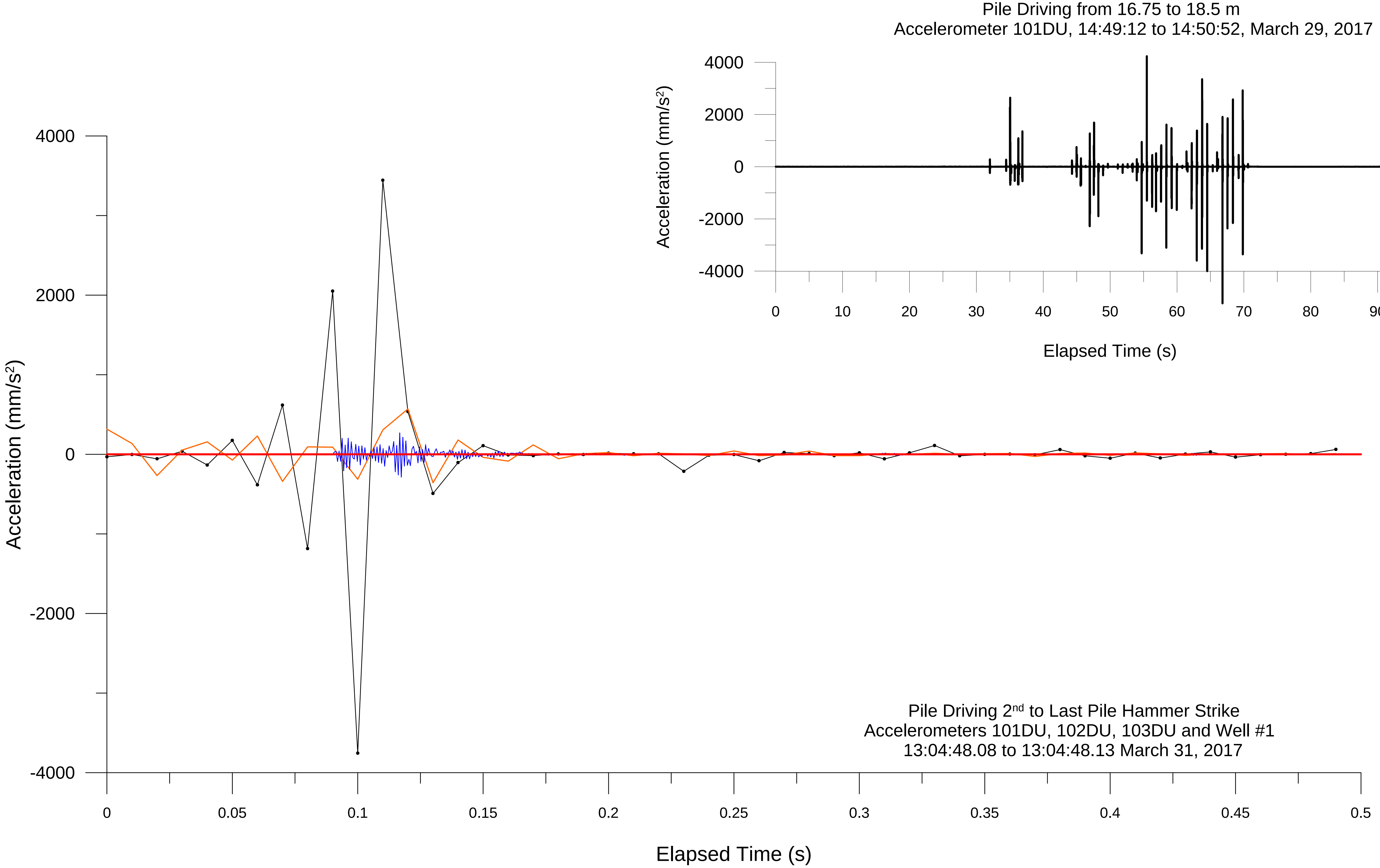
SITE AND INSTRUMENT LOCATION PLAN, T5

Golder Associates

PROJECT No.	1668031	FILE No.	1668031–2000–R01003
		SCALE	AS SHOWN
CADD	DCH	May 12/17	REV.
CHECK	SSB		

FIGURE 3

Drawing file: 1668031–2000–R01003.dwg   May 12, 2017 – 2:50pm



Pile Driving from 16.75 to 18.5 m
Accelerometer 101DU, 14:49:12 to 14:50:52, March 29, 2017

Pile Driving 2nd to Last Pile Hammer Strike
Accelerometers 101DU, 102DU, 103DU and Well #1
13:04:48.08 to 13:04:48.13 March 31, 2017

Notes:
1. This drawing to be read in conjunction with report text.
2. Data shown taken from Test Pile Site T42, accelerometers installed in rock at boreholes BH-101, BH-102 and BH-103 and accerometer installed on Well #1.
3. Elapsed time take from start times as indicated above.

PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Example Acceleration Time History Data
Test Pile T42

Golder Associates

PROJECT No. 1668031-2000
FILE No. 1668031-2000-R01004
SCALE AS SHOWN
REV. 0
DRAWN SJB May 2017
CHECK

FIGURE 4

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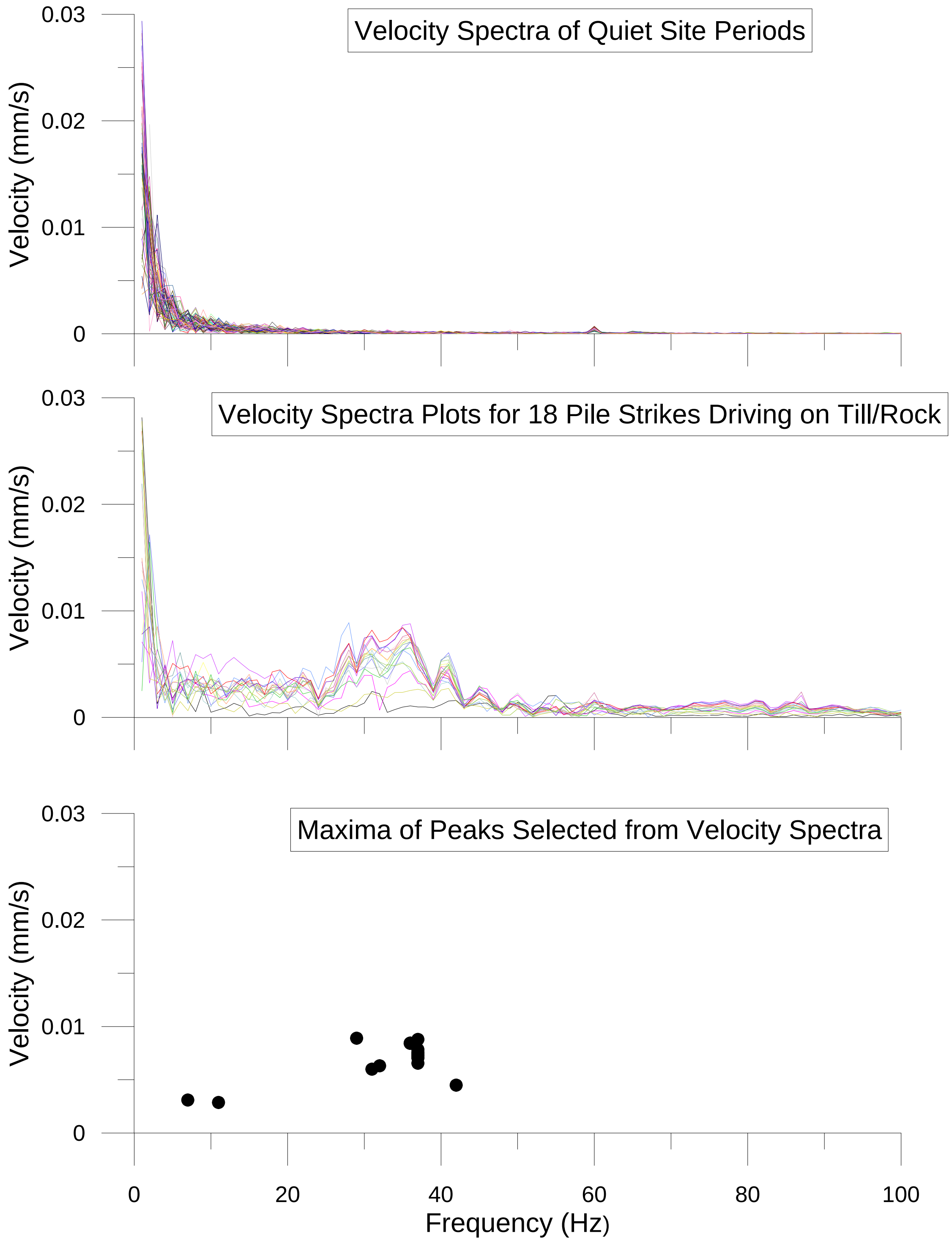

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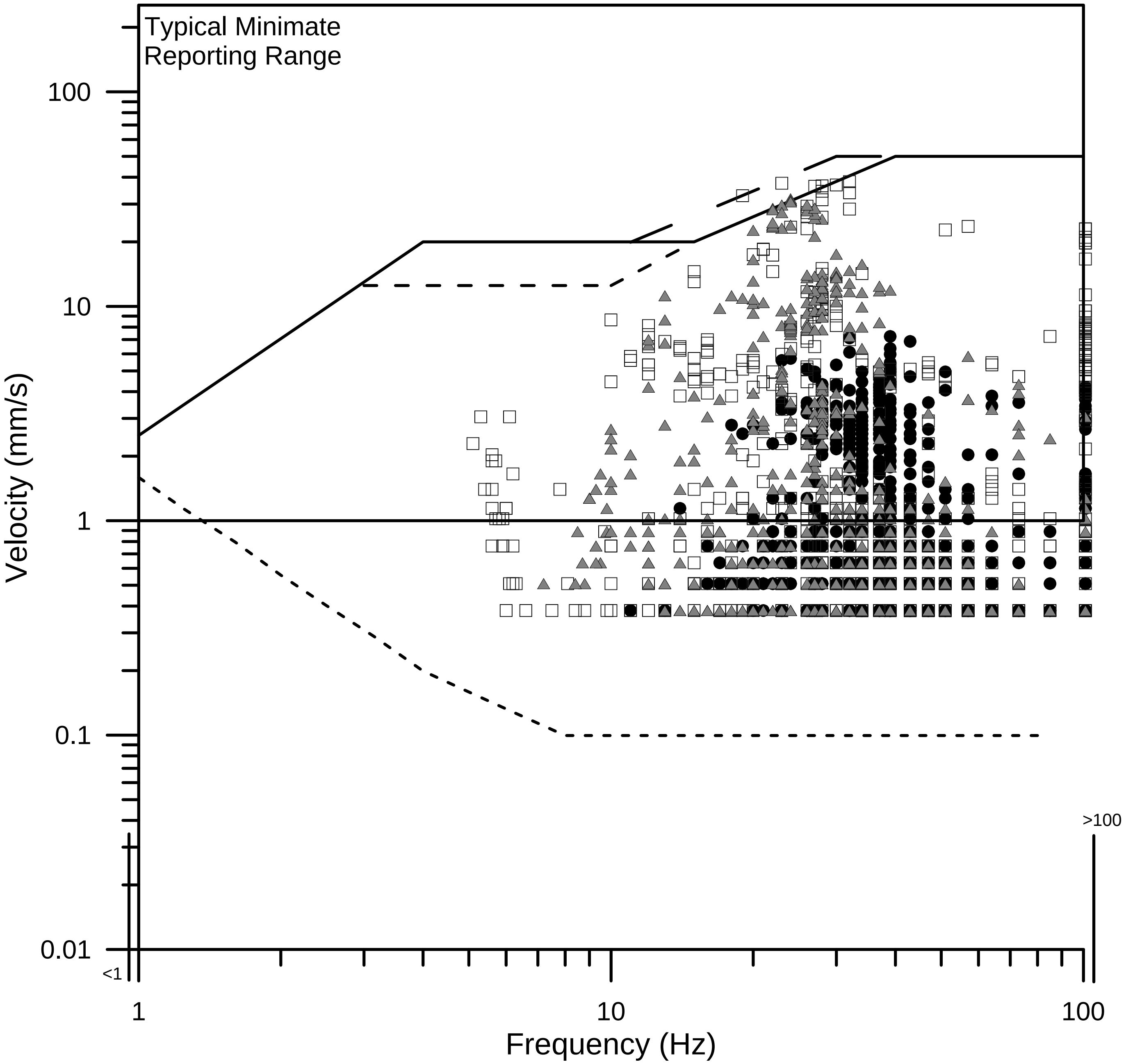
Notes:
1. This drawing to be read in conjunction with report text.

PROJECT
North Kent Wind
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Example of Data Processing
Accelerometer DTX103, Test Pile T42

PROJECT No.	1668031-2000	**FILE No.**	1668031-2000-R01005
		SCALE	AS SHOWN
		REV.	0
DRAWN	SJB	May 2017	
CHECK			

FIGURE 5



Legend

- □ NK1 Vertical at 3 m from Pile
- ● NK1 Transverse at 3 m from Pile
- ▲ NK1 Longitudinal at 3 m from Pile
- ── USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ── OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

Notes:
1. This drawing is to be read in conjuction with accompanying report.

PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

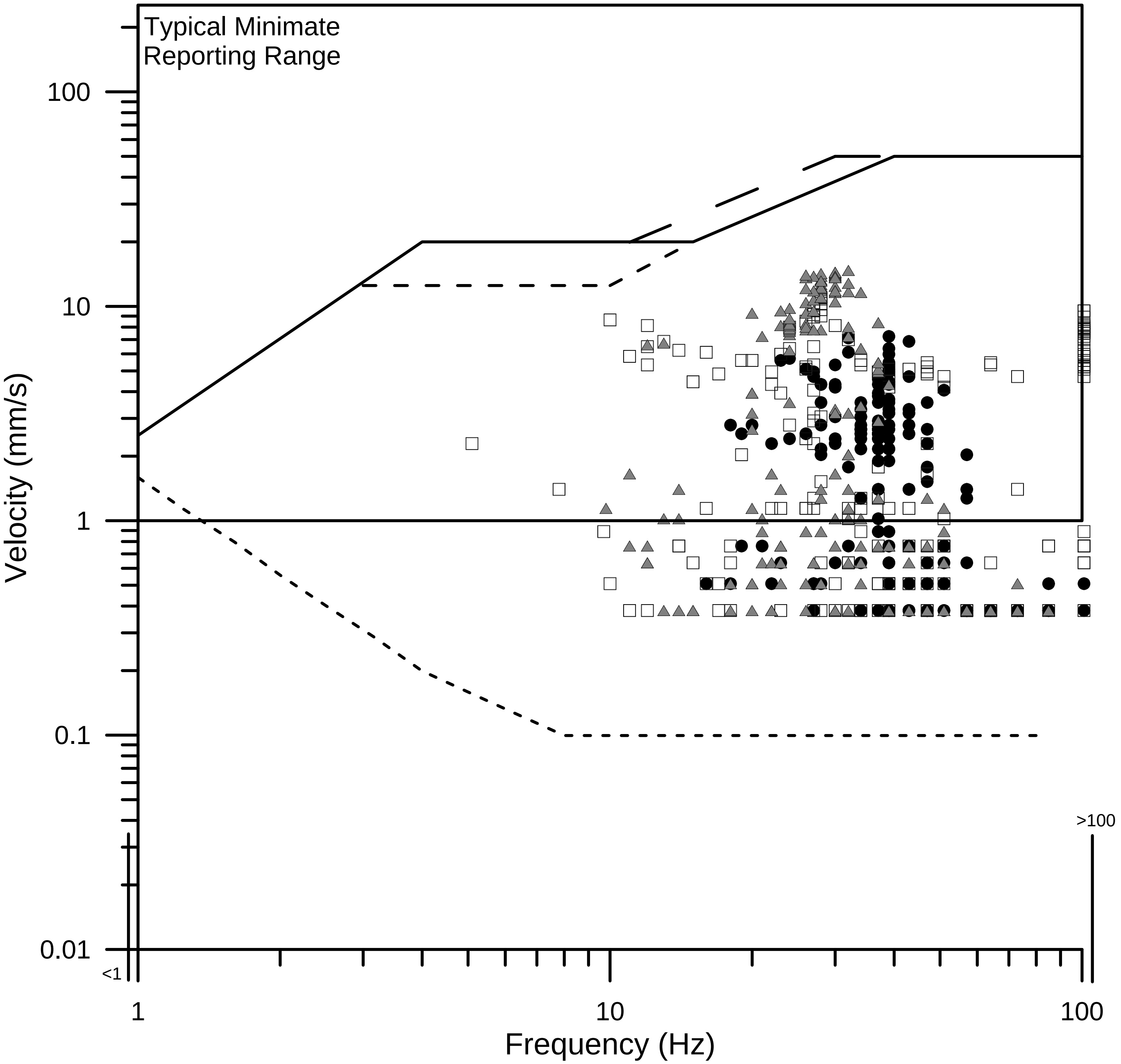
TITLE
Ground Surface Vibrations
3 m from Test Pile T42
Pile Driving - All Data

Golder Associates

PROJECT No.	1668031-R01		**FILE No.**	1668031-2000-R01006A
			SCALE AS SHOWN	**REV.** 0
DRAWN	SJB	May 2017		
CHECK				

FIGURE 6A

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01006A.grf



Legend

- □ NK1 Vertical at 3 m from Pile
- ● NK1 Transverse at 3 m from Pile
- ▲ NK1 Longitudinal at 3 m from Pile
- ——— USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ——— OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

Notes:
1. This drawing is to be read in conjuction with accompanying report.

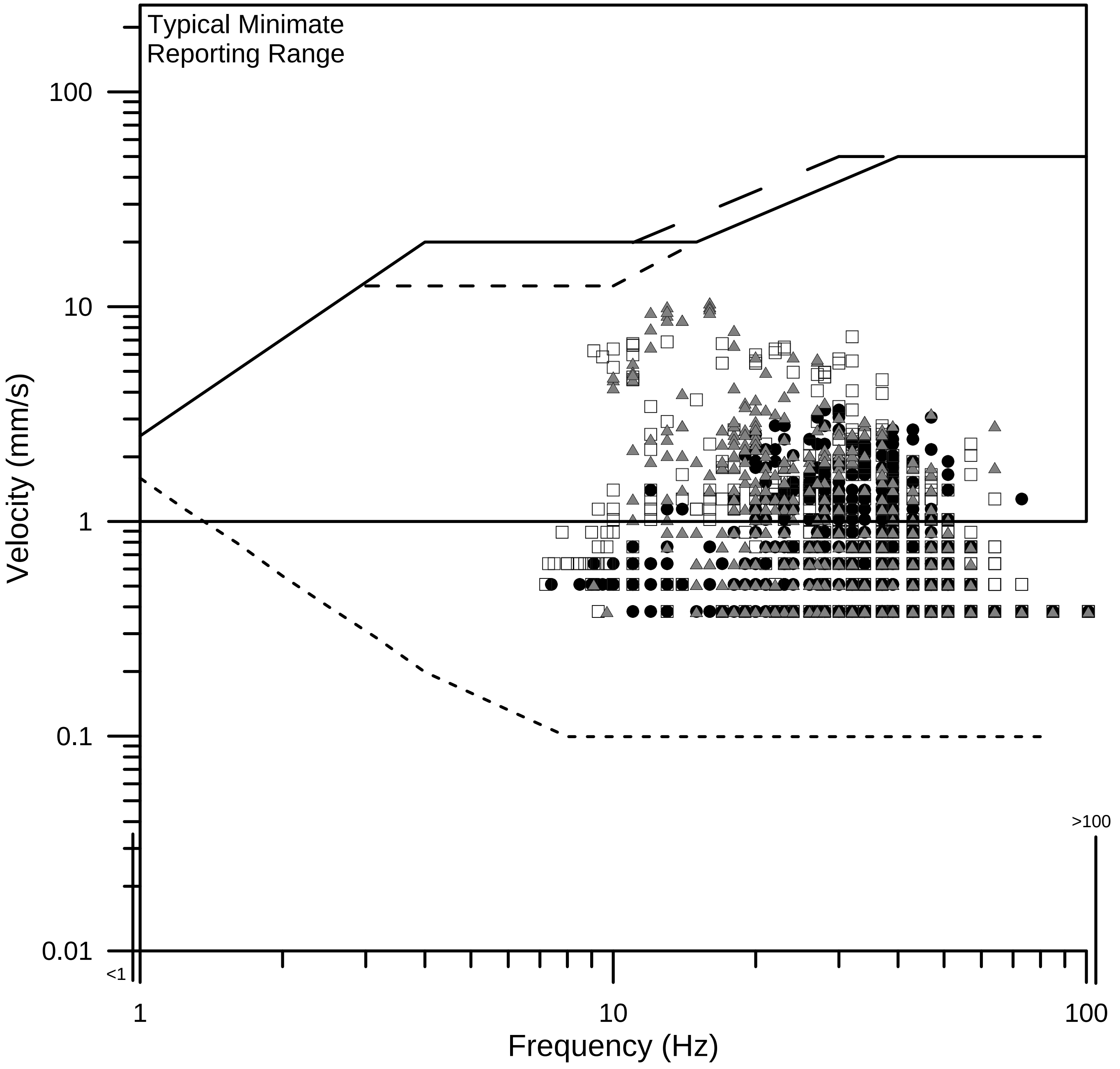
PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Ground Surface Vibrations
3 m from Test Pile T42
Pile Driving on Till/Rock

Golder Associates

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01006B	
		SCALE	AS SHOWN	REV. 0
DRAWN	SJB	May 2017		
CHECK			**FIGURE 6B**	

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01006B.grf



Notes:
1. This drawing is to be read in conjuction with accompanying report.

Legend

□ NK1 Vertical at 10 m from Pile
● NK1 Transverse at 10 m from Pile
▲ NK1 Longitudinal at 10 m from Pile
─── USBM Damage Threshold (Drywall)
– – USBM Damage Threshold (Plaster)
─── OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Ground Surface Vibrations
10 m from Test Pile T42
Pile Driving - All Data

Golder Associates

PROJECT No.	1668031-R01	**FILE No.**	1668031-2000-R01007A	
		SCALE	AS SHOWN	**REV.** 0
DRAWN	SJB	May 2017		
CHECK			**FIGURE 7A**	

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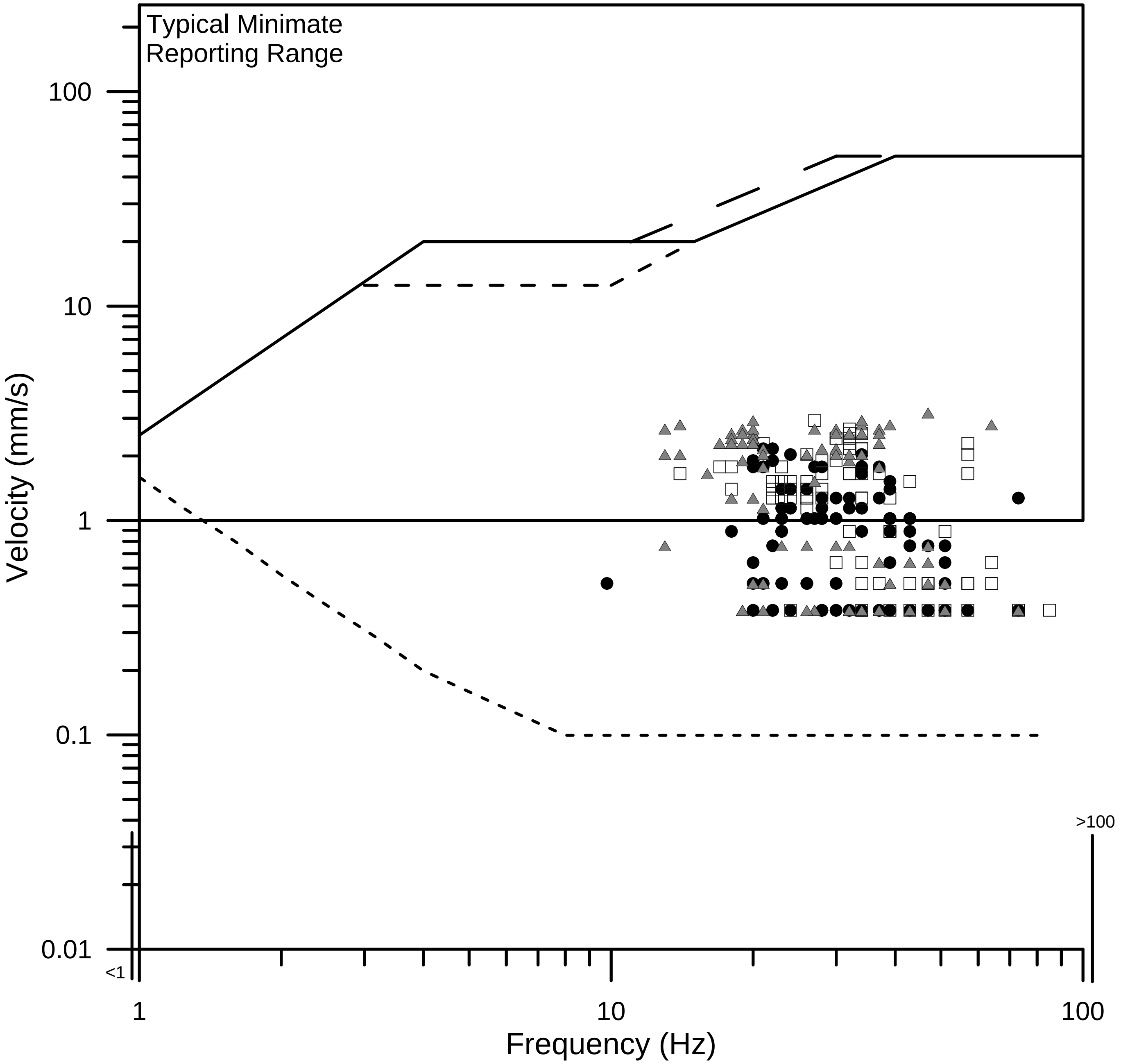


Notes:
1. This drawing is to be read in conjuction with accompanying report.

Legend
- ☐ NK1 Vertical at 10 m from Pile
- ● NK1 Transverse at 10 m from Pile
- ▲ NK1 Longitudinal at 10 m from Pile
- ——— USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ——— OSMRE Threshold
- - - - - ISO 2631-2 Human Response Threshold

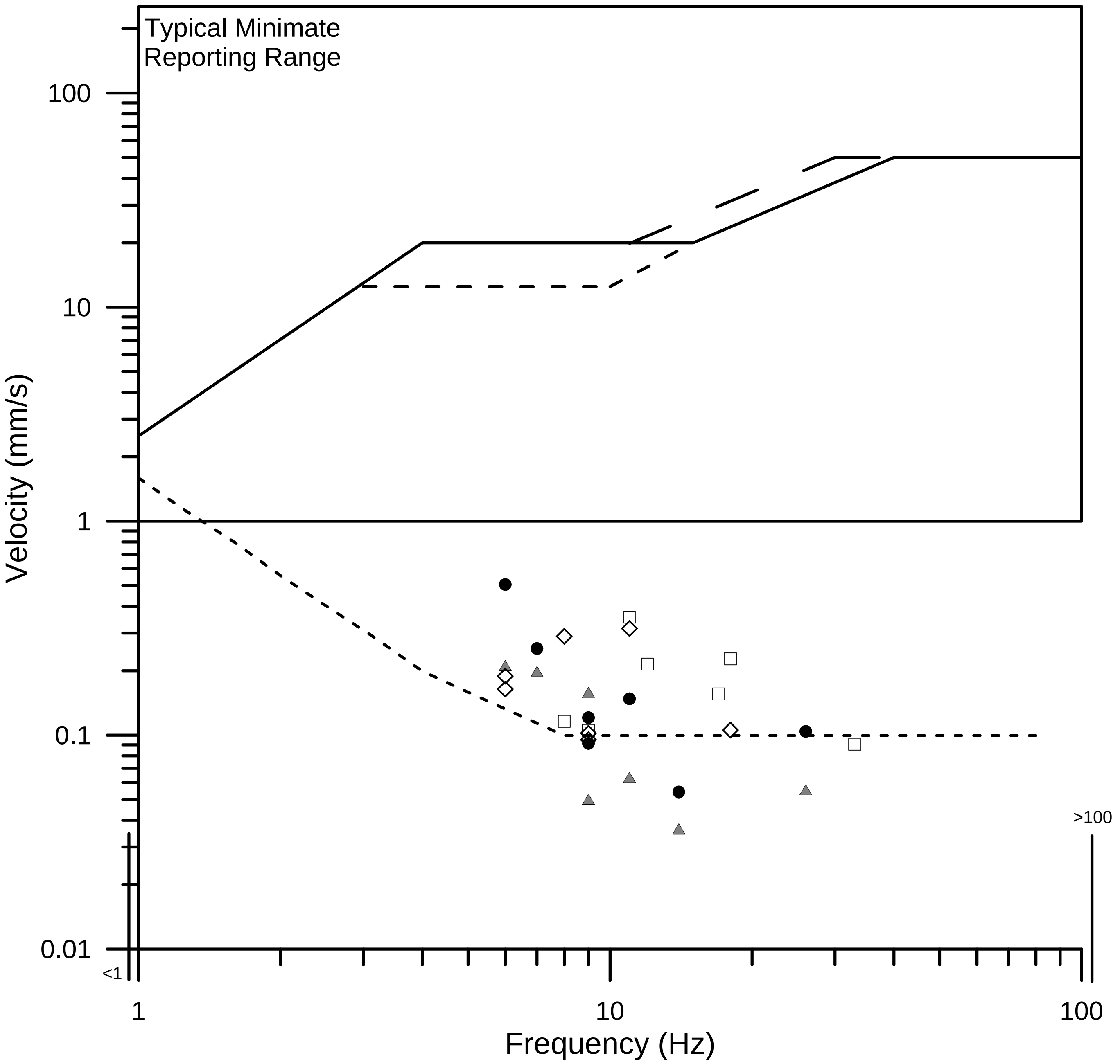
PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Ground Surface Vibrations
10 m from Test Pile T42
Pile Driving on Till/Rock

Golder Associates

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01007B
		SCALE	AS SHOWN REV. 0
DRAWN	SJB	April 2017	
CHECK			**FIGURE 7B**

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01007B.grf



Legend

- □ NK1 BH101STX Soil Triaxial Vertical
- ▲ NK1 BH101STY Soil Triaxial Longitudinal
- ● NK1 BH101STZ Soil Triaxial Transverse
- ◇ NK1 BH101SU Soil Uniaxial Vertical
- ——— USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ——— OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

Notes:
1. This drawing is to be read in conjuction with accompanying report.

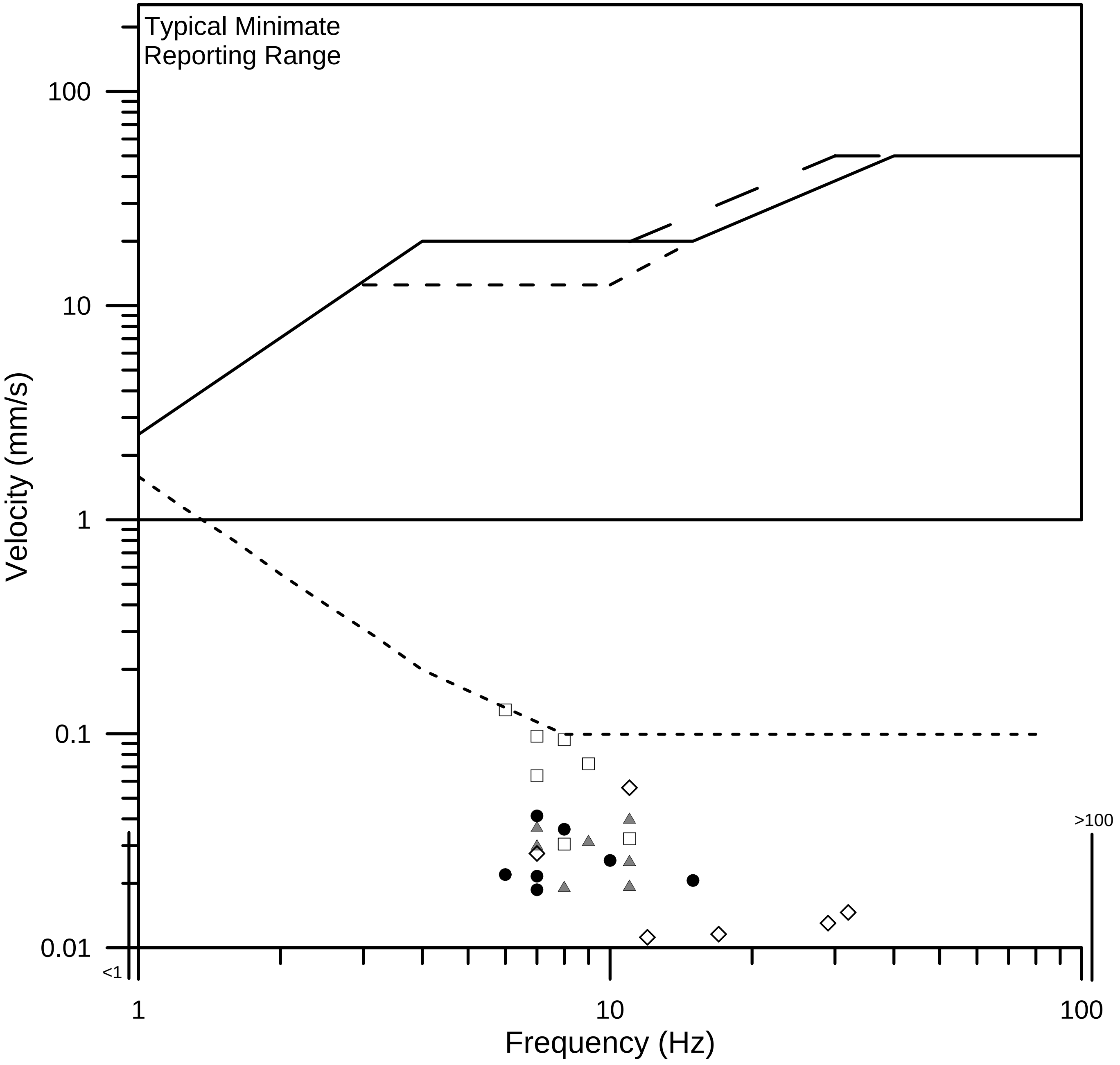
PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Soil Vibrations
12 m from Test Pile T42
Pile Driving in Top 2 m

Golder Associates

PROJECT No.	1668031-R01		FILE No.	1668031-2000-R01008A
			SCALE AS SHOWN	REV. 0
DRAWN	SJB	May 2017		
CHECK			**FIGURE 8A**	

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01008A.grf



Legend

- □ NK1 BH101DTX Rock Triaxial Vertical
- ▲ NK1 BH101DTY Rock Triaxial Longitudinal
- ● NK1 BH101DTZ Rock Triaxial Transverse
- ◇ NK1 BH101DU Rock Uniaxial Vertical
- ——— USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ——— OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

Notes:
1. This drawing is to be read in conjuction with accompanying report.

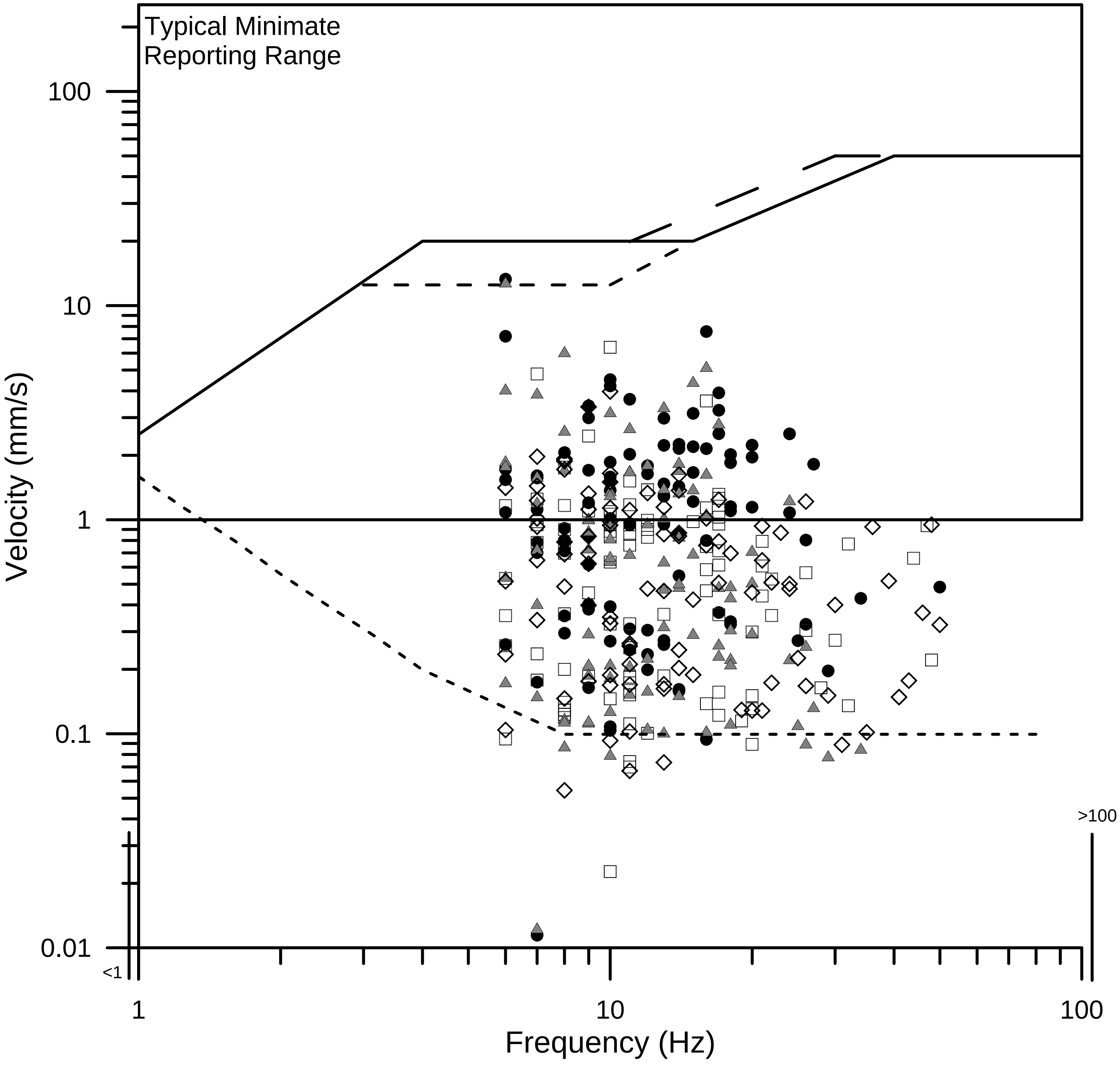
PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Rock Vibrations
10 m from Test Pile T42
Pile Driving in Top 2 m

Golder Associates

PROJECT No.	1668031-R01		**FILE No.**	1668031-2000-R01008B	
			SCALE	AS SHOWN	**REV.** 0
DRAWN	SJB	May 2017			
CHECK			**FIGURE 8B**		

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01008B.grf



Legend

- □ NK1 BH101STX Soil Triaxial Vertical
- ▲ NK1 BH101STY Soil Triaxial Longitudinal
- ● NK1 BH101STZ Soil Triaxial Transverse
- ◇ NK1 BH101SU Soil Uniaxial Vertical
- ―― USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ―― OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

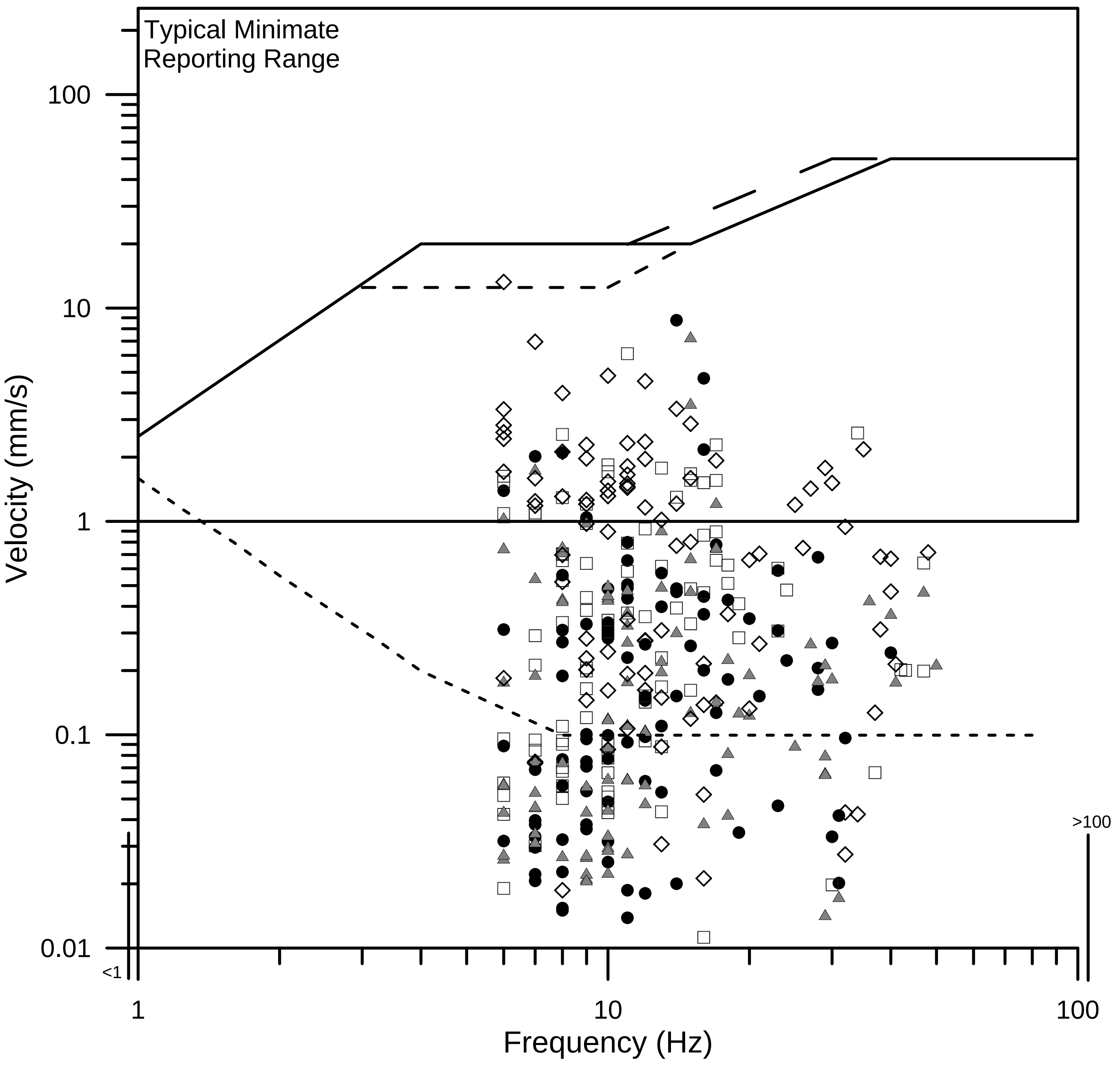
Notes:

1. This drawing is to be read in conjuction with accompanying report.

PROJECT	North Kent 1 Surface and Subsurface Vibration Monitoring Test Piles T5 andT42
TITLE	**Soil Vibrations** **12 m from Test Pile T42** **Pile Driving on Till/Rock**

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01008C	
		SCALE	AS SHOWN	REV. 0
DRAWN	SJB	May 2017		
CHECK			**FIGURE 8C**	

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01008C.grf



Legend

- □ NK1 BH101DTX Rock Triaxial Vertical
- ▲ NK1 BH101DTY Rock Triaxial Longitudinal
- ● NK1 BH101DTZ Rock Triaxial Transverse
- ◇ NK1 BH101DU Rock Uniaxial Vertical
- ——— USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ——— OSMRE Threshold
- - - - - ISO 2631-2 Human Response Threshold

Notes:
1. This drawing is to be read in conjuction with accompanying report.

PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Rock Vibrations
10 m from Test Pile T42
Pile Driving on Till/Rock

Golder Associates

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01008D	
		SCALE	AS SHOWN	REV. 0
DRAWN	SJB	May 2017		
CHECK			**FIGURE 8D**	

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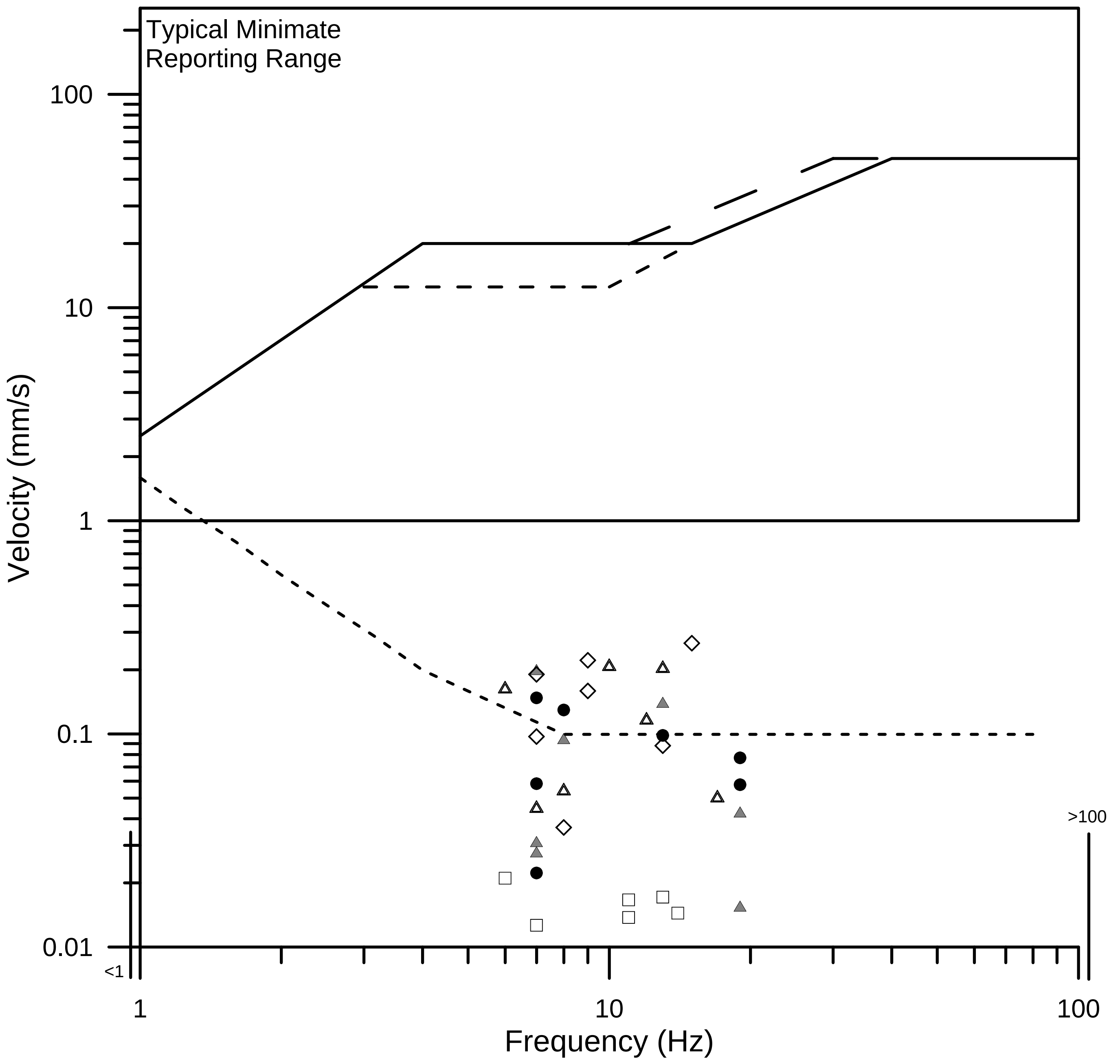

<u>Legend</u>

- □ NK1 BH102STX Soil Triaxial Vertical
- ▲ NK1 BH102STY Soil Triaxial Longitudinal
- ● NK1 BH102STZ Soil Triaxial Transverse
- ◇ NK1 BH102SU Soil Uniaxial Vertical
- △ NK1 102SS Ground Surface Uniaxial Vertical
- ——— USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ——— OSMRE Threshold
- - - - - ISO 2631-2 Human Response Threshold

Notes:
1. This drawing is to be read in conjuction with accompanying report.

PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Ground Surface and Soil Vibrations
30 m from Test Pile T42
Pile Driving in Top 2 m

Golder Associates

PROJECT No. 1668031-R01
FILE No. 1668031-2000-R01009A
SCALE AS SHOWN **REV.** 0
DRAWN SJB May 2017
CHECK

FIGURE 9A

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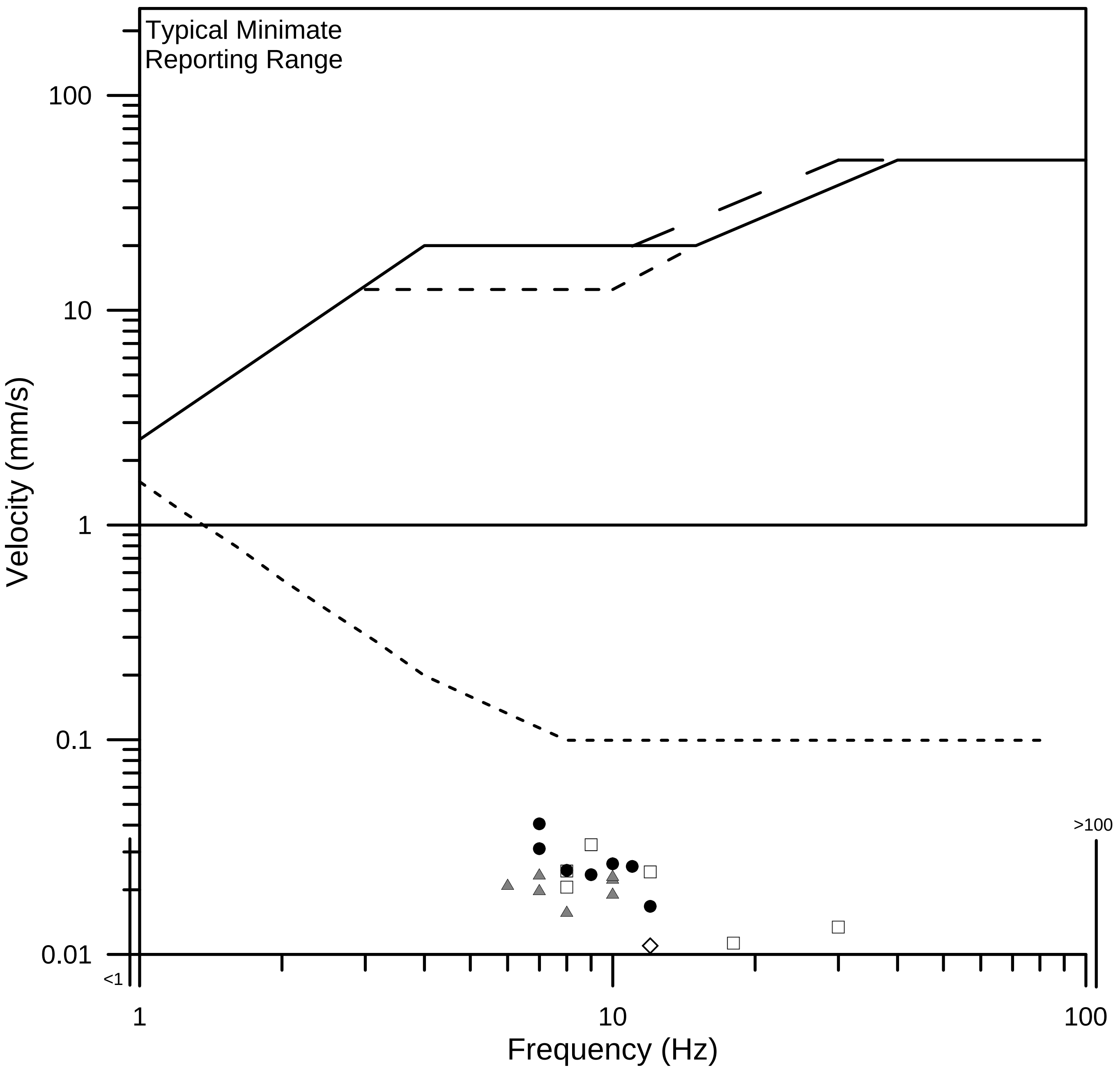


Legend

- □ NK1 BH102DTX Rock Triaxial Vertical
- ▲ NK1 BH102DTY Rock Triaxial Longitudinal
- ● NK1 BH102DTZ Rock Triaxial Transverse
- ◇ NK1 BH102DU Rock Uniaxial Vertical
- ──── USBM Damage Threshold (Drywall)
- ─ ─ USBM Damage Threshold (Plaster)
- ──── OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

Notes:
1. This drawing is to be read in conjuction with accompanying report.

PROJECT

North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

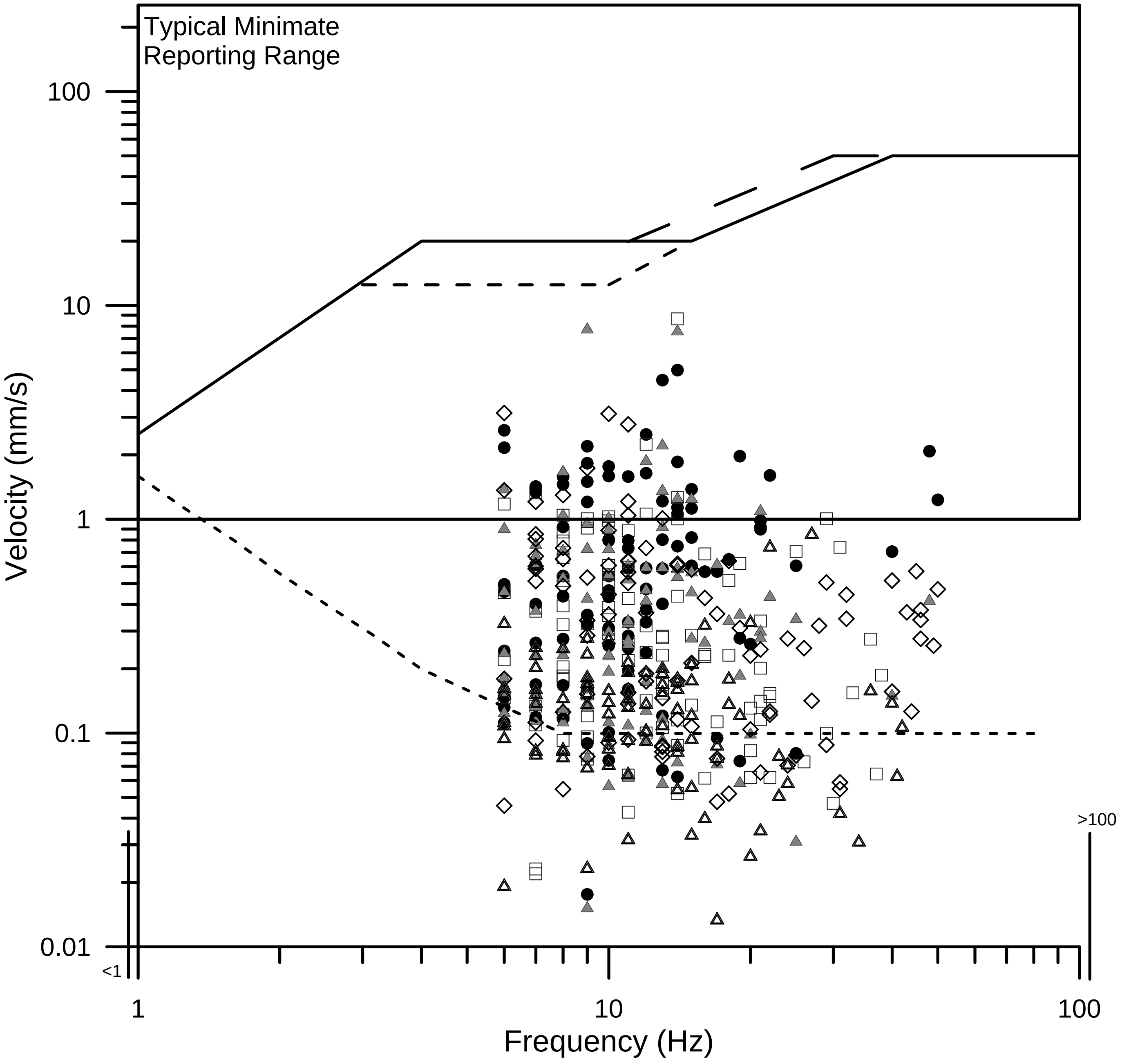
TITLE

Rock Vibrations
30 m from Test Pile T42
Pile Driving in Top 2 m

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01009B
		SCALE	AS SHOWN
		REV.	0
DRAWN	SJB	May 2017	
CHECK			

FIGURE 9B

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01009B.grf



Legend

- □ NK1 BH102STX Soil Triaxial Vertical
- ▲ NK1 BH102STY Soil Triaxial Longitudinal
- ● NK1 BH102STZ Soil Triaxial Transverse
- ◇ NK1 BH102SU Soil Uniaxial Vertical
- △ NK1 102SS Ground Surface Uniaxial Vertical
- ── USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ── OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

Notes:
1. This drawing is to be read in conjuction with accompanying report.

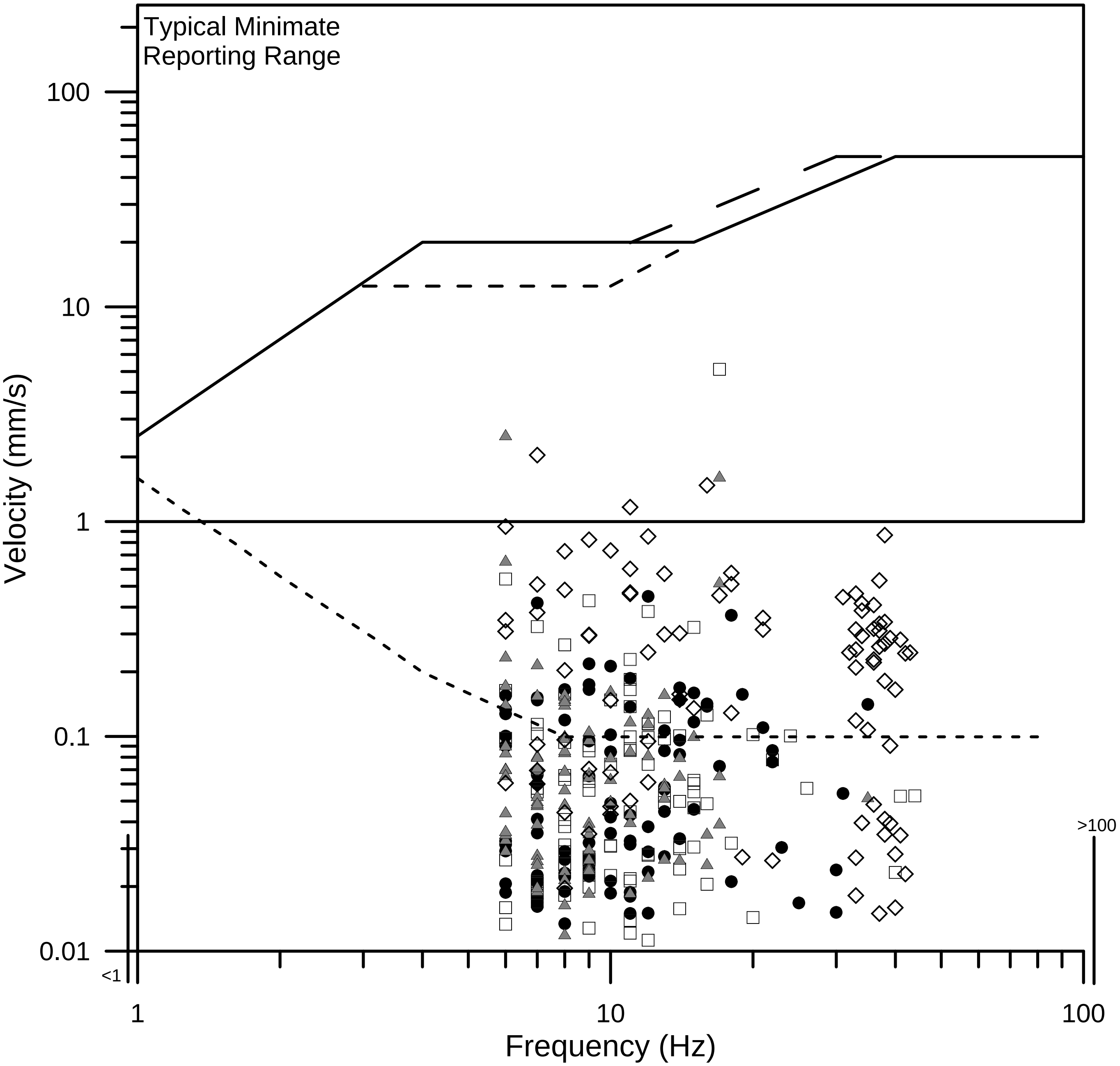
PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Ground Surface and Soil Vibrations
30 m from Test Pile T42
Pile Driving on Till/Rock

Golder Associates

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01009C	
		SCALE	AS SHOWN	REV. 0
DRAWN	SJB	May 2017		
CHECK			**FIGURE 9C**	

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01009C.grf



Legend

- □ NK1 BH102DTX Rock Triaxial Vertical
- ▲ NK1 BH102DTY Rock Triaxial Longitudinal
- ● NK1 BH102DTZ Rock Triaxial Transverse
- ◇ NK1 BH102DU Rock Uniaxial Vertical
- — USBM Damage Threshold (Drywall)
- – – USBM Damage Threshold (Plaster)
- — OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

Notes:

1. This drawing is to be read in conjuction with accompanying report.

PROJECT	North Kent 1 Surface and Subsurface Vibration Monitoring Test Piles T5 andT42
TITLE	**Rock Vibrations** **30 m from Test Pile T42** **Pile Driving on Till/Rock**

Golder Associates

PROJECT No.	1668031-R01		FILE No.	1668031-2000-R01009D
			SCALE AS SHOWN	REV. 0
DRAWN	SJB	May 2017		
CHECK			**FIGURE 9D**	

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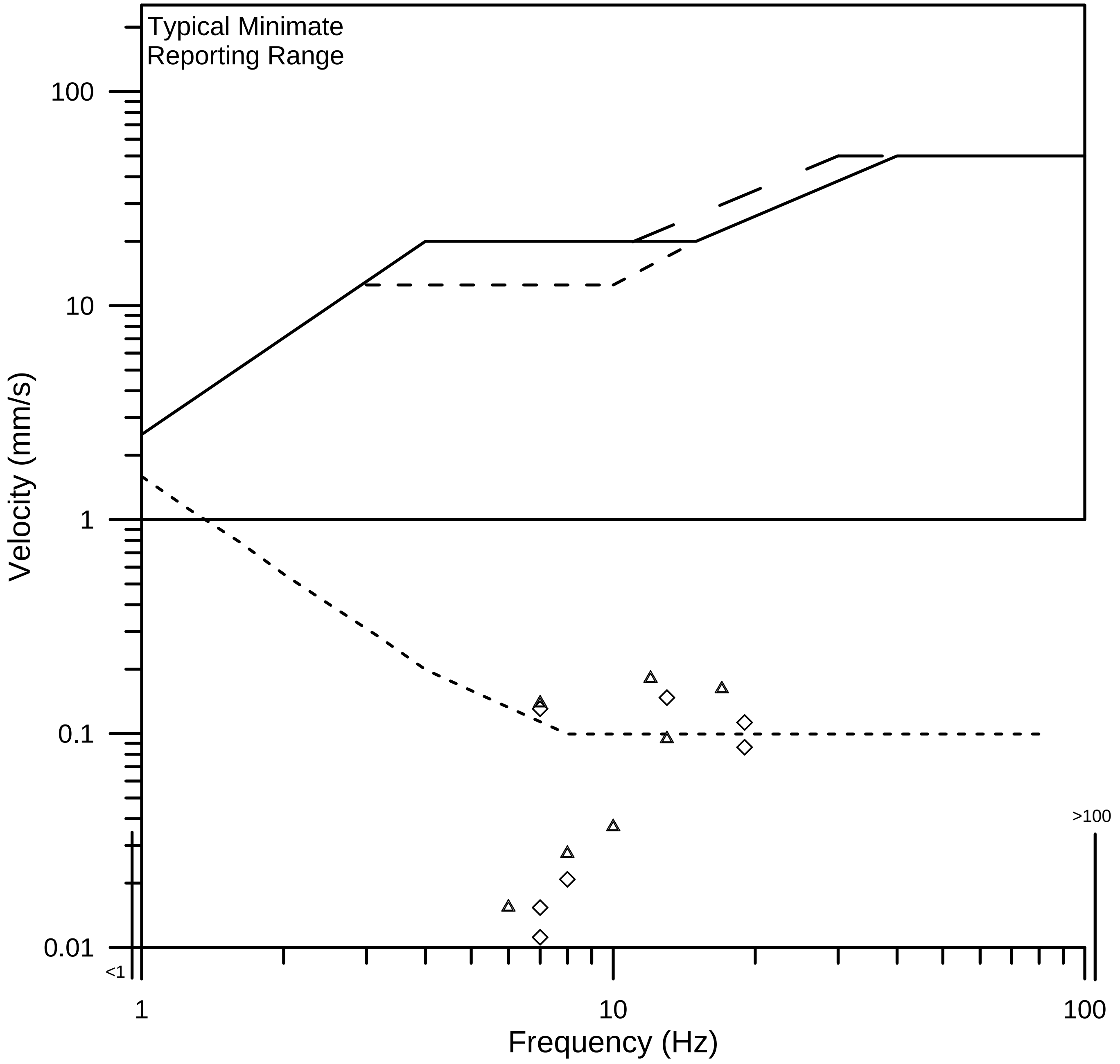


Notes:
1. This drawing is to be read in conjuction with accompanying report.

Legend

◇ NK1 BH103SU Soil Uniaxial Vertical
△ NK1 BH103SS Ground Surface Uniaxial Vertical
—— USBM Damage Threshold (Drywall)
– – USBM Damage Threshold (Plaster)
—— OSMRE Threshold
- - - ISO 2631-2 Human Response Threshold

PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

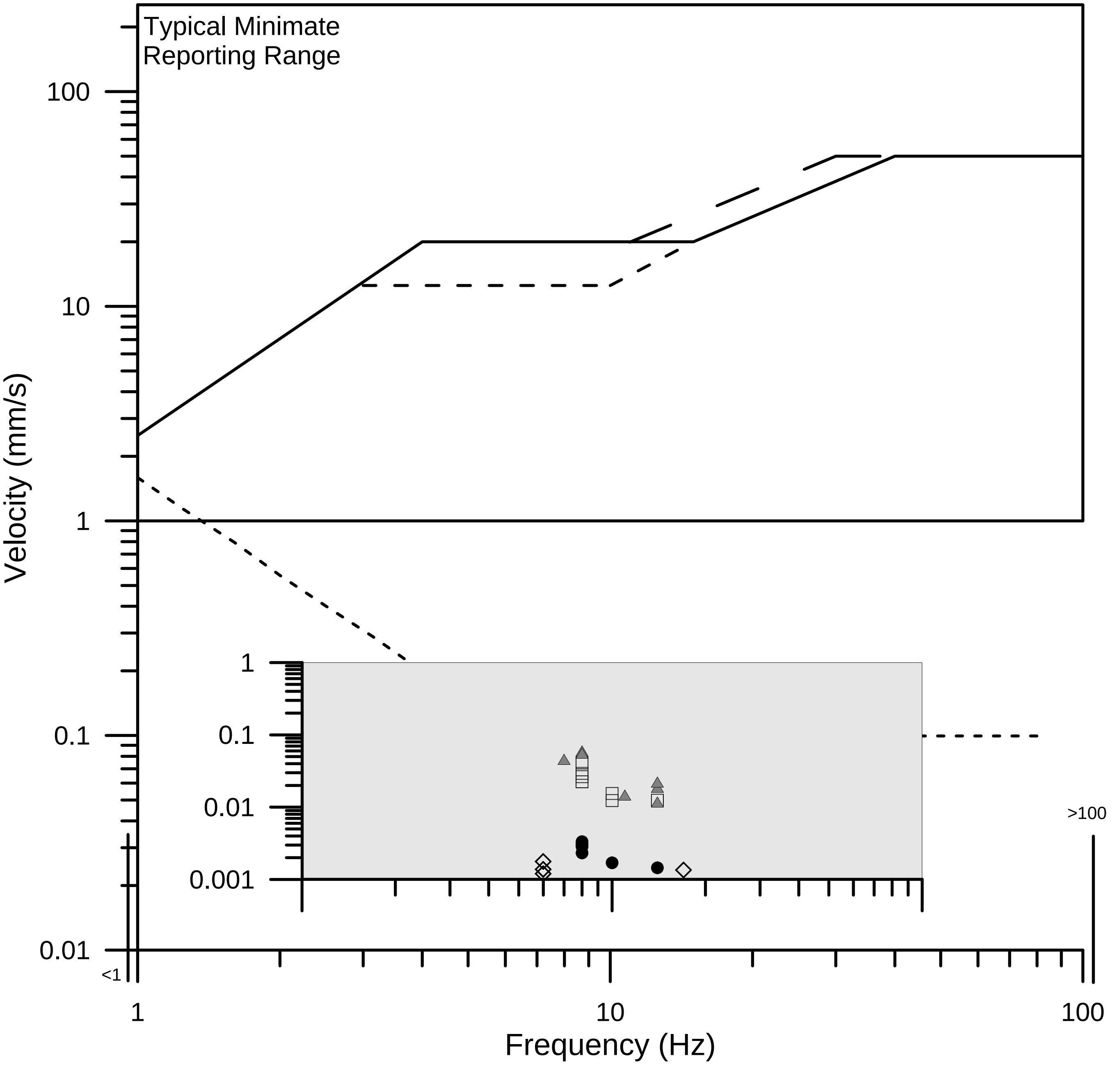
TITLE
Ground Surface and Soil Vibrations
50 m from Test Pile T42
Pile Driving in Top 2 m

Golder Associates

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01010A
		SCALE	AS SHOWN
		REV.	0
DRAWN	SJB	May 2017	
CHECK			

FIGURE 10A

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01010A.grf



Notes:
1. This drawing is to be read in conjuction with accompanying report.
2. Inset illustrates data at the low end and outside the velocity range scale used for the larger format graph.

Legend

- ☐ NK1 BH103DTX Rock Triaxial Vertical
- ▲ NK1 BH103DTY Rock Triaxial Longitudinal
- ● NK1 BH103DTZ Rock Triaxial Transverse
- ◇ NK1 BH103DU Rock Uniaxial Vertical
- ——— USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ——— OSMRE Threshold
- - - - - ISO 2631-2 Human Response Threshold

PROJECT

North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE

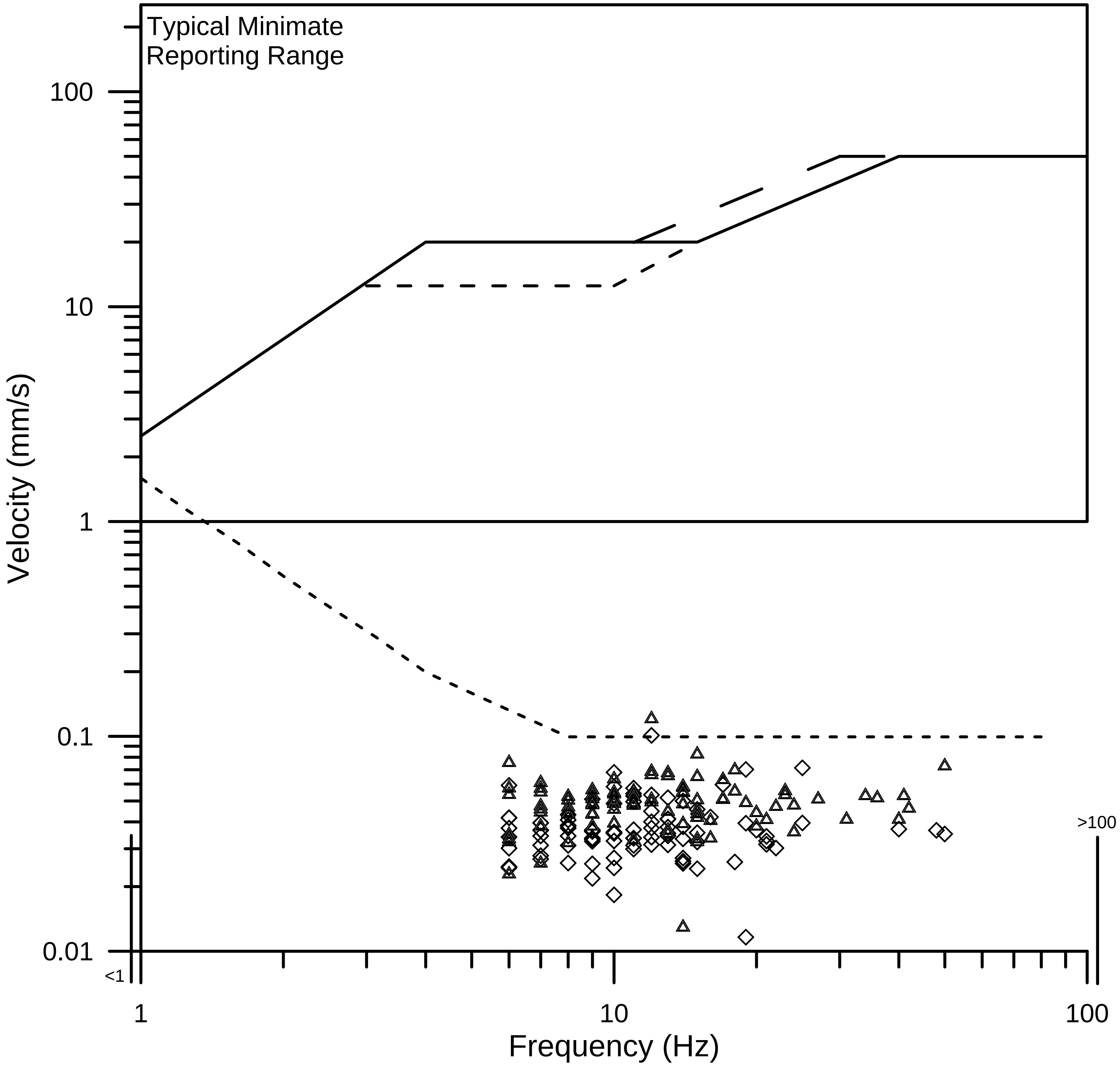
Rock Vibrations
50 m from Test Pile T42
Pile Driving in Top 2 m

Golder Associates

PROJECT No.	1668031-R01	**FILE No.**	1668031-2000-R01010B	
		SCALE	AS SHOWN	**REV.** 0
DRAWN	SJB	May 2017		
CHECK				

FIGURE 10B

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01010B.grf



Notes:
1. This drawing is to be read in conjuction with accompanying report.

<u>Legend</u>

◇ NK1 BH103SU Soil Uniaxial Vertical
△ NK1 BH103SS Ground Surface Uniaxial Vertical
—— USBM Damage Threshold (Drywall)
– – USBM Damage Threshold (Plaster)
—— OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

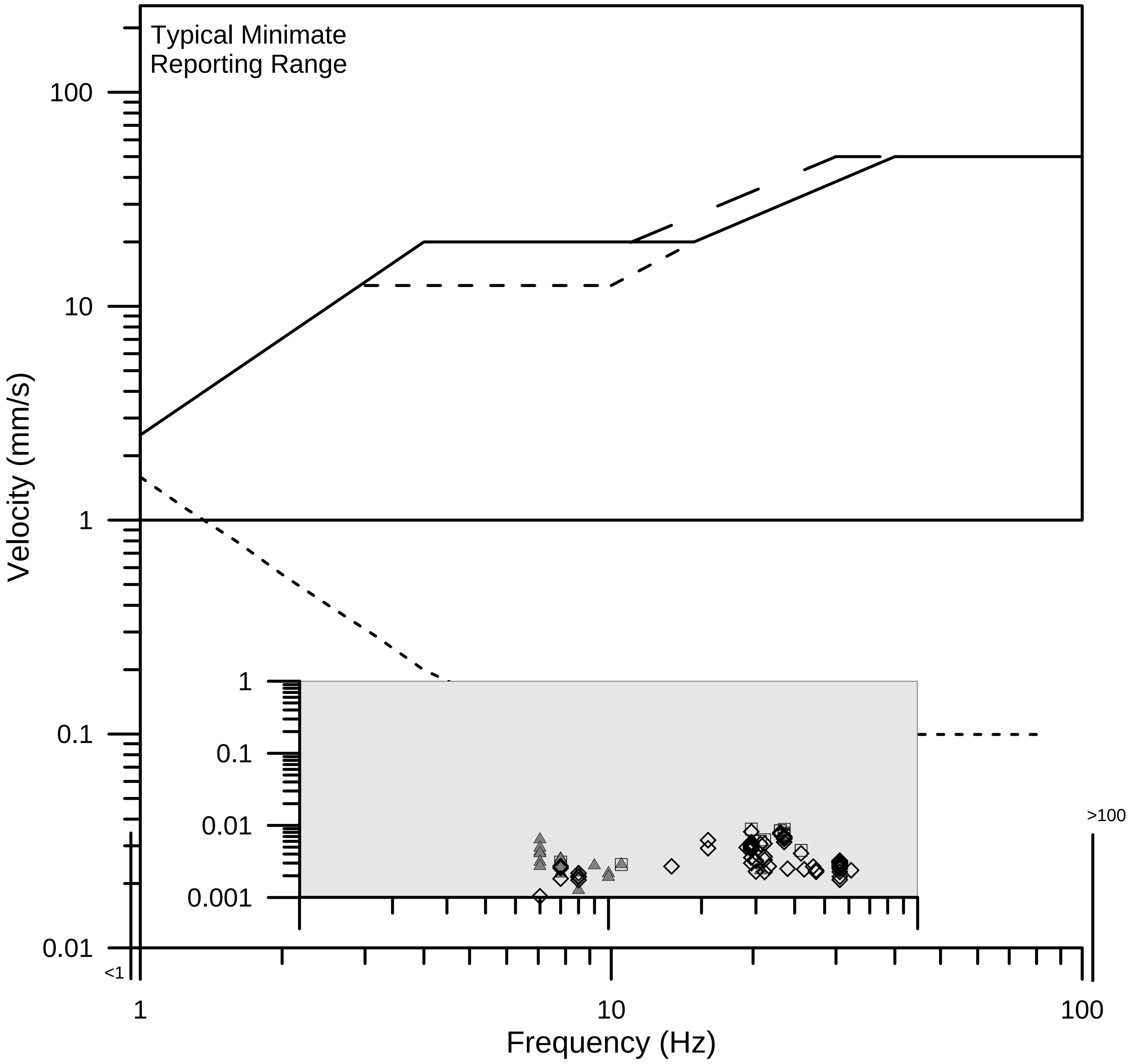
PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Ground Surface and Soil Vibrations
50 m from Test Pile T42
Pile Driving on Till/Rock

Golder Associates

PROJECT No.	1668031-R01		**FILE No.**	1668031-2000-R01010C
			SCALE AS SHOWN	**REV.** 0
DRAWN	SJB	May 2017		
CHECK			**FIGURE 10C**	

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01010C.grf



Notes:
1. This drawing is to be read in conjuction with accompanying report.
2. Inset illustrates data at the low end and outside the velocity range scale used for the larger format graph.

Legend

☐	NK1 BH103DTX Rock Triaxial Vertical
▲	NK1 BH103DTY Rock Triaxial Longitudinal
●	NK1 BH103DTZ Rock Triaxial Transverse
◇	NK1 BH103DU Rock Uniaxial Vertical
———	USBM Damage Threshold (Drywall)
— —	USBM Damage Threshold (Plaster)
———	OSMRE Threshold
- - - -	ISO 2631-2 Human Response Threshold

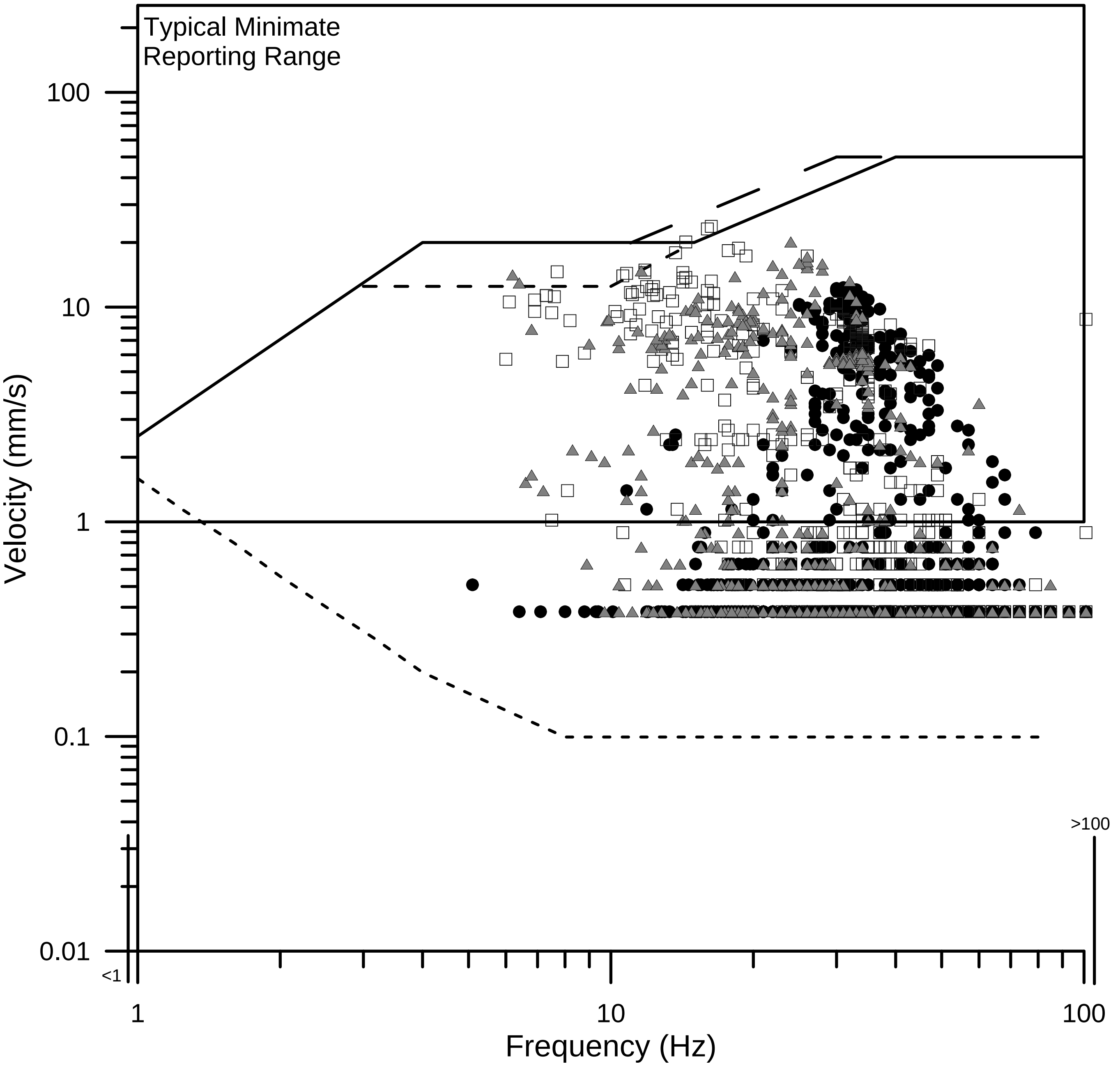
PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Rock Vibrations
50 m from Test Pile T42
Pile Driving on Till/Rock

Golder Associates

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01010D	
		SCALE	AS SHOWN	REV. 0
DRAWN	SJB	May 2017		
CHECK			**FIGURE 10D**	

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01010D.grf



Notes:
1. This drawing is to be read in conjuction with accompanying report.

Legend

- □ NK1 Vertical at 3 m from Pile
- ● NK1 Transverse at 3 m from Pile
- ▲ NK1 Longitudinal at 3 m from Pile
- —— USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- —— OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

PROJECT

North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

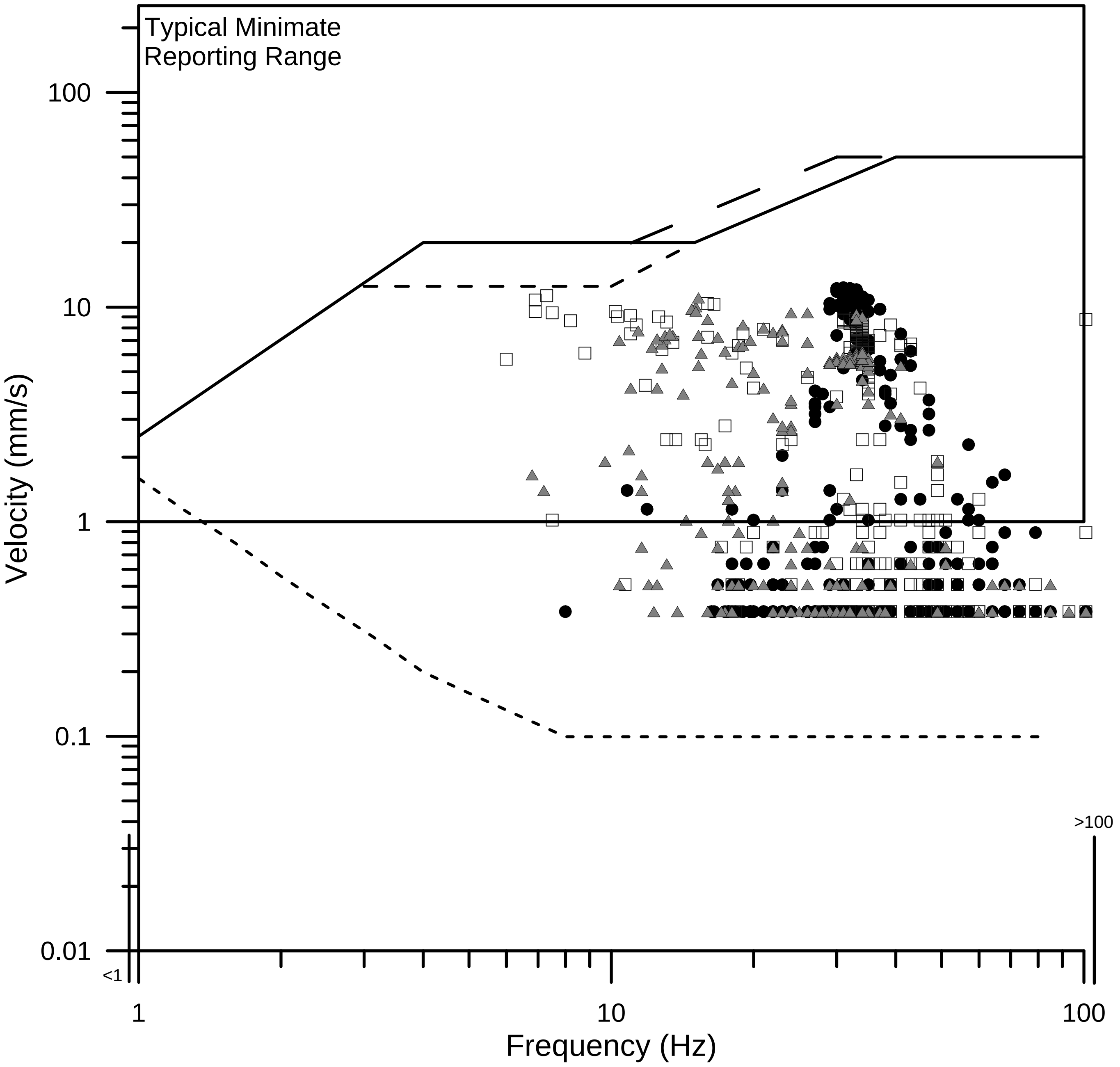
TITLE

Ground Surface Vibrations
3 m from Test Pile T5
Pile Driving - All Data

Golder Associates

PROJECT No.	1668031-R01	**FILE No.**	1668031-2000-R01011A
		SCALE	AS SHOWN **REV.** 0
DRAWN	SJB	May 2017	
CHECK			**FIGURE 11A**

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01011A.grf



Legend

- ☐ NK1 Vertical at 3 m from Pile
- ● NK1 Transverse at 3 m from Pile
- ▲ NK1 Longitudinal at 3 m from Pile
- —— USBM Damage Threshold (Drywall)
- – – USBM Damage Threshold (Plaster)
- —— OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

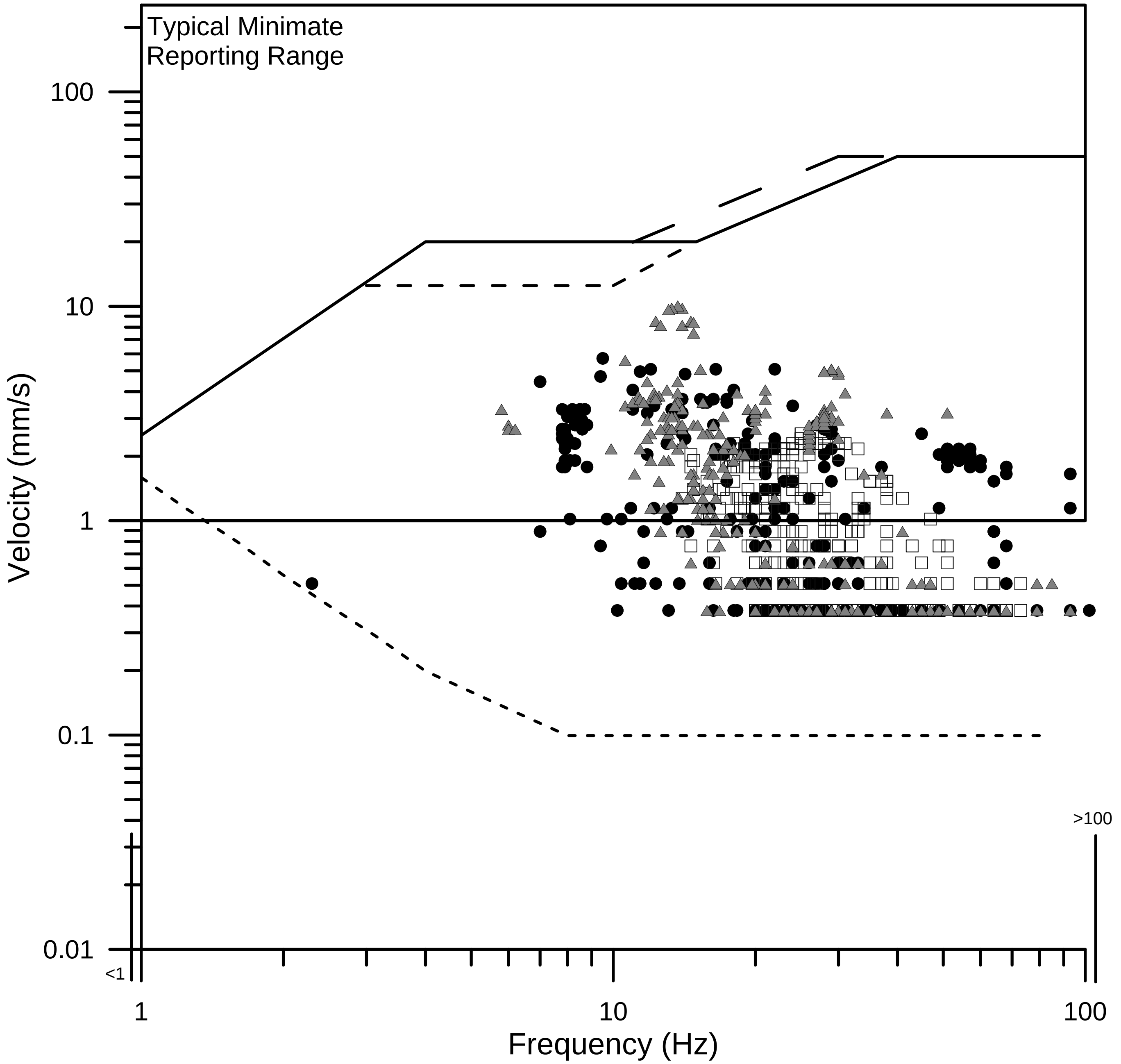
Notes:
1. This drawing is to be read in conjuction with accompanying report.

PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Ground Surface Vibrations
3 m from Test Pile T5
Pile Driving on Till/Rock

Golder Associates	PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01011B
			SCALE AS SHOWN	REV. 0
	DRAWN	SJB	May 2017	**FIGURE 11B**
	CHECK			

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01011B.grf



Legend

☐ NK1 Vertical at 10 m from Pile

● NK1 Transverse at 10 m from Pile

▲ NK1 Longitudinal at 10 m from Pile

—— USBM Damage Threshold (Drywall)

— — USBM Damage Threshold (Plaster)

—— OSMRE Threshold

- - - - ISO 2631-2 Human Response Threshold

Notes:
1. This drawing is to be read in conjuction with accompanying report.

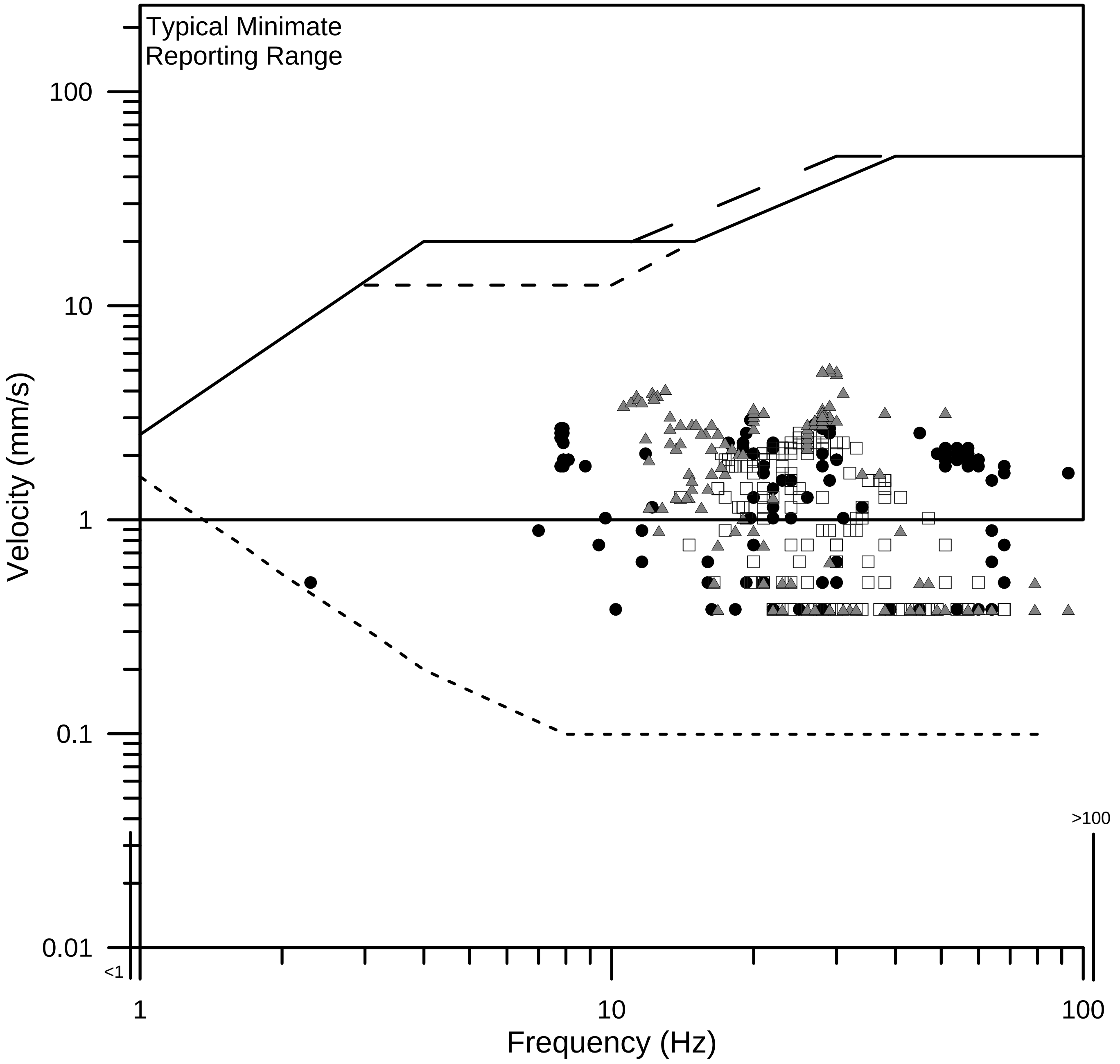
PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Ground Surface Vibrations
10 m from Test Pile T5
Pile Driving - All Data

Golder Associates

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01012A
		SCALE	AS SHOWN REV. 0
DRAWN	SJB	April 2017	
CHECK			**FIGURE 12A**

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01012A.grf



Legend
- ☐ NK1 Vertical at 10 m from Pile
- ● NK1 Transverse at 10 m from Pile
- ▲ NK1 Longitudinal at 10 m from Pile
- —— USBM Damage Threshold (Drywall)
- – – USBM Damage Threshold (Plaster)
- —— OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

Notes:
1. This drawing is to be read in conjuction with accompanying report.

PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

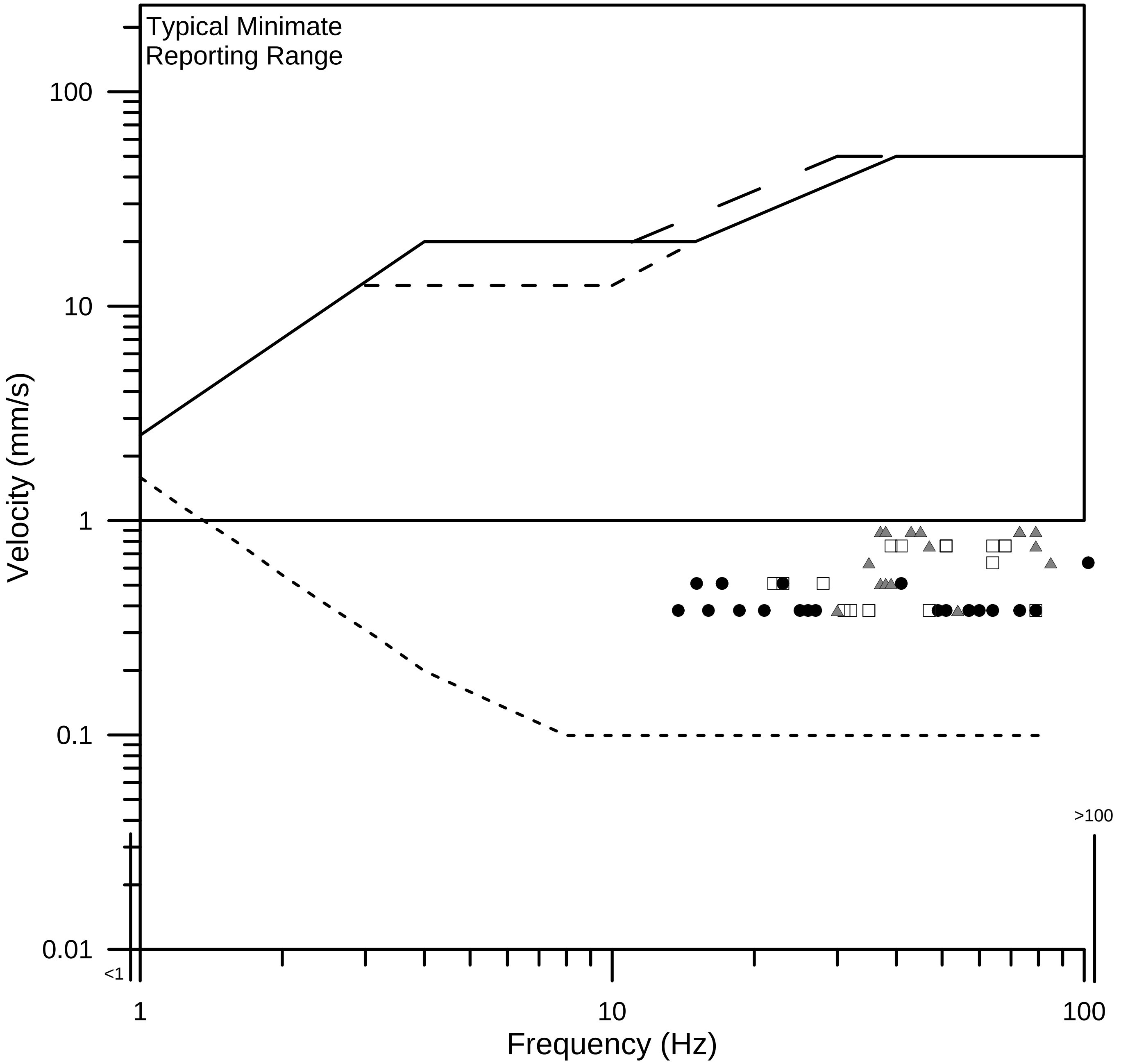
TITLE
Ground Surface Vibrations
10 m from Test Pile T5
Pile Driving on Till/Rock

Golder Associates

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01012B
		SCALE	AS SHOWN
		REV.	0
DRAWN	SJB	April 2017	
CHECK			

FIGURE 12B

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01012B.grf



Notes:
1. This drawing is to be read in conjuction with accompanying report.

Legend

- □ NK1 Vertical at 30 m from Pile
- ● NK1 Transverse at 30 m from Pile
- ▲ NK1 Longitudinal at 30 m from Pile
- ——— USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ——— OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

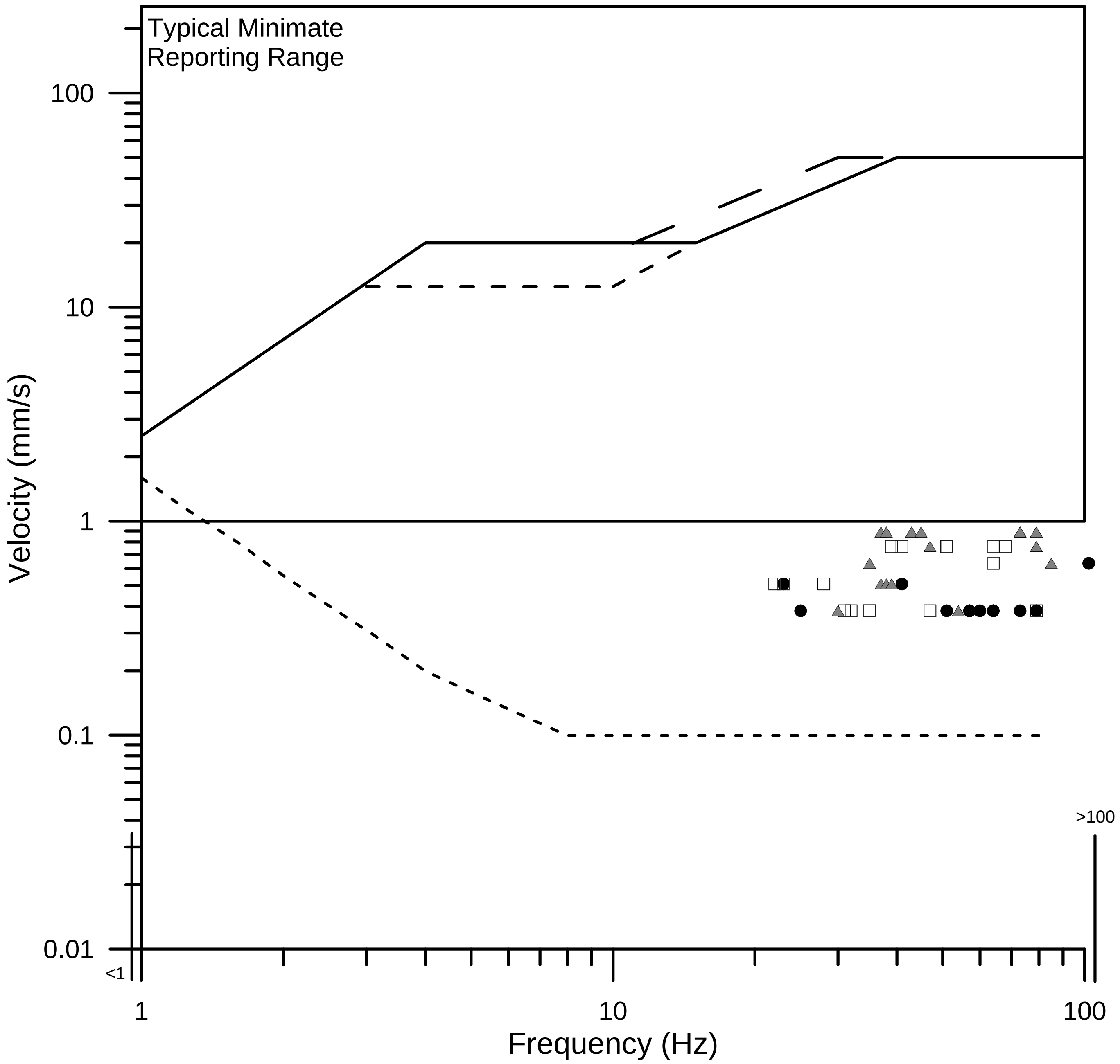
TITLE
Ground Surface Vibrations
30 m from Test Pile T5
Pile Driving - All Data

Golder Associates

PROJECT No. 1668031-R01
FILE No. 1668031-2000-R01013A
SCALE AS SHOWN
REV. 0
DRAWN SJB May 2017
CHECK

FIGURE 13A

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01013A.grf



Legend

- □ NK1 Vertical at 30 m from Pile
- ● NK1 Transverse at 30 m from Pile
- ▲ NK1 Longitudinal at 30 m from Pile
- ——— USBM Damage Threshold (Drywall)
- — — USBM Damage Threshold (Plaster)
- ——— OSMRE Threshold
- - - - ISO 2631-2 Human Response Threshold

Notes:
1. This drawing is to be read in conjuction with accompanying report.

PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

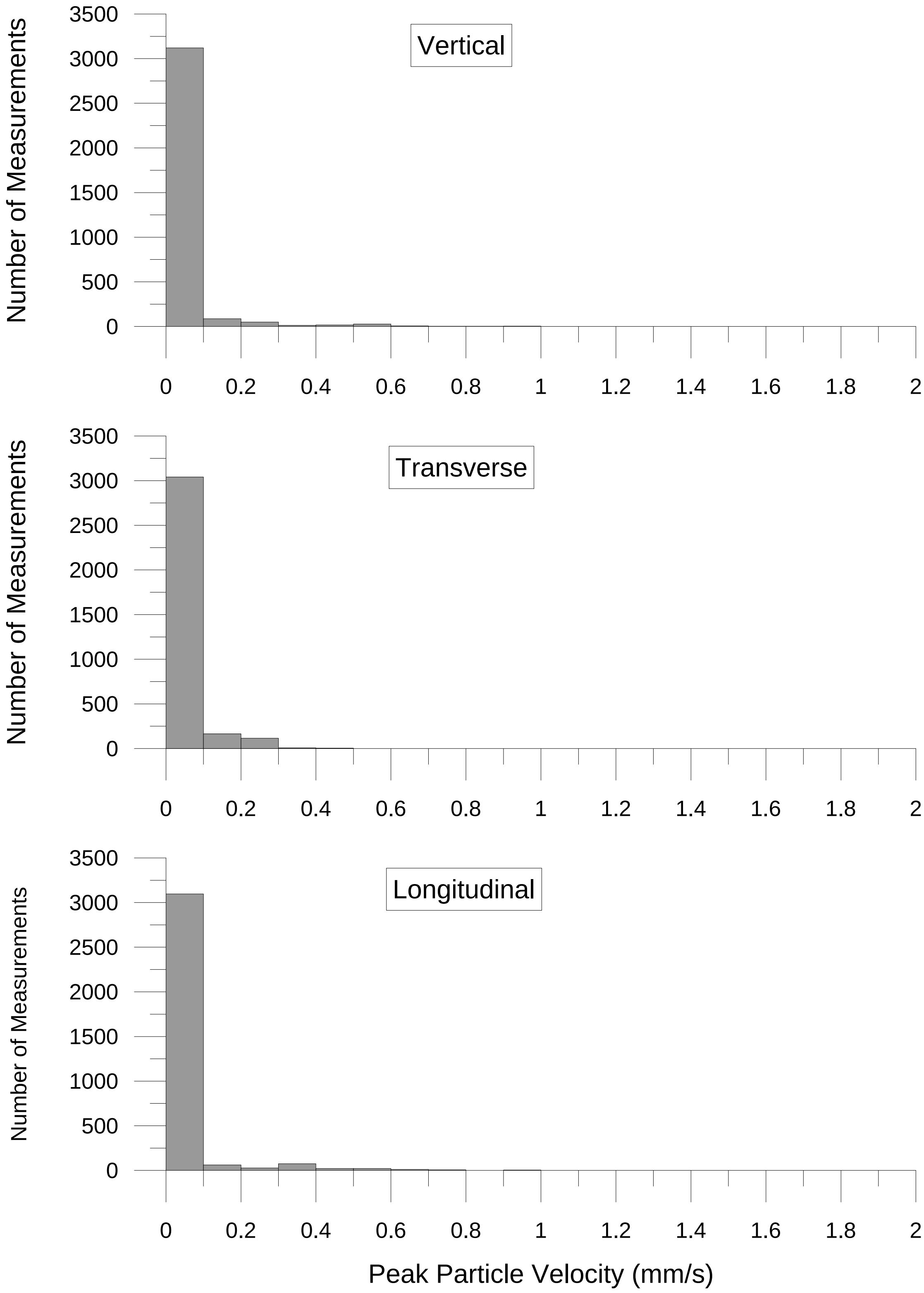
TITLE
Ground Surface Vibrations
30 m from Test Pile T5
Pile Driving on Till/Rock

Golder Associates

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01013B
		SCALE	AS SHOWN REV. 0
DRAWN	SJB	May 2017	
CHECK			

FIGURE 13B

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01013B.grf



PROJECT

North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE

Ground Surface Vibrations
50 m from Test Pile T5
Pile Driving - All Data

Golder Associates

PROJECT No.	1668031-R01	**FILE No.**	1668031-2000-R01014A
		SCALE	AS SHOWN **REV.** 0
DRAWN	SJB	May 2017	
CHECK			**FIGURE 14A**

Notes:
1. This drawing is to be read in conjuction with accompanying report.

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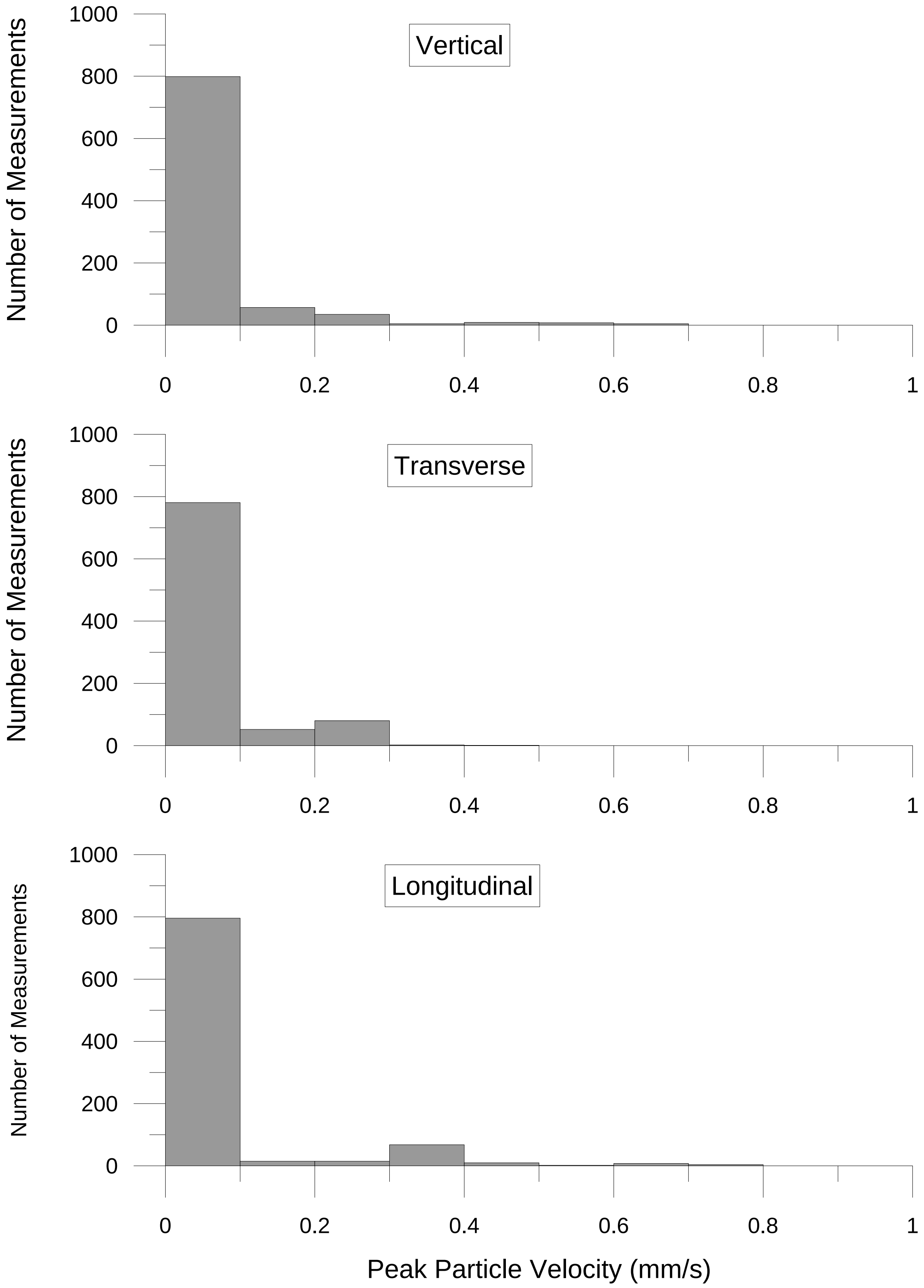

PROJECT

North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE

Ground Surface Vibrations
50 m from Test Pile T5
Pile Driving on Till/Rock

PROJECT No.	1668031-R01	**FILE No.**	1668031-2000-R01014B	
		SCALE	AS SHOWN	**REV.** 0
DRAWN	SJB	May 2017		
CHECK			**FIGURE 14B**	

Golder Associates

Notes:
1. This drawing is to be read in conjuction with accompanying report.

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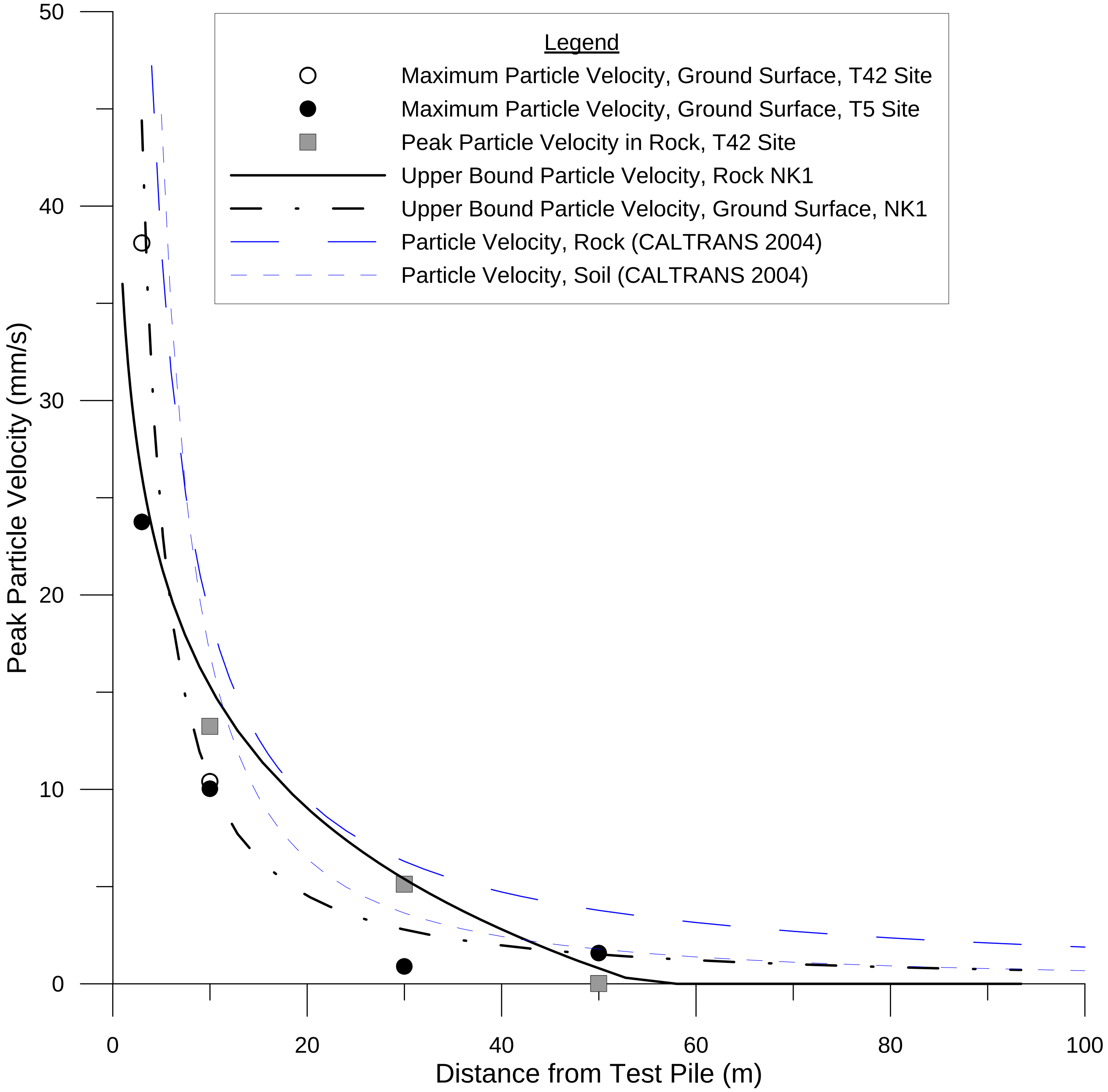


Notes:
1. This drawing is to be read in conjuction with accompanying report.

PROJECT
North Kent 1
Surface and Subsurface Vibration Monitoring
Test Piles T5 andT42

TITLE
Summary of Vibration
Distance-Attenuation Characteristics

Golder Associates

PROJECT No.	1668031-R01	FILE No.	1668031-2000-R01015
		SCALE AS SHOWN	REV. 0
DRAWN	SJB	April 2017	
CHECK			

FIGURE 15

N:\active\2016\3 Proj\1668031 Pattern_North Kent Vib Monit_Chatham-Kent\3-Drafting\Grapher Plots\R01\1668031-2000-R01015.grf

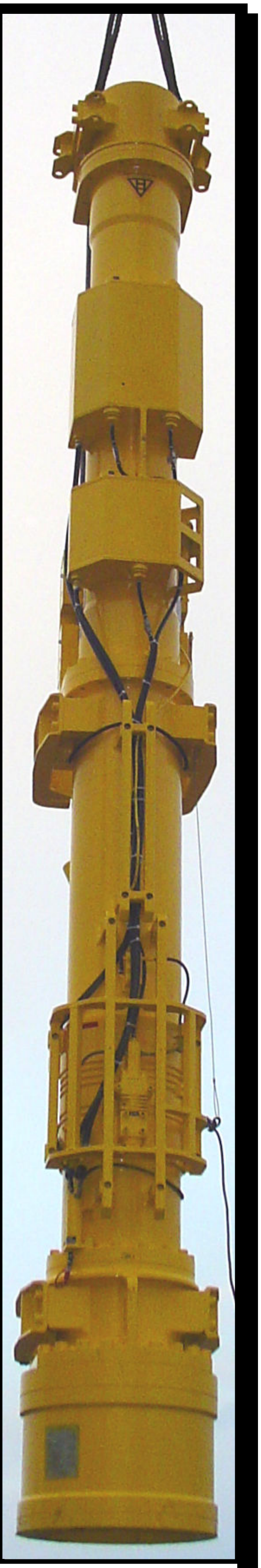
APPENDIX A

Berminghammer Model B-32 Operational Specifications

Berminghammer
FOUNDATION EQUIPMENT

Model B-32

Clean Series 2005



Features

- ☐ Remote Throttle – infinitely controlable energy
- ☐ Clean Combustion- Low Emissions
- ☐ Fuel injection
- ☐ Easy Start in soft driving
- ☐ Available with hydraulic trip
- ☐ Free-standing operation
- ☐ Specialty driving adapters
- ☐ Optional Kinetic Energy Monitor
- ☐ Optional Energy Control System (patented)
- ☐ Environmentally friendly (no-drip operation, bio-fuels and oils)

Operational Specifications

Ram mass:	**7,050 lbs (3 200 kg)**
Rated Energy:	**81,080 ft▪lbs (110 kJ)**
Stroke at Rated Energy:	11.5 ft (3.5 m) 35 blows per minute
Maximum Physical Stroke:	13.0 ft (4.0 m)
Range of Operation:	4.5-11.5 ft (1.4-3.5 m) 56-35 blows per minute
Kinetic Energy at Rated Stroke:	50,040 ft-lbs (67.8 kJ)
Hammer Weight – bare hammer:	14,110 lbs (6 400 kg)
Weight with Typical USA-Style Box Lead Guides:	14,570 lbs (6 610 kg) 26 in (660 mm) guides
Typical Direct-Drive Housing:	1,850 lbs (840 kg) 21 in (530 mm) opening
Total Typical Operating Weight:	16,420 lbs (7 450 kg) (with guides, trip, and drive housing)
Fuel Tank Capacity:	19.0 US Gal. (72 L)
Oil Tank Capacity:	6.5 US Gal. (25 L)
Overall Length:	20.1 ft (6.1 m)
Length including Direct-Drive Housing:	21.7 ft (6.6 m)
Minimum Box Lead size:	26 in (660 mm)

BERMINGHAM
FOUNDATION SOLUTIONS
SINCE 1897

Wellington Street Marine Terminal, Hamilton, ON, Canada L8L 4Z9
Phone 1.905.528.0425 ▪ Fax 1.905.528.6187 ▪ Toll Free (Canada & USA 1.800.668.9432)
www.berminghammer.com

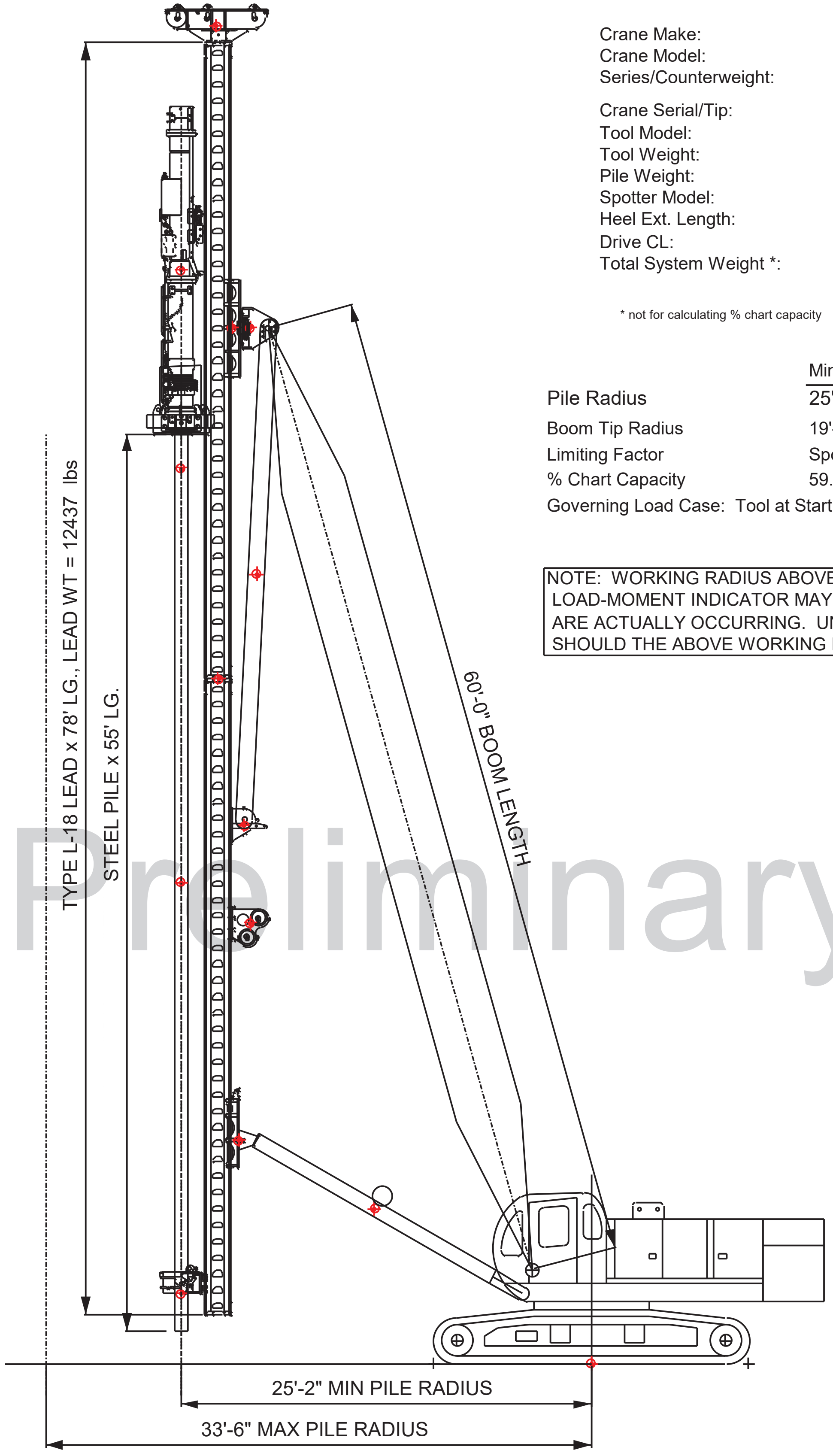
English Units

B-32	7,050 lb Piston		
BPM	Stroke (ft)	Potential Energy (ft▪lb)	Velocity (ft/s)
35	11.8	83,190	22.5
36	11.2	78,960	22.0
37	10.6	74,730	21.5
38	10.0	70,500	21.0
39	9.5	66,980	20.5
40	9.1	64,160	20.0
41	8.6	60,630	19.5
42	8.2	57,810	19.0
43	7.8	54,990	18.5
44	7.5	52,880	18.0
45	7.2	50,760	17.5
46	6.9	48,650	17.0
47	6.6	46,530	16.5
48	6.3	44,420	16.0
49	6.0	42,300	15.5
50	5.8	40,890	15.0
51	5.6	39,480	14.6
52	5.4	38,070	14.2
53	5.2	36,660	13.8
54	5.0	35,250	13.4
55	4.8	33,840	13.0
56	4.6	32,430	12.6

SI Units

B-32	3 200 kg Piston		
BPM	Stroke (m)	Potential Energy (kJ)	Velocity (m/s)
35	3.60	113	6.9
36	3.41	107	6.7
37	3.23	101	6.6
38	3.05	95.7	6.4
39	2.90	91.0	6.3
40	2.77	87.0	6.1
41	2.62	82.2	5.9
42	2.50	78.5	5.8
43	2.38	74.7	5.6
44	2.29	71.9	5.5
45	2.20	69.1	5.3
46	2.10	65.9	5.2
47	2.01	63.1	5.0
48	1.92	60.3	4.9
49	1.83	57.4	4.7
50	1.77	55.6	4.6
51	1.71	53.7	4.5
52	1.65	51.8	4.3
53	1.59	49.9	4.2
54	1.52	47.7	4.1
55	1.46	45.8	4.0
56	1.40	43.9	3.8

🟨 Stroke height is a function of soil resistance and may not be attainable in certain driving conditions.
⬜ Standard Operating Range.



Crane Make:	Kobelco
Crane Model:	BM700
Series/Counterweight:	GENERIC
Crane Serial/Tip:	GENERIC-2
Tool Model:	B-32
Tool Weight:	16420 lbs
Pile Weight:	2428 lbs
Spotter Model:	HHH-14
Heel Ext. Length:	24.75"
Drive CL:	18"
Total System Weight *:	45157 lbs

* not for calculating % chart capacity

	Min	Max
Pile Radius	25'-2"	33'-6"
Boom Tip Radius	19'-10"	28'-1"
Limiting Factor	Spotter Min	Stability
% Chart Capacity	59.8	95.0

Governing Load Case: Tool at Start of Driving Position

NOTE: WORKING RADIUS ABOVE GOVERNS. CRANE'S LOAD-MOMENT INDICATOR MAY READ LOWER LEVELS THAN ARE ACTUALLY OCCURRING. UNDER NO CIRCUMSTANCES SHOULD THE ABOVE WORKING RADII BE EXCEEDED.

BERMINGHAM
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Customer Name: BCL

Description: B32 ON BM700

Date:	Dwg. No.:	Orientation:	Rev.:
02 Feb 2017	SK-A17-002-1	1A	A

APPENDIX B

Records of Boreholes T42 and T5 (AMEC)

RECORD OF BOREHOLE No. T5

Project Number: **SWW167102**
Project Client: **North Kent Wind 1 GP Inc.**
Project Name: **North Kent Wind 1 Project**
Project Location: **Municipality of Chatham-Kent, Ontario**
Drilling Location: **N4708384, E391442**

Drilling Method: **150 mm O.D. Hollow Stem Augers**
Drilling Machine: **D-120**
Date Started: **15 May 2016** Date Completed: **15 May 2016**
Logged by: **SS** Compiled by: **SS**
Reviewed by: **SM** Revision No.: **0**

Local Ground Surface Elevation:

DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	FIELD TESTING	LAB TESTING
TOPSOIL (380mm thick)							
SILTY CLAY 0.4 Trace sand Mottled brown and grey Firm	SS	1	94	6	1	○	○ 24
FINE SAND 1.4 Trace silt Brown Compact	SS	2	67	12	2	○	○ 23
SILTY CLAY 2.1 Trace sand Grey Firm	SS	3	100	6		○	○ 24
Silt seams	SS	4	100	6	3	○	○ 27
Soft	SS	5	100	2	4	○	○ 34
	SS	6	100	2	5	○	○ 34
	TW	7	100		6		
	VT				7	△ 21 ▲ 7	

FIELD TESTING: PenetrationTesting ○ SPT ● DCPT; MTO Vane* △ Intact ▲ Remould; Nilcon Vane* ◇ Intact ◆ Remould; ■ Undrained Shear Strength (kPa) (from P. Penetrometer tests) 20 40 60 80

LAB TESTING: Atterberg Limits W_P W W_L Plastic Liquid; ✳ Passing 75 um (%); ○ Moisture Content (%); ★ Unit Weight (KN/m3) 20 40 60 80

INSTRUMENTATION INSTALLATION

COMMENTS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

▽ No freestanding groundwater observed in open borehole upon completion of drilling.

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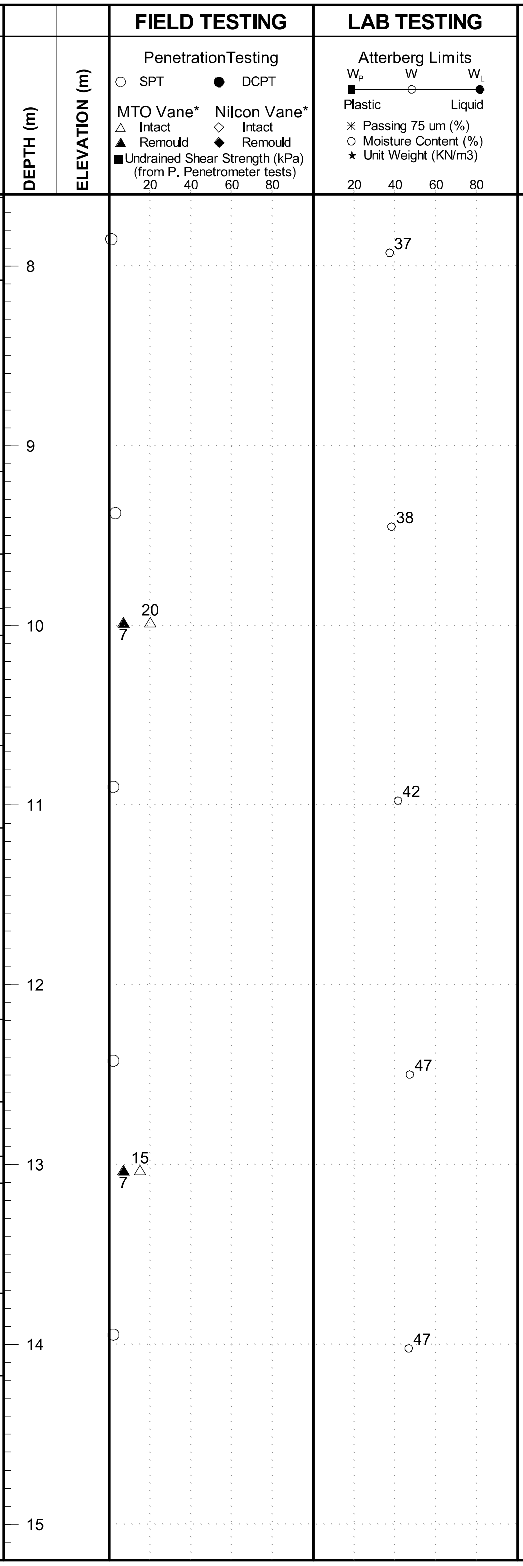
LITHOLOGY PROFILE		SOIL SAMPLING			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value
	SILTY CLAY Trace sand Grey	SS	8	100	1
		SS	9	100	3
		VT			
		SS	10	100	2
		SS	11	100	2
		VT			
		SS	12	100	2
	SAND AND GRAVEL TILL 14.6 Trace silt, trace clay Grey Loose				



INSTRUMENTATION INSTALLATION

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

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Drilling Method: **150 mm O.D. Hollow Stem Augers**
Drilling Machine: **D-120**
Date Started: **15 May 2016** Date Completed: **15 May 2016**
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LITHOLOGY PROFILE | SOIL SAMPLING | FIELD TESTING | LAB TESTING | INSTRUMENTATION INSTALLATION | COMMENTS & GRAIN SIZE DISTRIBUTION (%)

Field testing legend: Penetration Testing: ○ SPT ● DCPT; MTO Vane*: △ Intact ▲ Remould; Nilcon Vane*: ◇ Intact ◆ Remould; ■ Undrained Shear Strength (kPa) (from P. Penetrometer tests); scale 20 40 60 80

Lab testing legend: Atterberg Limits WP W WL; Plastic Liquid; ✳ Passing 75 um (%) ○ Moisture Content (%) ★ Unit Weight (KN/m3); scale 20 40 60 80

Grain size: GR SA SI CL

DESCRIPTION	Depth (m)	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	Field Testing	Lab Testing	Comments
SAND AND GRAVEL TILL Trace silt, trace clay Grey Loose		SS	13	100	8	○	○24	
Rock fragments	16							
FINE GRAINED SHALE Black alternating Dark grey	16.8	SS	14	100	>50/25mm		○13	
	17	RC	15	100				TCR = 100% SCR = 76% RQD = 60%
	18							
	19	RC	16	99				TCR = 95% SCR = 92% RQD = 91%
	20	RC	17	95				TCR = 99% SCR = 99% RQD = 99%
END OF BOREHOLE	20.5							
	21							
	22							

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RECORD OF BOREHOLE No. T42

Project Number:	SWW167102	Drilling Method:	150 mm O.D. Hollow Stem Augers
Project Client:	North Kent Wind 1 GP Inc.	Drilling Machine:	D-120
Project Name:	North Kent Wind 1 Project	Date Started:	11 May 2016
		Date Completed:	12 May 2016
Project Location:	Municipality of Chatham-Kent, Ontario	Logged by:	SS
		Compiled by:	SS
Drilling Location:	N4701243, E393628	Reviewed by:	SM
		Revision No.:	0

LITHOLOGY PROFILE — Lithology Plot — DESCRIPTION

Local Ground Surface Elevation:

DESCRIPTION	DEPTH (m)
TOPSOIL (355mm thick)	
SILTY CLAY Trace sand Mottled brown and grey Firm	0.4
FINE SAND Trace silt Brown Compact	1.4
SILTY CLAY Trace sand Grey Stiff Firm Soft	2.1

SOIL SAMPLING / FIELD TESTING / LAB TESTING

Penetration Testing: ○ SPT ● DCPT; MTO Vane*: △ Intact ▲ Remould; Nilcon Vane*: ◇ Intact ◆ Remould; ■ Undrained Shear Strength (kPa) (from P. Penetrometer tests) 20 40 60 80

Atterberg Limits: W_P W W_L Plastic Liquid; ✳ Passing 75 um (%); ○ Moisture Content (%); ★ Unit Weight (KN/m3) 20 40 60 80

INSTRUMENTATION INSTALLATION

COMMENTS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	Field Testing	Moisture Content (%)
SS	1	61	6	○	23
SS	2	83	14	○	24
SS	3	100	10	○	24
SS	4	100	6	○	24
SS	5	100	2	○	28
SS	6	100	1	○	31
SS	7	100	2	○	37
VT				▲ 7 △ 21	

DEPTH (m): 1 2 3 4 5 6 7

ELEVATION (m)

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Drilling Machine: **D-120**
Date Started: **11 May 2016** Date Completed: **12 May 2016**
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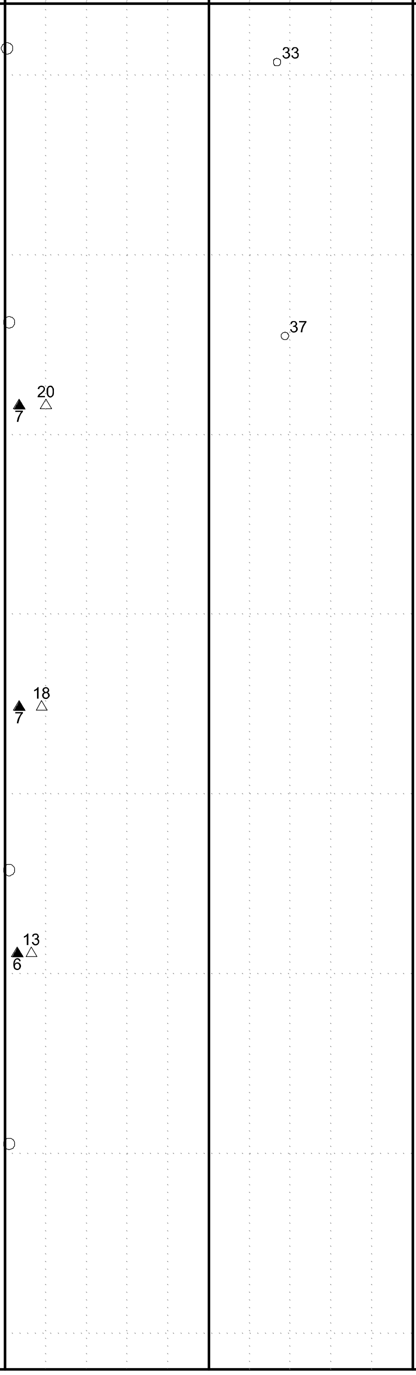
LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	Penetration Testing	Atterberg Limits	INSTRUMENTATION INSTALLATION	GR SA SI CL
▧	**SILTY CLAY** Trace sand Grey Soft	SS	8	100	1	7.8			33		
		SS	9	100	2	9.4			37		
		VT				9.9		20 / 7			
		TW	10	100		11.0					
		VT				11.6		18 / 7			
		SS	11	100	2	12.4					
		VT				12.9		13 / 6			
		SS	12	100	2	13.9					



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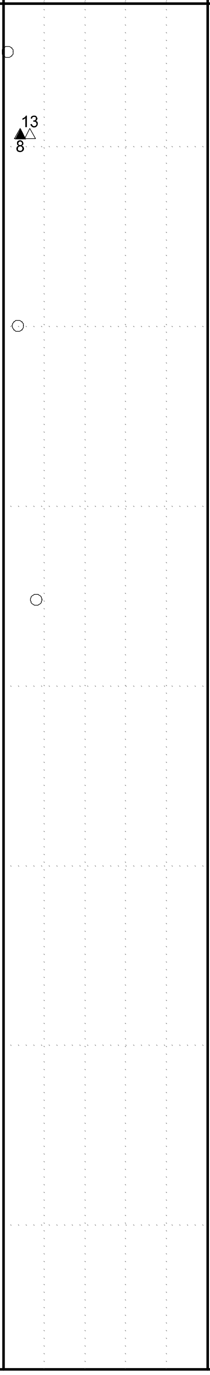
LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	PenetrationTesting ○ SPT ● DCPT MTO Vane* △ Intact ▲ Remould Nilcon Vane* ◇ Intact ◆ Remould ■ Undrained Shear Strength (kPa) (from P. Penetrometer tests) 20 40 60 80	Atterberg Limits W_P W W_L Plastic Liquid ✳ Passing 75 um (%) ○ Moisture Content (%) ★ Unit Weight (KN/m3) 20 40 60 80	INSTRUMENTATION INSTALLATION	GR SA SI CL
	SILTY CLAY Trace sand Grey Soft	SS	13	100	2						
		VT				16					
	Increased sand content Firm										
		SS	14	100	7	17					
	SAND AND GRAVEL TILL 17.7 Trace silt, trace clay Grey Compact					18					
		SS	15	100	16						
	Rock fragments Saturated Very dense					19					
		SS	16	100	>50/25mm						
	FINE GRAINED SHALE 19.9 Black and light grey					20					
		RC	17	100							TCR = 100% SCR = 95% RQD = 95%
						21					
		RC	18	100		22					TCR = 100% SCR = 93% RQD = 93%



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Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' Value	DEPTH (m)	ELEVATION (m)	PenetrationTesting ○ SPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould ■ Undrained Shear Strength (kPa) (from P. Penetrometer tests) 20 40 60 80	Atterberg Limits W_P W W_L Plastic Liquid ✳ Passing 75 um (%) ○ Moisture Content (%) ★ Unit Weight (KN/m3) 20 40 60 80	INSTRUMENTATION INSTALLATION	GR SA SI CL
	END OF BOREHOLE 22.9					23					
						24					
						25					
						26					
						27					
						28					
						29					
						30					

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APPENDIX C

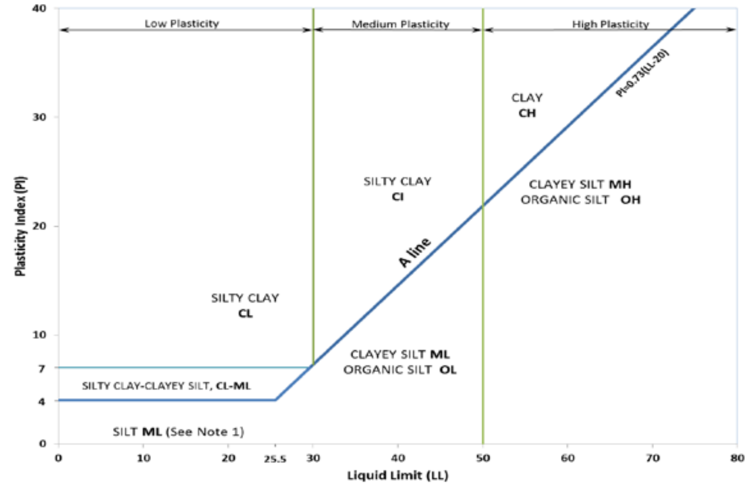
Records of Boreholes

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10}xD_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% (see Note 2)	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.

Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.

For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.

For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.

A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL, SAND and CLAY)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.).

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
FS	Foil sample
GS	Grab Sample
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size
TP	Thin-walled, piston – note size
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 - 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects.
2. Definition of compactness descriptions based on SPT 'N' ranges from Terzaghi and Peck (1967) and correspond to typical average N_{60} values.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\,\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma$ - u)
σ'_{vo}	initial effective overburden stress
σ_1, σ_2, σ_3	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan\delta$
c′	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan\phi'$

2 shear strength = (compressive strength)/2

PROJECT: 1668031

RECORD OF BOREHOLE BH-101\BH-101A

SHEET 1 OF 3

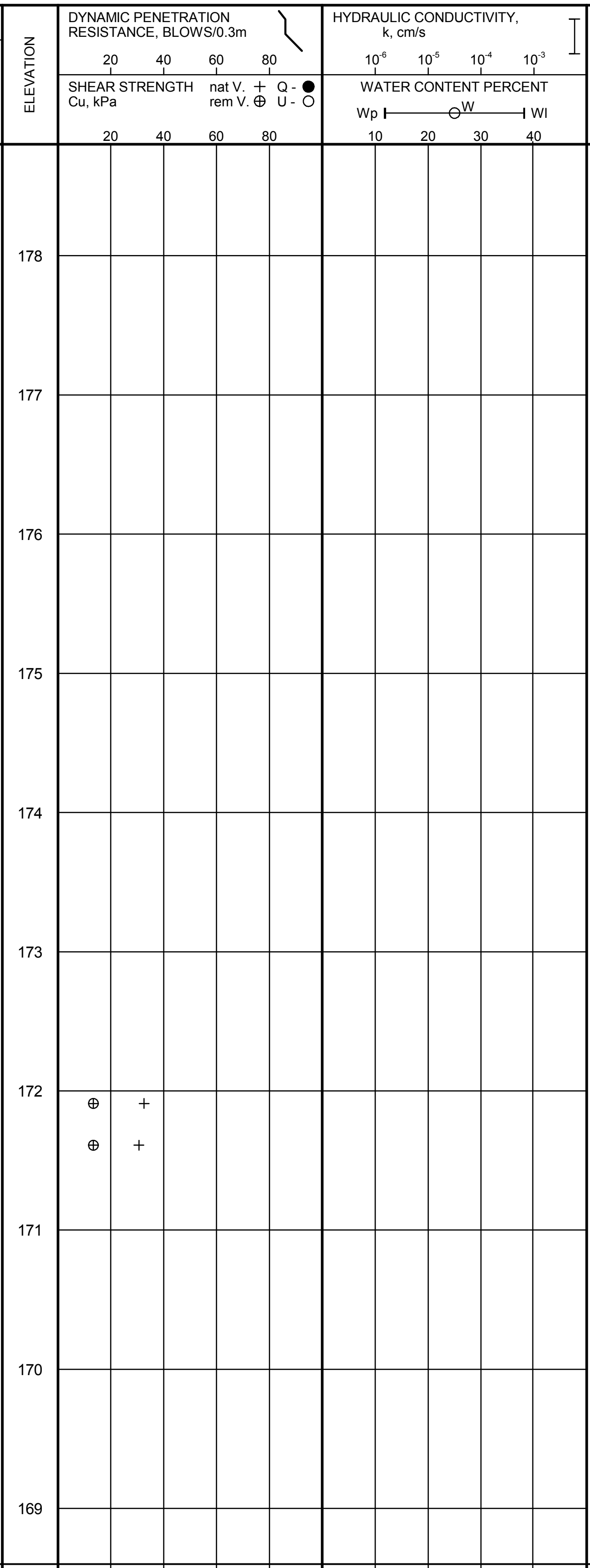
LOCATION: REFER TO LOCATION PLAN

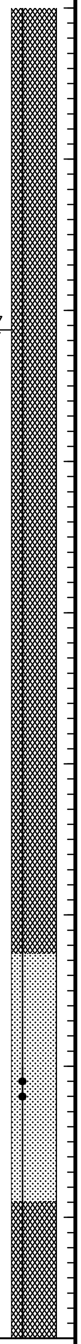
BORING DATE: March 14, 2017
DRILLING CONTRACTOR: WALKER DRILLING

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		GROUND SURFACE	177.40					
0	POWER AUGER 210mm OD HOLLOW STEM	**TOPSOIL**, clayey; dark brown	0.00					
		(CL) **SILTY CLAY**, some sand; brown and grey; stiff	177.22 0.18					
1				1	SS	10		
		(SM) **SILTY FINE SAND**; brown; compact	176.33 1.07					
				2	SS	11		
2								Enc WL ▽
				3	SS	11		
		(CL) - **SILTY CLAY**, some sand, with sand lenses; grey; stiff to soft	174.81 2.59					
3				4	SS	9		
4								
				5	SS	PH		
5	TRI-CONE WITH MUD UNCASED							
6								
								Instruments in BH-101A
7								101ST 101SU
8								Bottom of BH-101A ---
		--- CONTINUED NEXT PAGE ---						





DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MR
CHECKED: SSB

PROJECT: 1668031

RECORD OF BOREHOLE BH-101\BH-101A

SHEET 2 OF 3

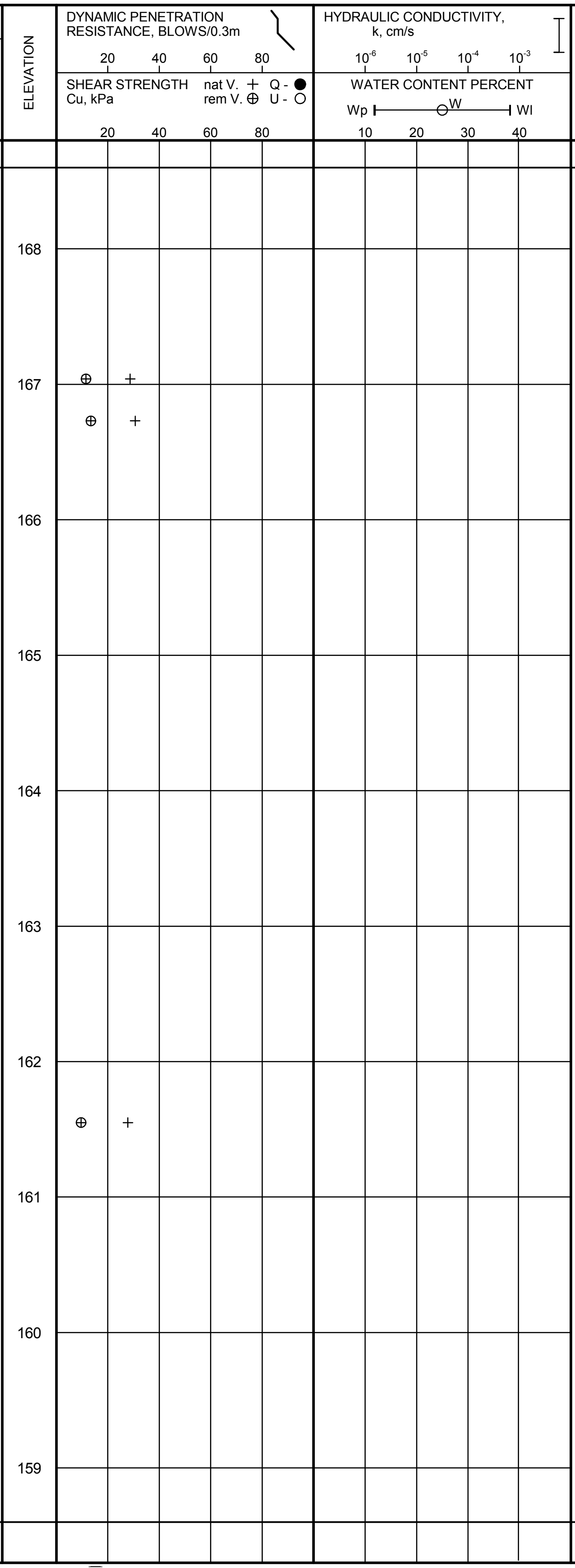
LOCATION: REFER TO LOCATION PLAN

BORING DATE: March 14, 2017
DRILLING CONTRACTOR: WALKER DRILLING

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		--- CONTINUED FROM PREVIOUS PAGE ---					
9 – 13	TRI-CONE WITH MUD UNCASED	(CL) - **SILTY CLAY**, some sand, with sand lenses; grey; stiff to soft					
13 – 17.68	MUD ROTARY DRILLING PQ CASING				6	SS	PH
17.68 –		(CL) - **SILTY CLAY**, some sand, some gravel, with shale fragments; grey, **TILL**; hard		159.72 17.68	7	SS	66
		--- CONTINUED NEXT PAGE ---					



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

LDN_BHS_07 1668031.GPJ GLDR_LON.GDT 07/04/17 DATA INPUT: ZJB

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MR
CHECKED: SSB

PROJECT: 1668031

RECORD OF BOREHOLE BH-101\BH-101A

SHEET 3 OF 3

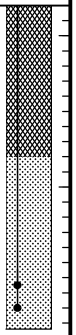
LOCATION: REFER TO LOCATION PLAN

BORING DATE: March 14, 2017
DRILLING CONTRACTOR: WALKER DRILLING

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} / WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---										
				158.53 18.87								
19	MUD ROTARY DRILLING PQRC	fine grained **SHALE** (bedrock); grey			8	PQ RC			T.C.R. (%) 100 S.C.R. (%) 50 R.Q.D. (%) 30			
20					9	PQ RC		158 157	T.C.R. (%) 94 S.C.R. (%) 81 R.Q.D. (%) 77			101DT 101DU
21		END OF BOREHOLE		156.46 20.94				156				Groundwater encountered during drilling at about 2.13 mbgs on March 14, 2017
22												
23												
24												
25												
26												
27												
28												



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MR
CHECKED: SSB

PROJECT: 1668031

RECORD OF BOREHOLE BH-102\BH-102A

SHEET 1 OF 3

LOCATION: REFER TO LOCATION PLAN

BORING DATE: March 14 - 17, 2017
DRILLING CONTRACTOR: WALKER DRILLING

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

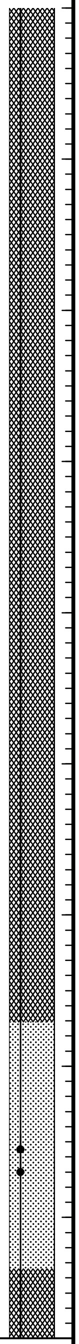
DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE: DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m) | SAMPLES: NUMBER, TYPE, BLOWS/0.3m | ELEVATION | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa, nat V. + Q - ●, rem V. ⊕ U - ○ (20 40 60 80) | HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT, Wp ⊢—○W—⊣ Wl (10 20 30 40) | ADDITIONAL LAB. TESTING | INSTALLATION AND GROUNDWATER OBSERVATIONS

DESCRIPTION	ELEV. / DEPTH (m)
SOIL DESCRIPTION FROM 0 TO 17.83m INFERRED FROM BH-101	
GROUND SURFACE	177.40
TOPSOIL, clayey; dark brown	0.00
(CL) **SILTY CLAY**, some sand; brown and grey; stiff	177.22 0.18
(SM) **SILTY FINE SAND**; brown; compact	176.33 1.07
(CL) - **SILTY CLAY**, some sand, with sand lenses; grey; stiff to soft	174.81 2.59

BORING METHOD: POWER AUGER, 210mm OD HOLLOW STEM (0 to approx. 4.9 m); TRI-CONE WITH MUD, UNCASED (below)

DEPTH SCALE: 0, 1, 2, 3, 4, 5, 6, 7, 8

ELEVATION: 178, 177, 176, 175, 174, 173, 172, 171, 170, 169



Instruments in
BH-102A
102ST
102SU

Bottom of
BH-102A ---

--- CONTINUED NEXT PAGE ---

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MR
CHECKED: SSB

PROJECT: 1668031

RECORD OF BOREHOLE BH-102\BH-102A

SHEET 2 OF 3

LOCATION: REFER TO LOCATION PLAN

BORING DATE: March 14 - 17, 2017
DRILLING CONTRACTOR: WALKER DRILLING

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---										
9	TRI-CONE WITH MUD UNCASED											
								168				
10												
								167				
11												
								166				
12												
								165				
13	MUD ROTARY DRILLING PQ CASING	(CL) - **SILTY CLAY**, some sand, with sand lenses; grey; stiff to soft										
								164				
14												
								163				
15												
								162				
16												
								161				
17												
								160				
		(CL) - **SILTY CLAY**, some sand, some gravel, with shale fragments; grey, **TILL**; hard		159.72 17.68								
18				17.83								
		(CL) - **SILTY CLAY**, some sand, some gravel, with shale fragments; grey, **TILL**						159				
		--- CONTINUED NEXT PAGE ---										

LDN_BHS_07 1668031.GPJ GLDR_LON.GDT 07/04/17 DATA INPUT: ZJB

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MR
CHECKED: SSB

PROJECT: 1668031

RECORD OF BOREHOLE BH-102\BH-102A

SHEET 3 OF 3

LOCATION: REFER TO LOCATION PLAN

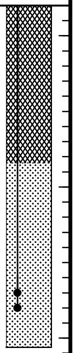
BORING DATE: March 14 - 17, 2017
DRILLING CONTRACTOR: WALKER DRILLING

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○: 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl: 10 20 30 40

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION / SHEAR STRENGTH	HYDRAULIC CONDUCTIVITY / WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---										
19	PQ CASING	(CL) - **SILTY CLAY**, some sand, some gravel, with shale fragments; grey, **TILL**		158.08 19.32								
	MUD ROTARY DRILLING PQRC	fine grained **SHALE** (bedrock); grey			7	PQ RC		158	T.C.R. (%) 100 S.C.R. (%) 100 R.Q.D. (%) 100			
20					8	PQ RC		157	T.C.R. (%) 100 S.C.R. (%) 100 R.Q.D. (%) 100			102DT 102DU
21				156.34 21.06								
		END OF BOREHOLE						156				
22												
23												
24												
25												
26												
27												
28												



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MR
CHECKED: SSB

PROJECT: 1668031

RECORD OF BOREHOLE BH-103\BH-103A

SHEET 1 OF 3

LOCATION: REFER TO LOCATION PLAN

BORING DATE: March 14 - 18, 2017
DRILLING CONTRACTOR: WALKER DRILLING

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE | SAMPLES | ELEVATION | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 | SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80 | HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} | WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40 | ADDITIONAL LAB. TESTING | INSTALLATION AND GROUNDWATER OBSERVATIONS

DESCRIPTION	ELEV. DEPTH (m)
SOIL DESCRIPTION FROM 0 TO 17.68m INFERRED FROM BH-101	
GROUND SURFACE	177.40
TOPSOIL, clayey; dark brown	0.00 177.22 0.18
(CL) **SILTY CLAY**, some sand; brown and grey; stiff	176.33 1.07
(SM) **SILTY FINE SAND**; brown; compact	174.81 2.59
(CL) - **SILTY CLAY**, some sand, with sand lenses; grey; stiff to soft	

Boring method: POWER AUGER 210mm OD HOLLOW STEM (0 to 5 m); TRI-CONE WITH MUD UNCASED (5 m onward)

Elevation scale: 178, 177, 176, 175, 174, 173, 172, 171, 170, 169

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8

Instrument in BH-103A

103SU

Bottom of BH-103A ---

--- CONTINUED NEXT PAGE ---

LDN_BHS_07 1668031.GPJ GLDR_LON.GDT 07/04/17 DATA INPUT: ZJB

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MR
CHECKED: SSB

PROJECT: 1668031

RECORD OF BOREHOLE BH-103\BH-103A

SHEET 2 OF 3

LOCATION: REFER TO LOCATION PLAN

BORING DATE: March 14 - 18, 2017
DRILLING CONTRACTOR: WALKER DRILLING

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---										
9 – 13	TRI-CONE WITH MUD UNCASED							168 167 166 165				
13 – 17.6	MUD ROTARY DRILLING PQ CASING	(CL) - **SILTY CLAY**, some sand, with sand lenses; grey; stiff to soft						164 163 162 161 160				
17.6 – 19	MUD ROTARY DRILLING PQ CASING	(CL) - **SILTY CLAY**, some sand, some gravel, with shale fragments; grey, **TILL**		159.72				159				
		--- CONTINUED NEXT PAGE ---										

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MR
CHECKED: SSB

PROJECT: 1668031

RECORD OF BOREHOLE BH-103\BH-103A

SHEET 3 OF 3

LOCATION: REFER TO LOCATION PLAN

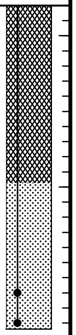
BORING DATE: March 14 - 18, 2017
DRILLING CONTRACTOR: WALKER DRILLING

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20, 40, 60, 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20, 40, 60, 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 10, 20, 30, 40

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ELEVATION	T.C.R. (%)	S.C.R. (%)	R.Q.D. (%)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---										
19		(CL) - **SILTY CLAY**, some sand, some gravel, with shale fragments; grey, **TILL**	158.20									
	MUD ROTARY DRILLING PQRC	fine grained **SHALE** (bedrock); grey	19.20	7	PQ RC		158	100	100	78		
20				8	PQ RC		157	95	95	95		
			156.40									103DT 103DU
21		END OF BOREHOLE	21.00				156					
22												
23												
24												
25												
26												
27												
28												



LDN_BHS_07 1668031.GPJ GLDR_LON.GDT 07/04/17 DATA INPUT: ZJB

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: MR
CHECKED: SSB

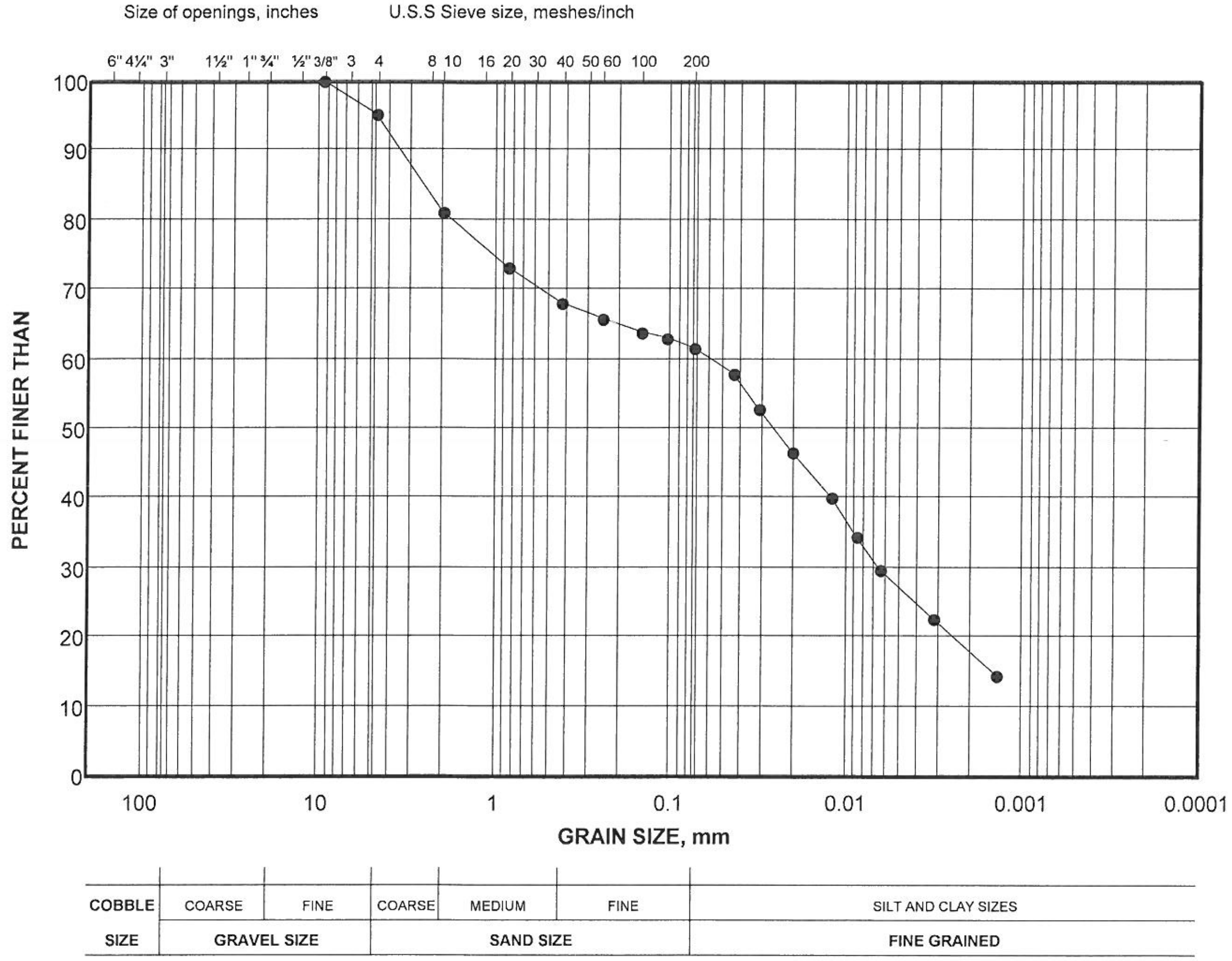
APPENDIX D

Laboratory Test Data

GRAIN SIZE DISTRIBUTION

BH-101-7

FIGURE



LEGEND

SYMBOL	SAMPLE	DEPTH(m)
●	BH-101-7	

Project Number: 1668031

Checked By: KP

Golder Associates

Date: 06-Apr-17

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 285(g)
Weight measured for back sieving = 50.09(g)
Weight of Sample for Hydrometer = 50.09(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	14.00	4.91	4.75	95.1
2.00mm	53.55	13.88	2.00	81.2
PAN	231.45	81.21	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	4.97	8.06	0.85	73.2
425µm	8.12	5.11	0.43	68.0
250µm	9.59	2.38	0.25	65.7
150µm	10.73	1.85	0.15	63.8
106µm	11.23	0.81	0.11	63.0
75µm	12.04	1.31	0.08	61.7

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	4/6/2017	Null
Finished :	4/6/2017	Null

Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	40.00	4.0	22.6	36.00	0.0445	57.8	True
2.00	37.00	4.0	22.6	33.00	0.0321	53.0	True
5.00	33.00	4.0	22.6	29.00	0.0208	46.5	True
15.00	29.00	4.0	22.6	25.00	0.0123	40.1	True
30.00	25.50	4.0	22.6	21.50	0.0088	34.5	True
60.00	22.50	4.0	22.6	18.50	0.0064	29.7	True
250.00	18.00	4.0	22.6	14.00	0.0032	22.5	True
1440.00	13.00	4.0	22.6	9.00	0.0014	14.4	True

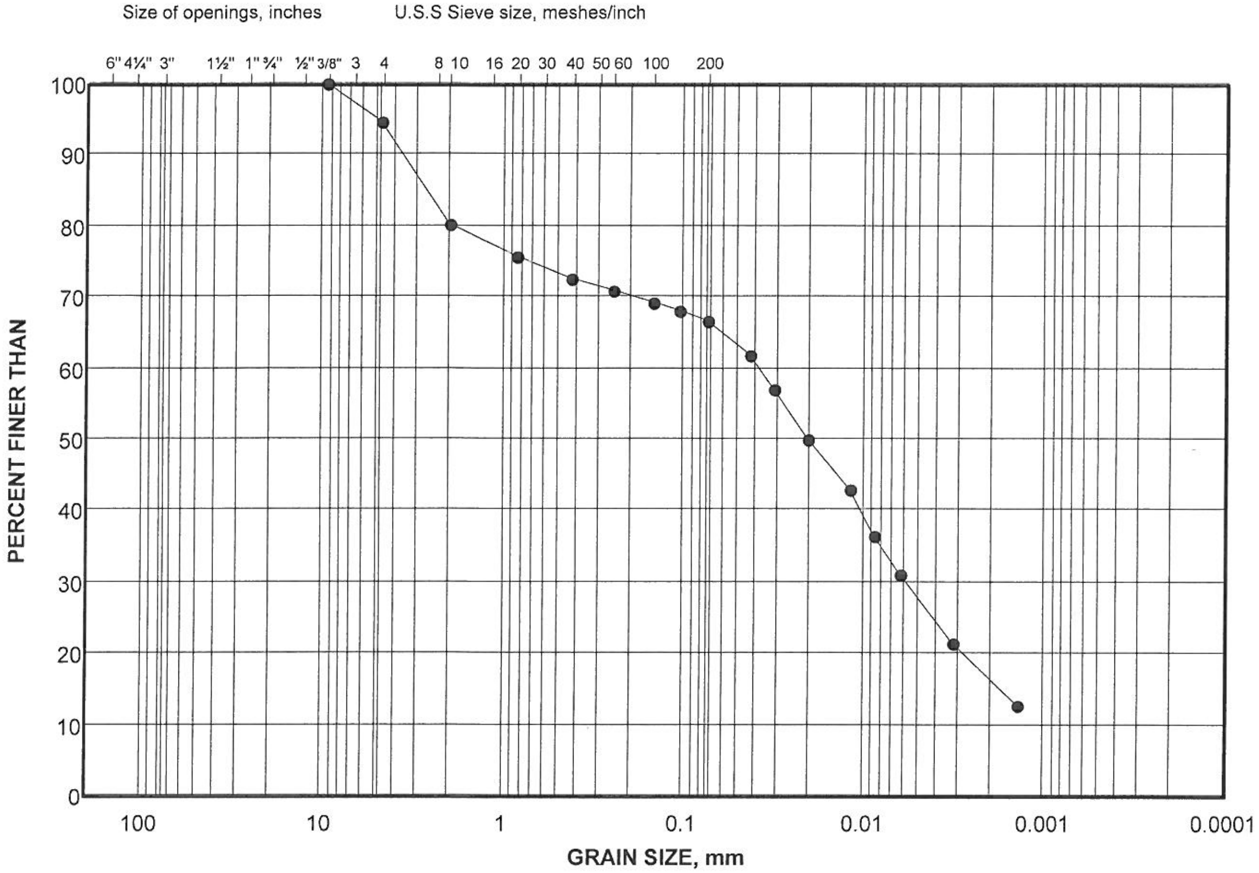
Project Number	1668031	Depth	
Project Task	1000	Units	Metric
		Testing Date	4/6/2017 11:39:25 AM
Sample Number	BH-101-7	Tested By	Sieve - KP, Hydrometer - KP
Checked By	______________________	LabID	17-155

Golder Associates

GRAIN SIZE DISTRIBUTION

BH-102-1

FIGURE



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	SAMPLE	DEPTH(m)
●	BH-102-1	

Project Number: 1668031

Checked By: KP

Golder Associates

Date: 06-Apr-17

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 186.33(g)
Weight measured for back sieving = 50.01(g)
Weight of Sample for Hydrometer = 50.01(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	10.15	5.45	4.75	94.6
2.00mm	36.82	14.31	2.00	80.2
PAN	149.51	80.24	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	2.85	4.57	0.85	75.7
425µm	4.68	2.94	0.43	72.7
250µm	5.82	1.83	0.25	70.9
150µm	6.93	1.78	0.15	69.1
106µm	7.57	1.03	0.11	68.1
75µm	8.44	1.40	0.08	66.7

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	4/6/2017	Null
Finished :	4/6/2017	Null

Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	43.00	4.0	22.6	39.00	0.0436	61.9	True
2.00	40.00	4.0	22.6	36.00	0.0315	57.2	True
5.00	35.50	4.0	22.6	31.50	0.0205	50.0	True
15.00	31.00	4.0	22.6	27.00	0.0121	42.9	True
30.00	27.00	4.0	22.6	23.00	0.0088	36.5	True
60.00	23.50	4.0	22.6	19.50	0.0063	31.0	True
250.00	17.50	4.0	22.6	13.50	0.0032	21.4	True
1440.00	12.00	4.0	22.6	8.00	0.0014	12.7	True

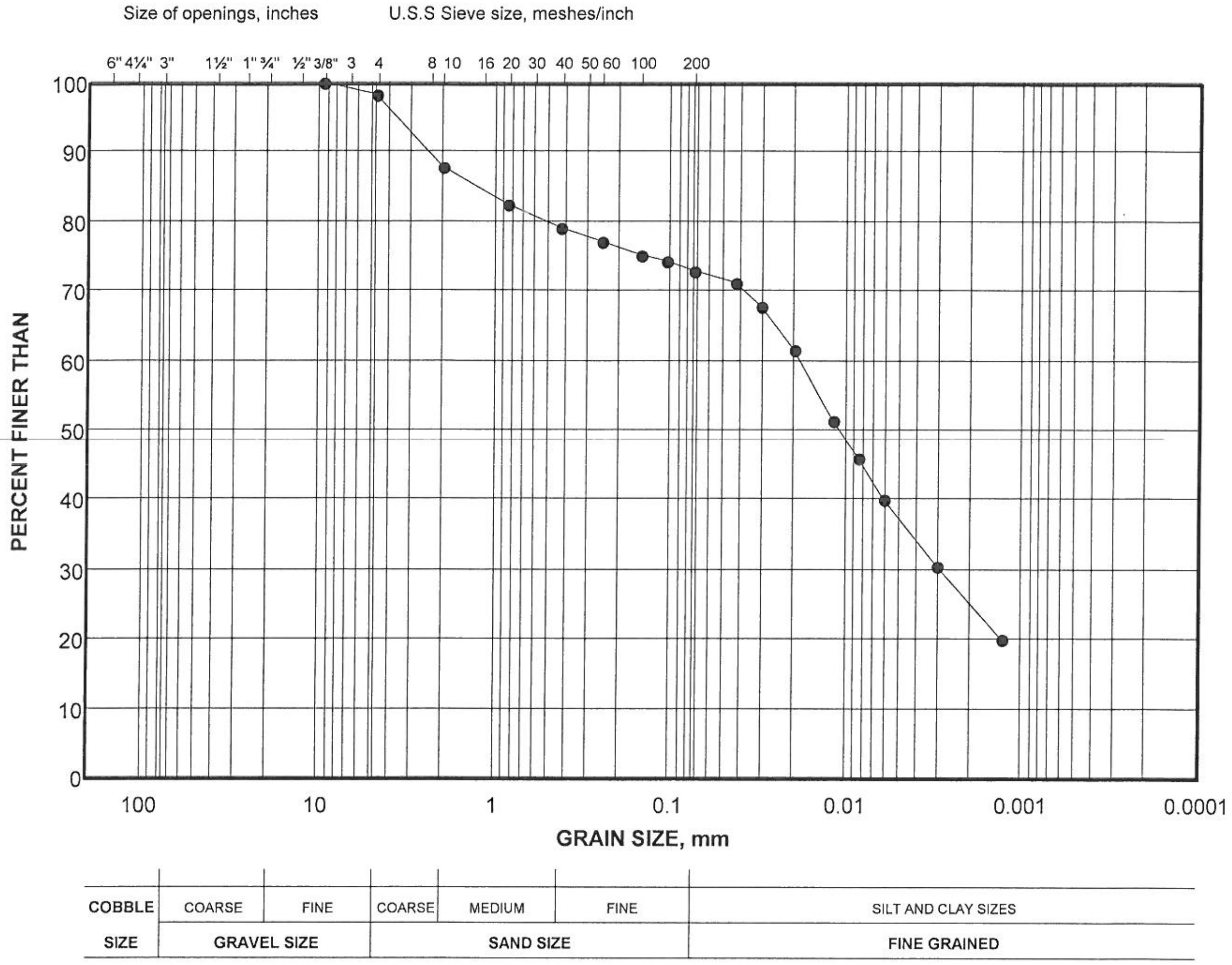
Project Number	1668031	Depth	
Project Task	1000	Units	Metric
		Testing Date	4/6/2017 11:37:30 AM
Sample Number	BH-102-1	Tested By	Sieve - KP, Hydrometer - KP
Checked By	______________	LabID	17-156

Golder Associates

GRAIN SIZE DISTRIBUTION

BH-103-1

FIGURE



LEGEND

SYMBOL	SAMPLE	DEPTH(m)
●	BH-103-1	

Project Number: 1668031

Checked By: KP

Golder Associates

Date: 06-Apr-17

SOIL SIEVE AND HYDROMETER ANALYSIS

Initial weight of dry sample = 207.6(g)
Weight measured for back sieving = 50.06(g)
Weight of Sample for Hydrometer = 50.06(g)

COARSE SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
75mm	0.00	0.00	75.00	100.0
63mm	0.00	0.00	63.00	100.0
53mm	0.00	0.00	53.00	100.0
37.5mm	0.00	0.00	37.50	100.0
26.5mm	0.00	0.00	26.50	100.0
19.0mm	0.00	0.00	19.00	100.0
13.2mm	0.00	0.00	13.20	100.0
9.5mm	0.00	0.00	9.50	100.0
4.75mm	3.51	1.69	4.75	98.3
2.00mm	25.09	10.39	2.00	87.9
PAN	182.51	87.92	0.00	0.0

HYDROMETER BACK SIEVING

SIEVE	CUM. MASS RETAINED (g)	% RETAINED	PARTICLE SIZE(mm)	% PASSING
850µm	3.07	5.39	0.85	82.5
425µm	4.98	3.35	0.43	79.2
250µm	6.13	2.02	0.25	77.2
150µm	7.23	1.93	0.15	75.2
106µm	7.73	0.88	0.11	74.4
75µm	8.54	1.42	0.08	72.9

HYDROMETER

	DATE (MM\DD\YYYY)	TIME (HH:MM:SS)
Started :	4/6/2017	Null
Finished :	4/6/2017	Null

Elapsed Time (min)	HYDROMETER READING	DEFLOCCULANT CORRECTION	WATER TEMP (°C)	CORRECTED HYDROMETER READING	PARTICLE SIZE (mm)	% PASSING	PLOT
1.00	45.00	4.0	22.6	41.00	0.0430	71.3	True
2.00	43.00	4.0	22.6	39.00	0.0308	67.8	True
5.00	39.50	4.0	22.6	35.50	0.0200	61.7	True
15.00	33.50	4.0	22.6	29.50	0.0120	51.3	True
30.00	30.50	4.0	22.6	26.50	0.0086	46.1	True
60.00	27.00	4.0	22.6	23.00	0.0062	40.0	True
250.00	21.50	4.0	22.6	17.50	0.0031	30.4	True
1440.00	15.50	4.0	22.6	11.50	0.0013	20.0	True

Project Number	1668031	Depth	
Project Task	1000	Units	Metric
		Testing Date	4/6/2017 11:41:02 AM
Sample Number	BH-103-1	Tested By	Sieve - KP, Hydrometer - KP
Checked By	________________	LabID	17-154

Golder Associates

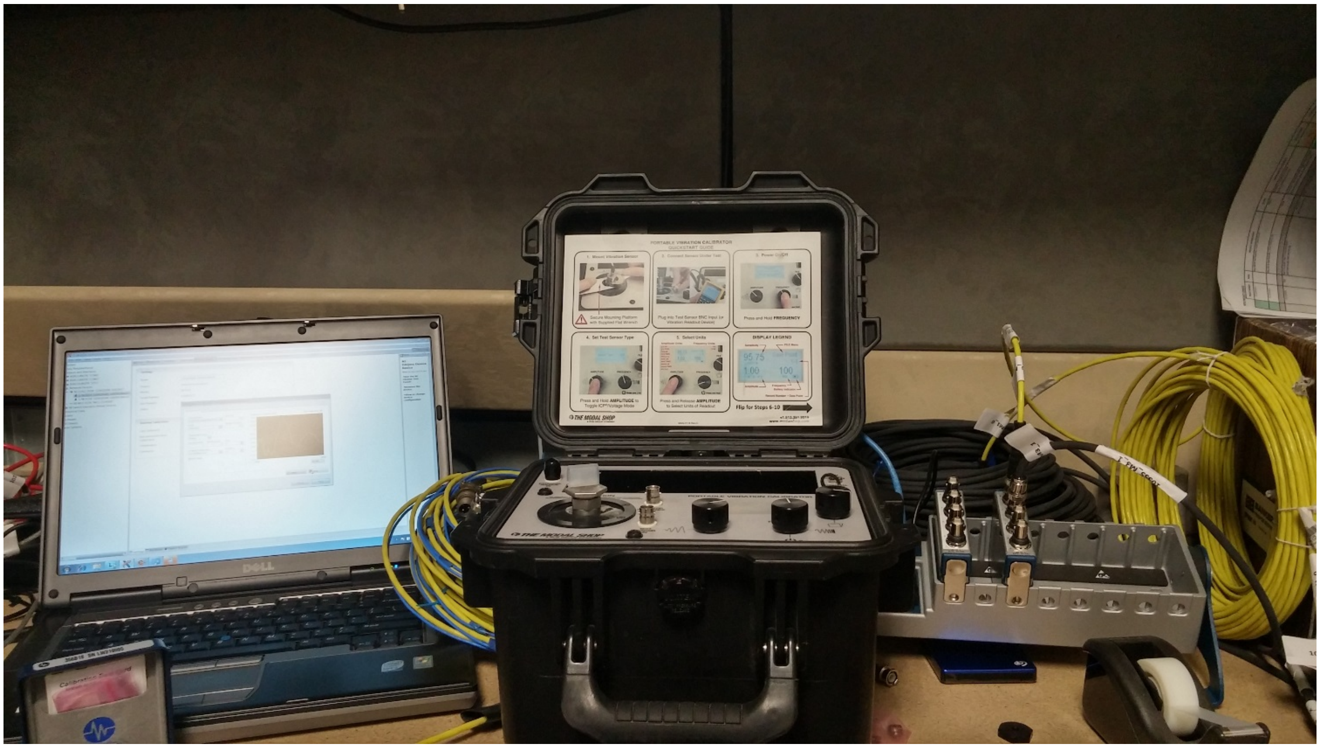
APPENDIX E

Photographs of Instrument Installations and Monitoring

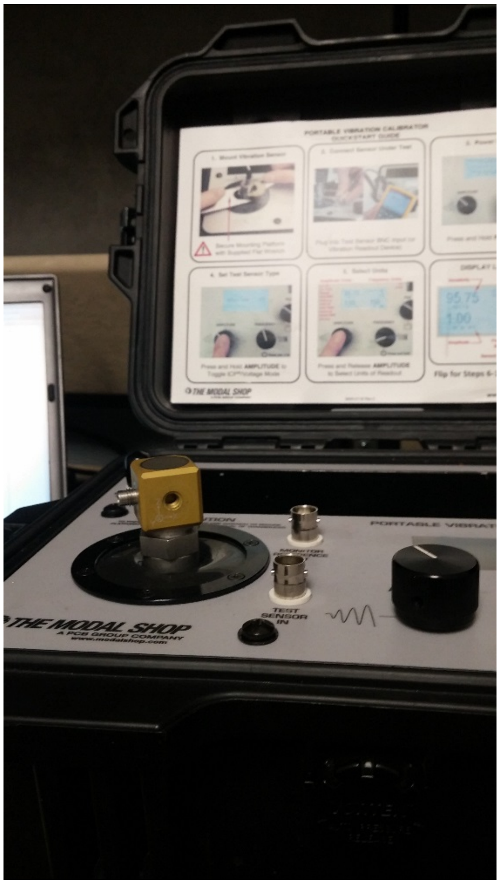
Photograph 1: Accelerometers delivered to Golder office.

Photograph 2: Seismic uniaxial accelerometer.

Photograph 3: Triaxial accelerometer.



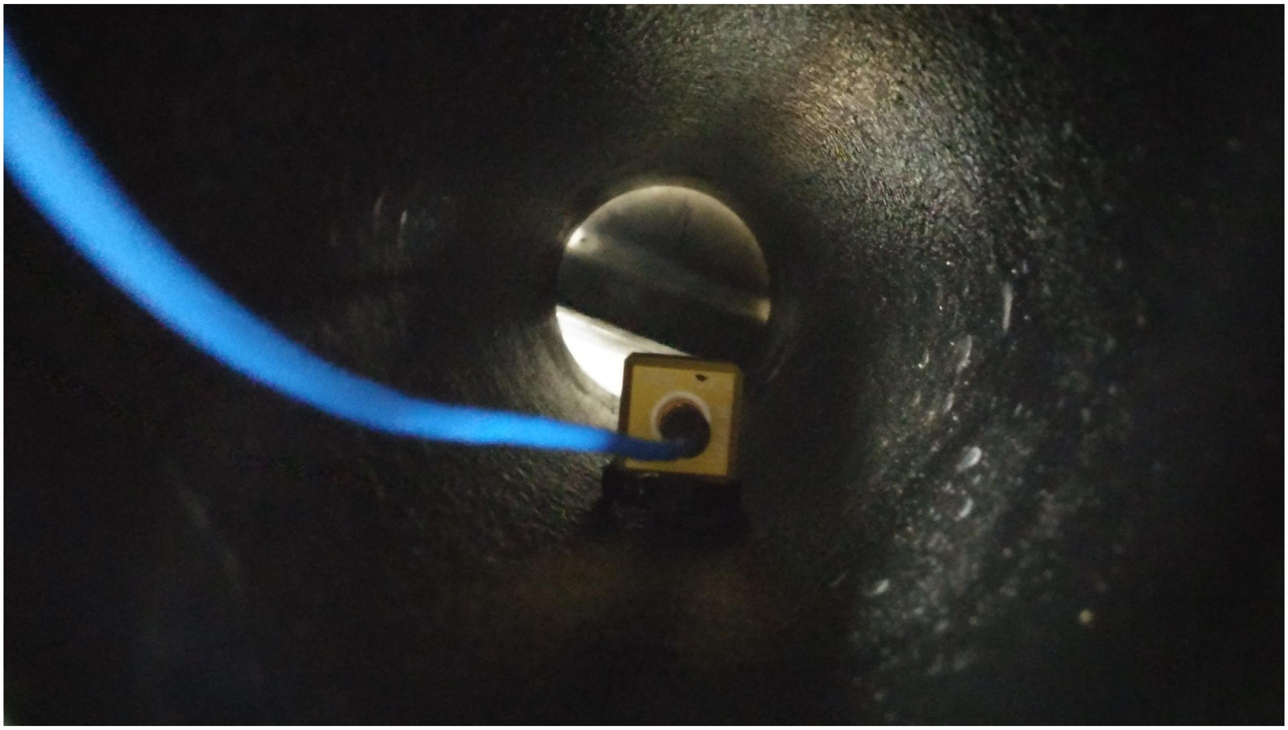
Photograph 4: Bench-scale controlled-source vibration measurement system for checking sensors.



Photograph 5: Triaxial accelerometer on controlled-source vibration measurement system.

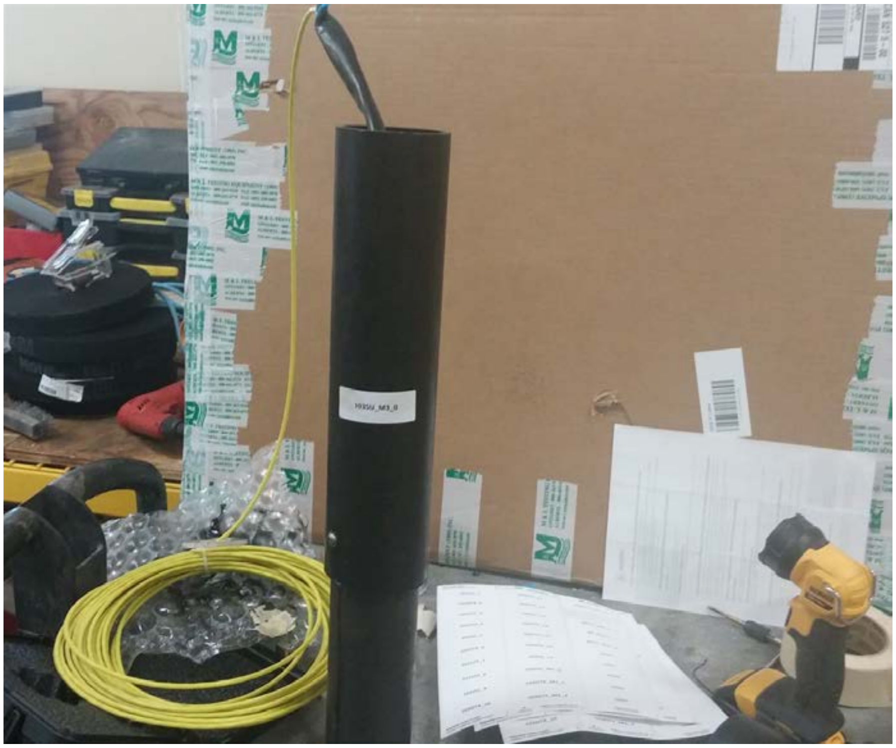
Photograph 6: Seismic accelerometer mounted on steel base of protective housing.

Photograph 7: Seismic accelerometer mounted on steel base of protective housing with connections coated with spray-plastic.



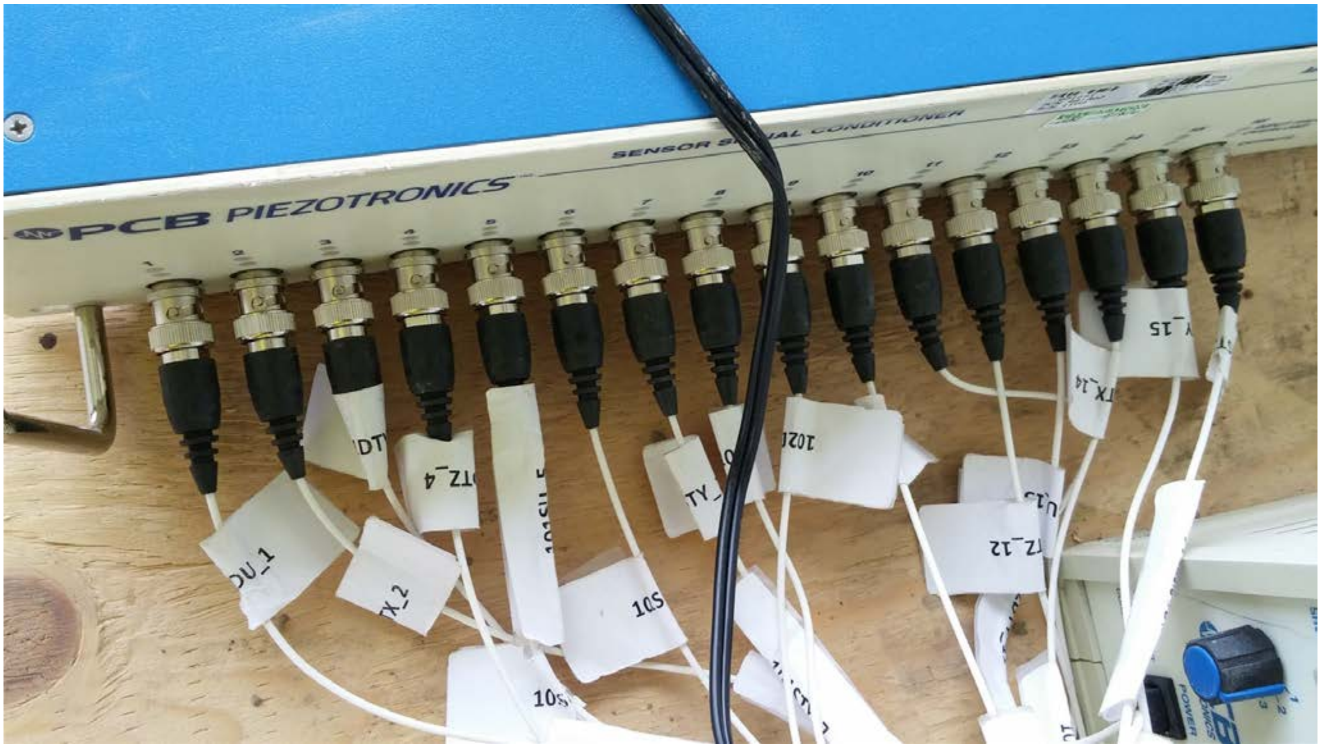
Photograph 8: Triaxial accelerometer mounted inside protective housing and with connection coated with spray-plastic prior to mounting housing to steel base.

Photograph 9: Top of protective housing, showing infilling with sand and clear plastic top cover (later sealed against water intrusion.



Photograph 10: Completed set of coupled sensors and housing with cables prior to field deployment.

Photograph 11: Field connection of signal conditioner/power source.



Photograph 12: Field connection of data logger.

Photograph 13: Drilling for borehole installation of accelerometers at T42 site.

Photograph 14: View of boreholes at T42 site looking toward Claymore Line along timber mat roadway.

Photograph 15: Coupling of accelerometers in protective housing to drill rig, as vibration source, along with independent accelerometer field checked with controlled-source vibration measurement system (at T42 site).

Photograph 16: Close-up view of coupled accelerometers in protective housing, drill rig and independent accelerometer (at T42 site).

Photograph 17: Installation of accelerometers in borehole at T42 site.

Photograph 18: Bucket immersed in grout for measuring down-hole grout quantities for coupling accelerometer housing to soil or rock in bottom of boreholes at T42 site.

Photograph 19: Drill rig tracking toward Claymore Line on timber mats at T42 site.

Photograph 20: Field set up of data loggers and signal conditioner systems for testing of installed accelerometer systems (looking toward Claymore Line) at T42 site.

Photograph 21: Field set up of data loggers and signal conditioner systems at T42 site for testing of installed accelerometer systems with Instantel Minimate data logger positioned temporarily on borehole casing and geophone placed nearby (looking toward test pile location).

Photograph 22: Vacuum truck operating at T42 site to remove cuttings and fluids after completion of installation and during baseline instrument readings.

Photograph 23: Seismic accelerometer coupled to ground stake near borehole BH101/101A at T42 site after removing topsoil.

Photograph 24: Pile toe (tip) showing welded plate to close end of pile (driving shoe).

Photograph 25: Pile driving on March 29, 2017 showing first pile section driven, second pile section on ground awaiting lifting and welding.

Photograph 26: Test pile site T5, May 3, 2017 looking south, showing test pile on ground.

Photograph 27: Test pile T5 tip, May 3, 2017.

Photograph 28: Layout of surface monitoring points at T5 test pile site looking west from near test pile.

Photograph 29: Controlled-source vibration measurement system at Well #1 location.

Photograph 30: Seismic accelerometer coupled to Well #1 casing.

Photograph 31: Seismic accelerometer coupled to Well #1 casing showing data logger and Golder van.

Photograph 32: Seismic accelerometer coupled to Well #2 casing.

Photograph 33: Well #3 casing and well lid conditions (note band/hose clamp and wire leading into well through gasket).

Photograph 34: Well #3 with accelerometers mounted to casing.

Photograph 35: Well #4 pump house.

Photograph 36: Well #4 well casing with accelerometers attached. Note corroded casing top and fittings.

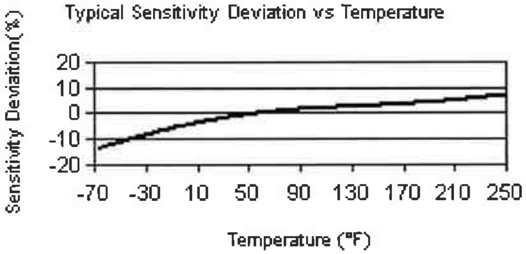
APPENDIX F

Instrument Specifications and Manufacturer’s Calibration Records

Model Number		
393A03	# SEISMIC ICP® ACCELEROMETER	Revision: H ECN #: 29751

	ENGLISH	SI	
Performance			
Sensitivity(± 5 %)	1000 mV/g	102 mV/(m/s²)	
Measurement Range	± 5 g pk	± 49 m/s² pk	
Frequency Range(± 5 %)	0.5 to 2000 Hz	0.5 to 2000 Hz	
Frequency Range(± 10 %)	0.3 to 4000 Hz	0.3 to 4000 Hz	
Frequency Range(± 3 dB)	0.2 to 6000 Hz	0.2 to 6000 Hz	
Resonant Frequency	≥ 10 kHz	≥ 10 kHz	
Broadband Resolution(1 to 10,000 Hz)	0.00001 g rms	0.0001 m/s² rms	[1]
Non-Linearity	≤ 1 %	≤ 1 %	[2]
Transverse Sensitivity	≤ 7 %	≤ 7 %	
Environmental			
Overload Limit(Shock)	± 5000 g pk	± 49,050 m/s² pk	
Temperature Range	-65 to +250 °F	-54 to +121 °C	
Temperature Response	See Graph	See Graph	
Base Strain Sensitivity	≤ 0.0005 g/με	≤ 0.005 (m/s²)/με	[1]
Electrical			
Excitation Voltage	18 to 30 VDC	18 to 30 VDC	
Constant Current Excitation	2 to 20 mA	2 to 20 mA	
Output Impedance	<250 ohm	<250 ohm	
Output Bias Voltage	8 to 12 VDC	8 to 12 VDC	
Discharge Time Constant	1 to 3 sec	1 to 3 sec	
Settling Time	<15 sec	<15 sec	
Spectral Noise(1 Hz)	2 μg/√Hz	20 (μm/sec^2)/√Hz	[1]
Spectral Noise(10 Hz)	0.5 μg/√Hz	5 (μm/sec^2)/√Hz	[1]
Spectral Noise(100 Hz)	0.2 μg/√Hz	2 (μm/sec^2)/√Hz	[1]
Spectral Noise(1 kHz)	0.1 μg/√Hz	1 (μm/sec^2)/√Hz	[1]
Electrical Isolation(Case)	≥ 10^8 ohm	≥ 10^8 ohm	
Physical			
Sensing Element	Ceramic	Ceramic	
Sensing Geometry	Shear	Shear	
Housing Material	Stainless Steel	Stainless Steel	
Sealing	Hermetic	Hermetic	
Size (Hex x Height)	1 3/16 in x 2 3/16 in	30.2 mm x 55.6 mm	
Weight	7.4 oz	210 gm	[1]
Electrical Connector	2-Pin MIL-C-5015	2-Pin MIL-C-5015	
Electrical Connection Position	Top	Top	
Mounting Thread	1/4-28 Female	1/4-28 Female	
Mounting Torque	2 to 5 ft-lb	3 to 7 N-m	

Typical Sensitivity Deviation vs Temperature



[3]

All specifications are at room temperature unless otherwise specified.
In the interest of constant product improvement, we reserve the right to change specifications without notice.

OPTIONAL VERSIONS

Optional versions have identical specifications and accessories as listed for the standard model except where noted below. More than one option may be used.

T - TEDS Capable of Digital Memory and Communication Compliant with IEEE P1451.4

Output Bias Voltage	8.5 to 12.5 VDC	8.5 to 12.5 VDC

NOTES:

[1] Typical.
[2] Zero-based, least-squares, straight line method.
[3] See PCB Declaration of Conformance PS023 for details.

SUPPLIED ACCESSORIES:

Model 081B20 Mounting Stud, with shoulder (1/4-28 to 1/4-28) (1)
Model 085A31 Protective Thermal Jacket (1)
Model ACS-1 NIST traceable frequency response (10 Hz to upper 5% point). (1)
Model ACS-4 Single axis, low frequency phase and amplitude response cal from 0.5 to 10 Hz (1)
Model M081B20 Mounting Stud 1/4-28 to M6 X 0.75 (1)

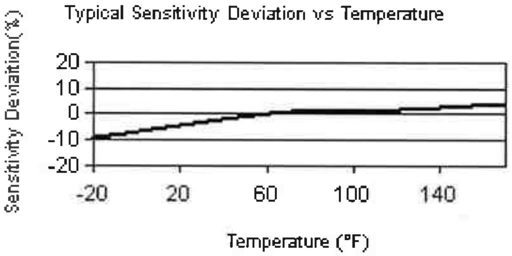
Entered:	Engineer:	Sales: WDC	Approved: EB	Spec Number:
Date: 12-2-08	Date: 11-24-08	Date: 11-24-08	Date: 12-1-08	**393-1030-80**

PCB PIEZOTRONICS
VIBRATION DIVISION
3425 Walden Avenue, Depew, NY 14043

Phone: 716-684-0001
Fax: 716-685-3886
E-Mail: vibration@pcb.com

Model Number		
356B18	**TRIAXIAL ICP® ACCELEROMETER**	Revision: G ECN #: 26468

Performance	ENGLISH	SI	
Sensitivity(± 10 %)	1000 mV/g	102 mV/(m/s²)	
Measurement Range	± 5 g pk	± 49 m/s² pk	
Frequency Range(± 5 %)	0.5 to 3000 Hz	0.5 to 3000 Hz	
Frequency Range(± 10 %)	0.3 to 5000 Hz	0.3 to 5000 Hz	
Resonant Frequency	≥ 20 kHz	≥ 20 kHz	
Phase Response(± 5 °)(at 70°F [21°C])	2 to 2000 Hz	2 to 2000 Hz	
Broadband Resolution(1 to 10,000 Hz)	0.00005 g rms	0.0005 m/s² rms	[1]
Non-Linearity	≤ 1 %	≤ 1 %	[2]
Transverse Sensitivity	≤ 5 %	≤ 5 %	
Environmental			
Overload Limit(Shock)	± 5000 g pk	± 5000 g pk	
Temperature Range(Operating)	-20 to +170 °F	-29 to +77 °C	
Temperature Response	See Graph	See Graph	
Base Strain Sensitivity	0.0007 g/με	0.007 (m/s²)/με	[1]
Electrical			
Excitation Voltage	20 to 30 VDC	20 to 30 VDC	
Constant Current Excitation	2 to 20 mA	2 to 20 mA	
Output Impedance	≤ 600 ohm	≤ 600 ohm	
Output Bias Voltage	8 to 12 VDC	8 to 12 VDC	
Discharge Time Constant	0.8 to 3.0 sec	0.8 to 3.0 sec	
Settling Time(within 10% of bias)	<12 sec	<12 sec	
Spectral Noise(1 Hz)	11.4 μg/√Hz	112 (μm/s²)/√Hz	[1]
Spectral Noise(10 Hz)	4.0 μg/√Hz	39 (μm/s²)/√Hz	[1]
Spectral Noise(100 Hz)	1.2 μg/√Hz	12 (μm/s²)/√Hz	[1]
Spectral Noise(1 kHz)	0.4 μg/√Hz	4.4 (μm/s²)/√Hz	[1]
Physical			
Sensing Element	Ceramic	Ceramic	
Sensing Geometry	Shear	Shear	
Housing Material	Anodized Aluminum	Anodized Aluminum	
Sealing	Epoxy	Epoxy	
Size (Height x Length x Width)	0.80 in x 1.03 in x 0.80 in	20.3 mm x 26.1 mm x 20.3 mm	
Weight	0.88 oz	25 gm	[1]
Electrical Connector	1/4-28 4-Pin	1/4-28 4-Pin	
Electrical Connection Position	Side	Side	
Mounting Thread	10-32 Female	10-32 Female	



CE [3]

All specifications are at room temperature unless otherwise specified.
In the interest of constant product improvement, we reserve the right to change specifications without notice.

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OPTIONAL VERSIONS

Optional versions have identical specifications and accessories as listed for the standard model except where noted below. More than one option may be used.

A - Adhesive Mount

Mounting Thread	None - Adhesive Mount Only	None - Adhesive Mount Only

Supplied Accessory : Model 080A109 Petro Wax (1)
Supplied Accessory : Model 080A90 Quick Bonding Gel (1)

J - Ground Isolated

Electrical Isolation(Base)	>10^8 ohm	>10^8 ohm
Size - Height x Length x Width	0.85 in x 1.03 in x 0.85 in	21.6 mm x 26.1 mm x 21.6 mm

T - TEDS Capable of Digital Memory and Communication Compliant with IEEE P1451.4
TLA - TEDS LMS International - Free Format
TLB - TEDS LMS International - Automotive Format
TLC - TEDS LMS International - Aeronautical Format
TLD - TEDS Capable of Digital Memory and Communication Compliant with IEEE 1451.4

Output Bias Voltage	8.5 to 13 VDC	8.5 to 13 VDC

NOTES:
[1] Typical.
[2] Zero-based, least-squares, straight line method.
[3] See PCB Declaration of Conformance PS023 for details.

SUPPLIED ACCESSORIES:
Model 080A109 Petro Wax (1)
Model 080A68 Adhesive mounting base (for Models 356B07 and 356B08) (1)
Model 081B05 Mounting Stud (10-32 to 10-32) (1)
Model ACS-1T NIST traceable triaxial amplitude response, 10 Hz to upper 5% frequency. (1)
Model M081B05 Mounting Stud 10-32 to M6 X 0.75 (1)

Entered: BLS	Engineer:	Sales:	Approved:	Spec Number:
Date: 5-16-07	Date: 5/16/07	Date: 5/16/07	Date: 5/16/07	11615

PCB PIEZOTRONICS™
VIBRATION DIVISION
3425 Walden Avenue, Depew, NY 14043

Phone: 716-684-0001
Fax: 716-685-3886
E-Mail: vibration@pcb.com

Standard Geophone

Measures ground motion in three orthogonal directions. The sensor includes three ground spikes for soft surfaces or can be bolted to hard surfaces.

PART NUMBER	714A9701
RESPONSE STANDARD	ISEE SPECIFICATION 2000 EDITION
FREQUENCY RANGE	2 TO 250 Hz
VELOCITY RANGE	UP TO 10 in/s (254 mm/s)
RESOLUTION	0.000625in/s (0.0159mm/s)
SENSOR DENSITY	133 lbs/ft³ (2.13 g/cc)
CABLE LENGTH	6 ft (2 m)
MAXIMUM CABLE LENGTH	250 ft (75 m)
REQUIRED SOFTWARE	BLASTWARE COMPLIANCE

DIN Geophone

Measures ground motion in three orthogonal directions. The sensor includes three ground spikes for soft surfaces or can be bolted to hard surfaces.

PART NUMBER	718A3301
RESPONSE STANDARD	DIN 45669-1 CLASS 1
FREQUENCY RANGE	1 TO 315 Hz
VELOCITY RANGE	UP TO 10 in/s (254 mm/s)
RESOLUTION	0.000625in/s (0.0159mm/s)
SENSOR DENSITY	133 lbs/ft³ (2.13 g/cc)
CABLE LENGTH	6 ft (2 m)
MAXIMUM CABLE LENGTH	3250 ft (1000 m)
REQUIRED SOFTWARE	BLASTWARE COMPLIANCE

Triaxial High Frequency Geophone

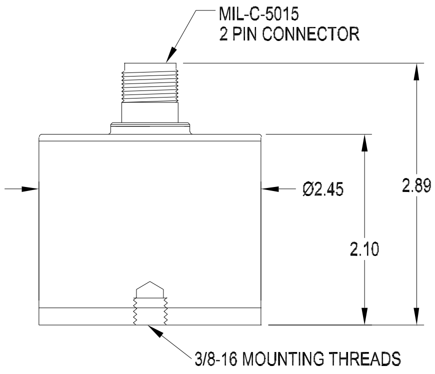
Measure high frequency, high amplitude vibrations in three orthogonal directions. Designed for near field monitoring of blasting activities.

Not available for Minimate Blaster.

PART NUMBER	714A9101
FREQUENCY RANGE	30 TO 1000 Hz
VELOCITY RANGE	UP TO 100in/s (2540mm/s)
RESOLUTION	0.05in/s (1.27mm/s)
SENSOR DENSITY	145 lbs/ft³ (2.33 g/cc)
CABLE LENGTH	100 ft (30 m)
MAXIMUM CABLE LENGTH	3250 ft (1000 m)
REQUIRED SOFTWARE	BLASTWARE ADVANCED

Model 731A
Ultra-quiet, ultra low frequency, seismic accelerometer

Features
- Ultra high sensitivity
- Ultra low-noise electronics for clear signals at sub micro-g levels
- Low frequency capable
- Low pass filtered to eliminate high frequencies
- Reverse wiring protection



Dynamic

Sensitivity, ±10%, 25°C	10 V/g
Acceleration range	0.5 g peak
Amplitude nonlinearity	1%
Frequency response:	
±10%	0.10 - 300 Hz
±3 dB	0.05 - 450 Hz
Resonance frequency	750 Hz
Transverse sensitivity, max.	1% of axial
Temperature response:	
−10°C	−12%
+65°C	+5%

Electrical

Power requirement:	voltage source	18 - 30 VDC
	current regulating diode	2 - 10 mA
Electrical noise, equiv. g:		
Broadband	2.5 Hz to 25 kHz	0.5 µg
Spectral	2 Hz	0.03 µg/√Hz
	10 Hz	0.01 µg/√Hz
	100 Hz	0.004 µg/√Hz
Output impedance, max.		100Ω
Bias output voltage		9 VDC
Grounding		case isolated

Environmental

Temperature range	−10 to 65°C
Vibration limit	10 g peak
Shock limit	fragile
Electromagnetic sensitivity @ 60 Hz	20 µg/gauss
Sealing	hermetic
Base strain sensitivity	0.0001 g/µstrain

Physical

Sensing element design	PZT ceramic / flexure
Weight	775 grams
Case material	316L stainless steel
Mounting	3/8 - 16 tapped hole
Output connector	2 pin, MIL-C-5015 style
Mating connector	R6 type
Recommended cabling	J9 / J9T2A

Connector pin	Function
Shell	ground
A	power/ signal
B	common

Note: Special handling required due to sensitivity, wooden protective case included

Accessories supplied: SF7 mounting stud; calibration data (level 3)

Options: Power unit/amplifier P31

Wilcoxon Research Inc
20511 Seneca Meadows Parkway
Germantown, MD 20876
USA

Tel: 301 330 8811
Fax: 301 330 8873
Email: wilcoxon@meggitt.com

www.meggitt.com

MEGGiTT
smart engineering for extreme environments

Calibration Data Card
SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218952 (z axis)

SENSITIVITY: 996 mV/g
(101.6 mV/m/s^2)

BIAS LEVEL: 11.0 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card
SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218952 (y axis)

SENSITIVITY: 1021 mV/g
(104.1 mV/m/s^2)

BIAS LEVEL: 11.0 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card
SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218952 (x axis)

SENSITIVITY: 1037 mV/g
(105.7 mV/m/s^2)

BIAS LEVEL: 11.0 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
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888-684-0013

Calibration Data Card
SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218950 (z axis)

SENSITIVITY: 987 mV/g
(100.7 mV/m/s^2)

BIAS LEVEL: 11.0 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card
SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218950 (y axis)

SENSITIVITY: 984 mV/g
(100.4 mV/m/s^2)

BIAS LEVEL: 11.0 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card
SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218950 (x axis)

SENSITIVITY: 1061 mV/g
(108.2 mV/m/s^2)

BIAS LEVEL: 10.9 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

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3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card
SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218953 (z axis)

SENSITIVITY: 1049 mV/g
(107.0 mV/m/s^2)

BIAS LEVEL: 11.0 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card
SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218953 (y axis)

SENSITIVITY: 967 mV/g
(98.6 mV/m/s^2)

BIAS LEVEL: 11.0 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card
SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218953 (x axis)

SENSITIVITY: 992 mV/g
(101.2 mV/m/s^2)

BIAS LEVEL: 10.9 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card

SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218951 (z axis)

SENSITIVITY: 1031 mV/g
(105.1 mV/m/s²)

BIAS LEVEL: 11.0 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card

SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218951 (x axis)

SENSITIVITY: 1050 mV/g
(107.1 mV/m/s²)

BIAS LEVEL: 11.0 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card

SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW218951 (y axis)

SENSITIVITY: 1020 mV/g
(104.0 mV/m/s²)

BIAS LEVEL: 11.0 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card

SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW219095 (z axis)

SENSITIVITY: 1065 mV/g
(108.6 mV/m/s²)

BIAS LEVEL: 11.2 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card

SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW219095 (y axis)

SENSITIVITY: 1013 mV/g
(103.3 mV/m/s²)

BIAS LEVEL: 11.2 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

Calibration Data Card

SHEAR ACCELEROMETER

MODEL #: 356B18
SERIAL #: LW219095 (x axis)

SENSITIVITY: 1034 mV/g
(105.5 mV/m/s²)

BIAS LEVEL: 11.2 VDC
Date: 2/15/17 By: C. Kinyon

For further information, please refer to the accompanying calibration certificate.

PCB PIEZOTRONICS
3425 WALDEN AVE · DEPEW, NY 14043
888-684-0013

~ Calibration Certificate ~

Sensor Information:

Model Number	393A03
Serial Number	33820
Manufacturer	
ID Number	
Description	

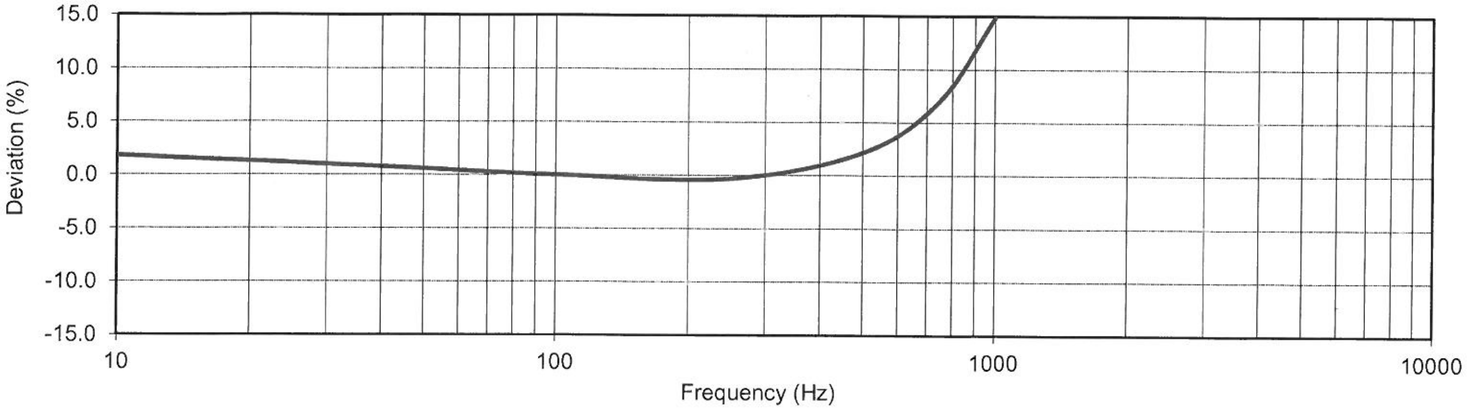
Calibration Data

Sensitivity @ 100 Hz:	1022.29	mV/g
Test Level:	0.50	g pk

Transducer Specifications

Amp. Range:		g
Resolution:		g
Resonant Freq:		Hz
Temp. Range:		°C
Axis:	X	

Deviation Plot



Data Table

Frequency (Hz)	Deviation (%)
10	1.8
25	1.1
50	0.6
100	0.0
250	-0.3
500	2.1
750	7.1
1000	14.9

Notes

Results relate only to the items calibrated.

This certificate may not be reproduced except in full, without written permission.

Traceable to NIST (Project Number 822/271196) and PTB (Project Number 5399).

This calibration was performed with TMS Portable Vibration Calibrator: S/N: 10235, Firmware version 5.1.0.

Back-to-Back Comparison per ISO 16063-21

User Notes

Customer:

Unit Condition

As Found:

As Left:

Lab Conditions

Temperature:	22	°C
Humidity:	70	%

Approval Information

Technician: J.Kiss

Approval:

Calibration Date: 19-Mar-17

Calibration Time: 19:52

Due Date: 19-Mar-18

~ Calibration Certificate ~

Sensor Information:

Model Number	393A03
Serial Number	33821
Manufacturer	
ID Number	
Description	

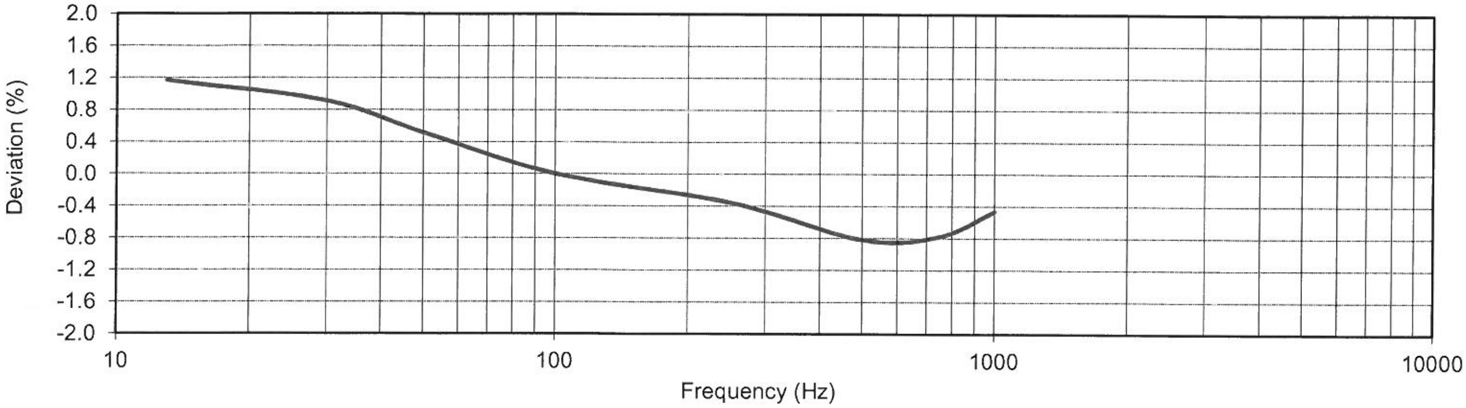
Calibration Data

Sensitivity @ 100 Hz:	1003.90	mV/g
Test Level:	1.00	g pk

Transducer Specifications

Amp. Range:	23	g
Resolution:		g
Resonant Freq:		Hz
Temp. Range:		°C
Axis:	X	

Deviation Plot



Data Table

Frequency (Hz)	Deviation (%)
13	1.2
30	0.9
50	0.5
100	0.0
250	-0.4
500	-0.8
750	-0.8
1000	-0.5

Notes

Results relate only to the items calibrated.

This certificate may not be reproduced except in full, without written permission.

Traceable to NIST (Project Number 822/271196) and PTB (Project Number 5399).

This calibration was performed with TMS Portable Vibration Calibrator: S/N: 10235, Firmware version 5.1.0.

Back-to-Back Comparison per ISO 16063-21

User Notes

Customer:

Unit Condition

As Found:

As Left:

Lab Conditions

Temperature:	22	°C
Humidity:	70	%

Approval Information

Technician: J.Kiss

Approval:

Calibration Date: 15-Mar-17

Calibration Time: 7:34

Due Date: 15-Mar-18

~ Calibration Certificate ~

Sensor Information:

Model Number	393A03
Serial Number	33822
Manufacturer	
ID Number	
Description	

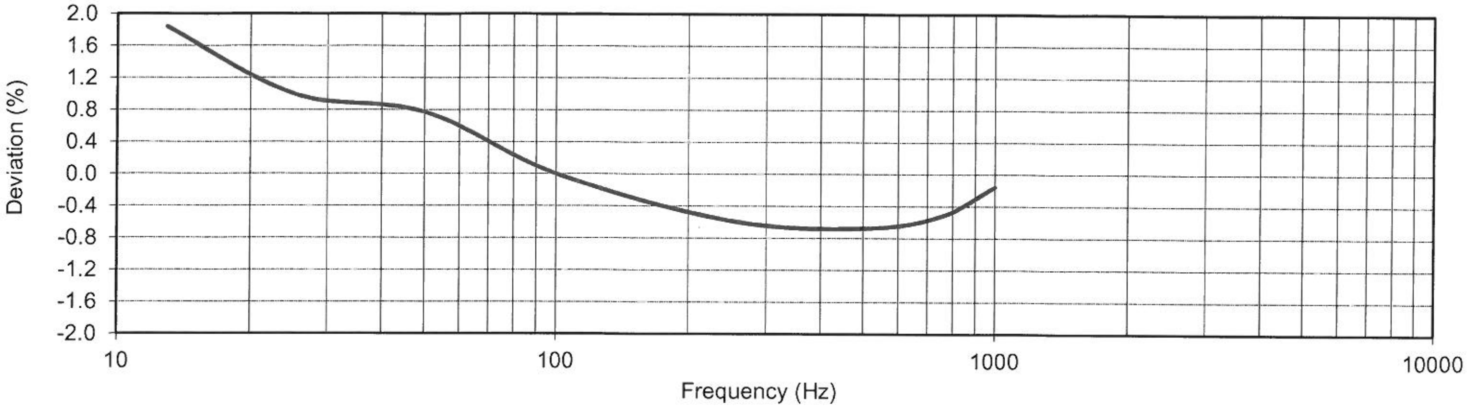
Calibration Data

Sensitivity @ 100 Hz:	997.36	mV/g
Test Level:	1.00	g pk

Transducer Specifications

Amp. Range:		g
Resolution:		g
Resonant Freq:		Hz
Temp. Range:		°C
Axis:	X	

Deviation Plot



Data Table

Frequency (Hz)	Deviation (%)
13	1.8
25	1.0
50	0.8
100	0.0
250	-0.6
500	-0.7
750	-0.5
1000	-0.2

Notes

Results relate only to the items calibrated.

This certificate may not be reproduced except in full, without written permission.

Traceable to NIST (Project Number 822/271196) and PTB (Project Number 5399).

This calibration was performed with TMS Portable Vibration Calibrator: S/N: 10235, Firmware version 5.1.0.

Back-to-Back Comparison per ISO 16063-21

User Notes

Customer:

Unit Condition

As Found:
As Left:

Lab Conditions

Temperature:	20	°C
Humidity:	70	%

Approval Information

Technician: J.Kiss
Approval:

Calibration Date: 15-Mar-17
Calibration Time: 7:40
Due Date: 15-Mar-18

~ Calibration Certificate ~

Sensor Information:

Model Number	393A03
Serial Number	33819
Manufacturer	
ID Number	
Description	

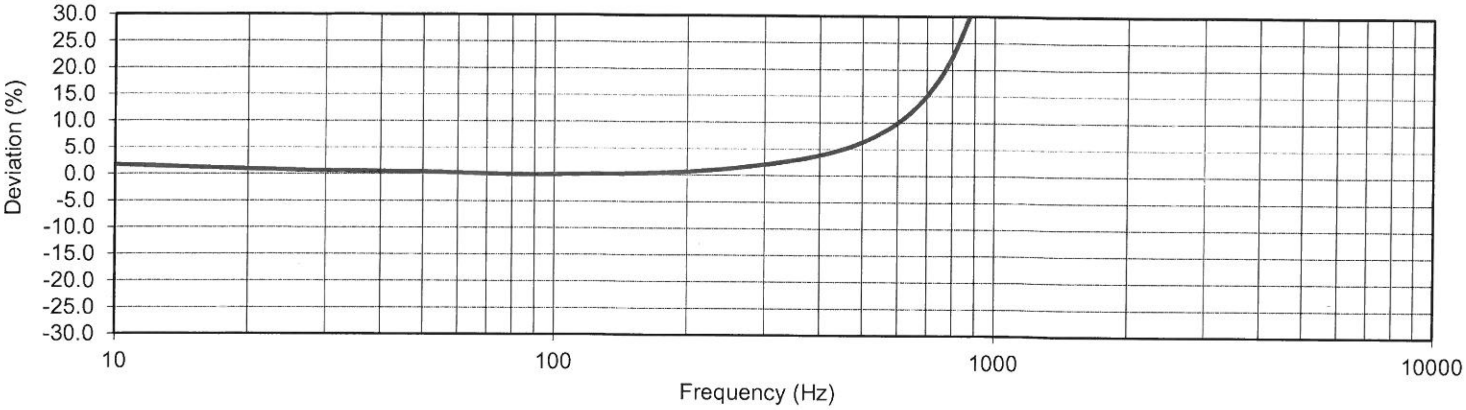
Calibration Data

Sensitivity @ 100 Hz:	992.17	mV/g
Test Level:	0.50	g pk

Transducer Specifications

Amp. Range:		g
Resolution:		g
Resonant Freq:		Hz
Temp. Range:		°C
Axis:	X	

Deviation Plot



Data Table

Frequency (Hz)	Deviation (%)
10	1.7
25	0.7
50	0.4
100	0.0
250	1.3
500	6.3
750	18.4
1000	42.4

Notes

Results relate only to the items calibrated.

This certificate may not be reproduced except in full, without written permission.

Traceable to NIST (Project Number 822/271196) and PTB (Project Number 5399).

This calibration was performed with TMS Portable Vibration Calibrator: S/N: 10235, Firmware version 5.1.0.

Back-to-Back Comparison per ISO 16063-21

User Notes

Customer:

Unit Condition

As Found:

As Left:

Lab Conditions

Temperature: 22 °C

Humidity: 70 %

Approval Information

Technician: J.Kiss

Approval:

Calibration Date: 19-Mar-17

Calibration Time: 19:47

Due Date: 17-Mar-18

MEGGITT

Calibration Data

Low Frequency Accelerometer

Model **731A**

Serial Number **10460**

Sensitivity **10.5 V/g**

Bias Voltage **9.7 Vdc**

Resonance **850 Hz**

Maximum Amplitude Range **0.5 g peak**

Frequency Response			
±1dB	**0.10 Hz**	to	**330 Hz**
±3dB	**0.05 Hz**	to	**490 Hz**

Calibrated by: **S.HONGMANIVAN** Date: **03/08/2017**

This calibration is traceable to the National Institute of Standards and Technology, Gaithersburg, MD 20899.
Frequency Response is traceable 5 Hz to 10 kHz.
Low end frequency response and amplitude range are nominal values.
Sensitivity measured at 10 Hz, 0.5g, 25°C.

Meggitt (Maryland), Inc. is an ISO 9001 Registered Company.

MEGGITT

Calibration Data

Low Frequency Accelerometer

Model **731A**

Serial Number **10461**

Sensitivity **10.4 V/g**

Bias Voltage **9.5 Vdc**

Resonance **850 Hz**

Maximum Amplitude Range **0.5 g peak**

Frequency Response			
±1dB	**0.10 Hz**	to	**330 Hz**
±3dB	**0.05 Hz**	to	**490 Hz**

Calibrated by: **S.HONGMANIVAN** Date: **03/08/2017**

This calibration is traceable to the National Institute of Standards and Technology, Gaithersburg, MD 20899.
Frequency Response is traceable 5 Hz to 10 kHz.
Low end frequency response and amplitude range are nominal values.
Sensitivity measured at 10 Hz, 0.5g, 25°C.

Meggitt (Maryland), Inc. is an ISO 9001 Registered Company.

MEGGITT

Calibration Data

Low Frequency Accelerometer

Model **731A**

Serial Number **10463**

Sensitivity **10.6 V/g**

Bias Voltage **9.3 Vdc**

Resonance **850 Hz**

Maximum Amplitude Range **0.5 g peak**

Frequency Response			
±1dB	**0.10 Hz**	to	**330 Hz**
±3dB	**0.05 Hz**	to	**500 Hz**

Calibrated by: **S.HONGMANIVAN** Date: **03/08/2017**

This calibration is traceable to the National Institute of Standards and Technology, Gaithersburg, MD 20899.
Frequency Response is traceable 5 Hz to 10 kHz.
Low end frequency response and amplitude range are nominal values.
Sensitivity measured at 10 Hz, 0.5g, 25°C.

Meggitt (Maryland), Inc. is an ISO 9001 Registered Company.

Calibration Data

Low Frequency Accelerometer

Model **731A**

Serial Number **10464**

Sensitivity **10.5 V/g**

Bias Voltage **9.4 Vdc**

Resonance **810 Hz**

Maximum Amplitude Range **0.5 g peak**

Frequency Response			
±1dB	**0.10 Hz**	to	**330 Hz**
±3dB	**0.05 Hz**	to	**490 Hz**

Calibrated by: **S.HONGMANIVAN** Date: **02/08/2017**

This calibration is traceable to the National Institute of Standards and Technology, Gaithersburg, MD 20899.
Frequency Response is traceable 5 Hz to 10 kHz.
Low end frequency response and amplitude range are nominal values.
Sensitivity measured at 10 Hz, 0.5g, 25°C.

Meggitt (Maryland), Inc. is an ISO 9001 Registered Company.

MEGGiTT

Calibration Data

Low Frequency Accelerometer

Model **731A**

Serial Number **10465**

Sensitivity **10.3 V/g**

Bias Voltage **9.6 Vdc**

Resonance **850 Hz**

Maximum Amplitude Range **0.5 g peak**

Frequency Response			
±1dB	**0.10 Hz**	to	**330 Hz**
±3dB	**0.05 Hz**	to	**490 Hz**

Calibrated by: **S.HONGMANIVAN** Date: **03/08/2017**

This calibration is traceable to the National Institute of Standards and Technology, Gaithersburg, MD 20899.
Frequency Response is traceable 5 Hz to 10 kHz.
Low end frequency response and amplitude range are nominal values.
Sensitivity measured at 10 Hz, 0.5g, 25°C.

Meggitt (Maryland), Inc. is an ISO 9001 Registered Company.

Calibration Certificate

Part Number: 714A9801
Description: LINEAR MICROPHONE 2-250HZ
Serial Number: BH9341
Calibration Date: February 22, 2017
Calibration Equipment: 714J7401

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By: ______________________
Li Pan

Instantel

Calibration Certificate

Part Number: 714A9701
Description: TRIAXIAL GEOPHONE (ISEE)
Serial Number: BG17714
Calibration Date: February 22, 2017
Calibration Equipment: 714J7401

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By: ______________________
Andrew Stockwell

Instantel

Calibration Certificate

Part Number: 716A0403
Description: MINIMATE PLUS W/EXT. GEO
Serial Number: BE18695
Calibration Date: February 22, 2017
Calibration Equipment: 718A1501

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By: ______________________
Andrew Stockwell

Instantel

Calibration Certificate

Part Number: 714A9801
Description: LINEAR MICROPHONE 2-250HZ
Serial Number: BH11358
Calibration Date: February 22, 2017
Calibration Equipment: 714J7401

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By: ______________________
Andrew Stockwell

Instantel

Calibration Certificate

Part Number: 716A0403
Description: MINIMATE PLUS W/EXT. GEO
Serial Number: BE15696
Calibration Date: February 22, 2017
Calibration Equipment: 718A1501

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By: ______________________
Li Pan

Instantel®

Calibration Certificate

Part Number: 714A9701
Description: TRIAXIAL GEOPHONE (ISEE)
Serial Number: BG9326
Calibration Date: February 22, 2017
Calibration Equipment: 714J7401

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By: ______________________
Li Pan

Instantel

Calibration Certificate

Part Number:	716A0403
Description:	MINIMATE PLUS W/EXT. GEO
Serial Number:	BE8719
Calibration Date:	March 13, 2017
Calibration Equipment:	718A1501

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By: ______________________
Tuyen Bui

Instantel

Calibration Certificate

Part Number:	714A9701
Description:	TRIAXIAL GEOPHONE (ISEE)
Serial Number:	BG16603
Calibration Date:	March 13, 2017
Calibration Equipment:	714J7401

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By:

Tuyen Bui

Instantel

Calibration Certificate

Part Number:	716A0403
Description:	MINIMATE PLUS W/EXT. GEO
Serial Number:	BE8720
Calibration Date:	March 13, 2017
Calibration Equipment:	718A1501

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By:

Tuyen Bui

Instantel

Calibration Certificate

Part Number: 714A9701
Description: TRIAXIAL GEOPHONE (ISEE)
Serial Number: BG18657
Calibration Date: March 13, 2017
Calibration Equipment: 714J7401

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By:

Tuyen Bui

~*Certificate of Calibration*~

Manufacturer: The Modal Shop
Model Number: 9100D
Serial Number: 737
Description: Portable Vibration Calibrator
Test Procedure: PRD-P278
Calibration Tech: BTH
Customer: TMS Rental

Calibration Date: 15-Nov-16
Calibration Due:
Temperature: 69.9 °F
21.1 °C
Humidity: 29.7 %

As found: In Tolerance
As left: In Tolerance

Internal Reference 10.18 **mV/g**
Sensitivity @ 100 Hz: 1.04 **mV/m/s^2**
(Measured at Monitor Reference Out BNC)

Reference Equipment:

Manufacturer	Description	Model Number	Serial Number	Due Date
PCB	Standard Sensor	353B02	126967	8/24/2017
PCB	Signal Cond.	442A102	299	8/23/2017
HP	DMM	34401A	US36061937	3/1/2017

Frequency Hz	Standard Sensor		Unit Under Test		% difference
	Measured Acceleration Level g pk	m/s^2	Displayed Acceleration Level g pk	m/s^2	Displayed / Measured
7	0.40	3.92	0.40	3.92	-0.01%
10	0.81	7.97	0.81	7.94	-0.36%
30	1.00	9.82	1.00	9.81	-0.18%
50	1.00	9.83	1.00	9.81	-0.21%
80	1.00	9.81	1.00	9.81	-0.08%
100	1.00	9.81	1.00	9.81	-0.04%
160	1.00	9.81	1.00	9.81	0.01%
300	1.00	9.78	1.00	9.81	0.23%
500	1.00	9.80	1.00	9.81	0.07%
1000	1.00	9.81	1.00	9.81	-0.05%
2000	1.00	9.80	1.00	9.81	0.11%
3000	1.00	9.82	1.00	9.81	-0.14%
4000	1.00	9.83	1.00	9.81	-0.26%
5000	1.00	9.83	1.00	9.81	-0.20%
6000	1.00	9.83	1.00	9.81	-0.26%
8000	1.00	9.79	1.00	9.81	0.19%
9000	1.01	9.86	1.00	9.81	-0.54%
10000	1.00	9.86	1.00	9.81	-0.49%

Notes:

1. This document certifies that the above meets published specifications.
2. The equipment referenced above has been calibrated using standards traceable to NIST (Project Number 822/271196) and PTB (Project Number 5399). Evidence of traceability is on file at The Modal Shop.
3. The results documented in this certificate relate only to the items tested or calibrated.
4. This certificate may not be reproduced, except in full, without the written consent of The Modal Shop, Inc.
5. Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 7<10 Hz; ±4.0%, 10<30 Hz; ± 3.0%, 30<100 Hz; ± 1.5%, 100 Hz; ± 1.5%, 100<2000 Hz; ± 1.5%, 2000-10,000 Hz; ± 4.0%.

ACCREDITED
Calibration Lab
Certificate Number 2649-01

THE MODAL SHOP INC.
A PCB GROUP CO.

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Cincinnati, Ohio 45241
+1-513-351-9919
www.modalshop.com

Calibration ID: 11/15/16 13:55

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A PCB GROUP CO.

~Calibration Certificate~

3149 East Kemper Rd.
Cincinnati, OH 45241
Ph : 513-351-9919
Fax: 513-458-2172
www.modalshop.com

Sensor Information

Model Number: 393A03
Serial Number: 45222
Manufacturer: PCB
ID Number: 57377
Description: ICP® Accelerometer

Calibration Data

Sensitivity @ 10 Hz:	1,008	mV/g
Phase @ 10 Hz:	0.03	deg.
Test Level:	1.00	g
Output Bias Level:	11.1	VDC

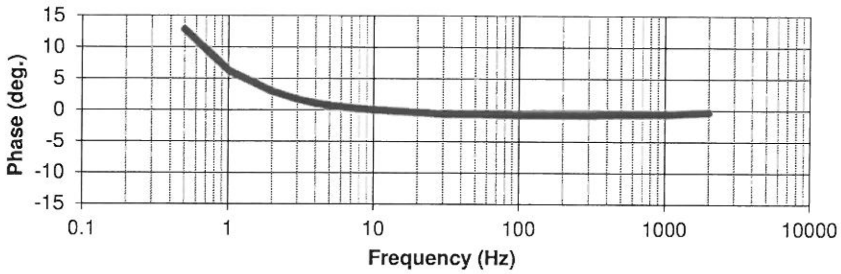
Transducer Specifications

Amp. Range:	± 5	g
Resolution:	0.00001	g
Resonant Freq:	≥ 10000	Hz
Temp. Range:	-54 to 121	℃
	-65 to 250	℉
Axis:	Uni-Axial	

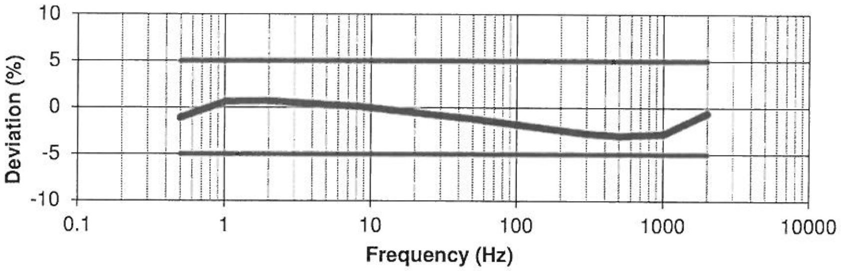
Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
0.5	-1.1135	12.8169
1	0.6316	6.2437
2	0.7043	2.9073
3	0.5200	1.6752
4	0.4246	1.0607
5	0.2988	0.7223
6.3	0.2181	0.4402
7	0.1874	0.3299
8	0.1677	0.1897
10	0.0000	0.0290
30	-0.8181	-0.6411
50	-1.2135	-0.6711
100	-1.7880	-0.7841
300	-2.7910	-0.7894
500	-3.0108	-0.6941
1000	-2.8024	-0.5980
2000	-0.5789	-0.3170

Phase Response



Amplitude Response



Notes

Results relate only to the items calibrated.
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Method: Back-to-Back Comparison Calibration per ISO 16063 Part 21
This calibration was performed with TMS 9155 Calibration Workstation 1 version 6.0.0
Calibration traceable to NIST (project number 822/271196).
Back-to-Back Comparison Calibration per ISO 16063-21
Procedures Used: PRD-P220, PRD-P214
Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 0.5-1 Hz; 1.10%; >1-10 Hz; ± 0.80%, 11-99 Hz; ±1.20%, 100 Hz; ± 0.75%, 101-920 Hz; ± 1.00%, 921-5000 Hz; ± 1.40%, 5001-10,000 Hz; ± 1.90%, 10,001-15,000 Hz; ± 2.20%, 15,001-20,000 Hz; ± 2.8%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Lab Conditions

Temperature: 74 (23) ℉ (℃)
Humidity: 44 %

Cal Date: 1-May-17
Due Date:

Approval Information

Technician: Adam Magee
Approval:

ACCREDITED
2649.01

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Equipment Used

Description	Manufacturer	Model	Serial	Due Date
Data Aquisition Card	NI	PCI-4461	19A1EE8	8/18/2017
Ref Std Conditioner	NI	PCI-6251	136F2A3	10/25/2017
Reference Std	PCB	080A200	110553	2/13/2018
Air Bearing Shaker	PCB	396C11	603	n/a
Ref Std Conditioner	PCB	442A102	305	2/13/2018
SUT Signal Conditioner	PCB	443B101	373	11/7/2017
Power Amplifier	TMS	2100E21-C	50002	n/a
Reference Std	TMS	2129E025	111	10/25/2017
Long Stroke Shaker	TMS	2129E025-779	111	n/a

Cal ID: 33051 Calibration Lab

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~Calibration Certificate~

3149 East Kemper Rd.
Cincinnati, OH 45241
Ph : 513-351-9919
Fax: 513-458-2172
www.modalshop.com

Sensor Information
Model Number: 393A03
Serial Number: 45215
Manufacturer: PCB
ID Number: 57379
Description: ICP® Accelerometer

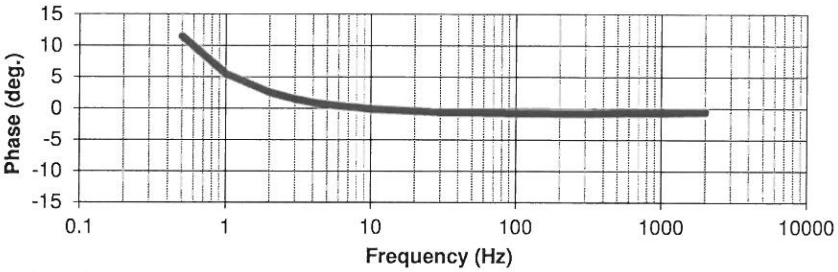
Calibration Data
Sensitivity @ 10 Hz: 998.5 mV/g
Phase @ 10 Hz: -0.09 deg.
Test Level: 1.00 g
Output Bias Level: 11.1 VDC

Transducer Specifications
Amp. Range: ± 5 g
Resolution: 0.00001 g
Resonant Freq: ≥ 10000 Hz
Temp. Range: -54 to 121 °C
-65 to 250 °F
Axis: Uni-Axial

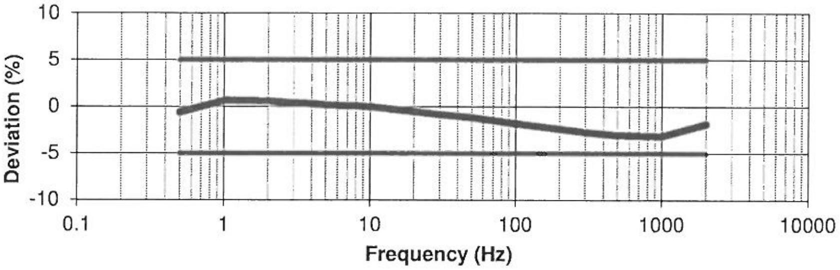
Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
0.5	-0.6098	11.4590
1	0.6453	5.4998
2	0.5800	2.5505
3	0.3932	1.4523
4	0.3126	0.9052
5	0.1979	0.5990
6.3	0.1280	0.3524
7	0.1046	0.2527
8	0.0931	0.1335
10	0.0000	-0.0883
30	-0.8297	-0.6485
50	-1.1549	-0.7093
100	-1.7910	-0.7903
300	-2.7340	-0.8262
500	-3.0301	-0.7639
1000	-3.1325	-0.7363
2000	-1.8563	-0.5469

Phase Response



Amplitude Response



Notes

Results relate only to the items calibrated.
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Method: Back-to-Back Comparison Calibration per ISO 16063 Part 21
This calibration was performed with TMS 9155 Calibration Workstation 1 version 6.0.0
Calibration traceable to NIST (project number 822/271196).
Back-to-Back Comparison Calibration per ISO 16063-21
Procedures Used: PRD-P220, PRD-P214
Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 0.5-1 Hz; 1.10%; >1-10 Hz; ± 0.80%, 11-99 Hz; ±1.20%, 100 Hz; ± 0.75%, 101-920 Hz; ± 1.00%, 921-5000 Hz; ± 1.40%, 5001-10,000 Hz; ± 1.90%, 10,001-15,000 Hz; ± 2.20%, 15,001-20,000 Hz; ± 2.8%.

Customer
TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Lab Conditions
Temperature: 73 (23) °F (°C)
Humidity: 45 %

Unit Condition
As Found: In Tolerance
As Left: In Tolerance

Equipment Used

Description	Manufacturer	Model	Serial	Due Date
Data Aquisition Card	NI	PCI-4461	19A1EE8	8/18/2017
Ref Std Conditioner	NI	PCI-6251	136F2A3	10/25/2017
Reference Std	PCB	080A200	110553	2/13/2018
Air Bearing Shaker	PCB	396C11	603	n/a
Ref Std Conditioner	PCB	442A102	305	2/13/2018
SUT Signal Conditioner	PCB	443B101	373	11/7/2017
Power Amplifier	TMS	2100E21-C	50002	n/a
Reference Std	TMS	2129E025	111	10/25/2017
Long Stroke Shaker	TMS	2129E025-779	111	n/a

Cal Date: 1-May-17
Due Date:

Approval Information
Technician: Adam Magee
Approval:

ACCREDITED
2649.01

Cal ID: 33048 Calibration Lab

THE MODAL SHOP INC.
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3149 East Kemper Rd.
Cincinnati, OH 45241
Ph : 513-351-9919
Fax: 513-458-2172
www.modalshop.com

~Calibration Certificate~

Sensor Information

Model Number: 393A03
Serial Number: 44845
Manufacturer: PCB
ID Number:
Description: ICP® Accelerometer

Calibration Data

Sensitivity @ 10 Hz:	1,020	mV/g
Phase @ 10 Hz:	0.10	deg.
Test Level:	1.00	g
Output Bias Level:	10.9	VDC

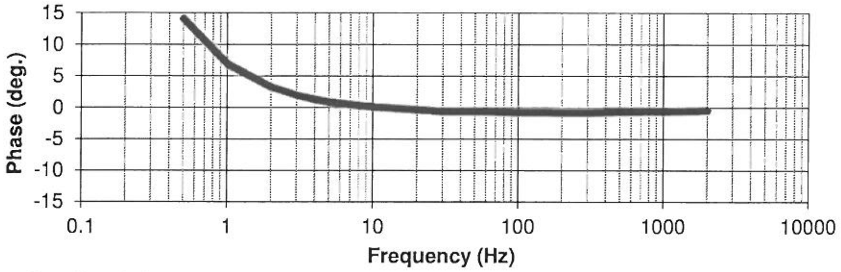
Transducer Specifications

Amp. Range:	± 5	g
Resolution:	0.00001	g
Resonant Freq:	≥ 10000	Hz
Temp. Range:	-54 to 121	°C
	-65 to 250	°F
Axis:	Uni-Axial	

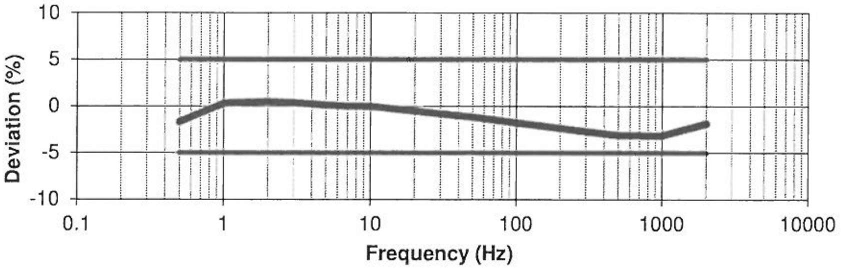
Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
0.5	-1.6633	14.0828
1	0.3320	6.9124
2	0.5019	3.2741
3	0.3457	1.9269
4	0.2598	1.2567
5	0.1370	0.8809
6.3	0.0631	0.5768
7	0.0373	0.4531
8	0.0206	0.2999
10	0.0000	0.0988
30	-0.8043	-0.5776
50	-1.1777	-0.6396
100	-1.7727	-0.7828
300	-2.7257	-0.8487
500	-3.1080	-0.7200
1000	-3.1394	-0.6401
2000	-1.8636	-0.4417

Phase Response



Amplitude Response



Notes

Results relate only to the items calibrated.
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Method: Back-to-Back Comparison Calibration per ISO 16063 Part 21
This calibration was performed with TMS 9155 Calibration Workstation 1 version 6.0.0
Calibration traceable to NIST (project number 822/271196).
Back-to-Back Comparison Calibration per ISO 16063-21
Procedures Used: PRD-P220, PRD-P214
Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 0.5-1 Hz; 1.10%; >1-10 Hz; ± 0.80%, 11-99 Hz; ±1.20%, 100 Hz; ± 0.75%, 101-920 Hz; ± 1.00%, 921-5000 Hz; ± 1.40%, 5001-10,000 Hz; ± 1.90%, 10,001-15,000 Hz; ± 2.20%, 15,001-20,000 Hz; ± 2.8%.

Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Lab Conditions

Temperature: 73 (23) °F (°C)
Humidity: 45 %

Cal Date: 1-May-17
Due Date:

Approval Information

Technician: Adam Magee
Approval:

ACCREDITED
2649.01

Cal ID: 33049 Calibration Lab

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Equipment Used

Description	Manufacturer	Model	Serial	Due Date
Data Aquisition Card	NI	PCI-4461	19A1EE8	8/18/2017
Ref Std Conditioner	NI	PCI-6251	136F2A3	10/25/2017
Reference Std	PCB	080A200	110553	2/13/2018
Air Bearing Shaker	PCB	396C11	603	n/a
Ref Std Conditioner	PCB	442A102	305	2/13/2018
SUT Signal Conditioner	PCB	443B101	373	11/7/2017
Power Amplifier	TMS	2100E21-C	50002	n/a
Reference Std	TMS	2129E025	111	10/25/2017
Long Stroke Shaker	TMS	2129E025-779	111	n/a

THE MODAL SHOP INC.
A PCB GROUP CO.

~Calibration Certificate~

3149 East Kemper Rd.
Cincinnati, OH 45241
Ph : 513-351-9919
Fax: 513-458-2172
www.modalshop.com

Sensor Information

Model Number:	393A03
Serial Number:	44846
Manufacturer:	PCB
ID Number:	
Description:	ICP® Accelerometer

Calibration Data

Sensitivity @ 10 Hz:	1,017	mV/g
Phase @ 10 Hz:	-0.10	deg.
Test Level:	1.00	g

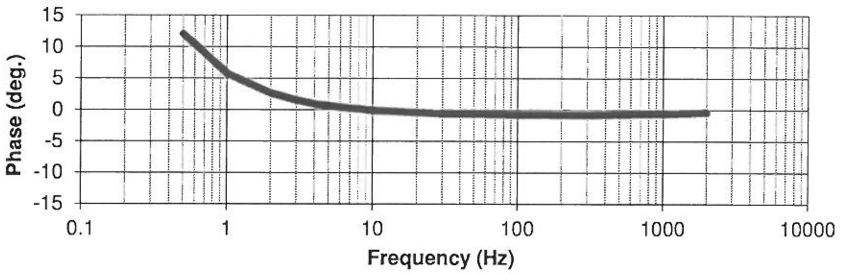
Transducer Specifications

Amp. Range:	± 5	g
Resolution:	0.00001	g
Resonant Freq:	≥ 10000	Hz
Temp. Range:	-54 to 121	℃
	-65 to 250	℉
Axis:	Uni-Axial	

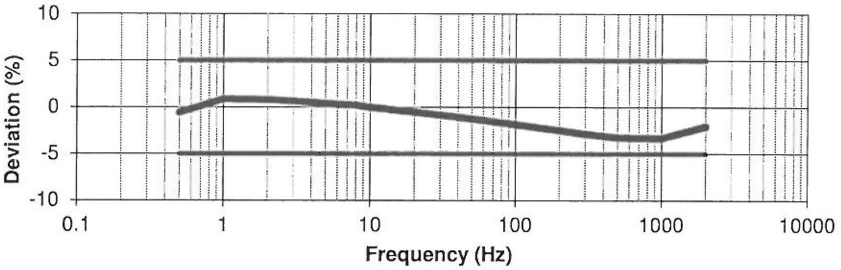
Data Table

Freq. (Hz)	Deviation (%)	Phase (deg)
0.5	-0.5587	12.0484
1	0.8912	5.7700
2	0.8196	2.6535
3	0.6069	1.4987
4	0.5040	0.9244
5	0.3717	0.6057
6.3	0.2843	0.3512
7	0.2564	0.2460
8	0.2369	0.1216
10	0.0000	-0.1049
30	-0.8271	-0.6569
50	-1.2656	-0.6832
100	-1.8599	-0.8089
300	-2.8676	-0.8467
500	-3.2330	-0.7538
1000	-3.2950	-0.6500
2000	-2.0466	-0.3827

Phase Response



Amplitude Response



Customer

TMS Rental
3149 E. Kemper Rd
Cincinnati, OH 45241

User Notes

Notes

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Method: Back-to-Back Comparison Calibration per ISO 16063 Part 21

This calibration was performed with TMS 9155 Calibration Workstation 1 version 6.0.0

Calibration traceable to NIST (project number 822/271196).

Back-to-Back Comparison Calibration per ISO 16063-21

Procedures Used: PRD-P220, PRD-P214

Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 0.5-1 Hz; 1.10%; >1-10 Hz; ± 0.80%, 11-99 Hz; ±1.20%, 100 Hz; ± 0.75%, 101-920 Hz; ± 1.00%, 921-5000 Hz; ± 1.40%, 5001-10,000 Hz; ± 1.90%, 10,001-15,000 Hz; ± 2.20%, 15,001-20,000 Hz; ± 2.8%.

Lab Conditions

Temperature:	74 (23)	℉ (℃)
Humidity:	23	%

Unit Condition

As Found: In Tolerance
As Left: In Tolerance

Equipment Used

Description	Manufacturer	Model	Serial	Due Date
Data Aquisition Card	NI	PCI-4461	19A1EE8	8/18/2017
Ref Std Conditioner	NI	PCI-6251	136F2A3	10/25/2017
Reference Std	PCB	080A200	110553	2/13/2018
Air Bearing Shaker	PCB	396C11	603	n/a
Ref Std Conditioner	PCB	442A102	305	2/13/2018
SUT Signal Conditioner	PCB	443B101	373	11/7/2017
Power Amplifier	TMS	2100E21-C	50002	n/a
Reference Std	TMS	2129E025	111	10/25/2017
Long Stroke Shaker	TMS	2129E025-779	111	n/a

Cal Date: 1-May-17
Due Date:

Approval Information

Technician: Adam Magee
Approval:

ACCREDITED
2649.01

Cal ID: 33050 Calibration Lab

The Modal Shop, Inc.
(513) 351-9919

Manufacturer: PCB
Model: 393A03
Serial: 44846
ID:

Sens: 1016.9601 mV/g @ 10Hz
Cal Date: 5/1/2017
Due Date:

The Modal Shop, Inc.
(513) 351-9919

Manufacturer: PCB
Model: 393A03
Serial: 45222
ID: 57377

Sens: 1008.3763 mV/g @ 10Hz
Cal Date: 5/1/2017
Due Date:

The Modal Shop, Inc.
(513) 351-9919

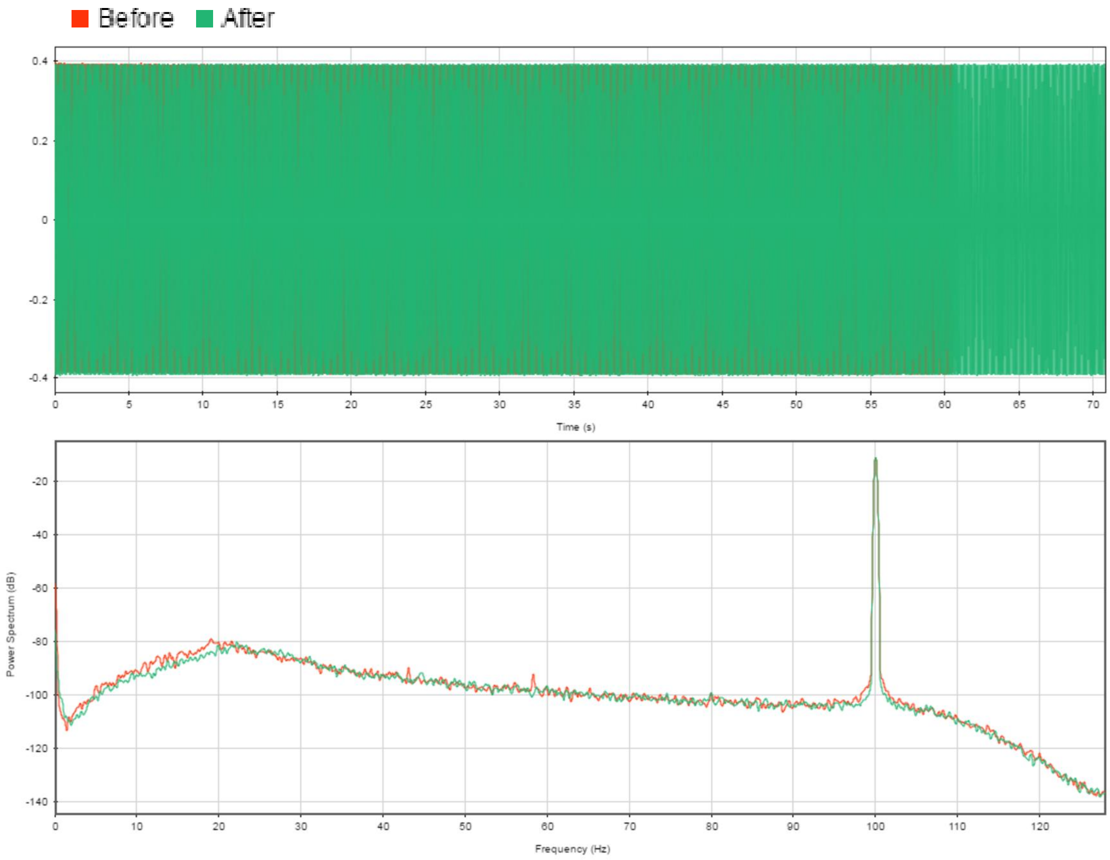
Manufacturer: PCB
Model: 393A03
Serial: 44845
ID:

Sens: 1020.3987 mV/g @ 10Hz
Cal Date: 5/1/2017
Due Date:

The Modal Shop, Inc.
(513) 351-9919

Manufacturer: PCB
Model: 393A03
Serial: 45215
ID: 57379

Sens: 998.4807 mV/g @ 10Hz
Cal Date: 5/1/2017
Due Date:



LEGEND

RED - BEFORE MONITORING

GREEN - AFTER MONITORING

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

PROJECT

VIBRATION MONITORING PROGRAM
NORTH KENT WIND FARM
CHATHAM-KENT, ONTARIO

TITLE

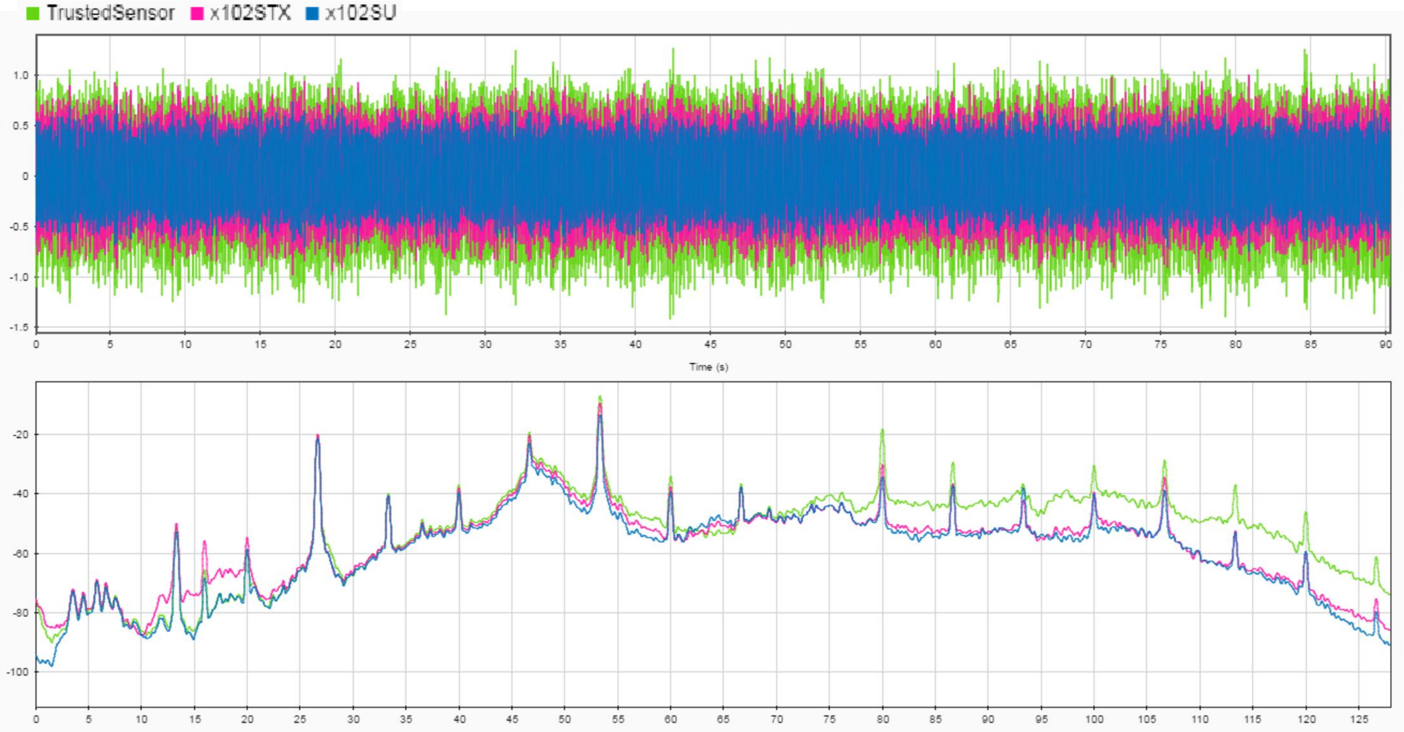
EXAMPLE OF
FIELD SURFACE/TEMPORARY ACCELEROMETER CHECKS

Golder Associates

PROJECT No. 1668031
FILE No. 1668031–2000–R010F1
SCALE AS SHOWN
REV.
CADD DCH Apr 24/17
CHECK SSJS

FIGURE F-1

Drawing file: 1668031–2000–R010F1.dwg Apr 24, 2017 – 4:32pm



NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

PROJECT

VIBRATION MONITORING PROGRAM
NORTH KENT WIND FARM
CHATHAM-KENT, ONTARIO

TITLE

**EXAMPLE OF
FIELD CHECKS FOR
PERMANENT SENSORS**

Golder Associates

PROJECT No.		1668031
CADD	DCH	Apr 24/17
CHECK	SSB	

FILE No.1668031–2000–R010F2

SCALE AS SHOWN REV.

FIGURE F-2

Drawing file: 1668031–2000–R010F2.dwg Apr 24, 2017 – 4:36pm

APPENDIX G

Temporary Well Monitoring System Evaluation

TEMPORARY MOUNTING OF ACCELEROMETERS

Typically, the type of accelerometers used for this project are mounted to fixed structures or machinery using one of three general methods:

1) Threaded Stud: Usually, for monitoring structures with a flat, smooth surface within which a threaded hole can be made, mounting accelerometers using a threaded stud provides the most secure sensor coupling. For this project, a flat and smooth surface was not available for the domestic well casings, other than the lid, and drilling and tapping a threaded hole in the casing was not acceptable since this would permanently damage the well casing. The accelerometers were not mounted to the lids since the well lid to well casing connection character was not known. Mounting stud orientation would require the accelerometers in this case to be oriented horizontally unless a right-angle bracket was utilized with a secondary mounting stud and two studs were used to secure the bracket to the well casing.

2) Adhesive: When drilling and tapping a threaded hole in the structure is not possible, yet a flat, clean and smooth surface is available, accelerometers can be mounted with the application of a thin layer of hot glue or wax for temporary mounting or epoxy can be used for permanent monitoring. A flat, clean and smooth surface was not available for the domestic well casings and the casings had been exposed to weathering that could readily influence the bonding of such adhesives. Further, adhering the sensor directly to the casing would have required mating the flat bottom of the accelerometer to the rounded side of the casing, positioning the accelerometer in the horizontal direction, or use of a right-angle bracket and additional mounting hardware (with a stud on the bracket for the accelerometer base). Accelerometers mounted with adhesives are known to suffer some reduction in high-frequency response. Use of hot glue to adhere the accelerometer to the aluminum well cover was not selected because the details regarding tightness of fit between the cover and steel were not known at the time and introduced another uncertainty. Wax was not considered suitable because of the temperature and weather conditions at the time.

3) Magnetic Mounting: Rare earth or ceramic magnets that are flat or dual rail magnets can sometimes be used to couple accelerometers to ferric structures or machinery. When magnetic mounts are used, the surfaces to which the magnets will contact often have to be cleaned and properly prepared since poor installations can result in a significant drop in accelerometer sensitivity at high frequencies. Dual rail magnet mounts also must be selected so that the rail sizes are compatible with the radius of curvature of any curved mounting surfaces. Prefabricated magnets, and particularly dual rail magnets, are most commonly manufactured to orient the accelerometer perpendicular to the plane of the surface to which the magnet will be attached. Thus, in this case, a secondary angle bracket or mount would have been required to achieve vertical accelerometer orientation. Magnetic mounting is also known to have the potential to generate very high acceleration levels (shock) during mounting and special precautions or shock-protected accelerometers can be required. Magnetic mounting was used for the horizontal accelerometers during well monitoring for the T5 test pile site (Wells #3 and #4). A concern with vertical mounting of accelerometers on a magnetic mount with an additional bracket or block mount was the potential for amplifying or damping vertical vibrations through the accelerometer inertia and horizontal moment arm generated by the magnet and mounting bracket dimensions.

Given the conditions and mounting concerns identified above, for field deployment the accelerometers were securely coupled to the domestic well casings using steel hose clamps. The steel hose clamps permitted control of the accelerometer orientation and coupling to a vertical cylindrical well casing(s) of various diameters that could be field-fit. During field monitoring of one well, the thin synthetic cover was left on the accelerometer for Wells #1 and #2 to both protect it from the hose clamp and, when subject to the high compressive stresses induced by the hose clamp, provide additional frictional resistance to any differential movement.

To address possible concerns about the potential for this coupling mechanism to adversely affect data, the hose-clamp coupling and field deployment of the sensors was mimicked on a controlled vibration induction system. This system included:

- APS 400 ELECTRO-SEIS® Long Stroke Shaker with Linear Ball Bearings, manufactured by APS Dynamics, Inc. is a subsidiary of SPEKTRA GmbH Dresden, Germany (see specification sheet, this Appendix);
- APS 0412 Reaction Mass Assembly (see specification sheet, this Appendix); and
- a piece of steel pipe, similar in diameter and wall thickness to the well casings;

The steel pipe section was fixed to the moving arm of the APS400 shaker unit with an angle bracket and bolt interior to the pipe, steel hose clamps and, for added security to avoid any tilting as compared to the arm, large plastic zip ties were used. Accelerometers (PCB393A03) were attached to the system, all with a vertical orientation, as follows:

1) accelerometer with synthetic cover attached to pipe with hose clamp;

2) accelerometer without synthetic cover attached to pipe with hose clamp;

3) accelerometer without synthetic cover attached to pipe with two ceramic magnets and angle bracket;

4) accelerometer attached to moving arm of the ASP400 shaker unit with mounting stud.

Photos of the laboratory configuration are provided below. Data from the accelerometers was gathered using the Rion DA21 unit.

During testing, the pipe and accelerometer assembly were subjected to controlled vibrations for a duration of 1 to 2 minutes and repeated several times. Shaker unit settings for frequency and force are in the table below. We note that at an acceleration value of about 0.5 g, the magnetic mounting system was shaken off the casing.

Table 1: Summary of Shaker Unit Vibration Settings

Frequency (Hz)	g[1] (approximate)	PPV (mm)/s
0.3	0.0047	24.5
1	0.4400	687.0
3	0.0300	15.6
10	0.0300	4.7
30	0.0300	1.6

Output from this experiment is illustrated by Figure G-1. The output illustrates that at an induced vibration frequency of 10 Hz, as controlled from the shaker unit, the output from the group of accelerometers mounted to the prototype well casing piece begins to depart from the output from the accelerometer mounted directly on the shaker unit arm in the frequency range above approximately 12 Hz. Similar departure of the results is illustrated at the induced vibration frequency of 30 Hz. However, in both these instances, all the accelerometers mounted on the prototype casing using different methods respond in a virtually identical manner (difference of less than about 10 per cent). Based on these results, Golder concluded that the differences in accelerometer mounting methods were not a source of output inconsistencies. Rather, it is clear that the group of accelerometers were measuring vibration response characteristics associated with the mounting of the prototype well casing to the shaker unit. The controlled-vibration system demonstrated that the hose clamp mounting system was suitable and reliable for the range of vibration magnitudes and frequencies of concern. This mounting system was also reviewed with the accelerometer supplier who expressed no concern with the field system for the range of frequencies and magnitude of vibrations expected and measured for this project (see attached correspondence).

---

[1] The approximate value for gravitational acceleration shown in the table above is based on the voltage-controlled settings on the shaker unit and measurements made during the experiment with the fixed accelerometer based on voltage output readings.

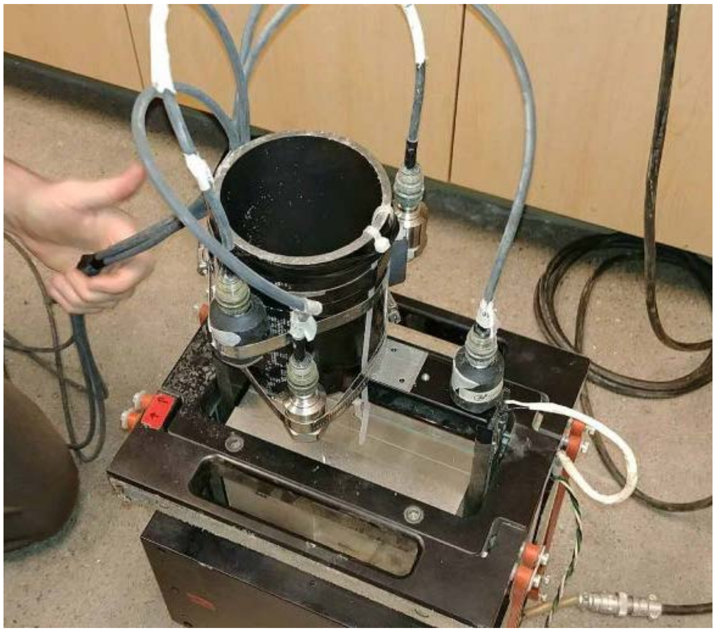


Figure G-1: Physical arrangement of shaker unit, pipe and four accelerometers prior to exposure to controlled vibrations.

n:\active\2016\3 proj\1668031 pattern_north kent vib monit_chatham-kent\ph 2000-vib monit field work\2-correspondence\5-rpts\5-revised final\appendix g\appendix g text.docx

APS 400 ELECTRO-SEIS®

Long Stroke Shaker with Linear Ball Bearings

The **APS 400 ELECTRO-SEIS®** shaker is a longstroke, electrodynamic force generator specifically designed to be used alone or in arrays for studying dynamic response characteristics of various structures. It finds use in modal excitation of complex structures, particularly when low frequencies are required. Furthermore it can be used for low frequency vibration testing of components and assemblies.

Applications

- Determination of natural mode frequencies, shapes, damping ratios, and stress distributions
- Excitation of manufactured equipment in the factory or installed in the field to demonstrate compliance with seismic specification criteria
- Seismic simulation for components
- Test and calibration for seismic instruments
- Geological Services, Science, Physics and Seismic

Features

- Can be used to generate sine wave, swept sine wave, random or impulse force waveforms, fully adjustable at source
- Test set-up flexibility - operates fixed body, free body, free armature
- Optimized to deliver power to resonant load with minimum shaker weight and drive power
- Adjustable armature re-centering for horizontal and vertical operation or other external pre-loads
- Two-Man Portability - 73 kg (160 lb) total weight

Description and Characteristics

The APS 400 ELECTRO-SEIS® shaker has been optimized for driving structures at their natural resonance frequencies. It is an electrodynamic force generator, the output of which is directly proportional to the instantaneous value of the current applied to it, independent of frequency and load response. It can deliver random or transient as well as sinusoidal waveforms of force to the load. The armature has been designed for minimum mass loading of the drive point. The ample armature stroke allows driving antinodes of large structures at low frequencies and permits rated force at low frequencies when operating in a free body mode.


APS 400 with APS 0412
Reaction Mass Assembly

The unit employs permanent magnets and is configured such that the armature coil remains in a uniform magnetic field over the entire stroke range - assuring force linearity. The enclosed, self-cooled construction provides safety and minimum maintenance. Attachment of the armature to the drive point is accomplished by a simple thrust rod like the APS 8610 - Modal Stinger.

An amplifier, such as the APS 145 **-** Power Amplifier, is required to provide armature drive power.

Modes of Operation

Free Armature Mode

In this mode, the armature provides the reaction mass for force delivered to the test structure via the shaker body. Auxiliary reaction mass may be added to the armature to decrease the low frequency limit for rated force operation.

The APS 400 shaker and APS 0412 - Reaction Mass may be used in a vertical or horizontal free armature mode with rated force down to less than 3 Hz. Feet and carrying handles are provided for ease in placement of the shaker on horizontal test surfaces.


APS 420 with APS 4222 - Trunnion
and APS 8610 Modal Stinger

Fixed Body Mode

By providing a rigid attachment between the body and ground, the full relative velocity and stroke capability is available for load motion. Maximum rated force can be delivered down to 0.01 Hz and 70 % maximum to 0 Hz.

Free Body Mode

In this mode, the body provides the reaction mass. Load and body motion are accommodated within the total relative velocity and stroke. Because of the high cross-axis stiffness provided by the armature linear guidance system, the shaker may be supported above ground level by means of suspension lines (APS 8612 - Steel Cable Kit) attached to the body. This provides a convenient mounting for introducing force parallel to a horizontal mounting surface. Examples of such surfaces include floors, roofs, platforms, cabinets, bridges and tanks.

APS 400 with APS 0452 - Auxiliary Table Kit – Horizontal

APS 420 with APS 8610 - Modal Stinger and
APS 8612 - Steel Cable Kit prepared for
Free Body Mode operation

Shaker Table Mode

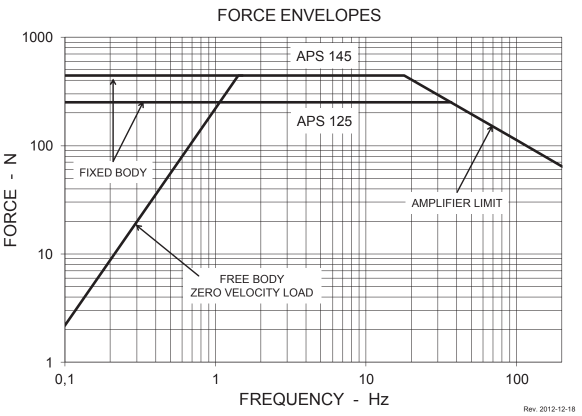
Auxiliary Table Kits are available which, when installed on the basic shaker, enable the shaker to provide long stroke excitation to components or model structures mounted on the table.

The APS 0452 Auxiliary Table Kit provides horizontal motion, the APS 0477 Auxiliary Table Kit provides vertical motion and the APS 0478 Auxiliary Table Kit provides either the vertical or horizontal motion configuration.

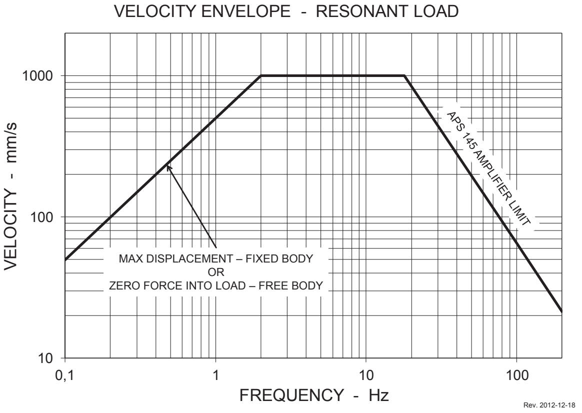
APS 400 with APS 0477 - Auxiliary Table Kit – Vertical

Performance

The primary purpose of the APS 400 ELECTRO-SEIS® shaker is to determine the dynamic characteristics of mechanical structures. At resonance, a large amount of energy is contained in the structure, and the shaker must accommodate the resulting motion. However, it need only supply the real mechanical power dissipated by damping mechanisms within the structure.

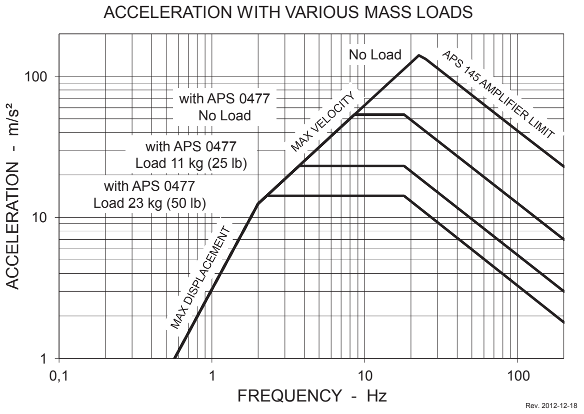


If a drive point on a structure in resonance is vibrating with a velocity of 1,000 mm/s (39 in/s) peak and a force of 445 N (100 lbf) peak is required to sustain the vibration level, then the shaker will be delivering approximately 220 W RMS to the structure. Such a load on the shaker is termed a matched resonant load, and it is purely resistive since the force is in a phase with the velocity.



If the resonant load input is other than 445 N x 1,000 mm/s, the full 220 watts of mechanical power cannot be delivered to the structure, the system being either force or velocity limited. If the resulting maximum response level is not great enough, the user may have the option of moving the shaker to a drive point having an impedance closer to the matched value, or adding more shakers to the array driving the structure.

Within the limitations of maximum force and velocity, the actual power delivered to a structure is a function of the input mechanical impedance at the drive point. In typical modal testing, this input impedance varies widely in magnitude and phase angle. At different frequencies, the input impedance of the drive point may appear predominately spring-like, mass-like, or resistive. Since the object of the tests is to establish resonant modes, at which the input mechanical impedance of all drive points are resistive, the shaker's maximum performance capability is most meaningful stated in terms of the force and velocity that can be obtained when driving a matched resistive load.



Therefore, performance is given in the form of graphs which present the envelopes of maximum force and velocity delivered to a resonant structure as functions of the resonance frequency of the structure.

Another application is the excitation for sensor calibration. Acceleration envelopes of the APS 400 ELECTRO-SEIS® shaker with various mass loads is shown in the lower graph for the 445 N rating.

Specifications

Shaker	**APS 400**
Force (Sine Peak)	445 N (100 lbf)
Velocity (Sine Peak)	1,000 mm/s (39 inch/s)
Stroke (Peak - Peak)	158 mm (6.25 inch)
Frequency Range	DC … 200 Hz
Operation	horizontal or vertical
Armature Weight	2.8 kg (6.2 lb)
Max. Overhung Load at Armature Attachment Point	9.0 kg (20 lb)
DC Coil Resistance	1.6 Ω
Total Shaker Weight	73.0 kg (161 lb)
Shipping Weight	86.0 kg (190 lb)
Overall Dimension L x W x H	526 x 314 x 178 mm (20.7 x 12.4 x 7.0 inch)
Operating Temperature	5 ... 40 degrees C
Storage Temperature	-25 ... 55 degrees C

Accessories (optional)

Shaker	**APS 400**
Power Amplifier	APS 145
System Cable for Connecting Shaker to Amplifier	APS 0082-6E
Zero Position Controller for Vibration Exciters	APS 0109
Reaction Mass Assembly	APS 0412
Lifting Handles (Set of 4)	APS 0414
Carrying Handles and Tie-down Bars	APS 0421
Auxiliary Table Kit − Horizontal	APS 0452
Auxiliary Table Kit − Vertical	APS 0477
Auxiliary Table Kit − Horizontal and Vertical	APS 0478
Horizontal Reaction Mass System	APS 4001
Overtravel Switch	APS 8543
Modal Stinger Kit	APS 8610
Steel Cable Kit	APS 8612

Additional accessories available

March 2014

Boone, Storer

From: Paul Gonsalves <pgonsalves@dalimar.ca>
Sent: Tuesday, May 02, 2017 9:48 AM
To: Boone, Storer
Cc: Kiss, Jordan
Subject: Mounting system opinion for Golder

Hi Storer,

You had asked for my opinion on a field method used to mount an accelerometer to a well casing for the purpose of monitoring ground vibrations.

The field mounting system in question consisted of:

- A steel hose clamp tightened to force the accelerometer into intimate contact with the steel well casing
- Leaving the thin black nylon protective cover on the accelerometer.

Background:
I understand that in this case that:

- It is not permissible to alter the steel well casing (e.g., drilling, tapping and treading a metal stud) or its aluminum lid
- Weather is cold, windy with occasional heavy rain, which rules out using wax or temporary glue to mount the accelerometer as they might fail
- Details of the well cover to well casing connection are unknown (e.g., looseness of fit, thread gauge, etc.)
- The range of frequencies of concern is 5 to 70 Hz and small fractions of gravitational acceleration (e.g., < 0.05 g) as might be associated with distant (e.g., >500 m) driving of foundation piles.

Conclusion:
While the hose-clamp mounting method is different than more typical approaches, I recognize that our instruments are adapted to address many challenging field conditions that require other mounting approaches.

If the range of frequency and amplitude concern were significantly greater than as noted above, I might have concern, but as it stands I'm comfortable with the set up proposed. The thin nylon cover is not readily compressible and, if it were to have any effect, might affect measurements at high frequencies (much greater than 100 Hz) and greater amplitudes.

As installed, I have no concern about the accelerometer readings being adversely affected by the mounting system and would fully expect the accelerometer movements to match the casing movements.

Best regards,

Paul Gonsalves
Industrial Technical Sales
C :647.226.3330

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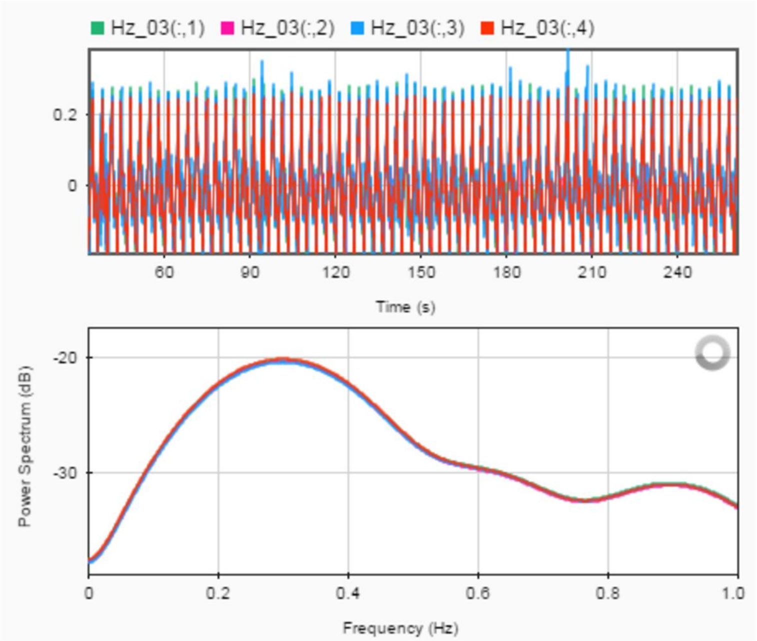
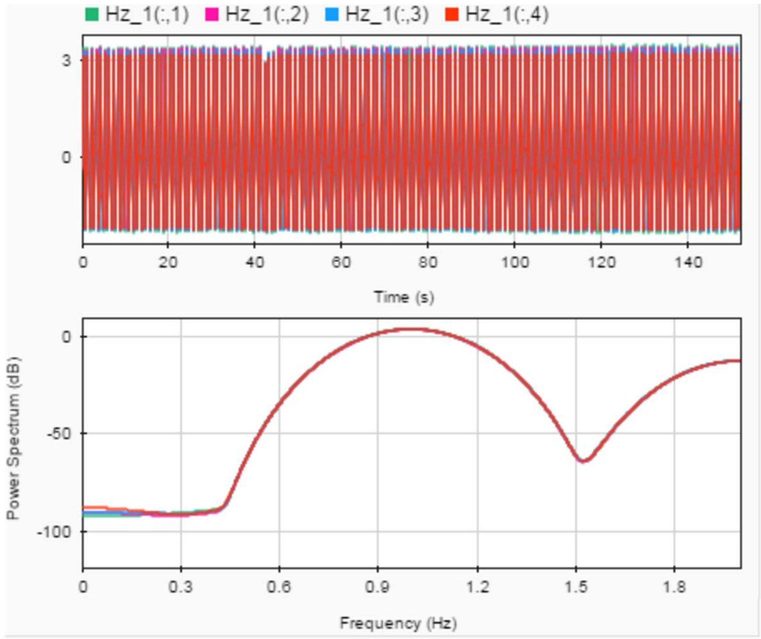
Best regards,

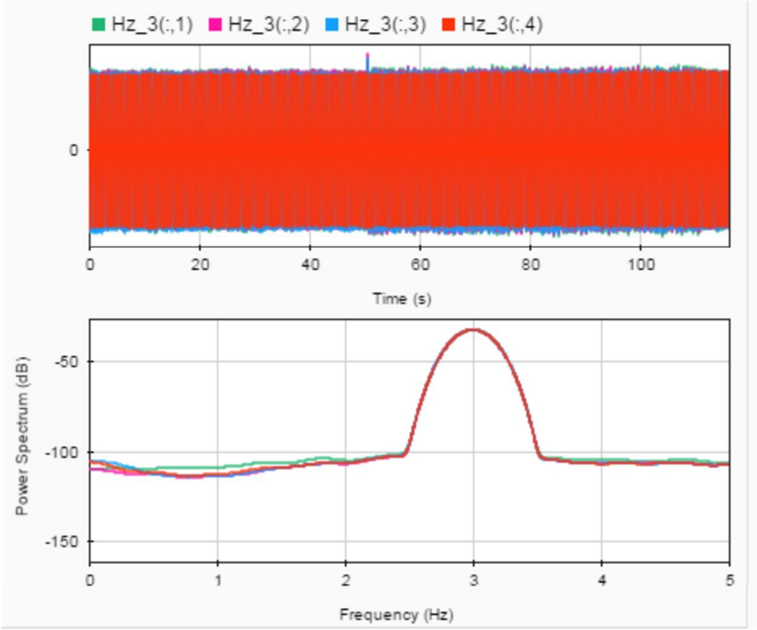
Paul Gonsalves



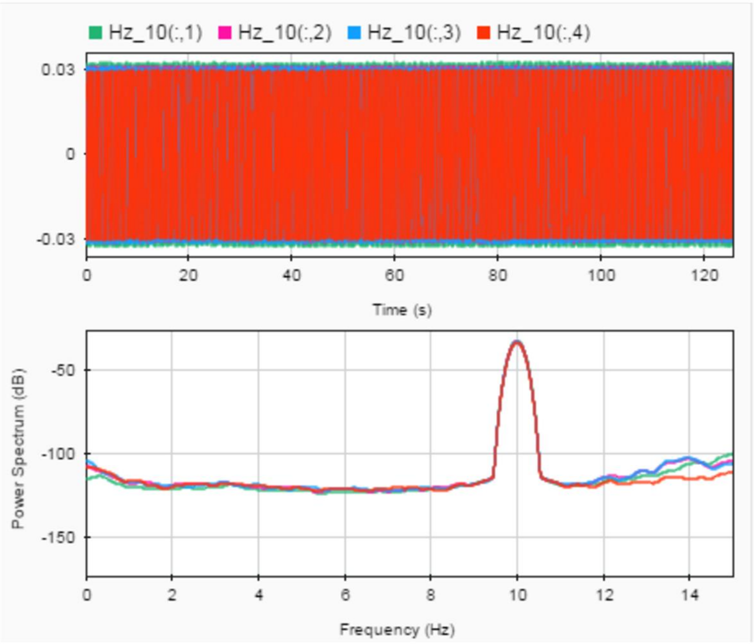
1 Hz



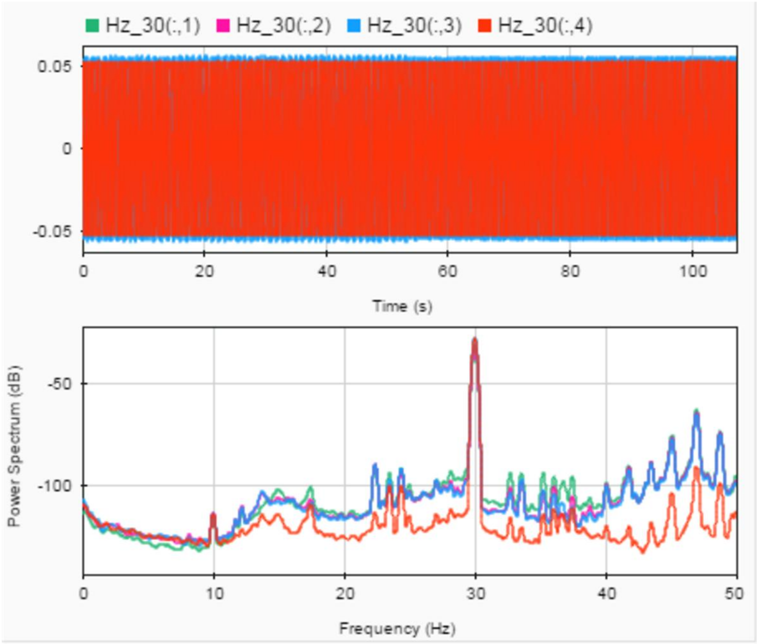
0.3 Hz



3 Hz



10 Hz



30 Hz

LEGEND

GREEN - AS MOUNTED TO WELL IN FIELD
PINK - AS MOUNTED WITHOUT RUBBER COVERING
BLUE - MAGNETIC COUPLING
RED - SENSOR FIXED TO SHAKER ARM

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

PROJECT
VIBRATION MONITORING PROGRAM
NORTH KENT WIND FARM
CHATHAM-KENT, ONTARIO

TITLE
TEMPORARY MOUNTING OF ACCELEROMETER EQUIPMENT RESULTS

Golder Associates

PROJECT No.	1668031	FILE No. 1668031-2000-R010G1	
		SCALE AS SHOWN	REV.
CADD	DCH	Apr 28/17	
CHECK	SSB		

FIGURE G-1

Drawing file: 1668031-2000-R010G1.dwg Apr 28, 2017 - 3:28pm

APPENDIX H

Instantel Minimate Data Reports

Event Report

Histogram Start Time	11:11:26 March 29, 2017
Histogram Finish Time	12:37:21 March 29, 2017
Number of Intervals	2577.00 at 2 seconds
Range	Geo:254 mm/s
Sample Rate	1024sps

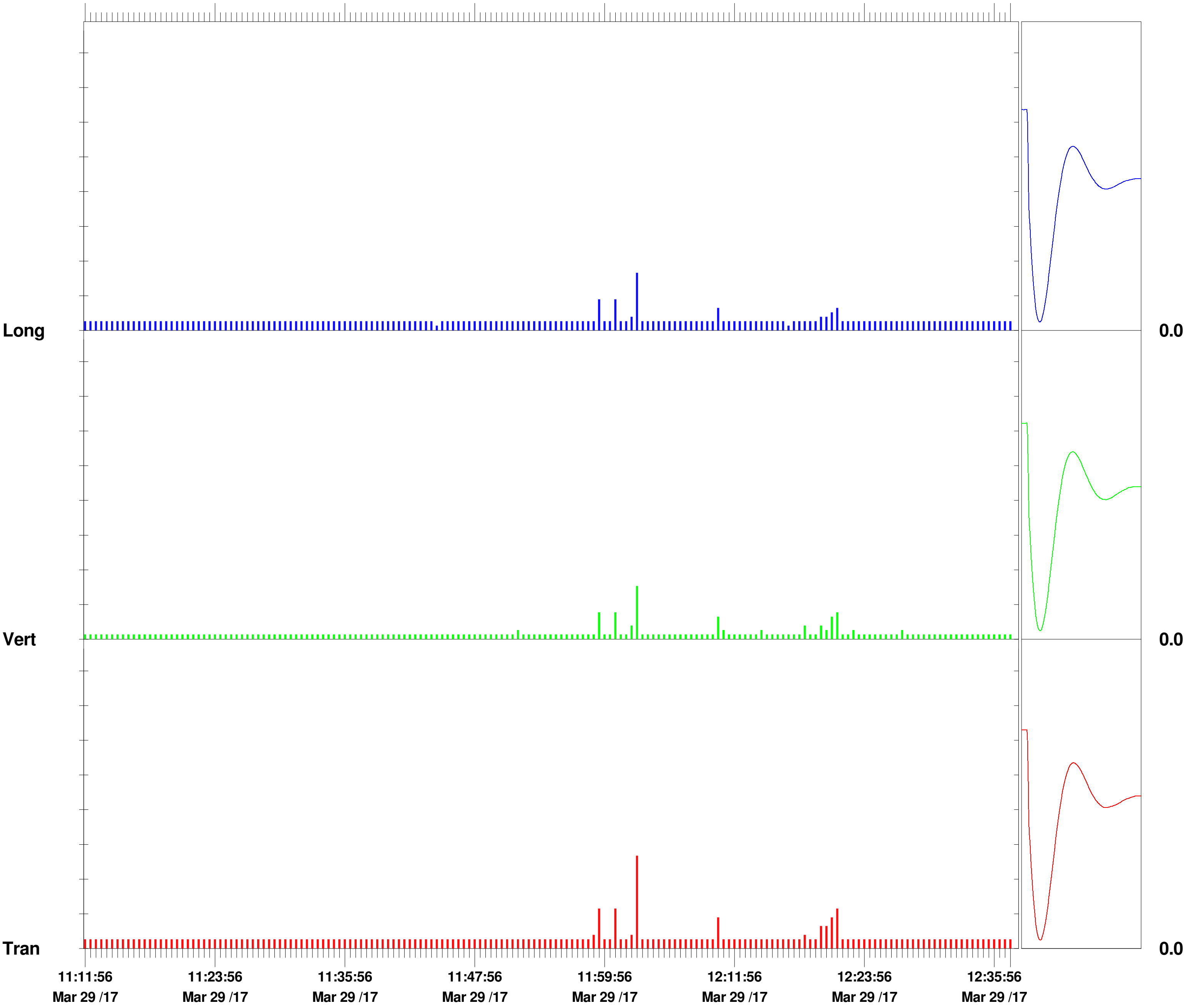
Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQF.320

Notes

Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

	Tran	Vert	Long	
PPV	2.67	1.52	1.65	mm/s
ZC Freq	39	47	47	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	12:02:54	12:02:46	12:02:54	
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 3.16 mm/s on March 29, 2017 at 12:02:54



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Event Report

Histogram Start Time	12:37:55 March 29, 2017
Histogram Finish Time	13:09:28 March 29, 2017
Number of Intervals	946.00 at 2 seconds
Range	Geo:254 mm/s
Sample Rate	1024sps

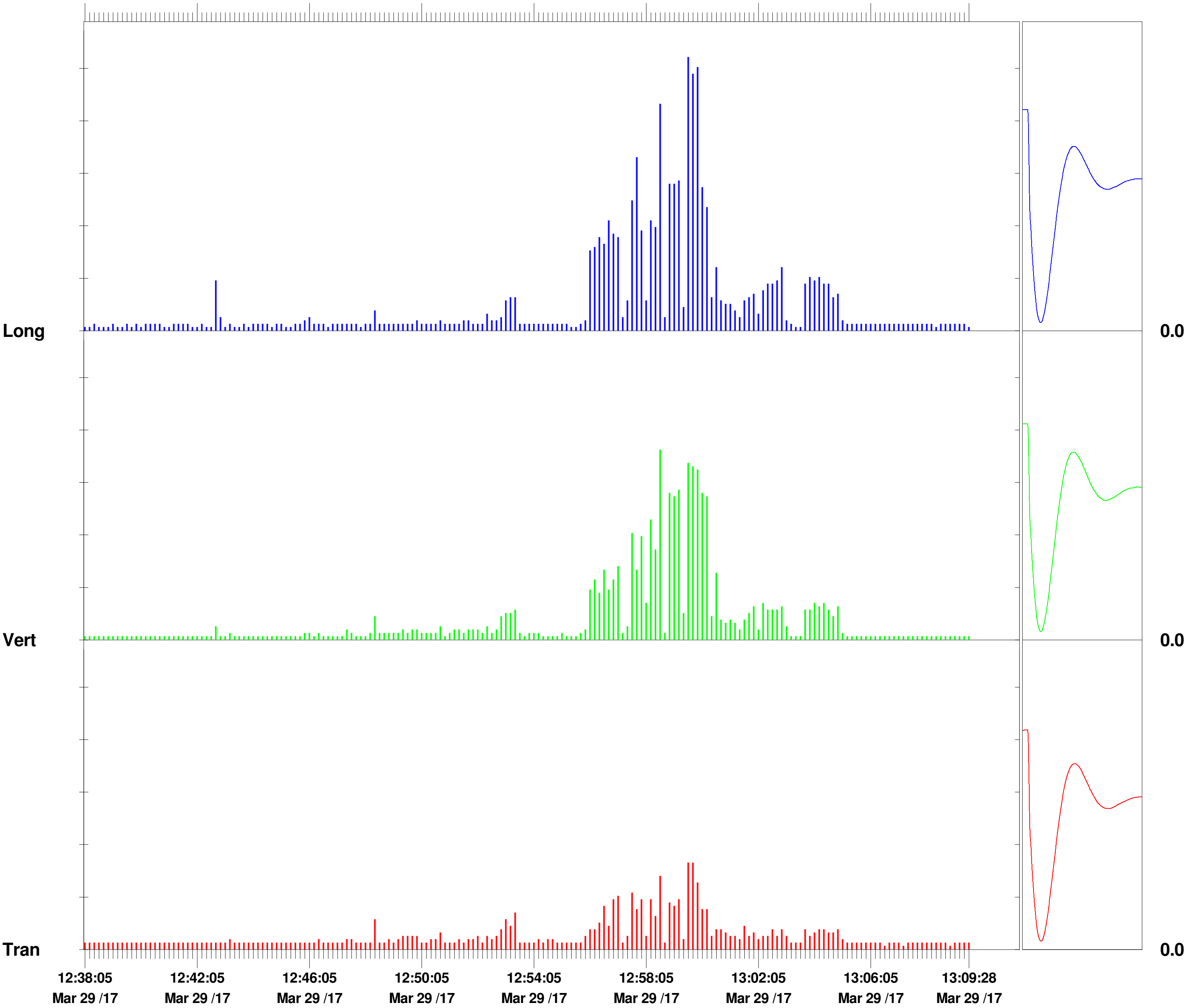
Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQJ.370

Notes

Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

	Tran	Vert	Long	
PPV	3.30	7.24	10.4	mm/s
ZC Freq	30	32	16	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	12:59:35	12:58:31	12:59:31	
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 10.4 mm/s on March 29, 2017 at 12:59:33



Time Scale: 10 seconds /div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Format © 1995-2013 Xmark Corporation

Instantel

Event Report

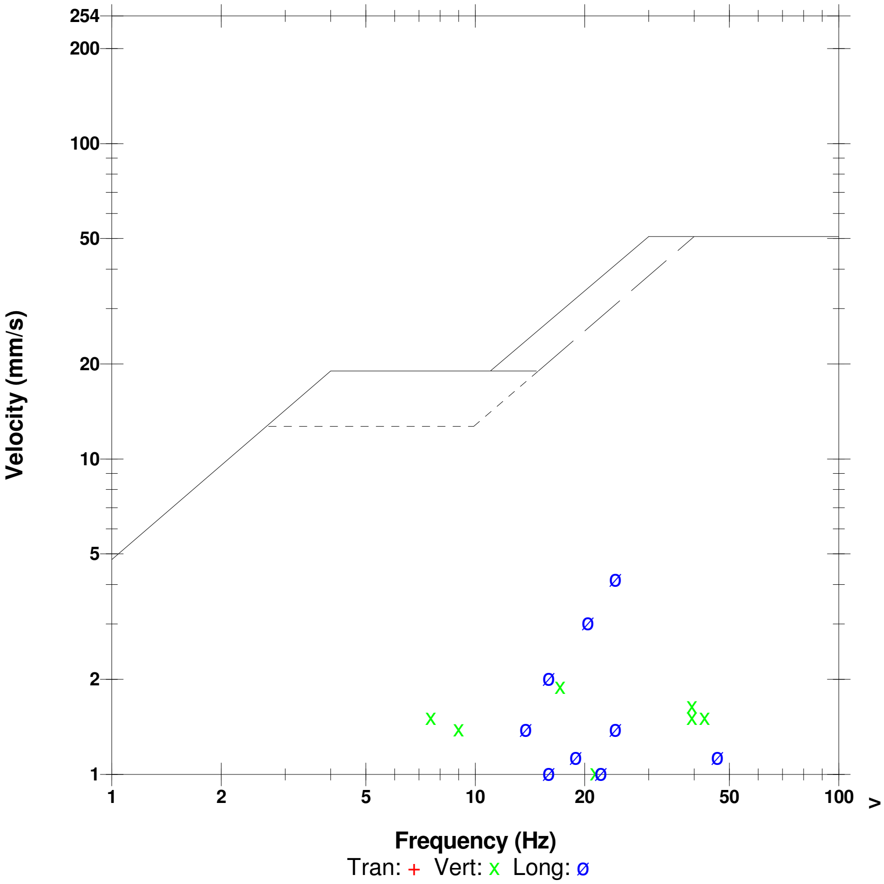
Date/Time Long at 12:56:40 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

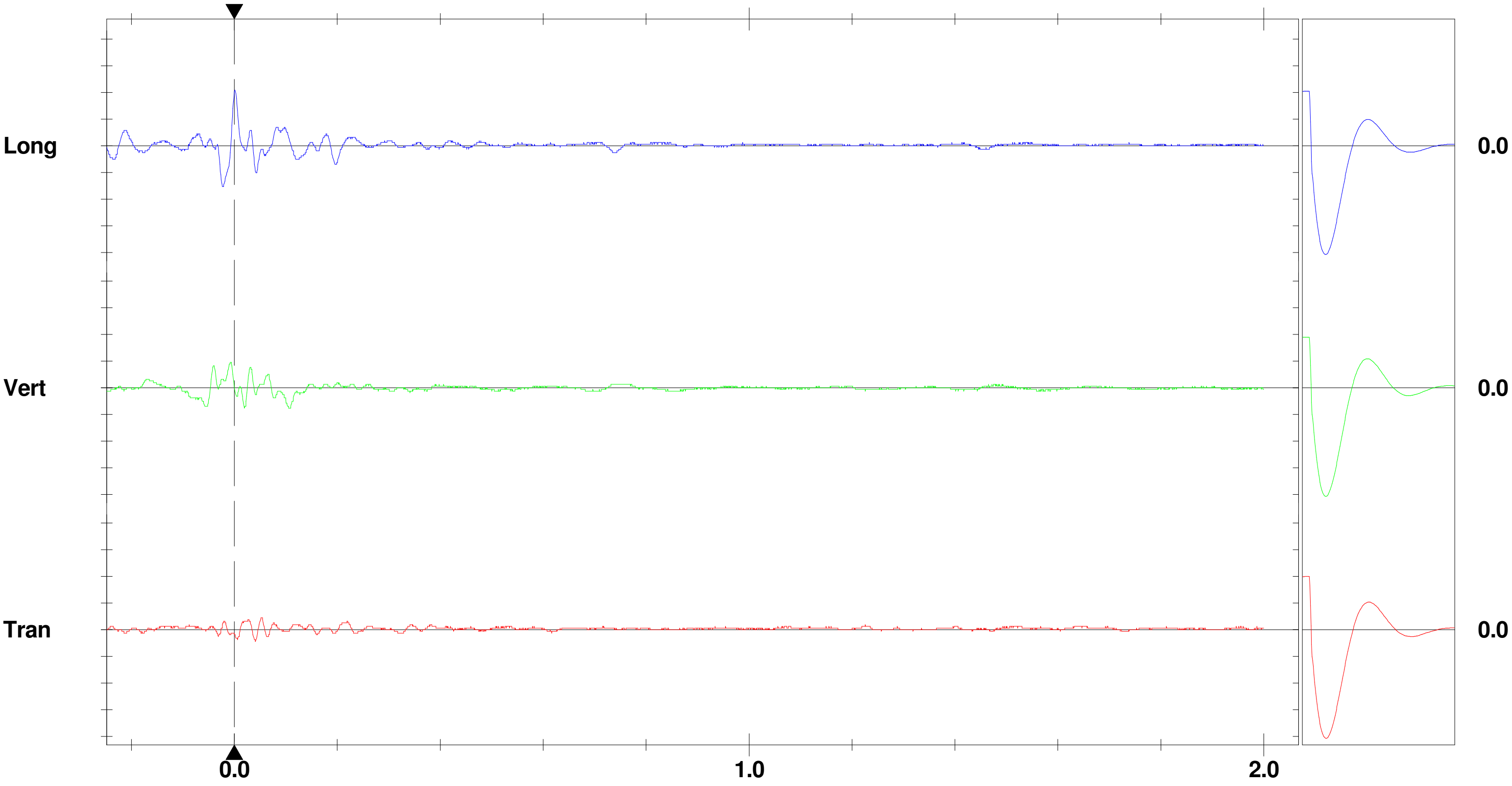
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQJ.YG0

	Tran	Vert	Long	
PPV	0.889	1.90	4.19	mm/s
ZC Freq	47	17	24	Hz
Time (Rel. to Trig)	0.041	-0.008	0.001	sec
Peak Acceleration	0.0265	0.0530	0.0795	g
Peak Displacement	0.00608	0.0209	0.0235	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 4.22 mm/s at 0.001 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

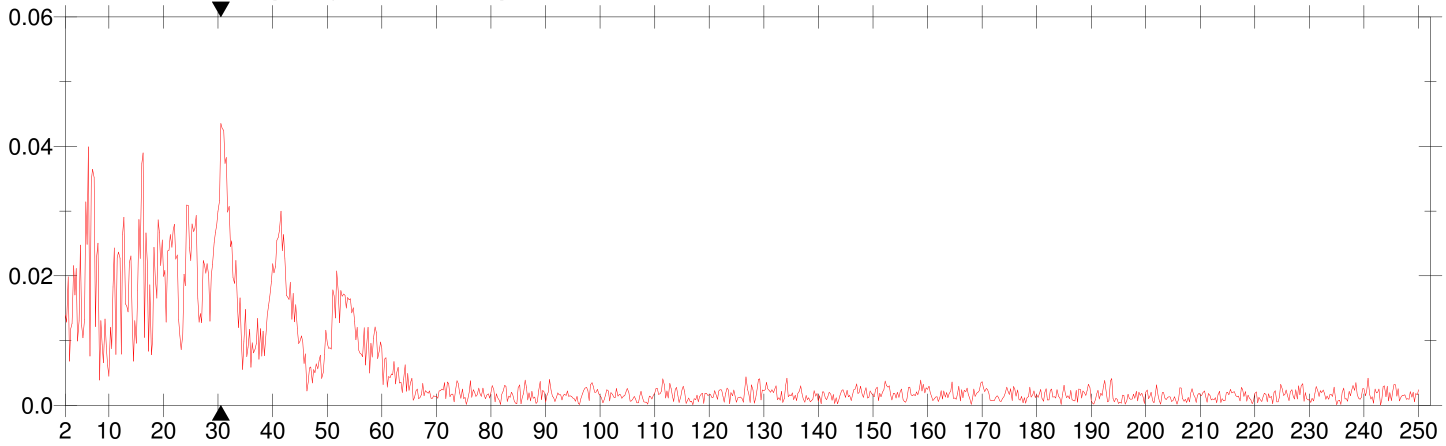
FFT Report

Date/Time	Long at 12:56:40 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQJ.YG0

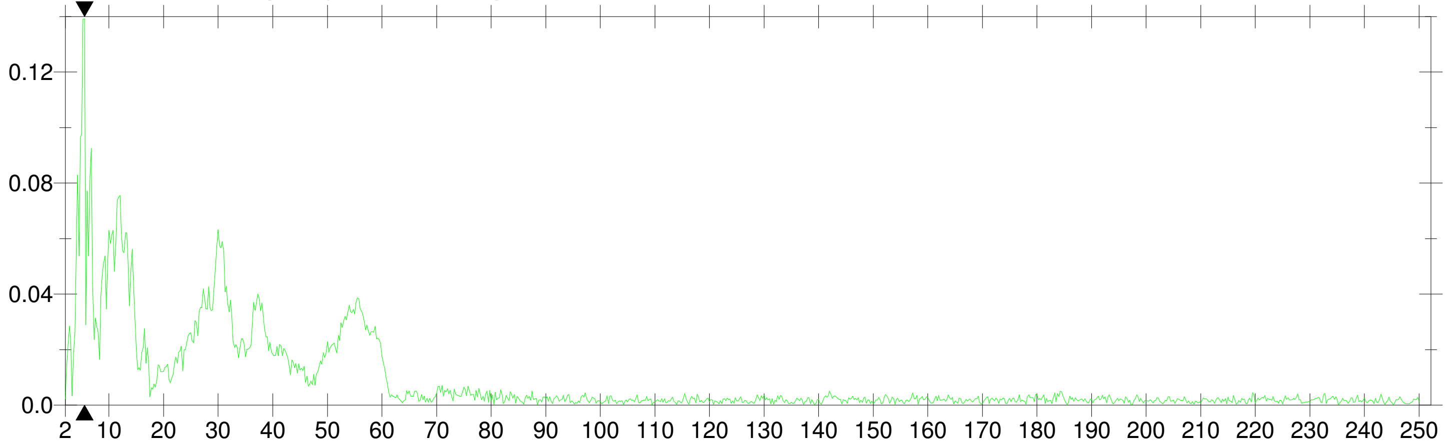
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

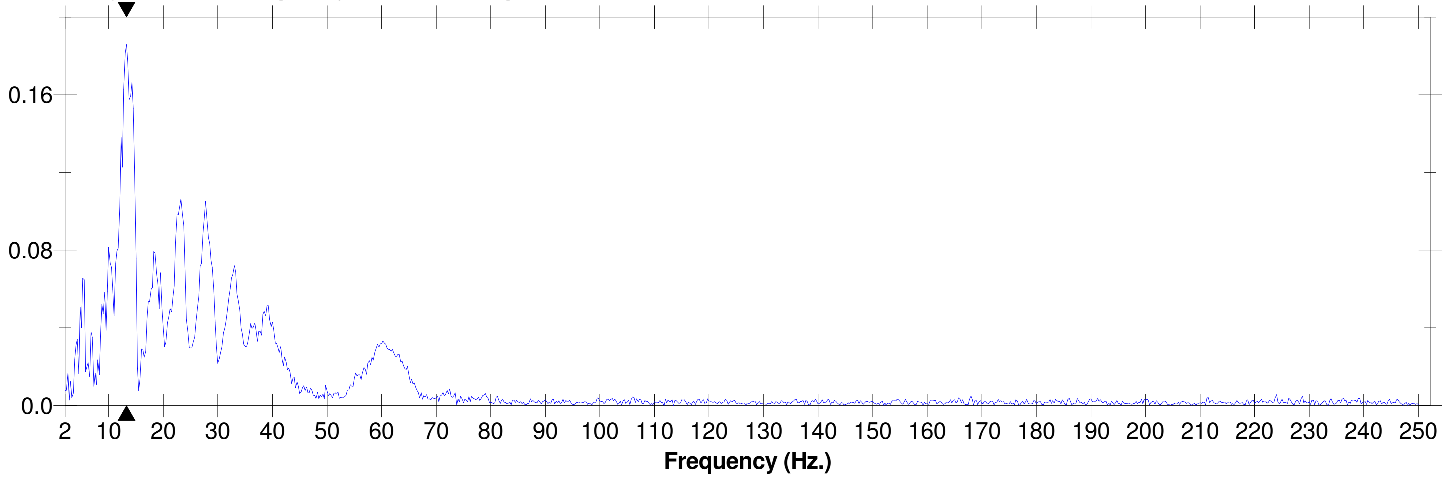
Tran Dominant Frequency = 30.5 Hz., Amplitude = 0.0435, PPV from Event = 0.889 mm/s



Vert Dominant Frequency = 5.50 Hz., Amplitude = 0.139, PPV from Event = 1.90 mm/s



Long Dominant Frequency = 13.3 Hz., Amplitude = 0.186, PPV from Event = 4.19 mm/s



Event Report

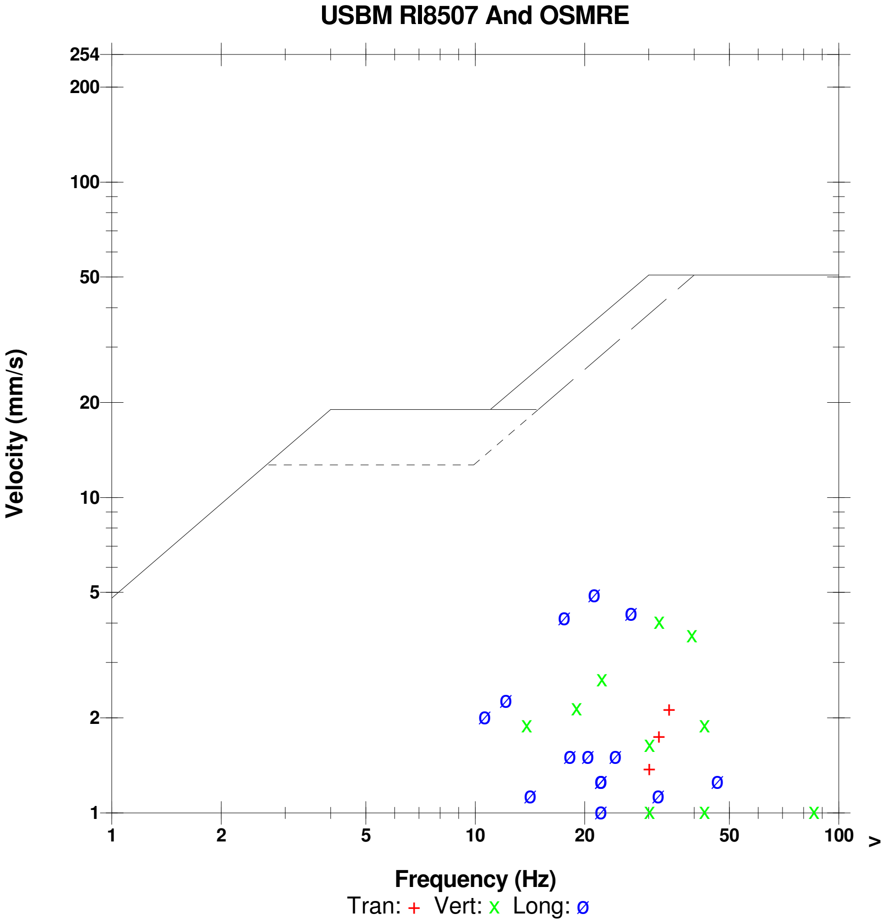
Date/Time	Long at 12:57:28 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQJ.ZS0

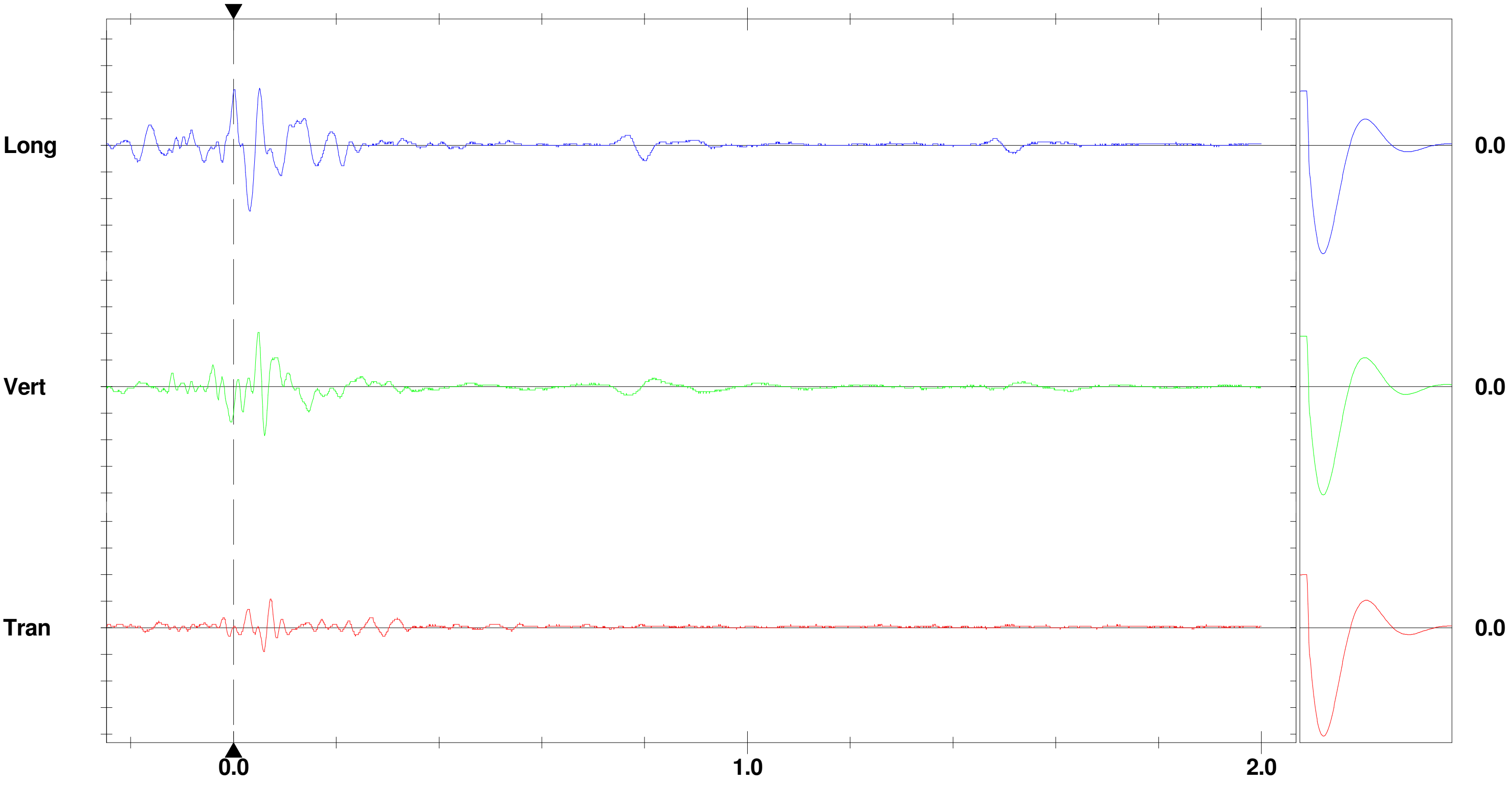
Notes

Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

	Tran	Vert	Long	
PPV	2.16	4.06	4.95	mm/s
ZC Freq	34	32	21	Hz
Time (Rel. to Trig)	0.071	0.048	0.031	sec
Peak Acceleration	0.0530	0.106	0.0928	g
Peak Displacement	0.00955	0.0215	0.0355	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 5.67 mm/s at 0.050 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

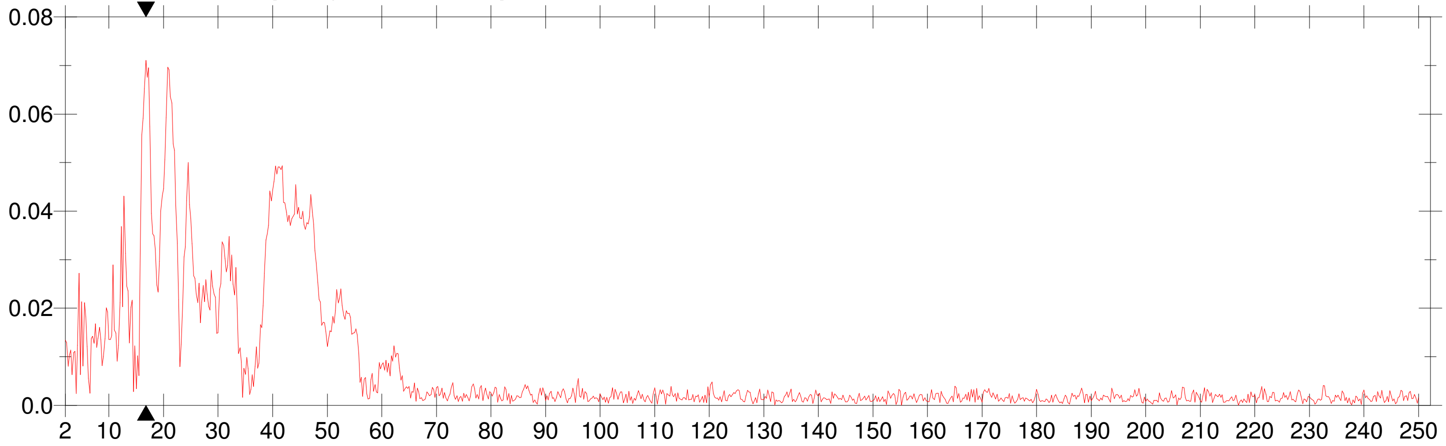
FFT Report

Date/Time	Long at 12:57:28 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQJ.ZS0

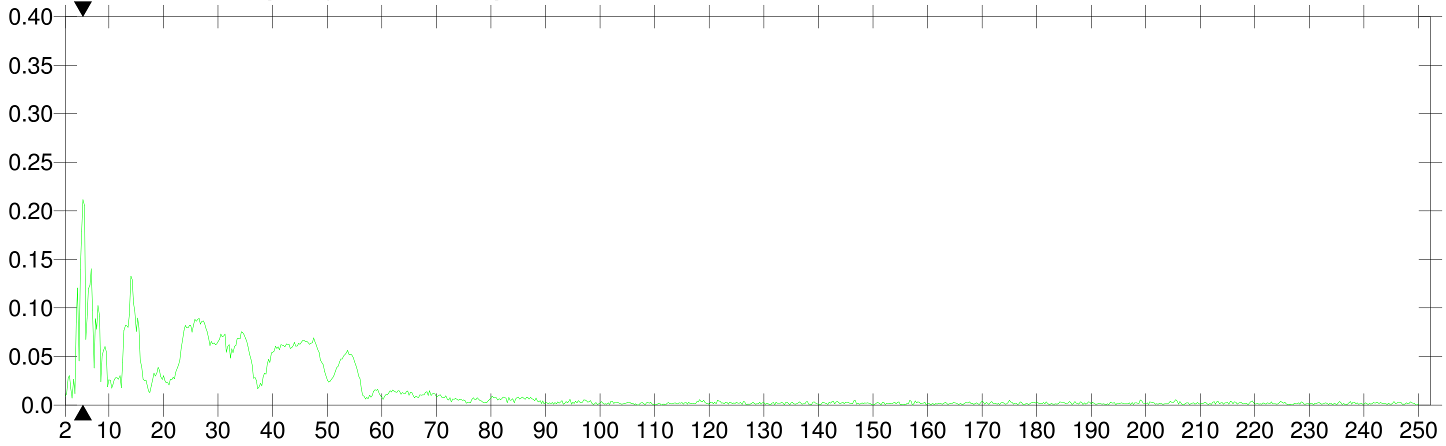
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

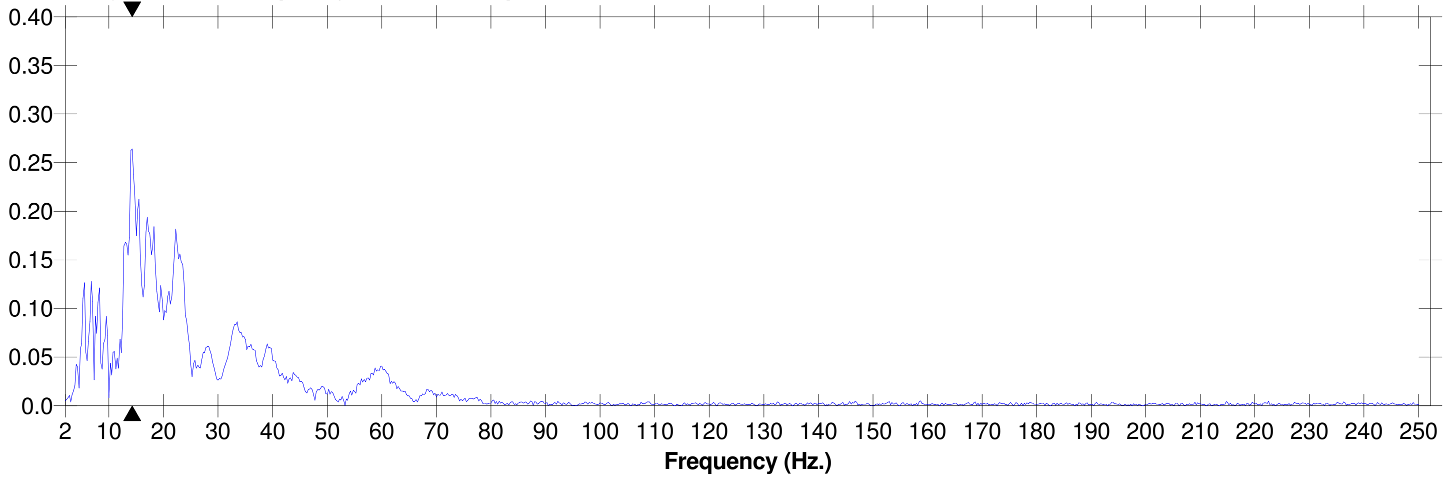
Tran Dominant Frequency = 16.8 Hz., Amplitude = 0.0710, PPV from Event = 2.16 mm/s



Vert Dominant Frequency = 5.25 Hz., Amplitude = 0.211, PPV from Event = 4.06 mm/s



Long Dominant Frequency = 14.3 Hz., Amplitude = 0.264, PPV from Event = 4.95 mm/s



Instantel

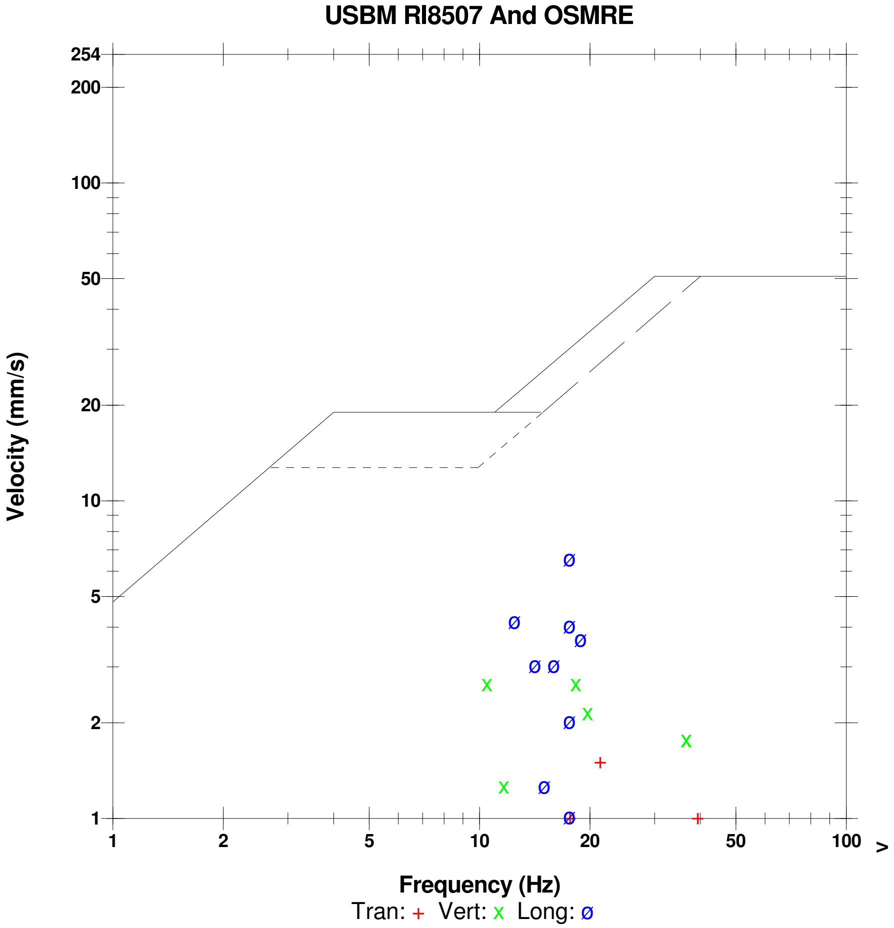
Event Report

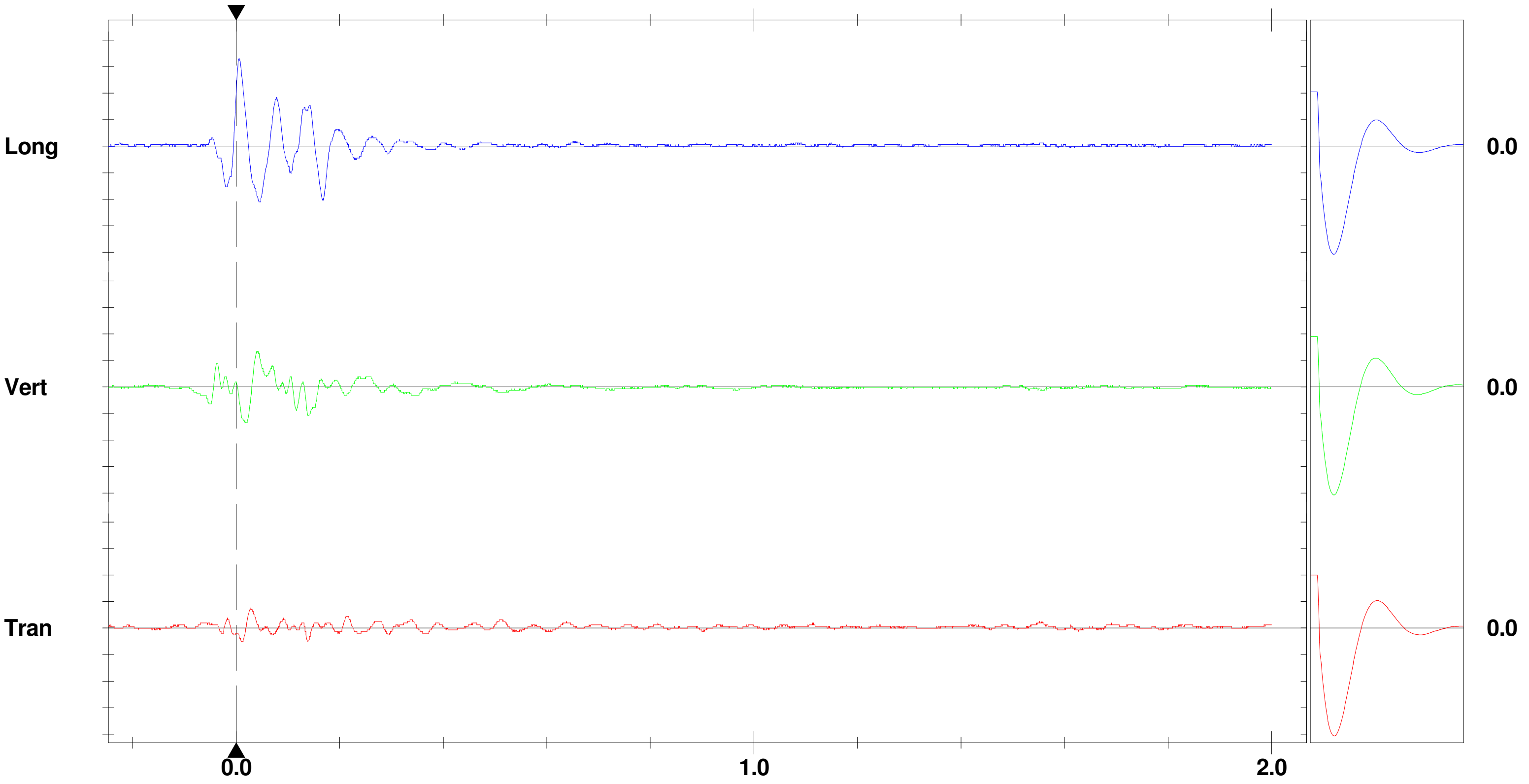
Date/Time Long at 12:57:38 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQK.020

	Tran	Vert	Long	
PPV	1.52	2.67	6.60	mm/s
ZC Freq	21	18	18	Hz
Time (Rel. to Trig)	0.028	0.016	0.005	sec
Peak Acceleration	0.0398	0.0530	0.0928	g
Peak Displacement	0.0107	0.0340	0.0548	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 6.71 mm/s at 0.006 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶—— ——◀

Sensor Check

Instantel

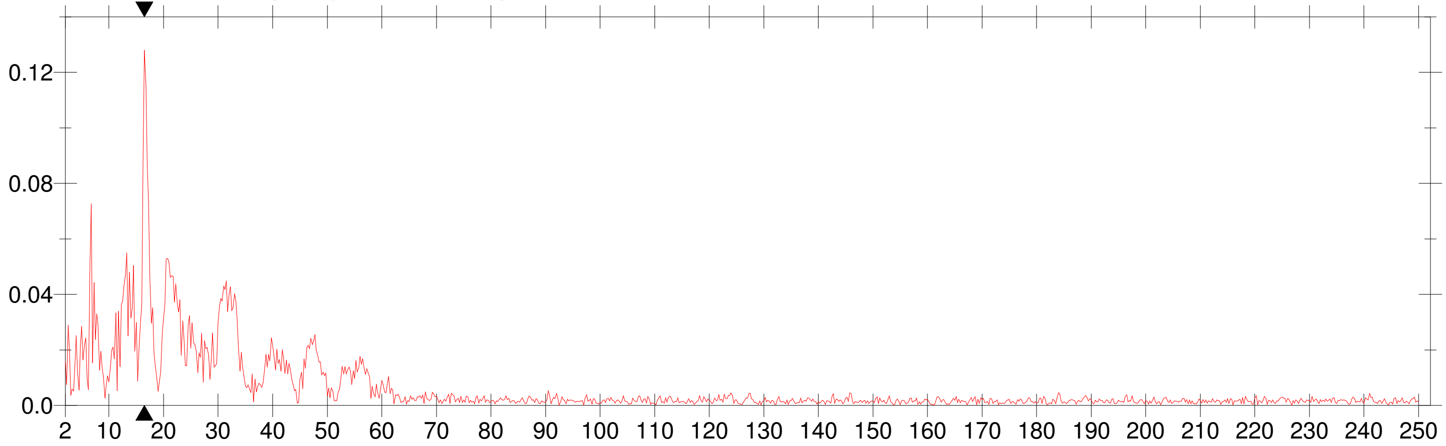
FFT Report

Date/Time	Long at 12:57:38 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQK.020

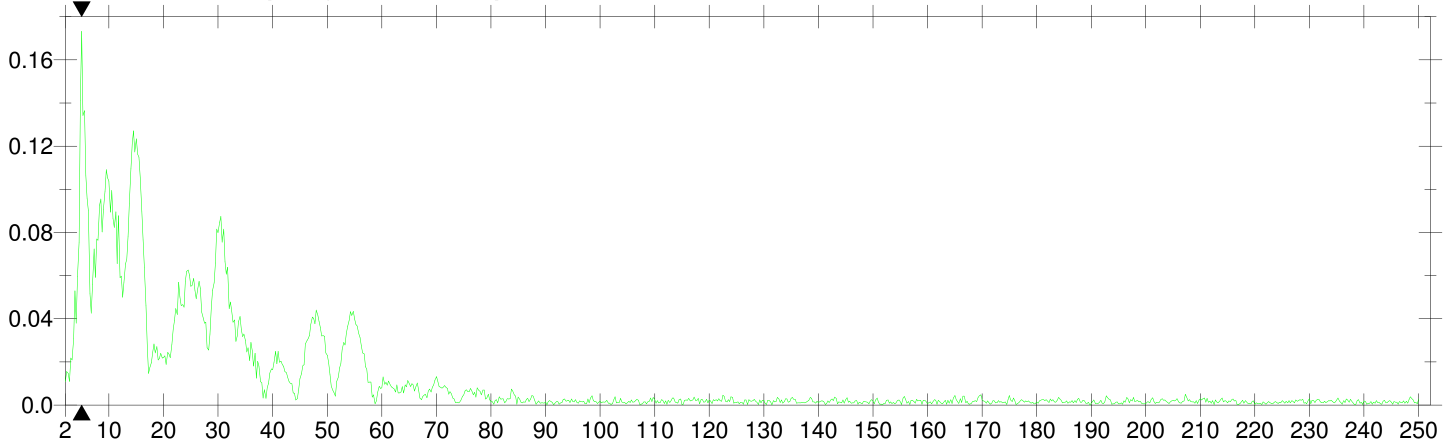
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

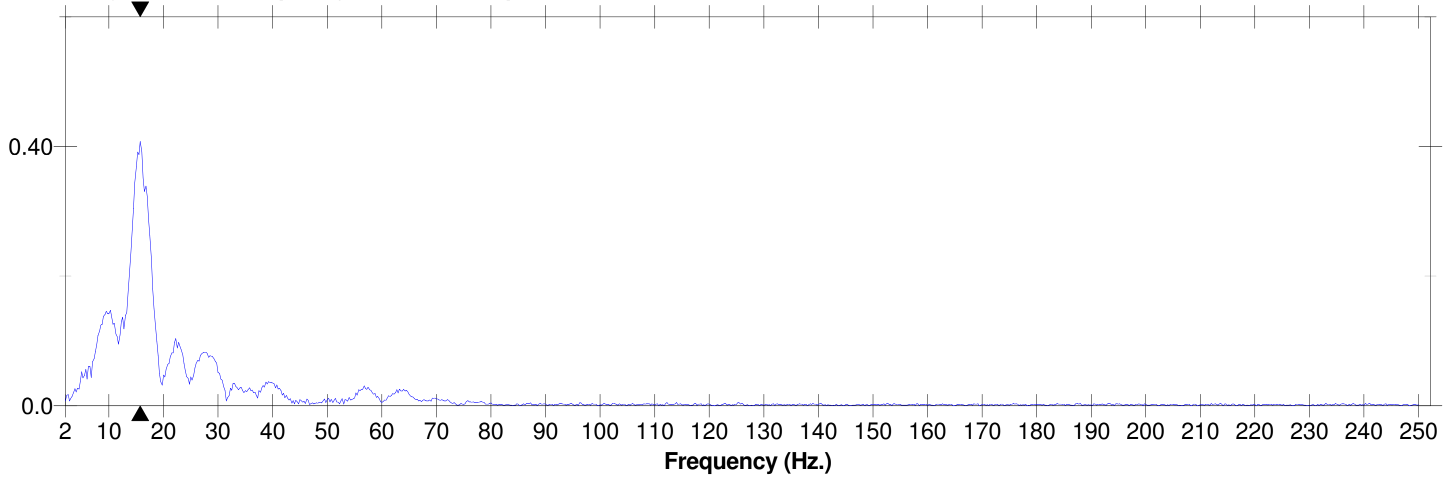
Tran Dominant Frequency = 16.5 Hz., Amplitude = 0.128, PPV from Event = 1.52 mm/s



Vert Dominant Frequency = 5.00 Hz., Amplitude = 0.173, PPV from Event = 2.67 mm/s



Long Dominant Frequency = 15.8 Hz., Amplitude = 0.408, PPV from Event = 6.60 mm/s



Event Report

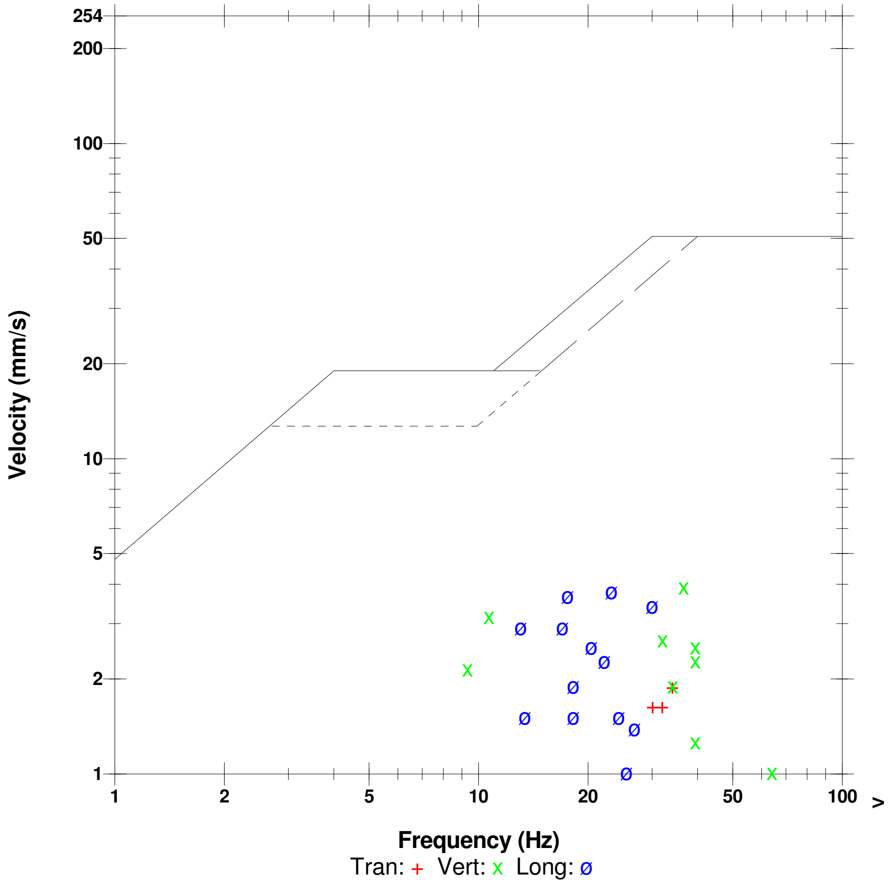
Date/Time Vert at 12:57:48 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

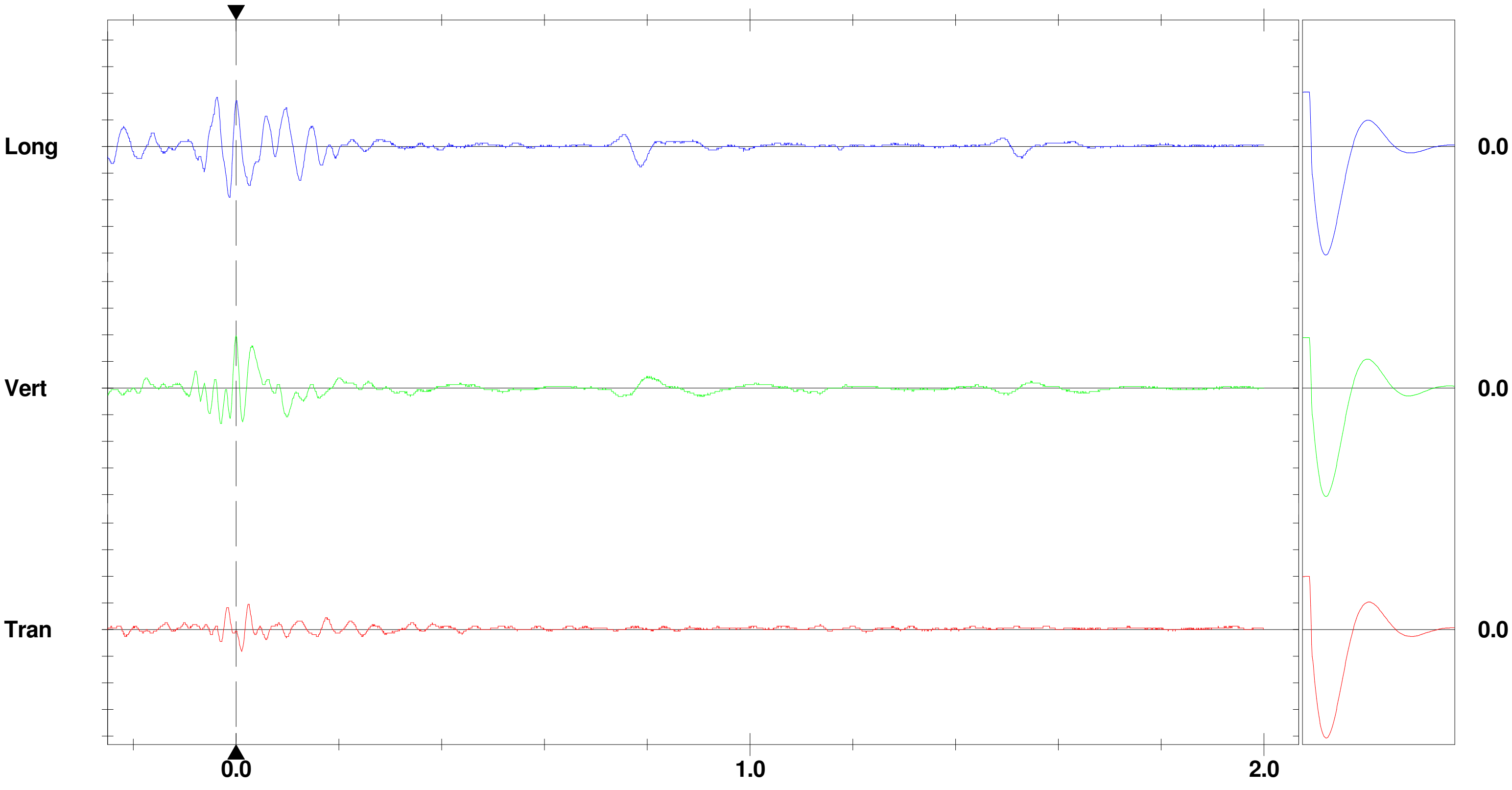
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQK.0C0

	Tran	Vert	Long	
PPV	1.90	3.94	3.81	mm/s
ZC Freq	34	37	23	Hz
Time (Rel. to Trig)	0.023	0.000	-0.014	sec
Peak Acceleration	0.0398	0.0928	0.0928	g
Peak Displacement	0.00868	0.0334	0.0320	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 5.22 mm/s at 0.000 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div Sensor Check
Trigger = ▶—— ——◀

Instantel

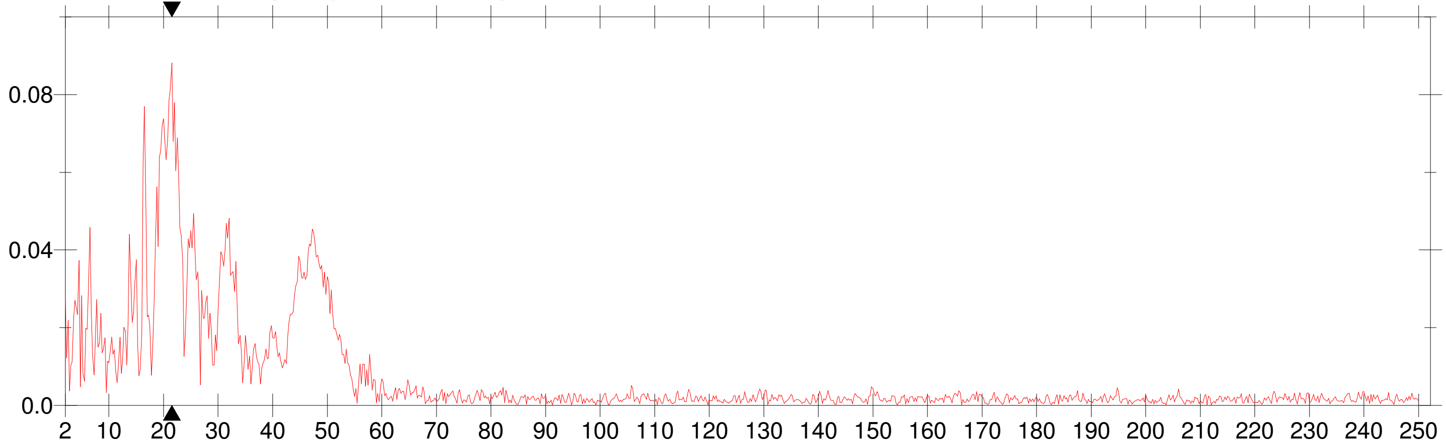
FFT Report

Date/Time	Vert at 12:57:48 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQK.0C0

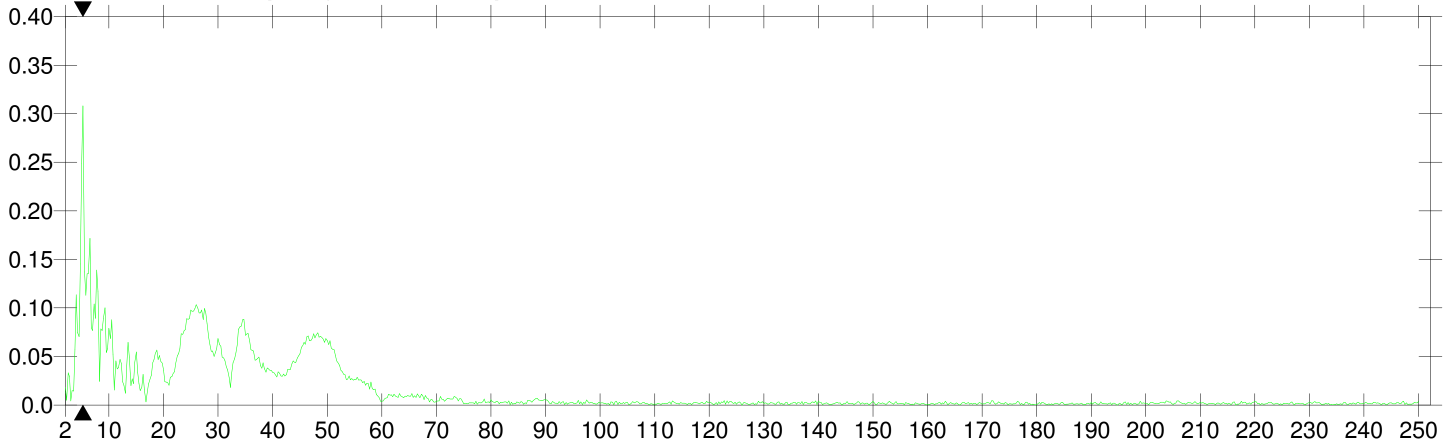
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

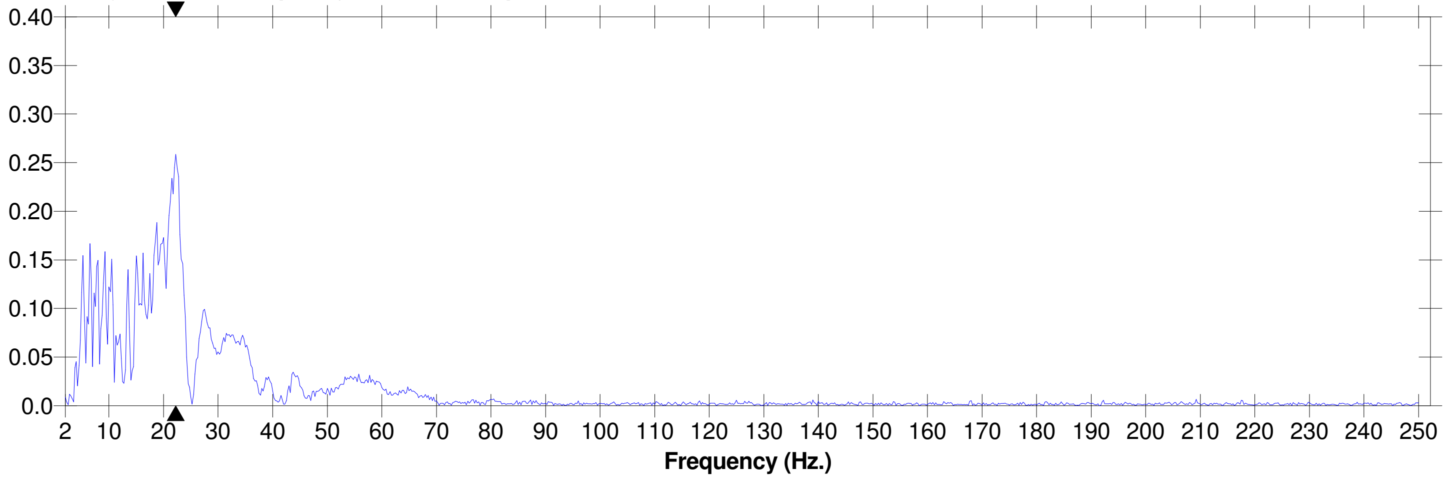
Tran Dominant Frequency = 21.5 Hz., Amplitude = 0.0881, PPV from Event = 1.90 mm/s



Vert Dominant Frequency = 5.25 Hz., Amplitude = 0.308, PPV from Event = 3.94 mm/s



Long Dominant Frequency = 22.3 Hz., Amplitude = 0.259, PPV from Event = 3.81 mm/s



Event Report

Date/Time	Long at 12:58:06 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQK.0U0

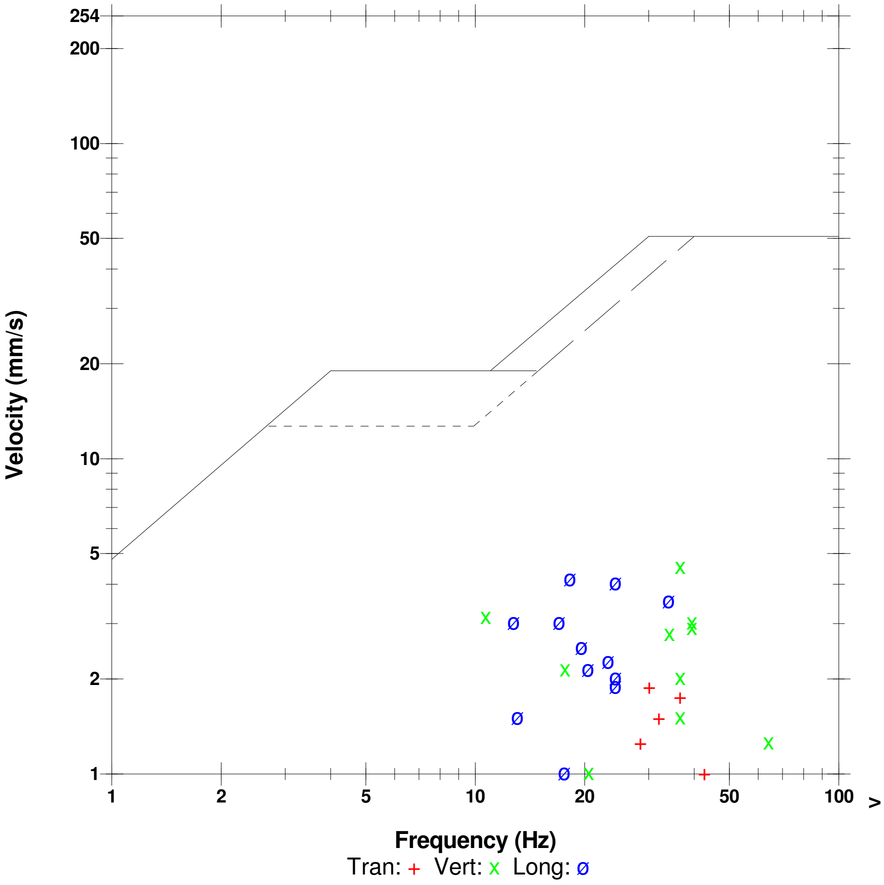
Notes

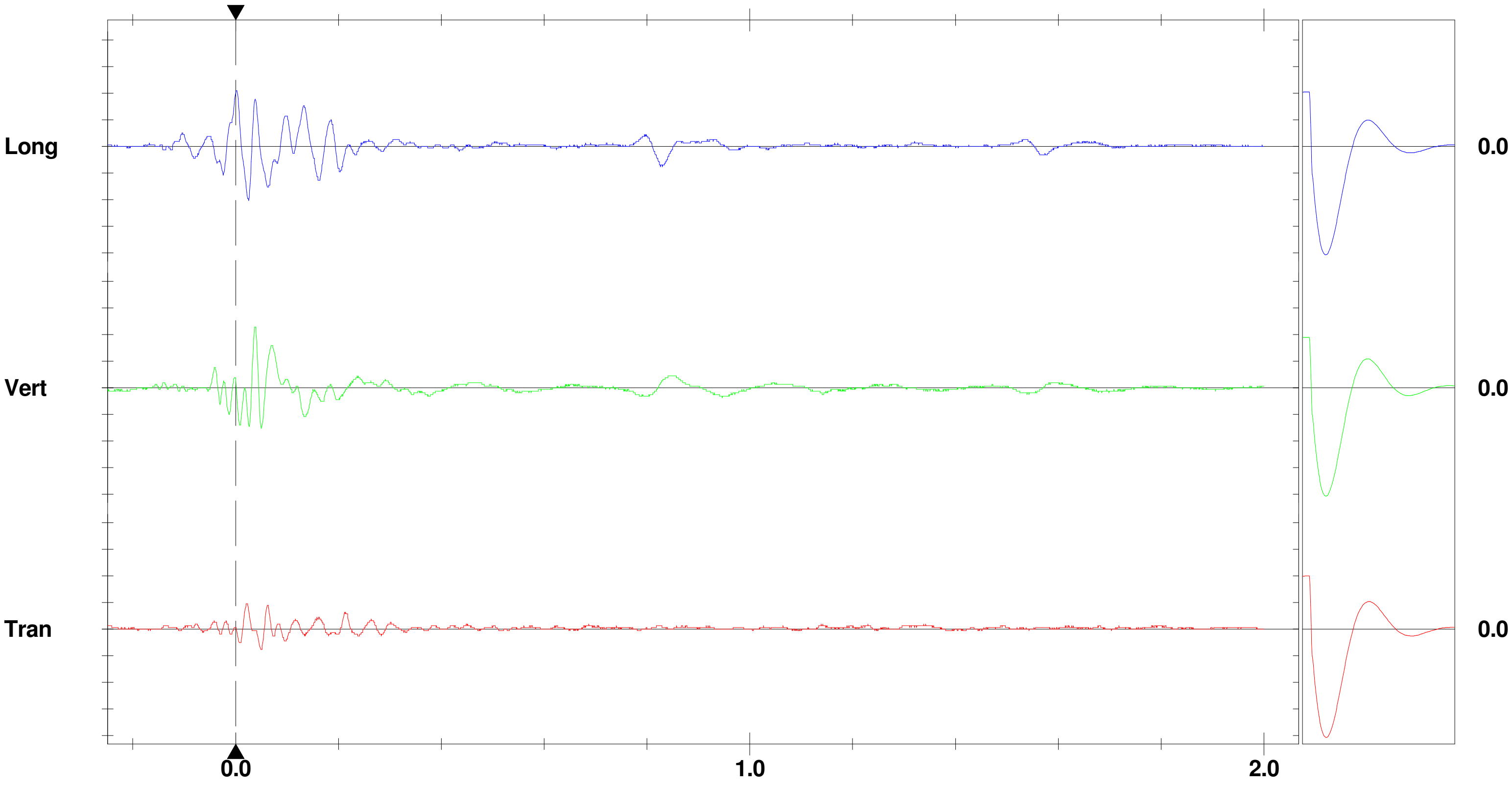
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.90	4.57	4.19	mm/s
ZC Freq	30	37	18	Hz
Time (Rel. to Trig)	0.021	0.037	0.001	sec
Peak Acceleration	0.0530	0.106	0.0928	g
Peak Displacement	0.00974	0.0323	0.0325	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 5.79 mm/s at 0.038 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Instantel

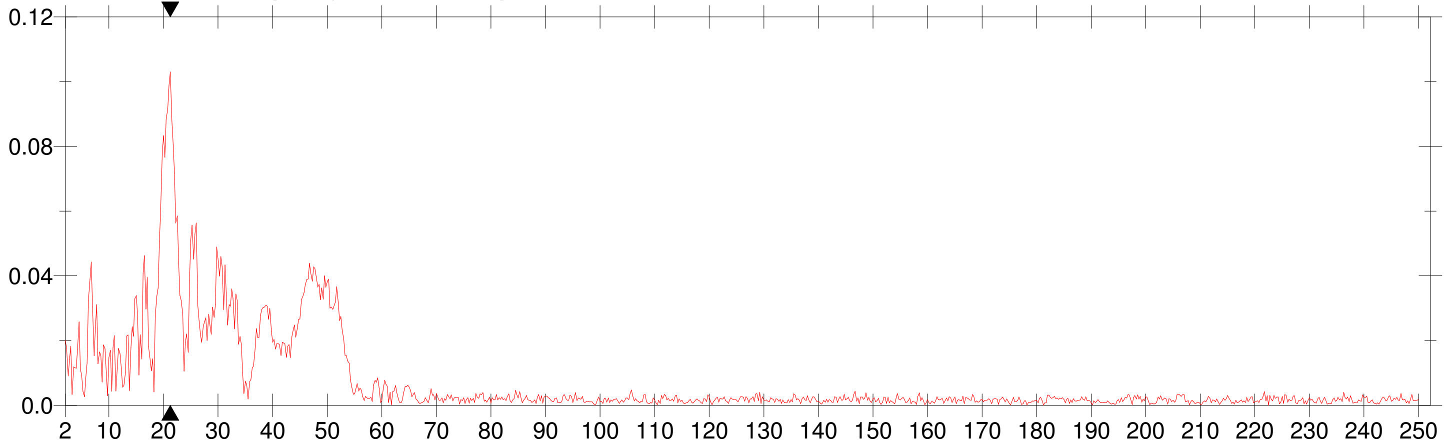
FFT Report

Date/Time	Long at 12:58:06 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQK.0U0

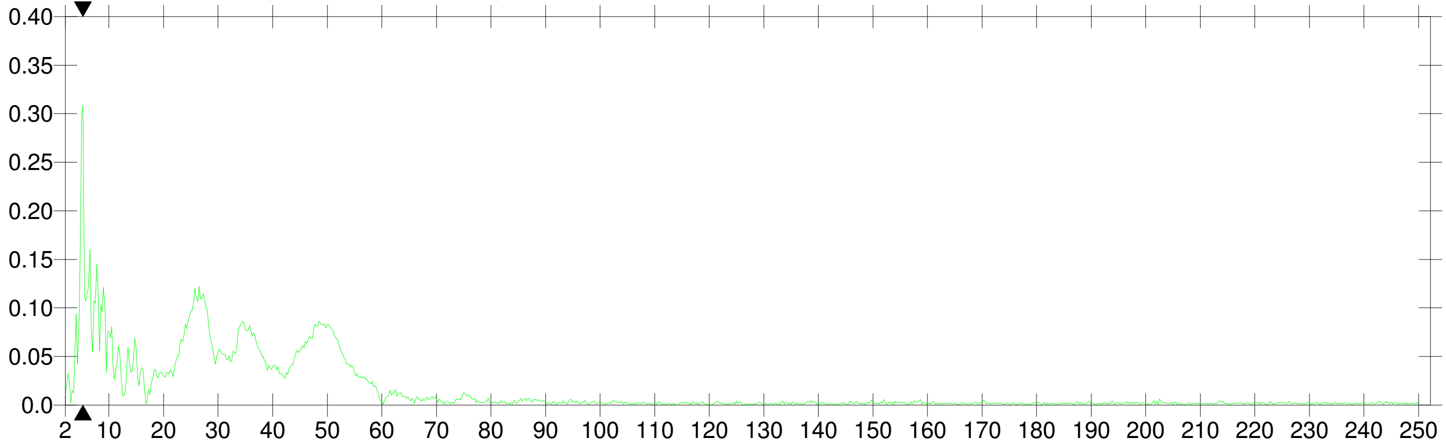
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

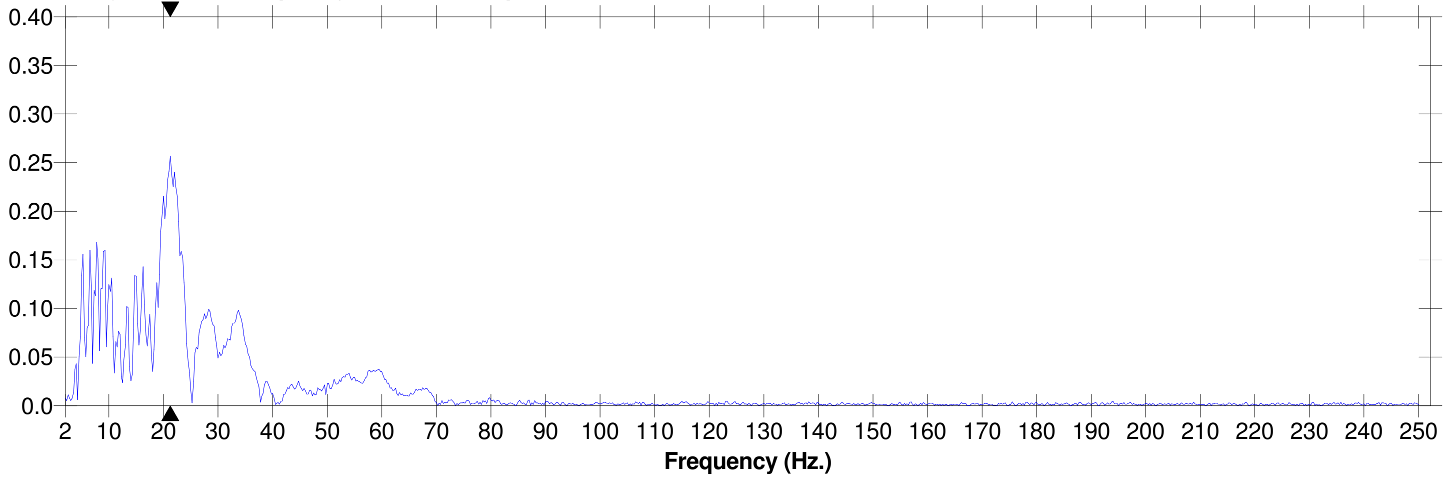
Tran Dominant Frequency = 21.3 Hz., Amplitude = 0.103, PPV from Event = 1.90 mm/s



Vert Dominant Frequency = 5.25 Hz., Amplitude = 0.309, PPV from Event = 4.57 mm/s



Long Dominant Frequency = 21.3 Hz., Amplitude = 0.257, PPV from Event = 4.19 mm/s



Instantel

Event Report

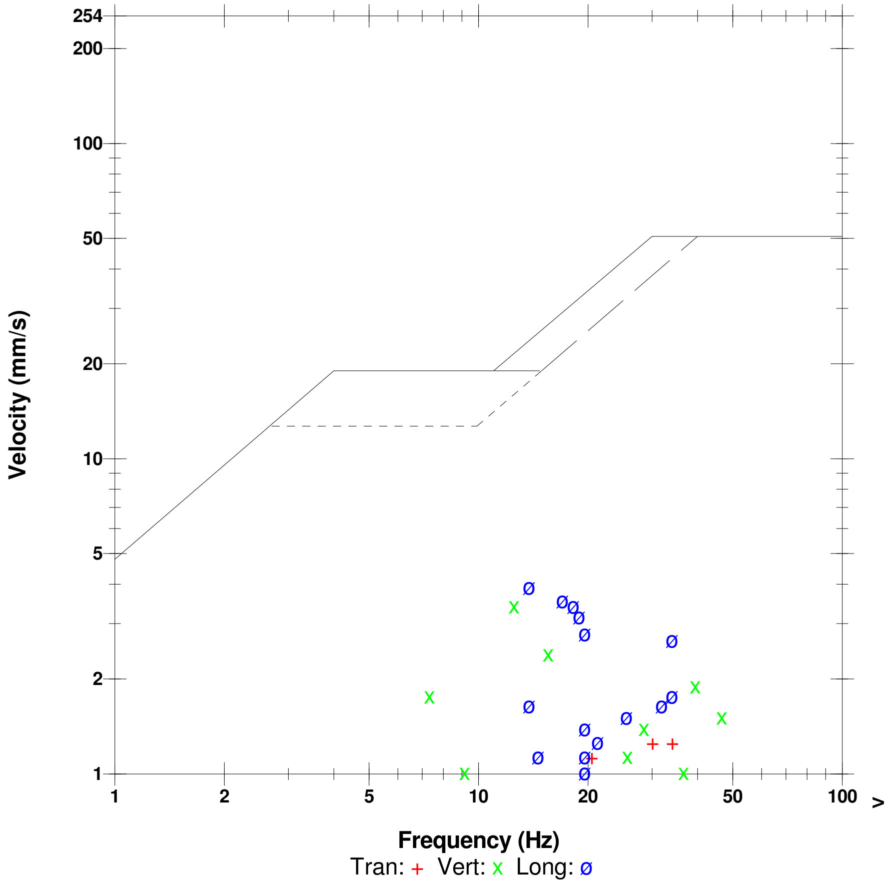
Date/Time Long at 12:58:16 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

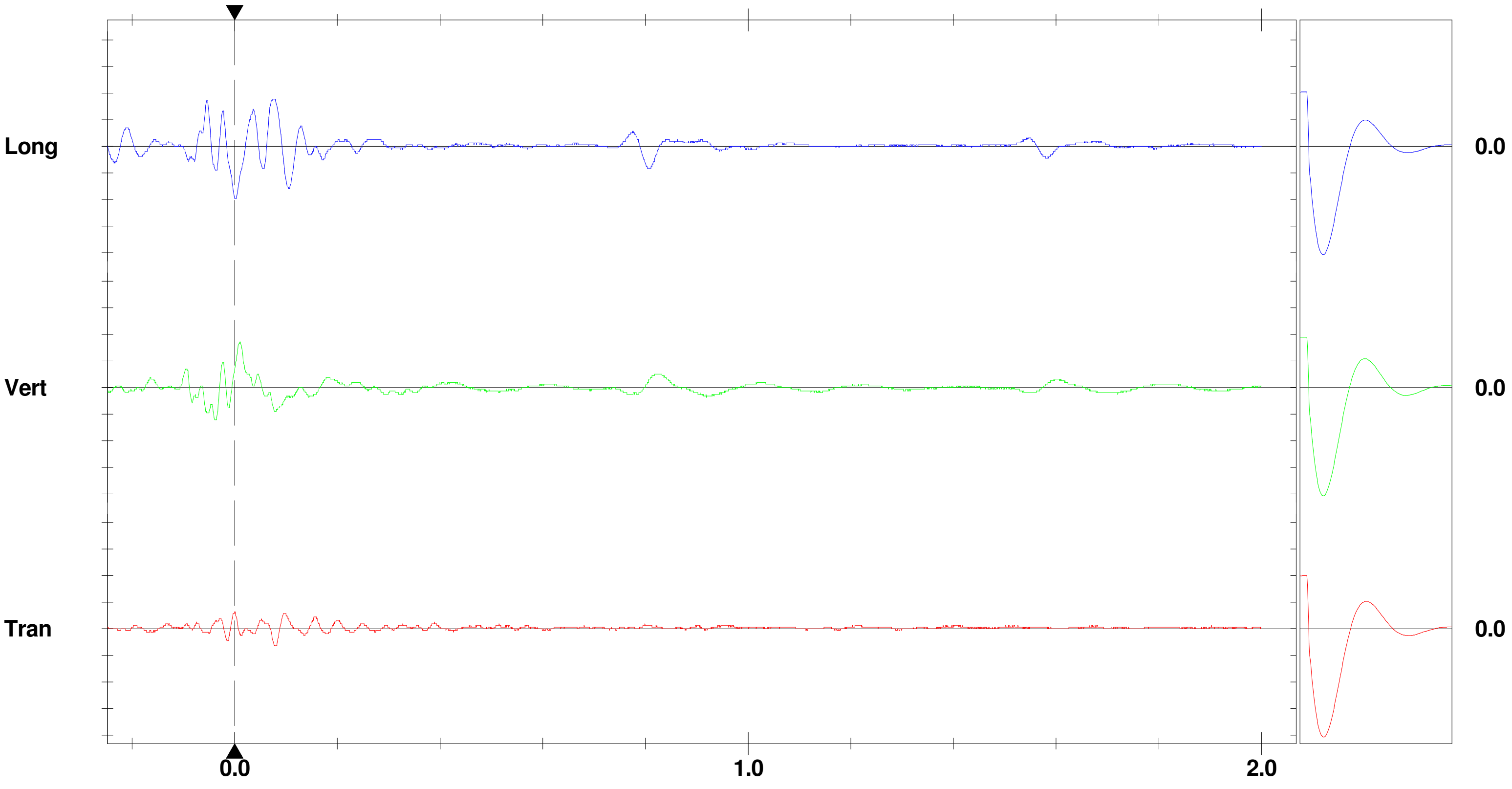
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQK.140

	Tran	Vert	Long	
PPV	1.27	3.43	3.94	mm/s
ZC Freq	34	12	14	Hz
Time (Rel. to Trig)	-0.001	0.010	0.000	sec
Peak Acceleration	0.0265	0.0530	0.0663	g
Peak Displacement	0.00868	0.0340	0.0399	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 4.49 mm/s at 0.002 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Instantel

FFT Report

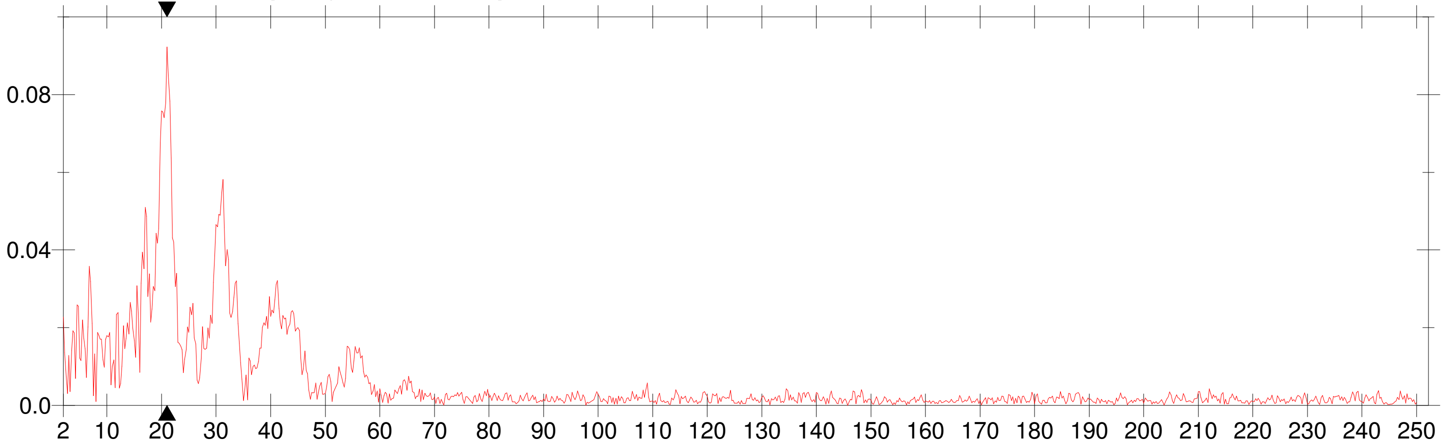
Date/Time	Long at 12:58:16 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQK.140

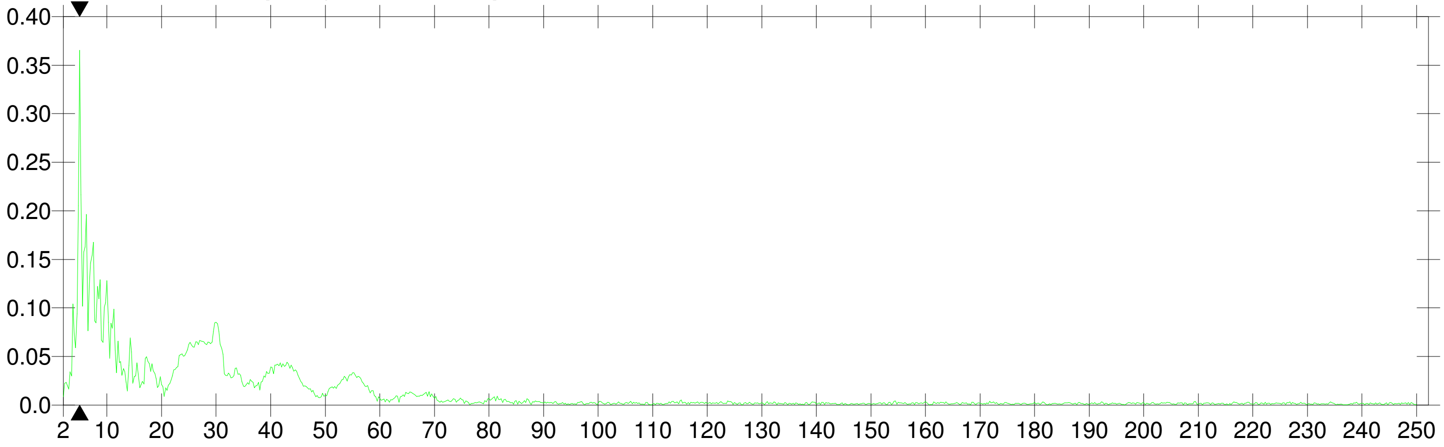
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

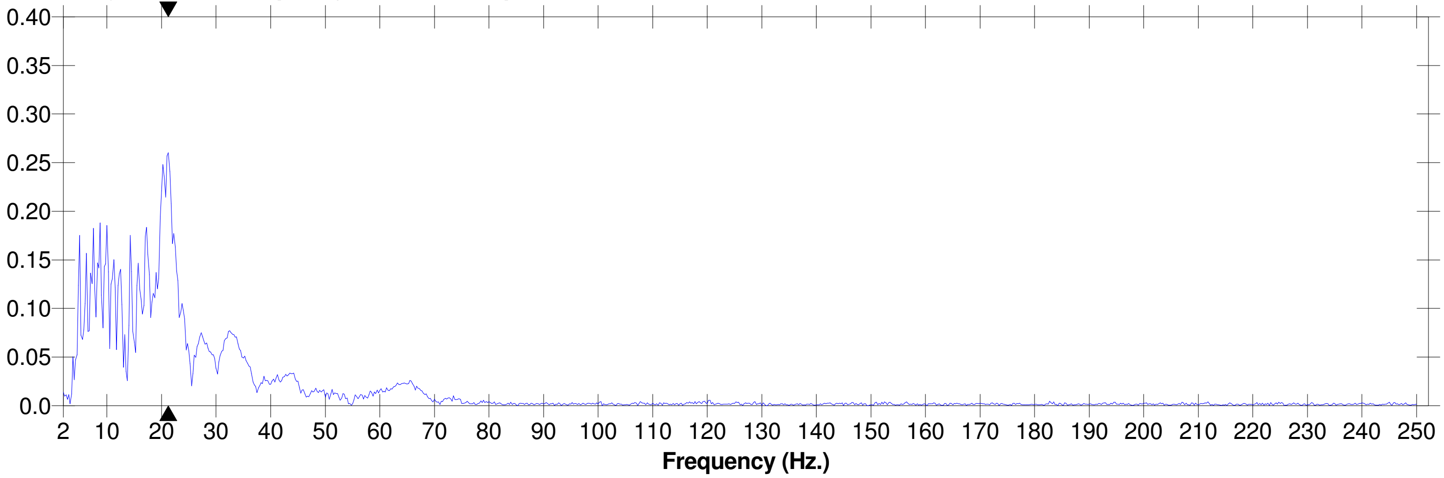
Tran Dominant Frequency = 21.0 Hz., Amplitude = 0.0923, PPV from Event = 1.27 mm/s



Vert Dominant Frequency = 5.00 Hz., Amplitude = 0.365, PPV from Event = 3.43 mm/s



Long Dominant Frequency = 21.3 Hz., Amplitude = 0.260, PPV from Event = 3.94 mm/s



Event Report

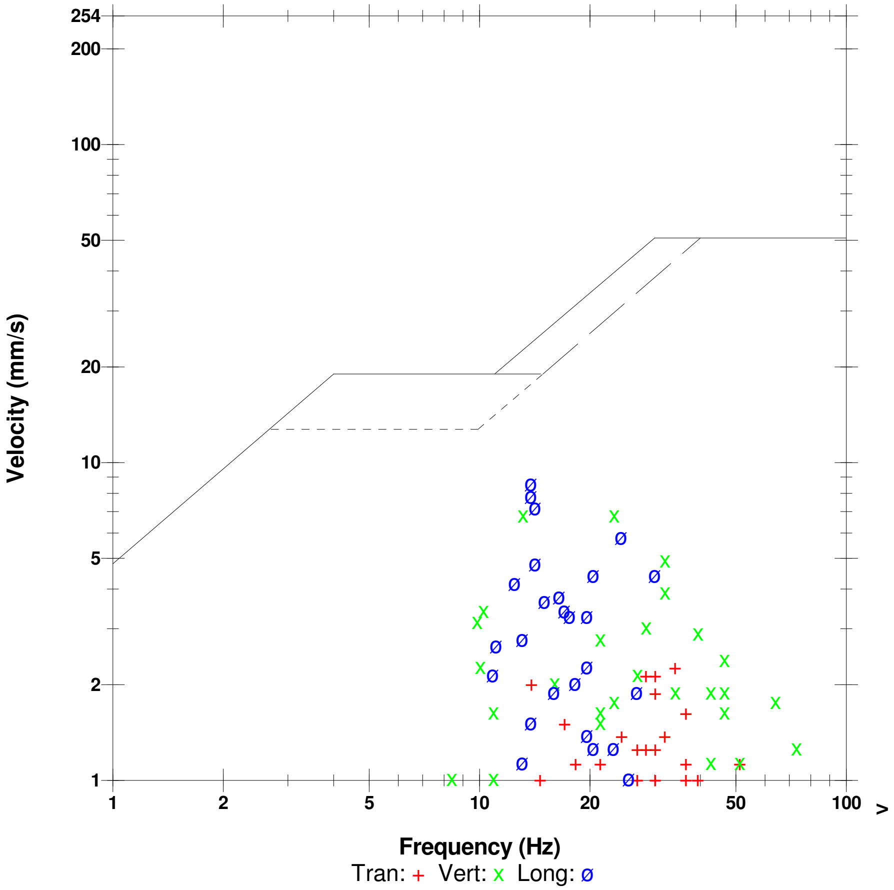
Date/Time Long at 12:58:27 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

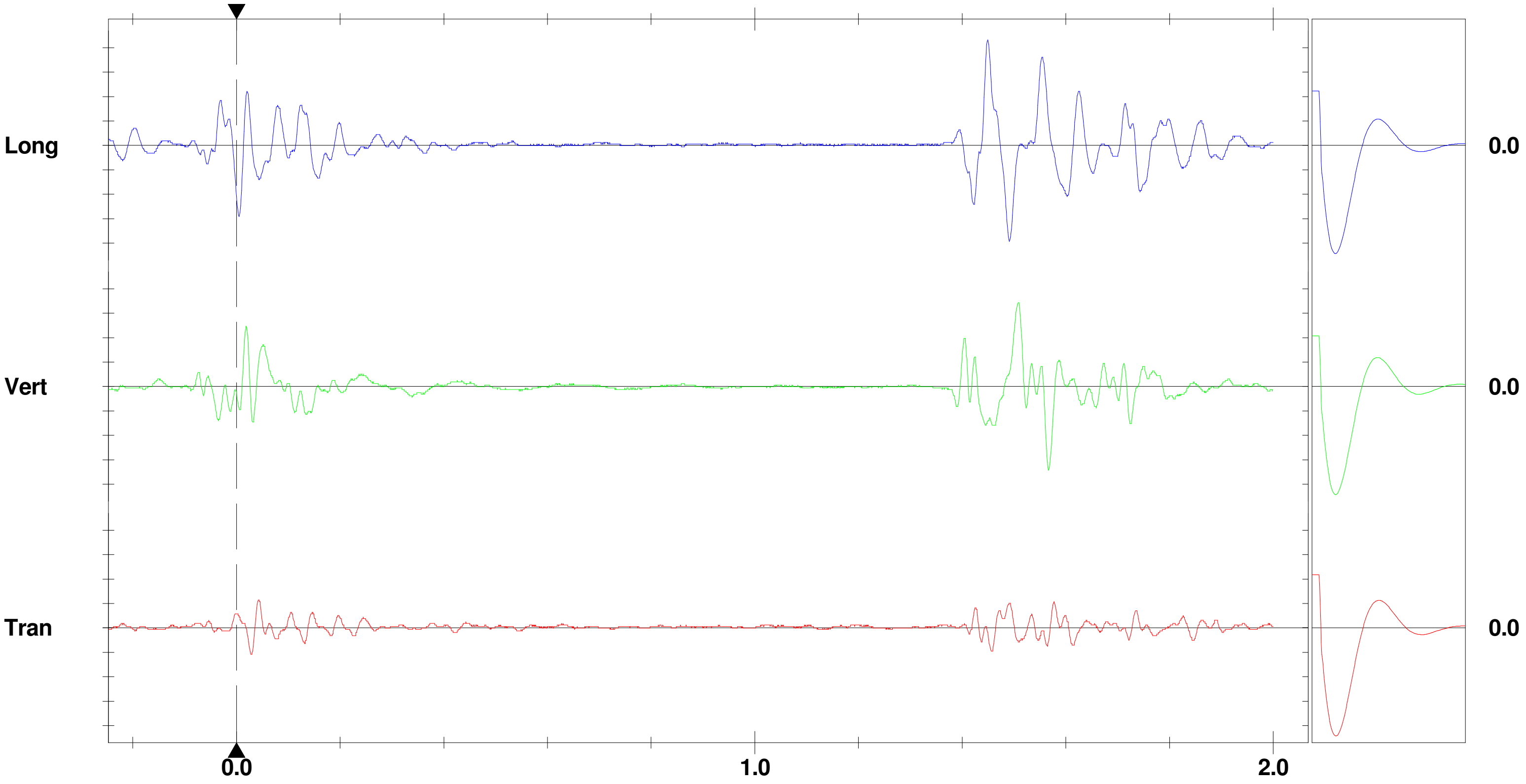
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQK.1F0

	Tran	Vert	Long	
PPV	2.29	6.86	8.64	mm/s
ZC Freq	34	13	14	Hz
Time (Rel. to Trig)	0.042	1.508	1.449	sec
Peak Acceleration	0.0530	0.106	0.119	g
Peak Displacement	0.0214	0.0628	0.0753	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 9.08 mm/s at 1.449 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

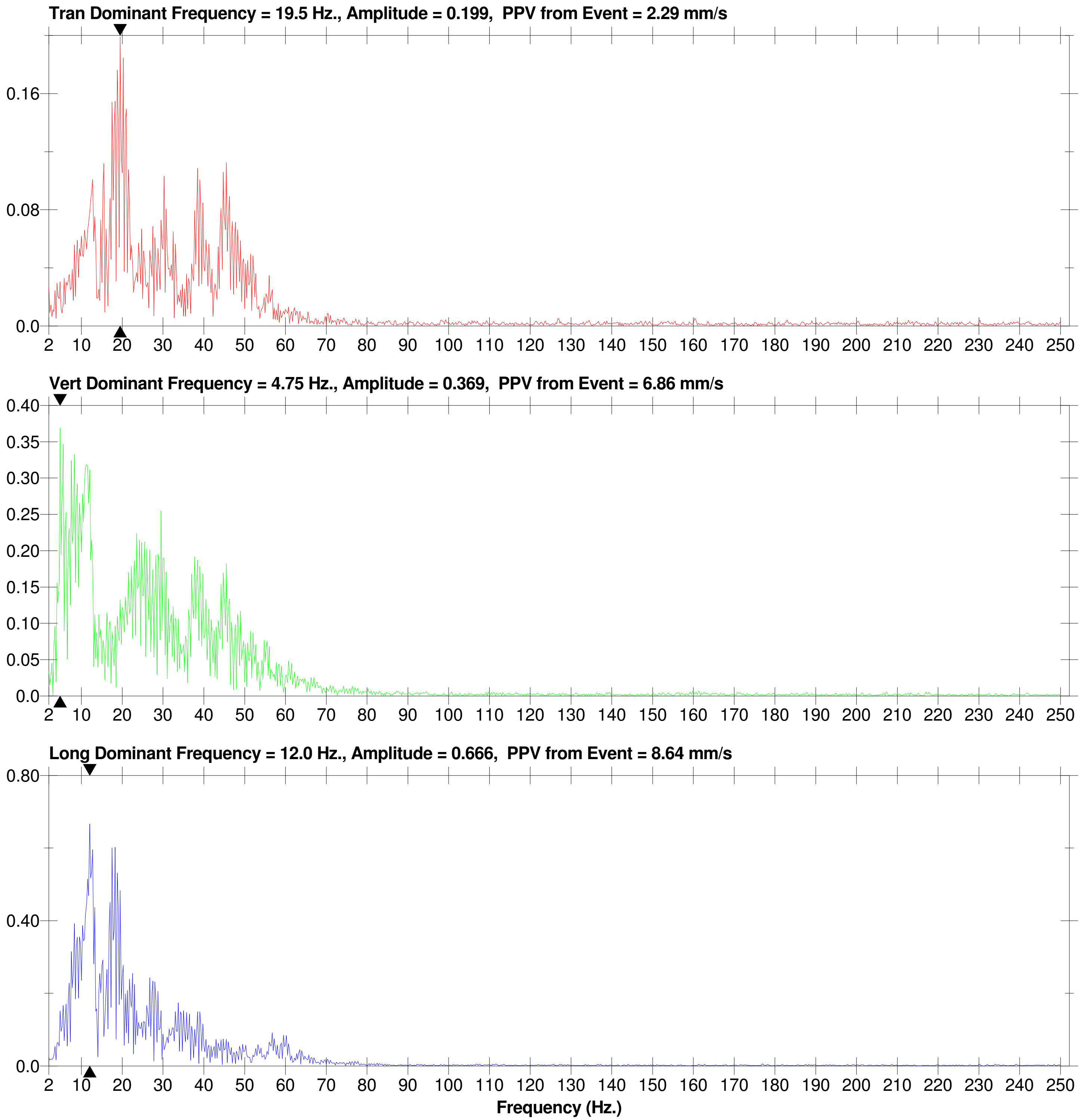
Trigger = ▶——— ———◀

FFT Report

Date/Time	Long at 12:58:27 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQK.1F0

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent



Instantel

Event Report

Date/Time	Long at 12:58:29 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQK.1H0

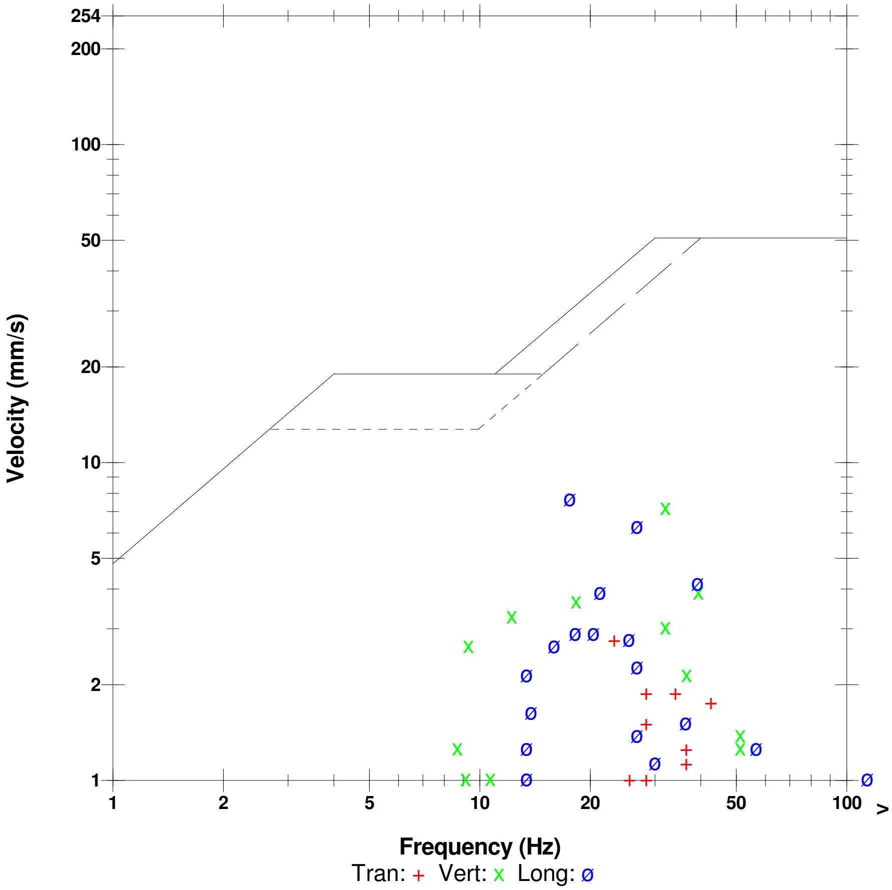
Notes

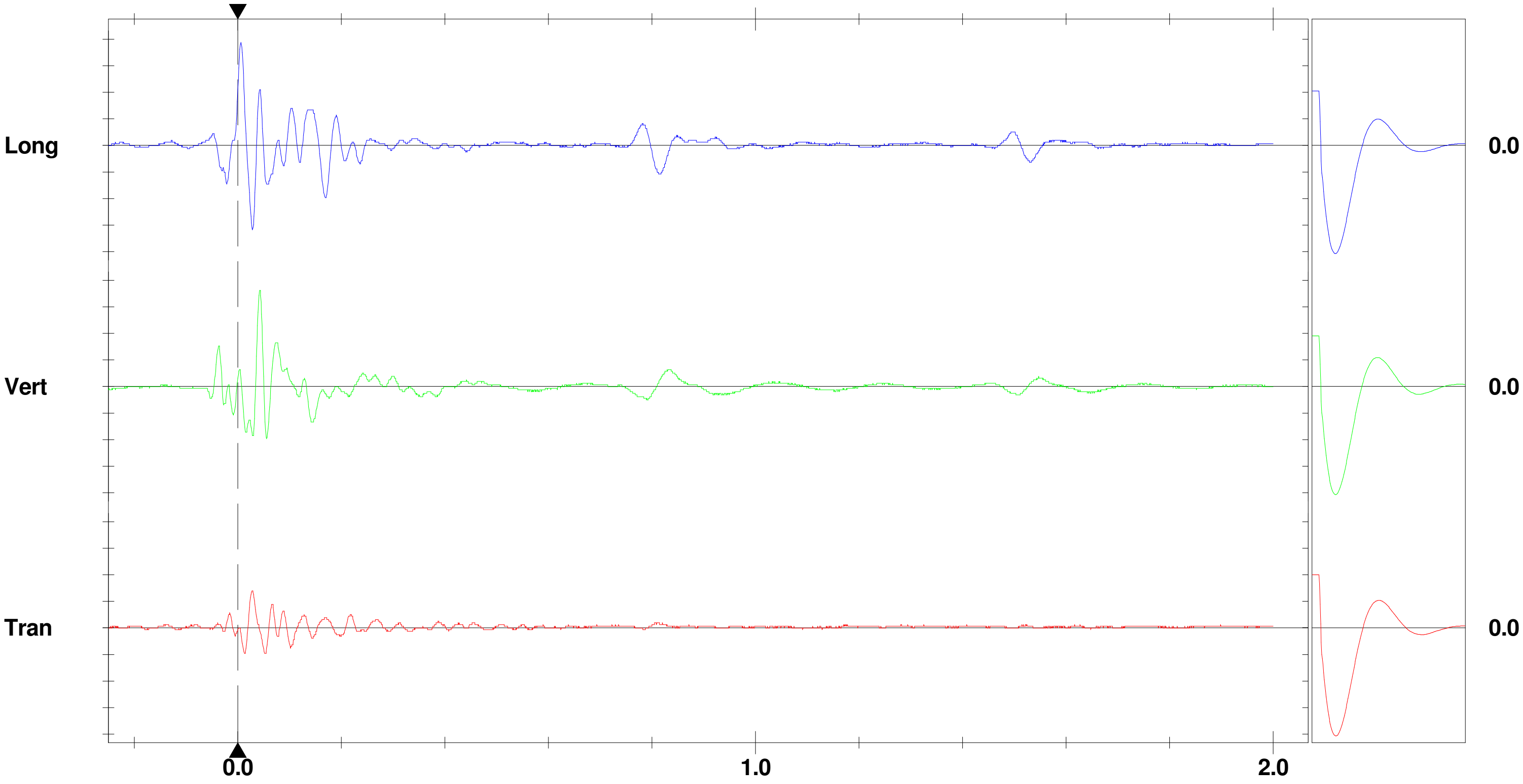
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	2.79	7.24	7.75	mm/s
ZC Freq	23	32	18	Hz
Time (Rel. to Trig)	0.027	0.042	0.006	sec
Peak Acceleration	0.0530	0.133	0.133	g
Peak Displacement	0.0167	0.0356	0.0502	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 8.37 mm/s at 0.043 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Instantel

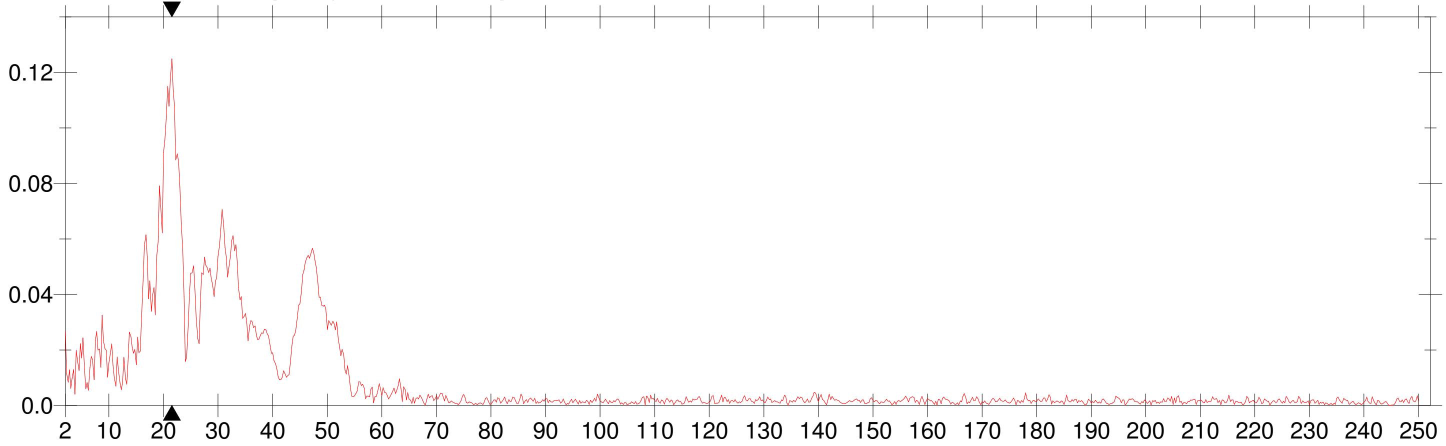
FFT Report

Date/Time Long at 12:58:29 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

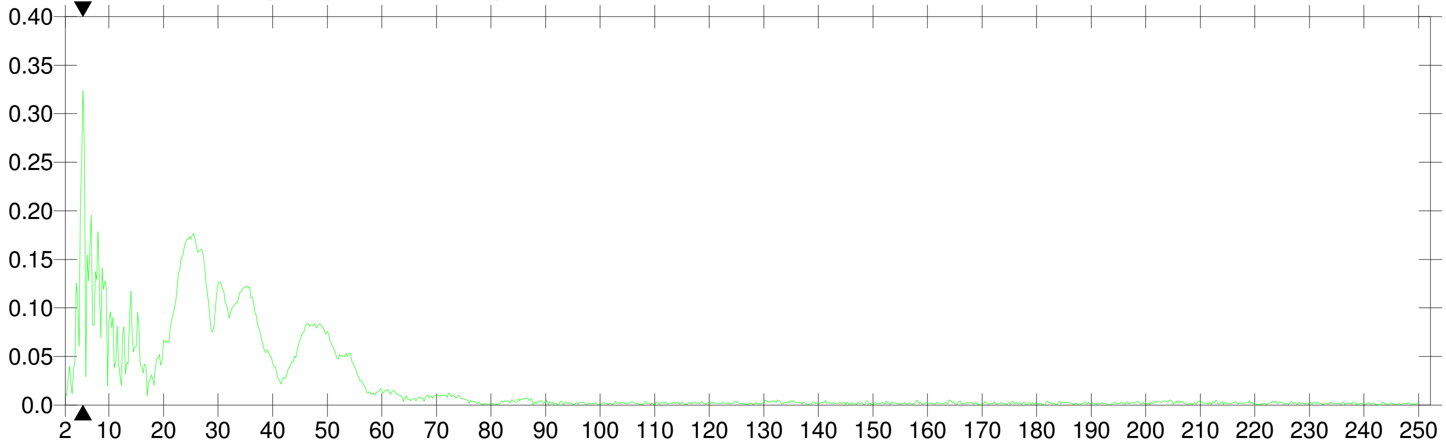
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQK.1H0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

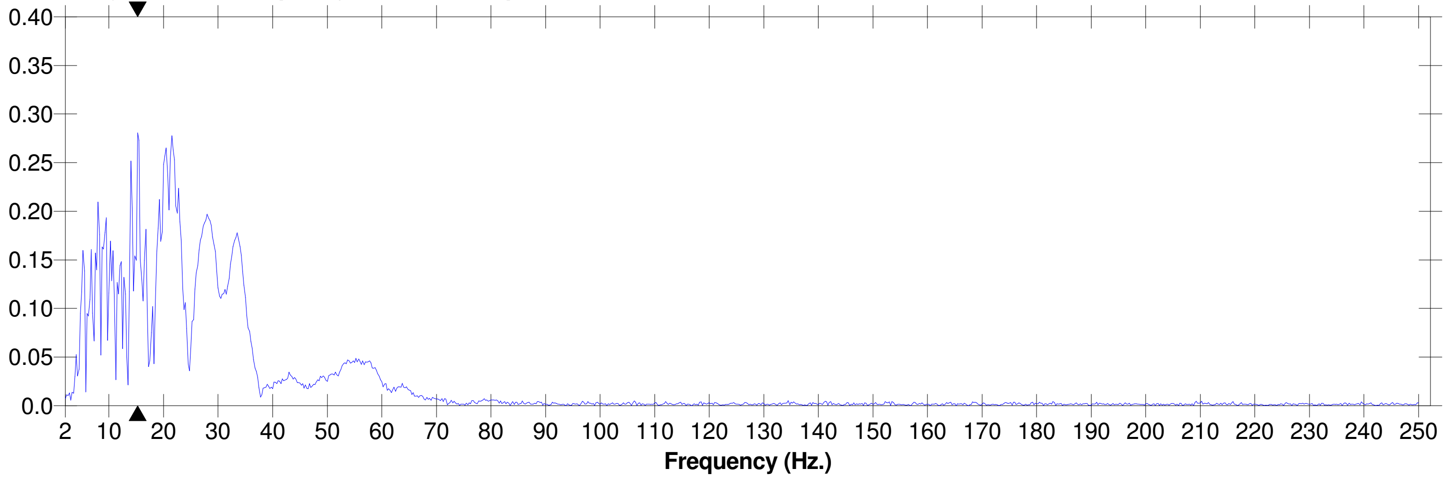
Tran Dominant Frequency = 21.5 Hz., Amplitude = 0.125, PPV from Event = 2.79 mm/s



Vert Dominant Frequency = 5.25 Hz., Amplitude = 0.324, PPV from Event = 7.24 mm/s



Long Dominant Frequency = 15.3 Hz., Amplitude = 0.281, PPV from Event = 7.75 mm/s



Event Report

Date/Time	Long at 12:58:51 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQK.230

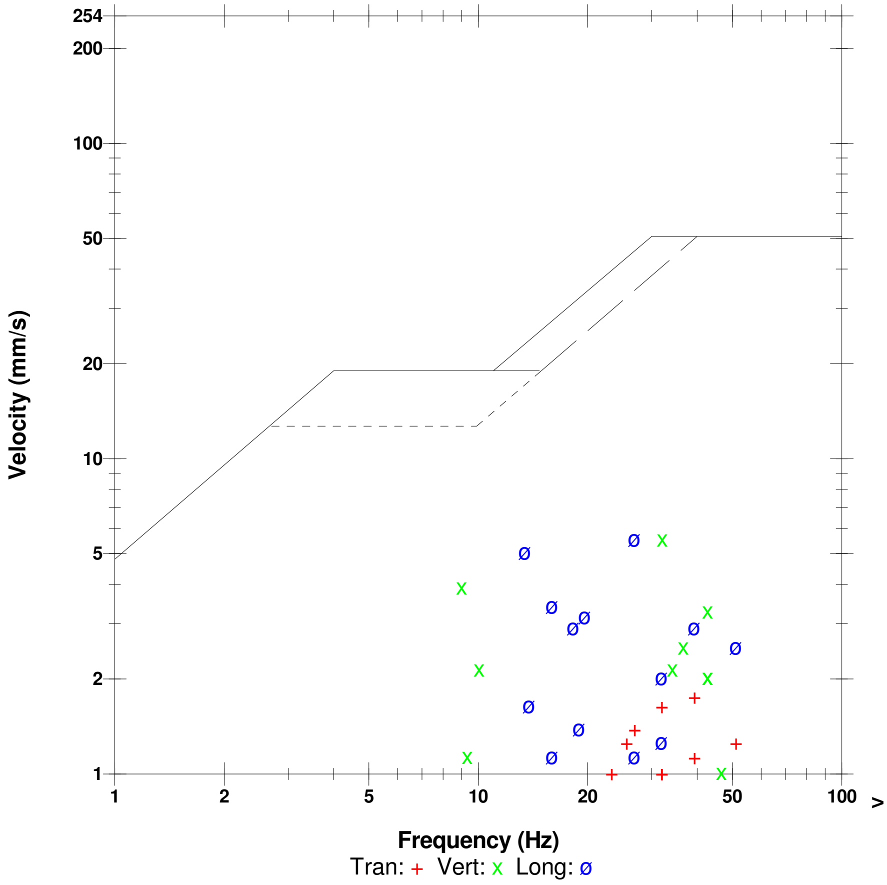
Notes

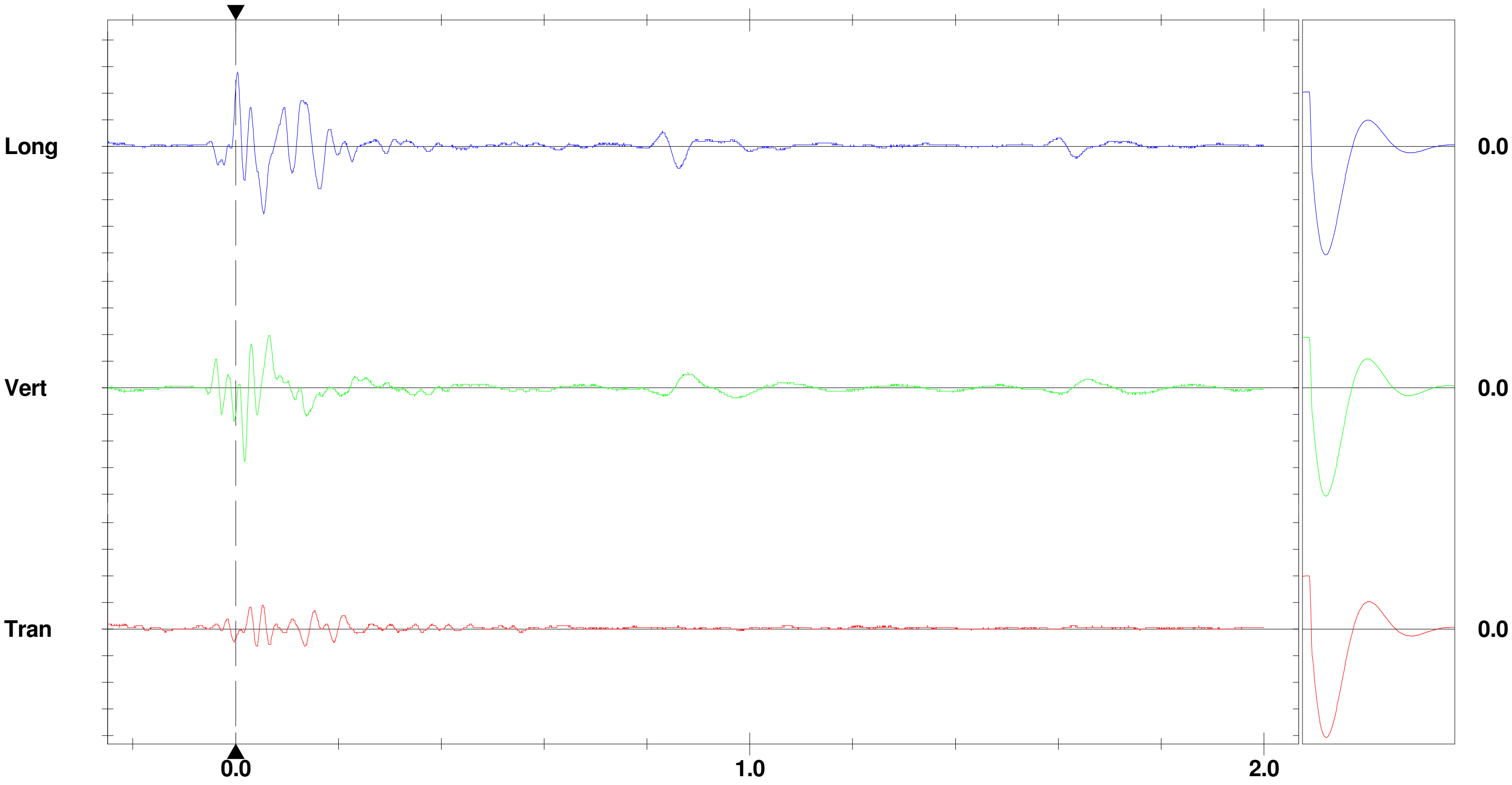
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.78	5.59	5.59	mm/s
ZC Freq	39	32	27	Hz
Time (Rel. to Trig)	0.052	0.018	0.004	sec
Peak Acceleration	0.0398	0.119	0.0928	g
Peak Displacement	0.00819	0.0400	0.0449	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 6.14 mm/s at 0.018 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶—— ——◀

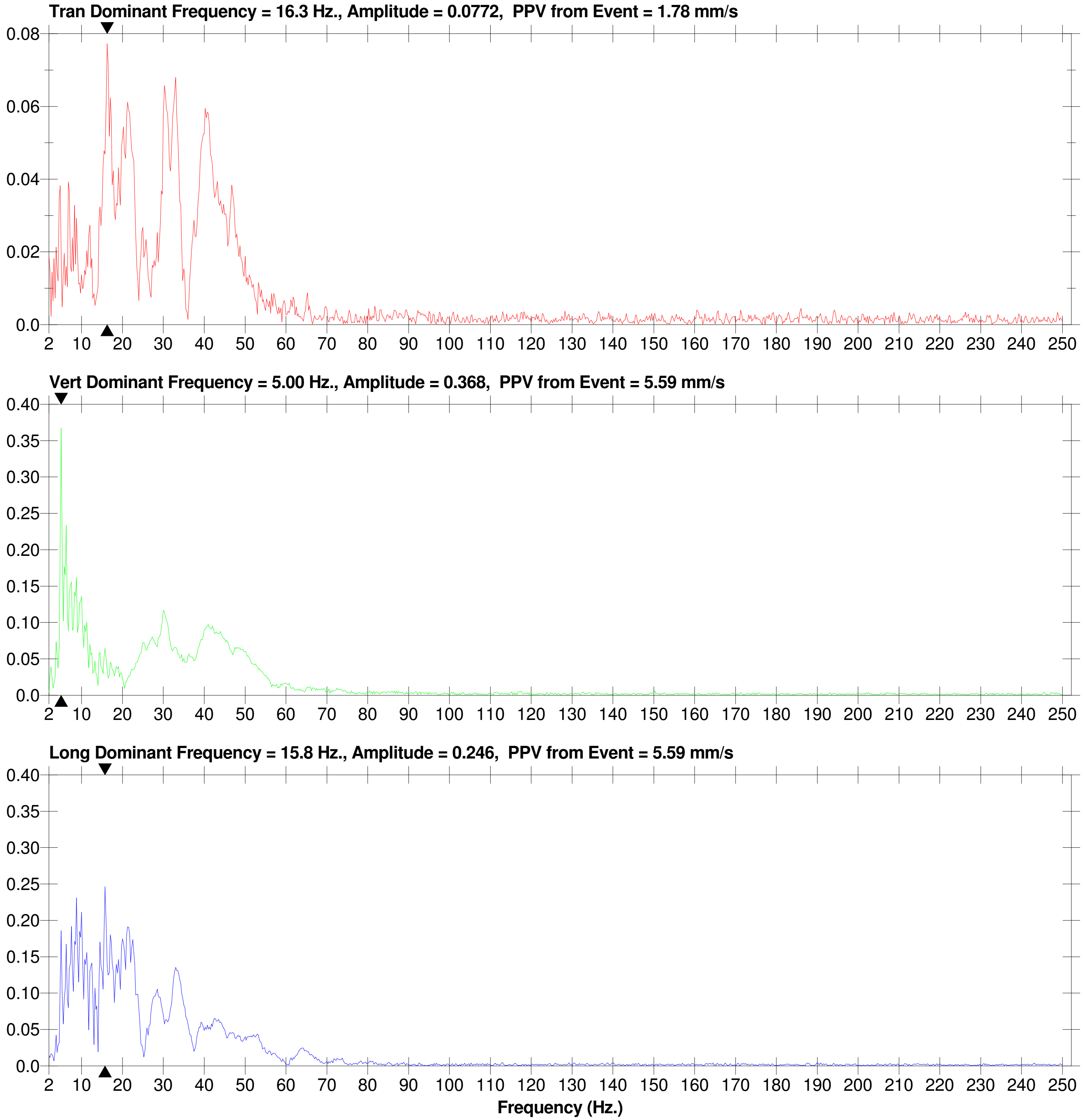
Sensor Check

FFT Report

Date/Time	Long at 12:58:51 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQK.230

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent



Event Report

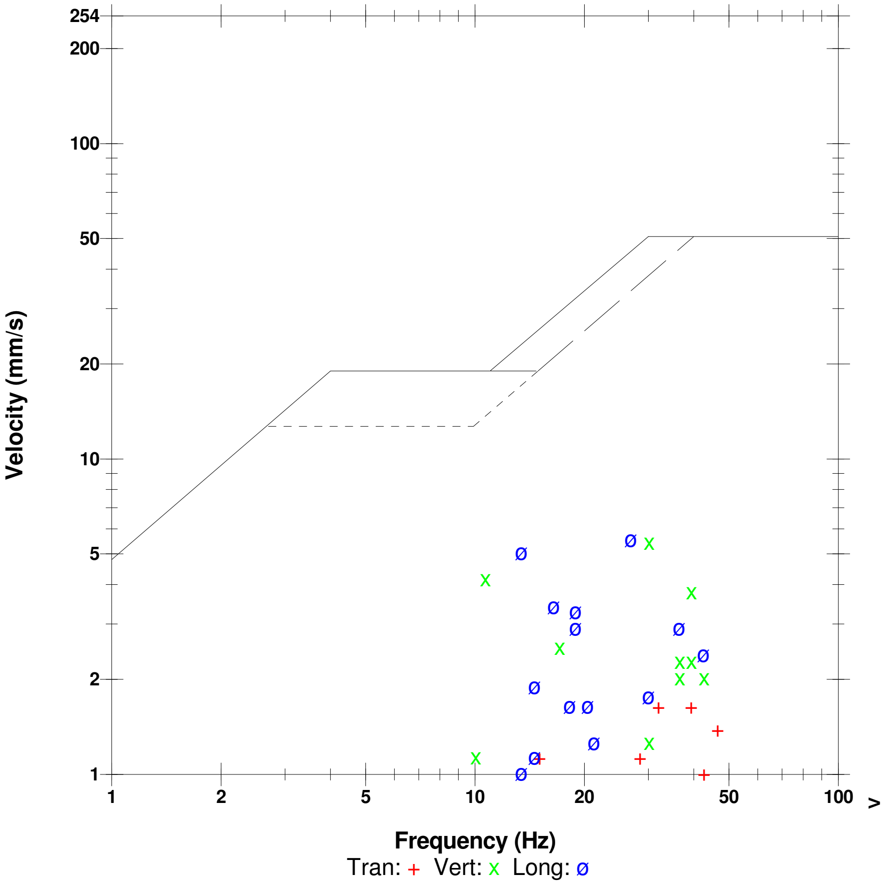
Date/Time Long at 12:59:01 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

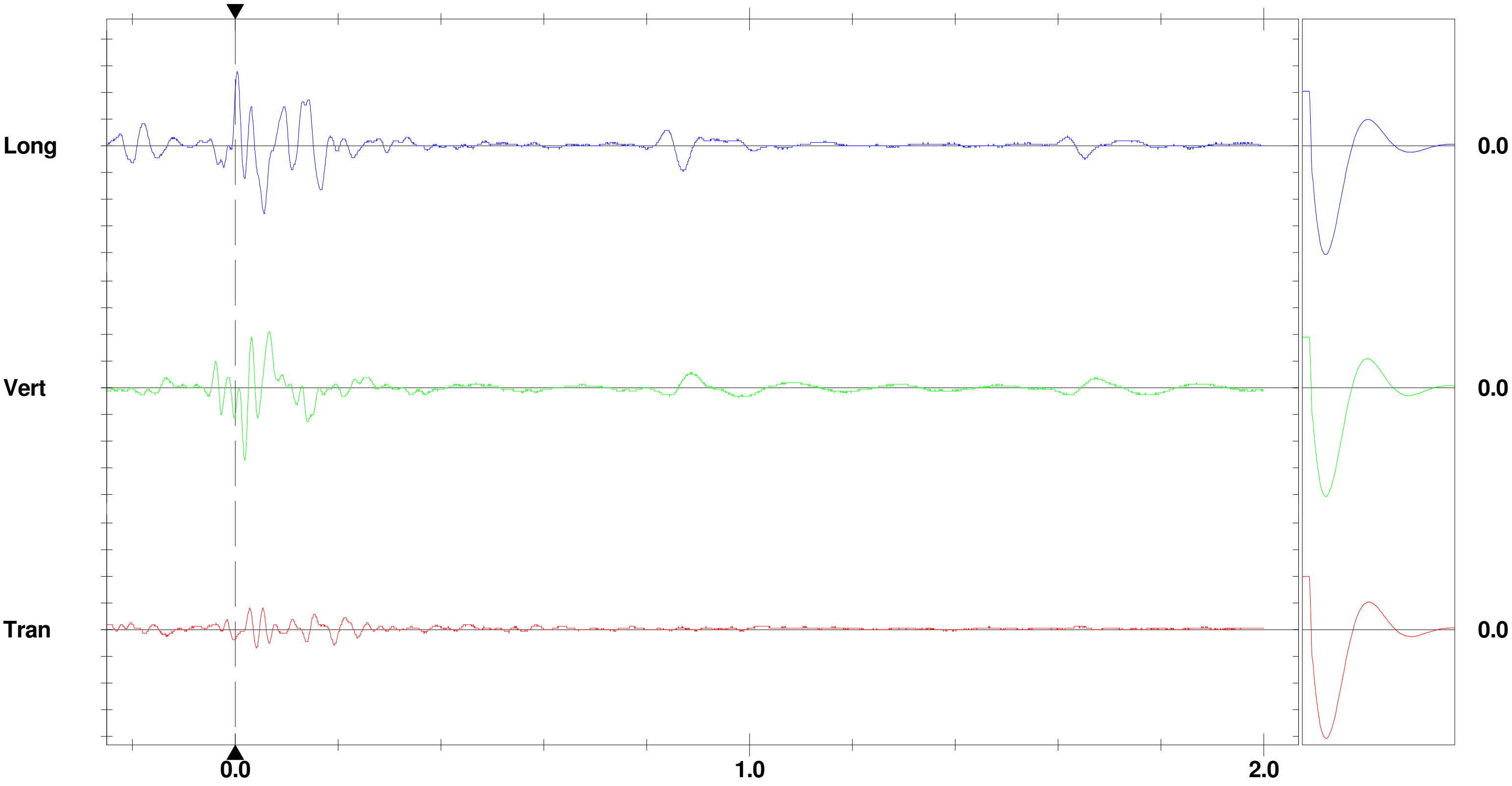
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQK.2D0

	Tran	Vert	Long	
PPV	1.65	5.46	5.59	mm/s
ZC Freq	32	30	27	Hz
Time (Rel. to Trig)	0.028	0.019	0.004	sec
Peak Acceleration	0.0398	0.119	0.106	g
Peak Displacement	0.00905	0.0405	0.0451	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 5.97 mm/s at 0.019 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶—— ——◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Instantel

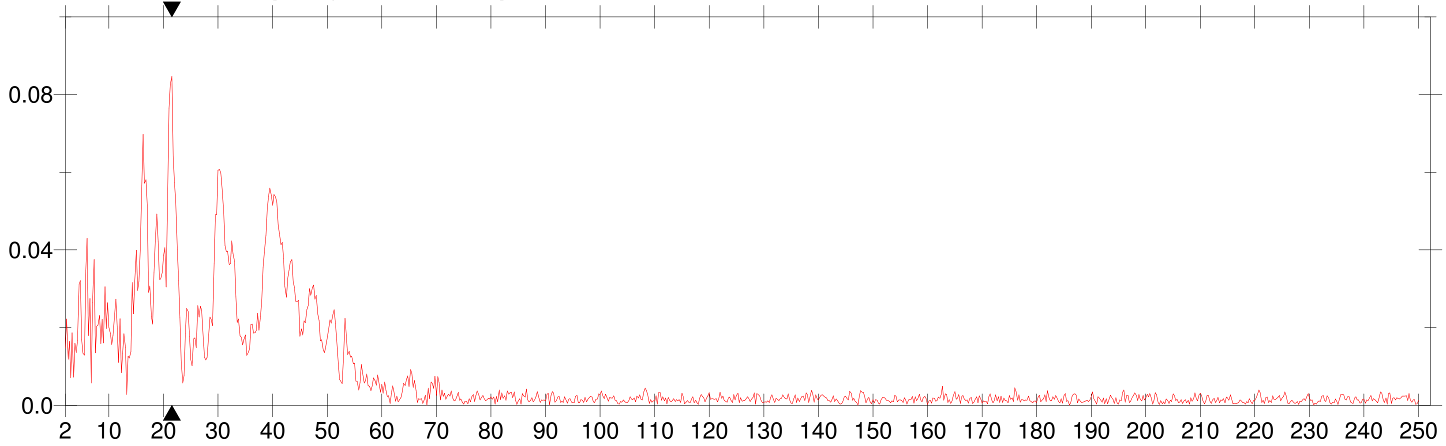
FFT Report

Date/Time	Long at 12:59:01 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQK.2D0

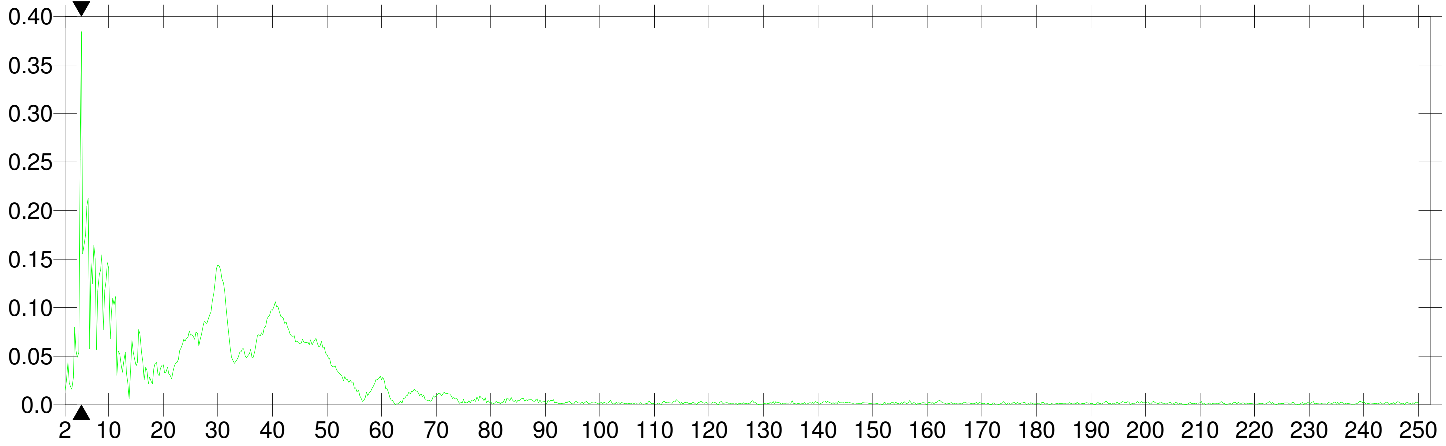
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

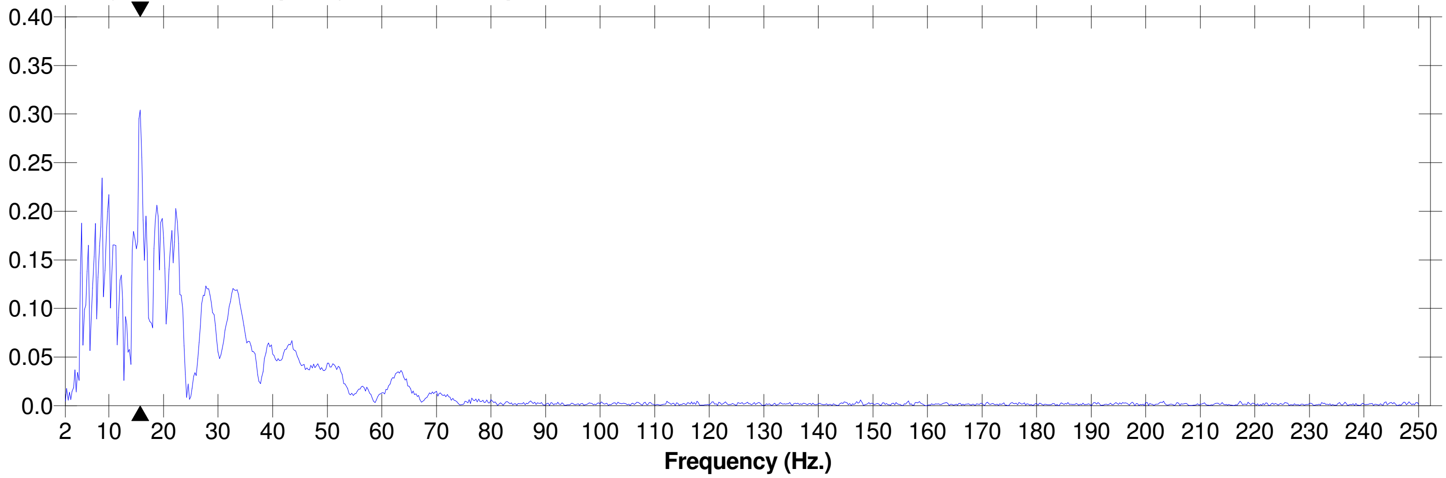
Tran Dominant Frequency = 21.5 Hz., Amplitude = 0.0847, PPV from Event = 1.65 mm/s



Vert Dominant Frequency = 5.00 Hz., Amplitude = 0.384, PPV from Event = 5.46 mm/s



Long Dominant Frequency = 15.8 Hz., Amplitude = 0.304, PPV from Event = 5.59 mm/s



Event Report

Date/Time	Long at 12:59:11 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQK.2N0

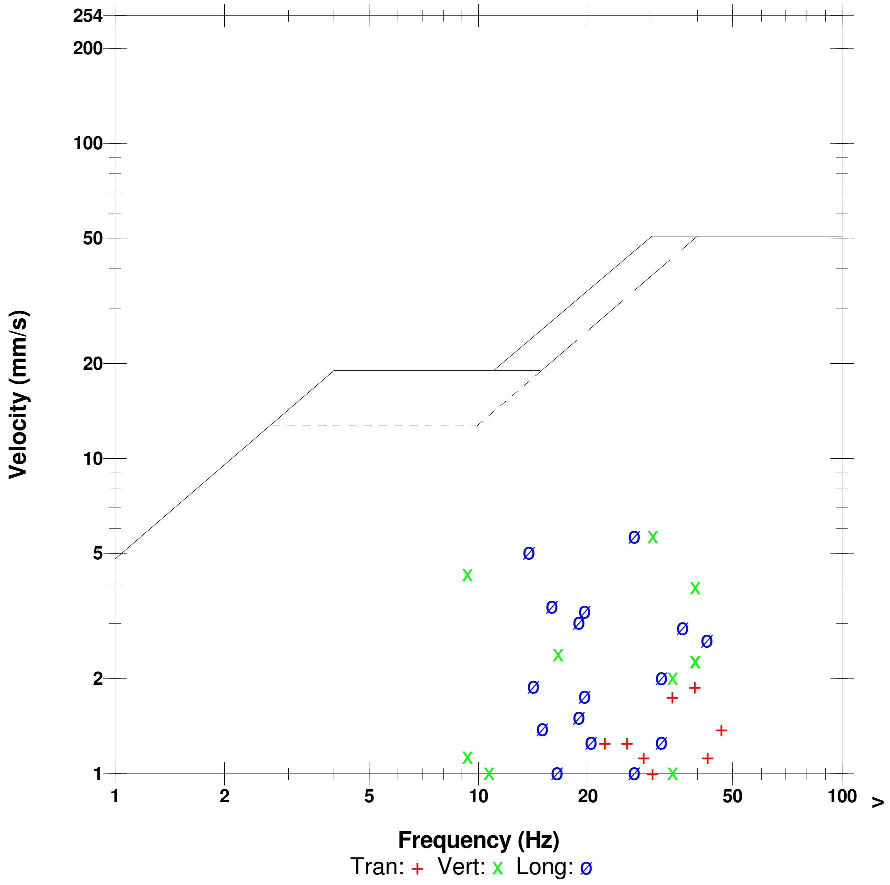
Notes

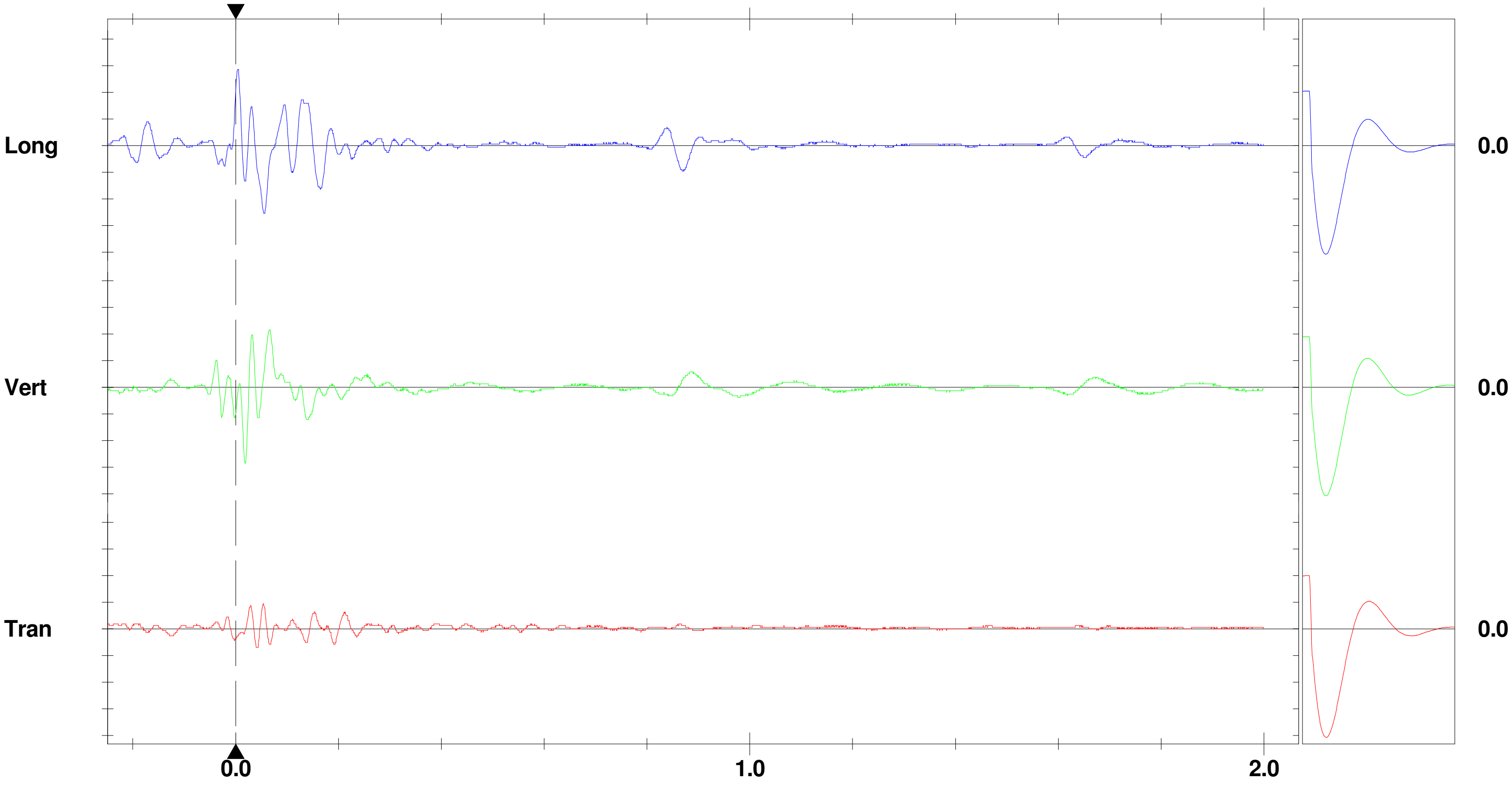
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.90	5.71	5.71	mm/s
ZC Freq	39	30	27	Hz
Time (Rel. to Trig)	0.054	0.019	0.004	sec
Peak Acceleration	0.0530	0.119	0.106	g
Peak Displacement	0.00862	0.0418	0.0450	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 6.31 mm/s at 0.019 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

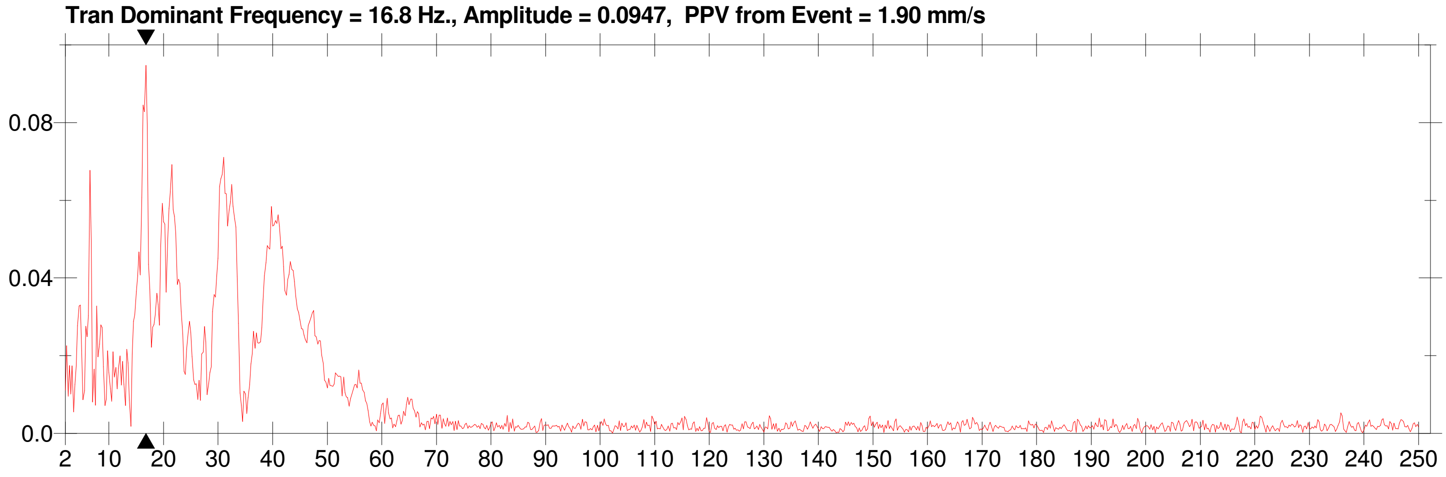
Printed: April 24, 2017 (V 10.60 - 10.60)

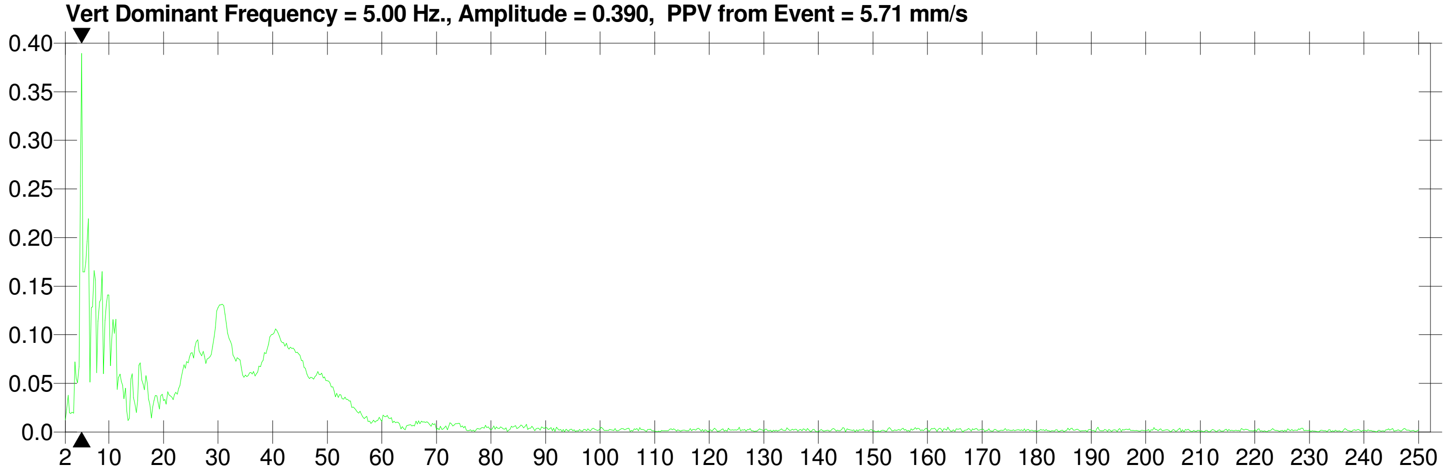
FFT Report

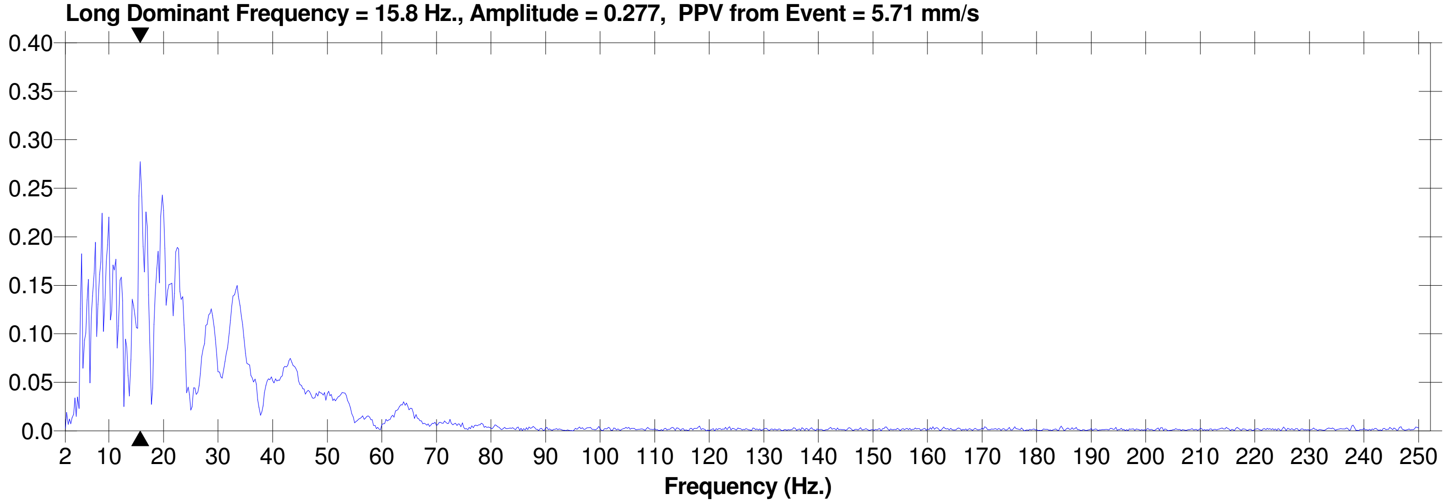
Date/Time Long at 12:59:11 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQK.2N0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent


Tran Dominant Frequency = 16.8 Hz., Amplitude = 0.0947, PPV from Event = 1.90 mm/s


Vert Dominant Frequency = 5.00 Hz., Amplitude = 0.390, PPV from Event = 5.71 mm/s


Long Dominant Frequency = 15.8 Hz., Amplitude = 0.277, PPV from Event = 5.71 mm/s

Event Report

Histogram Start Time	13:10:17 March 29, 2017
Histogram Finish Time	13:16:43 March 29, 2017
Number of Intervals	193.00 at 2 seconds
Range	Geo:254 mm/s
Sample Rate	1024sps

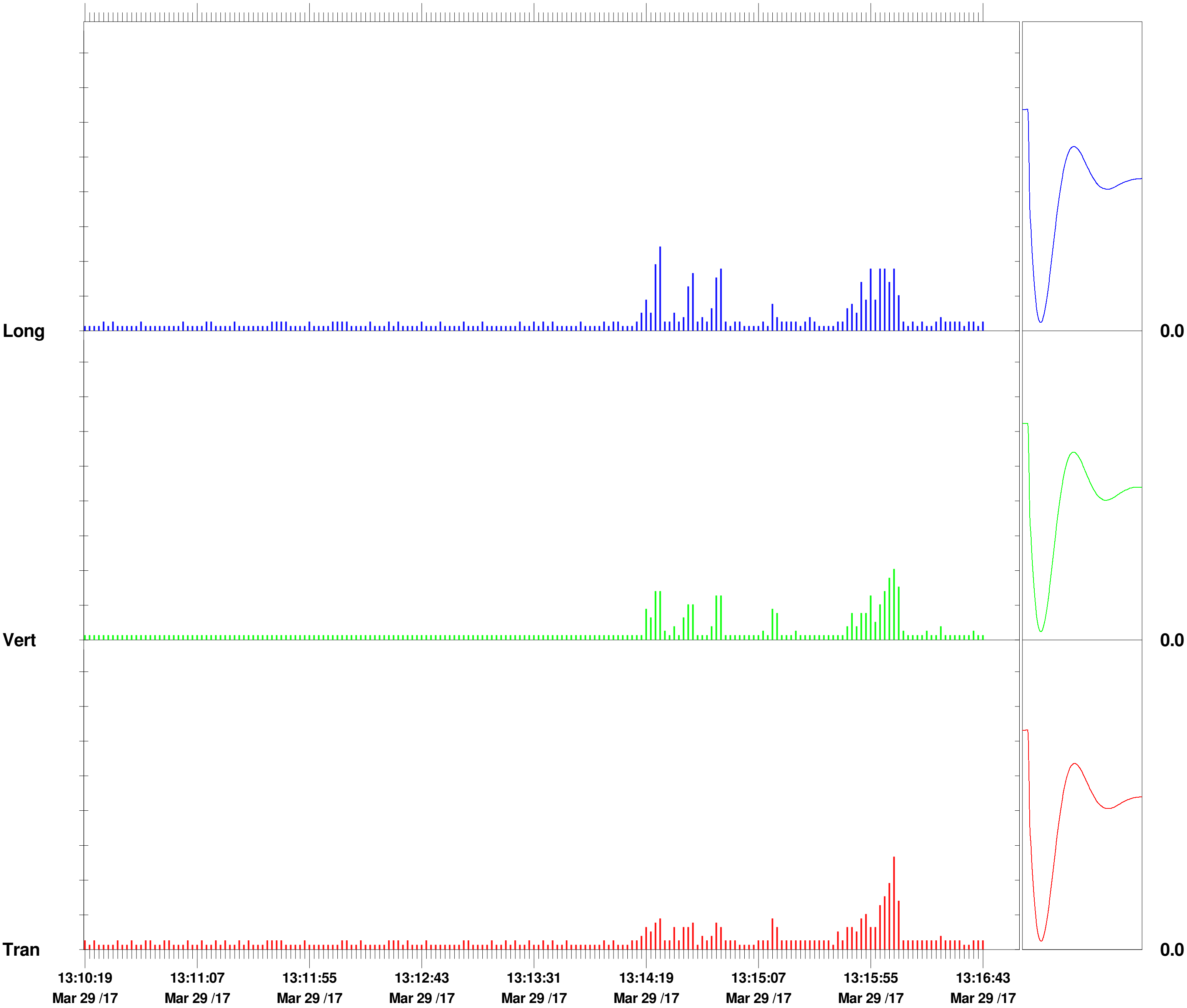
Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQK.L50

Notes

Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

	Tran	Vert	Long	
PPV	2.67	2.03	2.41	mm/s
ZC Freq	43	39	13	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	13:16:05	13:16:05	13:14:25	
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 3.17 mm/s on March 29, 2017 at 13:16:05



Time Scale: 2 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Event Report

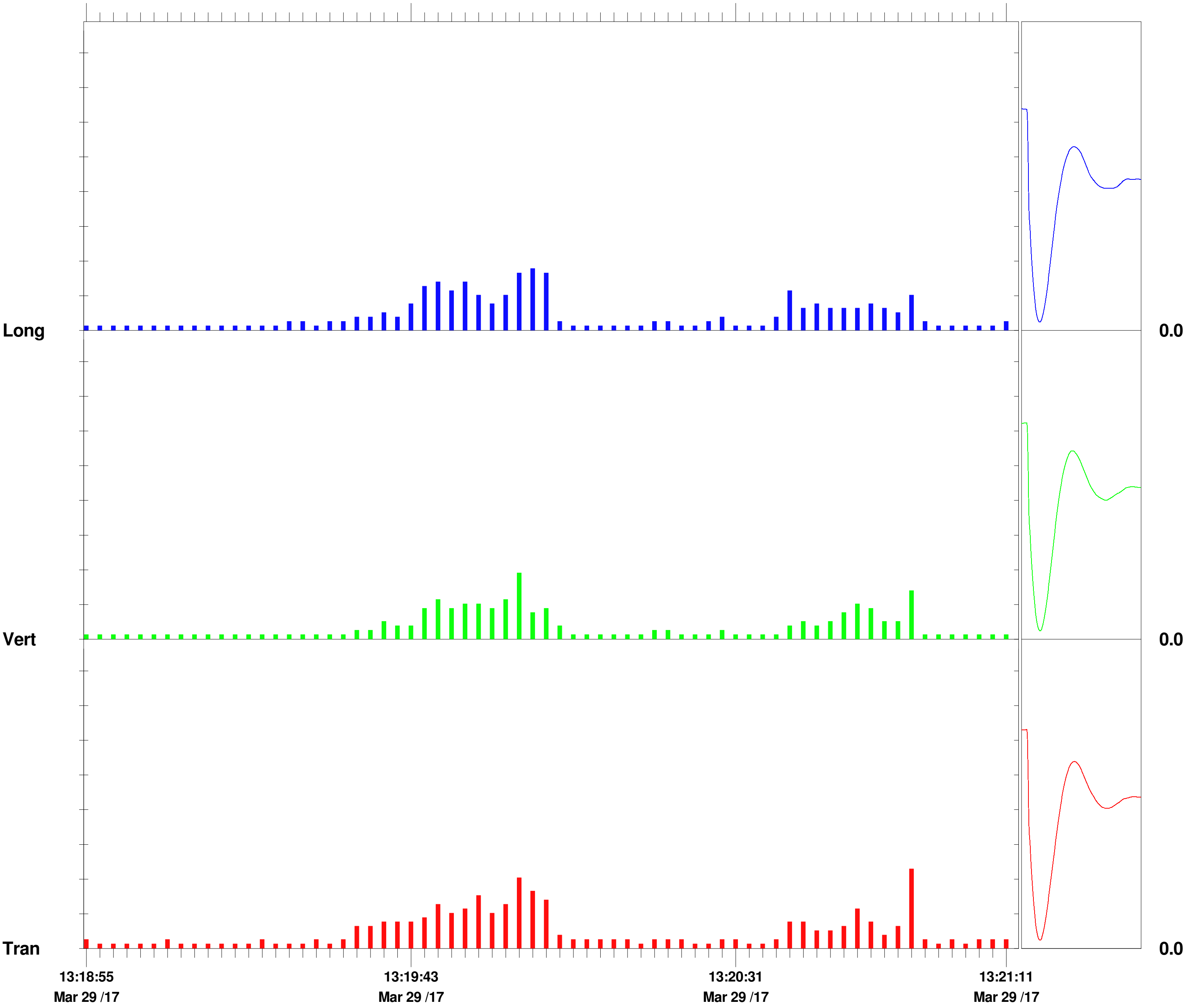
Histogram Start Time	13:18:53 March 29, 2017		**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	13:21:12 March 29, 2017		**Battery Level**	6.2 Volts
Number of Intervals	69.00 at 2 seconds		**Unit Calibration**	February 22, 2017 by Instantel
Range	Geo:254 mm/s		**File Name**	Q696GTQK.ZH0
Sample Rate	1024sps			

Notes

Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

	Tran	Vert	Long	
PPV	2.29	1.90	1.78	mm/s
ZC Freq	37	43	24	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	13:20:57	13:19:59	13:20:01	
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.6	7.5	Hz
Overswing Ratio	3.8	3.7	4.2	

Peak Vector Sum 2.40 mm/s on March 29, 2017 at 13:19:59



Time Scale: 2 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Event Report

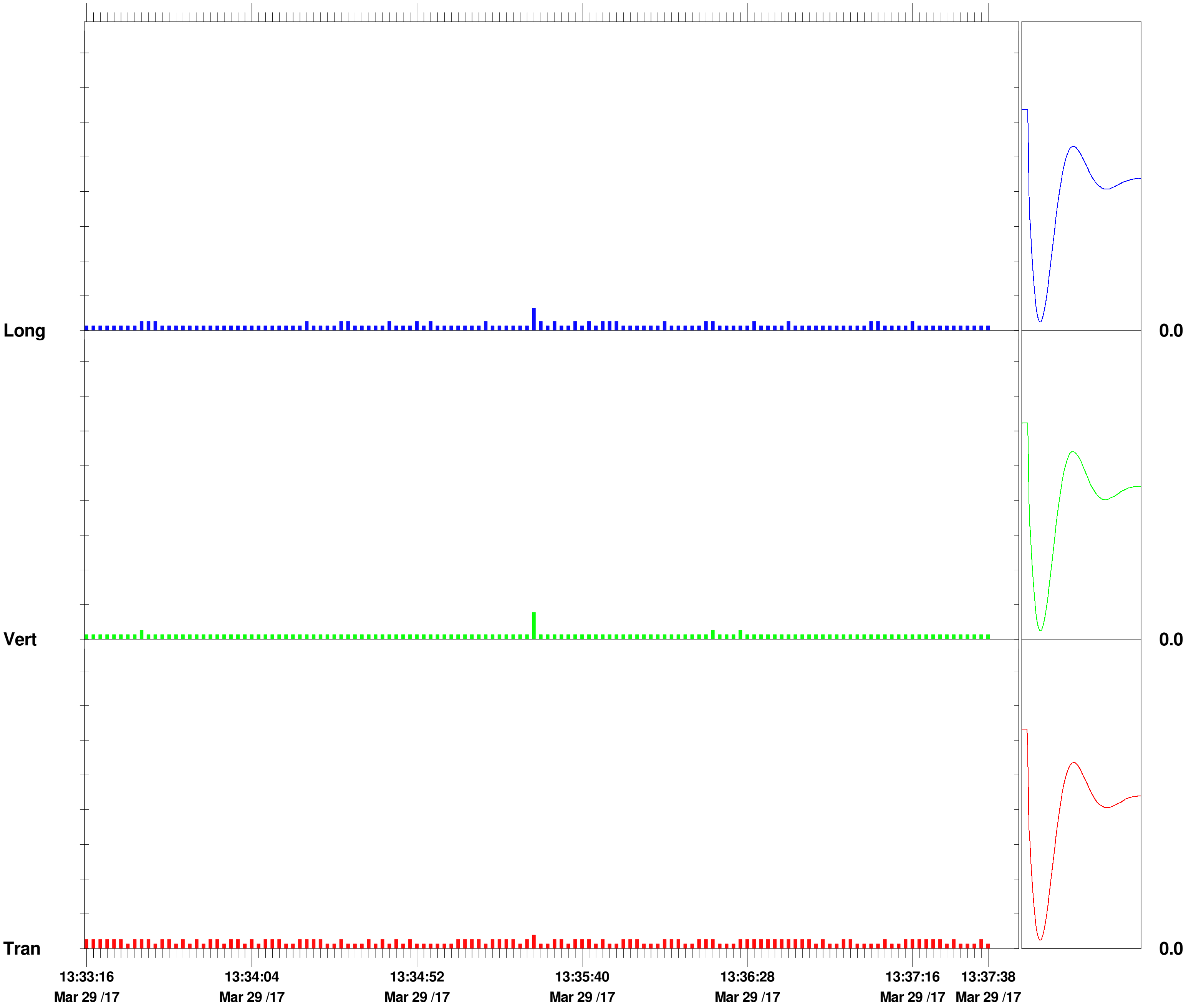
Histogram Start Time	13:33:14 March 29, 2017		**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	13:37:40 March 29, 2017		**Battery Level**	6.2 Volts
Number of Intervals	132.00 at 2 seconds		**Unit Calibration**	February 22, 2017 by Instantel
Range	Geo:254 mm/s		**File Name**	Q696GTQL.NE0
Sample Rate	1024sps			

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	0.381	0.762	0.635	mm/s
ZC Freq	57	43	43	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	13:35:26	13:35:26	13:35:26	
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 0.773 mm/s on March 29, 2017 at 13:35:26



Time Scale: 2 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Event Report

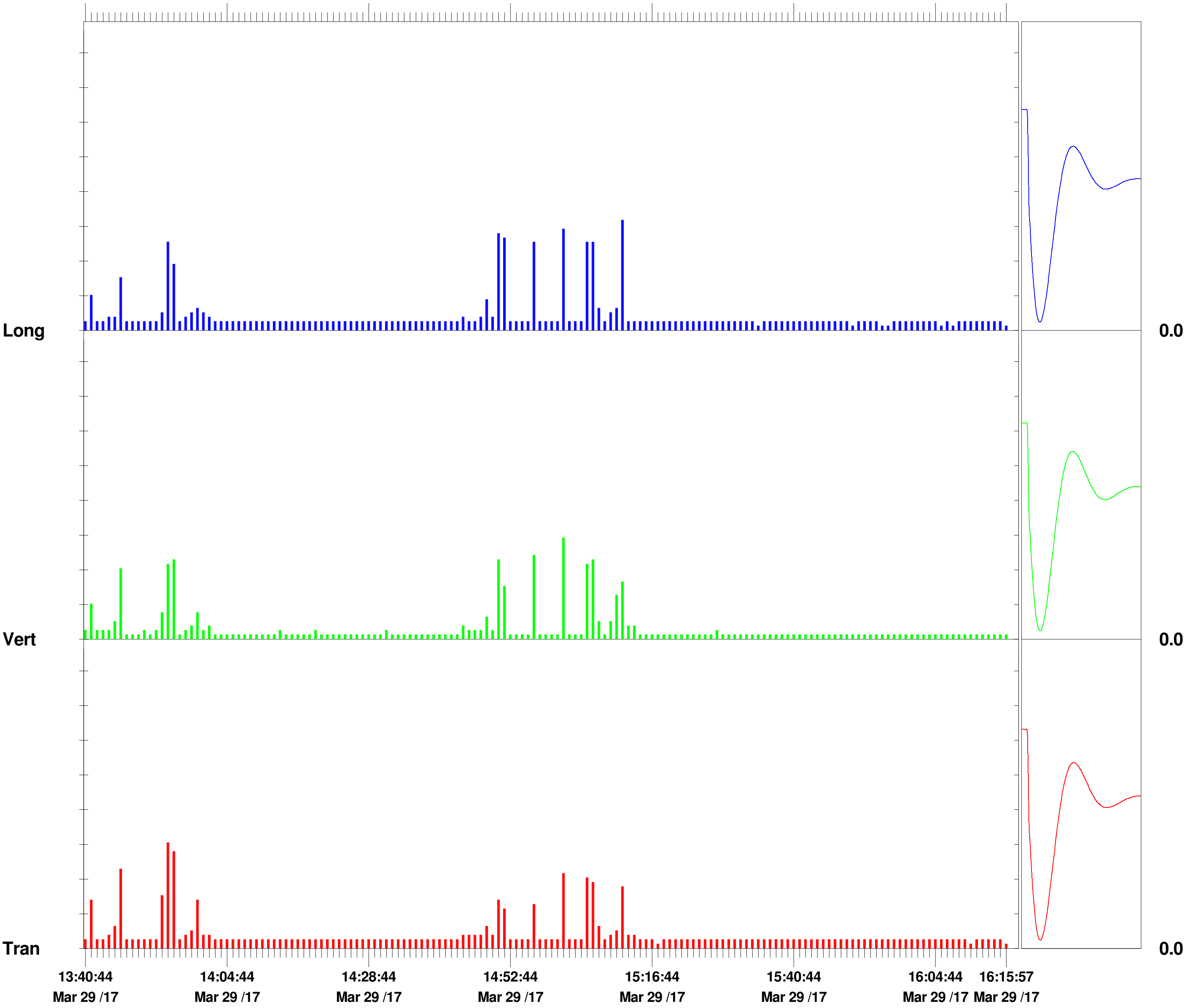
Histogram Start Time	13:39:44 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	16:15:57 March 29, 2017	**Battery Level**	6.2 Volts
Number of Intervals	4686.00 at 2 seconds	**Unit Calibration**	February 22, 2017 by Instantel
Range	Geo:254 mm/s	**File Name**	Q696GTQL.Y80
Sample Rate	1024sps		

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	3.05	2.92	3.17	mm/s
ZC Freq	47	27	47	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	13:54:42	15:01:18	15:11:38	
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 3.63 mm/s on March 29, 2017 at 13:54:42



Time Scale: 1 minute /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Instantel

Event Report

Date/Time	Vert at 13:40:44 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQL.ZW0

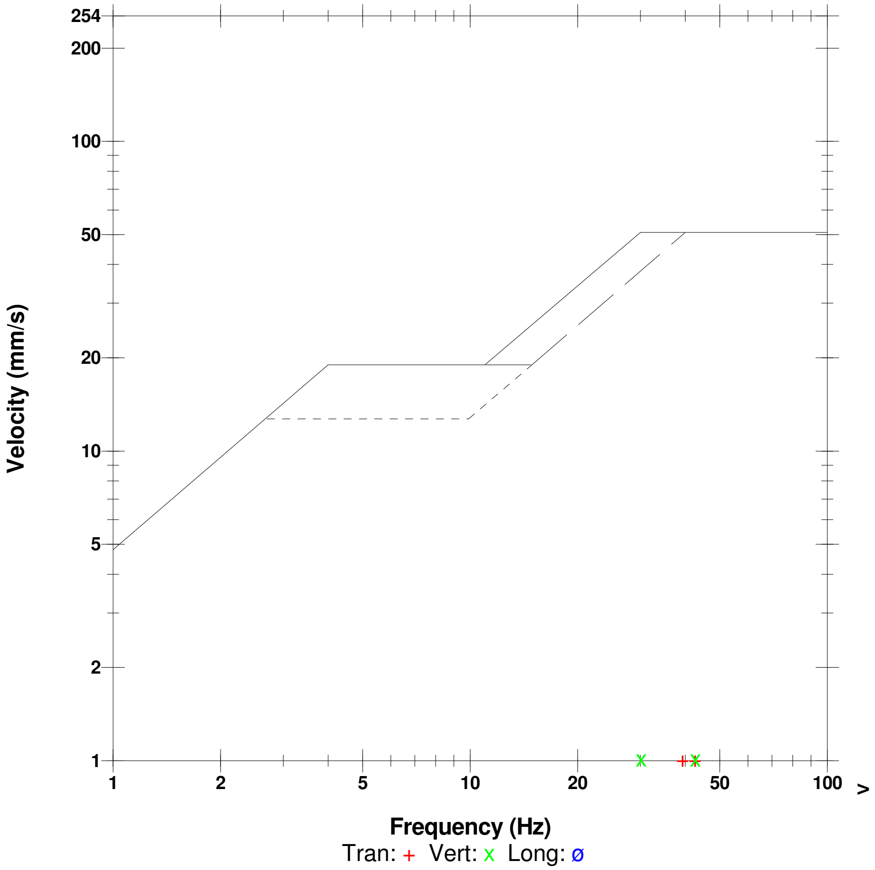
Notes

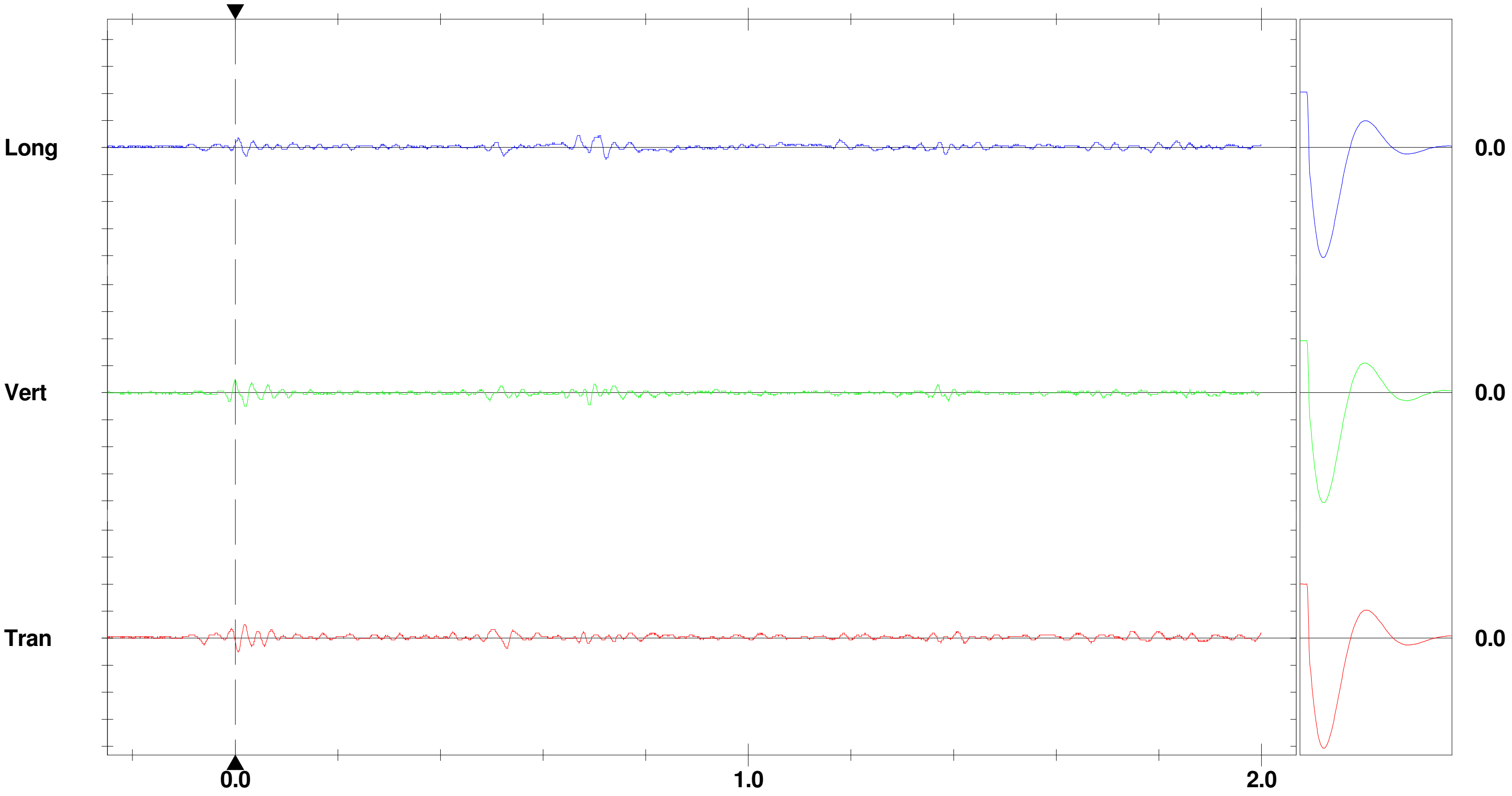
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	**Vert**	**Long**	
PPV	1.02	1.02	0.889	mm/s
ZC Freq	43	43	30	Hz
Time (Rel. to Trig)	0.005	0.000	0.667	sec
Peak Acceleration	0.0265	0.0265	0.0265	g
Peak Displacement	0.00527	0.00515	0.00707	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 1.57 mm/s at 0.020 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

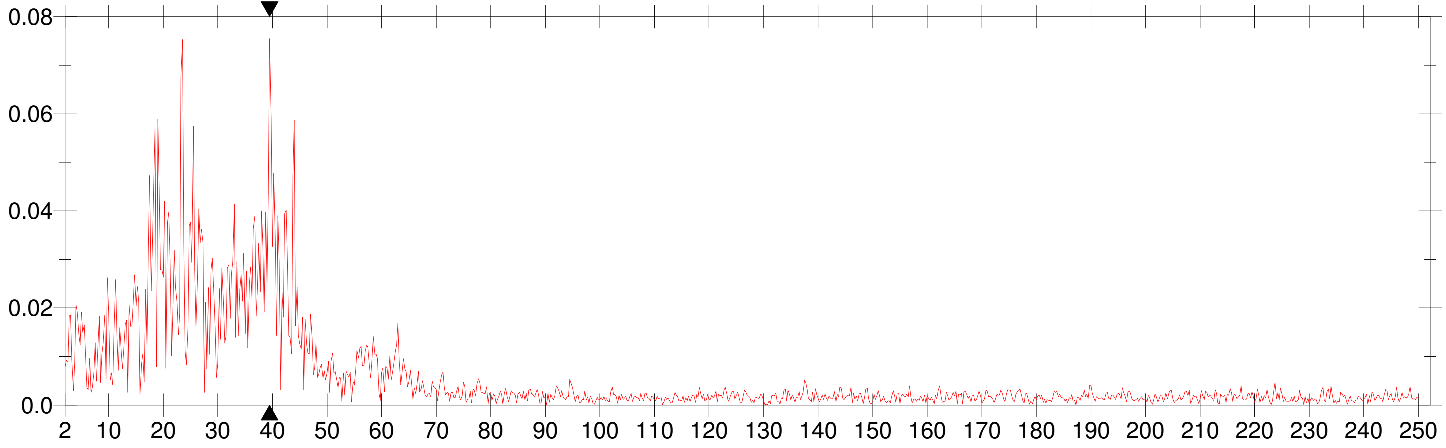
FFT Report

Date/Time	Vert at 13:40:44 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQL.ZW0

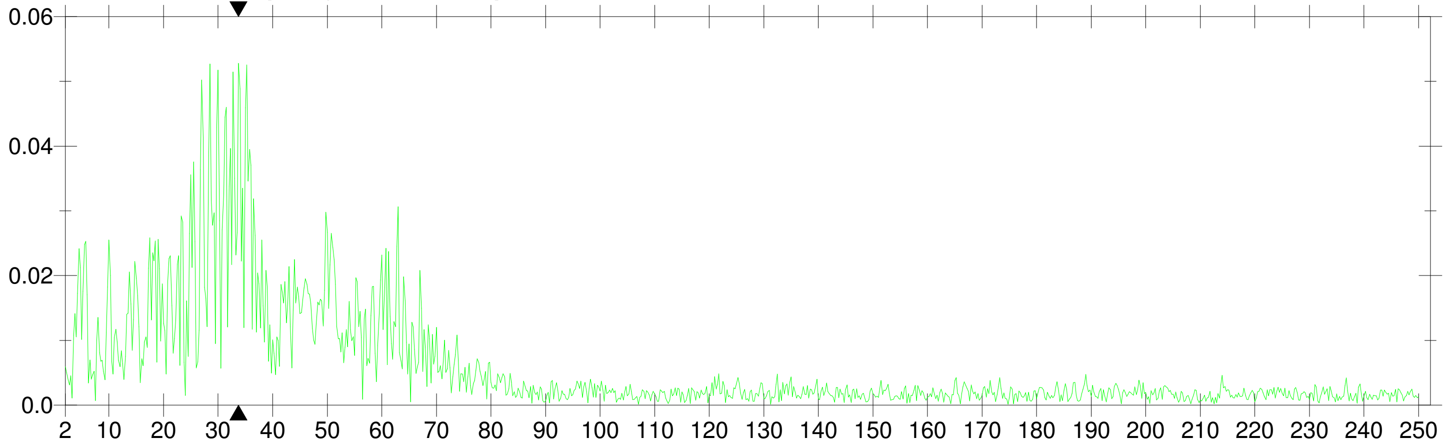
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

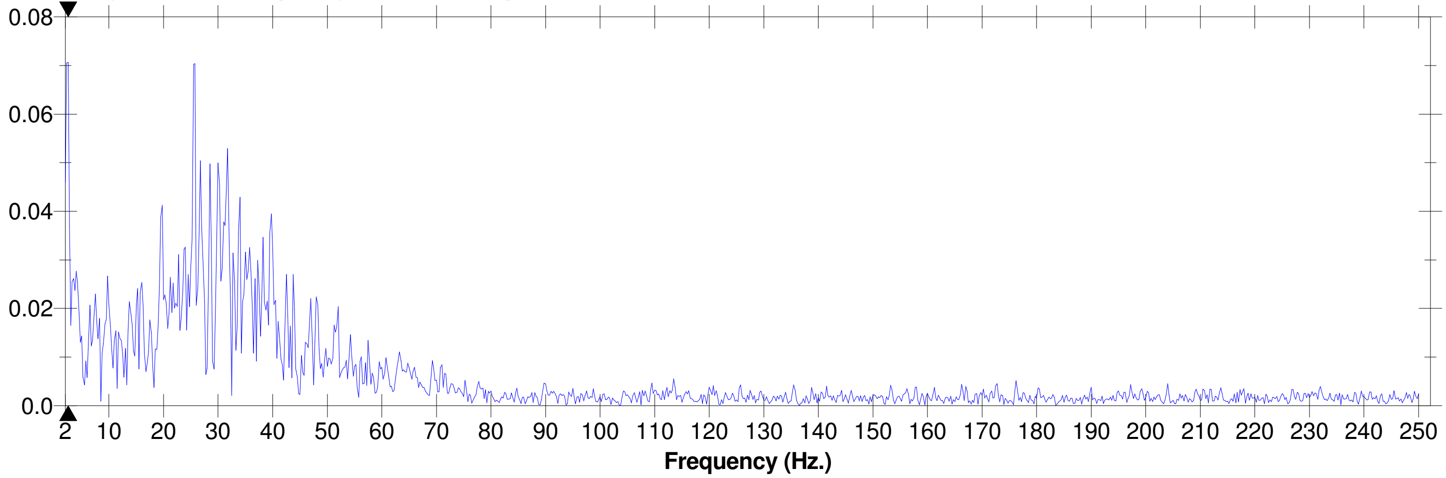
Tran Dominant Frequency = 39.5 Hz., Amplitude = 0.0754, PPV from Event = 1.02 mm/s



Vert Dominant Frequency = 33.8 Hz., Amplitude = 0.0528, PPV from Event = 1.02 mm/s



Long Dominant Frequency = 2.50 Hz., Amplitude = 0.0706, PPV from Event = 0.889 mm/s



Event Report

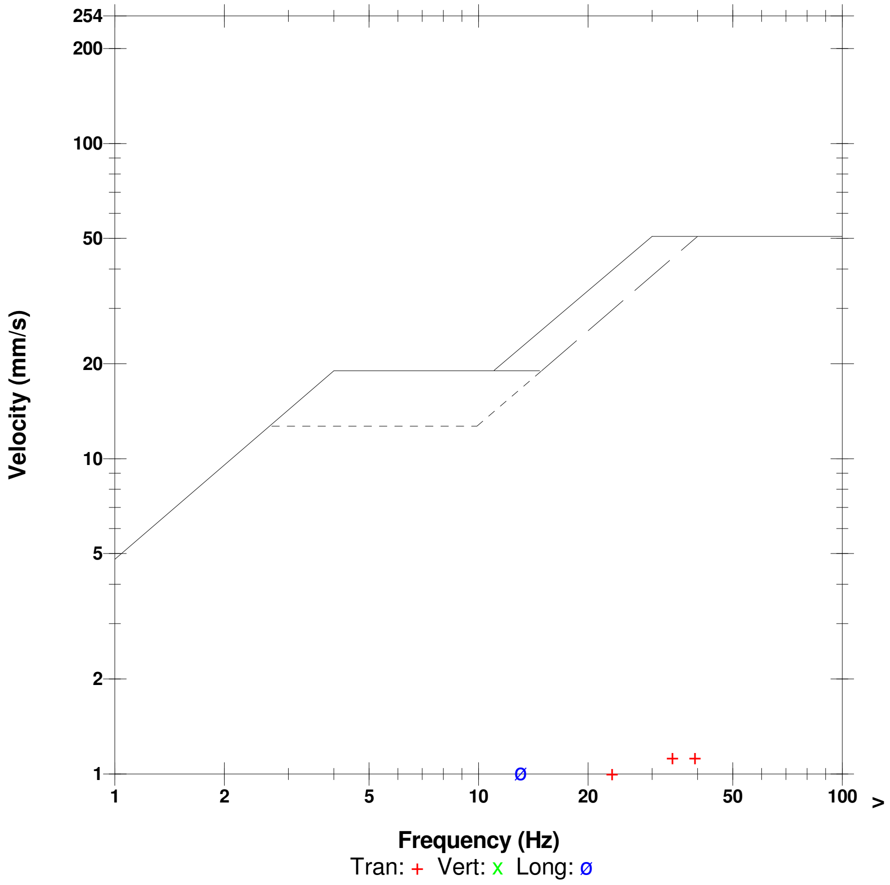
Date/Time Tran at 13:40:57 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

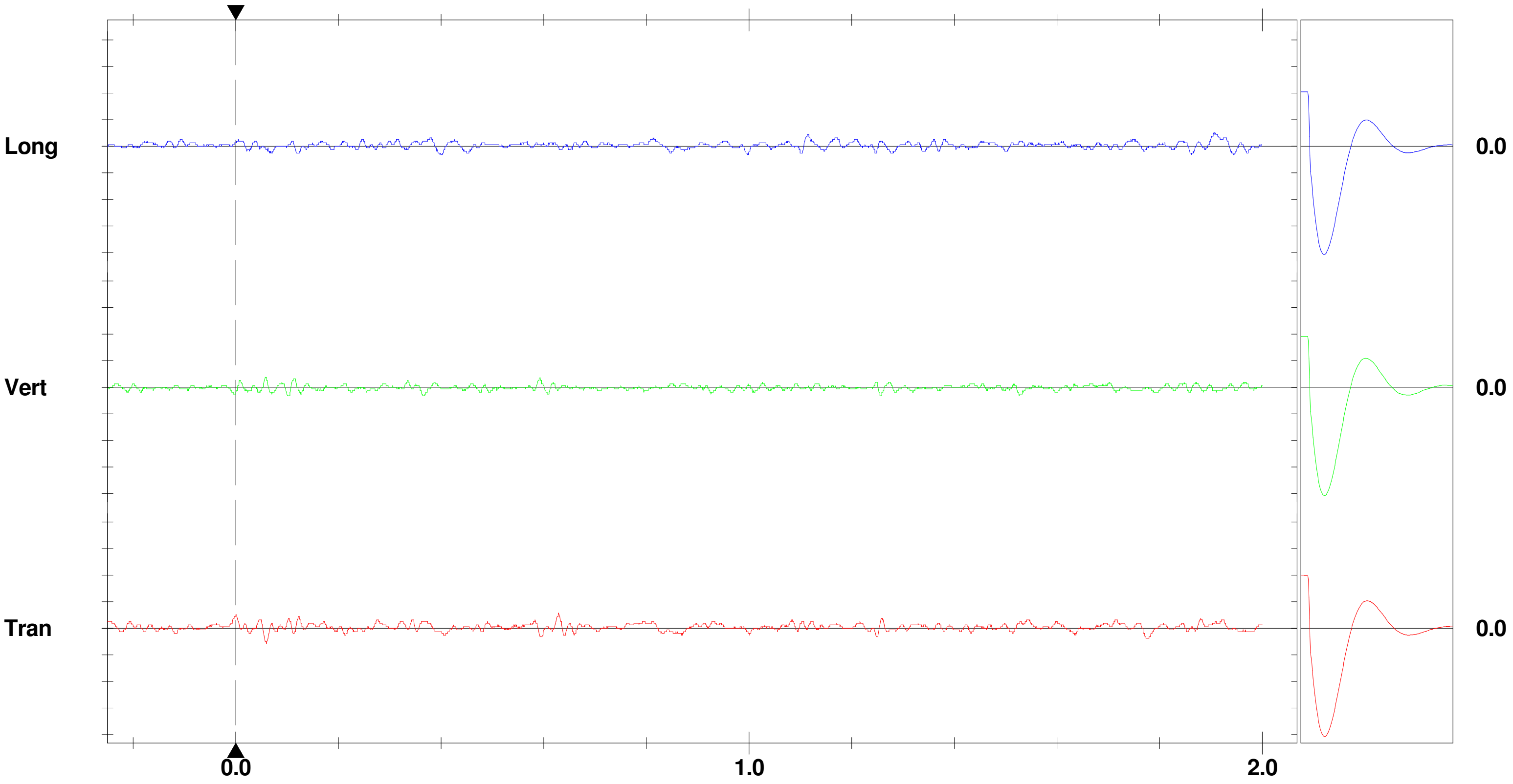
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQM.090

	Tran	Vert	Long	
PPV	1.14	0.762	1.02	mm/s
ZC Freq	39	51	13	Hz
Time (Rel. to Trig)	0.060	0.058	1.905	sec
Peak Acceleration	0.0265	0.0265	0.0265	g
Peak Displacement	0.0115	0.00322	0.0122	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 1.30 mm/s at 0.059 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

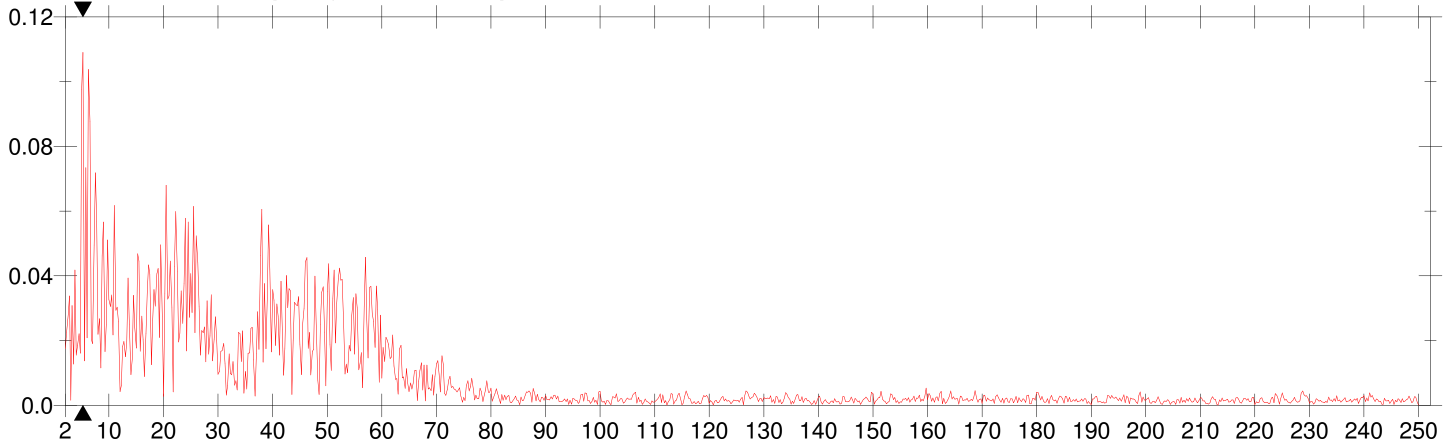
FFT Report

Date/Time	Tran at 13:40:57 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQM.090

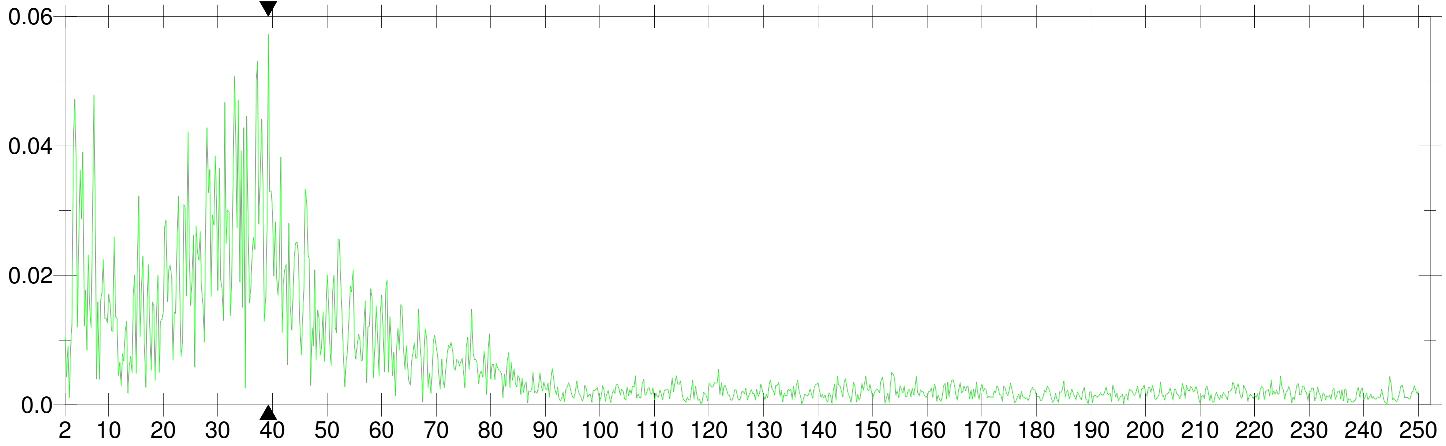
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

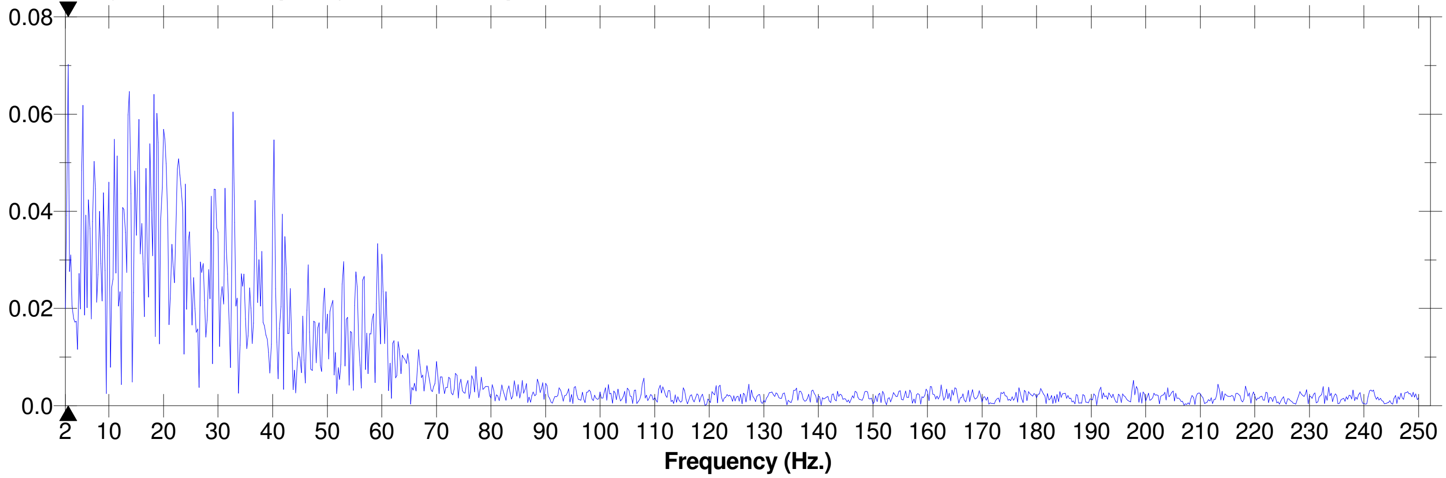
Tran Dominant Frequency = 5.25 Hz., Amplitude = 0.109, PPV from Event = 1.14 mm/s



Vert Dominant Frequency = 39.3 Hz., Amplitude = 0.0572, PPV from Event = 0.762 mm/s



Long Dominant Frequency = 2.50 Hz., Amplitude = 0.0702, PPV from Event = 1.02 mm/s



Event Report

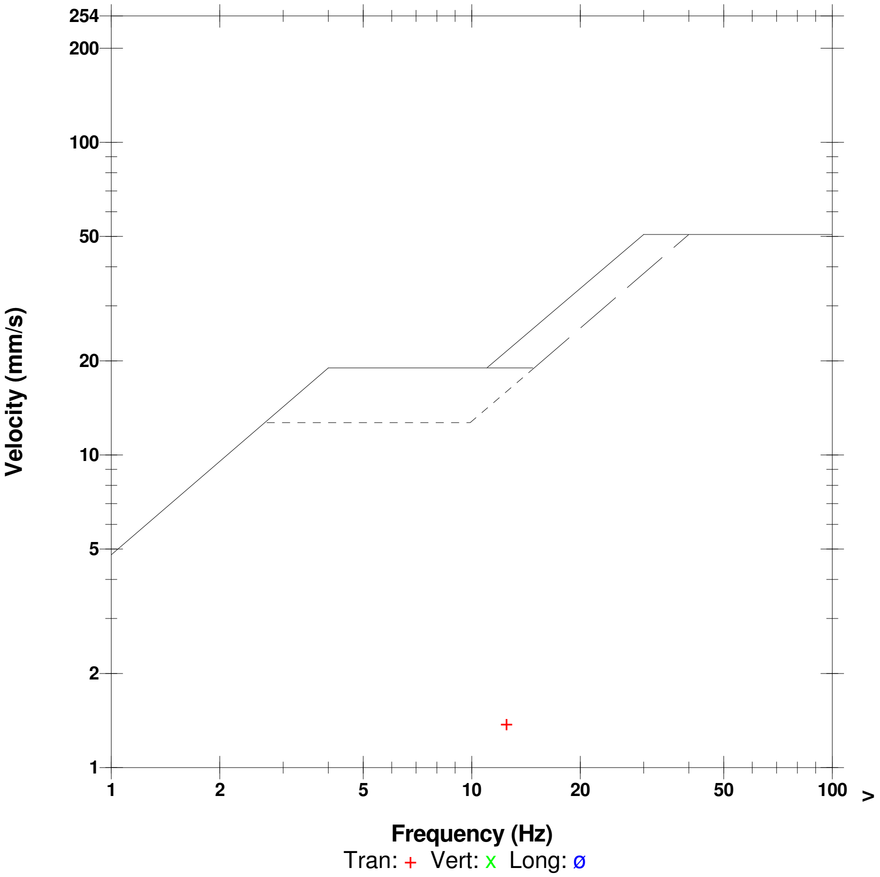
Date/Time Tran at 13:41:01 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

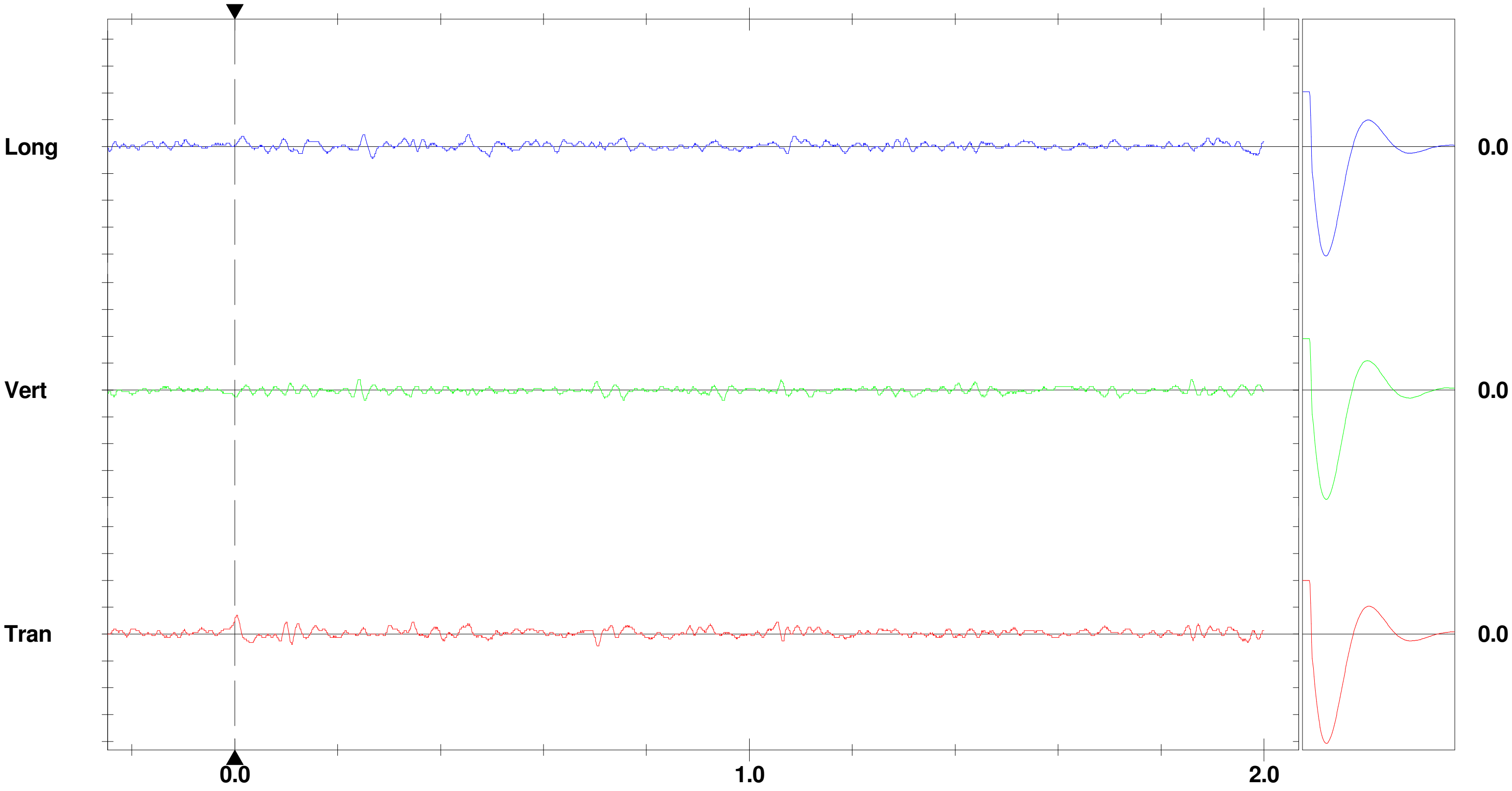
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQM.0D0

	Tran	Vert	Long	
PPV	1.40	0.762	0.889	mm/s
ZC Freq	12	43	34	Hz
Time (Rel. to Trig)	0.003	0.239	0.249	sec
Peak Acceleration	0.0265	0.0265	0.0398	g
Peak Displacement	0.0127	0.00490	0.00899	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 1.51 mm/s at 0.003 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Trigger = ▶——— ———◀

Printed: April 24, 2017 (V 10.60 - 10.60)

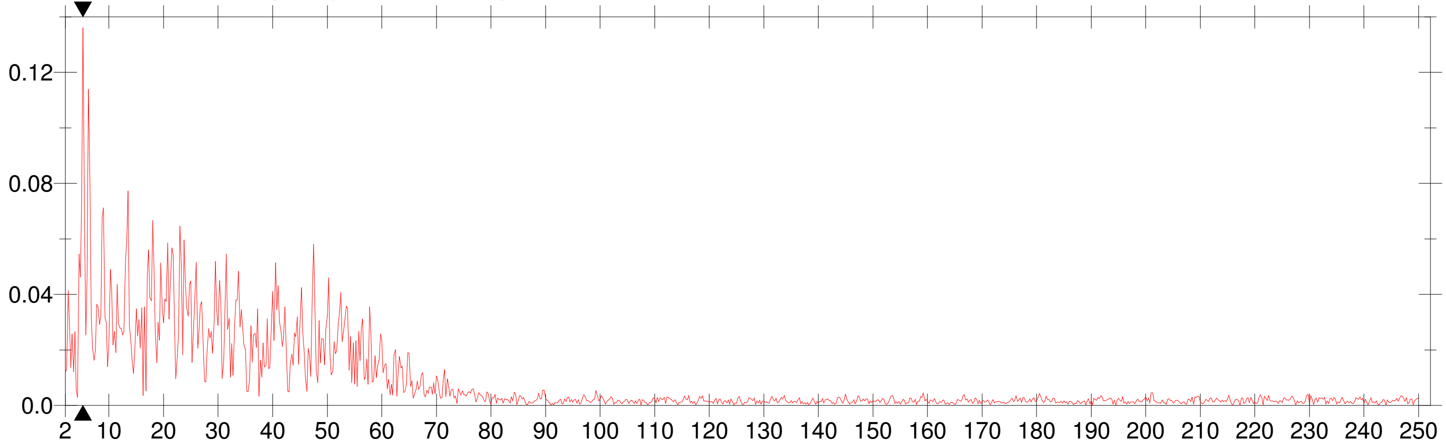
FFT Report

Date/Time	Tran at 13:41:01 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQM.0D0

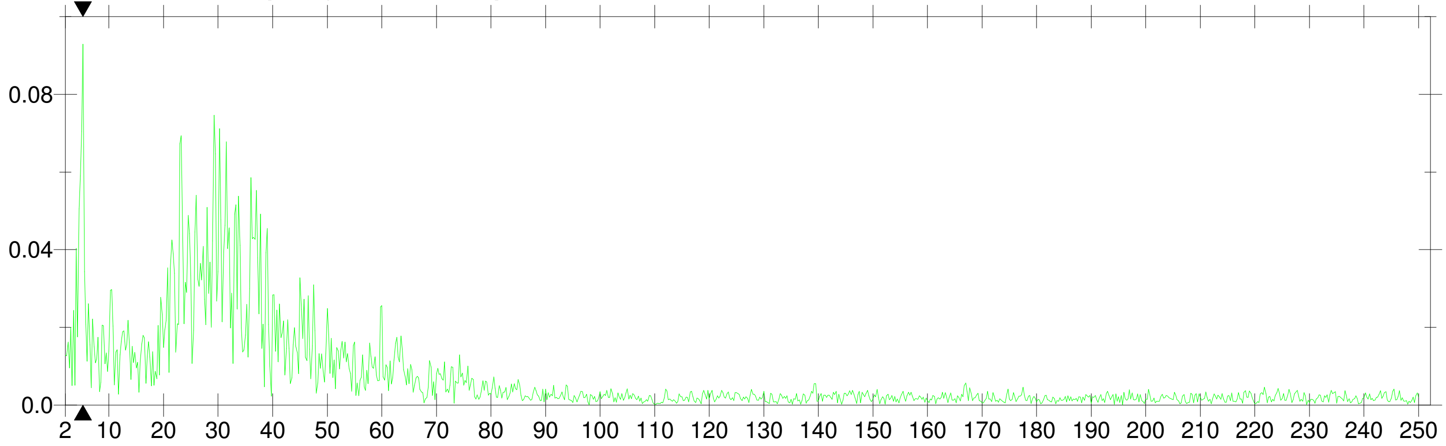
Notes

Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

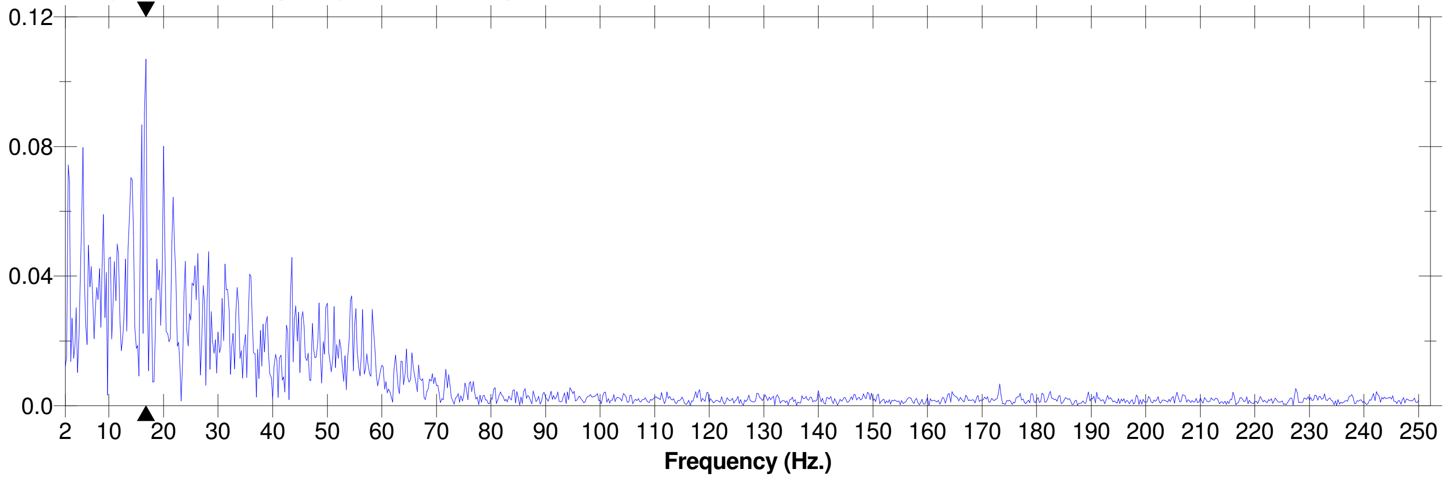
Tran Dominant Frequency = 5.25 Hz., Amplitude = 0.136, PPV from Event = 1.40 mm/s



Vert Dominant Frequency = 5.25 Hz., Amplitude = 0.0929, PPV from Event = 0.762 mm/s



Long Dominant Frequency = 16.8 Hz., Amplitude = 0.107, PPV from Event = 0.889 mm/s



Instantel

Event Report

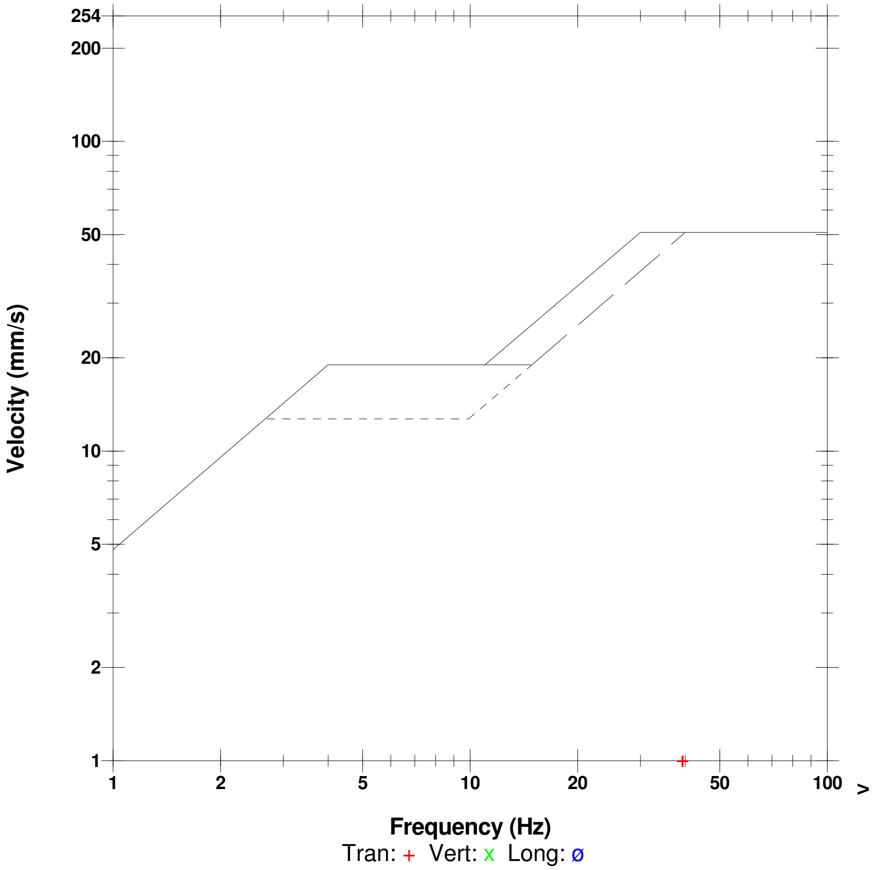
Date/Time Tran at 13:41:04 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

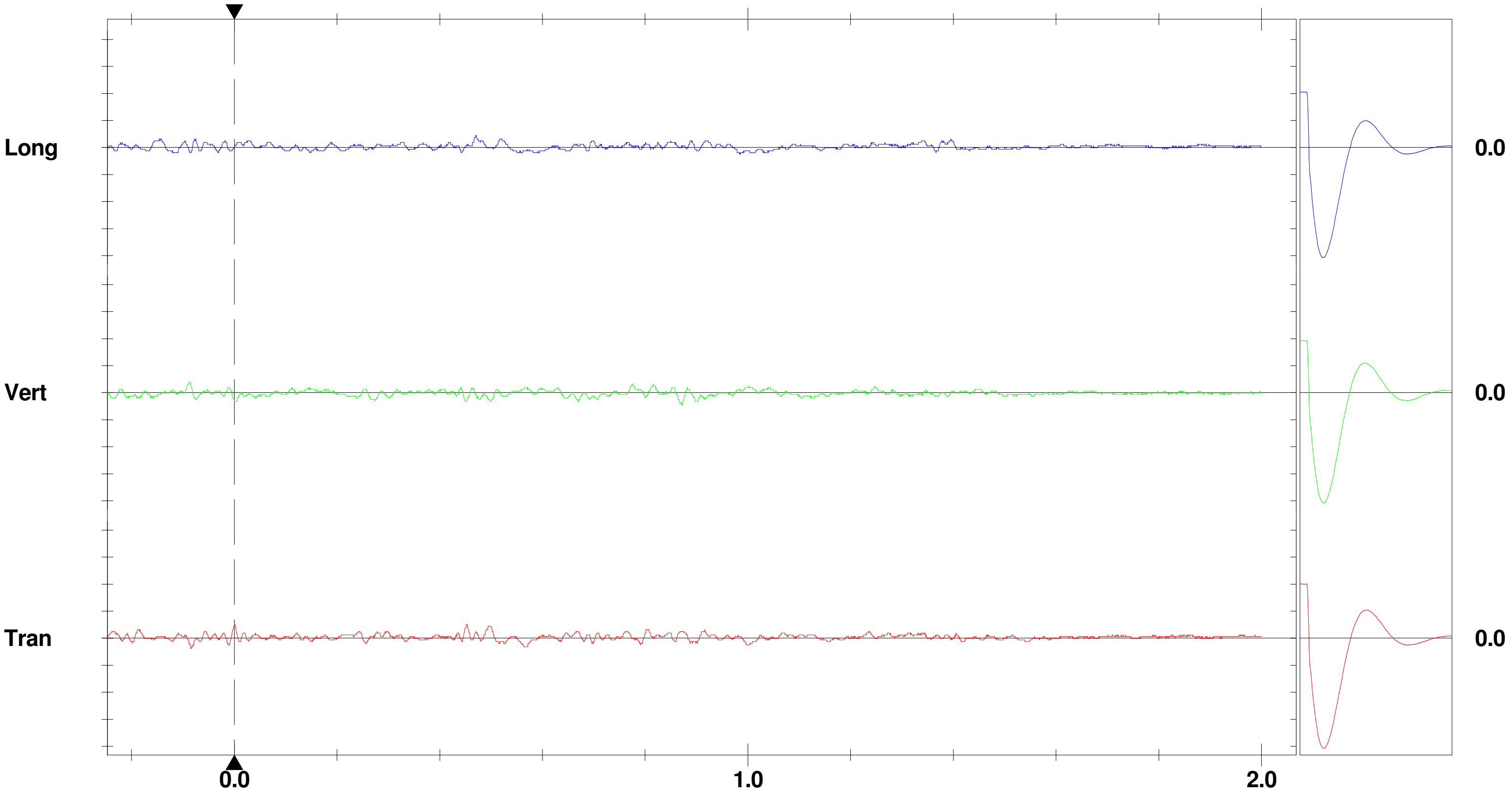
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQM.0G0

	Tran	Vert	Long	
PPV	1.02	0.889	0.889	mm/s
ZC Freq	39	30	20	Hz
Time (Rel. to Trig)	0.000	0.871	0.470	sec
Peak Acceleration	0.0265	0.0265	0.0265	g
Peak Displacement	0.00614	0.00564	0.00664	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 1.20 mm/s at 0.000 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶—— ——◀

Sensor Check

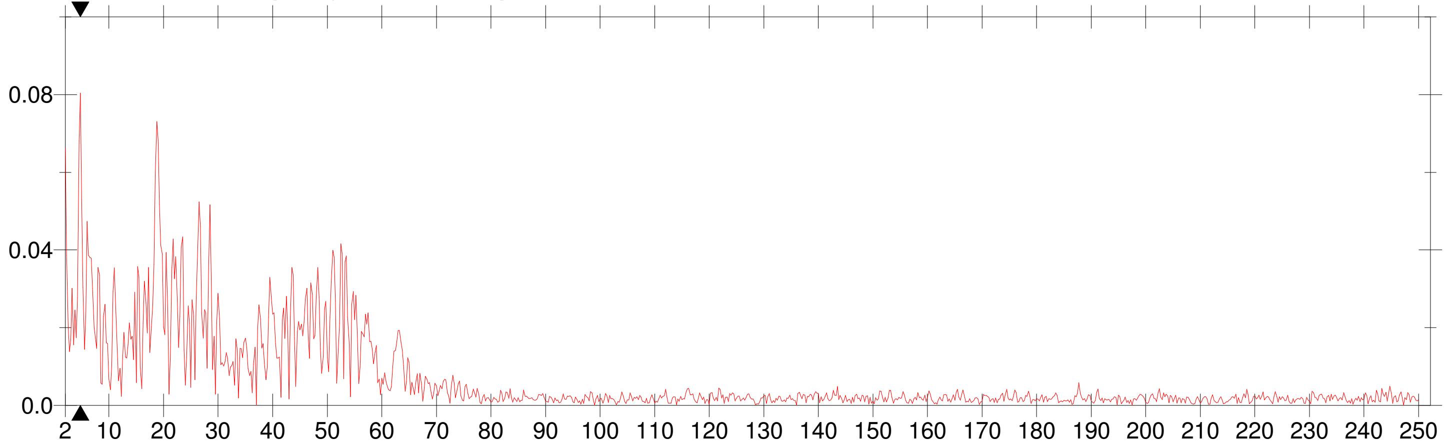
FFT Report

Date/Time	Tran at 13:41:04 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQM.0G0

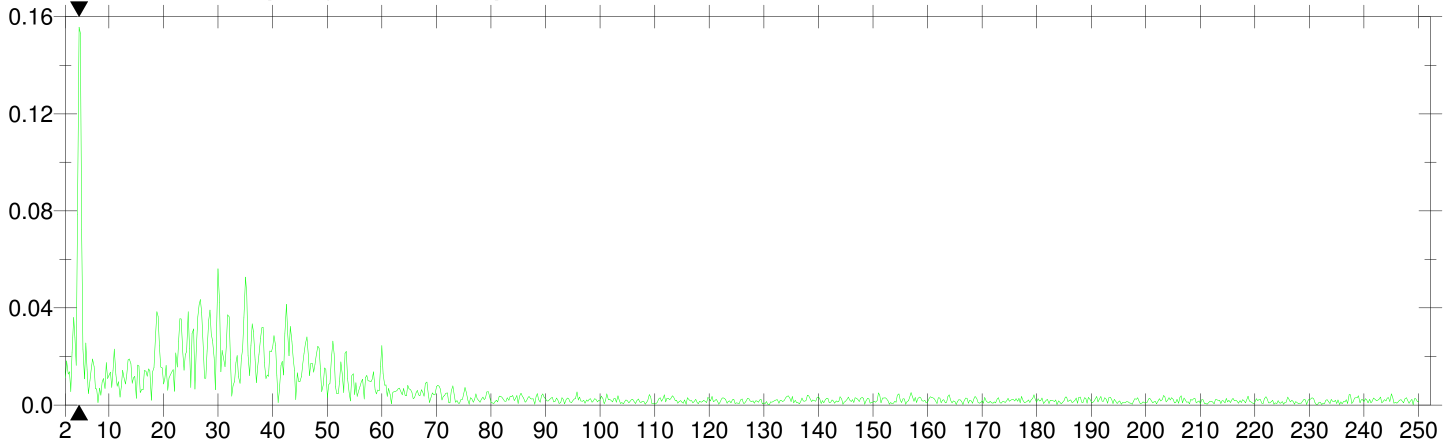
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

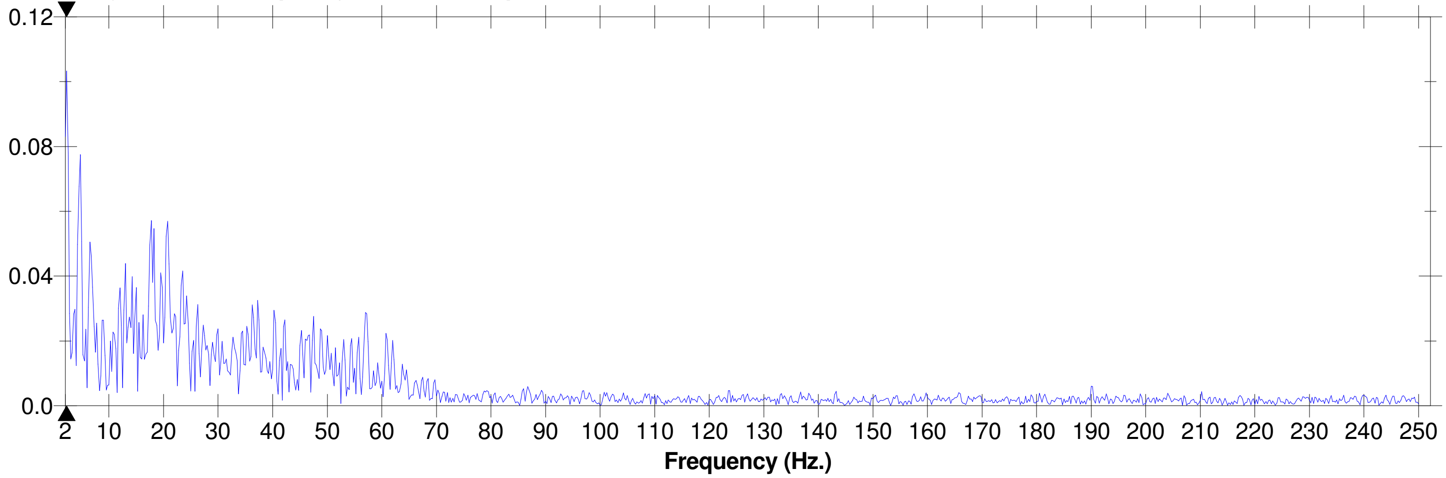
Tran Dominant Frequency = 4.75 Hz., Amplitude = 0.0804, PPV from Event = 1.02 mm/s



Vert Dominant Frequency = 4.50 Hz., Amplitude = 0.156, PPV from Event = 0.889 mm/s



Long Dominant Frequency = 2.25 Hz., Amplitude = 0.103, PPV from Event = 0.889 mm/s



Event Report

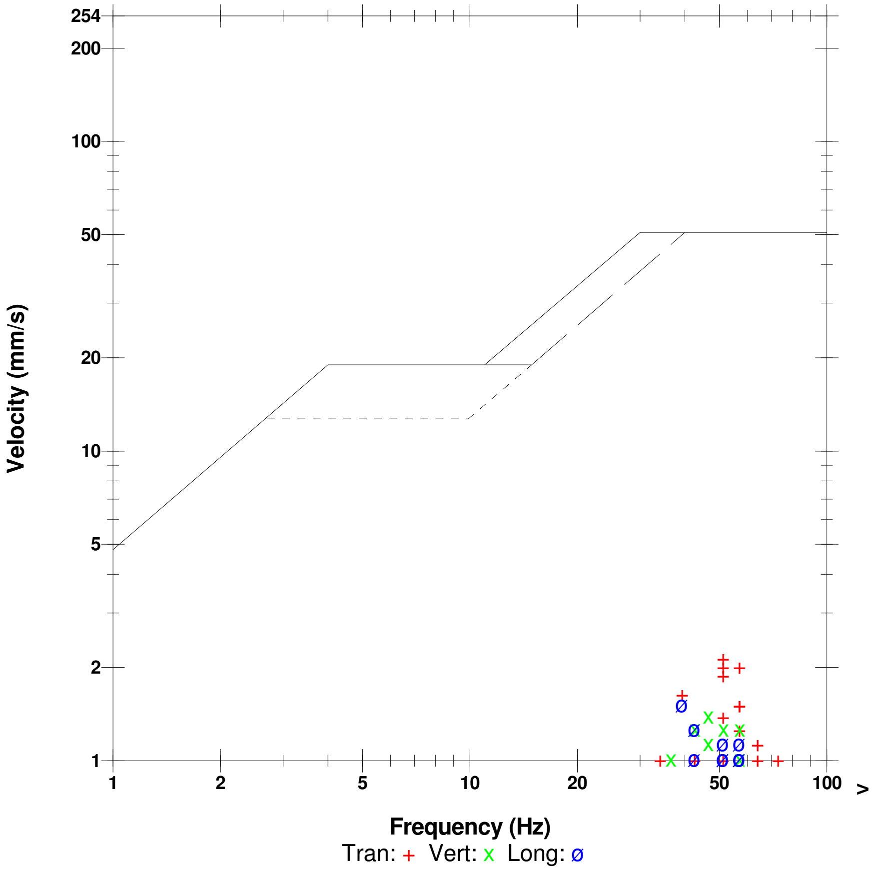
Date/Time Long at 13:46:02 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

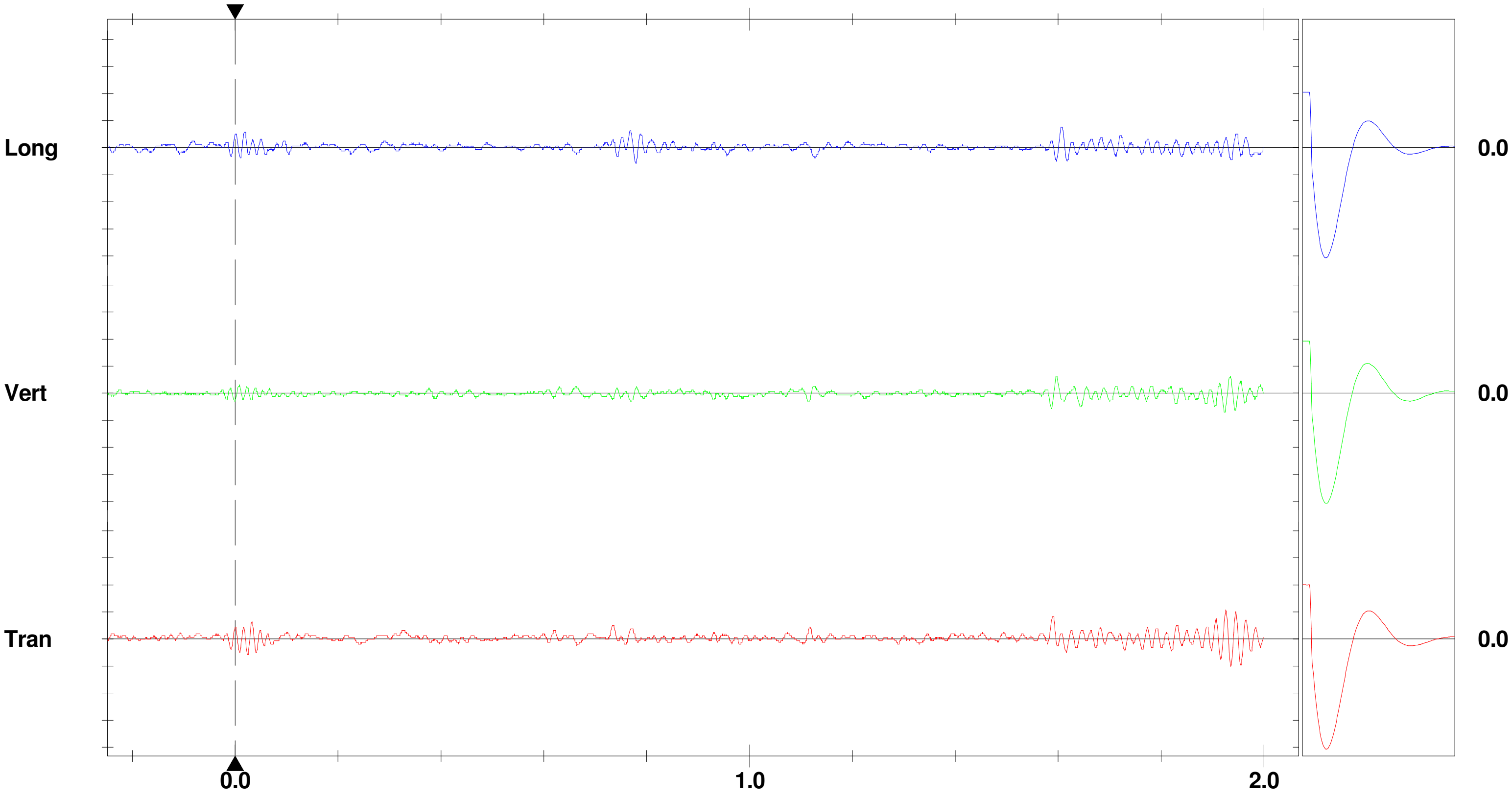
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQM.8Q0

	Tran	Vert	Long	
PPV	2.16	1.40	1.52	mm/s
ZC Freq	51	47	39	Hz
Time (Rel. to Trig)	1.926	1.923	1.605	sec
Peak Acceleration	0.0663	0.0398	0.0398	g
Peak Displacement	0.00682	0.00453	0.00608	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 2.54 mm/s at 1.945 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Trigger = ▶—— ——◀

Instantel

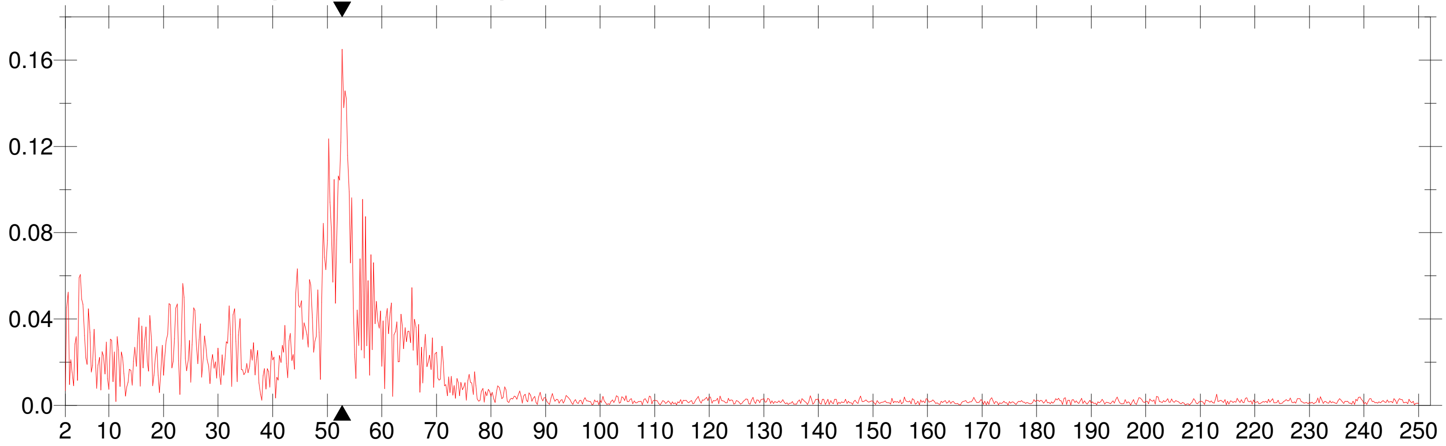
FFT Report

Date/Time	Long at 13:46:02 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQM.8Q0

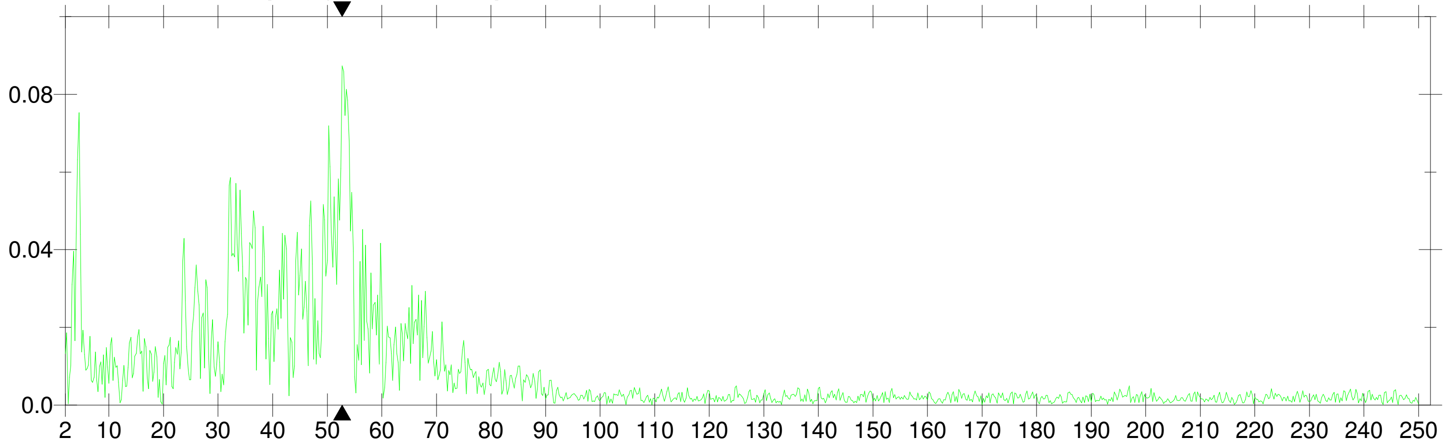
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

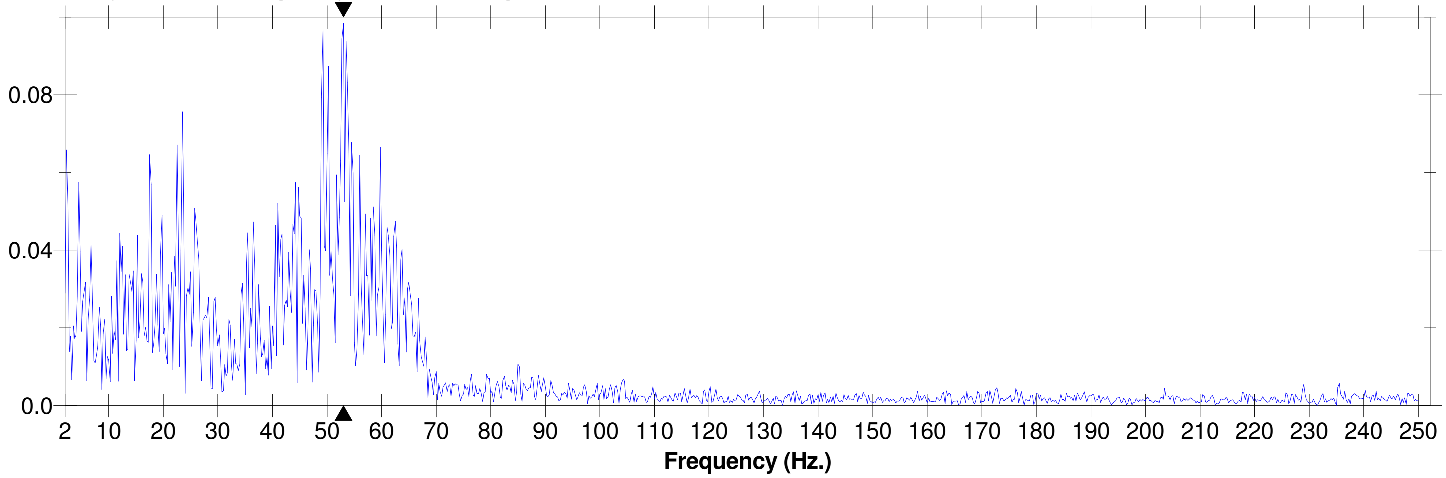
Tran Dominant Frequency = 52.8 Hz., Amplitude = 0.165, PPV from Event = 2.16 mm/s



Vert Dominant Frequency = 52.8 Hz., Amplitude = 0.0873, PPV from Event = 1.40 mm/s



Long Dominant Frequency = 53.0 Hz., Amplitude = 0.0983, PPV from Event = 1.52 mm/s



Instantel

Event Report

Date/Time	Vert at 13:46:05 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQM.8T0

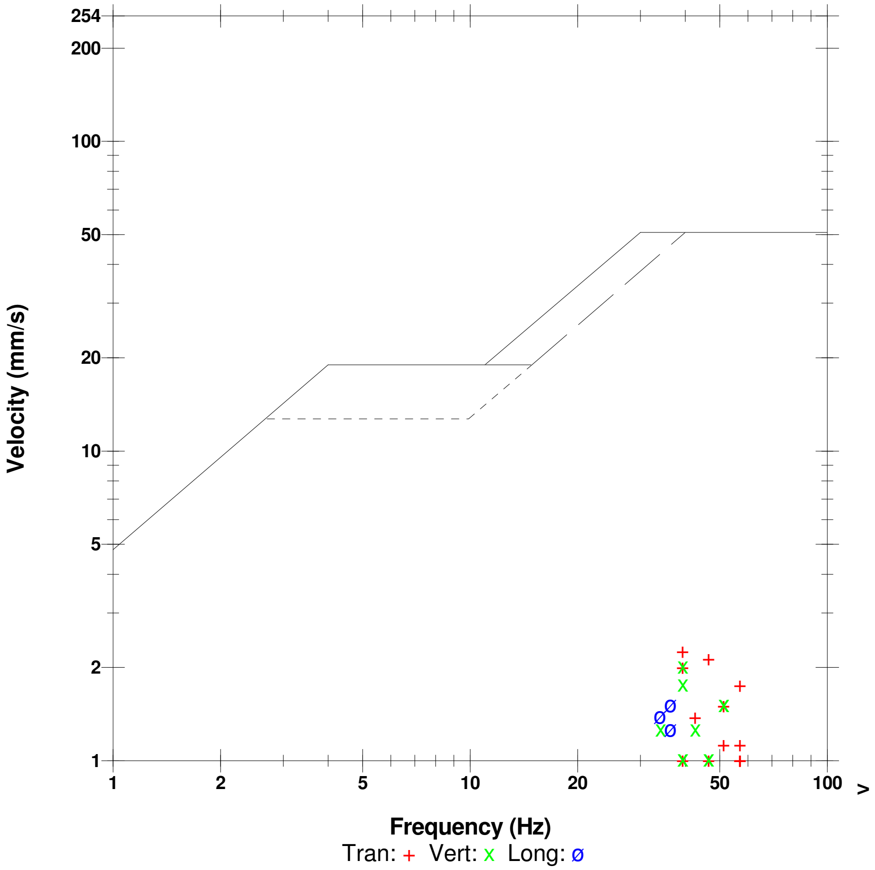
Notes

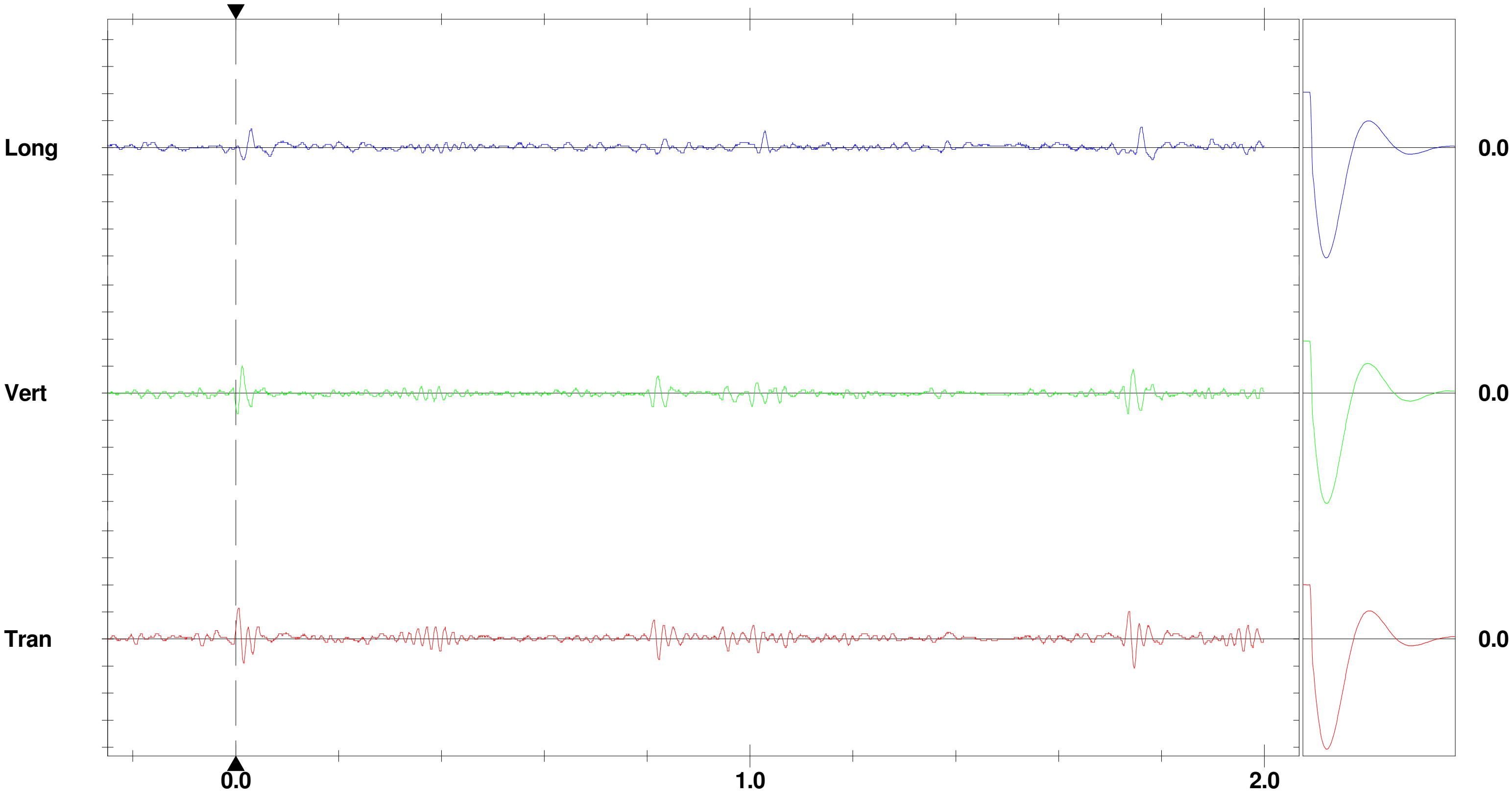
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	**Vert**	**Long**	
PPV	2.29	2.03	1.52	mm/s
ZC Freq	39	39	37	Hz
Time (Rel. to Trig)	0.005	0.013	1.760	sec
Peak Acceleration	0.0663	0.0663	0.0398	g
Peak Displacement	0.00899	0.00744	0.00682	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 2.68 mm/s at 0.005 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Trigger = ▶—— ——◀

Printed: April 24, 2017 (V 10.60 - 10.60)

Instantel

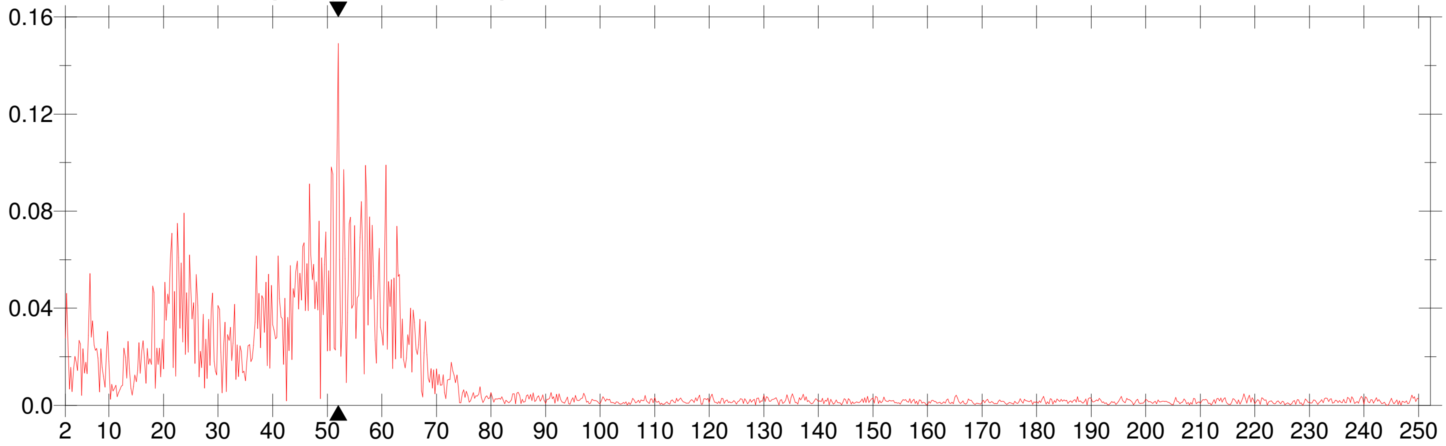
FFT Report

Date/Time	Vert at 13:46:05 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQM.8T0

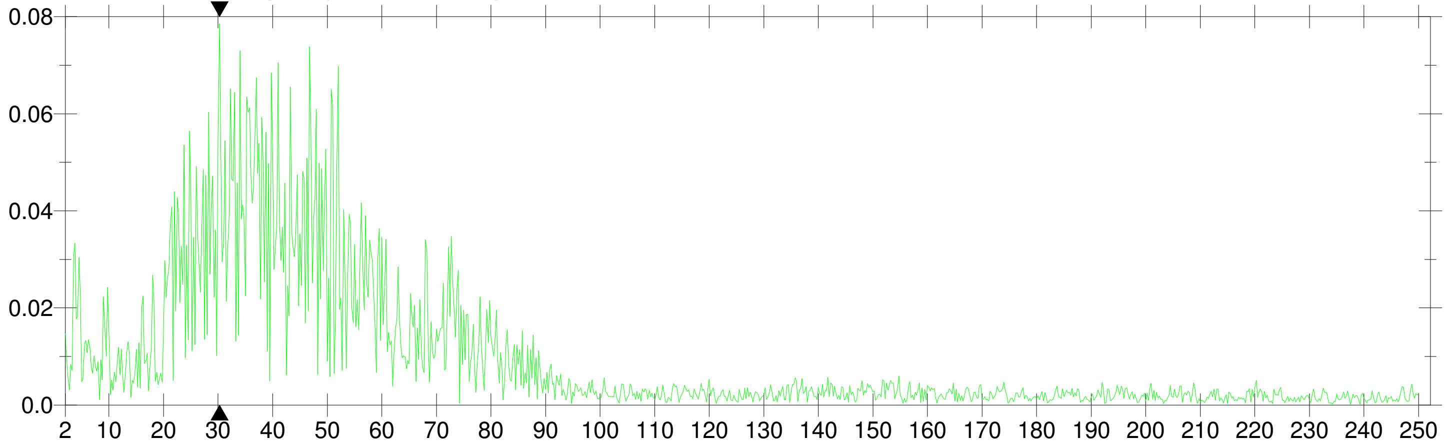
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

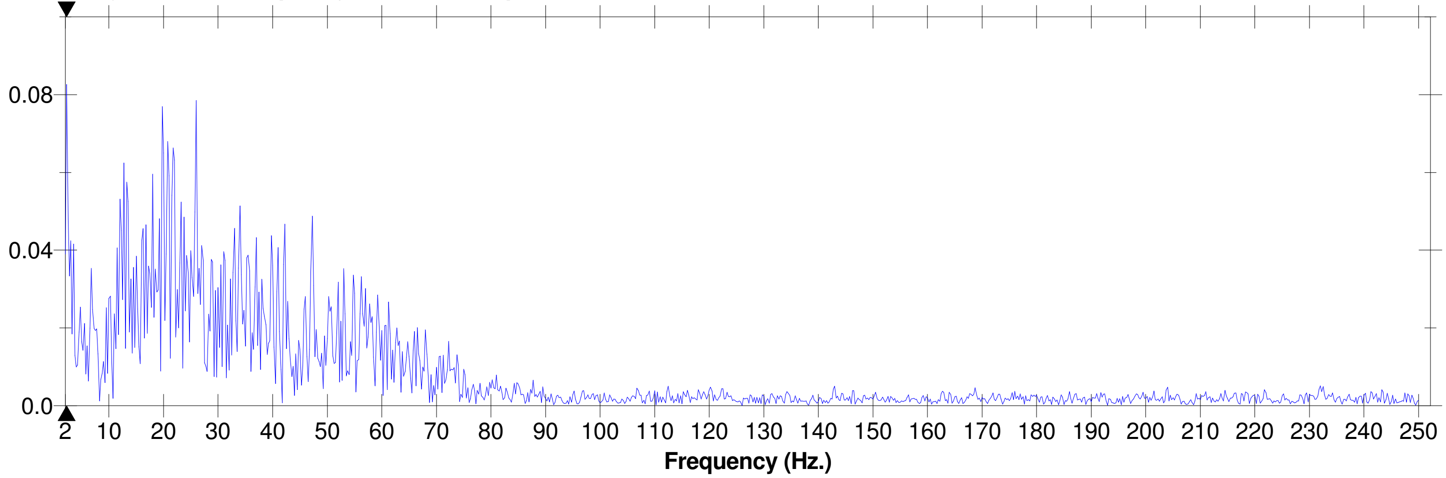
Tran Dominant Frequency = 52.0 Hz., Amplitude = 0.149, PPV from Event = 2.29 mm/s



Vert Dominant Frequency = 30.3 Hz., Amplitude = 0.0786, PPV from Event = 2.03 mm/s



Long Dominant Frequency = 2.25 Hz., Amplitude = 0.0826, PPV from Event = 1.52 mm/s



Instantel

Event Report

Date/Time	Vert at 13:46:10 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

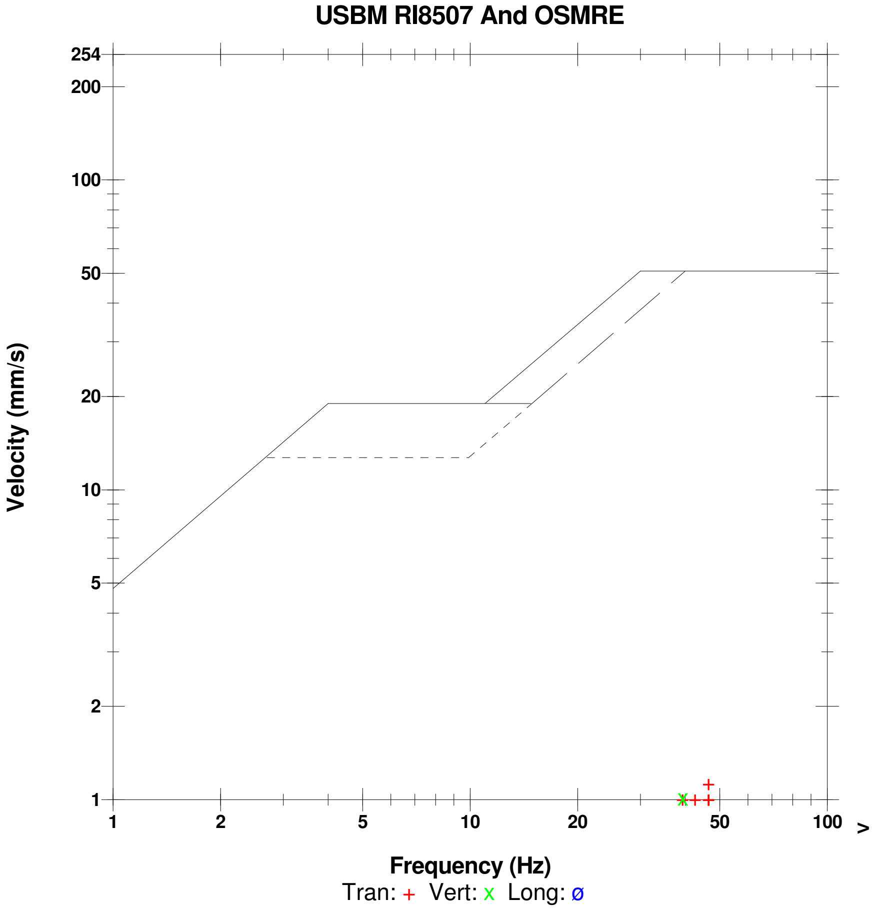
Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQM.8Y0

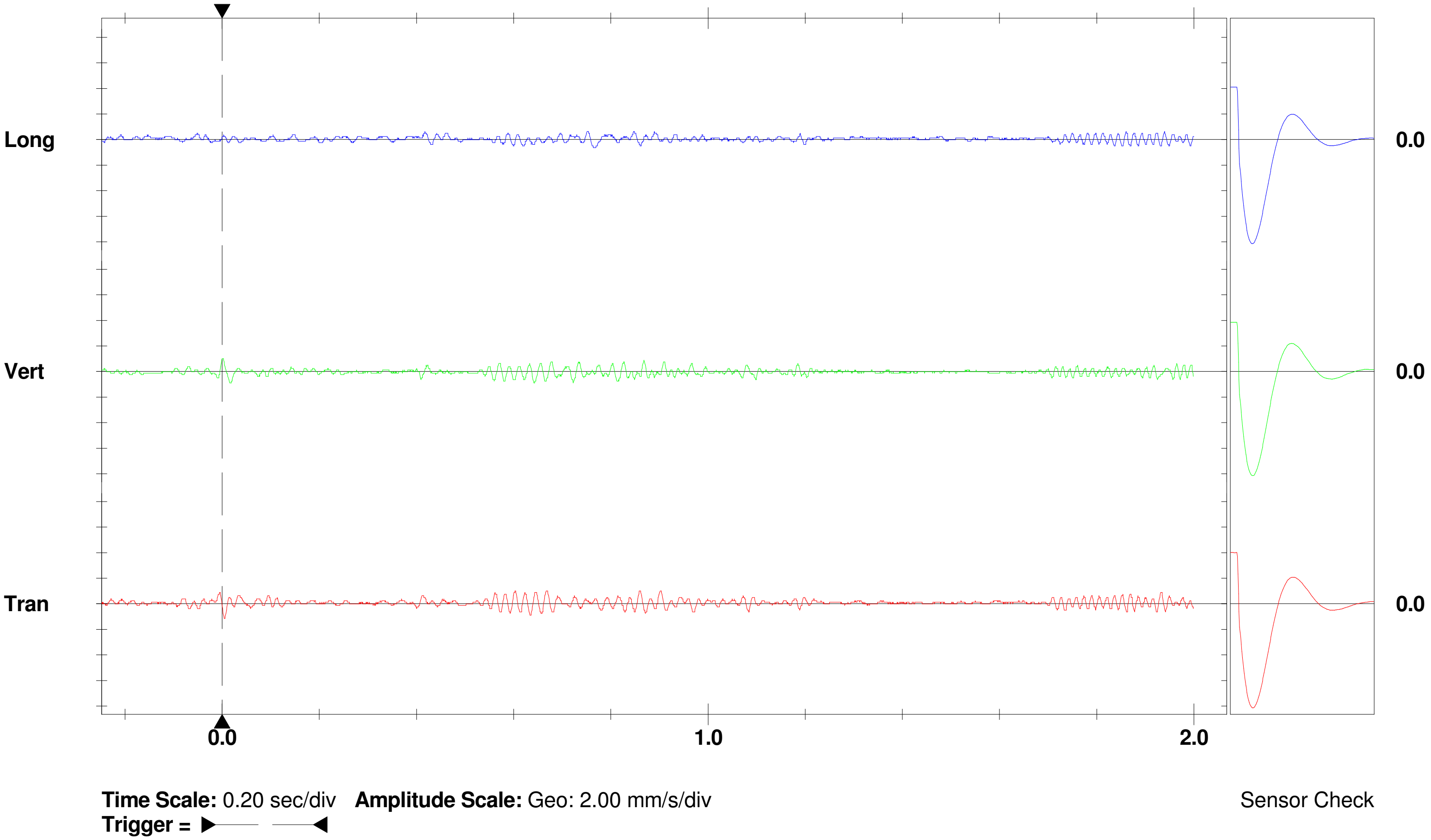
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.14	1.02	0.635	mm/s
ZC Freq	47	39	39	Hz
Time (Rel. to Trig)	0.004	0.000	0.417	sec
Peak Acceleration	0.0398	0.0398	0.0265	g
Peak Displacement	0.00422	0.00415	0.00384	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 1.40 mm/s at 0.004 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

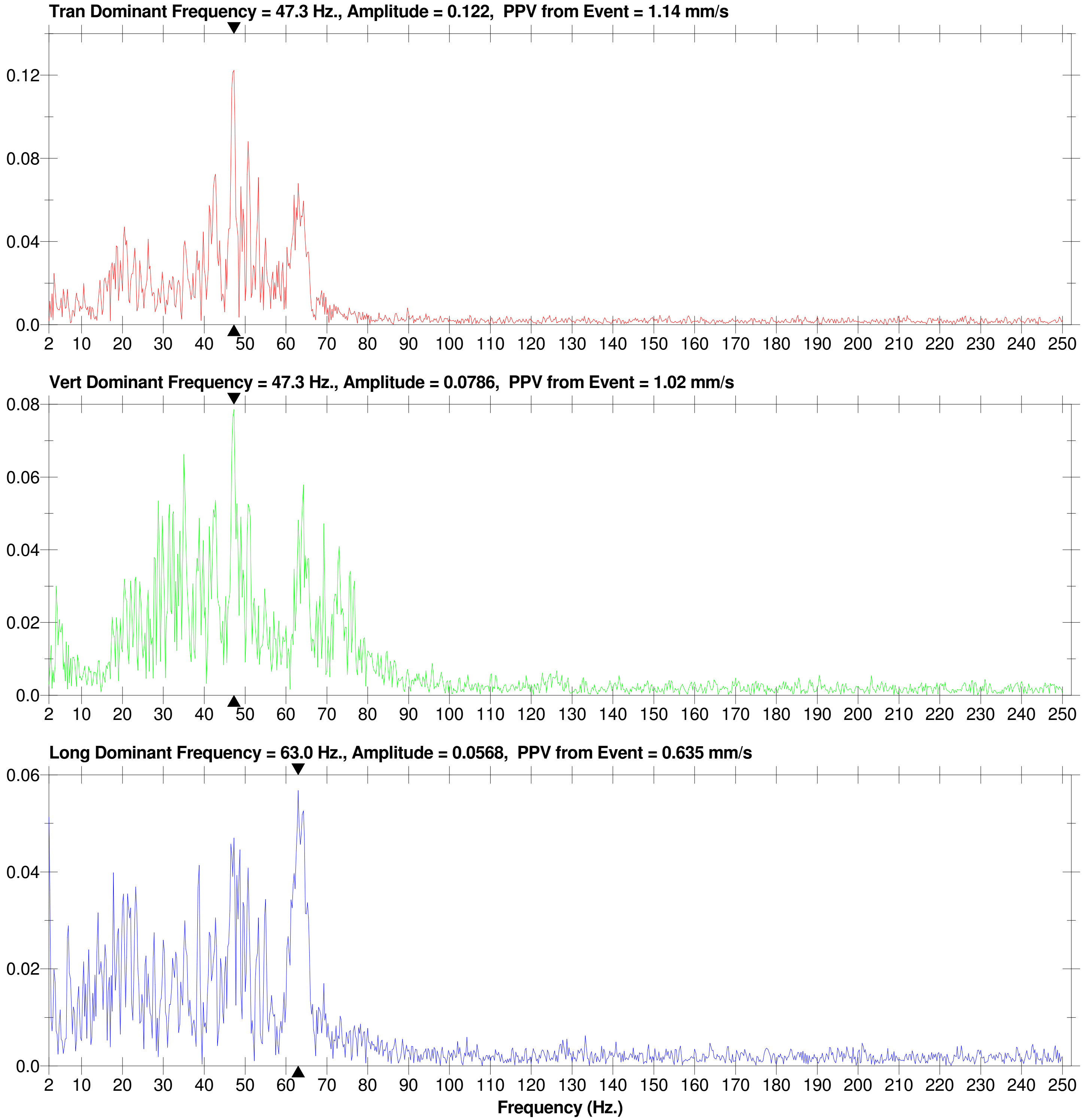
Printed: April 24, 2017 (V 10.60 - 10.60)

FFT Report

Date/Time Vert at 13:46:10 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQM.8Y0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent



Instantel

Event Report

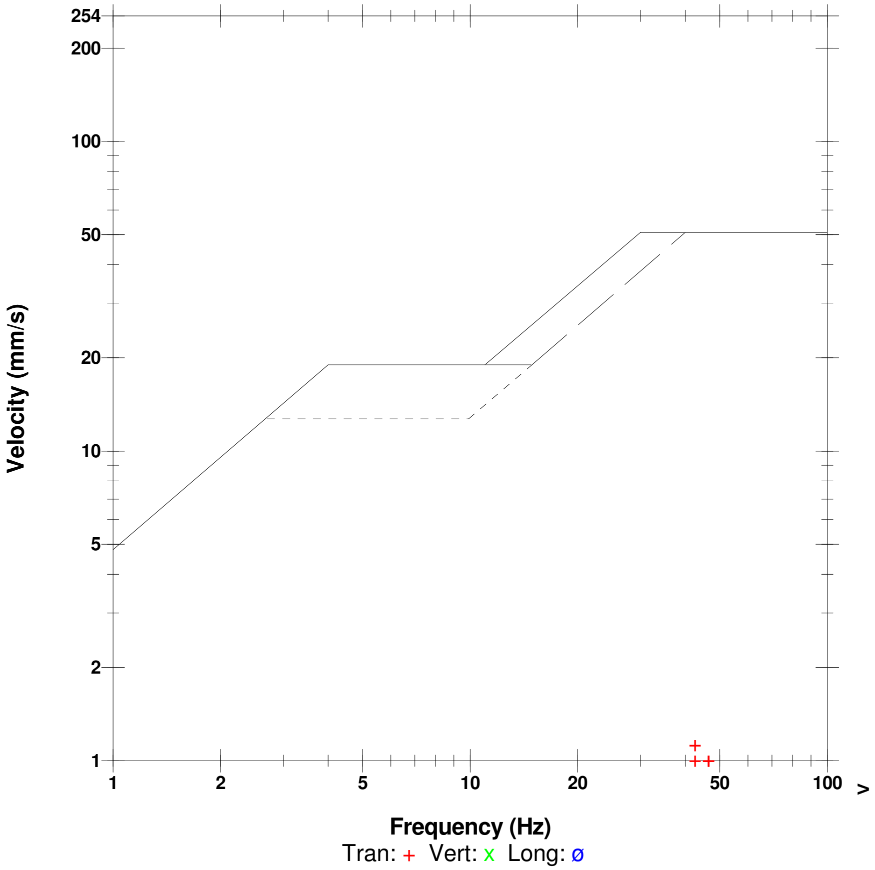
Date/Time Tran at 13:46:12 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

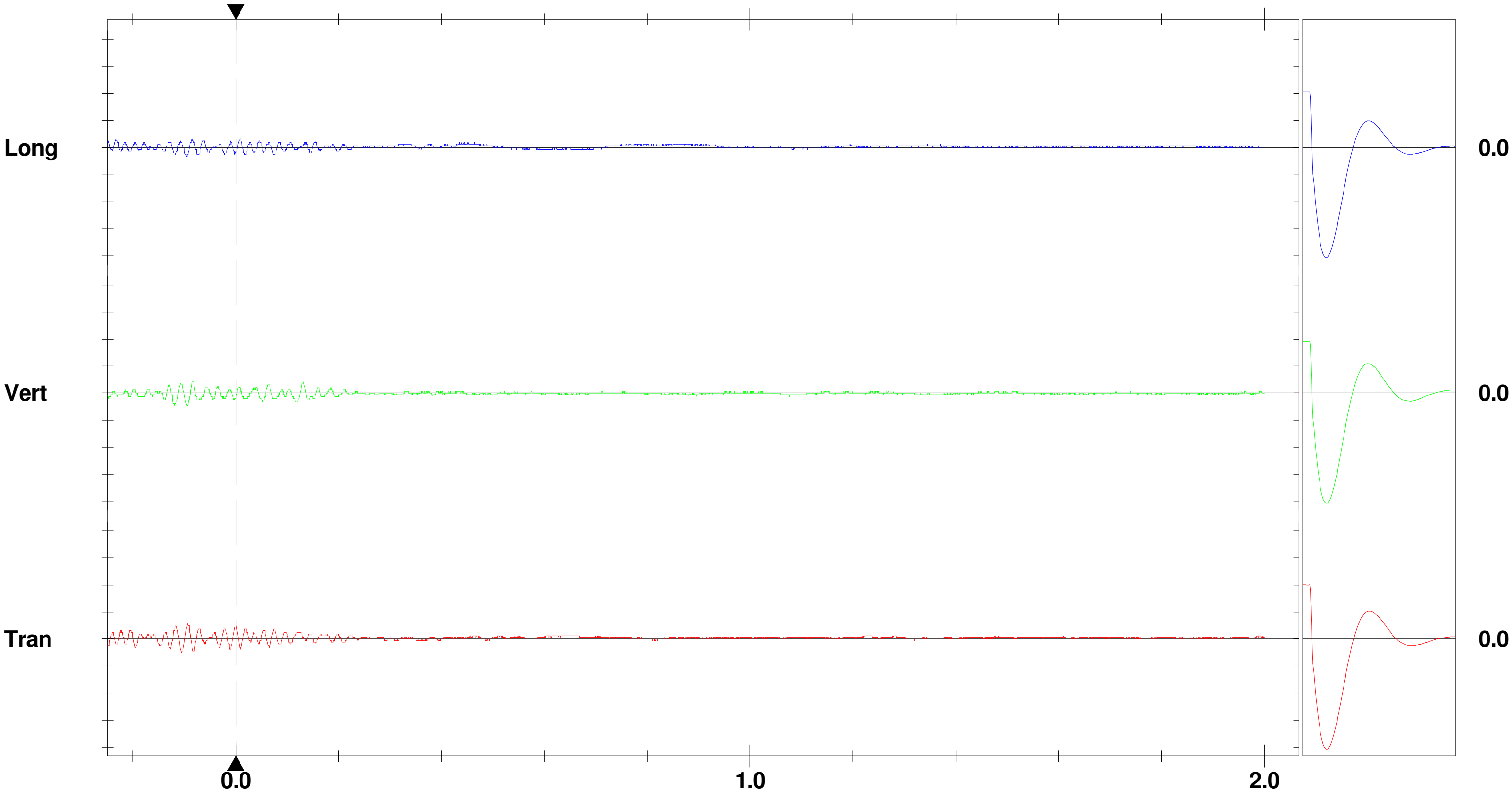
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQM.900

	Tran	Vert	Long	
PPV	1.14	0.889	0.635	mm/s
ZC Freq	43	43	57	Hz
Time (Rel. to Trig)	-0.094	-0.119	-0.233	sec
Peak Acceleration	0.0398	0.0398	0.0265	g
Peak Displacement	0.00471	0.00347	0.00564	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 1.53 mm/s at -0.094 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Trigger = ▶——— ———◀

Printed: April 24, 2017 (V 10.60 - 10.60)

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Instantel

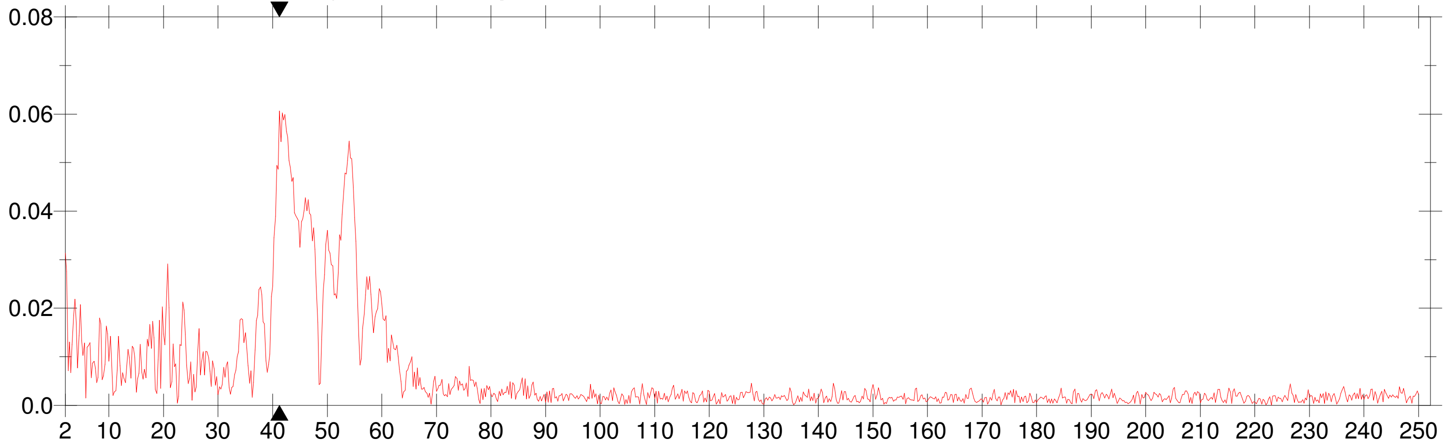
FFT Report

Date/Time	Tran at 13:46:12 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQM.900

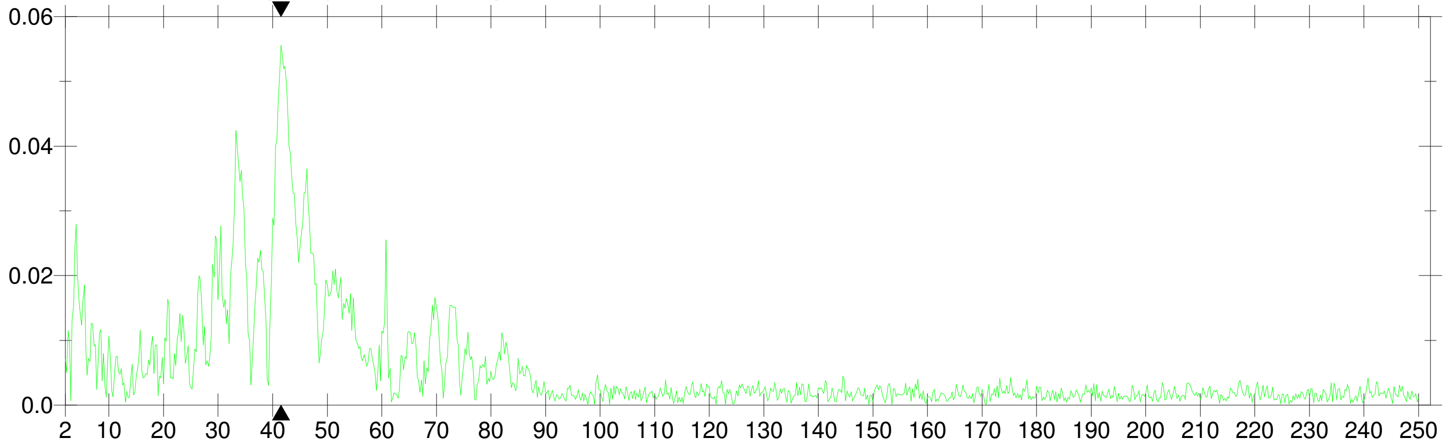
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

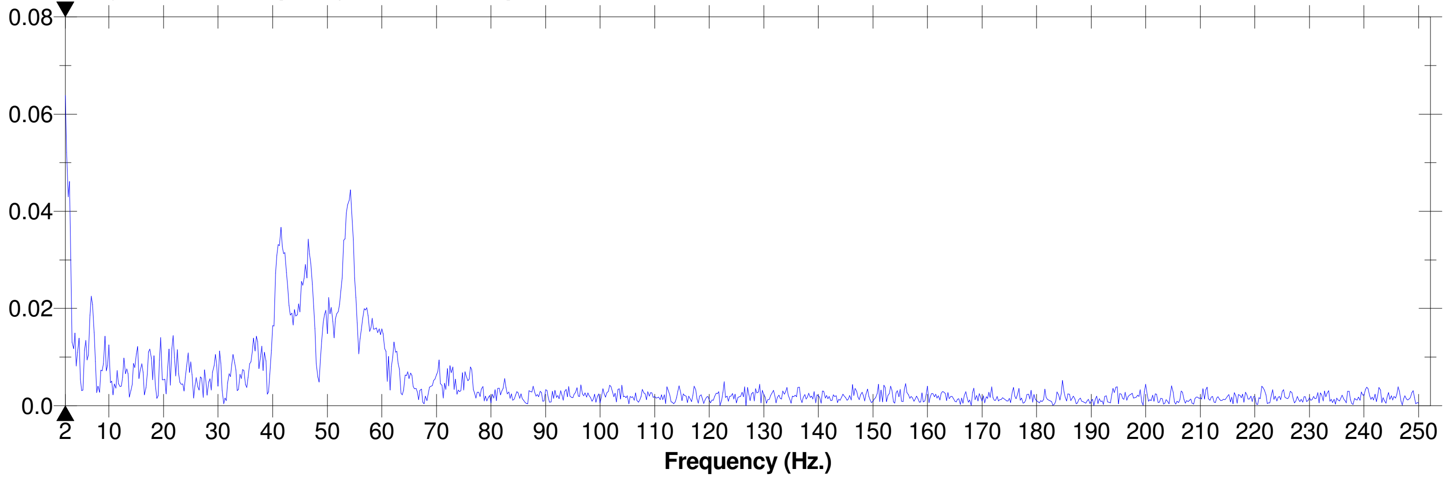
Tran Dominant Frequency = 41.3 Hz., Amplitude = 0.0606, PPV from Event = 1.14 mm/s



Vert Dominant Frequency = 41.5 Hz., Amplitude = 0.0555, PPV from Event = 0.889 mm/s



Long Dominant Frequency = 2.00 Hz., Amplitude = 0.0638, PPV from Event = 0.635 mm/s



Event Report

Date/Time	Tran at 13:53:18 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps
Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQM.KU0

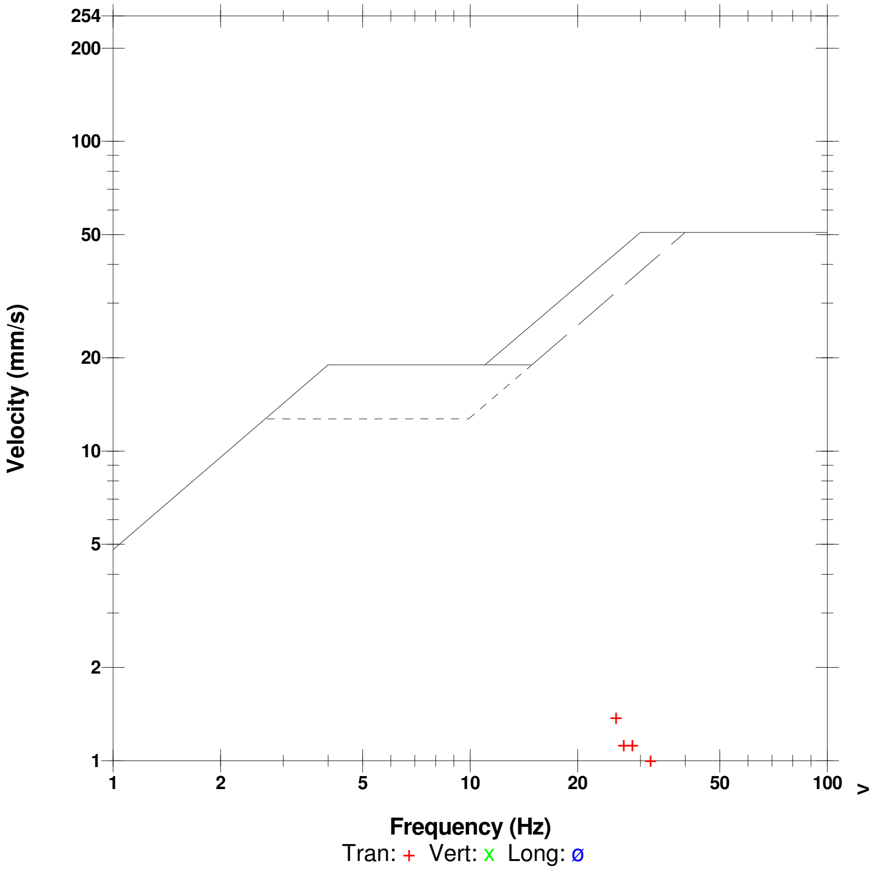
Notes

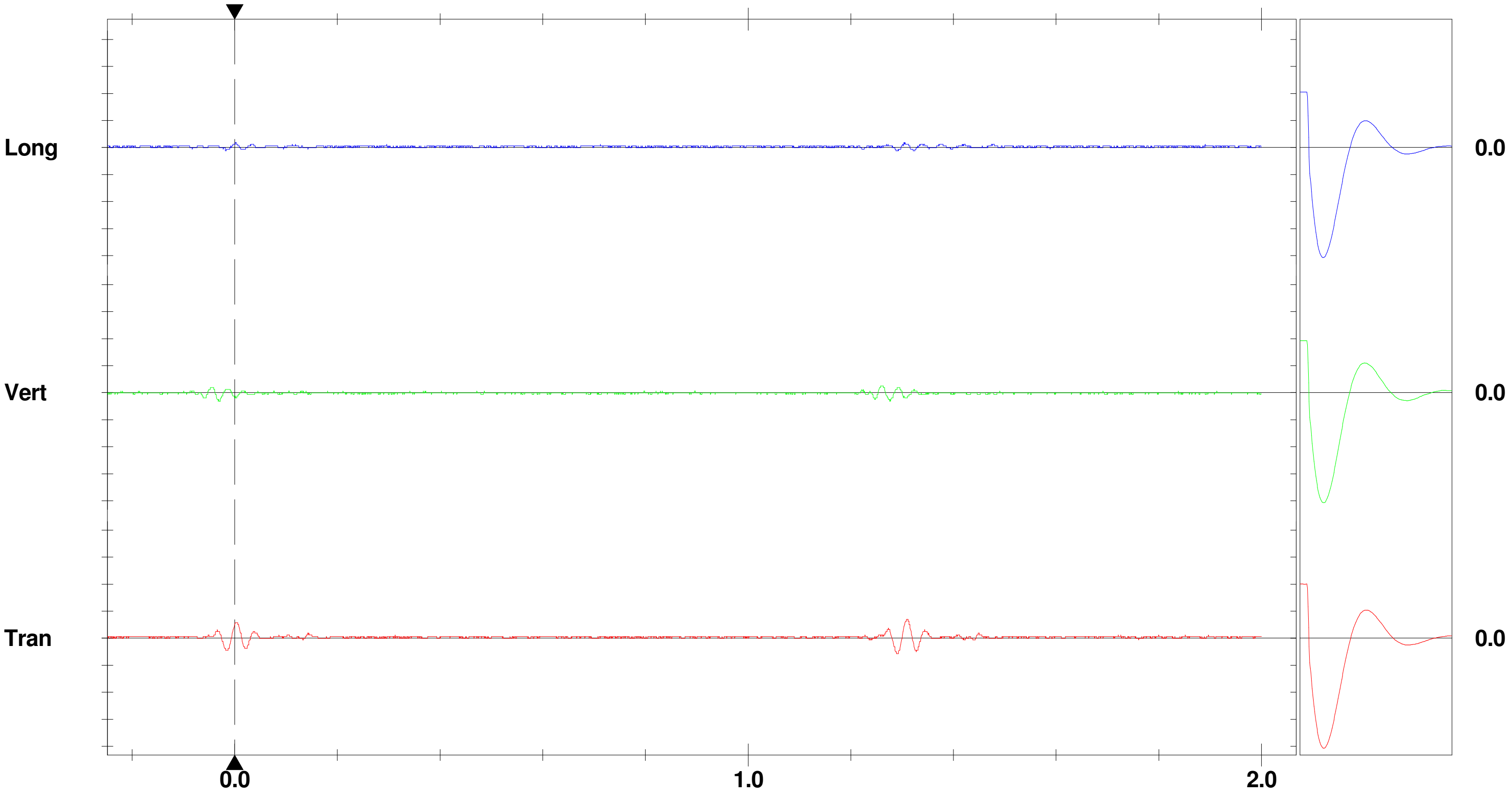
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.40	0.635	0.381	mm/s
ZC Freq	26	37	47	Hz
Time (Rel. to Trig)	1.309	-0.032	0.001	sec
Peak Acceleration	0.0265	0.0265	0.0265	g
Peak Displacement	0.00874	0.00291	0.00136	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 1.47 mm/s at 1.309 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

FFT Report

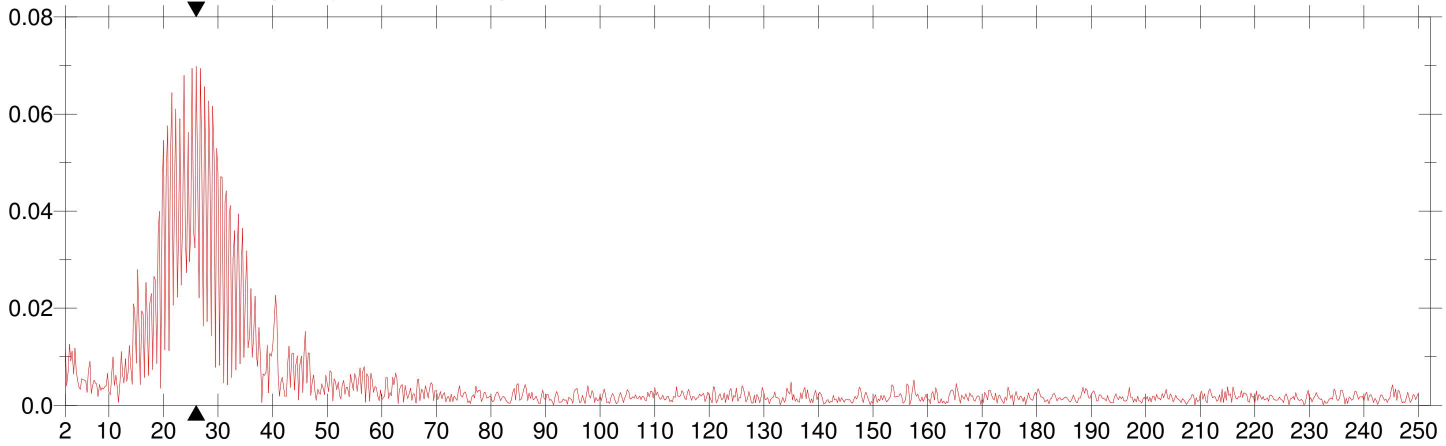
Date/Time	Tran at 13:53:18 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQM.KU0

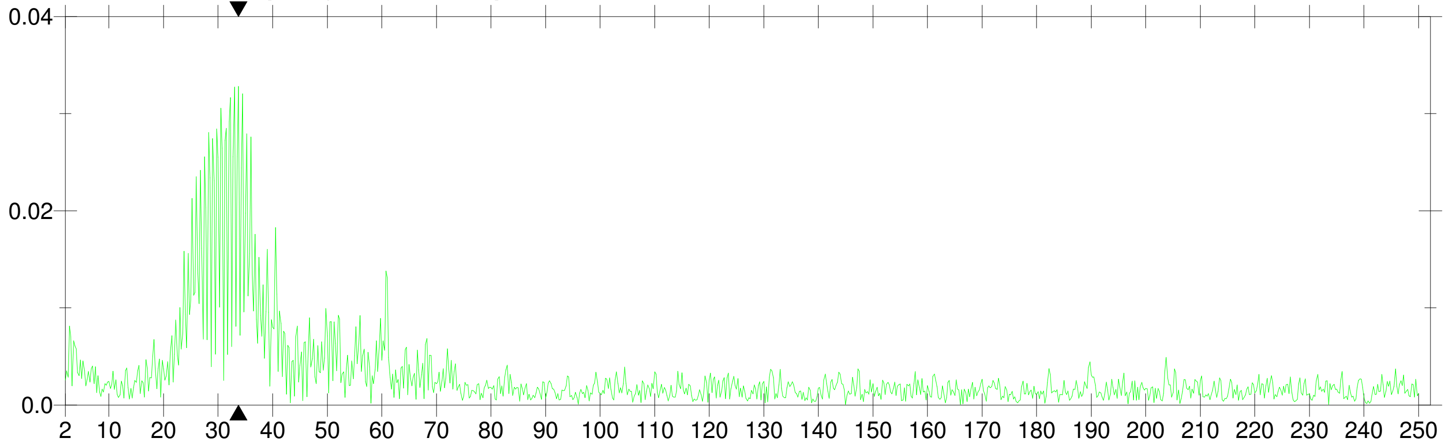
Notes

Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

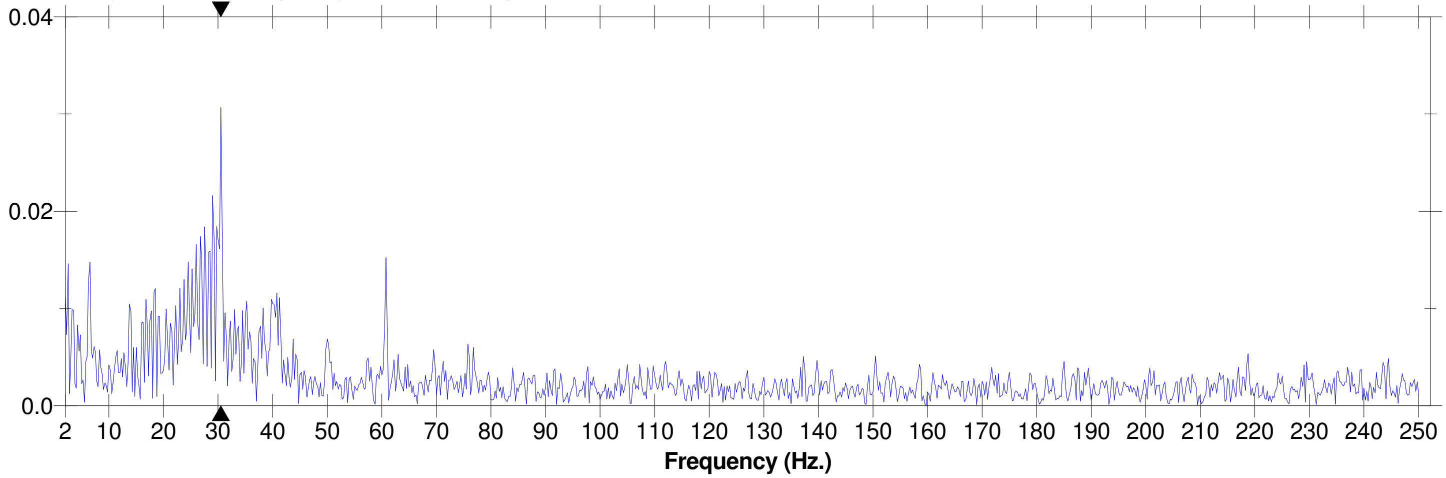
Tran Dominant Frequency = 26.0 Hz., Amplitude = 0.0698, PPV from Event = 1.40 mm/s



Vert Dominant Frequency = 33.8 Hz., Amplitude = 0.0328, PPV from Event = 0.635 mm/s



Long Dominant Frequency = 30.5 Hz., Amplitude = 0.0307, PPV from Event = 0.381 mm/s



Instantel

Event Report

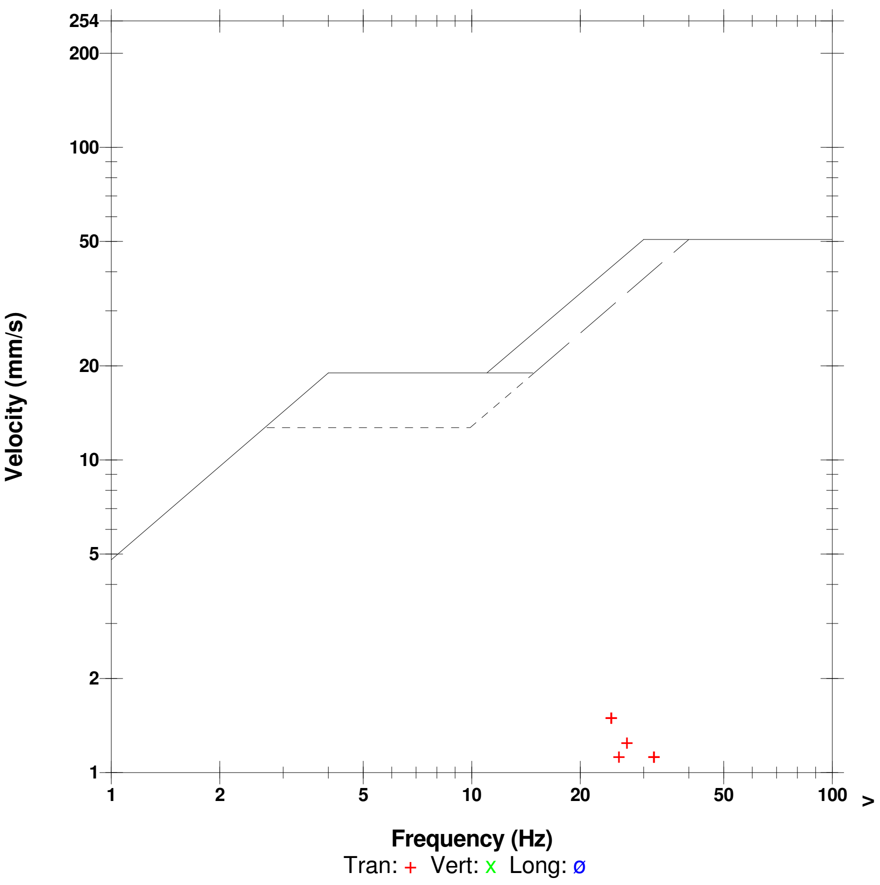
Date/Time Tran at 13:53:21 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

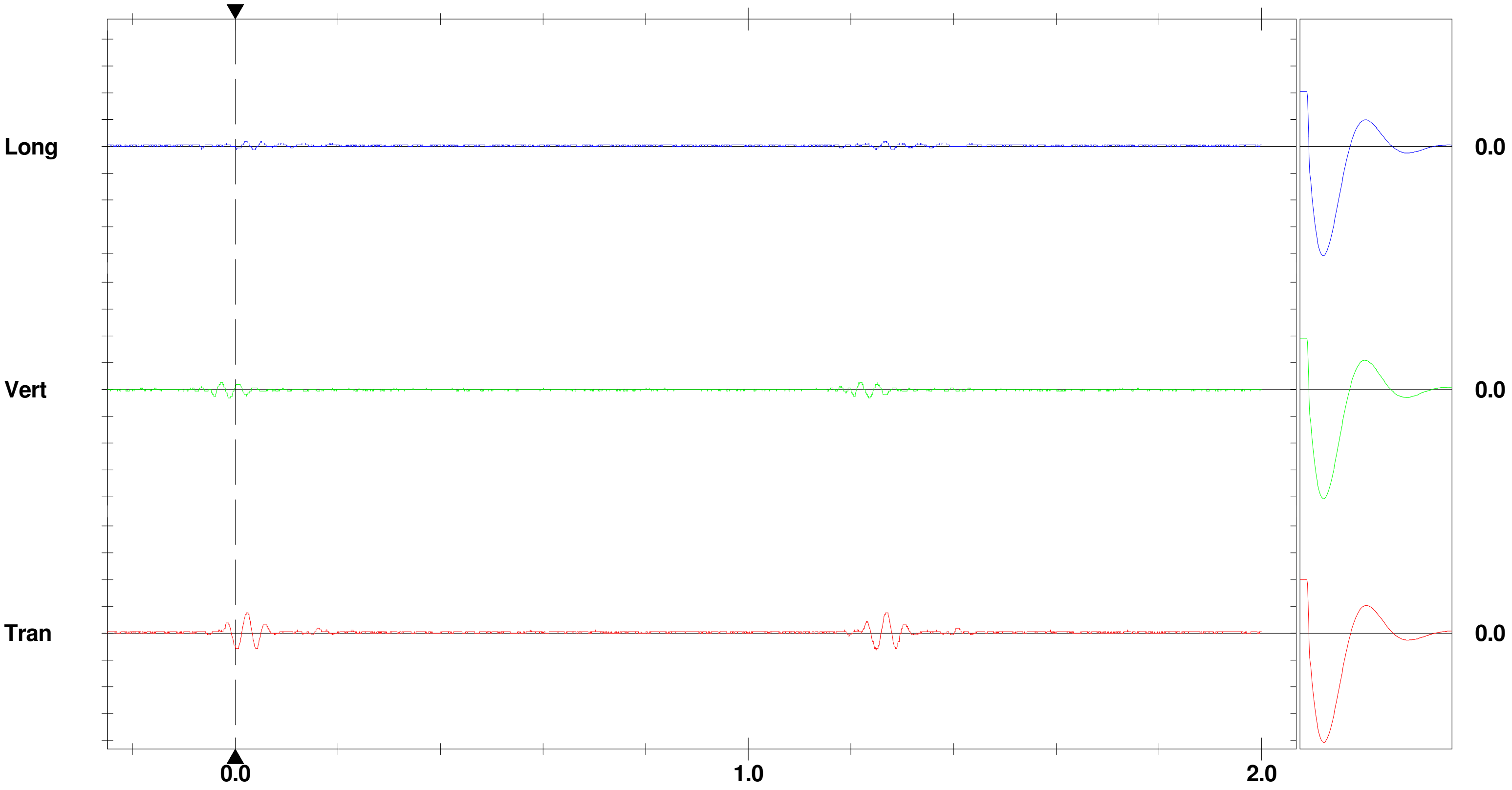
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQM.KX0

	Tran	Vert	Long	
PPV	1.52	0.635	0.381	mm/s
ZC Freq	24	34	43	Hz
Time (Rel. to Trig)	0.021	-0.014	0.019	sec
Peak Acceleration	0.0265	0.0265	0.0265	g
Peak Displacement	0.0101	0.00329	0.00192	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 1.65 mm/s at 0.021 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

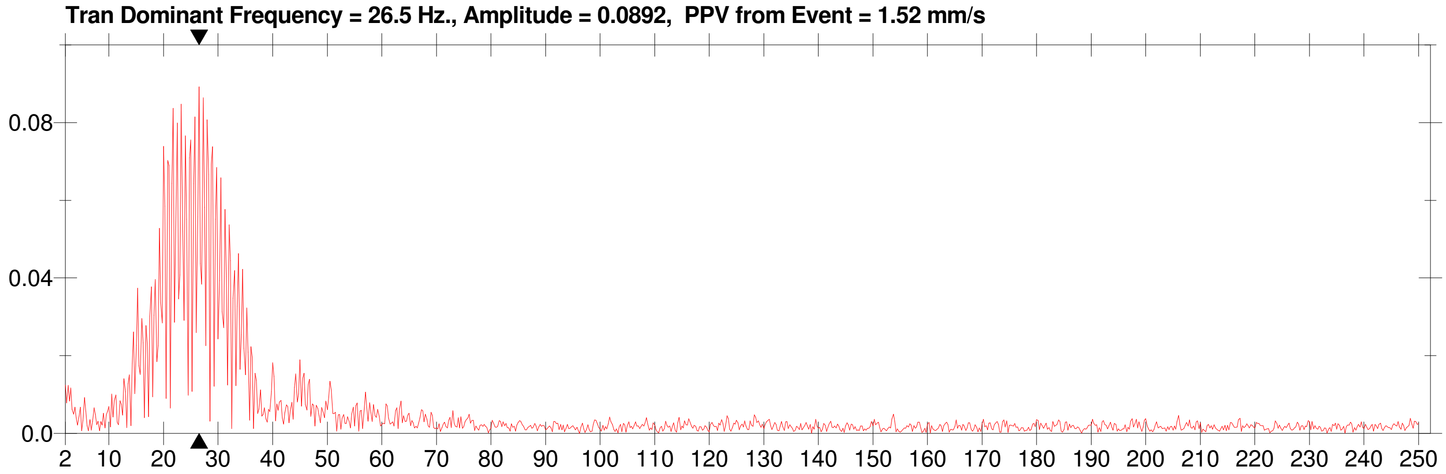
Instantel

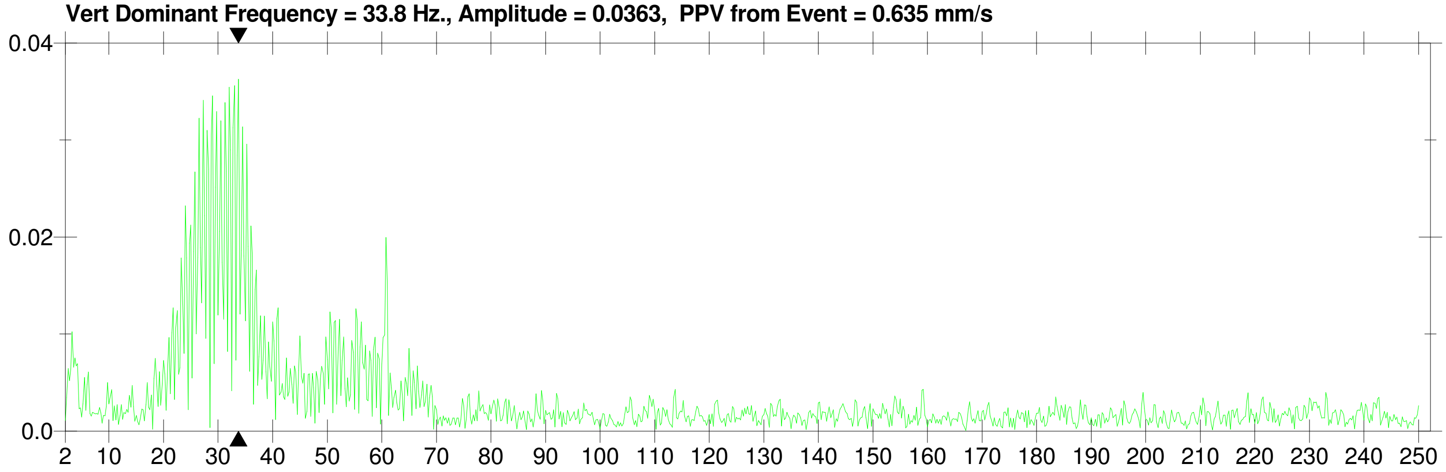
FFT Report

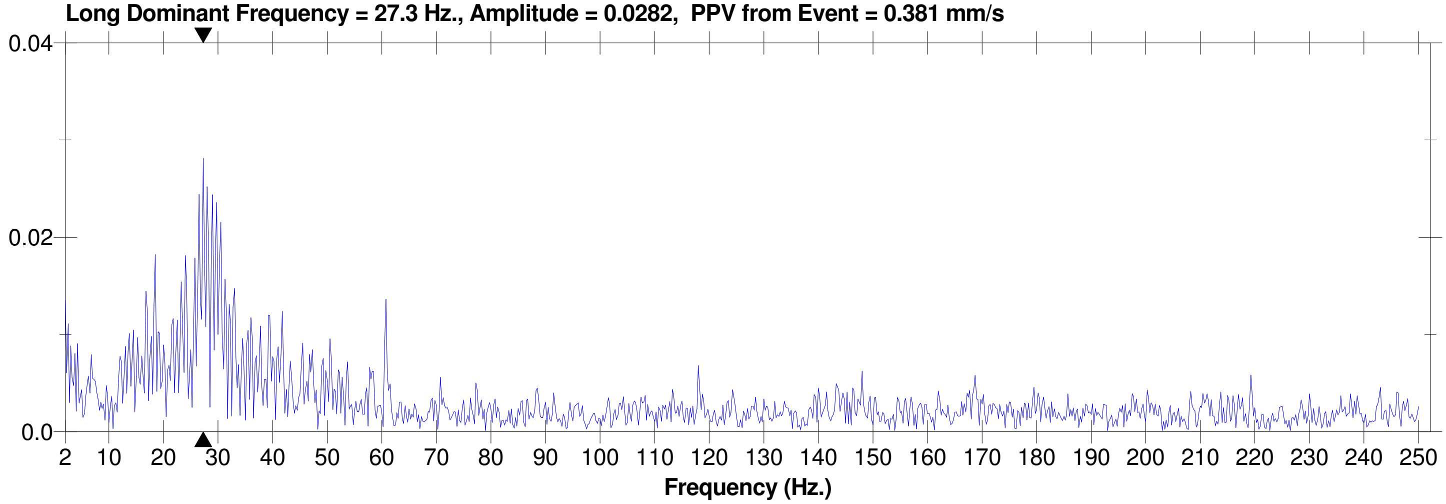
Date/Time	Tran at 13:53:21 March 29, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.2 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTQM.KX0

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent


Tran Dominant Frequency = 26.5 Hz., Amplitude = 0.0892, PPV from Event = 1.52 mm/s


Vert Dominant Frequency = 33.8 Hz., Amplitude = 0.0363, PPV from Event = 0.635 mm/s


Long Dominant Frequency = 27.3 Hz., Amplitude = 0.0282, PPV from Event = 0.381 mm/s

Event Report

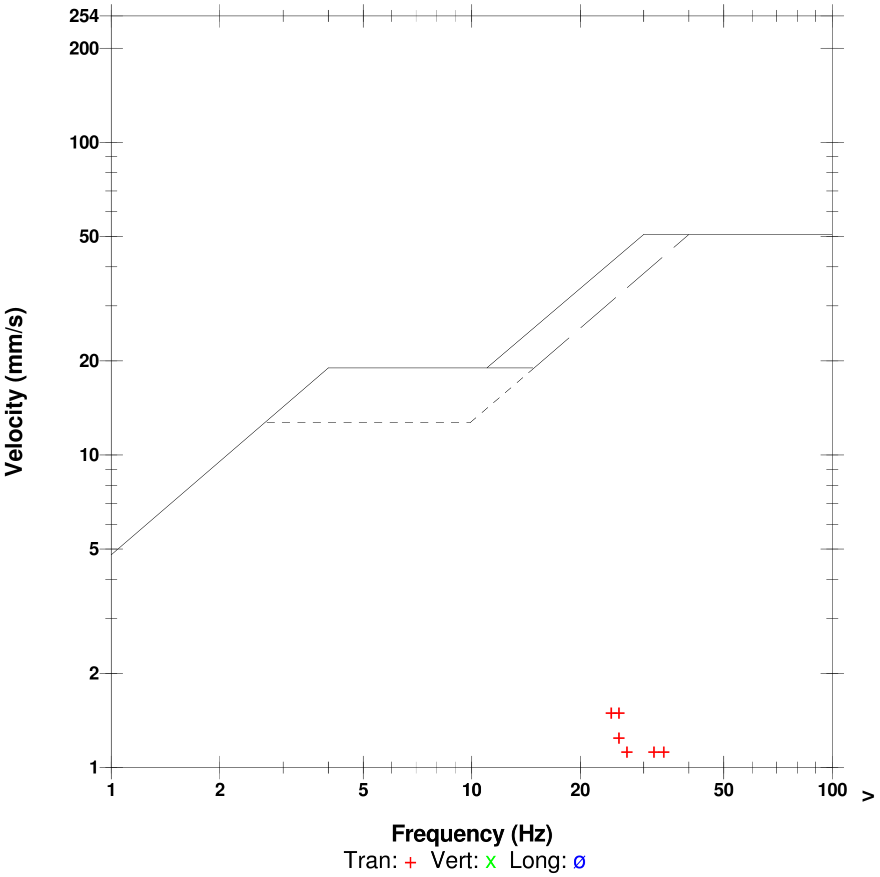
Date/Time Tran at 13:53:23 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

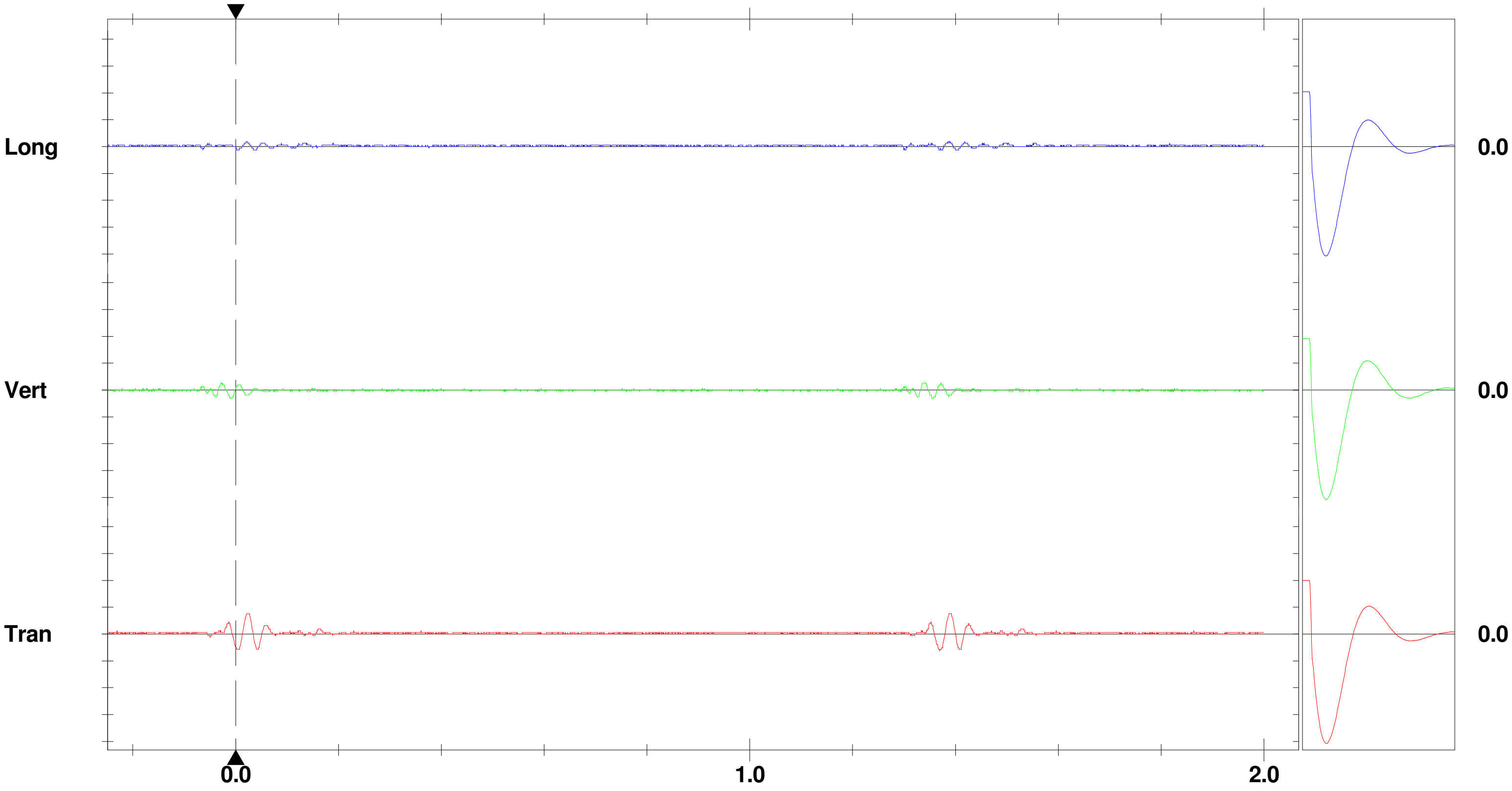
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.2 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTQM.KZ0

	Tran	Vert	Long	
PPV	1.52	0.635	0.381	mm/s
ZC Freq	24	37	47	Hz
Time (Rel. to Trig)	0.021	-0.011	0.021	sec
Peak Acceleration	0.0398	0.0265	0.0133	g
Peak Displacement	0.0104	0.00316	0.00186	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.6	7.5	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 1.62 mm/s at 0.021 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Instantel

FFT Report

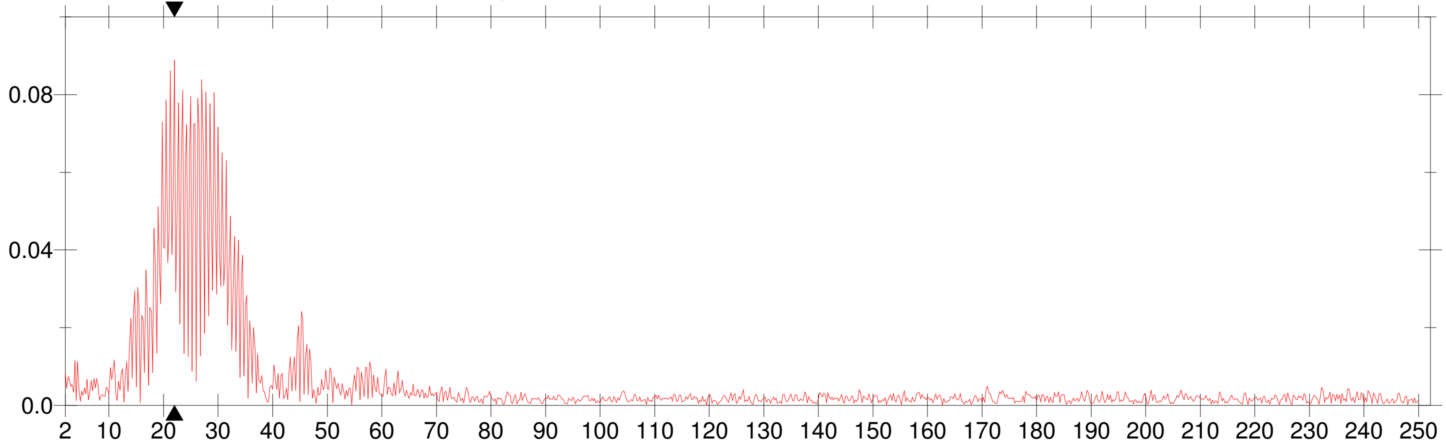
Date/Time	Tran at 13:53:23 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTQM.KZ0

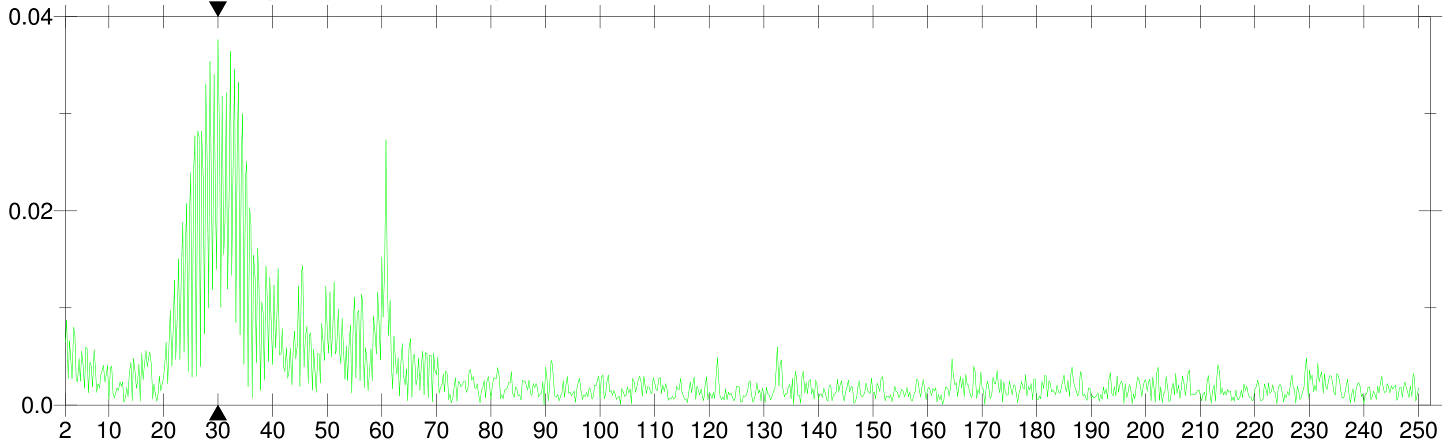
Notes

Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

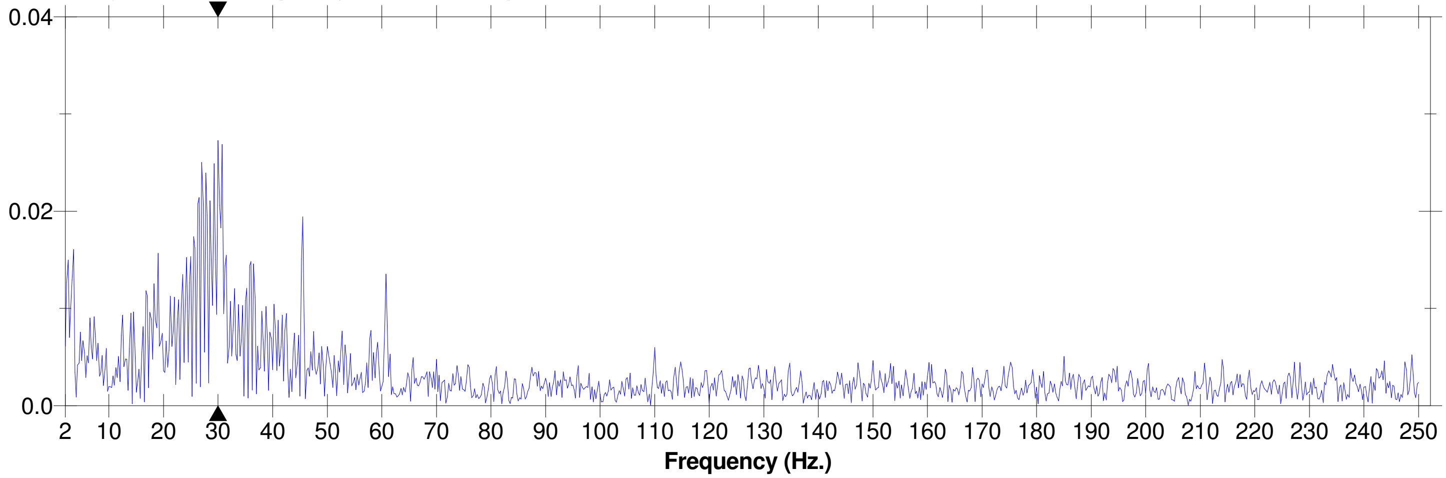
Tran Dominant Frequency = 22.0 Hz., Amplitude = 0.0888, PPV from Event = 1.52 mm/s



Vert Dominant Frequency = 30.0 Hz., Amplitude = 0.0376, PPV from Event = 0.635 mm/s



Long Dominant Frequency = 30.0 Hz., Amplitude = 0.0273, PPV from Event = 0.381 mm/s



Instantel

Event Report

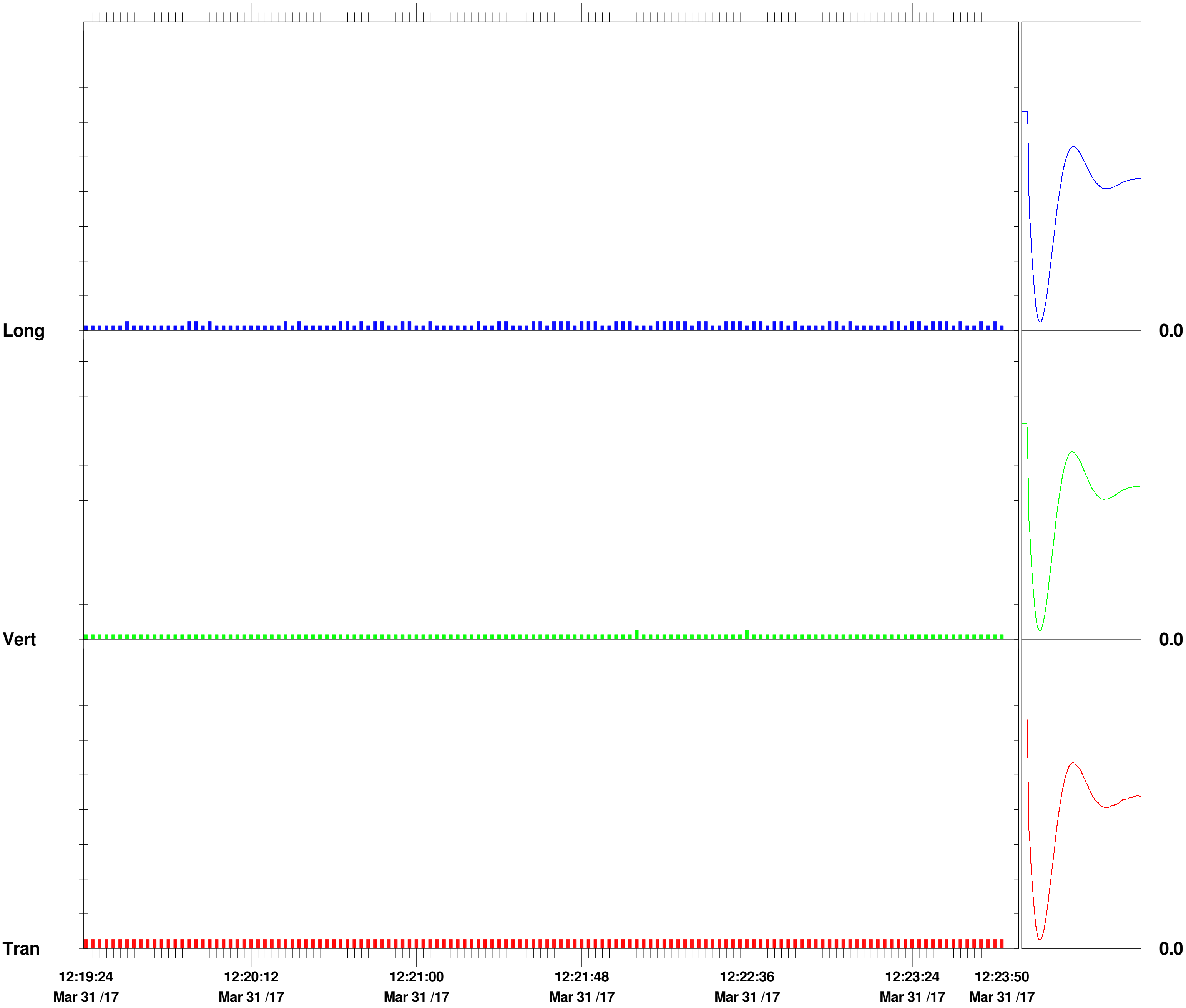
Histogram Start Time	12:19:22 March 31, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	12:23:51 March 31, 2017	**Battery Level**	6.1 Volts
Number of Intervals	134.00 at 2 seconds	**Unit Calibration**	February 22, 2017 by Instantel
Range	Geo:254 mm/s	**File Name**	Q696GTU7.KA0
Sample Rate	1024sps		

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	0.254	0.254	0.254	mm/s
ZC Freq	>100	>100	>100	Hz
Date	Mar 31 /17	Mar 31 /17	Mar 31 /17	
Time	12:19:24	12:22:04	12:19:36	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	3.9	3.8	4.2	

Peak Vector Sum 0.359 mm/s on March 31, 2017 at 12:20:48



Time Scale: 2 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

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Event Report

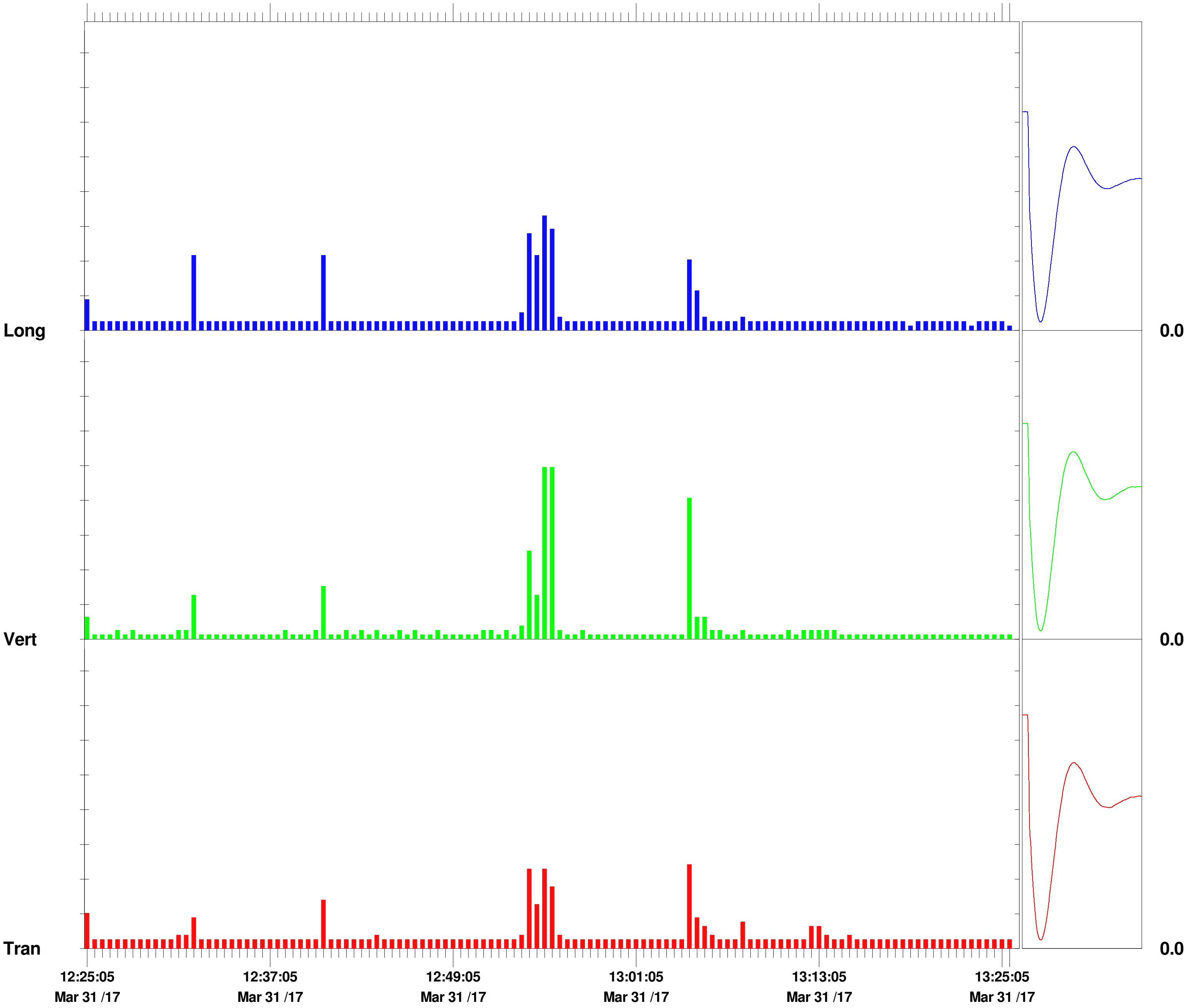
Histogram Start Time	12:24:35 March 31, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	13:25:09 March 31, 2017	**Battery Level**	6.1 Volts
Number of Intervals	1816.00 at 2 seconds	**Unit Calibration**	February 22, 2017 by Instantel
Range	Geo:254 mm/s	**File Name**	Q696GTU7.SZ0
Sample Rate	1024sps		

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	2.41	4.95	3.30	mm/s
ZC Freq	23	28	27	Hz
Date	Mar 31 /17	Mar 31 /17	Mar 31 /17	
Time	13:04:35	12:55:05	12:55:01	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 5.27 mm/s on March 31, 2017 at 12:55:05



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Instantel

Event Report

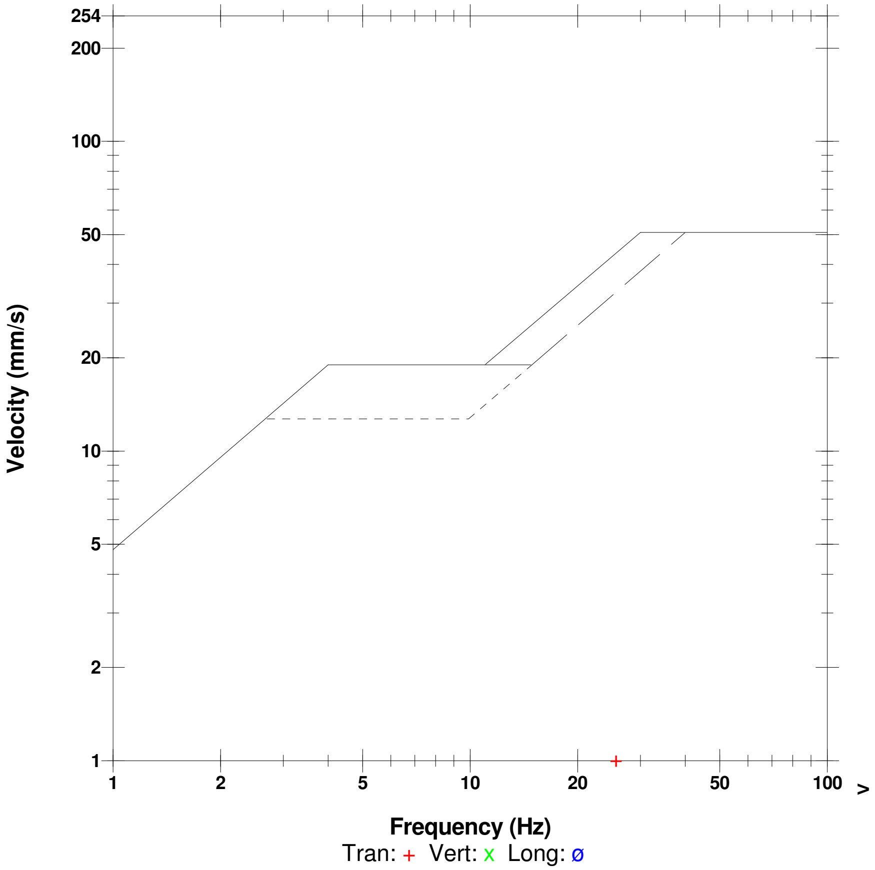
Date/Time Tran at 12:24:40 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

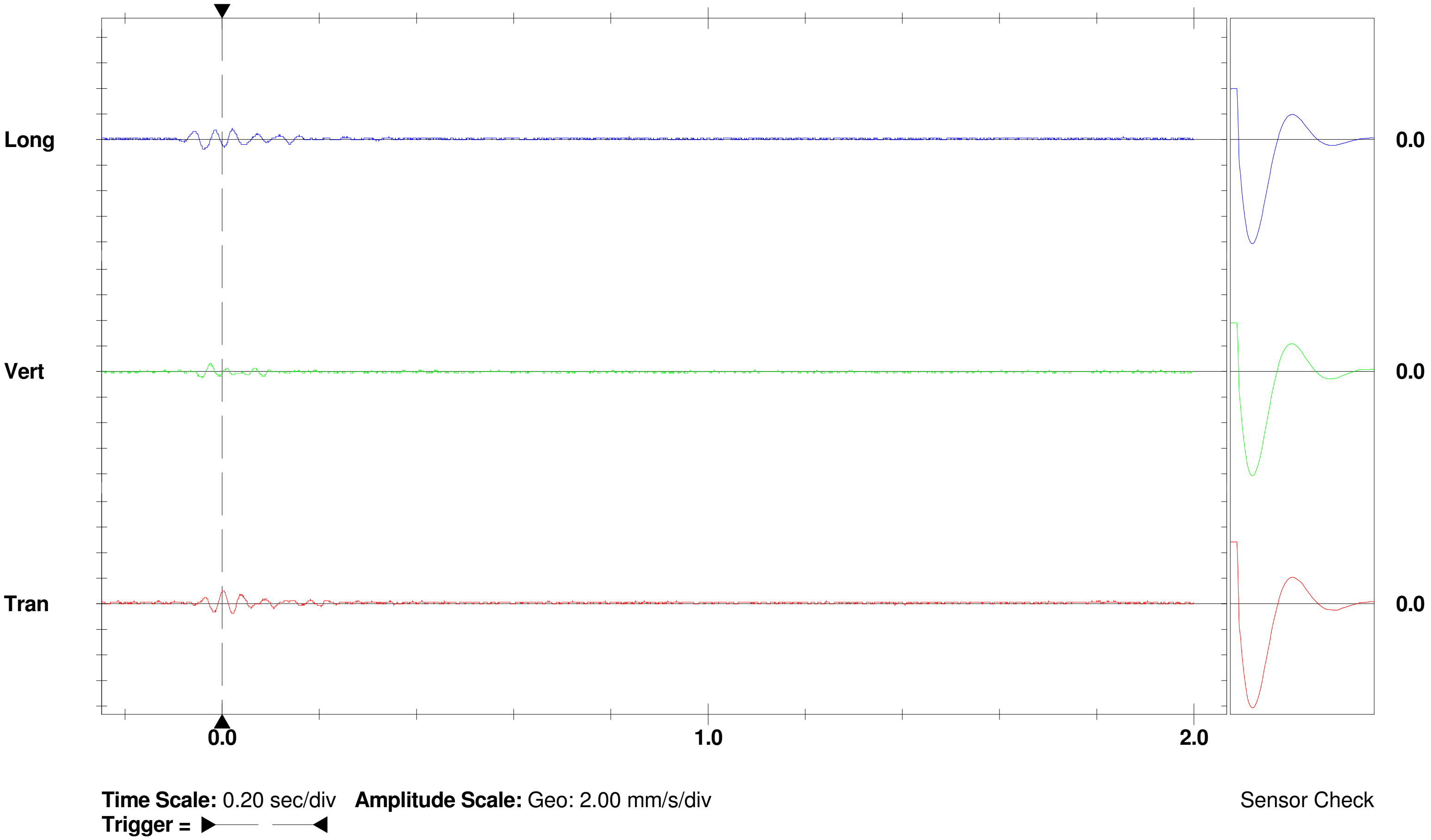
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.1 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTU7.T40

	Tran	Vert	Long	
PPV	1.02	0.635	0.889	mm/s
ZC Freq	26	32	27	Hz
Time (Rel. to Trig)	0.000	-0.026	0.021	sec
Peak Acceleration	0.0265	0.0133	0.0265	g
Peak Displacement	0.00670	0.00329	0.00552	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 1.20 mm/s at 0.004 sec

USBM RI8507 And OSMRE





Instantel

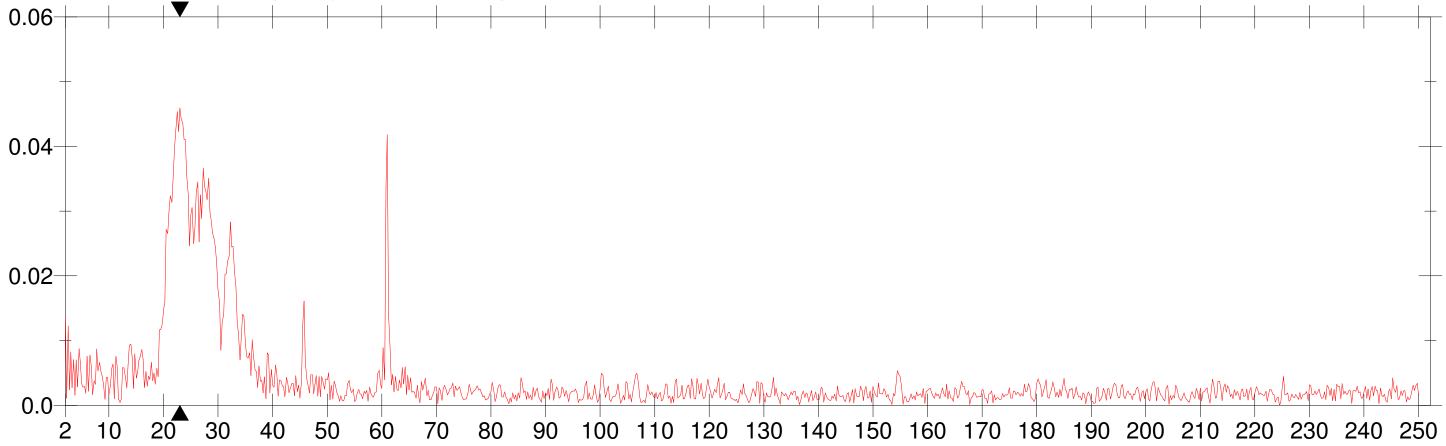
FFT Report

Date/Time	Tran at 12:24:40 March 31, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTU7.T40

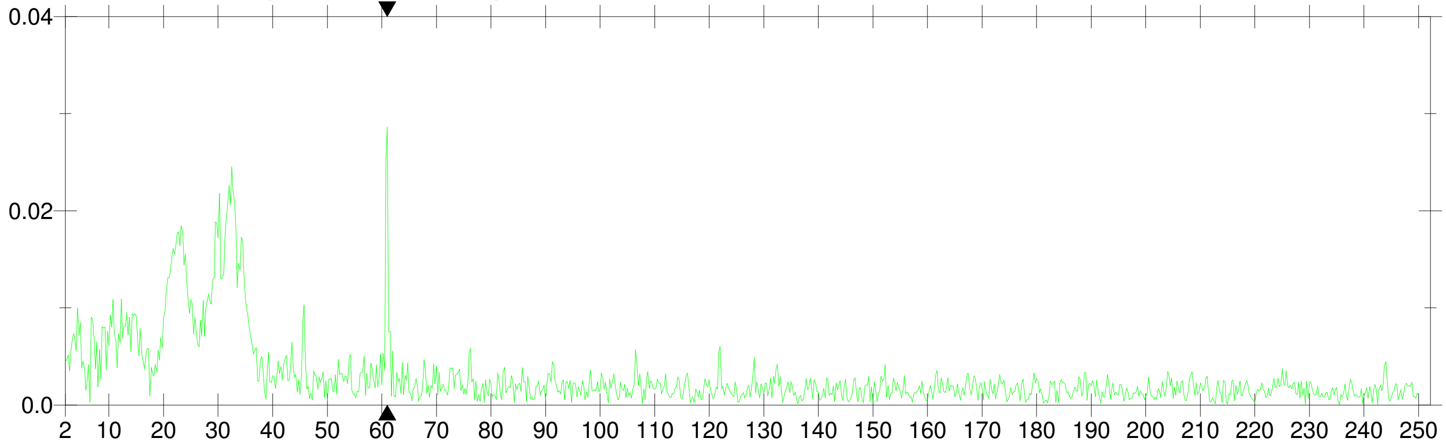
Notes

Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

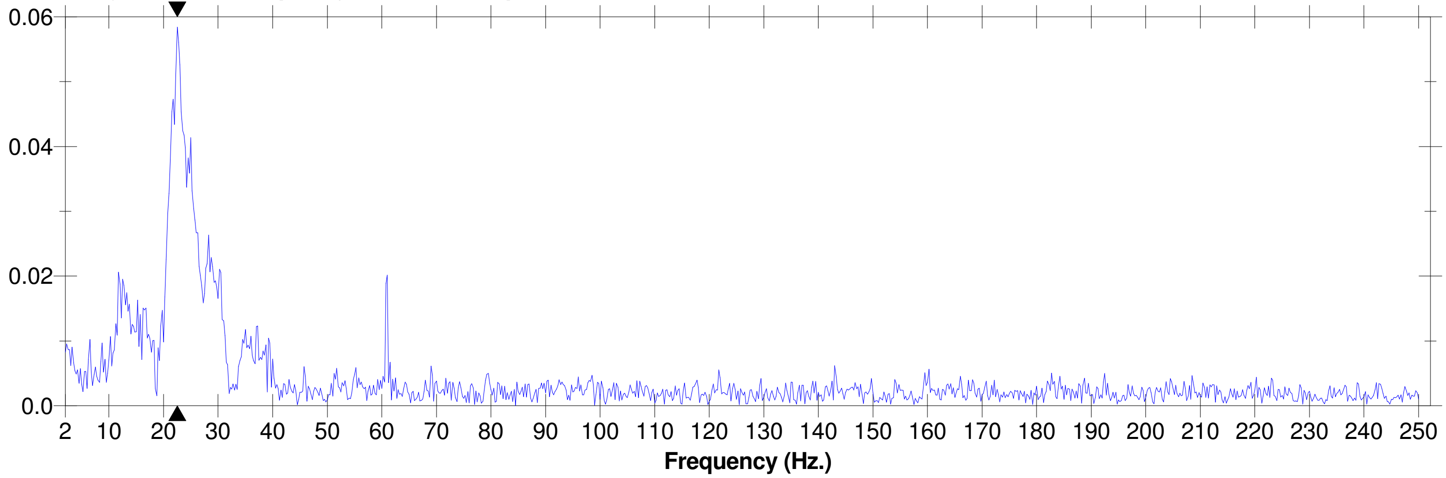
Tran Dominant Frequency = 23.0 Hz., Amplitude = 0.0459, PPV from Event = 1.02 mm/s



Vert Dominant Frequency = 61.0 Hz., Amplitude = 0.0286, PPV from Event = 0.635 mm/s



Long Dominant Frequency = 22.5 Hz., Amplitude = 0.0584, PPV from Event = 0.889 mm/s



Event Report

Date/Time	Long at 12:31:46 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.1 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTU8.4Y0

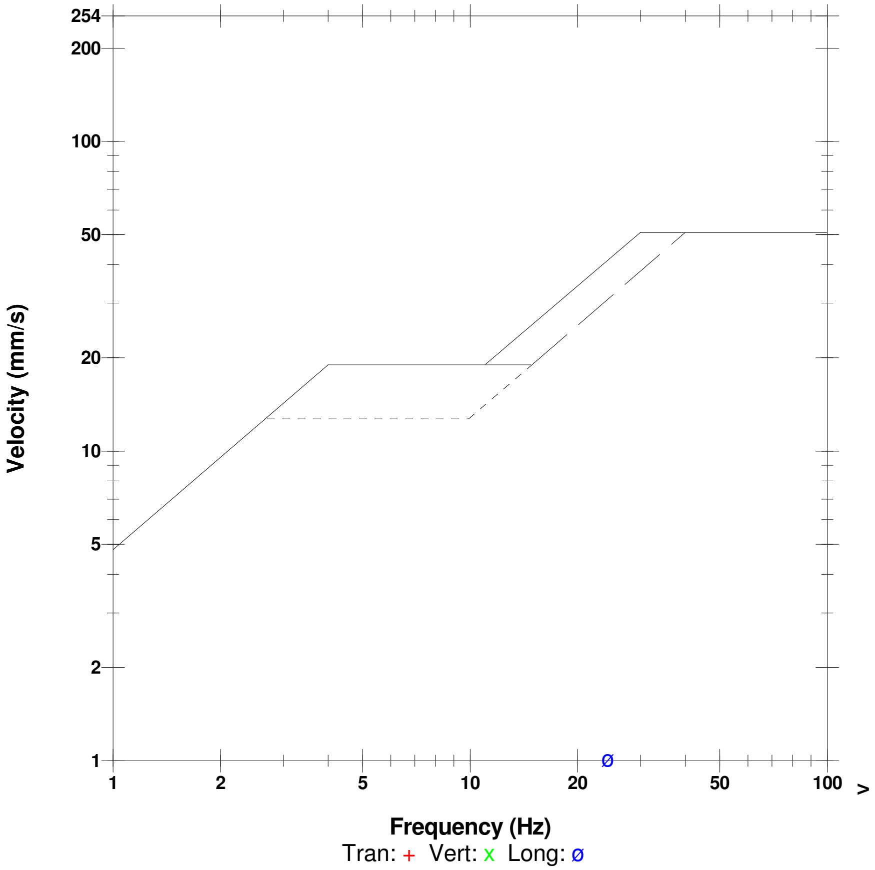
Notes

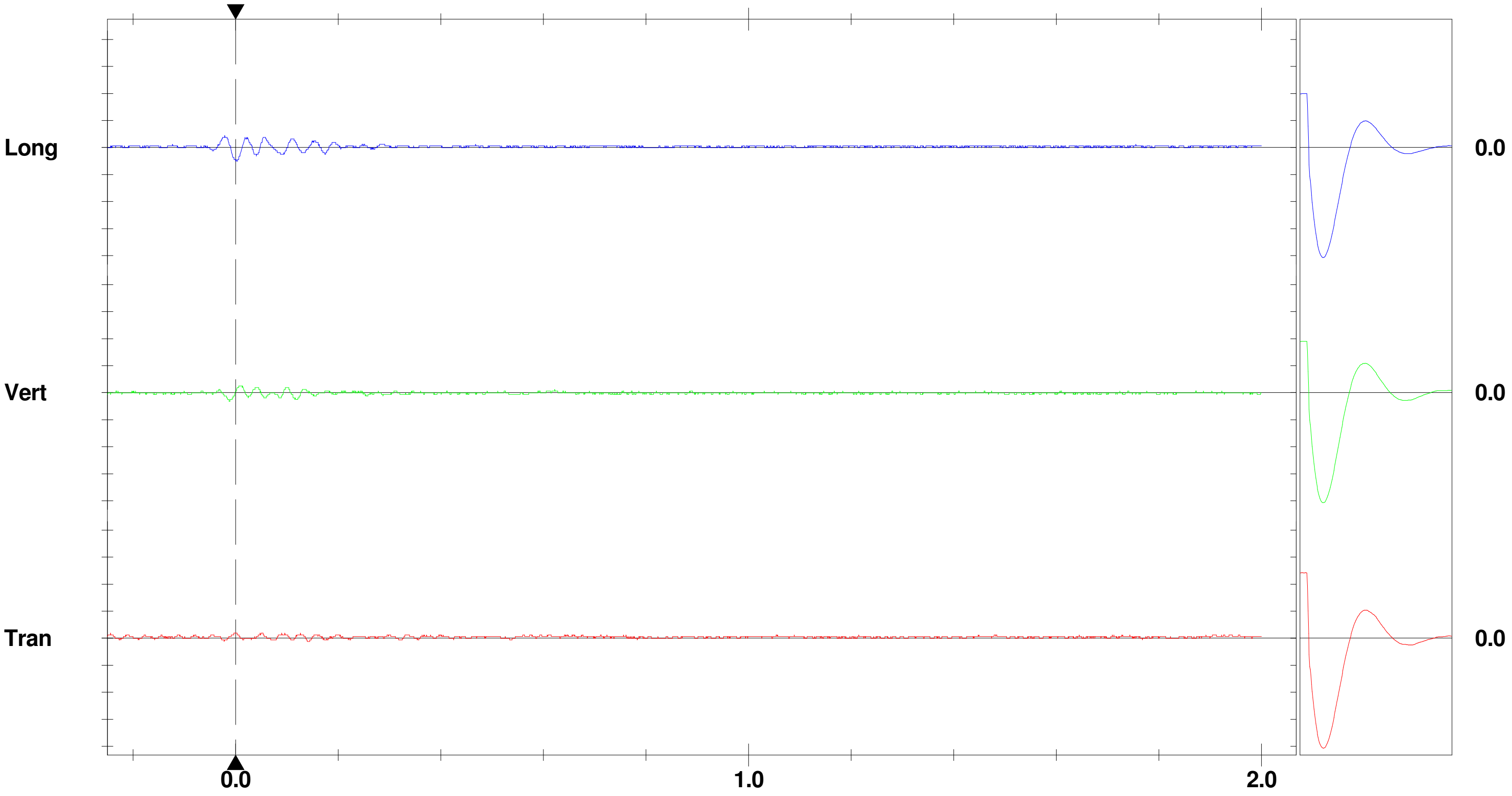
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	**Vert**	**Long**	
PPV	0.381	0.635	1.02	mm/s
ZC Freq	43	23	24	Hz
Time (Rel. to Trig)	-0.244	-0.013	0.000	sec
Peak Acceleration	0.0133	0.0265	0.0265	g
Peak Displacement	0.00248	0.00409	0.00713	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 1.11 mm/s at 0.002 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Instantel

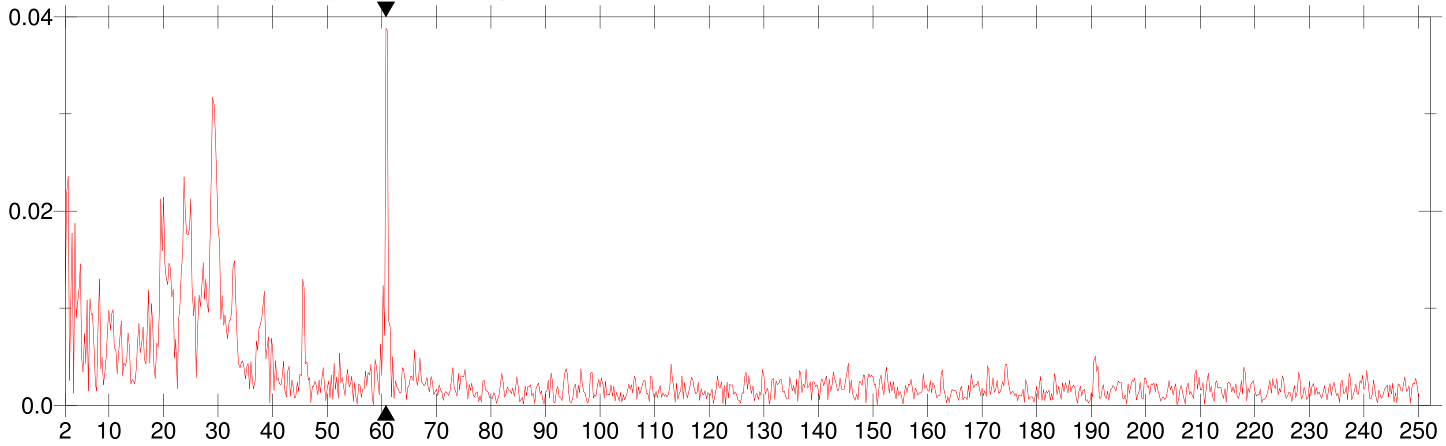
FFT Report

Date/Time	Long at 12:31:46 March 31, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTU8.4Y0

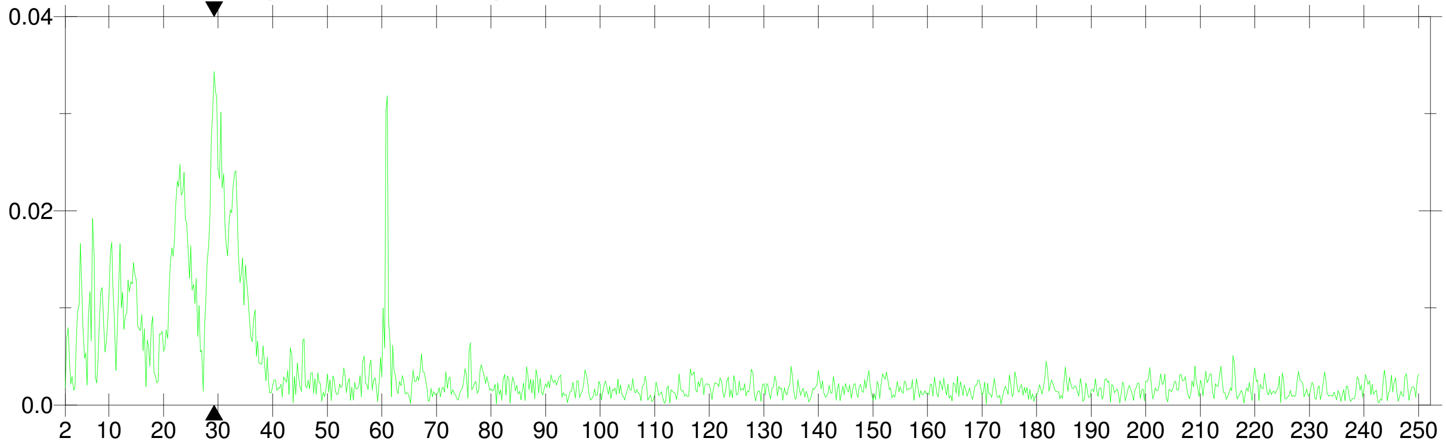
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

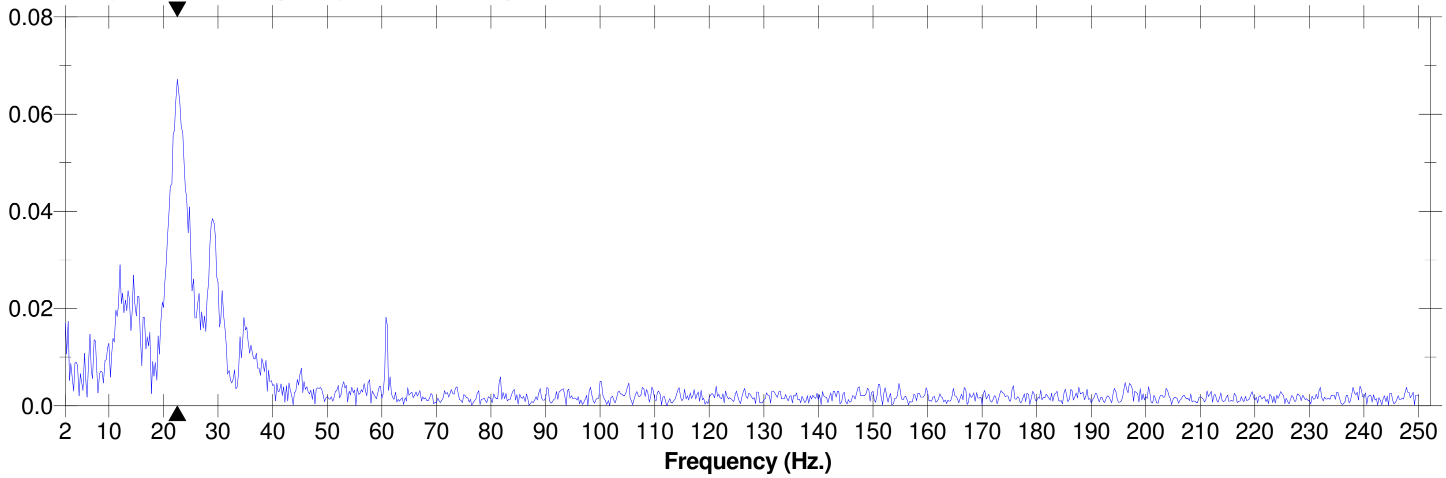
Tran Dominant Frequency = 60.8 Hz., Amplitude = 0.0388, PPV from Event = 0.381 mm/s



Vert Dominant Frequency = 29.3 Hz., Amplitude = 0.0343, PPV from Event = 0.635 mm/s



Long Dominant Frequency = 22.5 Hz., Amplitude = 0.0671, PPV from Event = 1.02 mm/s



Event Report

Date/Time	Long at 12:31:52 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.1 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTU8.540

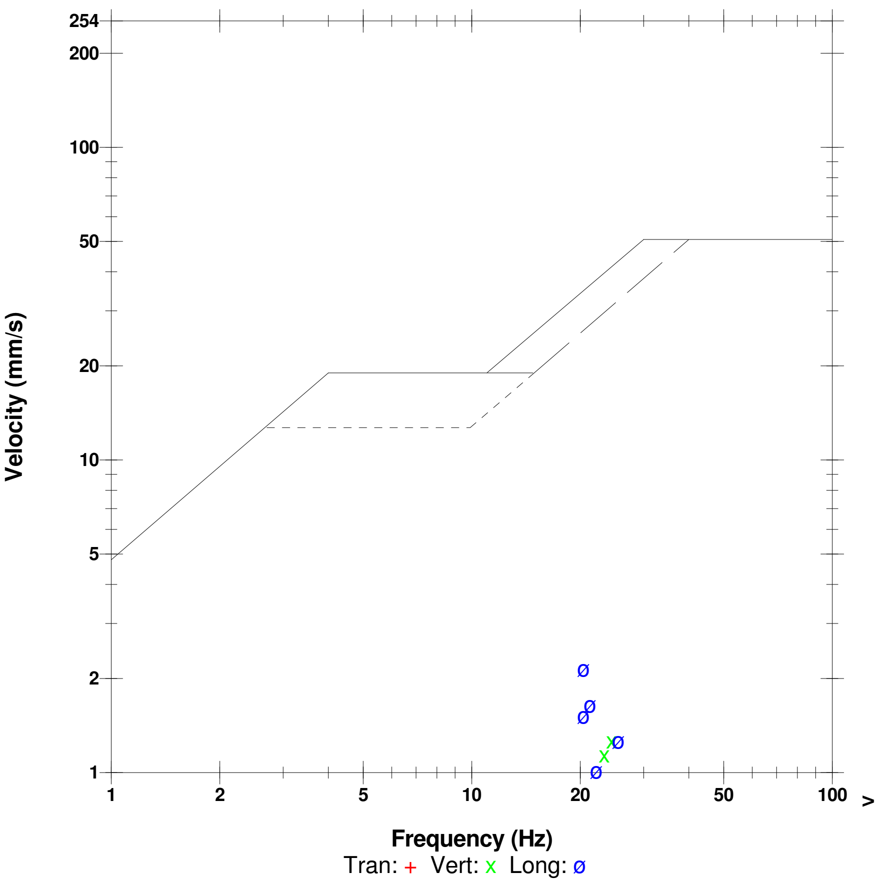
Notes

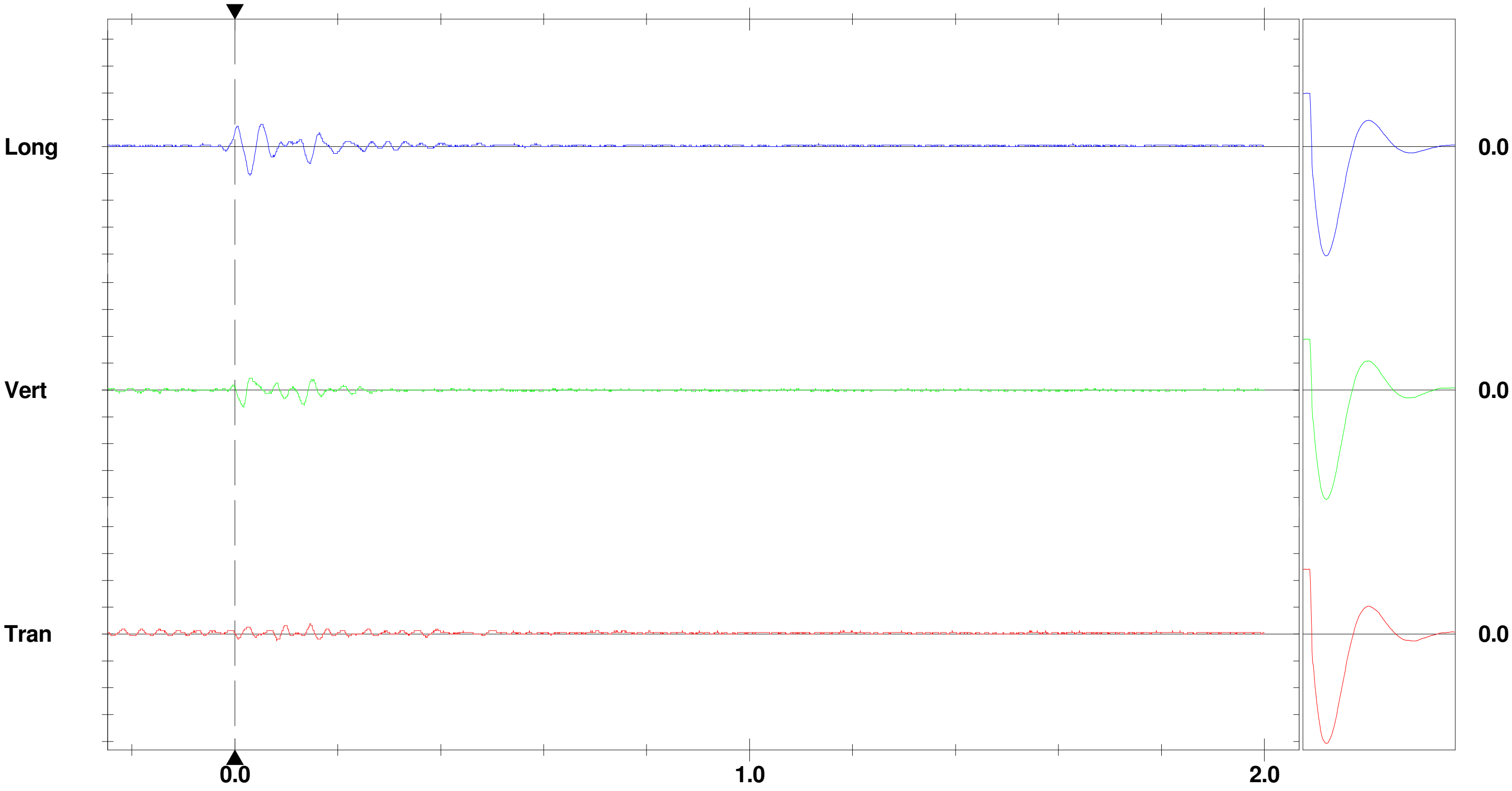
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	0.762	1.27	2.16	mm/s
ZC Freq	32	24	20	Hz
Time (Rel. to Trig)	0.146	0.016	0.029	sec
Peak Acceleration	0.0265	0.0398	0.0398	g
Peak Displacement	0.00366	0.00788	0.0158	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 2.39 mm/s at 0.029 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Trigger = ▶──── ────◀

Instantel

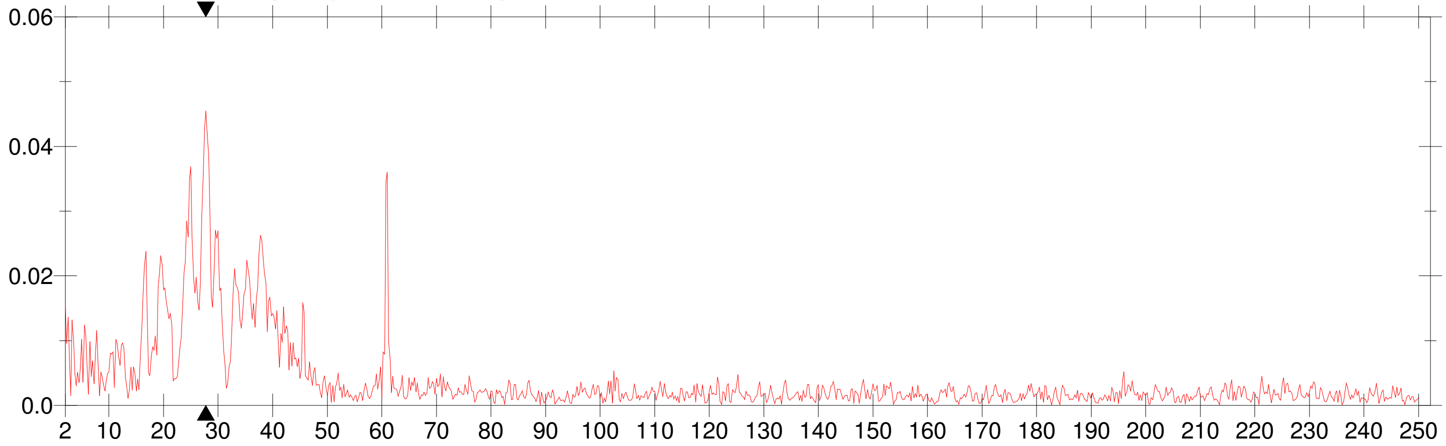
FFT Report

Date/Time Long at 12:31:52 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

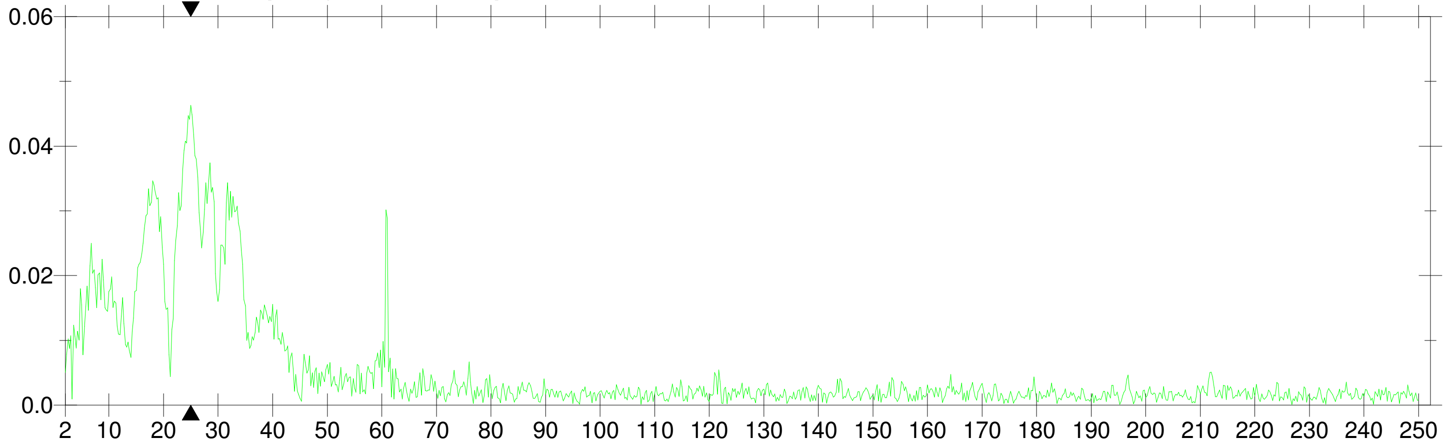
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.1 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTU8.540

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

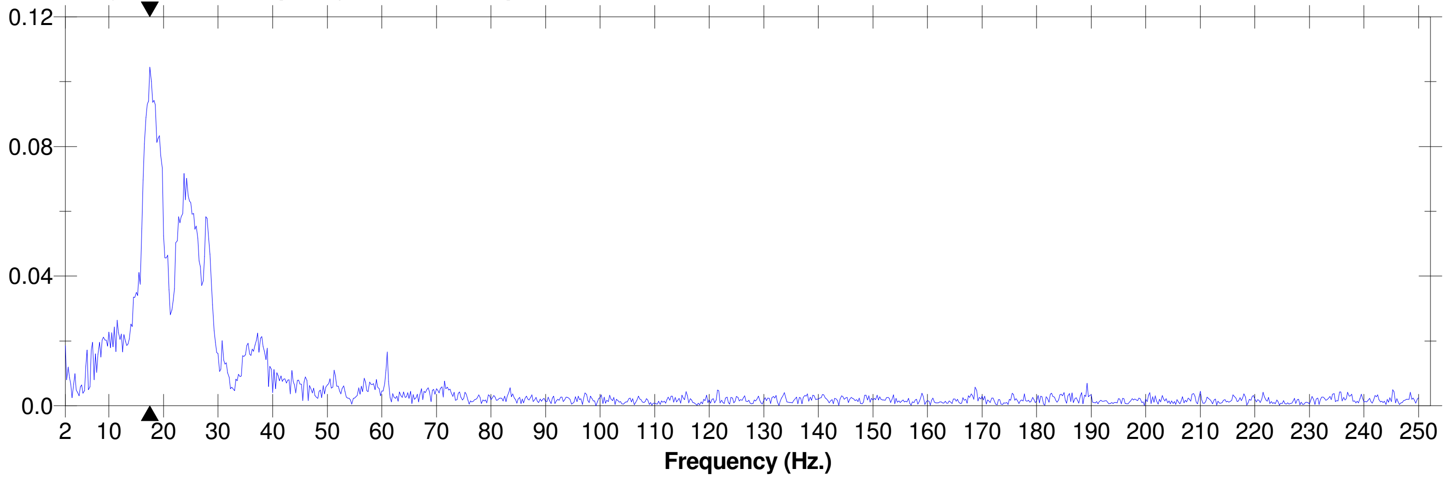
Tran Dominant Frequency = 27.8 Hz., Amplitude = 0.0455, PPV from Event = 0.762 mm/s



Vert Dominant Frequency = 25.0 Hz., Amplitude = 0.0463, PPV from Event = 1.27 mm/s



Long Dominant Frequency = 17.5 Hz., Amplitude = 0.104, PPV from Event = 2.16 mm/s



Event Report

Date/Time	Long at 12:40:30 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.1 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTU8.JI0

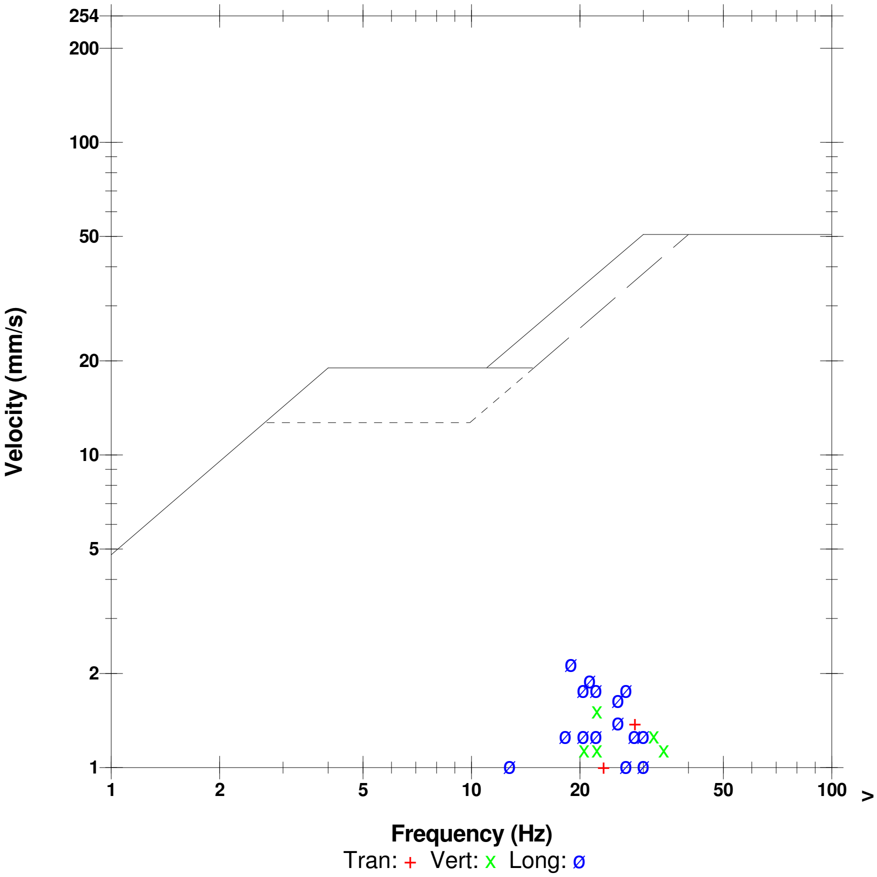
Notes

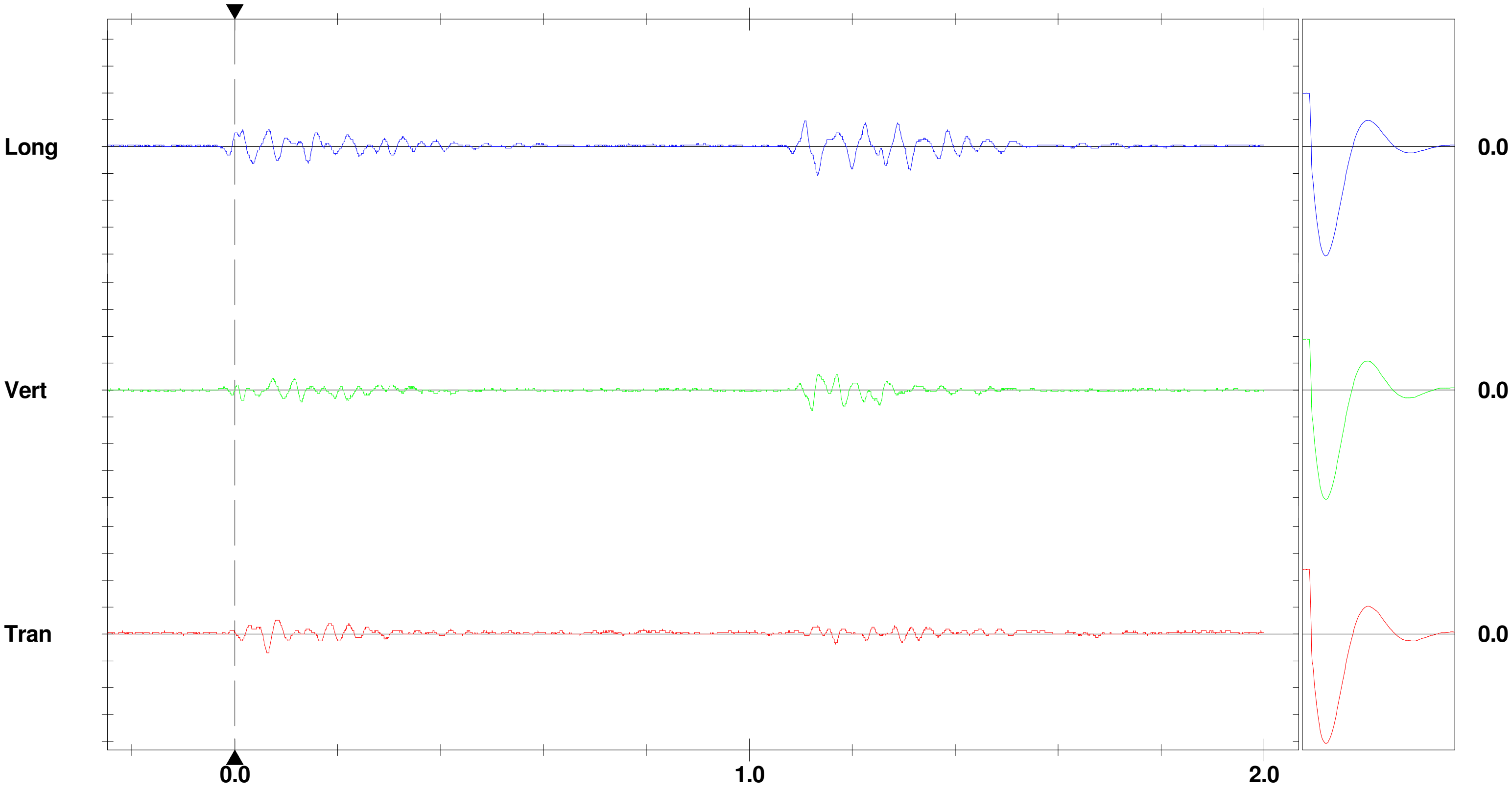
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.40	1.52	2.16	mm/s
ZC Freq	28	22	19	Hz
Time (Rel. to Trig)	0.063	1.121	1.133	sec
Peak Acceleration	0.0265	0.0398	0.0398	g
Peak Displacement	0.00788	0.00887	0.0148	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 2.52 mm/s at 1.133 sec

USBM RI8507 And OSMRE





Sensor Check

Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶──── ────◀

Printed: April 24, 2017 (V 10.60 - 10.60)

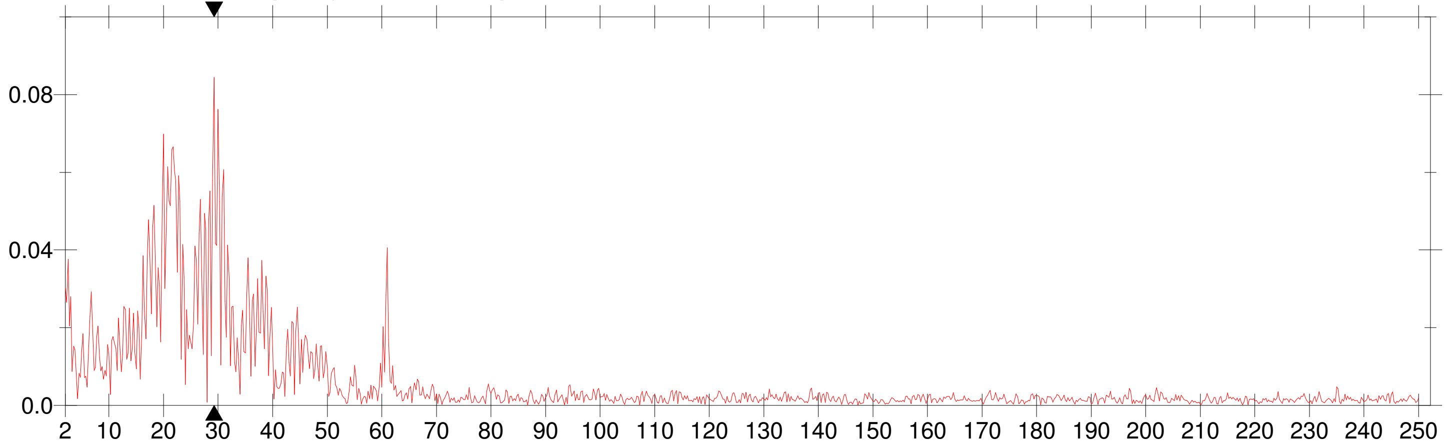
FFT Report

Date/Time Long at 12:40:30 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

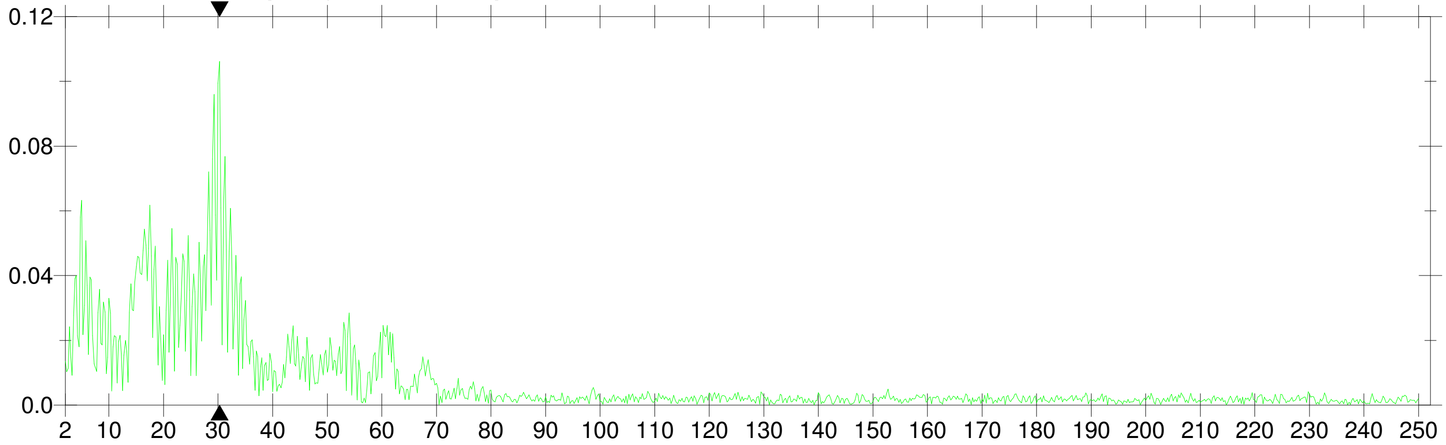
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.1 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTU8.JI0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

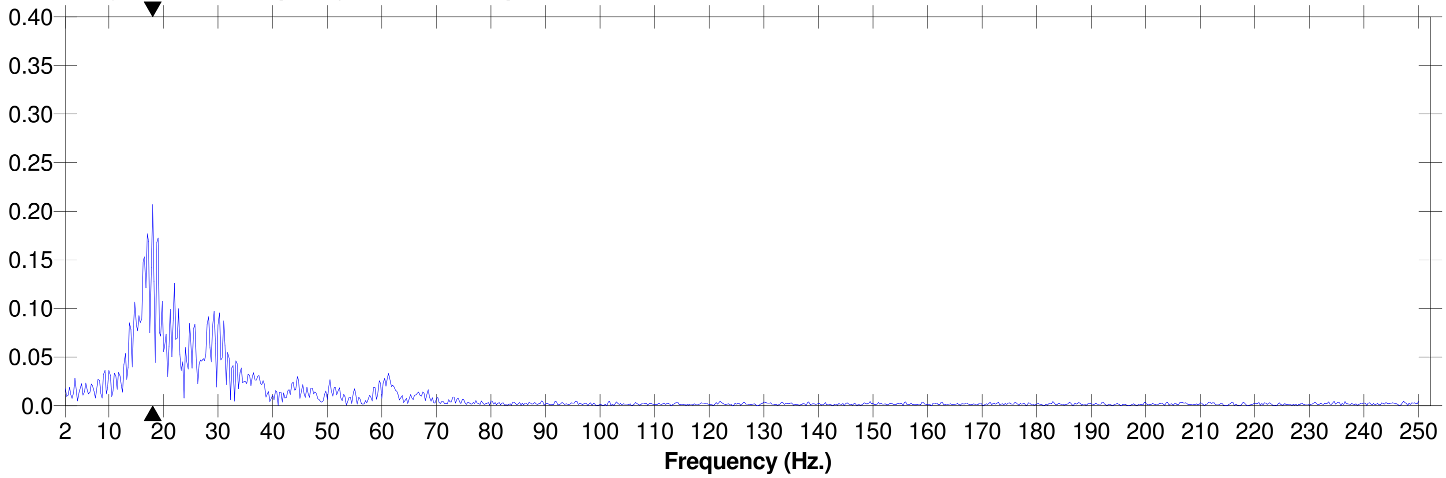
Tran Dominant Frequency = 29.3 Hz., Amplitude = 0.0844, PPV from Event = 1.40 mm/s



Vert Dominant Frequency = 30.3 Hz., Amplitude = 0.106, PPV from Event = 1.52 mm/s



Long Dominant Frequency = 18.0 Hz., Amplitude = 0.207, PPV from Event = 2.16 mm/s



Event Report

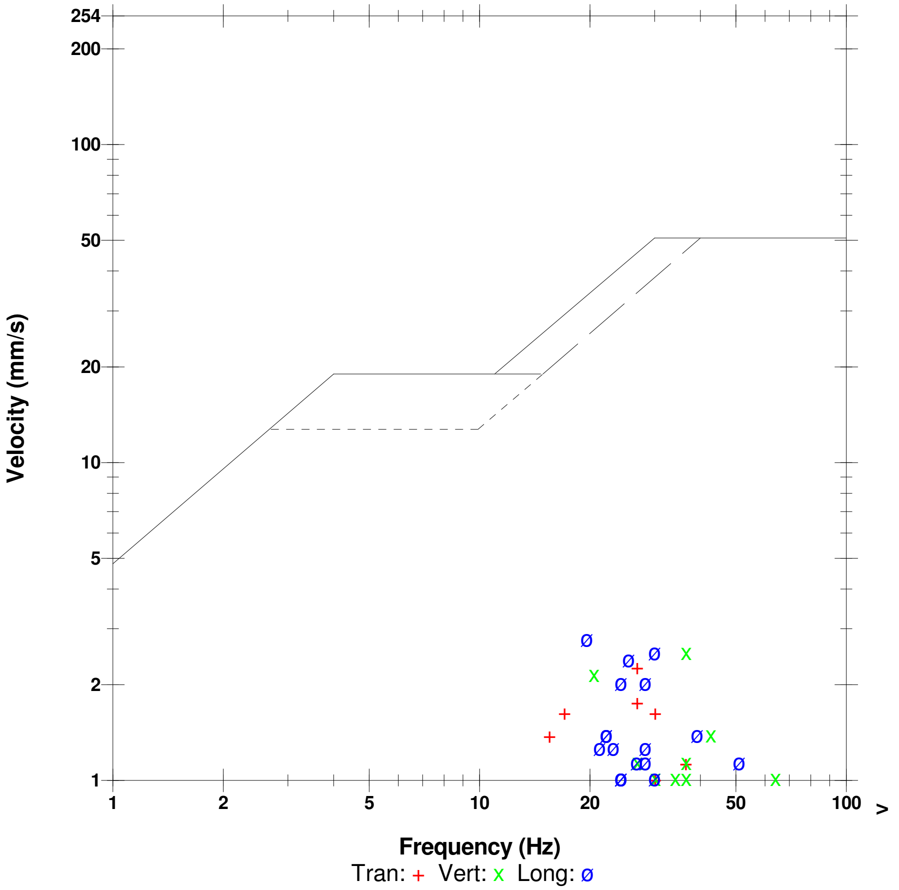
Date/Time Long at 12:53:40 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

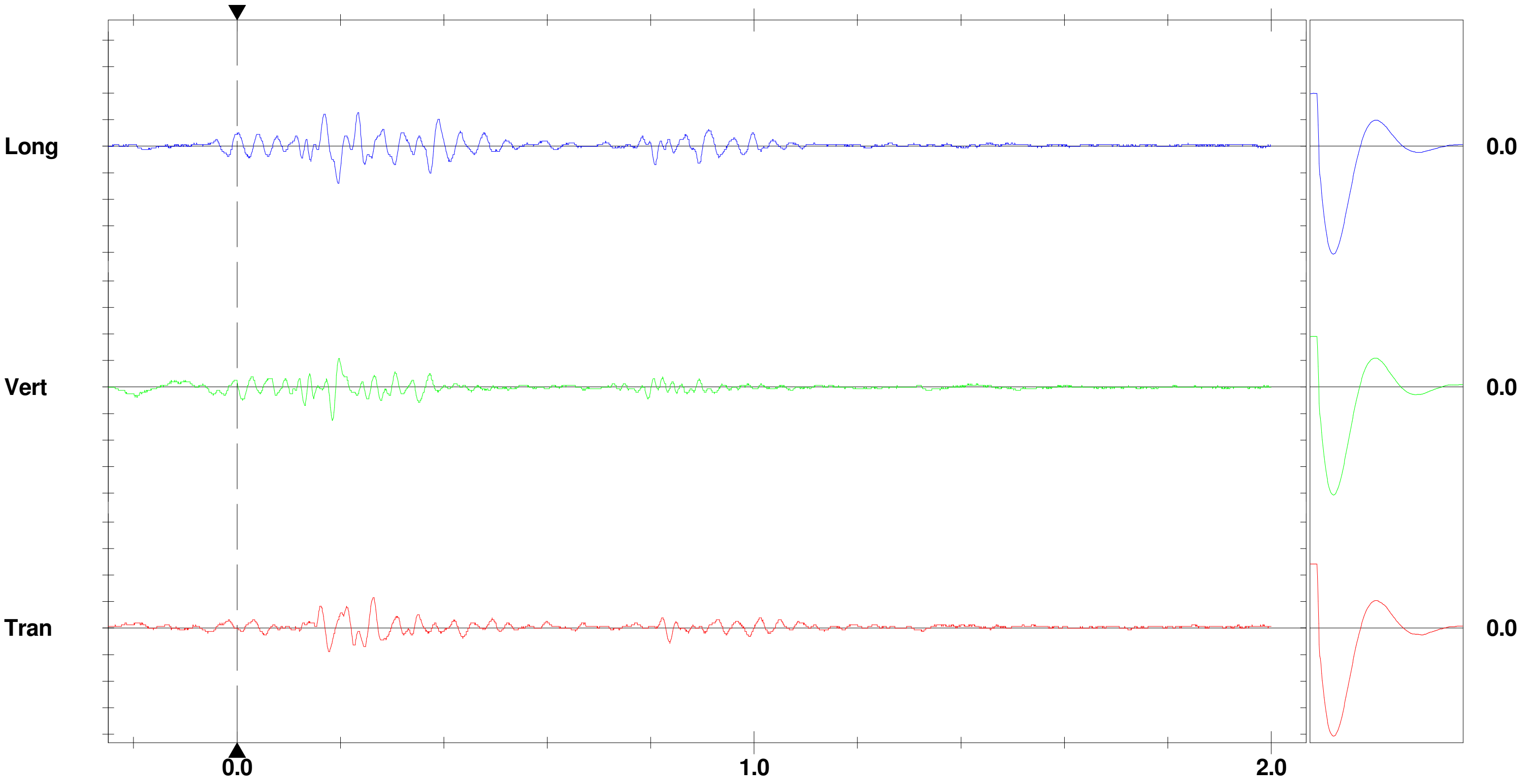
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.1 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTU9.5G0

	Tran	**Vert**	**Long**	
PPV	2.29	2.54	2.79	mm/s
ZC Freq	27	37	20	Hz
Time (Rel. to Trig)	0.263	0.185	0.195	sec
Peak Acceleration	0.0398	0.0663	0.0663	g
Peak Displacement	0.0141	0.0139	0.0191	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 3.59 mm/s at 0.196 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

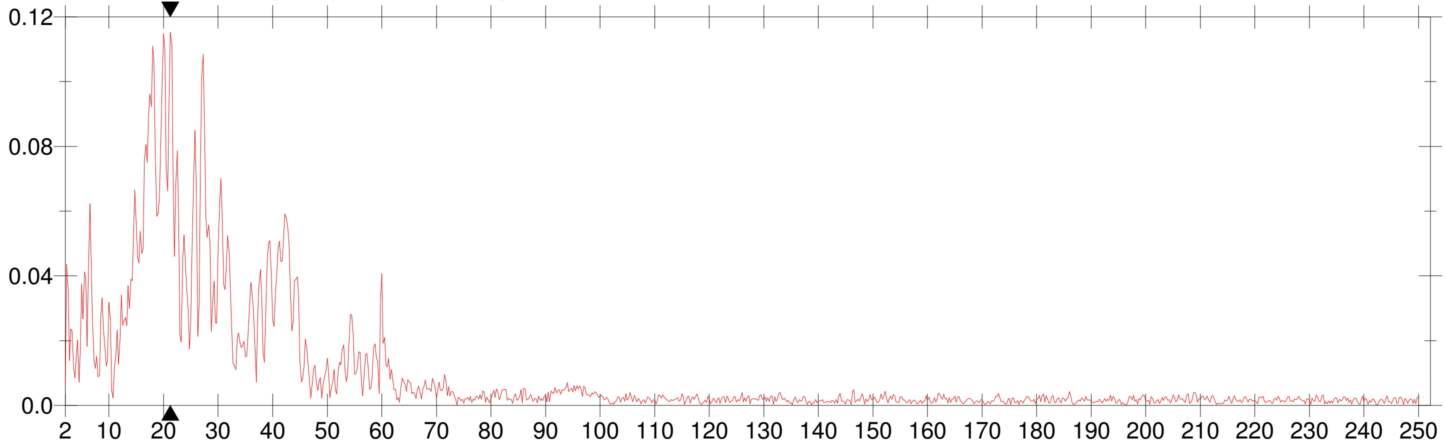
FFT Report

Date/Time Long at 12:53:40 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

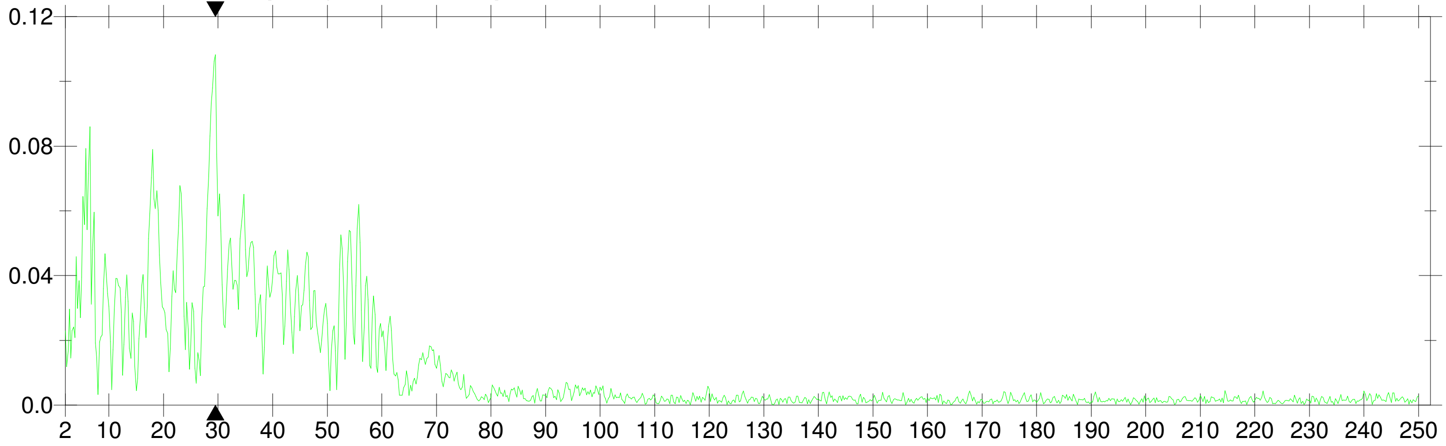
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.1 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTU9.5G0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

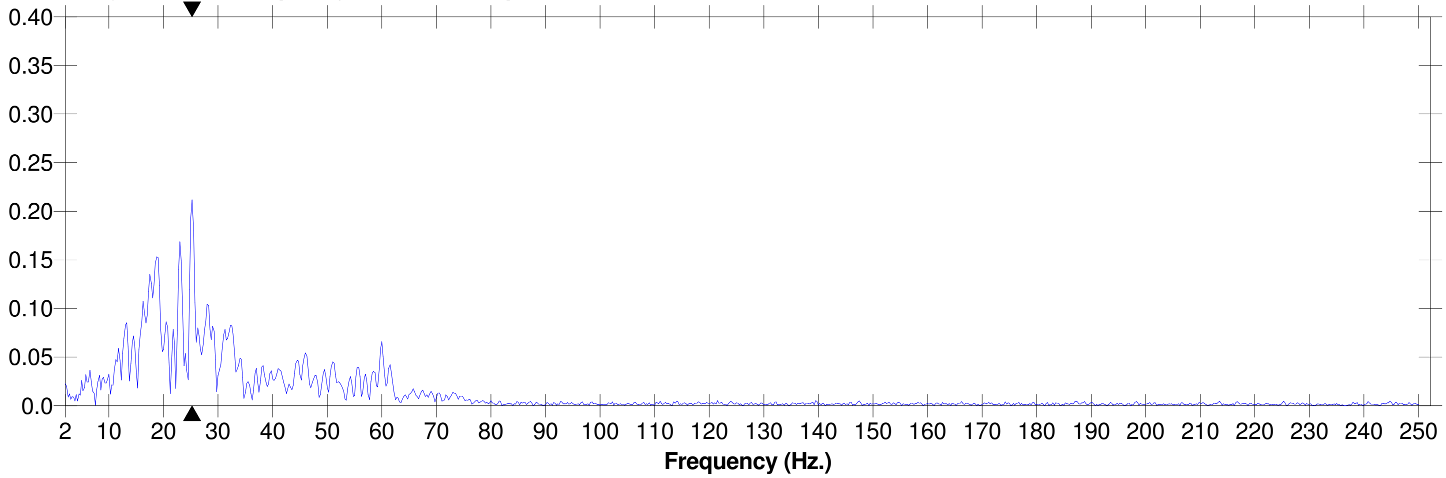
Tran Dominant Frequency = 21.3 Hz., Amplitude = 0.115, PPV from Event = 2.29 mm/s



Vert Dominant Frequency = 29.5 Hz., Amplitude = 0.108, PPV from Event = 2.54 mm/s



Long Dominant Frequency = 25.3 Hz., Amplitude = 0.212, PPV from Event = 2.79 mm/s



Instantel

Event Report

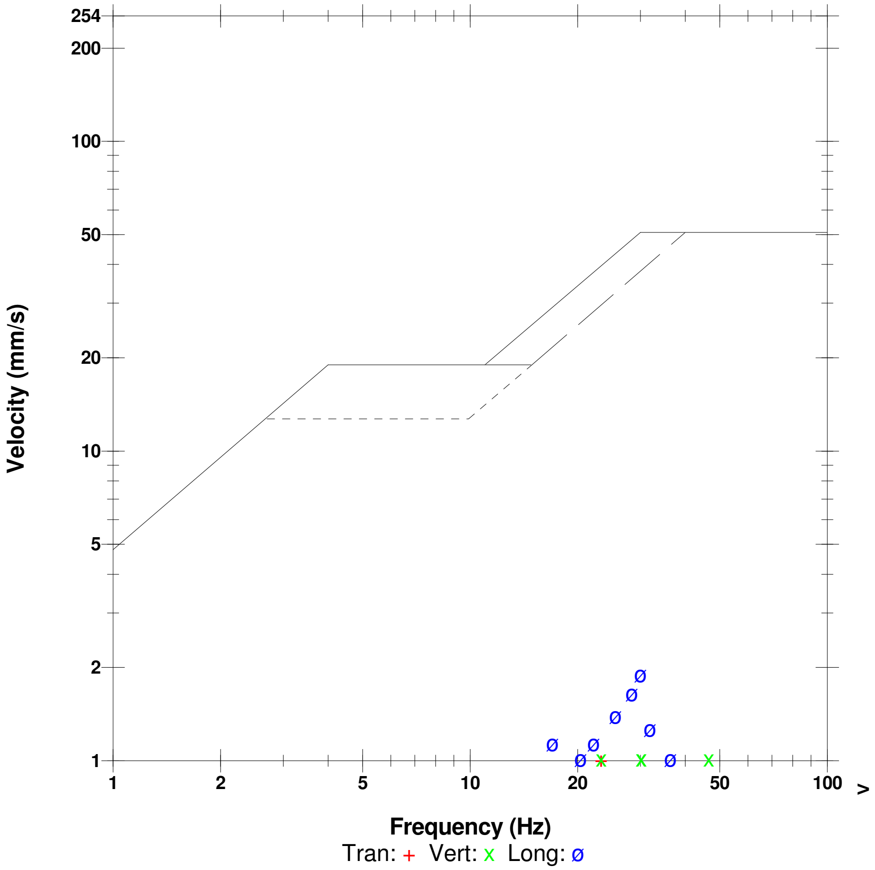
Date/Time	Long at 12:53:53 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps
Notes	
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

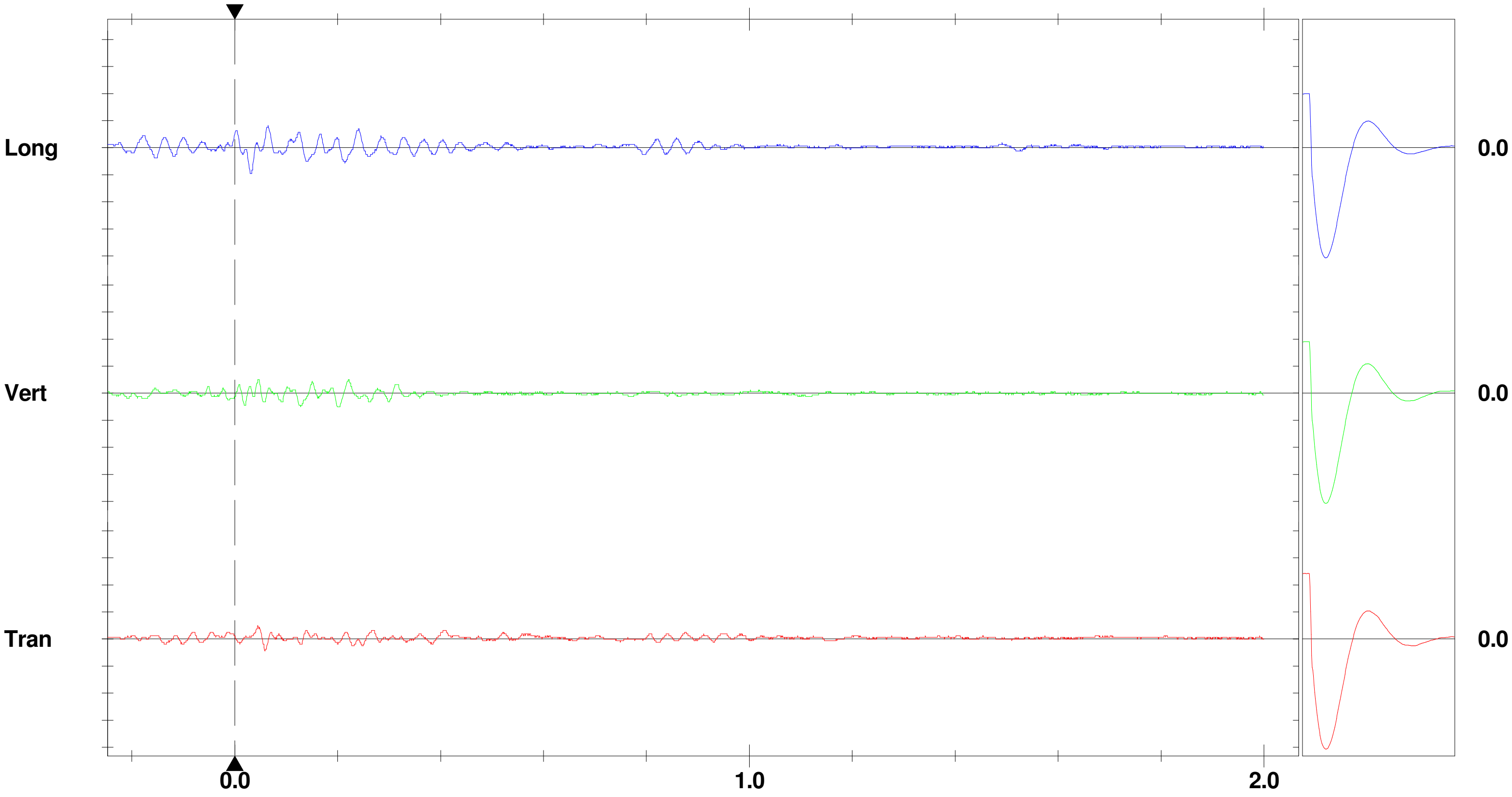
Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.1 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTU9.5T0

	Tran	**Vert**	**Long**	
PPV	1.02	1.02	1.90	mm/s
ZC Freq	23	47	30	Hz
Time (Rel. to Trig)	0.045	0.045	0.030	sec
Peak Acceleration	0.0398	0.0398	0.0398	g
Peak Displacement	0.00589	0.00633	0.00974	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 1.98 mm/s at 0.030 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Trigger = ▶——— ———◀

Printed: April 24, 2017 (V 10.60 - 10.60)

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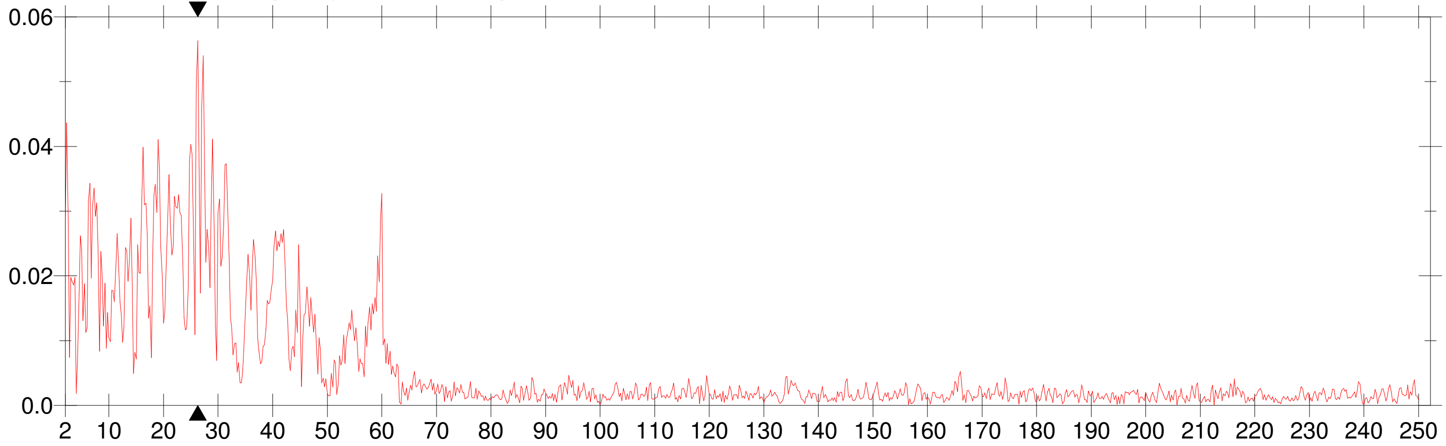
Instantel

FFT Report

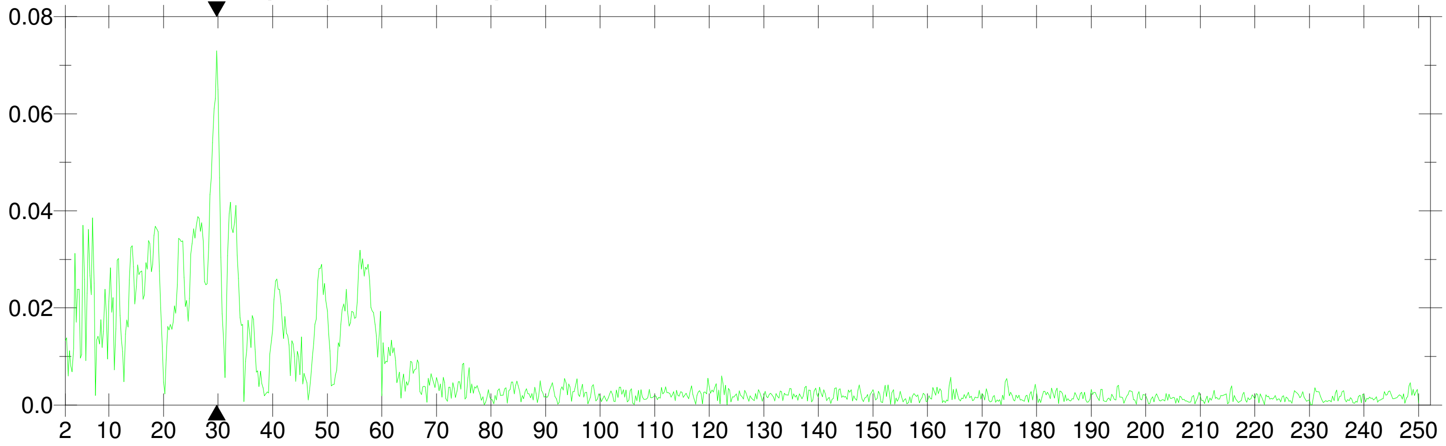
Date/Time	Long at 12:53:53 March 31, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTU9.5T0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

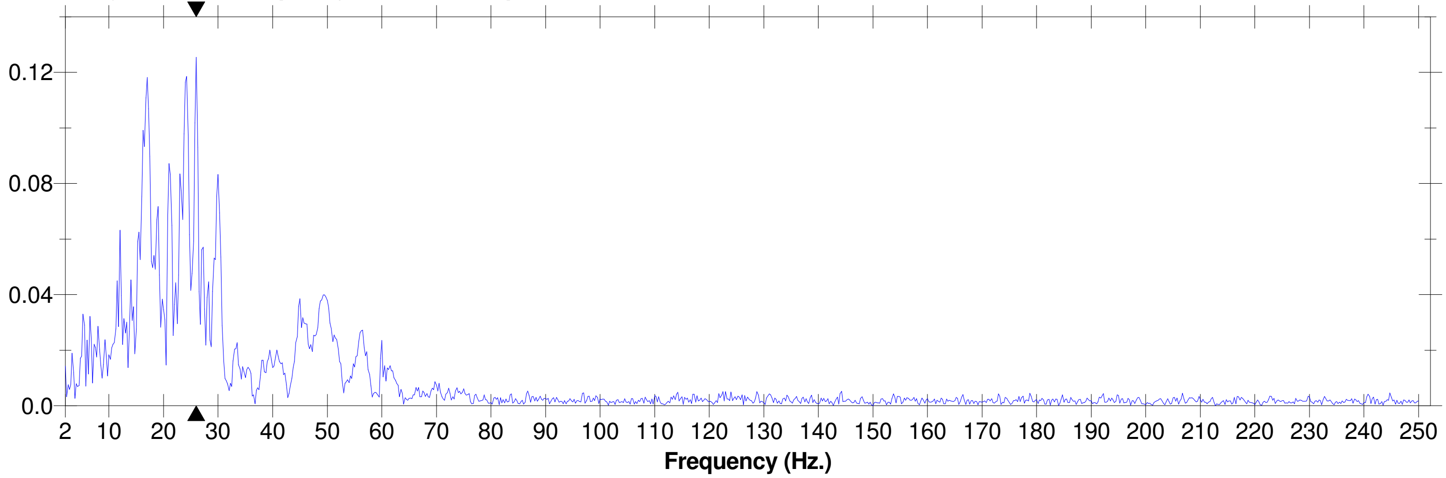
Tran Dominant Frequency = 26.3 Hz., Amplitude = 0.0564, PPV from Event = 1.02 mm/s



Vert Dominant Frequency = 29.8 Hz., Amplitude = 0.0729, PPV from Event = 1.02 mm/s



Long Dominant Frequency = 26.0 Hz., Amplitude = 0.125, PPV from Event = 1.90 mm/s



Event Report

Date/Time	Long at 12:54:05 March 31, 2017		**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s		**Battery Level**	6.1 Volts
Range	Geo: 254 mm/s		**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps		**File Name**	Q696GTU9.650

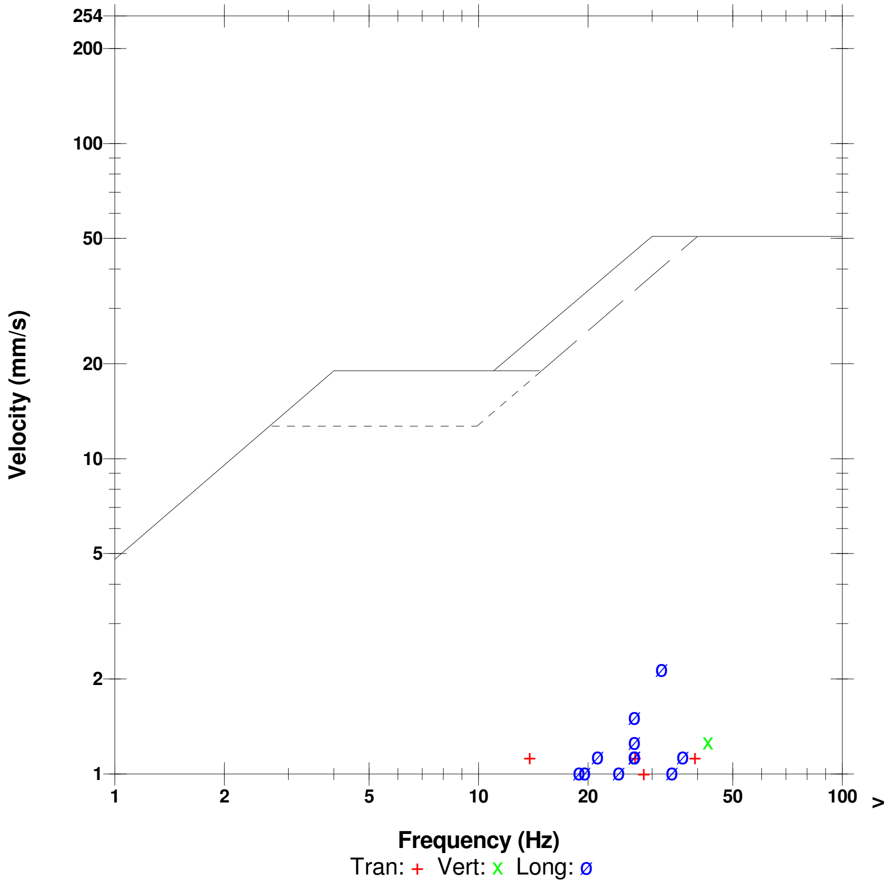
Notes

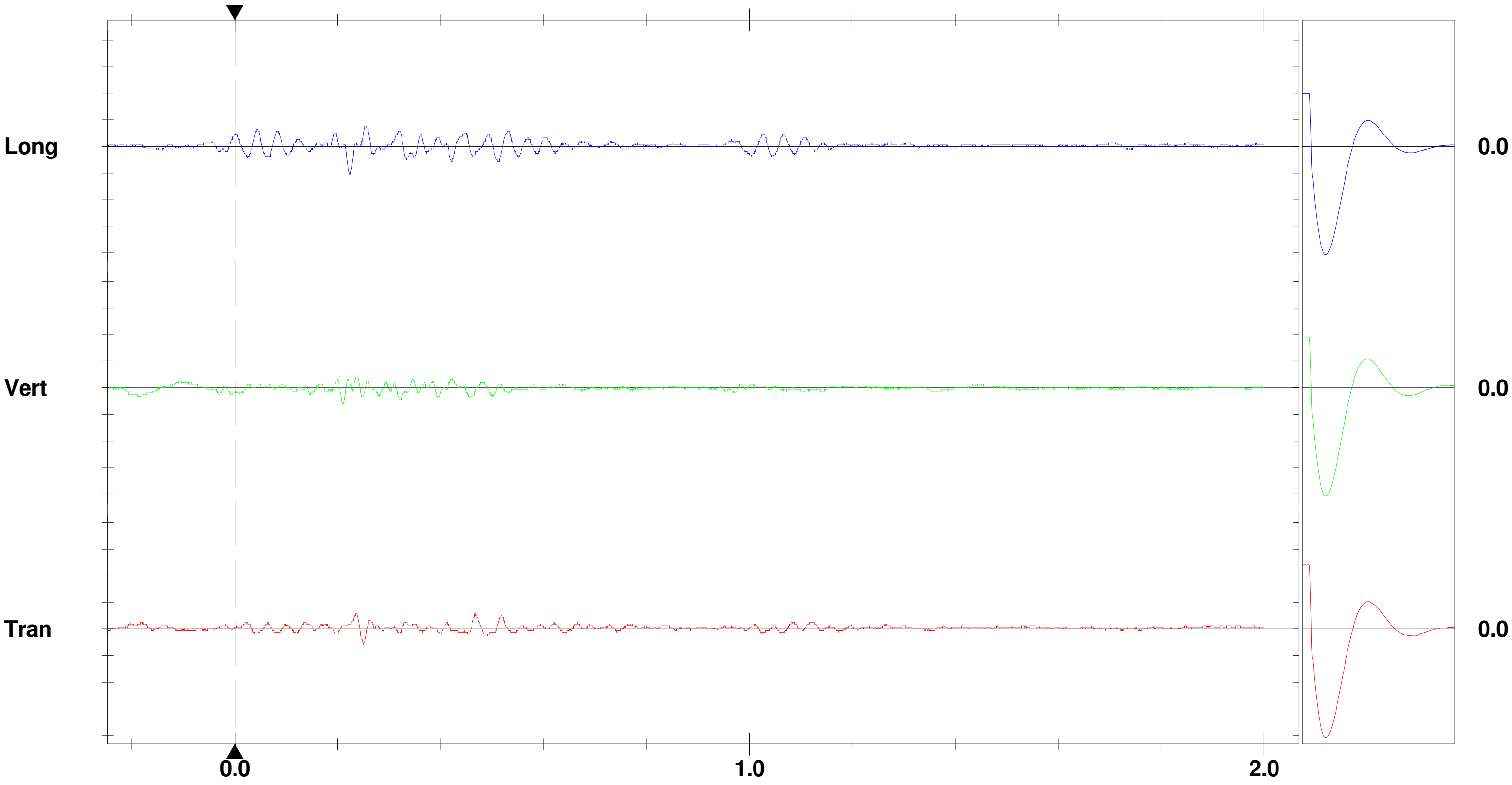
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.14	1.27	2.16	mm/s
ZC Freq	14	43	32	Hz
Time (Rel. to Trig)	0.235	0.210	0.224	sec
Peak Acceleration	0.0398	0.0398	0.0398	g
Peak Displacement	0.00967	0.0132	0.0102	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 2.23 mm/s at 0.224 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶—— ——◀

Sensor Check

Instantel

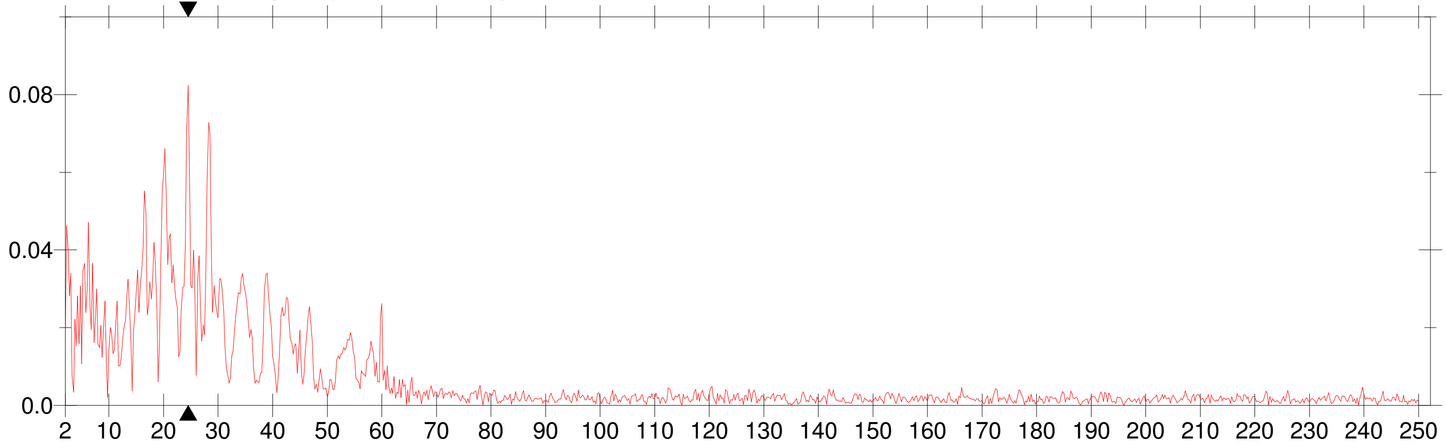
FFT Report

Date/Time	Long at 12:54:05 March 31, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTU9.650

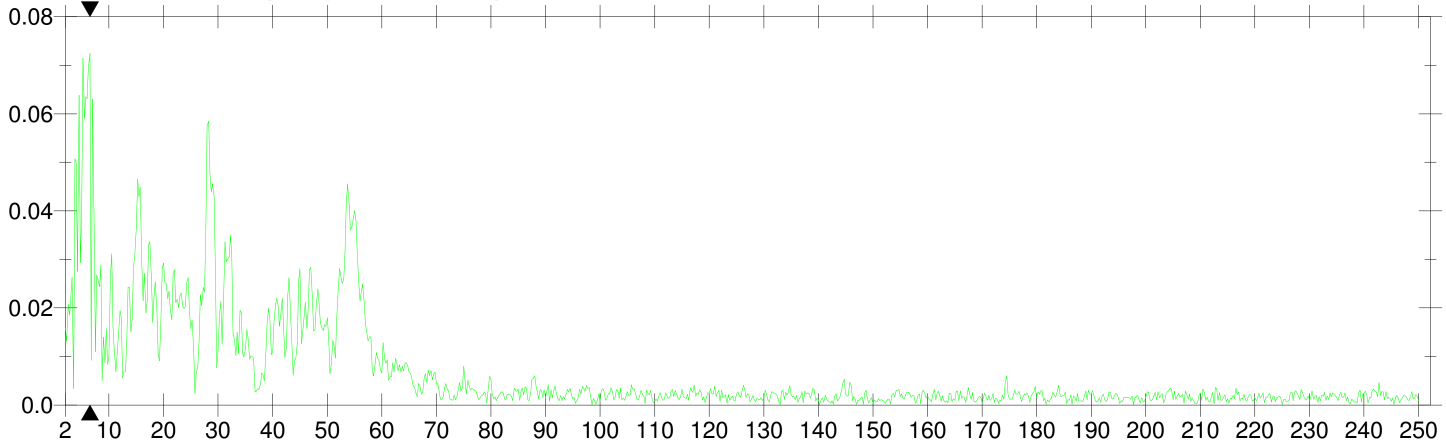
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

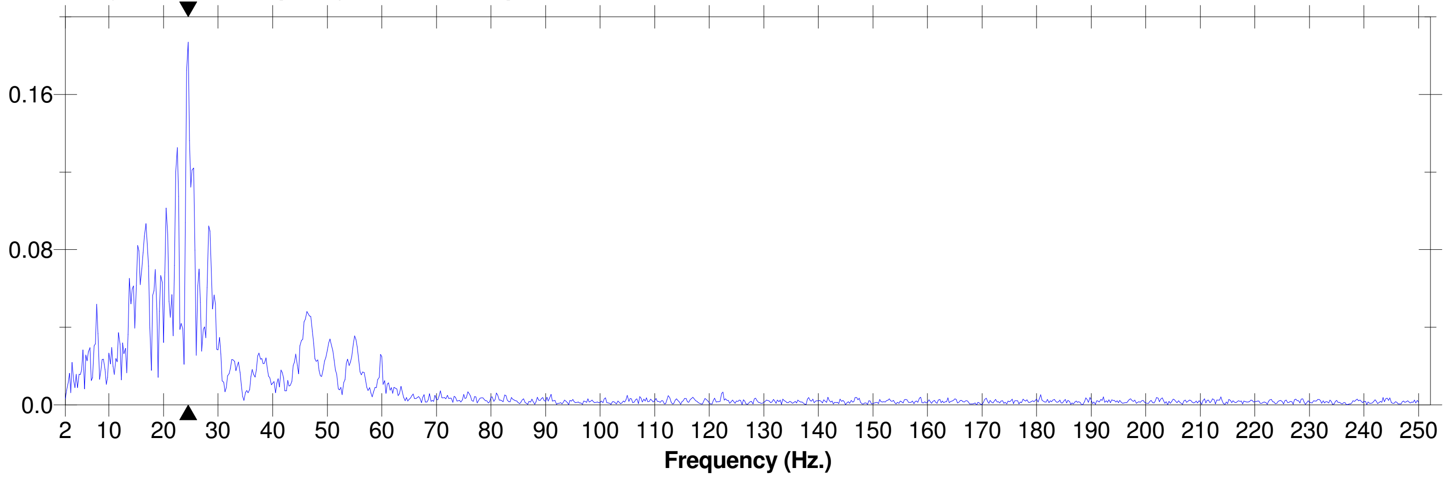
Tran Dominant Frequency = 24.5 Hz., Amplitude = 0.0823, PPV from Event = 1.14 mm/s



Vert Dominant Frequency = 6.50 Hz., Amplitude = 0.0724, PPV from Event = 1.27 mm/s



Long Dominant Frequency = 24.5 Hz., Amplitude = 0.187, PPV from Event = 2.16 mm/s



Event Report

Date/Time	Long at 12:54:22 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.1 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTU9.6M0

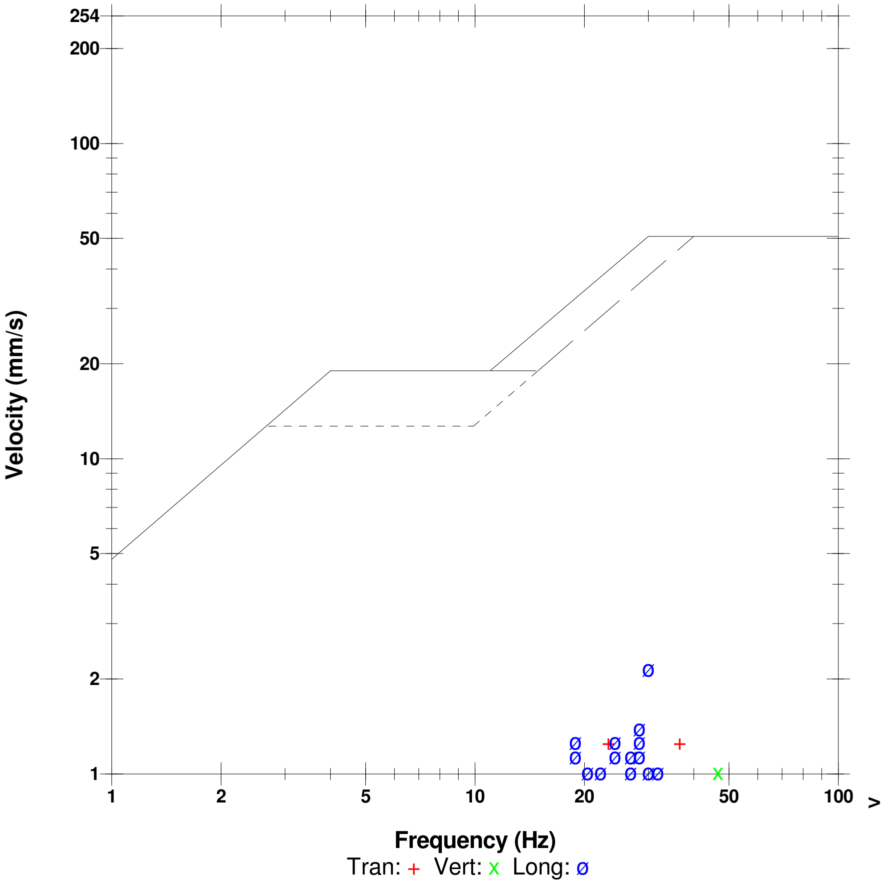
Notes

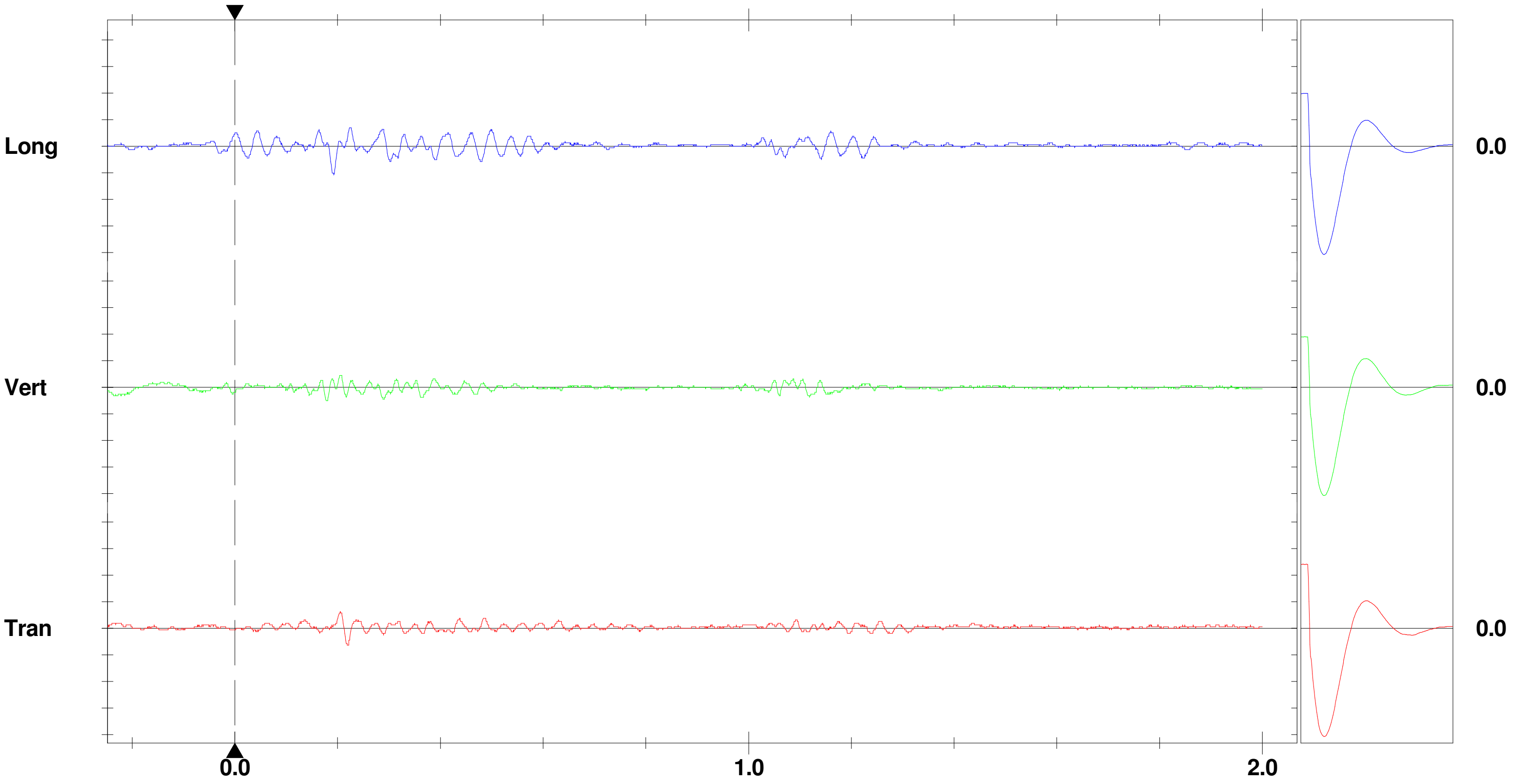
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.27	1.02	2.16	mm/s
ZC Freq	23	47	30	Hz
Time (Rel. to Trig)	0.205	0.178	0.192	sec
Peak Acceleration	0.0398	0.0265	0.0398	g
Peak Displacement	0.00713	0.0118	0.0108	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 2.21 mm/s at 0.192 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Trigger = ▶――― ―――◀

Printed: April 24, 2017 (V 10.60 - 10.60)

FFT Report

Date/Time	Long at 12:54:22 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.1 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTU9.6M0

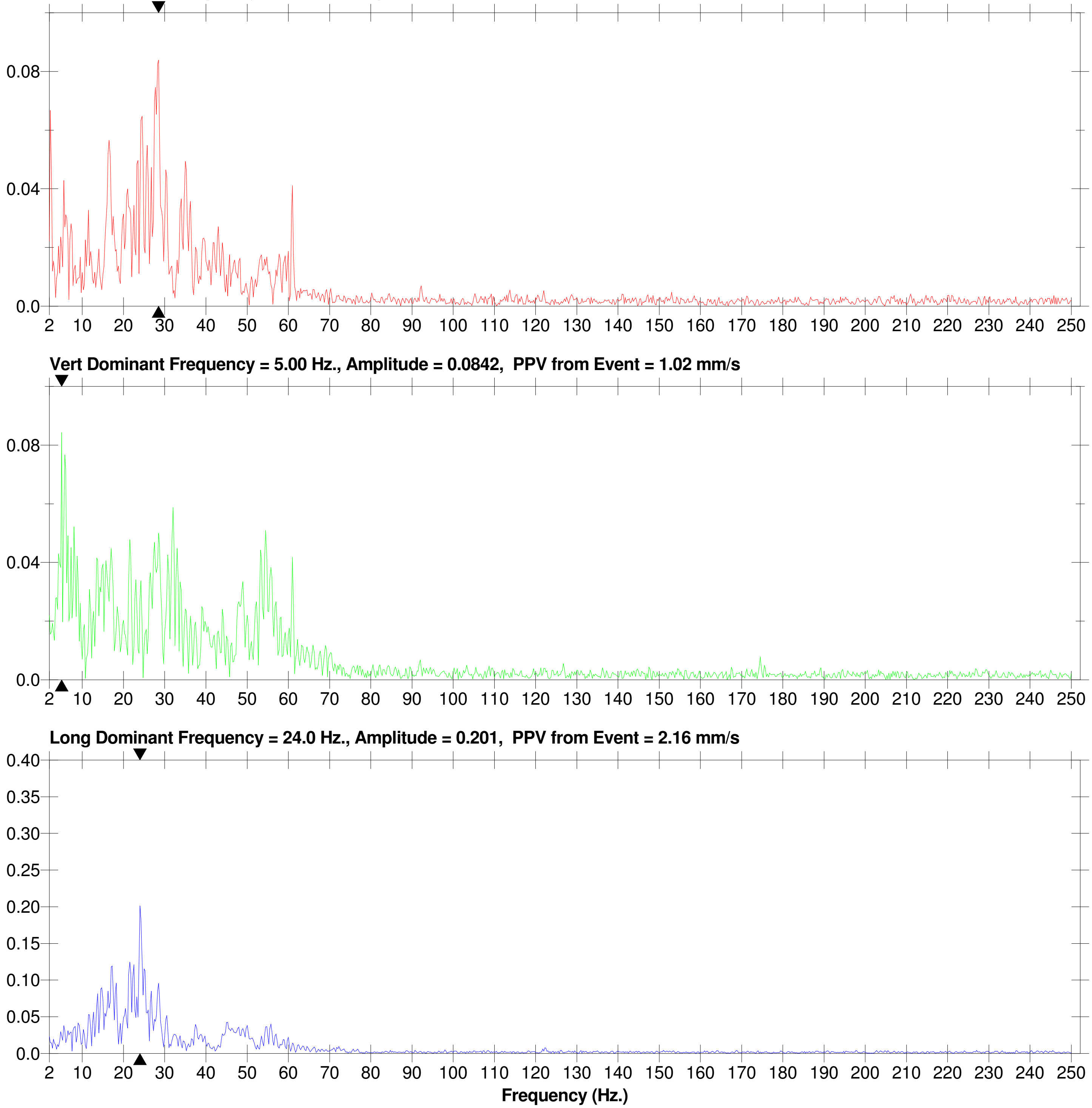
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

Tran Dominant Frequency = 28.5 Hz., Amplitude = 0.0838, PPV from Event = 1.27 mm/s

Vert Dominant Frequency = 5.00 Hz., Amplitude = 0.0842, PPV from Event = 1.02 mm/s

Long Dominant Frequency = 24.0 Hz., Amplitude = 0.201, PPV from Event = 2.16 mm/s



Printed: April 24, 2017 (V 10.60 - 10.60)

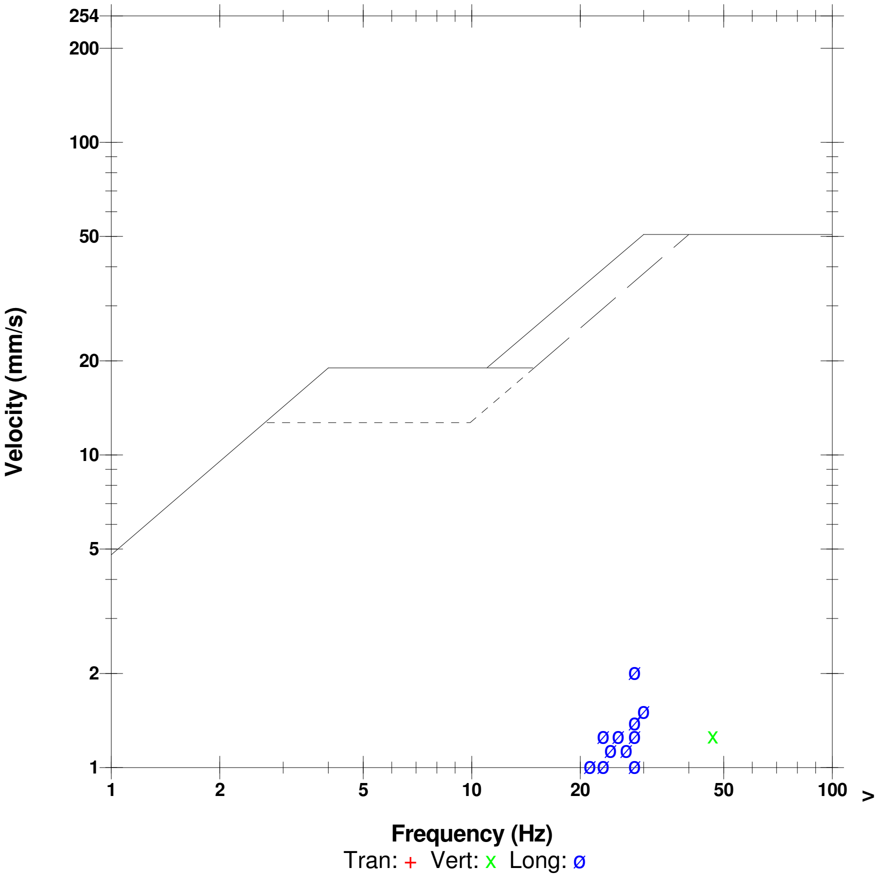
Event Report

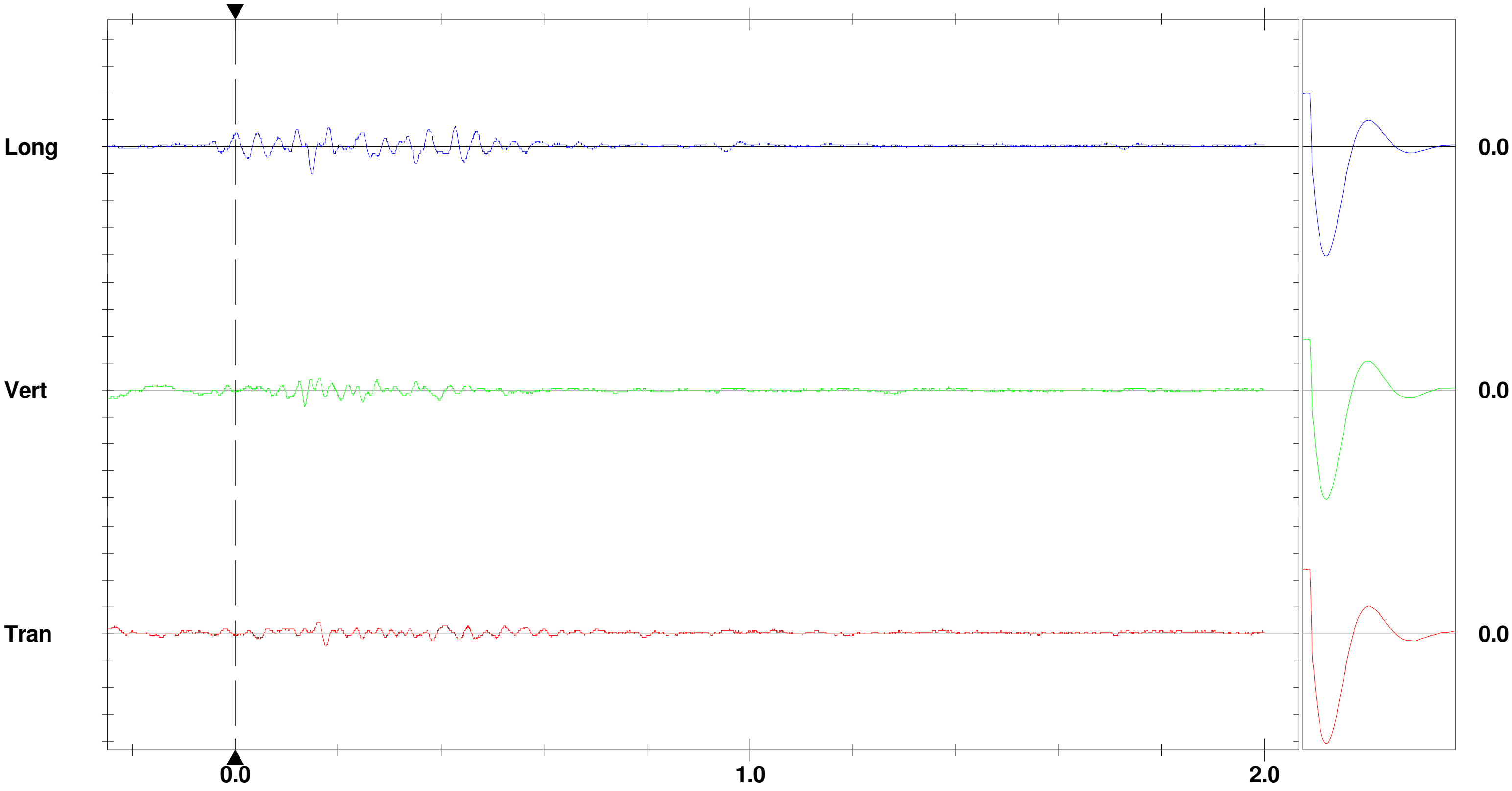
Date/Time Long at 12:54:39 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.1 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTU9.730

	Tran	Vert	Long	
PPV	0.889	1.27	2.03	mm/s
ZC Freq	27	47	28	Hz
Time (Rel. to Trig)	0.159	0.135	0.147	sec
Peak Acceleration	0.0265	0.0398	0.0530	g
Peak Displacement	0.00626	0.00967	0.0109	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 2.17 mm/s at 0.147 sec


USBM RI8507 And OSMRE



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Instantel

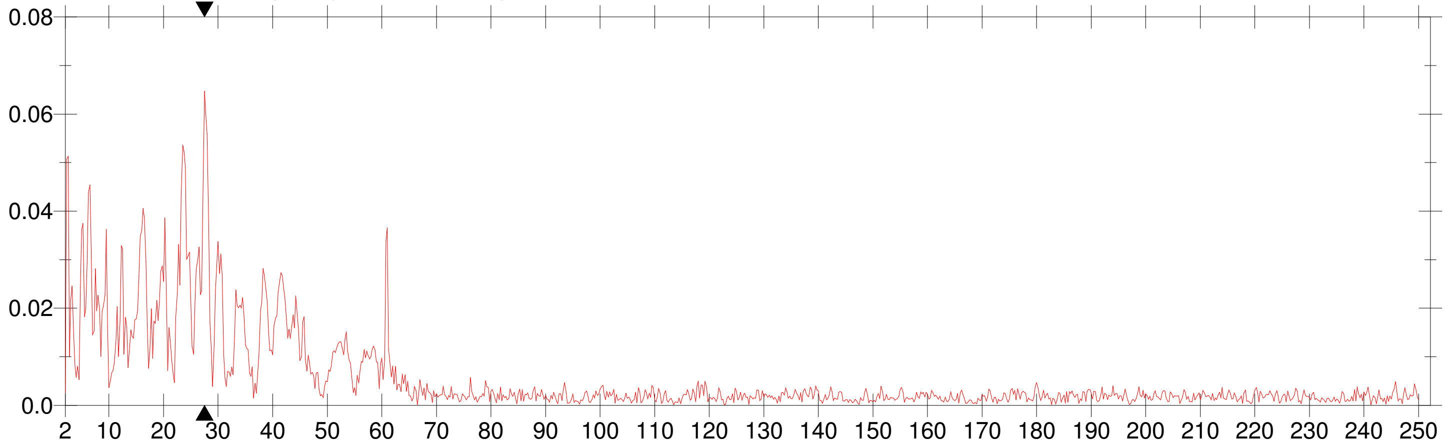
FFT Report

Date/Time Long at 12:54:39 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

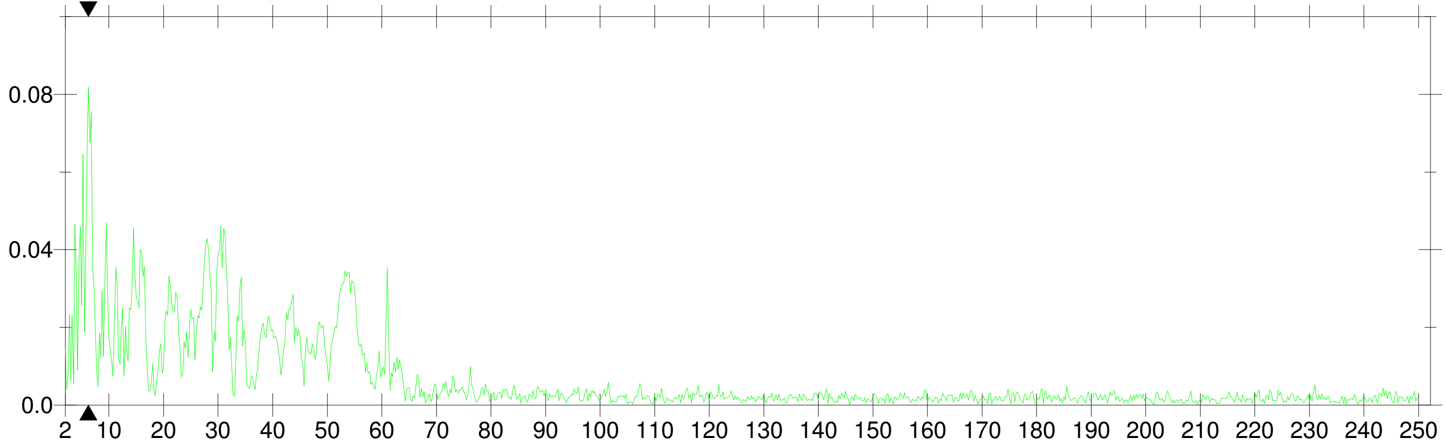
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.1 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTU9.730

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

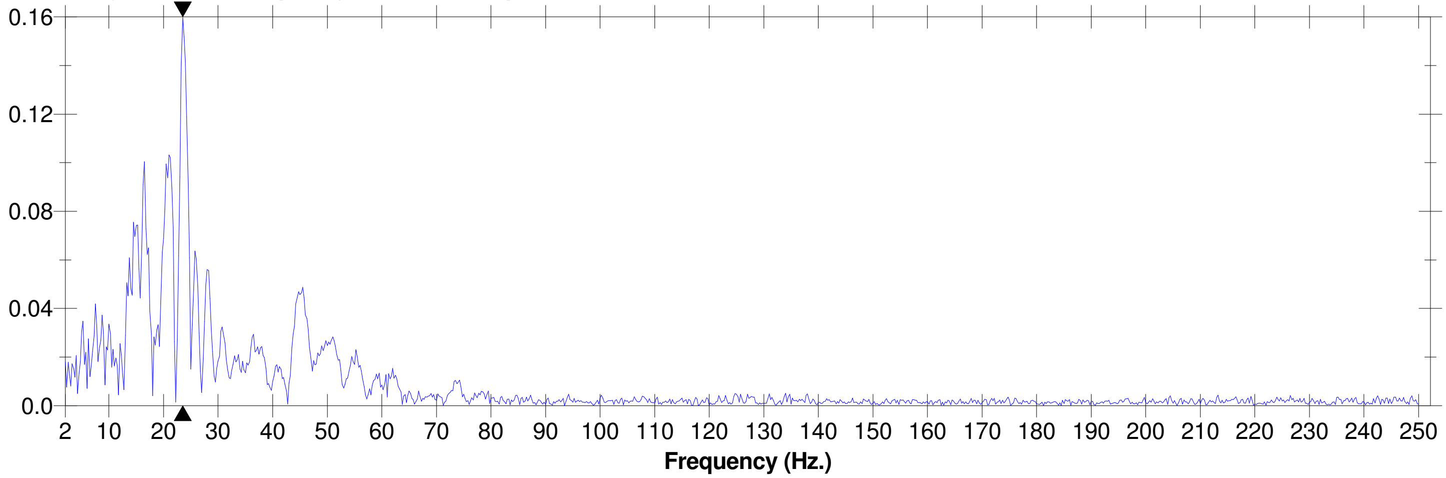
Tran Dominant Frequency = 27.5 Hz., Amplitude = 0.0647, PPV from Event = 0.889 mm/s



Vert Dominant Frequency = 6.25 Hz., Amplitude = 0.0818, PPV from Event = 1.27 mm/s



Long Dominant Frequency = 23.5 Hz., Amplitude = 0.160, PPV from Event = 2.03 mm/s



Instantel

Event Report

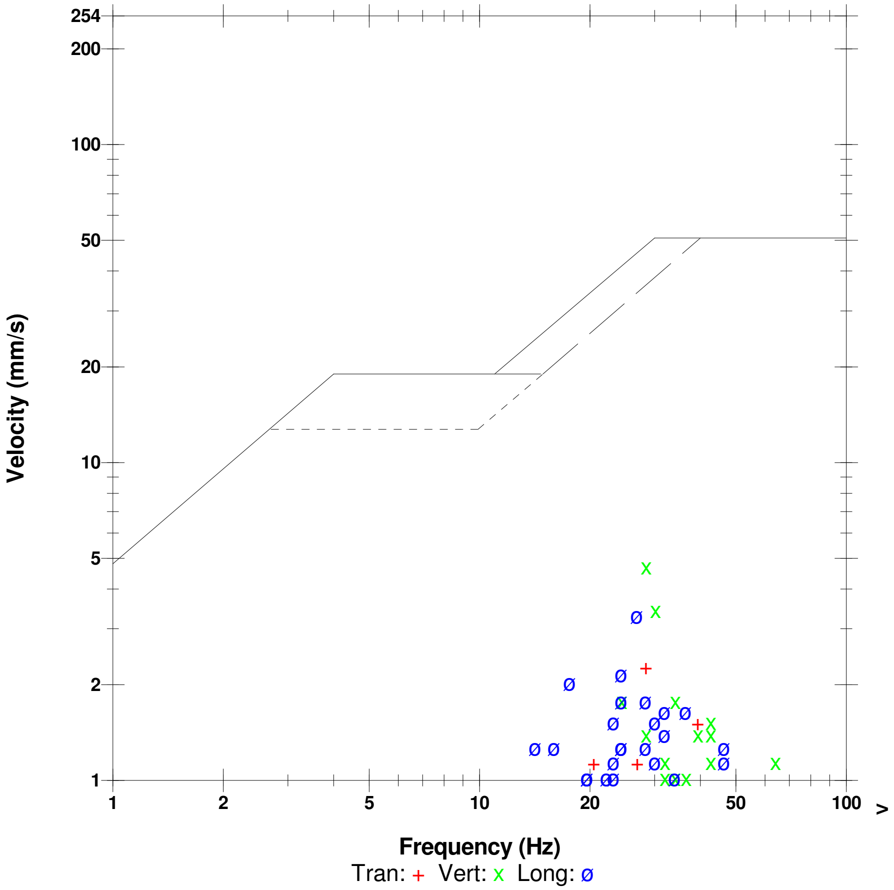
Date/Time Long at 12:54:57 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

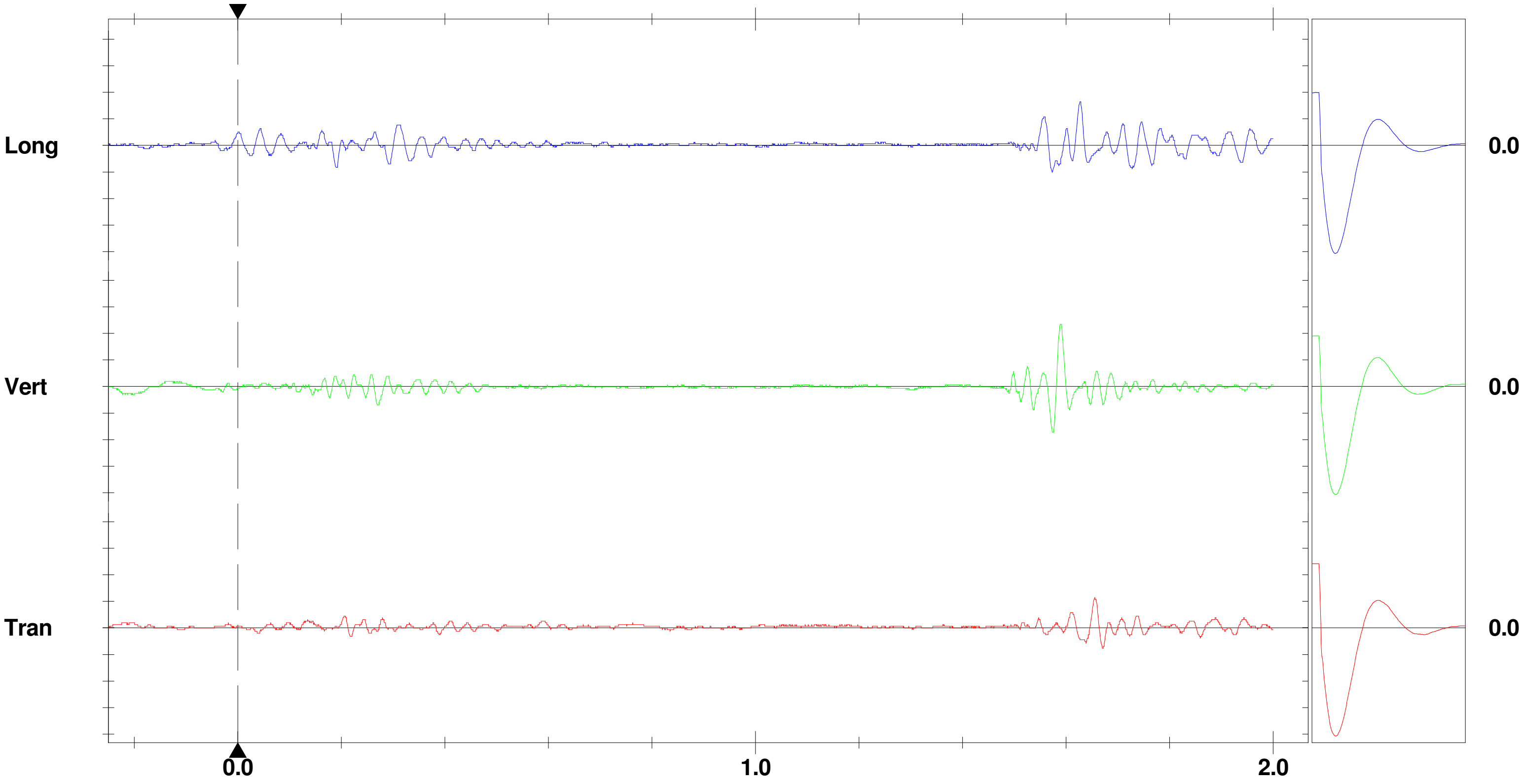
Serial Number BE15696 V 10.72-8.17 MiniMate Plus
Battery Level 6.1 Volts
Unit Calibration February 22, 2017 by Instantel
File Name Q696GTU9.7L0

	Tran	Vert	Long	
PPV	2.29	4.70	3.30	mm/s
ZC Freq	28	28	27	Hz
Time (Rel. to Trig)	1.655	1.589	1.627	sec
Peak Acceleration	0.0398	0.106	0.0530	g
Peak Displacement	0.0122	0.0263	0.0179	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 4.90 mm/s at 1.589 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Trigger = ▶———— ————◀

Printed: April 24, 2017 (V 10.60 - 10.60)

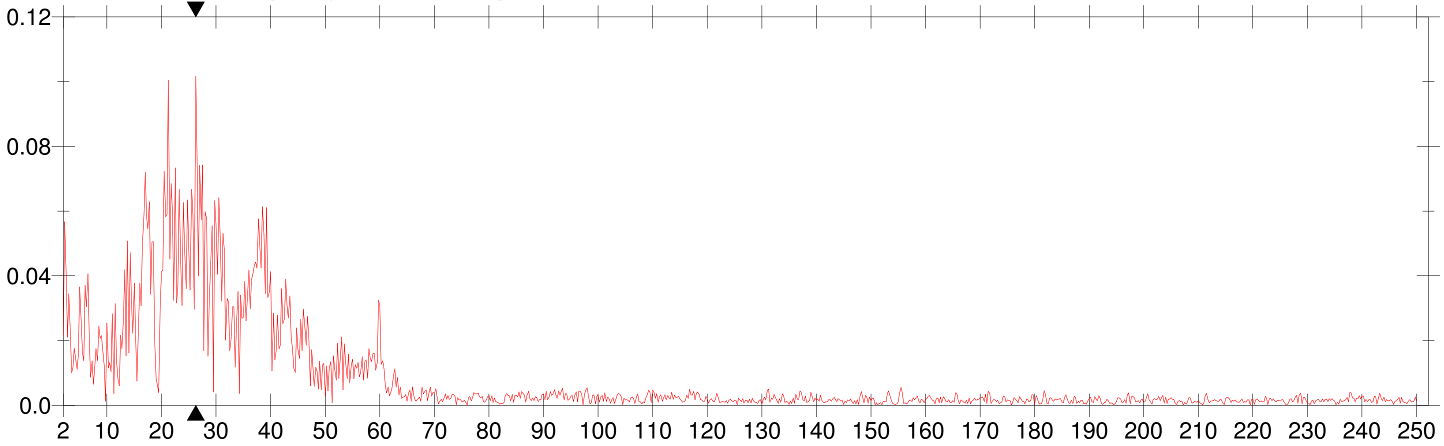
FFT Report

Date/Time	Long at 12:54:57 March 31, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTU9.7L0

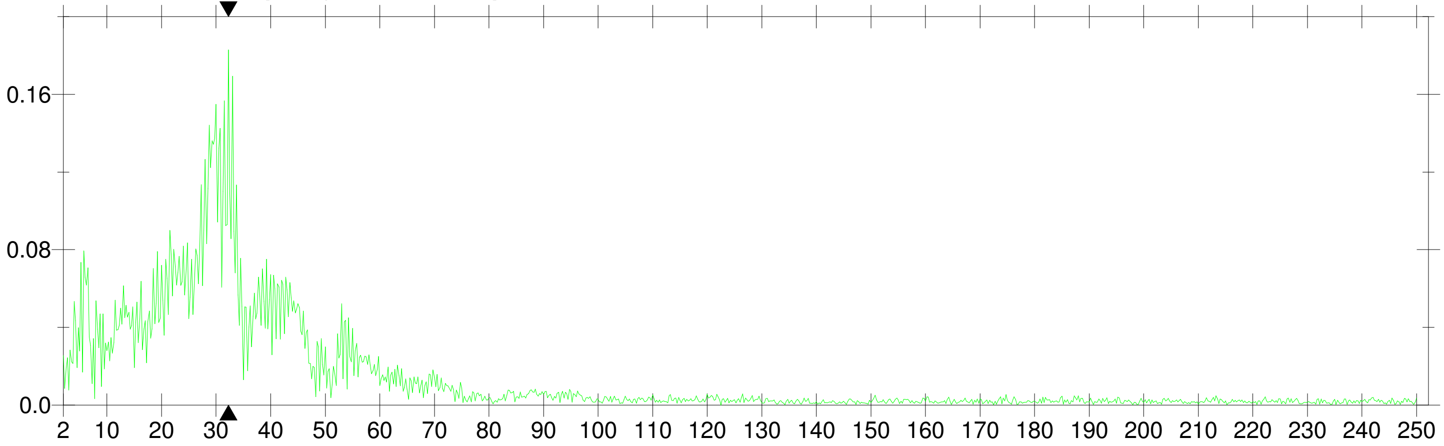
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

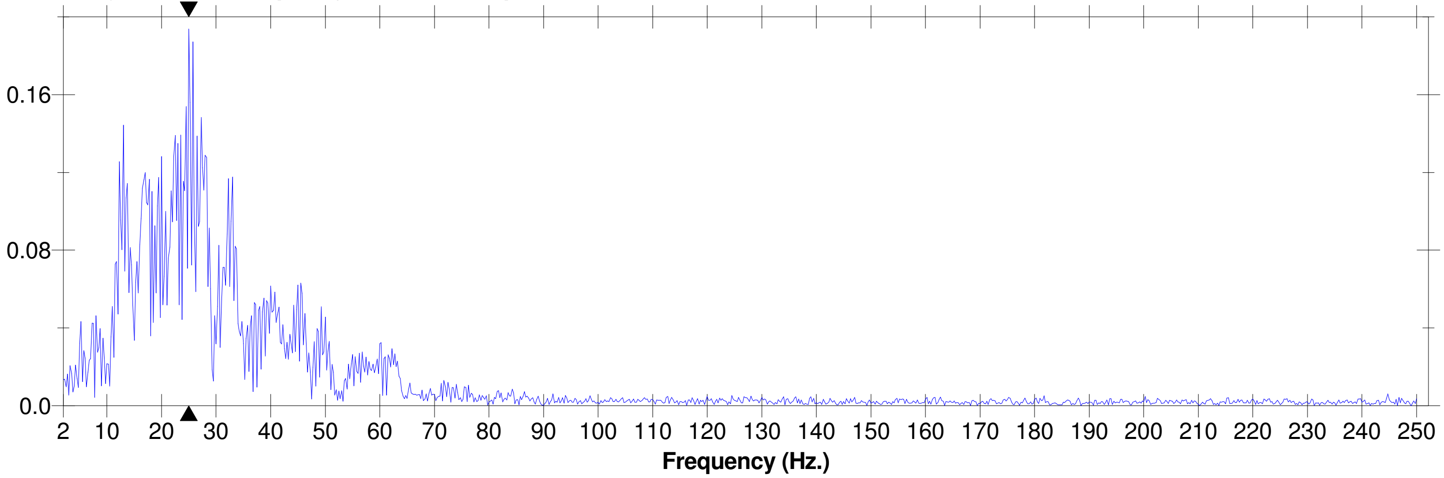
Tran Dominant Frequency = 26.3 Hz., Amplitude = 0.102, PPV from Event = 2.29 mm/s



Vert Dominant Frequency = 32.3 Hz., Amplitude = 0.183, PPV from Event = 4.70 mm/s



Long Dominant Frequency = 25.0 Hz., Amplitude = 0.194, PPV from Event = 3.30 mm/s



Instantel

Event Report

Date/Time	Vert at 12:55:00 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

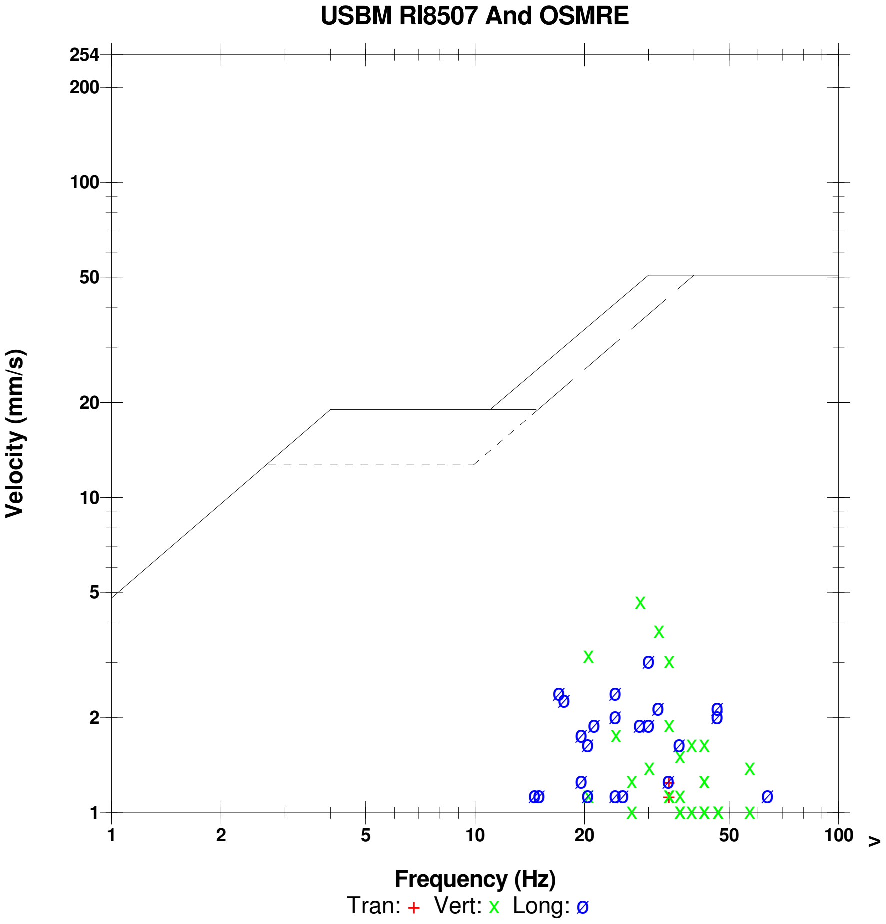
Serial Number	BE15696 V 10.72-8.17 MiniMate Plus
Battery Level	6.1 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	Q696GTU9.7O0

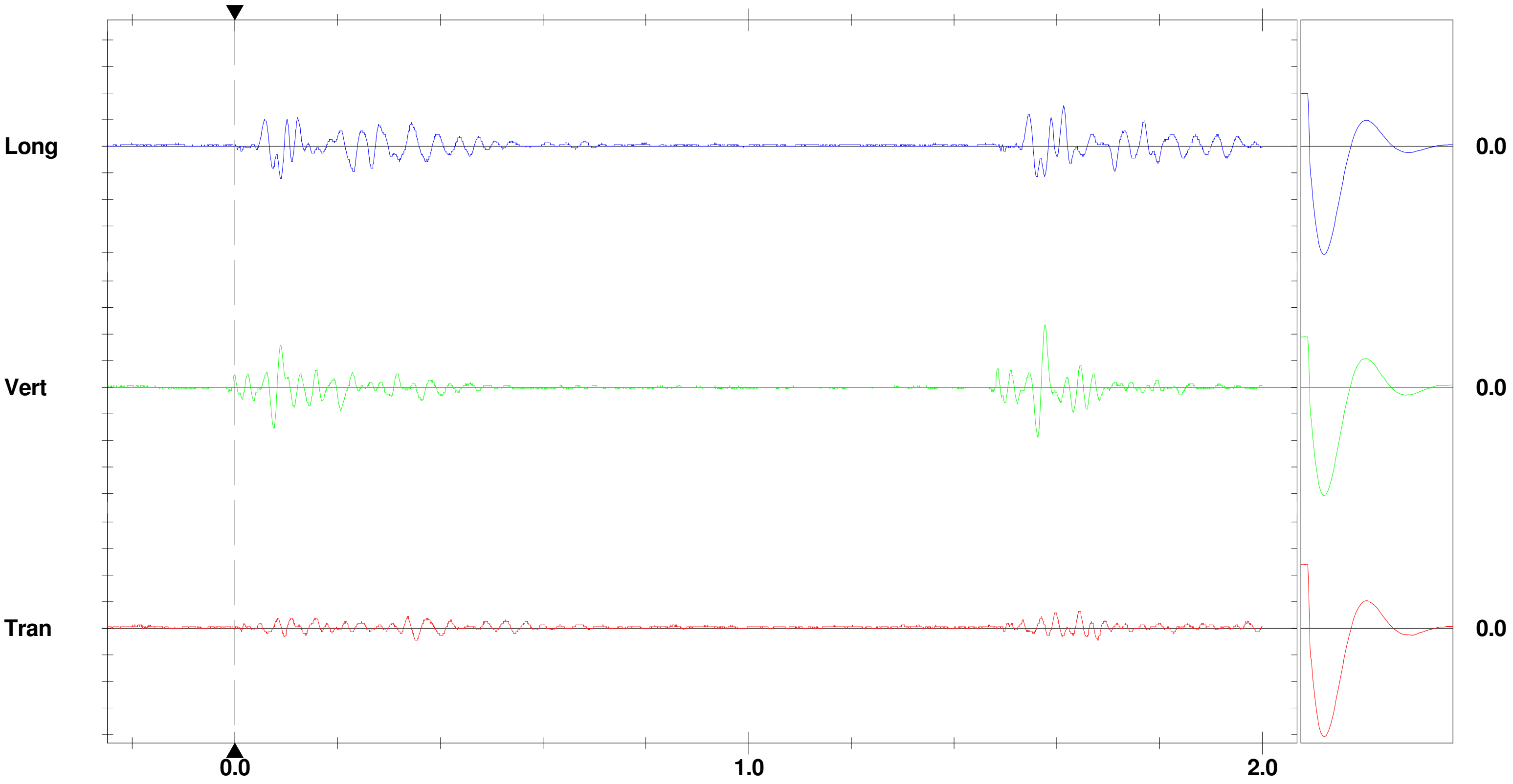
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.27	4.70	3.05	mm/s
ZC Freq	34	28	30	Hz
Time (Rel. to Trig)	1.643	1.577	1.613	sec
Peak Acceleration	0.0265	0.106	0.0663	g
Peak Displacement	0.00620	0.0239	0.0222	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.6	7.5	Hz
Overswing Ratio	4.0	3.8	4.2	

Peak Vector Sum 5.17 mm/s at 1.577 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Trigger = ▶——— ———◀

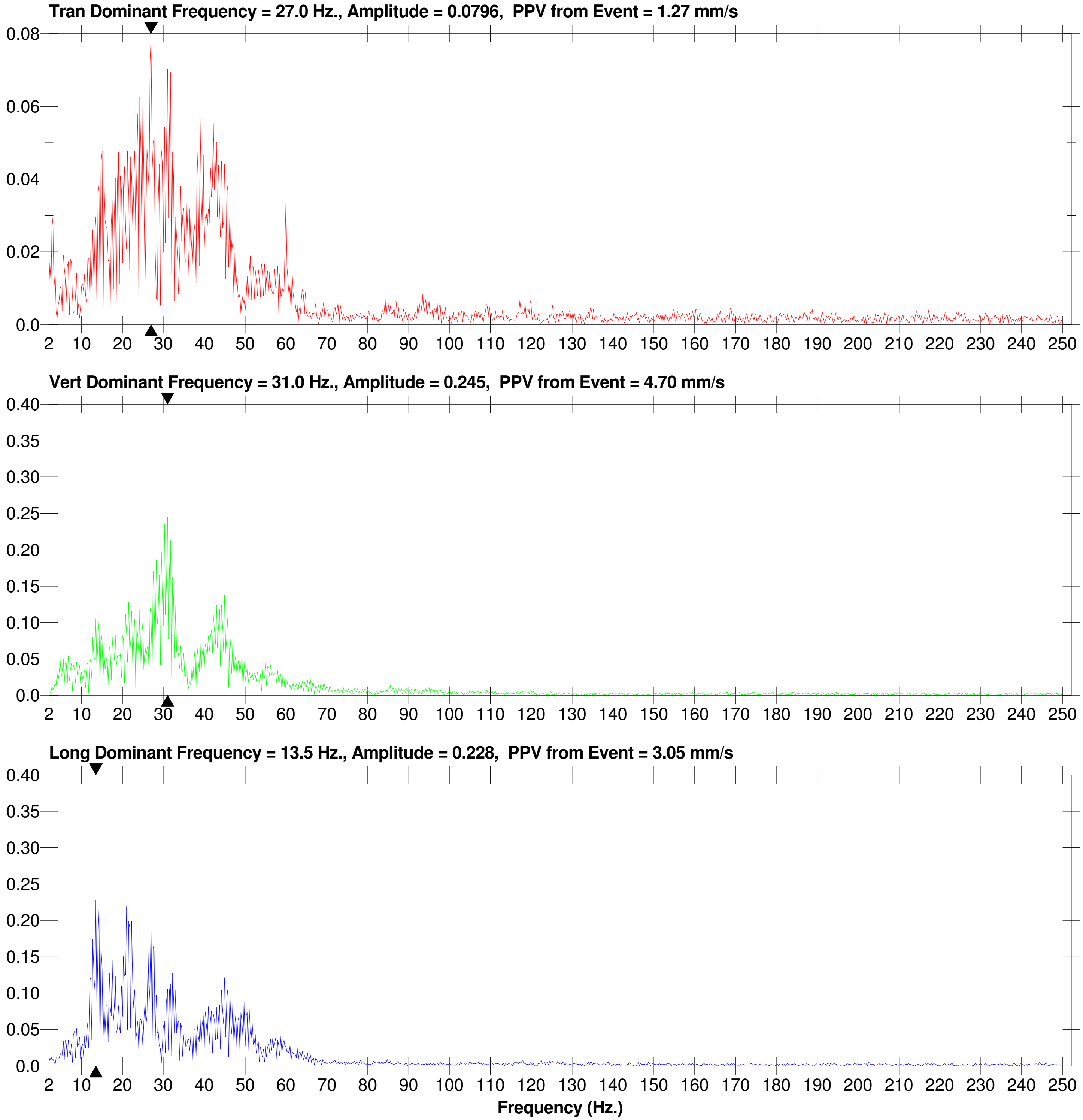
Instantel

FFT Report

Date/Time	Vert at 12:55:00 March 31, 2017	**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.1 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	Q696GTU9.7O0

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent



Printed: April 24, 2017 (V 10.60 - 10.60)

Instantel

Event Report

Histogram Start Time	17:09:23 May 3, 2017		**Serial Number**	BE15696 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	19:00:31 May 3, 2017		**Battery Level**	6.2 Volts
Number of Intervals	3334.00 at 2 seconds		**Unit Calibration**	February 22, 2017 by Instantel
Sample Rate	2048sps		**File Name**	Q696GVJO.ZN0

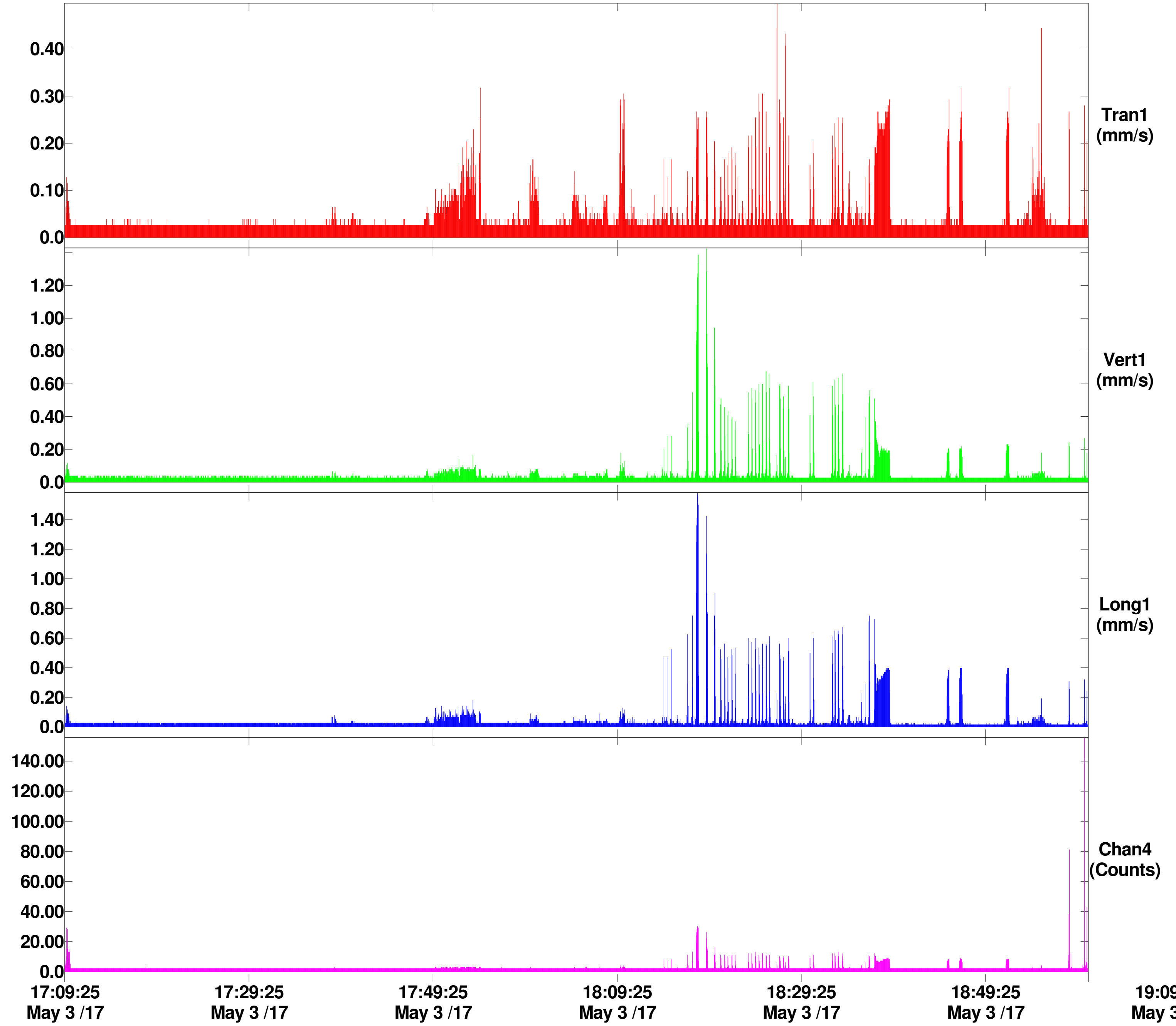
Notes

Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	50m, 1668031

Extended Notes

Geophone Anchored into subgrade and secured with sand bag

Channel	Name	Peak	Time (sec)	Gain	Range	Units
1	Tran1	0.495	1.133	1x	25.40	mm/s
2	Vert1	1.422	1.021	1x	25.40	mm/s
3	Long1	1.575	1.006	1x	25.40	mm/s
4	Chan4	155.0	1.622	1x	2000.0	Counts



Event Report

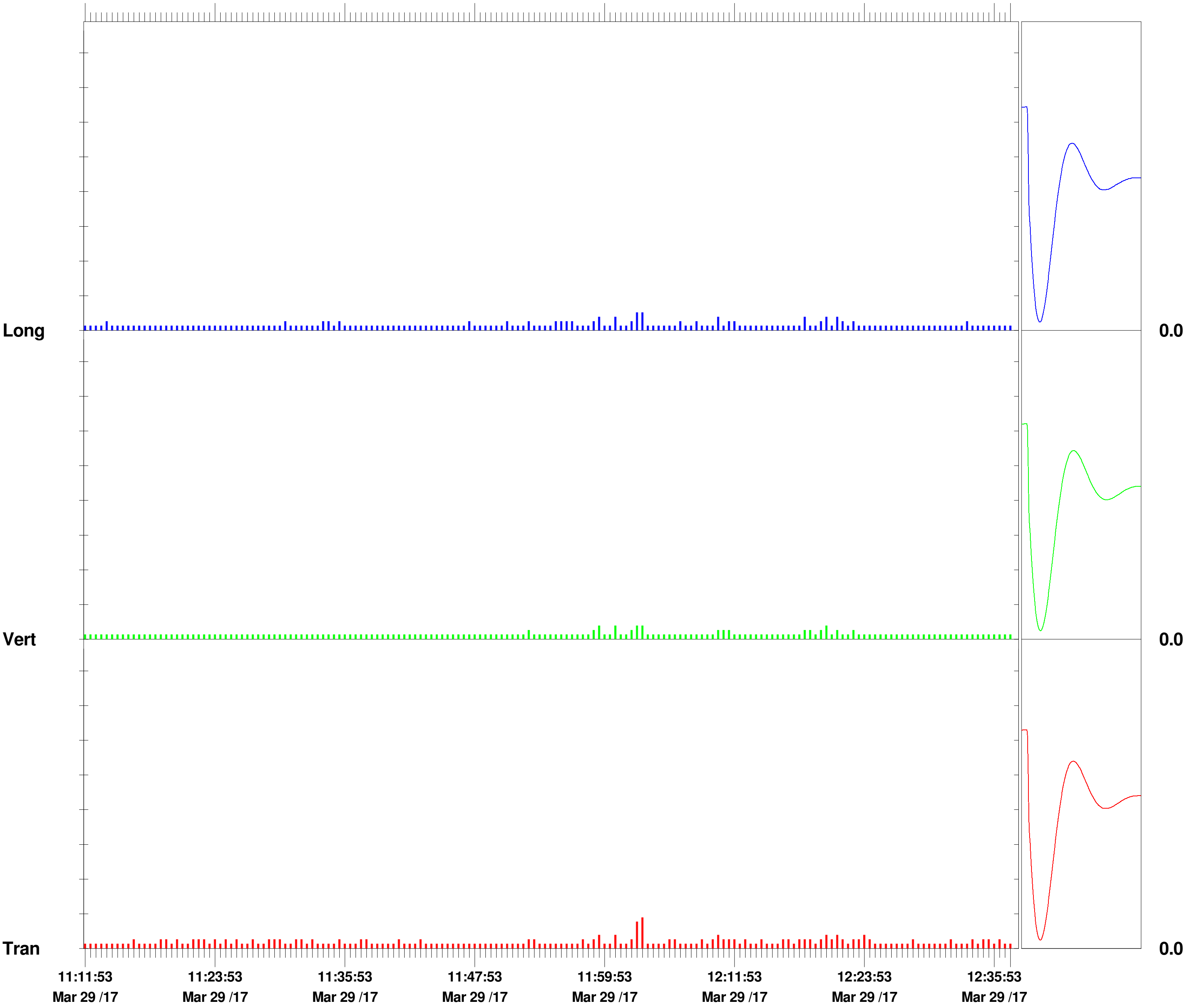
Histogram Start Time	11:11:23 March 29, 2017		**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	12:37:21 March 29, 2017		**Battery Level**	6.3 Volts
Number of Intervals	2578.00 at 2 seconds		**Unit Calibration**	February 22, 2017 by Instantel
Range	Geo:254 mm/s		**File Name**	T695GTQF.2Z0
Sample Rate	1024sps			

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	0.889	0.381	0.508	mm/s
ZC Freq	34	51	57	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	12:02:55	11:59:05	12:02:47	
Sensor Check	Passed	Passed	Passed	
Frequency	7.4	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 0.907 mm/s on March 29, 2017 at 12:02:55



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Instantel

Event Report

Histogram Start Time	12:37:55 March 29, 2017
Histogram Finish Time	13:09:30 March 29, 2017
Number of Intervals	947.00 at 2 seconds
Range	Geo:254 mm/s
Sample Rate	1024sps

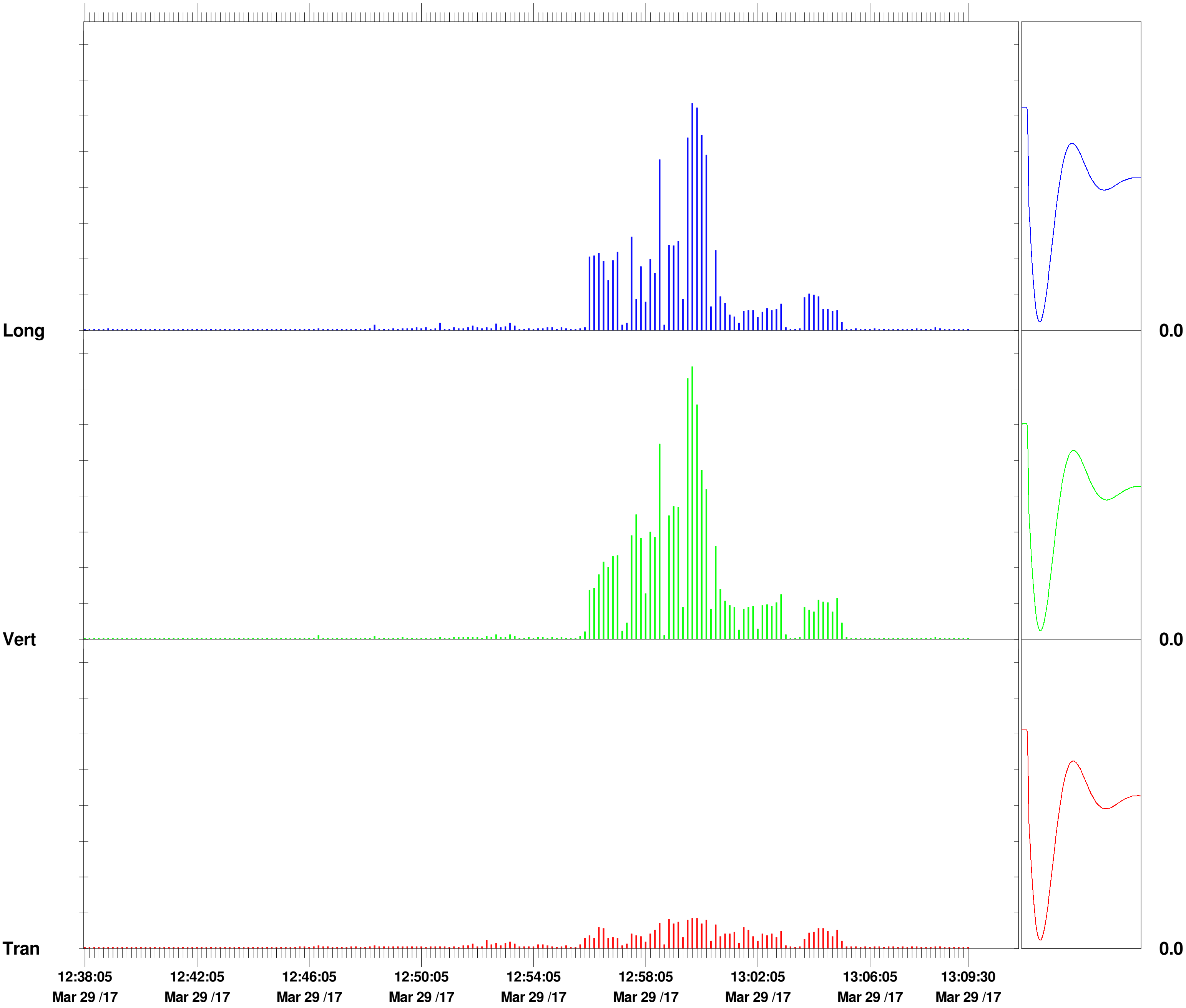
Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQJ.370

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	4.19	38.1	31.7	mm/s
ZC Freq	>100	32	24	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	12:59:43	12:59:39	12:59:45	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 40.8 mm/s on March 29, 2017 at 12:59:39



Time Scale: 10 seconds /div **Amplitude Scale:** Geo: 5.00 mm/s/div

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Instantel

Event Report

Date/Time	Long at 12:55:58 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

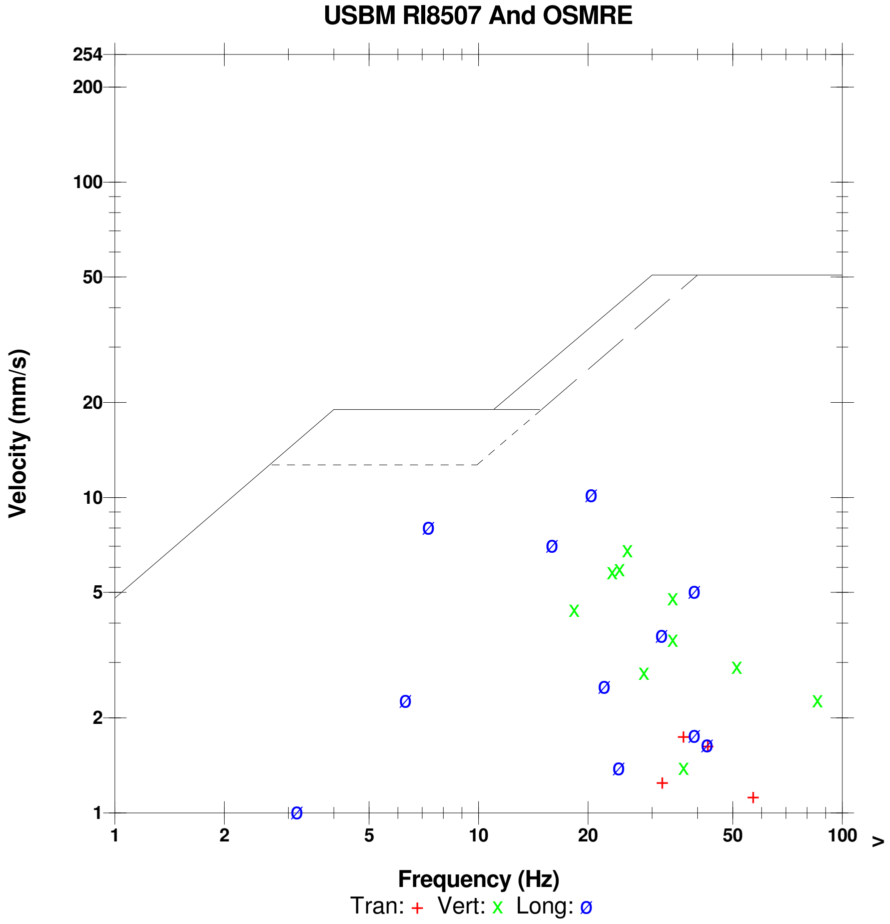
Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQJ.XA0

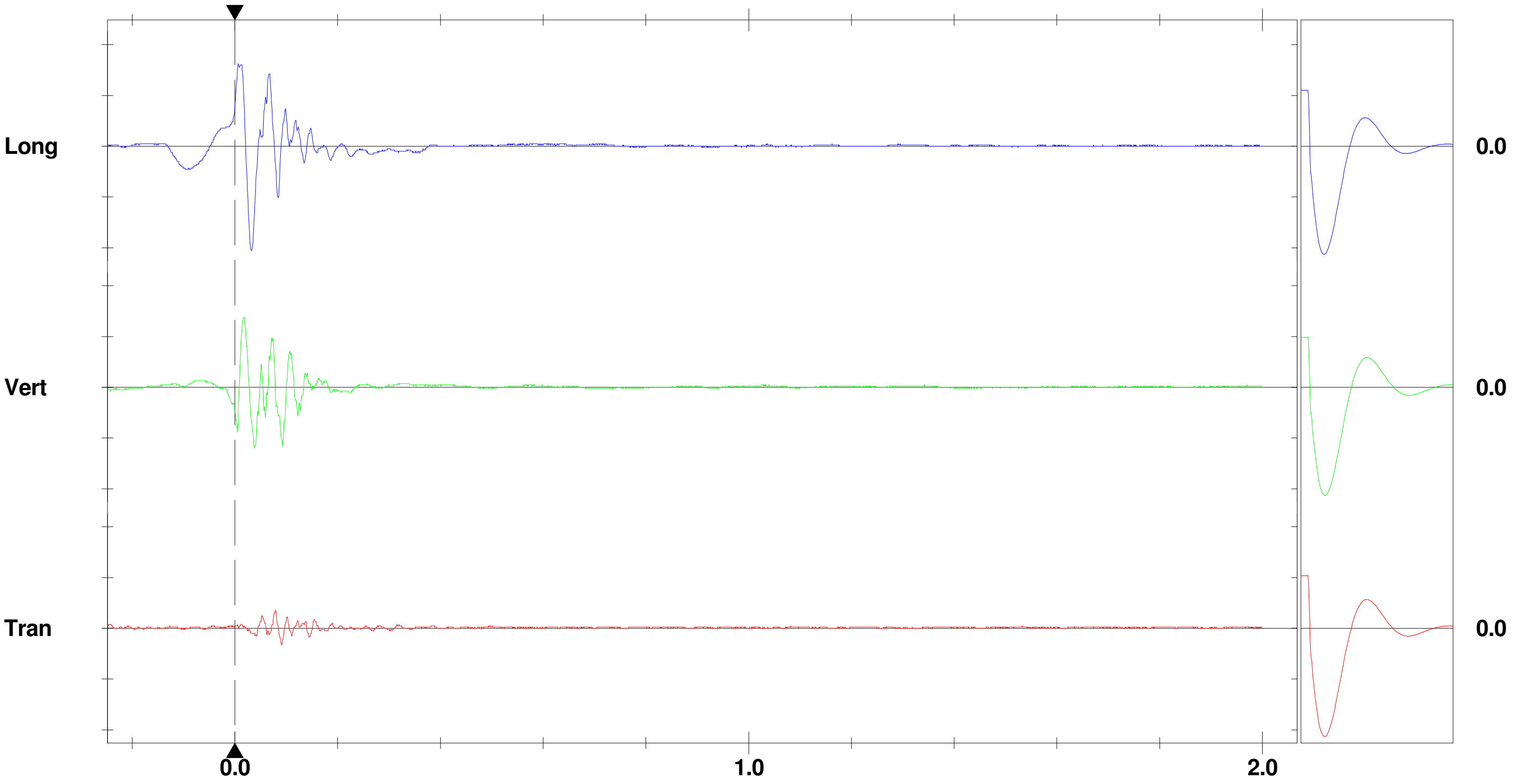
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	**Vert**	**Long**	
PPV	1.78	6.86	10.3	mm/s
ZC Freq	37	26	20	Hz
Time (Rel. to Trig)	0.079	0.017	0.032	sec
Peak Acceleration	0.0530	0.186	0.159	g
Peak Displacement	0.00620	0.0418	0.105	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 10.8 mm/s at 0.033 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Instantel

FFT Report

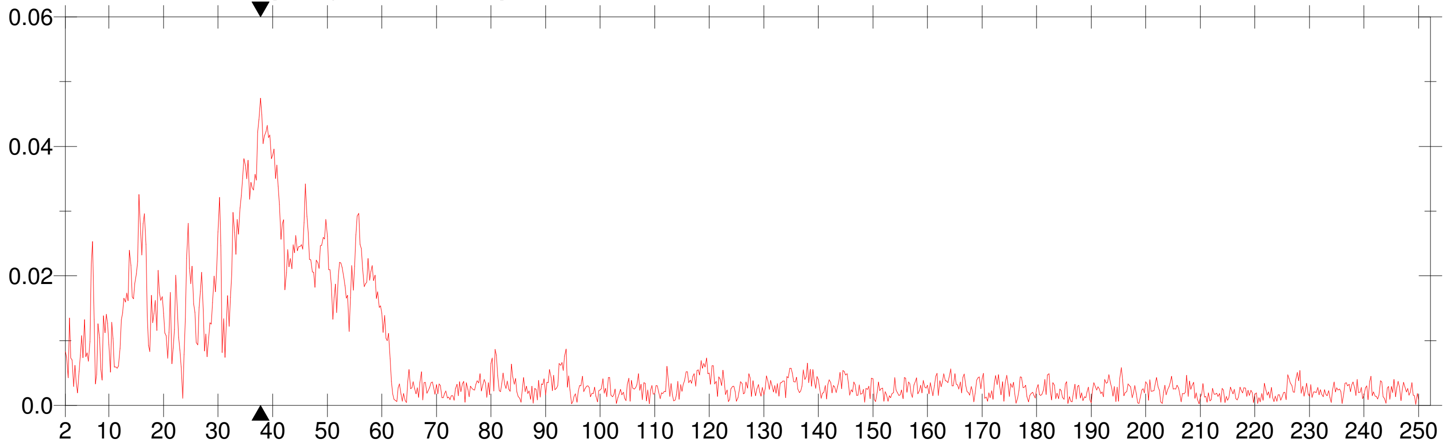
Date/Time	Long at 12:55:58 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQJ.XA0

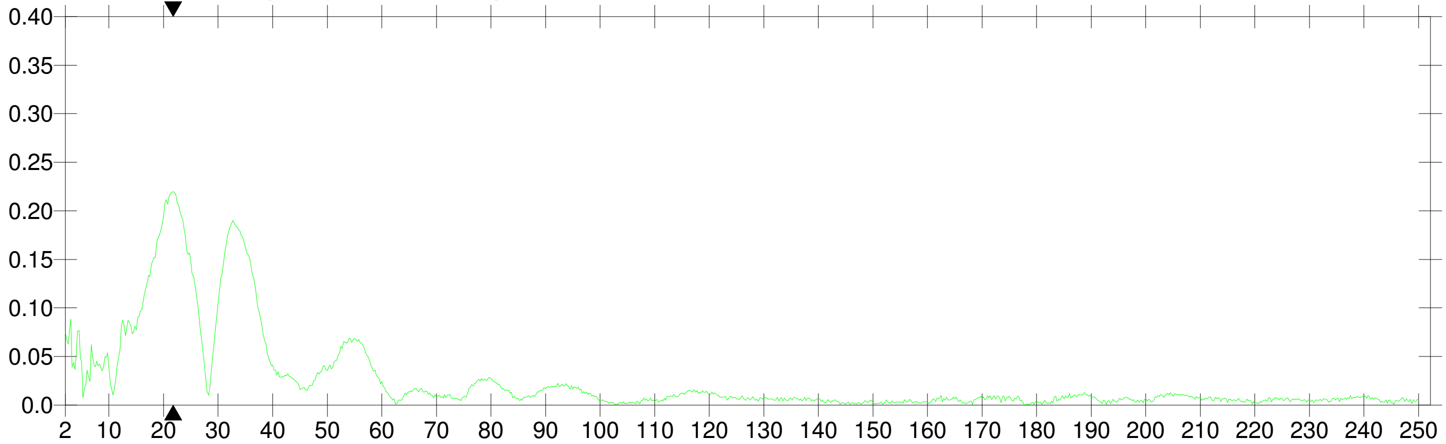
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

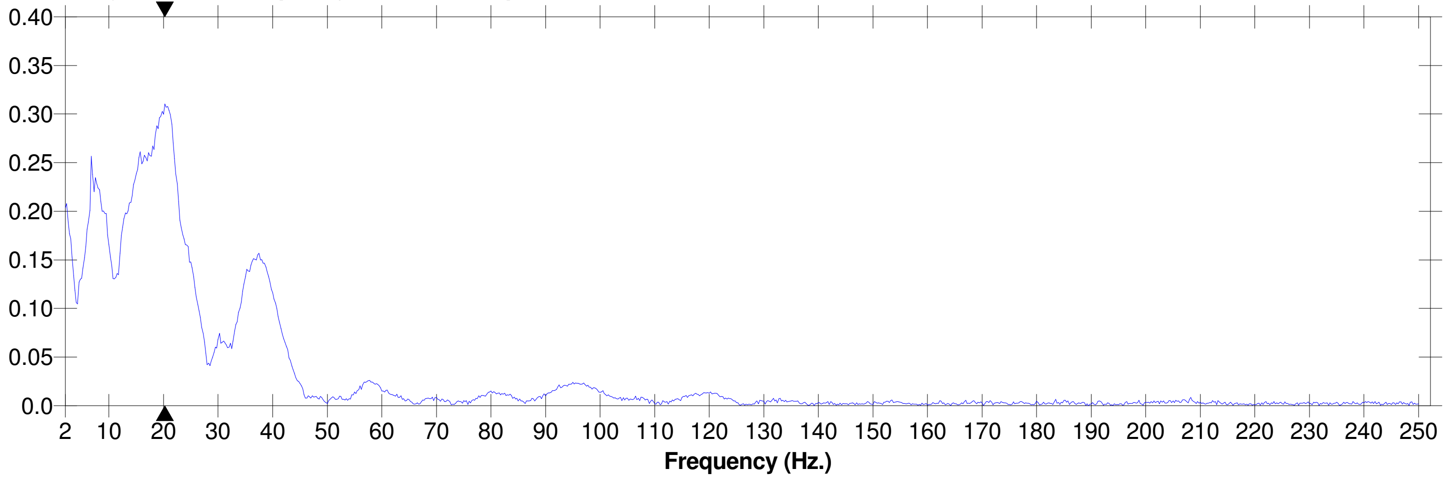
Tran Dominant Frequency = 37.8 Hz., Amplitude = 0.0474, PPV from Event = 1.78 mm/s



Vert Dominant Frequency = 21.8 Hz., Amplitude = 0.220, PPV from Event = 6.86 mm/s



Long Dominant Frequency = 20.3 Hz., Amplitude = 0.310, PPV from Event = 10.3 mm/s



Event Report

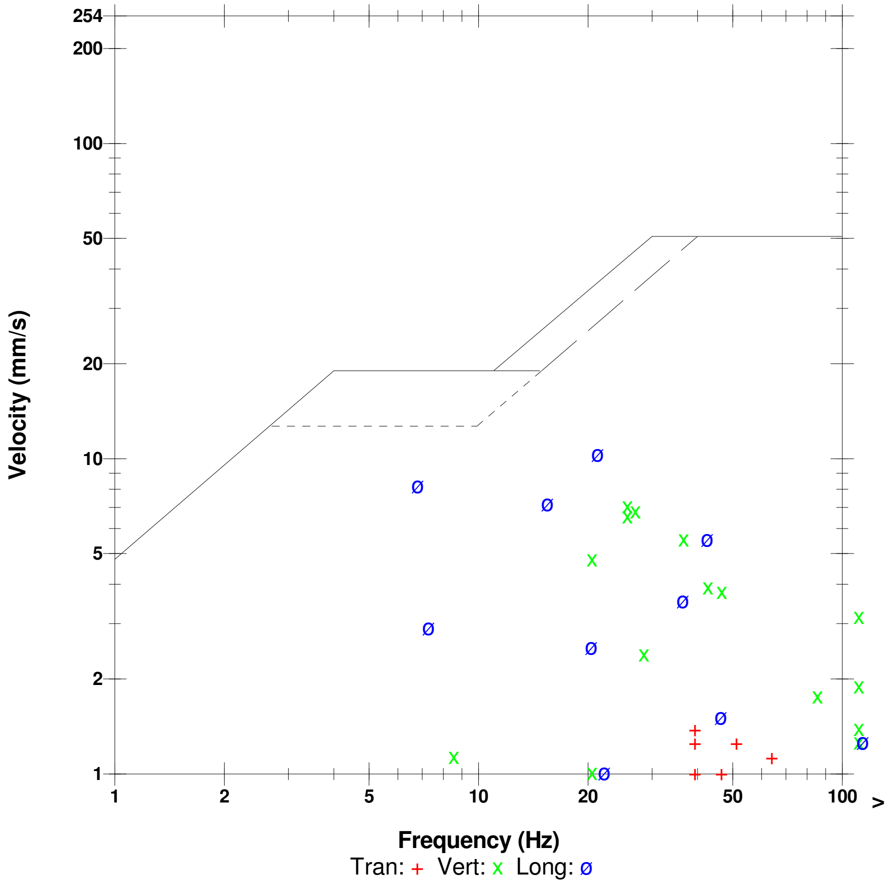
Date/Time Long at 12:56:07 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

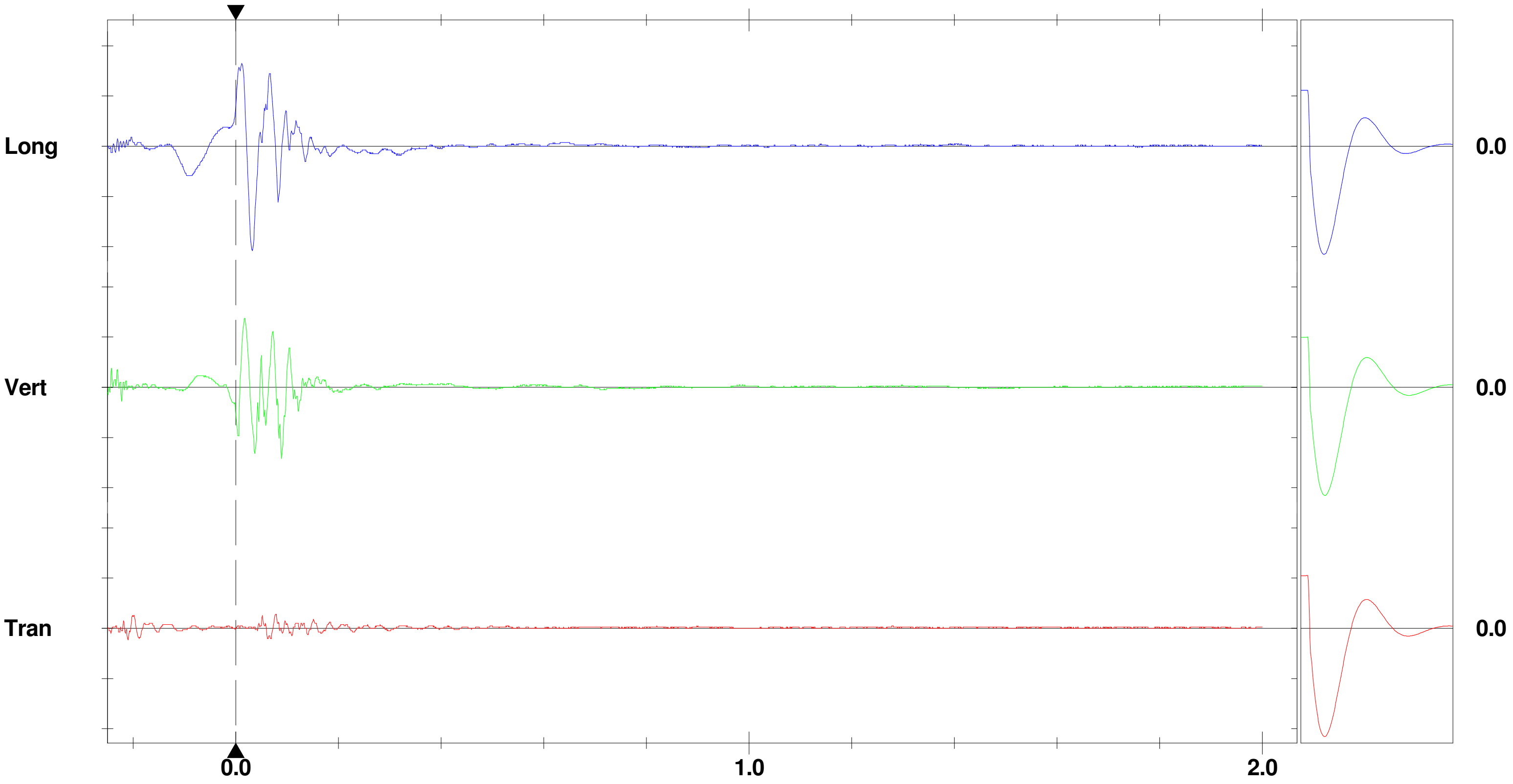
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQJ.XJ0

	Tran	Vert	Long	
PPV	1.40	7.11	10.4	mm/s
ZC Freq	39	26	21	Hz
Time (Rel. to Trig)	0.077	0.089	0.032	sec
Peak Acceleration	0.0663	0.252	0.159	g
Peak Displacement	0.00496	0.0404	0.108	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 11.1 mm/s at 0.033 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

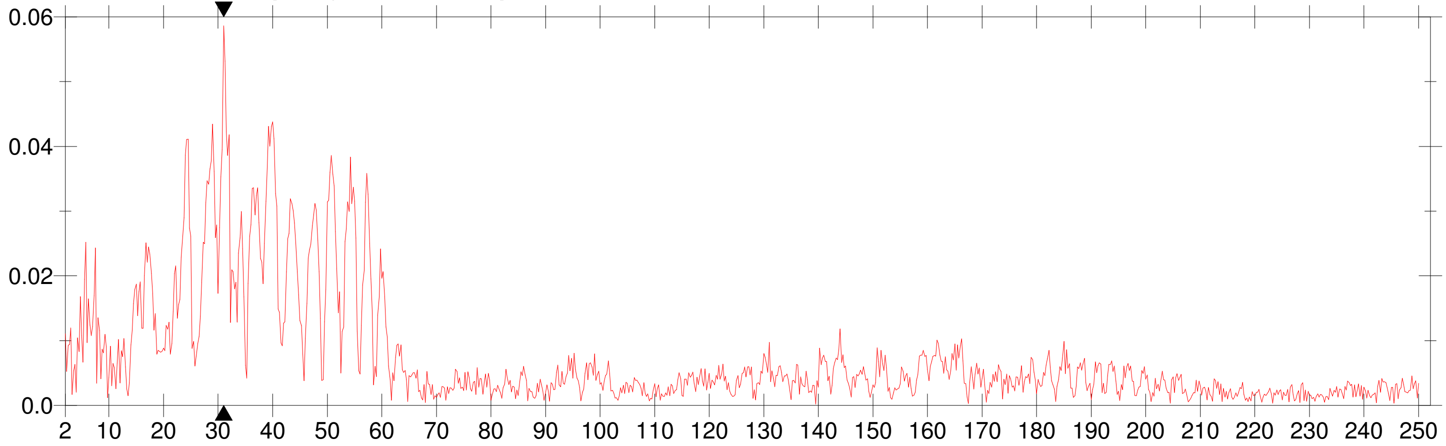
FFT Report

Date/Time	Long at 12:56:07 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQJ.XJ0

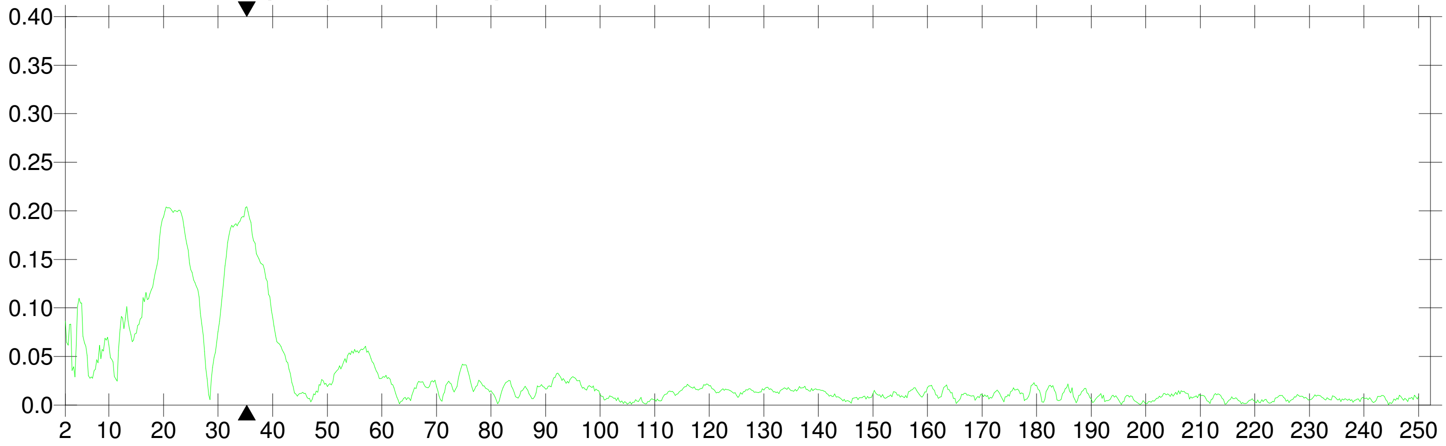
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

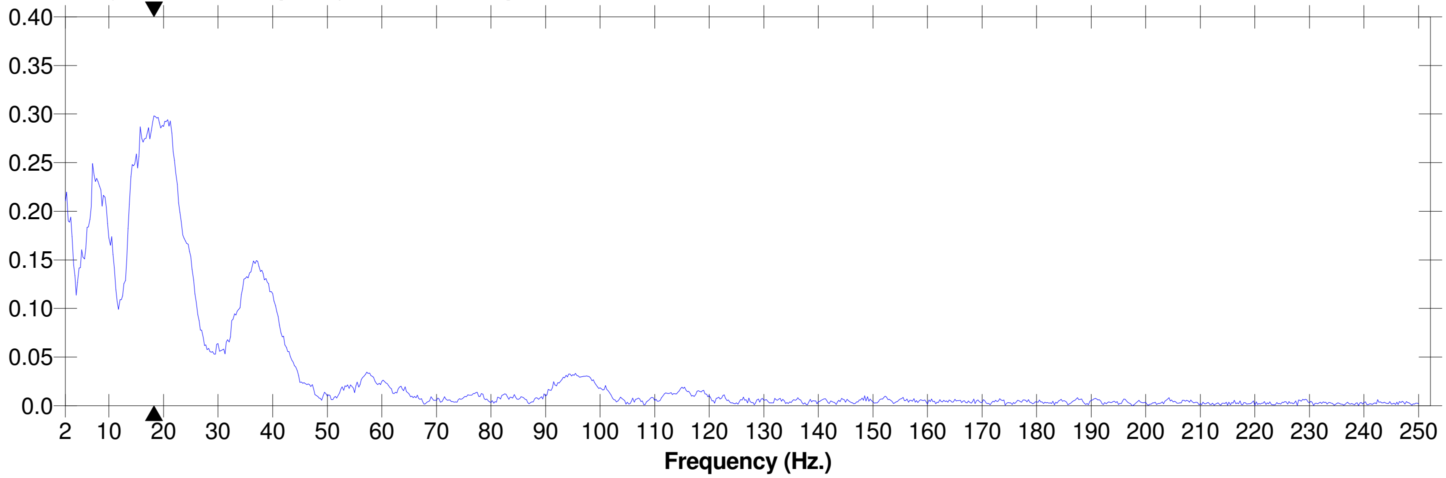
Tran Dominant Frequency = 31.0 Hz., Amplitude = 0.0586, PPV from Event = 1.40 mm/s



Vert Dominant Frequency = 35.3 Hz., Amplitude = 0.204, PPV from Event = 7.11 mm/s



Long Dominant Frequency = 18.3 Hz., Amplitude = 0.298, PPV from Event = 10.4 mm/s



Event Report

Date/Time	Long at 12:56:20 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps
Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQJ.XW0

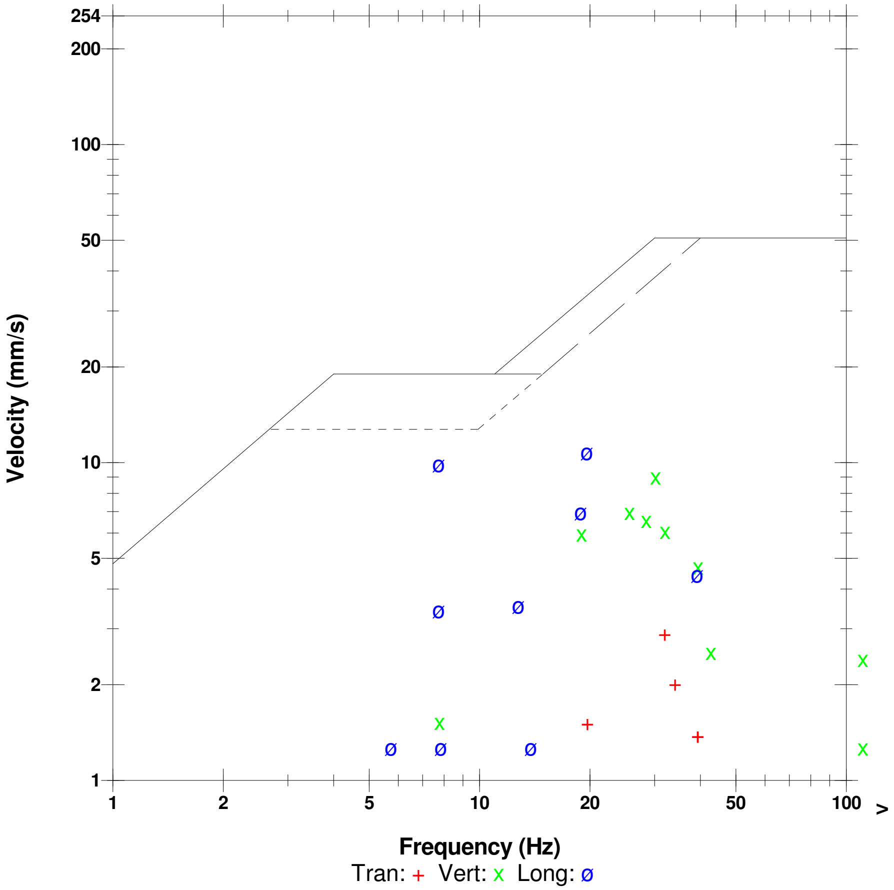
Notes

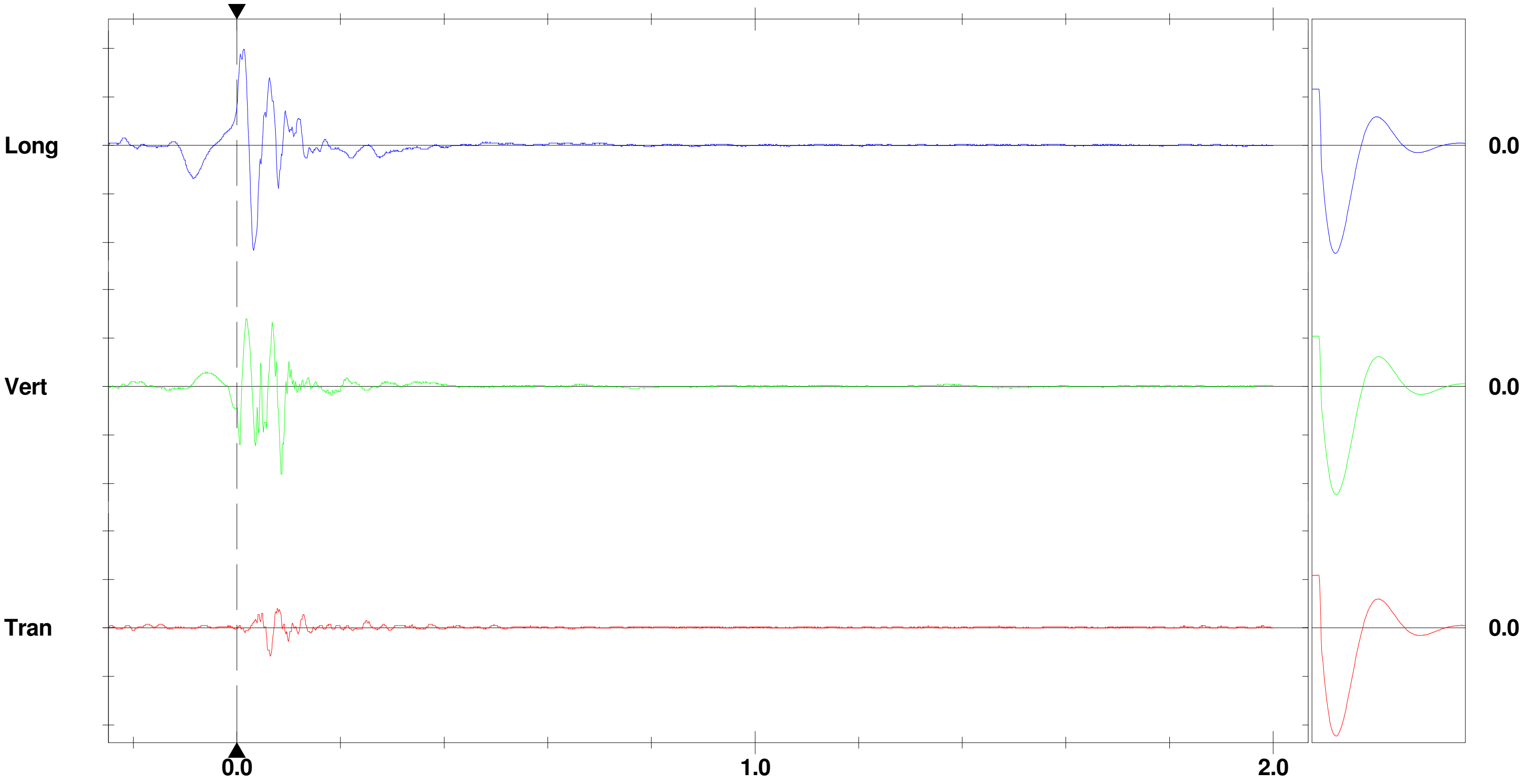
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	2.92	9.02	10.8	mm/s
ZC Freq	32	30	20	Hz
Time (Rel. to Trig)	0.064	0.085	0.032	sec
Peak Acceleration	0.0795	0.252	0.199	g
Peak Displacement	0.0141	0.0426	0.114	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 11.7 mm/s at 0.035 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Instantel

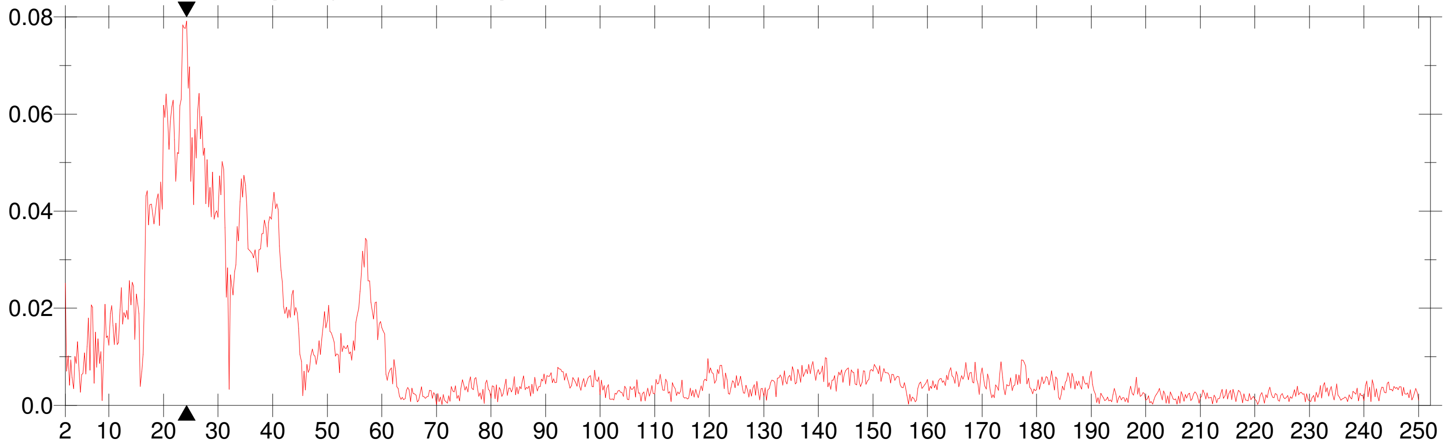
FFT Report

Date/Time	Long at 12:56:20 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQJ.XW0

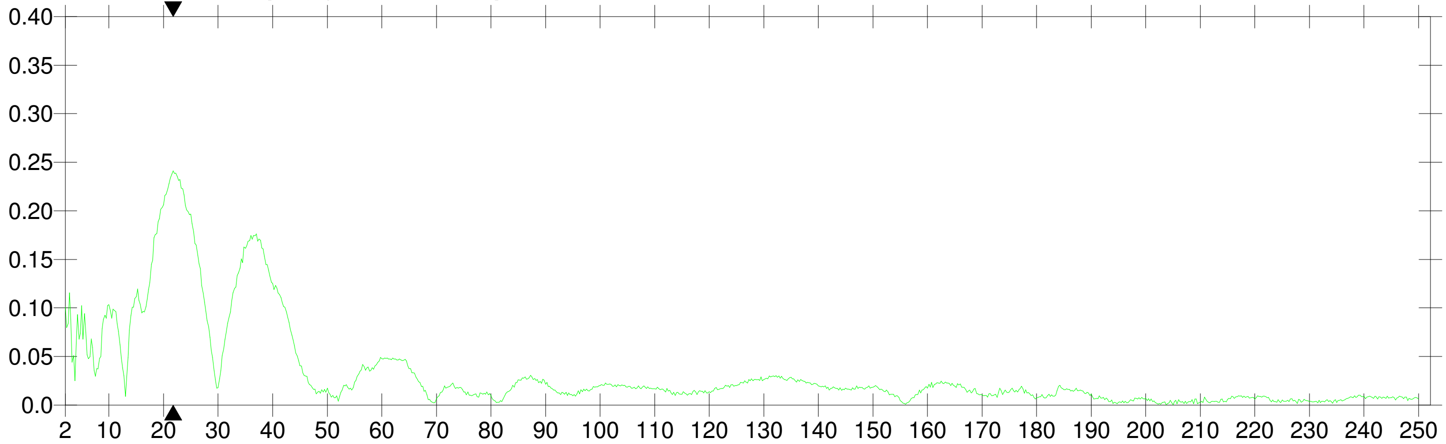
Notes

Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

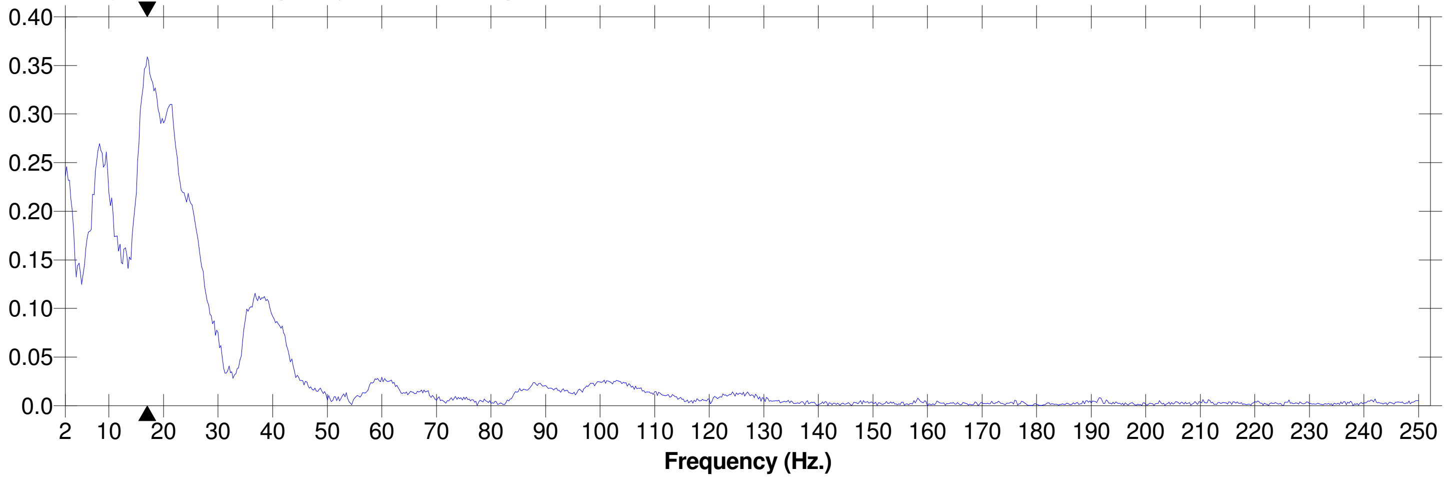
Tran Dominant Frequency = 24.3 Hz., Amplitude = 0.0791, PPV from Event = 2.92 mm/s



Vert Dominant Frequency = 21.8 Hz., Amplitude = 0.241, PPV from Event = 9.02 mm/s



Long Dominant Frequency = 17.0 Hz., Amplitude = 0.359, PPV from Event = 10.8 mm/s



Instantel

Event Report

Date/Time	Long at 12:56:30 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

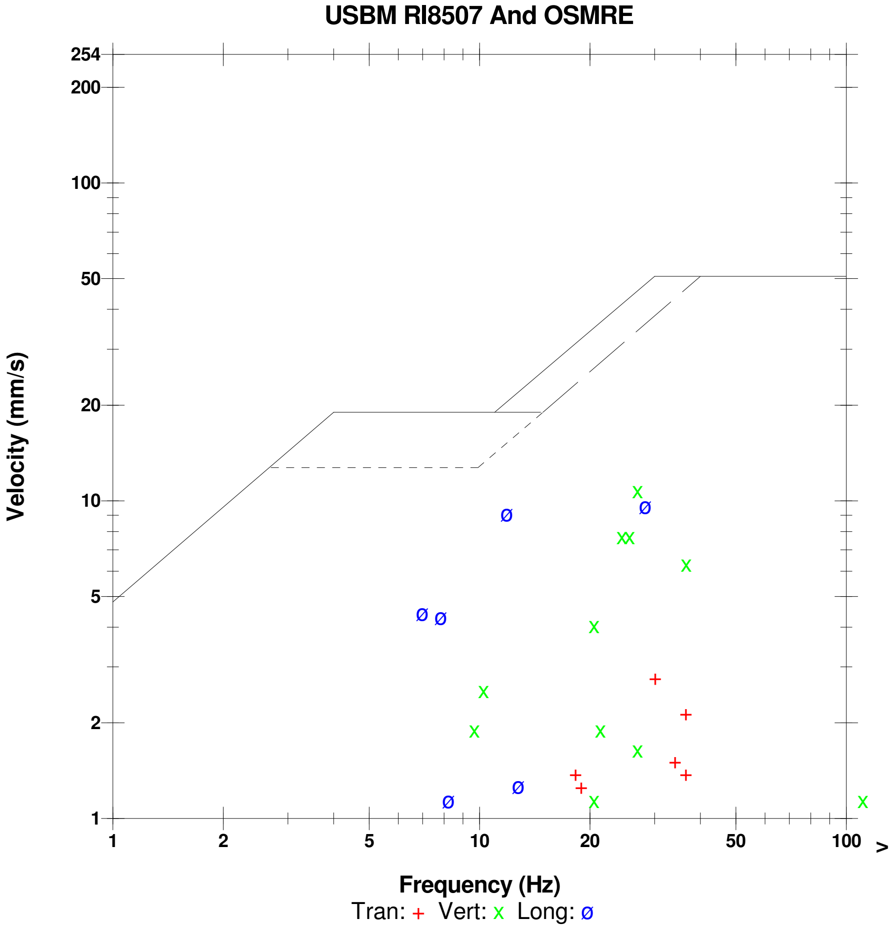
Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQJ.Y60

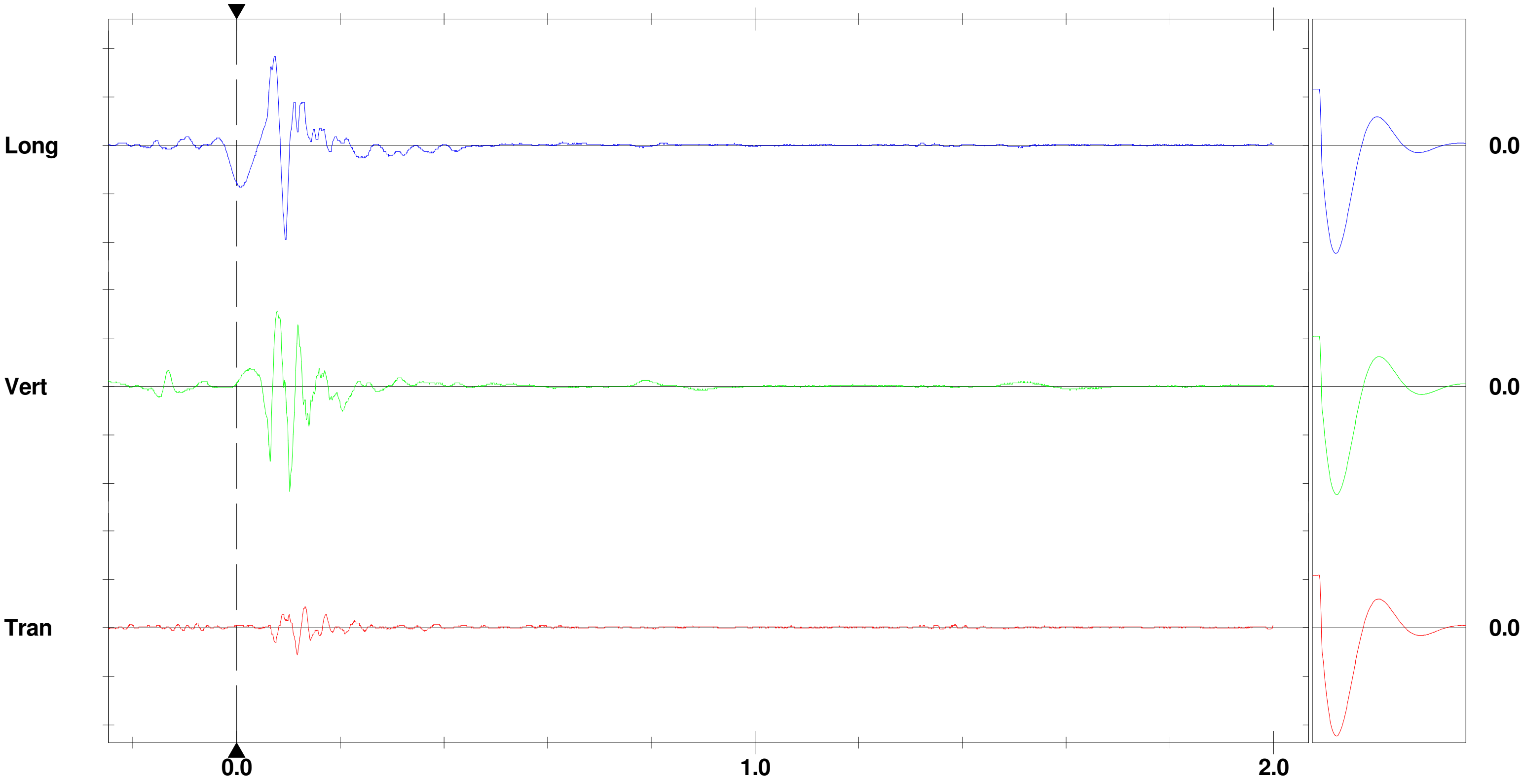
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	2.79	10.8	9.65	mm/s
ZC Freq	30	27	28	Hz
Time (Rel. to Trig)	0.117	0.103	0.094	sec
Peak Acceleration	0.0530	0.265	0.172	g
Peak Displacement	0.0117	0.0547	0.0939	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 11.3 mm/s at 0.075 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

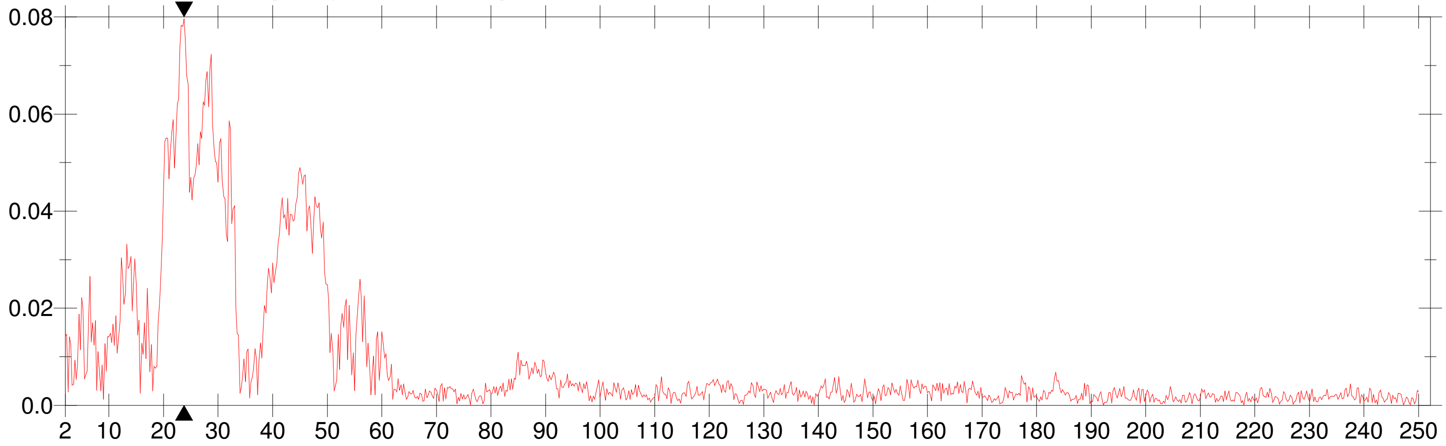
FFT Report

Date/Time	Long at 12:56:30 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQJ.Y60

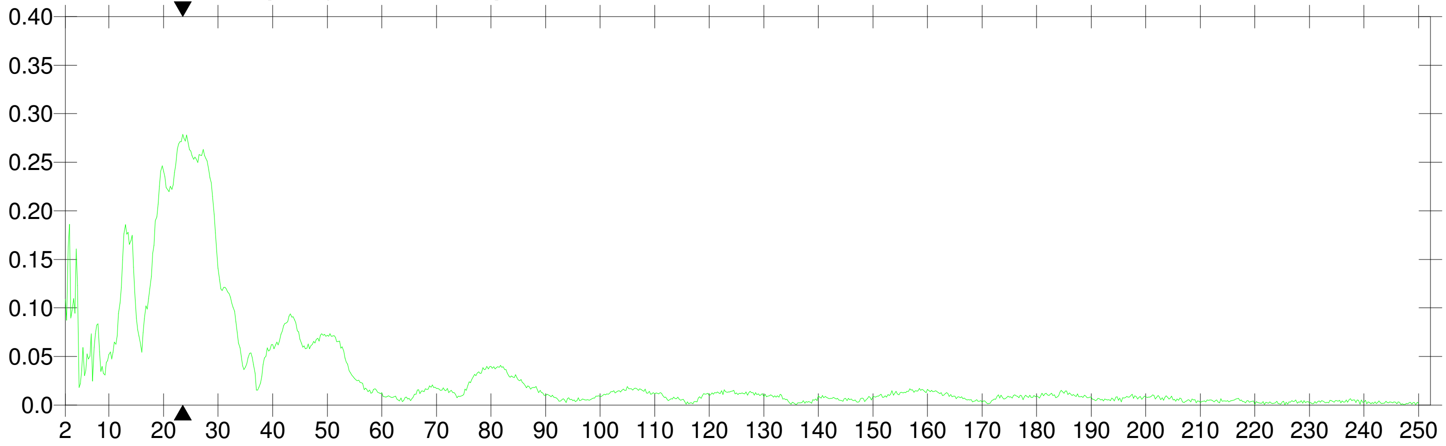
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

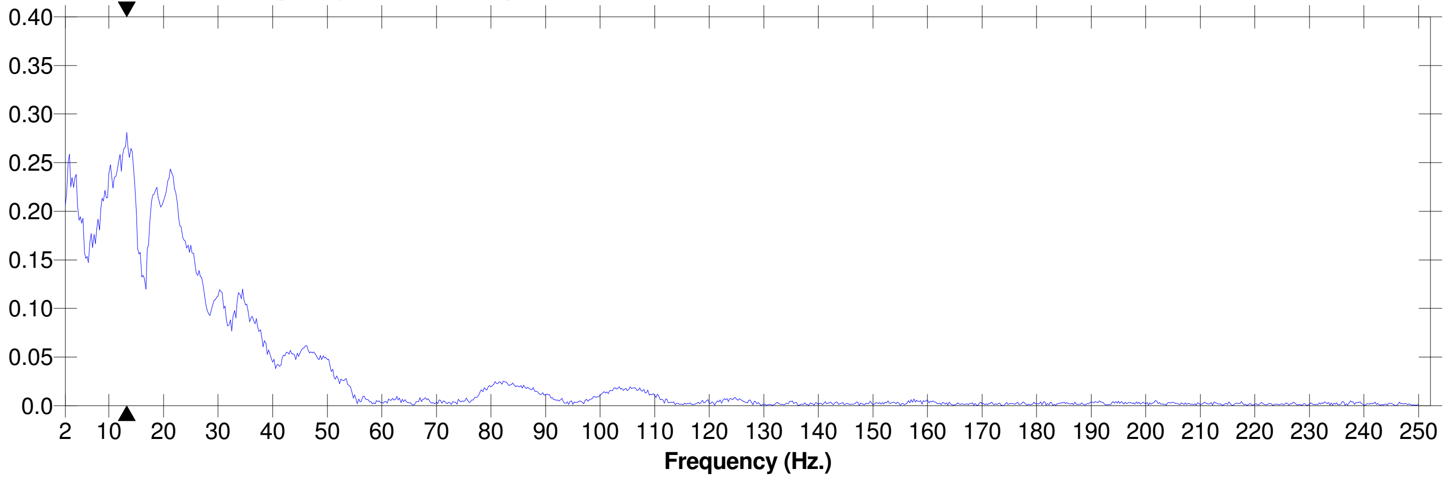
Tran Dominant Frequency = 23.8 Hz., Amplitude = 0.0796, PPV from Event = 2.79 mm/s



Vert Dominant Frequency = 23.5 Hz., Amplitude = 0.279, PPV from Event = 10.8 mm/s



Long Dominant Frequency = 13.3 Hz., Amplitude = 0.281, PPV from Event = 9.65 mm/s



Instantel

Event Report

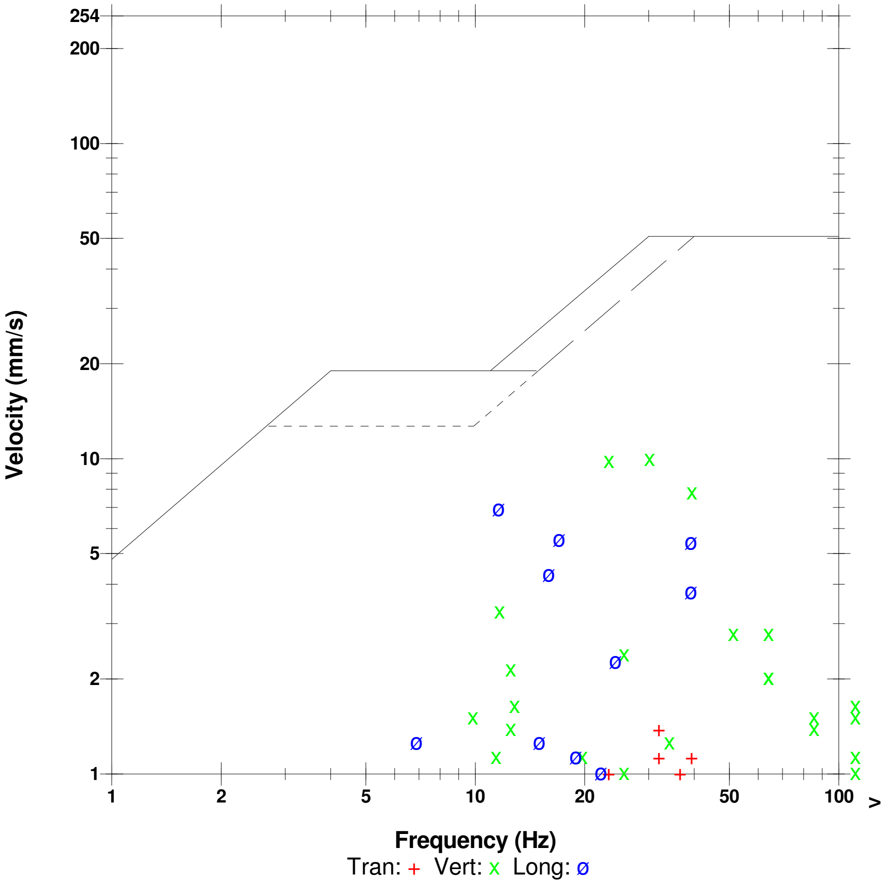
Date/Time Long at 12:56:40 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

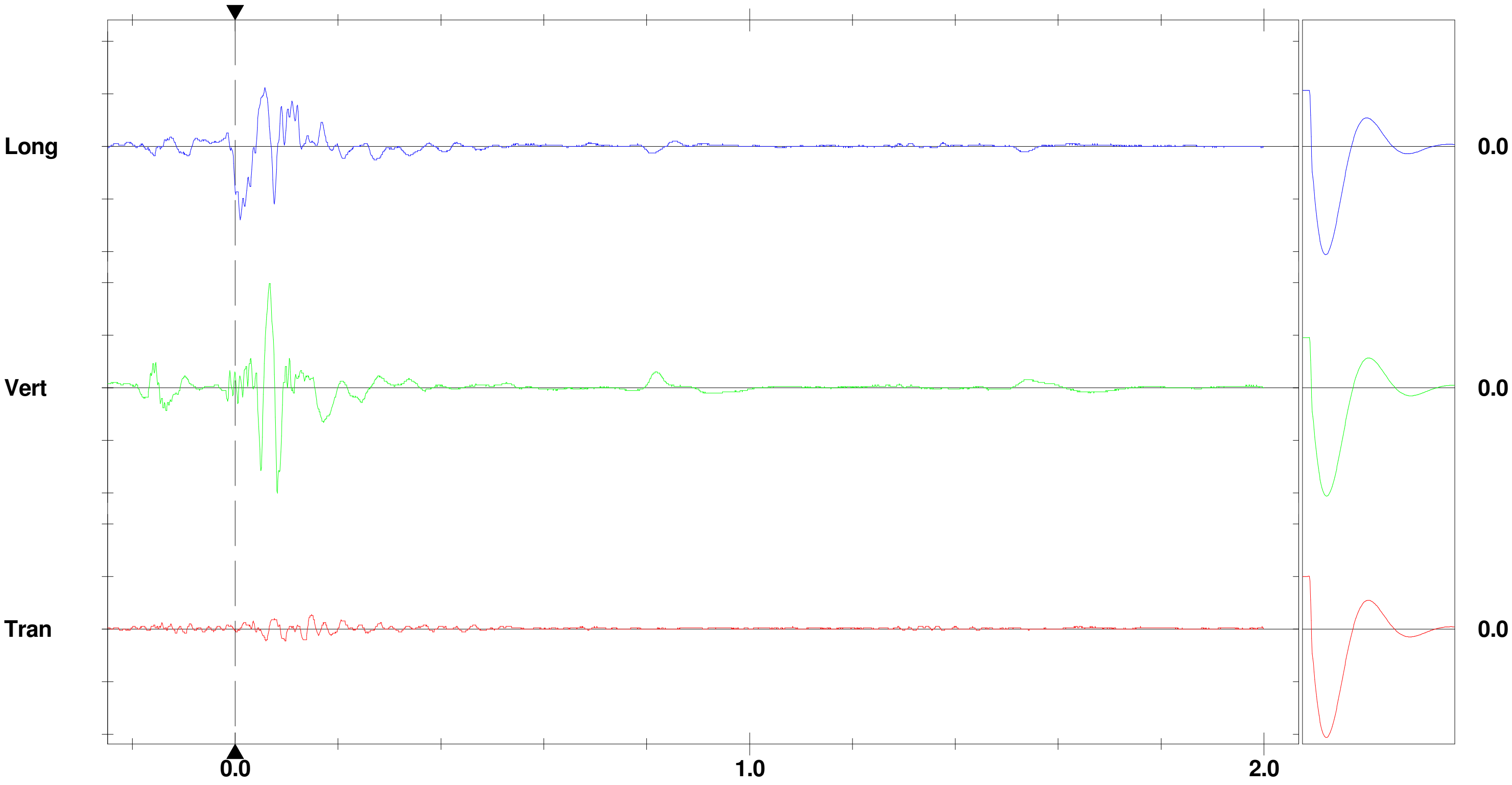
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQJ.YG0

	Tran	Vert	Long	
PPV	1.40	10.0	6.98	mm/s
ZC Freq	32	30	12	Hz
Time (Rel. to Trig)	0.148	0.082	0.010	sec
Peak Acceleration	0.0530	0.292	0.133	g
Peak Displacement	0.00738	0.0663	0.0833	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 10.1 mm/s at 0.066 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.00 mm/s/div
Trigger = ▶——— ———◀

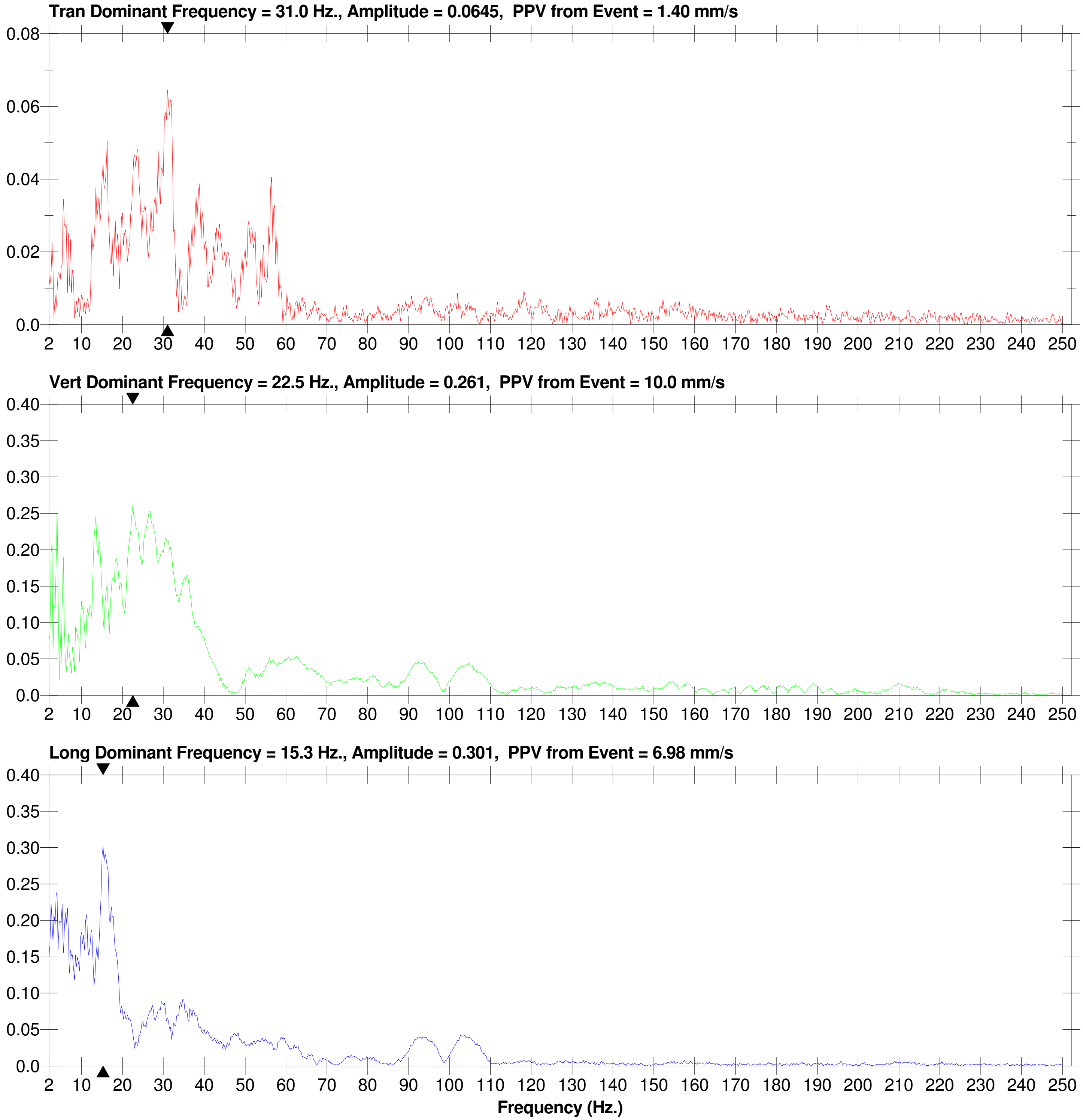
Sensor Check

FFT Report

Date/Time Long at 12:56:40 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQJ.YG0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent



Instantel

Event Report

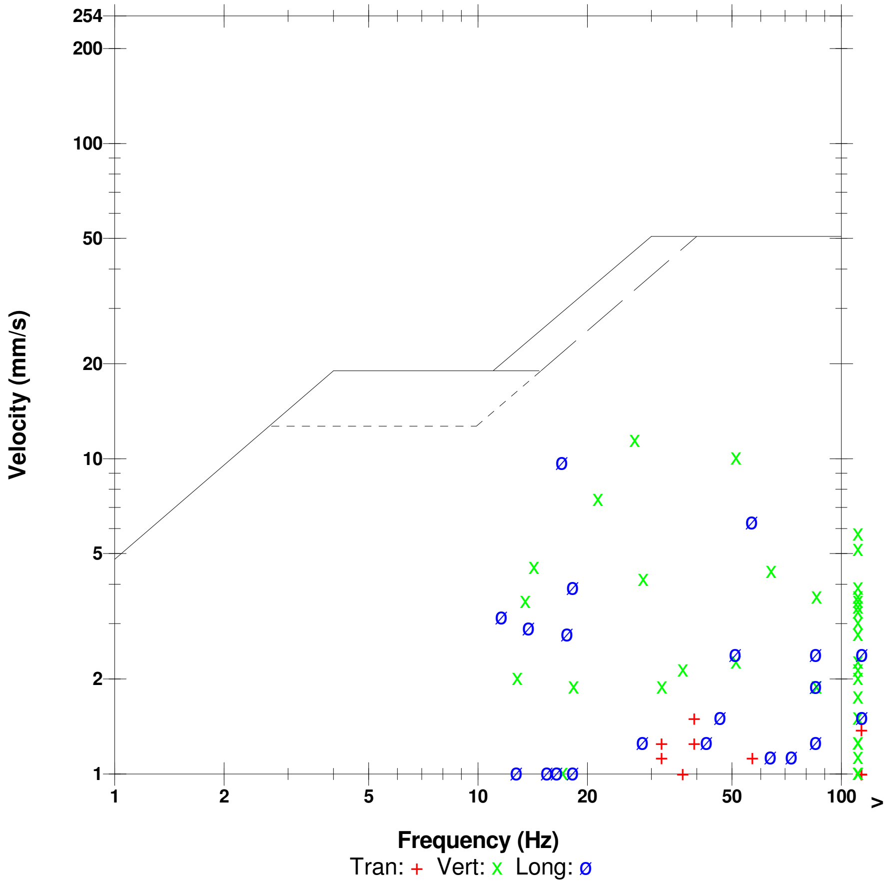
Date/Time Vert at 12:56:53 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

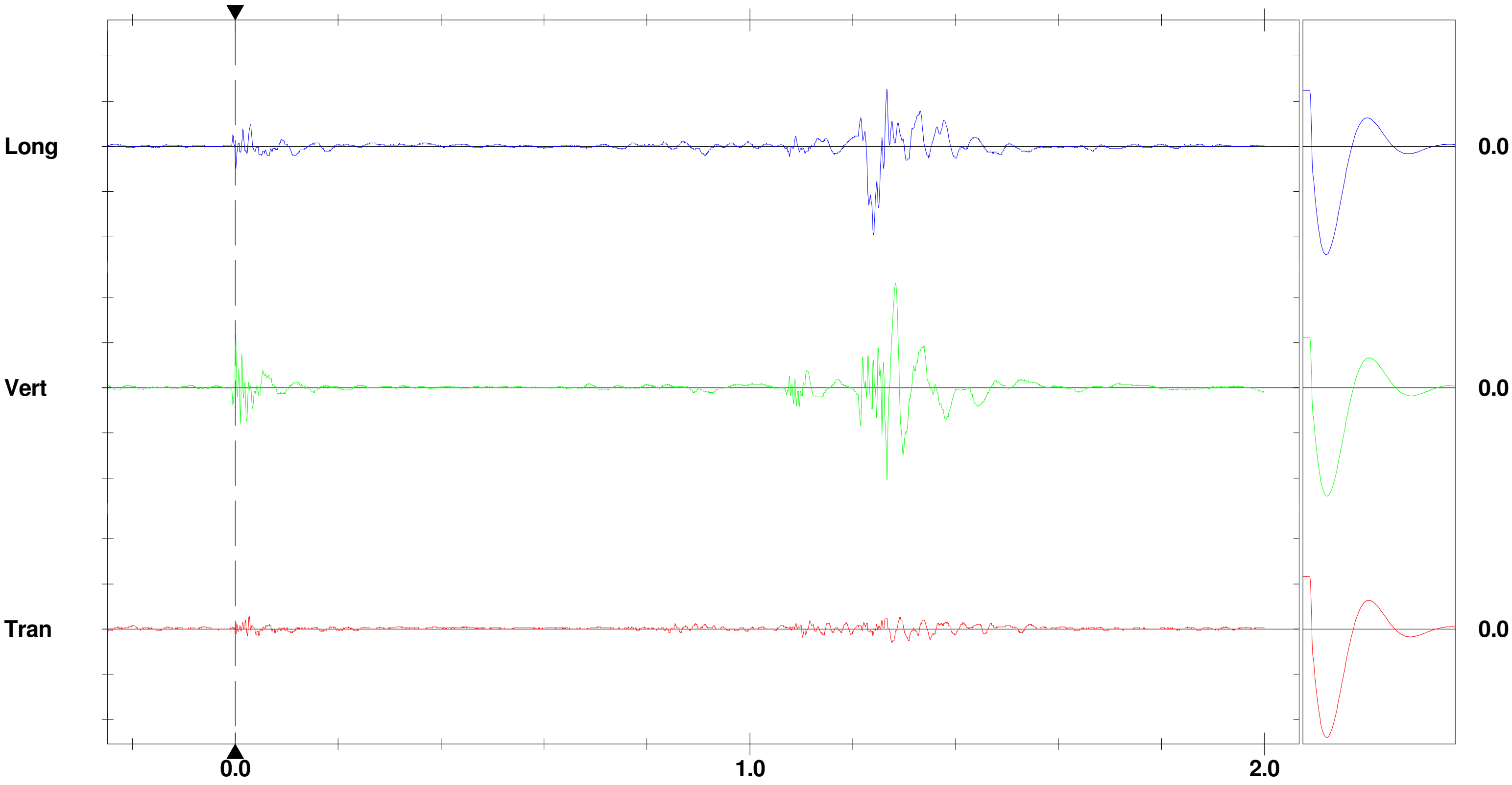
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQJ.YT0

	Tran	**Vert**	**Long**	
PPV	1.52	11.6	9.78	mm/s
ZC Freq	39	27	17	Hz
Time (Rel. to Trig)	1.276	1.283	1.240	sec
Peak Acceleration	0.0928	0.437	0.225	g
Peak Displacement	0.00744	0.0664	0.0805	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 12.0 mm/s at 1.267 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.00 mm/s/div

Sensor Check

Trigger = ▶—— ——◀

Instantel

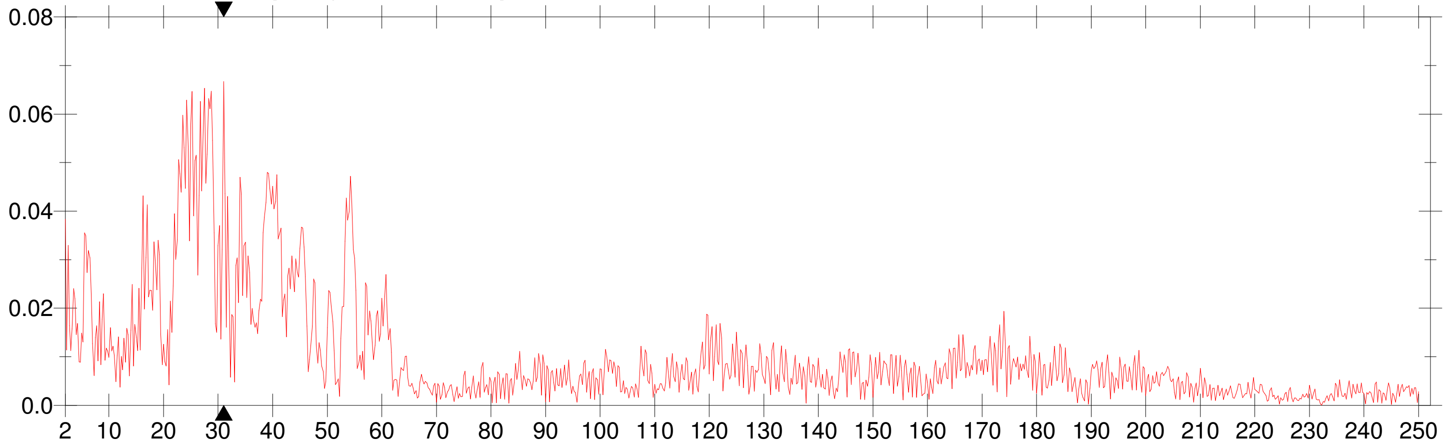
FFT Report

Date/Time	Vert at 12:56:53 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQJ.YT0

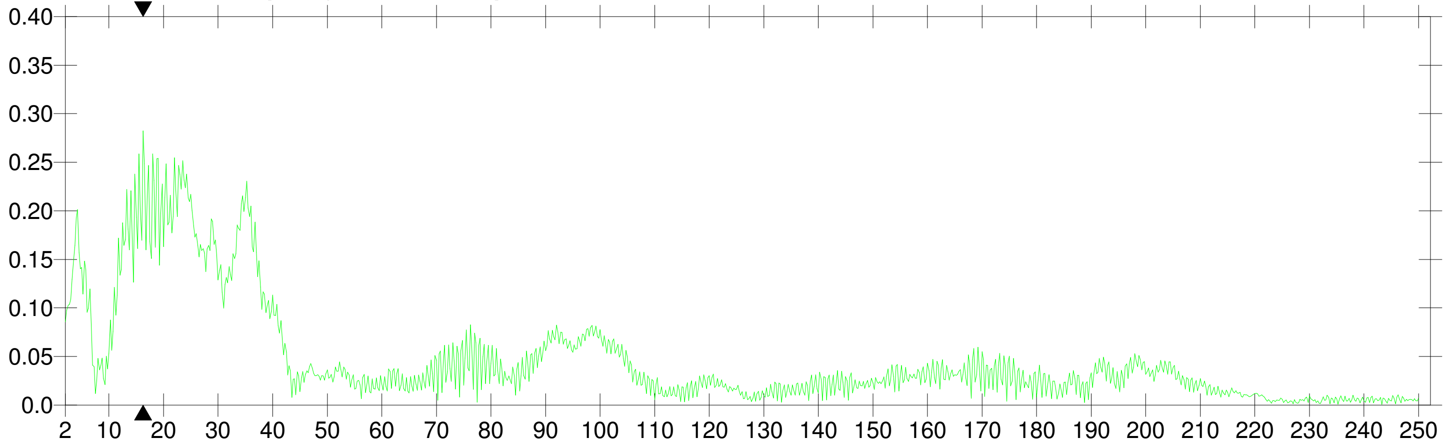
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

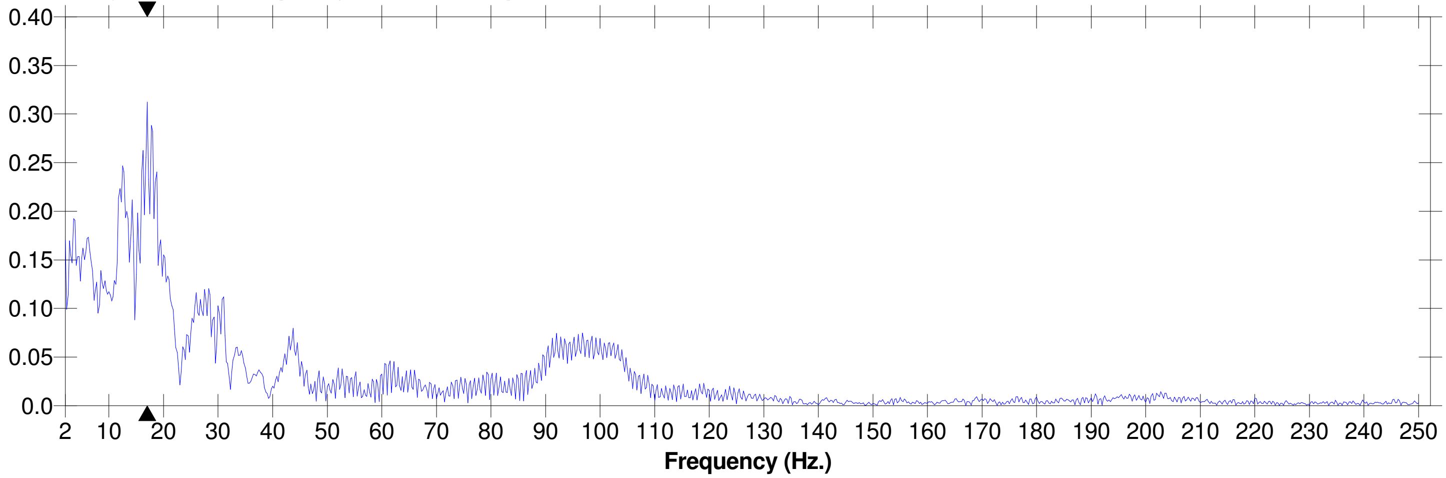
Tran Dominant Frequency = 31.0 Hz., Amplitude = 0.0667, PPV from Event = 1.52 mm/s



Vert Dominant Frequency = 16.3 Hz., Amplitude = 0.282, PPV from Event = 11.6 mm/s



Long Dominant Frequency = 17.0 Hz., Amplitude = 0.312, PPV from Event = 9.78 mm/s



Event Report

Date/Time	Vert at 12:57:02 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQJ.Z20

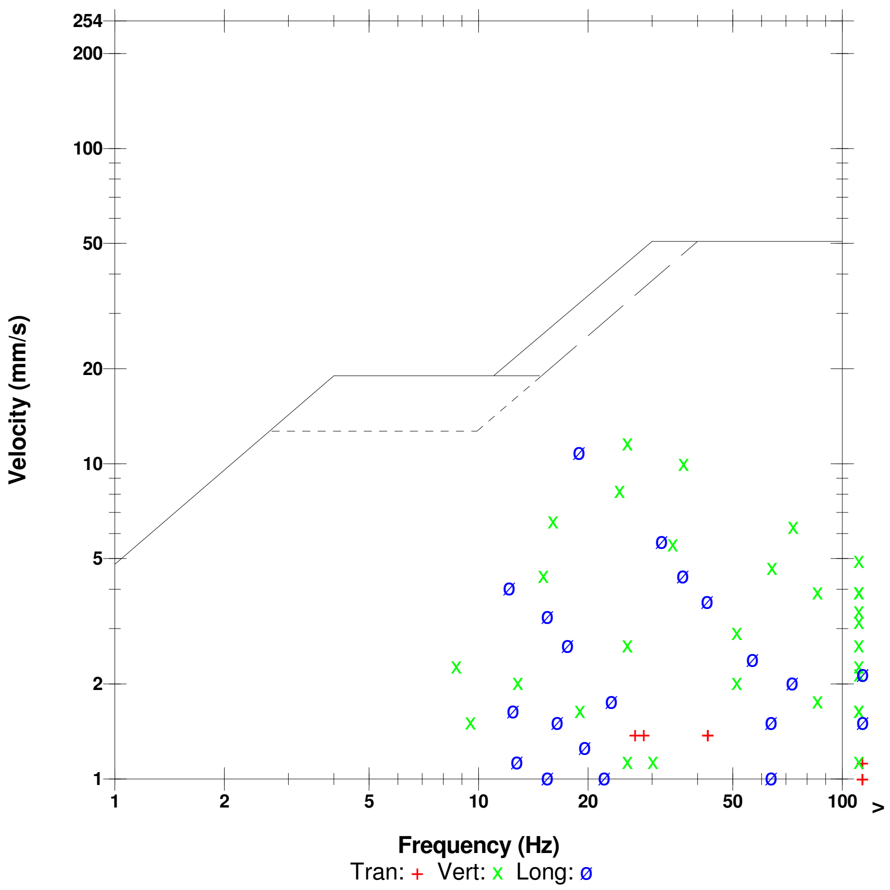
Notes

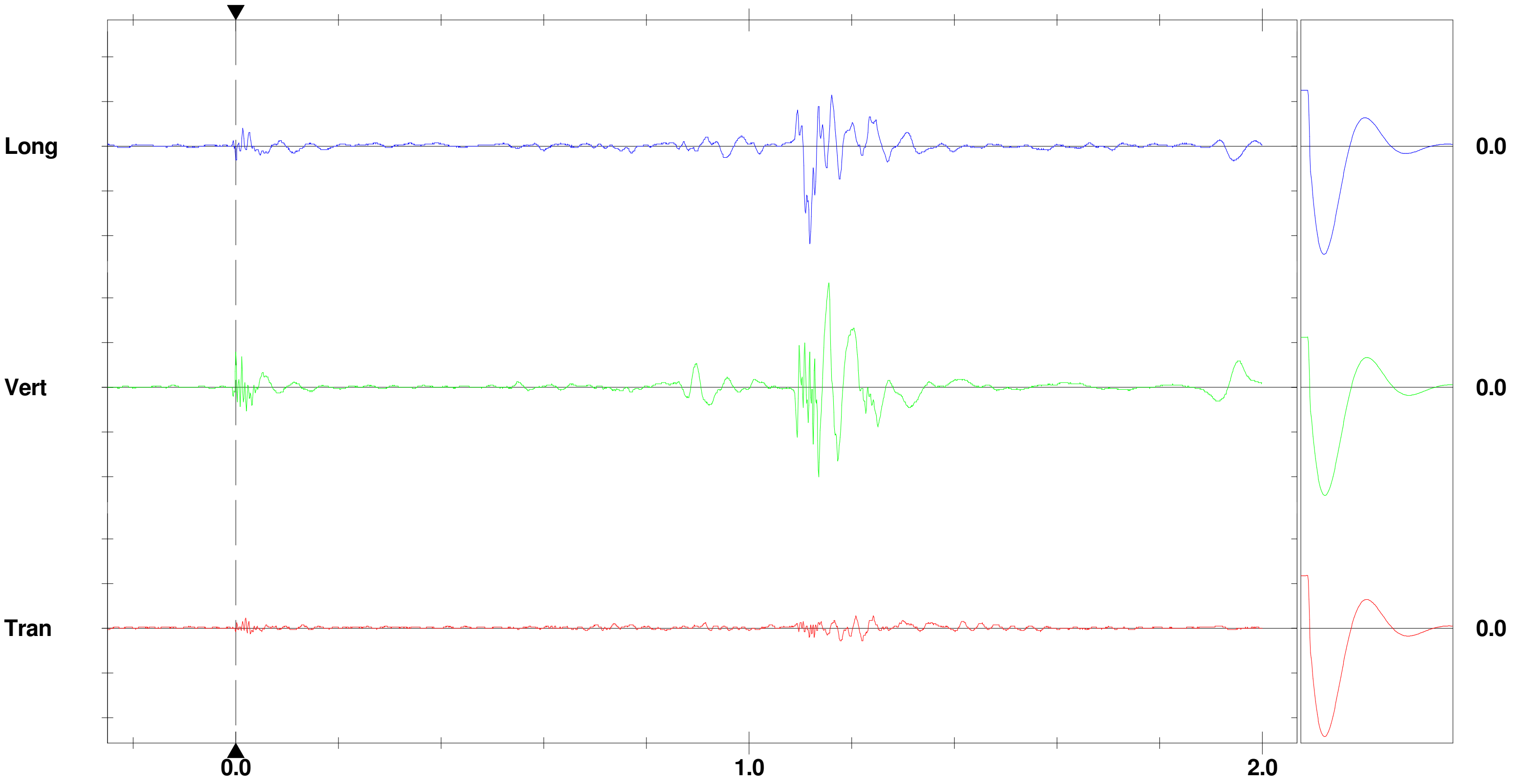
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.40	11.7	10.9	mm/s
ZC Freq	43	26	19	Hz
Time (Rel. to Trig)	1.178	1.155	1.118	sec
Peak Acceleration	0.0928	0.517	0.292	g
Peak Displacement	0.00794	0.0730	0.0752	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 11.7 mm/s at 1.155 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

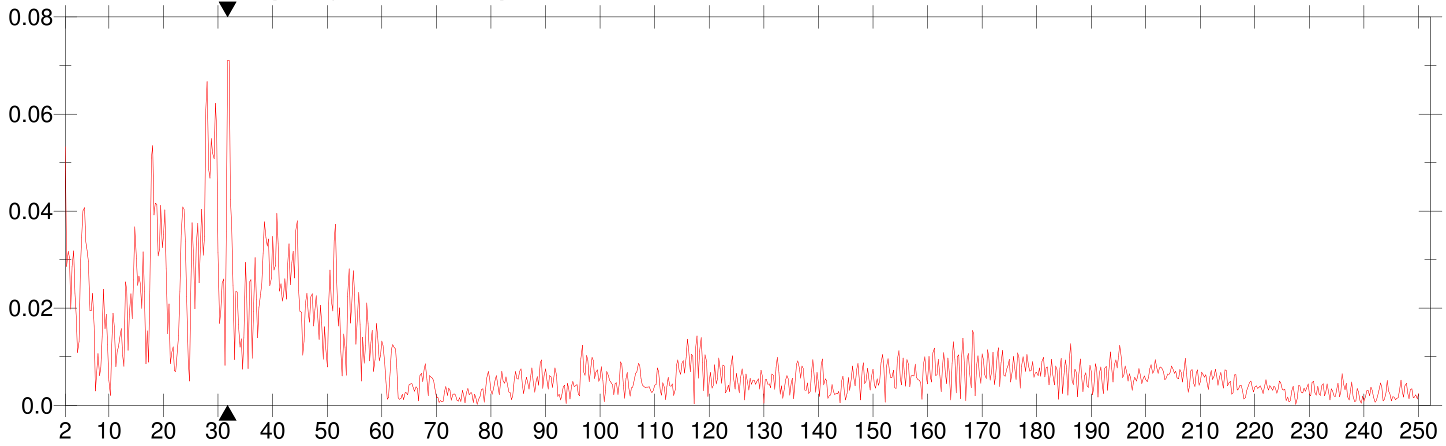
Instantel

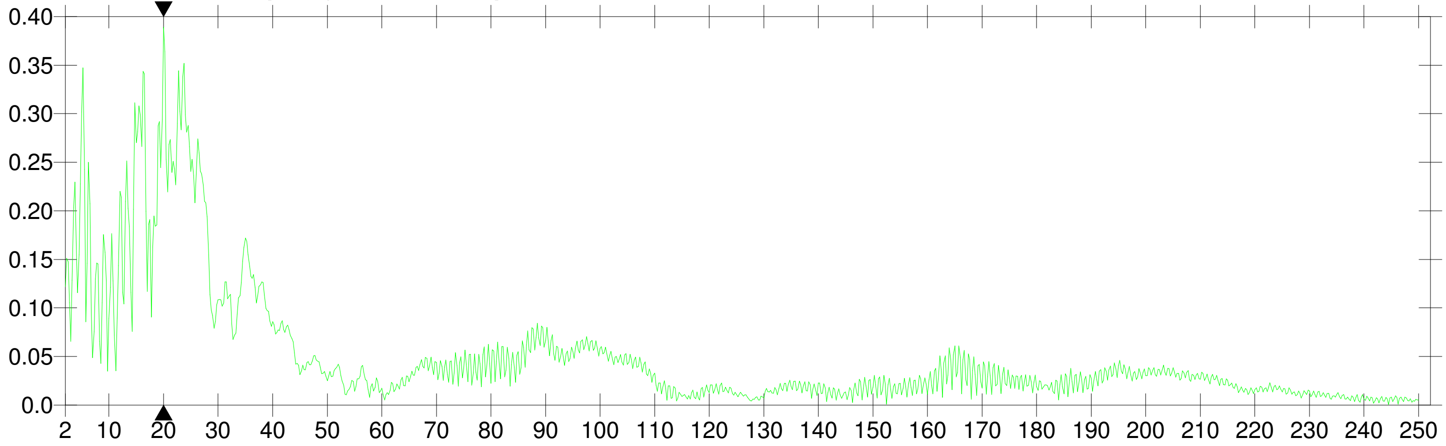
FFT Report

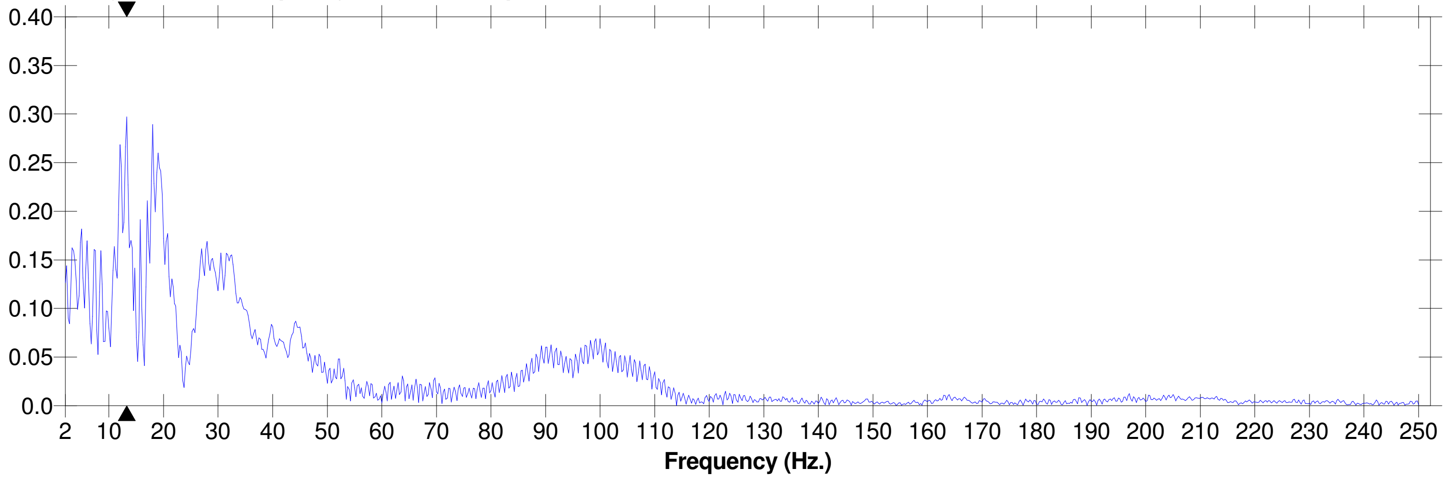
Date/Time Vert at 12:57:02 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQJ.Z20

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent


Tran Dominant Frequency = 31.8 Hz., Amplitude = 0.0710, PPV from Event = 1.40 mm/s


Vert Dominant Frequency = 20.0 Hz., Amplitude = 0.389, PPV from Event = 11.7 mm/s


Long Dominant Frequency = 13.3 Hz., Amplitude = 0.297, PPV from Event = 10.9 mm/s

Instantel

Event Report

Date/Time	Vert at 12:57:27 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

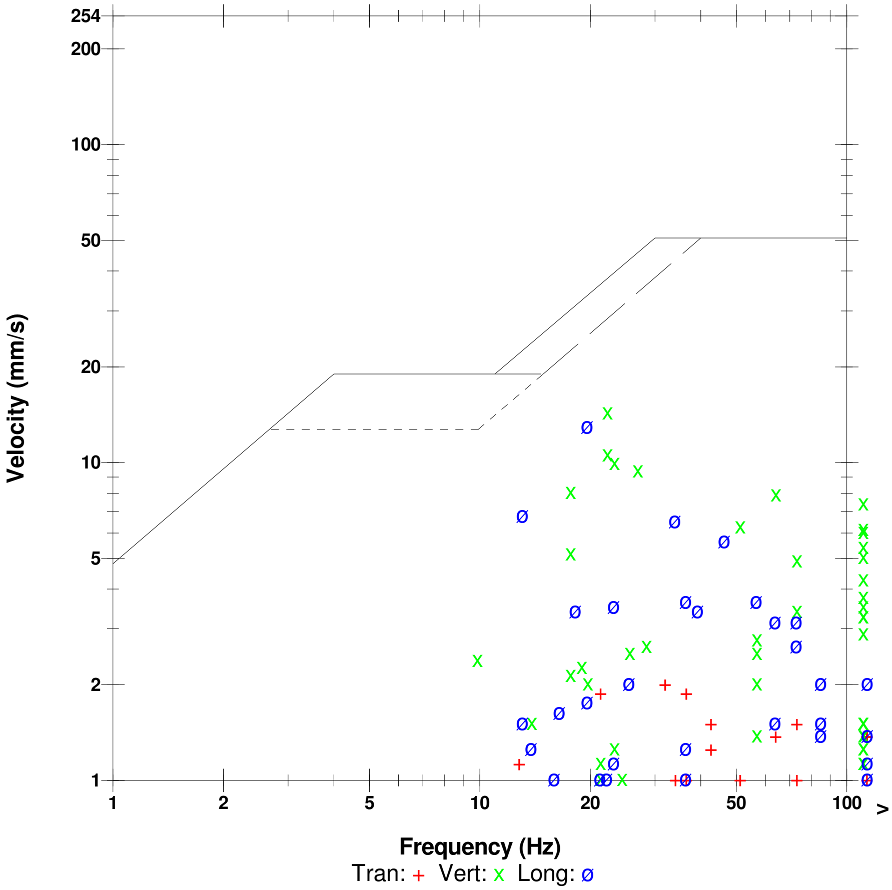
Notes

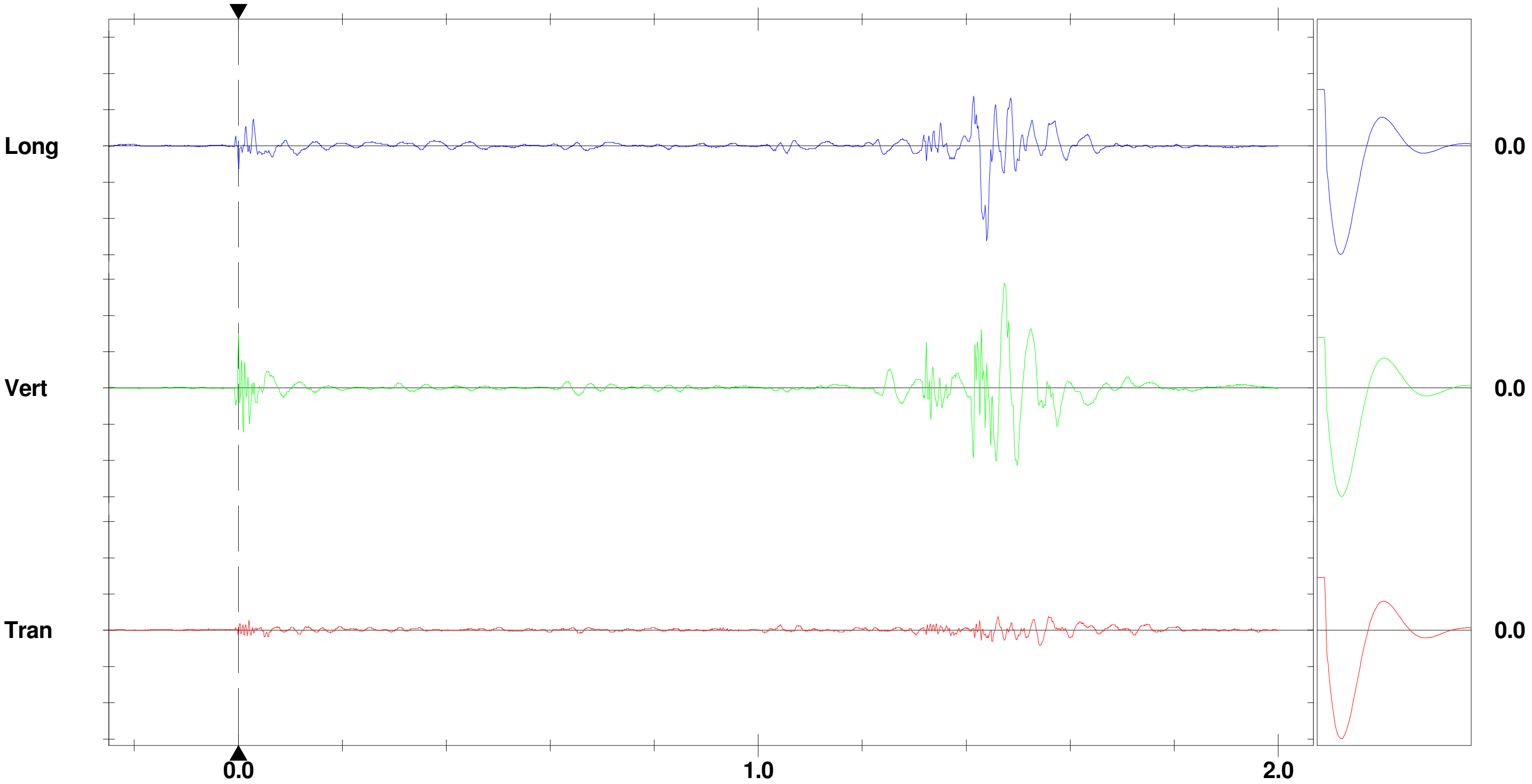
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQJ.ZR0

	Tran	Vert	Long	
PPV	2.03	14.5	13.1	mm/s
ZC Freq	32	22	20	Hz
Time (Rel. to Trig)	1.541	1.474	1.439	sec
Peak Acceleration	0.159	0.742	0.384	g
Peak Displacement	0.0132	0.0980	0.0876	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 14.9 mm/s at 1.474 sec


USBM RI8507 And OSMRE



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.00 mm/s/div

Trigger = ▶—— ——◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Instantel

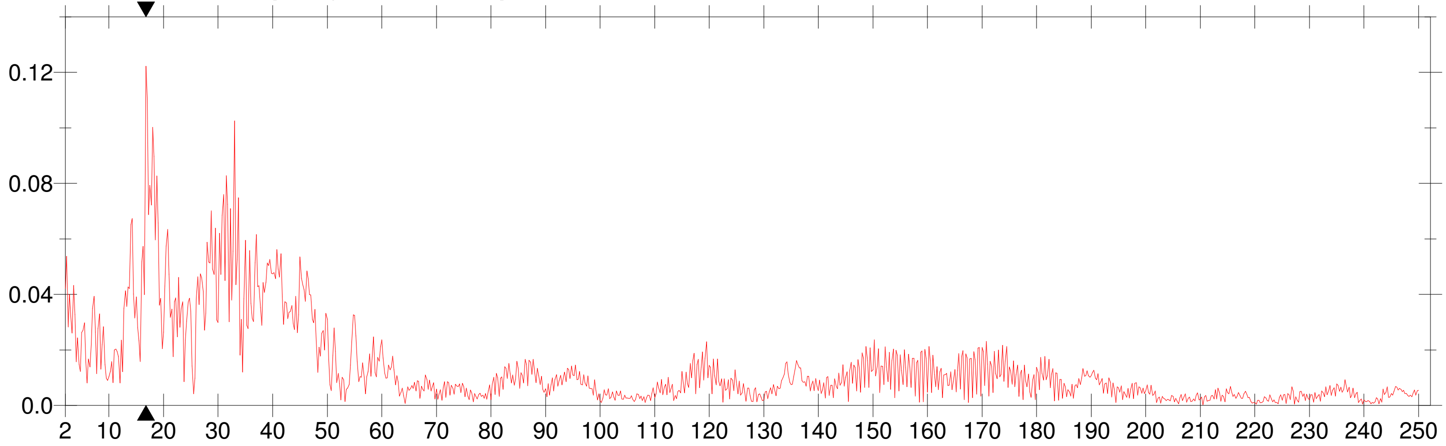
FFT Report

Date/Time	Vert at 12:57:27 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQJ.ZR0

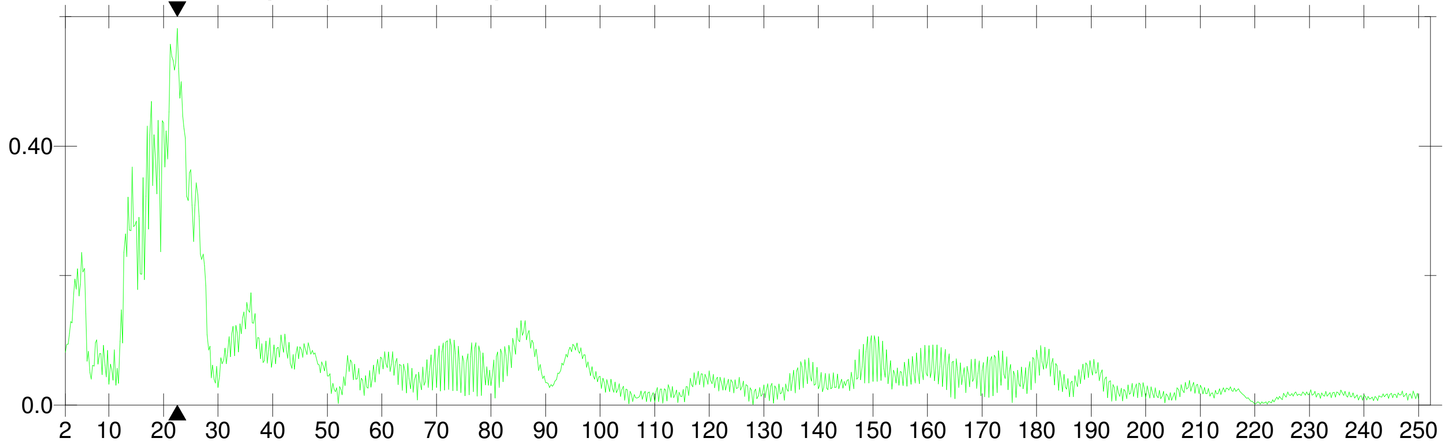
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

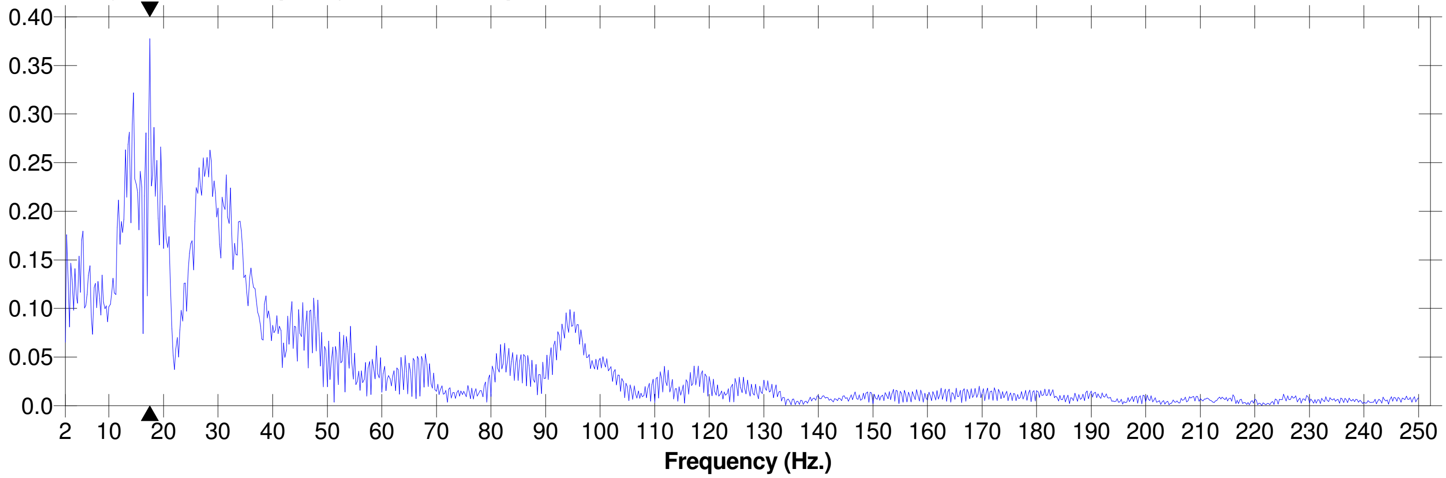
Tran Dominant Frequency = 16.8 Hz., Amplitude = 0.122, PPV from Event = 2.03 mm/s



Vert Dominant Frequency = 22.5 Hz., Amplitude = 0.582, PPV from Event = 14.5 mm/s



Long Dominant Frequency = 17.5 Hz., Amplitude = 0.378, PPV from Event = 13.1 mm/s



Event Report

Date/Time	Vert at 12:57:38 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQK.020

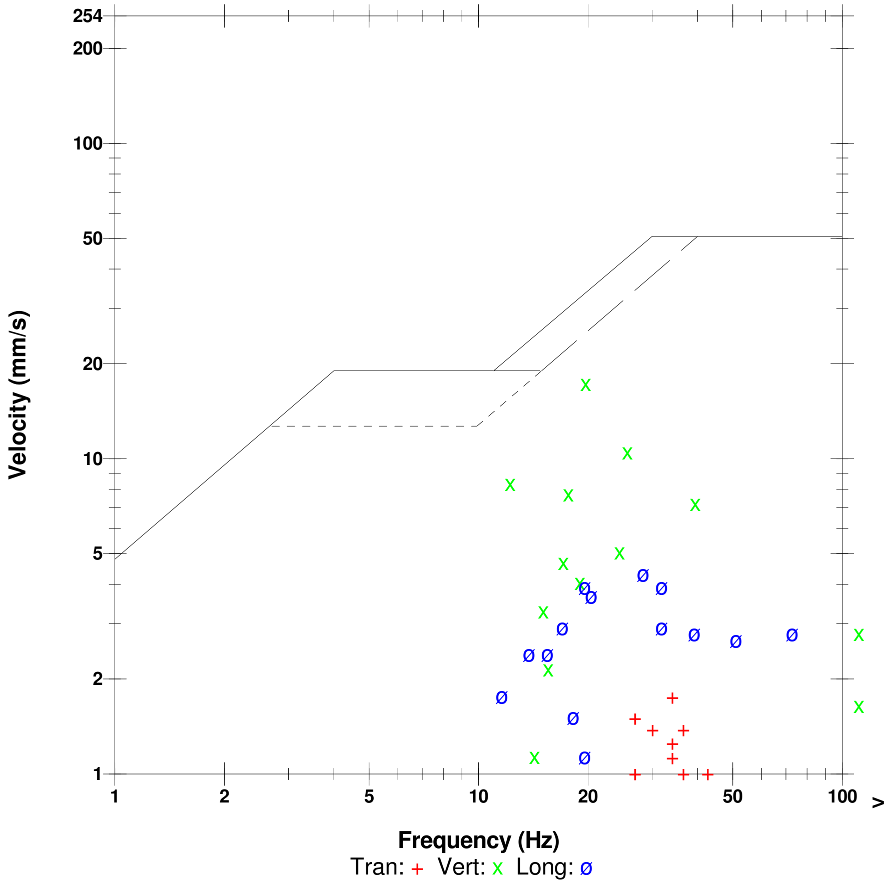
Notes

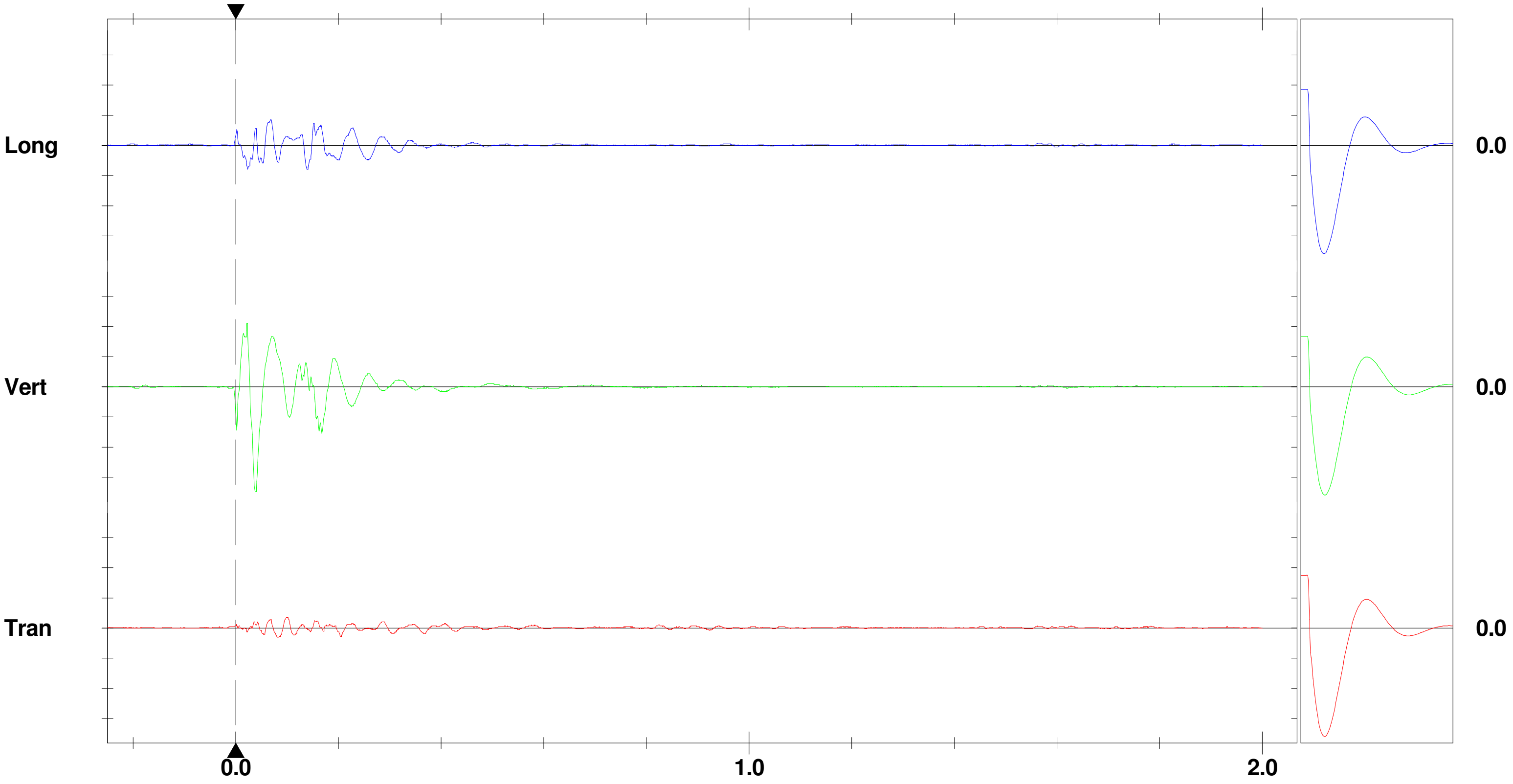
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.78	17.4	4.32	mm/s
ZC Freq	34	20	28	Hz
Time (Rel. to Trig)	0.099	0.038	0.068	sec
Peak Acceleration	0.0530	0.305	0.159	g
Peak Displacement	0.00974	0.120	0.0304	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 17.6 mm/s at 0.038 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

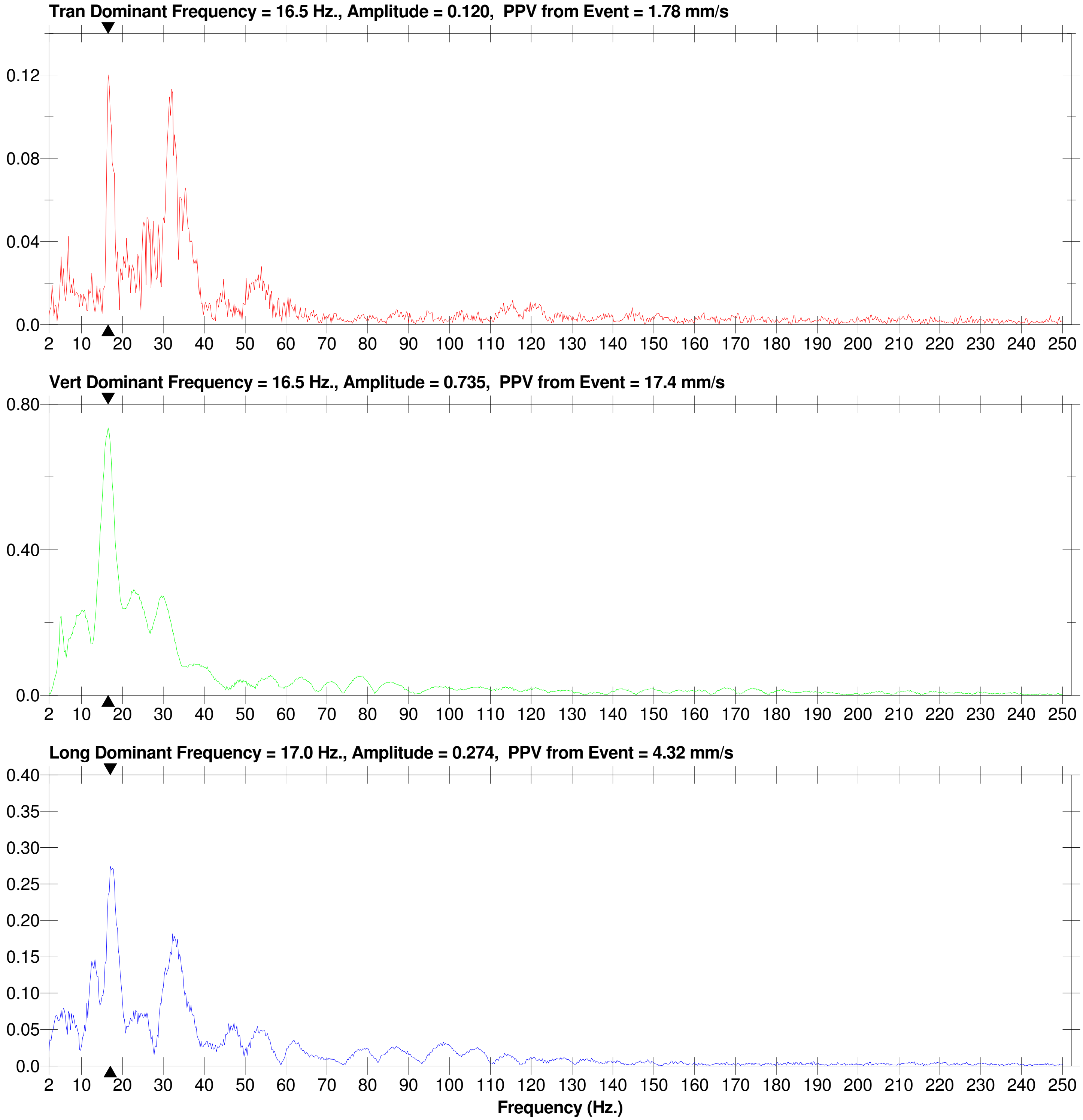
Printed: April 24, 2017 (V 10.60 - 10.60)

FFT Report

Date/Time	Vert at 12:57:38 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQK.020

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent



Instantel

Event Report

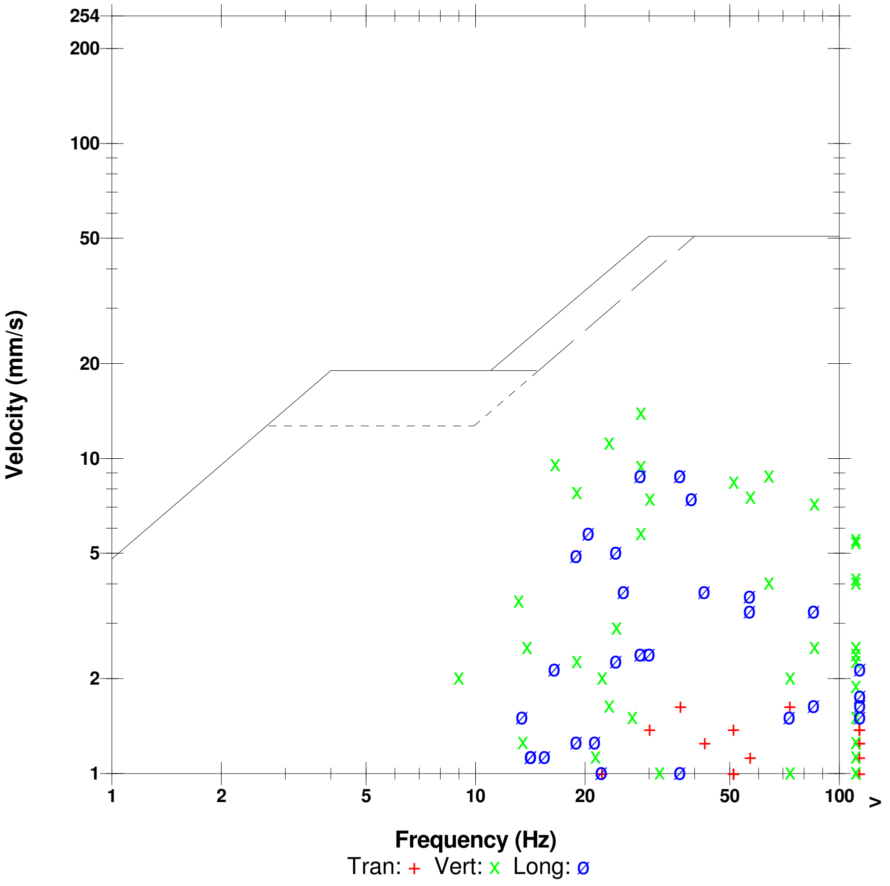
Date/Time Vert at 12:57:47 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

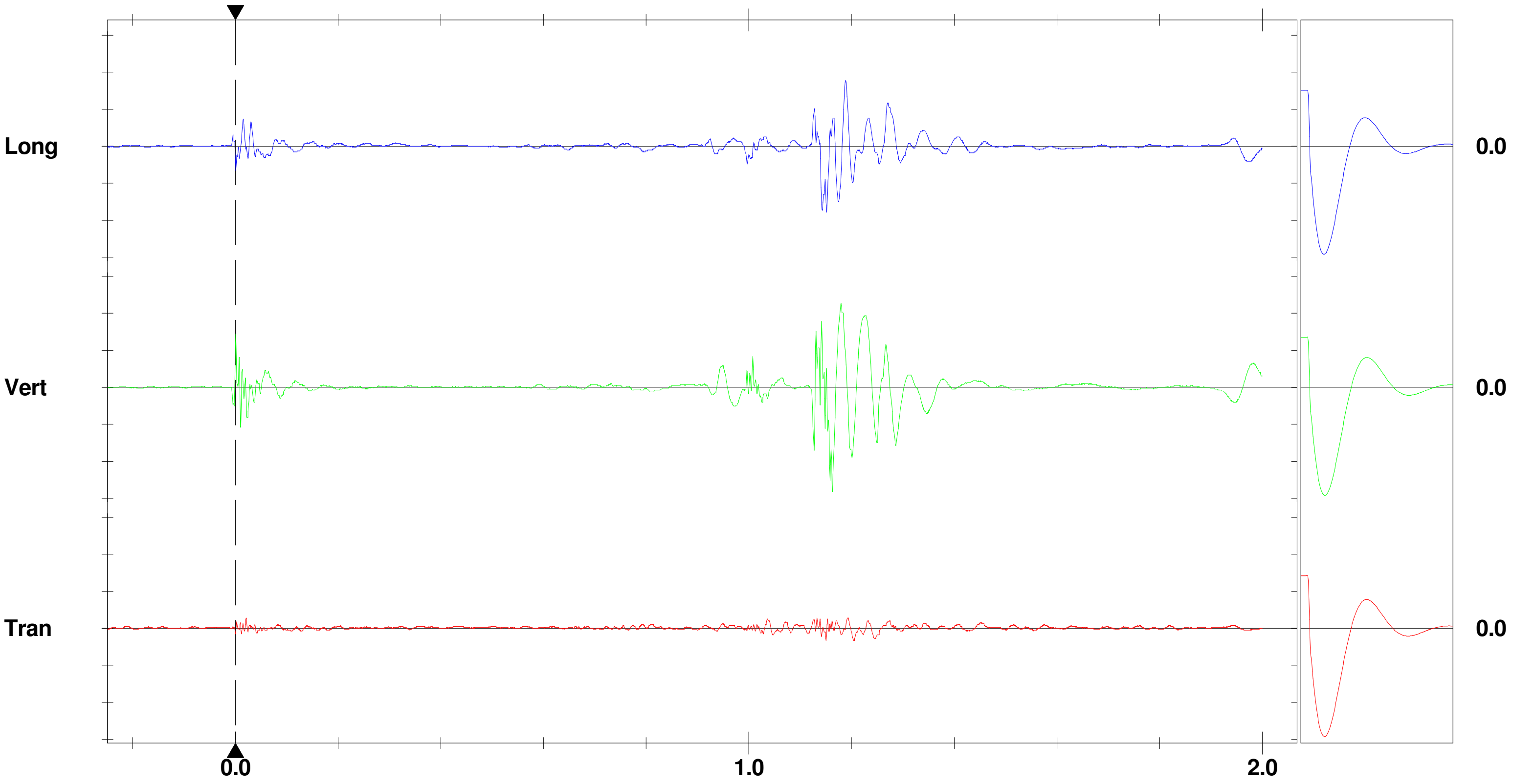
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQK.0B0

	Tran	**Vert**	**Long**	
PPV	1.65	14.1	8.89	mm/s
ZC Freq	73	28	28	Hz
Time (Rel. to Trig)	1.150	1.163	1.151	sec
Peak Acceleration	0.159	0.742	0.411	g
Peak Displacement	0.00763	0.101	0.0523	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 14.5 mm/s at 1.163 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.00 mm/s/div

Sensor Check

Trigger = ▶——— ———◀

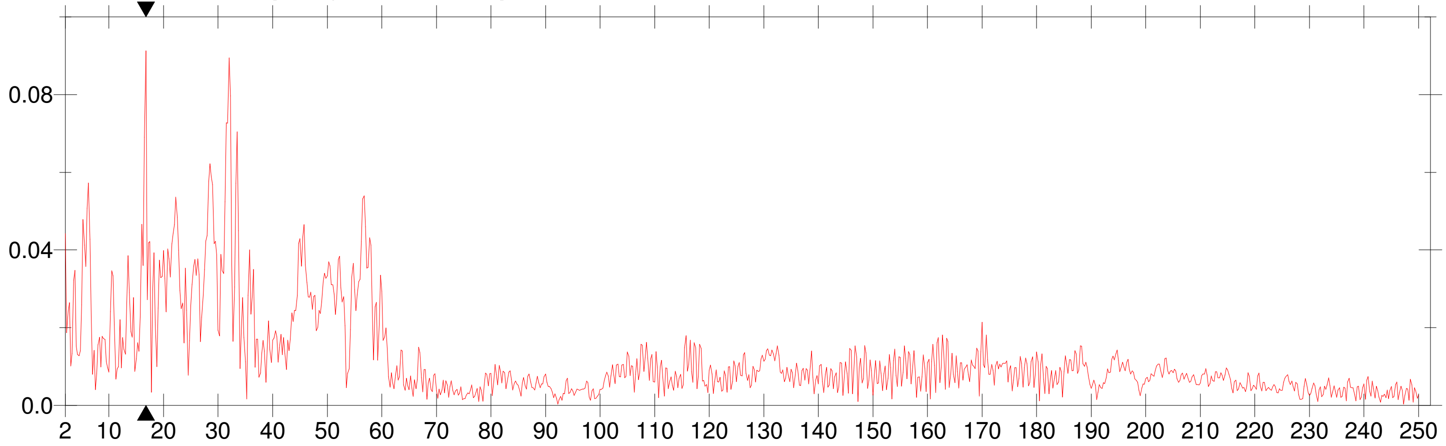
FFT Report

Date/Time	Vert at 12:57:47 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQK.0B0

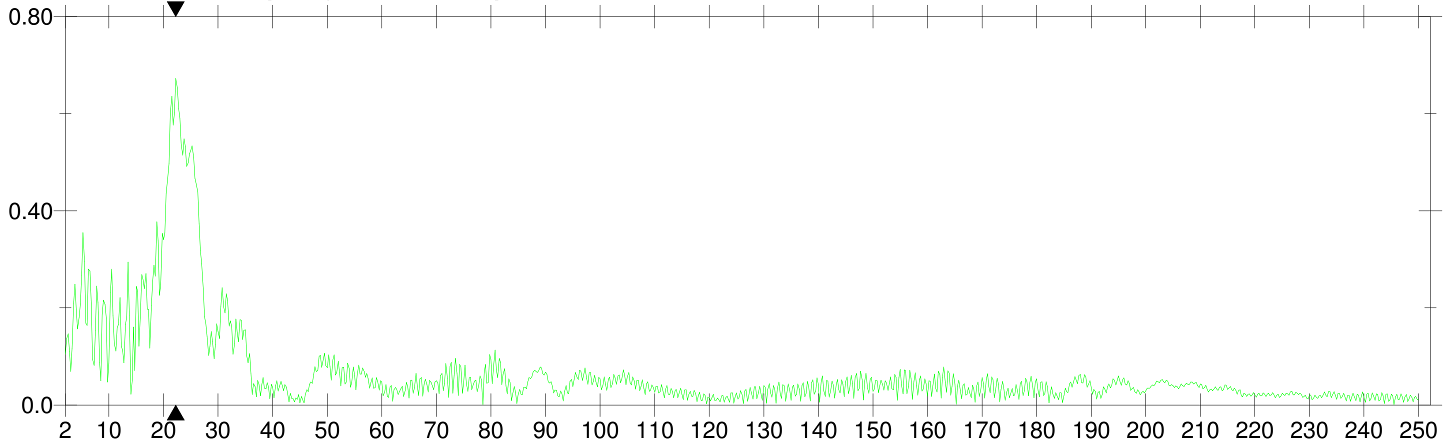
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

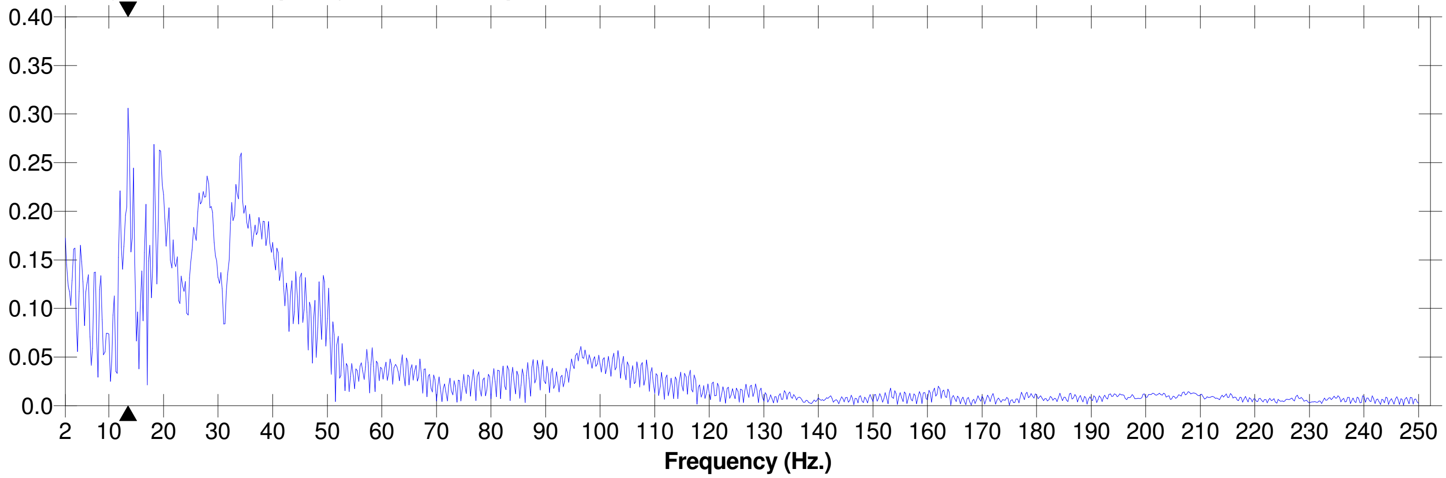
Tran Dominant Frequency = 16.8 Hz., Amplitude = 0.0912, PPV from Event = 1.65 mm/s



Vert Dominant Frequency = 22.3 Hz., Amplitude = 0.673, PPV from Event = 14.1 mm/s



Long Dominant Frequency = 13.5 Hz., Amplitude = 0.306, PPV from Event = 8.89 mm/s



Instantel

Event Report

Date/Time	Vert at 12:58:03 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQK.0R0

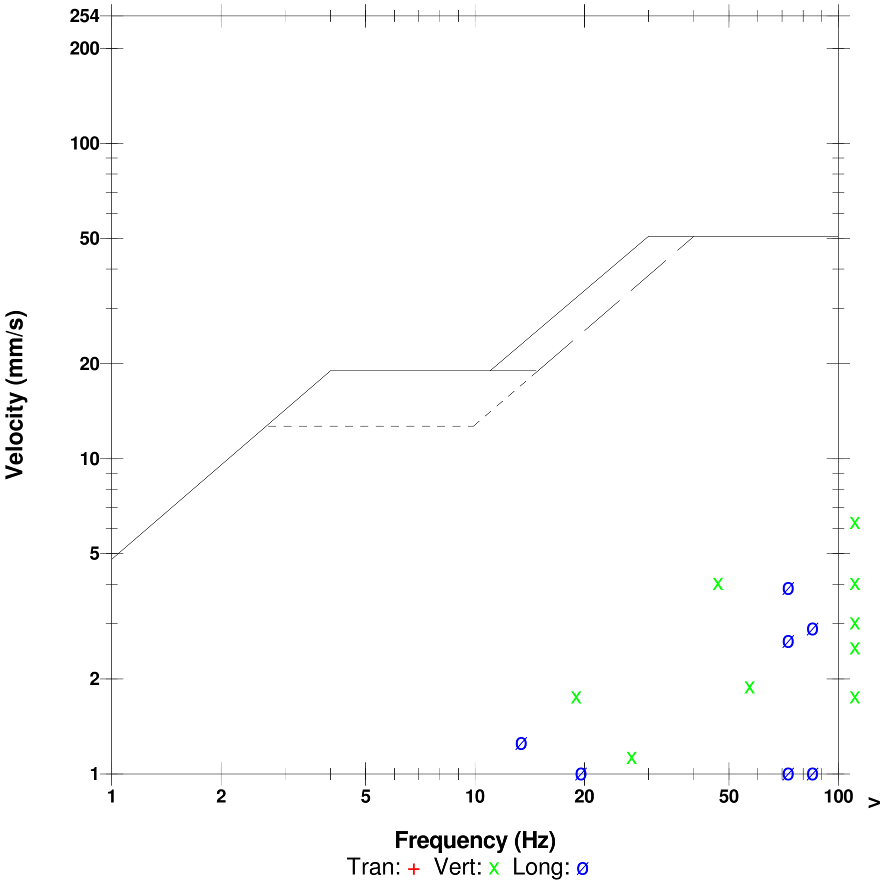
Notes

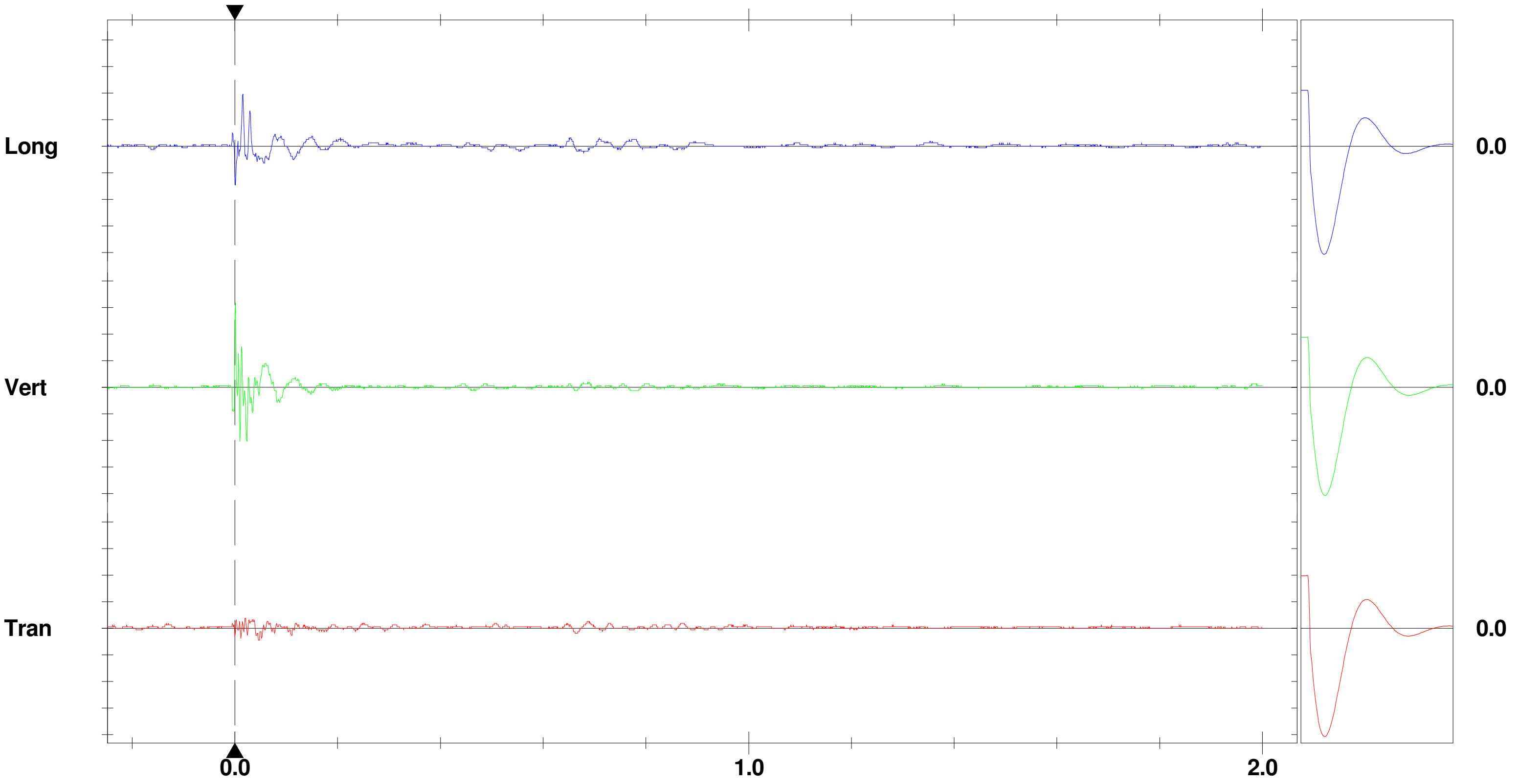
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	0.889	6.35	3.94	mm/s
ZC Freq	34	>100	73	Hz
Time (Rel. to Trig)	0.046	0.001	0.016	sec
Peak Acceleration	0.0795	0.451	0.186	g
Peak Displacement	0.00378	0.0148	0.0152	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.7	Hz
Overswing Ratio	3.8	3.7	3.8	

Peak Vector Sum 6.99 mm/s at 0.001 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

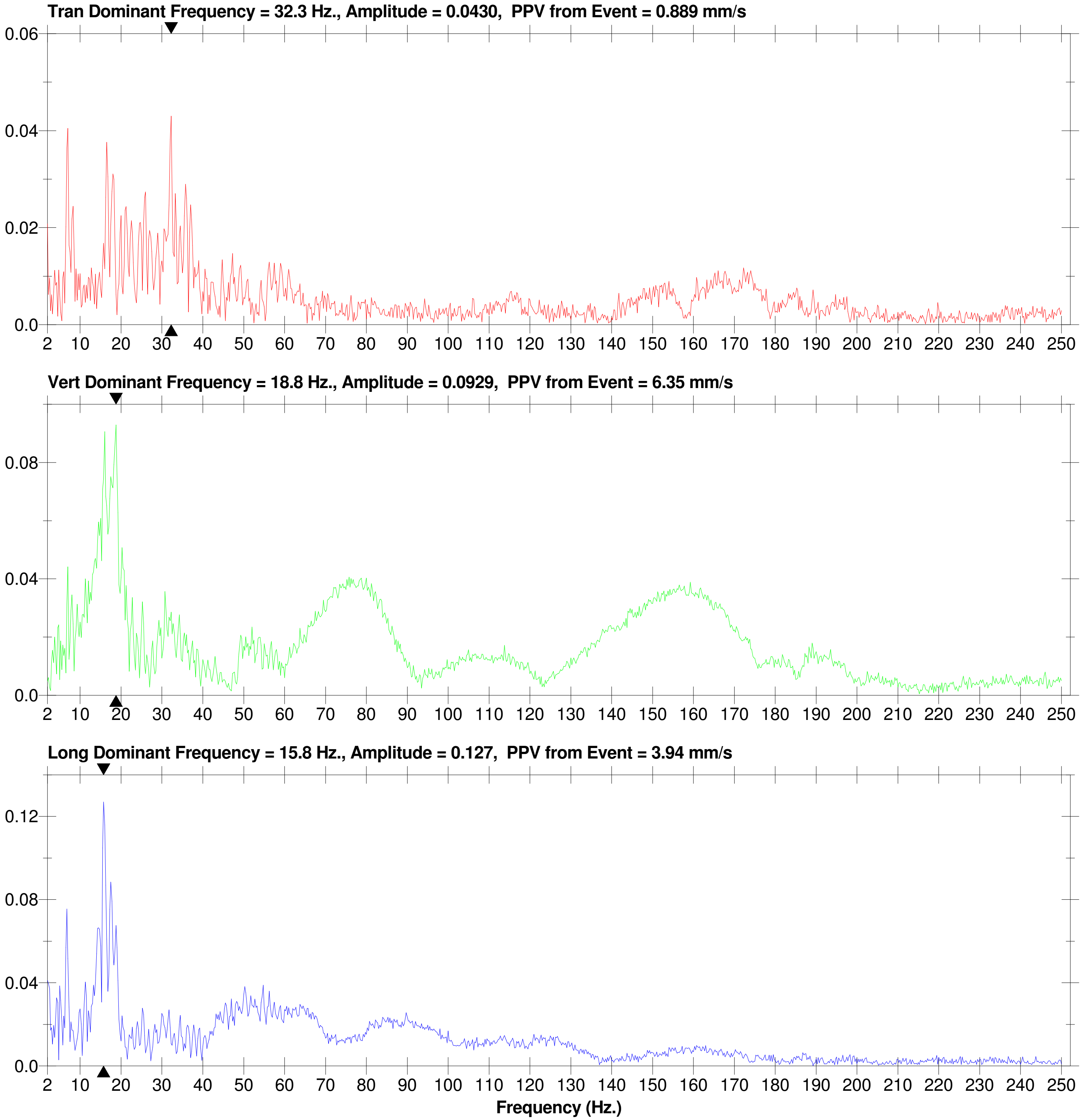
Sensor Check

FFT Report

Date/Time	Vert at 12:58:03 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQK.0R0

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent



Event Report

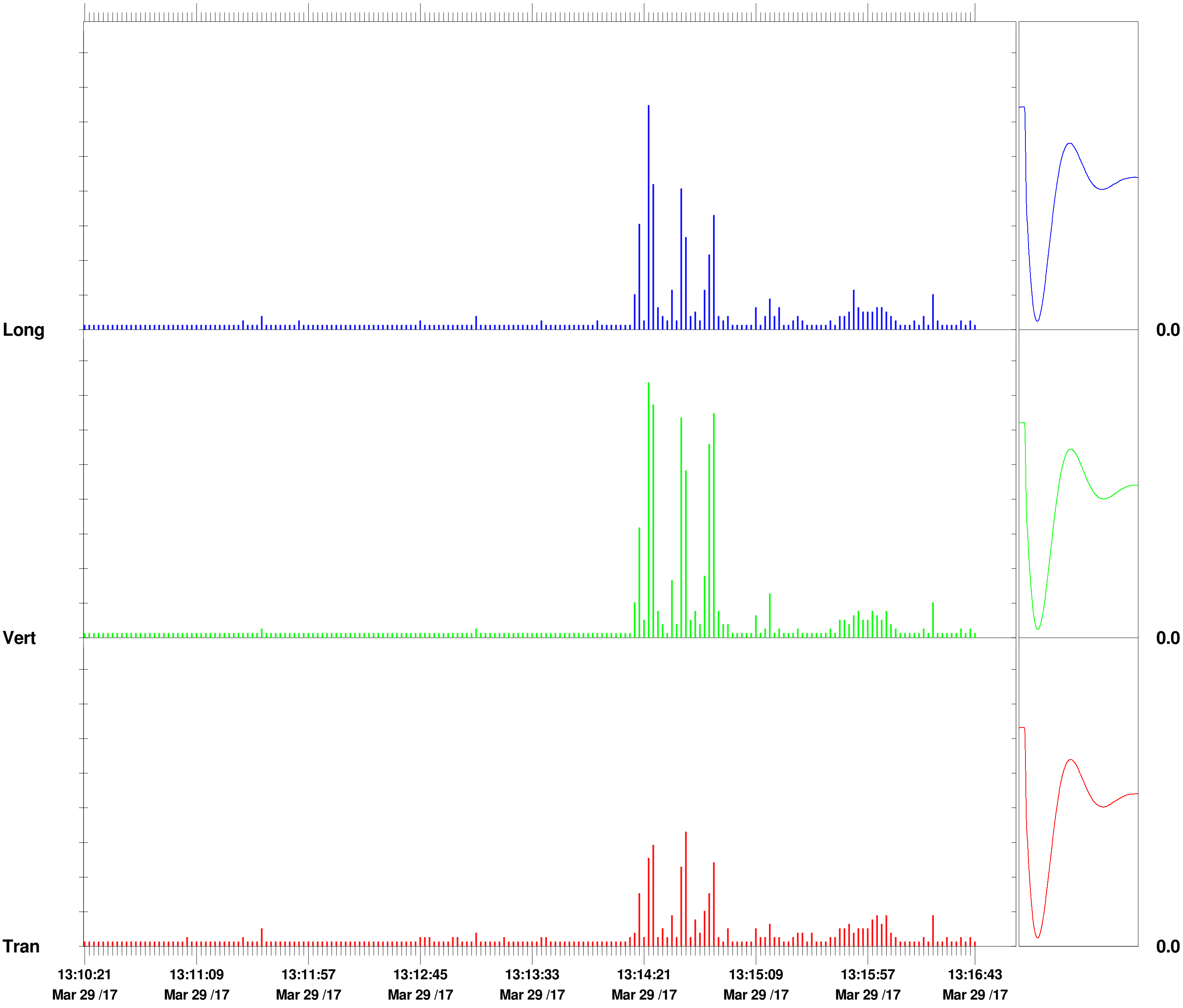
Histogram Start Time	13:10:19 March 29, 2017		**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	13:16:44 March 29, 2017		**Battery Level**	6.4 Volts
Number of Intervals	192.00 at 2 seconds		**Unit Calibration**	February 22, 2017 by Instantel
Range	Geo:254 mm/s		**File Name**	T695GTQK.L70
Sample Rate	1024sps			

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	3.30	7.37	6.48	mm/s
ZC Freq	39	12	20	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	13:14:39	13:14:23	13:14:23	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 7.91 mm/s on March 29, 2017 at 13:14:23



Time Scale: 2 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Instantel

Event Report

Date/Time	Long at 13:14:22 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

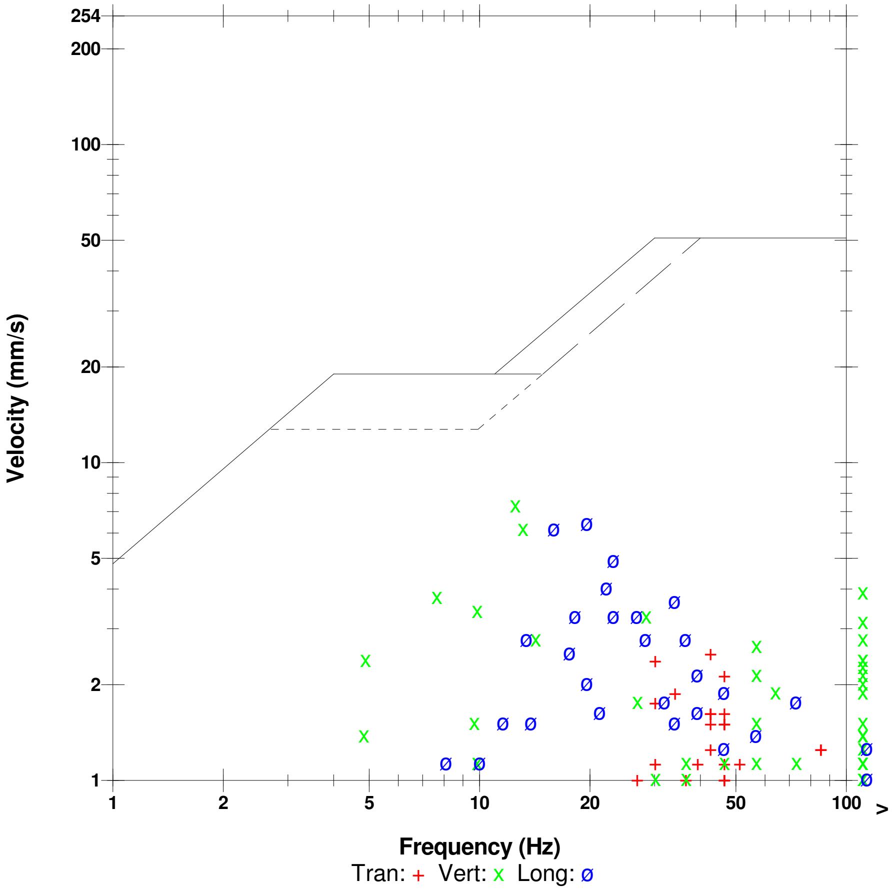
Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQK.RY0

Notes

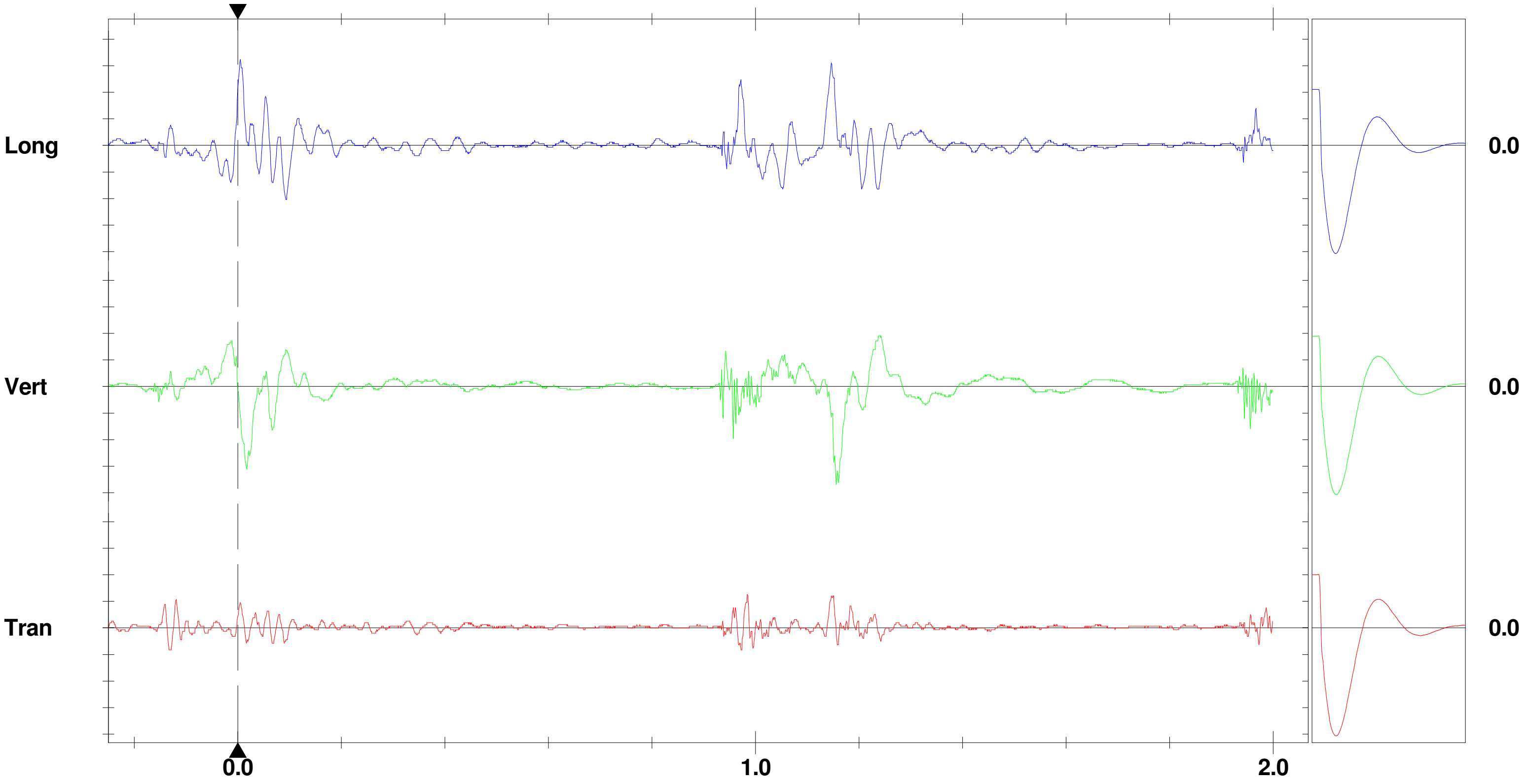
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	2.54	7.37	6.48	mm/s
ZC Freq	43	12	20	Hz
Time (Rel. to Trig)	0.984	1.156	0.005	sec
Peak Acceleration	0.106	0.292	0.133	g
Peak Displacement	0.0131	0.0716	0.0492	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 7.91 mm/s at 1.151 sec



USBM RI8507 And OSMRE



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

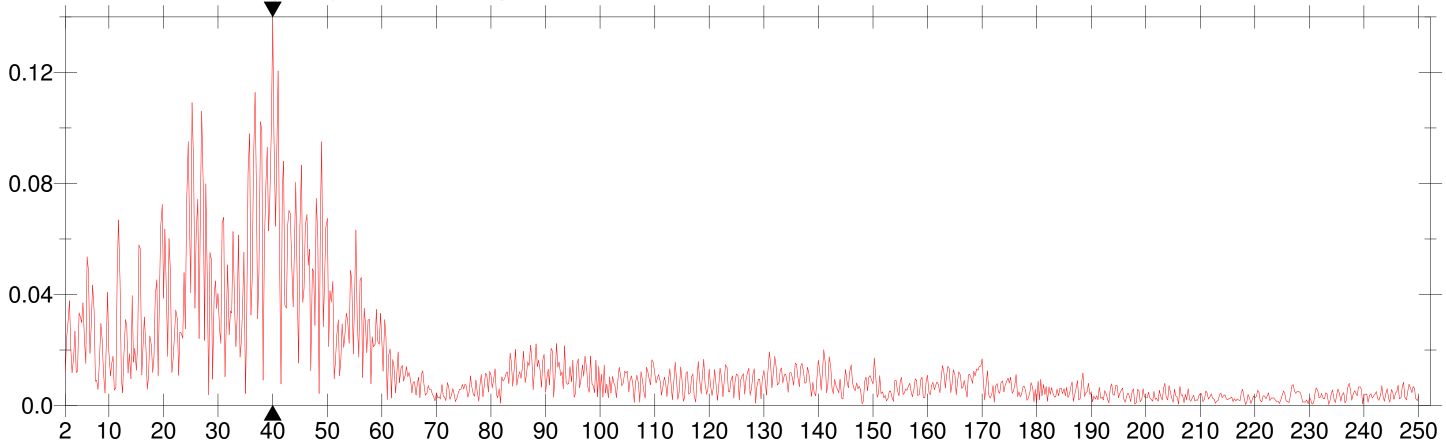
FFT Report

Date/Time	Long at 13:14:22 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQK.RY0

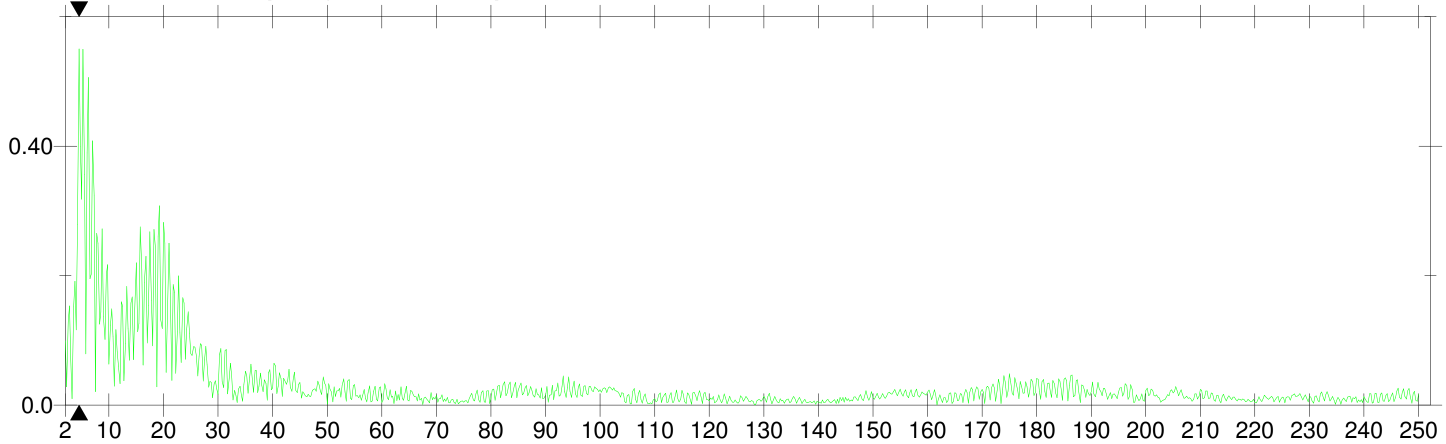
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

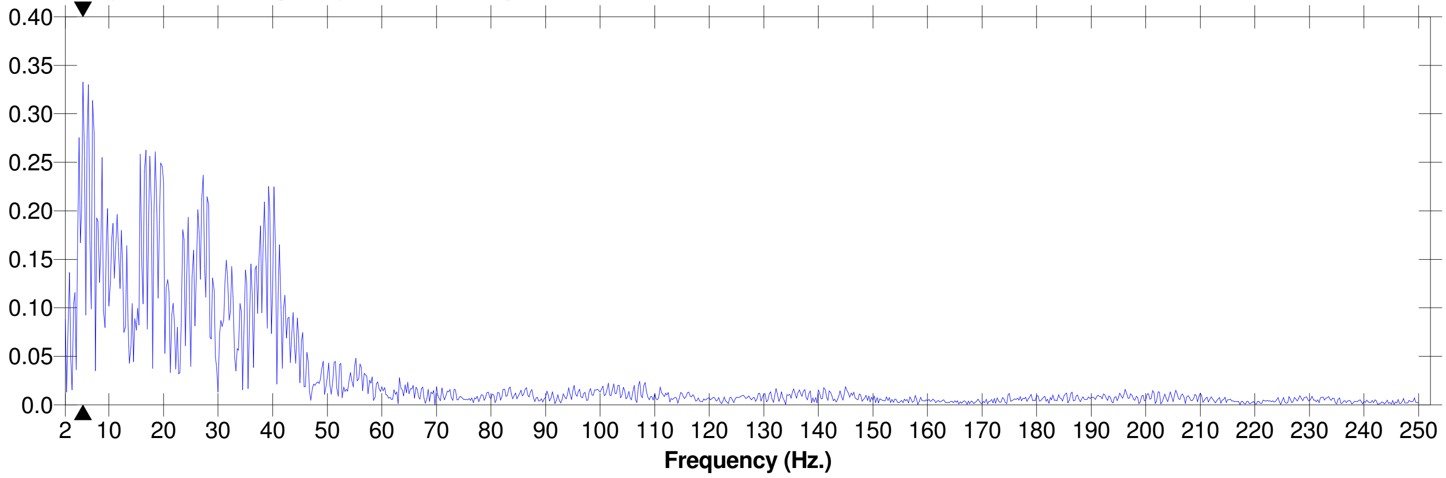
Tran Dominant Frequency = 40.0 Hz., Amplitude = 0.139, PPV from Event = 2.54 mm/s



Vert Dominant Frequency = 4.50 Hz., Amplitude = 0.550, PPV from Event = 7.37 mm/s



Long Dominant Frequency = 5.25 Hz., Amplitude = 0.333, PPV from Event = 6.48 mm/s



Event Report

Date/Time	Long at 13:14:36 March 29, 2017
Trigger Source	Geo: 4.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQK.SC0

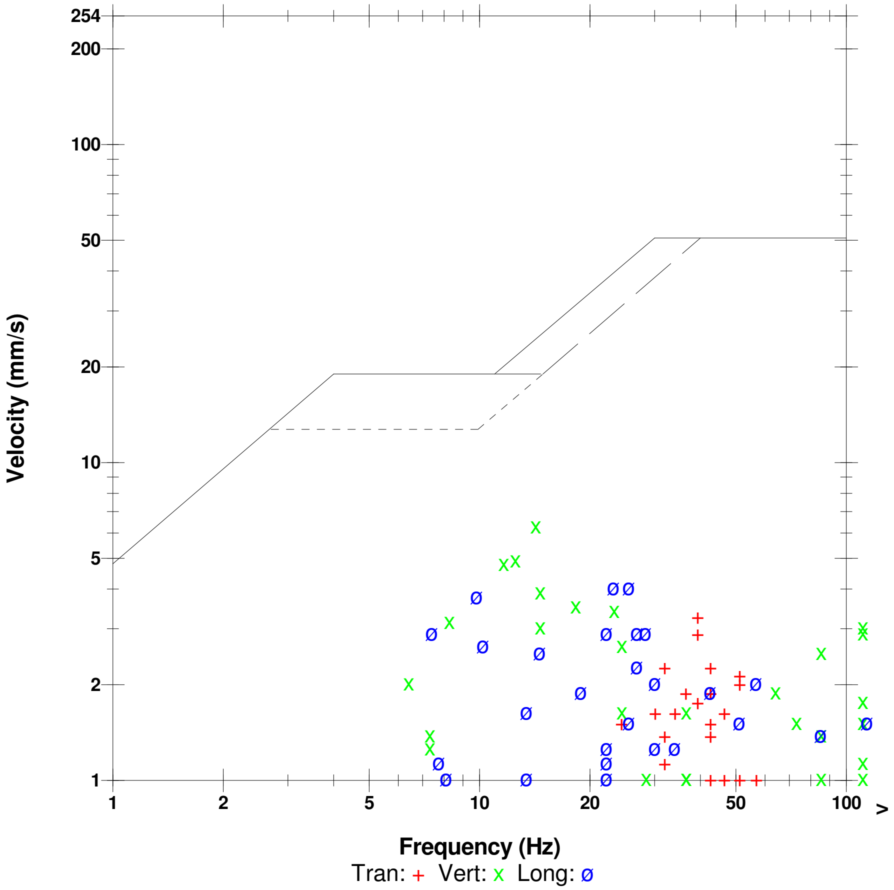
Notes

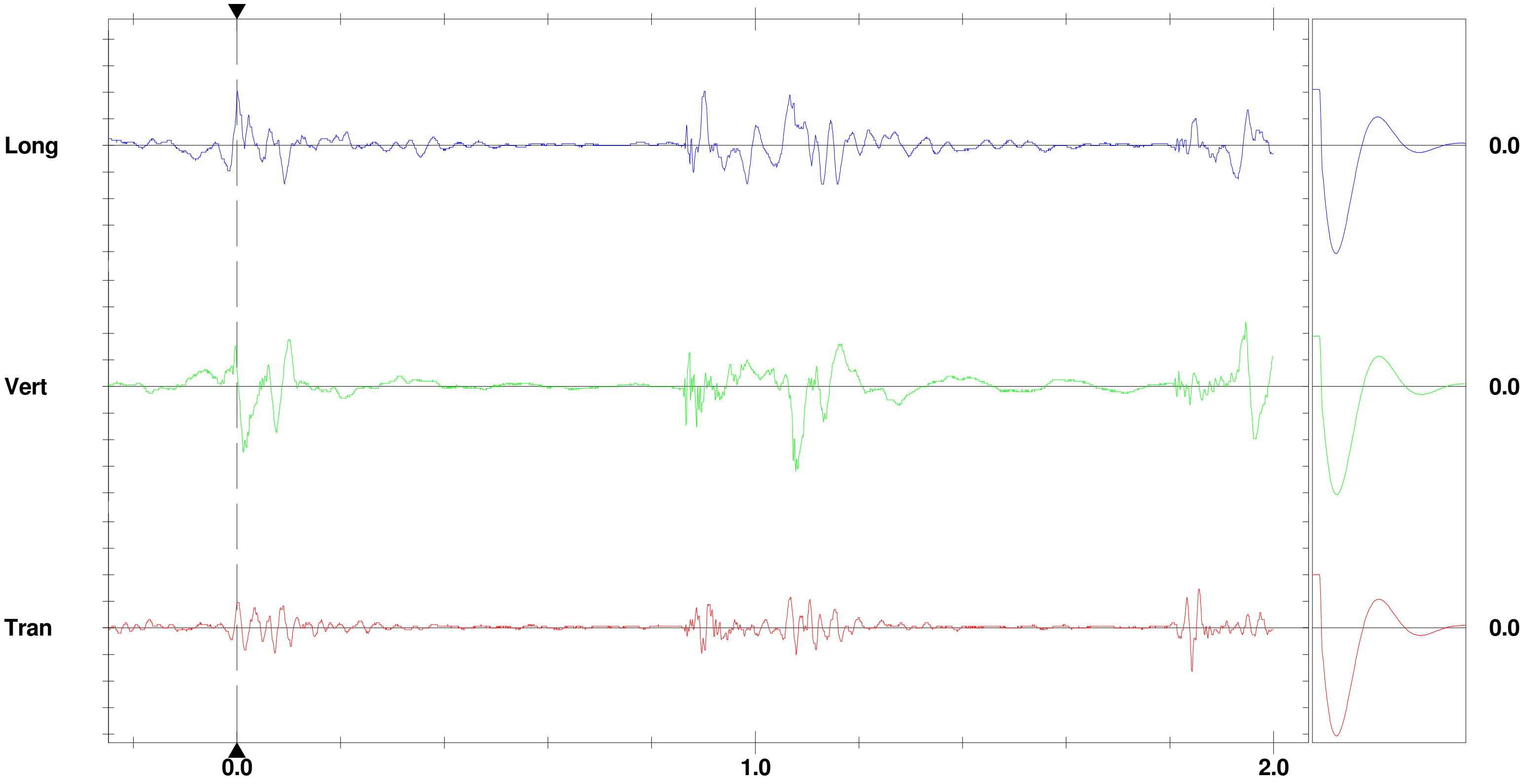
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	3.30	6.35	4.06	mm/s
ZC Freq	39	14	23	Hz
Time (Rel. to Trig)	1.843	1.078	0.001	sec
Peak Acceleration	0.106	0.239	0.106	g
Peak Displacement	0.0111	0.0616	0.0482	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 6.74 mm/s at 1.078 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Printed: April 24, 2017 (V 10.60 - 10.60)

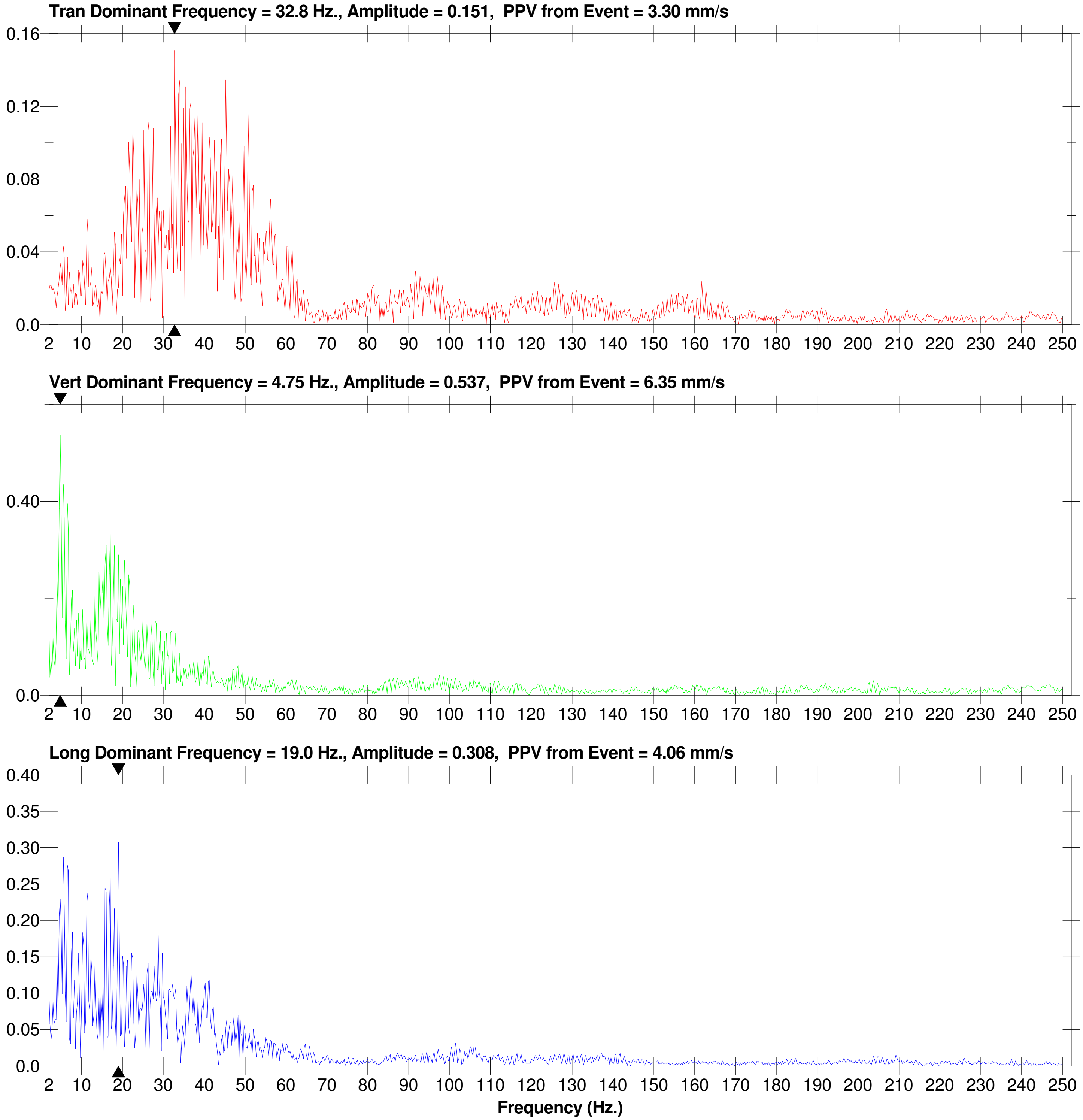
Instantel

FFT Report

Date/Time	Long at 13:14:36 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 4.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQK.SC0

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent



Event Report

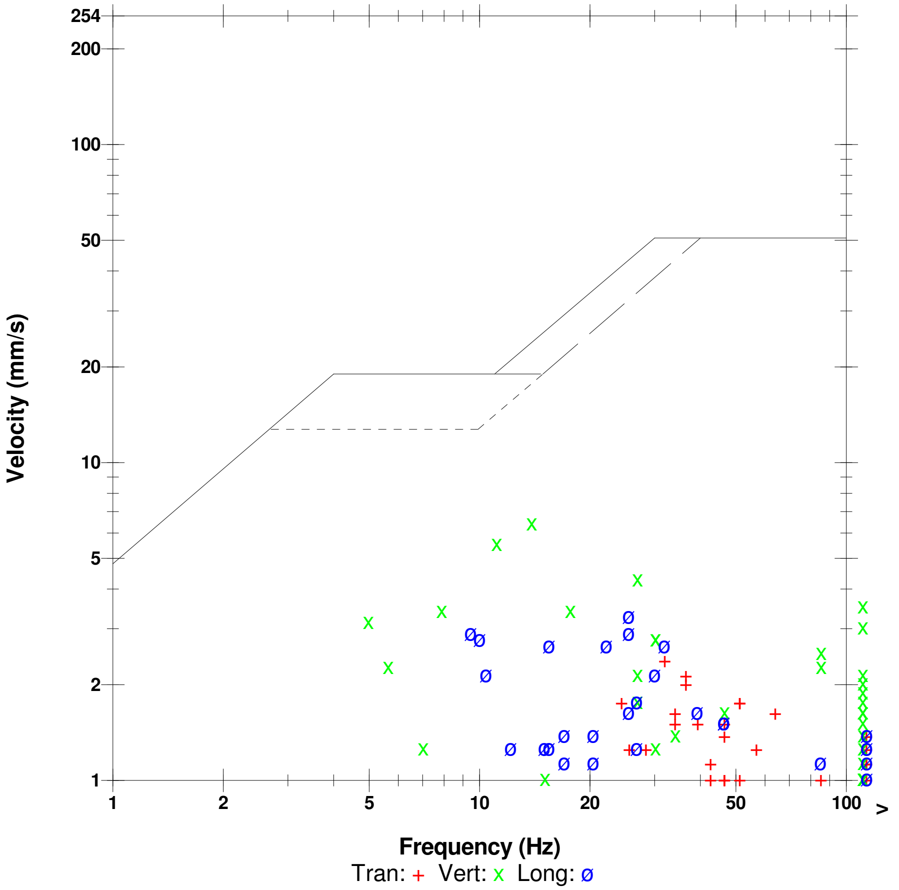
Date/Time Vert at 13:14:48 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

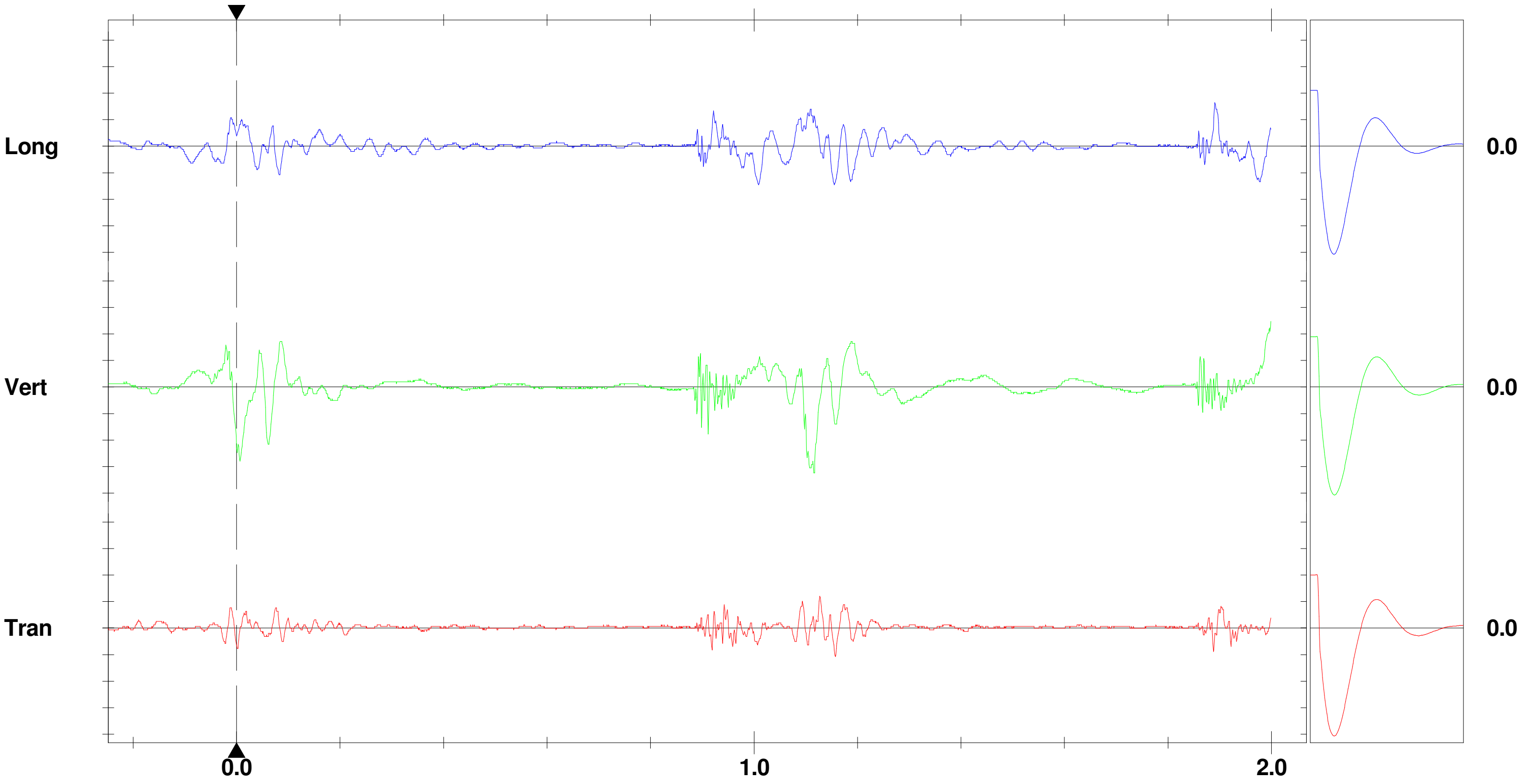
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQK.SO0

	Tran	Vert	Long	
PPV	2.41	6.48	3.30	mm/s
ZC Freq	32	14	26	Hz
Time (Rel. to Trig)	1.127	1.115	1.891	sec
Peak Acceleration	0.146	0.292	0.119	g
Peak Displacement	0.0120	0.0694	0.0419	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 6.87 mm/s at 1.116 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶———— ————◀

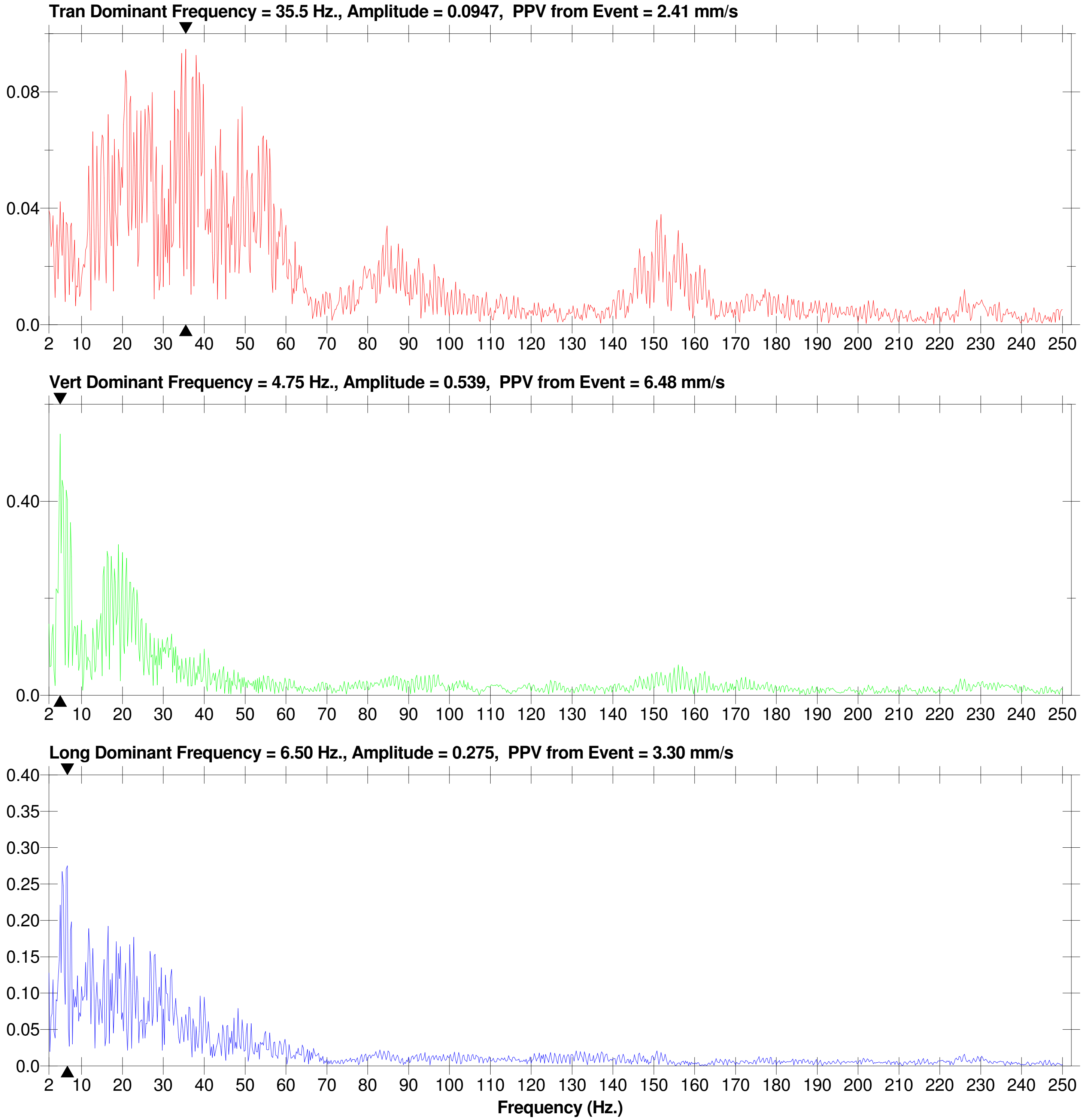
Sensor Check

FFT Report

Date/Time Vert at 13:14:48 March 29, 2017
Trigger Source Geo: 4.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQK.SO0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent



Event Report

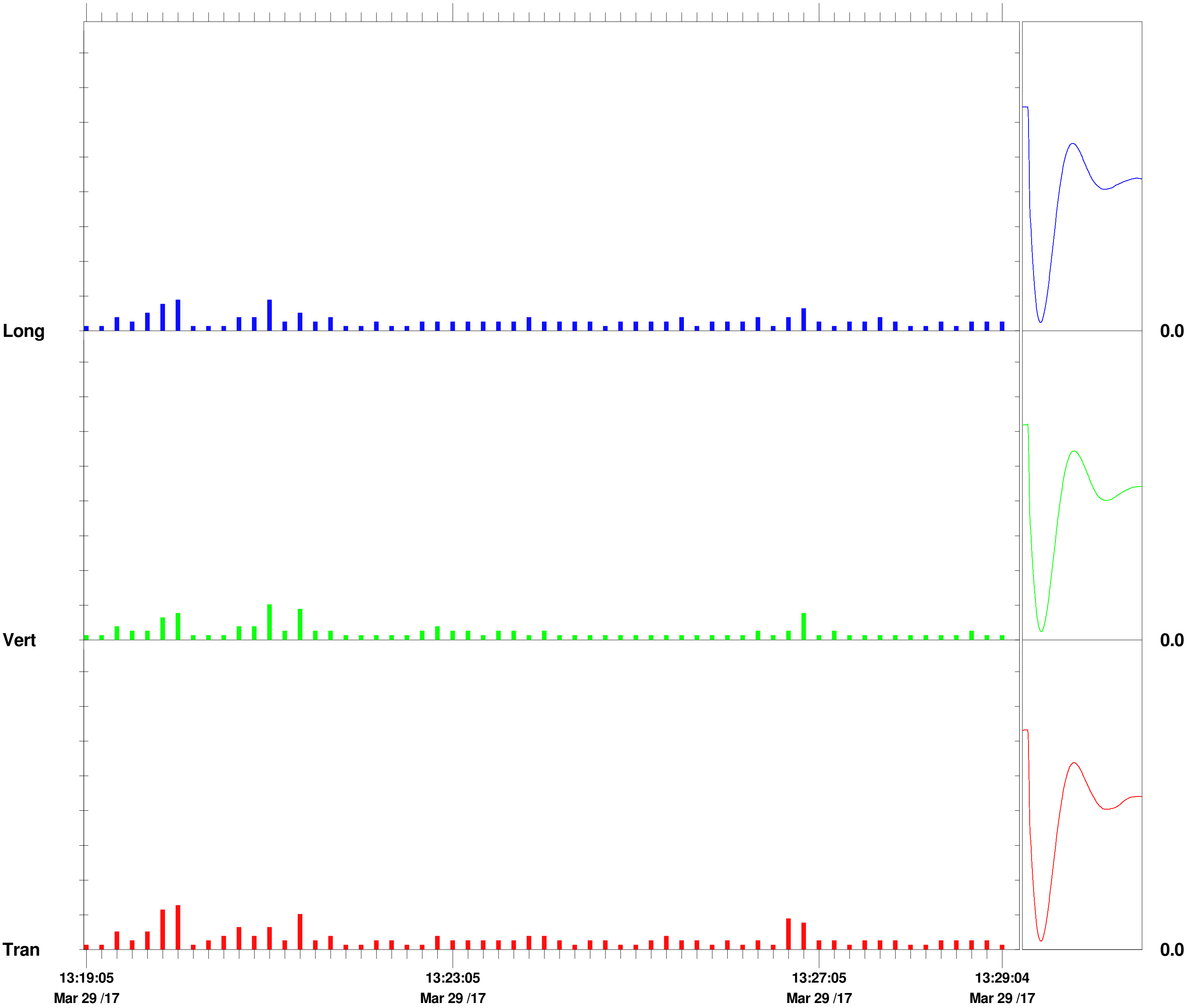
Histogram Start Time	13:18:55 March 29, 2017		**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	13:29:04 March 29, 2017		**Battery Level**	6.3 Volts
Number of Intervals	304.00 at 2 seconds		**Unit Calibration**	February 22, 2017 by Instantel
Range	Geo:254 mm/s		**File Name**	T695GTQK.ZJ0
Sample Rate	1024sps			

Notes

Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

	Tran	Vert	Long	
PPV	1.27	1.02	0.889	mm/s
ZC Freq	22	28	14	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	13:19:59	13:20:57	13:19:59	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.9	3.7	3.8	

Peak Vector Sum 1.35 mm/s on March 29, 2017 at 13:19:59



Time Scale: 10 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Event Report

Histogram Start Time	13:36:15 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	13:37:42 March 29, 2017	**Battery Level**	6.4 Volts
Number of Intervals	43.00 at 2 seconds	**Unit Calibration**	February 22, 2017 by Instantel
Range	Geo:254 mm/s	**File Name**	T695GTQL.SF0
Sample Rate	1024sps		

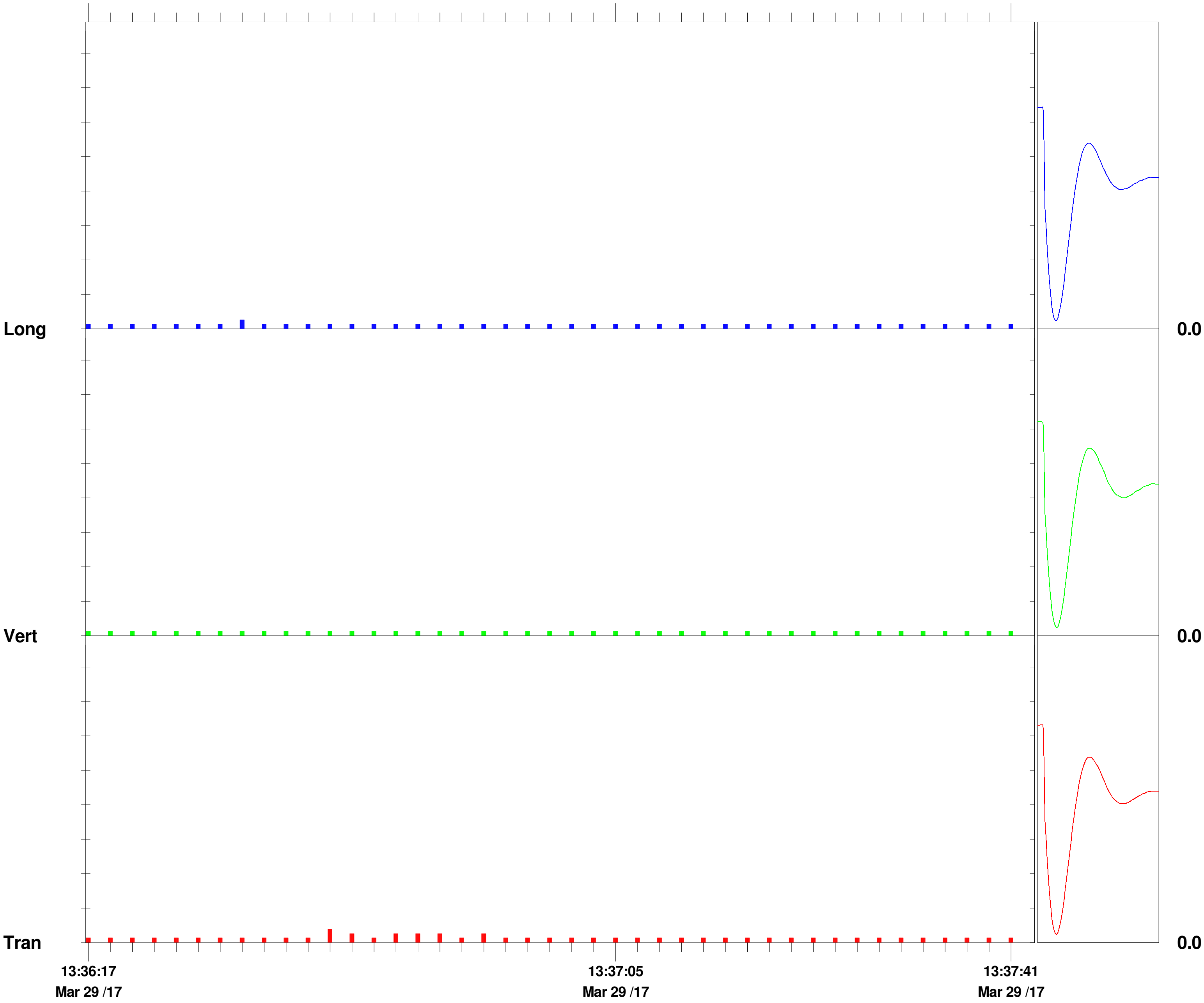
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	0.381	0.127	0.254	mm/s
ZC Freq	47	N/A	>100	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	13:36:39	13:36:17	13:36:31	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 0.402 mm/s on March 29, 2017 at 13:36:39

N/A: Not Applicable



Time Scale: 2 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Instantel

Event Report

Histogram Start Time	13:39:47 March 29, 2017
Histogram Finish Time	16:15:52 March 29, 2017
Number of Intervals	4682.00 at 2 seconds
Range	Geo:254 mm/s
Sample Rate	1024sps

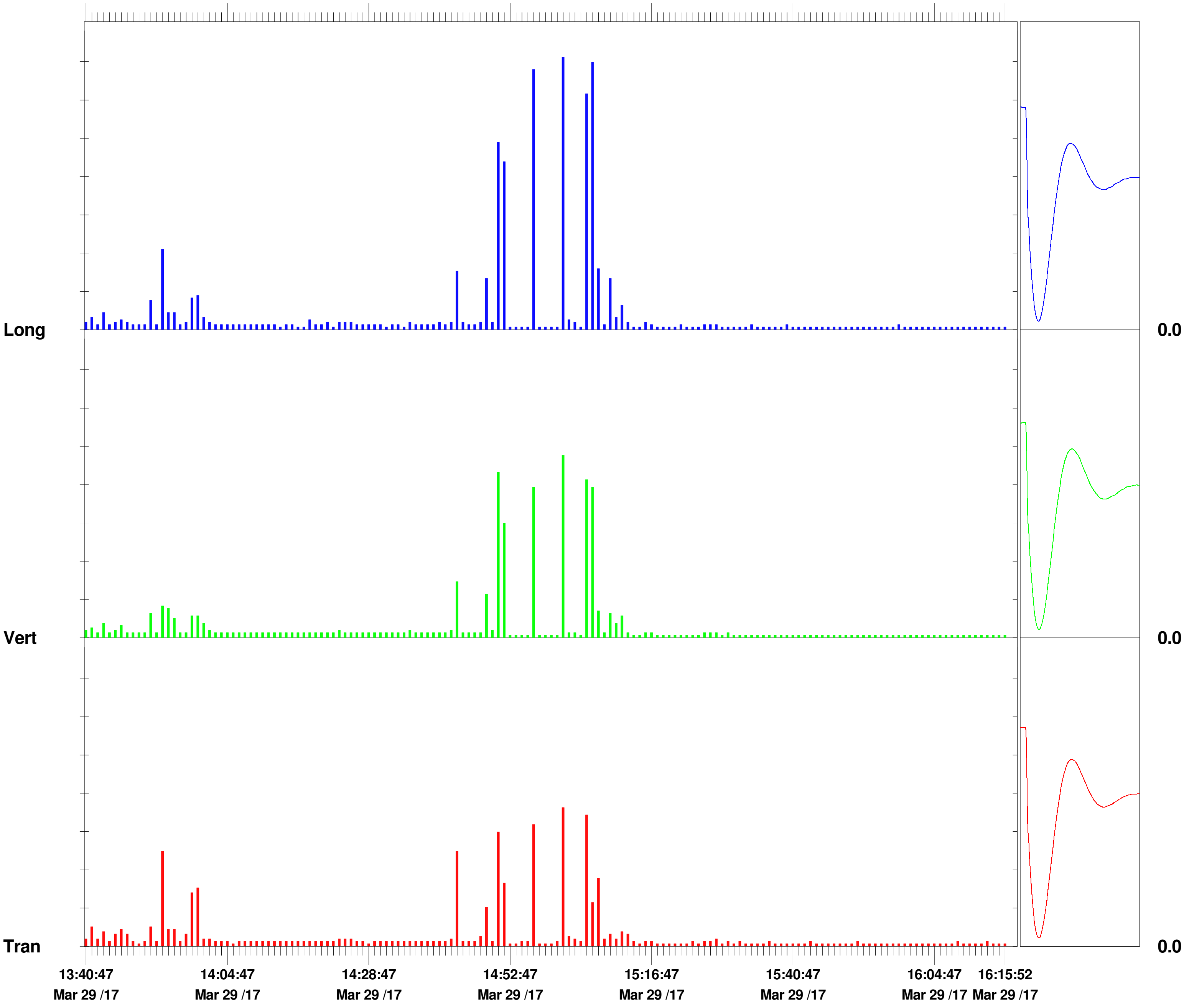
Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQL.YB0

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	7.24	9.52	14.2	mm/s
ZC Freq	39	>100	28	Hz
Date	Mar 29 /17	Mar 29 /17	Mar 29 /17	
Time	15:01:03	15:01:13	15:01:13	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 14.5 mm/s on March 29, 2017 at 15:01:13



Time Scale: 1 minute /div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Event Report

Date/Time	Tran at 13:41:01 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Notes

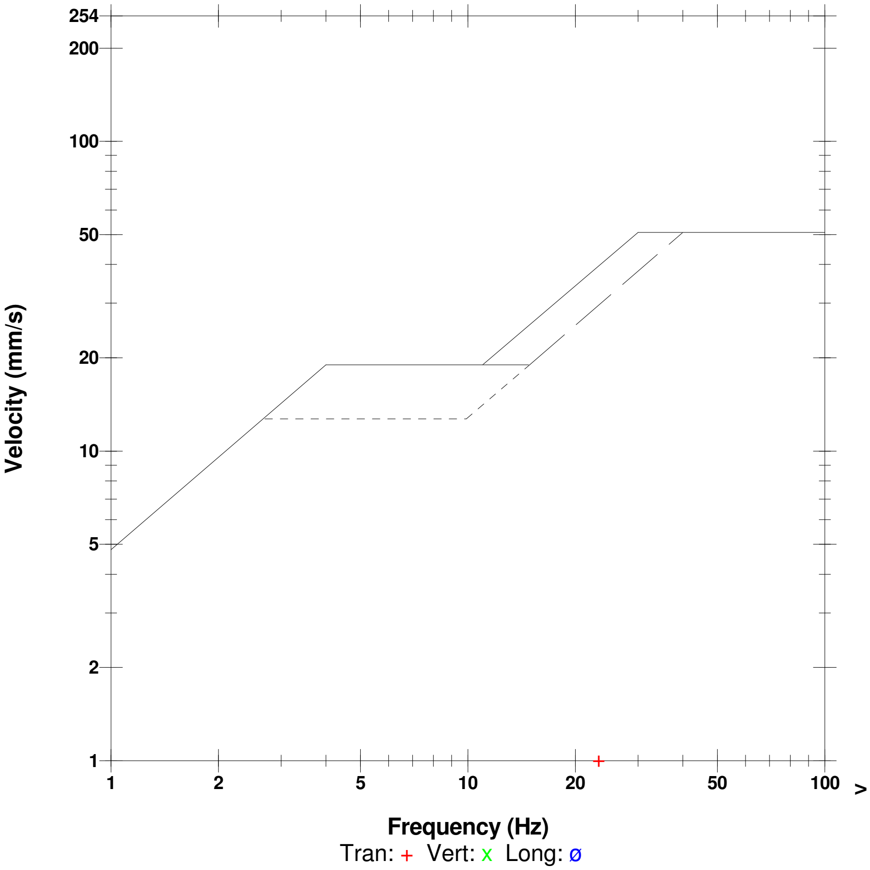
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

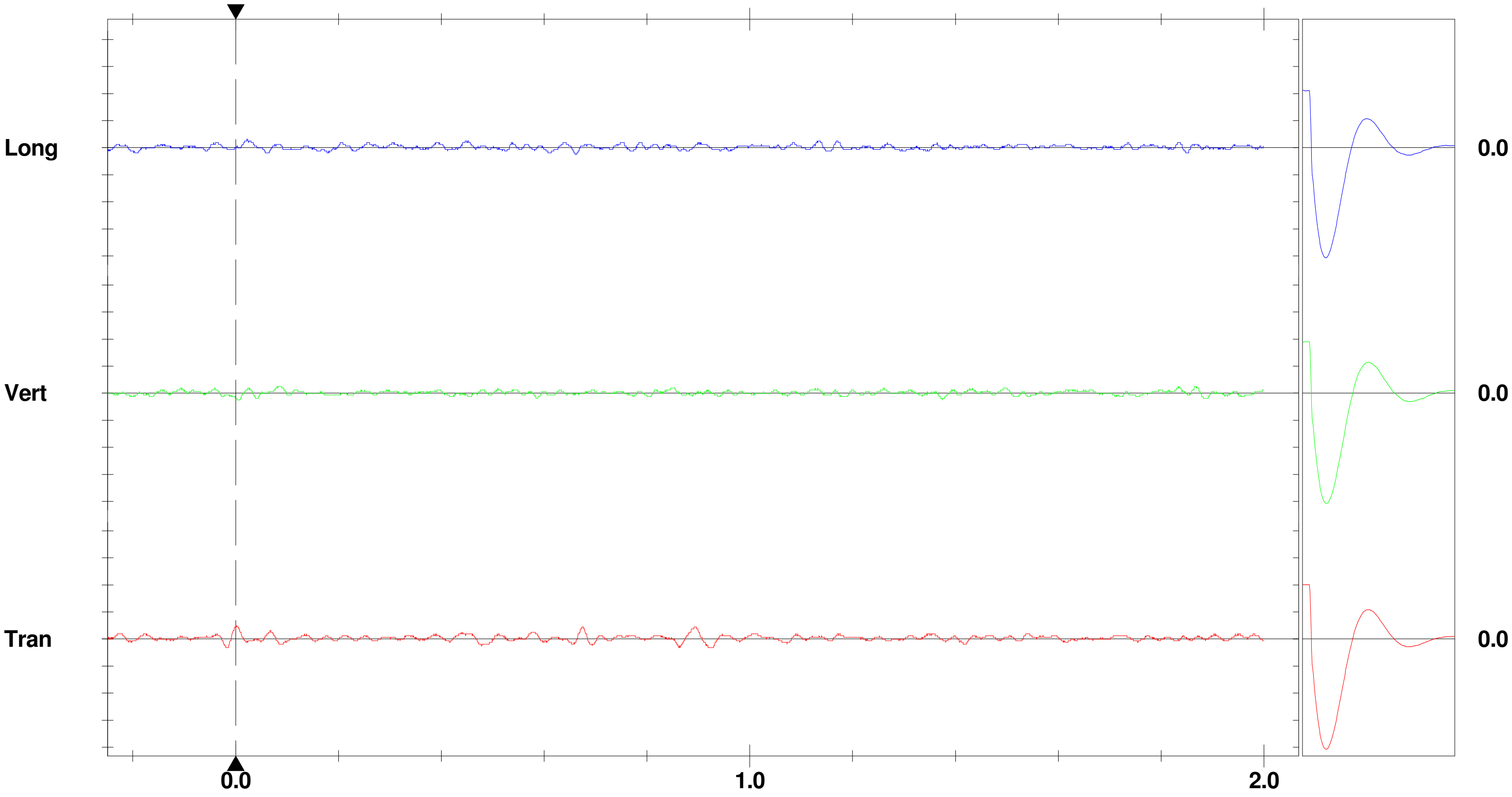
Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQM.0D0

	Tran	Vert	Long	
PPV	1.02	0.508	0.635	mm/s
ZC Freq	23	26	20	Hz
Time (Rel. to Trig)	0.000	0.003	0.021	sec
Peak Acceleration	0.0265	0.0265	0.0265	g
Peak Displacement	0.00831	0.00434	0.00502	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 1.09 mm/s at 0.002 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

FFT Report

Date/Time	Tran at 13:41:01 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQM.0D0

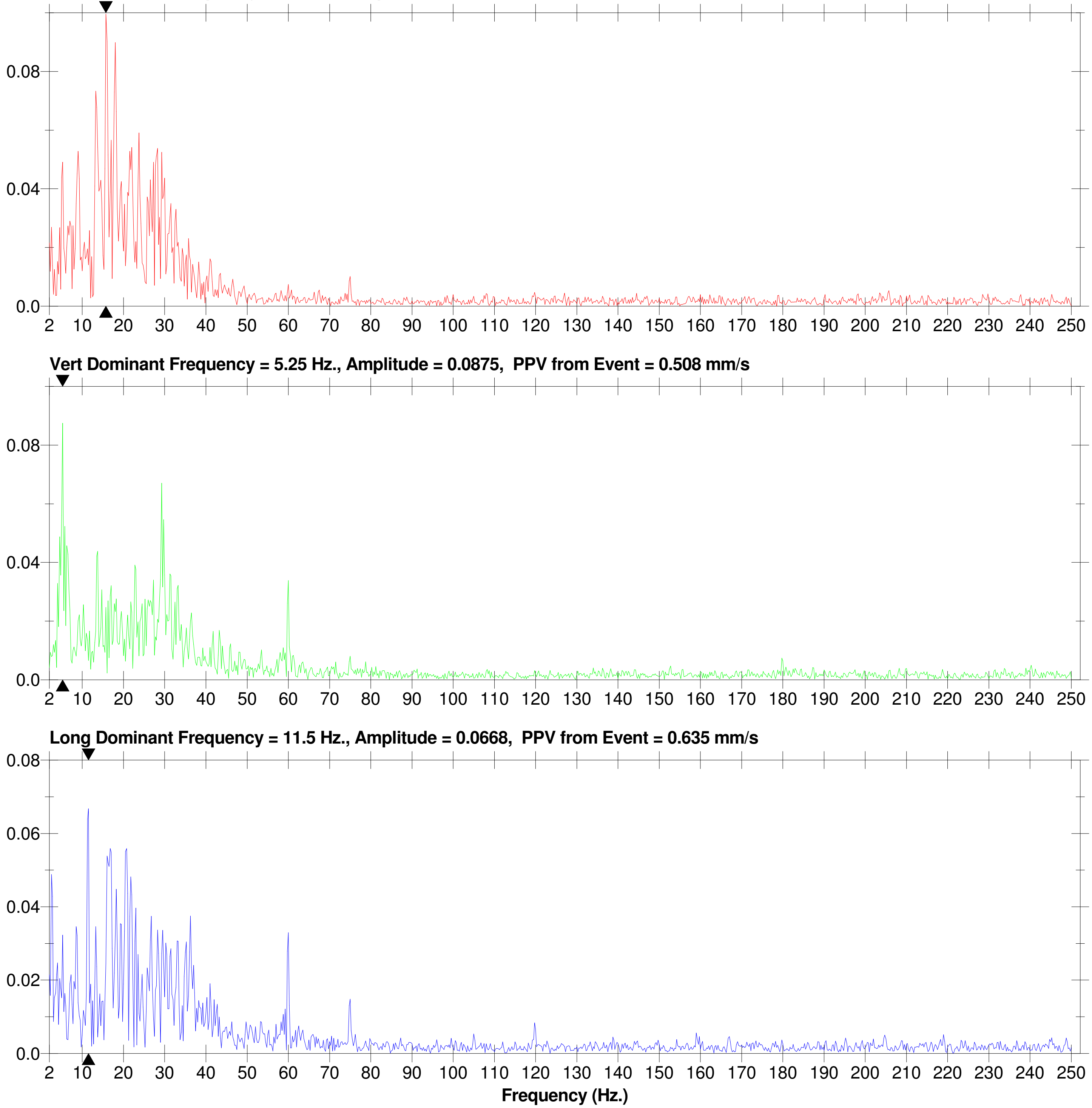
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

Tran Dominant Frequency = 15.8 Hz., Amplitude = 0.0996, PPV from Event = 1.02 mm/s

Vert Dominant Frequency = 5.25 Hz., Amplitude = 0.0875, PPV from Event = 0.508 mm/s

Long Dominant Frequency = 11.5 Hz., Amplitude = 0.0668, PPV from Event = 0.635 mm/s



Printed: April 24, 2017 (V 10.60 - 10.60)

Instantel

Event Report

Date/Time Long at 13:51:12 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

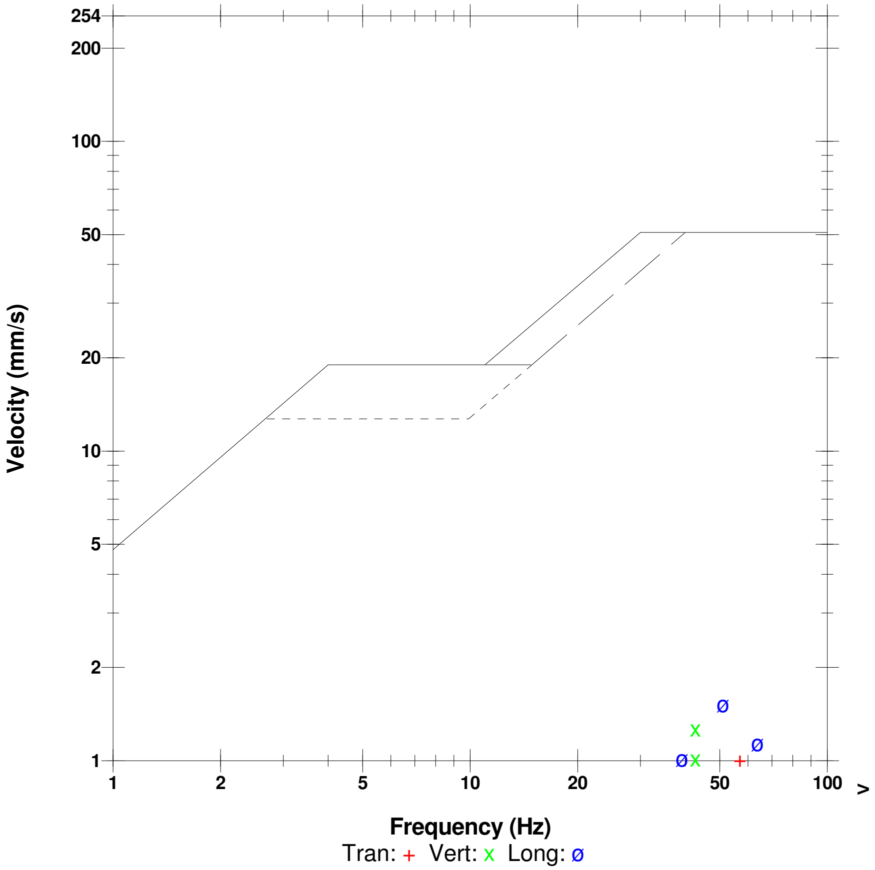
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQM.HC0

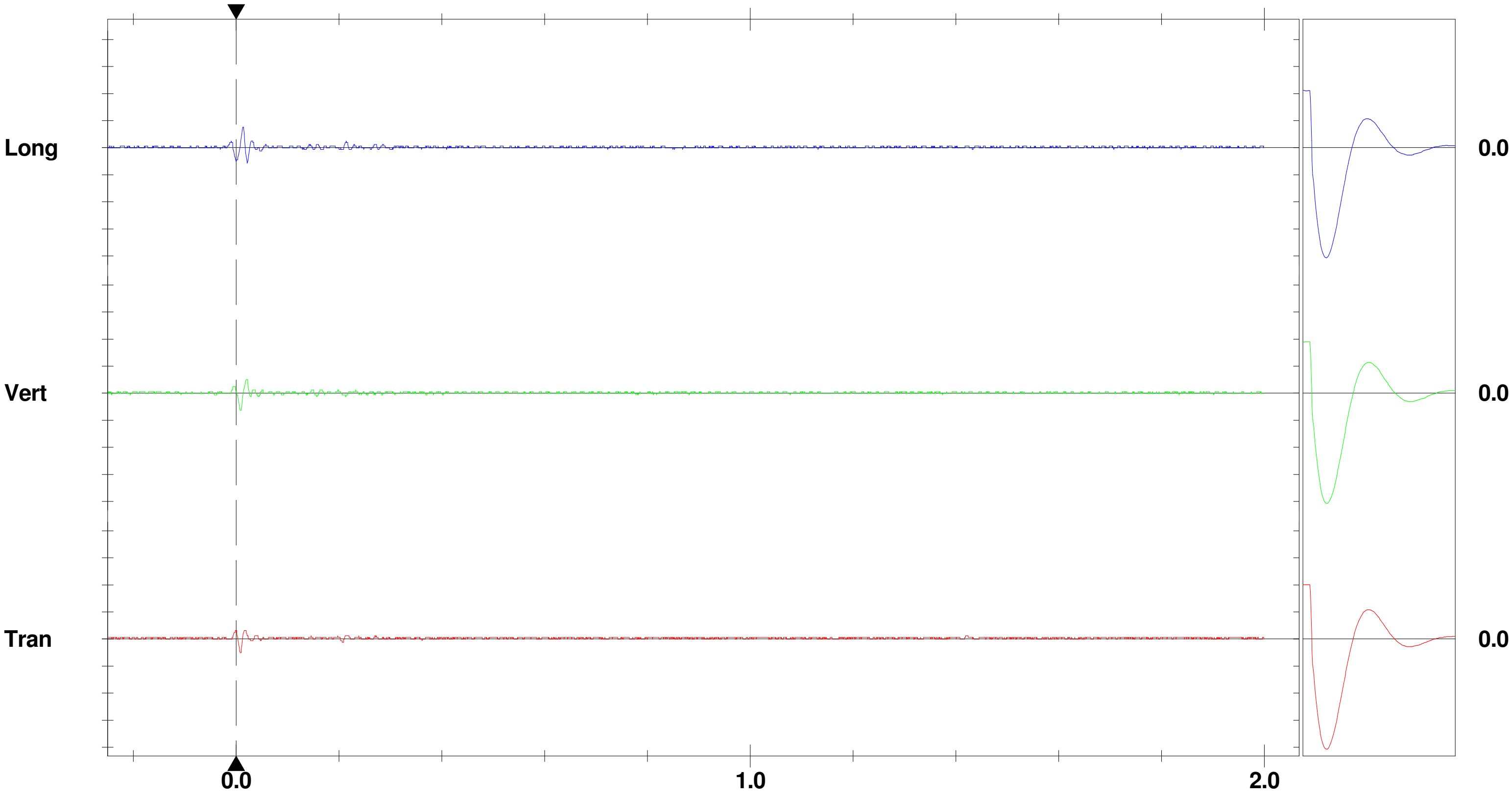
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

	Tran	Vert	Long	
PPV	1.02	1.27	1.52	mm/s
ZC Freq	57	43	51	Hz
Time (Rel. to Trig)	0.008	0.008	0.013	sec
Peak Acceleration	0.0398	0.0398	0.0530	g
Peak Displacement	0.00267	0.00434	0.00459	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 1.67 mm/s at 0.009 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

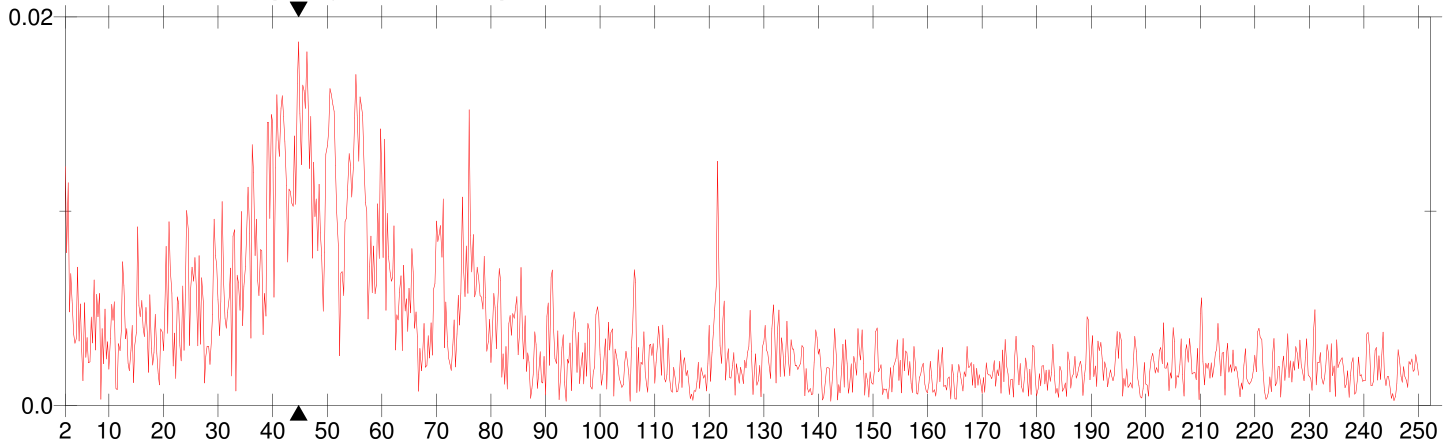
FFT Report

Date/Time	Long at 13:51:12 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQM.HC0

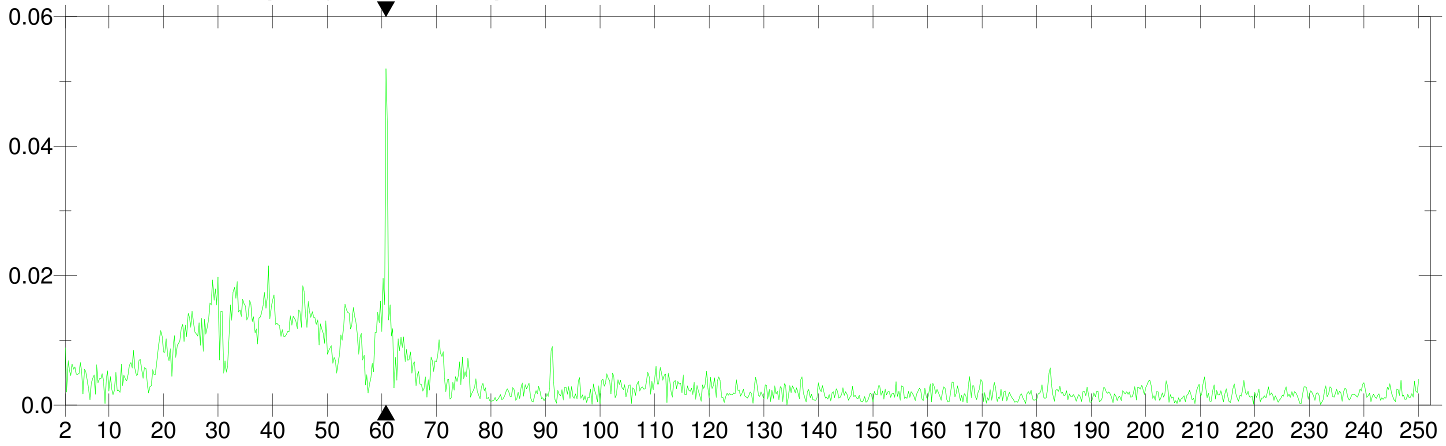
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

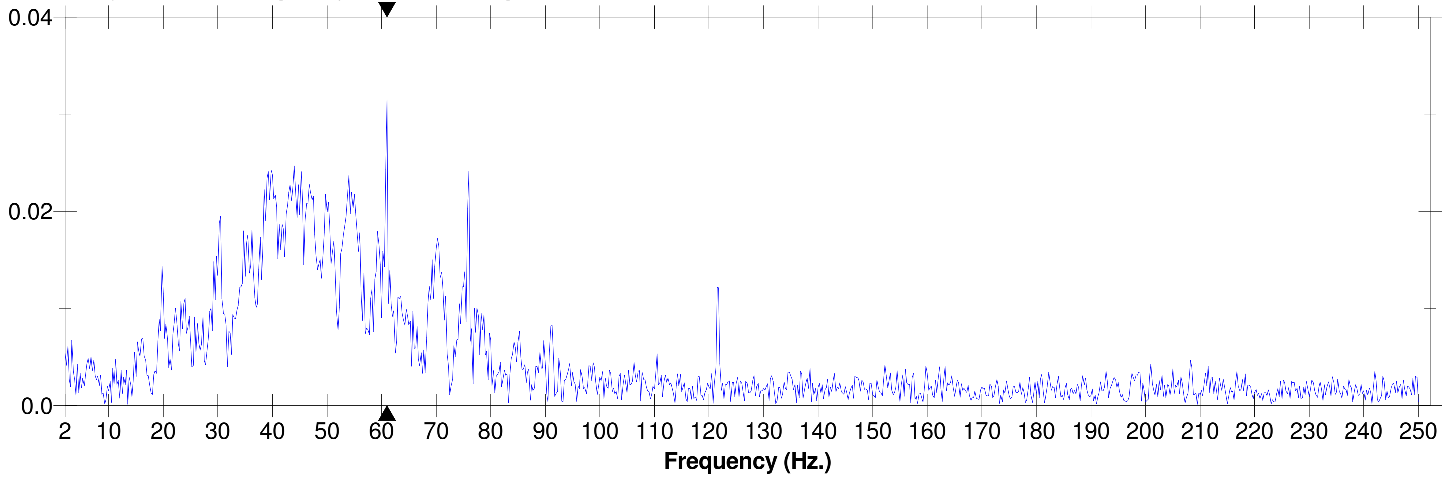
Tran Dominant Frequency = 44.8 Hz., Amplitude = 0.0187, PPV from Event = 1.02 mm/s



Vert Dominant Frequency = 60.8 Hz., Amplitude = 0.0519, PPV from Event = 1.27 mm/s



Long Dominant Frequency = 61.0 Hz., Amplitude = 0.0315, PPV from Event = 1.52 mm/s



Event Report

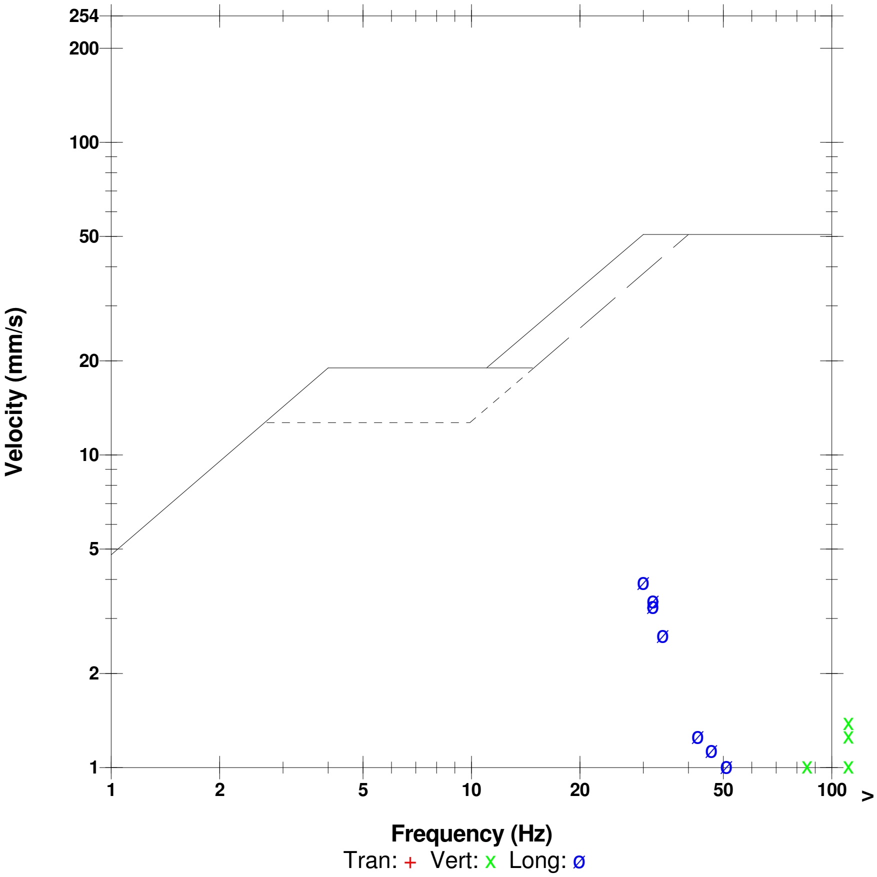
Date/Time Vert at 13:53:03 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

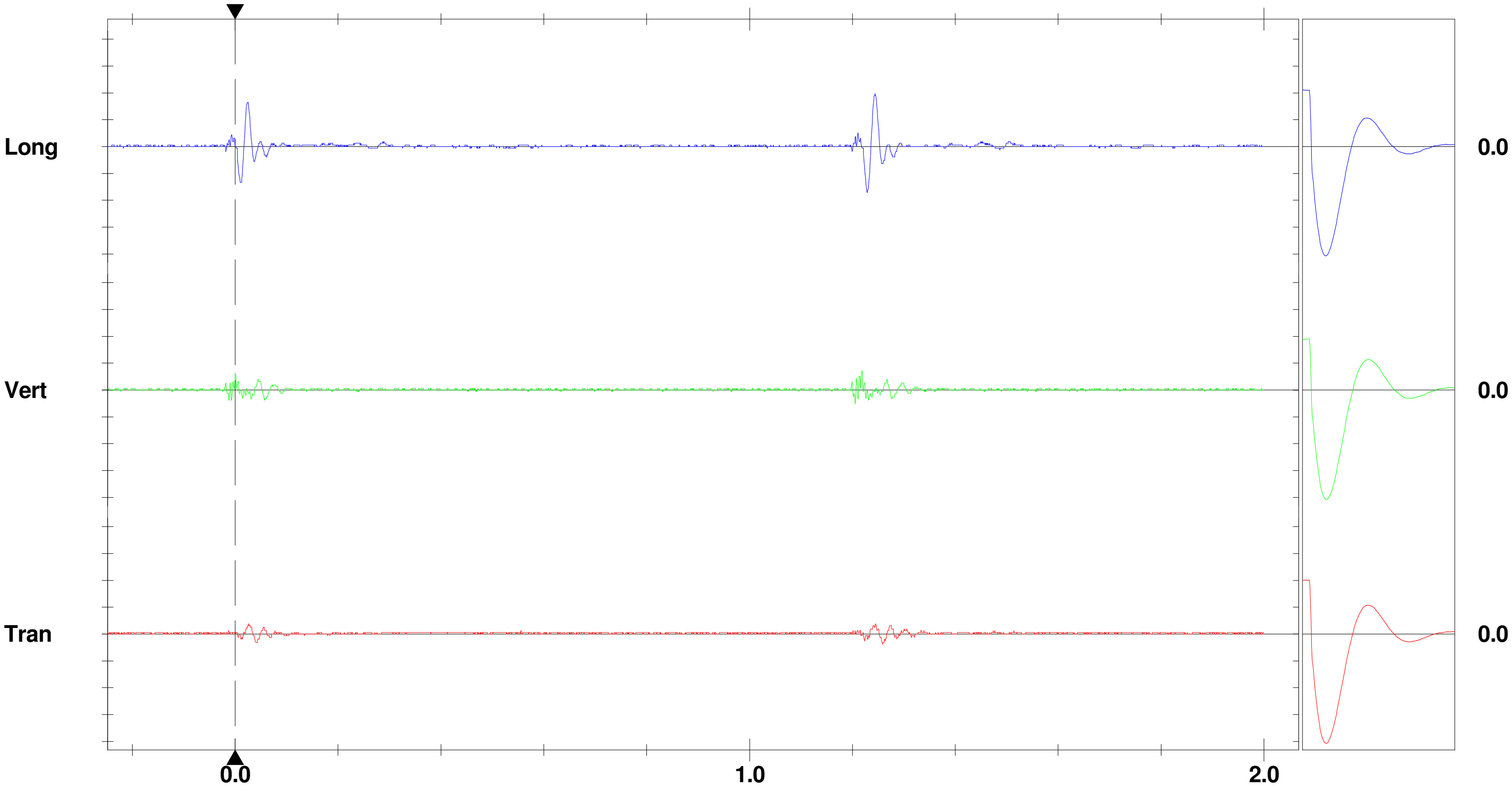
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQM.KF0

	Tran	Vert	Long	
PPV	0.762	1.40	3.94	mm/s
ZC Freq	37	>100	30	Hz
Time (Rel. to Trig)	0.026	1.218	1.244	sec
Peak Acceleration	0.0398	0.119	0.0795	g
Peak Displacement	0.00391	0.00322	0.0206	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 3.99 mm/s at 1.244 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

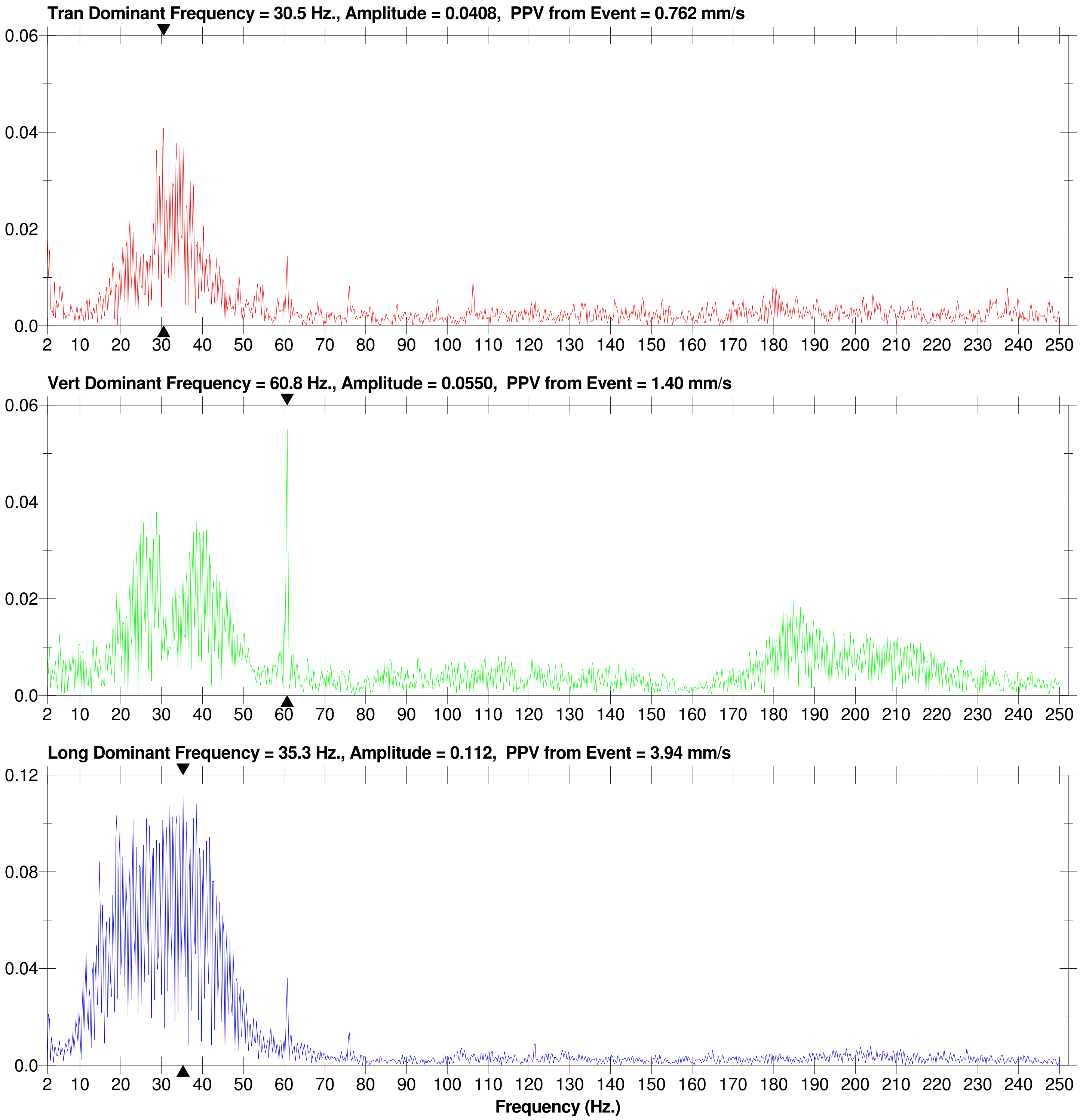
Printed: April 24, 2017 (V 10.60 - 10.60)

FFT Report

Date/Time	Vert at 13:53:03 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQM.KF0

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent



Printed: April 24, 2017 (V 10.60 - 10.60)

Event Report

Date/Time	Vert at 13:53:06 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQM.KI0

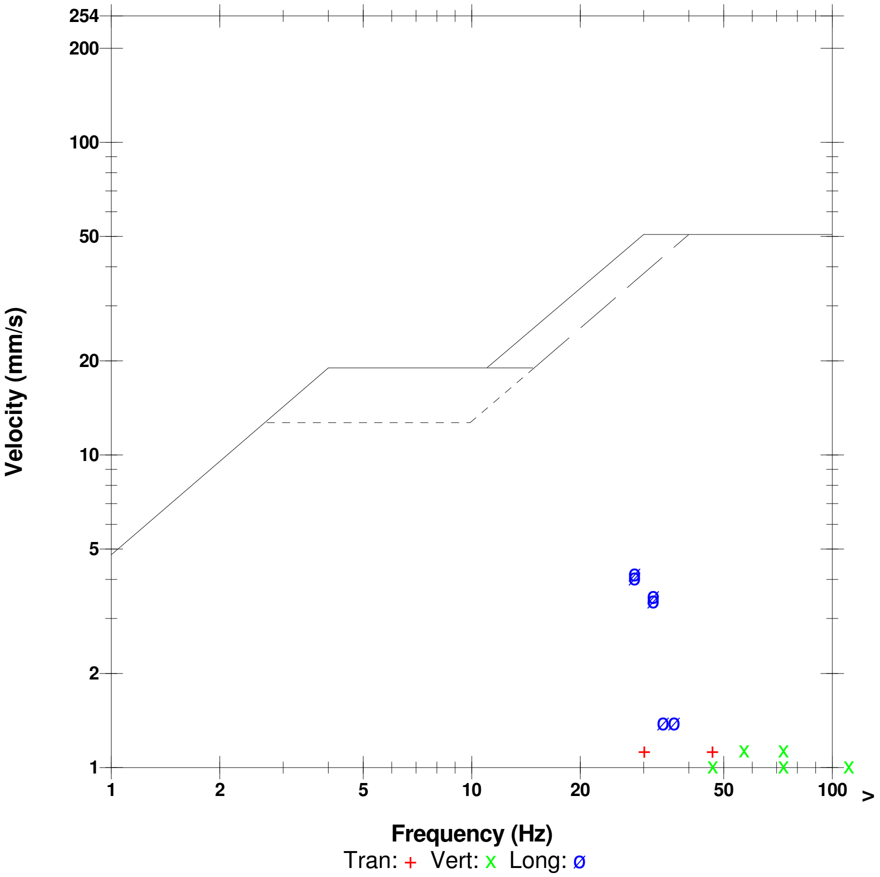
Notes

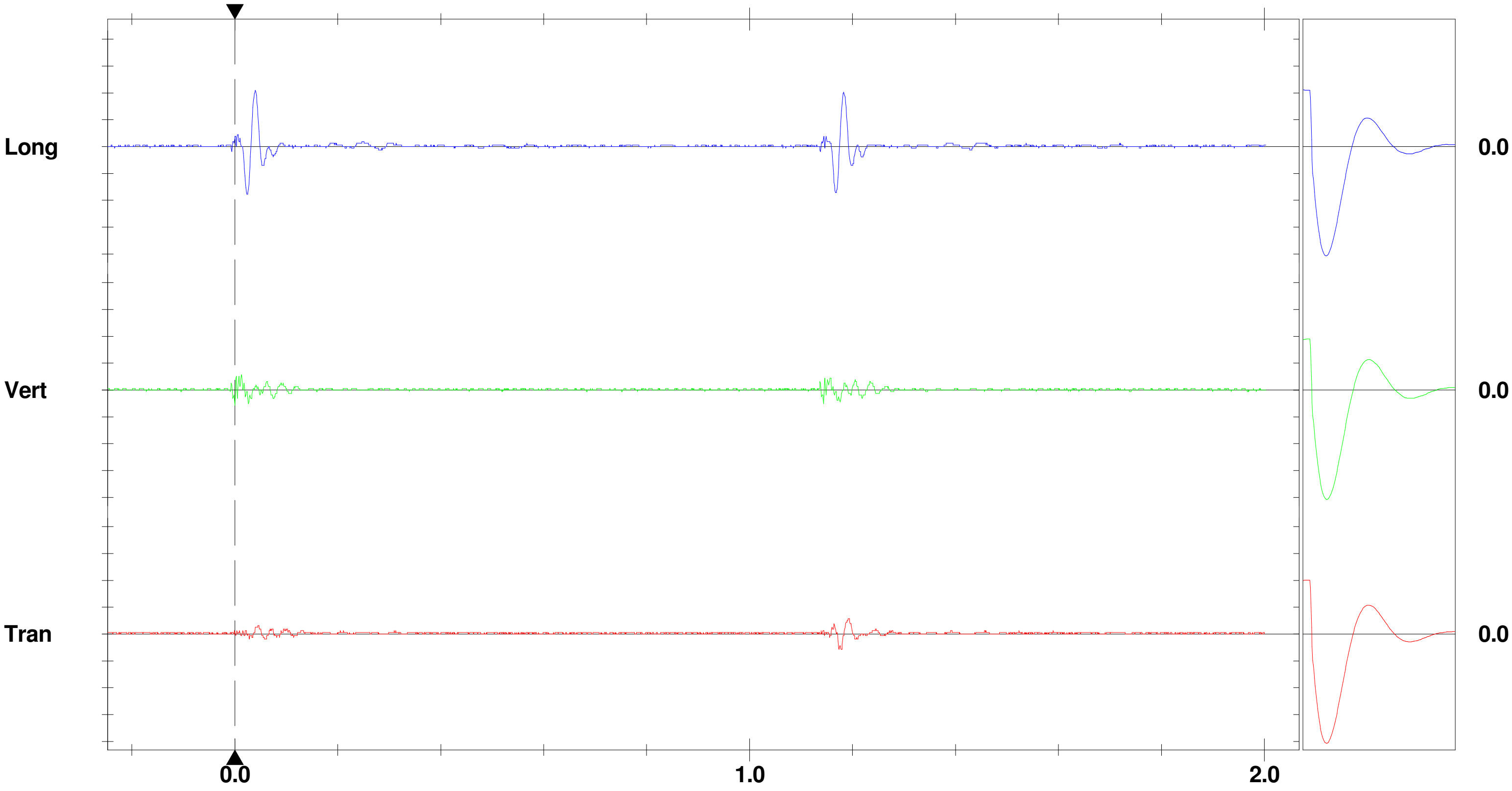
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.14	1.14	4.19	mm/s
ZC Freq	47	73	28	Hz
Time (Rel. to Trig)	1.174	0.000	0.040	sec
Peak Acceleration	0.0530	0.146	0.0928	g
Peak Displacement	0.00620	0.00341	0.0228	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 4.23 mm/s at 0.040 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶—— ——◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

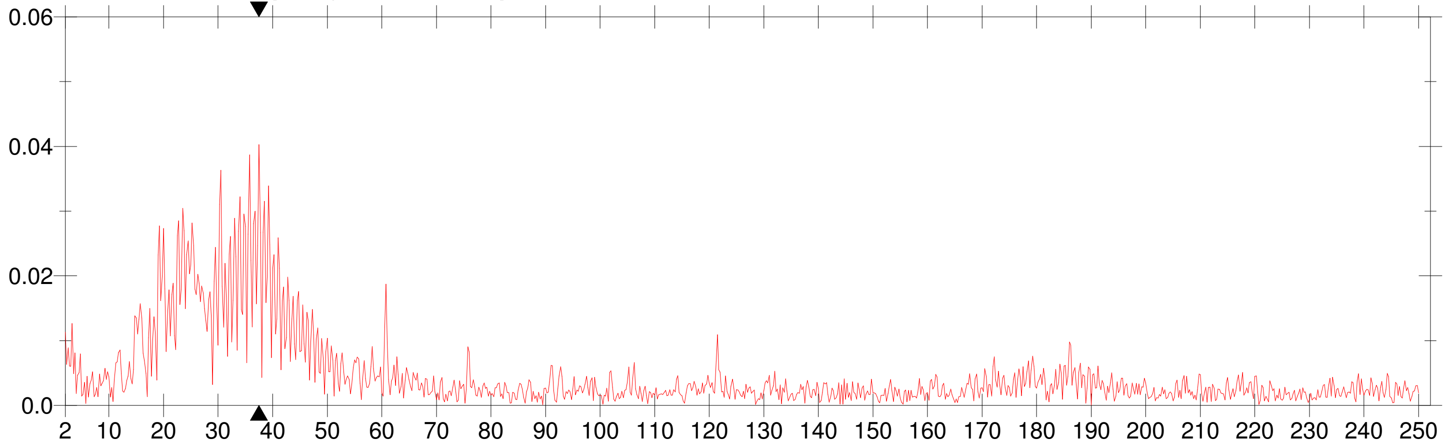
FFT Report

Date/Time Vert at 13:53:06 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

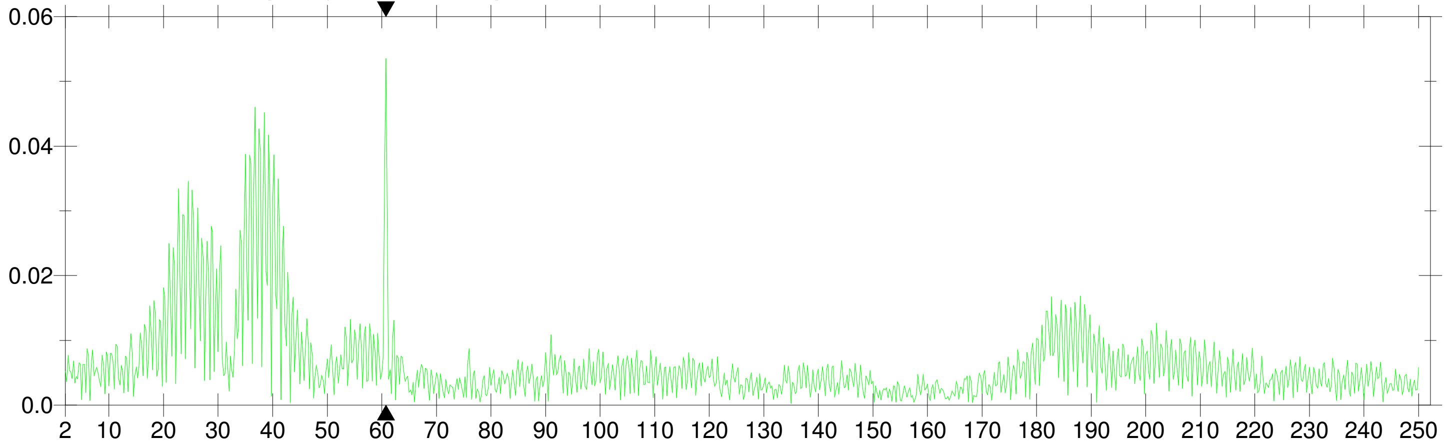
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQM.KI0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

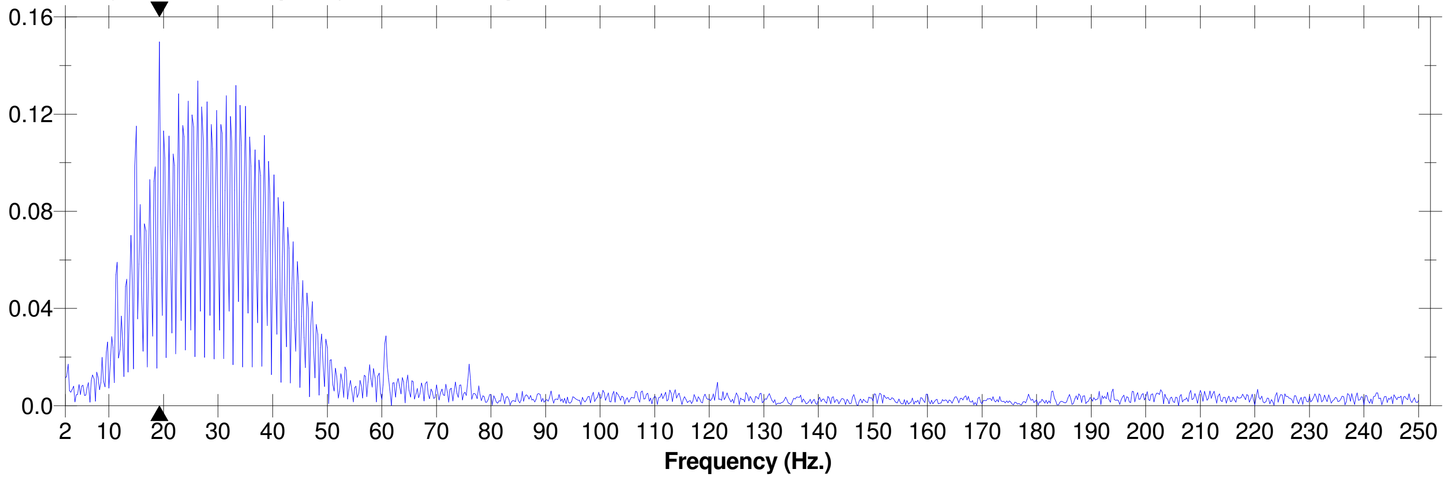
Tran Dominant Frequency = 37.5 Hz., Amplitude = 0.0403, PPV from Event = 1.14 mm/s



Vert Dominant Frequency = 60.8 Hz., Amplitude = 0.0535, PPV from Event = 1.14 mm/s



Long Dominant Frequency = 19.3 Hz., Amplitude = 0.150, PPV from Event = 4.19 mm/s



Event Report

Date/Time	Long at 13:53:09 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

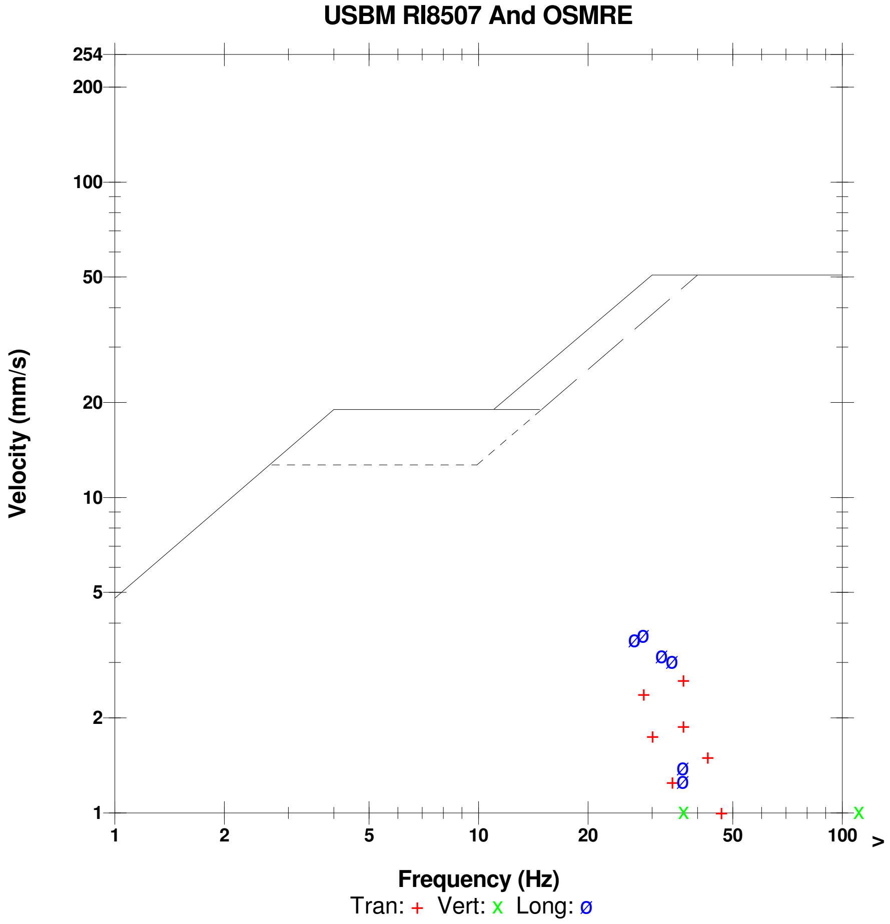
Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQM.KL0

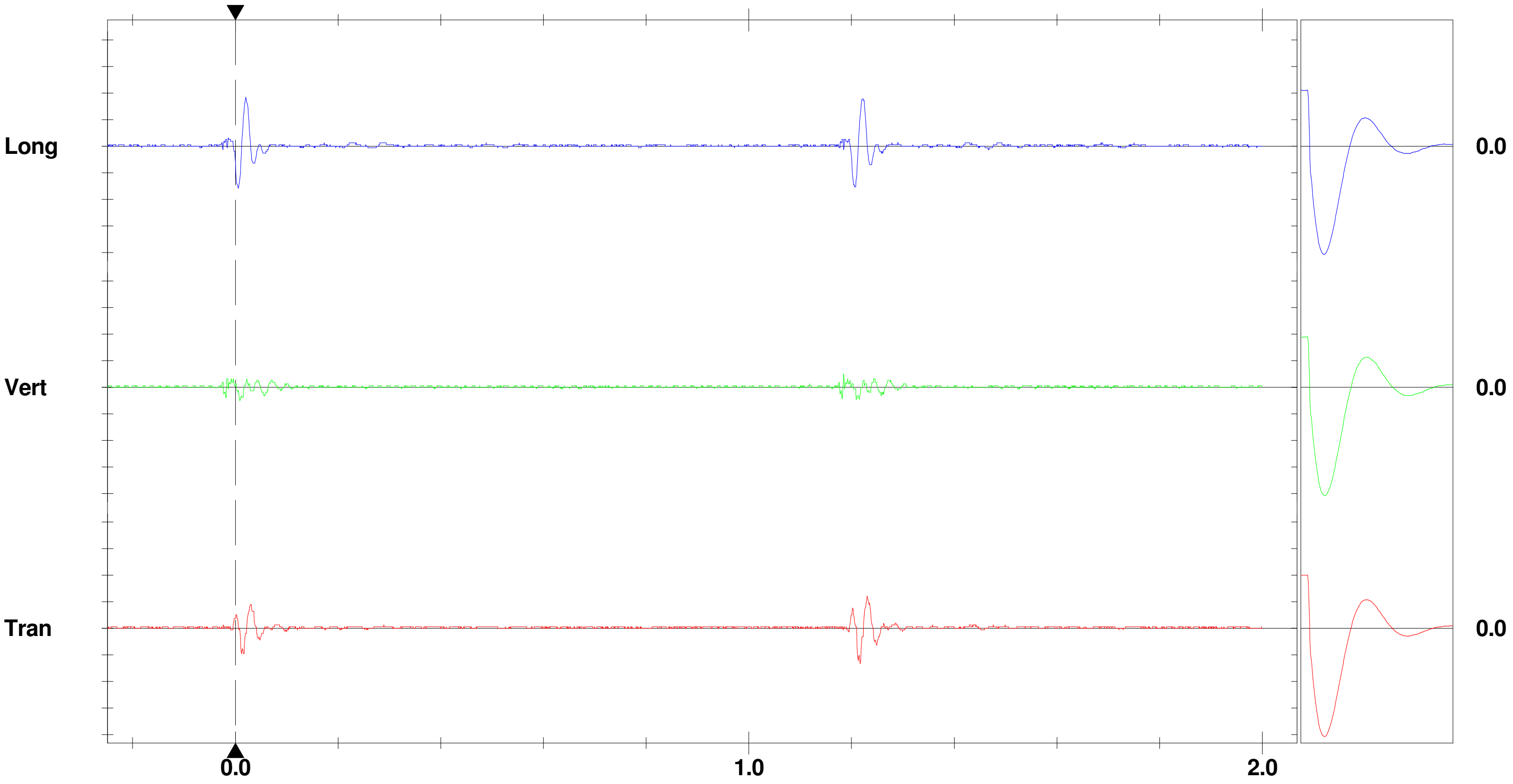
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	2.67	1.02	3.68	mm/s
ZC Freq	37	37	28	Hz
Time (Rel. to Trig)	1.217	0.009	0.021	sec
Peak Acceleration	0.106	0.0928	0.0928	g
Peak Displacement	0.0126	0.00409	0.0205	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 3.71 mm/s at 0.021 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶—— ——◀

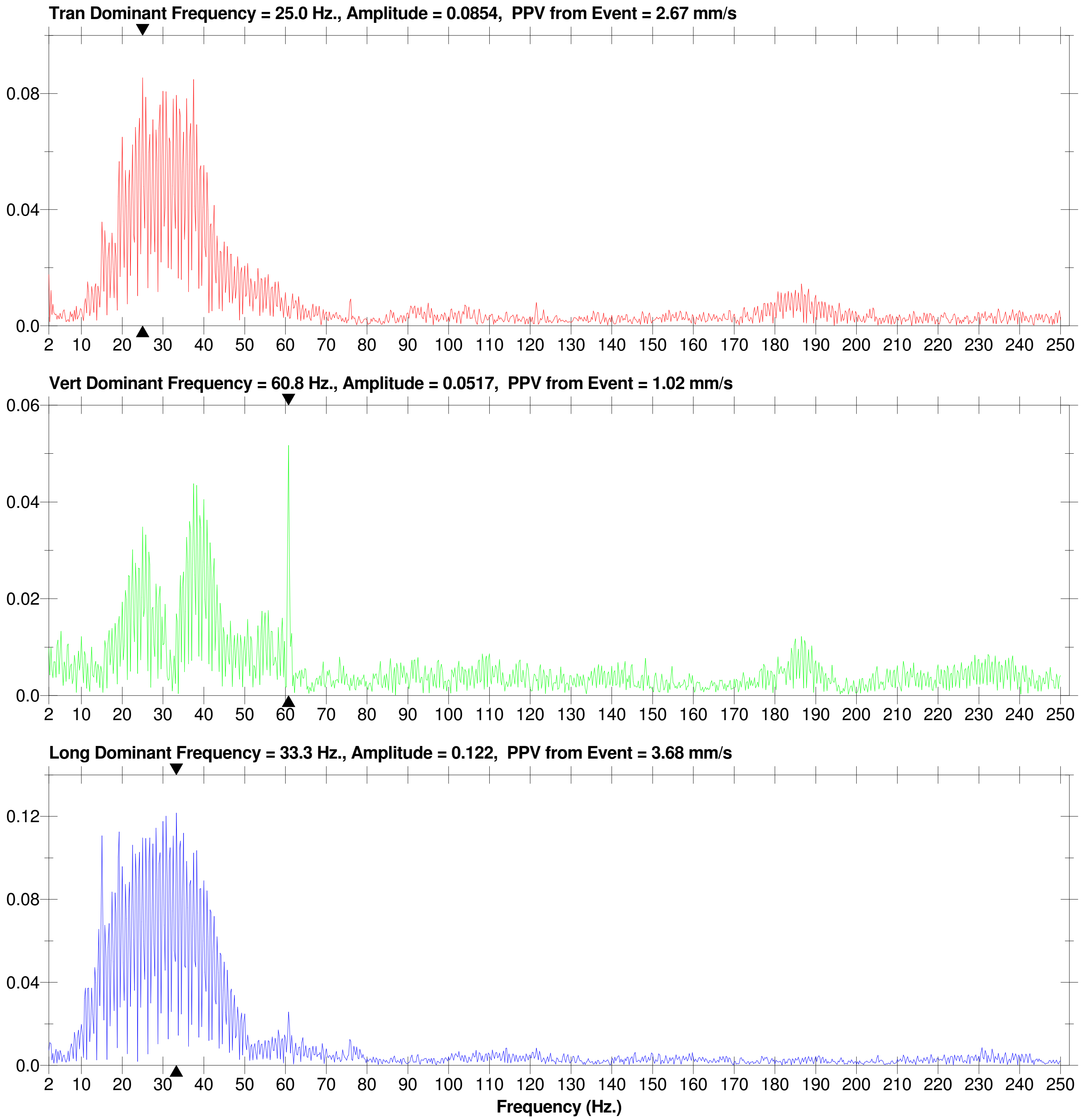
Sensor Check

FFT Report

Date/Time	Long at 13:53:09 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQM.KL0

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent



Instantel

Event Report

Date/Time	Tran at 13:53:12 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQM.KO0

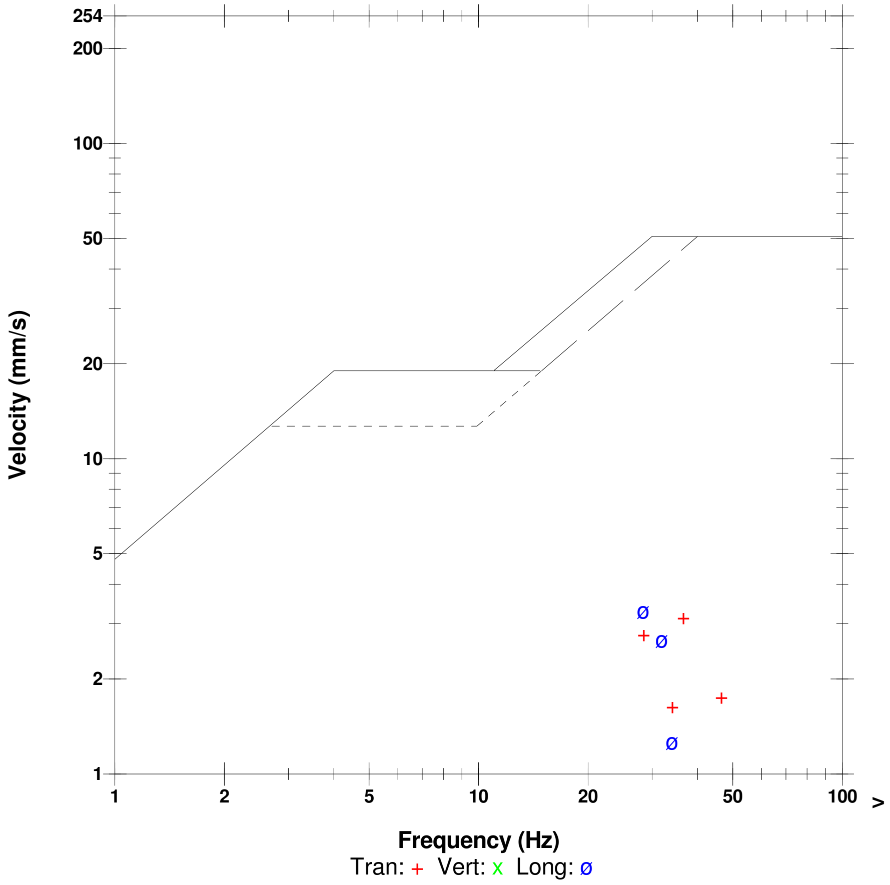
Notes

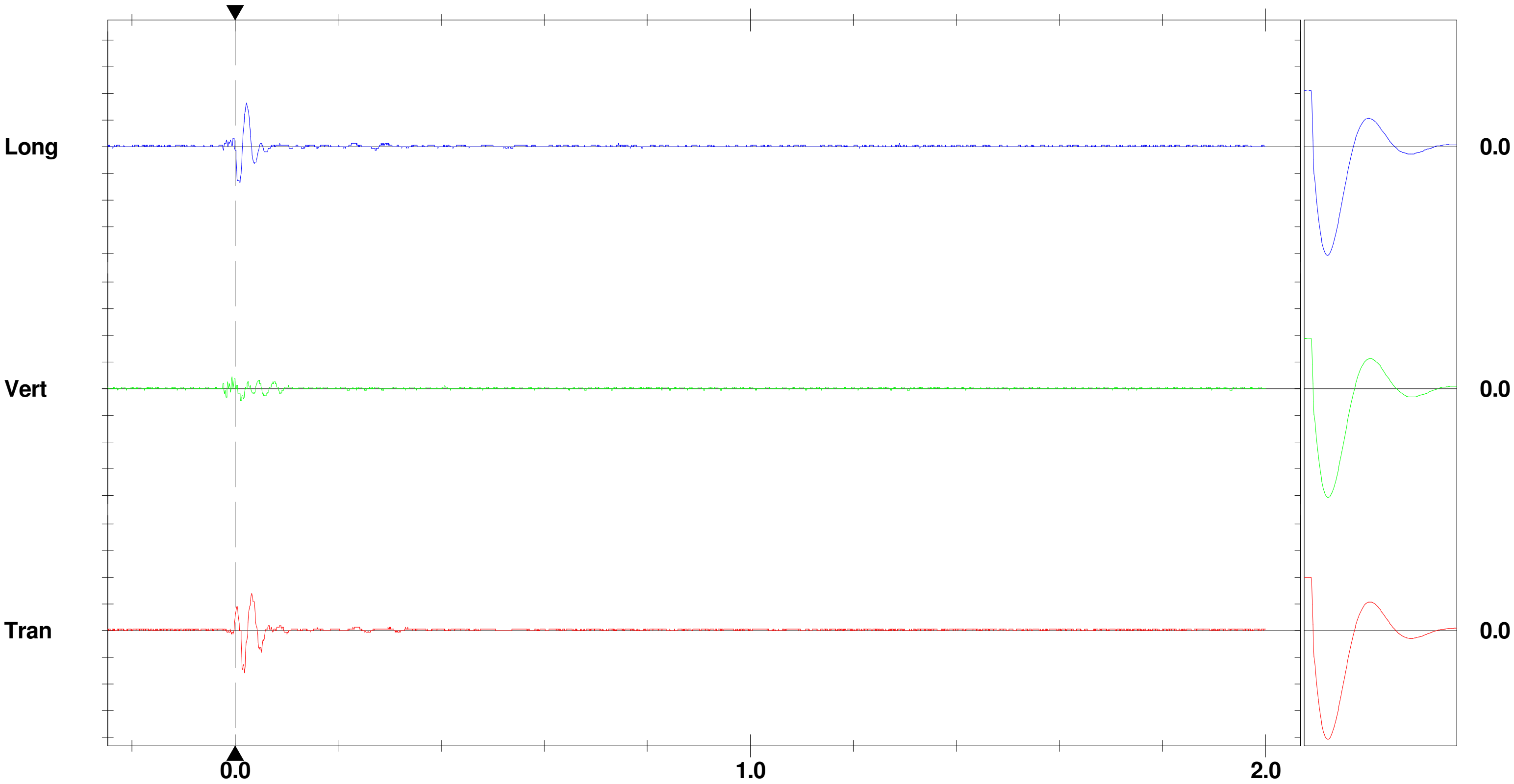
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	3.17	0.889	3.30	mm/s
ZC Freq	37	>100	28	Hz
Time (Rel. to Trig)	0.019	-0.006	0.022	sec
Peak Acceleration	0.133	0.0663	0.0928	g
Peak Displacement	0.0149	0.00366	0.0176	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 4.00 mm/s at 0.019 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶—— ——◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

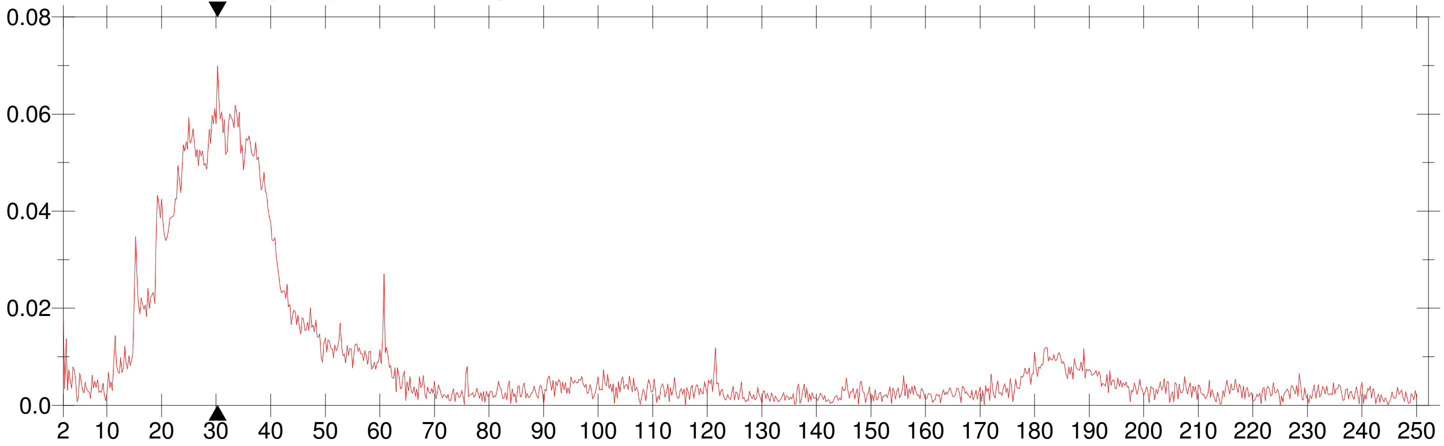
FFT Report

Date/Time	Tran at 13:53:12 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQM.KO0

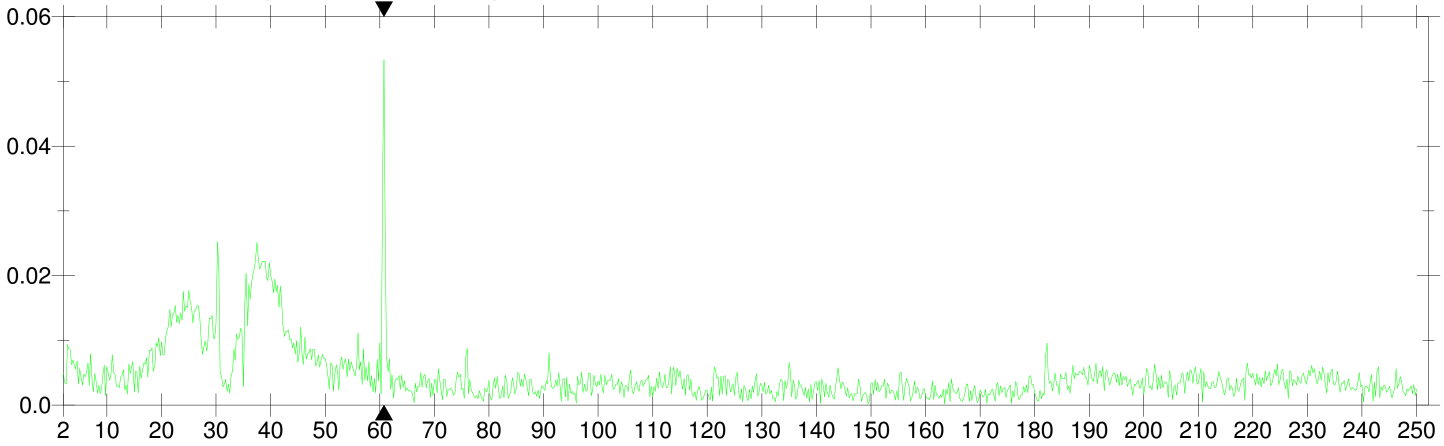
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

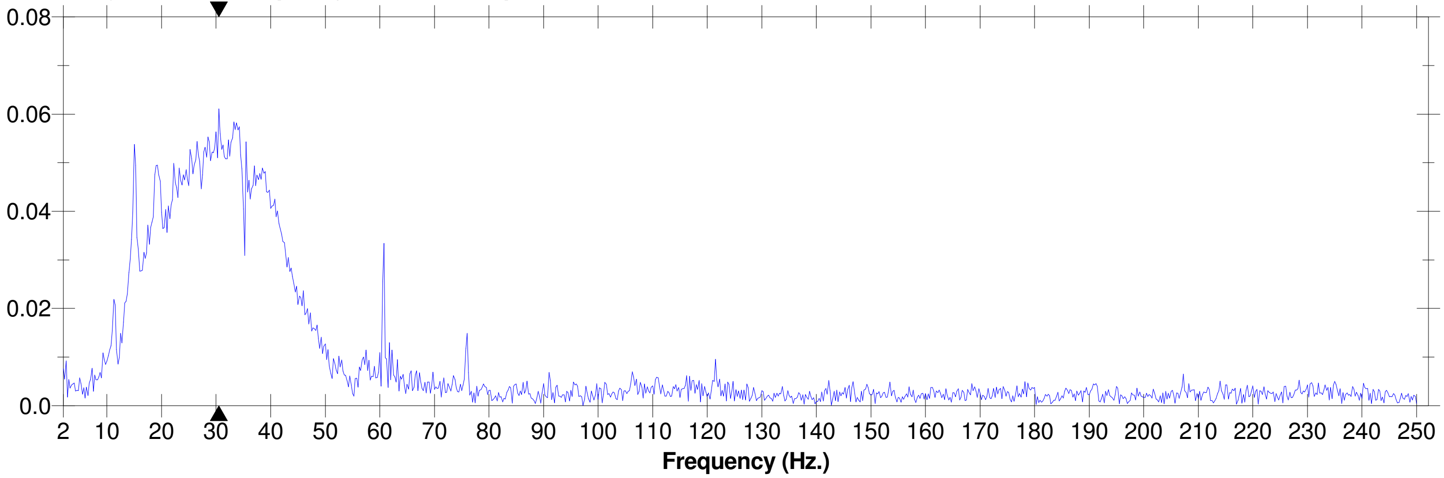
Tran Dominant Frequency = 30.3 Hz., Amplitude = 0.0698, PPV from Event = 3.17 mm/s



Vert Dominant Frequency = 60.8 Hz., Amplitude = 0.0533, PPV from Event = 0.889 mm/s



Long Dominant Frequency = 30.5 Hz., Amplitude = 0.0611, PPV from Event = 3.30 mm/s



Instantel

Event Report

Date/Time	Vert at 13:53:19 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQM.KV0

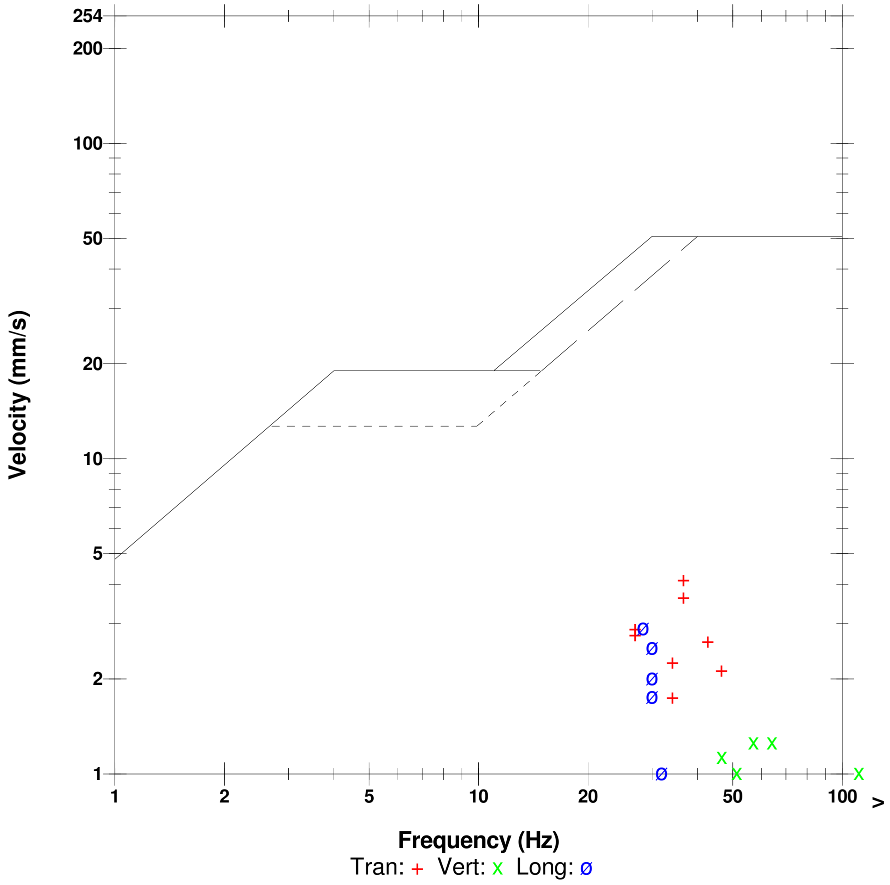
Notes

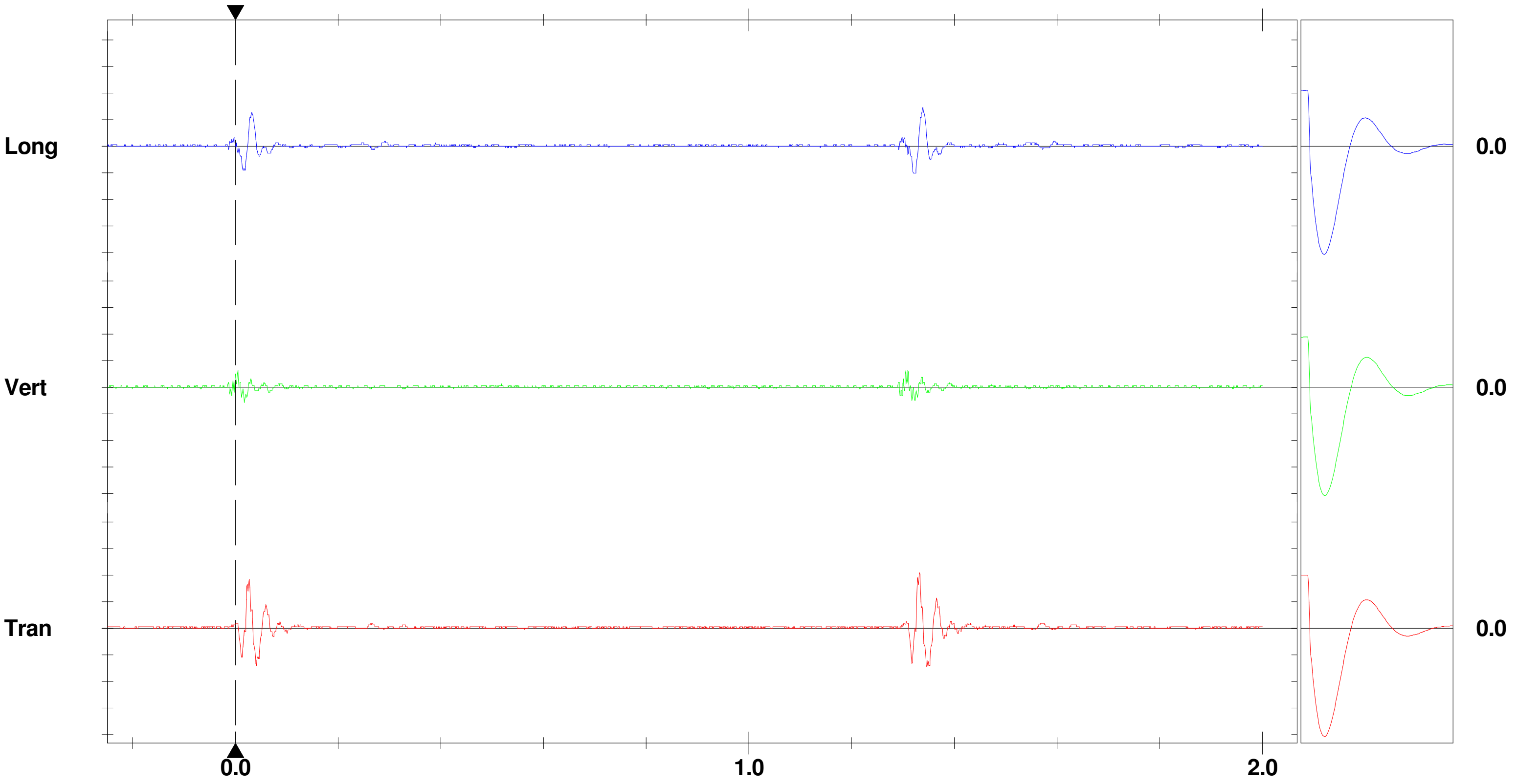
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	**Vert**	**Long**	
PPV	4.19	1.27	2.92	mm/s
ZC Freq	37	64	28	Hz
Time (Rel. to Trig)	1.332	0.005	1.339	sec
Peak Acceleration	0.186	0.0928	0.0663	g
Peak Displacement	0.0175	0.00322	0.0162	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 4.39 mm/s at 1.333 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div Sensor Check

Trigger = ▶—— ——◀

Instantel

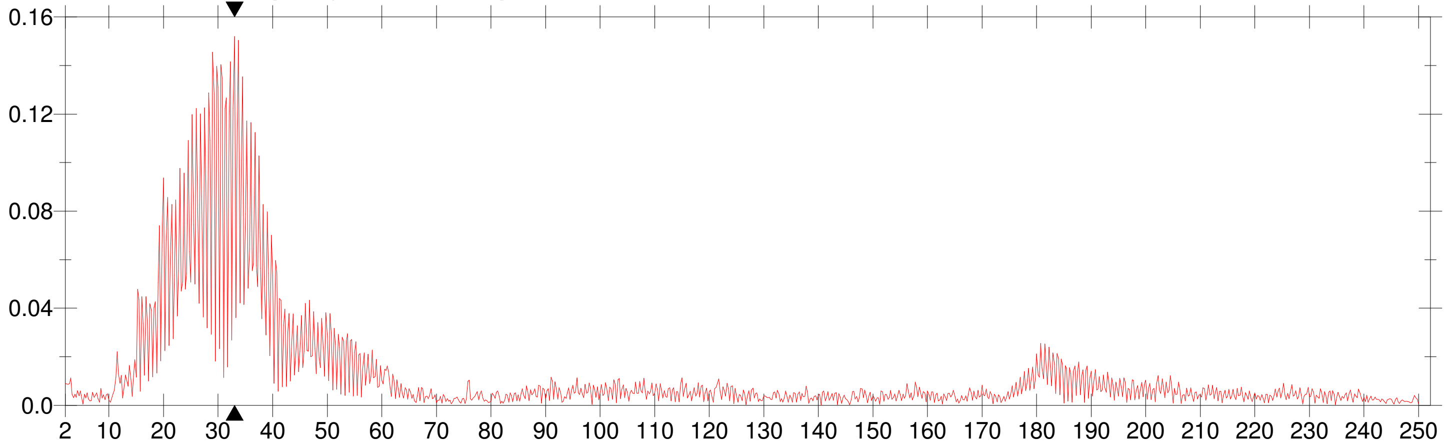
FFT Report

Date/Time	Vert at 13:53:19 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQM.KV0

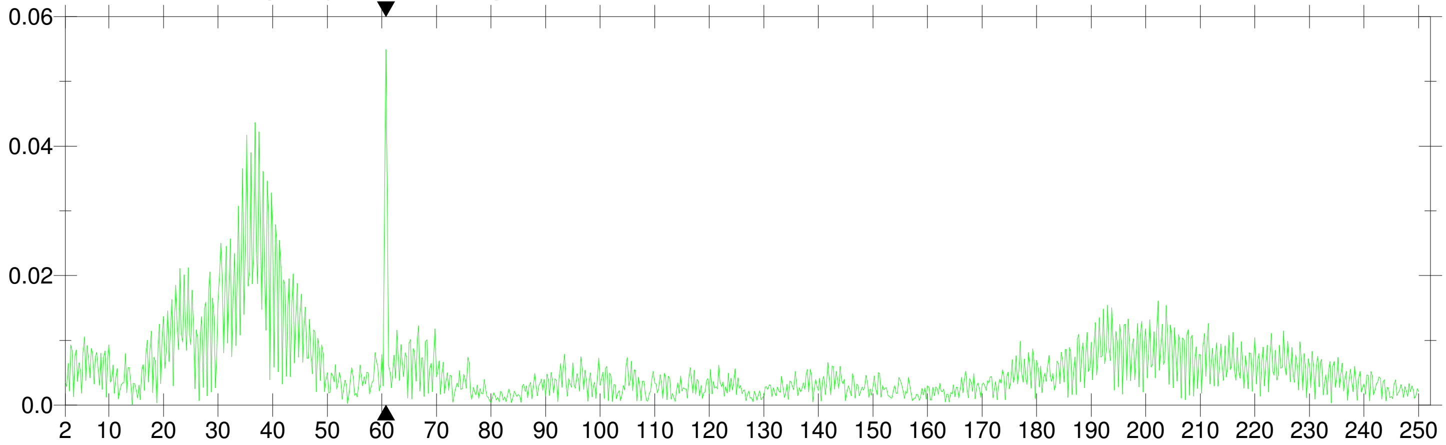
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

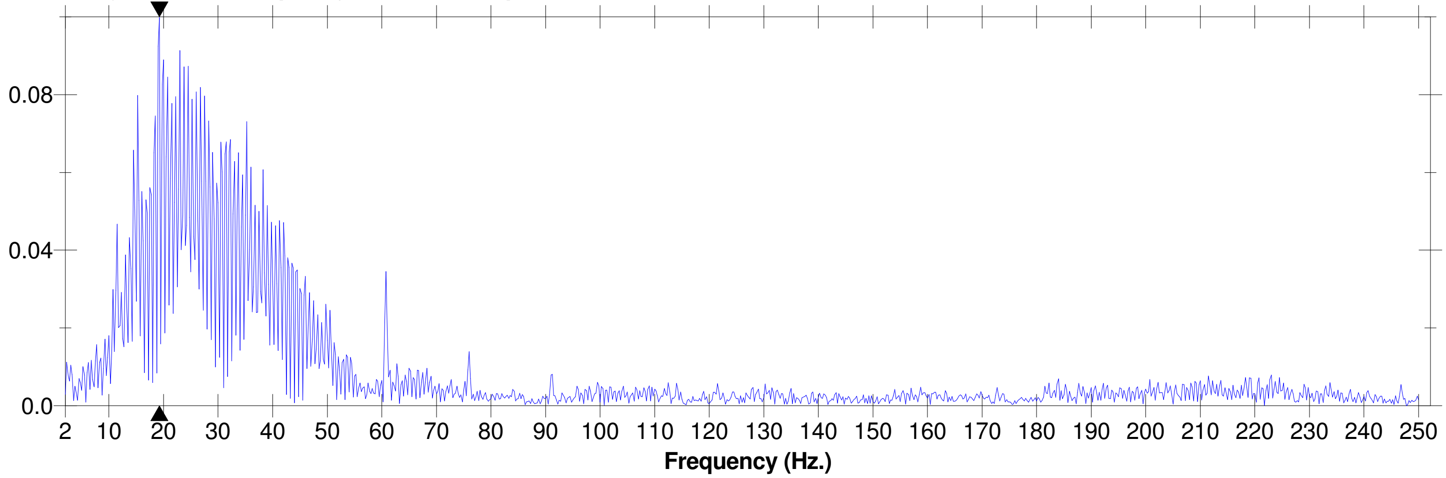
Tran Dominant Frequency = 33.0 Hz., Amplitude = 0.152, PPV from Event = 4.19 mm/s



Vert Dominant Frequency = 60.8 Hz., Amplitude = 0.0549, PPV from Event = 1.27 mm/s



Long Dominant Frequency = 19.3 Hz., Amplitude = 0.0999, PPV from Event = 2.92 mm/s



Printed: April 24, 2017 (V 10.60 - 10.60)

Instantel

Event Report

Date/Time	Vert at 13:53:21 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

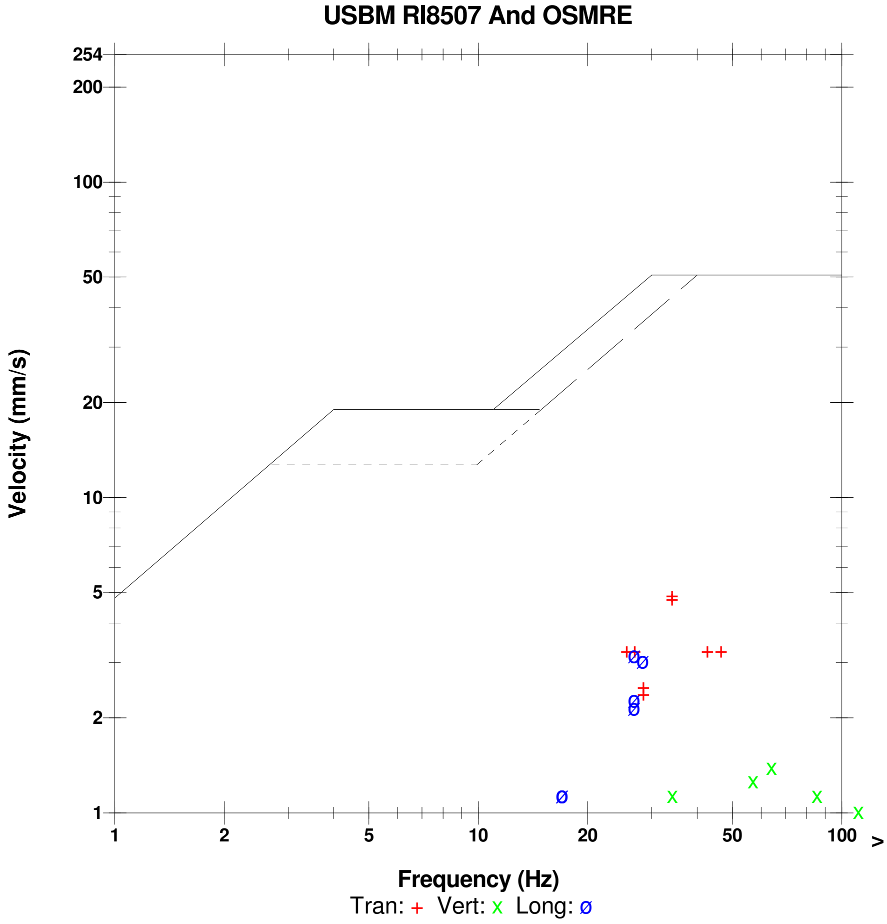
Notes

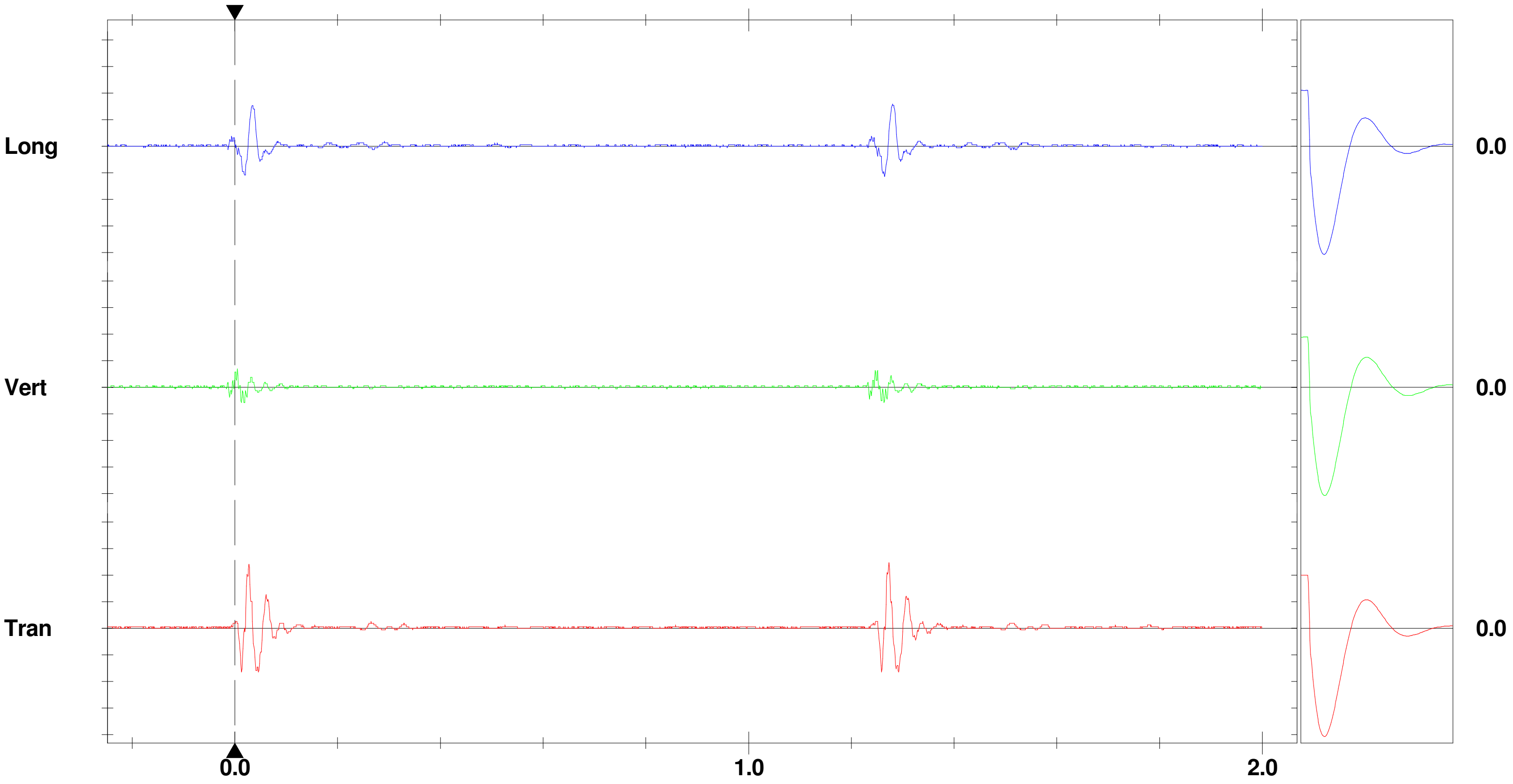
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQM.KX0

	Tran	Vert	Long	
PPV	4.95	1.40	3.17	mm/s
ZC Freq	34	64	27	Hz
Time (Rel. to Trig)	1.273	0.005	1.280	sec
Peak Acceleration	0.186	0.0928	0.0663	g
Peak Displacement	0.0210	0.00484	0.0187	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 5.09 mm/s at 1.273 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶—— ——◀

Sensor Check

Instantel

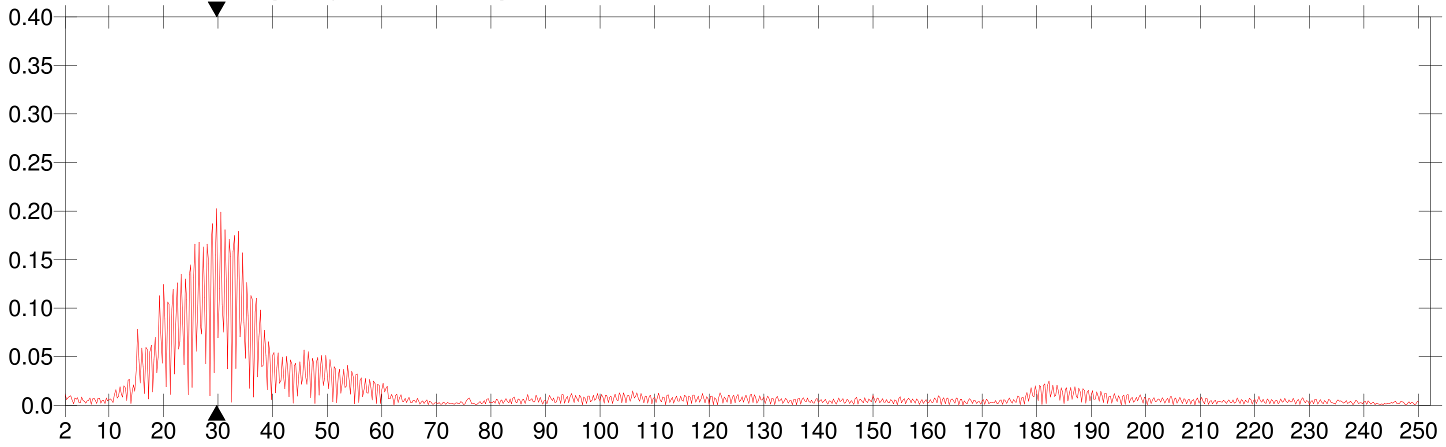
FFT Report

Date/Time Vert at 13:53:21 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

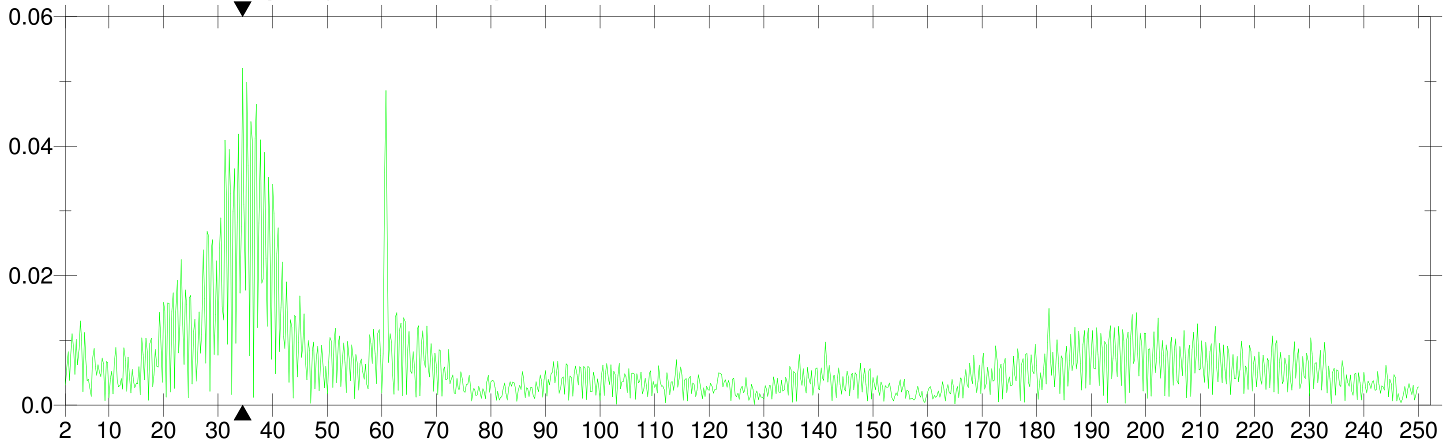
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQM.KX0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

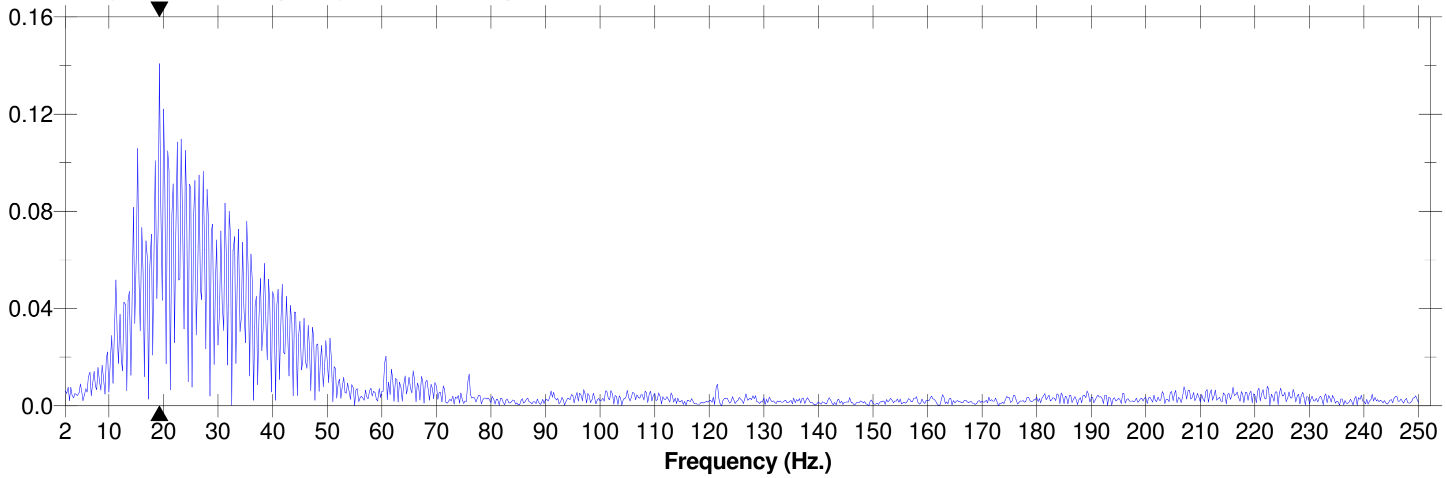
Tran Dominant Frequency = 29.8 Hz., Amplitude = 0.203, PPV from Event = 4.95 mm/s



Vert Dominant Frequency = 34.5 Hz., Amplitude = 0.0520, PPV from Event = 1.40 mm/s



Long Dominant Frequency = 19.3 Hz., Amplitude = 0.141, PPV from Event = 3.17 mm/s



Instantel

Event Report

Date/Time	Vert at 13:53:24 March 29, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTQM.L00

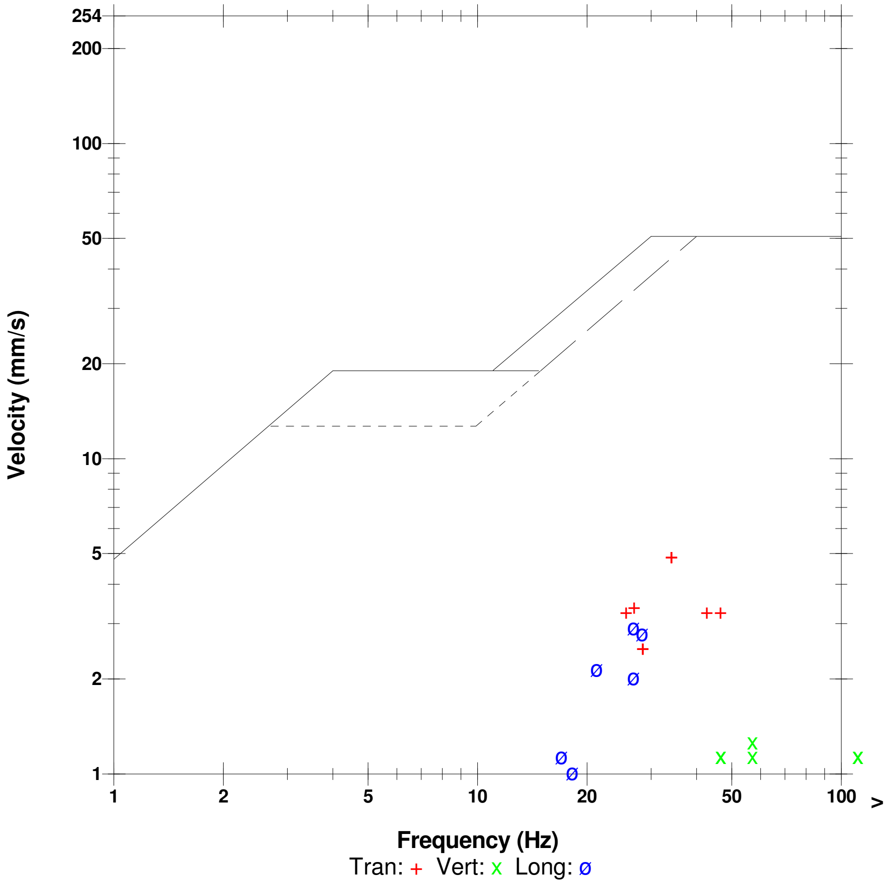
Notes

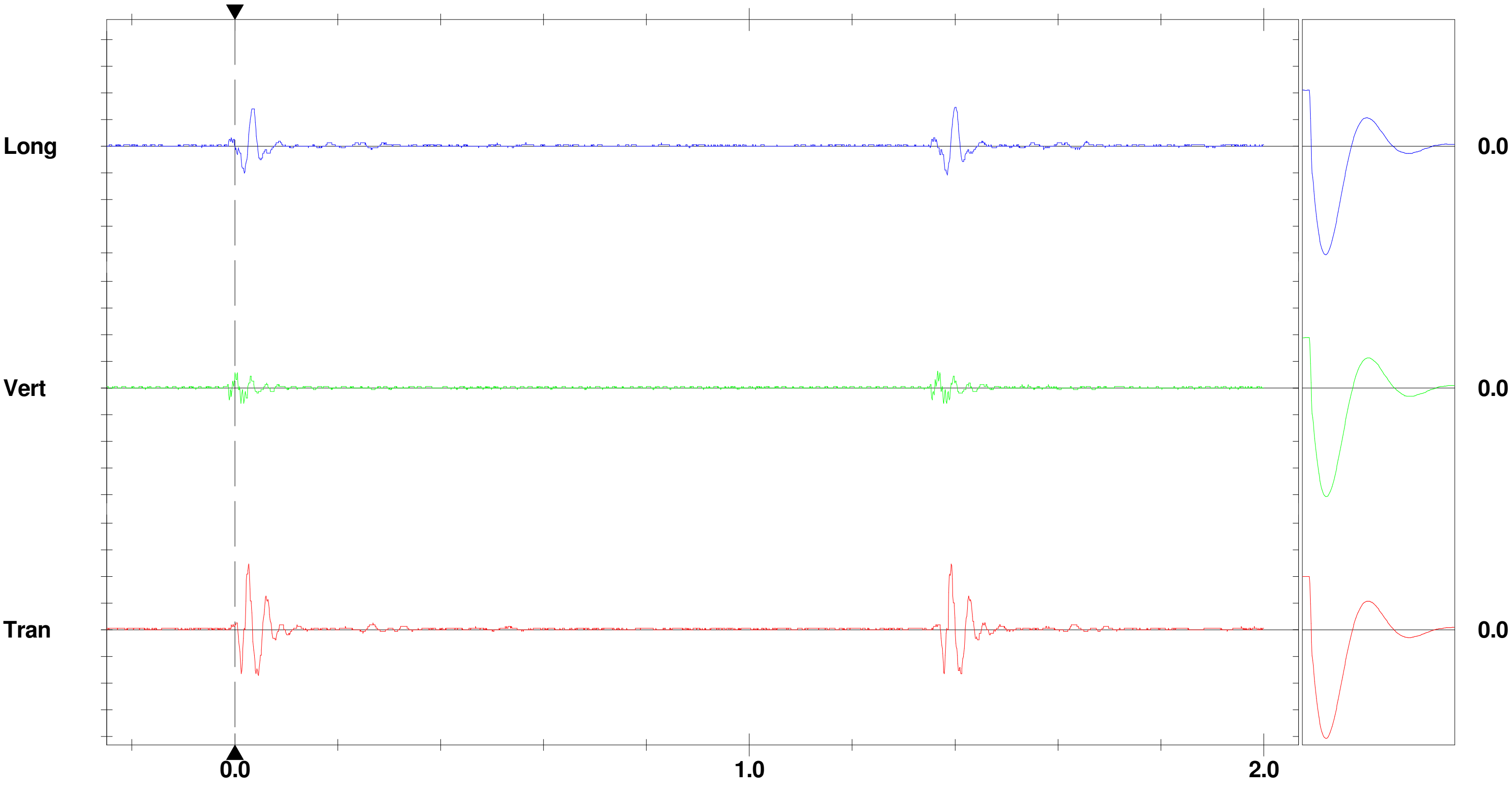
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	4.95	1.27	2.92	mm/s
ZC Freq	34	57	27	Hz
Time (Rel. to Trig)	0.027	1.366	1.399	sec
Peak Acceleration	0.186	0.0928	0.0663	g
Peak Displacement	0.0215	0.00341	0.0174	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 5.05 mm/s at 0.027 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

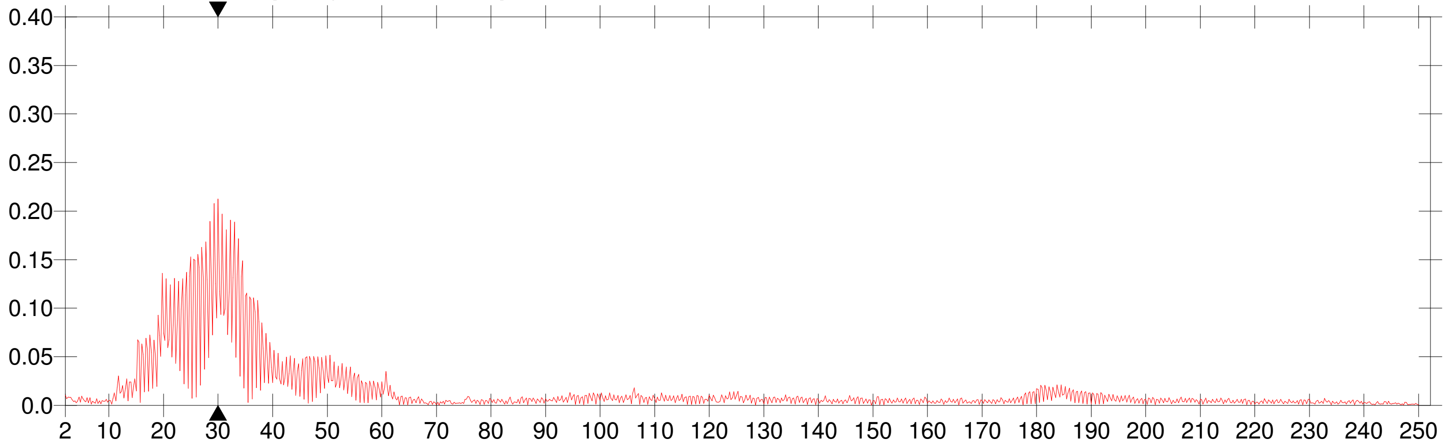
FFT Report

Date/Time	Vert at 13:53:24 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQM.L00

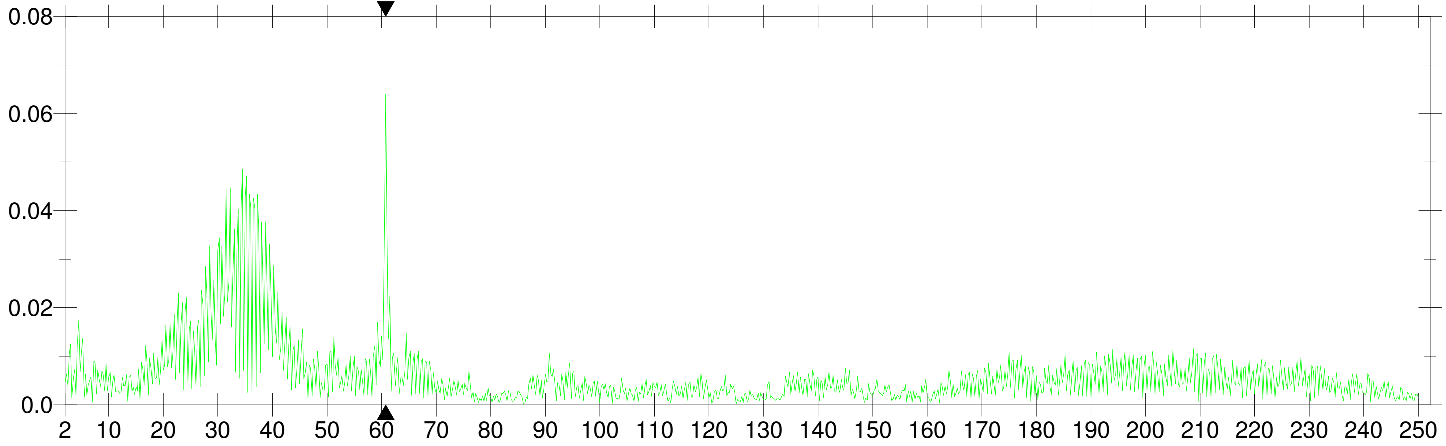
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

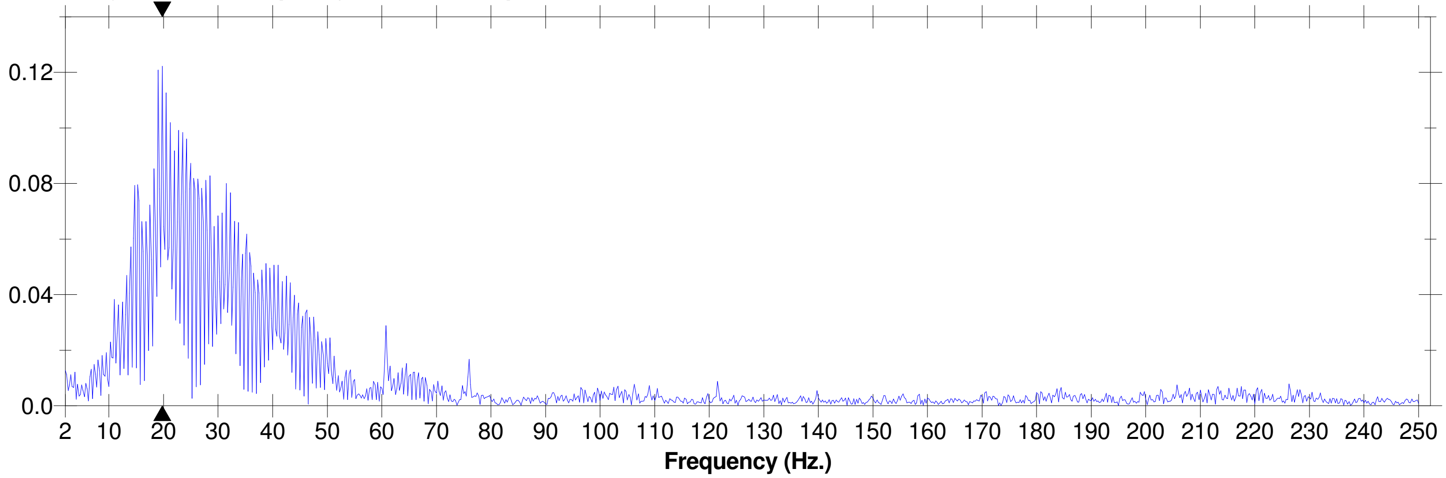
Tran Dominant Frequency = 30.0 Hz., Amplitude = 0.213, PPV from Event = 4.95 mm/s



Vert Dominant Frequency = 60.8 Hz., Amplitude = 0.0639, PPV from Event = 1.27 mm/s



Long Dominant Frequency = 19.8 Hz., Amplitude = 0.122, PPV from Event = 2.92 mm/s



Instantel

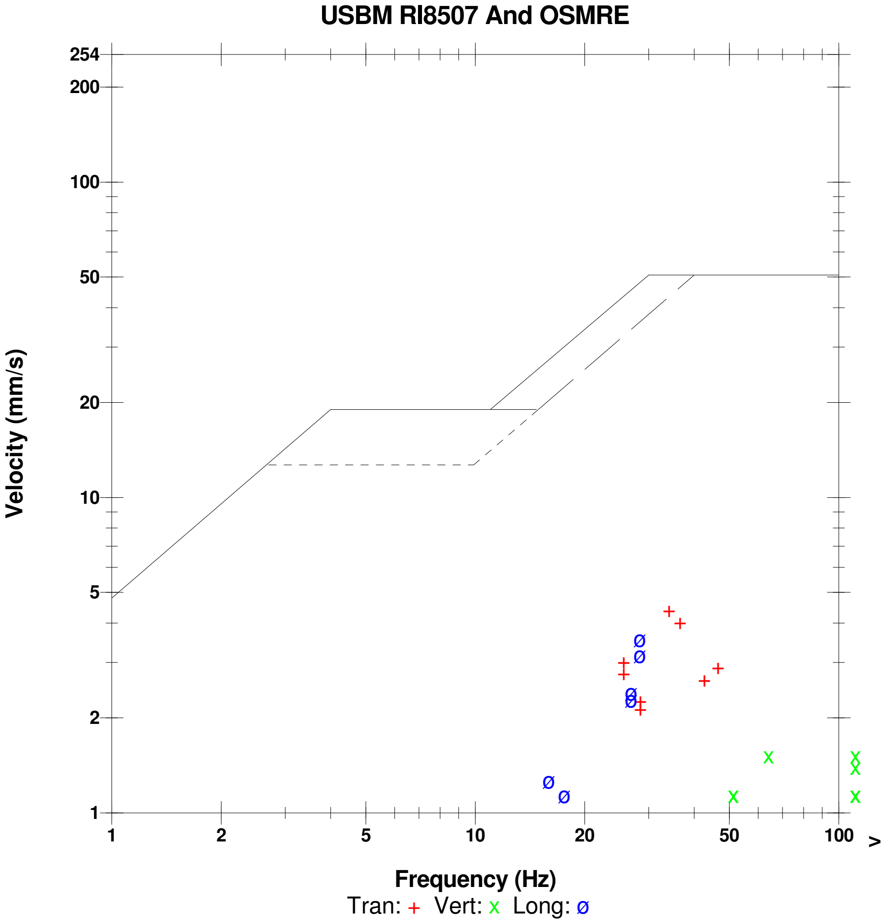
Event Report

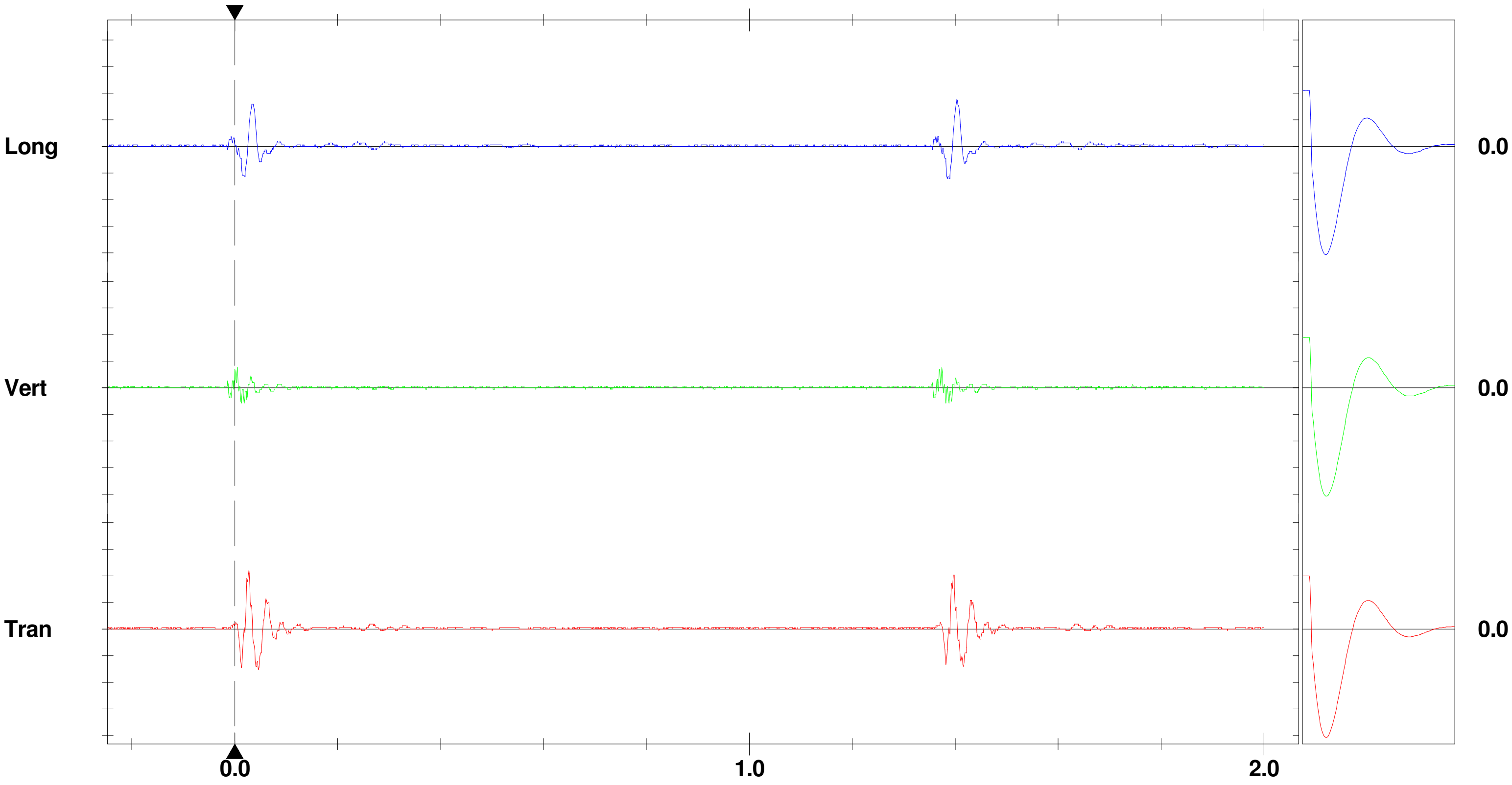
Date/Time Vert at 13:53:26 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQM.L20

	Tran	Vert	Long	
PPV	4.44	1.52	3.56	mm/s
ZC Freq	34	64	28	Hz
Time (Rel. to Trig)	0.027	0.005	1.403	sec
Peak Acceleration	0.186	0.106	0.0795	g
Peak Displacement	0.0189	0.00353	0.0198	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 4.60 mm/s at 0.027 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div Sensor Check
Trigger = ▶—— ——◀

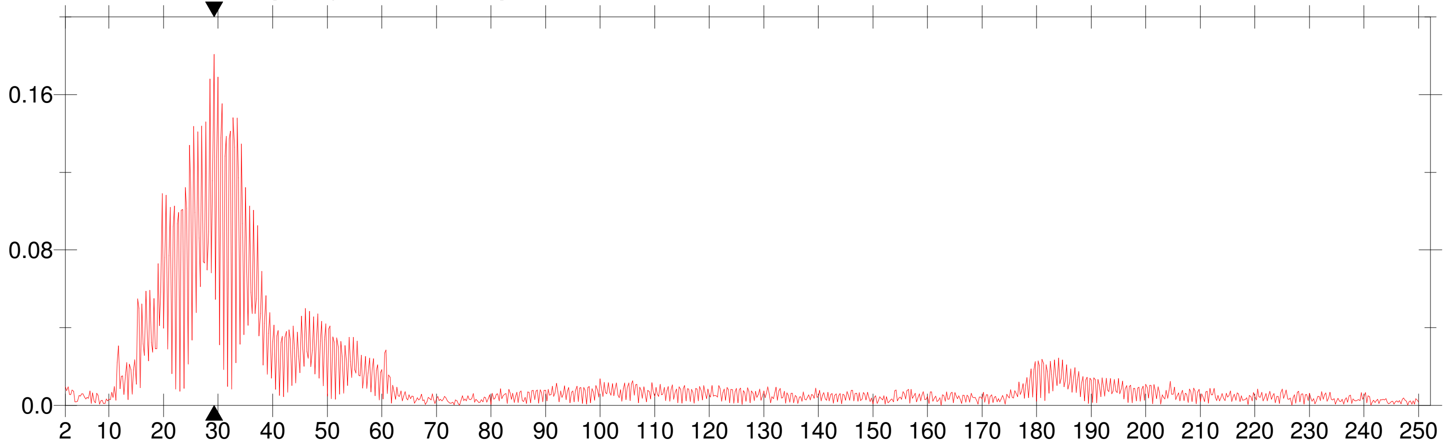
FFT Report

Date/Time	Vert at 13:53:26 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQM.L20

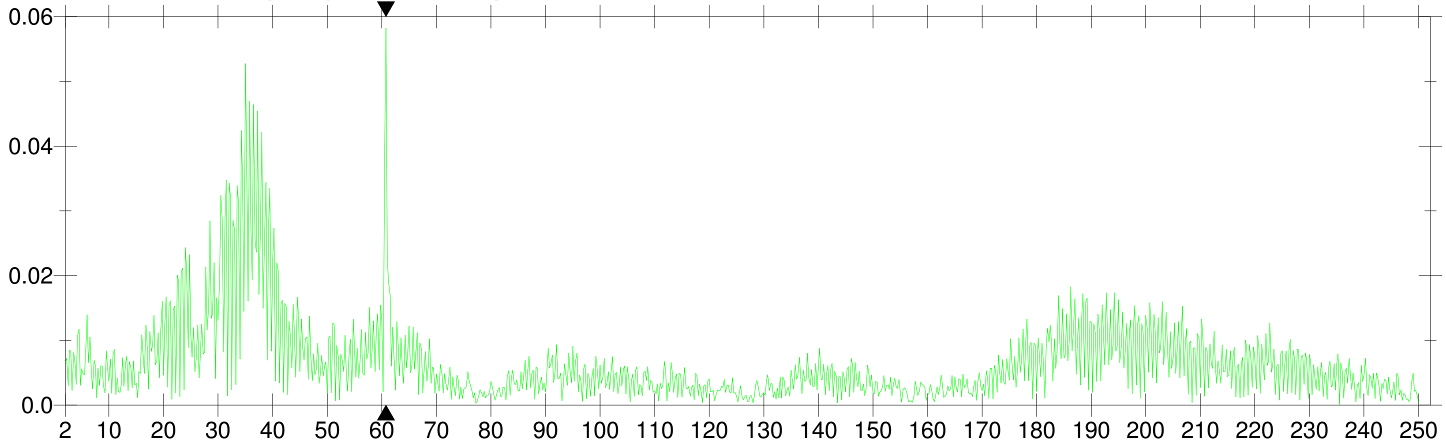
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

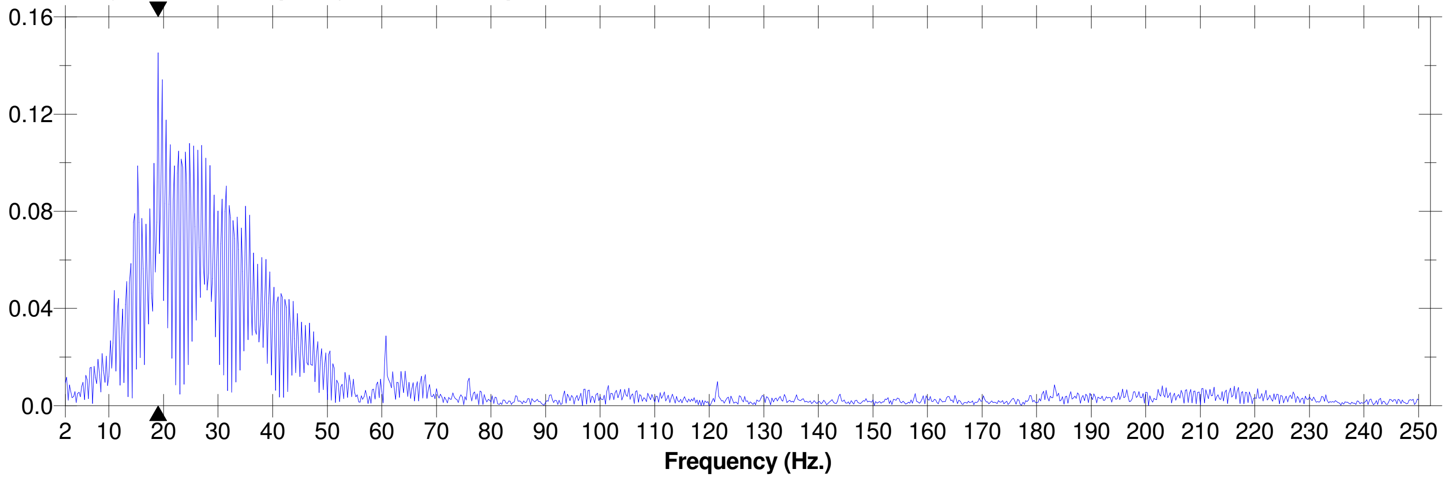
Tran Dominant Frequency = 29.3 Hz., Amplitude = 0.181, PPV from Event = 4.44 mm/s



Vert Dominant Frequency = 60.8 Hz., Amplitude = 0.0582, PPV from Event = 1.52 mm/s



Long Dominant Frequency = 19.0 Hz., Amplitude = 0.145, PPV from Event = 3.56 mm/s



Event Report

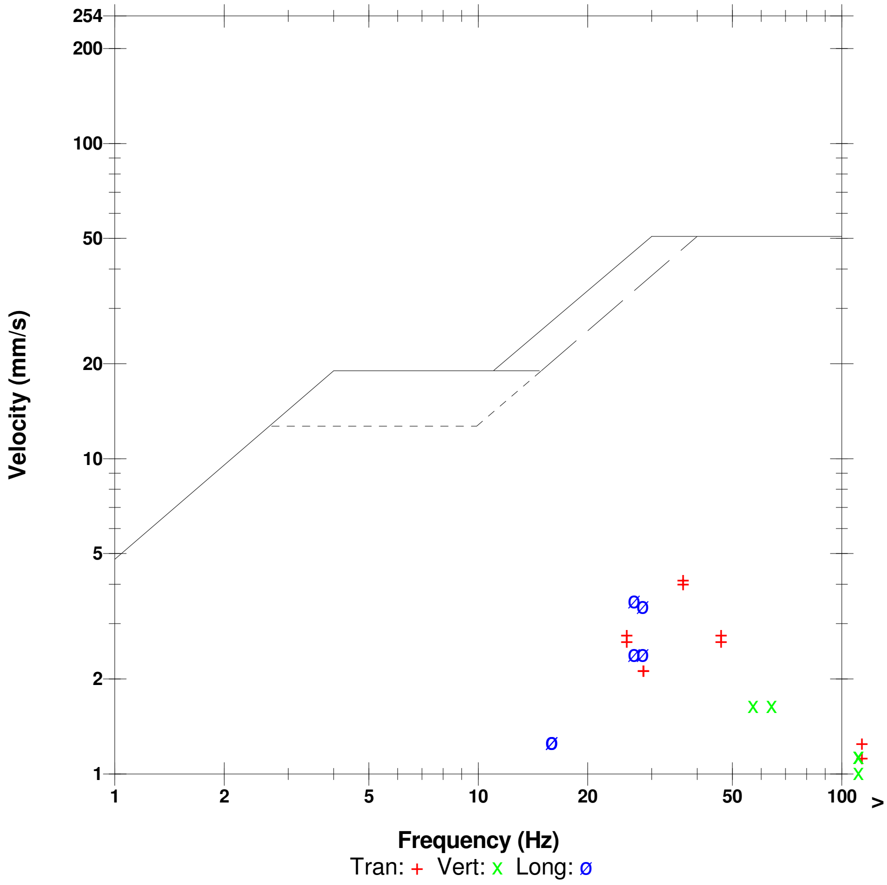
Date/Time Vert at 13:53:29 March 29, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

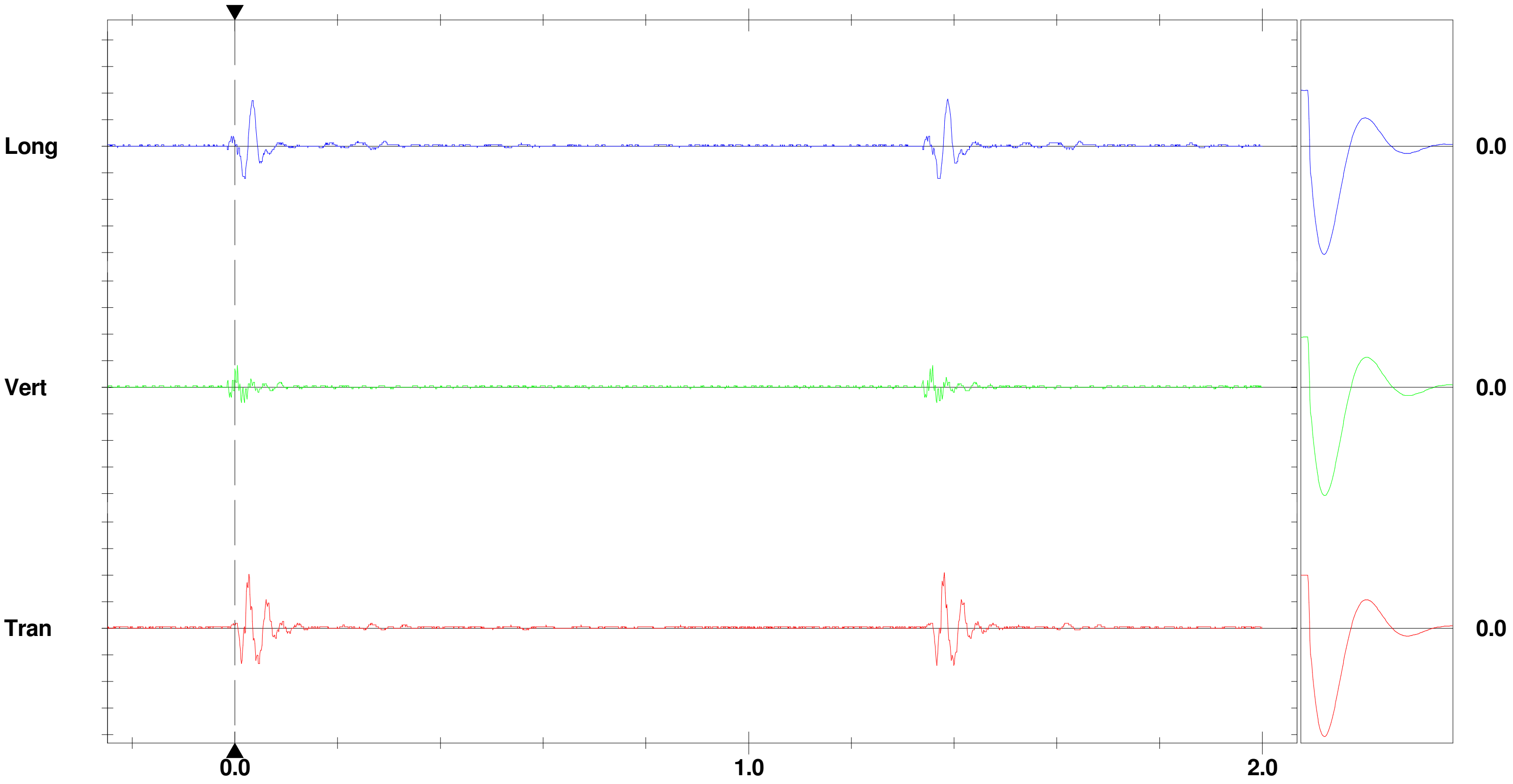
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTQM.L50

	Tran	Vert	Long	
PPV	4.19	1.65	3.56	mm/s
ZC Freq	37	64	27	Hz
Time (Rel. to Trig)	1.381	0.005	1.388	sec
Peak Acceleration	0.186	0.0928	0.0795	g
Peak Displacement	0.0167	0.00391	0.0200	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.7	Hz
Overswing Ratio	3.8	3.6	3.8	

Peak Vector Sum 4.42 mm/s at 1.381 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Instantel

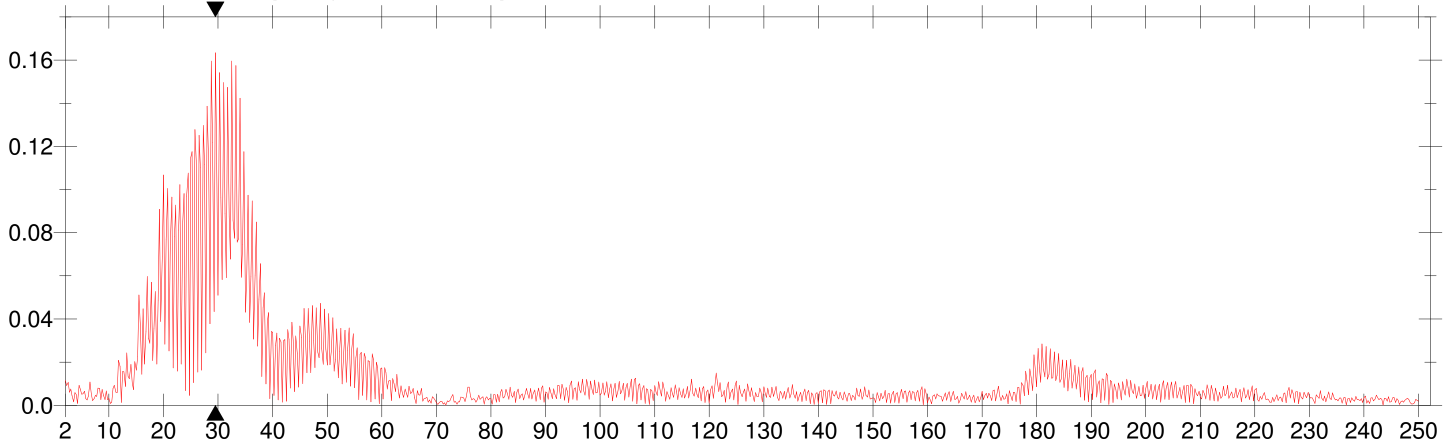
FFT Report

Date/Time	Vert at 13:53:29 March 29, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTQM.L50

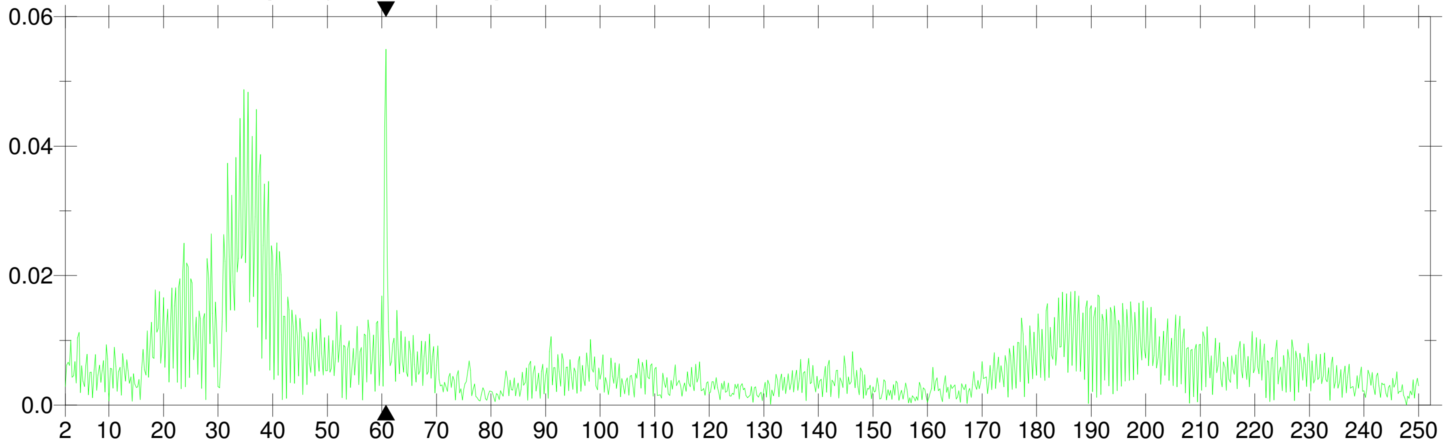
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

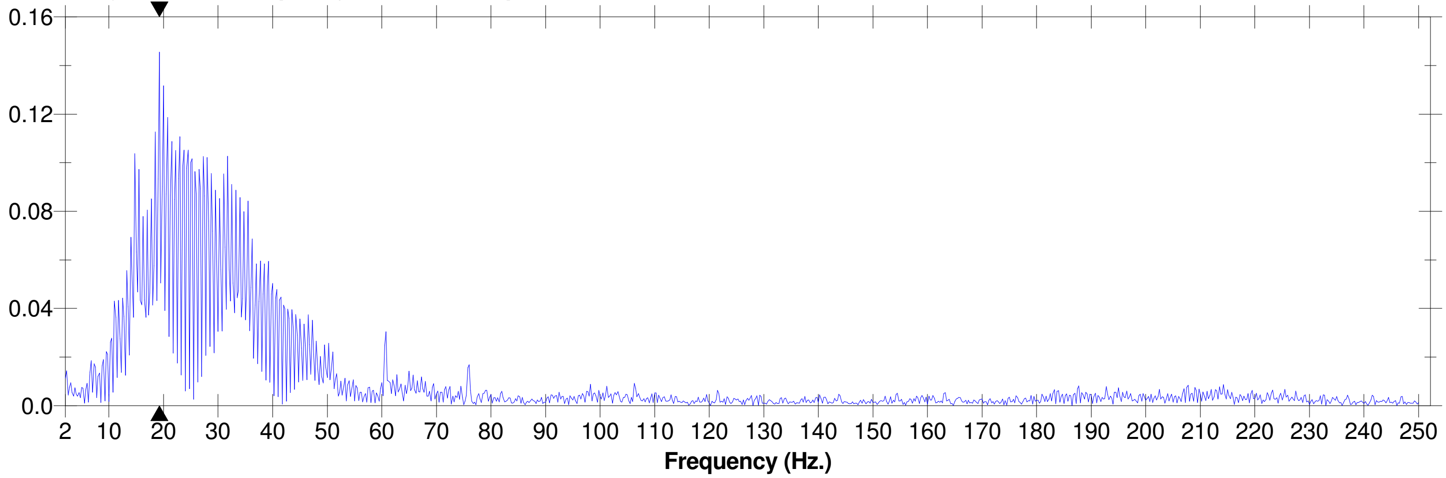
Tran Dominant Frequency = 29.5 Hz., Amplitude = 0.163, PPV from Event = 4.19 mm/s



Vert Dominant Frequency = 60.8 Hz., Amplitude = 0.0549, PPV from Event = 1.65 mm/s



Long Dominant Frequency = 19.3 Hz., Amplitude = 0.146, PPV from Event = 3.56 mm/s



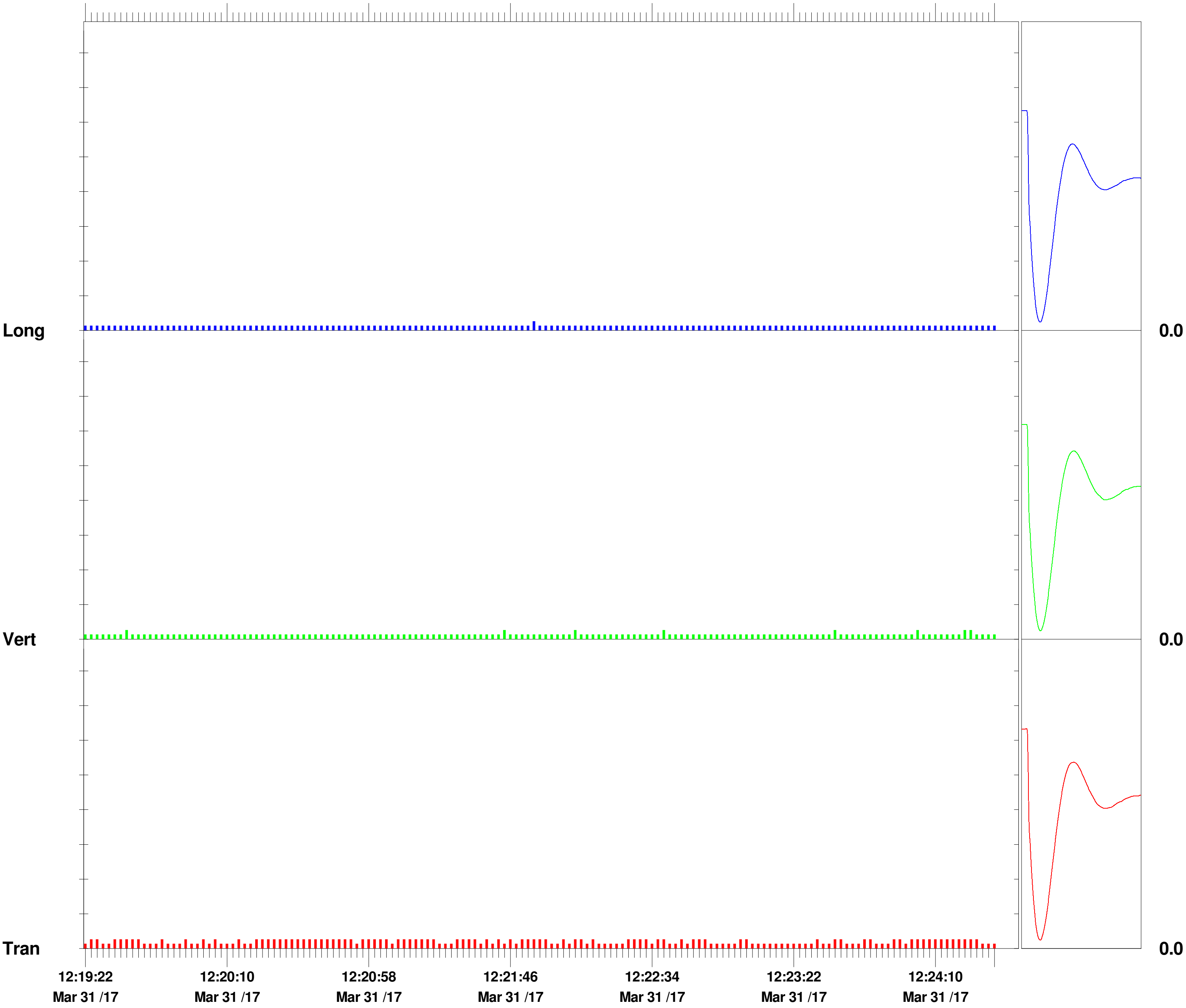
Event Report

Histogram Start Time 12:19:20 March 31, 2017
Histogram Finish Time 12:24:30 March 31, 2017
Number of Intervals 155.00 at 2 seconds
Range Geo:254 mm/s
Sample Rate 1024sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTU7.K80

	Tran	Vert	Long	
PPV	0.254	0.254	0.254	mm/s
ZC Freq	>100	>100	>100	Hz
Date	Mar 31 /17	Mar 31 /17	Mar 31 /17	
Time	12:19:24	12:19:36	12:21:54	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.6	Hz
Overswing Ratio	3.9	3.7	3.9	

Peak Vector Sum 0.311 mm/s on March 31, 2017 at 12:19:32



Time Scale: 2 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Event Report

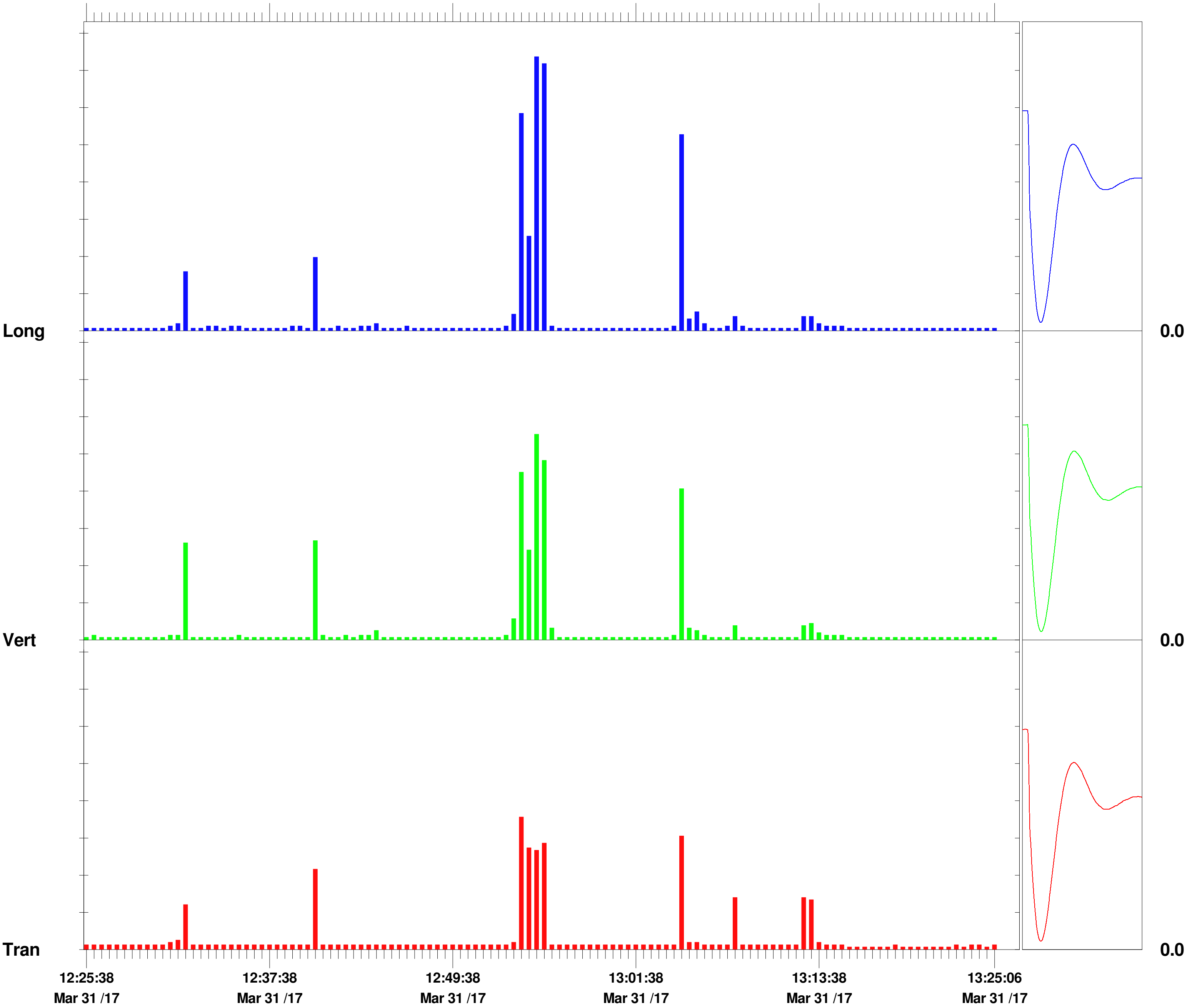
Histogram Start Time	12:25:08 March 31, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	13:25:06 March 31, 2017	**Battery Level**	6.3 Volts
Number of Intervals	1799.00 at 2 seconds	**Unit Calibration**	February 22, 2017 by Instantel
Range	Geo:254 mm/s	**File Name**	T695GTU7.TW0
Sample Rate	1024sps		

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	**Vert**	**Long**	
PPV	7.11	11.0	14.7	mm/s
ZC Freq	32	28	32	Hz
Date	Mar 31 /17	Mar 31 /17	Mar 31 /17	
Time	12:53:42	12:55:04	12:55:04	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 17.0 mm/s on March 31, 2017 at 12:55:04



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

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Event Report

Date/Time	Long at 12:31:47 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

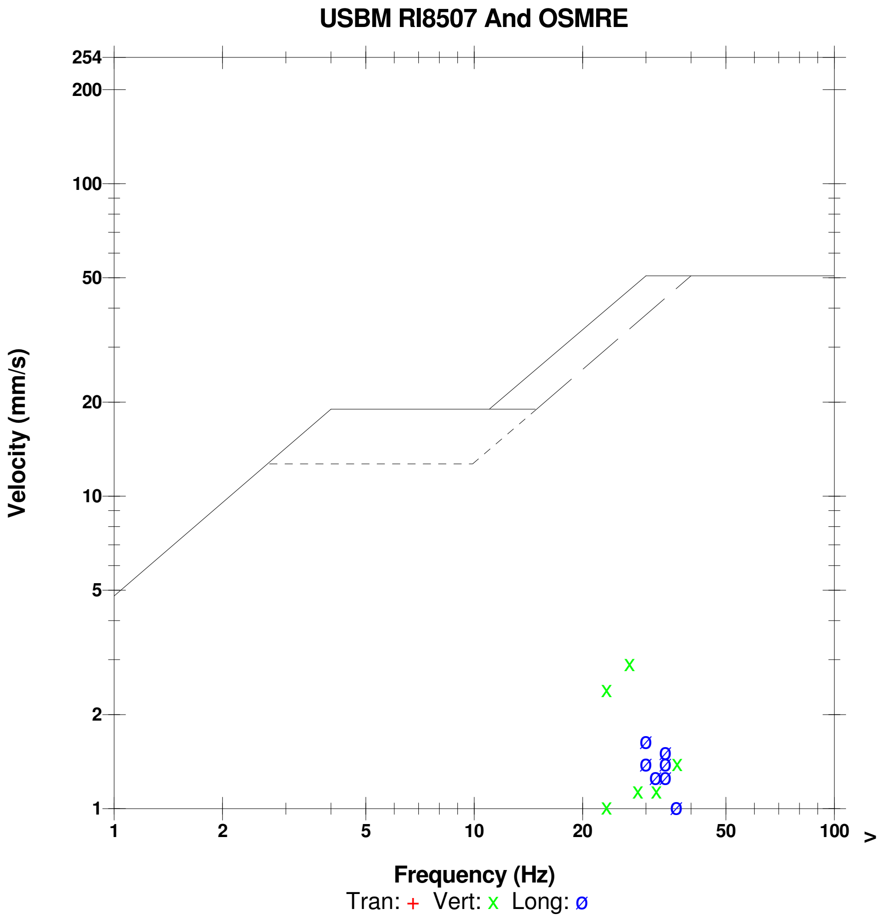
Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTU8.4Z0

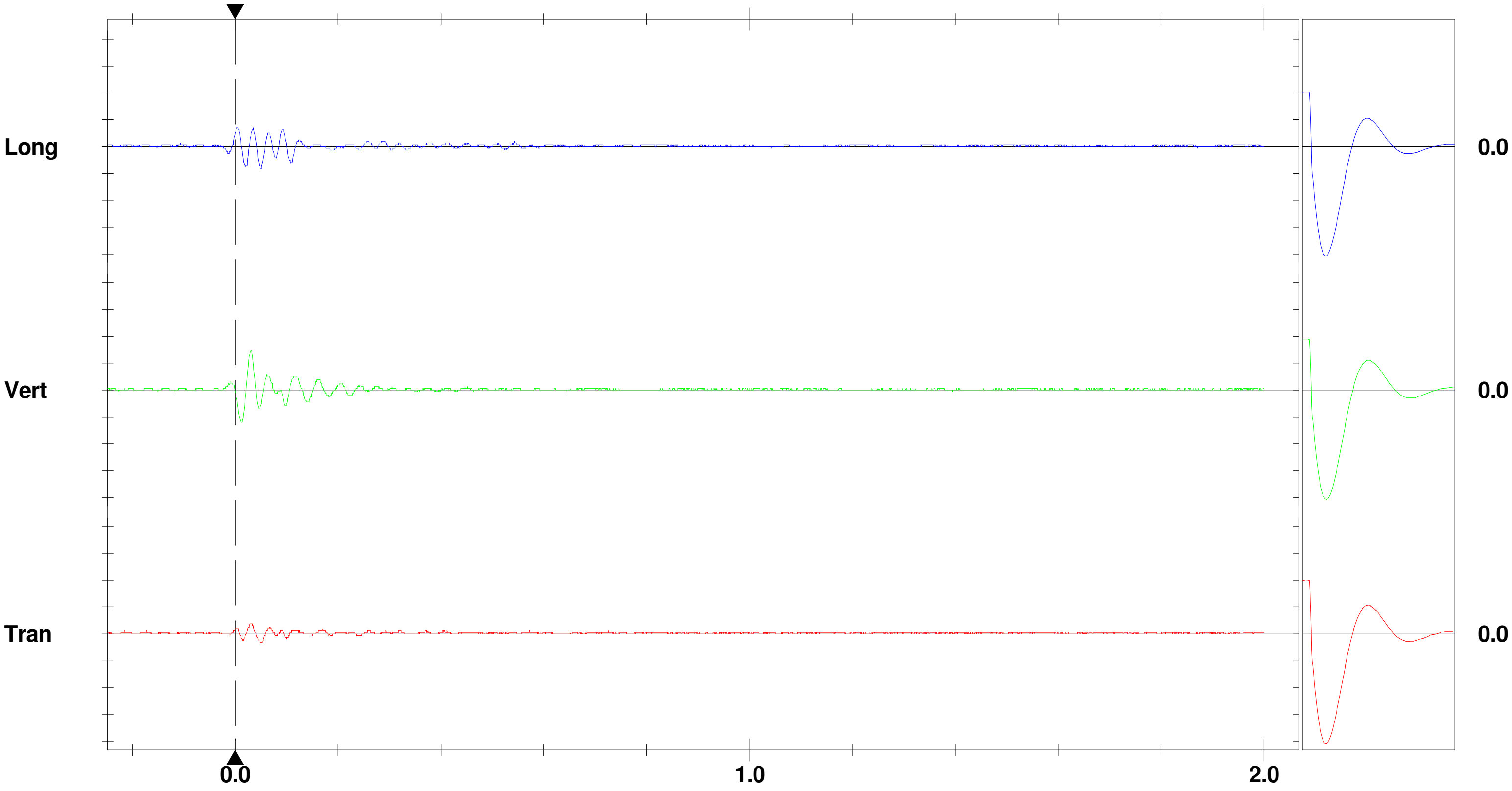
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	0.762	2.92	1.65	mm/s
ZC Freq	32	27	30	Hz
Time (Rel. to Trig)	0.028	0.030	0.049	sec
Peak Acceleration	0.0133	0.0530	0.0398	g
Peak Displacement	0.00415	0.0167	0.00837	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 3.19 mm/s at 0.031 sec


USBM RI8507 And OSMRE



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Instantel

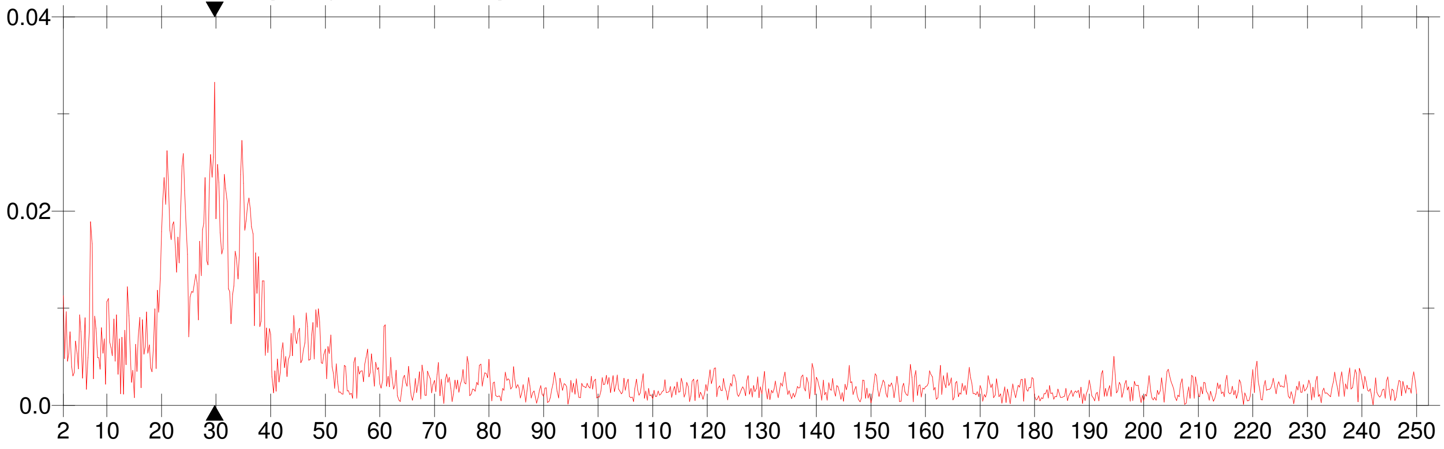
FFT Report

Date/Time	Long at 12:31:47 March 31, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTU8.4Z0

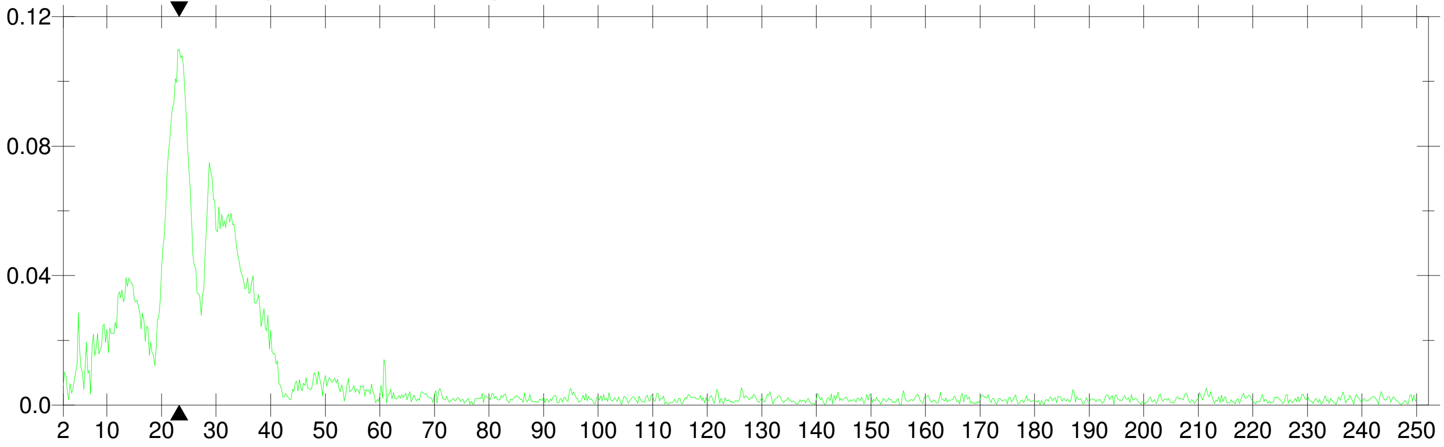
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

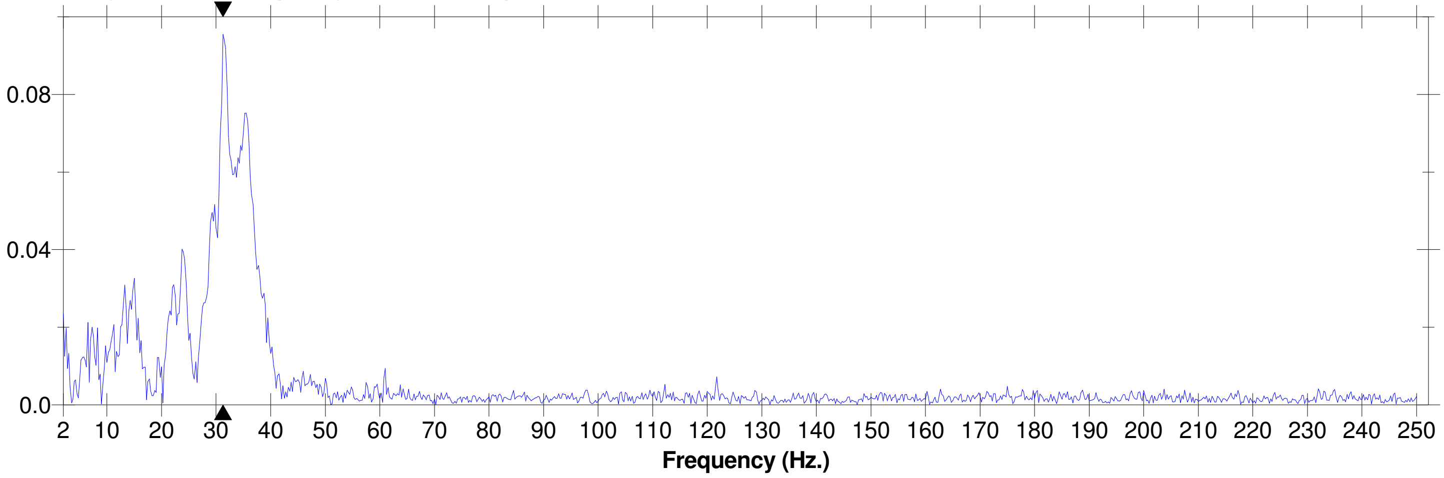
Tran Dominant Frequency = 29.8 Hz., Amplitude = 0.0333, PPV from Event = 0.762 mm/s



Vert Dominant Frequency = 23.3 Hz., Amplitude = 0.110, PPV from Event = 2.92 mm/s



Long Dominant Frequency = 31.3 Hz., Amplitude = 0.0955, PPV from Event = 1.65 mm/s



Event Report

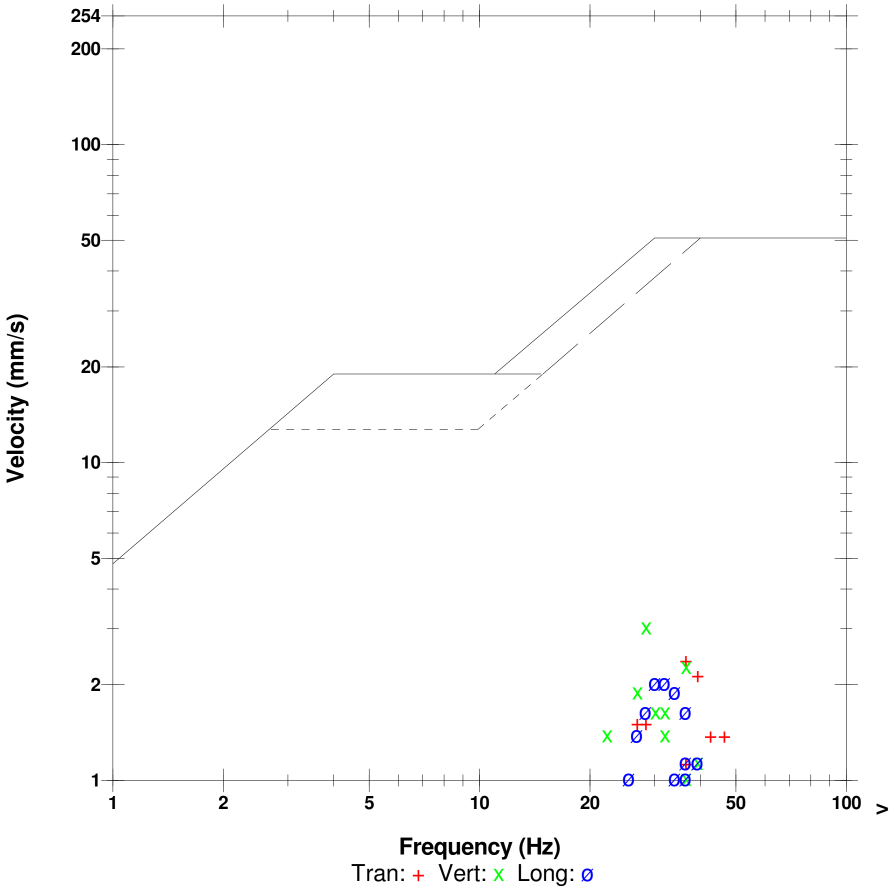
Date/Time Vert at 12:31:50 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

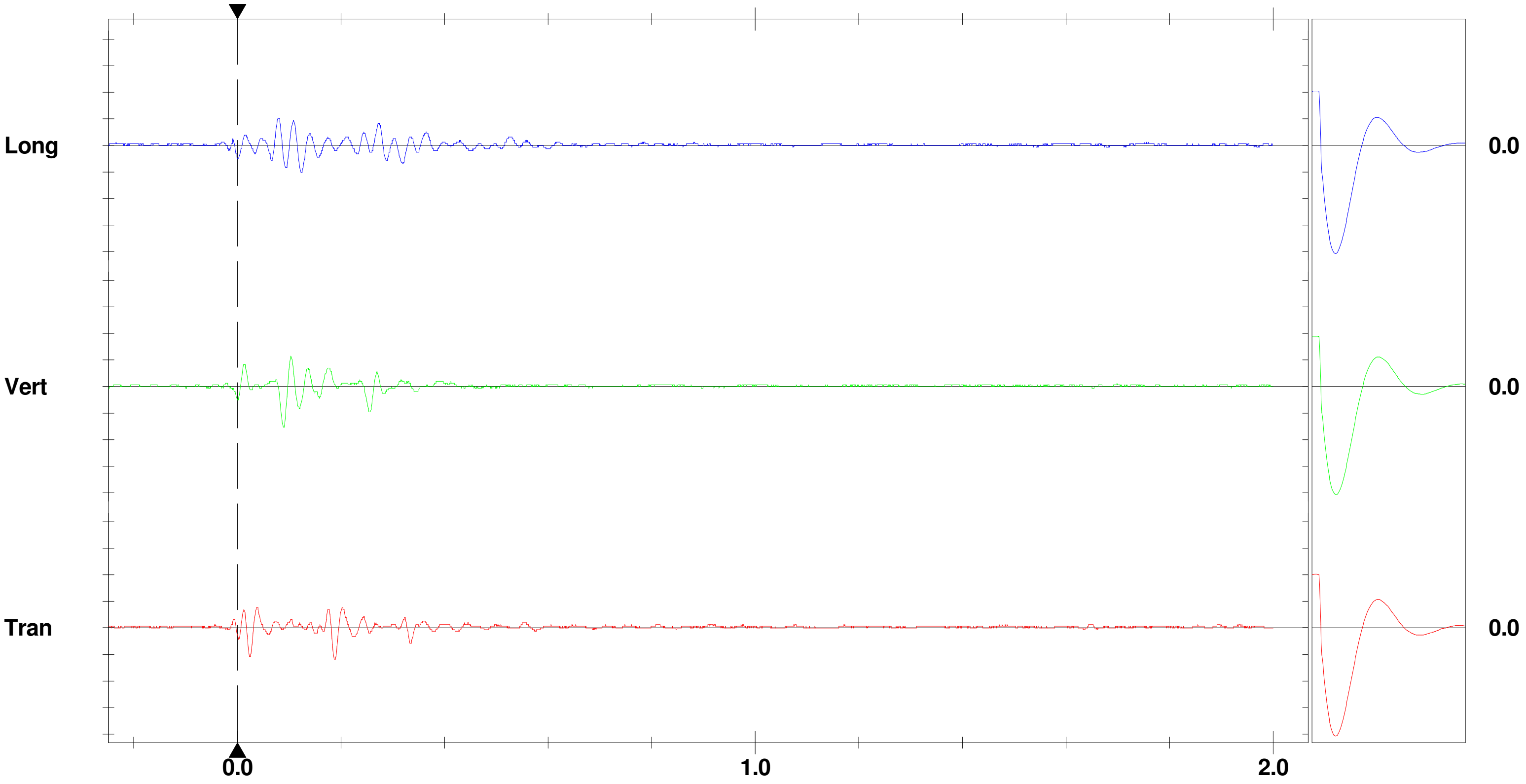
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTU8.520

	Tran	Vert	Long	
PPV	2.41	3.05	2.03	mm/s
ZC Freq	37	28	32	Hz
Time (Rel. to Trig)	0.188	0.089	0.078	sec
Peak Acceleration	0.0663	0.0530	0.0530	g
Peak Displacement	0.0108	0.0162	0.0109	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 3.26 mm/s at 0.090 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

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FFT Report

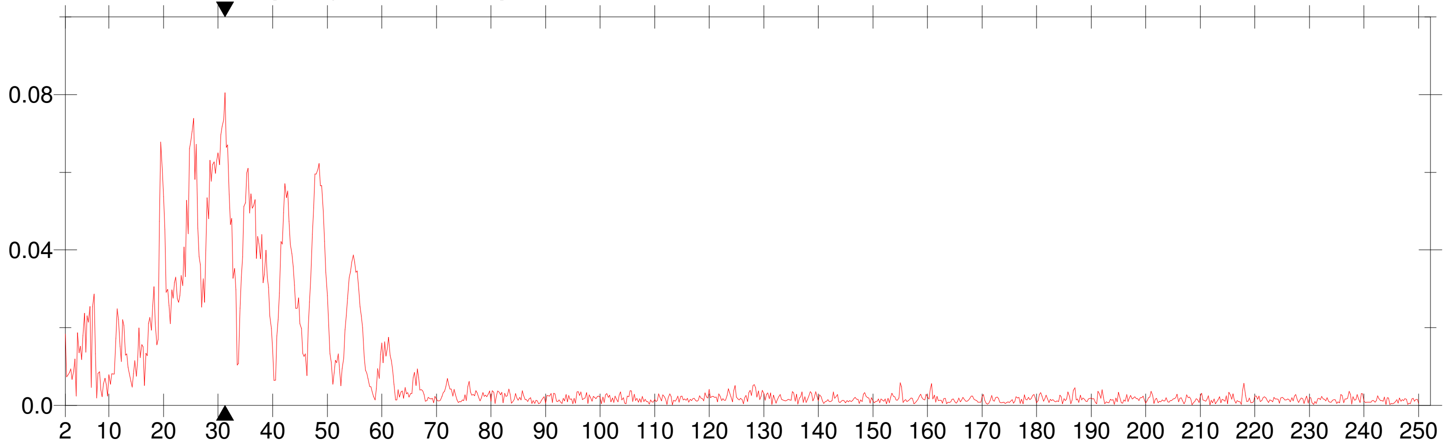
Date/Time	Vert at 12:31:50 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTU8.520

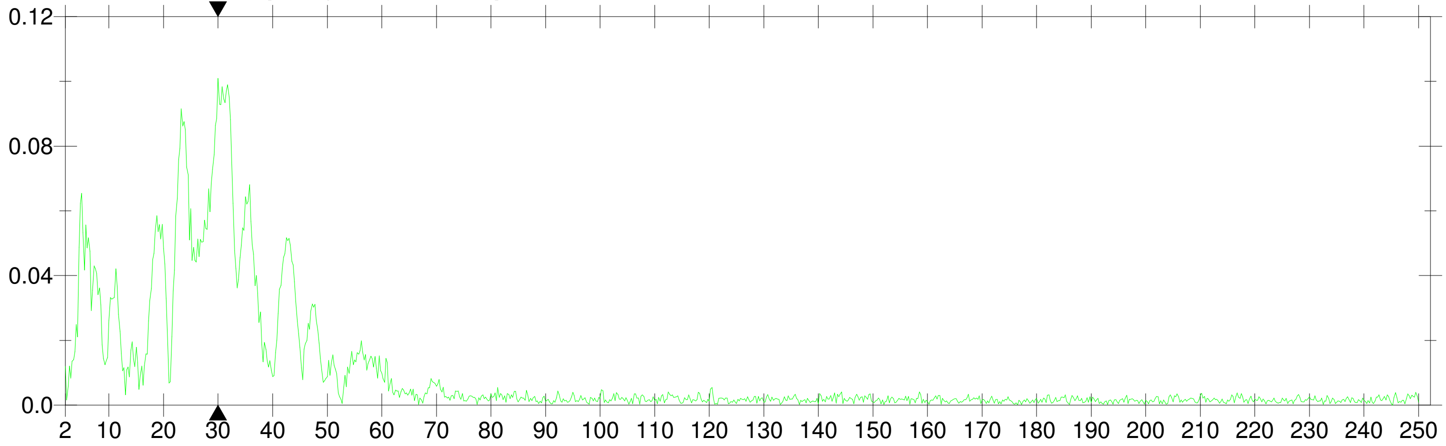
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

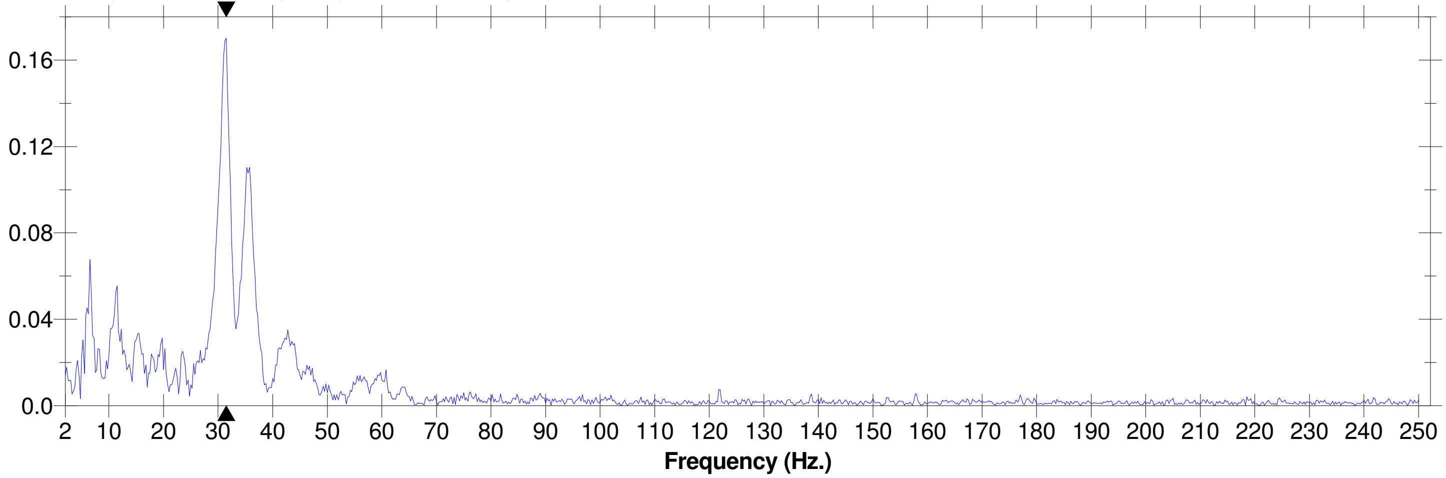
Tran Dominant Frequency = 31.3 Hz., Amplitude = 0.0804, PPV from Event = 2.41 mm/s



Vert Dominant Frequency = 30.0 Hz., Amplitude = 0.101, PPV from Event = 3.05 mm/s



Long Dominant Frequency = 31.5 Hz., Amplitude = 0.170, PPV from Event = 2.03 mm/s



Instantel

Event Report

Date/Time	Vert at 12:31:53 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTU8.550

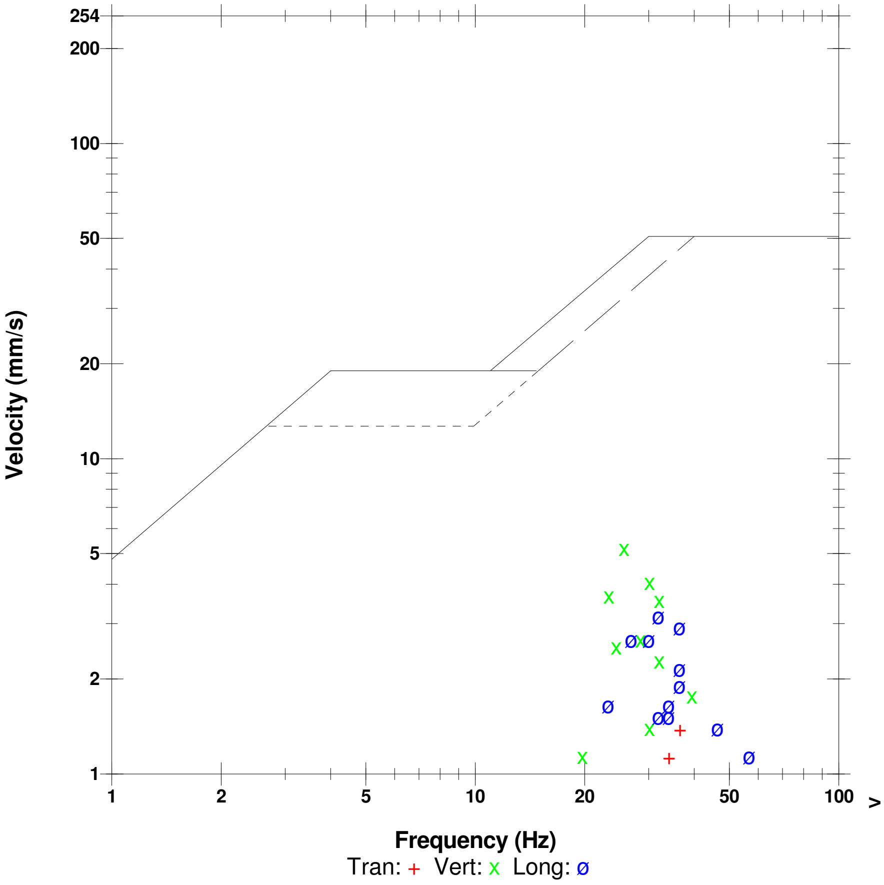
Notes

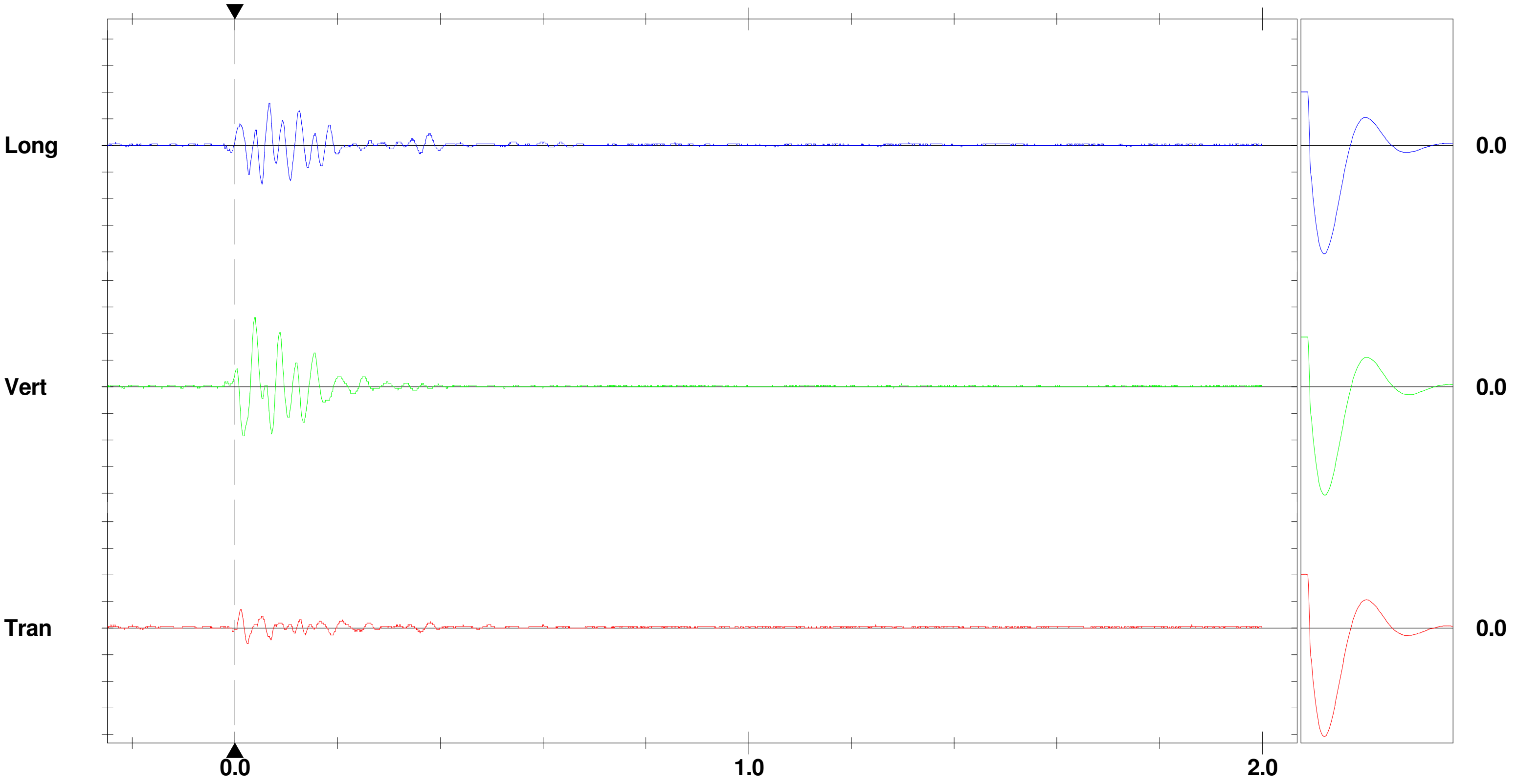
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	**Vert**	**Long**	
PPV	1.40	5.21	3.17	mm/s
ZC Freq	37	26	32	Hz
Time (Rel. to Trig)	0.011	0.038	0.066	sec
Peak Acceleration	0.0398	0.0928	0.0663	g
Peak Displacement	0.00595	0.0301	0.0148	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 5.31 mm/s at 0.039 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶—— ——◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

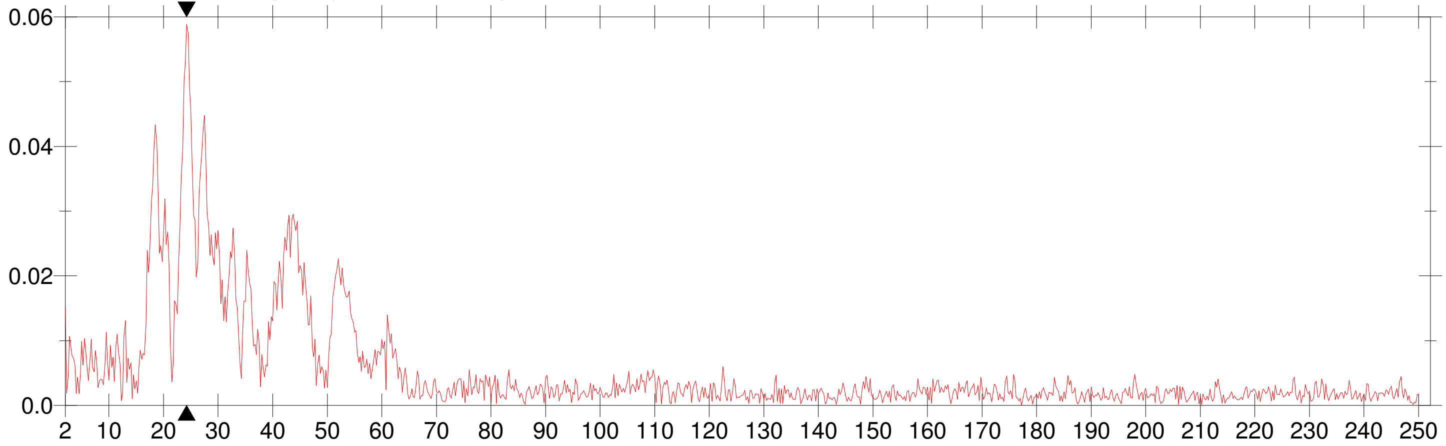
FFT Report

Date/Time	Vert at 12:31:53 March 31, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTU8.550

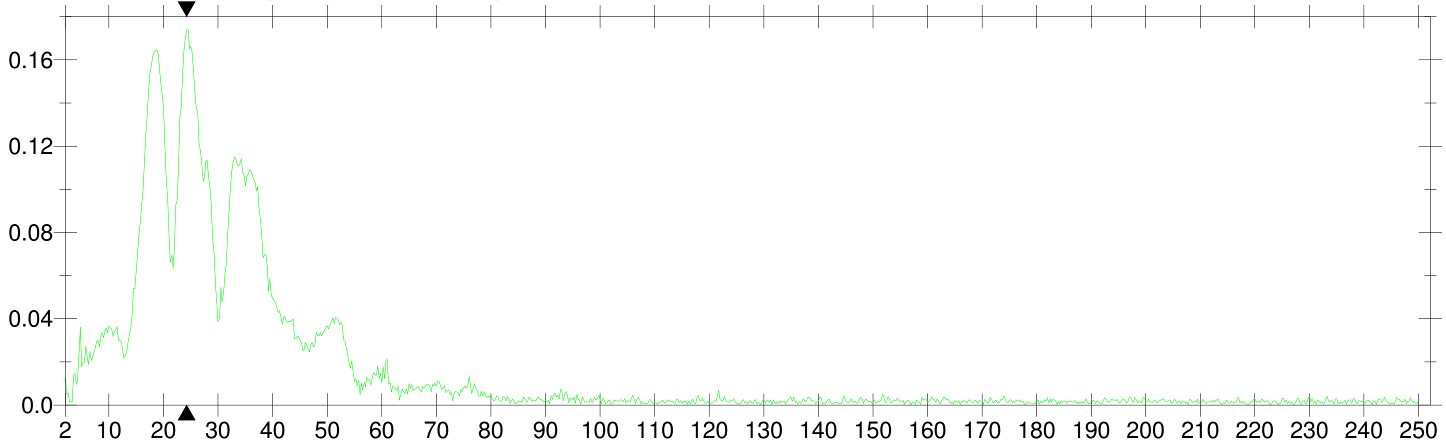
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

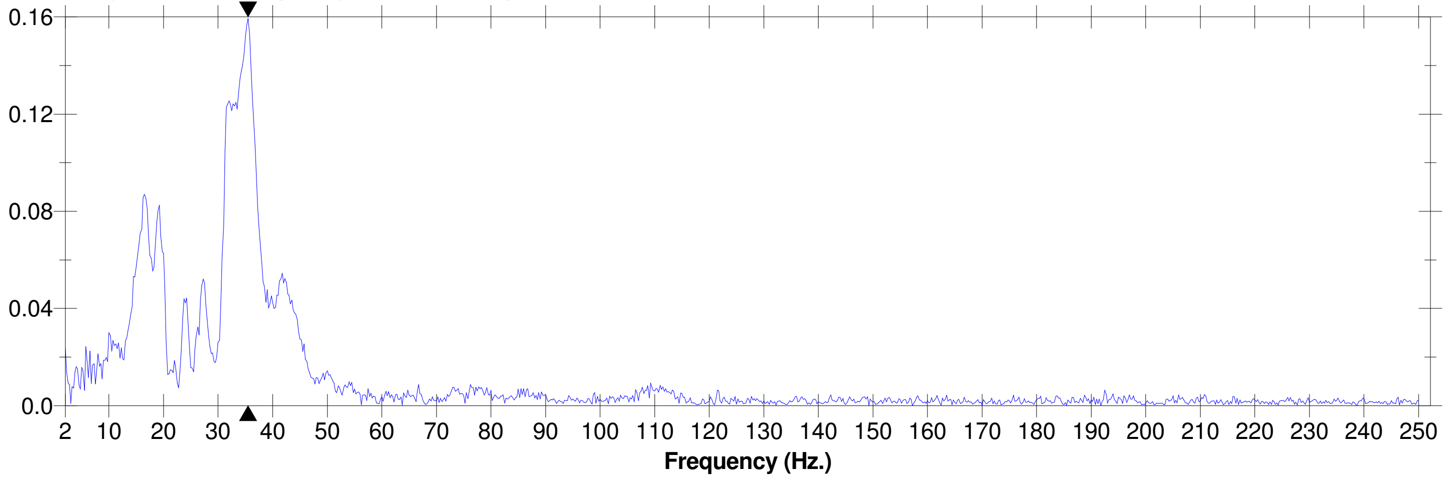
Tran Dominant Frequency = 24.3 Hz., Amplitude = 0.0589, PPV from Event = 1.40 mm/s



Vert Dominant Frequency = 24.3 Hz., Amplitude = 0.174, PPV from Event = 5.21 mm/s



Long Dominant Frequency = 35.5 Hz., Amplitude = 0.159, PPV from Event = 3.17 mm/s



Event Report

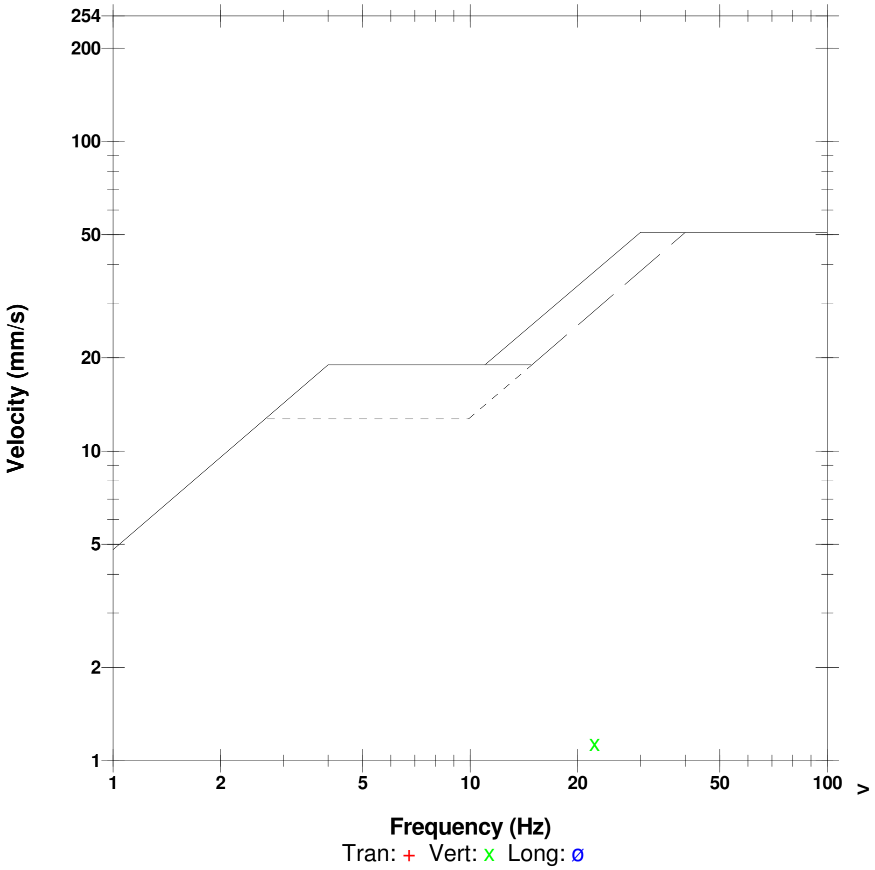
Date/Time Vert at 12:40:13 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

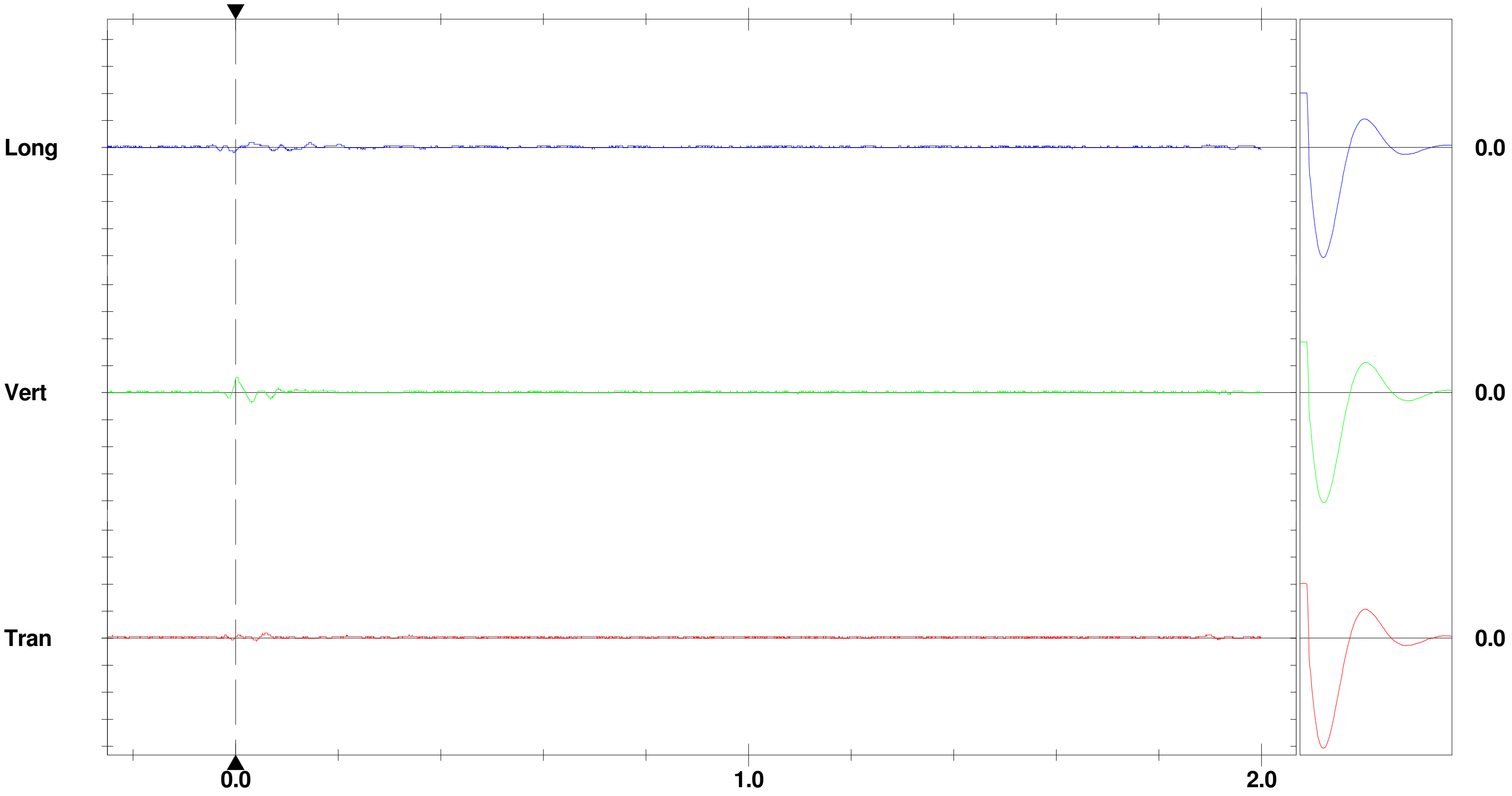
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTU8.J10

	Tran	Vert	Long	
PPV	0.381	1.14	0.381	mm/s
ZC Freq	27	22	32	Hz
Time (Rel. to Trig)	0.053	0.001	-0.005	sec
Peak Acceleration	0.0133	0.0265	0.0133	g
Peak Displacement	0.00267	0.00757	0.00347	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 1.18 mm/s at 0.001 sec

USBM RI8507 And OSMRE





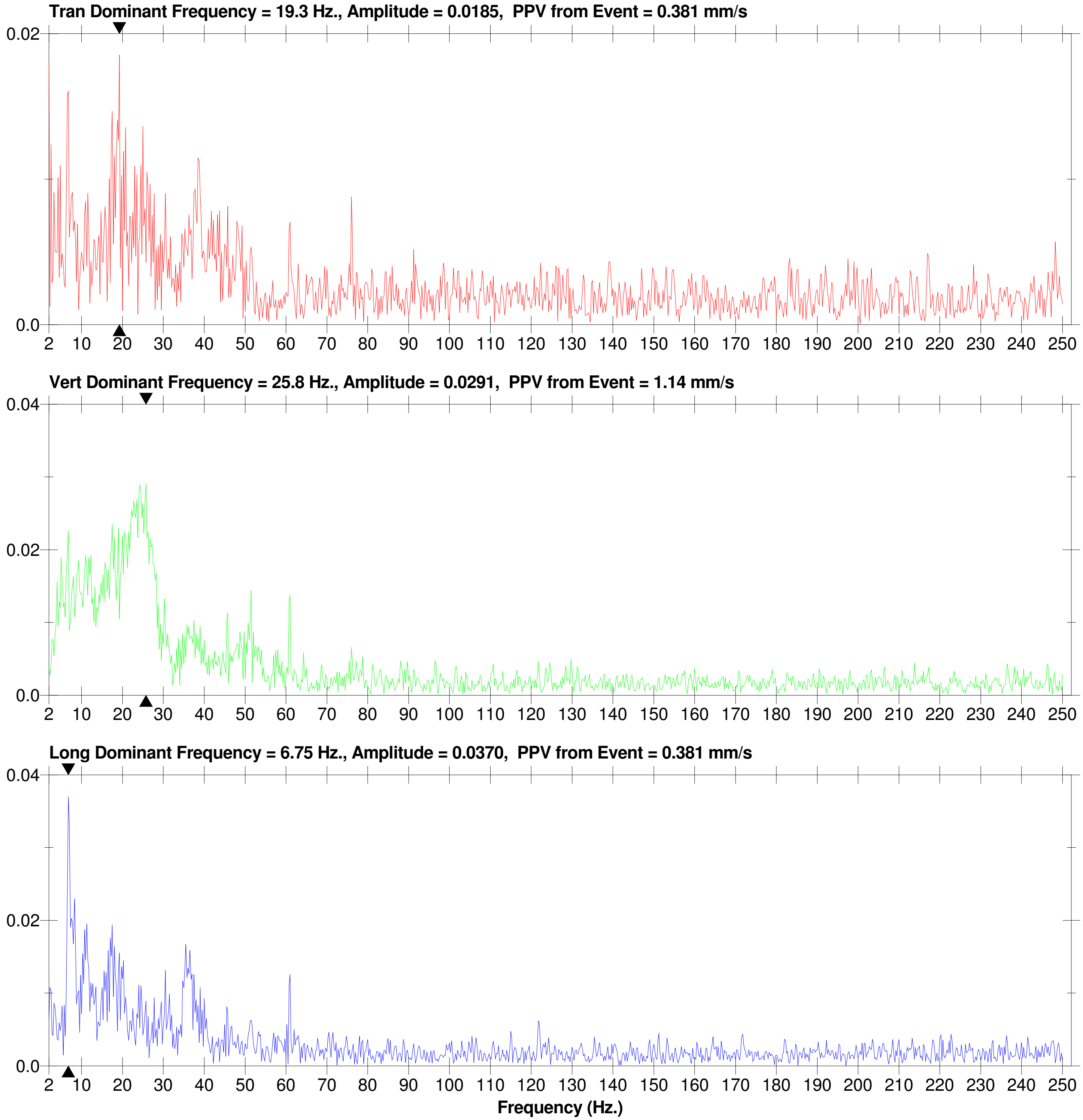
Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div Sensor Check
Trigger = ▶──── ────◀

FFT Report

Date/Time	Vert at 12:40:13 March 31, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTU8.J10

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent



Instantel

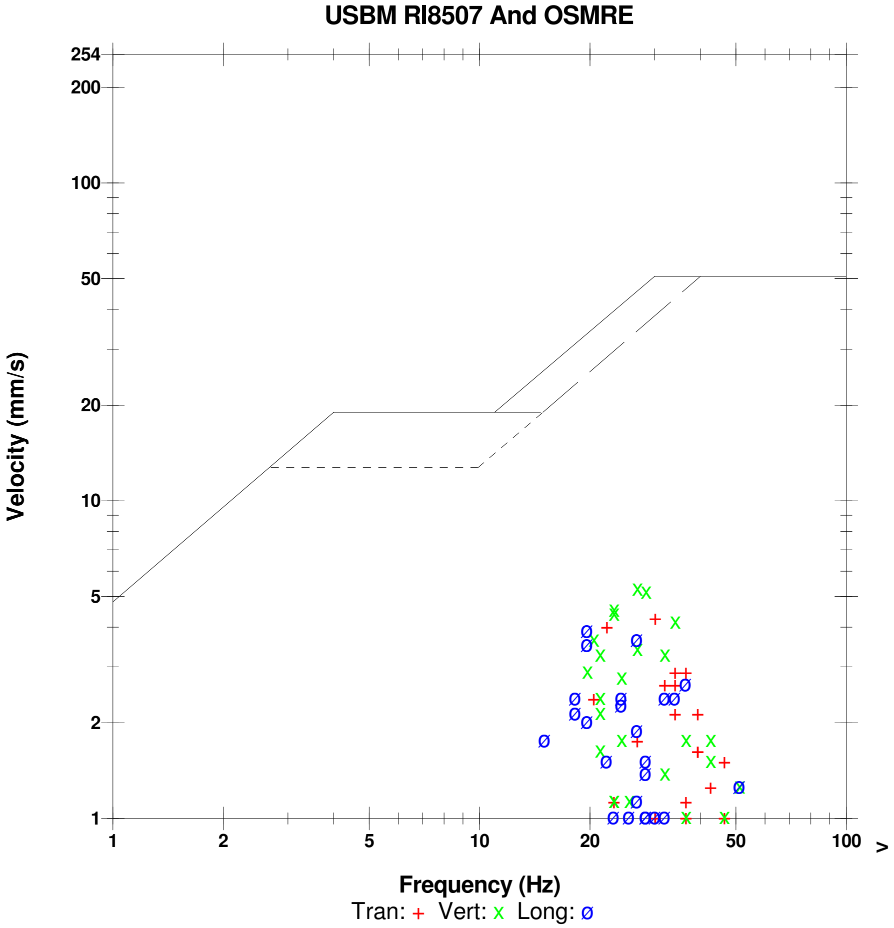
Event Report

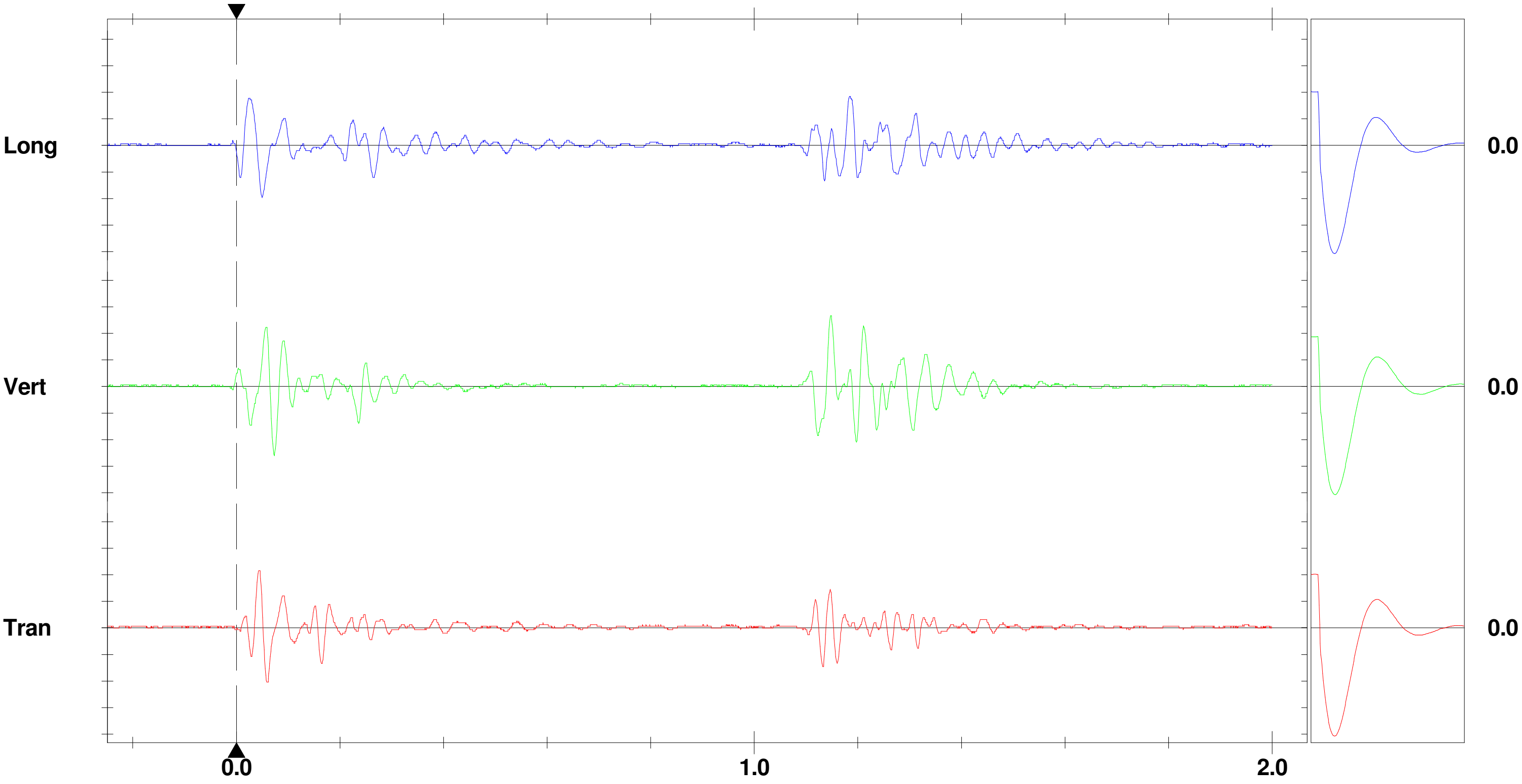
Date/Time Vert at 12:40:31 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTU8.JJ0

	Tran	Vert	Long	
PPV	4.32	5.33	3.94	mm/s
ZC Freq	30	27	20	Hz
Time (Rel. to Trig)	0.043	1.147	0.050	sec
Peak Acceleration	0.0928	0.106	0.0928	g
Peak Displacement	0.0244	0.0303	0.0306	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 6.32 mm/s at 0.058 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Instantel

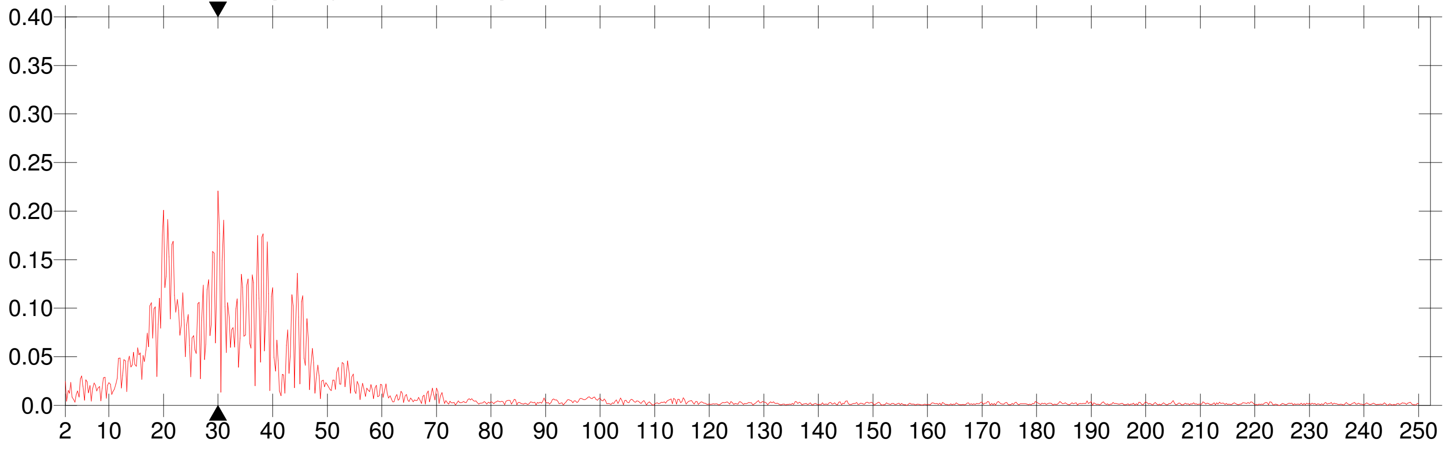
FFT Report

Date/Time Vert at 12:40:31 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

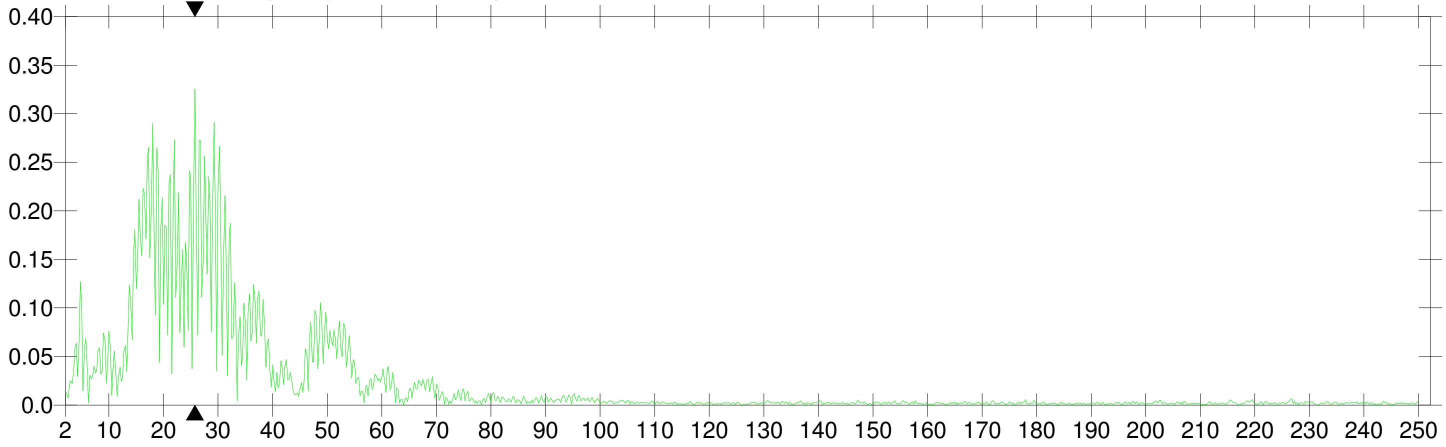
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTU8.JJ0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

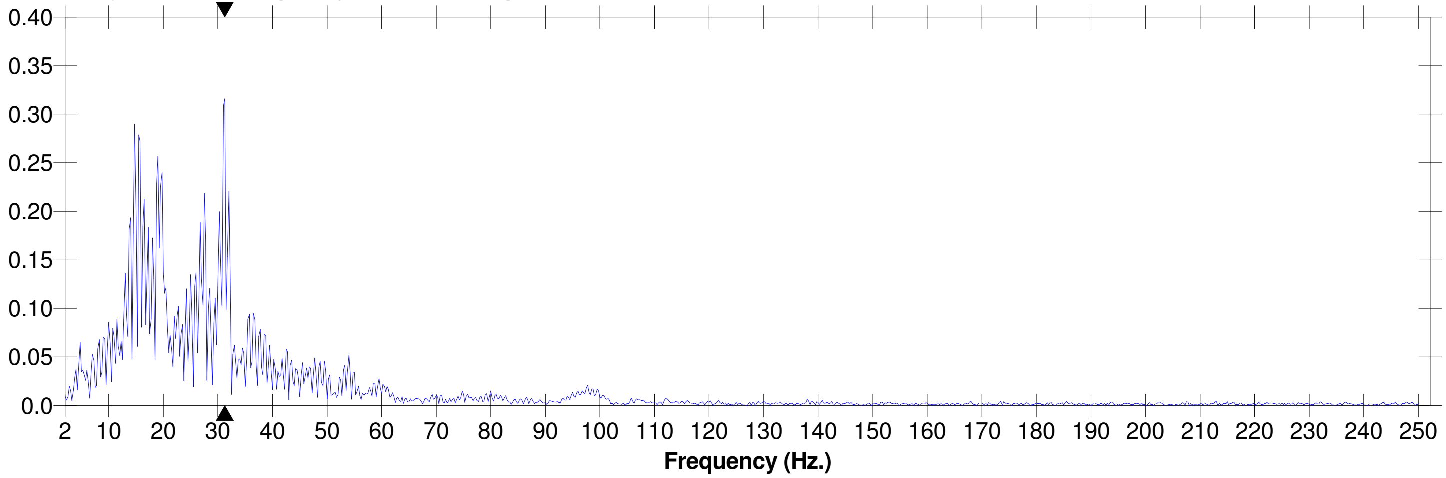
Tran Dominant Frequency = 30.0 Hz., Amplitude = 0.221, PPV from Event = 4.32 mm/s



Vert Dominant Frequency = 25.8 Hz., Amplitude = 0.325, PPV from Event = 5.33 mm/s



Long Dominant Frequency = 31.3 Hz., Amplitude = 0.316, PPV from Event = 3.94 mm/s



Event Report

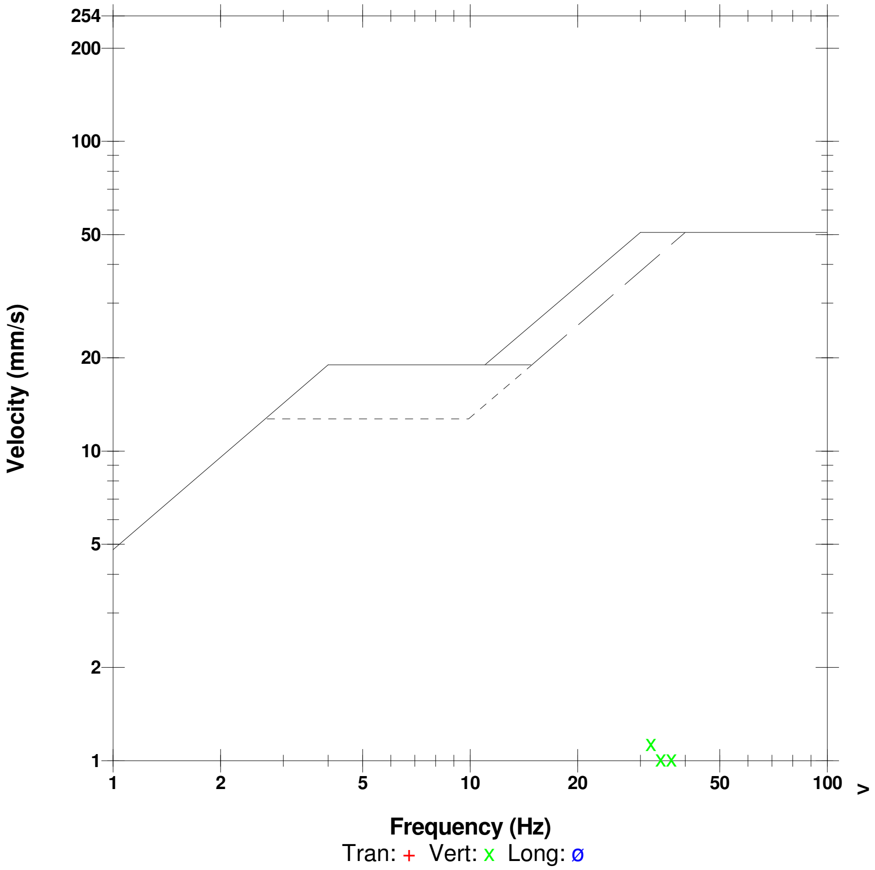
Date/Time Vert at 12:53:31 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

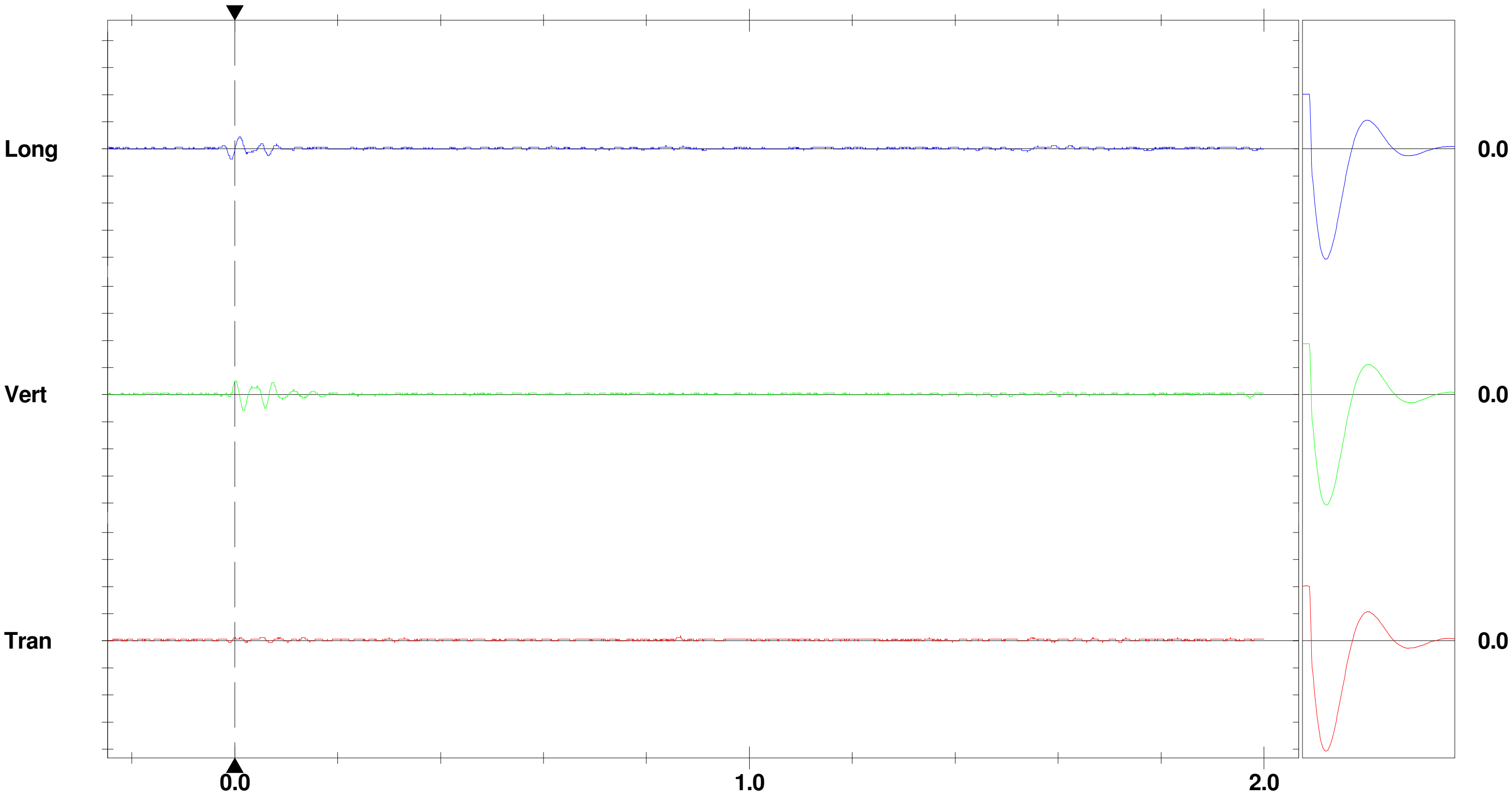
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTU9.570

	Tran	Vert	Long	
PPV	0.381	1.14	0.889	mm/s
ZC Freq	47	32	28	Hz
Time (Rel. to Trig)	0.866	0.016	0.008	sec
Peak Acceleration	0.0133	0.0265	0.0265	g
Peak Displacement	0.00130	0.00589	0.00521	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 1.26 mm/s at 0.016 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Sensor Check

Trigger = ▶——— ———◀

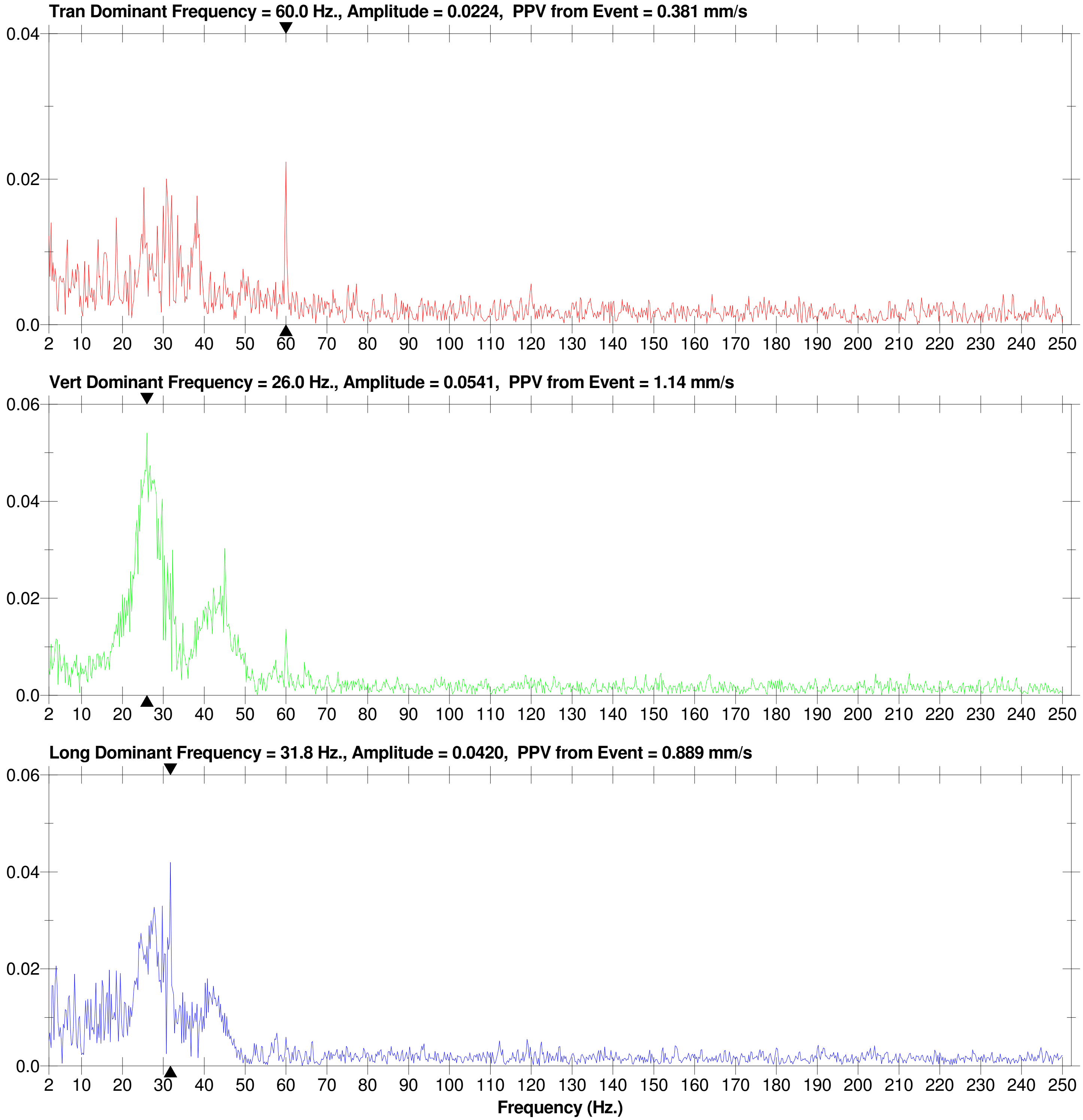
Instantel

FFT Report

Date/Time	Vert at 12:53:31 March 31, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTU9.570

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent



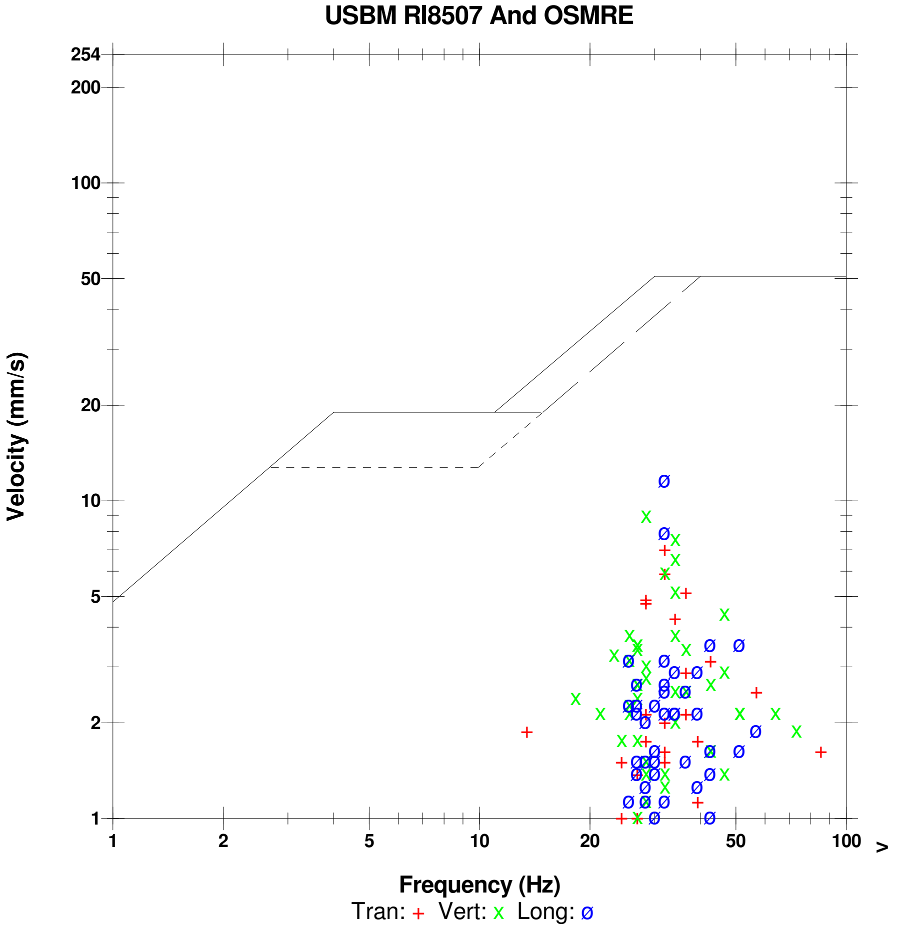
Event Report

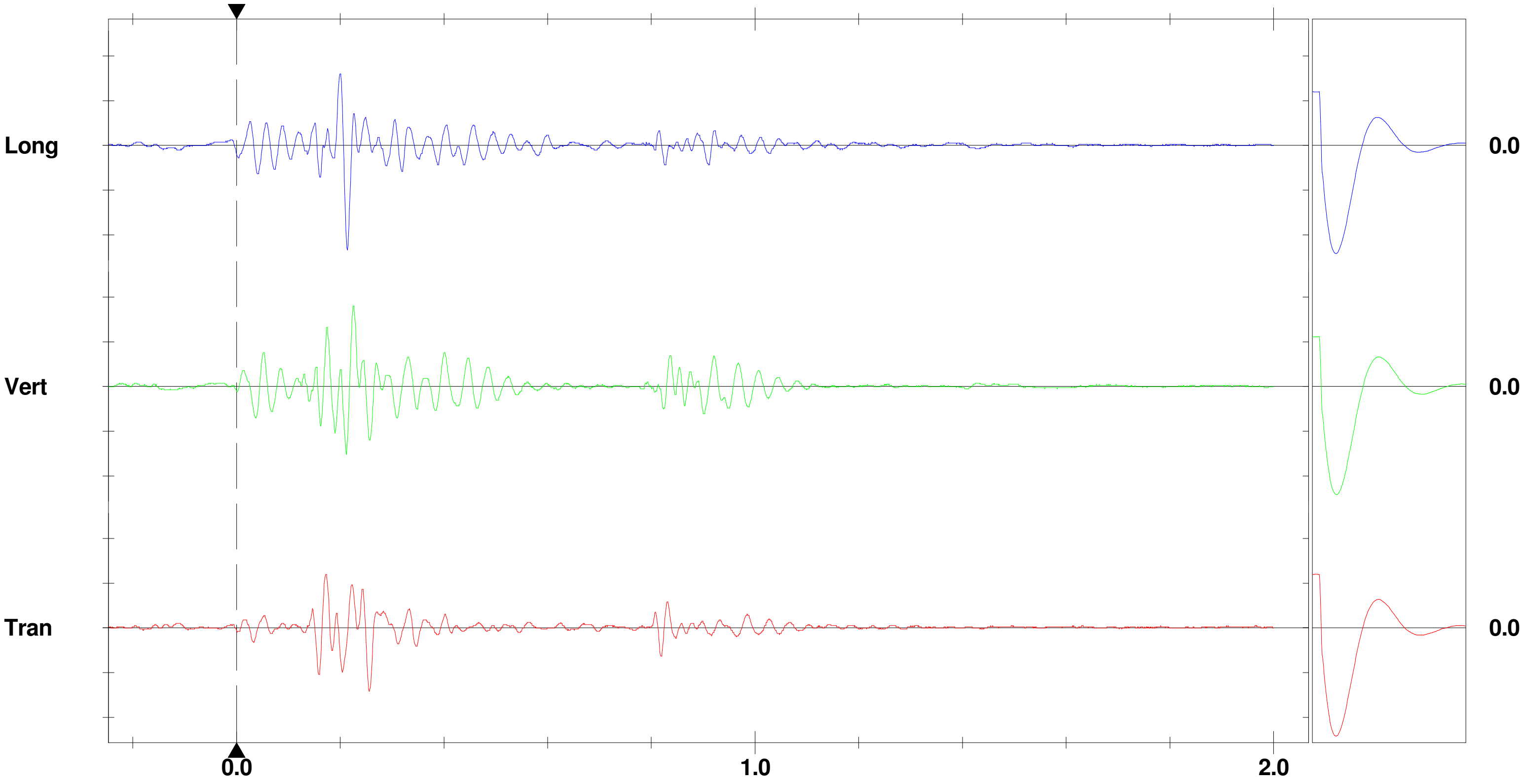
Date/Time Long at 12:53:40 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTU9.5G0

	Tran	Vert	Long	
PPV	7.11	9.02	11.7	mm/s
ZC Freq	32	28	32	Hz
Time (Rel. to Trig)	0.256	0.225	0.214	sec
Peak Acceleration	0.146	0.186	0.239	g
Peak Displacement	0.0342	0.0448	0.0545	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 13.5 mm/s at 0.213 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

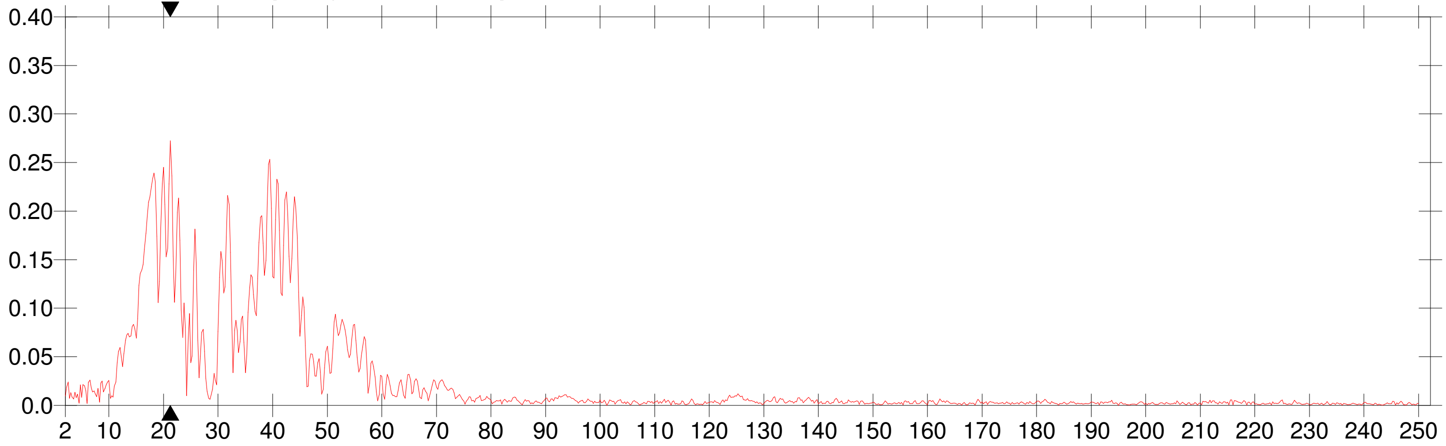
FFT Report

Date/Time	Long at 12:53:40 March 31, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTU9.5G0

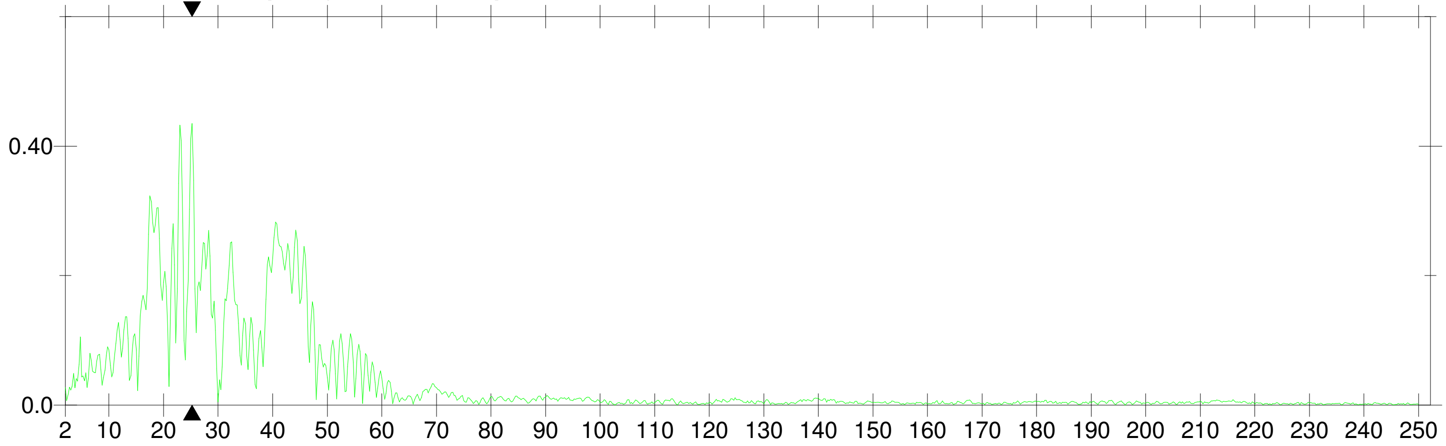
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

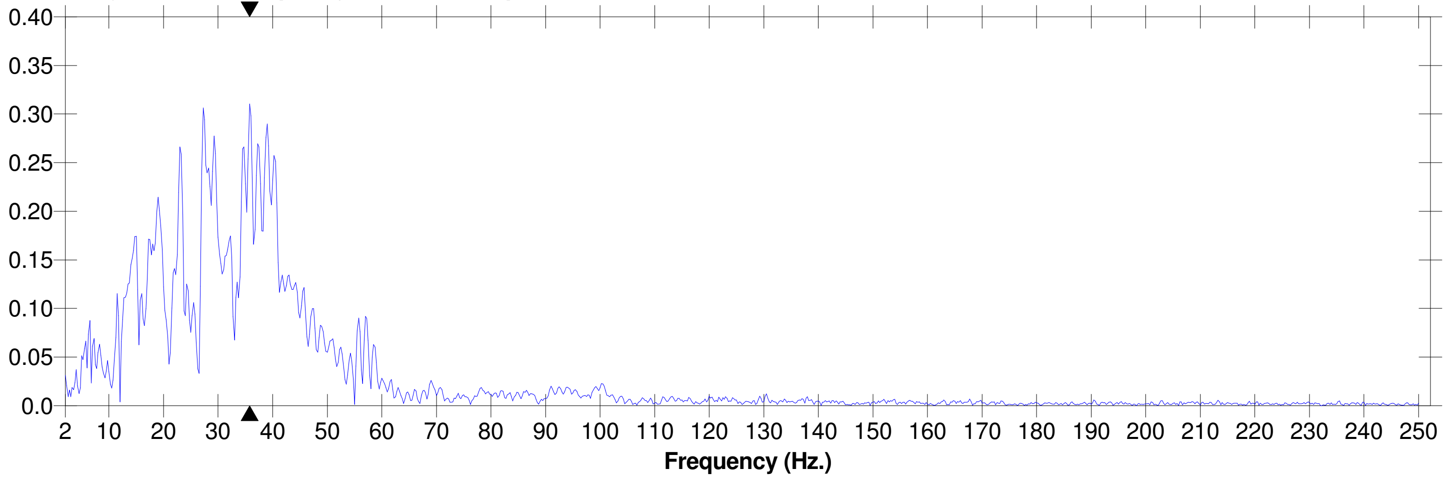
Tran Dominant Frequency = 21.3 Hz., Amplitude = 0.273, PPV from Event = 7.11 mm/s



Vert Dominant Frequency = 25.3 Hz., Amplitude = 0.435, PPV from Event = 9.02 mm/s



Long Dominant Frequency = 35.8 Hz., Amplitude = 0.310, PPV from Event = 11.7 mm/s



Event Report

Date/Time	Long at 12:53:53 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps
Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTU9.5T0

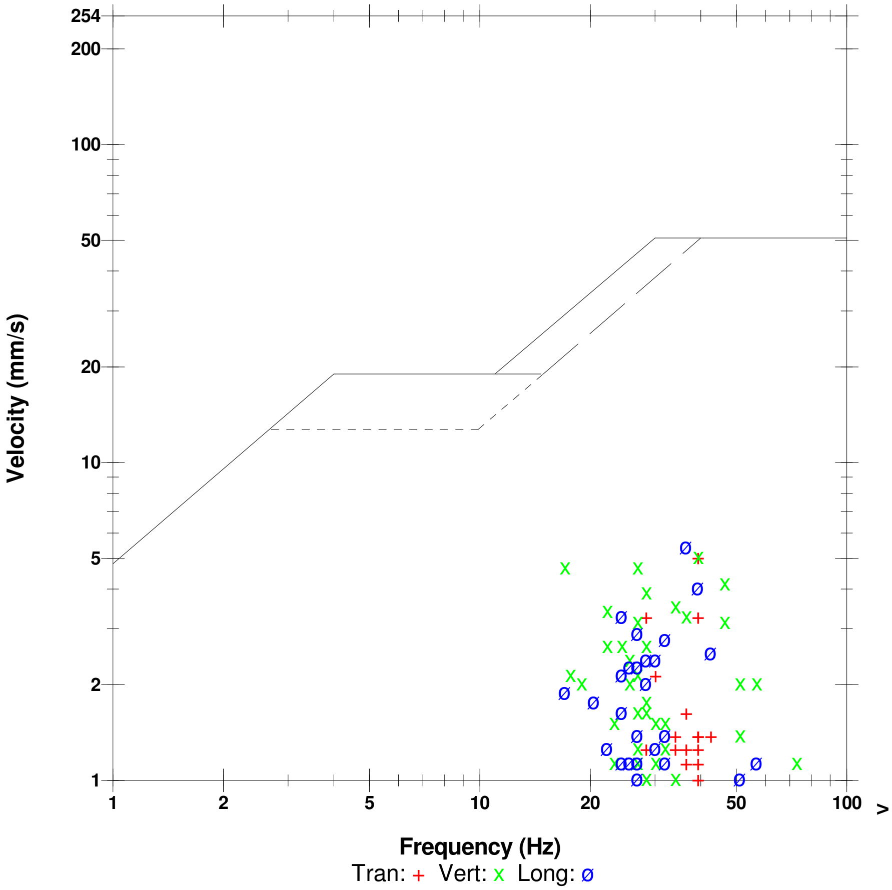
Notes

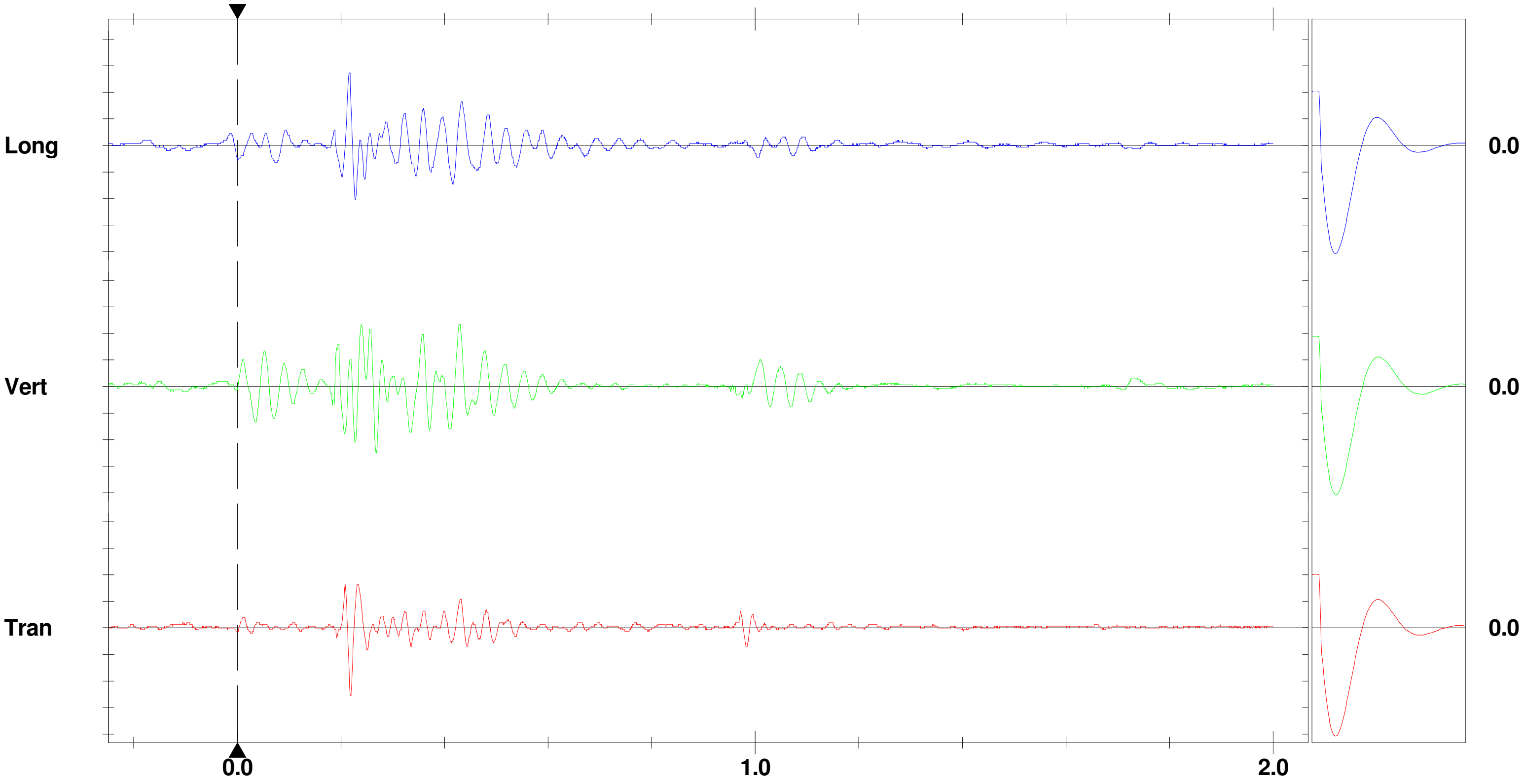
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	5.08	5.08	5.46	mm/s
ZC Freq	39	39	37	Hz
Time (Rel. to Trig)	0.218	0.268	0.216	sec
Peak Acceleration	0.133	0.146	0.119	g
Peak Displacement	0.0187	0.0398	0.0218	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 7.30 mm/s at 0.218 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

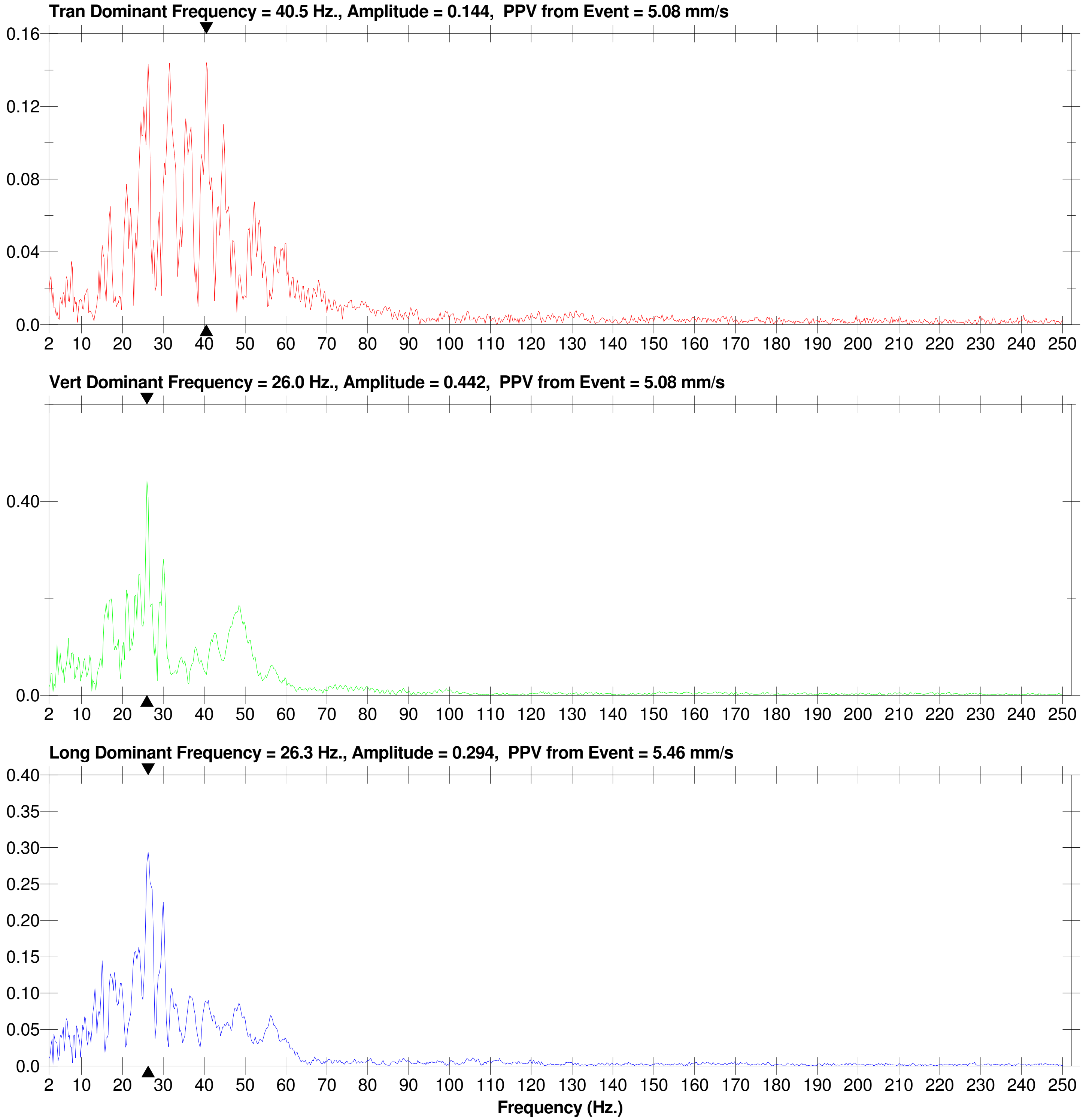
Sensor Check

FFT Report

Date/Time	Long at 12:53:53 March 31, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTU9.5T0

Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent



Event Report

Date/Time	Long at 12:54:04 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTU9.640

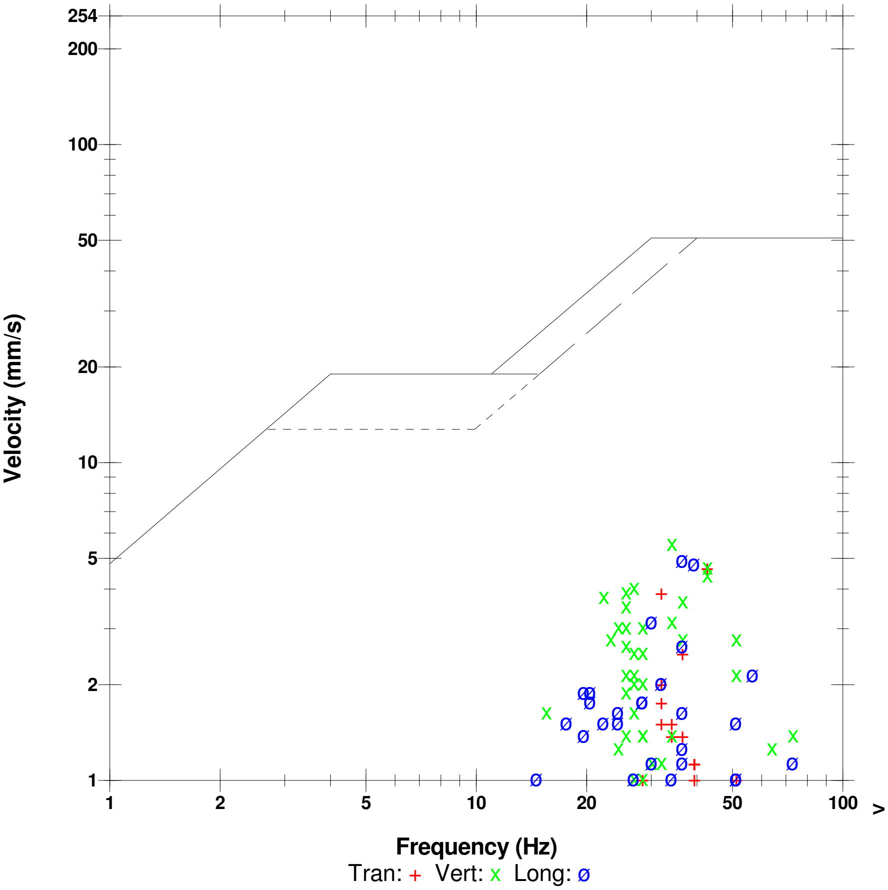
Notes

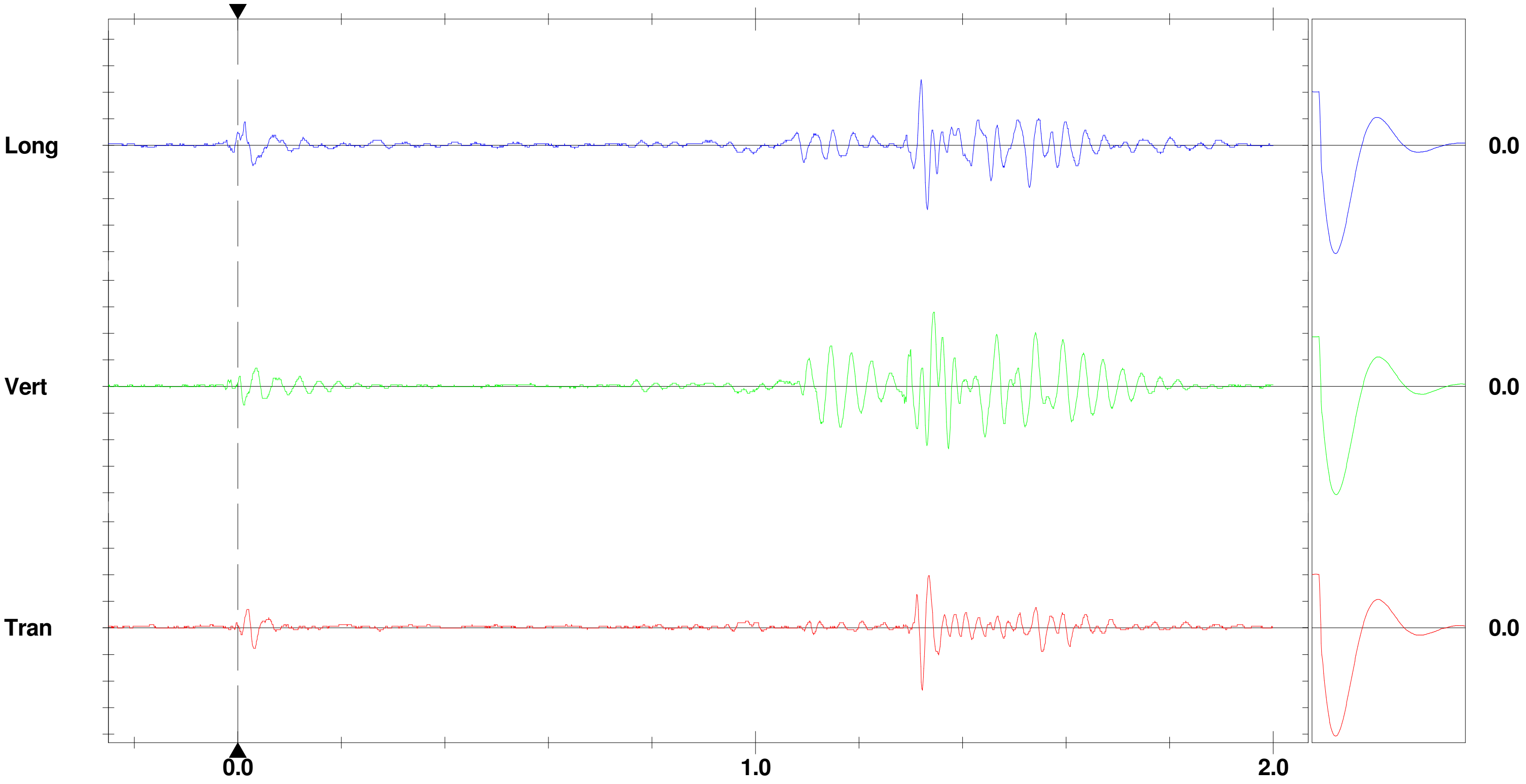
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	4.70	5.59	4.95	mm/s
ZC Freq	43	34	37	Hz
Time (Rel. to Trig)	1.322	1.344	1.320	sec
Peak Acceleration	0.119	0.146	0.133	g
Peak Displacement	0.0189	0.0260	0.0190	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 7.21 mm/s at 1.332 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

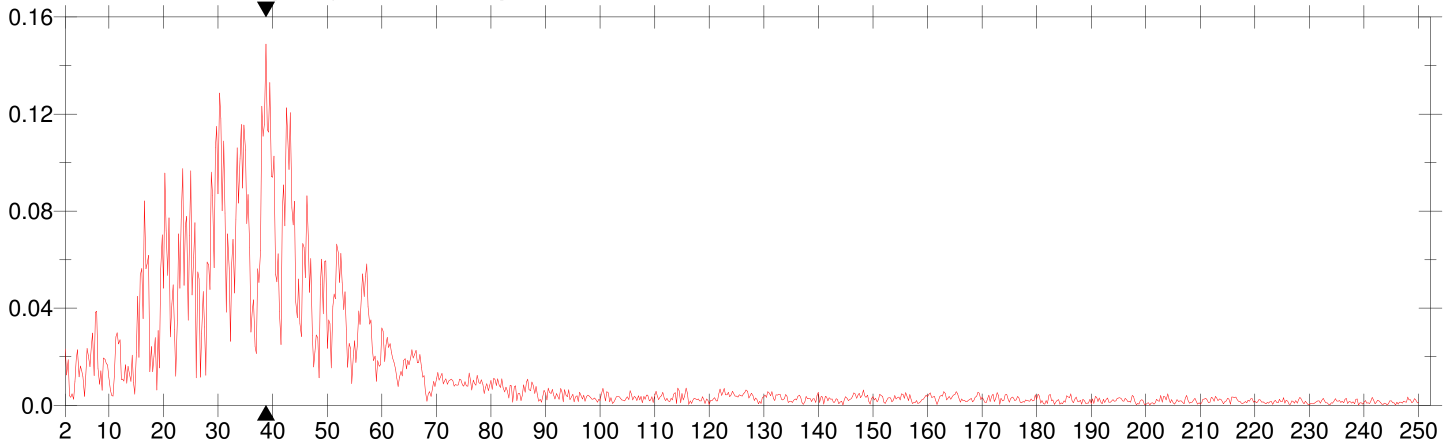
FFT Report

Date/Time	Long at 12:54:04 March 31, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.00 mm/s	**Battery Level**	6.3 Volts
Range	Geo: 254 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 1024 sps	**File Name**	T695GTU9.640

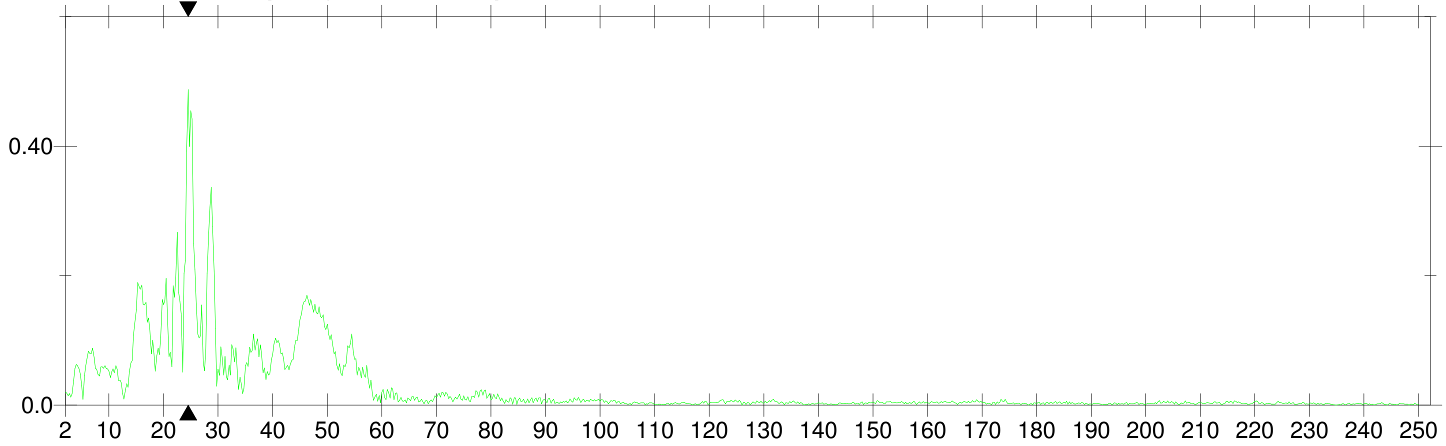
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

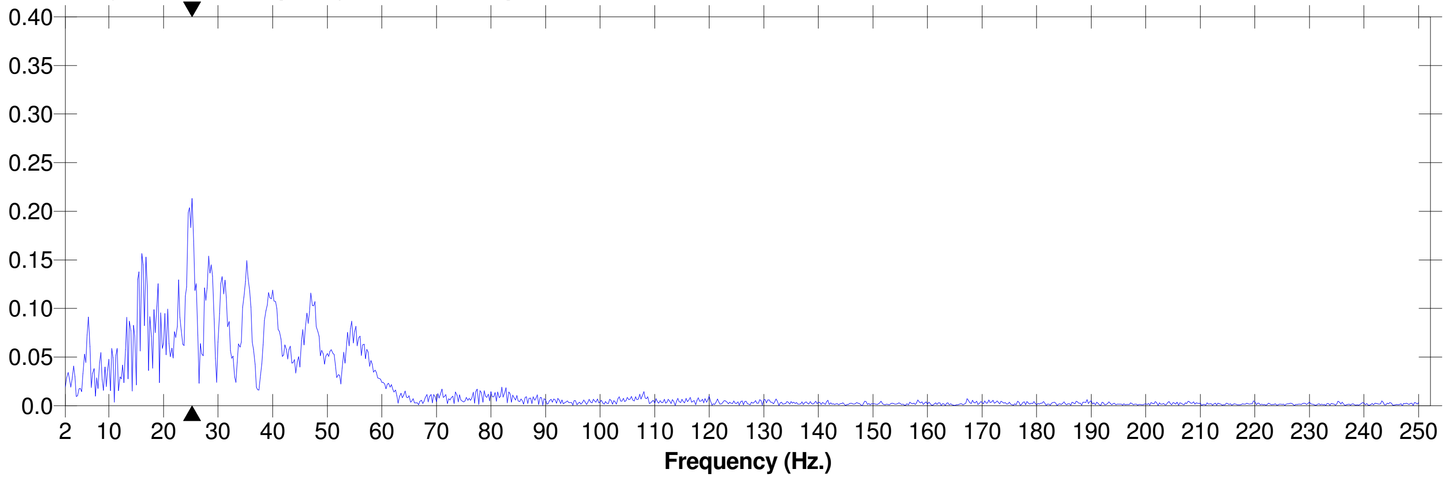
Tran Dominant Frequency = 38.8 Hz., Amplitude = 0.149, PPV from Event = 4.70 mm/s



Vert Dominant Frequency = 24.5 Hz., Amplitude = 0.487, PPV from Event = 5.59 mm/s



Long Dominant Frequency = 25.3 Hz., Amplitude = 0.213, PPV from Event = 4.95 mm/s



Instantel

Event Report

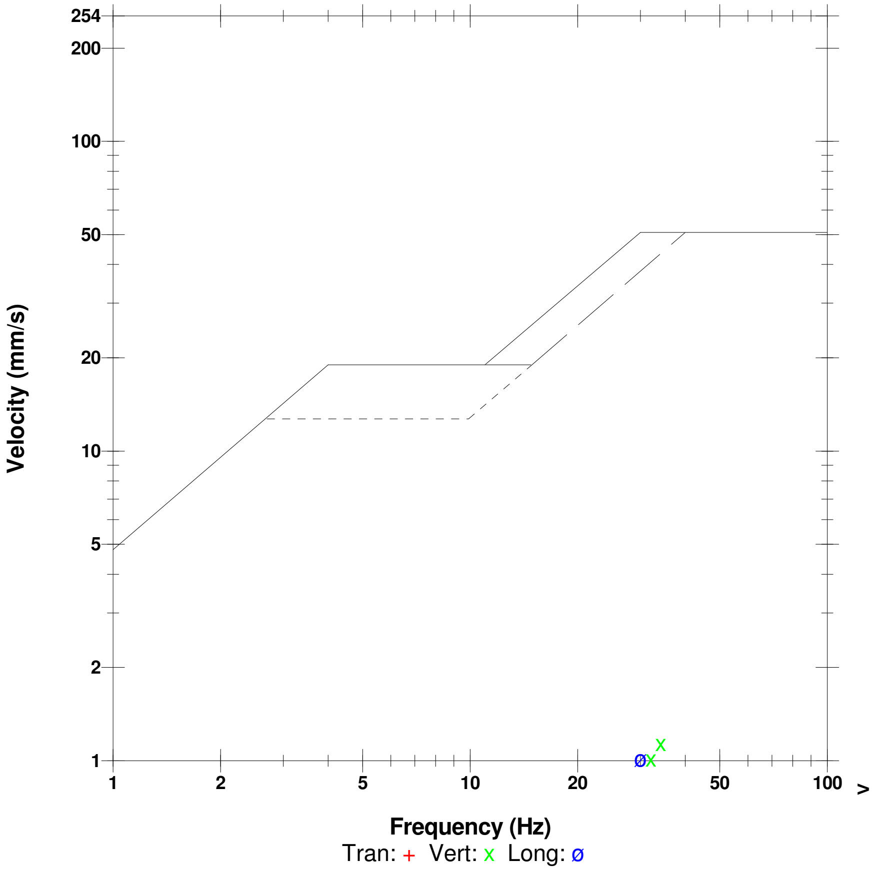
Date/Time Long at 12:54:11 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

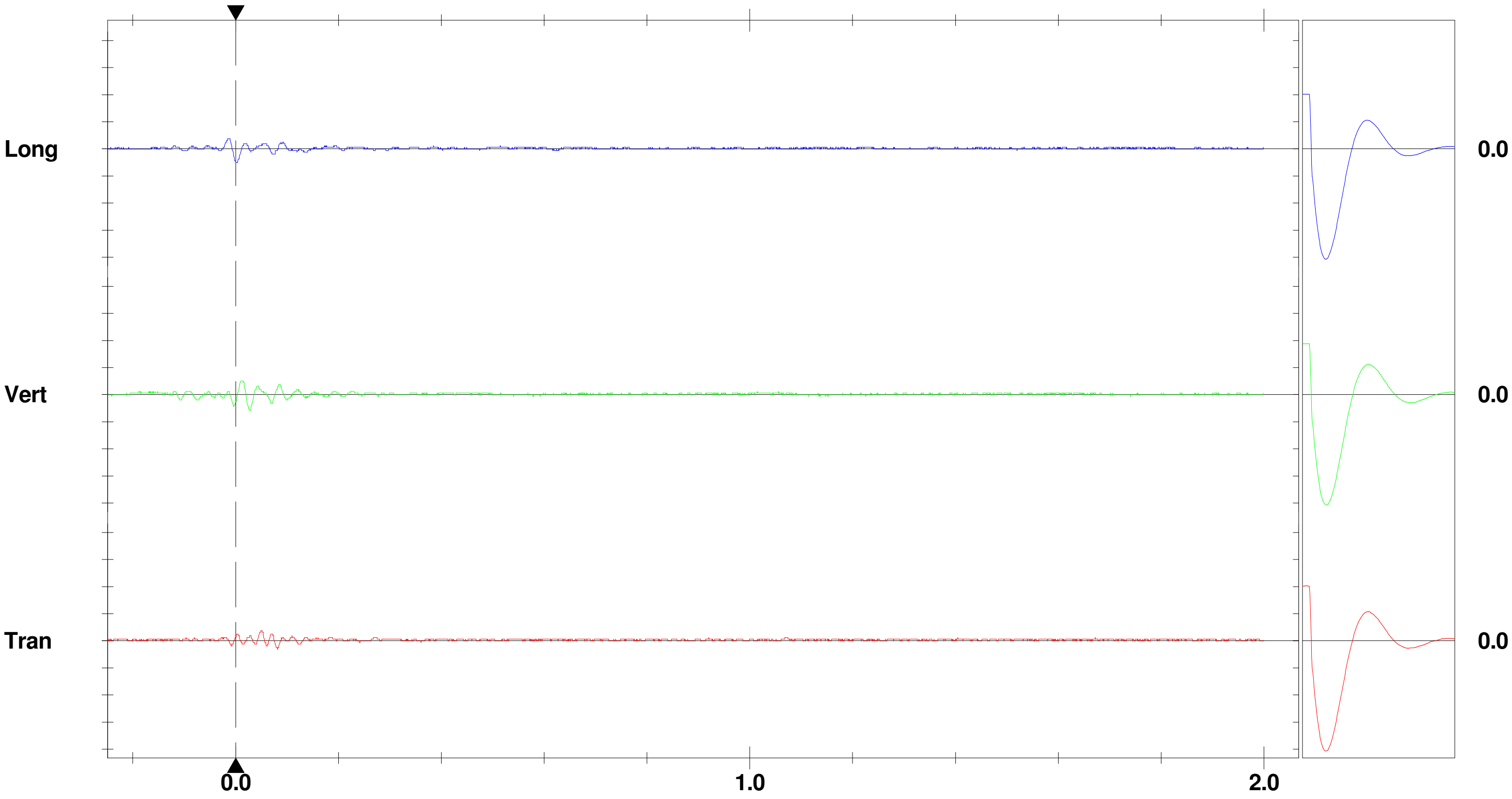
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTU9.6B0

	Tran	Vert	Long	
PPV	0.762	1.14	1.02	mm/s
ZC Freq	39	34	30	Hz
Time (Rel. to Trig)	0.049	0.026	0.000	sec
Peak Acceleration	0.0265	0.0265	0.0265	g
Peak Displacement	0.00322	0.00546	0.00558	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 1.21 mm/s at 0.027 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Printed: April 24, 2017 (V 10.60 - 10.60)

Instantel

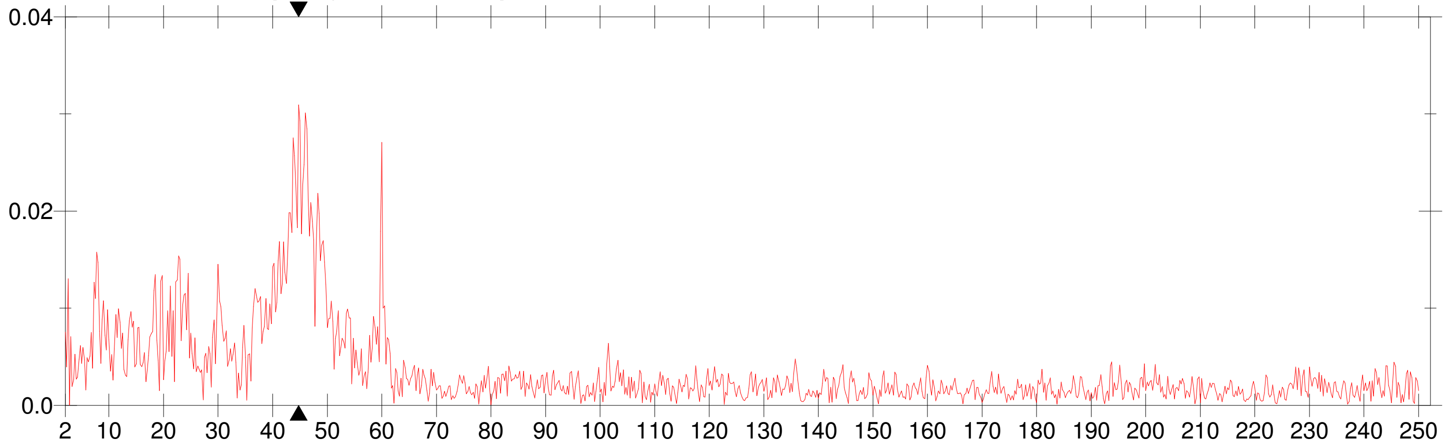
FFT Report

Date/Time Long at 12:54:11 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

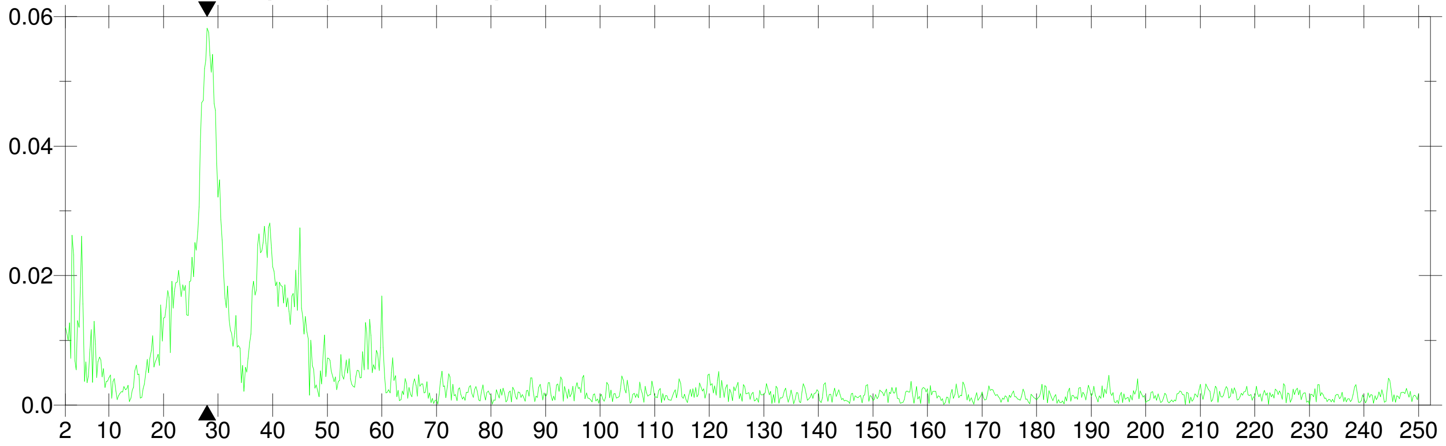
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTU9.6B0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

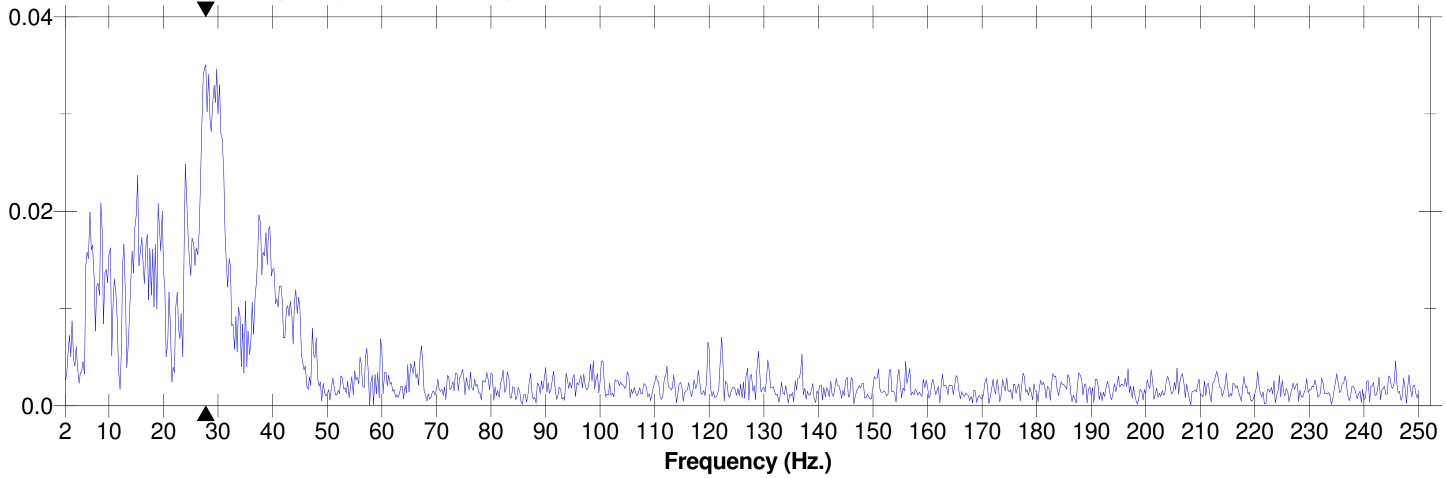
Tran Dominant Frequency = 44.8 Hz., Amplitude = 0.0309, PPV from Event = 0.762 mm/s



Vert Dominant Frequency = 28.0 Hz., Amplitude = 0.0582, PPV from Event = 1.14 mm/s



Long Dominant Frequency = 27.8 Hz., Amplitude = 0.0351, PPV from Event = 1.02 mm/s



Instantel

Event Report

Date/Time	Long at 12:54:19 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	2.0 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTU9.6J0

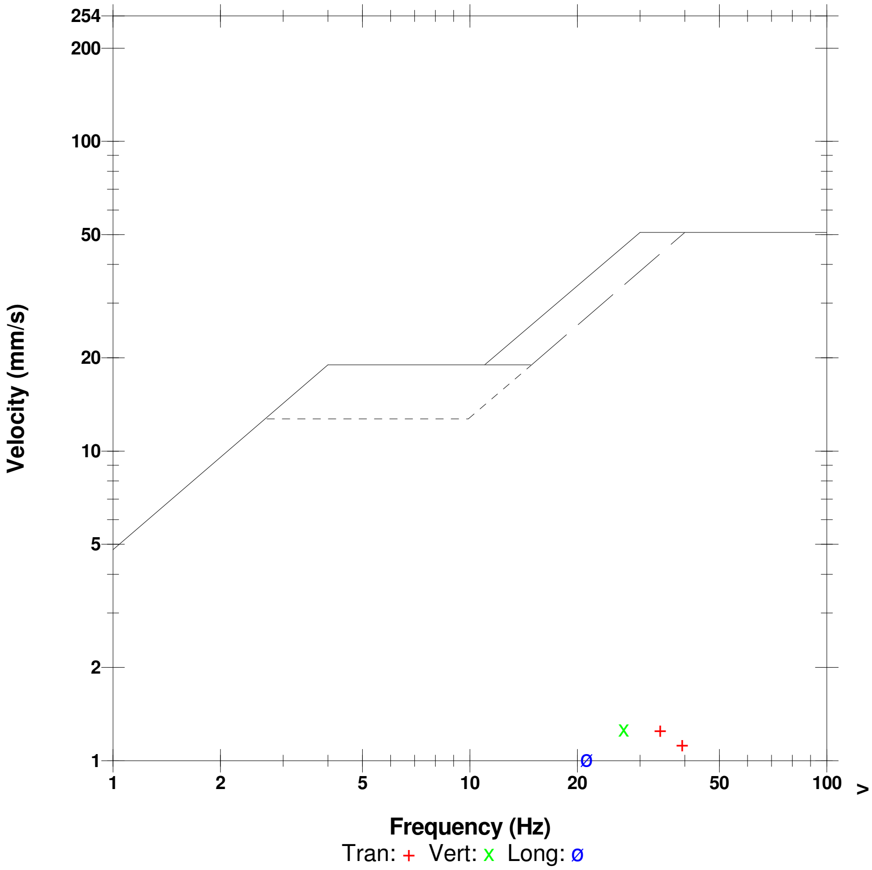
Notes

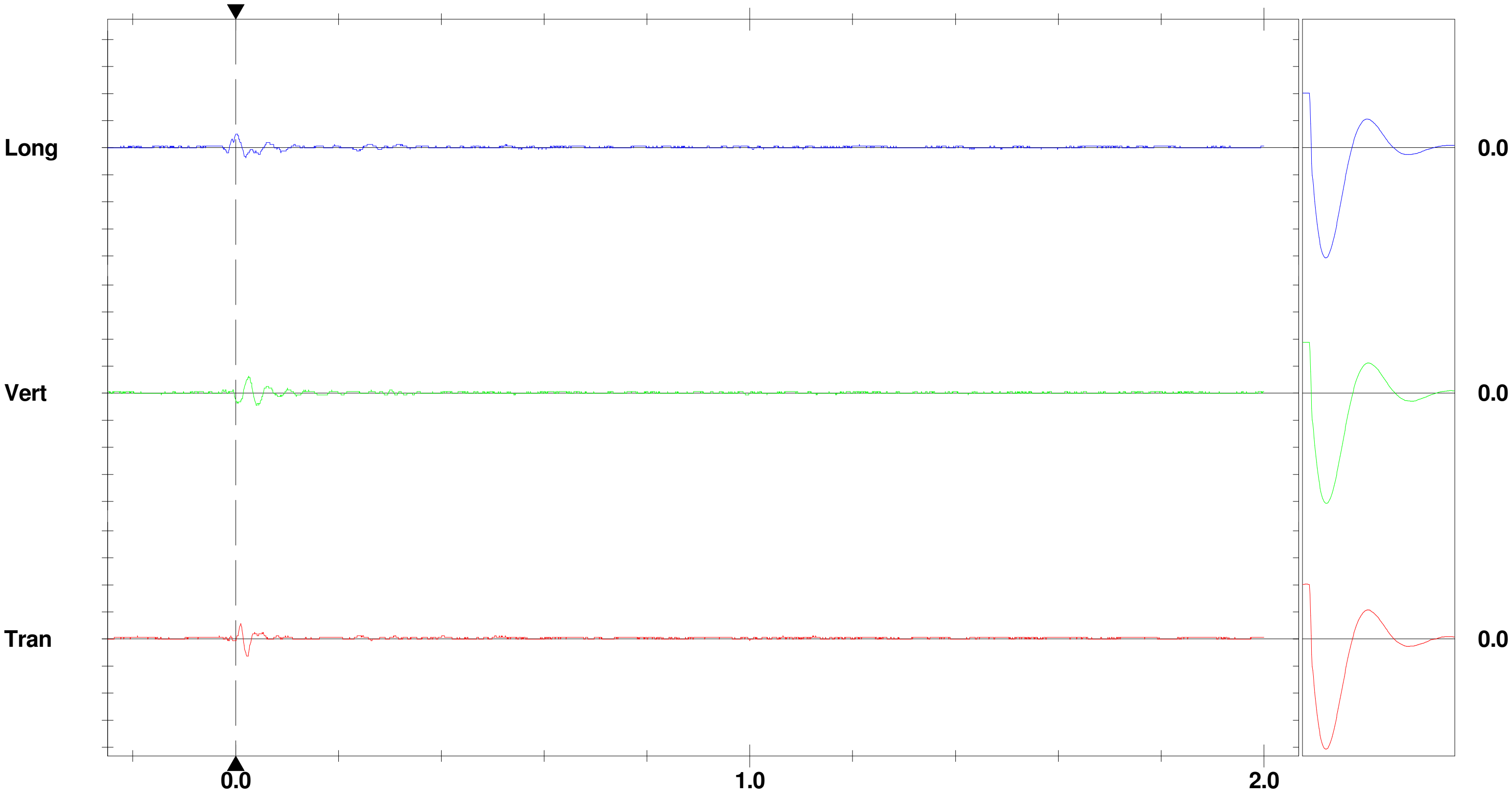
Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

	Tran	Vert	Long	
PPV	1.27	1.27	1.02	mm/s
ZC Freq	34	27	21	Hz
Time (Rel. to Trig)	0.021	0.025	0.000	sec
Peak Acceleration	0.0398	0.0265	0.0265	g
Peak Displacement	0.00595	0.00719	0.00713	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 1.75 mm/s at 0.023 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

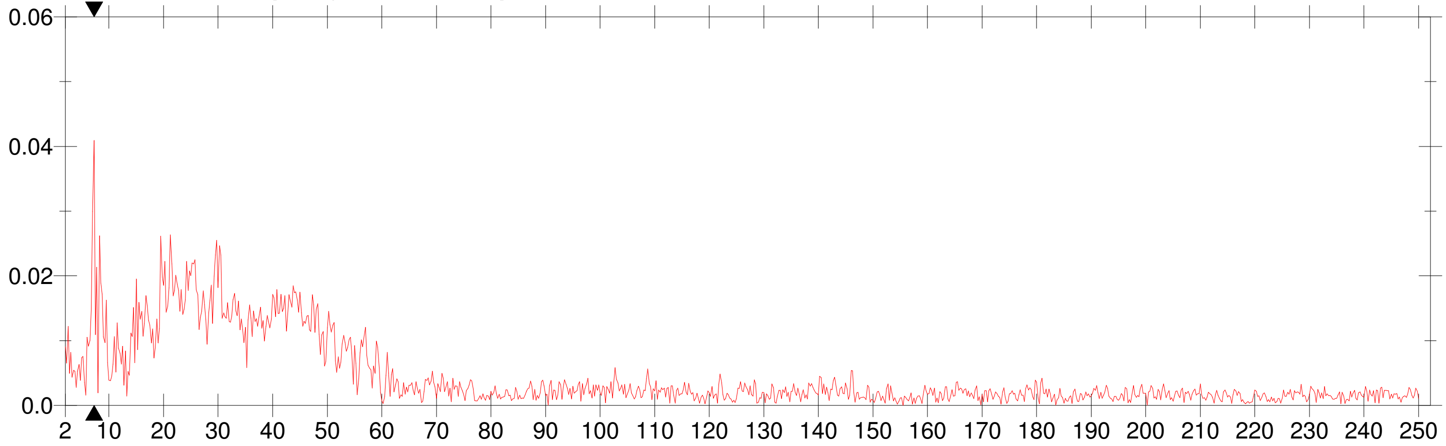
FFT Report

Date/Time Long at 12:54:19 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 2.0 sec at 1024 sps

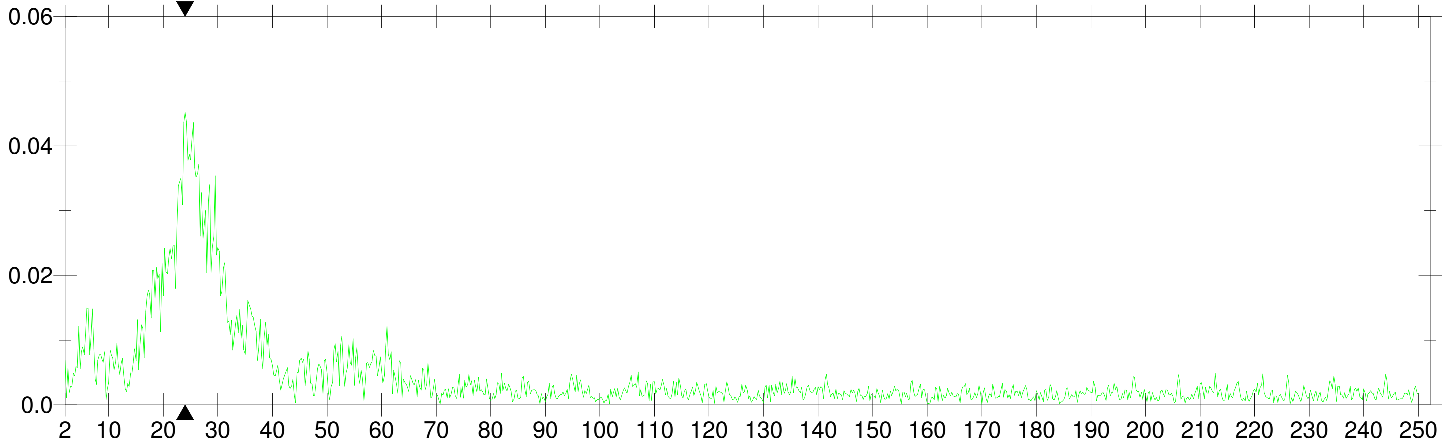
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTU9.6J0

Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

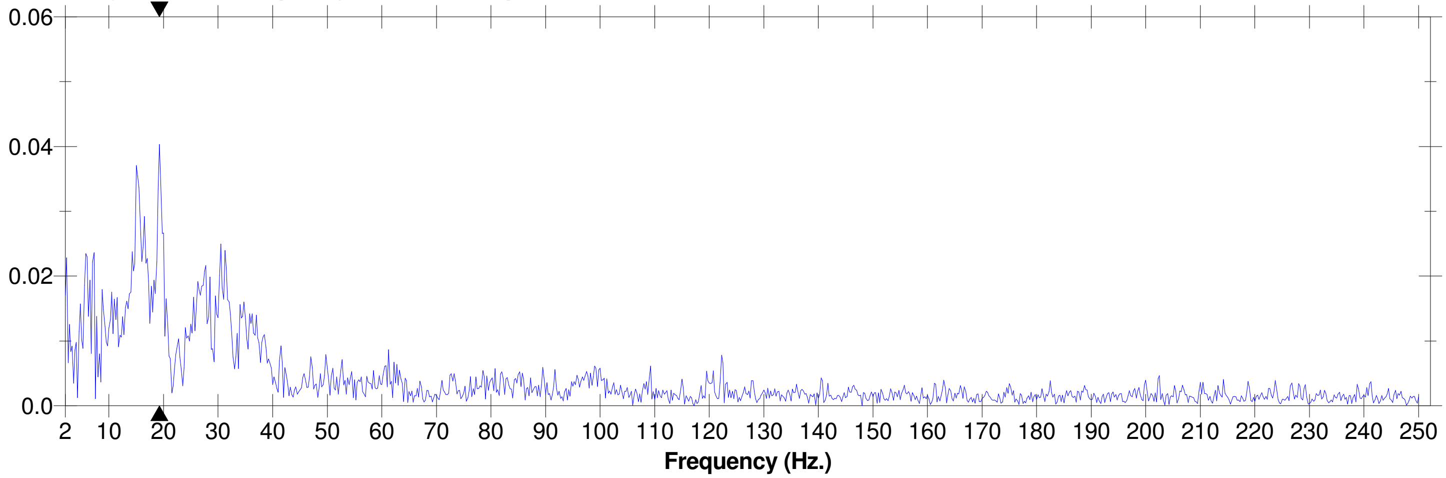
Tran Dominant Frequency = 7.25 Hz., Amplitude = 0.0409, PPV from Event = 1.27 mm/s



Vert Dominant Frequency = 24.0 Hz., Amplitude = 0.0452, PPV from Event = 1.27 mm/s



Long Dominant Frequency = 19.3 Hz., Amplitude = 0.0403, PPV from Event = 1.02 mm/s



Instantel

Event Report

Date/Time Long at 12:54:23 March 31, 2017
Trigger Source Geo: 1.00 mm/s
Range Geo: 254 mm/s
Record Time 1.842 sec at 1024 sps
Notes
Location: 8100 Claymore Rd
Client: Patern
User Name: Golder Associates Ltd.
General: North Kent

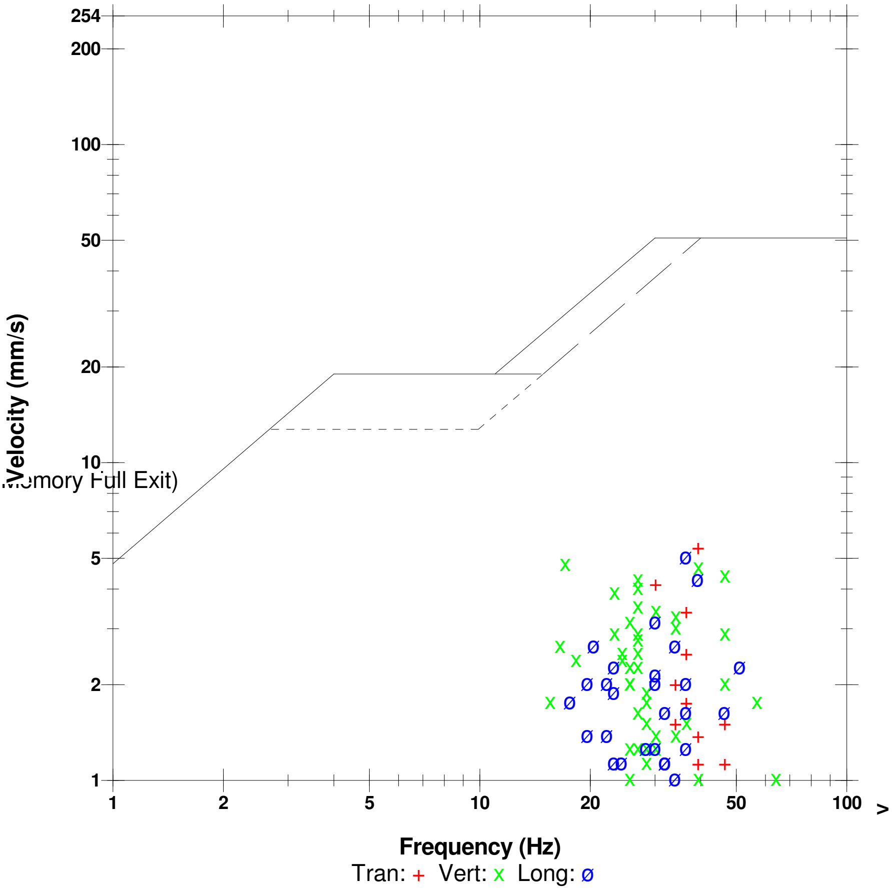
Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GTU9.6N0

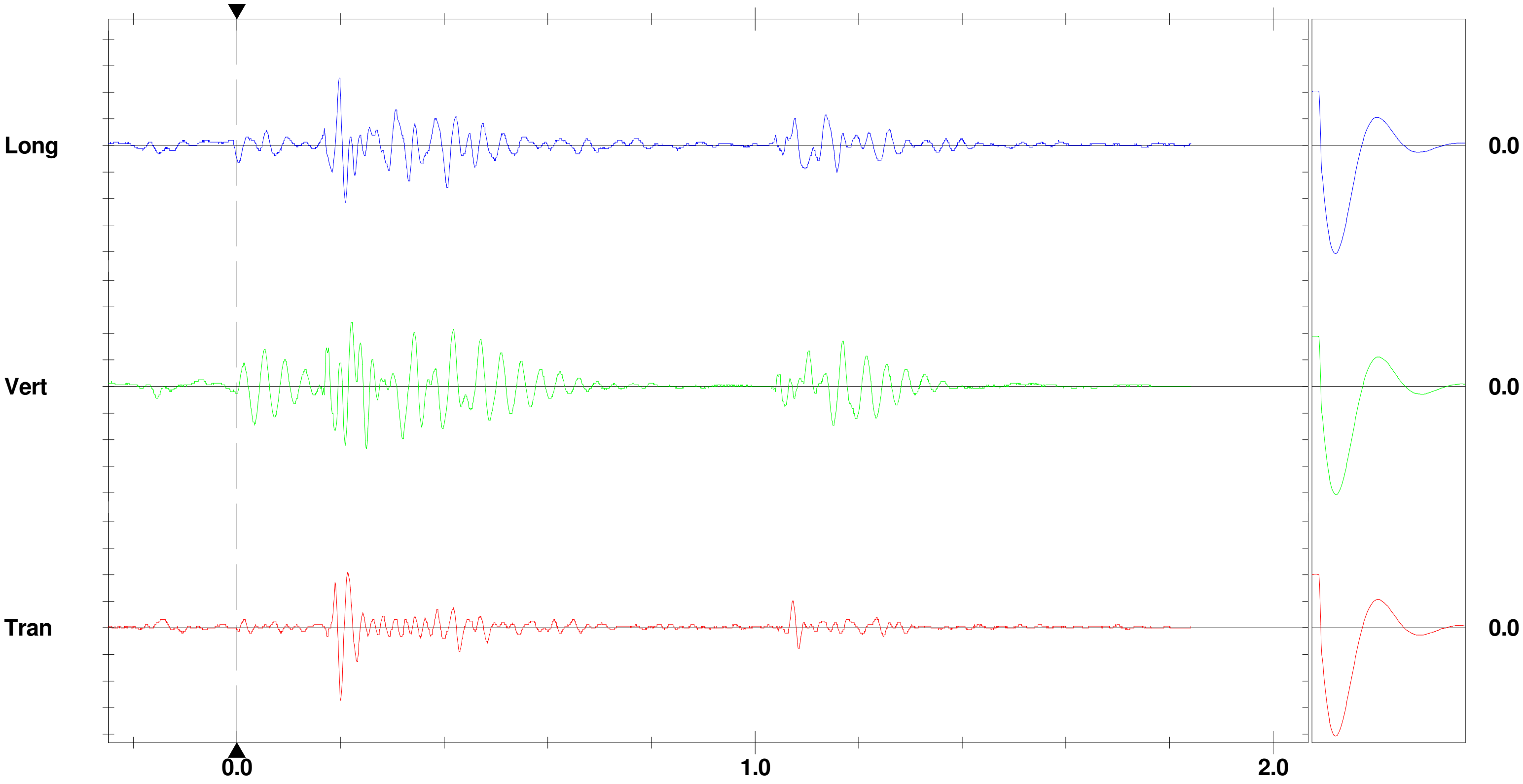
	Tran	Vert	Long	
PPV	5.46	4.83	5.08	mm/s
ZC Freq	39	17	37	Hz
Time (Rel. to Trig)	0.200	0.221	0.197	sec
Peak Acceleration	0.133	0.146	0.133	g
Peak Displacement	0.0218	0.0361	0.0193	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.6	Hz
Overswing Ratio	3.8	3.7	3.9	

Peak Vector Sum 7.07 mm/s at 0.199 sec

Monitor Log
Mar 31 /17 12:54:23   Mar 31 /17 12:54:25   Event recorded.   (Memory Full Exit)

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.00 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

FFT Report

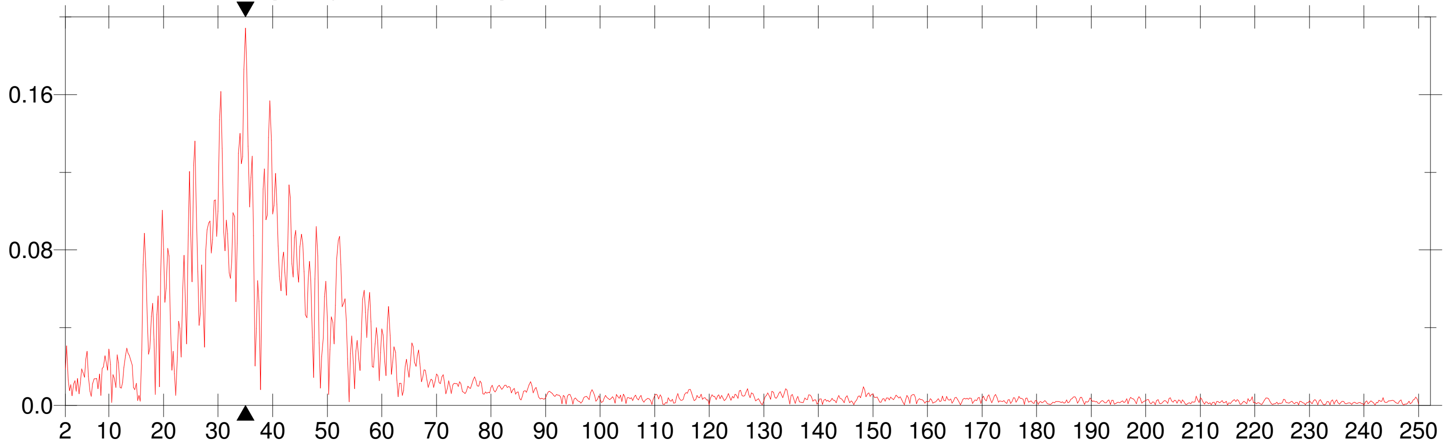
Date/Time	Long at 12:54:23 March 31, 2017
Trigger Source	Geo: 1.00 mm/s
Range	Geo: 254 mm/s
Record Time	1.842 sec at 1024 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GTU9.6N0

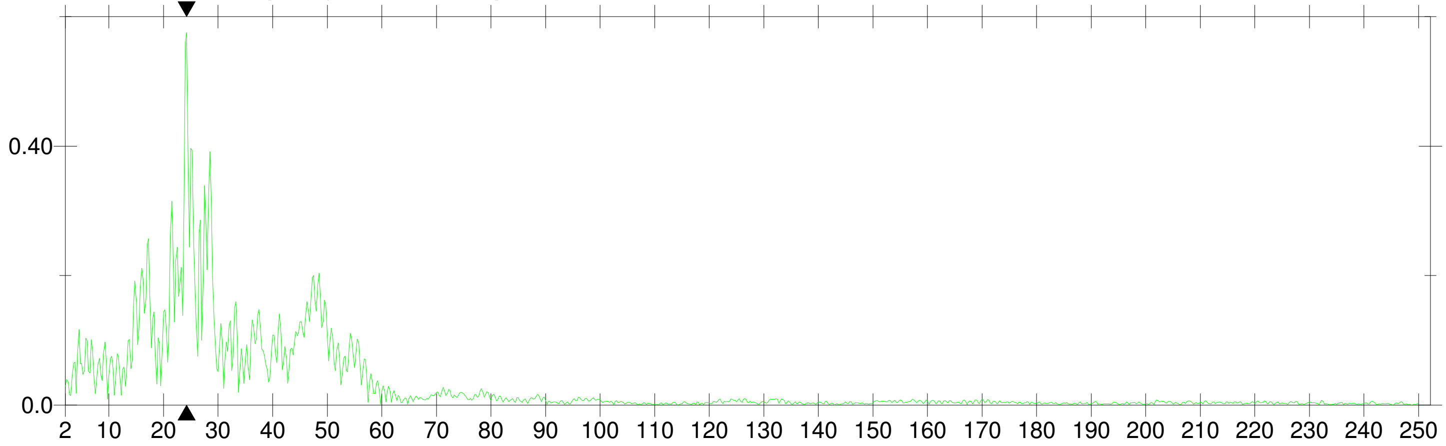
Notes

Location:	8100 Claymore Rd
Client:	Patern
User Name:	Golder Associates Ltd.
General:	North Kent

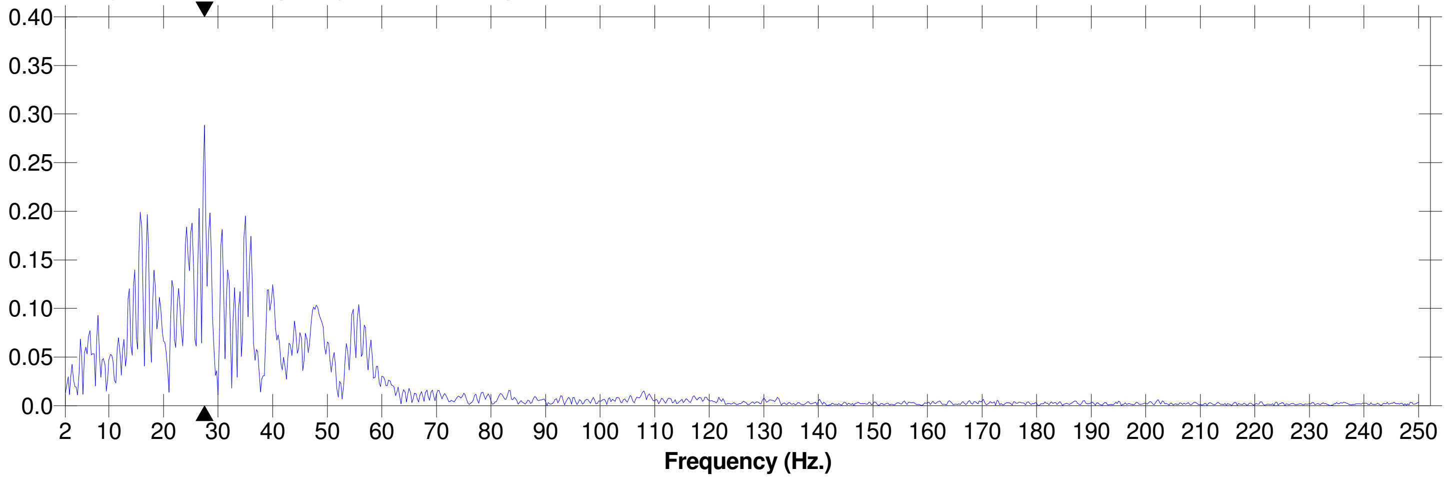
Tran Dominant Frequency = 35.0 Hz., Amplitude = 0.194, PPV from Event = 5.46 mm/s



Vert Dominant Frequency = 24.3 Hz., Amplitude = 0.575, PPV from Event = 4.83 mm/s



Long Dominant Frequency = 27.5 Hz., Amplitude = 0.289, PPV from Event = 5.08 mm/s



Event Report

Histogram Start Time	17:08:28 May 3, 2017
Histogram Finish Time	19:07:03 May 3, 2017
Number of Intervals	3557.00 at 2 seconds
Range	Geo:254.0 mm/s
Sample Rate	2048sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVJO.Y40

Notes

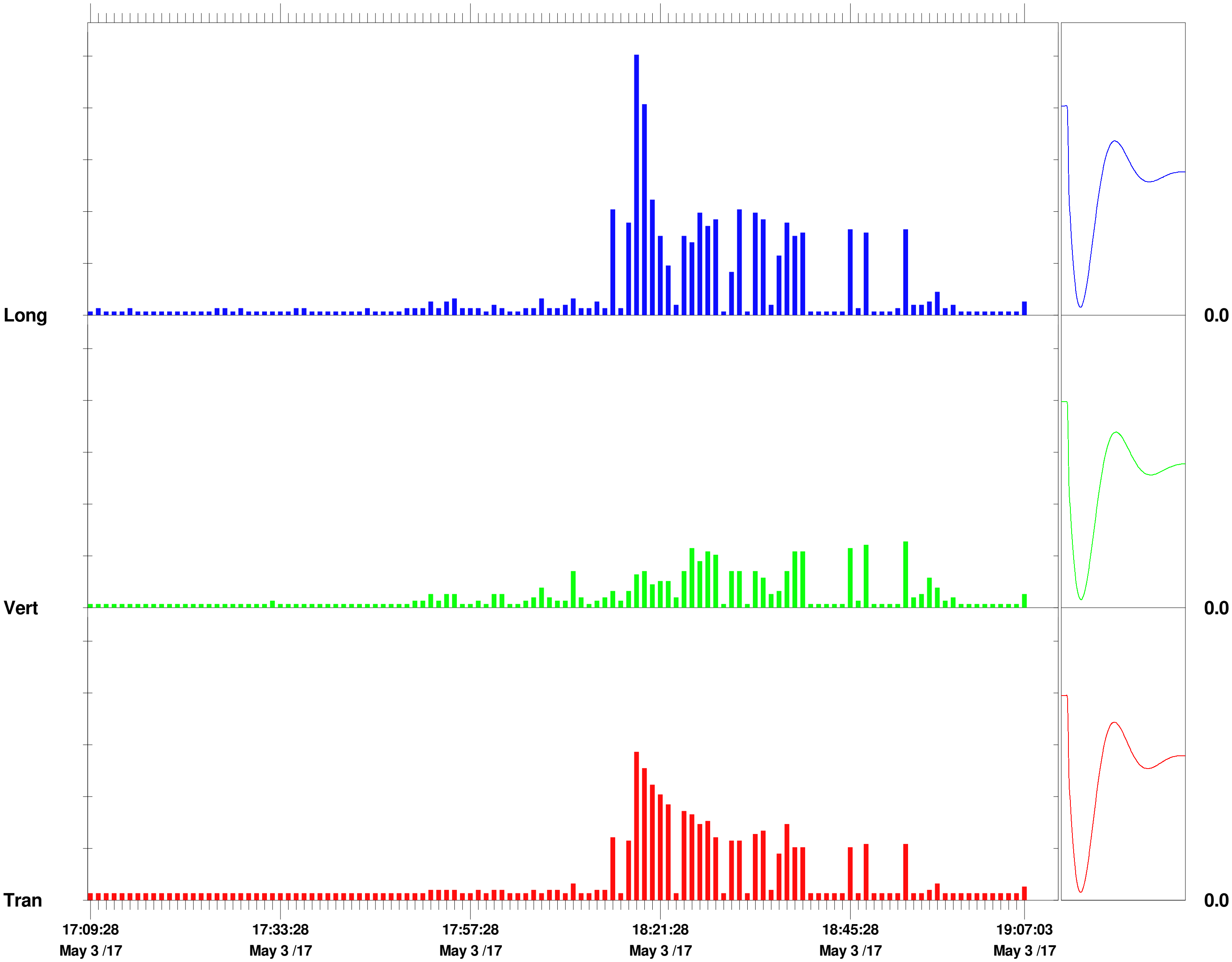
Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

Extended Notes

Geophone anchored into subgrade, and sandbagged

	Tran	**Vert**	**Long**	
PPV	5.715	2.540	10.03	mm/s
ZC Freq	9.5	28	13.7	Hz
Date	May 3 /17	May 3 /17	May 3 /17	
Time	18:18:08	18:51:46	18:18:08	
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.5	Hz
Overswing Ratio	3.7	4.0	4.1	

Peak Vector Sum 10.17 mm/s on May 3, 2017 at 18:18:08



Time Scale: 1 minute /div **Amplitude Scale:** Geo: 2.000 mm/s/div

Sensor Check

Printed: May 12, 2017 (V 10.72 - 10.72.1)

Instantel

Event Report

Date/Time Vert at 18:10:03 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GVJR.SR0

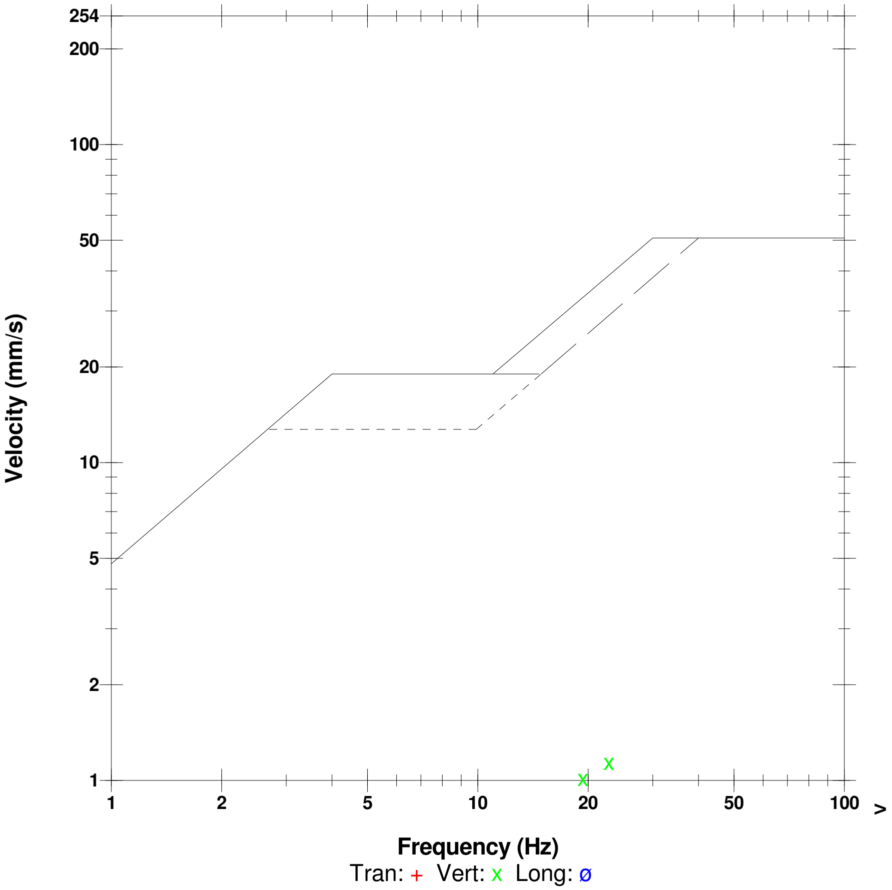
Notes
Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

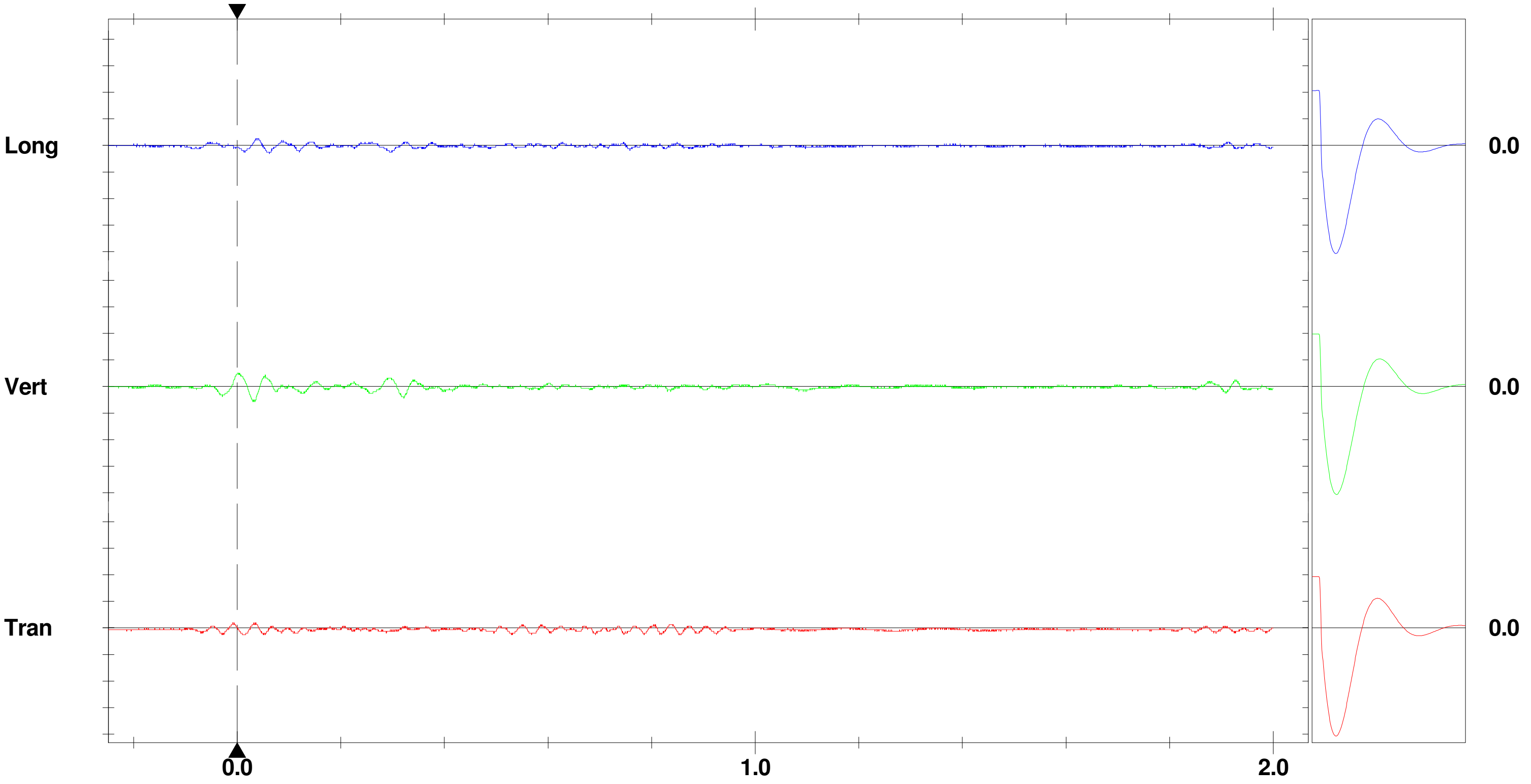
Extended Notes
Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	0.508	1.143	0.635	mm/s
ZC Freq	33	23	28	Hz
Time (Rel. to Trig)	-0.030	0.030	0.063	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.004	0.009	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.5	Hz
Overswing Ratio	3.7	4.0	4.1	

Peak Vector Sum 1.264 mm/s at 0.035 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Printed: May 12, 2017 (V 10.72 - 10.72.1)

FFT Report

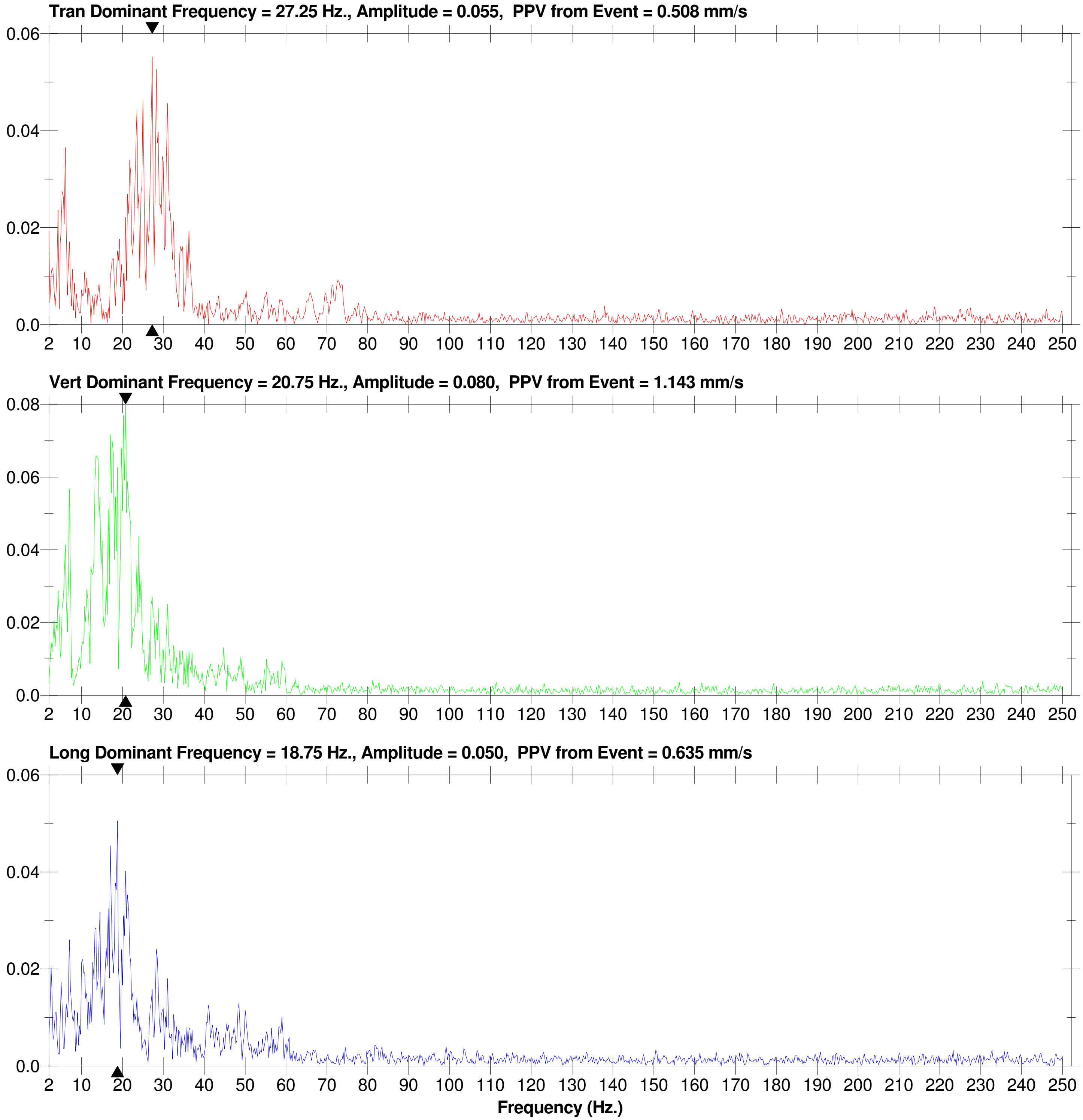
Date/Time	Vert at 18:10:03 May 3, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.000 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 2048 sps	**File Name**	T695GVJR.SR0

Notes

Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

Extended Notes

Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged



Event Report

Date/Time	Vert at 18:10:05 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVJR.ST0

Notes

Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

Extended Notes

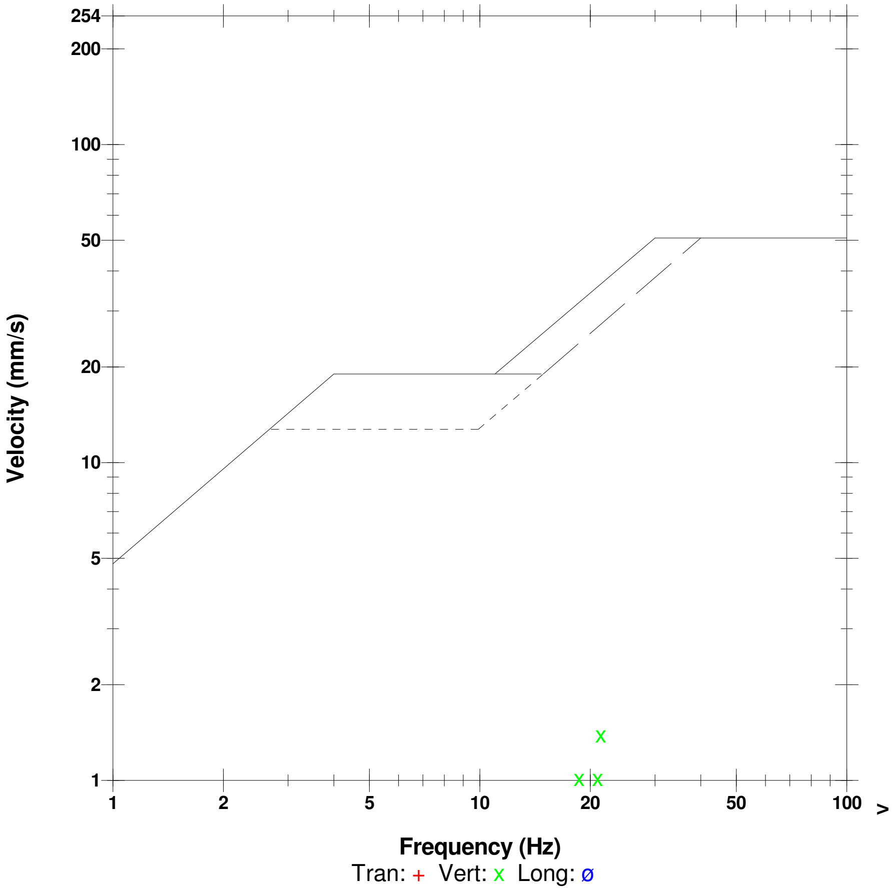
Combo Mode May 3, 2017 17:08:27

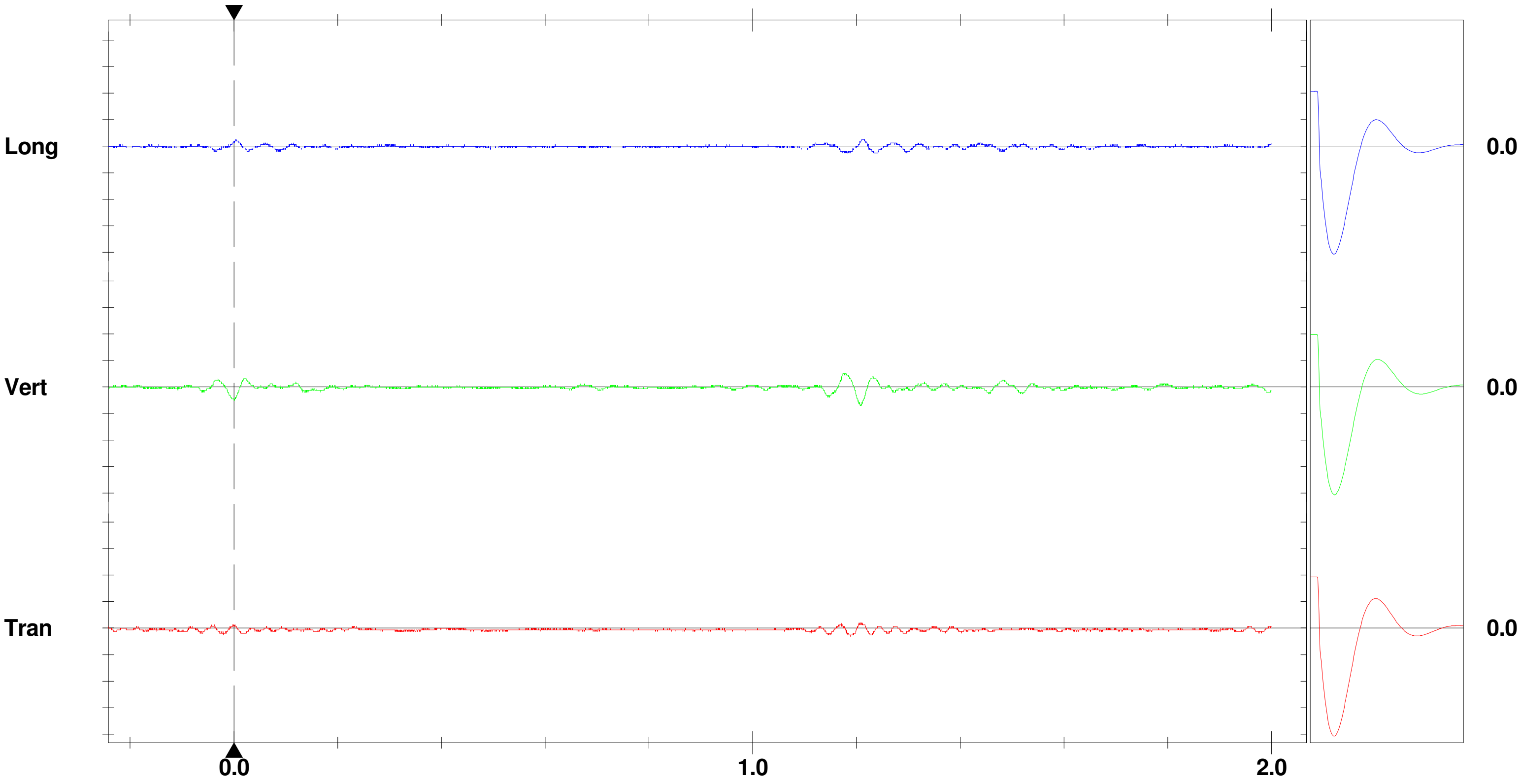
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	0.635	1.397	0.508	mm/s
ZC Freq	26	21	31	Hz
Time (Rel. to Trig)	1.189	1.207	0.003	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.004	0.010	0.005	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.5	Hz
Overswing Ratio	3.7	4.0	4.1	

Peak Vector Sum 1.497 mm/s at 1.208 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Trigger = ▶—— ——◀

Sensor Check

FFT Report

Date/Time	Vert at 18:10:05 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVJR.ST0

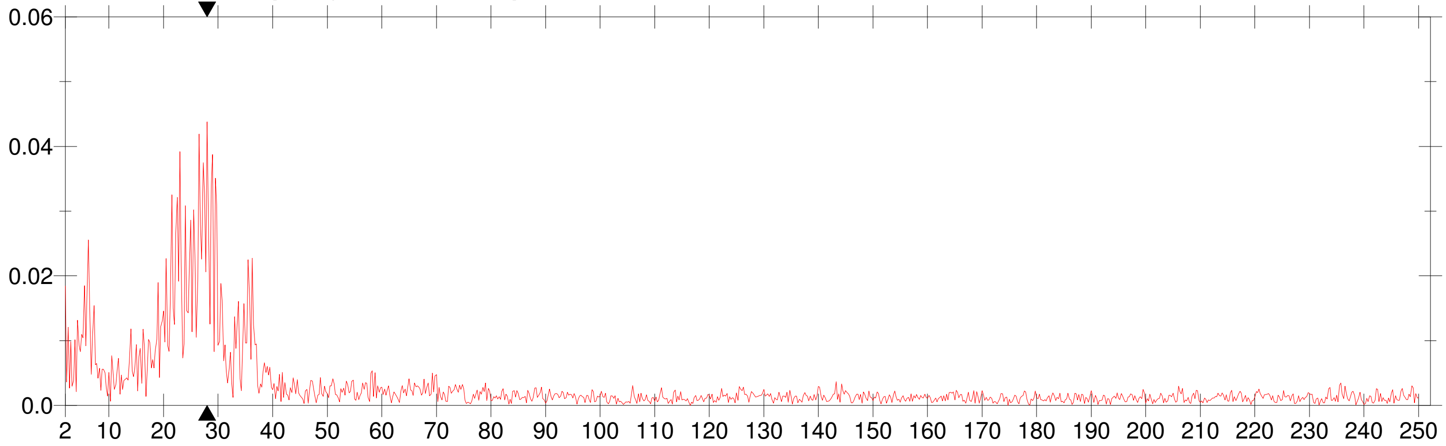
Notes

Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

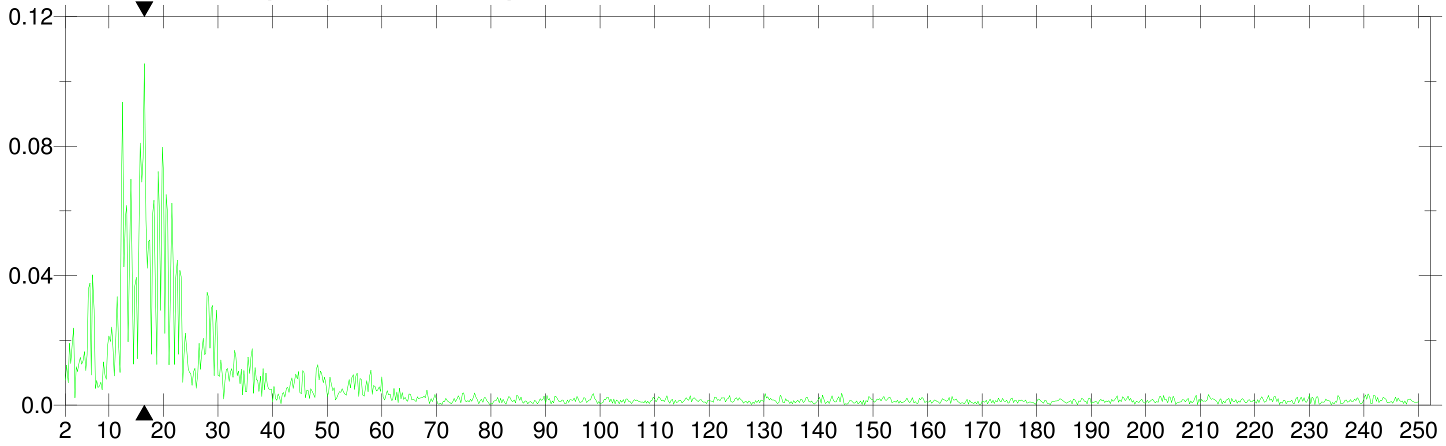
Extended Notes

Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged

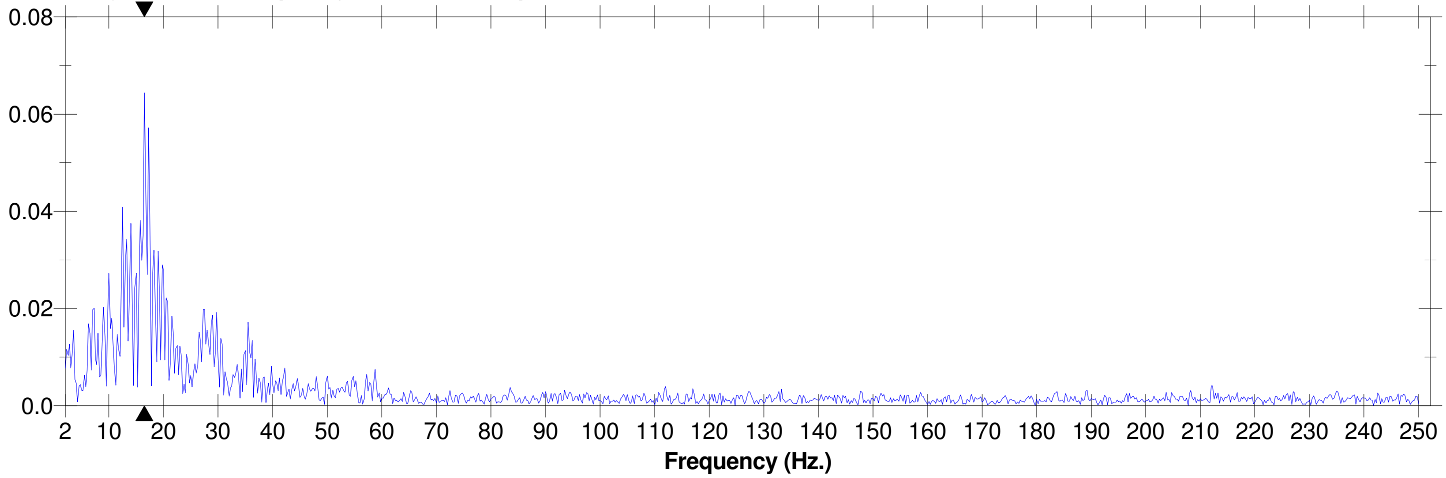
Tran Dominant Frequency = 28.00 Hz., Amplitude = 0.044, PPV from Event = 0.635 mm/s



Vert Dominant Frequency = 16.50 Hz., Amplitude = 0.106, PPV from Event = 1.397 mm/s



Long Dominant Frequency = 16.50 Hz., Amplitude = 0.064, PPV from Event = 0.508 mm/s



Event Report

Date/Time	Vert at 18:10:09 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVJR.SX0

Notes

Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

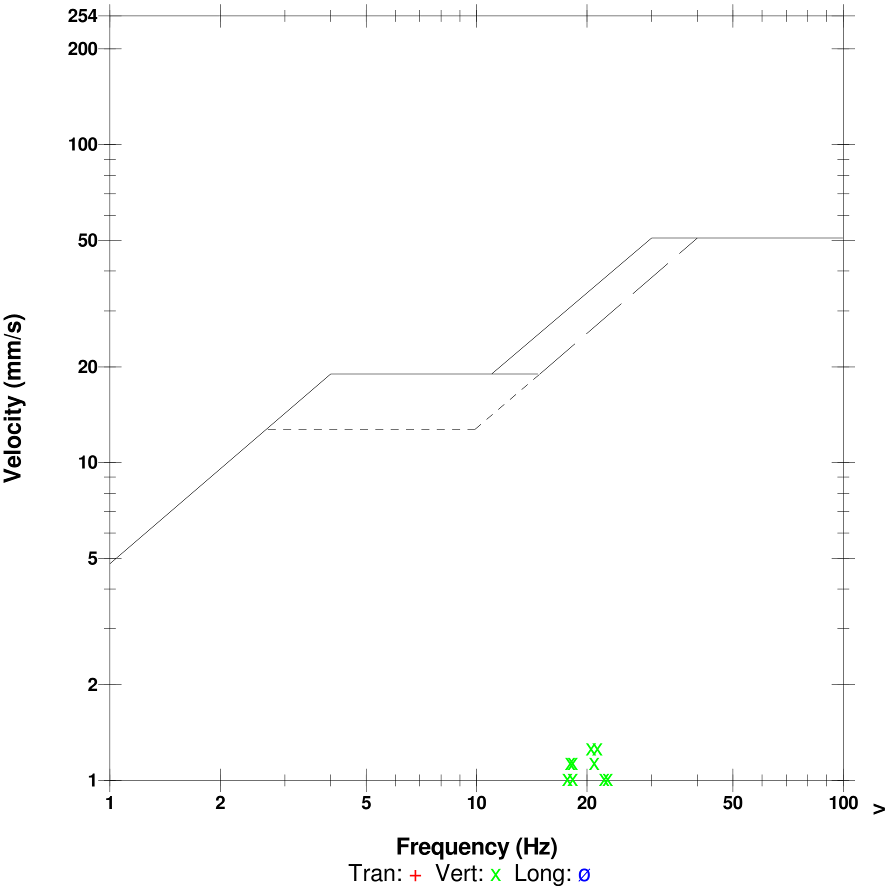
Extended Notes

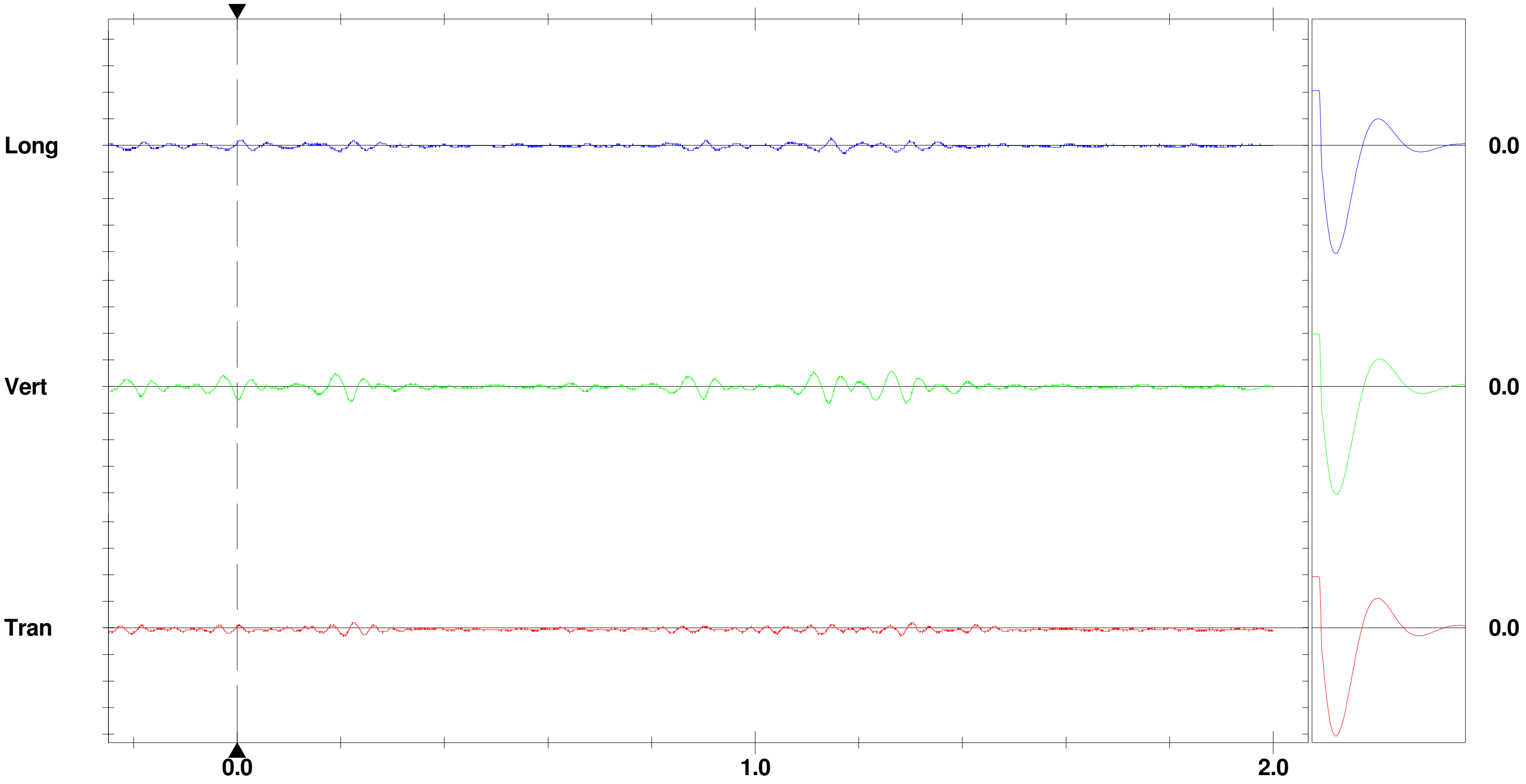
Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	0.635	1.270	0.635	mm/s
ZC Freq	24	21	33	Hz
Time (Rel. to Trig)	0.205	1.140	1.146	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.004	0.011	0.005	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.5	Hz
Overswing Ratio	3.7	4.0	4.1	

Peak Vector Sum 1.332 mm/s at 1.143 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

FFT Report

Date/Time	Vert at 18:10:09 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVJR.SX0

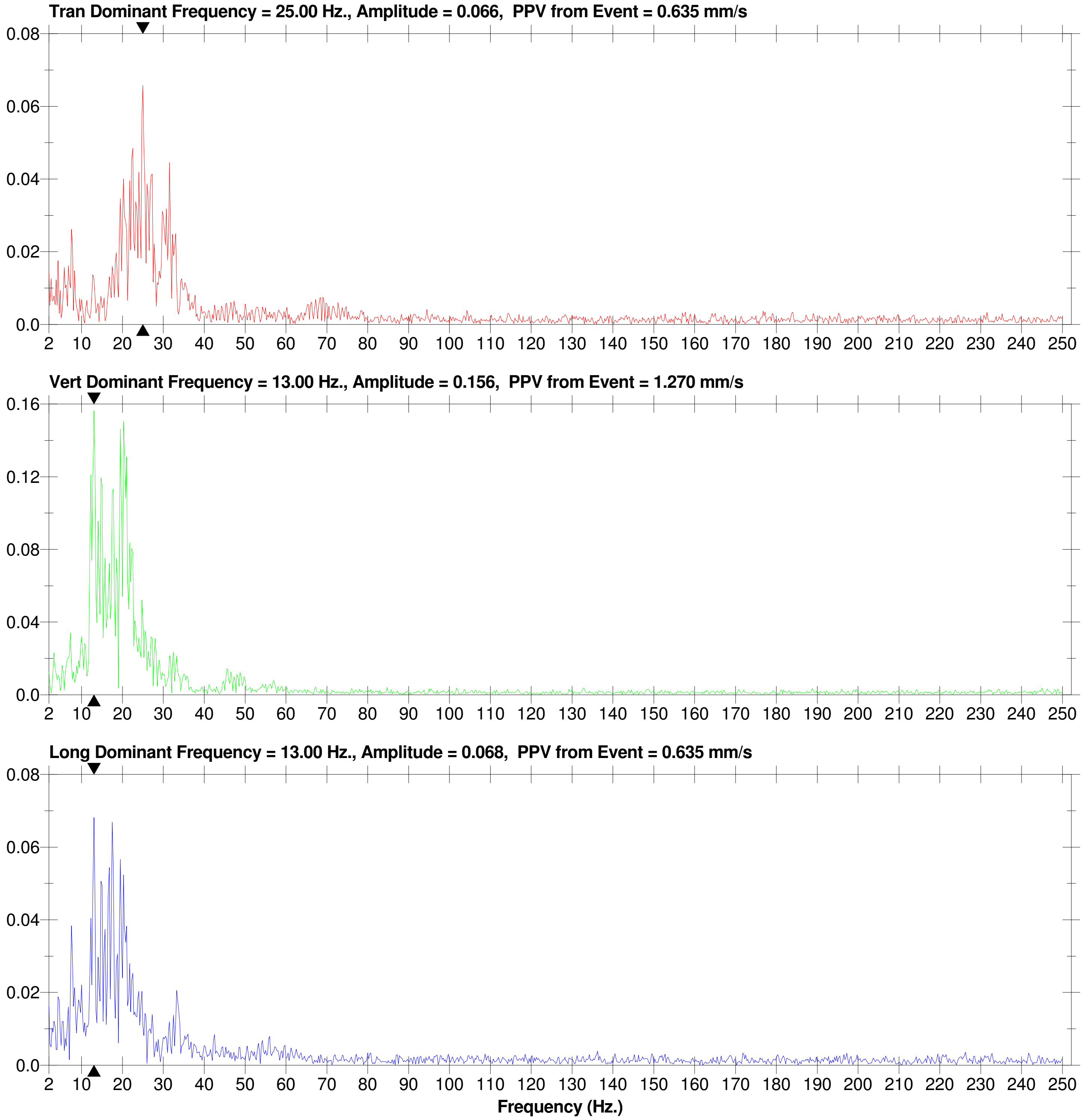
Notes

Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

Extended Notes

Combo Mode May 3, 2017 17:08:27

Geophone anchored into subgrade, and sandbagged



Tran Dominant Frequency = 25.00 Hz., Amplitude = 0.066, PPV from Event = 0.635 mm/s

Vert Dominant Frequency = 13.00 Hz., Amplitude = 0.156, PPV from Event = 1.270 mm/s

Long Dominant Frequency = 13.00 Hz., Amplitude = 0.068, PPV from Event = 0.635 mm/s

Event Report

Date/Time	Long at 18:14:28 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVJS.040

Notes

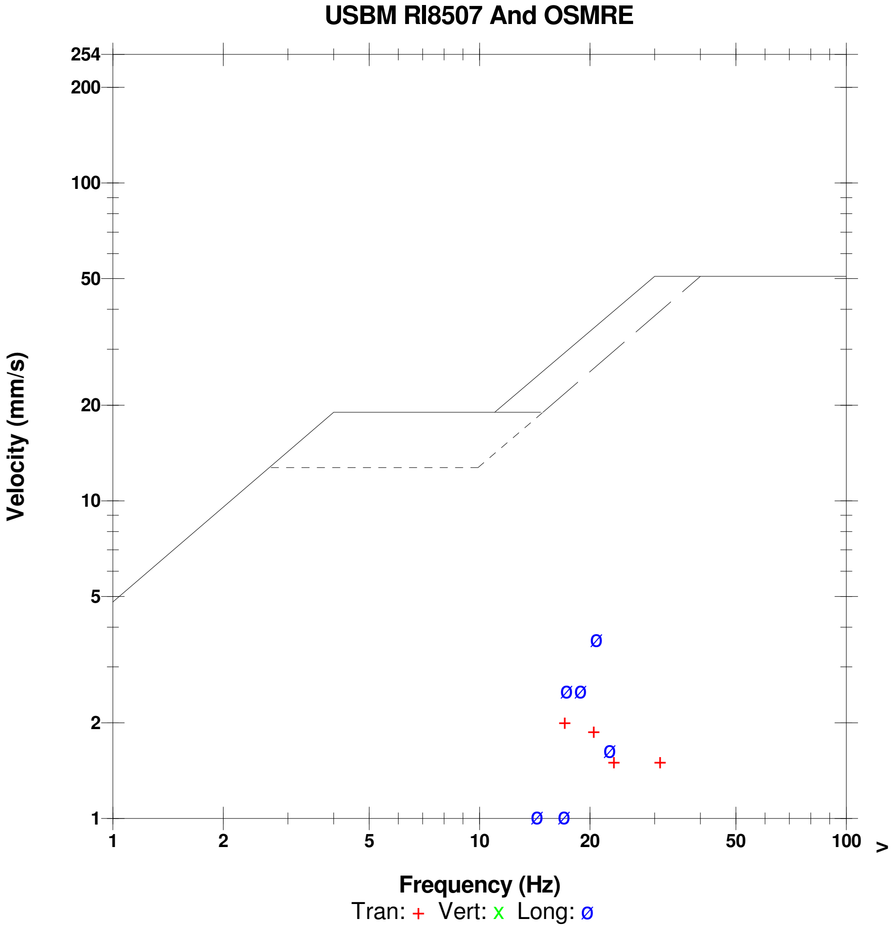
Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

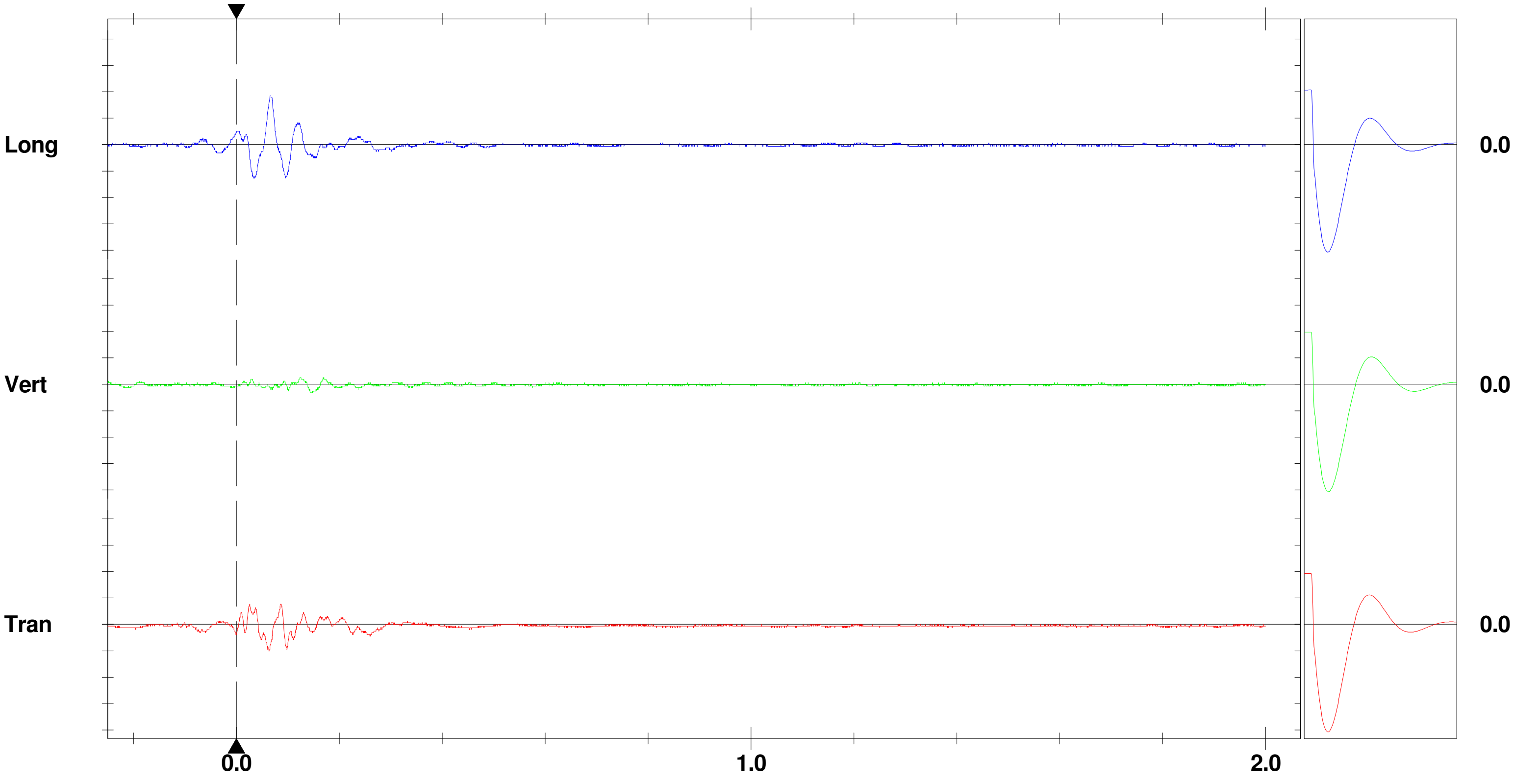
Extended Notes

Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	2.032	0.635	3.683	mm/s
ZC Freq	17.1	22	21	Hz
Time (Rel. to Trig)	0.063	0.143	0.065	sec
Peak Acceleration	0.080	0.053	0.080	g
Peak Displacement	0.017	0.005	0.026	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.5	Hz
Overswing Ratio	3.7	4.0	4.1	

Peak Vector Sum 4.098 mm/s at 0.065 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Sensor Check

Trigger = ▶——— ———◀

Printed: May 12, 2017 (V 10.72 - 10.72.1)

Instantel

FFT Report

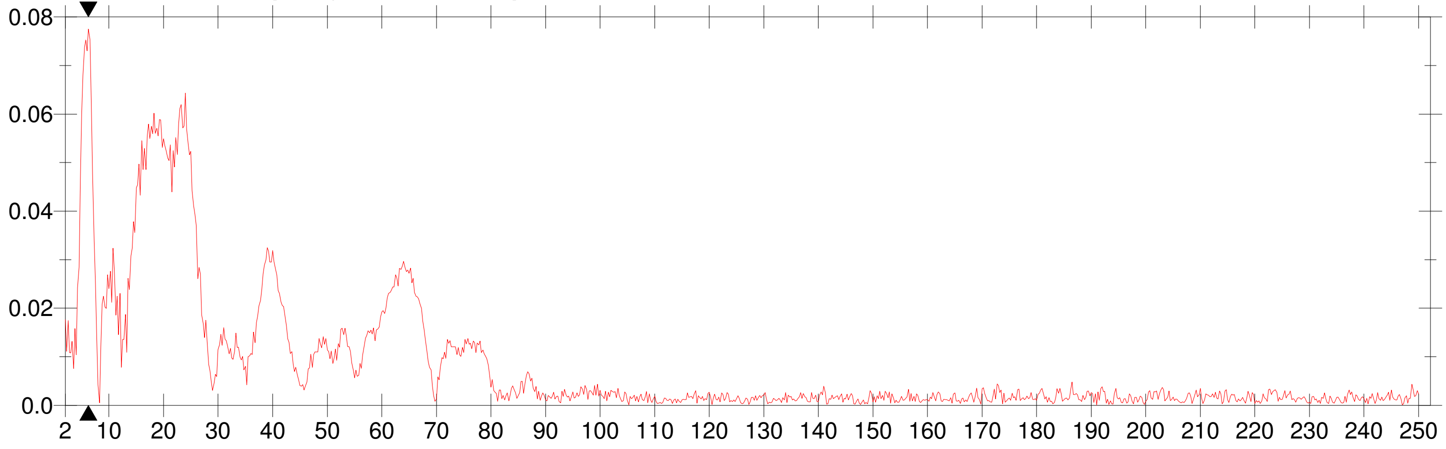
Date/Time Long at 18:14:28 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GVJS.040

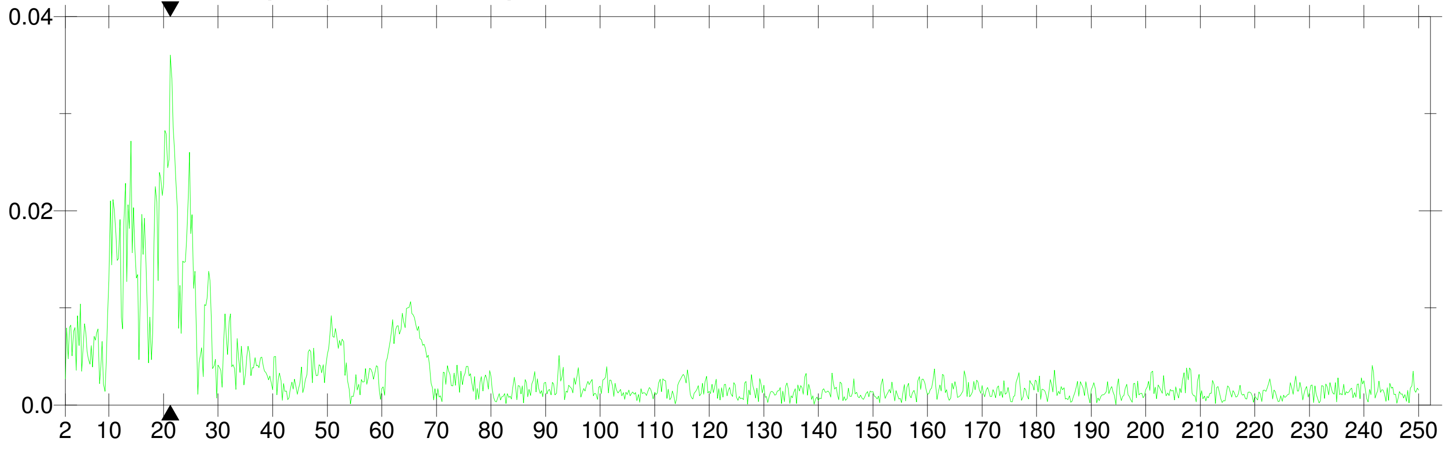
Notes
Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

Extended Notes
Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged

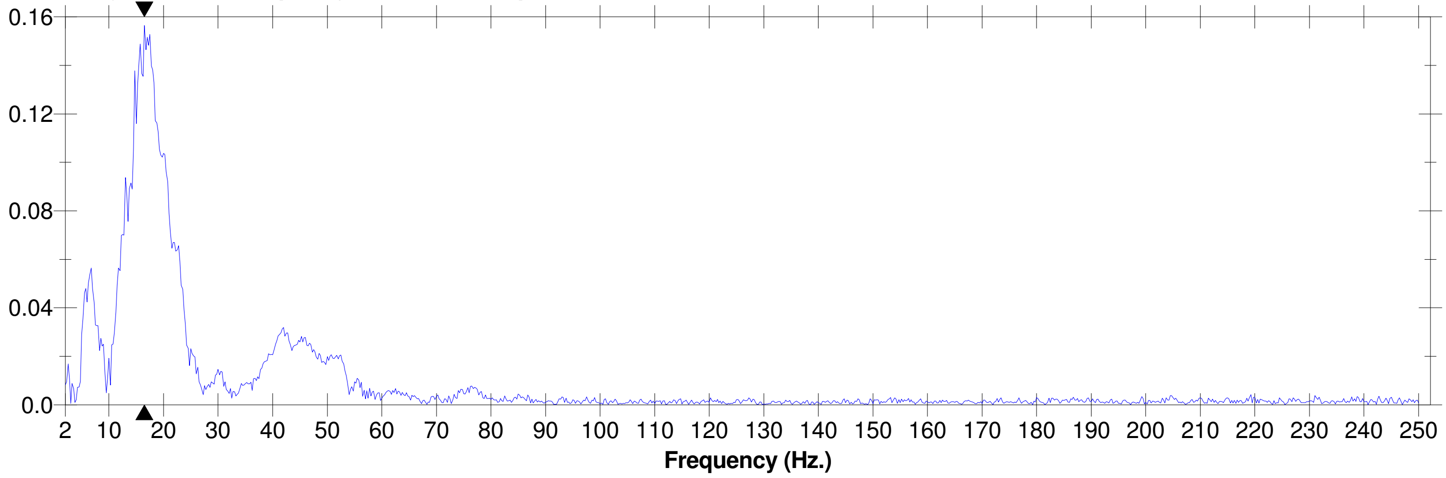
Tran Dominant Frequency = 6.250 Hz., Amplitude = 0.077, PPV from Event = 2.032 mm/s



Vert Dominant Frequency = 21.25 Hz., Amplitude = 0.036, PPV from Event = 0.635 mm/s



Long Dominant Frequency = 16.50 Hz., Amplitude = 0.156, PPV from Event = 3.683 mm/s



Printed: May 12, 2017 (V 10.72 - 10.72.1)

Instantel

Event Report

Date/Time	Long at 18:14:47 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVJS.0N0

Notes

Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

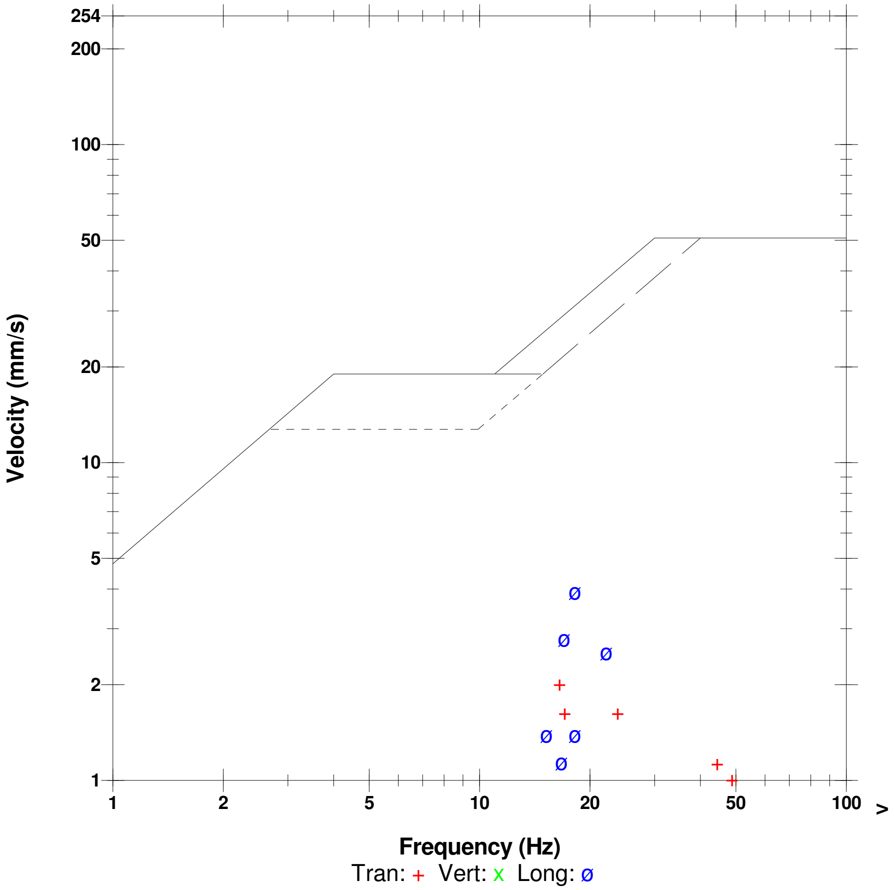
Extended Notes

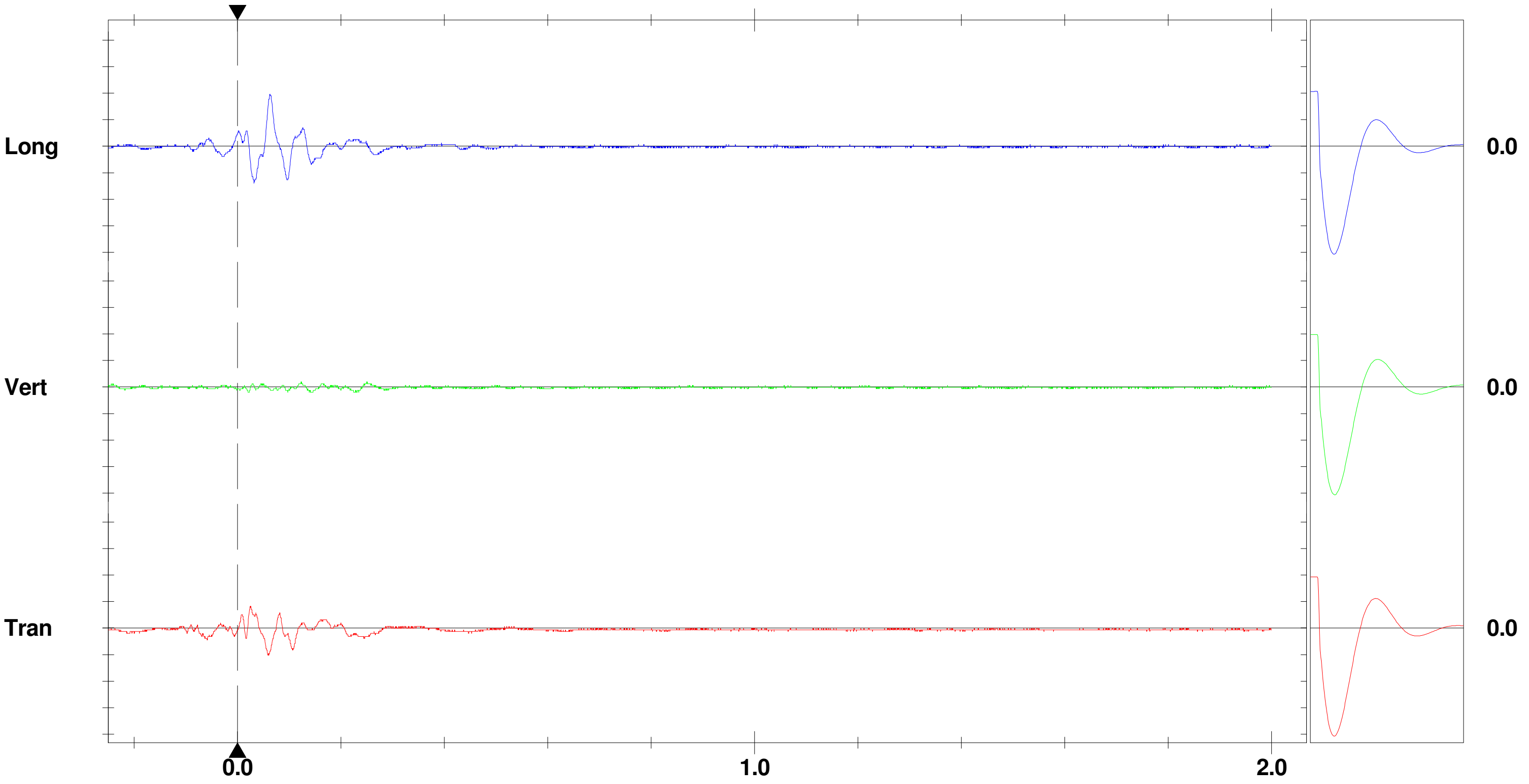
Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	2.032	0.381	3.937	mm/s
ZC Freq	16.5	73	18.3	Hz
Time (Rel. to Trig)	0.059	0.020	0.063	sec
Peak Acceleration	0.053	0.027	0.080	g
Peak Displacement	0.017	0.003	0.026	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.5	Hz
Overswing Ratio	3.7	4.0	4.1	

Peak Vector Sum 4.322 mm/s at 0.063 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div
Trigger = ▶—— ——◀

Sensor Check

Instantel

FFT Report

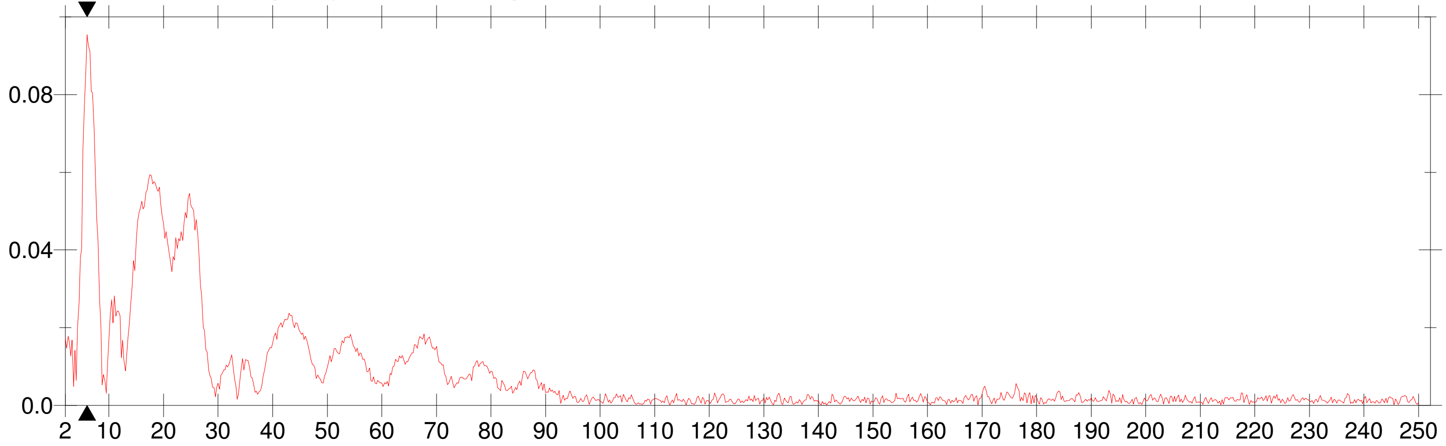
Date/Time	Long at 18:14:47 May 3, 2017	**Serial Number**	BE18695 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.000 mm/s	**Battery Level**	6.4 Volts
Range	Geo: 254.0 mm/s	**Unit Calibration**	February 22, 2017 by Instantel
Record Time	2.0 sec at 2048 sps	**File Name**	T695GVJS.0N0

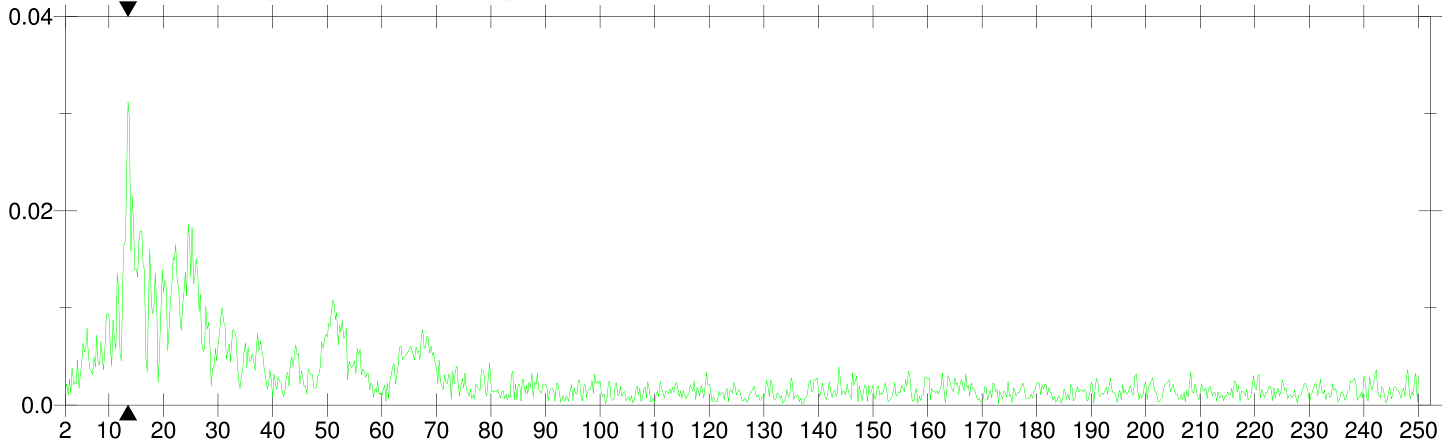
Notes

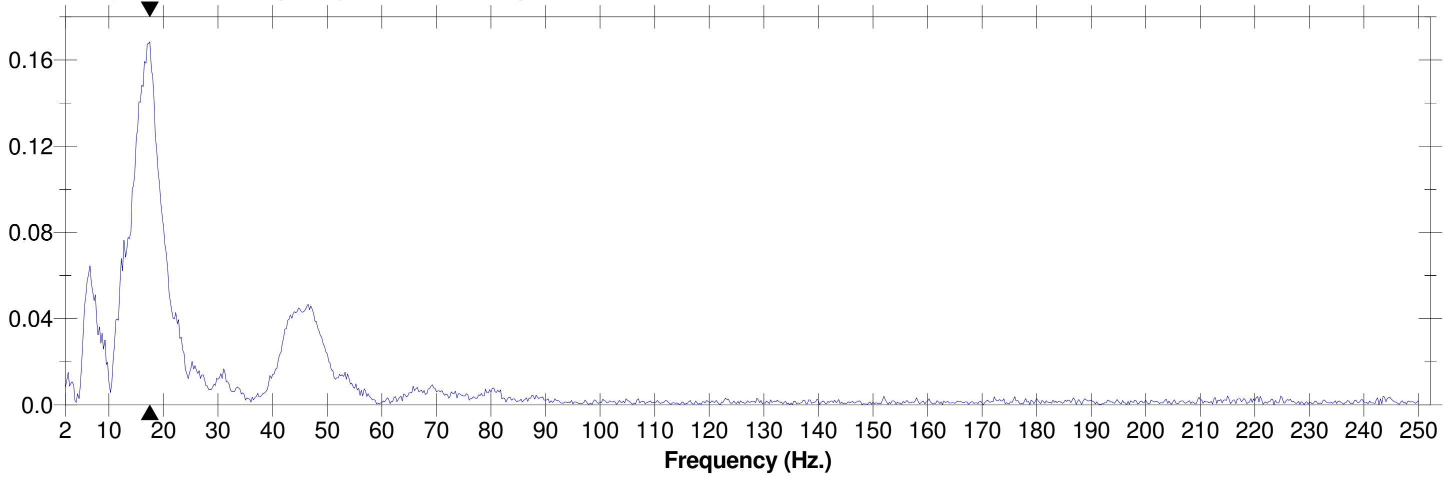
Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

Extended Notes

Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged


Tran Dominant Frequency = 6.000 Hz., Amplitude = 0.095, PPV from Event = 2.032 mm/s


Vert Dominant Frequency = 13.50 Hz., Amplitude = 0.031, PPV from Event = 0.381 mm/s


Long Dominant Frequency = 17.50 Hz., Amplitude = 0.168, PPV from Event = 3.937 mm/s

Event Report

Date/Time	Long at 18:15:19 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVJS.1J0

Notes

Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

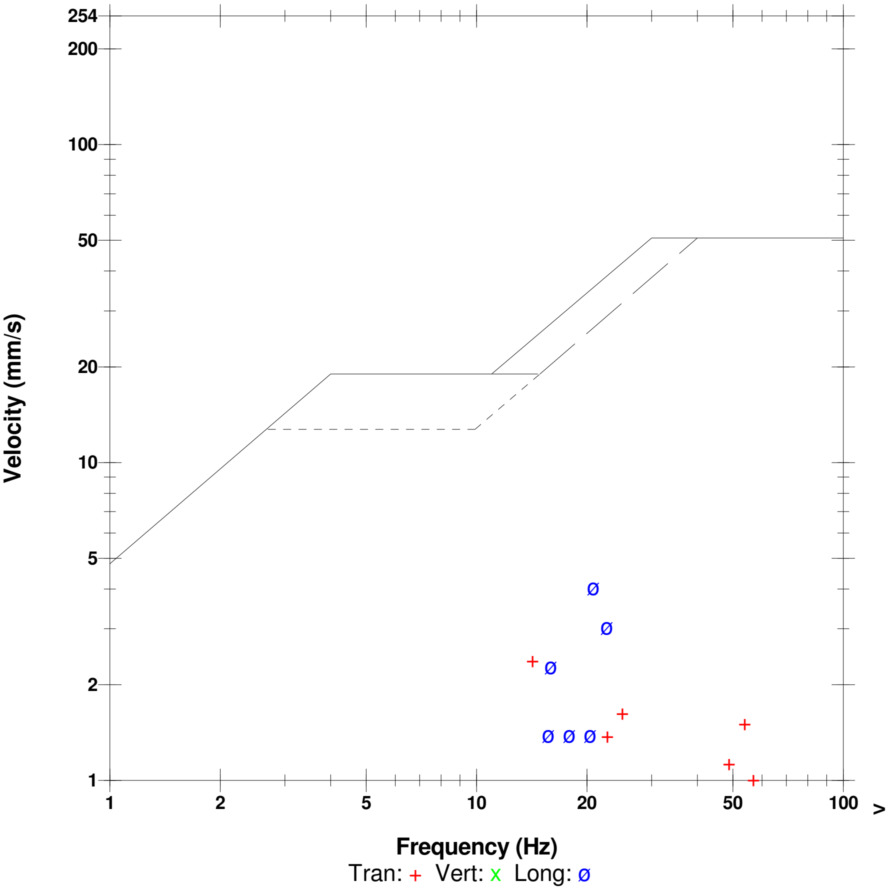
Extended Notes

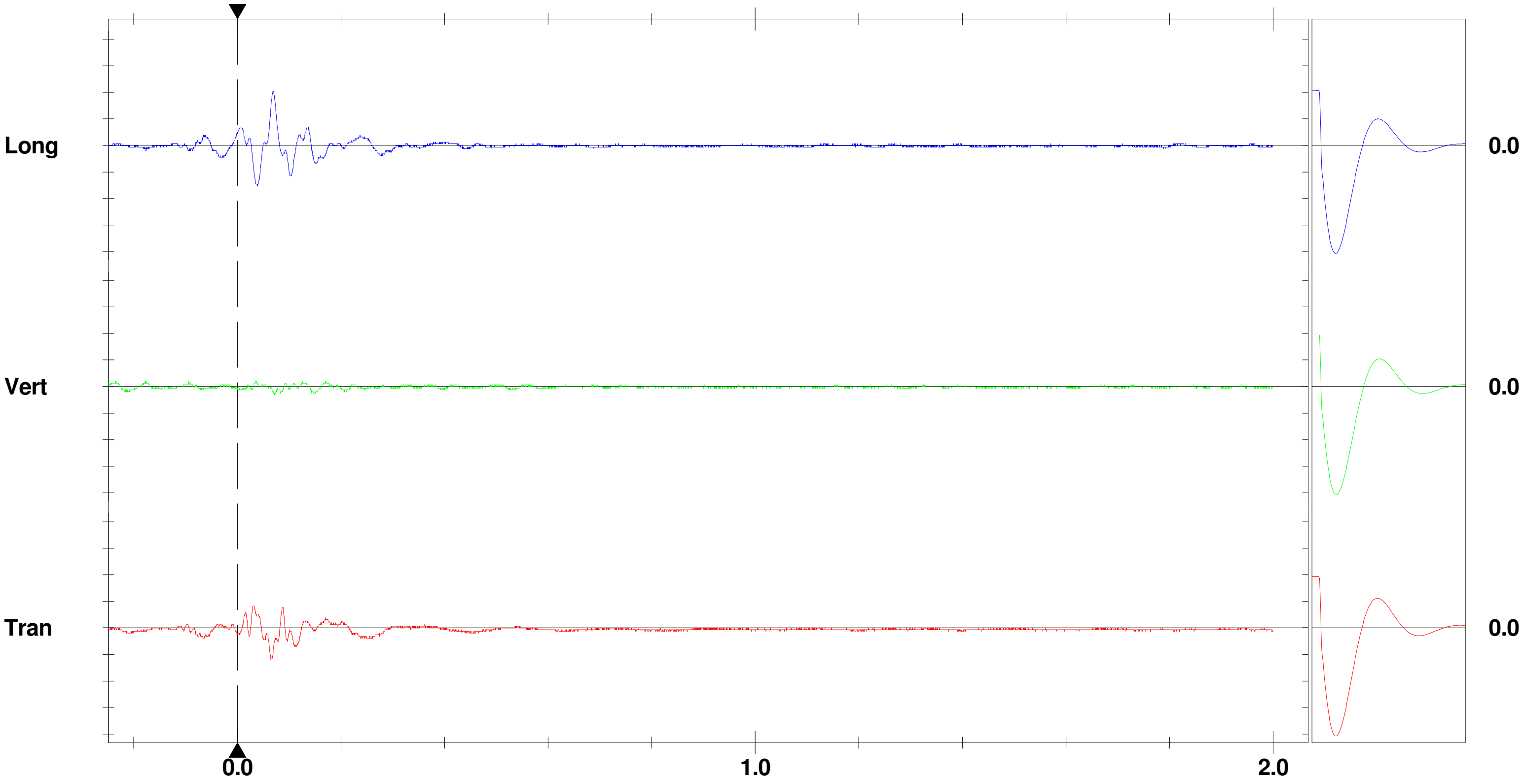
Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	2.413	0.635	4.064	mm/s
ZC Freq	14.2	45	21	Hz
Time (Rel. to Trig)	0.065	0.072	0.068	sec
Peak Acceleration	0.053	0.053	0.080	g
Peak Displacement	0.019	0.003	0.026	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.5	Hz
Overswing Ratio	3.7	4.0	4.1	

Peak Vector Sum 4.560 mm/s at 0.068 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Instantel

FFT Report

Date/Time	Long at 18:15:19 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVJS.1J0

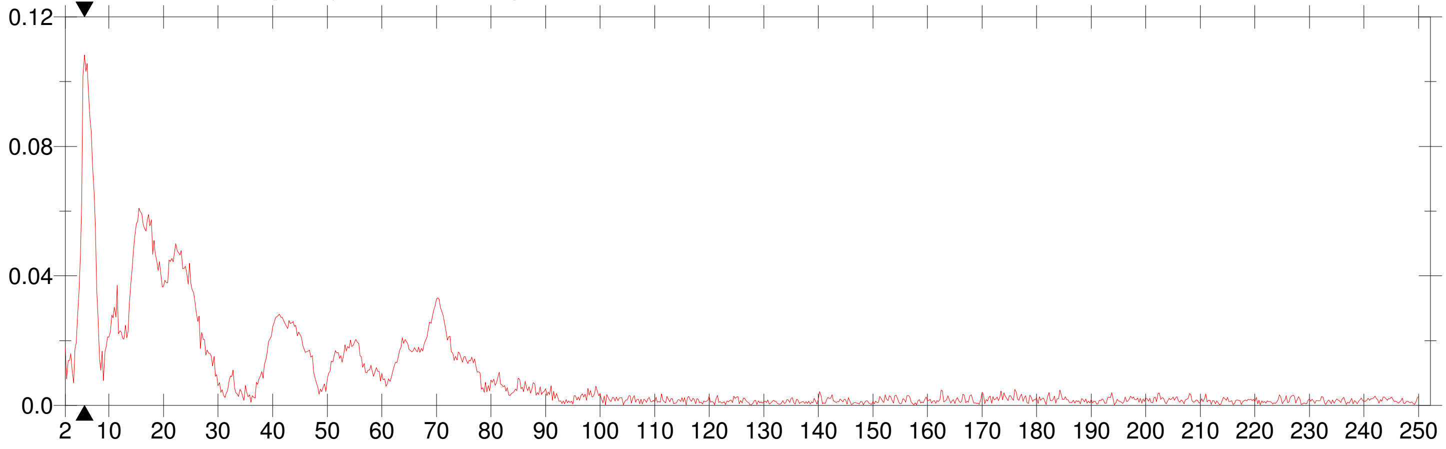
Notes

Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

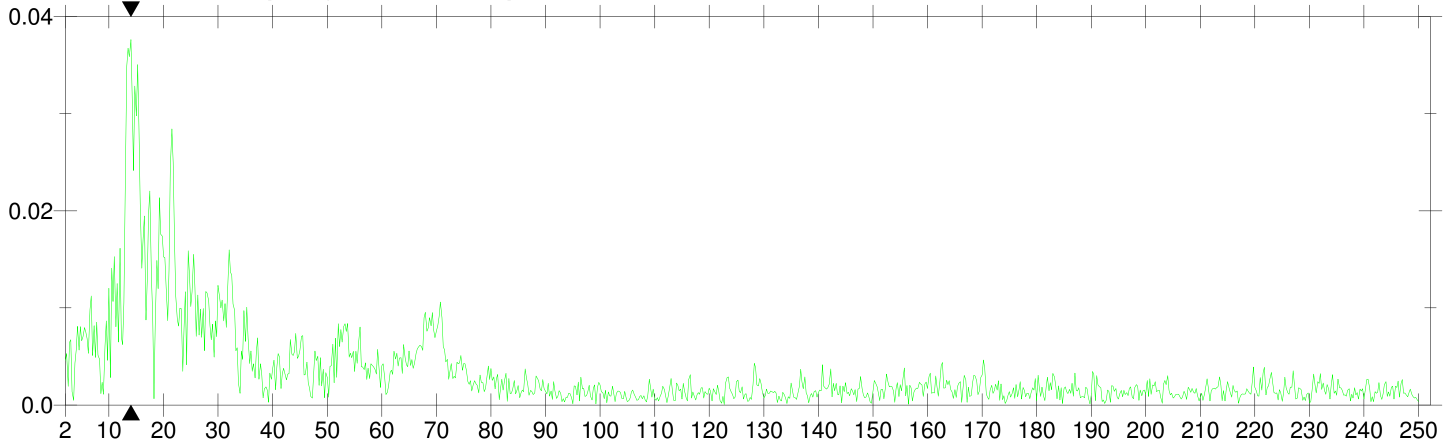
Extended Notes

Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged

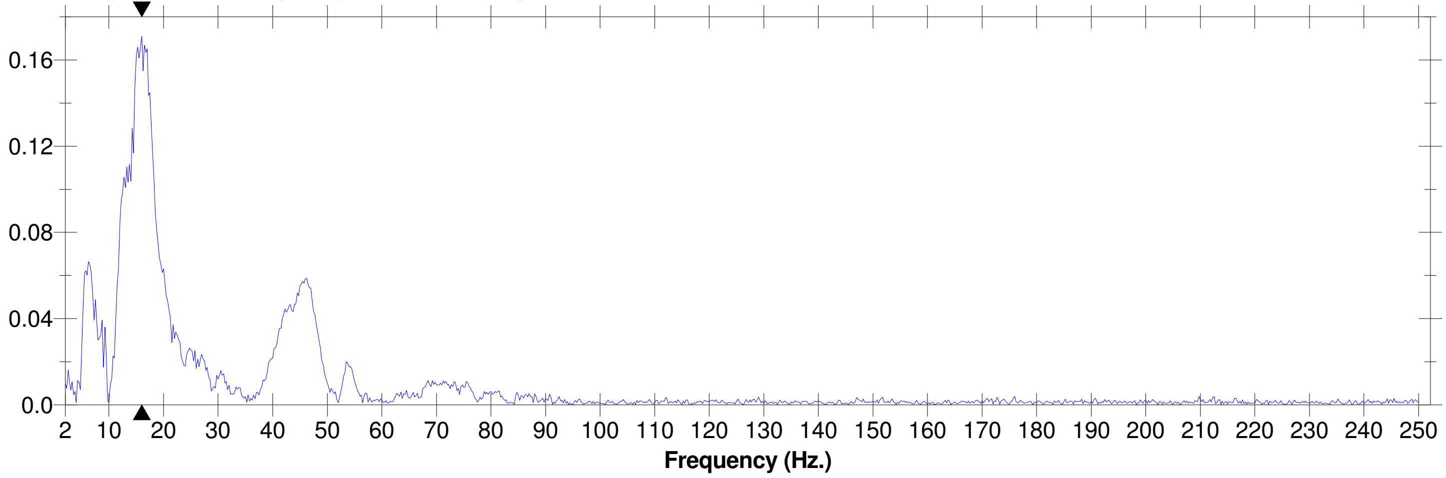
Tran Dominant Frequency = 5.500 Hz., Amplitude = 0.108, PPV from Event = 2.413 mm/s



Vert Dominant Frequency = 14.00 Hz., Amplitude = 0.038, PPV from Event = 0.635 mm/s



Long Dominant Frequency = 16.00 Hz., Amplitude = 0.171, PPV from Event = 4.064 mm/s



Printed: May 12, 2017 (V 10.72 - 10.72.1)

Event Report

Date/Time	Long at 18:17:02 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.4 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVJS.4E0

Notes

Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

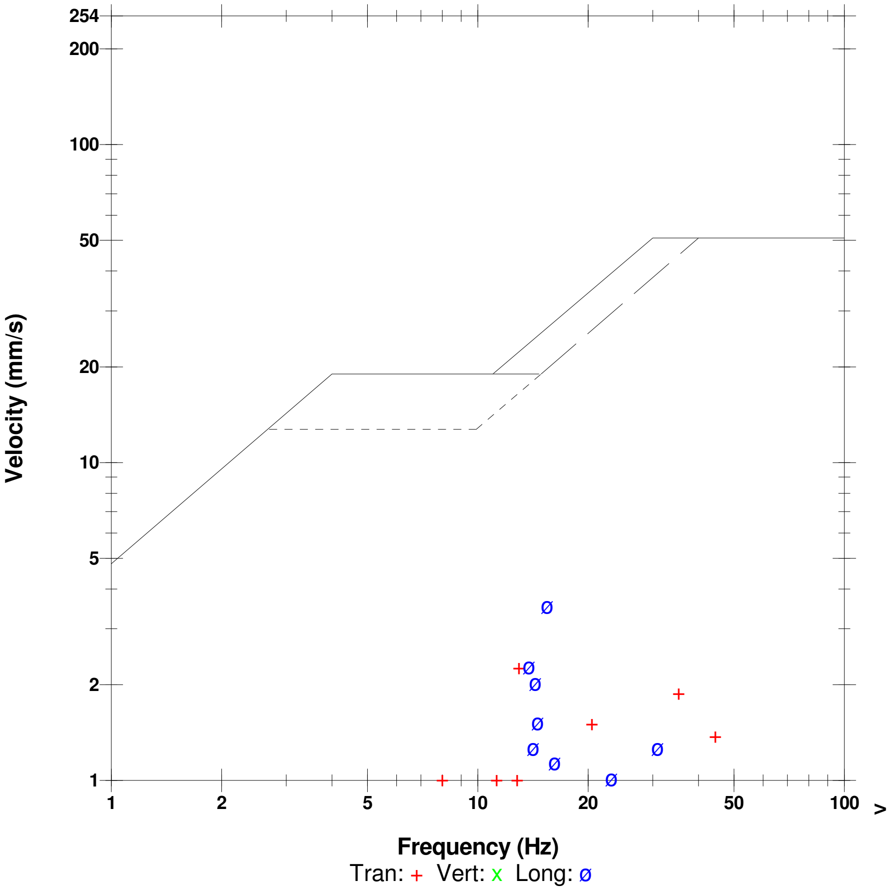
Extended Notes

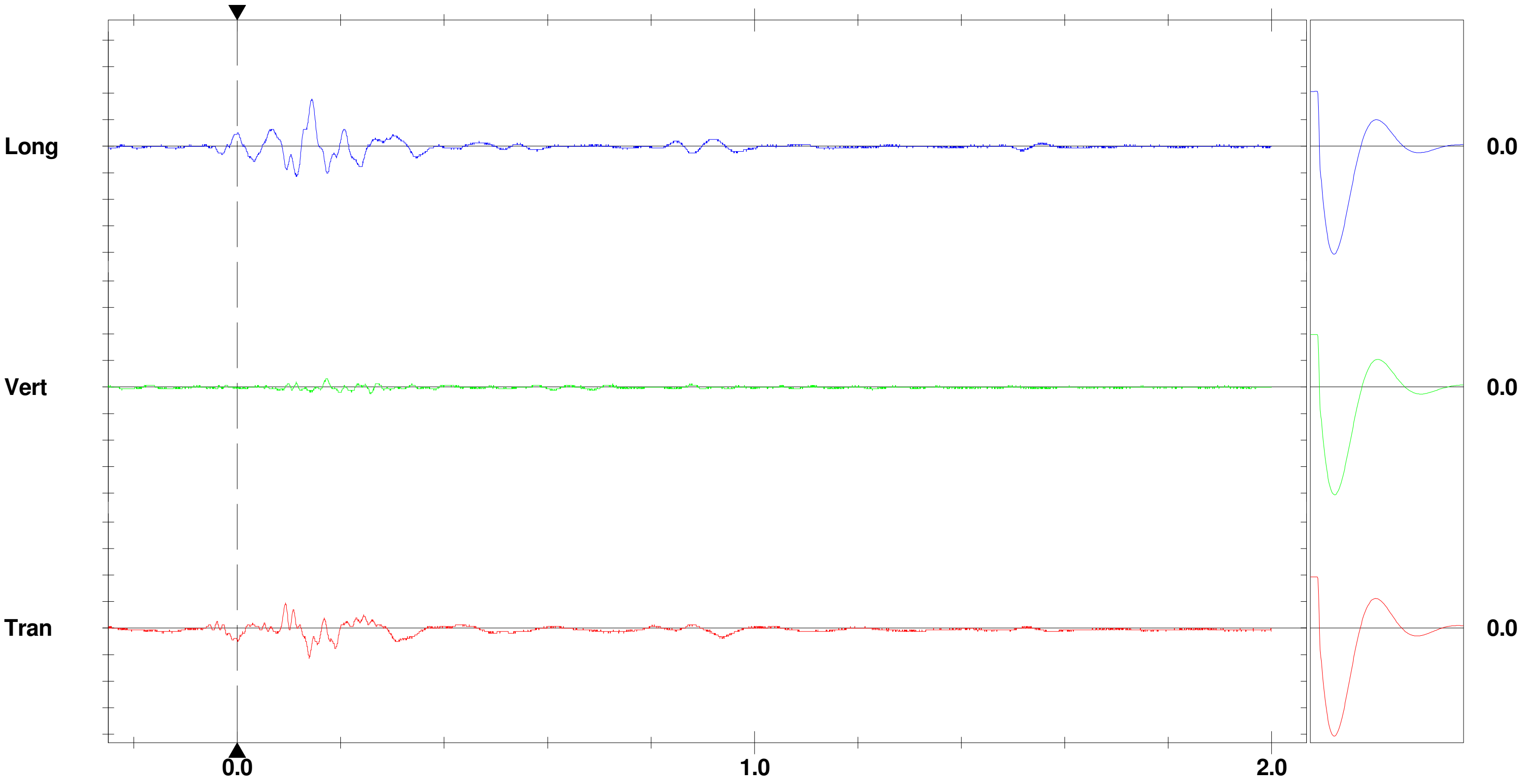
Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	2.286	0.635	3.556	mm/s
ZC Freq	13.0	37	15.5	Hz
Time (Rel. to Trig)	0.139	0.171	0.144	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.021	0.003	0.030	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.5	Hz
Overswing Ratio	3.7	4.0	4.1	

Peak Vector Sum 3.829 mm/s at 0.144 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: May 12, 2017 (V 10.72 - 10.72.1)

FFT Report

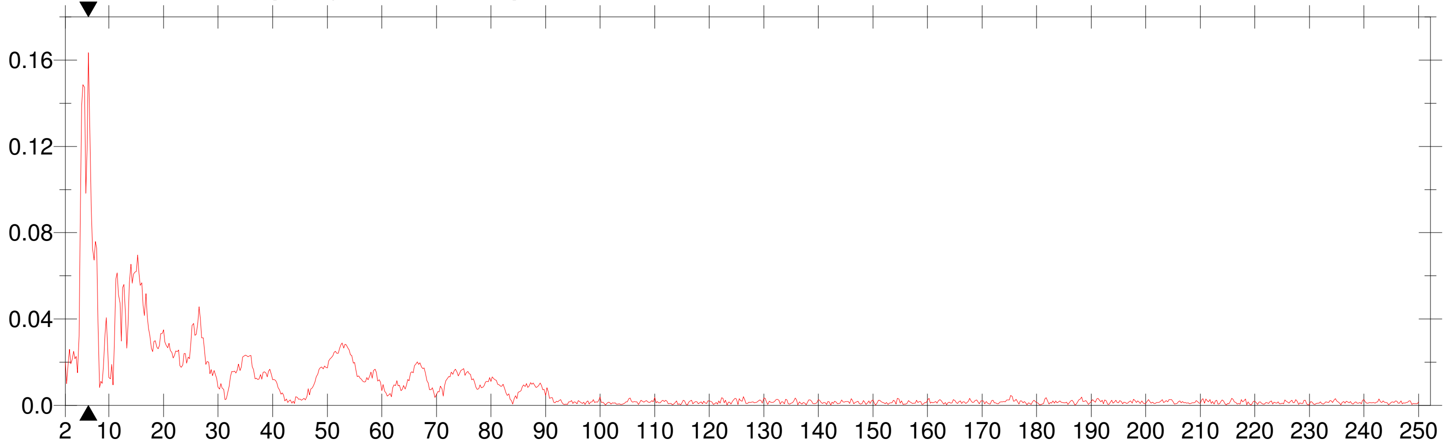
Date/Time Long at 18:17:02 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.4 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GVJS.4E0

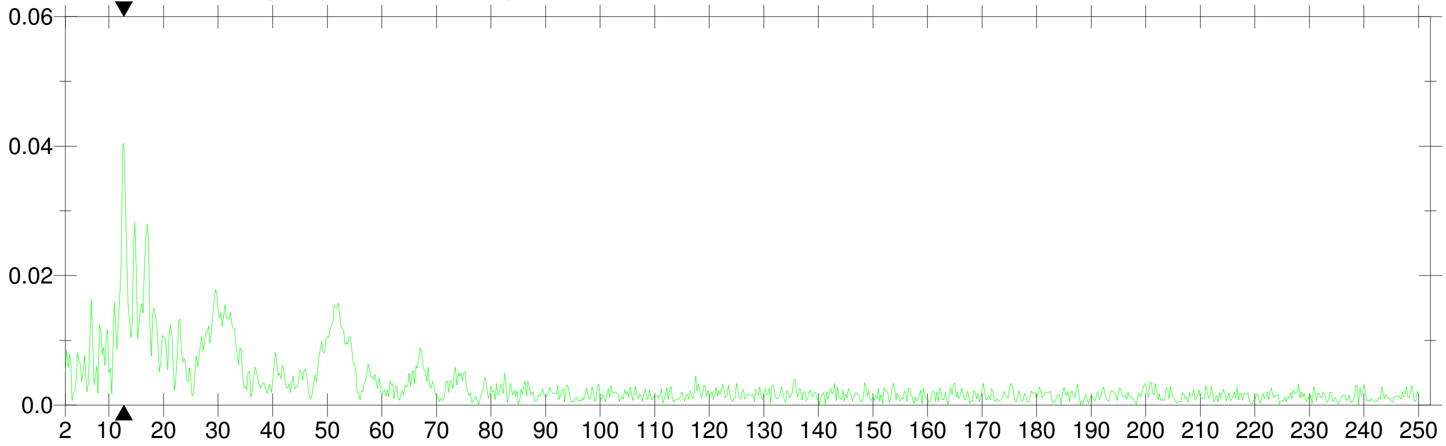
Notes
Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

Extended Notes
Combo Mode May 3, 2017 17:08:27
Geophone anchored into subgrade, and sandbagged

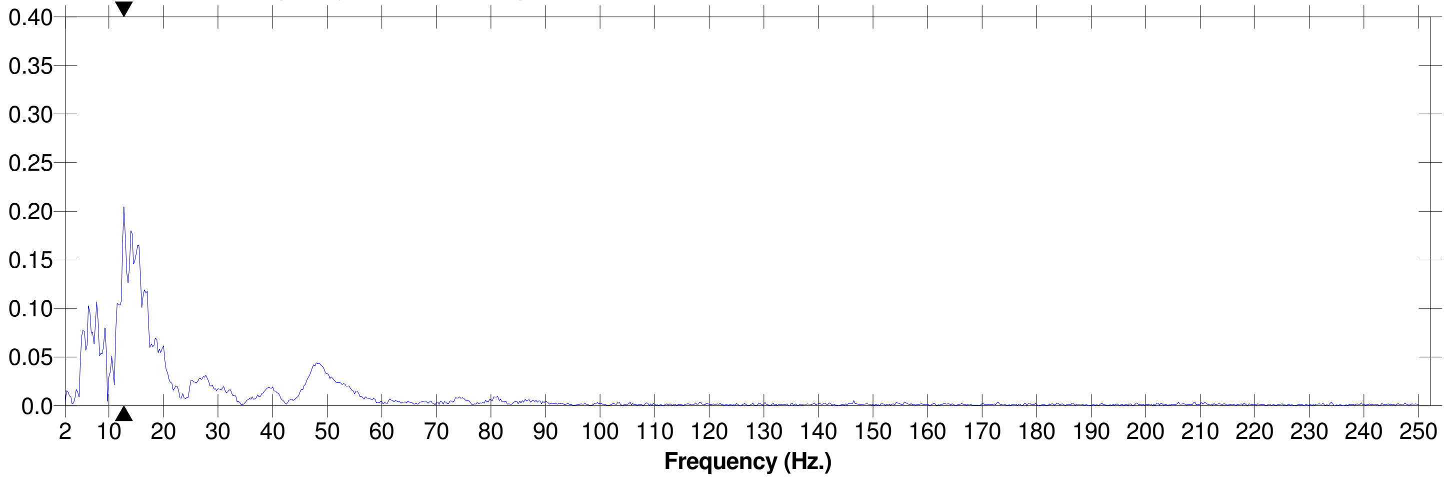
Tran Dominant Frequency = 6.250 Hz., Amplitude = 0.163, PPV from Event = 2.286 mm/s



Vert Dominant Frequency = 12.75 Hz., Amplitude = 0.041, PPV from Event = 0.635 mm/s



Long Dominant Frequency = 12.75 Hz., Amplitude = 0.205, PPV from Event = 3.556 mm/s



Event Report

Histogram Start Time	14:33:32 May 4, 2017
Histogram Finish Time	15:32:18 May 4, 2017
Number of Intervals	1763.00 at 2 seconds
Range	Geo:254.0 mm/s
Sample Rate	2048sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVLC.FW0

Notes

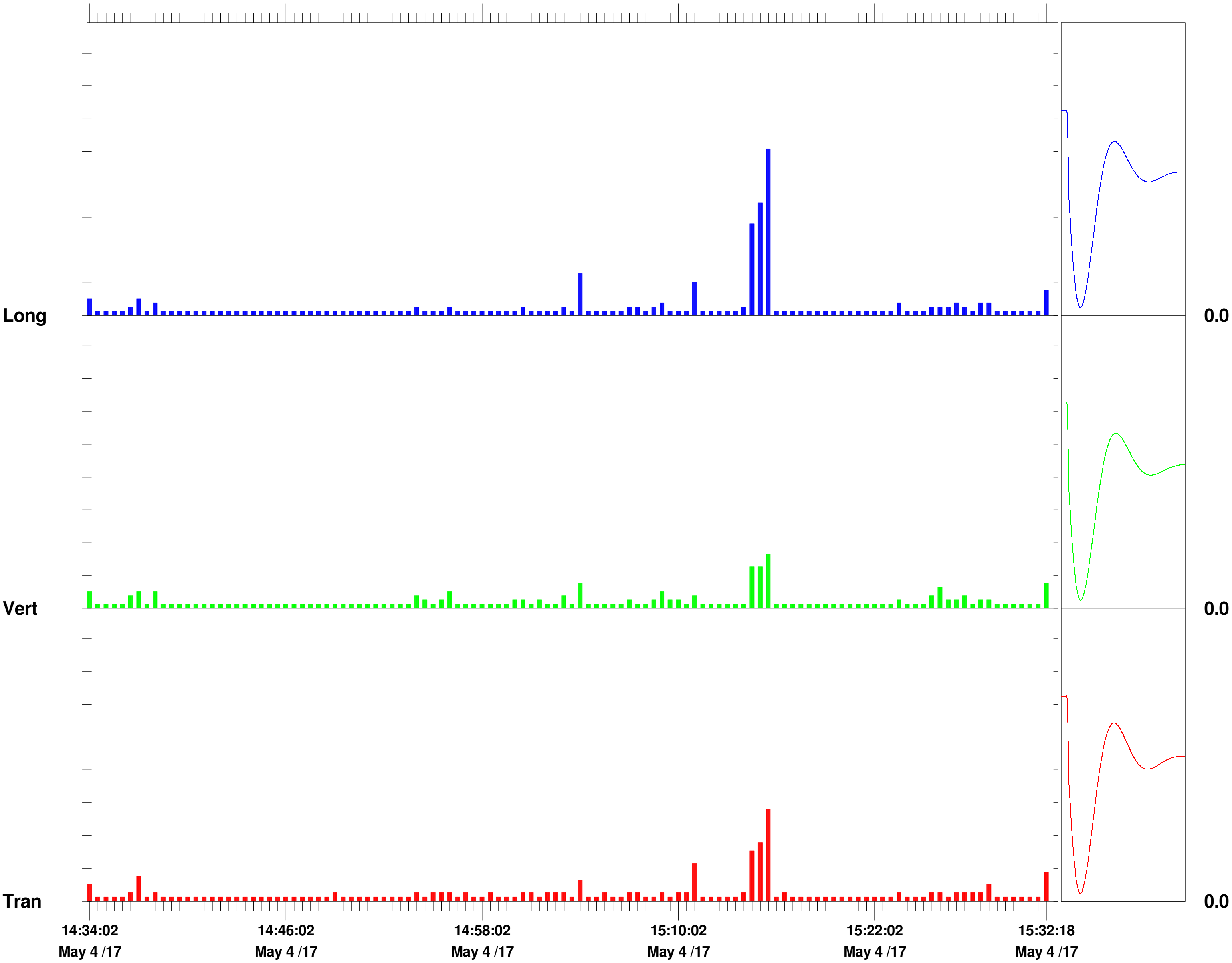
Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

Extended Notes

Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	2.794	1.651	5.080	mm/s
ZC Freq	27	32	29	Hz
Date	May 4 /17	May 4 /17	May 4 /17	
Time	15:15:20	15:15:20	15:15:12	
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.4	Hz
Overswing Ratio	3.7	4.0	4.2	

Peak Vector Sum 5.187 mm/s on May 4, 2017 at 15:15:12



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div

Sensor Check

Instantel

Event Report

Date/Time	Long at 15:03:34 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVLD.TY0

Notes

Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

Extended Notes

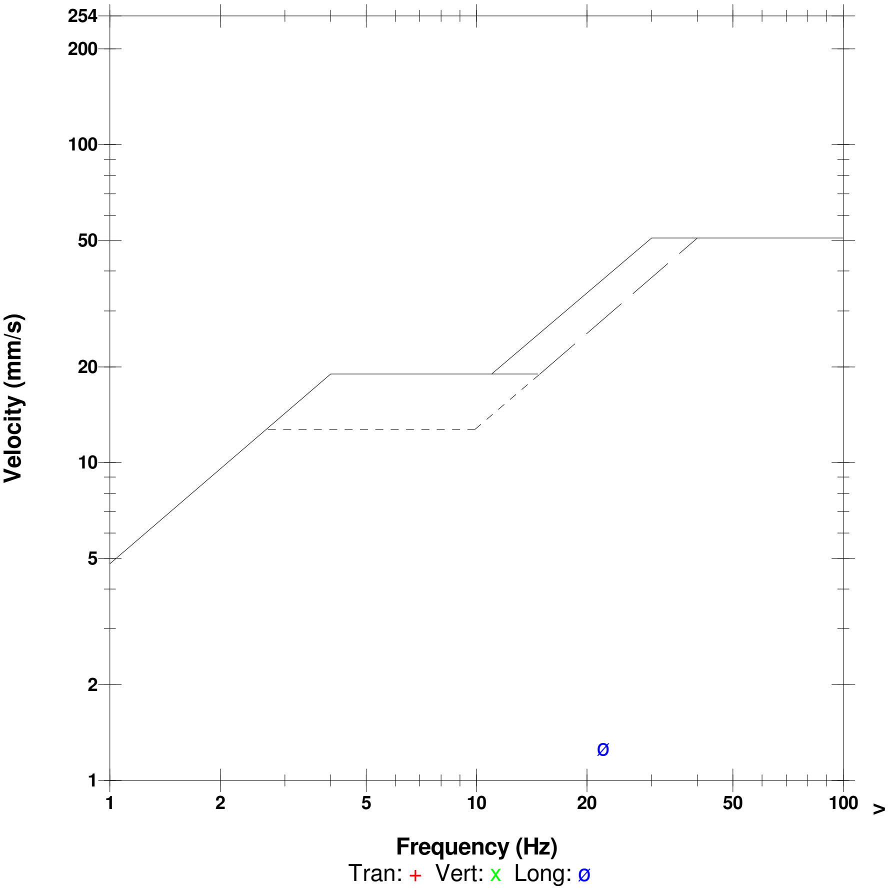
Combo Mode May 4, 2017 14:33:32

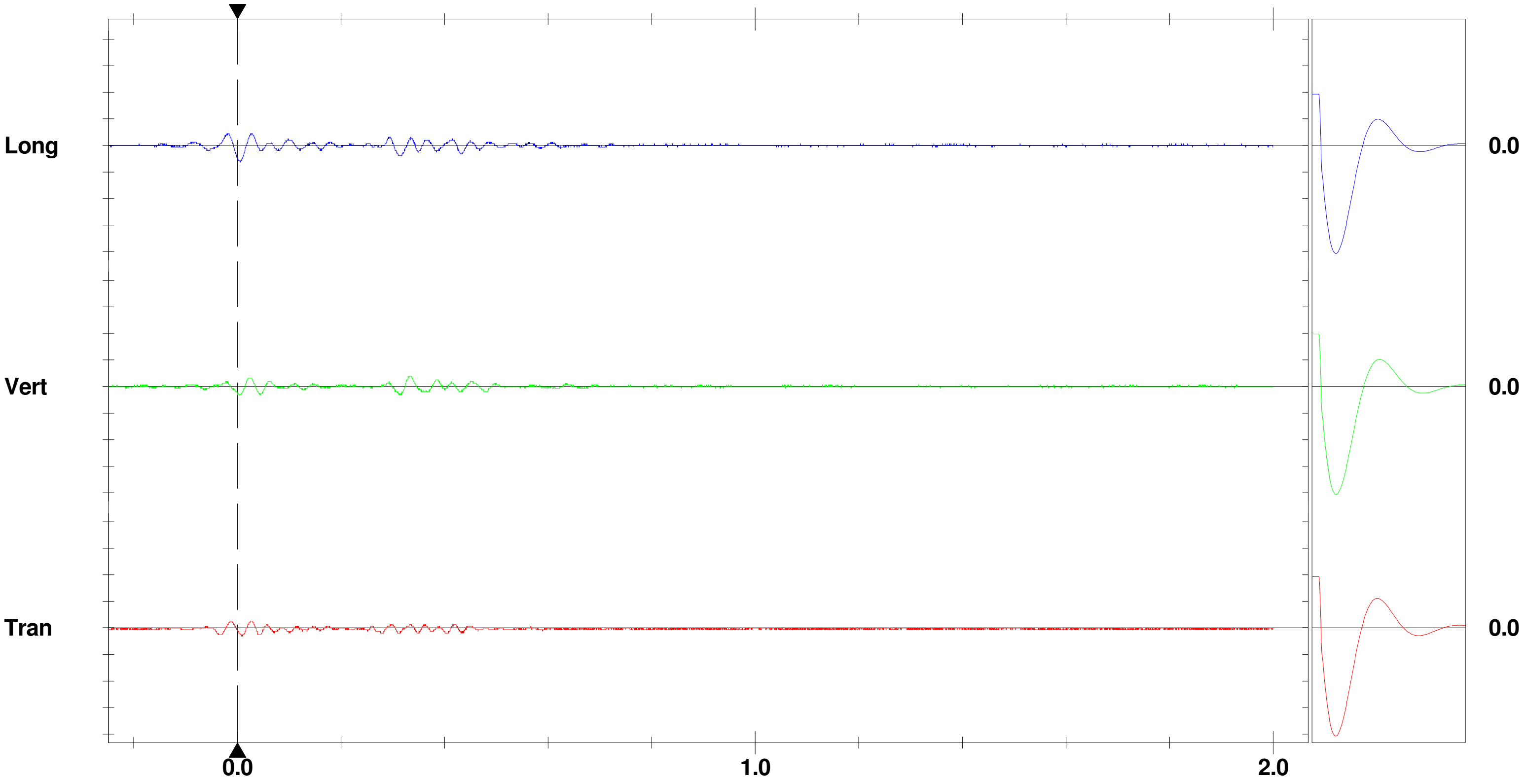
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	0.635	0.762	1.270	mm/s
ZC Freq	30	26	22	Hz
Time (Rel. to Trig)	0.008	0.330	0.005	sec
Peak Acceleration	0.027	0.027	0.053	g
Peak Displacement	0.004	0.005	0.009	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.4	Hz
Overswing Ratio	3.7	4.0	4.2	

Peak Vector Sum 1.508 mm/s at 0.005 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Sensor Check

Trigger = ▶——— ———◀

Instantel

FFT Report

Date/Time	Long at 15:03:34 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVLD.TY0

Notes

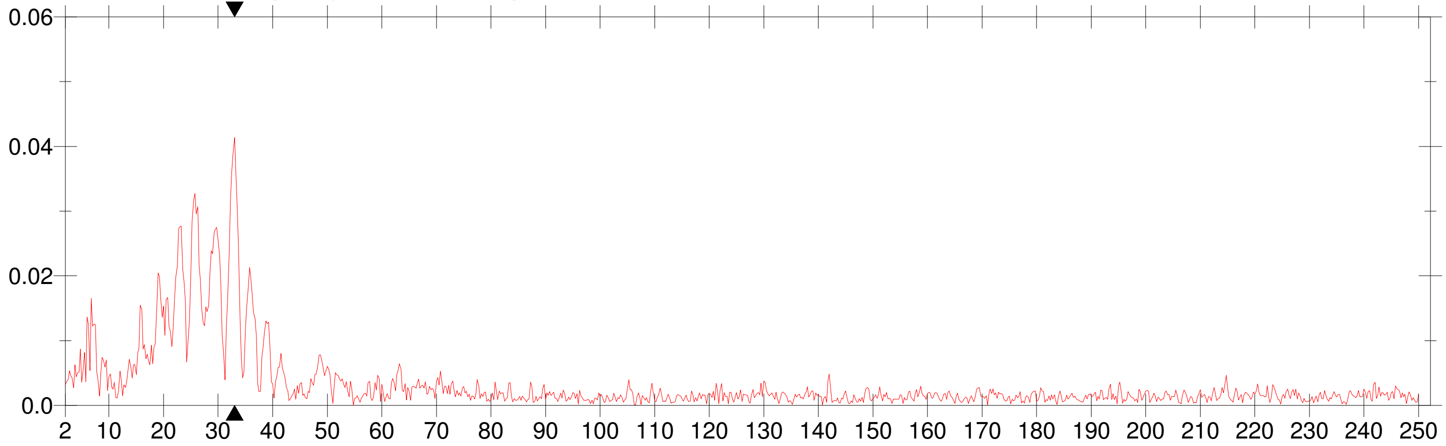
Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

Extended Notes

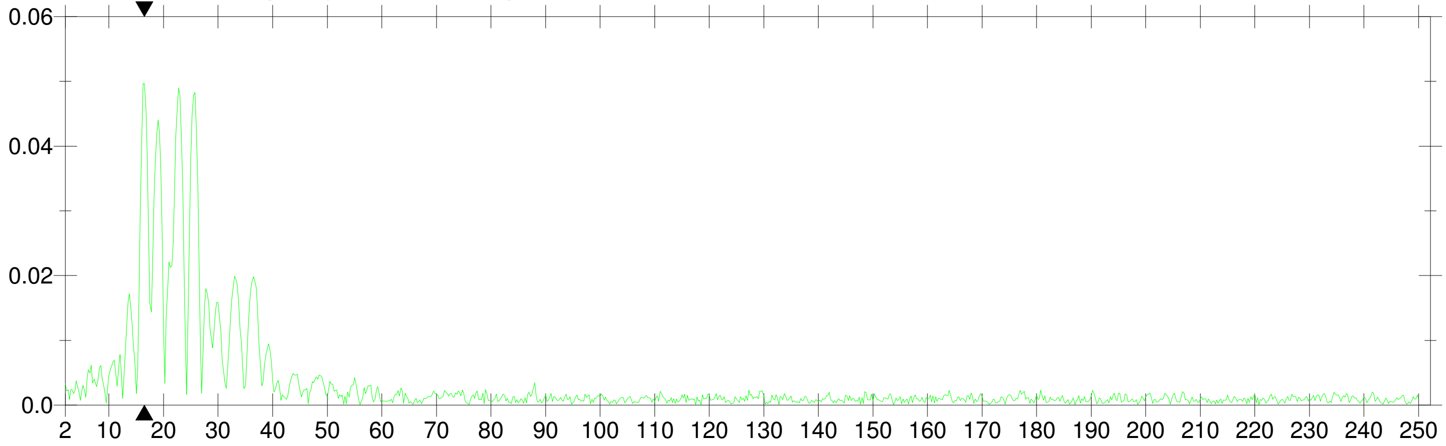
Combo Mode May 4, 2017 14:33:32

Geophone anchored into subgrade, and sandbagged

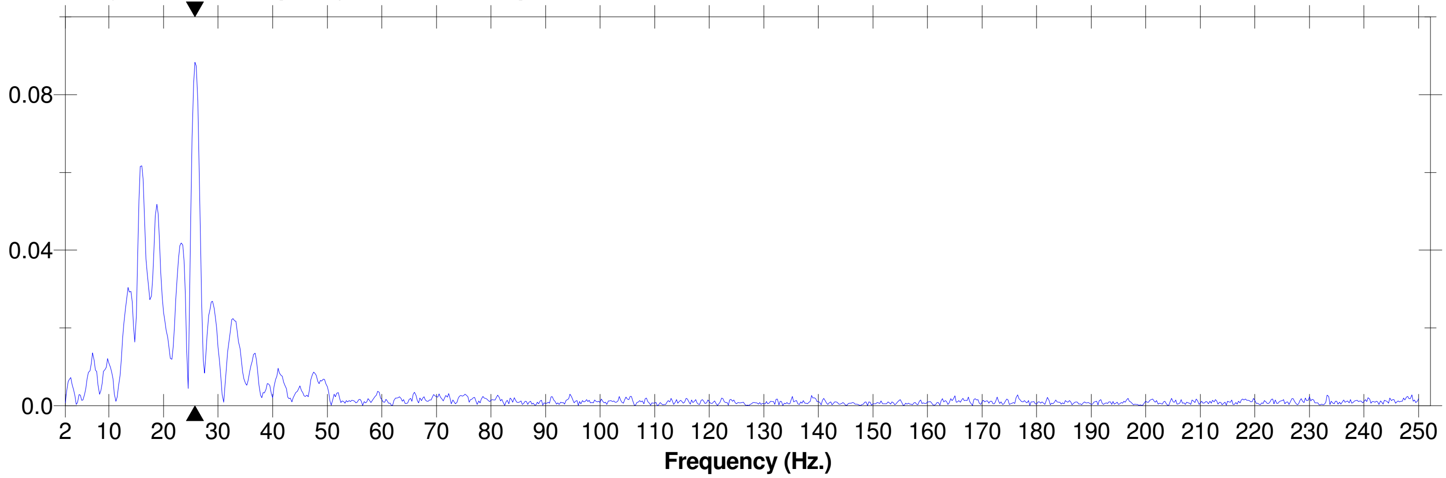
Tran Dominant Frequency = 33.00 Hz., Amplitude = 0.041, PPV from Event = 0.635 mm/s



Vert Dominant Frequency = 16.50 Hz., Amplitude = 0.050, PPV from Event = 0.762 mm/s



Long Dominant Frequency = 25.75 Hz., Amplitude = 0.088, PPV from Event = 1.270 mm/s



Event Report

Date/Time	Tran at 15:10:58 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVLE.6A0

Notes

Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

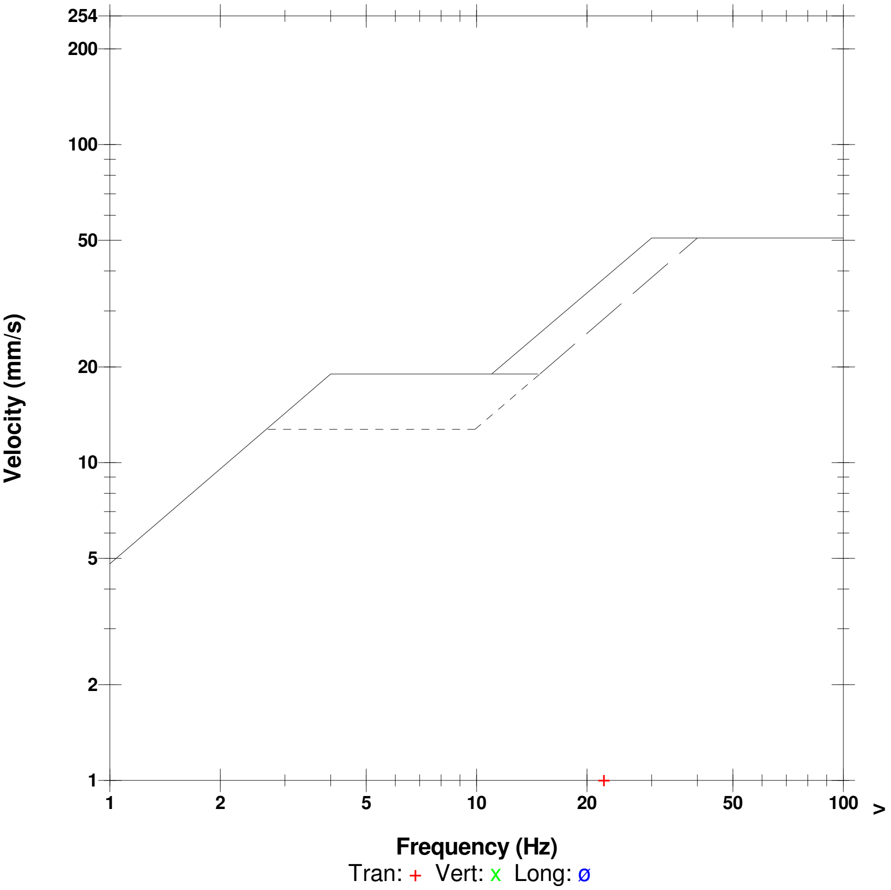
Extended Notes

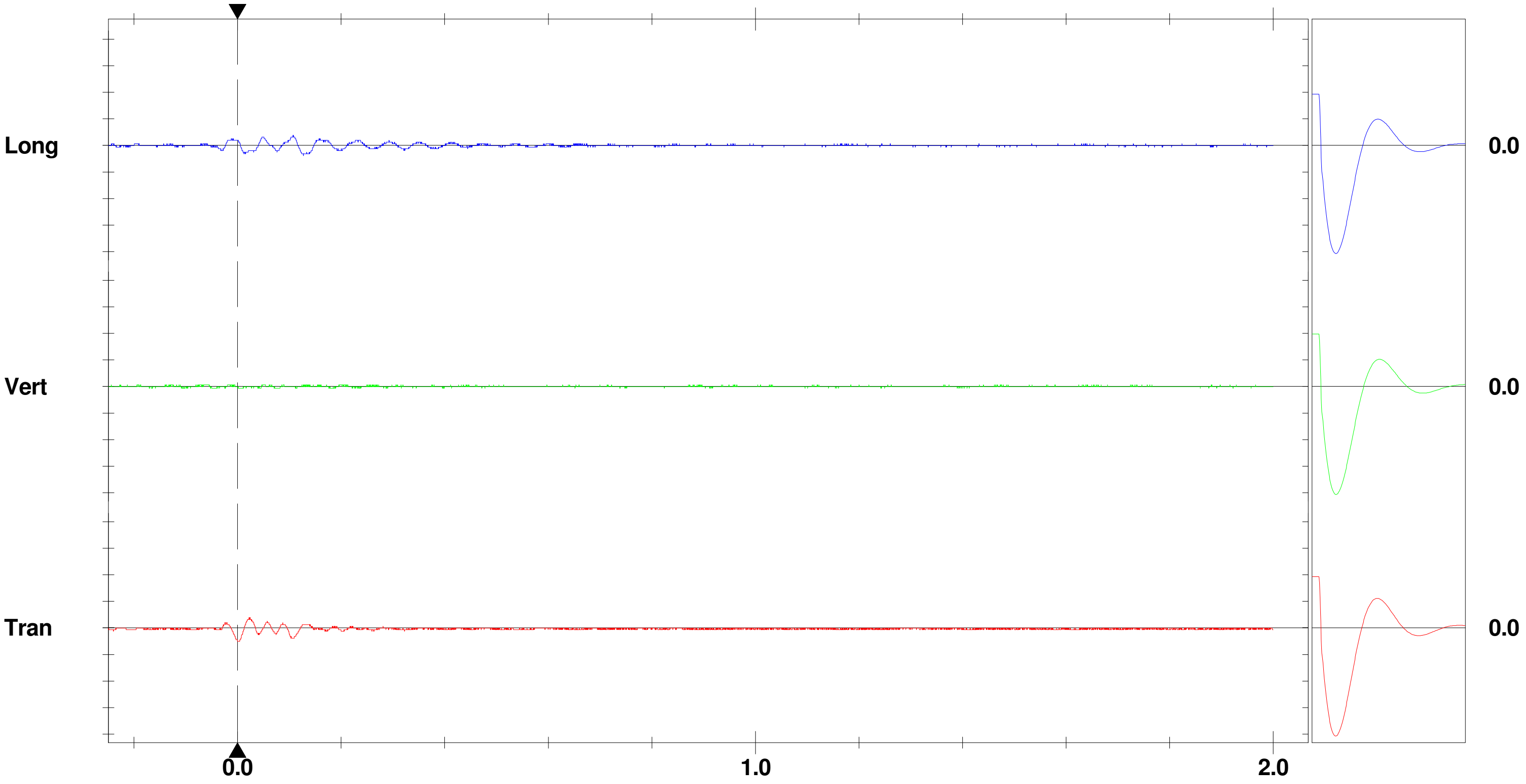
Combo Mode May 4, 2017 14:33:32
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	1.016	0.127	0.762	mm/s
ZC Freq	22	>200	21	Hz
Time (Rel. to Trig)	0.000	-0.244	0.107	sec
Peak Acceleration	0.027	0.053	0.027	g
Peak Displacement	0.007	0.000	0.007	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.4	Hz
Overswing Ratio	3.7	4.0	4.2	

Peak Vector Sum 1.092 mm/s at 0.000 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Sensor Check

Trigger = ▶——— ———◀

Printed: May 12, 2017 (V 10.72 - 10.72.1)

Format © 1995-2015 Xmark Corporation

FFT Report

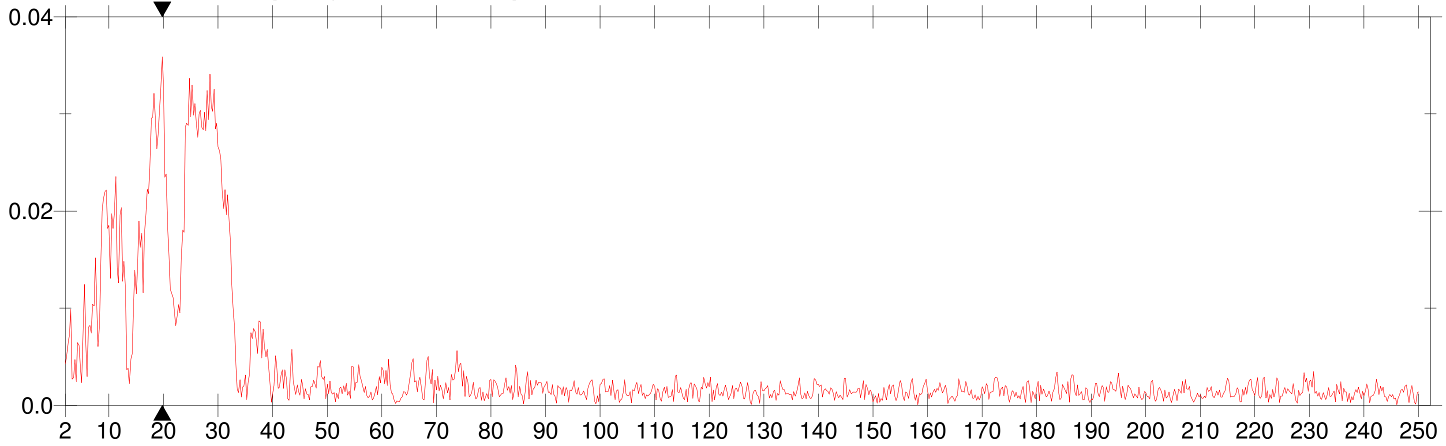
Date/Time Tran at 15:10:58 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GVLE.6A0

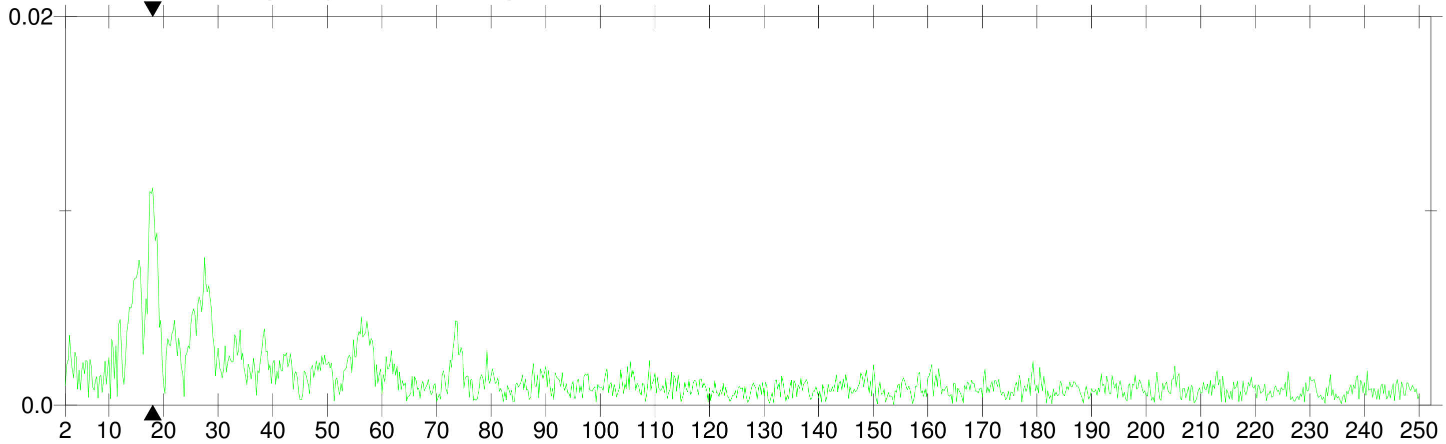
Notes
Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

Extended Notes
Combo Mode May 4, 2017 14:33:32
Geophone anchored into subgrade, and sandbagged

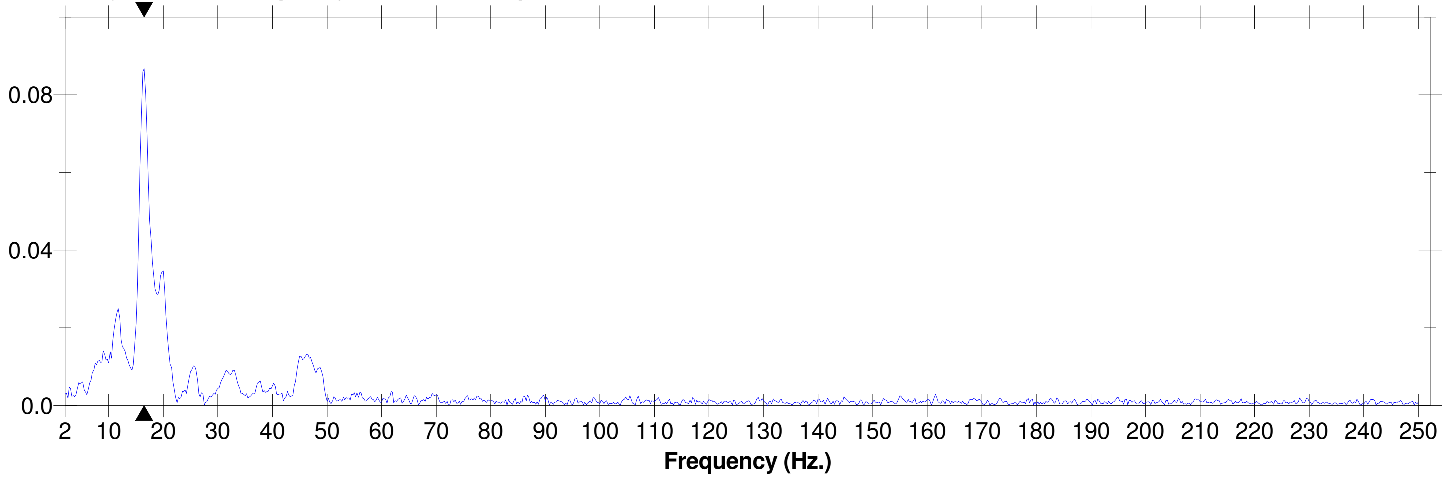
Tran Dominant Frequency = 19.75 Hz., Amplitude = 0.036, PPV from Event = 1.016 mm/s



Vert Dominant Frequency = 18.00 Hz., Amplitude = 0.011, PPV from Event = 0.127 mm/s



Long Dominant Frequency = 16.50 Hz., Amplitude = 0.087, PPV from Event = 0.762 mm/s



Instantel

Event Report

Date/Time	Long at 15:11:00 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVLE.6C0

Notes

Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

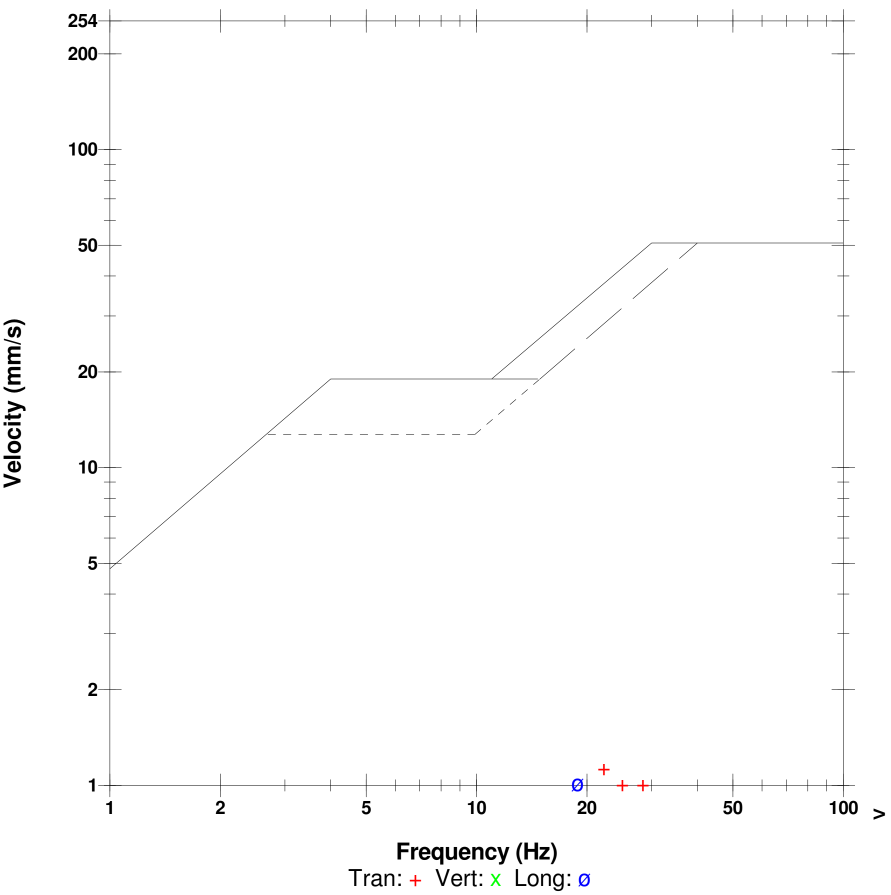
Extended Notes

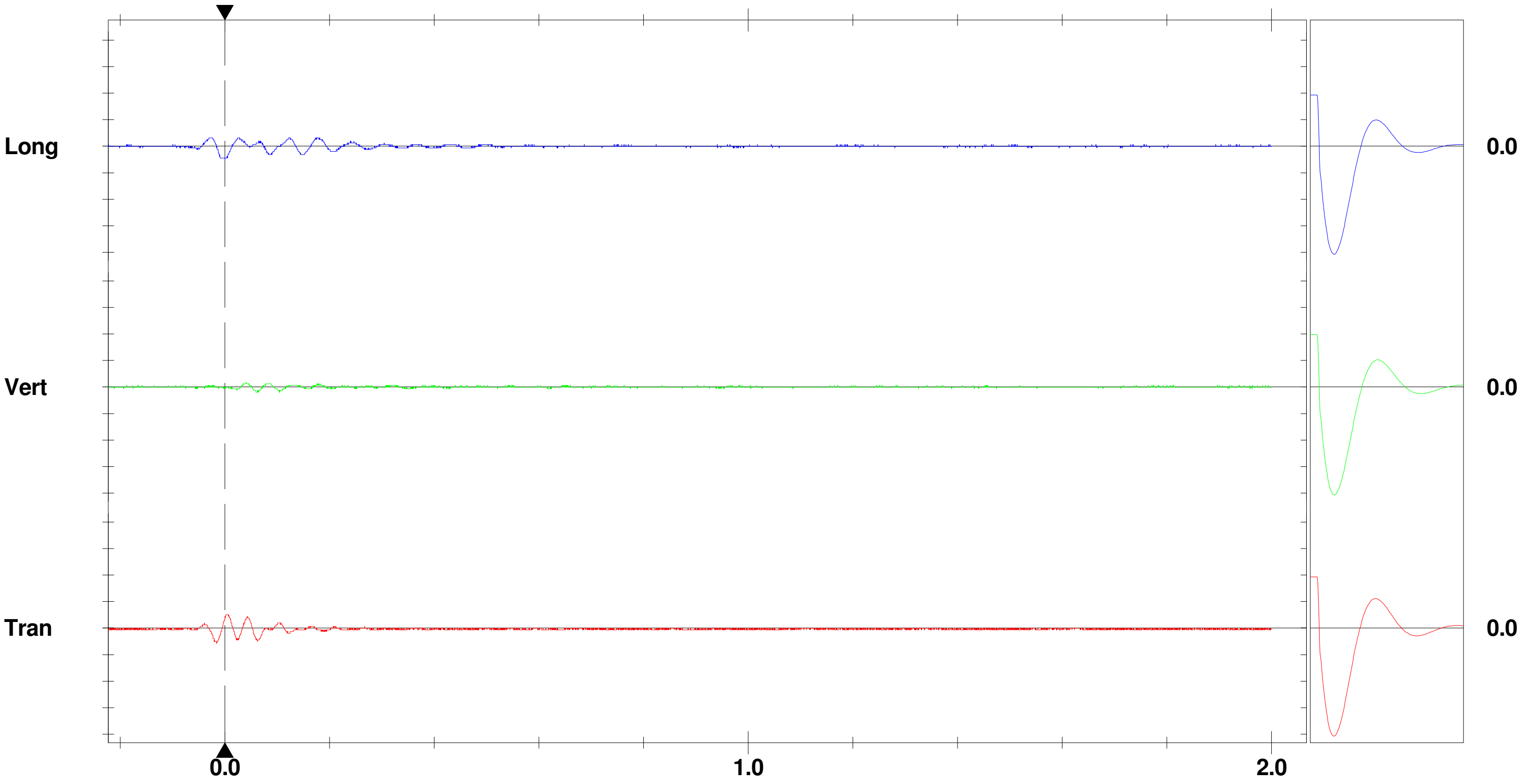
Combo Mode May 4, 2017 14:33:32
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	1.143	0.381	1.016	mm/s
ZC Freq	22	47	19.0	Hz
Time (Rel. to Trig)	-0.016	0.041	0.000	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.008	0.002	0.009	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.4	Hz
Overswing Ratio	3.7	4.0	4.2	

Peak Vector Sum 1.350 mm/s at 0.002 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Sensor Check

Trigger = ▶—— ——◀

FFT Report

Date/Time	Long at 15:11:00 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVLE.6C0

Notes

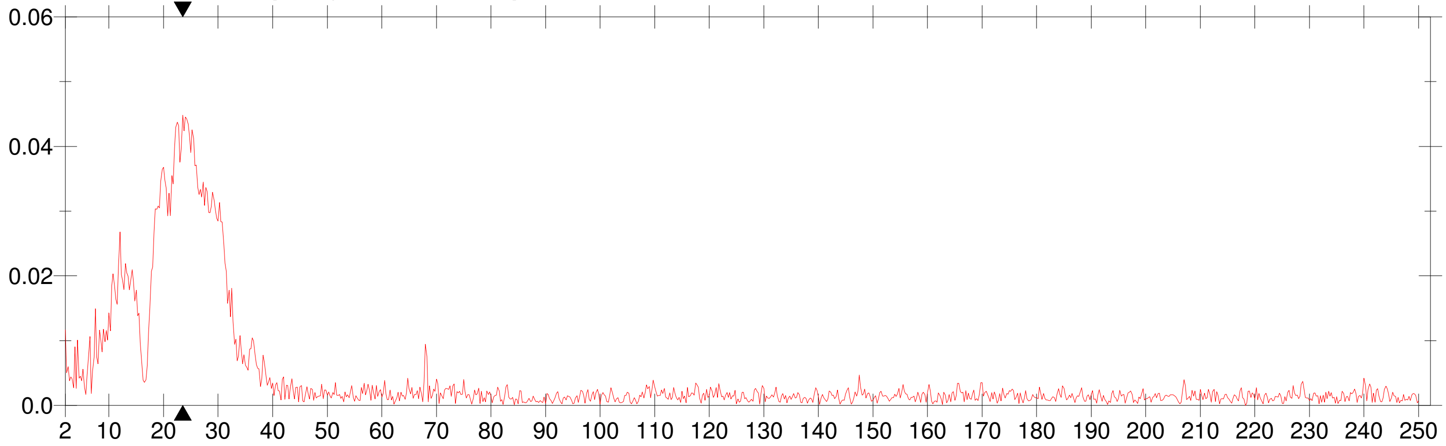
Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

Extended Notes

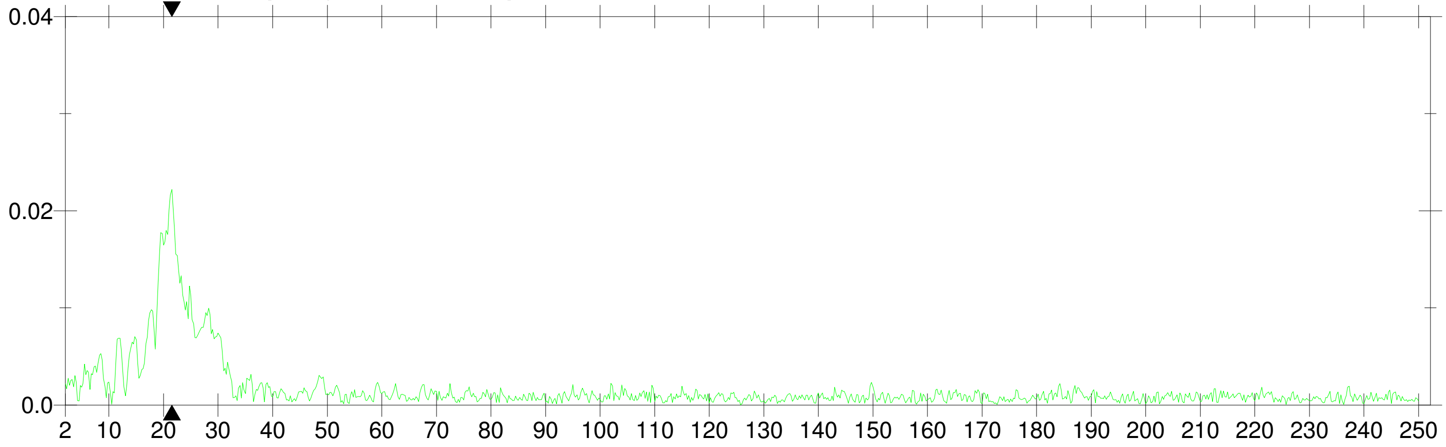
Combo Mode May 4, 2017 14:33:32

Geophone anchored into subgrade, and sandbagged

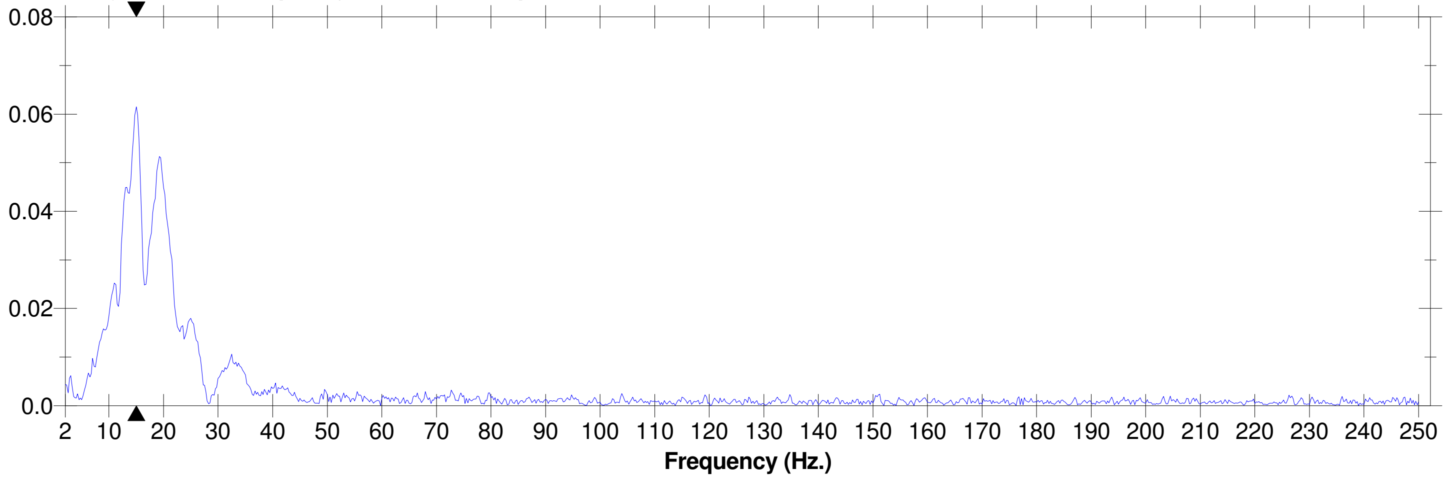
Tran Dominant Frequency = 23.50 Hz., Amplitude = 0.045, PPV from Event = 1.143 mm/s



Vert Dominant Frequency = 21.50 Hz., Amplitude = 0.022, PPV from Event = 0.381 mm/s



Long Dominant Frequency = 15.00 Hz., Amplitude = 0.061, PPV from Event = 1.016 mm/s



Event Report

Date/Time Long at 15:14:11 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GVLE.BN0

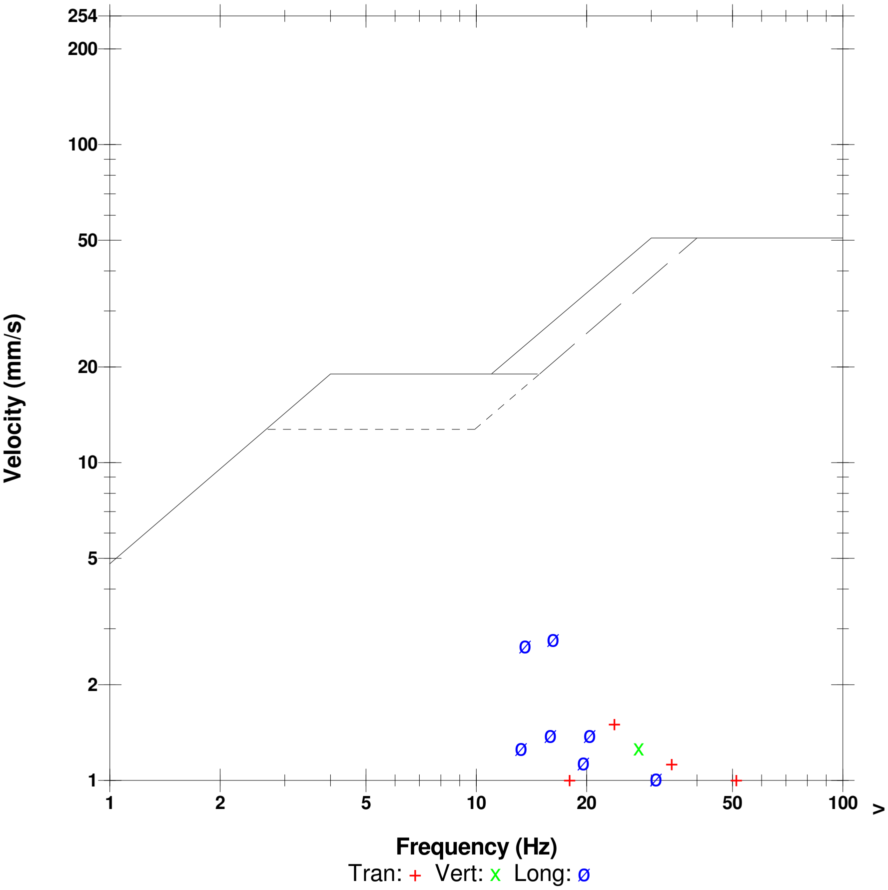
Notes
Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

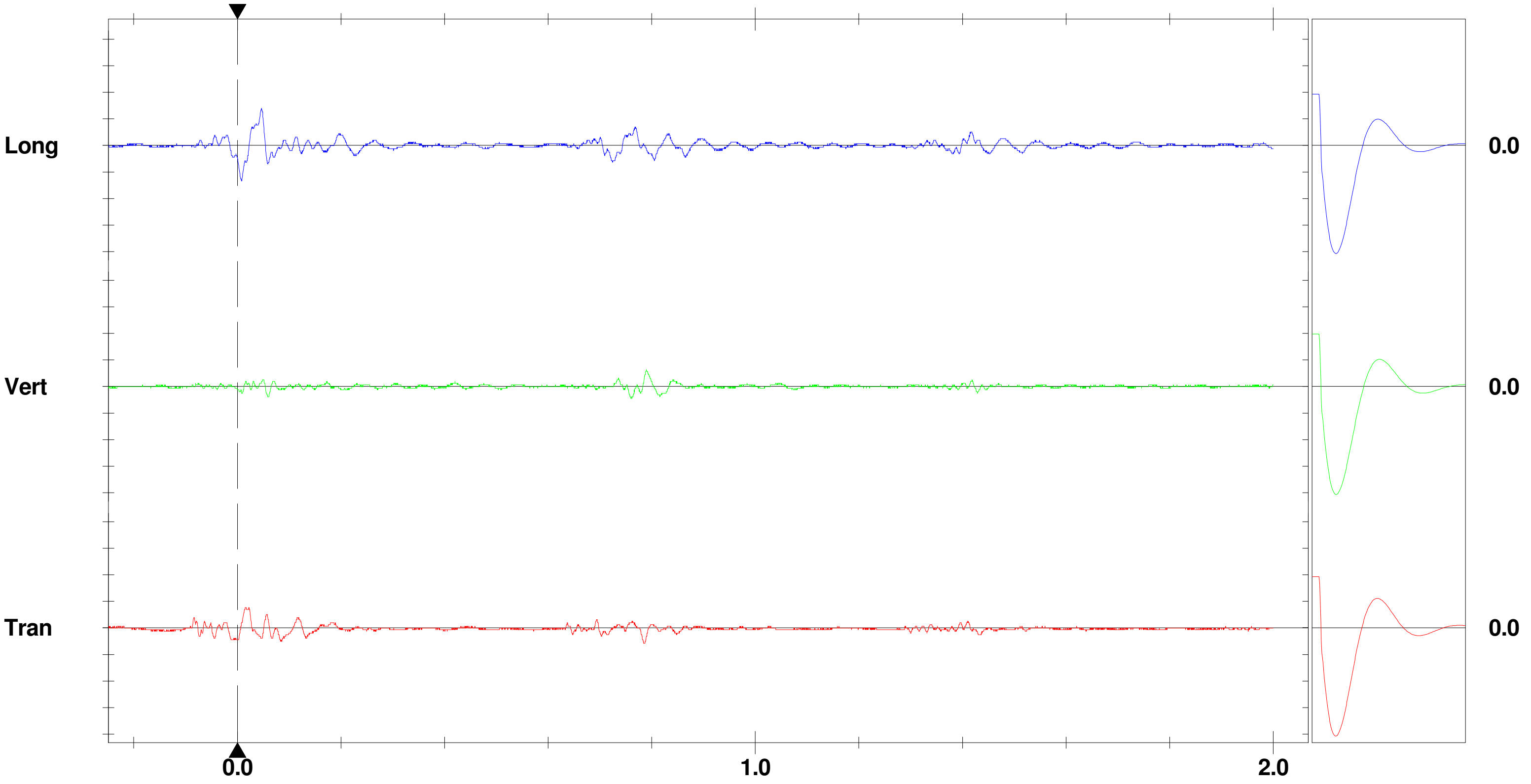
Extended Notes
Combo Mode May 4, 2017 14:33:32
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	1.524	1.270	2.794	mm/s
ZC Freq	24	28	16.3	Hz
Time (Rel. to Trig)	0.015	0.790	0.046	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.011	0.007	0.024	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.4	Hz
Overswing Ratio	3.7	4.0	4.2	

Peak Vector Sum 2.907 mm/s at 0.046 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Printed: May 12, 2017 (V 10.72 - 10.72.1)

Instantel

FFT Report

Date/Time Long at 15:14:11 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GVLE.BN0

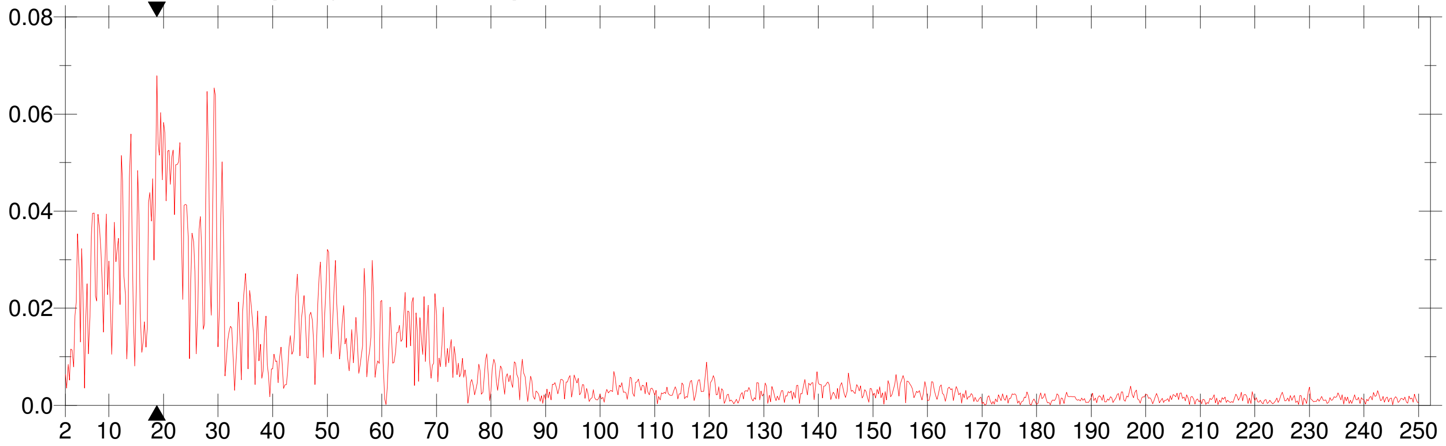
Notes

Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

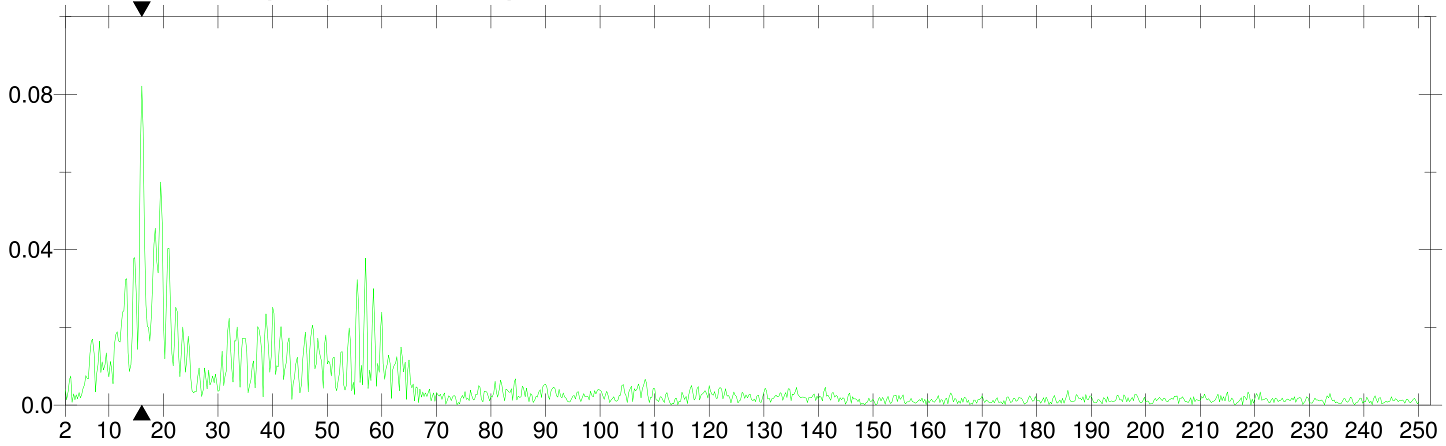
Extended Notes

Combo Mode May 4, 2017 14:33:32
Geophone anchored into subgrade, and sandbagged

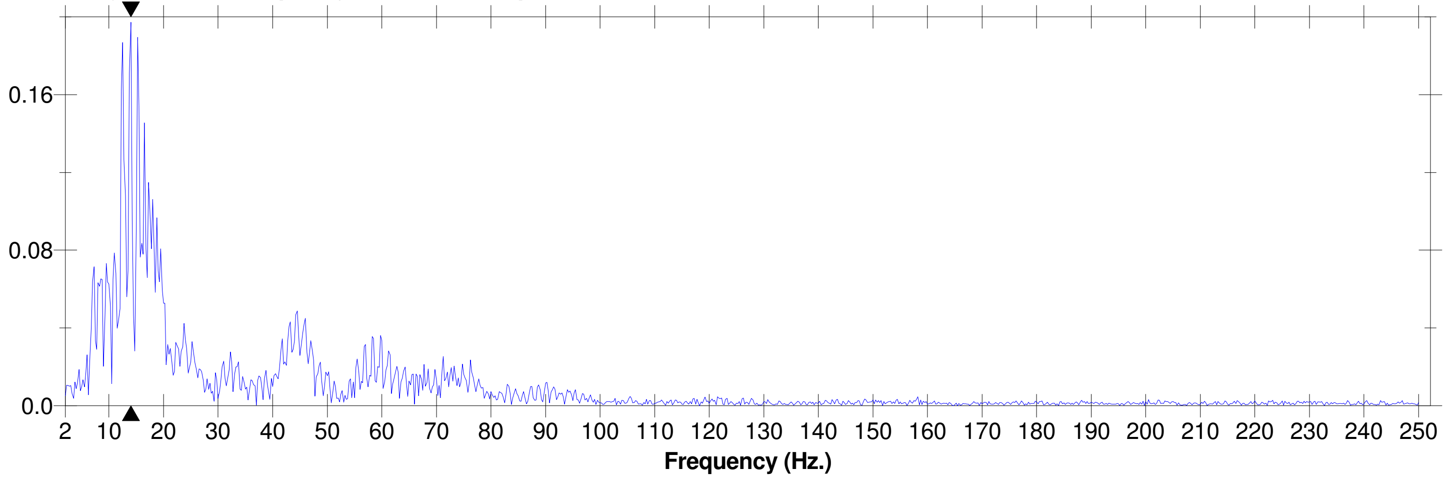
Tran Dominant Frequency = 18.75 Hz., Amplitude = 0.068, PPV from Event = 1.524 mm/s



Vert Dominant Frequency = 16.00 Hz., Amplitude = 0.082, PPV from Event = 1.270 mm/s



Long Dominant Frequency = 14.00 Hz., Amplitude = 0.197, PPV from Event = 2.794 mm/s



Event Report

Date/Time Long at 15:14:39 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GVLE.CF0

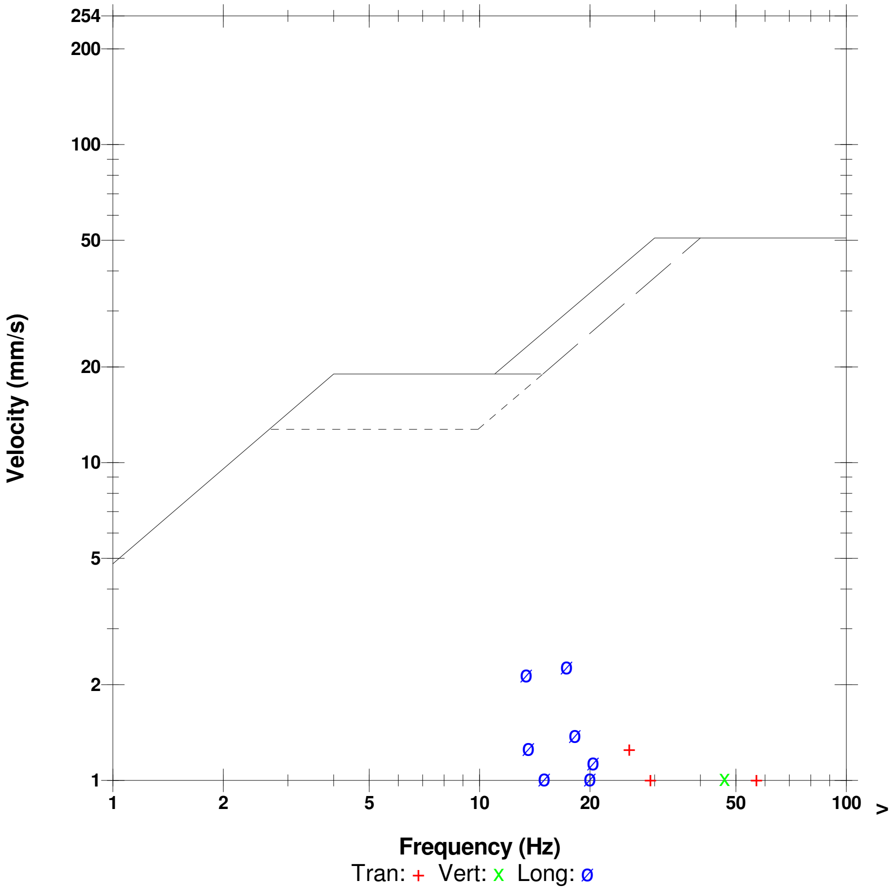
Notes
Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

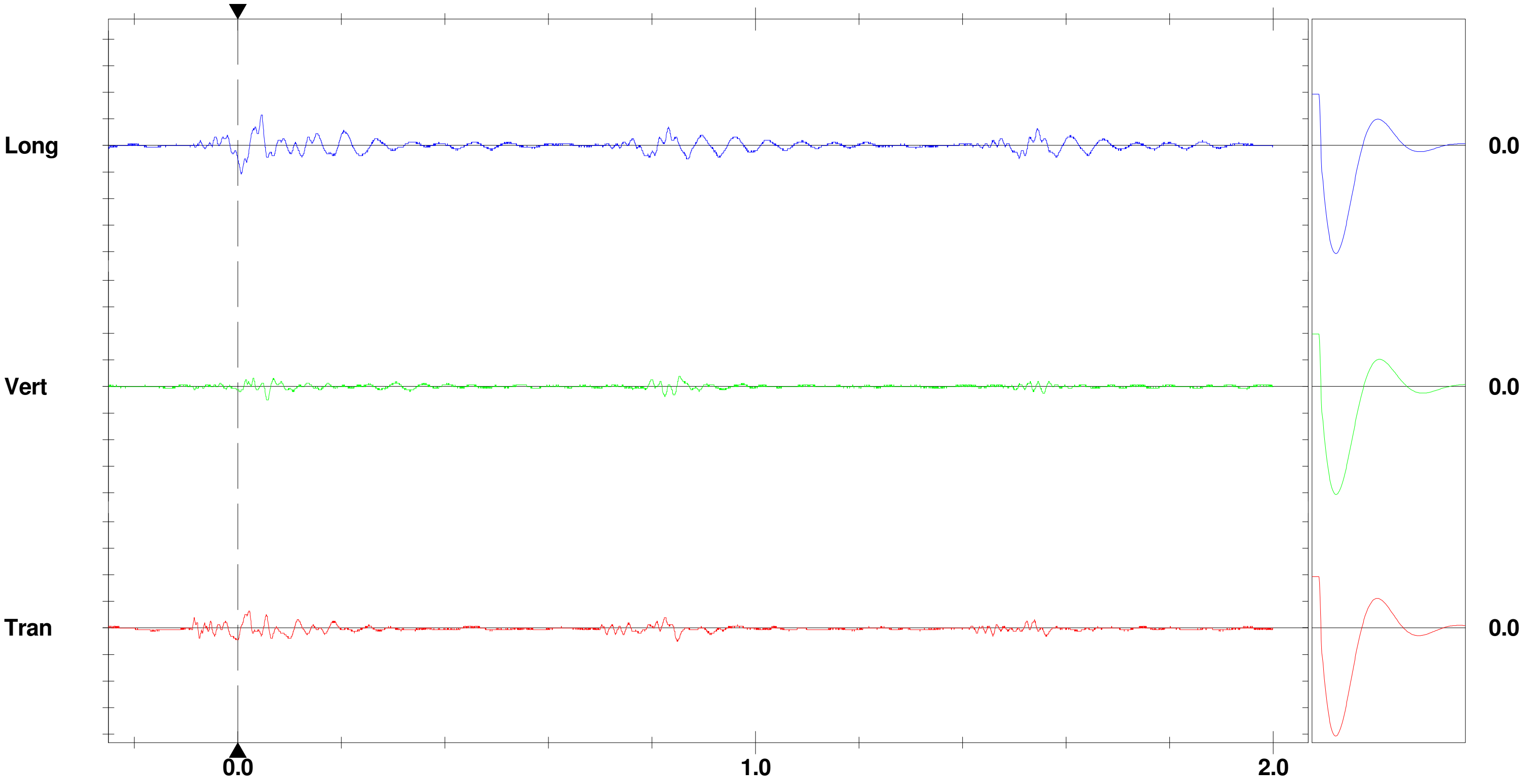
Extended Notes
Combo Mode May 4, 2017 14:33:32
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	1.270	1.016	2.286	mm/s
ZC Freq	26	47	17.4	Hz
Time (Rel. to Trig)	0.021	0.056	0.045	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.008	0.004	0.019	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.4	Hz
Overswing Ratio	3.7	4.0	4.2	

Peak Vector Sum 2.376 mm/s at 0.045 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div
Trigger = ▶—— ——◀

Sensor Check

FFT Report

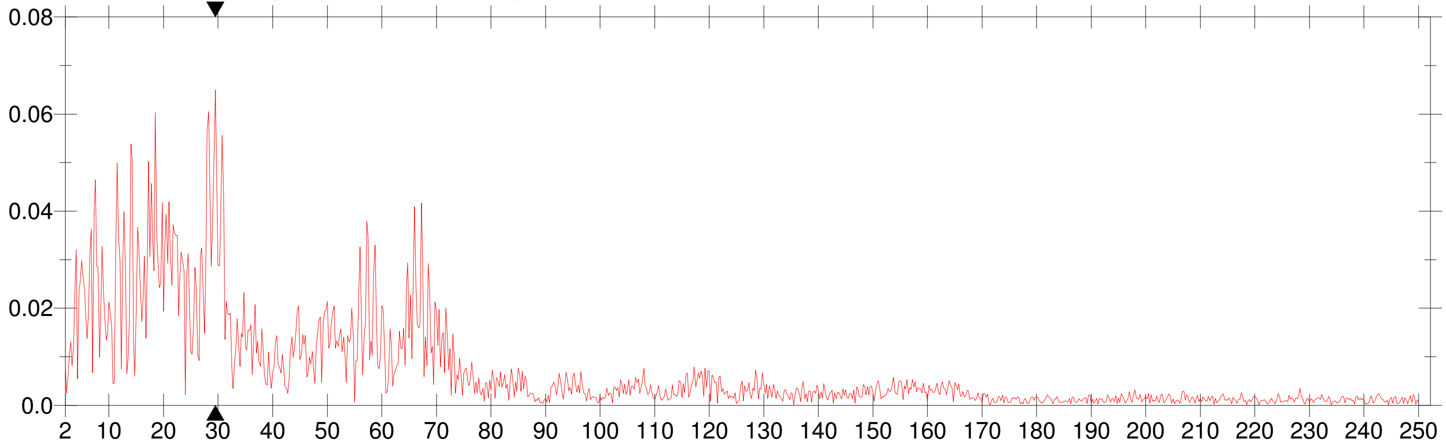
Date/Time Long at 15:14:39 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GVLE.CF0

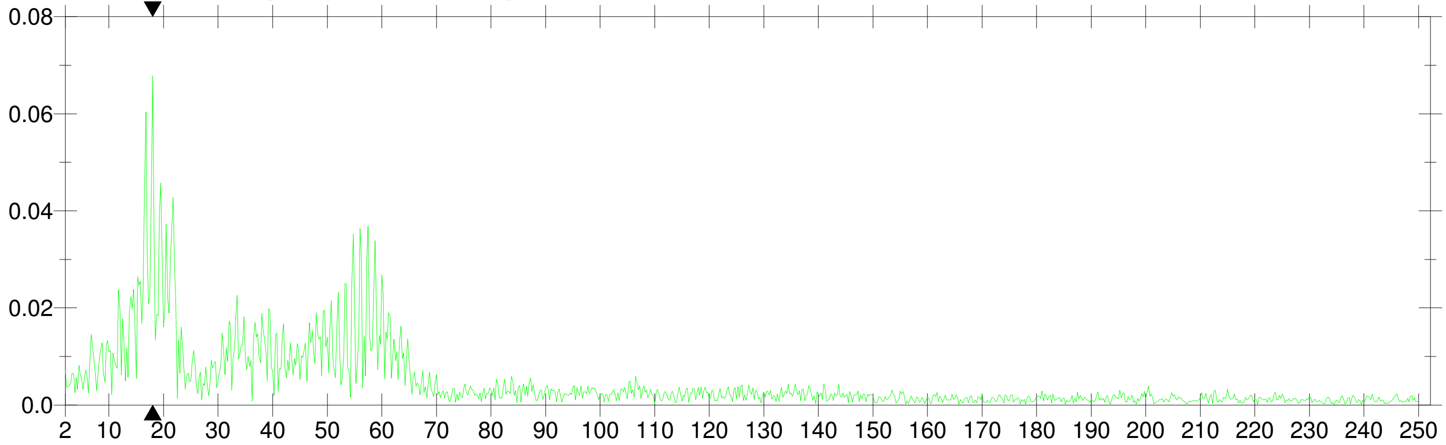
Notes
Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

Extended Notes
Combo Mode May 4, 2017 14:33:32
Geophone anchored into subgrade, and sandbagged

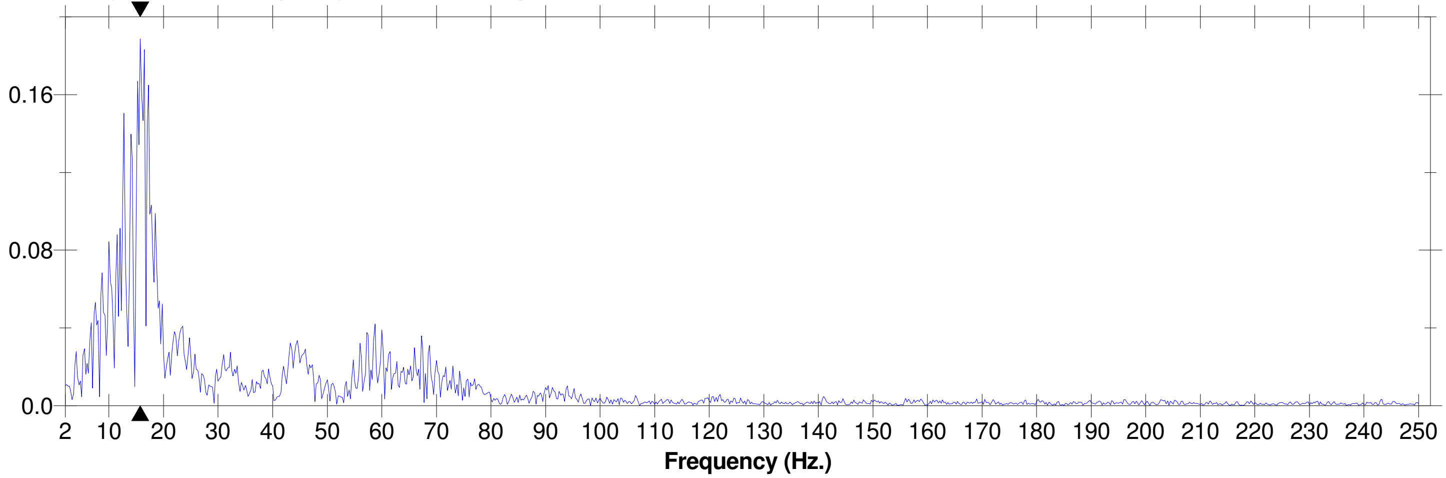
Tran Dominant Frequency = 29.50 Hz., Amplitude = 0.065, PPV from Event = 1.270 mm/s



Vert Dominant Frequency = 18.00 Hz., Amplitude = 0.068, PPV from Event = 1.016 mm/s



Long Dominant Frequency = 15.75 Hz., Amplitude = 0.189, PPV from Event = 2.286 mm/s



Instantel

Event Report

Date/Time Long at 15:15:00 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GVLE.D00

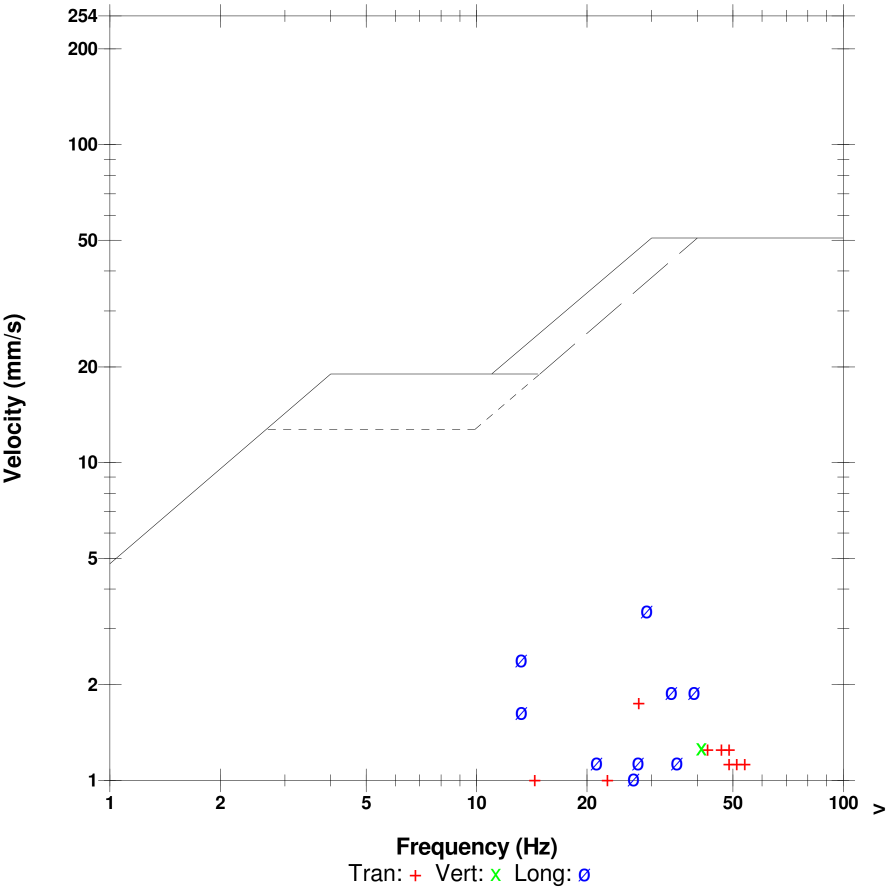
Notes
Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

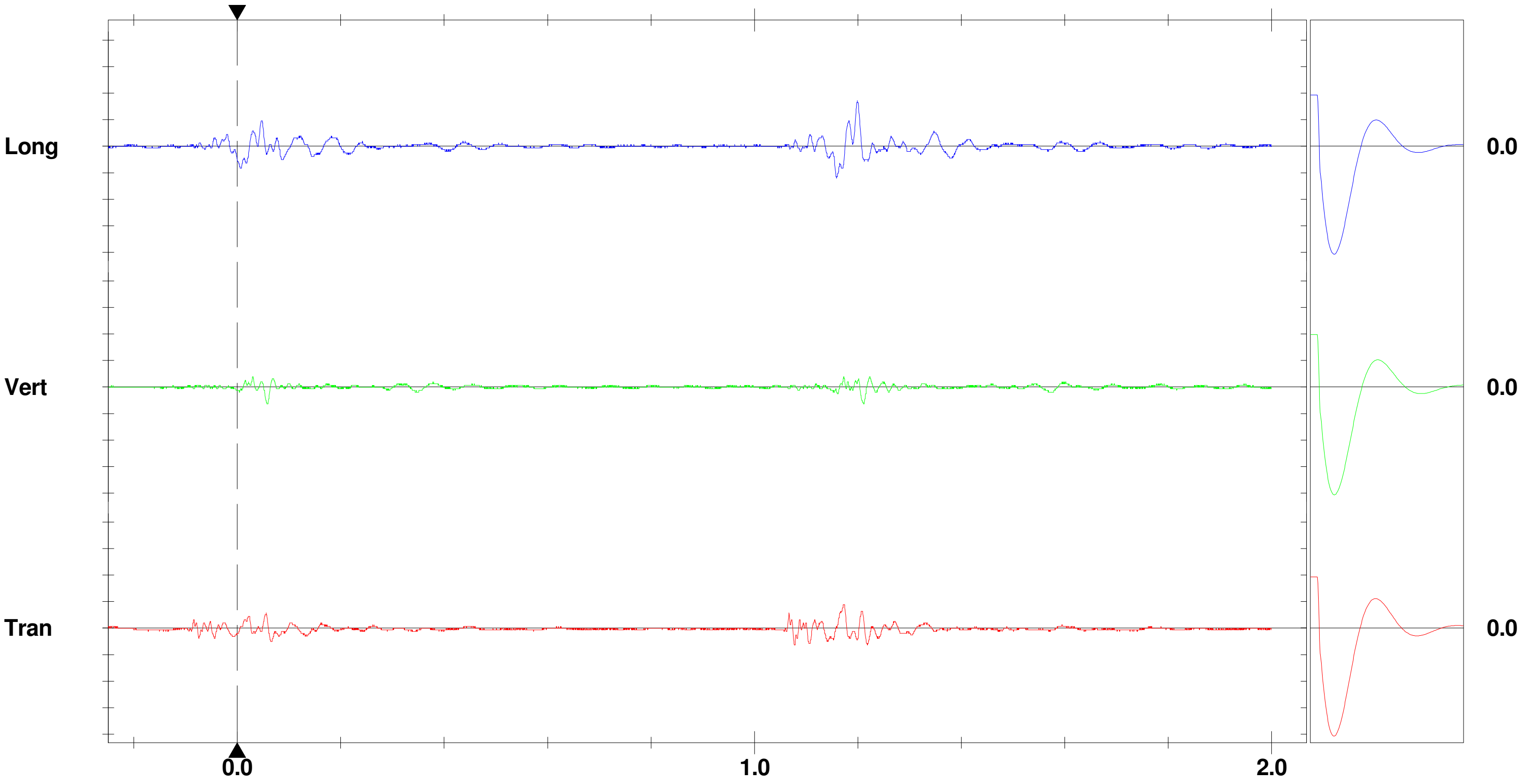
Extended Notes
Combo Mode May 4, 2017 14:33:32
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	1.778	1.270	3.429	mm/s
ZC Freq	28	41	29	Hz
Time (Rel. to Trig)	1.171	0.057	1.199	sec
Peak Acceleration	0.080	0.053	0.080	g
Peak Displacement	0.010	0.005	0.022	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.4	Hz
Overswing Ratio	3.7	4.0	4.2	

Peak Vector Sum 3.563 mm/s at 1.199 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Sensor Check

Trigger = ▶——— ———◀

FFT Report

Date/Time	Long at 15:15:00 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVLE.D00

Notes

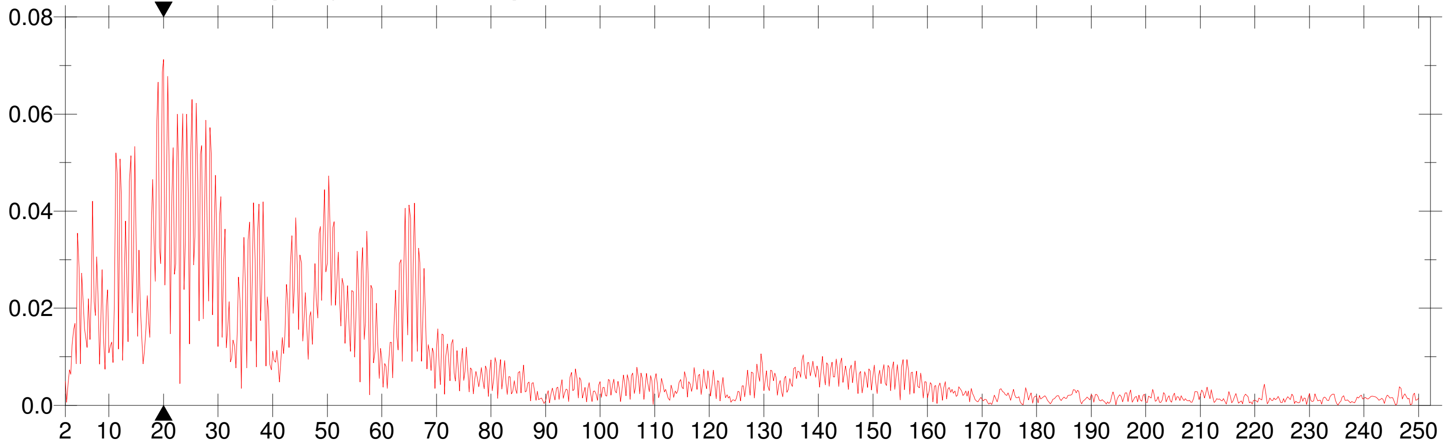
Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

Extended Notes

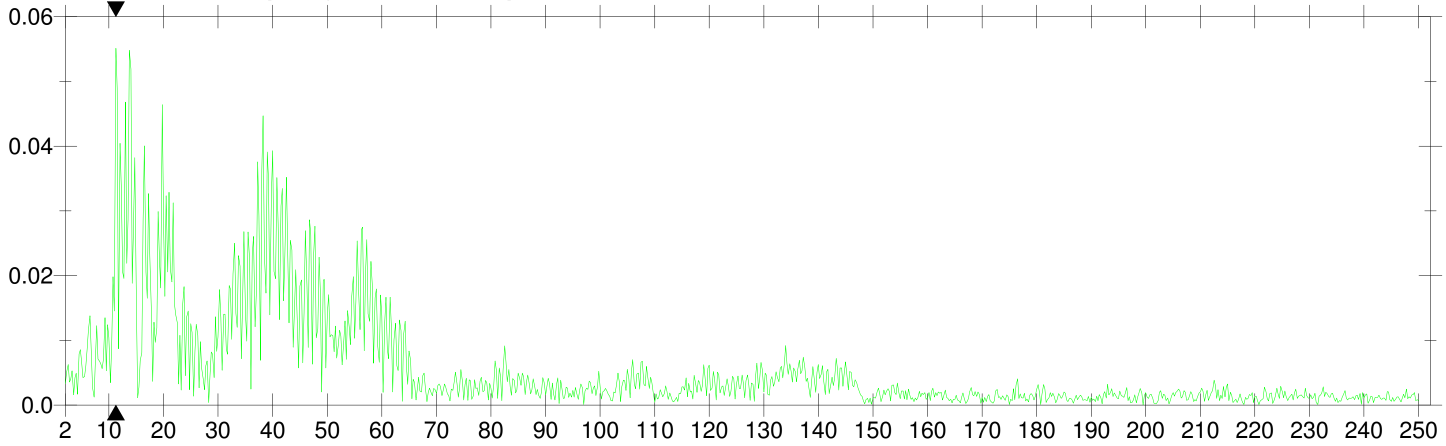
Combo Mode May 4, 2017 14:33:32

Geophone anchored into subgrade, and sandbagged

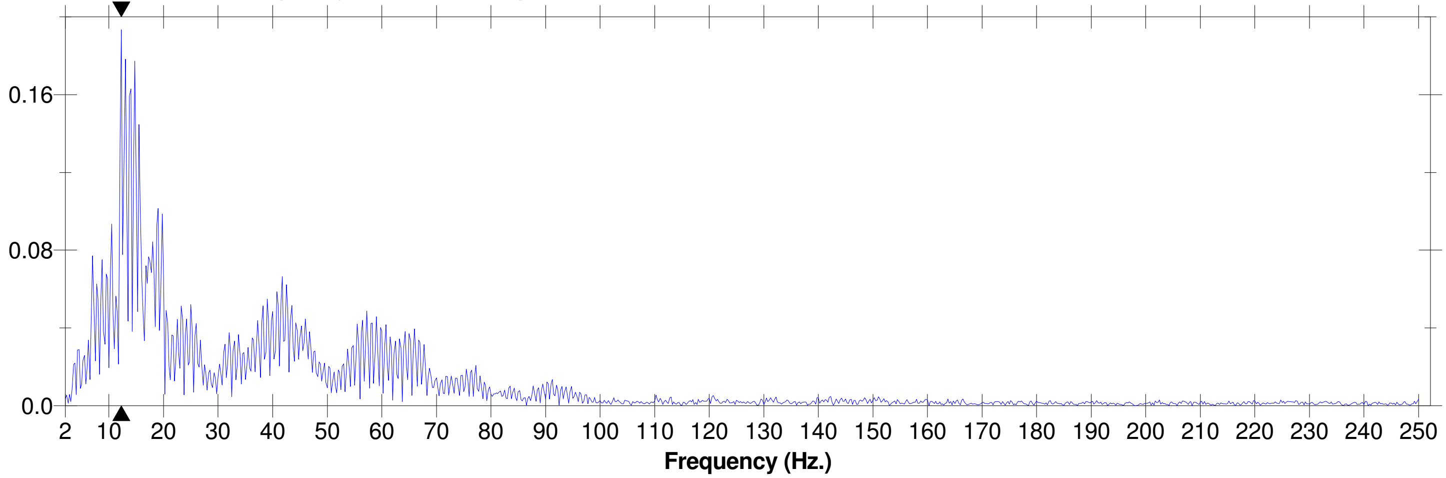
Tran Dominant Frequency = 20.00 Hz., Amplitude = 0.071, PPV from Event = 1.778 mm/s



Vert Dominant Frequency = 11.25 Hz., Amplitude = 0.055, PPV from Event = 1.270 mm/s



Long Dominant Frequency = 12.25 Hz., Amplitude = 0.193, PPV from Event = 3.429 mm/s



Event Report

Date/Time	Tran at 15:15:02 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVLE.D20

Notes

Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

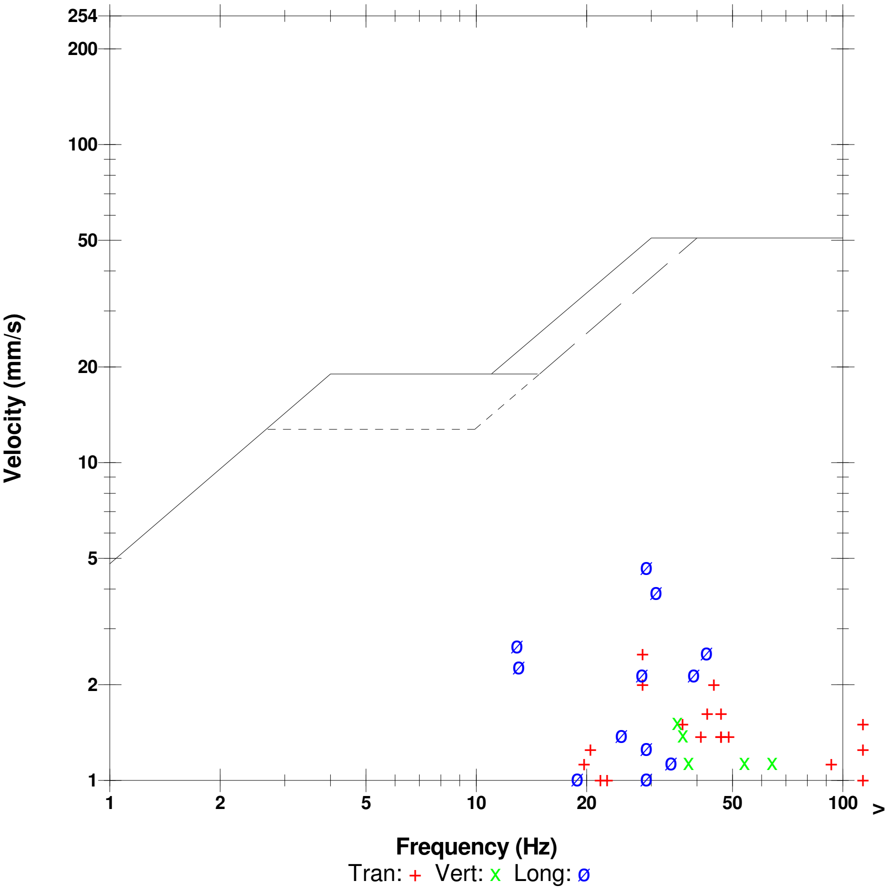
Extended Notes

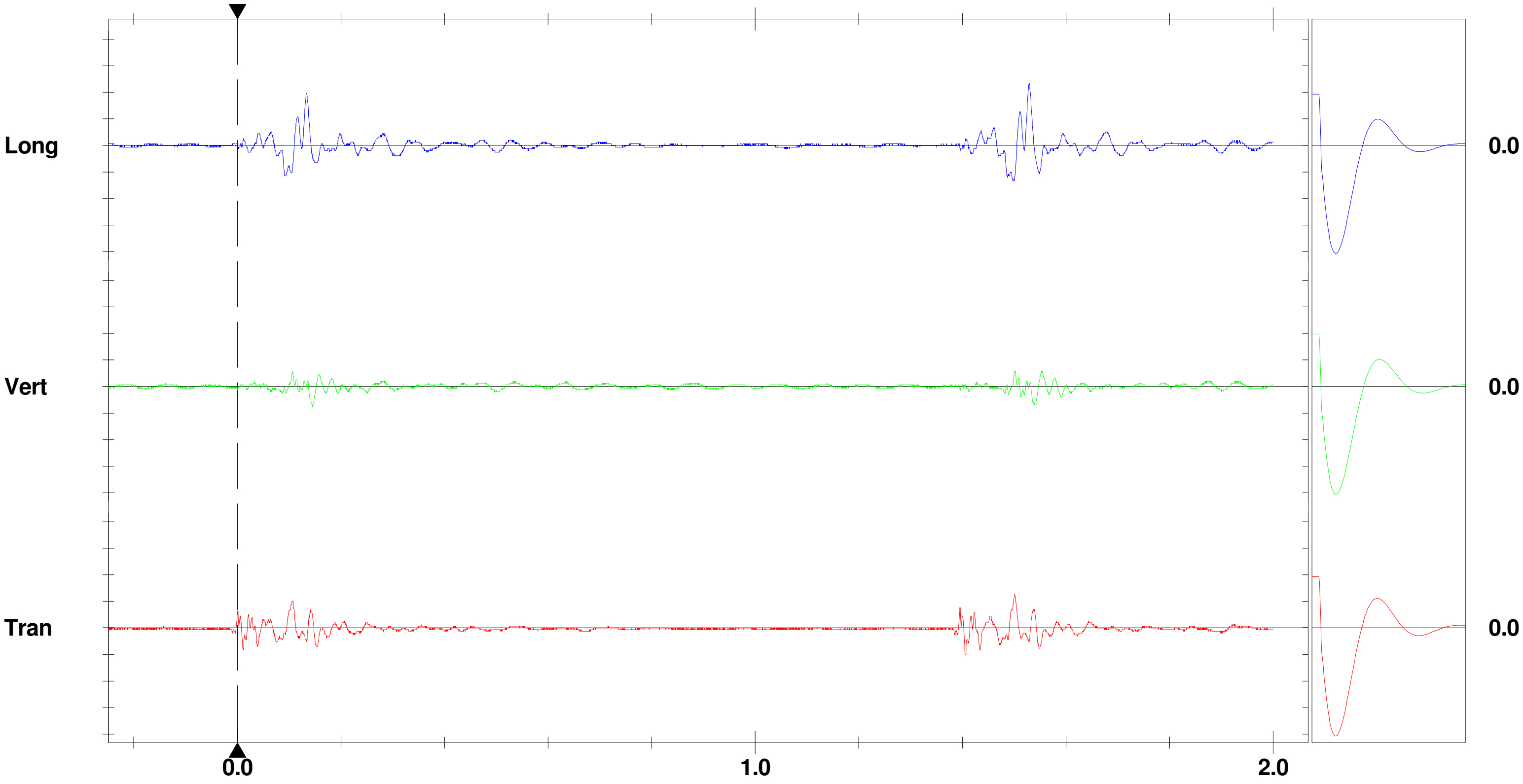
Combo Mode May 4, 2017 14:33:32
Geophone anchored into subgrade, and sandbagged

	Tran	Vert	Long	
PPV	2.540	1.524	4.699	mm/s
ZC Freq	28	35	29	Hz
Time (Rel. to Trig)	1.501	0.145	1.529	sec
Peak Acceleration	0.133	0.080	0.106	g
Peak Displacement	0.013	0.007	0.028	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.4	Hz
Overswing Ratio	3.7	4.0	4.2	

Peak Vector Sum 4.808 mm/s at 1.529 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

FFT Report

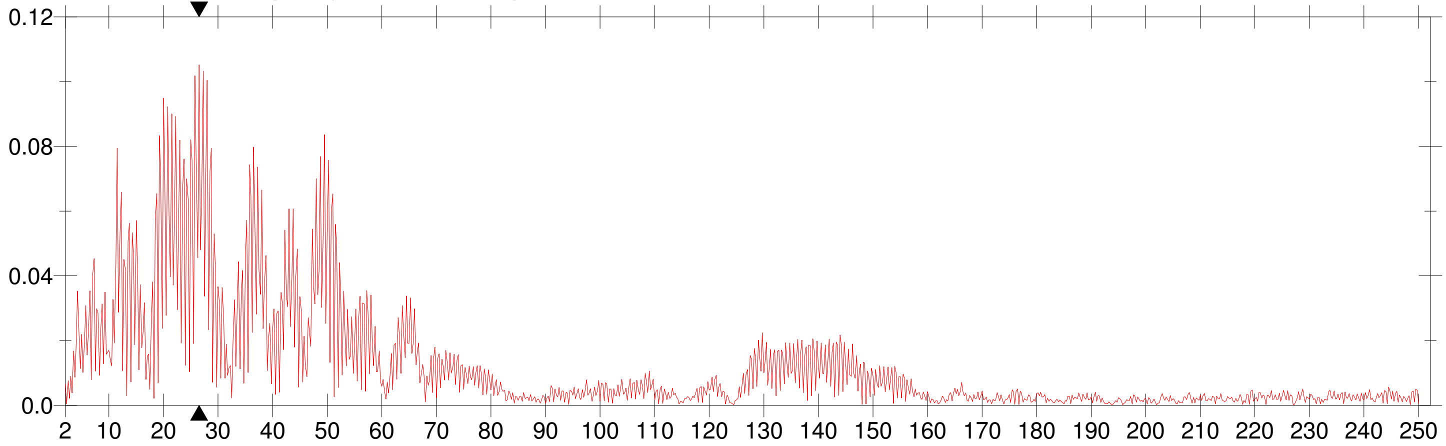
Date/Time Tran at 15:15:02 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE18695 V 10.72-8.17 MiniMate Plus
Battery Level 6.3 Volts
Unit Calibration February 22, 2017 by Instantel
File Name T695GVLE.D20

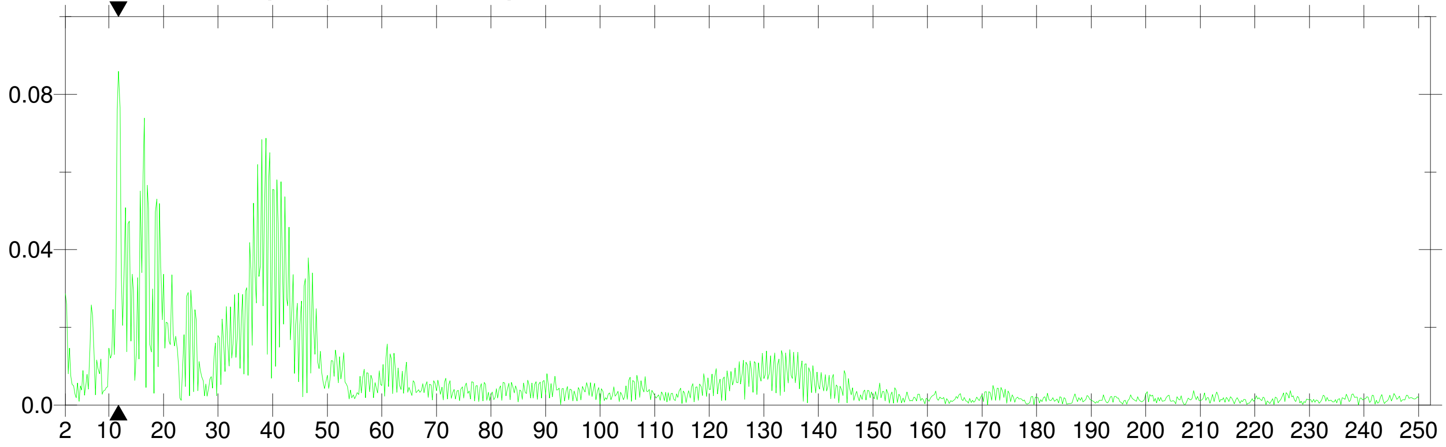
Notes
Location: ~~8100 Claymore Rd~~ 8680 Bush Line
Client: Pattern
User Name: Golder Associates Ltd.
General: 10m, 1668031

Extended Notes
Combo Mode May 4, 2017 14:33:32
Geophone anchored into subgrade, and sandbagged

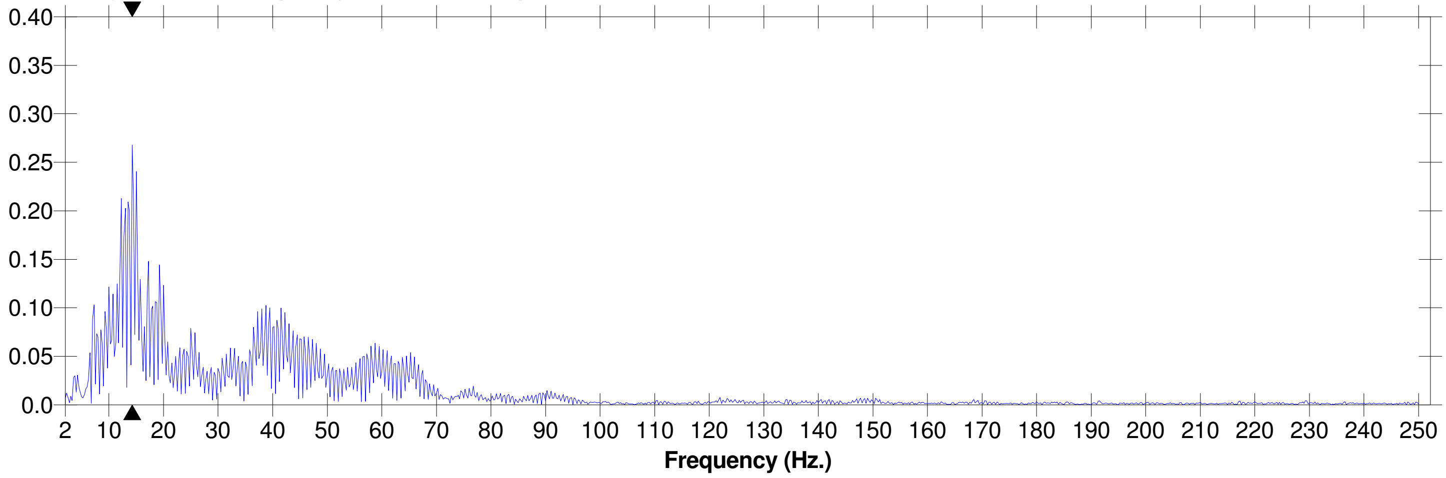
Tran Dominant Frequency = 26.50 Hz., Amplitude = 0.105, PPV from Event = 2.540 mm/s



Vert Dominant Frequency = 11.75 Hz., Amplitude = 0.086, PPV from Event = 1.524 mm/s



Long Dominant Frequency = 14.25 Hz., Amplitude = 0.268, PPV from Event = 4.699 mm/s



Printed: May 12, 2017 (V 10.72 - 10.72.1)

Event Report

Date/Time	Tran at 15:15:05 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	1.162 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVLE.D50

Notes

Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

Extended Notes

Combo Mode May 4, 2017 14:33:32

Geophone anchored into subgrade, and sandbagged

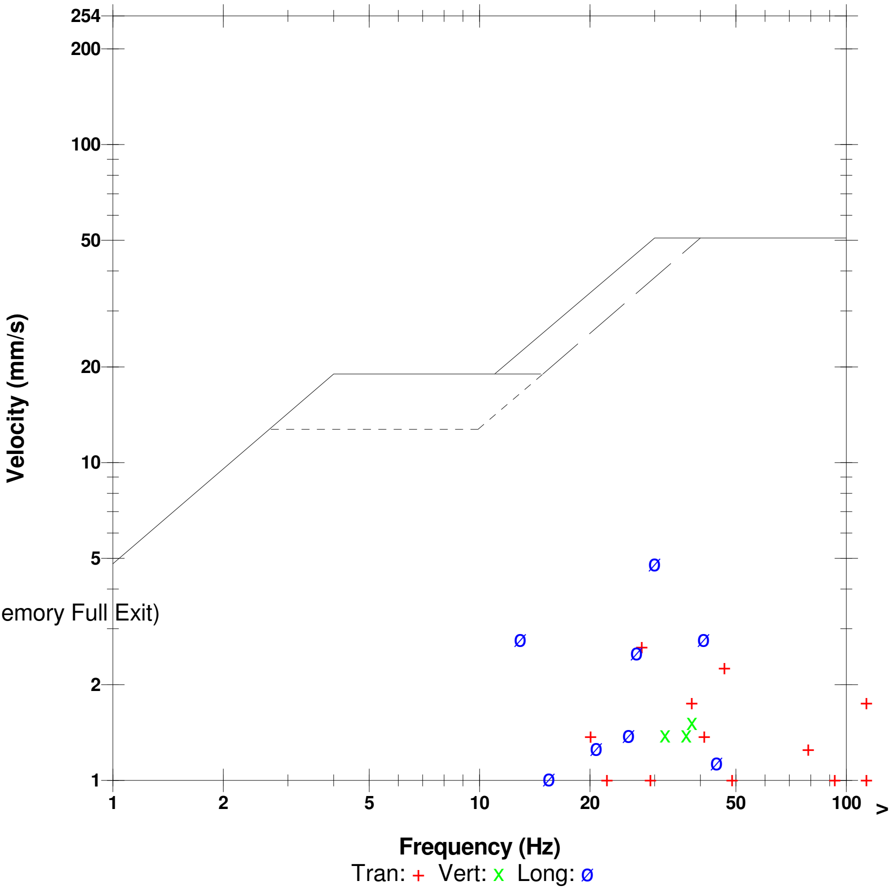
	Tran	Vert	Long	
PPV	2.667	1.524	4.826	mm/s
ZC Freq	28	38	30	Hz
Time (Rel. to Trig)	0.107	0.146	0.135	sec
Peak Acceleration	0.133	0.053	0.106	g
Peak Displacement	0.014	0.007	0.027	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.3	7.4	Hz
Overswing Ratio	3.7	4.0	4.2	

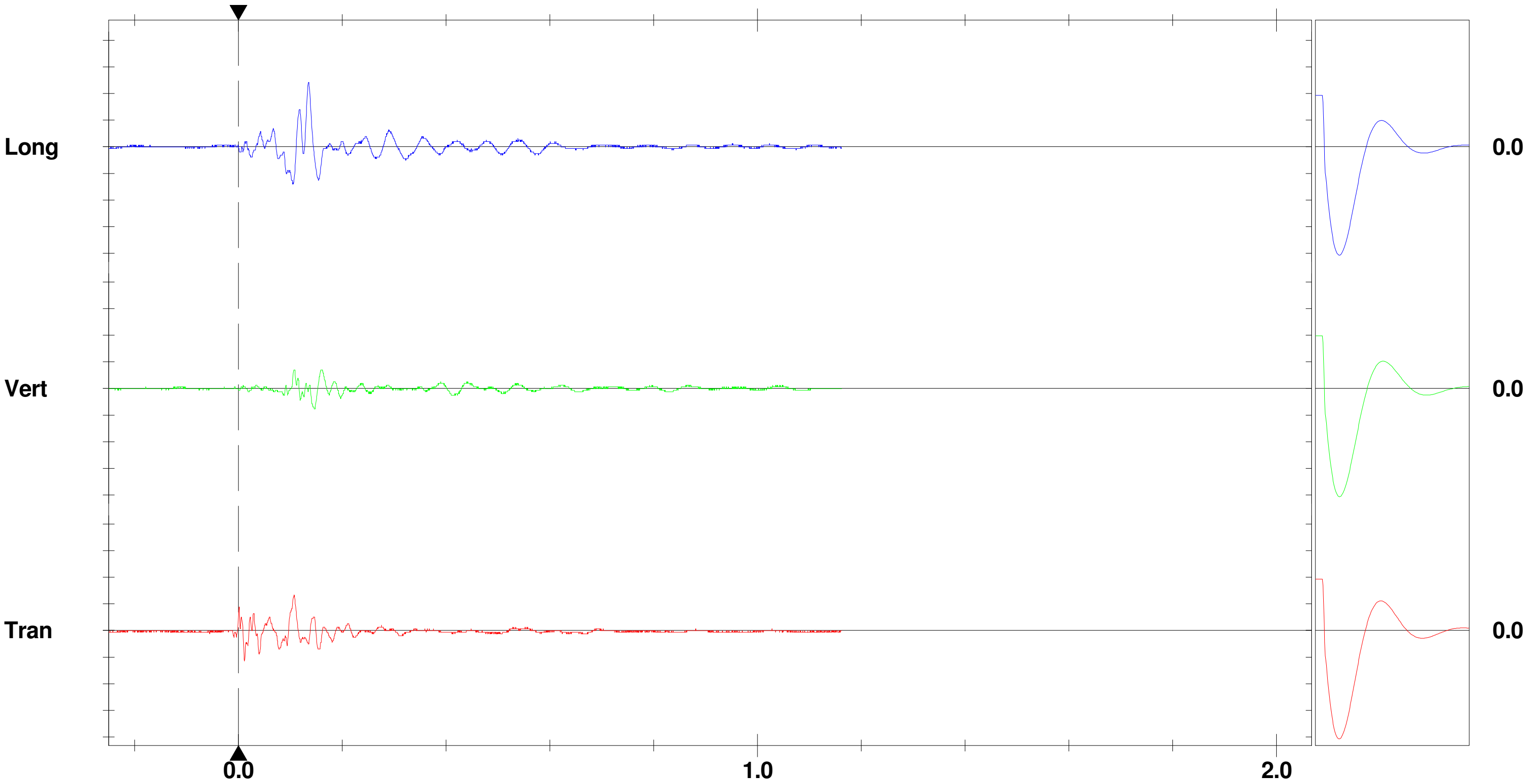
Peak Vector Sum 4.933 mm/s at 0.135 sec

Monitor Log

May 4 /17 15:15:05 May 4 /17 15:15:07 Event recorded. (Memory Full Exit)

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Trigger = ▶—— ——◀

Sensor Check

Instantel

FFT Report

Date/Time	Tran at 15:15:05 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	1.162 sec at 2048 sps

Serial Number	BE18695 V 10.72-8.17 MiniMate Plus
Battery Level	6.3 Volts
Unit Calibration	February 22, 2017 by Instantel
File Name	T695GVLE.D50

Notes

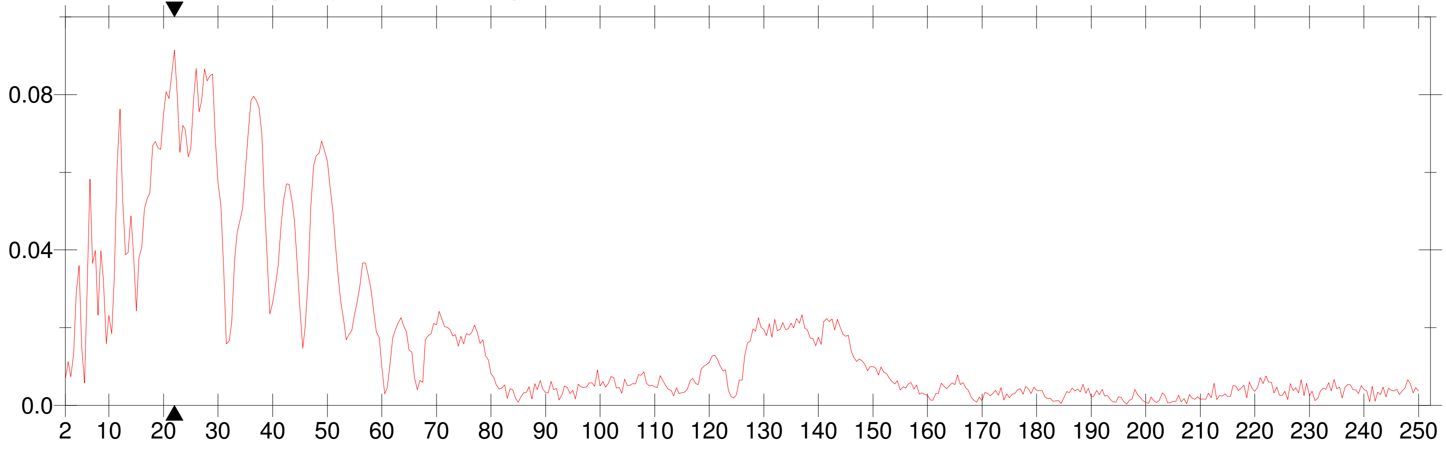
Location:	~~8100 Claymore Rd~~ 8680 Bush Line
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	10m, 1668031

Extended Notes

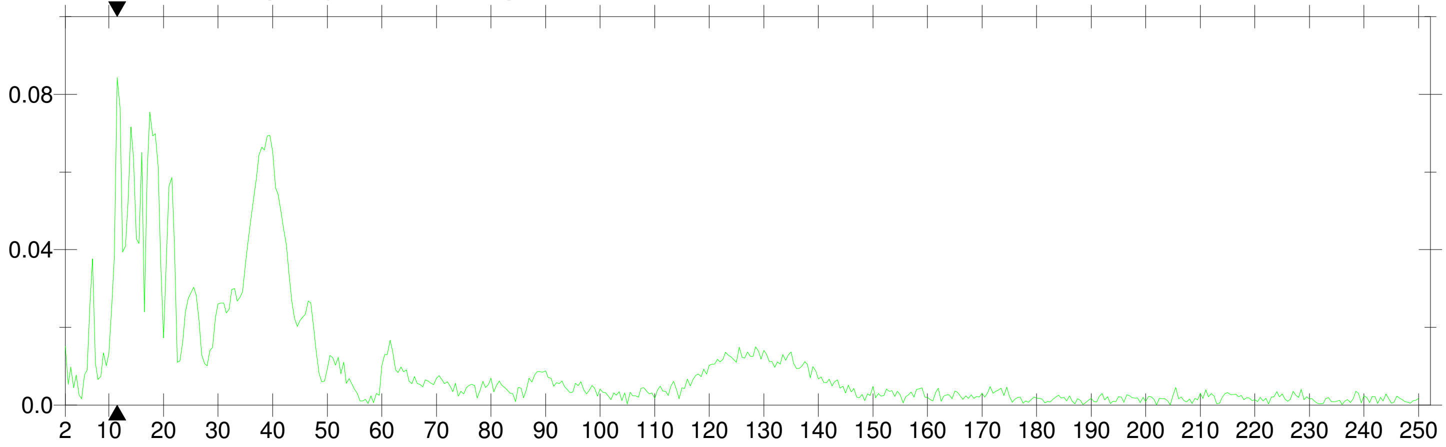
Combo Mode May 4, 2017 14:33:32

Geophone anchored into subgrade, and sandbagged

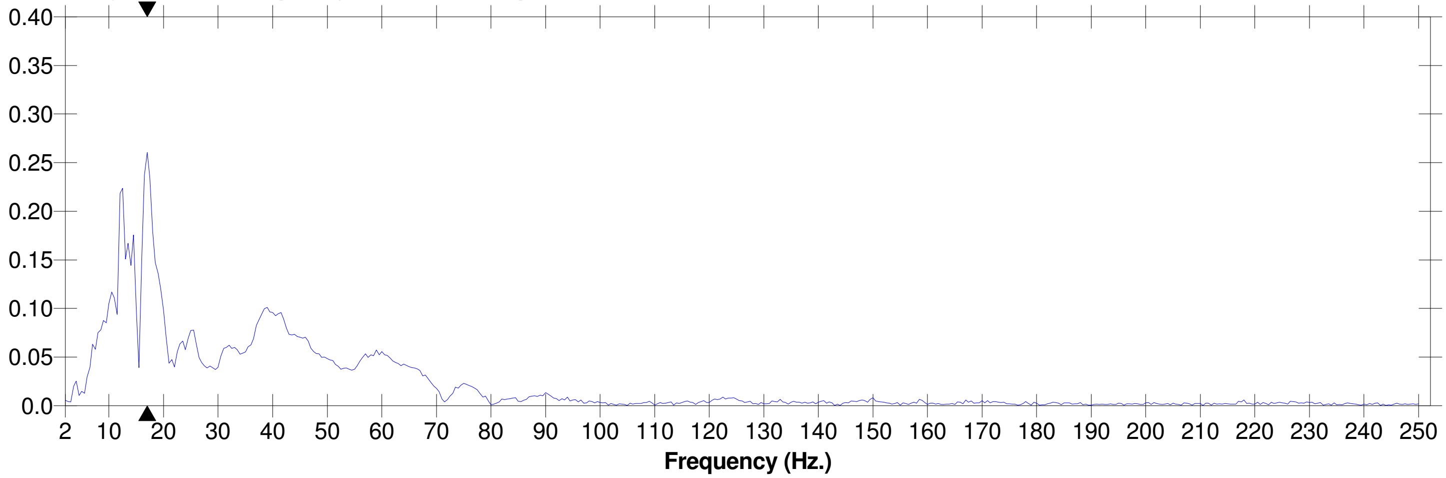
Tran Dominant Frequency = 22.00 Hz., Amplitude = 0.091, PPV from Event = 2.667 mm/s



Vert Dominant Frequency = 11.50 Hz., Amplitude = 0.084, PPV from Event = 1.524 mm/s



Long Dominant Frequency = 17.00 Hz., Amplitude = 0.260, PPV from Event = 4.826 mm/s



Event Report

Histogram Start Time	17:09:43 May 3, 2017		**Serial Number**	BE8719 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	18:00:00 May 3, 2017		**Battery Level**	6.3 Volts
Number of Intervals	1508.00 at 2 seconds		**Unit Calibration**	March 13, 2017 by Instantel
Range	Geo:254.0 mm/s		**File Name**	J719GVJP.070
Sample Rate	2048sps			

Notes

Location: T5, North Kent
Client: Pattern
User Name: Golder Associates Ltd.
General: 30m, 1668031

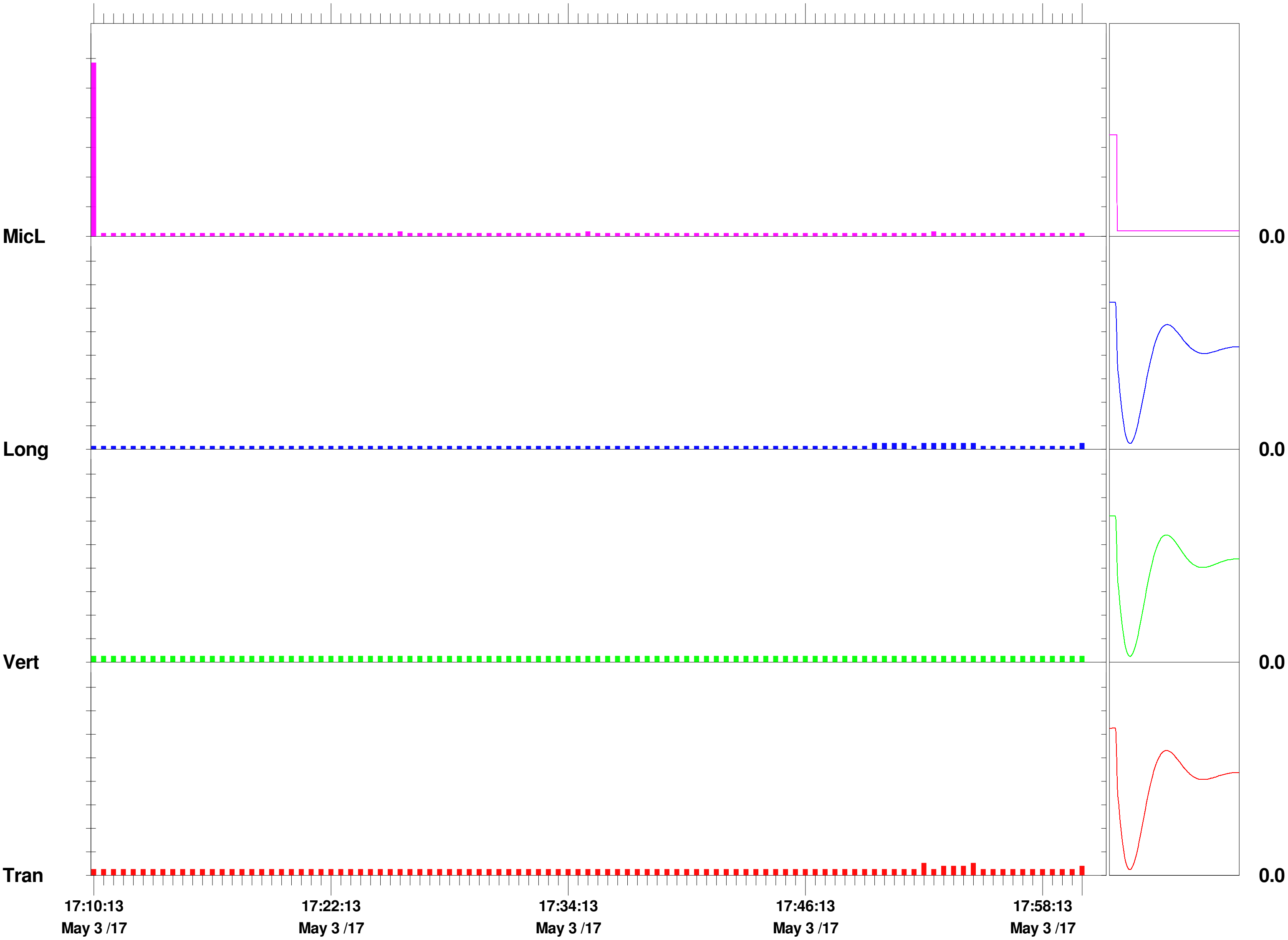
Extended Notes

Geophone anchored into subgrade and sandbagged

Microphone	Linear Weighting
PSPL	29.25 pa.(L) on May 3, 2017 at 17:09:51
ZC Freq	4.4 Hz
Channel Test	Check (Freq = 0.0 Hz Amp = 0 mv)

	Tran	Vert	Long	
PPV	0.508	0.254	0.254	mm/s
ZC Freq	15.1	>200	>200	Hz
Date	May 3 /17	May 3 /17	May 3 /17	
Time	17:52:11	17:09:45	17:49:41	
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.4	7.2	Hz
Overswing Ratio	4.1	3.7	4.2	

Peak Vector Sum 0.539 mm/s on May 3, 2017 at 17:52:11



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div Mic: 5.000 pa.(L)/div

Sensor Check

Instantel

Event Report

Histogram Start Time	14:35:24 May 4, 2017
Histogram Finish Time	15:33:26 May 4, 2017
Number of Intervals	1740.00 at 2 seconds
Range	Geo:254.0 mm/s
Sample Rate	2048sps

Serial Number	BE8719 V 10.72-8.17 MiniMate Plus
Battery Level	6.2 Volts
Unit Calibration	March 13, 2017 by Instantel
File Name	J719GVLC.J00

Notes

Location:	T5, North Kent
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	30m, 1668031

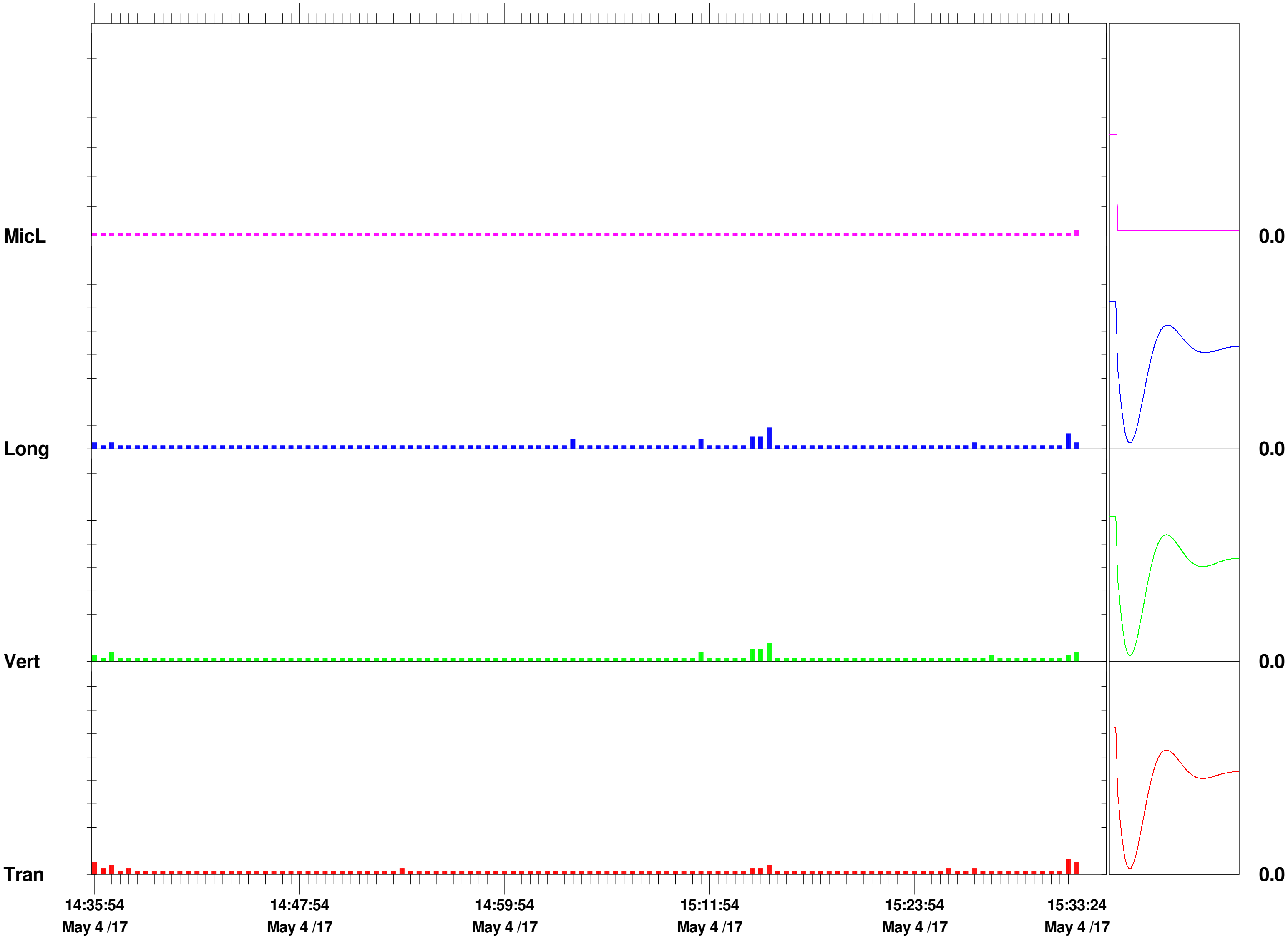
Extended Notes

Geophone anchored into subgrade and sandbagged

Microphone	Linear Weighting
PSPL	1.000 pa.(L) on May 4, 2017 at 15:33:12
ZC Freq	41 Hz
Channel Test	Check (Freq = 0.0 Hz Amp = 0 mv)

	Tran	**Vert**	**Long**	
PPV	0.635	0.762	0.889	mm/s
ZC Freq	102	39	37	Hz
Date	May 4 /17	May 4 /17	May 4 /17	
Time	15:32:34	15:15:04	15:15:04	
Sensor Check	Passed	Passed	Passed	
Frequency	7.3	7.4	7.1	Hz
Overswing Ratio	4.2	3.8	4.3	

Peak Vector Sum 0.976 mm/s on May 4, 2017 at 15:15:04



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 1.000 mm/s/div Mic: 5.000 pa.(L)/div

Sensor Check

Printed: May 12, 2017 (V 10.72 - 10.72.1)

Event Report

Histogram Start Time 17:09:27 May 3, 2017
Histogram Finish Time 18:48:27 May 3, 2017
Number of Intervals 2970.00 at 2 seconds
Range Geo:254.0 mm/s
Sample Rate 2048sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.7 Volts (Battery Very Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVJO.ZR0

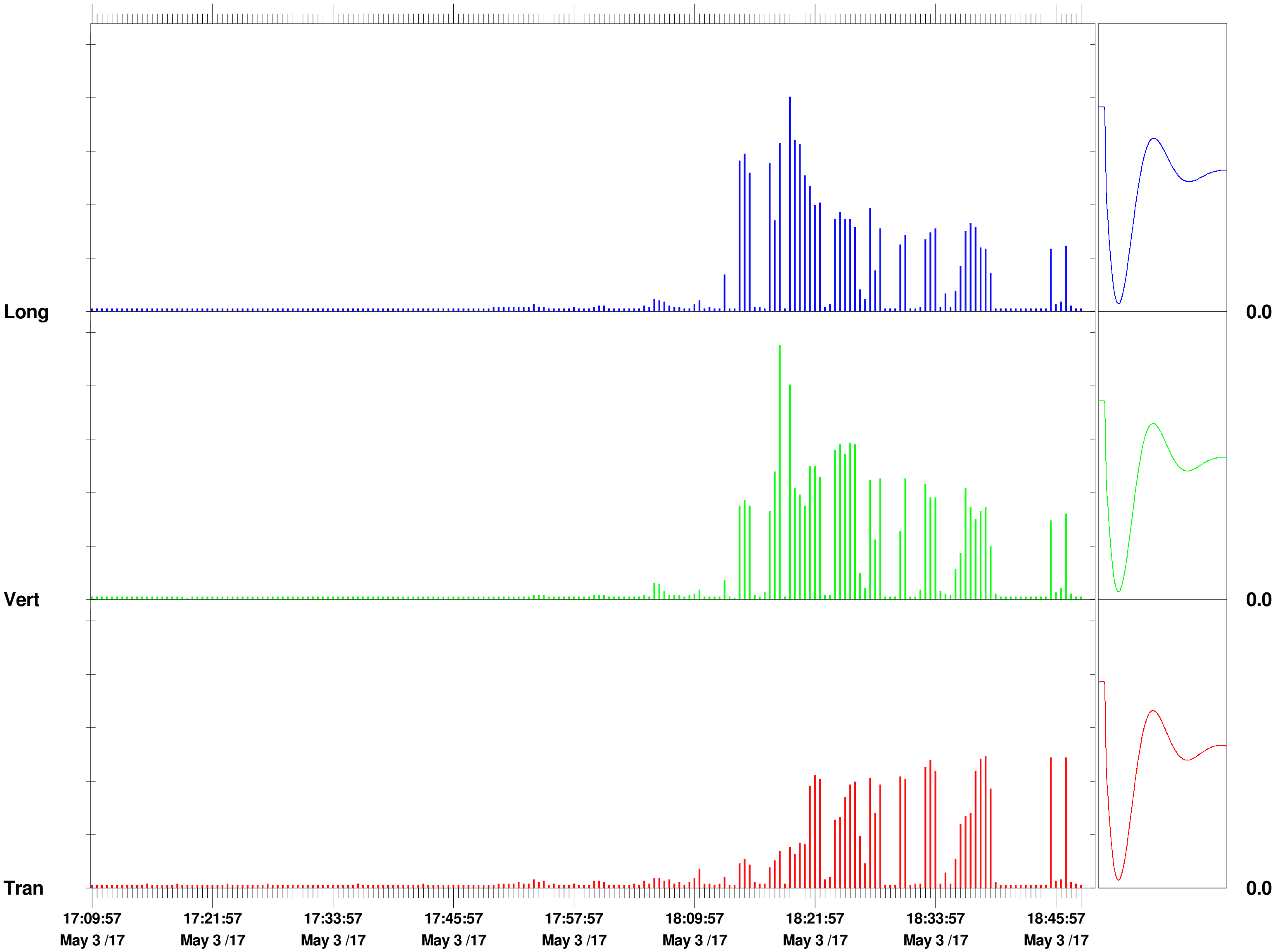
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	12.32	23.75	20.07	mm/s
ZC Freq	31	16.3	24	Hz
Date	May 3 /17	May 3 /17	May 3 /17	
Time	18:38:33	18:18:03	18:19:03	
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 23.90 mm/s on May 3, 2017 at 18:18:03

Monitor Log
May 3 /17 17:09:26 May 3 /17 18:48:27 Event recorded. (Battery Low Exit)



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 5.000 mm/s/div

Sensor Check

Instantel

Event Report

Date/Time	Vert at 18:05:56 May 3, 2017		**Serial Number**	BE8720 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.000 mm/s		**Battery Level**	5.9 Volts (Battery Low)
Range	Geo: 254.0 mm/s		**Unit Calibration**	March 13, 2017 by Instantel
Record Time	2.0 sec at 2048 sps		**File Name**	J720GVJR.LW0

Notes

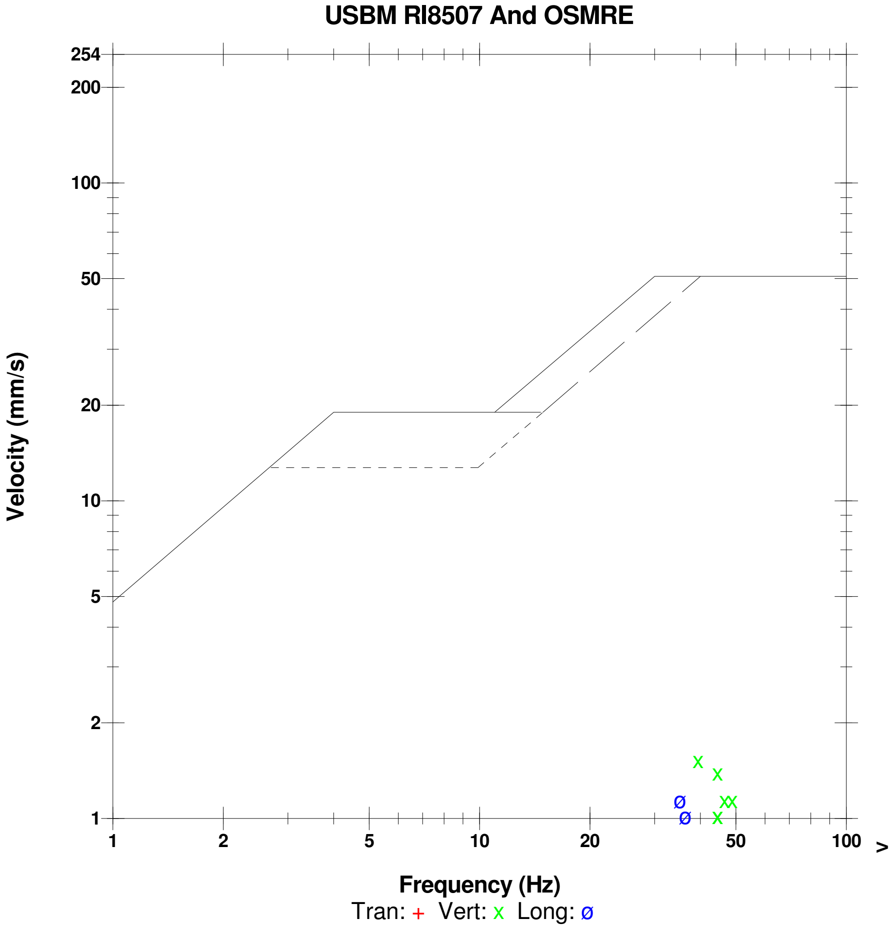
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

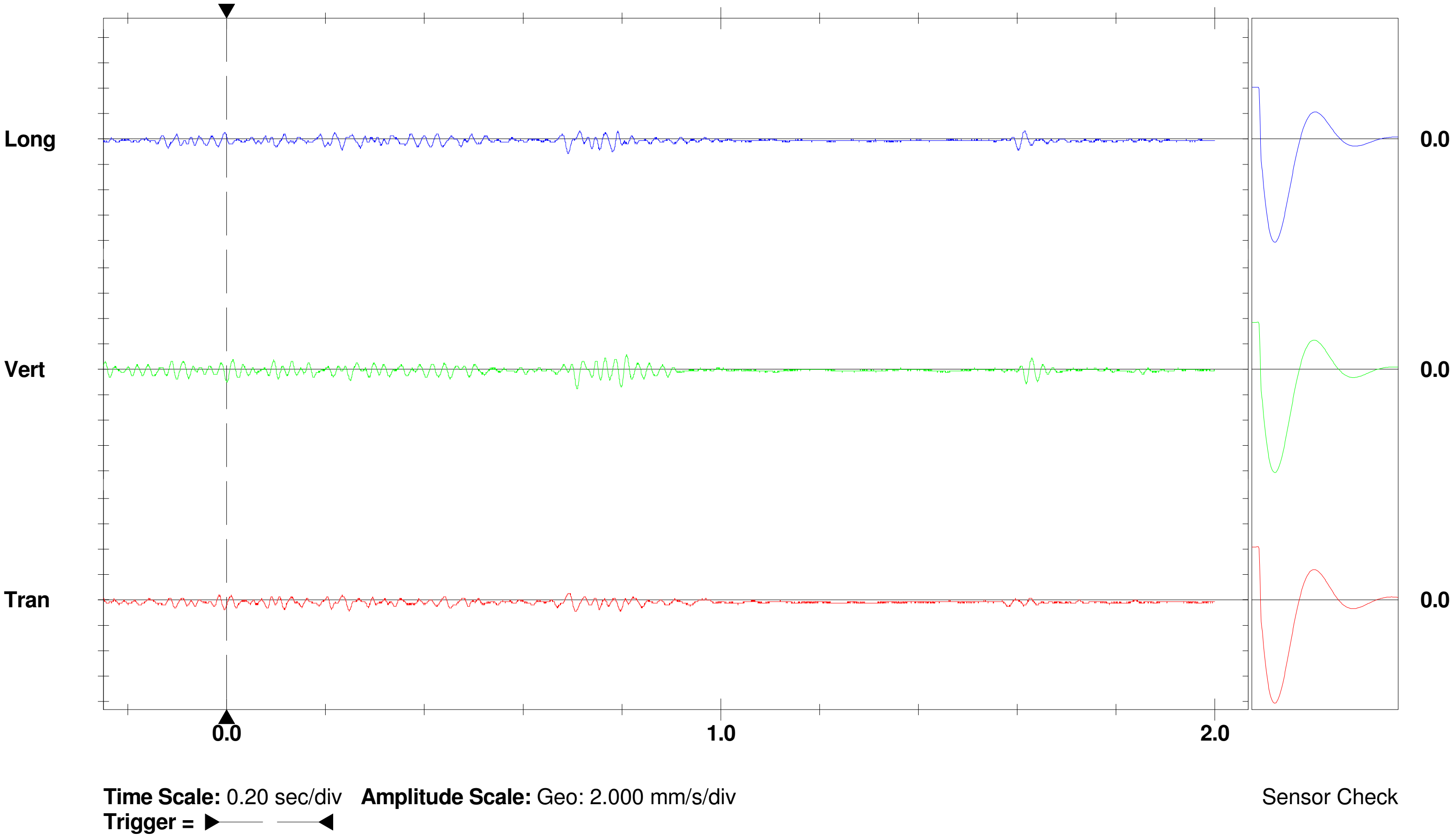
Extended Notes

Combo Mode May 3, 2017 17:09:26
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	0.889	1.524	1.143	mm/s
ZC Freq	38	39	35	Hz
Time (Rel. to Trig)	0.248	0.708	0.690	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.005	0.006	0.005	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 1.723 mm/s at 0.709 sec





Printed: May 12, 2017 (V 10.72 - 10.72.1)

FFT Report

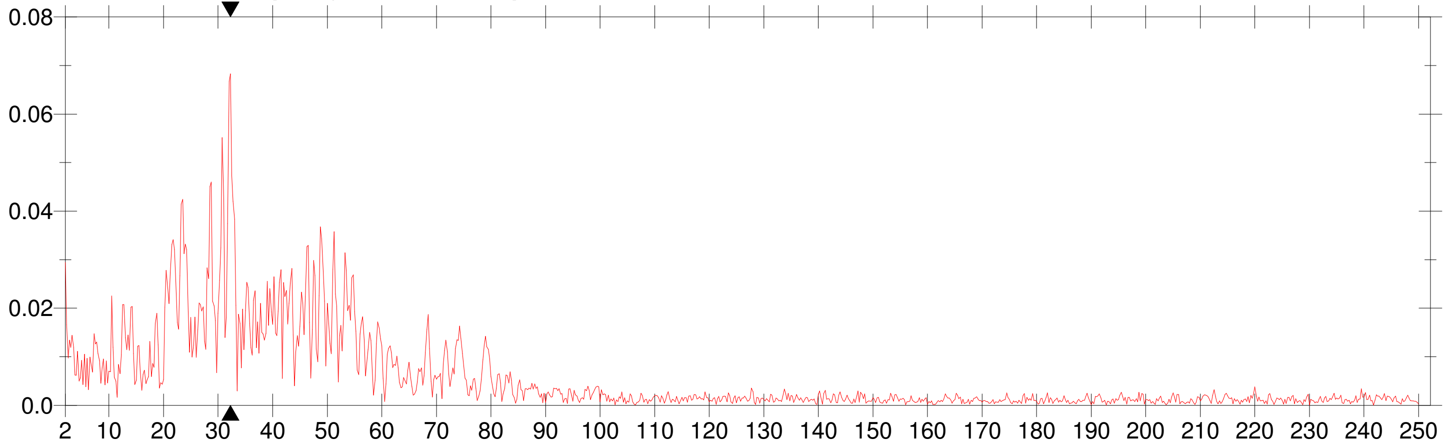
Date/Time Vert at 18:05:56 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVJR.LW0

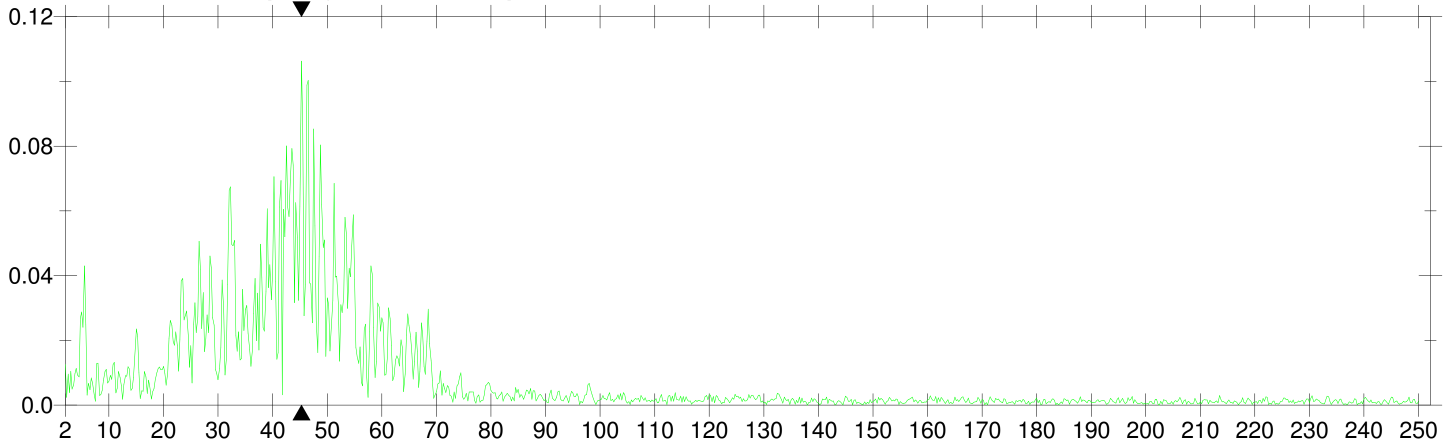
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 3, 2017 17:09:26
Geophone secured into subgrade under sandbag.

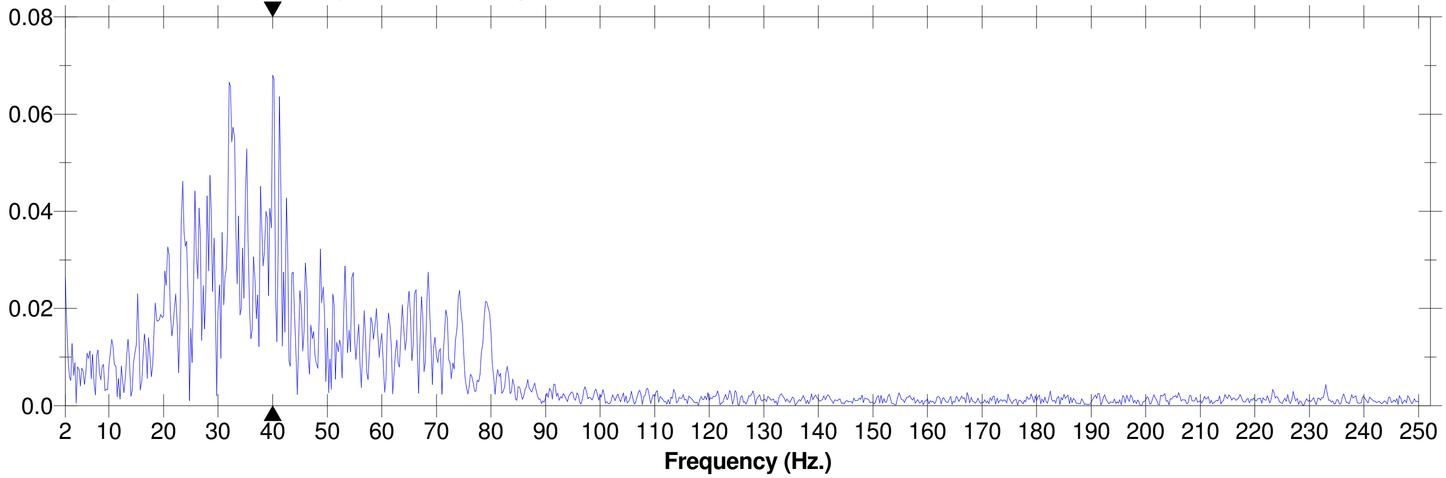
Tran Dominant Frequency = 32.25 Hz., Amplitude = 0.068, PPV from Event = 0.889 mm/s



Vert Dominant Frequency = 45.25 Hz., Amplitude = 0.106, PPV from Event = 1.524 mm/s



Long Dominant Frequency = 40.00 Hz., Amplitude = 0.068, PPV from Event = 1.143 mm/s



Printed: May 12, 2017 (V 10.72 - 10.72.1)

Event Report

Date/Time	Tran at 18:10:02 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts (Battery Low)
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVJR.SQ0

Notes

Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

Extended Notes

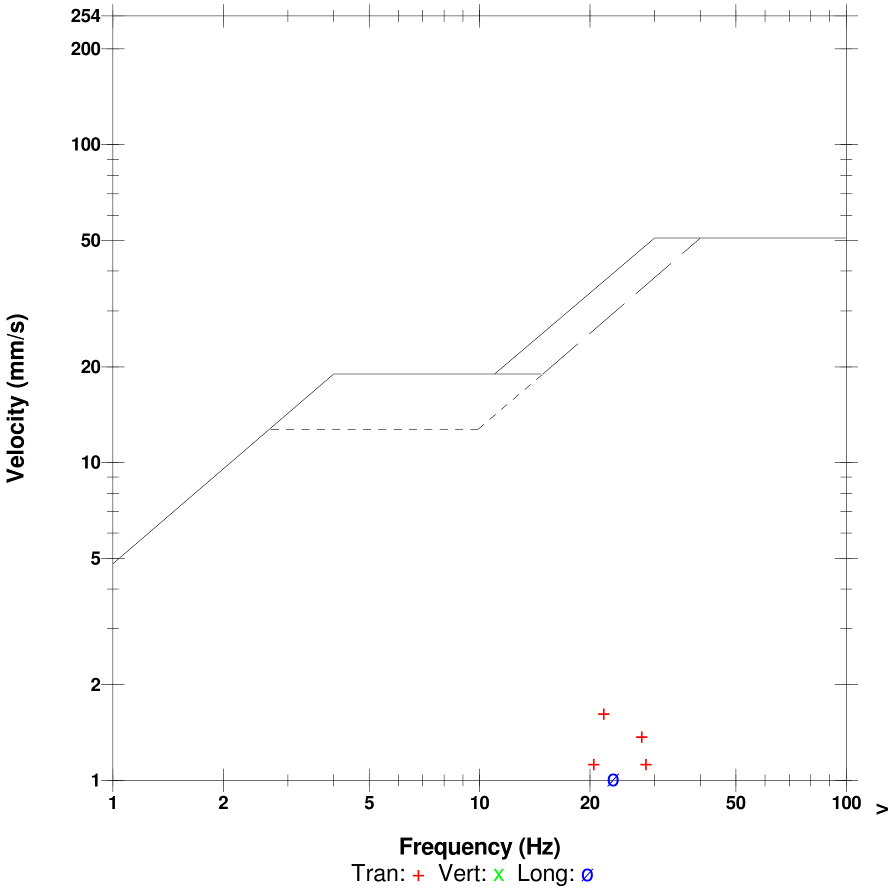
Combo Mode May 3, 2017 17:09:26

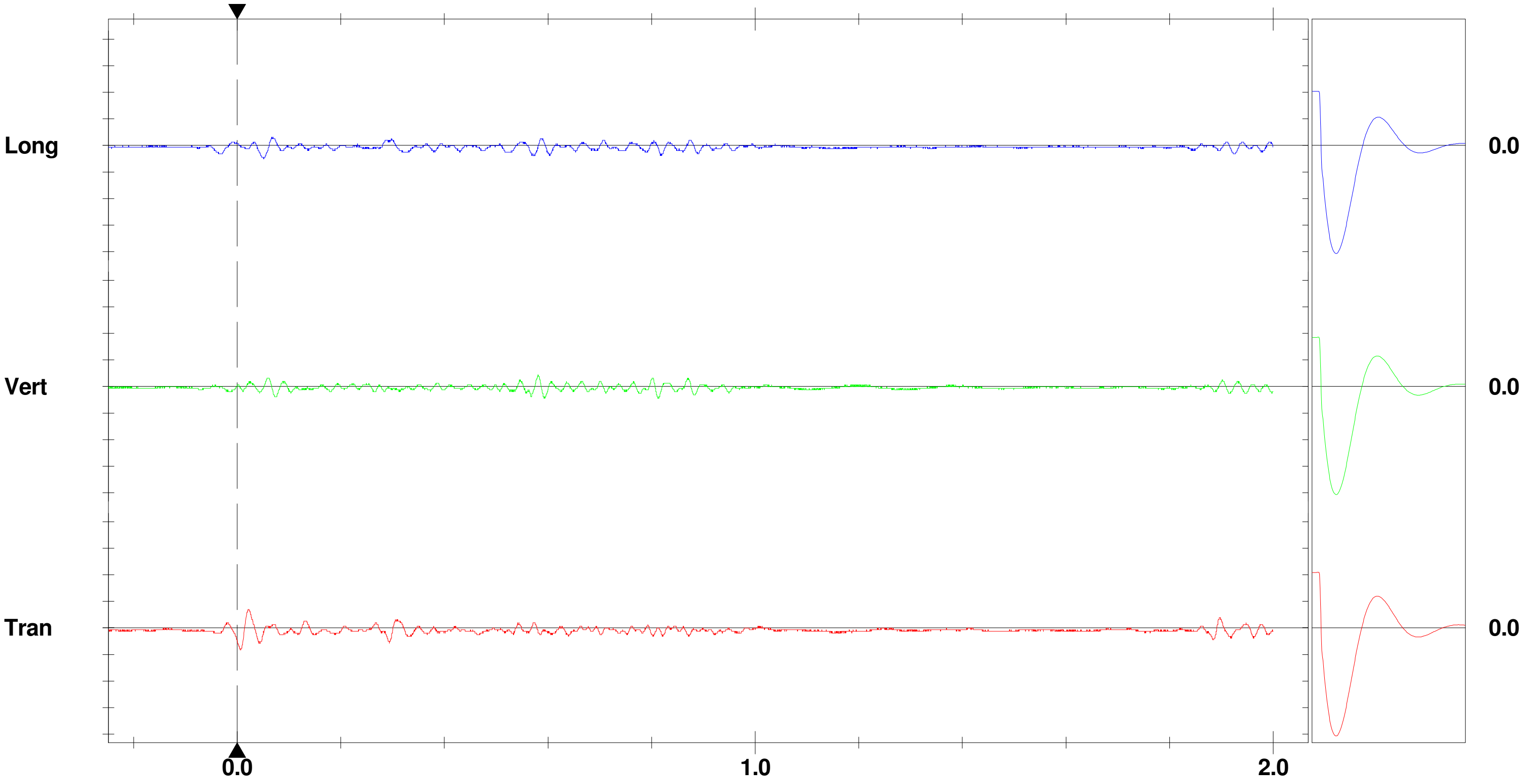
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	1.651	0.889	1.016	mm/s
ZC Freq	22	45	23	Hz
Time (Rel. to Trig)	0.006	0.581	0.051	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.011	0.004	0.007	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 1.661 mm/s at 0.006 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Sensor Check

Trigger = ▶—— ——◀

Printed: May 12, 2017 (V 10.72 - 10.72.1)

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Instantel

FFT Report

Date/Time	Tran at 18:10:02 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts (Battery Low)
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVJR.SQ0

Notes

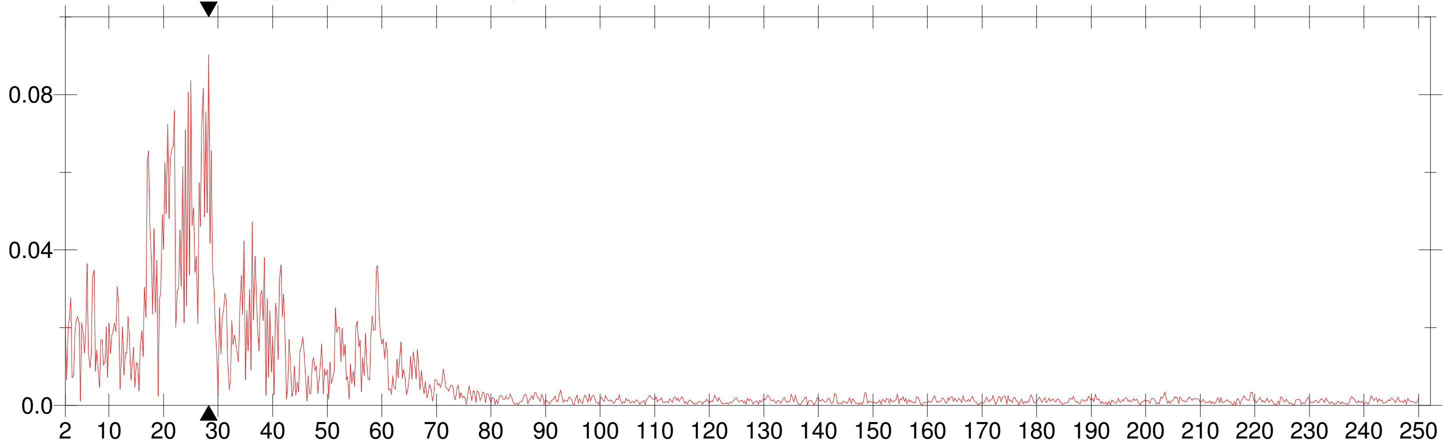
Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

Extended Notes

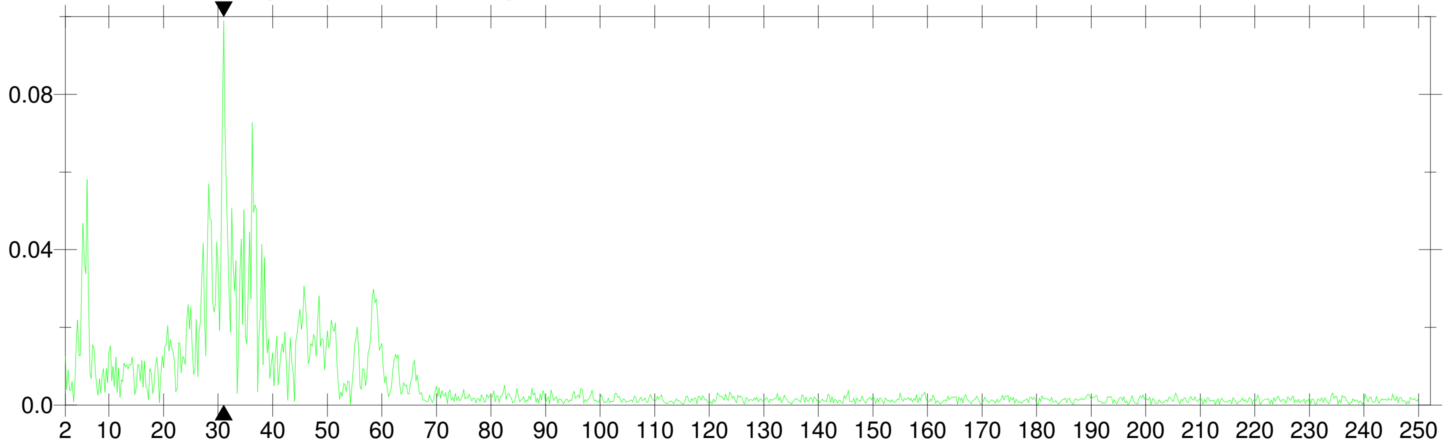
Combo Mode May 3, 2017 17:09:26

Geophone secured into subgrade under sandbag.

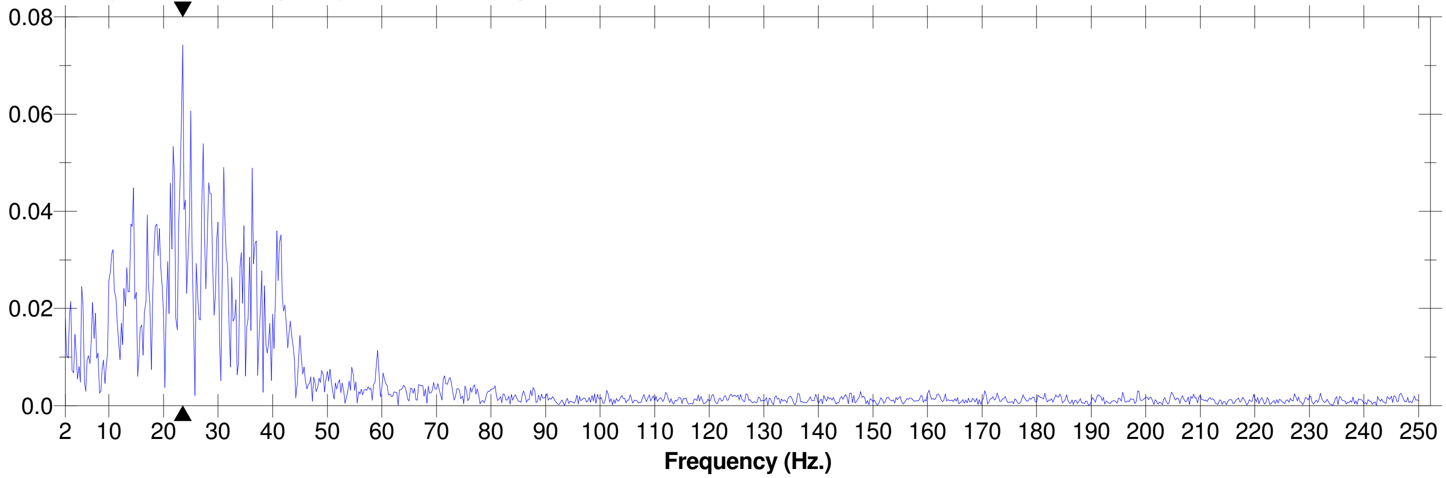
Tran Dominant Frequency = 28.25 Hz., Amplitude = 0.090, PPV from Event = 1.651 mm/s



Vert Dominant Frequency = 31.00 Hz., Amplitude = 0.099, PPV from Event = 0.889 mm/s



Long Dominant Frequency = 23.50 Hz., Amplitude = 0.074, PPV from Event = 1.016 mm/s



Instantel

Event Report

Date/Time Tran at 18:10:05 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

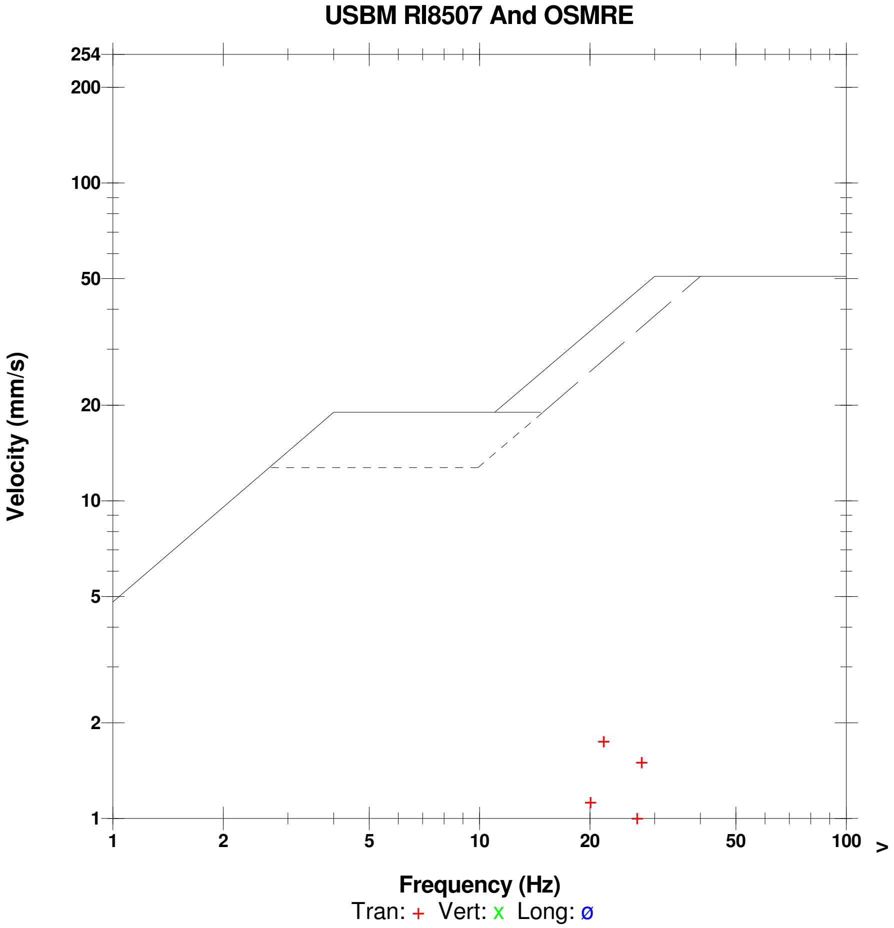
Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVJR.ST0

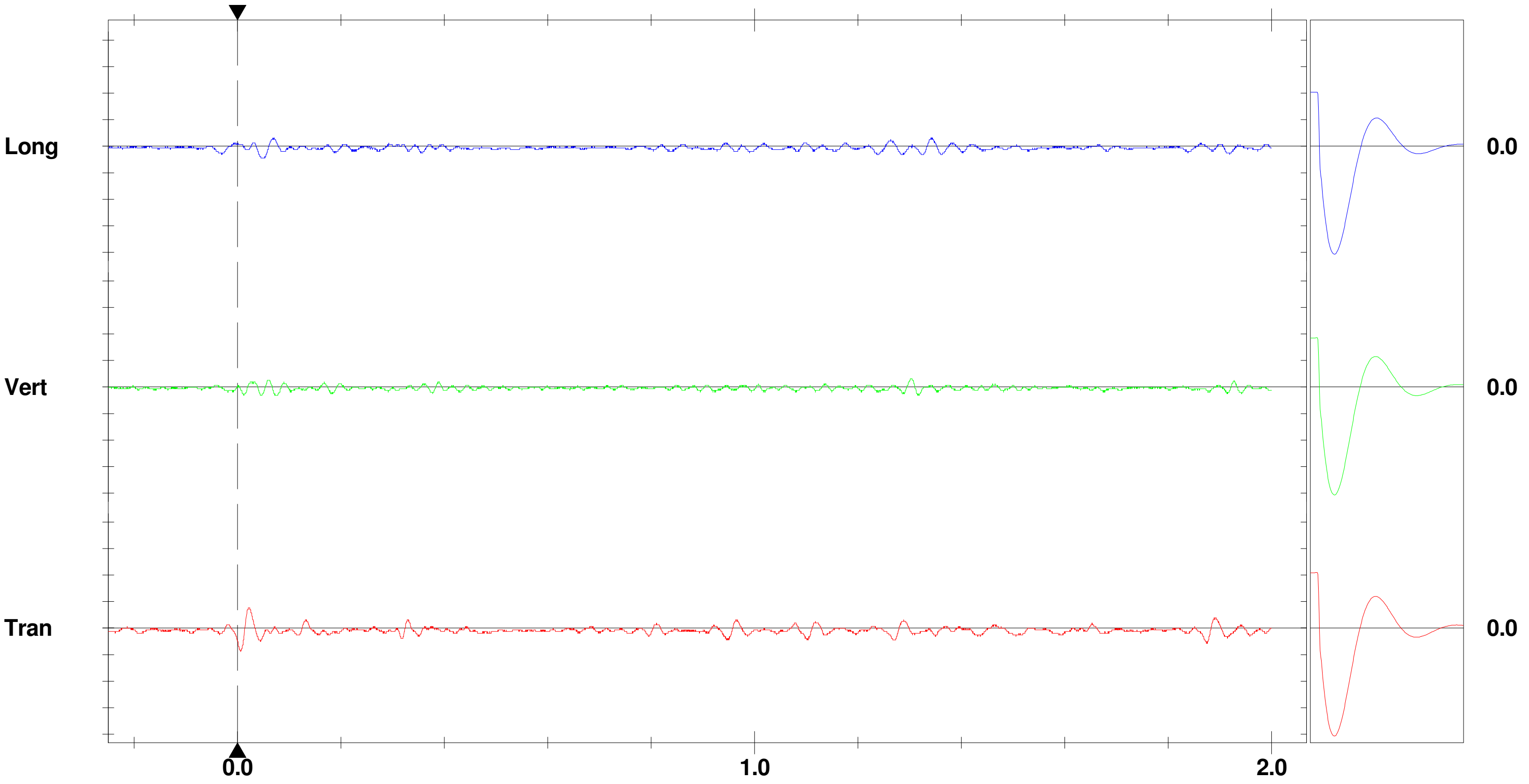
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 3, 2017 17:09:26
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	1.778	0.635	0.889	mm/s
ZC Freq	22	39	23	Hz
Time (Rel. to Trig)	0.006	0.012	0.045	sec
Peak Acceleration	0.053	0.027	0.053	g
Peak Displacement	0.011	0.004	0.007	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 1.801 mm/s at 0.006 sec


USBM RI8507 And OSMRE



Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div
Trigger = ▶—— ——◀

Instantel

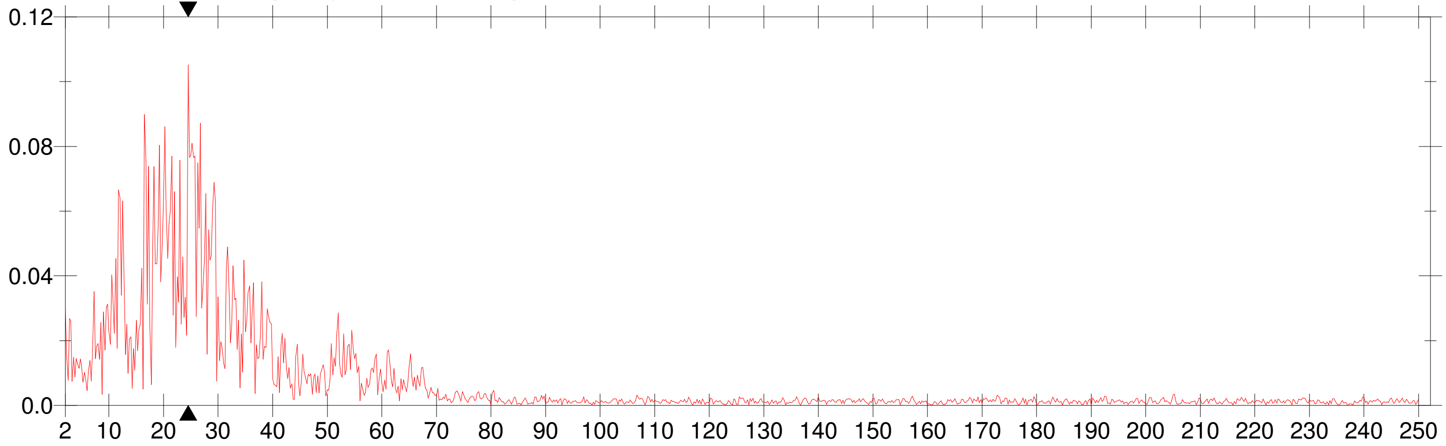
FFT Report

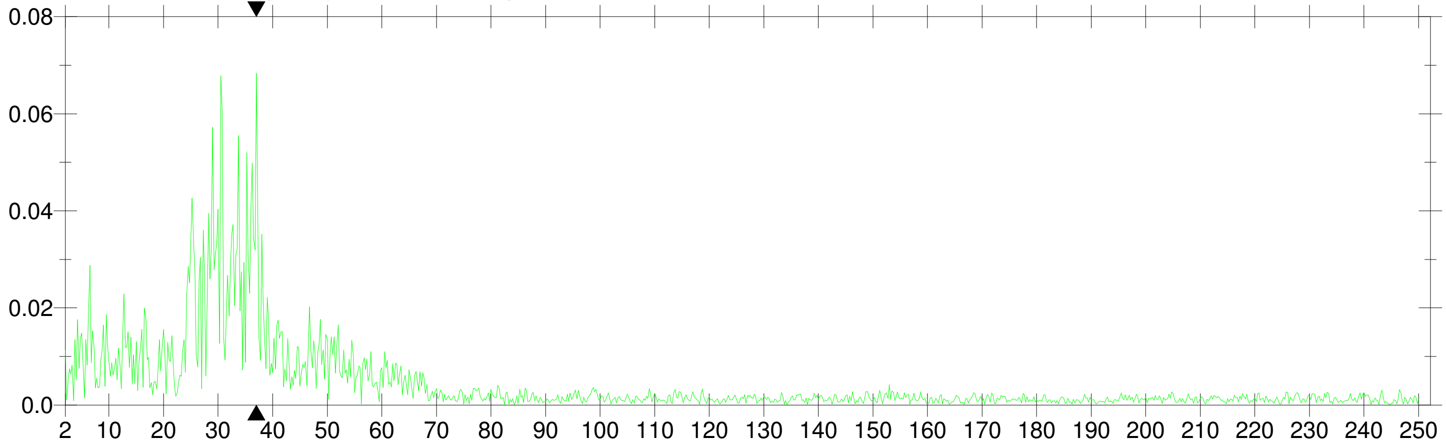
Date/Time Tran at 18:10:05 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

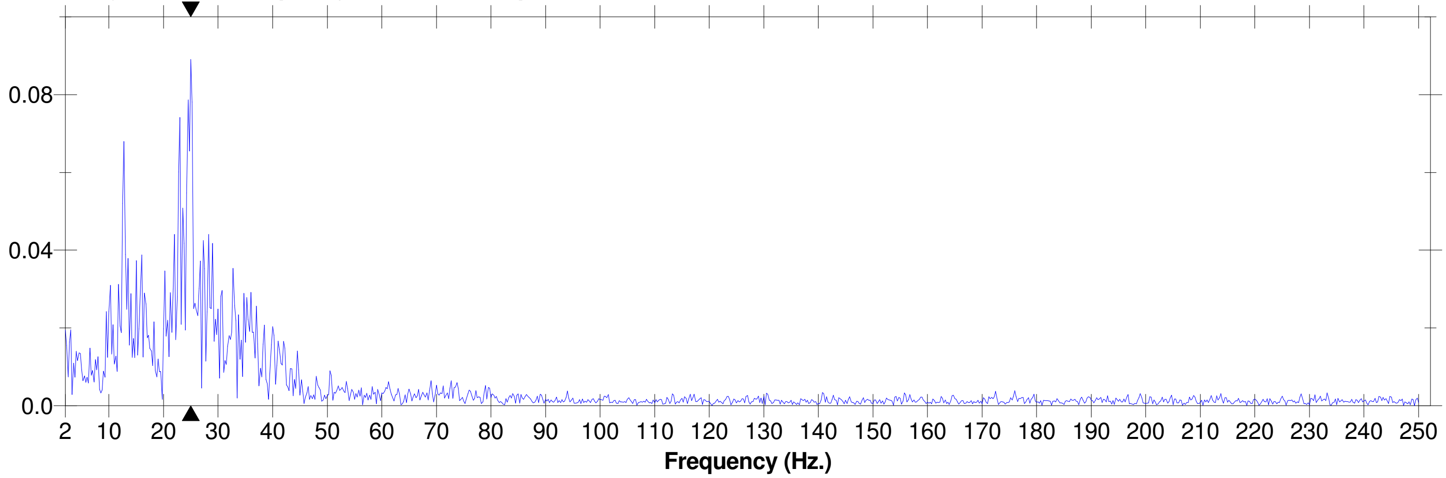
Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVJR.ST0

Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 3, 2017 17:09:26
Geophone secured into subgrade under sandbag.


Tran Dominant Frequency = 24.50 Hz., Amplitude = 0.105, PPV from Event = 1.778 mm/s


Vert Dominant Frequency = 37.00 Hz., Amplitude = 0.068, PPV from Event = 0.635 mm/s


Long Dominant Frequency = 25.00 Hz., Amplitude = 0.089, PPV from Event = 0.889 mm/s

Instantel

Event Report

Date/Time Tran at 18:10:07 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVJR.SV0

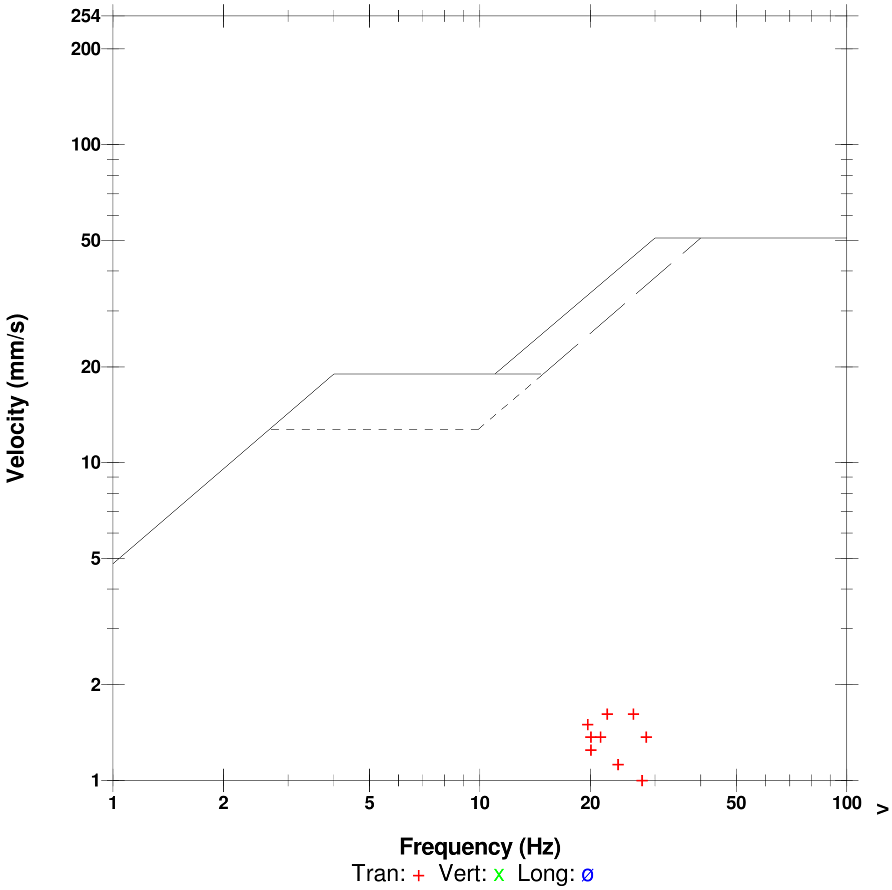
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

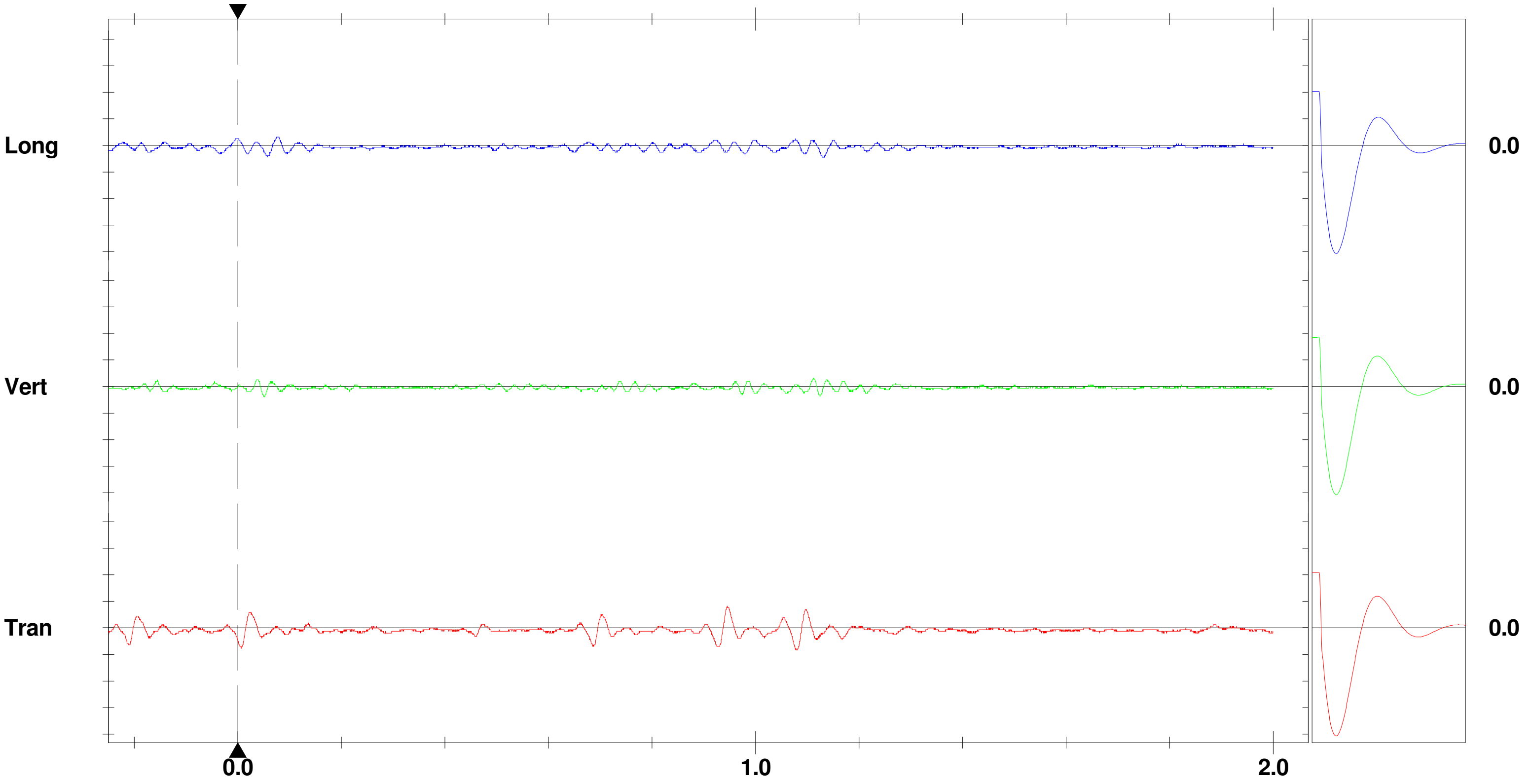
Extended Notes
Combo Mode May 3, 2017 17:09:26
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	1.651	0.762	0.889	mm/s
ZC Freq	26	41	26	Hz
Time (Rel. to Trig)	0.945	0.050	0.057	sec
Peak Acceleration	0.053	0.027	0.053	g
Peak Displacement	0.012	0.004	0.006	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 1.746 mm/s at 0.945 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

FFT Report

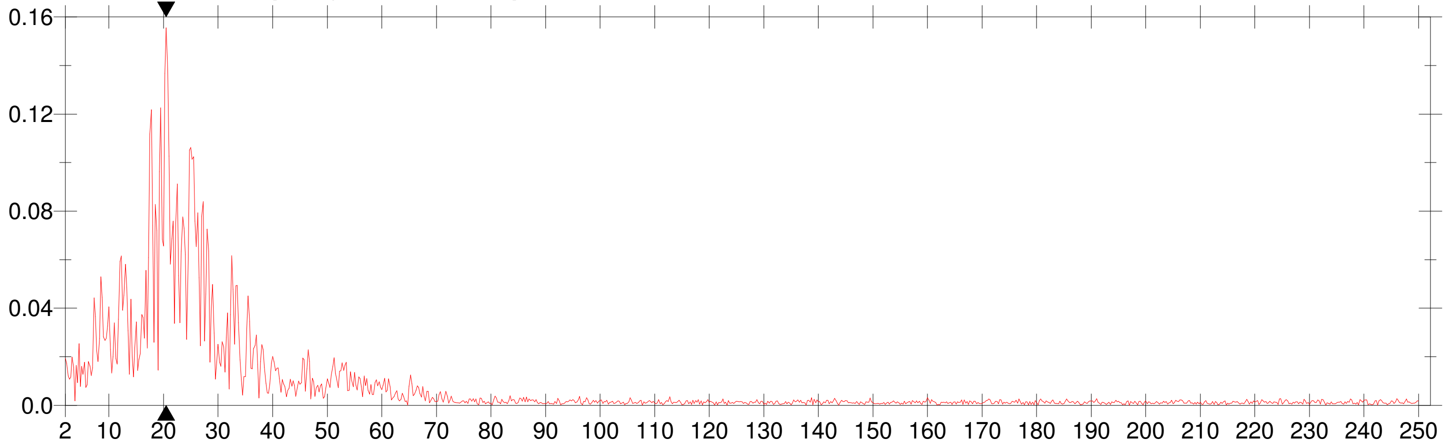
Date/Time Tran at 18:10:07 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVJR.SV0

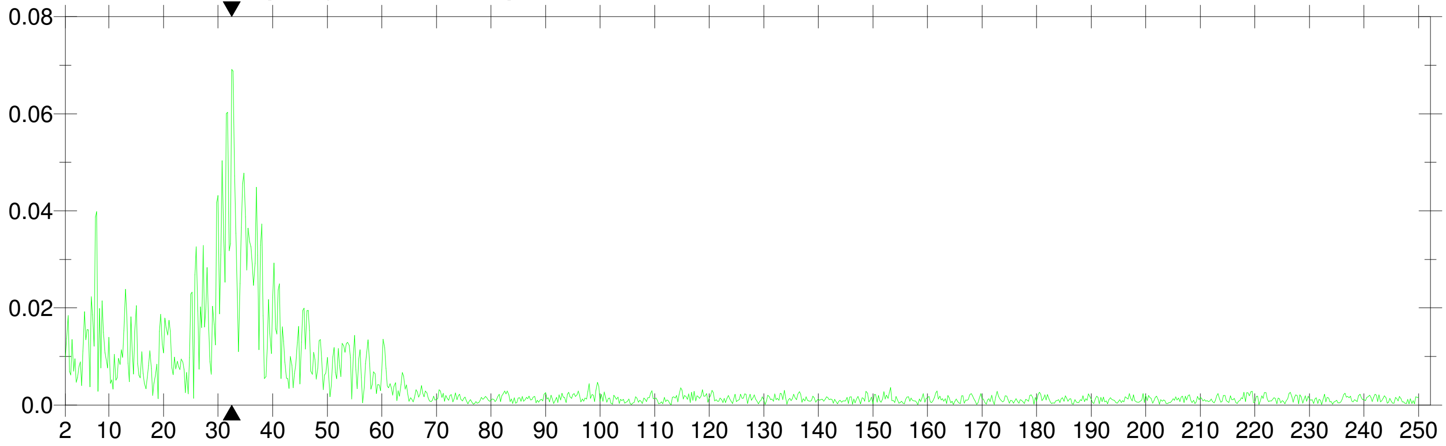
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 3, 2017 17:09:26
Geophone secured into subgrade under sandbag.

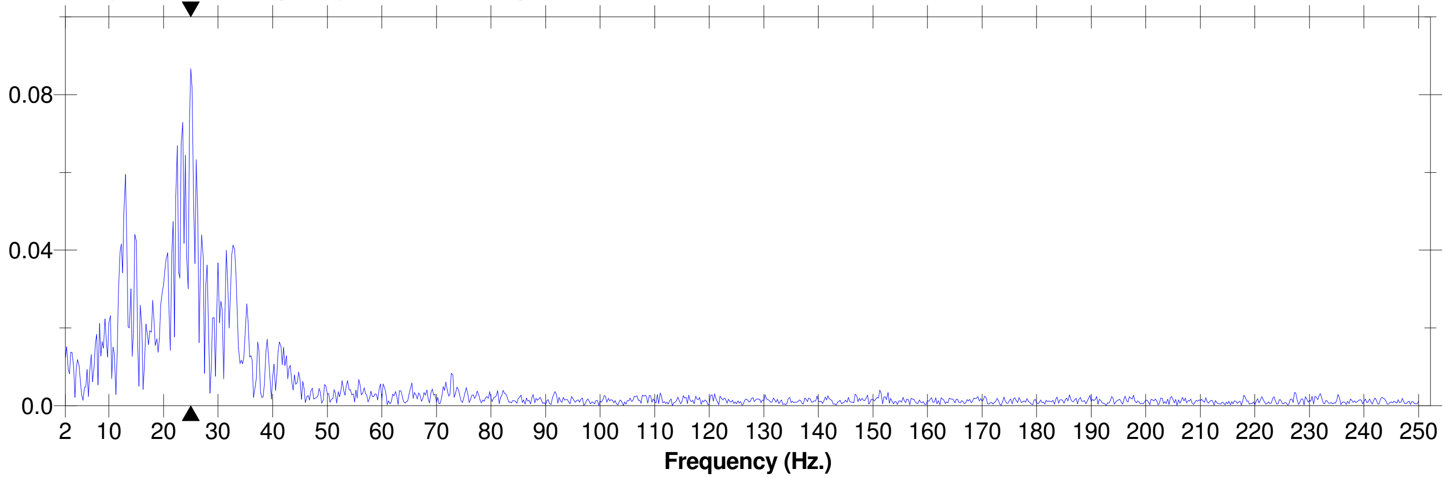
Tran Dominant Frequency = 20.50 Hz., Amplitude = 0.155, PPV from Event = 1.651 mm/s



Vert Dominant Frequency = 32.50 Hz., Amplitude = 0.069, PPV from Event = 0.762 mm/s



Long Dominant Frequency = 25.00 Hz., Amplitude = 0.087, PPV from Event = 0.889 mm/s



Event Report

Date/Time Long at 18:12:36 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

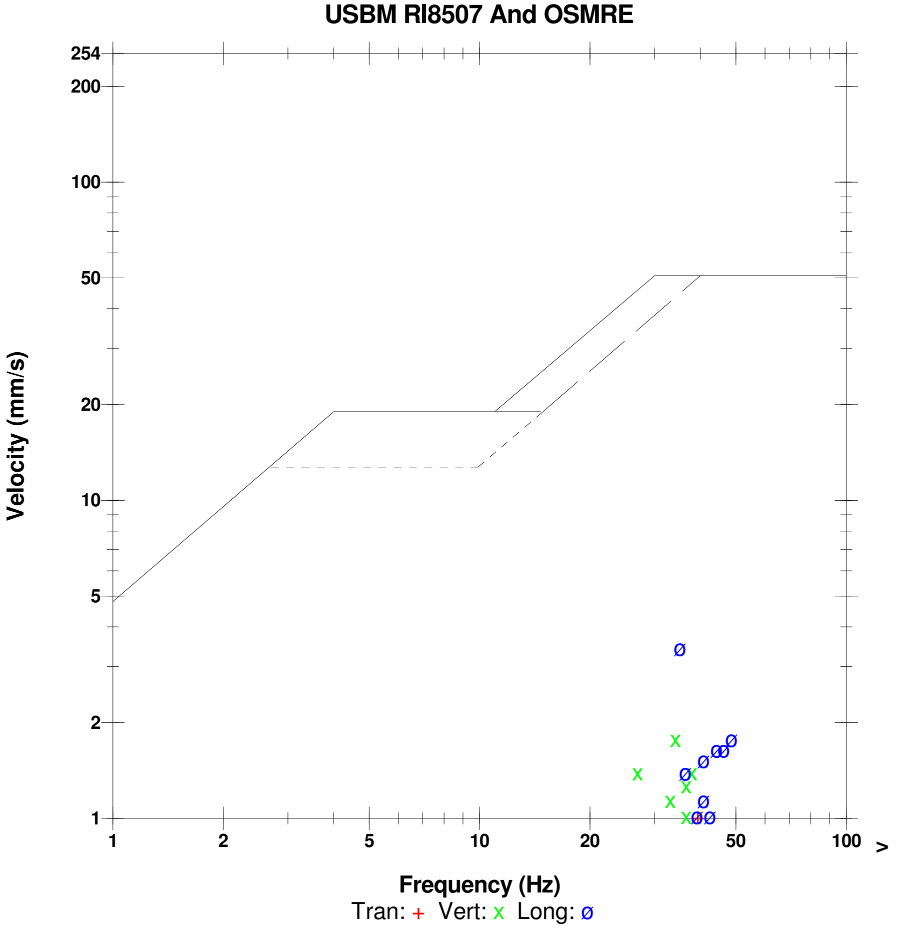
Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVJR.X00

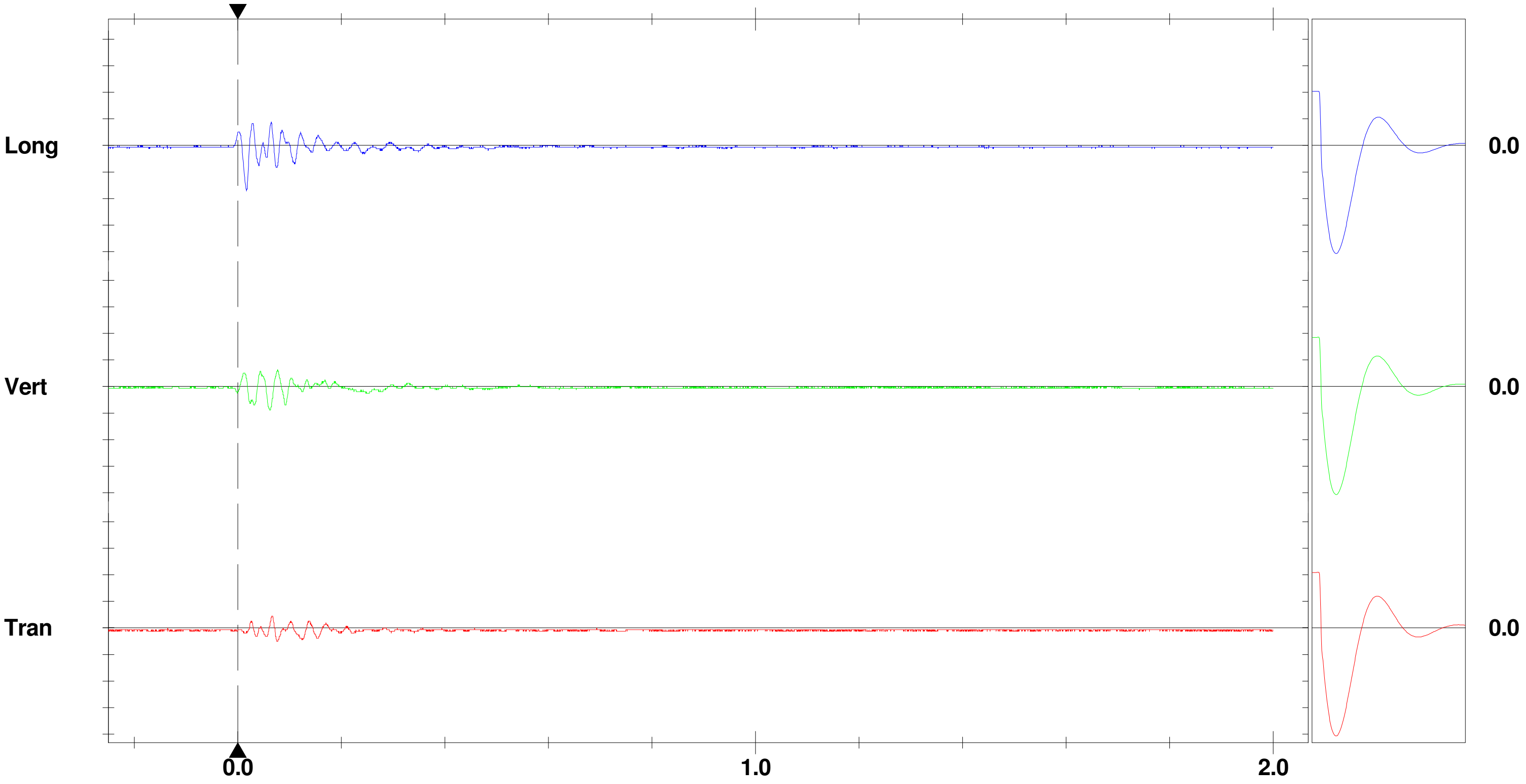
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 3, 2017 17:09:26
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	1.016	1.778	3.429	mm/s
ZC Freq	39	34	35	Hz
Time (Rel. to Trig)	0.075	0.061	0.017	sec
Peak Acceleration	0.053	0.053	0.080	g
Peak Displacement	0.006	0.010	0.014	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 3.497 mm/s at 0.017 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Printed: May 12, 2017 (V 10.72 - 10.72.1)

FFT Report

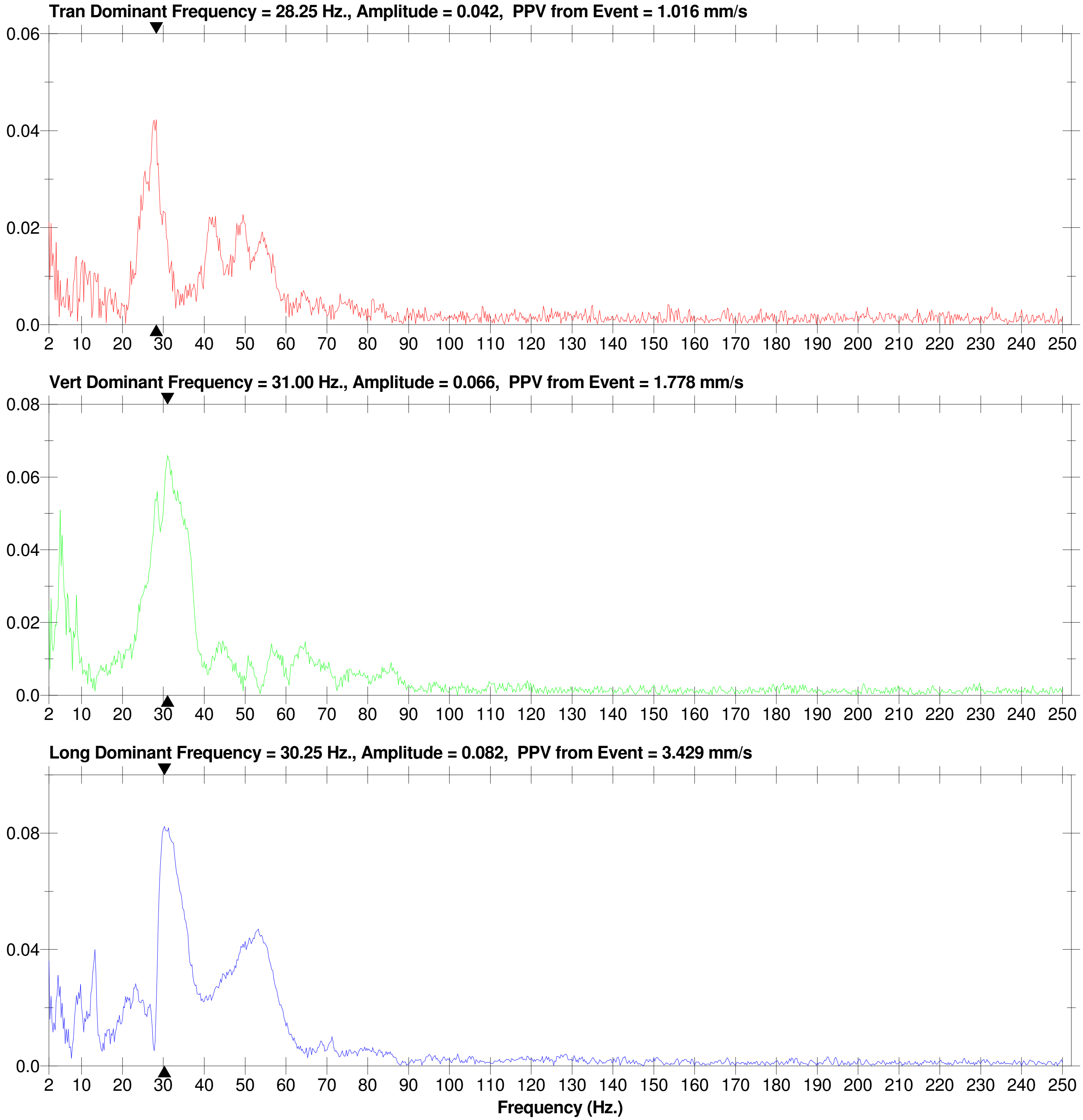
Date/Time	Long at 18:12:36 May 3, 2017	**Serial Number**	BE8720 V 10.72-8.17 MiniMate Plus
Trigger Source	Geo: 1.000 mm/s	**Battery Level**	5.9 Volts (Battery Low)
Range	Geo: 254.0 mm/s	**Unit Calibration**	March 13, 2017 by Instantel
Record Time	2.0 sec at 2048 sps	**File Name**	J720GVJR.X00

Notes

Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes

Combo Mode May 3, 2017 17:09:26
Geophone secured into subgrade under sandbag.



Event Report

Date/Time	Vert at 18:14:26 May 3, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.8 Volts (Battery Low)
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVJS.020

Notes

Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

Extended Notes

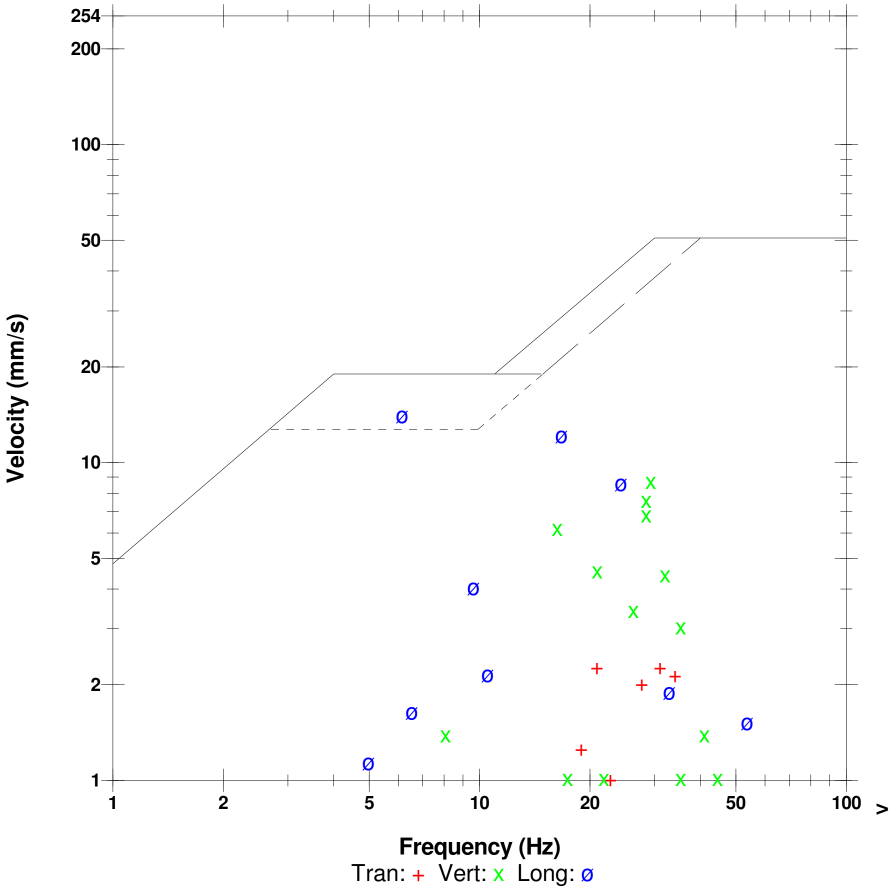
Combo Mode May 3, 2017 17:09:26

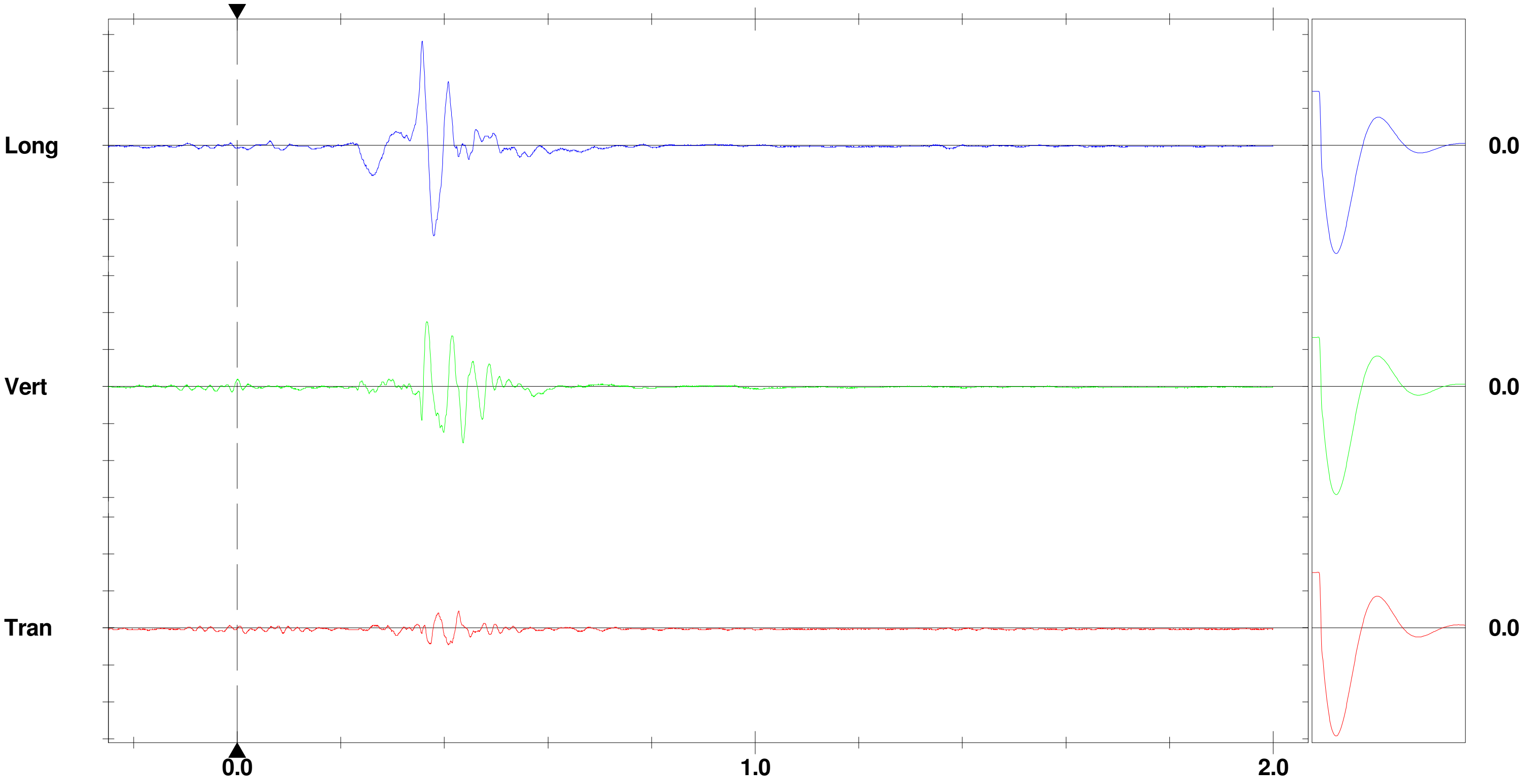
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	2.286	8.763	14.10	mm/s
ZC Freq	21	29	6.2	Hz
Time (Rel. to Trig)	0.407	0.366	0.357	sec
Peak Acceleration	0.080	0.239	0.186	g
Peak Displacement	0.018	0.059	0.131	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 14.80 mm/s at 0.357 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 5.000 mm/s/div

Trigger = ▶—— ——◀

Sensor Check

FFT Report

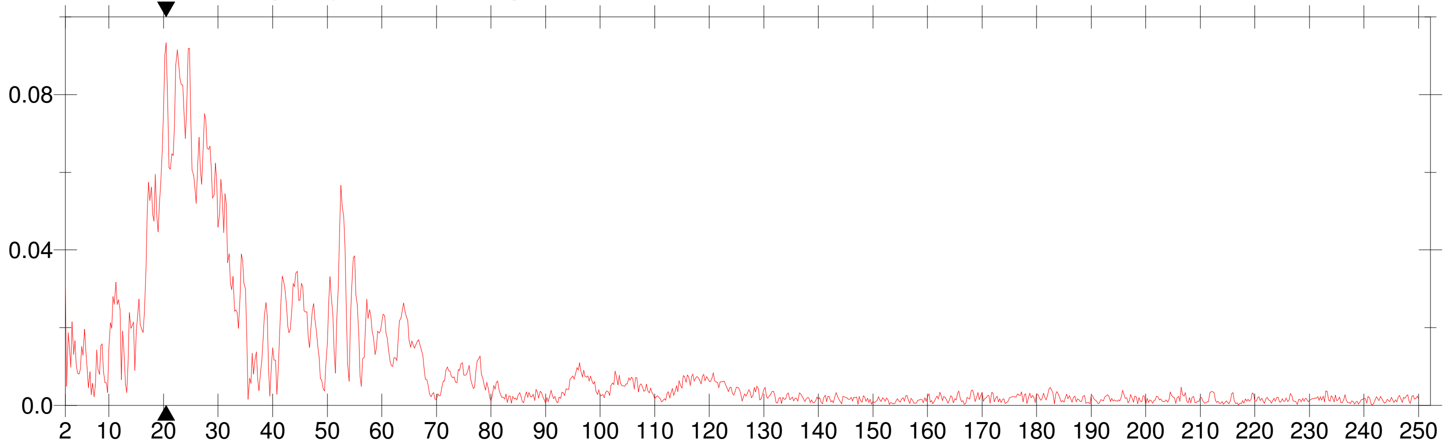
Date/Time Vert at 18:14:26 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.8 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVJS.020

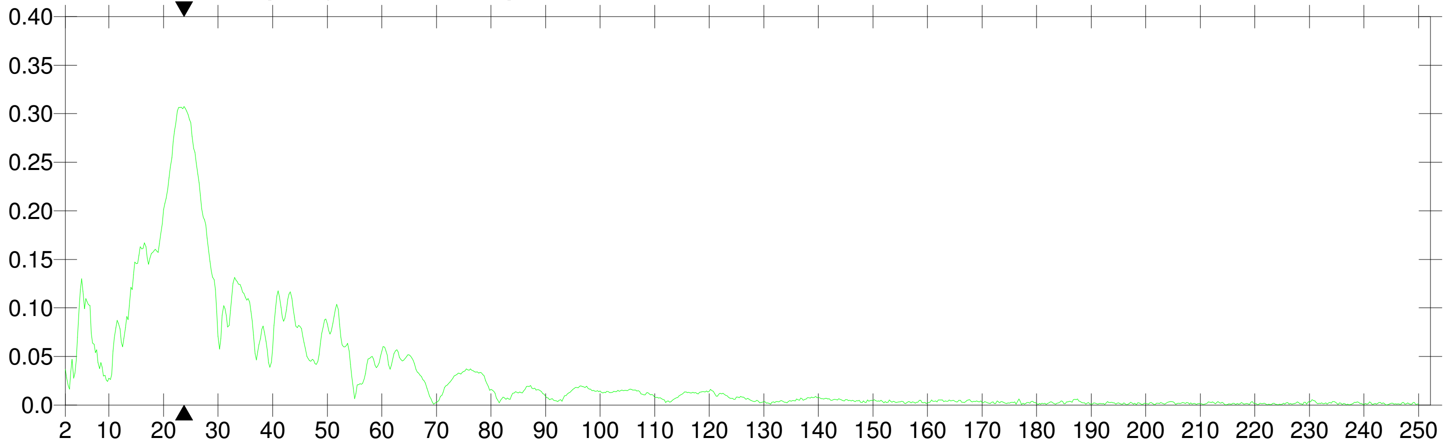
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 3, 2017 17:09:26
Geophone secured into subgrade under sandbag.

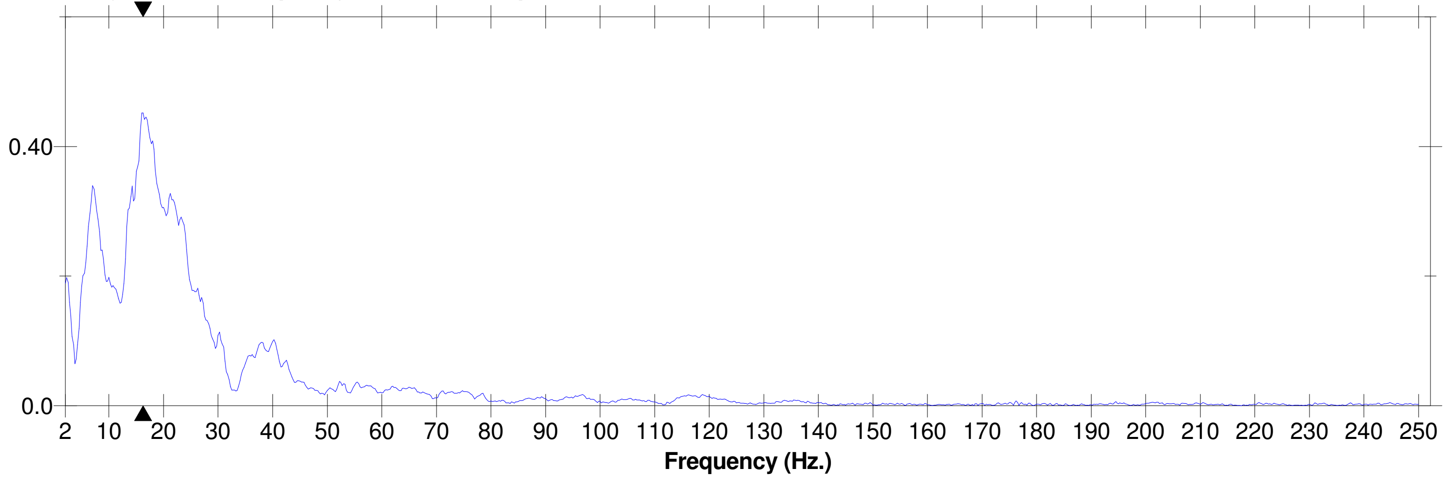
Tran Dominant Frequency = 20.50 Hz., Amplitude = 0.093, PPV from Event = 2.286 mm/s



Vert Dominant Frequency = 23.75 Hz., Amplitude = 0.307, PPV from Event = 8.763 mm/s



Long Dominant Frequency = 16.25 Hz., Amplitude = 0.452, PPV from Event = 14.10 mm/s



Instantel

Event Report

Date/Time Vert at 18:14:30 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

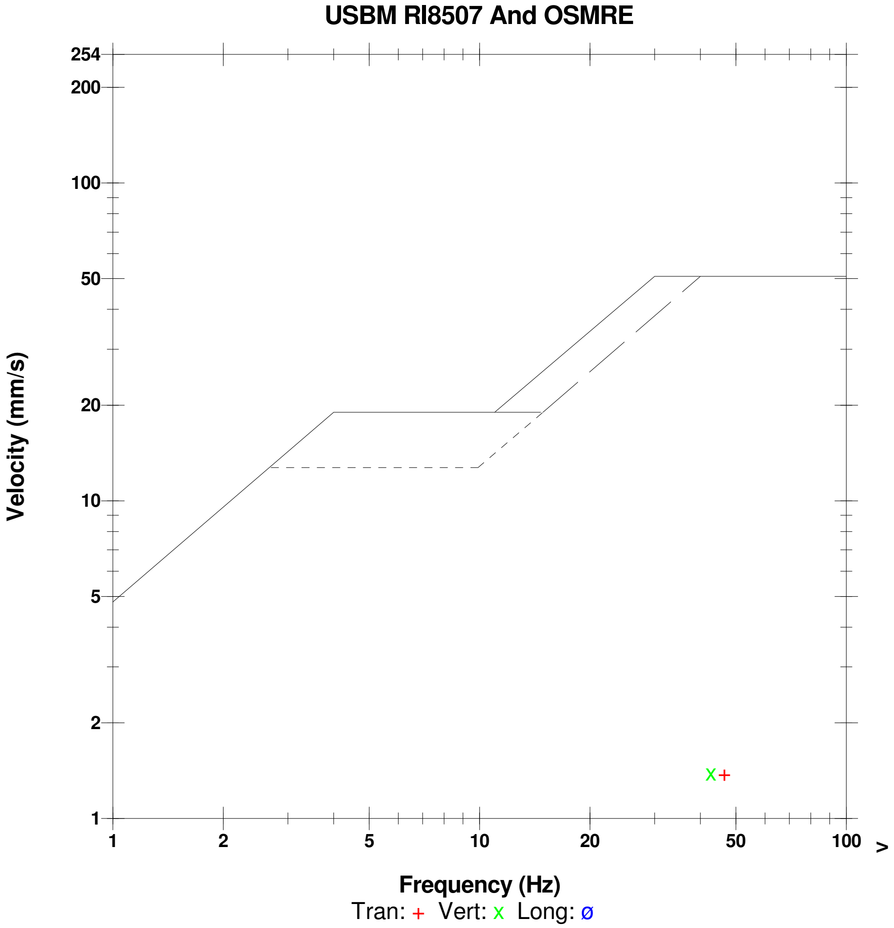
Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.8 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVJS.060

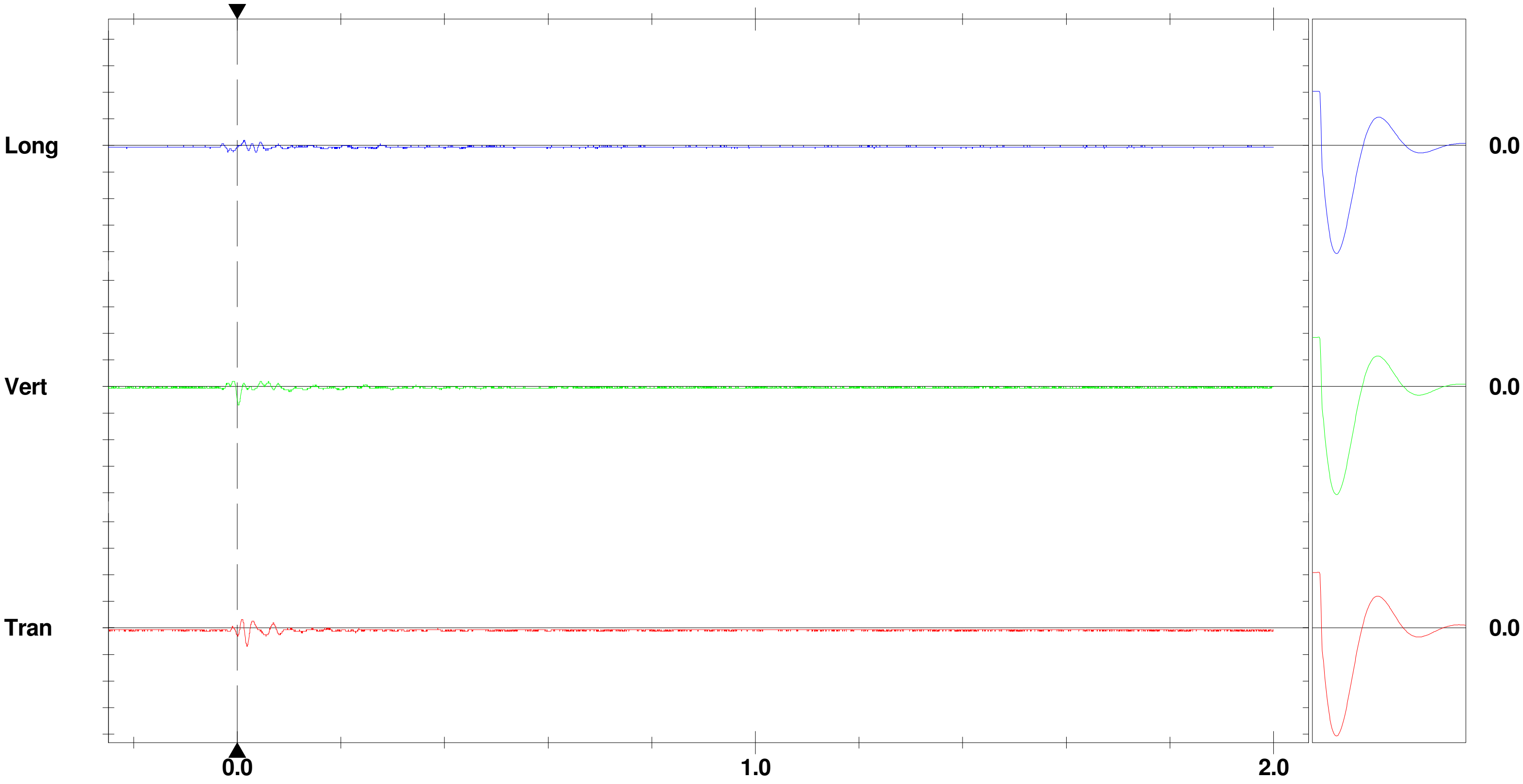
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 3, 2017 17:09:26
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	1.397	1.397	0.508	mm/s
ZC Freq	47	43	24	Hz
Time (Rel. to Trig)	0.019	0.001	-0.019	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.005	0.005	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.4	Hz
Overswing Ratio	3.4	3.6	3.9	

Peak Vector Sum 1.535 mm/s at 0.001 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

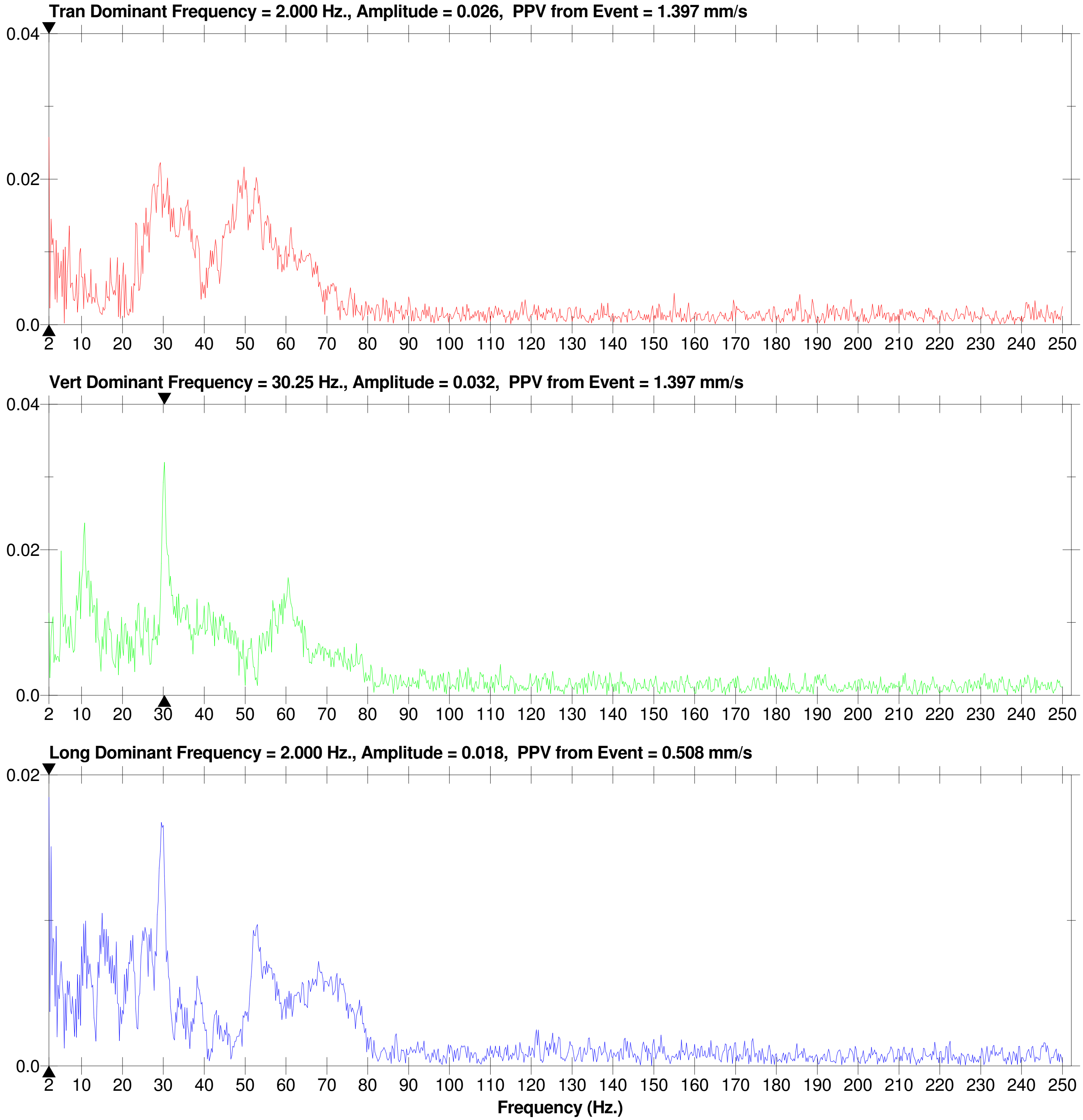
FFT Report

Date/Time Vert at 18:14:30 May 3, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.8 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVJS.060

Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 3, 2017 17:09:26
Geophone secured into subgrade under sandbag.



Event Report

Histogram Start Time	14:34:31 May 4, 2017		**Serial Number**	BE8720 V 10.72-8.17 MiniMate Plus
Histogram Finish Time	15:32:45 May 4, 2017		**Battery Level**	5.9 Volts (Battery Low)
Number of Intervals	1747.00 at 2 seconds		**Unit Calibration**	March 13, 2017 by Instantel
Range	Geo:254.0 mm/s		**File Name**	J720GVLC.HJ0
Sample Rate	2048sps			

Notes

Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

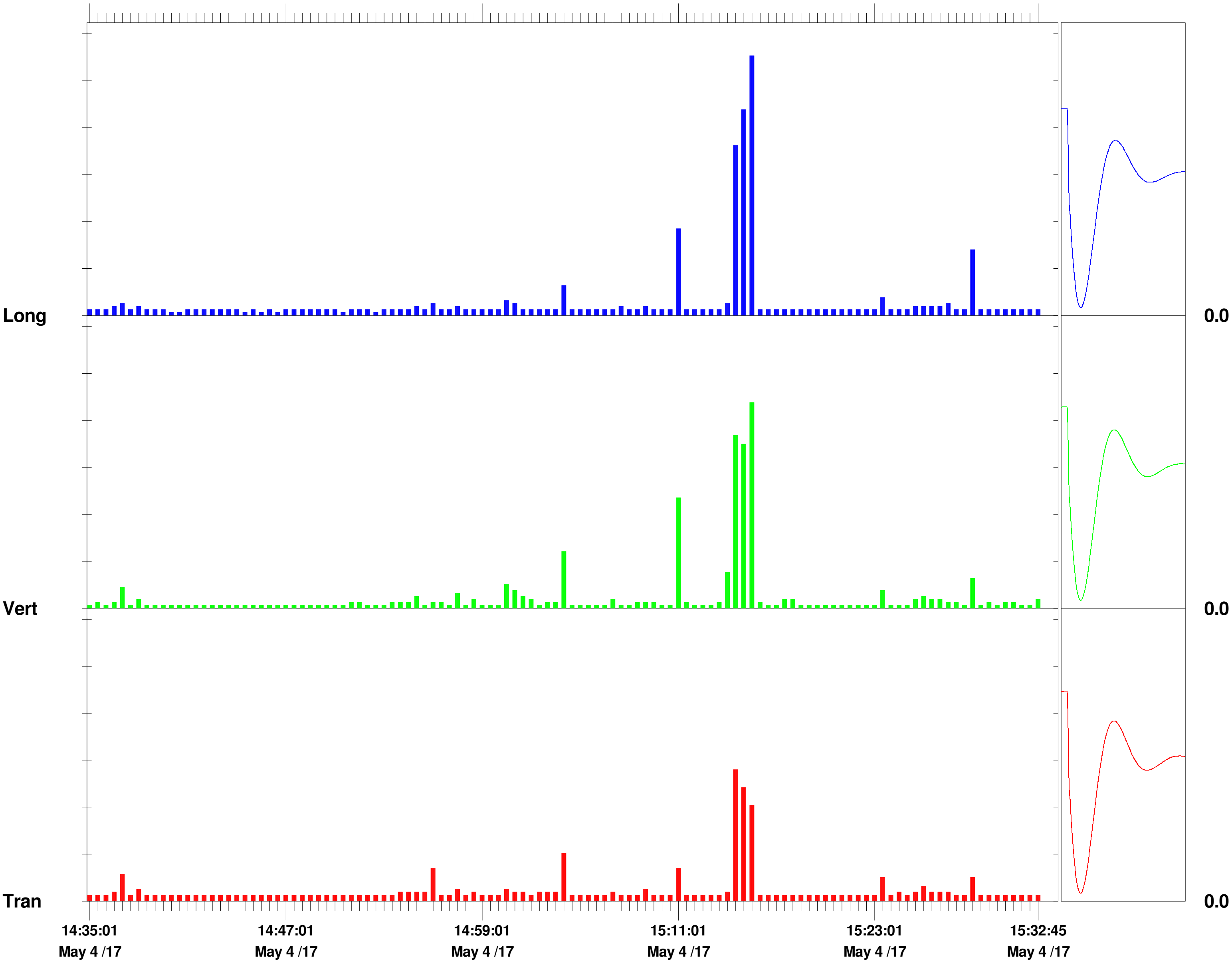
Extended Notes

Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	5.588	8.763	11.05	mm/s
ZC Freq	37	N/A	15.3	Hz
Date	May 4 /17	May 4 /17	May 4 /17	
Time	15:14:11	15:15:11	15:15:05	
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.3	Hz
Overswing Ratio	3.5	3.6	4.0	

Peak Vector Sum 11.28 mm/s on May 4, 2017 at 15:15:05

N/A: Not Applicable



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 2.000 mm/s/div Sensor Check

Instantel

Event Report

Date/Time	Tran at 14:36:31 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVLC.KV0

Notes

Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

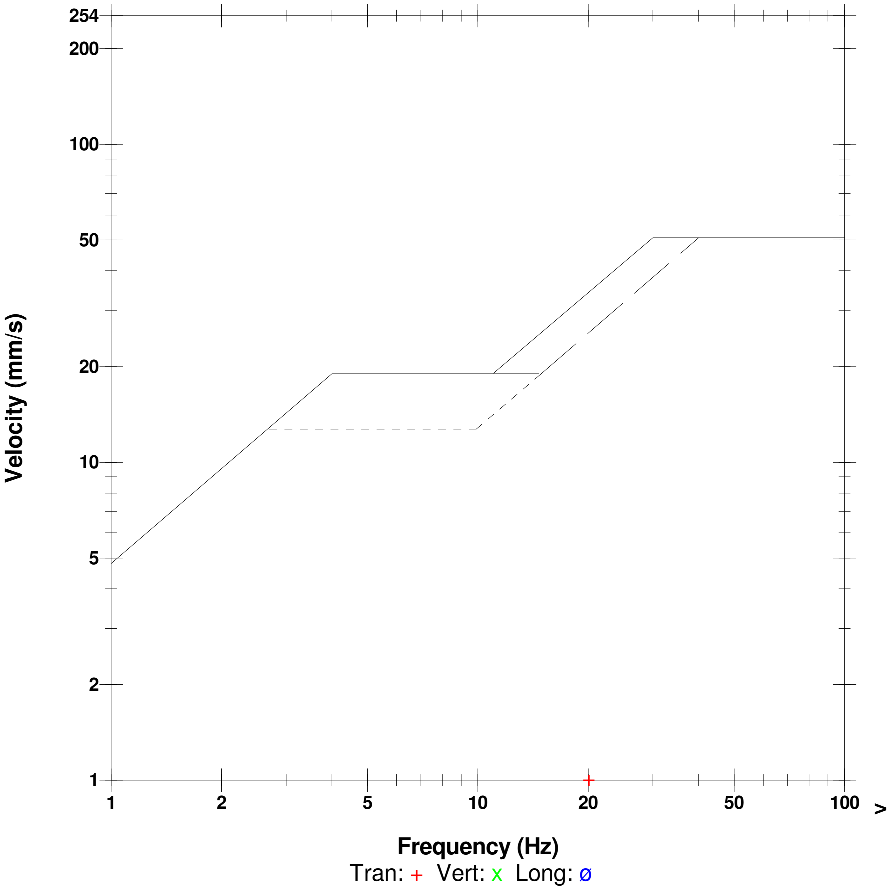
Extended Notes

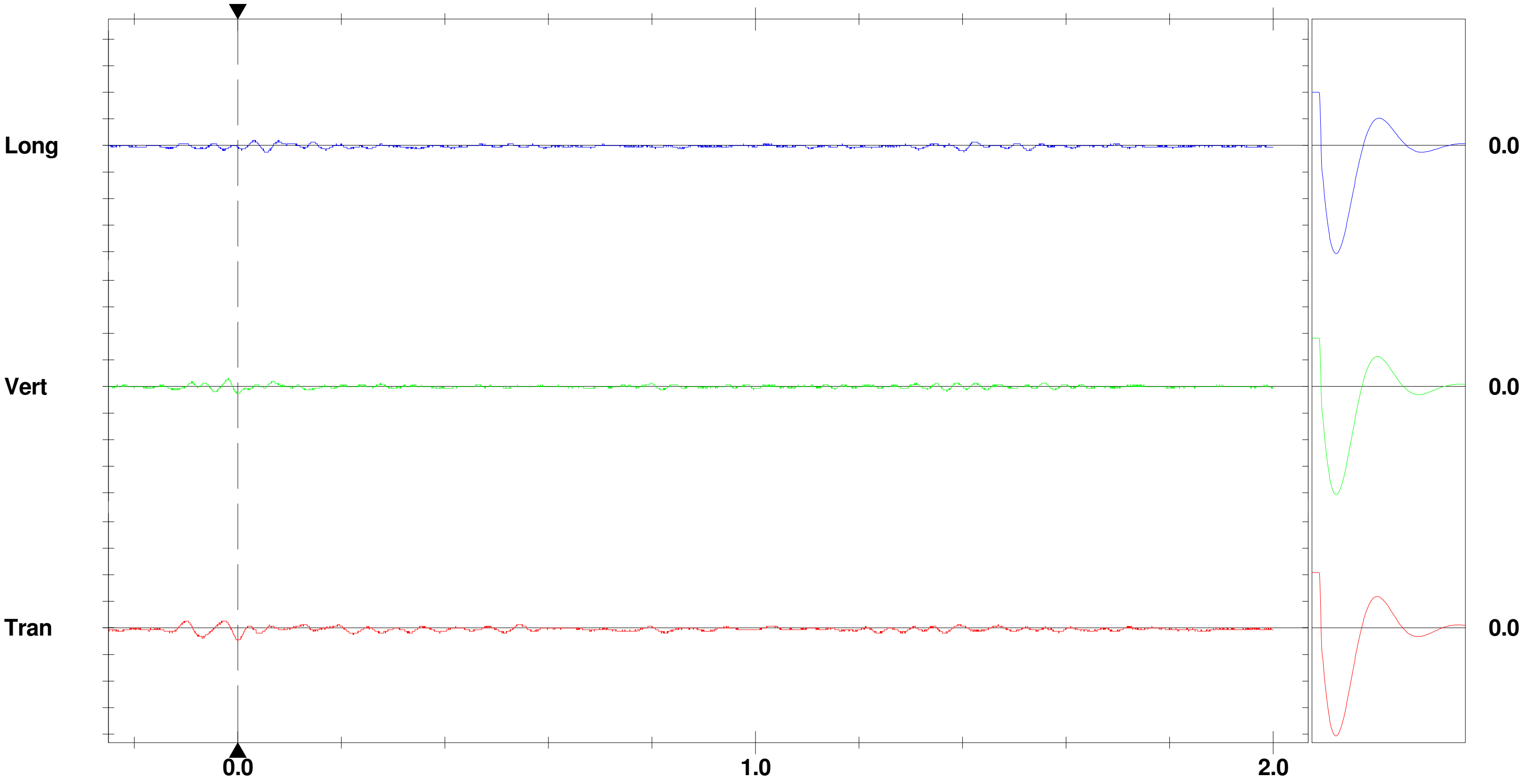
Combo Mode May 4, 2017 14:34:31
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	1.016	0.635	0.508	mm/s
ZC Freq	20	30	26	Hz
Time (Rel. to Trig)	0.000	-0.019	0.051	sec
Peak Acceleration	0.027	0.027	0.027	g
Peak Displacement	0.009	0.004	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.3	Hz
Overswing Ratio	3.5	3.6	4.0	

Peak Vector Sum 1.143 mm/s at 0.000 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Sensor Check

Trigger = ▶―― ――◀

FFT Report

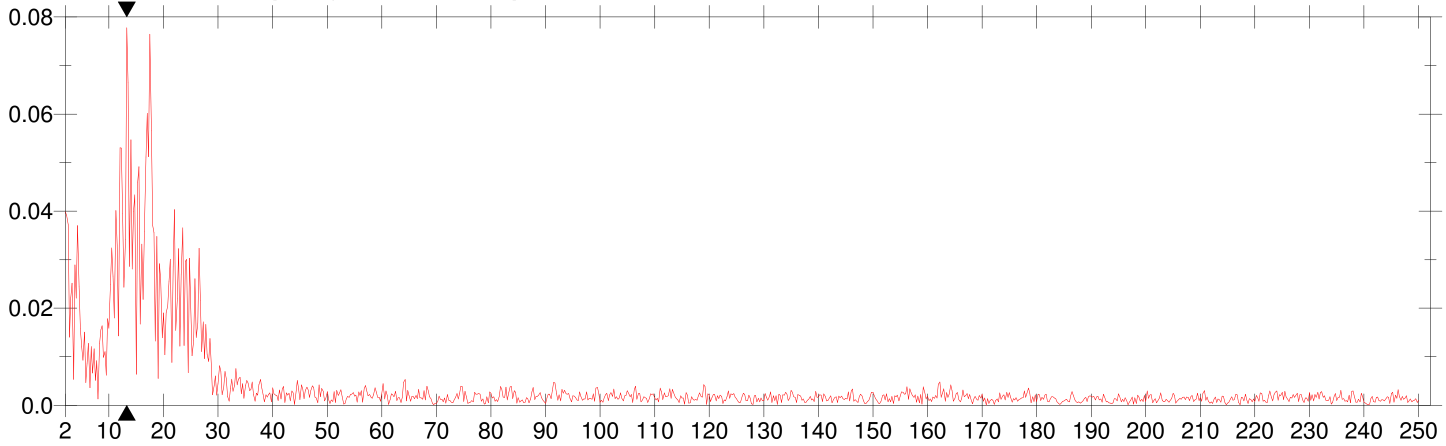
Date/Time Tran at 14:36:31 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts
Unit Calibration March 13, 2017 by Instantel
File Name J720GVLC.KV0

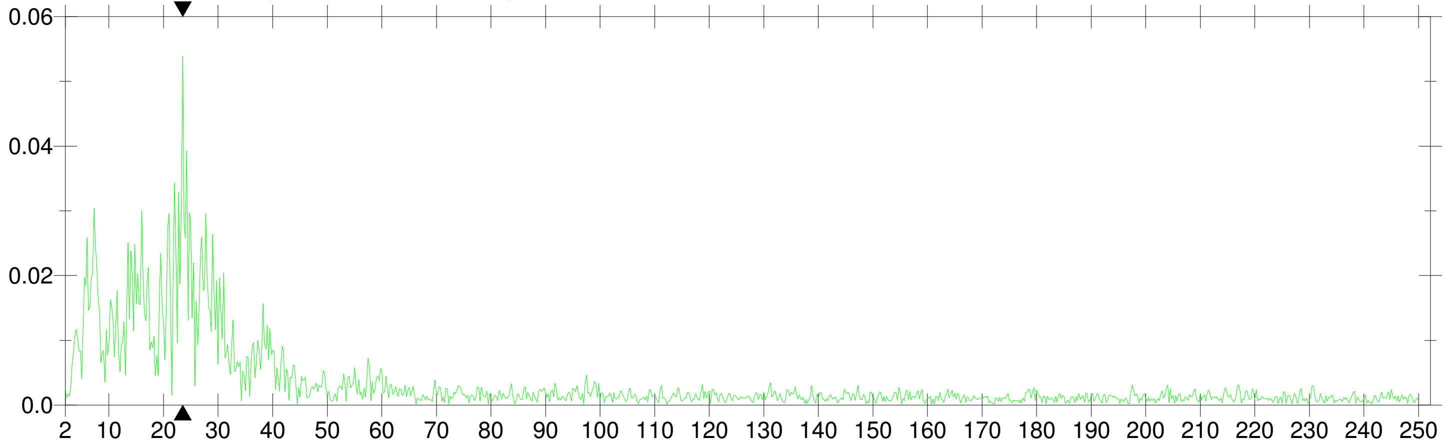
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 4, 2017 14:34:31
Geophone secured into subgrade under sandbag.

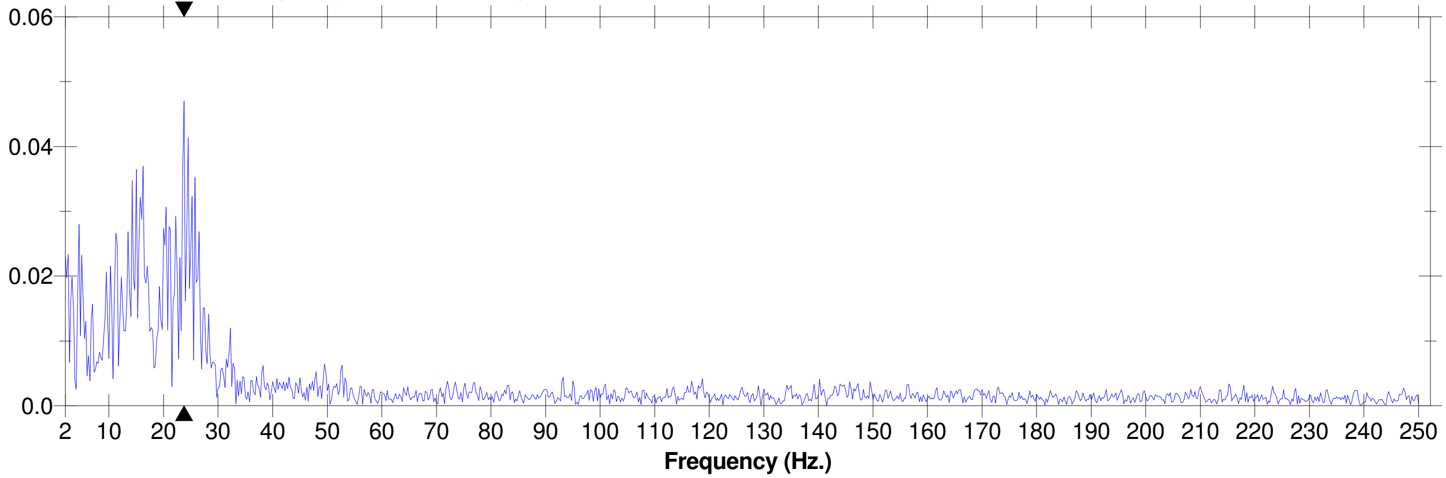
Tran Dominant Frequency = 13.25 Hz., Amplitude = 0.078, PPV from Event = 1.016 mm/s



Vert Dominant Frequency = 23.50 Hz., Amplitude = 0.054, PPV from Event = 0.635 mm/s



Long Dominant Frequency = 23.75 Hz., Amplitude = 0.047, PPV from Event = 0.508 mm/s



Instantel

Event Report

Date/Time	Tran at 14:36:33 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVLC.KX0

Notes

Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

Extended Notes

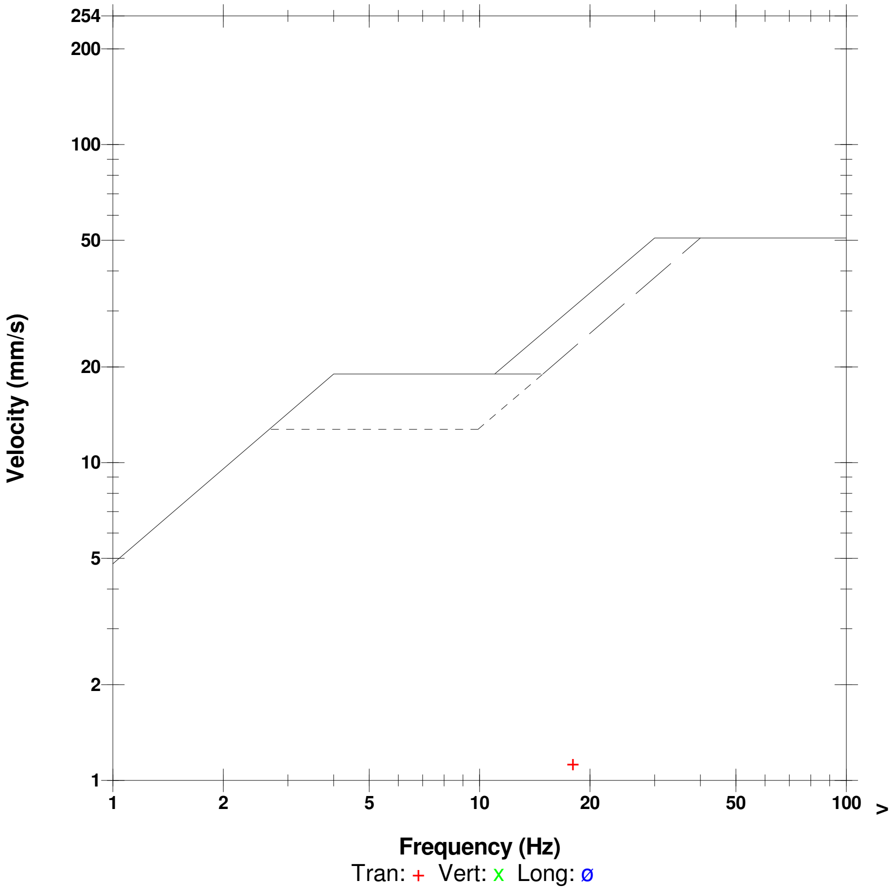
Combo Mode May 4, 2017 14:34:31

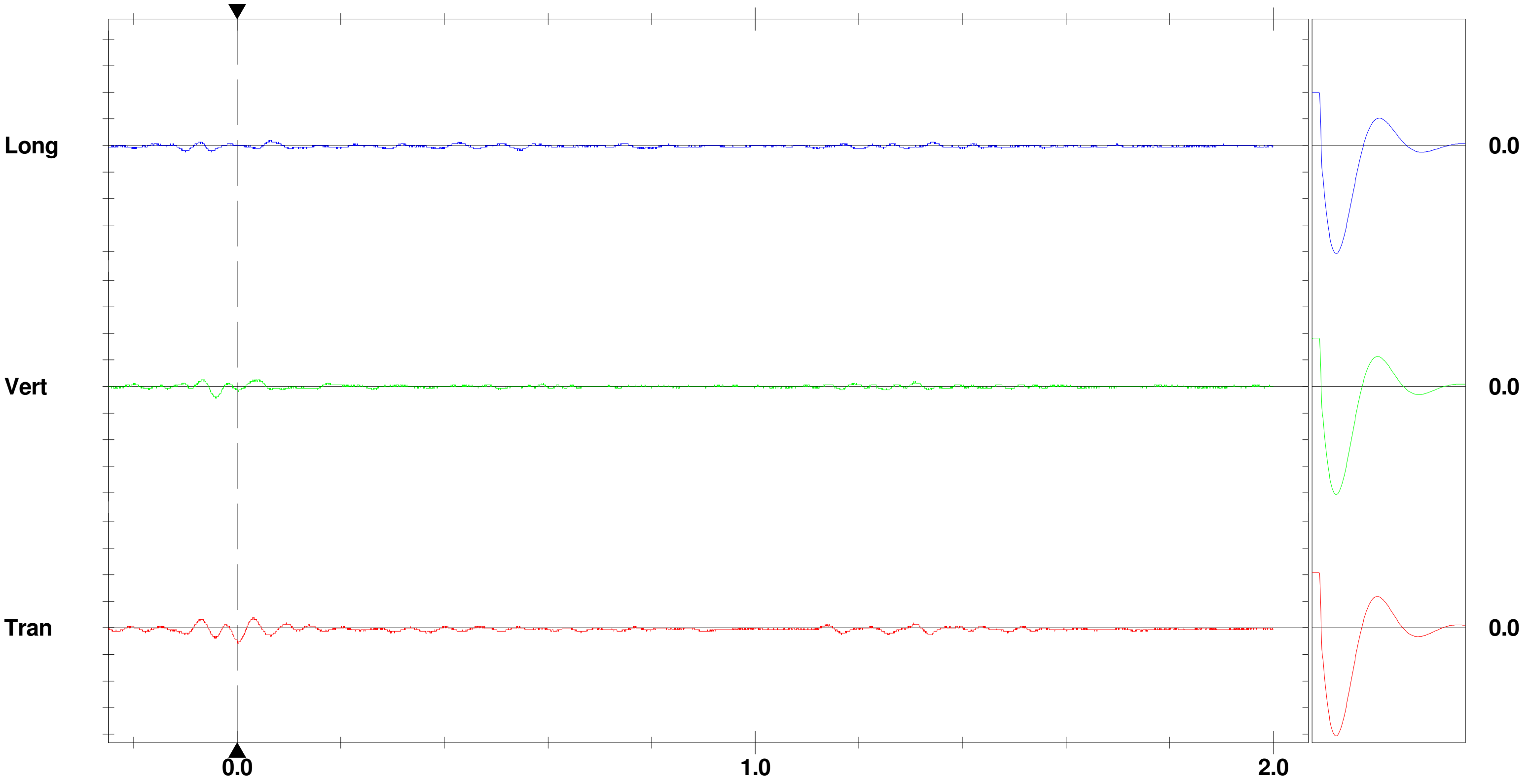
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	1.143	0.889	0.508	mm/s
ZC Freq	18.0	20	21	Hz
Time (Rel. to Trig)	0.001	-0.042	-0.100	sec
Peak Acceleration	0.027	0.053	0.053	g
Peak Displacement	0.010	0.007	0.004	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.3	Hz
Overswing Ratio	3.5	3.6	4.0	

Peak Vector Sum 1.205 mm/s at 0.002 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Trigger = ▶—— ——◀

Instantel

FFT Report

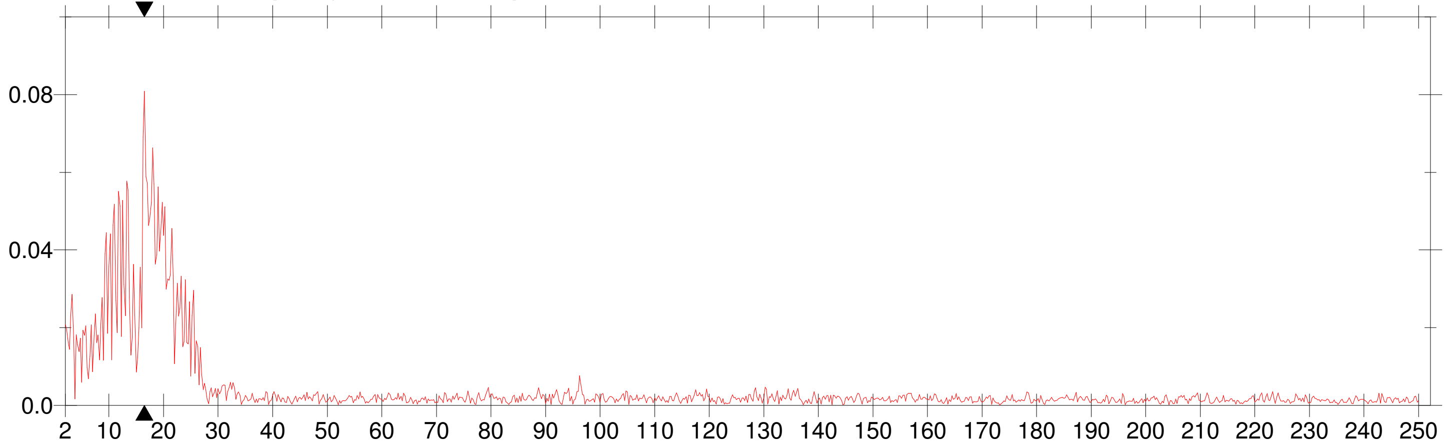
Date/Time Tran at 14:36:33 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts
Unit Calibration March 13, 2017 by Instantel
File Name J720GVLC.KX0

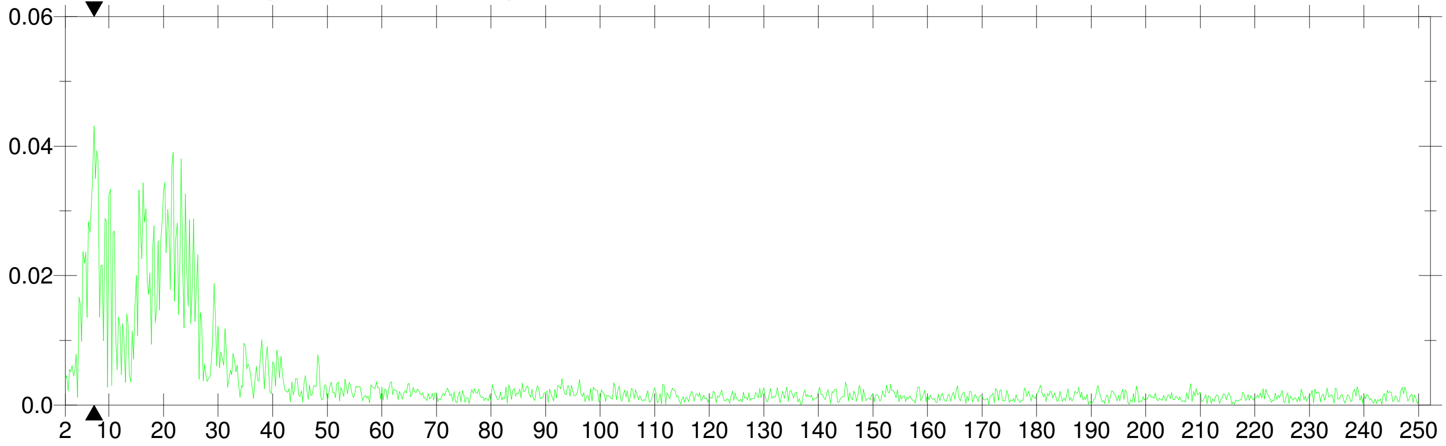
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 4, 2017 14:34:31
Geophone secured into subgrade under sandbag.

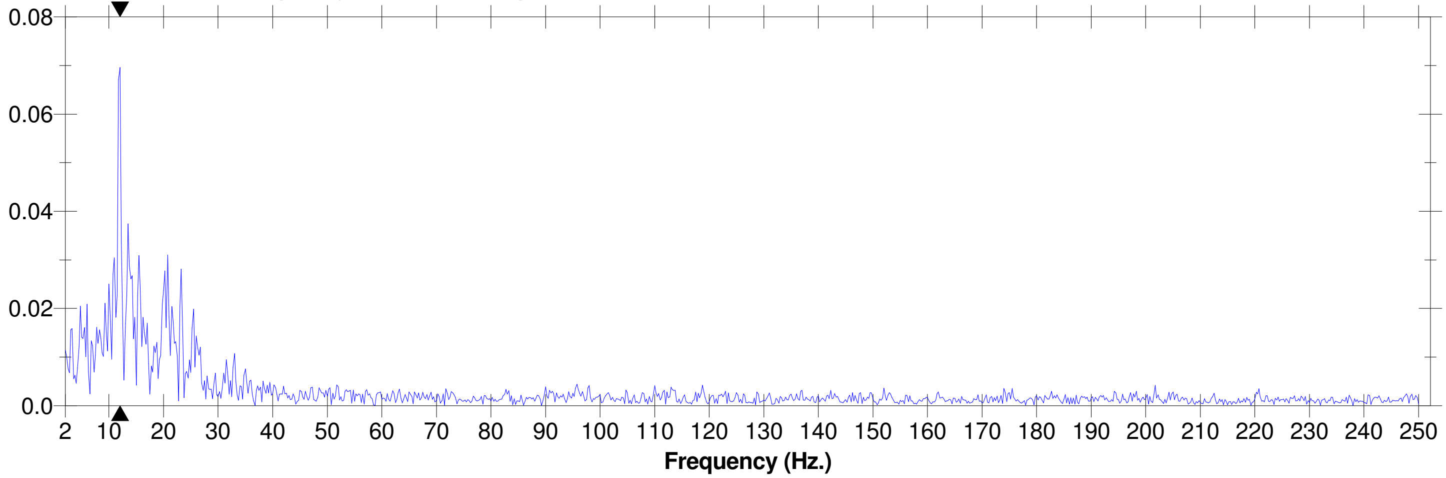
Tran Dominant Frequency = 16.50 Hz., Amplitude = 0.081, PPV from Event = 1.143 mm/s



Vert Dominant Frequency = 7.250 Hz., Amplitude = 0.043, PPV from Event = 0.889 mm/s



Long Dominant Frequency = 12.00 Hz., Amplitude = 0.070, PPV from Event = 0.508 mm/s



Printed: May 12, 2017 (V 10.72 - 10.72.1)

Event Report

Date/Time	Tran at 14:55:48 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts (Battery Low)
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVLD.H00

Notes

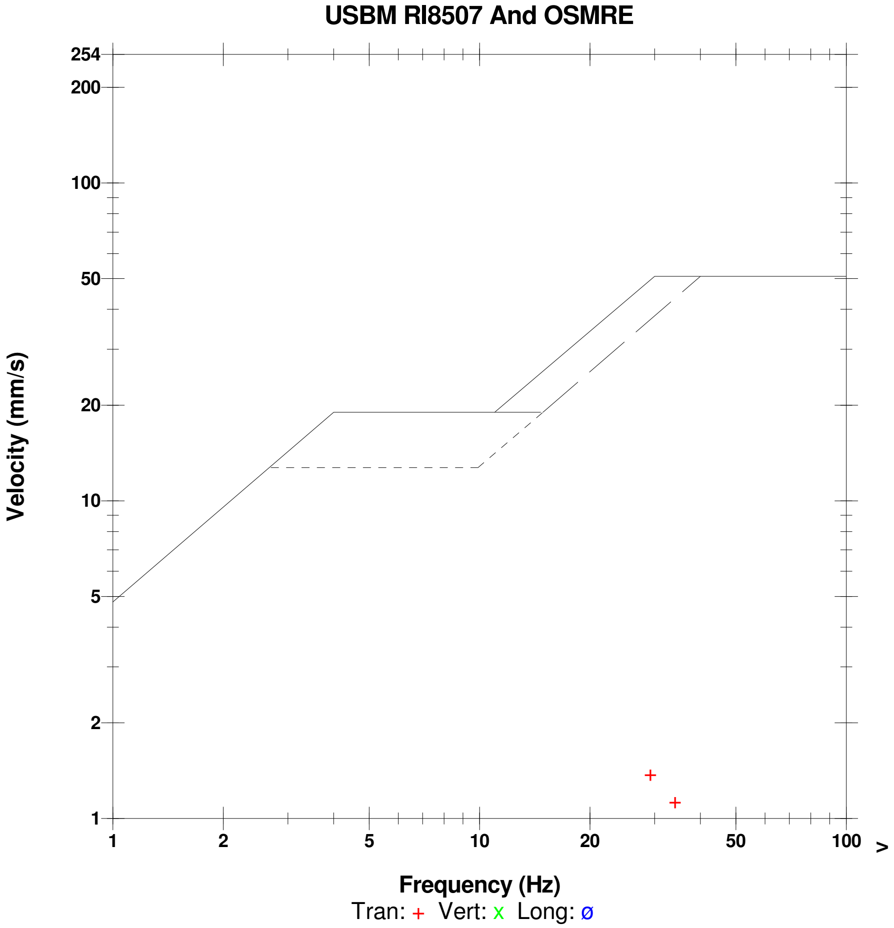
Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

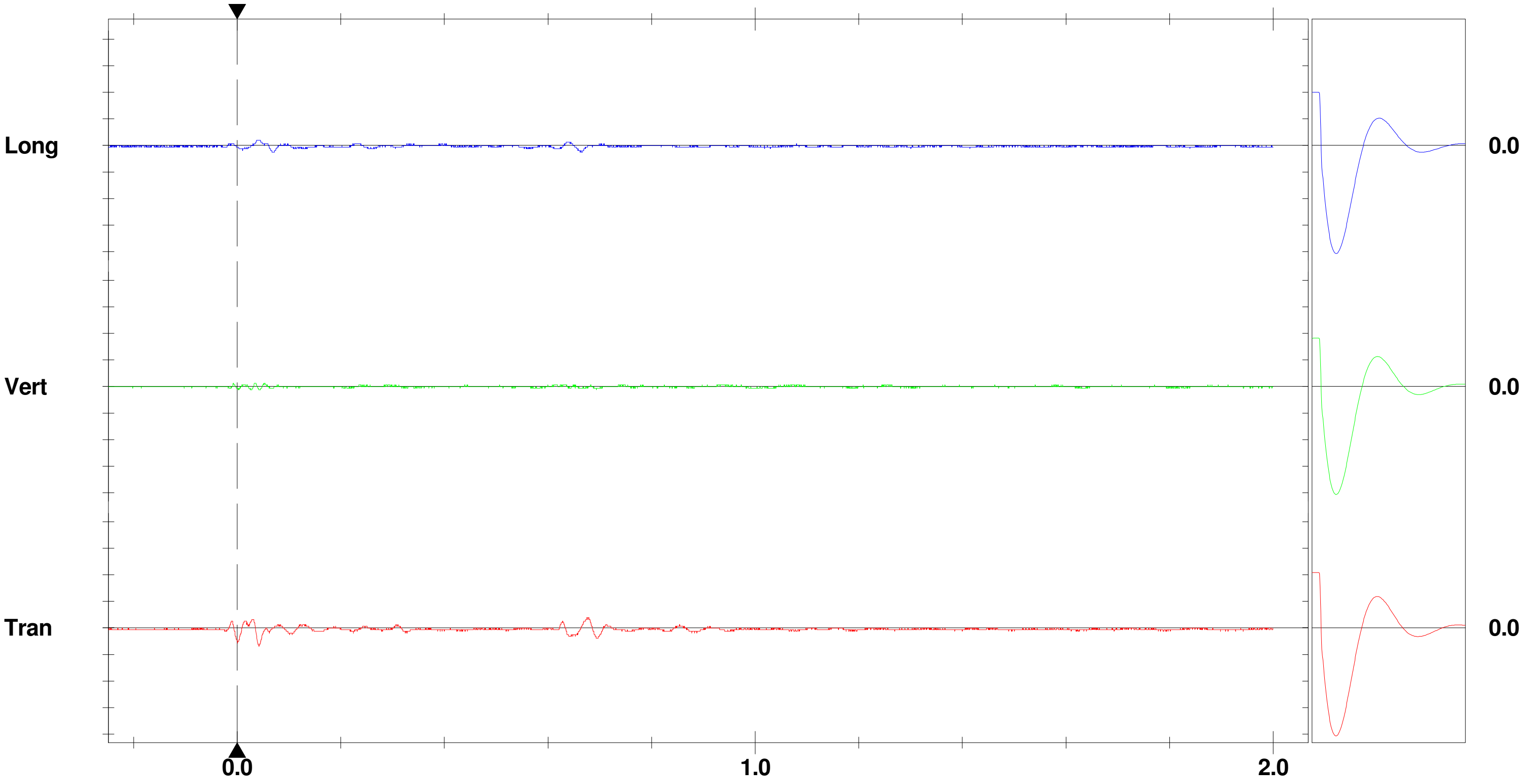
Extended Notes

Combo Mode May 4, 2017 14:34:31
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	1.397	0.254	0.508	mm/s
ZC Freq	29	>200	34	Hz
Time (Rel. to Trig)	0.042	-0.008	0.067	sec
Peak Acceleration	0.053	0.053	0.053	g
Peak Displacement	0.007	0.000	0.003	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.3	Hz
Overswing Ratio	3.5	3.6	4.0	

Peak Vector Sum 1.470 mm/s at 0.042 sec





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: May 12, 2017 (V 10.72 - 10.72.1)

Format © 1995-2015 Xmark Corporation

FFT Report

Date/Time	Tran at 14:55:48 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts (Battery Low)
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVLD.H00

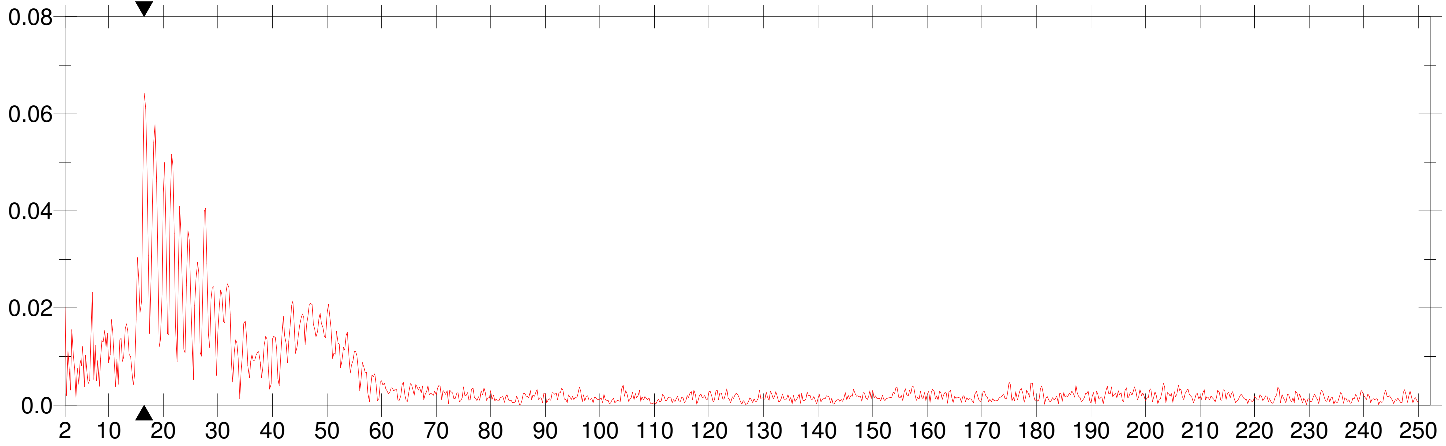
Notes

Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

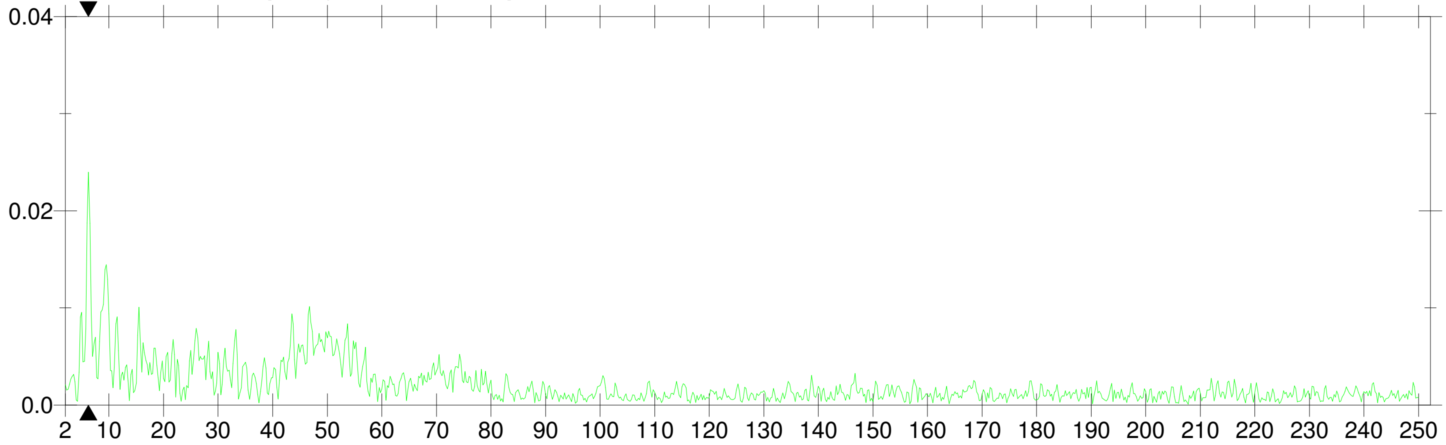
Extended Notes

Combo Mode May 4, 2017 14:34:31
Geophone secured into subgrade under sandbag.

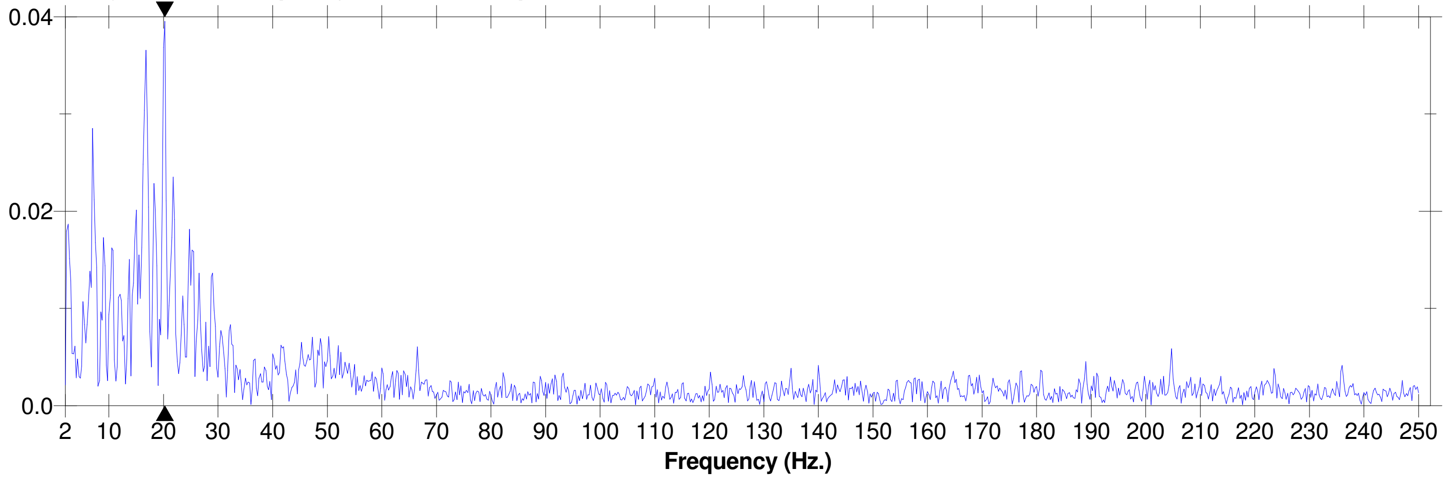
Tran Dominant Frequency = 16.50 Hz., Amplitude = 0.064, PPV from Event = 1.397 mm/s



Vert Dominant Frequency = 6.250 Hz., Amplitude = 0.024, PPV from Event = 0.254 mm/s



Long Dominant Frequency = 20.25 Hz., Amplitude = 0.040, PPV from Event = 0.508 mm/s



Event Report

Date/Time	Vert at 15:00:28 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts (Battery Low)
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVLD.OS0

Notes

Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

Extended Notes

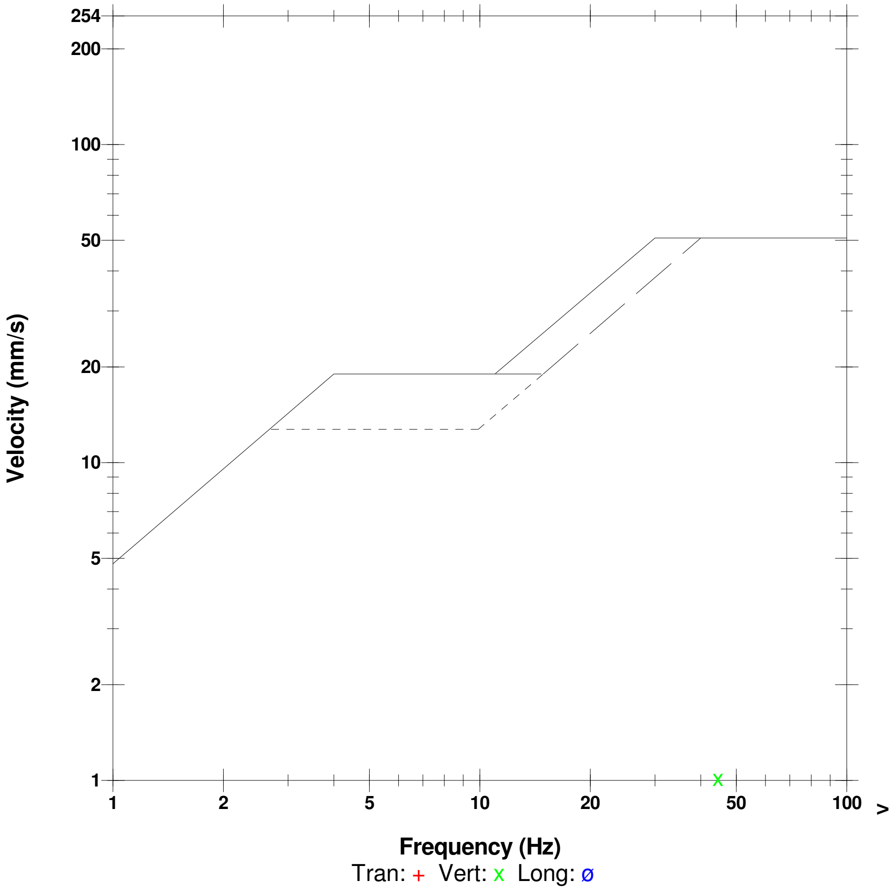
Combo Mode May 4, 2017 14:34:31

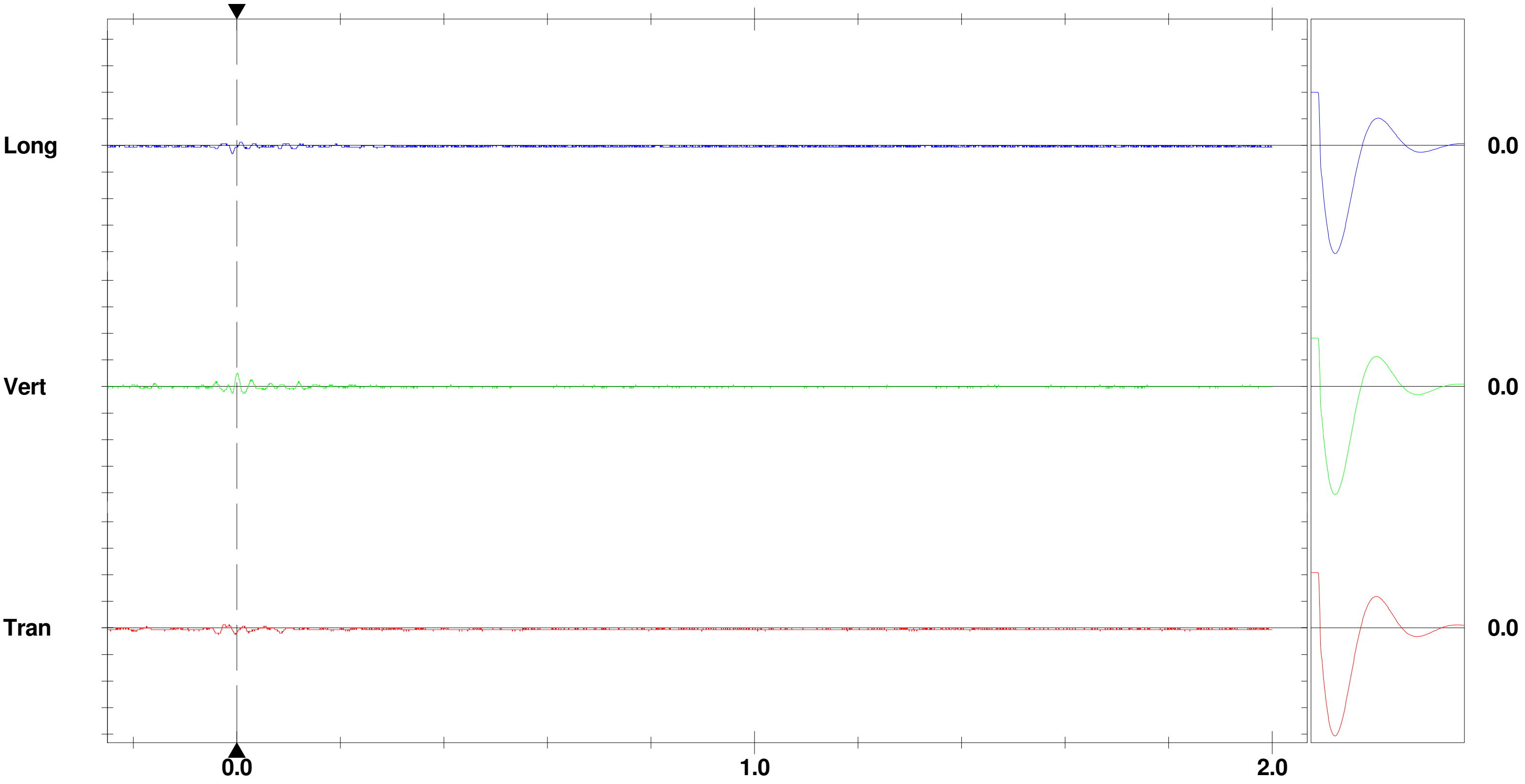
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	0.508	1.016	0.635	mm/s
ZC Freq	35	45	51	Hz
Time (Rel. to Trig)	-0.036	0.000	-0.010	sec
Peak Acceleration	0.053	0.053	0.027	g
Peak Displacement	0.002	0.004	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.3	Hz
Overswing Ratio	3.5	3.6	4.0	

Peak Vector Sum 1.092 mm/s at 0.000 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Printed: May 12, 2017 (V 10.72 - 10.72.1)

FFT Report

Date/Time	Vert at 15:00:28 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts (Battery Low)
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVLD.OS0

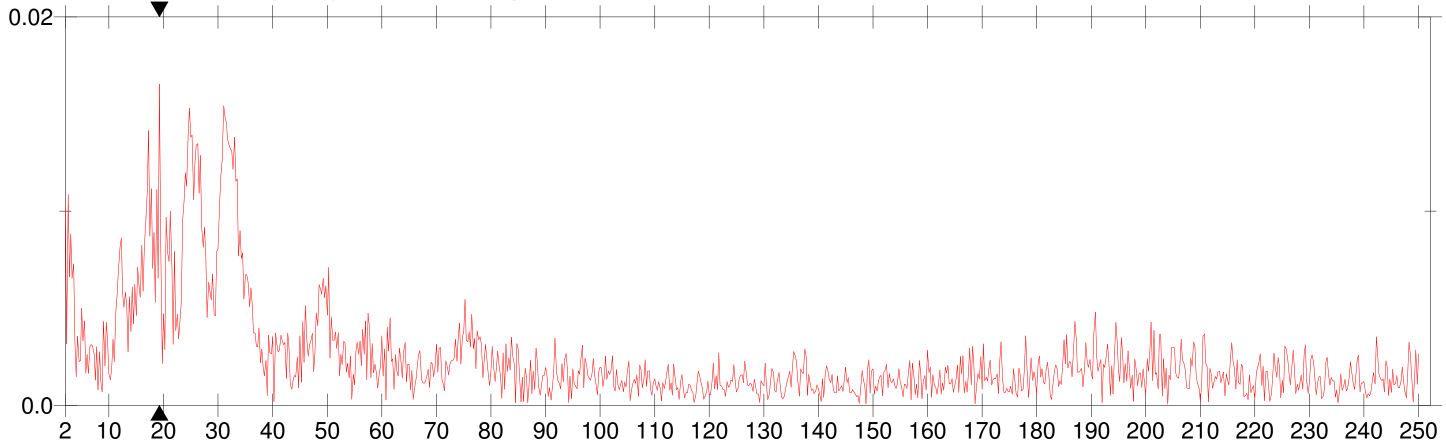
Notes

Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

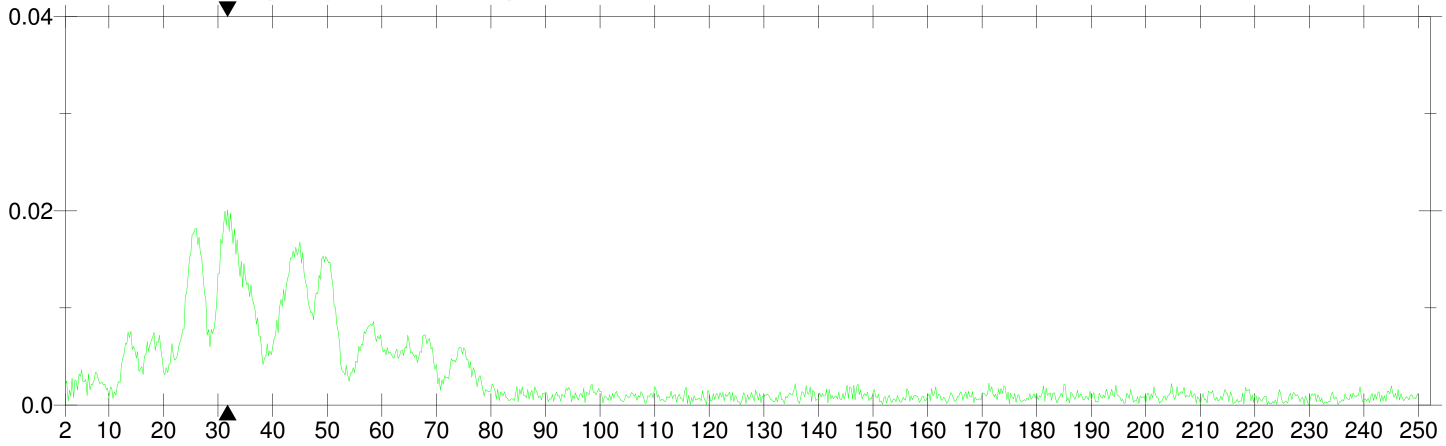
Extended Notes

Combo Mode May 4, 2017 14:34:31
Geophone secured into subgrade under sandbag.

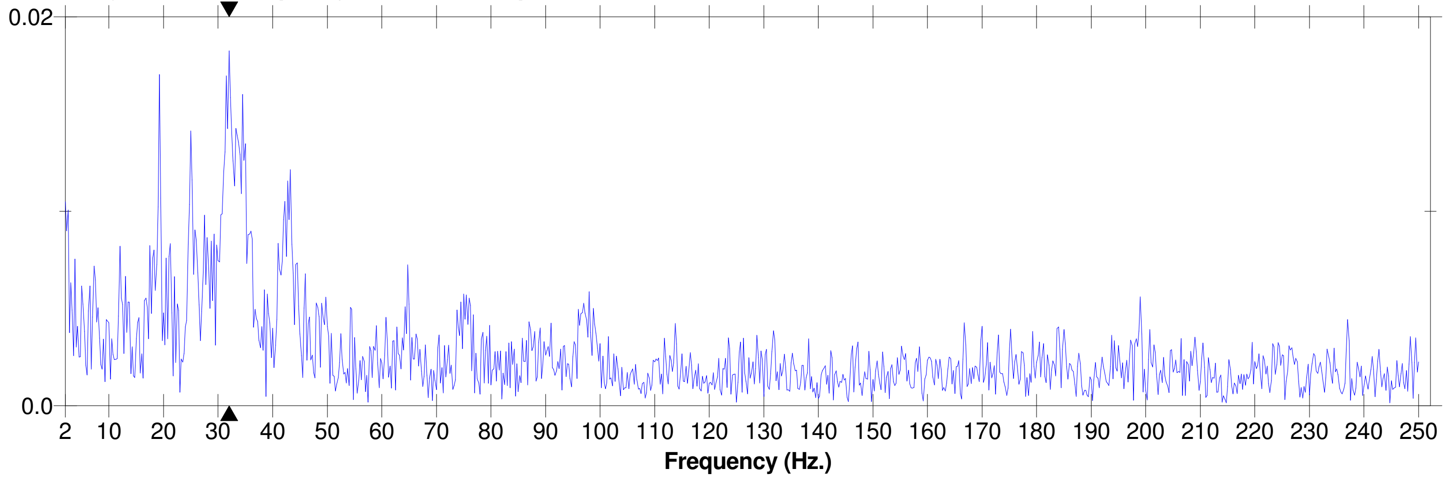
Tran Dominant Frequency = 19.25 Hz., Amplitude = 0.017, PPV from Event = 0.508 mm/s



Vert Dominant Frequency = 31.75 Hz., Amplitude = 0.020, PPV from Event = 1.016 mm/s



Long Dominant Frequency = 32.00 Hz., Amplitude = 0.018, PPV from Event = 0.635 mm/s



Instantel

Event Report

Date/Time Tran at 15:03:32 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVLD.TW0

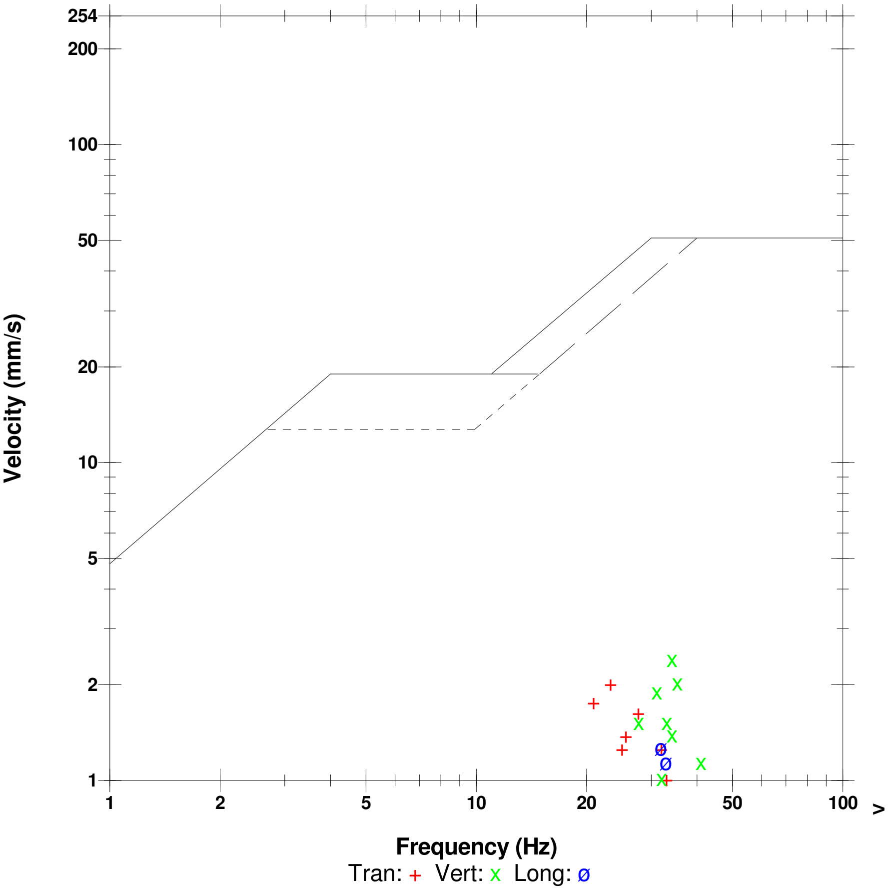
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

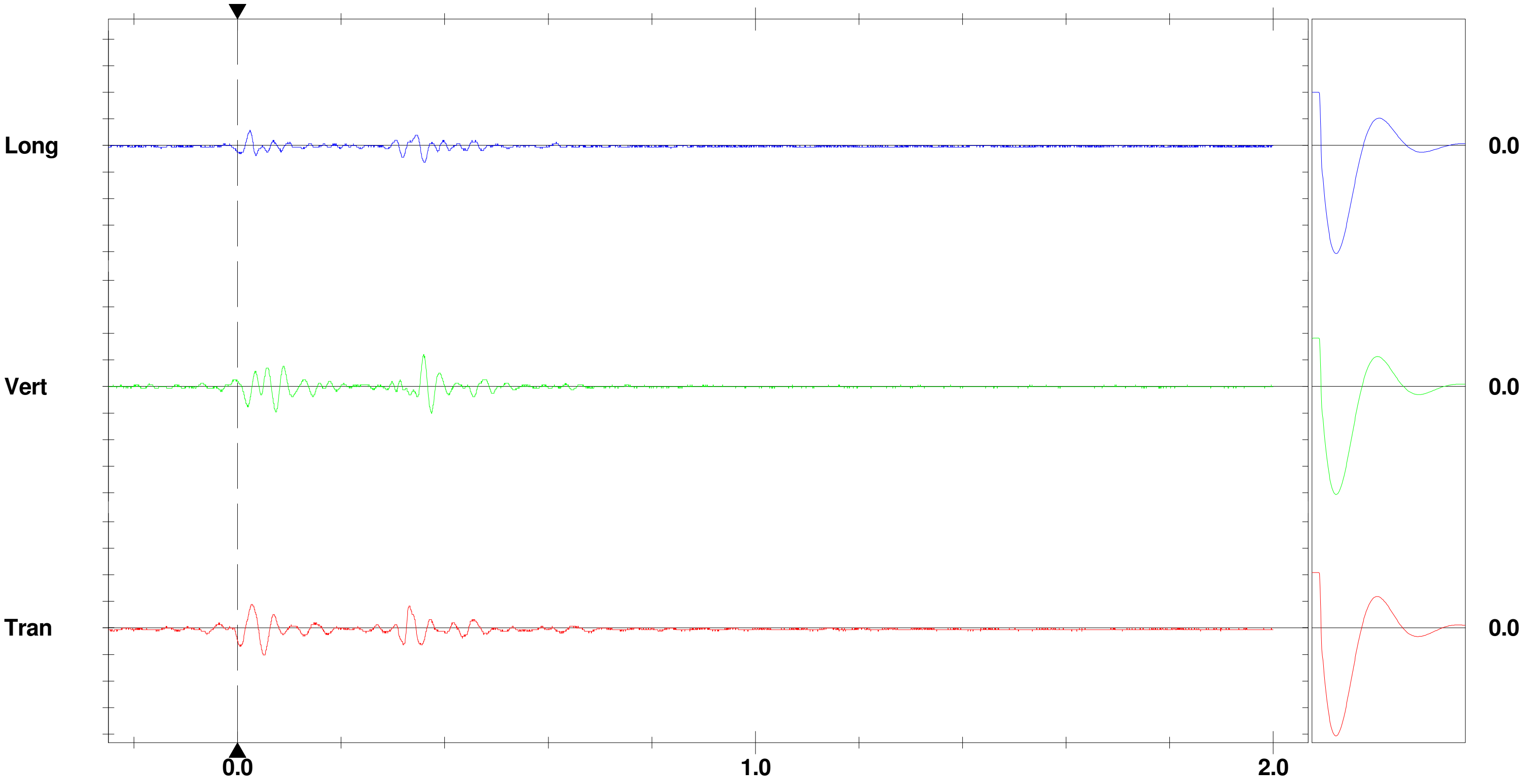
Extended Notes
Combo Mode May 4, 2017 14:34:31
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	2.032	2.413	1.270	mm/s
ZC Freq	23	34	32	Hz
Time (Rel. to Trig)	0.049	0.359	0.359	sec
Peak Acceleration	0.053	0.053	0.080	g
Peak Displacement	0.014	0.011	0.007	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.3	Hz
Overswing Ratio	3.5	3.6	4.0	

Peak Vector Sum 2.910 mm/s at 0.359 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div
Trigger = ▶——— ———◀

Sensor Check

Instantel

FFT Report

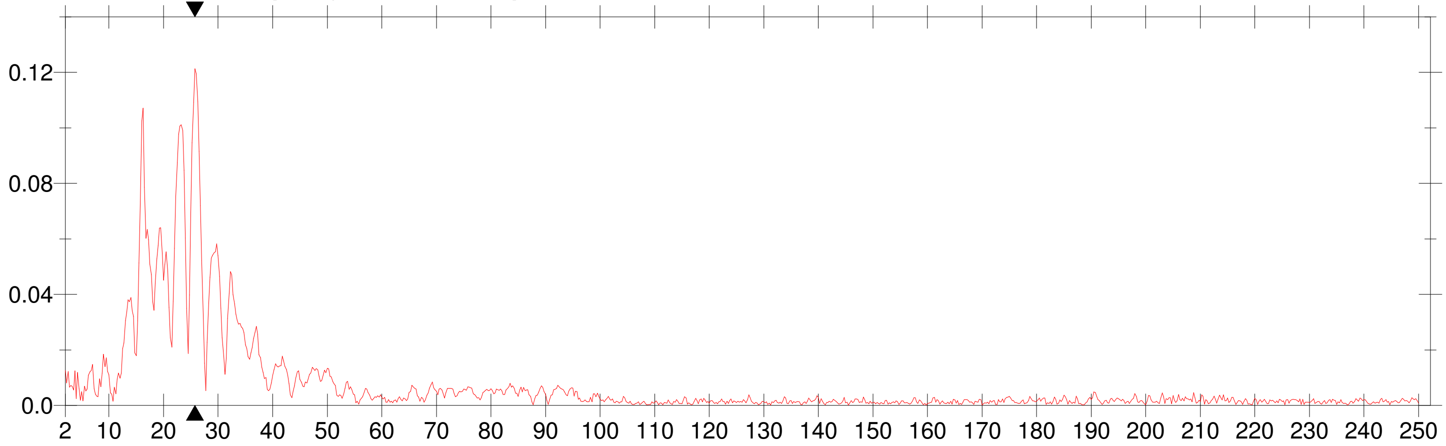
Date/Time Tran at 15:03:32 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 2.0 sec at 2048 sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVLD.TW0

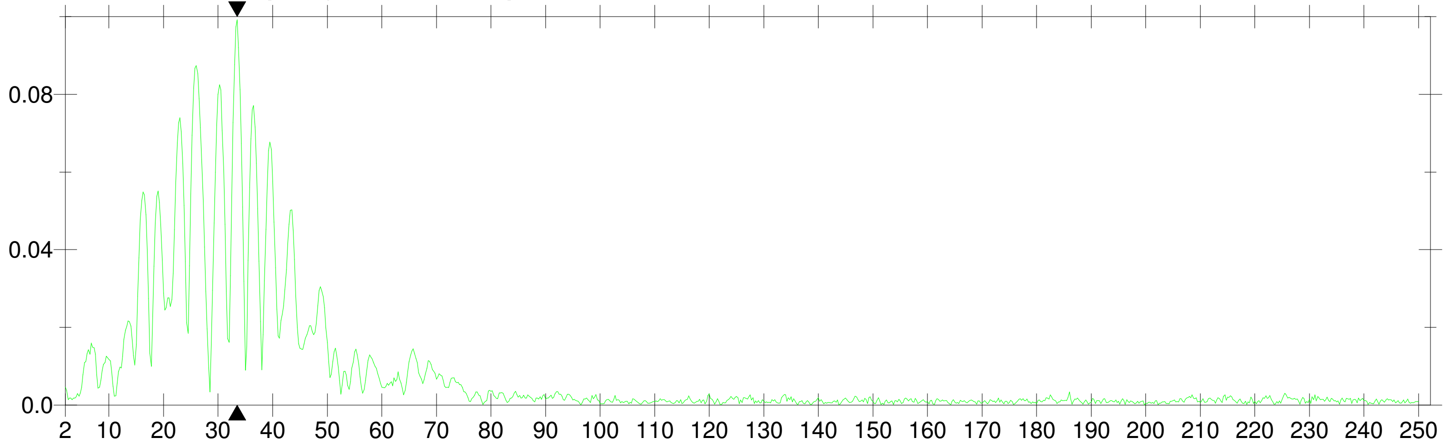
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 4, 2017 14:34:31
Geophone secured into subgrade under sandbag.

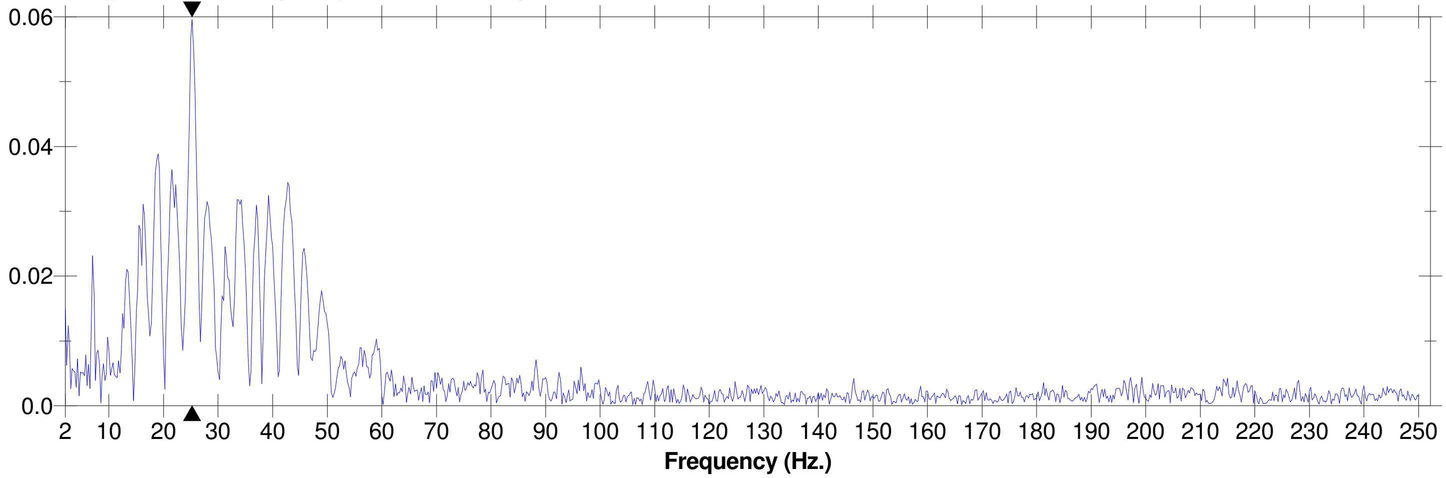
Tran Dominant Frequency = 25.75 Hz., Amplitude = 0.121, PPV from Event = 2.032 mm/s



Vert Dominant Frequency = 33.50 Hz., Amplitude = 0.099, PPV from Event = 2.413 mm/s



Long Dominant Frequency = 25.25 Hz., Amplitude = 0.060, PPV from Event = 1.270 mm/s



Instantel

Event Report

Date/Time	Long at 15:10:55 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts (Battery Low)
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVLE.670

Notes

Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

Extended Notes

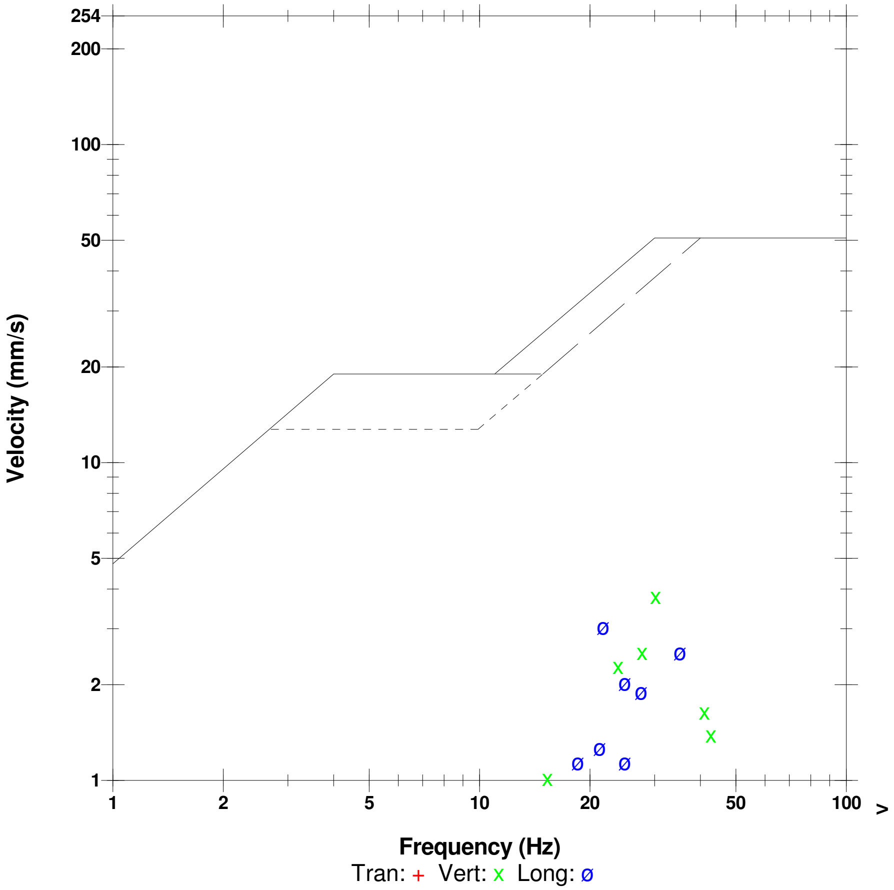
Combo Mode May 4, 2017 14:34:31

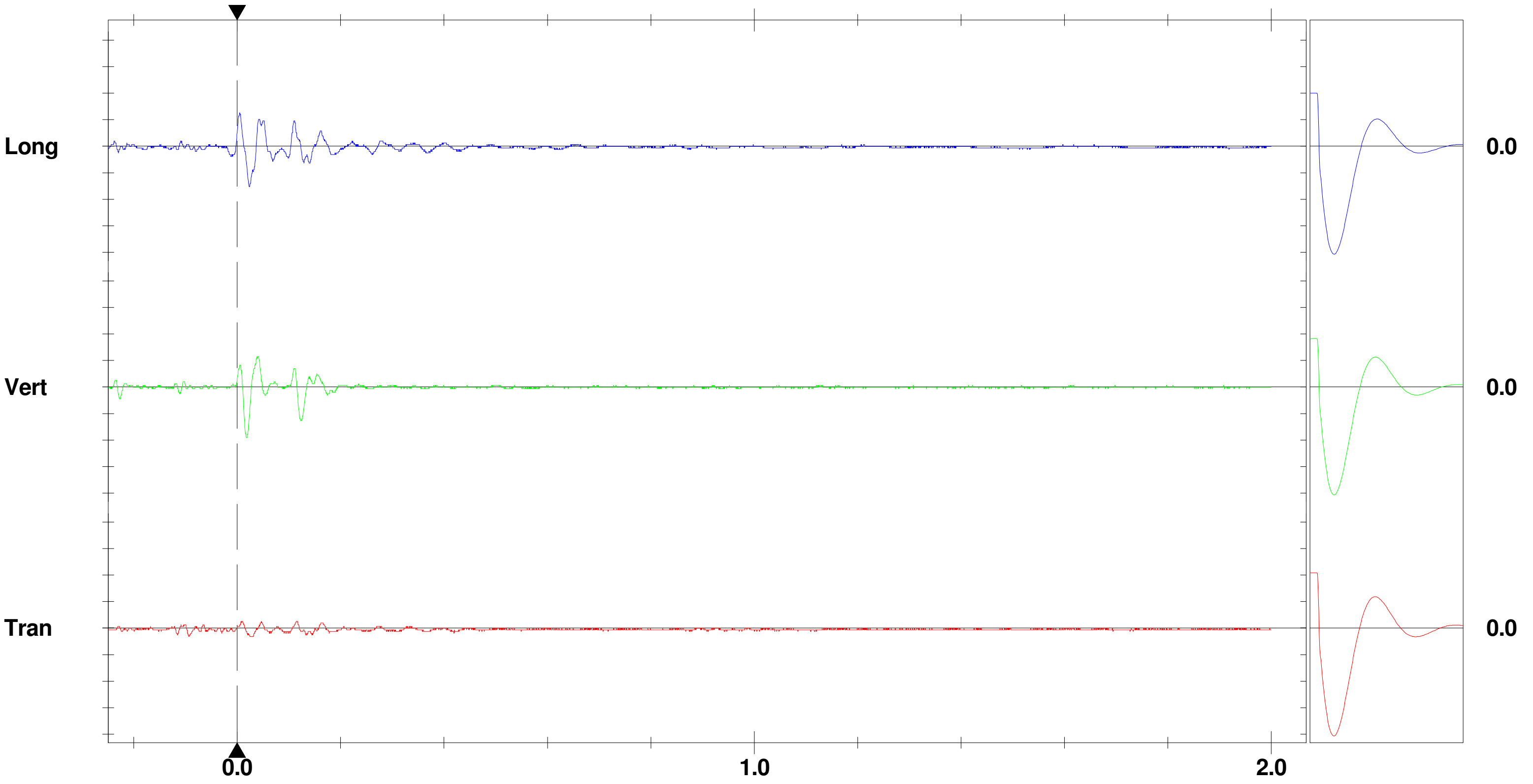
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	0.635	3.810	3.048	mm/s
ZC Freq	47	30	22	Hz
Time (Rel. to Trig)	-0.094	0.018	0.023	sec
Peak Acceleration	0.053	0.080	0.080	g
Peak Displacement	0.005	0.020	0.020	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.3	Hz
Overswing Ratio	3.5	3.6	4.0	

Peak Vector Sum 4.224 mm/s at 0.021 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Trigger = ▶——— ———◀

Sensor Check

Instantel

FFT Report

Date/Time	Long at 15:10:55 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts (Battery Low)
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVLE.670

Notes

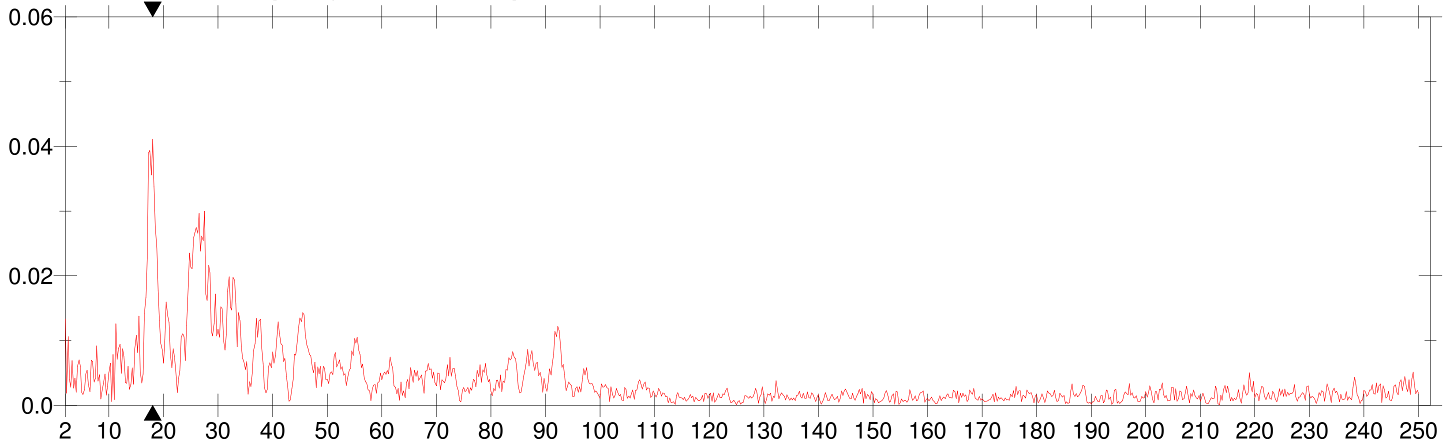
Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

Extended Notes

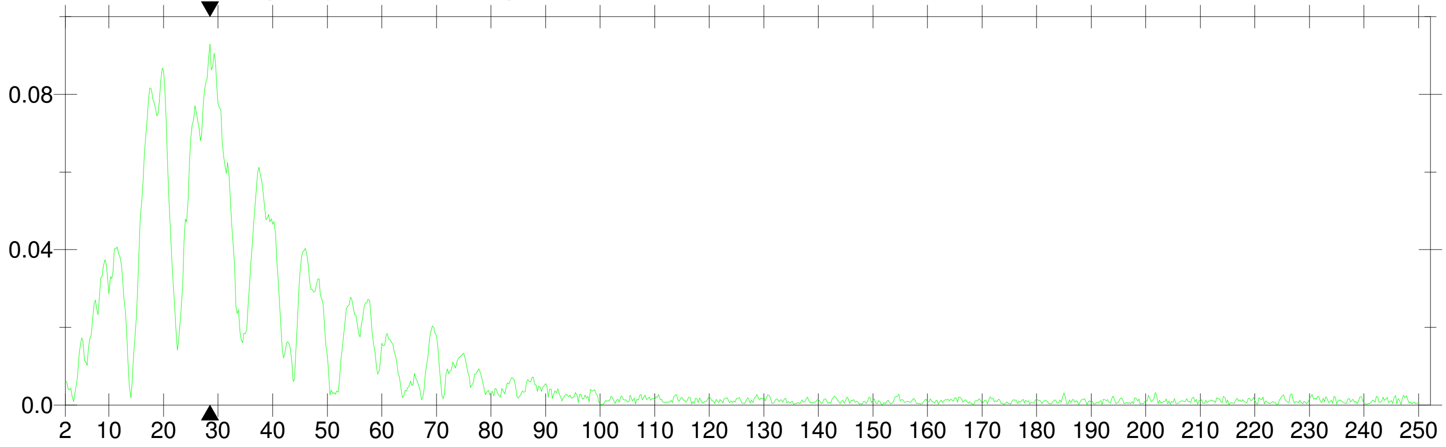
Combo Mode May 4, 2017 14:34:31

Geophone secured into subgrade under sandbag.

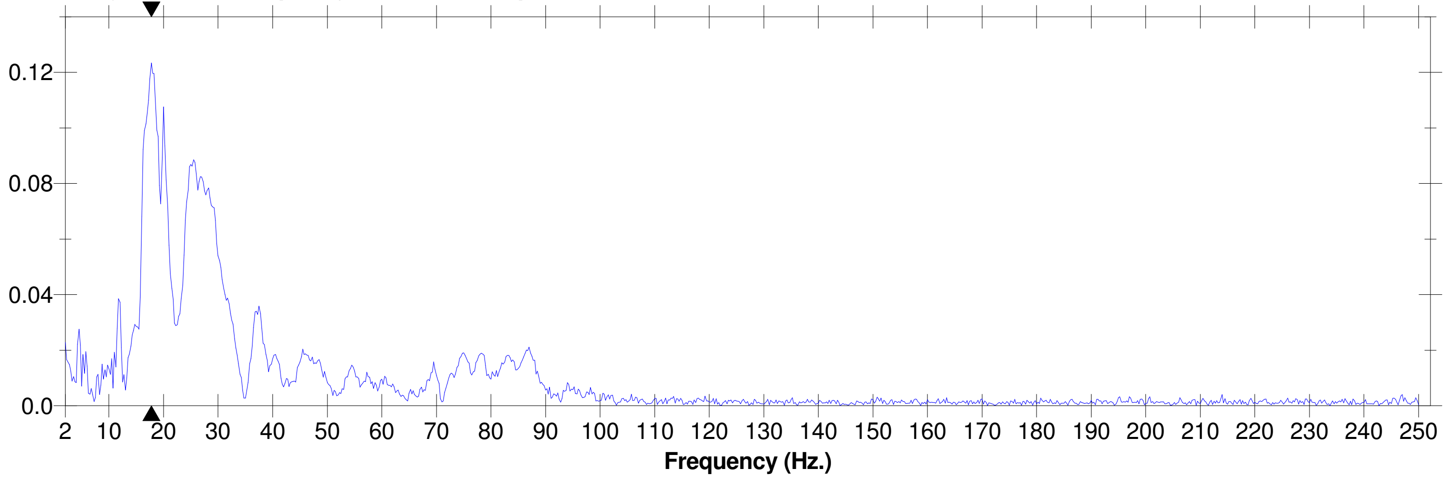
Tran Dominant Frequency = 18.00 Hz., Amplitude = 0.041, PPV from Event = 0.635 mm/s



Vert Dominant Frequency = 28.50 Hz., Amplitude = 0.093, PPV from Event = 3.810 mm/s



Long Dominant Frequency = 17.75 Hz., Amplitude = 0.123, PPV from Event = 3.048 mm/s



Printed: May 12, 2017 (V 10.72 - 10.72.1)

Instantel

Event Report

Date/Time	Long at 15:10:58 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts (Battery Low)
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVLE.6A0

Notes

Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

Extended Notes

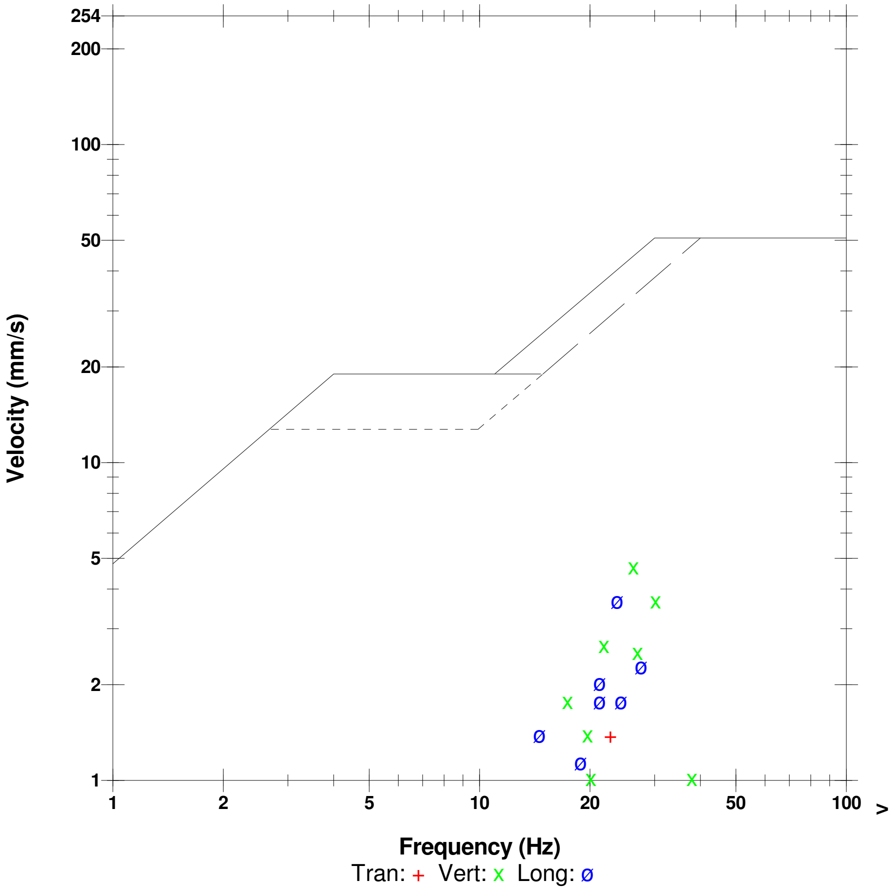
Combo Mode May 4, 2017 14:34:31

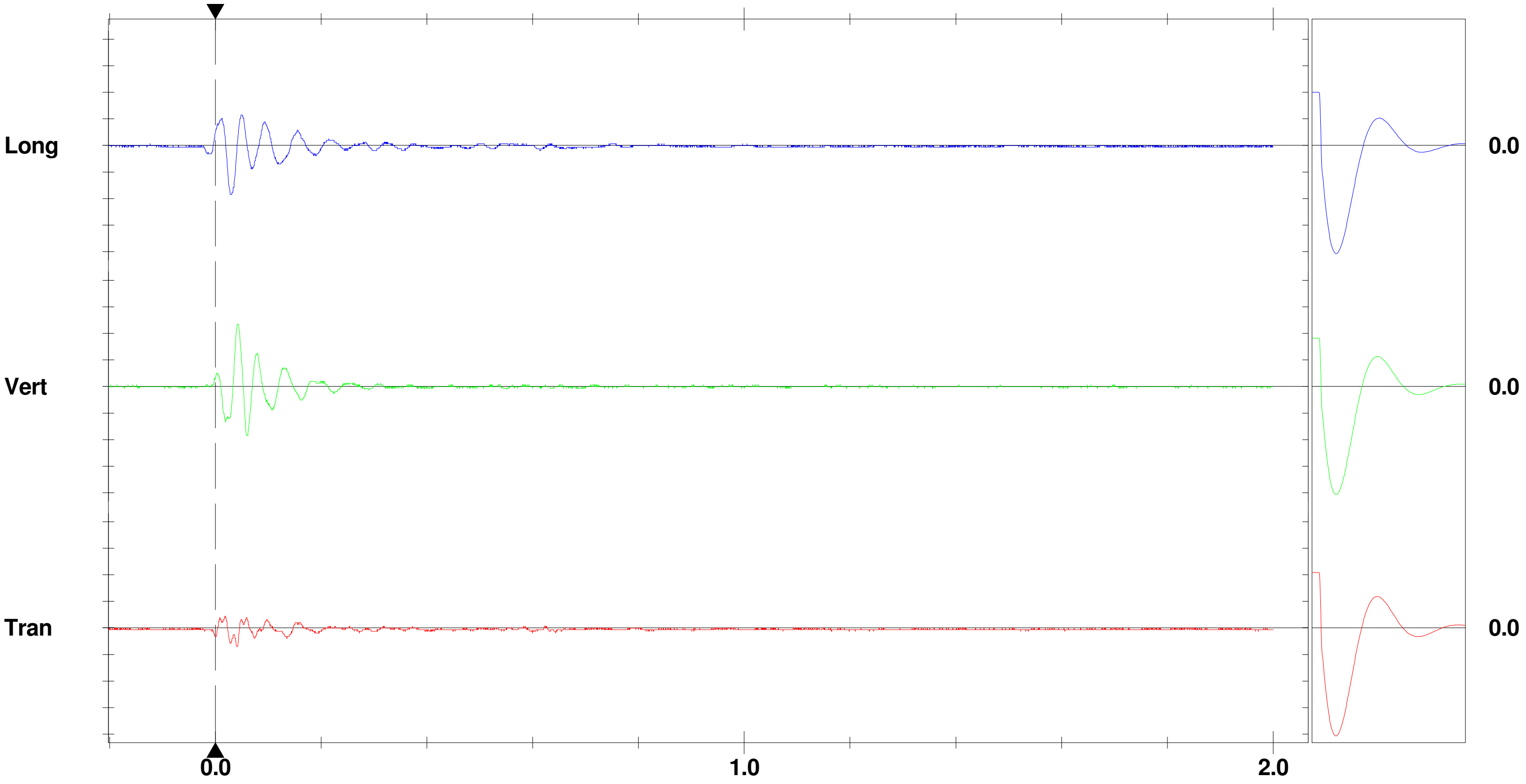
Geophone secured into subgrade under sandbag.

	Tran	Vert	Long	
PPV	1.397	4.699	3.683	mm/s
ZC Freq	23	26	24	Hz
Time (Rel. to Trig)	0.040	0.042	0.028	sec
Peak Acceleration	0.053	0.106	0.080	g
Peak Displacement	0.009	0.028	0.026	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.3	Hz
Overswing Ratio	3.5	3.6	4.0	

Peak Vector Sum 4.909 mm/s at 0.042 sec

USBM RI8507 And OSMRE





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Sensor Check

Trigger = ►——— ———◄

FFT Report

Date/Time	Long at 15:10:58 May 4, 2017
Trigger Source	Geo: 1.000 mm/s
Range	Geo: 254.0 mm/s
Record Time	2.0 sec at 2048 sps

Serial Number	BE8720 V 10.72-8.17 MiniMate Plus
Battery Level	5.9 Volts (Battery Low)
Unit Calibration	March 13, 2017 by Instantel
File Name	J720GVLE.6A0

Notes

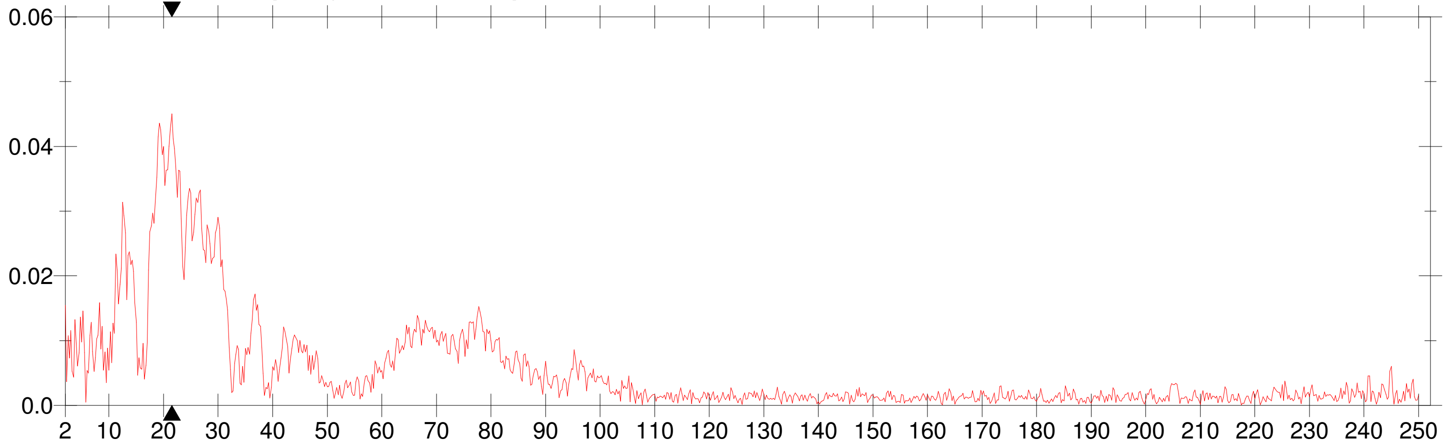
Location:	T5
Client:	Pattern
User Name:	Golder Associates Ltd.
General:	3m,1668031

Extended Notes

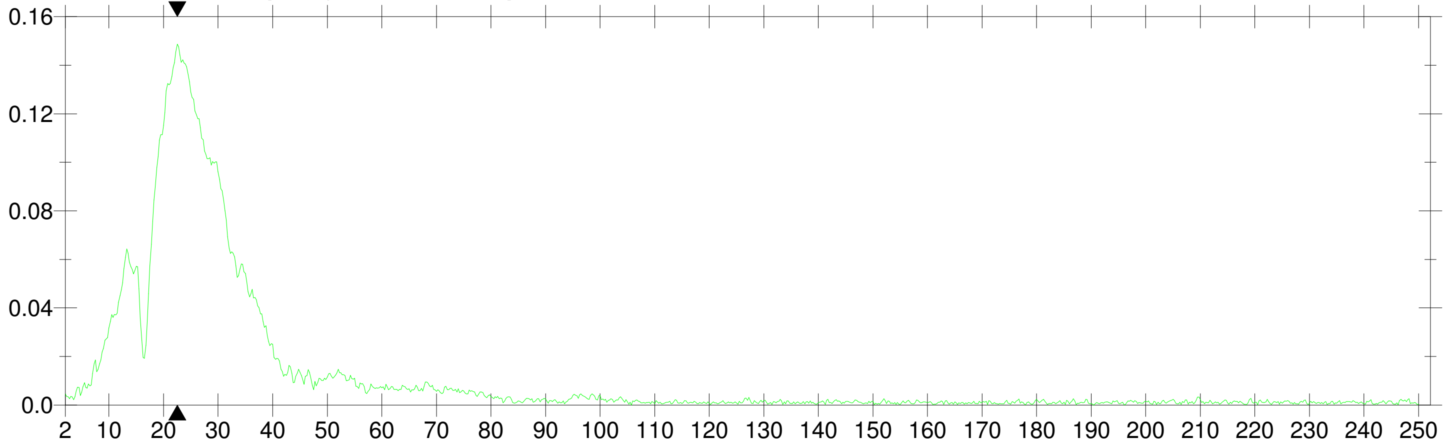
Combo Mode May 4, 2017 14:34:31

Geophone secured into subgrade under sandbag.

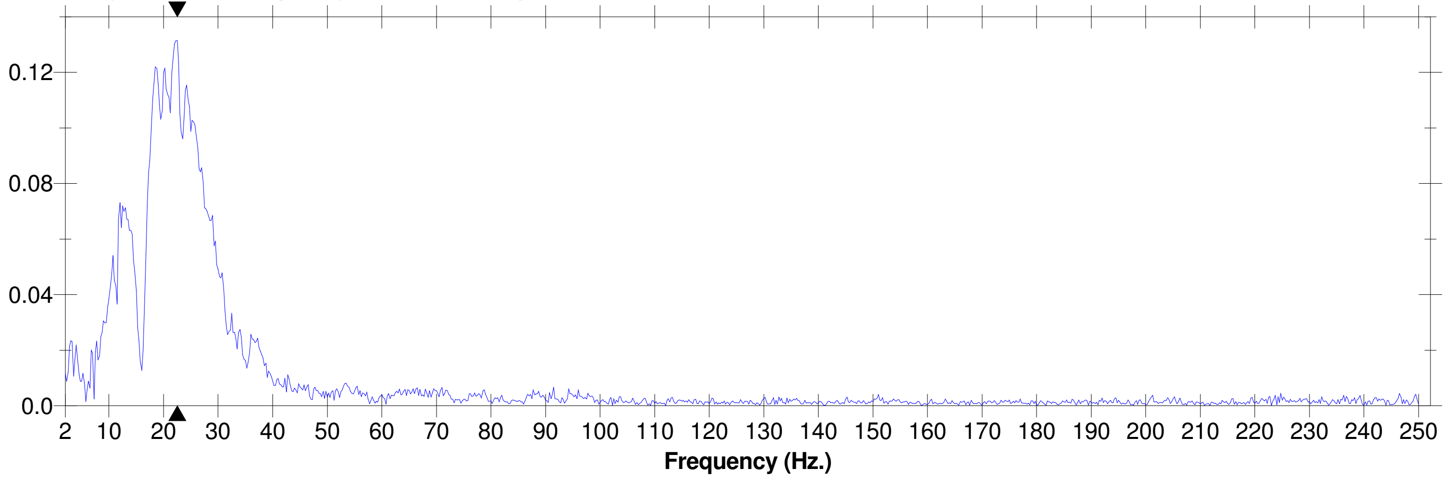
Tran Dominant Frequency = 21.50 Hz., Amplitude = 0.045, PPV from Event = 1.397 mm/s



Vert Dominant Frequency = 22.50 Hz., Amplitude = 0.149, PPV from Event = 4.699 mm/s



Long Dominant Frequency = 22.50 Hz., Amplitude = 0.131, PPV from Event = 3.683 mm/s



Instantel

Event Report

Date/Time Vert at 15:13:47 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 1.607 sec at 2048 sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVLE.AZ0

Notes

Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes

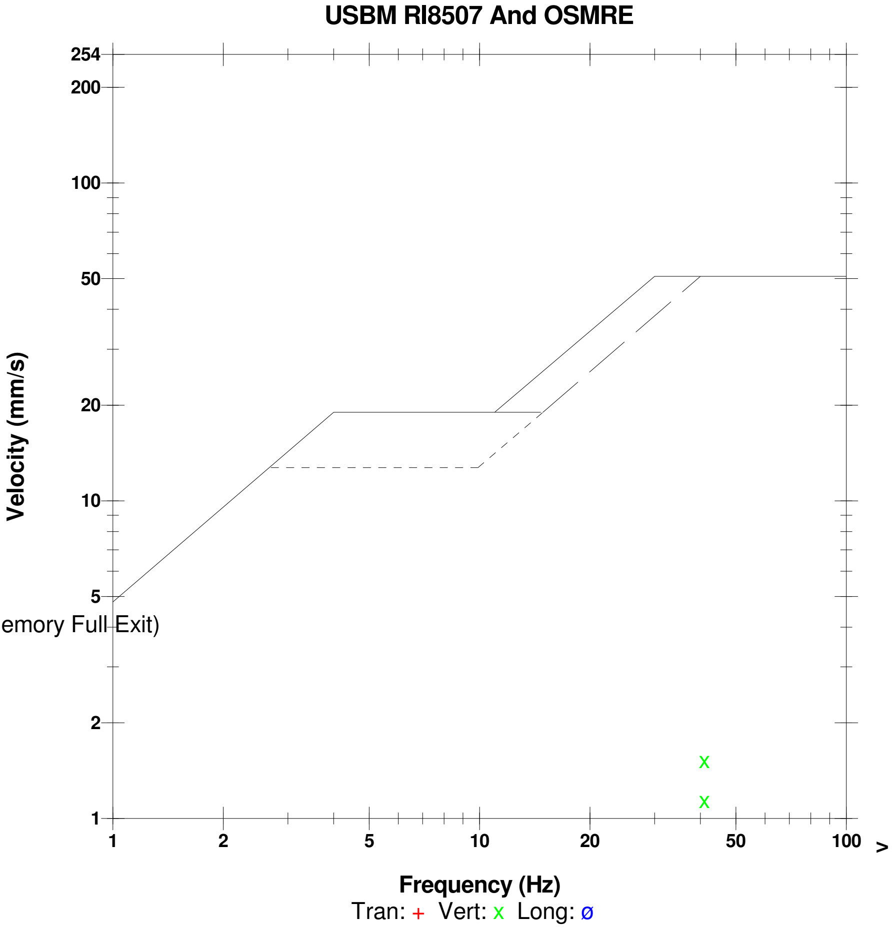
Combo Mode May 4, 2017 14:34:31
Geophone secured into subgrade under sandbag.

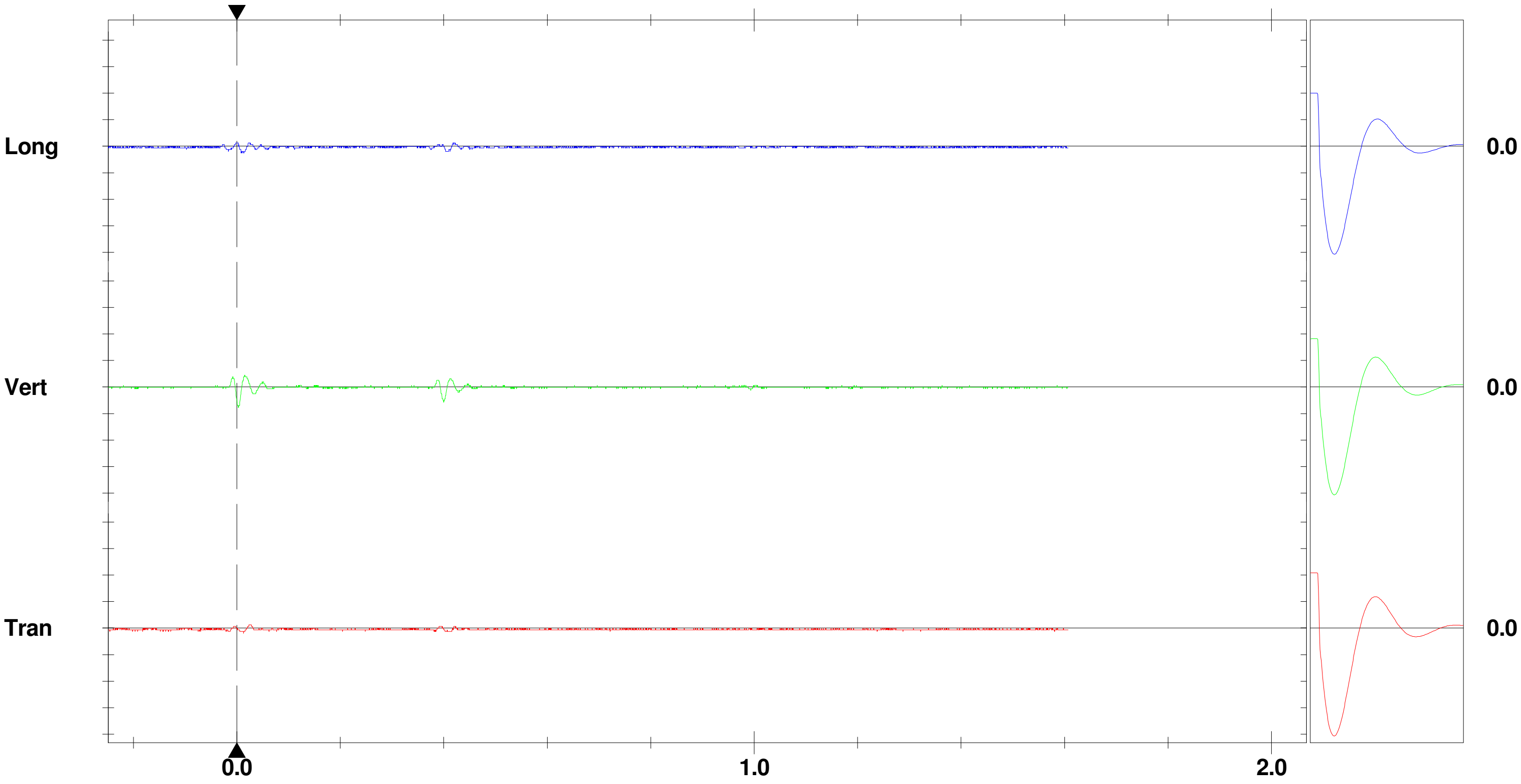
	Tran	Vert	Long	
PPV	0.381	1.524	0.508	mm/s
ZC Freq	45	41	39	Hz
Time (Rel. to Trig)	0.013	0.002	0.008	sec
Peak Acceleration	0.053	0.053	0.027	g
Peak Displacement	0.001	0.006	0.002	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.6	7.3	Hz
Overswing Ratio	3.5	3.6	4.0	

Peak Vector Sum 1.550 mm/s at 0.002 sec

Monitor Log

May 4 /17 15:13:47 May 4 /17 15:13:49 Event recorded. (Memory Full Exit)





Time Scale: 0.20 sec/div **Amplitude Scale:** Geo: 2.000 mm/s/div

Trigger = ▶—— ——◀

Sensor Check

Instantel

FFT Report

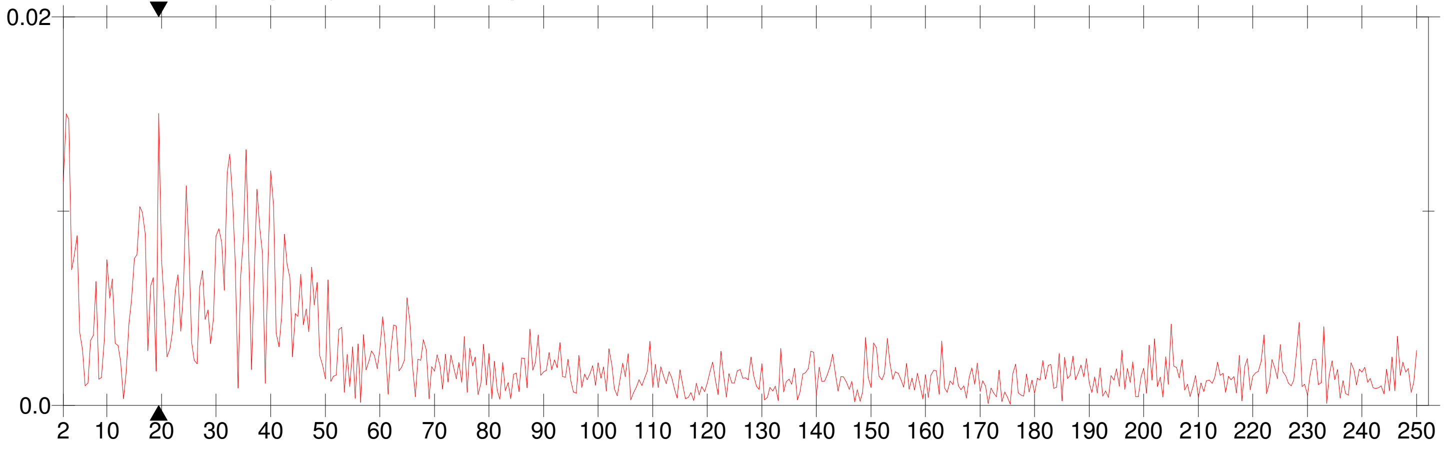
Date/Time Vert at 15:13:47 May 4, 2017
Trigger Source Geo: 1.000 mm/s
Range Geo: 254.0 mm/s
Record Time 1.607 sec at 2048 sps

Serial Number BE8720 V 10.72-8.17 MiniMate Plus
Battery Level 5.9 Volts (Battery Low)
Unit Calibration March 13, 2017 by Instantel
File Name J720GVLE.AZ0

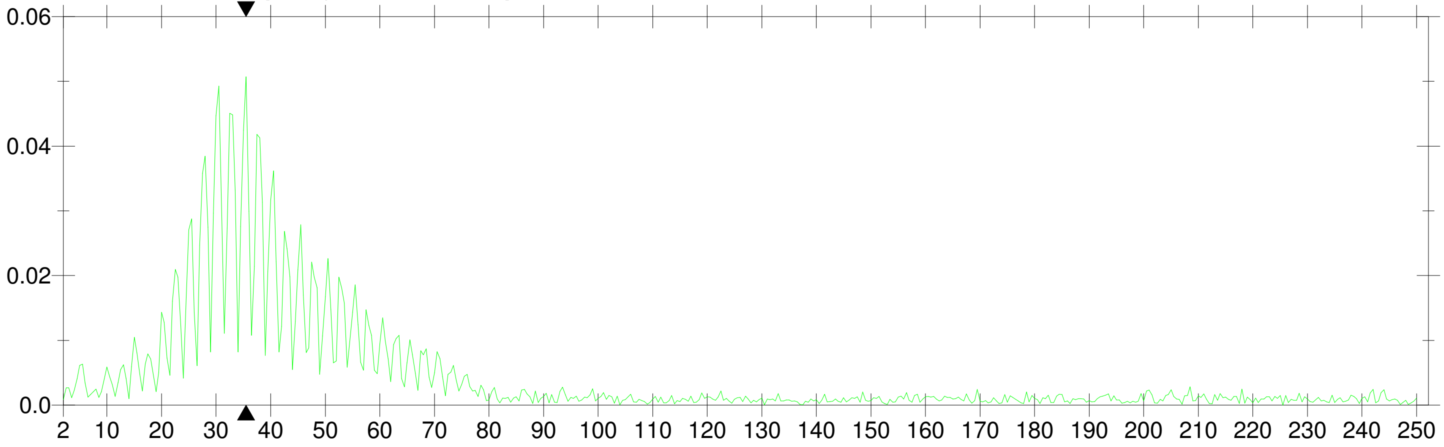
Notes
Location: T5
Client: Pattern
User Name: Golder Associates Ltd.
General: 3m,1668031

Extended Notes
Combo Mode May 4, 2017 14:34:31
Geophone secured into subgrade under sandbag.

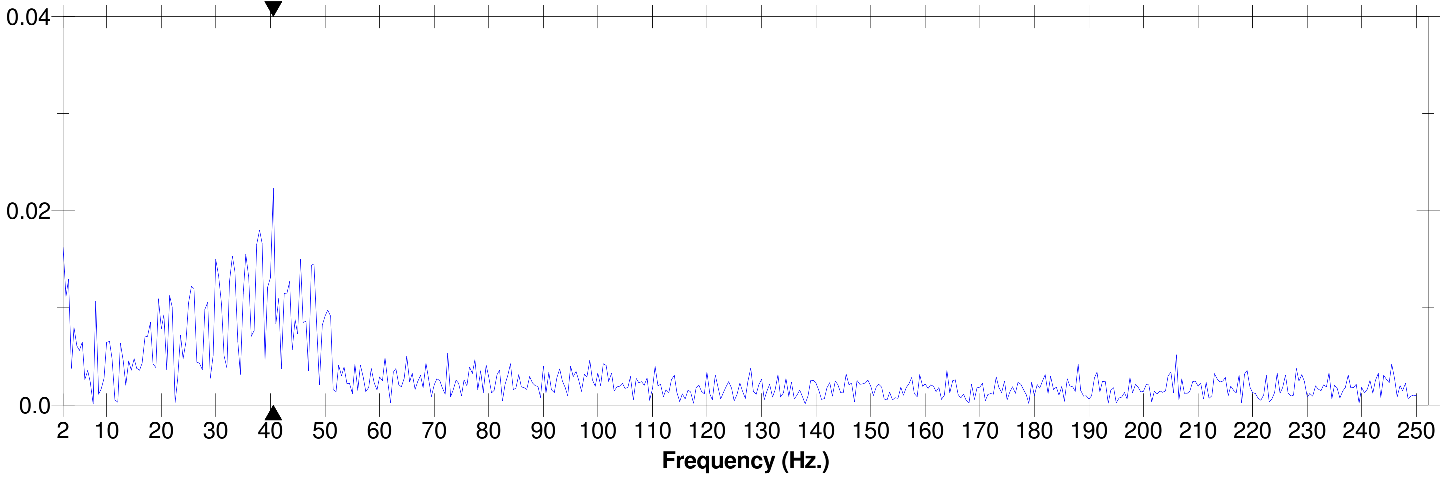
Tran Dominant Frequency = 19.50 Hz., Amplitude = 0.015, PPV from Event = 0.381 mm/s



Vert Dominant Frequency = 35.50 Hz., Amplitude = 0.051, PPV from Event = 1.524 mm/s



Long Dominant Frequency = 40.50 Hz., Amplitude = 0.022, PPV from Event = 0.508 mm/s



APPENDIX I

Example Data Analyses

EXAMPLE VIBRATION ANALYSES

As described in the report text, ground vibrations induced by impact pile driving are transient waveforms induced by the hammer energy delivered to ground through the pile. In this case, the same source and similar energy was used for each pile strike impulse event. Ground vibrations were monitored using accelerometers. Within the resulting time history of vibration data, acceleration values from pile driving dominate accelerometer response and were many orders of magnitude larger (e.g., 500 times) than background vibrations and system signal noise. The monitored ground vibrations at the domestic water wells were also transient waveforms induced by different sources such as passing traffic, walking or jumping pedestrians (in the case of Golder personnel deliberately inducing vibrations), passing farm equipment, activities within the nearby homes or outbuildings, and wind on the well casing, sensors and cables among other background conditions. The measured acceleration values from day-to-day activities and the induced vibrations at the well locations were extremely small and much nearer the magnitude of background vibrations and signal noise (i.e., 2 to 10 times background). Multiple examples of data analysis are provided in this appendix to illustrate evaluation of:

- acceleration data time histories;
- transformation of acceleration time histories to frequency spectra through the fast Fourier transform (FFT) process;
- transformation/integration of the acceleration-frequency spectra to velocity spectra; and
- selection of the maximum particle velocities for any given time period of analysis.

An overall description of each one of these evaluation steps types is provided below for additional context, followed by an annotated list for the examples providing notes for reviewing the provided graphics. The figures provided in this appendix are numbered consistent with the examples as numbered. When examples or results summaries have been already provided in the report text and additional figures are not included, these figure numbers are omitted.

Discrete vibration events (e.g., pile driving, jumping up and down) were clearly discernable in time histories of measured acceleration data. The vibration events associated with pile driving in this case exhibited a waveform amplitude that increased suddenly then diminished over short periods of time (less than 1 second in most cases) to near background values. As described in the report text, each individual pile strike event was evaluated separately where the block of the time history subject to FFT and velocity analysis was picked to be coincident with the start of the impulse as illustrated by Figure 4 in the report body for several instruments installed within the bedrock at the T42 site. An example acceleration time history overview for Well #1 on the 28th of March, 2017 is provided in Figure I-0 in this appendix (following text). For the specific examples provided in this appendix, acceleration time history data was also clipped and shown at scale ranges adjusted to better illustrate the waveforms for each of the examples.

The clearest demonstration of the relative magnitudes of vibration amplitudes associated with different conditions and distances from the test pile driving are the maximum accelerations measured during any given event and at any given location. Acceleration time histories provided in this appendix illustrate these relative acceleration magnitudes as measured in the field at the test pile and well sites. The acceleration time history and magnitude examples do not include ambiguities, artefacts of data processing or any interpretation. In these cases, whatever background vibrations or electronic signal noise that might be within the data is also included within the measured acceleration values as presented.

To illustrate the relative magnitudes of vibrations measured during test pile monitoring, Table I-1, below summarizes the approximate maximum acceleration values for specific cases that are included either in the body of the report (e.g., Figure 4) or in this appendix. The accelerometers used in the field returned voltage readings when exposed to vibrations. These voltage readings then correlated to specific rated scales of the gravitational acceleration constant for earth, *g* (9.81 m/s^2) for each accelerometer (see Appendix F). Example measured acceleration values are provided in Table I-1, presented in millimetres per second squared (mm/s^2) for ease of comparison. Table I-0 also includes a factor F which represents measured acceleration values for different conditions divided by the values measured during the quiet site period at Well #1 on March 28, 2017. This table and the associated examples demonstrate that the pile driving vibrations in the bedrock within close proximity to the test pile were more than 500 times the quiet site values. At the well locations other activities such as driving a van in the driveway, resting a vibrating cell phone on the well casing lid, and walking or jumping near the well caused acceleration magnitudes significantly greater than those induced by pile driving.

It should be noted that multiple factors can affect background vibration conditions and background vibration amplitudes should be expected to be variable at any time on any day. For example, the influence of road traffic passing the site will be influenced by factors including the direction of travel, numbers of vehicles passing the site at any given time interval, vehicle speed, vehicle weight, tire pressures, number of tires spacing of axels in the direction of travel and discontinuities in the road at the time of the vehicle travel. Environmental conditions and background vibration levels of uncertain origin also vary. Many of the measured results are extremely small values of peak particle velocity (one to two or more orders of magnitude below thresholds for human perception) and some of the measurement signals at very small amplitudes can be dominated by background vibrations, electronic signal noise, and environmental influences.

Table 1: Summary of Acceleration Magnitudes for Calculation Examples

Example Number	Example Condition	Approximate Acceleration Magnitude (mm/s^2)		F
		Negative	Positive	
1	Borehole BH101 (Rock) - During Pile Driving on March 29, 2017 (see Figure 4)	-5236	4232	567
2	Borehole BH102 (Rock) - During Pile Driving on March 29, 2017 (see Figure 4)	-1470	1280	167
3	Borehole BH103 (Rock) - During Pile Driving on March 29, 2017 (see Figure 4)	-301	299	36
4	Well #1, Quiet Period, March 28, 2017	-8	9	1
5	Well #1, Jumping at 0.9 m from Well, March 28, 2017	-29	65	6

Example Number	Example Condition	Approximate Acceleration Magnitude (mm/s^2)		F
		Negative	Positive	
6	Well #1, Jumping at 1.8 m from Well, March 28, 2017	-42	40	5
7	Well #1, Jumping at 2.7 m from Well, March 28, 2017	-29	25	3
8	Well #1, Approaching Well, March 28, 2017	-4	5	1
9	Well #1, Approaching Well, March 28, 2017	-19	16	2
10	Well #1, Cell Phone Vibrating on Well Lid, March 28, 2017	-15	16	2
11	Well #1, Walking on Porch, March 28, 2017	-9	9	1
12	Well #1, Van on Driveway, March 28, 2017	-5	6	1
13	Well #3, Identified Pile Driving Impulses, May 3, 2017	-2	2	0
14	Well #3, Jumping 1.0 m Well, May 3, 2017	-20	20	2
15A	T42, Borehole BH-103, March 23, 2017, Quiet Site	-0.2	0.5	
15B	T42, Borehole BH-103, March 23, 2017, Vacuum Truck	-0.7	0.9	

As described in the report text, the Fast Fourier Transformation (FFT) process was used to transform data from the acceleration-time domain to acceleration-frequency domain to permit subsequent integration to velocity spectra. Each of the examples dbelow includes a series of graphs illustrating various aspects of the signal analysis, processing and final results, except as noted with cross-reference to information already presented in the body of the report or the associated figures. As noted previously, the appendix figures are numbered consistent with the example numbers and, where the examples do not include additional figures, the representative numbers are omitted.

1) Borehole BH101 (Rock) - During Pile Driving

See Figure 4 and discussion in body of report

2) Borehole BH102 (Rock) - During Pile Driving

See Figure 4 and discussion in body of report

3) Borehole BH103 (Rock) - During Pile Driving

See Figure 4 and discussion in body of report

4) Well #1, Quiet Period, March 28, 2017

Figure I-4A illustrates a specific time segment (detail) from the overall Well #1 time history illustrated in Figure I-0 with the vertical and horizontal scales adjusted to better illustrate the signal in this region of the time history. Figure I-4B illustrates the acceleration FFT for a series of one-second intervals within this specific time period. Figure I-4C depicts the subsequent velocity spectra and the maxima selected from these same spectra.

5) Well #1, Jumping at 0.9 m from Well, March 28, 2017

Figure I-5A illustrates a specific time segment (detail) from the overall Well #1 time history illustrated in Figure I-0 with the vertical and horizontal scales adjusted to better illustrate the signal in this region of the time history. Figure I-5B illustrates the acceleration FFT for the series of jump instances and intervals between these instances as reported in Table 15 of the report. Figure I-7 depicts the subsequent velocity spectra.

6) Well #1, Jumping at 1.8 m from Well, March 28, 2017

Figure I-6A illustrates a specific time segment (detail) from the overall Well #1 time history illustrated in Figure I-0 with the vertical and horizontal scales adjusted to better illustrate the signal in this region of the time history. Figures I-6B and I-6C illustrate the FFT and velocity analyses of the data generated by jumping at a distance of 1.8 m from the well.

7) Well #1, Jumping at 2.7 m from Well, March 28, 2017

Figure I-7A illustrates a specific time segment (detail) from the overall Well #1 time history illustrated in Figure I-0 with the vertical and horizontal scales adjusted to better illustrate the signal in this region of the time history. Figures I-7B and I-7C illustrate the FFT and velocity analyses of the data generated by jumping at a distance of 2.7 m from the well.

8) Well #1, Approaching Well, March 28, 2017

Figure I-8A illustrates a specific time segment (detail) from the overall Well #1 time history illustrated in Figure I-0 with the vertical and horizontal scales adjusted to better illustrate the signal in this region of the time history. Figures I-8B and I-8C illustrate the series of FFT and velocity analyses of sequential one-second intervals during the footfalls as a Golder employee walked toward the well during the monitoring period.

9) Well #1, Approaching Well, March 28, 2017

See analysis results as presented in Table 15 in body of the report for a composite set of footfalls and time history that produced larger acceleration readings through the FFT process.

10) Well #1, Cell Phone Vibrating on Well Lid, March 28, 2017

Cell phone vibrations were induced by a source with a known vibration pulsation frequency and consistent amplitude. This very minor source could be directly identified and is one of the more clearly distinguishable deliberately-induced conditions. Figure I-10A illustrates a specific time segment (detail) from the overall Well #1 time history illustrated in Figure I-0 with the vertical and horizontal scales adjusted to better illustrate the signal in this region of the time history. Figures I-10B and I-10C illustrate the FFT and velocity analyses for the period of time during which the cell phone was ringing.

11) Well #1, Walking on Porch, March 28, 2017

Figure I-11A illustrates a specific time segment (detail) from the overall Well #1 time history illustrated in Figure I-0 with the vertical and horizontal scales adjusted to better illustrate the signal in this region of the time history. Figures I-11B and I-11C illustrate the FFT and velocity analyses the footfalls as an individual walked up the steps, rang the residence doorbell and descended the steps during the monitoring period.

12) Well #1, Van on Driveway, March 28, 2017

Figure I-12A illustrates a specific time segment (detail) from the overall Well #1 time history illustrated in Figure I-0 with the vertical and horizontal scales adjusted to better illustrate the signal in this region of the time history. Figures I-12B and I-12C illustrate the series of FFT and velocity analyses of sequential one-second intervals during the time a Golder employee drove a light utility van from the northern end of the driveway to the road and back to the well during the monitoring period.

13) Well #3, Identified Pile Driving Impulses, May 3, 2017

Figure I-13A illustrates a time history of accelerometer voltage data from all three accelerometers mounted on Well #3 located 911 metres from the T5 test pile site. In this and similar images, the top graph represents data from the vertically-oriented instrument, the middle graph represents the accelerometer oriented in the longitudinal direction toward the test pile, and the bottom presents data from the instrument oriented perpendicular to the longitudinal accelerometer (i.e., transverse direction). In this particular case, the accelerometer is calibrated to 1 *g* per 1000 millivolts, or 1 g per volt. This time history includes a period during which pile driving impulses could be discerned against a very low-noise background signal. This time history also includes a period during which a Golder employee jumped at a distance of 1.0 m from the well. Within this time history, the pile driving related impulses were detected near first 1/3 distance along the history and the vibrations induced by an employee jumping on the ground are near the end of this time history as illustrated in Figures I-13B and I-13C.

Figure I-13D illustrates a specific time segment (detail) from the Well #3 time history associated with pile driving as illustrated in Figures I-13A and I-13B with the vertical and horizontal scales adjusted to better illustrate the signal in this region of the time history. Figures I-13E and I-13F illustrate examples of FFT and velocity analyses associated with the pile driving impulses.

14) Well #3, Jumping 1.0 m Well, May 3, 2017

Figure I-14A illustrates a specific time segment (detail) from the Well #3 time history illustrated in Figure I-13A and I-13C with the vertical and horizontal scales adjusted to better illustrate the signal in this region of the time history. Figures I-14B and I-14C illustrate the series of FFT and velocity analyses associated with the individual impulses associated with each of the three jumping actions and intervening time periods.

15) T42 Site, March 23, 2017

Figures I-15A illustrates example acceleration data obtained during a quiet period on the T42 test site on March 23, 2017 in the absence of any site activities, without traffic on the nearby roadway and during optimum weather conditions. As summarized in the report text the particle velocity during this period, as evaluated from the most sensitive uniaxial accelerometer data, was about 0.0029 mm/s. Figures I-15B illustrates example acceleration data obtained during a time period on the T42 test site on March 23, 2017 when the vacuum truck was backing up slowly along the wooden mats and the particle velocity for this activity was about 0.0033 mm/s using data from the uniaxial accelerometer.

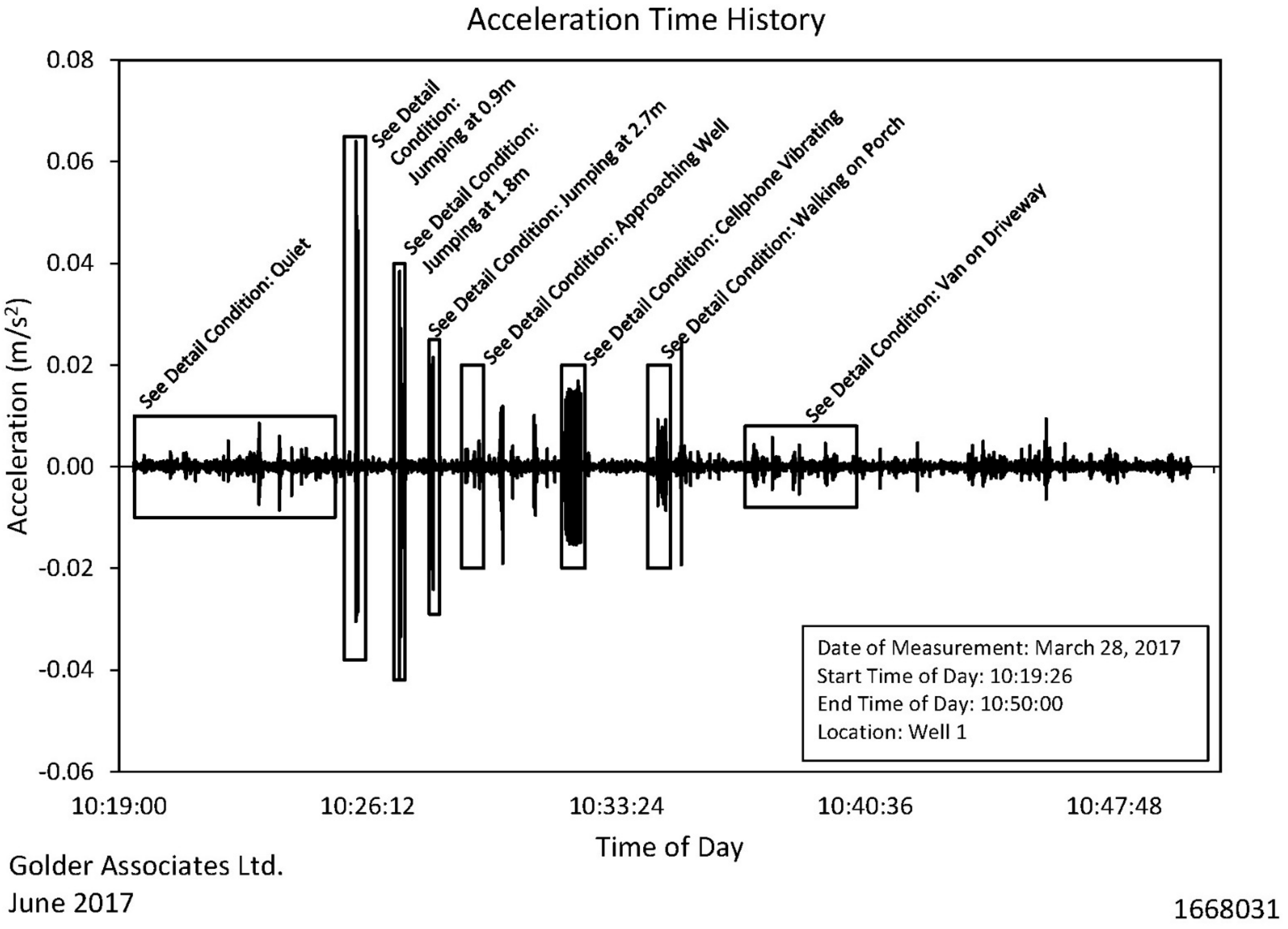


Figure I-01: March 28 Time History.

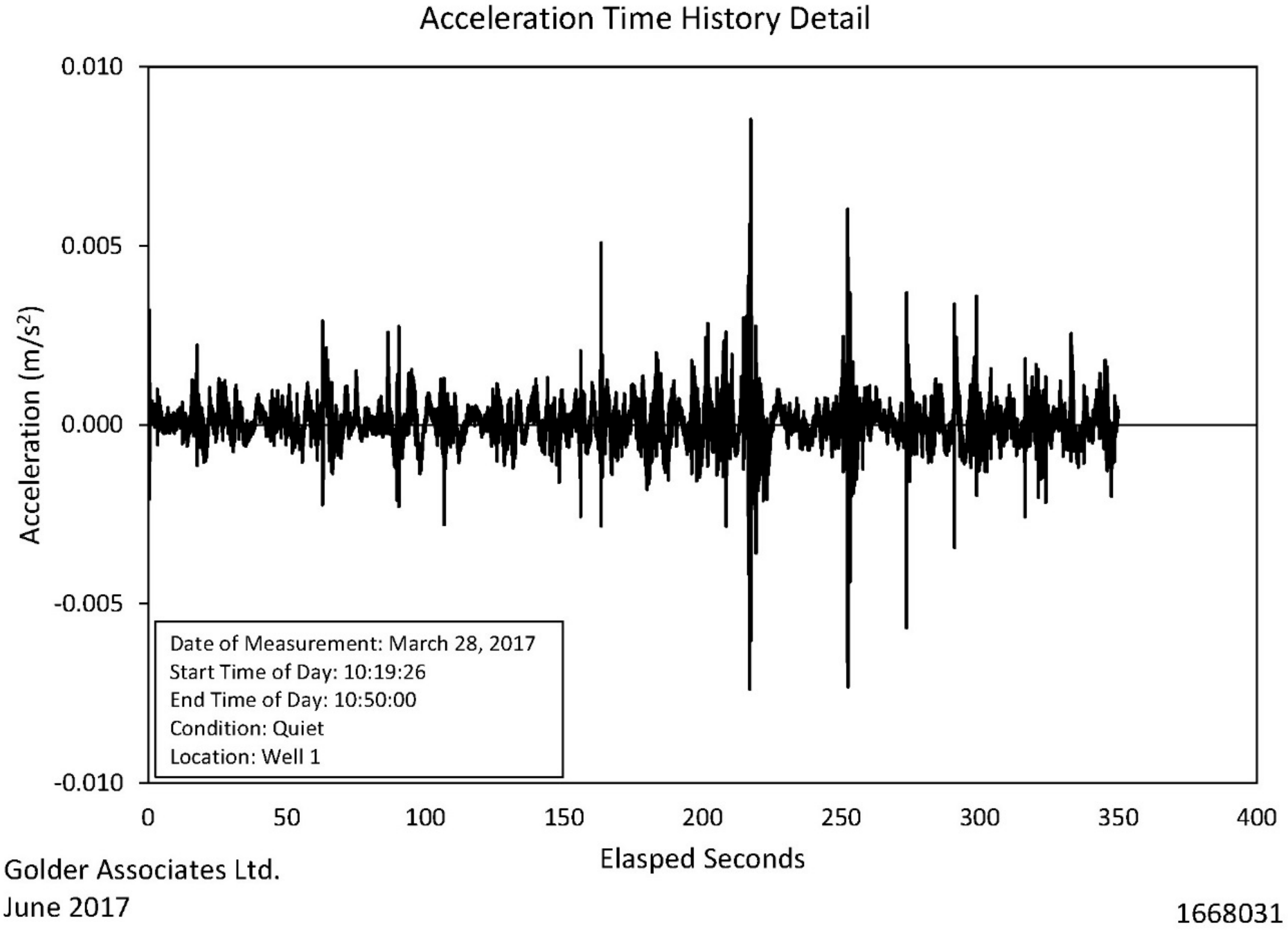


Figure I-4A: Acceleration-Time History Detail, Well #1, Quiet Period, March 28, 2017.

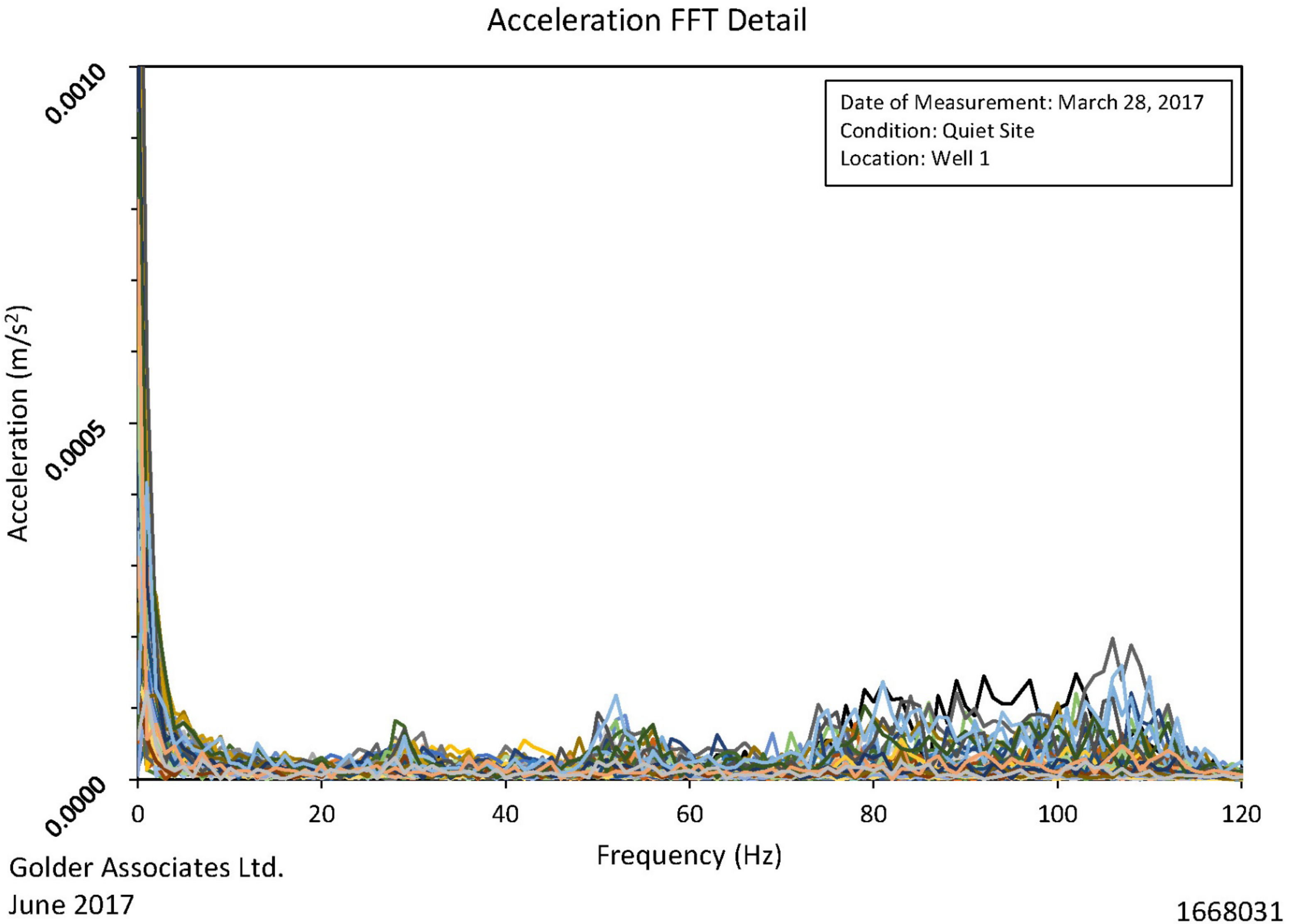


Figure I-4B: Acceleration FFT Detail, Well #1, Quiet Period, March 28, 2017.

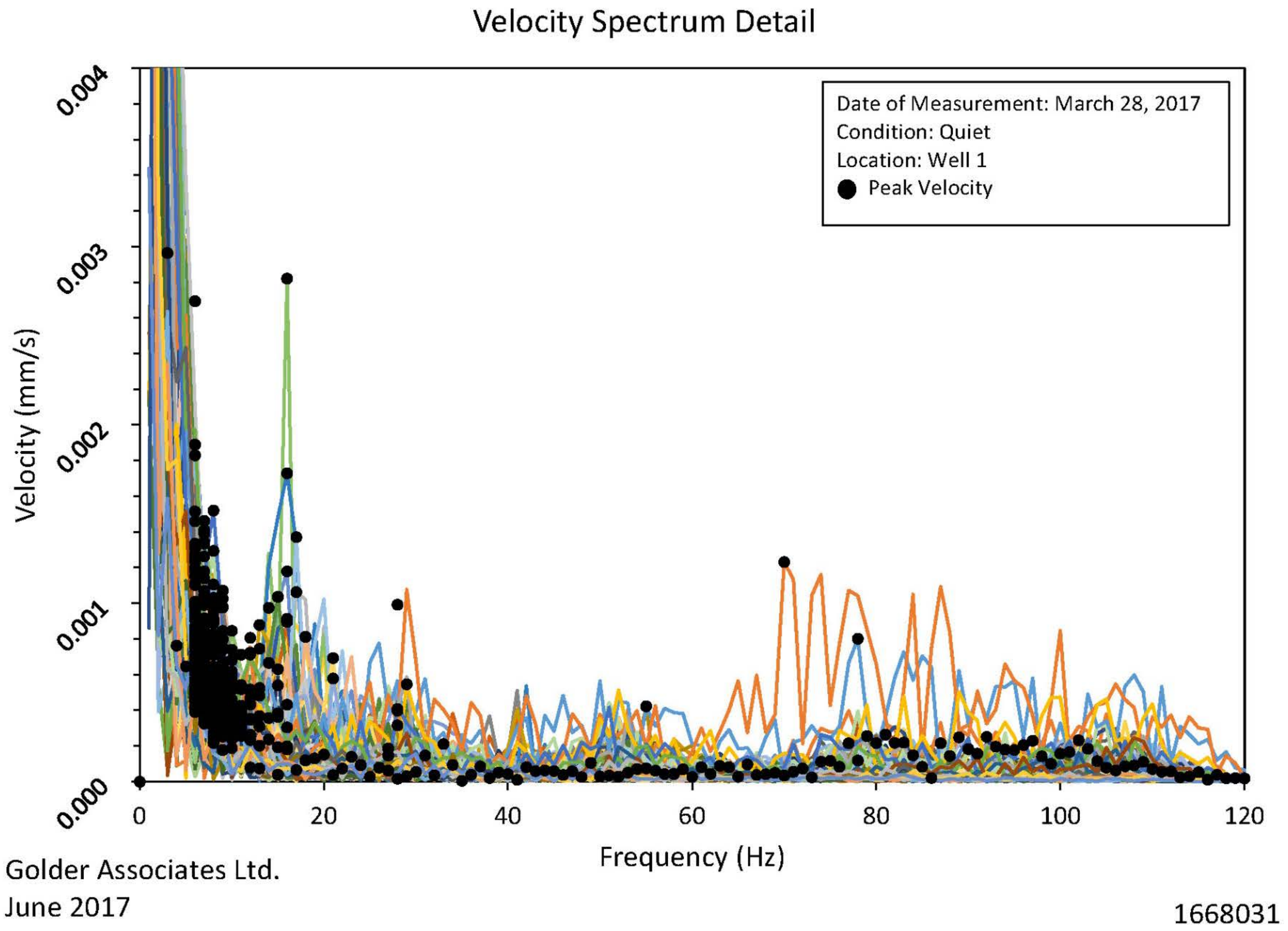


Figure I-4C: Velocity Spectrum Detail, Well #1, Quiet Period, March 28, 2017.

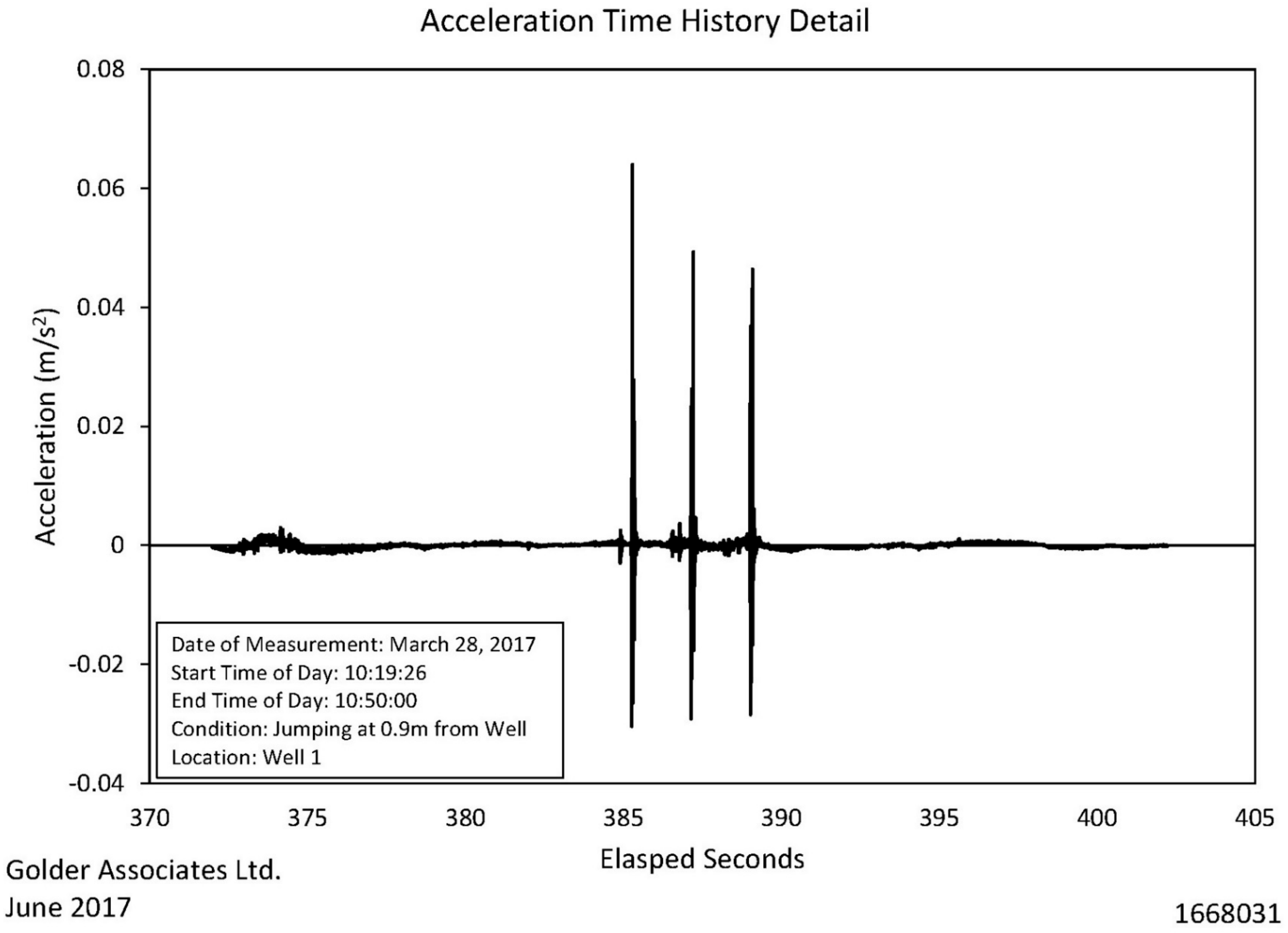


Figure I-5A: Acceleration-Time History Detail, Well #1, Jumping at 0.9 m from Well, March 28, 2017.

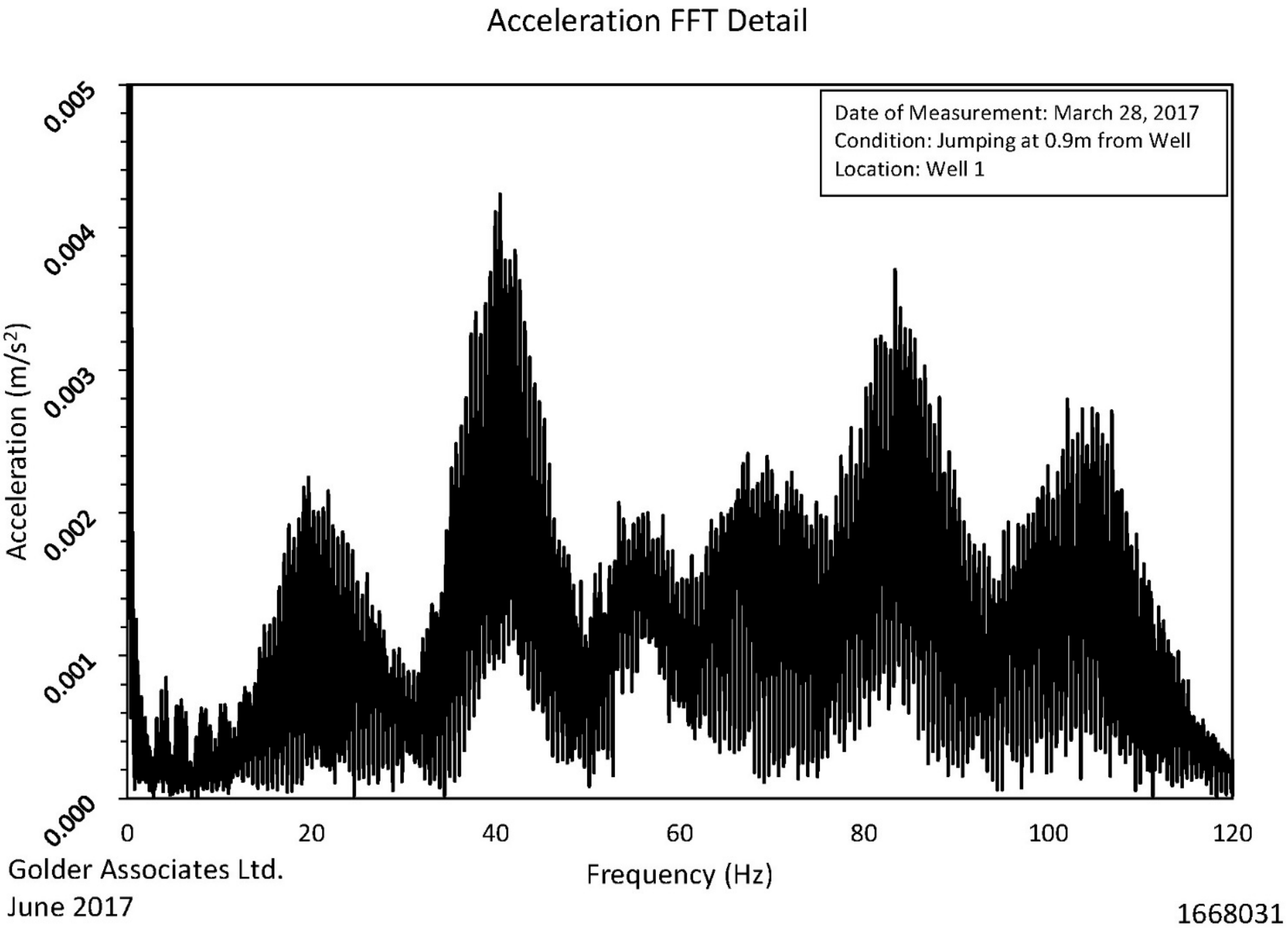


Figure I-5B: Acceleration FFT Detail, Well #1, Jumping at 0.9 m from Well, March 28, 2017.

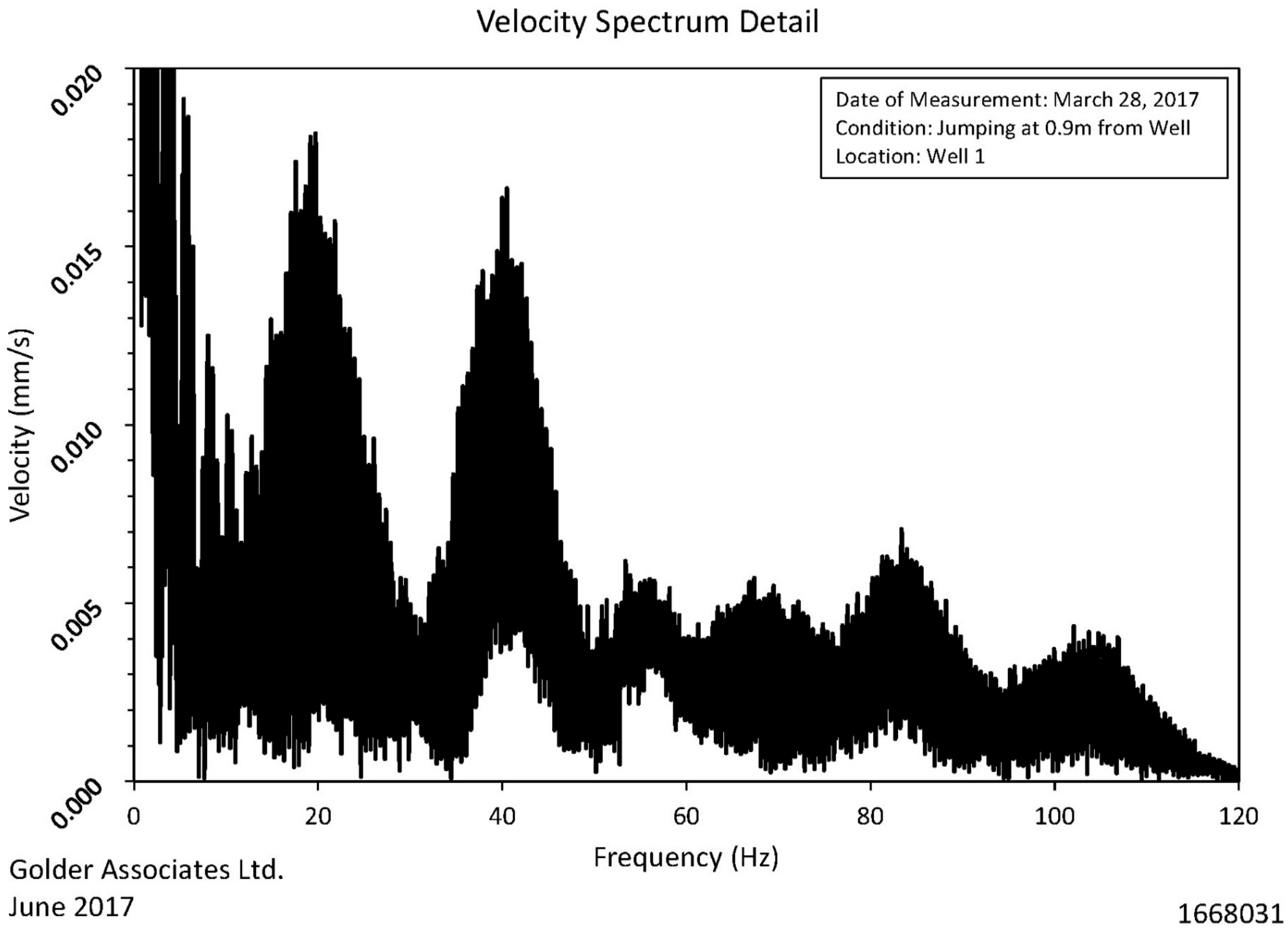


Figure I-5C: Velocity Spectrum Detail, Well #1, Jumping at 0.9 m from Well, March 28, 2017.

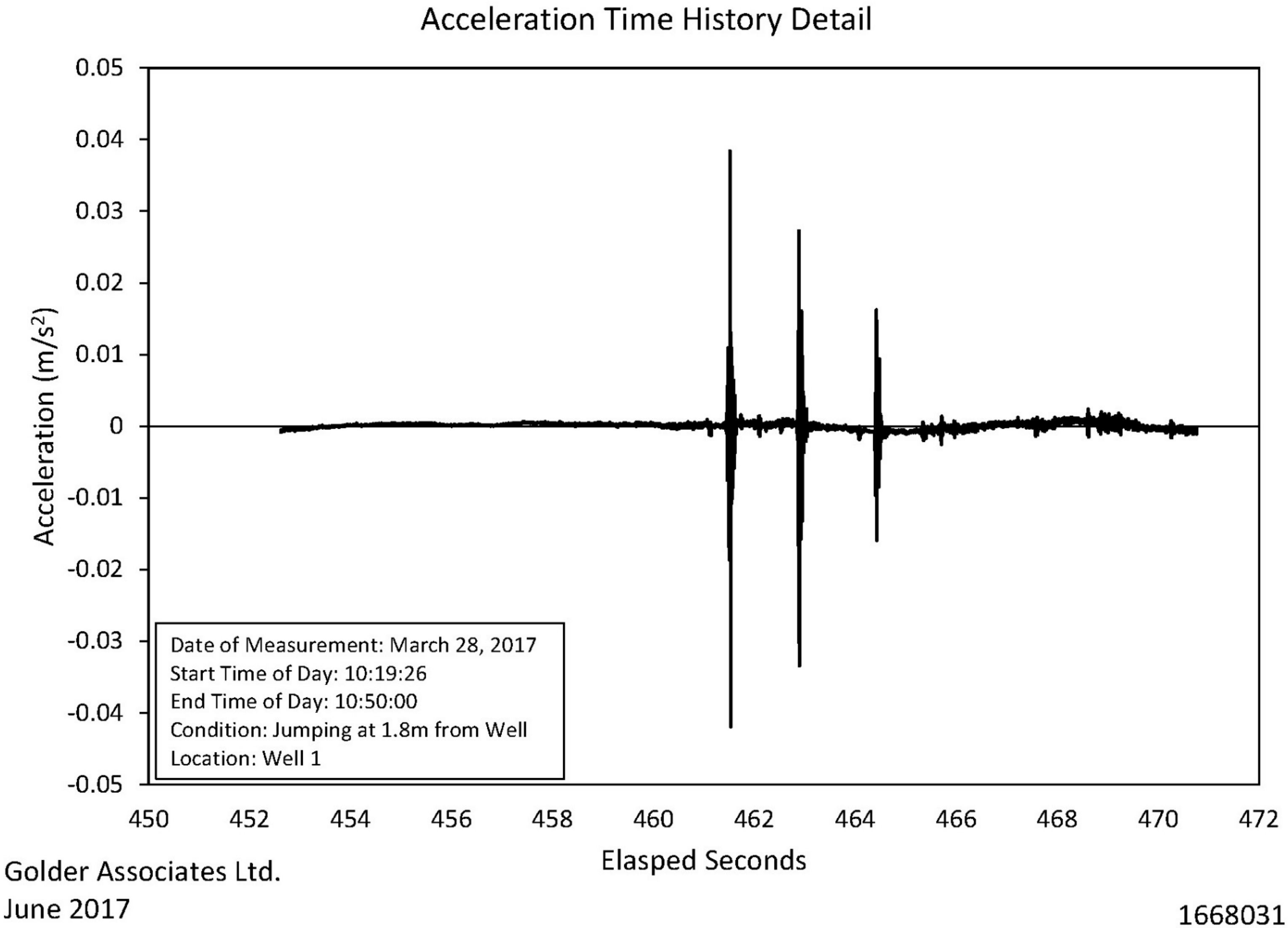


Figure I-6A: Acceleration-Time History Detail, Well #1, Jumping at 1.8 m from Well, March 28, 2017

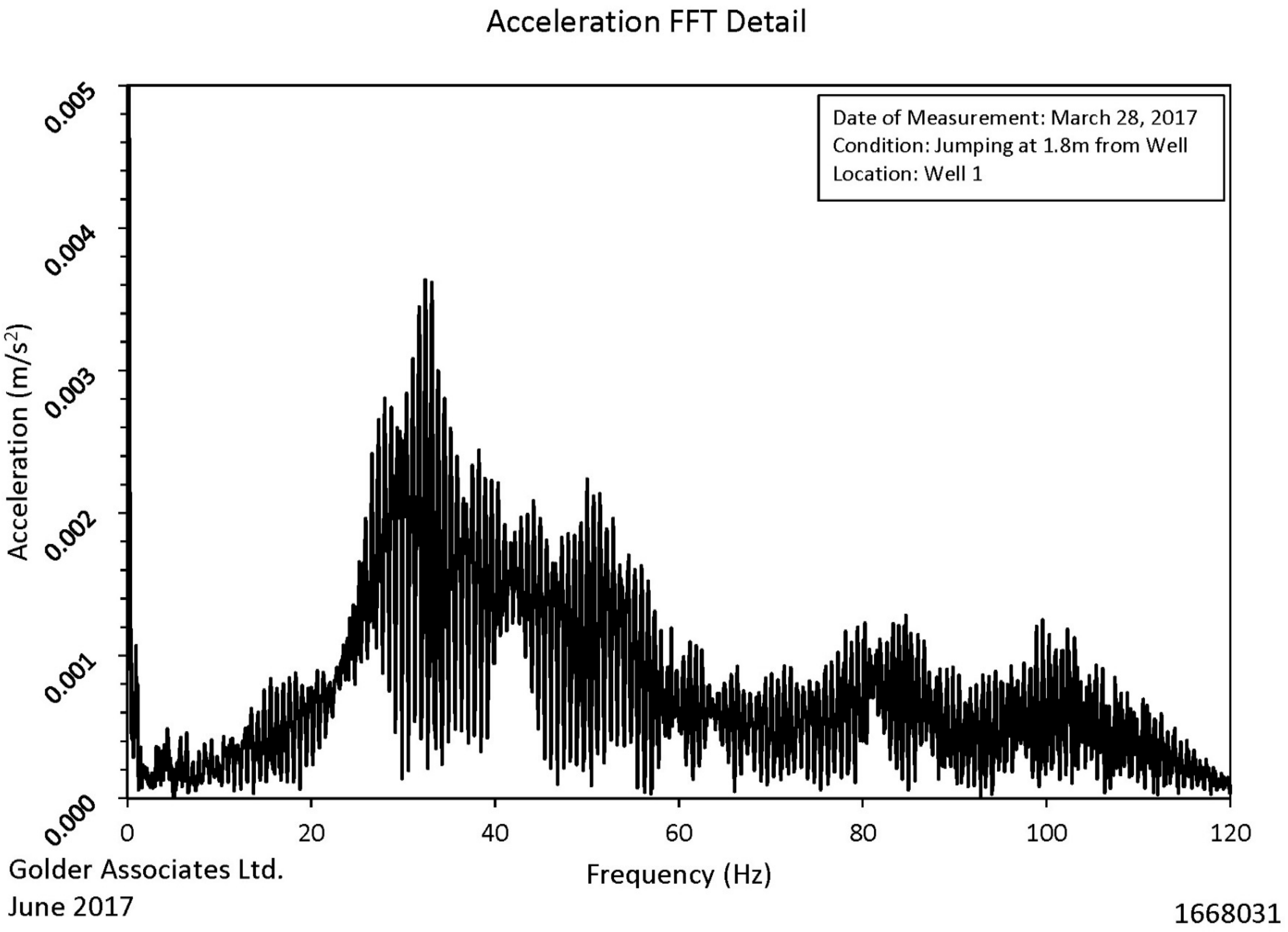


Figure I-6B: Acceleration FFT Detail, Well #1, Jumping at 1.8 m from Well, March 28, 2017.

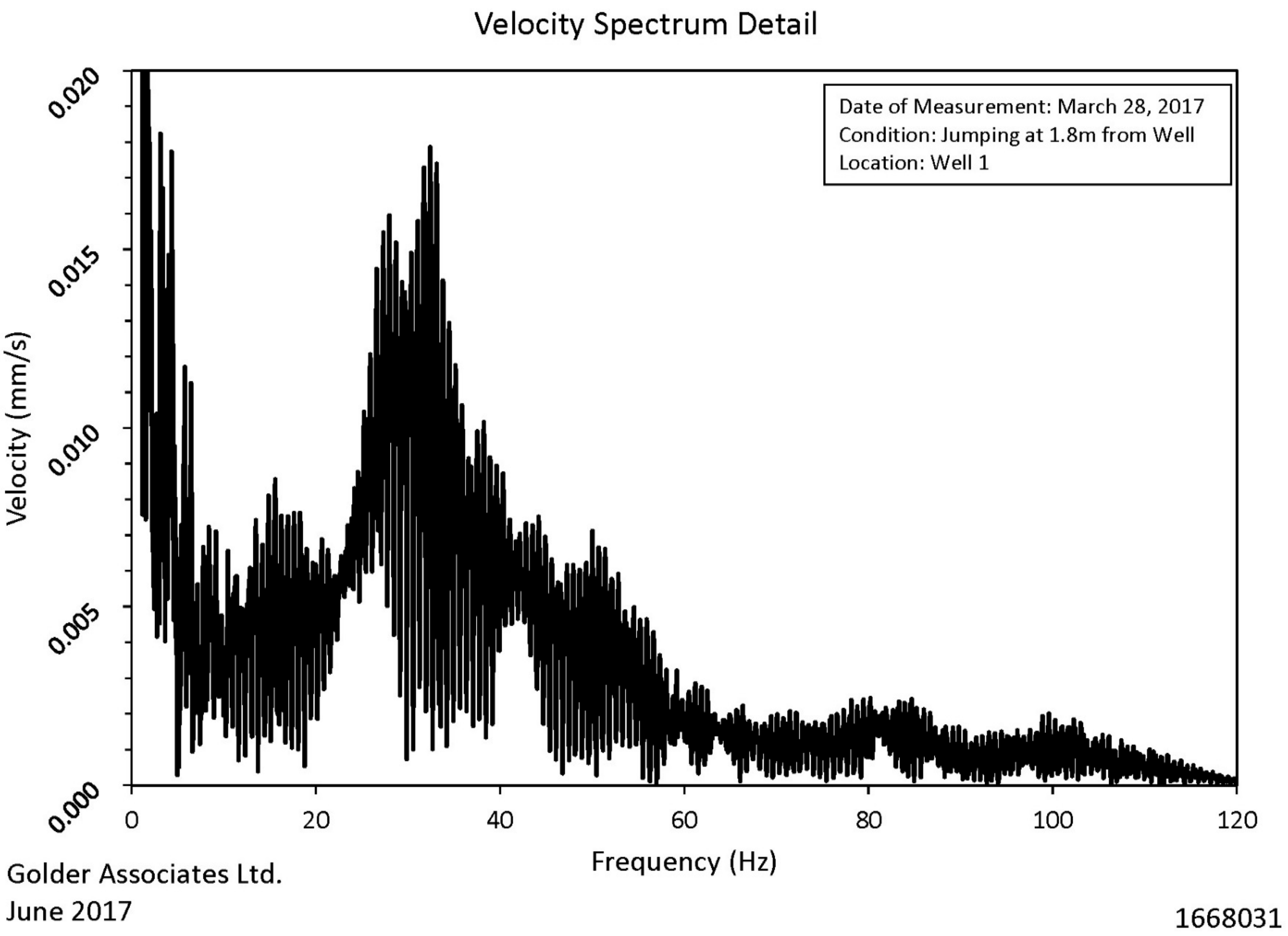


Figure I-6C: Velocity Spectrum Detail, Well #1, Jumping at 1.8 m from Well, March 28, 2017.

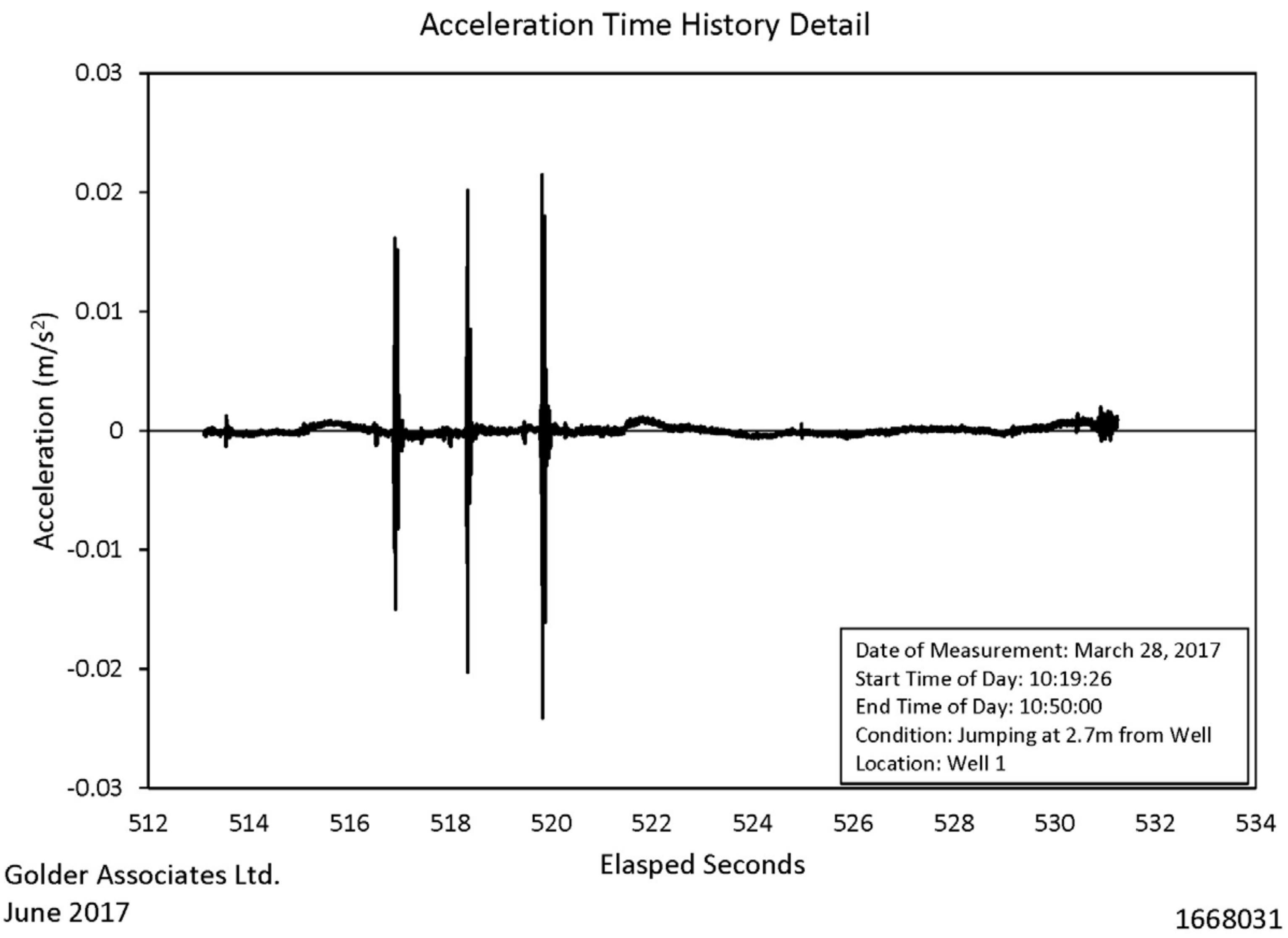


Figure I-7A: Acceleration-Time History Detail, Well #1, Jumping at 2.7 m from Well, March 28, 2017.

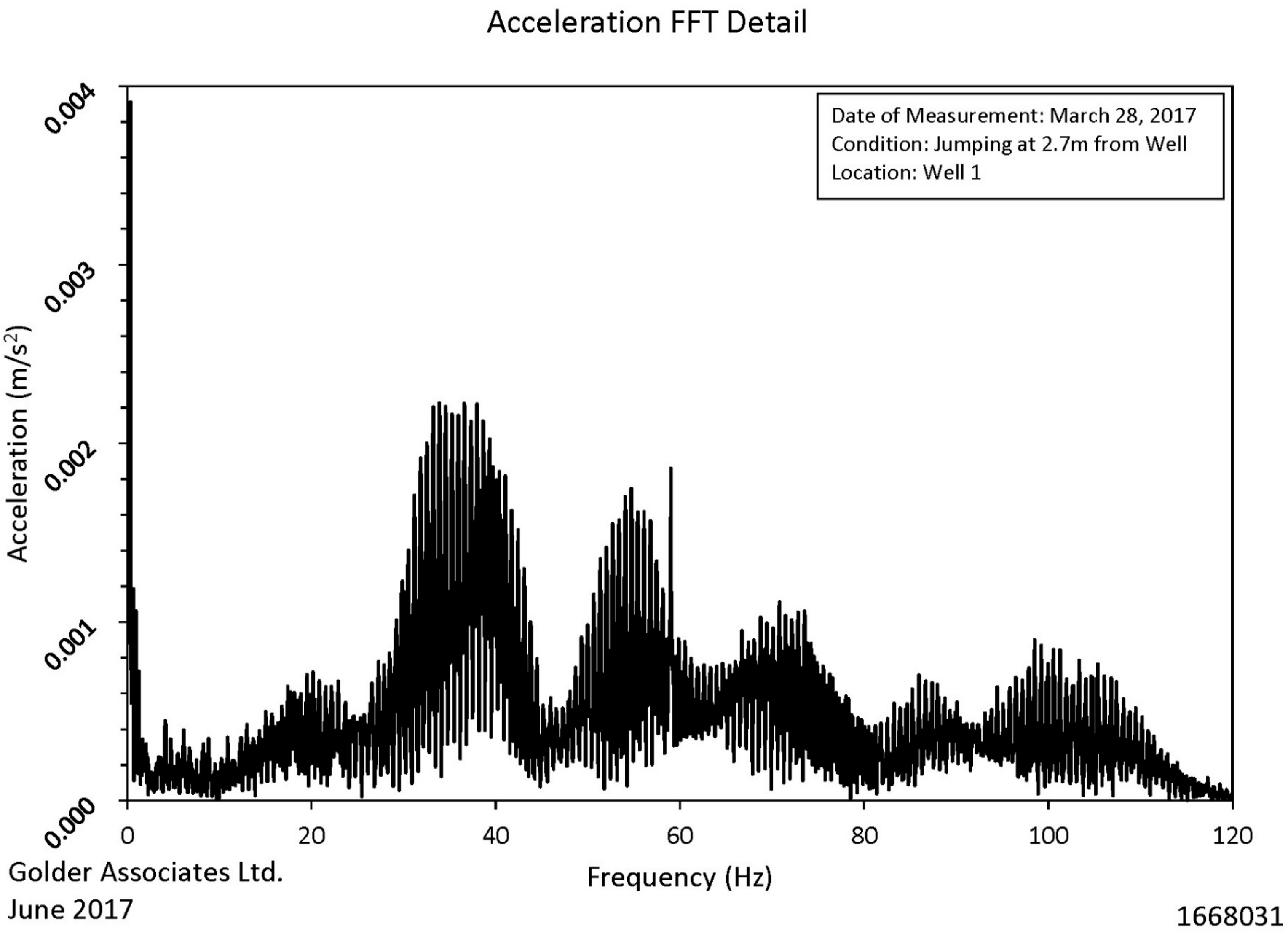


Figure I-7B: Acceleration FFT Detail, Well #1, Jumping at 2.7 m from Well, March 28, 2017

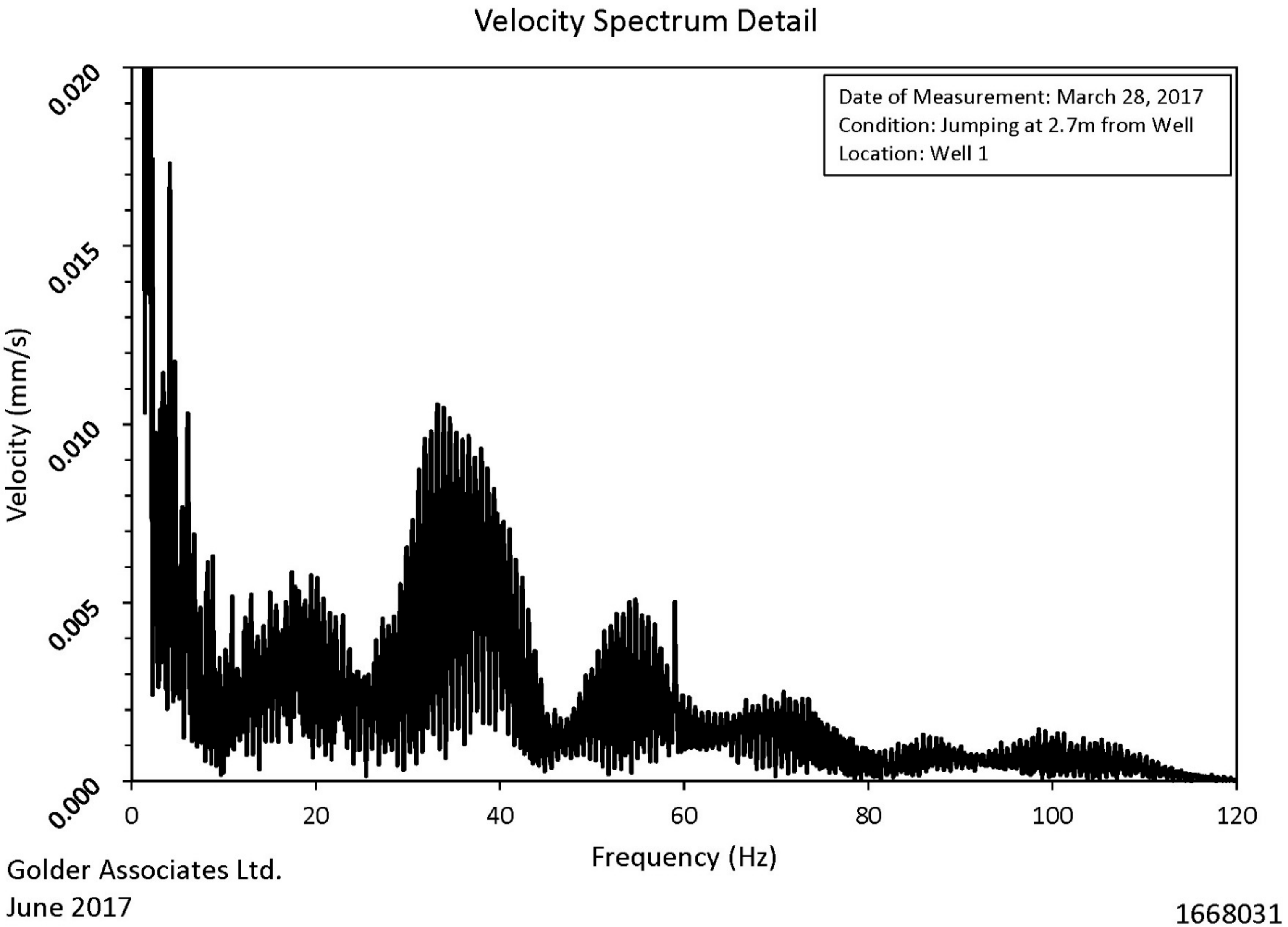


Figure I-7C: Velocity Spectrum Detail, Well #1, Jumping at 2.7 m from Well, March 28, 2017.

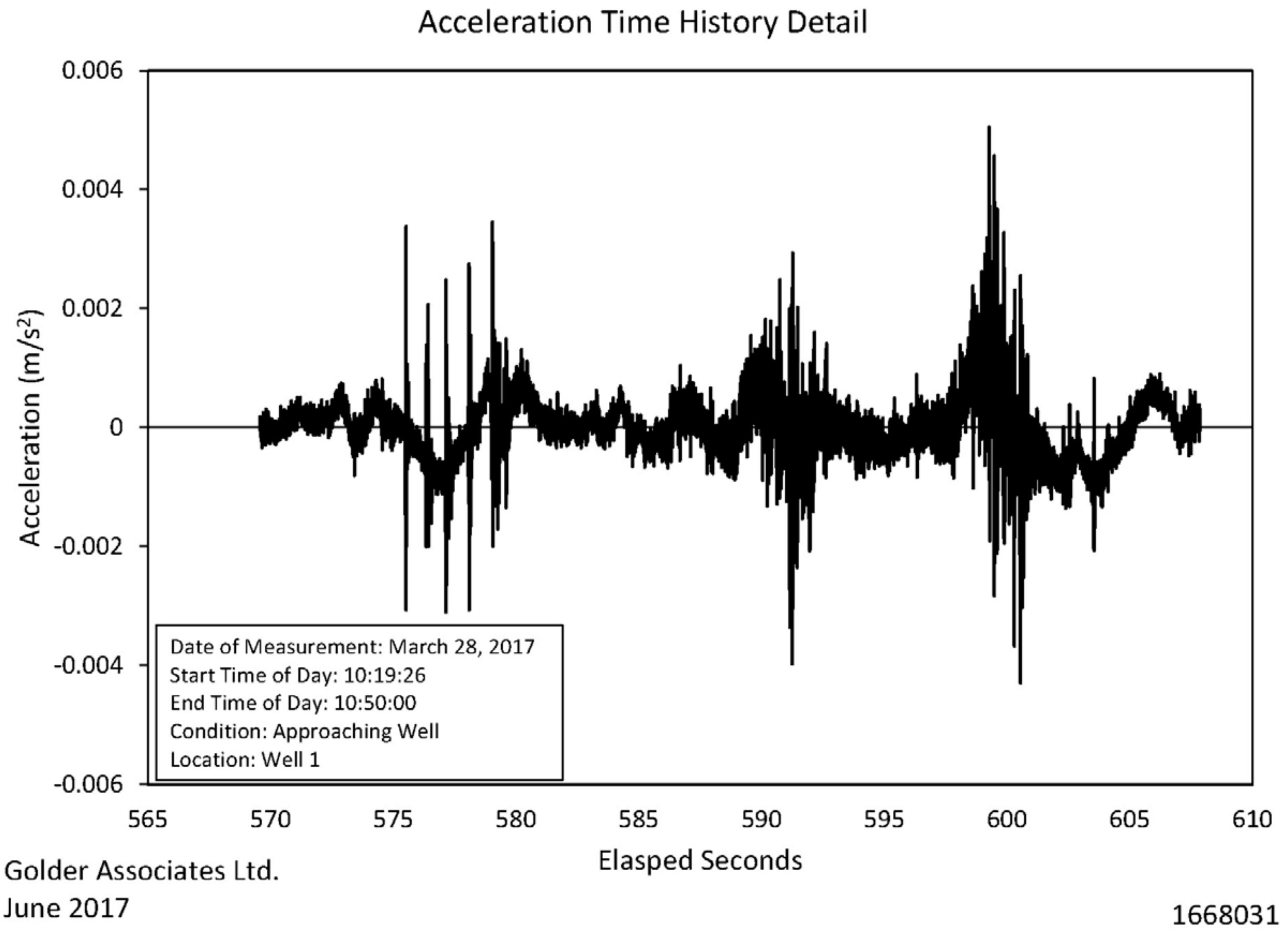


Figure I-8A: Acceleration-Time History Detail, Well #1, Approaching Well, March 28, 2017.

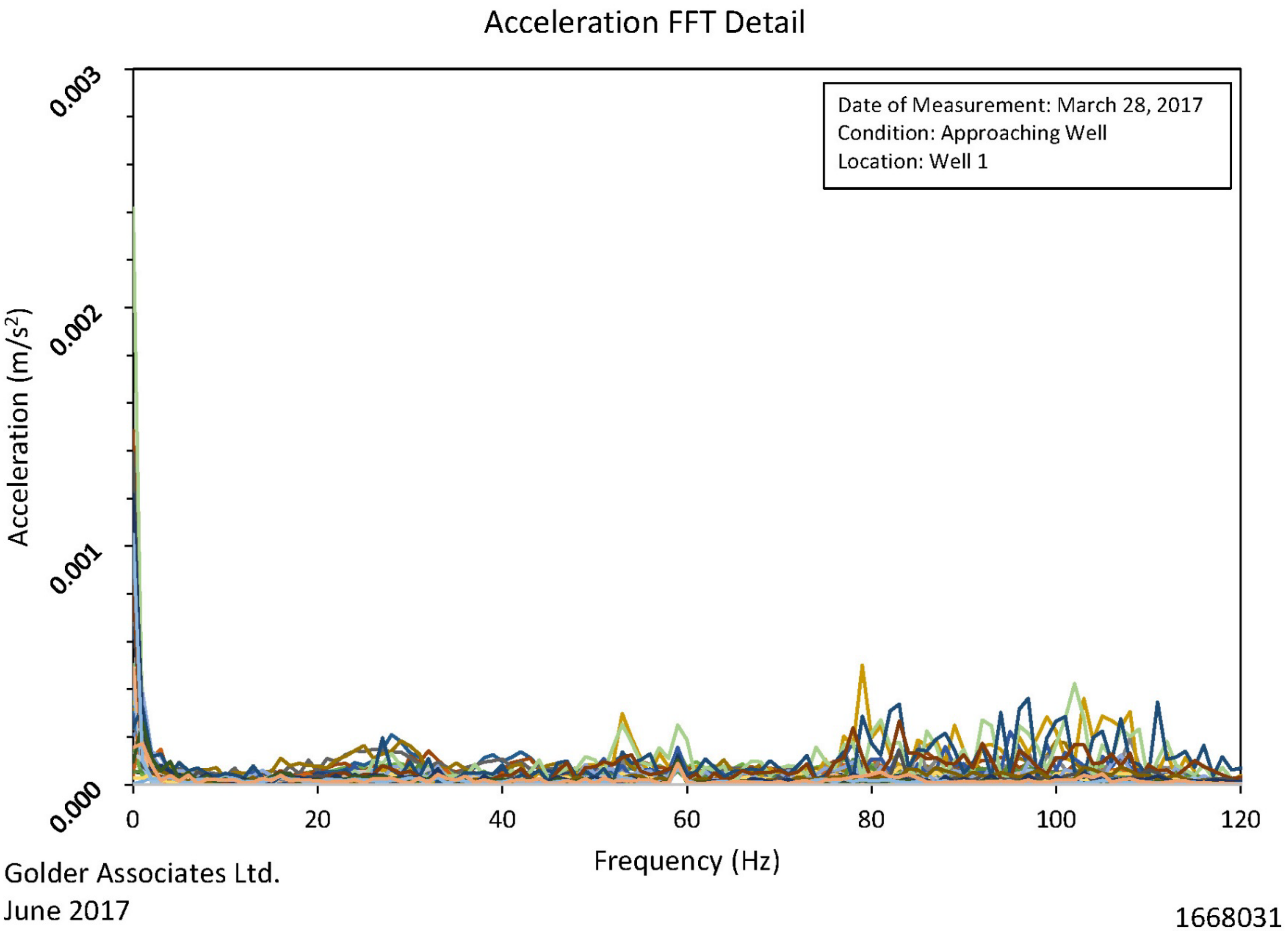


Figure I-8B: Acceleration FFT Detail, Well #1, Approaching Well, March 28, 2017.

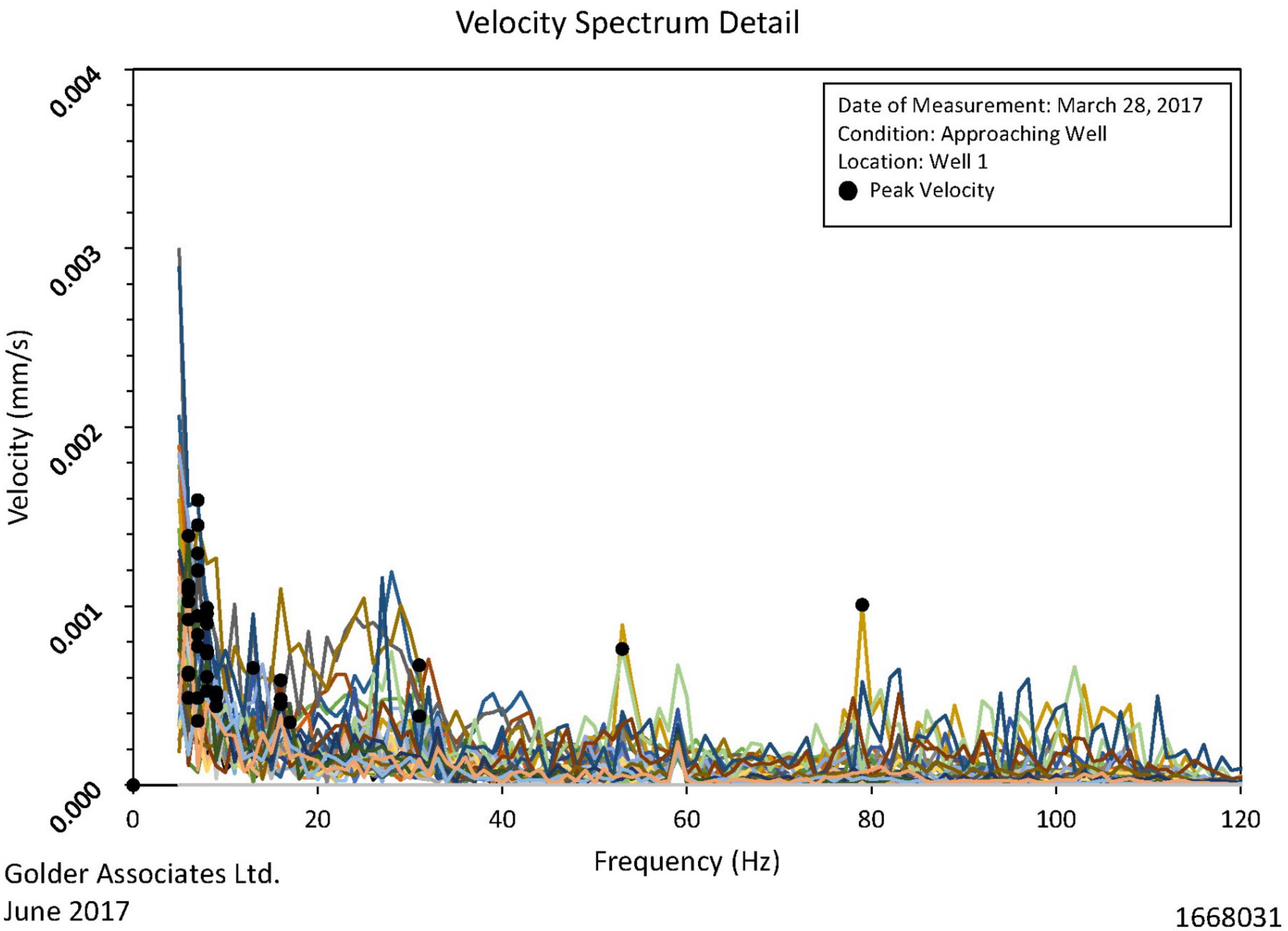


Figure I-8C: Velocity Spectrum Detail, Well #1, Approaching Well, March 28, 2017.

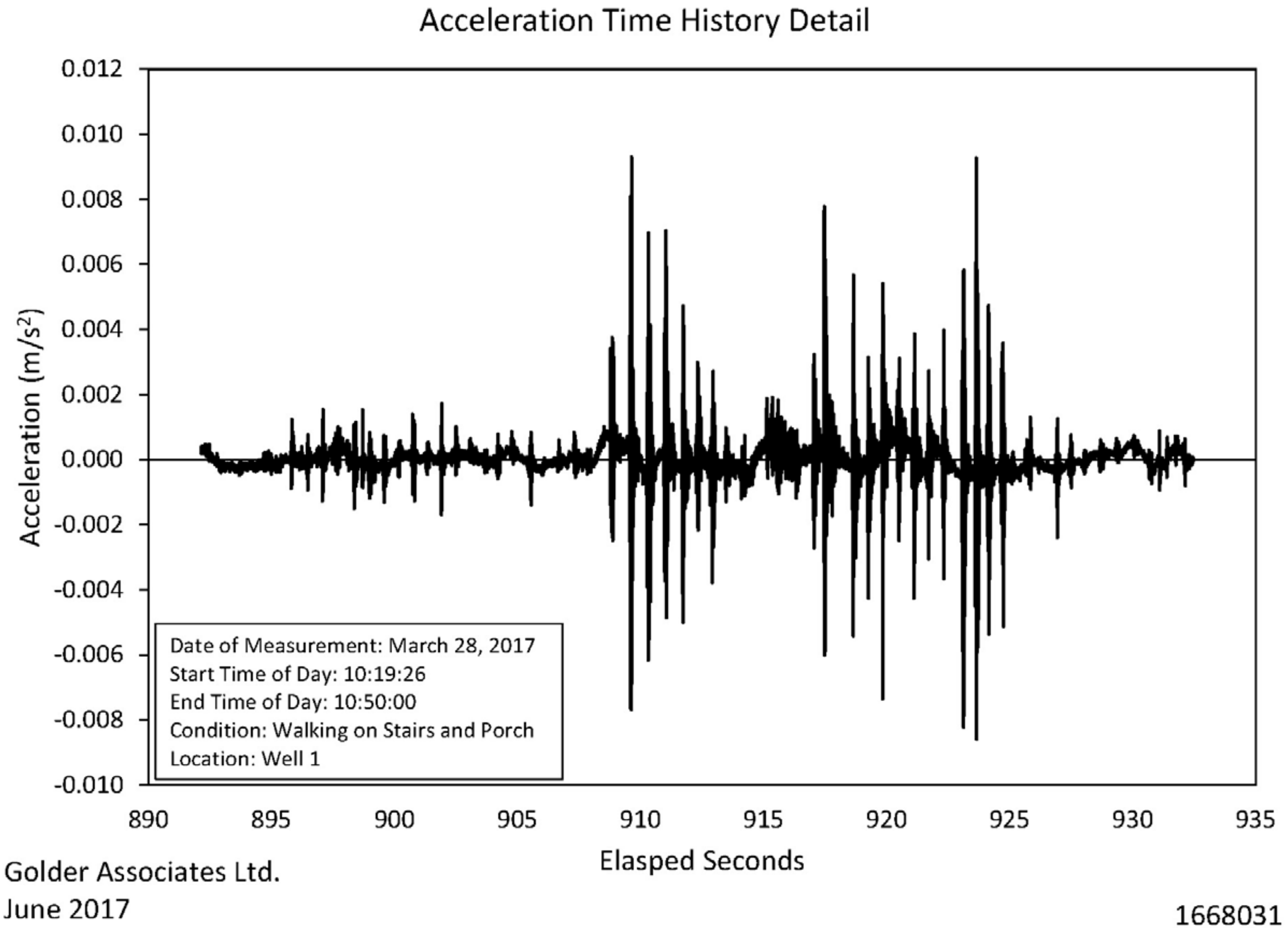


Figure I-11A: Acceleration-Time History Detail, Well #1, Walking on Porch, March 28, 2017.

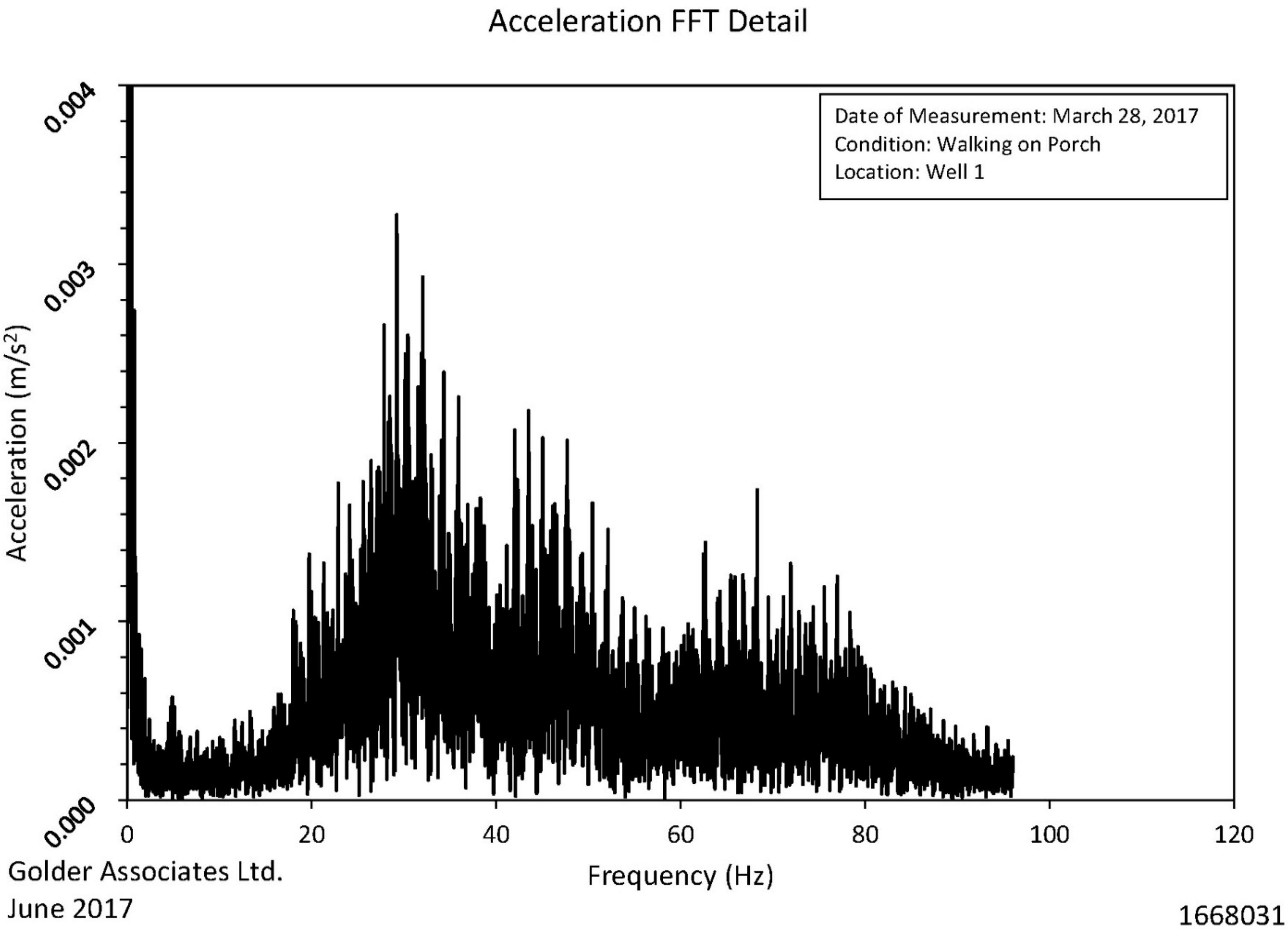


Figure I-11B: Acceleration FFT Detail, Well #1, Walking on Porch, March 28, 2017.

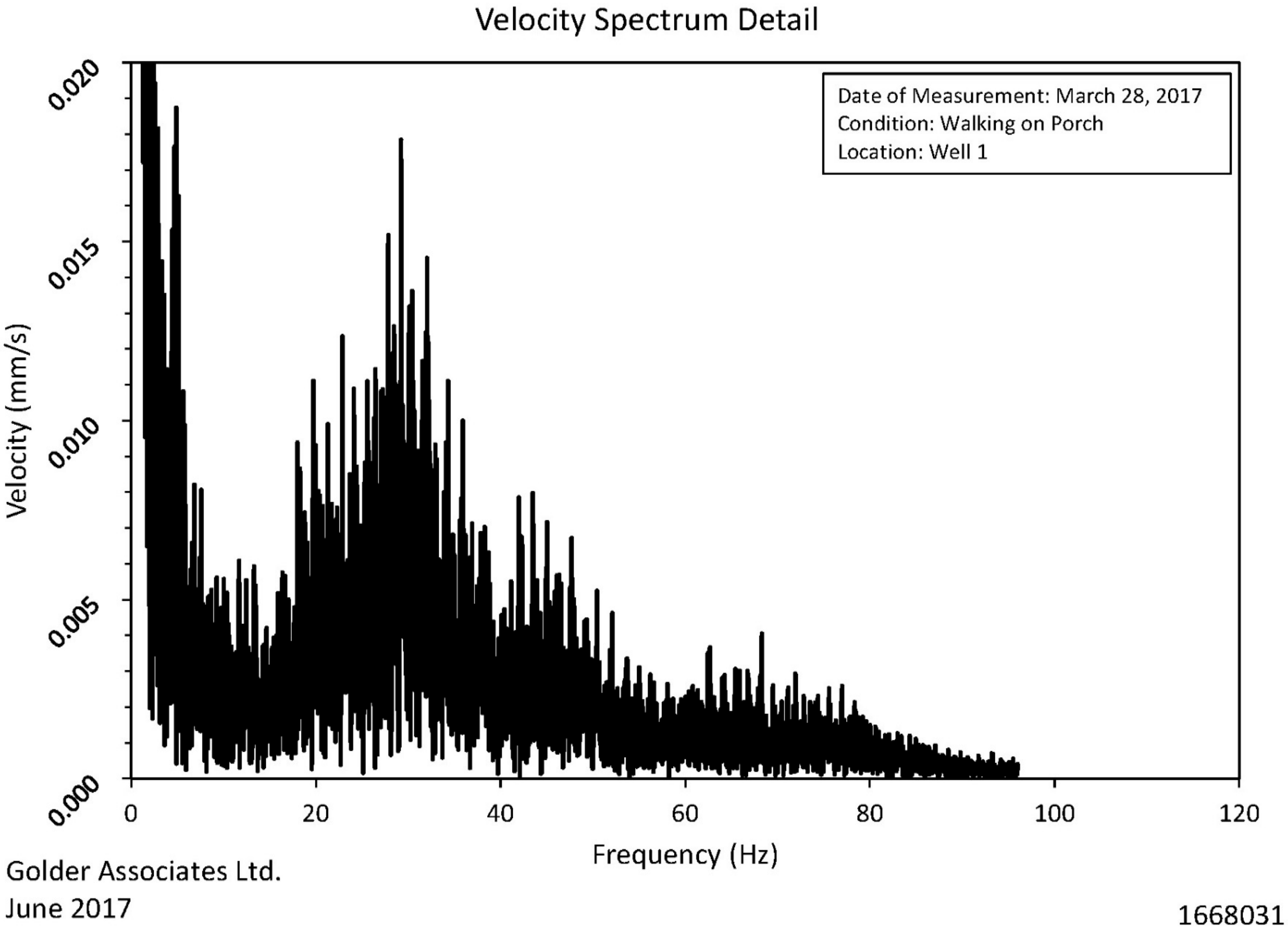


Figure I-11C: Velocity Spectrum Detail, Well #1, Walking on Porch, March 28, 2017.

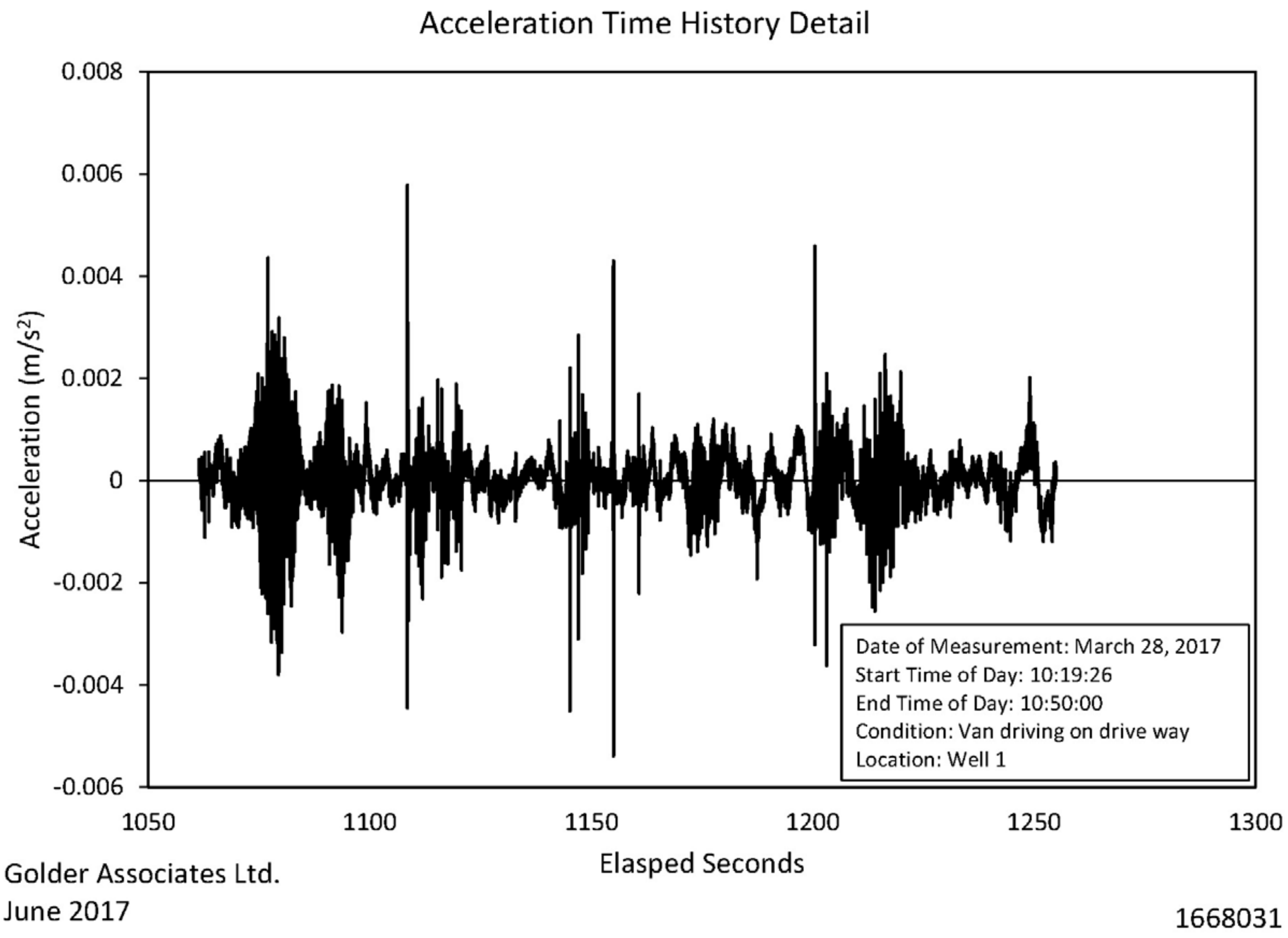


Figure I-12A: Acceleration-Time History Detail, Well #1, Van on Driveway, March 28, 2017.

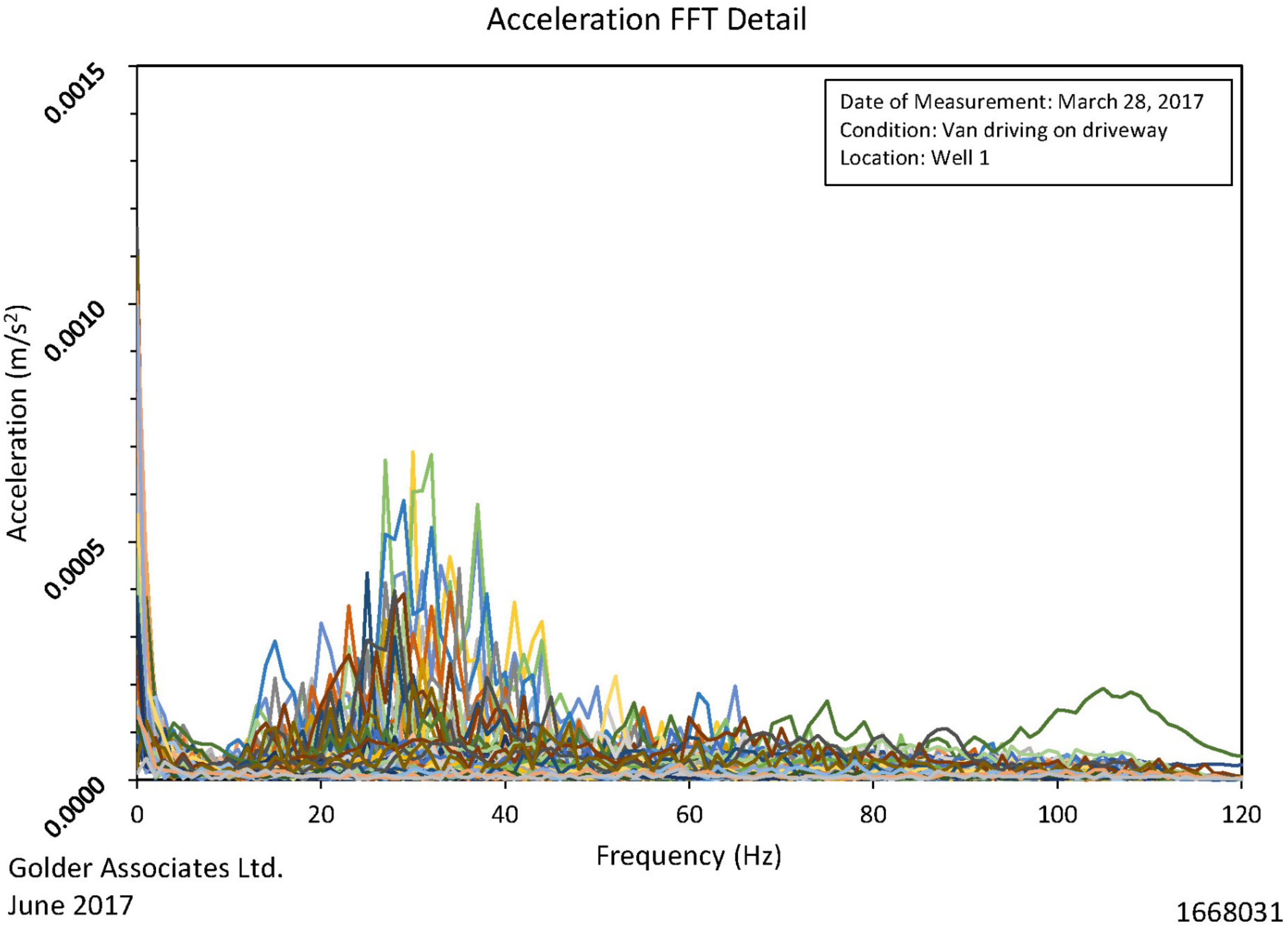


Figure I-12B: Acceleration FFT Detail, Well #1, Van on Driveway, March 28, 2017.

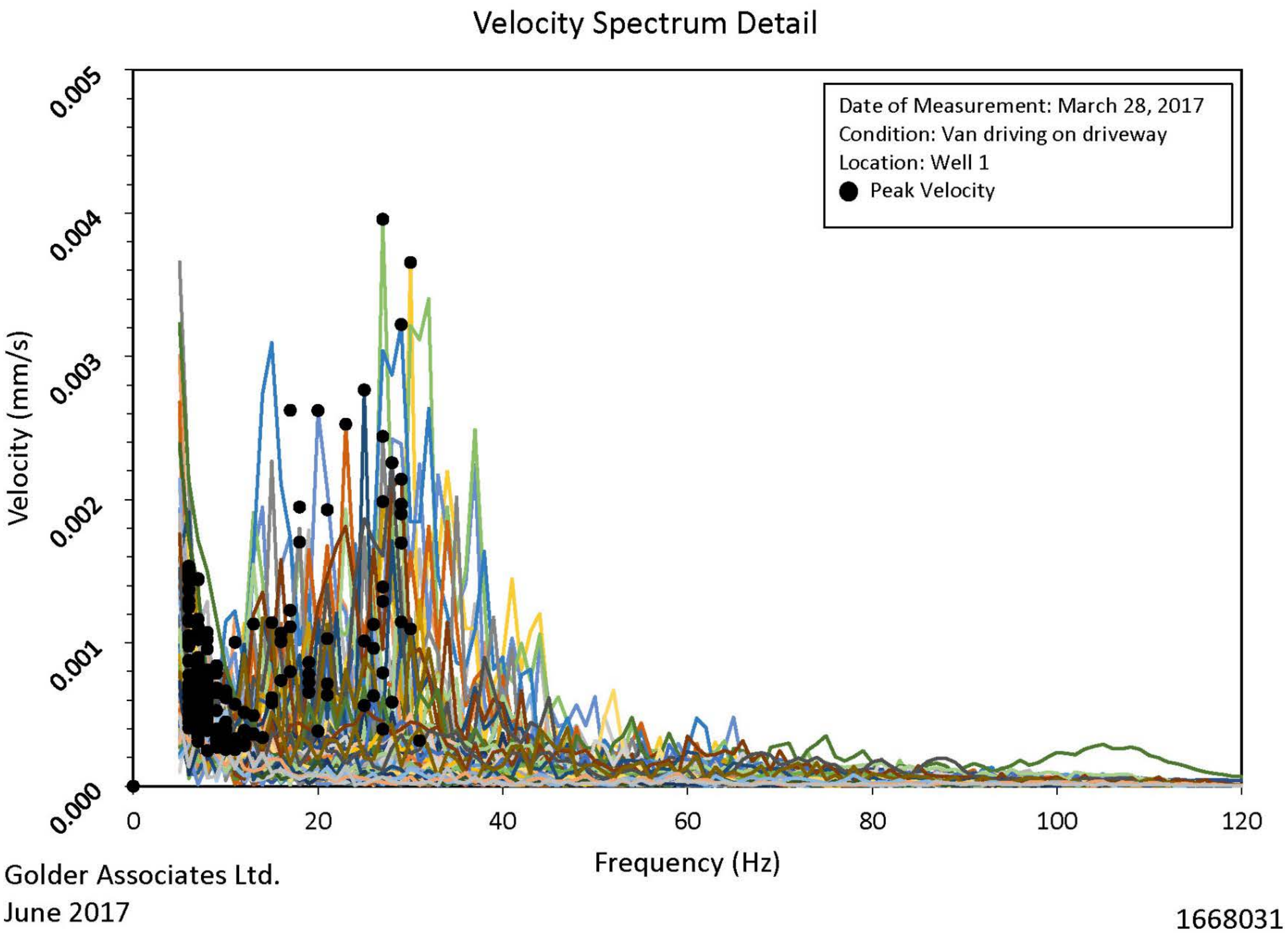
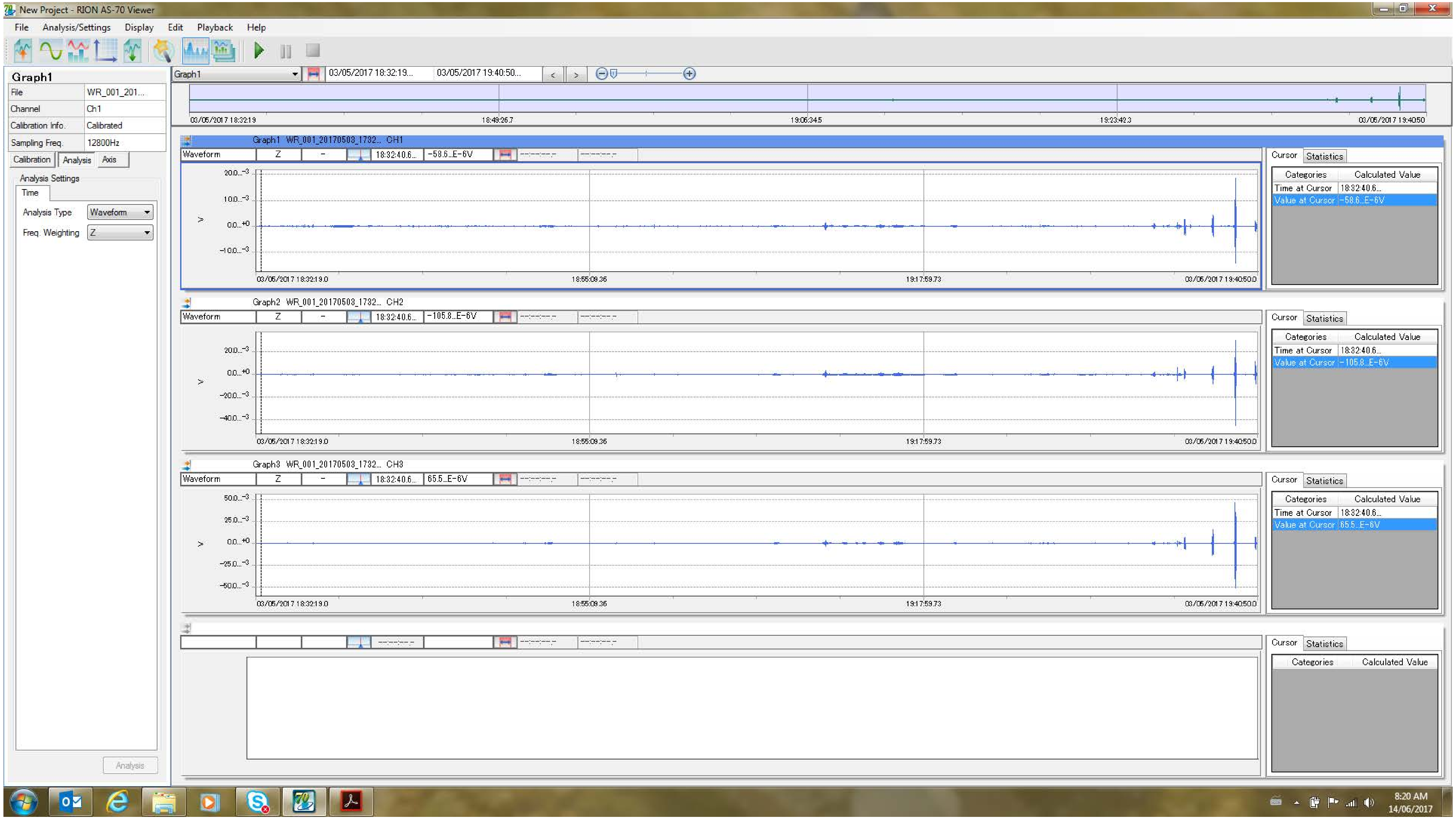


Figure I-12C: Velocity Spectrum Detail, Well #1, Van on Driveway, March 28, 2017.



Graph1

File	WR_001_201...
Channel	Ch1
Calibration Info.	Calibrated
Sampling Freq.	12800Hz

Analysis Settings

Time

Analysis Type: Waveform

Freq. Weighting: Z

Graph1 03/05/2017 18:32:19... 03/05/2017 19:40:50...

Graph1 WR_001_20170503_1732... CH1

Waveform Z – 18:32:40.6... -58.6...E-6V

Categories	Calculated Value
Time at Cursor	18:32:40.6...
Value at Cursor	-58.6...E-6V

Graph2 WR_001_20170503_1732... CH2

Waveform Z – 18:32:40.6... -105.8...E-6V

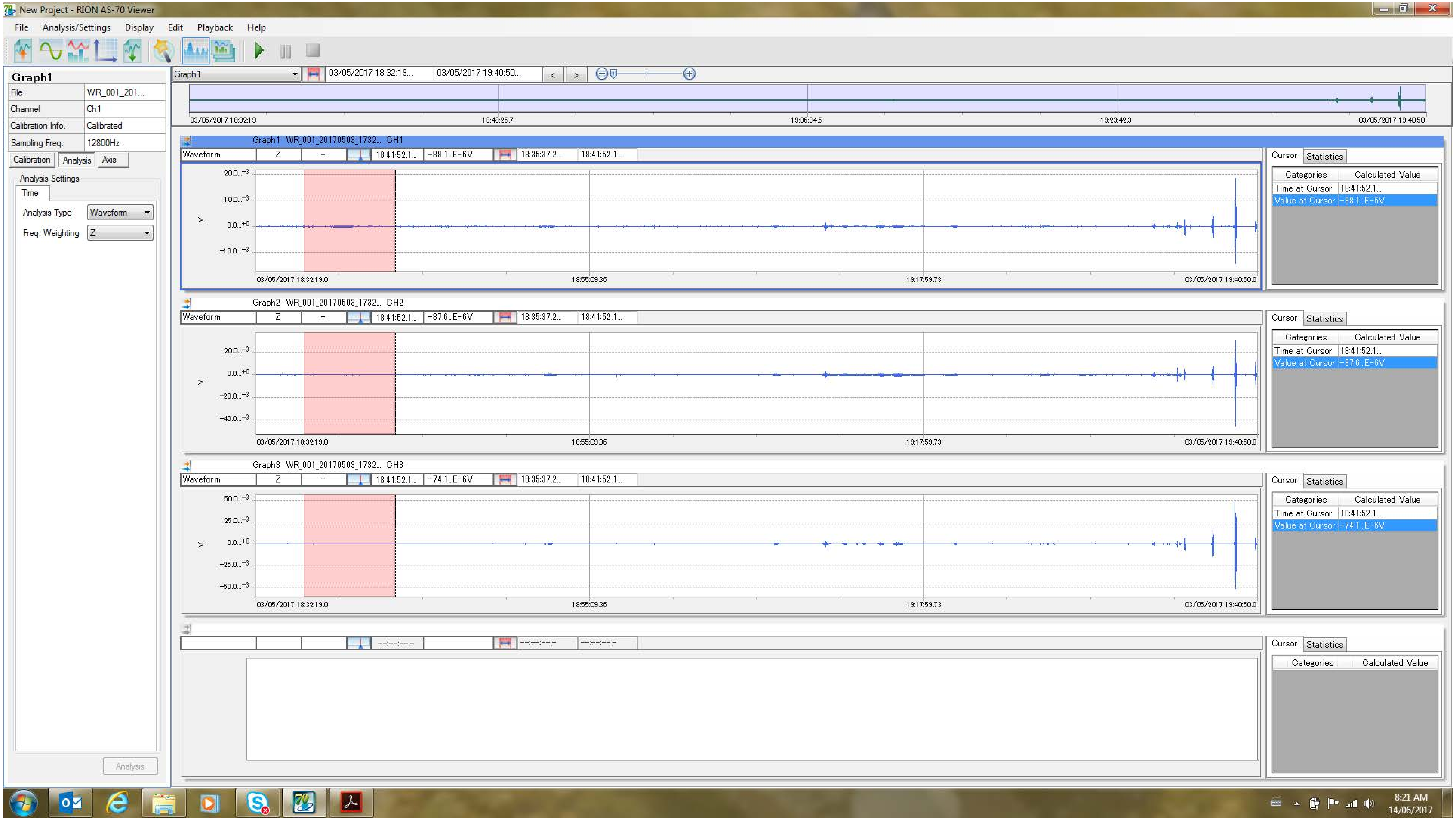
Categories	Calculated Value
Time at Cursor	18:32:40.6...
Value at Cursor	-105.8...E-6V

Graph3 WR_001_20170503_1732... CH3

Waveform Z – 18:32:40.6... 65.5...E-6V

Categories	Calculated Value
Time at Cursor	18:32:40.6...
Value at Cursor	65.5...E-6V

Figure I-13A: Acceleration Time History, Well #3, May 3, 2017 illustrating measured accelerometer voltage readings from mounted to well casing in vertical, longitudinal and transverse directions shown top to bottom of image, respectively. The minimum and maximum vertical axes tick mark labels and grid lines, as illustrated in each the graphs (top to bottom in image) are as follows, respectively: -10.0x10^{-3} V and 20.0x10^{-3} V; -40.0x10^{-3} V and 20.0x10^{-3} V; and -50.0x10^{-3} V and 50.0x10^{-3} V. For these accelerometers, 1 V equates to 1 g.



Graph1

File	WR_001_201...
Channel	Ch1
Calibration Info.	Calibrated
Sampling Freq.	12800Hz

Analysis Type: Waveform
Freq. Weighting: Z

Graph1 WR_001_20170503_1732... CH1
Waveform | Z | - | 18:41:52.1... | -88.1...E-6V | 18:35:37.2... | 18:41:52.1...

Categories	Calculated Value
Time at Cursor	18:41:52.1...
Value at Cursor	-88.1...E-6V

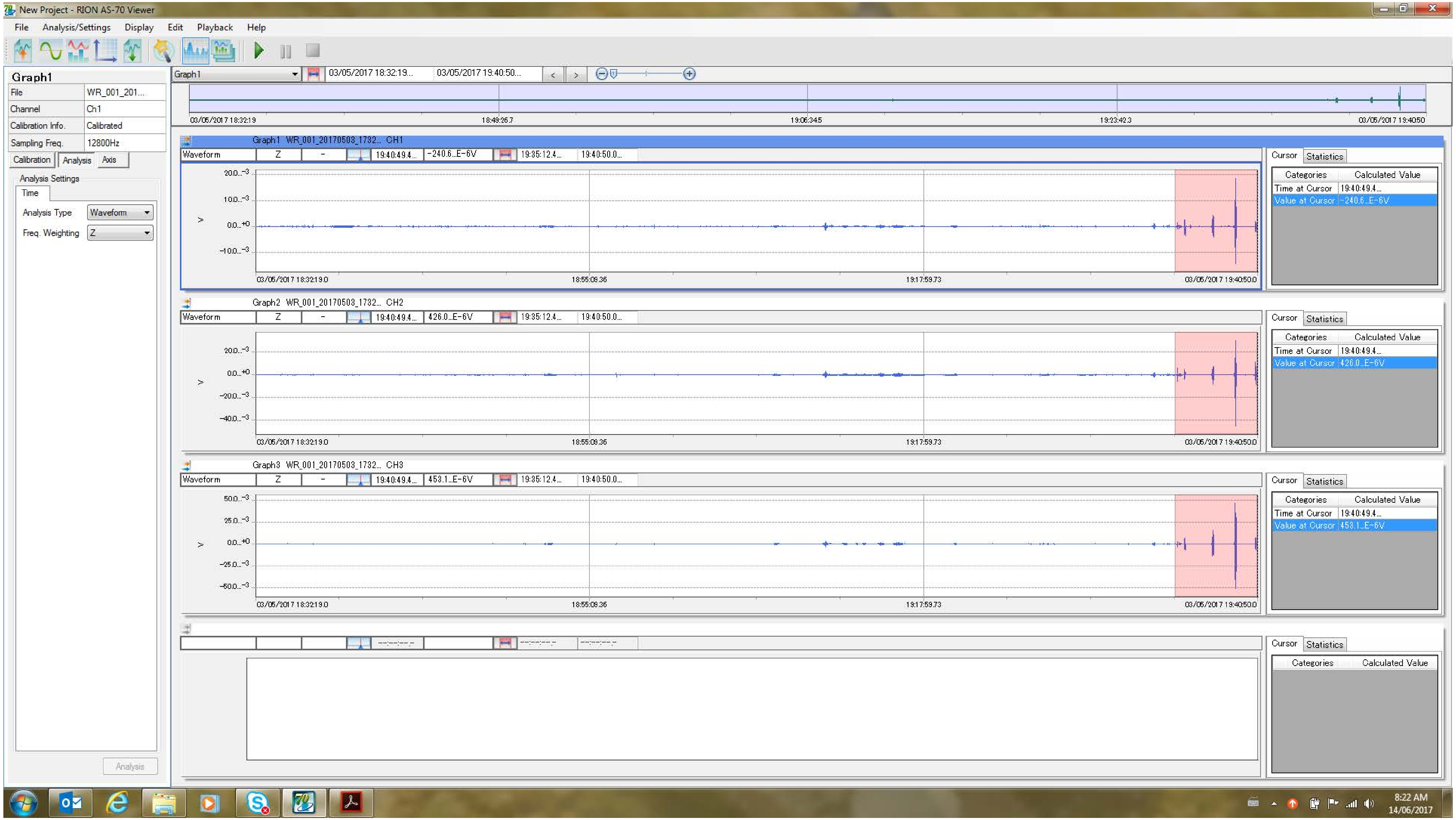
Graph2 WR_001_20170503_1732... CH2
Waveform | Z | - | 18:41:52.1... | -87.6...E-6V | 18:35:37.2... | 18:41:52.1...

Categories	Calculated Value
Time at Cursor	18:41:52.1...
Value at Cursor	-87.6...E-6V

Graph3 WR_001_20170503_1732... CH3
Waveform | Z | - | 18:41:52.1... | -74.1...E-6V | 18:35:37.2... | 18:41:52.1...

Categories	Calculated Value
Time at Cursor	18:41:52.1...
Value at Cursor	-74.1...E-6V

Figure I-13B: Acceleration Time History, Well #3, May 3, 2017 illustrating section of time history shown in Figure I-13A during which pile driving vibrations were identified.



New Project - RION AS-70 Viewer

Graph1

File	WR_001_201...
Channel	Ch1
Calibration Info.	Calibrated
Sampling Freq.	12800Hz

Analysis Settings

Time

Analysis Type: Waveform

Freq. Weighting: Z

Graph1 03/05/2017 18:32:19... 03/05/2017 19:40:50...

Graph1 WR_001_20170503_1732... CH1

Waveform | Z | - | 19:40:49.4... | -240.6...E-6V | 19:35:12.4... | 19:40:50.0...

Categories	Calculated Value
Time at Cursor	19:40:49.4...
Value at Cursor	-240.6...E-6V

Graph2 WR_001_20170503_1732... CH2

Waveform | Z | - | 19:40:49.4... | 426.0...E-6V | 19:35:12.4... | 19:40:50.0...

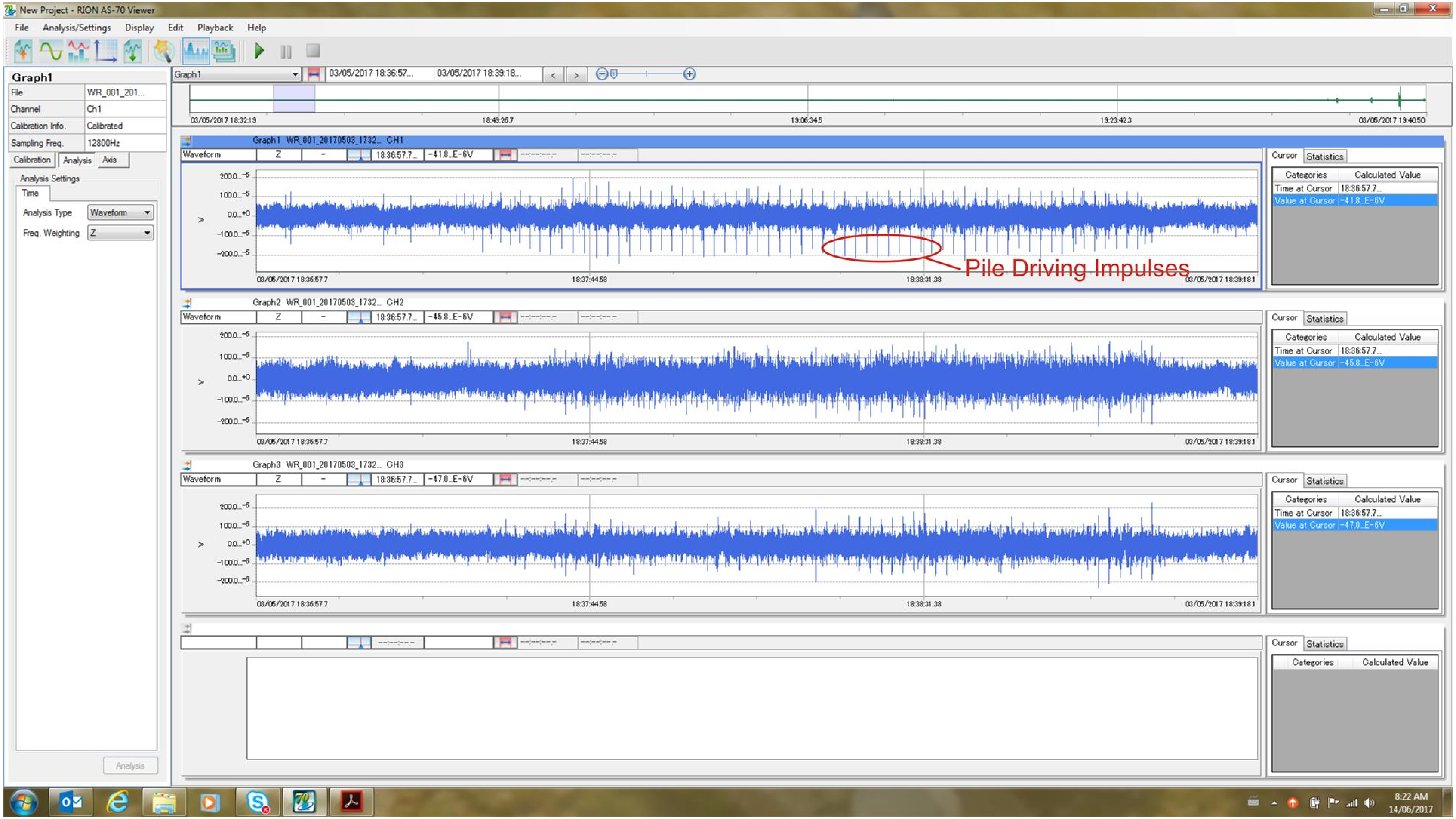
Categories	Calculated Value
Time at Cursor	19:40:49.4...
Value at Cursor	426.0...E-6V

Graph3 WR_001_20170503_1732... CH3

Waveform | Z | - | 19:40:49.4... | 453.1...E-6V | 19:35:12.4... | 19:40:50.0...

Categories	Calculated Value
Time at Cursor	19:40:49.4...
Value at Cursor	453.1...E-6V

Figure I-13C: Acceleration Time History, Well #3, May 3, 2017 illustrating section of time history shown in Figure I-13A during time period when Golder employee jumped at 1 m from well.



New Project - RION AS-70 Viewer

Graph1

File	WR_001_201...
Channel	Ch1
Calibration Info.	Calibrated
Sampling Freq.	12800Hz

Analysis Type: Waveform
Freq. Weighting: Z

03/05/2017 18:36:57... 03/05/2017 18:39:18...

Graph1 WR_001_20170503_1732.. CH1 — Waveform, Z, 18:36:57.7.., -41.8..E-6V

Categories	Calculated Value
Time at Cursor	18:36:57.7..
Value at Cursor	-41.8..E-6V

Graph2 WR_001_20170503_1732.. CH2 — Waveform, Z, 18:36:57.7.., -45.8..E-6V

Categories	Calculated Value
Time at Cursor	18:36:57.7..
Value at Cursor	-45.8..E-6V

Graph3 WR_001_20170503_1732.. CH3 — Waveform, Z, 18:36:57.7.., -47.0..E-6V

Categories	Calculated Value
Time at Cursor	18:36:57.7..
Value at Cursor	-47.0..E-6V

Figure I-13D: Acceleration Time History Detail, Well #3, May 3, 2017 illustrating section of time history during which pile driving vibrations were identified as shown in Figures I-13A and I-13B. Order of accelerometer graphs on page as in Figure I-13A. The minimum and maximum vertical axes tick mark labels and grid lines, as illustrated in all graphs are -200.0x10^{-6} V and 200.0x10^{-6} V (100 times smaller than those shown in Figures I-13A through I-13C).

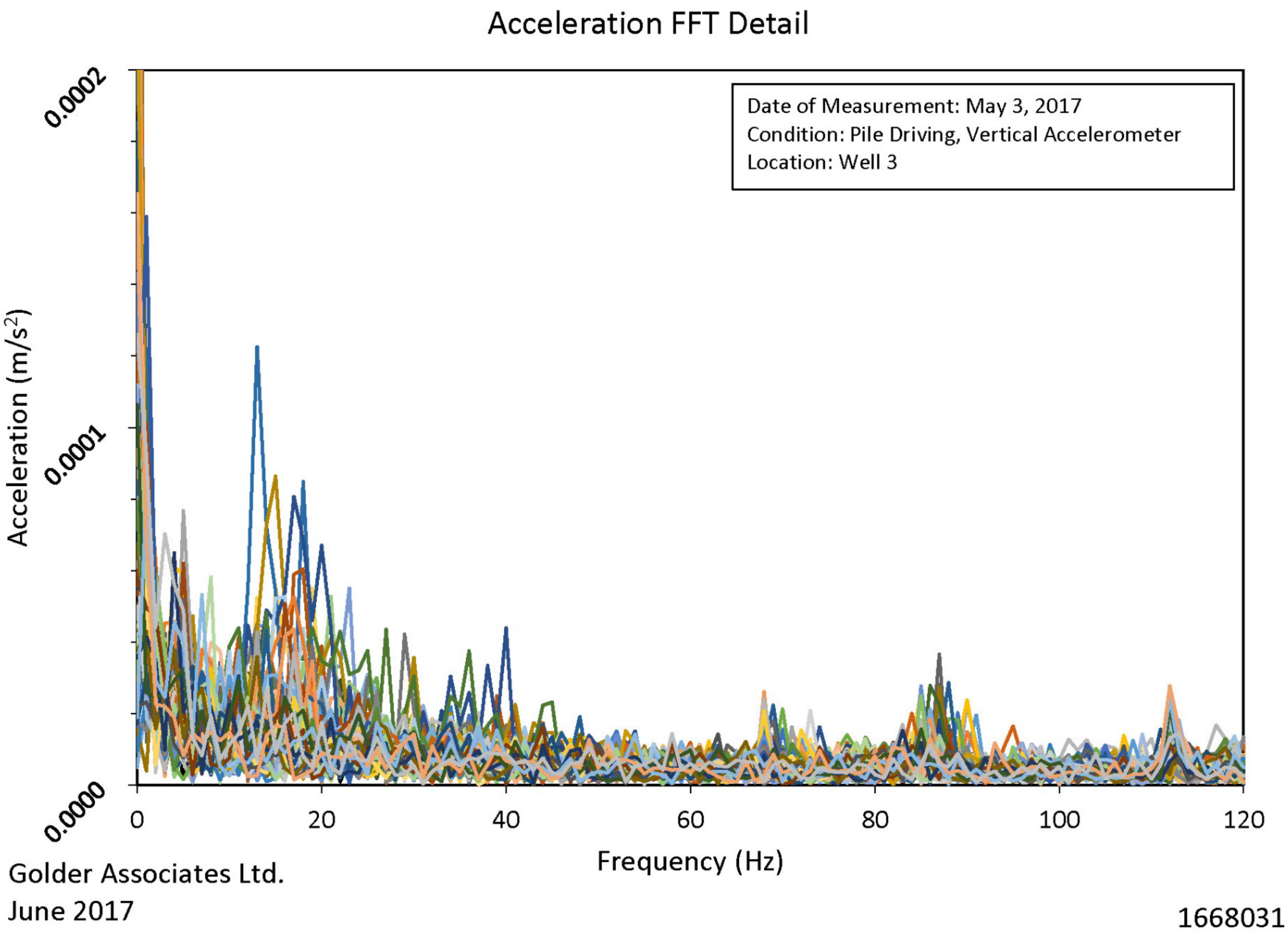


Figure I-13E: Acceleration FFT Detail, Well #3, May 3, 2017.

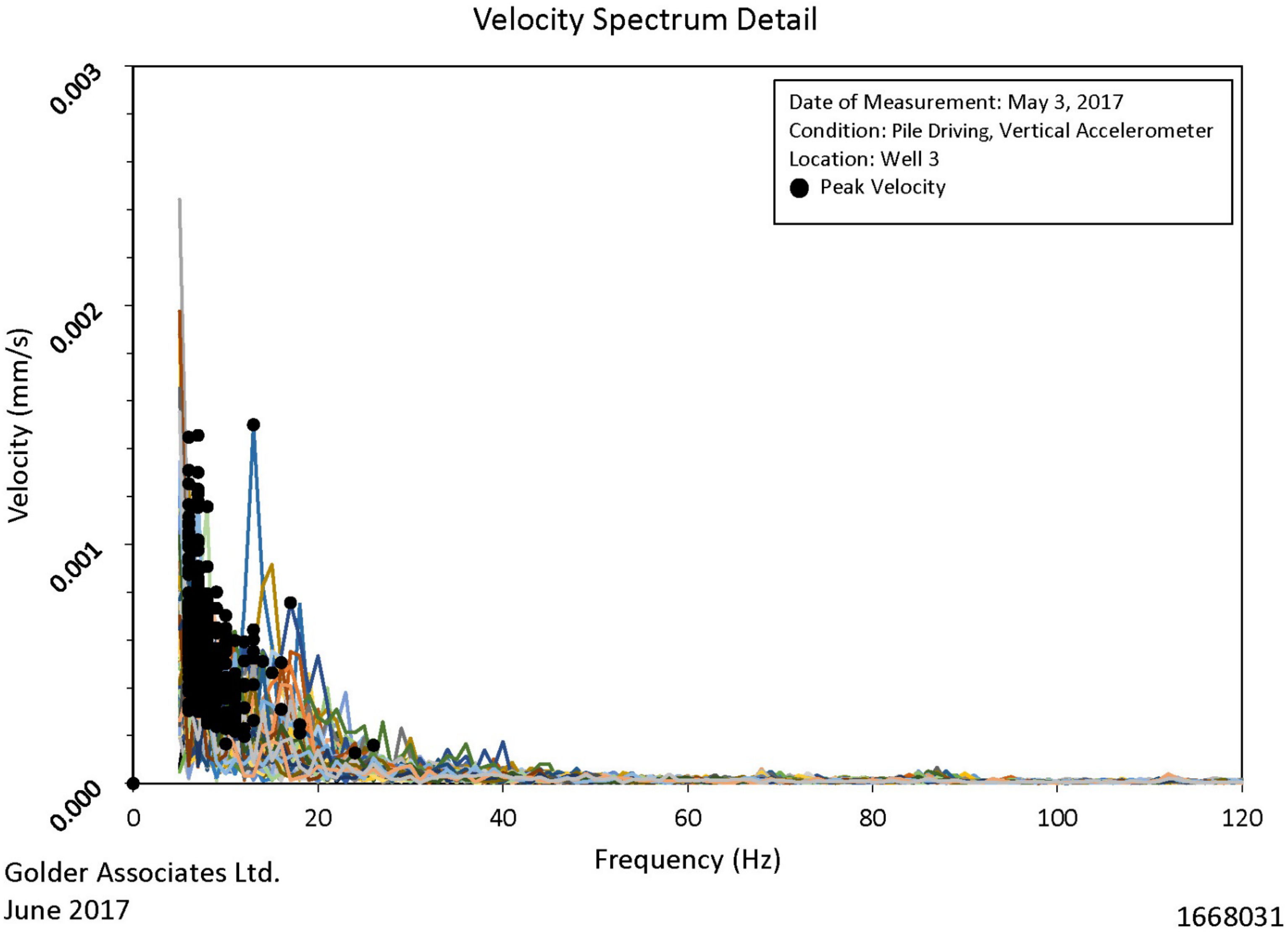
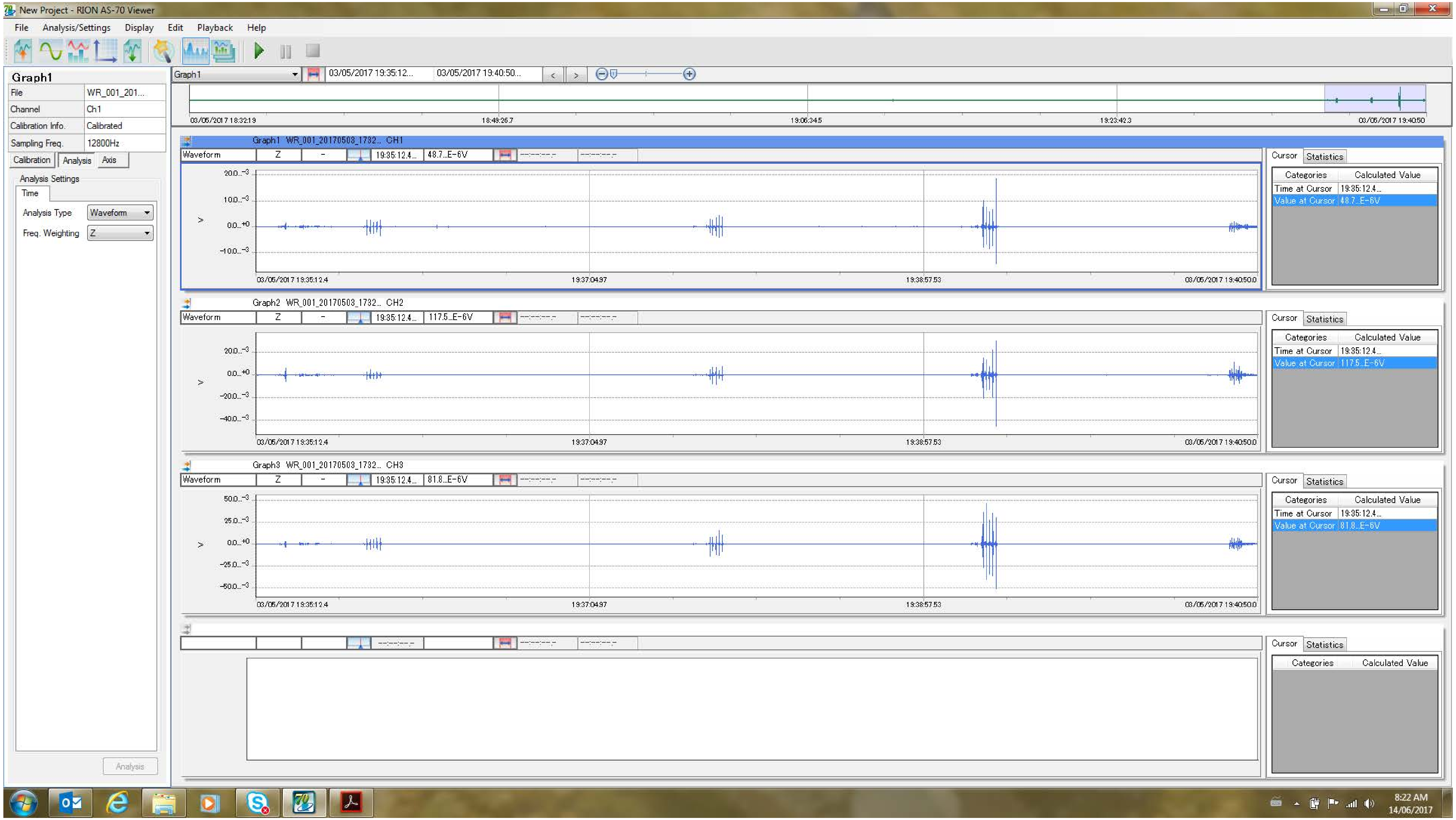


Figure I-13F: Velocity Spectrum Detail, Well #3, May 3, 2017.



Graph1

File	WR_001_201...
Channel	Ch1
Calibration Info.	Calibrated
Sampling Freq.	12800Hz

Analysis Type: Waveform
Freq. Weighting: Z

Graph1:

Categories	Calculated Value
Time at Cursor	19:35:12.4...
Value at Cursor	48.7...E-6V

Graph2:

Categories	Calculated Value
Time at Cursor	19:35:12.4...
Value at Cursor	117.5...E-6V

Graph3:

Categories	Calculated Value
Time at Cursor	19:35:12.4...
Value at Cursor	81.8...E-6V

Figure I-14A: Acceleration Time History Detail, Well #3, May 3, 2017 illustrating section of time history shown in Figures I-13A and I-13B during period when Golder employee jumped at 1 m from well.

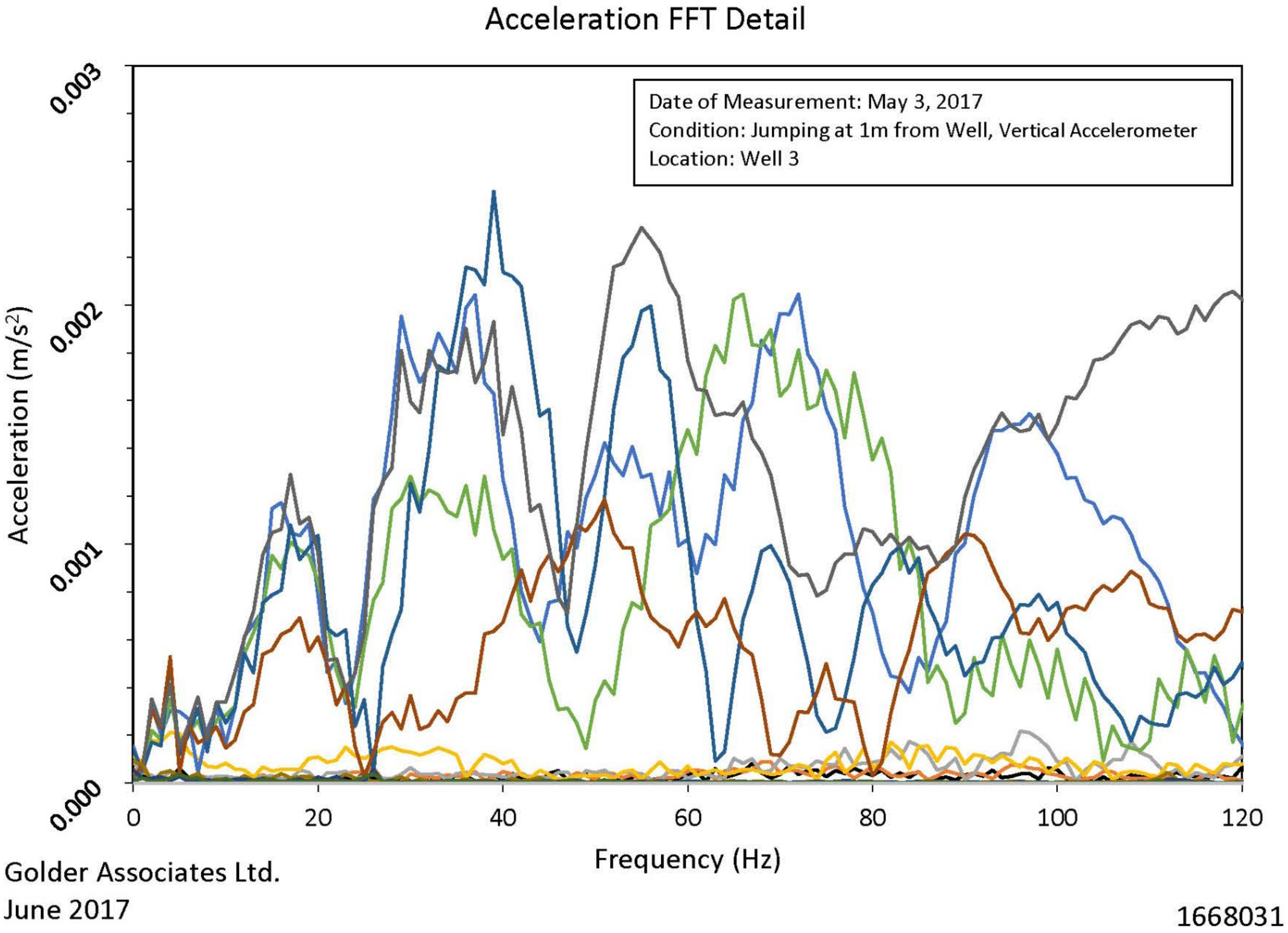


Figure I-14B: Acceleration FFT Detail, Well #3, May 3, 2017.

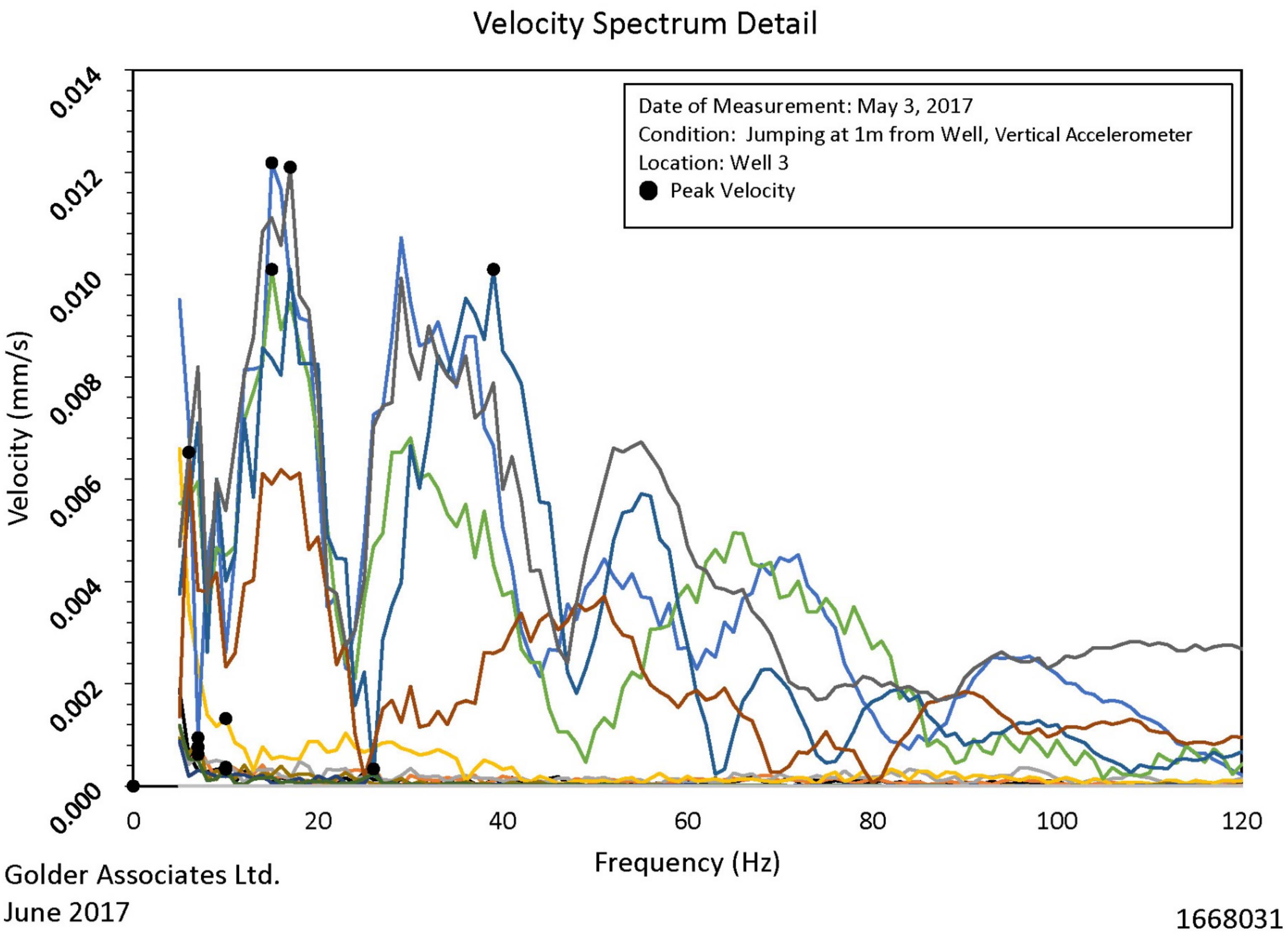


Figure I-14C: Velocity Spectrum Detail, Well #3, May 3, 2017.

Figure I-15A: Acceleration Time History Detail, T42 Site, March 23, 2017 illustrating data from accelerometers installed within rock at borehole BH-103 during a quiet period in the absence of any site activities and in the absence of nearby traffic. Uniaxial accelerometer data shown in white, with triaxial accelerometer data shown in red (vertical), green (longitudinal) and blue (transverse) for the different orientations. Note that the different ranges of output are primarily related to the differing performance specifications of the two types of instruments. Accelerometer output, using the data logger used at this site, is shown in fractions of the gravitational acceleration constant *g*. The minimum and maximum values shown on the vertical axis are -989.3x10^{-6} *g* and 875.7x10^{-6} *g* (*micro-g* as identified on graph axis with unit u).

Figure I-15B: Acceleration Time History Detail, T42 Site, March 23, 2017 illustrating acceleration data obtained during a time period on the T42 test site on March 23, 2017 when the vacuum truck backed slowly along the wooden mats, passing borehole BH-103 at a distance of about 5 m, and started operating to remove soil cuttings and water from a bin located about 35 m from borehole BH-103. The minimum and maximum values shown on the vertical axis are -600x10^{-6} *g* and 850x10^{-6} *g* (*micro-g* as identified on graph axis with unit u).

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